Air Quality Assessment

Land off Worksop Road, Mastin Moor

September 2020

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Quality Assurance – Approval Status

This document has been prepared and checked in accordance with Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS EN ISO 45001:2018)

Issue	Date	Prepared by	Checked by	Approved by
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Comments

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Executive Summary

Chatsworth Settlement Trustees is seeking to obtain outline planning permission for a residential-led development on land off Worksop Road, Mastin Moor located in the Chesterfield Borough Council administrative area.

With the implementation of a range of appropriate management practices to control dust, which could be secured through a standard planning condition, effects associated with construction dust from the construction phase are considered to not be significant.

It is anticipated that the effect of construction vehicle and construction plant emissions would not be significant, considering current background pollutant concentrations, local road traffic emissions and the temporary nature of the construction phase.

The Development would generate additional traffic in the vicinity of the Site and potentially change local air quality in terms of particulate matter (as PM_{10} and $PM_{2.5}$) and nitrogen dioxide (NO_2) concentrations.

Following completion, the Development is predicted to have a not significant effect on NO_2, PM_{10} and $PM_{2.5}$ concentrations, at all existing receptors considered.

Concentrations within the Development are also below the relevant objectives. As such, it is considered concentrations within the Development for future users are not significant.

1. Introduction

1.1. It should be noted that Chapters 1 and 2 of this report are common to all the submitted reports, the author being Planning & Design Group Ltd. The Air Quality Assessment of the proposed residential development is presented from Chapter 3 onwards which has been undertaken by Waterman Infrastructure and Environment Ltd (WIE).

Purpose

1.2. The purpose of this Air Quality Assessment Report is to explain and support an outline planning application for residential development of land at Mastin Moor (Chesterfield) as submitted to Chesterfield Borough Council (CBC) as the local planning authority (LPA) concerned. It outlines the context within which the application is made and provides a detailed assessment of the main air quality considerations, together with a reasoned justification in support of the development.

Structure of Report

1.3. This Report addresses the following:

- Context
- The Site and surrounding area
- Development proposal
- Planning policy considerations
- Key benefits
- Assessment of Air Quality
- Summary and conclusion.

1.4. The Air Quality Assessment Report concludes that during construction and operation of the development the likely air quality effects would be not significant and consequently there are no air quality reasons why residential development should not be supported on the site.

Other Reports

1.5. The proposal has been informed by a range of technical evidence. As such, the planning application comprises a suite of information which includes:

- Supporting Planning Statement
- Design and Access Statement
- Landscape and Visual Appraisal
- Transport Assessment
- Flood Risk Assessment
- Ecology Surveys
- Archaeological Assessment
- Geo-Environmental Assessment
- Noise and Vibration Assessment

- Air Quality Assessment
- Topographical Survey

Author

1.6. This Air Quality Report (WIE13188-11-R-1-2-1_AB)has been prepared by WIE. WIE is leading provider of environmental, sustainability, transport and engineering services to private and public sector clients and has a wealth of experience in undertaking EIAs of proposed residential developments of greenfield sites. Our contact details are as follows:

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2. Context

Applicant

2.1. The land subject of this application is owned and managed by Devonshire Property (MM) Limited (DPMML). DPMML is part of the Devonshire Group.

2.2. The Devonshire Group, known technically as the Chatsworth Settlement Trustees (CST), owns the land and estates of the Dukedom of Devonshire. Its main estates are in the vicinity of Chatsworth in Derbyshire and Bolton Abbey in North Yorkshire. It also runs visitor and other businesses on these estates, including hotels; retail and catering outlets; forestry; livestock and arable farming. It employs over 600 full time employees. It is committed to quality in all its activities and takes a responsible approach to development; as such, it measures performance in social and environmental as well as financial terms.

2.3. Together with the Chatsworth House Trust (registered charity no.1511149), CST's Derbyshire Estate provides over 450 full time equivalent jobs and contributes c.£50m of enabled Gross Value Added to the local economy each year (Source: New Economics Foundation 2014). Its income funds socio-economic facilities (e.g. village shop/post office) and environmental management activities (e.g. architectural conservation) without grant support. CST thereby provides benefits far beyond "just the estate".

2.4. CST has a range of interests in the Borough of Chesterfield including: agricultural land supporting modern farming; commercial properties supporting local employment; farmsteads supporting smaller scale rural enterprises; and the majority of the former Staveley Works site (including both the Clocktower Business Centre (leased to CBC and providing flexible term offices and workspaces) and the Devonshire Building (home to a gym and other enterprises)).

2.5. Whilst maintaining a long-term perspective, CST manages a diverse range of landholdings to achieve corporate and wider social and environmental objectives. It has thereby identified that the best long-term use for the land subject to this application would be for residential development. This will help deliver its own objective to deliver 1,000 new homes over the next ten years, and also meet the needs and aspirations of the local community and wider Borough, subject to securing a planning permission that is both attractive to the development market and commercially viable.

The Site

2.6. This section provides a summary of key features of the site. The site is more fully described within the Design and Access Statement submitted as part of the application.

2.7. The site is located at Mastin Moor, to the south of Worksop Road (A619) to both the east and west of Bolsover Road, with part of the site extending southwards to Woodthorpe Road. It encompasses some 46.2 ha of mainly agricultural land. The overall site forms a shallow valley sloping from the ridge lines along Worksop Road and Woodthorpe Road towards a watercourse that runs in a westerly direction through the site. The highest part of the site is around 119m AOD in the north-east with the lowest part in the south-west at around 56m AOD.

2.8. The site is primarily comprised of undulating arable fields with limited features. The main features of note include:

- An unnamed watercourse which flows in a westerly direction through the site
- Bolsover Road which runs through the site on a north-south axis
- Pumphouse Farm (dwelling and curtilage) which is surrounded by the development proposal but does not form part of it
- Field boundaries which are a mixture of hedgerows, stone walls and woodland
- Isolated trees

2.9. The main part of the settlement of Mastin Moor is located to the north of the site, on the northern side of Worksop Road. The settlement of Woodthorpe is located generally to the west of the site. The site abuts a limited number of residential properties, as well as the Mastin Moor Community Garden.

Photo 1: View over site from South-Eastern corner (adjacent Woodthorpe Road) looking towards Woodthorpe

Photo 2: View over site from Bolsover Road (close to Community Garden) looking towards Woodthorpe

Photo 3: View over site from Bolsover Road looking North West towards Worksop Road)

Photo 4: View over site from near North Eastern boundary adjacent to Worksop Road looking towards Bolsover Road and Woodthorpe

Design Process

2.10. CST first considered residential development options for its land at Mastin Moor in 2011 when it was identified in the Strategic Housing Land Availability Assessment by Chesterfield Borough Council. This formed part of the evidence base for what was at the time the emerging Local Plan: Core Strategy. CST appointed planning and masterplan specialists to explore these options. Outputs from that process formed part of CST's response to consultation on the Local Plan: Core Strategy.

2.11. Following adoption of the Local Plan: Core Strategy in 2013 which confirmed Mastin Moor as a focus for regeneration and growth, CST appointed an expanded team of specialists. Resulting technical surveys and reports contributed to a detailed appreciation of the development opportunity and potential constraints. These informed a masterplan-led approach that fully explored design options. The process had regard to the wider setting of the site and existing development in the locality.

2.12. Draft proposals were subject to extensive consultation with Chesterfield Borough Council, Derbyshire County Council and Staveley Town Council. Meetings were held with groups representing local residents and interest groups including Friends of Mastin Moor, the Woodthorpe Village Community Group and Mastin Moor Gardens and Allotments (formerly Mastin Moor Allotments Association). The resulting proposals were presented at two community consultation

events in July 2016, held at the Eventide Rest Room (Mastin Moor) and the Albert Inn (Woodthorpe), and were available to view at the same time on a website.

2.13. An outline planning application for 650 dwellings and other development was subsequently submitted to Chesterfield Borough Council (ref. CHE/17/00469/OUT) in June 2017. Contrary to the unequivocal recommendation of the Officer's report, and despite no objections being received from any statutory consultees, the application was refused by the Council's Planning Committee in October 2019. At the time of writing, an appeal against that refusal remains extant.

2.14. Feedback received during the course of the determination of the above application has informed the current proposals. The design process that has led to the proposals for which planning permission is now sought is more fully described within the Design and Access Statement.

Development Proposal

2.15. The proposed development seeks outline planning permission for residential development of up to 650 dwellings, a residential care facility with extra care, a Local Centre (including local retail, health facilities, leisure facilities, other local facilities and services, offices), open space, community garden extension, community building, parking and associated infrastructure and earthworks with all matters reserved except access. Details of scale, layout and landscaping are reserved for future consideration.

2.16. For illustrative purposes, an indicative layout has been prepared to show how the site could be developed. Further explanation of the design principles that have been incorporated into the proposals, and how the design has been informed and influenced by the comprehensive suite of technical information and analysis, is set out in the Design and Access Statement.

2.17. Key aspects of the proposal include:

- Up to 650 dwellings located on land to the south of Worksop Road (east and west of Bolsover Road) extending to Woodthorpe Road
- A residential care facility with extra care
- A Local Centre (including local retail, health facilities, leisure facilities, other local facilities and services, offices) located adjacent to Worksop Road
- A new signal-controlled junction on Worksop Road providing access to the new Local Centre and residential areas, incorporating pedestrian and cyclist crossing facilities
- New priority-controlled junctions on Bolsover Road and Woodthorpe Road
- An extension to the Community Garden (approximately doubling its existing size), including provision for a new community building and associated car park
- Significant new areas of parkland, play areas and other open space
- Retention of existing hedgerows and trees wherever possible
- Additional landscape planting and ecological enhancements
- New walking and cycling connections
- New drainage infrastructure including surface water storage ponds

- Financial contributions to allow the expansion of existing local services including Norbriggs Primary School.

2.18. The proposal therefore comprises a high quality development scheme designed to: address multiple deprivation issues at Mastin Moor; help regenerate the area in line with key related Local Plan policy; respect but integrate with the distinct communities of Woodthorpe and Mastin Moor; acknowledge and address the specific physical challenges and constraints of the site (e.g. topography, drainage).

Planning Policy

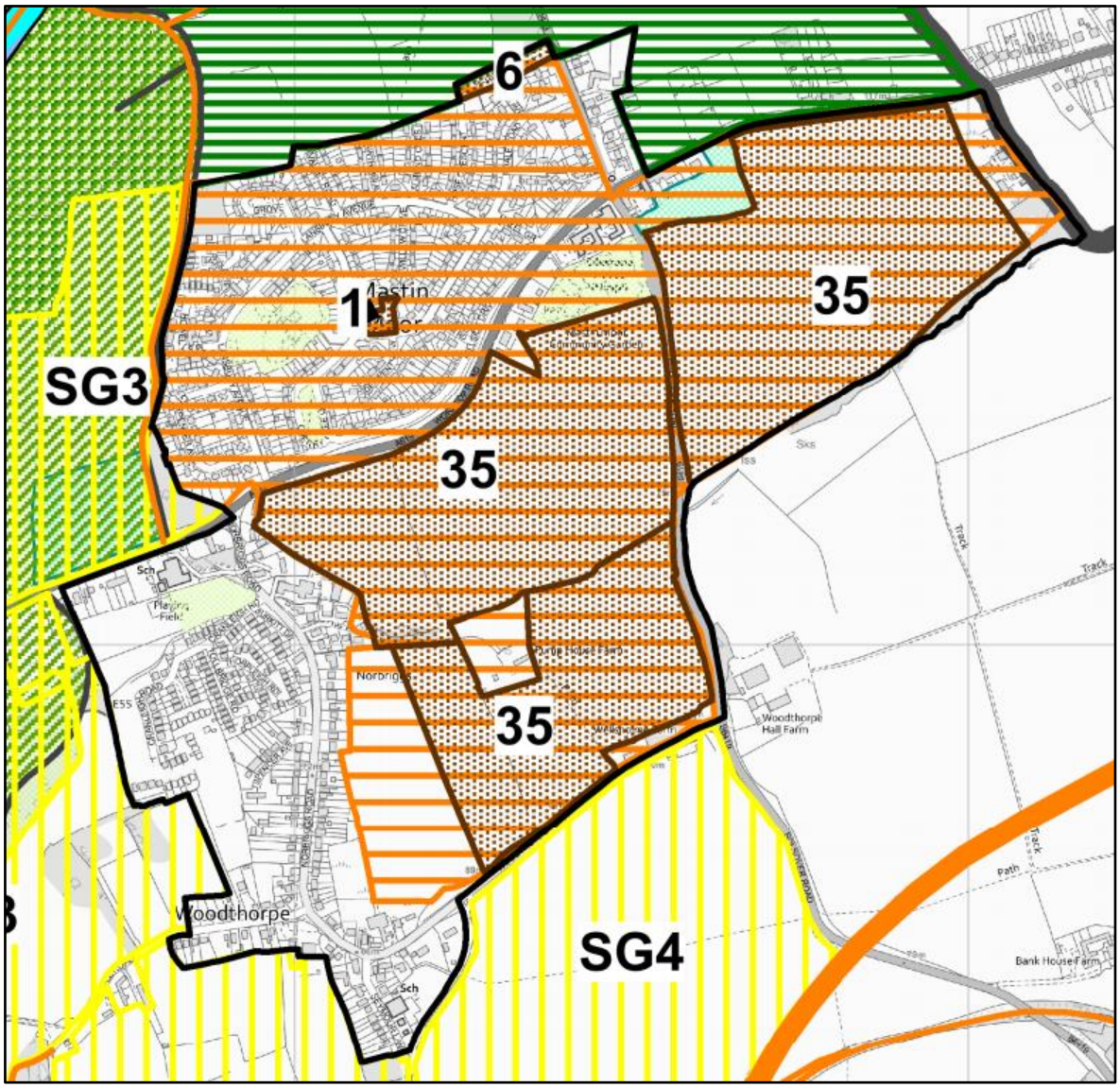
2.19. Section 38 (6) of the Planning and Compulsory Purchase Act 2004 requires that the determination of planning applications is undertaken in accordance with the development plan, unless material considerations indicate otherwise. The relevant document for this application is the Chesterfield Local Plan (2020) (the Local Plan).

2.20. The Local Plan allocates the site for development by way of Policy CLP3 Flexibility in Delivery of Housing. Table 4 within the Local Plan references the site as H35 (Land South of Worksop Road, and East and West of Bolsover Road, Mastin Moor), having a capacity of 650 dwellings, the extent of which is shown on the Local Plan Policies Map. Policy RP1 Regeneration Priority Areas sets out further specific requirements for any development within site H35.

2.21. Other relevant polices of the Local Plan include: CLP1 Spatial Strategy, CLP2 Principles for Location of Development, CLP4 Range of Housing, CLP6 Economic Growth, CLP8 Vitality and Viability of Centres, CLP9 Retail, CLP10 Social Infrastructure, CLP11 Infrastructure Delivery, CLP13 Managing the Water Cycle, CLP14 A Healthy Environment, CLP15 Green Infrastructure, CLP16 Biodiversity, Geodiversity and the Ecological Network, CLP17 Open Space, Play Provision, Sports Facilities and Allotments, CLP20 Design, CLP21 Historic Environment, CLP22 Influencing the Demand for Travel.

2.22. An extract from the Local Plan Policies Map showing the extent of the allocation and the wider Mastin Moor Regeneration Priority Area is shown below.

Figure 1: Local Plan Policies Map (extract)



2.23. The National Planning Policy Framework (NPPF) *'sets out the Government's planning policies for England and how these are expected to be applied'*. Paragraph 10 of the NPPF sets out that *'at the heart of the [NPPF] is a presumption in favour of sustainable development'.* Paragraph 11 states that '*For decision-taking this means:*

c) approving development proposals that accord with an up-to-date development plan without delay; or

d) where there are no relevant development plan policies, or the policies which are most important for determining the application are out-of-date, granting permission unless:

i. the application of policies in this Framework that protect areas or assets of particular importance provides a clear reason for refusing the development proposed6; or

ii. any adverse impacts of doing so would significantly and demonstrably outweigh the benefits, when assessed against the policies in this Framework taken as a whole.'

Planning Assessment

2.24. The proposal performs well against relevant Local Plan policies. In particular, it will deliver development in accordance with Policies CLP1 Spatial Strategy, CLP2 Principles for Location of Development, Policies CLP3 Flexibility in Delivery of Housing and Policy RP1 Regeneration Priority Areas.

2.25. It is also considered that there are no material considerations that indicate anything other than the fact that the LPA should determine the application in line with the extant plan as outlined above.

Benefits

2.26. Key benefits of the proposal would include:

- Provision of new, high quality housing
- New development in an area with acknowledged regeneration needs
- Greater variety of housing type and tenure (including Affordable Housing) to meet the diverse needs of the local community (including housing to buy and rent)
- Extension of the Community Garden (approximately doubling its existing size) including provision for a new community building and parking area
- Improved local services and facilities (including provision for retail, health and other local and community services within a new Local Centre)
- Significant new areas of parkland, play areas and other open greenspace available to existing and new residents
- New housing in a location where future residents will have a realistic choice of walking, cycling or using public transport, in preference to using private motor vehicles
- Additional capacity at local schools
- Opportunities for skills and learning through training programmes during construction and operational phases of the development
- New employment opportunities during construction and operational phases of the development
- Additional landscape planting and ecological enhancements
- New traffic signal-controlled junction on Worksop Road to include pedestrian and cyclist crossing facilities
- On-site water storage to help reduce existing off-site flood risk.

2.27. The proposal will therefore provide opportunities and benefits for all sections of the local community, including existing and future residents. Benefits will accrue in the short and longer term. It will help to overcome issues that can lead to deprivation and will contribute to regeneration in line with Local Plan objectives.

3. Air Quality Assessment Introduction

3.1. Waterman Infrastructure & Environment Ltd (hereafter referred to as 'Waterman') was instructed by Chatsworth Settlement Trustees (hereafter referred to as the 'Applicant') to undertake an air quality assessment (Chapters 3 to 10) to accompany the outline planning application for the residential-led development of up to 650 dwellings (including elderly care and specialist accommodation), a Local Centre (including local retail, health facilities, other local facilities and services), open space, community garden extension (including community building and parking) and associated infrastructure (hereafter referred to as the 'Development'). The Development is located on land off Worksop Road, Mastin Moor (hereafter referred to as the 'Site').

3.2. The Site is approximately 46.2 hectare (ha) in area, located within the administrative area of the Chesterfield Borough Council (CBC) and is centred on National Grid Reference 445570, 375290. Currently the Site comprises agricultural land.

3.3. The Site is located in an agricultural and residential area, and is bound to the north by Worksop Road, properties along Worksop Road and agricultural land, beyond which is Mastin Moor; to the west agricultural land beyond which lies Woodthorpe; to the south by agricultural land and individual properties; and to the east by agricultural land and individual properties.

3.4. The purpose of this air quality assessment is to provide a review of the existing air quality at, and surrounding the Site, and to assess the potential effects of the Development on local air quality during construction and on completion. Consideration is given to emissions from construction activities, as well as emissions from road traffic, once completed and operational, on existing sensitive receptors. The most significant pollutants associated with road traffic emissions, in relation to human health, are nitrogen dioxide (NO_2) and particulate matter (as PM_{10} and $PM_{2.5}$), therefore the assessment focuses on these pollutants.

3.5. Section 4 of this air quality assessment gives a summary of legislation and planning policy relevant to air quality. Section 5 provides details of the assessment methodology and Section 6 sets out the baseline conditions at and around the Site. The results of the assessments are presented in Section 7 and Section 8. Section 9 describes any required mitigation measures. A summary of the findings and conclusions of the assessment is given in Section 10. The air quality assessment is supported by:

- **Appendix A: Air Quality Assessment Detailed Methodology; and**
- **Appendix B: Consultation with Environmental Health Officer.**

4. Air Quality Legislation, Planning Policy and Guidance

Legislation

EU Framework Directive 2008/50/EC, 2008

4.1. Air pollutants at high concentrations can have adverse effects on the health of humans and ecosystems. European Union (EU) legislation on air quality forms the basis for UK legislation and policy on air quality.

4.2. The EU Framework Directive 2008/50/EC[1] on ambient air quality assessment and management came into force in May 2008 and was implemented by Member States, including the UK, by June 2010. The Directive aims to protect human health and the environment by avoiding, reducing or preventing harmful concentrations of air pollutants.

Air Quality Standards Regulations, 2010

4.3. The Air Quality Standards Regulations[2] implement Limit Values prescribed by the EU Framework Directive 2008/50/EC. The Limit Values are legally binding and the Secretary of State, on behalf of the UK Government, is responsible for their implementation.

The UK Air Quality Strategy, 2007

4.4. The current UK Air Quality Strategy (UK AQS) was published in July 2007[3] and sets out the objectives for local planning authorities (LPA) in undertaking their Local Air Quality Management (LAQM) duties. The UK AQS objectives of air pollutants relevant to this assessment are summarised in **Table 1**

Table 1: Summary of Relevant UK AQS Objectives

Pollutant	Objective		Date by which Objective to be Met
	Concentration	Measured as	
Nitrogen Dioxide (NO_2)	200µg/m^3	1 hour mean not to be exceeded more than 18 times per year	31/12/2005
	40µg/m^3	Annual Mean	31/12/2005
Particulate Matter (PM_{10}) (a)	50µg/m^3	24 hour mean not to be exceeded more than 35 times per year	31/12/2004
	40µg/m^3	Annual Mean	31/12/2004
Particulate Matter ($PM_{2.5}$) (b)	Target of 15% reduction in concentrations at urban background locations	Annual Mean	Between 2010 and 2020
	25µg/m^3	Annual Mean	01/01/2020

Note: (a) Particulate matter with a mean aerodynamic diameter less than 10 microns (or micrometres – µm)
(b) Particulate matter with a mean aerodynamic diameter less than 2.5 microns

1 Council Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air for Europe.
2 Defra, (2010) The Air Quality Standards (England) Regulations.
3 Department of the Environment, Food and Rural Affairs (Defra), (2007). 'The Air Quality Strategy for England, Scotland, Wales & Northern Ireland'.

4.5. Further to **Table 1**, the European Union (EU) also sets Limit Values for NO_2, PM_{10} and $PM_{2.5}$[4], which have been adopted by the UK[5]. The Limit Value for NO_2 is the same numerical level as the AQS objective but the target date differs. Achievement of these values is a national obligation rather than a local obligation. In the UK, only monitoring and modelling carried out by Defra and Central Government meets the specification required to assess compliance with the Limit Values. Further, Defra and other central government agencies do not recognise local authority monitoring or local modelling studies when determining the likelihood of the Limit Values being exceeded. As such the Limit Values have not been considered further in the Air Quality Assessment.

The Environment Act, 1995

4.6. In a parallel process, the Environment Act 1995[6] required the preparation of a national air quality strategy setting health-based air quality objectives for specified pollutants and outlining measures to be taken by LPAs in relation to meeting these objectives (the LAQM system).

4.7. Part IV of the Environment Act 1995 provides a system of LAQM under which LPAs are required to review and assess the future quality of the air in their area by way of a staged process. Should this process suggest that any of the AQS objectives will not be met by the target dates, the LPA must consider the declaration of an AQMA and the subsequent preparation of an Air Quality Action Plan (AQAP) to improve the air quality in that area in pursuit of the AQS objectives.

4.8. There is one Air Quality Management area (AQMA) currently declared in CBC along Church Street, Brimington approximately 5km west of the Site.

National Planning Policy

National Planning Policy Framework, 2019

4.9. The National Planning Policy Framework (NPPF)[7], published in February 2019, sets out the Government's planning policies for England and how these should be applied.

4.10. Paragraph 170 states "*… Development should, wherever possible, help to improve local environmental conditions such as air and water quality* …"

4.11. Furthermore, Paragraph 180 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…".*

4.12. Paragraph 181 states "*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.".*

[4] Council Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air for Europe.
[5] Defra, (2010) The Air Quality Standards (England) Regulations.
6 Office of the Deputy Prime Minister (ODPM), 1995, 'The Environment Act' 1995.
7 Department for Communities and Local Government, 2019, 'National Planning Policy Framework'. DCLG, London.

Local Planning Policy

Chesterfield Borough Council Local Plan; 2020

4.13. The CBC Local Plan[8] sets out the strategy for development across the borough until 2035 and identifies which broad areas are suitable for development. Strategic Objective 9 states that CBC's vision is to *'tackle traffic congestion, improve air quality secure strategic improvements to the transport system in the borough and enable healthier and more sustainable transport choices".*

4.14. In addition to the above Strategic Objective, the following policies relate to air quality:

CP14: A Healthy Environment:

> *"…Where appropriate, development proposals will include an assessment of impact on air quality and incorporate measures to avoid or mitigate increases in air pollution and minimise the exposure of people to poor air quality. Development that would make the air quality in a declared Air Quality Management Area (AQMA) materially worse either in isolation or cumulatively when considered in combination with other planned development, will not be permitted"*

Guidance

Department for Environment, Food and Rural Affairs, Clean Air Strategy,2019

4.15. Published in January 2019 the Clean Air Strategy[9] sets out a coherent framework and national action to improve air quality throughout the UK.

4.16. The Strategy is underpinned by new national powers to control major sources of air pollution, in line with the risk they pose to public health and the environment, plus new local powers to act in areas with an air pollution problem. The Strategy also supports the creation of Clean Air Zones to lower emissions from all sources of air pollution, backed up with clear enforcement mechanisms.

Improving Air Quality in the UK: Tackling Nitrogen Dioxide in our Towns and Cities. UK Air Quality Plan for Tackling Nitrogen Dioxide, 2017

4.17. The UK Government was required by the High Court to release an Air Quality Plan to meet the NO_2 Limit Value in the shortest timescale as possible. This document was adopted on 26 July 2017[10].

4.18. The plan focuses on reducing concentrations of NO_x and NO_2 around road vehicle emissions within the shortest possible time. With the principal aims to:

a. reduce emissions of NOx from the current road vehicle fleet in problem locations now; and

b. accelerate road vehicle fleet turnover to cleaner vehicles to ensure that the problem remains addressed and does not move to other locations.

4.19. The other aims include reducing background concentrations of NO_x from:

Other forms of transport such as rail, aviation and shipping;

Industry and non-road mobile machinery; and

Buildings, both commercial and domestic, and other stationary sources.

[8] Chesterfield Borough Council, Adopted Local Plan; 2020
9 Defra (2019) Clean Air Strategy, 2019
10 Defra (2017) Improving Air Quality in the UK: Tackling nitrogen dioxide in our towns and cities. Draft UK Air Quality Plan for Tackling Nitrogen Dioxide (Consultation Document)

4.20. The document provided additional measures to reduce NO_x and NO_2 concentrations in the UK, such measures include:

- Mandate local authorities to implement Clean Air Zones within the shortest possible time;
- Consultation on proposal for a Clean Air Zone Framework for Wales;
- Consultation on a draft National Low Emission Framework for Scotland;
- Commitment to establishing a Low Emission Zone for Scotland by 2018;
- Tackling air pollution on the English Road network;
- New real driving emissions requirement to address real world NOx emissions;
- Additional funding to accelerate uptake of hydrogen vehicles and infrastructure;
- Additional funding to accelerate the uptake of electric taxis;
- Further investment in retrofitting alongside additional support of low emission buses and taxis;
- Regulatory changes to support the take up of alternatively fuelled light commercial vehicles;
- Exploring the appropriate tax treatment for diesel vehicles;
- Call for evidence on updating the existing HGV Road User Levy;
- Call for evidence on use of red diesel;
- Ensure wider environmental performance is apparent to consumers when purchasing cars;
- Updating Government procurement policy;
- New emissions standards for non-road mobile machinery;
- New measures to tackle NOx emissions from Medium Combustion Plants; and,
- New measures to tackle NO_x emissions from generators.

4.21. The above measures do not provide any actions which are relevant to the operation or design of the Development.

4.22. A High Court ruling[11] on 21st February 2018, stated the UK Governments air quality improvement plan adopted on 31 July 2017 was unlawful as '*it does not contain measures sufficient to ensure substantive compliance with the 2008 Directive and the English Regulations'*. The UK Government '*must ensure steps are taken to achieve compliance as soon as possible, by the quickest route possible and by a means that makes that outcome likely'*.

4.23. The judgement stated that the UK Government must produce a supplementary plan, setting out requirements for feasibility studies to be undertaken in 33 Local Authority Areas, CBC is not one of the named authorities.

4.24. In May 2018, it was announced the European Union (EU) was going to take the UK to the European Commission over failure to meet the Limit Values for NO_2.

Environmental Protection UK & Institute of Air Quality Management Guidance; Land-Use Planning & Development Control: Planning for Air Quality, 2017

4.25. Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) Land-Use Planning & Development Control: Planning for Air Quality Guidance[12] provides a framework for air quality considerations within local development control processes, promoting a consistent approach to the treatment of air quality issues.

[11] https://www.judiciary.gov.uk/judgments/the-queen-on-the-application-of-clientearth-no-3-claimant-v-secretary-of-state-for-environment-food-and-rural-affairs-and-othrs/

12 Environmental Protection UK & Institute of Air Quality Management (2017), 'Land-Use Planning & Development Control: Planning for Air Quality', EPUK & IAQM, London.

4.26. The guidance explains how development proposals can adopt good design principles to reduce emissions and contribute to better air quality. The guidance also provides a method for screening the need for an air quality assessment and a consistent approach for describing the impacts at individual receptors.

4.27. The EPUK and IAQM guidance, advises that:

"In arriving at a decision about a specific proposed development the local planning authority is required to achieve a balance between economic, social and environmental considerations. For this reason, appropriate consideration of issues such as air quality, noise and visual amenity is necessary. In terms of air quality, particular attention should be paid to:

- *Compliance with national air quality objectives and of EU Limit Values;*
- *Whether the development will materially affect any air quality action plan or strategy;*
- *The overall degradation (or improvement) in local air quality; or*
- *Whether the development will introduce new public exposure into an area of existing poor air quality".*

Planning Practice Guidance

4.28. The Government's national Planning Practice Guidance[13] (PPG) states that air quality concerns are more likely to arise where development is proposed within an area of existing poor air quality, or where it would adversely impact upon the implementation of air quality strategies and / or action plans. The PPG notes that when deciding whether air quality is relevant to a planning application, considerations would include whether the development would lead to:

- Significant effects on traffic, such as volume, congestion, vehicle speed, or composition;
- The introduction of new point sources of air pollution, such as furnaces, centralised boilers and Combined Heat and Power (CHP) plant; and
- Exposing occupants of any new developments to existing sources of air pollutants and areas with poor air quality.

Local Air Quality Management Policy Guidance, 2016

4.29. The Local Air Quality Management Policy Guidance LAQM.PG (16)[14] provides additional guidance on the links between transport and air quality. LAQM.PG (16) describes how road transport contributes to local air pollution and how transport measures may bring improvements in air quality. Key transport-related Government initiatives are set out, including regulatory measures and standards to reduce vehicle emissions and improve fuels, tax-based measures and the development of an integrated transport strategy.

4.30. LAQM.PG (16) also provides guidance on the links between air quality and the land use planning system. The guidance advises that air quality considerations should be integrated within the planning process at the earliest stage and is intended to aid local authorities in developing action plans to deal with specific air quality issues and create strategies to improve air quality. LAQM.PG (16) summarises the means in which the land use planning system can help deliver compliance with the air quality objectives.

13 DCLG (2019), 'Planning Practice Guidance: Air Quality (ID 32)' (November 2019).

14 Defra (2016), 'Local Air Quality Management (LAQM) Policy guidance 2016 (LAQM.PG (16))', DEFRA, London.

Institute of Air Quality Management: Guidance on the Assessment of Dust from Demolition and Construction, 2016

4.31. The IAQM Construction Dust Guidance[15] provides guidance to consultants and Environmental Health Officers on how to assess air quality impacts from construction related activities. The guidance provides a risk-based approach based on the potential dust emission magnitude of the site (small, medium or large) and the sensitivity of the area to dust impacts. The importance of professional judgement is noted throughout the guidance. The guidance recommends that once the risk class of the site has been identified, the appropriate level of mitigation measures are implemented to ensure that the construction activities have no significant impacts.

15 Institute of Air Quality Management, 2016, 'Guidance on the Assessment of dust from demolition and construction v1.1.

5. Assessment Methodology and Significance

Assessment Methodology

5.1. This air quality assessment has been undertaken using a variety of information and procedures as follows:

- Consultation with the EHO at CBC to agree the approach to the assessment (see **Appendix B**);
- A review of CBC's air quality Review and Assessment documents to determine baseline conditions in the area of the Site and monitoring data to be used to verify the unadjusted predicted air quality modelled results;
- Review of the local area to identify potentially existing sensitive receptors that could be affected by changes in air quality that may result from the Development;
- Review and use of traffic flow data provided by the project Transport Consultants (Arup);
- Dispersion modelling of pollutant emissions using the ADMS-Roads model[16] to predict the likely pollutant concentrations at the Site and the likely effect of the completed and operational Development on local air quality in terms of traffic emissions. The latest NO_2 from NOx Calculator available from the LAQM Support website[17] has been applied to derive the road related NO_2 concentrations from the modelled NOx concentrations;
- Comparison of the predicted air pollutant concentrations with CBC monitored concentrations at the diffusion tubes located on Duke Street and Lowgates, Staveley (model verification details are provided in **Appendix A**);
- Determination and qualitative assessment of the potential impacts of construction works and activities on local air quality, and consideration of environmental management controls;
- Determination of the potential impacts of the Development, once completed and operational, on local air quality, comparing the modelled results with the significance criteria of EPUK/IAQM Guidance; and
- Identification of mitigation measures, where appropriate.

5.2. The UK Air Quality Strategy (AQS) identifies the pollutants associated with road traffic emissions and local air quality as:

- Nitrogen oxides (NO_X);
- Particulate matter (as PM_{10} (particles with a diameter up to 10µm) and $PM_{2.5}$ (particles with a diameter up to 2.5µm));
- Carbon monoxide (CO);
- 1, 3-butadiene (C_4H_6); and
- Benzene (C_6H_6).

5.3. Emissions of total NO_x from motor vehicle exhausts comprise nitric oxide (NO) and NO_2. NO oxidises in the atmosphere to form NO_2.

5.4. The most significant pollutants associated with road traffic emissions, in relation to human health, are NO_2 and particulates. This assessment therefore focuses on NO_2 and particulate matter (PM_{10} and $PM_{2.5}$).

16 Cambridge Environmental Research Consultants Ltd, ADMS-Roads, 2018, Version 4.1.1.
17 AEA, NO_x to NO_2 Calculator, http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php, Version 8.1, August 2020.

Construction Assessment

Dust Emissions

5.5. The assessment of the effects from the construction activities in relation to dust has been based on the IAQM's Guidance on the Assessment of Dust from Demolition and Construction, 2014 and the following:

- Consideration of planned construction activities and their phasing; and
- A review of the location (and distance) of sensitive uses surrounding the Site.

5.6. Following the IAQM's construction dust guidance, construction works were divided into the following four distinct activities:

- Demolition – any activity involved in the removal of an existing building;
- Earthworks – the excavation, haulage, tipping and stockpiling of material, but may also involve levelling the site and landscaping;
- Construction – any activity involved with the provision of a new structure; and
- Trackout – the movement of vehicles from unpaved ground on a site, where they can accumulate mud and dirt, onto the public road network where dust might be deposited.

5.7. IAQM's construction dust guidance considers the effects of dust, as follows:

- Annoyance due to dust soiling;
- Potential effects on human health due to significant increase in exposure to PM_{10}; and
- Harm to ecological receptors.

5.8. A summary of the four-step process, which was undertaken for the dust assessment of construction activities as set out in the IAQM's construction dust guidance, is presented in **Table 2**.

Table 2: Summary of the IAQM Guidance for Undertaking a Construction Dust Assessment

Step		Description
1	Screen the Need for a Detailed Assessment	Simple distance-based criteria are used to determine the requirement for a detailed dust assessment. An assessment will normally be required where there are 'human receptors' within 350m of the boundary of the site and / or within 50m of the route(s) used by construction vehicles on public highway, up to 500m from the site entrance or 'ecological receptors' within 50m of the boundary of the site and/or within 50m of the route(s) used by construction vehicles on public highway, up to 500m from the site entrance.
2	Assess the Risk of Dust Effects	The risk of dust arising in sufficient quantities to cause annoyance and/or health or ecological effects should be determined using three risk categories: low, medium and high based on the following factors: • the scale and nature of the works, which determines the risk of dust arising (i.e. the magnitude of potential dust emissions) classed as small, medium or large; and • the sensitivity of the area to dust effects, considered separately for ecological and human receptors (i.e. the potential for effects) defined as low, medium or high.
3	Site Specific Mitigation	Determine the site-specific measures to be adopted at the site based on the risk categories determined in Step 2 for the four activities. For the cases where the risk is 'negligible' no mitigation measures beyond those required by legislation are required. Where a local authority has issued guidance on measures to be adopted these should be taken into account.

Step		Description
4	Determine Significant Effects	Following Steps 2 and 3, the significance of the potential dust effects should be determined, using professional judgement, taking into account the factors that define the sensitivity of the surrounding area and the overall pattern of potential risks.

Construction Vehicle Exhaust and Plant Emissions

5.9. IAQM's guidance on assessing construction impacts states that "*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 effect 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. For site traffic on the public highway, if it cannot be scoped out, then if should be assessed using the same methodology and significance criteria as operational traffic impacts.*"

5.10. Following a review of the surrounding area in accordance with IAQM's guidance, it is considered that a quantitative assessment of the exhaust emissions from construction plant and traffic is not required, and a qualitative assessment is appropriate.

Operational Phase Assessment

ADMS model

5.11. The likely effect on local air quality from traffic emissions generated from the completed and operational Development has been assessed using the atmospheric dispersion model ADMS-Roads.

5.12. The ADMS-Roads dispersion model predicts how emissions from roads and small-scale industrial sources combine with local background pollution levels, taking account of meteorological conditions, to affect local air quality.

5.13. For the purposes of modelling, traffic data has been obtained from Arup further details are provided in **Appendix A**. The baseline year of 2019 (latest data available) has been assessed together with the 'without' and 'with' Development scenarios for the year 2026, the anticipated year of completion of the Development.

5.14. The Development does not propose a centralised energy plant such as a centralised gas-fired boiler or Combined Heat and Power Plant (CHP). If a centralised gas-fired boiler or CHP is subsequently proposed, details would be submitted to the CBC at the appropriate time, secured by way of a planning condition. This air quality assessment does not therefore consider any emissions to air from any centralised heating or energy plant.

5.15. The ADMS-Roads dispersion model predicts how emissions from roads combine with local background pollution levels, taking account of meteorological conditions, to affect local air quality. The model has been run for the completion year, using background data and vehicle emission rates for 2026 as inputs. For the verification assessment (referred to later in this Report),

background data and vehicle emission rates for 2019 have been used, which would be higher than the 2026 data.

5.16. Full details of the dispersion modelling study are presented within **Appendix A**.

Model Uncertainty

5.17. Analyses of historical monitoring data by Defra[i] identified a disparity between actual measured NO_X and NO_2 concentrations and the expected decline associated with emission forecasts, which form the basis of air quality modelling as described above. In February 2020, Air Quality Consultants published a report on Performance of Defra's Emission Factor Toolkit 2013-2019[ii]. The report concluded that recent analysis of recent NO_X measurements provides evidence that vehicle controls are working, and as a result, the Emission Factor Toolkit (EFT) is now reflecting the rate of observed reductions. Therefore, this air quality assessment has been undertaken using the emission factors published by Defra in the EFT version 9.

Background Pollutant Concentrations

5.18. To estimate the total concentrations due to the contribution of any other nearby sources of pollution, background pollutant concentrations need to be added to the modelled concentrations. Full details of the background pollution data used within the air quality assessment are included in **Appendix A: Air Quality Assessment Detailed Methodology**.

Model Verification

5.19. Model verification is the process of comparing monitored and modelled pollutant concentrations and, if necessary, adjusting the modelled results to reflect actual measured concentrations, to improve the accuracy of the modelling results. The model has been verified by comparing the predicted annual mean NO_2 concentrations for the baseline 2019, with the results from the Duke Street and Lowgates diffusion tubes in CBC. Modelled concentrations have then been adjusted accordingly. The verification and adjustment process are described in detail in **Appendix A: Air Quality Assessment Detailed Methodology**.

Potentially Sensitive Receptors

5.20. The approach adopted by the UK AQS is to focus on areas at locations at, and close to, ground level where members of the public (in a non-workplace area) are likely to be exposed over the averaging time of the objective in question (i.e. over 1-hour, 24-hour or annual periods). Objective exceedances principally relate to annual mean NO_2 and PM_{10}, and 24-hour mean PM_{10} concentrations, so that associated potentially sensitive locations relate mainly to residential properties and other sensitive locations (such as schools) where the public may be exposed for prolonged periods.

5.21. **Table 3** presents the existing sensitive receptors modelled due to the proximity to the road network likely to be affected by the Development and future sensitive receptor locations which are representative of sensitive uses proposed within the Development itself. The future sensitive receptor locations represent areas of the Development that would likely be exposed to the worst-case air quality conditions, i.e. locations within the Development that would be closest to road

traffic. The location of the selected existing and future receptors assessed are presented in **Figure 1**.

Table 3: Selected Receptor Locations

ID	Receptor Location	Receptor Type	OS Grid Reference	
1	Castle View	Residential	446030	375753
2	53 Worksop Road	Residential	445823	375812
3	Royal Oak Court	Residential	445482	375672
4	2 Renishaw Road	Residential	445496	375709
5	38 Hillside Drive	Residential	445343	375590
6	21 Hillside Drive	Residential	445210	375380
7	2 Lansbury Avenue	Residential	444961	375276
8	Norbriggs Primary School	Education	444873	375167
9	5 The Paddocks Norbriggs Road	Residential	445022	375015
10	22 Woodthorpe Road	Residential	445496	374835
11	**Proposed:** Northern Redline Boundary	Residential	445886	375794
12	**Proposed:** Southern Central Redline Boundary	Residential	445584	375253
13	**Proposed:** Southern Redline Boundary	Residential	445603	374930
14	**Proposed:** Western Redline Boundary	Residential	444952	375188

Notes: Ground floor assumed to be 0m to represent worst-case assessment of exposure as it is the closest location of the receptor to the tailpipe vehicle emission

Limitations and Assumptions

5.22. For the purposes of the assessment of dust emissions during demolition and construction, it was assumed that the construction works would be carried out at the Site boundary to provide a worst-case assessment.

5.23. The air quality model cannot take account of the benefits a building or green planting can have in terms of restricting the dispersion of vehicle emissions by providing a physical barrier or, for planting, the ability to trap and filter airborne pollutants. As such the results from the air quality model are worst-case. In addition, the model cannot take account of individual behavioural changes associated with sustainable transport measures such as cycle routes and electric charging facilities.

Determining Significance of Impacts

Construction

Construction Dust

5.24. The potential impacts of construction activities on local air quality were based on professional judgement and with reference to the criteria set out in IAQM's construction dust guidance. Appropriate mitigation that would be implemented to minimise any adverse impacts on air quality

have also been considered. Details of the assessors' experience and competence to undertake the dust assessment is provided in **Appendix A**.

5.25. The assessment of the risk of dust impacts arising from the likely construction activities, as identified by the IAQM's construction dust guidance, is based on the magnitude of potential dust emissions and the sensitivity of the area. The risk category matrix for construction activity types, taken from the IAQM guidance, are presented in **Table 4** to **Table 6**. Examples of the magnitude of potential dust emissions for each construction activity and factors defining the sensitivity of an area are provided in **Appendix A**. The Site is agricultural land and therefore demolition has not been considered further.

Table 4: Risk Category from Earthworks Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 5: Risk Category from Construction Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 6: Risk Category from Trackout Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

5.26. The risk category determined for each construction activity type was used to define the appropriate mitigation measures that should be applied. The IAQM's construction dust guidance recommends that significance is only assigned to the effect after considering mitigation and assumes that all actions to avoid or reduce the effects are inherent within the design of the development. In the case of construction mitigation, this would be secured through planning conditions, legal requirements or required by regulations.

5.27. It therefore follows that, within this assessment, no significance criteria are provided for the pre-mitigation likely effects of the construction work and, in accordance with the IAQM evidence based theory, the residual effects would be classified as not significant.

Construction Vehicle Exhaust and Plant Emissions

5.28. The significance of the effects from construction vehicle exhaust emissions and construction plant emissions on air quality were based on professional judgement.

Completed Development

5.29. The EPUK / IAQM guidance provides an approach to assigning the magnitude of changes as a result of a development as a proportion of a relevant assessment level, followed by examining this change in the context of the new total concentration and its relationship with the assessment criterion to provide a description of the impact at selected receptor locations.

5.30. **Table 7** presents the EPUK / IAQM framework for describing the impacts (the change in concentration of an air pollutant) at individual receptors. The Air Quality Assessment Level (AQAL) include air quality objectives or limit values, where these exist.

Table 7: Impact Descriptors for Individual Receptors

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

Note: AQAL may be an air quality objective, EU limit value, or an Environment Agency 'Environmental Assessment Level (EAL)'
The table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers.
Changes of 0% (i.e. less than 0.5%) are described as Negligible.
The table is only to be used with annual mean concentrations

5.31. The approach set out in the EPUK / IAQM guidance provides a method for describing the impact magnitude at individual receptors only. The guidance outlines that this change may have an effect on the receptor depending on the severity of the impact and other factors that may need to be taken into account. The assessment framework for describing impacts were used as a starting point to make a judgement on the significance of the effect. However, whilst there may be 'slight', 'moderate' or 'substantial' impact described at one or more receptors, the overall effect may not necessarily be judged as being significant in some circumstances.

5.32. Following the approach to assessing significance outlined in the EPUK / IAQM guidance, the significance of likely residual effects of the Development on air quality has been established through professional judgement and the consideration of the following factors:

- The geographical extent (local, district or regional) of effects;
- Their duration (temporary or long term);
- Their reversibility (reversible or permanent);
- The magnitude of changes in pollution concentrations;
- The exceedance of standards (e.g. AQS objectives); and
- Changes in pollutant exposure.

6. Baseline Conditions

Chesterfield Borough Council's Review and Assessment Process

6.1. CBC has completed all earlier stages of the quality review and assessment as required under the LAQM regime, a summary of these is presented below;

6.2. The 2003 Updating and Screening Assessment (USA)[18] determined that the AQS objectives for NO_2 and PM_{10} objectives were at risk of bring exceeded. This was followed by the 2004 detailed assessment, which determined no changes or action necessary however NO_2 and PM_{10} concentrations remained under close review

6.3. CBC subsequently undertook an USA in 2006[19], the findings of which confirmed that monitoring data highlighted three locations showing exceedence of the annual mean NO_2 Air Quality Objective. These were Chatsworth Road (A619), Derby Road (A61 South) and Chesterfield Road, Staveley (A619).

6.4. In 2007, CBC published its detailed assessment[20]. The findings confirmed that Chatsworth Road (A619), Derby Road (A61 South) and Chesterfield Road, Staveley (A619) showed exceedence of the annual NO_2 Air Quality Objective. Proposal was made to declare a ribbon AQMA.

6.5. In 2009[21], CBC determined monitoring data highlighted two further areas (both lying outside of the boundary for the proposed AQMA) showing elevated levels of NO_2 and possible exceedance of the annual NO_2 Air Quality Objective. These areas were Whittington Hill and Compton Street. Recommendation to produce detailed assessments for both areas.

6.6. Based on both monitoring and modelling the 2010 Detailed Assessment[22] indicated no exceedances of any of the objectives in 2009. Elevated levels were however found at a few locations and recommendations were made to continue to monitor trends throughout the Borough and especially at these locations.

6.7. Further progress reports concluded that the four areas identified as being at risk of breaching the Air Quality Objectives are all below objective and therefore no requirement to declare AQMA's.

6.8. The 2014 progress report[23] identified a breach of the NO_2 air quality objectives at a single row of terraced houses on Church Street, Brimington. This area was subsequently designated as an AQMA in August 2015.

6.9. The 2020 Annual Status Report[24] states that the overall trend in levels of NO_2, continues to show a decline in pollutant levels. However, there is a second location along Sheffield Road, Stonegravels which is under consideration for a second AQMA, due to changes in the levels of NO_2.

6.10. The site is located approximately 6km east of the Brimington AQMA and as such the site is not located within an AQMA.

18 Chesterfield Borough Council Updating and Screening Assessment, 2003.
19 Chesterfield Borough Council Updating and Screening Assessment, 2006.
20 Chesterfield Borough Council LAQM Detailed Assessment, May 2007.
21 Chesterfield Borough Council Updating and Screening Assessment, May 2009.
22 Chesterfield Borough Council Detailed Assessment, August 2010.
23 Chesterfield Borough Council Air Quality Progress Report, August 2014
24 Chesterfield Borough Council Annual Status Report,2020 (June 2020).

Chesterfield Borough Council's Local Monitoring

6.11. CBC currently undertakes monitoring of NO_2, PM_{10} and $PM_{2.5}$ at two automatic monitors within CBC. The automatic monitors are:

- The Chesterfield Roadside (AURN1) roadside monitor; monitoring NO_2, PM_{10}, and $PM_{2.5}$ located approximately 10.4km south-west of the Site; and
- The Chesterfield Loundsley Green (AURN2) urban background monitor; monitoring NO_2 and located approximately 9.5km north-west of the Site.

6.12. NO_2, PM_{10} and $PM_{2.5}$ concentrations from the Chesterfield Roadside (AURN1) automatic monitor is presented in **Table 8** below.

Table 8: Measured Concentrations at the AURN 1 CBC Roadside Monitor

Monitor	Pollutant	Averaging Period	AQS Objective	2015	2016	2017	2018	2019
AURN1	NO_2	Annual Mean (µg/m^3)	40µg/m^3	19.9	20.3	18.0	16.8	17.4
		1-Hour Mean (No. of Hours)	200µg/m^3 not to be exceeded more than 18 times a year	0	0	0	0	0
	PM_{10}	Annual Mean (µg/m^3)	40µg/m^3	19.8	17.7	14.3	16.8	14.1
		24-Hour Mean (No. of Days)	50µg/m^3 not to be exceeded more than 35 times a year	2	0	3	3	3
	$PM_{2.5}$	Annual Mean (µg/m^3)	25µg/m^3	10.4	11.3	8.8	9.7	8.9

Source: Data obtained from CBC 2020 Air Quality Annual Status Report

6.13. The monitoring results in **Table 8** indicate the respective NO_2, PM_{10}, and $PM_{2.5}$ AQS objectives were met in all years at the Chesterfield Roadside monitor.

6.14. CBC also measures NO_2 at 37 locations using diffusion tubes. The latest available results for the 9 NO_2 roadside diffusion tube within 6.0km from the centre of the Site are presented in **Table 9**.

Table 9: NO_2 Concentrations at the CBC diffusion tubes within 6.0km to the Site

Site ID	Location	Distance to Site (km)	Annual Mean NO_2 Concentration ($\mu g/m^3$)				
			2015	2016	2017	2018	2019
DT27	Lowgates, Stavely	1.8	30.6	31.9	28.3	29.6	27.2
DT33	55 Duke Street, Staveley	2.2	38.4	36.6	34.1	37.5	33.1
DT22	25/27 Ringwood Road, Brimington	5.2	32.8	32.2	26.5	32.1	29.1
DT10	7 High Street, Brimington	5.4	**43.1**	39.7	34.9	36.1	34.9
DT6	6 Church Street, Brimington	5.5	**40.5**	**44.3**	34.2	34.8	31.3
DT38	14 Church Street, Brimington	5.5	**44.4**	**42.5**	36.4	38.3	39.5
DT37	**50 Church Street, Brimington**	5.6	39.6	36.7	35.9	36.3	35.2
DT28	Patrick Hinds House, Church Street, Brimington	5.6	34.0	32.7	36.3	38.0	30.6
DT21	**14 Chesterfield Road, Brimington**	5.8	24.5	24.5	22.4	25.6	23.1

Notes: Data obtained from CBC 2020 Air Quality Annual Status Report
Exceedances of the AQS Objectives shown in **bold** text.

6.15. **Table 9** indicates the annual mean NO_2 objective of 40$\mu g/m^3$ were not exceeded at any of the 9 diffusion tube monitoring locations within 6.0km of the Site in 2019. Exceedances were recorded at three diffusion tube locations (DT10, DT6 and DT38) between 2015 and 2016.

7. Construction Phase Effects

Nuisance Dust

7.1. Construction activities of the Development have the potential to affect local air quality through Earthworks, Construction and Trackout activities, as described above. The Site is agricultural land and therefore effects of demolition has not been considered further.

7.2. The Site is located in an agricultural and residential area, with the nearest residential properties located at Castle View (approximately 1.6 km to the east of the Site); in Woodthorpe approximately 0.03 km to the west; properties along Worksop Road approximately 0.02 km to the north; and on Woodthorpe Road approximately 0.07 km to the south.

Earthworks

7.3. The area of the Site is approximately 46.2 hectares (ha), or 46,200m^2. Based on the size of the Site and considering the criteria in Step 2A of the IAQM guidance, the potential dust emissions during earthworks activities were considered in the worst case to be of **large** magnitude.

Construction

7.4. The Development would comprise the construction of approximately 650 residential properties. The estimate for the total volume of buildings to be constructed would exceed 100,000m^3. Based on this and considering the criteria in Step 2A of the IAQM guidance, the potential dust emissions during construction activities would be of **large** magnitude.

Trackout

7.5. It is estimated that the number of construction HDVs trips would range between 10 and 50 outward HDV trips per day (Monday to Saturday). Based on this and considering the criteria in Step 2A of the IAQM guidance, the potential for dust emissions due to trackout activities would be of **medium** magnitude.

Sensitivity of the area

7.6. The sensitivity of the area to each main activity has been assessed based on the number and distance of the nearest sensitive receptors to the activity, and the sensitivity of these receptors to dust soiling and human health.

Sensitivities of People to Dust Soiling Effects

7.7. There are estimated to be between 10-100 high sensitive receptor within 20m of the Site. On this basis (as set out in Table 2 of the IAQM guidance) the sensitivity of the area to dust soiling is **high**.

Sensitivities of People to the Health Effects of PM_{10}

7.8. The Defra background PM_{10} concentration for the Site is 13.4µg/m^3 in 2019 (see Appendix A, Table A5. On this basis (as set out in Table 2 of the IAQM guidance) the sensitivity of the area to human health is **low**.

Sensitivities of Receptors to Ecological Effects

7.9. The site does not lie within or adjacent to any sites designated at European, national or local level on the basis of the ecological importance. The sensitivity of the area to ecological impacts is therefore considered to be **low**.

Dust Risk Summary

7.10. The dust risk categories, based on the potential magnitude of dust emissions and the sensitivity of the area to dust, are presented in **Table 10**.

Table 10: Summary of Risk

Receptor Sensitivity	Sensitivity of the Surrounding Area		
	Earthworks	Construction	Trackout
Dust Soiling	High	High	Medium
Human Health	Low	Low	Low
Ecological	Low	Low	Low

7.11. The Site is considered **high risk** to dust soiling impacts consequently, mitigation would be required to ensure that adverse impacts be minimised, reduced and, where possible, eliminated.

Construction Vehicle Exhaust and Plant Emissions

7.12. Construction vehicles and plant operating on the Site would have the potential to increase local air pollutant concentrations, particularly in respect of NO_2 and particulate matter (both PM_{10} and $PM_{2.5}$).

7.13. Based on the size of the Site, it is estimated that number of HDVs could range between 10 and 50 HDV trips in any one day. Following review of the surrounding area, emissions from construction traffic would be relatively small compared to existing road traffic emissions on Worksop Road (20,241 daily vehicles including 13.6% HDVs, see **Appendix A**), where there is direct access to the M1 where construction traffic would disperse.

7.14. Considering the current traffic movements, background pollutant concentrations around the Site and the existing motorway network, the likely effect of construction vehicles entering and egressing the Site to air quality would be **negligible** during the construction period.

7.15. Emissions from plant operating on the Site would be very small in comparison to the emissions from traffic movements on the roads adjacent to the Site. It is therefore considered that even in the absence of mitigation, their likely effect on local air quality would be **negligible**.

8. Completed Development Effects

8.1. Effects on local air quality associated with the completed and operational Development would likely result from changes to traffic flows associated with the Development.

Nitrogen Dioxide

8.2. The results of the ADMS-Roads air quality modelling of operational traffic (based on current guidance, i.e. with reduced emission rates and background concentration to the completion year of 2026) for NO_2 are presented in **Table 11**.

Table 11: Results of the ADMS Modelling at Sensitive Receptors (NO_2)

ID	Receptor Location	NO_2 Annual Mean (µg/m³)			
		2019 Baseline	2026 Without Development	2026 With Development	2026 Change
1	Castle View	19.5	13.1	13.2	0.1
2	53 Worksop Road	23.3	15.1	15.4	0.3
3	Royal Oak Court	33.8	21.6	22.2	0.6
4	2 Renishaw Road	24.2	15.8	16.1	0.3
5	38 Hillside Drive	16.9	11.7	11.7	0.0
6	21 Hillside Drive	16.1	11.3	11.5	0.2
7	2 Lansbury Avenue	16.7	11.7	12.0	0.3
8	Norbriggs Primary School	31.0	19.1	19.7	0.6
9	5 The Paddocks Norbriggs Road	14.7	10.9	11.0	0.1
10	22 Woodthorpe Road	13.1	9.7	9.7	0.0
11	**Proposed:** Northern Redline Boundary	-	-	15.8	-
12	**Proposed:** Southern Central Redline Boundary	-	-	12.2	-
13	**Proposed:** Southern Redline Boundary	-	-	9.6	-
14	**Proposed:** Western Redline Boundary	-	-	12.7	-

Note: For accuracy, the changes arising from the Development have been calculated using the exact output from the ADMS models rather than the rounded numbers.

8.3. The results in **Table 11** indicate that for 2019, the NO_2 annual mean concentrations are predicted to meet the NO_2 objective at all sensitive receptor locations. The highest (33.8µg/m³) concentration is predicted at Receptor 3.

8.4. As discussed in **Appendix A**, the 1-hour mean AQS objective for NO_2 is unlikely to be exceeded at a roadside location where the annual mean NO_2 concentration is less than 60µg/m³. As shown in **Table 11**, the predicted NO_2 annual mean concentrations in 2019 are below 60µg/m³ at all of the

existing sensitive receptors modelled and therefore the 1-hour mean objective is met at these locations.

8.5. In 2026, both 'without' and 'with' the Development, all existing receptors are predicted to be below the NO_2 annual mean objective in 2026. Therefore, the 1-hour mean objective is also predicted to be met at all existing receptor locations.

8.6. The highest concentration (22.4µg/m^3) is predicted at Receptor 3 in the 'with' Development scenario.

8.7. Using the impact descriptors outlined in **Table 7**, the Development is predicted to result in a 'negligible' impact on annual mean NO_2 concentrations at all existing receptors. Using professional judgement and based on the reduction in annual mean NO_2 concentrations and the concentrations predicted at the sensitive receptors, it is considered the effect of the Development on NO_2 concentrations would be **not significant**.

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

8.8. The results of the ADMS-Roads air quality modelling of operational traffic for PM_{10} and $PM_{2.5}$ are presented in **Table 12**.

Table 12: Results of the ADMS Modelling at Sensitive Receptors (PM_{10})

ID	PM_{10} Annual Mean (µg/m³)				PM_{10} - Number of Days >50µg/m³				$PM_{2.5}$ Annual Mean (µg/m³)			
	2019 Baseline	2026 Without Development	2026 With Development	2026 Change	2019 Baseline	2026 Without Development	2026 With Development	2026 Change	2019 Baseline	2026 Without Development	2026 With Development	2026 Change
1	16.5	15.8	15.8	0.0	0	0	0	0	9.3	8.6	8.6	0.0
2	16.0	15.9	16.0	0.1	0	0	0	0	9.3	8.9	9.0	0.1
3	17.5	17.6	17.8	0.2	1	1	1	0	10.2	9.9	10.0	0.1
4	15.8	15.6	15.7	0.1	0	0	0	0	9.2	8.8	8.9	0.1
5	14.6	14.1	14.1	0.0	0	0	0	0	8.5	8.0	8.0	0.0
6	14.4	13.9	13.9	0.0	0	0	0	0	8.4	7.9	7.9	0.0
7	13.1	12.5	12.7	0.2	0	0	0	0	7.9	7.4	7.5	0.1
8	15.8	15.5	15.7	0.2	0	0	0	0	9.6	9.0	9.2	0.2
9	14.1	13.4	13.5	0.1	0	0	0	0	8.2	7.6	7.7	0.1
10	15.2	14.5	14.5	0.0	0	0	0	0	8.5	7.9	7.9	0.0
11	-	-	16.2	-	-	-	0	-	-	-	9.1	-
12	-	-	14.4	-	-	-	0	-	-	-	8.1	-
13	-	-	14.5	-	-	-	0	-	-	-	7.9	-
14	-	-	12.7	-	-	-	0	-	-	-	7.5	-

Note: For accuracy, the changes arising from the Development have been calculated using the exact output from the ADMS-Road model rather than the rounded numbers.

8.9. As shown in **Table 12**, the annual mean concentrations of PM_{10} are predicted to be well below the objective of 40µg/m³ in 2019 and in 2026, both 'without' and 'with' the Development, at all the existing sensitive receptors modelled. The maximum predicted concentration at an existing receptor is 17.8µg/m³ at Receptor 3 in 2026 'with' the Development. Using the impact descriptors outlined in **Table 7**, the Development is predicted to result in a 'negligible' impact at all existing sensitive receptors modelled.

8.10. The results in **Table 12** indicate that in 2019 and in 2026, both 'without' and 'with' the Development, all existing sensitive receptors are predicted to be below the 24-hour mean PM_{10} objective value of 35 days exceeding 50µg/m³. The maximum predicted concentration is 1 day at Receptor 3 in all modelled development scenarios.

8.11. The results in **Table 11** indicate that in 2019 and in 2026, both 'without' and 'with' the Development, all existing sensitive receptors are predicted to be below the annual mean $PM_{2.5}$ objective value of 25µg/m³. The maximum predicted concentration is 10.2µg/m³ at Receptor 3 in 2019 baseline Development scenario.

8.12. Using the impact descriptors outlined in **Table 8**, the Development is predicted to result in a 'negligible' impact at all existing sensitive receptors. Using professional judgement, based on the severity of the impact and the concentrations predicted at the existing sensitive receptors modelled, it is considered that the effect of the Development on local air quality would be not significant.

8.13. PM_{10} and $PM_{2.5}$ concentrations for locations within the Development are below the relevant objectives in 2026. As such, it is considered that for PM_{10} and $PM_{2.5}$ the effect of introducing residential uses to the Site is **not significant**.

9. Mitigation Measures and Residual Effects

Construction

Nuisance Dust

9.1. A range of environmental management controls would be developed, with reference to the IAQM guidance relating to High Risk sites and could include:

- Removal of materials that have potential to produce dust, where possible;
- Enclosure of material stockpiles at all times and damping down of dusty materials during dry weather;
- Provision of appropriate hoarding and / or fencing to reduce dust dispersion and restrict public access;
- Maintenance of Site fencing, barriers and scaffolding clean using wet methods;
- Control of cutting or grinding of materials on the Site and avoidance of scabbling;
- Dust generating machinery e.g. disk cutters to be fitted with vacuums;
- Appropriate handling and storage of materials, especially stockpiled materials;
- Restricting drop heights onto lorries and other equipment;
- Fitting equipment with dust control measures such as water sprays, wherever possible;
- Using a wheel wash, avoiding of unnecessary idling of engines and routing of Site vehicles as far from sensitive properties as possible;
- Ensuring bulk cement and other fine powder materials are delivered in enclosed tankers and stored silos with suitable emission control systems to prevent escape of material and overfilling during delivery;
- Using gas powered generators rather than diesel if possible and ensuring that all plant and vehicles are well maintained so that exhaust emissions do not breach statutory emission limits;
- Switching off all plant when not in use;
- No fires would be allowed on the Site; and
- Ensuring that a road sweeper is available to clean mud and other debris from hard-standing, roads and footpaths.

9.2. Such measures are routinely and successfully applied to major construction projects throughout the UK and are proven to reduce significantly the potential for adverse nuisance dust effects associated with the various stages of the construction work. Therefore, it is considered that the residual effects due to fugitive emissions would be **not significant**.

Construction Vehicle Exhaust and Plant Emissions

9.3. The likely residual effect of construction vehicles entering and egressing the Site to air quality would remain as per the likely effect, **not significant**.

9.4. Even in the absence of mitigation, the likely effect of any emissions from plant operation on the Site is considered to be **not significant.** This would therefore remain the likely residual effect.

Completed development

9.5. As identified earlier in this report, even in the absence of mitigation, the effect of the Development on local air quality would be **not significant**. Accordingly, mitigation measures would not be required, and residual effects would also be **not significant**.

10. Summary and Conclusions

10.1. The main likely effects on local air quality during construction relates to dust. A range of measures to minimise or prevent dust generated from construction activities would be implemented as a matter of best practice throughout the works. Therefore, it is considered that likely residual effects due to fugitive emissions would be **not significant**.

10.2. Any emissions from equipment and machinery operating on the Site during construction would be small in comparison to the emissions from the volume of vehicles travelling on roads in the surrounding area of the Site and would not significantly affect air quality. It is anticipated that the effect of construction vehicles entering and egressing the Site during the construction period would be **not significant**, in the context of local background pollutant concentrations and existing local road traffic emissions.

10.3. Any emissions from plant operating on the Site would be very small in comparison to the emissions from traffic movements on the roads adjacent to the Site. It is therefore considered that the effect on local air quality would be **not significant**.

10.4. Computer modelling has been carried out to predict the impact of future traffic-related exhaust emissions. The effect of the Development on local air quality has been predicted for existing sensitive receptor locations surrounding the Site. Following completion, the Development is predicted to have a negligible impact on NO_2, PM_{10} and $PM_{2.5}$ concentrations, at all existing receptors considered. The overall effect of the Development on air quality is therefore considered to be **not significant**.

10.5. Concentrations are predicted to be below the relevant objectives within the Development. As such, it is considered concentrations within the Development for future users are **not significant**.

Figures

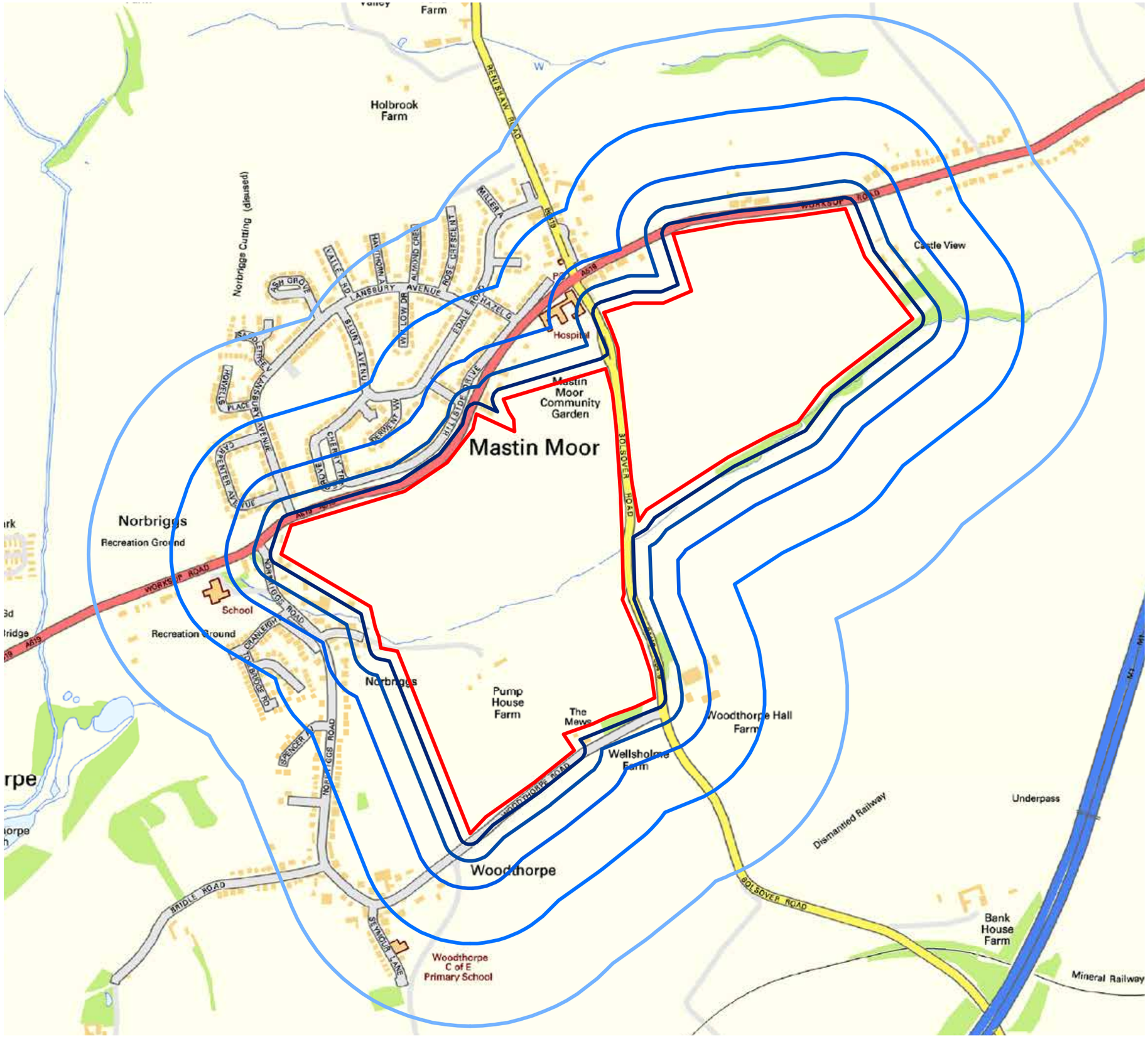
waterman

- Site Boundary
- R1 Existing Receptor Locations
- P1 Proposed Receptor Locations

N

Project Details	WIE13188-100: Land off Worksop Road, Mastin Moor
Figure Title	Figure 1: Sensitive Receptor Locations
Figure Ref	WIE13188-100_GR_AQ_1A
Date	September 2020
File Location	\\s-lncs\wiel\projects\wie13188\100\graphics\aq\issued figures

www.watermangroup.com



Site Boundary

20m from Site Boundary

50m from Site Boundary

100m from Site Boundary

200m from Site Boundary

350m from Site Boundary

N

Project Details	WIE13188-100: Land off Worksop Road, Mastin Moor
Figure Title	Figure 2: Construction Phase Assessment Bands
Figure Ref	WIE13188-100_GR_AQ_2A
Date	September 2020
File Location	\\s-lncs\wiel\projects\wie13188\100\graphics\aq\issued figures

APPENDICES

Appendix A: Air Quality Assessment Detailed Methodology

1.1 This appendix presents the technical information and data upon which the air quality assessment is based.

Completed Development Assessment

Model

1.2 In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; which requires a range of input data, which can include pollutant emissions rates, meteorological data and local topographical information.

1.3 The effect of the Development on local air quality was assessed using the advanced atmospheric dispersion model ADMS-Roads, considering the contribution of emissions from forecast road-traffic on the local road network by the completion year. The use of the ADMS-Roads model was agreed with Chesterfield Borough Council (CBC). Details of this consultation are provided in Appendix B.

1.4 At this stage the use of centralised heating or energy plants (such as a Combined Heat and Power Plant) are not proposed. Therefore, the air quality assessment does not consider further any emissions to air from any centralised heating or power plant.

ADMS-Roads

1.5 The ADMS-Roads model is a comprehensive tool for investigating air pollution in relation to road networks. On review of the Site, and its surroundings, ADMS-Roads was considered appropriate for the assessment of the long and short-term effects of the proposals on air quality. The model uses advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions of air pollutant concentrations. It can predict long-term and short-term concentrations, including percentile concentrations.

1.6 ADMS-Roads model is a formally validated model, developed in the United Kingdom (UK) by CERC (Cambridge Environmental Research Consultants). This includes comparisons with data from the UK's air quality Automatic Urban and Rural Network (AURN) and specific verification exercises using standard field, laboratory and numerical data sets. CERC is also involved in European programmes on model harmonisation, and their models were compared favourably against other EU and U.S. EPA systems. Further information in relation to this is available from the CERC web site at www.cerc.co.uk.

Model Scenarios

1.7 To assess the effect of the Development on local air quality, future 'without Development' and 'with Development' scenarios were assessed. The Development is anticipated to be complete in 2026 and therefore this is the year in which these future scenarios were modelled.

1.8 The year 2019 was modelled to establish the existing baseline situation, as it is the latest full year CBC air quality monitoring data is available, against which the air quality model is verified (discussed further below). Base year traffic data for 2019 and meteorological data for 2019 were also used to be consistent with the verification year.

1.9 Considering recent analyses by Defra[1] showing that historical nitrogen oxide (NO_x) and nitrogen dioxide (NO_2) concentrations are not declining in line with emission forecasts, as outlined in main chapter, a sensitivity analysis has been undertaken based on no future reductions in NO_x/NO_2 concentrations (i.e. considering the potential effects of the Development against the current baseline 2019 conditions by applying the 2026 road traffic data to 2019 background concentrations and road traffic emission rates). The results for this sensitivity analysis are presented in the main report.

Traffic Data

1.10 Traffic flow data comprising Annual Average Daily Traffic (AADT) flows, traffic composition (% Heavy-Duty Vehicles (HDVs)) used in the model was provided by the transport consultants (Arup), in **Table A1** below, which presents the traffic data used within the Air Quality Assessment.

1.11 The methodology for calculating the expected change in vehicle trips because of the Development, once completed and operational, is set out in detail within the Transport Assessment (submitted separately with the planning application) and covers all the proposed land uses.

Table A1: 24-hour AADT Data Used within the Assessment

Link Name	Speed (kph)	Base 2019		Without 2026		With 2026	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
Worksop Road 1	64	20,241	13.6	25,720	20.4	27,481	16.1
Worksop Road 2	64	17,754	15.8	22,375	25.4	25,013	18.4
Worksop Road 3	64	17,231	16.3	21,740	26.2	24,889	19.2
Worksop Road 4	64	17,225	16.3	21,740	26.2	21,067	21.5
Worksop Road 5	64	16,467	17.5	20,482	28.6	21,467	21.2
Bolsover Road 1	64	4,762	22.2	5,879	29.0	7,304	19.5
Bolsover Road 2	48	4,762	22.2	5,879	29.0	7,744	19.8
Bolsover Road 3	80	4,762	22.2	5,879	29.0	8,579	17.5
Bolsover Road 4	80	4,774	19.7	5,814	27.7	6,692	18.8
Bolsover Road 5	80	4,221	9.1	6,437	19.8	7,378	15.9
Norbriggs Road 1	48	2,504	1.7	3,375	2.6	3,440	3.9
Norbriggs Road 2	48	2,769	1.0	3,651	1.0	3,745	2.5
Woodthorpe Road 1	80	2,469	6.8	3,345	7.3	3,188	9.5
Woodthorpe Road 2	48	2,510	5.8	3,351	7.0	2,863	9.1
Woodthorpe Road 3	48	2,510	5.8	3,351	7.0	2,998	9.6
Lowgates 1	48	18,830	13.7	24,051	19.7	25,074	15.9
Duke Street 1	48	17,913	12.5	7,560	45.3	7,337	28.8
Renishaw Road 1	64	5,320	17.5	6,925	23.9	7,299	19.6

[1] http://laqm.defra.gov.uk/faqs/faqs.html: Measured nitrogen oxides (NOx) and/or nitrogen dioxide (NO_2) concentrations in my local authority area do not appear to be declining in line with national forecasts.

Vehicle Speeds

1.12 To consider the presence of slow moving traffic near junctions and at roundabouts with the model, the speed at each junction was reduced to 20 kph. This follows the criteria recommended within LAQM.TG(16)[2], which considers that in most instances the two-way average speed for all vehicles at a junction would be in the range of 20-40 kph based on the estimate that:

- Traffic pulling away from the lights, 40-50 kph;
- Traffic approach the lights when green, 20-50 kph; and
- Traffic on the carriageway approaching the lights when red, 5-20 kph, depending on the time of day and how congested the junction is.

Diurnal Profile

1.13 The ADMS-Roads model uses an hourly traffic flow based on the daily (AADT) flows. Traffic flows follow a diurnal variation throughout the day and week. Therefore, a diurnal profile was used in the model to replicate how the average hourly traffic flow would vary throughout the day and the week. This was based on data (the latest available at the time of the assessment) collated by Waterman from the Department for Transport (DfT) statistics Table TRA0307: 'Traffic Distribution by Time of Day on all roads in Great Britain', 2019[3], which is the latest data available at the time of undertaking the air quality assessment. **Figure A1** presents the diurnal variation in traffic flows which has been used within the model.

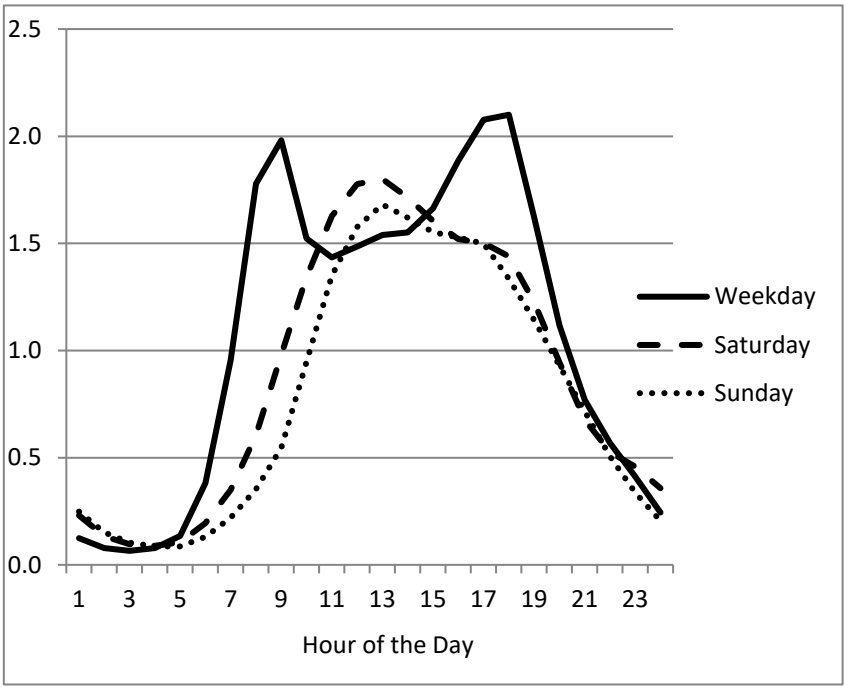


Figure A1: Department for Transport Diurnal Traffic Variation

Street Canyon Effect

1.14 Narrow streets with tall buildings on either side have the potential to create a confined space, which can interfere with the dispersion of traffic pollutants and may result in pollutant emissions

[2] Defra, 2016, Local Air Quality Management Technical Guidance LAQM.TG(16)

3 Department for Transport (DfT) Statistics, www.dft.gov.uk/statistics/series/traffic

accumulating in these streets. In an air quality model these narrow streets are described as street canyons.

1.15 ADMS-Roads includes a street canyon model to take account of the additional turbulent flow patterns occurring inside such a narrow street with relatively tall buildings on both sides. LAQM.TG(16) identifies a street canyon *"as narrow streets where the height of buildings on both sides of the road is greater than the road width."*

1.16 Following a review of the road network to be included within the model, it was considered that modelled roads are relatively wide and the existing buildings along these roads are not considered to be tall.

1.17 The proposed buildings within the Site would not cause any street canyons to be created where there is sensitive public exposure. Therefore, no street canyons were included within the model for any of the scenarios considered.

Road Traffic Emission Factors

1.18 The atmospheric dispersion model ADMS-Roads was used for the assessment. The model includes the vehicle emission factors published by Defra in the Emission Factors Toolkit (EFT) (v9.0 published in May 2019) and is based on the COPERT database published by the European Environment Agency. Following completion of the air quality assessment Defra published Version 10 (v10.1) of the EFT. Version 10.1 incorporates the following differences from v9.0:

- Lower NOx emissions for Euro 5 and 6 diesel LGVs, along with lower NOx emissions for motorcycles;
- Outside of London, the default fleet split assumptions, vehicle size distributions and Euro class compositions have been updated, including the uptake of low carbon passenger cars and LGV's with electric and hybrid propulsion systems; and
- Updated f-NO_2 values based on the latest available 'Primary NO_2 Emission factors for road transport (2020 version)' from the National Air Emissions Inventory (NAEI).

1.19 The default fleet projections in EFT v10.1 are based on fleet growth assumptions which were current before the Covid-19 outbreak in the UK. The default outputs from the tool do not reflect short- or longer-term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns.

1.20 EFT version 9.0 has been used for this assessment in order to display a worst-case assessment.

1.21 The EFT uses several parameters (traffic flow, percentage of HDV, speed and road type) to calculate road traffic emissions for the selected pollutants.

Background Pollutant Concentrations

1.22 Background pollutant concentration data (i.e. concentrations due to the contribution of pollution sources not directly considered in the dispersion modelling) have been added to contributions from the modelled pollution sources, for each year of assessment.

1.23 Background monitoring of NO_2 is undertaken within CBC at one automatic monitor at Loundsley Green (AURN 2), approximately 9.5km northwest of the Site. **Table A2** shows the most recent concentrations measured at the Loundsley Green monitor.

Table A2: Measured Concentrations at the Loundsley Green Urban Background Monitor

Pollutant	Averaging Period	AQS Objective	2015	2016	2017	2018	2019
NO_2	Annual Mean ($\mu g/m^3$)	40µg/m^3	14.4	16.7	12.4	12.2	12.4
	1-Hour Mean (No. of Hours)	200µg/m^3 not to be exceeded more than 18 times a year	0	0	0	0	0
PM_{10}	Annual Mean ($\mu g/m^3$)	40µg/m^3	14.4	14.8	12	14.4	12.7
	24-Hour Mean (No. of Days)	50µg/m^3 not to be exceeded more than 35 times a year	1	0	3	2	3
$PM_{2.5}$	Annual Mean ($\mu g/m^3$)	25µg/m^3	7.8	10.3	8.7	9.6	8.4

Notes: Data supplied by CBC Annual Status Report 2020

1.24 **Table A2** indicates that the AQS objectives for all pollutants (NO_2, PM_{10} and $PM_{2.5}$) are met in all years.

1.25 CBC does not undertake background air quality monitoring of NO_2 at any diffusion tube locations.

1.26 In addition to the monitoring data, background concentrations of NO_2, PM_{10} and $PM_{2.5}$ are available from the Defra LAQM Support website[4] for 1x1km grid squares for assessment years between 2018 and 2030. **Table A4** presents the Defra background concentrations for the year 2019, for the grid square the Site is located within OS Grid reference 445500,375500.

Table A3: Defra Background Maps in 2019 for the Grid Squares at the Site

Pollutant	2019 Annual Mean Concentration ($\mu g/m^3$)
NO_x	14.6
NO_2	11.0
PM_{10}	13.4
$PM_{2.5}$	7.8

1.27 **Table A2,** illustrate the NO_2 annual mean concentration at the AURN 2 automatic monitor are higher than the Defra maps NO_2 concentration. The AURN 2 automatic monitor is not considered a representation of air quality conditions at the Site, due to the characteristics of the location being in a more urban area, surrounded by a larger network of roads in comparison with the location of the proposed Development, and its distance from the Site it was not used in the assessment.

[4] http://laqm.defra.gov.uk/

Table A4: Background Concentrations used in the Assessment (µg/m^3)

Pollutant	Annual Mean Concentration (µg/m^3)	
	2019	2026
Grid Square 443500,374500; DT 33 and DT 27		
NO_2	13.3	-
PM_{10}	11.8	-
$PM_{2.5}$	7.4	-
Grid Square 446500, 375500; Receptor 1		
NO_2	17.1	11.8
PM_{10}	16.0	15.1
$PM_{2.5}$	9.0	8.3
Grid Square 445500, 375500; Receptors 2-6, Receptor 9 and Proposed Receptors 1-2		
NO_2	11.0	8.4
PM_{10}	13.4	12.6
$PM_{2.5}$	7.8	7.2
Grid Square 444500, 375500; Receptors 7-8 and Proposed Receptor 4		
NO_2	10.3	8.1
PM_{10}	11.8	11.0
$PM_{2.5}$	7.2	6.6
Grid Square 445500, 374500; Receptor 10 and Proposed Receptor 3		
NO_2	11.3	8.5
PM_{10}	14.8	14.0
$PM_{2.5}$	8.3	7.6

Meteorological Data

1.28 Local meteorological conditions strongly influence the dispersal of pollutants. Key meteorological data for dispersion modelling include hourly sequential data including wind direction, wind speed, temperature, precipitation and the extent of cloud cover for each hour of a given year. As a minimum ADMS-Roads requires wind speed, wind direction, and cloud cover.

1.29 Meteorological data to input into the model were obtained from the Nottingham/ Watley Meteorological Station, which is the closest to the Site and considered to be the most representative. The 2019 data were used to be consistent with the base traffic year and model verification year. It was also used for the 2026 scenario for the air quality assessment. **Figure A2** presents the wind-rose for the meteorological data.

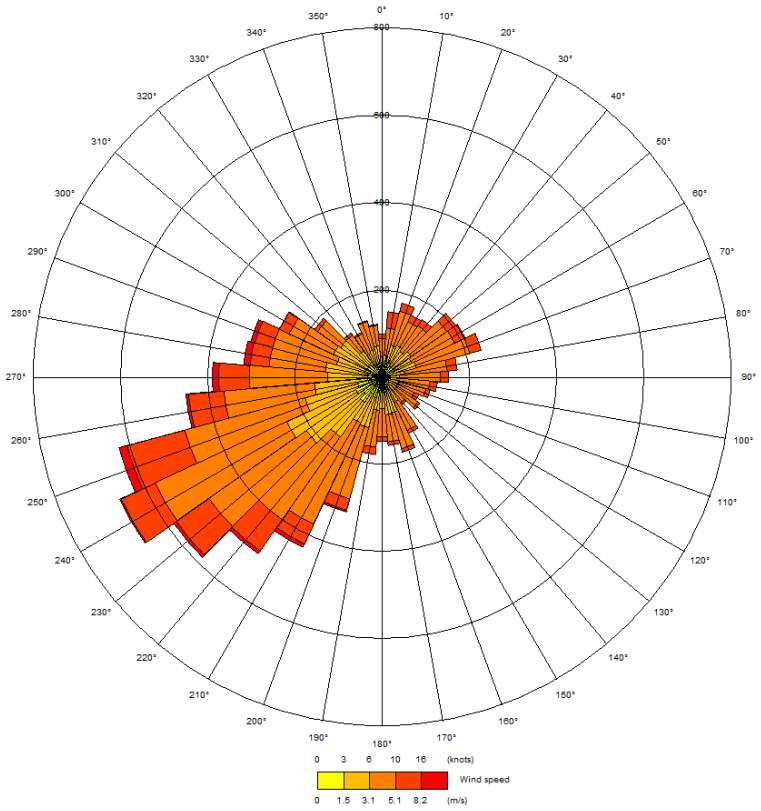


Figure A2: 2019 Wind Rose for the Nottingham/ Watley Meteorological Station

1.30 Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads and ADMS 5 treats calm wind conditions by setting the minimum wind speed to 0.75 m/s. It is recommended in LAQM.TG(16) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. LAQM.TG(16) recommends that meteorological data should only be used if the percentage of usable hours is greater than 85%. 2019 meteorological data from Nottingham/ Watley meteorological station includes 8,604 lines of usable hourly data out of the total 8,760 for the year, i.e. 98.4% of usable data. This is above the 85% threshold and is therefore adequate for the dispersion modelling.

1.31 A value of 0.5 was used for the Nottingham/Watley Meteorological Station, which is representative of open suburbia and is considered appropriate following a review of the local area surrounding the Meteorological Station.

Model Data Processing

1.32 The modelling results were processed to calculate the averaging periods required for comparison with the Air Quality Strategy Objectives.

1.33 NO_X emissions from combustion sources (including vehicle exhausts) comprise principally nitric oxide (NO) and NO_2. The emitted NO reacts with oxidants in the air (mainly ozone) to form more NO_2. Since only NO_2 is associated with impacts on human health, the air quality standards for the protection of human health are based on NO_2 and not total NO_X or NO.

1.34 The ADMS-Roads model was run without the Chemistry Reaction option to allow verification (see below). Therefore, a suitable NO_X:NO_2 conversion was applied to the modelled NO_X concentrations. There are a variety of different approaches to dealing with NO_X:NO_2 relationships, a number of which are widely recognised as being acceptable. However, the current approach was developed for roadside sites, and is detailed within the Technical Guidance LAQM.TG(16).

1.35 The LAQM Support website provides a spreadsheet calculator[5] to allow the calculation of NO_2 from NO_X concentrations, accounting for the difference between primary emissions of NO_X and background NO_X, the concentration of O_3, and the different proportions of primary NO_2 emissions, in different years. This approach is only applicable to annual mean concentrations.

1.36 Research[6] undertaken on behalf of Defra has indicated that the hourly mean limit value and objective for NO_2 is unlikely to be exceeded at a roadside location where the annual-mean NO_2 concentration is less than 60µg/m^3, LAQM.TG(16) confirms that this assumption is still valid. The hourly objective is, therefore, not considered further within this assessment where the annual-mean NO_2 concentration is predicted to be less than 60µg/m^3.

1.37 To calculate the number of daily exceedances of 50µg/m^3 PM_{10}, the relationship between the number of 24-hour exceedances of 50µg/m^3 and the annual mean PM_{10} concentration from LAQM.TG (16) was applied as follows:

Number of Exceedances = -18.5+0.00145 x annual mean^3 + (206/annual mean)

Other Model Parameters

1.38 There are a number of other parameters that are used within the ADMS-Roads model which are described for completeness and transparency:

- The model requires a surface roughness value to be inputted. A value of 0.5 was used for the Site and the Nottingham/Watley Meteorological Station, which is representative of open suburbia.
- The model requires the Monin-Obukhov length (a measure of the stability of the atmosphere) to be inputted. A value of 10m (representative of small towns) was used for the modelling; and
- The model requires the Road Type to be inputted. *'England [Urban]'* was selected and used for the modelling of the road links.

Model Verification

1.39 Model verification is the process of comparing monitored and modelled pollutant concentrations for the same year, at the same locations, and adjusting modelled concentrations if necessary to be consistent with monitoring data. This increases the robustness of modelling results.

1.40 Discrepancies between modelled and measured concentrations can arise for a number of reasons, for example:

- Traffic data uncertainties;
- Background concentration estimates;
- Meteorological data uncertainties;

[5] AEA, NOx to NO_2 Calculator, http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php Version 8.1, 26 June 2020

[6] Defra (2016), 'Local Air Quality Management Policy guidance PG(16)', DEFRA, London

- Sources not explicitly included within the model (e.g. car parks and bus stops);
- Overall model limitations (e.g. treatment of roughness and meteorological data, treatment of speeds); and
- Uncertainty in monitoring data, particularly diffusion tubes.

1.41 Verification is the process by which uncertainties such as those described above are investigated and minimised. Disparities between modelling and monitoring results are likely to arise as result of a combination of all of these aspects.

1.42 Box 7.15 of LAQM.TG(16) provides guidance on approaching model verification and adjustment. This requires the roadside NO_x contribution to be calculated. In addition, monitored NO_x concentrations are required, which have been calculated from the annual mean NO_2 concentration at the diffusion tube sites using the NO_x to NO_2 spreadsheet calculator as described above. The verification process applied here, has been based on Box 7.15.

Nitrogen Dioxide

1.43 The dispersion model was run to predict annual mean NOx concentrations at the Duke Street (DT33) and Lowgate (DT27) diffusion tubes. The monitoring locations are roadside and considered appropriate for the model verification.

1.44 The NO_2 concentrations are a function of NO_X concentrations. Therefore, the roadside NO_X concentration predicted by the model was converted to NO_2 using the NO_X to NO_2 calculator provided by Defra on the LAQM Support website. The background data for 2019 as presented in **Table A5** were used. The following tables present the adjusted model results using these input values.

Table A5: 2019 Annual Mean NO_2 Modelled and Monitored Concentrations (µg/m^3)

Site ID	Monitored Annual Mean NO_2 (µg/m^3)	Modelled Total Annual Mean NO_2 (µg/m^3)	% Difference (modelled – monitored)
DT33	33.1	19.1	-42.4
DT27	27.2	21.8	-20.0

1.45 **Table A6** indicates that the model is under predicting at the two monitoring locations. Technical Guidance LAQM.TG(16) suggests that where there is disparity between modelled and monitored results, particularly if this is by more than 25%, appropriate adjustment should be undertaken. The steps involved in the adjustment process are presented in **Table A7**.

Table A6: Model Verification Result for Adjustment NO_X Emissions (µg/m^3)

Site ID	Monitored Annual Mean NO_2 (µg/m^3)	Monitored Road NO_x (µg/m^3)	Modelled Road NO_x (µg/m^3)	Ratio of Monitored Road Contribution NO_x/Modelled Road Contribution NO_x
DT33	33.1	39.3	10.8	3.7
DT27	27.2	26.8	16.0	1.7

1.46 **Figure A3** shows the mathematical relationship between modelled and monitored roadside NOx (i.e. total NOx minus background NOx) in a scatter graph (data taken from **Table A7**), with a trendline passing through zero and its derived equation.

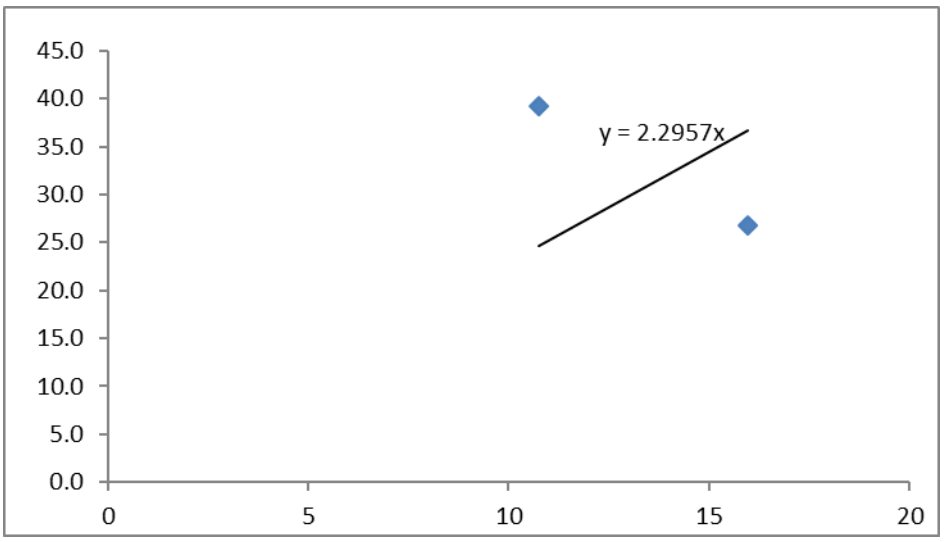


Figure A3: Unadjusted Modelled versus Monitored Annual Mean Roadside NO_x at the Monitoring Sites (µg/m^3)

1.47 Consequently, in **Table A8** the adjustment factor (2.2957) obtained from **Figure A3** was applied to the relevant modelled NO_x Roadside concentrations before being converted to annual mean NO_2 using the NO_x:NO_2 spreadsheet calculator.

Table A7: Model Verification Result for Adjustment NO_X Emissions (µg/m^3)

Site ID	Adjusted Modelled Road NO_X	Modelled Total NO_2	Monitored Total NO_2	% Difference
DT33	24.7	26.2	33.1	-21.0
DT27	36.7	31.9	27.2	17.2

1.48 The data in **Table A8** indicates a more conservative agreement between monitored and modelled annual mean NO_2 results compared to the unadjusted model in **Table A6**. The NO_X adjustment process was therefore applied to the roadside NOx modelling for 2019 'without' and 'with' the Development.

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

1.49 PM_{10} and $PM_{2.5}$ monitoring data is not available for the Site area. Therefore, the roadside modelled NO_x adjustment factor of 2.2957 was subsequently applied to all the roadside PM_{10} and $PM_{2.5}$ modelling results, before adding on the background concentrations for the study area for 2019 and each of the 2026 scenarios, at the specific receptors locations assessed, and before the number of daily exceedences was calculated.

Verification Summary

1.50 Any atmospheric dispersion model study will always have a degree of inaccuracy due to a variety of factors. These include uncertainties in traffic emissions data, the differences between available meteorological data and the specific microclimate at each receptor location, and simplifications made in the model algorithms that describe the atmospheric dispersion and chemical processes. There will also be uncertainty in the comparison of predicted concentrations with monitored data, given the potential for errors and uncertainty in sampling

methodology (technique, location, handling, and analysis) as well as processing of any monitoring data.

1.51 Whilst systematic under or over prediction can be taken into account through the model verification / adjustment process, random errors will inevitably occur, and a level of uncertainty will still exist in corrected / adjusted data.

1.52 Model uncertainties arise because of limited scientific knowledge, limited ability to assess the uncertainty of model inputs, for example, emissions from vehicles, poor understanding of the interaction between model and / or emissions inventory parameters, sampling and measurement error associated with monitoring sites and whether the model itself completely describes all the necessary atmospheric processes.

1.53 Overall, it is concluded that with the adjustment factors applied to the ADMS-Roads model, it is performing well and modelled results are suitable to determine the potential effects of the Development on local air quality.

Assessor Experience

Name: Alessandra Boccuzzi
Years of Experience: 2
Qualifications:

- BSc (Hons)

Alessandra has two years of experience specialising in the assessment of air quality and odour for a variety of projects. Alessandra has knowledge and experience of designing and undertaking ambient air quality monitoring programmes using passive diffusion tubes.

Name: Christopher Brownlie
Years of Experience: 13
Qualifications:

- BSc (Hons)
- MSc
- MIAQM (Member of the Institute of Air Quality Management)

Chris has over 13 years of experience in the assessment of air quality and odour for a variety of environmental impact assessment projects. Chris has knowledge and extensive experience of designing and undertaking ambient air quality monitoring programmes using real time equipment and passive diffusion tubes. This includes devising monitoring programs for dust deposition, typically to monitor levels of dust generated during construction activities in populated areas where there is the potential for nuisance to be caused.

Chris has been responsible for the technical delivery of a wide range of air quality projects for a variety of clients in both the public and private sector. These projects include consideration of emissions from both transportation and industrial sources, through both monitoring and modelling, and therefore he has an in depth understanding of the regulatory requirements for these sources and the published technical guidance for their assessment.

Appendix B Environmental Health Officer Consultation

Good afternoon, Alessandra

Thank you for sending the information through, I agree with the proposed methodology.

Regards, Steve Payne

District Environmental Health Officer

Chesterfield Borough Council

Stonegravels Depot

Old Brick Works Lane

Chesterfield

S41 7LF

[redacted]

Tel: [redacted]

From: Alessandra Boccuzzi [redacted]>
Sent: 11 September 2020 10:49
To: Steven Payne [redacted]>
Subject: FW: Mastin Moor- Air Quality Assessment

Good Morning Steven,

Waterman have been instructed to undertake an air quality assessment to accompany the planning application for the proposed residential led development on land off Worksop Road, Mastin Moor, and would like to agree with Chesterfield Borough Council (CBC) the scope and methodology for the assessment. Please note changes of design scheme, details were incorrect in my previous e-mail.

The existing site, located at Mastin Moor, to the south of Worksop Road (A619) to both the east and west of Bolsover Road, with part of the site extending southwards to Woodthorpe Road. It encompasses some 46.2 ha of mainly agricultural land. The design of the scheme will likely consist of 650 new residential dwellings, a local centre (including local retail and health facilities), open space, community garden extension and associated infrastructure.

We have identified the following potential impacts on air quality as a result of the proposed development:

- temporary generation of dust arising from the construction works leading to potential dust nuisance to surrounding sensitive receptors;

- temporary changes in traffic-related emissions during the construction works as a result of changes in traffic generated by such works / activities and emissions from construction plant; and
- long-term effects from the completed Development on local air quality particularly in relation to NO_2 and PM_{10} levels, due to emissions from traffic generated by the completed Development.

We understand that CBC have declared 1 AQMA within its administrative boundary, the site does not lie within the declared AQMA. It is therefore proposed to undertake an air quality assessment to assess the exposure of future occupants to poor air quality using the detailed dispersion model ADMS Roads, as well as the effect of any energy plant (if proposed within the Development) using the detailed dispersion model ADMS-5.

To take into account the trend that NOx and NO_2 concentrations are not declining as expected, the results will include an uncertainty section which will assess the future traffic on the basis of no future reductions.

To ensure the performance of the model, a comparison between monitored and modelled pollutant concentrations (model verification) at the Chesterfield Borough Council diffusion tube on Duke Street would be undertaken.

Further to the operational assessment, a qualitative assessment of the potential impacts of the development on local air quality during construction would be undertaken. This would use the IAQM guidance to assess dust nuisance and emissions from construction plant/ vehicles, detailing any mitigation measures required.

We are not aware of any other sources of pollution in the area, other than road traffic that may affect air quality at the site (and should therefore be considered in the assessment).

If you have any queries in relation to our proposed methodology please do let me know. However, it would be helpful if you could confirm that our proposed approach is acceptable.

Regards,

Alessandra Boccuzzi

Graduate Noise and Air Quality Consultant

Waterman Infrastructure & Environment Ltd

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Waterman

UK and Ireland Office Locations