Bristol City Council

2017 Air Quality Annual Status Report (ASR)

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

September, 2017

Local Authority Officer	Andrew Edwards, Steve Crawshaw, Matt Scammell
Department	Sustainable City and Climate Change Team
Address	3rd Floor CREATE Centre, Smeaton Road, Bristol, BS1 6XN
Telephone	01179224331 or 01179224158
E-mail	a.edwards@bristol.gov.uk steve.crawshaw@bristol.gov.uk
Report Reference number	BCC_ASR_2017
Date	September 2017

Executive Summary: Air Quality in Our Area

Air Quality in Bristol

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].

Bristol is a city, unitary authority area and ceremonial county in South West England, 105 miles (169 km) west of London, and 44 miles (71 km) east of Cardiff. With an estimated population of 432,500 for the unitary authority at present, and a surrounding urban area with an estimated 617,000 residents, it is England's sixth, and the United Kingdom's eighth most populous city, one of England's core cities and the most populous city in South West England.

The main pollutants of concern within Bristol are nitrogen dioxide and particulate matter. Monitoring in Bristol shows that we are currently in breach of the annual and hourly objectives for nitrogen dioxide, set at 40µg/m^{3}and 200µg/m^3 (with a permissible 18 hours per year above the 200µg/m^3 limit allowed) respectively.

Particulate Matter

Whilst monitoring of particulates in the city is limited it is possible that exceedance of objectives occur in some isolated areas. Health impacts from particulate pollution have been shown to occur at levels below the EU and UK target values, with the World Health Organisation (WHO) setting particulate pollution limits significantly lower than those adopted by Europe and the UK. Whilst much of the action to improve air pollution in the UK and Bristol is focussed on achieving compliance with nitrogen dioxide limits, it is important not to lose sight of the health improvements that

---

[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

can be achieved by reducing particulate pollution. In most cases, the measures to reduce nitrogen dioxide pollution should also reduce particulate pollution.

In those locations with the highest pollution levels, emissions from motor vehicles are by far the largest contributor to pollution. Contribution to air pollution is also made by other combustion processes such as domestic heating (especially wood burning) and industry for example. There is also a contribution from sources outside of the local authority area, particularly in the case of particulate pollution where contributions from agriculture and industry can be significant at times when weather patterns result in a build-up of pollution in the atmosphere.

Appliances that burn solid fuel contribute to local air pollution and evidence is that their contribution is increasing due to the popularity of solid fuel burning for occasional heating requirements in the winter time. Domestic solid fuel burning can generate significant levels of particulate pollution.

The whole of Bristol is a smoke control area. In a smoke control area only fuel on the list of authorised fuels, or any of the following 'smokeless' fuels can be burned, unless an exempt appliance is used.

- Anthracite
- Semi-anthracite
- Gas
- Low volatile steam coal

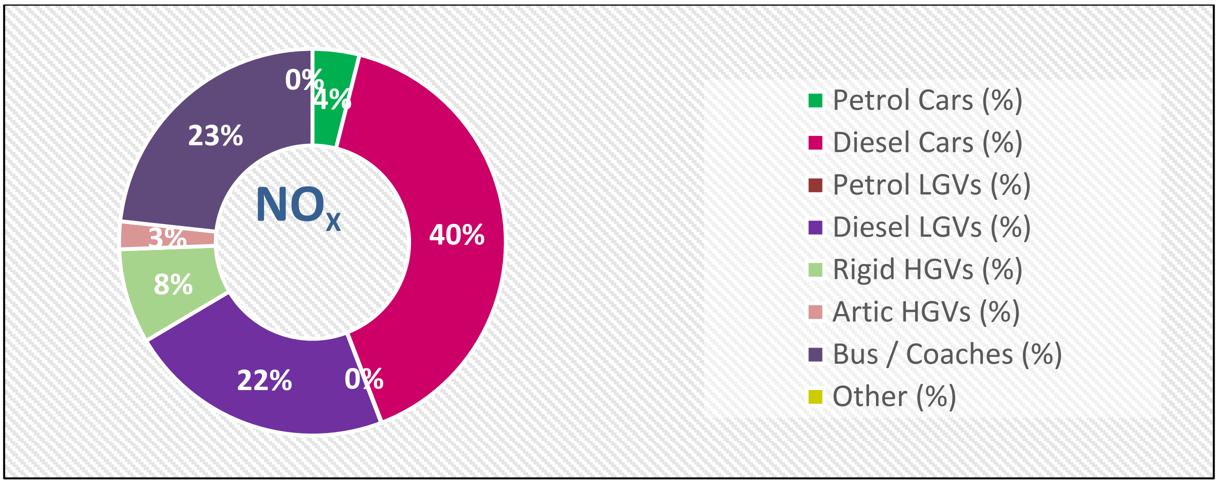
The health impacts from $PM_{2.5}$ pollution have been shown to occur at levels below EU and UK objectives and therefore the health impacts from local domestic wood burning, which often takes place during cold still days where dispersion of pollution is poor, could at times be significant. Non-compliance with the smoke control rules can result in a fine of up to £1000.

Nitrogen Dioxide Pollution

In those locations that exceed the nitrogen dioxide air quality objectives, over 80% of this pollution has been shown to be from local traffic sources. As a result, actions and decisions by BCC, other West of England (WoE) authorities and the decisions that citizens in the WoE take each day with regards to how they move around the area, all directly impact upon the level of air pollution in the city.

A 2017 study into the proportion of Nitrogen Oxide (NO_x) emissions from vehicles calculated that 96% of all NOx emissions from vehicles come from diesels with diesel cars (40%), Buses and Coaches (23%) and diesel Light Goods Vehicles (22%) being the largest contributors[4].

Figure 0.1 - Proportion of NOx Emissions by Vehicle Class in Central Bristol



A recent report into the health effects of air pollution in Bristol[5] concluded that around 300 deaths each year in the City of Bristol can be attributed to exposure to nitrogen dioxide and fine particulate matter ($PM_{2.5}$), with roughly an equal number attributable to both pollutants. This represents about 8.5% of deaths in the administrative area of Bristol being attributable to air pollution.

Pollutants such as sulphur dioxide, carbon monoxide and some heavy metals used to be monitored in Bristol, however, this has ceased as compliance with health based air quality objectives for these pollutants was demonstrated. Monitoring of nitrogen dioxide continues extensively throughout the city. Nitrogen dioxide concentrations have demonstrated an improving trend in recent years; however, exceedences of objectives for this pollutant are still measured at a number of locations throughout the city with 2016 data showing a general worsening when compared to 2015 data.

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. Further information related to declared AQMAs, including maps of AQMA boundaries are available online at https://uk-air.defra.gov.uk/aqma/local-authorities?la_id=36

[4] CH2M (2017). Bristol Clean Air Zone Feasibility Study: Option Sifting
[5] Air Quality Consultants Ltd. (2017). Health Impacts of Air Pollution in Bristol,

Approximately 100,000 people live within the AQMA and it also includes the central employment, leisure and shopping districts, major hospitals and dozens of schools and therefore many more people are exposed to the air pollution in their daily lives. There are also three small AQMAs in South Gloucestershire in Kingswood \ Warmley, Staple Hill and adjacent to the roundabout at Junction 17 of the M5.

Bristol's monitoring network is focused on nitrogen dioxide (NO_2), as the concentrations of this pollutant near busy roads exceed the health based UK and EU objectives.

The Bristol City Council monitoring network in 2016 consisted of:

- 4 real time NO_2 monitors[6] which provide continuous live data which is uploaded automatically to a public website: http://www.bristol.airqualitydata.com/
- 105 NO_2 diffusion tubes which provide a monthly and annual concentration for this pollutant.

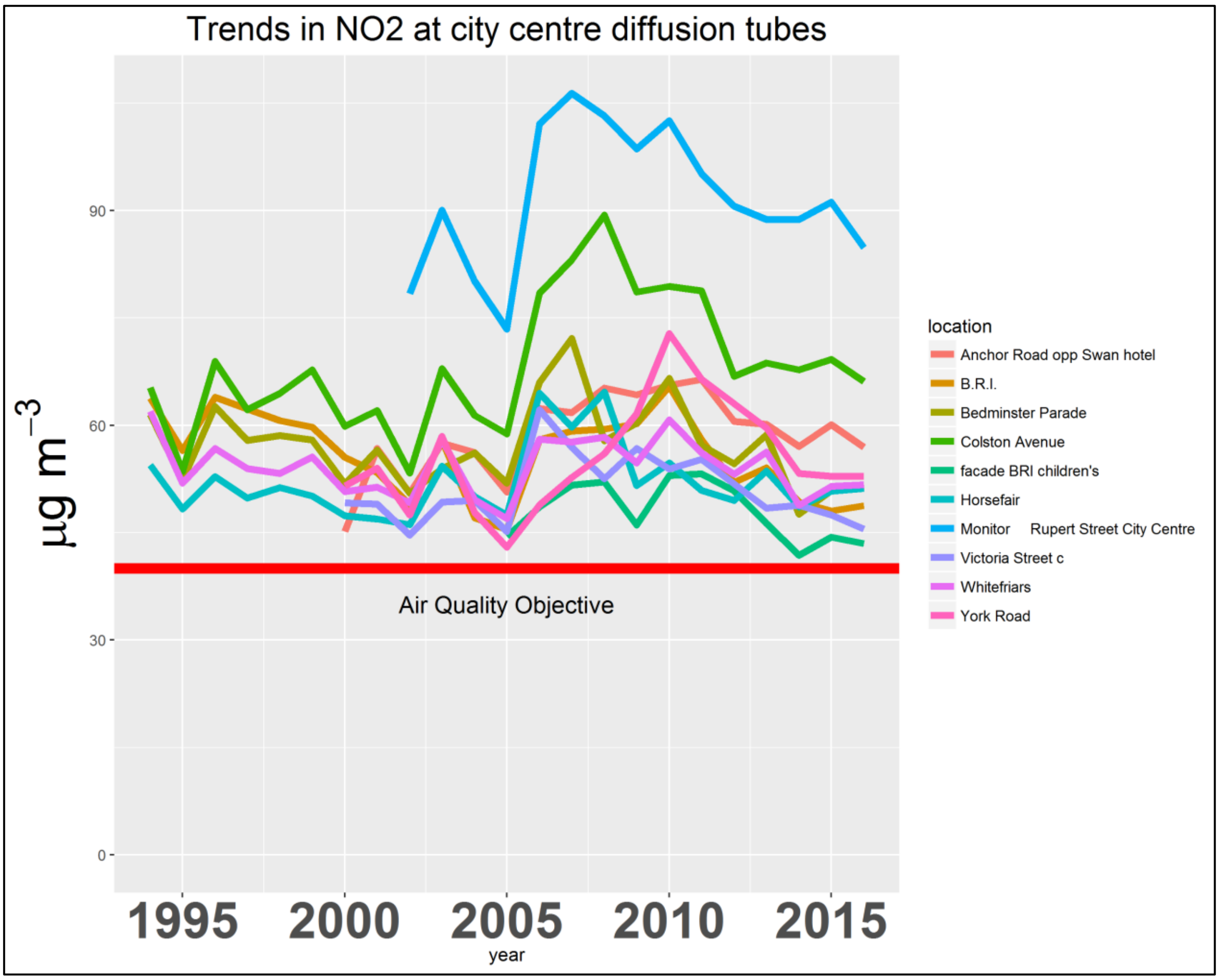
The Department for Environment, Food & Rural Affairs (Defra) operate one monitoring site in Bristol which measures NO_2, particulate matter (PM_{10} and $PM_{2.5}$) and ozone (O_3). This site is in St Pauls at an "urban background" location away from busy roads. The Defra site is representative of general pollution levels over Bristol but not of pollution levels at busy roadside locations in the city.

When considering the results from all diffusion tube locations around the city, there has been a slight has been a slight increase in NO_2 pollution levels in 2016 when compared to 2015. This equates to a This equates to a 1.2µg/m^3 increase for annual NO_2 concentrations on average over all tube locations. all tube locations. It should however be noted that levels fell at some locations and increased in increased in others. Concentrations are still at a similar level to those measured in 2000 and are still 2000 and are still higher than the health based EU and UK limits on many roads in the city centre and the city centre and along the main arterial routes leading from the city centre.

Figure 0.2 shows the long term trends in NO_2 concentrations at a selection of city centre monitoring sites.

[6] 2 monitors were temporarily out of action during 2016 due to redevelopment of the sites on which they were located. Rupert Street has been moved due to Metrobus works and will be replaced with a monitor located 20m from the old Rupert Street site. Newfoundland Way was moved due to the demolition of the building in which it was housed. A new Defra Affiliate site on Temple Way replaced Newfoundland Way and was commissioned in 2017.

Figure 0.2 - Trends in NO_2 at City Centre Site (1994-2016)



As previously discussed, air pollution in those locations exceeding the health based limits for nitrogen dioxide originates predominantly from motor vehicles. The approach to improving air pollution needs to focus on measures to reduce the number of vehicles on our roads, reduce congestion and clean up the emissions from vehicles.

There is a long established collaboration between the four former Avon authorities (now referred to as the West of England authorities). In this regard, the Travel West brand acknowledges the fact that the commuter doesn't think in terms of authority boundaries.

The Joint Local Transport Plan (JLTP) currently JLTP (3)[7], shared with the neighbouring authorities of Bath and North East Somerset, North Somerset and South Gloucestershire aims to address strategic transport planning in the area. The

[7] West of England Partnership. (2011). West of England Joint Local Transport Plan 3 2011-2026

JLTP (3) covers the period 2011 – 2026. Goal 3 within the JLTP3 is to improve air quality in the Air Quality Management Areas.

Actions to Improve Air Quality

A number of activities that have the potential to improve air quality are underway and planned within Bristol and the wider West of England region. These range from major infrastructure projects such as Metrobus to engagement in behavioural change initiatives such as work place travel planning.

Development of a Clean Air Action Plan

Bristol City Council has a statutory duty to develop an Air Quality Action Plan. It is currently being developed in line with emerging guidance from the Joint Air Quality Unit (JAQU) and is jointly referred to as our Clean Air Action Plan. The key purpose of this is to improve air quality so that we reduce the impact on human health and to achieve compliance with the UK legislative requirements for nitrogen dioxide concentrations. The Corporate Strategy sets out a commitment to develop an action plan and improve air quality.

To address the problem of air quality in the city Bristol City Council has developed a programme of work with two main elements:

- The undertaking of a feasibility study for a Clean Air Zone, in partnership with South Gloucestershire Council. This includes development of a Clean Air Action Plan for Bristol, which will consider a wider range of measures than just a CAZ.
- A communications, awareness raising and engagement programme to increase understanding of the air pollution issue.

In November 2016, Full Council unanimously supported a motion calling upon the Mayor to develop an air quality action plan, to implement a Clean Air Zone and to update Council on progress.

The Mayor reported back on the overall progress in response to that motion at Full Council on 18th July 2017 under item 151.

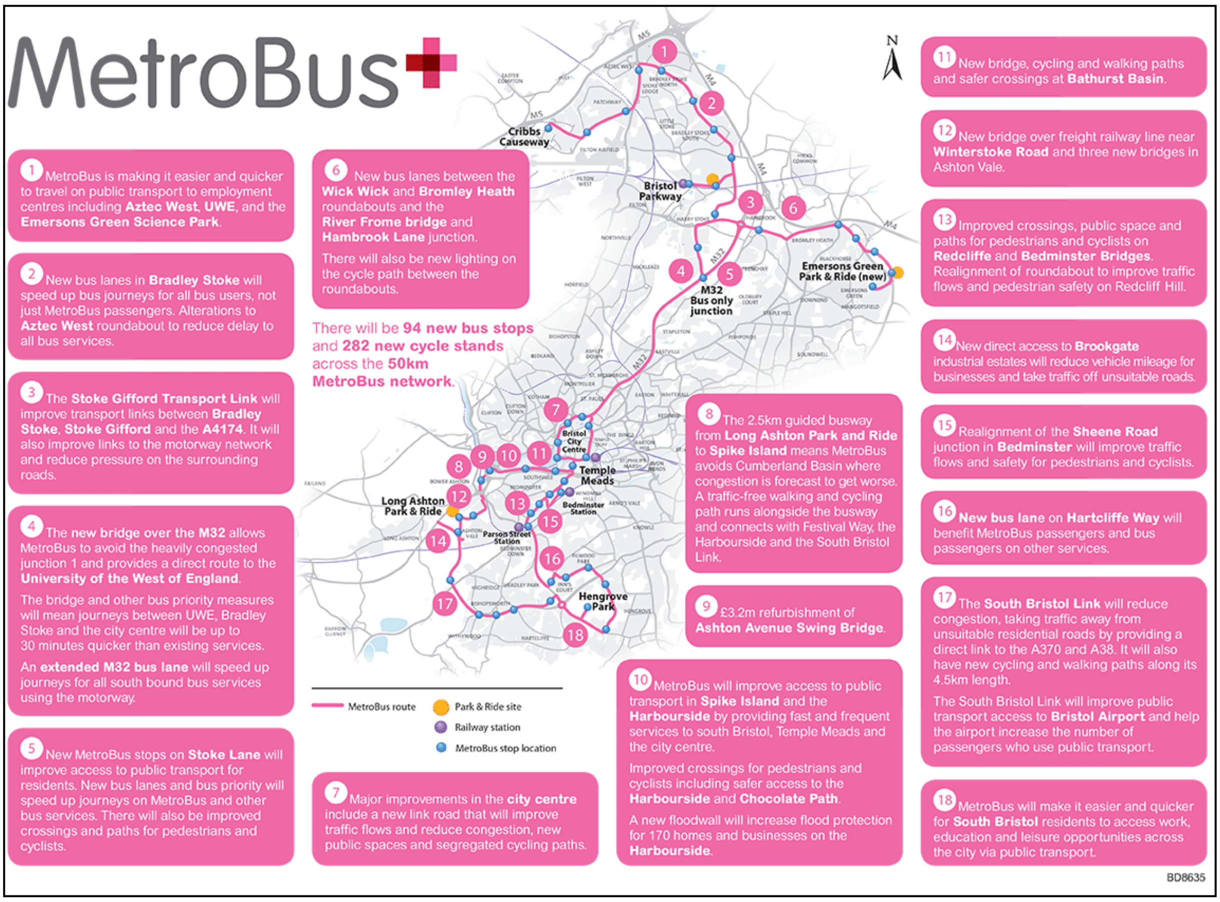
The Mayor has established a Mayoral Working Group on Air Pollution, which will work closely with the Congestion Task Force. The Working Group is chaired by Councillor Fi Hance. It has received expert advice from Council Officers and external experts on air pollution, transport and public health matters. This approach allows for an integrated approach to planning improvements in air quality which will be set out in a Clean Air Action Plan closely linked with emerging transport plans and will also align with the work of the congestion task group.

Bristol City Council and South Gloucestershire Council secured £498k of government funding at the end of 2016 to undertake a feasibility study into a Clean Air Zone. BCC is the lead authority. Consultants CH2M have been commissioned to undertake the CAZ feasibility study. An initial options appraisal has been completed which included a pollution source identification exercise which has calculated the proportion of Nitrogen Oxides (NO_x) emissions from vehicles in the centre of Bristol. It has been calculated from the vehicle movements in the transport model, and the latest vehicle emission figures provided by Defra. This shows that diesel vehicles contribute around 96% of the total NOx emissions from vehicles in the city centre.

Metrobus and MetroWest

Metrobus has been designed to link and connect with existing rail and bus services and is part of an integrated approach to travel investment that includes measures to improve cycling and walking, traffic and parking management and improvements to rail via MetroWest. Metrobus services are due to start operation in late 2017.

Figure 0.3 - Metrobus Details



GoUltraLowWest

GoUltraLowWest is an OLEV funded project which has provided grant funding for £7m investment in promotion of electric vehicles through the West of England region.

The main objectives and strategy:

- Double the existing provision of charge points to 400 in total
- Match funded business charge points and business demonstrator cars
- 4 exemplar demonstration charging hubs
- ULEV car club bays
- Conversion of 20% of the council fleet to ULEVs
- Improving air quality

Implementation of this project is being targeted for 2017-2021.

Bristol City Council operates an electric vehicle to carry out environmental monitoring work throughout the West of England. The purchase of the vehicle was funded through the Defra Air Quality Grant. The vehicle has been managed by Bristol City Council fleet services and has been a useful test for the wider adoption of EVs in the BCC fleet.

Figure 0.4 - Bristol City Council Electric Vehicle

Cycle Ambition Fund

The cycle ambition fund involves a combination of improving existing routes and revitalising streets, addressing barriers to cycling and walking such as busy roads, and overcoming the impact of the cities topography such as crossing rivers and avoiding steep hills enabling Bristol to provide better door-to-door journeys throughout the West of England region.

Residents' Parking Scheme

Residents parking schemes have been rolled out to many central areas of the city with the aim of reducing and discouraging commuter parking in these areas. It is thought that this initiative, combined with a restructuring of bus ticket pricing has led to a significant increase in bus patronage with a 17% increase between 2013/14 and 2014/15.

The conditions under which the Residents' Parking Scheme operates are currently under review and the Mayoral Air Pollution Working Group are engaged in this process in order to ensure that the latest local and national evidence on air pollution in considered during this review.

20mph Limits

20mph speed limits were rolled out in six phases throughout Bristol and completed in September 2015. The main aims of the scheme were to improve safety, health and community. There have been some negative responses against 20mph limits, however, BCC survey data show that a majority of residents support the idea of 20mph limits in their areas and once introduced, support for the new speed limits increases in those areas. Some of the arguments against 20mph limits centre around a perceived impact of worsening air pollution. The council has reviewed the available evidence on this issue. The summary of this evidence is shown below which provides support for the policy of 20mph speed limits from an air pollution perspective:

There are many factors which impact upon air pollution levels on a daily and annual basis and it is difficult to quickly and easily separate the influence of these from the impact of measures such as the introduction of 20mph limits. How drivers respond to 20mph limits, whether they are enforced effectively, whether the number of vehicle trips changes and the driving styles on a particular road are also likely to be important in the overall air pollution impact of this measure.

A number of studies have been conducted into the effects that 20mph limits have on air pollution. Overall, a smoothing of driving style and cutting out of the acceleration phase from 20mph to 30mph is considered to be beneficial for emissions of harmful pollutants. A study from Berlin concluded that the introduction of 30kph limits (18.6mph) resulted in up to 30% reduction in particulate emissions and 15% reduction in traffic related NO_X emissions but enforcement of the limit and smoothing of flow with traffic light coordination was thought to play an important role[8]. A 2013 study conducted in London, backed up with real-world monitoring showed that 20mph speed limits resulted in a reduction in emissions of particulates and NO_X from diesel vehicles[9].

[8] http://climate.blue/wp-content/uploads/Martin-Lutz_Air-Quality-Management-in-Berlin.compressed.pdf

[9] Transport and Environmental Analysis Group (2013). An evaluation of the estimated impacts of vehicle emissions of a 20mph speed restriction in central London. Centre for Transport Studies. Imperial College London. https://www.cityoflondon.gov.uk/business/environmental-health/environmental-protection/air-quality/Documents/speed-restriction-air-quality-report-2013-for-web.pdf

Overall, the evidence suggests that 20mph limits are likely to result in a small overall impact upon air pollution. The Draft NICE Guidance[10] on outdoor air quality suggested that 20mph limits should be considered as an air quality improvement measure. Evidence of negligible worsening of air pollution from 20mph speed limits appears to be limited, with a number of studies highlighting more significant air pollution improvements in certain circumstances. Wider benefits from 20mph limits include increases in walking and cycling, reductions in noise, and a range of co-benefits including reductions in casualties and severity of those which do occur as well as proportionately larger positive impacts for poorer communities which otherwise suffer from higher levels of road traffic pollution. Therefore it is considered that 20mph limits should be seen a positive measure for both safety, encouragement of modal shift and air pollution.

CLAiR-City

The four-year CLAiR-City project (Citizen-led air pollution reduction in cities), funded through the EU's Horizon 2020 program, features 16 research partners including the pilot cities of Bristol (UK); Amsterdam (NL); Aveiro region (PT); Ljubljana (SI); Sosnowiec (PL) and the Liguria region (IT). The project is aimed at creating a major shift in public understanding towards the causes of poor air quality – encouraging a focus on people's everyday practices like commuting and shopping rather than technology and top-down approaches. The project will use innovate tools like specially made apps and games for smart phones to generate citizen-led policies to improve air-related health in our cities.

As a partner city Bristol will help shape the tools being developed through extensive local engagement. The ultimate aim is to improve citizens' understanding of the air quality problem in the city and to engage them and wider stakeholders to inform acceptable strategies to reduce pollution.

A range of events have taken place as part of this project throughout Bristol in 2017, details of which can be found here http://www.claircity.eu/bristol/get-involved-2/events/. These have formed the basis for citizen and wider stakeholder engagement and will continue into autumn 2017 with outputs being used to help

[10] National Institute for Health and Care Excellence (2017) Air pollution: outdoor air quality and Health. NICE Guideline (NG70)

develop a policy game and app later in the project. http://www.claircity.eu/bristol/game-and-app/

Details of how people can get involved in the project can be found here http://www.claircity.eu/bristol/get-involved-2/

Conclusions and Priorities

The priority for Bristol City Council for the coming year is to address the problem of air pollution by developing a programme of work with two main elements:

- The undertaking of a feasibility study for a Clean Air Action Plan which is likely to include a Clean Air Zone as a key measure. A final business case will be submitted to the Secretary of State at the end of 2018.
- A communications, awareness raising and engagement programme to increase understanding of the air pollution issue.

These elements of work will require extensive stakeholder engagement and public consultation to develop them. It is likely that some of the required actions will result in some significant changes to the city and the way in which people chose to move around it. It will be necessary to ensure that residents, businesses and visitors to the area fully understand the serious nature of air pollution and the reasons why the improvement measures are needed. An effective communication strategy will be developed to underpin the case for action which may require fiscal measures.

The motion 'Clean air now for Bristol', received full council support in November 2016 and sets out a number of measures that are considered a priority. Full Council noted that "Bristol's air pollution urgently needs to be reduced." Full details of the motion can be found here (Motion 14).

In 2016 a Mayoral Air Quality Working group was set up within BCC. The aim of this group is to improve air quality, to provide a positive impact on health and wellbeing for all communities including the most vulnerable, support a flourishing local economy and accelerate the transition to a zero emission city. This working group co-chaired by the Cabinet Member City Health and Wellbeing aims:

- To advise on the implementation of the administration's air quality commitments.

- To guide the development of a new Clean Air Action Plan that improves health and addresses compliance with the exceedances of air quality objectives and fulfils the council's statutory duty.
- To develop plans for the implementation of a Clean Air Zone as part of the Clean Air Action Plan.
- To contribute to national policy and guidance such as from DEFRA and NICE.
- To monitor the impact of interventions on air quality and public health in Bristol.

It will be challenging to deliver and implement many of these priorities in the current financial climate. We will be replying upon a commitment from national government to provide the required funding to allow an effective and fully funded Clean Air Action Plan to be developed, adopted and fully implemented.

A National Air Quality Action Plan that is wide ranging and which uses all possible policy interventions, to compliment rather than contradict local air quality actions, will be essential to ensure that the benefits of local air quality improvement actions are maximised and effective in reducing pollution levels in Bristol.

Local Engagement and How to get Involved

There seems to have been a significant increase in interest and understanding of air pollution issue in Bristol over the past couple of years from citizens and subsequently the elected members representing those citizens. This led to the motion for clean air for Bristol being passed at the end of 2016 with full council support. This has occurred without Bristol City Council actively engaging with the public on the issue but a communications and awareness raising programme is being planned for 2018 and engagement work through the ClairCity project will continue over the life of the project.

There are many different ways in which people can help contribute towards reducing air pollution in Bristol. Air pollution, at locations where we are recording illegal levels of nitrogen dioxide, comes predominantly from emissions from vehicles. By choosing to travel around the city by foot, by bicycle or using public transport whenever possible people could reduce their personal contribution to air pollution in the city. To find out more information on sustainable transport options throughout the West of

England region you can visit the Travel West Website or its sister Website Better by Bike.

For those journeys taken by cars, choosing to travel outside of peak times can help. In the longer term, if you are deciding to replace your current car, as a general rule, the following hierarchy can be followed to identify which types of vehicles have the lowest emissions of pollutants which are harmful to health.

- Electric Vehicles
- Plug in Petrol Hybrid
- Petrol hybrid
- Gas or petrol
- Plug in Diesel Hybrid
- Diesel Hybrid
- Diesel

Whilst government vehicle taxation is based solely on the relative emissions of carbon dioxide (CO_2), this can be misleading to those looking for a vehicle with low emissions of pollutants that are directly harmful to health. Often, diesel cars are promoted as being 'low emission/eco' vehicles. Whilst these may offer relatively low 'official' CO_2 emissions, diesel vehicles are generally much worse for air pollutants such as nitrogen dioxide and particulates, which are of greatest concern for local air quality. There is also growing evidence that the real world whole lifecycle CO_2 emissions from diesel vehicles are higher than for Petrol vehicles as highlighted in a Study by Transport and Environment published in September 2017. Petrol vehicles are better for emission of pollutants that are harmful to health than diesel vehicles with petrol hybrids and fully electric vehicles being even better.

Annual reports which include results from air quality monitoring in the city are available on the Bristol City Council Website along with real time data.

Our diffusion tube monitoring data, which shows annual nitrogen dioxide at all our monitoring locations throughout the city, can be found on the Bristol City Council Pinpoint Website by using this link: http://maps.bristol.gov.uk/pinpoint/ and selecting 'Environment and Planning' and then ticking the 'Air Quality Monitors' box. The extent of the current air quality management area can also be displayed by ticking the relevant box.

Table of Contents

List of Tables

List of Figures

1 Local Air Quality Management

This report provides an overview of air quality in Bristol during 2016. 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 Bristol City 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 AQMAs declared by Bristol City 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=36. Alternatively, see Maps of Monitoring Locations and AQMAs, which provides maps of air quality monitoring locations in relation to the AQMA.

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 (inc. date of publication)
						At Declaration	Now	
Bristol AQMA	Declared 01/05/2001. Amended on 01/05/2003 and 01/05/2008 and 26/10/2011	NO2 Annual Mean	Bristol	An area covering the city centre and parts of the main radial roads including the M32.	YES			Joint Local Transport Plan 3 https://travelwest.info/projects/joint-local-transport-plan
Bristol AQMA	Declared 01/05/2001. Amended on 01/05/2003 and 01/05/2008 and 26/10/2011	NO2 1 Hour Mean	Bristol	An area covering the city centre and parts of the main radial roads including the M32.	YES			Joint Local Transport Plan 3 https://travelwest.info/projects/joint-local-transport-plan
Bristol AQMA	Declared 01/05/2001. Amended on 01/05/2003 and 01/05/2008 and 26/10/2011	PM10 24 Hour Mean	Bristol	An area covering the city centre and parts of the main radial roads including the M32.	YES			Joint Local Transport Plan 3 https://travelwest.info/projects/joint-local-transport-plan

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

The monitoring network in Bristol has changed considerably since the declaration of the Air quality Management Area in 2001. There is an extensive air quality monitoring network throughout the city which provides us with annual NO_2 data. The monitoring locations in 2016 are not directly comparable to those in 2001 and therefore the comparison between exceedence levels at declaration in 2001 and 2016 would not provide a true reflection of trends in air pollution over that timeframe. For this reason, the corresponding columns in Table 2.1 above have not been completed. Distance adjusted data for all 105 monitoring sites has been provided in Table B.1. An indication in general trends in annual NO_2 values over this time is shown in Figure 3.1 and Figure 3.2 with this trend being repeated throughout other areas of the city.

In 2001 PM_{10} was measured at 2 locations for the whole year, including a kerbside site. Currently PM_{10} is only monitored at an Urban Background site. No recent modelling has been carried out and therefore, a comparison of maximum monitored data between 2001 and 2016 is not considered a useful exercise given that comparison would have to be made between very different monitoring locations.

2.2 Progress and Impact of Measures to address Air Quality in Bristol

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

The Council are making good progress with air quality initiatives in the City. This includes installing electric charging points and rolling out a resident's parking scheme, which has reduced parking for non-residents, thereby encouraging commuters and shoppers to use other forms of transport such as taking the bus. This is commended.

For those areas where the annual mean NO_2 objective is still exceeded (and in some areas this is by a considerable amount), it is highly recommended that the Council implement measures to target these specific hotspots. For example, on Rupert Street and on other roads where high concentrations are recorded, consideration should be given to improving the traffic flows and / or reducing traffic levels.

The next steps for Bristol City Council are to:

- *Submit the 2017 Annual Status Report.*
- *Continue monitoring along Whiteladies Road and Avonmouth Road to determine whether an extension to the AQMA is required.*
- *Provide an updated Action Plan.*

The council has continued to progress work on the Metrobus bus rapid transit infrastructure and services are due to start operation on in 2017.

Monitoring has continued along Whiteladies Road and Avonmouth Road into 2016. Results from these sites have continued to show that compliance is being achieved at relevant receptor locations and therefore there is no need to make any extensions to the area covered by an AQMA in these particular locations.

Bristol City Council has taken forward a number of direct measures during the current reporting year of 2016 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 documents such as the Joint Local Transport Plan 3 2011-2026[7] which is supported by various strategies on key issues such as public transport, cycling and walking.

Bristol City Council expects the following measures to be completed over the course of the next reporting year:

- Development and submission of a Clean Air Action plan to secure compliance with air quality objectives for nitrogen dioxide in the shortest possible time.

BCC are ensuring that elected members are fully briefed and aware of the work being undertaken for the Clean Air Action Plan and that they have opportunities to input into the direction that some of the work is taking where appropriate.

It is likely that some of the required actions will result in some significant changes to the city and the way in which people chose to move around it. It will be challenging to ensure that residents, businesses and visitors to the area fully understand the serious nature of air pollution and the reasons why the improvement measures are needed. A major part of any process to implement air quality improvement actions will involve an effective communication strategy to enhance the understanding that people have of the local air quality problem and the severity of the health impacts that it causes.

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	Joint Transport Study and Spatial Plan	Policy Guidance and Development Control	Regional Groups Co-ordinating programmes to develop Area wide Strategies to reduce emissions and improve air quality	WoE authorities. LA Funded	Ongoing	2018	Set out a visons and plan for future development in the WoE up until 2036		Consultation in 2015 and 2016	Submission to Secretary of State planned for 2018	Joint Transport Study being prepared in in parallel with WoE Joint spatial Plan. The objective is to ensure the region plans and provides for the growth needs in WoE in the future whilst Improving quality of life and a healthy, natural environment: projects should aim to reduce traffic volumes, noise and emissions and protect the natural environment.
2	MetroBus BRT scheme	Transport Planning and Infrastructure	Bus route improvements	BCC/S.Glos/NE Somerset. Grant Funded	Finished	Ongoing	Improved bus Services, quicker journey times and more reliable services from both northern and southern city fringes	Encouragement of modal shift through provision of quick reliable bus services.	Construction Phase. Tender for Services	2017/18	Euro VI minimum for metrobus buses being specified for first two years then improvements on those standards moving forward.
3	Bristol Transport Plan	Transport Planning and Infrastructure	Other	BCC. LA funded	Ongoing	2018	Development and Adoption of Bristol Transport Plan	Vision of plan is to improve the active travel and public transport offer of the city to allow for the decoupling of growth from increase in cars movements	Document undergoing initial internal BCC consultation before moving onto wider stakeholder and public consultation phases in autumn 2017	2018	
4	Local Plan Review	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	BCC. LA Funded	Ongoing	2018	Development and Adoption of New Local Plan Documents	Adoption of standalone policy for Air Quality. Aim is to be able to account for cumulative impacts from many small developments, secure developer contributions towards air quality	Initial internal consultation and development of local plan started mid 2017. Progress anticipated throughout 2017/2018	2018	Support of proposed measures in plan needs to be gained at a local level and also approved by the Planning Inspectorate.

								action plan measures and strengthen weight given to air pollution in Local Plan policy documents			
5	Clean Bus Technology Fund	Vehicle Fleet Efficiency	Vehicle Retrofitting programmes	WoE Funded by CBTF Grant	16/17	16/17	35 Euro II and Euro II buses to achieve Euro V/VI standard using SCRT technology.		Buses have been retrofitted.	Retrofit complete 2017	
6	Cycle City Ambition Grant	Promoting Travel Alternatives	Cycling improvements and engagement.	BCC. Grant Funded	Ongoing	Ongoing	Increased levels of cycling in the city	Yes	Smoothing of cobbles on popular route, Improved crossing in Castle Park, 500 additional bike stands installed, improvement of harbourside bridge and 4 rounds of engagement in Easton to discuss how cycling can be encouraged.	Ongoing	Plan to implement a number of new developments to improve cycling infrastructure in the city. Details can be found at the travel west website: https://travelwest.info/projects/cycle-ambition-fund/bristol
7	Bus-based P&R	Alternatives to Private Car Use	Bus-based P&R	WoE LAs	3 Park and Ride Sites Already implemented	Already implemented	Monitoring usage of services		Usage figures have remained steady since 2006/7 to 2015. Cleaner buses being contracted to improve emissions performance.	Ongoing monitoring of usage	Service contract re-tendered in early 2016. New contract required operators to use Euro VI buses. This was an improvement of the previous contract which required a minimum of Euro IV. New Park and Ride sites due to open by end of 2018 at Emersons Green and Parkway North. Both sites are in South Gloucestershire but will be serving the city centre.
8	Doubling existing EV charge point network from 200-400 points	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	WoE LAs funded by OLEV Grant funding	16/17	17/18-20/21	Number of public/private charge point (not units)		200 additional charge points across the WoE	2020/21	Part of Go-Ultra Low OLEV grant funded project
9	1 Free permit per household for Band A vehicles in Bristol Resident	Promoting Low Emission Transport	Priority Parking for LEVs	Bristol	Ongoing	Ongoing	Number of ULEV permits administered		Free ULEV permits being issued when criteria met.	Ongoing. To be reviewed.	Band A based on CO2 emissions. Potential side effect of this measure is encouraging highly polluting diesel vehicles, many of which meet the CO2 Band A criteria but

	Parking Zones										are not good for emissions of pollutants that are harmful to health (NOX and PM). Residents' Parking Permit system being reviewed in 2017/2018 which presents an opportunity to change the system of free permits to reflect pollutants harmful to health as well as CO2 emissions
10	Freight Consolidation	Freight and Delivery Management	Freight Consolidation Centre (FCC)	Bristol and Bath. Private with LA subsidy	Ongoing	Ongoing	Number of businesses signed up. No. of journeys replaced through consolidation	Reducing pollution and congestion in the AQMA is the reason for the operation of the FCC.	140 businesses signed up to service across Bristol and Bath	Financial support for the FCC to come to an end in 2017	Since 2011 the FCC has resulted in 5 tonnes of NOx emissions avoided, 157 tonnes of CO2 and 18,000 trips saved. In recent corporate budget review FCC identified as a cost saving so future of this is now uncertain. Plan to develop this action in the AQAP to try to ensure its continued operation and expansion.
11	Upgrading Urban Traffic Management Control (UTMC) to deliver improved traffic management system	Traffic Management	UTC, Congestion management, traffic reduction	BCC	Ongoing	Ongoing	Improved traffic management capabilities and reduced congestion	Reduce congestion should improve air pollution.	Current upgrade completed end March/beginning April 2017	Apr-17	
12	20mph rollout	Traffic Management	Reduction of Speed Limits, 20mph zones	BCC	Implemented, but under review	Implemented, but under review	No Specific Indicator- Various before and after surveys will be carried out on traffic speeds, road casualties and noise. Continued annual monitoring of nitrogen dioxide at 105 locations throughout the city to identify the trends in pollutant levels along roads	No specific target for Improvement in Air Quality but the expected smoothing of traffic flows, improved safety and modal shift is aimed at improving Air Quality in the AQMA.	Scheme fully implemented in September 2015. Ongoing monitoring with review in Autumn 16/spring 17, with any changes arising from this coming into effect in 2017/18	2017/18	Petition launched in 2015 to scrap 20mph in all but hospital and school locations. One of main arguments against 20mph made on misunderstanding that it will worsen air quality. Counter petition launched to keep and extend 20mph zones which gained less support than the petition to scrap them. BCC position statement on 20mph and air quality put together by mayoral air pollution working group, details of which are included within this report.

							where 20mph has been introduced.				
13	Better Bus Area Fund	Transport Planning and Infrastructure	Bus Route Improvements	WoE. DfT and Cycling Ambition Fund 2	Ongoing	Ongoing	Improved services and increased bus patronage	Yes	Improved services, through reduced journey time and increased reliability on 8 important corridors	Ongoing	More detail is available at https://travelwest.info/projects/better-bus-area
14	Local Growth Fund	Traffic Management	Strategic highway improvements, Re-prioritising road space away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane	WoE. Local growth funded.	Ongoing	Ongoing	Demand management and increases in sustainable transport options.		Local Growth fund Currently delivering better walking and cycling infrastructure along River Avon Path. Roll out of real-time information at bus stops.	Ongoing	
15	Prioritising purchase of EV vehicles in public sector fleets	Promoting Low Emission Transport	Public Vehicle Procurement - Prioritising uptake of low emission vehicles	WoE. OLEV Grant Funded	2016/17	17/18 – 20/21	100 ULEV vehicles across WoE council fleet - representing 20-25% transfer. Expected that Bristol will procure around 45 EVs (10%) of the fleet.		1 EV in current BCC fleet used for environmental monitoring work. Business case for fleet replacement program being made.	2018	Currently identifying the charging infrastructure needed and assessing suitability of BCC sites to accommodate the requirement. Approval for BCC fleet replacement, which includes the purchase of EVs currently going through cabinet approval process.
16	Car Clubs	Alternatives to Private Car Use	Car Clubs	WoE. Private and LA	Ongoing	Ongoing	160 car clubs cars deployed in Bristol. 50 EV car clubs cars by 2021 in WoE area.		120 car club cars currently in use in Bristol. 0 EV car clubs currently	Ongoing	Expansion of 8 bays in East of Bristol planned for summer 2017. Co-Wheels using Replicate Grant to introduce EV Car club vehicles in Ashley, Easton and Lawrence Hill. Go-Ultra Low OLEV grant to be used to introduce additional EV car club bays.
17	Workplace Travel Planning	Promoting Travel Alternatives	Workplace travel plans	WoE. DfT funding	Ongoing	Ongoing	Number of employers signed up to receive travel planning support. Annual Travel to Work Survey monitoring	smoothing of traffic flows from reduction in single occupancy vehicle use and associated emissions (NO2)	200+ businesses receiving sustainable travel support' business engagement officers. Programme funded through DfT Sustainable Travel Transition Year Fund 16/17. Target for 2017/18 – 2019/20 to	2017/18	

							progress of employee travel habits and reduction in single occupancy vehicle use.		have 350 businesses signed up to this scheme, subject to funding award.		
18	Car and Lift-sharing scheme	Alternatives to Private Car Use	Car and lift-sharing schemes	WoE. Funding TBC	Ongoing	Ongoing	Number of employees participating in Join My Journey service		Pilot for 2017/18 subject to funding	2018	
19	Sustainable travel campaigns to promote alternatives to car use, promoted through our principle travel website: travelwest.info promoting sustainable transport schemes such as loan bikes, match-funded grants for employer onsite sustainable travel infrastructure	Promoting Travel Alternatives	Intensive active travel campaign & infrastructure	WoE. Various funding	Ongoing	Ongoing	Wide range of initiatives with individual targets for each.		22 electric loan bikes issued, 68 Dr Bike maintenance sessions delivered, 3430 people participated in the BCC travel challenge, 14 grants given to business to encourage walking and cycling and 24 travel champions recruited.	Ongoing	Promotion of some offers via http://www.betterbybike.info/ Website
20	Geo-fenced Electric Hybrid Bus Trial. 2 buses are being used in the trial.	Promoting Low Emission Transport	Public Vehicle Procurement - Prioritising uptake of low emission vehicles	Bristol. Grant and Private joint funding.	Ongoing	Jan-16	Performance of hybrid bus, charging infrastructure and geo-fencing technology being assessed.	Buses GPS geo-fencing technology to ensure buses operate in electric only mode within the AQMA.	2 buses operated on routes which traverse the city. Buses and charging technology working well.	Ongoing	Plug in charging and inductive charging methods being used for both buses.

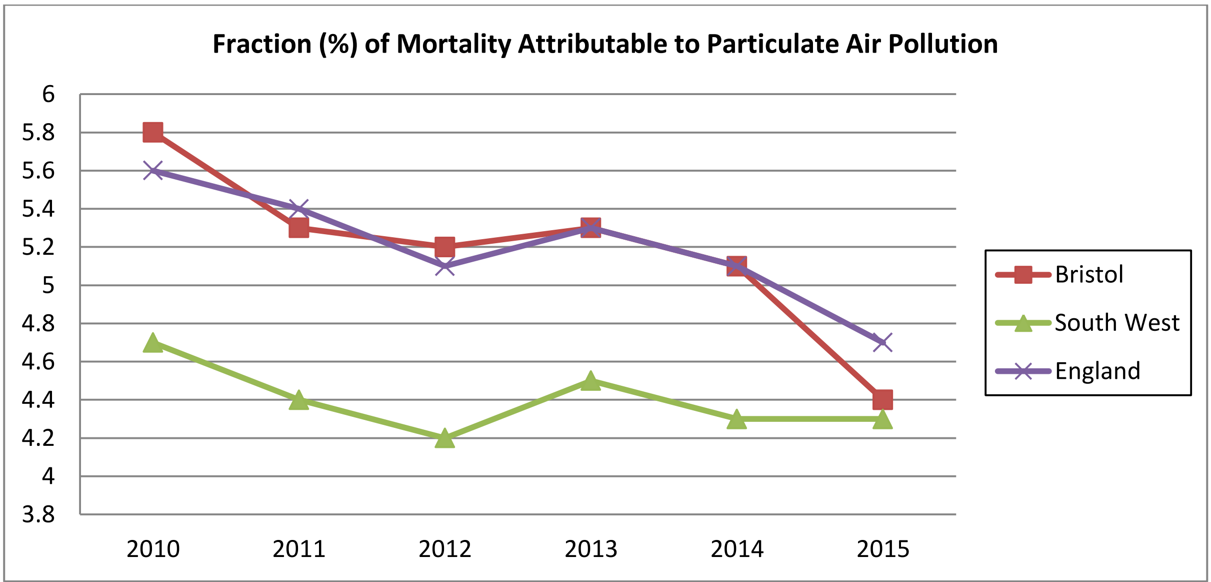
2.3 $PM_{2.5}$ – Local Authority Approach to Reducing Emissions and/or Concentrations

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.

All of the air quality improvement measures as described in section of 2.2 of this document will contribute towards reducing $PM_{2.5}$ pollution as well as nitrogen dioxide pollution in Bristol and the West of England.

In 2015, 4.4% of "all-cause adult mortality" in Bristol was considered attributable to "anthropogenic particulate air pollution"[11], which is similar to the national proportion and is mid-ranking for Core Cities. Figure 2.1 shows this value since 2010.

Figure 2.1 - Public Health Outcomes Framework Indicator 3.01



Appliances that burn solid fuel contribute to local air pollution and evidence[12] is that their contribution is increasing due to the popularity of solid fuel burning for occasional heating requirements in the winter time. Domestic solid fuel burning can

[11] Public Health Outcomes Framework, Nov 2016 *Source: Background annual average $PM_{2.5}$ concentrations for the year of interest are modelled on a 1km x 1km grid using an air dispersion model, and calibrated using measured concentrations taken from background sites in Defra's Automatic Urban and Rural Network (http://uk-air.defra.gov.uk/interactive-map.) Concentrations of anthropogenic, rather than total, $PM_{2.5}$ are used as the basis for this indicator, as burden estimates based on total $PM_{2.5}$ might give a misleading impression of the scale of the potential influence of policy interventions(2012).*

[12] Air Quality Expert Group (2017), The Potential Air Quality Impacts from Biomass Combustion

generate significant levels of particulate pollution. The whole of Bristol is a smoke control area. In a smoke control area only fuel on the list of authorised fuels, or 'smokeless' fuels can be burnt unless an exempt appliance is being used. Smokeless fuels include anthracite, semi-anthracite, gas and low volatile steam coal.

The health impacts from $PM_{2.5}$ pollution have been shown to occur at levels below EU and UK objectives and therefore the health impacts from local domestic wood burning, which often takes place during cold still days where dispersion of pollution is poor, could at certain times be significant. Enforcement of the smoke control regulations has been traditionally carried out by Environmental Health Officers; however, Local Authority enforcement of these regulations is limited. The Environmental Health team within Bristol City Council has seen significant reduction in available resource in recent years due to pressures on local authority finances and as a result reliance is currently placed on the sellers of fuels and stoves and the households using them to follow the requirements themselves. Non-compliance with the smoke control regulations can result in a fine of up to £1000.

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

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

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

Bristol City Council undertook automatic (continuous) monitoring at 4 sites during 2016. Monitoring at Rupert Street had to be stopped in 2016 due to the Metrobus works being carried out in the city centre. A new monitoring location has been prepared, with a new enclosure installed at the roadside at Colston Avenue. It was hoped that this would be operational in early 2017, however, due to ongoing works in the area is has not been possible to commission the site at the time of writing this report. It is expected that it will be commissioned in the autumn/winter of 2017 to allow a complete year of data to be collected in 2018. The Newfoundland Way site had to be decommissioned in 2016 due to the building in which it was housed being sold and demolished. BCC has worked with Defra to commission a new Defra Affiliate monitoring site in 2017 on Temple Way. BCC is currently measuring NO_2 pollution at this site and it is anticipated that by the end of 2017 Defra will install a new PM_{10} monitor at this site. Table A.1 in Appendix A shows the details of the automatic sites operating throughout 2016. National monitoring results are available at https://uk-air.defra.gov.uk/networks/site-info?site_id=BRS8&view=View

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

3.1.2 Non-Automatic Monitoring Sites

Bristol City Council undertook non- automatic (passive) monitoring of NO_2 at 105 sites during 2016. Table A.2 in Appendix A shows the details of the sites.

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

3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias and "annualisation". Distance corrected results have been reported in Table B.1. 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 bias adjusted monitored NO_2 annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3. Data in this table have not been corrected for distance to nearest relevant receptor location. 2017 is the first year in which Defra have asked specifically for all data to be presented with distance adjustment of data where considered relevant. Bias adjusted, annualised and distance corrected data are reported in Table B.1

For diffusion tubes, the full 2016 dataset of monthly mean values is provided in Appendix B.

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

Data capture rates at all the automatic NO_2 monitoring sites was above the required 90% rate, with the lowest capture rate of 96% being recorded at Wells Road. The continuous monitoring data generally shows similar results as recorded in previous years. 4 out of the 5 continuous monitoring sites recorded higher NO_2 concentrations in 2016 when compared to 2015. The Brislington Depot urban background site saw a 3.3 µg/m^3 decrease in 2016. The average increase at the 4 remaining automatic sites was 2.0µg/m^3.

When considering trends at automatic sites since 2012, the two urban background sites of Brislington Depot and St Pauls have seen the largest reductions in annual NO_2 concentrations over this period of -7.8µg/m^3 and -4.68µg/m^3 respecitvely. The trend at roadside sites has been less clear with Parsons Street showing a fall of 1.8µg/m^3 but with increases recorded at Wells Road and Fishponds Road of 0.3µg/m^3 and 3.2 µg/m^3 respectively.

Wells Road was the only site to record an hourly value greater than the 200 µg/m^3 hourly objective, with 1 hour of exceedence at this site. Parsons Street experienced two exceedences of the 200 µg/m^3 hourly average in 2014 but this fell to none in 2015 and remained at zero in 2016. Rupert Street has historically recorded the highest number of exceedences of the hourly objective with 169 in 2015 which is considerably over the 18 hours of exceedence allowed each year. It can be assumed that the short term objective continued to be exceeded in this location in 2016 despite no monitoring taking place here. Data for a site close to the Rupert Street site should be available in 2018.

Taking an average of all diffusion tube sites for which there is data since 2012 (96 in total) there has been an average of a 1.7µg/m^3 reduction in annual NO_2 values over that period. These 96 monitoring sites include a mix of kerbside, roadside and urban background sites.

Consideration of trends in NO_2 concentrations at a selection of kerb/roadside sites on the busiest road road corridors throughout Bristol since 1994 show that a very similar pattern is observed in all parts of the city. The following figures show consistent exceedence of the annual objectives for NO_2 at many locations. Concentrations in 2016 are similar to those recorded in 1994 or the year 2000 depending on when readings at a particular site began. The red line at 40µg/m^3 in Figure 3.1 and Figure 3.2 below represents the annual objective for nitrogen dioxide.

Figure 3.1 - Annual Nitrogen Dioxide at City Centre Locations

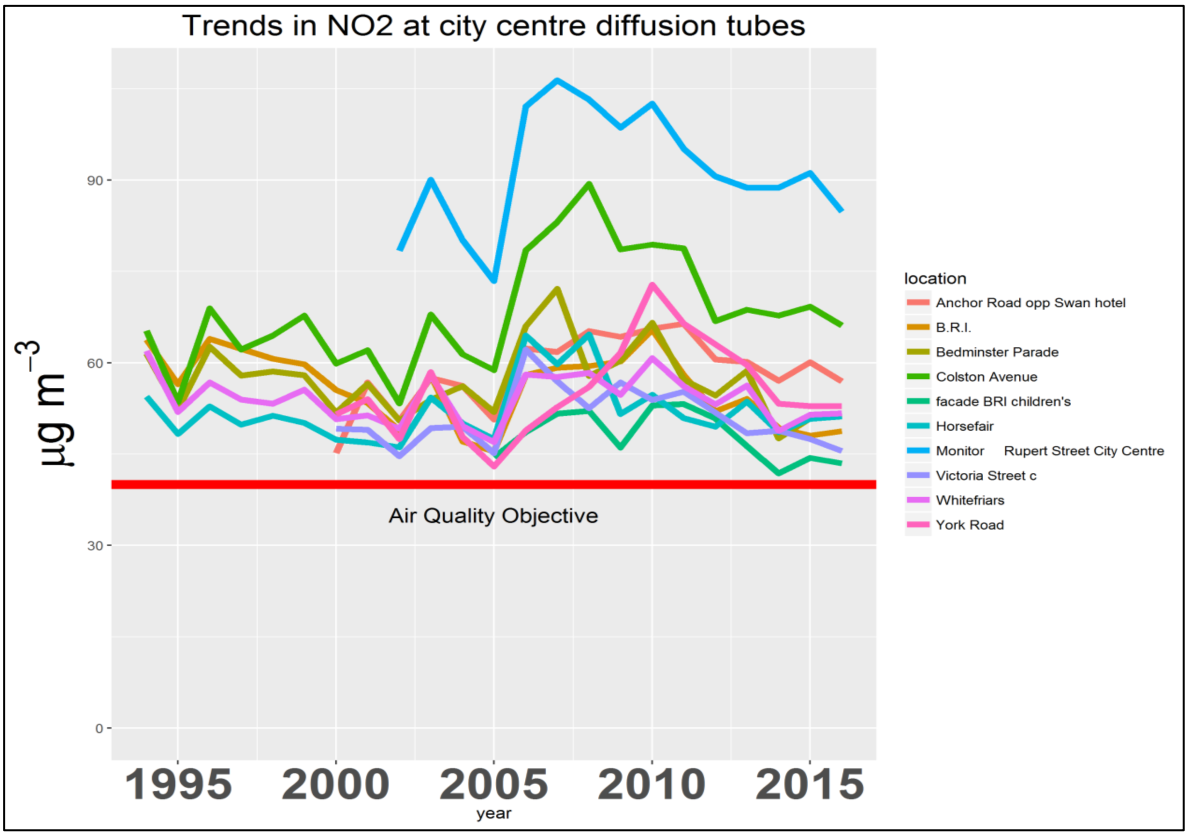


Figure 3.2 - Annual Nitrogen Dioxide at Gloucester Road Locations

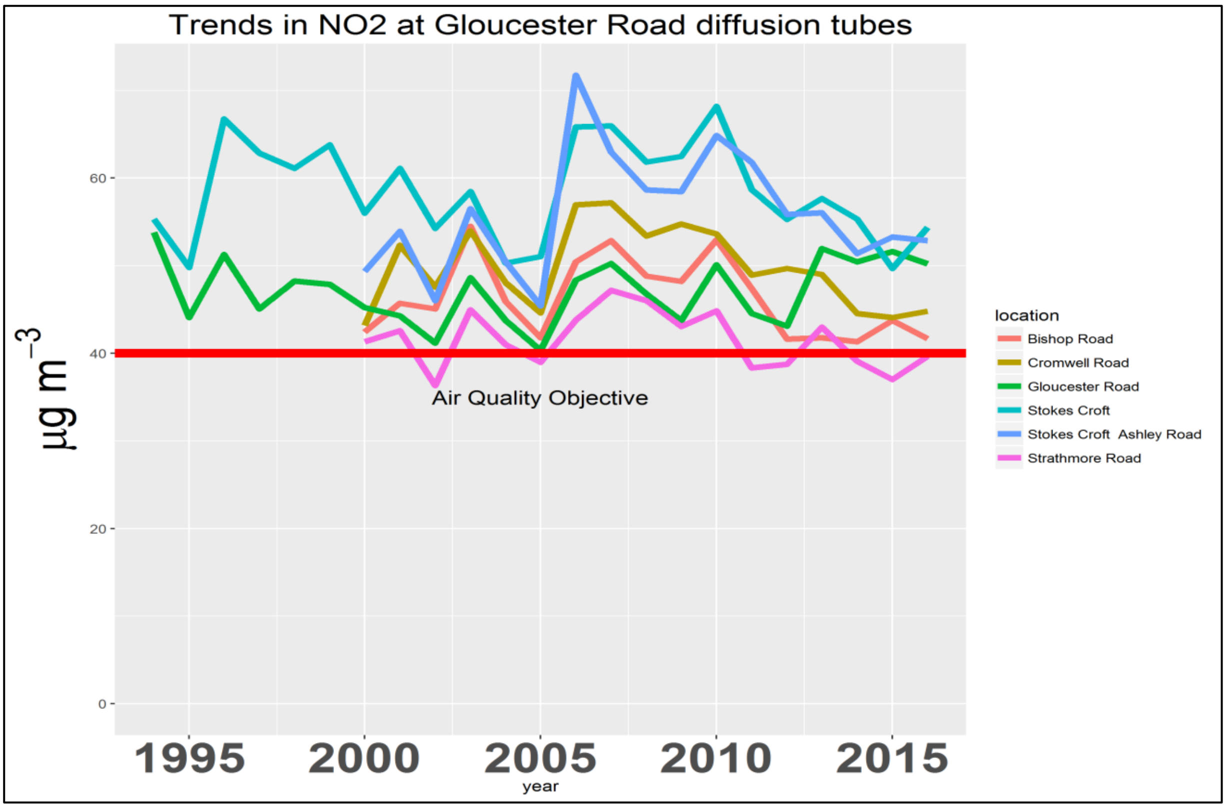


Figure 3.3 and Figure 3.4 show the location of nitrogen dioxide diffusion tube monitoring locations in Bristol. Those locations shown in yellow or red indicate locations where exceedence of the annual objective was measured in 2016. The data has not been distance adjusted in these maps to allow comparison with maps from previous BCC air quality reports.

This data is also shown online along with the previous 4 years of monitoring data at each location. This data can be viewed by selecting the Environment and Planning Option and ticking the Air Quality Monitors box here: http://maps.bristol.gov.uk/pinpoint/

Figure 3.3 - Nitrogen Dioxide Monitoring Results for 2016 – Central Area

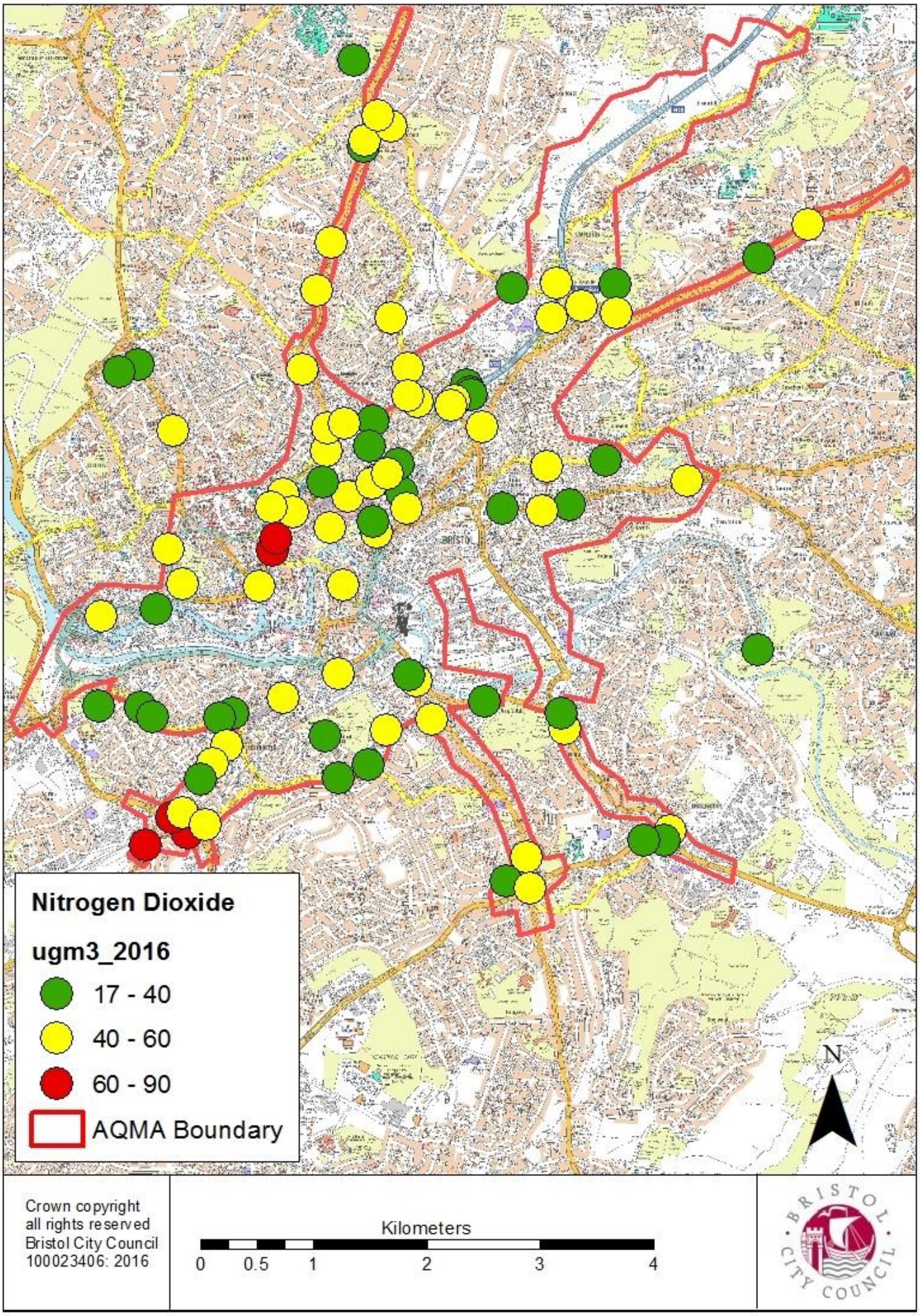
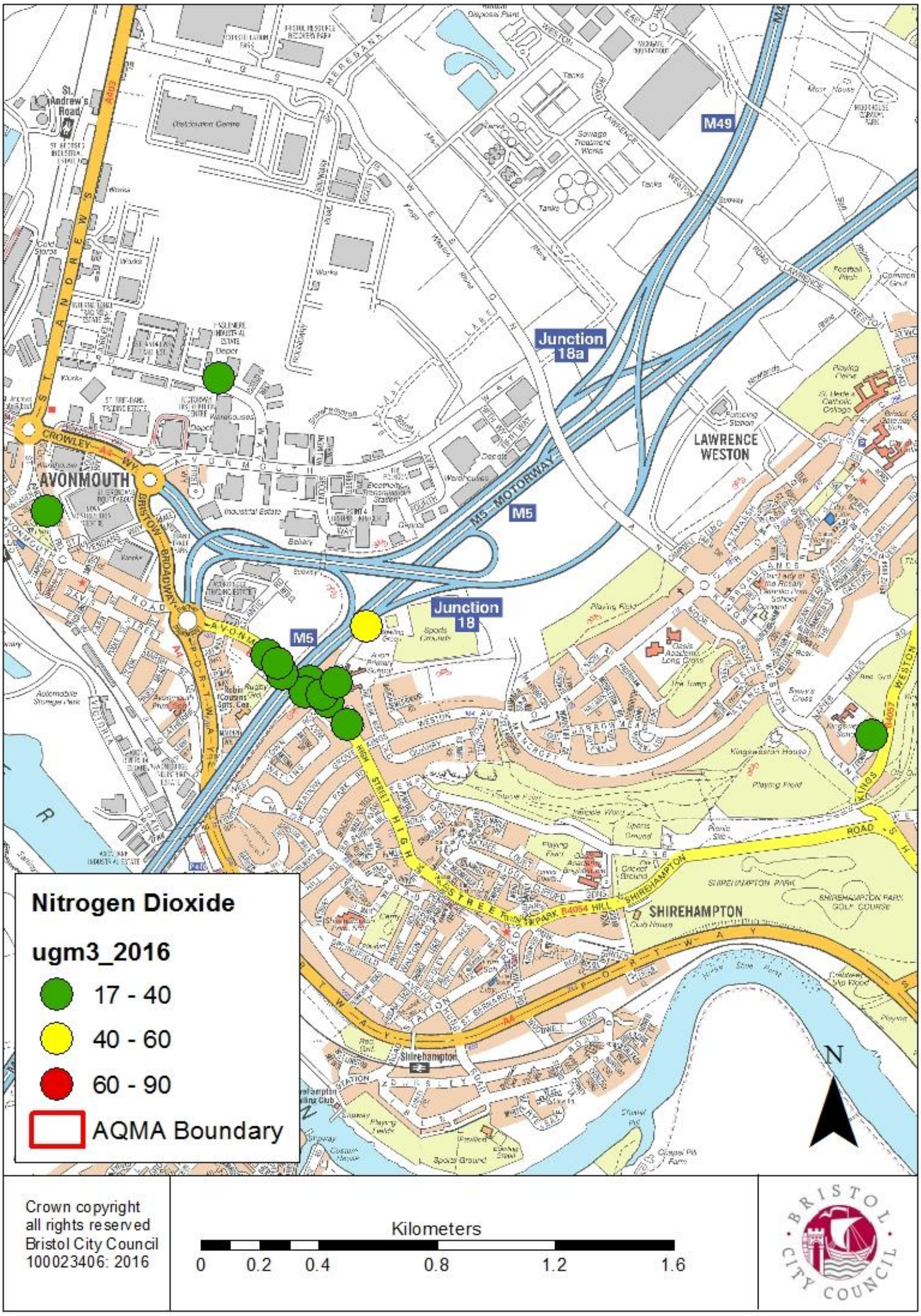


Figure 3.4 - Nitrogen Dioxide Monitoring Results for 2016 – Avonmouth and Lawrence Weston



3.2.2 Particulate Matter (PM_{10})

Table A.5 in Appendix A compares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3.

Table A.6 in Appendix A compares the ratified continuous PM_{10} daily mean concentrations for the past 5 years with the air quality objective of 50µg/m^3, not to be exceeded more than 35 times per year.

The St Pauls AURN site is the only location within Bristol at which PM_{10} is measured. The data from the AURN site are from an FDMS enabled TEOM instrument and are therefore in gravimetric units. Data for the AURN were downloaded from the national air quality archive.

There are no exceedences of the annual mean or hourly mean objectives at the St Pauls AURN site. Data for 2016 goes aginst the trend for recent years of a reduction in concentrations at this site with an increase in annual values to 15.4µg/m^3 in 2016 compared to 14.9µg/m^3 in 2015. The trend of 24hr concentrations is one that also shows an increase over the 2015 values from 3 to 5 24-hr periods averaging above above 50µg/m^3 in 2016, however, the number of hours of exceedence have remained stable since 2013.

Although no exceedences are reported from the monitoring data it is proposed that the AQMA declaration for PM_{10} is retained as a precautionary measure. Due to the fact the AURN sited at a background location, we can be confident that there are areas where concentrations are higher than at the St Pauls site, for example, at many roadside locations in the city centre and at many other roadside locations with high volumns of vehicle movements.

3.2.3 Particulate Matter ($PM_{2.5}$)

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

$PM_{2.5}$ is measured at the Bristol St Pauls AURN site. The annual average for this pollutant in 2016 was 10.4µg/m^3 which is below the UK annual objective of 25µg/m^3 but still just above the World Health Organisations (WHO) air quality guideline value of 10µg/m^3.

Between 2011 and 2016 $PM_{2.5}$ concentrations have fallen at this site by 31%. This trend will be monitored over the next few years to determine if the UK target for reduction of this pollutant of 15% between 2010 and 2020 is likely to be met.

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)
203	Brislington Depot	Urban Background	361178	171566	NO2	Yes	Chemiluminescent	0	18	3.5
215	Parson Street School	Roadside	358042	170582	NO2	Yes	Chemiluminescent	0	4	1.5
270	Wells Road	Kerbside	360903	170024	NO2	Yes	Chemiluminescent	10	1	1.5
452	AURN St. Pauls	Urban Background	359488	173924	NO2, O3, PM10, PM2.5	Yes	AURN Reference Methods	0	6	4
463	Fishponds Road	Roadside	362926	175590	NO2	Yes	Chemiluminescent	0	3	1.5

Notes:

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

(2) N/A if not applicable.

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

Site ID	Site Name	Site Type	X OS Grid Ref	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)
2	Colston Avenue	Roadside	358628	173011	NO2	Yes	49	1	NO	2.8
3	Blackboy Hill	Roadside	357448	174650	NO2	No	0	3	NO	2.8
4	Three Lamps	Roadside	359903	171850	NO2	Yes	47	3	NO	3.2
5	Bedminster Parade	Roadside	358723	171704	NO2	Yes	0	1	NO	3.2
6	Church Road	Roadside	361261	173413	NO2	Yes	0	3	NO	2.3
7	St. Andrew's Rd	Roadside	351706	178250	NO2	No	6	3	NO	2.6
8	Higham Street	Urban Background	359836	171903	NO2	Yes	0	40	NO	2.8
9	B.R.I.	Roadside	358729	173499	NO2	Yes	10	1	NO	2.4
10	Bath Road	Roadside	361217	171429	NO2	Yes	8	2	NO	3.2
11	Whitefriars	Roadside	358813	173342	NO2	Yes	0	5	NO	3.2
12	Galleries	Roadside	359142	173211	NO2	Yes	100	1	NO	2.4
13	Ferndown Close	Urban Background	354493	177489	NO2	No	0	135	NO	2.3
14	Red Lion Knowle	Roadside	360871	170291	NO2	Yes	8	2	NO	3.2
15	Horsefair	Roadside	359294	173485	NO2	Yes	4	1	NO	2.2
16	Third Way	Roadside	352287	178698	NO2	No	100	2	NO	2.7
17	Anglesea Place	Roadside	357273	174582	NO2	No	6	1	NO	2.8
18	Hillcrest	Urban Background	360691	170081	NO2	No	100	1	NO	3.2

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)
19	Conham Vale	Roadside	362921	172122	NO2	No	100	1	NO	2.5
20	Newfoundland Way	Roadside	359567	173630	NO2	Yes	0	3	NO	2
21	Gloucester Road	Roadside	359027	175300	NO2	Yes	4	1	NO	2.8
22	Stokes Croft	Roadside	359109	173886	NO2	Yes	2	2	NO	2.5
23	Old Market	Roadside	359555	173166	NO2	Yes	8	4	NO	2.5
81	Eastville Park	Urban Background	361657	175362	NO2	Yes	100	100	NO	2.6
99	Greville Smyth Park	Urban Background	357099	171627	NO2	No	1	2	NO	2.8
105	Victoria Park	Urban Background	359097	171368	NO2	No	0	100	NO	3.5
113	Victoria Street c	Roadside	359258	172696	NO2	Yes	2	3	NO	2.8
125	York Road	Roadside	359214	171917	NO2	Yes	5	2	NO	1.8
147	Anchor Road opp Swan hotel	Roadside	358514	172691	NO2	Yes	5	1	NO	2.2
154	Hotwells Road	Roadside	357601	172483	NO2	Yes	100	1	NO	2.4
155	Jacobs Wells road nr Hotwells rndbt	Roadside	357838	172713	NO2	Yes	100	2	NO	3.2
156	Jacobs Wells road opp Clifton hill	Roadside	357709	173018	NO2	Yes	1	2	NO	2.5
157	Stokes Croft Ashley Road	Roadside	359119	174090	NO2	Yes	0	2	NO	2.4

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)
159	Cromwell Road	Roadside	358891	174608	NO2	Yes	6	2	NO	2.5
161	Bishop Road	Roadside	359152	175733	NO2	Yes	6	2	NO	2.2
163	Strathmore Road	Roadside	359435	176574	NO2	Yes	10	3	NO	3.6
175	top of Brislington Hill	Roadside	362147	170525	NO2	Yes	16	2	NO	3.2
239	Parson St. A38 East	Roadside	357880	170506	NO2	Yes	10	1	NO	3.2
242	Parson Street Bedminster Down Road	Roadside	357510	170401	NO2	Yes	6	2	NO	3.2
254	Merchants Road Hotwells	Roadside	357118	172429	NO2	Yes	5	1	NO	2.6
260	Stapleton Road South	Roadside	361140	175366	NO2	Yes	5	2	NO	2.4
261	Stapleton Road Heath Street	Roadside	361103	175059	NO2	Yes	8	1	NO	2.1
263	Gatton Road	Roadside	360343	174473	NO2	Yes	21	17	NO	2.5
295	Lamppost 16 Ashley Road St. Pauls	Roadside	359913	174315	NO2	Yes	0	2	NO	2.8
300	Facade Haart Estate Agents 755 Fishponds Road Fishponds	Roadside	363365	175883	NO2	Yes	3	1	NO	2.4

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)
303	Facade 784 Muller Road Fishponds	Roadside	361368	175170	NO2	Yes	0	6	NO	2.2
305	Lamppost Sarah Street Redfield	Roadside	360661	173373	NO2	Yes	26	18	NO	2.5
307	Lamppost Glenfrome Road \ Muller Road Horfield	Roadside	360747	175328	NO2	Yes	5	2	NO	2.2
311	Give Way sign Chesterfield Rd \ Ashley Down Road St. Andrews	Roadside	359677	175057	NO2	No	6	1	NO	3.3
312	Lamppost Ashley Hill St. Pauls	Roadside	359832	174616	NO2	Yes	6	2	NO	2.7
314	Lamppost Whiteladies Road \ Cotham Hill Clifton	Roadside	357751	174063	NO2	No	3	1	NO	2.4
320	Monitor Bath Road Brislington	Roadside	361180	171567	NO2	Yes	0	18	YES	6
325	Facade 258 Fishponds Road Fishponds	Roadside	361667	175103	NO2	Yes	0	8	NO	2.4

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)
363	5102 façade	Roadside	359075	173613	NO2	Yes	0	3	NO	2.7
365	Unite façade	Roadside	359520	173264	NO2	Yes	0	10	NO	1.8
370	Great George Street lamppost	Roadside	359775	173513	NO2	Yes	0	2	NO	2.5
371	Lamb Street façade	Roadside	359813	173373	NO2	Yes	15	1	NO	2.6
373	123 Newfoundland Street façade	Roadside	359747	173774	NO2	Yes	15	17	NO	2.1
374	St. Paul Street	Roadside	359509	173595	NO2	Yes	4	1	NO	2.3
396	Avonmouth Rd No 28 on facia	Roadside	352593	177673	NO2	No	0	7	NO	1.9
397	facade avonmouth road underpass - house to SE	Roadside	352578	177637	NO2	No	0	12	NO	1.7
398	Avonmouth Rd No 31 on facia	Roadside	352501	177698	NO2	No	0	10	NO	1.7
403	Lamp post 48 230 Bath Road	Roadside	360508	171676	NO2	Yes	0	2	NO	2.8
405	Whitehall Rd/Easton Rd lamppost 4TZ	Roadside	361051	173743	NO2	Yes	3	1	NO	2.5
406	Whitehall Rd	Roadside	361578	173805	NO2	Yes	0	2	NO	2.3

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)
	lamppost 17 nr junction with Chalks Rd									
407	lamppost Sussex place	Roadside	359829	174370	NO2	Yes	10	1	NO	3.2
413	Wells Rd bus lane sign just below junction with Knowle Rd	Roadside	360043	171508	NO2	Yes	7	3	NO	3.2
417	St John's Lane No 26 lamppost 15 (just past roundabout)	Roadside	359635	171413	NO2	Yes	1	1	NO	3.2
418	Bedminster Down Rd lamppost between Ashton Motors & Plough PH	Roadside	357737	170642	NO2	Yes	0	2	NO	2.8
419	Parson St lamppost outside Bristol Scuba	Roadside	357832	170686	NO2	Yes	10	1	NO	2.8
420	North St/Dean Lane on roundabout sign	Roadside	358277	171562	NO2	Yes	2	1	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)
422	North St/Langton Park T junction	Roadside	358168	171525	NO2	Yes	0	1	NO	2.4
423	facade BRI children's	Roadside	358623	173386	NO2	Yes	0	13	NO	2
426	City Rd/Ashley Rd lamppost No 16	Roadside	359517	174153	NO2	Yes	6	1	NO	2.4
429	facade villiers road stapleton road junction	Roadside	360484	174097	NO2	Yes	0	6	NO	2.6
436	Shiners Garage	Roadside	361013	173352	NO2	Yes	22	3	NO	2.5
438	A37 Junction w/ Airport Road	Kerbside	360903	170024	NO2	Yes	10	1	YES	2.4
439	Parson Street School	Roadside	358042	170582	NO2	Yes	0	4	YES	1.5
455	St. Pauls Day Nursery	Urban Background	359487	173924	NO2	Yes	0	6	YES	2.8
461	Millpond School Fence	Roadside	360381	174405	NO2	Yes	0	14	NO	1.7
462	Millpond School play area	Roadside	360385	174381	NO2	Yes	0	35	NO	2.3
464	Fishponds Road	Roadside	362927	175592	NO2	Yes	0	3	YES	3
466	Savanna coffee	Roadside	357466	171622	NO2	Yes	0	2	NO	2.4

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)
	drainpipe									
467	Strada Exeter Road	Roadside	357568	171537	NO2	Yes	4	2	NO	2.8
469	Lamppost corner park avenue	Roadside	359479	171114	NO2	Yes	4	1	NO	2.8
470	Lamppost nr brick wall speed limit sign	Roadside	359213	170997	NO2	Yes	13	3	NO	3.2
472	Jamiesons Autos	Roadside	358226	171284	NO2	Yes	0	4	NO	2.4
473	B&G Snax West St	Roadside	358105	171124	NO2	Yes	0	2	NO	2.8
474	Martial Arts West Street	Roadside	357991	170979	NO2	Yes	0	2	NO	2.4
478	T shirt Shop W. Town Lane	Roadside	362091	170447	NO2	Yes	0	5	NO	2.8
479	cycle sign lamppost	Roadside	361917	170442	NO2	No	9	3	NO	3.2
482	Avonmouth Road – Lamp post (20) Opposite Number Hse No 45	Kerbside	352450	177760	NO2	No	11	8	NO	2.2
483	Avonmouth Road - Lamp post (19) Opposite Hse	Kerbside	352484	177735	NO2	No	11	8	NO	2.2

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)
	No 37									
485	Avonmouth Road - Telegraph Pole Opposite Hse No 4	Roadside	352654	177602	NO2	No	4	1	NO	2.6
486	Barracks's Lane - Telegraph Pole No 6. End of Lane Left Hand Side	Roadside	352785	177858	NO2	No	100	16	NO	2
487	Junction 3 Millpond Street	Kerbside	360243	174327	NO2	Yes	9	5	NO	2
488	Junction 3 Easton Way	Roadside	360205	174291	NO2	Yes	5	4	NO	1.8
489	Avonmouth Road Outside No 12	Roadside	352634	177629	NO2	No	8	5	NO	2
490	Avon School Barrack's Lane	Roadside	352683	177670	NO2	No	9	4	NO	2.8
491	Avonmouth Road Outside No 76	Roadside	352722	177525	NO2	No	6	4	NO	2.6
492	On 1 way sign at bottom of Wellington Hill	Roadside	359445	176627	NO2	Yes	13	3	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)
493	No.67 Filton Avenue on wall facing Muller Rd	Roadside	359677	176758	NO2	No	0	2	NO	2.3
494	Muller Road - Adjacent to Darnley Avenue	Roadside	359558	176850	NO2	No	6	2	NO	2.1
495	On green fence surrounding Western Power substation (?) adjacent to No.1 Dorian Road	Roadside	359353	177340	NO2	No	0	6	NO	1.9
496	385 Church Road Redfield	Roadside	362296	173620	NO2	Yes	0	3	NO	2.3
497	20 Ashley Road	Roadside	359268	174132	NO2	Yes	5	1	NO	2.3

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 2016 (%) [2]	NO_2 Annual Mean Concentration ($\mu g/m^3$) [3]				
					2012	2013	2014	2015	2016
203	Urban Background	Automatic	99%	99%	35.7	34.3	31.4	31.2	27.9
215	Roadside	Automatic	99%	99%	**47.9**	**50.8**	**45.7**	**44.2**	**46.1**
270	Kerbside	Automatic	96%	96%	**<u>41.2</u>**	39.0	**40.5**	39.3	**41.5**
452	Urban Background	Automatic	98%	98%	31.5	28.2	26.3	25.8	26.9
463	Roadside	Automatic	98%	98%	39.5	37.7	**43.3**	39.7	**42.7**
2	Roadside	Roadside	90%	90%	**<u>66.8</u>**	**<u>68.7</u>**	**<u>67.7</u>**	**<u>69.2</u>**	**<u>66.1</u>**
3	Roadside	Roadside	100%	100%	37.7	**41.2**	36.3	37.9	37.6
4	Roadside	Roadside	100%	100%	**<u>58.4</u>**	**<u>60.6</u>**	**55.8**	**53.3**	**55.2**
5	Roadside	Roadside	100%	100%	**54.6**	**58.7**	**47.6**	**50.9**	**51.3**
6	Roadside	Roadside	100%	100%	33.6	33.5	30.5	31.3	33.7
7	Roadside	Roadside	100%	100%	27.9	27.7	28.0	26.8	28.6
8	Urban Background	Urban Background	92%	92%	25.6	26.8	22.6	22.5	26.3
9	Roadside	Roadside	100%	100%	**52.0**	**54.0**	**49.3**	**48.0**	**48.8**
10	Roadside	Roadside	100%	100%	**58.4**	**<u>61.5</u>**	**50.1**	**49.3**	**54.5**
11	Roadside	Roadside	92%	92%	**53.2**	**56.3**	**48.8**	**51.4**	**51.7**
12	Roadside	Roadside	100%	100%	**50.8**	**56.7**	**51.3**	**52.5**	**52.8**
13	Urban Background	Urban Background	100%	100%	18.1	18.8	16.3	16.4	18.5
14	Roadside	Roadside	100%	100%	**43.2**	**42.2**	**40.4**	**40.1**	**42.3**
15	Roadside	Roadside	83%	83%	**49.5**	**53.6**	**48.6**	**50.8**	**51.2**

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3)				
					2012	2013	2014	2015	2016
16	Roadside	Roadside	100%	100%	36.4	33.3	34.6	35.9	35.7
17	Roadside	Roadside	91%	91%	21.3	25.0	21.2	20.0	21.9
18	Urban Background	Urban Background	100%	100%	21.3	22.3	18.1	17.8	20.2
19	Roadside	Roadside	100%	100%	22.0	27.2	20.8	19.7	22.4
20	Roadside	Roadside	100%	100%	**<u>74.7</u>**	**<u>64.3</u>**	**<u>65.3</u>**	**58.7**	**55.5**
21	Roadside	Roadside	100%	100%	**43.1**	**52.0**	**50.4**	**51.6**	**50.2**
22	Roadside	Roadside	100%	100%	**55.3**	**57.7**	**55.3**	**49.7**	**54.4**
23	Roadside	Roadside	100%	100%	**47.9**	**50.6**	**44.2**	**45.3**	**47.2**
81	Urban Background	Urban Background	90%	90%	21.0	18.2	17.5	17.9	17.0
99	Urban Background	Urban Background	100%	100%	30.0	33.1	27.2	28.7	31.6
105	Urban Background	Urban Background	100%	100%	20.4	21.2	17.2	18.2	20.8
113	Roadside	Roadside	100%	100%	**51.8**	**48.4**	**48.8**	**47.5**	**45.5**
125	Roadside	Roadside	98%	98%	**<u>63.0</u>**	**59.6**	**53.3**	**52.9**	**52.9**
147	Roadside	Roadside	100%	100%	**<u>60.6</u>**	**<u>60.2</u>**	**57.0**	**<u>60.1</u>**	**56.9**
154	Roadside	Roadside	99%	99%	**40.3**	**44.3**	38.5	37.2	39.6
155	Roadside	Roadside	91%	91%	**46.9**	**48.5**	38.8	39.9	**43.1**
156	Roadside	Roadside	100%	100%	**45.8**	**44.2**	38.0	38.9	**41.2**
157	Roadside	Roadside	100%	100%	**55.9**	**56.0**	**51.4**	**53.3**	**52.8**
159	Roadside	Roadside	100%	100%	**49.7**	**49.0**	**44.5**	**44.1**	**44.8**
161	Roadside	Roadside	100%	100%	**41.6**	**41.8**	**41.3**	**43.7**	**41.7**

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3)				
					2012	2013	2014	2015	2016
163	Roadside	Roadside	100%	100%	38.8	**43.0**	39.1	37.0	39.7
175	Roadside	Roadside	100%	100%	**54.7**	**55.3**	**51.7**	**52.9**	**56.5**
239	Roadside	Roadside	100%	100%	**<u>76.9</u>**	**<u>78.0</u>**	**<u>69.6</u>**	**<u>69.2</u>**	**<u>68.9</u>**
242	Roadside	Roadside	91%	91%	**<u>73.9</u>**	**<u>75.1</u>**	**56.2**	**<u>61.7</u>**	**<u>68.4</u>**
254	Roadside	Roadside	100%	100%	**55.3**	**53.2**	**51.5**	**54.4**	**51.8**
260	Roadside	Roadside	100%	100%	**45.8**	**46.5**	**46.3**	**45.6**	**45.4**
261	Roadside	Roadside	100%	100%	**53.0**	**55.8**	**50.6**	**51.3**	**53.1**
263	Roadside	Roadside	100%	100%	35.7	35.0	33.9	33.6	33.6
295	Roadside	Roadside	100%	100%	**57.8**	**57.2**	**58.6**	**<u>63.3</u>**	**55.7**
300	Roadside	Roadside	100%	100%	**49.9**	**48.5**	**42.4**	**45.9**	**48.1**
303	Roadside	Roadside	91%	91%	**48.5**	**48.2**	**43.5**	**46.1**	**46.2**
305	Roadside	Roadside	100%	100%	36.0	37.1	34.2	33.3	35.0
307	Roadside	Roadside	82%	82%	39.5	39.8	38.4	36.6	37.4
311	Roadside	Roadside	100%	100%	**46.7**	**49.5**	**43.3**	**44.0**	**46.2**
312	Roadside	Roadside	100%	100%	**43.7**	**44.5**	36.7	36.8	**41.6**
314	Roadside	Roadside	91%	91%	**40.4**	**44.4**	**43.0**	**43.9**	**41.5**
320	Roadside	Roadside	84%	84%	31.5	31.1	30.9	31.3	31.1
325	Roadside	Roadside	100%	100%	**49.8**	**45.8**	**49.7**	**50.8**	**50.5**
363	Roadside	Roadside	90%	90%	**48.0**	**44.3**	39.8	39.2	39.6
365	Roadside	Roadside	82%	82%	37.4	37.7	34.7	36.5	37.9
370	Roadside	Roadside	100%	100%	39.5	39.4	36.9	37.7	38.4
371	Roadside	Roadside	100%	100%	**47.5**	**46.9**	**42.8**	**44.8**	**42.7**

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3)				
					2012	2013	2014	2015	2016
373	Roadside	Roadside	100%	100%	**44.9**	**45.2**	**41.6**	38.3	39.5
374	Roadside	Roadside	100%	100%	**46.8**	**50.7**	**51.8**	**47.1**	**47.2**
396	Roadside	Roadside	100%	100%	34.7	31.9	30.7	32.0	32.8
397	Roadside	Roadside	100%	100%	34.0	34.4	28.5	33.0	33.8
398	Roadside	Roadside	100%	100%	31.8	34.0	31.9	30.1	31.8
403	Roadside	Roadside	100%	100%	**43.6**	**46.6**	39.2	**41.5**	37.5
405	Roadside	Roadside	100%	100%	**53.1**	**55.0**	**51.1**	**53.1**	**42.6**
406	Roadside	Roadside	100%	100%	36.5	36.5	34.9	35.4	36.2
407	Roadside	Roadside	100%	100%	**47.3**	**47.1**	**43.9**	**43.1**	**48.7**
413	Roadside	Roadside	100%	100%	**41.4**	**43.7**	38.4	39.3	**40.0**
417	Roadside	Roadside	100%	100%	**44.1**	**42.1**	**40.8**	**43.6**	**43.4**
418	Roadside	Roadside	100%	100%	**<u>81.8</u>**	**<u>74.0</u>**	**<u>67.7</u>**	**<u>63.7</u>**	**<u>69.3</u>**
419	Roadside	Roadside	100%	100%	**54.1**	**53.6**	**56.6**	**53.6**	**55.8**
420	Roadside	Roadside	100%	100%	38.1	38.9	37.2	36.7	38.6
422	Roadside	Roadside	100%	100%	39.8	39.0	34.1	35.0	39.4
423	Roadside	Roadside	100%	100%	**50.9**	**46.3**	**41.8**	**44.4**	**43.5**
426	Roadside	Roadside	100%	100%	39.5	38.0	34.0	32.5	34.2
429	Roadside	Roadside	89%	89%	**57.3**	**<u>60.6</u>**	**54.7**	**50.4**	**52.1**
436	Roadside	Roadside	100%	100%	39.6	**40.1**	38.2	37.9	**47.7**
438	Kerbside	Kerbside	100%	100%	**43.4**	**43.5**	**44.0**	**43.1**	**43.4**
439	Roadside	Roadside	100%	100%	**40.9**	**44.7**	**42.0**	**41.0**	**43.6**
455	Urban Background	Urban Background	100%	100%	29.5	30.1	27.3	26.5	27.9

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2016 (%) [2]	NO_2 Annual Mean Concentration ($\mu g/m^3$) [3]				
					2012	2013	2014	2015	2016
461	Roadside	Roadside	100%	100%	35.5	37.2	34.1	33.2	37.0
462	Roadside	Roadside	100%	100%	31.7	32.9	29.2	30.4	30.8
464	Roadside	Roadside	93%	93%	38.0	35.7	36.0	34.9	36.9
466	Roadside	Roadside	100%	100%	39.6	**41.1**	38.0	34.0	35.8
467	Roadside	Roadside	100%	100%	35.1	34.8	33.0	31.6	33.7
469	Roadside	Roadside	100%	100%	39.4	38.5	35.8	35.3	39.2
470	Roadside	Roadside	100%	100%	39.6	37.8	35.0	38.7	39.4
472	Roadside	Roadside	92%	92%	**46.5**	**48.2**	**45.2**	**40.0**	**45.3**
473	Roadside	Roadside	100%	100%	**44.6**	**43.5**	**40.7**	**49.6**	**57.1**
474	Roadside	Roadside	100%	100%	37.9	39.1	35.8	38.5	38.7
478	Roadside	Roadside	100%	100%	36.4	39.9	35.8	36.3	36.7
479	Roadside	Roadside	100%	100%	33.4	33.0	32.2	31.5	30.3
482	Kerbside	Kerbside	100%	100%	35.8	36.7	35.8	35.1	36.4
483	Kerbside	Kerbside	99%	100%	38.5	36.5	37.2	37.1	38.1
485	Roadside	Roadside	99%	100%	**41.2**	35.7	35.0	35.5	36.4
486	Roadside	Roadside	99%	100%	**41.5**	38.2	36.6	**40.8**	**41.7**
487	Kerbside	Kerbside	99%	100%		**47.4**	**47.4**	**46.2**	**45.7**
488	Roadside	Roadside	91%	91%		**42.6**	**40.1**	**42.7**	**42.5**
489	Roadside	Roadside	99%	100%			34.5	36.9	38.6
490	Roadside	Roadside	99%	100%			29.1	31.9	32.4
491	Roadside	Roadside	99%	100%			31.2	33.8	36.5
492	Roadside	Roadside	99%	100%				37.8	**40.3**

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3)				
					2012	2013	2014	2015	2016
493	Roadside	Roadside	99%	100%				36.4	**41.5**
494	Roadside	Roadside	99%	100%				38.4	**43.3**
495	Roadside	Roadside	99%	100%				21.7	25.8
496	Roadside	Roadside	99%	100%			**42.0**	39.3	**41.1**
497	Roadside	Roadside	91%	91%			**49.3**	**41.8**	**43.2**

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

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

☐ **If applicable, all data has been distance corrected for relevant exposure**

Data reported in the table has been bias corrected. Data capture was above 75% for all tubes data reported so it has not been necessary to annualise results. Data in this table has been reported for comparison with previous years monitoring, for which Defra did not require results to be distance corrected. In order to allow comparison with the previous data from 2012-2015, 2016 data has been reported as measured without distance correction. Where relevant, distance corrected data has been reported in Table B.1. Please refer to this table to see the calculated pollutant concentrations at relevant receptor locations.

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 **<u>bold and underlined.</u>**

(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 Concentration at a Selection of Monitoring Locations

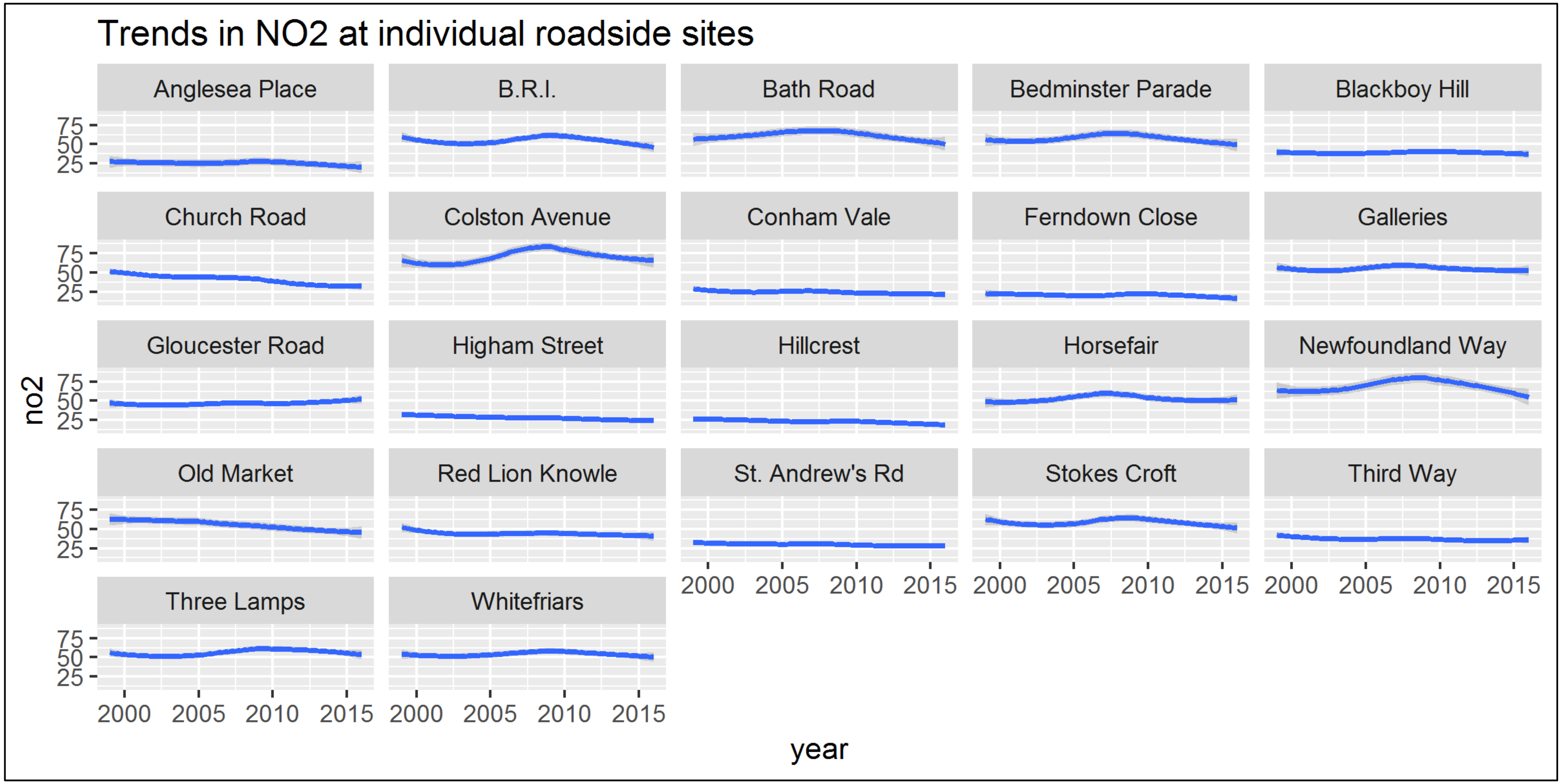


Table A.4 – 1-Hour Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	NO_2 1-Hour Means > 200µg/m^3 (3)				
					2012	2013	2014	2015	2016
203 – Brislington Depot	Urban Background	Automatic	99%	99%	0 (121.5)	3	0	1 (126)	0
215 – Parsons Street School	Roadside	Automatic	99%	99%	0 (143.7)	1	2	0	0
270 – Wells Road	Kerbside	Automatic	96%	96%	1 (145.7)	17	0	6	1
452 – AURN St. Pauls	Urban Background	Automatic	98%	98%	0	0	0	0	0
463 – Fishponds Road	Roadside	Automatic	98%	98%	0	0	1 (131)	0	0

Notes:

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

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

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

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

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

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2016 (%) [2]	PM_{10} Annual Mean Concentration ($\mu g/m^3$) [3]				
				2012	2013	2014	2015	2016
452	Urban Background	95	95	18	17.8	16.4	14.9	15.4

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

Notes:

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

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

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

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

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

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	PM_{10} 24-Hour Means > 50µg/m^3 (3)				
				2012	2013	2014	2015	2016
452	Urban Background	95	95	8 (33)	3	4	3	5

Notes:

Exceedances of the PM_{10} 24-hour mean objective (50µg/m^3 not to be exceeded more than 35 times/year) are shown in **bold.**

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

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

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

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

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	$PM_{2.5}$ Annual Mean Concentration ($\mu g/m^3$) (3)				
				2012	2013	2014	2015	2016
452	Urban Background	77	77	13	13	13	10.6	10.4

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

Notes:

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

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

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

Appendix B: Full Monthly Diffusion Tube Results for 2016

Table B.1 – NO_2 Monthly Diffusion Tube Results – 2016

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 (0.93) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
2	82.7	78.7	66.5	78.8	70.7	64.7	64.4	64.7	71.0	69.0		70.8	71.1	**<u>66.1</u>**	32.5
3	37.9	42.2	49.8	46.6	45.9	36.9	21.8	28.3	30.6	52.2	49.0	44.2	40.5	37.6	37.6
4	58.9	66.2	60.3	66.9	63.0		42.6	52.0	57.5	73.1	62.4	50.4	59.4	**55.2**	30.2
5	52.3	61.1	56.7	58.2	56.2	54.8	49.2	47.1	50.6	58.1	57.8	60.5	55.2	**51.3**	**51.4**
6	36.5	41.9	40.3	35.4	34.6	34.9	28.3	27.8	31.3	40.0	41.1	43.0	36.3	33.7	33.7
7	35.2	33.6	37.2	29.9	29.3	24.8	18.7	21.6	23.0	34.6	41.0	40.4	30.8	28.6	28.3
8	26.9	32.9	33.4	27.7	26.7	23.2		11.3	19.3	32.5	34.1	42.7	28.2	26.3	26.3
9	58.3	57.4	56.4	56.8	55.1	46.2	41.0	38.4	49.1	54.8	53.8	62.1	52.5	**48.8**	37.0
10	60.0	63.1	62.7	69.1	53.7	57.2	45.1	47.3	54.1	62.8	61.4	66.5	58.6	**54.5**	**42.7**
11	58.7	58.6	60.5	60.2	56.3			43.9	51.8	52.7	55.5	57.6	55.6	**51.7**	**51.7**
12	56.9	60.2	59.0	64.5	61.0	58.0	50.9	50.1	53.6	53.5	53.1	60.7	56.8	**52.8**	**52.8**
13	24.1	25.1	21.3	18.3	20.2	15.4	12.4	13.8	14.3	19.8	25.3	28.9	19.9	18.5	18.5
14	38.1	45.6	50.5	48.0	50.7	48.5	34.4	34.1	41.1	52.7	50.7	52.0	45.5	**42.3**	34.1
15	54.3	61.3	56.3	58.7		53.5	44.2		50.5	55.9	56.1	59.9	55.1	**51.2**	**43.9**
16	47.9	44.5	39.7	37.5	34.7	32.5	31.3	31.0	35.9	34.2	43.5	48.0	38.4	35.7	35.7

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 (0.93) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
17	26.1	27.2		22.6	20.4	16.3	12.5	12.9	16.7	34.7	32.6	37.3	23.6	21.9	20.7
18	21.5	25.6	25.8	20.1	19.3	16.9	11.6	11.4	16.8	33.7	26.2	32.2	21.8	20.2	20.2
19	27.9	28.3	24.7	20.2	21.1	17.4	17.4	13.3	19.3	45.2	24.9	29.5	24.1	22.4	22.4
20		66.4	59.1	42.5	59.3	63.0	77.2	60.7	64.9	43.6	60.1		59.7	**55.5**	**55.5**
21	59.8	58.3	54.1	53.0	56.0	51.1	52.3	43.1	51.6	49.3	60.7	58.8	54.0	**50.2**	**41.5**
22	58.9	58.6	65.8	57.1	60.5	59.7	40.9	45.6	53.1	65.9	65.4	70.1	58.5	**54.4**	**54.4**
23	53.2	50.3	53.4	53.6	54.2	50.2	43.3	37.7	47.9	52.3	52.7	60.6	50.8	**47.2**	**42.9**
81	26.3	23.5	23.2	16.2	15.6	14.9	13.2	13.3	17.1	19.4			18.3	17.0	17.0
99	34.0	38.5	42.8	30.8	32.9	27.2	26.8	23.0	31.8	38.3	37.0	44.9	34.0	31.6	33.7
105	21.9	31.6	25.4	18.8	22.2	17.7	11.0	13.2	16.0	24.9	30.9	34.7	22.4	20.8	20.8
113	59.2	52.5	49.6	49.3	48.9	44.2	44.2	36.5	51.3	46.0	46.6	58.7	48.9	**45.5**	**47.6**
125	70.1	63.8	61.1	58.7	51.5	48.6	50.9	45.4	40.2	58.8	57.2	76.1	56.9	**52.9**	**45.9**
147	73.8	65.7	64.7	74.9	49.5	58.4	50.4	48.3	55.9	57.2	63.0	72.6	61.2	**56.9**	**45.5**
154	50.9	36.2	48.4	47.1	33.4	38.0	32.5	29.9	34.3	47.0	56.9	56.8	42.6	39.6	39.6
155	46.0	46.7	48.7	48.1	43.8				40.4	43.4	50.2	50.0	46.4	**43.1**	**43.1**
156	53.5	45.0	47.6	39.4	41.8	40.6	31.1	32.3	41.0	45.3	54.3	60.0	44.3	**41.2**	**44.6**
157				61.6	53.0	58.0	53.9	43.8	52.9	54.6	68.8	64.9	56.8	**52.8**	**52.9**
159	56.7	44.7	55.6	54.7	50.0	45.6	29.6	32.1	43.3	48.6	58.5	58.6	48.2	**44.8**	38.3
161	57.3	47.1	46.8	44.9	40.7	42.2	35.5	31.3	39.3	44.6	50.8	56.8	44.8	**41.7**	35.8
163	48.7	44.8	51.1	44.1	35.2	41.0	28.1	27.2	39.5	43.1	53.1	55.8	42.6	39.7	32.9

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 (0.93) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
175	72.4	57.3	55.2	61.6	48.9	65.9	62.4	47.5	64.6	69.5	66.3	57.4	60.8	**56.5**	37.3
239	80.5	71.2	76.6	80.2	69.1	80.1	73.8	55.6	72.1	75.7	74.9	79.0	74.1	**68.9**	**45.6**
242	71.8	67.6	74.7	76.9		76.3	76.3	53.3	69.1	76.6	75.2	91.4	73.6	**68.4**	**55.6**
254	70.9	46.3	58.2	63.0	47.5	53.5	51.7	45.7	48.6	53.4	65.4	64.7	55.7	**51.8**	**41.1**
260	59.4	51.0	49.7	48.7	40.7	47.6	45.2	38.5	46.0	45.6	54.8	58.1	48.8	**45.4**	**40.1**
261	57.0	55.6	58.2	55.1	50.7	57.8	50.5	46.8	50.9	60.0	74.4	68.1	57.1	**53.1**	39.6
263	46.4	41.5	39.2	36.6	30.7	31.9	28.4	25.4	23.8	34.7	42.6	52.2	36.1	33.6	32.7
295	73.3	66.1	56.4	66.4	55.1	64.9	64.1	54.7	58.7	16.2	64.5	78.4	59.9	**55.7**	**55.7**
300	57.3	51.2	54.3	51.3	52.3	56.0	51.3	42.7	44.2	52.0	54.2	53.7	51.7	**48.1**	**41.7**
303	57.7	48.7	50.2	48.0	48.7	45.5	53.3		42.4	46.1	50.5	55.2	49.7	**46.2**	**46.2**
305	39.6	44.0	37.9	37.7	36.1	36.9	25.7	26.8	27.3	45.7	45.5	48.0	37.6	35.0	33.2
307	42.8	40.7	44.6		39.6	32.4	24.2	27.8		42.0	48.3	60.0	40.2	37.4	33.8
311	52.8	49.2	50.0	51.9	43.8	47.4	44.7	41.3	48.1	51.5	53.8	61.8	49.7	**46.2**	36.3
312	48.4	46.7	31.4	44.4	34.8	45.2	33.7	30.0	39.6	36.8	87.0	58.6	44.7	**41.6**	36.3
314	56.3			53.0	43.2	41.0	33.3	35.6	37.9	39.0	49.7	57.2	44.6	**41.5**	36.4
320	39.2	40.7			28.3	28.9	28.8	24.3	30.9	32.2	36.4	44.2	33.4	31.1	31.1
325	57.4	52.5	55.2	46.3	37.3	55.3	48.1	47.5	54.0	49.0		94.9	54.3	**50.5**	**50.5**
363	49.8	45.1	41.1	43.0	38.9	38.8	38.2	36.3		39.8	44.9	53.2	42.6	39.6	39.6
365	40.8	43.2	39.6		43.0		29.4	30.1	36.4	47.6	45.0	52.7	40.8	37.9	37.9
370	47.9	45.9	42.0	45.5	31.7	36.6	33.0	30.5	38.7	43.5	45.3	55.1	41.3	38.4	38.4

Site ID	NO_2 Mean Concentrations (µg/m^3)														
													Annual Mean		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Raw Data	Bias Adjusted (0.93) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
371	50.7	54.7	53.7	52.7	43.9	47.1	39.9	37.8	46.1	28.1	49.3	46.8	45.9	**42.7**	33.1
373	53.2	47.4	47.1	42.3	42.0	35.9	30.8	31.8	39.4	42.3	46.7	50.3	42.4	39.5	**40.3**
374	53.6		56.3	51.8	51.6	54.7	39.7	40.3	47.8	50.5	51.0	60.8	50.7	**47.2**	**41.0**
396	32.7	36.1	39.5	40.1	32.9	35.0	34.8	34.2	28.7	35.8	37.7	36.3	35.3	32.8	32.8
397	34.0	39.5	40.8	41.7	36.2	36.1	33.8	32.4	28.3	33.8	40.8	39.3	36.4	33.8	33.9
398	38.3	40.7	30.2	37.4	34.8	30.6	19.6	25.4	30.7	39.4	39.7	43.8	34.2	31.8	31.8
403	46.2	47.9	39.9	45.6	37.0	33.2	34.7	33.2	35.3	41.3	41.7	48.2	40.4	37.5	37.5
405	61.5	52.3	45.3	49.4	41.2	46.5	36.4	35.3	44.3	49.0	46.5	42.1	45.8	**42.6**	37.9
406	40.8	45.2	42.1	41.1	37.8	37.0	29.1	25.3	32.9	44.0	41.5	50.8	38.9	36.2	36.2
407	52.9	53.0	57.0	59.0	54.0	47.2	34.5	38.6	47.5	58.6	61.2	64.3	52.3	**48.7**	35.9
413	43.4	47.6	40.1	44.5	42.6	40.3	35.2	35.2	38.6	46.7	49.8	52.5	43.0	**40.0**	35.3
417	48.1	53.2	49.7	47.8	50.7	44.8	41.9	32.1	41.0	48.6	47.0	55.0	46.7	**43.4**	**43.4**
418	77.5	75.3	74.7	80.4	77.6	67.1	68.2	66.2	77.8	77.3	69.5	82.9	74.5	**69.3**	**69.3**
419	60.1	63.4	60.3	67.6	61.3	55.1	57.0	51.1	58.7	58.0	59.8	67.8	60.0	**55.8**	38.6
420	42.8	46.0		47.5	43.6	38.3	31.5	30.5	35.0	38.3	50.5	52.1	41.5	38.6	36.0
422	46.9	46.8	42.3	42.0	41.6			30.5	35.4	43.5	43.6	51.6	42.4	39.4	39.4
423	51.5	49.3	46.9	50.4	47.9	43.2	42.7	40.8	47.0	40.7	48.2	52.3	46.7	**43.5**	**43.5**
426	42.4		41.6	30.7	39.1	31.0	22.9	27.0		38.2	44.3	50.8	36.8	34.2	29.5
429	60.9	62.4	54.9	60.7	61.7	55.9	50.2	45.8	55.0	50.1	58.3		56.0	**52.1**	**52.1**
436		66.3	46.4	56.6	55.7	51.2	47.2	40.3	44.9	50.0	56.6	48.4	51.2	**47.7**	34.1

Site ID	NO_2 Mean Concentrations (µg/m³)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
													Raw Data	Bias Adjusted (0.93) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
438	54.1	52.0	48.4	46.7	47.6	42.8	42.1	36.3	47.5	43.7	46.2	52.6	46.7	**43.4**	31.1
439	51.4	49.3	47.6	47.6	51.7	45.0	41.5	37.0	44.1	43.4	46.0	57.4	46.8	**43.6**	**43.6**
455	41.8	35.3	31.3	28.4	26.7	21.3	17.7	19.7	25.4	30.3	36.7	45.4	30.0	27.9	27.9
461	37.4	44.6	46.4	41.5	41.1	38.4	27.2		30.5	37.6	45.1	48.3	39.8	37.0	37.0
462	37.9	37.5	38.2	34.3	33.5	29.1	23.7	21.1	30.0	33.9	35.4	43.2	33.2	30.8	30.8
464	49.7	41.7	40.8	38.4	39.0	35.6	34.1	28.7	36.1	37.4	46.5	51.4	40.0	36.9	36.9
466	43.8	42.0	38.5	38.3	37.5	33.6	32.0	28.9	38.7	36.4	43.3	49.7	38.5	35.8	35.8
467	40.0	39.8	40.7	36.4	33.9	34.1	23.2	23.6	31.3	38.2	42.7	50.7	36.2	33.7	31.2
469	43.4	47.6	45.7	39.8	43.6	41.2	31.3	24.2	36.6	43.0	53.8	55.7	42.2	39.2	33.9
470	41.8	46.3	47.8	44.8	45.9	42.7	33.5	27.9	35.2	50.6	44.2	47.4	42.3	39.4	30.6
472	52.8	49.7	51.1		53.0	47.2	35.8	34.5	45.6	50.1	53.1	62.4	48.7	**45.3**	**45.3**
473	46.4	58.5	50.4	50.7	49.0	46.3	48.0	38.5	51.2	55.5	123.0	118.7	61.4	**57.1**	**57.1**
474	43.4	43.9	42.5	43.9	39.9	39.8	31.2	27.5	37.9	44.9	48.7	55.8	41.6	38.7	38.7
478	28.3	40.8	45.3	44.6	42.4	43.9	26.1	29.6	36.1	43.6	43.0	49.7	39.5	36.7	36.7
479	40.4	37.0	34.0	36.5	29.7	27.7	21.6	17.0	31.8	28.6	38.9	47.3	32.6	30.3	26.4
482	43.5	40.6	44.7	41.0	37.2	33.5	26.8	27.4	34.3	39.7	47.9	53.2	39.2	36.4	34.9
483	44.7	41.0	42.9	44.4	36.0	34.7	35.0	29.3	37.4	39.1	57.0	49.6	40.9	38.1	36.4
485	38.1	39.7	44.1	43.2	34.7	34.2	45.4	32.2	32.1	34.2	46.8	45.6	39.2	36.4	32.7
486	46.0	44.1	50.5	52.7	42.7	47.3		38.6	34.4	36.5	60.4	40.2	44.9	**41.7**	**41.7**
487	55.3	56.8	52.2	49.8	48.2	47.9	43.6	35.5	48.7	48.2	53.8	49.7	49.1	**45.7**	**42.0**

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 (0.93) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
488	51.1	48.7		49.7	45.2	44.1	31.6	33.7	42.4	50.4	51.4	55.0	45.7	**42.5**	**41.4**
489	44.3	40.0	47.2	47.6	38.5	40.8	39.4	35.5	34.3	37.8	48.8	44.0	41.5	38.6	36.4
490	38.6	38.0	39.7	37.0	32.2	33.9	32.3	29.2	25.8	31.5	42.8	37.3	34.9	32.4	30.3
491	40.9	39.6	40.0	40.8	37.7	35.5	33.3	30.7	32.5	35.3	54.3	50.6	39.3	36.5	35.0
492	56.1	44.5	44.4	43.1	41.1	41.2	31.2	30.1	37.8	42.2	51.0	57.6	43.4	**40.3**	31.8
493	47.5	44.1	49.3	45.9	41.1	41.4	38.2	35.1	35.2	45.3	54.7	58.0	44.6	**41.5**	**41.5**
494	53.6	45.8	43.0	48.1	42.7	44.4	40.3	38.7	43.8	42.6	58.7	57.3	46.6	**43.3**	36.8
495	32.3	29.2	28.7	24.4	24.0			16.2	21.0	28.4	34.9	38.5	27.8	25.8	25.8
496	53.5	52.5	43.3	42.1	35.6	43.4	46.3	31.0	41.3	38.9	50.8	51.1	44.2	**41.1**	**41.1**
497	51.3	47.6	47.2	44.3	44.0	42.3	32.9	38.5	43.7		55.5	63.3	46.4	**43.2**	36.0

☒ **Local bias adjustment factor used**

☐ **National bias adjustment factor used**

☒ **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) See Appendix C for details on bias adjustment and annualisation.

(2) Distance corrected to nearest relevant public exposure.

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

New Sources of Pollution

There have not been any significant changes to sources of pollution that have not been considered in previous reviews and assessments. During 2016 the construction works for the new Metrobus routes have continued to take place and in some locations have continued to cause significant, but what will be temporary, disruptions to traffic flows. Any potential short term increases in pollution as a result of increased congestion should ultimately be off-set with improvements associated with a significantly improved public transport system for the city which aims to encourage modal shift to public transport.

Clean Air Zone Feasibility Study Progress to Date

A Clean Air Zone is being assessed as part of the Clean Air Action Plan. Bristol City Council will comply with the reporting requirements of the emeging JAQU guidance for this project.

Locations Recording Exceedence Outside AQMA

The next section of the report discusses the locations which have shown some exceedences of the annual objective for NO_2 in the past 5 years but are located outside of the AQMA. Table C.1 lists all these locations and provides measured pollutant concentrations for the past 5 years where available.

Table C.1 - Tubes Outside AQMA Exceeding the Annual Air Quality Objective for NO_2 Since 2012

Site	Site ID	Annual Mean Concentrations (µg/m^3)					Action
		2012	2013	2014	2015	2016*	
Blackboy Hill	3	37.7	**41.2**	36.3	37.9	37.6	Slight exceedence recorded in 2013 after two years of compliance. 2014, 2015 and 2016 showed compliance, with concentrations comparable to those measured in 2011 and 2012. Monitoring to continue in this location.
Give Way sign Chesterfield Rd \ Ashley Down Road St. Andrews	311	**46.7**	**49.5**	**43.3**	**44.0**	**46.2** (36.3)	NO_2 concentration at relevant receptor location (using distance from roads calculator) is below the air quality strategy objective. No further action required.
No.67 Filton Avenue on wall facing Muller Rd	493	Not Monitored	Not Monitored	Not Monitored	36.4	**41.5**	2016 was the first full year of monitoring in this location with data from 2015 being annualised. The monitoring location is on the façade of a residential dwelling and is therefore representative of relevant exposure. Bristol City Council intend to continue monitoring in this location and will consider whether it is necessary to expand the current AQMA boundary, which follows Gloucester Road and passes within 175m of monitoring site 493.
Muller Road - Adjacent to Darnley Avenue	494	Not Monitored	Not Monitored	Not Monitored	38.4	**43.3** (36.8)	2016 was the first full year of monitoring in this location with data from 2015 being annualised. The NO_2 concentration at relevant receptor location (using distance from roads calculator) is below the air quality strategy objective as shown in brackets. No further action required.
Lamppost Whiteladies Road \ Cotham Hill Clifton	314	**40.4**	**44.4**	**43.0**	**43.9**	**41.5** (36.4)	NO_2 concentration at relevant receptor location is below the air quality strategy objective when calculated using distance calculator tool. Monitoring in this location to continue to ensure that exceedence at the relevant receptor does not occur consistently in future years.
Avonmouth Road - Telegraph Pole Opposite Hse No 4	485	**41.2**	35.7	35.0	35.5	36.4	Compliance has been achieved at all monitoring locations along Avonmouth Road during 2016. Monitoring will continue in some locations, however, the number of sites will be reduced in 2017 due to continued compliance being demonstrated. No further action is required with regards to AQMA declaration.
Barrack's Lane - Telegraph	486	**41.5**	38.2	36.6	**40.8**	**41.7**	The purpose of monitoring location is to assess local contribution of the M5 motorway to NO_2 concentrations. This

Site	Site ID	Annual Mean Concentrations ($\mu g/m^3$)					Action
		2012	2013	2014	2015	2016*	
Pole No 6. End of Lane Left Hand Side							tube appears to indicate that the M5 contribution to NO_2 concentrations in 2016 was greater than at any year over the last 5 years. It is the only tube to record an exceedence in the area despite being located 270m from Avonmouth Road. This would indicate that any exccedences of the annual objective in this area would be due to the influence of pollution from the M5 Motorway and not the local road.

*Distance adjusted values in ()

Chesterfield Road/Ashley Down Road

Diffusion tube 311 is located on the give way sign at a congested road junction approximately half a metre from the kerbside. The nearest property façade is some 8.5 metres from the kerbside. The NO_2 distance calculator has previously been used to assess whether the nearby property could be at risk of exceedence of the annual mean NO_2 objective every year since 2009. For all years it was concluded that the objective would be met where relevant exposure occurred. There has been a 2.2 $\mu g/m^3$ increase in NO_2 concentrations in this location in 2016 compared to 2015 and an increase of almost $3\mu g/m^3$ since 2014. The NO_2 distance calculator results for 2016 are summarised in **Error! Reference source not found.** and shows that the redicted concentration at the façade of the nearest relevant receptor is once again below the annual mean objective. Background NO_2 concentrations used in the calculations below have been taken from the Defra published background pollution maps for 2016. Distance adjusted data is reported in Table B.1.

Blackboy Hill and Whiteladies Road

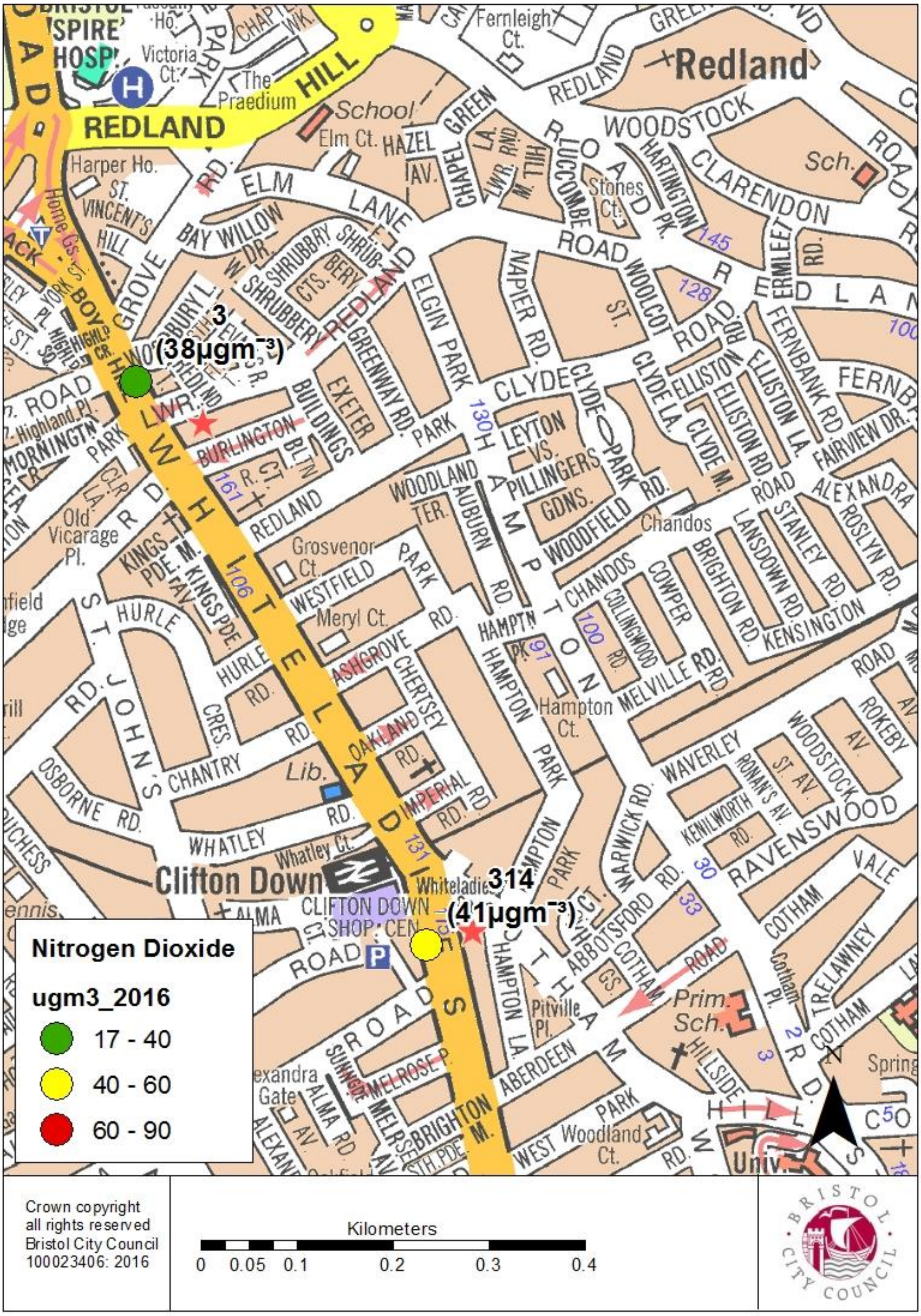
The 2011 Detailed Assessment concluded that an extension to the central AQMA should be made to include Whiteladies Road and Blackboy Hill. Bristol City Council were planning to start the consultation process for the extension of the AQMA, however, the 2011 data considered for both these sites in the 2012 Updating and Screening Assessment[13] showed that there had been a marked reduction in NO_2 concentrations measured in these locations compared to 2010. The 2012 data for

[13] Bristol City Council. (2012). 2012 Updating and Screening Assessment for Bristol City Council.

Tube 314 and Tube 3 confirm that the decision in 2012 to defer the declaration of an AQMA along Whiteladies Road was the right approach to take. Data for 2013 at Tube 314 on Whiteladies Road shows that there was a marginal exceedence (40.3µg/m^3) where relevant exposure occurs, however, the data from 2014, 2015 and 2016 shows compliance with 2016 data showing an annual average of 36.4µg/m^3 when distance adjusted for relevant exposure. The location of the moinitoring sites in this area are shown in Figure C.1.

Tube 3 on Blackboy Hill is located on the façade of a building and is representative of relevant exposure. In both 2011 and 2012 the objective was met at this location; however, in 2013 the objective was exceeded with 41.2µg/m^3 being recorded. 2015 and 2016 data once again show compliance at this location with an annual NO_2 concentrations of 37.9µg/m^3 and 37.6µg/m^3 respectively. The latest monitoring data has continued the trend of marginal exceedence and compliance in this location and confirms the need to continue to monitor the annual variation in air quality being recorded here.

Figure C.1 - Location of Diffusion Tube Sites on Whiteladies Road and Blackboy Hill (including 2016 Annual NO_2 Data)



Avonmouth Road and Barrack's Lane

Monitoring has continued around the M5 Avonmouth Bridge over Avonmouth Road following revocation of the AQMA here in 2008. The 2011 Detailed Assessment concluded that consultation for the re declaration of an AQMA at Avonmouth Road should begin. This consultation process was under way with statutory bodies; however, 2011 data, reported in the 2012 Updating and Screening Assessment, casts some doubt over the necessity to declare in this location. After consultation with the LAQM Helpdesk it was agreed that the declaration process could be deferred in order for additional data to be collected.

Annual NO_2 concentrations at 9 diffusion tube locations in the Avonmouth Road area during 2016 were again below the objective. Tube 486 on Barrack's Lane recorded an increase from 36.6µg/m^3 in 2014 to 40.8µg/m^3 in 2015 and a further increase in 2016 to 41.7. There is not any relavant exposure in this particular location but it is an indication of pollution concentrations at similar distances all along this section of the M5 motorway. The latest data would indicate that pollution levels have increased significantly over the past 2 years in this location (a 5.1µg/m^3 increase). Whilst being over 250m from Avonmouth Road, this is the only location out of 10 monitoring sites that has recorded an exceedence of the objective in the past 4 years, which would indicate that it is the M5 motorway that is the most significant (and potentially increasing) source of pollution in the Avonmouth Road area. It should however be noted that the M5 motorway is at ground level in the vicinity of monitoring site 486. The motorway then gains significant height as it pases over the Avonmouth Bridge over Avonmouth Road and the River Avon.

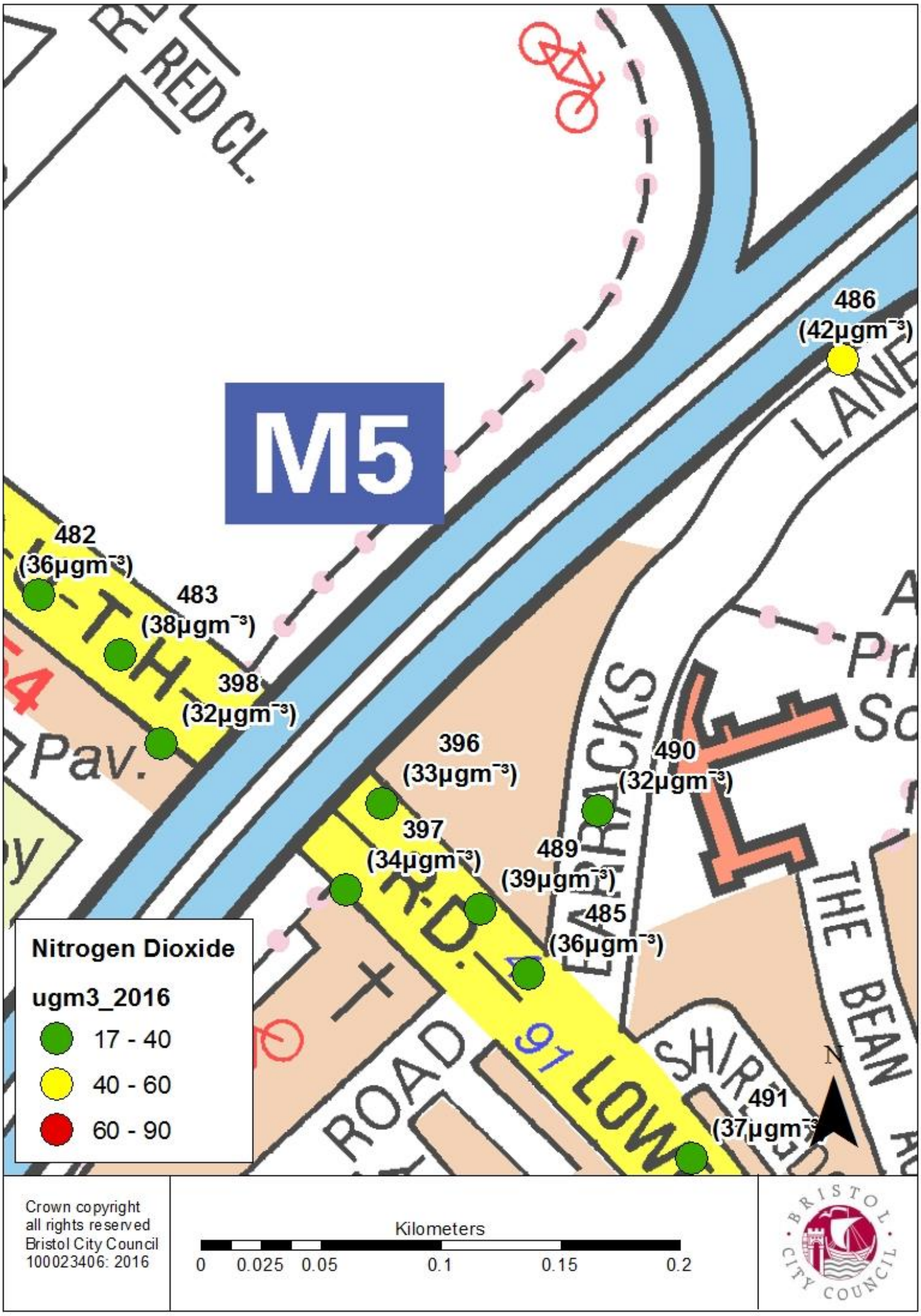
Locations of monitoring sites is shown in Figure C.2 with results from all monitoring locations in the Avonmouth Road area reported in Table C.2.

Table C.2 - Diffusion Tube Results for Avonmouth Road 2012-2016

Site	Site ID	Annual Mean Concentrations				
		2012	2013	2014	2015	2016
Avonmouth Rd No 28 on facia	396	34.7	31.9	30.7	32.0	32.8
facade Avonmouth road underpass - house to SE	397	34.0	34.4	28.5	33.0	33.8
Avonmouth Rd No 31 on facia	398	31.8	34.0	31.9	30.1	31.8
Avonmouth Road - Lamppost (20)	482	35.8	36.7	35.8	35.1	36.4

Site	Site ID	Annual Mean Concentrations				
		2012	2013	2014	2015	2016
Opposite Number Hse No 45						
Avonmouth Road - Lamppost (19) Opposite Hse No 37	483	38.5	36.5	37.2	37.1	38.1
Avonmouth Road - Telegraph Pole Opposite Hse No 4	485	**41.2**	35.7	35.0	35.5	36.4
Barrack's Lane - Telegraph Pole No 6. End of Lane Left Hand Side	486	**41.5**	38.2	36.6	**40.8**	**41.7**
Avonmouth Road Outside No 12	489			34.5	36.9	38.6
Avon School Barrack's Lane	490			29.1	31.9	32.4
Avonmouth Road Outside No 76	491			31.2	33.8	36.5

Figure C.2 – Avonmouth Road Monitoring Locations (including 2016 Annual NO_2 Data)



Muller Road

Monitoring sites 493 and 494 were added to the monitoring network in 2015 along Muller Road. Both recorded exceedences of the annual NO_2 objective during 2016. When adjusted for distance to relevant exposure Tube 494 is compliant, however, tube 493 is at a location of relevant exposure. Tube 493 is located approximately 175m from the boundary of the current AQMA which runs along Gloucester Road. Monitoring will continue here to determine if there is a need to extend the AQMA boundary to cover this location. In the meantime however, it should be noted that measures to reduce air pollution in the current AQMA boundary should impact positively in this location despite being just outside the AQMA.

QA/QC of Diffusion Tube Monitoring

Precision calculations were undertaken for all sites in the collocation study. The precision checks indicated a "good" precision rating for all measurement periods at all sites. Automatic monitor data capture rates were good at all sites for all months except for February at the Wells Road site. Summary tables from the analysers used for bias adjustment and precision calculation are included in the Figures below.

Figure C.3 - Summary Data for Bias and Precision Calculation: Brislington

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	04/01/2016	02/02/2016	37.6	42.0	38.1	39	2.4	6	6.1	29	99.5	Good	Good
2	02/02/2016	01/03/2016	38.5	36.1	47.5	41	6.0	15	15.0	31	92.6	Good	Good
3	01/03/2016	31/03/2016								29	99.9		Good
4	31/03/2016	26/04/2016								28	99.8		Good
5	26/04/2016	26/05/2016	26.7	28.4	29.8	28	1.6	6	3.9	25	99.5	Good	Good
6	26/05/2016	28/06/2016	29.1	28.3	29.2	29	0.5	2	1.2	22	99.9	Good	Good
7	28/06/2016	26/07/2016	27.7	28.5	30.1	29	1.2	4	3.0	21	99.9	Good	Good
8	26/07/2016	25/08/2016	23.0	23.8	26.1	24	1.6	7	4.0	23	99.7	Good	Good
9	25/08/2016	28/09/2016	32.3	31.0	29.5	31	1.4	4	3.4	29	100	Good	Good
10	28/09/2016	27/10/2016	31.8	32.8	32.1	32	0.5	2	1.3	28	99.8	Good	Good
11	27/10/2016	29/11/2016	36.1	37.6	35.5	36	1.1	3	2.7	31	99.9	Good	Good
12	29/11/2016	04/01/2017	44.2	43.7	44.6	44	0.4	1	1.1	39	99.7	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

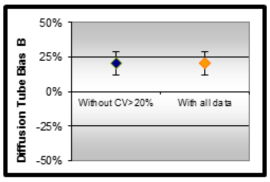
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Brislington

Precision 10 out of 10 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	0.83 (0.78 - 0.9)
Bias B	20% (12% - 29%)
Diffusion Tubes Mean:	33 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	28 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	28 (26 - 30) μgm^{-3}

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 10 periods of data	
Bias factor A	0.83 (0.78 - 0.9)
Bias B	20% (12% - 29%)
Diffusion Tubes Mean:	33 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	28 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	28 (26 - 30) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Figure C.4 - Summary Data for Bias and Precision Calculation: Fishponds

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Automatic Method Period Mean	Automatic Method Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	07/01/2016	04/02/2016	48.8	50.8	49.6	50	1.0	2	2.5	44	85.4	Good	Good
2	04/02/2016	04/03/2016	41.6	41.4	42.0	42	0.3	1	0.7	43	96.2	Good	Good
3	04/03/2016	01/04/2016	41.0	39.9	41.3	41	0.7	2	1.8	44	99.9	Good	Good
4	01/04/2016	28/04/2016	39.7	38.4	37.0	38	1.3	3	3.3	45	88.2	Good	Good
5	28/04/2016	27/05/2016	37.3	38.2	41.5	39	2.2	6	5.6	47	99.9	Good	Good
6	27/05/2016	30/06/2016	35.7	35.1	36.1	36	0.5	1	1.3	39	99.8	Good	Good
7	30/06/2016	27/07/2016	34.7	33.6	34.0	34	0.5	2	1.3	38	99.8	Good	Good
8	27/07/2016	26/08/2016	29.3	29.4	27.5	29	1.0	4	2.6	38	99.8	Good	Good
9	26/08/2016	29/09/2016	36.1	36.2	35.9	36	0.1	0	0.4	40	99.9	Good	Good
10	29/09/2016	29/10/2016	37.8	37.1		37	0.5	1	4.2	46	99.9	Good	Good
11	29/10/2016	01/12/2016	45.4	47.7	46.5	46	1.1	2	2.8	50	99.7	Good	Good
12	01/12/2016	06/01/2017	48.8	54.0		51	3.6	7	32.5	38	99.9	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

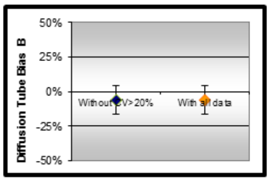
Site Name/ ID: Fishponds

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A: 1.07 (0.96 - 1.2)
Bias B: -6% (-17% - 4%)
Diffusion Tubes Mean: 40 μgm^{-3}
Mean CV (Precision): 3
Automatic Mean: 43 μgm^{-3}
Data Capture for periods used: 97%
Adjusted Tubes Mean: 43 (38 - 48) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A: 1.07 (0.96 - 1.2)
Bias B: -6% (-17% - 4%)
Diffusion Tubes Mean: 40 μgm^{-3}
Mean CV (Precision): 3
Automatic Mean: 43 μgm^{-3}
Data Capture for periods used: 97%
Adjusted Tubes Mean: 43 (38 - 48) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Figure C.5 - Summary Data for Bias and Precision Calculation: Parsons Street

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Automatic Method Period Mean	Automatic Method Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	04/01/2016	02/02/2016	52.4	51.2	50.5	51	1.0	2	2.4	54	99.9	Good	Good
2	02/02/2016	01/03/2016	49.8	49.1	49.0	49	0.4	1	1.0	56	99.8	Good	Good
3	01/03/2016	31/03/2016	48.2	47.2	47.4	48	0.5	1	1.4	49	99.9	Good	Good
4	31/03/2016	26/04/2016	47.2	48.7	46.9	48	1.0	2	2.4	45	99.9	Good	Good
5	26/04/2016	26/05/2016	51.7	52.2	51.1	52	0.6	1	1.4	47	99.9	Good	Good
6	26/05/2016	28/06/2016	45.5	43.3	46.3	45	1.6	3	3.9	42	99.9	Good	Good
7	28/06/2016	26/07/2016	43.1	40.4	41.1	42	1.4	3	3.6	37	100	Good	Good
8	26/07/2016	25/08/2016	36.4	38.2	36.4	37	1.1	3	2.6	34	100	Good	Good
9	25/08/2016	28/09/2016	44.3	44.7	43.2	44	0.8	2	2.0	36	86.2	Good	Good
10	28/09/2016	27/10/2016	44.5	42.7	43.0	43	0.9	2	2.4	47	99.9	Good	Good
11	27/10/2016	29/11/2016	44.0	45.3	48.8	46	2.5	5	6.1	46	99.8	Good	Good
12	29/11/2016	04/01/2017	57.6	56.6	58.0	57	0.7	1	1.7	60	99.9	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

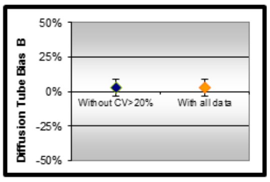
Site Name/ ID: Parsons Street

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A: 0.98 (0.93 - 1.05)
Bias B: 2% (-5% - 8%)
Diffusion Tubes Mean: 47 μgm^{-3}
Mean CV (Precision): 2
Automatic Mean: 46 μgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 46 (44 - 49) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A: 0.98 (0.93 - 1.05)
Bias B: 2% (-5% - 8%)
Diffusion Tubes Mean: 47 μgm^{-3}
Mean CV (Precision): 2
Automatic Mean: 46 μgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 46 (44 - 49) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Figure C.6 - Summary Data for Bias and Precision Calculation: St Pauls

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Automatic Method: Period Mean	Automatic Method: Data Capture (% DC)	Data Quality Check: Tubes Precision Check	Data Quality Check: Automatic Monitor Data
1	07/01/2016	04/02/2016	41.3	42.4	41.5	42	0.6	1	1.4	33.6	96.8	Good	Good
2	04/02/2016	04/03/2016	34.9	34.8	36.3	35	0.8	2	2.1	32.9	100	Good	Good
3	04/03/2016	01/04/2016	32.7	29.5	31.9	31	1.6	5	4.1	33.9	100	Good	Good
4	01/04/2016	28/04/2016	28.0	28.7	28.5	28	0.4	1	0.9	23	99.7	Good	Good
5	28/04/2016	27/05/2016	26.8	27.5	25.7	27	0.9	4	2.4	22	99.7	Good	Good
6	27/05/2016	30/06/2016	22.5	21.9	19.4	21	1.7	8	4.2	18	100	Good	Good
7	30/06/2016	27/07/2016	17.6	17.8	17.8	18	0.1	1	0.3	15	94	Good	Good
8	27/07/2016	26/08/2016	20.2	18.8	20.0	20	0.7	4	1.8	16	97.9	Good	Good
9	26/08/2016	29/09/2016	25.3	25.2	25.8	25	0.3	1	0.8	20	99.9	Good	Good
10	29/09/2016	29/10/2016	32.0	30.6	28.2	30	1.9	6	4.7	30	98.3	Good	Good
11	29/10/2016	01/12/2016	36.3	36.1	37.8	37	0.9	2	2.3	36.5	99.9	Good	Good
12	01/12/2016	06/01/2017	45.6	47.7	43.0	45	2.3	5	5.8	45.1	99.4	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

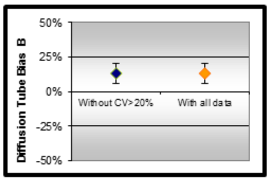
Site Name/ ID: St Pauls

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)	
without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.9 (0.85 - 0.97)
Bias B	11% (3% - 18%)
Diffusion Tubes Mean:	30 μgm^{-3}
Mean CV (Precision):	3
Automatic Mean:	27 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	27 (26 - 29) μgm^{-3}

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.9 (0.85 - 0.97)
Bias B	11% (3% - 18%)
Diffusion Tubes Mean:	30 μgm^{-3}
Mean CV (Precision):	3
Automatic Mean:	27 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	27 (26 - 29) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Figure C.7 - Summary Data for Bias and Precision Calculation: Wells Road

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Automatic Method: Period Mean	Automatic Method: Data Capture (% DC)	Data Quality Check: Tubes Precision Check	Data Quality Check: Automatic Monitor Data
1	04/01/2016	02/02/2016	51.5	57.5	53.2	54	3.1	6	7.6	42	97.6	Good	Good
2	02/02/2016	01/03/2016	50.6	49.8	55.5	52	3.1	6	7.7	49	57	Good	or Data Capture
3	01/03/2016	31/03/2016	48.1	50.7	46.5	48	2.1	4	5.2	47	96.9	Good	Good
4	31/03/2016	26/04/2016	41.7	48.7	49.8	47	4.4	9	10.8	38	93.6	Good	Good
5	26/04/2016	26/05/2016	44.5	49.9	48.5	48	2.8	6	7.0	37	99.8	Good	Good
6	26/05/2016	28/06/2016	42.5	44.2	41.8	43	1.3	3	3.2	34	99.7	Good	Good
7	28/06/2016	26/07/2016	39.3	43.1	44.0	42	2.5	6	6.1	37	99.4	Good	Good
8	26/07/2016	25/08/2016	36.0	35.5	37.4	36	1.0	3	2.4	37	99.8	Good	Good
9	25/08/2016	28/09/2016	46.1	49.6	46.6	47	1.9	4	4.7	38	99.7	Good	Good
10	28/09/2016	27/10/2016	45.2	44.1	41.9	44	1.7	4	4.2	41	99.8	Good	Good
11	27/10/2016	29/11/2016	44.9	47.4	46.4	46	1.2	3	3.1	48	99.8	Good	Good
12	29/11/2016	04/01/2017	50.3	51.9	55.5	53	2.7	5	6.6	51	99.7	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

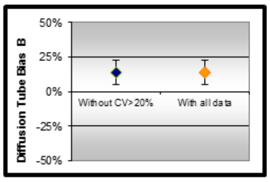
Site Name/ ID: Wells Road

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)	
without periods with CV larger than 20%	
Bias calculated using 11 periods of data	
Bias factor A	0.89 (0.82 - 0.96)
Bias B	13% (4% - 22%)
Diffusion Tubes Mean:	46 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	41 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	41 (38 - 44) μgm^{-3}

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 11 periods of data	
Bias factor A	0.89 (0.82 - 0.96)
Bias B	13% (4% - 22%)
Diffusion Tubes Mean:	46 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	41 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	41 (38 - 44) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Diffusion Tube Bias Adjustment Factors

Since March 2012 diffusion tube analysis has been carried out by Somerset Scientific Services. This lab is not UKAS accredited for diffusion tube analysis but does participate in the AIR PT Scheme for nitrogen dioxide tubes. All reference materials are of at least analytical grade or equivalent. Standards are prepared using equipment that is all within the normal quality system. The tubes used are recycled Gradko tubes prepared and set on a monthly basis. The tube changing frequency is as per the calendar on the Air Quality Archive web site and is carried out by Bristol City Council officers. The tubes are prepared with 50 µL of 20% triethanolamine in water. The method follows that set out in the practical guidance document.

Table C.3 – AIR PT Scheme Results for Somerset County Council

AIR PT Scheme Results: AR0229 – Somerset County Council Round 15 onwards				
Round	15	16	18	19
Tube 1 (µg NO2)	0.91	2.11	0.92	0.58
Tube 2 (µg NO2)	1.40	2.34	1.17	0.59
Tube 3 (µg NO2)	0.91	2.22	1.18	1.20
Tube 4 (µg NO2)	1.40	2.12	0.91	1.20
Z' Score tube 1	0.30	0.53	0.74	0.73
Z' Score tube 2	0.77	0.35	0.48	0.71
Z' Score tube 3	0.30	-0.12	0.47	0.58
Z' Score tube 4	0.81	0.43	0.44	0.78
Performance classification	Satisfactory	Satisfactory	Satisfactory	Satisfactory

Discussion of Choice of Factor to Use

Box 7.1 of LAQM TG16 was used in order to decide on the most appropriate BAF to use. Bristol has a relatively large network of automatic NO_X analysers that are operated to national QA/QC procedures. In 2016, 5 of these sites recoded data capture rates of more than 90%. After detailed analysis of data capture rates, diffusion tube data capture rates and precision, 5 of these sites have been identified as appropriate to use for bias adjustment calculations for 2016. The precision of the analysis at these co-located triplicate tubes was classed as good. The Review and Assessment helpdesk spread sheet number 06/16 contains data from only two additional studies using Somerset Scientific Services for their diffusion tube analysis. Due to the factors outlined above it was decided that the locally derived BAF would be more representative and should be used. The locally derived BAF was 0.93.

Short-term to Long-term Data Adjustment

Data capture rates for both the Newfoundland Way and Rupert Street sites for 2016 were below 40% for each site and as a result have not been reported here.

Adjustment of short term to long term data was not required for any sites as data capture rates for 2016 were above 75% in all other locations.

QA/QC of Automatic Monitoring

The Council's monitoring network is operated and run by officers trained in all aspects of the monitoring processes including routine site operations, field calibrations and data ratification. The QA/QC for the AURN Bristol St Pauls site is carried out by Ricardo-AEA.

Routine Site Operations

The Council's monitoring sites have a programme of routine operational checks and programmed fortnightly site visits including:

- Daily communications checks on lines, data transfer and analyser operation;
- Daily checks of data quality;
- Repairs of faulty equipment under arrangements with outside contractors;
- Fortnightly site inspections of equipment operational status, site safety, security and calibration checks;
- Planned six monthly servicing and re-calibration of analysers by equipment suppliers under contract to the Council.

Equipment Servicing and Maintenance Regimes

Analysers have planned maintenance schedules that broadly follow those assigned to the AURN and affiliated site network. All analysers are maintained following manufacturers' instructions and have a six monthly full service and re-calibration conducted under the servicing contract. During 2016 the Equipment Support Services (ESU) were carried out by ESU1 Ltd. BCC's internal data ratification procedures have been used to ensure that the reported data is valid and meets the required standards. Results of the servicing, calibrations and repairs that were carried out by ESU1 Ltd are fully documented and stored centrally. BCC staff carry out routine maintenance during regular fortnightly site visits where all associated equipment such as sample lines, modem, and electrical system are examined and sample inlet filters are changed. Any faults, repairs or changes made to the equipment are also recorded and stored centrally and at analyser locations.

Calibration Methods

The calibration procedures are the same for all the Council's continuous analysers, with a two point zero/span calibration check being performed at regular intervals of two weeks. The methodology for the calibration procedure being derived from the manufacturers' instruction handbooks and from the AURN Site Operator's Manuals, as follows:

- Pre-calibration check - the site condition and status of the analyser is recorded prior to the zero/span check being conducted;
- Zero check – the response of the analyser to the absence of the gas being monitored;
- Span check – the response of the analyser to the presence of the gas of a known concentration;
- Post calibration check - the site condition and status of the analyser upon completion of all checks.

Each analyser zero/span check is fully documented with records being kept centrally using Google Sheets. Diagnostics data is recorded automatically through Envista ARM. Calibration factors are calculated in Google Sheets and are used in the scaling and ratification process.

Analyser Calibration

A two point calibration is conducted on Bristol City Council analysers with a reference NO mixture at a concentration of approximately 470ppb. Gases are supplied and certified by BOC.

Zero Air Generation

The contents of the portable scrubber (hopcalite, activated charcoal, purafil and drierite) are changed when necessary or at least every six months.

Appendix D: Maps of Monitoring Locations and AQMAs

Figure D.1 - Extent of Air Quality Management Area

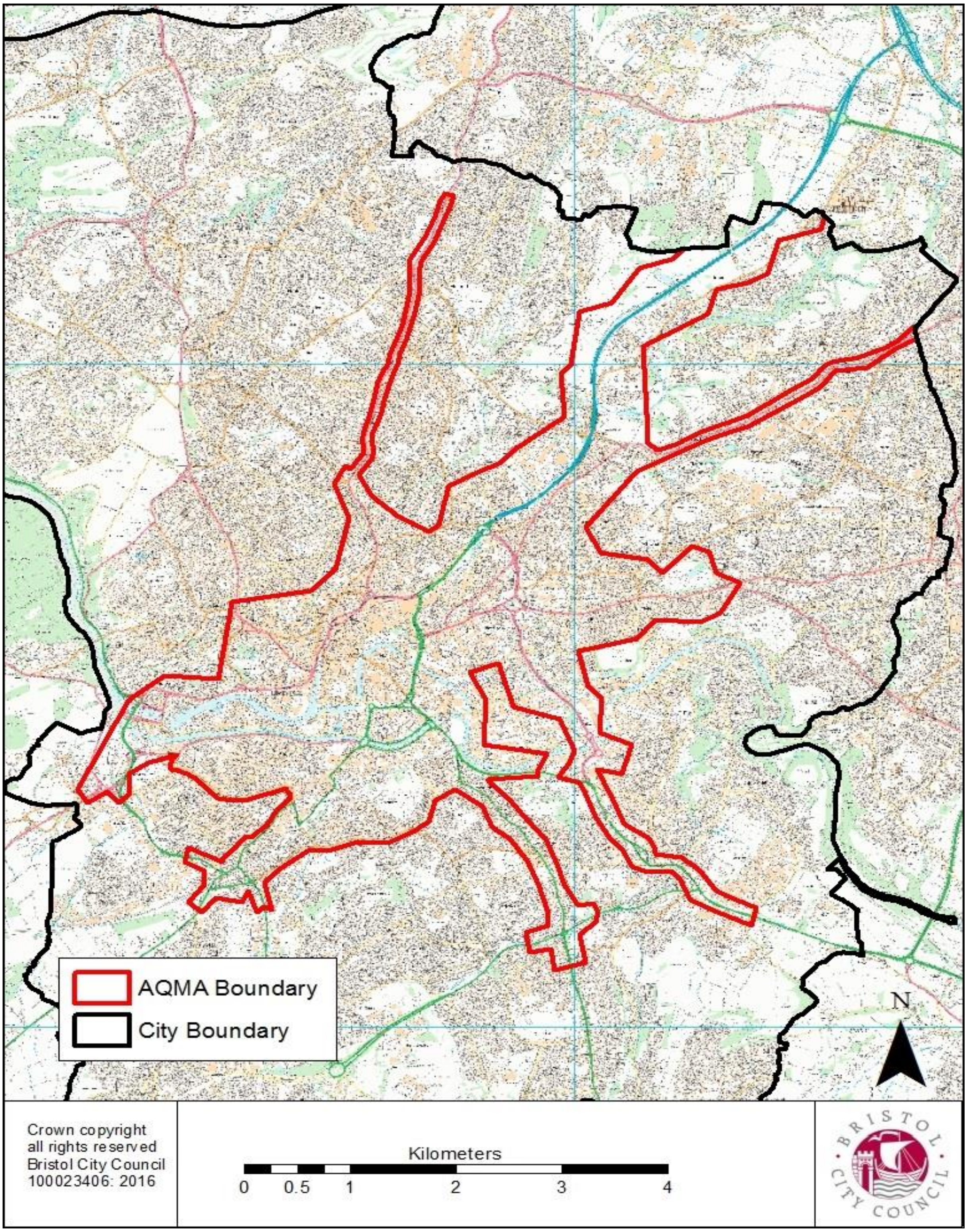


Figure D.2 - Central Monitoring Locations and 2016 Measured Annual NO_2 Concentrations

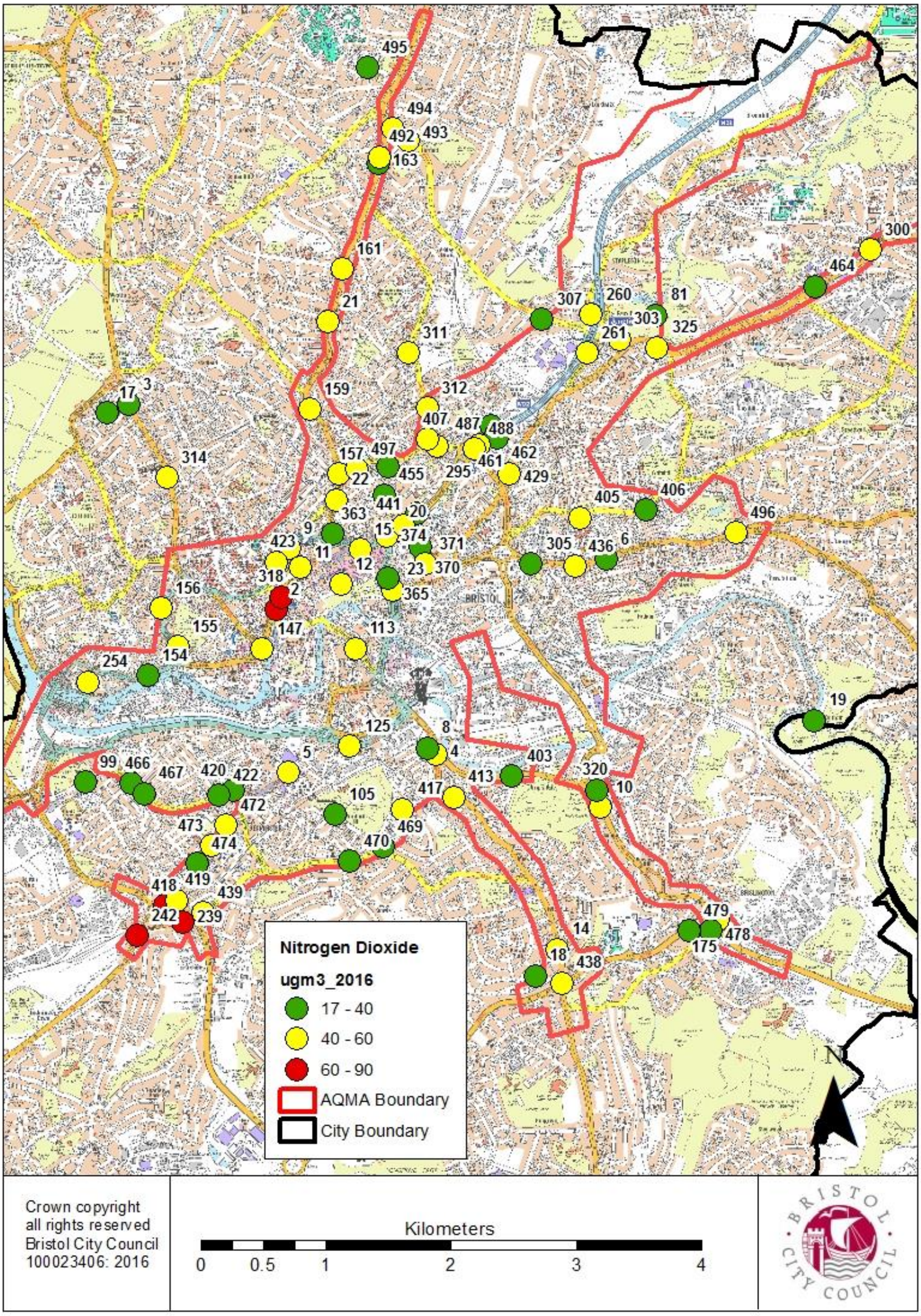


Figure D.3 - Central Monitoring Locations and 2016 Distance Adjusted Annual NO_2 Concentrations

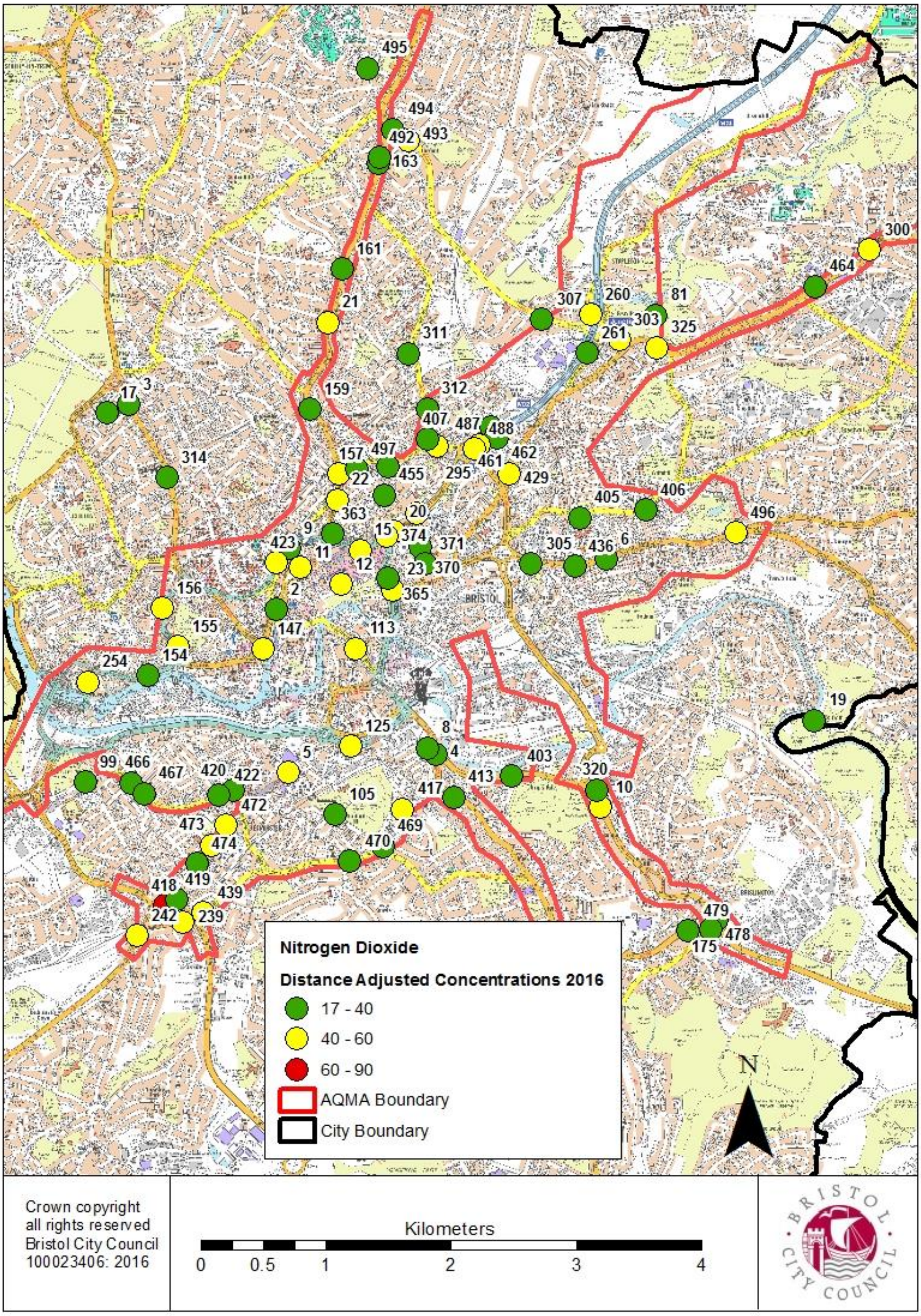


Figure D.4 - Avonmouth Monitoring Locations and 2016 Annual NO_2 Concentrations

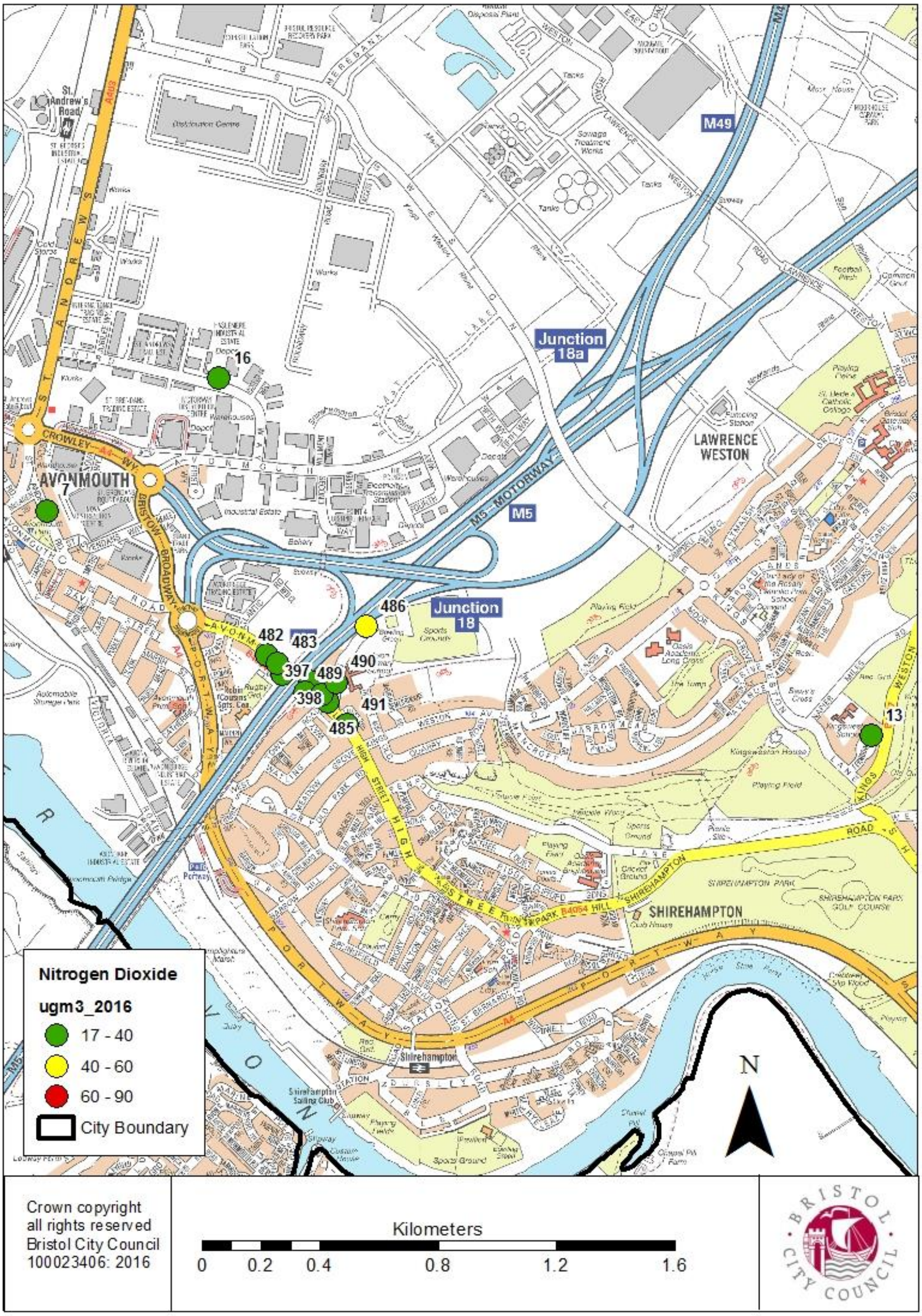
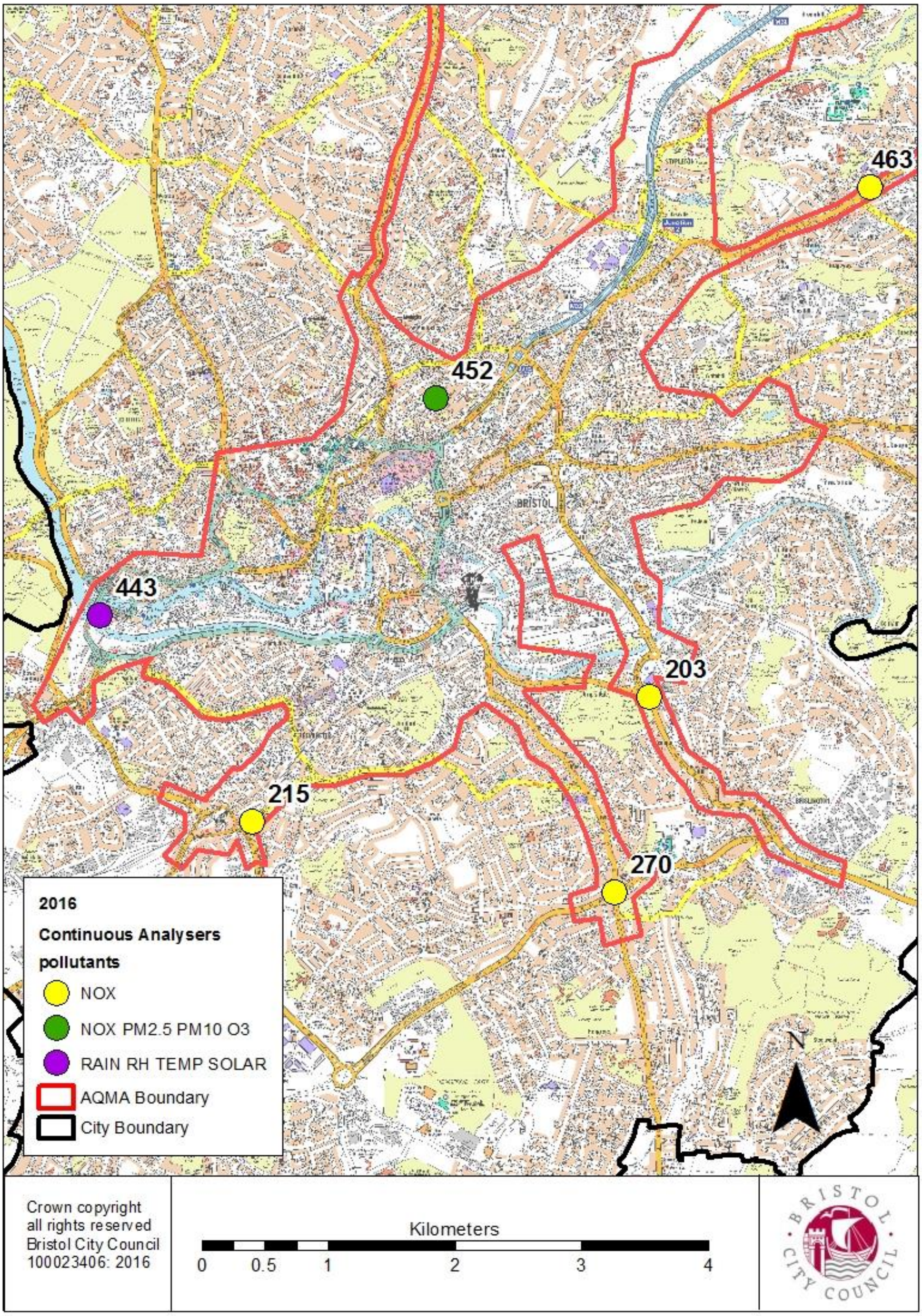


Figure D.5 - Continuous (real-time) Monitoring Locations in 2016



Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England

Pollutant	Air Quality Objective[14]	
	Concentration	Measured as
Nitrogen Dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
	40 µg/m^3	Annual mean
Particulate Matter (PM_{10})	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
	40 µg/m^3	Annual mean
Sulphur Dioxide (SO_2)	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

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

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values’
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
ASR	Air quality Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
EU	European Union
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide
CAZ	Clean Air Zone