STROUD DISTRICT COUNCIL

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2019 Air Quality Annual Status Report (ASR)

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

July, 2019

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Executive Summary: Air Quality in Our Area

The most significant influence on air quality within the Stroud district arises from road traffic emissions. The principal pollutant of concern from road traffic is Nitrogen Dioxide (NO_2). Diffusion tubes are used to measure NO_2 and a number of these are located across the district. These tubes are collected and sent off for analysis on a monthly basis. The overall picture for the district is that air quality continues to be very good but, over the last year, levels of NO_2 have increased. In particular, two discrete locations (when accounting for distance attenuation) are reporting levels above the annual air quality objective.

The increase in NO_2 levels over the last year appears to go against the trend noted in preceding years. In the 2018 Annual Status Report (ASR) it was identified that the majority of NO_2 levels had decreased from levels in the 2017 ASR. This follows the longer term trend of slowly descending levels of NO_2.

As the 2018 monitoring has identified that levels of NO_2 have increased across the district, it will be necessary to undertake a detailed assessment of the situation to evaluate whether or not the Council will need to declare an Air Quality Management Area (AQMA) at the locations of concern.

Air Quality in Stroud District

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children and older people, and those with heart and lung conditions. There is also often a strong correlation with equalities issues, because areas with poor air quality are also often the less affluent areas[1,2]. The annual health cost to society of the impacts of particulate matter alone in the UK is estimated to be around £16 billion[3].

The Stroud district continues to experience good air quality. Within the district, on a more localised basis, bonfires from domestic and industrial/trade premises, as well

[1] Environmental equity, air quality, socioeconomic status and respiratory health, 2010
[2] Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006
[3] Defra. Abatement cost guidance for valuing changes in air quality, May 2013

as emissions from industrial activities also influence air quality. However, the main pollutant of concern in the district is NO_2 which arises from road traffic.

The long term trend for NO_2 in the Stroud district is that it is decreasing. The monitoring results for NO_2 during 2018 do appear to have bucked the trend as all monitoring locations are reporting increases against previous years. Given that the bias correction factor used to calculate the annual mean is also elevated against the factor used in previous years, it is considered that the increases may be linked to this. The current hotspot location is at Dudbridge where, after corrections for distance, two monitoring locations have reported NO_2 to be above the annual air quality objective.

Within the Stroud district there is a new major source of emission currently undergoing commissioning before commencement operations in late July/early August 2019. This source is a 65.3MW energy from waste plant at Javelin Park, near Haresfield. In preparation for this development, Stroud District Council started monitoring NO_2 at seven nearby locations to obtain background data. Monitoring will continue once the plant is in operation. In addition, Stroud District Council is supporting a local liaison group which has purchased two particulate monitors which have been located in areas of potential exposure. Background data from these monitors is being obtained and measurements will continue once the plant is in operation.

Stroud District Council works in partnership with Gloucestershire County Council on developing strategies relating to traffic management across the County. Further details on the Local Transport Plan can be found at https://www.gloucestershire.gov.uk/transport/gloucestershires-local-transport-plan-2015-2031/introduction/.

The plan aims to support sustainable economic growth, enable community connectivity, conserve the environment and improve community health and wellbeing. Within the document, transport options relating to bus travel, the cycle network, the freight network, highways and rail travel are considered and there is also a document promoting travel choice called think travel. These documents feed into district based strategies called Connecting Places Strategies. The strategy relating to the Stroud district can be found at https://www.gloucestershire.gov.uk/media/2211/6_-_ltp_-_stroud_cps-66794.pdf.

In addition to monitoring pollutants and developing strategies for dealing with traffic management, Stroud District Council regulates and takes any necessary enforcement of industrial emissions through the environmental permitting regime.

Actions to Improve Air Quality

Over the course of the last year, Stroud District Council has focused on monitoring NO_2 levels across the district to demonstrate continuing compliance with annual air quality objectives. Additional NO_2 monitoring locations have been added to the programmed round of monitoring locations in preparation for a new major emissions source; a 65.3MW energy from waste plant, as well as real time particulate monitoring at two nearby locations.

Stroud District Council continues to work with Gloucestershire County Council on developing traffic management strategies in the County as well as the Gloucestershire Air Quality and Health Strategy.

Conclusions and Priorities

The Stroud district continues to experience good air quality, as it has done for a number of years. Over the longer term, NO_2 within the district has been declining; as demonstrated in figure A.1. However, the data accrued across 2018 identified that the annual mean concentrations at all monitoring locations increased above the annual mean concentrations at the same locations in 2017.

The impact of these increases is that two discrete locations in Dudbridge reported annual mean NO_2 concentration exceedances of the annual air quality objective; once corrected for distance to public exposure. In addition, there were four locations (once corrected for distance to exposure) that were within 10% of the annual air quality objective, i.e. above 36µg/m^3. Comparatively, in 2017, no monitoring locations were within 10% of the annual air quality objective.

Given that the annual mean concentrations at all monitoring locations increased above the annual mean concentrations from 2017, the cumulative of these concentrations was at its highest since 2013, and because the bias correction factor was higher than in previous years, it is considered that the bias correction factor may have contributed to the elevated annual mean concentrations across all locations.

Following discussions with the DEFRA helpdesk about the potential impact of the bias correction factor on the exceedances and the inaccuracy of diffusion tubes, it was agreed that the most appropriate course of action going forward would be to undertake detailed analysis of NO_2 at those locations exceeding the annual air quality objective. Therefore, the priority for Stroud District Council over the coming year is to organise the installation of a reference unit providing real time monitoring to establish accurate and real-time NO_2 data at those locations which have exceeded the annual air quality objective. There may be some difficulties in appropriately locating the equipment as a result of limited space and power provision; however, it is thought that there may be some options available which may mean that these difficulties can be overcome.

Local Engagement and How to get Involved

Stroud District Council engages with decision makers and the public through a number of forums. Gloucestershire Pollution Group is made up of environmental protection professionals from local authorities as well as air quality representatives from Gloucestershire County Council (GCC). At this forum good practice and ideas for improving air quality are shared.

Stroud District Council is represented at the County Air Quality and Behaviour Change sub group which is made of professionals and electoral representatives from across the county. In this forum members work towards producing the Gloucestershire Air Quality and Health Strategy.

Stroud District Council also has involvement with a community liaison group set up with reference to air quality issues. The group has a specific concern relating to the development of the Energy from Waste plant. This group is made up by local electoral representatives, Environment Agency representatives, representatives of the operator as well as members of the public.

Within the Stroud district, interest in air quality is quite high and this is reflected in the political composition of the Council. For example, Stroud District Council currently has nine Green Party Councillors. All Councillors actively engage in a whole range of environmental issues, including air quality. In general, outside of those with a professional interest in air quality, there appears to be a lack of knowledge and understanding of how air quality is measured and monitored. Despite this, there is

definitely an increase in those wanting to improve their understanding of air quality or wishing to become involved in air quality projects locally.

The general public can help to improve air quality in the Stroud District by reducing unnecessary vehicular travel. They can also find alternative methods of disposal of household and garden waste other than burning.

Copies of the latest air quality report for Stroud District can be found on the Council's website at https://www.stroud.gov.uk/environment/environmental-health/pollutionand-nuisance/air-quality.

Any queries about air quality should be directed to the Environmental Protection team within Stroud District Council.

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1 Local Air Quality Management

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

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by Stroud District Council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England can be found in **Error! Reference source not found.** in Appendix E.

2 Actions to Improve Air Quality

Stroud District Council works with Gloucestershire County Council on developing strategies relating to traffic management across the County through the Local Transport Plan (LTP). Further details on the LTP can be found at https://www.gloucestershire.gov.uk/transport/gloucestershires-local-transport-plan-2015-2031/introduction/.

The plan aims to support sustainable economic growth, enable community connectivity, conserve the environment and improve community health and wellbeing. It considers transport options through specific policy documents relating to bus travel, the cycle network, the freight network, highways, rail travel and think travel, which is a document promoting travel choice. It identifies opportunities and pressures within the county and addresses these through Connecting Places Strategies. These are district based strategies; the strategy relating to the Stroud district can be found at https://www.gloucestershire.gov.uk/media/2211/6_-_ltp_-_stroud_cps-66794.pdf.

Stroud District Council is also working with the Gloucestershire Air Quality and Behaviour Change sub group. The aim of this group is to produce an Air Quality and Health Strategy for Gloucestershire. The strategy is currently being drafted by Gloucestershire County Council.

2.1 Air Quality Management Areas

AQMAs are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority must prepare an AQAP within 12-18 months setting out measures it intends to put in place in pursuit of compliance with the objectives.

Stroud District Council currently does not have any AQMAs.

2.2 Progress and Impact of Measures to address Air Quality in Stroud District

DEFRA's appraisal of last year's ASR concluded that it did not include any maps of monitoring sites and it did not draw links between $PM_{2.5}$ emissions and the Public Health Outcomes Framework. To address these points, two maps of monitoring locations can be found in Appendix D and a discussion of the link between PM2.5 emissions and the Public Health Outcomes Framework can be found in section 3.2.3. Additionally, DEFRA's appraisal stated that there was no discussion of local developments and their impacts on future air quality. However, this is in fact incorrect as the report did indicate that a 65.3MW energy from waste plant was under construction at Javelin Park, near Haresfield and that this could have an impact on local air quality.

Stroud District Council has taken forward a number of direct measures during the current reporting year of 2019 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.1.

Stroud District Council's priorities for the coming year are to prepare for a more detailed analysis of air quality around the Dudbridge area of Stroud as this is where two monitoring locations are reporting NO_2 levels slightly above the annual air quality objective. This will likely include the installation of a reference real time air quality monitor to accurately measure NO_2.

Table 2.1 – Progress on Measures to Improve Air Quality

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
1	Glos. Local Transport Plan 2015 - 2031	Promoting Travel Alternatives	Intensive active travel campaign & infrastructure	LA and County Council	Pre-implementation	2015-2031	NOx	Reduced vehicle emissions	Implementation on-going	2031	Lengthy timescale
2	Connecting Places Strategy - Stroud	Transport Planning and Infrastructure	Public transport improvements-interchanges stations and services	LA and County Council	Pre-implementation	2015-2031	NOx	Reduced vehicle emissions	Implementation on-going	2031	Lengthy timescale
3	Glos. Air Quality and Health Strategy	Promoting Low Emission Transport	Other	LA and County Council	Pre-implementation		Nox	Reduced vehicle emissions	Implementation on-going		
4	Extension of Cotswold Canals	Promoting Travel Alternatives	Promote use of rail and inland waterways	LA and charity	Pre-implementation		Nox	Reduced vehicle emissions	Implementation on-going		
5	Improve air quality	Environmental Permits	Measures to reduce pollution through IPPC Permits going beyond BAT	LA and regulated industry				Reduced emissions	Implementation on-going		
6	SDC Carbon neutral commitment by 2030	Other	Other	LA	Currently being planned		CO2	Carbon neutral		2030	
7	Improve public accessibility to air quality data	Public Information	Other	LA and County Council	Currently being planned			Reduced emissions			

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.

Stroud District Council is taking the following measures to address $PM_{2.5}$:

- Working with Gloucestershire County Council to develop and implement strategies set out in the LTP and the Connecting Places Strategy relating to traffic management. Through implementing transport schemes and promoting travel alternatives, traffic based pollutants (including $PM_{2.5}$) can be reduced.
- Working with Gloucestershire Air Quality and Behaviour Change sub group to develop an Air Quality and Health Strategy for Gloucestershire. The aims of the Air Quality and Health Strategy include improving the publication/availability of air quality information to the public, promoting active travel in schools and workplaces, promoting the uptake of low emission vehicles, cleaner public sector vehicle fleet and cleaner public transport services.

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

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

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

In conjunction with a local community liaison group, Stroud District Council undertook automatic (continuous) monitoring of particulates at two sites during 2018. Table A.1 in Appendix A shows the details of the sites. National monitoring results are available at https://uk-air.defra.gov.uk/networks/.

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

3.1.2 Non-Automatic Monitoring Sites

Stroud District Council undertook non-automatic (passive) monitoring of NO_2 at twenty two sites during 2018. The diffusion tubes (20% TEA in water) were supplied and analysed by Somerset Scientific Services. Table A.2 in Appendix A shows the details of the sites.

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

3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias, “annualisation” and distance correction. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen Dioxide (NO_2)

Table A.3 in Appendix A compares the ratified and adjusted monitored NO_2 annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3.

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

Table A.43 in identifies that there are four monitoring locations that are reporting exceedances of the annual air quality objective; locations 21a (42.18µg/m^3), 25a (42.54µg/m^3), 25c (43.12µg/m^3) and 25e (40.34µg/m^3). To establish the representative figures for public exposure, these locations have been corrected to account for distance. Following correction of these annual mean values, the NO_2 annual mean concentration for each location is: 39.6µg/m^3 at location 21a, 36.6µg/m^3 at location 25a, 41.6µg/m^3 at location 25c and 40.3µg/m^3 at location 25e. This means that there are still two locations where there are exceedances of the annual air quality objective; locations 25c and 25e.

Whilst distance correction meant locations 21a and 25a fell below the annual air quality objective, they still remained within 10% (i.e. above 36µg/m^3) of the objective. In addition, there were three other locations within 10% of the annual air quality objective; locations 16 (37.28µg/m^3), 25d (38.83µg/m^3) and 38 (39.71µg/m^3). It should be noted that there is no relevant receptor at location 38 meaning that realistically, in 2018, two locations exceeded the annual air quality objective and four locations were within 10% of the objective. In 2017, there were no locations within 10% of the annual air quality objective (once adjusted for bias, annualisation and distance correction).

Given that the annual mean concentrations of all locations showed increases above the annual mean concentrations of the same locations in 2017 and, the bias correction factor was higher than in previous years, it is considered that the bias correction factor may have played a significant part in the elevated annual mean concentrations across all locations. Therefore, discussions were held with the DEFRA helpdesk about the potential impact of the bias correction factor on the exceedances noted in the 2018 results. Given the inaccuracy of diffusion tubes (it is generally regarded as significant), it was agreed that the most appropriate course of action going forward would be to undertake detailed analysis of NO_2 at locations 25c and 25e using a reference unit providing real time monitoring data.

3.2.2 Particulate Matter (PM_{10})

Error! Reference source not found.4 in Appendix A compares the ratified and adjusted monitored PM_{10} annual mean concentration for 2018. Monitoring of PM_{10}

started during 2018 and, as such, valid data capture for the automated monitoring location at Hardwicke is 16.7% and 20.3% at Haresfield. Based on that data capture, the annual mean concentration at Hardwicke is 9.8µg/m^3 and at Haresfield it is 9.9µg/m^3. Both locations are well below the air quality objective of 40µg/m^3.

Table A.5 in Appendix A compares the ratified continuous monitored PM_{10} daily mean concentrations for 2018. The valid data capture for the automated monitoring location at Hardwicke is 16.7% and 20.3% at Haresfield. Both locations recorded no exceedances of the 24 hour mean air quality objective of 50µg/m^3.

3.2.3 Particulate Matter ($PM_{2.5}$)

Table A.6 in Appendix A presents the ratified and adjusted monitored $PM_{2.5}$ annual mean concentration for 2018. Monitoring of $PM_{2.5}$ started during 2018 and, as such, valid data capture for the automated monitoring location at Hardwicke is 16.7% and 20.3% at Haresfield. Based on the data captured, the annual mean concentration at Hardwicke is 7.14µg/m^3 and at Haresfield it is 7.16µg/m^3.

$PM_{2.5}$ is the pollutant which has the biggest impact on public health and, therefore, it is the pollutant which is used as a wider determinant of health in the Public Health Outcomes Framework (PHOF). In terms of the link between $PM_{2.5}$ and the PHOF, there are three indicators of relevance:

- Air pollution: fine particulate matter
- Fraction of mortality attributable to particulate air pollution
- Access to health assets and hazards index

The 2019 PHOF reports that $PM_{2.5}$ within the Stroud district is 8.2µg/m^3. This is based on 2016 data. Comparatively, the South West region averages 7.9µg/m^3 and the average for England is 9.3µg/m^3. Evidently, the Stroud value in the PHOF is slightly elevated against the particulate data from the automated monitors, as reported above. However, it should be noted that the automatic monitors are located in relatively rural and sub-urban settings where air pollution from road traffic would not necessarily be expected to be significant.

The fraction of mortality attributable to particulate air pollution data accrued in 2017. For the Stroud district, mortality was reported to be 4.5%. This is above the South West region value of 4.4% but below the 5.1% value for England.

The access to health assets and hazards index is an index developed for measuring how healthy neighbourhoods are. It combines a number of indicators but, in terms of particulates, the important component part is the physical environment (green space and three air pollutants). The data used dates back to 2016 and, for the Stroud district, the score is 3.1%. Comparatively, the South West region performed marginally worse at 7.9% but significantly better than the average for England at 21.2%.

Appendix A: Monitoring Results

Table A.1 – Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
Hardwicke	Hardwicke	Suburban	380203	212842	PM_{10}, $PM_{2.5}$	NO	Particulate monitor	N/A	N/A	1.5
Haresfield	Haresfield	Rural	381324	210015	PM_{10}, $PM_{2.5}$	NO	Particulate monitor	N/A	N/A	1.5

Notes:

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

(2) N/A if not applicable.

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

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
15	Nailsworth - Bath Road	Roadside	385023	199748	NO2	NO	11.7	4.1	NO	2.4
16a	Painswick – St Marys House	Roadside	386492	209473	NO2	NO	3.3	2	NO	2
16	Painswick – High Street Lights	Kerbside	386677	209768	NO2	NO	3.2	0.5	NO	2.4
16b	Painswick – Traffic Camera	Kerbside	386700	209794	NO2	NO	1	0.5	NO	2.4
16c	Painswick – Melrose	Roadside	386810	209992	NO2	NO	4.8	2.8	NO	2.4
21a	Stroud – British Oak Bowbridge	Roadside	385785	204370	NO2	NO	1.9	1.3	NO	2.4
25a	Stroud – Signal House, Dudbridge Hill	Roadside	383652	204557	NO2	NO	5.7	2.7	NO	2.4
25c	Stroud – 1 Signal House, Dudbridge Hill	Roadside	383655	204551	NO2	NO	0.9	0.7	NO	1.5
25d	Stroud – 2 Signal House, Dudbridge Hill	Roadside	383659	204556	NO2	NO	0	3.9	NO	2.4
25e	Stroud – 3 Signal House, Dudbridge Hill	Roadside	383662	204554	NO2	NO	0	2.9	NO	2.4
25f	Stroud – 4 Signal House, Dudbridge Hill	Roadside	383676	204545	NO2	NO	0	8	NO	2.4
25g	Stroud – 5 Signal House, Dudbridge Hill	Roadside	383672	204538	NO2	NO	0	2.5	NO	5
31	Upton St Leonards – 50 Woodland Green	Kerbside	386301	215294	NO2	NO	8	0.5	NO	2.4
33	Trevose, Hardwicke	Roadside	380188	211951	NO2	NO	21.7	4.7	NO	2.4
34	30, Hunts Grove Drive, Hardwick	Other	381142	212271	NO2	NO	N/A	N/A	NO	2.4
35	The Lodge Haresfield	Other	380232	210421	NO2	NO	N/A	N/A	NO	2.4

37	Grove Lane, Westend	Other	378290	206899	NO2	NO	N/A	N/A	NO	2.4
38	Stroud, Beeches Green	Roadside	384929	205522	NO2	NO	N/A	3	NO	2.4
39	Cainscross, Westward Road	Roadside	383471	204988	NO2	NO	0	3.7	NO	2.4
40	Hardwicke, Bristol Road	Roadside	380639	213013	NO2	NO	9.2	1.8	NO	2.4
41	Stonehouse, Downton Road	Roadside	380473	204886	NO2	NO	8.8	3.4	NO	2.4
42	Stroud, Slad Brook	Roadside	385082	205398	NO2	NO	7.6	1.6	NO	2.4

Notes:

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

(2) N/A if not applicable.

Table A.3 – Annual Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2018 (%) [2]	NO_2 Annual Mean Concentration ($\mu g/m^3$) [3]				
					2014	2015	2016	2017	2018
15	Roadside	Diffusion Tube	N/A	100	27.76	24.9	25.54	22.06	25.46
16a	Roadside	Diffusion Tube	N/A	92	26.85	24.2	31.12	21.58	24.35
16	Kerbside	Diffusion Tube	N/A	100	29.3	29.5	30.1	35.51	37.28
16b	Kerbside	Diffusion Tube	N/A	100	36.5	31.3	31.5	28.57	32.22
16c	Roadside	Diffusion Tube	N/A	100	25.07	23.8	25.47	20.92	21.63
21a	Roadside	Diffusion Tube	N/A	100	35.6	37.6	38.4	38.64	**42.18**
25a	Roadside	Diffusion Tube	N/A	75	37.8	36.2	36.2	30.98	**42.54**
25c	Roadside	Diffusion Tube	N/A	83	42	39.5	39.1	38.98	**43.12**
25d	Roadside	Diffusion Tube	N/A	100	**41.7**	38.2	37.1	34.02	38.83
25e	Roadside	Diffusion Tube	N/A	100	37.2	37.9	37.8	35.97	**40.34**
25f	Roadside	Diffusion Tube	N/A	100	27.96	25	28.09	25.54	27.74
25g	Roadside	Diffusion Tube	N/A	100	29.52	26.7	28.93	24.77	29.02
31	Kerbside	Diffusion Tube	N/A	100	22.91	24.6	27.05	21.42	22.52
33	Roadside	Diffusion Tube	N/A	100	N/A	N/A	34.64	30.15	32.83
34	Other	Diffusion Tube	N/A	100	N/A	N/A	19.07	14.58	15.84
35	Other	Diffusion Tube	N/A	92	N/A	N/A	24.08	20	21.35
37	Other	Diffusion Tube	N/A	83	N/A	N/A	16.67	12.64	20.34
38	Roadside	Diffusion Tube	N/A	83	N/A	N/A	N/A	36.32	39.71
39	Roadside	Diffusion Tube	N/A	92	N/A	N/A	N/A	N/A	28.78
40	Roadside	Diffusion Tube	N/A	100	N/A	N/A	N/A	N/A	27.12
41	Roadside	Diffusion Tube	N/A	100	N/A	N/A	N/A	N/A	25.23

42	Roadside	Diffusion Tube	N/A	100	N/A	N/A	N/A	N/A	34.36

Diffusion tube data has been bias corrected

Annualisation has been conducted where data capture is <75%

Notes:

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

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

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

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

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

Figure A.2 – Trends in Annual Mean NO_2 Concentrations

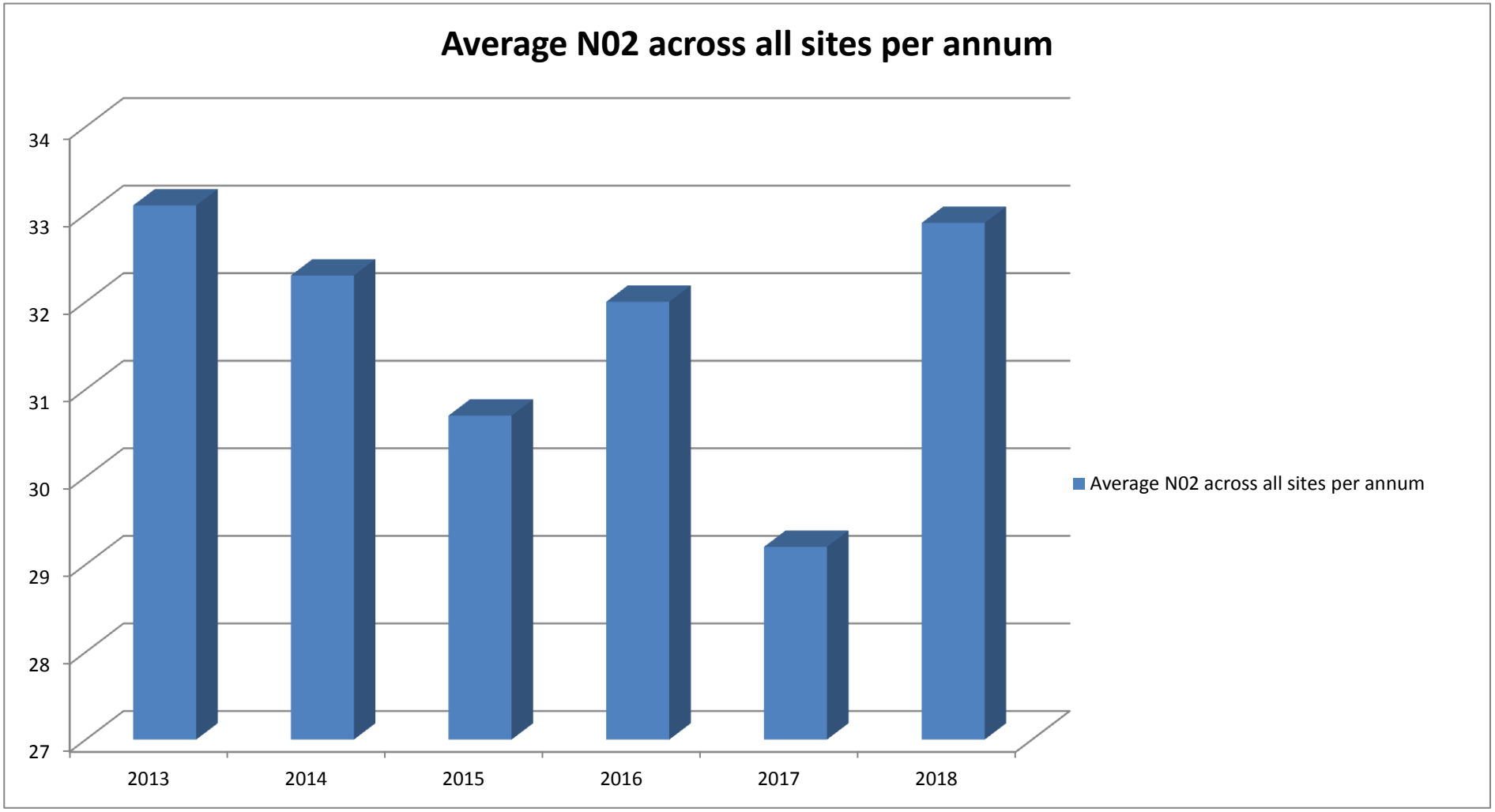


Table A.4 – Annual Mean PM_{10} Concentrations

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	PM_{10} Annual Mean concentration µg/m^3 (3)				
				2014	2015	2016	2017	2018
Hardwicke	Suburban	82.4	16.71	N/A	N/A	N/A	N/A	9.85
Haresfield	Rural	100	20.27	N/A	N/A	N/A	N/A	9.9

Notes:

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

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

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

Table A.5 – 24-Hour Mean PM_{10} Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	PM_{10} 24-Hour Means > 50µg/m^3 (3)				
				2014	2015	2016	2017	2018
Hardwicke	Suburban	82.4	16.71	N/A	N/A	N/A	N/A	0
Haresfield	Rural	100	20.27	N/A	N/A	N/A	N/A	0

Notes:

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

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

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

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

Table A.6 – $PM_{2.5}$ Monitoring Results

Site ID	Site Type	Valid Data Capture for monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	PM2.5 Annual Mean Concentration (µg/m^3) (3)				
				2014	2015	2016	2017	2018
Harwicke	Urban Centre	82.4	16.71	N/A	N/A	N/A	N/A	7.14
Haresfield	Rural	100	20.27	N/A	N/A	N/A	N/A	7.16

Notes:

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

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

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

Appendix B: Full Monthly Diffusion Tube Results for 2018

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

Site ID	NO_2 Mean Concentrations ($\mu g/m^3$)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
													Raw Data	Bias Adjusted (factor) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
15	32.96	33.95	31.61	29.77	29.07	23.74	26.61	21.62	23.39	28.42	32.11	29.97	28.60	25.46	
16a	31.16	30.67	29.30	25.58	31.93	25.32	29.54	21.24	24.54	25.87		25.76	27.35	24.35	
16	49.57	46.38	42.58	42.04	43.30	33.33	42.70	36.65	44.83	43.23	35.92	42.09	41.88	37.28	
16b	38.60	41.25	37.71	37.66	39.75	29.35	34.79	29.78	36.19	36.75	33.59	38.94	36.20	32.22	
16c	25.26	25.91	29.56	28.55	23.10	20.40	22.22	17.78	20.12	27.35	27.83	23.59	24.31	21.63	
21a	54.00	50.65	47.90	43.75	51.73	43.56	53.61	40.35	46.44	45.79	46.43	44.49	47.39	**42.18**	39.6
25a	42.97	51.08	48.55	48.77	56.24	49.59	48.62	37.76				46.57	47.79	**42.54**	36.6
25c	51.24		51.43		57.14	51.93	51.01	40.06	41.12	48.82	49.00	42.78	48.45	**43.12**	**41.6**
25d	41.75	44.34	44.44	46.48	49.72	41.17	51.41	37.85	40.29	43.71	38.72	43.61	43.62	38.83	
25e	46.69	44.65	45.40	49.55	53.93	45.43	51.28	38.67	40.42	42.99	42.77	42.18	45.33	**40.34**	**40.3**
25f	34.05	35.56	32.58	30.64	33.88	30.99	31.86	24.50	27.10	32.65	27.02	33.25	31.17	27.74	
25g	34.24	38.15	31.29	30.01	37.04	30.81	34.52	29.11	30.88	35.50	24.98	34.78	32.61	29.02	
31	31.42	32.90	28.41	26.06	21.60	19.06	21.69	22.53	24.41	28.31	21.60	25.72	25.31	22.52	
33	41.04	38.59	36.68	35.17	38.79	28.36	41.31	35.35	42.15	39.13	28.26	37.79	36.88	32.83	
34	32.45	20.90	18.85	14.90	15.53	10.29	13.18	12.45	15.89	19.39	19.60	20.12	17.80	15.84	

35	21.86		27.70	25.38	23.20	19.64	22.95	18.12	17.17	29.73	29.11	28.95	23.98	21.35	
37	42.39	23.50	20.52		16.24	11.98	16.11		39.58	18.49	18.55	21.14	22.85	20.34	
38	36.36	41.62	48.29		50.12	45.14	51.48	42.17		43.53	43.53	43.89	44.61	39.71	
39	35.14	42.54	38.03	32.49	35.48	28.53	23.82	23.78	28.51	33.06		34.36	32.34	28.78	
40	28.09	37.04	35.91	31.03	29.92	23.39	25.75	24.21	28.12	31.64	34.96	35.57	30.47	27.12	
41	47.26	34.88	28.28	20.17	31.57	27.60	25.48	18.26	22.62	29.14	27.16	27.75	28.35	25.23	
42	36.94	26.90	42.97	41.17	38.34	34.44	40.38	37.37	39.58	41.92	41.72	41.49	38.60	34.36	

National bias adjustment factor used
Annualisation has been conducted where data capture is <75%
Where applicable, data has been distance corrected for relevant exposure

Notes:
Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.
NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **bold and underlined.**
(1) See Appendix C for details on bias adjustment and annualisation.
(2) Distance corrected to nearest relevant public exposure.

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

To provide relevant and valid data, there are a number of corrections and calculations that need to be applied to the raw data. Specific corrections include annualisation, bias adjustment and distance correction.

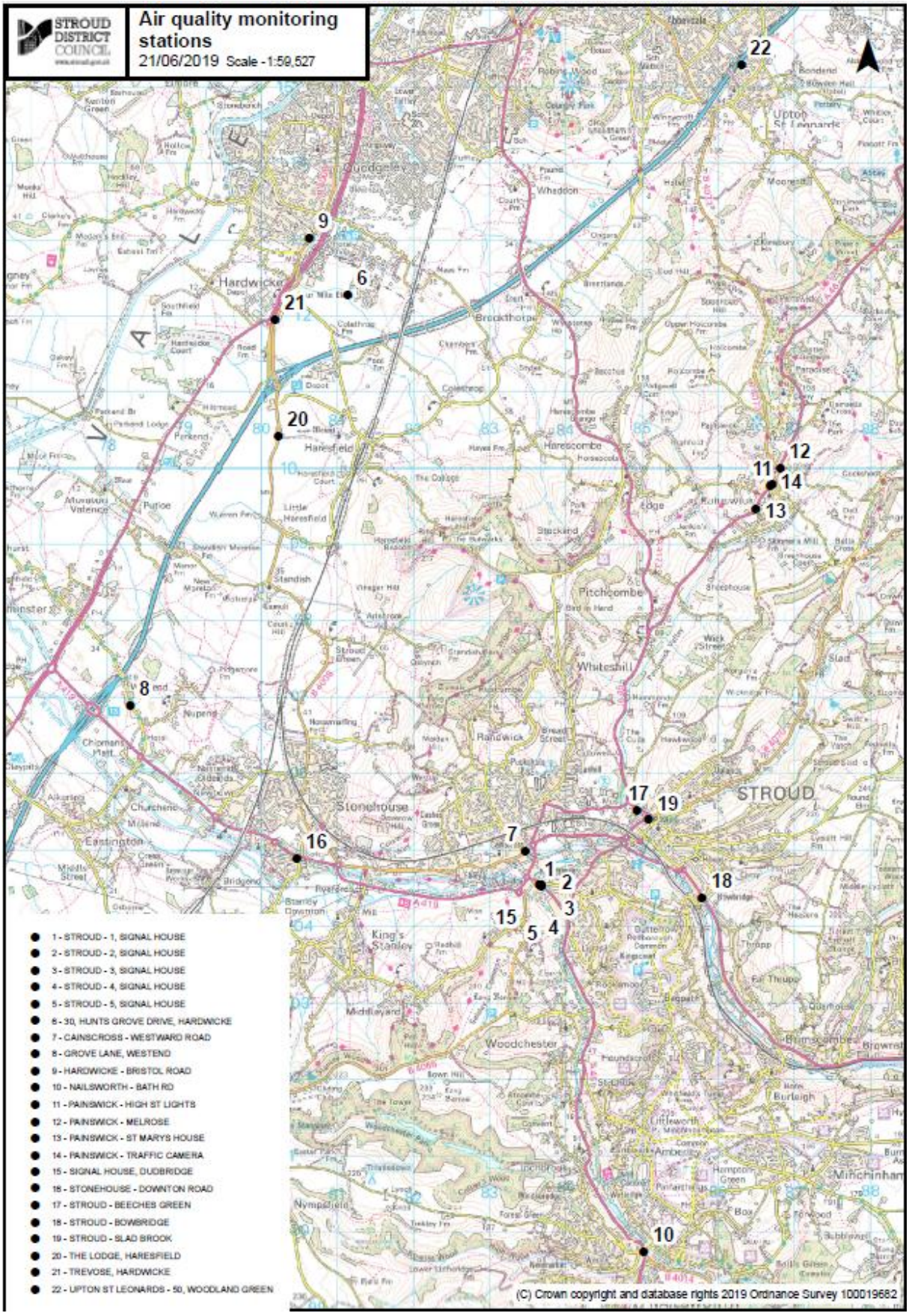
Annualisation is a means of validating data. It is used in cases where data capture at a location was below 75% for the year. In such instances, annualisation techniques can be used to estimate an annual average from a part year average. For annualisation to be completed there must be 3 months of monitoring data available. In 2018, no annualisation was necessary as data capture was above 75% for all monitoring locations.

After annualisation is completed (where necessary), diffusion tube data should then be corrected for any bias. Bias is the inclination of any diffusion tube to over or under read the actual levels of the pollutant being monitored against a reference chemiluminescence analyser. Where local authorities undertake collocation studies (diffusion tubes and reference unit measurement together) a local bias adjustment factor can be obtained. All local collocation study data is forwarded to the LAQM support desk where it is collated to create a national bias adjustment figure. This bias adjustment figure can then be used by all local authorities to correct the raw data. The bias adjustment factor published by DEFRA to be used in the 2019 ASR is 0.89. This is the adjustment factor used by Stroud District Council to correct the raw data. The reason for this is that Stroud District Council does not currently operate a reference monitoring unit and, therefore, is unable to undertake a colocation study in order to produce a local bias adjustment factor.

In most circumstances, diffusion tubes should be located so that the data is representative of public exposure. Where this is not possible, it is necessary to calculate the estimated level at the point of exposure. To do this, there is a calculator spreadsheet available at the LAQM support website. It is recommended that all locations exceeding the annual mean concentration should be distance corrected. Additionally, all locations that report annual mean concentrations within 10% of the annual objective should be corrected for distance. The reason is that this should

reduce some of the uncertainty that is standard in diffusion tube monitoring concentration data.

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


STROUD DISTRICT COUNCIL
Air quality monitoring stations
21/06/2019 Scale - 1:59,527
1 - STROUD - 1, SIGNAL HOUSE
2 - STROUD - 2, SIGNAL HOUSE
3 - STROUD - 3, SIGNAL HOUSE
4 - STROUD - 4, SIGNAL HOUSE
5 - STROUD - 5, SIGNAL HOUSE
6 - 30, HUNTS GROVE DRIVE, HARDWICKE
7 - CAINSCROSS - WESTWARD ROAD
8 - GROVE LANE, WESTEND
9 - HARDWICKE - BRISTOL ROAD
10 - NAILSWORTH - BATH RD
11 - PAINSWICK - HIGH ST LIGHTS
12 - PAINSWICK - MELROSE
13 - PAINSWICK - ST MARYS HOUSE
14 - PAINSWICK - TRAFFIC CAMERA
15 - SIGNAL HOUSE, DUDBRIDGE
16 - STONEHOUSE - DOWNTON ROAD
17 - STROUD - BEECHES GREEN
18 - STROUD - BOWBRIDGE
19 - STROUD - SLAD BROOK
20 - THE LODGE, HARESFIELD
21 - TREVOSE, HARDWICKE
22 - UPTON ST LEONARDS - 50, WOODLAND GREEN
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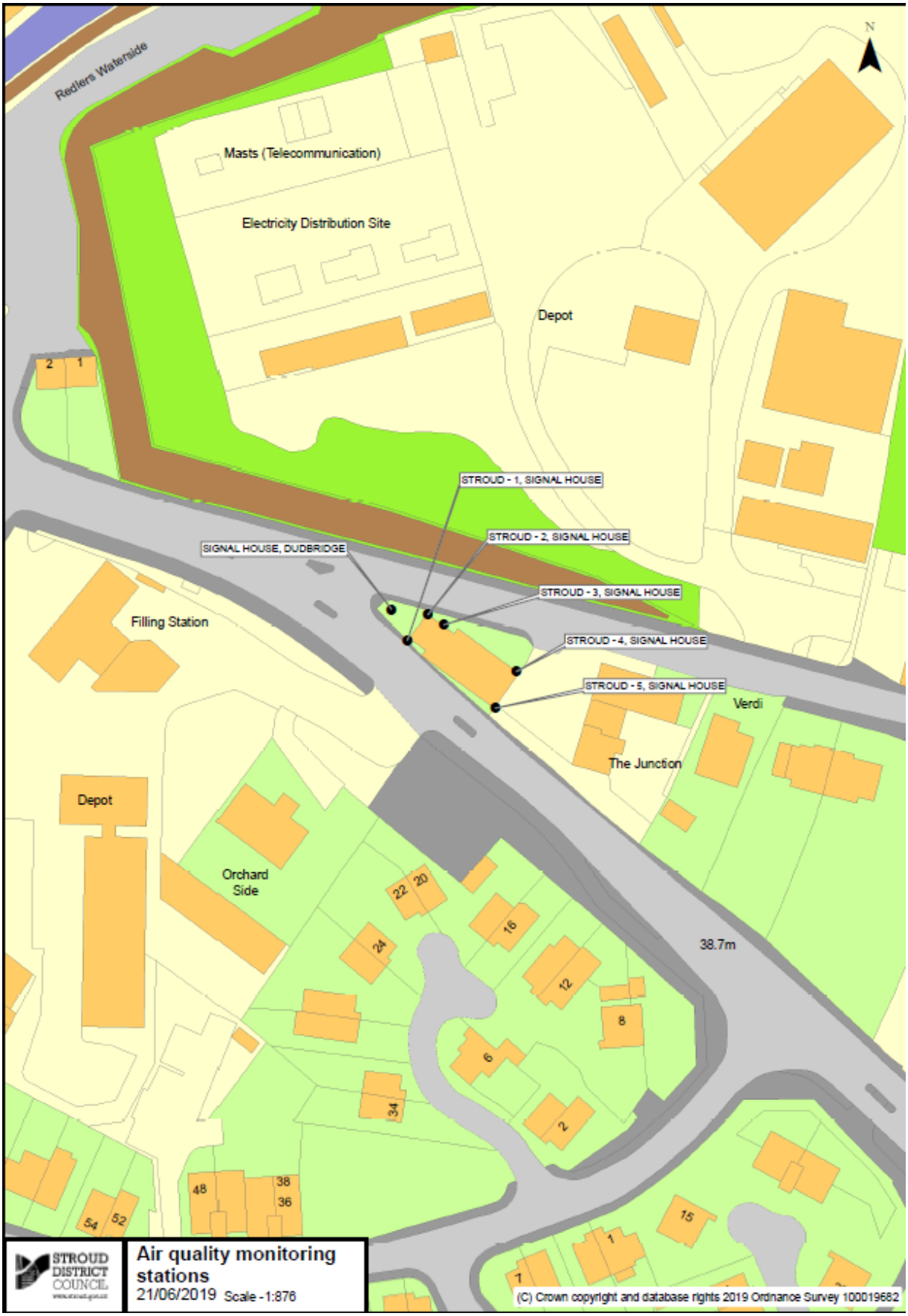
Redlers Waterside
Masts (Telecommunication)
Electricity Distribution Site
Depot
2
1
STROUD - 1, SIGNAL HOUSE
STROUD - 2, SIGNAL HOUSE
SIGNAL HOUSE, DUDBRIDGE
STROUD - 3, SIGNAL HOUSE
Filling Station
STROUD - 4, SIGNAL HOUSE
STROUD - 5, SIGNAL HOUSE
Verdi
The Junction
Depot
Orchard Side
22
20
24
16
12
8
6
34
2
38.7m
48
38
36
54
52
15
1
1
N
STROUD DISTRICT COUNCIL
Air quality monitoring stations
21/06/2019 Scale - 1:876
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Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England

Pollutant	Air Quality Objective[4]	
	Concentration	Measured as
Nitrogen Dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
	40 µg/m^3	Annual mean
Particulate Matter (PM_{10})	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
	40 µg/m^3	Annual mean
Sulphur Dioxide (SO_2)	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

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

Glossary of Terms

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