2020 Air Quality Annual Status Report (ASR)

In fulfilment of Part IV of the Environment Act 1995 Local Air Quality Management

June 2020

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Executive Summary: Air Quality in Our Area

Air Quality in Nottingham City Council's administrative area

Air pollution is associated with a number of 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].

Air pollution is defined as a mixture of gases and particles that have been emitted into the atmosphere by natural and human-made processes.

The combustion of fossil and other carbon based fuels such as coal, gas, petrol, diesel and wood are the most significant sources of the key pollutants of concern: nitrogen oxides, particles and sulphur dioxide; and also carbon dioxide, a key greenhouse gas.

In Nottingham the main sources of urban NO_2 are natural gas fired heating/hot water systems and boilers (industrial, commercial and domestic sources) and motor vehicles. Furthermore, in some locations in Nottingham, particularly near busy roads, monitored concentrations of NO2 exceed the annual mean Air Quality Objective/EU limit value of 40 ug/m3.

The largest local contributors to ambient concentrations of particulate matter (PM_{10}, $PM_{2.5}$, $PM_{0.1}$) are road transport: diesel engine vehicles, tyre, brake, and road surface wear, and the burning of solid fuel such as coal-based 'smokeless fuels' and wood. However, air quality modelling indicates that the majority of Nottingham's fine particulate air pollution ($PM_{2.5}$ and smaller) comes from sources outside the City, and comprising a proportion of secondary particles formed by chemical reactions between air pollutants such as ammonia, sulphur dioxide and nitrogen dioxide.

[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

Air quality modelling and monitoring data identified locations in Nottingham where the annual mean air quality objective for nitrogen dioxide (40 ug/m3) would be exceeded, requiring the declaration of two Air Quality Management Areas (AQMA).

In January 2019 Nottingham City Council varied one of the NO2 AQMAs to encompass the Council's entire administrative area[4] . In January 2019 and January 2020 it also took the opportunity to review the distribution of its nitrogen dioxide diffusion tubes in order to align monitoring as closely as possible with guidance on relevant and representative exposure.

Air Quality Monitoring data 2019

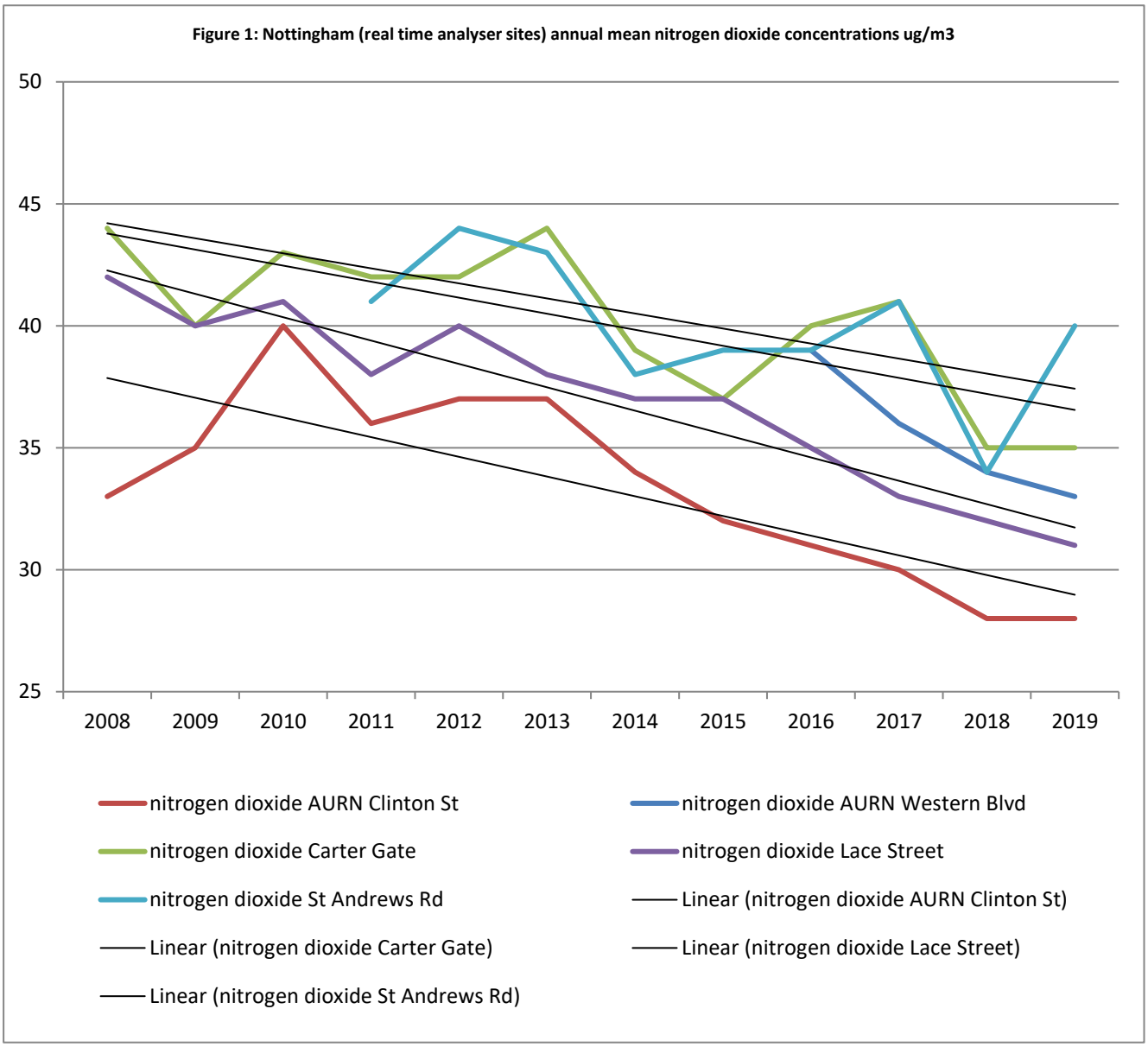
As Nottingham has an AQMA for NO_2 it is required to carry out NO_2 monitoring and uses both real time analysers and nitrogen dioxide diffusion tubes to do this.

DEFRA operates two AURN stations (for the Nottingham 'Agglomeration'), monitoring a range of pollutants of concern. Monitoring data from the Clinton Street East AURN station and from the Western Boulevard AURN station show NO2 concentrations are below the air quality objective and continue to fall.

The 2019 NO_2 real time air quality monitoring data show a continuing downward trend in NO2 concentrations at four locations, except for a marked and unexpected increase at the St Andrews Road analyser site. The reasons for this increase are being investigated.

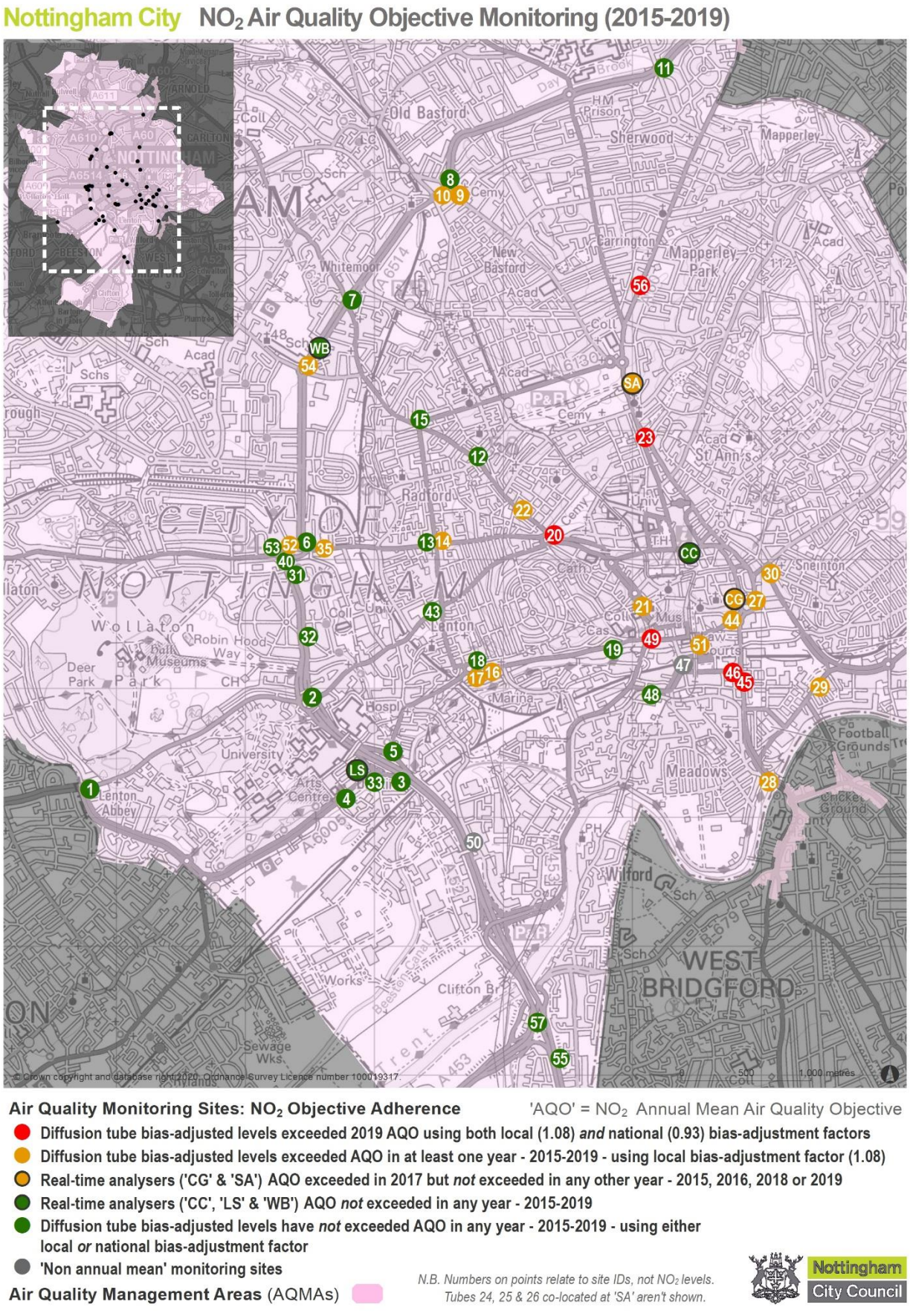
[4] Nottingham City Council: LAQM revocation of AQMA No3 and variation of AQMA No2 January 2019.

Figure 1. 2008-2019 NO2 real time analyser monitoring data.



The 2019 NO2 diffusion tube data indicate very little change when compared to 2018 and 2017, although the long term trend for the majority of the diffusion tubes continues downwards. Again concentrations monitored at a number of roadside and kerbside locations exceeded, or potentially exceeded, the NO_2 annual mean air quality objective. A number of these locations are affected by traffic congestion and from congestion caused by road and lane closures that are necessary for the construction activity associated with redevelopment activity in the City Centre.

Fig. 2 Summary of 2015-2019 NO2 monitoring data.

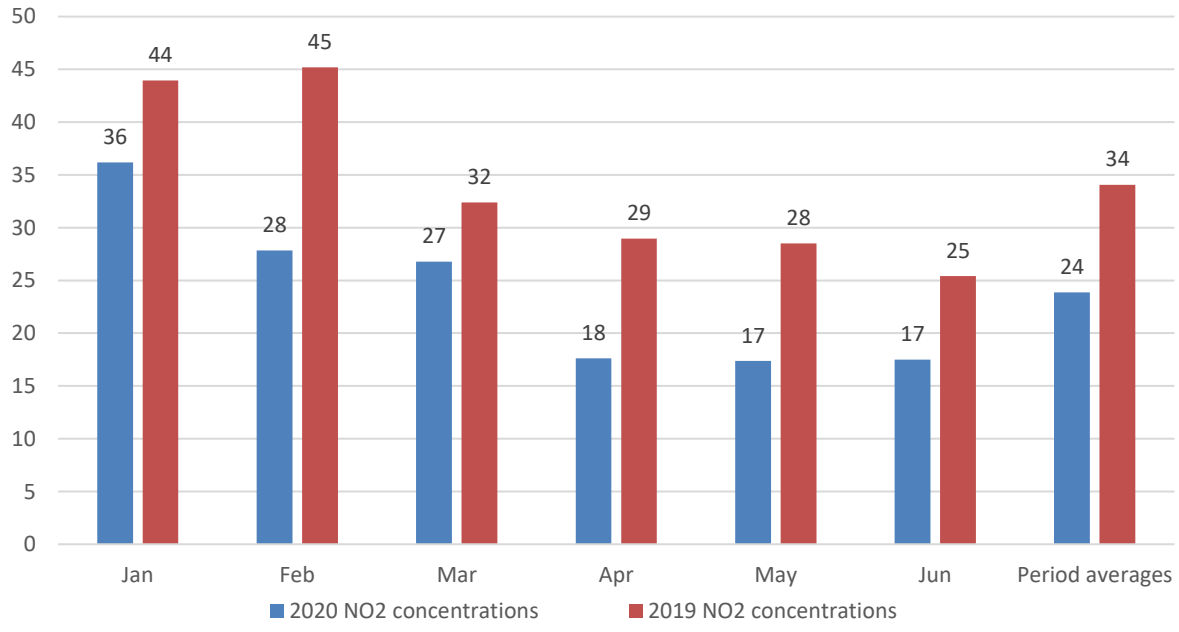


Latest Air Quality Monitoring Data (January 2020 – June 2020).

It has been reported that the international and national response to the coronavirus pandemic and it's economic impact has resulted in reductions in CO_2 emissions and the co-pollutants of concern NOx/NO_2 and particles. The noticeable improvement in local air quality in major cities throughout the UK has also been widely reported by the media.

However during the main lockdown months (April and May), and despite the noticeable (over 80%) reduction in traffic on most roads, there was only a reduction of approximately 35% in measured NO2 concentrations. This highlights the need for further significant holistic action to be taken to reduce emissions of NOx/NO2 from all sources if we are to quickly recapture the air quality improvements that occurred during 'lockdown' and enable Nottingham City Council's ambitious target to reduce NO2 concentrations by 20% (compared to 2018 levels) to be met by 2024.

Figure 3. Comparison of Q1&2 2019 2020 average NO2 concentrations (from 5 real time analysers)



Note the averaged real time analyser data for January to March 2020 indicates NO_2 concentrations had fallen when compared to 2019. The 'lockdown' will have contributed to the NO_2 reduction measured in April and May.

Actions to Improve Air Quality

Nottingham City Council pledge to reduce air pollution

Nottingham City Council is committed to improving air quality by cutting Nitrogen Dioxide and particulate pollution by 20%.

https://www.nottinghamcity.gov.uk/media/2215620/nccplan19-web.pdf

It intends to achieve this by the range of strategies, plans and activity outlined below.

Nottingham Local Plan Part 1 and 2

Nottingham City Council has been working to improve air quality by reducing emissions of CO_2, NO_x/NO_2 and particles (PM_{10}, $PM_{2.5}$) by increasing energy efficiency across Nottingham City Council and Nottingham City Homes building stock, and investing in alternative energy generation.

Nottingham City Council's Land and Planning Policies Development Plan Document (Local Plan Part 2) which was in development at the time of publication of the ASR 2019 was adopted in January 2020.

It supports the wider Broxtowe Borough, Gedling Borough and Nottingham City Aligned Core Strategy. The Core Strategy details policies and objectives) of which the majority directly address or contribute towards improving air quality e.g.

i) Environmentally responsible development addressing climate change

ii) High quality new housing

v) Regeneration

viii) Health and wellbeing

x) Excellent transport systems and reducing the need to travel

xi) Protecting and improving natural assets

xii) Timely and viable infrastructure

https://www.nottinghamcity.gov.uk/information-for-business/planning-and-building-control/planning-policy/the-local-plan-and-planning-policy/the-adopted-local-plan/

Local Plan to Improve Air Quality in Nottingham (Action plan to reduce NO2 concentrations in locations at risk of infraction of EU limit values).

The main element of this air quality action plan, which was the retrofit of approximately 185 Euro V emission standard Nottingham City Transport buses with NO2 abatement technology to bring them up to Euro VI emission standard and the accelerated introduction of lower NO_2 emissions Bio-gas buses, was substantially completed by February 2020.

https://www.nottinghaminsight.org.uk/d/aBFPtBx

A significant proportion of the buses operating on the roads where infraction of the EU limit NO2 annual mean was predicted were upgraded by August 2019. The reduction in NOx/NO2 emissions and ambient NO2 concentrations were calculated, submitted to and, provisionally accepted by, DEFRA in August 2019.

The second element of the plan, Nottingham City Council's revised Hackney Carriage and Private Hire Vehicle Strategy 2017-2020 designed to transition the fleet to Euro VI compliant taxi's from January 2020, and for a minimum of 40% of the HC and 25% of the Private Hire fleet to be Ultra Low Emission Vehicles is progressing. https://nottinghaminsight.org.uk/d/aBFPtrI

Nottingham and Nottinghamshire Air Quality Strategy

In November 2019 Nottingham and Nottinghamshire completed the review of their joint Air Quality Strategy and each Council's respective Health and Wellbeing Boards subsequently approved the drafts. The two versions of the Strategy, an interactive webpage and the more detailed strategy document, are available to download from each Council's website (search on-line for Nottingham and Nottinghamshire Air Quality Strategy).

The strategy draws together work by local authorities, police, fire and rescue services, NHS trusts, Environment Agency and Highway's England to develop, promote and support activity within their own organisations and complement each other to reduce harmful emissions from their activity, estate, staff and customers/service users. https://www.nottinghaminsight.org.uk/d/aYjleqG

Air Quality and Emissions Mitigation – Guidance for Developers 2019 (draft)

Nottingham City Council is working to transpose the draft supplementary planning document, developed in partnership with East Midlands Air Quality Network, into an

easy to follow guide and menu for developers in Nottingham to use. The guidance will enable developers to develop sites whilst minimising air pollution and carbon emissions from the development over its lifetime.

https://www.nottinghaminsight.org.uk/d/aavR2kmH

Carbon Neutral Action Plan

This plan builds on Nottingham 2028 Carbon Neutral Charter by setting out high-level objectives in order to achieve a resilient and carbon neutral Nottingham by 2028.

Nottingham's approach to sustainable carbon neutrality will integrate carbon reduction with sustainability and an ambition to identify and realise multiple benefits, termed co-benefits.

Co-benefits are deliberate or incidental positive outcomes across a range of other areas in addition to the central aim of an intervention. An example of a co-benefit is moving towards more active travel to tackle air-quality also has benefits for health from exercise and mental wellbeing, and reducing carbon emissions.

The approach encompasses all current and foreseeable emission sources and will reduce or negate entirely the combustion of carbon based fuels and, in turn, will reduce or negate emissions of NOx/NO2 and particles and other combustion by products.

https://www.nottinghamcity.gov.uk/cn2028

Carbon Neutral Supplementary Planning Document (draft)

In accordance with the Council's agreed Action Plan to achieve Carbon Neutrality by 2028, Planning Policy is currently preparing a supplementary planning document to provide detailed guidance on the range of measures possible to reduce Carbon in new residential and commercial development proposals. It will supplement existing Planning Policies as contained in the Nottingham City Aligned Core Strategy (2014) and the Local Plan Part 2 and highlight the Councils agreed targets.

Taking into consideration the policy context and best practice examples, it is anticipated that this SPD will firstly; provide guidance in relation to energy efficiency, renewable energy and sustainable design and construction and secondly; present a Carbon Neutrality checklist for applicants to demonstrate compliance with the policy approach.

Clear Zone (in development)

Although Nottingham City was not required to introduce a Clean Air Zone it has continued to review practicable options and measures to encourage and facilitate the switch to ultra-low emission vehicles travelling through and operating in the City Centre. This project is still in development with plans to introduce it late 2020. The City Centre Clear Zone will be modified to ensure only the cleanest vehicles will be able to access the city centre by introducing a permit scheme with emissions based criteria.

Benefits include:-

- Encourage the uptake of cleaner vehicles that service the heart of the city centre
- Support the Council's Plan to reduce the level of NO2 in the City and moving towards Carbon Neutral City 2028
- Improve the pedestrian environment, more people wanting to come to the city centre for shopping and leisure
- Reducing illegal trading practices by private hire vehicles; increasing bus punctuality and reducing congestion
- Improve bus journey times and reliability by reducing unnecessary traffic in the City Centre

Go Ultra Low Nottingham programme

Through our Go Ultra Low Nottingham project we are helping to support uptake for electric cars and other low emission vehicles across the city. Our vision is for Nottingham to become an exemplar for low emission vehicles, spanning private cars, vans, buses, taxis and commercial fleets as a core part of our sustainable transport system.

Nottingham has been named one of the UK's first Go Ultra Low Cities. £6.1m funding awarded by the Office for Low Emission Vehicles has introduced a range of innovative projects to support the uptake in Ultra Low Emission Vehicles (ULEVs).

https://www.transportnottingham.com/driving/ultra-low-emission-vehicles/

Nottingham - Derby Access Fund

A comprehensive package of sustainable travel behaviour change measures to support capital infrastructure investment in Nottingham and Derby building on local good practice.

Objectives:

Improve air quality to support the introduction of Clean Air Zones,

Embed sustainable and active travel cultures in our businesses and communities

Improve access to work and jobs

https://www.nottinghamshire.gov.uk/media/117257/nottinghamderbyaccessfundbid.pdf

Citizen science and school's air quality project

A key aim of the Council's plan to reduce air pollution is through raising awareness amongst children and parents of the effects of air pollution to encourage behavioural change and sustainable travel choices.

The Council continues to collaborate with the City's two universities in applying for government grants to initiate low cost air quality monitoring projects for schools.

Conclusions and Priorities

Air pollution remains a concern to Nottingham City Council, its citizens and businesses. There appears to be greater awareness and individual citizen experiences of both localised air pollution problems and a noticed reduction in air pollution as a result of the Covid-19 lockdown.

2019's monitoring generally shows a reduction in the number of diffusion tube monitoring sites exceeding the annual mean air quality objective (when applying the local and national bias adjustment factor) and, except for St Andrew's Road, a reduction in monitored NO2 concentrations at the real time analyser sites. All RTA sites remained below the NO2 annual mean air quality objective of 40 ug/m3.

Priorities to improve air quality

The local (and conurbation wide) priority to improve air quality continues to be how to reduce levels of nitrogen dioxide, and identify and implement practicable measures to reduce particle emissions and concentrations in the City area.

The local priorities and challenges to improve air quality in Nottingham and reduce emissions are:-

i. Increase activity to raise awareness of air pollution and its health impacts,

ii. Enforce the Road Traffic (Vehicle Emissions) (Fixed Penalty) (England) Regulations 2002, and issue Fixed Penalty Notices to drivers unnecessarily idling a stationary vehicles' engine.

iii. Go Ultra Low Nottingham – continues to secure funding to promote and support a range of initiatives and projects to facilitate the take-up of Ultra Low Emission Vehicles (ULEV) in Nottingham,

iv. Complete the feasibility study into a low emission/ clear zone for the City Centre and identify/secure funding for implementation,

v. Encourage all bus operators to implement a retrofit or replacement programme for older polluting buses,

vi. Continue work with Nottingham's taxi companies to introduce low and zero emission vehicles.

vii. Integrate East Midlands Air Quality Network Air Quality and Emission Mitigation guidance as Supplementary Planning Guidance in the Local Plan.

viii. Further develop plans and secure funding for extension of Nottingham's Tram network (lines 4 and 5),

ix. Continue to work with major private and public sector employers to review vehicle use to reduce emissions,

x. Continue to roll-out/improve energy efficiency in Nottingham City Council's housing stock, as and when funding permits,

xi. Promote energy efficiency and the transition to/installation of alternative technologies that significantly reduce/negate NO2/NOx emissions in the commercial/industrial sector,

xii. Identify opportunities and secure further funding to transition Nottingham City Council commercial vehicle fleet to ULEV,

Identify and implement practicable local solutions to reduce particle emissions and concentrations.

Local Engagement and How to get involved

What is the Council doing to reduce emissions?

Nottingham City Council is concerned about air pollution, climate change, and air quality and recognises that these issues are complex and interlinked.

The Council's strategies and action on climate change and public transport have reduced CO_2 emissions and air pollution in the City, but the Council recognises it is necessary to go much further to reduce emissions from the range of sources that generate particles and nitrogen dioxide and impact on health.

Portfolio Holders Air Quality Steering Group

This group comprises Nottingham City Council's Portfolio Holder for Energy and Environment (including Air Quality), Corporate Director of Development, Director of Transport, Director of Public Health, Head of Environmental Health and Safer Housing, and officers from their teams. It develops strategies, policies and implementation plans to deliver improved air quality in Nottingham.

Health and Wellbeing Board

This group comprises Nottingham City Council and a large number of organisations, including Primary Health Care commissioners and providers, Registered Social Landlords, and third sector organisations.

http://www.healthynottingham.co.uk/

Public health Steering Group

This group comprises officers from Public Health England, Nottingham City Council and Nottinghamshire County Council Public Health teams, the NHS, Nottingham City Council's Environmental Health service, and a representative of Nottinghamshire's district Environmental Health services.

The group identifies current and emerging public/environmental health issues that require joint and concerted action to resolve, and prepares reports and chapters for the Joint Strategic Needs Assessment, used to inform the Health and Wellbeing Board and its formulation of Strategy.

Health and Wellbeing Board Air Quality group

Reporting to the HWb Board, this group comprises Officers from Nottingham City Council, the Health Sector: Clinical Commissioning Group, Nottingham University Hospitals Trust, Circle; East Midlands Ambulance Service, Nottinghamshire Fire and Rescue Service, Nottingham Trent University and University of Nottingham, and co-ordinates action to improve air quality across HWb Board member organisations.

Nottingham Green Partnership

Nottingham Green Partnership is a wide range of organisations in the public, private and voluntary sectors that are working together to reduce the city's environmental impact. It recognises the environmental issues that affect Nottingham and its citizens, and aims to deliver actions that will reduce our reliance on fossil fuels, increase resilience and improve quality of life.

http://www.onenottingham.org.uk/?page_id=4952

What can I do to improve air quality?

When burned in air, carbon containing fuels e.g. wood and fossil fuels, emit carbon dioxide, nitrogen oxides (NOx) – nitrogen oxide (NO) and nitrogen dioxide (NO_2), and particles (including PM_{10} and $PM_{2.5}$). Although it does not affect local air quality, carbon dioxide is a greenhouse gas and contributes to climate change. Nitrogen dioxide and particles adversely affect local air quality therefore reducing emissions of these pollutants will improve air quality.

Measures that help to reduce emissions of air pollution and thereby improve air quality:-

Travel choices: walking, cycling, public transport, and journey/travel planning

Walking and cycling, also known as 'active travel', have mental and physical health benefits in addition to reducing air pollution. Follow the links below for more information:

Walking in Nottingham: https://www.nottinghamcity.gov.uk/information-for-residents/transport-parking-and-streets/rights-of-way-walking-and-cycling/walking-in-nottingham/ and http://walkit.com/

Cycling in Nottingham: http://www.transportnottingham.com/cycling/

Nottingham has a high quality public transport network located within the City, including the NET tram network as well as an established bus network.

Nottingham NET: http://www.thetram.net/

Nottingham City Transport: https://www.nctx.co.uk/

Trent Barton: https://www.trentbarton.co.uk/

Stagecoach: https://stagecoachbus.com

Nottingham Car club: https://www.transportnottingham.com/driving/car-club/

A car club is a membership scheme that offers pay-as-you-go basis car rental, At the end of the journey you return your car to its dedicated on-street car club parking space. Nottingham currently has a network for 14 car club vehicles in 11 locations.

Energy efficiency:

We use energy in the form of electricity or natural gas to heat our homes, cook and power electrical equipment. Insulating our homes and using energy efficient appliances reduces energy consumption and emissions, both at power stations and locally from domestic gas boilers and gas cookers.

Visit http://www.energysavingtrust.org.uk/ for ideas on home to save energy and money.

Clean Air Day

On the 20th June 2019 Nottingham, together with other Cities and organisations across the UK, participated in the third (National) Clean Air Day. The aim of the day was to raise awareness about air pollution, what people can do, and publicise via social media what people did, to reduce emissions and their exposure to air pollution.

Due to Covid-19 this 2020's Clean Air Day is planned for 8th October 2020.

Please visit https://www.cleanairday.org.uk/

https://www.cleanairday.org.uk/best-practice-in-nottingham

https://www.cleanairday.org.uk/Pages/Category/nottingham for more information.

Although promoted as a single 'Clean Air Day', the event is to highlight the year round issue of air pollution and its effects on health, enable Citizens identify what they can do on Clean Air Day and in the future to reduce personal exposure to air pollution, reduce emissions, and improve air quality.

To demonstrate and promote ongoing activity to improve air quality participants have been using the twitter hashtag #cleanaireveryday to maintain awareness and publicise activity to reduce emission and spread information on how to reduce exposure.

World Car Free Day

On the 22nd September 2019 Nottingham joined with many cities around the world to promote and celebrate World Car Free Day. A similar event is planned for 2020.

https://www.visit-nottinghamshire.co.uk/whats-on/car-free-day-p784271

https://www.nctx.co.uk/nottingham-car-free-day-2019

For more information, to comment or raise your concerns about air pollution and air quality please visit

https://www.nottinghamcity.gov.uk/information-for-business/environmental-health-and-safer-housing/environmental-health-and-safer-places/

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1 Local Air Quality Management

This report provides an overview of air quality in the City of Nottingham monitored during 2019, and briefly highlights the impact of Covid-19 on air quality during the first half of 2020. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by Nottingham City Council to improve air quality and any progress that has been made.

The statutory air quality objectives and relevant locations applicable to LAQM in England can be found in Table E.1 and E.2 in Appendix E.

2 Actions to Improve Air Quality

2.1 Air Quality Management Areas

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority must prepare an Air Quality Action Plan (AQAP) within 12-18 months setting out measures it intends to put in place in pursuit of compliance with the objectives.

A summary of AQMAs declared by Nottingham City Council for NO_2 can be found in Table 2.1. Further information related to declared or revoked AQMAs, including maps of AQMA boundaries are available online at https://uk-air.defra.gov.uk/aqma/local-authorities?la_id=188 .

Alternatively, see Figure 2 which provides a map of air quality monitoring locations in relation to the AQMA.

Further information detailing declared or revoked AQMAs, including maps of AQMA boundaries are available online at

https://uk-air.defra.gov.uk/aqma/details?aqma_ref=112 (AQMA No. 2 - varied 2019).

Table 2.1 – Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	City / Town	One Line Description	Is air quality in the AQMA influenced by roads controlled by Highways England?	Level of Exceedance (maximum monitored/modelled concentration at a location of relevant exposure)				Action Plan		
						At Declaration		Now		Name	Date of Publication	Link
AQMA No.2	Declared 2002, Amended 2010 and 2019	NO2 Annual Mean (40 ug/m3)	City of Nottingham	The AQMA covers the entire administrative area of Nottingham City Council.	NO	**41** (St Andrew's Rd)	ug/m3	40	µg/m3	LTP Implementation Plan 2010 2015-18, 2016-19, 2017-20, 2018-21 and 2019-22	June 2010 Jun-19	http://aqma.defra.gov.uk/action-plans/NottCC%20AQAP%202010.pdf https://www.nottinghaminsight.org.uk/Documen Library/Document-Library/aBFyzqe and https://www.nottinghaminsight.org.uk/search?q=transp
AQMA No.2	Declared 2002, Amended 2010 and 2019	NO2 Annual Mean (40 ug/m3)	City of Nottingham	As above.	NO	**44** (Carter gate)	ug/m3	35	ug/m3	As above	As above	As above

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	City / Town	One Line Description	Is air quality in the AQMA influenced by roads controlled by Highways England?	Level of Exceedance (maximum monitored/modelled concentration at a location of relevant exposure)				Action Plan		
						At Declaration		Now		Name	Date of Publication	Link
AQMA No.2	Declared 2002, Amended 2010 and 2019	NO2 Annual Mean (40 ug/m3)	City of Nottingham	As above.	NO	**42** (Lace Street)	ug/m3	31	ug/m3	As above	As above	As above
AQMA No.2	Declared 2002, Amended 2010 and 2019	NO2 Annual Mean (40 ug/m3)	City of Nottingham	As above.	NO	33 (AURN Clinton St East)	ug/m3	28	ug/m3	As above	above	As above
AQMA Name 2	Declared 2002, Amended 2010 and 2019	NO2 Annual Mean (40 ug/m3)	City of Nottingham	As above.	NO	**42** (AURN Western Blvd)	ug/m3	33	ug/m3	As above	As above	As above

☒ **Nottingham City Council confirm the information on UK-Air regarding their AQMA(s) is up to date**

2.2 Progress and Impact of Measures to address Air Quality in the City of Nottingham

Defra's appraisal of Nottingham City Council's 2019 ASR can be downloaded at

https://www.nottinghaminsight.org.uk/d/aaiMFXmM

In summary it concluded 'On the basis of the evidence provided by the local authority the conclusions reached are acceptable for all sources and pollutants.'

Specific issues raised in the appraisal related to the annualisation of data from 2 diffusion tube monitoring locations (to take account of less than 9 months of (monthly) tube data, and how the spreadsheet calculator rejected values of less than 10 ug/m3 when averaging diffusion tube concentrations.

Fortunately 2019's diffusion tube data collection was above 75% so annualisation calculations were not required. The spreadsheet calculator has been amended to identify missing tubes with an M rather than a value <10.

An amended ASR 2019, reflecting the recommendations, was published on the Council's website in January 2020.

Nottingham City Council has taken forward a number of direct measures during the current reporting year of 2019 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2.

Table 2.2 – Progress on Measures to Improve Air Quality

Measure No.	Measure	EU Category	EU Classification	Date Measure Introduced	Organisations involved	Funding Source	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
1	DEFRA Air Quality funding	Promoting Low Emission Transport	Other	Led by Nottingham City Council. Joint Air Quality Unit / DEFRA funding	2017/18	2019/20	Project specific outputs	Likely positive impact	Initial works underway	2020/2021	
2	Go Ultra Low Nottingham Programme	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	Led by Nottingham City Council. OLEV grant funding (Go Ultra Low Programme)	2015	2016-17 - 2019/20	Project specific outputs	City-wide effect		2020	
3	Nottingham Workplace Parking Levy (WPL)	Traffic Management	Workplace Parking Levy, Parking Enforcement on highway	Nottingham City Council.	2011	2012 - onwards	WPL liable businesses, WPL compliance	City-wide effect	Ongoing	2037	
4	Midland Mainline Enhancements	Transport Planning and Infrastructure	Public transport improvements-interchanges stations and services	Network Rail.	2016/17	2016 - 2023		Positive effect on City Centre area	Electrification to Nottingham cancelled. New rolling stock may deliver improvements to air quality	2023	Electrification cancelled. Uncertainty relating to enhancements on Midland Mainline. New rolling stock may contribute to improving air quality.
5	A52 Nottingham Junctions Improvement	Traffic Management	Strategic highway improvements, Re-prioritising road space away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane	Highways England	2018/19	2019 - onwards		Localised impact on route		2021	
6	M1 Smart Motorway	Traffic Management	Strategic highway improvements, Re-prioritising road space	Highways England	2017	2018		Impact on AQMA along M1 motorway (Greater Nottingham Area)	Now on site	2020	

Measure No.	Measure	EU Category	EU Classification	Date Measure Introduced	Organisations involved	Funding Source	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
			away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane								
7	Southside Transport Strategy (Broadmarsh)	Traffic Management	Strategic highway improvements, Re-prioritising road space away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane	Nottingham City Council. Funding from Local Growth Fund, LTP and prudential borrowing	2014/15 - 2015/16	2016 - 2020		Positive effect on City Centre area	Works to demolish car park finished in 2018. Further road space works planned to take place in future years	2020/2021	Large-scale regeneration project. High number of dependencies for the works
8	Connecting Eastside Phase 2	Traffic Management	Strategic highway improvements, Re-prioritising road space away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane	Nottingham City Council. Funding to be confirmed.	2017/18	Unknown		Positive effect on City Centre area	Project being reviewed.	To be determined	
9	Smarter Travel Hubs / Access Fund	Promoting Travel Alternatives	Personalised Travel Planning	Nottingham City Council. DfT grant funding (Access Fund)	2015	2015/16 - 2019/20	Specific project outputs / behavioural change	City-wide effect	Project underway	2020/2021	Continuation funding now received enabling programme to continue through to 2021
10	Nottingham Enterprise Zone Sustainable Transport Package	Transport Planning and Infrastructure	Cycle network	Nottingham City Council. Funding from Local Growth Fund and developer	2016-17	2018 - 2019	Public Transport Usage (Bus) LTP Indicator: Cycle Index	Nil	Works completed	2019	Delay to original scheme due to Network Rail / design refinements

Measure No.	Measure	EU Category	EU Classification	Date Measure Introduced	Organisations involved	Funding Source	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
				contributions.							
11	CAZ additional measures	Transport Planning and Infrastructure	Taxi strategy	DEFRA grant	2018	2020	% Euro 6 and % ULEV private hire vehicles operating to strategy	City wide effect	Project underway (some delays due to Covid impacts on trade)	Sep 2020	
12	CAZ additional measures	Transport Planning and Infrastructure	Bus retrofit project	DEFRA grant	2018	2019		City wide effect. Most pronounced in City Centre due to concentration of routes.	Project complete	October 2019	
13	DfT Emergency Active Travel Measures	Promoting Travel Alternatives	Monitoring Cameras, Cycle Lanes, School Street Closures and Pop up Cycle Parking	DfT Fund	2020	2020		Positive effect City wide	Project underway	Summer 2020	DfT Emergency Active Travel Measures

2.3 $PM_{2.5}$ – Local Authority Approach to Reducing Emissions and/or Concentrations

As detailed in Policy Guidance LAQM.PG16 (Chapter 7), Local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$. There is clear evidence that $PM_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

Nottingham City Council is implementing and considering the following measures to address $PM_{2.5}$:

Existing measures are focused on:-

i. reducing emissions from transport by constraining traffic growth and encouraging/facilitating walking, cycling and use of public transport and

ii. on-going regulatory activity re Permitted Processes, ensuring compliance with the City's existing Smoke Control Orders, discouraging bonfires and uncontrolled burning, and ensuring construction/demolition activity implement dust minimisation measures.

Additional measures being considered include:-

i. Reducing emissions from non-vehicle fixed and mobile sources and

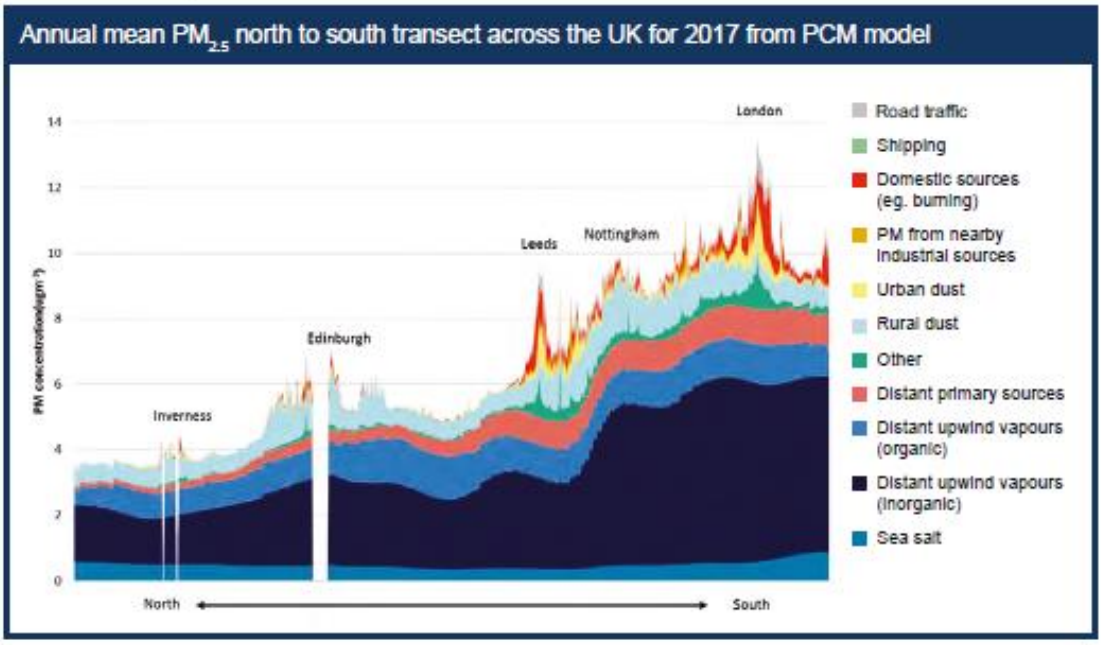
ii. Planting to reduce weathering/entrainment of soil/surface particles and increasing green surface area for adsorption/impingement/entrapment of particles by foliage.

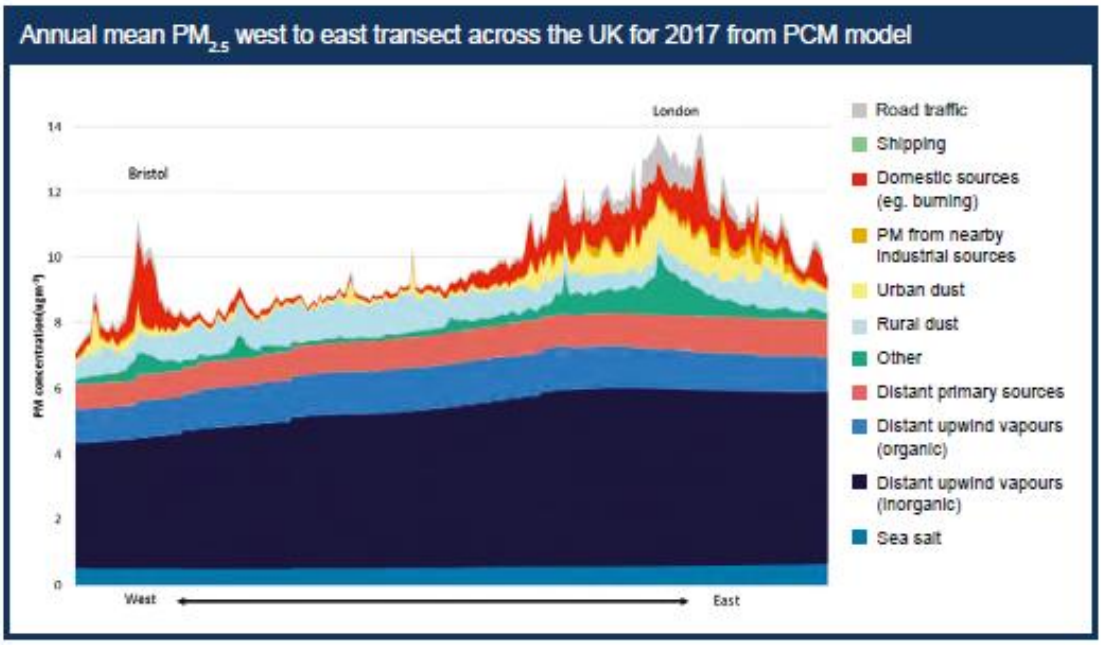
It should be noted that the UK Governments Air Quality Strategy (May 2019) details PM2.5 source contribution to annual mean concentrations across the UK, highlighting a number of cities that fall on the chosen transect line, including Nottingham. (Fig 4).

The PCM model indicates that as much as 80% of Nottingham's PM2.5 levels come from distant primary sources and distant upwind vapours e.g. industrial, commercial and agricultural sources outside the City's boundary and therefore any action by Nottingham City Council will only have a small impact on PM2.5 levels.

Figure 4: $PM_{2.5}$ distribution and source apportionment from Clean Air Strategy May 2019.

These images show how particulate matter from across the country can build up in the atmosphere as 'background pollution' and the role that this can play in combination with local sources in areas with a pollution challenge.







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3 Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

This section sets out what monitoring has taken place and how it compares with objectives.

Nottingham City Council has an air quality monitoring network comprising three NOx/NO2 real time analysers and 50 NO_2 diffusion tubes. There are also two DEFRA AURN air quality monitoring stations located in the City area.

Nottingham City Council undertook automatic (continuous) monitoring at three sites during 2019. Table A.1 in Appendix A shows the details of the sites. National monitoring results are available at https://uk-air.defra.gov.uk/data/data_selector

Carter Gate NOx (CG), Carter Gate, City Centre

This unit has been located at Carter Gate monitoring since December 2003. The site is a suburban mixed commercial/residential area of the City adjacent to the A60. It is approximately 10 metres from the A60 which is a major traffic route and, approximately 3 metres from a busy B road. It is classed as a 'Roadside' site. There are residential properties approximately 12 metres from the unit and 2 metres away from the A60.

Lace Street NOx (LS), Lace Street, Dunkirk

This is a fixed unit located at Lace Street since March 2007. The site is a suburban, mixed education/commercial/residential area of the City adjacent to the A6005, a busy road traffic route. It is approximately 4 metres from the A6005 and 1 metre from a minor road and is classed a 'Roadside' site. The unit is located within an enclosure sited on the pavement at the boundary with a residential property and in-line with the front-facade building line.

St Andrews Road NOx (SA), St Andrew's Road, Mapperley

This site was established in June 2010 following the expansion of Nottingham City Council's Air Quality Management Area No.2. The monitoring unit is located on a small residential street - St Andrews Road, approximately 13 metres from the A60

Mansfield Road. The A60 is a major traffic route through the City, and south across the River Trent.

The SA NOx is a fixed unit sited on the pavement at the boundary of a residential property. It is classed as a 'Kerbside' site.

To give a complete overview of Automatic Monitoring Sites in the Nottingham City Area it is also necessary to mention the two DEFRA funded Automatic Urban Rural Network (AURN) stations: at Clinton Street East (comprising a suite of air quality monitoring equipment, including NOx/NO2, PM10 and PM2.5 and classed as an Urban Background), and Western Boulevard (comprising NOx/NO2 and PM10) near its junction with Aspley Lane (NO2 and PM10 and classed as Roadside).

Further information is available at: https://uk-air.defra.gov.uk/ and

https://uk-air.defra.gov.uk/networks/find-sites

A data map showing the location of the monitoring sites is provided in Appendix D. Further details on how the monitors are calibrated and how the data has been adjusted are included in Appendix C.

3.1.2 Non-Automatic Monitoring Sites

Nottingham City Council undertook non- automatic (passive) monitoring of NO2 at 47 different locations during 2019.

Appendix A Table A.2 shows the details of the sites.

Maps showing the location of the monitoring sites are provided in Appendix D. Further details on Quality Assurance/Quality Control (QA/QC) for the diffusion tubes, including bias adjustments and any other adjustments applied (e.g. "annualisation" and/or distance correction), are included in Appendix C.

Local Air Quality monitoring results

Figure 1 indicates the spatial distribution of all the air quality monitoring sites in Nottingham. Real time analyser monitoring locations are identified by letters, and diffusion tubes by numbers. Note diffusion tubes 24, 25, 26 are collocated with the real time analyser marked SA and used in the national annual diffusion tube bias study.

To assist the visualisation of the monitoring data Figure 1 combines 2019 real time analyser monitoring results, historical monitoring results (from 2015) and an approach that highlights the diffusion tubes monitoring locations where an exceedance of the AQO is likely to have occurred. Nottingham's NO2 diffusion tube monitoring results, adjusted using both the national and local bias adjustment factors, are detailed in Appendix B Table B1.

See Appendix A Tables A1 and A2 for detailed information about the locations, and Table A3 for 2015-2019 monitoring results.

Nottingham's (and the DEFRA AURN station) NO2 real time analysers use the chemiluminescence technique recognised by EU legislation and DEFRA as a reference method for monitoring NO2 concentrations.

In addition to real time analysers, Nottingham uses nitrogen dioxide diffusion tubes to measure NO2 (Appendix B Table B1). Diffusion tubes are not a 'reference method', and only give an average NO2 concentration for the period of exposure. They have low accuracy, and their measurements require a correction, known as bias adjustment. The bias adjustment factor is derived from a collocation study with a local real time analyser (the reference methodology), or by applying a national bias adjustment derived from a large number of national collocation studies (Appendix C). For more information https://laqm.defra.gov.uk/bias-adjustment-factors/bias-adjustment.html

Nottingham City Council's 2019 collocation study satisfied the range of criteria (LAQM.TG16. Box 7.11) necessary to have confidence in the use of the local bias adjustment factor in preference to the national bias adjustment factor.

For mapping purposes, and to give comparability with the real time analyser results and greater confidence in the likelihood of exceedance of the AQO, only those locations where applying both local and national bias adjustment factors to the diffusion tube measurements resulted in levels higher than 40 ug/m3 are shown as red dots in Fig. 1.

3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias[5], "annualisation" (where the data capture falls below 75%), and distance correction[6]. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen Dioxide (NO_2)

Nottingham City Council conducts nitrogen dioxide monitoring in 47 different locations (4 diffusion tubes are collocated with real time analysers). The results of the real time analysers are presented in Fig 1 below. Fig 2 combines rta and diffusions tube data. All but 2 of the diffusion tubes are in relevant/sensitive locations with respect to the annual mean objective. 2 tubes are in sensitive locations with respect to the 1-hour objective (200 ug/m3 not to be exceeded 18 times a year). The locations of real time analysers and diffusion tubes are detailed in Table A.1 and Table A.2 respectively.

Fig 1: Nottingham (real time analyser sites) annual mean nitrogen dioxide concentrations ug/m3

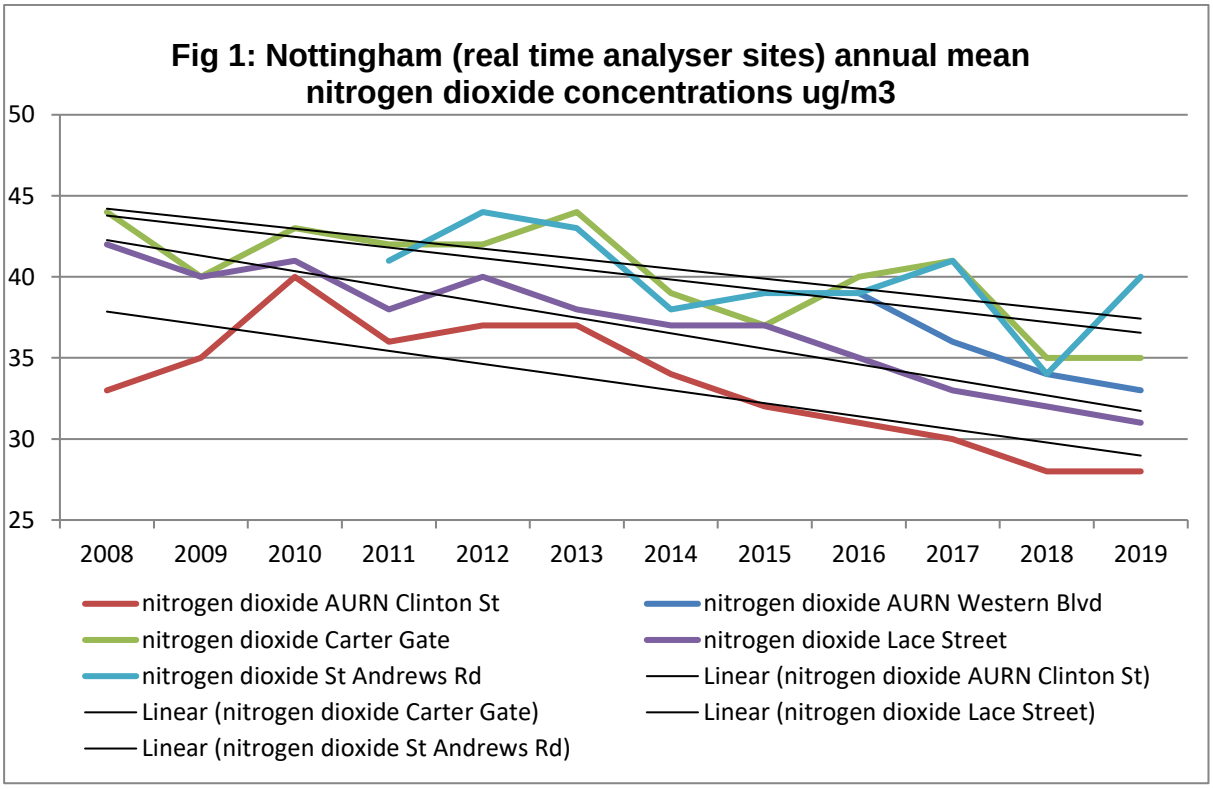


Table A.3 in Appendix A compares the ratified and adjusted monitored NO_2 annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3.

[5] https://laqm.defra.gov.uk/bias-adjustment-factors/bias-adjustment.html
[6] Fall-off with distance correction criteria is provided in paragraph 7.77, LAQM.TG(16)

Note that the concentration data presented in Table A.3 represents the concentration at the location of the monitoring site, following the application of bias adjustment and annualisation, as required (i.e. the values are exclusive of any consideration to fall-off with distance adjustment).

For diffusion tubes, the full 2019 dataset of monthly mean values is provided in Appendix B. Note that the concentration data presented in Table B.1 includes distance corrected values, only where relevant.

Table A.4 in Appendix A compares the ratified continuous monitored NO_2 hourly mean concentrations for the past 5 years with the air quality objective of 200µg/m^3, not to be exceeded more than 18 times per year.

3.2.2 Particulate Matter (PM_{10})

Nottingham City Council does not undertake its own monitoring for PM10. However, monitoring is undertaken at the DEFRA AURN station located in the City centre and therefore reported here. Monitoring since 2011, when the PM10 FDMS, unit was installed, shows levels meet both annual mean and daily mean air quality objectives (Fig. 5).

Table A.5 in Appendix A compares the ratified and adjusted monitored PM10 annual mean concentrations for the past 5 years with the air quality objective of 40µg/m3.

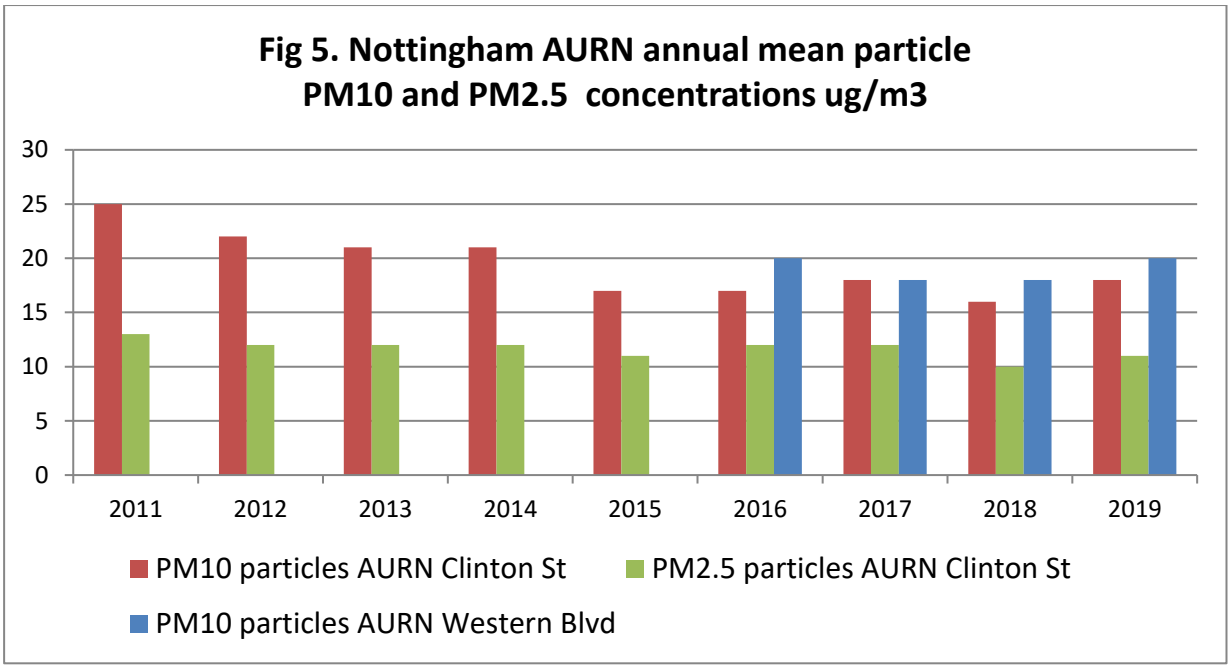
Table A.6 in Appendix A compares the ratified continuous monitored PM10 daily mean concentrations for the past 5 years with the air quality objective of 50µg/m3, not to be exceeded more than 35 times per year.

There were no monitored exceedances of the air quality objectives for PM10.

3.2.3 Particulate Matter ($PM_{2.5}$)

Nottingham City Council does not undertake its own monitoring for PM2.5. However, monitoring is undertaken at the DEFRA AURN station located in the City centre and therefore reported here. There are no air quality objectives for PM2.5 in England. A manifesto proposal by the Conservative Government in the run up to the 2019 general election to include legally binding targets for PM2.5 in new air quality legislation (2020) was dropped from the current draft legislation by the elected, conservative majority, government.

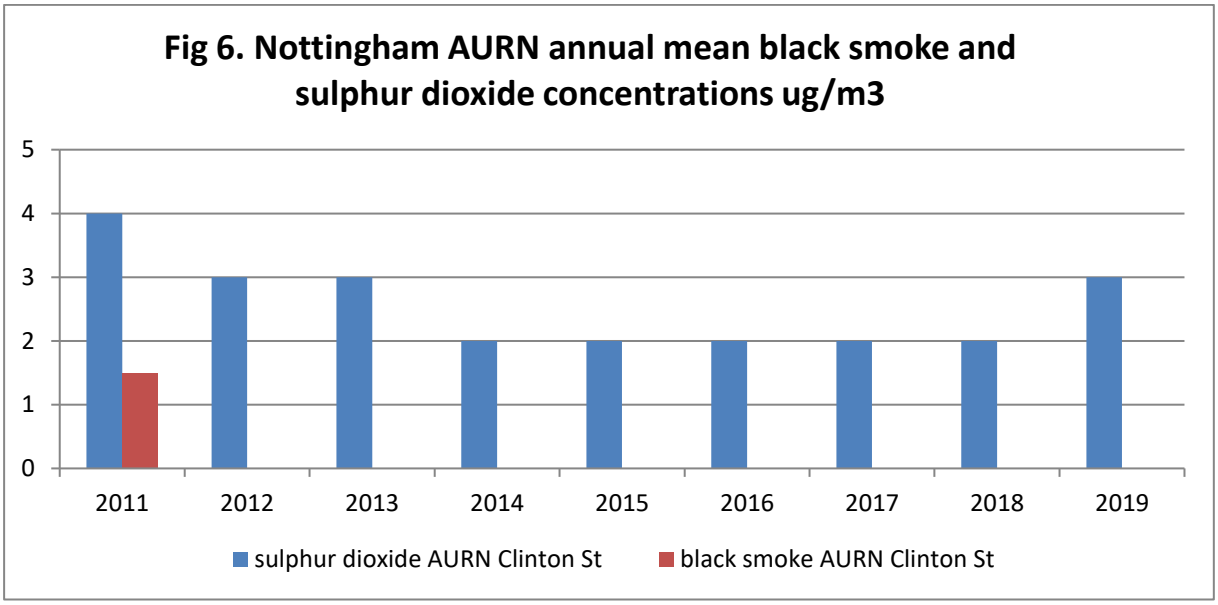
Table A.7 in Appendix A presents the ratified and adjusted monitored $PM_{2.5}$ annual mean concentrations for the past 5 years.



3.2.4 Sulphur Dioxide (SO_2)

Nottingham City Council does not undertake its own monitoring for sulphur dioxide. However, monitoring is undertaken at the DEFRA AURN station located in the City centre and therefore reported here. Monitoring shows levels did not exceed any of the SO2 air quality objectives.

Table A.8 in Appendix A compares the ratified continuous monitored SO2 concentrations for year 2019 with the air quality objectives for SO2.



Appendix A: Monitoring Results

Table A.1 - Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
CG NOx	Carter Gate	Roadside	457945	339667	NO2 NO NOx	Y	Chemiluminescent	12	4	2.5
LS NOx	Lace Street	Roadside	454940	338314	NO2 NO NOx	Y	Chemiluminescent	3	9	1.5
SA NOx	St. Andrews Road	Roadside	456967	341382	NO2 NO NOx	Y	Chemiluminescent	12	13	1.7
CC AURN	Clinton St East.	Urban background	457437	340049	PM2.5,PM10 NO2, NO, NOx O3 SO2	N	FDMS, FDMS Chemiluminescent Ultra Violet Absorption (UVA) Ultra Violet Fluorescence (UVF)	N/A	35	3
WB AURN	Western Boulevard	Kerbside	454573	341643	PM10 NO2	NO	FDMS Chemiluminescent	15	1	2.5

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property).

(2) N/A if not applicable

Table A.2 – Details of Non-Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
1	Woodside Road	Roadside	452795	338219	NO2	Y	0	10	N	2.5
2	Derby Road	Roadside	454520	338931	NO2	Y	0	23	N	2.5
3	Marlborough Street	Roadside	455208	338277	NO2	Y	0	5	N	2.5
4	Beeston Rd	Roadside	454784	338146	NO2	Y	0	10	N	2.5
5	Abbey Street	Roadside	455146	338511	NO2	Y	0	5	N	2.5
6	Western Blvd	Roadside	454466	340111	NO2	Y	0	17	N	2.5
7	Wilkinson St	Roadside	454829	342013	NO2	Y	0	21	N	2.5
8	Nottingham Rd	Roadside	455573	342860	NO2	Y	0	13	N	2.5
9	Nottingham Road	Roadside	455606	342840	NO2	Y	0	3	N	2.5
10	Valley Road	Roadside	455528	342828	NO2	Y	0	7	N	2.5
11	Danethorpe Vale	Roadside	457248	343813	NO2	Y	0	17	N	2.5
12	Bentinck Rd - Sch	Roadside	455809	340800	NO2	Y	0	6	N	2.5
13	Ilkeston Road	Roadside	455439	340131	NO2	Y	0	3	N	2.5
14	Ilkeston Road	Roadside	455485	340135	NO2	Y	0	4	N	2.5
15	Gregory Blvd	Roadside	455358	341086	NO2	Y	0	10	N	2.5
16	Castle Gardens	Roadside	455870	339133	NO2	Y	0	3	N	2.5
17	Castle Boulevard	Roadside	455955	339129	NO2	Y	0	5	N	2.5

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube collocated with a Continuous Analyser?	Height (m)
18	LP 3P17 Park Road	Roadside	455809	339178	NO2	Y	4	27	N	2.5
19	Castle Blvd	Roadside	456853	339303	NO2	Y	0	4	N	2.5
20	Canning Terrace	Roadside	456399	340191	NO2	Y	0	5	N	2.5
21	Maid Marian Way	Roadside	457083	339637	NO2	Y	0	3	N	2.5
22	LP 80A01 Alfreton Rd	Roadside	456156	340383	NO2	Y	0	3	N	2.5
23	Mansfield Rd	Roadside	457102	340946	NO2	Y	0	2	N	2.5
24	St Andrew's Rd B	Roadside	456967	341382	NO2	Y	12	16	Y	1.5
25	St Andrew's Rd M	Roadside	456967	341382	NO2	Y	12	16	Y	1.5
26	St Andrew's Rd T	Roadside	456967	341382	NO2	Y	12	16	Y	1.5
27	Cartergate	Roadside	457963	339681	NO2	Y	0	8	N	2.5
28	Trent Bridge	Roadside	458060	338276	NO2	Y	0	2	N	2.5
29	Meadow Lane	Roadside	458459	339011	NO2	Y	0	3	N	2.5
30	LP 53890 Manvers Street	Roadside	458078	339891	NO2	Y	0	3	N	2.5
31	Middleton Boulevard	Roadside	454399	339886	NO2	Y	0	17	N	2.5
32	Middleton Boulevard	Roadside	454493	339402	NO2	Y	0	19	N	2.5
33	Lace Street NOx RTA	Roadside	454941	338314	NO2	Y	0	9	Y	2.5

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
35	Lampost 70 Wollaton Road	Roadside	454587	340097	NO2	Y	10	3	N	2.5
40	Lampost Middleton Boulevard/Crown Island	Roadside	454321	339931	NO2	Y	15	5	N	2.5
43	Outside 328 Derby Road	Roadside	455453	339595	NO2	Y	6	3	N	2.5
44	Parking Post Cliff Road	Roadside	457775	339530	NO2	Y	4	17	N	2.5
45	66 London Road	Roadside	457871	339051	NO2	Y	3	20	N	2.5
46	Hicking Building Queens Road	Roadside	457781	339123	NO2	Y	0	3	N	2.5
47	Sheriffs Way/ Railway Station	Roadside	457398	339183	NO2	Y	23	16	N	2.5
48	Kinglake Place	Roadside	457151	338953	NO2	Y	0	12	N	2.5
49	2 Castle Boulevard	Roadside	457150	339384	NO2	Y	0	4	N	2.5
50	A52 Clifton Boulevard	Roadside	455713	337838	NO2	Y	-	3	N	2.5
51	Trent Street	Roadside	457528	339339	NO2	Y	0	2	N	2.5
52	Lamppost Crown Public House	Roadside	454386	340087	NO2	Y	0	3	N	2.5
53	3 Bayard Court	Roadside	454243	340057	NO2	Y	0	3	N	2.5
54	Trafford gardens play area	Roadside	454493	341505	NO2	Y	0	3	N	2.5

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
55	40 Horwood Drive	Roadside	456441	336131	NO2	Y	0	3	N	2.5
56	Lampost 119M38 Mansfield Road (roadside)	Kerbside	457064	342128	NO2	Y	10	1	N	2.5
57	Clifton Lane Stepping Stones Retirement Park	Roadside	456265	336412	NO2	Y	35	35	N	2.5

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property).

(2) N/A if not applicable.

Table A.3 – Annual Mean NO_2 Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3) (4)				
							2015	2016	2017	2018	2019
CG NOx	457945	339667	Roadside	Automatic		99	37	40	**41**	35	35
LS NOx	454940	338314	Roadside	Automatic		94	37	35	33	32	31
SA NOx	456967	341382	Roadside	Automatic		99	39	39	**41**	34	40
AURN CC	457437	340049	Urban Background	Automatic		97	32	31	30	28	28
AURN WB	454573	341643	Roadside	Automatic		94	-	39	36	34	33
1	452795	338219	Roadside	Diffusion Tube		100	38	34	37	32	34
2	454520	338931	Roadside	Diffusion Tube		92	30	27	32	27	30
3	455208	338277	Roadside	Diffusion Tube		100	25	25	27	24	27
4	454784	338146	Roadside	Diffusion Tube		100	33	32	35	32	35
5	455146	338511	Roadside	Diffusion Tube		92	36	33	36	30	32
6	454466	340111	Roadside	Diffusion Tube		100	31	30	36	29	33
7	454829	342013	Roadside	Diffusion Tube		100	31	31	36	29	33
8	455573	342860	Roadside	Diffusion Tube		100	38	38	39	35	40
9	455606	342840	Roadside	Diffusion Tube		100	**42**	**41**	**46**	**42**	**45**
10	455528	342828	Roadside	Diffusion Tube		100	39	38	**41**	40	**41**

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3) (4)				
							2015	2016	2017	2018	2019
11	457248	343813	Roadside	Diffusion Tube		100	30	29	34	29	31
12	455809	340800	Roadside	Diffusion Tube		100	32	38	**41**	33	35
13	455439	340131	Roadside	Diffusion Tube		100	36	35	35	33	35
14	455485	340135	Roadside	Diffusion Tube		100	**41**	**47**	**50**	**46**	**46**
15	455358	341086	Roadside	Diffusion Tube		100	36	31	35	30	34
16	455870	339133	Roadside	Diffusion Tube		92	**48**	37	**41**	36	**41**
17	455955	339129	Roadside	Diffusion Tube		100	**48**	39	38	38	39
18	455809	339178	Roadside	Diffusion Tube		100	32	29	32	29	30
19	456853	339303	Roadside	Diffusion Tube		100	37	33	34	32	33
20	456399	340191	Roadside	Diffusion Tube		100	**48**	**49**	**49**	**50**	**49**
21	457083	339637	Roadside	Diffusion Tube		92	**45**	**43**	**46**	**43**	**44**
22	456156	340383	Roadside	Diffusion Tube		100	**41**	**47**	**48**	**44**	**41**
23	457102	340946	Roadside	Diffusion Tube		100	**43**	**46**	**47**	**46**	**48**
24	456967	341382	Roadside	Diffusion Tube		100	38	36	40	34	39
25	456967	341382	Roadside	Diffusion Tube		92	38	36	**42**	35	36

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3) (4)				
							2015	2016	2017	2018	2019
26	456967	341382	Roadside	Diffusion Tube		100	39	34	**41**	35	39
27	457963	339681	Roadside	Diffusion Tube		100	**42**	40	**48**	**41**	**42**
28	458060	338276	Roadside	Diffusion Tube		92	37	39	**41**	36	36
29	458459	339011	Roadside	Diffusion Tube		100	**42**	**45**	**46**	**45**	**45**
30	458078	339891	Roadside	Diffusion Tube		100	**41**	**45**	**46**	**44**	**42**
31	454399	339886	Roadside	Diffusion Tube		100	31	29	37	27	30
32	454493	339402	Roadside	Diffusion Tube		100	26	27	32	27	31
33	454941	338314	Roadside	Diffusion Tube		100		34	38	34	36
35	454587	340097	Roadside	Diffusion Tube		100		**42**	**42**	**42**	40
40	454321	339931	Roadside	Diffusion Tube		92		23	36	37	36
43	455453	339595	Roadside	Diffusion Tube		100		30	35	28	29
44	457775	339530	Roadside	Diffusion Tube		100		26	**41**	39	40
45	457871	339051	Roadside	Diffusion Tube		92		**53**	**61**	**56**	**59**
46	457781	339123	Roadside	Diffusion Tube		100		**46**	**53**	**48**	**53**
47	457398	339183	Roadside	Diffusion Tube		100		**45**	**47**	**46**	**49**

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3) (4)				
							2015	2016	2017	2018	2019
48	457151	338953	Roadside	Diffusion Tube		100		18	33	27	30
49	457150	339384	Roadside	Diffusion Tube		100		**51**	**53**	**46**	**48**
50	455713	337838	Roadside	Diffusion Tube		92				**51**	**55**
51	457528	339339	Roadside	Diffusion Tube		83				**49**	37
52	454386	340087	Roadside	Diffusion Tube		83					**41**
53	454243	340057	Roadside	Diffusion Tube		100					34
54	454493	341505	Roadside	Diffusion Tube		92					**43**
55	456441	336131	Roadside	Diffusion Tube		100					31
56	457064	342128	Kerbside	Diffusion Tube		100					**52**
57	456265	336412	Roadside	Diffusion Tube		100					28

☒ **Diffusion tube data has been bias corrected**

☒ **Annualisation has been conducted where data capture is <75%**

☒ **Reported concentrations are those at the location of the monitoring site (bias adjusted and annualised, as required), i.e. prior to any fall-off with distance adjustment**

Notes:

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **bold and underlined.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) Means for diffusion tubes have been corrected for bias. All means have been "annualised" as per Boxes 7.9 and 7.10 in LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

(4) Concentrations are those at the location of monitoring and not those following any fall-off with distance adjustment.

Figure A.1 – Trends in Annual Mean NO_2 Concentrations

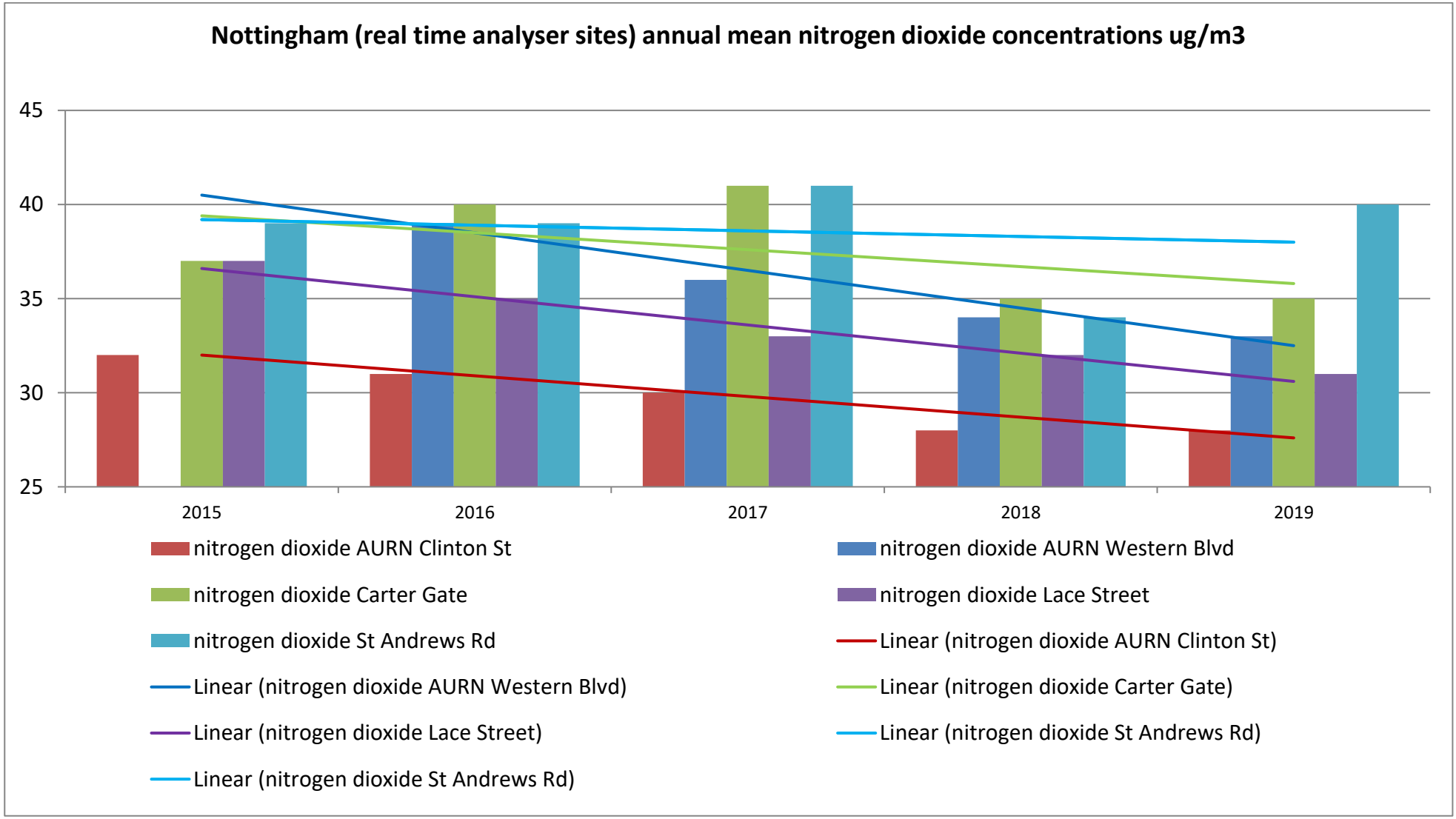


Table A.4 – 1-Hour Mean NO_2 Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 1-Hour Means > 200µg/m^3 (3)				
							2015	2016	2017	2018	2019
CG NO2	457945	339667	Roadside	Automatic	-	100	**0**	**0**	**0**	**0**	**0**
LS NO2	454940	338314	Roadside	Automatic	-	96	**0**	**0**	**0**	**0**	**0**
SA NO2	456967	341382	Roadside	Automatic	-	91	**0**	**0**	**2**	**0**	**0**
CC AURN	457437	340049	Urban Background	Automatic	-	98	**0**	**0**	**0**	**0**	**0**
WB AURN	454573	341643	Roadside	Automatic	-	100	**-**	**0**	**0**	**0**	**0**

Notes:

Exceedances of the NO_2 1-hour mean objective (200µg/m^3 not to be exceeded more than 18 times/year) are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets.

Table A.5 – Annual Mean PM_{10} Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	PM_{10} Annual Mean Concentration ($\mu g/m^3$) (3)				
						2015	2016	2017	2018	2019
CC AURN	457437	340049	Urban Background	-	97	17	17	18	16	18
WB AURN	454573	341643	Roadside	-	98	-	20	18	18	20

☒ **Annualisation has been conducted where data capture is <75%**

Notes:

Exceedances of the PM_{10} annual mean objective of 40$\mu g/m^3$ are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) All means have been "annualised" as per Boxes 7.9 and 7.10 in LAQM.TG16, valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Figure A.2 – Trends in Annual Mean PM_{10} Concentrations

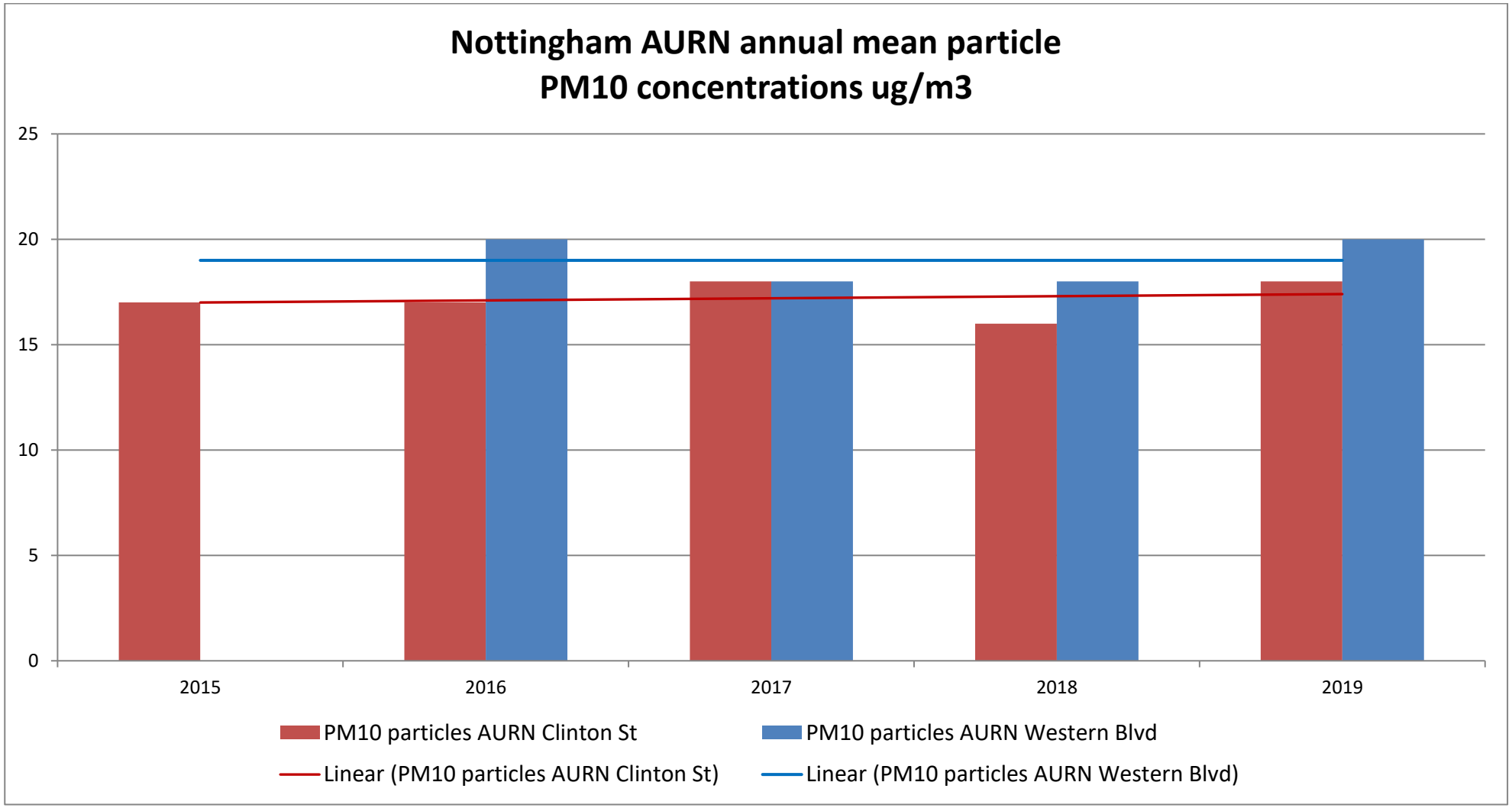


Table A.6 – 24-Hour Mean PM_{10} Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	PM_{10} 24-Hour Means > 50µg/m³ (3)				
						2015	2016	2017	2018	2019
CC AURN	457437	340049	Urban Background	-	97	6	4	5	2	9
WB AURN	454573	341643	Roadside	-	98	-	5	8	2	12

Notes:

Exceedances of the PM_{10} 24-hour mean objective (50µg/m³ not to be exceeded more than 35 times/year) are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.

Table A.7 – $PM_{2.5}$ Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	$PM_{2.5}$ Annual Mean Concentration ($\mu g/m^3$) (3)				
						2015	2016	2017	2018	2019
CC AURN	457437	340049	Urban Background	-	97	11	12	12	10	11

☒ **Annualisation has been conducted where data capture is <75%**

Notes:

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) All means have been "annualised" as per Boxes 7.9 and 7.10 in LAQM.TG16, valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Figure A.3 – Trends in Annual Mean $PM_{2.5}$ Concentrations

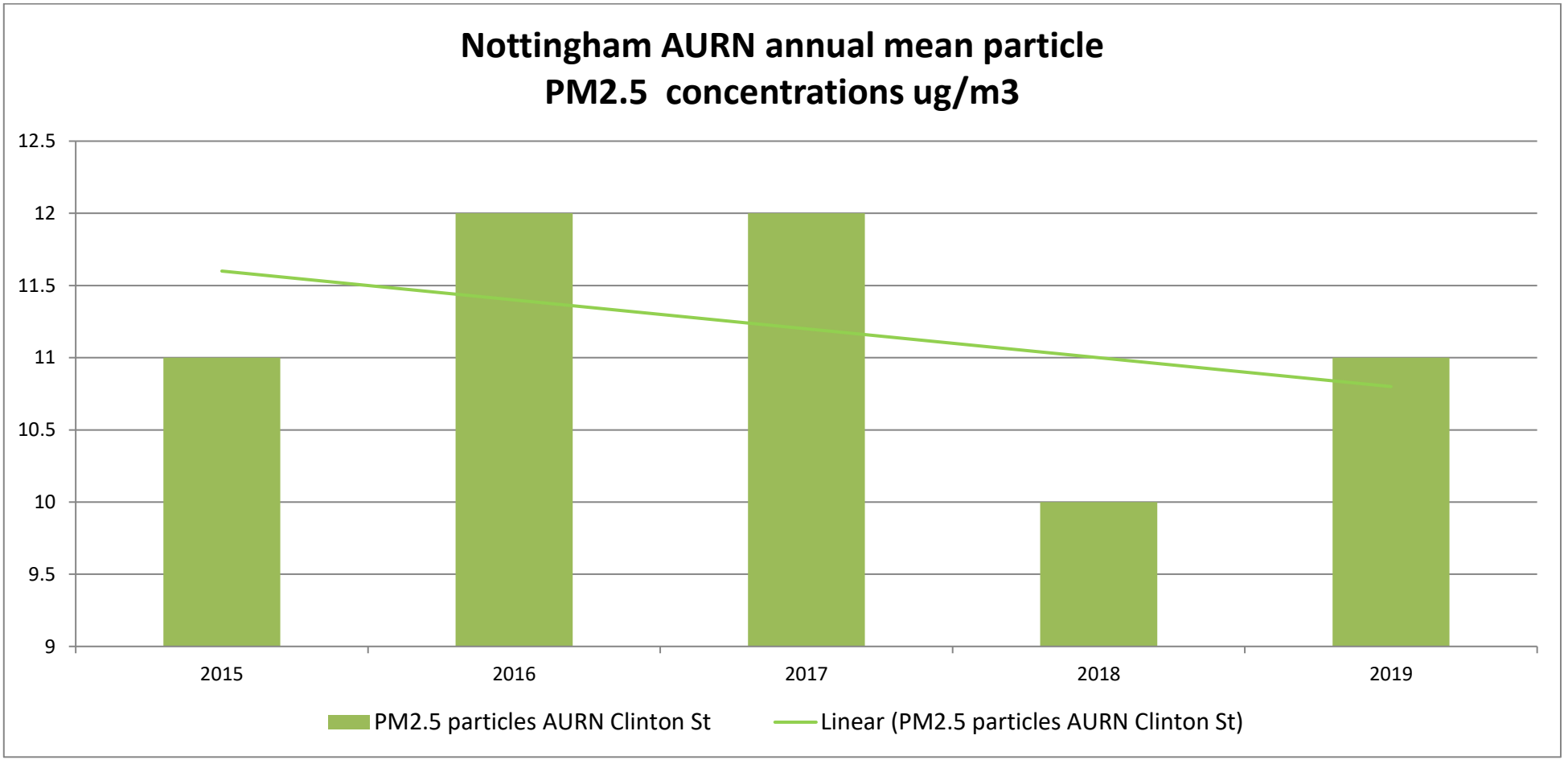


Table A.8 – SO_2 Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	Number of Exceedances 2019 (percentile in bracket) (3)		
						15-minute Objective (266 µg/m^3)	1-hour Objective (350 µg/m^3)	24-hour Objective (125 µg/m^3)
CC AURN	457437	340049	Urban Background	-	77	0	0	0

Notes:

Exceedances of the SO_2 objectives are shown in **bold** (15-min mean = 35 allowed a year, 1-hour mean = 24 allowed a year, 24-hour mean = 3 allowed a year)

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the relevant percentiles are provided in brackets.

Appendix B: Full Monthly Diffusion Tube Results for 2019

Table B.1 - NO_2 Monthly Diffusion Tube Results - 2019

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	NO_2 Mean Concentrations ($\mu g/m^3$)														
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
															Raw Data	Bias Adjusted (1.08) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
1	452795	338219	46.7	31.2	32.9	33.3	24.8	28.8	28.0	27.2	33.5	33.0	37.6	19.7	31.4	33.9	34
2	454520	338931	41.6	25.9	26.2	22.1	21.1	M	22.1	22.7	22.6	27.5	38.5	30.5	27.3	29.5	30
3	455208	338277	35.6	29.3	19.9	31.4	20.7	21.6	16.9	16.3	20.3	24.3	36.7	23.2	24.7	26.7	27
4	454784	338146	44.5	44.1	32.1	31.2	28.7	26.8	27.8	26.7	30.8	27.1	41.6	27.1	32.4	35.0	35
5	455146	338511	40.4	27.0	28.1	29.5	26.1	24.3	22.5	22.7	25.3	M	41.5	33.3	29.2	31.5	32
6	454466	340111	43.9	38.6	28.4	23.9	25.9	24.8	26.2	30.6	28.4	30.2	38.8	28.2	30.7	33.1	33
7	454829	342013	47.2	33.2	36.1	21.4	29.1	24.4	27.7	27.6	30.0	29.6	32.8	28.7	30.6	33.1	33
8	455573	342860	51.9	38.7	36.5	37.2	33.2	32.4	31.7	31.5	35.1	38.2	41.9	34.2	36.9	39.8	40
9	455606	342840	57.7	45.5	41.1	38.6	41.2	40.9	40.8	36.4	41.1	44.7	42.4	28.1	41.5	**44.9**	**45**
10	455528	342828	52.7	37.0	35.5	36.5	36.1	34.7	35.6	26.2	33.6	36.5	51.5	29.3	37.1	**40.1**	**41**
11	457248	343813	45.1	34.8	32.7	16.5	25.1	23.5	25.6	32.2	25.3	25.8	32.4	26.2	28.8	31.1	31
12	455809	340800	44.3	37.0	35.0	22.5	30.7	27.0	27.6	29.2	30.5	31.8	42.5	29.6	32.3	34.9	35
13	455439	340131	41.4	36.6	28.1	38.4	32.6	28.9	27.2	29.0	30.6	33.2	38.5	29.3	32.8	35.4	35
14	455485	340135	55.3	47.4	45.1	47.5	40.8	39.6	38.7	23.7	41.6	41.5	59.9	34.6	43.0	**46.4**	**46**

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	NO_2 Mean Concentrations (µg/m^3)														
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
															Raw Data	Bias Adjusted (1.08) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
15	455358	341086	41.9	36.9	31.0	23.7	28.7	25.8	27.6	41.0	26.8	29.4	38.3	29.5	31.7	34.2	34
16	455870	339133	48.8	50.2	40.4	24.7	30.6	M	48.5	30.6	29.5	31.2	43.9	31.9	37.3	**40.3**	**41**
17	455955	339129	46.4	43.1	37.4	23.2	31.9	32.9	31.9	32.2	30.7	34.1	38.8	45.5	35.7	38.5	39
18	455809	339178	38.8	36.2	28.8	21.3	21.8	23.2	21.8	23.9	26.3	27.8	32.3	31.6	27.8	30.0	30
19	456853	339303	43.2	36.8	31.2	33.2	27.4	25.9	21.2	20.2	26.5	28.8	40.3	34.0	30.7	33.2	33
20	456399	340191	62.3	43.4	48.7	54.6	48.1	42.7	41.4	36.5	35.1	36.3	57.2	38.5	45.4	**49.0**	**49**
21	457083	339637	52.3	37.9	43.8	41.8	43.9	29.7	M	31.2	36.4	44.9	49.9	31.1	40.3	**43.5**	**44**
22	456156	340383	52.1	38.5	29.9	46.8	38.2	40.2	29.2	24.9	31.9	37.3	50.7	29.7	37.5	**40.5**	**41**
23	457102	340946	54.4	50.2	32.6	54.5	44.7	48.2	40.1	33.9	41.3	43.5	58.6	33.1	44.6	**48.2**	**48**
24	456967	341382	52.2	44.7	43.7	20.5	31.1	26.2	30.1	31.0	39.1	31.1	37.2	40.5	35.6	38.5	39
25	456967	341382	45.5	43.8	37.8	19.8	32.0	27.6	33.0	32.8	30.2	31.1	34.6	M	33.5	36.1	36
26	456967	341382	52.0	48.7	43.6	19.4	31.9	29.9	34.2	34.8	38.3	30.6	37.3	33.1	36.1	39.0	39
27	457963	339681	48.0	46.5	45.1	31.8	32.5	32.7	34.9	40.0	36.5	36.1	44.7	40.8	39.1	**42.3**	**42**
28	458060	338276	45.0	41.6	M	27.7	30.3	30.4	29.9	23.8	32.0	30.9	43.1	30.1	33.2	35.8	36
29	458459	339011	52.8	44.2	38.7	42.9	43.8	40.2	40.1	33.3	39.3	37.2	52.8	36.6	41.8	**45.2**	**45**
30	458078	339891	48.0	45.0	42.0	42.0	38.7	34.3	34.2	35.6	36.3	37.3	40.8	36.1	39.2	**42.3**	**42**
31	454399	339886	36.2	34.4	23.9	21.6	23.7	22.8	24.9	24.2	25.3	27.6	35.5	28.0	27.3	29.5	30
32	454493	339402	41.7	35.3	33.2	20.3	22.9	23.5	21.7	21.8	28.6	30.2	38.2	26.7	28.7	31.0	31
33	454941	338314	43.7	45.5	34.0	32.3	26.2	29.0	25.7	26.8	31.6	34.6	41.4	32.9	33.6	36.3	36

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	NO_2 Mean Concentrations ($\mu g/m^3$)														
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
															Raw Data	Bias Adjusted (1.08) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
35	454587	340097	42.7	47.5	40.6	32.6	34.4	30.1	31.5	32.9	35.7	35.7	46.4	32.3	36.9	39.8	40
40	454321	339931	43.6	32.8	M	42.3	34.9	30.7	28.1	20.8	26.6	31.8	46.5	27.0	33.2	35.8	36
43	455453	339595	36.9	33.1	27.2	26.4	22.0	22.4	20.1	19.7	23.5	24.6	37.7	27.4	26.8	28.9	29
44	457775	339530	47.2	44.4	38.1	36.6	31.7	30.0	31.1	27.1	31.1	36.0	47.2	38.0	36.5	39.5	40
45	457871	339051	65.4	61.3	61.2	40.4	52.1	49.6	46.9	M	50.0	54.1	70.7	50.9	54.8	**59.2**	**59**
46	457781	339123	55.4	63.2	45.8	44.9	44.8	42.9	52.3	47.1	44.0	48.4	54.7	44.3	49.0	**52.9**	**53**
47	457398	339183	53.6	46.2	42.5	55.6	49.0	40.4	41.6	38.2	38.9	49.9	54.0	34.0	45.3	**48.9**	**49**
48	457151	338953	41.0	31.8	30.5	24.4	21.6	22.0	19.5	19.5	22.8	29.4	39.5	25.5	27.3	29.5	30
49	457150	339384	59.7	55.3	46.3	42.0	35.6	39.8	41.8	34.7	41.8	42.7	53.2	42.1	44.6	**48.1**	**48**
50	455713	337838	65.4	60.6	54.1	36.7	50.4	42.6	46.7	39.9	48.7	52.8	61.8	M	50.9	**54.9**	**55**
51	457528	339339	49.0	M	M	24.7	27.0	30.2	29.6	29.0	35.7	37.6	42.6	37.5	34.3	37.0	37
52	454386	340087	45.2	46.3	34.9	35.5	36.6	35.5	M	23.3	31.0	42.3	47.1	M	37.8	**40.8**	**41**
53	454243	340057	42.2	39.1	27.6	31.8	23.4	25.8	24.2	33.5	25.4	32.3	45.5	30.7	31.8	34.3	34
54	454493	341505	47.2	52.2	45.4	30.2	M	29.5	36.1	31.4	40.8	39.1	44.3	39.2	39.6	**42.7**	**43**
55	456441	336131	42.1	37.6	33.8	17.4	23.8	23.9	23.6	24.6	27.8	28.1	34.0	30.8	29.0	31.3	31
56	457064	342128	52.0	62.5	52.4	35.2	43.8	45.3	48.2	44.5	46.5	51.7	53.1	45.6	48.4	**52.3**	**52**
57	456265	336412	31.9	30.3	24.5	27.6	22.5	22.7	20.1	20.1	24.2	23.4	33.4	24.9	25.5	27.5	28

☒ **Local bias adjustment factor used**

☐ **National bias adjustment factor used**

☒ **Annualisation has been conducted where data capture is <75%**

☒ **Where applicable, data has been distance corrected for relevant exposure in the final column**

Notes:

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **bold and underlined.**

(1) See Appendix C for details on bias adjustment and annualisation.

(2) Distance corrected to nearest relevant public exposure.

Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC

QA/QC for Diffusion Tube Monitoring

Gradko International supply and analyse Nottingham City Council's diffusion tubes. The organisation is UKAS accredited and is assessed annually for compliance to ISO 17025 and participates in other proficiency schemes.

Gradko have confirmed that their procedures follow the guidance issued on behalf of Defra (AEA Energy & Environment, Feb 2008) relating to the preparation, extraction, analysis and calculation procedures for passive NO_2 diffusion tubes

Gradko participate in a number of QA/QC monitoring systems to demonstrate satisfactory performance including the Workplace Analysis Scheme for Proficiency (WASP) programme to ensure uniformity in data throughout the year.

Precision vs Accuracy (Bias)

A further aspect of QA/QC for a laboratory is the reproducibility of results i.e. precision. Precision should not be confused with accuracy. Diffusion tube precision can be described as the ability of a measurement to be consistently reproduced, i.e. how similar the results of duplicate or triplicate tubes are to each other.

Accuracy represents the ability of the measurement to represent the 'true' value, which for the monitoring results, is defined as the results from the automatic analysers. When averaged over a number of sets of results bias can be evident. This represents the overall tendency of the diffusion tubes to depart from the 'true' value, i.e. to systematically over-or under-read when compared against the reference method.

Once identified, bias can be adjusted for to improve the accuracy of diffusion tube results. This is done using bias adjustment factors which have been found to be specific to a laboratory and tube preparation method. See Appendix A subsection A-1 above.

Unlike bias, poor precision cannot be adjusted for. It can only be improved by careful handling of the tubes in both the laboratory and the field.

The LAQM website provides a link to the summary of precision results for individual laboratories - **Summary of Diffusion Tube Precision 2008-2019 (updated March 2020)**. It can be downloaded as a PDF from http://laqm.defra.gov.uk/diffusion-tubes/precision.html.

The 2019 precision rating for Gradko supplied/analyzed diffusion tubes was 'good'. This precision reflects the laboratory's performance/consistency in preparing and analyzing the tubes, as well as the subsequent handling of the tubes in the field.

Nottingham City Council's collocation study data contributes to the rating. The data spreadsheet also allows NCC to determine whether its collocation study's bias adjustment factor should be used in preference to the national bias adjustment factor derived from collocation studies conducted by other local authorities.

Nottingham City Council's 2019 collocation study results:-

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	08/01/2019	05/02/2019	52.2	45.5	52.0	50	3.8	8	9.5	52	99.3	Good	Good
2	05/02/2019	05/03/2019	44.7	43.8	48.7	46	2.6	6	6.5	49	100	Good	Good
3	05/03/2019	02/04/2019	43.7	37.8	43.6	42	3.4	8	8.5	43	100	Good	Good
4	02/04/2019	30/04/2019	20.5	19.8	19.4	20	0.6	3	1.4	36	56.7	Good	or Data Capture
5	30/04/2019	04/06/2019	31.1	32.0	31.9	32	0.5	2	1.2	42	40.6	Good	or Data Capture
6	04/06/2019	02/07/2019	26.2	27.6	29.9	28	1.9	7	4.6	29	99.4	Good	Good
7	02/07/2019	06/08/2019	30.1	33.0	34.2	32	2.1	6	5.2	33	100	Good	Good
8	06/08/2019	03/09/2019	31.0	32.8	34.8	33	1.9	6	4.7	32	100	Good	Good
9	03/09/2019	02/10/2019	39.1	30.2	38.3	36	4.9	14	12.3	35	100	Good	Good
10	02/10/2019	05/11/2019	31.1	31.1	30.6	31	0.3	1	0.7	37	99.9	Good	Good
11	05/11/2019	03/12/2019	37.2	34.6	37.3	36	1.5	4	3.8	39	99.9	Good	Good
12	03/12/2019	08/01/2020	40.5		33.1	37	5.2	14	47.0	50	99.7	Good	Good
13													
												Good precision	Good Overall DC

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Overall survey -->

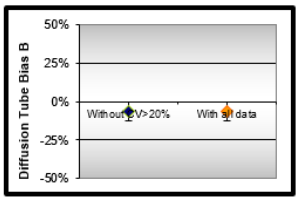
Site Name/ ID:

Precision 12 out of 12 periods have a CV smaller than 20%

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 10 periods of data	
Bias factor A	1.08 (1.01 - 1.16)
Bias B	-7% (-13% - -1%)
Diffusion Tubes Mean:	37 μgm^{-3}
Mean CV (Precision):	7
Automatic Mean:	40 μgm^{-3}
Data Capture for periods used:	100%
Adjusted Tubes Mean:	40 (37 - 43) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 10 periods of data	
Bias factor A	1.08 (1.01 - 1.16)
Bias B	-7% (-13% - -1%)
Diffusion Tubes Mean:	37 μgm^{-3}
Mean CV (Precision):	7
Automatic Mean:	40 μgm^{-3}
Data Capture for periods used:	100%
Adjusted Tubes Mean:	40 (37 - 43) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Adjustment of DUPLICATE or TRIPLICATE Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Average	Standard Deviation	CV	95% CI mean	Data Quality Check: Diffusion Tubes Precision Check
1	08/01/2019	05/02/2019	52.2	45.5	52.0	49.9	3.83	7.68	9.53	Good
2	05/02/2019	05/03/2019	44.7	43.8	48.7	45.7	2.61	5.71	6.49	Good
3	05/03/2019	02/04/2019	43.7	37.8	43.6	41.7	3.41	8.17	8.46	Good
4	02/04/2019	30/04/2019	20.5	19.8	19.4	19.9	0.57	2.89	1.43	Good
5	30/04/2019	04/06/2019	31.1	32.0	31.9	31.7	0.50	1.58	1.24	Good
6	04/06/2019	02/07/2019	26.2	27.6	29.9	27.9	1.87	6.69	4.63	Good
7	02/07/2019	06/08/2019	30.1	33.0	34.2	32.4	2.09	6.43	5.19	Good
8	06/08/2019	03/09/2019	31.0	32.8	34.8	32.9	1.91	5.80	4.74	Good
9	03/09/2019	02/10/2019	39.1	30.2	38.3	35.9	4.94	13.79	12.28	Good
10	02/10/2019	05/11/2019	31.1	31.1	30.6	30.9	0.29	0.92	0.71	Good
11	05/11/2019	03/12/2019	37.2	34.6	37.3	36.4	1.54	4.23	3.82	Good
12	03/12/2019	08/01/2020	40.5		33.1	36.8	5.23	14.22	47.01	Good
13										

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Jaume Targa, for AEA

Version 04 - February 2011

Site Name/ ID: St Andrews Road, Nottingham

Adjusted measurement (95% confidence level)
Without periods with CV larger than 20%
Bias calculated using 10 periods of data
Tube Precision: 7 Automatic DC: 100%
Bias factor A: 1.08 (1.01 - 1.16)
Bias B: -7% (-13% - -1%)

Information about tubes to be adjusted
Diffusion Tube average: 35 μgm^{-3}
Average Precision (CV): 7
Adjusted Tube average: 38 +/- 3 μgm^{-3}

Adjusted measurement (95% confidence level)
with all data
Bias calculated using 10 periods of data
Tube Precision: 7 Automatic DC: 100%
Bias factor A: 1.08 (1.01 - 1.16)
Bias B: -7% (-13% - -1%)

Information about tubes to be adjusted
Diffusion Tube average: 35 μgm^{-3}
Average Precision (CV): 7
Adjusted Tube average: 38 +/- 3 μgm^{-3}

National Diffusion Tube Bias Adjustment Factor Spreadsheet

Spreadsheet Version Number: 03/20

Follow the steps below **in the correct order** to show the results of **relevant** co-location studies
Data only apply to tubes exposed monthly and are not suitable for correcting individual short-term monitoring periods
Whenever presenting adjusted data, you should state the adjustment factor used and the version of the spreadsheet
This spreadsheet will be updated every few months: the factors may therefore be subject to change. This should not discourage their immediate use.

This spreadsheet will be updated at the end of June 2020
LAQM Helpdesk Website

The LAQM Helpdesk is operated on behalf of Defra and the Devolved Administrations by Bureau Veritas, in conjunction with contract partners AECOM and the National Physical Laboratory.

Spreadsheet maintained by the National Physical Laboratory. Original compiled by Air Quality Consultants Ltd.

Step 1: Select the Laboratory that Analyses Your Tubes from the Drop-Down List
If a laboratory is not shown, we have no data for this laboratory.

Step 2: Select a Preparation Method from the Drop-Down List
If a preparation method is not shown, we have no data for this method at this laboratory.

Step 3: Select a Year from the Drop-Down List
If a year is not shown, we have no data[2]

Step 4: Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor[3] shown in blue at the foot of the final column.
If you have your own co-location study then see footnote[4]. If uncertain what to do then contact the Local Air Quality Management Helpdesk at LAQMHelpdesk@uk.bureauveritas.com or 0800 0327953

Analysed By[1]	Method (Tube preparation, choose [All] from the pop-up list)	Year[2] (Tube preparation, choose [All])	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) ($\mu g/m^3$)	Automatic Monitor Mean Conc. (Cm)	Bias (B)	Tube Precision[4]	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	20% TEA in water	2019	R	Blackburn with darwen Borough Council	10	29	21	36.9%	G	**0.73**
Gradko	20% TEA in water	2019	R	Cheshire West and Chester	12	39	38	2.0%	G	**0.98**
Gradko	20% TEA in water	2019	R	Cheshire West and Chester	11	34	34	-2.1%	G	**1.02**
Gradko	20% TEA in water	2019	R	Gedling Borough Council	12	32	30	7.3%	G	**0.93**
Gradko	20% TEA in water	2019	R	NOTTINGHAM CITY COUNCIL	10	37	40	-7.0%	G	**1.07**
Gradko	20% TEA in water	2019	R	Bedford Borough Council	11	29	29	-1.0%	G	**1.01**
Gradko	20% TEA in water	2019	R	Bedford Borough Council	12	37	32	13.0%	G	**0.89**
Gradko	20% TEA in water	2019	R	Gateshead Council	12	30	25	18.1%	G	**0.85**
Gradko	20% TEA in water	2019	R	Gateshead Council	10	32	34	-7.2%	G	**1.08**
Gradko	20% TEA in water	2019	R	Gateshead Council	12	34	27	23.7%	P	**0.81**
Gradko	20% TEA in water	2019	R	Gateshead Council	11	40	44	-10.5%	G	**1.12**
Gradko	20% TEA in water	2019	KS	Marylebone Road Intercomparison	12	85	65	30.1%	G	**0.77**
Gradko	20% TEA in water	2019	R	Borough Council of King's Lynn and West Nc	9	27	21	28.4%	G	**0.78**
Gradko	20% TEA in water	2019	R	Lancaster City Council	13	40	34	16.4%	G	**0.86**
Gradko	20% TEA in water	2019	R	Lancaster City Council	12	31	31	1.6%	G	**0.98**
Gradko	20% TEA in Water	2019	R	Monmouthshire County Council	12	39	39	1.3%	G	**0.99**
Gradko	20% TEA in water	2019	UC	Belfast City Council	10	29	24	21.8%	G	**0.82**
Gradko	20% TEA in water	2019	R	Dudley MBC	12	33	32	4.5%	G	**0.96**
Gradko	20% TEA in water	2019	R	Dudley MBC	12	44	42	3.9%	G	**0.96**
Gradko	20% TEA in water	2019	UB	Dudley MBC	12	23	19	19.8%	G	**0.83**
Gradko	20% TEA in water	2019	UB	Eastleigh Borough Council	12	24	26	-7.1%	G	**1.08**
Gradko	20% TEA in water	2019	R	Gateshead Council	12	34	27	23.7%	P	**0.81**
Gradko	20% TEA in water	2019	R	Gateshead Council	11	40	44	-10.5%	G	**1.12**
Gradko	20% TEA in water	2019	R	Gateshead Council	10	32	34	-7.2%	G	**1.08**
Gradko	20% TEA in water	2019	R	Gateshead Council	12	30	25	18.1%	G	**0.85**
Gradko	20% TEA in water	2019	R	Thurrock Borough Council	12	29	24	21.6%	G	**0.82**
Gradko	20% TEA in water	2019	R	Brighton & Hove City Council	11	45	50	-9.3%	G	**1.10**
Gradko	20% TEA in water	2019		**Overall Factor[3] (27 studies)**				**Use**		**0.93**

QA/QC Information for Automatic Monitoring

Quality Control, Maintenance, Calibration

AURN Site

The analysers at the AURN site are subject to a four weekly calibration regime. The calibrations are undertaken by a trained local site operator (LSO) and conducted in accordance with the Local Site Operators' Manual.

CG NOx, LS NOx and SA NOx Sites

At Nottingham City Council's CG NOx, LS NOx and SA NOx sites calibrations are carried out fortnightly. The calibrations, using zero air and span gases, are undertaken by the LSOs that prior to 2016 were also the LSOs for the City Centre AURN site. Calibrations are conducted using the same principles and procedures as given in the AURN LSO Manual.

The equipment is fully serviced every six months by Matts Monitors Ltd, Stroud.

Calibration Gas Traceability

AURN Site

Please visit the DEFRA site https://uk-air.defra.gov.uk/networks/ for more information.

CG NOx, LS NOx and SA NOx Sites

Calibration gases used in the CG NOx, LS NOx and SA NOx monitoring sites are supplied by Matts Monitors Ltd. The gases are supplied with a certificate of analysis.

Data Collection and Processing

AURN Site

Please visit https://uk-air.defra.gov.uk/data/ for more information.

CG NOx, LS NOx and SA NOx Sites

During 2019 data collection, validation and ratification was carried out by Air Quality Data Management Ltd http://www.aqdm.co.uk/

Throughout 2019, data from the CG NOx, LS NOx and SA NOx sites was polled remotely directly from the analysers and collected as 15 minute averages using Envista ARM data collection software. The data has been scaled and converted into hourly (or other values) using the Envista ARM data management system.

The software allows users to remotely view, analyse, report and distribute environmental quality data. Manipulation of raw data to verified data can be conducted in a structured approach.

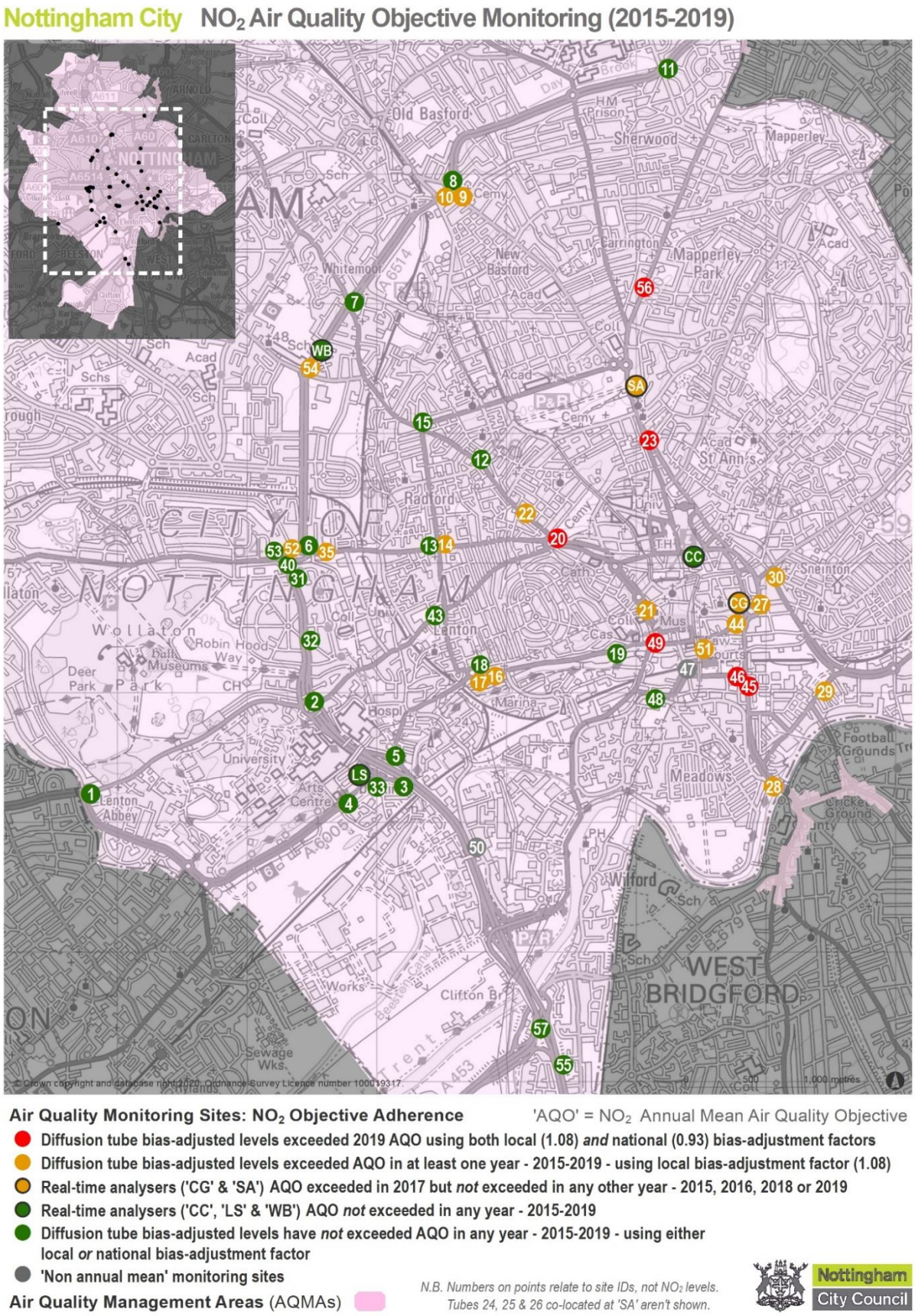
Data validation is carried out and involves screening the scaled values to identify unusual measurements, errors due to equipment failure etc. and flagging them for further investigation.

Data ratification is carried out monthly. This involves looking at the data more closely and includes:

- examination of calibration records to ensure correct application of calibration factors;
- examination of data for other pollutants and monitoring sites to highlight any anomalies;
- deletion of data shown from chart or other records to be spurious, for example, spikes generated by the analyser;
- correction of any baseline drift as indicated by examination of daily automatic calibration records.

Once this process has been carried out and data has been verified, amended or rejected as appropriate, the data is ratified. This final data set is used for the R & A process.

Appendix D: Map(s) of Monitoring Locations and AQMAs



Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England

Pollutant	Air Quality Objective[7]	
	Concentration	Measured as
Nitrogen Dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
	40 µg/m^3	Annual mean
Particulate Matter (PM_{10})	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
	40 µg/m^3	Annual mean
Sulphur Dioxide (SO_2)	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

Table E.2 – Examples of Where the Air Quality Objectives Should Apply

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24-hour mean and 8-hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties[9].	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably expected to spend one hour or longer.	Kerbside sites where the public would not be expected to have regular access.
15-min mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes	

[7] The units are in micrograms of pollutant per cubic metre of air (µg/m^3).

Appendix F

Background – Nottingham's geography and weather.

A location's air quality is affected by both local and distant emissions, from a wide range of sources, seasonal and day-to-day weather conditions, and the prevailing wind direction.

Nottingham's location in England means it does not experience daily coastal sea-breeze effects and is therefore subject to the wind direction of the air masses moving across the UK. The wind rose (Figure 9 is typical of data measured at Watnall meteorological station on the western edge of the Nottingham conurbation) shows the wind direction with the greatest frequency as the large lobe at 220^0. This 'prevailing wind' direction is roughly from the southwest. Thus, Nottingham's air quality is significantly influenced by sources ranged in an arc from the west-south-west to the south-south-west.

Fig 9: Nottingham City Council's geographic location in England and example Windrose (Watnall)

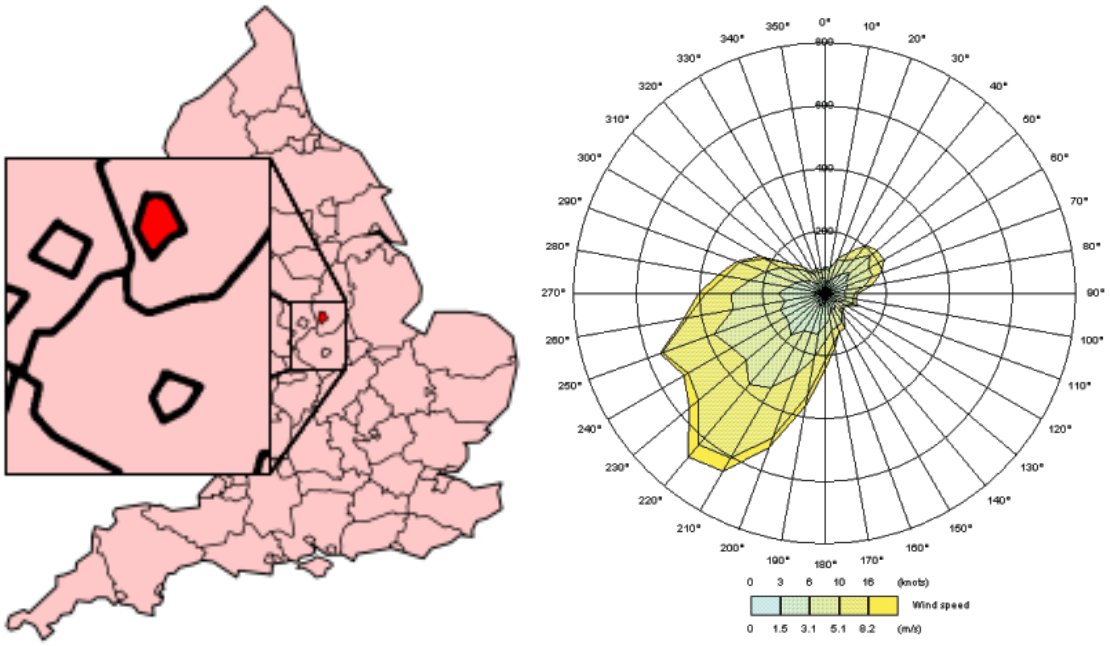
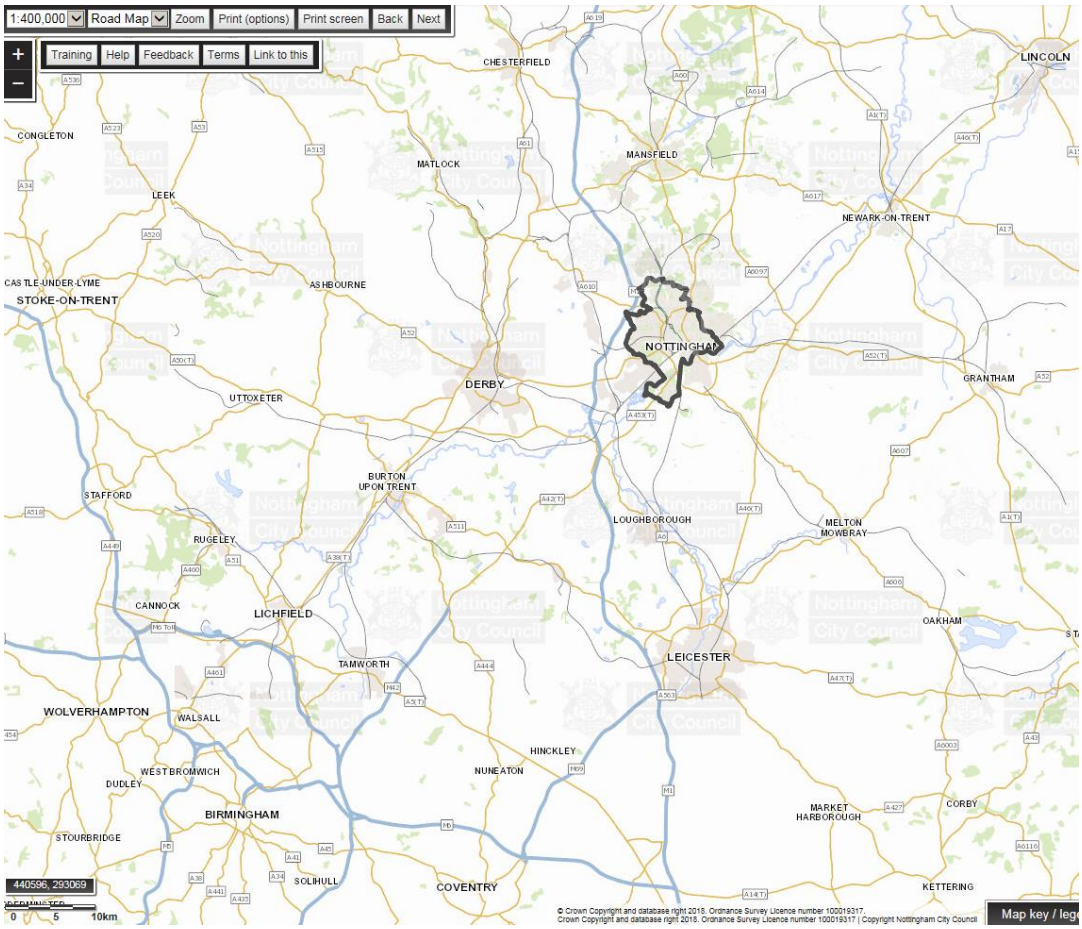


Fig 10: Nottingham City Council's geographic location (detailed)



Nottingham is surrounded by agricultural land, the M1 motorway bounds Nottingham to the west, and the very large urban industrial conurbation of the West Midlands is approximately 40 miles to its southwest (Fig. 10). Emissions from agricultural activity outside the conurbation as well as those from closer and more distant domestic, commercial, industrial and transport sources outside Nottingham contribute to the levels of NO2 and particles measured in Nottingham.

When carrying out air quality modelling it is necessary to quantify and include the contribution these distant and local sources make to modelled concentrations.

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
ASR	Air quality Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
EU	European Union
FDMS	Filter Dynamics Measurement System
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
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide
…	…

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