



2022 Air Quality Annual Status Report (ASR)

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

Date: June 2022

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Executive Summary: Air Quality in Our Area

Air Quality in Worcester City

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 ages³, with a total estimated healthcare cost to the NHS and social care of £157 million in 2017⁴.

Worcestershire Regulatory Services (WRS) is a shared service formed from the Environmental Health and Licensing departments of the six Worcestershire District Councils. Responsibility for managing (monitoring and reporting of) local air quality transferred from the partnership councils to WRS in April 2011.

Three Air Quality Management Areas (AQMA) were declared by Worcester City Council in 2009 for exceedances of the annual average objective for nitrogen dioxide (NO₂):

- Dolday/Bridge Street AQMA declared 1st March 2009;
- Lowesmoor/Rainbow Hill AQMA declared 1st March 2009; and
- Newtown Road AQMA declared 1st March 2009.

The Newtown Road AQMA was revoked by the council on 30th July 2014.

A further AQMA was declared by the council for the St Johns area of Worcester for exceedance of the annual mean objective for NO₂ on 26th September 2014.

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 2021

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

In 2017, a detailed assessment was undertaken of an area within London Road and Sidbury by Air Quality Consultants (AQC) on behalf of Worcester City Council. The AQC report concluded that an area at the western end of London Road should be declared as an AQMA.

Additionally, long term trend measurements and automatic analyser results up to 2018 within Foregate Street, The Butts and The Tything, Worcester indicated that requirement for a new AQMA declaration of this combined study area would likely be confirmed by detailed assessment.

On 11th June 2019 Worcester City Council formally declared the Worcester City AQMA (Worcester City (Political Boundary)) which encompasses the whole district area as an AQMA, for likely breach of the nitrogen dioxide annual mean.

Additionally, Worcester City Council AQMA Variation Order 2019 consolidates the existing 2009 and 2014 AQMAs, as detailed above, into the Worcester City AQMA (Worcester City (Political Boundary)) as of 11th June 2019.

Details of declaration and plans of the AQMAs can be found on the following pages of WRS website: [Air Quality Management Area Declarations | Worcestershire Regulatory Services \(worcsregservices.gov.uk\)](https://www.worcsregservices.gov.uk)

Poor areas of air quality within Worcester typically coincide with the strategic road network in and around the city centre in proximity with sensitive residential receptors. These generally relate to The Butts / All Saints Road / Bridge Street strategic road one way system, The Tything (A38) to The Foregate Street corridor, Lowesmoor / Rainbow Hill / Astwood Road (B4850) corridor, St Johns Bull Ring (A44) and London Road (A44).

Like many parts of the UK, poor air quality in Worcester City is linked to areas with high volumes of traffic, congestion and 'street canyon' landscapes (where height of the building is greater than width of road). Worcestershire County Council has responsibility for strategic transport issues in the county and published the fourth Local Transport Plan (LTP4) in 2017. WRS continues to liaise with the County Council in the development of countywide plans to ensure that remediation of the AQMA remain a strategic transport priority.

WRS has good working relationship with the County Council's Strategic Transport Team and has also experienced closer working ties with the Director of Public Health (DoPH) and Sustainability departments within the County Council in the last 2 – 3 years.

A new Air Quality Partnership led by the DoPH, supported by WRS, and comprising members from public health, air quality, strategic planning, sustainability, highways and transport was set up in 2019. The group have discussed potential actions to improve air quality across the County and work was continuing into 2020 to formalise an action plan for implementation. However due to the COVID-19 pandemic the work of the group was postponed indefinitely following the outbreak. It is anticipated that the partnership will continue later in 2022.

Monitoring data from 2020 does not represent a standard year with the emergence of the COVID-19 Pandemic and first lockdown in March 2020 and subsequent lockdowns that followed. With the number of vehicle journeys massively reduced much lower concentrations of nitrogen dioxide can be seen in all locations compared to previous years. As such, monitoring data from 2021 shows an overall increase in average recorded annual mean NO₂ concentrations compared to 2020, increasing by 13.2% (3.2 µg/m³). All monitoring stations (with the exception of Lwm1 and BrS2) saw an increase from 2020 to 2021. This is likely to have been caused by the increase in traffic following the easing of 'lockdowns' in 2020 caused by the COVID-19 pandemic. However, NO₂ concentrations at all monitoring stations (with the exception of Mcl) decreased in 2021 compared to 2019 which is the most recent pre-covid year.

No exceedances of the annual mean objective were recorded within Worcester City during 2021. In 2021, the highest concentration of NO₂ recorded across Worcester City was 39.1 µg/m³ at BUT2 (which is 0.9 µg/m³ below the exceedance threshold (40 µg/m³)). This location has recorded the highest concentration across the city for the last 5 years with a concentration of 35.9 µg/m³ in 2020 and 42.1 µg/m³ in 2019.

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 Strategy⁵ sets out the case for action, with goals to reduce exposure to harmful pollutants. The Road to Zero⁶ sets out the 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.

In 2013, WRS produced a countywide Air Quality Action Plan (AQAP) for Worcestershire which was adopted by Worcester City Council. WRS have produced two updates to the AQAP, the latest in September 2016. For details of all measures completed, in progress or planned, please refer to the 'Air Quality Action Plan Progress Report for Worcestershire April 2015-2016'. A copy of this, the previous update, and the AQAP, is available to view or download at: <http://www.worcsregservices.gov.uk/pollution/air-quality/air-quality-action-plan.aspx>

In 2014 WRS set up the Worcester Urban (Steering) Sub-Group to facilitate progressing the implementation of actions identified in the AQAP.

On 26th July 2017 Worcester City Council Environmental and Licensing Group voted to set up a Task and Finish Group to explore actions to improve air quality in the city. The group comprised council members from three political parties, council officers, representatives of the Director of Public Health and Worcestershire County Council Highways. WRS Technical Services officers provided technical advice and expertise on air pollution and potential measures to the group.

In 2018, WRS prepared a summary report of Worcester City Task & Finish Group work and recommendations for future air quality improvement measures. The final report was approved by Worcester City Council Environment and Licensing Committee in January 2019 which made the following 6 recommendations which have been adopted as prioritised measures with work continuing. Full details are provided in Table 2.2.

- 1) Consideration of air quality impacts (as a health & safety implication) in the development of every Council Policy, formal decision, and key project by the Council.

⁵ Defra. Clean Air Strategy, 2019

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

- 2) Feasibility of installing electric vehicle infrastructure for residential streets in the most appropriate locations for air quality.
- 3) Full consideration of air quality in proposals for car parking in the City Centre (as part of the Masterplan).
- 4) Investigation of feasibility for procurement and operation of ULEV pool cars for use by Council Officers.
- 5) Study of feasibility and potential impacts for proposing an emission standard for Taxi's licensed by the Council (Taxi Strategy Task and Finish Group).
- 6) Low Emission Strategy for adoption by the Council top include all the above recommendations.

Other key actions are: -

- **Declaration of Worcester City AQMA (Political Boundary), 11th June 2019.**
Worcester City Council is currently working towards a new Air Quality Action Plan (AQAP) setting out measures to improve local air quality following declaration of the citywide AQMA in 2019. Unfortunately, this work was delayed in 2020 due to the COVID-19 outbreak and subsequent UK lockdowns. Traffic surveys are necessary to allow for source apportionment work to inform the AQAP. A draft source apportionment (2022) has now been completed.

- **City Centre Masterplan adopted 16th July 2019.** The Masterplan document can be found via the following link:

<https://www.worcester.gov.uk/planning/city-centre-masterplan>

Actions within the plan potentially benefitting local air quality include:

- Development opportunities that include the replacement of numerous surface level car parks with multi storey car parking at strategic points; and
- Development opportunities and public realm enhancements supporting more active movements around the city e.g. walking and cycling.
- **Railway Arches Development** - The Council are redeveloping the Victorian railway arches in the heart of the city. The development includes conversion of spaces into workshops and studios and pedestrian/cyclist access between Worcester Foregate Station and the river front. It is anticipated improved access will encourage additional uptake of active travel within the city centre and is due completion in 2022.

Worcestershire County Council Highways & Transport Improvements

- **Worcestershire Parkway Station SWST1** – Works completed in 2019 and the new station opened on 23rd February 2020, 3 weeks prior to the first COVID-19 lockdown. Initial indications were of high use exceeding that anticipated in the business plan, with the car park 75% full and strong ticket sales. Rail use declined because of the pandemic but is now in recovery. The station is at the heart of the emerging proposals for Worcestershire Parkway Strategic Growth area arising from the review of South Worcestershire Development Plan. The train station delivers regional connectivity for the County as it sits at the crossing point of the North Cotswolds and Birmingham to Bristol lines. A major increase in the connectivity by rail for the county.
- **Southern Link Road (A4440) Phase 4 (Ketch to Powick Hams) SWST5** – Work began in March 2019 on Phase 4 to complete dualling of carriageway between the Ketch and Powick roundabouts, capacity improvements to those junctions, an additional bridge over River Severn, and new foot/cycle bridges. Completion is now anticipated in spring 2022. Increase in journey time reliability and reduction in congestion on the major route linking Worcester to the strategic road network and to south Worcestershire and Herefordshire is expected. Further information is available via the following link: -

[The A4440 Worcester Southern Link Road Improvements | Worcestershire County Council](#)

- **Worcester Western Link Road SWST12** – to develop a new link road connecting A4440 with B4204 Martley Road. A detailed Options Appraisal Report has been prepared for this scheme but was delayed due to COVID-19. The scheme is reliant on WCC working with the West of Worcester developers to ensure that access arrangements facilitate the opportunity to deliver the Link Road. No additional progress has been made since the 2021 ASR.
- **LTP4 Scheme W1 (Worcester Rainbow Hill/Astwood Road/Bilford Road/Blackpole Road Key Corridor of Improvement)** – An Options Appraisal Report is expected to be undertaken to identify a package of measures to improve the efficient and safe operation of this corridor.

- **LTP4 Scheme W4 Worcester East** – West Axis Way Key Corridor Improvement – This corridor improvement scheme is mostly completed except for St Johns District Centre with works continuing in 2021. Further information is available via the following link: - <https://www.worcestershire.gov.uk/stjohnsimprovements>
- **Shrub Hill station** - As part of the Shrub Hill regeneration work to deliver the Shrub Hill station including the restoration of train services a bid was submitted to DfT through the Levelling Up Fund round 1. The bid was not successful and other funding options are now being reviewed.
- **Active Travel Network** – Worcester City Towns Fund bid included proposals for an active travel network. County Council have planning permission for Kepax Bridge a new active travel bridge across the Severn. Worcester City are also funding this in part through the Towns Fund. Active travel investments are also being delivered along the canal towpath to Blackpole and also from Ketch to Diglis linking to Duck Brook and routes from Ronkswood. [Worcester Towns Investment Plan](#)

Various active travel corridors outlined in LTP4 at varying stages of development. City Masterplan includes 5 Public Realm enhancements including active corridors and spaces, with ‘The Arches’ due for completion 2021/22. Active Travel funding secured from the (Emergency) Active Travel Fund for enhancements to the canal towpath between Diglis and Sixways including surfacing and passing places. Complemented by the active travel elements within the Towns Fund bid from Worcester City which provide additional links to the Ketch roundabout and onwards links to Powick.

The Kepax bridge scheme will increase connectivity between east and west banks of river and allows future expansion to walking and cycling routes. The Hams Way active travel bridge is now open connecting active travel networks in Worcester with further connections proposed for Malvern (subject to funding). The Broomhall Way active travel footbridge which links St Peters / Worcester with the new community of Hopfields was completed in the summer of 2021. Crookbarrow Way active travel bridge is open and links St Peter’s north of the Broomhall Way bridge to Norton and onward to Worcestershire Parkway rail station and the proposed new settlement.

Additional actions to improve air quality following the 2021 ASR include the development of a Freight Quality Partnership; installation of electric vehicle (EV) charging points; greening of Council and business fleets; requiring Travel Planning for all new housing

developments (including car sharing) and developing the Air Quality Supplementary Planning Document (SPD). These actions are ongoing.

Worcester City Council have not published an AQAP following last year's ASR. However, Worcester City Council have carried out a Source Apportionment Assessment in fulfilment of the requirement of the Local Air Quality Management (LAQM) process as set out in Part IV of the Environment Act 1995, the Air Quality Strategy for England, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance.

The Source Apportionment Assessment (2022) has been carried out for a number of areas of concern within the city; the Tything, Foregate Street, the Butts, the Cross, Bridge Street, All Saints Road, and Lowesmoor. The outcome of the source apportionment assessment using traffic count data from November 2021 shows that background concentration contributes a significant proportion of the overall concentration of NO₂ measured within each of the study areas varying from 25.97% to 39.27%. Cars were shown to comprise the largest proportion of traffic volume, with between 65.74% and 82.54% contributing to between 18.91% and 49.87% of vehicle source emissions. Buses comprise a much smaller proportion of the traffic volume ranging between 1.19% and 10.47% but contributing much larger proportions of vehicle emissions of between 13.7% and 58.19%.

For the majority of the locations, it is likely that a reduction across all vehicle types, or combination of several categories, would be required to achieve the Air Quality Objective of <40 µg/m³ for annual mean NO₂ concentrations. Using annual mean NO₂ concentrations measured in 2018, the study indicated that a maximum reduction in NO₂ of 37.7% would be required to achieve the objective within all areas. A maximum reduction of 43% would be necessary across all vehicle types to achieve results 5% below the objective, and 48.1% to achieve 10% below the objective.

Whilst all monitoring stations within the Worcester City (Political Boundary) AQMA are compliant in 2021, Worcester City Council will consider the effects of reducing targeted vehicle types to further reduce NO₂ concentrations.

Conclusions and Priorities

Worcester City Council undertook non- automatic (passive) monitoring of NO₂ at 37 sites during 2021. No exceedance of the long-term objective for NO₂ was recorded in 2021, with all but two locations recording 10% below the air quality objective (AQO) for NO₂ (40 µg/m³) - the exceptions being station But2 (39.1 µg/m³) and Ast3 (38.3 µg/m³). Although

monitoring data from 2021 shows an overall increase in average recorded annual mean NO₂ concentrations compared to 2020, increasing by 13.2% (3.2 µg/m³), 2020 was not representative of a standard year due to the COVID-19 Pandemic and first lockdown in March 2020 and subsequent lockdowns that followed.

The principal challenges and barriers to implementation of improving measures that Worcester City anticipates facing are resourcing and funding sources for potential significant improving actions and measures, and the continued delays to programs and work streams as a result of the COVID-19 outbreak and enforced lockdowns in 2020.

The 2017 'UK plan for tackling roadside nitrogen dioxide' outlines Government's approach and preferred options for mitigation of national areas of poor air quality detailing 29 local authorities required to produce strategies to accelerate compliance with the air quality objectives in their areas. A further 33 local authorities have since been required to produce feasibility studies on accelerating compliance following a High Court order. In autumn budget 2017, the chancellor announced a £220 million Clean Air Fund to support those local authorities and the people and businesses affected by these local plans. Worcester City Council is not one of these named councils and therefore has not been prioritised for access to that funding.

The COVID-19 and subsequent mitigation measures and lockdowns put in place by the UK government to combat the impact of the virus led to a temporary cessation of many local council activities and programs which impact on potential improvement measures, such as progressing new strategies and policies, strategic highway improvement works and implementation of new infrastructure. As a result, timelines for delivery of planned actions and measures have been subject to delays and changes in some circumstances.

Local Engagement and How to get Involved

A new Air Quality Partnership led by the officers of the Director of Public Health (DoPH), and supported by WRS Land and Air Quality Team, was set up in 2019 to discuss potential actions to improve air quality across the County and determine an action plan for implementation. The group comprises officers from the County and District authorities from public health, air quality, strategic planning, sustainability, highways and transport disciplines, and also representatives from the NHS and Highways England. Further discussions and work to formalise an action plan were continuing in 2020 but were subsequently suspended indefinitely following the outbreak of the COVID-19 pandemic.

WRS is a member of Central England Environmental Protection Managers Group (CEEPG) which provides a strategic overview and direction for the delivery of Environmental Protection Services across the area of Central England covered by participating authorities. CEEPG responsibilities covers all environmental health matters regarding air quality, noise, contaminated land and LAPPC/IPPC including cooperation and coordination with the Environment Agency and Public Health England.

There are several ways members of the public can help to improve local air quality:

- **Walk or cycle, leave your car at home:** Leaving your car at home and walking or cycling instead will benefit in three ways - increased exercise, reduced pollution exposure and will reduce individual's pollution emissions.
- WCC have launched a car sharing website, **LiftShare**, to help people find others journeying to the same destinations to share journeys and costs, and reduce traffic and emissions. Visit this link for more information:
 - [Worcestershire Liftshare community - part of the Liftshare network](#)
- **Turn off your engine when stationary or parked**, do not 'idle', particularly outside sensitive receptors such as schools, hospitals, care homes and residential properties.
- General **travel planning** advice is available on WCC's website (including walking, cycling and bus maps and timetables) and Government website:
 - http://www.worcestershire.gov.uk/info/20007/travel_and_roads
 - <https://www.gov.uk/government/publications/smarter-choices-main-report-aboutchanging-the-way-we-travel>
- **Hold meetings by Conference Call** by phone or Skype rather than driving to meetings. This reduces fuel and other travel costs, vehicle maintenance and hire cost, increases productivity through reduction in hours lost through unnecessary travel.
- Facilitate **Flexible Working Arrangements** for non-front line staff to work remotely from home or nearer home facilities for one or more days a week thus removing or reducing any journey to work. This reduces congestion which has beneficial impacts for delivery times, reduced business costs and thus economic benefits. Additionally, provides social benefits through improved work life balance for employees, reduces local air quality and reduced emergency vehicle response times.

- **Switch Fleet to Low Emission Vehicles:**

- **EV Chargepoint Grant -**

- The EV chargepoint grant provides funding of up to 75% towards the cost of installing electric vehicle smart chargepoints at domestic properties across the UK. It replaced the Electric Vehicle Homecharge Scheme (EVHS) on 1 April 2022.

- **Workplace Charging Scheme -**

- The Workplace Charging Scheme (WCS) is a voucher-based scheme that provides support towards the up-front costs of the purchase and installation of electric vehicle charge-points, for eligible businesses, charities and public sector organisations.

- There is an approved charge points list and a list of authorised installers.

- [Grant schemes for electric vehicle charging infrastructure - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/grants/ev-grants)

- If you must drive follow fuel efficient driving advice, often known as ‘Smarter Driving Tips’, to save on fuel and reduce your emissions. Several websites promote such advice including:

- <https://energysavingtrust.org.uk/advice/ecodriving/>
 - <https://www.theaa.com/driving-advice/fuels-environment/drive-smart>
 - <https://www.vehicle-certification-agency.gov.uk/fcb/smarter-driving-tips.asp>

- **Reduce air pollution from open fires and wood-burning stoves.** Advice is available from Defra on choosing the right stove, using the right fuels and maintenance enabling householders to reduce their impact on their health and air quality from open fires and wood burning stoves. Further information is available on the [smoke-control-areas](#) page on WRS website.

Air pollution can affect all of us over our lifetime however certain groups will be more sensitive to the effects of air pollution. Vulnerable groups include adults and children with lung or heart conditions such as asthma, chronic bronchitis, emphysema and chronic obstructive lung disease (COPD)^{7,8}. Senior citizens are more likely to be affected by

⁷ <http://www.breathelondon.org/>

⁸ <https://www.londonair.org.uk/LondonAir/guide/MyActionsForMe.aspx>

respiratory diseases and children are more likely to be affected by air pollution due to relatively higher breathing and metabolic rates as well as a developing lung and immune system.

Vulnerable individuals and groups can keep informed of:

- Current levels and forecasts of air pollution from Defra at [Pollution forecast - Defra, UK](#)
- If you are sensitive to the effects of air pollution, it may be appropriate to limit the length of time spent in areas of local poor air quality – see advice from Defra at [Daily Air Quality Index - Defra, UK](#)
- If you are on social media, sign up to the WRS Twitter feed @RegServs. WRS tweet when pollution is forecast by Defra to be moderate to very high.
- Further information for the general public on reducing your family’s exposure to poor air quality in Worcestershire and how individuals, business and schools can assist with reducing their impact on local air quality can currently be found at [protecting-me-and-others-from-air-pollution](#) page on WRS website .

Local Responsibilities and Commitment

This ASR was prepared by Ricardo PLC for Worcestershire Regulatory Services on behalf of Worcester City Council with the support and agreement of the following officers and departments:

Stephen Williams / Neil Kirby – Land and Air Quality Team, Technical Services,
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Worcestershire County Council Highways Department

Worcester City Council

This ASR has been approved by Worcestershire Regulatory Services. This ASR has not been signed off by a Director of Public Health. If you have any comments on this ASR please send them to:

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1 Local Air Quality Management

This report provides an overview of air quality in Worcester City 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 Worcester 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 Worcester City Council can be found in Table 2.1. The table presents a description of the AQMA that is currently designated within Worcester City. Appendix D: Map(s) of Monitoring Locations and AQMAs provides maps of AQMA(s) and also the air quality monitoring locations in relation to the AQMA. The air quality objectives pertinent to the current AQMA designation is the NO₂ annual mean concentration.

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 National Highways?	Level of Exceedance: Declaration	Level of Exceedance: Current Year	Name and Date of AQAP Publication	Web Link to AQAP
Worcester City AQMA (Political Boundary)	11.08.2019	NO2 Annual Mean	AQMA encompasses whole district within political boundary of Worcester City.	NO	55	39.1	Citywide AQMA Action Plan in progress - delayed due to Covid-19	Not yet published

Worcester City Council confirm the information on UK-Air regarding their AQMA(s) is up to date (confirm by selecting in box).

Worcester City Council confirm that all current AQAPs have been submitted to Defra (confirm by selecting in box).

2.2 Progress and Impact of Measures to address Air Quality in Worcester City

Defra's appraisal of last year's ASR concluded that the report is well structured, detailed, and provides the information specified in the Guidance:

- The Council have included detailed discussion on the range of measures to address air quality and have highlighted a number of measures that have been completed. The Council is encouraged to continue with their aim to improve air quality in the City.
- Detailed QA/QC method has been provided as appropriate which justification clearly stated. The national bias adjustment factor has been applied as appropriate, further evidence could be provided by including a screen capture of the bias adjustment spreadsheet depicting the chosen bias adjustment factor.
- The Council have provided a thorough report which contains the required content and more.

The following comment was designed and provided to help inform future reports:

- An AQAP is due to be published following the declaration of the recent citywide AQMA. There have been understandable delays to the AQAP due to COVID-19 restrictions. The Council should prioritise the development of the AQAP in the coming year (2022) and report their progress in the next ASR.

Worcester City Council have not published an AQAP following last year's ASR. However, Worcester City Council have carried out a Source Apportionment Assessment in fulfilment of the requirement of the Local Air Quality Management (LAQM) process as set out in Part IV of the Environment Act 1995, the Air Quality Strategy for England, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance.

Worcester City Council has taken forward a number of direct measures during the current reporting year of 2021 in pursuit of improving local air quality. These are continuations of the measures presented in the 2021 ASR. Details of all measures completed, in progress or planned are set out in Table 2.2. 30 measures are included within Table 2.2, with the type of measure and the progress Worcester City Council have made during the reporting year of 2021 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 the existing Action Plan.

A key measure that have been progressed since the previous 2021 ASR are:

- **Worcestershire Parkway Station SWST1** – Works completed in 2019 and the new station opened on 23rd February 2020, 3 weeks prior to the first lockdown. Initial indications were of high use exceeding that anticipated in the business plan, with the car park 75% full and strong ticket sales. Nationally train travel has been affected by COVID-19 but is now in recovery.

Progress on the following measure has been slower than expected due to not securing funding:

- **Shrub Hill station** - As part of the Shrub Hill regeneration work to deliver the Shrub Hill Quarter, aspects of the vision were submitted to the Towns Fund , with works on the station itself may form part of a Levelling Up Fund bid. The bids included active travel links to the city centre, and link to the proposals within the North Cotswolds Link Task force to enhance the rail service. This bid was not successful, however other funding options are being reviewed.

Whilst the measures stated above and in Table 2.2 will help to contribute towards compliance, Worcester City Council anticipates that further additional measures not yet prescribed will be required in subsequent years to achieve compliance and enable the revocation of Worcester City (Political Boundary) AQMA.

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
T&F 1	Consider AQ impacts in every Council Policy	Policy Guidance and Development Control	Other policy	2019		Worcester City Council	Worcester City Council (Officer Resource)	No	Not Funded	< £10k	Implementation	0	Implementation of Policy	Air quality is a consideration as part of policy and formal report writing.	Represents an ongoing process
T&F 2	Electric Vehicle Infrastructure in Residential Streets	Promoting Low Emission Transport	Procuring alternative refuelling infrastructure to promote Low Emission Vehicles, EV recharging, gas fuel recharging	2019	2026	Worcester City Council, Worcestershire County Council	Possible funding streams available	No	Partially Funded	£1 million - £10 million	Planning	0 - 8 %	Implementation of EV charging points in local residential areas, uptake of ULEV	Work nearing completion to map relevant factors (including areas of poor air quality, limited parking, existing charging, and land availability for new infrastructure). Report will then be produced identifying best locations to cater for need and explore options for implementation.	22% of residents have no access to off road parking. Significant funding required to provide all with access to EV charge points
T&F 3	AQ in Car Parking (Masterplan) Proposals	Transport Planning and Infrastructure	Other	2019		Worcester City Council	Unknown at this time	No	Not Funded		Planning	Unknown	Design and location of multi storeys to replace multiple single level car parking and limit AQ impact e.g. promote ULEV	AQ group formed to implement T&F measures in Nov 2019. Currently no changes in respect of car parking charges or physical infrastructure.	Long timeline of 20+ years for implementation of Masterplan strategy. Economic recovery from COVID-19 may cause delay in changes to parking strategy.
T&F 4	ULEV Pool Cars	Promoting Low Emission Transport	Other	2019		Worcester City Council	Not identified at this time	No	Not Funded		Planning	<0.2 µg/m3	Purchase and use of vehicles for staff journeys	Initial study prior to COVID-19 indicated relatively low business mileage for officers - possibly linked to size of city and various shared services -difficult to justify shift to ULEV pool cars. Working practices also changed significantly during COVID so will need to be reassessed once returned to 'new' normal. Number of EV vehicles within fleet has increased and trials continue on larger vehicles.	Assessed to be low demand - changes following COVID-19 also need to be examined.
T&F 5	Emissions Standard for Licensed Taxis	Promoting Low Emission Transport	Taxi Licensing Conditions	2019		Worcester City Council, Worcestershire Regulatory Services	Not identified at this time	No	Not Funded		Planning	0 - 9 %	Introduction of emission standard, uptake of ULEV	Initial study undertaken following creation of Taxi Strategy Task & Finish Group in 2019. More detailed understanding is required to allow for viable transition of taxi network to hybrid and EV vehicles. DfT due to review vehicle standards which is expected to direct licensing policies.	Vast majority vehicles are currently either Euro 4 (petrol) or Euro 6 (diesel) standard - highest standard vehicles for emissions. Limited infrastructure at present to support EV network - EV vehicles are expensive and technology evolving.
T&F 6	Low Emission Strategy	Policy Guidance and Development Control	Low Emissions Strategy	2019		Worcester City Council, Worcestershire Regulatory Services	Officer Time	No	Not Funded	< £10k		0	Completion of LES	An Environmental Sustainability Strategy is proposed off which the Low Emission Strategy could hang - the ESS is a considerable piece of work and is reliant on support from key partners. Options appraisal to be undertaken. Outline of purpose and scope of strategy to be determined.	Reliant on other ES strategy
NAWC1	Develop and implement Worcester City Centre Masterplan	Traffic Management	UTC. Congestion management, traffic reduction	2015	2032	Worcester City Council and others for the various measures	TBC as various measures progress	No	Not Funded	> £10 million	Planning	Not quantifiable at this time	Masterplan - potentially reduced vehicle movements in some key areas through car parking provision strategy (e.g. uptake of EV), realm enhancements	Masterplan adopted 16th July 2019. Plan to be implemented over the next 20+ years.	Long time to implementation. Pre COVID-19 plans subject to delay.

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													supporting walking and cycling.		
5.2.10	Installing electric vehicle charging points	Promoting Low Emission Transport	Procuring alternative refuelling infrastructure to promote Low Emission Vehicles, EV recharging, gas fuel recharging	2013		Worcester City Council, Worcestershire County Council	Developers as part of planning and variable funding streams for other schemes	No	Not Funded	£500k - £1 million	Implementation	0 to 37%	Increase in availability of EV charging points and corresponding increase in uptake of electric vehicles	Standard recommendation for installation of EV Charging Points on relevant planning consents is ongoing. Formalised in 'WRS Technical Guidance for Planning' but not adopted by BDC planning authority. Electrical charging points for taxi scheme being installed 2021. Virgin Media and OLEV funding for 3 charge points	Significant funding required for publicly available charge points.
5.2.1	Bus Quality Partnership	Promoting Low Emission Transport	Public vehicle procurement – prioritising uptake of Low Emission Vehicles	2013		Worcester City Council, Worcestershire County Council, local bus companies	Unknown at this time	No	Not Funded		Planning	0 to 23 %	Replacement of lower Euro standard buses on key city centre routes	Meetings with First Bus group July 2018	Worcester is non profitable area for bus companies proving barrier to LEV investment locally. Requires LA subsidisation and/or enforcement.
5.2.2	Freight Quality Partnership	Traffic Management	UTC. Congestion management, traffic reduction	2013	2018	WCC	WCC	No	Partially Funded	£50k - £100k	Completed	Unknown	Fewer HGVs travelling through AQMA	On-going duty under Traffic Management	Can take time for information to filter down to users. HGVs may still need to travel through AQMAs on major arterial routes
LRH7 / 5.1.1	Alteration to traffic light phasing - Lowesmoor impretment scheme. Renewed enforcement of an existing TRO restricting all vehicles, with the exception of buses at certain times of day	Traffic Management	Strategic highway improvements and congestion reduction	2013		Worcestershire County Council	Worcestershire County Council	No	Not Funded		Implementation	5 - 10 %	Improved flow of traffic through Lowesmoor. Reduced congestion. Reduced volume of traffic	Implemented January 2015. Potentially enforcement cameras to be added in future.	No date currently for enforcement cameras.
5.3.4	Promote flexible working arrangements	Promoting travel alternatives	Encourage / facilitate home-working	2013		Worcester City Council, Worcestershire County Council	Various	No	Not Funded	£50k - £100k	Implementation	Unknown	Increase in number of people able to work from home	County Council have pushed for maximum coverage of fibre optic broadband. Ongoing - 9% coverage as of December 2019.	Reliant on uptake from private sector companies
5.1.7	Signage to avoid AQMA	Traffic Management	Other	2013	2016	Worcestershire County Council	DfT	No	Funded		Completed	Reduces Emissions - not quantified at this time	Decrease in number of strategic journeys through AQMA	VMS around City completed 2016	
5.1.4	Variable Message Systems	Traffic Management	Other	2013	2016	Worcestershire County Council	DfT	No	Funded		Completed	Reduces Emissions - not quantified at this time	Decrease in traffic movements through AQMA	VMS around City completed 2016	
5.1.1	Major signalling infrastructure update at St Johns, St Clements, Croft Road, Dolday, Sidbury, Commandery Road and London Road	Traffic Management	UTC. Congestion management, traffic reduction	2013	2022	National Productivity Investment Fund	National Productivity Investment Fund	No	Funded		Implementation	Reduces Emissions - not quantified at this time	Improve network efficiency and accessibility for all modes of transport	Completed with exception of St John centre. Funding secured	Delivery of St Johns scheme delayed by COVID-19
5.1.5 /LRH5	Loading and unloading restrictions during peak traffic times (Lowesmoor / Rainbow Hill)	Traffic Management	Workplace parking levy, parking enforcement on highway	2013	2020	Worcester City Council	Worcester City Council	No	Funded		Implementation	Reduces Emissions - Not quantified at this time	Reduced incidence of loading and unloading during peak times	TRO implemented and updated. MTE cameras purchased & ready for installation.	Bus Lane Enforcement (MTE) cameras to be installed within next few months
5.1.1/DD3	Alteration to phasing of traffic light systems /	Traffic Management	Strategic highway improvements, reprioritising	2013	2015	Worcestershire County Council	National Productivity Investment Fund	No	Funded		Completed	1.2 - 6.8% (Dolday)	Improved Traffic Flow	Completed	

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	Junction review (Dolday)		road space away from cars, including access management, selective vehicle priority, bus priority, high vehicle occupancy lane												
5.5.1	Produce Air Quality Supplementary Planning Document	Policy Guidance and Development Control	Air quality planning and policy guidance	2013	2022	Worcestershire County Council Strategic Planner, WRS and South Worcestershire Councils	Worcestershire County Council Strategic Planner, WRS and South Worcestershire Councils (Resources)	No	Funded		Implementation	Reduces emissions from new developments	Formal adoption and utilised by Worcester City Council planning authority	WRS 'Technical Guidance Note for Planning' published 2018. Initial discussions on AQ SPD for SWDP Jan 2020.	SPD work awaiting outcome of South Worcestershire Development Plan review due 2021. Work currently suspended due to COVID-19 impacts.
5.2.4	Railway Enhancements - new Worcestershire Parkway Station	Transport Planning and Infrastructure	Public transport improvements interchanges stations and services	2013	2020	Worcestershire Council Council, Worcestershire Local Enterprise Partnership	DfT, Worcestershire Local Enterprise Partnership	No	Funded		Completed	Reduces Emissions - Not quantified at this time	Reduce commuter traffic, destined for city central stations at Shrub Hill and Foregate Street	Works completed in 2019 and the new station opened on 23rd February 2020, 3 weeks prior to the first lockdown. Initial indications were of high use in excess of the business plan, with the car park 75% full and strong ticket sales. Station is at the heart of the emerging proposals for Worcestershire Parkway Strategic Growth area arising from the review of South Worcestershire Development Plan.	Rail use has recovered nationally following to the COVID-19 pandemic, though longer term trends are still to emerge
5.2.5	Greening Council Fleets	Promoting Low Emission Transport	Procuring alternative refuelling infrastructure to promote Low Emission Vehicles, EV recharging, gas fuel recharging	2013		Worcester City Council, Worcestershire County Council	Not identified at this time	No	Not Funded	£100k - £500k	Planning	Reduces Emissions - Not quantified at this time	Increase in number of Council fleet and contractors' vehicles of higher Euro Standard or ULEV	T&F4 recommendation procurement ULEV pool cars 2019	Initial study prior to COVID-19 indicated relatively low business mileage for officers to justify shift to ULEV pool cars. Working practices also changed significantly during COVID so will need to be reassessed once returned to 'new' normal
5.3.6	Improve cycling and walking routes in local areas	Promoting travel alternatives	Promotion of cycling	2013		Worcestershire County Council	Worcestershire Network Efficiency Programme, National Productivity Investment Fund	No	Partially Funded	£1 million - £10 million	Implementation	Reduces emissions - see comment	Uptake in commuter journeys undertaken by cycle or walking	8 active corridors included in LTP4 at various stages of development. City Masterplan includes 5 Public Realm enhancements including active corridors and spaces. The Arches due for completion 2021. Funding secured (Emergency Active Travel Fund) for the canal towpath between Diglis and Sixways. Complemented by active travel elements from Towns Fund bid from Worcester City with links to the Ketch roundabout and onwards to Powick. Kepax bridge scheme will provide additional crossing over the River Severn to the north of the city at Ghulevelt Park linking to existing cycle routes (park/racecourse/Waterworks Roads/ Severn Path. Increases connectivity between east and west banks of river and allows future expansion to walking and cycling routes. Hams Way active travel bridge now open connecting to active travel network in Worcester with further connections proposed to Malvern (subject to funding). The	PHE Public Health Outcomes Framework (PHOF) data indicates levels of cycling and walking in Worcester is above regional and national data indicating limited potential for significant uptake and improvement. However, experience of Choose How You Move programs in Worcestershire indicates uptake of cycling and walking may continue following easing of COVID-19 lockdown measures. Kepax Bridge scheme subject to successful

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														Broomhall Way active travel footbridge links St Peters/Worcester with the new community of Hopfields completed in 2021. Crookbarrow Way active travel bridge is open and links St Peter's north of the Broomhall Way bridge to Norton and onward to Worcestershire Parkway rail station and the proposed new settlement.	planning application due for determination July 2021. Other schemes subject to funding.
5.3.1	Travel Planning	Promoting travel alternatives	Personalised travel planning	2013		WCC	WCC	No	Not Funded		Implementation	Unknown	Increased uptake of alternative modes of transport	This proven tool encourages modal shift in new developments towards more sustainable and space efficient forms of transport.	Ongoing
5.3.2	Car Sharing	Alternatives to private vehicle use	Car & lift sharing schemes	2013		WCC	WCC	No	Not Funded	£10k - 50k	Implementation	<1%	Increase in number of people car sharing	Liftshare website scheme launched Autumn 2015. Currently in operation	Following an initial surge in interest from public, use of service has slowed down
5.6.3	Air Quality Networks	Policy Guidance and Development Control	Regional Groups Co-ordinating programmes to develop Area wide Strategies to reduce emissions and improve air quality	2013		WRS CEEPG DEFRA	Officer time (WRS)	No	Not Funded	< £10k	Implementation	0	Improved cross boundary working between local authorities in West Midlands	WRS are member of regional environmental protection managers group (CEEPG) and member of Defra LAQM Team Local Authority Advisory Group both formed in 2017.	Differing AQ issues, priorities, and resources in regional authorities. Largely on hold due to global Covid pandemic.
5.4.1	Smarter Driving Tips	Public Information	Via the internet	2013		WRS & WCC	Officer time (WRS)	No	Not Funded	£10k - 50k	Implementation	<0.2 µg/m3	Increase in website hits	Advice page created for all groups affected by and impacting air quality and shared with County Public Health.	Created Mar 2017, Updated March 2019
5.4.5	Raise the profile and increase awareness of air quality within the region	Other	Other	2013		WRS CEEPG MJAC DEFRA	Officer time (WRS)	No	Not Funded	£10k - 50k	Implementation	0	Improved cross boundary knowledge sharing between local authorities in West Midlands	WRS held position of Air Quality technical coordinator for MJAC, member of CEEPG and member of Defra LAQM Team Local Authority Advisory Group both formed in 2017.	WRS was MJAC AQ Technical Coordinator 2014/17. MJAC/CEEPG Knowledge Hub group set up in 2017 delivered by joint working between WRS and Cannock Chase DC. Member of LA advisory group to Defra LAQM team following invitation 2017.
5.1.13	Alteration to Parking Provision	Traffic Management	UTC. Congestion management, traffic reduction	2013		Worcester City Council, Worcestershire County Council	Not identified at this time	No	Not Funded	£1 million - £10 million	Planning	Reduces emissions - not quantified at this time	Reduced traffic movements and congestion in inner city	City Masterplan (adopted 2019) proposals to consolidate existing multiple single level surface car parking into fewer multi story car parks at strategic points - see T&F3 for further info.	Masterplan long lifetime of 20+ years. Congestion may increase in interim period between sale of existing car park land and implementation of replacement multi storey car parks
5.6.8	Forge closer links with local health agencies	Other	Other	2013		WRS WCC PHE	DoPH, Officer time (WRS)	No	Not Funded	< £10k	Implementation	0	Increase participation of Public Health in Worcestershire Air Quality issues and action groups	County Air Quality Partnership set up May 2019 by DoPH supported by WRS	On hold due to global Covid-19 pandemic
5.4.2	Provide link to real time air quality information	Public Information	Via the internet	2013		WRS WCC PHE	Officer time (WRS)	No	Not Funded	£10k - 50k	Implementation	0	Increase in WRS Twitter subscribers	System put in place at WRS to tweet alerts when Air pollution is moderate or worse in any given 5 day forecast on Defra Daily Air Quality Index and shared with County Public Health representative	Limited to Twitter users. Ongoing

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
5.4.4	Make air quality information more available and accessible	Public Information	Via the internet	2013		WRS	Officer time (WRS)	No	Not Funded	£10k - 50k	Implementation	0	Website hits and enquiries for information	All existing LAQM reports and details of AQMAs are available to public on WRS website. WRS use Twitter account to release information.	Ongoing.

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.

There are currently no automatic PM_{2.5} monitoring stations in Worcestershire. The nearest AURN PM_{2.5} monitoring station is the Birmingham Acocks Green site approximately 25 miles to the north east of the Worcester City area. WRS has reviewed the Defra national background maps to determine projected PM_{2.5} concentrations with Worcester City for the 2021 calendar year. The average total PM_{2.5} at 32 locations (centre points of 1km x 1km grids) across Worcester City is 8.32 µg/m³, with a minimum concentration of 7.82 µg/m³ and a maximum concentration of 9.39 µg/m³.

This indicates that PM_{2.5} concentrations within the Worcester City District is below the proposed annual average limit value for PM_{2.5} target of 10µg/m³ to be met across England by 2040.

The whole district area of Worcester City is a Smoke Control Area.

WRS has reviewed the fraction of mortality attributable to particulate air pollution (indicator D01) as published by Public Health England as part of the Public Health Outcomes Framework⁹. The fraction of mortality attributable to particulate emissions in Worcestershire in 2020 (the most recent year available) was 5.0%. This falls below the national figure for England (5.6% in 2020) and below the figure for the West Midlands region (5.4% in 2020). Recent trend data is not available for Worcestershire due to a lack of data points with valid values.

More information on the Public Health Outcomes Frameworks that examines indicators that help us understand trends in public health can be found at:

[Public Health Outcomes Framework - PHE](#)

⁹ [Public Health Outcomes Framework - OHID \(phe.org.uk\)](#)

As outlined in Policy Guidance LAQM.PG16, WRS have discussed the role of the DoPH, and the details of PM_{2.5} levels across the County, with the DoPH at Worcestershire County Council. In 2019 a new Air Quality Partnership led by the DoPH and supported by WRS Land and Air Quality Team was set up to discuss potential actions to improve air quality across the County and determine an action plan for implementation. The group comprised officers from the County and District authorities from public health, air quality, strategic planning, sustainability, highways and transport disciplines, and representatives from the NHS and Highways England. The group met initially in May 2019 to discuss terms and references and in September to discuss potential actions. The group is largely driven by DoPH so, due to Covid-19 taking priority in 2020, the business of the partnership was postponed indefinitely but is anticipated to restart later this year.

No additional actions are currently planned by Worcester City Council in relation to the reduction of PM_{2.5} levels. However, it is anticipated that any potential actions to improve NO₂ levels will likely result in a linked improvement in PM_{2.5} levels.

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

This section sets out the monitoring undertaken within 2021 by Worcester City Council and how it compares with the relevant air quality objectives. In addition, monitoring results are presented for a five-year period between 2017 and 2021 to allow monitoring trends to be identified and discussed.

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

Worcester City Council did not undertake any automatic monitoring during 2021.

3.1.2 Non-Automatic Monitoring Sites

Worcester City Council undertook non- automatic (i.e. passive) monitoring of NO₂ at 37 sites during 2021. Table A.1 in Appendix A presents the details of the non-automatic sites.

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

3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias, 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 (NO₂)

Table A.2 in Appendix A compares the ratified and adjusted monitored NO₂ annual mean concentrations for the past five years with the air quality objective of 40 µg/m³. 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 2021 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.

There have been no changes to the monitoring network across Worcester City during 2021.

Monitoring data from 2020 does not represent a standard year with the emergence of the COVID-19 Pandemic and first lockdown in March 2020 and subsequent lockdowns that followed. With the number of vehicle journeys massively reduced much lower concentrations of nitrogen dioxide can be seen in all locations compared to previous years. As such, monitoring data from 2021 shows an overall increase in average recorded annual mean NO₂ concentrations from 2020, increasing by 13.2% (3.2 µg/m³). All monitoring stations (with the exception of Lwm1 and BrS2) saw an increase from 2020 to 2021. This is likely to have been caused by the increase in traffic following the easing of 'lockdowns' in 2020 caused by the COVID-19 pandemic. However, NO₂ concentrations at all monitoring stations (with the exception of Mcl) decreased in 2021 relative to 2019.

No exceedances of the annual mean objective were recorded within Worcester City during 2021. In 2021, the highest concentration of NO₂ recorded across Worcester City was 39.1 µg/m³ at BUT2 (which is 0.9 µg/m³ below the exceedance threshold (40 µg/m³)). This location has recorded the highest concentration across the city for the last 5 years with a concentration of 35.9 µg/m³ in 2020 and 42.1 µg/m³ in 2019. Monitoring results within the Worcester City area demonstrate a general downward trend in concentrations over the 5-year period 2017 – 2021.

3.2.2 Particulate Matter (PM₁₀)

Worcester City Council does not undertake PM₁₀ monitoring.

3.2.3 Particulate Matter (PM_{2.5})

Worcester City Council does not undertake PM_{2.5} monitoring.

3.2.4 Sulphur Dioxide (SO₂)

Worcester City Council does not undertake SO₂ monitoring.

Appendix A: Monitoring Results

Table A.1 – 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)
LR1	London Road Lampost 6569 by Bargain Booze	Roadside	385636	254158	NO ₂	Yes - Worcester City AQMA - Political Boundary	2.9	1.6	No	2.1
LR2	London Road Lampost 6561 by Royal Court	Roadside	385428	254238	NO ₂	Yes - Worcester City AQMA - Political Boundary	3.0	1.5	No	2.2
LR3	London Road traffic sign 572 for A58(City)	Roadside	385357	254272	NO ₂	Yes - Worcester City AQMA - Political Boundary	0.5	1.8	No	2.3
LR5	London rd Bus stop SL6554 opp Bath rd	Roadside	385325	254329	NO ₂	Yes - Worcester City AQMA - Political Boundary	0.3	1.5	No	2.2
LR4	London Rd SL6565 adj no65	Roadside	385525	254219	NO ₂	Yes - Worcester City AQMA - Political Boundary	31.0	1.9	No	2.1

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)
SidFG	Sidbury Street sign o/s Fisher German Agents	Roadside	385146	254474	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 3.94	2.3	No	2.2
But1	Magdala Court, The Butts	Roadside	384776	255107	NO ₂	Yes - Worcester City AQMA - Political Boundary	0.0	1.2	No	2.5
But2	Magdala Court, The Butts	Roadside	384724	255086	NO ₂	Yes - Worcester City AQMA - Political Boundary	0.0	1.7	No	2.4
Dd1	Dolday opposite bus station	Roadside	384652	254986	NO ₂	Yes - Worcester City AQMA - Political Boundary	N/A	2.2	No	2.2
DDASH	Lampost opposite All Saints House	Roadside	384682	254924	NO ₂	Yes - Worcester City AQMA - Political Boundary	2.0	2.3	No	2.1
BrS	Bridge Street lampost outside John Gwen House	Kerbside	384666	254818	NO ₂	Yes - Worcester City AQMA - Political Boundary	2.0	0.7	No	2.2
BrS2	Bridge Street sign opposite John Gwynne House	Roadside	384695	254840	NO ₂	Yes - Worcester City AQMA - Political Boundary	1.0	2.0	No	2.1

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)
Tyn3	No 26 Upper Tything (Lp opp Kwik Fit)	Roadside	384679	255998	NO ₂	Yes - Worcester City AQMA - Political Boundary	0.1	2.0	No	2.2
Tyn2	Lamb & Flag PH Upper Tything (LP934)	Roadside	384767	255606	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.29	2.3	No	2.2
Tyn	925 - HAMMERCHILDS, Upper Tything	Roadside	384833	255461	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.29	1.6	No	2.2
Fos2	Hewitt Recruitment, 35 Foregate Street (downpipe)	Roadside	384866	255367	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.36	3.2	No	2.1
Fos3	Café Mela, 22 Foregate Street (downpipe)	Roadside	384899	255329	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.03	2.2	No	2.5
Fos	Foregate Street at junction with Shaw Street (Traffic lights)	Kerbside	384941	255140	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.19	1.0	No	2.5
Crs1	My Coffee, 29 The Cross (downpipe)	Roadside	384967	255012	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.33	3.4	No	2.2

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)
Swth1	Scope Shop, St Swithins Street	Roadside	385013	254987	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.33	2.1	No	2.2
Lwm2	Lowesmoor 2 Town End. Adj private shop	Roadside	385164	255134	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1	1.9	No	2.5
Lwm1	Lowesmoor 1 Rainbow Hill End outside 4 Seasons	Roadside	385268	255191	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF1	1.4	No	2.6
BkC	Façade of Berkeley Court, Foregate Street, Worcester	Roadside	384948	255111	NO ₂	Yes - Worcester City AQMA - Political Boundary	0.2	4.1	No	2.5
RH	Rainbow Hill	Roadside	385420	255413	NO ₂	Yes - Worcester City AQMA - Political Boundary	7.8	1.5	No	2.4
GS	52 or 54 George Street	Roadside	385358	254969	NO ₂	Yes - Worcester City AQMA - Political Boundary	0.0	2.0	No	2.3
StJ1	Scott of Tattoo, 1A St. John's (downpipe)	Roadside	384137	254510	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.48	2.7	No	2.0

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)
Brm	10 Bromyard Road (downpipe)	Roadside	383967	254481	NO ₂	Yes - Worcester City AQMA - Political Boundary	0.0	8.8	No	1.9
KCP	King Charles Place outside bakery Lampost 5372	Roadside	384016	254399	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.41	2.2	No	2.1
StJ2	The Fortune House, 65 St Johns	Roadside	384013	254356	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.53	2.2	No	2.0
StJ3	The Bell, 35 St Johns	Roadside	384046	254424	NO ₂	Yes - Worcester City AQMA - Political Boundary	FF 1.53	2.1	No	2.0
Mcl	McIntyre Road lamppost outside last house before cemetery	Suburban	383454	254606	NO ₂	Yes - Worcester City AQMA - Political Boundary	4.5	1.2	No	2.3
Ast4	246 Astwood Road	Roadside	386097	256565	NO ₂	Yes - Worcester City AQMA - Political Boundary	0.0	9.9	No	2.0
AST1b	LP5129 outside 170/172 Astwood Road	Roadside	386022	256401	NO ₂	Yes - Worcester City AQMA - Political Boundary	5.5	3.5	No	2.1

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)
Ast3	Astwood Road 3 Rainbow Hill	Roadside	385764	255968	NO ₂	Yes - Worcester City AQMA - Political Boundary	6.6	1.7	No	2.3
OAK	22 Oaklands on drainpipe	Roadside	387810	254993	NO ₂	Yes - Worcester City AQMA - Political Boundary	0.0	7.0	No	1.9
LRW	within vicinity of London Road Waitrose	Kerbside	386654	253761	NO ₂	Yes - Worcester City AQMA - Political Boundary	4.0	0.5	No	1.9
BG2	located on metal post adjacent to 17 Broomhall Green, Broomhall, Worcester, WR5 2PG	Roadside	386165	252146	NO ₂	Yes - Worcester City AQMA - Political Boundary	5.3	5.1	No	2.3

Notes:

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

(2) N/A if not applicable.

Table A.2 – Annual Mean NO₂ Monitoring Results: Non-Automatic Monitoring (µg/m³)

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 2021 (%) ⁽²⁾	2017	2018	2019	2020	2021
LR1	385636	254158	Roadside	100.0	100.0	32.8	35.5	29.3	22.8	25.1
LR2	385428	254238	Roadside	67.3	67.3	35.0	39.8	34.5	25.1	32.3
LR3	385357	254272	Roadside	100.0	100.0	36.1	42.3	33.7	26.5	31.0
LR5	385325	254329	Roadside	92.3	92.3	35.4	44.1	35.0	27.5	30.5
LR4	385525	254219	Roadside	100.0	100.0	32.0	38.4	29.7	24.7	27.8
SidFG	385146	254474	Roadside	100.0	100.0	35.7	41.9	34.3	25.9	29.7
But1	384776	255107	Roadside	100.0	100.0	40.3	44.4	33.5	27.3	31.0
But2	384724	255086	Roadside	100.0	100.0	42.8	52.4	42.1	35.9	39.1
Dd1	384652	254986	Roadside	82.7	82.7	31.1	37.2	29.7	23.2	25.3
DDASH	384682	254924	Roadside	100.0	100.0	37.8	43.8	36.8	29.0	30.5
BrS	384666	254818	Kerbside	90.4	90.4	32.7	42.3	31.0	24.9	29.4
BrS2	384695	254840	Roadside	92.3	92.3	39.2	47.7	38.6	35.6	33.8
Tyn3	384679	255998	Roadside	100.0	100.0	30.2	37.9	29.5	23.4	26.2
Tyn2	384767	255606	Roadside	100.0	100.0	40.6	47.8	39.9	31.3	34.6
Tyn	384833	255461	Roadside	100.0	100.0	40.3	47.2	41.8	31.1	34.3
Fos2	384866	255367	Roadside	100.0	100.0	31.3	35.8	30.7	22.8	25.6
Fos3	384899	255329	Roadside	84.6	84.6	25.9	32.9	27.6	21.3	24.3
Fos	384941	255140	Kerbside	100.0	100.0	40.2	48.5	37.3	27.5	33.1
Crs1	384967	255012	Roadside	100.0	100.0	33.2	36.8	29.1	22.0	22.9
Swth1	385013	254987	Roadside	100.0	100.0	23.8	30.0	23.4	17.8	19.0
Lwm2	385164	255134	Roadside	100.0	100.0	28.9	35.9	29.5	23.1	24.5
Lwm1	385268	255191	Roadside	100.0	100.0	33.4	41.2	33.9	31.8	31.6
BkC	384948	255111	Roadside	100.0	100.0	-	46.9	38.4	29.4	32.9
RH	385420	255413	Roadside	67.3	67.3	29.5	34.3	30.1	21.6	27.8
GS	385358	254969	Roadside	100.0	100.0	-	-	36.3	29.4	32.5
StJ1	384137	254510	Roadside	92.3	92.3	36.0	42.7	36.0	22.7	28.0
Brm	383967	254481	Roadside	100.0	100.0	27.4	32.4	27.8	19.1	22.0
KCP	384016	254399	Roadside	100.0	100.0	27.6	33.3	27.9	22.0	24.5
StJ2	384013	254356	Roadside	90.4	90.4	22.1	30.3	23.5	17.5	21.1
StJ3	384046	254424	Roadside	100.0	100.0	27.9	34.3	27.9	19.9	25.0
Mcl	383454	254606	Suburban	100.0	100.0	11.6	14.3	11.9	10.1	12.7
Ast4	386097	256565	Roadside	100.0	100.0	21.3	25.3	21.6	16.9	19.8

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 2021 (%) ⁽²⁾	2017	2018	2019	2020	2021
AST1b	386022	256401	Roadside	100.0	100.0	27.3	34.2	28.9	23.9	27.2
Ast3	385764	255968	Roadside	100.0	100.0	39.1	50.6	40.0	31.3	38.1
OAK	387810	254993	Roadside	100.0	100.0	16.6	19.0	16.7	13.1	13.1
LRW	386654	253761	Kerbside	75.0	75.0	36.4	45.2	35.7	25.0	30.4
BG2	386165	252146	Roadside	92.3	92.3	21.3	27.4	22.8	16.8	20.7

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 $\mu\text{g}/\text{m}^3$.

Exceedances of the NO₂ annual mean objective of $40\mu\text{g}/\text{m}^3$ are shown in **bold**.

NO₂ annual means exceeding $60\mu\text{g}/\text{m}^3$, indicating a potential exceedance of the NO₂ 1-hour mean objective are shown in **bold and underlined**.

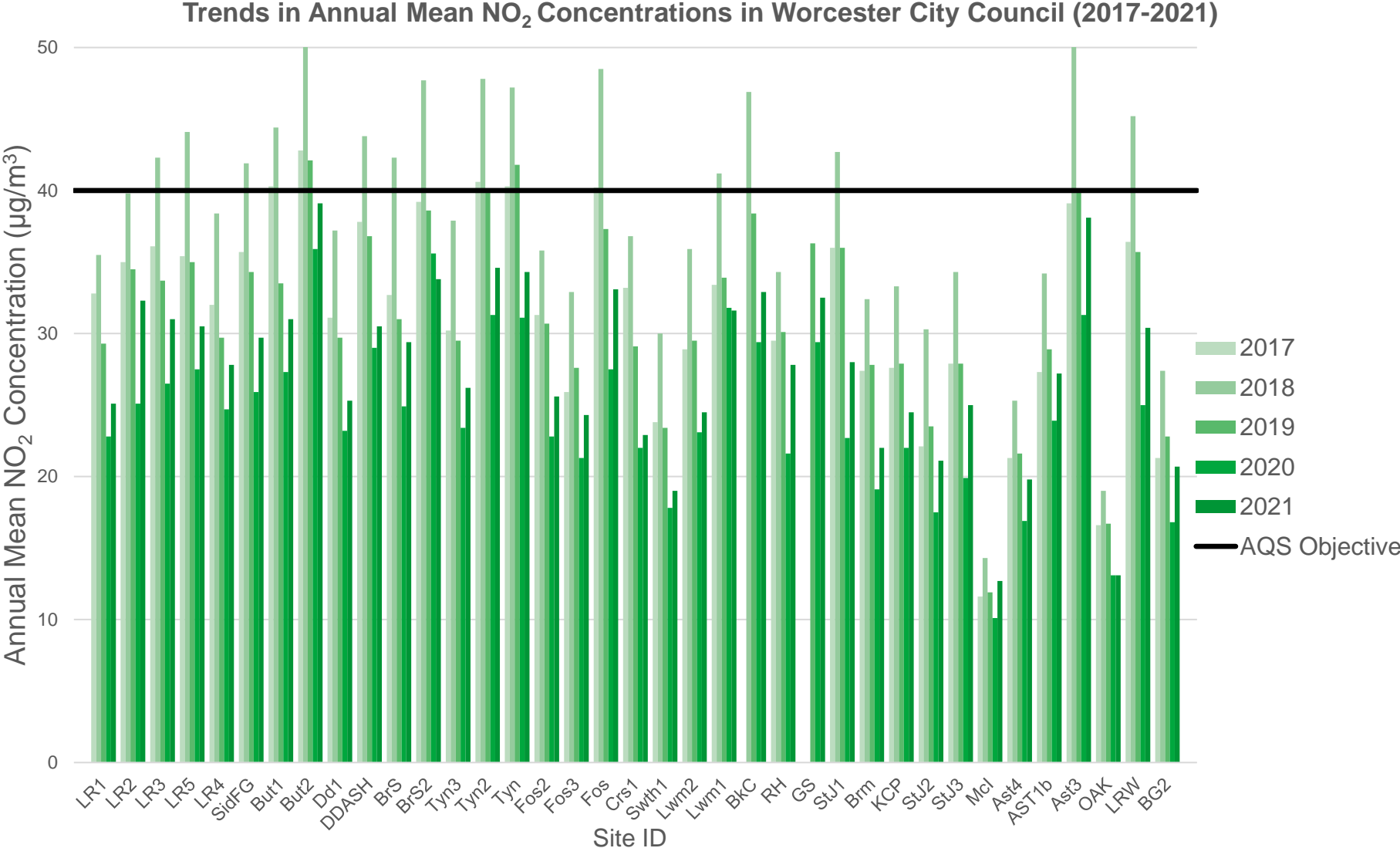
Means for diffusion tubes have been corrected for bias. All means have been “annualised” as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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

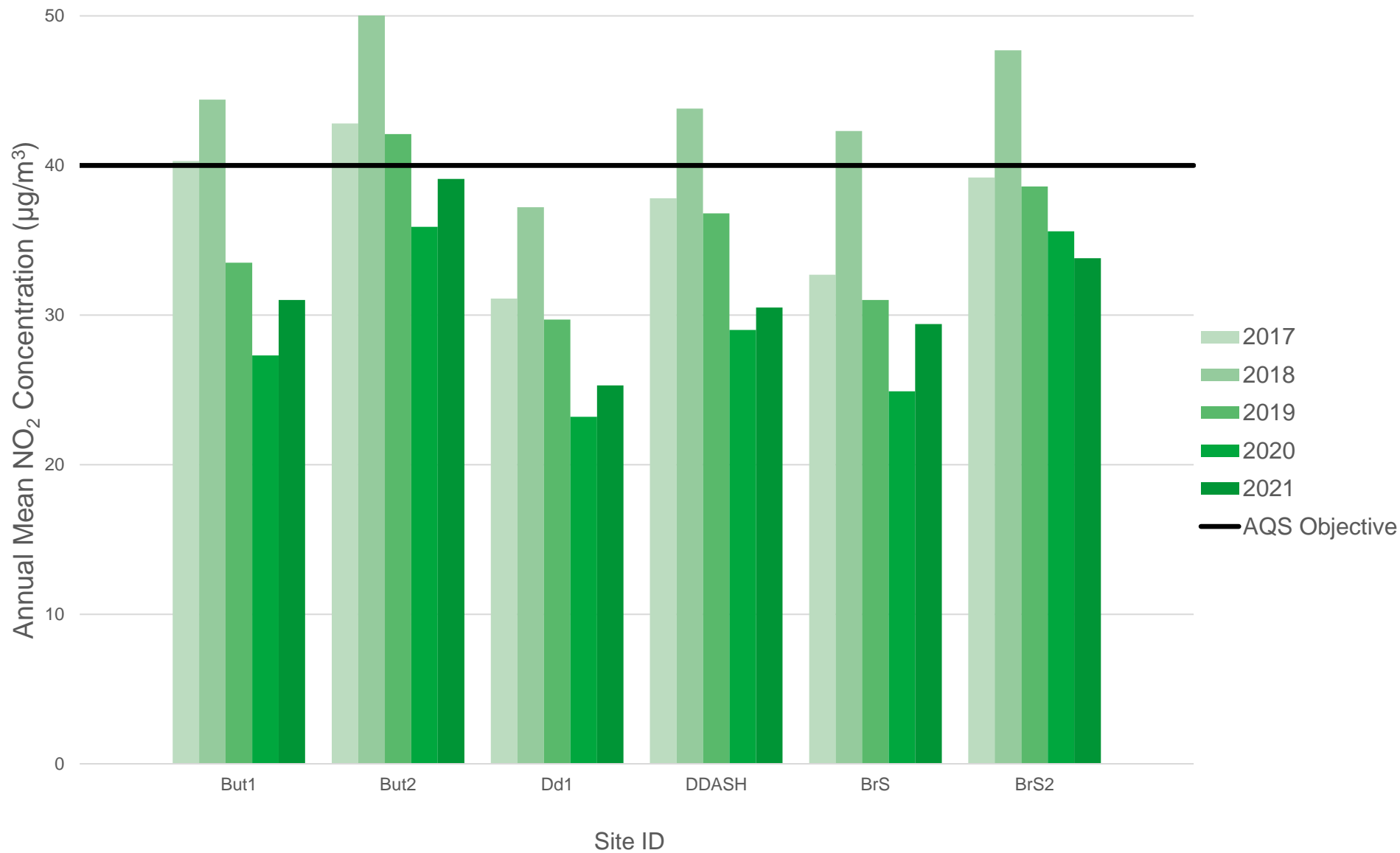
(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

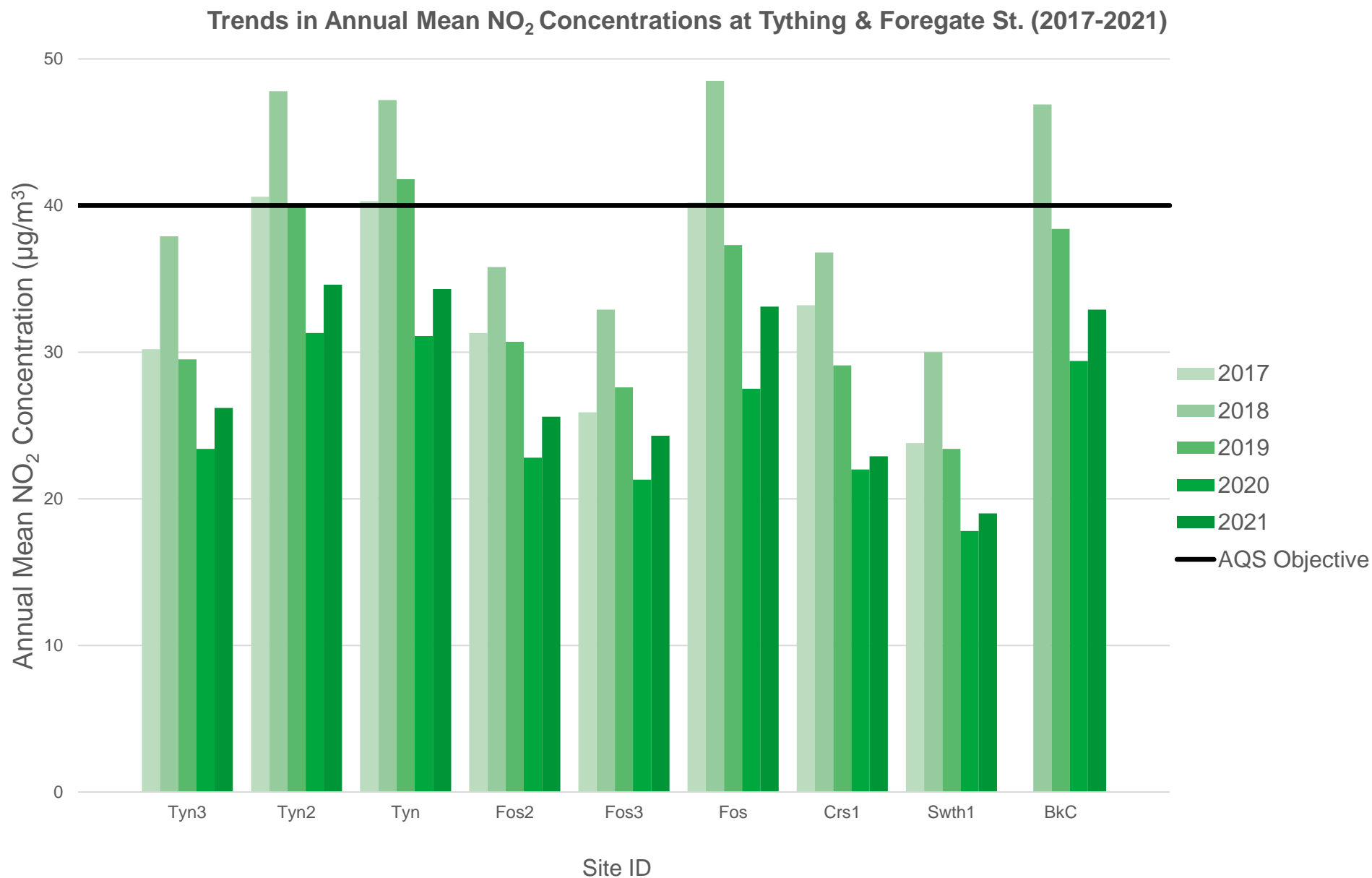
(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Figure A.1 – Trends in Annual Mean NO₂ Concentrations

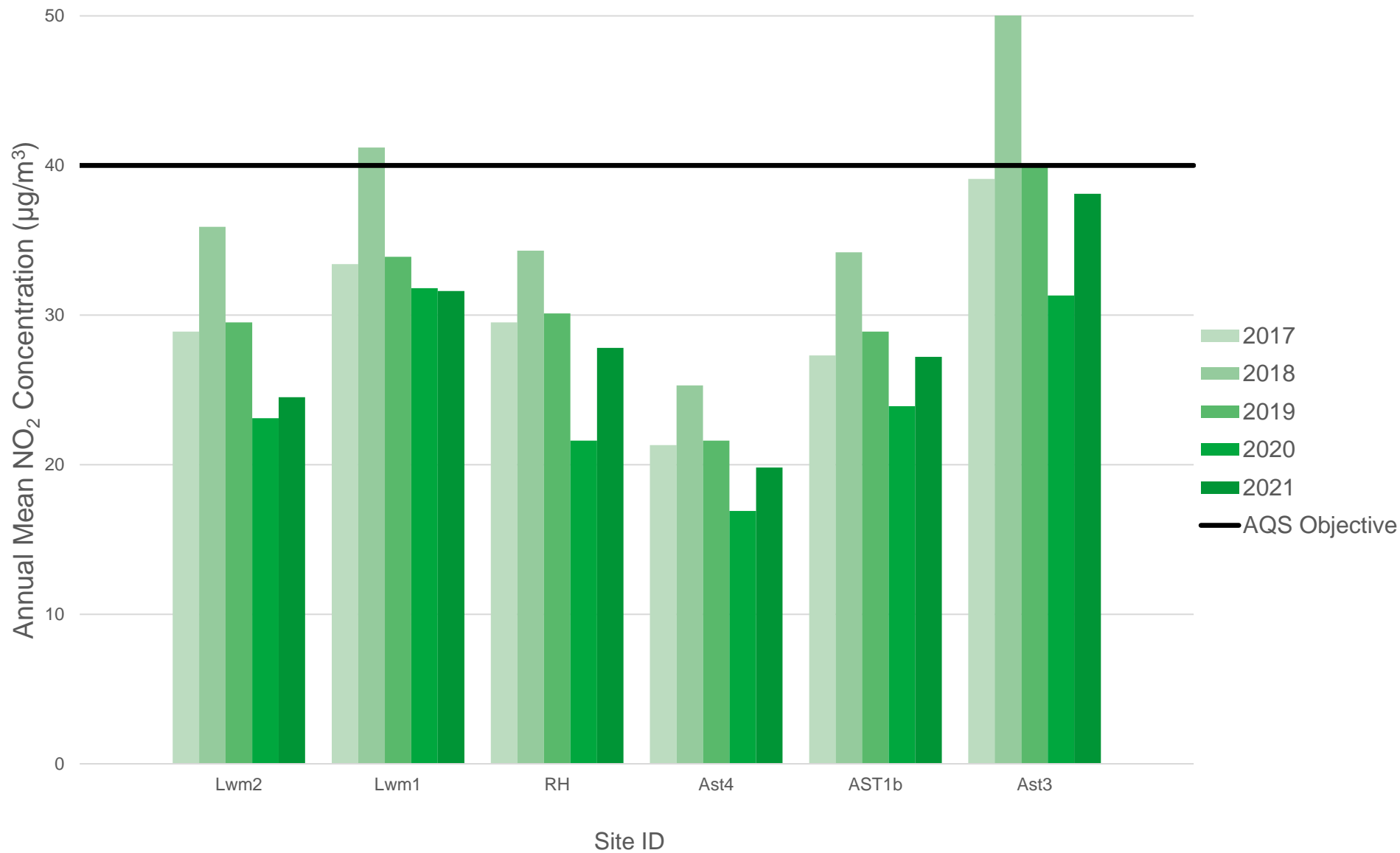


Trends in Annual Mean NO₂ Concentrations at Dolday, Bridge St. & the Butts (2017-2021)

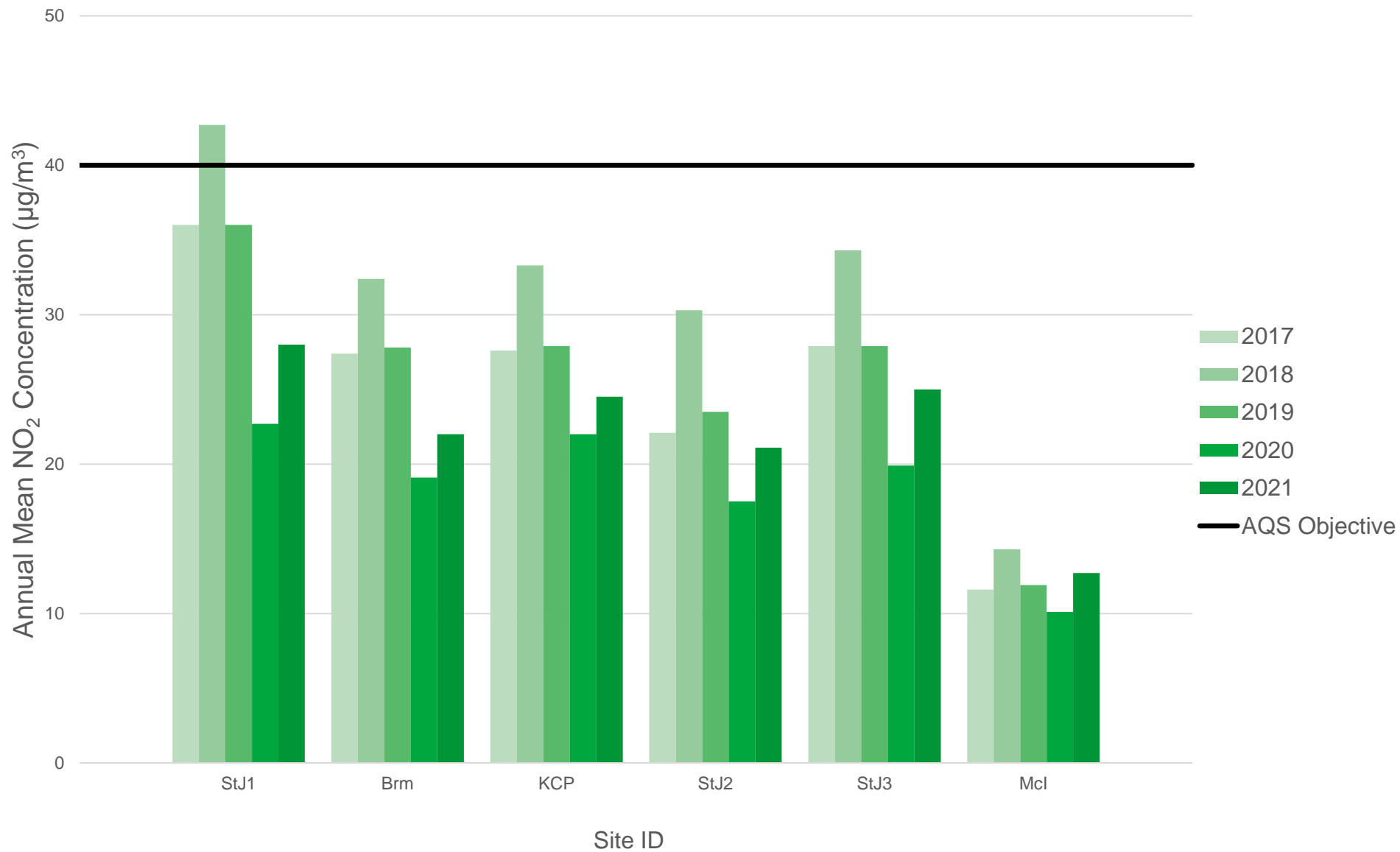




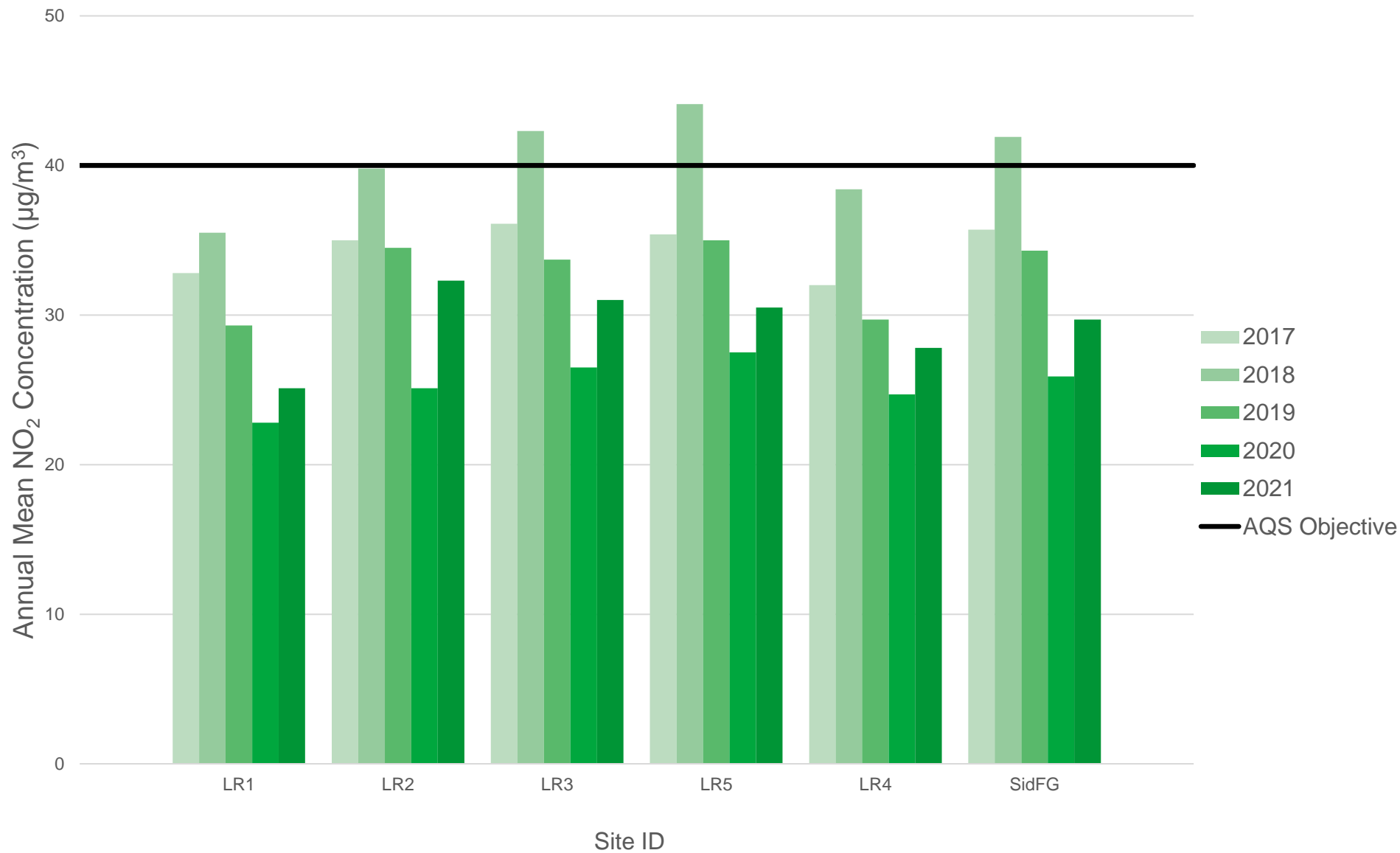
Trends in Annual Mean NO₂ Concentrations at Lowesmoor, Rainbow Hill & Astwood (2017-2021)



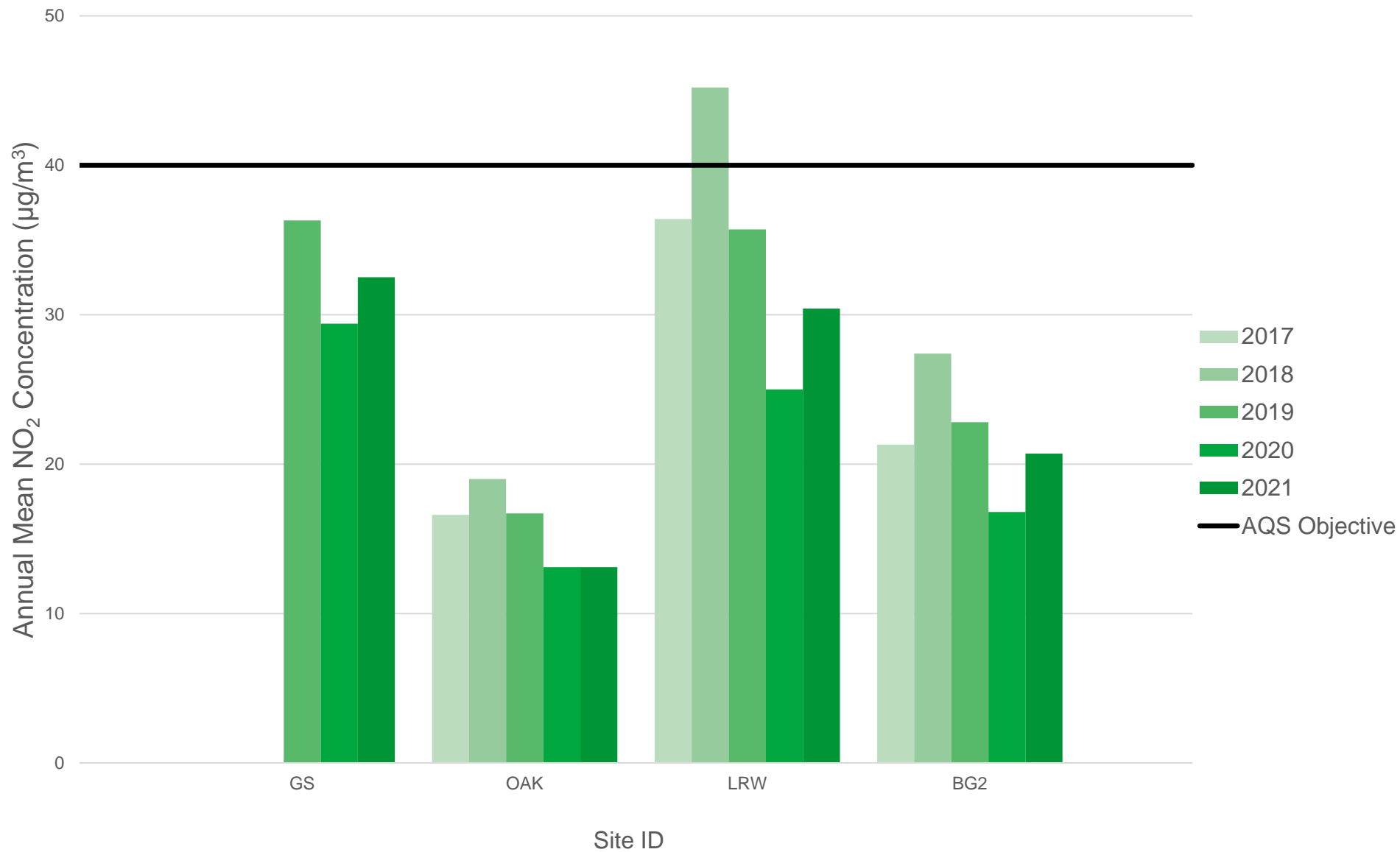
Trends in Annual Mean NO₂ Concentrations at St Johns (2017-2021)



Trends in Annual Mean NO₂ Concentrations at London Road & Sidbury (2017-2021)



Trends in Annual Mean NO₂ Concentrations at other locations in Worcester City (2017-2021)



Appendix B: Full Monthly Diffusion Tube Results for 2021

Table B.1 – NO₂ 2021 Diffusion Tube Results (µg/m³)

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 (0.84)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
LR1	385636	254158	36.8	31.5	30.9	29.1	28.7	25.7	24.2	25.0	33.9	28.3	33.8	30.5	29.9	25.1		
LR2	385428	254238		35.2				31.8	30.9	34.0	42.5	37.8	39.4	35.1	35.8	32.3		
LR3	385357	254272	39.1	35.9	35.7	32.8	37.9	32.1	32.7	40.4	42.3	37.2	42.3	34.2	36.9	31.0		
LR5	385325	254329	44.4	38.5	35.7	43.9	37.3	37.3	33.9	33.9	41.2	24.4		29.6	36.4	30.5		
LR4	385525	254219	35.6	33.0	34.1	36.9	30.4	30.5	30.7	30.4	37.1	30.1	36.3	32.2	33.1	27.8		
SidFG	385146	254474	42.7	33.3	37.3	34.8	35.9	32.9	32.7	30.9	40.8	34.1	42.3	26.8	35.4	29.7		
But1	384776	255107	38.3	35.5	35.8	40.6	34.0	32.5	33.8	36.5	42.0	36.6	46.4	31.6	37.0	31.0		
But2	384724	255086	48.5	27.5	46.6	43.2	48.3	45.7	50.6	43.0	52.9	50.9	59.4	42.4	46.6	39.1		
Dd1	384652	254986	30.6	32.6			29.3	29.0	27.3	30.0	36.0	27.6	31.8	27.4	30.2	25.3		
DDASH	384682	254924	37.9	34.2	31.2	30.8	34.3	33.1	36.0	36.2	42.9	41.0	43.7	35.1	36.3	30.5		
BrS	384666	254818	36.6	34.4	33.5	37.6	28.9	34.4	36.2	36.2	38.1		41.8	27.3	35.0	29.4		
BrS2	384695	254840	42.5	42.2	36.5	40.5	43.2	37.6	40.0		51.2	39.5	35.2	34.1	40.2	33.8		
Tyn3	384679	255998	33.7	37.2	26.1	33.4	29.3	27.8	28.7	29.5	34.1	29.6	34.9	29.5	31.1	26.2		
Tyn2	384767	255606	45.8	39.5	40.7	36.5	39.0	36.2	38.8	38.1	47.7	44.7	50.4	36.8	41.2	34.6		
Tyn	384833	255461	44.1	38.6	40.8	37.9	39.0	37.2	42.0	40.1	45.7	42.7	46.9	35.3	40.8	34.3		
Fos2	384866	255367	35.9	31.4	27.1	26.1	25.7	26.0	28.7	26.8	33.3	33.9	38.0	32.2	30.4	25.6		
Fos3	384899	255329	36.4	31.2		26.8		24.5	26.7	25.4	32.4	24.8	30.9	30.0	28.9	24.3		
Fos	384941	255140	40.7	37.5	35.9	41.2	35.0	38.7	38.0	37.9	46.0	36.1	48.1	37.3	39.4	33.1		
Crs1	384967	255012	30.7	23.9	26.7	27.8	25.5	24.7	24.3	26.3	26.7	27.3	36.9	26.0	27.2	22.9		
Swth1	385013	254987	26.8	24.6	20.2	26.1	19.9	20.2	19.5	20.3	21.8	19.4	28.0	24.5	22.6	19.0		
Lwm2	385164	255134	33.9	33.8	26.8	31.9	26.3	25.3	25.5	25.6	32.5	27.6	33.4	27.6	29.2	24.5		
Lwm1	385268	255191	44.7	37.2	32.3	40.7	34.4	34.1	32.1	34.6	42.5	38.1	46.8	34.4	37.7	31.6		
BkC	384948	255111	44.3	37.3	38.9	41.3	37.3	39.8	39.0	39.3	41.4	30.9	44.0	36.4	39.1	32.9		
RH	385420	255413				25.5	26.9	25.4	24.7	26.5	35.1	31.5	35.3		28.9	27.8		
GS	385358	254969	44.5	43.1	37.4	36.7	33.0	32.3	38.6	35.2	47.1	40.0	44.6	32.2	38.7	32.5		
StJ1	384137	254510		26.3	30.8	30.8	32.1	28.8	32.8	29.6	40.9	41.6	36.2	37.3	33.4	28.0		
Brm	383967	254481	32.7	32.3	23.9	24.9	18.6	20.1	18.9	18.9	28.6	31.8	31.8	32.2	26.2	22.0		
KCP	384016	254399	32.1	26.0	27.6	29.8	24.2	27.0	26.8	27.5	31.8	29.2	36.1	31.8	29.1	24.5		
StJ2	384013	254356	28.9	28.3	22.2	29.1	22.3	21.2	22.0	22.4	28.0	24.2	27.7		25.1	21.1		
StJ3	384046	254424	30.1	28.9	25.2	33.7	27.6	28.2	27.1	26.5	34.2	32.1	31.1	32.3	29.7	25.0		
Mcl	383454	254606	52.9	18.4	10.6	11.6	8.1	8.8	8.7	8.7	11.0	12.5	13.5	16.3	15.1	12.7		
Ast4	386097	256565	27.0	25.0	21.8	22.9	21.2	19.4	19.5	20.9	26.2	25.5	28.2	24.8	23.5	19.8		
AST1b	386022	256401	37.5	35.5	33.5	33.4	29.5	28.0	26.3	29.3	33.2	34.4	34.6	34.0	32.4	27.2		
Ast3	385764	255968	49.4	44.3	40.7	45.6	40.7	42.7	42.8	40.7	53.3	47.3	53.2	43.4	45.3	38.1	28.8	
OAK	387810	254993	21.5	19.0	16.3	14.9	12.6	3.3	12.8	12.4	17.2	18.3	19.5	19.8	15.6	13.1		
LRW	386654	253761	38.0	35.1	32.7	43.7	34.7	36.8	36.2				36.1	33.0	36.2	30.4		
BG2	386165	252146	27.4	34.4	20.7	26.5	19.4		20.6	20.8	25.7	24.3	24.4	26.5	24.6	20.7		

- All erroneous data has been removed from the NO₂ diffusion tube dataset presented in Table B.1.
- Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16.
- National bias adjustment factor used
- Where applicable, data has been distance corrected for relevant exposure in the final column.
- Worcester City Council confirm that all 2021 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System.

Notes:

Exceedances of the NO₂ annual mean objective of 40µg/m³ are shown in **bold**.

NO₂ annual means exceeding 60µg/m³, indicating a potential exceedance of the NO₂ 1-hour mean objective are shown in **bold and underlined**.

See Appendix C for details on bias adjustment and annualisation.

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

New or Changed Sources Identified Within Worcester City During 2021

Worcester City Council has not identified any new sources relating to air quality within the reporting year of 2021.

Additional Air Quality Works Undertaken by Worcester City Council During 2021

A draft Source Apportionment Assessment (2022) has been carried out for a number of areas of concern within the city; the Tything, Foregate Street, the Butts, the Cross, Bridge Street, All Saints Road, and Lowesmoor. The outcome of the source apportionment assessment using traffic count data from November 2021 shows that background concentration contributes a significant proportion of the overall concentration of NO₂ measured within each of the study areas varying from 25.97% to 39.27%. Cars were shown to comprise the largest proportion of traffic volume, with between 65.74% and 82.54% contributing to between 18.91% and 49.87% of vehicle source emissions. Buses comprise a much smaller proportion of the traffic volume ranging between 1.19% and 10.47% but contributing much larger proportions of vehicle emissions of between 13.7% and 58.19%.

For the majority of the locations, it is likely that a reduction across all vehicle types, or combination of several categories, would be required to achieve the Air Quality Objective of <40 µg/m³ for annual mean NO₂ concentrations. Using annual mean NO₂ concentrations measured in 2018, the study indicated that a maximum reduction in NO₂ of 37.7% would be required to achieve the objective within all areas. A maximum reduction of 43% would be necessary across all vehicle types to achieve results 5% below the objective, and 48.1% to achieve 10% below the objective.

Whilst all monitoring stations within the Worcester City (Political Boundary) AQMA are compliant in 2021, Worcester City Council will consider the effects of reducing targeted vehicle types to further reduce NO₂ concentrations.

QA/QC of Diffusion Tube Monitoring

The following UKAS accredited company provided Worcester City Council with nitrogen dioxide diffusion tubes and analysis in 2021:

Gradko International Limited

St. Martins House

77 Wales Street

Winchester

SO23 0RH

diffusion@gradko.com

The 20% Triethanolamine (TEA) / De-ionised Water preparation method is used.

Gradko International Limited participate in the AIR NO₂ Proficiency Testing Scheme (AIR-PT).

All monitoring undertaken has been completed in accordance with the 2021 Diffusion Tube Monitoring Calendar, i.e. on or within ± 2 days of the specified date.

Diffusion Tube Annualisation

Annualisation was required for two stations in Worcester City Council area (LR2 and RH) as recorded data capture was <75% during 2021. Data from three AURN monitoring sites; Leamington Spa, Leominster and Birmingham Ladywood, was used to provide location specific diffusion tube average annualisation factors to apply to the raw data annual mean, giving an annualised annual mean for each location. Data from the AURN monitoring site Birmingham Acocks Green was unavailable for 2021. Details on annualisation methodology is presented in Table C.2.

Diffusion Tube Bias Adjustment Factors

The diffusion tube data presented within the 2022 ASR have been corrected for bias using an adjustment factor. Bias represents the overall tendency of the diffusion tubes to under or over-read relative to the reference chemiluminescence analyser. LAQM.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/NO₂ continuous analysers. Alternatively, the national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method.

Worcester City Council have applied a national bias adjustment factor of 0.84 to the 2021 monitoring data. A summary of bias adjustment factors used by Worcester City Council over the past five years is presented in Table C.1. WRS has determined the appropriate national bias adjustment factor using Version 03/22 of the Defra published National Diffusion Tube Bias Adjustment Spreadsheet using 32 Gradko studies for the relevant diffusion tubes (20% TEA in water) for 2021.

Table C.1 – Bias Adjustment Factor

Monitoring Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2021	National	03/22	0.84
2020	National	03/21	0.81
2019	National	03/20	0.78
2018	National	03/19	0.89
2017	National	09/18	0.77

NO₂ Fall-off with Distance from the Road

Wherever possible, monitoring locations are representative of exposure. However, where this is not possible, the NO₂ concentration at the nearest location relevant for exposure has been estimated using the Diffusion Tube Data Processing Tool/NO₂ fall-off with distance calculator available on the LAQM Support website. Where appropriate, non-automatic annual mean NO₂ concentrations corrected for distance are presented in Table B.1.

One diffusion tube NO₂ monitoring locations within the Worcester City Council area required distance correction during 2021 (Ast3). Distance correction was considered at Ast3 as the annual mean concentration is greater than 36 µg/m³ (38.1 µg/m³ after bias adjustment) as the monitoring site is not located at a point of relevant exposure. Details on the fall-off with distance calculation carried out using the Diffusion Tube Data Processing Tool are presented in Table C.4.

QA/QC of Automatic Monitoring

No automatic monitoring was undertaken within the Worcester City district during 2021.

Table C.2 – Annualisation Summary (concentrations presented in $\mu\text{g}/\text{m}^3$)


Site ID	Annualisation Factor Leamington Spa	Annualisation Factor Leominster	Annualisation Factor Birmingham Ladywood	Average Annualisation Factor	Raw Data Annual Mean	Annualised Annual Mean	Comments
LR2	1.0438	1.1047	1.0730	1.0738	35.8	38.5	
RH	1.1533	1.1663	1.1202	1.1466	28.9	33.1	

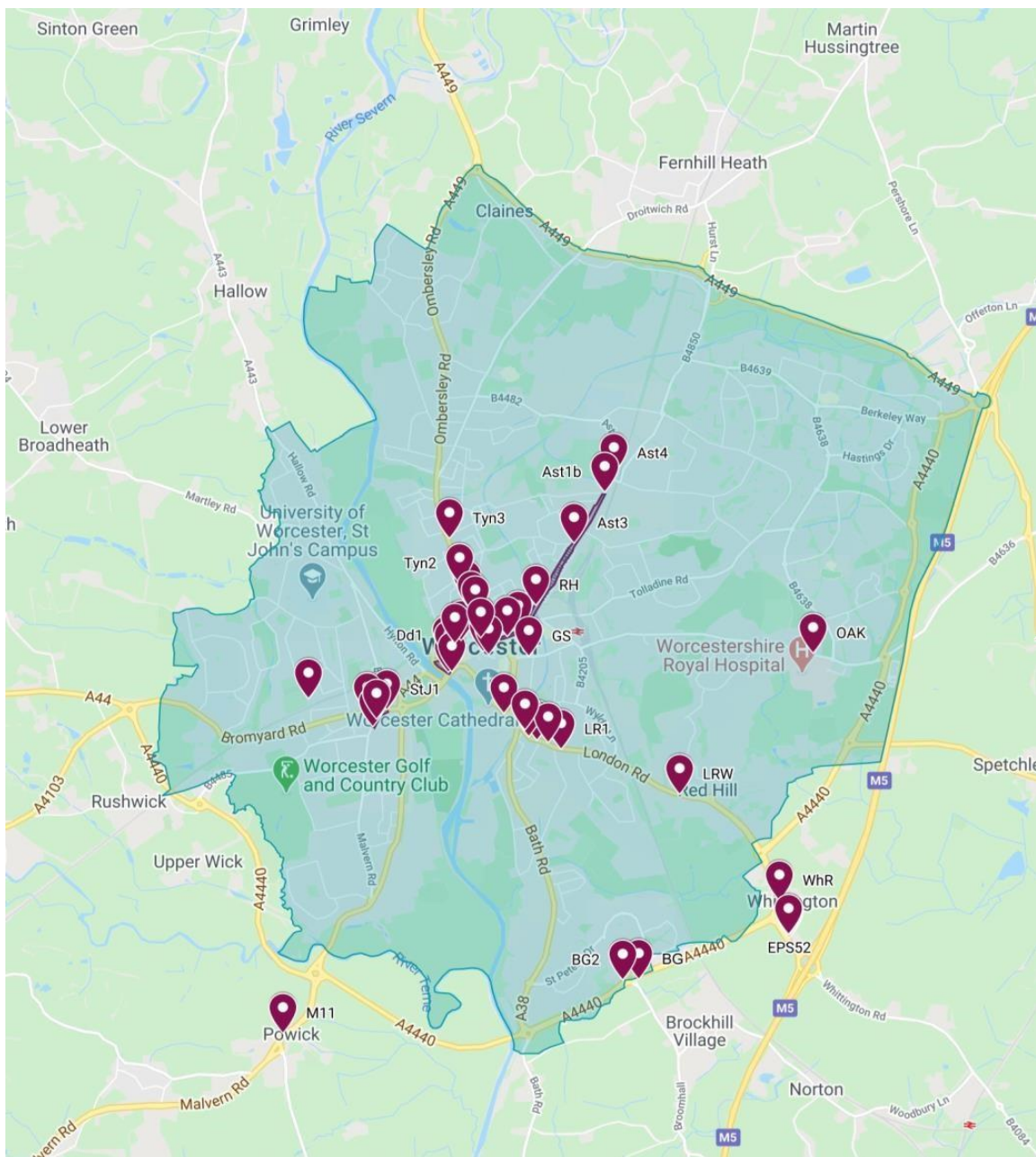
Table C.3 – NO₂ Fall off With Distance Calculations (concentrations presented in µg/m³)

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
Ast3	1.7	8.3	38.1	12.1	28.8	

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

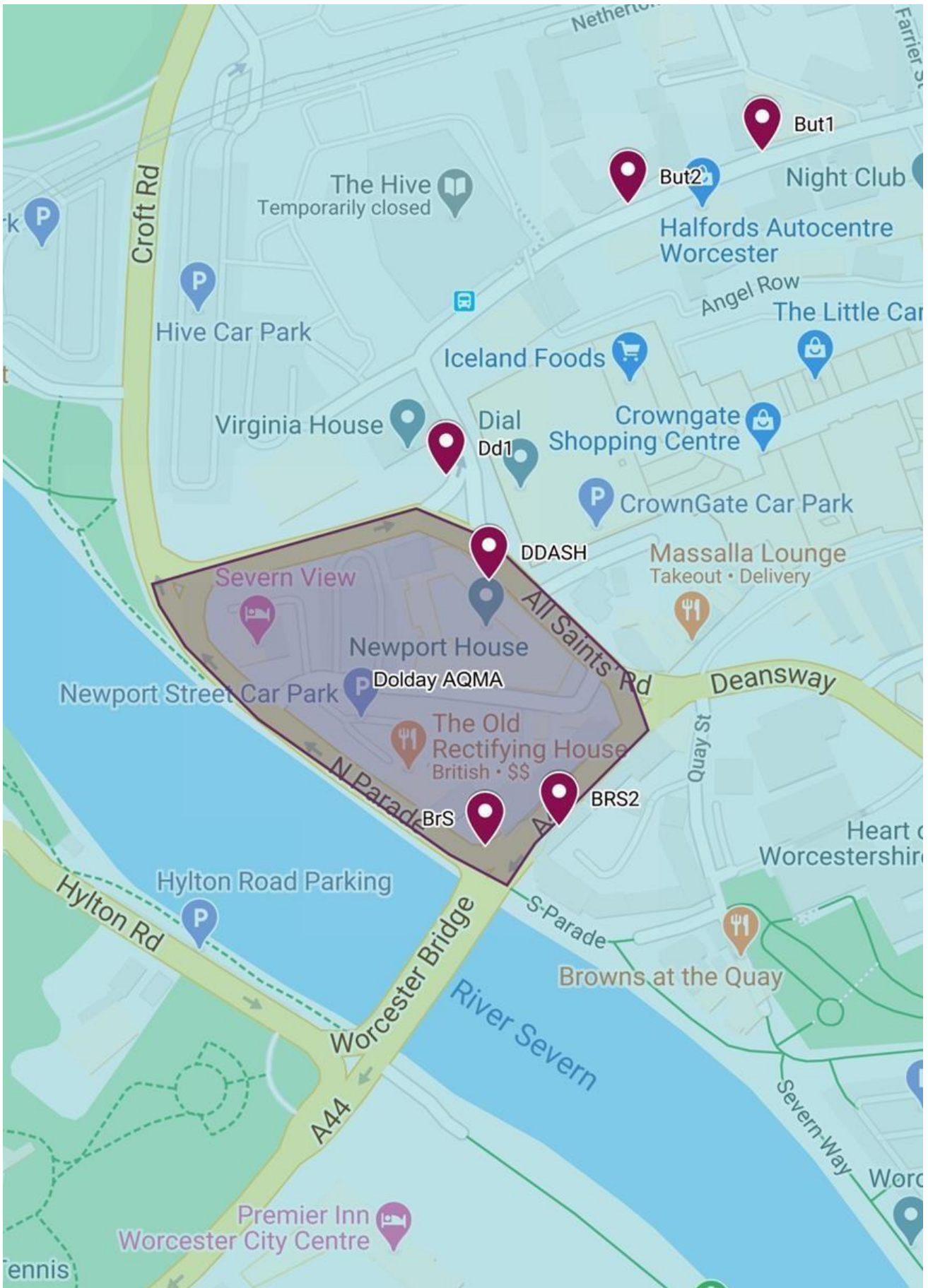
Figure D.1 – Map of Non-Automatic Monitoring Sites

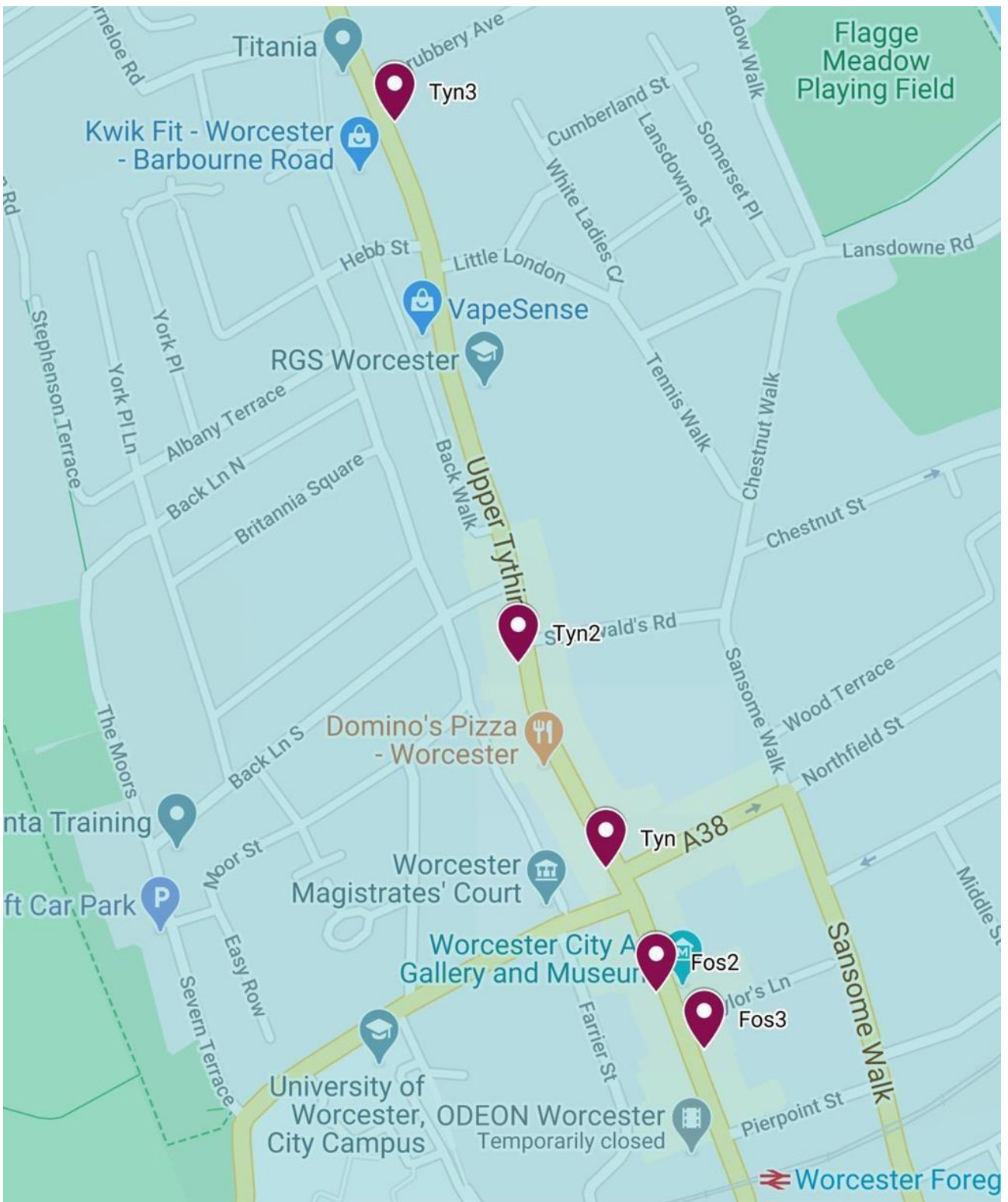
<p>Figure D.1 – Worcester City AQMA (Political Boundary) and Overview of Monitoring Locations</p>	<p>Legend</p> <ul style="list-style-type: none">  Monitoring Locations (ID)  AQMA
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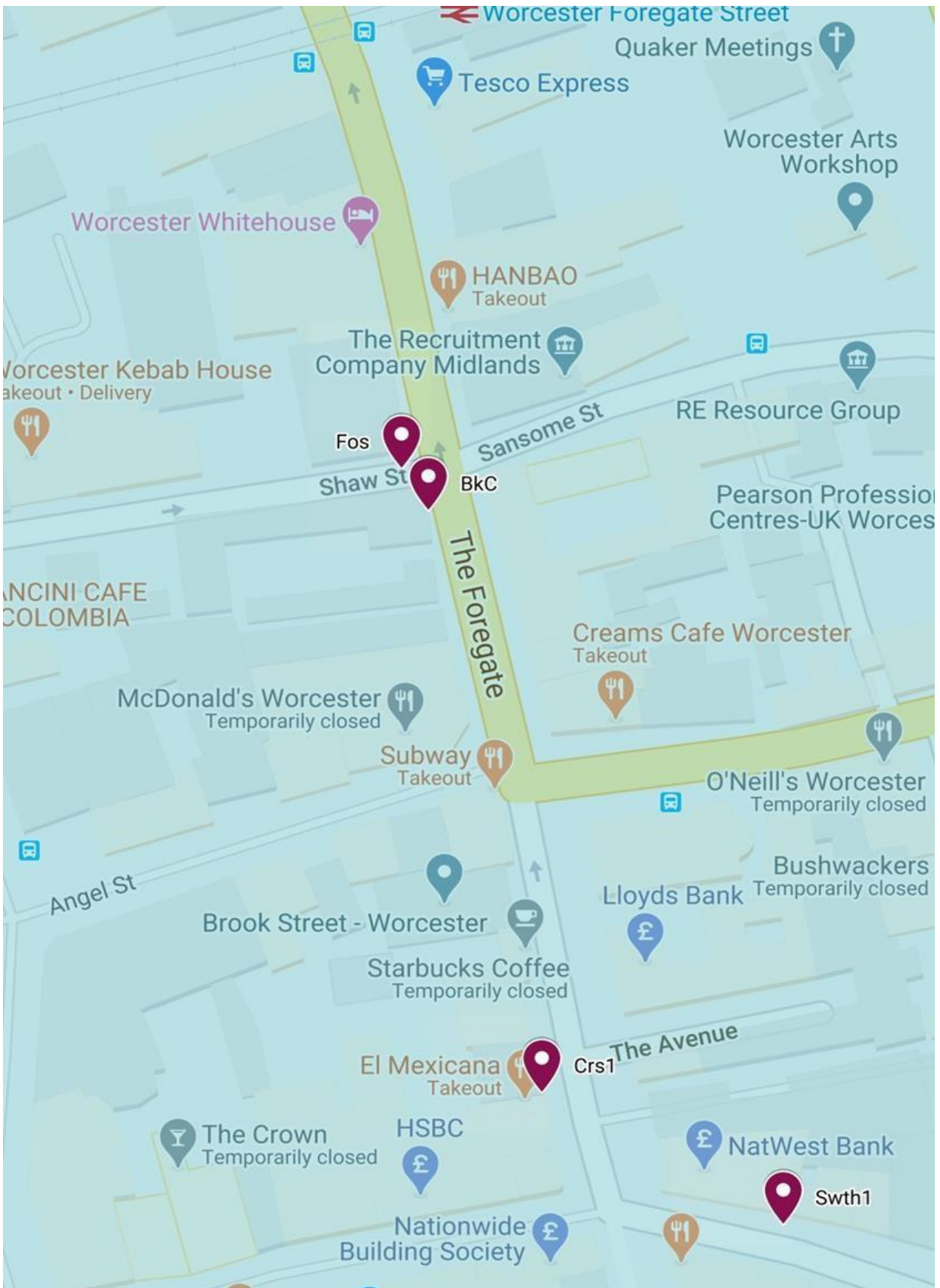


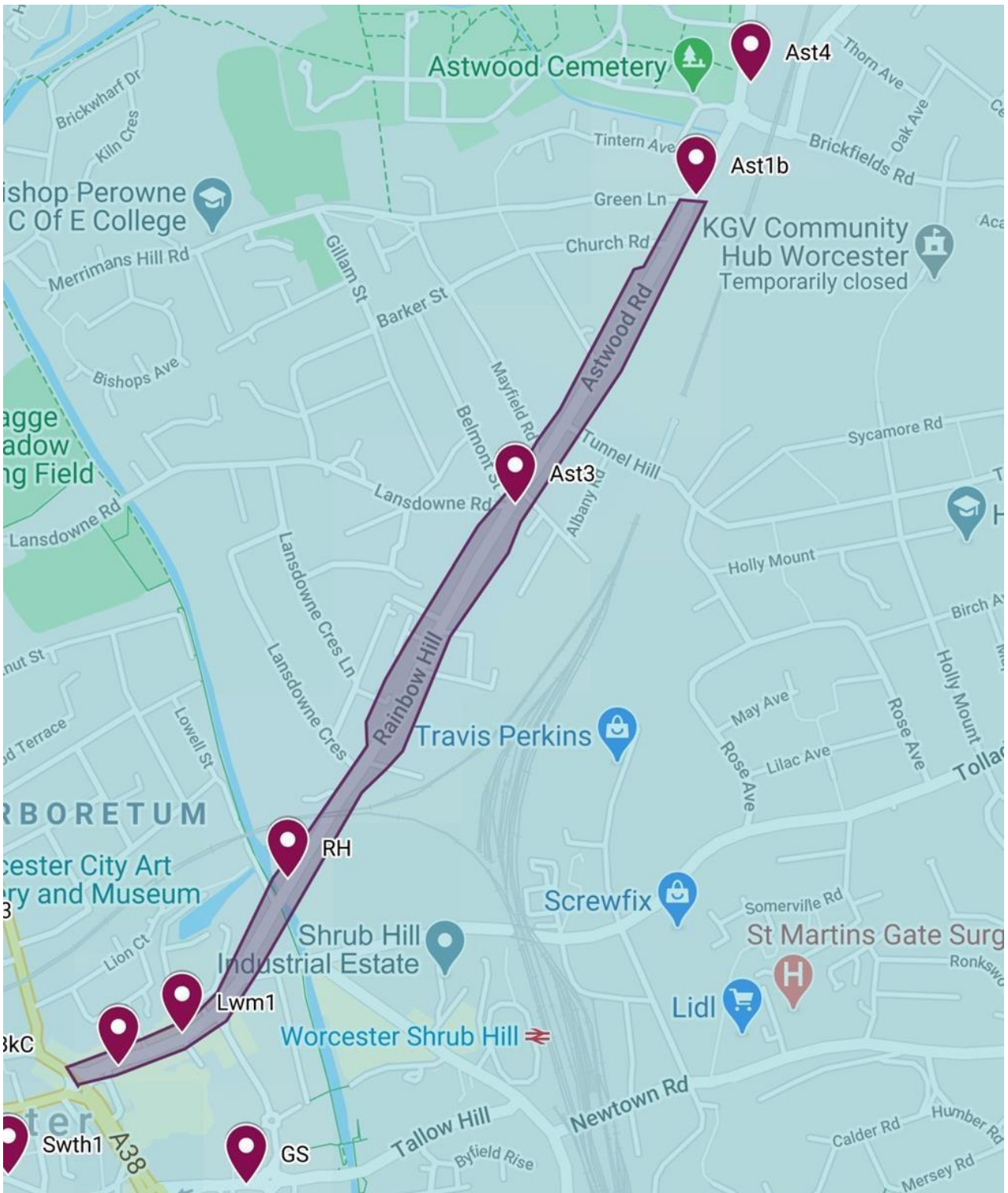
Date: 18.05.2022

Copyright: Map data ©2020 Google United Kingdom

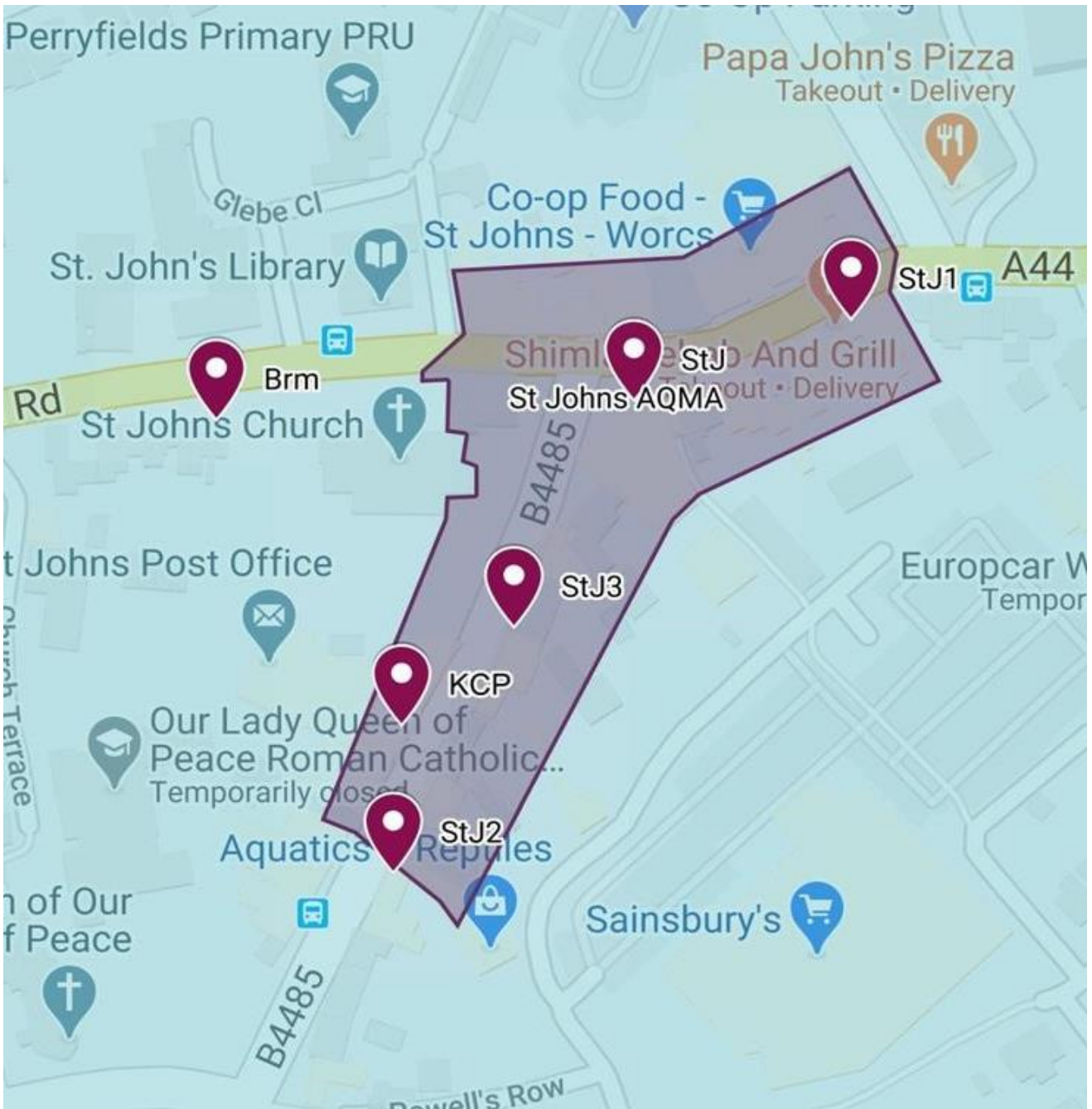


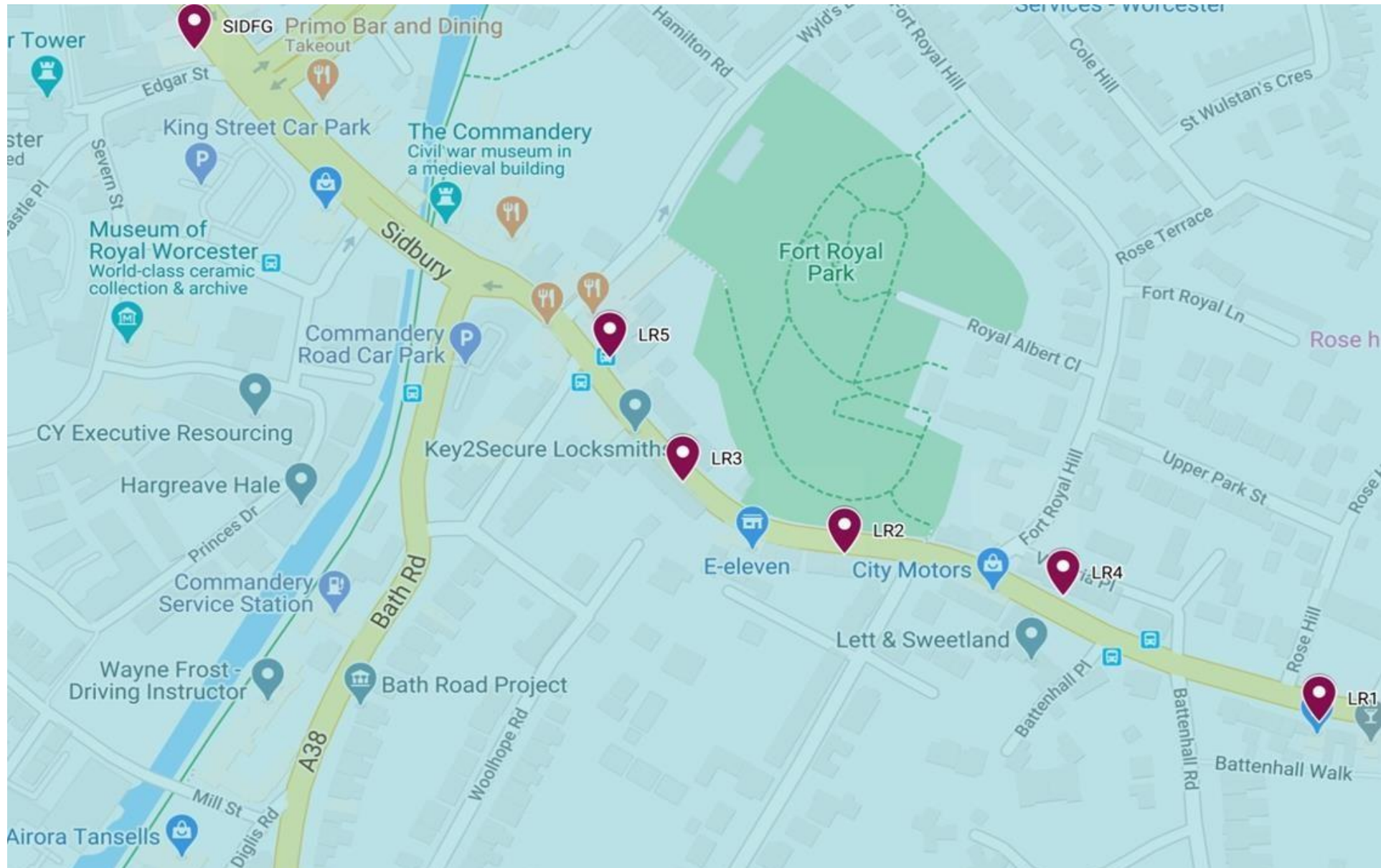


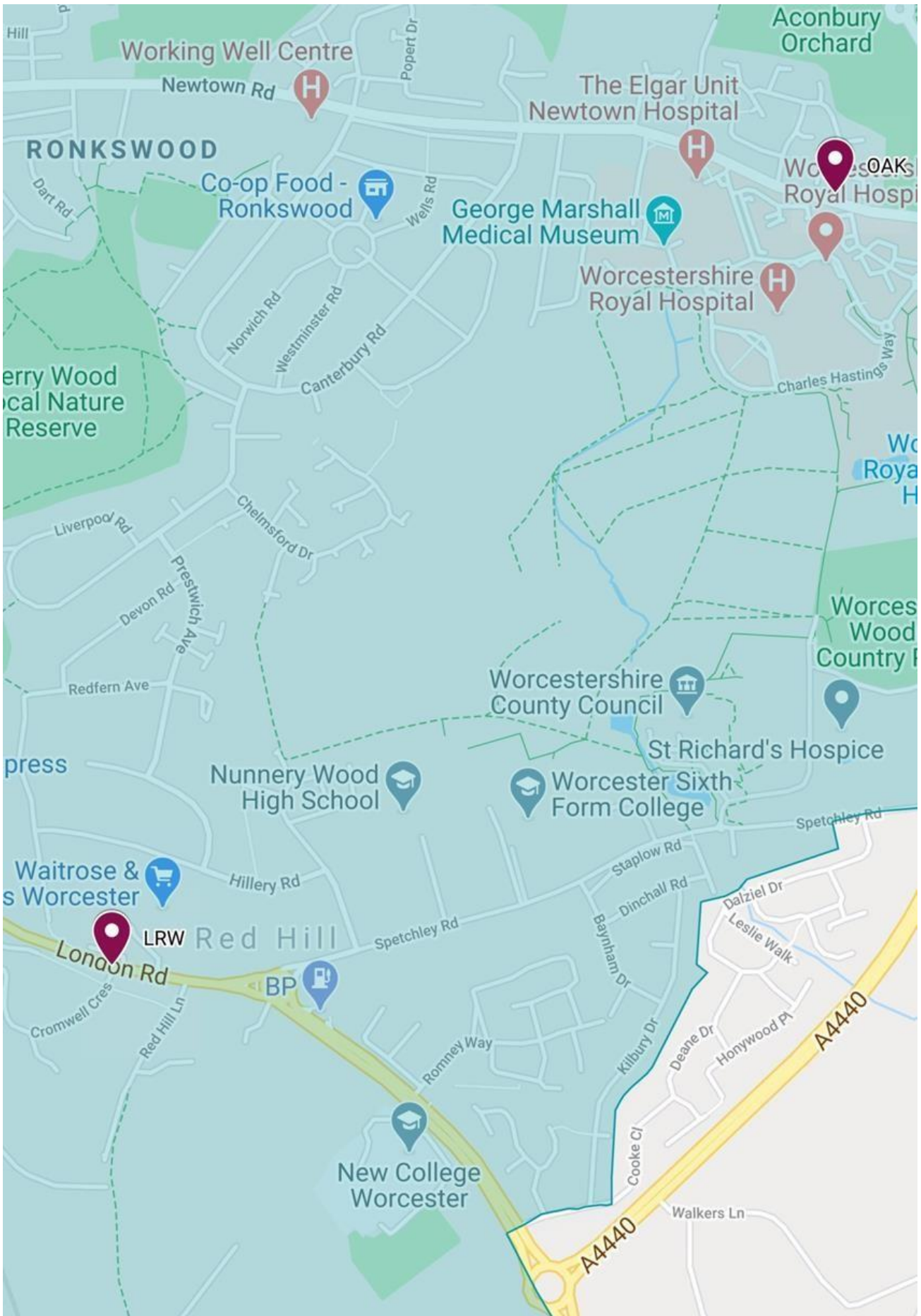


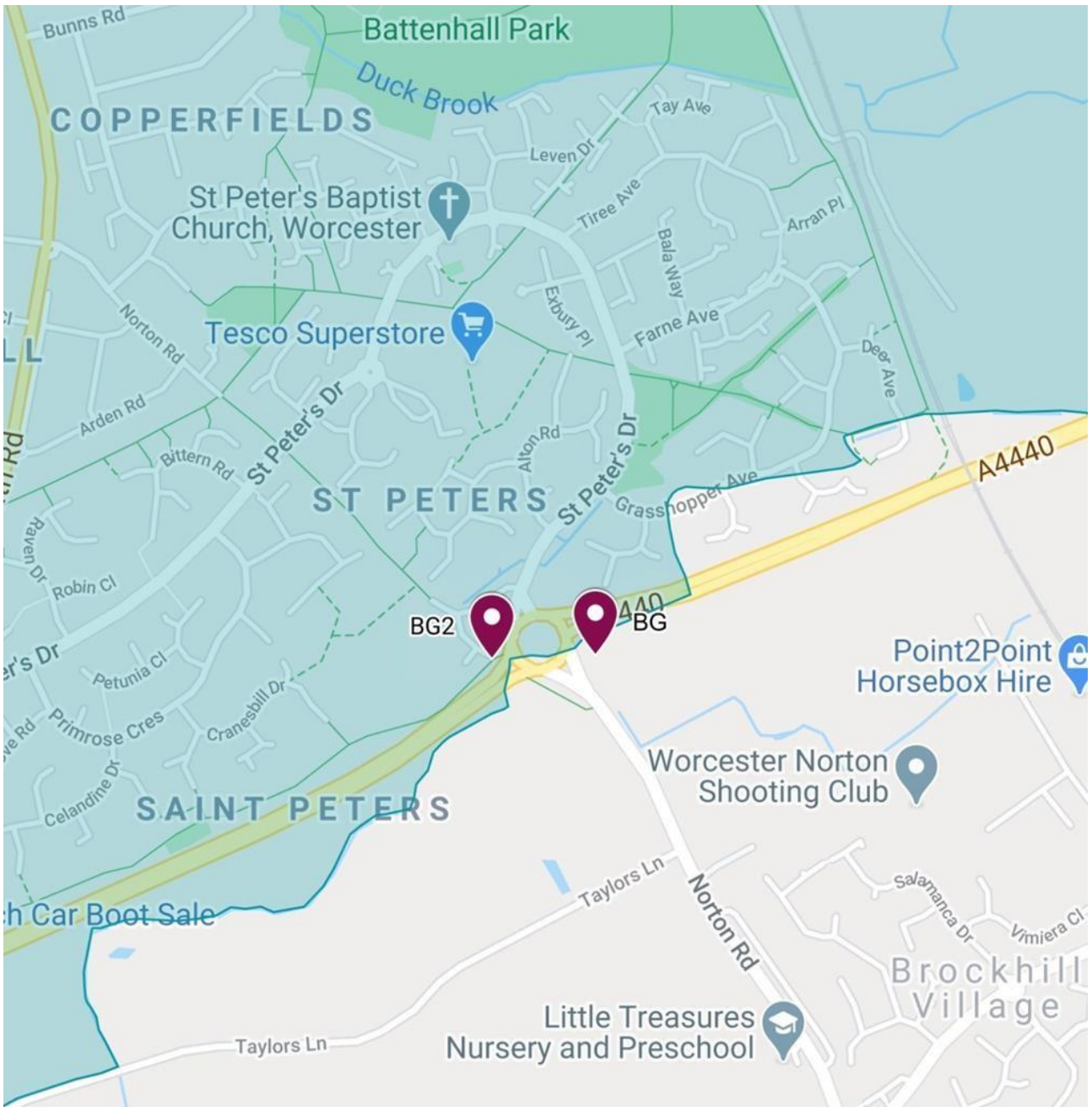












Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England¹⁰

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

¹⁰ The units are in microgrammes of pollutant per cubic metre of air (µg/m³).

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 National Highways
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

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