Annual Progress Report (APR)

Falkirk Council

2019 Air Quality Annual Progress Report (APR) for
Falkirk Council

In fulfilment of Part IV of the
Environment Act 1995

Local Air Quality Management

June 2019

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Executive Summary: Air Quality in Our Area

Air Quality in Falkirk Council

In 2018, the air quality within the Falkirk Council area continued to be good from 2017.

Falkirk Council air quality monitoring results for all pollutants measured have shown a slight increase in National Air Quality Strategy (NAQS) objective exceedances from results recorded in 2017 for certain pollutants. There were no national NAQS objective exceedances in 2017 however, there were three in 2018.

Specifically these were:

One exceedance of the nitrogen dioxide (NO_2) NAQS (annual mean) objective limit (40µg/m^3) at a (non-automatic) diffusion tube location: NA27 Falkirk West Bridge St (44µg/m^3).

Two exceedances of the *estimated* (see Appendix C for details) particulate matter ($PM_{2.5}$) NAQS (annual mean) objective limit (10µg/m^3) recorded at fixed automatic locations: A5 Falkirk Hope Street (11µg/m^3) and A15 Main Street, Bainsford (12µg/m^3).

Falkirk West Bridge St is located within the Falkirk Town Centre Air Quality Management Area (AQMA) which was declared in 2011 in recognition of the potential to exceed NAQS objectives for NO_2 and Particulate Matter (PM_{10}). The Falkirk Town Centre Air Quality Management Action Plan (AQAP) was approved in June 2015 and focuses on long-term key point actions to reduce air pollution in the area rather than short-term fixes. Key measures outlined in the plan are:

- Reducing emissions from individual vehicles;
- Promoting the EcoStars Fleet Recognition Scheme;
- Promoting alternative and sustainable modes of transport;
- To educate and inform the public on air quality issues.

In 2018, Falkirk Council made significant progress in implementing these measures. For example, there are now forty electric vehicle (EV) charging bays throughout the Falkirk Council area with more planned in the upcoming year, an action which is helping to promote alternative modes of travel and help to achieve measures

included in Falkirk Council's Sustainable Development and Climate Change Strategy 2012 - 2017.

Plans for future upgrades of the EV charge network include:

- In 2018 / 19, Falkirk Council are installing an additional sixteen (7, 22, and 50kW) EV chargers which will be registered on the Charge Place Scotland website;
- The Low Carbon Vehicle Hub at Falkirk Stadium is due to open in October 2019, which will provide five 50kW chargers, eight 22kW chargers and include a photovoltaic (PV) charging canopy;
- Falkirk Council are planning to install a new 50kW charger at Larbert train station as part of improvement works to the station's car park;

The Falkirk Council vehicle fleet currently includes twenty seven electric cars and seven electric vans. This is a significant increase from 2017 in EV within the Council's ownership. There are plans to increase this EV fleet further in the future.

The Council are also promoting a variety of active and sustainable travel measures and schemes in 2018 / 19 to help reduce traffic emissions. Full details of the progress Falkirk Council is making towards the measures outlined in the Air Quality Action Plans can be seen in Section 2.2 of this report.

In 2018, all seven automatic NO_2 analysers within Falkirk Council's air quality monitoring network met both NO_2 NAQS objectives. The remaining sixty NO_2 (non-automatic) diffusion tubes in Falkirk Council's network met the NAQS objective.

Falkirk Council measured PM_{10} concentrations at eight locations during 2018. The NAQS objectives for PM_{10} were met at all eight locations. The PM_{10} analyser located at Falkirk Grahams Road was transferred to nearby Hope Street on the 10th October 2018.

The site with the highest annual mean PM_{10} concentration (but within the NAQS PM_{10} objective) was A4 Haggs (Roadside, 14µg/m^3). Over a five year period (from 2014 until 2018), all eight sites have recorded PM_{10} (annual mean) long-term reductions.

The A14 Banknock 3 monitoring site recorded the greatest number of PM_{10} daily exceedances (2) which is a slight increase from none recorded in 2017, however, this is within the NAQS limit (>50µg/m^3).

Over a five year period (from 2014 to 2018), all eight montioring sites have recorded PM_{10} (annual mean) concentration reductions. Of these eight sites, three have recorded PM_{10} (24-hr mean) reductions: A4 Falkirk Haggs (Roadside), A7 Falkirk West Bridge St (Roadside) and A13 Banknock 2 (Roadside). One site recorded an increased PM_{10} (24-hr mean) result: A14 Banknock 3 (Urban Background). Four sites have recorded the same PM_{10} (24-hr mean) concentrations: A8 Grangemouth AURN (Urban Background / Industrial), A10 Grangemouth Municipal Chambers (Urban Background / Industrial), A12 Falkirk Grahams Rd (Roadside) and A15 Main St, Bainsford (Roadside).

$PM_{2.5}$ is measured at three locations within the Falkirk Council area, these are: A7 Falkirk West Bridge St (Roadside), A8-Grangemouth AURN (Urban Background / Industrial) and A13-Banknock 2 (Roadside). During 2018 there were no exceedances of the $PM_{2.5}$ Scottish NAQS objective (10µg/m^3) at any of the three monitoring sites.

Two sites (A7 Falkirk West Bridge St and A13 Banknock 2) recorded the same annual mean $PM_{2.5}$ concentration (6µg/m^3). A8 Grangemouth AURN site recorded a concentration of 7µg/m^3. The $PM_{2.5}$ concentrations at the Grangemouth AURN site have gradually reduced from 9.2µg/m^3 in 2015 to 6µg/m^3 in 2016 and 2017. 2018 saw a marginal increase to 7µg/m^3 however, this concentration remains reasonably low and within the NAQS objective limit. This reduction may be may be attributed to the commisioning of the tail gas treatment (TGT) unit at the INEOS Grangemouth complex in 2013. Since the commissioning of the TGT unit, SO_2 concentrations have reduced within the Grangemouth AQMA. As sulphate species are known to contribute towards the formation of secondary $PM_{2.5}$, a reduction in SO_2 could also impact local $PM_{2.5}$ concentrations.

The $PM_{2.5}$ estimations indicate that two sites: A5 Falkirk Hope Street (11µg/m^3) and A15 Main Street, Bainsford (12µg/m^3) exceeded the NAQS objective limit of 10µg/m^3. The $PM_{2.5}$ concentrations are estimated using a local correction factor as per LAQM.TG (16)[Ref 1] based on continuous PM_{10} data. See Appendix C for further details.

In 2018, Falkirk Council monitored sulphur dioxide (SO_2) at six locations. Four of the sites are located within the Grangemouth (15-minute) AQMA and two of the sites are located outwith the AQMA. There were no exceedances of the SO_2 objectives (15-

minute, hourly or daily) recorded at any of the Falkirk Council monitoring locations during 2018.

The site that recorded the only exceedance of the 15-minute NAQS objective during 2018 was A9 Grangemouth Moray (1). No other SO_2 exceedances were recorded at any of the other sites during 2018.

This is the fifth consecutive year that no breaches of the SO_2 objectives (15-minute, hourly or daily) have been recorded at any site in the Grangemouth AQMA. It is important to stress that although there was an exceedance of the 15-minute NAQS objective concentration, the number of exceedances were below the maximum permitted by the respective NAQS objective.

The Grangemouth Emission Study 2018 / 19 which is being completed by Sweco is currently being prepared and expected to be published in late summer 2019. The study report will include a review and assessment of the Grangemouth AQMA.

The benzene and 1, 3-butadiene diffusion tube monitoring conducted in 2018 met the NAQS (annual running mean) objectives for each pollutant respectively.

Actions to Improve Air Quality

Falkirk Council made significant improvements to its air quality monitoring network during 2018. These improvements included upgrading the Grangemouth AURN PM_{10} and $PM_{2.5}$ analysers from R&P 1400 TEOM analysers to Met One 1020 Beta Attenuation Monitors (BAM). This was shortly followed by an upgrade to the NO_x and SO_2 continuous analysers at the Grangemouth AURN site. See Photos 1 and 2 for equipment upgrade details.

Photo 1 – Met One 1020 PM_{10} and $PM_{2.5}$ BAMs at the Grangemouth AURN Site

The NO_x analyser was upgraded from a MLME Monitor Europe 'Evo' Series to an API Teledyne T200 model. The SO_2 analyser was upgraded from a MLME Monitor Europe 'Evo' Series to an Ecotech Serinus 50 model. The equipment upgrades completed at the Grangemouth AURN were required as certain manufacturer (Monitor Europe) parts are being discontinued in the coming years and the new analysers will utilise the latest technology which should increase accuracy and data capture rates (through using readily available spare parts).

Photo 2 – API Teledyne T200 (NO_x) and Ecotech Serinus 50 (SO_2) Analysers at the Grangemouth AURN Site

The PM_{10} (R&P 1400 TEOM) analyser that was located at the Falkirk Grahams Road site was transferred to the nearby Falkirk Hope St site on 10th October 2018. It was decided that the PM_{10} monitoring location was more prominent (for monitoring road traffic emissions) if housed within the nearby Falkirk Hope Street site. The Falkirk Grahams Road roadside site was subsequently decommissioned and removed from street level on 11th March 2019, this network change should increase efficiency through reduced energy use.

Multiple Falkirk Council monitoring sites had the sample inlet roof cages replaced with new units. Improved weather protection and aesthetics were achieved after cage installations at the following sites: A5 Falkirk Hope St, A7 Falkirk West Bridge St, A8 Grangemouth AURN, A10 Grangemouth Municipal Chambers, A11 Grangemouth Zetland Park and A13 Banknock 2.

It is anticipated that there will be an upgrade to the PM_{10} analyser at Grangemouth Municipal Chambers in 2019 to include the functionality to measure $PM_{2.5}$, details of this upgrade will be provided in the 2020 Annual Progress Report (APR).

In the year 2018 / 19 Falkirk's ECO Stars fleet scheme has grown significantly from one hundred and fifty six members to two hundred and eight members. Falkirk's ECO

Stars taxi scheme has a small but engaged membership of seven members. ECO Stars membership consists of operators located within the Falkirk Council local authority area as well as those whose depot is located outwith the Council boundary but operate vehicles within that area; all of these operators have an impact on local air quality. In the past year local membership has grown, with notable fleets such as Scottish Gas Networks and Mackie's Coaches joining the scheme. In addition Falkirk Council has been working closely with fellow members of the East Central Scotland Vehicle Emissions Partnership (ECSVEP) to work to the objectives set out in the Scottish Government's Cleaner Air for Scotland (CAFS). Air Quality Action Plan (AQAP) funding has been provided to continue the operation of the Falkirk EcoStars scheme (Fleet Operators and Taxis) during 2018 / 2019.

Falkirk Council also continues to work closely with its partner organisations to manage local air quality issues. The council works closely with SEPA, INEOS and Petroineos to reduce exceedances of the SO_2 objectives within the Grangemouth AQMA.

Local Priorities and Challenges

Education and Awareness of Air Quality Issues

In 2019, Falkirk Council will be developing our engagement with locals through promotion of air quality education resources such as the 'Learn About Air' teaching package, the Clean Air Day in Scotland and working closer with the Transport Planning department on promoting alternative / sustainable local transport solutions.

Low Emission Zones

Low Emission Zones (LEZ) are being planned and operated in the four major Scottish cities: Glasgow, Edinburgh, Aberdeen and Dundee over the next few years. There are no current plans for any form of LEZ in the Falkirk Council area. Falkirk Council will be undertaking the 'Stage 1 Screening Exercise (clause 2.2.25)' assessment in late 2019 in accordance with the National Low Emissions Framework to inform this process.

How to Get Involved

To obtain further information on air quality within the Falkirk Council area, please visit our air policy webpage at

http://www.falkirk.gov.uk/services/environment/environmental-policy/air-quality/

There are twelve automatic air quality monitoring sites across the Falkirk Council area. The monitoring data from all of the sites can be viewed on the Scottish Air Quality website at:

http://www.scottishairquality.co.uk/latest/summary?view=la

To learn more about the EcoStars Fleet Recognition Scheme and for details of how to join if you are a commercial fleet operator please visit:

https://www.ecostars-uk.com/eco-stars-schemes/

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1. Local Air Quality Management

This report provides an overview of air quality in Falkirk Council 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 Progress Report (APR) is summarises the work being undertaken by Falkirk 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		Date to be achieved by
	Concentration	Measured as	
Nitrogen dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	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
	18 µg/m^3	Annual mean	31.12.2010
Particulate Matter ($PM_{2.5}$)	10 µg/m^3	Annual mean	31.12.2020
Sulphur dioxide (SO_2)	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	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
Lead	0.25 µg/m^3	Annual Mean	31.12.2008

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 must prepare an Air Quality Action Plan (AQAP) within 12 months, setting out measures it intends to put in place in pursuit of the objectives.

A summary of the AQMAs declared by Falkirk Council can be shown in Table 2.1.

Further information related to declared or revoked AQMAs, including maps of AQMA boundaries are available online at https://uk-air.defra.gov.uk/aqma/local-authorities?la_id=371 – see full list at https://uk-air.defra.gov.uk/aqma/list.

The monitoring data so far indicates that the NAQS objectives for both NO_2 and PM_{10} are being met and for this reason Falkirk Council will not be declaring Main Street, Bainsford an AQMA. It is noted that in 2018 the estimated annual mean $PM_{2.5}$ objective concentration of 10µg/m^3 was exceeded at the Main St, Bainsford location. As this result is an estimation based on the automatic PM_{10} monitoring results, further continuous automatic monitoring will be undertaken and reviewed to ensure compliance with the future NAQS objectives.

The Banknock AQMA (PM_{10} 24-hr and annual mean) revocation summary report has been drafted and will be progressed by Falkirk Council in 2019. If the decision to revoke the Banknock AQMA is made it is likely that the Palas Fidas 200 particulate analyser will be transferred to a more appropriate monitoring location such as the Main St, Bainsford roadside site (due to 2018 $PM_{2.5}$ estimated result exceedance).

Monitoring data for 2018 has highlighted that the Haggs AQMA will be reviewed in 2019 as the site continues to meet the NAQS objectives.

Sweco have been commissioned by Falkirk Council to complete the Grangemouth Emissions Study 2018/19, it is anticipated this will be published late 2019. The report will include a review of the Grangemouth AQMA.

Table 2.1 – Declared Air Quality Management Areas

AQMA Name	Pollutants and Air Quality Objectives	City / Town	Description	Action Plan
Falkirk Town Centre	NO_2 annual mean PM_{10} 24-hour mean and annual mean	Falkirk	An area encompassing an area of Falkirk Town Centre	Air Quality Action Management Plan (Falkirk Town Centre and Haggs) 2015 Air Quality Management Action Plan (Falkirk Town Centre and Haggs) June 2015
Banknock	PM_{10} 24-hour mean and annual mean	Banknock	An area encompassing an area within Banknock, Falkirk	Air Quality Action Management Plan (Banknock)
Haggs	NO_2 annual mean	Haggs	An area that connects Banknock and Haggs around the road junction of the A803 and M80	Air Quality Management Plan (Falkirk Town Centre and Haggs) 2015 Air Quality Management Action Plan (Falkirk Town Centre and Haggs) June 2015
Grangemouth	SO_2 15-min mean	Grangemouth	An area encompassing the Grangemouth industry areas, shipping port and adjacent residential areas	Air Quality Action Plan Update (Grangemouth) 2009 Available on request

2.2 Progress and Impact of Measures to address Air Quality in Falkirk Council

Falkirk Council has taken forward a number of key measures during the current reporting year of 2018 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.3. Further details on these key measures can be found in the Air Quality Action Plans relating to each AQMA.

Key completed measures during 2018 include:

Measure 3: Improved (Publically Accessible) Air Quality Information

Falkirk Council has reinstated the public display unit (PDU) at their Abbotsford House reception area. This PDU displays current local and national air quality information to users of the building as well as providing an information display area for relevant, linked campaigns such as Clean Air Day for Scotland and Falkirk Council's Take the Right Route. See Photo 3 for details.

Photo 3: PDU Located in Falkirk Council Abbotsford House Reception Area

Measure 3: Improved Public Air Quality Information (cont.)

All Falkirk Council air quality stations have new mobile phone QR code posters displayed on their external walls for public (air quality specific) information access. The posters have been installed in prominent air quality station locations for ease of information access. See Photo 4 for details.

Photo 4: Falkirk West Bridge St Mobile Phone QR Code Posters

Measure 5: Electric Vehicles (EV) and Plug-ins

EV charging points located at Council depots and public places throughout the region can be shown in Table 2.2.

Table 2.2 Electric Vehicle Charging Points at Council Depots / Public Places in the Falkirk Council Area

Location	Type	Number of Bays	Available to the Public?
Municipal Buildings, West Bridge Street, Falkirk FK1 5RS	2 x 7kW	4	No
Abbotsford House, David's Loan, Falkirk, FK2 7YZ	1 x 7kW	2	No
Dalgrain Depot, McCafferty Way, Grangemouth, FK3 8EB	1 x 7kW 1 x 50kW	2 1	No
Inchyra Depot, Inchyra Road, Grangemouth, FK3 9XB	2 x 7kW	4	No
Larbert Railway Station, Foundry Loan (East), Larbert, FK5 4PJ	1 x 22kW	2	Yes
Grahamston Railway Station, Meeks Road, Falkirk, FK2 7EZ	1 x 50kW	2	Yes
Town House Street, Denny, FK6 5DX	1 x 22kW	2	Yes
Union Road Car Park, Grangemouth, FK3 8AB	1 x 22kW	2	Yes
Falkirk Stadium, 4 Stadium Way, Falkirk, FK2 9EE	2 x 22kW 1 x 50kW	4 2	Yes
Davies Row, Denny	1 x 22kW	2	Yes
Herbertshire Castle Park, Dunipace	1 x 22kW	2	Yes
Garrison Place (West), Falkirk	1 x 7kW 1 x 50kW	2 2	Yes
Grangemouth Sports Complex, Grangemouth	1 x 22kW	2	Yes
Hallam Road, Stenhousemuir	1 x 22kW	2	Yes
James St, Laurieston	1 x 7kW	2	Yes
Meeks Road, Falkirk	1 x 50kW	2	Yes
Melville St, Falkirk	1 x 22kW 1 x 50kW	2 2	Yes
Polmont Station, Polmont	1 x 22kW	2	Yes
Union St, Bo'ness	1 x 22kW 1 x 50kW	2 2	Yes
Mariner Centre, Camelon	1 x 7kW	2	Yes

The EV charge points located throughout the Falkirk Council area can be viewed using the following link:

https://www.chargeyourcar.org.uk/

The following chargepoint locations are planned to be installed for 2019/20 in the Falkirk Council area:

Table 2.3 Electric Vehicle Charging Points Planned in 2019/20

Location	Type	Number of Bays	Available to Public?
Forth Valley College, Falkirk	1 x 22kW	2	Yes
Union Road, Grangemouth	1 x 7kW 1 x 22kW 1 x 50kW	2 2 2	Yes
Abbotsgrange Road, Grangemouth	1 x 22kW 1 x 50kW	2 2	Yes
Baird Street, Camelon	1 x 22kW	2	Yes
Seaview Place, Bo'ness	1 x 22kW	2	Yes
Bo'ness Recreation Centre, Bo'ness	1 x 22kW	2	Yes

Falkirk Council will be planning to open a new Low Carbon Vehicle Hub within the grounds of the Falkirk Stadium in October 2019. The hub will provide five 50kW and eight 22kW EV chargers for public use. The hub will utilise a solar photovoltaic (PV) roof to aid the low carbon power generation at the site.

A 50kW charger is also planned to be installed by Falkirk Council at Larbert train station car park in 2019.

Falkirk Council has applied for Transport Scotland's Switched on Towns and Cities Travel Fund which (if approved) will provide additional EV chargepoints throughout the region thus increasing and extending the overall capacity for network users.

The Air Quality team within Falkirk Council Environmental Health department received a new Renault Kangoo ZE fully electric van in June 2019 for LAQM related work. Further details on this EV will be provided in the 2020 APR.

Measure 11: Take the Right Route / Promotion of Alternative Travel

Falkirk Council's Take the Right Route completed the following local initiatives in 2018:

Abbotshaugh Bridge – Public Opening Event – 19th June 2018

A £842,000 cycle and pedestrian bridge was installed over the River Carron connecting the local communities of Langlees, Bainsford, Carron and Carronshore. The new bridge will also form part of the wider 'Helix' path network. The bridge was funded through Falkirk Council, Sustrans and the European Union (EU). A wild flower planting project was completed by four local schools with one hundred and ten pupils planting two hundred and fifty wild flowers near the new bridge. One hundred and twenty green travel maps were issued to participants to make them aware of the local walking and cycling path network.

Community Engagement Project - Maddiston Community Council

Falkirk Council worked with Maddiston Community Council to promote local walking and cycling path networks and highlighting local facilities. Nine granite way markers depicting the scenery of Maddiston were installed March 2018. Five hundred bike lights were issued to those who took part in project. This project helped encourage more walking and cycling for recreation and utility trips in the Maddiston area.

Forth Valley Royal Hospital Cycling Festival

Event to highlight benefits of cycling to visitors and users of the Forth Valley Royal Hospital was completed by Falkirk Council in September 2018. This included led local cycle rides, provision of sustainable travel information and advice including partner working with Forth Environment Link (FEL), the Forestry Commission, Get Out Get Active, Bells on Bikes, Recyke a Bike, Free Wheel and Sustrans.

Measure 12: Bike Hire Scheme

Forth Bike (in conjunction with Forth Environment Link) operates an electric bike hire scheme within the Falkirk and Stirling areas utilising the local path network. The Forth Bike system currently includes over one hundred electric pedal assist 'Pedelec' bikes distributed between their four local stations: the Falkirk Wheel, the Helix, Forth Valley Royal Hospital, and the University of Stirling.

The scheme operates using a smart phone app to aid in the selection of the electric bikes from one of the local stations. The user then rents the bike for the amount of time they require for their journey. The bikes can be picked up and dropped off any of the above stations. Further information can be found at: https://www.forthbike.co.uk/. The 'Pedelec' bikes can be shown in Photo 5.

Photo 5: Forth Bike 'Pedelec' Electric Bike

Measure 13: Soft Measures – Increased Falkirk Council Electric Pool Car Fleet

Falkirk Council has significantly increased their EV fleet in 2018. The Council now currently owns:

- Twenty seven electric cars (such as Kia Soul and Renault Zoe models); and
- Eight electric vans (such as Nissan e-NV200 and Renault Kangoo ZE models)

Photo 6 – Example of an EV Kia Soul located at Falkirk Council's Abbotsford House

Table 2.4 – Progress on Measures to Improve Air Quality

Meas No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date	Comments
1	Improving SO_2 data access	Public Information	Supplying SO_2 monitoring data to SEPA, Petroineos, INEOS and other interested organisations.	Falkirk Council	2013	2013	AQ Objectives met in 2013, 2014 and 2015.	Anticipated reduction in SO_2 concentration/ breaches of NAQS objectives.	Data sent after Grangemouth SO_2 exceedances- monthly summary reports sent with ongoing totals.	Completed and ongoing.	
2	Grangemouth Working Group	Policy Guidance and Development Control	Bringing together: Petroineos, INEOS, S.Gov, SEPA and Falkirk Council.	Falkirk Council	2013	2013	AQ Objectives met in 2013, 2014 and 2015.	Reduction in SO_2 due to cooperative working and agreement of priorities.	Completed. TGU fully commissioned in August 2013, meeting held in November 2013. Further meeting only if breach of objective occurs.	Completed.	

Meas No.	Measure	Category	Focus	Lead Authority	Plannin -g Phase	Impleme- ntation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completio- n Date	Comments
3	Text Alert System	Public Information	Real-time notification of exceedances by SMS and Email.	Falkirk Council	2013	2013	Text alerts received by Falkirk Council, SEPA, Petroineos and INEOS when an NAQS objective exceedance occurs within the Grangemouth AQMA.	Anticipated reduction in SO_2 NAQS objective exceedances due to real time alerts of exceedances supplied to SEPA, Petroineos and INEOS so action to rectify any plant emission / process issues can be addressed.	Completed and on-going.	Completed in 2013 / Upgraded in 2018	Rather than a text alert system linked to individual analysers this system has been upgraded in 2018 to incorporate the Council's data collection system and can be used for any measured pollutant.
4	Review Monitoring Network	Public Information	Grangemouth Moray SO_2 in Scottish Air Quality Network (SAQN). Monitoring conducted in Grangemouth Zetland Park.	Falkirk Council	Falkirk Park St ceased operation in April 2014. Zetland Park commen ced operation April 2015.	2014 and 2015	All Grangemouth automatic monitoring sites are affiliated with the SAQN.	Affiliation with the SAQN increases data capture allowing better comparison to the NAQS objectives.	Completed. In addition the Bo'ness, Falkirk Graham's Rd and Main St, Bainsford stations were affiliated to the SAQN in 2016.	Completed.	

Meas No.	Measure	Category	Focus	Lead Authority	Plannin -g Phase	Impleme- ntation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completio- n Date	Comments
5	Electric Vehicles and Plug-ins	Promoting Low Emission Transport	Cars / Fleet	Falkirk Council	2012	2012 and on-going	Charging points at Falkirk Council depots	Anticipated reduction in NO_X and PM emissions due to increased use of electric vehicles.	In 2018, the EV charging point bays increased from 27 to 40. These are located at depots and public places across the Falkirk Council area. Falkirk Council also purchased an additional 20 EVs for it's fleet in 2018 making a total of 27 electric pool cars and 8 electric pool vans available for use by Council staff.	Completed and on-going	The Air Quality team within the Env. Health Department at Falkirk Council have received a new fully electric Renault Kangoo ZE van in June 2019 – further details will be provided in the 2020 APR.
6	Eco-advanced Driver Training	Promoting Low Emission Transport	All types of vehicle, fuel use and emissions	Falkirk Council	2014	2015	Offered to Council services by fleet	Anticipated reduction in NO_X and PM emissions due to promotion of efficient driving practices.	Offered to Council services by fleet.	Completed and on-going training offered.	

Meas No.	Measure	Category	Focus	Lead Authority	Plannin-g Phase	Impleme-ntation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completio-n Date	Comments
7	Review of School Bus Contracts with View to Raising EURO Engine Standards	Vehicle Fleet Efficiency	Buses	Falkirk Council	2017	2020	n/a	Anticipated reduction in NO_X and PM emissions from buses operating within the Falkirk Council area.	Meetings to be arranged in 2019 with Public Transport Co-ordinator and Procurement Services to discuss the feasibility of raising the EURO standards for local and school bus contracts from 2020 onwards.	2020	
8	Improvements of Traffic Lights at Bankside	Transport Planning and Infrastructur e	Congestion	Falkirk Council	2013	2014	n/a	Anticipated reduction in NO_X and PM emissions due to traffic queue reduction at Bankside traffic lights.	Completed.	Completed.	
9	Feasibility Study of Haggs Infrastructure Changes	Transport Planning and Infrastructur e	Congestion	Falkirk Council	Dependent on developer contributions and planning applications.	Dependent on developer contributions and planning applications.	n/a.	Anticipated reduction in NO_X and PM emissions.	Dependent on developer contributions and planning applications.	Dependent on developer contributions and planning applications. Future action.	

Meas No.	Measure	Category	Focus	Lead Authority	Plannin -g Phase	Impleme- ntation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completio- n Date	Comments
10	Feasibility study of West Bridge St and Town Centre Traffic Management Changes (speed limits, TROs etc.)	Transport Planning and Infrastructur e	Congestion	Falkirk Council	n/a	n/a	n/a	Anticipated reduction in NO_X and PM emissions.	This measure was linked to a planning application to build new council offices at Falkirk Town Centre Municipal Buildings. However, this project is still being decided upon. However, traffic signals along West Bridge St have been altered to improve traffic flows.	Completed	
11	Take the Right Route / Walk to School & School Travel Plan Pack	Promote Travel Alternatives	Car travel	Falkirk Council	2009	2013 and ongoing	Scheme in place and publicly advertised on Falkirk Council website.	Anticipated reduction in NO_X and PM emissions due to an increase in green travel such as walking and cycling.	In 2018 Take the Right Route continually promoted across the Falkirk Council area with on street interviews, online campaigns, bus and newspaper advertising and leaflets distributed.	Completed and on-going.	

Meas No.	Measure	Category	Focus	Lead Authority	Plannin -g Phase	Impleme- ntation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completio- n Date	Comments
12	Bike Hire Scheme	Promote Travel Alternatives	Mode transfer	Falkirk Council	2016	2018	Unknown	Anticipated reduction in NO_X and PM emissions due to an increase in green travel alternatives.	Forth Bike (in conjunction with Forth Environment Link) operates an electric bike hire scheme within the Falkirk and Stirling area The Forth Bike system currently includes over one hundred electric pedal assist (Pedelec) bikes spread between their four local stations: the Falkirk Wheel, the Helix, Forth Valley Royal Hospital, and University of Stirling.	Completed. Forth Bike scheme established and running in 2018. Expansion of the scheme expected in future years.	

Meas No.	Measure	Category	Focus	Lead Authority	Plannin -g Phase	Impleme- ntation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completio- n Date	Comments
13	Soft Measures e.g. travel planning (larger employers, schools), journey sharing, changes to mileage, home and mobile working.	Promote Travel Alternatives	Variety	Falkirk Council	2006	2014	Development of Travel Plans	Anticipated reduction in NO_X and PM emissions due to promotion of travel alternatives.	Increased fuel efficient and electric pool car vehicles for staff use as part of Council's travel plan Operational car sharing database for Falkirk Council area.	On-going	
14	Consideration of Air Quality in Local Development Plan	Policy Guidance and Developmen t Control	Development	Falkirk Council	2015	2015	Air quality policy statement in local development plan	Air Quality Assessment required for developments within AQMAs.	Air quality policy statement in plan.	Completed	
15	Appropriate Air Quality Monitoring in AQMAs.	Public Information	Improving data capture.	Falkirk Council	2005	2005	Good data capture (90%) in AQMAs	Good data capture will allow strict comparison of PM_{10}, $PM_{2.5}$, SO_2, NO_X concentrations against the NAQS objectives.	Monitoring maintained in AQMAs. Equipment upgrades completed during 2018.	Completed and on-going	

Meas No.	Measure	Category	Focus	Lead Authority	Plannin -g Phase	Impleme- ntation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completio- n Date	Comments
16	Promotion of ECO Stars	Vehicle Fleet Efficiency	Commercial vehicles, taxis and private hire cars.	Falkirk Council	2013	2013 and on-going	The latest Falkirk Eco Stars report shows that recruitment in Falkirk is over target with 84 members operating 4060 vehicles	Anticipated reduction in NO_X and PM emissions due to promotion of efficient driving practices.	During 2018, reference to EcoStars is now included in the tender specification for Falkirk Council Adult and Children's Service passenger transport. Member meetings were held regularly during 2018.	On-going	
17	Review of Park and Ride Facilities	Transport Planning and Infrastructur e	Cars	Falkirk Council	2017	2018	Unknown at time of writing.	Anticipated reduction in NO_X and PM emissions.	There is currently no progress in taking forward any new bus park and ride facilities. However, additional parking has been created at Falkirk High and Larbert train stations to help improve park and ride facilities.	Completed and on-going	

Meas No.	Measure	Category	Focus	Lead Authority	Plannin-g Phase	Impleme-ntation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completio-n Date	Comments
18	Taxi Licensing	Vehicle Fleet Efficiency	Taxis	Falkirk Council	2013	2015	Increase in taxi services signed up to Eco Stars Scheme.	Anticipated reduction in NO_X and PM emissions due to promotion of efficient driving and vehicles.	Changes to licensing in May 2013 and Eco Stars extended to taxis and private hire cars.	On-going	
19	Vehicle Emissions Partnership (testing and idling) - enforcement and fines rather than raising awareness.	Promoting Low Emission Transport	Cars	Falkirk and other neighbouring authorities.	2012	2012 and on-going	Maintain membership of the partnership.	Anticipated reduction in NO_X and PM emissions through anti-idling enforcement.	The ESVEP continues to assist in promoting anti idling in the Falkirk Council area. Improvements of the associated 'Switch Off and Breathe' website have taken place.	On-going subject to annual funding allocation.	16/06/2019: Installation of new, more prominent Anti Idling signs on Upper Newmarket Street, Falkirk to remind bus / taxi drivers to minimise idling on this street.

Meas No.	Measure	Category	Focus	Lead Authority	Plannin-g Phase	Impleme-ntation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completio-n Date	Comments
20	Introduce Quality Bus Corridors	Transport Planning and Infrastructur e	Buses	Falkirk Council	2017	On-going depending on funding to complete the scheme.	Unknown	Anticipated reduction in NO_X and PM emissions through improved public transport.	The Council has secured areas of land along the A803 Glasgow Road corridor in Camelon. In addition to this the Council has updated the traffic signals on the B902 Grahams Road corridor to "intelligent" traffic signals which better manage the flows of traffic increasing green time along the main corridor, the knock on effect of this improves bus journey times into the town centre.	2030	

2.3 Cleaner Air for Scotland

Cleaner Air for Scotland – The Road to a Healthier Future (CAFS) is a national cross-government strategy that sets out how the Scottish Government and its partner organisations propose to reduce air pollution to protect human health and fulfil Scotland's legal responsibilities as soon as possible. A series of actions across a range of policy areas are outlined, a summary of which is available at https://www.gov.scot/Publications/2015/11/5671/17. Progress by Falkirk Council against relevant actions within this strategy is demonstrated below.

2.3.1 Transport – Avoiding travel – T1

All local authorities should ensure that they have a corporate travel plan (perhaps within a carbon management plan) which is consistent with any local air quality action plan. Falkirk Council has a local transport strategy published in 2014 entitled Falkirk Council Local Transport Strategy. This strategy sets out the Council's overall transport vision. This includes objectives directly related to providing sustainable transport options such as encouraging more travel by foot / bicycle / rail, and ensuring new transport infrastructure is delivered to support sustainable travel choices.

Falkirk Council has an active travel scheme which promotes alternative transport methods to car. Projects completed with local communities in 2018 include:

- Take the Right Route: utilising online marketing campaigns, extensive local bus / newspaper / business advertising, social media presence with market research feedback concluded;
- Provision of public static bike pumps: five static bike pumps installed at following locations: Helix Plaza, Kelpies Visitor Centre, Falkirk Town Centre, Stenhousemuir Town Centre, and Bo'ness Town Centre;
- Local School Travel Plans: Four schools identified for 'Daily Mile Tracks': Shieldhill Primary, Avonbridge Primary, California Primary and Drumbowie Primary. 'Daily Mile Tracks' delivered to encourage walking as part of the school day;
- Kelpies to Kick Off: Community walking event that takes participants around Helix Park / Kelpies and finishes at Falkirk Football Stadium. Participants get

a free ticket and pie voucher for the Falkirk football match, which starts at 3pm on the day;

- Falkirk Active Travel Hub (Forth Environment Link) is located in Falkirk town centre and is open to the public to increase awareness of active travel throughout the region, more information can be found using the above link.

2.3.2 Climate Change – Effective co-ordination of climate change and air quality policies to deliver co-benefits – CC2

Scottish Government expects any Scottish local authority which has or is currently developing a Sustainable Energy Action Plan to ensure that air quality considerations are covered. Falkirk Council has a Sustainable Development and Climate Change Strategy 2012 - 2017. The strategy refers to air quality considerations throughout the document. Plans are being made by the Council to update this strategy in 2019.

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 been completed and how local concentrations of the main air pollutants compare with the NAQS objectives.

Falkirk Council undertook automatic (continuous) monitoring at twelve sites during 2018. Table A.1 in Appendix A shows the details of the sites. National air quality monitoring results are available at http://www.scottishairquality.scot/.

Maps showing the location of the air quality monitoring sites are provided in Appendix A, Figure 26. Further details on how the analysers are calibrated and how data has been adjusted are included in Appendix C.

3.1.2 Non-Automatic Monitoring Sites

Falkirk Council undertook non-automatic (passive) monitoring of NO_2 at sixty one sites during 2018. Table A.2 in Appendix A shows the details of the NO_2 sites.

Falkirk Council also undertook non-automatic (passive) monitoring of 1, 3 butadiene at three sites during 2018. Table A.9 in Appendix A shows the details of the 1, 3 butadiene sites.

In addition, Falkirk Council also undertook non-automatic (passive) monitoring of benzene at sixteen sites during 2018. Table A.10 in Appendix A shows the details of the benzene sites.

Further details on Quality Assurance / Quality Control (QA/QC) and bias adjustment for the NO_2 diffusion tubes are included in Appendix C.

3.2 Individual pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for annualisation and bias. Further details on data 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 five years with the NAQS objective of 40µg/m^3.

For NO_2 diffusion tubes, the full 2018 dataset of monthly mean values are provided in Appendix B.

Table A.4 in Appendix A compares the ratified continuous monitored NO_2 hourly mean concentrations for the past five years with the NAQS objective of 200µg/m^3, not to be exceeded more than eighteen times per year.

NO_2 Automatic Analyser Fixed Station Results

The 2018 monitoring results (as displayed in Tables A.3 and A.4) show that all seven automatic NO_2 analysers in Falkirk Council's network met both NO_2 NAQS objectives. The highest NO_2 annual mean result in 2018 was recorded at Falkirk West Bridge St site (39µg/m^3) this has increased from 2017's result (36µg/m^3). The lowest result was recorded at the Grangemouth AURN site (14µg/m^3) - this has remained at the same concentration as 2017's result. Overall, most fixed station's NO_2 concentrations have remained the same as 2017's results however some sites have seen a marginal increase. The last exceedance in relation to NO_2 annual mean concentration was recorded in 2014 at the Falkirk West Bridge Street site (41µg/m^3).

Over a five year period (from 2014 to 2018), five sites have recorded NO_2 concentration reductions: A4 Haggs, A5 Hope St, A7 Falkirk West Bridge St, A8 Grangemouth AURN and A10 Grangemouth Municipal Chambers. Two sites have recorded increased NO_2 concentrations: A9 Grangemouth and A15 Main St, Bainsford.

Long term NO_2 trend graphs are shown in Appendix A, Figures 1 to 7. There is an overall downward trend in NO_2 (annual mean) concentrations at the following sites: A4 Haggs (Figure 1), A5 Falkirk Hope St (Figure 2), A8 Grangemouth AURN (Figure 4) and A10 Grangemouth Municipal Chambers (Figure 6). A7 Falkirk West Bridge Street (Figure 3) trend has largely remained at the same level. A9 Grangemouth Moray (Figure 5) and A15 Main St, Bainsford show an overall upward increase in NO_2 (annual mean) concentrations.

Likely contributing factors to the reduction in NO_2 concentrations at the above sites include traffic light timing amendments (on Falkirk West Bridge Street) to minimise congestion and idling, road upgrades (M80 at Haggs) and speed limit enforcement measures (30mph on A803). Increased ownership of hybrid and electric vehicle may also have contributed to the overall NO_2 reduction. Likely contributing factors to the

increase in NO_2 at A9 Grangemouth Moray would be localised roadworks and frequent use of the car parks at the local schools near the monitoring station. At A15 Main St, Bainsford localised roadworks associated with increased building developments may have caused the increase in overall NO_2 concentrations.

Annual NO_2 Diffusion Tube Results

The 2018 annual NO_2 diffusion tube monitoring results (as displayed in Table A.3) show that one (non-automatic) NO_2 tube exceeded the NAQS objective of 40µg/m^3 at NA27 Falkirk West Bridge Street. The remaining sixty tubes in Falkirk Council's network met the objective.

Three diffusion tubes were close to the 40µg/m^3 annual limit with the highest concentrations recorded at the following sites: NA36 Kerr Crescent, Haggs, NA111 Falkirk West Bridge Street Air Quality Station and NA114 Glasgow Rd, Camelon. These tubes are all located at roadside locations, two of which are located within AQMAs (NA36 Haggs AQMA and NA111 Falkirk Town Centre AQMA).

Diffusion tube NA27 is colocated with the Falkirk West Bridge Street fixed monitoring station. This site contains an automatic NO_2 reference method (API Teledyne T200 – Chemiluminescence) analyser which has recorded an annual NO_2 concentration of 39µg/m^3 during 2018 which is comparable and representative (within the NAQS objective limit).

Historically, diffusion tube NA27 Falkirk West Bridge Street records a higher concentration than the automatic analyser despite the close proximity to one another. The most likely reason for a higher concentration at this location is that the automatic site is located further from the kerb than the NA27 tube and is therefore less exposed to traffic emissions.

The lowest NO_2 annual mean diffusion tube concentrations were recorded at the following locations: NA105 West of Shieldhill (Rural, 8µg/m^3) and NA113 Union St, Bo'ness (Urban Background / Industrial, 15µg/m^3).

In addition, the diffusion tubes are affected by several sources of interference which can cause substantial under or overestimation (often referred to as "bias") compared to the automatic chemiluminescence NO_2 reference analyser (defined within the EU as the reference method) [ref 1]. Due to this, NO_2 concentrations recorded using

diffusion tubes are typically of lower accuracy than that recorded by reference method using automatic (chemiluminescence) NO_2 analysers.

3.2.2 Particulate Matter (PM_{10})

Table A.5 in Appendix A compares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past five years with the NAQS objective of 18µg/m^3.

Table A.6 in Appendix A compares the ratified continuous monitored PM_{10} daily mean concentrations for the past five years with the NAQS objective of 50µg/m^3, not to be exceeded more than seven times per year.

Falkirk Council measured PM_{10} concentrations at eight locations during 2018. The Scottish NAQS objectives for PM_{10} were met at all eight locations. The PM_{10} (R&P 1400 TEOM) analyser that was located at the Falkirk Grahams Road site was transferred to the nearby Falkirk Hope Street site on 10th October 2018. It was decided that the PM_{10} monitoring location was more prominent and effective if housed within the nearby Falkirk Hope St site. The Falkirk Grahams Road roadside site was subsequently decommissioned and removed from street level on 11th March 2019.

The site with the highest recorded annual mean PM_{10} concentration in 2018 (but within the Scottish NAQS PM_{10} objective) was A4 Falkirk Haggs (Roadside, 14µg/m^3). Data capture was reasonable for this site at 89%.

The two sites with the lowest annual mean PM_{10} concentrations were: A7 Falkirk West Bridge Street (Roadside, 6µg/m^3) and A14 Banknock 3 (Urban Background, 6.9µg/m^3). Data capture rate was poor at the Falkirk West Bridge Street site at 67% and reasonable for the Banknock 3 site at 80%.

Over a five year period (from 2014 to 2018), all eight sites have recorded PM_{10} (annual mean) reductions. A selection of long-term trend graphs which show these PM_{10} reductions can be shown in Appendix A, Figures 8 to 13.

The A14 Banknock 3 monitoring site recorded the greatest number of daily exceedances (2) which is a marginal increase from 2017's result of none. Further investigation into the daily exceedances of the 24-hr Scottish NAQS objective indicated that localised garden maintenance activities were the likely cause. The full results are shown in Appendix A, Table A.6.

Over a five year period (from 2014 to 2018), three sites have recorded PM_{10} (24-hr mean) reductions: A4 Falkirk Haggs (Roadside), A7 Falkirk West Bridge Street (Roadside) and A13 Banknock 2 (Roadside). One site recorded increased PM_{10} (24-hr mean) result: A14 Banknock 3 (Urban Background). Four sites have remained at the same PM_{10} (24-hr mean) concentration: A8 Grangemouth AURN (Urban Background / Industrial), A10 Grangemouth Municipal Chambers (Urban Background / Industrial), A12 Falkirk Grahams Road (Roadside) and A15 Main Street, Bainsford (Roadside).

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 Scottish NAQS objective of 10µg/m^3.

$PM_{2.5}$ is measured at three locations within the Falkirk Council area, these are: A7 Falkirk West Bridge Street (Roadside), A8 Grangemouth AURN (Urban Background / Industrial) and A13 Banknock 2 (Roadside).

During 2018 there were no exceedances of the $PM_{2.5}$ Scottish NAQS objective (10µg/m^3) at any of the three monitoring sites.

Two sites (A7 Falkirk West Bridge St and A13 Banknock 2) recorded the same annual mean $PM_{2.5}$ concentration (6µg/m^3). The A8 Grangemouth AURN site recorded a concentration of 7µg/m^3. Data capture was good for the A8 Grangemouth AURN (92%) and A13 Banknock 2 (99%) sites but poor for the A7 Falkirk West Bridge Street (67%) site.

The $PM_{2.5}$ concentrations at the Grangemouth AURN site have gradually reduced from 9.2µg/m^3 in 2015 to 6µg/m^3 in 2016 and 2017. 2018 saw a marginal concentration increase to 7µg/m^3 however this concentration remains reasonably low and within the Scottish NAQS objective. This reduction may be may be attributed to the commissioning of the tail gas treatment (TGT) unit at the INEOS Grangemouth complex in 2013. Since the commissioning of the TGT unit, SO_2 concentrations have reduced within the Grangemouth AQMA. As sulphate species are known to contribute towards the formation of secondary $PM_{2.5}$, a reduction in SO_2 could also impact local $PM_{2.5}$ concentrations.

Long-term trend analysis has been completed on all three sites for $PM_{2.5}$ and can be shown in Appendix A, Figures 14 to 16. In general terms, there has been a long-term reduction in $PM_{2.5}$ concentrations at the Grangemouth AURN site since 2014 however, concentrations have remained stable at 6µg/m^3 for the A7 Falkirk West Bridge Street and A13 Banknock 2 sites since they were commissioned (2015 onwards).

To appraise compliance with the new $PM_{2.5}$ objective at locations that currently do not monitor $PM_{2.5}$ concentrations, Falkirk Council has applied locally derived correction factors of 1 (urban roadside), 0.58 (urban background / industrial) and 0.55 (non-urban roadside) following guidance set out in LAQM TG (16)[Ref1]. This methodology provides an estimation of $PM_{2.5}$ data from PM_{10} data where only one of the two metrics were available. For urban roadside sites the correction factor was derived using PM data from the A7 Falkirk West Bridge Street site, for the background / industrial sites the factor was derived using PM data from the A8 Grangemouth AURN site and for non-urban roadside sites the correction factor was derived using PM data from the A13 Banknock 2 site. For further details of these factors see Appendix C, Table C.1.

The $PM_{2.5}$ estimations indicate that all five sites where the correction factor was applied met the $PM_{2.5}$ annual mean objective in 2017. A10 Grangemouth Municipal Chambers recorded the highest estimated annual $PM_{2.5}$ concentration of 8µg/m^3. A15 Main Street, Bainsford recorded the second highest estimated annual concentration of 7.8µg/m^3. See Appendix A, Table A.12 for a full comparison of estimated $PM_{2.5}$ annual mean concentrations against the NAQS objective.

The $PM_{2.5}$ estimations indicate that two sites: A5 Falkirk Hope Street (11µg/m^3) and A15 Main Street, Bainsford (12µg/m^3) exceeded the NAQS objective limit of 10µg/m^3. Data capture was poor for the A15 Main Street, Bainsford site at 70%. Data capture was 20% for A5 Falkirk Hope Street however, the analyser was installed at this site (from the nearby A12 Falkirk Grahams Rd site) on 10th October 2018 so this low data capture rate was expected.

The remaining three monitoring sites where the $PM_{2.5}$ correction factor was applied met the NAQS objective in 2018. See Appendix A, Table A12 in for full comparison of estimated $PM_{2.5}$ annual mean concentrations against the Scottish NAQS objective.

3.2.4 Sulphur Dioxide (SO_2)

Appendix A, Table A8 compares the ratified continuous monitored SO_2 concentrations for 2018 with the NAQS objectives for SO_2.

In 2018, Falkirk Council monitored SO_2 at six locations. Four of the sites are located within the Grangemouth (15-minute NAQS objective) AQMA and two of the sites are located outwith the AQMA.

There were no exceedances of the SO_2 objectives (15-minute, hourly or daily) recorded at any of the Falkirk Council monitoring locations during 2018.

The site recording the only exceedance of the 15-minute NAQS objective during 2018 was at A9 Grangemouth Moray (1). No other SO_2 exceedances were recorded at any of the other sites during 2018.

This is the fifth consecutive year that no breaches of the SO_2 NAQS objectives (15-minute, hourly or daily) have been recorded at any site in the Grangemouth AQMA. It is important to stress that although there was an exceedance of the 15-minute NAQS objective, the number of exceedances were below the maximum permitted.

The Grangemouth Emission Study 2018 / 19 which has been contracted to Sweco is currently being prepared and expected to be published in late 2019. The study will include an assessment of the Grangemouth AQMA within this report.

Polar roses for the Grangemouth sites are shown in Appendix A, Figure 23, A) to F).

3.2.5 Carbon Monoxide, Lead and 1, 3-Butadiene

Carbon Monoxide

No monitoring undertaken.

Lead

No monitoring undertaken.

1, 3-Butadiene

In 2018, Falkirk Council monitored 1, 3-butadiene at three locations using passive diffusion tubes. All the results were within the NAQS objective and are shown in Appendix A, Table A.9. No changes have occurred since the submission of the previous APR.

Benzene

In 2018, Falkirk Council monitored benzene at sixteen locations using passive diffusion tubes. In addition, at the A8 Grangemouth AURN site, a pumped diffusion tube operates as part of the AURN network. The results from the passive diffusion tubes are shown in Appendix A, Table A.10 with the pumped diffusion tube results shown in Table A.11 in Appendix A.

All the benzene concentrations recorded by the passive diffusion tubes were within the NAQS objectives. Seven of the sixteen benzene diffusion tubes achieved 100% data capture (NA27, NA37, NA41, NA42, NA44, NA57 and NA80), five tubes achieving 91% (NA3, NA21, NA38, NA81 and NA94), and three achieving 83% (NA55, NA77 and NA105).

In 2018, the pumped diffusion tube at the A8 Grangemouth AURN site recorded an annual average concentration of 0.74µg/m^3. The concentration recorded continues to be within the relevant annual mean NAQS objective (of 3.25µg/m^3) and is a slight increase (of 0.09µg/m^3) compared to 2017's result (0.65µg/m^3).

4. New Local Developments

4.1 Road Traffic Sources

4.1.2 Narrow Congested Streets

There have been no changes from last year's APR. There are no new locations that are likely to be congested residential streets that have not been considered before or are not already in AQMAs.

4.1.3 Busy Streets

Falkirk Council has not identified any streets where pedestrians may spend one hour or more in close proximity to road traffic.

For info: the Falkirk Council automatic monitoring network recorded no exceedances of the hourly NO_2 NAQS objective concentration and there was one exceedance of the NO_2 non-automatic diffusion tube NAQS objective concentration of 40µg/m^3 at Falkirk West Bridge Street (44µg/m^3). The remaining NO_2 non-automatic diffusion tubes (across the Falkirk Council network) recorded 2018 annual concentrations of below 40µg/m^3.

4.1.4 Roads with a High Flow or Buses and / or HGVs

Since the closure of the Falkirk town centre bus station, additional buses are using Upper Newmarket Street. In anticipation of this increase in bus traffic, Falkirk Council have supplied additional NO_2 (diffusion tube) monitoring on Glebe St and worked with ECSVEP to locate more prominent anti-idling signs on Upper Newmarket Street.

4.1.5 Junctions

There were no new road junctions constructed during 2018 within the Falkirk Council area.

4.1.6 New Roads Constructed or Proposed

There were no new roads constructed or proposed during 2018 within the Falkirk Council area.

4.1.7 Roads with Significantly Changed Traffic Flows

There were no roads with significantly changed traffic flows during 2018 within the Falkirk Council area.

4.1.8 Bus or Coach Stations

The Falkirk town centre bus station was located adjacent to Meadow Street as indicated using this weblink, the station closed in August 2018 after many years of operation. Bus routes have been diverted via the Upper Newmarket St hub since the closure of the main town centre bus station. There are no new bus or coach stations constructed or planned for the foreseeable future within the Falkirk Council area

Photos of Falkirk Bus Station are shown in Photos 7 and 8.

Photo 7 – Falkirk Bus Station after Closure in August 2018 (1)

Photo 8 – Falkirk Bus Station after Closure in August 2018 (2)

4.2 Other Transport Sources

4.2.1 Airports

The nearest major airport to the Falkirk Council area is Edinburgh. Airport passenger movements between January 2017 and 2018 have increased by 7.1% from 781,072 in 2017 to 836,943[Ref 2] in 2018. This airport does not need considering further as it is greater than 1km from the Falkirk Council boundary.

Falkirk Council is not aware of any significant changes to Cumbernauld airport. This is small airport situated near to the Falkirk Council boundary.

No other new airports are constructed or planned for the foreseeable future.

4.2.2 Stationary trains

Falkirk Council has not identified any new locations where locomotives or trains are stationary for more than 15-minutes that would not have been assessed in previous APRs.

4.2.3 Railways (diesel and steam trains)

Falkirk Council confirms that there are no new locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m.

4.2.4 Ports for Shipping

Falkirk Council confirms that there are no ports or shipping that requires further consideration. The Grangemouth Port is the nearest major port within Falkirk Council area and this has been operating for many years.

4.3 Industrial Sources

Industrial Installations – New / Proposed Installations

New KG Plant Extension (Furnace 10) – Ineos Chemicals Grangemouth Ltd.

During October 2017, Falkirk Council received a planning application for a proposed development of installing a new, tenth furnace (similar to the nine existing furnaces onsite) at Ineos Chemicals Grangemouth complex. The additional furnace is required to extend the processing capability of the existing KG Plant. As described in the associated Jacobs Supporting Environmental Appraisal Document:

'This development would increase stack extensions to three of the adjacent furnaces to the proposed new furnace. Furnace ten will be sited adjacent to the most southerly side of the existing bank of furnaces that make up the KG Plant. The requirement for the Proposed Development is to compensate for the reduced availability of the existing units and allow the production of ethylene to return to the site's nameplate production rate.'

As stated in Section 3.2.7 of the Jacobs – Supporting Environmental Appraisal Document:

'No net increase in air emissions is anticipated as a result of the Proposed Development. The combination of the extended stack height of the Proposed Development along with the extension of stacks belonging to three existing furnaces is expected to result in greater overall dispersion of pollutants, resulting in a reduction in the potential for ground level pollutant concentrations and an overall improvement in local air quality.'

As noted in section 3.2, the proposed development is located within the Grangemouth AQMA and adjacent areas, declared for exceedances of the SO_2 15-min mean NAQS objective.

In accordance with Falkirk Council's Local Development Plan Policy RW07 'Air Quality', the Supporting Environmental Appraisal assesses the potential impacts of this development on the AQMA and the wider environment.

The Supporting Environmental Appraisal concludes that the additional KG Furnace would have no net increase in air emissions as a result of the Proposed Development. As stated within section 3.2.7 'The combination of the extended stack height of the Proposed Development along with the extension of stacks belonging to

three existing furnaces is expected to result in greater overall dispersion of pollutants, resulting in a reduction in the potential for ground level pollutant concentrations and an overall improvement in local air quality.'

The operation of the plant falls within the remit of the Pollution Prevention and Control (PPC) (Scotland) regulations and will require a variation of the existing PPC Part A permit which SEPA will have responsibility for.

Within section 3.2.5 of the Supporting Environmental Appraisal states that the "level of risk due to emissions of dust during the construction phase is negligible and no further assessment is required". The appraisal document recommends that Ineos Chemicals Grangemouth Limited adopt best practice and follow recommended Institute of Air Quality Management (IAQM) mitigation measures during the construction phase. If any dust complaints are received within this area during the planned works Falkirk Council would have an obligation to investigate and ensure the mitigation measures are being followed.

New Small-Scale Gas Peaking Plant, Caledon Green, Grangemouth – Forsa Energy

During August 2018, Falkirk Council received a planning application for a proposed gas peaking plant comprising of ten container units, each of which contains a gas engine and electricity generator. The proposed site is located adjacent to Caledon Green in Grangemouth. The intention of the proposed development is to export electricity to the local electrical grid at times of peak demand or when the grid requires various forms of electrical support.

The air quality report was submitted to Falkirk Council to provide an assessment of potential air quality impacts of emissions of nitrogen from the operation of the proposed development. The proposed development is located within the Grangemouth AQMA (declared for SO_2 15-min mean). The air quality assessment report was completed by Arcus Consultancy Services on behalf of Forsa Energy.

The report states that in relation to the proposed development the baseline air quality is substantially below the NAQS objectives in the absence of the development, and remains so with the development included. The long term impacts at the six assessed receptors have been assessed as negligible. The short-term impacts at

three of the assessed receptors are moderate, two are slight and one receptor is negligible.

Overall, a scenario assuming operation of the development for 3,000 hours per year has been used to predict worst case concentrations of NO_2 at the nearest receptor locations. The report concludes that after adding background concentrations of NO_2 to the dispersed emissions from the proposed development and from the nearby M9 and A905 roads the total concentrations of NO_2 at the worst case receptor (21 Stuart Grove, Grangemouth) would comply with short-term and long-term NAQS objectives. The proposed development will be designed and operate with the new requirements of the Medium Combustion Plant Directive (MCPD).

Since the publication of the air quality assessment, a consultation between Arcus, SEPA and Falkirk Council on the suitability of dispersion of emissions and relevant stack height have taken place. A further assessment report is due to be issued in 2019.

4.4 Commercial and Domestic Sources

4.4.1 Biomass Combustion Plants

Proposed Renewable Energy Plant – Grangemouth Renewable Energy Plant, Port of Grangemouth – Forth Energy – Air Quality Assessment – June 2018

Falkirk Council received an air quality assessment for a proposed commercial development of Grangemouth Renewable Energy Plant in the Port of Grangemouth via a planning enquiry in June 2018.

The air quality report was submitted to Falkirk Council to provide an assessment of point source emissions of combustion gases from the main and auxiliary boilers, emissions of acidic compounds and nitrogen-containing species from the main and auxiliary boilers, emissions of pollutants from road traffic, dust generated during the construction / decommissioning of the plant and fugitive emissions from the biomass handling / storage areas (dust and odours). The development is proposed to be located within the Grangemouth AQMA (declared for SO_2 15-min mean). The air quality assessment report was completed by Forth Energy which is a joint venture formed by Scottish and Southern Energy (SSE) and Forth Ports.

The main pollutants that were (long-term) impact assessed within the report included: emissions of nitrogen, carbon monoxide, particulate matter (primarily PM_{10} and $PM_{2.5}$), sulphur dioxide as well as some trace species (such as metals and volatile organic compounds). The shorter term impacts associated with emissions of particulate matter from the proposed development's construction and decommissioning have been assessed against the current legislative NAQS objectives.

The air quality assessment concludes by stating that that the proposed biomass plant will incorporate a number of mitigation measures to reduce or remove potential impacts during the construction and operational phases such as suitable dust control and monitoring, the selection of efficient combustion technology, carefully selected stack height and the continuous monitoring of stack emissions. The report states that the impacts of dust generation on sensitive receptors in the area will be minimised and no significant impact is predicted during the construction or decommissioning phases. The potential impact due to road traffic emissions during the construction and operational phases of the biomass plant is forecast not to be significant.

If any dust complaints are received within this area during any of proposed development works Falkirk Council would have an obligation to investigate and ensure the stated mitigation measures are being followed. The operation of the proposed plant will fall within the remit of the Pollution Prevention and Control (PPC) (Scotland) regulations, and would require a permit which SEPA would have responsibility for.

4.4.2 Biomass Combustion Plants – Combined Sources

Falkirk Council has assessed domestic biomass or other fuel burning in previous reports. Falkirk Council has received no significant number of complaints about particular areas in relation to or changes to the following:

- Complaints about nuisance dust or odour relating to burning;
- Visual signs of chimney smoke being emitted from several properties in close proximity to each other;
- Significant odours of burning biomass fuel;
- Known high levels of sales of biomass or other fuels via home delivery or local outlets;
- Areas known to have limited or no access to mains gas.

4.4.3 Domestic Solid Fuel Burning

Falkirk Council has assessed domestic solid fuel burning in previous reports and has not identified any new areas that would need consideration.

A map of the smoke control areas in the Falkirk Council area is available to view via Falkirk Council website at:
http://www.falkirk.gov.uk/services/environment/environmental-policy/air-quality/smoke-control-areas.aspx

4.4.4 Combined Heat and Power (CHP) Plant

There are no new individual CHP plant installations that require consideration.

4.5 New Developments with Fugitive or Uncontrolled Sources

Landfill sites are regulated by SEPA licences and no changes with respect to the pollutants covered in this report have been indicated by SEPA.

Falkirk Council is not aware of any other changes to unmade haulage roads on industrial sites, waste transfer stations or other potential sources of fugitive particulate emissions.

5. Planning Applications

5.1 Proposed Residential Development – Williamson St, Falkirk – Air Quality Assessment – November 2018

Falkirk Council received an air quality assessment for a proposed residential development at Williamson St, Falkirk in November 2018. The proposed development is for the erection of thirty six flatted dwellings (for use as retirement housing) with external courtyards and associated parking provision.

The air quality report was submitted to Falkirk Council to provide an assessment of construction dust and potential traffic impacts of the proposed development. The proposed development is located within the Falkirk AQMA (declared for NO_2 and PM_{10} annual mean and PM_{10} 24-hour mean). The air quality assessment report was completed by Surface Property on behalf of Link Group.

The report demonstrates that the construction dust effect will not exceed the NAQS PM_{10} objective of 18µg/m^3. A risk assessment for construction dust effects was also detailed in accordance with Institute of Air Quality Management (IAQM). No significant effects are predicted if the stated best practice mitigation measures are implemented.

The results from the Design Manual for Roads and Bridges (DMRB) assessment (section 5.2) demonstrate that although the development will introduce new receptors to the AQMA this will not result in exposing new residents to poor air quality. The predicted 2023 concentrations of NO_2 and PM_{10} at the worst case receptor (DMRB R1) with traffic generated from development are predicted to be 26.4% and 54.2% of the NO_2 and PM_{10} (annual mean) NAQS objectives respectively. It was also stated that NO_2 and PM_{10} concentrations in 2023 (with the development included) were 2.06µg/m^3 and 0.18µg/m^3 lower than the 2018 baseline concentrations; this indicated that whilst traffic numbers increased during this period the background concentrations will reduce.

The assessment concludes that the development will have a negligible impact on local air quality.

5.2 Proposed Residential Development – Standrigg Road, Wallacestone, Falkirk – Air Quality Assessment – March 2018

Falkirk Council received an air quality assessment for a proposed residential development at Standrigg Road, Wallacestone, Falkirk in March 2018. The proposed development is for the erection of approximately two hundred new dwellings including a site for a local community facility, alongside associated infrastructure and landscaping.

The air quality report was submitted to Falkirk Council to provide an assessment of construction dust and potential traffic impacts of the development. The development is located out with any Falkirk Council AQMA (the nearest being the Grangemouth AQMA approximately 3km east of the proposed development). The air quality assessment report was completed by REC on behalf of Persimmon Homes Limited.

The report assesses the construction phase air quality impacts from fugitive dust emissions. The report states that the ‘use of good practice control measures would provide suitable mitigation for a development of this size and nature and reduce potential impacts to an acceptable level.’

The report states that dispersion modelling was utilised to quantify existing pollutant concentrations at the site and predict air quality impacts as a result of road vehicle exhaust emissions associated with traffic generated by the development. The results indicated that pollutant levels across the site were below relevant air quality standards. The assessment concluded that overall impact on pollutant levels as a result of operational phase vehicle emissions were predicted to be not significant at any sensitive location in the vicinity of the site.

5.3 Proposed Residential Development – Garngrew Road, Banknock– Air Quality Assessment – June 2018

Falkirk Council received an air quality assessment for a proposed residential development at Garngrew Road, Banknock via a planning enquiry in June 2018. The proposed development is for the erection of approximately forty new dwellings alongside associated infrastructure.

The air quality report was submitted to Falkirk Council to provide an assessment of potential traffic impacts of the development. The development is partially located

within the Banknock AQMA. The air quality assessment report was completed by Energised Environments on behalf of S. Brown Builders.

The report states that the main aim of the assessment is to consider existing air quality on the site, particularly in the context of the existing AQMA and emissions from road traffic on the M80 – the assessment considers emissions of NO_2 and PM_{10} as the principal emissions from road traffic.

The report states that dispersion modelling study was undertaken to predict air quality concentrations across the development site. These predictions indicated that NO_2 and PM_{10} concentrations on the western portion of the site near the M80 are higher than the eastern portion of the site. Predicted concentrations across all parts of the site are below NAQS objectives for both NO_2 and PM_{10} based on a minimum stand-off distance of 15m from the motorway.

The reports concludes that 'the levels of traffic generated by the site will be directly proportional to the number of houses in the development, however it is considered unlikely that traffic levels, and the resulting emissions, will be at a level likely to cause adverse effect to local air quality.'

5.4 Proposed Commercial Development – Rosebank Distillery, Falkirk – Air Quality Assessment – August 2018

Falkirk Council received an air quality assessment for a proposed commercial development at the former Rosebank Distillery in Falkirk via a planning enquiry in August 2018. The proposed development is for a new distillery within the area of the former Rosebank distillery.

The air quality report was submitted to Falkirk Council to provide an assessment of air quality impacts from construction activities, post development changes to road traffic and the new boiler plant within the development. The proposed development is not located within any Falkirk Council AQMA – the closest being the Falkirk town centre AQMA (approx. distance 340m east of site). The air quality assessment report was completed by ITP Energised on behalf of Blyth and Blyth Consulting Engineers.

The report states that the number of heavy (construction) goods vehicle movements associated with the development will vary on a daily basis; however the maximum number of movements is expected to be less than one hundred per day during the construction period. This is lower than the IAQM guidance criteria to establish the

need for an air quality assessment for the construction phase traffic. The effect on local air quality at sensitive receptors has been assessed as not significant. Construction phase fugitive emissions have been assessed for the following development activities: demolition work, earthworks, construction and transfer of dust-making materials from the site onto the local road network. The full dust assessment (including PM_{10} short term 24hr mean NAQS objective) in accordance with IAQM guidance is presented within the report and concludes that with the implementation of good-practice mitigation measures the residual impact of construction generated dust negligible.

The operational phase of the distillery has been assessed in relation to associated traffic emissions and considers the relevant traffic-related pollutants of interest (NO_2 and PM_{10}). A traffic statement has been included within the report which quantifies the traffic flows as two hundred and twenty four Light Duty Vehicle (LDV) Annual Average Daily Traffic (AADT) movements and twenty two Heavy Duty Vehicle (HDV) AADT movements. This section concludes by stating that when the projected traffic flows are considered in conjunction with locally measured NO_2 and PM_{10} concentrations it is considered unlikely that the proposed development will have no significant adverse effect on local air quality.

The proposed distillery's new boiler plant will captured under the Medium Combustion Plant Directive (MCPD) as the thermal input will be above 1 MW_{th} which is regulated by SEPA. The air quality impact at all sensitive receptors for long and short term exposure to NO_2 concentrations from boiler operation has been assessed as negligible / not significant.

The report concludes that proposed development will therefore not result in any significant adverse impacts to local air quality.

5.4 Proposed Construction Project – Grangemouth Flood Protection Scheme (Piled Viaduct on Kincardine Bridge Refurb) – EIA Scoping Report – Air Quality and Climate – July 2018

Falkirk Council received an Environmental Impact Assessment (EIA) report in July 2018 with an air quality and climate section for a proposed construction project of a piled viaduct as part of the Kincardine Bridge refurbishment. The proposed works are detailed within the Grangemouth Flood Prevention Scheme (FPS): EIA Scoping Report. The EIA report was submitted to Falkirk Council to provide an assessment of

air quality and climate change impacts from the emissions of dust and vehicles during the construction phase of the scheme. The proposed development is partially located within the Grangemouth AQMA and within approx. 1.5km of the Falkirk Town Centre AQMA. The EIA scoping report was completed by Jacobs on behalf of Transport Scotland.

The construction phase of the FPS will include various activities and the potential effects have been assessed with the EIA scoping report which follows stated EPUK guidance. The main construction activities generate and deposit dust (PM_{10} fraction stated) closer to their sources. It is acknowledged that dust deposition onto nearby properties can lead to complaints, may constitute a statutory notice as well as permanent ecological and adverse human health effects.

Construction impacts were assessed by following the stated IAQM guidance. The guidance on the assessment of dust from construction and demolition activities uses the most recent publication stated and guidance provided in the DMRB HA207/07.

It is anticipated that the works will not change the traffic flow, speed or composition of vehicles on the road network so the (vehicle emissions) pollution contribution will not change.

The proposed scheme is also unlikely to change any human receptors location in relation to the works so the effect during operation is negligible.

6. Conclusions and Proposed Actions

6.1 Conclusions from New Monitoring Data

Falkirk Council has assessed its automatic and non-automatic 2018 monitoring data and results.

All seven automatic NO_2 analysers in Falkirk Council's network met both NO_2 NAQS objectives. There has been an overall reduction in NO_2 levels at all sites since 2014 apart from the A15 Main St, Bainsford site which recorded 24µg/m^3 NO_2 (annual mean) concentrations in 2016 and has shown a downward trend to 22µg/m^3 in 2018. Since 2016, there has been an overall downward trend in NO_2 (annual mean) concentrations at four of the seven sites. The A7 Falkirk West Bridge St site recorded an increased concentration of 39µg/m^3 in 2018 which has increased by 3µg/m^3 from 2017's result (36µg/m^3).

The 2018 annual NO_2 diffusion tube monitoring results (as displayed in Table A.3) show that one (non-automatic) NO_2 diffusion tube exceeded the NAQS objective of 40µg/m^3 at NA27 Falkirk West Bridge Street. The remaining sixty tubes in the Falkirk Council's network met the NAQS objective. This is a slight decline from 2017 as all sixty one NO_2 diffusion tubes in the Falkirk Council's network met the NO_2 (annual mean) NAQS objective. Three diffusion tubes were close to the 40µg/m^3 NAQS annual mean objective limit with the highest recorded concentrations at the following sites: NA36 Kerr Crescent, Haggs, NA111 Falkirk West Bridge Street air quality station and NA114 Glasgow Rd, Camelon. These tubes are all located at roadside locations, two of these are located within AQMAs (NA36 Haggs AQMA and NA111 Falkirk Town Centre AQMA).

The NA27 Falkirk West Bridge Street tube has recorded exceedances of the NAQS NO_2 (annual mean) objective in 2014, 2015, 2016 and 2018. The NA111 Falkirk West Bridge Street tube has recorded only one exceedance in the past five years (in 2016).

Falkirk Council measured PM_{10} concentrations at eight monitoring locations during 2018. The Scottish NAQS objectives for PM_{10} were met at all eight monitoring locations.

The site with the highest annual mean PM_{10} concentration (but within the Scottish NAQS PM_{10} objective) was A4 Falkirk Haggs (Roadside, 14µg/m^3). Over a five year

period (from 2014 to 2018), three sites have recorded PM_{10} (24-hr mean) reductions: A4 Falkirk Haggs (Roadside), A7 Falkirk West Bridge St (Roadside) and A13 Banknock 2 (Roadside). One site recorded an increased PM_{10} (24-hr mean) concentration: A14 Banknock 3 (Urban Background). Four sites have remained at the same PM_{10} (24-hr mean) concentration: A8 Grangemouth AURN (Urban Background / Industrial), A10 Grangemouth Municipal Chambers (Urban Background / Industrial), A12 Falkirk Grahams Rd (Roadside) and A15 Main St, Bainsford (Roadside).

During 2018, there were no exceedences of the $PM_{2.5}$ Scottish NAQS objective (10µg/m^3) at any of the three automatic monitoring sites. All three sites recorded the same annual mean $PM_{2.5}$ concentration (within the Scottish NAQS $PM_{2.5}$ objective) of 6µg/m^3. During 2018 there were no exceedances of the $PM_{2.5}$ Scottish NAQS objective (10µg/m^3) at any of the three automatic monitoring sites. Two sites (A7 Falkirk West Bridge St and A13 Banknock 2) recorded the same annual mean $PM_{2.5}$ concentration (6µg/m^3). A8 Grangemouth AURN site recorded a concentration of 7µg/m^3. Data capture was good at A8 Grangemouth AURN (92%) and A13 Banknock 2 (99%) but poor for A7 Falkirk West Bridge Street (67%).The $PM_{2.5}$ concentrations at the Grangemouth AURN site have gradually reduced from 9.2µg/m^3 in 2015 to 6µg/m^3 in 2016 and 2017. 2018 saw a marghinal increase to 7µg/m^3 however this concentration remains reasonably low and within the NAQS objective.

There were no exceedances of the SO_2 NAQS objectives (15-minute, hourly or daily) recorded at any of the Falkirk Council monitoring locations during 2018. The site that recorded the only exceedance of the 15-minute NAQS objective during 2018 was A9 Grangemouth Moray (1). No other SO_2 exceedances were recorded at any of the other sites during 2018. This is the fifth consecutive year that no breaches of the SO_2 NAQS objectives (15-minute, hourly or daily) have been recorded at any site in the Grangemouth AQMA. It is important to stress that although there was an exceedance of the 15-minute objective concentration, the number of exceedances were below the maximum permitted by the respective NAQS objective.

In 2018, Falkirk Council monitored 1, 3-butadiene at three locations and sixteen locations using passive diffusion tubes, all the results were within the NAQS objective. In 2018, the pumped diffusion tube at the A8 Grangemouth AURN site recorded an annual average concentration of 0.74µg/m^3. This concentration continues to be within the relevant 1, 3-butadiene (annual mean) NAQS objective (of

3.25µg/m^3) and is a slight increase (of 0.09µg/m^3) compared to the 2017 result (0.65µg/m^3).

Local Air Quality Policy PG (S) 16[Ref3] states that "There are no set criteria on which a revocation decision will be based, and the Scottish Government considers each request on a case by case basis. A minimum requirement however will normally be at least three consecutive years where the objectives of concern are being achieved."

Although SO_2 NAQS objectives have been achieved within the Grangemouth AQMA for five consecutive years; Falkirk Council considers the AQMA remains justified based upon continual exceedances of the 15min NAQS objective concentration recorded at the A9 Grangemouth Moray and A10 Grangemouth Municipal Chambers sites for the past four consecutive years. It is to be noted that an assessment of the Grangemouth AQMA (in conjunction with a comprehensive pollution modelling study) will be completed by Sweco, due to be published by late 2019.

The Falkirk town centre AQMA remains justified as there was one exceedance of the NO_2 (annual mean) NAQS objective recorded at NA27 Falkirk West Bridge Street (within the Falkirk town centre AQMA). The automatic station result for A7 Fallkirk West Bridge recorded 39µg/m^3 which is also close to the NAQS objective. An additional (town centre) located diffusion tube was close to the 40µg/m^3 limit - this was NA111 Falkirk West Bridge Street air quality station (37µg/m^3). The PM_{10} annual mean and 24-hour concentrations continue to be meeting the relevant NAQS objectives.

The Haggs AQMA will be reviewed in 2019 as the results (recorded at the automatic station) for NO_2 and PM_{10} (annual mean) NAQS objectives have been met for five consecutive years. It is noted that a relatively high concebtration (37µg/m^3) was recorded at (non automatic NO_2 diffusion tube) site: NA36 Kerr Crescent, Haggs. A detailed assessment will be completred in 2019 to understand whether an application to revoke is appropriate.

The roadside and background monitoring within the Banknock AQMA has shown compliance with the PM_{10} (24-hour mean and annual mean) NAQS objectives for more than five years. This AQMA was declared in August 2011 when Cowdenhill quarry was indentified as the primary PM_{10} source. Falkirk Council has produced an AQMA revocation proposal report for the Banknock AQMA; this is currently being reviewed and will be published once approved. If the (PM_{10} 24-hour mean and

annual mean) NAQS objectives continue to be met within this AQMA in 2019 it is anticipated that it will be revoked.

Site A15 Main St, Bainsford met all NAQS objectives for NO_2 and PM_{10} in 2018. There was a $PM_{2.5}$ (annualised estimation) NAQS (annual mean) exceedance (12 µg/m^3) recorded at this site in 2018. Falkirk Council undertook a detailed assessment of NO_2, PM_{10} and $PM_{2.5}$ in Main St, Bainsford in 2016. Falkirk Council will update this assessment in 2019 which will inform future management of the air quality in relation to a potential AQMA process.

6.2 Conclusions Relating to New Local Developments

Falkirk Council has assessed new and proposed local developments in the Falkirk and Grangemouth area during 2018 and concludes that none of the developments have the potential to introduce new exceedances of relevant pollutant levels, or exacerbate existing ones.

A Supporting Environmental Appraisal (SEA) was received in relation to a planning application for installing a new, tenth furnace (similar to the nine existing furnaces onsite) at Ineos Chemicals Grangemouth complex. The additional furnace is required to extend the processing capability of the existing KG Plant.

The conclusions from the SEA were as follows:

- No net increase in air emissions as a result of the proposed development;
- Anticipated greater dispersion of pollutants through the combination of extended stack height of the proposed development and the extension of three existing stacks;
- Level of risk due to emissions of dust during the construction phase is negligible;

The operation of the plant falls within the remit of the PPC (Scotland) regulations and will require a variation of the existing PPC Part A permit (which SEPA will have responsibility for) if planning permission is granted.

Falkirk Council Environmental Health was satisfied with outcomes of the air quality section (3. Specific Environmental Impact Areas) relating to the construction phase of the proposed development.

An air quality assessment was received in relation to a planning application for installing a proposed gas peaking plant comprising of ten container units, each of which contains a gas engine and electricity generator. The proposed site is located adjacent to Caledon Green in Grangemouth. The intention of the proposed development is to export electricity to the local electrical grid at times of peak demand or when the grid requires various forms of electrical support.

The conclusions from the air quality assessment were as follows:

- The baseline air quality is substantially below the NAQS objectives in the absence of the development, and remains so with the development included;

- With the addition of background concentrations of NO_2 to the dispersed emissions from the proposed development and traffic emissions from the nearby M9 and A905 roads the total concentrations of NO_2 at the worst case receptor would comply with short-term and long-term NAQSA Objectives;
- The proposed development will be designed and operate with the new requirements of the Medium Combustion Plant Directive (MCPD).

Since the publication of the air quality assessment, a consultation between Arcus, SEPA and Falkirk Council on the dispersion of emissions and a suitable stack height have taken place. A further assessment report is due to be issued in 2019, which will then be further reviewed by Falkirk Council.

An air quality assessment was received in relation to a planning application for a proposed commercial development of Grangemouth Renewable Energy Plant in the Port of Grangemouth. This report provides an assessment of point source emissions of combustion gases from the main and auxiliary boilers, emissions of acidic compounds and nitrogen-containing species from the main and auxiliary boilers, emissions of pollutants from road traffic, dust generated during the construction / decommissioning of the plant and fugitive emissions from the biomass handling / storage areas (dust and odours)

The conclusions from the air quality assessment were as follows:

- The proposed biomass plant will incorporate a number of mitigation measures to reduce or remove potential impacts during the construction and operational phases such as suitable dust control and monitoring, the selection of efficient combustion technology, carefully selected stack height and the continuous monitoring of stack emissions;
- The impacts of dust generation on sensitive receptors in the area will be minimised and no significant impact is predicted during the construction or decommissioning phases;
- The potential impact due to road traffic emissions during the construction and operational phases of the biomass plant is forecast not to be significant.

Falkirk Council Environmental Health were satisfied with outcomes of the air quality assessment relating to the construction phase of the proposed development. The

operational phase of the proposed development will be regulated under the control of a SEPA PPC permit.

An air quality assessment was received in relation to a planning application for a proposed residential development at Williamson St, Falkirk for the erection of thirty six flatted dwellings (for use as retirement housing) with external courtyards and associated parking provision.

The air quality report was submitted to Falkirk Council to provide an assessment of construction dust and potential traffic impacts of the development.

The conclusions from the air quality assessment were as follows:

- The construction dust effect will not exceed the NAQS PM_{10} objective of 18µg/m^3. A risk assessment for construction dust effects was also detailed in accordance with Institute of Air Quality Management (IAQM). No significant effects are predicted if the stated best practice mitigation measures are implemented;

- The results from the Design Manual for Roads and Bridges (DMRB) assessment (section 5.2) demonstrate that although the development will introduce new receptors to the AQMA this will not result in exposing new residents to poor air quality;

- The assessment concludes that the development will have a negligible impact on local air quality.

Falkirk Council Environmental Health requested some improvements from the air quality assessment report which were then provided, assessed and then deemed satisfactory.

An air quality assessment was received in relation to a planning application for a proposed residential development at Standrigg Road, Wallacestone, Falkirk for the erection of two hundred new dwellings including a site for a local community facility, alongside associated infrastructure and landscaping.

The air quality report was submitted to Falkirk Council to provide an assessment of construction dust and potential traffic impacts of the development.

The conclusions from the air quality assessment were as follows:

- Dispersion modelling was utilised to quantify existing pollutant concentrations at the site and predict air quality impacts as a result of road vehicle exhaust emissions associated with traffic generated by the development. The results indicated that pollutant levels across the site were below relevant air quality standards;
- Overall impact on pollutant levels as a result of operational phase vehicle emissions were predicted to be not significant at any sensitive location in the vicinity of the site

Falkirk Council Environmental Health were satisfied with outcomes of the air quality assessment.

An air quality assessment was received in relation to a planning application for a proposed residential development at Garngrew Road, Banknock for the erection of forty two new dwellings alongside associated infrastructure.

The air quality report was submitted to Falkirk Council to provide an assessment of potential traffic impacts of the development.

The conclusion from the air quality assessment was as follows:

- The levels of traffic generated by the proposed site will be directly proportional to the number of houses in the development, however it is considered unlikely that traffic levels, and the resulting emissions, will be at a level likely to cause adverse effect to local air quality.

Overall, Falkirk Council Environmental Health were satisfied with outcomes of the air quality assessment however, some of the stated legislation / guidance documents required to be updated.

An air quality assessment was received in relation to a planning application for a proposed commercial development at the former Rosebank Distillery in Falkirk.

The air quality report was submitted to Falkirk Council to provide an assessment of air quality impacts from construction activities, post development changes to road traffic and the new boiler plant within the development.

The conclusions from the air quality assessment were as follows:

- The full dust assessment (including PM_{10} short term 24hr mean NAQS objective) in accordance with IAQM guidance is presented within the report

and concludes that with the implementation of good-practice mitigation measures the residual impact of construction generated dust negligible;

- The full dust assessment (including PM_{10} short term 24hr mean NAQS objective) in accordance with IAQM guidance is presented within the report and concludes that with the implementation of good-practice mitigation measures the residual impact of construction generated dust as negligible;
- The projected traffic flows were considered in conjunction with locally measured NO_2 and PM_{10} concentrations and concluded that it is unlikely that the proposed development will have no significant adverse effect on local air quality;
- The air quality impact at all sensitive receptors for long and short term exposure to NO_2 concentrations from boiler operation has been assessed as negligible / not significant.

Falkirk Council Environmental Health were satisfied with outcomes of the air quality assessment if stated mitigation measures were implemented if necessary.

An EIA was received in relation to a proposed construction project of a piled viaduct as part of the Kincardine Bridge refurbishment. The EIA report was submitted to Falkirk Council to provide an assessment of air quality and climate change impacts from the emissions of dust and vehicles during construction phase of the scheme.

The conclusions from the air quality assessment were as follows:

- It is anticipated that the works will not change the traffic flow, speed or composition of vehicles on the road network so the (vehicle emissions) pollution contribution will not change;
- The proposed scheme is also unlikely to change any human receptors location in relation to the works so the effect during operation is negligible.

Falkirk Council Environmental Health requested some additional information to be added to the EIA air quality section prior to further assessment.

Proposed Actions

Falkirk Council has examined its automatic and non-automatic monitoring results for 2018. One (non-automatic) NO_2 tube exceeded the NAQS objective of 40µg/m^3 at NA27 Falkirk West Bridge Street. The remaining sixty tubes in Falkirk Council's network met the NAQS objective. This NO_2 diffusion tube is located within the Falkirk town centre AQMA. No new Detailed Assessment is required on this occasion for this pollutant.

The 2014 updating and screening assessment identified the need for a Detailed Assessment of PM_{10} and NO_2 concentrations at Main Street, Bainsford. Automatic monitoring commenced in June 2015. The monitoring data so far indicates that the NAQS objectives for both NO_2 and PM_{10} are being met and for this reason Falkirk Council will not be declaring Main Street, Bainsford as an AQMA. It is noted in 2018 the estimated annual mean $PM_{2.5}$ NAQS objective concentration of 10µg/m^3 was exceeded at the A15 Main St, Bainsford site. As this result is an estimation based on the automatic PM_{10} monitoring results, further monitoring will be undertaken and reviewed to ensure compliance with the future NAQS objectives.

The Banknock AQMA (PM_{10} 24-hr and annual mean) revocation report has been drafted and will be progressed by Falkirk Council in 2019. If the decision to revoke the Banknock AQMA is made it is highly likely that the Palas Fidas 200 combined particulate (PM_{10}+$PM_{2.5}$) analyser will be transferred to a more appropriate monitoring location such as the A15 Main St, Bainsford location (due to $PM_{2.5}$ estimated concentration exceedances).

Monitoring data for 2018 has highlighted that the Haggs AQMA will be reviewed in 2019 as the site continues to meet the NAQS objectives over a five year period.

Sweco have been commissioned by Falkirk Council to complete the Grangemouth Emissions Study 2018/19, it is anticipated this will be published late 2019. The report will include a review of the Grangemouth AQMA.

The Air Quality Progress Report (APR) as required by the Scottish Government shall be submitted in June 2020. This report will include the results from Falkirk Council's National Low Emission Framework Stage 1 Screening Exercise.

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)
A3	Bo'ness	Urban Background / Industrial	299815	681481	SO_2	N	SO_2: Horiba, APSA 370, UV Fluorescence.	5	22	1.2
A4	Falkirk Haggs	Roadside	278977	679271	NO_2, PM_{10}	Y (NO_2)	NO_2: API Teledyne T200, Chemiluminescence. PM_{10}: R&P 1400 TEOM, Gravimetric.	5	2	1.2
A5	Falkirk Hope Street	Roadside	288688	680218	SO_2, NO_2, PM_{10}	Y (NO_2 and PM_{10})	SO_2: Horiba APSA 360, UV Fluorescence. NO_2: Horiba APNA 360, Chemiluminescence. PM_{10}: R&P 1400 TEOM, Gravimetric.	1	5	1.5
A7	Falkirk West Bridge Street	Roadside	288457	680064	NO_2, PM_{10}	Y (NO_2 and PM_{10})	NO_2: API Teledyne T200, Chemiluminescence. PM_{10}: Palas Fidas 200 (Optical).	1	2	1.2

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)
A8	Grangemouth Automatic Urban and Rural Network (AURN)	Urban Background / Industrial	293830	681022	Benzene, SO_2, NO_2, PM_{10} and $PM_{2.5}$	Y (SO_2)	Benzene: Pumped absorption tube. SO_2: Monitor Europe MLME, UV Fluorescence. NO_2: Monitor Europe MLME, Chemiluminescence. PM_{10}: Jan – June 2018: R&P 1400 TEOM, Gravimetric. June 2018 – present: Met One 1020 Beta Attenuation Monitor (BAM). $PM_{2.5}$: Jan – June 2018: R&P 1400 TEOM, Gravimetric. June 2018 – present: Met One 1020 Beta Attenuation Monitor (BAM).	5	20	3.5
A9	Grangemouth Moray	Urban Background / Industrial	293469	681321	SO_2, NO_2	Y (SO_2)	SO_2: Horiba APSA 370, UV Fluorescence. NO_2: Monitor Europe MLME, Chemiluminescence.	1	25	3.5
A10	Grangemouth Municipal Chambers	Urban Background / Industrial	292816	682009	SO_2, NO_2, PM_{10}	Y (SO_2)	SO_2: Horiba APSA 370, UV Fluorescence. NO_2: Horiba APNA 360, Chemiluminescence. PM_{10}: R&P 1400 TEOM, Gravimetric	1	40	3.5

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)
A11	Grangemouth Zetland Park	Urban Background / Industrial	292969	681106	SO_2	Y (SO_2)	SO_2: Horiba APSA 360, UV Fluorescence.	1	135	3.5
A12	Falkirk Grahams Road	Roadside	288823	680242	PM_{10}	Y (NO_2 and PM_{10})	PM_{10}: R&P 1400 TEOM, Gravimetric. PM_{10} analyser transferred to nearby Falkirk Hope St on 10/10/2018, site decommissioned thereafter.	1	10	1.2
A13	Banknock 2	Roadside	277247	679027	PM_{10}	Y (PM_{10})	Palas Fidas 200 (Optical).	7	3	1.2
A14	Banknock 3	Urban Background	277168	679254	PM_{10}	Y (PM_{10})	Turnkey Osiris (Optical)	19	17	1.3
A15	Main St, Bainsford	Roadside	288566	681508	NO_2, PM_{10}	N	NO_2: Horiba APNA 360, Chemiluminescence. PM_{10}: R&P 1400 TEOM, Gravimetric.	1	2	1.2

(1) 0 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?
NA3	Tinto Drive, Grangemouth	Urban Background	293427	680386	Benzene, NO_2	N	<5	2.6	N
NA5	Copper Top pub, Camelon	Roadside	287332	680333	NO_2	N	<2	0.6 (Traffic Island)	N
NA7	Irving Parish Church, Camelon	Urban Background	287324	680442	NO_2	N	<5	1.4	N
NA9	Bellsdyke Rd, Larbert	Roadside	286048	683542	NO_2	N	<2	0.7	N
NA19	Kilsyth Rd, Banknock	Roadside	278779	679301	NO_2	Y	<2	2.2	N
NA20	Garngrew Rd, Haggs	Urban Background	278957	679172	NO_2	N	<5	1.5	N
NA21	Grangemouth Rd, Falkirk College	Roadside	290112	680500	Benzene, NO_2	N	<2	1.8	N
NA24	Kerse Lane, Falkirk	Roadside	289189	680018	NO_2	Y	<2	3	N
NA26	Weir St, Falkirk	Urban Background	289207	680123	NO_2	Y	<5	1.7	N
NA27	West Bridge St, Falkirk	Roadside	288490	680055	Benzene, NO_2	Y	<2	0.5	Y
NA29	Wellside Place, Falkirk	Urban Background	288467	680220	NO_2	N	<5	1.6	N
NA36	Kerr Crescent, Haggs	Roadside	278985	679273	NO_2	Y	<5	2.1	N
NA37	Denny Town House	Urban Centre	281226	682526	Benzene, NO_2	N	<5	8.9	N
NA38	Larbert Village Primary School	Urban Background	285937	682309	Benzene, NO_2	N	<5	2.3	N

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?
NA41	Seaview Place, Bo'ness	Roadside	299722	681594	Benzene, 1,3 Butadiene, NO_2	N	<2	0.1	N
NA42	Municipal Chambers, Grangemouth	Urban Centre / Industrial	292817	682000	Benzene, NO_2	N	<5	37.5	Y
NA44	Harvey Avenue, Polmont	Urban Background	293720	678911	Benzene, NO_2	N	<5	1.6	N
NA48	Hayfield, Falkirk	Urban Background	289197	681564	NO_2	N	<5	3.1	N
NA50	Upper Newmarket St, Falkirk	Urban Background	288671	680047	NO_2	Y	<5	9	N
NA51	Mary St, Laurieston	Roadside	290965	679490	NO_2	N	1	4.5	N
NA52	Main St, Larbert	Roadside	285866	682356	NO_2	N	<2	4.4	N
NA53	Denny Cross	Roadside	281211	682727	NO_2	N	<2	0.8	N
NA57	Inchyra Road, Grangemouth	Urban Background / Industrial	294028	680829	Benzene, NO_2	N	<5	1.2	N
NA58	Callendar Rd, Falkirk	Roadside	290194	679624	NO_2	N	<2	0.5	N
NA59	Carron Rd, Bainsford	Roadside	288392	681931	NO_2	N	<2	1.2	N
NA60	Ronades Rd, Carron	Roadside	288133	681587	NO_2	N	<2	1.6	N
NA61	Canal Rd, Falkirk	Roadside	287976	680656	NO_2	Y	<2	1.5	N
NA62	Arnot St, Falkirk	Roadside	289125	679705	NO_2	Y	<2	1.2	N

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?
NA63	Camelon Rd, Falkirk	Urban Background	288055	680134	NO_2	On FTC AQMA boundary	<5	1.4	N
NA64	New Hallglen Rd, Falkirk	Roadside	288807	678422	NO_2	N	<2	1.7	N
NA65	Redding Rd, Redding	Roadside	291356	678644	NO_2	N	<2	0.6	N
NA67	Queen St, Falkirk	Urban Background	289430	680433	NO_2	N	<5	1.8	N
NA68	Bellevue St, Falkirk	Roadside	289234	679945	NO_2	Y	<2	1.7	N
NA69	Kerse Lane, Falkirk	Roadside	289025	679991	NO_2	Y	<2	2.3	N
NA71	Park St, Falkirk	Roadside	288910	680112	NO_2	Y	<2	1.5	N
NA72	Vicar St, Falkirk	Roadside	288824	680120	NO_2	Y	<2	1.5	N
NA73	West Bridge St RHS, Falkirk	Roadside	288467	680048	NO_2	Y	<2	0.3	N
NA76	Tryst Rd, Stenhousemuir	Roadside	286851	683229	NO_2	N	<2	1.8	N
NA77	Kinnaird Village	Roadside	286490	683775	Benzene, NO_2	N	<2	3.9	N
NA78	Glen Brae, Falkirk	Roadside	288525	678991	NO_2	N	<2	2.6	N
NA80	Cow Wynd, Falkirk	Roadside	288765	679456	Benzene, NO_2	N	<2	1.8	N
NA81	Grahams Rd, Falkirk	Roadside	288817	680911	Benzene, NO_2	N	<2	0.5	N
NA82	Castings Av, Falkirk	Roadside	288858	681036	NO_2	N	<2	1	N

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?
NA83	Main St, Bainsford	Roadside	288614	681415	NO_2	N	<2	0.5	N
NA85	Auchinloch Dr, Banknock	Roadside	278752	679049	NO_2	Y	<2	0.8	N
NA86	Wolfe Rd, Falkirk	Urban Background	289667	679871	NO_2	N	<2	2	N
NA87	M80 Slip South, Haggs	Roadside	279017	679305	NO_2	Y	<2	1.6	N
NA88	Ure Crescent, Bonnybridge	Roadside	282444	681074	NO_2	N	<2	1.7 (16 to M876)	N
NA89	Grahams Rd / Meeks Rd, Falkirk	Roadside	288856	680336	NO_2	Y	<2	2.2	N
NA94	A905 (Glensburgh Rd), Grangemouth	Roadside	291213	681927	Benzene, NO_2	N	7	5.4	N
NA98	Arnothill, Falkirk	Urban Background	288080	680073	NO_2	N	23	1.6	N
NA99	St Crispins Pl, Falkirk	Roadside	288924	679675	NO_2	Y	7.6	2.7	N
NA101	Glensburgh Rd (2), Grangemouth	Roadside	291127	682007	NO_2	N	7	0.9	N
NA105	West of Shieldhill	Rural	288279	676875	Benzene, NO_2	N	Background Rural Site	1.7	N
NA107	Main St (East), Bainsford	Roadside	288640	681396	NO_2	N	4	0.5	N
NA110	Banknock 2 Air Quality Station	Roadside	277247	679027	NO_2	Y	5.2	2.6	N
NA111	Falkirk West Bridge St, Air Quality Station	Urban Centre	288457	680064	NO_2	Y	4.3	2.3	Y
NA112	Phillip St, Bainsford	Urban Background	288505	681443	NO_2	N	5.4	1.1	N

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?
NA113	Union St, Bo'ness	Urban Background / Industrial	300133	681780	NO_2, Benzene	N	4	2.3	N
NA114	Glasgow Rd, Camelon	Roadside	286624	680577	NO_2	N	2	0.5	N
NA115	Brown St, Camelon	Urban Background	286761	680413	NO_2	N	2	1.5	N

(1) 0 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 (µg/m^3) (3)				
					2014	2015	2016	2017	2018
A4	Falkirk Haggs	Automatic	93	93	32	30	33	28	28
A5	Falkirk Hope St	Automatic	94	94	23	21	23	19	21
A7	Falkirk West Bridge St	Automatic	85	85	**41**	37	37	36	39
A8	Grangemouth AURN	Automatic	93	93	16	14	16	14	14
A9	Grangemouth Moray	Automatic	94	94	15	15	18	17	17
A10	Grangemouth Municipal Chambers	Automatic	98	98	19	18	21	17	18
A15	Main St, Bainsford	Automatic	96	96	Not Operating	15	24	23	22
NA3	Tinto Drive, Grangemouth	Diffusion Tube	100	100	19	20	19	18	18
NA5	Copper Top pub, Camelon	Diffusion Tube	100	100	27	27	25	24	24
NA7	Irving Parish Church, Camelon	Diffusion Tube	100	100	18	17	16	15	17
NA9	Bellsdyke Rd, Larbert	Diffusion Tube	91	91	29	26	25	24	22
NA19	Kilsyth Rd, Banknock	Diffusion Tube	83	83	36	26	33	26	28
NA20	Garngrew Rd, Haggs	Diffusion Tube	83	83	22	23	24	22	22
NA21	Grangemouth Rd, Falkirk College	Diffusion Tube	100	100	28	28	28	28	28
NA24	Kerse Lane, Falkirk	Diffusion Tube	91	91	37	38	35	39	34
NA26	Weir St, Falkirk	Diffusion Tube	100	100	18	17	18	17	20
NA27	West Bridge St, Falkirk	Diffusion Tube	100	100	**45**	**47**	**48**	38	**44**
NA29	Wellside Pl, Falkirk	Diffusion Tube	100	100	17	15	17	17	18
NA36	Kerr Crescent, Haggs	Diffusion Tube	91	91	38	37	38	35	37
NA37	Denny Town House	Diffusion Tube	100	100	20	18	17	15	17

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
NA38	Larbert Village Primary School	Diffusion Tube	100	100	18	16	17	15	17
NA41	Seaview Pl, Bo'ness	Diffusion Tube	91	91	21	21	21	20	22
NA42	Municipal Chambers, Grangemouth	Diffusion Tube	100	100	19	20	20	17	19
NA44	Harvey Av, Polmont	Diffusion Tube	83	83	16	12	12	16	19
NA48	Hayfield, Falkirk	Diffusion Tube	100	100	20	19	19	16	18
NA50	Upper Newmarket St, Falkirk	Diffusion Tube	100	100	27	22	24	20	24
NA51	Mary St, Laurieston	Diffusion Tube	100	100	25	19	25	22	24
NA52	Main St, Larbert	Diffusion Tube	100	100	21	24	24	21	23
NA53	Denny Cross	Diffusion Tube	100	100	31	28	29	23	26
NA57	Inchyra Rd, Grangemouth	Diffusion Tube	100	100	26	20	23	19	21
NA58	Callendar Rd, Falkirk	Diffusion Tube	83	83	26	20	23	19	23
NA59	Carron Rd, Bainsford	Diffusion Tube	100	100	26	29	26	28	28
NA60	Ronades Rd, Carron	Diffusion Tube	100	100	27	24	26	23	24
NA61	Canal Rd, Falkirk	Diffusion Tube	100	100	25	24	24	20	24
NA62	Arnot St, Falkirk	Diffusion Tube	100	100	38	39	39	34	34
NA63	Camelon Rd, Falkirk	Diffusion Tube	100	100	36	36	36	33	35
NA64	New Hallglen Rd, Falkirk	Diffusion Tube	100	100	18	18	18	14	16
NA65	Redding Rd, Redding	Diffusion Tube	100	100	18	27	26	23	24
NA67	Queen St, Falkirk	Diffusion Tube	91	91	28	25	29	27	27
NA68	Bellevue St, Falkirk	Diffusion Tube	83	83	29	35	31	27	25
NA69	Kerse Lane, Falkirk	Diffusion Tube	100	100	35	30	34	30	32
NA71	Park St, Falkirk	Diffusion Tube	100	100	33	35	29	30	31
NA72	Vicar St, Falkirk	Diffusion Tube	91	91	32	30	32	25	26
NA73	West Bridge St RHS, Falkirk	Diffusion Tube	100	100	33	31	22	28	31
NA76	Tryst Rd, Stenhousemuir	Diffusion Tube	100	100	23	23	22	19	20

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
NA77	Kinnaird Village	Diffusion Tube	100	100	22	23	33	21	22
NA78	Glen Brae, Falkirk	Diffusion Tube	100	100	30	32	31	28	30
NA80	Cow Wynd, Falkirk	Diffusion Tube	100	100	30	32	27	29	28
NA81	Grahams Rd, Falkirk	Diffusion Tube	100	100	29	26	19	28	30
NA82	Castings Av, Falkirk	Diffusion Tube	100	100	18	20	38	17	19
NA83	Main St, Bainsford	Diffusion Tube	66	66	34	35	21	31	34
NA85	Auchinloch Dr, Banknock	Diffusion Tube	100	100	21	20	16	17	19
NA86	Wolfe Rd, Falkirk	Diffusion Tube	100	100	15	18	32	15	16
NA87	M80 Slip South, Haggs	Diffusion Tube	91	91	32	32	30	27	28
NA88	Ure Crescent, Bonnybridge	Diffusion Tube	100	100	29	29	30	28	27
NA89	Grahams Rd / Meeks Rd, Falkirk	Diffusion Tube	100	100	30	31	32	28	30
NA94	A905 (Glensburgh Rd), Grangemouth	Diffusion Tube	100	100	31	24	21	30	31
NA98	Arnothill, Falkirk	Diffusion Tube	100	100	22	15	26	19	18
NA99	St Crispins Pl, Falkirk	Diffusion Tube	100	100	25	22	21	24	25
NA101	Glensburgh Rd (2), Grangemouth	Diffusion Tube	100	100	25	22	21	24	23
NA105	West of Shieldhill	Diffusion Tube	100	100	9	10	8	7	8
NA107	Main St (East), Bainsford	Diffusion Tube	91	91	30	28	30	26	27
NA110	Banknock 2 Air Quality Station	Diffusion Tube	100	100	18	19	19	16	16
NA111	Falkirk West Bridge St, Air Quality Station	Diffusion Tube	94	94	33	33	**43**	36	37
NA112	Phillip St, Bainsford	Diffusion Tube	100	100	16	16	17	16	17
NA113	Union St, Bo'ness	Diffusion Tube	100	100	New Location for 2018				15
NA114	Glasgow Rd, Camelon	Diffusion Tube	100	100	New Location for 2018				39

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
NA115	Brown St, Camelon	Urban Background	75	75	New Location for 2018				18

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 LAQM.TG (16) if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Table A.4 – 1-Hour 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 1-Hour Means > 200µg/m^3 (3)				
					2014	2015	2016	2017	2018
A4 Falkirk Haggs	Roadside	Automatic	85	85	0	0	0 (119)	0 (107)	0
A5 Falkirk Hope St	Urban Background	Automatic	95	95	0	0	0	0 (82)	0
A7 Falkirk West Bridge St	Roadside	Automatic	85	85	0	0 (115)	0 (107)	0	0
A8 Grangemouth AURN	Urban Background / Industrial	Automatic	94	94	0	0	0	0	0
A9 Grangemouth Moray	Urban Background / Industrial	Automatic	94	94	0	0	0	0	0
A10 Grangemouth Municipal Chambers	Urban Background / Industrial	Automatic	99	99	0	0 (86)	0 (72)	0	0
A15 Main St, Bainsford	Roadside	Automatic	96	96	Not Operating	0 (45)	0 (94)	0	0

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

(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 99.8th percentile of 1-hour means is provided in brackets.

Figure 1 – A4 Falkirk Haggs Long Term NO_2 Concentrations

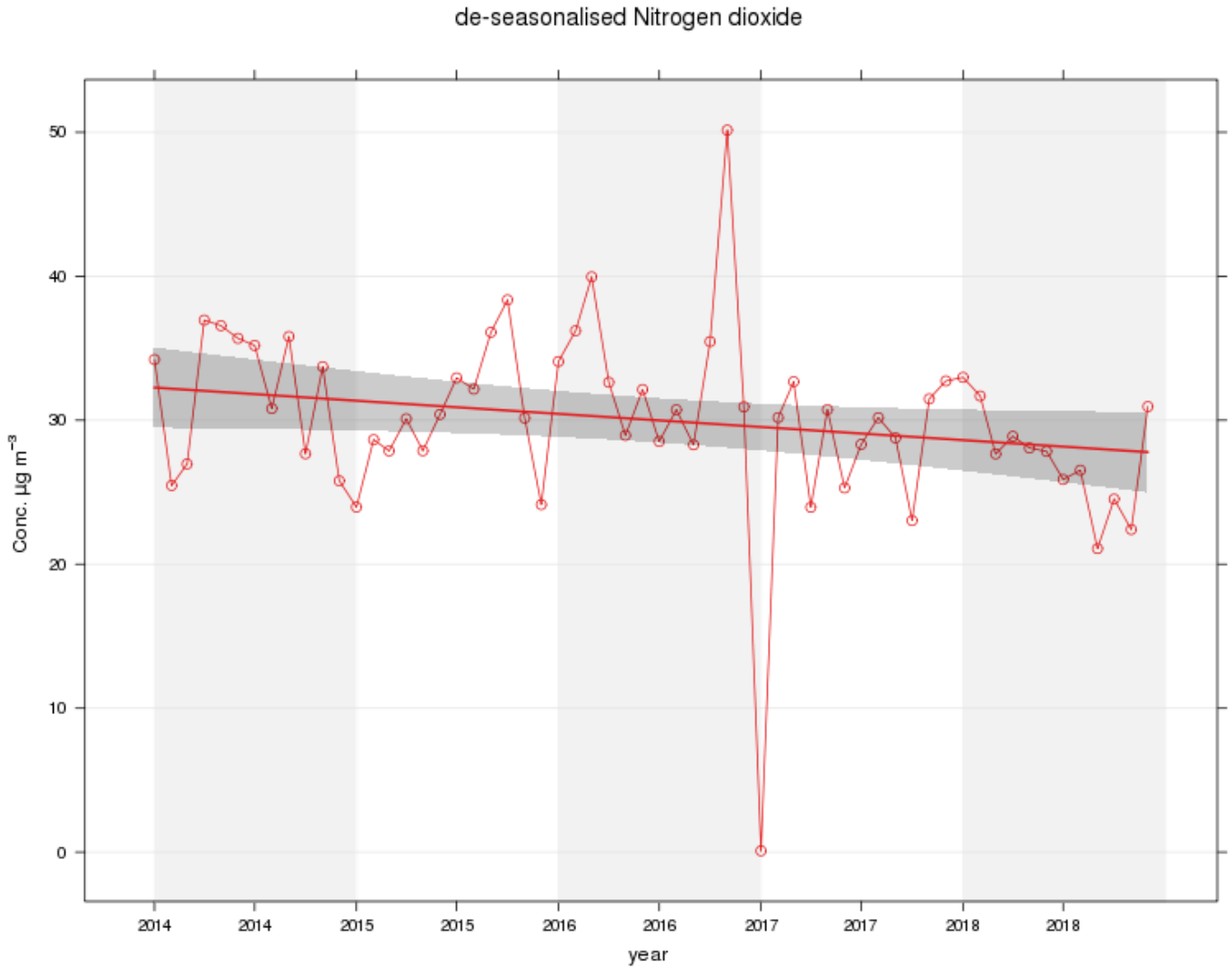


Figure 2 – A5 Falkirk Hope St Long Term NO_2 Concentrations

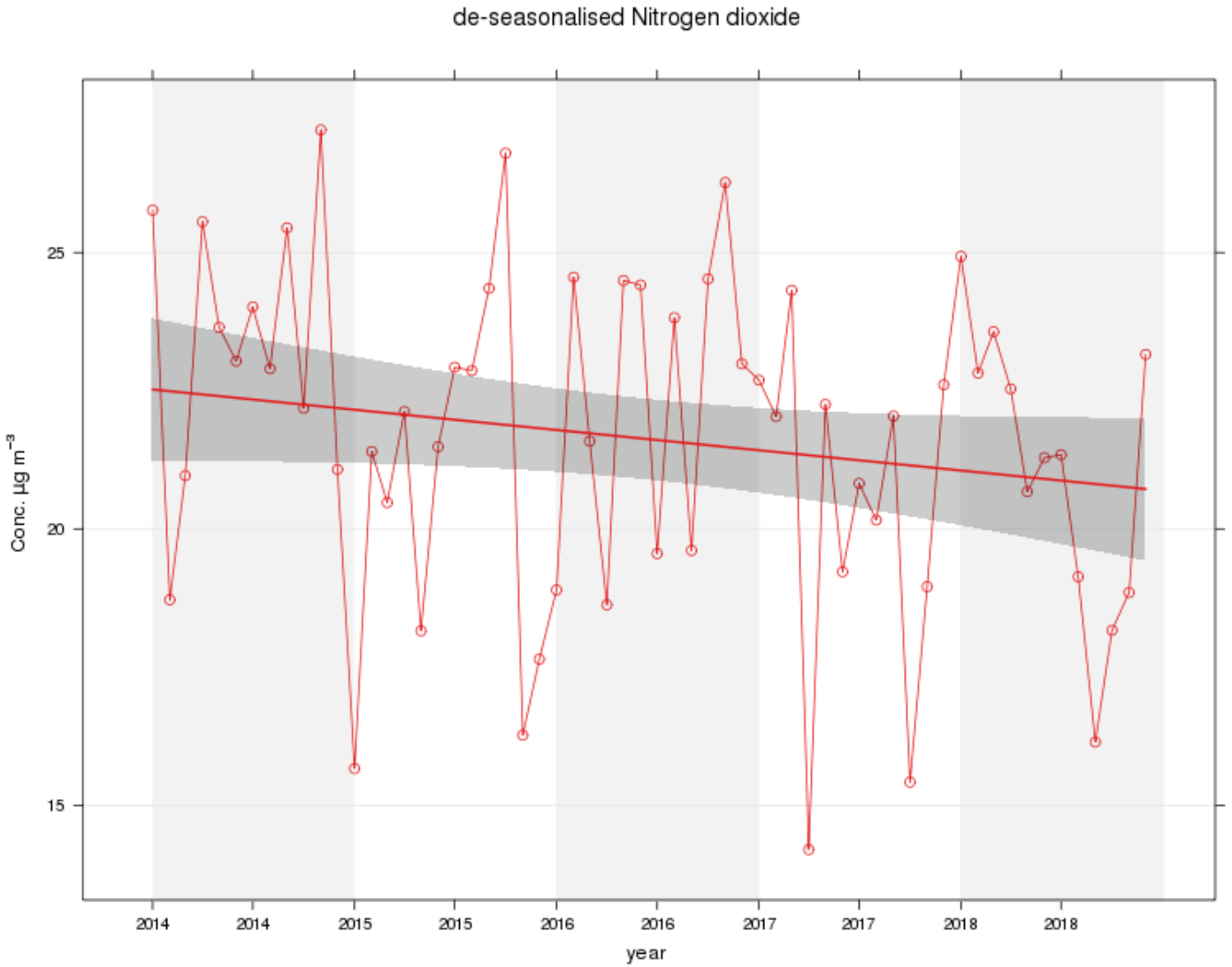


Figure 3 – A7 Falkirk West Bridge St Long Term NO_2 Concentrations

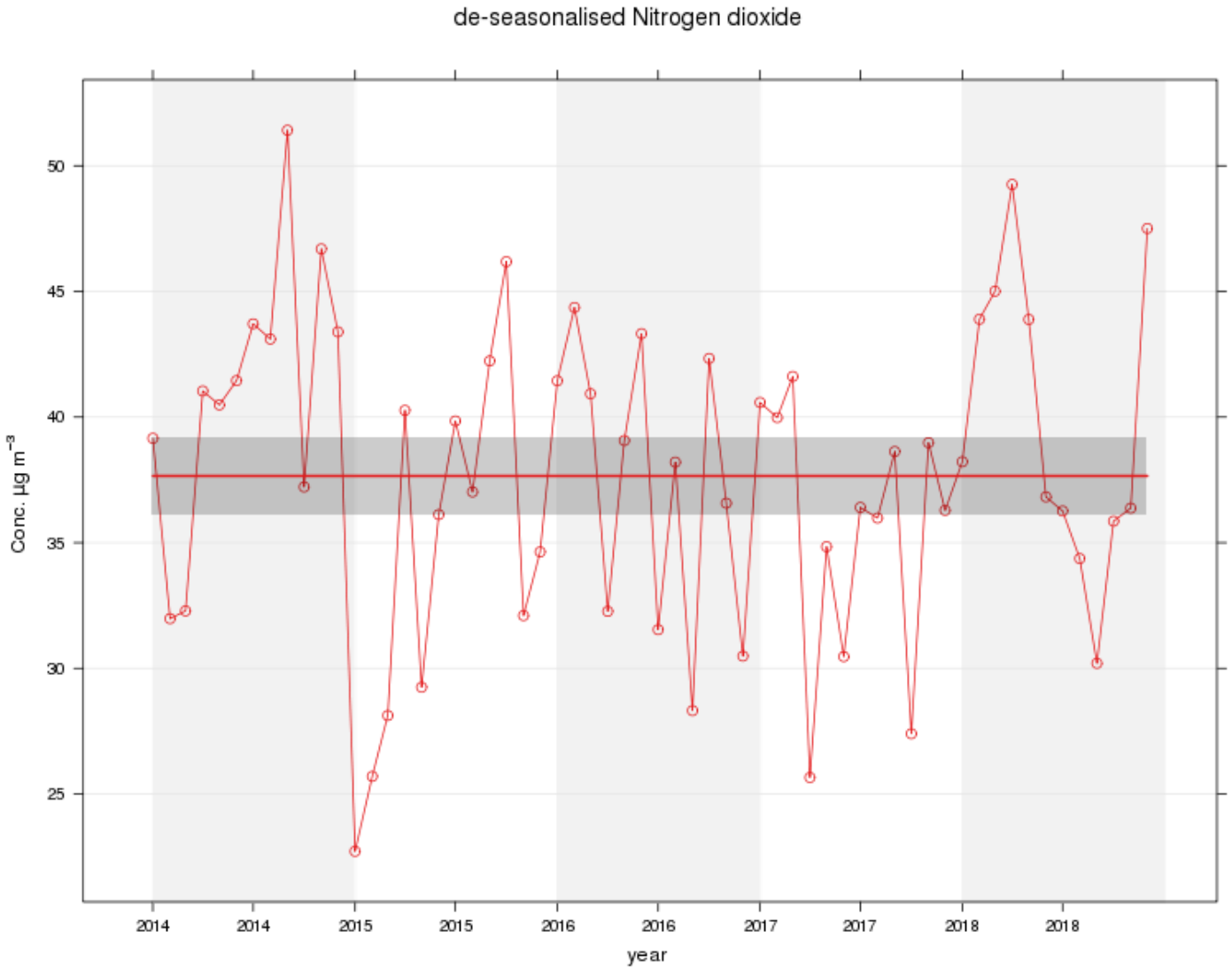


Figure 4 – A8 Grangemouth AURN Long Term NO_2 Concentrations

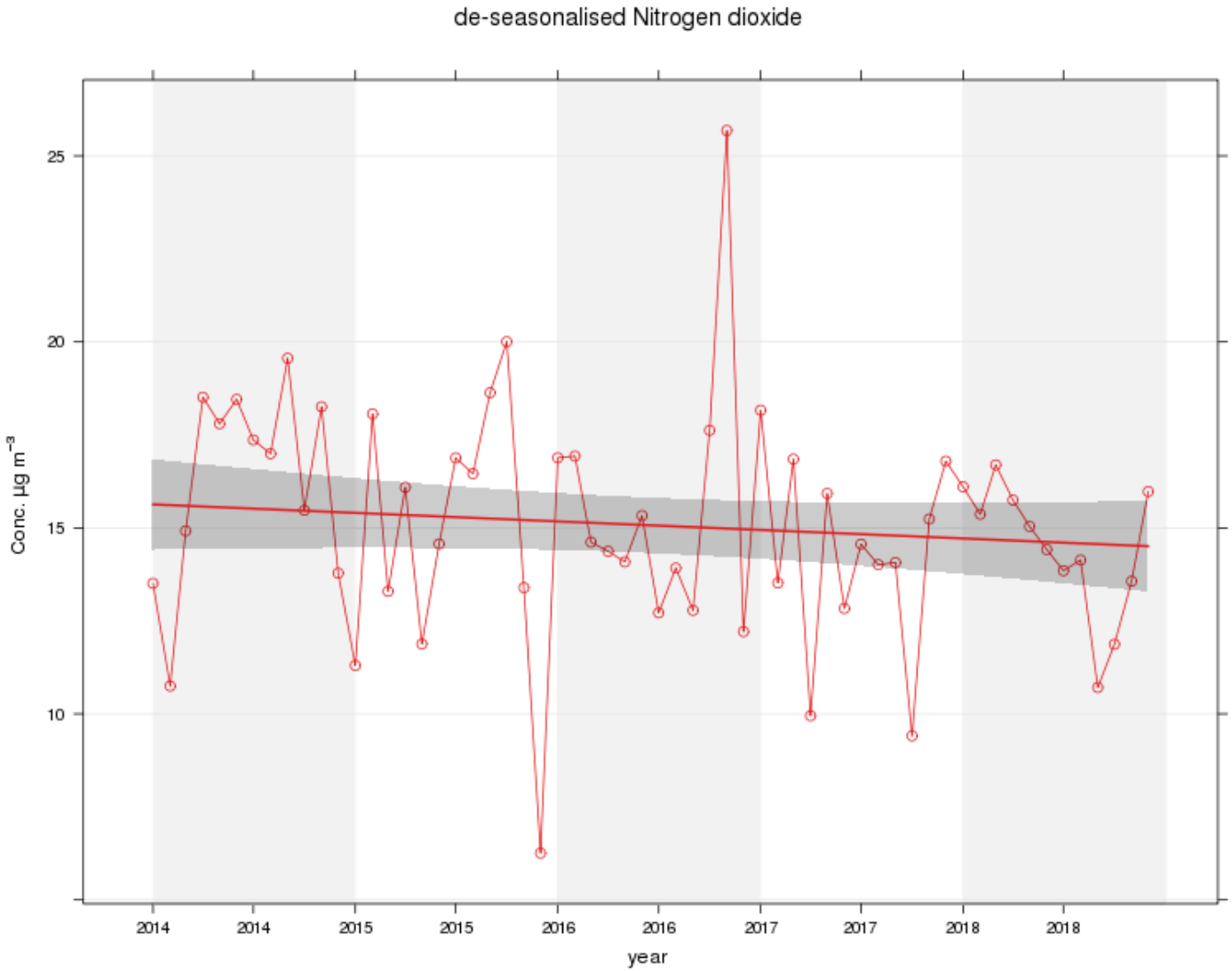


Figure 5 – A9 Grangemouth Moray Long Term NO_2 Concentrations

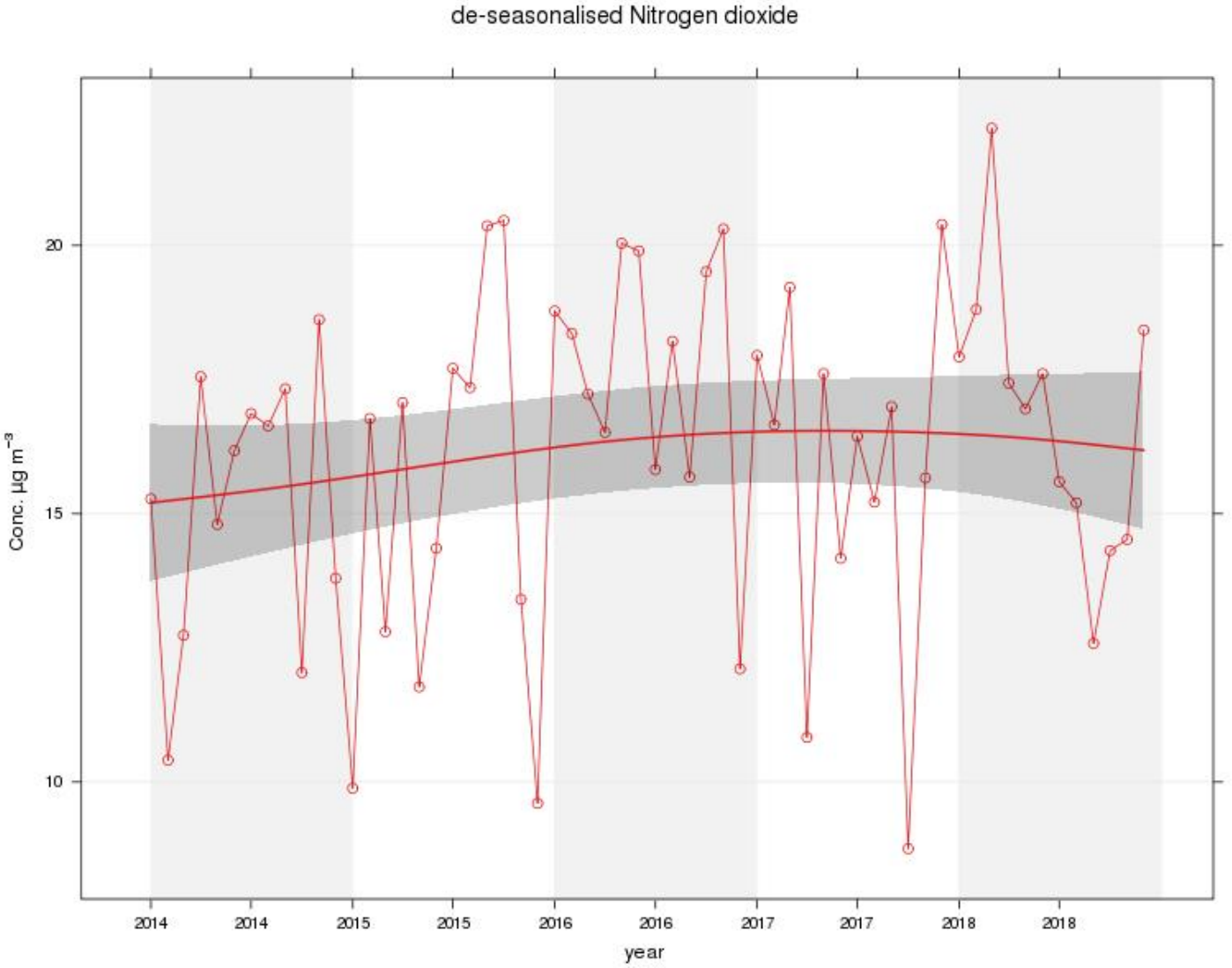


Figure 6 – A10 Grangemouth Municipal Chambers Long Term NO_2 Concentrations

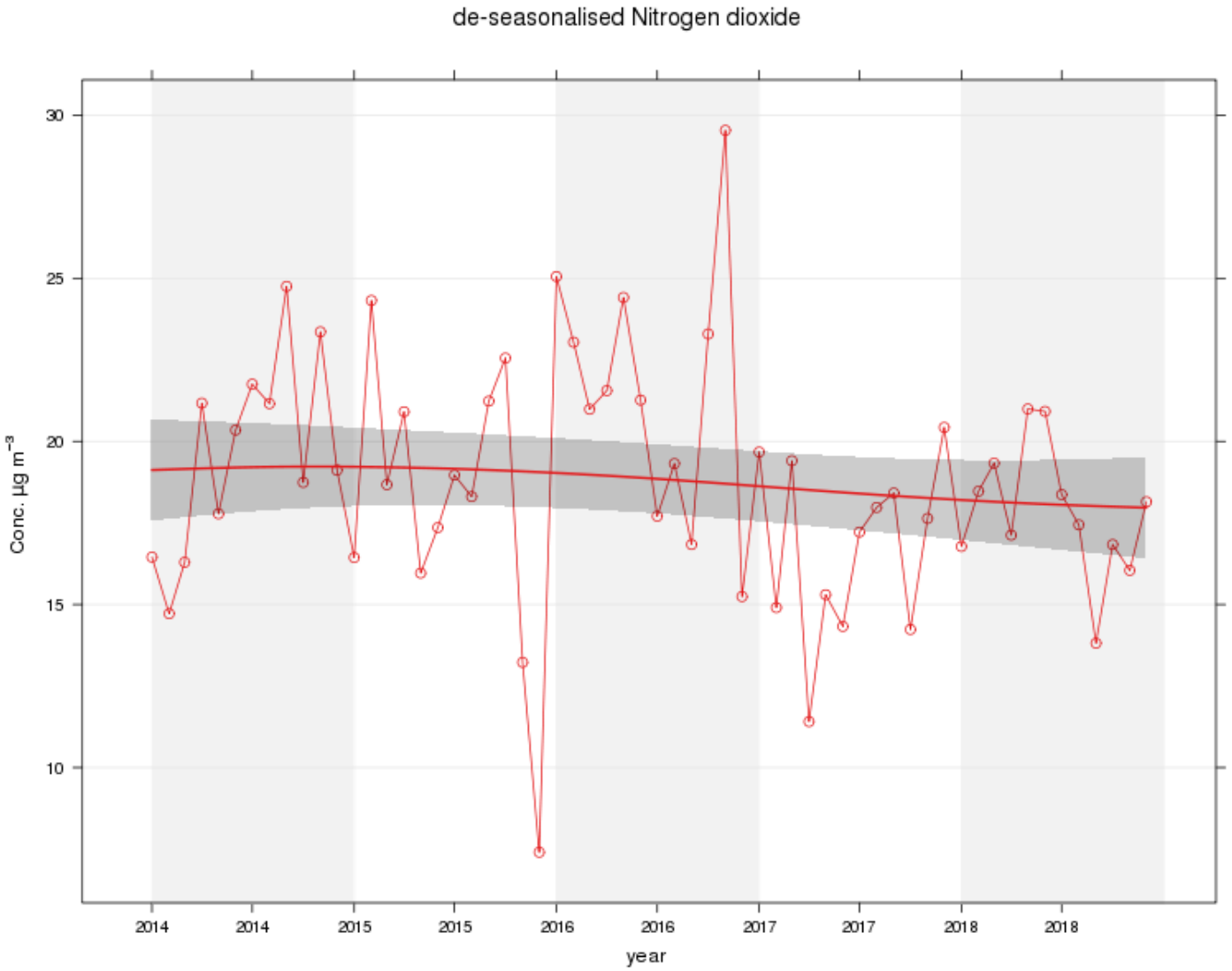


Figure 7 – A15 Main St, Bainsford Long Term NO_2 Concentrations

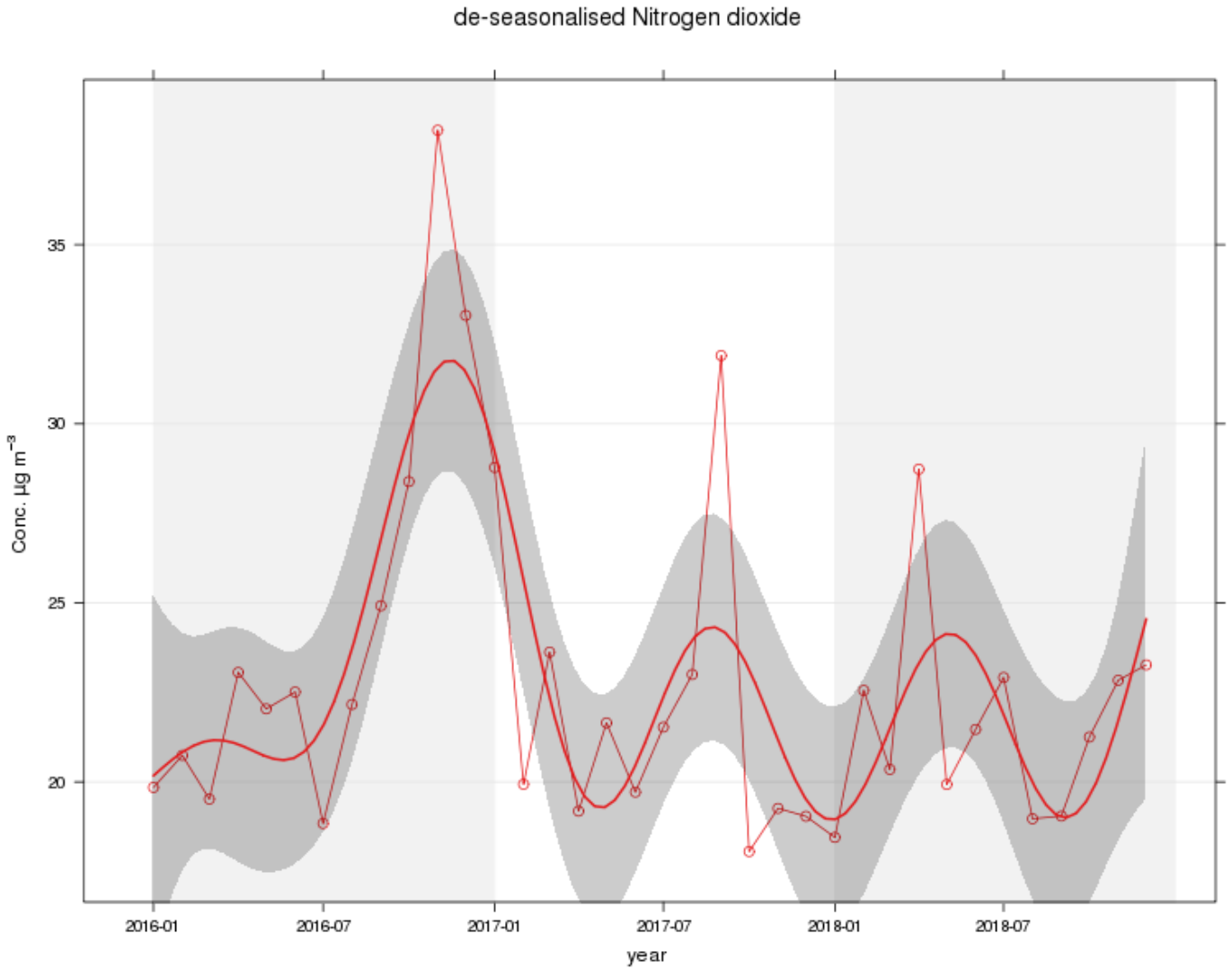


Table A.5 – Annual Mean PM_{10} Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	PM_{10} Annual Mean Concentration ($\mu g/m^3$) (3)				
				2014	2015	2016	2017	2018
A4	Falkirk Haggs	89	89	16.5	15	14	12	14
A5	Falkirk Hope St	19 (1)	19 (1)	PM_{10} analyser transferred from Falkirk Grahams Rd to Hope St site on 10/10/2018				11
A7	Falkirk West Bridge St	67	67	17.7	15	15	10	6
A8	Grangemouth AURN	90	90	12.4	12.2	11	9	12
A10	Grangemouth Municipal Chambers	88	88	14.6	13	13	12	12
A12	Falkirk Grahams Rd	73	73	13.2	11.8	13	12	14
A13	Banknock 2	99	99	13.2	11	11	13	11
A14	Banknock 3	80	80	15	8.2	n/n	7	6.9
A15	Main St, Bainsford	70	70	Not Operating	12.8	10	13	12

Notes: Exceedances of the PM_{10} annual mean objective of $18\mu g/m^3$ 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) All means have been "annualised" as per LAQM.TG (16); valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Table A.6 – 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
A4	Falkirk Haggs	90	90	1	1	0	0	0
A5	Falkirk Hope St	20 (1)	20 (1)	PM10 analyser transferred from Grahams Rd to Hope St on 10/10/2018				0 (30)
A7	Falkirk West Bridge St	67	67	2 (40)	2 (29)	0	0	0 (47)
A8	Grangemouth AURN	90	90	0	1 (21)	0	1	0
A10	Grangemouth Municipal Chambers	89	89	0	0	0	0	0
A12	Falkirk Grahams Rd	73	73	0	0 (18)	0	0	0
A13	Banknock 2	100	100	3	4	n/m	7	0
A14	Banknock 3	80	80	0 (24)	1	3	0	2 (10)
A15	Main St, Bainsford	70	70	Not Operating	0 (16)	0 (16)	0	0 (33)

Notes: Exceedances of the PM_{10} 24-hour mean objective (50µg/m^3 not to be exceeded more than 7 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 98.1st percentile of 24-hour means is provided in brackets.

Figure 8 – A4 Haggs Long Term PM_{10} (24-hour mean) Concentrations

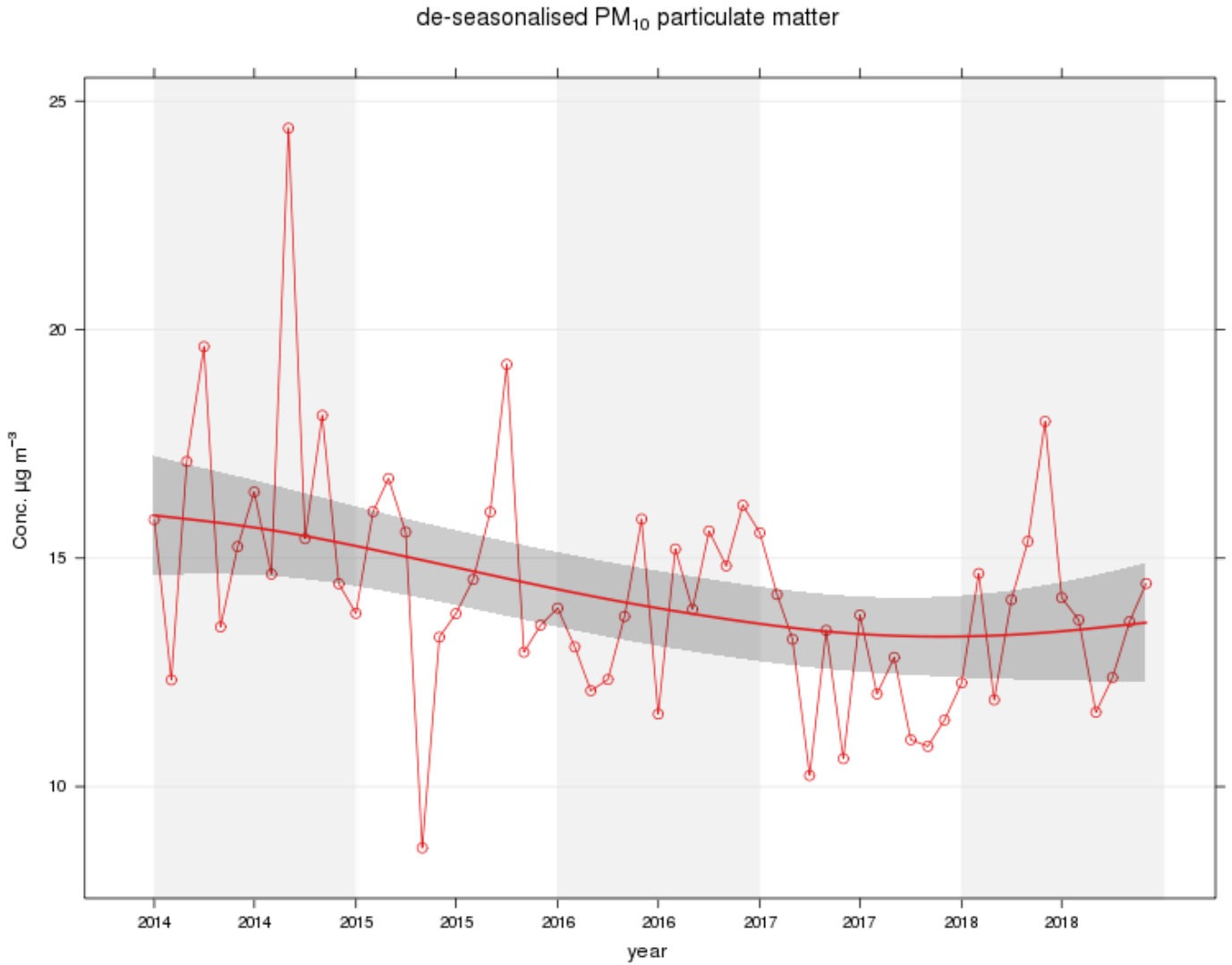


Figure 9 – A5 Falkirk West Bridge St Long Term PM_{10} (24-hour mean) Concentrations

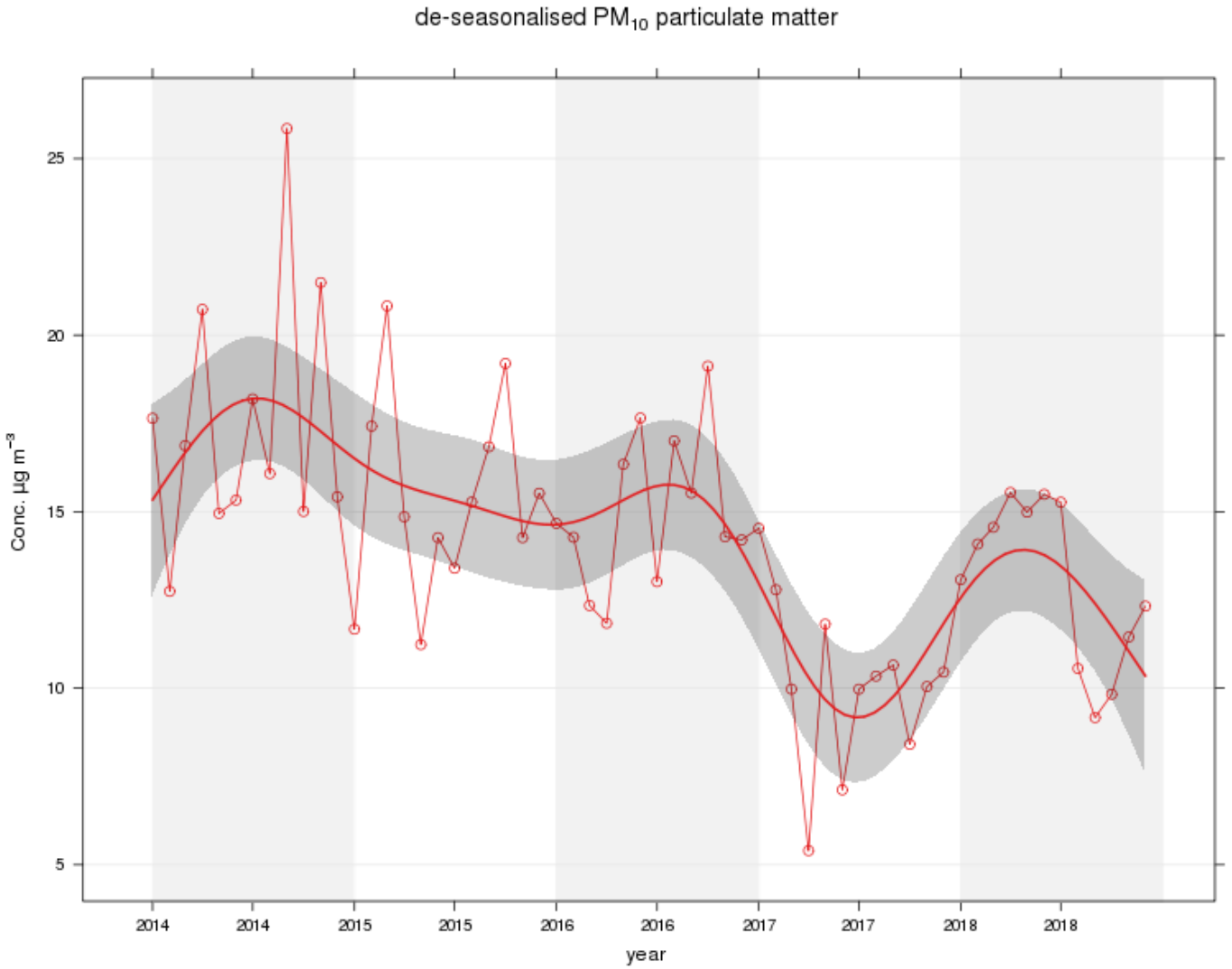


Figure 10 – A8 Grangemouth AURN Long Term PM_{10} (24-hour mean) Concentrations

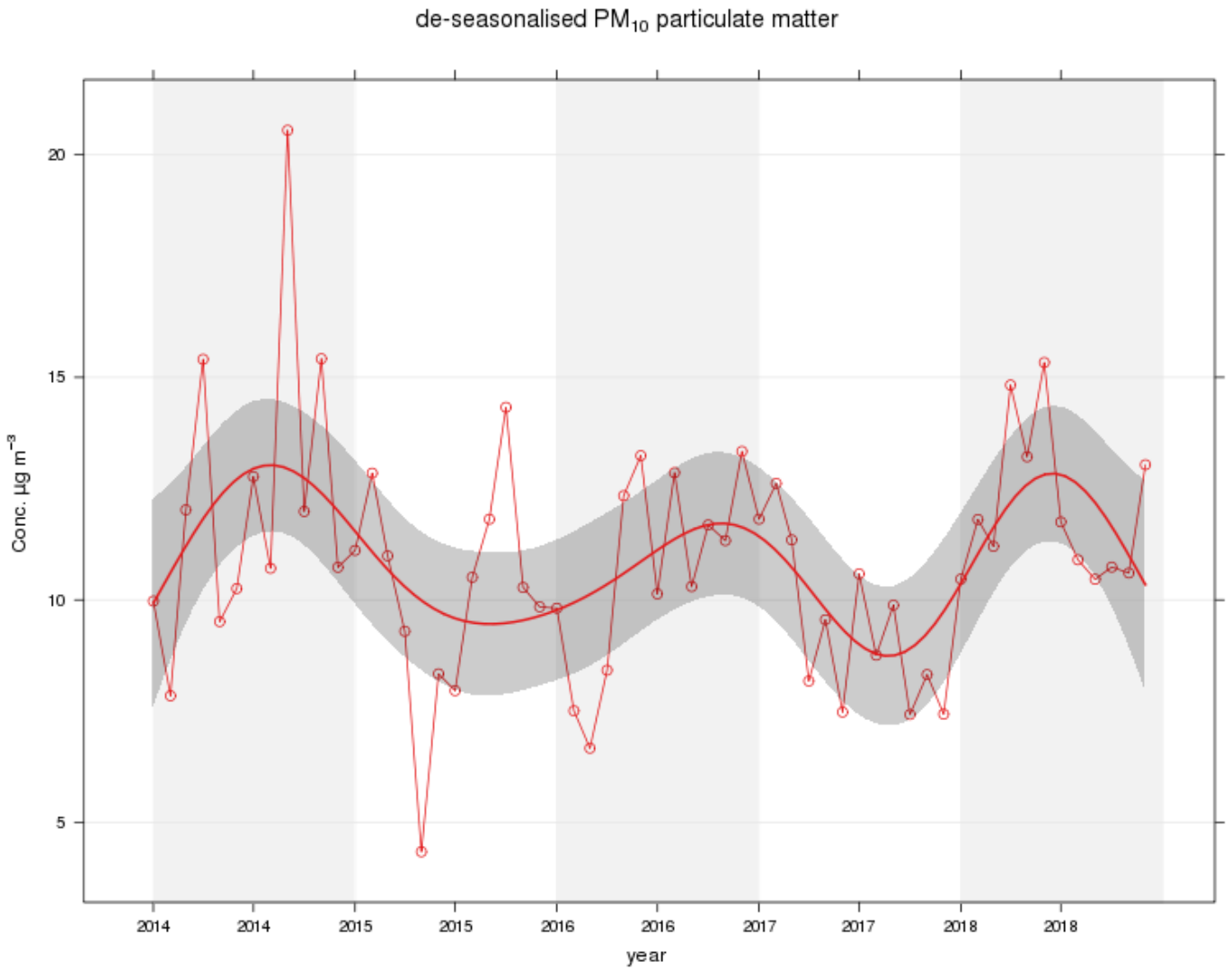


Figure 11 – A10 Grangemouth Municipal Chambers Long Term PM_{10} (24-hour mean) Concentrations

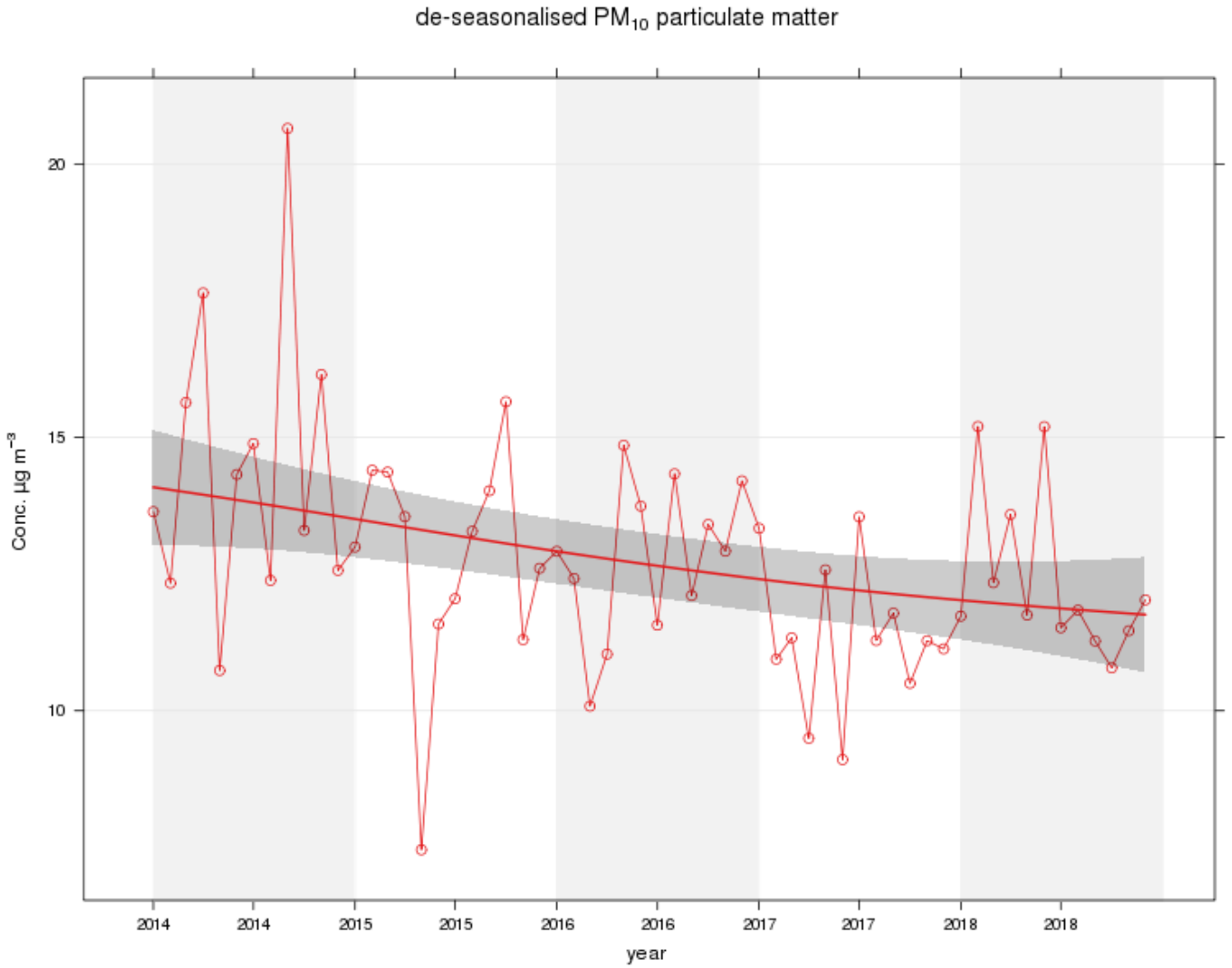


Figure 12 – A13 Banknock 2 Long Term PM_{10} (24-hour mean) Concentrations

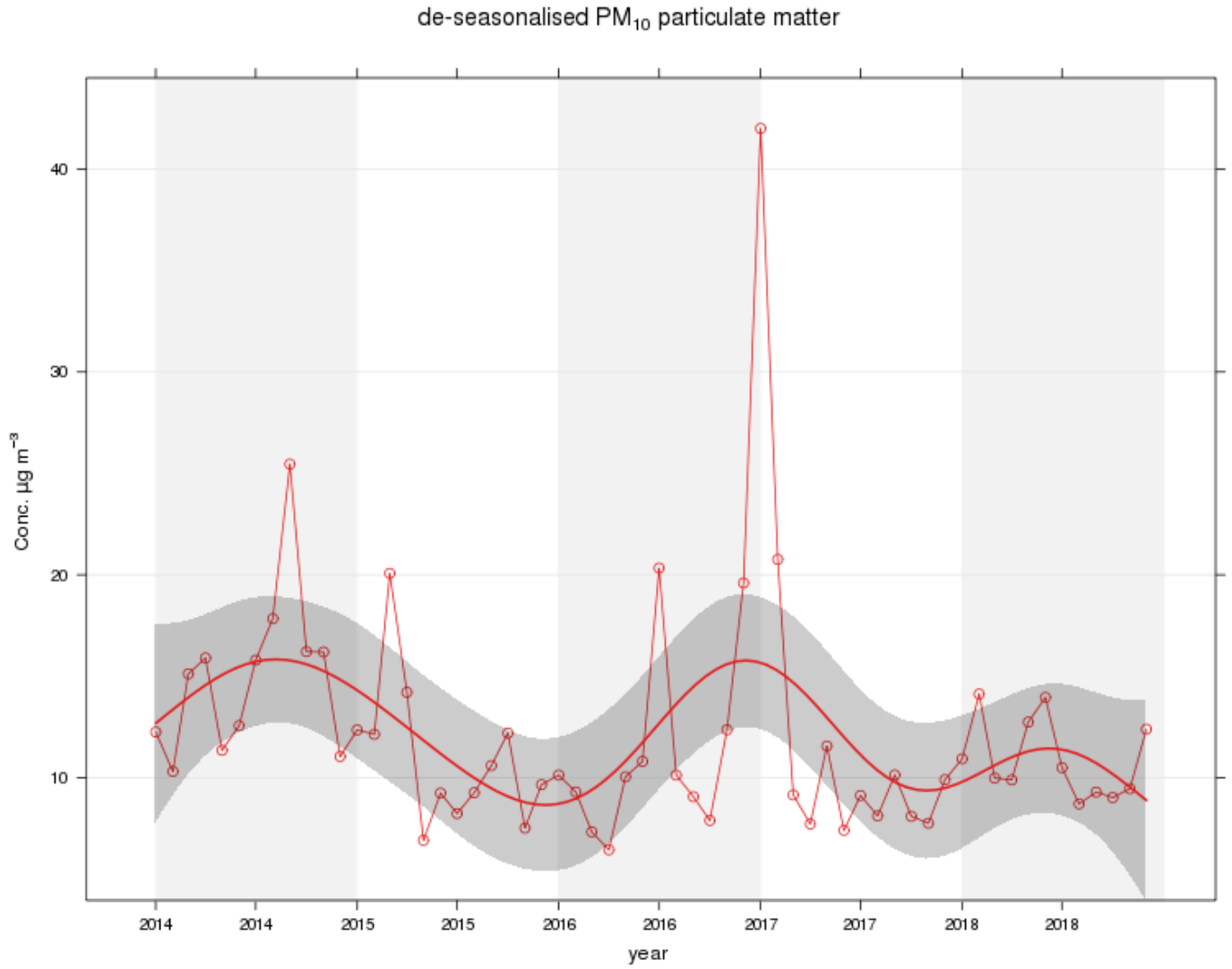


Figure 13 – A15 Main St, Bainsford Long Term PM_{10} (24-hour mean) Concentrations

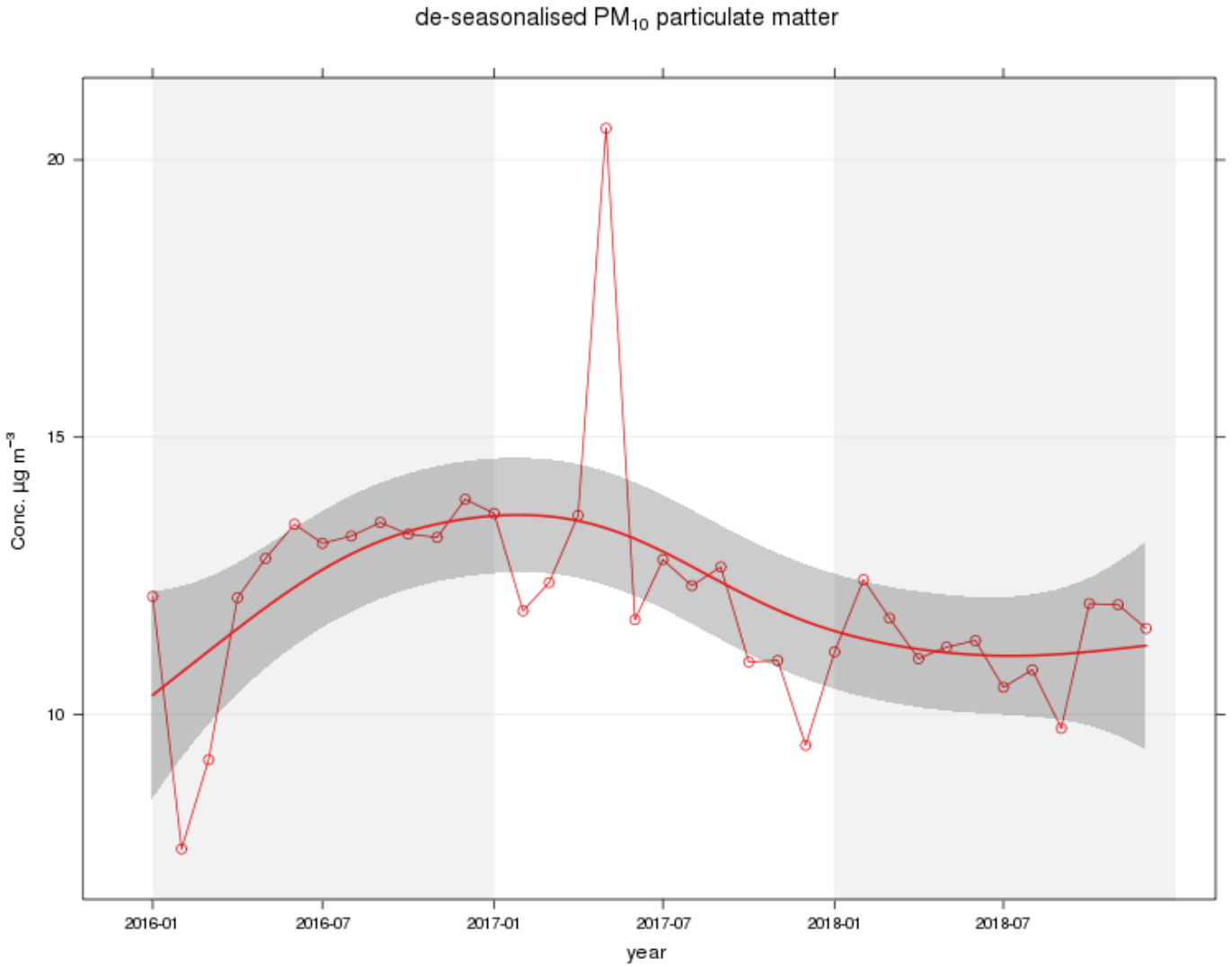


Table A.7 – Annual Mean $PM_{2.5}$ Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	$PM_{2.5}$ Annual Mean Concentration (µg/m^3) (3)				
				2014	2015	2016	2017	2018
A7	Falkirk West Bridge St	67	67	Not Operating		6	6	6
A8	Grangemouth AURN	92	92	8	9.2	6	6	7
A13	Banknock 2	99	99	Not Operating	6	5	6	6

Notes: Exceedances of the PM_{10} annual mean objective of 10µg/m^3 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) All means have been "annualised" as per LAQM.TG (16); valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Figure 14 – A7 Falkirk West Bridge St Long Term $PM_{2.5}$ Concentrations

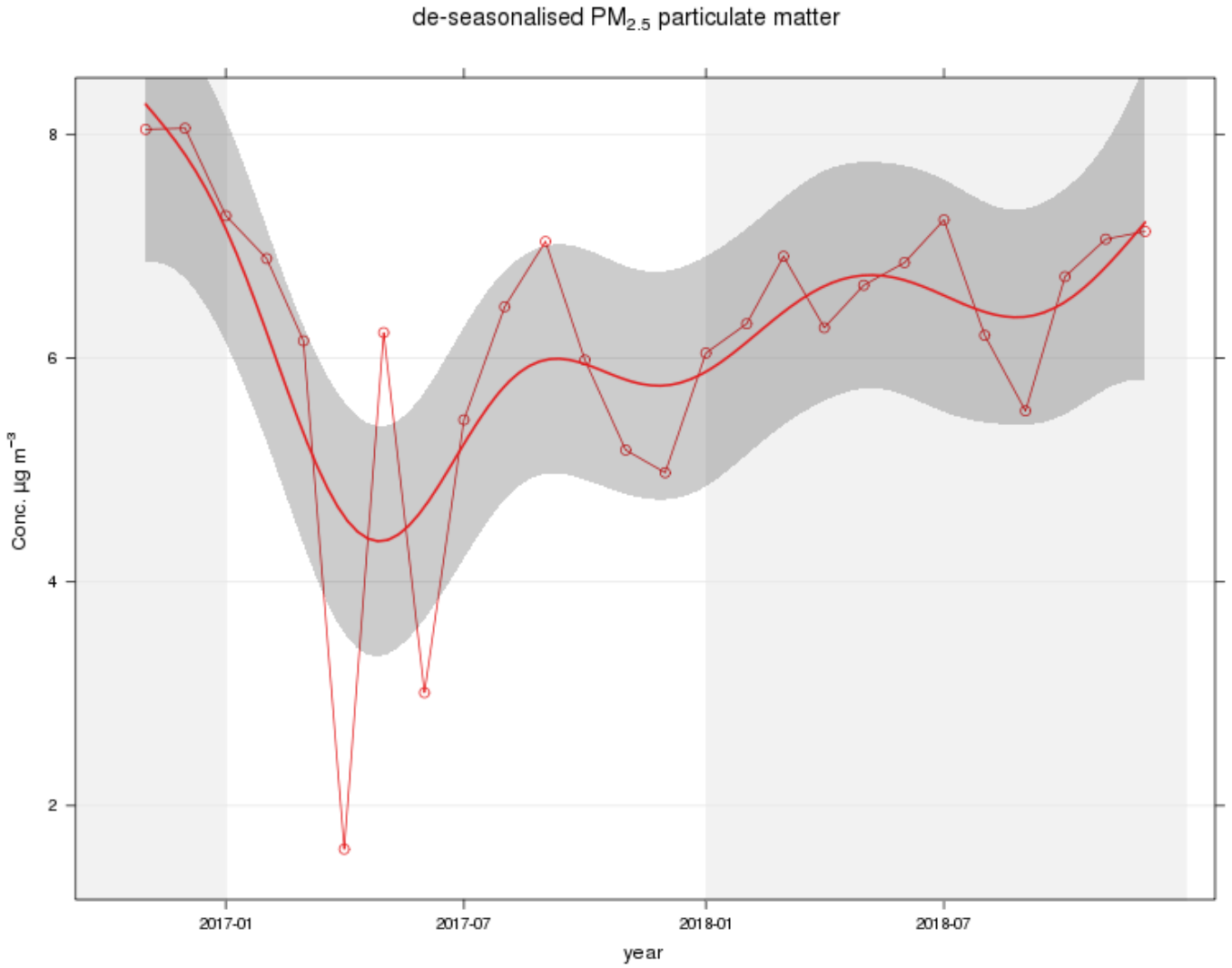


Figure 15 – A8 Grangemouth AURN Long Term $PM_{2.5}$ Concentrations

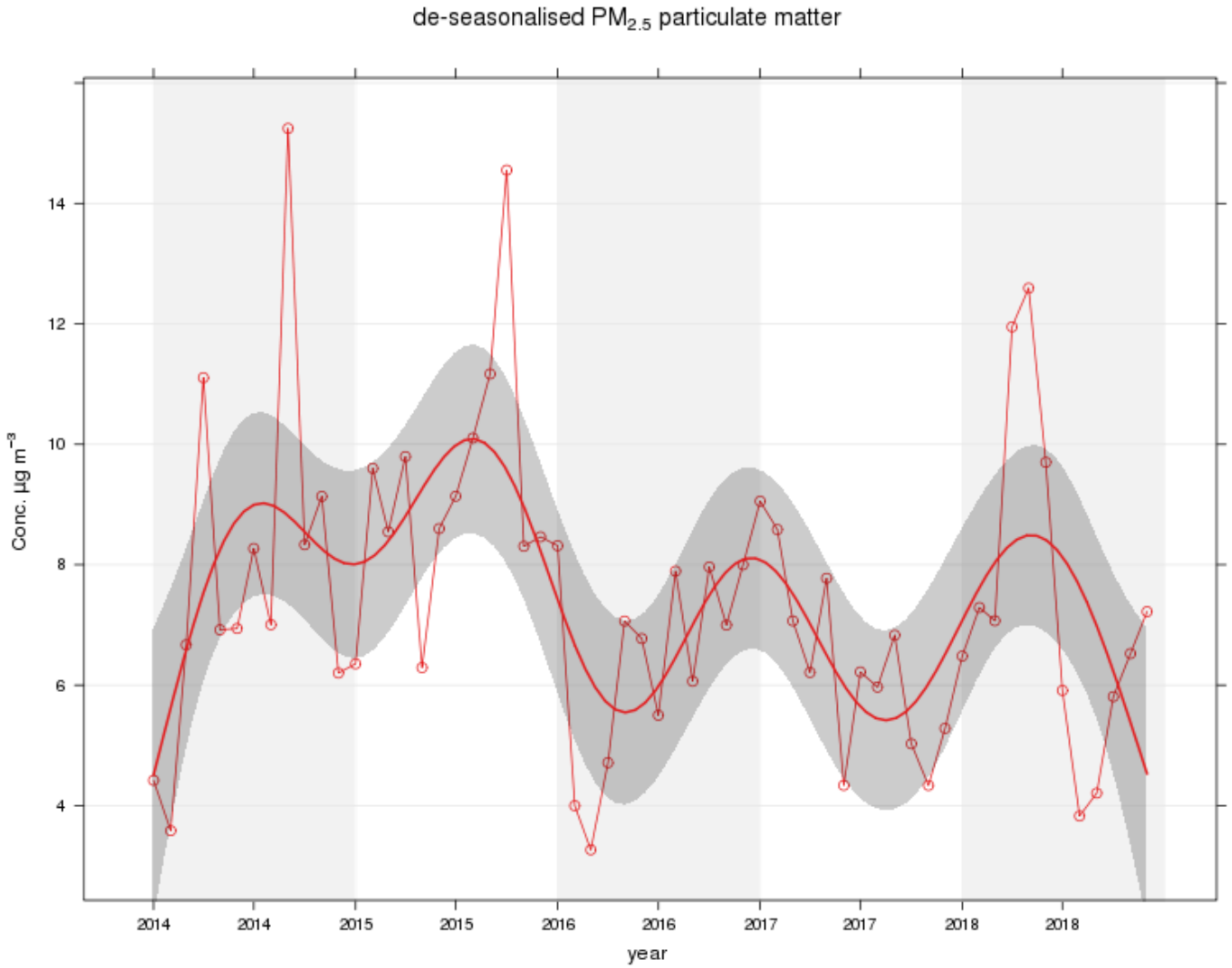


Figure 16 – A13 Banknock 2 Long Term $PM_{2.5}$ Concentrations

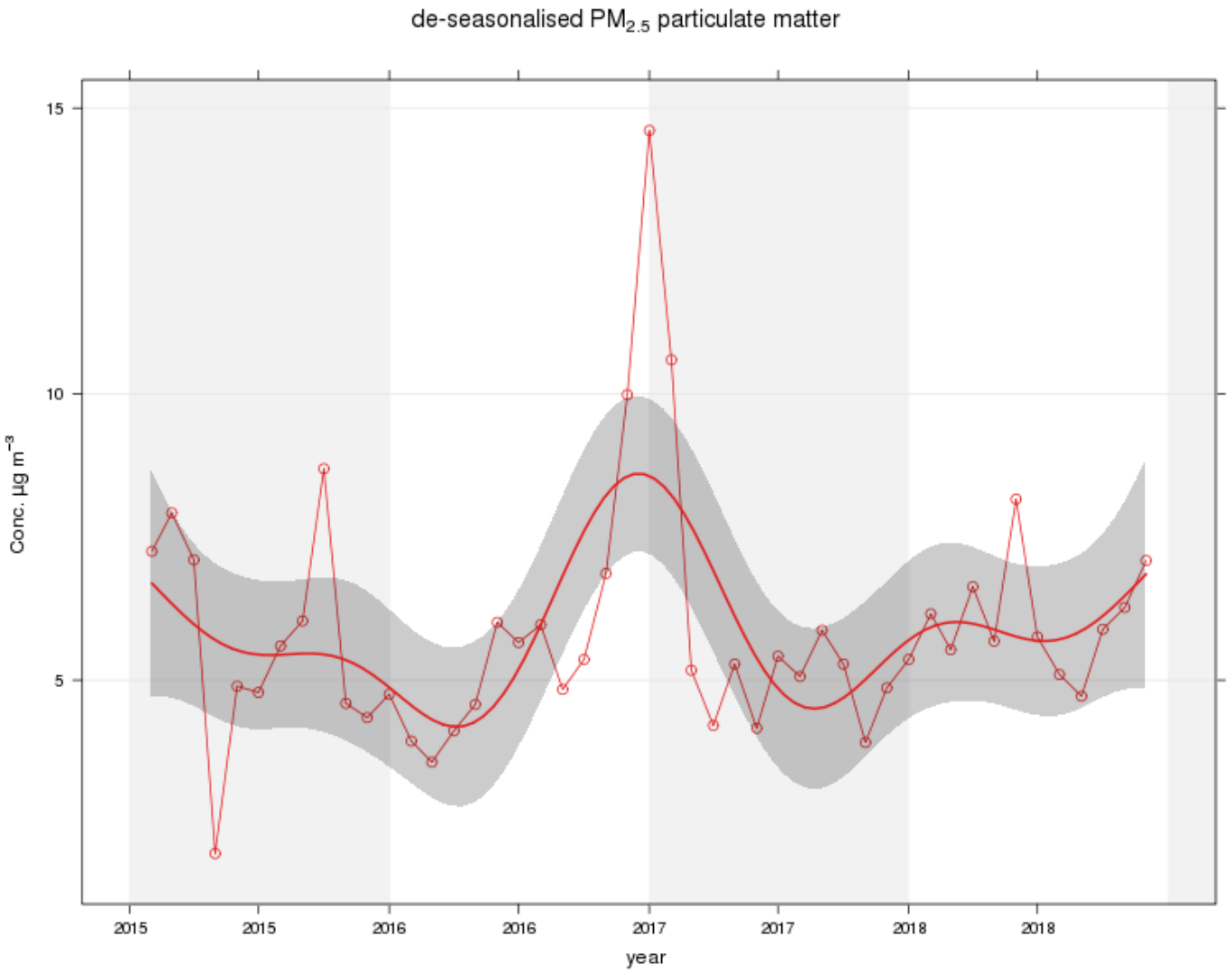


Table A.8 – SO_2 Monitoring Results

Site ID	Site Type	Valid Data Capture for monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	Number of Exceedances (percentile in bracket) (3)		
				15-minute Objective (266 µg/m^3)	1-hour Objective (350 µg/m^3)	24-hour Objective (125 µg/m^3)
A3	Bo'ness	97	97	0	0	0
A5	Falkirk Hope St	93	93	0	0	0
A8	Grangemouth AURN	95	95	0	0	0
A9	Grangemouth Moray	93	93	1	0	0
A10	Grangemouth Municipal Chambers	97	97	0	0	0
A11	Grangemouth Zetland Park	90	90	0	0	0

Notes: Exceedances of the SO_2 objectives are shown in **bold** (15-min mean = 35 allowed a year, 1-hour mean = 24 allowed a year, 24-hour mean = 3 allowed a year)

(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 relevant percentiles are provided in brackets.

Figure 17 – A3 Bo'ness Long Term SO_2 Concentrations

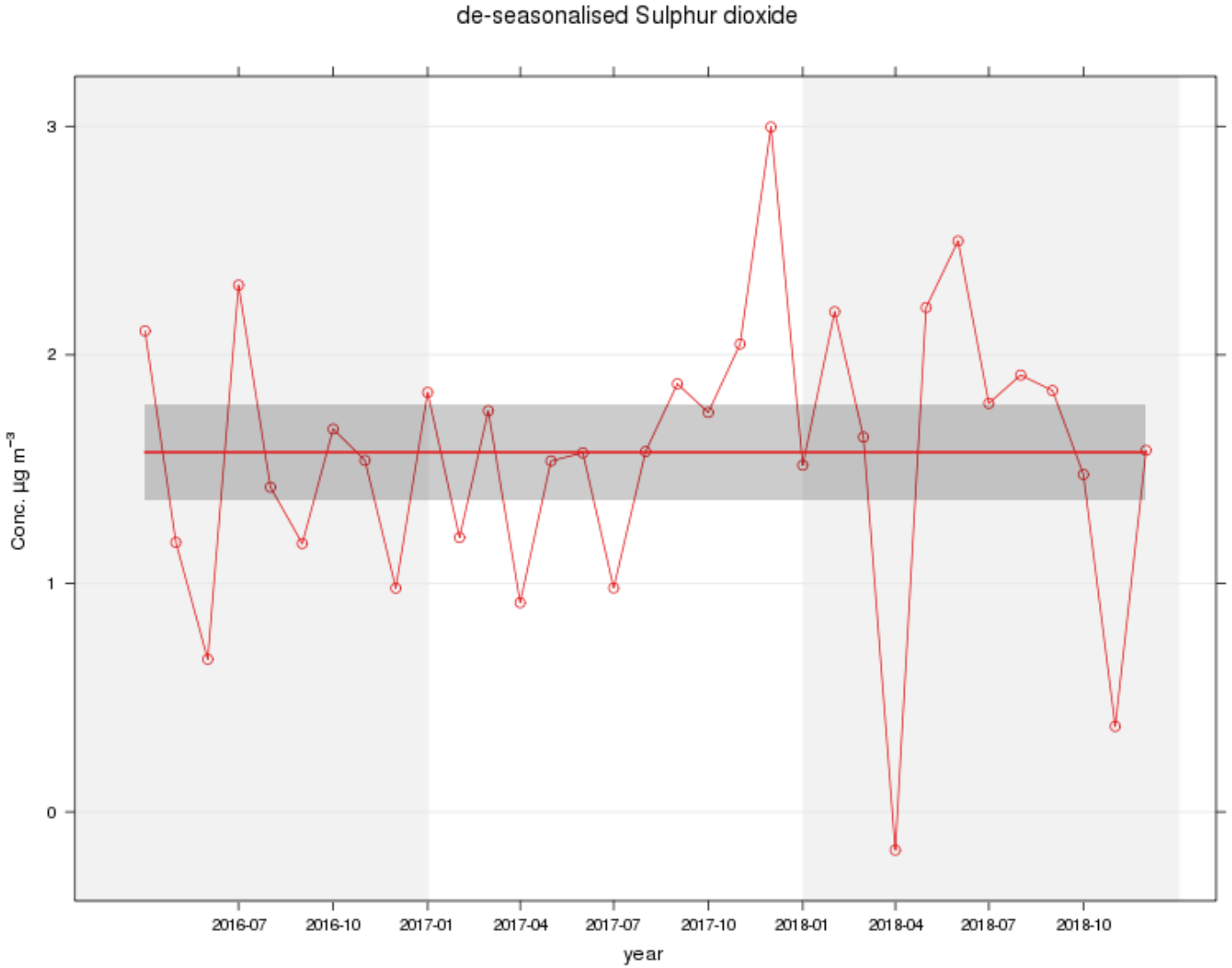


Figure 18 – A5 Falkirk Hope St Long Term SO_2 Concentrations

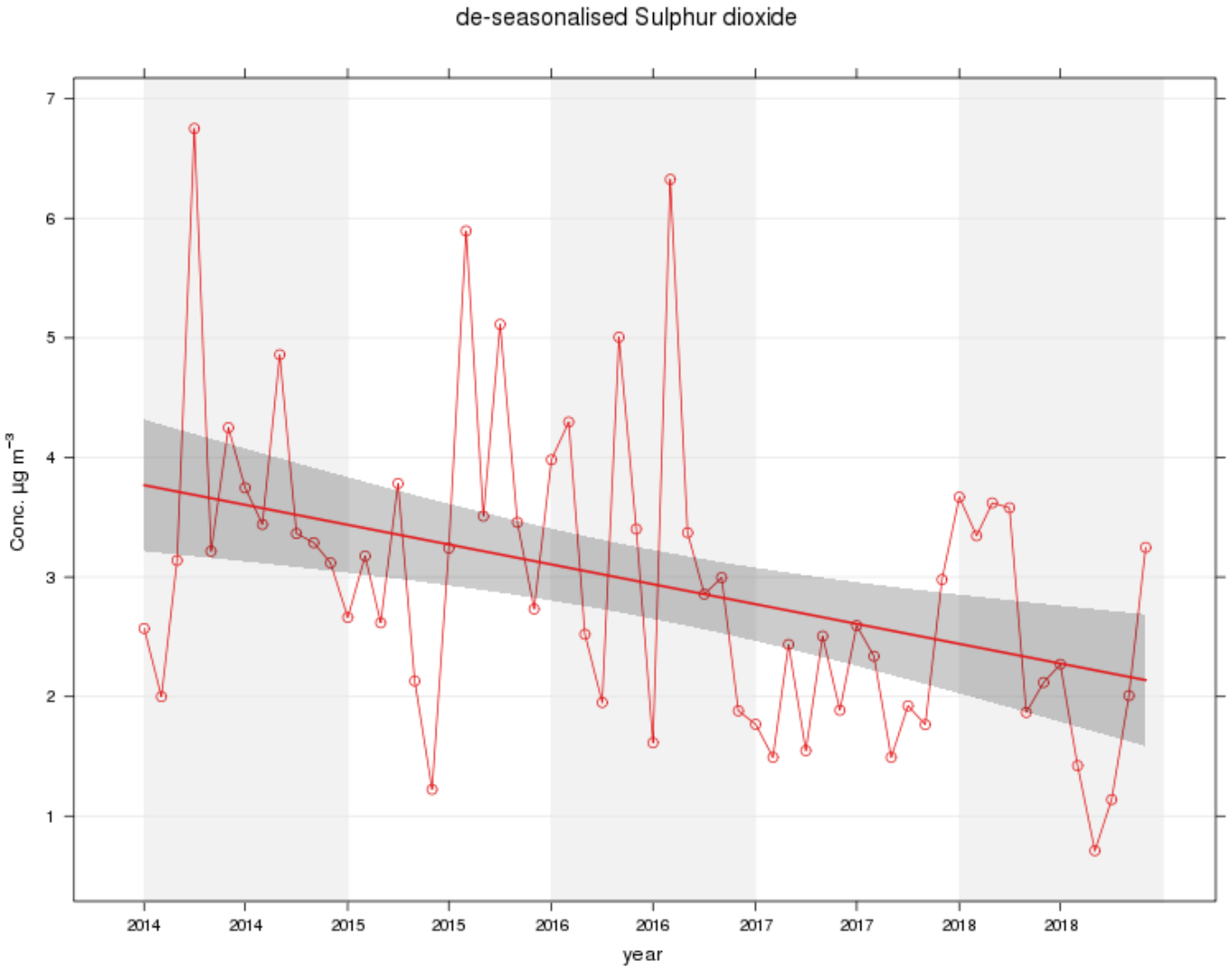


Figure 19 – A8 Grangemouth AURN Long Term SO_2 Concentrations

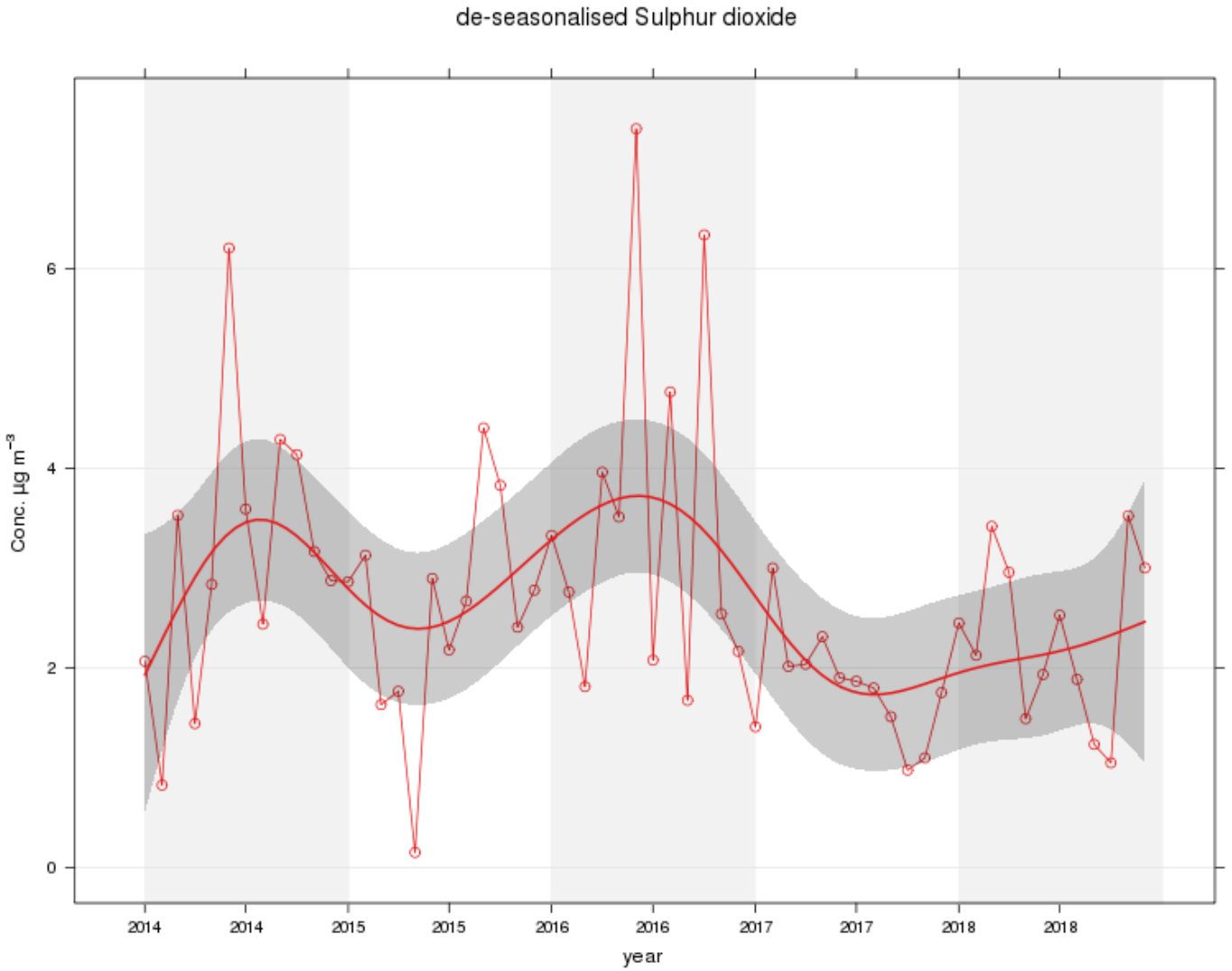


Figure 20 – A9 Grangemouth Moray Long Term SO_2 Concentrations

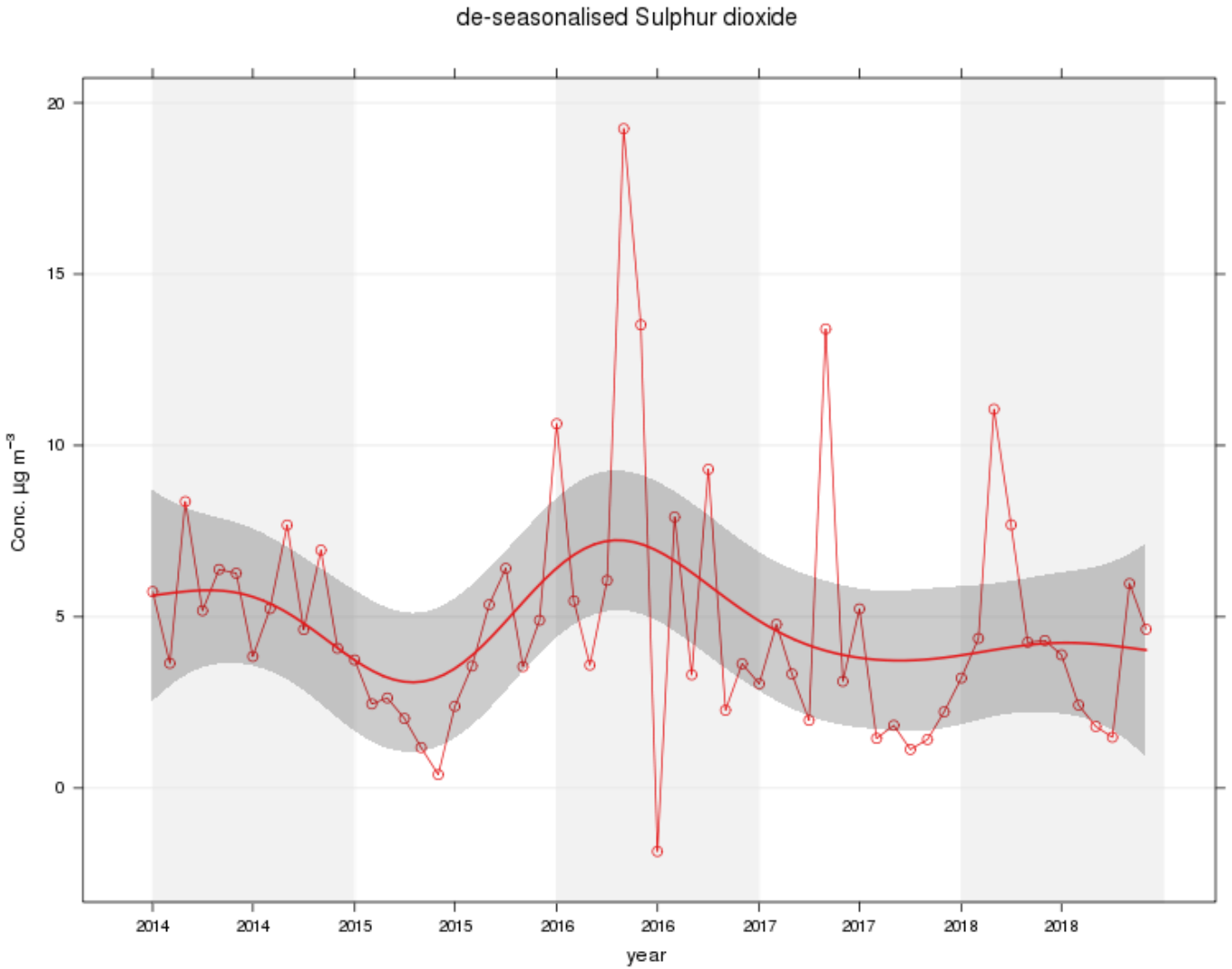


Figure 21 – A10 Grangemouth Municipal Chambers Long Term SO_2 Concentrations

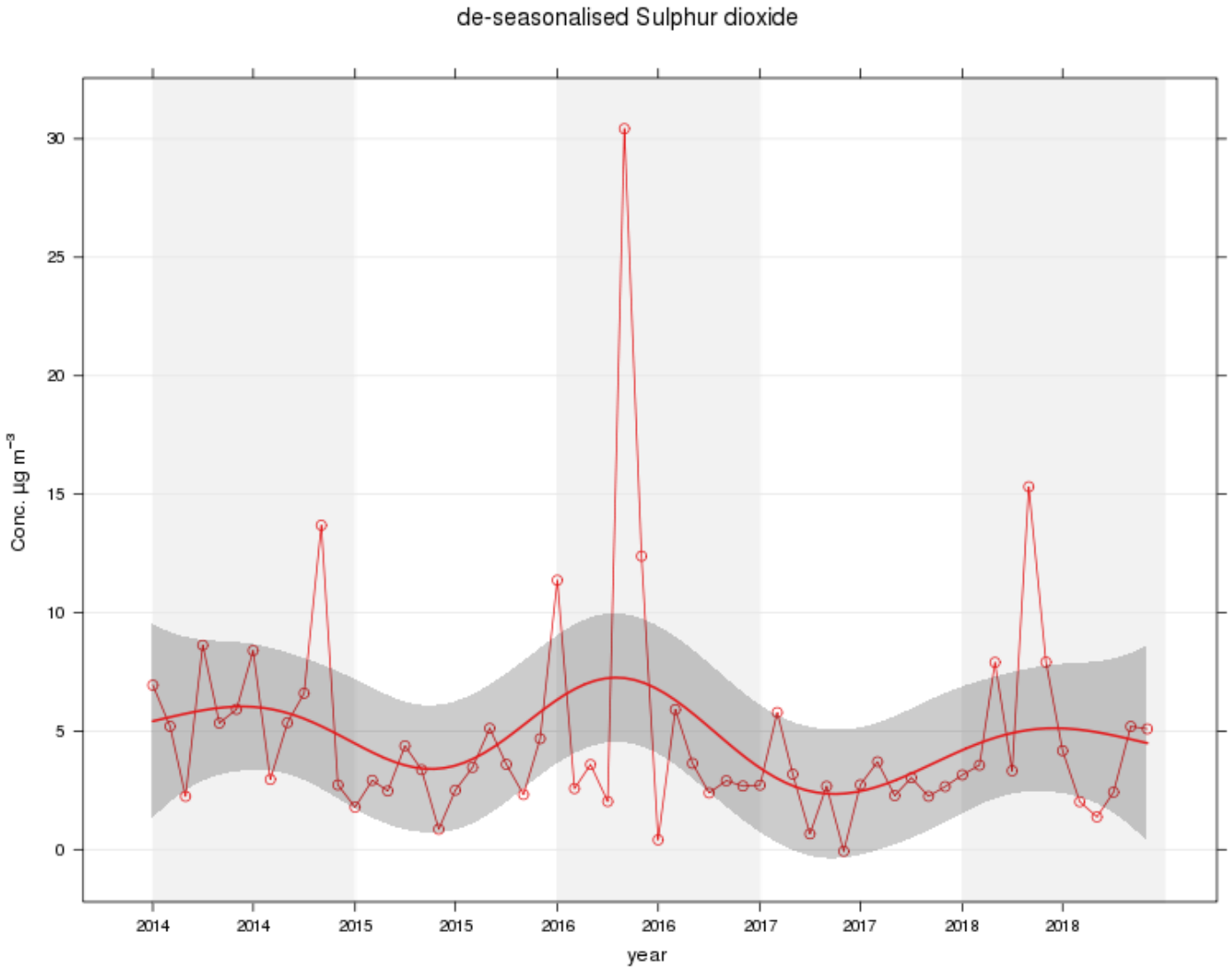


Figure 22 – A11 Grangemouth Zetland Park Long Term SO_2 Concentrations

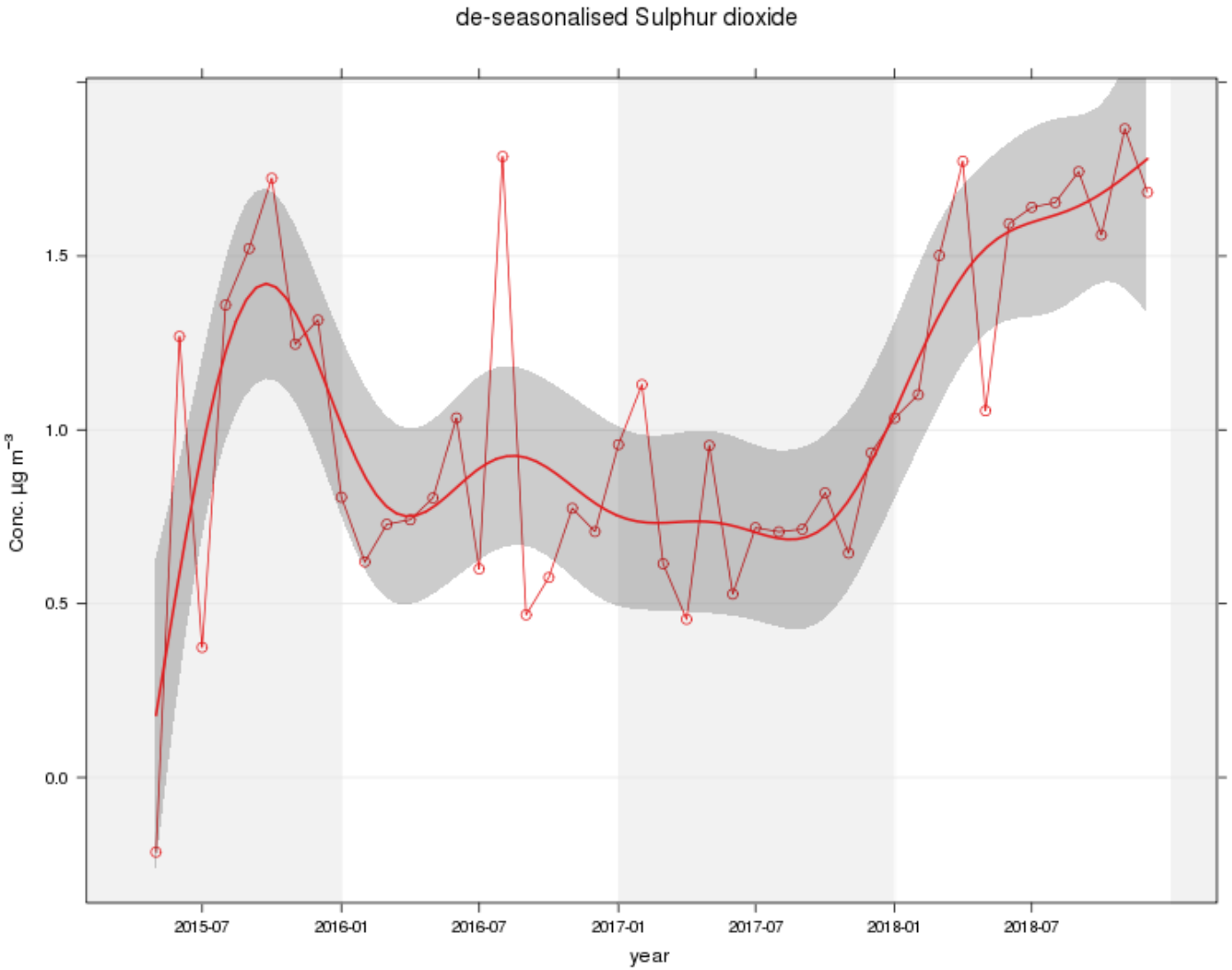
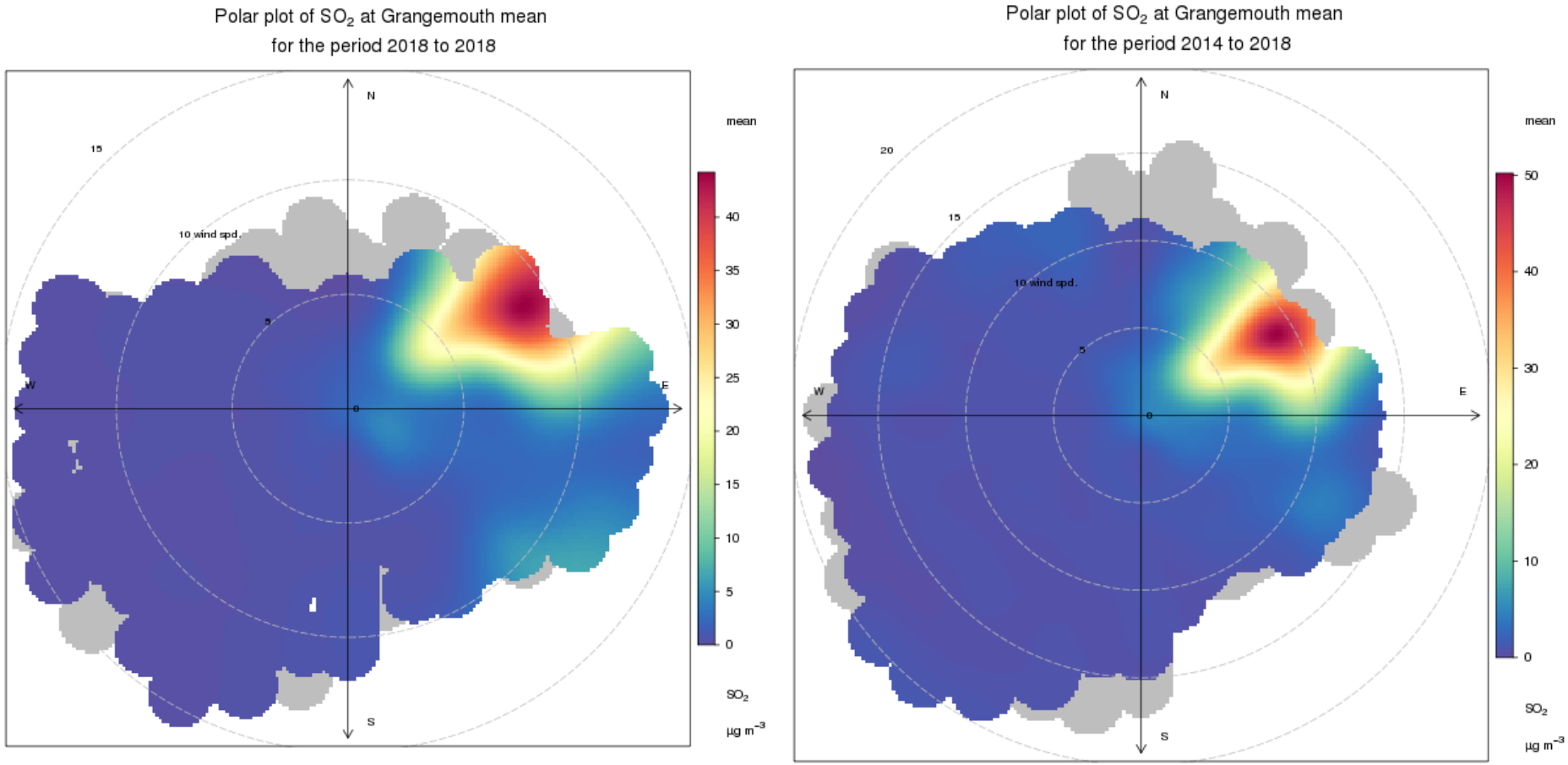


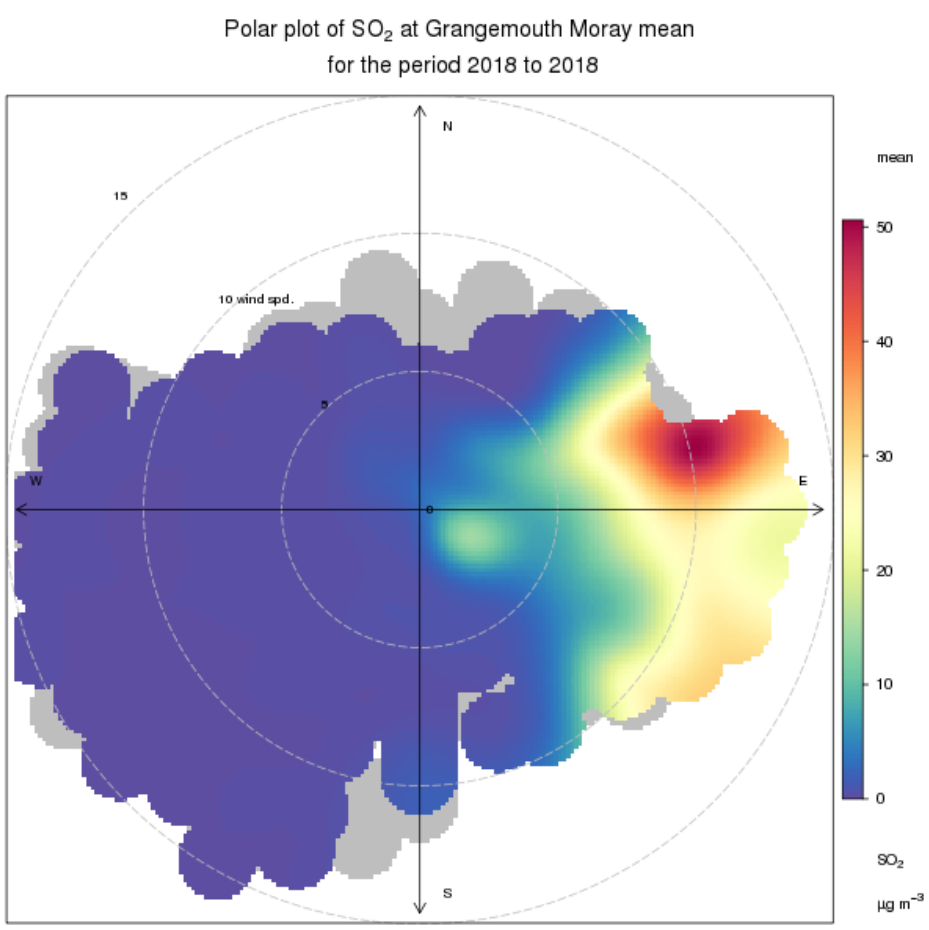
Figure 23 – Polar Plots of Average SO_2 Concentrations Recorded at the Grangemouth Sites

A) Grangemouth AURN: 2018

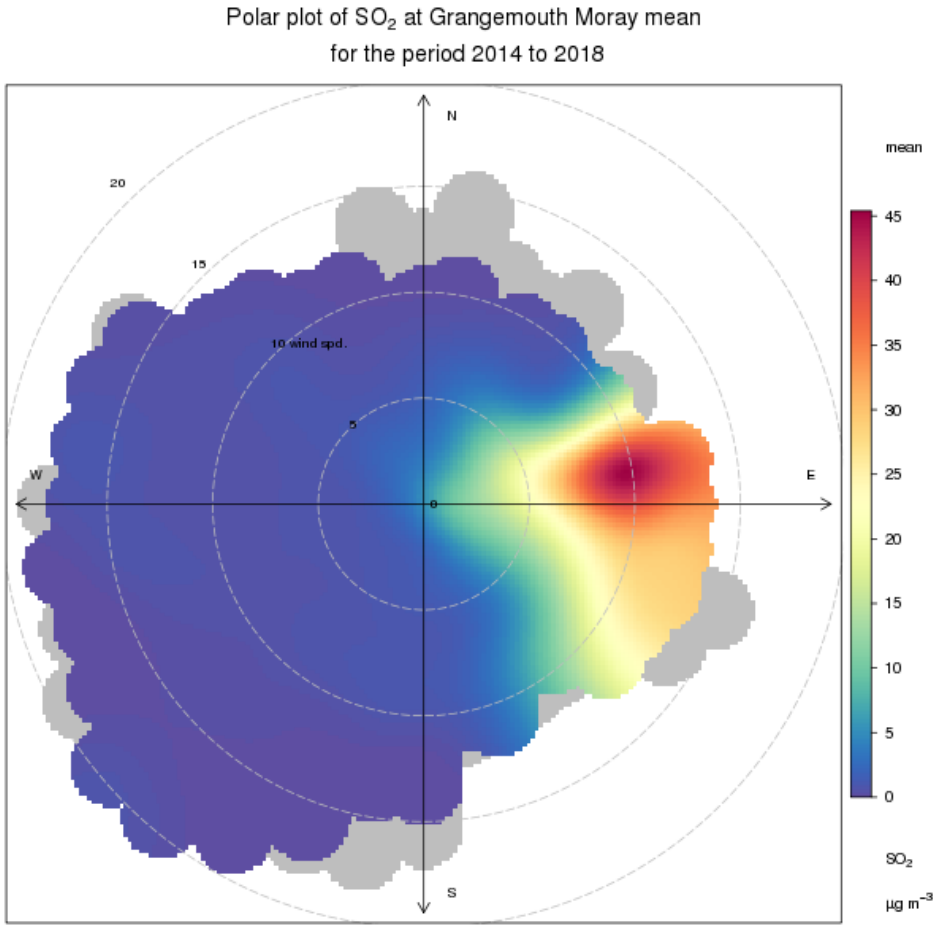
B) Grangemouth AURN: 2014 – 2018



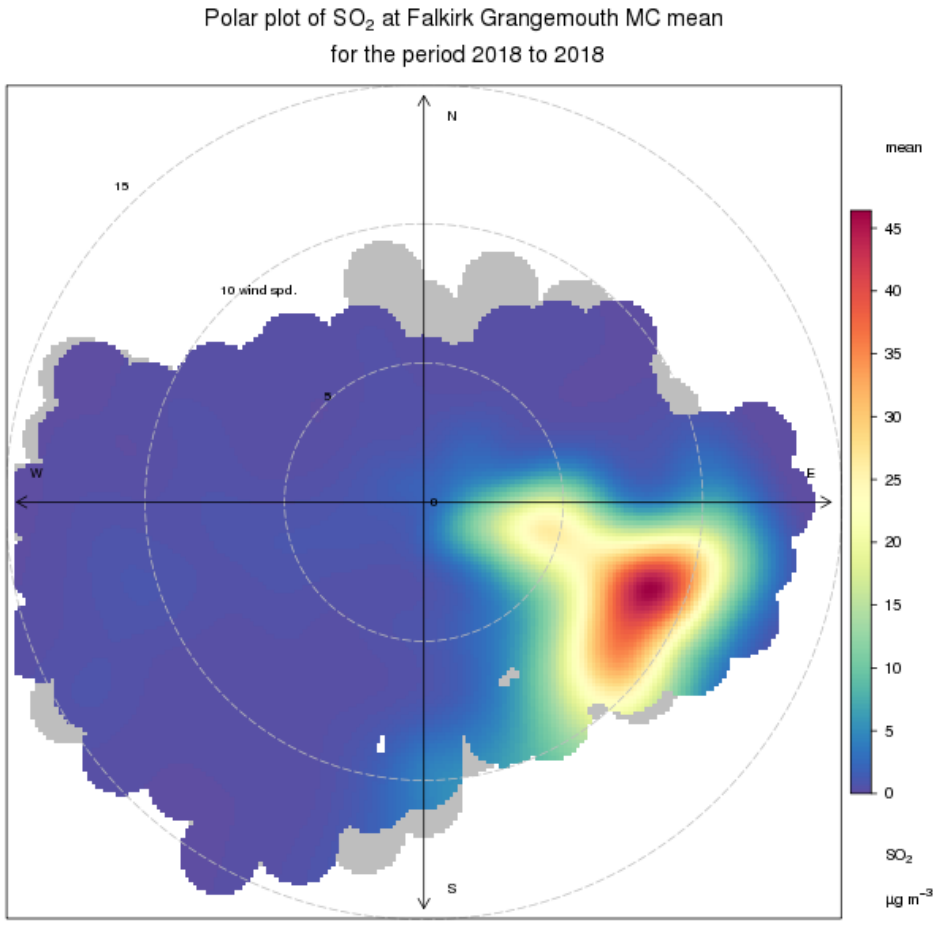
C) Grangemouth Moray: 2018



D) Grangemouth Moray 2014 – 2018



E) Grangemouth Municipal Chambers: 2018



F) Grangemouth Municipal Chambers: 2014 – 2018

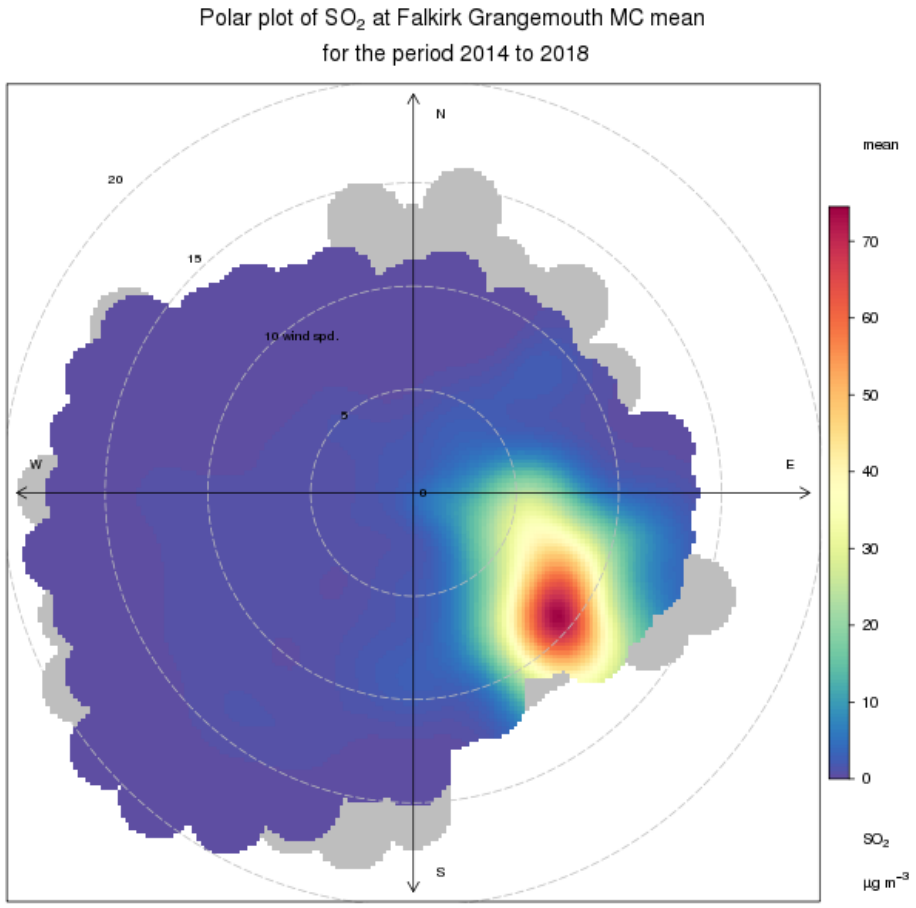


Figure 24 – Exceedances of the 15 Minute SO_2 NAQS Objective Concentration at the Grangemouth Sites 2014 – 2018

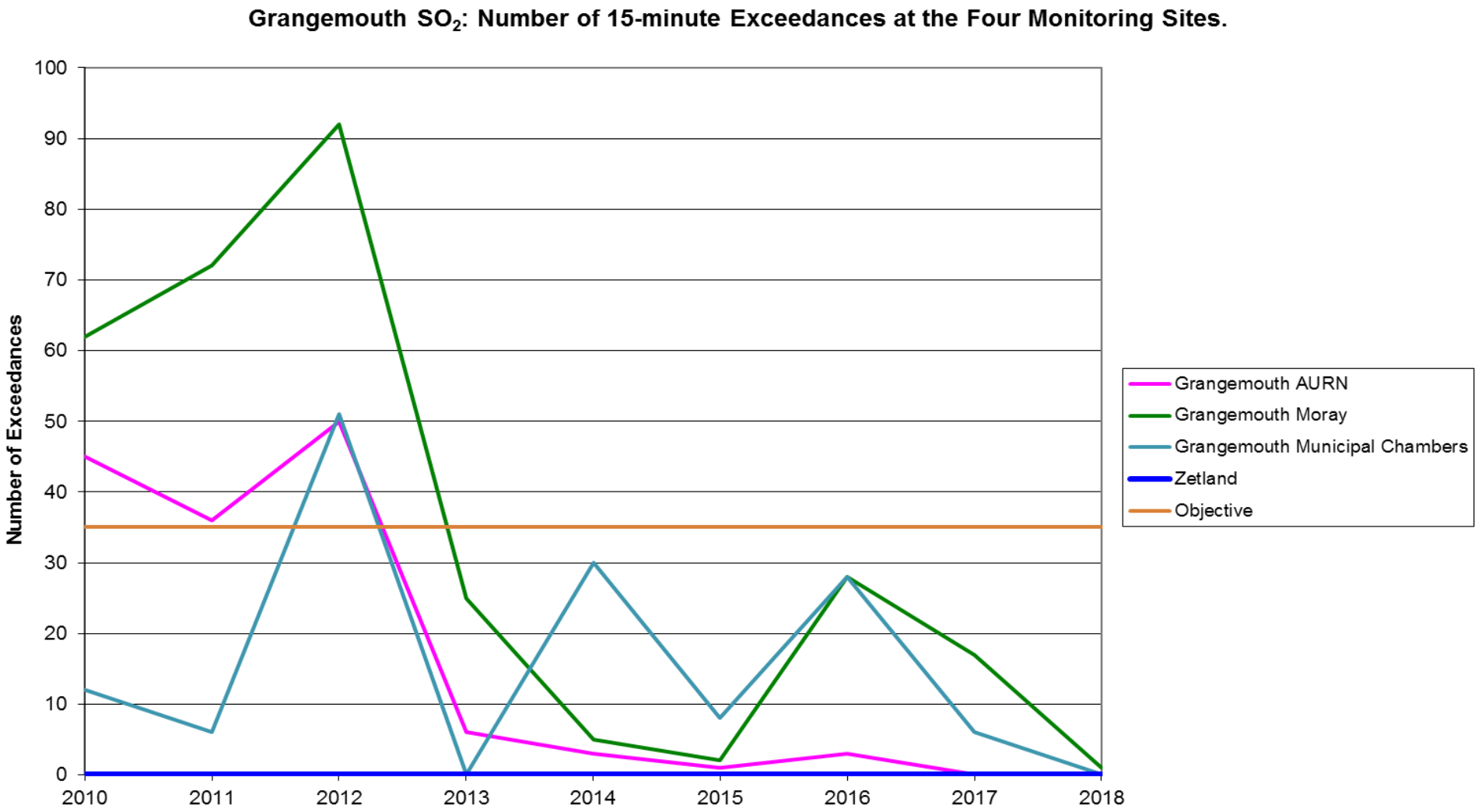


Table A.9 – 1, 3 Butadiene Annual Mean Diffusion Tube Results for 2018

Site ID	Location	Within 1, 3 butadiene AQMA?	Data capture in 2018, %.(1)	Annual Mean concentrations (µg/m^3)				
				2014	2015	2016	2017	2018
NA41	Seaview Place, Bo'ness	N	91.7	0.42	0.11	0.10	0.1	0.06
NA55	Inchyra Station, Grangemouth	N	91.7	0.48	0.09	0.10	0.07	0.07
NA104	Powdrake Road, Grangemouth	N	100	0.47	0.13	0.11	0.1	0.11

Note: Exceedances of the 1, 3 butadiene running annual mean NAQS objective are shown in **bold.**

Table A.10 – Benzene Annual Mean Diffusion Tube Results for 2018

Site ID	Location	Within Benzene AQMA?	Data capture in 2018, %.(1)	Annual mean concentrations (µg/m^3)				
				2014	2015	2016	2017	2018
NA3	Tinto Drive, Grangemouth	N	91.7	1.3	1.16	0.51	0.58	0.66
NA21	Grangemouth Road, Falkirk College	N	91.7	1.13	0.72	0.46	0.56	0.6
NA27	West Bridge Street, Falkirk	N	100	2.39	0.69	0.78	0.68	0.7
NA37	Denny Town House	N	100	1.09	0.59	0.58	0.56	0.49
NA38	Larbert Village Primary School	N	91.7	1.04	0.55	0.51	1.01	0.5
NA41	Seaview Place, Bo'ness	N	100	1.97	0.91	1.11	0.82	0.91
NA42	Municipal Chambers, Grangemouth	N	100	1.25	0.69	0.79	0.47	0.63
NA44	Harvey Avenue, Polmont	N	100	1.34	0.56	0.48	0.39	0.52
NA55	Inchyra AQ Station, Grangemouth	N	83.3	1.32	0.5	0.46	0.52	0.52
NA57	Inchyra Road, Grangemouth	N	100	1.96	0.69	0.90	0.57	0.91
NA77	Kinnaird Village	N	83.3	1.04	0.65	0.44	0.51	0.44
NA80	Cow Wynd, Falkirk	N	100	1.33	0.81	0.56	0.57	0.52
NA81	Grahams Road, Falkirk	N	91.7	1.25	0.88	0.95	0.7	0.81
NA94	A905 (Glensburgh Rd), Grangemouth	N	91.7	1.13	0.68	0.78	0.64	0.68
NA105	West of Shieldhill	N	83.3	0.74	0.34	0.19	0.69	0.3
NA113	Union St, Bo'ness	N	100	New site for 2018				0.64

Note: Exceedances of the Benzene running annual mean objective of 3.25µg/m^3 are shown in **bold.**

Table A.11 – Pumped Benzene Annual Mean Results for 2018

Site ID	Location	Within Benzene AQMA?	Data capture in 2018, % (1)	Annual mean concentrations (µg/m^3)				
				2014	2015	2016	2017	2018
A8	Grangemouth AURN	N	100	0.99	0.73	0.64	0.65	0.74

Note: Exceedences of the Benzene running annual mean objective of 3.25µg/m^3 are shown in **bold.**

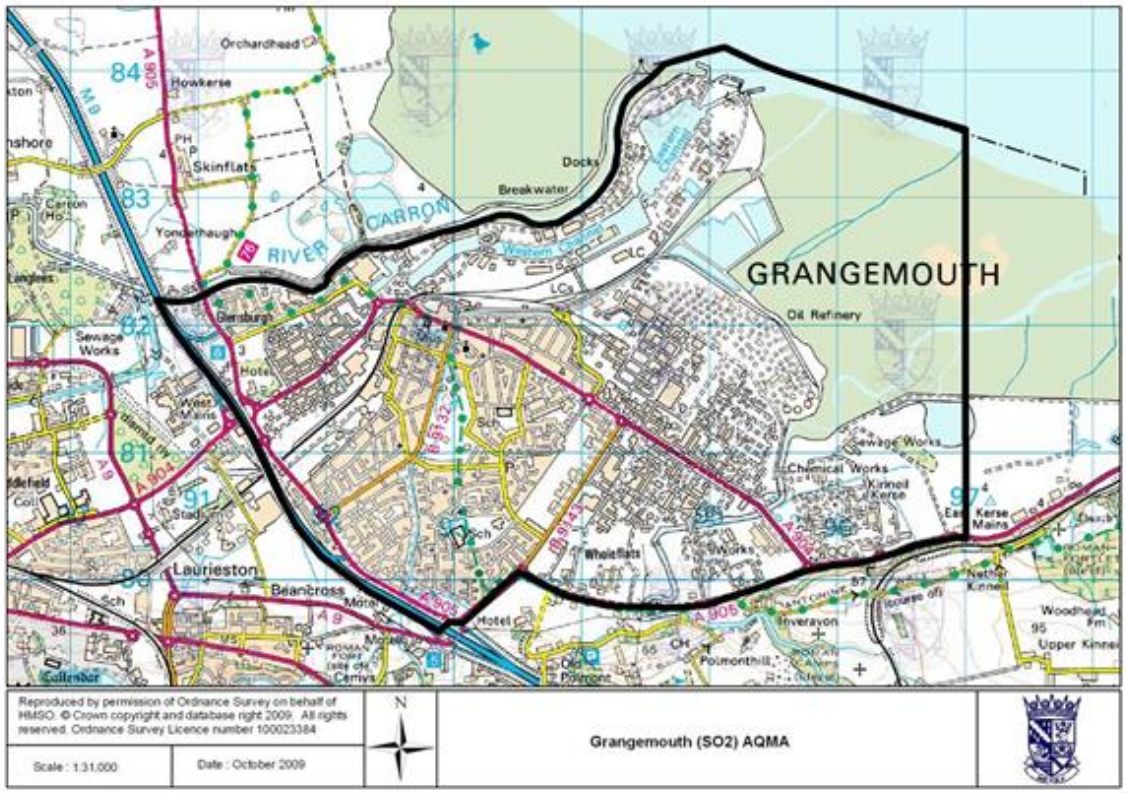
Table A.12 – Estimated Annual Mean $PM_{2.5}$ Results for 2018

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture in 2018 (%) (2)	Correction Factor	Estimated $PM_{2.5}$ Annual Mean Concentration (µg/m^3) (3)				
					2014	2015	2016	2017	2018
A4 Falkirk Haggs	Roadside (Non-urban)	89	89	0.55	7.62	6.92	6.46	5.54	7.7
A5 Falkirk Hope St	Roadside (Urban)	19 (1)	19 (1)	1	PM_{10} analyser not operating at this site				**11**
A10 Grangemouth Municipal Chambers	Urban Background / Industrial	88	88	0.58	9.73	8.67	8.67	8.00	6.96
A14 Banknock 3	Roadside (Non-urban)	80	80	0.55	6.92	3.78	n/m	3.05	4
A15 Main St, Bainsford	Roadside (Urban)	70	70	1	n/m	7.68	6.00	7.80	**12**

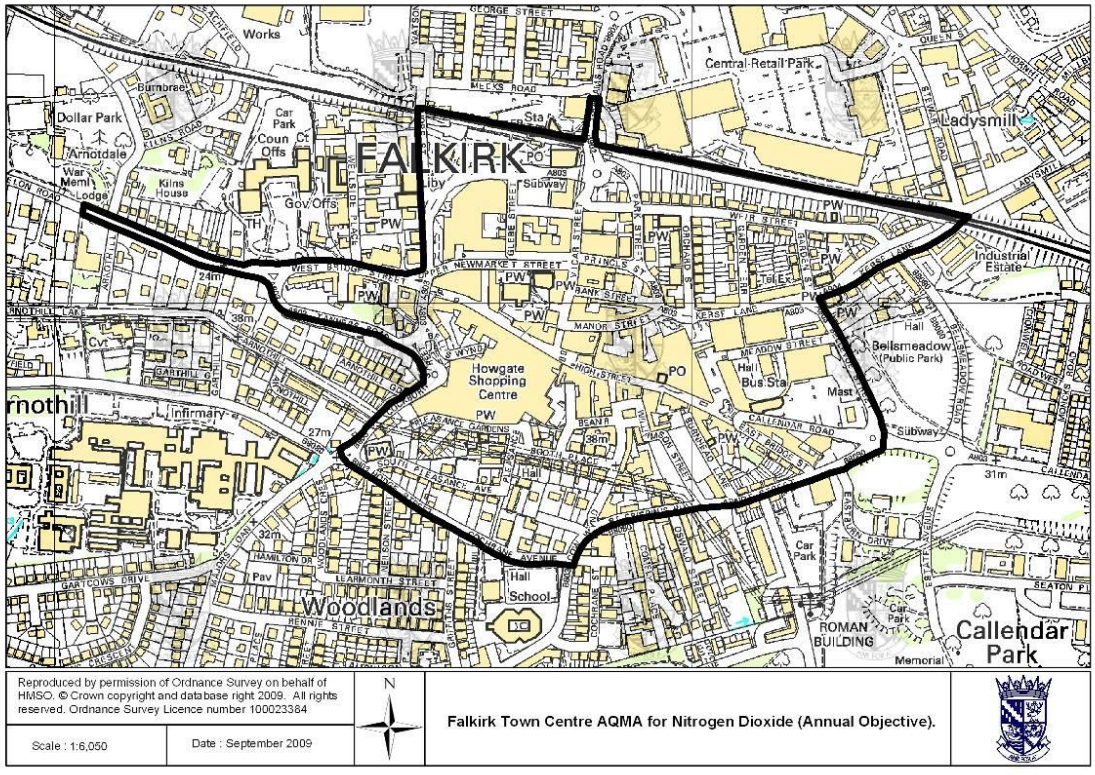
Note: Exceedences of the $PM_{2.5}$ annual mean objective of 10µg/m^3 are shown in **bold.**
(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%)
(3) All means have been estimated using a local correction factor as per LAQM.TG (16). See Appendix C for details.

Figure 25 – Maps of the AQMA Boundaries in the Falkirk Council Area

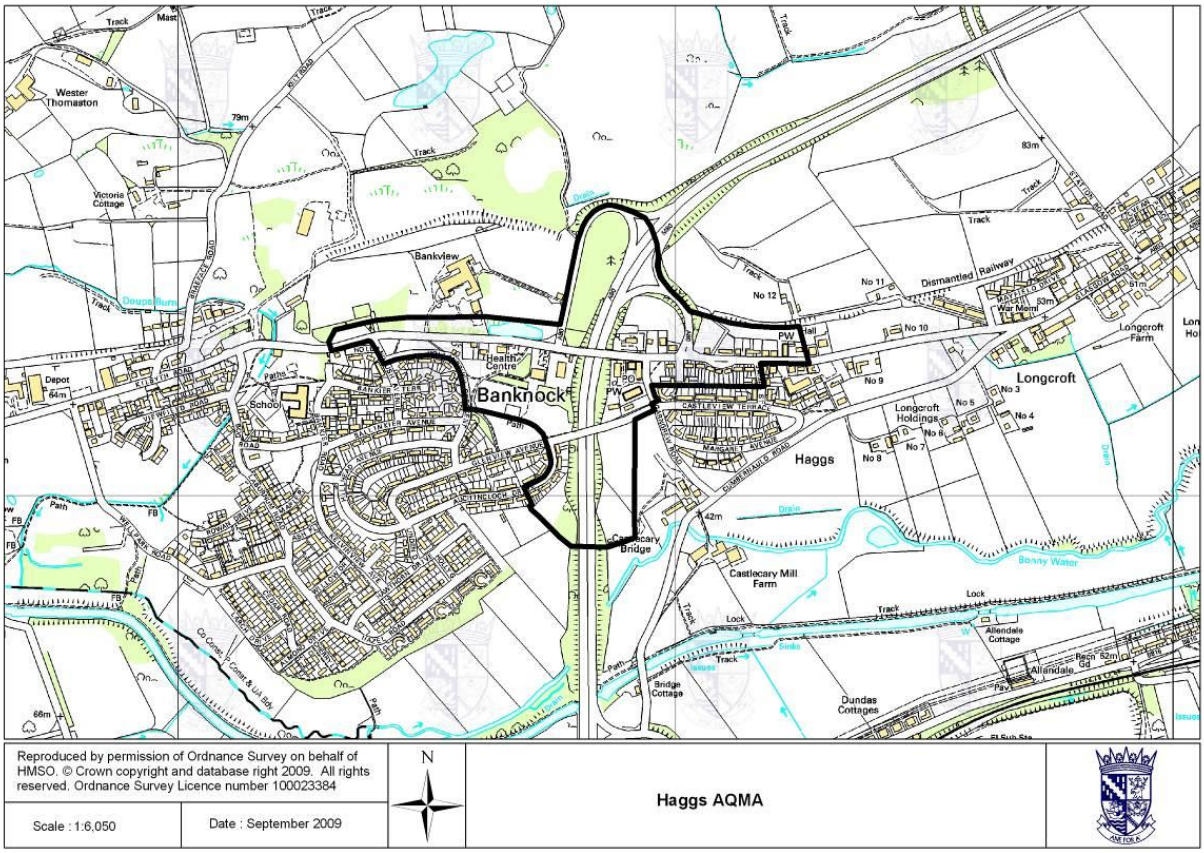
A) Grangemouth AQMA (SO_2, 15min mean), declared November 2005



B) Falkirk Town Centre AQMA (NO_2 Annual Mean, PM_{10} annual and 24-hour mean), declared March 2010



C) Haggs AQMA (NO_2 annual mean), declared March 2010



D) Banknock AQMA (PM_{10} 24-hour mean), declared August 2011

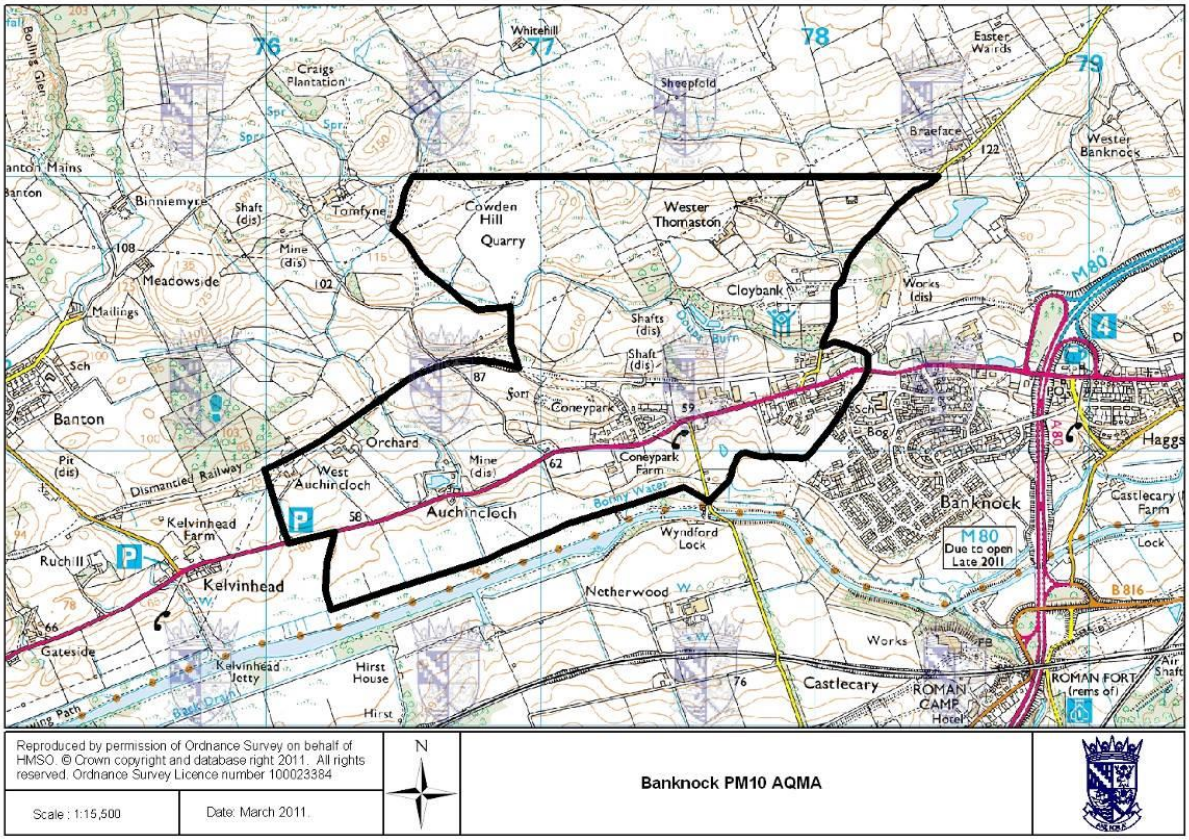
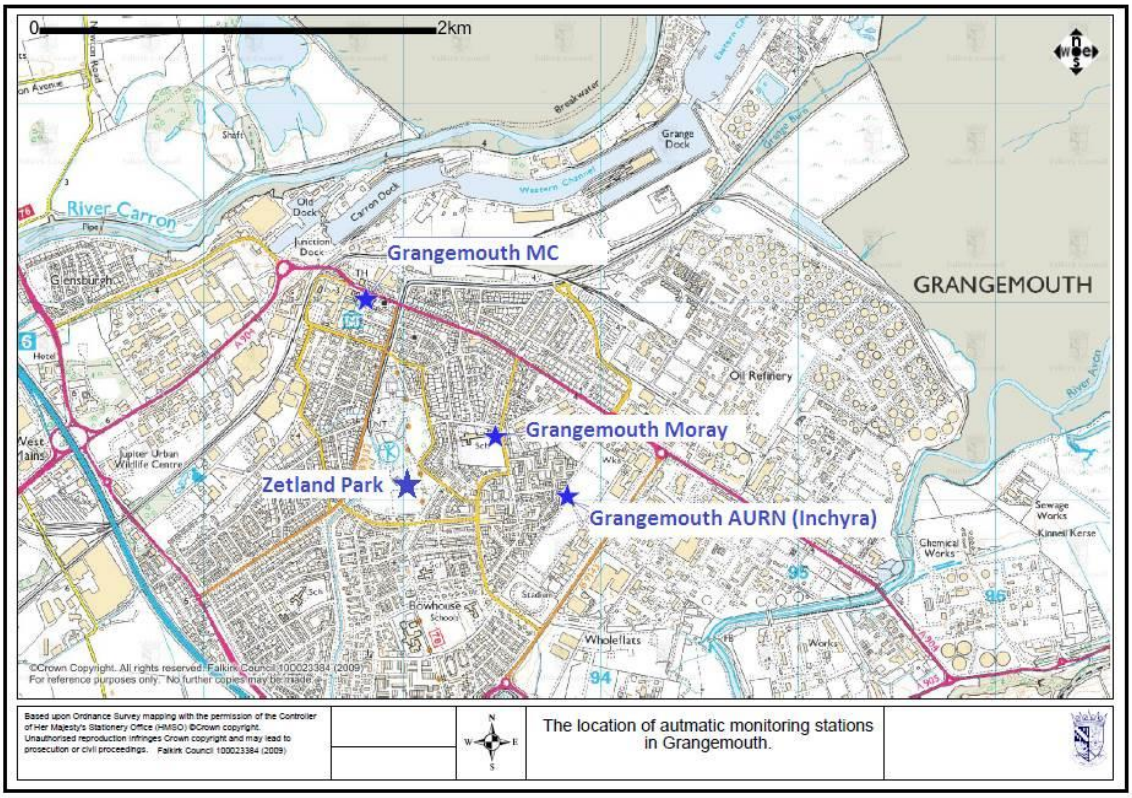
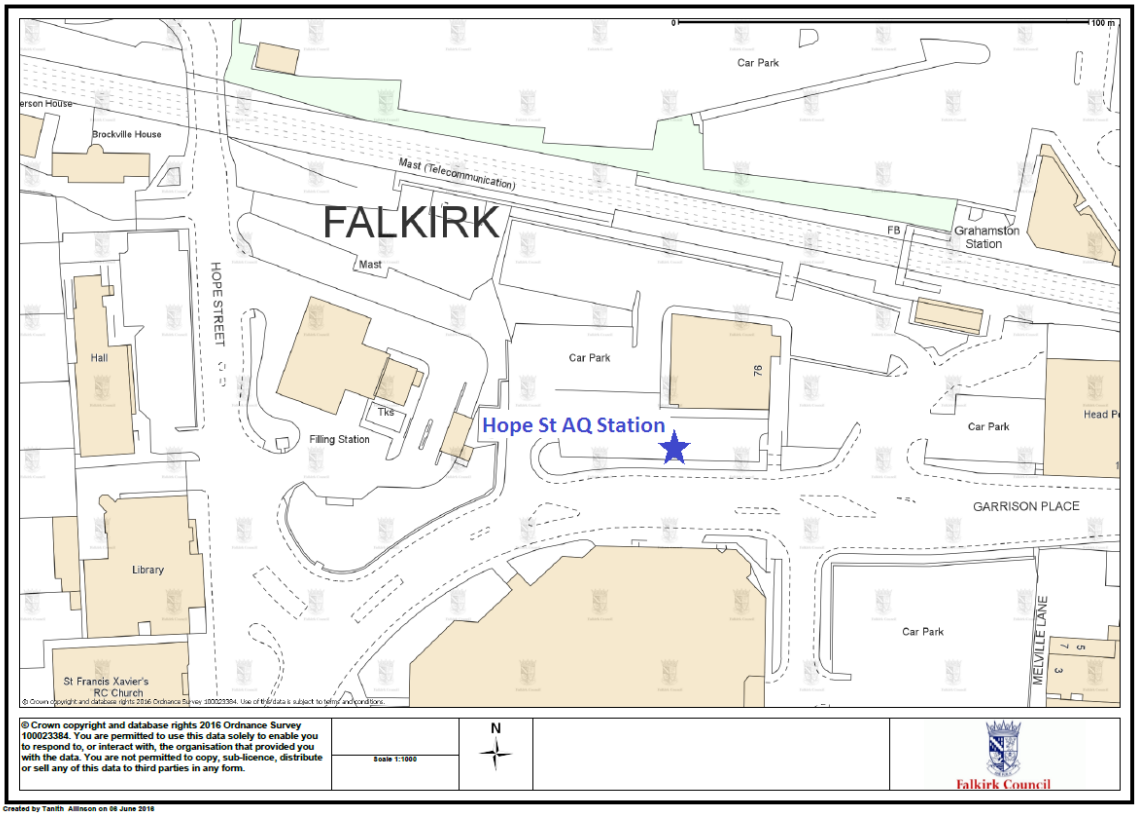


Figure 26 – Maps Showing Automatic Monitoring Locations

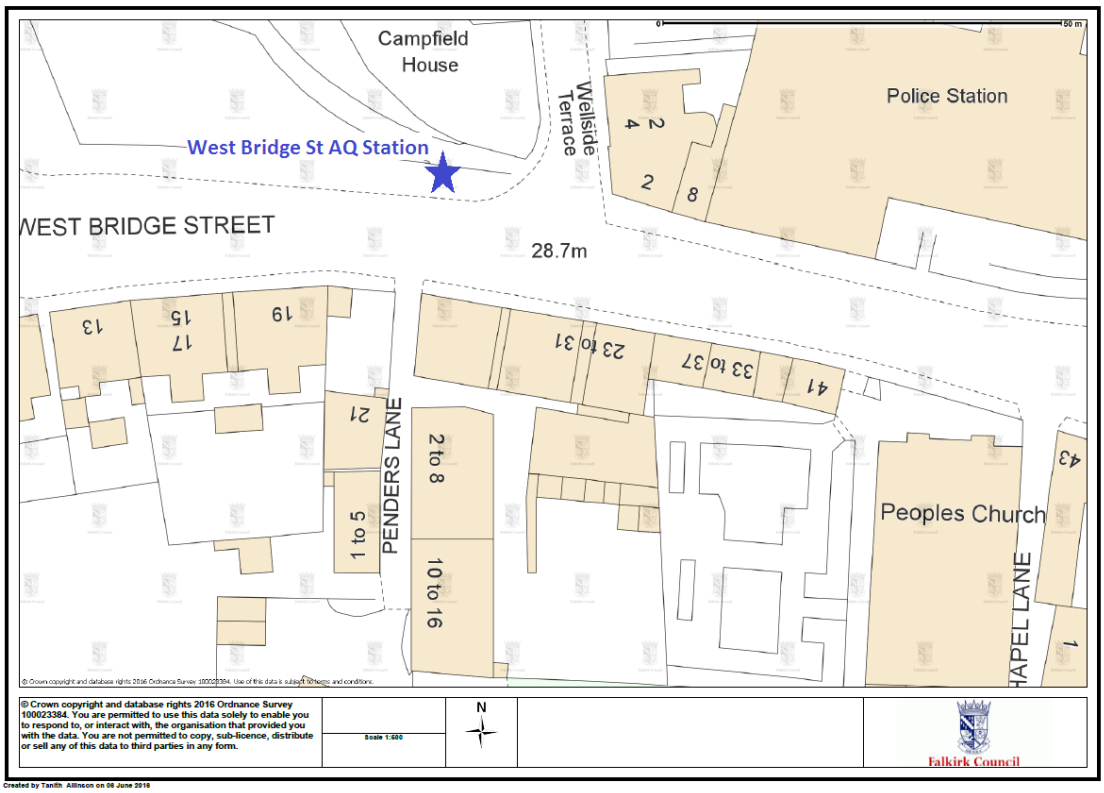
A) Grangemouth Air Quality (AQ) Stations



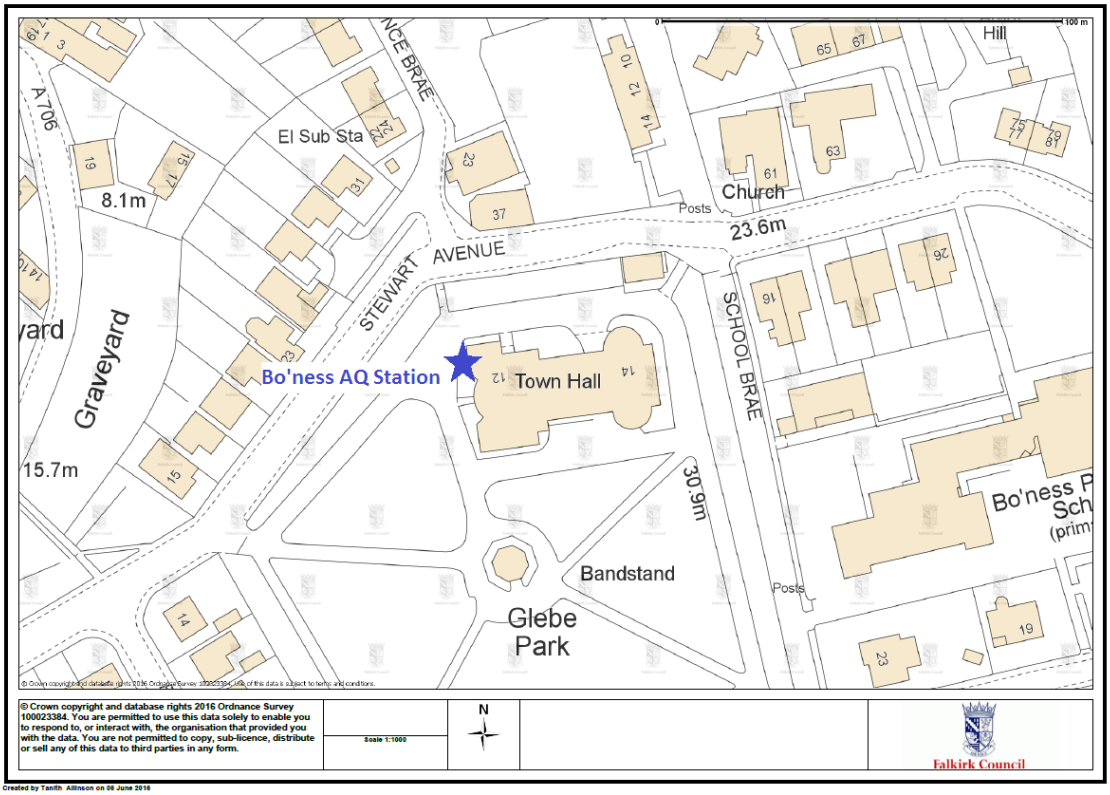
B) Falkirk Hope St AQ Station



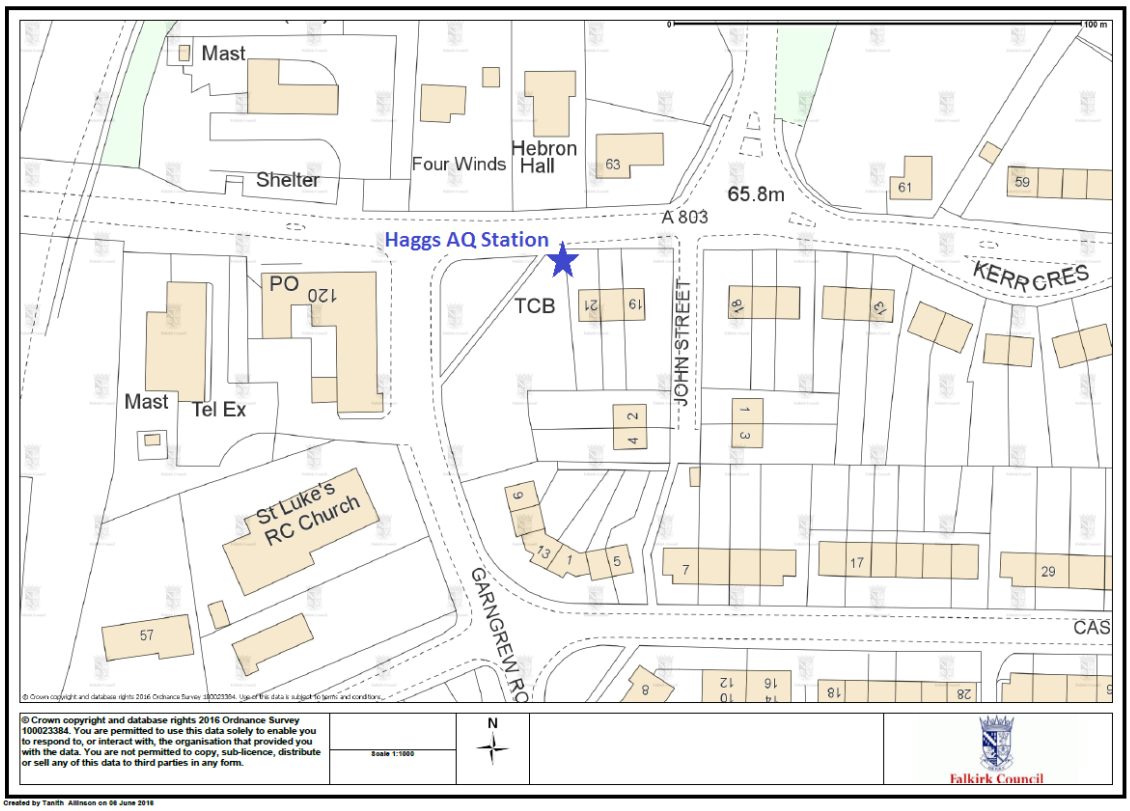
C) Falkirk West Bridge St AQ Station



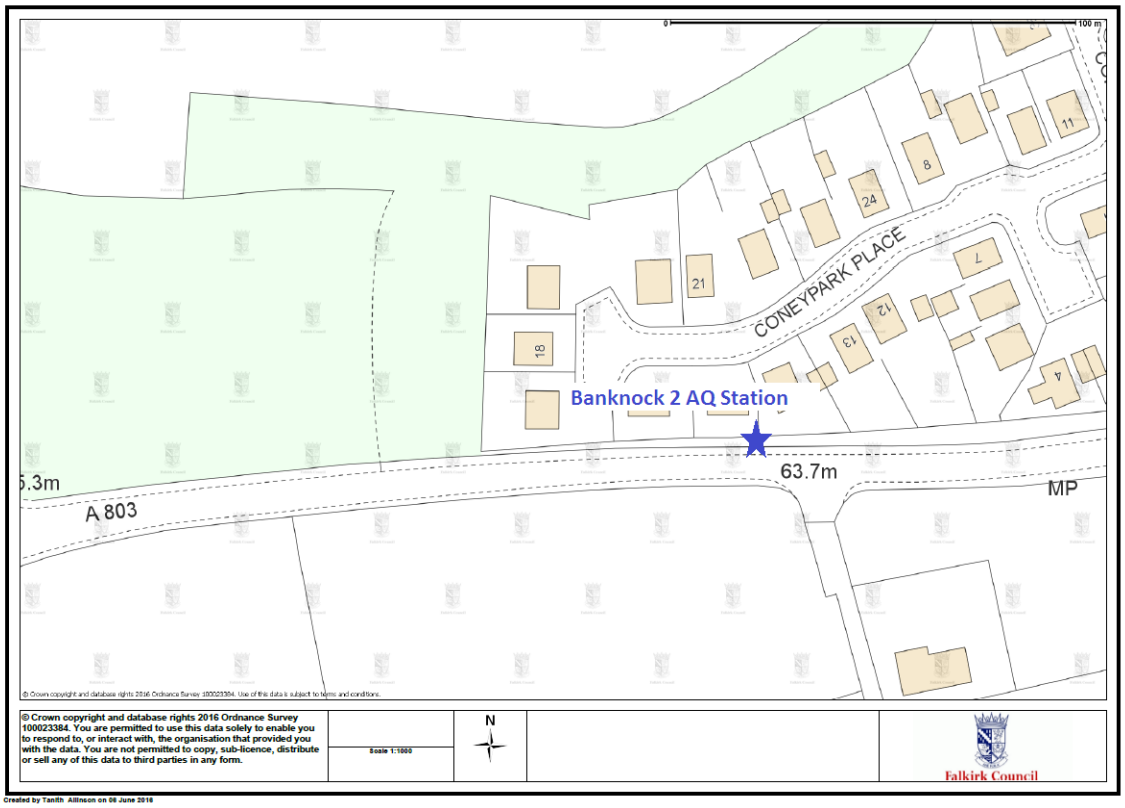
D) Bo'ness AQ Station



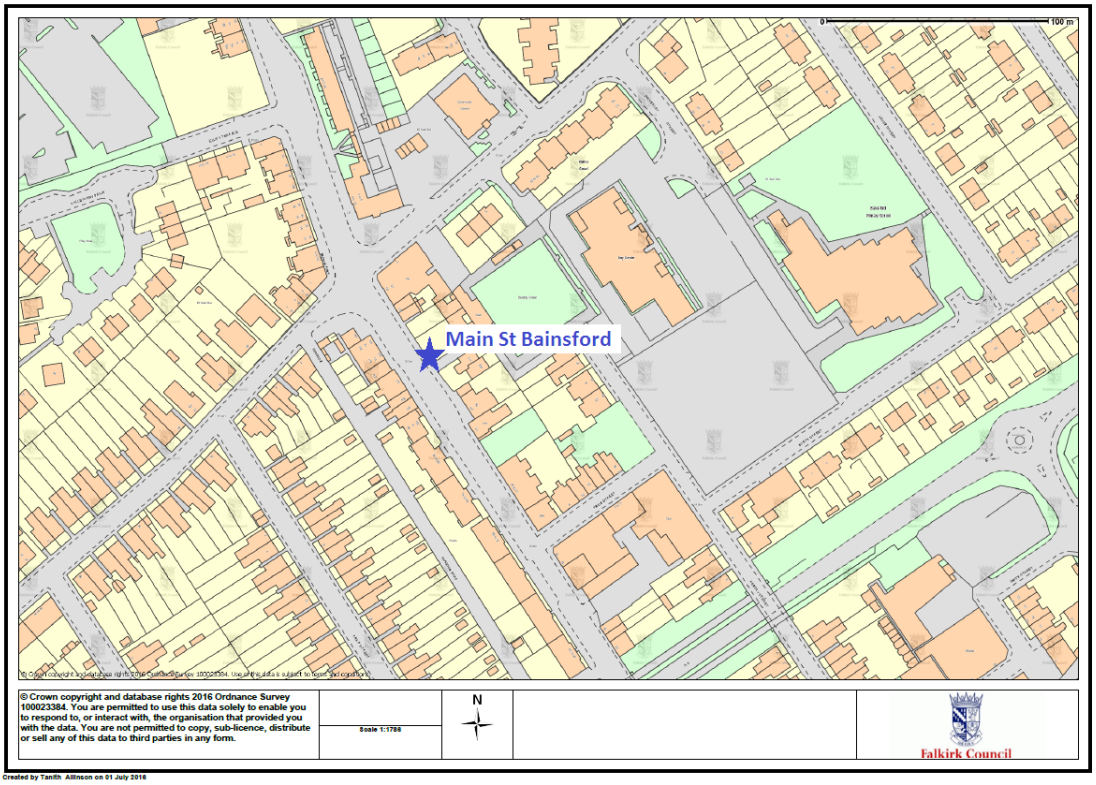
E) Falkirk Haggs AQ Station



F) Banknock 2 AQ Station



G) Main St, Bainsford, Falkirk AQ Station



Appendix B: Full Monthly Diffusion Tube Results for 2018

Table B.1 – NO_2 Monthly Diffusion Tube Results for 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 (1)
NA3	25.02	25.34	21.89	19.33	20.49	16.48	14.29	12.48	14.29	21.93	30.20	26.99	21	18
NA5	34.59	29.48	27.28	25.69	21.92	24.42	22.23	22.26	23.85	29.24	37.01	35.74	28	24
NA7	28.46	22.67	21.38	17.02	16.63	14.46	13.08	12.35	11.61	17.25	24.51	25.81	19	17
NA9	-	30.17	24.81	21.32	21.71	19.44	19.41	21.69	21.01	28.34	33.57	36.82	25	22
NA19	40.41	-	36.88	33.65	34.04	17.97	24.15	21.54	-	29.22	42.91	38.35	32	28
NA20	30.91	29.16	-	21.30	20.03	18.99	17.53	19.93	-	25.61	33.70	32.79	25	22
NA21	30.56	31.24	40.15	32.71	26.37	31.22	27.99	26.58	24.39	31.78	40.67	38.41	32	28
NA24	42.30	49.32	35.64	38.50	-	34.89	35.87	33.56	34.99	35.53	39.11	46.37	39	34
NA26	26.70	30.69	26.62	24.14	20.25	17.94	15.20	15.16	14.84	21.10	28.41	31.21	23	20
NA27	50.34	48.75	58.30	57.35	48.09	45.15	42.56	36.77	37.04	47.12	66.39	59.77	**50**	**44**
NA29	29.52	23.93	22.92	20.09	18.75	16.09	13.52	13.46	9.21	19.51	28.39	27.34	20	18
NA36	51.75	41.01	41.76	39.09	-	40.17	34.01	35.74	32.25	44.95	52.36	44.90	**42**	37
NA37	25.83	23.23	22.24	15.78	17.64	15.90	12.81	13.11	11.88	19.31	25.31	25.19	19	17
NA38	29.87	22.36	20.04	15.22	16.77	15.07	11.79	12.75	12.08	19.16	25.17	28.76	19	17
NA41	27.22	29.05	23.74	-	24.91	21.19	20.47	20.25	21.44	21.56	29.79	35.25	25	22

Site ID	NO_2 Mean Concentrations (µg/m^3)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean	
													Raw Data	Bias Adjusted (1)
NA42 (3 Tubes)	23.52	23.40	24.12	17.80	22.80	18.32	14.76	14.88	15.76	19.75	26.81	30.91	21	19
	25.41	26.81	21.18	19.76	23.58	19.40	14.19	14.49	15.96	19.89	27.83	30.78		
	25.74	24.80	21.90	19.90	22.81	18.38	14.78	14.39	14.92	20.15	27.67	30.92		
NA44	25.07	25.18	22.35	17.48	19.15	-	-	14.68	14.76	18.37	26.42	28.35	21	19
NA48	28.91	22.30	26.07	18.94	20.27	20.32	15.20	13.55	12.41	18.09	28.48	27.60	21	18
NA50	28.50	29.66	36.00	30.43	27.68	26.70	20.02	17.55	16.24	25.81	33.80	30.16	27	24
NA51	33.59	30.70	27.84	27.93	24.39	20.32	21.15	22.03	19.02	26.60	34.35	35.24	27	24
NA52	35.05	27.55	27.92	24.31	24.18	19.87	19.52	21.59	17.61	27.61	33.57	33.91	26	23
NA53	34.56	30.00	37.40	32.58	33.77	28.28	21.24	19.13	17.31	25.20	41.17	34.23	30	26
NA57	28.29	30.57	25.23	24.13	19.08	17.46	17.97	16.32	16.79	25.63	33.87	35.20	24	21
NA58	35.68	29.89	23.43	23.23	20.72	19.53	-	-	16.99	28.63	30.02	28.62	26	23
NA59	42.46	35.35	32.10	26.82	31.50	25.33	22.96	24.61	26.51	33.70	38.74	46.01	32	28
NA60	35.85	31.01	28.89	24.58	24.58	24.36	19.50	19.35	22.05	28.70	37.40	37.61	28	24
NA61	36.11	28.67	30.11	22.04	23.01	23.06	19.27	19.34	19.06	28.83	37.50	34.57	27	24
NA62	43.94	43.58	36.79	42.59	34.84	33.37	31.99	26.89	33.22	37.97	49.20	43.60	38	34
NA63	56.05	40.46	39.40	38.63	35.27	38.20	31.99	30.10	24.44	41.01	46.22	48.91	39	35
NA64	23.86	21.15	24.58	18.75	18.44	17.55	12.16	11.55	11.81	11.36	29.05	24.65	19	16
NA65	35.34	28.41	30.45	26.98	26.27	26.16	19.37	19.60	20.85	26.79	34.26	36.48	28	24
NA67	36.29	35.09	37.86	33.67	27.39	29.05	23.71	-	27.13	33.18	38.23	12.79	30	27
NA68	40.37	38.76	29.20	26.67	21.72	25.60	27.17	22.23	17.74	-	-	34.30	28	25

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 (1)
NA69	41.07	44.55	41.68	39.94	38.30	36.60	31.97	27.68	23.78	29.66	40.55	39.87	36	32
NA71	36.47	43.20	37.88	31.05	30.99	27.66	26.83	28.20	31.22	38.58	38.82	47.55	35	31
NA72	32.64	-	38.10	32.93	32.35	28.69	25.20	23.94	18.86	34.53	17.40	38.87	29	26
NA73	38.77	33.42	39.66	38.89	36.59	30.65	28.41	29.10	25.86	33.87	48.27	44.47	36	31
NA76	32.50	26.16	21.33	16.63	19.16	16.00	15.08	16.89	17.98	23.29	29.62	33.05	22	20
NA77	35.57	29.35	24.71	19.32	22.14	17.35	19.06	18.72	19.80	26.02	32.17	31.38	25	22
NA78	41.14	39.49	34.94	34.46	32.42	27.20	30.39	29.99	29.39	31.24	42.56	38.63	34	30
NA80	45.61	33.47	35.05	17.94	27.78	24.74	28.39	28.08	30.05	33.86	37.50	40.18	32	28
NA81	33.71	37.95	37.44	36.76	32.42	30.73	24.64	27.21	25.06	33.34	47.11	42.08	34	30
NA82	26.92	28.60	26.72	20.34	19.16	16.08	14.46	14.48	11.53	21.78	27.92	29.49	21	19
NA83	45.83	39.19	32.27	28.59	-	-	-	29.70	52.42	-	41.08	42.01	39	34
NA85	28.34	23.22	22.55	25.17	21.01	21.04	14.82	13.52	9.93	19.59	31.24	29.81	22	19
NA86	27.58	22.56	22.82	18.77	15.46	12.71	10.84	11.20	10.22	18.50	23.66	27.11	18	16
NA87	36.70	32.39	29.74	28.36	-	26.55	27.83	26.61	29.73	32.80	39.48	36.81	32	28
NA88	44.05	32.18	30.80	32.56	23.24	25.79	23.22	23.39	27.67	31.54	36.12	37.39	31	27
NA89	38.26	38.47	36.66	32.46	30.38	26.42	25.93	26.94	29.52	36.84	41.24	41.77	34	30
NA94	36.97	48.21	35.64	31.41	36.40	27.15	30.05	31.04	30.06	34.90	37.60	48.37	36	31
NA98	30.55	24.05	20.86	19.63	18.33	15.48	13.59	14.30	13.76	21.31	22.88	28.01	20	18
NA99	31.95	32.93	32.11	28.11	26.03	24.08	23.09	20.23	22.67	25.38	35.88	36.17	28	25

Site ID	NO_2 Mean Concentrations (µg/m^3)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean	
													Raw Data	Bias Adjusted (1)
NA101	28.26	31.66	30.45	26.05	28.32	19.49	19.21	17.52	16.90	24.54	34.29	35.04	26	23
NA105	16.67	10.69	10.48	8.68	7.93	8.17	7.58	5.92	4.26	6.18	13.75	11.81	9	8
NA107	41.91	33.03	32.24	-	29.50	27.10	23.06	23.09	21.97	33.41	38.57	39.52	31	27
NA110	25.43	22.17	19.47	15.41	18.05	15.39	13.52	14.93	13.31	17.08	23.49	25.47	19	16
NA111 (3 tubes)	41.09	41.21	48.78	50.68	45.06	37.67	29.49	32.76	31.33	44.72	49.81	47.52	**42**	37
	43.41	44.22	53.42	-	41.06	41.95	36.59	28.46	34.38	44.72	48.98	49.52		
	45.46	45.81	45.35	-	41.87	38.62	34.42	28.94	33.84	42.84	51.09	48.47		
NA112	29.65	22.77	23.23	15.19	17.50	16.04	12.85	11.87	11.00	20.15	28.95	26.29	20	17
NA113	20.36	21.64	16.19	14.36	14.71	13.92	13.98	13.84	16.07	15.52	20.75	28.39	17	15
NA114	54.49	44.49	41.99	40.41	42.21	41.12	38.96	38.06	34.70	46.36	57.22	50.79	**44**	39
NA115	29.02	21.15	25.41	16.30	-	-	-	11.23	11.80	17.68	27.71	26.90	21	18

(1) See Appendix C for details on bias adjustment

Table B.2 – 1, 3 Butadiene Monthly Diffusion Tube Results for 2018

Site ID	1,3 Butadiene Mean Concentrations													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean Raw Data	Annual Mean Raw Data
	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	µg/m^3
41	0.03	0.05	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.04	0.03	0.02	0.03	0.06
55	0.03	0.02	0.02	0.02	0.02	0.10	0.02	0.02	0.02	0.02	-	0.07	0.03	0.07
104	0.03	0.23	0.04	0.05	0.04	0.02	0.03	0.02	0.02	0.07	0.02	0.02	0.05	0.11

Table B.3 – Benzene Monthly Diffusion Tube Results for 2018

Site ID	Benzene Mean Concentrations													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean Raw Data	Annual Mean Raw Data
	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	µg/m^3
3	0.39	0.28	0.18	0.2	0.23	0.15	0.09	-	0.09	0.13	0.28	0.23	0.20	0.66
21	0.3	0.27	0.29	-	0.23	0.17	0.08	0.14	0.11	0.16	0.05	0.22	0.18	0.60
27	0.42	0.34	0.15	0.19	0.22	0.2	0.09	0.14	0.13	0.25	0.05	0.39	0.21	0.70
37	0.33	0.21	0.07	0.13	0.19	0.15	0.09	0.1	0.1	0.15	0.05	0.23	0.15	0.49
38	0.28	0.19	0.07	0.15	0.15	0.13	0.07	-	0.11	0.1	0.24	0.19	0.15	0.50
41	0.47	0.35	0.3	0.28	0.23	0.21	0.09	0.16	0.16	0.26	0.4	0.44	0.28	0.91
42	0.34	0.07	0.26	0.23	0.14	0.2	0.1	0.1	0.1	0.12	0.43	0.24	0.19	0.63
44	0.26	0.15	0.17	0.23	0.14	0.19	0.07	0.07	0.14	0.12	0.22	0.16	0.16	0.52
55	0.3	0.07	-	-	0.2	0.16	0.09	0.12	0.08	0.11	0.27	0.19	0.16	0.52
57	0.39	0.31	0.43	0.33	0.28	0.28	0.12	0.2	0.11	0.17	0.52	0.22	0.28	0.91
77	0.25	0.2	0.07	-	0.14	0.14	0.07	0.09	0.08	0.14	-	0.18	0.14	0.44
80	0.07	0.24	0.2	0.21	0.2	0.14	0.07	0.05	0.1	0.15	0.27	0.23	0.16	0.52
81	0.57	0.29	0.21	-	0.22	0.21	0.1	0.15	0.14	0.22	0.33	0.31	0.25	0.81
94	0.39	0.27	0.17	-	0.24	0.22	0.09	0.14	0.13	0.16	0.29	0.21	0.21	0.68
105	0.21	-	0.06	0.09	0.09	0.11	0.07	0.05	0.07	0.07	-	0.09	0.09	0.30
113	0.39	0.32	0.19	0.27	0.2	0.13	0.07	0.08	0.15	0.2	0.12	0.26	0.20	0.64

Appendix C: Supporting Technical Information / Air Quality Monitoring Data Quality Assurance (QA) / Quality Control (QC)

Diffusion Tube Monitoring QA/QC

In 2018 the nitrogen dioxide (NO_2), benzene and 1, 3-butadiene ambient air diffusion tubes deployed by Falkirk Council were supplied and analysed by Gradko International Ltd. The analysis method used for the NO_2 tubes is 50% tri-ethanolamine (TEA) and 50% acetone. The benzene tube type is Carbograph 1TD (thermal desorption / gas chromatography) and for 1, 3-butadiene the tube type is Carbopack X (ATD) with analysis using TD-GCMS.

Nitrogen Dioxide Diffusion Tubes

In 2018, the NO_2 diffusion tube analysis was completed by Gradko International Ltd. Gradko adheres to the DEFRA guidance for the preparation and analysis of the NO_2 diffusion tubes. All the results relating to the concentration of NO_2 present on the diffusion tube are within the scope of Gradko's UKAS accreditation

The full set of monthly NO_2 diffusion tube results are shown in Table B.1 in Appendix B.

1, 3-Butadiene Diffusion Tubes

Gradko International Ltd. performed the quantitative analysis of 1, 3-butadiene on diffusion tubes by TD-GCMS. Analysis has been completed in accordance with in-house method GLM 13-6 under UKAS fixed scope accreditation.

The full set of monthly 1, 3-butadiene diffusion tube results are shown in Table B.2 in Appendix B.

Benzene Diffusion Tubes

Gradko International Ltd. analysed Falkirk Council's benzene diffusion tubes by ATD-GC-MS. Analysis has been completed in accordance with Gradko's in-house method 'GLM 4' under UKAS fixed scope accreditation. The full set of monthly Benzene diffusion tube results are shown in Table B.3 in Appendix B.

NO_2 Diffusion Tube Bias Adjustment Factor (Local and National)

In accordance with LAQM TG16, a locally derived Bias Adjustment Factor has been calculated for the 2018 NO_2 diffusion tube results based on the following two co-location sites: NA42 Grangemouth Municipal Chambers and NA111 Falkirk West

Bridge Street. The local results have been submitted to the LAQM Helpdesk to contribute to the national bias factor.

The results of the locally derived bias adjustment factor spreadsheets are shown in Figure 27 A) and B).

The national diffusion tube bias adjustment factor spreadsheet is displayed in Figure 28 for comparison purposes. The overall national bias factor in 2018 was **0.92**.

A comparison in summary form of the local and national bias factor summary is shown in table C1.

Table C1 – Comparison of Local vs National Bias Factor Summary

Local NO_2 Bias Adjustment Factor	**0.88**
National NO_2 Bias Adjustment Factor	**0.92**
Difference	**0.04**

In accordance with LAQM TG16 Box 7.11 – data quality checks of the local bias adjustment spreadsheet have been assessed as 'good' for both co-location sites. Falkirk Council have a full years' worth of co-location data at the representative locations (A10 Grangemouth Municipal Chambers: Urban background / Industrial – typical off-street urban location that is likely to measure traffic and industrial emissions. A7 West Bridge Street: roadside – traffic related, elevated NO_2 levels at typical daytime peak traffic periods).

Using the above reasons it has been decided to apply the locally derived bias adjustment factor for the 2018 NO_2 diffusion tube results.

Figure 27 – NO_2 Locally Derived Bias Adjustment Factor Spreadsheets

A) A10 Grangemouth Municipal Chambers

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	04/01/2018	31/01/2018	23.5	25.4	25.7	25	1.2	5	3.0	25	99	Good	Good
2	31/01/2018	27/02/2018	23.4	26.8	24.8	25	1.7	7	4.3	23	96	Good	Good
3	27/02/2018	28/03/2018	24.1	21.2	21.9	22	1.5	7	3.8	21	99	Good	Good
4	28/03/2018	02/05/2018	17.8	19.8	19.9	19	1.2	6	2.9	16	99	Good	Good
5	02/05/2018	06/06/2018	22.8	23.6	22.8	23	0.4	2	1.1	17	99	Good	Good
6	06/06/2018	04/07/2018	18.3	19.4	18.4	19	0.6	3	1.5	14	100	Good	Good
7	04/07/2018	01/08/2018	14.8	14.2	14.8	15	0.3	2	0.8	10	99	Good	Good
8	01/08/2018	05/09/2018	14.9	14.5	14.4	15	0.3	2	0.6	10	99	Good	Good
9	05/09/2018	03/10/2018	15.8	16.0	14.9	16	0.6	4	1.4	11	98	Good	Good
10	03/10/2018	31/10/2018	19.8	19.9	20.2	20	0.2	1	0.5	17	98	Good	Good
11	31/10/2018	05/12/2018	26.8	27.8	27.7	27	0.5	2	1.4	22	98	Good	Good
12	05/12/2018	09/01/2018	30.9	30.8	30.9	31	0.1	0	0.2	28	99	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

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

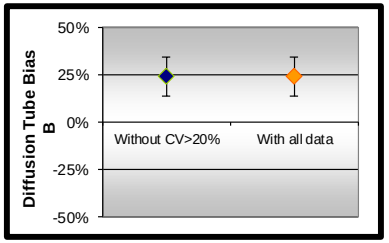
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Grangemouth Municipal Chambers

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

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.84 (0.77 - 0.91)
Bias B	20% (9% - 30%)
Diffusion Tubes Mean:	21 μgm^{-3}
Mean CV (Precision):	3
Automatic Mean:	18 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	18 (16 - 19) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.84 (0.77 - 0.91)
Bias B	20% (9% - 30%)
Diffusion Tubes Mean:	21 μgm^{-3}
Mean CV (Precision):	3
Automatic Mean:	18 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	18 (16 - 19) μgm^{-3}



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B) A7 Falkirk West Bridge St

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	04/01/2018	31/01/2018	41.1	43.4	45.5	43	2.2	5	5.4	43	97	Good	Good
2	31/01/2018	27/02/2018	41.2	44.2	45.8	44	2.3	5	5.8	48	100	Good	Good
3	27/02/2018	28/03/2018	48.8	53.4	45.4	49	4.1	8	10.1	48	100	Good	Good
4	28/03/2018	02/05/2018	50.7							53	48		or Data Capture
5	02/05/2018	06/06/2018	45.1	41.1	41.9	43	2.1	5	5.3			Good	
6	06/06/2018	04/07/2018	37.7	42.0	38.6	39	2.2	6	5.6	32	83	Good	Good
7	04/07/2018	01/08/2018	29.5	36.6	34.4	34	3.6	11	9.0	27	99	Good	Good
8	01/08/2018	05/09/2018	32.8	28.5	28.9	30	2.4	8	5.9	26	100	Good	Good
9	05/09/2018	03/10/2018	31.3	34.4	33.8	33	1.6	5	4.0	28	100	Good	Good
10	03/10/2018	31/10/2018	44.7	44.7	42.8	44	1.1	2	2.7	38	97	Good	Good
11	31/10/2018	05/12/2018	49.8	49.0	51.1	50	1.1	2	2.6	43	100	Good	Good
12	05/12/2018	09/01/2018	47.5	49.5	48.5	49	1.0	2	2.5	50	100	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

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

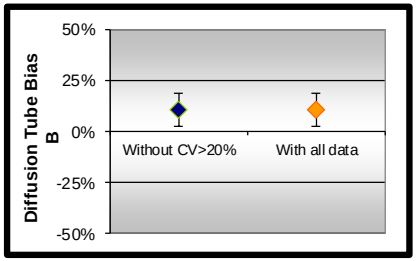
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Falkirk West Bridge St

Precision: 11 out of 11 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 10 periods of data	
Bias factor A	0.92 (0.86 - 1)
Bias B	8% (0% - 17%)
Diffusion Tubes Mean:	41 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	38 μgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	38 (36 - 41) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 10 periods of data	
Bias factor A	0.92 (0.86 - 1)
Bias B	8% (0% - 17%)
Diffusion Tubes Mean:	41 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	38 μgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	38 (36 - 41) μgm^{-3}



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C) Calculation of Two Colocation Results: A10 Grangemouth Municipal Chambers and A7 Falkirk West Bridge St

	FWBS (%)	GMC (%)	Average (%)	2 Locations Factor	Inverse to give local Bias Adjustment Factor
Bias Factor B	8	20	14	1.14	**0.88**

Figure 28 – NO_2 National Derived Bias Adjustment Factor Spreadsheet

National Diffusion Tube Bias Adjustment Factor Spreadsheet

Spreadsheet Version Number: 03/19

Follow the steps below **in the correct order** to show the results of **relevant** co-location studies
Data only apply to tubes exposed monthly and are not suitable for correcting individual short-term monitoring periods
Whenever presenting adjusted data, you should state the adjustment factor used and the version of the spreadsheet
This spreadhseet will be updated every few months: the factors may therefore be subject to change. This should not discourage their immediate use.

This spreadsheet will be updated at the end of June 2019

LAQM Helpdesk Website

The LAQM Helpdesk is operated on behalf of Defra and the Devolved Administrations by Bureau Veritas, in conjunction with contract partners AECOM and the National Physical Laboratory.

Spreadsheet maintained by the National Physical Laboratory. Original compiled by Air Quality Consultants Ltd.

Step 1: Select the Laboratory that Analyses Your Tubes from the Drop-Down List

If a laboratory is not shown, we have no data for this laboratory.

Step 2: Select a Preparation Method from the Drop-Down List

If a preparation method is not shown, we have no data for this method at this laboratory.

Step 3: Select a Year from the Drop-Down List

If a year is not shown, we have no data[2]

Step 4:

Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor[3] shown in blue at the foot of the final column.

If you have your own co-location study then see footnote[4]. If uncertain what to do then contact the Local Air Quality Management Helpdesk at LAQMHelpdesk@uk.bureauveritas.com or 0800 0327953

Analysed By[1]	Method (To undo your selection, choose (All) from the pop-up list)	Year[5] (To undo your selection, choose (All))	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m^3)	Automatic Monitor Mean Conc. (Cm) (µg/m^3)	Bias (B)	Tube Precision[6]	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	50% TEA in acetone	2018	R	City of London	12	84	94	-10.7%	G	1.12
Gradko	50% TEA in acetone	2018	B	City of London	10	38	32	20.9%	G	0.83
Gradko	50% TEA in acetone	2018	R	RBWM	12	39	36	7.8%	G	0.93
Gradko	50% TEA in acetone	2018	R	RBWM	12	35	34	2.2%	G	0.98
Gradko	50% TEA in acetone	2018	SU	Redcar and Cleveland Borough Council	9	18	10	83.3%	G	0.55
Gradko	50% TEA in acetone	2018	R	West Berkshire	10	40	37	10.5%	G	0.91
Gradko	50% TEA in acetone	2018	KS	Marylebone Road Intercomparison	11	91	85	6.5%	G	0.94
Gradko	50% TEA in acetone	2018	UB	Reading Borough Council	12	20	26	-22.6%	G	1.29
Gradko	50% TEA in acetone	2018		**Overall Factor[3] (8 studies)**				**Use**		0.92

PM_{10} Monitoring Adjustment

All PM_{10} R&P TEOM data from 2008 onwards has been adjusted using the King's College London Volatile Correction Method (VCM). This was carried out by Ricardo for the sites affiliated to the Scottish Air Quality Network in 2015 as part of the Scottish Government's contract.

The PM_{10} monitor at the A8 Grangemouth AURN site has been a FDMS since April 2009 and so no correction factor has been applied to the data after this date. The VCM has been applied to the 2008 and 2009 AURN TEOM data by King's College under contract to DEFRA. A PM_{10} Met One 1020 BAM analyser has replaced the R&P TEOM FDMS at the A8 Grangemouth AURN site on 06/06/2018 and no correction factor has been applied to this PM_{10} data since the installation of this analyser.

The PM_{10} monitor at the A13 Banknock 2 site has been a Palas FIDAS 200 analyser since February 2015 so no correction factor has been applied to the data after this date.

Estimating $PM_{2.5}$ from PM_{10} Measurements

LAQM TG (16) describes two methodologies for estimating $PM_{2.5}$ from PM_{10} measurements. Method one is to apply a locally derived correction ratio calculated from local sites measuring both PM_{10} and $PM_{2.5}$. The second is to apply a nationally derived correction ratio of **0.7**. The national correction ratio should only be used where no appropriate local sites measuring both PM_{10} and $PM_{2.5}$ are available. The locally derived correction ratio should only be used at sites of the same classification.

In 2018, Falkirk Council had three local sites monitoring both PM_{10} and $PM_{2.5}$ these were the A7 Falkirk West Bridge St, A8 Grangemouth AURN and A13 Banknock 2 sites. The A7 Falkirk West Bridge St automatic station was upgraded to include $PM_{2.5}$ monitoring capability through the commissioning of a Palas FIDAS 200 analyser in November 2016. A sufficient volume of monitoring data has been collected since this installation date.

Using the guidance stated in LAQM TG (16) the $PM_{2.5}$ / PM_{10} ratios were calculated for the A7 Falkirk West Bridge St, A8 Grangemouth AURN and A13 Banknock 2 sites. The ratio derived from the A13 Banknock 2 data was applied to sites classified as 'roadside (non-urban)', the ratio derived from the A8 Grangemouth AURN data

was applied to sites classified as ‘urban background / industrial’ and the ratio derived from the A7 Falkirk West Bridge St data was applied to sites classified as ‘roadside (urban)’.

The local correction ratios were used to estimate $PM_{2.5}$ from PM_{10} measurements at the following sites: A4 Falkirk Haggs, A5 Falkirk Hope St, A10 Grangemouth Municipal Chambers, A14 Banknock 3 and A15 Main St Bainsford. Results are shown in Table A12 in Appendix A. Table C. 2 displays how the local ratios have been derived.

Table C.1 – Locally Derived $PM_{2.5}$ / PM_{10} Correction Ratio

Site	Site Type	Annual Average PM_{10} ($\mu g/m^3$), 2018	Annual Average $PM_{2.5}$ ($\mu g/m^3$), 2018	Ratio
A7 Falkirk West Bridge St	Roadside (Urban)	6	6	1
A8 Grangemouth AURN	Urban Background / Industrial	12	7	0.58
A13 Banknock 2	Roadside (Non-urban)	11	6	0.55

QA / QC Automatic Monitoring

Table C. 2 – Details of the QA / QC at the Automatic Monitoring Stations in 2018

QA / QC in 2018		
Site	**Analyser**	**Network**
A3. Bo'ness	SO_2	SAQN
A4. Falkirk Haggs	NO_x	SAQN
	PM_{10} (TEOM)	
A5. Falkirk Hope St	NO_x	SAQN
	SO_2	
	PM_{10} (TEOM)	
A7. Falkirk West Bridge St	NO_x	SAQN
	$PM_{10,}$ $PM_{2.5}$ (FIDAS)	
A8. Grangemouth AURN (Inchyra)	NO_x	AURN
	PM_{10} (BAM)	
	$PM_{2.5}$ (BAM)	
	SO_2	

A9. Grangemouth Moray	NO_x	AURN
	SO_2	SAQN
A10. Grangemouth Municipal Chambers	NO_x	SAQN
	PM_{10} (TEOM)	
	SO_2	
A11. Grangemouth Zetland Park	SO_2	SAQN
A12. Falkirk Grahams Rd	PM_{10} (TEOM)	SAQN
A13. Banknock 2	$PM_{10,}$ $PM_{2.5}$ (FIDAS)	SAQN
A14. Banknock 3	PM_{10} (Osiris)	Local
A15 Main St Bainsford	NO_x	SAQN
	PM_{10} (TEOM)	SAQN

Local sites:

- Analyser data is downloaded and a flow check is completed on a fortnightly basis.

- A filter change is completed on an approximate four weekly basis, although this is dependent on the weather and filter loading. The filters are retained for analysis.

- As with the other sites all LSO site visits are completed by Falkirk Council staffs that are audited to AURN standards.

- The Turnkey Osiris at Banknock 3 site is serviced on an annual basis and covered by a service agreement for any breakdowns, both are completed off-site.

AURN and Scottish AQ network sites:

- All NO_x and SO_2 analysers receive fortnightly zero and span checks and filter changes.

- TEOM heads are cleaned and the filter changed on a four weekly basis or more frequently if the filter loading increases above 90%.

- BAM PM_{10} and $PM_{2.5}$ nozzles are cleaned and tapes are changed every eight weeks.

- All LSO site visits are carried out by Falkirk Council staffs that are audited to AURN standards.

- Analysers are covered by an emergency callout contract and receive a service every six months.

- QA / QC are conducted to AURN / 'national' standards.

- Falkirk Council also checks the data on its internal systems and is in regular communication with Ricardo to ensure the best data quality is collected / presented. Unscaled data is supplied by Falkirk Council to Ricardo for the Scottish AQ Network sites on a six monthly basis to improve data capture

Glossary of Terms

Abbreviation	Description
AADT	Annual Average Daily Traffic – total volume of vehicle traffic on a highway or road for a year divided by 365 days.
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
APR	Annual Progress Report in relation to air quality
AURN	Automatic Urban and Rural Network (UK air quality monitoring network)
BAM	Beta Attenuation Monitor
CAFS	Cleaner Air for Scotland
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
ECSVEP	East Central Scotland Vehicle Emissions Partnership
EIA	Environmental Impact Assessment
EPUK	Environmental Protection UK
EU	European Union
FEL	Forth Environment Link
FDMS	Filter Dynamics Measurement System
FPS	Flood Prevention Scheme
GCMS	Gas Chromatography–Mass Spectrometry - analysis method
HDV	Heavy Duty Vehicle
IAQM	Institute of Air Quality Management

LAQM	Local Air Quality Management
LDV	Light Duty Vehicle
MCPD	Medium Combustion Plant Directive
NAQS	National Air Quality Strategy
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
PDU	Public Display Unit
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
PV	Photovoltaic (in relation to solar energy)
QA/QC	Quality Assurance and Quality Control
SEA	Supporting Environmental Appraisal
SEPA	Scottish Environment Protection Agency
SO_2	Sulphur Dioxide
TD	Thermal Desorption – Analysis Method
TEOM	Tapered Element Oscillating Microbalance
TGT	Tail Gas Treatment

References

1. Technical Guidance LAQM.TG (16), DEFRA and Devolved Administrations, February 2018.

2. Civil Aviation Authority, UK Airport Statistics: http://www.caa.co.uk/data-and-analysis/#Data

3. Policy Guidance LAQM.PG (S) 16, Defra and Devolved Administrations, March 2016.