2021 Air Quality Annual Status Report (ASR)

In fulfilment of Part IV of the Environment Act 1995

Local Air Quality Management

Date: August 2021

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

The mortality burden of air pollution within the UK is equivalent to 28,000 to 36,000 deaths at typical ages[3], with a total estimated healthcare cost to the NHS and social care of £157 million in 2017[4].

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. It has an estimated population of 463,400[5] for the unitary authority at present, and a surrounding urban area with an estimated 668,400 residents (mid 2018). Within England and Wales it is the 8th largest city outside of London and the 11th largest local authority.

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 possibly the hourly objective, set at 40µg/m^3 and

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

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

[3] Defra. Air quality appraisal: damage cost guidance, July 2020

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

[5] ONS 2019 Mid-Year Population Estimate

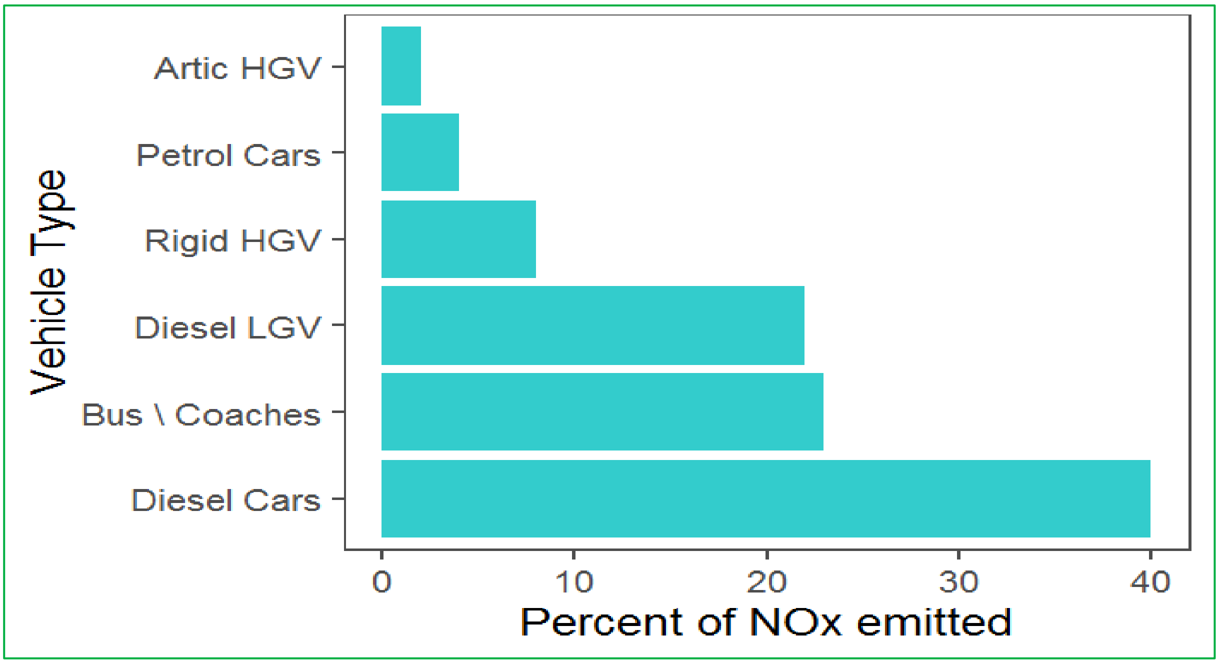
200µg/m^3 (with a permissible 18 hours per year above the 200µg/m^3 limit allowed) respectively.

Nitrogen Dioxide

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. Actions and decisions by BCC, other West of England (WoE) authorities and the decisions that citizens in the WoE have to make 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[6].

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



[6] 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[7] and exacerbates lung and heart disease in older people[8]. A 2017 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 nitrogen dioxide (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[9]. This has an estimated cost to the NHS of £83m. It should be noted that the baseline year for the study into premature deaths was 2013. Whilst NO_2 pollution at roadside locations has fallen significantly since that date, the change in background levels of NO_2 and $PM_{2.5}$ pollution have not seen such a significant fall. A revised study using more recent air quality data would calculate a different number of premature deaths, however, it would still demonstrate that air pollution leads to a significant number of premature deaths each year despite the measured improvements in roadside pollution levels since the 2013 baseline year.

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, exceedances of objectives for this pollutant were still measured widely in the city in 2019. The impact of Covid-19 on people’s movements and travel patterns in 2020

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[7] Royal College of Pediatrics and Child Health, Every breath we take – The lifelong impact of air pollution, February 2016

[8] Simoni et al., Adverse effects of outdoor pollution in the elderly, Journal of Thoracic Disease, January 2015

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

has had an effect on measured pollution levels in 2020, alongside other factors like vehicle fleet composition and meteorological conditions, which influence pollution levels year on year. The air quality data has shown that pollution fell in 2020 compared to 2019; however, there were still three locations at which measured annual NO_2 concentrations exceeded the annual objective for this pollutant.

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 can be found on the Defra website, including maps of AQMA boundaries.

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 air pollution in their daily lives. There are also two small AQMAs in South Gloucestershire, in Kingswood\Warmley and Staple Hill. Monitoring of air pollution at the Junction 17 Cribbs Causeway AQMA has demonstrated compliance in recent years and this AQMA was revoked recently.

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 2020 consisted of:

- 7 real time NO_2 monitors which provide continuous live data which is uploaded automatically to a public open data air quality dashboard
- 5 real time particulate monitors (2 x $PM_{2.5}$ and 3 x PM_{10})
- 102 NO_2 diffusion tubes which provide a monthly and annual concentration for this pollutant.

In late 2019 a new $PM_{2.5}$ monitor was installed at Parsons Street School. 2020 is the first year where data for this site was available.

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. 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. All other sites are owned and operated by Bristol City Council.

When considering the results from all diffusion tube locations around the city there has been a decrease in NO_2 pollution levels in 2020 when compared to 2019. This equates to a 7.4µg/m^3 (-20.6%) decrease of annual NO_2 concentrations over all 98 tube locations for which data was available in 2019 and 2020. This compared to a 6.6µg/m^3 (-15.8%) reduction that was observed between 2018 and 2019 data. It should however be noted that changes over the city were not uniform with pollution falling more at some locations but actually increasing at 1 location between 2019 and 2020. This increase was measured at diffusion tube Site 3, Blackboy Hill. Whilst an increase was seen here in 2020 compared to 2019, the 2020 value was still lower than those measured in 2016, 2017 and 2018. Measured concentrations remain higher than the health-based EU and UK limits at five locations. When adjusted for distance to the nearest sensitive receptor location two sites were shown to exceed objectives, these were Colston Avenue in the city centre and tube 418 on Bedminster Down Road. More details of the patterns of reduction are discussed in later sections of the report.

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. The graph shows that NO_2 levels fell from 2010 to 2020 at all monitoring sites whilst many still exceeded objectives in 2019, 2020 was the first year in which all the sites shown achieved compliance with annual NO_2 objectives. It should be noted that Colston Avenue is not included in this figure.

Figure 0-2 - Trends in Annual NO_2 at City Centre Sites (2010-2020)

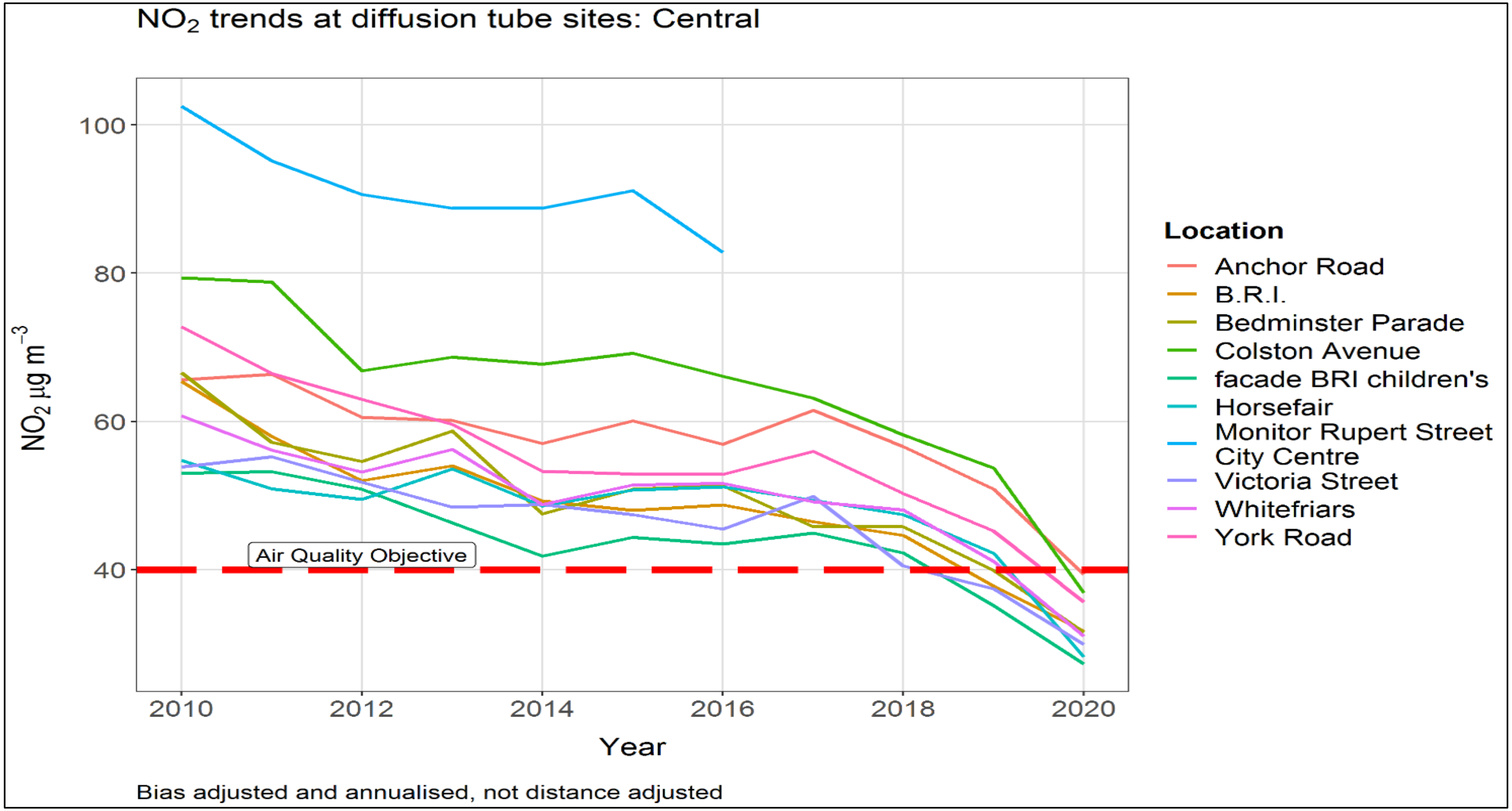
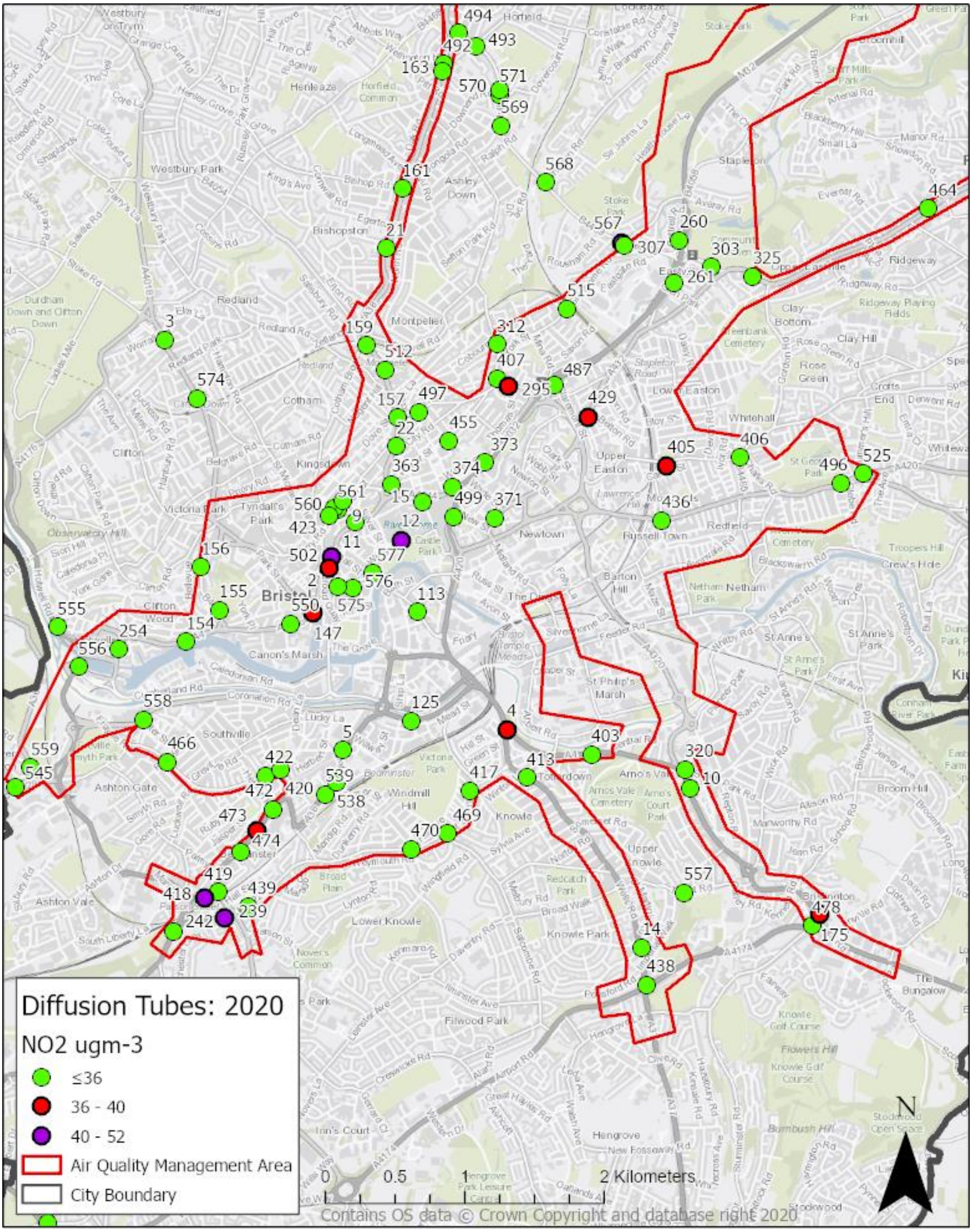


Figure 0-3 shows the locations in which monitored pollution concentrations exceed 36µg/m^3. 36µg/m^3 has been used to account for diffusion tube monitoring uncertainty. It should be noted that these are monitoring concentration and not the concentrations at relevant receptor locations as defined in the LAQM TG16 (e.g. facades of houses, schools, elderly people’s homes and hospitals).

Figure 0-3 - Monitoring Locations Where 2020 Annual NO_2 > 36µg/m^3



Particulate Matter

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

In those locations with the highest nitrogen dioxide 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 domestic 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 particulate matter (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 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 national research suggests that the health impacts from local domestic wood burning are significant. As a result of this national evidence, Bristol City Council commissioned a study, Impact of Solid Fuel Burning in Bristol: Policy Options for Reducing Emissions, to try to determine the scale of solid fuel burning in the city and the contribution that it has to particulate pollution. The report identified the next steps in taking action to reduce the health impacts associated with this activity.

Under the Clean Air Act of 1993 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.

Government proposed to amend the Clean Air Act through the new Environment Bill to make the enforcement easier. It however remains to be seen what form these changes take in the final Act.

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.

In additional to the report quantifying pollutant emissions from solid fuel use, a report into the emissions from construction Non-Road Mobile Machinery (NRMM) has also been commissioned by BCC. The aim of the report is to provide the evidence base needed to develop appropriate policies to manage emissions from this potentially significant pollutant source.

Actions to Improve Air Quality

Whilst air quality has improved significantly in recent decades, and will continue to improve due to national policy decisions, there are some areas where local action is needed to improve air quality further.

The 2019 Clean Air Strategy[10] sets out the case for action, with goals more ambitious than EU requirements to reduce exposure to harmful pollutants. The Road to zero[11] sets out the

[10] Defra. Clean Air Strategy, 2019

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

approach to reduce exhaust emissions from road transport through a number of mechanisms; this is extremely important given that the majority of Air Quality Management Areas (AQMAs) are designated due to elevated concentrations heavily influenced by transport emissions.

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 is focused on measures to reduce the number of vehicles on our roads, clean up the emissions from those vehicles and to reduce congestion.

Development of a Clean Air Zone

Bristol City Council has been directed by the UK Government to achieve compliance with air quality objectives in the shortest possible time. A small area Class D Clean Air Zone is being planned for Bristol for implementation in 2022. At the time of writing BCC is awaiting approval of the Full Business Case for the CAZ.

For updates on the progress with the Bristol Clean Air Plan please visit the Clean Air for Bristol Website

Bristol Transport Strategy

The Bristol Transport Strategy was adopted in July 2019 sets out a vision on how the city will:

- create an inclusive transport system that provides realistic transport options for everyone;
- create healthy places that promote active transport, improve air quality and improve road safety;
- make better use of our streets to enable more efficient journeys;
- enable more reliable journeys by minimising the negative impact of congestion; and
- support sustainable growth by enabling efficient movement of people and goods, reducing carbon emissions.

Liveable Neighbourhoods Strategy

Bristol City Council are currently developing a strategy for Liveable Neighbourhoods which will go to public consultation in 2021 with a plan for it to be adopted in late 2021.

One City Plan

The One City approach brings together a wide range of public, private, and third sector partners within Bristol. They share an aim to make Bristol a fair, healthy and sustainable city. A city of hope and aspiration, where everyone can share in its success.

Within the plan there are commitments and aspirations on air pollution including:

- Making progress towards cleaner air in the fastest time possible by working with city partners on successfully planning the launch of the Clean Air Zone; and
- A target to achieve WHO Guideline values for air quality by 2030.

One City Climate Strategy

This Strategy provides more detail on the commitment within the One City Plan for Bristol to become carbon neutral by 2030. Many actions aimed at reducing carbon have benefits to air pollution. Within the One City Climate Strategy transport is an area where it has been identified that action is needed with a focus on:

switching to significantly more walking, cycling and zero carbon public transport modes; converting the remaining vehicles to zero carbon fuels; transforming freight, aviation and shipping.

Bristol Climate Emergency Declaration

In November 2018 the Mayor declared a Climate Emergency and an initial plan of action has been developed to address this. The initial plan provided funding to work with city partners and stakeholders to develop a climate strategy for the city. For more details go to The Mayor's Climate Emergency Action Plan.

Freight Consolidation

As part of the One City Plan, Bristol City Council are aiming for 95% of deliveries within the city centre to be made by electric freight vehicles within the next decade, with consolidation centres at all our main access routes.

In Feb 2020, the application process began for a £100k grant from Go Ultra Low West, a £7m transport project that provides the infrastructure for large scale conversion to electric and ultra-low emission vehicles in the West of England. The grant was awarded to Zedify to set up a zero emissions hub to allow HGV's and diesel vans to drop off goods without entering the city centre. Deliveries will be consolidated and completed on a cargo bike or trike capable of carrying up to 200kg of packages.

No Idling and School Street

In 2020, Bristol City Council were planning to ask drivers to turn their engines off when stopped to help improve air quality citywide, but especially around air pollution and idling hotspots, such as schools and hospitals. The intention was to make Bristol a healthier place for everyone. This work was impacted by Covid restrictions, but engagement work was carried out at two primary schools before the restrictions were implemented and further engagement is being planned in 2021.

School Streets have been introduced by local authorities across the UK. The scheme transforms roads directly outside of schools, removing motor vehicles so that only pedestrians and cyclists can gain access at school start and finish times. Bristol City Council will have four school streets in place at the end of the 2020/2021 academic year with a further two being planned by the end of 2021.

Travel West and West of England Combined Authority (WECA)

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, JTLP 4 was published in March 2020 which sets the West of England Combined Authority (WECA) regions transport vision through to 2036. A greater emphasis than previously is placed on air pollution compared to the superseded JLTP (3). The JLTP 4 document *"shows how we will aim to achieve a well-connected sustainable transport network that works for residents across the region; a network that offers greater, realistic travel choices and makes walking, cycling and public transport the natural way to travel"*

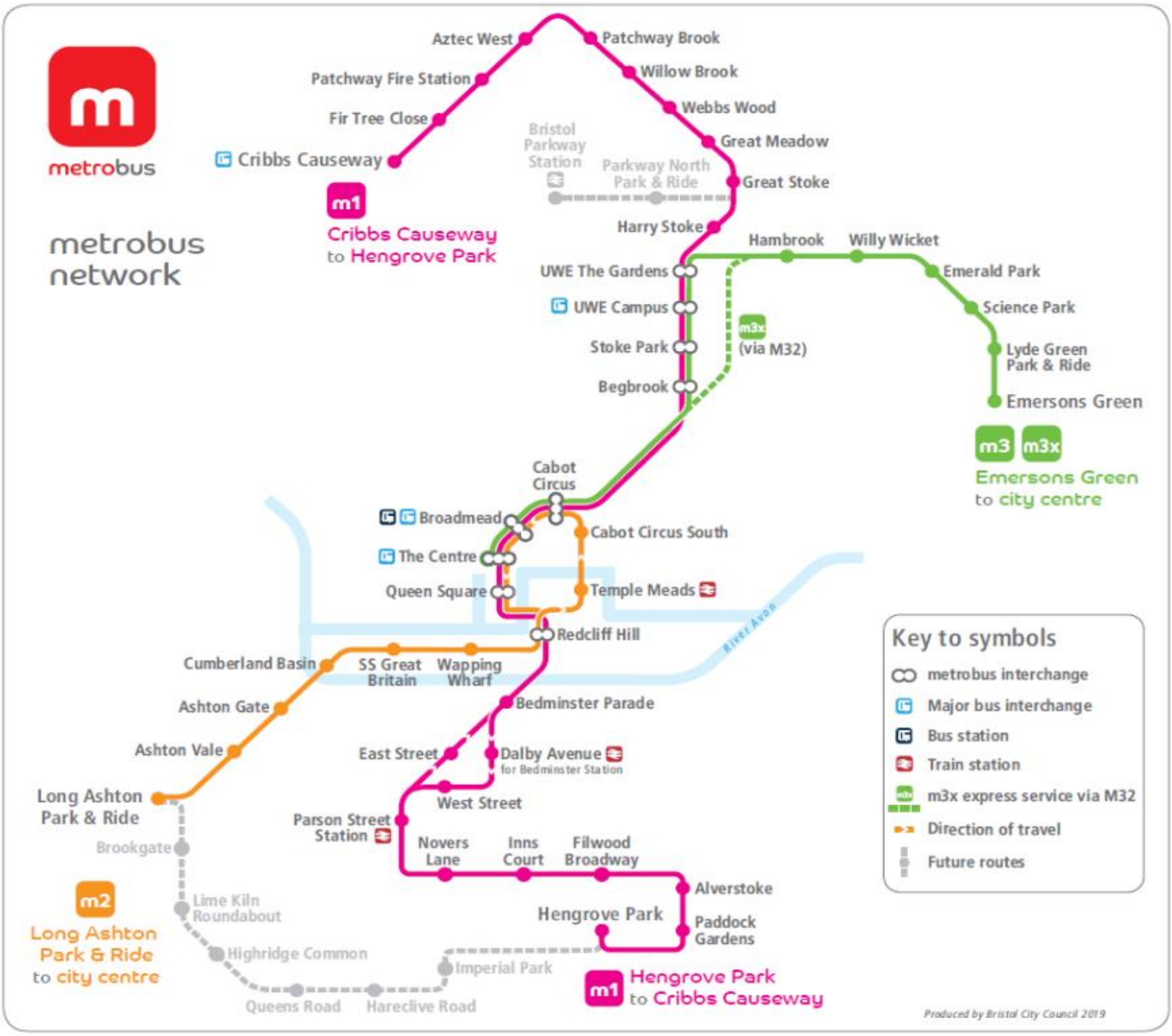
On 1st of April 2020 the Bath & North East Somerset, Bristol and South Gloucestershire councils combined resources so the delivery of some operational transport functions is now carried out directly by WECA. Working together in this way means Bristol can achieve more to address our challenges as a region, planning public transport across council boundaries.

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 Metro West to engagement in behavioural change initiatives such as work place travel planning.

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. Work is continuing throughout 2021 on the planning for Phase 1 of MetroWest – Portishead Branch Line

Figure 0-4 - 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.

Local Cycling and Walking Infrastructure Plan (LCWIP)

The Local Cycling and Walking Infrastructure Plan is a detailed plan that identifies that over £400m of investment is needed and will be sought and channelled through the West of England Combined Authority. Working with Bath & North East Somerset, Bristol, North Somerset and South Gloucestershire councils, the aim is to provide high quality infrastructure to ensure the West of England is a region where cycling and walking are the preferred choice for shorter trips. Public consultation on the plan took place in early 2020.

Solid Fuel Use Communication and Awareness Raising

In December and January 2020/21 Bristol City Council launched the “Slow the Smoke” campaign to try to highlight the health issues associated with solid fuel use and raise awareness of measures that can be used to reduce these impacts. Three animations were promoted through Facebook and Instagram. Over a period of 6 days in January the adverts reached 292,000 people with 336,000 impressions which resulted in 1000 link clicks.

Air Quality Grant Funding – Slow the Smoke Citizen Engagement

Bristol City Council were awarded £120,000 through the annual Defra Air Quality Grant fund to carry out a study into solid fuel use in Bristol. The intention of the project is to engage with a citizens through workshops and the use of low cost pollution sensors to measure particulate pollution. An equivalence standard sensor will also be installed in the study area at the same time to cross reference against the low cost sensors. Analysis of the data will look to see if patterns of particulate pollution can be linked to times when solid fuel use are likely to be at their highest. The intention of the project is to demonstrate whether monitoring data, combined with innovative citizen engagement techniques, can be an effective way to engage people with the topic of solid fuel use and particulate pollution. The project will run through 2021 to the end of 2022.

Conclusions and Priorities

Monitoring

Whist the trend of year on year reductions in annual NO_2 concentrations since 2010 has continued into 2020 it should be noted that 2020 was a very unusual year with regards to traffic flows and pollution. As a result of lockdown restrictions and wider restrictions on activities traffic flows over the year were lower than usual. It is unclear what will happen in the future as restrictions are eased. In 2020 there were two monitoring locations where distance adjusted (representing relevant exposure) annual nitrogen dioxide concentrations was greater than 40µg/m^3. In 2020 four additional sites were at risk of exceedance when considering locations where annual NO_2 concentrations were greater than 36µg/m^3 at locations of relevant exposure.

The particulate matter (PM_{10}) trends for the past 5 years are available from one urban background site, Bristol St Pauls, with data from two new roadside sites only being available for the past two to three years. At Bristol St Pauls annual PM_{10} concentrations have increased since 2016 by 1.9µg/m^3 to 17.3µg/m^3. Annual 2020 PM_{10} concentrations increased at this site when compared to 2019, rising from 16µg/m^3 to 17.3µg/m^3. Despite the fall in traffic movements over 2020, PM_{10} concentrations increased which illustrates that there are a wider range of sources of PM pollution impacting on PM_{10} pollution levels, especially at background monitoring locations. 2020 annual concentrations from the roadside Temple Way and Colston Avenue sites were 19.7µg/m^3 and 19.4µg/m^3 respectively, both of which were lower than 2019 levels. This could be explained by the fact that these locations are more heavily influenced by particulates generated by traffic movements, which were reduced significantly in 2020 due to lockdown restrictions.

$PM_{2.5}$ concentrations at Bristol St Pauls have fluctuated since 2016 with a decrease from 11.7µg/m^3 in 2016 to 9.7µg/m^3 in 2020 which meant that the WHO annual guideline value for $PM_{2.5}$ of 10µg/m^3 was met at this site in 2020. Recent monitoring shows that this is not necessarily a downward trend that will continue, so measures to reduce local emissions of $PM_{2.5}$ remain important. Annual $PM_{2.5}$ concentrations measured at the roadside site at Parsons Street School were 11.8µg/m^{3}in 2020, above the WHO guideline value but below the EU and UK annual value which is set at 25µg/m^3.

The monitoring data indicates that action is still have been needed to achieve compliance with annual NO_2 objectives in all locations in 2020, even when considering the large reduction in traffic at certain times of the year during 2020. It also demonstrates that reductions in $PM_{2.5}$ concentrations are needed in order to meet the WHO guideline concentrations for this pollutant at the Parsons Street School site. $PM_{2.5}$ concentrations at this site are likely to be indicative of $PM_{2.5}$ concentrations at roadside locations in many parts of the city.

Measured exceedance of the annual objective was identified at one location along Muller Road that was outside of the current AQMA boundary. This site was tube 567 on the Muller Road/Glenfrome Road Junction. An annual NO_2 concentration of 41.3µg/m^3 was measured, however, once adjusted for distance to the closest relevant exposure, compliance was shown to be achieved with a value of 37.3µg/m^3. Despite being outside of the AQMA, it is only marginally outside, with the AQMA boundary passing with 20m to the south of this monitoring location. Details of this exceedance is contained within

Table C.1. Monitoring in this location and others along Muller Road have continued in 2021.

Pollution Reduction Actions

The priority for Bristol City Council for the coming year is to agree with the Joint Air Quality Unit a programme of work to achieve compliance with air quality objectives in the shortest time possible. The other initiatives and plans will continue to be taken forward and developed.

The planning work has identified that a Class D Clean Air Zone that charges non-compliant private cars and commercial vehicles will bring Bristol into compliance by 2023. This will be introduced in Bristol in the summer of 2022. A substantial financial support package will be offered to individuals and business to help adapt to the changes. Full details can be found on the Clean Air Zone Support pages.

Bristol City Council will consider the conclusions within the reports commissioned on pollution from solid fuel and non-road mobile machinery to identify appropriate next steps to reduce emissions from these sources. Action has already been taken on communication and awareness raising on solid fuel emissions through the 'Slow the Smoke' communications in winter 2020/21. Engagement and awareness raising will continue on this issue through the Defra air quality grant funded 'Slow the Smoke' project.

In response to the Covid-19 pandemic Bristol City Council announced plans in May 2020 to assist people to socially distance in certain areas of the city. The aim of the changes were to

- Allow better social distancing, especially in local shopping areas
- Encourage people to travel by bike or walk
- Reduce air pollution
- Allow businesses to trade outdoors.

More details of the changes made during 2020/21 in response to the Covid crisis can be found in Appendix F: Impact of COVID-19 upon LAQM.

Other Items

Recent events in Bristol linked to the Black Lives Matter protests have resulted in the Mayor of Bristol starting a conversation to decide what to do with our memorials, statues and street names. We will await the outcome of this city conversation before deciding whether to rename any air quality monitoring sites.

Local Engagement and How to get Involved

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 it is possible, people can 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, when deciding to replace a 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 advertised CO_2 emissions, on average, diesel vehicles are generally 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.

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 are contributing significantly to NO_2 pollution. Euro 6 diesels, whilst better than Euro 5 vehicles, are still, on average, worse for NO_X emissions when compared to their petrol or petrol hybrid equivalents.

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 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.

How Can Pollution Be Reduced? - Domestic Heating

It is important to use a wood burner or open fire correctly to ensure that Smoke Control Area regulations are not breached. The whole of Bristol is a smoke control area. This means that, for domestic heating purposes, wood can only be burnt in a Defra approved stove. It is not permitted 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 a property does not already have 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.

The lowest emission stoves currently on the market are those that are ‘Eco-design 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, known as an ‘exempt appliance’.

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: Open fires and wood-burning stoves – A practical guide. 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 exempt appliance. It is not permitted to burn even seasoned wood in an open fire or an appliance not considered exempt 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)

In May 2021 the Air Quality (Domestic Solid Fuels Standards)(England) Regulations 2020 came into force. They have been introduced to reduce emissions of PM from residential burning of wood and other solid fuels. The regulations will phase out the use of bituminous coal and unseasoned wood in residential heating appliances.

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1 Local Air Quality Management

This report provides an overview of air quality in Bristol during 2021. 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 are presented in Table E.1

2 Actions to Improve Air Quality

2.1 Air Quality Management Areas

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority should prepare an Air Quality Action Plan (AQAP) within 12 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. The table presents a description of the one AQMA that is currently designated within Bristol City Council. Appendix D: Map(s) of Monitoring Locations and AQMAs provides maps of the AQMA and also the air quality monitoring locations in relation to the AQMA. The air quality objectives pertinent to the current AQMA designation are as follows:

- NO_2 annual mean;
- PM_{10} 24-hour mean.

Table 2-1 – Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	One Line Description	Is air quality in the AQMA influenced by roads controlled by Highways England?	Level of Exceedance: Declaration	Level of Exceedance: Current Year	Name and Date of AQAP Publication	Web Link to AQAP
Bristol AQMA	Declared 01/05/2001. Amended on 01/05/2003 and 01/05/2008 and 26/10/2011	NO_2 Annual Mean	An area covering the city centre and parts of the main radial roads including the M32.	YES	N/A	N/A	Joint Local Transport Plan 4 Clean Air Zone (CAZ)	JLTP 4 at Travelwest Website Clean Air for Bristol Website for CAZ Plans
Bristol AQMA	Declared 01/05/2001. Amended on 01/05/2003 and 01/05/2008 and 26/10/2011	NO_2 1 Hour Mean	An area covering the city centre and parts of the main radial roads including the M32.	YES	N/A	N/A	Joint Local Transport Plan 4 Clean Air Zone	JLTP 4 at Travelwest Website Clean Air for Bristol Website for CAZ Plans
Bristol AQMA	Declared 01/05/2001. Amended on 01/05/2003 and 01/05/2008 and 26/10/2011	PM_{10} 24 Hour Mean	An area covering the city centre and parts of the main radial roads including the M32.	YES	N/A	N/A	Joint Local Transport Plan 4 Clean Air Zone	JLTP 4 at Travelwest Website Clean Air for Bristol Website for CAZ Plans

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

☒ **Bristol City Council confirm that all current AQAPs have been submitted to Defra.**

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 2020 are not directly comparable to those in 2001 and therefore the comparison between exceedance levels at declaration in 2001 and 2020 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 (where relevant) data for all 102 nitrogen dioxide diffusion tube 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 A.1 to Figure A.4 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 report is well written, well structured, very detailed and comprehensive, and provides the information specified in the Guidance, using the latest report template. The below comments could be considered in future reports;

- Two concentrations greater than 40µg/m3 were monitored just outside of the AQMA boundary at sites 571 and 567. When distance corrected for relevant exposure, these sites fell just below the AQS objective, though for 567 this was very marginal. It is suggested that further monitoring should be undertaken within the vicinity of sites 571 and 567, and if exceedances occur then the council should consider expanding their AQMA to cover these areas.

  Continued monitoring has taken place at these locations in 2020 and will continue to take place until the data shows that compliance with objectives, in accordance with LAQMTG16, can be demonstrated.

- The AQAP table could have been improved by filling blank cells with 'N/A', 'TBC' or 'Unknown' to highlight that nothing has been missed.

This has been addressed in this report.

- Distance correction calculations were missing the following sites; 14, 21, 113, 175, 239, 242, 254, 261, 407, 419, 571. The council is reminded that calculations for all sites where distance correction is necessary should be presented.

The process of distance correction has now been automated in the Defra diffusion tube data processing tool so it will no longer be possible to show calculations.

- Mapping showing which sites were inside or outside the AQMA with a colour coded system to identify exceedances was exceptionally helpful and is highly encouraged for all future reports.

This mapping has been included in this year's report.

- The Council provides a section on hotspots after last year's suggestion. This section is well detailed, and this level of consideration shows good practice by the Council and should be continued into future reports.

This has been continued in this year's report.

- The Council provides an extensive and detailed QA/QC section, and this should be continued into future reports. It is noted that the Council updated their 2020 ASR having identified an erroneous application of bias adjustment factor, which shows a strong quality auditing process.
- Whilst it is recognised that the LAQM Helpdesk was consulted on local bias adjustment, and the report states that the method in paragraph 7.193 of LAQM.TG(16) was used, the calculation used to combine local factors should be provided within the ASR to confirm their validity.

The calculations are included in the 2021 ASR.

- The Council is reminded that the screen shots for local bias adjustment factor show the ID's of the automatic monitors and not the passive tubes. It would be helpful if the tube number was also indicated as it is unclear to the reader which tube was used for co-location e.g. 270 and 501.

This has been addressed in the report.

Bristol City Council has taken forward a number of direct measures during the current reporting year of 2020 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2-2. 18 measures are included within Table 2-2, with the type of measure and the progress Bristol City Council have made during the reporting year of 2020 presented. Where there have been, or continue to be barriers restricting the implementation of the measure, these are also presented within Table 2-2.

More detail on these measures can be found in their respective Action Plans, for example at the Clean Air for Bristol website or on the TravelWest website and within section of this report.

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

- Development and delivery of the Bristol Clean Air Zone in agreement with the Government's Joint Air Quality Unit to deliver compliance with air quality objectives in the shortest time possible.
- Make progress with the Slow the Smoke Air Quality Grant funded citizen engagement project related to solid fuel.

Bristol City Council anticipates that the measures stated above and in Table 2-2 will achieve compliance in the Bristol AQMA in the shortest possible time.

Table 2-2 – Progress on Measures to Improve Air Quality

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
1	Bristol Clean Air Zone	Promoting Low Emission Transport	Low Emission Zone	TBC	2021	BCC	Government	NO	Funded	> £10 million	Planning	Reduced vehicle emissions	Achieving Compliance within the shortest timeframe possible	For latest Developments see https://www.cleanairforbristol.org/	N/A
2	MetroBus BRT scheme	Transport Planning and Infrastructure	Bus route improvements	2018	2022	BCC/S.Glos/NE Somerset.	Government Funding/WECA	NO	Funded	> £10 million	Implementation	Encouragement of modal shift through provision of quick reliable bus services.	Improved bus Services, quicker journey times and more reliable services from both northern and southern city fringes	Implementation on-going	N/A
3	Bristol Transport Strategy	Transport Planning and Infrastructure	Other	2019	2019	BCC	LA Funded	NO	Funded	£100k - £500k	Completed	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	Development and Adoption of Bristol Transport Strategy	Adopted	N/A
4	Local Plan Review	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	Ongoing	2023	BCC	LA Funded	NO	Funded	£100k - £500k	Planning	Adoption of standalone policy for Air Quality and strengthen weight given to air pollution in Local Plan policy documents	Development and Adoption of New Local Plan Documents	Revised programme yet to be published	N/A
5	Changes to road layout and additional space created for walking and cycling in response to Covid and the need for social distancing	Promoting Travel Alternatives	Intensive active travel campaign & infrastructure	2020	2021	BCC	Govt, LA	NO	Funded	Not Known	Implementation	encouragement of walking and cycling in a Covid safe environment by providing extra space for these activities	Space for business and people to operate on move around whilst maintaining social distancing	Ongoing development and review of the measures introduced	N/A
6	Slow the Smoke	Other	Other	2021	2023	BCC, Knowle West Media Centre, University of the West of England	Government	YES	Funded	£100k - £500k	Planning	Raised awareness of emissions and impact from solid fuel use leading to behaviour change	Increased public understanding of solid fuel impacts on health and air quality. Improved understanding of BCC of impact of solid fuel use on air pollution.	Project Planning	Timeline to needed to get equivalence monitor in place by the 2021/22 heating season.
7	OLEV Bus funding	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	2017	2020	BCC, SGC, First Bus	OLEV	NO	Funded	£1 million - £10 million	Completed	110 Biogas powered buses to be introduced into the first Bus WoE fleet	Reduced emissions from bus fleet operating in the city	Complete	N/A
8	Clean Bus Fund	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	2017	2020	BC, First Bus, CTPlus	OLEV	NO	Funded	£1 million - £10 million	Completed	£2.2m funding to include 69 SCR retrofit and some electric/hybrid replacement	Reduced emissions from bus fleet operating in the city	Complete	N/A
9	Freight Consolidation	Freight and Delivery Management	Freight Consolidation Centre (FCC)	2020	2021	BCC, Zedify	OLEV	NO	Funded	£50k - £100k	Implementation	Reduction in GHV and LDV mileage in city centre and replaced with zero emission last mile	95% of deliveries in the city centre by EVs or bikes by 2030	Ongoing development and expansion of the FCC	N/A

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
10	Cycle City Ambition Grant	Promoting Travel Alternatives	Cycling improvements and engagement.	2015	2020	BCC	BCC, Govt.	NO	Funded	> £10 million	Completed	Increase in active travel in the city	improving existing routes and revitalising streets, addressing barriers to cycling and walking such as busy roads, and overcoming the impact of cities topography	Complete	N/A
11	Installation of 120 new charge point connections. 4 Rapid charging hubs. EV car clubs, business grants and demonstration vehicles.	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	2017	2022	WoE Authorities	OLEV	NO	Funded	£1 million - £10 million	Implementation	Reduced emissions from vehicles on the road by facilitating uptake of EVs	Number of public/private charge points (not units)	Ongoing	N/A
12	Awareness raising campaign related to emissions from solid fuel	Public Information	Via the Internet	2020	2021	BCC	BCC	NO	Funded	£10k - 50k	Completed	Reduced emissions from solid fuel if information influences behaviour resulting in less or 'better' burning practices	Raising awareness of health impacts of solid fuel use and best practice	Complete but possible this may be repeated in 2021/22 heating season	N/A
13	Better Bus Area Fund 2	Transport Planning and Infrastructure	Bus Route Improvements	2017	2021	WoE Authorities	Government	NO	Funded	£500k - £1 million	Completed	Improved bus services and increased passenger numbers. Providing viable alternatives to car use	Improved services, through reduced journey time and increased reliability on 8 important corridors.	Complete	N/A
14	Prioritising purchase of EV vehicles in public sector fleets	Promoting Low Emission Transport	Public Vehicle Procurement - Prioritising uptake of low emission vehicles	2017	Ongoing	WoE Authorities	Govt, LA	NO	Funded	Not Know	Implementation	Reduced emissions from LA vehicle fleet	100 ULEV vehicles across WoE council fleet - representing 20-25% transfer. Expected that Bristol will procure around 45 EVs (10%) of the fleet.	Ongoing	N/A
15	Car Clubs	Alternatives to Private Car Use	Car Clubs	Not Known	Ongoing	WoE Authorities	Private and LA, EU H2020 - Replicate	NO	Funded	Not Known	Implementation	Reduced car ownership	120 car club cars currently in use in Bristol. BCC EU H2020 Replicate project. 11 EVs being trialled in Replicate project and 24 on street charge points installed	Ongoing	N/A
16	Portbury, Avonmouth and Severnside (PAS)	Promoting Travel Alternatives	Intensive active travel campaign & infrastructure	2020	Ongoing	BCC, SCG,NSC	LA Funded	NO	Funded	Not Known	Planning	Increased active travel	Improve connectivity, promote growth and provide sustainable travel alternatives	Ongoing	N/A
17	School Streets Project	Promoting Travel Alternatives	Other	2020	Ongoing	BCC	LA Funded	NO	Not Known	Not Known	Implementation	Lower pollution outside schools and increased active travel	Closing streets to motor vehicles outside schools at the start and end of the school day	Ongoing	N/A
18	No Idling	Public Information	Other	2020	Ongoing	BCC	LA Funded	NO	Funded	Not Known	Implementation	Reduced emissions and greater	Asking drivers to switch off	Ongoing	N/A

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
												awareness of air pollution	especially at hotspots like hospitals and schools		

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.

Bristol City Council have identified that the recent focus on NO_2 compliance at both a national and local level through the LAQM process has resulted in there being a lack of in-depth knowledge on the scale and sources of primary $PM_{2.5}$ emissions. The clear evidence on health impacts and requirement to work towards reducing $PM_{2.5}$ emissions and/or concentrations led Bristol City Council to commission studies to develop a more in depth understanding of local emissions of this pollutant. Whilst many actions targeted at reducing emissions of NO_2 will also reduce $PM_{2.5}$ emissions, other potentially significant sources of local primary $PM_{2.5}$ have been identified.

In 2020 two studies were carried out by Air Quality Consultants Ltd for BCC. These attempted to quantify pollutant emissions from solid fuel and construction non-road mobile machinery (NRMM) and identify policy measures to reduce emissions from these sources.

The lowest estimate from the study into solid fuel showed that solid fuel burning accounted for a third of all PM_{10} emissions and half of $PM_{2.5}$ emissions in Bristol. The report provided a number of recommendations that could reduce emissions from this source. In 2020/21 Bristol City Council launched a 'Slow the Smoke' communications campaign aimed at raising awareness of the health impacts of solid fuel and options for people to reduce emissions. Additionally, a Defra air quality grant funded project started in 2021 which will use low-cost sensors and innovate citizen engagement to better understand the impact of solid fuel use on air pollution.

Estimates of NRMM emissions using national data showed that this source accounts for approximately 3% of total PM_{10}, 5% of $PM_{2.5}$ and 6% of NOx emissions in Bristol. Whilst not representing a large proportion of total emissions it should be recognised that close to large scale construction sites, NRMM will be a more significant source locally than the Bristol-wide calculations suggest. The estimates are based on national data as local data is limited on this source.

The recommendations from these reports will be considered further by BCC in 2021 to identify opportunities to reduce emissions.

Bristol City Council is taking these additional measures to address $PM_{2.5}$:

- Development of a Clean Air Compliance plan to tackle nitrogen dioxide pollution and to achieve compliance with annual objectives for NO_2 in the shortest time possible. Whilst the plan is focussed on compliance with nitrogen dioxide objectives, it will have benefits for particulate pollution
- The development of policy and infrastructure to support public and active travel will contribute to reducing particulate pollution
- The projects, as outlined in Table 2-2, that provide investment in cleaner buses and electric vehicles will reduce particulate emissions from transport

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

This section sets out the monitoring undertaken within Bristol by Bristol City Council and how it compares with the relevant air quality objectives. In addition, monitoring results are presented for a five-year period between 2016 and 2020 to allow monitoring trends to be identified and discussed.

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

Bristol City Council undertook automatic (continuous) monitoring at 7 sites during 2020. Table A.1 in Appendix A shows the details of the automatic monitoring sites. The Bristol Open Data Platform page presents automatic monitoring results for Bristol City Council with automatic monitoring results also available through the UK-Air website.

Maps showing the location of the 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 (i.e. passive) monitoring of NO_2 at 102 sites during 2020. Table A.2 in Appendix A presents the details of the non-automatic sites.

Maps showing the location of the monitoring sites are provided in Appendix D: Map(s) of Monitoring Locations and AQMAs. Further details on Quality Assurance/Quality Control (QA/QC) for the diffusion tubes, including bias adjustments and any other adjustments applied (e.g. annualisation 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, annualisation (where the annual mean data capture is below 75% and greater than 25%), and distance correction. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen Dioxide (NO_2)

Table A.3 and Table A.4 in Appendix A compare the ratified and adjusted monitored NO_2 annual mean concentrations for the past five years with the air quality objective of 40µg/m^3. Note that the concentration data presented represents the concentration at the location of the monitoring site, following the application of bias adjustment and annualisation, as required (i.e. the values are exclusive of any consideration to fall-off with distance adjustment).

For diffusion tubes, the full 2020 dataset of monthly mean values is provided in Appendix B. Note that the concentration data presented in Table B.1 includes distance corrected values, only where relevant.

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

Data capture rates at 6 out of the 7 automatic NO_2 monitoring sites were above the required 90% rate, with the lowest capture rate of 79% being recorded at the Fishponds Road site. This lower data collection rate is due to an ongoing analyser fault with a new analyser that it has proven difficult to rectify. The problem started in early 2019 and continued to cause significant data losses in 2020.

The continuous monitoring data in 2020 shows a reduction in measured annual NO_2 concentrations when compared to 2019 data at all sites. This was to be expected given the impact that Covid related restrictions had on travel behaviour throughout 2020. The Colston Avenue roadside site saw the largest decrease of -20.3µg/m^3 when comparing 2020 with 2019 concentrations. The second biggest fall was observed at Fishponds Road with a decrease of -17.3µg/m^3 in 2020 when compared to 2019. Despite the 20.3µg/m^3 fall in annual NO_2 concentrations at Colston Avenue in 2020 it continued to record exceedances of the annual objective for NO_2. Annual NO_2 concentrations in 2020 were 45.2µg/m^3.

Colston Avenue was the only site at which an hourly value greater than the 200 µg/m^3 hourly objective was measured in 2020, with 6 hours recorded. This compares to 8 hours in 2019.

Consideration of trends in NO_2 concentrations at a selection of kerb/roadside sites on the busiest road corridors throughout Bristol, since 2010, show that a 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 but with a consistent reduction in concentrations of NO_2 over this period. Some sites have seen larger reductions than others over this period. Trends in various parts of the city from 2010 to 2020 are shown in Figure A.1 to Figure A.4.

Figure 3-1 and Figure 3-2 show nitrogen dioxide diffusion tube monitoring locations in Bristol. Those sites shown in red or purple indicate locations where exceedence of the annual objective was measured in 2020. The data has been annualised but not distance adjusted in these maps.

All our air pollution monitoring data is available on our open data portal through an 'Air Quality Dashboard'.

Figure 3-1 - Nitrogen Dioxide Monitoring Results 2020 – Central Area

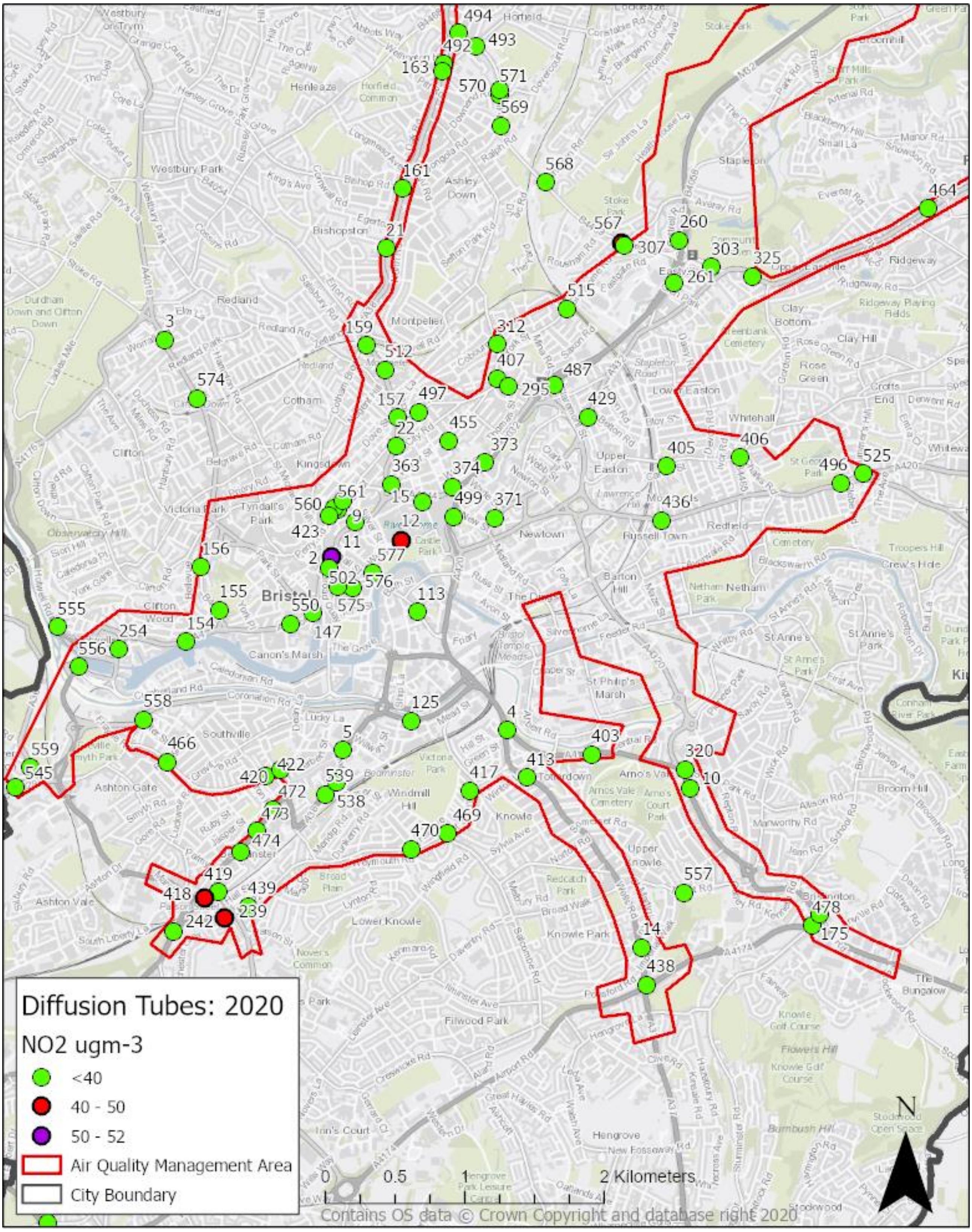
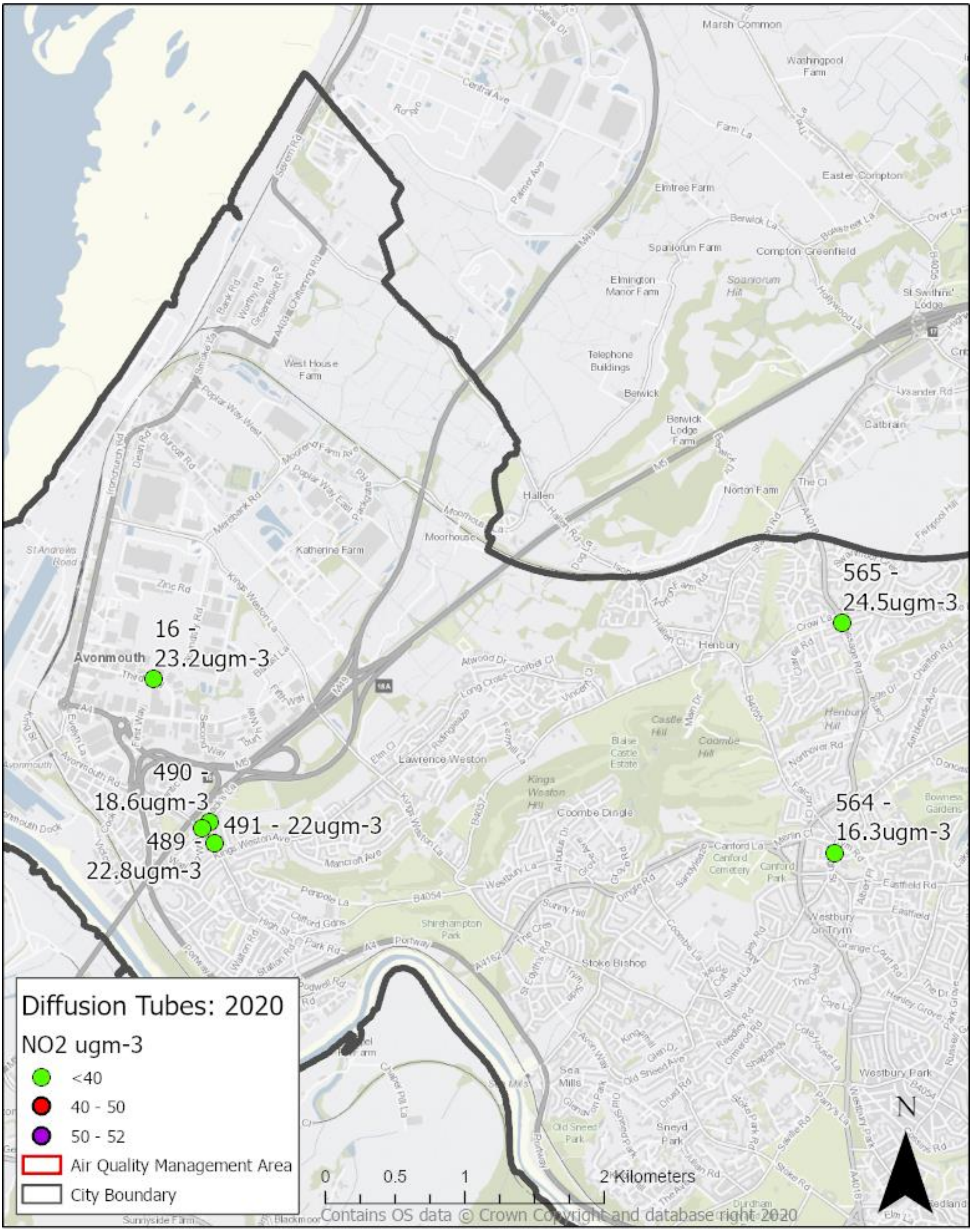


Figure 3-2 - Nitrogen Dioxide Monitoring Results 2020 – Avonmouth



3.2.2 Particulate Matter (PM_{10})

Table A.6 in Appendix A: Monitoring Resultscompares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past five years with the air quality objective of 40µg/m^3.

Table A.7 in Appendix A compares the ratified continuous monitored PM_{10} daily mean concentrations for the past five years with the air quality objective of 50µg/m^3, not to be exceeded more than 35 times per year.

PM_{10} was monitored at three locations in 2020, one urban background site and two roadside sites. There are no exceedances of the annual mean or hourly mean objectives at any of the monitoring sites. Data for 2020 at the St Pauls urban background site shows a 1.3µg/m^3 increase in annual concentrations to 17.3µg/m^3 in 2020 compared to 2019 and this is the third year in a row which has seen an increase. In 2020 there were two 24-hr periods averaging above above 50µg/m^3 compared to none in both 2018 and 2019.

Data for 2019 from the Temple Way and Colston Avenue sites did not show any exceedence of objectives and recorded annual PM_{10} concentrations of 19.7µg/m^3 and 19.4µg/m^3 respectively. As would be expected, measured PM_{10} concentrations are higher at these roadside sites than the AURN urban background site. The data from Temple Way shows a reduction of 1.2µg/m^3 in 2020 when compared to 2019. There were 4 days of the year when the 24 hour average was above the 50 µg/m^3 in 2020 compared to 10 in 2019. The data from Colston Avenue shows a reduction of 2.4µg/m^3 in 2020 when compared to 2019. At all sites the number of days exceeding the 24 hour average of 50µg/m^3 were below the 35 days per year which are allowed to exceed this average value before breach of the air quality objective occurs.

Although no exceedances 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.8 in Appendix A presents the ratified and adjusted monitored $PM_{2.5}$ annual mean concentrations for the past five years.

$PM_{2.5}$ is measured at the Bristol St Pauls AURN and BCC operated Parsons Street School sites. 2020 is the first year for which $PM_{2.5}$ data is available at Parsons Street. The annual average for this pollutant in 2020 was 9.7µg/m^3 at St Pauls and 11.8µg/m^3 at Parsons Street School. For the St Pauls site this is a decrease of 1.1µg/m^3 when compared to the

2019 annual average of 10.8µg/m^3. Both are below the UK annual objective of 25µg/m^3. The Parsons Street School site is above the World Health Organisations (WHO) air quality guideline value of 10µg/m^3.

At Bristol St Pauls, annual $PM_{2.5}$ concentrations have fluctuated between 9.7 µg/m^3 and 12.0µg/m^3 since 2016. Rather than displaying a clear trend of rising or falling it has fluctuated up and down within this range over the most recent 5 year period.

Appendix A: Monitoring Results

Table A.1 – Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
203	Brislington Depot	Urban background	361178	171566	NOX NO2 NO	FALSE	Chemiluminescent	NA	18	3.5
215	Parson Street School	Roadside	358042	170582	NOX NO2 NO PM2.5	TRUE	Chemiluminescent / BAM	0	4	1.5
270	Wells Road	Roadside	360903	170024	NOX NO2 NO	TRUE	Chemiluminescent	9	1	1.5
452	AURN St Pauls	Urban background	359488	173924	NOX NO2 NO PM2.5 PM10 O3	TRUE	Chemiluminescent / BAM	NA	NA	4
463	Fishponds Road	Roadside	362926	175590	NOX NO2 NO	TRUE	Chemiluminescent	0	3	1.5
500	Temple Way	Roadside	359522	173381	NOX NO2 NO PM10	TRUE	Chemiluminescent / BAM	0	5	1.5
501	Colston Avenue	Roadside	358640	173090	NOX NO2 NO PM10	TRUE	Chemiluminescent / BAM	3	2	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

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
2	Colston Avenue	Roadside	358628	173011	NO2	Yes	0.0	0.0	No	2.8
3	Blackboy Hill	Roadside	357448	174650	NO2	No	0.0	3.0	No	2.8
4	Three Lamps	Roadside	359903	171850	NO2	Yes	0.0	0.0	No	3.2
5	Bedminster Parade	Roadside	358723	171704	NO2	Yes	0.0	1.0	No	3.2
9	B.R.I.	Roadside	358729	173499	NO2	Yes	0.0	1.0	No	2.4
10	Bath Road	Roadside	361217	171429	NO2	Yes	5.0	4.0	No	3.2
11	Whitefriars	Roadside	358813	173342	NO2	Yes	0.0	0.0	No	3.2
12	Galleries	Roadside	359142	173211	NO2	Yes	0.0	0.0	No	2.4
14	Red Lion Knowle	Roadside	360871	170291	NO2	Yes	6.0	2.0	No	3.2
15	Horsefair	Roadside	359294	173485	NO2	Yes	0.0	0.0	No	2.2
16	Third Way	Roadside	352287	178698	NO2	No	0.0	0.0	No	2.7
21	Gloucester Road	Roadside	359035	175306	NO2	Yes	3.0	2.0	No	2.8
22	Stokes Croft	Roadside	359109	173886	NO2	Yes	0.0	2.0	No	2.5
113	Victoria Street	Roadside	359258	172696	NO2	Yes	2.0	3.0	No	2.8
125	York Road	Roadside	359214	171917	NO2	Yes	3.0	2.0	No	1.8
147	Anchor Road	Roadside	358514	172691	NO2	Yes	0.0	0.0	No	2.2
154	Hotwells Road	Roadside	357601	172483	NO2	Yes	0.0	0.0	No	2.4
155	Jacobs Wells Road South	Roadside	357838	172713	NO2	Yes	0.0	0.0	No	3.2
156	Jacobs Wells road opp Clifton hill	Roadside	357709	173018	NO2	Yes	0.0	2.0	No	2.5
157	Stokes Croft Ashley Road	Roadside	359119	174090	NO2	Yes	0.0	2.0	No	2.4
159	Cromwell Road	Roadside	358891	174608	NO2	Yes	4.0	2.0	No	2.5
161	Bishop Road	Roadside	359152	175733	NO2	Yes	4.0	2.0	No	2.2
163	Strathmore Road	Roadside	359435	176574	NO2	Yes	7.0	3.0	No	3.6
175	top of Brislington Hill	Roadside	362147	170525	NO2	Yes	13.0	2.0	No	3.2
239	Parson St. A38 East	Roadside	357880	170506	NO2	Yes	8.3	0.7	No	3.2

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
242	Parson Street Bedminster Down Road	Roadside	357510	170401	NO2	Yes	5.0	0.5	No	3.2
254	Merchants Road Hotwells	Roadside	357118	172429	NO2	Yes	3.7	0.8	No	2.6
260	Stapleton Road South	Roadside	361140	175366	NO2	Yes	1.5	3.5	No	2.4
261	Stapleton Road Heath Street	Roadside	361103	175059	NO2	Yes	5.0	3.0	No	2.1
295	Lamppost 16 Ashley Road St. Pauls	Roadside	359913	174315	NO2	Yes	0.0	2.0	No	2.8
300	Facade Haart Estate Agents 755 Fishponds Road Fishponds	Roadside	363365	175883	NO2	Yes	2.0	1.0	No	2.4
303	Facade 784 Muller Road Fishponds	Roadside	361368	175170	NO2	Yes	0.0	6.0	No	2.2
307	Lamppost Glenfrome Road \ Muller Road Horfield	Roadside	360747	175328	NO2	Yes	3.0	2.0	No	2.2
312	Lamppost Ashley Hill St. Pauls	Roadside	359832	174616	NO2	Yes	4.0	2.0	No	2.7
320	Monitor Bath Road Brislington	Roadside	361180	171567	NO2	Yes	0.0	0.0	Yes	6
325	Facade 258 Fishponds Road Fishponds	Roadside	361667	175103	NO2	Yes	0.0	8.0	No	2.4
363	5102 faÃ§ade	Roadside	359075	173613	NO2	Yes	0.0	3.0	No	2.7
371	Lamb Street faÃ§ade	Roadside	359813	173373	NO2	Yes	14.0	1.0	No	2.6
373	123 Newfoundland Street faÃ§ade	Roadside	359747	173774	NO2	Yes	0.0	17.0	No	2.1
374	St. Paul Street	Roadside	359509	173595	NO2	Yes	0.0	8.0	No	2.3

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
403	Lamp post 48 230 Bath Road	Roadside	360508	171676	NO2	Yes	0.0	2.0	No	2.8
405	Whitehall Rd/Easton Rd lamppost 4TZ	Roadside	361051	173743	NO2	Yes	1.0	1.0	No	2.5
406	Whitehall Rd lamppost 17 nr juction with Chalks Rd	Roadside	361576	173806	NO2	Yes	0.0	2.0	No	2.3
407	lamppost sussex place	Roadside	359829	174370	NO2	Yes	6.7	1.8	No	3.2
413	Wells Rd bus lane sign just below junction with Knowle Rd	Roadside	360043	171508	NO2	Yes	4.0	3.0	No	3.2
417	St John's Lane No 26 lamppost 15 (just past roundabout)	Roadside	359635	171413	NO2	Yes	0.0	1.0	No	3.2
418	Bedminster Down Rd lamppost between Ashton Motors & Plough PH	Roadside	357737	170642	NO2	Yes	0.0	2.0	No	2.8
419	Parson St lamppost outside Bristol Scuba	Roadside	357832	170686	NO2	Yes	4.0	0.5	No	2.8
420	North St/Dean Lane on roundabout sign	Roadside	358277	171562	NO2	Yes	1.0	1.0	No	2.8
422	North St/Langton Park T junction	Roadside	358168	171525	NO2	Yes	0.0	1.0	No	2.4
423	facade BRI children's	Roadside	358623	173386	NO2	Yes	0.0	13.0	No	2

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
429	facade villiers road stapleton road junction	Roadside	360484	174097	NO2	Yes	0.0	6.0	No	2.6
436	Shiners Garage	Roadside	361013	173352	NO2	Yes	0.0	3.0	No	2.5
438	A37 Junction w/ Airport Road	Kerbside	360903	170024	NO2	Yes	9.0	1.0	Yes	2.4
439	Parson Street School	Roadside	358042	170582	NO2	Yes	0.0	4.0	Yes	1.5
455	St. Pauls Day Nursery	Urban background	359487	173924	NO2	Yes	0.0	0.0	Yes	2.8
464	Fishponds Road	Roadside	362927	175592	NO2	Yes	0.0	3.0	Yes	3
466	Savanna coffee drainpipe	Roadside	357466	171622	NO2	Yes	0.0	2.0	No	2.4
469	Lamppost corner park avenue	Roadside	359479	171114	NO2	Yes	3.0	1.0	No	2.8
470	Victoria Park Primary	Roadside	359213	170997	NO2	Yes	10.0	3.0	No	3.2
472	Jamiesons Autos	Roadside	358226	171284	NO2	Yes	0.0	4.0	No	2.4
473	B&G Snax West St	Roadside	358105	171124	NO2	Yes	0.0	2.0	No	2.8
474	Martial Arts West Street	Roadside	357991	170979	NO2	Yes	0.0	2.0	No	2.4
478	T shirt Shop W. Town Lane	Roadside	362091	170447	NO2	Yes	0.0	5.0	No	2.8
487	Junction 3 Millpond Street	Kerbside	360243	174327	NO2	Yes	4.0	5.0	No	2
489	Avonmouth Road Outside No 12	Roadside	352634	177629	NO2	No	3.0	5.0	No	2
490	Avon School Barrack's Lane	Roadside	352683	177670	NO2	No	0.0	0.0	No	2.8
491	Avonmouth Road Outside No 76	Roadside	352722	177525	NO2	No	2.0	4.0	No	2.6
492	On 1 way sign at bottom of Wellington Hill	Roadside	359445	176627	NO2	Yes	10.0	3.0	No	2.8

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
493	No 67 Filton Avenue on wall facing Muller Rd	Roadside	359677	176758	NO2	No	0.0	2.0	No	2.3
494	Muller Road - Adjacent to Darnley Avenue	Roadside	359558	176850	NO2	No	5.5	0.5	No	2.1
496	385 Church Road Redfield	Roadside	362296	173620	NO2	Yes	0.0	3.0	No	2.3
497	20 Ashley Road	Roadside	359268	174132	NO2	Yes	4.0	1.0	No	2.3
499	Temple Way Nox site	Roadside	359522	173381	NO2	Yes	0.0	5.0	Yes	1.5
502	Co-located Colston Ave	Roadside	358640	173090	NO2	Yes	3.0	2.0	Yes	1.5
512	Colston girls	Roadside	359026	174432	NO2	Yes	2.0	3.0	No	2
515	St. Werburghs park nursery	Roadside	360333	174871	NO2	Yes	2.0	3.0	No	2
525	Summer hill a420	Roadside	362455	173687	NO2	Yes	0.0	1.0	No	2
538	Dalby avenue	Roadside	358681	171478	NO2	Yes	0.0	0.0	No	2
539	Dalby avenue church lane	Roadside	358599	171391	NO2	Yes	2.0	2.0	No	2
545	Ashton park school	Roadside	356379	171436	NO2	Yes	0.0	0.0	No	2
550	Cathedral School	Roadside	358353	172613	NO2	Yes	0.0	9.0	No	2
555	420 Hotwell Road A4	Roadside	356679	172589	NO2	Yes	2.0	3.0	No	2
556	South Eastern stair access Plimsoll Bridge	Kerbside	356827	172303	NO2	Yes	0.0	0.0	No	2
557	Talbot Road 20mph lamppost	Roadside	361171	170685	NO2	No	7.0	1.0	No	2
558	Coronation Road Walter Street No Entry	Roadside	357294	171926	NO2	Yes	1.0	2.0	No	2

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
559	Except local buses sign Blackmoors Lane	Roadside	356485	171580	NO2	Yes	8.0	2.0	No	2
560	Lamppost outside BRI CAZ	Roadside	358665	173439	NO2	Yes	2.0	2.5	No	2
561	Lamppost opposite BRI CAZ	Roadside	358688	173431	NO2	Yes	3.0	5.0	No	2
562	Lamp post near Queens Head pub South Bristol link	Roadside	356960	168194	NO2	No	9.0	1.0	No	2
563	Lamp post at junction with Highridge rd. near Cox brothers garage. South Bristol link.	Roadside	356606	168316	NO2	No	4.0	2.0	No	2
564	Westbury on Trym High Street Lamp post by Athena restaurant	Roadside	357173	177453	NO2	No	1.0	1.0	No	2
565	A4018 Lamp post by layby before roundabout for Crow Ln/ Knole Ln	Roadside	357227	179101	NO2	No	0.0	1.0	No	2
567	Muller road/ Glenfrome road junction north	Roadside	360728	175345	NO2	No	1.5	1.5	No	2
568	Traffic light on the corner of Shaldon road	Roadside	360178	175779	NO2	No	3.5	0.5	No	2
569	Lampost on North corner of Draycott road junction with Muller road.	Roadside	359855	176186	NO2	No	2.0	2.5	No	2

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
570	Muller road junction with Downend road lampost north of the junction.	Roadside	359847	176439	NO2	No	2.6	0.4	No	2
571	Muller road junction with Downend road traffic light to the south of the junction.	Roadside	359848	176411	NO2	No	5.5	1.0	No	2
574	Whiteladies road, on loading sign next to Redland library	Roadside	357678	174229	NO2	No	0.0	3.0	No	2
575	Baldwin Street traffic light outside domino's	Roadside	358685	172881	NO2	Yes	0.0	0.0	No	2
576	Baldwin Street lamp post by cycle way, opp St Stephens St	Roadside	358792	172874	NO2	Yes	0.0	0.0	No	2
577	High St lamp post outside Wards solicitors	Roadside	358935	172981	NO2	Yes	0.0	0.0	No	2

Notes:

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

(2) N/A if not applicable.

Table A.3 – Annual Mean NO_2 Monitoring Results: Automatic Monitoring (µg/m³)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2020 (%) (2)	2016	2017	2018	2019	2020
203	361178	171566	Urban background	94	94	28	29.5	25.4	25.2	18.8
215	358042	170582	Roadside	98.6	98.6	**46.2**	**41.1**	39	32.3	28.6
270	360903	170024	Roadside	94.9	94.9	**41.5**	39	33	29.7	27.9
452	359488	173924	Urban background	95.9	95.9	27.4	23.7	23.8	23.4	15.2
463	362926	175590	Roadside	79	79	**42.7**	39.1	**41.5**	39.5	22.2
500	359522	173381	Roadside	99.7	99.7		37.8	**44.3**	39.2	28.3
501	358640	173090	Roadside	95.3	95.3			**67.2**	**65.5**	**45.2**

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16.**

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

Notes:

The annual mean concentrations are presented as µg/m³.

Exceedances of the NO_2 annual mean objective of 40µg/m³ are shown in **bold**.

All means have been "annualised" as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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

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

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

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

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2020 (%) (2)	2016	2017	2018	2019	2020
2	358628	173011	Roadside	92.3	92.3	**66.1**	**63.1**	**58.2**	**53.7**	36.9
3	357448	174650	Roadside	100.0	100.0	37.6	34.4	34.4	27.7	28.7
4	359903	171850	Roadside	100.0	100.0	**55.2**	**52.7**	**53.5**	**41**	36.8
5	358723	171704	Roadside	92.3	92.3	**51.3**	**45.8**	**45.8**	39.9	31.6
9	358729	173499	Roadside	100.0	100.0	**48.8**	**46.5**	**44.6**	37.8	31.7
10	361217	171429	Roadside	100.0	100.0	**54.5**	**51.6**	**51.5**	**42.2**	33.6
11	358813	173342	Roadside	100.0	100.0	**51.7**	**49.1**	**48.1**	**41.1**	31.1
12	359142	173211	Roadside	92.3	92.3	**52.8**	**56.6**	**57.5**	**51.8**	**41.9**
14	360871	170291	Roadside	100.0	100.0	**42.3**	**41.1**	**47.6**	38.7	32.4
15	359294	173485	Roadside	100.0	100.0	**51.2**	**49.4**	**47.5**	**42.2**	28.2
16	352287	178698	Roadside	92.3	92.3	35.7	35.2	32.6	28.6	23.2
21	359035	175306	Roadside	92.3	92.3	**50.2**	**49.3**	**46.4**	38.3	33.4
22	359109	173886	Roadside	100.0	100.0	**54.4**	**52.5**	**51**	**44.3**	34.3
113	359258	172696	Roadside	100.0	100.0	**45.5**	**49.9**	**40.5**	37.4	29.9
125	359214	171917	Roadside	100.0	100.0	**52.9**	**56**	**50.3**	**45.2**	35.6
147	358514	172691	Roadside	100.0	100.0	**56.9**	**61.5**	**56.6**	**50.9**	39.4
154	357601	172483	Roadside	100.0	100.0	39.6	38.5	36.1	30	22.1
155	357838	172713	Roadside	90.4	90.4	**43.1**	37.9	**40**	31.1	22.9
156	357709	173018	Roadside	92.3	92.3	**41.2**	39.3	36.2	30.5	20.7
157	359119	174090	Roadside	90.4	90.4	**52.8**	**48.5**	**45.4**	**43.1**	35.7
159	358891	174608	Roadside	100.0	100.0	**44.8**	**42**	**43.2**	35.8	28.5
161	359152	175733	Roadside	100.0	100.0	**41.6**	38.8	38	31.7	25.3
163	359435	176574	Roadside	100.0	100.0	39.6	38	36.6	30.8	24.5
175	362147	170525	Roadside	82.7	82.7	**56.5**	**54**	**54.9**	**44.6**	36.4
239	357880	170506	Roadside	100.0	100.0	**68.9**	**66.8**	**65.2**	**54.4**	**47.6**
242	357510	170401	Roadside	92.3	92.3	**68.4**	**56**	**51.1**	**41**	32.2
254	357118	172429	Roadside	100.0	100.0	**51.8**	**52.2**	**49.4**	**40.5**	31.1
260	361140	175366	Roadside	100.0	100.0	**45.4**	**42.6**	**43.1**	36.2	29.5
261	361103	175059	Roadside	100.0	100.0	**53.1**	**52.4**	**51**	**41.5**	34.7
295	359913	174315	Roadside	67.3	67.3	**55.7**	**65.1**	**59.6**	**48.1**	37.2
300	363365	175883	Roadside	100.0	100.0	**48.1**	**45.9**	**41.1**	35.1	28.9
303	361368	175170	Roadside	100.0	100.0	**46.2**	**44**	**43.8**	36.5	29.2
307	360747	175328	Roadside	100.0	100.0	37.4	32.6	37.3	30.7	24.6
312	359832	174616	Roadside	100.0	100.0	**41.6**	38.5	38.5	32.8	26.2
320	361180	171567	Roadside	100.0	100.0	31	30.7	27.9	23.4	19.3

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2020 (%) (2)	2016	2017	2018	2019	2020
325	361667	175103	Roadside	100.0	100.0	**50.5**	**49.2**	**48.1**	39.4	34.1
363	359075	173613	Roadside	100.0	100.0	39.6	38.5	37.2	34	23.5
371	359813	173373	Roadside	92.3	92.3	**42.7**	**44.7**	**42.2**	34.1	25.8
373	359747	173774	Roadside	92.3	92.3	39.5	38.5	35.7	31.2	23.9
374	359509	173595	Roadside	92.3	92.3	**47.2**	**45.2**	**47.8**	39.9	29.9
403	360508	171676	Roadside	100.0	100.0	37.5	35.7	35.5	28.1	23.4
405	361051	173743	Roadside	100.0	100.0	**42.6**	**50.4**	**56.2**	**48.5**	38.7
406	361576	173806	Roadside	100.0	100.0	36.2	38.9	38.5	31	26.6
407	359829	174370	Roadside	100.0	100.0	**48.7**	**44.5**	**46.7**	37.3	26.7
413	360043	171508	Roadside	100.0	100.0	**40**	38.7	37.6	31.2	25.5
417	359635	171413	Roadside	100.0	100.0	**43.4**	35.2	36	31	26.3
418	357737	170642	Roadside	100.0	100.0	**69.3**	**58.4**	**55.7**	**51.1**	**40.2**
419	357832	170686	Roadside	100.0	100.0	**55.8**	**51.3**	**45**	39	31.4
420	358277	171562	Roadside	73.1	73.1	38.6	33.3	37.1	30.4	23.2
422	358168	171525	Roadside	92.3	92.3	39.4	36.5	34.1	27.4	23.4
423	358623	173386	Roadside	100.0	100.0	**43.5**	**45**	**42.2**	35.2	27.3
429	360484	174097	Roadside	71.2	71.2	**52.1**	**47.8**	**46.8**	**41.2**	38.8
436	361013	173352	Roadside	100.0	100.0	**47.6**	**45.8**	**50.6**	**42**	29.2
438	360903	170024	Kerbside	100.0	100.0	**43.4**	**43.2**	36.6	31.8	27.1
439	358042	170582	Roadside	92.3	92.3	**43.5**	37.7	37.7	31.7	25.4
455	359487	173924	Urban background	100.0	100.0	27.9	26	24.4	20.9	15.9
464	362927	175592	Roadside	100.0	100.0	36.9	36.8	34.4	29.7	24.2
466	357466	171622	Roadside	100.0	100.0	35.8	33.4	33.2	27.4	20.8
469	359479	171114	Roadside	100.0	100.0	39.2	34.6	36.2	27.4	23.4
470	359213	170997	Roadside	90.4	90.4	39.4	35.9	37.9	29.4	25.1
472	358226	171284	Roadside	100.0	100.0	**45.2**	**41.6**	37.3	33.7	26.2
473	358105	171124	Roadside	90.4	90.4	**57**	**40.1**	**44**	**42.4**	40.0
474	357991	170979	Roadside	100.0	100.0	38.7	35.8	31.9	29.1	22.9
478	362091	170447	Roadside	100.0	100.0	36.7	35.4	36.5	28.8	23.5
487	360243	174327	Kerbside	90.4	90.4	**45.7**	**44.5**	**41.9**	35.1	27.7
489	352634	177629	Roadside	100.0	100.0	38.6	37.7	35.5	28.6	22.8
490	352683	177670	Roadside	100.0	100.0	32.4	31	26.8	22.4	18.6
491	352722	177525	Roadside	100.0	100.0	36.5	34.4	33.5	27.3	22.0
492	359445	176627	Roadside	100.0	100.0	**40.3**	36.8	34.8	31.3	25.2
493	359677	176758	Roadside	100.0	100.0	**41.5**	**41.9**	**41.8**	37	29.5
494	359558	176850	Roadside	82.7	82.7	**43.3**	39.5	38.7	32	25.1
496	362296	173620	Roadside	100.0	100.0	**41.1**	**41.1**	39.2	33	25.0

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2020 (%) (2)	2016	2017	2018	2019	2020
497	359268	174132	Roadside	92.3	92.3	**43.1**	**42.4**	38	29.1	24.6
499	359522	173381	Roadside	100.0	100.0		38.5	**43.2**	33.6	26.0
502	358640	173090	Roadside	100.0	100.0				**<u>68.7</u>**	**52.1**
512	359026	174432	Roadside	90.4	90.4			**47.5**	**40.6**	30.7
515	360333	174871	Roadside	92.3	92.3			33.7	27.9	22.4
525	362455	173687	Roadside	73.1	73.1			**43.5**	35.3	24.1
538	358681	171478	Roadside	92.3	92.3			33.7	26.6	20.4
539	358599	171391	Roadside	100.0	100.0			**43.3**	35.6	27.4
545	356379	171436	Roadside	90.4	90.4			34.9	28.6	22.0
550	358353	172613	Roadside	82.7	82.7			36.9	35.1	21.1
555	356679	172589	Roadside	84.6	84.6				32	26.5
556	356827	172303	Kerbside	92.3	92.3				37	31.7
557	361171	170685	Roadside	92.3	92.3				25.2	21.9
558	357294	171926	Roadside	82.7	82.7				27.8	22.3
559	356485	171580	Roadside	75.0	75.0				29	19.8
560	358665	173439	Roadside	100.0	100.0				**40.4**	30.2
561	358688	173431	Roadside	100.0	100.0				**47**	33.8
562	356960	168194	Roadside	80.8	80.8				37.3	30.1
563	356606	168316	Roadside	92.3	92.3				24.6	19.2
564	357173	177453	Roadside	82.7	82.7				24.3	16.3
565	357227	179101	Roadside	100.0	100.0				31.4	24.5
567	360728	175345	Roadside	100.0	100.0				**44**	**41.3**
568	360178	175779	Roadside	90.4	90.4				36.2	29.0
569	359855	176186	Roadside	100.0	100.0				31.4	22.8
570	359847	176439	Roadside	82.7	82.7				33.1	28.4
571	359848	176411	Roadside	100.0	100.0				**42.8**	31.3
574	357678	174229	Roadside	100	69.2					27.3
575	358685	172881	Roadside	100	59.6					30.9
576	358792	172874	Roadside	82.9	50.0					23.9
577	358935	172981	Roadside	100	51.9					30.5

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16.**

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

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

Notes:

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

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

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

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

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

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

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

Figure A.1 – Trends in Annual Nitrogen Dioxide at City Centre Locations 2010 to 2020

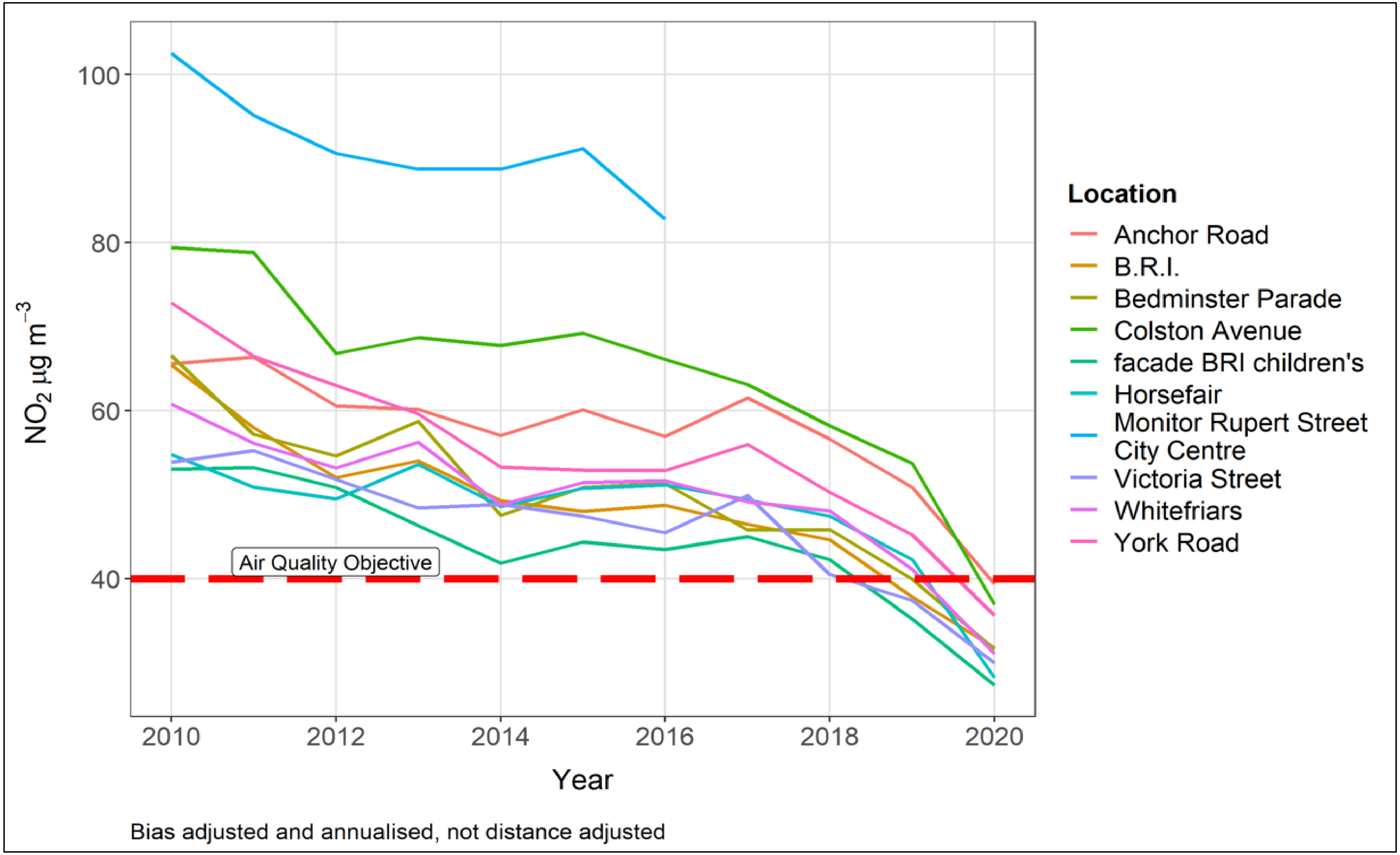


Figure A. 2 – Trends in Annual Nitrogen Dioxide at Gloucester Road Locations 2010 to 2020

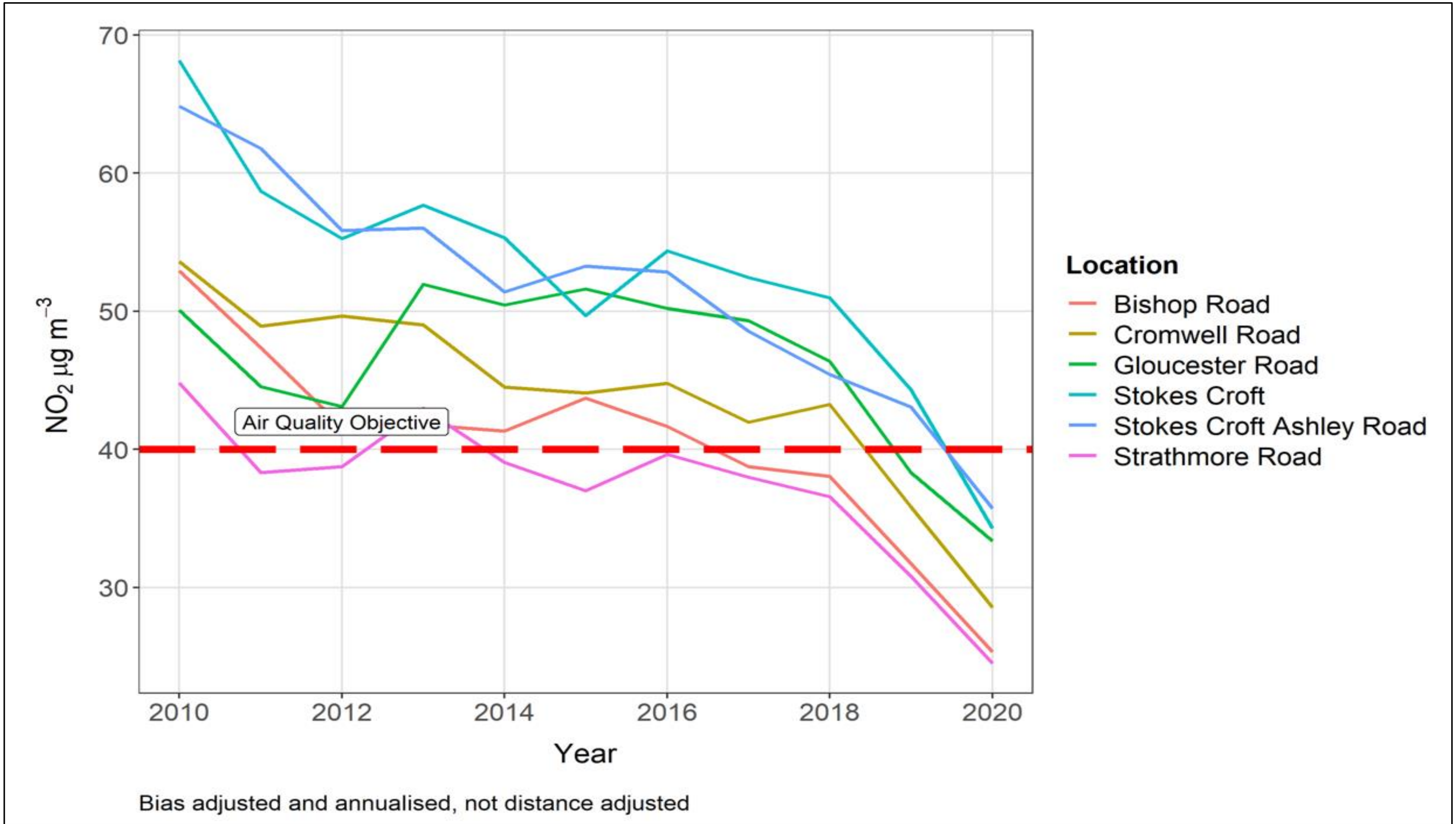


Figure A.3 - Trends in Annual Nitrogen Dioxide at Parson Street Gyratory Locations 2010 to 2020

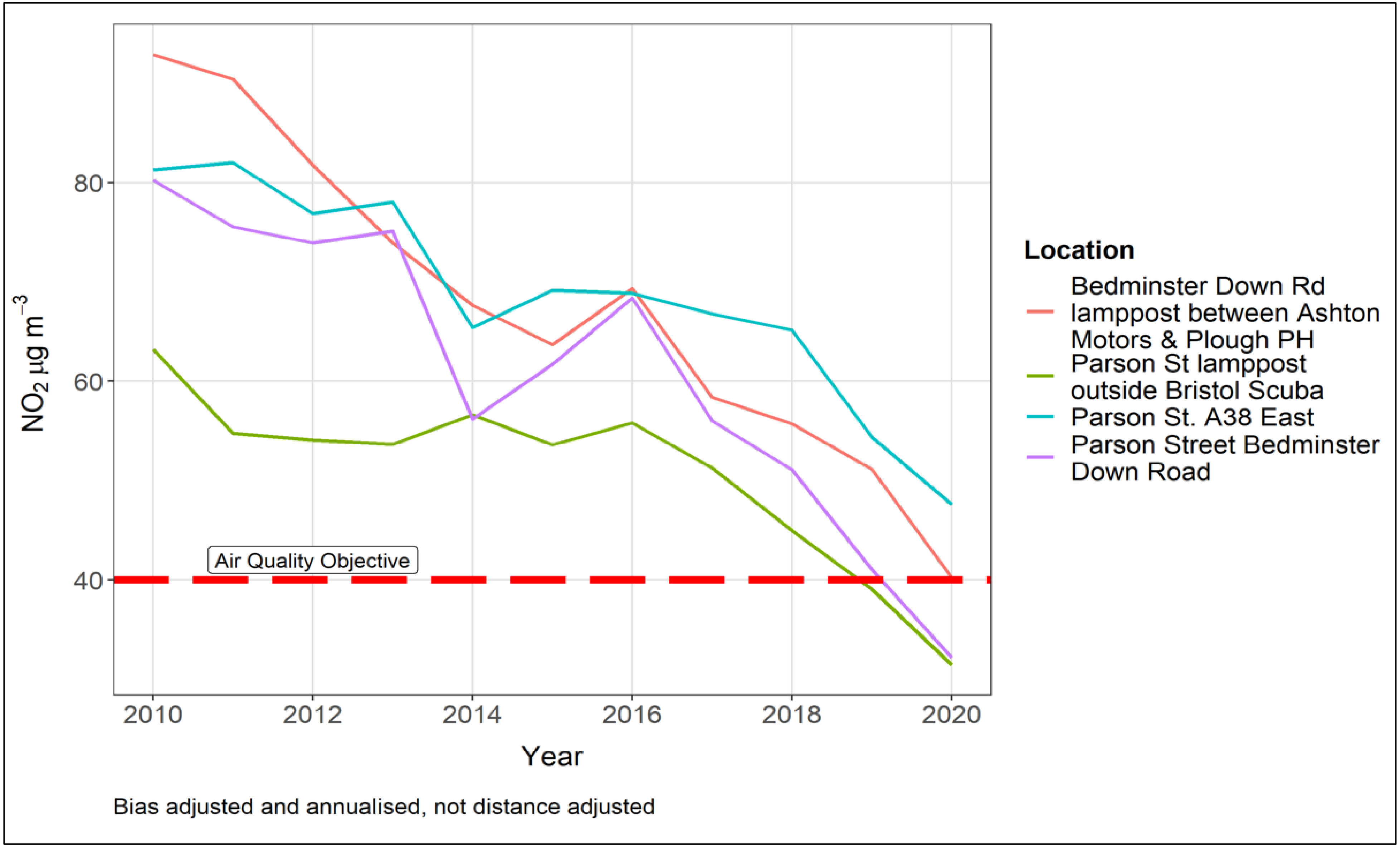


Figure A.4 – Trends in Annual Nitrogen Dioxide at Newfoundland Way / M32 Locations 2010 to 2020

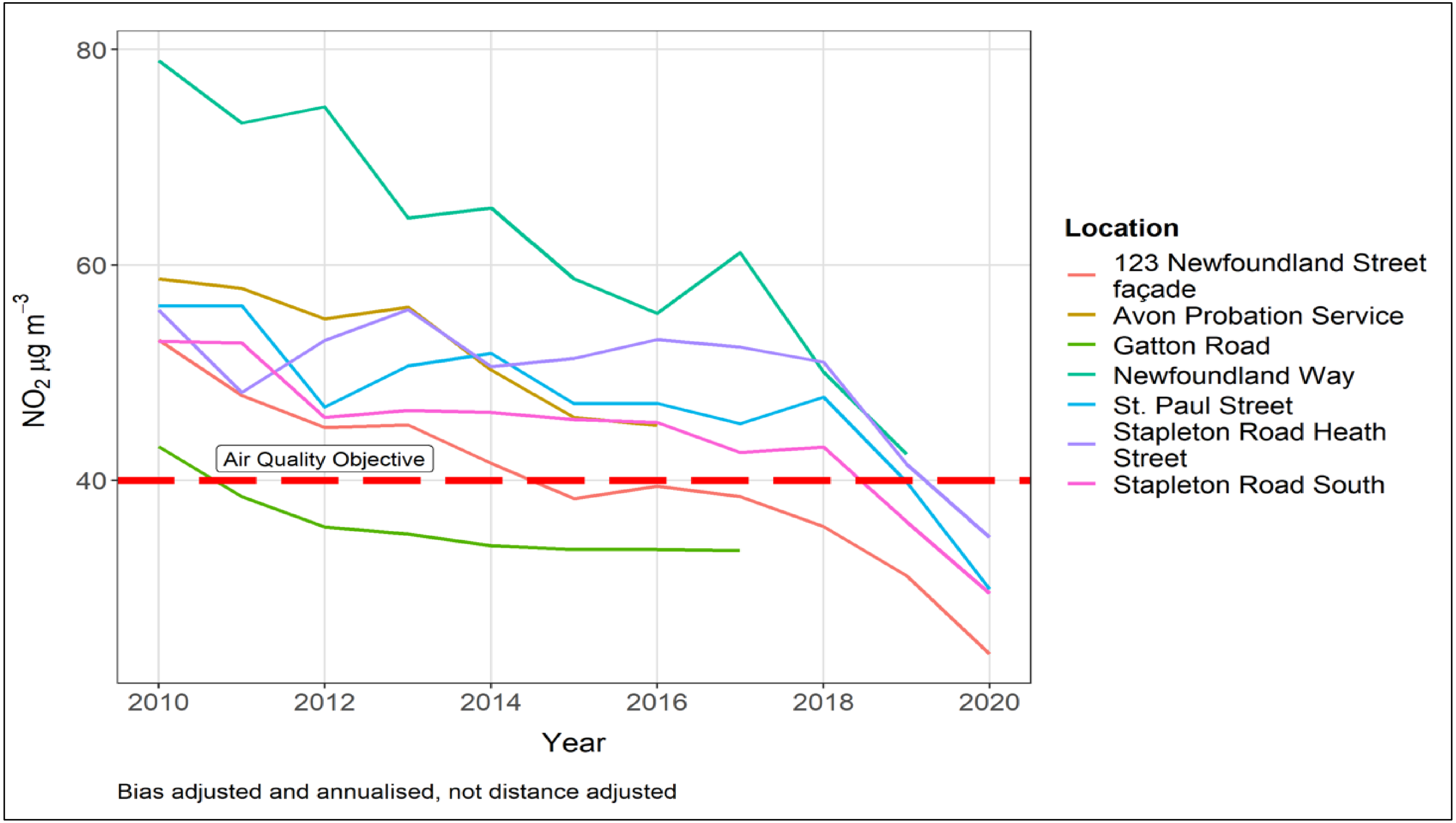


Table A.5 – 1-Hour Mean NO_2 Monitoring Results, Number of 1-Hour Means > 200µg/m^3

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2020 (%) (2)	2016	2017	2018	2019	2020
203	361178	171566	Urban background	94	94	0	0	0	0	0
215	358042	170582	Roadside	98.6	98.6	0	1	0	0	0
270	360903	170024	Roadside	94.9	94.9	1	2 (168)	0	0	0
452	359488	173924	Urban background	95.9	95.9	0	0	0 (93)	0	0
463	362926	175590	Roadside	79	79	0	0	1	0 (118)	0 (81)
500	359522	173381	Roadside	99.7	99.7	0	2 (128)	0	0	0
501	358640	173090	Roadside	95.3	95.3	0	0	0 (186)	8	6

Notes:

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

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

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

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

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

Table A.6 – Annual Mean PM_{10} Monitoring Results (µg/m³)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2020 (%) (2)	2016	2017	2018	2019	2020
452-AURN St Pauls	359488	173924	Urban background	95.9	95.9	15.4	14.7	15.9	16.0	17.3
500-Temple Way	359522	173381	Roadside	95.7	95.7			22.6	20.9	19.7
501-Colston Avenue	358640	173090	Roadside	91.1	91.1				21.8	19.4

Notes:

The annual mean concentrations are presented as µg/m³.

Exceedances of the PM_{10} annual mean objective of 40µg/m³ are shown in **bold**.

All means have been "annualised" as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

(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.7 – 24-Hour Mean PM_{10} Monitoring Results, Number of PM_{10} 24-Hour Means > 50µg/m^3

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2020 (%) (2)	2016	2017	2018	2019	2020
52-AURN St Pauls	359488	173924	Urban background	95.4	95.4	5	2	0 (27)	0 (28)	2
500-Temple Way	359522	173381	Roadside	94.8	94.8			3	10	4
501-Colston Avenue	358640	173090	Roadside	90.7	90.7				4	0

Notes:

Results are presented as the number of 24-hour periods where daily mean concentrations greater than 50µg/m^3 have been recorded.

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**.

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

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

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

Table A.8 – Annual Mean $PM_{2.5}$ Monitoring Results ($\mu g/m^3$)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2020 (%) (2)	2016	2017	2018	2019	2020
452 - AURN St Pauls	359488	173924	Urban background	93.8	93.8	11.7	9.7	12	10.8	9.7
215 - Parson Street School	358042	170582	Roadside	95.2	95.2					11.8

Notes:

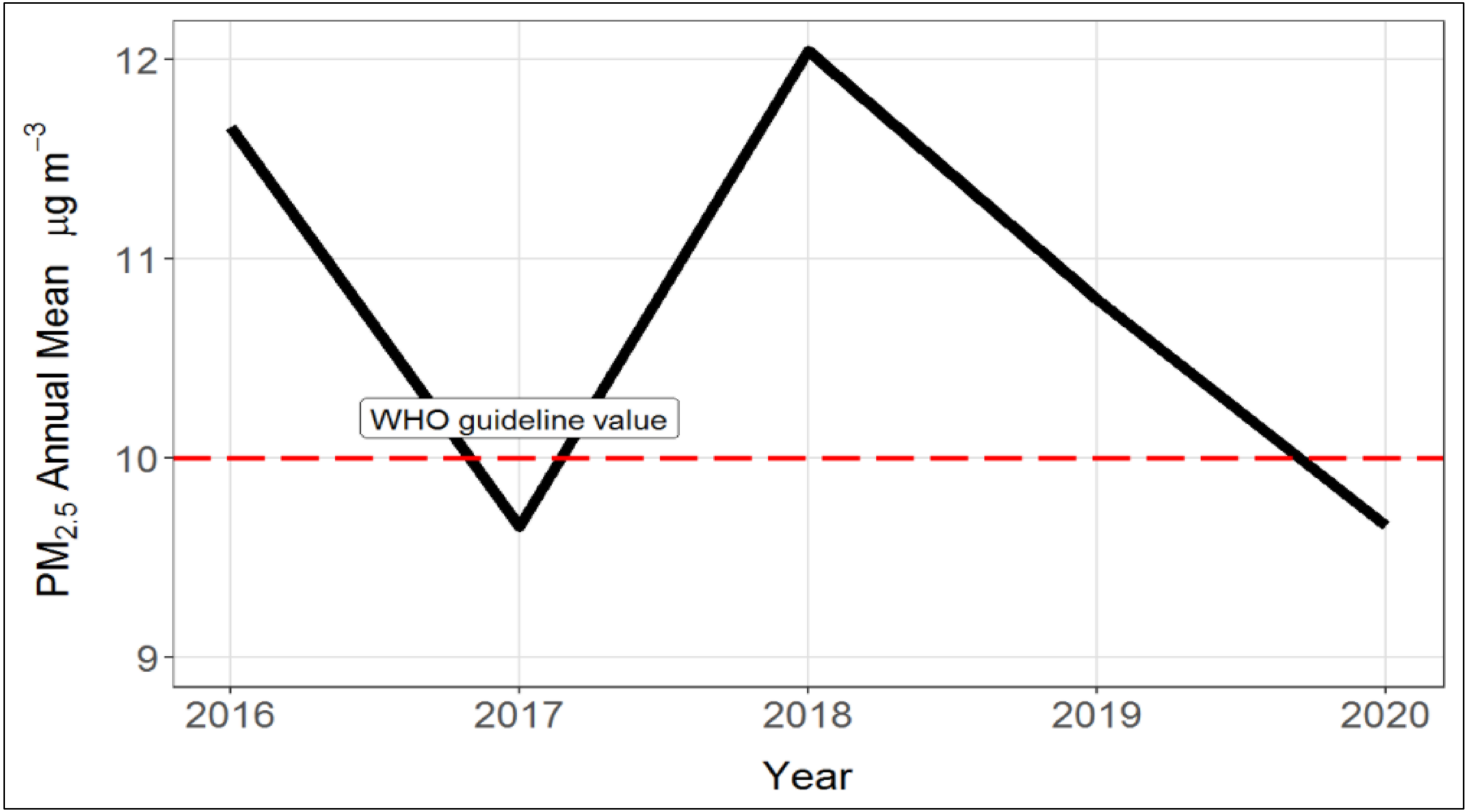
The annual mean concentrations are presented as $\mu g/m^3$.

All means have been "annualised" as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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

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

Figure A.5 – Trends in Annual Mean $PM_{2.5}$ Concentrations - AURN St Pauls



Appendix B: Full Monthly Diffusion Tube Results for 2020

Table B.1 – NO_2 2020 Diffusion Tube Results (µg/m^3)

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.85)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
2	358628	173011	70.5	49.2	40.2	25.2	16.0		30.4	43.2	51.1	48.0	56.3	47.6	43.4	36.9		
3	357448	174650	34.3	21.7	26.2	20.2	17.0	19.1	13.1	28.4	48.8	58.4	53.6	63.8	33.7	28.7		
4	359903	171850	53.9	39.4	43.0	36.1	32.6	36.4	33.1	45.7	49.5	48.1	51.5	50.0	43.3	36.8		
5	358723	171704	52.1	39.6	41.0	24.4	23.8	29.7	29.0	39.1	43.3	42.1		44.7	37.2	31.6		
9	358729	173499	54.3	45.1	38.2	28.4	19.7	25.4	23.1	34.1	42.2	40.9	50.0	46.8	37.3	31.7		
10	361217	171429	52.1	39.1	41.9	33.1	31.5	35.4	25.5	41.1	40.9	40.1	48.8	45.0	39.5	33.6		
11	358813	173342	54.5	36.5	40.5	27.0	22.8	29.3	24.9	37.8	41.6	36.1	44.2	43.1	36.5	31.1		
12	359142	173211	64.1	53.8	52.1	32.3	29.8	38.9	47.0	71.5		51.5	51.7	49.6	49.3	41.9		
14	360871	170291	43.4	33.5	38.8	33.5	32.7	33.5	28.2	40.4	46.9	40.8	41.3	43.9	38.1	32.4		
15	359294	173485	51.1	36.0	27.7	20.7	13.9	24.7	21.3	33.6	41.8	40.9	44.7	42.1	33.2	28.2		
16	352287	178698	39.3		29.4	19.1	15.7	19.7	23.1	24.5	30.0	32.9	35.8	30.2	27.2	23.2		
20	359567	173630	32.7												-	-		Monitoring in this location was stopped in 2020
21	359035	175306	57.0	50.0	38.2	17.3	20.2		32.0	38.0	44.0	43.7	48.6	43.0	39.3	33.4		
22	359109	173886	60.1	41.4	42.5	29.3	24.0	30.9	25.6	42.5	46.4	45.7	47.6	48.0	40.3	34.3		
113	359258	172696	53.9	47.4	38.0	23.3	18.9	18.4	25.8	35.4	38.0	40.1	45.1	38.4	35.2	29.9		
125	359214	171917	59.5	46.3	43.6	33.5	28.9	30.9	26.9	43.1	49.4	45.9	46.6	48.2	41.9	35.6		
147	358514	172691	59.8	56.8	45.8	33.9	17.4	43.7	37.1	42.8	51.0	57.0	56.2	54.0	46.3	39.4		
154	357601	172483	34.7	32.6	29.4	18.2	10.0	16.5	17.2	21.6	29.0	30.6	35.9	36.4	26.0	22.1		
155	357838	172713	35.5	32.0	29.9	20.1	22.0	18.0	16.8	28.6	33.8	27.7	32.2		27.0	22.9		
156	357709	173018	34.8	28.1	26.4	17.7	14.0	18.2	16.2	23.6	28.8	29.4		31.2	24.4	20.7		
157	359119	174090	51.1	49.3	46.4	25.1	24.8	32.2	33.1	44.7	50.0		51.2	54.4	42.0	35.7		
159	358891	174608	40.5	39.7	37.3	21.2	21.5	26.1	21.4	35.8	38.8	39.4	39.1	42.3	33.6	28.5		
161	359152	175733	42.7	35.9	31.9	16.3	13.1	21.1	19.1	28.9	34.1	34.8	40.3	39.7	29.8	25.3		
163	359435	176574	39.1	35.1	28.1	18.2	13.7	25.1	17.7	28.1	32.2	35.0	37.1	36.5	28.8	24.5		
175	362147	170525	47.1		44.5	29.1	32.6	40.8	41.5	46.5	51.1		48.1	46.6	42.8	36.4	25.7	
239	357880	170506	70.7	56.2	65.3	46.3	41.7	30.2	50.1	55.9	68.2	60.0	72.5	55.0	56.0	47.6	31.9	
242	357510	170401	41.9	35.9	37.5	30.6	27.9		33.5	39.1	42.2	42.4	42.3	43.1	37.8	32.2		
254	357118	172429	42.8	45.7	39.4	22.9	22.2	24.8	30.5	39.3	42.5	44.9	46.9	36.8	36.5	31.1		
260	361140	175366	44.0	41.4	34.8	20.1	22.6	26.9	29.1	35.0	39.1	41.5	43.2	38.8	34.7	29.5		
261	361103	175059	49.6	43.8	41.2	30.4	24.8	28.8	34.4	42.6	46.9	47.3	50.2	50.3	40.8	34.7		
295	359913	174315				28.3		33.1	34.8	42.6	46.6	52.7	54.7	52.7	43.2	37.2		
300	363365	175883	40.8	40.3	37.3	18.3	20.2	22.3	28.0	32.5	37.4	41.6	40.4	48.3	33.9	28.9		
303	361368	175170	41.3	39.6	30.7	23.0	27.3	31.1	34.8	37.1	34.6	39.3	39.7	33.3	34.3	29.2		
307	360747	175328	35.5	29.3	29.1	24.8	19.1	22.3	15.5	28.4	28.7	32.7	39.9	41.7	28.9	24.6		
312	359832	174616	41.1	33.4	27.7	24.2	22.3	18.8	17.9	32.8	34.8	34.9	40.7	41.9	30.9	26.2		
320	361180	171567	30.1	26.2	21.5	14.7	13.3	18.0	17.0	22.0	25.2	26.2	28.6	29.9	22.7	19.3		
325	361667	175103	42.6	42.8	36.0	29.7	25.8	37.1	33.9	44.9	52.7	45.4	47.1	43.9	40.2	34.1		
363	359075	173613	34.8	35.1	29.3	17.0	15.8	16.8	19.0	24.7	32.2	32.5	37.6	36.7	27.6	23.5		
370	359775	173513	36.5												-	-		Monitoring in this location was stopped in 2020
371	359813	173373	43.8	37.3	29.2	18.5	14.5		11.4	27.5	40.2	34.1	37.7	40.0	30.4	25.8		
373	359747	173774	39.6		29.3	21.0	17.1	17.7	17.5	26.5	29.5	29.1	40.6	41.1	28.1	23.9		
374	359509	173595	50.2		36.4	29.3	19.8	22.0	20.2	35.5	37.8	40.3	49.6	45.7	35.2	29.9		
403	360508	171676	32.8	30.6	28.1	20.9	17.3	20.1	20.4	27.1	30.6	29.3	40.4	32.2	27.5	23.4		
405	361051	173743	50.1	48.9	39.2	35.5	36.2	40.4	36.7	47.1	53.2	51.5	50.4	57.3	45.5	38.7	35.6	
406	361576	173806	37.2	37.7	34.2	22.6	23.3	21.6	24.8	25.5	36.1	37.9	35.8	38.9	31.3	26.6		

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.85)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
407	359829	174370	34.8	33.3	30.5	28.2	24.2	27.2	15.2	33.3	33.0	35.3	40.9	41.7	31.4	26.7		
413	360043	171508	34.7	30.2	32.3	23.2	21.4	23.5	28.1	29.8	35.1	33.4	33.4	34.8	30.0	25.5		
417	359635	171413	36.2	37.0	31.7	23.8	20.6	21.4	21.0	30.5	33.1	35.7	40.7	40.2	31.0	26.3		
418	357737	170642	58.1	50.3	45.2	35.6	35.8	39.9	37.6	30.7	53.0	57.5	63.0	60.9	47.3	40.2		
419	357832	170686	43.5	43.5	37.0	20.2	23.7	31.5	29.0	39.5	40.2	41.5	49.6	44.4	37.0	31.4		
420	358277	171562	30.9	31.5	31.6	23.7	16.1	17.8			29.7	31.3	32.8		27.3	23.2		
422	358168	171525	40.6	31.1		19.2	14.2	19.6	17.1	21.7	29.1	44.2	32.5	34.0	27.6	23.4		
423	358623	173386	49.9	42.1	33.7	18.7	18.0	23.3	24.3	29.6	35.3	34.0	39.4	37.5	32.1	27.3		
429	360484	174097	55.6	60.4	51.9	25.4	30.3	25.1	48.8		45.6		67.4		45.6	38.8		
436	361013	173352	49.3	40.1	30.2	21.5	24.0	27.6	30.6	34.4	38.0		42.3	39.8	34.3	29.2		
438	360903	170024	41.5	34.0	29.6	21.3	20.3	29.6	25.7	31.1	34.1	35.6	41.4	38.8	31.9	27.1		
439	358042	170582		33.0	31.9	21.0	22.4	23.7	25.9	30.0	34.2	34.0	35.9	36.4	29.8	25.4		
455	359487	173924	31.3	22.7	18.7	12.4	9.0	10.9	10.8	16.0	19.4	20.9	25.7	26.6	18.7	15.9		
461	360381	174405	34.3												-	-		Monitoring in this location was stopped in 2020
464	362927	175592	41.2	35.2	28.3	18.6	17.0	20.3	20.2	24.6	31.2	33.4	37.0	34.0	28.4	24.2		
466	357466	171622	36.4	30.0	25.4	13.0	13.1	16.8	16.1	23.2	25.2	28.8	30.4	34.9	24.4	20.8		
469	359479	171114	37.8	27.4	29.2	18.6	19.2	21.9	18.1	27.0	30.7	31.9	30.8	37.6	27.5	23.4		
470	359213	170997	35.4	28.5	32.3	20.8	23.3	22.6	21.9		34.0	34.0	33.2	38.4	29.5	25.1		
472	358226	171284	41.6	31.7	33.9	22.8	17.4	23.7	16.8	31.0	35.7	36.4	40.1	39.4	30.9	26.2		
473	358105	171124	73.8	40.0	53.9	24.4		20.0	24.5	21.9	35.9	68.9	77.8	76.3	47.0	40.0		
474	357991	170979	34.0	30.2	30.8	19.6	15.8	20.9	14.6	26.5	28.2	31.9	34.1	37.1	27.0	22.9		
478	362091	170447	33.4	23.2	26.9	24.0	24.0	25.2	18.9	30.8	32.4	28.8	29.8	34.1	27.6	23.5		
487	360243	174327	52.0	41.9	35.0	20.8	18.3	19.8	25.5		33.2	37.2	35.7	39.5	32.6	27.7		
489	352634	177629	34.3	30.6	27.1	17.2	17.6	23.3	24.3	25.9	31.9	27.8	32.4	29.6	26.8	22.8		
490	352683	177670	28.1	25.9	21.6	13.4	13.6	16.8	20.8	19.8	27.0	26.0	25.8	23.4	21.8	18.6		
491	352722	177525	34.1	28.5	27.0	20.1	11.6	21.4	21.0	24.2	28.5	32.0	30.7	31.2	25.8	22.0		
492	359445	176627	43.3	32.0	30.9	19.3	18.4	20.5	18.4	28.7	32.5	34.7	40.0	37.5	29.7	25.2		
493	359677	176758	48.4	45.3	34.3	23.5	21.1	19.7	30.4	35.0	38.5	38.4	41.5	40.1	34.7	29.5		
494	359558	176850	41.2		27.2	21.1		22.9	21.2	29.4	28.5	32.9	34.8	36.0	29.5	25.1		
496	362296	173620	44.0	40.7	28.3	14.1	18.6	21.6	29.3	23.9	34.1	34.2	30.0	34.2	29.4	25.0		
497	359268	174132	41.9		27.9	18.8	17.7	20.2	18.3	29.0	32.0	35.8	38.6	38.1	28.9	24.6		
499	359522	173381	39.4	31.1	32.5	27.6	21.4	21.6	18.9	31.0	38.1	34.9	33.8	37.2	30.6	26.0		
502	358640	173090	90.7	80.7	65.2	26.3	24.4	48.3	52.4	61.7	77.0	77.1	66.0	65.5	61.3	52.1	45.6	
512	359026	174432	49.0	34.1	38.3	21.5	20.2	30.5	27.9		45.6	45.4	40.7	43.6	36.1	30.7		
515	360333	174871	35.5		28.5	19.4	17.1	18.9	15.2	27.3	29.6	30.5	33.2	34.3	26.3	22.4		
525	362455	173687	47.8	37.8	27.4	14.3	17.5	22.7	24.7	25.1	38.2				28.4	24.1		
538	358681	171478		26.9	26.8	17.5	14.9	18.2	15.0	25.1	27.6	28.1	31.9	32.3	24.0	20.4		
539	358599	171391	46.7	37.6	32.4	18.4	19.7	26.4	24.2	32.4	37.8	37.7	34.2	39.0	32.2	27.4		
545	356379	171436	38.1	32.3	25.9	16.3		21.5	12.7	25.0	25.4	23.3	32.5	32.1	25.9	22.0		
550	358353	172613		32.1	38.9	17.6	15.0	22.2	20.5	24.9	33.5	25.1	18.4		24.8	21.1		
555	356679	172589	37.7	27.9	31.7	20.5	23.5			32.8	38.4	29.5	36.1	33.2	31.1	26.5		
556	356827	172303	52.2	43.6	32.6	20.3	18.0	28.0		42.1	45.8	42.1	44.5	41.2	37.3	31.7		
557	361171	170685	43.6	27.1		16.4	17.6	18.7	18.9	23.2	27.3	31.2	29.8	30.1	25.8	21.9		
558	357294	171926	38.6	33.0	29.4	18.8	14.5	19.0	22.4	26.1	31.1	29.3			26.2	22.3		
559	356485	171580		23.8	21.7	12.5		16.5	13.4	23.8		28.4	34.3	35.3	23.3	19.8		
560	358665	173439	52.6	46.8	35.5	19.8	21.6	28.1	26.9	29.3	41.7	40.6	43.0	40.4	35.5	30.2		
561	358688	173431	58.4	55.3	42.2	21.5	23.9	33.1	25.9	38.4	42.8	43.3	47.7	45.0	39.8	33.8		
562	356960	168194	41.9	34.6	36.6	31.7	29.7	30.9	28.0		40.5	40.6	39.5		35.4	30.1		
563	356606	168316	30.3	25.4		14.4	14.0	17.8	17.4	20.4	26.5	26.2	29.8	26.7	22.6	19.2		
564	357173	177453		22.2	16.4	12.9		15.2	11.3	17.9	21.5	21.0	28.6	25.3	19.2	16.3		
565	357227	179101	42.4	34.5	26.7	16.1	17.1	22.9	23.8	31.7	36.0	33.0	30.2	31.6	28.8	24.5		
567	360728	175345	66.7	60.4	45.6	24.5	35.6	37.4	42.6	50.1	53.3	56.0	55.9	55.6	48.6	41.3	37.3	
568	360178	175779	49.3	41.5	33.0	22.0	18.3	26.3	26.1	37.3	39.2		38.6	43.5	34.1	29.0		

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.85)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
569	359855	176186	39.7	28.7	22.3	16.4	16.3	20.2	17.0	27.6	29.9	31.8	34.5	37.1	26.8	22.8		
570	359847	176439	52.0	40.8	29.9	18.1	20.9	26.7	22.1			37.9	43.5	42.4	33.4	28.4		
571	359848	176411	55.0	45.1	36.1	18.3	26.7	26.4	27.4	37.2	33.9	43.5	45.9	46.9	36.9	31.3		
574	357678	174229					15.8	22.5	22.9	31.1	38.1	33.5	40.8	36.1	30.1	27.3		
575	358685	172881						29.1	27.9	30.3	42.1	39.5	40.8	39.8	35.6	30.9		
576	358792	172874						24.4	21.1	25.3	29.5		33.4	33.0	27.8	23.9		
577	358935	172981							30.0	37.4	42.4	38.3	35.7	37.3	36.8	30.5		

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

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16.**

☒ **Local bias adjustment factor used.**

☐ **National bias adjustment factor used.**

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

☒ **Bristol City Council confirm that all 2020 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System.**

Notes:

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

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

See Appendix C for details on bias adjustment and annualisation.

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

New or Changed Sources Identified Within Bristol During 2020

Bristol City Council has not identified any new sources relating to air quality within the reporting year of 2020.

Clean Air Zone Progress to Date

Bristol City Councill are continuing to develop plans to achieve complaince with air quality objectives in the shortest time possible as directed by government. For the latest information on the development of these plans please visit the Clean Air for Bristol Website.

Locations Recording Exceedence Outside the AQMA

The next section of the report discusses the locations which have shown some exceedances of the annual objective for NO_2 in the past 3 years but are located outside of the AQMA. Table C.1 shows these locations and provides measured pollutant concentrations for the past 5 years where available. The locations are all along Muller Road in Bristol. In 2019 additional sites were set up along Muller Road to identify whether other locations outside of the AQMA have exceedances in locations of relevant exposure. This extra data will allow Bristol City Council to consider whether it is necessary to expand the current AQMA boundary, which follows Gloucester Road, and passes within 175m of monitoring site 493.

Table C.1- Tubes Outside AQMA Exceeding the Annual Air Quality Objective for NO2 Since 2016 – Muller Road

Site Location	Site ID	Annual Mean Concentrations (µg/m^3)					Action
		2016	2017	2018	2019	2020	
No.67 Filton Avenue on wall facing Muller Rd	493	**41.5**	**41.9**	**41.8**	37.0	29.5	2019 data shows that the site was compliant with the annual objective for nitrogen dioxide for the first time since 2015. 2020 data saw a significant fall of pollution at the location but 2020 is not considered to be a typical year. The monitoring location is on the façade of a residential dwelling and is therefore representative of relevant exposure.
Muller Road - Adjacent to Darnley Avenue	494	**43.3**	39.5	38.7	32	25.1	The NO_2 concentration at the relevant receptor location (using distance from roads calculator) was below the air quality strategy objective in 2016. For all years since 2016 data show compliance at the monitoring site. Monitoring will continue here in 2021.

Site Location	Site ID	Annual Mean Concentrations (µg/m³)					Action
		2016	2017	2018	2019	2020	
Muller road/ Glenfrome road junction north	567	N/A	N/A	N/A	**44.0** (39.9)*	**41.3** (37.3)*	This site was set up in 2019 to investigate whether there are exceedances along Muller Road. The tubes were established in mid-2019 with results being annualised. 2019 and 2020 monitoring data was in breach of air quality objectives at this location. The distance adjusted concentration to the nearest receptor was 39.9µg/m³ in 2019 and 37.3µg/m³ in 2020.
Muller road junction with Downend road traffic light to the south of the junction.	571	N/A	N/A	N/A	**42.8** (32.7)*	31.3	This site was set up in 2019 to investigate whether there are more exceedances along Muller Road. The tubes were established in mid-2019 with results being annualised. Monitoring data was in breach of air quality objectives in at this location in 2019 but compliant in 2020 at 31.3µg/m³.

*Distance adjusted data reported in ()

Muller Road

Monitoring sites 493 and 494 were added to the monitoring network in 2015 along Muller Road. Both recorded exceedances 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 2020 and shows compliance at Tube 493 with an annual average NO_2 concentration of 29.5µg/m^3. Tube 494 was also compliant at 25.1µg/m^3.

Due to the continued monitored exceedance outside of the existing AQMA the Local Air Quality Management helpdesk was consulted in 2019 in order to agree an appropriate course of action. BCC asked the LAQM Helpdesk four questions via e-mail in July 2019. The query reference was 5607 with the following answers received to the following questions:

Q1: Should BCC consider amending the AQMA boundary to include the monitored location of exceedance based on the 3 years of monitored marginal exceedance?

A1: *Due to the marginal exceedances I think the best approach would be for further investigation to understand the extent of the additional exceedances outside of the AQMA, this could be additional monitoring or a detailed modelling assessment.*

Q2: Would there be a requirement to conduct modelling to support this or is diffusion tube data sufficient evidence given that modelling will be verified against monitoring data anyway?

A2: *A modelling study would provide information on the wider area, across areas where monitoring has possibly not be completed. This could lead to a better understanding of the area and provide a full review of the current designations of AQMAs.*

Q3: Would consideration be needed of possibly extending the AQMA further along Muller Road given that there is the possibility of other locations of exceedance outside of the AQMA boundary?

A3: *Following the completion of a detailed study (modelling or further monitoring), the extent of any possible amendments should be investigated and implemented where* *required.*

Q4: Should BCC amend the AQMA boundary what is the current process by which this can be done and does it involve a requirement for public consultation?

A4: *Consultation is encouraged, with Defra being the key statutory consultee but a recommended list is provided within Chapter 6 of PG(16).*

As a result of the information provided above, Bristol City Council added a number of new diffusion tube monitoring locations along Muller Road in August 2019. Diffusion tube monitoring was chosen over modelling as it provides more robust data and will be helpful if modelling is conducted at a later date. Figure C.1 and Figure C.2 shows the location of the new monitoring sites on Muller Road and the 2020 measured NO_2 concentrations. Measured and distance adjusted concentrations for those tubes exceeding the objective are reported in Table C.1.

The additional monitoring has highlighted another location on Muller Road that is very close to exceedance of objectives at a location with relevant exposure. An annual NO_2 concentration of 41.3µg/m^3 was measured at tube 567 on the junction of Muller Road with Glenfrome Road. When adjusted for distance to the nearest location of relevant exposure marginal compliance of 37.3µg/m^3 was predicted in 2020. It is proposed to continue monitoring in these locations in 2021.

Figure C.1 - Muller Road 2019 Measured Annual NO_2 Concentrations – North

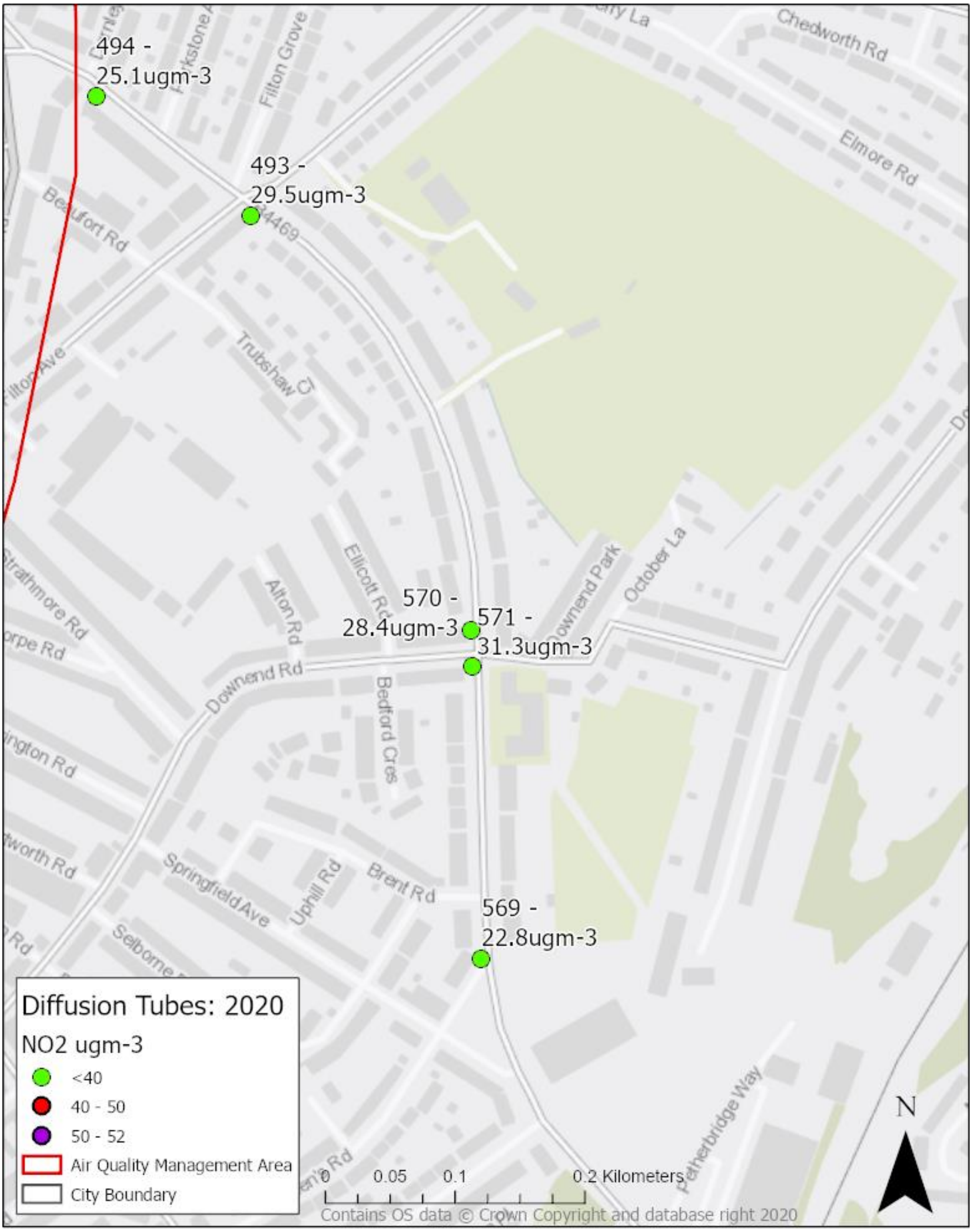
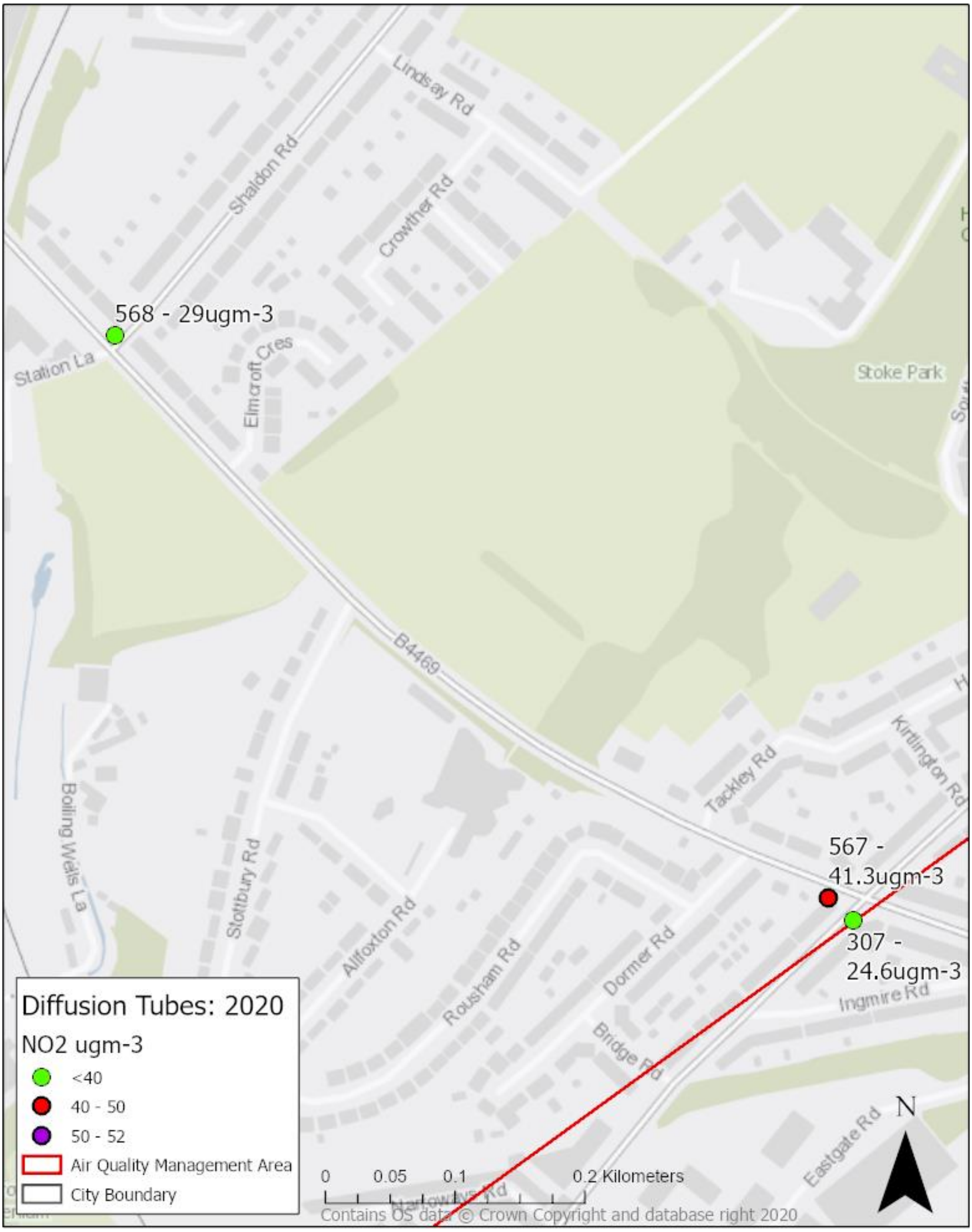


Figure C.2 - Muller Road 2019 Measured Annual NO_2 Concentrations – South



Local Pollution Hotspots – Measured Data

In the review of the 2019 ASR provided by Defra, a request was made for future ASRs to highlight and identify pollution hotspots in the city.

In order to identify the locations in the city with the highest monitored pollution levels, a summary of results and map showing monitoring data, in locations where annual NO_2 concentrations above 50µg/m^3 were measured in 2019 were included within the 2021 Annual Status Report. Whilst 2020 pollution levels were significantly lower due to restrictions imposed by the Government in response to the Covid-19 pandemic, the 2020 data from these sites highlighted in the 2020 ASR have been reported. This shows the impact these restrictions had on air pollution in some of the most polluted parts of the city. These are shown in Table C.2. Six monitoring locations had measured concentrations above 50µg/m^3 in 2019. One site recorded levels above 50µg/m^3 in 2020, site 502 at Colston Avenue, with a value of 52.1µg/m^3. The location of this site is shown in Figure C.3. This figure of over 50µg/m^3 has been chosen by BCC to illustrate the most polluted sites in the city.

Colston Avenue – Tube 502 and Tube 2

In 2020 the annual NO_2 concentration at Tube 502 was 52.1µg/m^3 with 36.9µg/m^3 being measured at Tube 2. Tube 502 has the highest recorded annual NO_2 concentration measured within Bristol. It is a city centre location impacted by large numbers of vehicles, including many buses, with high levels of congestion and restricted pollutant dispersion. At the nearest location of relevant exposure, concentrations of 45.6µg/m^3 have been calculated. Despite the significant fall in annual NO_2 concentrations in this location in 2020 compared to 2019 exceedance at relevant receptor locations was still measured.

Parsons Street Gyratory A38 East – Tube 239 and Tube 418

Tube 239 is located less than 1m from the kerbside with 2020 NO_2 measured at 47.6µg/m^3. The road in this location has a relatively steep incline, with 3 lanes of traffic often accelerating from a standing start from traffic lights, which are located a relatively short distance from the monitoring site. The nearest relevant exposure is

9m from the kerbside and shows compliance at 31.9µg/m^3 when adjusted for this distance.

Tube 418 is located next to the façade of a house on the A38 Bedminster Down Road. The 40.2µg/m^3 annual NO_2 concentration measured here in 2020 is representative of relevant exposure. This location is 2m from the kerb and is subject to 3 lanes of traffic which is often either accelerating or queuing in this location. Again, 2020 data shows continued exceedance at relevant receptor locations despite the significant impact that Covid 19 had on travel patterns during 2020.

Galleries - Tube 12

This tube is located inside a tunnel and is therefore not representative of relevant exposure.

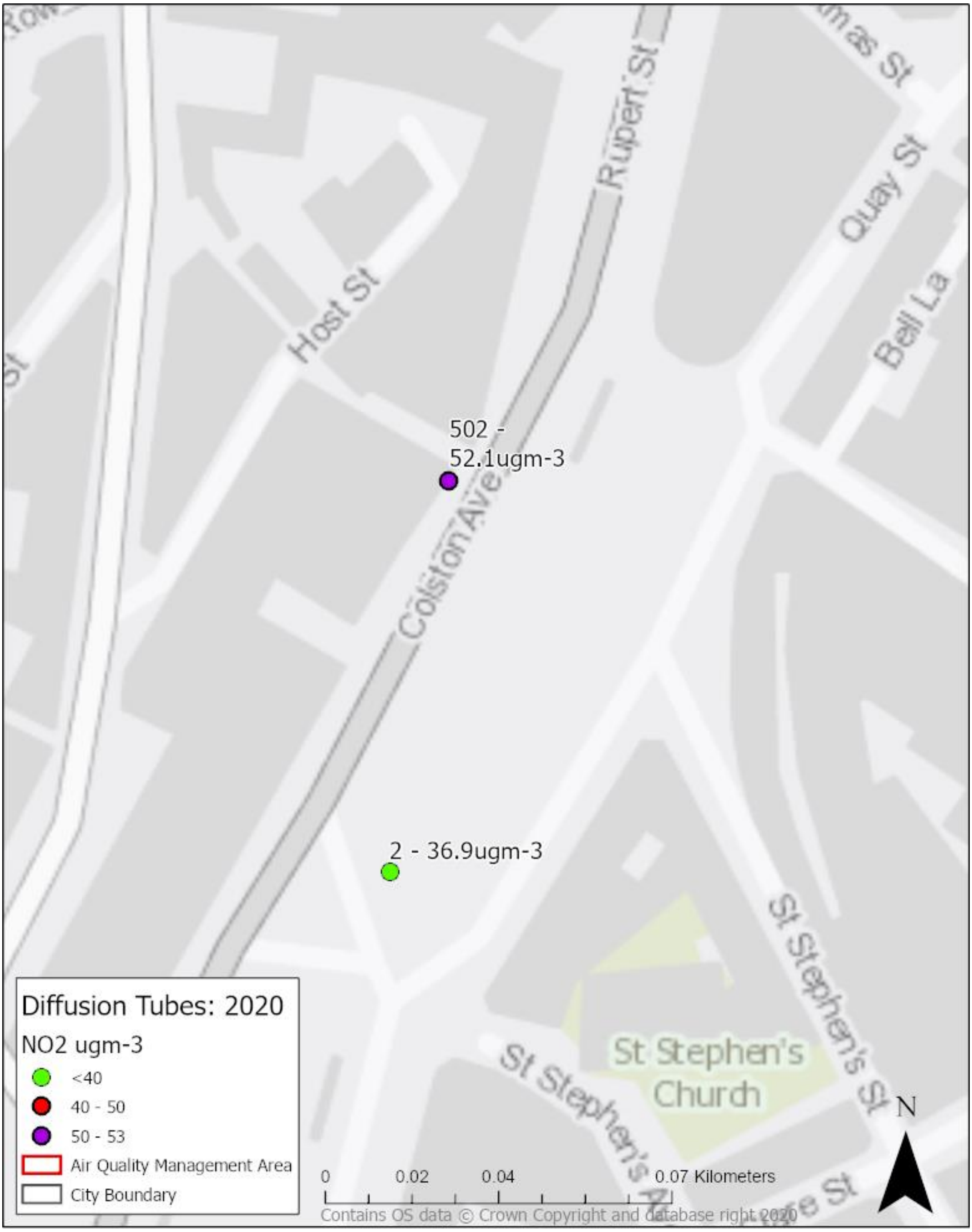
Anchor Road –Tube 147

This tube is located at a pedestrian crossing with traffic often either queuing or accelerating by the tube which is located 1m from the kerb. 2020 data showed a measured compliance in this location in 2020 at 39.4µg/m^3.

Table C.2 – Locations at which NO_2 Concentrations Above 50µg/m^3 were Measured in 2019

Site ID	Site Name	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	NO_2 Annual Mean Concentration (µg/m^3)				
				2016	2017	2018	2019	2020
2	Colston Avenue	358628	173011	**66.1**	**63.1**	**58.2**	**53.7**	36.9
12	Galleries	359142	173211	**52.8**	**56.6**	**57.5**	**51.8**	**41.9**
147	Anchor Road	358514	172691	**56.9**	**61.5**	**56.6**	**50.9**	39.4
239	Parson St. A38 East	357880	170506	**68.9**	**66.8**	**65.2**	**54.4**	**47.6**
418	Bedminster Down Rd lamppost between Ashton Motors & Plough PH	357737	170642	**69.3**	**58.4**	**55.7**	**51.1**	**40.2**
502	Co-located Colston Ave	358640	173090				**68.7**	**52.1**

Figure C.3 – Measured Annual NO_2 Concentrations at locations > 50µg/m³ in 2020

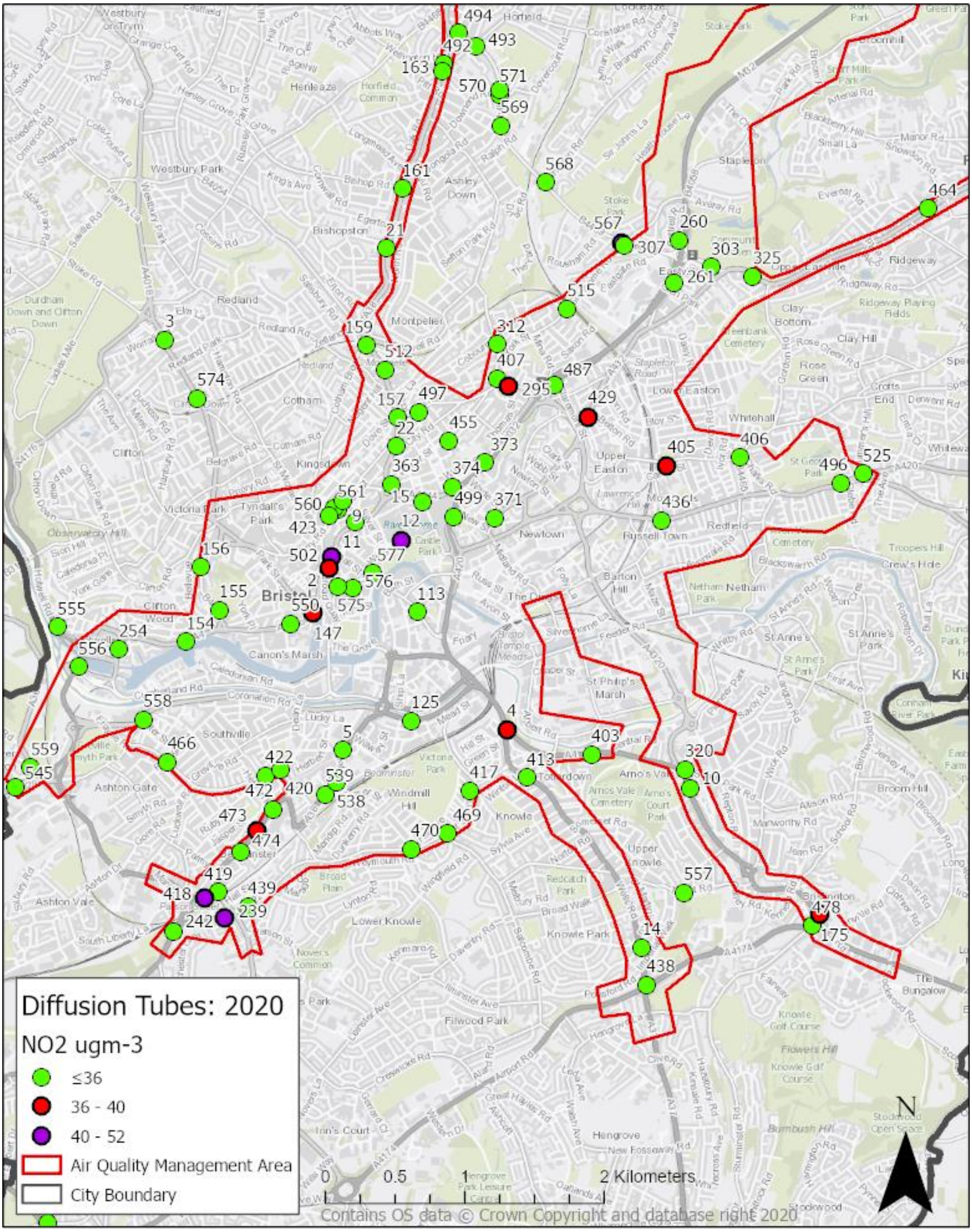


Diffusion tube data for 2019 shows that there were 28 monitoring locations at which exceedances of the annual objective for NO_2 were measured. In 2020 this had fallen to 5.

When taking into account diffusion tube measurement uncertainty it is useful to consider monitoring locations with annual concentrations above 36µg/m^3 which could indicate a location of possible exceedance. An additional 8 locations are at risk of exceedance if this criterion is used to define a “hotspot”.

These locations are spread throughout the city on many different central roads and arterial routes, the locations of which are shown in Figure C4.

Figure C.4- 2020 Measured Annual NO_2 Concentrations > 36µg/m³



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 December at the Brislington site, January, February, April and June at the Fishponds site and for April at the Colston Avenue site. Due to the real time monitor data losses at Fishponds the results from this site have been used in the diffusion tube bias adjustment calculations, as described in detail later in this section of the report. Summary tables from the analysers used for bias adjustment and precision calculation are included in the Figures below.

Figure C. 5 - 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	08/01/2020	04/02/2020	29.3	29.4	31.4	30	1.2	4	3.0		27.6	96.0	Good	Good
2	04/02/2020	04/03/2020	26.3	25.8	26.4	26	0.3	1	0.7		23.8	99.3	Good	Good
3	04/03/2020	31/03/2020	21.8	22.0	20.7	21	0.7	3	1.8		19.8	98.9	Good	Good
4	31/03/2020	29/04/2020	14.1	14.5	15.5	15	0.7	5	1.8		15.5	99.7	Good	Good
5	29/04/2020	04/06/2020	13.8	12.7	13.5	13	0.6	5	1.5		12.2	99.4	Good	Good
6	04/06/2020	01/07/2020	18.6	18.1	17.4	18	0.6	3	1.5		12.6	99.2	Good	Good
7	01/07/2020	29/07/2020	18.3	15.1	17.7	17	1.7	10	4.3		14.5	96.0	Good	Good
8	29/07/2020	02/09/2020	21.8	22.2	21.8	22	0.2	1	0.5		15.6	99.2	Good	Good
9	02/09/2020	30/09/2020	24.5	25.0	26.1	25	0.8	3	2.0		18.1	98.7	Good	Good
10	30/09/2020	06/11/2020	26.1	25.4	27.1	26	0.9	3	2.2		21.3	99.0	Good	Good
11	06/11/2020	02/12/2020	27.9	29.7	27.9	29	1.0	4	2.5		24.5	97.0	Good	Good
12	02/12/2020	07/01/2021	29.3	30.2	30.3	30	0.6	2	1.4		24.6	45.2	Good	oor Data Capture
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

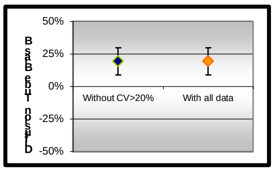
Site Name/ ID:	D Tube 320 - RT 203 Brislington

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 11 periods of data	
Bias factor A	0.85 (0.78 - 0.93)
Bias B	18% (8% - 28%)
Diffusion Tubes Mean:	22 μgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	19 μgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	19 (17 - 21) μgm^{-3}

Accuracy	(with 95% confidence interval)
WITH ALL DATA	
Bias calculated using 11 periods of data	
Bias factor A	0.85 (0.78 - 0.93)
Bias B	18% (8% - 28%)
Diffusion Tubes Mean:	22 μgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	19 μgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	19 (17 - 21) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

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

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm⁻³	Tube 2 µgm⁻³	Tube 3 µgm⁻³	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Automatic Method: Period Mean	Automatic Method: Data Capture (% DC)	Data Quality Check: Tubes Precision Check	Data Quality Check: Automatic Monitor Data
1	09/01/2020	05/02/2020	39.2	41.5	42.9	41	1.9	5	4.6	38.3	51.2	Good	or Data Capture
2	05/02/2020	05/03/2020	37.6	33.5	34.5	35	2.2	6	5.4	16.2	57.5	Good	or Data Capture
3	05/03/2020	01/04/2020	28.4	28.1	28.3	28	0.2	1	0.4	15.7	92.1	Good	Good
4	01/04/2020	29/04/2020	18.8	18.4		19	0.3	2	2.7	18.3	66.6	Good	or Data Capture
5	29/04/2020	05/06/2020	17.0	17.1		17	0.0	0	0.3	20.8	86.2	Good	Good
6	05/06/2020	03/07/2020	20.8	18.2	21.8	20	1.9	9	4.6	22.4	57.7	Good	or Data Capture
7	03/07/2020	30/07/2020	18.7	21.3	20.8	20	1.4	7	3.5	23.0	77.0	Good	Good
8	30/07/2020	03/09/2020	24.0	26.8	23.1	25	1.9	8	4.8	21.3	99.5	Good	Good
9	03/09/2020	01/10/2020	29.7	33.3	30.6	31	1.9	6	4.7	29.5	96.7	Good	Good
10	01/10/2020	05/11/2020	34.0	33.5	32.8	33	0.6	2	1.5	20.6	98.1	Good	Good
11	05/11/2020	03/12/2020	36.0	36.0	36.2	36	0.1	0	0.4	11.3	81.9	Good	Good
12	03/12/2020	08/01/2021	33.7	33.7	34.6	34	0.5	2	1.3	30.9	94.5	Good	Good
13													

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

Overall survey --> Good precision | Poor Overall DC

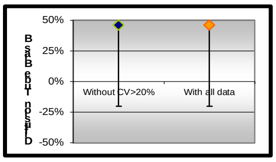
Site Name/ ID: D tube - 464 RT - 463 Fishponds Road

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 8 periods of data	
Bias factor A	0.77 (0.51 - 1.55)
Bias B	30% (-36% - 96%)
Diffusion Tubes Mean:	28 µgm⁻³
Mean CV (Precision):	3
Automatic Mean:	22 µgm⁻³
Data Capture for periods used:	91%
Adjusted Tubes Mean:	22 (14 - 44) µgm⁻³

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 8 periods of data	
Bias factor A	0.77 (0.51 - 1.55)
Bias B	30% (-36% - 96%)
Diffusion Tubes Mean:	28 µgm⁻³
Mean CV (Precision):	3
Automatic Mean:	22 µgm⁻³
Data Capture for periods used:	91%
Adjusted Tubes Mean:	22 (14 - 44) µgm⁻³



Jaume Targa, for AEA
Version 04 - February 2011

Figure C.7 - Summary Data for Bias and Precision Calculation: Parsons Street

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm⁻³	Tube 2 µgm⁻³	Tube 3 µgm⁻³	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Automatic Method: Period Mean	Automatic Method: Data Capture (% DC)	Data Quality Check: Tubes Precision Check	Data Quality Check: Automatic Monitor Data
1	08/01/2020	04/02/2020								38.0	96.9		Good
2	04/02/2020	04/03/2020	33.2	33.3	32.6	33	0.4	1	1.0	29.7	99.6	Good	Good
3	04/03/2020	31/03/2020	32.6	31.3	31.7	32	0.7	2	1.6	31.0	99.5	Good	Good
4	31/03/2020	29/04/2020	20.6	21.2	21.2	21	0.4	2	0.9	21.8	99.7	Good	Good
5	29/04/2020	04/06/2020	22.2	22.6	22.4	22	0.2	1	0.4	20.3	99.5	Good	Good
6	04/06/2020	01/07/2020	23.1	25.1	22.8	24	1.2	5	3.1	22.7	97.8	Good	Good
7	01/07/2020	29/07/2020	25.7	26.2	25.9	26	0.2	1	0.6	19.6	99.0	Good	Good
8	29/07/2020	02/09/2020	29.7	30.4		30	0.5	2	4.1	22.3	99.0	Good	Good
9	02/09/2020	30/09/2020	32.7	35.7		34	2.2	6	19.6	37.9	99.1	Good	Good
10	30/09/2020	06/11/2020	34.3	34.1	33.5	34	0.4	1	1.1	31.0	99.0	Good	Good
11	06/11/2020	01/12/2020	36.5	34.8	36.2	36	0.9	3	2.3	35.9	96.8	Good	Good
12	01/12/2020	07/01/2021	38.3	35.7	35.2	36	1.6	5	4.1	37.9	97.0	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

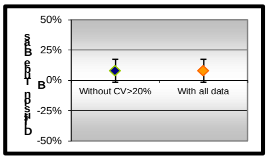
Site Name/ ID: D Tube - 439 RT - 215 Parsons Street

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	0.94 (0.87 - 1.04)
Bias B	6% (-4% - 15%)
Diffusion Tubes Mean:	30 µgm⁻³
Mean CV (Precision):	3
Automatic Mean:	28 µgm⁻³
Data Capture for periods used:	99%
Adjusted Tubes Mean:	28 (26 - 31) µgm⁻³

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 11 periods of data	
Bias factor A	0.94 (0.87 - 1.04)
Bias B	6% (-4% - 15%)
Diffusion Tubes Mean:	30 µgm⁻³
Mean CV (Precision):	3
Automatic Mean:	28 µgm⁻³
Data Capture for periods used:	99%
Adjusted Tubes Mean:	28 (26 - 31) µgm⁻³



Jaume Targa, for AEA
Version 04 - February 2011

Figure C.8 - Summary Data for Bias and Precision Calculation: St Pauls

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm-3	Tube 2 µgm-3	Tube 3 µgm-3	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
	Diffusion Tubes Measurements									Automatic Method		Data Quality Check	
1	09/01/2020	05/02/2020	31.6	31.4	31.1	31	0.2	1	0.6	26.8	92.3	Good	Good
2	05/02/2020	05/03/2020	22.5	22.4	23.2	23	0.5	2	1.1	15.6	96.4	Good	Good
3	05/03/2020	01/04/2020	19.1	17.7	19.1	19	0.8	4	2.0	15.9	98.8	Good	Good
4	01/04/2020	29/04/2020	12.7	12.8	11.6	12	0.7	5	1.6	13.5	95.1	Good	Good
5	29/04/2020	03/06/2020	9.3	8.6	9.2	9	0.4	4	0.9	8.5	92.5	Good	Good
6	03/06/2020	02/07/2020	10.9	11.0	10.7	11	0.2	1	0.4	8.4	95.7	Good	Good
7	02/07/2020	30/07/2020	10.5	11.5	10.4	11	0.6	5	1.5	5.8	99.1	Good	Good
8	30/07/2020	03/09/2020	16.0	16.0	15.9	16	0.1	1	0.2	10.7	97.3	Good	Good
9	03/09/2020	01/10/2020	19.2	19.1	19.9	19	0.4	2	1.0	15.2	99.7	Good	Good
10	01/10/2020	05/11/2020	22.1	20.5	20.2	21	1.0	5	2.5	16.7	95.1	Good	Good
11	05/11/2020	03/12/2020	25.7	25.7		26	0.0	0	0.0	24.2	95.5	Good	Good
12	03/12/2020	08/01/2021	25.6	27.6		27	1.4	5	12.8	24.7	95.0	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

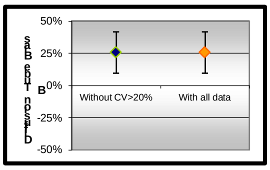
Site Name/ ID: D Tube - 455 RT - 452 St Pauls

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.83 (0.73 - 0.96)
Bias B 21% (5% - 37%)
Diffusion Tubes Mean: 19 µgm-3
Mean CV (Precision): 3
Automatic Mean: 15 µgm-3
Data Capture for periods used: 96%
Adjusted Tubes Mean: 16 (14 - 18) µgm-3

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.83 (0.73 - 0.96)
Bias B 21% (5% - 37%)
Diffusion Tubes Mean: 19 µgm-3
Mean CV (Precision): 3
Automatic Mean: 15 µgm-3
Data Capture for periods used: 96%
Adjusted Tubes Mean: 16 (14 - 18) µgm-3



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Version 04 - February 2011

Figure C.9 - Summary Data for Bias and Precision Calculation: Wells Road

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm-3	Tube 2 µgm-3	Tube 3 µgm-3	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
	Diffusion Tubes Measurements									Automatic Method		Data Quality Check	
1	08/01/2020	04/02/2020	41.4	42.8	40.2	41	1.3	3	3.3	31.4	98.2	Good	Good
2	04/02/2020	04/03/2020	32.3	35.9	33.8	34	1.8	5	4.5	27.1	99.6	Good	Good
3	04/03/2020	01/04/2020	30.9	29.5	28.4	30	1.2	4	3.0	25.3	99.9	Good	Good
4	31/03/2020	29/04/2020	22.8	20.8	18.0	21	2.4	12	6.0	19.0	99.9	Good	Good
5	29/04/2020	04/06/2020	18.9	21.9	20.0	20	1.5	7	3.7	17.4	99.8	Good	Good
6	04/06/2020	01/07/2020	30.9	29.3	28.5	30	1.2	4	3.0	22.6	88.1	Good	Good
7	01/07/2020	29/07/2020	23.8	25.2	28.2	26	2.2	9	5.5	24.7	87.8	Good	Good
8	29/07/2020	02/09/2020	34.0	32.2	27.2	31	3.5	11	8.7	34.9	76.0	Good	Good
9	02/09/2020	30/09/2020	33.8	35.4	33.1	34	1.2	3	2.9	20.7	99.3	Good	Good
10	30/09/2020	06/11/2020	34.8	35.8	36.2	36	0.7	2	1.8	21.9	98.9	Good	Good
11	06/11/2020	02/12/2020	39.7	40.8	40.8	40	0.7	2	1.7	43.3	95.8	Good	Good
12	02/12/2020	07/01/2021	39.1	38.2	39.0	39	0.5	1	1.1	48.0	97.2	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

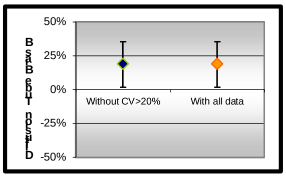
Site Name/ ID: D Tube - 438 RT - 270 Wells Road

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.88 (0.77 - 1.04)
Bias B 13% (-3% - 30%)
Diffusion Tubes Mean: 32 µgm-3
Mean CV (Precision): 5
Automatic Mean: 28 µgm-3
Data Capture for periods used: 95%
Adjusted Tubes Mean: 28 (24 - 33) µgm-3

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.88 (0.77 - 1.04)
Bias B 13% (-3% - 30%)
Diffusion Tubes Mean: 32 µgm-3
Mean CV (Precision): 5
Automatic Mean: 28 µgm-3
Data Capture for periods used: 95%
Adjusted Tubes Mean: 28 (24 - 33) µgm-3



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Version 04 - February 2011

Figure C.10 - Summary Data for Bias and Precision Calculation: Temple Way

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Automatic Method: Period Mean	Automatic Method: Data Capture (% DC)	Data Quality Check: Tubes Precision Check	Data Quality Check: Automatic Monitor Data
1	08/01/2020	04/02/2020	39.2	37.5	41.4	39	2.0	5	4.9	39.3	99.8	Good	Good
2	04/02/2020	04/03/2020	32.4	28.7	32.2	31	2.1	7	5.1	25.8	99.7	Good	Good
3	04/03/2020	31/03/2020	31.9	32.5	33.2	33	0.6	2	1.5	29.0	99.8	Good	Good
4	31/03/2020	29/04/2020	29.1	29.5	24.2	28	3.0	11	7.4	25.6	99.9	Good	Good
5	29/04/2020	04/06/2020	21.5	21.4	21.3	21	0.1	1	0.3	21.2	99.5	Good	Good
6	04/06/2020	01/07/2020	22.8	19.3	22.6	22	2.0	9	4.9	20.6	100.0	Good	Good
7	01/07/2020	29/07/2020	19.0	18.9	18.9	19	0.1	0	0.2	15.3	98.5	Good	Good
8	29/07/2020	04/09/2020	31.4	31.2	30.5	31	0.5	2	1.2	27.4	99.7	Good	Good
9	04/09/2020	02/10/2020	38.9	37.8	37.8	38	0.6	2	1.5	34.1	99.9	Good	Good
10	02/10/2020	06/11/2020	34.9	34.2	35.6	35	0.7	2	1.8	33.3	99.5	Good	Good
11	06/11/2020	02/12/2020	34.9	32.9	33.6	34	1.0	3	2.5	35.6	99.8	Good	Good
12	02/12/2020	07/01/2021	37.5	37.1	37.0	37	0.3	1	0.6	35.6	99.8	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

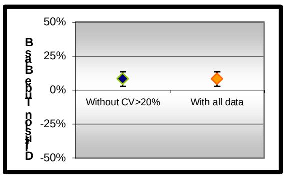
Site Name/ ID: D Tube - 499 RT - 500 Temple Way

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 0.93 (0.89 - 0.98)
Bias B 7% (2% - 13%)
Diffusion Tubes Mean: 31 μgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 29 μgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 28 (27 - 30) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.93 (0.89 - 0.98)
Bias B 7% (2% - 13%)
Diffusion Tubes Mean: 31 μgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 29 μgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 28 (27 - 30) μgm^{-3}



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Version 04 - February 2011

Figure C.11 – Summary Data for Bias and Precision Calculation: Colston Avenue

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Automatic Method: Period Mean	Automatic Method: Data Capture (% DC)	Data Quality Check: Tubes Precision Check	Data Quality Check: Automatic Monitor Data
1	08/01/2020	04/02/2020	85.3	90.3	96.5	91	5.6	6	14.0	79.2	99.8	Good	Good
2	04/02/2020	04/03/2020	79.1	80.4	82.8	81	1.9	2	4.6	61.6	99.1	Good	Good
3	04/03/2020	31/03/2020	61.9	67.5	66.4	65	2.9	4	7.3	50.6	99.7	Good	Good
4	31/03/2020	29/04/2020	26.8	27.3	25.0	26	1.2	5	3.0	20.5	68.7	Good	or Data Capture
5	29/04/2020	04/06/2020	22.7	25.3	25.2	24	1.5	6	3.7	19.0	99.8	Good	Good
6	04/06/2020	01/07/2020	49.8	47.1	48.0	48	1.4	3	3.5	33.4	85.8	Good	Good
7	01/07/2020	29/07/2020	52.7	46.7	57.9	52	5.6	11	14.0	31.2	99.4	Good	Good
8	29/07/2020	02/09/2020	59.5	63.6	61.9	62	2.1	3	5.1	43.1	99.8	Good	Good
9	02/09/2020	02/10/2020	79.0	77.6	74.5	77	2.3	3	5.6	47.9	99.7	Good	Good
10	02/10/2020	06/11/2020	77.2	77.6	76.5	77	0.6	1	1.4	50.7	99.2	Good	Good
11	06/11/2020	02/12/2020	67.1	67.8	62.9	66	2.6	4	6.6	54.8	88.8	Good	Good
12	02/12/2020	07/01/2021	67.8	62.5	66.4	66	2.8	4	6.8	42.5	99.3	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

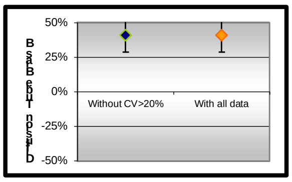
Site Name/ ID: D Tube - 502 RT - 501 Colston Avenue

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 11 periods of data
Bias factor A 0.73 (0.67 - 0.79)
Bias B 38% (26% - 50%)
Diffusion Tubes Mean: 64 μgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 47 μgm^{-3}
Data Capture for periods used: 97%
Adjusted Tubes Mean: 47 (43 - 51) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 11 periods of data
Bias factor A 0.73 (0.67 - 0.79)
Bias B 38% (26% - 50%)
Diffusion Tubes Mean: 64 μgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 47 μgm^{-3}
Data Capture for periods used: 97%
Adjusted Tubes Mean: 47 (43 - 51) μgm^{-3}



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Version 04 - February 2011

Diffusion Tube Annualisation

Data capture rates for sites 295, 574, 575, 576 and 577 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[12]. Data from the Background AURN monitoring sites at Swindon Walcot, Newport, Bournemouth and Bristol St Paul's were used in the process.

The calculations made to annualise the data for these sites are included in Table C.5.

Diffusion Tube Bias Adjustment Factors

The diffusion tube data presented within the 2020 ASR have been corrected for bias using an adjustment factor. Bias represents the overall tendency of the diffusion tubes to under or over-read relative to the reference chemiluminescence analyser. LAQM.TG16 provides guidance with regard to the application of a bias adjustment factor to correct diffusion tube monitoring. Triplicate co-location studies can be used to determine a local bias factor based on the comparison of diffusion tube results with data taken from NO_x/NO_2 continuous analysers. Alternatively, the national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method.

Bristol City Council have applied a local bias adjustment factor of 0.85 to the 2020 monitoring data. A summary of bias adjustment factors used by Bristol City Council over the past five years is presented in Table C.4.

Somerset Scientific Services were used throughout the whole of 2020 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

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

follows that set out in the practical guidance document.

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

Air PT Round	Percent Of tubes submitted found to be satisfactory
Air PT AR036 – Jan/Feb 2020	100%
Air PT AR037 – May/June 2020	NR (4) Cancelled due to pandemic
Air PT AR039 – July/August 2020	NR (4) Cancelled due to pandemic
Air PT AR040 – Sept/October 2020	100%

Discussion of Choice of Factor to Use

Box 7.1 of LAQM TG16 was used in order to determine the most appropriate BAF to use in 2020. Bristol has a relatively large network of automatic NO_X analysers that are operated using robust QA/QC procedures. In 2020, 6 of these sites recorded data capture rates of more than 90%. The precision of the analysis at these co-located triplicate tubes was classed as good for all sites and all months.

The locally derived bias adjustment factor calculated for 2020 was 0.85.

Bias adjustment factors used since 2016 have been provided in Table C.4 to provide transparency and put the 2020 BAF in context to those used in previous years.

Table C.4 – Bias Adjustment Factor

Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2020	Local	N/A	0.85
2019	Local	N/A	0.82
2018	Local	N/A	0.92
2017	Local	N/A	0.95
2016	Local	N/A	0.93

NO_2 Fall-off with Distance from the Road

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

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.

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 2020 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.

PM_{10} and $PM_{2.5}$ Monitoring Adjustment

The type of PM_{10}/$PM_{2.5}$ monitors utilised within Bristol City Council do not required the application of a correction factor.

Automatic Monitoring Annualisation

All automatic monitoring locations within Bristol recorded data capture of greater than 75% therefore it was not required to annualise any monitoring data. In addition, any sites with a data capture below 25% do not require annualisation.

Table C.5 – Annualisation Summary (concentrations presented in µg/m^3)

Site ID	Annualisation Factor Bristol St Paul's	Annualisation Factor Bournemouth	Annualisation Factor Newport	Annualisation Factor Swindon Walcot	Average Annualisation Factor	Raw Data Annual Mean	Annualised Annual Mean	Comments
295	1.0265	0.9808	1.0290	1.0117	1.0120	43.2	43.7	
574	1.0777	1.0471	1.0666	1.0717	1.0658	30.1	32.1	
575	1.0147	1.0135	1.0335	1.0190	1.0202	35.6	36.4	
576	1.0279	0.9897	1.0321	1.0082	1.0145	27.8	28.2	
577	0.9545	0.9739	0.9938	0.9701	0.9731	36.8	35.8	

Table C.6 – Local Bias Adjustment Calculation

	Local Bias Adjustment Input 502 Colston Avenue	Local Bias Adjustment Input 320 Brislington	Local Bias Adjustment Input 439 Parsons Street	Local Bias Adjustment Input 455 St Paul's	Local Bias Adjustment Input 499 Temple Way	Local Bias Adjustment Input 438 Wells Road
Periods used to calculate bias	11	11	11	12	12	12
Bias Factor A	0.73 (0.67 - 0.79)	0.85 (0.78 - 0.93)	0.94 (0.87 - 1.04)	0.83 (0.73 - 0.96)	0.93 (0.89 - 0.98)	0.88 (0.77 - 1.04)
Bias Factor B	38% (26% - 50%)	18% (8% - 28%)	6% (-4% - 15%)	21% (5% - 37%)	7% (2% - 13%)	13% (-3% - 30%)
Diffusion Tube Mean (µg/m^3)	64	22	30	19	31	32
Mean CV (Precision)	4%	4	3	3	4	5
Automatic Mean (µg/m^3)	47	19	28	15	29	28
Data Capture	97%	98	99	96	100	95
Adjusted Tube Mean (µg/m^3)	47 (43 – 51)	19 (17 - 21)	28 (26 - 31)	16 (14 - 18)	28 (27 - 30)	28 (24 - 33)

Notes:

A combined local bias adjustment factor of 0.85 has been used to bias adjust the 2020 diffusion tube results.

Table C.7 – NO_2 Fall off With Distance Calculations (concentrations presented in µg/m³)

Site ID	Distance (m): Monitoring Site to Kerb	Distance (m): Receptor to Kerb	Monitored Concentration (Annualised and Bias Adjusted	Background Concentration	Concentration Predicted at Receptor	Comments
175	2.0	15.0	36.4	13.69657	25.7	
239	0.7	9.0	47.6	14.96654	31.9	
405	1.0	2.0	38.7	16.51421	35.6	
502	2.0	5.0	52.1	21.7274	**45.6**	*Predicted concentration at Receptor above AQS objective.*
567	1.5	3.0	41.3	15.04739	*37.3*	*Predicted concentration at Receptor within 10% the AQS objective.*

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

Figure D.1 – Extent of Air Quality Management Area

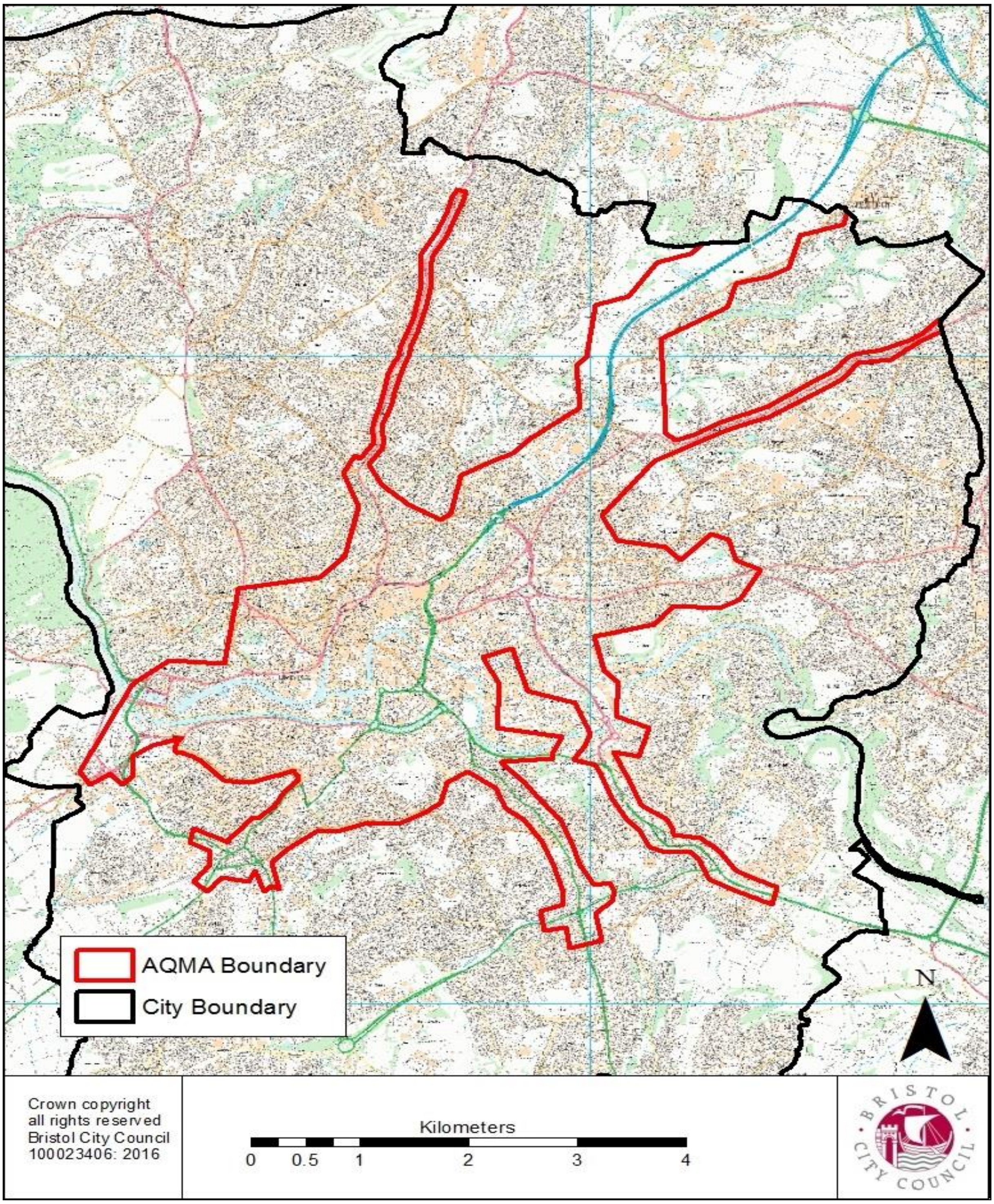


Figure D.2 - Central Monitoring Locations: 2020 Annual NO_2 Concentrations

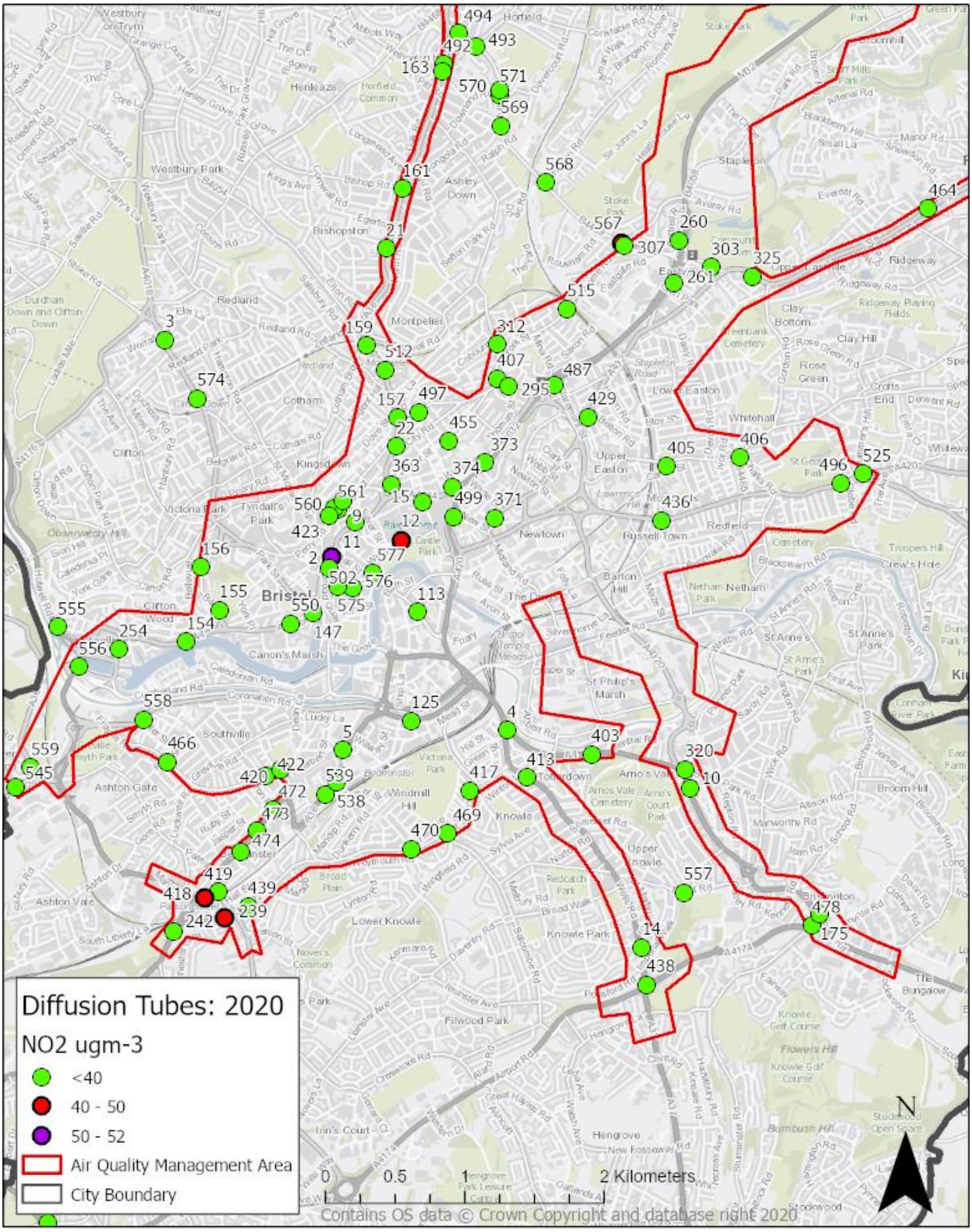


Figure D.3 - Central Monitoring Locations: 2020 Annual NO_2 Concentrations Distance Adjusted (where relevant)

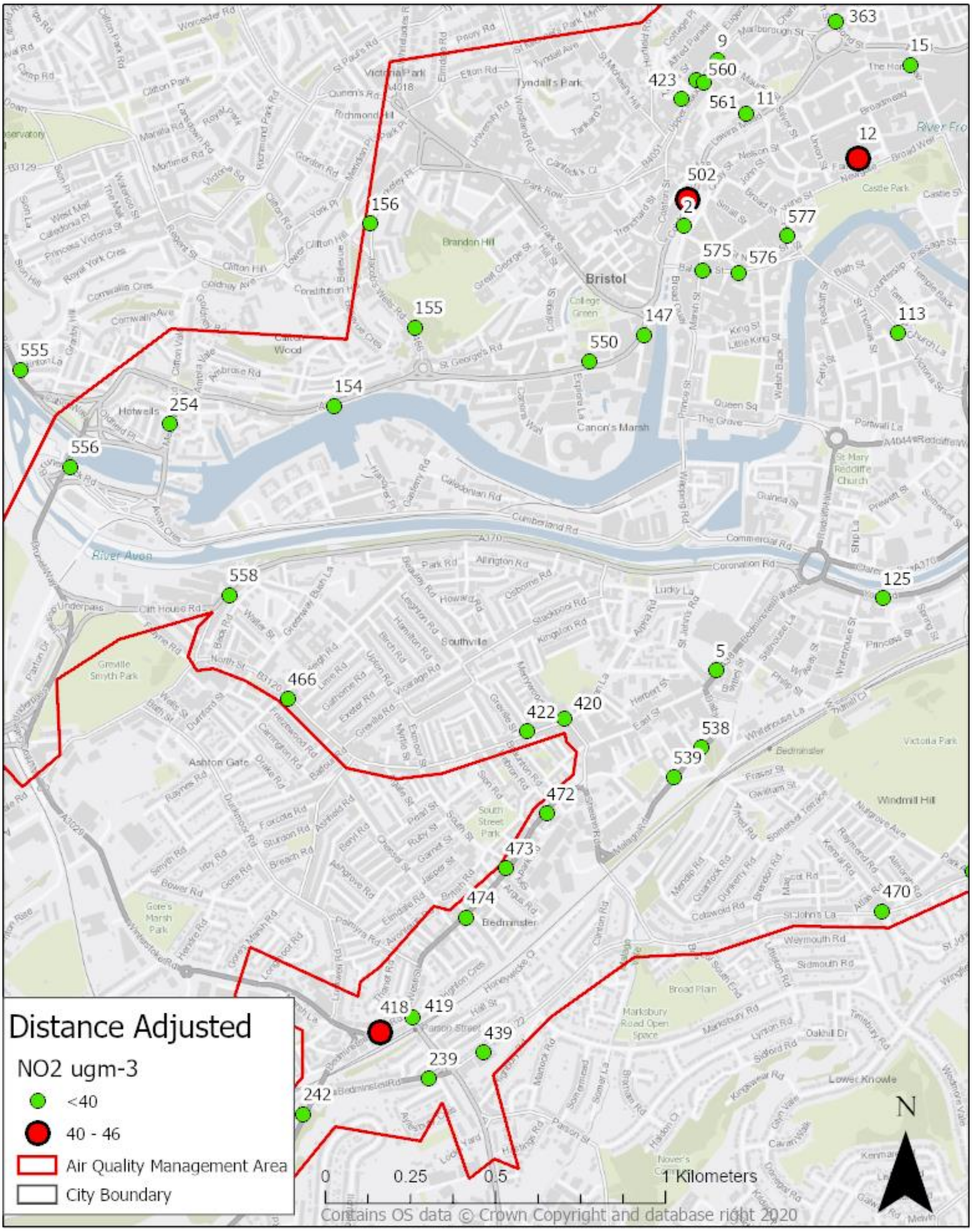


Figure D.4 - Avonmouth Monitoring Locations

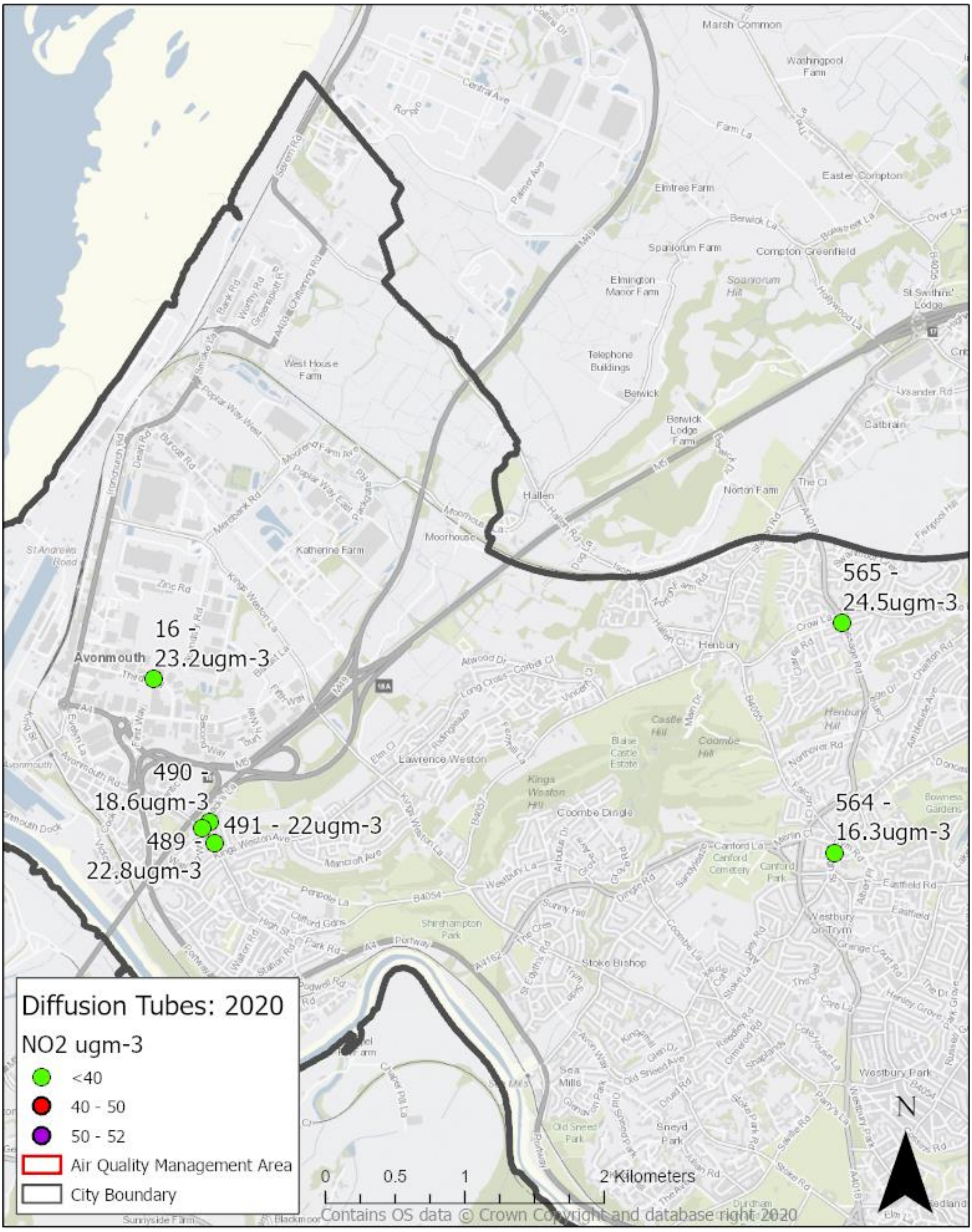
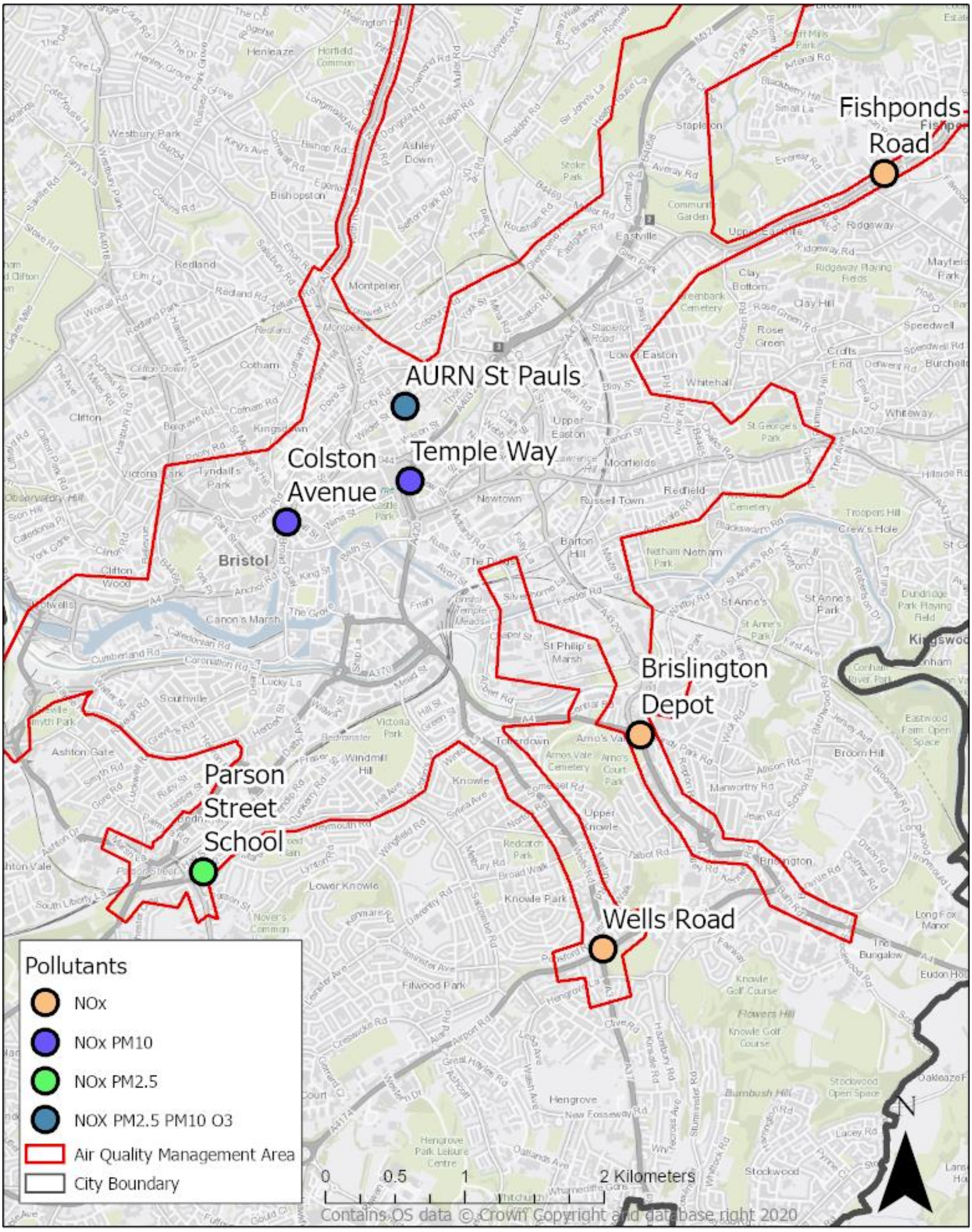


Figure D.5 - Continuous (real-time) Monitoring Locations in 2020



Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England[13]

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

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

Appendix F: Impact of COVID-19 upon LAQM

COVID-19 has had a significant impact on society. Inevitably, COVID-19 has also had an impact on the environment, with implications to air quality at local, regional and national scales.

COVID-19 has presented various challenges for Local Authorities with respect to undertaking their statutory LAQM duties in the 2021 reporting year. Recognising this, Defra provided various advice updates throughout 2020 to English authorities, particularly concerning the potential disruption to air quality monitoring programmes, implementation of Air Quality Action Plans (AQAPs) and LAQM statutory reporting requirements. Defra has also issued supplementary guidance for LAQM reporting in 2021 to assist local authorities in preparing their 2021 ASR. Where applicable, this advice has been followed.

Despite the challenges that the pandemic has given rise to, the events of 2020 have also provided Local Authorities with an opportunity to quantify the air quality impacts associated with wide-scale and extreme intervention, most notably in relation to emissions of air pollutants arising from road traffic. The vast majority (>95%) of AQMAs declared within the UK are related to road traffic emissions, where attainment of the annual mean objective for nitrogen dioxide (NO_2) is considered unlikely. On 23rd March 2020, the UK Government released official guidance advising all members of public to stay at home, with work-related travel only permitted when absolutely necessary. During this initial national lockdown (and to a lesser extent other national and regional lockdowns that followed), marked reductions in vehicle traffic were observed; Department for Transport (DfT) data[14] suggests reductions in vehicle traffic of up to 70% were experienced across the UK by mid-April, relative to pre COVID-19 levels.

This reduction in travel in turn gave rise to a change of air pollutant emissions associated with road traffic, i.e. nitrous oxides (NO_x), and exhaust and non-exhaust particulates (PM). The Air Quality Expert Group (AQEG)[15] has estimated that during the initial lockdown period in 2020, within urbanised areas of the UK reductions in NO_2 annual mean concentrations were between 20 and 30% relative to pre-pandemic levels, which

[14] Prime Minister's Office, COVID-19 briefing on the 31st of May 2020

[15] Air Quality Expert Group, Estimation of changes in air pollution emissions, concentrations and exposure during the COVID-19 outbreak in the UK, June 2020

represents an absolute reduction of between 10 to 20µg/m^3 if expressed relative to annual mean averages. During this period, changes in $PM_{2.5}$ concentrations were less marked than those of NO_2. $PM_{2.5}$ concentrations are affected by both local sources and the transport of pollution from wider regions, often from well beyond the UK. Through analysis of AURN monitoring data for 2018-2020, AQEG have detailed that $PM_{2.5}$ concentrations during the initial lockdown period were of the order 2 to 5µg/m^3 lower relative to those that would be expected under business-as-usual conditions.

As restrictions are gradually lifted, the challenge is to understand how these air quality improvements can benefit the long-term health of the population.

Impacts of COVID-19 on Air Quality within Bristol

The comparison of raw data between 2019 and 2020 was for the period 25-03-2019 to 01-01-2020 and 24-02-2020 to 31-12-2020.

Analysis of air quality data from Bristol City Council's continuous air monitoring network comparing the lockdown period in 2020 to the same period in 2019 shows a significant change in nitrogen dioxide (NO_2), a traffic pollutant, of a maximum -86% as a weekly average. Reductions in NOx (oxides of nitrogen), which can be considered a surrogate for direct exhaust emissions, also fell with a maximum mean weekly change of -86%. These changes cannot be attributed solely to the lockdown measures because of the effect of weather and the small effect of changes in the vehicle fleet between the two comparison periods.

Measures of particulate matter (PM) - PM_{10} and $PM_{2.5}$ also fell but the reduction was less. This is because the local contribution to ambient PM is a small part of the total. There are significant regional and background components present which were unaffected by the lockdown measures. For PM_{10} the roadside increment in 2019 was 27% when comparing a background and roadside site in the central city.

Ozone (O_3) rose in the first lockdown when compared to the baseline period. This is expected because as NOx declines, less ozone is chemically reduced in the photochemical reaction between these two species and hence concentrations of ozone may rise. Unusually sunny weather also contributed to the higher than usual levels of ozone.

Traffic flows started to decline when the first measures were announced on the 16th March. By the time full lockdown was operating (from 24th March), traffic flows had declined by more than 50% compared to normal levels. Data are from BCC's Urban Traffic Control (UTC) system and represent smoothed daily mean speeds and total flows at routes or counters close to the continuous air quality monitoring sites.

It can be seen that traffic flows began to climb slowly again after the first week in April.

Figure F.1 – Daily vehicle flow and speed near air quality monitoring sites

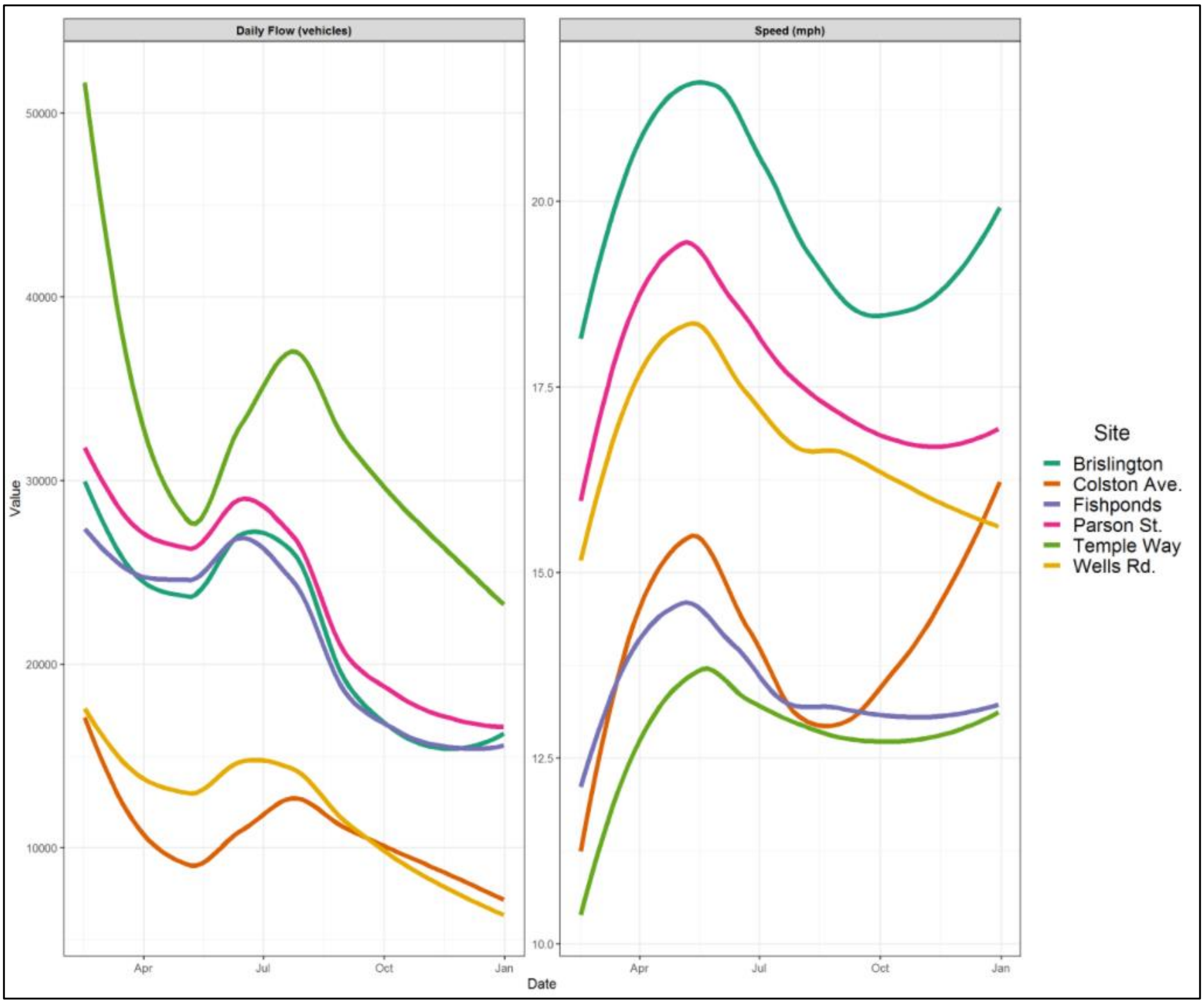


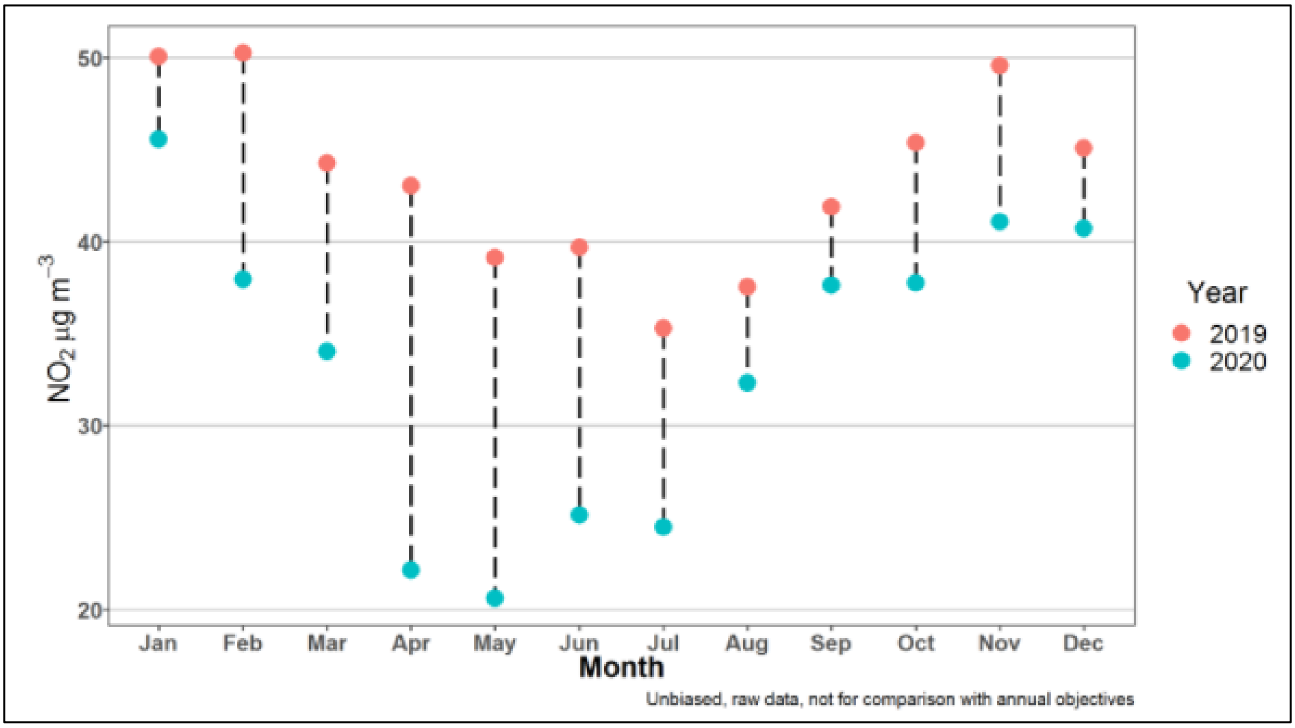
Table F1 shows the maximum percentage changes of weekly mean concentrations aggregated by site and pollutant. Roadside sites have been selected as these are the most affected. The analysis compares weekly averages to the same week in the preceding year, i.e. 2019. While this does not take into account the effects of the weather on concentrations, it provides an indication of the extent of change and by using weekly means, noise that would be apparent when using a daily mean value is reduced. Data from the national network sites (Bristol St. Pauls and Bristol Temple Way) were not fully ratified at the time of producing the data below.

Table F.1 – Maximum Weekly Change by Pollutant and Site 2019 – 2020 comparison

Maximum Weekly change by Pollutant and Site				
Site Id	Site	Pollutant	Week Beginning	Change
215	Parsons Street	NO_2	24.08.20	-55%
215	Parsons Street	NOx	06.4.20	-59%
270	Wells Road	NO_2	20.04.20	-51%
270	Wells Road	NOx	19.10.20	-58%
463	Fishponds Road	NO_2	16.11.20	-86%
463	Fishponds Road	NOx	28.12.20	-79%
500	Temple Way	NO_2	06.07.20	-79%
500	Temple Way	NOx	06.07.20	-84%
501	Colston Avenue	NO_2	20.04.20	-76%
501	Colston Avenue	NOx	20.04.20	-86%

The chart below shows that the difference in concentrations between 2019 and 2020 increased dramatically as the first lockdown took effect and diminished as lockdown measures were eased during the summer. A subset of sites was selected where sites existed in both 2019 and 2020 for each month.

Figure F.2 – Comparison of Monthly Mean NO_2 Values for All Sites*



*data not bias adjusted so not for use to compare against annual objectives.

Opportunities Presented by COVID-19 upon LAQM within Bristol City Council Area

In response to the changes in transport patterns and a need to maintain social distancing Bristol City Council opened up space usually reserved for parking and driving to cyclist and pedestrians.

The impacts of the changes have been considered alongside consultation with local residents, businesses and ward councillors before making any changes permanent. The changes made are:

- Bristol Bridge and Baldwin Street: closing the roads to general through-traffic to give priority to pedestrians, cycling and public transport;
- Upper Maudlin Street, Marlborough Street and Park Row: new protected cycle lanes by reducing two traffic lanes to one, and removal of parking and traffic lane where necessary to widen pavements for pedestrians;
- Lewins Mead: creation of new cycle lane. A new bus lane has also been installed on Haymarket, which cyclists can share after leaving the Lewins Mead bike lane;

- Cotham Hill: Two sections of the road is closed to motorists between Whiteladies Gate and Hampton Lane, and between Hampton Park and Abbotsford Road. This provides outdoor space for traders, pedestrians and cyclists. Space for loading, disabled parking, and drop off/pick up points will be available at each end of the closed areas;
- Clifton Village: suspension of parking bays on Princess Victoria Street between Regent Street to The Mall, and The Mall between Princess Victoria Street;
- Westbury Village: parking bays suspended and pavements widened in retail area;
- Clifton Triangle: widened pavement and cycle lane introduced in retail area through parking bay suspension and traffic lane removal;
- King Street: widened pavement in recreational area through suspension of parking bays and timed street closure;
- Mina Road, St Werburgh's: new protected cycle route along Mina Road on its eastern side to improve safety for southbound cyclists along this stretch and improve visibility along the road for all users. This has also involved the removal of on street parking along the eastern side of Mina Road from the railway tunnel southwards to the junction of Mina Road and Mercia Drive;
- Counterslip near Bristol Bridge: new protected bike lanes, and
- Merchants Road Bridge, Hotwells: creating a safe social distancing one way system for pedestrians, including an improved road crossing facility.

Pedestrianisation of the Old City has been introduced through parking restrictions and timed closures. These will last for a maximum of 18 months and during this period assessment and consultations will take place to decide if these or similar changes should be made permanent. Additional blue badge parking bays have been created in this area as part of the changes.

Challenges and Constraints Imposed by COVID-19 upon LAQM within Bristol City Council

No challenges or constraints relating to LAQM have arisen during 2020 as a consequence of COVID-19 within Bristol City Council. The impact is described as 'None', using the matrix outlined in Table F 2.

Table F.2 – Impact Matrix

Category	Impact Rating: None	Impact Rating: Small	Impact Rating: Medium	Impact Rating: High
Automatic Monitoring – Data Capture (%)	More than 75% data capture	50 to 75% data capture	25 to 50% data capture	Less than 25% data capture
Automatic Monitoring – QA/QC Regime	Adherence to requirements as defined in LAQM.TG16	Routine calibrations taken place frequently but not to normal regime. Audits undertaken alongside service and maintenance programmes	Routine calibrations taken place infrequently and service and maintenance regimes adhered to. No audit achieved	Routine calibrations not undertaken within extended period (e.g. 3 to 4 months). Interruption to service and maintenance regime and no audit achieved
Passive Monitoring – Data Capture (%)	More than 75% data capture	50 to 75% data capture	25 to 50% data capture	Less than 25% data capture
Passive Monitoring – Bias Adjustment Factor	Bias adjustment undertaken as normal	<25% impact on normal number of available bias adjustment colocation studies (2020 vs 2019)	25-50% impact on normal number of available bias adjustment studies (2020 vs 2019)	>50% impact on normal number of available bias adjustment studies (2020 vs 2019) and/or applied bias adjustment factor studies not considered representative of local regime
Passive Monitoring – Adherence to Changeover Dates	Defra diffusion tube exposure calendar adhered to	Tubes left out for two exposure periods	Tubes left out for three exposure periods	Tubes left out for more than three exposure periods
Passive Monitoring – Storage of Tubes	Tubes stored in accordance with laboratory guidance and analysed promptly.	Tubes stored for longer than normal but adhering to laboratory guidance	Tubes unable to be stored according to be laboratory guidance but analysed prior to expiry date	Tubes stored for so long that they were unable to be analysed prior to expiry date. Data unable to be used
AQAP – Measure Implementation	Unaffected	Short delay (<6 months) in development of a new AQAP, but is on-going	Long delay (>6 months) in development of a new AQAP, but is on-going	No progression in development of a new AQAP
AQAP – New AQAP Development	Unaffected	Short delay (<6 months) in development of a new AQAP, but is on-going	Long delay (>6 months) in development of a new AQAP, but is on-going	No progression in development of a new AQAP

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	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 or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide

References

- Local Air Quality Management Technical Guidance LAQM.TG16. April 2021. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.
- Local Air Quality Management Policy Guidance LAQM.PG16. May 2016. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.