South Kesteven District Council

Air Quality Action Plan

In fulfilment of Part IV of the Environment Act 1995

Local Air Quality Management

November 2024

Information	Details
Local Authority Officer	Tom Amblin-Lightowler
Department	Public Protection – Environmental Protection
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Report Reference Number	2024 AQAP
Date	November 2024

Executive Summary

This Air Quality Action Plan (AQAP) has been produced as part of our statutory duties required by the Local Air Quality Management framework. It outlines the action we will take to improve air quality in South Kesteven District Council between 2024 - 2029.

This action plan replaces the previous action plan published in 2016. Projects delivered through the past action plan include completion of phase 1 and 2 of the Grantham Southern relief road; ongoing work to promote cycling, walking and public transport; an anti-idling campaign focused in and around the AQMA; and improvements in South Kesteven District Council's own vehicle fleet.

Air pollution is associated with several adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children and older people, and those with heart and lung conditions. There is also often a strong correlation with equalities issues because areas with poor air quality are also often the less affluent areas[1,2].

The annual health cost to society of the impacts of particulate matter alone in the UK is estimated to be around £16 billion[3]. South Kesteven District Council is committed to reducing the exposure of people in South Kesteven to poor air quality to improve health.

We have developed actions that can be considered under 5 broad topics:

- Promoting low emission transport
- Promoting travel alternatives
- Public information
- Traffic management

[1] Environmental equity, air quality, socioeconomic status, and respiratory health, 2010

[2] Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006

[3] Defra. Abatement cost guidance for valuing changes in air quality, May 2013

- Vehicle fleet efficiency
- Our priorities are to sustain a downward trend in emissions reduction through partnership work. The delivery of the Grantham Southern relief road remains a major focus to divert traffic away from the town centre. Traffic management and infrastructure for walking and cycling are prioritised by the Grantham Transport Strategy published in 2022. The Clean Air Lincolnshire project will continue to raise awareness of issues of air quality and provide additional monitoring data within the AQMA. Vehicle fleet efficiency and electrification opportunities will continue to be implemented by South Kesteven District Council.

In this AQAP we outline how we plan to effectively tackle air quality issues within our control. However, we recognise that there are many air quality policy areas that are outside of our influence (such as vehicle emissions standards agreed in Europe), but for which we may have useful evidence, and so we will continue to work with regional and central government on policies and issues beyond South Kesteven District Council's direct influence.

Responsibilities and Commitment

This AQAP was prepared by the Environmental Health department of South Kesteven District Council with the support and agreement of the following officers and departments:

The Climate Change and Sustainability Manager

The final AQAP will be approved by:

Councillor Rhea Rayside – Cabinet Member for People and Communities.

Graham Watts - Assistant Director (Governance and Public Protection)

Ayeisha Kirkham – Head of Service – Public Protection

The AQAP has been developed in conjunction with Lincolnshire County Council from a highways and sustainability perspective.

This draft AQAP has not been signed off by a Director of Public Health. However, the final AQAP will be reviewed by the Director of Public Health.

This Air Quality Action Plan (AQAP) has been prepared and developed in partnership with other relevant bodies, particularly the Highways team of Lincolnshire County Council (LCC) and the relevant teams of South Kesteven District Council to incorporate localised engineered measures in the AQMA.

This AQAP will be subject to an annual review, appraisal of progress and South Kesteven District Councils Environment over and scrutiny Committee. Progress each year will be reported in the Annual Status Reports (ASRs) produced by South Kesteven District Council, as part of our statutory Local Air Quality Management duties.

If you have any comments on this AQAP, please send them to Tom Amblin-Lightowler at:

South Kesteven District Council

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1 Introduction

This report outlines the actions that South Kesteven District Council will deliver between 2024 – 2029 to reduce concentrations of air pollutants and exposure to air pollution; thereby positively impacting on the health and quality of life of residents and visitors to the South Kesteven District Council administrative area.

It has been developed in recognition of the legal requirement on the local authority to work towards Air Quality Strategy (AQS) objectives under Part IV of the Environment Act 1995 and relevant regulations made under that part and to meet the requirements of the Local Air Quality Management (LAQM) statutory process.

This Plan will be reviewed every five years at the latest and progress on measures set out within this Plan will be reported on annually within South Kesteven District Council's air quality ASR.

South Kesteven District Council is committed to working to improve the air quality in our district where levels of air pollutants are exceeding air quality objectives.

Air quality in South Kesteven is generally good. However, there are locations where pollutant levels are high, with the highest levels being along narrow, congested street canyons (roads with properties close to the road on either side of the street) in Grantham.

Monitoring has revealed that the annual mean air quality objectives for NO_2 for the previous 3 years have been close to the National Air Quality objective of 40 µg/m^3 but have not exceeded this threshold at any of the monitoring locations in Grantham town centre, some of which are within an Air Quality Management Area (AQMA).

Monitoring data for the last 5 years with the Air Quality Management Area have identified:

- There is an overall decreasing trend in nitrogen dioxide air pollution at monitoring sites.
- There remain three sites which have only been under objective levels for air pollution for the last 2-3 years, which includes 2020 where results are not considered typical due to abnormal traffic levels.

- There were no exceedances of the 1 hour mean target for NO_2 air pollution for the last 5 years.

Department for Food and Rural Affairs (DEFRA) based upon the lack of exceedances of the 1 hour mean target recommend that this be removed from the current AQMA.

There is now an intention to review the existing AQMA to reflect the updated NO_2 monitoring data.

The district of South Kesteven is very diverse, comprising principal towns of Grantham, Stamford, Bourne and The Deepings surrounded by small rural villages and hamlets.

The main source of air pollution in the district is road traffic emissions from major roads, notably the A1, A52, A15 and A607. The district and surrounding areas are illustrated in Figure 1.

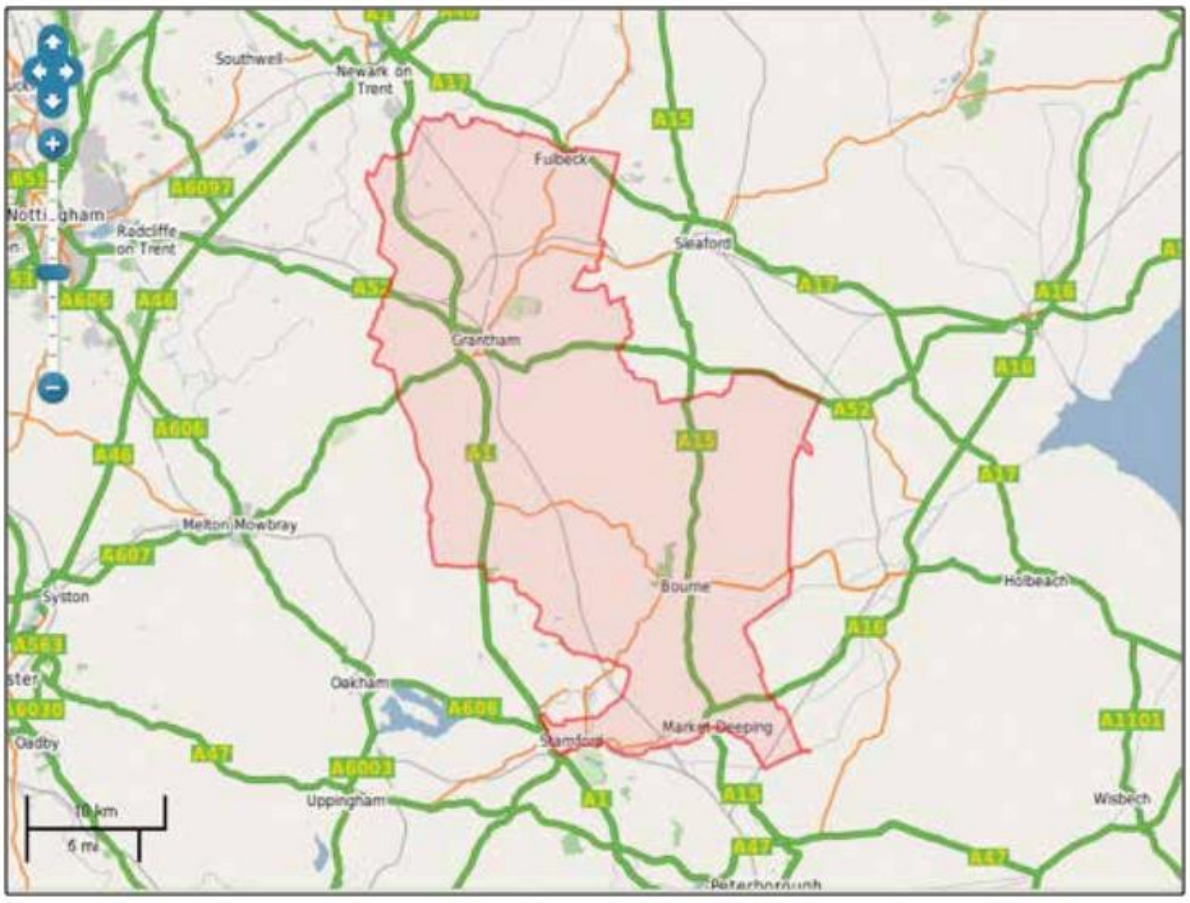

Figure 1 – South Kesteven District Council boundary and Surrounding Area

2 Summary of Current Air Quality in South Kesteven District Council

Please refer to the latest ASR from South Kesteven District Council.

In 2013, the council declared an AQMA for the area encompassing the main roads in the town centre of Grantham. The AQMA is illustrated in Figure 2. Several roads included within the AQMA are likely to lead to a “street canyon effect” due to the road and building layout, trapping, and preventing the dispersion of air pollutant emissions from road-traffic, therefore explaining the higher levels of pollution in these areas.

A recent review of the population within the AQMA puts the potential exposed population at 635. The NO_2 monitoring data for the previous 5 years as stated have not exceed the annual or hourly means and we are confident that the proposed measure included within the AQAP will continue to see a downward trend and remain below the National Air Quality Objectives.

Historical source apportionment indicated that emissions from local moving traffic are the main contributor to overall NO_2 levels, although idling emissions due to queuing vehicles are also particularly important near traffic lights. Given that there have been no substantial changes to the physical environment and that it remains predominantly a residential and retail setting it remains highly likely that that local moving traffic is the main contributor of NO_2. A recent source apportionment exercise has been completed, which found that diesel cars are responsible for just over half (50.3% of NOx emissions in the measured area, followed by diesel light goods vehicles (28.2%).More detail is available within the Source Apportionment chapter of this document.

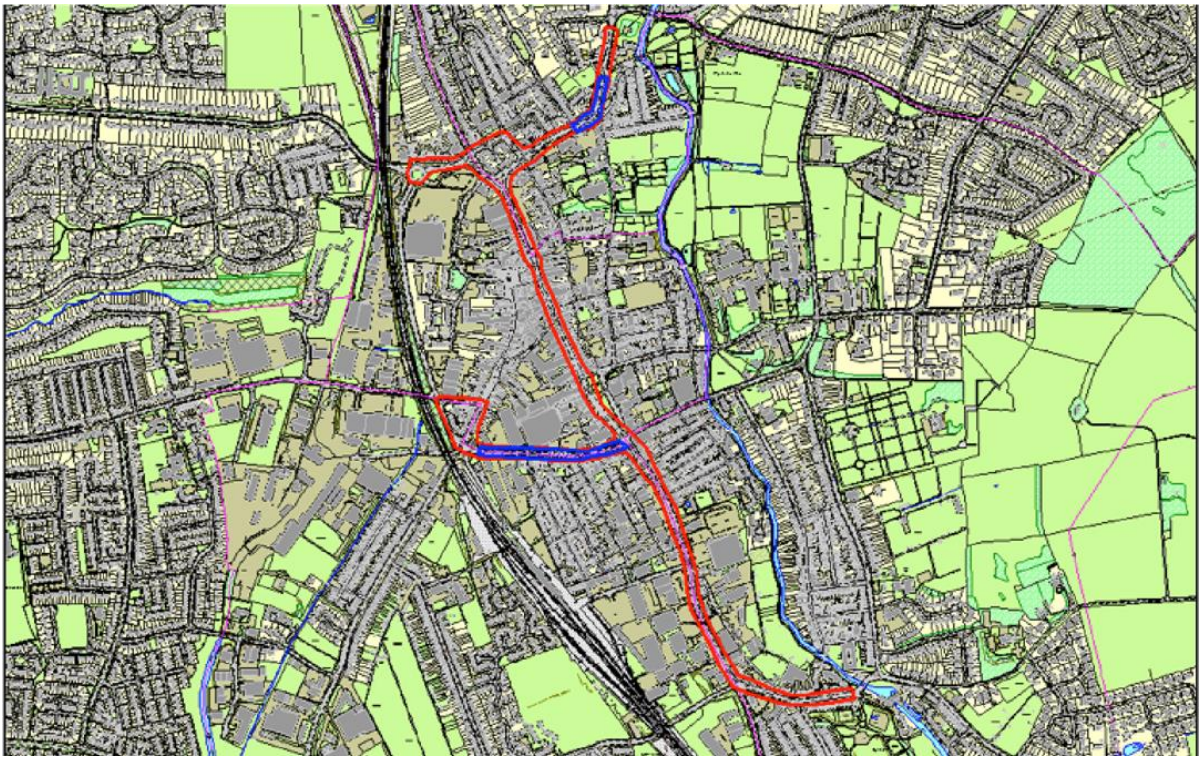

Figure 2 - Grantham Air Quality Management Area

In red, current AQMA boundary (declared in 2013). In blue, previous AQMA areas.

The council carries out passive NO_2 monitoring at 37 sites across the district using diffusion tubes. This includes 15 duplicate tube and four triplicate tube locations, which are aimed at improving reliability of the data.

Full details of monitoring data are shown within the ASR:

South_Kesteven_District_Council_ASR_2023_v3.pdf (southkesteven.gov.uk)

3 South Kesteven District Council's Air Quality Priorities

3.1 Public Health Context

Air pollution is associated with several adverse health impacts. It is recognised as a contributing factor in the onset of both heart and respiratory diseases and lung cancer[4]. Additionally, air pollution particularly affects the most vulnerable in society: children, the elderly, and those with existing heart and lung conditions. There is also often a strong correlation with equalities issues because areas with poor air quality are also often less affluent areas[5][6].

The mortality burden of air pollution within the UK is equivalent to 29,000 to 43,000 deaths at typical ages[7], with a total estimated healthcare cost to the NHS and social care of £157 million in 2017[8].

Given that South Kesteven is predominantly a rural setting and that the NO_2 monitoring data from within the district is below the National Air Quality Objectives the healthy implications are deemed to be minimal. However the World Health Organization has a recommended guideline level of 10 µg/m^3 which is far below the National Air Quality Objective of 40 µg/m^3 and it is recognised that low levels of such pollutants affects health. Therefore any reduction in emissions can only have a positive impact upon the health of those living in the area.

[4] Health Matters: air pollution - GOV.UK (www.gov.uk)

[5] Public Health England. Air Quality: A Briefing for Directors of Public Health, 2017

[6] Defra, Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006.

[7] Defra, Air quality appraisal: damage cost guidance, January 2023

[8] Public Health England. Estimation of costs to the NHS and social care due to the health impacts of air pollution: summary report, May 2018

3.2 Planning and Policy Context

South Kesteven District's Local Plan 2011-2036 has links to improving air quality with the considerations for contributing to low-carbon travel through the expectations for residential and commercial developments to provide electric vehicle charging points[9].

It is hoped that this will encourage the switch to electric vehicles and reduce the contribution of traffic towards NO_2 levels.

Additionally larger scale developments have development principles specified within the Local Plan to provide footway and cycleway connections to local amenities.

South Kesteven District Council have a Green Fleet Strategy currently at draft stage that contains 3 key outcomes which will aid in reducing the NO2 emissions from council owned fleet vehicles. This focuses on exploration of alternative fuel, low emission fuel alternatives and use of electric vehicles where possible. In addition to transitioning to greener driving behaviours.

The Grantham Transport Strategy December 2022 has been developed by Lincolnshire County Council and provides a vision for the future of transport in and around Grantham up to 2036[10]. One of the objectives within this strategy is to enhance health and well being of residents within Grantham by improving air quality. This has led the development of some key policies that will directly link to the measures within the AQAP. This also incorporates a junction improvement package that looks to review problematic junctions and identified improvements to help traffic flow, ease congestion and some of these are within the AQMA which once completed will assist in reducing emissions and directly relates to one of the measures within the AQAP. The overall strategy supports improved air quality within South Kesteven by:

- Creating mobility hubs – places where people can interchange modes of travel as well as providing amenities and facilities

[9] South Kesteven District Council. Local Plan 2011-2036

[10] The Grantham Transport Strategy 2022

- Grantham Cycling and Walking network plan – investing in high- quality walking and cycling infrastructure along key corridors
- Sustainable urban extensions (SUE) packages
- Active travel infrastructure package – Grantham wide scheme to support cycling and walking
- Electric Vehicle Package – infrastructure to support decarbonisation of our vehicles.
- Junction improvement package – optimising traffic flow on the highway network and improving the efficiency of junctions in Grantham

Locally South Kesteven District Council Hackney Carriage and Private Hire Licensing Policy 1 June 2024 also requires new vehicles to meet the Euro 6 Standards to ensure that the taxi's operating within the district meet the latest emissions standards.

3.3 Source Apportionment

Source apportionment has been carried out in May 2024 for the modelled receptors along the road links that are either within the AQMA or lead into the AQMA. Apportionment for both NO_x and NO_2 concentrations has been completed for the following vehicle classes:

- Petrol and Diesel Cars
- Petrol and Diesel LGV's
- Rigid HGV's
- Artic HGV's
- Buses and Coaches
- Other (including Motorcycle, Hybrid and EV cars)

It is worth noting that NO_x concentrations are always higher than those for NO_2 since NO_x is made up of NO and NO_2. There is no air quality limit for human health for NO_x but is nevertheless a useful indicator when considering source apportionment. Results are illustrated in Figure 3.1 to Figure 3.6.

Table 3.1 shows the percentage contribution of road and background sources. Across all modelled receptors, 57.07% of the NO_x contribution is from road sources, and the remaining 42.93% is from background sources. Of the background contribution,

23.65% is from the local background, whilst 19.28% is from regional the regional background.

Table 3.1 – Total NO_x Source Apportionment Average Across All Receptors

Results	Local Background NO_x	Regional Background NO_x	Local Road NO_x
NO_x Concentration ($\mu g/m^3$)	7.85	6.40	18.94
Percentage of total NO_x	23.65%	19.28%	57.07%

Local background NO_x, which is considered to be the emissions a local authority has influence over, including building, road and rail emissions etc, accounts for 23.65% of the total NO_x concentration on average at all receptor location. Regional background NO_x concentrations account for those emissions that the local authority has no influence over, with these emissions forming 19.28% of the total NO_x concentration on average across all modelled receptors. Therefore, a total of 57.07% of NO_x emissions on average within the AQMA is derived from local road traffic.

The source apportionment results provide the relative contribution (as a percentage) of each vehicle type towards a specific pollutant. Therefore, when considering the average NO_x concentration across all modelled receptors, road traffic is responsible for 57.07% of emissions. Of the total road NO_x, diesel cars are the greatest contributor accounting for 50.3% of emissions, followed by diesel light good vehicles (28.2%) and rigid HGVs (8.4%).

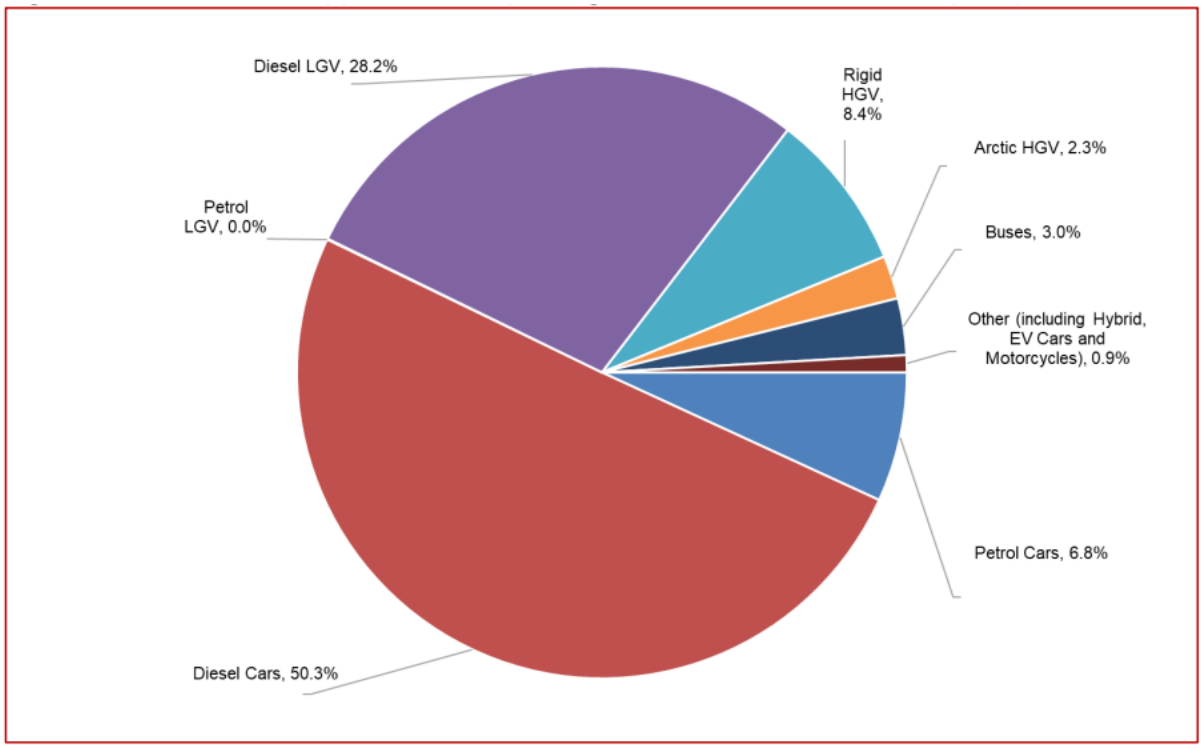

Figure 3.1– NO_x Source Apportionment (Average Across All Modelled Receptors)

When considering the modelled receptor location at which the maximum road NO_x concentration is observed (Receptor 41), road traffic is responsible for 82.2% of total NO_x emissions. Of the road traffic proportion, 53.7% is from diesel cars, 30.4% from diesel light good vehicles and 6.8% from petrol cars.

These percentages are similar to the average across all modelled receptors, albeit rigid HGVs are more prevalent in the wider context of all modelled receptors comparative to the maximum location (Receptor 41). This is likely due to the large sized AQMA, so the influence of emissions on the maximum receptor is broadly similar to those experienced across the whole of the AQMA albeit petrol cars may be more influential here due to the close proximity of the service station and local school.

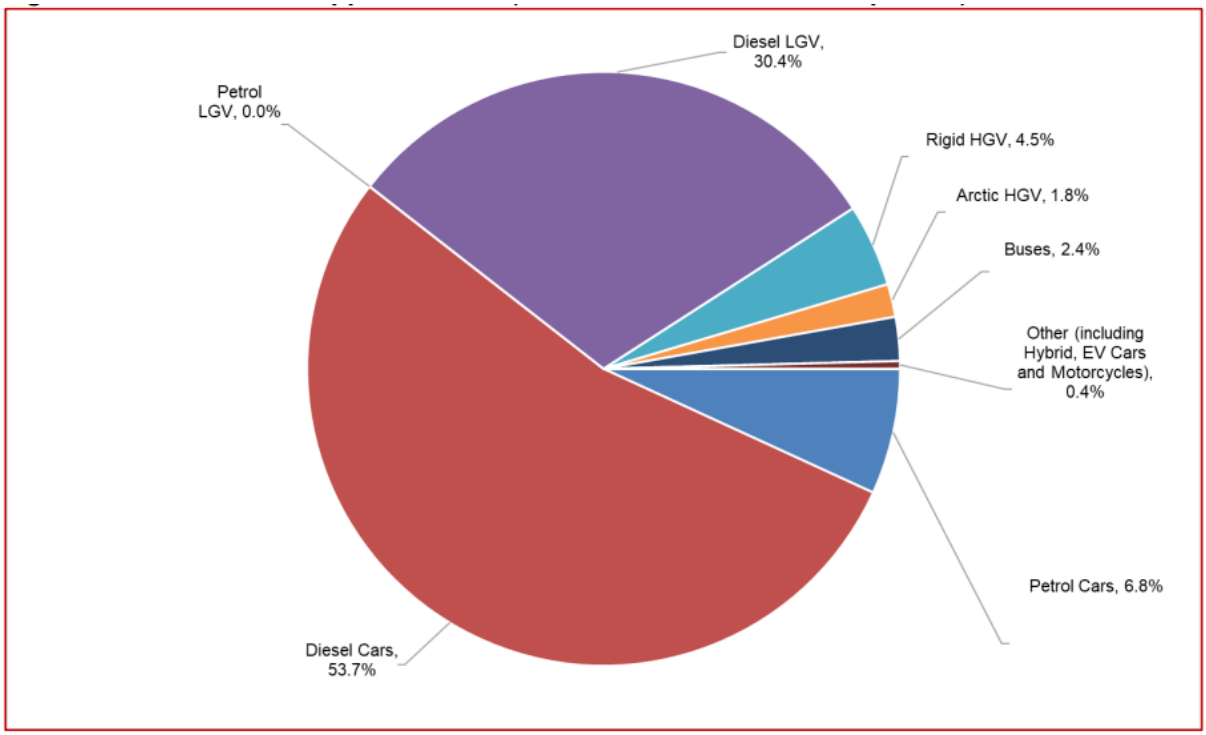

Figure 3.2 - NO_x Source Apportionment (At Maximum Modelled Receptor 41)

The full source apportionment report can be found in the appendix B to the AQAP and was conducted in accordance with LAQM.TG(22).

3.4 Required Reduction in Emissions

The following section outlines the required reduction in emissions for the AQMA to be compliant for the objective which it was declared for (NO_2 1-Hour and Annual Mean). Due to the uncertainty with diffusion tube monitoring, an annual mean NO_2 concentration of 36 µg/m^3 has instead been used to determine compliance, instead of the air quality standards objective of 40 µg/m^3 .

Table 3.2 – NOx Reduction Required to Achieve Compliance in AQMA No.6 at Worse Case Location

Metric	Value (Concentrations as µg/m^3)
Current Road NO_x Concentration	61.7
Required Road NO_x Concentration (to achieve an NO_2 concentration of 35.9 µg/m^3)	52.0
Required Road NO_x Reduction	9.7
Required NO_x Percentage Reduction	15.8 %

The data in Table 3.2 indicates that there needs to be a 15.8% reduction in NO_x emissions within the AQMA to ensure concentrations remain below 36 µg/m^3 (to account for the uncertainty in diffusion tube monitoring). This equates to a reduction of 9.7 µg/m^3 , from the current maximum modelled road NO_x concentration of 61.7 µg/m^3 to 52.0 µg/m^3 . This reduction will ensure an NO_2 concentration of in line with the AQO is achieved within the AQMA, and eventually result in the AQMA being able to be revoked.

3.5 It is anticipated that as the key measures are delivered within the AQAP the required reduction will be achieved within 2026/2027.Key Priorities

Our priorities are to sustain a downward trend in emissions reduction through partnership work. The delivery of the Grantham Southern relief road remains a major focus to divert traffic away from the town centre. Traffic management and infrastructure for walking and cycling are prioritised by the Grantham Transport Strategy published in 2022. The Clean Air Lincolnshire project will continue to raise awareness of issues of air quality and provide additional monitoring data withing the AQMA. Vehicle fleet efficiency and electrification opportunities will continue to be implemented by South Kesteven District Council.

- Priority 1 - The delivery of the Grantham Southern relief road remains a major focus to divert traffic away from the town centre – Phase 3
- Priority 2 – Implementation of Traffic management and infrastructure for walking and cycling as prioritised by the Grantham Transport Strategy published in 2022.
- Priority 3 – Raise continual awareness in conjunction with the Clean Air Lincolnshire project.

4 Development and Implementation of South Kesteven District Council AQAP

4.1 Consultation and Stakeholder Engagement

In developing/updating this AQAP, we have worked with other local authorities, agencies, businesses, and the local community to improve local air quality. Schedule 11 of the Environment Act 1995 requires local authorities to consult the bodies listed in Table 4.1. We consulted on this AQAP in late 2024 with stakeholders and methodology for consultation is detailed below.

- Website
- Articles in local newspaper
- Questionnaire available via online survey platform
- Localised marketing campaign.

The response to our consultation stakeholder engagement will be published within the final AQAP.

Table 4.1 – Consultation Undertaken

Consultee	Consultation Undertaken
The Secretary of State	No
The Environment Agency	Yes - proposed
The highways authority	Yes - proposed
All neighbouring local authorities	Yes - proposed
Other public authorities as appropriate, such as Public Health officials	Yes - proposed
Bodies representing local business interests and other organisations as appropriate	Yes - proposed

4.2 Steering Group

As part of developing this Action Plan, a steering group was established to review the existing actions that are in progress to improve air quality within the South Kesteven District Council's Air Quality Management Area as well as any future actions. This steering group will also oversee the implementation and monitoring of the actions contained within this and future revisions of the Action Plan.

This steering group is chaired by the Head of Service – Public Protection and consist of the following internal service areas:

- Environmental Health – Environmental Protection Leads
- Sustainability & Climate Change Lead
- Waste Services
- Planning Policy Team
- Housing Maintenance Services

The internal steering group liaise directly with relevant external stakeholders which include:

- Lincolnshire County Council – Highways
- Lincolnshire County Council - Assisting Development Team
- Lincolnshire County Council – Public Health

It is anticipated that the steering group meeting twice annually to measure against the measures and track progression against the required reduction in emissions, in addition to measuring against the AQAP in the annual status reports.

It is the view of the steering group that the implementation of the measures contained within the action plan will result in the continuation of the National Air Quality Standards being met. It is anticipated that the implementation of the measures will see a further reduction in below the objective level than already achieved.

The AQAP will be reviewed in 2029 if the AQMA is not revoked prior to that date.

5 AQAP Measures

Appendix A: Response to Consultation

Table A.1 – Summary of Responses to Consultation and Stakeholder Engagement on the AQAP

Consultee	Category	Response
Director of Public Health at Lincolnshire County Council	Statutory	Thank you for the opportunity to comment on this draft Air Quality Action Plan produced by South Kesteven District Council. The overall position is well explained in the plan, and I am pleased to endorse it. It is good to see that concentrations of Nitrogen Oxides (NO_x) are decreasing in the Air Quality Management Area declared in Grantham town centre. Whilst national objective levels are set, the view is that no level of air pollution is deemed to be safe for humans. South Kesteven District Council's ongoing commitment to reduce levels further in the centre of Grantham is, therefore, welcome. I am pleased to see the measures to improve air quality in Table 5.1, many of which have been developed in partnership with Lincolnshire County Council such as the Clean Air Lincolnshire website, which we will continue to develop to improve its usefulness. The focus on alternative, active travel (cycling and walking) is important,

Consultee	Category	Response
		and my team will be working with South Kesteven District Council and sustainable travel officers to increase active travel rates and use of public transport, noting also the drive to improve the bus fleet and reduce emissions.
Environment Agency	statutory	No response received
Defra	statutory	Response received
Highways Authority	statutory	No response received
Neighbouring Authorities	statutory	No response received
Grantham Town Council	statutory	No response received
Bodies representing Local businesses and other organisations as appropriate	statutory	Response received
Residents	public	Response received – full report on responses received will be published along with the AQAP – link to follow

Appendix B: Source Apportionment – Detailed Modelling Assessment

shows the South Kesteven District Council AQAP measures. It contains:

- a list of the actions that form part of the plan.
- the responsible individual and departments/organisations who will deliver this action.
- estimated cost of implementing each action (overall cost and cost to the local authority)
- expected benefit in terms of pollutant emission and/or concentration reduction.
- the timescale for implementation
- how progress will be monitored

NB: Please see future ASRs for regular annual updates on implementation of these measures.

Table 5.1 – Air Quality Action Plan Measures

Measure No.	Measure	Category	Classification	Estimated Year Measure to be Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Target Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Potential Barriers to Implementation
M1	Grantham Southern Quadrant East West Relief Road	Traffic Management	Strategic highway improvements, Re-prioritising Road space away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane	Ongoing project	2025	Lincolnshire County Council Highways & South Kesteven District Council	Lincs County Council Highways Infrastructure funding Highways England Growth and Housing Fund Developer contributions	No	Fully funded	>£10 million	Implementation	0.5 - 1µg/m3	Reduced HGV through traffic in the town centre – reduced overall traffic flows through the town	Work commenced on site in late 2015. Phase 1 complete, Phase 2 completed December 2022, Phase 3 estimated completion 2025.	In progress/ potential delay to estimated completion date.
M2	Improve traffic management at key junctions.	Traffic Management	Strategic highway improvements, Re-prioritising Road space away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane.	Ongoing project	2024+ 3-5 years	Lincolnshire County Council Highways	Lincs County Council Highways Infrastructure funding	No	As funding opportunities arise	£50k-£100k	Planning	1 - 2µg/m3	Reduced congestion and increased average speeds through the AQMA.	The Grantham Transport Strategy 2023 sets out several improvements planned for improving traffic management in and around Grantham.	Lack of funding/change in priorities
M3	Improvements in Bus fleet emissions	Promoting Low Emission Transport	Other	Ongoing project	2024+ 3-5 years	Lincolnshire County Council Highways & South Kesteven DC	Lincolnshire County Council Transport Services	No	As funding opportunities arise	£50k-£100k	Planning	1 - 2µg/m3	Improved bus fleet composition. Bus use more attractive to potential users – increased passenger numbers.	The Lincolnshire Bus Service Improvement Plan 2023 has been approved. Working in partnership with operators and stakeholders this will enhance bus services and further improve the bus offer to residents and visitors over the next 5 - 10 years.	Lack of funding/change in priorities
M4	Clean Air Lincolnshire air quality monitoring and	Public Information	Via the internet	2023	2024+ 1-2 years	Lincolnshire County Council and South Kesteven DC	DEFRA	Yes	Fully funded	£50k-£100k	Implementation	0.2 - 0.5µg/m3	Engagement sessions completed with school in AQMA.	Air monitors installed and engagement session underway	Clean Air Lincolnshire is a county wide project

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	communication														
M5	Encouraging modal shift	Promoting Travel Alternatives	Intensive active travel campaign & infrastructure	Ongoing	2024+ 3-5 years	Lincolnshire County Council and South Kesteven DC	Lincolnshire County Council South Kesteven District Council	No	Partially funded	<£10k	Implementation	0.2 - 0.5µg/m3	Reduced vehicle usage and increased use of public transport.	The Grantham Cycling & Walking Network Plan has been developed as part of the new Grantham Transport Strategy 2022. This document will inform all future schemes.	Lack of funding
M6	Provision of Cycling infrastructure	Promoting Travel Alternatives	Promotion of cycling	Ongoing	2024+ 3-5 years	Lincolnshire County Council Highways	Lincs County Council Highways Infrastructure funding Active Travel England funding	No	Not funded	£100k-500k	Planning	0.2 - 0.5µg/m3	Increased number of cycle lanes makes cycling a more attractive alternative method of transport.	The Grantham Cycling & Walking Network Plan has been developed as part of the new Grantham Transport Strategy 2022. This document will inform all future schemes.	Lack of funding/change in priorities/developments
M7	Rolling programme of replacing older more polluting vehicles with newer cleaner vehicles	Vehicle fleet efficiency	Company Vehicle Procurement - Prioritising uptake of low emission vehicles	Ongoing	2024+ 3-5 years	South Kesteven District Council	South Kesteven District Council	No	Partially funded	£100k-500k	Implementation	0.2 - 0.5µg/m3	Continue to improve average euro class of the whole council owned fleet and introduce additional EVs.	Fleet review completed 2021. New depot site targeted end of 2025 Review further EV implementation 2026 onward	Relocation of fleet to new facilities.
M8	Implement improved travel planning amongst the council's employees.	Public information	Via the internet	Ongoing	2024+ 3-5 years	South Kesteven District Council	South Kesteven District Council	No	Partially funded	<£10k	Implementation	0.2 - 0.5µg/m3	Reduce number of council staff driving to work	Staff travel survey completed 2020 showing decrease in single occupancy car travel. Hybrid working policy in place from 2021 to minimise need to travel. Cycle to work scheme in place- approx. 6 users each year	Lack of take up

Appendix A: Response to Consultation

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Consultee	Category	Response
		Kesteven District Council and sustainable travel officers to increase active travel rates and use of public transport, noting also the drive to improve the bus fleet and reduce emissions.
Environment Agency	statutory	No response received
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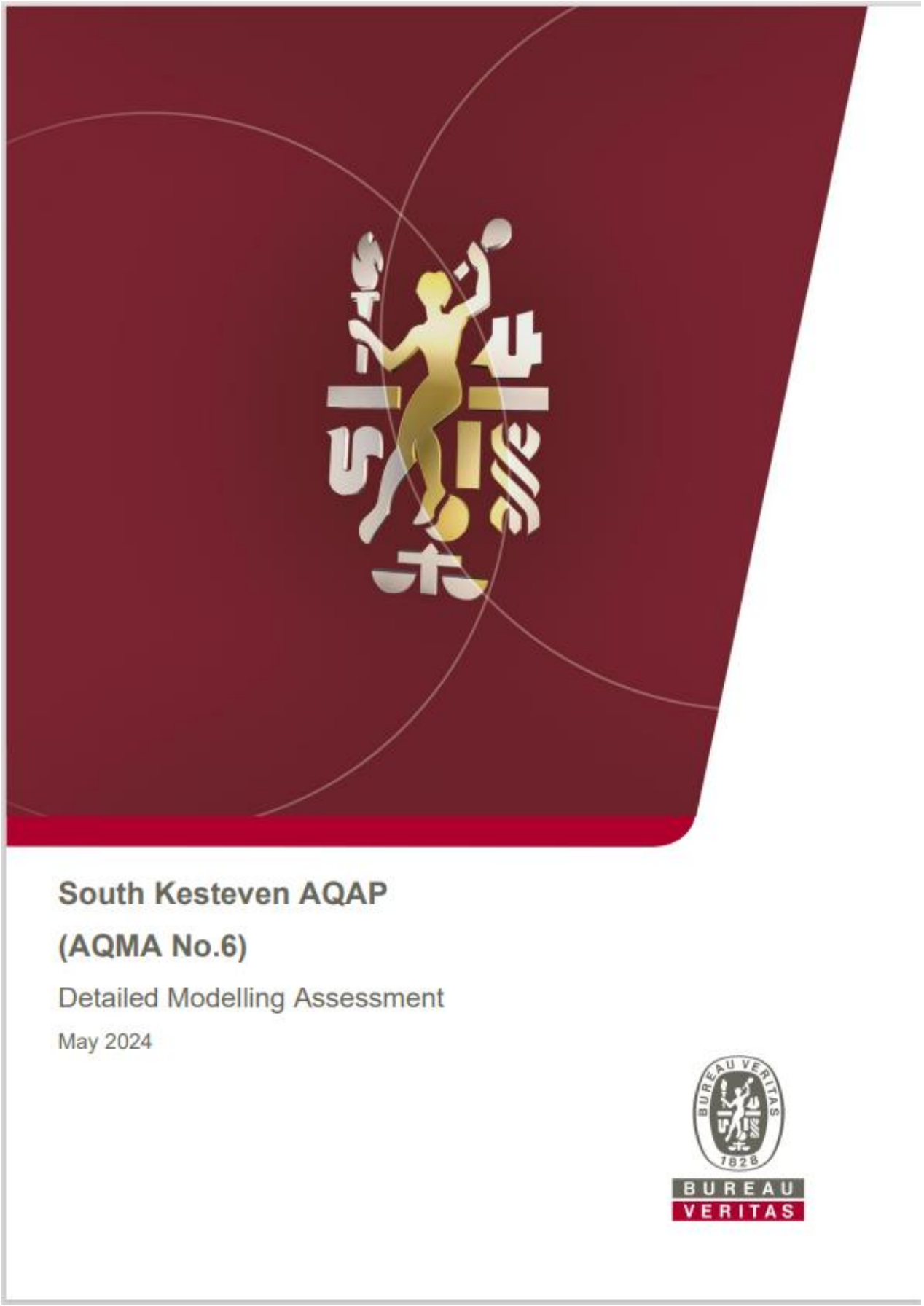
South Kesteven AQAP
(AQMA No.6)
Detailed Modelling Assessment
May 2024
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Document Control Sheet

Identification	
Client	South Kesteven District Council
Document Title	AQAP (AQMA No.6) – Technical Report
Bureau Veritas Ref No.	AIR21369978

Contact Details		
Company Name	Bureau Veritas UK Limited	South Kesteven District Council
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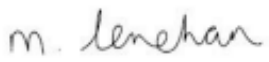
Prepared By	Meg Lenehan	Air Quality Consultant	
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Executive Summary

South Kesteven District Council has commissioned Bureau Veritas to complete a detailed assessment of the Council's existing Air Quality Management Area (AQMA) to help in the development of a new Air Quality Action Plan (AQAP). The Council currently has one AQMA designation which was declared in 2013 for exceedance of the 1-Hour and annual mean Air Quality Objective (AQO) for Nitrogen Dioxide (NO_2). This detailed assessment focuses on this AQMA, named 'AQMA No.6' which is described as an area encompassing Manthorpe Road, Wharf Road, High Street and London Road.

The aim of this technical report is to identify the extent, if at all, to which the annual mean objective for NO_2 is exceeded within the AQMA, and to determine the exposure at sensitive receptors. The technical report identifies the contribution from different vehicle classes so that the measures adopted can be targeted towards the main pollutant sources.

A dispersion modelling assessment has been completed and NO_2 concentrations have been predicted across all relevant areas at both specific receptor locations, and across a gridded area, to allow for the production of concentration isopleths. This has been used to supplement local monitoring data to provide a clear picture of the NO_x and NO_2 pollutant conditions within 'AQMA No.6'.

Following the completion of the analysis of both monitoring data and modelled concentrations across the assessed area, the following conclusions have been made for AQMA No.6:

- Detailed modelling has predicted that the maximum NO_2 annual mean concentration within AQMA No.6 is 40.2 µg/m^3 at Receptor 41, located on Manthorpe Road opposite Grantham Service Station. This concentration is higher than the annual AQO of 40 µg/m^3.
- Additionally, Receptor 11 reported a concentration of 39.1 µg/m^3 located at the junction of North Street, Barrowby Road, Broad Street, and North Parade, and Receptor 12, located outside 34 Manthorpe Road, reported a concentration of 36.9 µg/m^3. Both locations are within the AQMA and are within 10% of the AQO.
- No exceedances of the NO_2 annual mean AQO of 40 µg/m^3 were predicted outside of the current AQMA boundary.
- Overall, diesel cars accounted for the majority of NO_x emissions in the AQMA, followed by diesel LGVs and rigid HGVs. The AQAP should prioritise measures to reduce emissions from these sources.
- The background concentrations within the AQMA are largely made up of rural and domestic sources.
- Based upon the analysis of results, it is recommended that the AQMA remains in place with the current boundary and monitoring to continue in this area. The Local Authority may wish to expand the diffusion tube network along Manthorpe Road, High Street, Market Place, St Peter's Hill and St Catherine's Road junction, adjacent to the residential properties as well as outside The King's School Grantham, due to elevated modelled concentrations in these areas.

The next steps upon completion of this technical note by Bureau Veritas are for South Kesteven District Council to develop, through consideration of merit, a defined set of achievable measures to be brought forward into the finalised AQAP for AQMA No.6.

1 Introduction

South Kesteven District Council ("the Council") has commissioned Bureau Veritas to complete a review of the Council's existing Air Quality Management Area (AQMA) to help in the development of a new AQAP. The AQMA for which this detailed modelling study is related to is AQMA No.6, described as an area encompassing Manthorpe Road, Wharf Road, High Street and London Road. This AQMA was declared in August 2013 and Local Air Quality Management Policy Guidance (22)[1] recommends that as a minimum, Local Authorities should revise their AQAP every 5 years.

To supplement the works that have been ongoing since the AQMA was declared, a detailed modelling assessment has been undertaken to provide further information in support of preparation of the latest iteration of the AQAP.

The geographical extent of the AQMA included in the assessment is shown in Figure 1.1. Details of AQMA No.6 are as follows:

- **Extent**: An area encompassing Manthorpe Road, Wharf Road, High Street and London Road.
- **Declared:** August 2013.
- **Pollutant:** NO_2 1-Hour and Annual Mean.

Figure 1.1 – AQMA No.6

[1] Local Air Quality Management Policy Guidance LAQM PG(22) – August 2022. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

Table 1.1 presents the monitoring data collected by South Kesteven District Council, at diffusion tube sites within and around AQMA No.6.

Table 1.1 – Passive NO_2 Monitoring Within and Around AQMA No.6

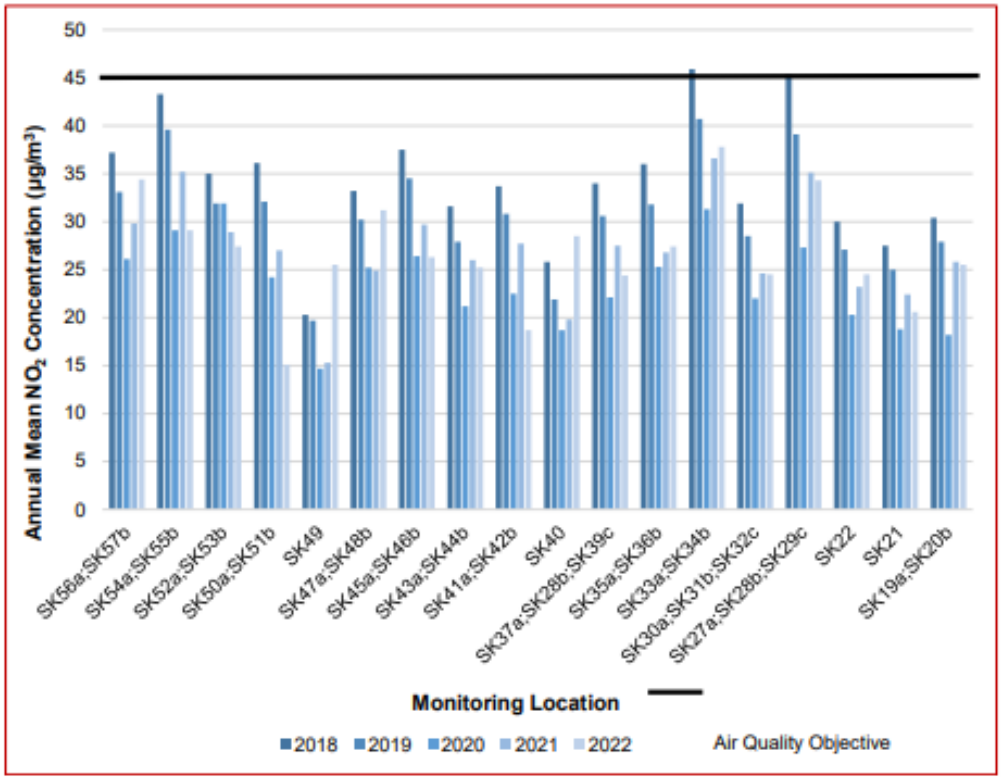
Site ID	Grid Reference		Annual Mean NO_2 Concentration (µg/m³)				
	X	Y	2018	2019	2020	2021	2022
Included for Model Verification							
SK56a;SK57b	491384	335506	*37.2*	33.1	26.1	29.8	34.4
SK54a;SK55b	491508	335512	**43.3**	*39.6*	29.1	35.2	29.1
SK52a;SK53b	491200	335636	35.0	31.9	31.9	28.9	27.4
SK50a;SK51b	491184	335575	*36.1*	32.1	24.2	27.0	15.1
SK49	491427	335193	20.3	19.7	14.7	15.3	25.5
SK47a;SK48b	492066	334926	33.2	30.2	25.2	24.9	31.2
SK45a;SK46b	491869	334960	*37.5*	34.5	26.4	29.7	26.3
SK43a;SK44b	491734	335196	31.6	27.9	21.2	26.0	25.2
SK41a;SK42b	491604	335486	33.7	30.8	22.5	27.7	18.7
SK40	491512	335719	25.8	21.9	18.7	19.8	28.5
SK37a;SK28b;SK39c	491460	335715	34.0	30.6	22.1	27.5	24.4
SK35a;SK36b	491330	336022	*36.0*	31.8	25.3	26.8	27.4
SK33a;SK34b	491512	336389	**45.9**	**40.7**	31.3	*36.6*	*37.8*
SK30a;SK31b;SK32c	491470	336318	31.9	28.5	22.0	24.6	24.5
SK27a;SK28b;SK29c	491496	336353	**45.3**	*39.1*	27.3	35.1	34.3
SK22	491260	336188	30.0	27.1	20.3	23.2	24.5
SK21	491270	336256	27.5	25.0	18.8	22.4	20.6
SK19a;SK20b	491067	336209	30.4	27.9	18.2	25.8	25.5

Note: 1) Exceedances of the NO_2 annual mean objective of 40µg/m³ are shown in **bold**; 2) Annual values within 10% of the AQO are shown in *italics*.

The data shows that the NO_2 annual mean objective of 40 µg/m³ has not been exceeded at any diffusion tube site within the AQMA since 2020, albeit COVID-19 may have influenced the concentrations. However, there is one site within 10% of the annual mean objective, SK33a;SK34b in 2022 where a concentration of 37.8 µg/m3 was measured. This site is located on Manthorpe Road, north of Grantham Service Station and The King's School and within 250m of the junction with Brook Street and Brownlow Street leading into the High Street City Centre. The site is also located on one of the A-Roads out of Grantham Centre. As such, the higher concentration is likely a result of the stopping and starting/idling of vehicles as traffic builds up on approach to the services, school and junction, as well as through traffic.

The annual mean NO_2 concentrations from the sites in and around AQMA No.6 are shown in **Figure 1.2**. The figure shows that the annual mean objective of 40 µg/m³ has not been exceeded at any location within the AQMA since 2019 (40.7 µg/m³ at site SK33a;SK34b), but is within 10% in 2021 and 2022. This shows the effectiveness of measures South Kesteven have been implementing to date as well as the effect of changes in concentrations as a result of the Covid-19 pandemic.

Figure 1.2 – Annual Mean NO_2 Results Around AQMA No.6



1.1 Scope of Report

This technical report seeks, with reasonable certainty, to predict the magnitude and geographical extent of any exceedances of the Air Quality Strategy (AQS) objectives, providing the Council with updated modelling data that can be used for the development and/or updates to specific measures that are to be included within the AQAP for AQMA No.6. The areas considered as part of this study are illustrated in the figures presented throughout. The following are the main objectives of this technical report:

- To assess the air quality at selected locations (receptors) at areas of relevant exposure, representative of worst-case exposure within, and close to the existing AQMA boundary, based on modelling of emissions from road traffic on the local road network.
- To determine the geographical extent of any potential exceedances of the 1-Hour and annual mean AQS objective for NO_2.
- To determine the relative contributions of separate vehicular and non-vehicular source types to the overall pollutant concentrations through the completion of a source apportionment study.
- To put forward recommendations as to the extent of any changes to the current AQMA boundary and any changes to the declaration of the specific AQMA.

The approach adopted in this assessment to determine the impact of road traffic emissions on air quality utilised the atmospheric dispersion model ADMS-Roads version 5.0.1, focusing on emissions of oxides of nitrogen (NO_x), which comprise nitric oxide (NO) and NO_2.

The guiding principles for air quality assessments as set out in the latest guidance and tools provided by Defra for air quality assessment (LAQM Technical Guidance (22)[2]) have been used.

[2] Local Air Quality Management Technical Guidance LAQM TG(22) – August 2022. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

2 Assessment Methodology

To predict the pollutant concentrations emitted from road traffic sources, atmospheric modelling was carried out using ADMS Roads version 5.0.1, developed by Cambridge Environmental Research Consultants (CERC). The approach used was based upon the following:

- Prediction of NO_2 concentrations to which existing receptors may be exposed and comparison with the relevant AQS objectives;
- Quantification of relative NO_2 contribution attributable to separate vehicular and non-vehicular sources in relation to overall NO_x and NO_2 pollutant concentration; and
- Determination of the geographical extent of any potential exceedances in regard to the existing AQMA boundary.

Concentrations of NO_2 have been predicted for a base year of 2022, with model inputs relevant to the assessment based upon the same year. The use of 2022 data was based on professional judgement that the impacts on road traffic that occurred as a result of the COVID-19 pandemic are no longer as significant as that observed throughout 2020 and 2021. 2023 data was not available at the time of preparation of this assessment.

2.1 Traffic Inputs

Traffic flows for the road links included within the model have been sourced from Department for Transport (DfT) road traffic manual count points on: Spittlegate, Bridge End Road, Market Place, Westgate, Barrowby Road, Harlaxton Road, London Road, Saint Catherine Road, Avenue Road, and Sankt Augustine Way. The data has been obtained in AADT (Annual Average Daily Traffic) format for the relevant road links in terms of a number of vehicle types; cars, LGVs (light good vehicles), HGVs (heavy good vehicles), buses and coaches, and other vehicle types, inclusive of hybrid vehicles, motorcycles and electric vehicles (EVs).

Additional traffic data was also obtained from Intelligent Data Collection Ltd in a survey which was undertaken in February-March 2024. Roads surveyed were Broad Street, North Street, Brook Street, Manthorpe Road, High Street, Watergate, Chambers Street, Albion Street, Swinegate and St Peter's Hill. This is owing to the fact that these road links which form the northern sector of AQMA 6 were not covered by DfT, which instead focussed on the major road links in Grantham and which form 'AQMA 6'. Automatic Number Plate Recognition (ANPR) data was captured for Broad Street, North Street, Brook Street, Manthorpe Road, Watergate, Chambers Street, Albion Street, Swinegate and St Peter's Hill which allowed for a detailed breakdown of vehicles and modelling of different engine types (e.g. Euro Classes). Automatic Traffic Count (ATC) data was captured for High Street, which allowed for breakdown of vehicles and observed mean speed to be captured for this link.

Full details of the traffic data used in the dispersion model are shown in Appendix A.

Traffic speeds were modelled at the relevant speed limits for each road apart from High Street, for which observed ATC data was available. In accordance with LAQM TG(22)[2], where appropriate, traffic speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to occur.

The Emissions Factors Toolkit (EFT) version 12.0.1[3] has been used to determine vehicle emissions factors for input into the ADMS-Roads model. The emissions factors are based upon the traffic data

[3] Defra, Emissions Factors Toolkit – version 12.0.1 (2023), available at: https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/.

inputs used within the assessment, with the total vehicle flows and proportion of vehicle types being provided by both Intelligent Data Collection Ltd and the Department for Transport.

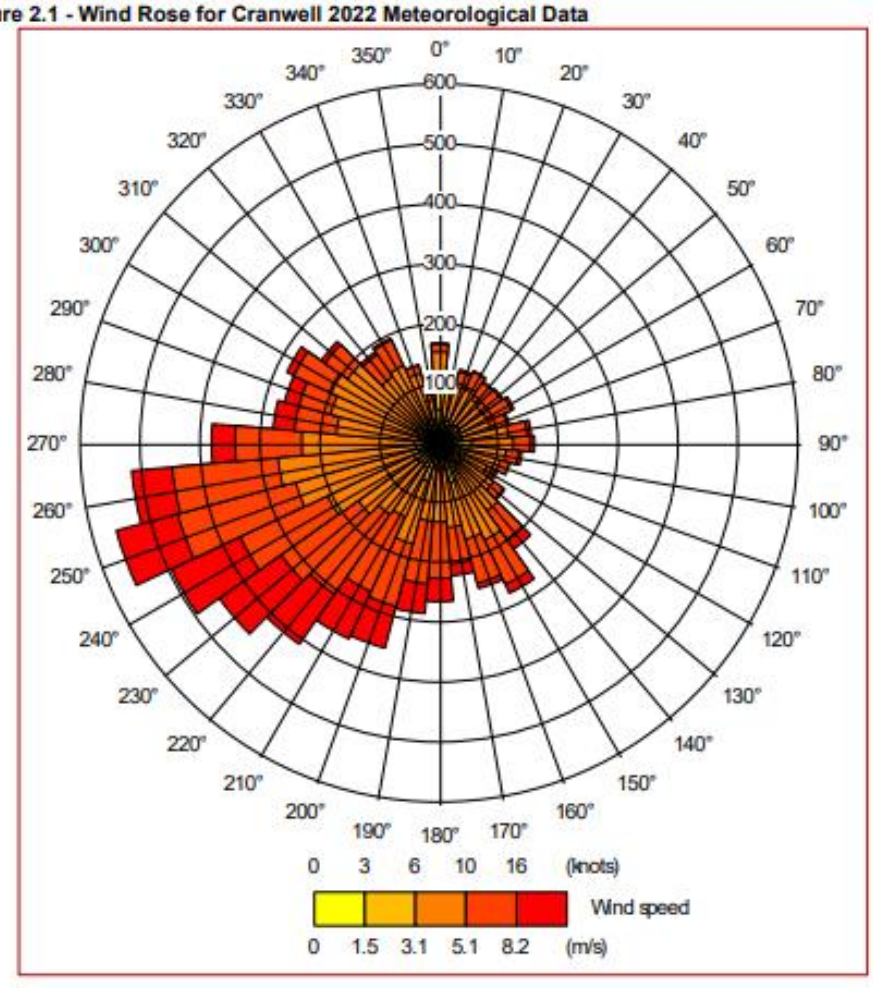
2.2 General Model Inputs

A site surface roughness value of 1m was entered into the ADMS-roads model, consistent with the nature of the modelled domain 'Cities, woodlands'. In accordance with CERC's ADMS Roads user guide[4], a minimum Monin-Obukhov Length of 30 m was used for the ADMS Roads model to reflect the urban topography of the model domain, 'Cities and large towns'.

One year of hourly sequential meteorological data from a representative synoptic station is required by the dispersion model. For the completion of the modelling, 2022 meteorological data from the Cranwell weather station has been used within this assessment. This particular site has been chosen due to it being the nearest site with a complete data set for 2022 and is considered representative of the area.

A wind rose for this site for the year 2022 is presented in Figure 2.1. From the wind rose it is evident that the prevailing wind direction within South Kesteven District, Grantham and surrounding areas is from the west-south-west, with an average wind speed of 5.1 m/s.

Figure 2.1 - Wind Rose for Cranwell 2022 Meteorological Data



[4] CERC (2020), ADMS-Roads User Guide Version 5.

2.3 Modelled Road Sources

A total of 52 road sources were included throughout the model domain, with the majority of the road sources being main roads or approaches to junctions (slow-downs). No point sources have been included within the model under the assumption that road traffic is the primary source of NO_2 emissions. The road links included in the model are presented in Figure 2.2, and include the main roads that pass through AQMA No.6.

2.4 Modelled Sensitive Receptors

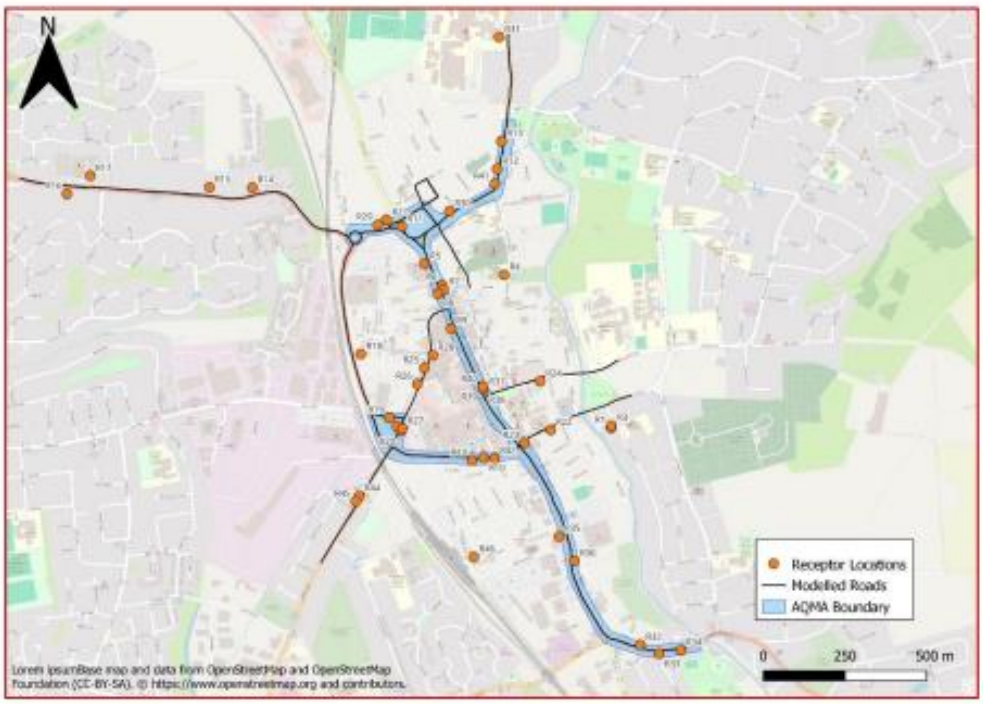
A total of 46 discrete receptors were included within the assessment to represent locations of relevant exposure. The locations were identified through completion of a desktop study, and included places such as residential properties, care homes, hospitals, and schools. Receptors were modelled at heights of 1.5 m – 7 m, to represent the typical breathing zone (1.5m) and breathing zones at height where residential properties may be above commercial properties. For example, R37-R40 are two storey flats above shops, therefore R37 and R39 have been modelled at 4m and R38 and R40 modelled at 7m.

A description of the receptors included in the model is provided in Table 2.1, with their locations shown in Figure 2.2.

Table 2.1 – Modelled Receptor Locations

Receptor ID	Receptor Description	Receptor ID	Receptor Description
R1	The Kings School Grantham	R24	31 Avenue Road
R2	Saint Mary The Immaculate Church	R25	86 Westgate
R3	Birchwood Retirement Home	R26	80 Westgate
R4	National C of E Junior School Grantham	R27	35B Westgate
R5	LIDL Watergate	R28	7 Westgate
R6	49 Watergate	R29	8 Barrowby Road
R7	6-8 Watergate	R30	41 Brook Street
R8	23 Watergate	R31	Grantham and District Hospital
R9	Subway High Street	R32	11 Bridge End Road
R10	Grantham Baptist Church	R33	7 Houghton Road
R11	Premier Court Residential Estate	R34	52 Bridge End Road
R12	34 Manthorpe Road	R35	St Johns Medical Centre
R13	65 Manthorpe Road	R36	69-71 London Road
R14	St Barnabas Hospice and Wellbeing Centre	R37	38-39 High Street
R15	100 Barrowby Road	R38	38-39 High Street
R16	153 Barrowby Road	R39	37 High Street
R17	Barchester Newton House Care Home	R40	37 High Street
R18	27 Greyfriars	R41	21 Manthorpe Road
R19	7 Dysart Road	R42	9 Wharf Road
R20	32A Westgate	R43	18A Wharf Road
R21	57-58 Westgate	R44	36 Harlaxton Road
R22	11 St Catherines Road	R45	44 Harlaxton Road
R23	Jubilee Church Life Centre	R46	12a Launder Terrace

Figure 2.2 – Modelled Road Sources & Sensitive Receptors



2.5 Model Outputs

Background pollutant values for 2022, derived from Defra Background Maps[5], have been used in conjunction with the concentrations predicted by the ADMS-Roads model to calculate predicted total annual mean concentrations of NO_x.

For the prediction of annual mean NO_2 concentration for the modelled scenarios, the output of the ADMS-Roads model for road NO_x contributions have been concentrated to total NO_2 following the methodology in LAQM.TG(22), using the NO_x to NO_2 conversion tool developed on behalf of Defra. This assessment has utilised the most up-to-date version of the NO_x to NO_2 conversion tool, v8.1[6].

Verification of the model has been carried out using the local authority NO_2 passive monitoring locations within AQMA No.6, in accordance with the methodology detailed within LAQM TG(22)[2]. It was not necessary to exclude any passive diffusion tube monitoring sites within the AQMA for model verification as all tubes identified were positioned an appropriate distance from the kerb (less than 20 m), and without influence from vegetation (e.g. sheltered by overgrown trees/ bushes).

Overall, of the 18 monitoring sites that were included in the ADMS model, the locations and heights of the diffusion tubes have been checked and where necessary adjusted and validated via a desktop study.

[5] https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

[6] Defra, NO_x to NO_2 Calculator. (2020). Available at: https://laqm.defra.gov.uk/air-quality/air-quality-assessment/nox-to-no2-calculator/

2.6 Source Apportionment

To help inform the development of measures as part of the action plan stage of the project, a source apportionment exercise was undertaken for the following vehicle classes.

- Petrol and Diesel Cars;
- Petrol and Diesel LGV's;
- Rigid HGV;
- Artic HGV;
- Buses and Coaches; and
- Other (including Motorcycle, Hybrid and EV cars).

This provides vehicle contributions of NO_x as a proportion of the total NO_x concentration, which will allow the Council to develop specific AQAP measures targeting a reduction in emissions from specific vehicle types. The survey undertaken by Intelligent Data Collection Ltd, provided locally defined fleet information, as such local averages in terms of Euro Class proportions of different vehicles have been used to acquire representative local emission rates.

It should be noted that emission sources of NO_2 are dominated by a combination of direct NO_2 (f-NO_2) and oxides of nitrogen (NO_x), the latter of which is chemically unstable and rapidly oxidised upon release to form NO_2. Reducing levels of NO_x emissions therefore reduces concentrations of NO_2. Consequently, the source apportionment study has firstly considered the emissions of NO_x, which are assumed to be representative of the main sources of NO_2, and secondly emissions of NO_2.

With regards to the discrete receptor locations, consideration has been given to the following groups of receptors located within, and surrounding the boundary, of the AQMA. The source apportionment study has evaluated the following receptor combinations:

- The average NO_x and NO_2 contributions across all modelled locations (i.e., all locations covered by the model, both within and outside of the AQMA boundary). This provides useful information when considering possible action measures to test and adopt. It will however underestimate road NO_x concentrations in problem areas as results are averaged out across areas with higher and lower concentrations.
- The NO_x and NO_2 contributions at the receptor with the maximum road NO_x and NO_2 contribution. This provides a comparison to the previous two groups, with the identification of the most prominent vehicle source at receptor with the highest predicted NO_2 concentration.

3 Modelling Results

The following section provides a detailed assessment of AQMA No.6, comparing monitoring completed over a 5-year period (2018-2022) with the modelled concentrations of annual mean NO_2. Details of each monitoring location and the monitoring results have been taken from the 2023 Annual Status Report[7]. Analysis of receptor locations has been completed both within and outside of the existing AQMA designation to determine the level of exceedance within the AQMA and also if there are any areas outside of the current boundary where the annual mean concentration of NO_2 is predicted to exceed the annual mean objective.

In line with the standardised LAQM reporting, the tabulated results present any exceedance of the annual mean AQS objective of 40 µg/m³ in bold, and any predicted concentrations in exceedance of 60 µg/m³ underlined and in bold. Additionally, annual mean concentrations that are predicted to be within 10% of the objective are presented in italics to ensure that any uncertainty in relation to the predicted modelling concentrations is taken into consideration for any recommendations made in terms of AQMA designation, amendment or revocation.

In addition, the NO_x source apportionment results which have been split across the vehicle classifications detailed in Section 2.6 are presented in both tabular and pie chart formats. This allows the main vehicular sources to be identified within AQMA No.6, therefore aiding the development of measures that are of specific relevance to the AQMA.

3.1 Modelled Receptor Concentrations, Annual Mean NO_2

Table 3.1 provides the modelled annual mean NO_2 concentrations predicted at existing receptor locations in 2022. Of the 46 receptors included in the assessment, 29 are located within the AQMA boundary, whilst the remaining 17 are situated on the modelled roads that lead into the AQMA.

Table 3.1 – Modelled Receptor Concentrations, Annual Mean NO_2

Receptor ID	OS Grid X	OS Grid Y	Height (m)	In AQMA?	AQS objective (µg/m³)	2022 Modelled Annual Mean NO_2 (µg/m³)	% of AQS objective
R1	491850	335601	1.5	N	40	13.2	33.1
R2	491163	336232	1.5	Y	40	20.8	52.0
R3	491851	335608	1.5	N	40	13.3	33.3
R4	491522	336066	1.5	N	40	12.1	30.4
R5	491279	336099	1.5	Y	40	17.9	44.6
R6	491333	336034	4	Y	40	18.7	46.6
R7	491337	336021	4	Y	40	19.4	48.5
R8	491320	336009	4	Y	40	17.7	44.3
R9	491360	335903	1.5	Y	40	21.7	54.2
R10	491460	335510	1.5	Y	40	35.7	89.1
R11	491209	336213	1.5	Y	40	*39.1*	97.8
R12	491512	336389	1.5	Y	40	*36.9*	92.3
R13	491514	336472	1.5	Y	40	20.8	52.0

[7] South Kesteven District Council 2023 Air Quality Annual Status Report (2023). Available at: https://www.southkesteven.gov.uk/sites/default/files/2023-07/South_Kesteven_District_Council_ASR_2023_v3.pdf

Receptor ID	OS Grid X	OS Grid Y	Height (m)	In AQMA?	AQS objective (µg/m³)	2022 Modelled Annual Mean NO_2 (µg/m³)	% of AQS objective
R14	490752	336331	1.5	N	40	14.9	37.4
R15	490621	336332	1.5	N	40	14.4	36.1
R16	490185	336312	1.5	N	40	9.9	24.6
R17	490256	336367	1.5	N	40	9.9	24.8
R18	491084	335825	1.5	N	40	16.2	40.6
R19	491171	335631	1.5	Y	40	22.8	57.1
R20	491206	335591	4	Y	40	25.3	63.3
R21	491195	335605	4	Y	40	22.5	56.3
R22	491665	335594	1.5	N	40	19.1	47.9
R23	491585	335555	1.5	Y	40	34.1	85.2
R24	491633	335742	1.5	N	40	17.6	44.1
R25	491278	335783	4	N	40	19.2	48.1
R26	491257	335734	4	N	40	19.4	48.4
R27	491211	335598	4	N	40	24.4	61.1
R28	491304	335821	4	Y	40	20.4	51.0
R29	491136	336218	1.5	N	40	21.9	54.7
R30	491355	336259	1.5	Y	40	25.1	62.7
R31	491507	336789	1.5	Y	40	13.2	33.1
R32	491939	334941	1.5	N	40	21.0	52.6
R33	491996	334914	1.5	Y	40	18.1	45.2
R34	492063	334924	1.5	Y	40	19.6	48.9
R35	491691	335271	1.5	Y	40	16.0	39.9
R36	491738	335196	4	Y	40	19.0	47.4
R37	491460	335717	4	Y	40	22.2	55.5
R38	491460	335717	7	Y	40	16.9	42.1
R39	491457	335726	4	Y	40	21.6	54.0
R40	491457	335726	7	Y	40	16.7	41.8
R41	491496	336353	1.5	Y	40	**40.2**	100.5
R42	491493	335507	4	Y	40	20.4	51.1
R43	491424	335502	4	Y	40	19.8	49.6
R44	491079	335393	1.5	Y	40	22.8	56.9
R45	491069	335377	1.5	N	40	22.7	56.7
R46	491429	335208	1.5	N	40	12.2	30.6

From the modelled concentrations presented within Table 3.1, it is evident that the AQS annual mean NO_2 objective of 40 µg/m³ is predicted to be exceeded at Receptor 41, reporting a predicted concentration of 40.2 µg/m³ . The site is located within the existing AQMA boundary at a point of relevant exposure. There are predicted concentrations at receptors within the AQMA that are within

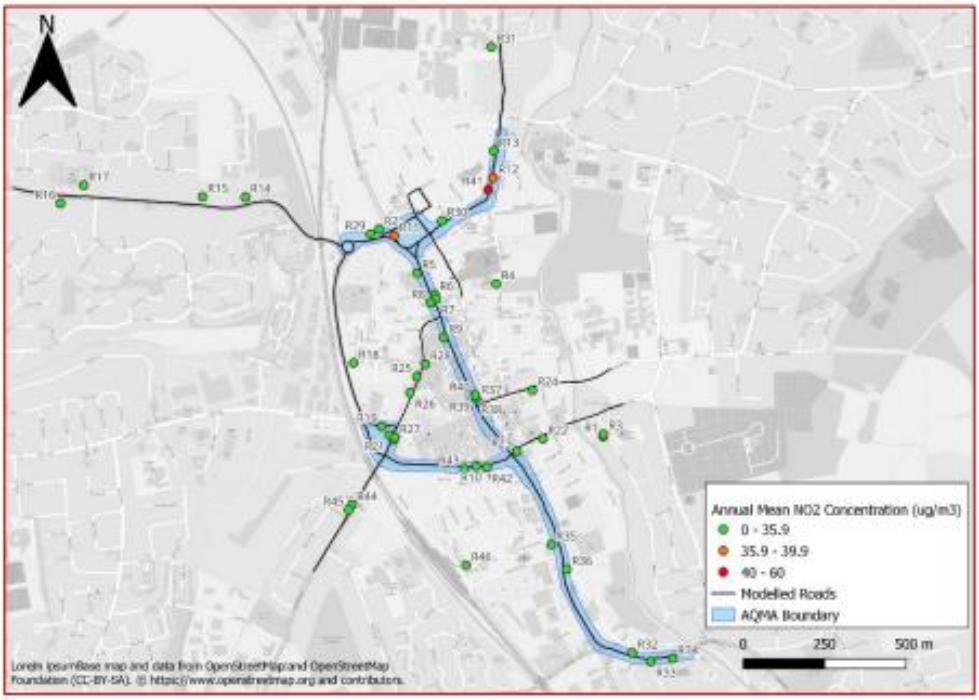
10% of the annual mean NO_2 objective, Receptor 11 predicting a concentration of 39.1 µg/m^3 and Receptor 12 predicting a concentration of 36.9 µg/m^3.

The receptor where the maximum NO_2 annual mean objective is predicted to occur within the AQMA (Receptor 41) is located on Manthorpe Road, opposite Grantham Service Station. This maximum concentration, which is in breach of the annual AQS objective, is likely a result of the stopping and starting/idling of vehicles, as traffic builds up on approach to the centre of Grantham and surrounding the service station facilities, where the receptor is located.

The receptor where the penultimate maximum NO_2 annual mean objective is predicted to occur within the AQMA (Receptor 11) is located at the junction of North Street, Barrowby Road, Broad Street, and North Parade. This maximum concentration, which is nearly in breach of the AQS objective, is likely a result of the stopping and starting/idling of vehicles, as traffic builds up on approach to the junction where the receptor is located.

The spatial location of the modelled NO_2 concentrations at each receptor is illustrated in Figure 3.1.

Figure 3.1 - AQMA No.6 Modelled Receptor NO_2 Concentrations



3.2 Required Reductions in Emissions

The following section outlines the required reduction in emissions for the AQMA to be compliant for the objective which it was declared for (NO_2 1-Hour and Annual Mean). Due to the uncertainty with diffusion tube monitoring, an annual mean NO_2 concentration of 36 µg/m³ has instead been used to determine compliance, instead of the air quality standards objective of 40 µg/m³.

Table 1.2 – NO_x Reduction Required to Achieve Compliance in AQMA No.6 at Worse Case Location

Metric	Value (Concentrations as µg/m³)
Current Road NO_x Concentration	61.7
Required Road NO_x Concentration (to achieve an NO_2 concentration of 35.9 µg/m³)	52.0
Required Road NO_x Reduction	9.7
Required NO_x Percentage Reduction	15.8 %

The data in Table 1.2 indicates that there needs to be a 15.8% reduction in NO_x emissions within the AQMA to ensure concentrations remain below 36 µg/m³ (to account for the uncertainty in diffusion tube monitoring). This equates to a reduction of 9.7 µg/m³, from the current maximum modelled road NOx concentration of 61.7 µg/m³ to 52.0 µg/m³. This reduction will ensure an NO_2 concentration of in line with the AQO is achieved within the AQMA, and eventually result in the AQMA being able to be revoked.

3.3 Modelled NO_2 Concentration – Contour Plot

The contour plot in Figure 3.2 reiterates the findings in Section 3.1 of an exceedance of the AQS annual mean NO_2 objective of 40 µg/m³ being predicted within the AQMA at points of relevant exposure (e.g. sensitive receptor locations). The contour plot shows that there are locations where NO_2 is elevated, but not exceeding the annual objective.

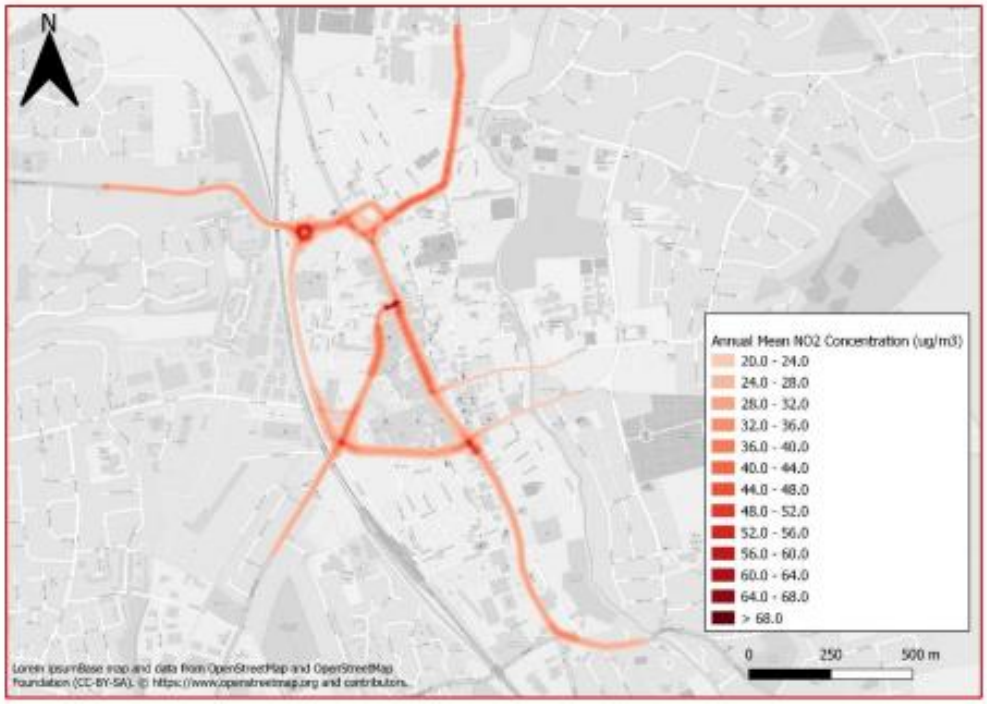
The area where the predicted NO_2 concentration exceeds the annual NO_2 AQS objective is on Manthorpe Road, opposite Grantham Service Station. This elevated concentration is in a location where frequent stopping and starting/idling of vehicles is probable, as traffic builds up on approach to the centre of Grantham and surrounding the service station facilities. Thus, increasing emissions in this area.

The area where the predicted NO_2 concentration is within 10% of the AQS objective is at the junction between North Street, Barrowby Road, Broad Street, and North Parade. There are elevated concentrations of the annual AQS objective shown at Sankt Augustin Way Roundabout, Market Place and High Street junction, and the junction between St Peter's Hill, Wharf Road (A52), St Catherine's Road, and London Road. This is likely a result of the stopping and starting of vehicles on approach to the junctions and roundabout, which increases emissions.

There are a number of sensitive receptors located along these road stretches, including residential properties and a school (The King's School Grantham). As such, the diffusion tube network should be expanded along Manthorpe Road, High Street, Market Place, St Peter's Hill and St Catherine's Road junction, and outside of The King's School Grantham.

Based on the analysis of results, primarily the fact that multiple receptors come into contact with the contour that is within 10% of the annual AQS objective at a point of relevant exposure, as well as the exceedance of the annual AQO at a point of relevant exposure, it is considered that the current AQMA designation is appropriate and does not require amendment.

Figure 3.2– Contour Plot of Modelled NO_2 Concentrations



3.4 Source Apportionment

Source apportionment has been carried out for the modelled receptors along the road links that are either within the AQMA or lead into the AQMA. Apportionment for both NO_x and NO_2 concentrations has been completed for the vehicle classes listed in Section 2.6. It is worth noting that NO_x concentrations are always higher than those for NO_2 since NO_x is made up of NO and NO_2. There is no air quality limit for human health for NO_x but is nevertheless a useful indicator when considering source apportionment. Results are tabulated in Table 3.3 and Table 3.4, and illustrated in Figure 3.3– Figure 3.6.

Figure 3.3 shows the percentage contribution of road and background sources. Across all modelled receptors, 57.07% of the NO_x contribution is from road sources, and the remaining 42.93% is from background sources. Of the background contribution, 23.65% is from the local background, whilst 19.28% is from regional the regional background.

Table 3.2 – Total NO_x Source Apportionment Average Across All Receptors

Results	Local Background NO_x	Regional Background NO_x	Local Road NO_x
NO_x Concentration ($\mu g/m^3$)	7.85	6.40	18.94
Percentage of total NO_x	23.65%	19.28%	57.07%

Figure 3.3 shows the relative contribution of different sources to the background concentration at the receptor with the maximum modelled NO_x concentration (Receptor 41). From this figure, it is evident that the predominant contribution is rural (48.0%), domestic sources (16.0%) and primary A-roads (9%).

Figure 3.3– Average NO_x Background Split Across All Modelled Receptors

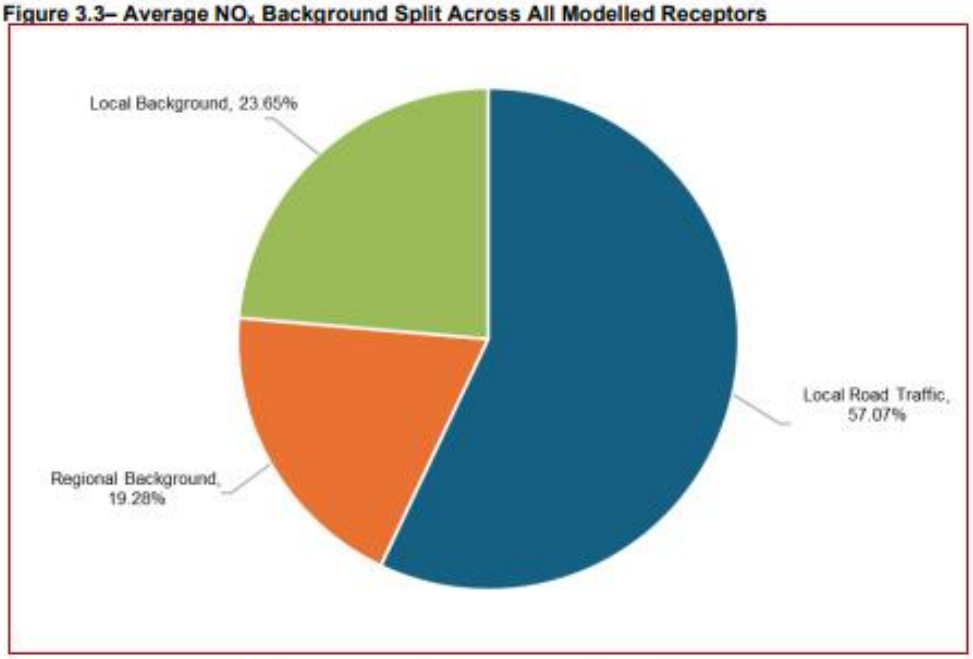
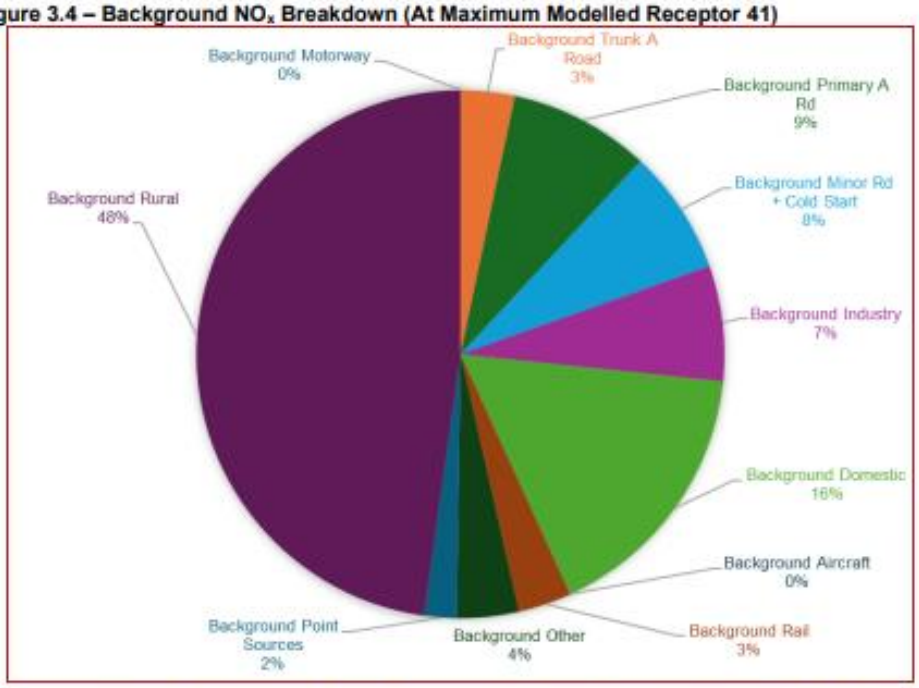


Figure 3.4 – Background NO_x Breakdown (At Maximum Modelled Receptor 41)



The apportionment between road NO_x and background NO_x has also been detailed in Figure 3.3. Local background NO_x, which is considered to be the emissions a local authority has influence over, including building, road and rail emissions etc, accounts for 23.65% of the total NO_x concentration on average at all receptor location. Regional background NO_x concentrations account for those emissions

that the local authority has no influence over, with these emissions forming 19.28% of the total NO_x concentration on average across all modelled receptors. Therefore, a total of 57.07% of NO_x emissions on average within AQMA No.6 is derived from local road traffic.

The source apportionment results provide the relative contribution (as a percentage) of each vehicle type towards a specific pollutant. Therefore, when considering the average NO_x concentration across all modelled receptors, road traffic is responsible for 57.07% of emissions (18.94 µg/m^3). Of the total road NO_x, diesel cars are the greatest contributor accounting for 50.3% of emissions, followed by diesel light good vehicles (28.2%) and rigid HGVs (8.4%).

When considering the modelled receptor location at which the maximum road NO_x concentration is observed (Receptor 41), road traffic is responsible for 82.2% of total NO_x emissions. Of the road traffic proportion, 53.7% is from diesel cars, 30.4% from diesel light good vehicles and 6.8% from petrol cars. These percentages are similar to the average across all modelled receptors, albeit rigid HGVs are more prevalent in the wider context of all modelled receptors comparative to the maximum location (Receptor 41). This is likely due to the large sized AQMA, so the influence of emissions on the maximum receptor is broadly similar to those experienced across the whole of the AQMA albeit petrol cars may be more influential here due to the close proximity of the service station and local school.

Table 3.3 – NO_x Source Apportionment Results

Results	All Vehicles	Petrol Cars	Diesel Cars	Petrol LGV	Diesel LGV	Rigid HGV	Arctic HGV	Buses	Other (Motorcycles, Hybrid Cars, EV Cars)	Background
Average Across All Modelled Receptors										
NO_x Concentration ($\mu g/m^3$)	18.9	1.3	9.5	<0.1	5.3	1.6	0.4	0.6	0.2	14.2
Percentage of Total NO_x	57.1%	3.9%	28.7%	<0.1%	16.1%	4.8%	1.3%	1.7%	0.5%	42.9%
Percentage Contribution to Road NO_x	100.0%	6.8%	50.3%	<0.1%	28.2%	8.4%	2.3%	3.0%	0.9%	-
Max Modelled Receptor (41)										
NO_x Concentration ($\mu g/m^3$)	61.7	4.2	33.1	<0.1	18.8	2.8	1.1	1.5	0.3	13.4
Percentage of Total NO_x	82.2%	5.6%	44.1%	<0.1%	25.0%	3.7%	1.5%	2.0%	0.3%	17.8%
Percentage Contribution to Road NO_x	100.0%	6.8%	53.7%	<0.1%	30.4%	4.5%	1.8%	2.4%	0.4%	-

Table 3.4 – NO_2 Source Apportionment Results

Results	All Vehicles	Petrol Cars	Diesel Cars	Petrol LGV	Diesel LGV	Rigid HGV	Arctic HGV	Buses	Other (Motorcycles, Hybrid Cars, EV Cars)	Background
Average Across All Modelled Receptors										
NO_2 Concentration ($\mu g/m^3$)	9.8	0.7	4.9	<0.1	2.8	0.8	0.2	0.3	0.1	10.7
Percentage of Total NO_2	47.8%	3.3%	24.0%	<0.1%	13.5%	4.0%	1.1%	1.4%	0.4%	52.2%
Percentage Contribution to Road NO_2	100.0%	6.9%	50.2%	<0.1%	28.3%	8.4%	2.3%	3.0%	0.9%	-
Max Modelled Receptor (41)										
NO_2 Concentration ($\mu g/m^3$)	30.0	2.1	16.1	<0.1	9.1	1.3	0.5	0.7	0.1	10.2
Percentage of Total NO_2	74.7%	5.1%	40.1%	<0.1%	22.7%	3.4%	1.3%	1.8%	0.3%	25.3%
Percentage Contribution to Road NO_2	100.0%	6.8%	53.7%	<0.1%	30.4%	4.5%	1.8%	2.4%	0.4%	-

Figure 3.5– NO_x Source Apportionment (Average Across All Modelled Receptors)

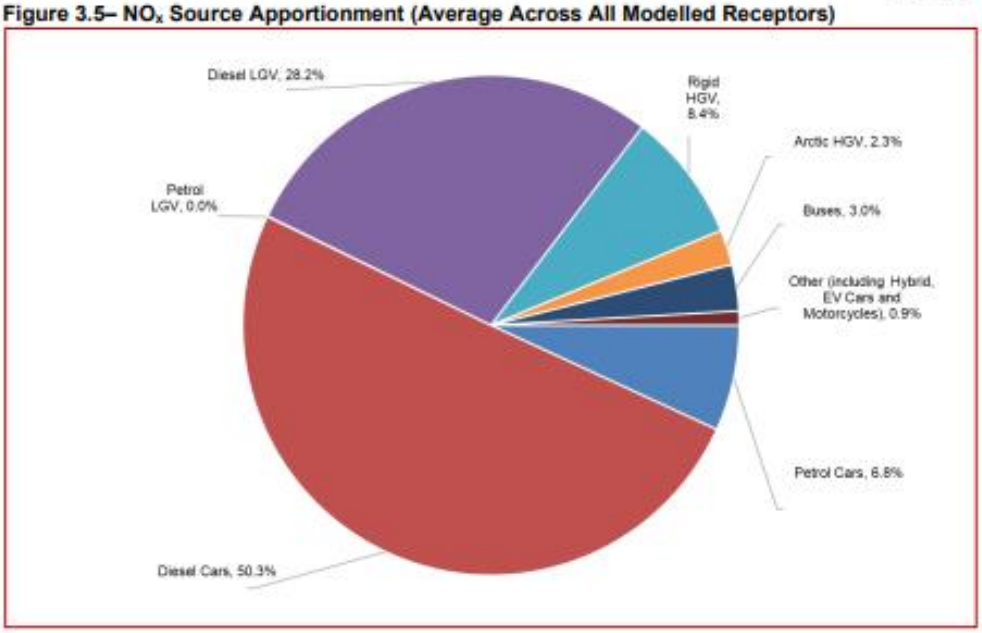


Figure 3.6 – NO_x Source Apportionment (At Maximum Modelled Receptor 41)

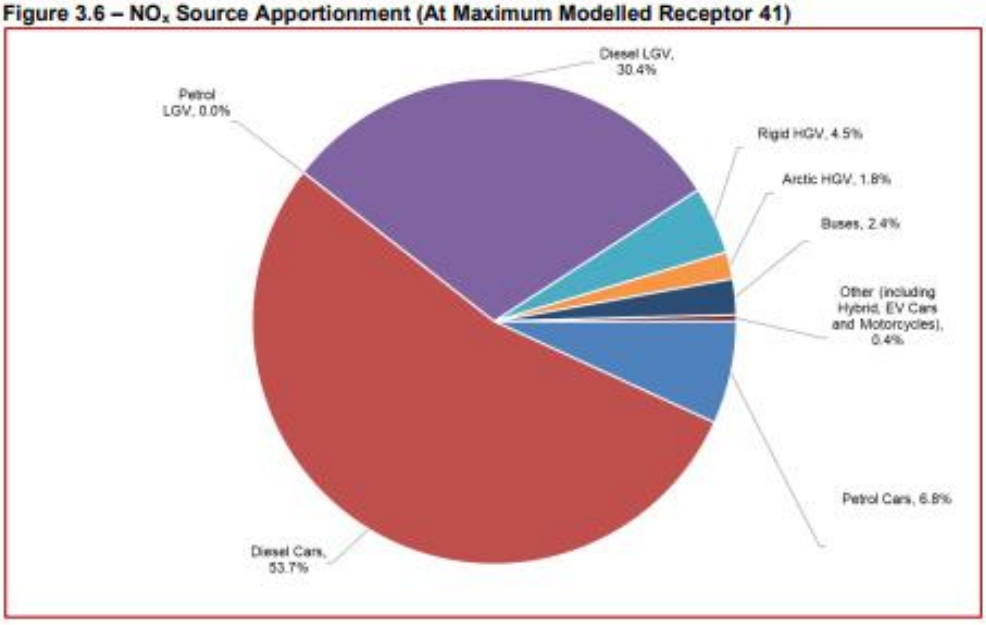
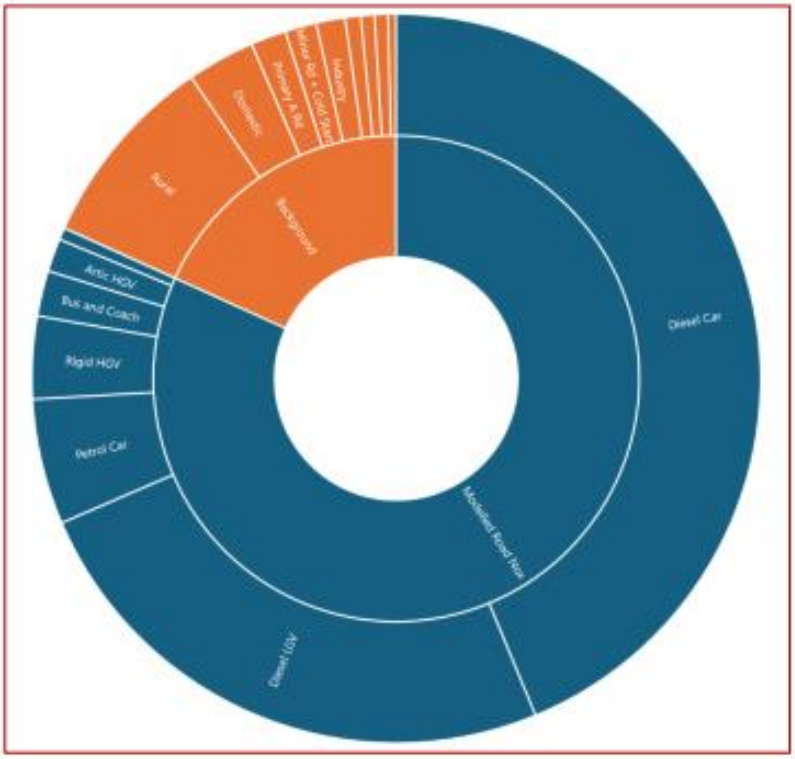


Figure 3.7 – NO_x Source Apportionment Summary



4 Conclusions and Recommendations

Following the completion of the analysis of both monitoring data and modelled concentrations across the modelled area, in particular AQMA No.6, the following conclusions and recommendations are made.

AQMA No.6 is currently designated for exceedances of the NO_2 1-Hour and annual mean and has been in place since it was declared in August 2013. The maximum modelled concentration within this AQMA in the assessment year of 2022 at a point of relevant exposure was 40.2 µg/m^3 (Receptor 41), indicating that there is currently an area of exceedance within the AQMA on Manthorpe Road. This is somewhat in agreement with South Kesteven District Council's monitoring data for 2022, where the maximum NO_2 concentration measured at a diffusion tube site was 37.8 µg/m^3 (SK33a;SK34b), on Manthorpe Road but within 10% of the NO_2 annual mean AQO. It is evident from both the monitored and modelled concentrations that there are parts of the AQMA that are within 10% of breaching the NO_2 annual mean AQO at relevant exposure and, as such, is not in a position to be revoked.

Another area predicted by the model to be within 10% of the annual air quality objective for NO_2 is located at a major junction, centred around North Street, Barrowby Road, Broad Street, and North Parade. This is likely reflective of the build-up of traffic on approach to the junction and towards Sankt Augustin Way roundabout, which results in the stopping/starting of vehicles and subsequently increased emissions.

Based upon the analysis of results, it is recommended that the AQMA remains in place with the current boundary and monitoring should continue in this area. The diffusion tube network could be expanded along High Street, Market Place, and St Peter's Hill and St Catherine's Road junction (adjacent to the residential properties) as the modelled NO_2 concentration that receptors along these roads are exposed to were the highest of all receptors, besides Receptors 11, 12 and 41 located at a major junction (i.e. between North Street, Barrowby Road, Broad Street, and North Parade), and along Manthorpe Road respectively.

No receptors outside of the AQMA boundary exceeded the annual NO_2 AQO in the modelled results.

An initial review of the road NO_x and background NO_x apportionment indicated that road NO_x accounted for 82.2% of emissions at the receptor with the highest modelled NO_x concentration (Receptor 41) and background concentrations accounted for 17.8% of emissions.

Source apportionment analysis of AQMA No.6 demonstrates that diesel cars account for the largest contribution of road NO_x (50.3%), with diesel light good vehicles (28.2%) and rigid heavy good vehicles (8.4%) being the next largest contributors. As such, measures contained within the AQAP for AQMA No.6 should focus on reducing emissions from these vehicle classes and modernising the fleet within South Kesteven District.

Appendix A – Traffic Data

Table A.2 – Annual Average Daily Traffic (AADT) Data – Department for Transport (DfT)

Source ID	Source Name	Traffic Data Source	Traffic Count ID	Speed (kph)	Traffic Flow (AADT)	% Car	% Taxi (black cab)	% LGV	% HGV	% Bus and Coach	% Motorcycle
1	BarrowbyRd3	DfT	6542	48	13173	83.82	0.00	12.33	3.26	0.14	0.46
2	BarrowbyRd3_SD	DfT	6542	20	13173	83.82	0.00	12.33	3.26	0.14	0.46
3	BarrowbyRd_Round	DfT/ IDC	Average of DfT 17986, ANPR 9, DfT 6542.	5	11012	85.27	0.00	10.06	3.89	0.06	0.72
4	SanktAugustinWay_SD1	DfT	17986	20	9948	85.27	0.00	10.06	3.89	0.06	0.72
5	SanktAugustinWay	DfT	17986	48	9948	85.27	0.00	10.06	3.89	0.06	0.72
6	SanktAugustinWay_SD2	DfT	17986	20	9948	85.27	0.00	10.06	3.89	0.06	0.72
7	DysartRd_SD2	DfT	33% of 17986	20	3316	85.27	0.00	10.06	3.89	0.06	0.72
8	DysartRd_SD3	DfT	33% of 17986	20	3316	85.27	0.00	10.06	3.89	0.06	0.72
9	AvenueRd_SD	DfT	940471	20	7462	89.63	0.00	8.42	0.75	0.21	0.98
10	AvenueRd	DfT	940471	48	7462	89.63	0.00	8.42	0.75	0.21	0.98
11	SaintCathRd_SD	DfT	806396	20	7395	86.49	0.00	11.24	0.90	0.74	0.62
12	SaintCathRd	DfT	806396	48	7395	86.49	0.00	11.24	0.90	0.74	0.62
13	LondonRd_SD	DfT	18374	20	14098	83.48	0.00	12.07	3.75	0.33	0.36
14	LondonRd	DfT	18374	48	14098	83.48	0.00	12.07	3.75	0.33	0.36
15	WharfRd_SD1	DfT	1/2 of DfT 806396 + 1/3 of DfT 18374 + 1/3 of DfT 17986	20	12522	84.70	0.00	11.24	3.19	0.33	0.53
16	WharfRd	DfT	1/2 of DfT 806396 + 1/3 of DfT 18374 + 1/3 of DfT 17986	30.26	12522	84.70	0.00	11.24	3.19	0.33	0.53
17	WharfRd_SD2	DfT	1/2 of DfT 806396 + 1/3 of DfT	20	12522	84.70	0.00	11.24	3.19	0.33	0.53

Source ID	Source Name	Traffic Data Source	Traffic Count ID	Speed (kph)	Traffic Flow (AADT)	% Car	% Taxi (black cab)	% LGV	% HGV	% Bus and Coach	% Motorcycle
			18374 + 1/3 of DfT 17986								
18	Westgate2_SD	DfT	57368	20	12032	80.66	0.00	15.22	3.13	0.36	0.64
19	SanktAugustinWay_SD3	DfT	1/2 of DfT 806396 + 1/3 of DfT 18374 + 1/3 of DfT 17986	20	9948	84.70	0.00	11.24	3.19	0.33	0.53
20	Westgate2_RD1	DfT	57368	48	12032	80.66	0.00	15.22	3.13	0.36	0.64
21	Westgate2_SD1	DfT	57368	20	12032	80.66	0.00	15.22	3.13	0.36	0.64
22	Market Place_SD	DfT	57368	20	12032	80.66	0.00	15.22	3.13	0.36	0.64
23	HarlaxtonRd_SD	DfT	57368	20	12032	80.66	0.00	15.22	3.13	0.36	0.64
24	HarlaxtonRd	DfT	57368	48	12032	80.66	15.22	3.13	0.36	0.64	
25	BarrowbyRd1	DfT	940498	48	685	80.66	0.00	15.22	3.13	0.36	0.64
26	BarrowbyRd2	DfT	940498	48	685	91.15	0.00	7.51	0.00	0.17	1.17
27	Westgate2_RD2	DfT	57368	48	12032	91.15	0.00	7.51	0.00	0.17	1.17
28	Market Place_Rd1	DfT	57368	48	12032	80.66	0.00	15.22	3.13	0.36	0.64
29	Bridge End Road	DfT	80686	48	11779	80.66	0.00	15.22	3.13	0.36	0.64
30	Spittlegate_SD1	DfT	80686	20	11779	77.14	0.00	15.28	6.32	0.38	0.88
31	Spittlegate_SD2	DfT	80686	20	11779	77.14	0.00	15.28	6.32	0.38	0.88

Notes:
DfT = Data provided the Department for Transport (DfT) Road Traffic Statistics
IDC = Data provided from Intelligent Data Collection Ltd Survey (February-March 2024)

Table A.3 – Annual Average Daily Traffic (AADT) Data – ANPR Counts

Source Name	Traffic Count ID	Speed (kph)	Traffic Flow (AADT)	% Petrol Car	% Petrol Hybrid Car	% Petrol Plugin Hybrid Car	% Diesel Car	% Diesel Hybrid Car	% Electric Car	% Petrol LGV	% Petrol Hybrid LGV	% Diesel LGV	% Electric LGV	% Rigid HGV (Diesel)	% Rigid HGV Electric	% Artic HGV (Diesel)	% Conventional Bus
BroadStreet	ANPR 4	48	10768	42.50	4.95	0.00	36.39	0.03	2.47	0.01	10.35	0.17	1.33	0.01	1.36	10.35	0.41
BarrowbyRd4_SD1	ANPR 4	20	10768	42.50	4.95	0.00	36.39	0.03	2.47	0.01	10.35	0.17	1.33	0.01	1.36	10.35	0.41
BarrowbyRd4_SD2	ANPR 4	20	10768	42.50	4.95	0.00	36.39	0.03	2.47	0.01	10.35	0.17	1.33	0.01	1.36	10.35	0.41
NorthStreet_SD1	ANPR 9	20	9916	42.91	5.19	0.00	36.04	0.04	2.52	0.06	0.01	10.08	0.23	1.34	0.00	1.18	0.38
NorthStreet_SD2	ANPR 9	20	9916	42.91	5.19	0.00	36.04	0.04	2.52	0.06	0.01	10.08	0.23	1.34	0.00	1.18	0.38
BrookStreet_SD1	ANPR 9	20	9916	42.91	5.19	0.00	36.04	0.04	2.52	0.06	0.01	10.08	0.23	1.34	0.00	1.18	0.38
BrookStreet_SD2	ANPR 6	20	11447	42.13	5.07	0.00	36.22	0.02	2.33	0.04	0.01	11.08	0.17	1.35	0.01	1.19	0.38
ManthorpeRd	ANPR 6	48	11447	42.13	5.07	0.00	36.22	0.02	2.33	0.04	0.01	11.08	0.17	1.35	0.01	1.19	0.38
Watergate1_SD1	ANPR 9	20	9916	42.91	5.19	0.00	36.04	0.04	2.52	0.06	0.01	10.08	0.23	1.34	0.00	1.18	0.38
Watergate1_SD2	ANPR 9	20	9916	42.91	5.19	0.00	36.04	0.04	2.52	0.06	0.01	10.08	0.23	1.34	0.00	1.18	0.38
Chambers Street	ANPR 5	48	669	50.82	3.14	0.00	33.18	0.00	1.94	0.00	0.00	9.87	0.15	0.90	0.00	0.00	0.00
Albion Street	ANPR 8	20	114	37.72	5.26	0.00	37.72	0.00	4.39	0.00	0.00	14.91	0.00	0.00	0.00	0.00	0.00
Swinegate	ANPR 7	48	1176	43.96	3.74	0.00	39.12	0.00	2.47	0.00	0.00	9.10	0.43	1.11	0.00	0.09	0.00

Appendix B – Model Verification

Model Setup

The ADMS-Roads dispersion model has been widely validated for this type of assessment and is specifically listed in the LAQM.TG(22) guidance as an accepted dispersion model.

Model validation undertaken by the software developer (CERC) will not have included validation in the specific modelled area. It is therefore necessary to perform a comparison of modelled results with local monitoring data at relevant locations. This process of verification attempts to minimise the modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results.

The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons, including uncertainties associated with:

- Background concentration estimates;
- Source activity data such as traffic flows and emissions factors;
- Monitoring data, including locations; and
- Overall model limitations.

Model verification is the process by which these and other uncertainties are investigated and where possible minimised. In reality, the differences between modelled and monitored results are likely to be a combination of all these aspects.

Model setup parameters and input data were checked prior to running the models in order to reduce these uncertainties. The following were checked to the extent possible to ensure accuracy:

- Traffic data;
- Distance between sources and monitoring as represented in the model;
- Speed estimated on roads; and
- Background monitoring and background estimates.

NO_2 Verification Calculations

The verification of the model output was performed in accordance with the guidance provided in Chapter 7 of LAQM.TG(22)[2].

Relevant monitoring locations within the Council's jurisdiction have been used in the verification. Of the Council's diffusion tube network, 18 passive monitoring sites within AQMA No.6 were included in the ADMS model, in accordance with the methodology detailed within LAQM TG(22)[2]. It was not necessary to exclude any passive diffusion tube monitoring sites within the AQMA for model verification as all tubes identified were positioned an appropriate distance from the kerb (less than 20 m), and without influence from vegetation (e.g. sheltered by overgrown trees/ bushes).

Table B.1 shows an initial comparison of the monitored and unverified modelled NO_2 results for the year 2022, in order to determine if verification and adjustment was required.

Table B.1 – Unverified Modelled and Monitored NO_2 Concentrations

Site ID	Background NO_2 ($\mu g/m^3$)	Monitored Total NO_2 ($\mu g/m^3$)	Unverified Modelled Total NO_2 ($\mu g/m^3$)	% Difference (Modelled vs. Monitored)
SK56a;SK57b	11.4	29.4	15.8	-46.2

Site ID	Background NO_2 ($\mu g/m^3$)	Monitored Total NO_2 ($\mu g/m^3$)	Unverified Modelled Total NO_2 ($\mu g/m^3$)	% Difference (Modelled vs. Monitored)
SK54a;SK55b	11.4	34.4	16.1	-53.1
SK52a;SK53b	11.4	29.1	15.5	-46.9
SK50a;SK51b	11.4	27.4	15.8	-42.3
SK49	11.4	15.1	11.6	-23.1
SK47a;SK48b	9.2	25.5	12.1	-52.7
SK45a;SK46b	9.1	31.2	14.9	-52.2
SK43a;SK44b	11.4	26.3	15.0	-43.0
SK41a;SK42b	11.4	25.2	14.2	-43.7
SK40	11.4	18.7	14.2	-24.0
SK37a;SK28b;SK39c	11.4	28.5	15.9	-44.1
SK35a;SK36b	11.4	24.2	15.9	-34.2
SK33a;SK34b	11.4	24.5	15.9	-35.0
SK30a;SK31b;SK32c	10.2	27.4	14.5	-47.0
SK27a;SK28b;SK29c	10.2	37.8	17.6	-53.4
SK22	10.2	24.5	13.9	-43.5
SK21	10.2	34.3	18.7	-45.5
SK19a;SK20b	10.2	24.5	14.8	-39.8

The data in Table B.1 shows that the model was under predicting at all monitoring locations. At this stage, all model inputs were checked to ensure their accuracy; this includes road and monitoring site geometry, traffic data, link emission rates, 2022 monitoring results, background concentrations and modelling features such as street canyons. The difference between modelled and monitored concentrations was greater than -25% at the majority of locations therefore adjustment of the results was necessary. The relevant data was then gathered to allow the adjustment factor to be calculated.

Table B.2 provides the relevant data required to calculate the model adjustment based on regression of the modelled and monitored road source contribution to NO_x.

Table B.2 – Data Required for Adjustment Factor Calculation

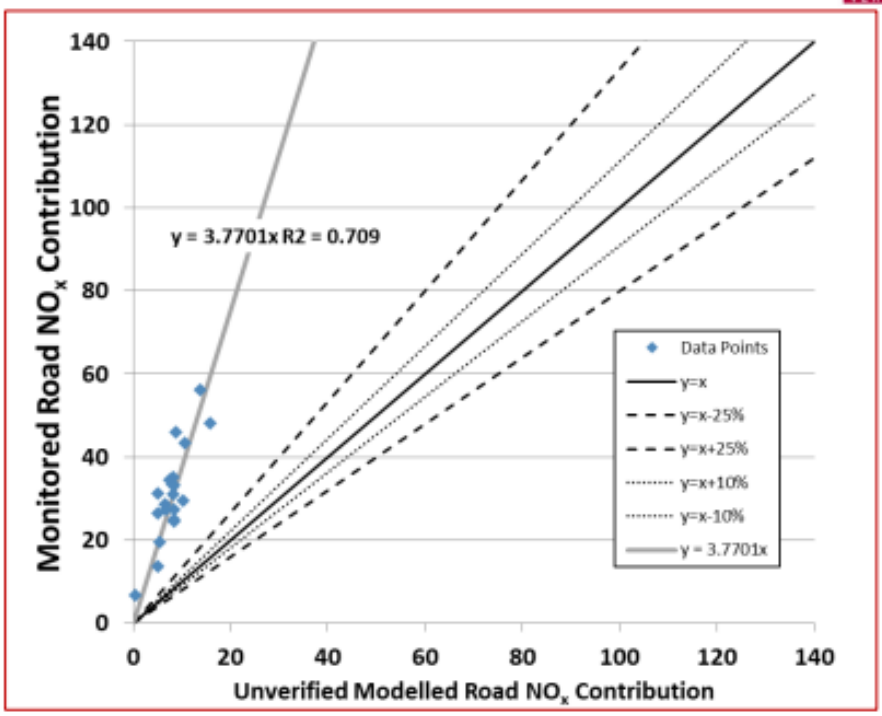
Site ID	Monitored Total NO_2 ($\mu g/m^3$)	Monitored Total NO_x ($\mu g/m^3$)	Background NO_2 ($\mu g/m^3$)	Background NO_x ($\mu g/m^3$)	Monitored Road Contribution NO_2 (Total - Background) ($\mu g/m^3$)	Monitored Road Contribution NO_x (Total - Background) ($\mu g/m^3$)	Modelled Road Contribution NO_x (Excludes Background) ($\mu g/m^3$)
SK56a; SK57b	29.4	50.4	11.4	15.2	18.0	35.2	8.2
SK54a; SK55b	34.4	61.2	11.4	15.2	23.0	46.0	8.7
SK52a; SK53b	29.1	49.8	11.4	15.2	17.7	34.5	7.5
SK50a; SK51b	27.4	46.2	11.4	15.2	16.0	31.0	8.1
SK49	15.1	22.0	11.4	15.2	3.7	6.8	0.4
SK47a; SK48b	25.5	43.3	9.2	12.1	16.3	31.3	5.1
SK45a; SK46b	31.2	55.4	9.1	11.9	22.1	43.5	10.6
SK43a; SK44b	26.3	43.9	11.4	15.2	14.9	28.7	6.6

Site ID	Monitored Total NO_2 ($\mu g/m^3$)	Monitored Total NO_x ($\mu g/m^3$)	Background NO_2 ($\mu g/m^3$)	Background NO_x ($\mu g/m^3$)	Monitored Road Contribution NO_2 (Total - Background) ($\mu g/m^3$)	Monitored Road Contribution NO_x (Total - Background) ($\mu g/m^3$)	Modelled Road Contribution NO_x (Excludes Background) ($\mu g/m^3$)
SK41a; SK42b	25.2	41.7	11.4	15.2	13.8	26.5	5.1
SK40	18.7	28.8	11.4	15.2	7.3	13.6	5.2
SK37a; SK28b; SK39c	28.5	48.5	11.4	15.2	17.1	33.3	8.3
SK35a; SK36b	24.2	39.7	11.4	15.2	12.8	24.4	8.3
SK33a; SK34b	24.5	40.3	11.4	15.2	13.1	25.1	8.3
SK30a; SK31b; SK32c	27.4	46.8	10.2	13.4	17.2	33.4	8.0
SK27a; SK28b; SK29c	37.8	69.6	10.2	13.4	27.6	56.2	13.8
SK22	24.5	40.8	10.2	13.4	14.3	27.4	6.8
SK21	34.3	61.7	10.2	13.4	24.1	48.3	15.9
SK19a; SK20b	24.5	40.8	10.2	13.4	14.3	27.4	8.4

Figure B.1 provides a comparison of the modelled road contribution NO_x versus monitored road contribution NO_x, and the equation of the trend line based on linear regression through zero. The total monitored NO_x contribution has been derived by back-calculating NO_x from the NO_x/NO_2 empirical relationship using the spreadsheet tool available from Defra's website.

The equation of the trend lines presented in Figure B.1 gives an adjustment factor for the modelled results of 3.770.

Figure B.1 – Unverified Modelled Road NO_x Contribution



Model adjustment needs to be undertaken for NO_x rather than NO_2. For the monitoring results used in the calculation of the model adjustment, NO_x was derived from NO_2, using the NO_x to NO_2 calculator (V8.1) spreadsheet tool available from the LAQM website.

The results of the final verification factor are presented in Table B.3. All diffusion tube locations are within the ±25% acceptance level. Alongside this, the RMSE for this verification is 3.2, which according to TG(22) as the RMSE is below 4, indicates that this final verification is performing accurately. The verification factor used for the receptors in this AQA is 3.770.

Table B.3 – Final Verification Calculation

Site ID	Ratio of Monitored Road Contribution NO_x / Modelled Road Contribution NO_x	Adjustment Factor for Modelled Road Contribution NO_x	Adjusted Modelled Road Contribution NO_x ($\mu g/m^3$)	Adjusted Modelled Total NO_x (Including Background NO_x) ($\mu g/m^3$)	Modelled Total NO_2 (Based upon Empirical NO_x / NO_2 Relationship) ($\mu g/m^3$)	Monitored Total NO_2 ($\mu g/m^3$)	% Difference (Adjusted Modelled NO_2 vs. Monitored NO_2)
SK56aSK57b	4.31	3.770	30.8	46.0	27.3	29.4	-7.2
SK54aSK55b	5.26		33.0	48.2	28.4	34.4	-17.6
SK52aSK53b	4.62		28.2	43.4	26.1	29.1	-10.5
SK50aSK51b	3.80		30.7	45.9	27.3	27.4	-0.5
SK49	17.89		1.4	16.6	12.2	15.1	-19.3
SK47aSK48b	6.09		19.4	31.4	19.6	25.5	-23.3
SK45aSK46b	4.10		40.0	51.9	29.6	31.2	-5.2

Site ID	Ratio of Monitored Road Contribution NO_x / Modelled Road Contribution NO_x	Adjustment Factor for Modelled Road Contribution NO_x	Adjusted Modelled Road Contribution NO_x ($\mu g/m^3$)	Adjusted Modelled Total NO_x (Including Background NO_x) ($\mu g/m^3$)	Modelled Total NO_2 (Based upon Empirical NO_x / NO_2 Relationship) ($\mu g/m^3$)	Monitored Total NO_2 ($\mu g/m^3$)	% Difference (Adjusted Modelled NO_2 vs. Monitored NO_2)
SK43aSK44b	4.33		25.0	40.2	24.5	26.3	-7.0
SK41aSK42b	5.16		19.3	34.6	21.6	25.2	-14.1
SK40	2.64		19.5	34.7	21.7	18.7	16.1
SK39c	3.99		31.4	46.7	27.6	28.5	-3.1
SK38b	2.93		31.4	46.7	27.6	24.2	14.1
SK37a	3.00		31.4	46.7	27.6	24.5	12.7
SK35aSK36b	4.17		30.2	43.6	25.9	27.4	-5.6
SK33aSK34b	4.06		52.2	65.6	36.1	37.8	-4.6
SK30aSK31bSK32c	4.06		25.4	38.9	23.5	24.5	-4.0
SK27aSK28bSK29c	3.03		60.0	73.4	39.4	34.3	15.0
SK22	3.26		31.7	45.1	26.6	24.5	8.6

Figure B.2 – Verified Modelled Road NO_x Contribution

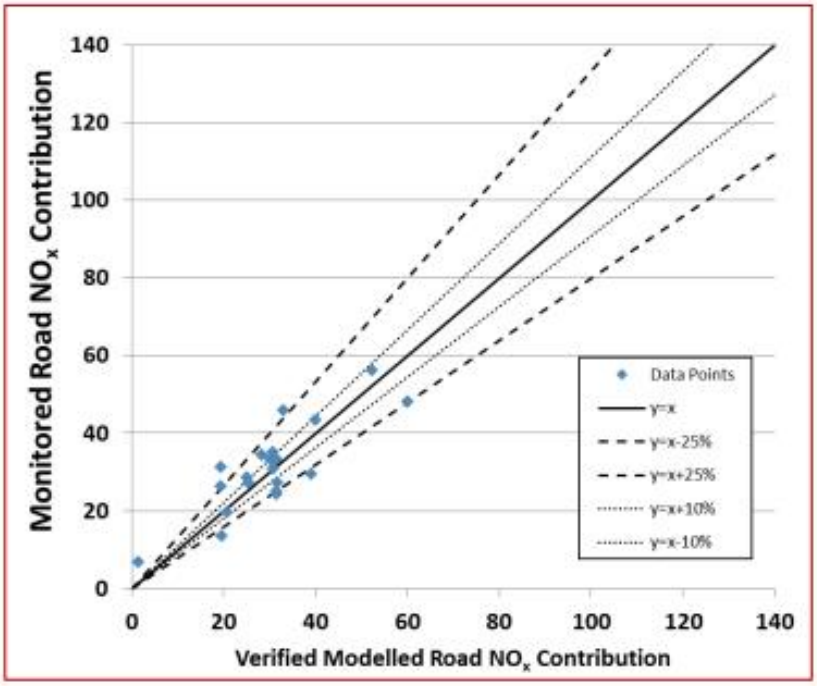
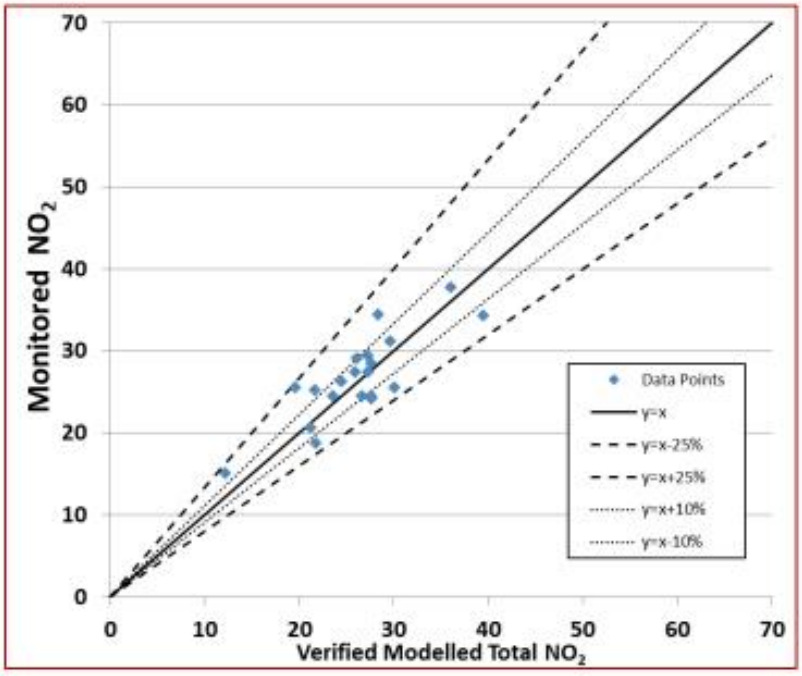


Figure B.3 – Verified Modelled Total NO_2



Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values'
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
AQS	Air Quality Strategy
ASR	Air Quality Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
EU	European Union
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less