

Annual Progress Report (APR)



2024 Air Quality Annual Progress Report (APR) for Stirling Council

In fulfilment of Part IV of the Environment Act 1995, as amended by the
Environment Act 2021

Local Air Quality Management

30 August 2024

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Executive Summary: Air Quality in Our Area

Air Quality in Stirling Council

This Annual Progress Report provides an overview of air quality in the Stirling Council area. Air quality monitoring was performed at the automatic monitoring station on Craig's Roundabout in the City of Stirling measuring nitrogen dioxide (NO₂) and particulate matter (PM_{2.5} and PM₁₀), and passive monitoring was undertaken for NO₂, using diffusion tubes at 15 sites in the wider urban area.

Based on the available monitoring data for NO₂, PM_{2.5} and PM₁₀, there were no exceedances of the relevant Air Quality Objectives and it is unlikely that they will be exceeded in the near future. Therefore, it is not considered necessary to declare an Air Quality Management Area (AQMA) in the Stirling area.

Actions to Improve Air Quality

When we breathe polluted air, pollutants get into our lungs; they can enter the bloodstream and be carried to our internal organs such as the brain. This can cause severe health problems such as asthma, cardiovascular diseases and even cancer, and reduces the quality and number of years of life. Vulnerable groups – such as children, people with chronic diseases, and the elderly – are particularly sensitive to the dangerous effects of toxic air pollution and so it is critical that human health and the environment are protected. Stirling Council has a number of initiatives and actions to improve air quality, such as a sustainable transport strategy, a comprehensive monitoring programme, and developmental control requirements.

Stirling Council has partnered with East Central Scotland Vehicles Emissions Partnership, which is a coalition of East Lothian, Falkirk, Midlothian and West Lothian councils. The remit of the Vehicles Emissions Partnership is to reduce vehicle emissions by encouraging drivers to switch off their engines, and to handle idling complaints. Further information can be found at <http://switchoffandbreathe.org/about/>

Local Priorities and Challenges

Stirling Council procured 10 mobile air quality Zephyr monitoring sensors in spring 2019. The Zephyr is a compact and lightweight air pollution sensor that measures NO₂, NO, O₃, PM₁, PM_{2.5} and PM₁₀. Locations for sensors are chosen based on pollution sources, such as traffic or industry, proximity to more sensitive recipients, and proximity to past air quality surveys. The Zephyrs can be used to determine trends in pollutant levels around schools with the aim of spreading awareness of local air quality issues to teachers, parents and children.

New development in the Stirling area is a key issue affecting air quality. Where relevant, development applications are requested to submit an Air Quality Impact Assessment to allow for the potential impact to be assessed and any necessary mitigation measures to be applied. Applications include biomass installations and increased traffic emissions from major housing developments.



Stirling Council's Local Transport Strategy (LTS) establishes a long-term strategic vision for transport management, provision and services, and sets out how Stirling Council will work to promote and deliver sustainable travel and transportation.

Routine reviews of the LTS, and the associated consultations, have identified that progress towards achieving many of the objectives is largely positive.

The Local Transport Strategy is delivered via a number of supporting plans including the City Transport Plan 2013; the Towns, Villages and Rural Transport Plan 2014; and the Walking and Cycling to a Healthier Stirling: Active Travel Action Plan. The Active Travel Action Plan focuses on encouraging walking and cycling through improving infrastructure and changing behaviours via training and promotional activities.

Stirling Council's Sustainable Development Strategy establishes a collective vision to balance the needs of its communities and businesses with the needs of the environment. The strategy establishes objectives that focus on five main areas: energy, transport, sustainable ecosystems, sustainable resource/waste management, and climate change adaption. This includes reducing fuel poverty levels to zero by 2040; Stirling City Centre

Emissions Free Zones by 2030; 40% natural vegetation cover by 2040; Zero Waste City by 2040; and 80% reduction in carbon emissions by 2050.



Stirling Council actively participates in and promotes the Cycle to Work Scheme and the NextBikes cycle hire scheme, encouraging staff to use sustainable methods of transport for both commuting and work purposes.

A number of Schools within the Stirling Council area deliver the Level 1 Bikeability Scotland Cycle Training, providing children with the skills, confidence and encouragement to cycle safely on the roads. Further information can be found at:

<http://www.bikeabilityscotland.org/>

Stirling Council is part of the Tactran (Tayside and Central Scotland Transport Partnership) Electric Vehicle Steering Group and has contributed to the Regional Electric Vehicle Strategy, which was published at the end of 2019. Tactran has the primary purpose of developing a regional transport strategy setting out a vision for the medium- to long-term future of transport in the area, and to oversee its implementation.

Stirling Council has significantly increased its fleet of electric vehicles and installed additional charging bays, with projects ongoing.

Local Priorities and Challenges

The anticipated growth in traffic volume is seen as a priority air quality issue and the above plans were developed to manage this issue into the future. The reports and other related documents can be viewed at: <http://my.stirling.gov.uk/services/transport-and-streets/transport-policy>

How to Get Involved

A number of local and national organisations exist to promote more active and sustainable travel, and members of the public can access further information or become directly involved by following the links below:

www.pathsforall.org.uk

www.felscotland.org

<https://www.livingstreets.org.uk/who-we-are/scotland>

<http://www.sustrans.org.uk/scotland>

<http://www.stirlingcyclehub.org>

<http://nextbike.co.uk>

[http://Stirlingshire Villages Project - Air Quality \(sepa.org.uk\)](http://Stirlingshire Villages Project - Air Quality (sepa.org.uk))

Air quality data specific to the Stirling Council area can be found at:

http://www.scottishairquality.co.uk/latest/site-info?site_id=STRL

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1 Local Air Quality Management

This report provides an overview of air quality in Stirling Council during 2023. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995), as amended by the Environment Act (2021), 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 Progress Report (APR) summarises the work being undertaken by Stirling Council to improve air quality and any progress that has been made.

Table 1.1 – Summary of Air Quality Objectives in Scotland

Pollutant	Air Quality Objective Concentration	Air Quality Objective Measured as	Date to be Achieved by
Nitrogen dioxide (NO ₂)	200 µg/m ³ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
Nitrogen dioxide (NO ₂)	40 µg/m ³	Annual mean	31.12.2005
Particulate Matter (PM ₁₀)	50 µg/m ³ , not to be exceeded more than 7 times a year	24-hour mean	31.12.2010
Particulate Matter (PM ₁₀)	18 µg/m ³	Annual mean	31.12.2010
Particulate Matter (PM _{2.5})	10 µg/m ³	Annual mean	31.12.2021
Sulphur dioxide (SO ₂)	350 µg/m ³ , not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
Sulphur dioxide (SO ₂)	125 µg/m ³ , not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
Sulphur dioxide (SO ₂)	266 µg/m ³ , not to be exceeded more than 35 times a year	15-minute mean	31.12.2005
Benzene	3.25 µg/m ³	Running annual mean	31.12.2010
1,3 Butadiene	2.25 µg/m ³	Running annual mean	31.12.2003
Carbon Monoxide	10.0 mg/m ³	Running 8-Hour mean	31.12.2003

2 Actions to Improve Air Quality

2.1 Air Quality Management Areas

Air Quality Management Areas (AQMA) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority must prepare publish and implement an Air Quality Action Plan (AQAP) within the shortest possible time and no later than 12 months of the date of AQMA Designation Order. The AQAP must set out measures the local authority intends to put in place in pursuit of the objectives within the shortest possible time. Measures should be provided with milestones and a final date for completion. The action plan itself should have a timescale for completion and for revocation of the AQMA. Where measures to reduce air pollution may require a longer timescale an action plan shall be reviewed and republished within five years of initial publication and then five-yearly thereafter.

Stirling Council currently does not have any AQMAs, and the results of past and present monitoring indicate that it will not be necessary to declare any AQMAs in the foreseeable future.

2.2 Cleaner Air for Scotland 2

[Cleaner Air for Scotland 2 – Towards a Better Place for Everyone \(CAFS2\)](#) is Scotland's second air quality strategy. CAFS2 sets out how the Scottish Government and its partner organisations propose to further reduce air pollution to protect human health and fulfil Scotland's legal responsibilities over the period 2021 – 2026. CAFS2 was published in July 2021 and replaces [Cleaner Air for Scotland – The Road to a Healthier Future \(CAFS\)](#), which was published in 2015. CAFS2 aims to achieve the ambitious vision for Scotland "to have the best air quality in Europe". A series of actions across a range of policy areas are outlined, a summary of which is available on the Scottish Government's website.

Progress by Stirling Council against relevant actions for which local authorities are the lead delivery bodies within this strategy is demonstrated below.

2.2.1 Placemaking – Plans and Policies

Local authorities working with Transport Scotland and SEPA will look at opportunities to promote zero-carbon city centres within the existing LEZs structure.

Walk, Cycle, Live Stirling is a transformational active travel project that will deliver 6.5km of new active travel infrastructure from the Forth Valley College to the city centre, and Stirling University to the train station; making it easier for people to walk and cycle in Stirling. Having this transport choice will reduce car dependence and congestion, and hopefully contribute towards improving air quality.

2.2.2 Transport – Low Emission Zones

Stirling Council has no Low Emission Zones.

2.3 Implementation of Air Quality Action Plan(s) and/or measures to address air quality

In order to ensure that local authorities implement the measures within an action plan by the timescales stated within that plan, the Scottish Government expects authorities to submit updates on progress through the APR process. Stirling Council has taken forward a number of measures within the action plan during the current reporting year of 2023 in pursuit of improving local air quality and meeting the air quality objectives within the shortest possible time. Details of all measures completed, in progress or planned are set out in Table 2.1.

Key completed measures for this reporting year (2023) are:

- An additional eight public EV bays.
- An additional ten fleet charging bays.
- A dedicated bus charger.
- Four electric minibuses.

It is anticipated that a further 47 public charging bays, 22 fleet charging bays and a dedicated bus charger will be delivered in 2024.

Table 2.1 – Progress on Measures to Improve Air Quality

Project	Category	Expected/Actual Completion year	Measure Status	Funding Status	Key Milestones	Progress	Barriers to implementation
Procurement of additional EVs for the Council's Fleet.	Alternatives to private vehicle use.	2032	Delivery	No funding for 24/25 allocated	Phase out of internal combustion engine (ICE) cars in the public sector fleet by 2025 and all ICE vehicles by 2030.	14.1% of Fleet vehicles are now electric.	Funding and availability of suitable vehicles.
EV Policy - Transition to a fossil fuel-free climate ready area by 2045.	Promoting low emission transport.	Ongoing	Adopted October 22	No funding for 24/25 allocated	Residents have access to charging within 10-minute walk.	Total increase of 19 charging bays (public & fleet) in 2023 = 7.6%	Funding, availability of suitable Council land and electricity grid constraints.
Transport Scotland's Switched on Towns and Cities - To encourage the uptake of EV's in towns and cities.	Promoting low emission transport.	2023	Delivery	Funding now closed.	Project completion of remaining Electrical Vehicle Charging Points (EVCP) installations.	The number of plug-in vehicles registered in Stirling at fourth quarter 2023 = 10,740, an increase of 38% compared with 2022.	Project is now complete.
Climate and Nature Emergency Plan.	Covers a number of the categories.	Stirling Council area will be net zero by 2045.	Delivery	Various	75% carbon reduction by 2030.	43.4% reduction in emissions by 2021 (Data from UK Govt Department of Energy Security and Net-Zero (DBESNZ). This data is published 2 years in arrears due to long verification process.	Availability of project funding. Staff resource and lack of experience in the workforce. Increasing demand for limited resources.
Investigating the purchase and implementation of Variable Messaging Signs to use in conjunction with air quality monitors.	Promoting low emission transport Public Information Traffic Management	2023	Planning	Confirmed for pilot	Unconfirmed	Not taken forward.	Not seen as a priority for capital funding.
Walk, Cycle, Live, Stirling	Promoting travel alternatives.	50% - expected completion date summer 2024.	In Progress	Fully funded. Sustrans with match form City Region Deal and developer contributions.	Award issued. Consultation and design. Concept design. Detailed design. Developed design. Construction. Routes promoted. Monitoring and evaluation (baseline data is already established).	Airthrey Road: complete. Causewayhead Rd: 90% complete. Cowane Street: 90% complete. Lower Bridge Street: 10% complete. Raploch Rd (South), Albert Place, and Dumbarton Road: all complete. Goosecroft Rd: 99% complete. Upper Craigs: 95% complete. Raploch Rd street design: 35% complete	Project is generally running smoothly. Congestion and delays are creating some public pushback. Inflation and increasing costs are an issue.

3 Air Quality Monitoring Data and Comparison with Air Quality Objectives

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

This section sets out what monitoring has taken place and how local concentrations of the main air pollutants compare with the objectives.

Stirling Council undertook automatic (continuous) monitoring at one site during 2023. Table A.1 in Appendix A shows the details of the site. National monitoring results are available at [Site Data | Scottish Air Quality](#).

A map showing the location of the automatic monitoring site is provided in Figure A.1 in Appendix A. 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

Stirling Council undertook ongoing non-automatic (passive) monitoring of NO₂ at 12 sites with an additional three monitoring sites added in March 2023. Table A.2 in Appendix A shows the details of the sites. A map showing the location of the monitoring sites is provided in Figure A.2 in Appendix A. Further details on Quality Assurance/Quality Control (QA/QC), annualisation, and bias adjustment for the diffusion tubes are included in Appendix C.

3.1.3 Other Monitoring Activities

Stirling Council has 10 Zephyr units located in and around the Stirling Council area which have been recording data throughout 2023. Some sensors have also been shared with specialists at SEPA for a project with local schools.

3.2 Individual Pollutants

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

3.2.1 Nitrogen Dioxide (NO₂)

Table A.4 in Appendix A compares the ratified continuous monitored NO₂ hourly mean concentrations for the past five years, with the air quality objective of 200µg/m³ not to be exceeded more than 18 times per year.

For diffusion tubes, the full 2023 dataset of monthly mean values is provided in Table B.1 in Appendix B. Figure B.1 shows the trends in annual mean NO₂ concentrations between 2016 and 2023. There were no exceedances of the objectives.

3.2.2 Particulate Matter (PM₁₀)

Table A.5 in Appendix A compares the ratified and adjusted monitored PM₁₀ annual mean concentrations for the past five years, with the air quality objective of 18µg/m³.

Table A.6 in Appendix A compares the ratified continuous monitored PM₁₀ daily mean concentrations for the past five years, with the air quality objective of 50µg/m³ not to be exceeded more than seven times per year. There were no exceedances of the objectives.

3.2.3 Particulate Matter (PM_{2.5})

Table A.7 in Appendix A compares the ratified and adjusted monitored PM_{2.5} annual mean concentrations for the past five years, with the air quality objective of 10µg/m³. Stirling Council has only been monitoring PM_{2.5} since 2019, therefore, there is limited data for this pollutant. There have been no exceedances of the objectives thus far.

3.2.4 Sulphur Dioxide (SO₂)

Stirling Council does not monitor for SO₂.

3.2.5 Carbon Monoxide, Lead and 1,3-Butadiene

Stirling Council does not monitor for Carbon Monoxide, Lead, or 1,3-Butadiene.

4 New Local Developments

4.1 Road Traffic Sources

There are no new road traffic sources, as listed below, that would have a significant impact on air quality.

- Narrow congested streets with residential properties close to the kerb.
- Busy streets where people may spend one hour or more close to traffic.
- Roads with a high flow of buses and/or HGVs.
- Junctions.
- Bus or coach stations.

4.2 Other Transport Sources

There are no new sources, as listed below, that would have a significant impact on air quality.

- Airports.
- Locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m.
- Locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m.
- Ports for shipping.

The Stirling Council Public Transport Co-ordinator confirmed that the total number of movements at Stirling Bus Station for 2023 is 126,646. This approximates to a four-week average of 9,742, or daily average of 347. The criterion for assessment where there is relevant exposure within 10m is 2,500 movements a day. It is therefore concluded that a Design Manual for Roads and Bridges (DMRB) assessment is not required.

4.3 Industrial Sources

It is confirmed that during 2023 none of the following would warrant further assessment:

- Industrial installations: new or proposed installations for which an air quality assessment has been carried out.
- Industrial installations: existing installations where emissions have increased substantially or new relevant exposure has been introduced.

- Industrial installations: new or significantly changed installations with no previous air quality assessment.
- Major fuel storage depots storing petrol.
- Poultry farms.

SEPA confirmed that no new PPC permits were issued in the Stirling Council area in 2023.

4.4 Commercial and Domestic Sources

The locations of previously assessed and proposed biomass installations are summarised in Table 5.1. Based on a keyword search of the planning portal and departmental records there are no clusters of installations in 500 x 500 metre squares that could result in cumulative impacts of emissions of PM₁₀.

With the exception of the Acharn Power Station (Killin) Development, which is operational, all are small-scale plants with minimal potential for significant release of PM₁₀ or NO_x. Where required, the applications were screened using the Defra review and assessment tools, and further assessment was not considered necessary.

4.5 New Developments with Fugitive or Uncontrolled Sources

There are no new developments with fugitive or uncontrolled sources, as listed below, that would have a significant impact on air quality:

- Landfill sites.
- Unmade haulage roads on industrial sites.
- Waste transfer stations.

5 Planning Applications

Stirling Council's Local Development Plan (LDP) identifies a number of sites for large-scale development between 2014 and 2034. Each development site shall be assessed for its impact on air quality through the planning consultation process.

A full application for a major housing and mixed development (Durieshill) has been in progress for several years. This is an application for a 3,000-house residential development, village centre, employment land, community campus and primary school located on land between Plean and the Bannockburn Interchange. The air quality assessment has been reviewed. Modelling used in the assessment indicated that there are mainly negligible impacts on NO₂, PM₁₀ and PM_{2.5} from the development at the 29 receptors selected, with the exception of NO₂, which has a minor impact at four of the 29 receptors. The development approval process is ongoing.

Planning permission for a redevelopment of the Craigforth Campus to comprise offices, retail, leisure, public houses, restaurants, residential premises, hotel, care home, nursery, distillery, landscaping, car park and associated infrastructure is still under consideration.

Table 5.1 – Locations of Installed, Permitted and Proposed Biomass Combustion Plant within Stirling Council

Name	Reference	Status	Easting	Northing
Wester Auchentroig, Buchlyvie	20/00628/FUL	Granted	10695	343755
Ogilvie House Pirnhall biomass boiler, Stirling	20/00399/FUL	Granted	84931	929328
Broich Arngomery Kippen FK8 3EN	21/00417/LAW	Permitted 30/06/2021 Status unknown	128510	188565
Lendrick Cottage, Callander FK17 8HR	2021/0283/LAW	Withdrawn	226904	340725
West Rosburn Lane Farm, Stirling, FK9 4AH	20/00142/FUL (retrospective)	Permitted 18 May 2020 Status: Operational	146354	042009
Stockbridge Nursery, Kilbryde and Brack Road, Doune, FK15 9ND	18/00712/FUL	Permitted 27 November 2018 Status: Unknown	191627	991943
Land adjacent to North and West of 27 Whitehouse Rd, Forthside Way, Stirling	16/00775/FUL	Permitted 27/02/2017 Status: Unknown	280695	693347
Carsten Mews, Drumbeg Rd, Killearn	16/00749/FUL	Permitted 15/02/2017 Status: Unknown	250499	684139
48 Glasgow Road, Blanefield	15/00644/FUL	Permitted 30/11/2015 Status: Unknown	255744	679621

6 Conclusions and Proposed Actions

6.1 Conclusions from New Monitoring Data

The annual mean for NO₂ at the active monitoring station shows a notable increase from 2022 (15ug/m³) to 2023 (22.2 ug/m³). However, this increase is likely to be attributable to the positive annualization process required due missing data for the months of July, August and September (See Appendix C for details of the annualisation calculation).

Based on the data in Tables A.3 to A.7 and the graph in Figure B.1 of Appendix B, it can be seen that there was no significant changes in NO₂ at the passive monitoring sites. However, a minor fall in mean concentrations was notes at DT1, DT2, DT3, DT4(A-C), DT5, DT6, DT8, DT9, DT11 AND DT12. A minor increase was noted at sites DT7 and DT10. Ongoing monitoring will determine if any of the above changes represent long-term trends in air quality.

The PM₁₀ results at the automatic monitoring station are consistent with previous years and may indicate that the increase from the artificially low levels of 2020, due to the pandemic travel restrictions, have levelled off. As above, ongoing monitoring will determine if any of the above changes represent long-term trends in air quality.

PM_{2.5} has only been measured since 2019. The results for the annual mean (Table A.7) show no change since 2021, however, there is minor increase since 2020.

The following conclusions can be made:

- Based on the air quality data collected in 2023, there are no exceedances of the relevant Air Quality Objectives and it is considered unlikely that they will be exceeded in the near future.
- On this basis it is not considered necessary to declare an AQMA within the Stirling area.

6.2 Conclusions relating to New Local Developments

In relation to new local developments, it is determined that the key issue regarding air quality is the potential for increased road traffic. It is recognised that future and pending applications may increase traffic numbers and, as a result, negatively impact on the air quality within the Stirling Council area.

Biomass installations are also still considered a potential source of increased emissions affecting air quality. As such, biomass applications are screened using the Defra review-and-assessment tools and are not expected to have a significant impact on local air quality.

6.3 Proposed Actions

Stirling Council will continue with the following actions:

- Monitor for NO₂, PM_{2.5} and PM₁₀ at the locations detailed in this report. Results of the monitoring and other air quality assessment work will be presented in the next Annual Progress Report.
- Require air quality assessments where a development may result in significant increases in traffic as outlined in Defra Local Air Quality Guidance Management, Technical Guidance (TG16).
- Screening of biomass applications to assess the potential impact on local air quality.
- Provide information and support to Stirling Council Sustainable Development Team on future developments in the Stirling area.

As detailed in Table 2.1, the Sustainable Development Team has taken forward a number of measures to improve local air quality.

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? Which AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) ⁽¹⁾	Distance to kerb of nearest road (m) ⁽²⁾	Inlet Height (m)
CM1	Craig's Roundabout	Roadside	279944	693005	PM ₁₀ ; PM _{2.5}	N	FDMS (Palas Fidas)	10m	3	2.2
CM2	Craig's Roundabout	Roadside	279944	693005	NO _x	N	Chemiluminescent (Serinus)	10m	3	2.2

Notes:

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

(2) N/A if not applicable.

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

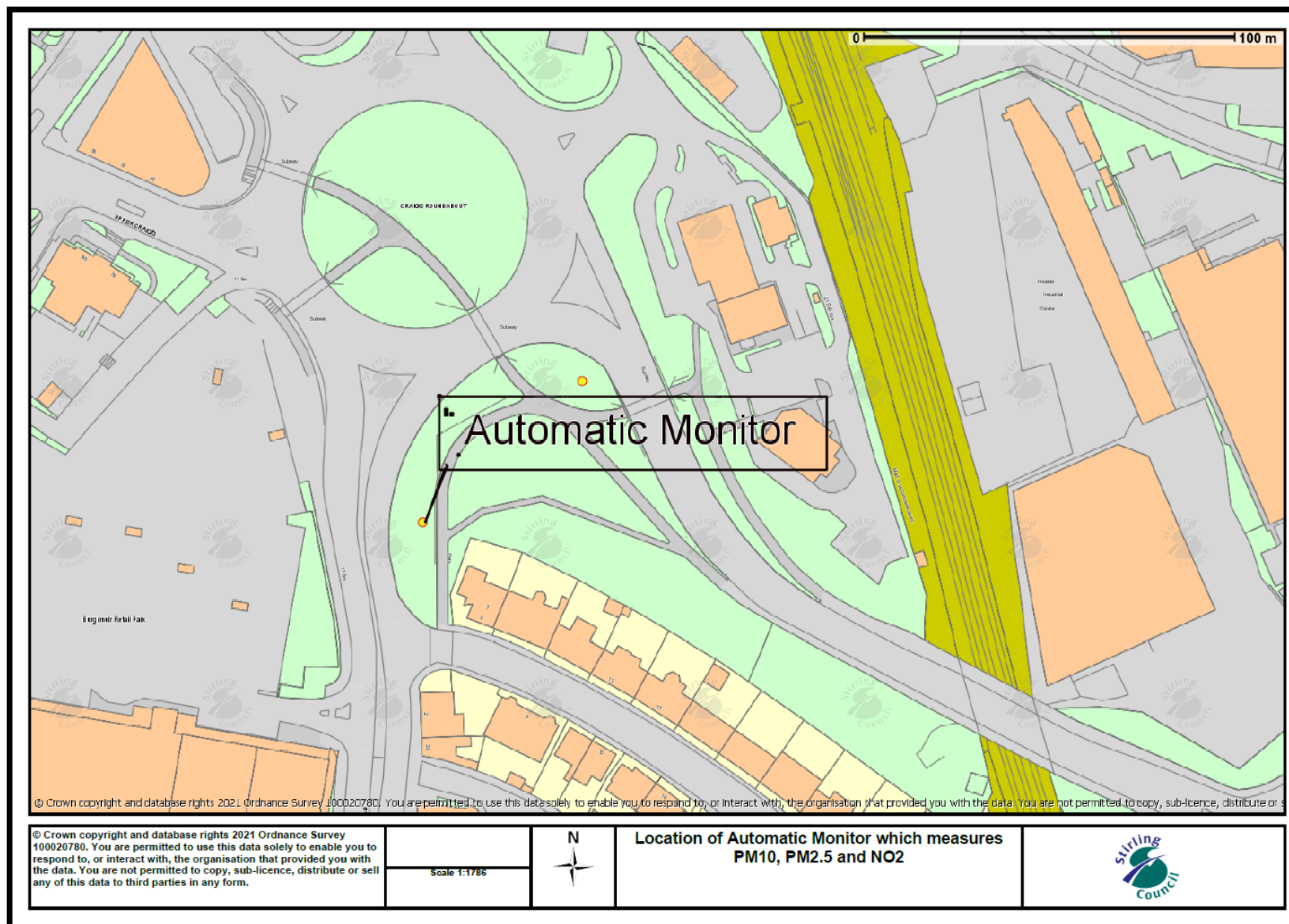
Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) ⁽¹⁾	Distance to kerb of nearest road (m) ⁽²⁾	Tube co-located with a Continuous Analyser?
DT1	Dumbarton Road	Kerbside	279655	693240	NO ₂	N	2	0.5	N
DT2	Port Street	Kerbside	279634	693160	NO ₂	N	2	0.5	N
DT3	Craigs Roundabout No. 1	Roadside	279987	693043	NO ₂	N	10	2	N
DT4A,B,C	Craigs Roundabout No.2	Roadside	279944	693005	NO ₂	N	10	3	Y
DT5	Lennox Avenue, Stirling	Urban Background	279354	691933	NO ₂	N	4	1.5	N
DT6	Barnsdale Road, Stirling	Roadside	279520	691252	NO ₂	N	18	1.5	N
DT7	Main Street, Plean	Roadside	283222	687582	NO ₂	N	6	1.5	N
DT8	Alloa Road	Roadside	282075	695057	NO ₂	N	9	2	N
DT9	Henderson Street, Bridge of Allan	Roadside	279177	697497	NO ₂	N	7	1.5	N
DT10	Stirling Road, Dunblane	Roadside	278081	700580	NO ₂	N	8	1.5	N
DT10B	Montgomery Street, Dunblane	Roadside	277240	700489	NO ₂	N	4	2	N
DT11	Stirling University	Roadside	280346	696339	NO ₂	N	>50	2	N
DT12	Airthrey Road, Stirling	Roadside	280505	695719	NO ₂	N	3	2	N
DT13	Birkhill Rd, Cambusbarron	Roadside	278019	692542	NO ₂	N	8	2	N
DT14	Gateside Rd, St. Ninians	Roadside	278858	691160	NO ₂	N	3	2	N

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.

Figure A.1 - Automatic monitor location



Created by Kirsty Cheape on 25 June 2021

Figure A.2 – Diffusion tube locations

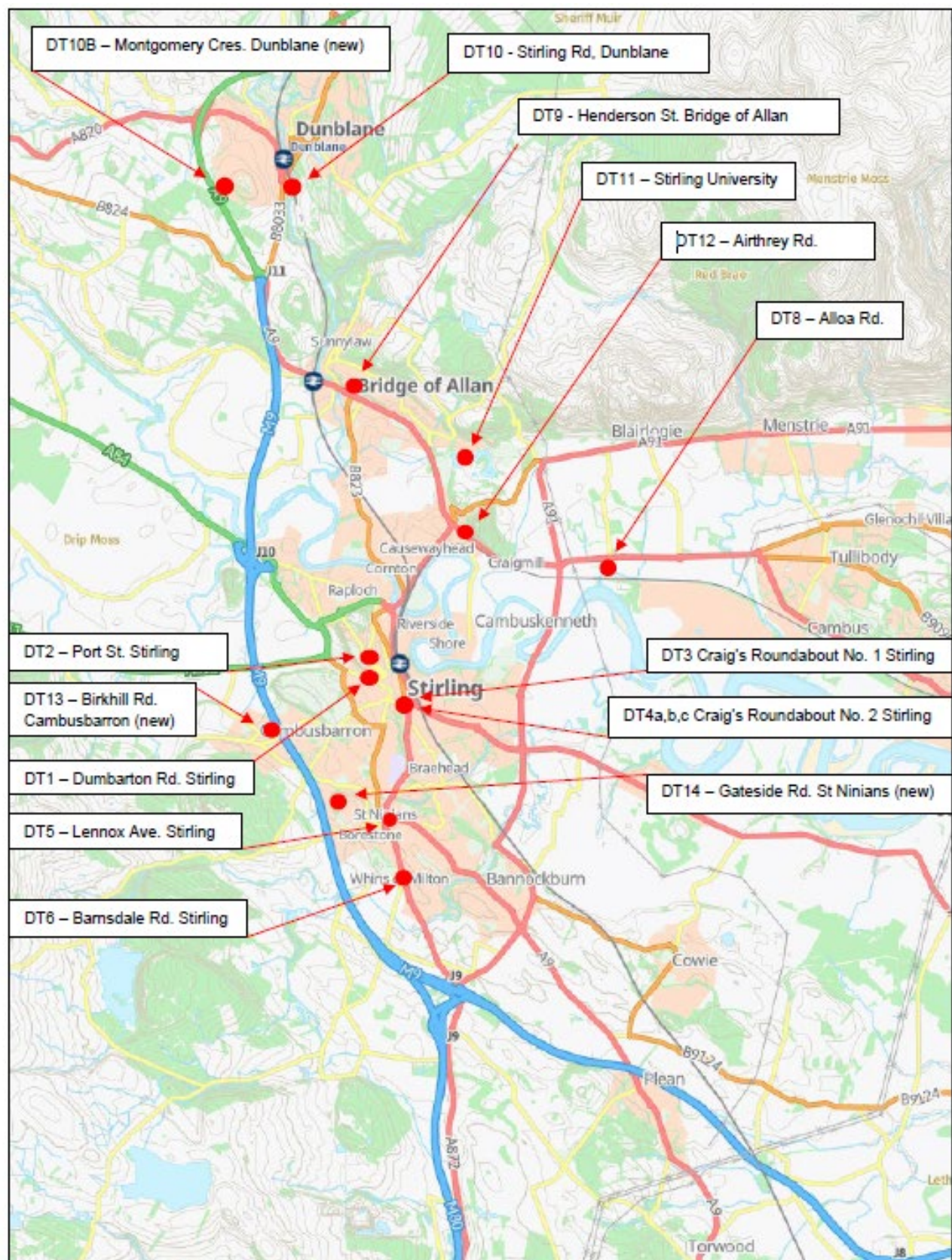


Table A.3 – Annual Mean NO₂ Monitoring Results: Automatic Monitoring and Diffusion Tubes combined (µg/m³)

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2023 (%) (2)	2019	2020	2021	2022	2023
CM1	Roadside	Automatic	65	65	20	14	15	15	22.2(a)
DT1	Kerbside	Diffusion Tube	67.3	67.3	20.4	16.2	16.6	13.8(a)	12.6(a)
DT2	Kerbside	Diffusion Tube	82.7	82.7	19.7	14.6	15.7	16.2	14
DT3	Roadside	Diffusion Tube	82.7	82.7	22.0	17.6	16.8	17.7	17.1
DT4A,4B,4C	Roadside	Diffusion Tube	82.7	82.7	19.6	14.3	15.3	16.7	15.9
DT5	Urban Background	Diffusion Tube	82.7	82.7	10.3	8.3	8.5	8.9	8.2
DT6	Roadside	Diffusion Tube	73.1	73.1	14.0	10.5	12.6	10.6(a)	10 (a)
DT7	Roadside	Diffusion Tube	57.7	57.7	13.8	10.5	12	11.4(a)	12.2(a)
DT8	Roadside	Diffusion Tube	82.7	82.7	22.3	16.2	15.3	16	15.4
DT9	Roadside	Diffusion Tube	65.4	65.4	17.6	12.2	14.3	13.9	11.9(a)
DT10	Roadside	Diffusion Tube	82.7	82.7	11.6	9.1	10.5	8.6(a)	10.2
DT10B	Roadside	Diffusion Tube	80	67.3	NA	NA	NA	NA	7(a)
DT11	Roadside	Diffusion Tube	75	75	16.3	11.5	11.4	11.8	11.2
DT12	Roadside	Diffusion Tube	65.4	65.4	16.7	14.0	13.2	13.4	10.3(a)
DT13	Roadside	Diffusion Tube	70	57.7	NA	NA	NA	NA	14.4(a)
DT14	Roadside	Diffusion Tube	60	50	NA	NA	NA	NA	14.3(a)

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**.

Means for diffusion tubes have been corrected for bias. All means have been “annualised” as per LAQM.TG22 if valid data capture for the full calendar year is less than 75% - denoted subscript (a). See Appendix C for details.

- (1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
- (2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Table A.4 – 1-Hour Mean NO₂ Monitoring Results, Number of 1-Hour Means > 200µg/m³

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2023 (%) ⁽²⁾	2019	2020	2021	2022	2023
CM2	Roadside	Automatic	65	65	0	0	0	0	0

Notes:

Exceedances of the NO₂ 1-hour mean objective (200 µg/m³ not to be exceeded more than 18 times/year) are shown in bold.

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

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

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

Table A.5 – Annual Mean PM₁₀ Monitoring Results (µg/m³)

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2021 (%) ⁽²⁾	2019	2020	2021	2022	2023
CM1	Roadside	99	99	14	11	8.7	10	10

Notes:

Exceedances of the PM₁₀ annual mean objective of 18 µg/m³ are shown in bold.

All means have been “annualised” as per LAQM.TG(22), valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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

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

Table A.6 – 24-Hour Mean PM₁₀ Monitoring Results, Number of PM10 24-Hour Means > 50µg/m³

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2023 (%) ⁽²⁾	2019	2020	2021	2022	2023
CM1	Roadside	99	99	0	0	0	0	0

Notes:

Exceedances of the PM₁₀ 24-hour mean objective (50 µg/m³ not to be exceeded more than seven times/year) are shown in bold.

If the period of valid data is less than 85%, the 98.1st percentile of 24-hour means is provided in brackets.

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

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

Table A.7 – Annual Mean PM_{2.5} Monitoring Results (µg/m³)

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2020 (%) ⁽²⁾	2019	2020	2021	2022	2023
CM1	Roadside	99	99	5.6	4.25	5	5	5

Notes:

Exceedances of the PM_{2.5} annual mean objective of 10 µg/m³ are shown in bold.

All means have been “annualised” as per LAQM.TG(22), valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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

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

Appendix B: Full Monthly Diffusion Tube Results for 2023

Table B.1 – NO₂ 2023 Monthly Diffusion Tube Results (µg/m³)

Site ID	Site Name	New / Existing	Single / Duplicate / Triplicate	Site Type	National or Local Bias Adjustment	Bias Adjustment Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Raw Annual Mean (µg/m ³)	Bias Adjusted and Annualised Annual Mean (µg/m ³)
DT1	Dumbarton Rd, Stirling	Existing	Single	Kerbside	National	0.81	18.6	18.0	24.2	15.6	Missing	Missing	Missing	11.3	Missing	16.6	21.6	15.8	17.7	12.6 (a)
DT2	Port Street	Existing	Single	Kerbside	National	0.81	20.5	22.4	22.1	15.1	13.6	Missing	Missing	11.6	15.4	15.4	21.2	15.8	17.3	14.0
DT3	Craigs Roundabout No. 1	Existing	Single	Roadside	National	0.81	22.4	22.6	24.5	22.8	14.8	Missing	Missing	15.2	21.6	21.5	25.0	21.3	21.2	17.1
DT4A, DT4B, DT4C	Craigs Roundabout No. 4	Existing	Triplicate	Roadside	National	0.81	24.3	22.5	20.6	16.3	17.1	Missing	Missing	18.7	17.6	19.5	20.9	19.3	19.7	15.9
DT5	Lennox Ave, Stirling	Existing	Single	Urban Background	National	0.81	11.5	10.9	13.1	9.0	10.0	Missing	Missing	4.6	6.7	14.4	14.1	7.2	10.2	8.2
DT6	Barnsdale Rd, Stirling	Existing	Single	Roadside	National	0.81	13.5	13.5	Missing	11.7	12.5	Missing	Missing	7.5	12.0	15.8	18.2	6.0	12.3	10.0 (a)
DT7	Main St, Plean	Existing	Single	Roadside	National	0.81	13.5	Missing	Missing	15.7	Missing	Missing	Missing	12.1	19.3	15.9	22.8	15.2	16.4	12.2 (a)
DT8	Alloa Rd Rbt, Stirling	Existing	Single	Roadside	National	0.81	19.2	15.9	24.3	15.6	17.5	Missing	Missing	13.6	23.1	22.3	18.3	20.1	19.0	15.4
DT9	Henderson St, BOA	Existing	Single	Roadside	National	0.81	18.7	16.3	15.8	10.8	11.7	Missing	Missing			24.7	26.9	10.7	17.0	11.9
DT10	Stirling Rd, Dunblane	Existing	Single	Roadside	National	0.81	15.6	14.0	14.6	16.6	10.1	Missing	Missing	7.7	10.0	12.9	20.2	3.9	12.6	10.2
DT10B	Montgomery St Dunblane	New	Single	Roadside	National	0.81	Missing	Missing	9.9	17.4	6.7	Missing	Missing	5.3	7.0	10.7	8.6	6.5	9.0	7.0 (a)
DT11	Stirling University	Existing	Single	Roadside	National	0.81	14.2	13.0	13.1	Missing	21.1	Missing	Missing	11.7	12.8	12.9	15.4	10.7	13.9	11.2 (a)
DT12	Airthrey Road	Existing	Single	Roadside	National	0.81	20.5	17.2	21.0	9.2	Missing	Missing	Missing	Missing	10.5	12.2	14.9	11.8	14.7	10.3 (a)
DT13	Birkhill Rd Cambusbarron	New	Single	Roadside	National	0.81			16.8	31.7	10.5	Missing	Missing	9.3	16.5	18.7	Missing	11.9	16.5	14.4 (a)
DT14	Gateside Rd St Ninians	New	Single	Roadside	National	0.81			Missing	31.1	Missing	Missing	Missing	6.4	9.1	13.9	38.9	10.9	18.4	14.3 (a)

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**.
Subscript (a) denotes annualised data. See Appendix C for details on bias adjustment and annualisation.

Figure B.1 Trends in Annual Mean Concentration of NO₂ at Diffusion Tube Sites 2016-2022

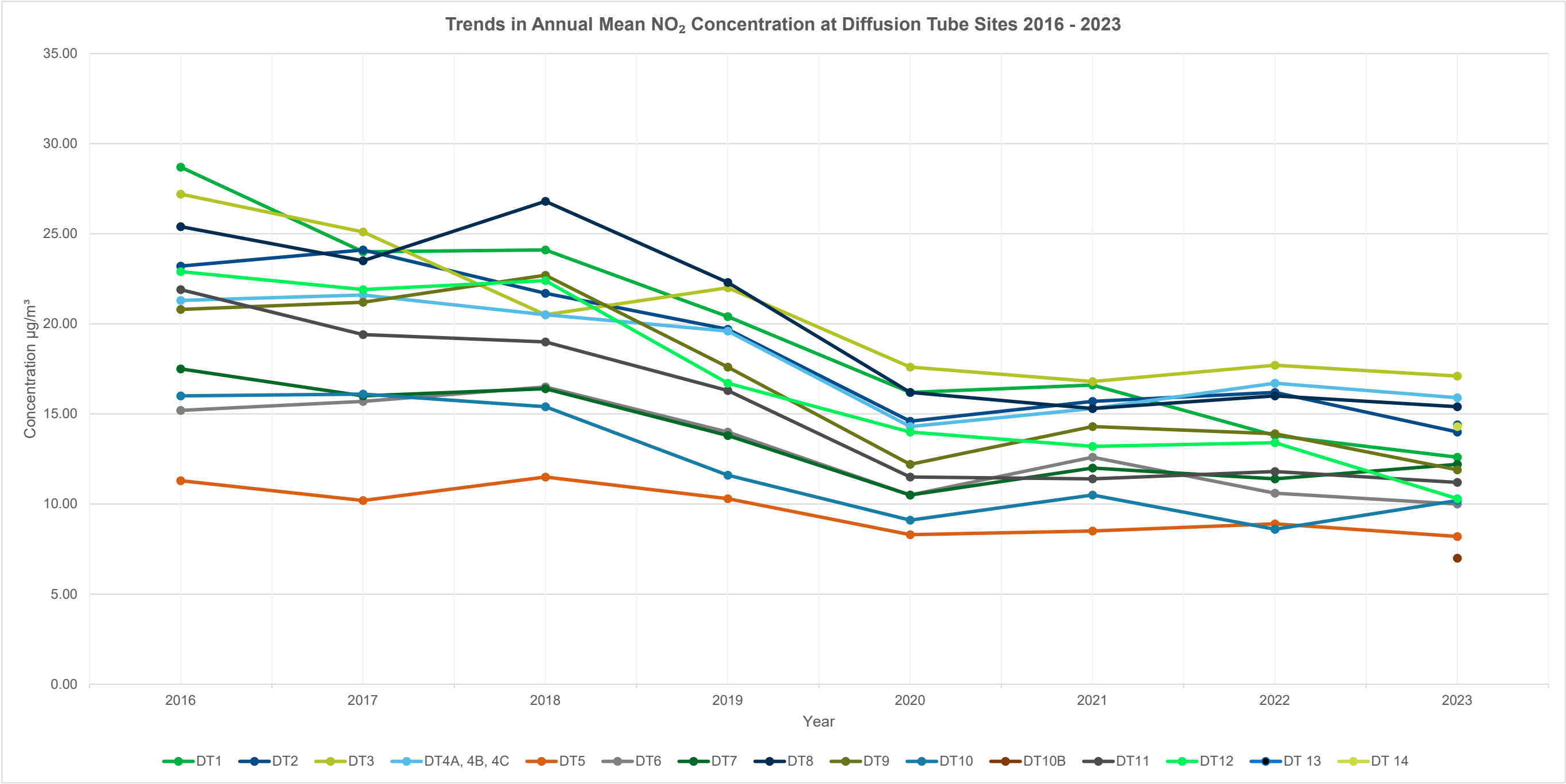
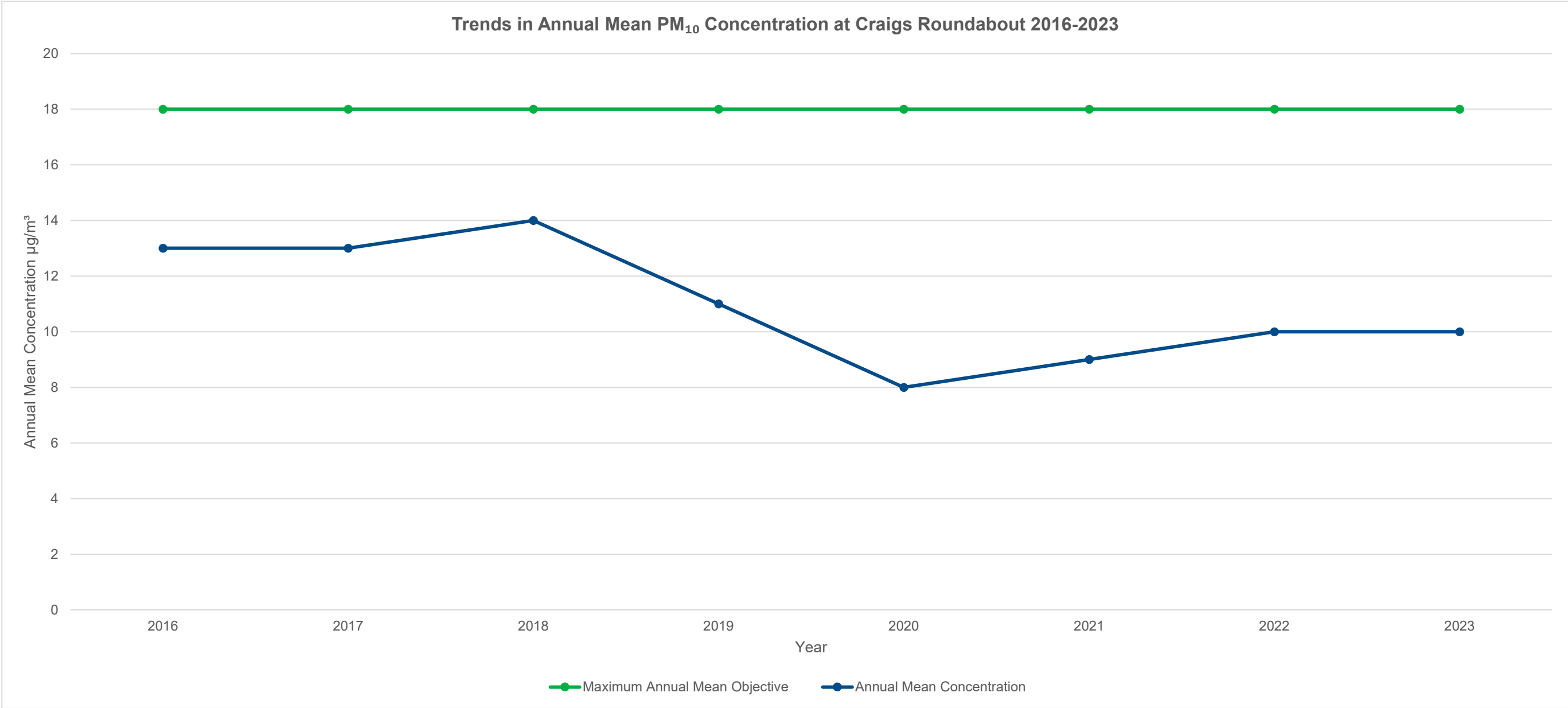


Figure B.2 Trends in Annual Mean PM₁₀ Concentration at Craigs Roundabout 2016-2020



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

New or Changed Sources Identified Within Stirling Council

Stirling Council has not identified any new sources relating to air quality within the reporting year of 2023.

Additional Air Quality Works Undertaken by Stirling Council

An additional three diffusion tube monitoring points were established in March 2023 (details provided in Table B.1 and Figure A.2).

Stirling Council has 10 Zephyrs located in and around the Stirling Council area which have been recording data throughout 2023. Scottish Government funding to pay for annual licence fees associated with the Zephyrs is applied for in January each year to pay for the subsequent year.

QA/QC of Diffusion Tube Monitoring

Stirling Council receives the diffusion tubes from Edinburgh Scientific Services. The tubes are prepared using 50% TEA in acetone.

Edinburgh Scientific Services are United Kingdom Accreditation Service (UKAS) accredited for the analysis method that they use. The analysis is a colorimetric method with the absorbance being measured at 540nm using a spectrophotometer.

In addition to internal quality control samples, they take part in two external quality analysis schemes; the first one run by the National Physics Laboratory (NPL) and the second scheme is the AIR_PT scheme, run by LGC.

Diffusion Tube Annualisation

As a result of procedural errors the tubes for all sites were exposed for two months (June and July 2023) before collection, therefore, no data was available for these months. These

omissions combined with other data gaps resulted data capture rates less than 75% (but greater than 25%) as detailed in Table B.1.

The data was therefore subject to annualisation following the procedures detailed in the Diffusion Tube Data Processing Tool. Annualisation was performed using a comparison to automatic monitoring data obtained for Glasgow Anderston, Glasgow Townhead and Falkirk Grangemouth MC.

Diffusion Tube Bias Adjustment Factors

Stirling Council has applied a national bias adjustment factor of 0.81 to the 2023 monitoring data (Table C.2). This factor was taken from the 06/23 version of the national spreadsheet, which can be viewed at the following link: <https://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html>.

A summary of bias adjustment factors used by Stirling Council over the past five years is presented below in Table C.1. A national bias adjustment factor was chosen, as this is the factor that has been used in Stirling Council for the previous five years, ensuring consistency.

Table C.1 – Bias Adjustment Factor

Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2023	National	06/24	0.81
2022	National	06/23	0.81
2021	National	09/22	0.85
2020	National	03/21	0.9
2019	National	09/20	1.01
2018	National	06/19	1.05

NO₂ Fall-off with Distance from the Road

No diffusion tube NO₂ monitoring locations within Stirling Council required distance correction during 2023.

QA/QC of Automatic Monitoring

QA/QC of Automatic Monitoring

The automatic monitoring equipment is calibrated monthly and audited every six months by Ricardo Energy and Environment. Data recorded by the station is analysed by Ricardo Energy and Environment. The data used within this APR is ratified and live, and historic data can be viewed through the Scottish Air Quality website. The website can be accessed here: http://www.scottishairquality.scot/latest/site-info?site_id=STRL

PM₁₀ and PM_{2.5} Monitoring Adjustment

The type of PM₁₀/PM_{2.5} monitors used within Stirling Council do not require the application of a correction factor.

Automatic Monitoring Annualisation

Annualisation was not required for PM₁₀ and PM_{2.5} as 99% recovery was achieved.

No data from the automatic monitor was captured for July, August and September 2023 (65% recovery) therefore annualisation was carried out using the method detailed in Technical Guidance (TG22) and summarised in Table C.2 below.

Table C.2 – Annualisation automatic monitor

Location	Annual mean (2023)	Period mean (2023)	Ratio
Glasgow Anderston (Urban background)	20.49	14.72	1.39
Glasgow Townhead (Urban background)	15.58	10.17	1.53
Falkirk Grangemouth MC (Urban background)	13.53	9.98	1.35
Falkirk Moray (Urban background)	10.91	8.4	1.29
Annualisation Factor (average)			1.39

NO₂ Fall-off with Distance from the Road

No automatic NO₂ monitoring locations required distance correction during 2022.

Local Bias Adjustment Calculations

No automatic NO₂ monitoring locations required Local Bias correction during 2023.

Glossary of Terms

Please add a description of any abbreviation included in the APR – An example is provided below.

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the LA 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
AURN	Automatic Urban and Rural Network (UK air quality monitoring network)
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
DT	Diffusion Tube
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
PM ₁₀	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
PM _{2.5}	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO ₂	Sulphur Dioxide

References

- (1) http://www.scottishairquality.scot/latest/site-info?site_id=STRL
- (2) http://www.scottishairquality.scot/latest/site-info?site_id=STRL&view=statistics
- (3) <https://laqm.defra.gov.uk/technical-guidance/index.html?d=Chapter7>
- (4) <https://laqm.defra.gov.uk/bias-adjustment-factors/bias-adjustment.html>
- (5) 2022 Air Quality Annual Progress Report for Stirling Council