Cheltenham Borough Council

Annual Status Report 2023

Bureau Veritas

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Document Control Sheet

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CHELTENHAM
BOROUGH COUNCIL

2023 Air Quality Annual Status Report (ASR)

In fulfilment of Part IV of the Environment Act 1995 Local Air Quality Management, as amended by the Environment Act 2021

Date: May 2023

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Executive Summary: Air Quality in Our Area

Air Quality in Cheltenham Borough Council

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, the elderly, and those with existing heart and lung conditions. There is also often a strong correlation with equalities issues because areas with poor air quality are also often less affluent areas[1,2].

The mortality burden of air pollution within the UK is equivalent to 29,000 to 43,000 deaths at typical ages[3], with a total estimated healthcare cost to the NHS and social care of £157 million in 2017[4].

The main source of air pollution in the district of Cheltenham is road traffic emissions from major roads, particularly the A4013 – Princess Elizabeth Way, A40 - Gloucester Road, A4019 Tewkesbury Road/Swindon Road, A435 – London Road, A46 High Street and A46 Bath Road. These roads, amongst others, form the main arterial highway network within Cheltenham and experience high volumes of road traffic. As a result, these roads tend to become congested, mainly through Cheltenham Town Centre, resulting in increased pollution concentrations.

In response to these increased concentrations, Cheltenham Borough Council has one Air Quality Management Area (AQMA) that was declared in September 2020. This AQMA was declared (following the revocation of the borough-wide AQMA) for exceedances of the NO_2 annual mean AQS objective of 40 µg/m^3, and can be viewed on the UK-Air website.

Details of the AQMA are provided in Table 2.1 and a map of the boundary is presented in Appendix D: Maps of Monitoring Locations and AQMAs.

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

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

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

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

During 2022, concentrations of Nitrogen Dioxide (NO_2) were monitored at 46 diffusion tube sites. One of these was a triplicate site co-located with the automatic analyser (located on St Georges Street), which also measured NO_2.

In 2022, the maximum NO_2 annual mean concentration within the AQMA was 36.0 µg/m^3 (Site ID: 5). Outside the AQMA boundary, the highest recorded annual concentrations were 30.5 µg/m^3 (Site ID: 12), 30.2 µg/m^3 (Site ID: 16) and 30.8 µg/m^3 (Site ID: 27). Although the maximum concentration was higher in the AQMA, it is evident that the NO_2 annual mean AQS objective was not exceeded within the AQMA in 2022. This is a trend that has been observed over the past two years, with the NO_2 annual mean limit last being breached within the AQMA in 2019, when a concentration of 40.3 µg/m^3 was recorded (Site ID: 7). Outside of the AQMA, the annual mean limit of 40 µg/m^3 has not been exceeded in the last five years, suggesting that there is no need to amend the current AQMA boundary.

During 2022, the annual mean NO_2 concentration was not greater than 60 µg/m^3 at any diffusion tube site and, therefore, an exceedance of the 1-hour mean objective at any location with the borough is considered unlikely. The automatic monitoring station did not record any hourly concentrations above 200 µg/m^3 during 2022.

Actions to Improve Air Quality

Whilst air quality has improved significantly in recent decades, there are some areas where local action is needed to protect people and the environment from the effects of air pollution.

The Environmental Improvement Plan[5] sets out actions that will drive continued improvements to air quality and to meet the new national interim and long-term $PM_{2.5}$ targets. The National Air Quality Strategy, due to be published in 2023, will provide more information on local authorities' responsibilities to work towards these new targets and reduce $PM_{2.5}$ in their areas. The Road to Zero[6] details the approach to reduce exhaust emissions from road transport through a number of mechanisms; this is extremely

[5] Defra. Environmental Improvement Plan 2023, January 2023

[6] DfT. The Road to Zero: Next steps towards cleaner road transport and delivering our Industrial Strategy, July 2018

important given that the majority of Air Quality Management Areas (AQMAs) are designated due to elevated concentrations heavily influenced by transport emissions.

Cheltenham Borough Council's Air Quality Action Plan (AQAP) is under preparation but has not yet been published. The intention of the AQAP is to focus on a number of key actions that are being taken to tackle sources of air pollution. As road traffic is the main source of air pollution, especially within the AQMA, the actions within the AQAP primarily target transport emissions. These actions can be categorised into five key priorities:

Priority 1 – Transport: Focusing on areas that Cheltenham Borough Council have direct control over (e.g. planning and procurement of outsourced functions) and areas where measures can be implemented via partnerships with Gloucestershire County Council and others.

Priority 2 – Planning and Infrastructure: Cheltenham Borough Council will work with both developers and partner organisations to ensure that infrastructure, services and community facilities are delivered in a sustainable manner, with the least potential negative impact on air quality.

Priority 3 – Policy Guidance: Existing strategies/policies adopted by Cheltenham Borough Council and Gloucestershire County Councils are key mechanisms to reducing emissions across the borough. To effectively reduce NO_2 concentration, especially within the AQMA, the existing Transport Plans, Freight Strategies, Climate Change Strategies and Cycle Strategies should be revised, taking into account the impact on air quality.

Priority 4 – Public Health and Wellbeing Behavioural Change: The most effective way to achieve a reduction in vehicle numbers is to change the attitudes and behaviour of people towards travel. This ranges from education/raising awareness to schemes which incentivise change.

Priority 5 – Air Quality Monitoring: Cheltenham Borough Council currently monitoring air quality passively via a diffusion tube network and automatically via a continuous analyser. Recently, Cheltenham Borough Council have also introduced nine AQ Mesh Pods to help measure air quality and identify any areas of likely exceedance. This monitoring also assists with determining the success of the measures outlined in the AQAP.

These actions are primarily directed towards reducing vehicle emissions. In a source apportionment exercise carried out in 2022 during the preparation of the draft AQAP, vehicles were responsible for 70.4% of the total NO_x concentrations within the AQMA. The majority of this was accounted for by cars (39.4%) and LGVs (20.1%).

Conclusions and Priorities

During 2022, no exceedances of the NO_2 annual mean objective were recorded within or outside of the AQMA boundary. As this is the same as in the previous reporting year, the NO_2 annual mean objective has not been exceeded at any site within Cheltenham Borough Council during both 2021 and 2022. This is likely in part due to changes in travel behaviour as a result of the COVID-19 pandemic. Overall, across the entire diffusion tube network (to which five new sites were added in 2022), the maximum NO_2 annual mean concentration in 2022 was recorded within the AQMA at Site ID: 5 (36.0 µg/m^3). Notably, this value is within 10% of the Air Quality Objective (AQO) for NO_2; predicted concentrations need to be below 10% of the AQO before revocation of the AQMA can be considered in line with LAQM.TG22. The site where this maximum concentration was recorded (Site ID: 5) has also recorded the maximum NO_2 annual mean concentration for the last five years. For the 46 diffusion tube sites that were part of the network in 2022, the annual mean concentration increased at 29 sites in 2022, meaning that compared to 2021, the concentration of NO_2 was higher at 63% of sites in 2022.

As highlighted above, Cheltenham Borough Council are in the process of updating the 2014 AQAP which highlights the priorities for the coming years. These measures primarily relate to reducing vehicle emissions as road transport is the predominant contributor to air pollution within the borough, especially within the AQMA.

Local Engagement and How to get Involved

Cheltenham Borough Council's website provides an opportunity to engage with the public on air quality issues. The website includes information on multiple aspects of air quality, such as current air quality monitoring, declared AQMAs, previous annual status reports, smoke control areas, and open fires/wood burning stoves.

Information on sustainable transport is provided to the public via the Think Travel website, which outlines options available across the county of Gloucestershire. These range from local walking maps, cycle routes, public transport journey planners, park and ride facilities, eco driving, car sharing, to information on electrical vehicles.

Local Responsibilities and Commitment

This ASR was prepared by Bureau Veritas on behalf of Cheltenham Borough Council with the support and agreement of the following officers and departments:

Gareth Jones, Senior Environmental Health Officer

This ASR has not been signed off by a Director of Public Health.

If you have any comments on this ASR please send them to Environmental Protection at:

Municipal Offices, Promenade, Cheltenham, GL50 9SA

envhealth@cheltenham.gov.uk

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1 Local Air Quality Management

This report provides an overview of air quality in Cheltenham Borough Council during 2022. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995), as amended by the Environment Act (2021), 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 order to achieve and maintain the objectives and the dates by which each measure will be carried out. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by Cheltenham Borough Council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England are presented in Table E.1.

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 should prepare an Air Quality Action Plan (AQAP) within 18 months. The AQAP should specify how air quality targets will be achieved and maintained, and provide dates by which measures will be carried out.

A summary of AQMAs declared by Cheltenham Borough Council can be found in Table 2.1. The table presents a description of the single AQMA that is currently designated within Cheltenham Borough Council. Appendix D: Maps of Monitoring Locations and AQMAs provides maps of the AQMA (replacing the now revoked borough-wide AQMA) and also the air quality monitoring locations in relation to the AQMA. The current AQMA has been declared in response to localised exceedances of the annual mean objective for NO_2, north of the town centre.

Table 2.1 – Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	One Line Description	Is air quality in the AQMA influenced by roads controlled by Highways England?	Level of Exceedance: Declaration	Level of Exceedance: Current Year	Number of Years Compliant with Air Quality Objective	Name and Date of AQAP Publication	Web Link to AQAP
Cheltenham Borough Council AQMA 2020	15/09/2020	NO_2 Annual Mean	Includes properties with a façade fronting onto: High Street from junction of Gloucester Road and Tewkesbury Road to junction of Burton Street; Poole Way; and Swindon Road from junction of Poole Way to St Georges Street	No	46.5 µg/m^3	36.0 µg/m^3	2 years	Cheltenham Air Quality Action Plan, September 2022 (Under Revision)	Under Revision

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

☒ **Cheltenham Borough Council confirm that all current AQAPs have been submitted to Defra.**

Notes: The 2014 AQAP is currently being revised but was not published at the time of writing this report. Once available, the updated 2022 AQAP will be accessible on the AQAP available downloads section of Cheltenham Borough Council's website

2.2 Progress and Impact of Measures to address Air Quality in Cheltenham Borough Council

Defra's appraisal of last year's ASR concluded that:

1. *The Council have provided clear maps of the diffusion tube monitoring network and boundary of the AQMA; trends are displayed and discussed in the report, this is welcomed.*
2. *In section 3 'Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance' under 3.1.2, the text states that '20 months of data' was lost, which is incorrect. The text in the ASR should be checked to ensure accuracy.*
3. *Some of the formatting in the document needs to be amended. Pages 14 – 17 state the figure titles without the figures beneath them. This is then repeated below in the ASR with the figures included.*
4. *Robust and accurate QA/QC procedures were applied and there is clear reasoning and evidence for the calculation of a local bias adjustment factor.*
5. *Overall, this report is well detailed and concise. It is clear that Cheltenham Borough Council is committed to maintaining good air quality, with an AQAP published in 2022. Further comments on the progress of this should be included in the 2023 ASR.*

Based on Defra's appraisal of last year's ASR, the Cheltenham Borough Council will continue to provide detailed ASRs in accordance with the relevant Policy and Technical Guidance documents, ensuring the above comments are addressed.

Cheltenham Borough Council has taken forward a number of direct measures during the current reporting year of 2022 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2. 17 measures are included within Table 2.2, with the type of measure and the progress Cheltenham Borough Council have made during the reporting year of 2022 presented. Where there have been, or continue to be, barriers restricting the implementation of the measure, these are also presented within Table 2.2.

More detail on these measures can be found in their respective Action Plans (see Cheltenham Borough Council 2014 AQAP). Although not available at the time of writing this report, an updated version of the AQAP will be uploaded to the AQAP available downloads section of Cheltenham Borough Council's website once published and is expected to be adopted in May 2023.

Key completed measures are:

- *Highways Improvements:* A range of highways amendments have taken place, such as the 2-way junction priority changes at Albion Street and Imperial Square, which allows traffic easier access to town centre car parks. Upgrades have also taken place to the traffic signals on St Margaret's Road/A4019 area. These are now running on the new scoot system which is helping to keep traffic moving in the area.
- *Low Emission Bus Fleet:* The current fleet of stagecoach buses now have a black box system, which promotes fuel-efficient driving and anti-idling.
- *Workplace Travel Plans:* A scoping exercise was carried out in 2021 with LiftShare to explore different opportunities for staff to use more sustainable modes of travel for their commute – a Cycle2Work scheme was introduced in 2021.

The following measures outline Cheltenham Borough Council's priorities for the coming years. These measures are predominantly derived from the updated AQAP, which is to be published during 2023, and include the following:

- *Promoting Low Emission Transport:* Working with companies such as Royal Mail to encourage the uptake of low emission vehicles. This is significant as the main access road to the Royal Mail depot (Swindon Road) passes through the AQMA. The uptake of low emission vehicles is also to be encouraged by offering discounts for parking permits to residents who have an electrical vehicle (EV) within/around the AQMA. Cheltenham Borough Council therefore intend to install more EV charging points.
- *Increasing Public Awareness:* Raise the awareness of the importance of air quality mitigation by working with Gloucestershire County Council's 'behavioural experts' and marketing teams. Cheltenham Borough Council also plan to work with local NHS trusts to raise awareness amongst the most vulnerable groups (i.e. children/elderly).
- *Develop Understanding of Vehicle Movements:* Cheltenham Borough Council are to commission a study to understand the reasoning for vehicle trips through the AQMA.

These measures listed in the updated AQAP can be categorised under 5 priorities:

Priority 1 – Transport: Focusing on areas that Cheltenham Borough Council have direct control over (e.g. planning and procurement of outsourced functions) and areas where measures can be implemented via partnerships with Gloucestershire County Council and others.

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In November 2022 the Council installed a new monitoring station on Gloucester Road to monitor PM_{10} and $PM_{2.5}$. It is expected that a full dataset for the site will be available in the 2024 ASR for CBC.

Progress on the following measures has been slower than expected due to the AQAP still being in development, however, it is due to be adopted in 2023.

Table 2.2 – Progress on Measures to Improve Air Quality

Measure No.	Measure	Category	Classification	Year Measure Introduced in AQAP	Estimated / Actual Completion Date	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
1	Highways Improvements	Transport Planning and Infrastructure	Other	2016-18	2018	Gloucestershire County Council / Local Sustainable Transport Fund	GCC	TBC by GCC	TBC by GCC	TBC by GCC	Completed	1 – 2%	Reduction in through traffic and improved access to car parks.	Phase 3 completed Autumn 2017. 2-way junction priority changes at Albion Street and Imperial Square allowing traffic easier access to town centre car parks.	-
2	Low Emission Bus Fleet	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	2014-16	Ongoing	Cheltenham Borough Council	Bus Operators	No	TBC by GCC	TBC by GCC	TBC by GCC	0.00005	Bus fleet data.	All Stagecoach vehicles are powered by Euro V and increasingly Euro V1 engines. The current fleet of Stagecoach buses now have a black box system which monitors driving behaviour and promotes more fuel efficient driving and anti-idling.	The main bus fleet company in Cheltenham and Gloucester has the most modern fleet in any area of the UK. Many buses are now Euro 6 compliant.
3	Promotion of Park & Ride	Alternatives to Private Vehicle Use	Bus Based Park & Ride	2014-16	2018	Gloucestershire County Council	GCC	TBC by GCC	TBC by GCC	TBC by GCC	TBC by GCC	0.1 – 1%	Reduced car travel into and out of Cheltenham.	Arle Court Park & Ride has been redesigned, and is currently undergoing a major expansion project to meet increased demand.	-
4	Promotion of Greener Vehicles	Promoting Low Emission Transport	Promoting Alternative Refuelling Infrastructure to Promote Low Emission Vehicles	2013-15	Ongoing	Gloucestershire County Council	GCC	TBC by GCC	TBC by GCC	TBC by GCC	TBC by GCC	<0.5%	Charge point usage data.	Roll-out of further electric charging points to continue in liaison with Climate Change team.	The Borough and County Councils continue to encourage EV usage through the installation of charging points in car parks or on-street. Cheltenham and Gloucestershire County Councils will also investigate the potential for differential parking charges for electric and hybrid vehicles in both car parks and on-street. The Borough currently provide free EV charging at its car park charging points.
5	Twenty is Plenty	Promoting Low Emission Transport	Other	2015-17	Ongoing	Cheltenham Borough Council	CBC	No	Not Funded	£100k - £500k	Planning	<0.5%	Traffic count / speed data.	The Cabinet working group are awaiting better guidance on the benefits and implementation.	Assessed in the "Connecting Cheltenham" report (2020). The report was also issued to GCC to help inform their LTP as: "Introduce speed limits in accordance with their current national guidelines and prioritise them based on available evidence – including 20mph zones".
6	Increased Car Sharing	Alternatives to Private Vehicle Use	Car & Lift Sharing Schemes	2015	2016	Gloucestershire County Council	GCC	TBC by GCC	TBC by GCC	TBC by GCC	TBC by GCC	0.00001	Traffic data count.	Parish Lift, Carshare Gloucestershire, available via Gloucestershire County Council.	'Parish Lift' a new community car sharing scheme was developed in 2016 to help support social inclusivity and rural accessibility across

Measure No.	Measure	Category	Classification	Year Measure Introduced in AQAP	Estimated / Actual Completion Date	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
															the Cotswolds Area of Outstanding Natural Beauty (AONB). The scheme compliments the current Carshare Gloucestershire initiative and is being funded by Communities Connected, a Community Interest Company (CIC). Parish Lift is an online platform designed to help match registered users, whether they be drivers of people seeking a 'lift'.
7	Air Quality Information	Public Information	Via the Internet	2015-16	Ongoing	Cheltenham Borough Council	CBC	No	Not Funded	£10k - £50k	Planning	<0.1%	Hit counter on webpage.	Gloucestershire County Council have created a county-wide interactive air quality monitoring data webpage, to be optionally hosted on each Council website.	Currently going through approval, expected to be live in Autumn 2022.
8	Business Travel Grants	Promoting Low Emission Transport	Other	2014-15	2018	Gloucestershire County Council	GCC	TBC by GCC	TBC by GCC	TBC by GCC	Completed	<0.1%	Uptake of grants.	Grants no longer available under this scheme.	In 2016/17, 132 businesses (representing 2,205 staff) were contacted in the Cheltenham parking zone areas to raise awareness of parking enforcement and encourage a shift towards more sustainable modes of travel. 13 businesses (representing 14,865 staff) were engaged in a more intensive site assessment and awareness raising events promoting Thinktravel and sustainable modes.
9	Wayfinding Initiative	Promoting Travel Alternatives	Promotion of Cycling & Walking	2014-15	2017	Gloucestershire County Council	GCC	TBC by GCC	TBC by GCC	TBC by GCC	Completed	<0.1%	-	No further work since completion of this project.	Signage installed.
10	Promotion of Workplace Travel Plans	Promoting Travel Alternatives	Workplace Travel Planning	2015	Unknown	Cheltenham Borough Council	CBC	No	Funded	£10k - £50k	Planning	<0.1%	Whether or not a plan is implemented.	CBC carried out a scoping exercise in 2021 with LiftShare to explore opportunities for staff to use more sustainable modes of travel for their commute. The Cycle2Work scheme was introduced in 2021. A staff travel survey will be conducted in September 2022 to get baseline data.	These will be used to encourage businesses in Cheltenham to develop and implement similar plans.
11	Air Quality Planning Policy	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	2015	Unknown	Cheltenham Borough Council	CBC	No	Funded	<£10k	Completed	Unknown but potentially significant	Air Quality Planning Policy adopted.	Air quality is still a material consideration with planning and air quality impacts of all significant developments will be properly assessed and mitigation actions taken where necessary.	Although no specific policy on air quality is adopted as part of the Cheltenham Local Plan (2017-18), air quality is still a material consideration with planning.

Measure No.	Measure	Category	Classification	Year Measure Introduced in AQAP	Estimated / Actual Completion Date	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
12	Traffic Light Appraisal	Traffic Management	Strategic Highway Improvements, Re-prioritising Road Space away from Cars, including Access Management, Selective Vehicle Priority, Bus Priority, and High Vehicle Occupancy Lanes	2015-17	Ongoing	Gloucestershire County Council	GCC	TBC by GCC	TBC by GCC	TBC by GCC	TBC by GCC	Potentially significant in current areas of poor air quality.	Number of traffic lights removed and traffic count/ speed data.	Upgrades of some of the traffic signals have taken place on St Margaret's Road/ A4019 area. These are now running on the new scoot system which is helping to keep traffic moving in the area. GCC are also looking at air quality sensors in the locations, but there has been contractor delays on this.	MOVA is an intelligent traffic signal system, which over time can optimise traffic signals reducing queues and congestion. These are currently being installed following routine upgrades to signal systems in Cheltenham.
13	Bus and Taxi Quality Partnership	Promoting Low Emission Transport	Public Vehicle Procurement – Prioritising Uptake of Low Emission Vehicles.	2016	Ongoing	Gloucestershire County Council	GCC	TBC by GCC	TBC by GCC	TBC by GCC	TBC by GCC	Unknown	Anecdotal.	Gradual uptake as there has been recent requirement for taxis to be updated for accessibility, rather than air quality issues.	No specific partnership but buses and taxis are not allowed to idle at bus stops and taxi ranks in town.
14	Green Planting	Traffic Management	Other	2014-16	Ongoing	Cheltenham Borough Council	CBC	No	Partially Funded	£50k - £100k	Implementation	<0.1%	Number of urban planning applications with green planting schemes adopted.	In 2021, works completed in High Street. Further work required due to planting not thriving.	CBC are delivering the Habitat Cheltenham biodiversity projects.
15	Vehicle Management Signage	Traffic Management	Other	2014-18	Unknown	Cheltenham Borough Council	CBC	No	Not Funded	£50k - £100k	Aborted	<0.1%	Traffic count data.	Bids for funding have been aimed at other projects, so this has not been pursued.	-
16	Cycle Safety Improvements	Transport Planning and Infrastructure	Cycle Network	2014-16	Ongoing	Cheltenham Borough Council	CBC	No	Funded	£50k - £100k	Completed	<0.1%	Number of cyclists / accident & injury statistics.	Barriers to Cycling project completed Autumn 2017 with installation of contraflow cycle lane on Sandford Mill Road.	-
17	Installation of AQ Mesh Pods	Monitoring	Other	2020	Ongoing	Cheltenham Borough Council	CBC	No	Funded	£10k - £50k	Completed	-	Monitoring of PM2.5 and NOx at 9 sites within the borough, which will lead to a greater understanding of the distribution of pollutants, allowing more effective and targeted measures.	Results up to end of 2021 available on CBC website. An "upgrade" in winter 21-22 resulted in a software error that has compromised result accuracy.	Corrected results should be published shortly.

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

As detailed in Policy Guidance LAQM.PG22 (Chapter 8), local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5µm or less). There is clear evidence that $PM_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

During 2022, Cheltenham Borough Council continue to deploy the nine AQ Mesh Pods that were installed in August 2020 to monitor real-time localised NO_x, PM_{10} and $PM_{2.5}$. However, due to issues with reliability/accuracy, the results are not yet available. The data is to be published on Cheltenham Borough Council's website once available. The monitored results for 2023 are expected to be included in next year's Annual Status Report to provide indicative localised levels of these pollutants.

In November 2022 the Council also installed a new monitoring station on Gloucester Road to monitor PM_{10} and $PM_{2.5}$. It is expected that a full dataset for the site will be available in the next year's ASR.

The current Defra 2022 background maps for Cheltenham Borough Council (2018 based)[7] show that all background concentrations of $PM_{2.5}$ are far below the annual mean AQS objective of 25 µg/m^3. The highest concentration is predicted to be 9.7 µg/m^3 within the grid square (1 x 1 km) with the centroid grid reference of 395500, 222500. This grid square encompasses the north-east of Cheltenham city centre including part of the A46, which is a key arterial route, where the PM secondary fraction (formed from gaseous pollutants) constitutes as the key contributor to $PM_{2.5}$.

Smoke control zones are a defined geographical region within which smoke cannot be legally emitted from a chimney, unless using authorised fuels or using exempt appliances. There are currently a number of designated smoke control zones within the Borough. These areas will be replaced by a borough-wide smoke control zone once the updated AQAP is adopted.

[7] Defra Background Mapping (2018 Based). Available at: https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

The Public Health Outcomes Framework data tool compiled by Public Heath England quantifies the mortality burden of $PM_{2.5}$ within England on a county and local authority scale. The 2021 fraction of mortality attributable to $PM_{2.5}$ pollution within Cheltenham is 5.5%. This remains lower than average for England as a whole and the South West region, which are 5.5% and 5.1% respectively.

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

This section sets out the monitoring undertaken within 2022 by Cheltenham Borough Council and how it compares with the relevant air quality objectives. In addition, monitoring results are presented for a five-year period between 2018 and 2022 to allow monitoring trends to be identified and discussed.

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

Cheltenham Borough Council undertook automatic (continuous) monitoring at one site during 2022. Table A.1 in Appendix A shows the details of the automatic monitoring sites. This automatic monitor is co-located with three diffusion tubes, allowing a local bias adjustment factor to be derived through a triplicate co-location study. A map showing the location of the monitoring site 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.

In November 2022 the Council installed a new monitoring station on Gloucester Road to monitor PM_{10} and $PM_{2.5}$. It is expected that a full dataset for the site will be available in the 2024 ASR for CBC.

3.1.2 Non-Automatic Monitoring Sites

Cheltenham Borough Council undertook non-automatic (i.e. passive) monitoring of NO_2 at 44 in 2022, including one triplicate site, resulting in a total of 46 diffusion sites being deployed each month. An additional five sites were added to the diffusion tube network in 2022, which include the following:

- 29 Cambray Place (Site ID: 24)
- Fiddlers Green/Kempton Grove (Site ID: 30)
- 51 Upper Norwood Street (Site ID: 37)
- 54 Linden Avenue (Site ID: 41)
- 16 Seneca Way (Site ID: 44)

Notably, Fiddlers Green/Kempton Grove was added to the network to monitor concentrations in the immediate vicinity of a new large scale development, which is due to be constructed to the west of Cheltenham in 2024. The remaining sites were added to improve urban and suburban background monitoring. Table A.2 in Appendix A presents the details of the non-automatic sites.

Maps showing the location of the monitoring sites are provided in Appendix D, with an interactive monitoring map also available of Cheltenham Borough Council's website. 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.

During 2022, the diffusion tube network was well maintained, with the average data capture being approximately 97%. Across all 44 sites, there was only a total of 13 months data lost, with no site losing more than three months of data.

3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias, annualisation (where the annual mean data capture is below 75% and greater than 25%), and distance correction. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen Dioxide (NO_2)

Table A.3 and Table A.4 in Appendix A compare the ratified and adjusted monitored NO_2 annual mean concentrations for the past five years with the air quality objective of 40µg/m^3. Note that the concentration data presented 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).

In comparison to the 39 sites that made up the diffusion tube network in 2021, the NO_2 annual mean concentration increased at 29 sites. Therefore, the concentration was higher in 2022 than in 2021 at 74% of site. This is the same as the previous reporting year. During 2022, the maximum NO_2 annual mean concentration was recorded as 36.0 µg/m^3 (Site ID: 5). This site is within the current AQMA designation and is an increase from the maximum NO_2 concentration recorded at the site in 2021 (34.5 µg/m^3).

Across the four diffusion tube sites that are located inside the AQMA, the average NO_2 annual mean concentration in 2022 was 31.3 µg/m^3. The NO_2 annual mean AQS objective of 40 µg/m^3 has not been exceeded at any diffusion tube site within the AQMA boundary over the last two years, although concentrations have been within 10% of the AQO in 2022 (Site ID: 5). Across the 36 diffusion tube sites that are located outside of the AQMA, the average NO_2 annual mean concentration in 2022 was 22.3 µg/m^3; a decrease from 23.0 µg/m^3 in 2021. In 2022, the maximum concentration outside the AQMA was 30.8 µg/m^3 (Site ID: 27). Over the last five years, the AQS annual mean objective for NO_2 has not been exceeded at any site outside of the AQMA, therefore there is no need to amend the current AQMA boundary.

For diffusion tubes, the full 2022 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.

The automatic monitoring site located on Swindon Road (CM1) recorded an annual mean concentration of 27.0 µg/m^3. As the data capture at this automatic monitoring site was 97.2%, the results are highly reflective of the NO_2 concentration during 2022.

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

In 2022, the NO_2 hourly mean objective of 200 µg/m^3 was not exceeded on any occasion, with the maximum hourly concentration recorded at the automatic monitoring site (CM1) being 134 µg/m^3. Furthermore, as no single diffusion tube site recorded an annual mean concentration above 60 µg/m^3, it can be suggested that the 1-hour mean objective was not likely to be breached at any other site.

The data presented within the following sections has been bias adjusted using the local bias adjustment factor calculated at the automatic monitoring site (CM1), where three diffusion tubes (Site ID: 8/9/10) are co-located. In terms of data capture, all diffusion tube sites had sufficient data capture to not require annualisation in 2022.

Appendix A: Monitoring Results

Table A.1 – Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
CM1	Swindon Road	Kerbside	394760	222878	NO_2	YES; Cheltenham Borough Council Air Quality Management Area 2020	Chemiluminescent	0	2.4	1.3

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

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
1	Ladies College	Roadside	394621	222215	NO_2	No	0.0	5.7	No	2.9
2	Gloucester Rd School	Kerbside	393906	222873	NO_2	No	12.5	0.3	No	2.9
3	Gloucester Rd / Stoneville St	Roadside	394180	222982	NO_2	No	1.6	1.9	No	2.9
4	2 Gloucester Road	Kerbside	394235	223055	NO_2	Yes	2.0	0.5	No	2.9
5	422 High St	Roadside	394350	222923	NO_2	Yes	0.0	1.8	No	2.9
6	48 Swindon Road	Roadside	394635	222928	NO_2	Yes	2.0	2.2	No	3.3
7	New Rutland Court	Roadside	394738	222888	NO_2	Yes	0.0	1.9	No	2.9
8, 9, 10	Co-location - 3	Roadside	394760	222878	NO_2	No	1.0	2.4	Yes	1.3
11	50 St Georges Street	Kerbside	394708	222763	NO_2	No	2.3	0.4	No	3.0
12	2 Swindon Road	Roadside	394830	222845	NO_2	No	1.0	2.1	No	2.9
13	22 St Pauls Road	Kerbside	394902	223004	NO_2	No	1.5	1.1	No	2.9
14	Elvis Villas	Roadside	394980	222735	NO_2	No	0.0	2.2	No	2.9
15	Portland Street	Kerbside	395110	222670	NO_2	No	1.0	1.6	No	3.1
16	Winchcombe St./Fairview 2022	Roadside	395210	222618	NO_2	No	1.0	3.2	No	3.1
17	54 Albion Street	Kerbside	395207	222465	NO_2	No	2.0	1.2	No	2.8
18	Berkeley Place	Roadside	395340	222071	NO_2	No	2.8	1.9	No	3.2
19	2 London Road	Roadside	395362	222000	NO_2	No	1.0	3.0	No	2.9
20	Sandford Park Alehouse	Roadside	395300	222027	NO_2	No	6.5	1.9	No	3.4
21	YMCA Shop - High St	Kerbside	395182	222183	NO_2	No	5.0	1.9	No	3.0
22	8a Bath Road	Roadside	395146	222149	NO_2	No	0.0	2.0	No	3.0
23	St Lukes College Road	Kerbside	395156	221866	NO_2	No	2.3	0.6	No	2.9
24	29 Cambray Place	Urban Background	395037	222222	NO_2	No	9.5	2.4	No	2.8
25	Boots Corner	Urban Centre	394954	222511	NO_2	No	2.1	3.3	No	2.8

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
26	Clarence Parade Alternative	Kerbside	394810	222439	NO_2	No	1.0	0.4	No	2.9
27	Princess Elizabeth Way North	Kerbside	393081	223643	NO_2	No	1.0	1.2	No	2.9
28	Princess Elizabeth Way South 2022	Kerbside	392066	222540	NO_2	No	9.5	1.3	No	2.8
29	Hatherley Lane	Roadside	391178	221641	NO_2	No	0.0	3.7	No	2.8
30	Fiddlers Green Lane / Kempton Grove	Suburban Background	391462	222662	NO_2	No	12.9	0.3	No	2.9
31	Telstar Way	Kerbside	391507	221978	NO_2	No	7.8	1.0	No	2.8
32	A40 PE Way Roundabout	Kerbside	391869	222084	NO_2	No	19.3	6.0	No	2.9
33	Gloucester Rd (Benhall)	Roadside	392267	222009	NO_2	No	22.0	4.0	No	2.4
34	264 Gloucester Road	Kerbside	393296	222170	NO_2	No	0.0	0.8	No	2.5
35	340 Gloucester Road	Roadside	392912	221862	NO_2	No	0.0	3.6	No	2.8
36	Norwood / Gratton Rd	Roadside	394473	220935	NO_2	No	5.8	1.5	No	3.0
37	51 Upper Norwood Street	Suburban Background	394492	220822	NO_2	No	3.1	1.5	No	2.9
38	81 London Road	Roadside	395660	221670	NO_2	No	0.0	4.7	No	2.7
39	Opp. Wokswagon London Rd	Roadside	395862	221424	NO_2	No	8.4	2.2	No	2.8
40	Prestbury High Street	Roadside	397009	223887	NO_2	No	0.0	1.8	No	2.8
41	54 Linden Ave	Suburban Background	396399	224044	NO_2	No	8.1	1.6	No	2.9
42	170 Prestbury Rd	Roadside	395980	223322	NO_2	No	1.3	1.7	No	2.9
43	Prestbury Rd / Portland Square	Kerbside	395394	222875	NO_2	No	2.7	0.8	No	2.8

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
44	16 Seneca Way	Suburban Background	394026	224231	NO_2	No	8.8	2.1	No	2.9
45	Warden Hill School	Suburban	393262	220358	NO_2	No	6.1	1.6	No	2.9
46	Farmfield Road	Suburban	393010	220348	NO_2	No	6.7	2.1	No	2.8

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: Automatic Monitoring (µg/m^3)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2022 (%) (2)	2018	2019	2020	2021	2022
CM1	394760	222878	Kerbside	97.2	97.2	32.7	36	24.7	25.3	27

☐ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG22**

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

Notes:

The annual mean concentrations are presented as µg/m^3.

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

All means have been "annualised" as per LAQM.TG22 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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

(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%).

Table A.4 – Annual Mean NO_2 Monitoring Results: Non-Automatic Monitoring (µg/m^3)

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2022 (%) [2]	2018	2019	2020	2021	2022
1	394621	222215	Roadside	100.0	100.0	27.5	29.6	20.8	21.8	23.0
2	393906	222873	Kerbside	100.0	100.0	-	-	24.3	24.5	25.0
3	394180	222982	Roadside	100.0	100.0	-	-	25.3	26.8	28.3
4	394235	223055	Kerbside	100.0	100.0	**41.2**	**43.1**	32.3	31.5	33.3
5	394350	222923	Roadside	100.0	100.0	**45.2**	**46.5**	32.9	34.5	36.0
6	394635	222928	Roadside	100.0	100.0			21.5	23.1	23.1
7	394738	222888	Roadside	100.0	100.0	**41.6**	37.9	**40.3**	30.3	32.6
8, 9, 10	394760	222878	Roadside	100.0	100.0	36.4	32.9	35.1	24.8	27.2
11	394708	222763	Kerbside	100.0	100.0	31.9	31.6	21.5	22.4	23.5
12	394830	222845	Roadside	83.3	83.3	39.4	35.6	39.2	26.6	30.5
13	394902	223004	Kerbside	100.0	100.0	29.0	31.3	22.7	22.6	22.8
14	394980	222735	Roadside	100.0	100.0	-	-	24.5	25.0	27.1
15	395110	222670	Kerbside	100.0	100.0	35.9	32.6	34.1	24.1	25.5
16	395210	222618	Roadside	100.0	100.0	31.8	34.4	24.5	26.1	30.2
17	395207	222465	Kerbside	100.0	100.0	31.3	30.4	22.3	22.0	22.9
18	395340	222071	Roadside	100.0	100.0			19.1	20.2	19.5
19	395362	222000	Roadside	100.0	100.0	37.4	37.4	27.5	28.5	28.6
20	395300	222027	Roadside	100.0	100.0			27.7	28.2	27.4
21	395182	222183	Kerbside	100.0	100.0	29.1	28.5	20.3	23.1	23.1
22	395146	222149	Roadside	100.0	100.0	34.5	34.4	25.1	27.0	27.2
23	395156	221866	Kerbside	100.0	100.0	24.8	27.6	17.7	18.7	19.2
24	395037	222222	Urban Background	100.0	100.0	-	-	-	-	13.9
25	394954	222511	Urban Centre	92.1	92.1	-	-	20.3	23.5	24.9
26	394810	222439	Kerbside	100.0	100.0	-	31.6	22.1	22.8	23.9
27	393081	223643	Kerbside	100.0	100.0	38.4	38.2	31.2	31.3	30.8
28	392066	222540	Kerbside	100.0	100.0	31.2	33.7	24.7	25.3	21.1
29	391178	221641	Roadside	73.7	73.7	34.9	33.4	25.2	25.0	25.5
30	391462	222662	Suburban Background	100.0	100.0	-	-	-	-	16.4
31	391507	221978	Kerbside	100.0	100.0	-	-	-	18.3	21.3
32	391869	222084	Kerbside	100.0	100.0	-	-	23.9	22.2	22.4
33	392267	222009	Roadside	100.0	100.0	-	-	21.6	22.1	22.5
34	393296	222170	Kerbside	100.0	100.0	34.4	30.6	33.4	23.6	25.0

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2022 (%) (2)	2018	2019	2020	2021	2022
35	392912	221862	Roadside	92.3	92.3	38.6	35.3	36.2	25.5	24.8
36	394473	220935	Roadside	100.0	100.0	-	-	16.9	17.8	17.0
37	394492	220822	Suburban Background	100.0	100.0	-	-	-	-	11.6
38	395660	221670	Roadside	92.3	92.3	38.4	37.3	37.6	28.4	29.3
39	395862	221424	Roadside	89.9	89.9	-	-	21.7	21.7	21.6
40	397009	223887	Roadside	100.0	100.0	-	-	-	22.9	24.6
41	396399	224044	Suburban Background	73.2	73.2	-	-	-	-	10.1
42	395980	223322	Roadside	100.0	100.0	-	-	14.8	15.8	15.6
43	395394	222875	Kerbside	100.0	100.0	-	-	23.6	22.8	23.9
44	394026	224231	Suburban Background	100.0	100.0	-	-	-	-	14.8
45	393262	220358	Suburban	92.3	92.3	-	-	-	10.3	11.0
46	393010	220348	Suburban	100.0	100.0	-	-	-	10.0	10.2

☐ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG22**

☒ **Diffusion tube data has been bias adjusted.**

☒ **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 correction.**

Notes:

The annual mean concentrations are presented as µg/m^3.

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**.

Means for diffusion tubes have been corrected for bias. All means have been “annualised” as per LAQM.TG22 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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

(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%).

Figure A.1 – Trends in Annual Mean NO_2 Concentrations (Within AQMA)

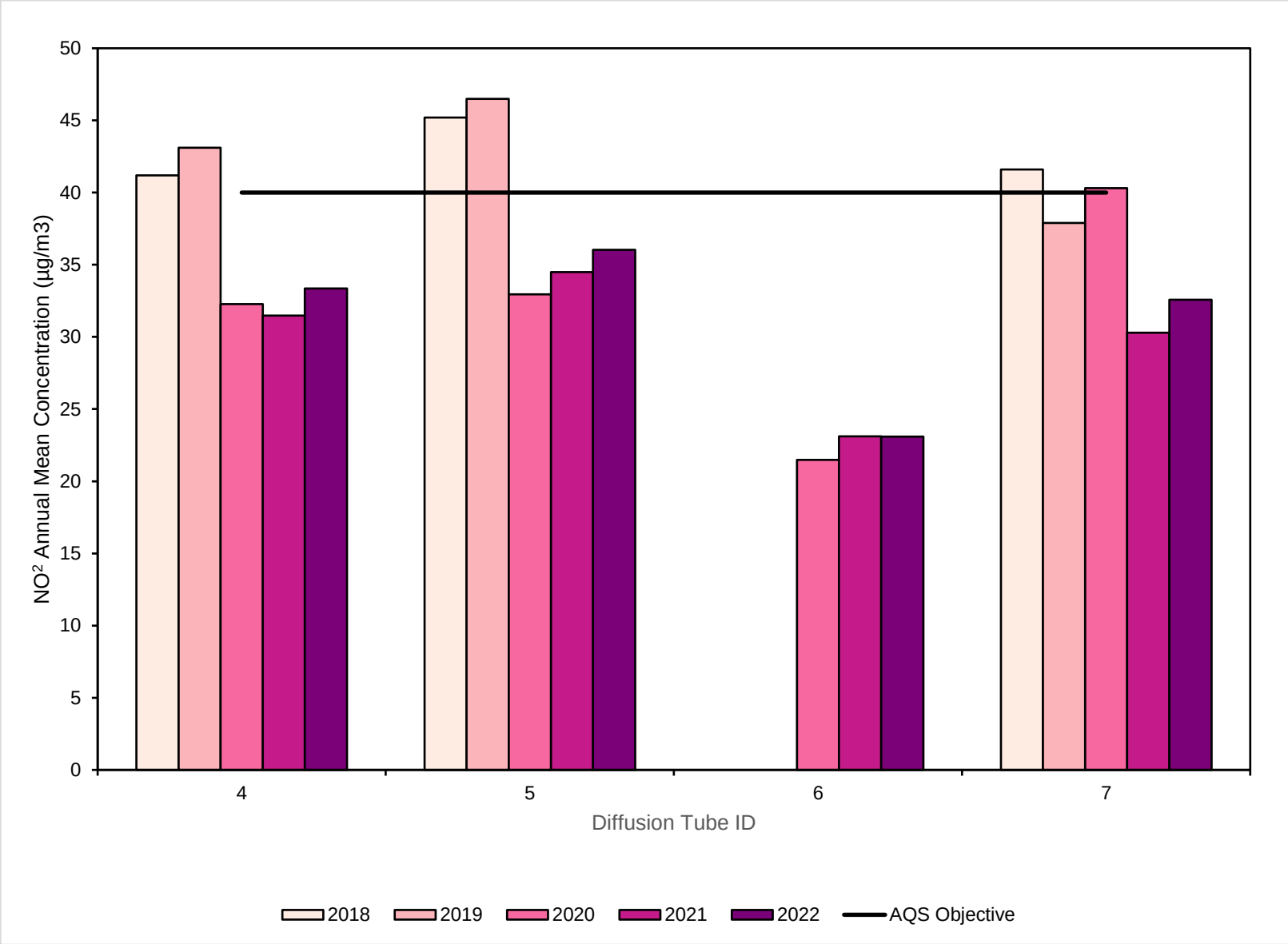


Figure A.2 – Trends in Annual Mean NO_2 Concentrations (Sites 1 - 13)

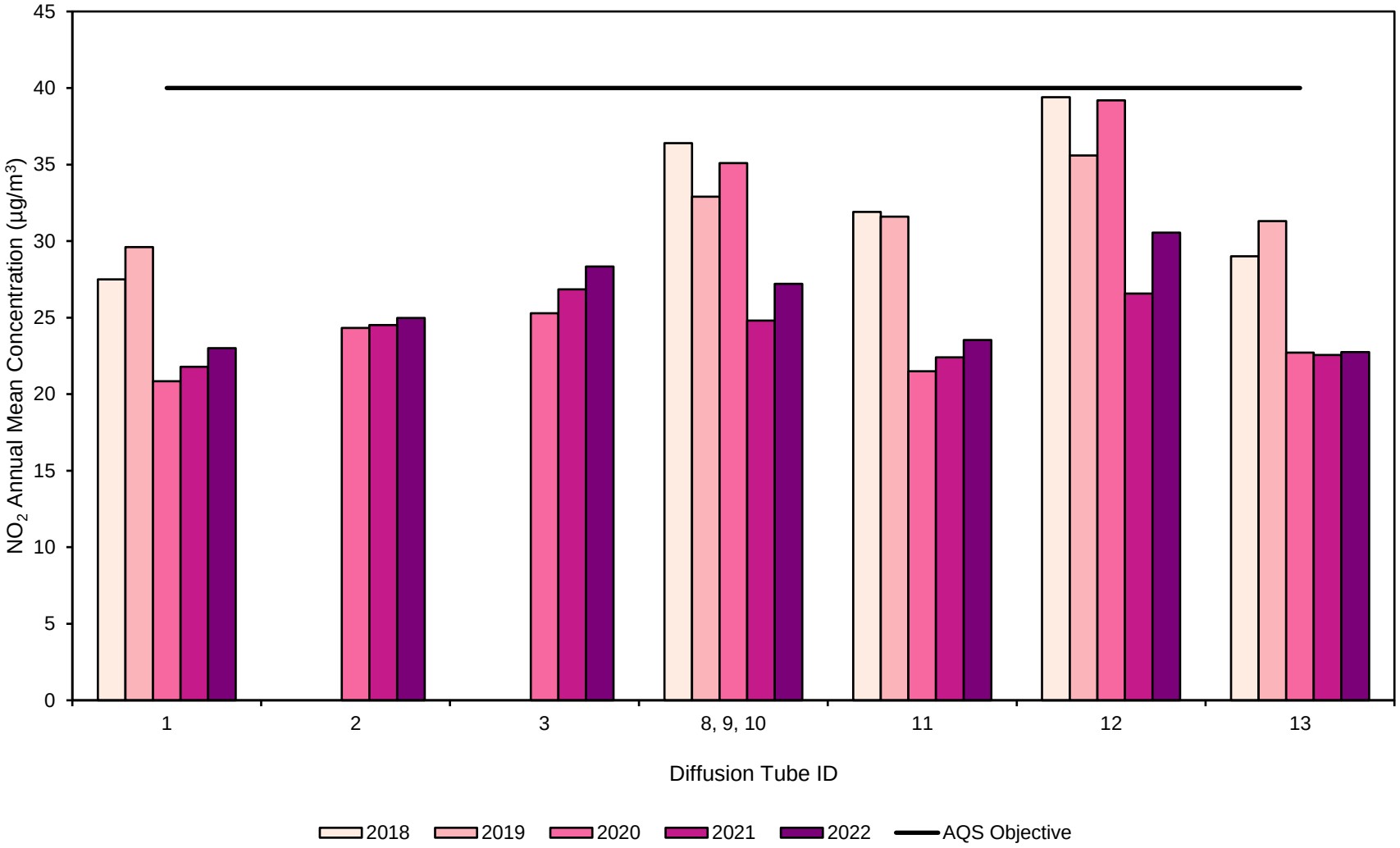


Figure A.3 – Trends in Annual Mean NO_2 Concentrations (Sites 14 - 20)

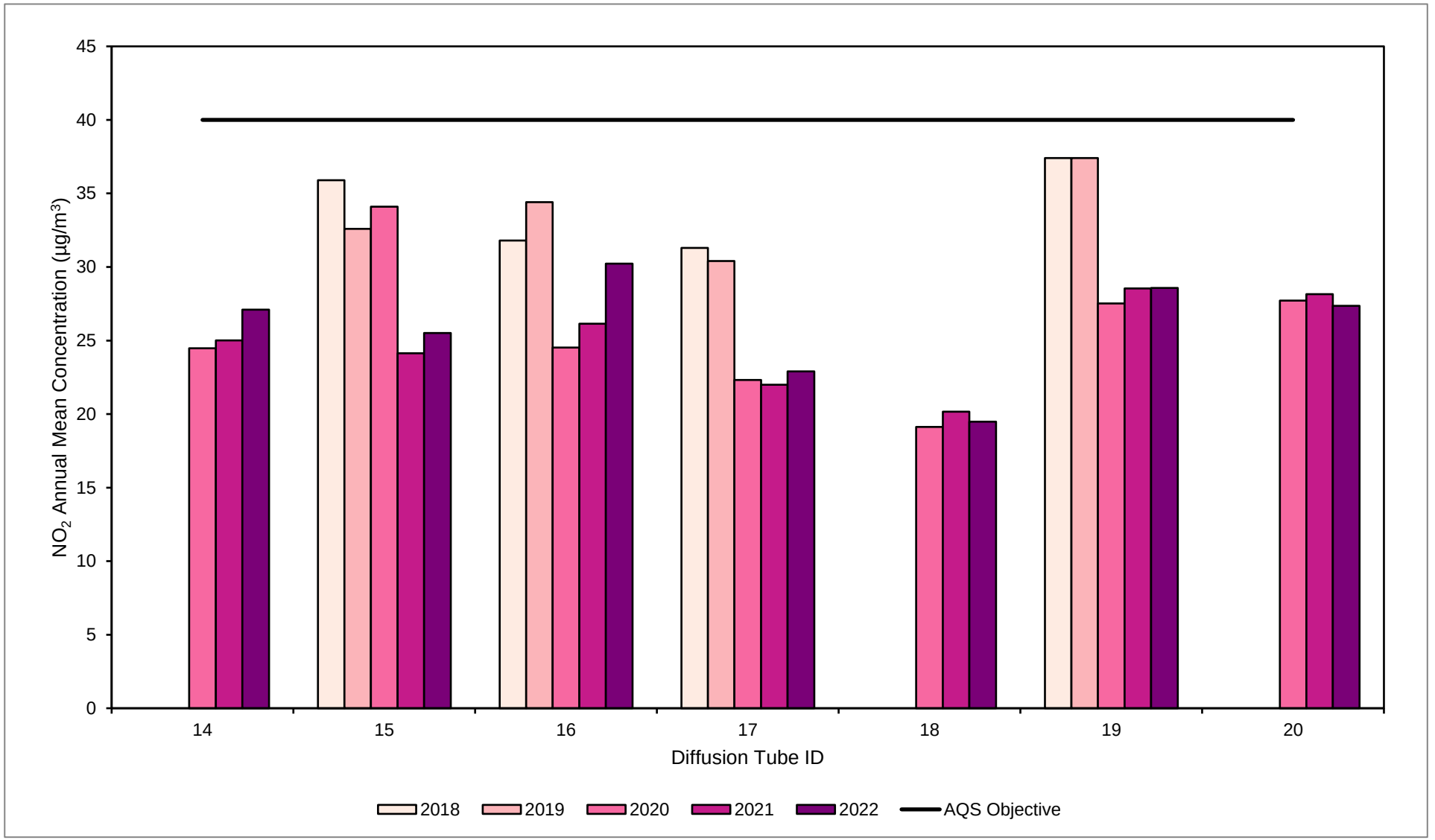


Figure A.4 – Trends in Annual Mean NO_2 Concentrations (Sites 26 - 32)

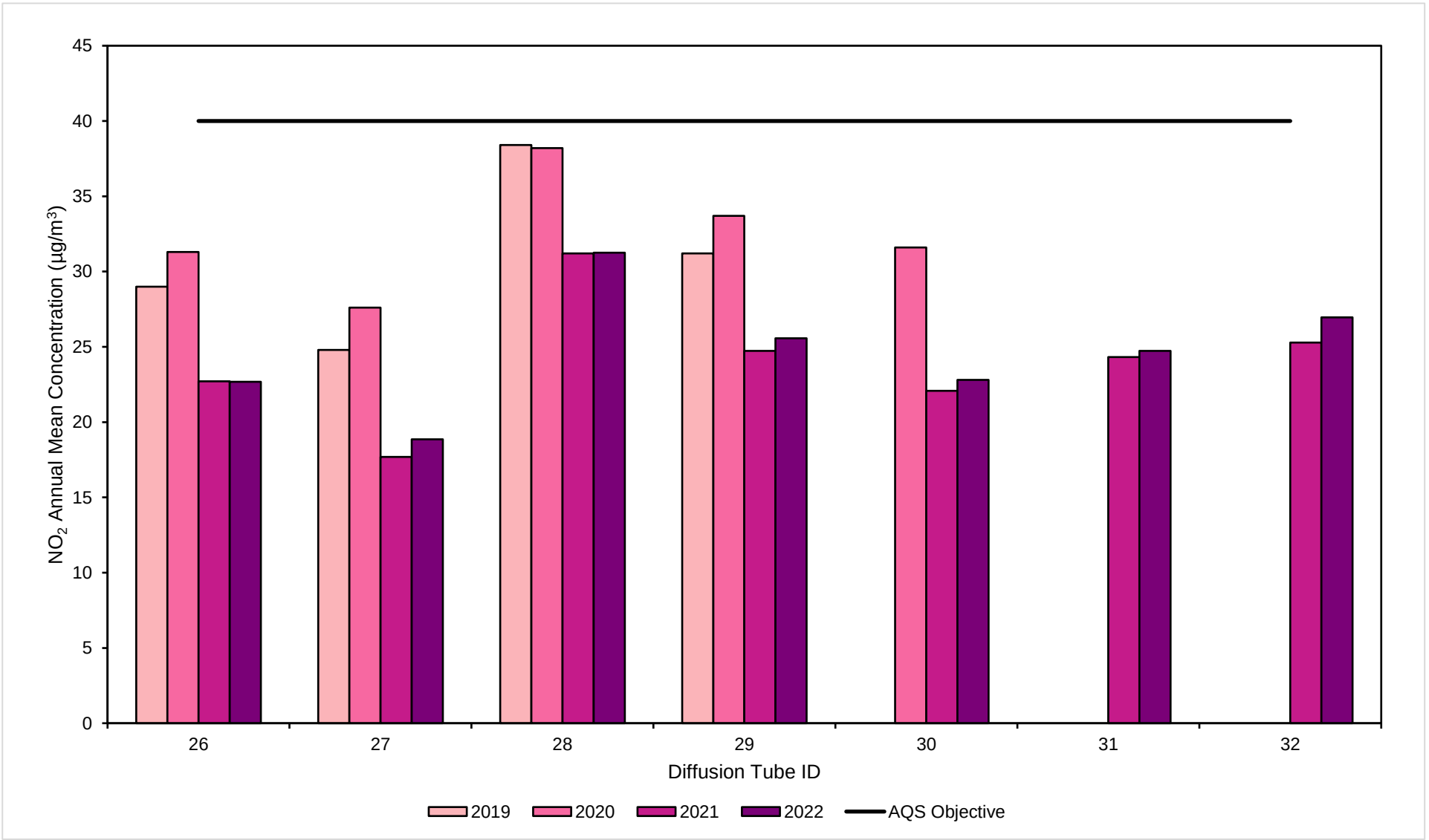


Figure A.5 – Trends in Annual Mean NO_2 Concentrations (Sites 35 - 41)

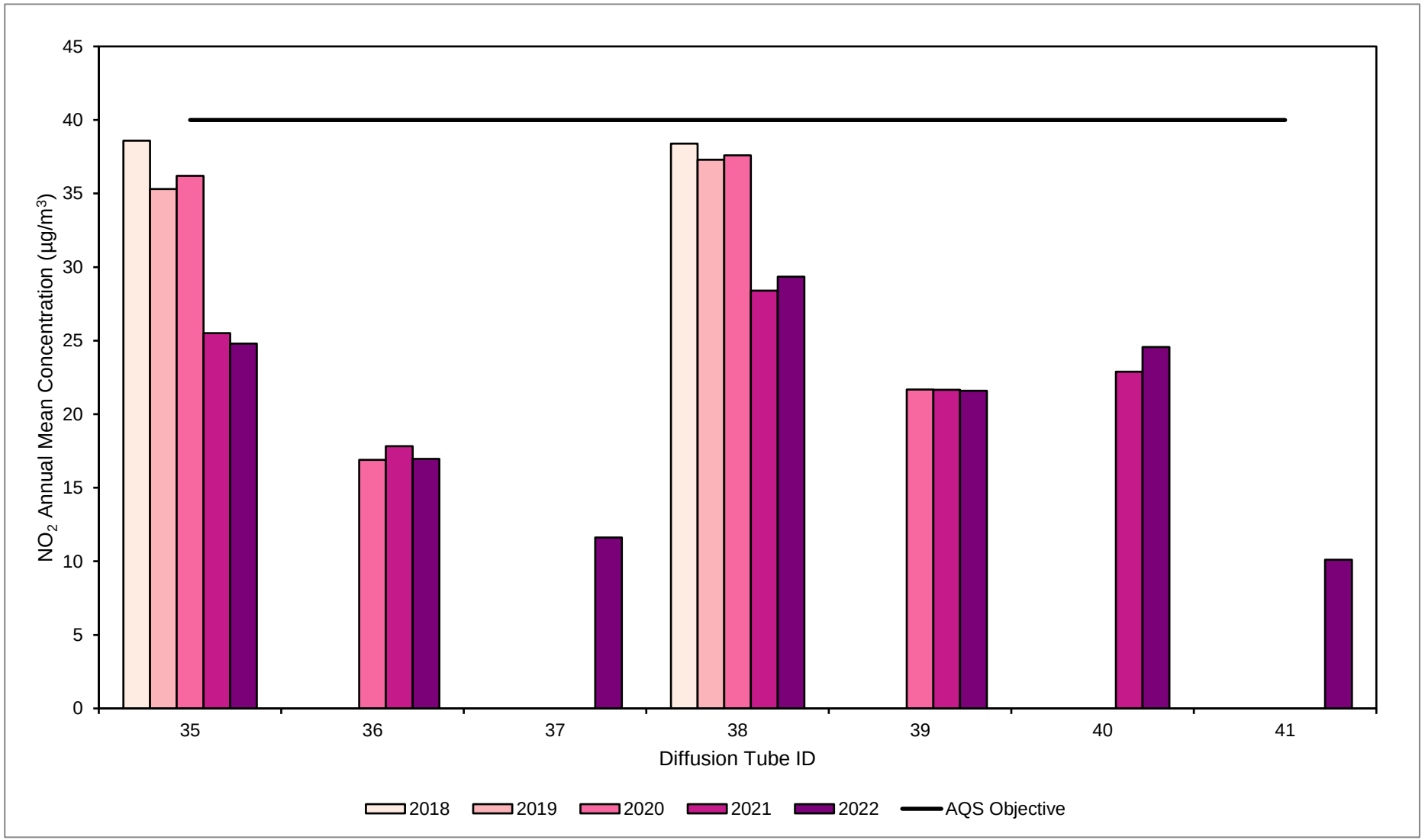


Figure A.6 – Trends in Annual Mean NO_2 Concentrations (Sites 42 - 46)

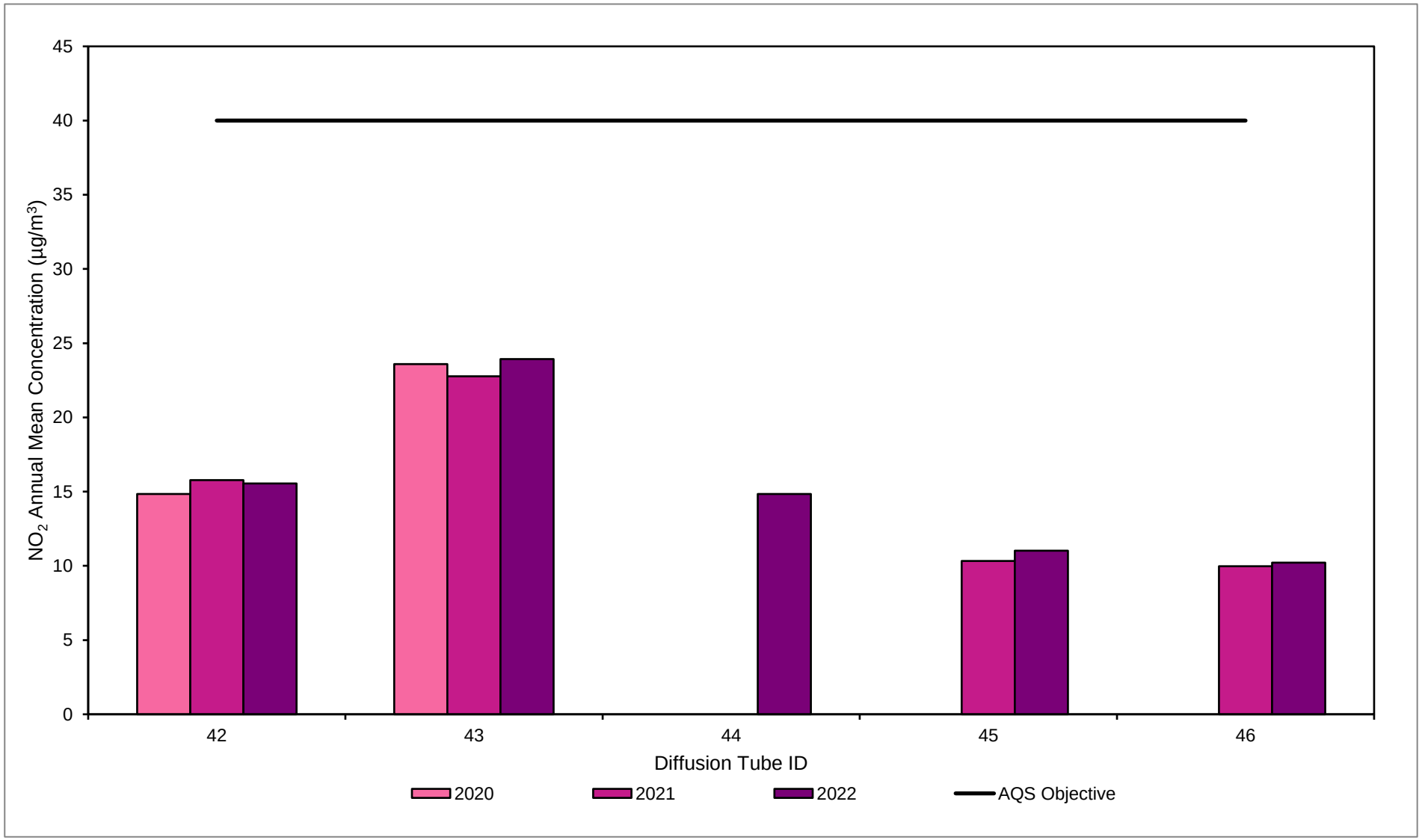


Table A.5 – 1-Hour Mean NO_2 Monitoring Results, Number of 1-Hour Means > 200µg/m^3

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2022 (%) (2)	2018	2019	2020	2021	2022
CM1	394760	222878	Kerbside	97.2	97.2	0	0	0	0	0

Notes:

Results are presented as the number of 1-hour periods where concentrations greater than 200µg/m^3 have been recorded.

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**.

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

(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%).

Appendix B: Full Monthly Diffusion Tube Results for 2022

Table B.1 – NO_2 2022 Diffusion Tube Results ($\mu g/m^3$)

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.94)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
1	394621	222215	35.6	25.4	26.2	20.6	20.3	20.2	21.5	21.1	22.5	23.2	27.7	29.3	24.5	23.0		
2	393906	222873	40.3	24.2	26.6	23.7	21.7	20.2	24.1	24.2	24.3	24.3	30.3	34.7	26.6	25.0		
3	394180	222982	44.8	23.9	33.2	29.4	26.3	23.8	27.8	28.0	30.4	28.4	30.6	35.2	30.1	28.3		
4	394235	223055	50.7	32.5	37.3	30.2	30.4	30.6	33.1	29.0	34.4	35.9	41.5	40.1	35.5	33.3		
5	394350	222923	53.5	38.6	42.5	28.5	36.4	32.2	37.4	34.8	38.2	35.6	42.8	39.6	38.3	36.0		
6	394635	222928	32.2	23.2	31.7	23.5	19.6	16.8	22.7	21.7	25.3	23.2	25.9	29.0	24.6	23.1		
7	394738	222888	47.6	34.7	35.8	28.9	31.4	29.4	33.2	27.9	34.3	35.2	39.2	38.3	34.7	32.6		
8	394760	222878	39.4	24.7	33.2	17.6	27.5	25.0	29.4	24.3	28.9	27.3	31.7	33.6	-	-		Triplicate Site with 8, 9 and 10 - Annual data provided for 10 only
9	394760	222878	39.9	29.7	33.6	25.3	25.4	23.3	28.7	27.6	27.2	27.6	32.3	32.8	-	-		Triplicate Site with 8, 9 and 10 - Annual data provided for 10 only
10	394760	222878	39.0	26.3	30.4	24.3	25.8	25.9	26.1	27.6	31.4	28.7	30.7	30.1	28.9	27.2		Triplicate Site with 8, 9 and 10 - Annual data provided for 10 only
11	394708	222763	37.0	23.8	31.0	23.4	19.6	18.3	21.8	21.7	23.5	22.8	27.3	30.3	25.0	23.5		
12	394830	222845	43.5		37.7	27.5	26.0	27.0	29.7	27.5	32.2		38.1	35.7	32.5	30.5		
13	394902	223004	42.7	23.8	27.4	19.9	18.7	17.1	18.8	19.0	22.3	21.2	27.7	32.0	24.2	22.8		
14	394980	222735	42.2	25.0	30.9	23.3	24.2	23.9	29.1	24.9	28.8	30.3	31.2	32.2	28.8	27.1		
15	395110	222670	37.2	24.7	32.9	25.5	22.3	21.2	24.7	25.0	28.2	25.5	29.3	29.4	27.1	25.5		

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.94)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
16	395210	222618	49.4	29.9	33.1	32.4	27.6	25.1	32.5	23.9	35.3	29.6	31.6	35.7	32.2	30.2		
17	395207	222465	36.7	21.6	27.3	23.9	19.5	18.1	22.0	23.2	23.5	21.1	24.1	31.4	24.4	22.9		
18	395340	222071	31.2	17.3	27.3	20.7	15.4	14.0	17.4	19.1	20.8	17.8	20.7	27.0	20.7	19.5		
19	395362	222000	40.0	24.9	35.1	30.6	26.7	24.3	29.4	31.5	31.6	27.2	30.4	32.8	30.4	28.6		
20	395300	222027	44.5	29.6	28.1	24.5	25.4	23.2	27.5	25.3	27.4	28.4	32.8	32.7	29.1	27.4		
21	395182	222183	36.1	20.2	29.2	23.2	19.0	19.8	22.2	22.0	24.4	23.8	26.5	28.9	24.6	23.1		
22	395146	222149	38.2	26.1	30.9	27.7	22.5	25.3	27.1	26.2	27.8	29.4	33.4	32.1	28.9	27.2		
23	395156	221866	32.9	18.2	24.8	18.8	16.8	16.5	15.3	15.9	18.9	19.8	23.0	24.1	20.4	19.2		
24	395037	222222	26.8	13.9	18.1	12.6	8.8	9.6	10.4	10.8	13.6	13.3	17.2	22.3	14.8	13.9		
25	394954	222511	39.2	24.5	29.6	26.2	21.6	20.4	24.9	27.8	27.0	21.1		28.5	26.4	24.9		
26	394810	222439	37.8	22.3	26.2	22.7	20.5	21.1	22.8	22.4	26.1	23.4	26.4	33.0	25.4	23.9		
27	393081	223643	43.6	30.7	31.0	33.2	28.8	29.1	30.3	30.4	31.6	32.1	35.7	36.2	32.7	30.8		
28	392066	222540	33.7	18.0	26.8	23.1	16.4	17.3	19.5	21.8	22.3	20.5	21.2	28.6	22.4	21.1		
29	391178	221641	39.9		30.3		22.3	20.3	24.7	26.0	26.8		24.4	29.2	27.1	25.5		
30	391462	222662	29.0	14.8	20.0	17.0	12.7	12.5	14.3	15.2	16.5	16.2	17.0	24.1	17.5	16.4		
31	391507	221978	32.8	23.1	28.1	19.3	17.1	15.7	16.3	17.0	20.9	23.5	28.5	29.9	22.7	21.3		
32	391869	222084	30.8	19.0	29.9	18.9	17.0	15.3	19.2	20.4	23.1	27.5	31.9	33.1	23.9	22.4		
33	392267	222009	28.3	24.4	26.5	19.3	19.8	19.1	20.3	19.9	24.2	25.0	29.3	30.6	23.9	22.5		
34	393296	222170	37.0	25.9	28.5	23.0	22.5	22.5	25.3	23.6	27.1	25.8	28.0	29.9	26.6	25.0		
35	392912	221862	31.0	20.5	25.1	20.9	21.8	23.4	24.8		27.9	28.6	33.3	32.9	26.4	24.8		
36	394473	220935	29.3	16.3	20.6	18.6	13.3	13.1	14.3	16.3	16.5	15.3	18.1	24.7	18.1	17.0		
37	394492	220822	24.6	11.4	15.1	11.8	7.8	7.3	7.8	9.5	10.9	10.0	12.4	19.6	12.4	11.6		
38	395660	221670	40.3		34.3	26.4	25.6	28.1	27.4	27.0	30.4	31.5	37.1	35.3	31.2	29.3		
39	395862	221424	36.5	22.1	17.7	22.1	20.3	19.9	22.0	22.1	24.6	21.4	24.1		23.0	21.6		
40	397009	223887	40.0	27.5	30.1	22.7	20.8	21.9	21.0	20.8	23.8	25.7	29.9	29.5	26.1	24.6		
41	396399	224044	22.2	11.1	13.6	9.3	7.2	6.6	6.6	6.2			14.0		10.8	10.1		
42	395980	223322	30.0	17.7	18.7	13.3	12.2	10.8	12.6	12.2	14.7	14.8	18.2	23.4	16.5	15.6		
43	395394	222875	33.8	24.7	29.6	22.7	20.4	19.9	21.7	22.1	25.0	24.4	28.7	32.3	25.5	23.9		
44	394026	224231	29.1	15.5	19.8	13.8	9.6	8.9	11.4	11.8	14.7	14.4	17.9	22.5	15.8	14.8		
45	393262	220358	20.1		13.3	9.1	7.1	6.7	7.8	8.8	10.4	13.5	12.4	19.8	11.7	11.0		

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.94)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
46	393010	220348	20.6	9.8	13.2	9.8	7.2	6.4	8.5	8.3	9.4	9.2	11.1	16.8	10.9	10.2		

☒ **All erroneous data has been removed from the NO_2 diffusion tube dataset presented in Table B.1.**

☐ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG22.**

☒ **Local bias adjustment factor used.**

☐ **National bias adjustment factor used.**

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

☒ **Cheltenham Borough Council confirm that all 2022 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System.**

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**.

See Appendix C for details on bias adjustment and annualisation.

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

New or Changed Sources Identified Within Cheltenham Borough Council During 2022

During 2022, Cheltenham Borough Council has identified a new large scale mixed-use development due to be constructed in the Borough in 2024. The scheme will be located in the west of Cheltenham and will include commercial and residential elements.

Additional Air Quality Works Undertaken by Cheltenham Borough Council During 2021

During 2022, Cheltenham Borough Council continued to work with Bureau Veritas to formalise the update to the 2014 AQAP. This new action plan identifies five key areas for action, ranging from transport, planning and infrastructure, policy guidance, behavioural change, to air quality monitoring. These actions outline the measures that are to be put in place by Cheltenham Borough Council over the next five years, and is due to be adopted in May 2023.

As in the previous reporting year, AQ Mesh Pods were continued to be deployed during 2022 at nine sites around the town. In spring 2021, Cheltenham Borough Council underwent a cross-referencing and co-locating study of each AQ Mesh site to improve the reliability of the data. However, shortly after the sensors were reaching the end of their reliable life, and started to fail. Cheltenham Borough Council therefore changed the servicing and data handling contracts to the original manufactures of the pods, who replaced numerous failed and failing sensors. Whilst this got the units working consistently, they were providing results of dubious accuracy over the first few months of use. Cheltenham Borough Council are now carrying out more co-locating and cross-referencing to other data sources and, as a result, an error was found in the supplier's software which was skewing the results. The supplier is now fixing this problem across their network, with the roll out of the fixed software expected in the next month. Once corrected, the results of the AQ Mesh Pods will be published on Cheltenham Borough Council's website. These AQ Mesh Pods highlight that Cheltenham

Borough Council are continuously looking to expand the monitoring network, so that any exceedances, or likely exceedances, can be identified and acted upon.

QA/QC of Diffusion Tube Monitoring

The diffusion tubes for the year 2022 were supplied and analysed by Gradko International Ltd, using the 20% TEA in water preparation method. Gradko International, a UKAS accredited laboratory, participate in the AIR-PT scheme for NO_2 diffusion tube analysis and Annual Field Intercomparison Exercise. These provide strict criteria relating to performance that participating laboratories must meet, thereby ensuring that the reported NO_2 concentrations are of a high calibre. The latest available AIR-PT result is AIR-PT AR050 (May – June 2022), in which Gradko scored 100% – the percentage score reflects the results deemed satisfactory based upon the z-score of < ±2. Data from June 2022 onwards has not yet been made available.

The precision of the current 27 local authority co-location studies in 2022 detailed within the national bias adjustment factor spreadsheet (version 03/23) was rated as ‘good’ (tubes are considered to have "good" precision where the coefficient of variation of duplicate or triplicate diffusion tubes for eight or more periods during the year is less than 20%). Full details of the precision summary results are available here.

The diffusion tubes deployed during 2022 were done so in line with the national monitoring calendar (±2 days).

Diffusion Tube Annualisation

No single diffusion tube site required annualisation during 2022, with no site missing more than three months of data. This is because the LAQM technical guidance states that:

“For any monitoring sites with fewer than nine months’ worth of data, it is necessary to perform annualisation”.

Notably, although diffusion tube Site 29 and Site 41 had a data capture of 73.7% and 73.2% respectively, the data has not been annualised. This is because this percentage is the amount of data captured for the annual monitoring period calendar carried out in line with the LAQM calendar, not the number of months that data is available for. As shown in Table B.1, there was still nine months of data available for both sites, therefore annualisation was not required despite having a data capture below 75%.

Diffusion Tube Bias Adjustment Factors

The diffusion tube data presented within the 2022 ASR have been corrected for bias using an adjustment factor. Bias represents the overall tendency of the diffusion tubes to under or over-read relative to the reference chemiluminescence analyser. LAQM.TG22 provides guidance with regard to the application of a bias adjustment factor to correct diffusion tube monitoring. Triplicate co-location studies can be used to determine a local bias factor based on the comparison of diffusion tube results with data taken from NO_x/NO_2 continuous analysers. Alternatively, the national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method.

Cheltenham Borough Council have applied a local bias adjustment factor of 0.94 to the 2022 monitoring data. This value is derived from the co-located study at the automatic monitoring site on Swindon Road, where the triplicate diffusion tube site (8/9/10) is co-located. The output of this local bias adjustment calculation is summarised in Table C.1 and Table C.2. The local factor was used to bias adjust the 2022 diffusion tube data as it was more conservative than using the national factor. In 2022, the national bias adjustment factor for diffusion tubes supplied by Gradko International using the 20% TEA in water preparation method was 0.83.

Table C.1 – Bias Adjustment Factor

Monitoring Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2022	Local	-	0.94
2021	Local	-	0.89
2020	Local	-	0.89
2019	Local	-	0.99
2018	Local	-	0.97

Table C.2 – Local Bias Adjustment Calculation

	Local Bias Adjustment Input
Periods used to calculate bias	12
Bias Factor A	0.94 (0.89 – 0.99)
Bias Factor B	7% (1% - 12%)
Diffusion Tube Mean (µg/m^3)	28.9
Mean CV (Precision)	6.3%
Automatic Mean (µg/m^3)	27.2
Data Capture	96%
Adjusted Tube Mean (µg/m^3)	27 (26 – 29)

Notes: A single local bias adjustment factor has been used to bias adjust the 2022 diffusion tube results.

NO_2 Fall-off with Distance from the Road

Wherever possible, monitoring locations are representative of exposure. However, where this is not possible, the NO_2 concentration at the nearest location relevant for exposure has been estimated using the Diffusion Tube Data Processing Tool/NO_2 fall-off with distance calculator available on the LAQM Support website. Where appropriate, non-automatic annual mean NO_2 concentrations corrected for distance are presented in Table B.1.

No diffusion tube NO_2 monitoring locations within Cheltenham Borough Council required distance correction during 2022.

QA/QC of Automatic Monitoring

Cheltenham Borough Council's automatic monitoring site CM1, located on St Georges Street/Swindon Road Junction, is operated and managed by Enviro Technology Services plc. The M200E NO_x analyser is MCERTS approved, mirroring compliance with the European Committee for Standardisation (CEN) standard EN1421:2012, and measures NO_x, NO_2 and NO. The unit was installed in August 2011 and Enviro Technology Services undertake routine monthly calibration visits and data download services. Data received is ratified by Geoff Broughton from Air Quality Data Management (AQDM), with concentration data provided every quarter.

Automatic Monitoring Annualisation

The automatic monitoring station within Cheltenham Borough Council (CM1) recorded data capture greater than 75% during 2022 (97.2%) and, therefore, annualisation was not required.

Appendix D: Maps of Monitoring Locations and AQMAs

Figure D.1 – Map of Non-Automatic & Automatic Monitoring Sites (AQMA/Cheltenham Centre)

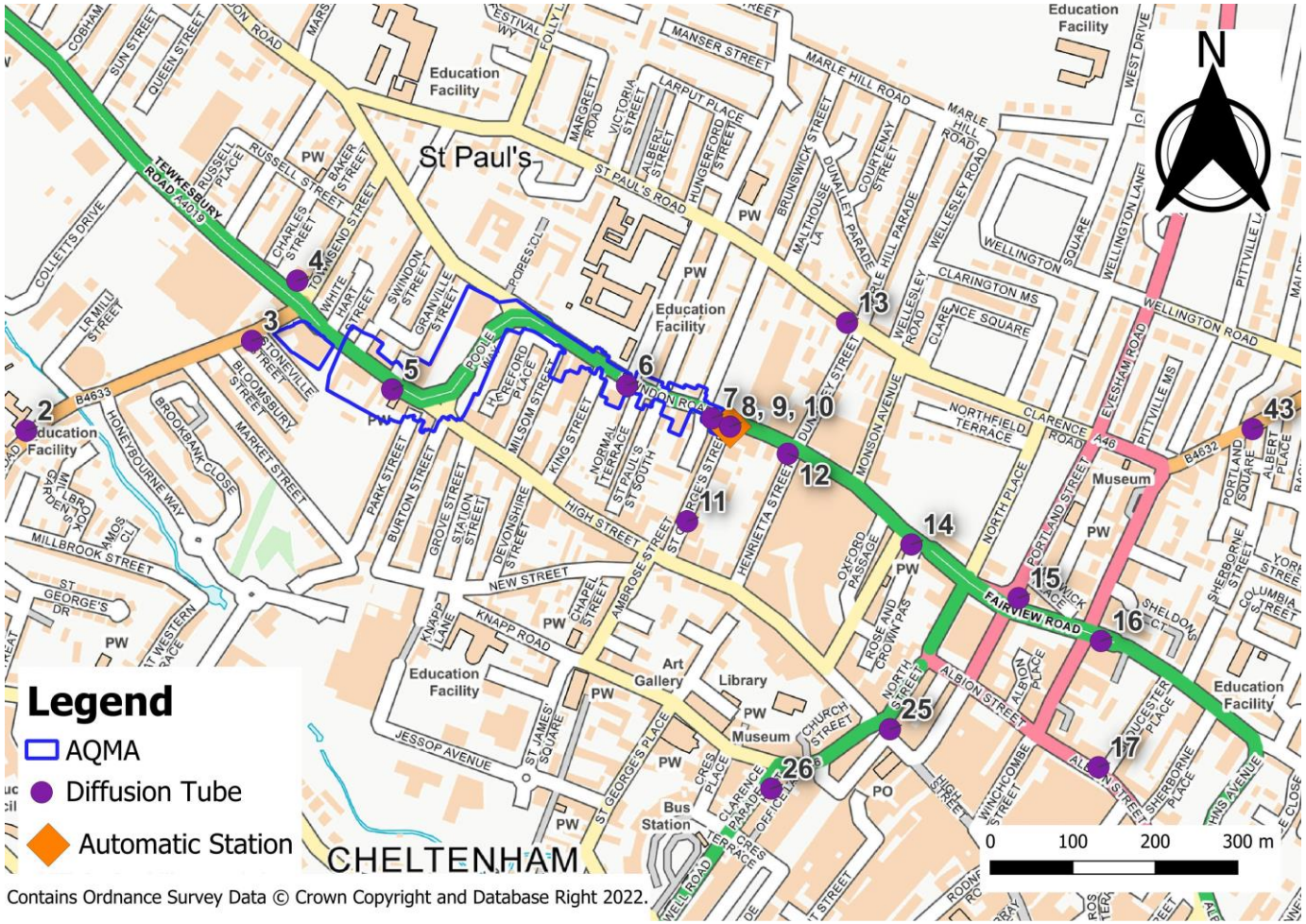


Figure D.2 – Map of Non-Automatic Monitoring Sites (Cheltenham Centre)

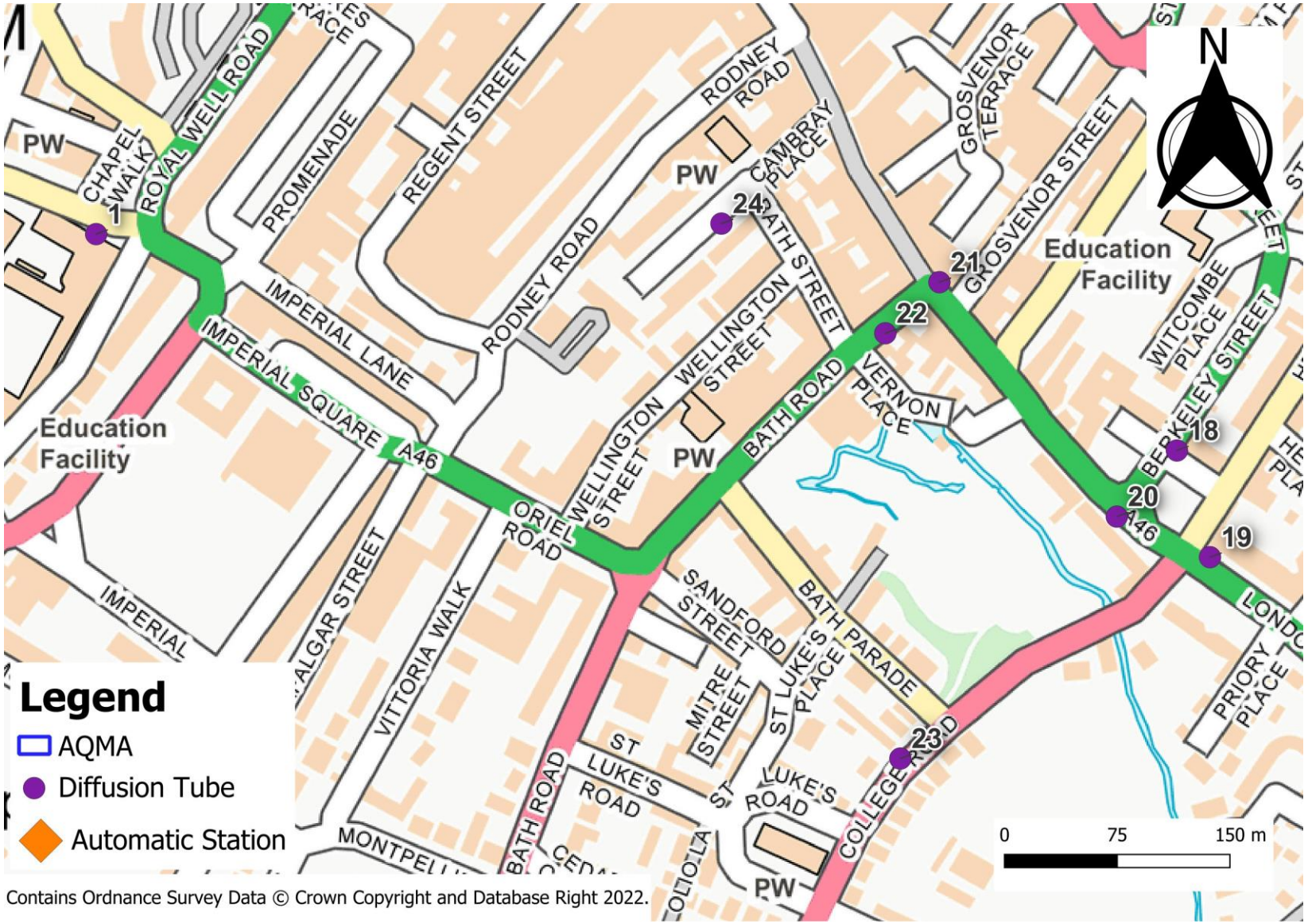


Figure D.3 – Map of Non-Automatic Monitoring Sites (London Road)

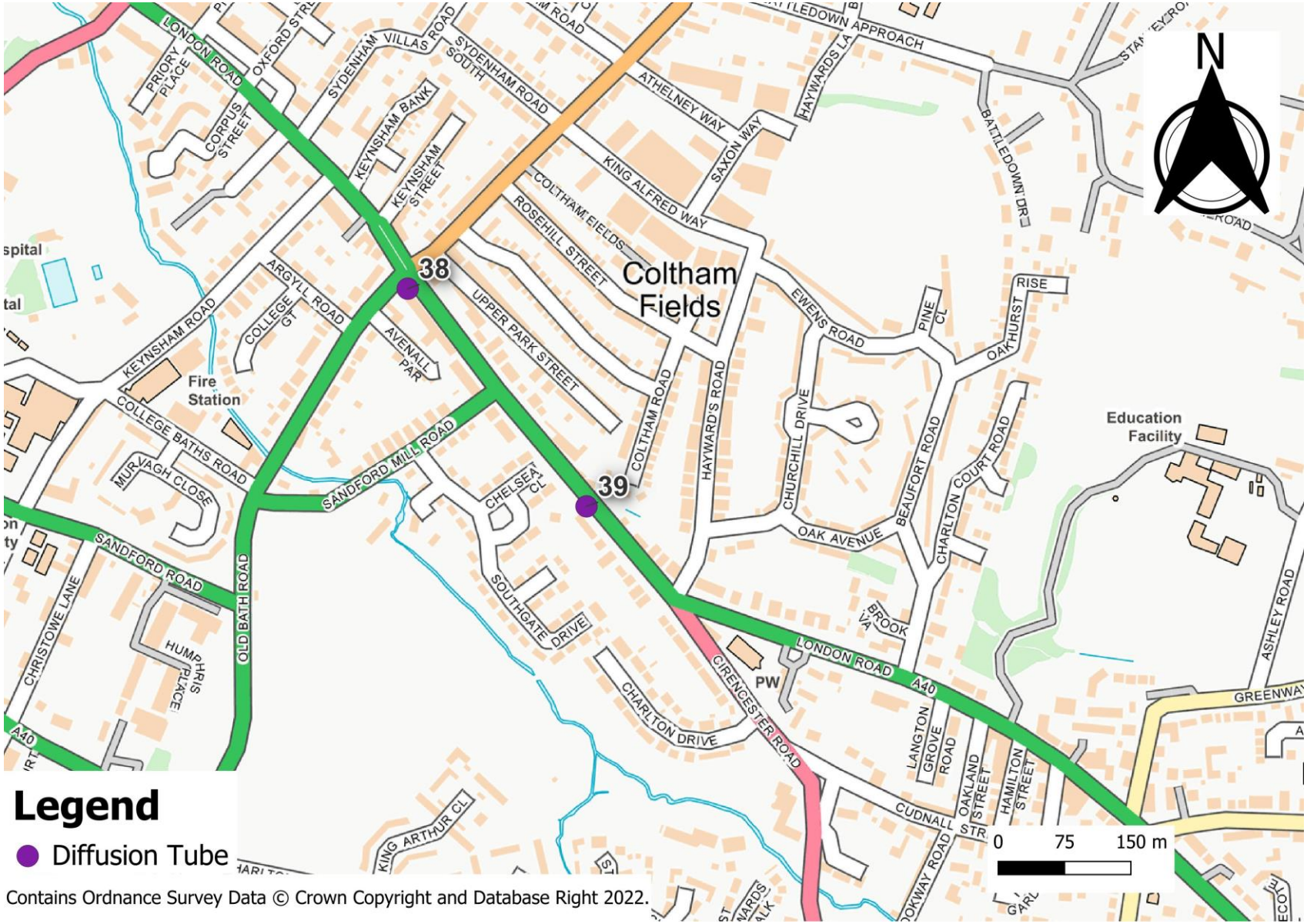


Figure D.4 – Map of Non-Automatic Monitoring Sites (Leckhampton/Warden Hill)

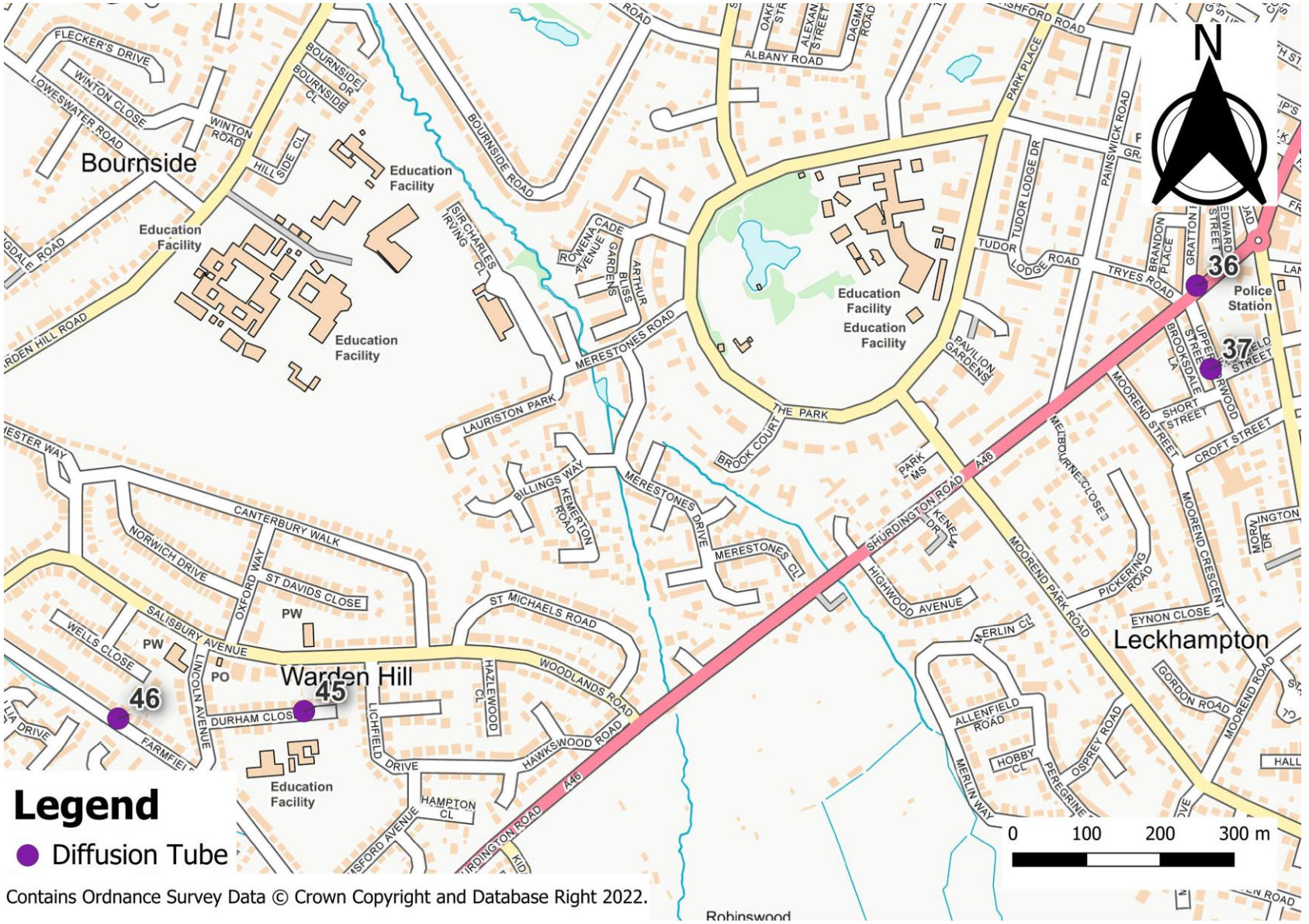


Figure D.5 – Map of Non-Automatic Monitoring Sites (Benhall/St Marks)

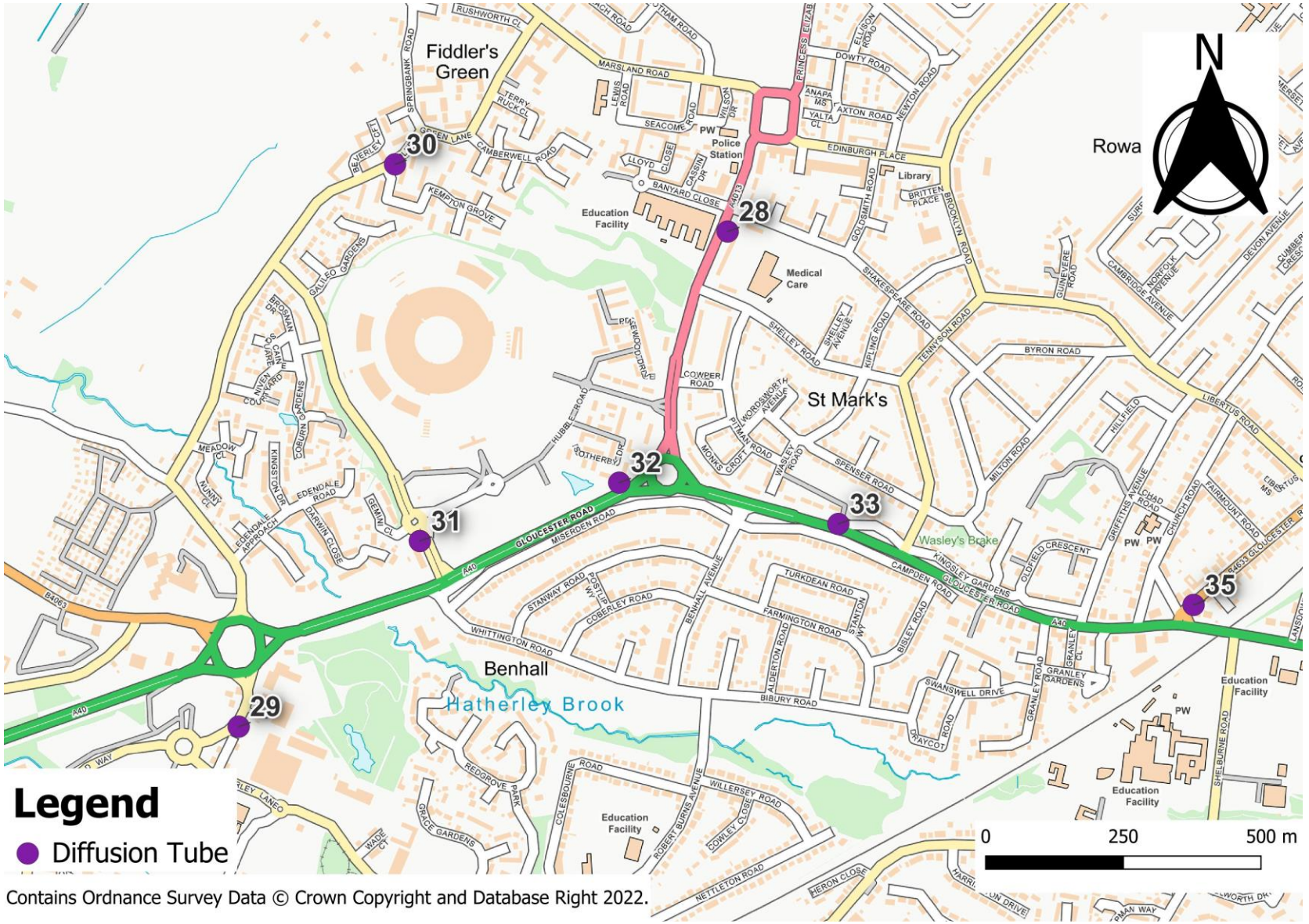


Figure D.6 – Map of Non-Automatic Monitoring Sites (Princess Elizabeth Way/Seneca Way)

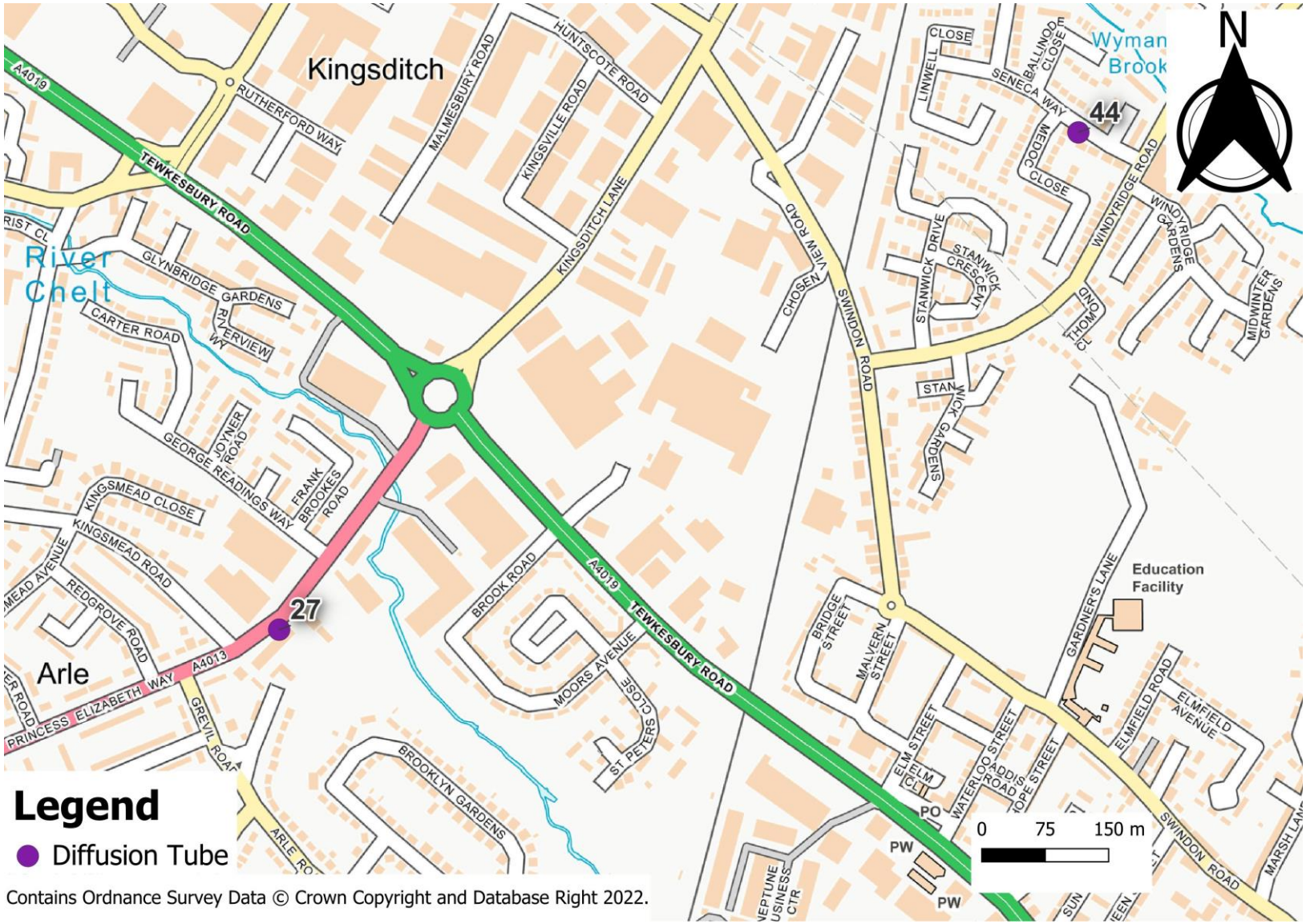
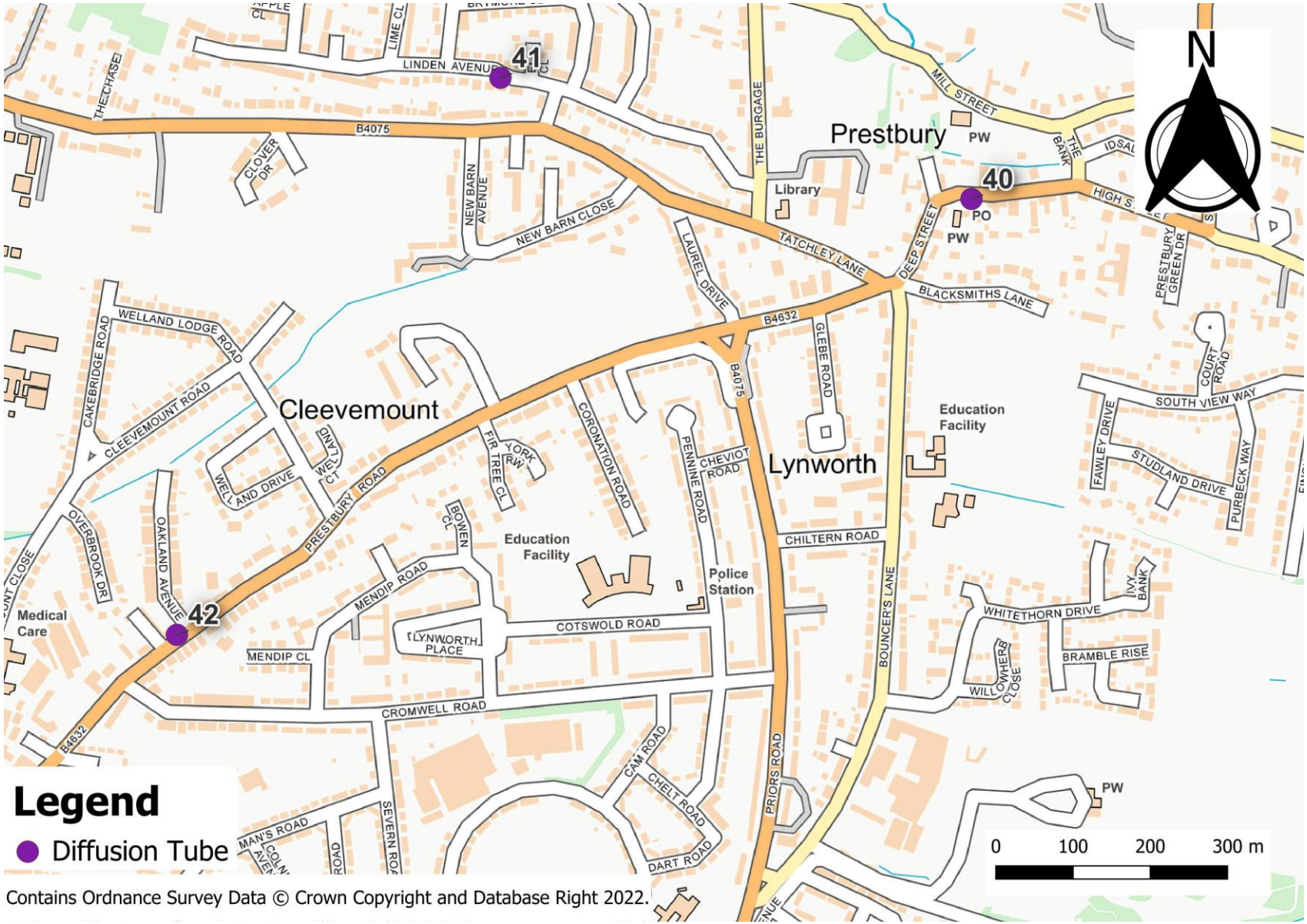


Figure D.7 – Map of Non-Automatic Monitoring Sites (Cleemount/Prestbury)



Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England[8]

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

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

Glossary of Terms

Abbreviation	Description
AONB	Area of Outstanding Natural Beauty
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'
AQDM	Air Quality Data Management
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
AQO	Air Quality Objective
ASR	Annual Status Report
CBC	Cheltenham Borough Council
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by National Highways
EU	European Union
EV	Electric Vehicle
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 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

References

- Local Air Quality Management Technical Guidance LAQM.TG22. August 2022. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.
- Local Air Quality Management Policy Guidance LAQM.PG22. August 2022. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.
- Defra Background Mapping Data for Local Authorities – 2018 Based.
- Cheltenham Borough Council AQAP 2014.
- National Diffusion Tube Bias Adjustment Spreadsheet. Version 03/23. Published March 2023.
- Public Health Outcomes Framework, Public Health England.