



Worcestershire  
**Regulatory Services**

*Supporting and protecting you*

# 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 Malvern Hills District Council

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children, 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<sup>1,2</sup>.

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

The Malvern Hills District experiences good air quality. No Air Quality Management Areas (AQMAs) have been declared in the Malvern Hills District to date. Monitoring data over previous years, carried out at numerous locations identified as representing worst-case conditions, has been well below the national objectives for nitrogen dioxide (NO<sub>2</sub>).

Monitoring results within the Malvern Hills Borough area demonstrate that there were no exceedances of the NO<sub>2</sub> air quality objective of 40µg/m<sup>3</sup> in 2021. Monitoring data shows that there is an increase in nitrogen dioxide concentrations at all but one location when monitoring data for 2021 is compared with that from 2020. An average increase of 9.7% (1.6 µg/m<sup>3</sup>) can be seen across the District between 2020 and 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, NO<sub>2</sub> concentrations at all monitoring stations decreased in 2021 relative to 2019.

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<sup>1</sup> Public Health England. Air Quality: A Briefing for Directors of Public Health, 2017

<sup>2</sup> Defra. Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006

<sup>3</sup> Defra. Air quality appraisal: damage cost guidance, July 2021

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

There is no discernible upward or downward trend in concentrations over the 5-year period 2017- 2021.

No annual means greater than 60ug/m<sup>3</sup> have been recorded indicating that it is very unlikely that there have been any exceedances of the 1-hour mean objective for NO<sub>2</sub> at any monitoring sites.

## 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<sup>5</sup> sets out the case for action, with goals to reduce exposure to harmful pollutants. The Road to Zero<sup>6</sup> 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.

No specific actions have been progressed to improve air quality in the Malvern Hills District as there is currently no declared AQMA in the area. However, the general actions to improve air quality detailed in the current Worcestershire AQAP apply across Worcestershire as a whole, including the Malvern Hills area. Please refer to the Air Quality Action Plan Progress Report for Worcestershire 2015-2016, available at [Air Quality Action Plan - Worcestershire Regulatory Services \(worcsregservices.gov.uk\)](https://www.worcsregservices.gov.uk/air-quality-action-plan).

## Conclusions and Priorities

There are currently no AQMAs declared in the Malvern Hills District. Concentrations at identified worse-case scenario locations have been recorded well below the objectives for nitrogen dioxide.

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<sup>5</sup> Defra. Clean Air Strategy, 2019

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

The priorities for Malvern Hills District Council are to continue to monitor nitrogen dioxide at key points across the area. WRS, on behalf of the District Council, will continue to review and comment on planning applications where air quality is a relevant concern.

## Local Engagement and How to get Involved

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

- **Walk or cycle around the District instead of driving:** 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;
- **Turn off your engine when stationary or parked,** don't 'idle', particularly outside sensitive receptors such as schools, hospitals, care homes and residential properties;
- Worcestershire County Council 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:  
<https://liftshare.com/uk/community/worcestershire>
- General **travel planning** advice is available on Worcestershire County Council's website (including walking, cycling and bus maps and timetables) and Government website:
  - [Travel and Roads | Worcestershire County Council](#)
  - [Smarter choices: changing the way we travel - GOV.UK \(www.gov.uk\)](#)
- If you have to drive, follow fuel efficient driving advice, often known as '**Smarter Driving Tips**', to save on fuel and reduce your emissions. A number of websites promote such advice including:
  - [Save money and emissions through ecodriving - Energy Saving Trust](#)
  - [How to drive economically - Eco-driving tips | AA \(theaa.com\)](#)
  - [Fuel Consumption & CO2 Databases | Vehicle Certification Agency \(vehiclecertification-agency.gov.uk\)](#)
- 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:** The government is providing £80m funding to encourage installation of Electric Vehicle (EV) charging points. Eligible businesses, charities and public sector organisations with off street parking for staff or vehicles fleets can apply for vouchers to redeem costs of electric vehicle charge-points. There is a limit of 1 voucher per applicant; however, applicants with a 'franchise' may apply for up to 20 franchisees. There is an approved charge points list and a list of authorised installers

<https://www.gov.uk/government/collections/government-grants-for-low-emission-vehicles#workplace-charging-scheme>

## 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,  
Worcestershire Regulatory Services

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 Malvern Hills District Council 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 Malvern Hills District 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.

Malvern Hills District Council currently does not have any declared AQMAs.

Concentrations continue to be well below the annual mean objective for nitrogen dioxide at measured locations. For reference, maps of Malvern Hills District's monitoring locations are available in Appendix D.

## 2.2 Progress and Impact of Measures to address Air Quality in Malvern Hills District Council

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

1. Trends in air quality are presented and the report includes a detailed discussion on the observed trends, with a comparison to the 2019 monitoring results for each monitoring locations.
2. The Public Health Outcomes Frameworks was mentioned and has referred specifically to indicator 3.01 (Fraction of mortality attributable to particulate air pollution). This is encouraged.
3. QA/QC of monitoring data is good. However, the national bias adjustment screen captures should be updated to show the filtered sheet and final adjustment factor applicable to the Council's monitoring.
4. Appendix F of the 2021 ASR reports clearly the impacts of COVID-19 on LAQM. However, there is a paragraph that makes reference to an AQMA but there are no AQMAs within Malvern Hill District. This paragraph should be updated to either specify the AQMA being referred to, or removed if not relevant to this ASR.
5. Overall, the report is detailed, concise and mostly satisfies the criteria of the relevant reporting standard. The Council should continue their good work.

The above points are noted. Appendix F is no longer included in the 2022 ASR and no reference has been made to any AQMA being located in Malvern Hills.

No specific actions have been progressed to improve air quality in the Malvern Hills District as there is currently no declared AQMA in the area. However, the general actions to improve air quality detailed in the current Worcestershire AQAP apply across Worcestershire as a whole, including the Malvern Hills area. Please refer to the Air Quality Action Plan Progress Report for Worcestershire 2015-2016, available at [Air Quality Action Plan - Worcestershire Regulatory Services \(worcsregservices.gov.uk\)](https://www.worcsregservices.gov.uk/air-quality-action-plan)

## 2.3 PM<sub>2.5</sub> – 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<sub>2.5</sub> (particulate matter with an aerodynamic diameter of 2.5 µm or less). There is clear evidence that PM<sub>2.5</sub> has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

Malvern Hills District Council has taken the following measures to address PM<sub>2.5</sub>. WRS has reviewed the 2018 based DEFRA national background maps to determine projected PM<sub>2.5</sub> concentrations with the Malvern Hills District for the 2021 calendar year.

The average total PM<sub>2.5</sub> at 577 locations (centre points of 1km x 1km grids) across the Malvern Hills District is 7.3 µg/m<sup>3</sup>, with a minimum concentration of 6.5 µg/m<sup>3</sup> and a maximum concentration of 9.1 µg/m<sup>3</sup>.

This indicates that PM<sub>2.5</sub> concentrations within the Malvern Hills District is below the proposed annual average limit value for PM<sub>2.5</sub> target of 10µg/m<sup>3</sup> to be met across England by 2040.

There are no smoke control areas in the Malvern Hills District 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 Framework<sup>7</sup>. 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.

As outlined in Policy Guidance LAQM.PG16 WRS has discussed the role of the DoPH, and the details of PM<sub>2.5</sub> levels across the County, with the Director of Public Health at Worcestershire County Council. A new Air Quality Partnership led by the Director of Public Health at Worcestershire County council, and supported by WRS, 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

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<sup>7</sup> [Public Health Outcomes Framework - OHID \(phe.org.uk\)](https://www.phe.org.uk/publication/public-health-outcomes-framework)

District authorities from public health, air quality, strategic planning, sustainability, highways and transport disciplines, and also 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. Further discussions and work to formalise an action plan were proposed to continue in 2020 however the work of the group was postponed indefinitely due to the Covid-19 pandemic but is anticipated to restart later this year.

No additional actions are currently planned by Malvern Hills District Council in relation to the reduction of PM<sub>2.5</sub> levels. However, it is anticipated that any actions taken to improve NO<sub>2</sub> levels across Worcestershire will likely result in a linked improvement in PM<sub>2.5</sub> 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 Malvern Hills District 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

Malvern Hills District Council did not undertake any automatic monitoring during 2021.

#### 3.1.2 Non-Automatic Monitoring Sites

Malvern Hills District Council undertook non-automatic (i.e. passive) monitoring of NO<sub>2</sub> at eight 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 (NO<sub>2</sub>)

**Error! Reference source not found.** and Table A.2 in Appendix A compare the ratified and adjusted monitored NO<sub>2</sub> annual mean concentrations for the past five years with the air quality objective of 40µg/m<sup>3</sup>. 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.

**Error! Reference source not found.** in Appendix A compares the ratified continuous monitored NO<sub>2</sub> hourly mean concentrations for the past five years with the air quality objective of 200µg/m<sup>3</sup>, not to be exceeded more than 18 times per year.

There has been no exceedance of the Nitrogen Dioxide Annual Mean Air Quality Objective at any location across the Malvern Hills District area in 2021.

### 3.2.2 Particulate Matter (PM<sub>10</sub>)

PM<sub>10</sub> is not monitored within Malvern Hills District Council.

### 3.2.3 Particulate Matter (PM<sub>2.5</sub>)

PM<sub>2.5</sub> is not monitored within Malvern Hills District Council.

### 3.2.4 Sulphur Dioxide (SO<sub>2</sub>)

SO<sub>2</sub> is not monitored within Malvern Hills District Council.

## 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) <sup>(1)</sup>	Distance to kerb of nearest road (m) <sup>(2)</sup>	Tube Co-located with a Continuous Analyser?	Tube Height (m)
UP1	2 Old Street, Upton WR8 0HA	Roadside	385171	240555	NO <sub>2</sub>	No	0.0	2.0	No	2.1
UP3	15 Old Street, Upton WR8 0HA	Roadside	385157	240508	NO <sub>2</sub>	No	0.0	1.3	No	2.0
M3N	Teme Avenue, WR14 2XA Street Light o/s no 10	Urban Background	379790	245677	NO <sub>2</sub>	No	7.0	1.0	No	2.2
M2	Give way sign (445) on Junction of Howsell Rd with Worcs Rd (outside Santler Court near Railway Station)	Roadside	378320	247570	NO <sub>2</sub>	No	5.0	1.0	No	2.2
M5N	Richmond Road - Link Wines WR14 1NE	Roadside	378520	247753	NO <sub>2</sub>	No	0.5	4.5	No	2.3
M11	Old Post Office, Powick	Roadside	383231	251684	NO <sub>2</sub>	No	7.0	2.1	No	2.1
M14	278 Worcester Road, Malvern, WR14 1BD on drainpipe next to bay window	Roadside	379156	248248	NO <sub>2</sub>	No	0.0	5.9	No	3.2
TEN 1	Street light opposite Kings Head Public House, Cross Street	Roadside	359475	268053	NO <sub>2</sub>	No	0.0	1.0	No	2.0

**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 NO<sub>2</sub> Monitoring Results: Non-Automatic Monitoring (µg/m<sup>3</sup>)**

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2021 (%) <sup>(2)</sup>	2017	2018	2019	2020	2021
UP1	385171	240555	Roadside	100.0	100.0	30.1	33.7	30.9	21.5	23.0
UP3	385157	240508	Roadside	92.3	92.3	28.7	32.4	26.3	20.9	22.7
M3N	379790	245677	Urban Background	100.0	100.0	8.1	10.0	8.2	6.6	6.5
M2	378320	247570	Roadside	92.3	92.3	17.6	24.4	19.1	15.7	17.3
M5N	378520	247753	Roadside	100.0	100.0	22.8	26.3	21.1	16.4	18.7
M11	383231	251684	Roadside	100.0	100.0	25.9	31.4	25.2	20.7	21.4
M14	379156	248248	Roadside	100.0	100.0	17.7	22.2	18.8	13.5	16.1
TEN 1	359475	268053	Roadside	100.0	100.0	-	-	22.9	16.6	18.9

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<sup>3</sup>.

Exceedances of the NO<sub>2</sub> annual mean objective of 40µg/m<sup>3</sup> are shown in **bold**.

NO<sub>2</sub> annual means exceeding 60µg/m<sup>3</sup>, indicating a potential exceedance of the NO<sub>2</sub> 1-hour mean objective are shown in **bold and underlined**.

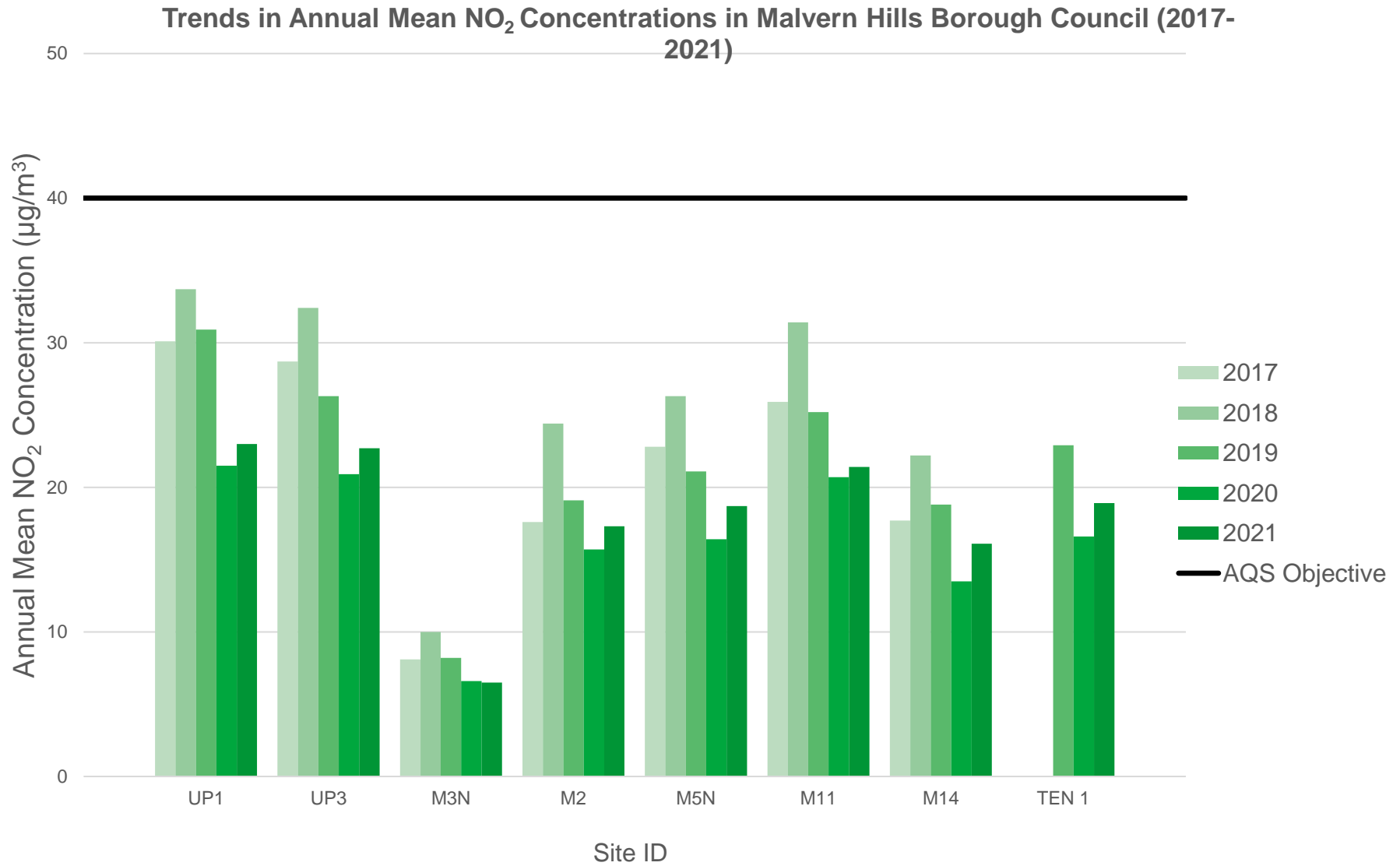
Means for diffusion tubes have been corrected for bias. All means have been “annualised” as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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 NO<sub>2</sub> Concentrations



## Appendix B: Full Monthly Diffusion Tube Results for 2021

Table B.1 – NO<sub>2</sub> 2021 Diffusion Tube Results (µg/m<sup>3</sup>)

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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
UP1	385171	240555	34.8	27.2	26.0	23.0	25.0	24.6	25.3	24.4	28.0	30.8	32.0	27.7	27.4	23.0	-	
UP3	385157	240508	31.4	-	26.2	27.6	23.5	27.4	25.1	27.5	28.8	28.6	29.3	22.2	27.0	22.7	-	
M3N	379790	245677	11.7	11.7	8.8	8.0	4.8	5.8	5.1	5.5	6.2	6.3	10.3	8.1	7.7	6.5	-	
M2	378320	247570	21.6	24.7	20.3	23.8	-	20.8	18.9	20.5	19.4	19.8	17.6	19.3	20.6	17.3	-	
M5N	378520	247753	26.7	23.1	21.7	21.5	21.3	19.6	19.3	19.5	24.4	22.6	23.7	23.8	22.3	18.7	-	
M11	383231	251684	31.5	31.5	20.2	21.6	22.0	23.1	20.5	25.3	21.1	32.1	27.5	29.1	25.5	21.4	-	
M14	379156	248248	20.3	25.3	18.6	20.7	18.6	17.5	16.6	17.0	20.4	17.9	20.0	17.5	19.2	16.1	-	
TEN 1	359475	268053	26.4	28.3	26.4	19.8	19.9	19.8	21.3	16.9	20.9	21.8	28.2	20.5	22.5	18.9	-	

All erroneous data has been removed from the NO<sub>2</sub> diffusion tube dataset presented in Table B.1

National bias adjustment factor used.

Malvern Hills District Council confirm that all 2021 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System.

### Notes:

Exceedances of the NO<sub>2</sub> annual mean objective of 40µg/m<sup>3</sup> are shown in **bold**.

NO<sub>2</sub> annual means exceeding 60µg/m<sup>3</sup>, indicating a potential exceedance of the NO<sub>2</sub> 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 Malvern Hills District During 2021**

Malvern Hills District Council has not identified any new sources relating to air quality within the reporting year of 2021.

### **Additional Air Quality Works Undertaken by Malvern Hills District Council During 2021**

Malvern Hills District Council has not completed any additional works within the reporting year of 2021.

### **QA/QC of Diffusion Tube Monitoring**

The following UKAS accredited company provided Malvern Hills District 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](mailto:diffusion@gradko.com)

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

Gradko International Limited participate in the AIR NO<sub>2</sub> Proficiency Testing Scheme (AIR-PT).

All monitoring undertaken has been completed in accordance with the 2020 Diffusion Tube Monitoring Calendar, i.e. on or within  $\pm 2$  days of the specified date.

### Diffusion Tube Annualisation

All diffusion tube monitoring locations within Malvern Hills District Council recorded data capture of 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.

### Diffusion Tube Bias Adjustment Factors

The diffusion tube data presented within the 2021 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<sub>x</sub>/NO<sub>2</sub> continuous analysers. Alternatively, the national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method.

Malvern Hills District Council have applied a national bias adjustment factor of 0.84 to the 2021 monitoring data. A summary of bias adjustment factors used by Malvern Hills District Council over the past five years is presented in 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. 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

<b>2018</b>	National	03/19	0.89
<b>2017</b>	National	03/18	0.77

### **NO<sub>2</sub> Fall-off with Distance from the Road**

Wherever possible, monitoring locations are representative of exposure. However, where this is not possible, the NO<sub>2</sub> concentration at the nearest location relevant for exposure has been estimated using the Diffusion Tube Data Processing Tool/NO<sub>2</sub> fall-off with distance calculator available on the LAQM Support website. Where appropriate, non-automatic annual mean NO<sub>2</sub> concentrations corrected for distance are presented in Table B.1.

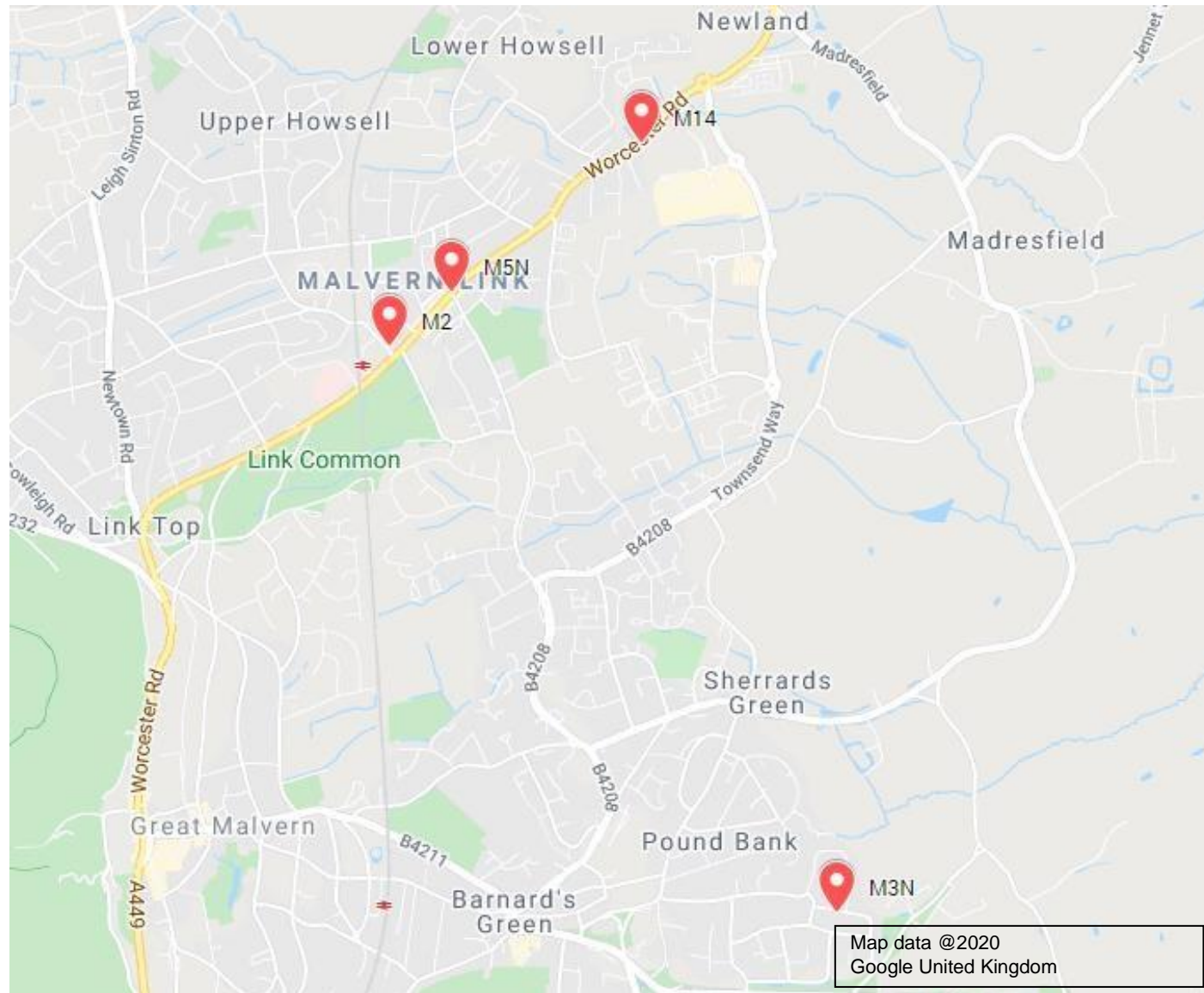
No diffusion tube NO<sub>2</sub> monitoring locations within Malvern Hills District Council required distance correction during 2021.


### **QA/QC of Automatic Monitoring**

No Automatic Monitoring was completed in Redditch Borough Council in 2021.

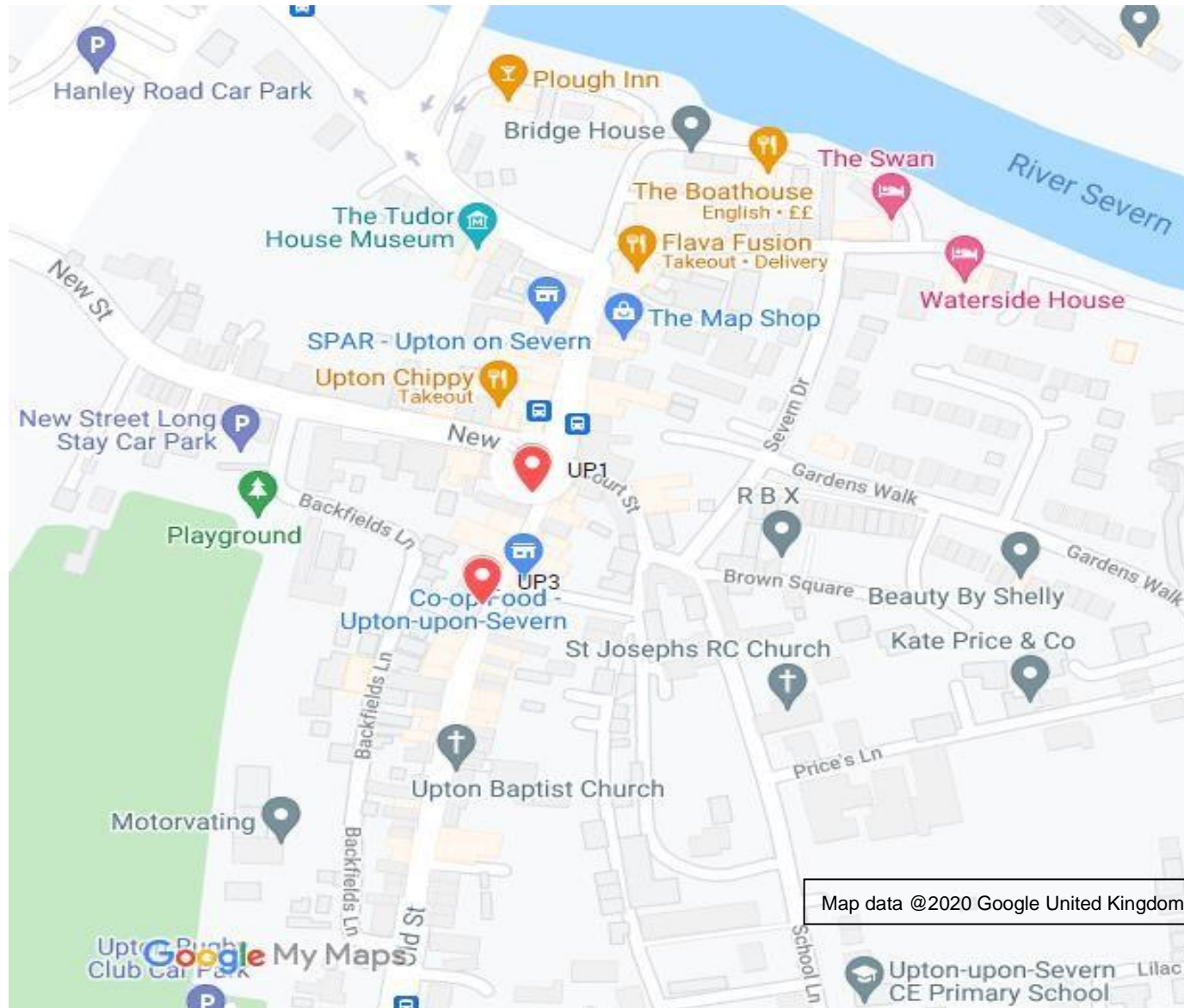
## Appendix D: Map(s) of Monitoring Locations and AQMAs


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




 Diffusion Tube Location ID






 Diffusion Tube Location ID



 Diffusion Tube Location ID



Map data ©2020 Google United Kingdom

 Diffusion Tube Location ID

## Appendix E: Summary of Air Quality Objectives in England

**Table E.1 – Air Quality Objectives in England<sup>8</sup>**

Pollutant	Air Quality Objective: Concentration	Air Quality Objective: Measured as
Nitrogen Dioxide (NO <sub>2</sub> )	200µg/m <sup>3</sup> not to be exceeded more than 18 times a year	1-hour mean
Nitrogen Dioxide (NO <sub>2</sub> )	40µg/m <sup>3</sup>	Annual mean
Particulate Matter (PM <sub>10</sub> )	50µg/m <sup>3</sup> , not to be exceeded more than 35 times a year	24-hour mean
Particulate Matter (PM <sub>10</sub> )	40µg/m <sup>3</sup>	Annual mean
Sulphur Dioxide (SO <sub>2</sub> )	350µg/m <sup>3</sup> , not to be exceeded more than 24 times a year	1-hour mean
Sulphur Dioxide (SO <sub>2</sub> )	125µg/m <sup>3</sup> , not to be exceeded more than 3 times a year	24-hour mean
Sulphur Dioxide (SO <sub>2</sub> )	266µg/m <sup>3</sup> , not to be exceeded more than 35 times a year	15-minute mean

<sup>8</sup> The units are in microgrammes of pollutant per cubic metre of air (µg/m<sup>3</sup>).

## 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 <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Nitrogen Oxides
PM <sub>10</sub>	Airborne particulate matter with an aerodynamic diameter of 10µm or less
PM <sub>2.5</sub>	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO <sub>2</sub>	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.
- DEFRA (2022) National Diffusion Tube Bias Adjustment Factor Spreadsheet v.03/22
- DEFRA (2018) Background Mapping for Local Authorities
- Worcestershire Regulatory Services (2013) 'Air Quality Action Plan for Worcestershire'
- Worcestershire Regulatory Services (2015) 'Air Quality Action Plan Progress Report for Worcestershire April 2013-April 2015'
- Worcestershire Regulatory Services (2016) 'Air Quality Action Plan Progress Report for Worcestershire April 2015 – April 2016'
- Worcestershire Regulatory Services (2021). Annual Status Report for Malvern Hills District Council.
- Public Health Outcomes Framework. 2022. Public Health England.