Cheltenham Borough Council
Annual Status Report 2019

Bureau Veritas

July 2019

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CHELTENHAM
BOROUGH COUNCIL

2019 Air Quality Annual Status Report (ASR)

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

July 2019

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Executive Summary: Air Quality in Our Area

Air Quality in Borough Council of 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 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].

The main source of air pollution in the Borough is road traffic emissions from major roads, notably the A40 – Gloucester Road, A4013 – Princess Elizabeth Way, A4019 – Tewkesbury Road, A4019 – Swindon Road, A435 – London Road, A46 – High Street, A46 Bath Road and A435 – Hewlett Road. These roads, among others, form the main arterial highway network within Cheltenham, carrying high volumes of traffic within the Borough, specifically through areas such as Cheltenham Town Centre, where congestion is frequently experienced. As a result, Cheltenham Borough Council (CBC, 'the Council') has one Borough-wide AQMA that was declared in November 2011 for the exceedance of the Nitrogen Dioxide (NO_2) annual mean UK Air Quality Strategy (AQS) of 40µg/m^3.

The current Borough-wide AQMA can be viewed online at https://uk-air.defra.gov.uk/aqma/local-authorities?la_id=54, details of the AQMAs are provided in Table 2.1 and boundary maps are presented in Appendix D: Maps of Monitoring Locations and AQMAs. In response, to this an Air Quality Action Plan (AQAP) was adopted by the Council in 2014. This AQAP outlines a series of measures to be completed in order to improve air quality within the AQMA and therefore the Borough as a whole.

In 2018, due to the reduction of NO_2 concentrations across the Borough-wide AQMA demonstrated in previous reporting years, CBC decided to undertake a Detailed

[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

Modelling Assessment to assess NO_2 concentrations within Cheltenham via a dispersion modelling exercise. The Detailed Modelling Assessment primarily aims at determining the full extent of any annual mean exceedances across the Borough, with the view of amending the current AQMA in response to both monitored and modelled concentrations, ensuring areas of exceedance are appropriately managed and are reflective of the current circumstance. The Detailed Modelling Assessment is currently in the later stages of development, and is scheduled to be published later this year. Details of the assessment will be presented with the ASR to be completed in 2020.

Due to the declaration of the Borough-wide AQMA, NO_2 is the principal pollutant of concern for the Council attributed to traffic sources, and as a result is solely monitored. NO_2 has been measured in Cheltenham since 1996. During 2018, NO_2 was monitored at 30 sites across the Borough inclusive of one automatic monitoring site and 29 non-automatic sites.

During 2018, two sites (Site 4 and 5) reported an exceedance of the NO_2 annual mean AQS objective limit, whereas four reported concentrations were within 10%.

Looking at the past five years, NO_2 annual mean concentrations appear to have reduced at all sites (15 out of 15 sites with available data over 5 years), demonstrating the Councils' continued commitment and work towards improving air quality across the District.

The annual mean NO_2 concentration was not greater than 60 µg/m^3 at any non-automatic monitoring site. Therefore exceedance of the 1-hour mean objective during 2018 at any monitoring location within Cheltenham is considered to be unlikely. Furthermore, the continuous NO_2 monitors present within Cheltenham reported no exceedance of the short term NO_2 1-hour objective throughout 2018, or since 2014.

Actions to Improve Air Quality

The AQAP for CBC is the main document to drive a reduction in air pollution within the Borough. This AQAP was published in 2014, in response to the declaration of the Borough-wide AQMA in 2011, for the monitored NO_2 annual mean exceedance across Cheltenham. The AQAP provides a series of measures (20) designed to help Cheltenham achieve compliance with the NO_2 annual mean AQS objective across the

Borough. These mainly consisted of promoting alternative modes of travel, various traffic/highway measures, and a change to Planning Policy.

In 2018, due to the localisation of annual mean NO_2 exceedances towards the north of the Town Centre, as demonstrated in previous reporting years, CBC decided to undertake a Detailed Modelling Assessment to assess NO_2 concentrations within Cheltenham via a dispersion modelling exercise. The Detailed Modelling Assessment is primarily aimed at determining the full extent of exceedances across the Borough, aiding potential amendments to the current AQMA boundary to ensure areas of exceedance are appropriately managed and are reflective of the current circumstance. In addition, the Detailed Assessment aims to provide an up to date understanding of key vehicle contributors in modelled exceedance to help inform the discussion of potential AQAP measures if required.

Outside of the AQAP, Gloucestershire County Council's Sustainable Transport Plan & Fund aims to achieve a modal shift to public transport, cycling & walking. The Cheltenham Transport Plan aims to reduce vehicle use leading to improved air quality. The Gloucestershire initiative *Thinktravel* provides information & resources for sustainable travel in Gloucestershire. The initiative can be found here www.thinktravel.info. More detailed information regarding these initiatives is given within the main body of this report.

Conclusions and Priorities

During the 2018 reporting year, CBC demonstrated proactive steps to improve air quality across the Borough. These measures include the development of a Detailed Modelling Assessment to improve the Council's understanding of air quality within the region, and the inclusion of additional NO_2 diffusion tubes positioned at targeted locations across the borough, at locations which have been predicted to be in exceedance of the AQS annual mean NO_2 objective limit.

During 2018 there was only two reported exceedances of the annual mean NO_2 AQS objective limit (Site 4 and 5), demonstrating the challenge CBC faces with localisation of air quality hotspots in line with wider improvements. Four sites reported NO_2 annual mean concentrations to be within 10% of the AQS objective.

Within the current monitoring network, Site 4 and 5 have reported the highest annual mean NO_2 concentration each year since 2014. Site 4 is located on the corner of 2 Gloucester Road along a stretch of the A4019, and Site 5 is located at 422 High Street. The A4019 is one of the most significant arterial routes through Cheltenham.

The main priorities for the Council in 2019 are to:

- Complete the Detailed Modelling Assessment;
- Continue to monitor NO_2 concentrations throughout the Borough, and consider the relocation and/or deployment of additional monitors in support of the Detailed Modelling Assessment findings;
- The decision to revoke or amend existing boundaries has been supported by Defra and therefore will be considered by CBC following the completion of the assessment. For further guidance please refer to LAQM Technical Guidance 16 (TG16); and

Update the existing AQAP in response of the declaration of an AQMA/s – if necessary.

Local Engagement and How to get Involved

Members of the public can do their bit by choosing alternative means of transport, particularly in the winter months. Further examples[4] of modifying behaviour to contribute positively to air quality are:

“Can I get into town without using the car?” Perhaps dig out that old bike?

“It’s a nice day, I think I’ll walk”. In fact at some times of the day your walk can almost take the same time as it does to drive. You’ll get fitter and feel better for it.

How about taking the bus and let somebody else do the driving whilst you relax?

Do you have any work colleagues who live nearby and would like to share the cost of taking the car? You’ll not only reduce your costs at least by half (the more who share, the greater the savings), but save on wear and tear, and mileage increases on your vehicles.

[4] Cheltenham Borough Council Annual Status Report 2018

If living outside Cheltenham then perhaps think of our Park and Ride facilities (pay for the bus fare and receive free parking).

How about walking your child to school? Not only will the reduction in vehicles bring improved air quality, but you and your child will have the added benefit from the exercise.

Local schools can continue their work in persuading parents to encourage their children to walk or cycle to school and leave the car at home.

User greener and cleaner vehicles (Electric Vehicles, Hybrid, LPG, etc.)

Lead by example and champion better air quality.

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1 Local Air Quality Management

This report provides an overview of air quality in Cheltenham Borough Council during 2018. 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 Cheltenham Borough Council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England can be found in Table E. 1 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 AQMA declared by Cheltenham Borough Council 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=54. Alternatively, see Appendix D: Maps of Monitoring Locations and AQMAs, which provides for a map of air quality monitoring locations in the Borough.

In 2018, Due to the localisation of annual mean NO_2 exceedances towards the north of the Town Centre, demonstrated in previous reporting years, CBC decided to undertake a Detailed Modelling Assessment to evaluate NO_2 concentrations within Cheltenham via dispersion modelling. The Detailed Modelling Assessment primarily aimed at determining the full extent of exceedances across the Borough, aiding potential amendments to the current AQMA boundary to ensure areas of exceedance are appropriately managed and are reflective of the current circumstance.

It is considered that a new, focused AQMA would: -

- Illustrate to visitors, residents, and prospective purchasers of properties within Cheltenham that the whole of the Borough is not an area of poor air quality; and
- Allow more concerted and targeted action, by the District and County Councils and their partners, to address the known areas of poor air quality.

The Detailed Modelling Assessment is currently in the later stages of development, and is scheduled to be published later this year. Currently, CBC propose to keep the current borough wide AQMA in Cheltenham (see monitoring section) and to review both the modelling and ongoing monitored results prior to making any amendments to the current AQMA boundary.

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
Cheltenham Whole Borough AQMA	18/11/2011	NO_2 Annual Mean	Cheltenham	The whole borough of Cheltenham	Yes	47.9µg/m^3	45.2µg/m^3	Cheltenham Borough Council 2014 A|QAP	2014	https://www.cheltenham.gov.uk/downloads/file/3780/air_quality_action_plan_2014

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

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

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

1. *"The decision to revoke (to replace with a smaller AQMA) or amend existing boundaries is supported. For further guidance please refer to LAQM Technical Guidance 16 (TG16).*
2. *Please ensure Table 2.1 matches the template version and includes data regarding current levels of exceedances. For further guidance please refer to TG16.*
3. *The AQAP presented is comprehensive and contains good discussion/commentary of progress. The majority of measures are expected to be completed by the end of 2018. The Council should review their plan and update it accordingly, ideally introducing further, more specific measures that target known hotspots. For further guidance please refer to TG16.*
4. *The Council recently expanded their monitoring network, this is supported. The Council should aim to increase monitoring where resources allow.*
5. *Generally the report is concise, well written and illustrates the hard work the Council are undertaking to improve local air quality. However further actions are required to bring the Borough within national limits."*

The comments made within the appraisal report, as shown above, have been taken into account for the completion of the 2019 ASR.

The Council has taken forward a number of direct measures during the current reporting year of 2018 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2.

More detail on these measures can be found in the Council's Action Plans. A list of measures completed prior to 2018 can be found in the 2018 ASR.

The Council expects all ongoing measure to be actively managed and progressed over the course of the next reporting year.

Whilst the measures stated above and in Table 2.2 will help to contribute towards compliance, the Council anticipates that further additional measures not yet prescribed will be required in subsequent years to achieve compliance across Cheltenham. These measures are expected to be discussed within future, updated, AQAP.

Table 2.2 – Progress on Measures to Improve Air Quality

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
1	Highways improvements	Transport Planning and Infrastructure	Other	Gloucestershire County Council and Local Sustainable Transport Fund	2013-14	2016-18	Reduction in through traffic and improved access to car parks. Reduced congestion at key junctions	1-2%	A range of highway amendments have taken place and others are planned, subject to traffic regulation orders. To take place in 4 phases.	2018	Phase 3 completed in Autumn 2017. Phase 4 (closure of Boots Corner to through traffic – allowing buses and taxis). This is to be implemented in Summer 2018 on a trial basis. 2-way junction priority changes at Albion Street and Imperial Square allowing traffic easier access to town centre car parks was completed in 2017.
2	Air Quality Information	Public Information	Via the Internet	Cheltenham Borough Council	2014-15	2015-16	Hit counter on webpage	<0.1%	Up to date Air Quality information available on CBC website	Ongoing	Emission reductions directly attributable to this action cannot be measured.
3	Promotion of Park & Ride	Alternatives to private vehicle use	Bus based Park & Ride	Gloucestershire County Council	2014-15	2014-16	Reduced car travel into & out of Cheltenham	0.1-1%	Improved signage installed at Arle Court. 22 new spaces added to Arle Court Park and Ride.	2018	The Elmbridge Park & Ride proposal on the outskirts of Gloucester is the subject of a separate funding bid. The Elmbridge highway improvements were completed on time. A further scheme at Elms Park, Tewkesbury Road (to the west of Cheltenham) forms part of the proposed Bloor/Persimmon Development

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
4	Promotion of Greener Vehicles	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	Gloucestershire County Council	2012	2013-15	Charge Point usage data	<0.5%	Electric charging points (fast) are installed at Regent Arcade, Montpellier Street and Arle Court Park and Ride site. Rapid chargers are installed at Cheltenham Chase Hotel (Brockworth) and Compass Holidays (Cheltenham Railway Station). Promenade charging has not been installed to date.	Ongoing	The Borough and County Councils continue to encourage electric vehicle use 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 on street and in car parks. The Borough currently provide free EV charging at its car park charging points.
5	HGV Restrictions	Freight and Delivery Management	Route Management Plans/ Strategic routing strategy for HGV's	Gloucestershire County Council	2014	2015	Traffic count data	<0.5%	Boots Corner closure implemented in summer 2018	2018	HGV/LGV restrictions in Phase 4 of the Cheltenham Transport Plan Ph4 (Boots Corner closure) are currently being implemented. Deliveries are restricted to certain times only. This junction will however be closed to all vehicles apart from delivery vehicles. Buses and taxis.
6	Increased Car Sharing	Alternatives to private vehicle use	Car & lift sharing schemes	Gloucestershire County Council	2013	2015	Traffic count data	0.10%	A new website has been launched with promotional work taking place at businesses and on street across Cheltenham via flyers and face to face	2016	'Parish Lift', a new community car sharing scheme was developed in 2016 to help support social inclusivity and rural accessibility across the Cotswolds Area of

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
									discussions. New road signage is installed.		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 or people seeking a 'lift'.
7	Business Travel Grants	Promoting Low Emission Transport		Gloucestershire County Council	2013	2014-15	Uptake of grants	<0.1%	Grants completed in 2015	2018	In 2016/17, 132 businesses, representing 2,205 staff, were contacted in the Cheltenham parking zones 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.
8	Wayfinding Initiative	Promoting Travel Alternatives		Gloucestershire County Council	2013	2014-15	None	<0.1%	Signage installed	2017	Work is ongoing to improve signage and route access for cyclists and pedestrians Phase 2

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
											was completed in 2017.
9	Promote Workplace Travel Plans	Promoting Travel Alternatives		Cheltenham Borough Council	2014	2015	Whether or not a plan is implemented	<0.1%	No plan to date	unknown	Cheltenham Borough Council will develop its own workplace 'smarter' travel plan where resources allow and encourage larger businesses in Cheltenham to develop and implement similar plans. This will encourage more sustainable transport choices such as bus travel, car-sharing, cycling and walking.
10	Air Quality Planning Policy	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	Cheltenham Borough Council	2013	2015	Air Quality Planning Policy adopted	Unknown but potentially significant	Planning for Air Quality - a good practice guide for Planners and Developers was published in 2013. The Joint Core Strategy contains policies that require consideration of air quality in planning.	unknown	Although no specific policy on Air Quality will be adopted as part of the emerging Cheltenham Local Plan (due 2017-2018), 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.
11	Traffic Light Appraisal	Traffic Management	Strategic highway improvements, Re-prioritising road space away from cars, including	Gloucestershire County Council	2014	2015-17	Number of traffic lights removed and traffic count/speed data	Potentially significant in current areas of poor air quality	Under the Cheltenham Transport Plan 2 sets of traffic lights have been removed. No further removals planned. Upgrades to	Ongoing	MOVA is an intelligent traffic signal system, which over time can optimise traffic signals reducing queues and congestion. These are currently being

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
			Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane						traffic lights to MOVA system is ongoing. (see comments)		installed following routine upgrades to signal systems in Cheltenham.
12	Bus and Taxi quality partnership	Promoting Low Emission Transport		Gloucestershire County Council	2014	2016-16	Anecdotal	Unknown	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.	2018 and ongoing	The Council's AQAP proposed a Bus and Taxi Quality Partnership, to obtain an agreement with the main taxi and bus operators to encourage fuel efficient driving, no-idling when stationary and training in safe driving practices – with the aim of reducing vehicle emissions. No specific partnership but buses and taxis are not allowed to idle at bus stops and taxi ranks in town.
13	Twenty is plenty	Promoting Low Emission Transport		Cheltenham Borough Council	2014-15	2015-17	Traffic count/speed data	<0.5%	The Cabinet working group are awaiting better guidance on the benefits and implementation	Ongoing	Cheltenham and Gloucestershire County Council will look at the potential for reducing urban traffic speed limit to 20mph in some areas to reduce congestion and improve traffic flow on busier roads, which may improve highway safety for cyclists and pedestrians as well as improve air quality.

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
14	Low emission bus fleet	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	Cheltenham Borough Council	2013	2014-16	Bus fleet data	0.50%	Initial funding bid to Government failed but received positive response.	Ongoing	The main bus fleet company in Cheltenham and Gloucester has the most modern fleet in any area of the UK. Many buses are Euro 6 compliant.
15	Green Planting	Traffic Management	Other	Cheltenham Borough Council	2014	2014-16	Number of urban planning applications with green planting schemes adopted	<0.1%	Greening of parts of Cheltenham High Street is due as part of improvements to the public realm during 2018/19.	Ongoing	Cheltenham Borough Council will seek to encourage green planting through planning control to help off-set potential pollution impacts where developments occur in areas of poorer air quality. Such measures include planting through planning controls, on CBC parks and property, and on Highways, which is ongoing and planting as part of street enhancement schemes (particularly through the Cheltenham Transport Plan) scheduled between 2016-2019.
16	Vehicle management signage	Traffic Management	Other	Cheltenham Borough Council	2014	2014-18	Traffic Count data	<0.1%	Air Quality Grant Scheme bid submitted in 2016 but was unsuccessful. Further bids will be looked at.	Unknown	Through the Cheltenham Transport Plan and the CBC Car Parking Strategy the Borough Council will work with the County Council on the implementation of Vehicle Management Signage. This proposal is for the

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
											installation of electronically operated signs to inform drivers of the nearest available car parking spaces and alert drivers of possible congestion. This may encourage more sustainable transport choices and reduce traffic queues which will improve air quality
17	Cycle Safety Improvements	Transport Planning and Infrastructure	Cycle network	Cheltenham Borough Council	2014	2014-16	Number of cyclists and accident & injury statistics	<0.1%	See comments	Ongoing	Barriers to Cycling' project completed Autumn 2017 with installation of contraflow cycle lane on Sandford Mill Road Cycle Improvements on Up Hatherley Way with a new Shared Use Footway Cycleway, completed in June 2018. Kingsditch Lane Cycle Improvements, conversion of existing footway to shared use completed Oct 2017. Pitville to the Park Cycle Route – signing of the cycle route completed.

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 $PM_{2.5}$ (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.

Currently there is no monitoring of $PM_{2.5}$ completed within the Borough, as efforts are being concentrated on monitoring NO_2 levels in line with the established Borough-wide AQMA. However, as primary emissions of both NO_2 and particulates predominately originate from the same source, measures which attempt to reduce NO_2 levels within Cheltenham will simultaneously reduce levels of PM_{10} and $PM_{2.5}$. Examples of such measures can be found in Table 2.2, for instance, but not limited to, measures 1, 4, 5, and 6.

In the absence of monitoring, the current Defra 2018 background maps[5] for Cheltenham (2017 based) show that all background concentrations of PM2.5 are far below the 2020 annual mean AQS objective for PM2.5. The highest concentration is predicted to be 10.1µg/m^3 within the 1 x 1km grid square with the centroid grid reference of 396500, 223500. This grid square is located north-east of Cheltenham adjacent to the B4632 Prestbury Road where the PM secondary fraction (formed from gaseous pollutants), constitutes as the key contributor to $PM_{2.5}$.

The Public Health Outcomes Framework[6] data tool complied by Public Health England quantifies the mortality burden of $PM_{2.5}$ within England on a county and local authority scale. The 2017 fraction of mortality attributable to $PM_{2.5}$ pollution in Cheltenham is 5.0%, below the national average of 5.1%, but higher than the regional average (South West) 4.4%.

[5] https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2017

[6] Public Health Outcomes Framework, Public Health England. data tool available online at http://www.phoutcomes.info/public-health-outcomes-framework

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

3.1 Summary of Monitoring Undertaken

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

3.1.1 Automatic Monitoring Sites

In 2018, the Council operated one continuous monitor, located adjacent to the St George's Street intersection with Swindon Road, recording NO_x/NO_2 concentrations via a chemiluminescence analyser. This automatic monitor is co-located with three diffusion tubes, allowing a bias adjustment factor to be derived through a triplicate co-location study.

Table A. 1 in Appendix A shows the details of the automatic monitoring site, and its location is presented 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

Cheltenham undertook non-automatic (passive) monitoring of NO_2 at 29 sites during 2018, including a triplicate colocation study (sites 7, 8, and 9). During 2018, nine additional diffusion tubes were deployed (Sites 21 to 29) to expand the monitoring network providing more clarity for NO_2 concentrations across Cheltenham. Site 21 was installed for data capture in December, Site 22 in May, and Sites 23 to 29 in August.

Table A. 2 in Appendix A shows the details of the sites and maps showing the location of the monitoring sites are provided in Appendix D: Maps of Monitoring Locations and AQMAs.

Further details on Quality Assurance/Quality Control (QA/QC) for the diffusion tubes, including bias adjustments and any other adjustments applied (e.g. "annualisation"), are included in Appendix C.

3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias, “annualisation” and distance correction. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen Dioxide (NO_2)

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.

For diffusion tubes, the full 2018 dataset of monthly mean values is provided in Appendix B.

Results for 2018 have been bias adjusted using a local bias adjustment factor of 0.97 derived from the co-location study at CM1. Full details of the bias adjustment and QA/QC procedure are provided in Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC

The table below provides a summary of measured annual mean concentrations (annualised and bias adjusted) that were recorded for 2018. During 2018, two sites (sites 4 and 5) reported an exceedance of the NO_2 annual mean AQS objective limit, whereas four other sites (sites 6, 14, 18, 28) reported concentrations to be within 10% (Table 3.1). All sites were considered to reperesent relevant exposure; apart from sites 4 and 28 which have been distance corrected in accordance with LAQM.TG(16), the remaining sites are therefore comparable with the AQS objective limit.

Site 4 and 5 have reported the highest annual mean NO_2 concentration within the Borough since 2014, and are located within 175m of one another. Site 4 is located on the corner of 2 Gloucester Road along a stretch of the A4019 and Site 5 is located at 422 High Street. The A4019 is an arterial route through Cheltenham where highway and towncentre traffic meet (2018 count was upto 20632 motorised vehicles; start junction A4019 and end junction B4385).

Table 3.1 - Summary of Measured Annual Mean NO_2 Exceedances and Near Exceedances

Site ID	Site Location Within AQMA	Site Type	NO_2 Annual Mean Concentration ($\mu g/m^3$)
4	2 Gloucester Road	Roadside	**41.2**
5	422 High St	Roadside	**45.2**
6	New Rutland	Roadside	37.9
14	2 London Road	Roadside	37.4
18	81 London Road	Roadside	37.3
28	Princess Elizabeth Way North	Roadside	38.4

Looking at the past five years, NO_2 annual mean concentrations appear to have reduced at all sites (15 out of 15 sites with available data over 5 years), demonstrating the Councils' continued commitment and work towards improving air quality across the District. Site 12 recorded the largest reduction in NO_2 concentrations, in comparison with 2014 level, illustrating a 7.5$\mu g/m^3$ reduction. Site 12 is located adjacent to the A46.

The annual mean NO_2 concentration was not greater than 60$\mu g/m^3$ at any non-automatic monitoring site. Therefore exceedance of the 1-hour mean objective during 2018 at any monitoring location within Cheltenham is considered to be unlikely. Furthermore the continuous NO_2 monitors present within Cheltenham reported no exceedance of the short term NO_2 1-hour objective throughout 2018, or since 2014.

Based on historical and 2018 monitoring data discussed, it is recommended that the current AQMA is reviewed and upon completion of the Detailed Modelling Assessment a review of the AQMA boundaries is completed. The decision to complete a review of the current AQMA boundary has previously been supported by Defra and is currently under consideration by the Council.

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)
CM1	St Georges Street	Kerbside	394760	222878	NO_2	YES	Chemiluminescence	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.

Y OS grid reference has been corrected in the 2019 ASR from 228878 to 222878.

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

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	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	Municipal Offices (Front)	Roadside	394757	222320	NO_2	YES	0	6.5	NO	3.7
2	Municipal Offices (Back)	Roadside	394724	222320	NO_2	YES	10	4.5	NO	2.7
3	Ladies College	Roadside	394621	222215	NO_2	YES	0	5.7	NO	2.9
4	2 Gloucester Road	Roadside	394235	223055	NO_2	YES	2	0.5	NO	2.9
5	422 High St	Roadside	394350	222923	NO_2	YES	0	1.8	NO	2.9
6	New Rutland	Roadside	394738	222888	NO_2	YES	0	1.9	NO	2.9
7,8,9	St Georges Street	Roadside	394760	222878	NO_2	YES	1	2.4	YES	1.3
10	2 Swindon Road	Kerbside	394830	222845	NO_2	YES	1	2.1	NO	2.9
11	Portland Street	Roadside	395110	222670	NO_2	YES	2	1.6	NO	3.1
12	Winchcombe/Fairview	Roadside	395210	222618	NO_2	YES	1	3.2	NO	3.1
13	Albion Street (outside no. 54)	Kerbside	395207	222465	NO_2	YES	5	1.2	NO	2.8
14	2 London Road	Roadside	395362	222000	NO_2	YES	0	3	NO	2.9
15	YMCA - High St	Roadside	395182	222183	NO_2	YES	0	1.9	NO	3
16	8a Bath Road	Roadside	395146	222149	NO_2	YES	0	2	NO	3
17	Clarence Parade (opp no. 6)	Roadside	394801	222454	NO_2	YES	0	2.9	NO	2.8
18	81 London Road	Roadside	395660	221670	NO_2	YES	0	4.7	NO	2.7
19	264 Gloucester Road	Roadside	393296	222170	NO_2	YES	5	0.8	NO	2.5
20	340 Gloucester Road	Roadside	392912	221862	NO_2	YES	0	3.6	NO	2.8

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	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)
21	14 Imperal Square	Roadside	394809	222060	NO_2	YES	4	0.4	NO	2.8
22	Hatherley Lane	Roadside	391179	221640	NO_2	YES	7	3.7	NO	2.8
23	St James Square	Roadside	394577	222424	NO_2	YES	2.3	0.5	NO	2.8
24	St Gregorys Church	Roadside	394566	222600	NO_2	YES	1.5	0	NO	0
25	St Georges Street	Roadside	394708	222763	NO_2	YES	2.3	0.4	NO	2.95
26	St Pauls Road	Roadside	394902	223004	NO_2	YES	1	1.1	NO	2.9
27	St Lukes College Road	Roadside	395156	221866	NO_2	YES	9.5	0.6	NO	2.85
28	Princess Elizabeth Way North	Roadside	393081	223643	NO_2	YES	8	1.2	NO	2.9
29	Princess Elizabeth Way South	Roadside	392066	222540	NO_2	YES	17	1.3	NO	2.8

Notes:

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

(2) N/A if not applicable.

Table A. 3 – Annual Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2018 (%) [2]	NO_2 Annual Mean Concentration (µg/m³) [3]				
					2014	2015	2016	2017	2018
CM1	Roadside	Automatic	89.4	89.4	35.0	35.0	34.0	36.0	32.7
1	Roadside	Diffusion Tube	100.0%	100.0%	-	-	-	26.4	22.9
2	Roadside	Diffusion Tube	100.0%	100.0%	-	-	-	32.9	28.0
3	Roadside	Diffusion Tube	100.0%	100.0%	33.9	36.6	33.8	32.8	27.5
4	Roadside	Diffusion Tube	100.0%	100.0%	**41.7**	**46.5**	**43.2**	**45.4**	**41.2**
5	Roadside	Diffusion Tube	100.0%	100.0%	**46.5**	**47.3**	**45.5**	**49.9**	**45.2**
6	Roadside	Diffusion Tube	100.0%	100.0%	**42.1**	**42.4**	**40.8**	**41.6**	37.9
7,8,9	Roadside	Diffusion Tube	97.2%	97.2%	34.4	34.6	33.3	36.4	32.9
10	Kerbside	Diffusion Tube	91.7%	91.7%	38.8	37.9	38.2	39.4	35.6
11	Roadside	Diffusion Tube	100.0%	100.0%	35.2	36.8	35.7	35.9	32.6
12	Roadside	Diffusion Tube	100.0%	100.0%	39.3	33.0	32.2	32.8	31.8
13	Kerbside	Diffusion Tube	100.0%	100.0%	-	-	-	34.8	31.3
14	Roadside	Diffusion Tube	100.0%	100.0%	**40.1**	**40.0**	38.0	37.1	37.4
15	Roadside	Diffusion Tube	100.0%	100.0%	35.2	34.5	32.9	31.9	29.1
16	Roadside	Diffusion Tube	100.0%	100.0%	**40.8**	**41.1**	38.4	38.0	34.5
17	Roadside	Diffusion Tube	58.3%	58.3%	-	-	-	33.8	31.5
18	Roadside	Diffusion Tube	100.0%	100.0%	**41.8**	**41.4**	39.6	38.4	37.3
19	Roadside	Diffusion Tube	100.0%	100.0%	34.0	36.7	32.2	34.4	30.6
20	Roadside	Diffusion Tube	100.0%	100.0%	36.3	38.7	35.9	38.6	35.3
21	Roadside	Diffusion Tube	100.0%	100.0%	-	-	-	-	23.4
22	Roadside	Diffusion Tube	100.0%	66.7%	-	-	-	-	34.9

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3)				
					2014	2015	2016	2017	2018
23	Roadside	Diffusion Tube	100.0%	41.7%	-	-	-	-	30.9
24	Roadside	Diffusion Tube	100.0%	41.7%	-	-	-	-	27.9
25	Roadside	Diffusion Tube	100.0%	41.7%	-	-	-	-	31.9
26	Roadside	Diffusion Tube	100.0%	41.7%	-	-	-	-	29.0
27	Roadside	Diffusion Tube	100.0%	41.7%	-	-	-	-	24.8
28	Roadside	Diffusion Tube	100.0%	41.7%	-	-	-	-	38.4
29	Roadside	Diffusion Tube	100.0%	41.7%	-	-	-	-	31.2

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

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

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.

Figure A.1 – Trends in Annual Mean NO_2 Concentrations Measured at all Monitoring Sites: Borough-Wide AQMA

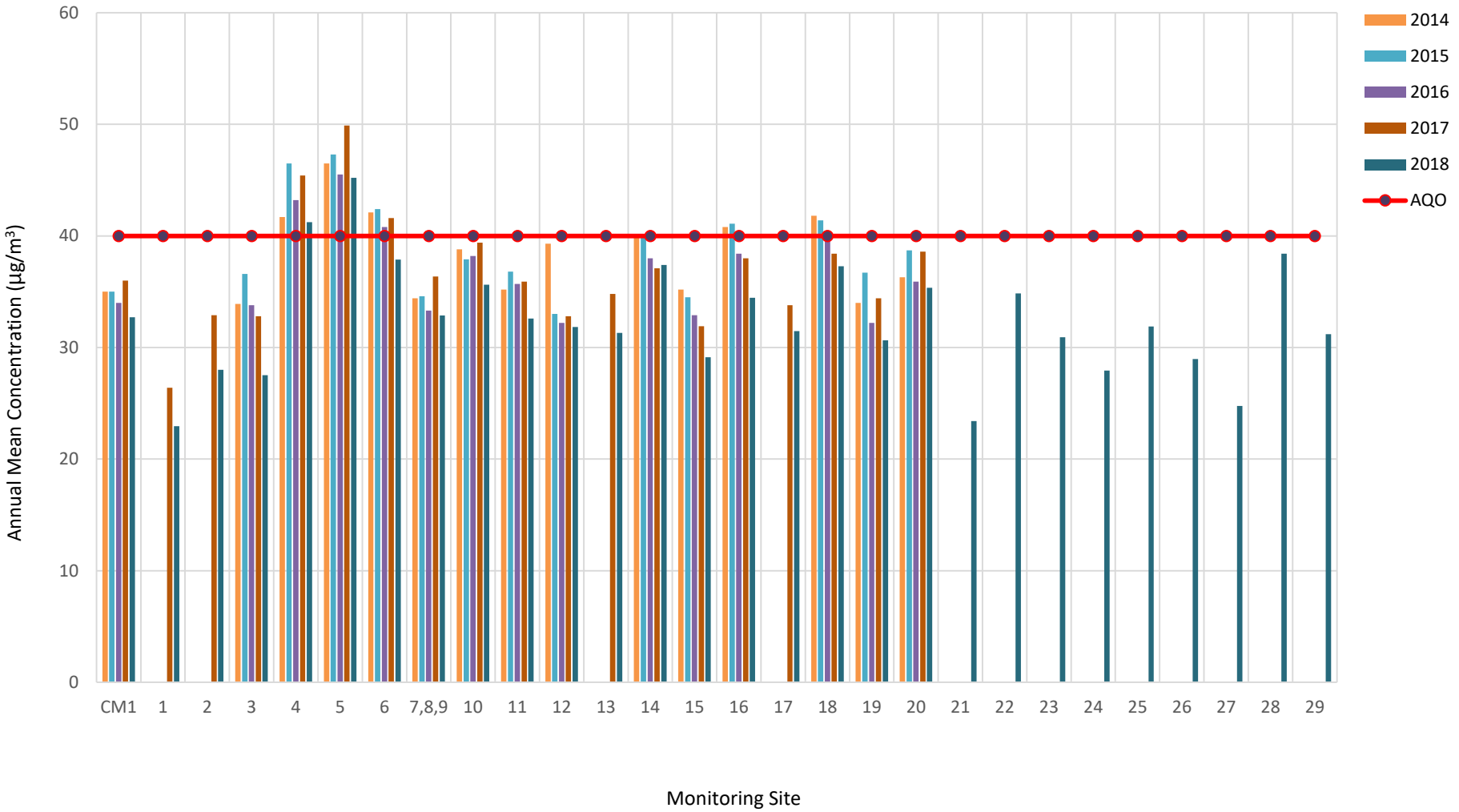


Table A.1 – 1-Hour Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	NO_2 1-Hour Means > 200µg/m^3 (3)				
					2014	2015	2016	2017	2018
CM1	Roadside	Automatic	89.4	89.4	0	0	0	0	0

Notes:

Exceedances of the NO_2 1-hour mean objective (200 µg/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.

Appendix B: Full Monthly Diffusion Tube Results for 2018

Table B.1 – NO_2 Monthly Diffusion Tube Results - 2018

Site ID	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 (0.97) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
1	29.4	25.6	25.0	23.3	19.5	15.9	22.7	19.9	22.6	25.6	25.5	28.9	23.7	22.9	-
2	31.0	36.0	36.5	29.1	28.5	22.3	21.8	21.9	25.4	28.4	33.7	31.7	28.9	28.0	-
3	34.2	29.8	29.7	25.0	25.0	21.6	27.6	24.9	28.2	28.2	28.3	37.9	28.4	27.5	-
4	45.4	40.5	42.0	45.6	37.8	31.0	47.3	34.1	40.7	47.2	40.6	57.8	**42.5**	**41.2**	29.2
5	52.1	48.5	47.9	47.2	42.6	35.9	44.8	41.7	49.7	45.0	46.8	56.9	**46.6**	**45.2**	-
6	46.9	39.5	41.9	37.4	42.5	28.3	41.5	37.7	43.4	45.4	43.5	20.6	39.1	37.9	-
7	38.2	Missing	33.6	35.9	31.2	26.8	34.2	30.8	28.2	36.4	33.4	40.3	33.6	32.6	-
8	39.4	32.6	33.8	34.9	34.2	26.9	34.4	32.6	34.1	35.4	33.8	39.5	34.3	33.3	-
9	36.1	34.2	35.4	33.8	30.5	25.5	34.8	31.5	35.3	34.8	34.1	39.5	33.8	32.8	-
10	43.3	39.1	38.5	38.1	35.0	29.3	33.8	29.4	36.0	Missing	36.0	45.5	36.7	35.6	-
11	36.8	35.8	42.1	36.0	33.1	30.9	29.8	25.8	29.8	33.5	36.4	33.4	33.6	32.6	-
12	32.7	32.9	33.9	29.2	28.3	23.6	31.3	31.3	30.4	42.0	35.7	42.5	32.8	31.8	-
13	35.9	37.8	33.5	32.1	34.4	24.3	29.8	23.8	30.6	35.7	30.2	39.3	32.3	31.3	-
14	36.2	43.7	42.8	39.4	39.4	43.7	34.9	35.2	33.2	37.8	35.8	40.5	38.5	37.4	-
15	33.4	33.2	34.1	29.5	29.2	25.3	27.5	25.5	26.4	33.0	28.9	34.6	30.0	29.1	-
16	40.0	40.8	37.6	37.0	34.7	32.4	33.3	31.1	31.8	30.2	37.6	40.1	35.5	34.5	-

Site ID	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 (0.97) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
17	39.3	38.6	32.9	28.5	32.3	25.5	24.3	-	-	-	-	-	31.6	31.5	-
18	45.0	40.4	39.5	39.8	35.8	34.0	35.0	33.0	36.5	40.3	41.3	40.8	38.4	37.3	-
19	38.4	35.1	36.0	30.8	28.6	22.8	32.6	28.5	31.1	33.6	27.8	33.8	31.6	30.6	-
20	40.1	40.9	38.8	37.6	34.9	28.2	32.2	30.8	33.4	35.7	42.0	42.5	36.4	35.3	-
21	26.4	29.1	28.8	24.0	23.5	17.7	19.4	18.4	20.4	25.8	25.6	30.6	24.1	23.4	-
22	-	-	-	-	34.2	33.4	30.7	29.0	34.1	35.7	30.5	35.8	32.9	34.9	-
23	-	-	-	-	-	-	-	29.5	31.7	33.2	35.8	33.8	32.8	30.9	-
24	-	-	-	-	-	-	-	22.5	26.9	33.0	32.0	33.7	29.6	27.9	-
25	-	-	-	-	-	-	-	25.7	32.9	35.8	37.2	37.4	33.8	31.9	-
26	-	-	-	-	-	-	-	23.3	30.5	33.3	31.8	34.6	30.7	29.0	-
27	-	-	-	-	-	-	-	21.7	23.8	28.6	29.9	27.2	26.3	24.8	-
28	-	-	-	-	-	-	-	34.2	41.2	43.4	42.2	42.7	40.7	38.4	25.0
29	-	-	-	-	-	-	-	27.5	25.3	32.7	39.3	40.6	33.1	31.2	-

☒ **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**

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.
“-“ tubes not installed during this month due to termination of sampling or prior to commissioning of sample location.

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

Diffusion Tube Local Bias Adjustment Factors

Cheltenham Council operate one continuous NO_2 analyser (CM1) that has a triplicate site of diffusion tubes co-located at the monitoring site. A local bias adjustment factor has been calculated for the location using the Precision and Bias adjustment spreadsheet (v04), the output is presented below in Figure C.1.

Figure C.1 – Local Bias Correction Output: St George's Street (Tubes 7/8/9)

Checking Precision and Accuracy of 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 Mean	Standard Deviation	Coefficient of Variation	95% CI of mean
1	03/01/2018	31/01/2018	38.2	39.4	36.1	38	1.7	4	4.1
2	31/01/2018	28/02/2018		32.6	34.2	33	1.1	3	10.2
3	28/02/2018	28/03/2018	33.6	33.8	35.4	34	1.0	3	2.5
4	28/03/2018	02/05/2018	35.9	34.9	33.8	35	1.1	3	2.7
5	02/05/2018	06/06/2018	31.2	34.2	30.5	32	1.9	6	4.8
6	06/06/2018	04/07/2018	26.8	26.9	25.5	26	0.8	3	1.9
7	04/07/2018	01/08/2018	34.2	34.4	34.8	34	0.3	1	0.7
8	01/08/2018	05/09/2018	30.8	32.6	31.5	32	0.9	3	2.2
9	05/09/2018	03/10/2018	28.2	34.1	35.3	33	3.8	12	9.4
10	03/10/2018	31/10/2018	36.4	35.4	34.8	36	0.8	2	1.9
11	31/10/2018	05/12/2018	33.5	33.8	34.1	34	0.3	1	0.8
12	05/12/2018	09/01/2019	40.3	39.5	39.5	40	0.5	1	1.2
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor
39.5	71.9	Good	Poor Data Capture
		Good	
37.2	95.7	Good	Good
32.6	99.6	Good	Good
30.2	99.8	Good	Good
21.6	95.4	Good	Good
30.5	100.0	Good	Good
28.7	99.9	Good	Good
32.1	99.9	Good	Good
36.3	99.7	Good	Good
34.6	99.9	Good	Good
42.2	99.9	Good	Good
Overall survey -->		Good precision	Good Overall DC

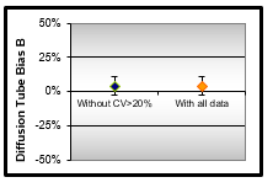
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Cheltenham Borough Council

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

Accuracy (with 95% confidence interval) without periods with CV larger than 20%
Bias calculated using 10 periods of data
Bias factor A: 0.97 (0.91 - 1.04)
Bias B: 3% (-4% - 9%)
Diffusion Tubes Mean: 34 µgm^{-3}
Mean CV (Precision): 3
Automatic Mean: 33 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 33 (31 - 35) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 10 periods of data
Bias factor A: 0.97 (0.91 - 1.04)
Bias B: 3% (-4% - 9%)
Diffusion Tubes Mean: 34 µgm^{-3}
Mean CV (Precision): 3
Automatic Mean: 33 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 33 (31 - 35) µgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

If you have any enquiries about this spreadsheet please contact the LAQM Helpdesk at: LAQMHelpdesk@uk.bureauveritas.com

Diffusion Tube National Bias Adjustment Factor

The diffusion tubes used by Cheltenham Council are supplied and analysed by Gradko International, the tubes were prepared using the 20% TEA in acetone preparation method. The 2018 national bias adjustment factor for Gradko 20% TEA in water is 0.92, based on 37 studies, as derived from the national bias adjustment factor spreadsheet (Round 1 of 3)[7].

[7] National Diffusion Tube Bias Adjustment Factor Spreadsheet version 03/19 available at https://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html

Figure C.2 – National Diffusion Tube Bias Adjustment Factors

National Diffusion Tube Bias Adjustment Factor Spreadsheet — Spreadsheet Version Number: 06/19

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 spreadhseet 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 September 2019

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 (Select your selection, or use "All" from the pop-up list)	Year[2] (Select your selection, or use "All")	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m³)	Automatic Monitor Mean Conc. (Cm) (µg/m³)	Bias (B)	Tube Precision[5]	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	20% TEA in water	2018	R	Ards and North Down Borough Council	11	36	29	27.4%	G	0.78
Gradko	20% TEA in water	2018	R	Gedling Borough Council	12	33	32	5.6%	G	0.95
Gradko	20% TEA in water	2018	R	Lisburn & Castlereagh City Council	12	32	24	32.1%	G	0.76
Gradko	20% TEA in water	2018	R	Monmouthshire County Council	12	38	36	4.7%	G	0.96
Gradko	20% TEA in water	2018	UB	Northampton Borough Council	12	16	13	26.8%	G	0.79
Gradko	20% TEA in water	2018	R	Bedford Borough Council	11	32	29	9.2%	G	0.92
Gradko	20% TEA in water	2018	R	Borough Council of King's Lynn and West Norfolk	12	26	24	6.0%	G	0.94
Gradko	20% TEA in water	2018	R	Cheshire West and Chester	12	36	37	-2.5%	G	1.03
Gradko	20% TEA in water	2018	R	Cheshire West and Chester	12	43	40	6.1%	G	0.94
Gradko	20% TEA in water	2018	R	Fareham Borough Council	12	28	34	-17.5%	G	1.21
Gradko	20% TEA in water	2018	R	Fareham Borough Council	12	37	34	8.9%	G	0.92
Gradko	20% TEA in water	2018	R	Fareham Borough Council	12	32	28	12.6%	G	0.89
Gradko	20% TEA in water	2018	R	NOTTINGHAM CITY COUNCIL	12	35	34	0.3%	G	1.00
Gradko	20% TEA in water	2018	R	Bracknell Forest Borough Council	12	44	37	19.4%	G	0.84
Gradko	20% TEA in water	2018	R	Brighton & Hove City Council	9	48	50	-3.7%	G	1.04
Gradko	20% TEA in water	2018	R	Eastleigh Borough Council	11	28	32	-12.0%	G	1.14
Gradko	20% TEA in water	2018	R	Eastleigh Borough Council	12	42	38	10.2%	G	0.91
Gradko	20% TEA in water	2018	UB	Eastleigh Borough Council	12	27	28	-4.4%	G	1.05
Gradko	20% TEA in water	2018	R	Gateshead Council	12	29	25	13.9%	G	0.88
Gradko	20% TEA in water	2018	R	Gateshead Council	12	32	29	10.8%	G	0.90
Gradko	20% TEA in water	2018	R	Gateshead Council	9	40	41	-1.8%	G	1.02
Gradko	20% TEA in water	2018	R	Wokingham Borough Council	12	38	33	13.2%	G	0.88
Gradko	20% TEA in water	2018	R	Bath & North East Somerset	12	40	39	4.0%	G	0.96
Gradko	20% TEA in water	2018	R	Bedford Borough Council	10	30	27	8.8%	G	0.92
Gradko	20% TEA in water	2018	KS	Marylebone Road Intercomparison	11	93	85	9.3%	G	0.91
Gradko	20% TEA in water	2018	R	South Gloucestershire Council	12	21	20	6.3%	G	0.94
Gradko	20% TEA in water	2018	R	Thurrock Borough Council	12	53	52	2.3%	S	0.98
Gradko	20% TEA in water	2018	R	Thurrock Borough Council	12	34	30	15.1%	G	0.87
Gradko	20% TEA in water	2018	R	Thurrock Borough Council	12	31	24	28.8%	G	0.78
Gradko	20% TEA in water	2018	UB	Thurrock Borough Council	12	27	25	9.2%	S	0.92
Gradko	20% TEA in water	2018	UC	Belfast City Council	12	32	27	16.4%	G	0.86
Gradko	20% TEA in water	2018	R	City of Lincoln Council	12	44	34	32.1%	G	0.76
Gradko	20% TEA in water	2018	R	Lancaster City Council	11	39	35	12.4%	G	0.89
Gradko	20% TEA in water	2018	R	Lancaster City Council	11	31	34	-8.5%	G	1.09
Gradko	20% TEA in water	2018	UB	Liverpool City Council	12	20	18	11.0%	G	0.90
Gradko	20% TEA in water	2018	R	Blackburn with Darwen Borough Council	12	26	20	28.8%	G	0.78
Gradko	20% TEA in water	2018	R	Dartford Borough Council	11	50	48	4.3%	G	0.96
Gradko	20% TEA in water	2018		Overall Factor[3] (37 studies)				Use		0.92

Discussion of Choice of Bias Adjustment Factor to Use

The diffusion tube data has been corrected using a bias adjustment factor, which is an estimate of the difference between diffusion tube concentration and continuous monitoring, the latter assumed to be a more accurate method of monitoring. The Defra LAQM.TG(16) 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.

The local bias adjustment factor (0.97) has been used to adjust the 2018 diffusion tube data. The automatic monitor and co-located diffusion tubes all had good overall data capture for the period, whilst the diffusion tubes had good precision throughout.

QA/QC of Automatic Monitoring

CM1, located on St Georges Street/Swindon Road junction, is operated and managed by Enviro Technology Services plc. The M200E NOx analyser is MCERTS approved, mirroring compliance with the European Committee for Standardisation (CEN) standard EN14211:2012, and measures NOx, 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.

QA/QC of Diffusion Tube Monitoring

Gradko International Ltd (Gradko) is a UKAS accredited laboratory and participates in the AIR-PT Scheme (a continuation of the Workplace Analysis Scheme for Proficiency (WASP) for NO_2 tube analysis and the Annual Field Inter-Comparison Exercise. This provide strict performance criteria for participating laboratories to meet, thereby ensuring NO_2 concentrations are reported to a high level of accuracy. The lab follows the procedures set out in the Harmonisation Practical Guidance.

In the 2018 AIR-PT results, AIR-PT AR024 (January to February 2018), AIR PT AR025 (April to May 2018), AIR PT AR027 (July to August 2018) and AIR PT AR028 (September to October 2018), Gradko scored 100%. The percentage score reflects the results deemed to be satisfactory based upon the z-score of $< \pm 2$.

Short-term to Long-term Data Adjustment

In regards to the 2018 diffusion tube data set, annualisation was required at three diffusion tube locations due to data capture being below 75%. Annualisation has been completed in line with Box 7.9 and Box 7.10 within LAQM.TG(16) and full working details are presented in Table C.1 to Table C.4.

In completing the annualisation process, data has been taken from a number of automatic monitoring sites that are part of the AURN. In line with LAQM.TG(16) the monitoring sites that have been used lie within a radius of approximately 50 miles of the sites to be annualised and have a data capture of 85% or above. The monitoring sites that were used are listed in Table C.1 to Table C.4.

Table C.1 – AURN Monitoring Stations used for Annualisation

Pollutant	Background AURN Sites used for Annualisation
NO_2	1. Leamington Spa – Urban Background 2. Leominster – Suburban Background 3. Swindon Walcot – Urban Background

Table C.2 - Annualisation of NO_2 Data Recorded at Site 17

Site 17				
Site	**Site Type**	**Annual Mean ($\mu g/m^3$)**	**Period Mean ($\mu g/m^3$)**	**Ratio Annual Mean / Period Mean**
Leamington Spa	Urban Background	17.57	17.46	1.006
Leominster	Suburban Background	8.21	8.19	1.003
Swindon Walcot	Urban Background	13.66	12.79	1.067
Average Ratio				**1.026**

Table C.3 - Annualisation of NO_2 Data Recorded at Site 22

Site 22				
Site	**Site Type**	**Annual Mean ($\mu g/m^3$)**	**Period Mean ($\mu g/m^3$)**	**Ratio Annual Mean / Period Mean**
Leamington Spa	Urban Background	17.57	15.19	1.157
Leominster	Suburban Background	8.21	7.56	1.086
Swindon Walcot	Urban Background	13.66	13.21	1.033
Average Ratio				**1.092**

Table C.4 - Annualisation of NO_2 Data Recorded at Site 23 to 29

Site 23 to 29				
Site	**Site Type**	**Annual Mean ($\mu g/m^3$)**	**Period Mean ($\mu g/m^3$)**	**Ratio Annual Mean / Period Mean**
Leamington Spa	Urban Background	17.57	17.70	0.993
Leominster	Suburban Background	8.21	8.25	0.996
Swindon Walcot	Urban Background	13.66	14.74	0.927
Average Ratio				**0.972**

Fall-off With Distance Correction

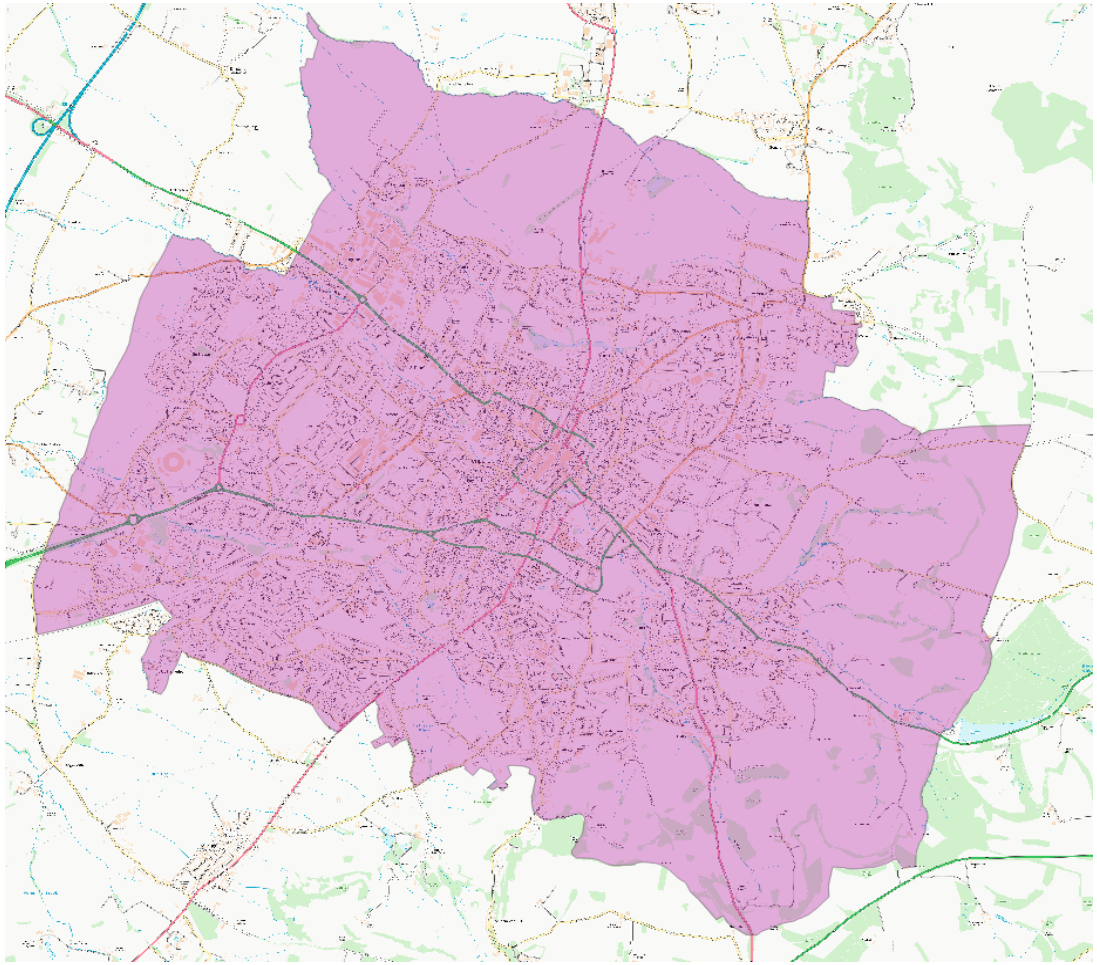
In accordance with TG(16); Section 7.78, distance correction calculations have been applied using the NO_2 fall-off with distance calculator. Sites 4 and 28 were corrected as the annual mean was within 10% of the AQS. Details of the correction are tabulated below.

Figure C.3 – Distance from Road Calculations

Site Name/ID	**Distance (m)**		**NO_2 Annual Mean Concentration ($\mu g/m^3$)**		
	Monitoring Site to Kerb	**Receptor to Kerb**	**Background**	**Monitored at Site**	**Predicted at Receptor**
Site 4	0.5	6.0	13.9	41.2	29.2
Site 28	1.2	20.0	15.7	38.4	25.0

Appendix D: Maps of Monitoring Locations and AQMAs

Figure D.1 – Borough-Wide AQMA



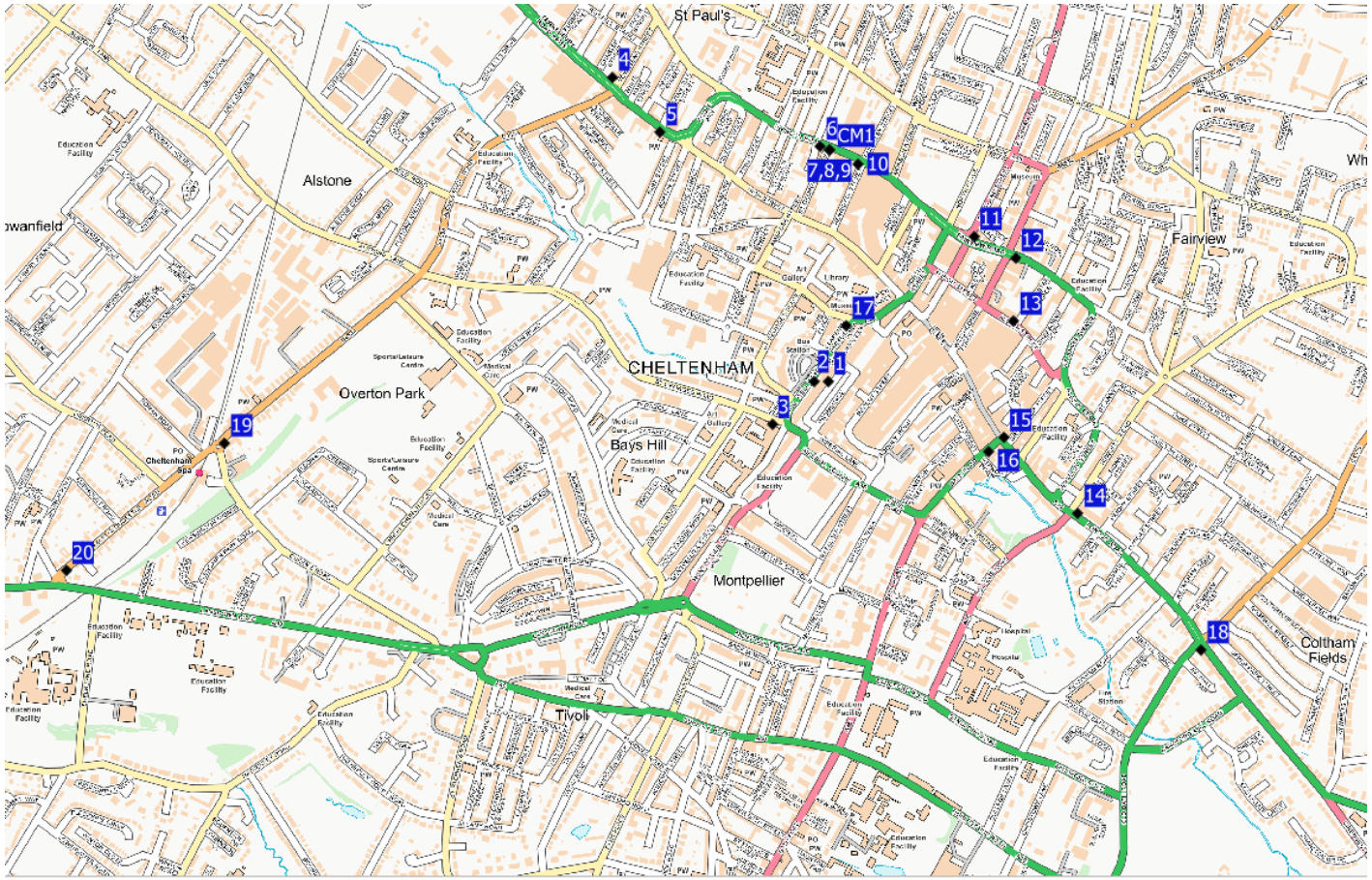
Legend

AQMA

Air Quality
Bureau Veritas
5th Floor
66 Prescot Street
London, E1 8HG

Location	
Cheltenham	
Title	
Cheltenham Whole Borough AQMA Boundary	
By	**Approved**
TC	PB
Scale	**Job Ref**
Not to Scale	6486236
Date	**Figure No.**
June 2019	**D.1**

Figure D.2 – Monitoring Locations within AQMA



Legend

AQMA

GRXX Diffusion Tube Location

CMX Automatic Station Location

Air Quality
Bureau Veritas
5th Floor
66 Prescot Street
London, E1 8HG

Location	Cheltenham
Title	Monitoring Location with AQMA Boundary
By TC	**Approved** PB
Scale Not to Scale	**Job Ref** 6486236
Date June 2019	**Figure No.** **D.2**

Appendix E: Summary of Air Quality Objectives in England

Table E. 1 – Air Quality Objectives in England

Pollutant	Air Quality Objective	
	Concentration	Measured as
Nitrogen Dioxide (NO_2)	200µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
	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
	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
	125µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
	266µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

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
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
CBC	Cheltenham Borough Council

References

- Local Air Quality Management Technical Guidance LAQM.TG(16). February 2018. 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.PG(16). May 2016. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.
- National Diffusion Tube Bias Adjustment Factor Spreadsheet, version 03/19 published in March 2019.
- Cheltenham Borough Council Annual Status Report 2018.
- Cheltenham Borough Council AQAP 2014.