2019 Air Quality Annual Status Report (ASR)

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

June 2019v1

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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 454,200[4] for the unitary authority at present, and a surrounding urban area with an estimated 648,800 residents (mid 2015), 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 objective for nitrogen dioxide and probably the hourly objective, 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

[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
[4] ONS 2016 Mid-Year Population Estimate

nitrogen dioxide limits, it is important not to lose sight of the health improvements that 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 solid fuel burning) and industry. There is also a contribution from sources outside of the local authority area. In the case of particulate pollution, contributions from agriculture, industry and natural sources can be significant at times when weather patterns result in a build-up of pollution in the atmosphere and the formation of secondary particulate pollution. Secondary PM is formed in the atmosphere through chemical reactions between other air pollutant gases such as nitrogen oxides (NOx), ammonia (NH_3) and sulphur dioxide (SO_2).

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, especially 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

Non-compliance with the smoke control rules can result in a fine of up to £1000.

The health impacts from $PM_{2.5}$ pollution have been shown to occur at levels below EU and UK objectives. Recent evidence from national studies shows that domestic solid fuel burning contributes more than previously thought to particulate emissions. This new research suggests that the health impacts from local domestic wood burning are significant.

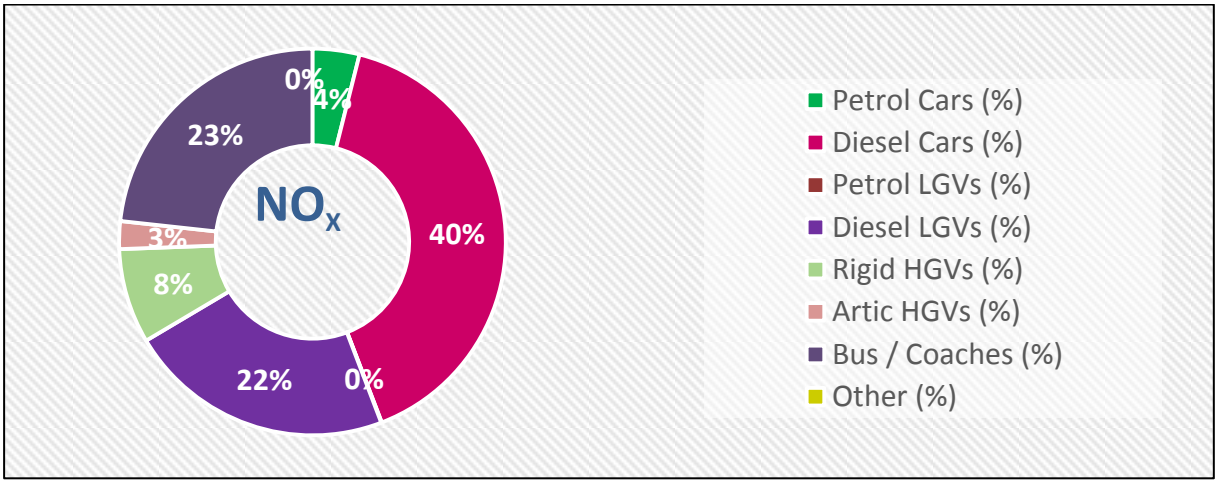
At the end of 2017 the Department for the Environment, Food and Rural Affairs (Defra) issued a practical guide on open fires and wood burning stoves. The guide provides steps that should be taken to reduce the health impacts of burning solid fuel. This guidance can be found on the Bristol City Council smoke control webpage with additional information on solid fuel burning and impacts provided on the Clean Air for Bristol webpage.

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 NO_X emissions from vehicles come from diesels, with diesel cars (40%), buses and coaches (23%) and diesel Light Goods Vehicles (22%) being the largest contributors[5].

Figure 0-1 - Proportion of NOx Emissions by Vehicle Class in Central Bristol



[5] CH2M (2017). Bristol Clean Air Zone Feasibility Study: Option Sifting

Health Impacts

Air pollution has negative impacts on the health of people in Bristol, especially vulnerable members of the population. Evidence suggests that it can cause permanent lung damage in babies and young children[6] and exacerbates lung and heart disease in older people[7]. A recent report into the health effects of air pollution in Bristol concluded that around 300 premature deaths each year in the City of Bristol can be attributed to exposure to NO_2 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[8]. This has an estimated cost to the NHS of £83m.

Monitoring

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 has been demonstrated. Monitoring of nitrogen dioxide continues extensively throughout the city. Nitrogen dioxide concentrations have demonstrated a slightly improving trend since 2010; however, exceedences of objectives for this pollutant are still measured widely in the city. 2018 NO_2 concentrations at diffusion tube sites show a general improvement when compared to 2017 data with improvements in some locations and worsening in others.

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

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.

[6] Royal College of Paediatrics and Child Health, Every breath we take – The lifelong impact of air pollution, February 2016 (URL: https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution)

[7] Simoni et al., Adverse effects of outdoor pollution in the elderly, Journal of Thoracic Disease, January 2015 (URL:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4311079/)

[8] Air Quality Consultants, Health Impacts of Air Pollution in Bristol, February 2017

Monitoring of air pollution at the Junction 17 Cribbs Causeway AQMA has demonstrated compliance in recent years and therefore consideration is being given by South Gloucestershire to revoke this AQMA.

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 and Defra monitoring network in 2018 consisted of:

- 6 real time NO_2 monitors which provide continuous live data which is uploaded automatically to a public website: https://opendata.bristol.gov.uk/pages/air-quality-dashboard-new/air-quality-now#air-quality-now
- 3 real time particulate monitors (1 x $PM_{2.5}$ and 2 x PM_{10})
- 128 NO_2 diffusion tubes which provide a monthly and annual concentration for this pollutant.

In November 2018 a replacement for the decommissioned nitrogen dioxide (NO_2) real-time Rupert Street monitoring station was installed on Colston Avenue, approximately 20m from the site of the old Rupert Street. A BCC operated PM_{10} monitor was also installed at the new Colston Avenue site at the end of 2018.

Defra operate the Bristol St Paul's monitoring site 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. This Defra site is representative of general pollution levels over central Bristol but not of pollution levels at busy roadside locations in the city. In addition to this Defra operate the PM_{10} monitor at the Temple Way site which also houses a BCC operated NO_2 analyser. This is known as an affiliate site where Defra and the Local Authority share infrastructure that houses monitoring equipment.

During 2017 and 2018 Bristol City Council replaced the ageing NOx analysers at all of the existing sites with new analysers in order to ensure the BCC continue to collect high quality data and to achieve a >90% data collection rate throughout the year.

When considering the results from all diffusion tube locations around the city, on average, there has been a decrease in NO_2 pollution levels in 2018 when compared to 2017. This equates to a 1.1µg/m^3 decrease for annual NO_2 concentrations on

average over all 78 tube locations for which data was available in 2017 and 2018. When comparing data for all tubes for which there is data from 2014 (74 tubes), the average decrease over this 5 year period is 2.1µg/m^3. It should however be noted that levels fell at some locations and increased in others. Concentrations remain higher than the health based EU and UK limits on many roads in the city centre and along the main arterial routes leading from the city centre.

2018 Schools Monitoring

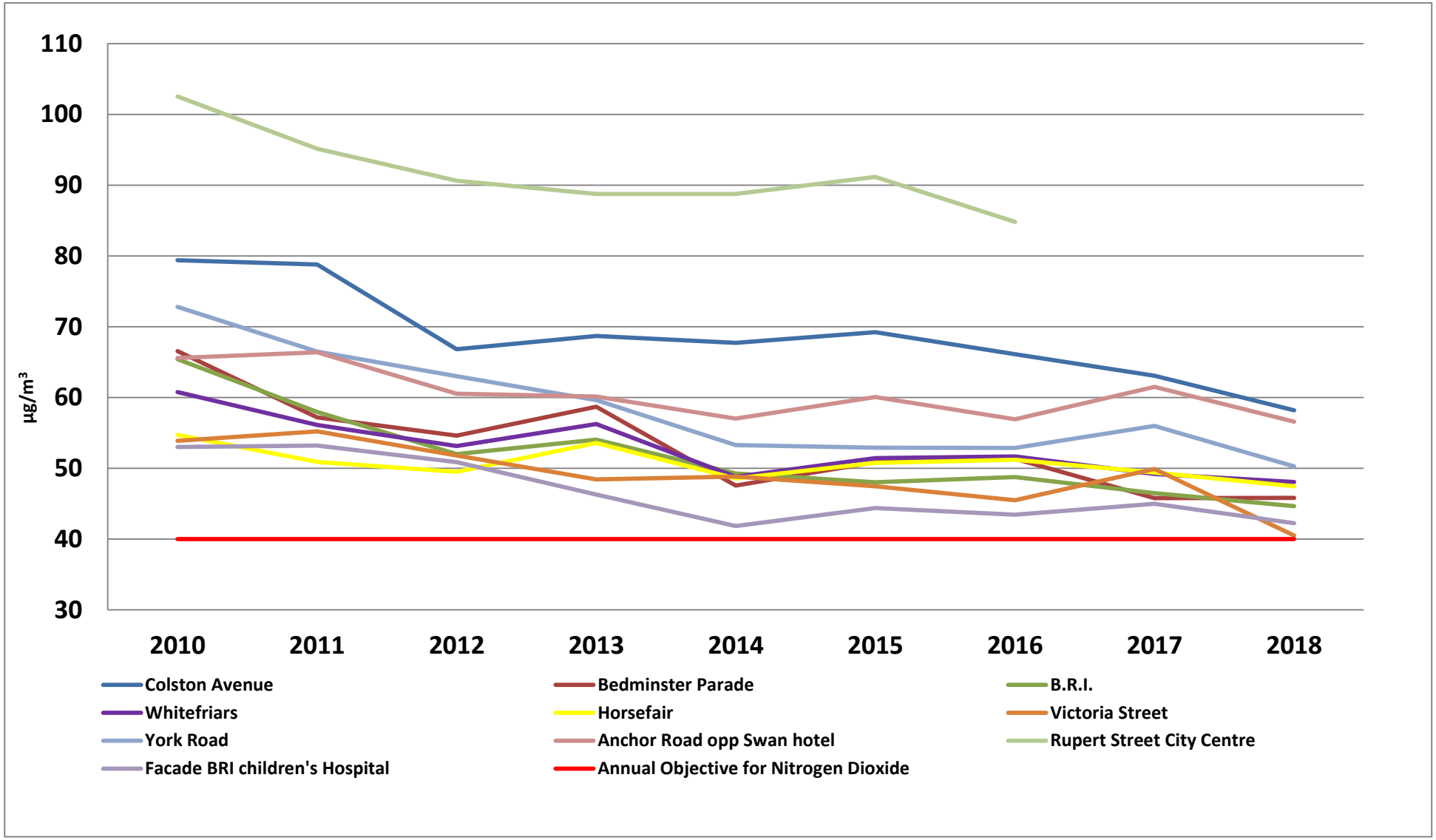
In 2017 BCC decided to implement an air quality monitoring campaign focussing on schools, as a result of concern from parents. In order to monitor in the areas of most need the following criteria were used to determine the schools to monitor:

- School is within the AQMA
- School is 100m or less from a main road
- The centre point of the school was used for this criterion

Monitoring took place at 47 schools throughout the city. Of these, two recorded pollution levels in excess of the annual objective for nitrogen dioxide. These schools were Colston Girls School which is on the A38 and Summer Hill School on the A420, both of which are roads which experience large volumes of traffic on a daily basis. Full details of results from this monitoring can be found here: https://opendata.bristol.gov.uk/pages/schools-air-quality-monitoring/

Figure 0-2 shows the long term trends in NO_2 concentrations at a selection of city centre monitoring sites. Monitoring at Rupert Street was stopped due to the change in road layout associated with the Metrobus works. A new site on Colston Avenue was commissioned at the end of 2017 which is in a location approximately 20m from the Rupert Street site. Data will be available for 2019 at this new monitoring location.

Figure 0-2 - Trends in Annual NO_2 at City Centre Sites (2010-2018)



Actions to Improve Air Quality

As previously discussed, air pollution in those locations exceeding the health based limits for nitrogen dioxide originates predominantly from motor vehicles. The approach to reducing NO_2 concentrations needs to focus on measures to reduce the number of vehicles on our roads, clean up the emissions from vehicles and to reduce congestion.

There is a long established collaboration between the three 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)[9], 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 JLTP (3) covers the period 2011 – 2026. Goal 3 within the JLTP3 is to improve air quality in the Air Quality Management Areas.

The JTLP is currently being updated to develop the JLTP4 for the West of England Combined Authority (WECA) to take planning beyond 2026 through to 2036. Consultation on JLTP4 took place in early 2019. It is expected that the final JLTP4 will be published in late 2019. A greater emphasis than previously will be placed on air pollution in the revised JLTP.

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 Plan

Due to continued forecasted air quality exceedances, Bristol City Council has been directed by the Environment Minister to produce a Clean Air Plan to achieve compliance with air quality objectives in the shortest possible time.

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

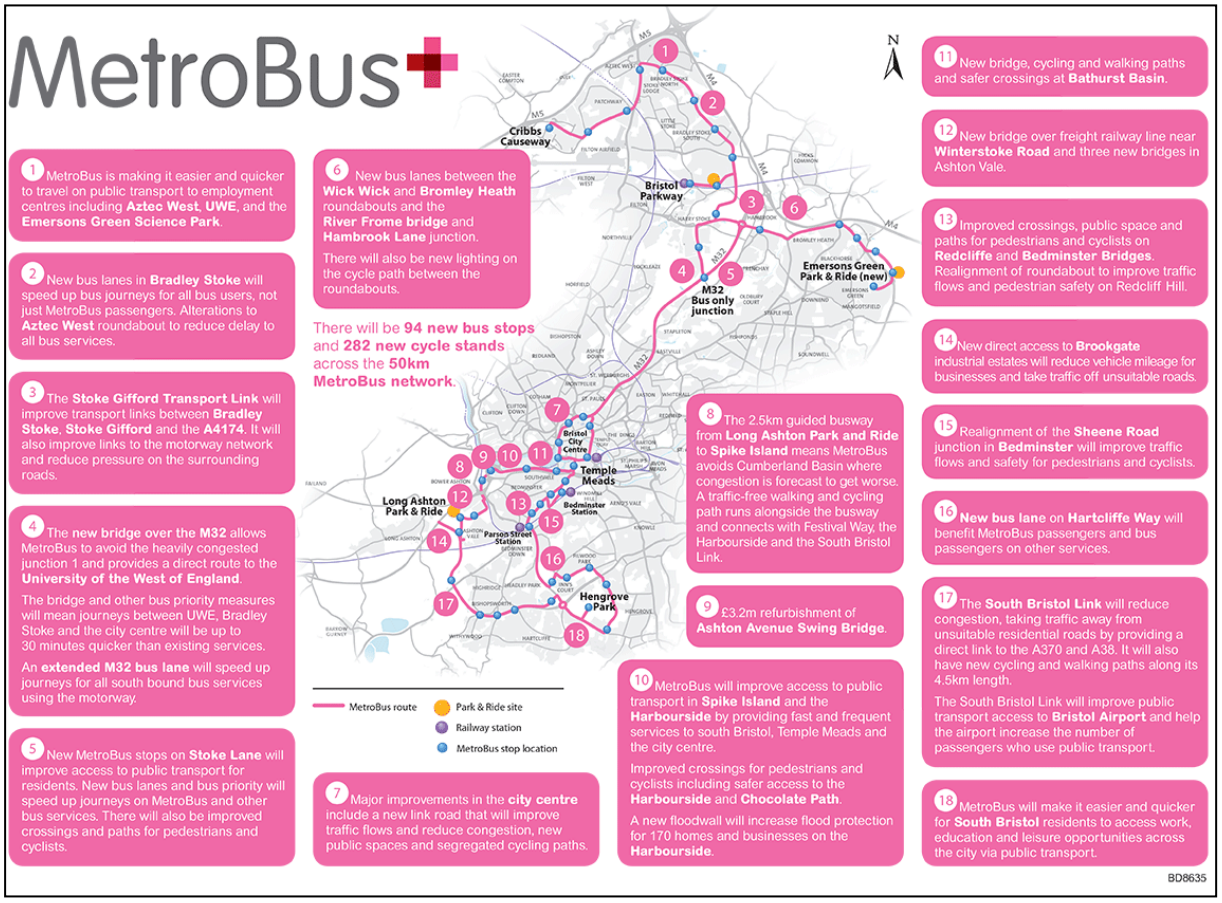
In November 2016, Full Council unanimously supported a motion calling upon the Mayor to develop an air quality action plan, to implement a Clean Air Zone and to update Council on progress.

In March 2018 Cabinet agreed to the submission of a Strategic Outline Case (SOC) to Government, including engagement and consultation activities and the submission of funding bids including spend of up to £2m. This was approved by government. The SOC included 5 shortlisted options to be further developed in the next phase; an Outline Business Case (OBC) - a small and Medium CAZ C (charging all modes except cars) and D (charging all modes) with a fifth non-charging option. Work began on engaging with the public to begin highlighting the issues around poor air quality and the potential 5 options proposed to address them. The impact of the identified options on lower income households led to the need to try and find options which would meet the obligations of the Council on air quality but avoiding or reducing if possible these impacts. Other options were therefore considered for further analysis, in liaison with JAQU. For updates on the progress with the Bristol Clean Air Plan please visit the Clean Air for Bristol Website

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 started operation in 2018.

Figure 0-3 - Metrobus Details



GoUltraLowWest

GoUltraLowWest is an Office for Low Emission Vehicles (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
- Ultra-Low Emission Vehicle (ULEV) car club bays
- Conversion of 20% of the council fleet to ULEVs (first major BCC fleet purchases took place in 2018)
- Improving air quality

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

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.

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 uses innovative 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.

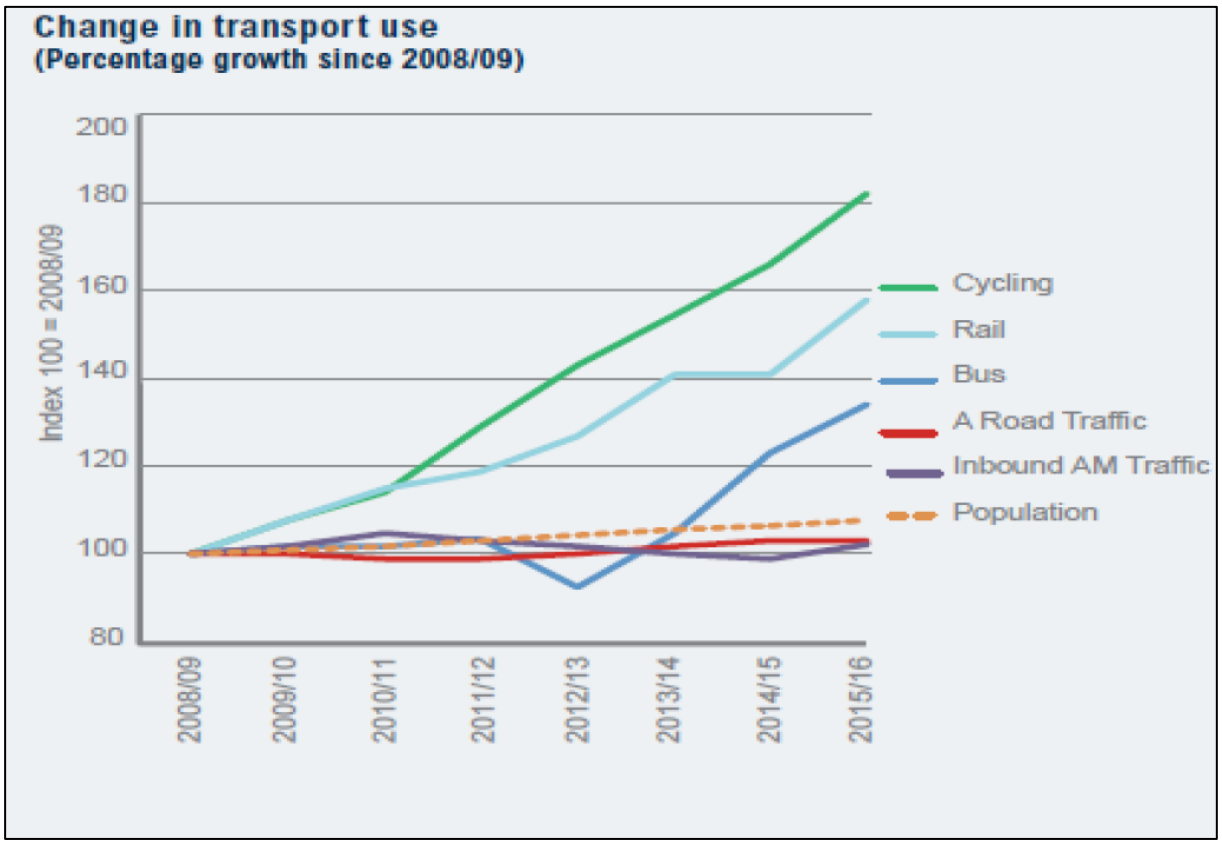
A range of events have taken place as part of this project throughout Bristol in 2017/2018, details of which can be found here http://www.claircity.eu/bristol/get-involved-2/events/. These have formed the basis for citizen and wider stakeholder engagement which has been complimentary to engagement being undertaken during the Clean Air Plan development by Bristol City Council. Outputs from engagement in 2017 have been used to help develop a policy game and app. The Game was launched in April 2018 and the App is still being developed. http://www.claircity.eu/bristol/game-and-app/.

Transport Trends in Bristol

In recent year Bristol has had some of the most successful increases in walking and cycling and Buses are improving more rapidly that the other large English cities, albeit from a lower starting point. Trends are shown in Figure 0-4 which highlight that

whilst sustainable transport use has increased considerably over this period that “A Road” traffic has remained constant and risen slightly.

Figure 0-4 - Change in Transport Use in Bristol 2008/09 – 2015/16



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 to achieve compliance with air quality objectives. Consultation on options to achieve compliance will take place from 1st July 2019.

Local Engagement and How to get Involved

In mid-2018 Bristol City Council launched the Clean Air for Bristol website. The section on how to get involved contains a link to the events calendar and contains a range of information about air pollution in Bristol and the plans being developed to tackle the issue.

How Can Pollution Be Reduced? - Transport

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.

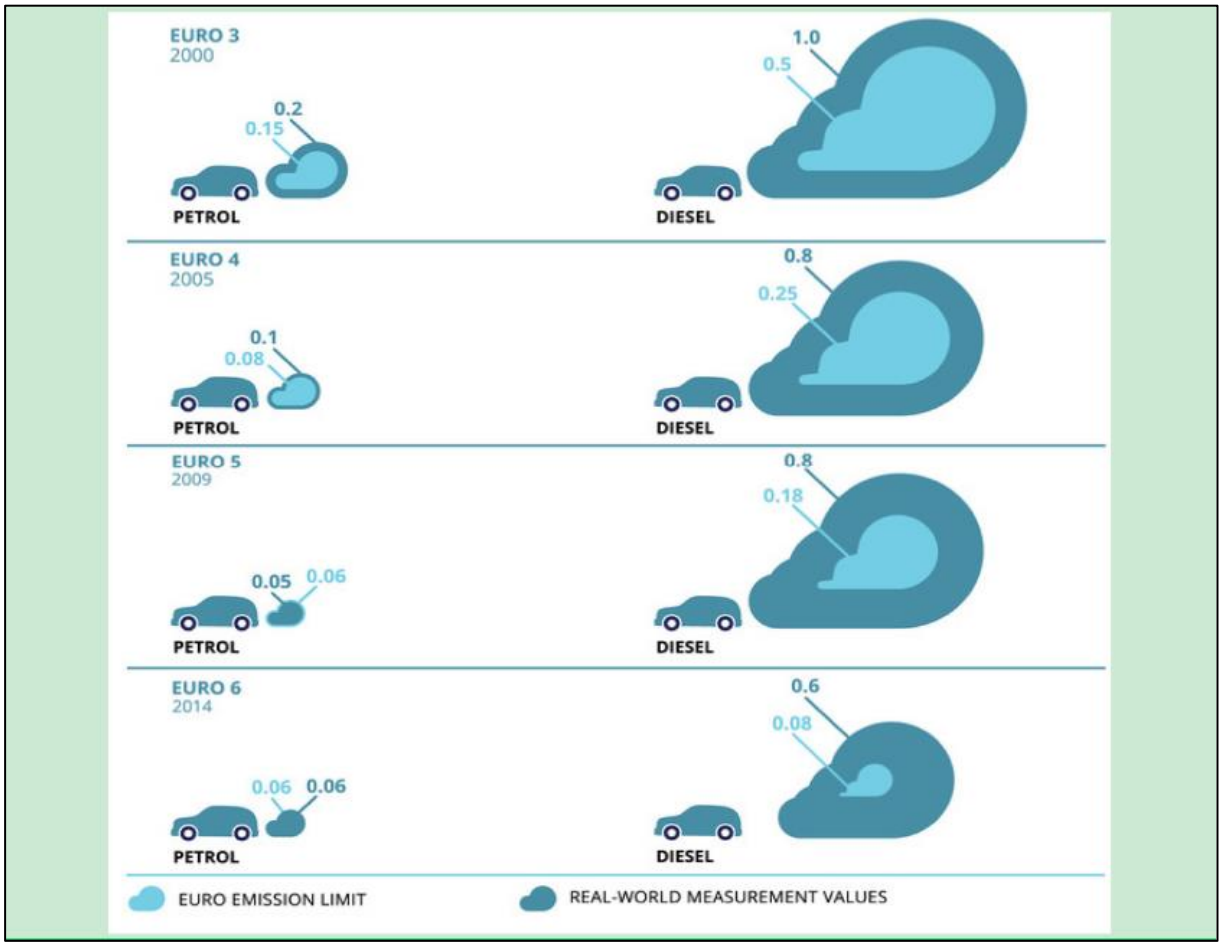
- Electric Vehicles
- Petrol hybrid
- Gas or petrol
- Diesel Hybrid
- Diesel

Whilst government vehicle taxation is based 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. Diesel cars have been promoted as being 'low emission / eco' vehicles. Whilst these may offer relatively low 'official' CO_2 emissions, on average, diesel vehicles are generally much worse for air pollutants such as nitrogen dioxide and particulates, which are of greatest concern for local air quality.

Measurement of real-world vehicle emissions have shown that large discrepancies exist between the required vehicle emissions standards, as defined by Euro emissions standards, and the level of pollution emitted under real world driving conditions. The largest discrepancies are related to nitrogen oxides (NO_x) emissions which lead to the formation of NO_2 pollution. Figure 0-5 is adapted from a report by

the European Environment Agency[10] and shows how, on average, vehicles perform in the real-world when compared to the official emission limits.

Figure 0-5 - Comparison of NO_X (g/km) Emission Standards for Different Car Euro Standards, by emission limit and Real-World Performance



This illustrates why diesel cars continue to present problems to achievement of NO_2 air quality objectives in the city and why older diesel vehicles in particular a contributing significantly to NO_2 pollution. Euro 6 diesels, whilst better than Euro 5 vehicles, are still, on average, considerably worse for NO_X emissions when compared to their petrol or petrol hybrid equivalents.

The above illustration represents average emissions for each Euro class when tested in the real world. Some vehicle manufacturers and models perform much better than others with some Euro 6 diesel cars now performing very well in the real world whilst others do not. The Mayor of London launched an online vehicle checker to allow consumers to get the latest data on real world vehicle emissions. The information has

[10] European Environment Agency (EEA), 'Explaining road transport emissions – A non-technical guide', 2016 <www.eea.europa.eu/publications/explaining-road-transport-emissions>

been compiled through robust independent emissions tests by a UK based company, Emissions Analytics and the International Council on Clean Transportation (ICCT). Emissions Analytics is a well respect independent vehicle testing company. To check the emissions of your vehicle or to check the relative performance of vehicles that you are considering purchasing the online checker can be accessed here.

How Can Pollution Be Reduced? - Domestic Heating

If you are currently using a wood burner or open fire make sure that you are using it correctly and not breaking the Smoke Control Area regulations. The whole of Bristol is a smoke control area. This means that you are only allowed to burn wood in a Defra approved stove. You are not allowed to burn wood in an open fire in Bristol. Only exempt smokeless fuels are permitted to be burnt in an open fire.

From an air pollution perspective, if you do not already own a stove or open fireplace, the best option is not to install one. Recent research shows that even the lowest emitting wood burning appliance emits an order of magnitude more particulate matter than a gas oil appliance and two orders of magnitude more than a gas appliance.

Should you plan to install a stove or upgrade your existing stove or fireplace, then the lowest emission stoves currently on the market are those that are 'Ecodesign Ready'. These will meet the future EU standards set to be introduced for all new stoves in the UK in 2022. Within Bristol, as a minimum a wood burning stove should be approved for use within a smoke control area.

Whilst the type of solid fuel appliance used is an important factor in determining the level of pollution emitted, the way in which they are used is equally as important. Understanding the right fuels and the right way to use them is explained within guidance issued by Defra which can be found here. The measure outlined for reducing emissions include:

- Choosing the right stove
- Considering burning less
- Buying 'Ready to Burn' fuel
- Season freshly chopped wood before use (wood can only be burnt in Bristol within a Defra approved appliance. It is not permitted to burn even seasoned

wood in an open fire or an appliance not approved by Defra for use in a smoke control area).

- Do not burn treated waste wood (e.g. old furniture) or household rubbish
- Regularly service and maintain your stove (annually)
- Get your chimney swept regularly (up to twice a year)

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1 Local Air Quality Management

This report provides an overview of air quality in Bristol during 2018. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by 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 Appendix D: Map(s) of Monitoring Locations and AQMAs in Appendix D of this report.

Table 2.1 – Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	City / Town	One Line Description	Is air quality in the AQMA influenced by roads controlled by Highways England?	Level of Exceedance (maximum monitored/modelled concentration at a location of relevant exposure)				Action Plan
						At Declaration		Now		
Bristol AQMA	Declared 01/05/2001. Amended on 01/05/2003 and 01/05/2008 and 26/10/2011	NO_2 Annual Mean	Bristol	An area covering the city centre and parts of the main radial roads including the M32.	YES	N/A	N/A	N/A	N/A	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	NO_2 1 Hour Mean	Bristol	An area covering the city centre and parts of the main radial roads including the M32.	YES	N/A	N/A	N/A	N/A	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	PM_{10} 24 Hour Mean	Bristol	An area covering the city centre and parts of the main radial roads including the M32.	YES	N/A	N/A	N/A	N/A	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 annual NO_2 data. The monitoring locations in 2018 are not directly comparable to those in 2001 and therefore the comparison between exceedence levels at declaration in 2001 and 2018 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 128 monitoring sites has been provided in Table B.1. An indication of general trends in annual NO_2 values from 2010 are shown in Figure 3-1 and Figure 3-2 and is considered to be more representative of trends in recent years than would be established from looking at data from one worst case site as requested in Table 2.1.

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

Defra's appraisal of last year's ASR concluded that the next steps for Bristol City Council are to:

- Continue with the development of the Clean Air Action Plan for a Clean Air Zone; and
- Submit the next Annual Status Report in 2019.

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

More detail on some of these measures will emerge as the Clean Air Plan, Joint Local Transport Plan 4 and Bristol Transport Strategy are developed.

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

- Development and submission of a full business case for a Clean Air Plan to secure compliance with air quality objectives for nitrogen dioxide.
- Publication of the Joint Local Transport Plan4 to set out the regional vision to 2036.

- Publication of the Bristol Transport Strategy

The Draft Bristol Transport Strategy

The draft Bristol Transport Strategy (BTS) went out to public consultation at the end of 2018. Bristol has the Joint Local Transport Plan that covers the whole of the West of England region and also individual strategies relating to transport, such as walking and cycling strategies. Bristol currently do not have a strategy that links the wider West of England transport plan with the individual focussed strategies in Bristol and it is this gap that is filled by the BTS. The strategy reflects the challenges of growth in housing and jobs, equality in transport connectivity, health (air pollution and inactivity), making better places, reliable journeys and making growth sustainable. The vision for Bristol's transport in the BTS is for people from all areas of the city to be able to access jobs, training, education and everyday facilities all over the city by many different transport options, such as buses, trains, cycling and walking.

It sets out approaches that seek to invest in sustainable transport modes and includes transformative measures such as mass transit and the consultation on the draft BTS has shown that this approach is widely supported by the public. During the consultation 3,189 responses were received and over 5,000 individual comments were analysed. The vast majority of respondents strongly agreed or agreed with the objectives and the approaches of the draft strategy.

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	2019	Set out a visons and plan for future development in the WoE up until 2036		Consultation in 2015 - 2019	Final Version to be Published in 2019	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	Finished	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	Commission of Services on Metrobus routes took place in 2018.	Euro VI minimum for metrobus buses being specified for first two years then improvements on those standards moving forward.
3	Bristol Transport Strategy	Transport Planning and Infrastructure	Other	BCC. LA funded	Ongoing	2018/19	Development and Adoption of Bristol Transport Strategy	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 underwent initial internal BCC consultation before moving onto wider stakeholder and public consultation phases in 2018	2019	2018 public consultation shows support for proposed strategy
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 and strengthen weight given to air pollution in Local Plan policy documents	Initial internal consultation and development of local plan started mid-2017. Progress anticipated throughout 2017/2018/2019	2020	Support of proposed policy in plan needs to be gained at a local level and also approved by the Planning Inspectorate.

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
5	OLEV Bus funding	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	OLEV	17/18	18/19	110 Biogas powered buses to be introduced into the first Bus WoE fleet	Buses will be Euro VI and better with regards to emissions of NOx and reduce particulate tailpipe emissions to better than Euro VI.	Planning Phase	2019/2020	
6	Clean Bus Fund	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	OLEV	18/19	18/19	81 buses to be retro-fitted from Euro IV/V standard to VI	£2.2m funding to include 69 SCR retrofit and some electric/hybrid replacement	Funding awarded in Feb 2018. Planning phase	2019	
7	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 harbour side bridge and 4 rounds of engagement in Easton to discuss how cycling can be encouraged. Range of other infrastructure improvements around the city.	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
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 points (not units)		200 additional charge points across the WoE including rapid charging hubs and on street charging infrastructure. https://travelwest.info/drive/electric-vehicles/go-ultra-low-west	2020/21	Part of Go-Ultra Low OLEV grant funded project
9	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 ended in 2017 but the developing Clean Air Plan includes increased use of FCCs to tackle air	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

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
										pollution.	cost saving but FCC is now being considered as part of the Bristol Clean Air Plan being developed.
10	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 where 20mph has been introduced.	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 2018, with any changes arising from this coming into effect in 2018/19	2018/2019	Review of 20mph speed limits concluded that no significant changes need to be made to the measures introduced between 2012 and 2015. Consultation responses showed public support for 20mph speed limits.
11	Better Bus Area Fund 2	Transport Planning and Infrastructure	Bus Route Improvements	WoE. DfT and Cycling Ambition Fund 2	Ongoing	Ongoing	Improved services, through reduced journey time and increased reliability on 8 important corridors.	Yes	Informal public consultation took place in autumn 2017.	Ongoing	More detail is available at https://travelwest.info/projects/better-bus-area
12	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	

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
13	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.		December 2017 Cabinet Meeting decision to approve purchase of at least 50 EV's for BCC Fleet. In early 2019 there were 22 EV's in the BCC fleet with an additional 21 planned for purchase by 2021.	Ongoing	There have been difficulties with ensuring sufficient on-site charging infrastructure is available to operate the EV fleet.
14	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 but development of EV car club bays is part of the BCC EU H2020 Replicate project. 11 EVs being trialled in 2019.	Ongoing	Expansion of 8 bays in East of Bristol planned for summer 2017. Co-Wheels using EU H2020 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.
15	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 progress of employee travel habits and reduction in single occupancy vehicle use.	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 have 350 businesses signed up to this scheme, subject to funding award.	2017/18	
16	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. Website online https://www.joinmyjourney.org/	2018	
17	Sustainable travel campaigns to promote alternatives to car use, promoted through our principle travel	Promoting Travel Alternatives	Intensive active travel campaign & infrastructure	WoE. Various funding	Ongoing	Ongoing	Wide range of initiatives with individual targets for each.		46 electric loan bikes issued, 68 Dr Bike maintenance sessions delivered, 37,000 journeys logged in the travelwest challenge, 36 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

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
	website: travelwest.info promoting sustainable transport schemes such as loan bikes, match-funded grants for employer onsite sustainable travel infrastructure								363 bike loan discounts and free bus tickets provided to individuals seeking employment as part of the wheels to work scheme.		

Whilst the measures outlined above in Table 2.2 will help to contribute towards compliance, Bristol City Council, the Joint Air Quality Unit have identified that additional measures will be required to achieve compliance in the shortest time possible. These are being developed in the Traffic Clean Air Zone plan.

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 and there is understood to be no safe threshold below which no adverse effects would be anticipated[11].

Sources of $PM_{2.5}$

Human-made sources of $PM_{2.5}$ are more important than natural sources, which make only a small contribution to the total concentration. Within UK towns and cities, emissions of $PM_{2.5}$ from road vehicles are an important source. Consequently, levels of $PM_{2.5}$ (and population exposure) close to roadsides are often much higher than those in background locations. In some places, industrial emissions can also be important, as can the use of solid fuels for heating and other domestic sources of smoke such as bonfires. Under some meteorological conditions, air polluted with $PM_{2.5}$ from the continent may circulate over the UK – a condition known as the long range transportation of air pollution. Long range transport, together with pollution from local sources, can result in short term episodes of high pollution which can have an impact on the health on those sensitive to high pollution.

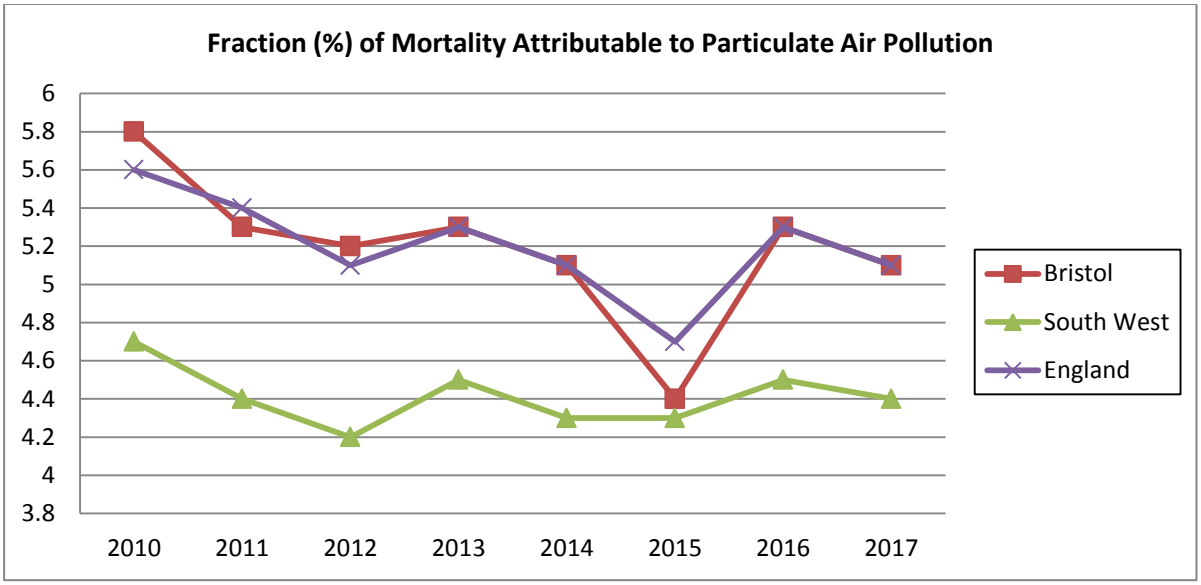
In addition to these direct (i.e. primary) emissions of particles, $PM_{2.5}$ can also be formed from the chemical reactions of gases such as sulphur dioxide (SO_2) and nitrogen oxides (NOx: nitric oxide, NO plus nitrogen dioxide, NO_2); these are called secondary particles. Measures to reduce the emissions of these precursor gases are therefore often beneficial in reducing overall levels of $PM_{2.5}$.

[11] Air Quality Guidelines, Global Update 2005, World Health Organization (2006)

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 (which is also a precursor for the formation of $PM_{2.5}$ pollution) in Bristol and the West of England.

In 2017, 5.1% of "all-cause adult mortality" in Bristol was considered attributable to "anthropogenic particulate air pollution"[12], which is the same as the national proportion. Figure 2-1 shows this value since 2010.

Figure 2-1 - Public Health Outcomes Framework Indicator 3.01



Solid Fuel Use

Appliances that burn solid fuel contribute to local air pollution, and strong evidence[13] exists that their contribution is increasing due to the popularity of solid fuel burning for occasional heating requirements in the winter time.

Recent evidence suggests that the contribution of domestic wood burning in the UK has been underestimated by a factor of 3 in the national emissions inventory[14] making it the largest source of $PM_{2.5}$ emissions in the UK. A 2017 report by Kings College London[15] analysed monitoring data to estimate that on an annual basis, wood burning's contribution to $PM_{2.5}$ ranged from between 6 to 9% averaged across

[12] 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).*

[13] Air Quality Expert Group (2017), The Potential Air Quality Impacts from Biomass Combustion
[14] Waters, L. 2016. Summary Results of the Domestic Wood Use Survey.
[15] Environmental Research Group – Kings College London, NPL (March 2017) Airborne Particles from Wood Burning in UK Cities

UK urban areas. In London and Birmingham wood burning contributed to between 23% and 31% of the urban derived $PM_{2.5}$. The report concluded that control of wood burning is an important urban issue but that "*it should be remembered that the majority of PM_{10} and $PM_{2.5}$ in urban and rural areas is not from primary emissions. Instead the majority comes from reactions between other gaseous pollutants forming secondary particles."* The new evidence highlights that improvements in local air pollution could be achieved by reducing the contribution of domestic solid fuel burning to $PM_{2.5}$ emissions. The latest National Emissions Inventory Data attributes 38% of $PM_{2.5}$ emissions nationally to domestic solid fuel use whilst only 7% of the population have access to an open fire or stove to burn solid fuel.

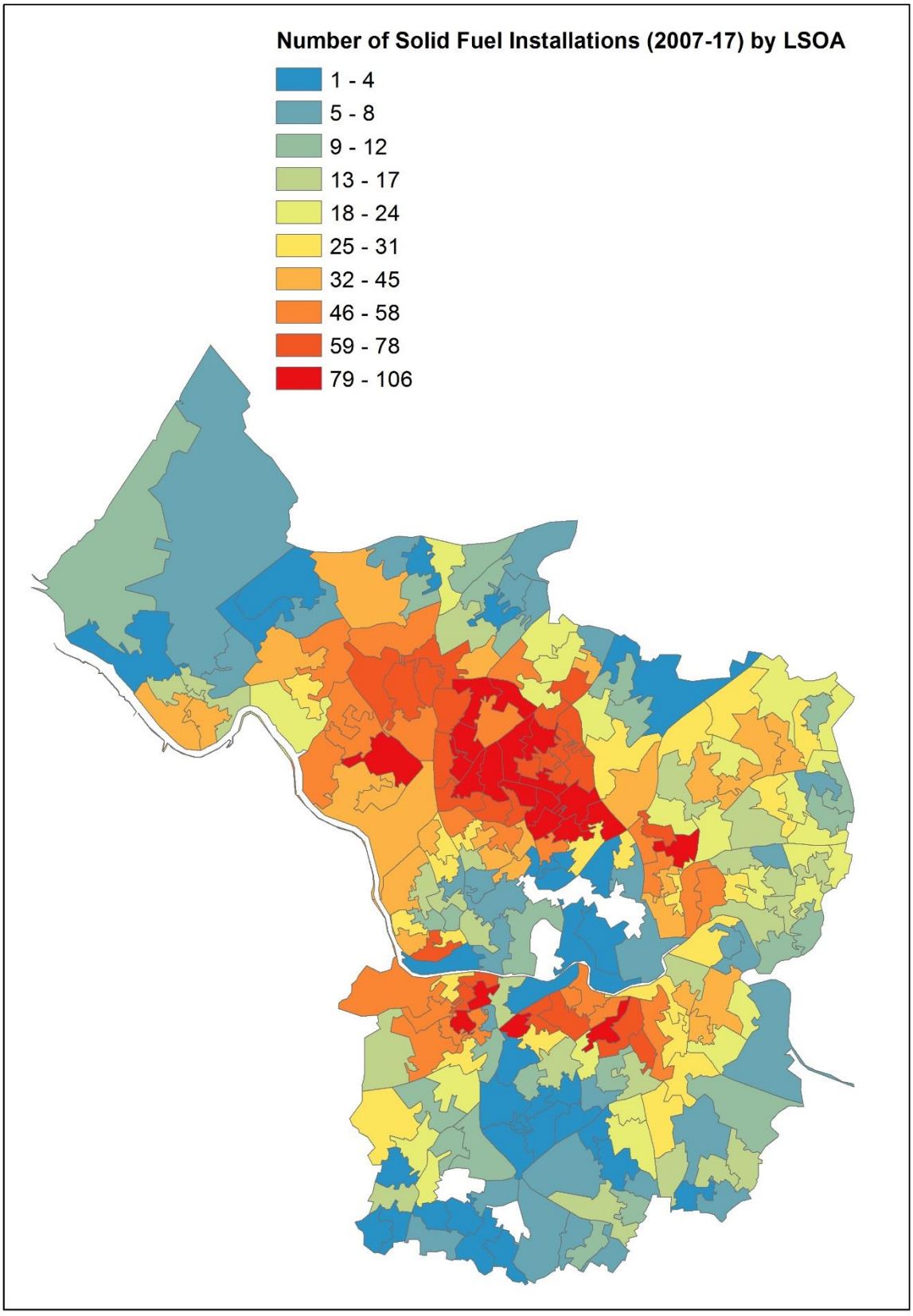
The contribution of solid fuel combustion to $PM_{2.5}$ concentrations has been recognised in the Air Quality Strategy which was published by Government in early 2019.

Government acknowledged that the current system of enforcement in smoke control areas is not fit for purpose within their 2019 Clean Air Strategy. Changes are proposed to the legislation in the new Environment Bill in order to make enforcement of smoke control regulations easier for Local Authorities.

Distribution of Solid Fuel Appliances in Bristol

Postcode data from HETAS Ltd has been used in order to determine an indicative pattern of solid fuel installations over the city at the Lower Layer Super Output Area level as shown in Figure 2-2. Whilst only representing a snapshot of installations in the previous 10 years, it provides an indication of where we might expect to find the largest concentration of solid fuel appliances in the city. This data will be used to identify locations in which local monitoring of particulate pollution may be useful in order to understand better the scale of the issue in Bristol.

Figure 2-2 - Solid Fuel Installations by Lower Layer Super Output Area (LSOA)



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 5 sites during the whole of 2018 with a sixth site (Colston Avenue) commissioned at the very end of 2018. Monitoring at the city centre Rupert Street site ceased in 2016 due to the Metrobus works being carried out in the city centre. A replacement automatic monitoring station, approximately 20 metres from the old Rupert Street site, was commissioned in November 2018. This new site houses real-time NO_2 and PM_{10} analysers at a roadside location on Colston Avenue. Table A.1 in Appendix A shows the details of the automatic sites operating throughout 2018.

In addition to the BCC automatic network, Defra operate an urban background monitoring site at Bristol St Paul's and a PM_{10} monitor at the same location as BCCs Temple Way site. National monitoring results are available at:

https://uk-air.defra.gov.uk/networks/network-info?view=aurn

And also on the council's Air Quality Dashboard:

https://opendata.bristol.gov.uk/pages/air-quality-dashboard-new/map#air-quality-now

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 128 sites during 2018. 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. Annualised and distance corrected results are only 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 adjusted monitored NO_2 annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3.

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

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

Data capture rates at 5 out of the 6 automatic NO_2 monitoring sites was above the required 90% rate, with the lowest capture rate of 84% being recorded at the Defra AURN St Pauls site.

The continuous monitoring data generally shows similar results as recorded in previous years but with 3 sites recording lower NO_2 concentrations in 2018 when compared to 2017 and three sites showing higher concentrations in 2018. The Wells Road roadside site saw the largest decrease of 6µg/m^3 when comparing 2018 with 2017 concentrations. Brislington Depot and Parsons Street saw decrease in 2018 of 4.1 µg/m^3 and 2.1 µg/m^3 respectively. Increases of 2.4 µg/m^3, 1.1 µg/m^3 and 0.1 µg/m^3 were recorded at Fishponds, Temple Way and Bristol St Pauls respectively.

When considering trends at automatic sites since 2014, the two urban background sites of Brislington Depot and St Pauls have seen reductions in annual NO_2 concentrations over this period of -6µg/m^3 and -2.5µg/m^3 respectively. The trend at roadside sites has been one of falling NO_2 concentration over this period with the largest reduction of -7.5µg/m^3 and smallest reductions of -1.8 µg/m^3 being recorded as Wells Road and Fishponds Road respectively.

Fishponds Road was the only site at which an hourly value greater than the 200 µg/m^3 hourly objective was measured in 2018. The number of hourly concentrations above 200 µg/m^3 reflects similar trends as observed over the period 2014-2018 with

a maximum of 2 hours exceeding the hourly value at any one site over this time period. 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. Data from the new Colston Avenue site, which is close to the old Rupert Street site will be available for 2019 onwards.

Taking an average of all diffusion tube sites for which there is data since 2014 (74 in total) there has been an average of a 2.1µg/m^3 reduction in annual NO_2 values over the period 2014-2018. When looking at the difference between 2018 data compared to 2017 at the 78 sites with data for both years, the average fall in NO_2 concentrations was -1.1 µg/m^3. These monitoring sites are kerbside or roadside sites with the exception of one urban background site.

Consideration of trends in NO_2 concentrations at a selection of kerb/roadside sites on the busiest road road corridors throughout Bristol since 2010 show that a very similar pattern is observed in all parts of the city. Monitoring has shown consistent exceedence of the annual objectives for NO_2 at many locations. 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 2010 to 2018

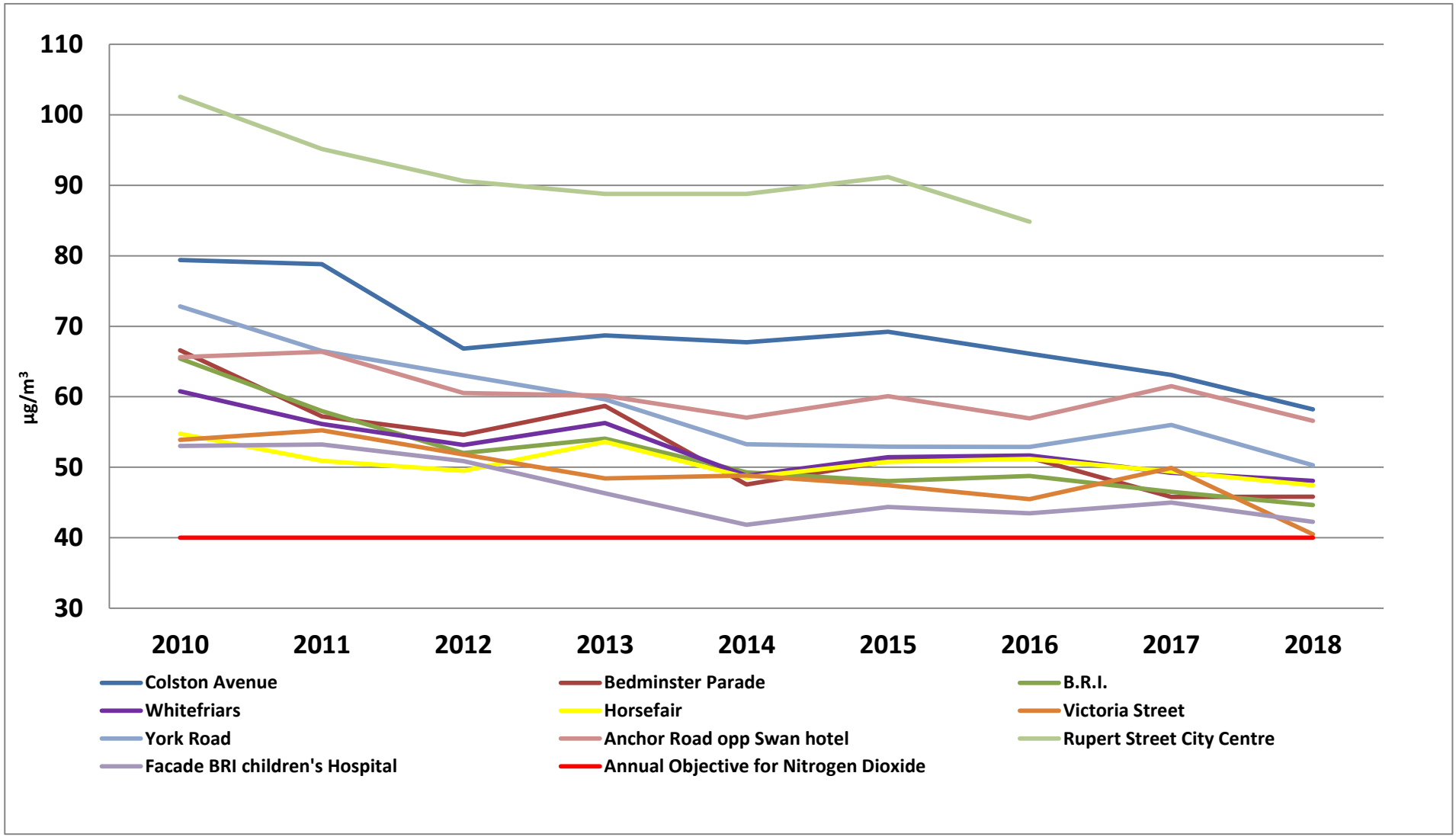


Figure 3-2 - Annual Nitrogen Dioxide at Gloucester Road Locations 2010 to 2018

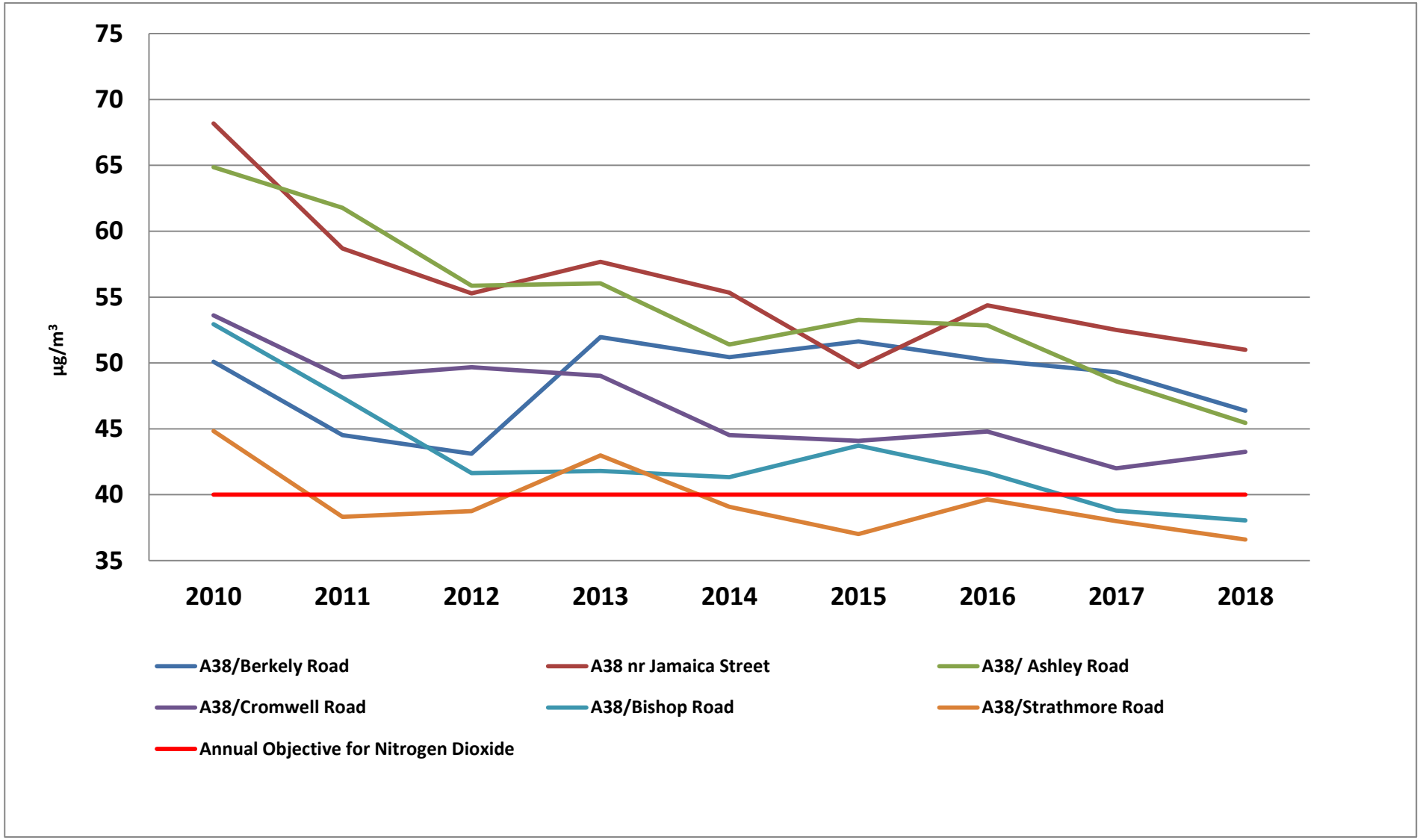


Figure 3-3 and Figure 3-4 show nitrogen dioxide diffusion tube monitoring locations in Bristol. Those sites shown in yellow or red indicate locations where exceedence of the annual objective was measured in 2018. The data has not been annualised or distance adjusted in these maps to allow comparison with maps from previous BCC air quality reports.

All our air pollution monitoring data is available on our open data portal through an 'Air Quality Dashboard' which can be viewed here.

Figure 3-3 - Nitrogen Dioxide Monitoring Results for 2018 – Central Area

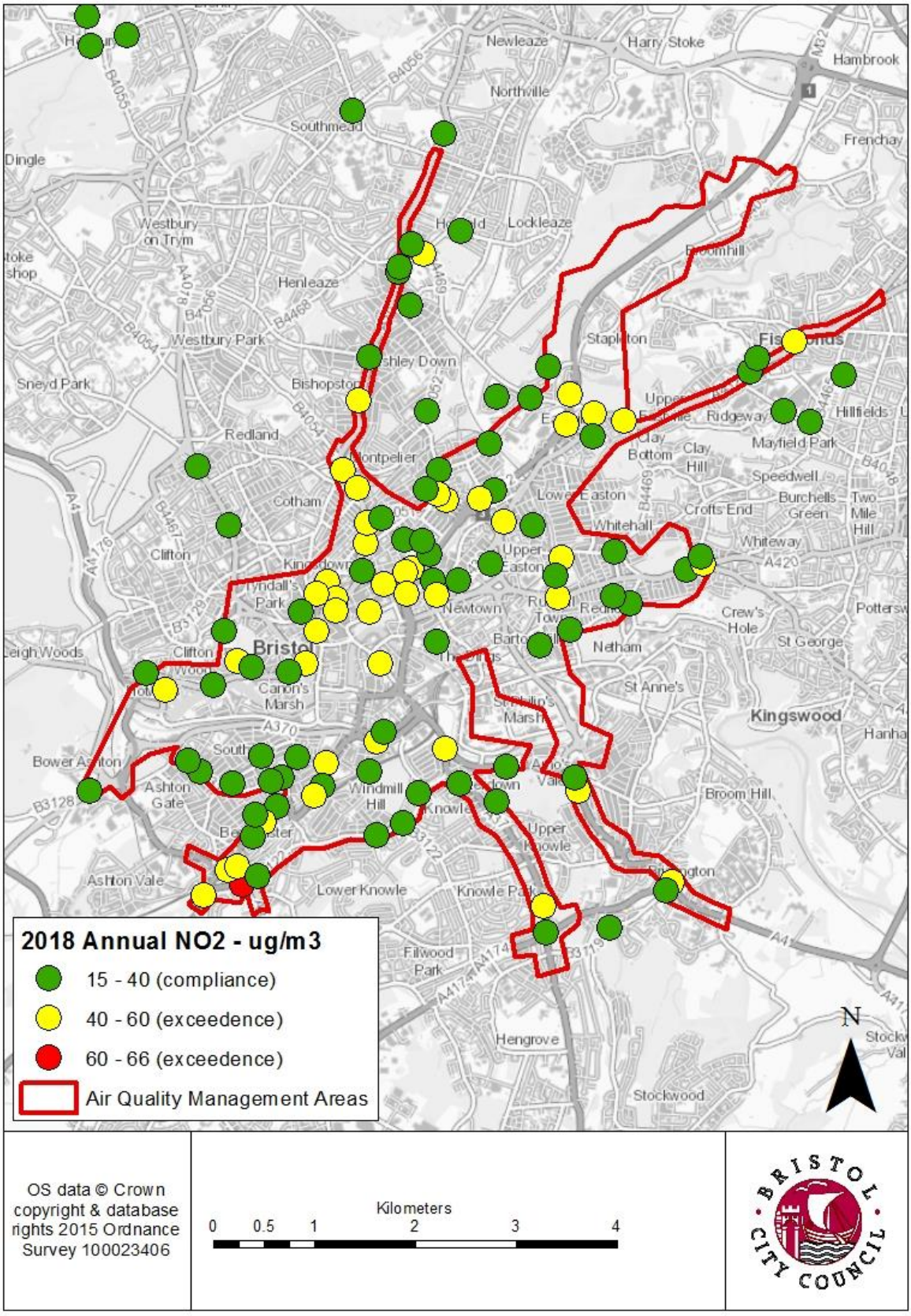
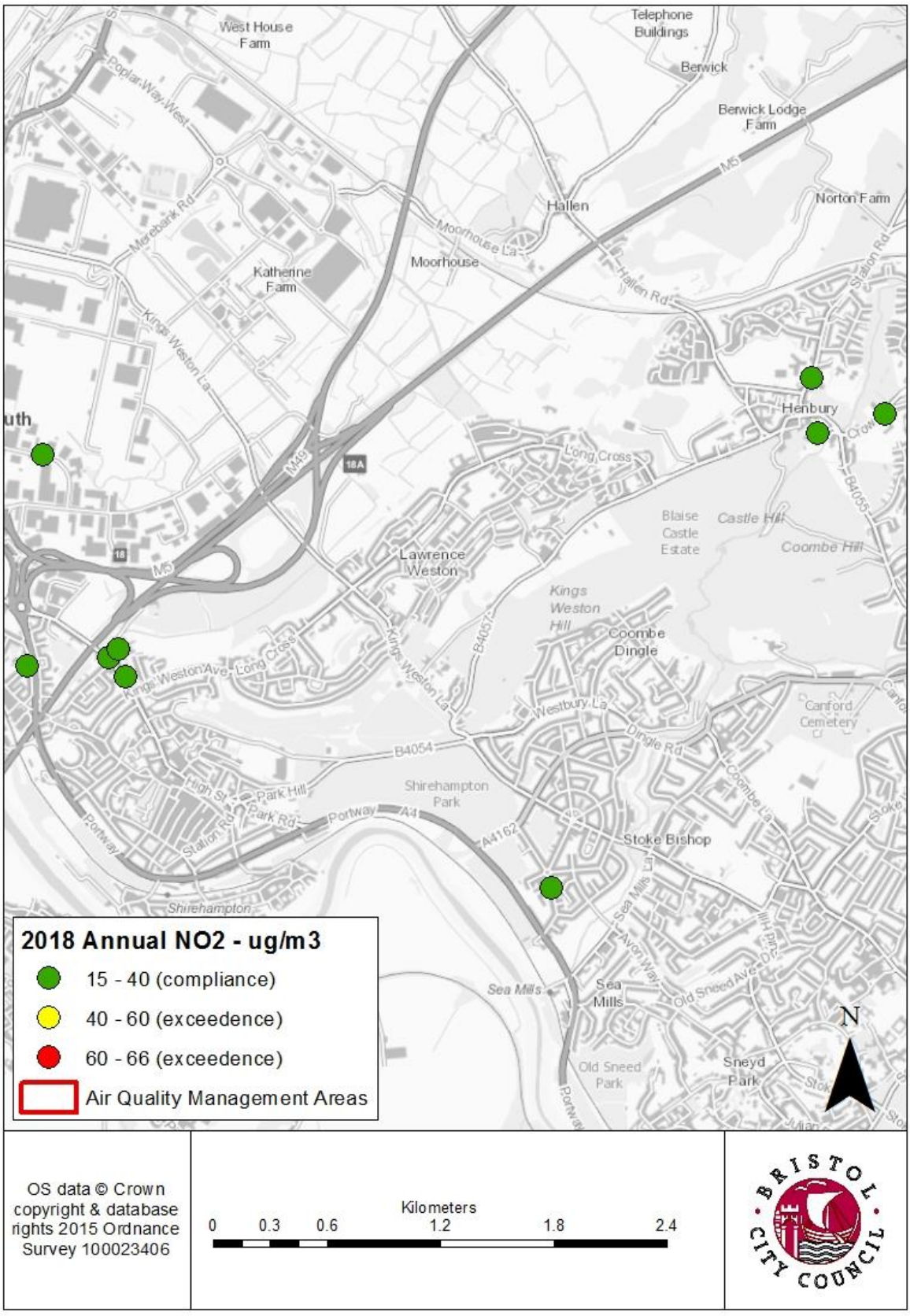


Figure 3-4 - Nitrogen Dioxide Monitoring Results for 2018 – Avonmouth, Lawrence Weston and Henbury Areas



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 monitored 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.

PM_{10} was monitoried at two locations throughout the whole of 2018, one urban background site and one roadside site. PM_{10} monitoring at the Temple Way Defra affiliate site started in November 2017. The data from the St Pauls 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 either of the monitoring sites. Data for 2018 at the St Pauls urban background site shows an increase in annual concentrations to 15.9µg/m^3 in 2018 compared to 14.7µg/m^3 in 2017. The 2018 annual concentration is comparable to 2014 values. The trend of 24hr concentrations is one that conversely shows a decrease over the 2017 values from two to zero 24-hr periods averaging above above 50µg/m^3 in 2018. It should be noted that date collection rates for the Bristol St Paul's site was 80% and does not meet the target of 90%.

Data for 2018 from the Temple Way site did not show any exceedence of objectives but recored an annual PM_{10} concentration of 22.6µg/m^3 which, as would be expected, is greater than the urban background PM_{10} concentration recorded at Bristol St Pauls. On 4 days of the year the 24 hour average was above the 50 µg/m^3 objective level but this is below the 35 days per year which are allowed to exceed this average value before breach of the air quality objective occurs.

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.

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 2018 was 12µg/m^3 which is below the UK annual objective of 25µg/m^3 but above the World Health Organisations (WHO) air quality guideline value of 10µg/m^3. This is an increase of 2µg/m^3 when compared to the 2017 annual average of 10µg/m^3

Between 2011 and 2018 $PM_{2.5}$ concentrations have fallen at this site by 20%. 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 has been met. Should $PM_{2.5}$ concentrations rise again in 2019 it would put the target level of pollutant reduction at risk.

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	NOx	NO	Chemiluminescent	0	18	3.5
215	Parson Street School	Roadside	358042	170582	NOx	YES	Chemiluminescent	0	4	1.5
270	Wells Road A37 Airport Road Junction	Kerbside	360903	170024	NOx	YES	Chemiluminescent	9	1	1.5
452	AURN St Pauls	Urban Background	359488	173924	NOx, $PM_{2.5}$ PM_{10} O_3	YES	AURN Reference Methods	0	N/A	4
463	Fishponds Road	Roadside	362926	175590	NOx	YES	Chemiluminescent	0	3	1.5
500	Temple Way	Roadside	359522	173381	NOx PM_{10}	YES	AURN Reference Methods	0	5	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	48	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	44	3	No	3.2
5	Bedminster Parade	Roadside	358723	171704	NO2	Yes	0	1	No	3.2
9	B.R.I.	Roadside	358729	173499	NO2	Yes	9	1	No	2.4
10	Bath Road	Roadside	361217	171429	NO2	Yes	6	2	No	3.2
11	Whitefriars	Roadside	358813	173342	NO2	Yes	0	5	No	3.2
12	Galleries	Roadside	359142	173211	NO2	Yes	99	1	No	2.4
14	Red Lion Knowle	Roadside	360871	170291	NO2	Yes	6	2	No	3.2
15	Horsefair	Roadside	359294	173485	NO2	Yes	3	1	No	2.2
16	Third Way	Roadside	352287	178698	NO2	No	98	2	No	2.7
20	Newfoundland Way	Roadside	359567	173630	NO2	Yes	0	3	No	2
21	Gloucester Road	Roadside	359035	175306	NO2	Yes	3	1	No	2.8
22	Stokes Croft	Roadside	359109	173886	NO2	Yes	0	2	No	2.5
113	Victoria Street c	Roadside	359258	172696	NO2	Yes	0	3	No	2.8
125	York Road	Roadside	359214	171917	NO2	Yes	3	2	No	1.8
147	Anchor Road opp Swan	Roadside	358514	172691	NO2	Yes	4	1	No	2.2

	hotel									
154	Hotwells Road	Roadside	357601	172483	NO2	Yes	99	1	No	2.4
155	Jacobs Wells road nr Hotwells rndbt	Roadside	357838	172713	NO2	Yes	98	2	No	3.2
156	Jacobs Wells road opp Clifton hill	Roadside	357709	173018	NO2	Yes	0	2	No	2.5
157	Stokes Croft Ashley Road	Roadside	359119	174090	NO2	Yes	0	2	No	2.4
159	Cromwell Road	Roadside	358891	174608	NO2	Yes	4	2	No	2.5
161	Bishop Road	Roadside	359152	175733	NO2	Yes	4	2	No	2.2
163	Strathmore Road	Roadside	359435	176574	NO2	Yes	7	3	No	3.6
175	top of Brislington Hill	Roadside	362147	170525	NO2	Yes	14	2	No	3.2
239	Parson St. A38 East	Roadside	357880	170506	NO2	Yes	9	1	No	3.2
242	Parson Street Bedminster Down Road	Roadside	357510	170401	NO2	Yes	4	2	No	3.2
254	Merchants Road Hotwells	Roadside	357118	172429	NO2	Yes	4	1	No	2.6
260	Stapleton Road South	Roadside	361140	175366	NO2	Yes	3	2	No	2.4
261	Stapleton Road Heath Street	Roadside	361103	175059	NO2	Yes	7	1	No	2.1
295	Lamppost 16 Ashley Road St. Pauls	Roadside	359913	174315	NO2	Yes	0	2	No	2.8
300	Facade Haart Estate Agents	Roadside	363365	175883	NO2	Yes	2	1	No	2.4

	755 Fishponds Road Fishponds									
303	Facade 784 Muller Road Fishponds	Roadside	361368	175170	NO2	Yes	0	6	No	2.2
307	Lamppost Glenfrome Road \ Muller Road Horfield	Roadside	360747	175328	NO2	Yes	3	2	No	2.2
312	Lamppost Ashley Hill St. Pauls	Roadside	359832	174616	NO2	Yes	4	2	No	2.7
314	Lamppost Whiteladies Road \ Cotham Hill Clifton	Roadside	357751	174063	NO2	No	2	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
363	5102 façade	Roadside	359075	173613	NO2	Yes	0	3	No	2.7
370	Great George Street lamppost	Roadside	359775	173513	NO2	Yes	0	2	No	2.5
371	Lamb Street façade	Roadside	359813	173373	NO2	Yes	14	1	No	2.6
373	123 Newfoundland Street façade	Roadside	359747	173774	NO2	Yes	0	17	No	2.1
374	St. Paul Street	Roadside	359509	173595	NO2	Yes	3	1	No	2.3

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	2	1	No	2.5
406	Whitehall Rd lamppost 17 nr juction with Chalks Rd	Roadside	361576	173806	NO2	Yes	0	2	No	2.3
407	lamppost Sussex place	Roadside	359829	174370	NO2	Yes	9	1	No	3.2
413	Wells Rd bus lane sign just below junction with Knowle Rd	Roadside	360043	171508	NO2	Yes	4	3	No	3.2
417	St John's Lane No 26 lamppost 15 (just past roundabout)	Roadside	359635	171413	NO2	Yes	0	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	9	1	No	2.8
420	North St/Dean Lane on roundabout sign	Roadside	358277	171562	NO2	Yes	1	1	No	2.8

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
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	19	3	No	2.5
438	A37 Junction w/ Airport Road	Kerbside	360903	170024	NO2	Yes	9	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			YES	2.8
461	Millpond School Fence	Roadside	360381	174405	NO2	Yes	0	14	No	1.7
464	Fishponds Road	Roadside	362927	175592	NO2	Yes	0	3	YES	3
466	Savanna coffee drainpipe	Roadside	357466	171622	NO2	Yes	0	2	No	2.4
469	Lamppost corner park avenue	Roadside	359479	171114	NO2	Yes	3	1	No	2.8
470	Victoria Park Primary	Roadside	359213	170997	NO2	Yes	10	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
487	Junction 3 Millpond Street	Kerbside	360243	174327	NO2	Yes	4	5	No	2
489	Avonmouth Road Outside No 12	Roadside	352634	177629	NO2	No	3	5	No	2
490	Avon School Barrack's Lane	Roadside	352683	177670	NO2	No	5	4	No	2.8
491	Avonmouth Road Outside No 76	Roadside	352722	177525	NO2	No	2	4	No	2.6
492	On 1 way sign at bottom of Wellington Hill	Roadside	359445	176627	NO2	Yes	10	3	No	2.8
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	4	2	No	2.1
496	385 Church Road Redfield	Roadside	362296	173620	NO2	Yes	0	3	No	2.3
497	20 Ashley Road	Roadside	359268	174132	NO2	Yes	4	1	No	2.3
499	Temple Way NOx site	Roadside	359522	173381	NO2	Yes	0	5	YES	1.5
503	Sea mills pharmacy no stopping sign	Urban Background	354977	176406	NO2	No			No	2
504	Avonmouth primary	Urban Background	352204	177585	NO2	No			No	2

505	Henbury school	Urban Background	356352	179109	NO2	No			No	2
506	Woodstock school	Urban Background	356387	178813	NO2	No			No	2
507	Blaise school	Urban Background	356744	178916	NO2	No			No	2
508	Orchard school	Urban Background	359881	177941	NO2	No			No	2
509	Filton avenue primary	Urban Background	360050	176983	NO2	No			No	2
510	Ashley down primary	Urban Background	359556	176239	NO2	No			No	2
511	Sefton park	Urban Background	359717	175191	NO2	No			No	2
512	Colston girls	Roadside	359026	174432	NO2	Yes	1	1	No	2
513	Cabot primary	Urban Background	359674	173915	NO2	Yes			No	2
514	St. Barnabas	Urban Background	359707	174422	NO2	No			No	2
515	St. Werburghs park nursery	Roadside	360333	174871	NO2	Yes	2	5	No	2
516	Fairfield high school	Urban Background	360411	175336	NO2	No			No	2
517	Glenfrome primary	Urban Background	360922	175640	NO2	Yes			No	2
518	Fishponds c of e	Urban Background	362989	175722	NO2	No			No	2
519	Briarwood school	Urban Background	363854	175554	NO2	No			No	2
520	St. Joseph's RC primary	Urban Background	363517	175084	NO2	No			No	2
521	Chester park infants	Urban Background	363251	175200	NO2	No			No	2
522	May park primary	Urban Background	361362	174945	NO2	Yes			No	2
523	Bannerman	Urban	360764	174069	NO2	Yes			No	2

	road	Background								
524	City academy	Urban Background	360990	173569	NO2	Yes			No	2
525	Summer hill a420	Roadside	362455	173687	NO2	Yes	2	1	No	2
526	Summer hill Plummers hill	Urban Background	362436	173751	NO2	Yes			No	2
527	St Patricks	Urban Background	361732	173291	NO2	Yes			No	2
528	Redfield educate together	Urban Background	361564	173363	NO2	Yes			No	2
529	Bristol futures academy	Urban Background	361132	173030	NO2	Yes			No	2
530	Barton Hill Academy	Urban Background	360838	172869	NO2	Yes			No	2
531	Easton c of e academy	Urban Background	360345	173688	NO2	Yes			No	2
532	St. Nicholas of tolentine	Roadside	360025	173521	NO2	Yes	39	1	No	2
533	Hannah more front	Urban Background	359814	172913	NO2	Yes			No	2
534	Hillcrest primary	Urban Background	360412	171327	NO2	Yes			No	3
535	West town lane academy	Urban Background	361532	170073	NO2	No			No	3
536	St Mary redcliffe secondary	Urban Background	359291	172012	NO2	Yes			No	2
537	St Mary redcliffe primary	Urban Background	359145	171623	NO2	Yes			No	2
538	Dalby avenue	Roadside	358681	171478	NO2	Yes	98	2	No	2
539	Dalby avenue church lane	Roadside	358599	171391	NO2	Yes	2	2	No	2

540	Compass point	Urban Background	358017	171192	NO2	No			No	2
541	Holy cross primary	Urban Background	358437	171762	NO2	Yes			No	2
542	Southville primary	Urban Background	358078	171774	NO2	Yes			No	2
543	Southville primary Myrtle street	Urban Background	357791	171501	NO2	Yes			No	2
544	Ashton gate primary	Urban Background	357345	171727	NO2	Yes			No	2
545	Ashton park school	Urban Background	356379	171436	NO2	Yes			No	2
546	HotWells primary	Urban Background	356927	172605	NO2	No			No	2
547	St George's primary	Urban Background	357979	172661	NO2	Yes			No	2
548	St Michaels on the mount	Urban Background	358473	173201	NO2	Yes			No	2
550	Cathedral School	Roadside	358353	172613	NO2	Yes	0	9	No	2
551	Cod Almighty downpipe	Roadside	358981	178173	NO2	No	0	10	No	2
554	Nelson Street	Roadside	358812	173217	NO2	Yes	0	3	NO	2

Notes:

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

(2) N/A if not applicable.

Table A.3 – Annual Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3)				
					2014	2015	2016	2017	2018
203	Urban Background	Automatic	97%	97%	31.4	31.2	27.9	29.5	25.4
215	Roadside	Automatic	99%	99%	**45.7**	**44.2**	**46.1**	**41.1**	39.0
270	Kerbside	Automatic	98%	98%	**40.5**	39.3	**41.5**	39	33.0
452	Urban Background	Automatic	84%	84%	26.3	25.8	26.9	23.7	23.8
463	Roadside	Automatic	96%	96%	**43.3**	39.7	**42.7**	39.1	**41.5**
500	Roadside	Automatic	98%	98%				**43.2**	**44.3**
2	Roadside	Diffusion Tube	100%	100%	**67.7**	**69.2**	**66.1**	**63.1**	**58.2**
3	Roadside	Diffusion Tube	100%	100%	36.3	37.9	37.6	34.4	34.4
4	Roadside	Diffusion Tube	100%	100%	**55.8**	**53.3**	**55.2**	**52.7**	**53.5**
5	Roadside	Diffusion Tube	100%	100%	**47.6**	**50.9**	**51.3**	**45.8**	**45.8**
9	Roadside	Diffusion Tube	100%	100%	**49.3**	**48.0**	**48.8**	**46.5**	**44.7**
10	Roadside	Diffusion Tube	100%	100%	**50.1**	**49.3**	**54.5**	**51.6**	**51.5**
11	Roadside	Diffusion Tube	100%	100%	**48.8**	**51.4**	**51.7**	**49.2**	**48.1**
12	Roadside	Diffusion Tube	92%	92%	**51.3**	**52.5**	**52.8**	**56.6**	**57.5**
14	Roadside	Diffusion Tube	50%	50%	**40.4**	**40.1**	**42.3**	**41.1**	**47.6**
15	Roadside	Diffusion Tube	92%	92%	**48.6**	**50.8**	**51.2**	**49.4**	**47.5**
16	Roadside	Diffusion Tube	100%	100%	34.6	35.9	35.7	35.2	32.6
20	Roadside	Diffusion Tube	75%	75%	**65.3**	**58.7**	**55.5**	**61.2**	**50.1**
21	Roadside	Diffusion Tube	100%	100%	**50.4**	**51.6**	**50.2**	**49.3**	**46.4**
22	Roadside	Diffusion Tube	100%	100%	**55.3**	**49.7**	**54.4**	**52.5**	**51.0**
113	Roadside	Diffusion Tube	58%	58%	**48.8**	**47.5**	**45.5**	**49.9**	**40.5**

125	Roadside	Diffusion Tube	92%	92%	**53.3**	**52.9**	**52.9**	**56.0**	**50.3**
147	Roadside	Diffusion Tube	58%	58%	**57.0**	**60.1**	**56.9**	**61.5**	**56.6**
154	Roadside	Diffusion Tube	100%	100%	38.5	37.2	39.6	38.5	36.2
155	Roadside	Diffusion Tube	92%	92%	38.8	39.9	**43.1**	37.9	**40.1**
156	Roadside	Diffusion Tube	100%	100%	38.0	38.9	**41.2**	39.3	36.2
157	Roadside	Diffusion Tube	92%	92%	**51.4**	**53.3**	**52.8**	**48.6**	**45.4**
159	Roadside	Diffusion Tube	100%	100%	**44.5**	**44.1**	**44.8**	**42.0**	**43.3**
161	Roadside	Diffusion Tube	100%	100%	**41.3**	**43.7**	**41.7**	38.8	38.0
163	Roadside	Diffusion Tube	92%	92%	39.1	37.0	39.7	38.0	36.6
175	Roadside	Diffusion Tube	100%	100%	**51.7**	**52.9**	**56.5**	**54.0**	**54.9**
239	Roadside	Diffusion Tube	100%	100%	**65.4**	**69.2**	**68.9**	**66.8**	**65.2**
242	Roadside	Diffusion Tube	92%	92%	**56.2**	**61.7**	**68.4**	**56.0**	**51.1**
254	Roadside	Diffusion Tube	92%	92%	**51.5**	**54.4**	**51.8**	**52.2**	**49.4**
260	Roadside	Diffusion Tube	92%	92%	**46.3**	**45.6**	**45.4**	**42.6**	**43.1**
261	Roadside	Diffusion Tube	75%	75%	**50.6**	**51.3**	**53.1**	**52.4**	**51.0**
295	Roadside	Diffusion Tube	100%	100%	**58.6**	**63.3**	**55.7**	**65.1**	**59.6**
300	Roadside	Diffusion Tube	92%	92%	**42.4**	**45.9**	**48.1**	**45.9**	**41.1**
303	Roadside	Diffusion Tube	92%	92%	**43.5**	**46.1**	**46.2**	**44.0**	**43.8**
307	Roadside	Diffusion Tube	92%	92%	38.4	36.6	37.4	32.6	37.3
312	Roadside	Diffusion Tube	100%	100%	36.7	36.8	**41.6**	38.5	38.5
314	Roadside	Diffusion Tube	100%	100%	**43.0**	**43.9**	**41.5**	38.3	37.7
320	Roadside	Diffusion Tube	100%	100%	30.9	31.3	31.1	30.7	27.9
325	Roadside	Diffusion Tube	100%	100%	**49.7**	**50.8**	**50.5**	**49.2**	**48.1**
363	Roadside	Diffusion Tube	92%	92%	39.8	39.2	39.6	38.5	37.2
370	Roadside	Diffusion Tube	100%	100%	36.9	37.7	38.4	37.5	36.6
371	Roadside	Diffusion Tube	100%	100%	**42.8**	**44.8**	**42.7**	**44.7**	**42.2**
373	Roadside	Diffusion Tube	83%	83%	**41.6**	38.3	39.5	38.5	35.7

374	Roadside	Diffusion Tube	75%	75%	**51.8**	**47.1**	**47.2**	**45.2**	**47.8**
403	Roadside	Diffusion Tube	100%	100%	39.2	**41.5**	37.5	35.7	35.6
405	Roadside	Diffusion Tube	100%	100%	**51.1**	**53.1**	**42.6**	**50.4**	**56.2**
406	Roadside	Diffusion Tube	92%	92%	34.9	35.4	36.2	38.9	38.5
407	Roadside	Diffusion Tube	92%	92%	**43.9**	**43.1**	**48.7**	**44.6**	**46.7**
413	Roadside	Diffusion Tube	100%	100%	38.4	39.3	**40.0**	38.7	37.6
417	Roadside	Diffusion Tube	92%	92%	**40.8**	**43.6**	**43.4**	35.2	36.0
418	Roadside	Diffusion Tube	100%	100%	**67.7**	**63.7**	**69.3**	**58.4**	**55.7**
419	Roadside	Diffusion Tube	100%	100%	**56.6**	**53.6**	**55.8**	**51.3**	**45.0**
420	Roadside	Diffusion Tube	83%	83%	37.2	36.7	38.6	33.3	37.1
422	Roadside	Diffusion Tube	100%	100%	34.1	35.0	39.4	36.5	34.1
423	Roadside	Diffusion Tube	100%	100%	**41.8**	**44.4**	**43.5**	**45.0**	**42.3**
429	Roadside	Diffusion Tube	100%	100%	**54.7**	**50.4**	**52.1**	**47.8**	**46.8**
436	Roadside	Diffusion Tube	100%	100%	38.2	37.9	**47.7**	**45.8**	**50.6**
438	Kerbside	Diffusion Tube	75%	75%	**44.0**	**43.1**	**43.4**	**43.2**	36.6
439	Roadside	Diffusion Tube	100%	100%	**42.0**	**41.0**	**43.6**	37.7	37.7
455	Urban Background	Diffusion Tube	97%	97%	27.3	26.5	27.9	26.0	24.4
461	Roadside	Diffusion Tube	100%	100%	34.1	33.2	37.0	30.4	33.9
464	Roadside	Diffusion Tube	97%	97%	36.0	34.9	36.9	36.8	34.4
466	Roadside	Diffusion Tube	83%	83%	38.0	34.0	35.8	33.4	33.2
469	Roadside	Diffusion Tube	100%	100%	35.8	35.3	39.2	34.6	36.2
470	Roadside	Diffusion Tube	100%	100%	35.0	38.7	39.4	35.9	37.9
472	Roadside	Diffusion Tube	100%	100%	**45.2**	**40.0**	**45.3**	**41.6**	37.3
473	Roadside	Diffusion Tube	92%	92%	**40.7**	**49.6**	**57.1**	**40.1**	**44.0**
474	Roadside	Diffusion Tube	100%	100%	35.8	38.5	38.7	35.8	31.9
478	Roadside	Diffusion Tube	100%	100%	35.8	36.3	36.7	35.4	36.5

487	Kerbside	Diffusion Tube	83%	83%	**47.4**	**46.2**	**45.7**	**44.5**	**41.9**
489	Roadside	Diffusion Tube	92%	92%	34.5	36.9	38.6	37.7	35.5
490	Roadside	Diffusion Tube	100%	100%	29.1	31.9	32.4	31.0	26.8
491	Roadside	Diffusion Tube	100%	100%	31.2	33.8	36.5	34.4	33.5
492	Roadside	Diffusion Tube	100%	100%		37.6	**40.3**	36.8	34.8
493	Roadside	Diffusion Tube	83%	83%		36.2	**41.5**	**41.9**	**41.8**
494	Roadside	Diffusion Tube	83%	83%		37.5	**43.3**	39.5	38.7
496	Roadside	Diffusion Tube	100%	100%	**42.0**	39.3	**41.1**	**41.1**	39.2
497	Roadside	Diffusion Tube	83%	83%	**49.3**	**41.8**	**43.2**	**42.4**	38.0
499	Roadside	Diffusion Tube	81%	81%				38.5	**43.2**
503	Urban Background	Diffusion Tube	100%	100%					19.1
504	Urban Background	Diffusion Tube	100%	100%					26.7
505	Urban Background	Diffusion Tube	83%	83%					22.0
506	Urban Background	Diffusion Tube	83%	83%					14.9
507	Urban Background	Diffusion Tube	75%	75%					22.0
508	Urban Background	Diffusion Tube	100%	100%					23.2
509	Urban Background	Diffusion Tube	75%	75%					26.3
510	Urban Background	Diffusion Tube	100%	100%					22.2
511	Urban Background	Diffusion Tube	100%	100%					27.0
512	Urban Background	Diffusion Tube	100%	100%					**47.6**
513	Urban Background	Diffusion Tube	92%	92%					24.3
514	Urban	Diffusion Tube	100%	100%					23.4

	Background								
515	Urban Background	Diffusion Tube	100%	100%					33.7
516	Urban Background	Diffusion Tube	67%	67%					20.2
517	Urban Background	Diffusion Tube	100%	100%					20.3
518	Urban Background	Diffusion Tube	100%	100%					24.8
519	Urban Background	Diffusion Tube	100%	100%					17.8
520	Urban Background	Diffusion Tube	100%	100%					20.9
521	Urban Background	Diffusion Tube	92%	92%					25.9
522	Urban Background	Diffusion Tube	100%	100%					24.1
523	Urban Background	Diffusion Tube	100%	100%					25.4
524	Urban Background	Diffusion Tube	100%	100%					31.7
525	Urban Background	Diffusion Tube	100%	100%					**43.5**
526	Urban Background	Diffusion Tube	100%	100%					28.0
527	Urban Background	Diffusion Tube	100%	100%					29.9
528	Urban Background	Diffusion Tube	58%	58%					29.7
529	Urban Background	Diffusion Tube	83%	83%					31.6
530	Urban Background	Diffusion Tube	100%	100%					29.7
531	Urban Background	Diffusion Tube	100%	100%					27.7
532	Urban	Diffusion Tube	100%	100%					32.6

	Background								
533	Urban Background	Diffusion Tube	100%	100%					31.0
534	Urban Background	Diffusion Tube	92%	92%					18.8
535	Urban Background	Diffusion Tube	100%	100%					20.4
536	Urban Background	Diffusion Tube	67%	67%					32.6
537	Urban Background	Diffusion Tube	100%	100%					27.8
538	Urban Background	Diffusion Tube	67%	67%					33.7
539	Urban Background	Diffusion Tube	75%	75%					**43.3**
540	Urban Background	Diffusion Tube	92%	92%					24.6
541	Urban Background	Diffusion Tube	100%	100%					27.5
542	Urban Background	Diffusion Tube	83%	83%					22.6
543	Urban Background	Diffusion Tube	83%	83%					20.8
544	Urban Background	Diffusion Tube	100%	100%					28.3
545	Urban Background	Diffusion Tube	100%	100%					34.9
546	Urban Background	Diffusion Tube	83%	83%					22.5
547	Urban Background	Diffusion Tube	75%	75%					18.9
548	Urban Background	Diffusion Tube	83%	83%					29.9
550	Roadside	Diffusion Tube	58%	58%					36.9
551	Roadside	Diffusion Tube	100%	67%					27.9

554	Roadside	Diffusion Tube	100%	33%					**43.8**

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

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

Notes:

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

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

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

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

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 2018 (%) (2)	NO_2 1-Hour Means > 200µg/m^3 (3)				
					2014	2015	2016	2017	2018
203 – Brislington Depot	Urban Background	Automatic	97%	97%	0	1 (126)	0	0	0
215 – Parsons Street School	Roadside	Automatic	99%	99%	2	0	0	1	0
270 - Wells Road A37 Airport Road Junction	Kerbside	Automatic	98%	98%	0	6	1	2 (122)	0
452 - AURN St Pauls	Urban Background	Automatic	84%	84%	0	0	0	0	0 (92.5)
463 - Fishponds Road	Roadside	Automatic	96%	96%	1 (131)	0	0	0	1
500 - Temple Way	Roadside	Automatic	98%	98%				2	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 Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	PM_{10} Annual Mean Concentration ($\mu g/m^3$) (3)				
				2014	2015	2016	2017	2018
452 - AURN St Pauls	Urban Background	80	80	16.4	14.9	15.4	14.7	15.9
500 - Temple Way	Roadside	94	94					22.6

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 2018 (%) (2)	PM_{10} 24-Hour Means > 50µg/m^3 (3)				
				2014	2015	2016	2017	2018
452 - AURN St Pauls	Urban Background	80	80	4	3	5	2	0 (29.8)
500 - Temple Way	Roadside	94	94					4

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 2018 (%) (2)	$PM_{2.5}$ Annual Mean Concentration (µg/m^3) (3)				
				2014	2015	2016	2017	2018
452 - AURN St Pauls	Urban Background	80	80	13	10.6	12	10	12

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 2018

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

	NO_2 Mean Concentrations ($\mu g/m^3$)														
													Annual Mean		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Raw Data	Bias Adjusted (0.92) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
2	71.0	69.5	67.7	65.8	59.7	57.1	60.5	58.3	61.4	60.2	66.4	61.7	63.3	**58.2**	31.7
3	37.7	45.0	44.4	39.7	43.4	39.2	29.1	17.0	31.5	41.2	40.4	39.7	37.4	34.4	34.4
4	57.1	67.4	72.1	58.1	65.5	62.2	58.4	49.2	54.6	55.7	48.7	49.3	58.2	**53.5**	27.7
5	57.1	60.1	51.4	44.8	52.2	44.4	48.1	43.3	51.2	49.0	44.8	51.5	49.8	**45.8**	**45.8**
9	53.6	57.3	59.6	48.2	45.2	46.7	41.2	34.5	47.1	46.8	54.0	48.2	48.5	**44.7**	35.2
10	52.7	66.0	66.8	60.9	55.3	57.4	55.8	46.0	50.6	51.8	56.7	51.8	56.0	**51.5**	**40.1**
11	50.4	59.1	55.0	53.2	57.7	50.8	52.1	44.7	51.4	49.1	50.3	53.2	52.2	**48.1**	**48.1**
12	57.5	63.5	64.5	61.7	65.0	70.1	73.2	61.4	59.1	56.4	55.4		62.5	**57.5**	**57.5**
14						55.6	50.7	40.9	43.8		44.7	41.1	46.1	**47.6**	39.2
15	54.9	58.5	57.8	54.0	51.8	50.4	48.9	45.2	48.7		44.9	52.3	51.6	**47.5**	**41.0**
16	39.8	40.5	49.7	36.6	28.0	26.0	25.9	29.5	33.2	34.8	43.3	38.5	35.5	32.6	32.6
20	63.6	55.6	56.1	54.2	49.8	45.9	62.3	45.3			56.8		54.4	**50.1**	**50.1**
21	53.1	54.0	54.5	45.3	45.6	44.7	53.5	47.2	55.8	47.5	51.1	52.7	50.4	**46.4**	38.3
22	56.8	68.1	66.5	54.2	55.4	58.6	44.8	45.2	47.2	51.5	61.3	55.6	55.4	**51.0**	**51.0**
113	51.9					37.4		50.1	45.2	46.6	49.6	52.8	47.7	**40.5**	**40.5**
125	56.8	62.0	57.8	53.4		53.1	53.2	48.2	51.8	52.6	54.0	58.3	54.7	**50.3**	**43.2**

147	72.9	81.8			59.4	65.0			60.9		68.9	57.0	66.5	**56.6**	**46.6**
154	52.6	41.6	49.2	36.5	38.2	38.8	31.3	30.8	32.1	38.1	40.7	41.6	39.3	36.2	36.2
155	41.5	51.5	49.0	48.2	45.3	46.0	43.2	35.3		39.7	40.1	39.3	43.5	**40.1**	**40.1**
156	43.7	46.2	43.5	35.8	38.1	32.1	37.0	29.8	38.3	41.0	43.9	42.7	39.3	36.2	36.2
157	55.3	10.1	56.4	58.9	54.8	43.7	56.1	43.5	58.0	52.0	54.7		49.4	**45.4**	**45.4**
159	51.4	58.7	53.9	53.0	49.4	41.5	35.6	34.4	45.3	45.4	49.4	46.2	47.0	**43.3**	36.8
161	47.3	50.0	47.2	43.2	39.7	34.1	36.0	32.3	41.6	39.6	44.0	41.1	41.4	38.0	32.7
163	39.7	49.8	42.3	37.9	43.6	34.6	37.6	29.0	38.8	42.0		42.2	39.8	36.6	30.3
175	54.0	65.4	61.5	57.9	61.9	55.9	69.9	55.1	66.5	58.0	57.4	52.5	59.7	**54.9**	35.7
239	71.5	76.9	75.9	76.2	66.7	70.4	77.3	60.5	71.1	69.3	66.6	67.6	70.8	**65.2**	**42.5**
242	52.2	62.4	60.2	53.9	60.5	51.1	61.4		55.2	56.8	49.0	48.2	55.5	**51.1**	**42.1**
254		54.9	54.6	59.0	56.0	50.0	54.7	50.9	57.0	50.5	54.1	48.8	53.7	**49.4**	38.8
260	48.7	53.2	48.5	53.7	48.7	41.2	41.5	40.6	50.1	45.8		43.2	46.9	**43.1**	38.2
261		70.8	60.3	53.6	59.2	51.7		46.8	58.6	48.0	49.8		55.4	**51.0**	38.2
295	87.0	67.6	67.9	69.6	57.7	43.9	60.9	57.5	70.5	56.8	67.4	70.3	64.8	**59.6**	**59.6**
300		50.5	44.2	45.7	47.8	37.7	45.8	40.9	45.1	42.3	42.3	49.4	44.7	**41.1**	35.9
303		42.3	52.0	48.5	55.3	47.5	45.8	43.8	51.1	45.7	42.5	49.0	47.6	**43.8**	**43.8**
307	43.3	51.2	48.0	43.0		37.3	31.7	27.0	35.5	41.4	46.0	41.7	40.6	37.3	33.1
312	46.4	52.7	48.4	39.8	41.5	29.9	36.6	30.2	41.0	42.2	46.7	46.2	41.8	38.5	33.7
314	48.4	46.8	45.5	41.4	38.9	28.2	40.6	34.1	41.4	38.4	41.1	47.2	41.0	37.7	33.1
320	35.3	38.8	31.8	29.0	27.3	22.3	25.3	27.9	30.7	30.2	30.8	34.6	30.3	27.9	27.9
325	54.0	52.6	55.7	54.6	56.5	49.7	48.6	49.3	55.6	48.3	50.5	52.3	52.3	**48.1**	**48.1**
363	49.0	44.8	41.8	40.1		24.1	37.6	36.8	42.2	40.0	43.8	44.6	40.4	37.2	37.2
370	47.8	46.2	43.6	39.7	38.8	27.7	35.4	31.5	39.0	42.8	41.7	42.9	39.8	36.6	36.6
371	51.9	51.6	51.6	47.7	46.9	36.4	43.2	39.8	45.0	44.6	44.0	47.8	45.9	**42.2**	32.5
373	45.6	46.1			35.4	31.5	31.4	28.6	38.5	38.4	47.4	45.1	38.8	35.7	35.7
374	53.3	56.5	57.1	54.0	39.5	44.9	42.5		45.1		74.4		51.9	**47.8**	**41.2**

403	46.0	44.3	45.5	40.4	35.4	28.8	36.5	30.4	34.0	37.6	43.8	41.1	38.7	35.6	35.6
405	63.3	57.8	63.3	62.5	63.0	65.7	60.3	52.1	57.9	62.8	60.8	63.2	61.1	**56.2**	**48.2**
406	49.3	45.6	44.2	38.4	46.4	40.1	38.8	35.1	41.3		38.7	42.5	41.9	38.5	38.5
407	52.6	58.0	59.8	49.8	55.3	47.2	39.3	33.7		53.9	59.7	49.3	50.8	**46.7**	34.4
413	44.4	45.6	47.3	39.6	41.7	35.7	43.2	36.4	38.8	41.3	35.8	40.7	40.9	37.6	33.0
417		46.9	44.8	36.0	41.7	30.1	38.5	31.7	38.2	41.4	38.5	42.8	39.2	36.0	36.0
418	70.6	63.8	73.4	40.4	58.7	48.4	59.2	58.8	65.1	56.8	62.9	68.9	60.6	**55.7**	**55.7**
419	57.6	49.7	53.2	46.1	49.3	32.1	50.3	42.0	51.0	51.9	52.2	51.1	48.9	**45.0**	31.6
420		49.2	48.3		44.5	32.2	36.9	31.2	39.5	42.0	38.3	40.7	40.3	37.1	34.4
422	48.2	40.4	46.4	33.1	36.2	31.4	35.8	28.2	30.0	34.2	39.9	41.2	37.1	34.1	34.1
423	56.7	50.5	51.4	42.6	45.3	35.3	46.0	39.1	48.2	35.0	48.2	52.9	45.9	**42.3**	**42.3**
429	59.6	59.2	51.6	46.0	53.8	41.2	43.5	44.9	52.7	54.7	49.9	53.6	50.9	**46.8**	**46.8**
436	60.0	62.6	56.2	51.3	60.2	43.9	53.2	51.6	55.2	55.5	54.0	56.7	55.0	**50.6**	34.8
438				40.9	36.8	31.2	43.0	38.0	40.8	42.3	43.3	42.1	39.8	36.6	26.5
439	45.4	43.3	47.3	39.2	41.0	36.5	42.0	36.2	38.0	37.8	43.1	42.0	41.0	37.7	37.7
455	36.8	33.0	31.7	24.5	22.6	16.2	20.1	20.5	26.5	29.9	27.8	31.5	26.5	24.4	24.4
461	41.7	43.8	40.3	33.9	42.0	35.9	32.1	27.1	32.9	35.4	35.3	42.2	36.9	33.9	33.9
464	51.7	43.8	44.6	34.8	29.0	27.8	31.9	33.1	39.3	33.9	40.2	42.7	37.3	34.4	34.4
466		40.8	41.8	34.9	30.5		36.8	30.8	35.8	34.5	40.7	34.2	36.1	33.2	33.2
469	47.1	47.1	46.5	40.5	40.1	32.9	34.5	33.8	35.2	34.3	40.3	40.4	39.4	36.2	30.9
470	50.2	50.5	42.8	39.9	44.8	33.6	39.6	38.0	42.6	39.1	35.2	38.1	41.2	37.9	28.7
472	43.6	54.4	50.9	42.4	40.0	37.1	18.3	31.6	37.8	38.2	47.2	44.5	40.5	37.3	37.3
473		50.0	58.0	30.6	43.0	36.0	40.4	44.2	42.3	52.1	56.0	74.0	47.9	**44.0**	**44.0**
474	16.1	43.7	44.6	38.7	34.8	29.2	32.3	26.3	34.2	35.1	43.6	37.1	34.6	31.9	31.9
478	40.9	43.6	43.1	41.2	42.1	44.0	41.8	28.2	36.7	40.8	37.8	35.5	39.6	36.5	36.5
487	66.2	47.3	47.6	47.8	41.0	28.7	48.1	41.4	48.1	38.8			45.5	**41.9**	38.8
489	48.4	42.1	42.6	38.2	40.2	30.7	39.3	34.4	40.8	35.7	31.9		38.6	35.5	33.4

490	40.6	29.2	30.8	30.9	31.7	24.7	29.5	30.1	33.8	31.5	4.9	31.8	29.1	26.8	25.4
491	46.6	41.4	42.8	35.2	37.5	24.7	28.2	30.6	35.8	38.1	36.4	39.2	36.4	33.5	32.0
492	47.6	41.2	41.1	38.6	36.0	26.5	33.4	28.9	38.7	38.3	45.0	38.8	37.8	34.8	27.9
493	58.0	50.2		44.9	42.0	39.2	45.7	40.5	47.0	42.6		44.3	45.4	**41.8**	**41.8**
494	53.5	46.1	44.6	43.6			37.3	30.6	36.1	39.7	47.8	41.6	42.1	38.7	33.0
496	58.1	44.8	49.1	38.6	40.3	37.2	37.6	39.9	42.5	38.7	38.6	46.3	42.6	39.2	39.2
497	49.9	43.2	47.3	41.2	34.5	32.1		33.9	41.5	38.8	50.9		41.3	38.0	32.2
499	48.6	56.8	51.3		50.7	52.0	44.2	33.6	44.2	44.3	46.9	41.3	46.9	**43.2**	**43.2**
503	23.0	24.0	20.4	16.7	17.4	14.5	15.6	13.8	16.6	42.6	21.1	23.5	20.8	19.1	19.1
504	29.7	39.0	36.5	25.4	23.3	28.8	21.6	21.5	26.5	32.6	34.2	28.9	29.0	26.7	26.7
505	26.2	27.5	26.4	23.5	24.7	19.1	17.7	16.6			27.9	29.6	23.9	22.0	22.0
506		21.6	19.4	16.3	14.2		12.2	10.7	13.6	15.3	18.4	20.3	16.2	14.9	14.9
507	28.4		26.5	24.2		20.0	20.2	18.7	22.9		26.4	27.9	23.9	22.0	22.0
508	31.2	34.2	20.5	25.0	24.3	22.2	19.3	14.4	22.8	27.3	31.7	29.2	25.2	23.2	23.2
509	33.2	34.2		36.2	25.4	19.3		18.8	28.0		29.9	31.8	28.5	26.3	26.3
510	31.1	31.7	26.8	23.2	20.0	16.0	14.4	17.2	22.7	26.8	31.0	28.5	24.1	22.2	22.2
511	34.7	32.8	35.8	25.0	27.5	21.9	25.0	20.5	29.4	32.2	35.4	32.3	29.4	27.0	27.0
512	44.4	60.0	57.1	50.5	53.2	53.3	49.3	42.3	52.8	54.5	51.7	51.1	51.7	**47.6**	**43.7**
513	34.0	34.6		25.4	22.5	17.0	19.1	17.3	26.7	29.8	34.2	29.8	26.4	24.3	24.3
514	27.8	33.1	29.1	22.2	23.3	18.5	17.5	23.2	21.5	27.8	32.1	29.7	25.5	23.4	23.4
515	38.7	45.5	44.5	35.9	40.7	37.4	28.1	26.5	34.2	34.0	38.6	35.3	36.6	33.7	32.4
516			26.0		19.3		15.4	15.1	20.6	27.3	28.9	28.5	22.6	20.2	20.2
517	27.8	29.4	23.7	20.9	18.0	14.5	15.7	14.6	20.3	21.7	28.6	28.9	22.0	20.3	20.3
518	31.2	32.4	33.0	24.8	24.0	18.2	22.9	20.4	24.3	29.0	31.9	31.9	27.0	24.8	24.8
519	23.9	25.3	22.5	14.9	17.5	11.9	17.0	14.7	17.8	20.0	22.7	23.7	19.3	17.8	17.8
520	29.8	29.9	27.6	20.4	19.0	10.8	17.3	17.1	21.5	24.6	27.7	27.1	22.7	20.9	20.9
521	33.2	34.3		27.4	27.9	22.5	27.4	23.9	23.3	28.8	30.6	30.2	28.1	25.9	25.9

522	34.0	35.2	25.3	23.2	23.7	18.0	20.1	20.5	27.1	28.3	27.2	31.7	26.2	24.1	24.1
523	33.9	41.5	27.7	25.5	20.7	19.0	21.4	21.5	27.3	29.8	29.9	33.1	27.6	25.4	25.4
524	43.0	48.9	32.2	31.8	29.1	24.5	28.9	30.4	37.9	34.7	34.2	38.5	34.5	31.7	31.7
525	49.9	50.0	47.1	43.7	47.8	42.6	50.6	41.0	49.2	46.1	48.0	50.9	47.2	**43.5**	37.6
526	34.4	36.2	36.6	30.2	25.3	21.5	22.1	23.7	28.0	33.4	37.0	36.9	30.4	28.0	28.0
527	40.1	47.7	29.8	27.2	31.0	26.0	25.7	25.8	31.1	36.9	34.5	34.7	32.5	29.9	29.9
528	41.1			32.6		22.7	22.8		33.2		32.6	37.4	31.8	29.7	29.7
529	39.5	49.3	32.7			24.1	28.5	29.3	33.9	34.8	34.5	36.9	34.4	31.6	31.6
530	41.9	45.4	25.9	29.1	27.4	24.4	26.6	28.7	32.4	32.5	33.9	39.4	32.3	29.7	29.7
531	33.4	44.8	29.6	27.6	26.8	22.4	22.2	22.0	27.4	31.0	31.9	42.9	30.2	27.7	27.7
532	40.2	50.6	34.6	32.1	27.7	24.7	28.4	27.9	37.4	36.6	42.5	42.6	35.4	32.6	25.4
533	42.3	58.7	34.4	33.2	26.7	21.0	24.8	23.7	31.1	35.5	36.3	36.4	33.7	31.0	31.0
534	27.3	34.1	20.2	19.1	17.3	13.6	14.7	16.1	18.9	23.3	19.8		20.4	18.8	18.8
535	25.0	37.5	21.7	20.2	19.4	16.5	16.2	14.3	19.9	21.9	27.3	26.8	22.2	20.4	20.4
536			32.2	30.1	31.3	28.4	35.1	32.7	37.6	35.2			32.8	32.6	32.6
537	32.7	49.9	27.5	27.8	31.2	28.1	26.7	24.7	28.3	30.5	27.7	28.1	30.3	27.8	27.8
538	37.6	59.3	33.4			31.9	30.3	26.8			51.0	38.1	38.5	33.7	33.7
539		66.4	43.3	41.9	45.4			42.2	47.9	45.7	43.5	47.5	47.1	**43.3**	39.1
540	29.3	41.5	22.8	23.3	24.6		21.0	20.1	24.7	27.9	29.0	30.0	26.7	24.6	24.6
541	34.9	48.9	29.0	27.3	26.3	21.2	21.8	20.4	28.3	30.5	34.1	36.1	29.9	27.5	27.5
542	28.1	40.4	23.9			17.9	17.8	16.0	21.5	22.7	28.8	28.6	24.6	22.6	22.6
543	24.1	38.4	22.3			12.4	15.8	14.5	19.9	24.4	26.4	27.9	22.6	20.8	20.8
544	34.0	48.9	30.0	27.7	33.6	26.7	27.3	23.7	28.2	26.9	30.5	31.2	30.7	28.3	28.3
545	36.1	54.7	36.2	41.8	36.8	34.3	30.6	28.3	34.5	33.2	47.8	40.7	37.9	34.9	34.9
546		33.0	20.5	18.7	19.2	12.5	16.8	16.7		55.1	26.5	25.2	24.4	22.5	22.5
547			20.8	19.8	16.0		17.4	16.8	21.2	22.9	25.3	25.1	20.6	18.9	18.9
548		48.6		30.8	28.6	22.9	25.3	25.5	33.0	29.9	39.7	40.2	32.5	29.9	29.9

550			45.3	41.9	51.9	53.8		28.6			23.4	38.9	40.6	36.9	36.9
551					33.4	26.6	14.5	27.9	32.5	32.0	37.5	35.7	30.0	27.9	27.9
554								41.2	47.0	43.3	56.9		47.1	**43.8**	**43.8**

☒ **Local bias adjustment factor used**

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

☒ **Where applicable, data has been distance corrected for relevant exposure**

Notes:

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

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

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

(2) Distance corrected to nearest relevant public exposure.

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 that haven't had the impacts on air pollution considered through the planning process. During 2018 the construction works for the new Metrobus routes have continued to take place and in some locations have continued to cause significant, but 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

The Mayor wrote to Theresa Coffey, Secretary of State for Department of Food and Rural Affairs, on the 1st March stating that a programme would be submitted to the Joint Air Quality Unit (JAQU) by the end of March 2019, which was achieved. The submitted programme shows that an Outline Business Case (OBC) will be submitted to JAQU by Sept 2019 and a Full Business Case (FBC) by the end of 2019.

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 NO2 Since 2014

Site	Site ID	Annual Mean Concentrations ($\mu g/m^3$)					Action
		2014	2015	2016	2017	2018	
No.67 Filton Avenue on wall facing Muller Rd	493	Not Monitored	36.4	**41.5**	**41.9**	**41.8**	2016 was the first full year of monitoring in this location with data from 2015 being annualised. 2018 data shows that the site continues to exceed the annual objective for nitrogen dioxide. The monitoring location is on the façade of a residential dwelling and is therefore representative of relevant exposure. Bristol City Council intends to continue monitoring in this location. Given that there are now three consecutive years of evidence of exceedence, Bristol City Council will consider whether it is necessary to expand the current AQMA boundary which follows Gloucester Road and passes within 175m of monitoring site 493. Monitoring will continue and a further update will be provided in the 2020 report.
Muller Road - Adjacent to Darnley Avenue	494	Not Monitored	38.4	**43.3**	39.5	38.7	2016 was the first full year of monitoring in this location with data from 2015 being annualised. The NO_2 concentration at the relevant receptor location (using distance from roads calculator) was below the air quality strategy objective in 2016. 2017 and 2018 data show compliance at the monitoring site. Monitoring will continue here but no further action is currently required with regards to extension of the AQMA.
Blackboy Hill	3	36.3	37.9	37.6	34.4	34.4	Exceedence recorded in 2013 with compliance recorded each year since.
Lamppost Whiteladies Road \ Cotham Hill Clifton	314	**43.0**	**43.9**	**41.5**	38.3	37.7	Despite exceedence being measured, from 2014-2016, the NO_2 concentration at a relevant receptor location was below the air quality strategy objective when calculated using the distance calculator tool. 2018 monitoring data is compliant without distance adjustment. Monitoring in this location will continue to ensure that exceedence at the relevant receptor does not occur in future years.

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[16] showed that there had been a marked reduction in NO_2 concentrations measured in these locations compared to 2010. The 2017 and 2018 data for Tube 314 and data for the past 5 years at Tube 3 show compliance with the annual objective for NO_2. This confirms that the decision in 2012 to defer the declaration of an AQMA along Whiteladies Road was the right approach to take. Data for 2014, 2015 and 2016 at Tube 314 on Whiteladies Road shows that using the distance adjustment calculator to determine pollution levels where relevant exposure occurs, that compliance with objectives was achieved.

Tube 3 on Blackboy Hill is located on the façade of a building and is representative of relevant exposure. 2014 to 2018 data show compliance at this location.

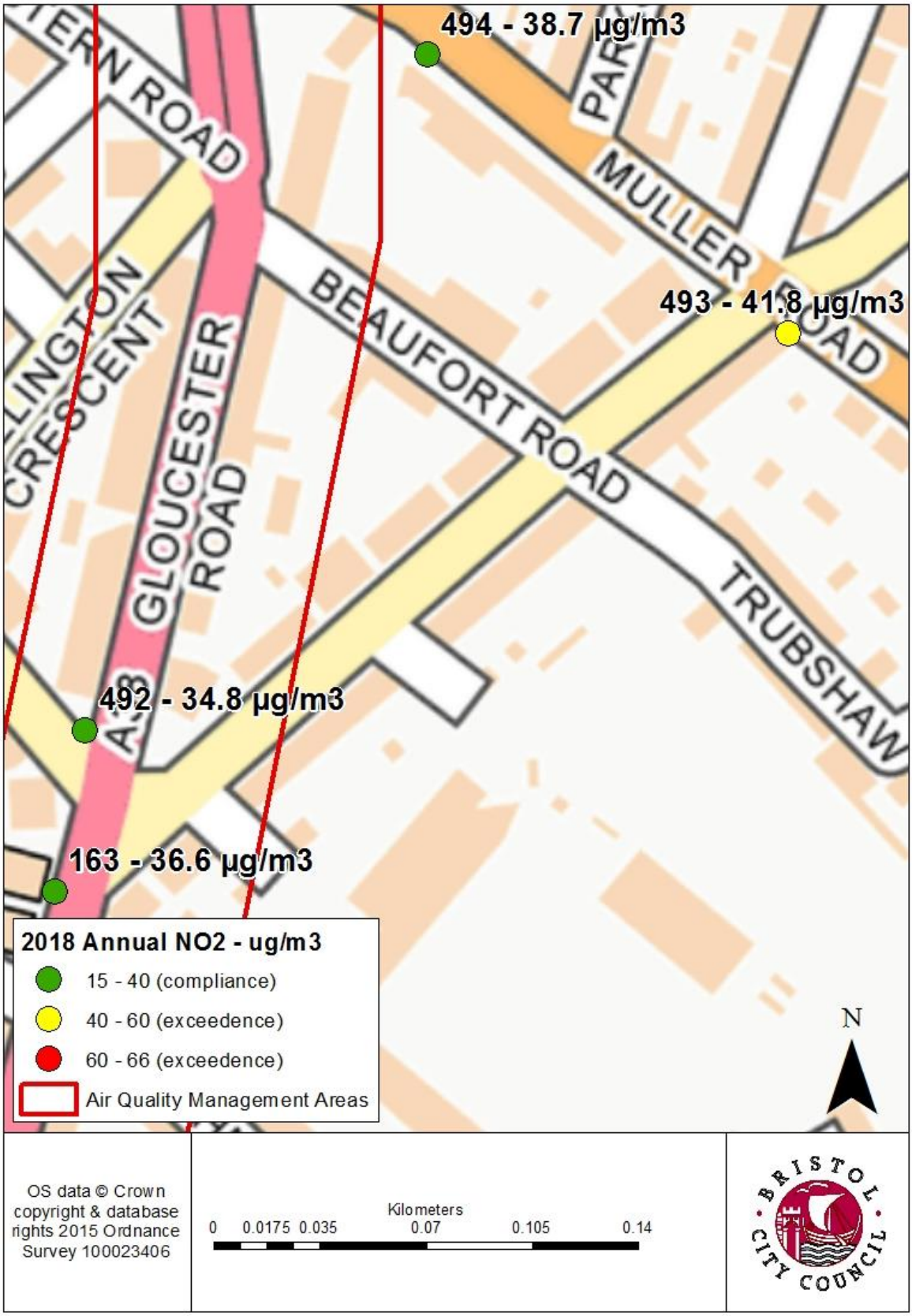
[16] Bristol City Council. (2012). 2012 Updating and Screening Assessment for Bristol City Council.

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 was 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 continued in 2018 and again showed non-compliance at Tube 493 with an annual average NO_2 concentration of 41.8µg/m^3. Tube 494 was compliant with objectives without distance correction at 38.7µg/m^3.

A decision will be taken in 2019 to determine whether there is an immediate need to extend the AQMA boundary to cover this location. In the meantime monitoring will continue and 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.

Figure C.1– Muller Road Diffusion Tubes 2018



QA/QC of Diffusion Tube Monitoring

Precision calculations were undertaken for all sites in the co-location study. The precision checks indicated a “good” precision rating for all measurement periods at all sites when two or more tubes were available for analysis. Automatic monitor data capture rates were good at all sites for all months except for September at the Fishponds site and for July and September at the Defra St Pauls site. Summary tables from the analysers used for bias adjustment and precision calculation are included in the Figures below.

Figure C.2 - 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	03/01/2018	31/01/2018	34.6	36.3	35.1	35	0.9	2	2.2	34	99.6	Good	Good
2	31/01/2018	28/02/2018	35.8	41.2	39.5	39	2.8	7	6.9	31	96.7	Good	Good
3	28/02/2018	27/03/2018	31.2	30.8	33.4	32	1.4	4	3.5	29	100	Good	Good
4	27/03/2018	02/05/2018	27.7	29.7	29.6	29	1.1	4	2.8	23	99.9	Good	Good
5	02/05/2018	06/06/2018	27.4	27.0	27.6	27	0.3	1	0.8	22	100	Good	Good
6	06/06/2018	04/07/2018	19.9	23.1	23.8	22	2.1	9	5.2	17	99.9	Good	Good
7	04/07/2018	01/08/2018	26.4	25.5	24.0	25	1.2	5	3.0	23	100	Good	Good
8	01/08/2018	03/09/2018	26.7	28.1	28.9	28	1.1	4	2.8	24	99.7	Good	Good
9	03/09/2018	02/10/2018	30.8	31.1	30.1	31	0.5	2	1.3	22	75.9	Good	Good
10	02/10/2018	30/10/2018	28.1	31.0	31.5	30	1.8	6	4.6	25	99.7	Good	Good
11	30/10/2018	05/12/2018	31.5	31.1	29.9	31	0.8	3	2.1	29	99.9	Good	Good
12	05/12/2018	08/01/2019	34.8	34.2	34.8	35	0.3	1	0.9	31	99.8	Good	Good
13													
												Good precision	Good Overall DC

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

Overall survey -->

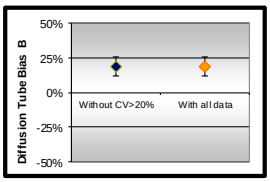
Site Name/ ID:	320 - Brislington

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	0.85 (0.8 - 0.91)
Bias B	17% (10% - 24%)
Diffusion Tubes Mean:	30 µgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	26 µgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	26 (24 - 28) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.85 (0.8 - 0.91)
Bias B	17% (10% - 24%)
Diffusion Tubes Mean:	30 µgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	26 µgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	26 (24 - 28) µgm^{-3}



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Version 04 - February 2011

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

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	04/01/2018	01/02/2018	52.7	50.6		52	1.5	3	13.3	46	99.9	Good	Good
2	01/02/2018	01/03/2018	44.5	43.7	43.1	44	0.7	2	1.7	41	99.7	Good	Good
3	01/03/2018	28/03/2018	45.5	45.4	42.9	45	1.5	3	3.7	42	92	Good	Good
4	28/03/2018	03/05/2018	35.0	36.1	33.2	35	1.5	4	3.6	36	99.9	Good	Good
5	03/05/2018	07/06/2018	32.6	28.9	25.6	29	3.5	12	8.7	40	100	Good	Good
6	07/06/2018	05/07/2018	28.6	26.5	28.4	28	1.2	4	2.9	35	99	Good	Good
7	05/07/2018	02/08/2018	31.6	33.5	30.8	32	1.4	4	3.4	38	100	Good	Good
8	02/08/2018	04/09/2018	33.2	32.0	34.1	33	1.1	3	2.6	37	99.6	Good	Good
9	04/09/2018	03/10/2018	40.0	40.1	37.7	39	1.4	3	3.4	50	72.7	Good	or Data Capture
10	03/10/2018	31/10/2018	31.2	33.8	36.7	34	2.8	8	6.8	46	99.3	Good	Good
11	31/10/2018	06/12/2018	40.8	40.6	39.3	40	0.8	2	2.0	47	99.4	Good	Good
12	06/12/2018	09/01/2019	42.8	41.5	43.8	43	1.2	3	2.9	49	99.4	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

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

Site Name/ ID: 464 - Fishponds 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: 1.11 (1 - 1.23)
Bias B: -10% (-19% - 0%)
Diffusion Tubes Mean: 38 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 42 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 42 (38 - 46) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA

Bias calculated using 11 periods of data
Bias factor A: 1.11 (1 - 1.23)
Bias B: -10% (-19% - 0%)
Diffusion Tubes Mean: 38 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 42 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 42 (38 - 46) µgm^{-3}

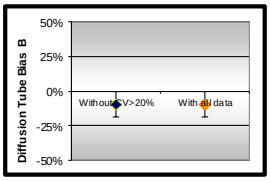

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Figure C.4 - Summary Data for Bias and Precision Calculation: Parsons Street

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	03/01/2018	31/01/2018	44.3	45.8	46.3	45	1.0	2	2.6	44	99.1	Good	Good
2	31/01/2018	28/02/2018	41.6	44.2	44.0	43	1.4	3	3.6	46	99.6	Good	Good
3	28/02/2018	27/03/2018	47.1	47.1	47.8	47	0.4	1	1.0	48	100	Good	Good
4	27/03/2018	02/05/2018	39.8	40.5	37.3	39	1.7	4	4.2	39	99.9	Good	Good
5	02/05/2018	06/06/2018	42.0	41.5	39.6	41	1.3	3	3.1	40	99.9	Good	Good
6	06/06/2018	04/07/2018	36.3	34.3	39.0	37	2.4	6	5.9	38	100	Good	Good
7	04/07/2018	01/08/2018	42.1	42.6	41.4	42	0.6	1	1.5	38	99.9	Good	Good
8	01/08/2018	03/09/2018	36.3	36.1	36.1	36	0.1	0	0.3	31	99.6	Good	Good
9	03/09/2018	02/10/2018	38.2	37.7	38.1	38	0.3	1	0.7	29	99.9	Good	Good
10	02/10/2018	30/10/2018	38.4	35.1	39.8	38	2.4	6	6.0	37	99.9	Good	Good
11	30/10/2018	05/12/2018	42.7	43.6	43.2	43	0.5	1	1.1	43	99.9	Good	Good
12	05/12/2018	08/01/2019	42.0	42.4	41.8	42	0.3	1	0.8	44	99.1	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

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

Site Name/ ID: 439 - 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: 0.97 (0.91 - 1.04)
Bias B: 3% (-4% - 10%)
Diffusion Tubes Mean: 41 µgm^{-3}
Mean CV (Precision): 3
Automatic Mean: 40 µgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 40 (37 - 43) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA

Bias calculated using 12 periods of data
Bias factor A: 0.97 (0.91 - 1.04)
Bias B: 3% (-4% - 10%)
Diffusion Tubes Mean: 41 µgm^{-3}
Mean CV (Precision): 3
Automatic Mean: 40 µgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 40 (37 - 43) µgm^{-3}

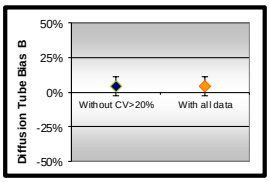

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Figure C.5 - Summary Data for Bias and Precision Calculation: St Pauls

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	04/01/2018	01/02/2018	38.3	35.3		37	2.1	6	19.1	29	96.2	Good	Good
2	01/02/2018	01/03/2018	33.7	32.2	33.1	33	0.8	2	1.9	30	99.7	Good	Good
3	01/03/2018	28/03/2018	31.7	33.4	30.1	32	1.7	5	4.1	27	99.5	Good	Good
4	28/03/2018	03/05/2018	23.9	25.0	24.6	25	0.6	2	1.4	21	100	Good	Good
5	03/05/2018	07/06/2018	22.4	22.8	22.6	23	0.2	1	0.5	19	99.9	Good	Good
6	07/06/2018	05/07/2018	16.4	15.5	16.8	16	0.7	4	1.7	14	100	Good	Good
7	05/07/2018	31/07/2018	19.8	20.2	20.2	20	0.2	1	0.6	17	54.5	Good	or Data Capture
8	31/07/2018	04/09/2018	20.4	20.7	20.4	21	0.2	1	0.4	0	0	Good	or Data Capture
9	04/09/2018	03/10/2018	27.2	26.3	26.1	27	0.6	2	1.5	25	63.9	Good	or Data Capture
10	03/10/2018	31/10/2018	28.8	31.2	29.6	30	1.2	4	3.0	27	99.8	Good	Good
11	31/10/2018	06/12/2018	24.6	29.1	29.7	28	2.8	10	6.9	28	100	Good	Good
12	06/12/2018	09/01/2019	31.1	31.6	31.9	32	0.4	1	1.0	28	99.3	Good	Good
13													
										Overall survey -->		Good precision	Poor Overall DC

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

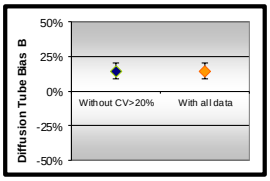
Site Name/ ID:	455 - St Pauls

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 9 periods of data
Bias factor A 0.88 (0.84 - 0.92)
Bias B 14% (8% - 20%)
Diffusion Tubes Mean: 28 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 25 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 25 (24 - 26) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 9 periods of data
Bias factor A 0.88 (0.84 - 0.92)
Bias B 14% (8% - 20%)
Diffusion Tubes Mean: 28 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 25 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 25 (24 - 26) µgm^{-3}



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Version 04 - February 2011

Figure C.6 - Summary Data for Bias and Precision Calculation: Wells Road

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	03/01/2018	31/01/2018											
2	31/01/2018	28/02/2018											
3	28/02/2018	27/03/2018											
4	27/03/2018	02/05/2018	39.4	40.8	42.4	41	1.5	4	3.7	33	99.8	Good	Good
5	02/05/2018	06/06/2018	36.0	36.2	38.2	37	1.2	3	3.0	30	97.5	Good	Good
6	06/06/2018	04/07/2018	29.8	31.8	32.0	31	1.2	4	3.0	25	99.9	Good	Good
7	04/07/2018	01/08/2018	44.8	43.7	40.5	43	2.2	5	5.5	30	99.9	Good	Good
8	01/08/2018	03/09/2018	39.0	36.0	38.9	38	1.7	4	4.2	28	89.4	Good	Good
9	03/09/2018	02/10/2018	40.7	43.2	38.5	41	2.4	6	5.8	34	99.7	Good	Good
10	02/10/2018	30/10/2018	43.5	43.7	39.6	42	2.3	5	5.7	35	95.8	Good	Good
11	30/10/2018	05/12/2018	43.5	42.2	44.1	43	1.0	2	2.4	35	99.9	Good	Good
12	05/12/2018	08/01/2019	43.3	41.4	41.7	42	1.0	2	2.5	36	99.9	Good	Good
13													
										Overall survey -->		Good precision	Good Overall DC

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

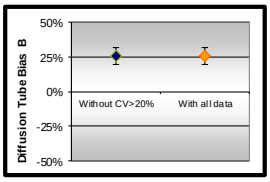
Site Name/ ID:	438 - Well Road

Precision: 9 out of 9 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 9 periods of data
Bias factor A 0.8 (0.76 - 0.84)
Bias B 25% (19% - 32%)
Diffusion Tubes Mean: 40 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 32 µgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 32 (30 - 33) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 9 periods of data
Bias factor A 0.8 (0.76 - 0.84)
Bias B 25% (19% - 32%)
Diffusion Tubes Mean: 40 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 32 µgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 32 (30 - 33) µgm^{-3}



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Version 04 - February 2011

Figure C.7 - Summary Data for Bias and Precision Calculation: Temple Way

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	03/01/2018	31/01/2018	50.3	45.1	50.3	49	3.0	6	7.5	43	99.3	Good	Good
2	31/01/2018	28/02/2018	56.8	59.5	54.2	57	2.7	5	6.6	56	97	Good	Good
3	28/02/2018	27/03/2018	53.8	51.4	48.5	51	2.7	5	6.6	49	99.7	Good	Good
4	27/03/2018	02/05/2019								44	99.6		Good
5	02/05/2018	06/06/2018	54.6	46.7		51	5.6	11	50.2	54	99.6	Good	Good
6	06/06/2018	04/07/2018	50.8	52.1	53.1	52	1.2	2	2.9	48	99.7	Good	Good
7	04/07/2018	02/08/2018	41.9	46.0	44.6	44	2.1	5	5.2	35	97	Good	Good
8	02/08/2018	03/09/2018	34.4	33.0	33.2	34	0.8	2	1.9	30	86	Good	Good
9	03/09/2018	02/10/2018	44.2	44.2		44	0.0	0	0.0	40	99.8	Good	Good
10	02/10/2018	30/10/2018	45.1	43.4		44	1.2	3	10.8	48	99.8	Good	Good
11	30/10/2018	05/12/2018	46.2	46.3	48.3	47	1.2	3	2.9	47	99.6	Good	Good
12	05/12/2018	08/01/2019	41.5	41.2		41	0.2	1	1.9	41	99.6	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

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

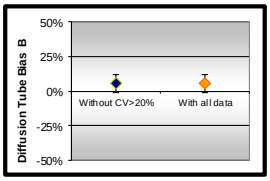
Site Name/ ID:	499 - Temple Way

Precision: 11 out of 11 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	0.96 (0.9 - 1.02)
Bias B	5% (-2% - 11%)
Diffusion Tubes Mean:	47 µgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	45 µgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	45 (42 - 48) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 11 periods of data	
Bias factor A	0.96 (0.9 - 1.02)
Bias B	5% (-2% - 11%)
Diffusion Tubes Mean:	47 µgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	45 µgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	45 (42 - 48) µgm^{-3}



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Version 04 - February 2011

Diffusion Tube Bias Adjustment Factors

Somerset Scientific Services were used throughout the whole of 2018 to provide and analyse diffusion tubes for BCC. 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.2 – AIR PT Scheme Results for Somerset County Council

Air PT Round	Percent Of tubes submitted found to be satisfactory
Air PT AR024 – Jan/Feb 2018	100%
Air PT AR025 – April/May 2018	100%
Air PT AR027 – July/August 2018	100%
Air PT AR028 – Sept/October 2018	100%
Air PT AR030 – Jan/Feb 2019	100%

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 2018, 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, the BCC and Defra AURN co-locations sites have been identified as appropriate to use for bias adjustment calculations for 2018. The precision of the analysis at these co-located triplicate tubes was classed as good for all sites and all months. 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 is 0.92.

Short-term to Long-term Data Adjustment

Data capture rates for sites 14, 113, 147, 516, 528, 536, 538, 550, 551 and 554 were below 75% as monitoring was either carried out for part of the year or diffusion tubes were tampered with by members of the public and taken from their sites.

Annualisation of diffusion tube data for all sites with less than 75% data capture was carried out in accordance with the methodology in Box 7.10 of LAQM TG16[17]. Data from the Background AURN monitoring sites at Swindon Walcot and Charlton Mackrell were used in the process.

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 and Temple Way sites is carried out by Ricardo-AEA.

[17] Defra, Local Air Quality Management Technical Guidance TG16 (Feb 2018)

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.

The Temple Way site is an Affiliate site which is owned and maintained by Bristol City Council but also incorporated in the Defra AURN network. This site is maintained in accordance with the QA/QC processes as required for sites that form part of the National AURN network.

Equipment Servicing and Maintenance Regimes

BCC 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 2018 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: Map(s) of Monitoring Locations and AQMAs

Figure D.1 - Extent of Air Quality Management Area

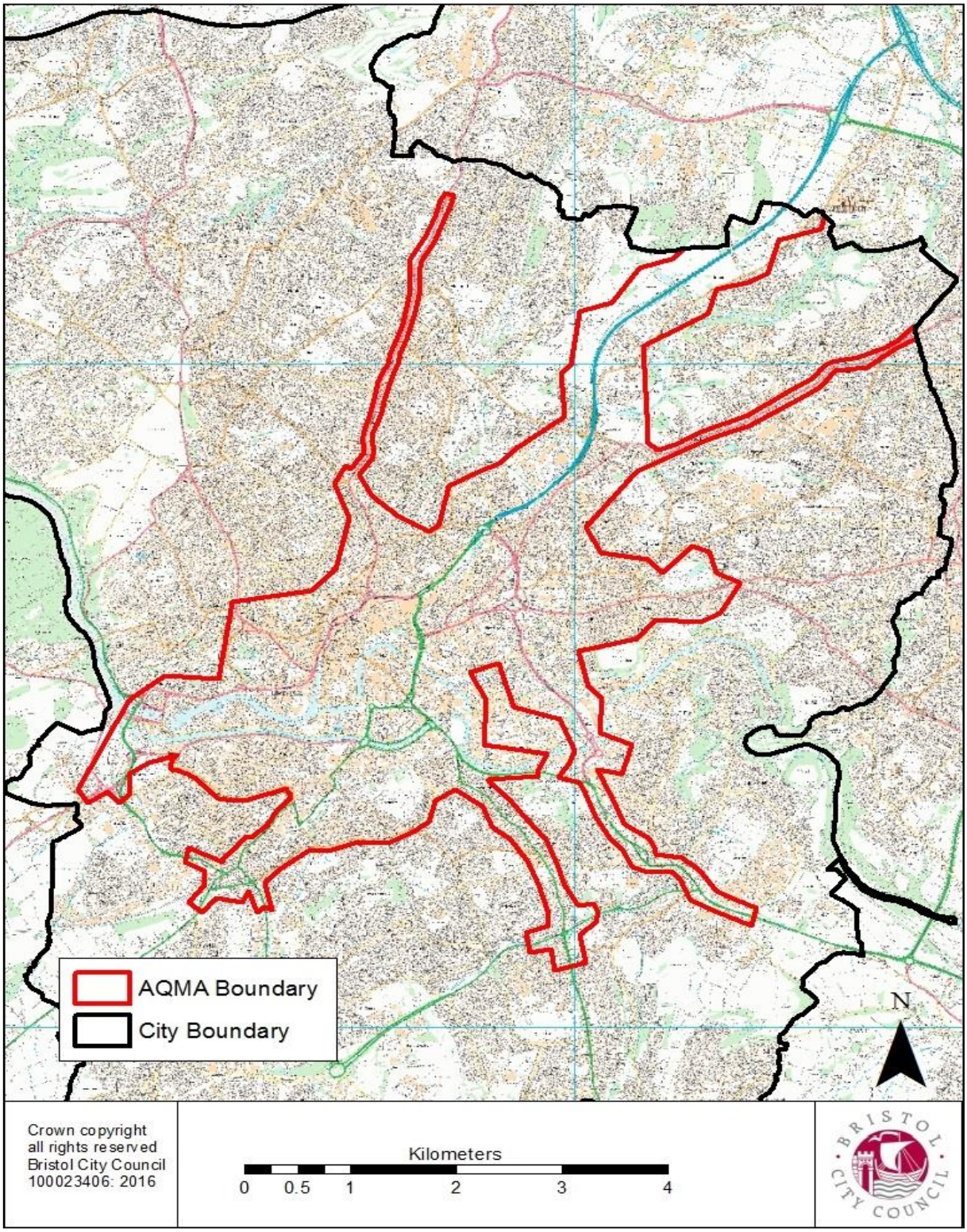


Figure D.2 - Central Monitoring Locations and 2018 Annual NO_2 Concentrations

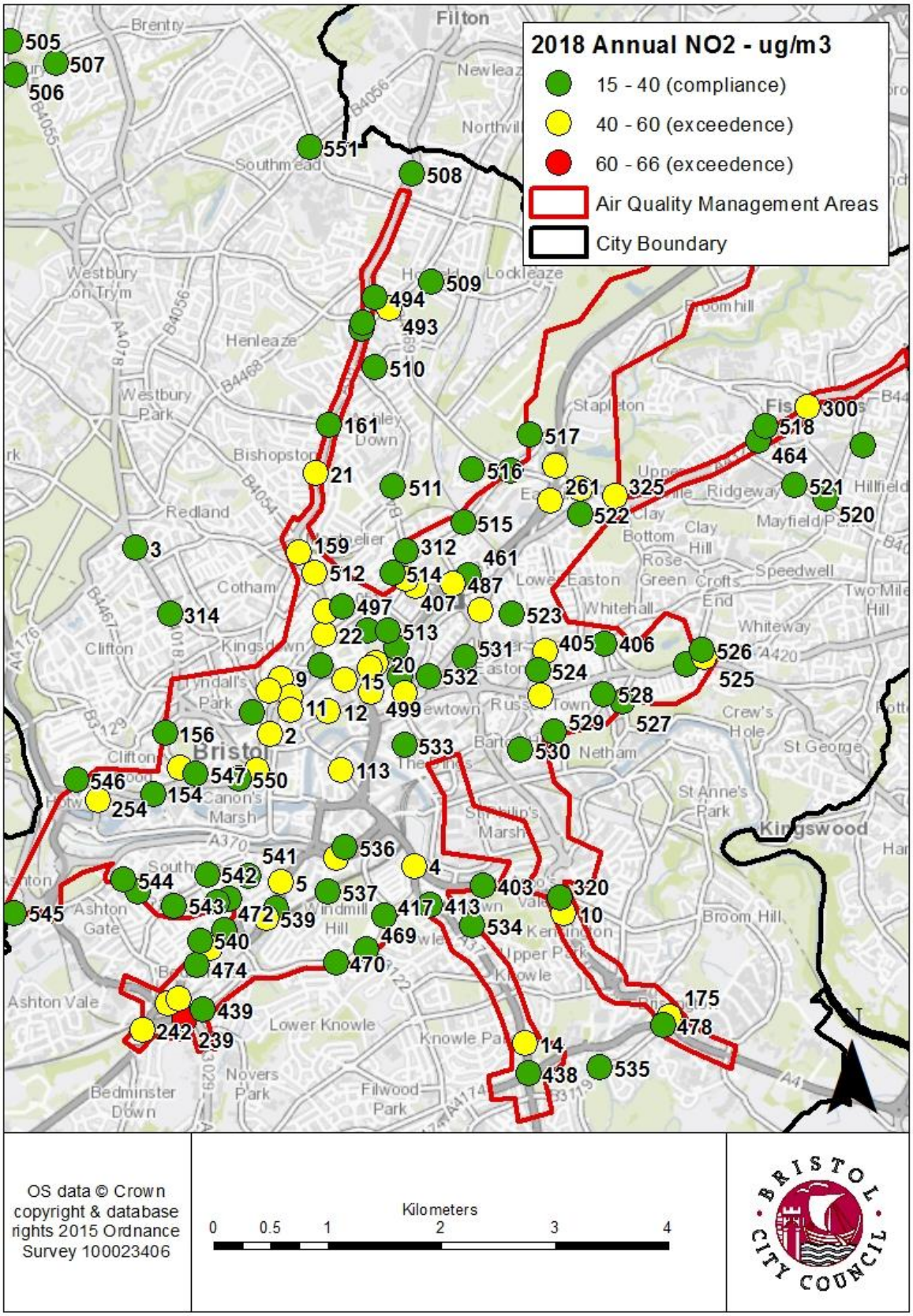


Figure D.3 - Central Monitoring Locations and 2018 Distance Adjusted and Annualised (where required)

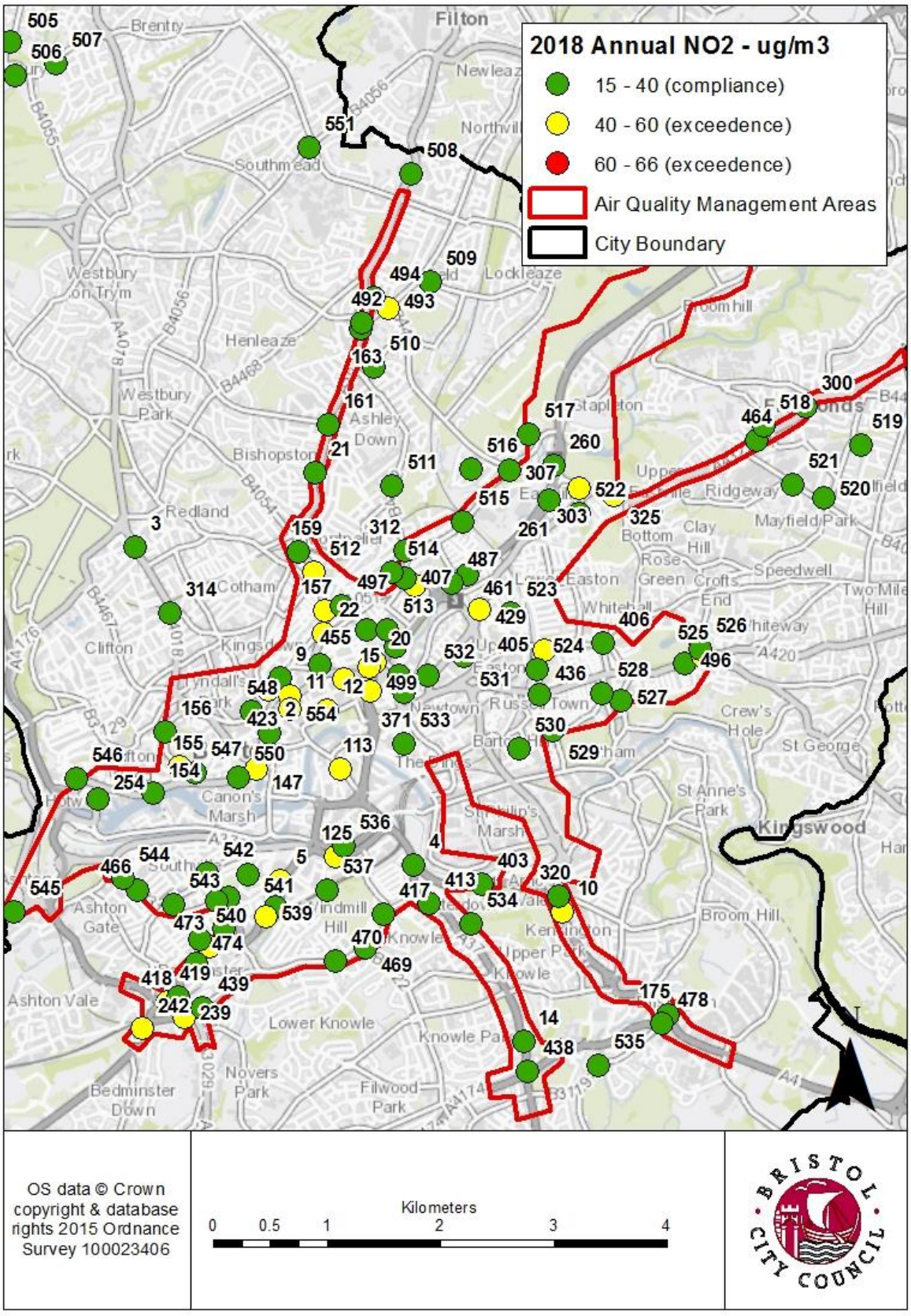


Figure D.4 - Avonmouth Monitoring Locations

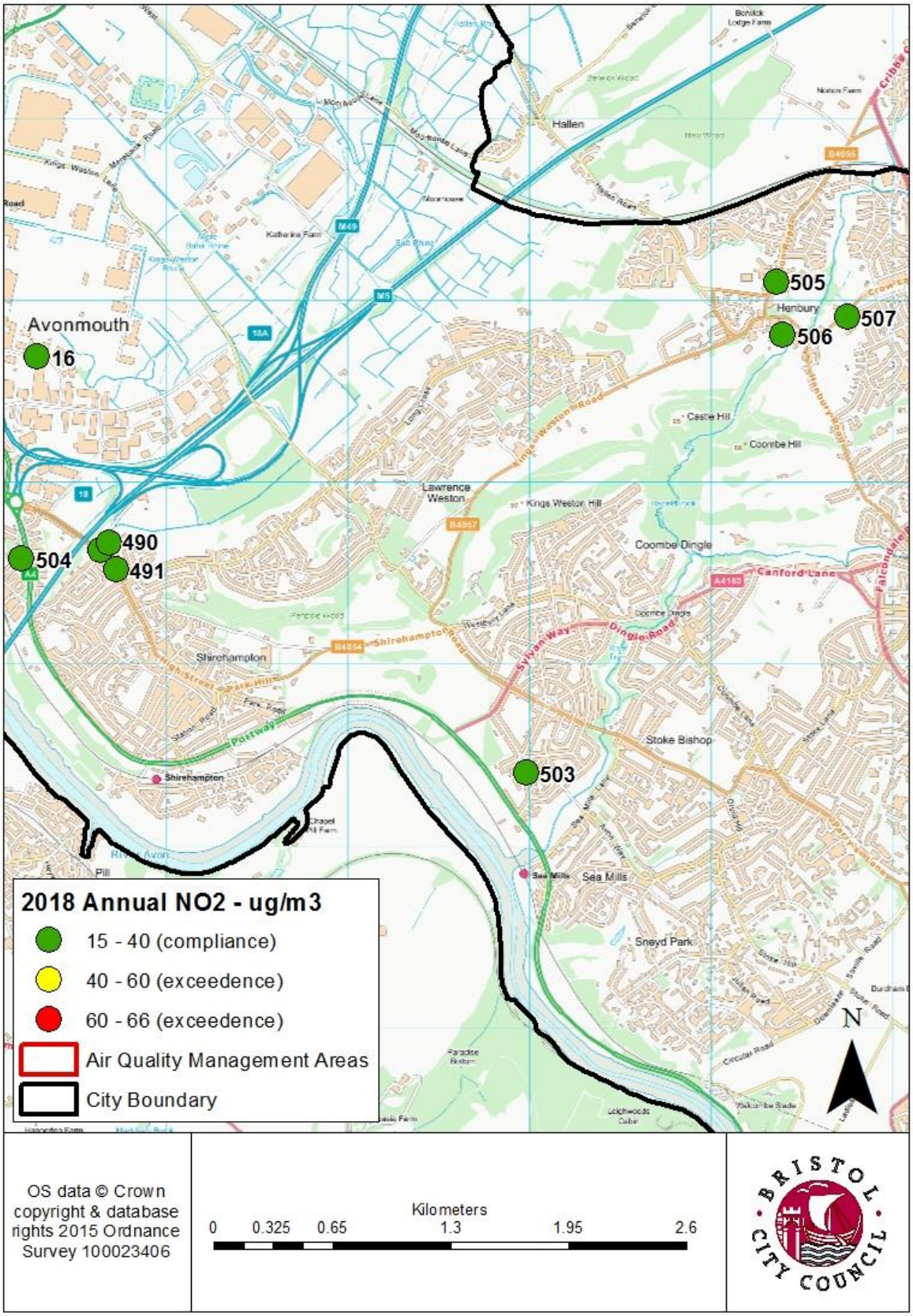
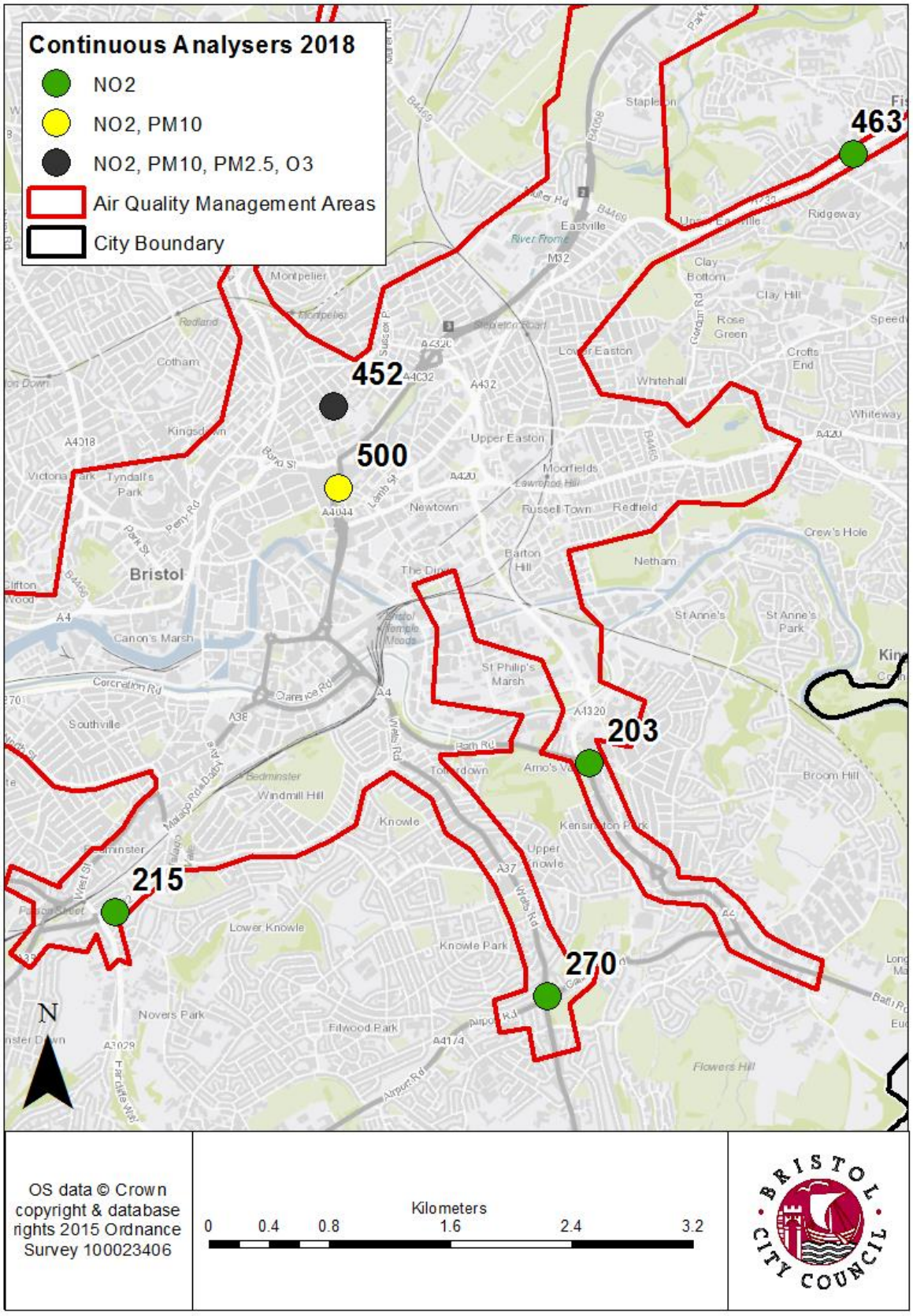


Figure D.5 - Continuous (real-time) Monitoring Locations in 2018



Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England

Pollutant	Air Quality Objective[18]	
	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

[18] The units are in microgrammes 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