Annual Progress Report (APR)

Falkirk Council

2020 Air Quality Annual Progress Report (APR) for
Falkirk Council

In fulfilment of Part IV of the
Environment Act 1995

Local Air Quality Management

November 2020

Local Authority Officer	John Millar
Department	Environmental Health
Address	Abbotsford House, Davids Loan, Falkirk, FK2 7YZ
Telephone	01324 504873
E-mail	JohnA.Millar@falkirk.gov.uk
Report Reference Number	Annual Progress Report 2020
Date	November 2020

Executive Summary: Air Quality in Our Area

Air Quality in Falkirk Council

In 2019, the air quality within the Falkirk Council area continued to be good from 2018.

The Falkirk Council air quality monitoring results for all pollutants measured have shown a slight decrease in National Air Quality Strategy (NAQS) objective exceedances from 2018 for certain pollutants. There were three NAQS objective exceedances in 2018 and there were two recorded in 2019.

Specifically, these were:

Two exceedances of the nitrogen dioxide (NO_2) NAQS (annual mean) objective limit (40µg/m^3) at (non-automatic) diffusion tube locations:

- NA27 Falkirk West Bridge Street (47µg/m^3); and
- NA114 Glasgow Road, Camelon (41µg/m^3).

No other NAQS exceedances were recorded throughout the Falkirk Council air quality monitoring network in 2019.

The NA27 NO_2 diffusion tube is located on Falkirk West Bridge Street which is within the Falkirk Town Centre Air Quality Management Area (AQMA). This AQMA was declared in 2011 in recognition of the potential to exceed NAQS objectives for NO_2 and Particulate Matter (PM_{10}). The NA114 NO_2 diffusion tube is located on Glasgow Road in Camelon, Falkirk and is outwith any Falkirk Council declared AQMA. This location will be subject to a local air quality management (LAQM) Detailed Assessment in 2021.

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 include:

- 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 2019, Falkirk Council made significant progress in implementing these measures. To illustrate, there are now sixty-four electric vehicle (EV) charging bays throughout the Falkirk Council area with more planned in the upcoming year. This action helps to promote alternative, sustainable modes of travel and achieve measures included in Falkirk Council's Sustainable Development and Climate Change Strategy 2012 - 2017.

On the 10th August 2020, the Falkirk Stadium Vehicle Charging Hub was opened and became operational. The £1.4m facility has capacity for twenty-six electric vehicles - 30% more than the second largest EV facility in Scotland which supports the Scottish Government's ambition to phase-out the need for new petrol and diesel vehicles by 2032 as outlined in the Renewable and Low Carbon Energy Policy. The Falkirk Stadium Vehicle Charging hub is an integral part of Transport Scotland's Electric A9 project with the overall aim of improving the electric vehicle charging infrastructure throughout Scotland.

Plans for future upgrades of the EV charge network within the Falkirk Council area include:

- Falkirk Council are installing an additional sixty-seven (7, 22, and 50kW) EV chargers by June 2021 which will be registered on Charge Place Scotland;
- The development of the 'Plugged in Falkirk' project funded through the Scottish Government's Switched on Towns and Cities Challenge Fund.

Falkirk Council's vehicle fleet currently includes forty electric vehicles (EV). This shows a significant increase from twenty-seven in 2018. There are plans to increase the EV fleet by a further twenty-six in 2020.

The Council also promoted a variety of active and sustainable travel measures in 2019 / 20 to help reduce overall traffic emissions. Full details of the progress Falkirk Council is making towards these measures are outlined in the Air Quality Action Plans (Section 2.2).

In 2019, all seven automatic NO_2 analysers within Falkirk Council's air quality monitoring network met both the NO_2 NAQS objectives (1hr + annual mean). The remaining fifty-nine 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 2019. The NAQS objectives (24hr + annual mean) for PM_{10} were met at all eight locations.

The sites with the highest annual mean PM_{10} concentrations (but within the NAQS PM_{10} objective) were A4 Haggs (Roadside, 14µg/m^3), A10 Grangemouth Municipal Chambers (Urban Background / Industrial, 14µg/m^3) and A15 Main Street, Bainsford (Roadside, 14µg/m^3). Over a five-year period (from 2015 to 2019), four of the eight monitoring sites have recorded long-term PM_{10} (annual mean) concentration reductions.

The A15 Main Street, Bainsford monitoring site recorded the greatest amount of PM_{10} daily NAQS objective exceedances (five) which is a noticeable increase from none recorded in 2018, however, this is still within the NAQS overall PM_{10} limit (50µg/m^3 not to be exceeded more than seven times per year).

Over a five-year period (from 2015 to 2019), two of the eight montioring sites have recorded PM_{10} (annual mean) concentration reductions, these were: A7 Falkirk West Bridge Street (Roadside) and A13 Banknock 2 (Roadside). Five sites recorded increased PM_{10} (24-hr mean) results, these were: A4 Falkirk Haggs (Roadside), A5 Falkirk Hope Street (Roadside), A8 Grangemouth Automatic Urban and Rural Network (AURN - Urban Background / Industrial), A10 Grangemouth Municipal Chambers (Urban Background / Industrial) and A15 Main Street, Bainsford (Roadside). One site, A14 Banknock 3 (Urban Background), recorded the same PM_{10} (24-hr mean) concentration during this period.

$PM_{2.5}$ is measured at four locations within the Falkirk Council area, these are: A7 Falkirk West Bridge Street (Roadside), A8 Grangemouth AURN (Urban Background / Industrial), A13 Banknock 2 (Roadside) and A14 Banknock 3 (Urban Background). During 2019, there were no exceedances of the $PM_{2.5}$ Scottish NAQS objective (10µg/m^3) at any of the aforementioned monitoring sites.

In 2019, the A8 Grangemouth AURN site recorded the highest $PM_{2.5}$ concentration of 8µg/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 respectively. 2018 saw a marginal increase to 7µg/m^3 then increased further to 8µg/m^3 in 2019. These concentrations remain reasonably low and within the NAQS $PM_{2.5}$ objective limit. This reduction may be attributed to the commisioning of the Tail Gas Treatment (TGT) unit at the INEOS Grangemouth industrial complex in 2013. Since the commissioning of the TGT unit, SO_2 concentrations have significantly 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 on recorded local $PM_{2.5}$ concentrations.

In 2018, the $PM_{2.5}$ concentration *estimations* showed that two monitoring sites: A5 Falkirk Hope Street (11µg/m^3) and A15 Main Street, Bainsford (12µg/m^3) exceeded the NAQS $PM_{2.5}$ objective limit of 10µg/m^3. In 2019, all sites with *estimated* $PM_{2.5}$ concentrations were within the NAQS objective. The $PM_{2.5}$ concentrations are estimated using a local correction factor as found in LAQM.TG (16)[Ref1] based on continuous PM_{10} monitoring data. See Appendix C for further details.

In 2019, Falkirk Council monitored sulphur dioxide (SO_2) at six locations. Four of the sites are located within the Grangemouth AQMA and two of the sites are located outwith this AQMA. There were no exceedances of the SO_2 NAQS objective limits (15-minute, hourly or daily) recorded at any of the Falkirk Council monitoring locations during 2019.

It is worth noting that twelve SO_2 15-min NAQS exceedances were recorded at A9 Grangemouth Moray in 2019. This is the sixth consecutive year that no breaches of the SO_2 objectives (15-minute, hourly or daily) have been recorded at any site within the Grangemouth AQMA. It is important to stress that although there were exceedances of the 15-min NAQS SO_2 objective concentration limit at the Grangemouth Moray and AURN sites, the number of exceedances were below the maximum permitted by the respective NAQS objective.

The Grangemouth Emission Study has been completed by Sweco and is currently being assessed and authorised by the relevant organisations prior to it's publication in 2020.The study report includes a review and assessment of the Grangemouth AQMA. A Sweco Technical Note summary of the above study can be shown in Appendix D2.

The benzene and 1, 3-butadiene diffusion tube monitoring conducted by Falkirk Council in 2019 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 2019. These improvements included upgrading the Rupprecht and Patashnick (R&P) Tapered Element Oscillating Microbalance (TEOM) particulate (PM_{10}) analyser at the Grangemouth Municipal Chambers site to a combined ($PM_{10+2.5}$) Palas Fidas 200 analyser.

The Falkirk Council weather station was relocated from the rooftop location on the Grangemouth Municipal Chambers building to the Grangemouth Zetland Park air quality monitoring trailer to improve the quality of the (live polled) local weather data. Falkirk Hope Street and Grangemouth Zetland Park air quality sites had their internal air conditioning systems upgraded.

The Falkirk Council Environmental Health department now own a fully electric van (Renault Kangoo ZE33), this van is used for all routine air quality site work. See photos below for these aforementioned equipment / vehicle upgrades.

Photo 1 Palas Fidas 200 Combined $PM_{10+2.5}$ Analyser at the Grangemouth Municipal Chambers Site

Photo 2 Relocated Falkirk Council Weather Station at Grangemouth Zetland Park Site

Photo 3 Air Conditioning System Upgrade at Falkirk Hope Street

Photo 4 Air Conditioning System Upgrade at Grangemouth Zetland Park Site

Photo 5 Falkirk Council Environmental Health – Fully Electric Van (Renault Kangoo ZE33)

ECOStars Fleet Recognition Scheme

Throughout 2019 and 2020 Falkirk Council's ECOStars fleet recognition scheme has grown significantly from two-hundred and eight to two-hundred and twenty-seven members. Falkirk Council's ECOStars taxi scheme has a small but engaged membership of seven members. ECOStars membership consists of vehicle fleet operators located within the Falkirk Council local authority area as well as those whose depots are located outwith the Council boundary but operate vehicles within that area; all of these operators have an impact on local air quality. In addition, Falkirk Council has been working closely with fellow members of the East Central Scotland Vehicle Emissions Partnership (ECSVEP Switch Off and Breathe) to work to the objectives set out in the Scottish Government's Cleaner Air for Scotland (CAFS, 2015) strategy. Air Quality Action Plan (AQAP) funding has been provided to continue the operation of the Falkirk ECOStars scheme (for fleet operators and taxis) during 2019 / 20.

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

Local Priorities and Challenges

Education and Awareness of Air Quality Issues

In 2020, Falkirk Council will be developing our engagement with locals through promotion of air quality education resources such as the 'Learn About Air' teaching package, promoting the Clean Air Day in Scotland and working closer with the Falkirk Council Transport Planning department on promoting alternative and sustainable local transport solutions.

Low Emission Zones

Low Emission Zones (LEZ) are currently 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 has undertaken the 'Stage 1 Screening Exercise (clause 2.2.25)' assessment in section 2.3 in accordance with the Scottish Government's 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 quality policy webpage:

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

There are eleven automatic air quality monitoring sites across the Falkirk Council area. The air quality data from all the monitoring 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/

Table of Contents

List of Tables

List of Figures

List of Photos

1. Local Air Quality Management

This report provides an overview of air quality in Falkirk Council during 2019. 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

1. Actions to Improve Air Quality

1.1 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 AQMAs declared by Falkirk Council can be found 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.

Falkirk Town Centre AQMA

The air quality monitoring data recorded in 2019 shows that two exceedances of the NO_2 NAQS (annual mean) objective limit (40µg/m^3) were recorded at (non-automatic) diffusion tube locations: NA27 Falkirk West Bridge Street (47µg/m^3) and NA114 Glasgow Road, Camelon (41µg/m^3). The NA27 NO_2 diffusion tube is located on Falkirk West Bridge Street which is within the Falkirk Town Centre Air Quality Management Area (AQMA). This AQMA was declared in 2011 in recognition of the potential to exceed NAQS objectives for NO_2 and particulate matter (PM_{10}) it is recommended that the Falkirk Town Centre AQMA is amended so that the NO_2 element remains in place and is potentially extended to include the Glasgow Road, Camelon area (pending a LAQM Review and Assessment exercise in 2021) until the (road-traffic related) NO_2 results are compliant with the NAQS objective. There have been over five years where PM_{10} results at both Falkirk Town Centre AQMA automatic monitoring locations (Falkirk Grahams Road, Hope Street and West Bridge Street) have complied with the PM_{10} NAQS objective. It is anticipated that the PM_{10} element of the Falkirk Town Centre AQMA will be assessed for revocation eligibility during 2021.

Banknock AQMA

The Banknock AQMA (PM_{10} 24-hr and annual mean) revocation summary report has been completed (see Appendix D1) and approved by the Scottish Government and the Scottish Environment Protection Agency (SEPA). The final stages of this AQMA

revocation are being progressed and will be completed in 2020. The combined ($PM_{10+2.5}$) particulate analyser (Palas Fidas 200) that was located within the Banknock roadside monitoring site has been relocated to the nearby Haggs site to replace the R&P TEOM PM_{10} analyser (spare parts are now obsolete for this R&P analyser model).

Haggs AQMA

Monitoring data for 2019 has highlighted that the Haggs AQMA will be reviewed in 2020 / 21 as the site continues to meet the NAQS objectives for traffic-related PM_{10} emissions.

Grangemouth AQMA

The Grangemouth Emission Study which has been completed by Sweco is currently being assessed and authorised by the relevant organisations prior to it's publication in 2020. The study report includes an LAQM Review and Assessment of the Grangemouth AQMA. The Sweco Technical Note summary of the study can be shown in Appendix D2.

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

1.2 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 further 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 within this strategic document. Progress by Falkirk Council against relevant CAFS actions are demonstrated below.

1.2.1 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 future sustainable travel choices.

Falkirk Council has an active travel scheme which promotes alternative transport methods to car. Projects completed with local communities in 2019 include:

- Take the Right Route: utilising online marketing campaigns, extensive local bus / newspaper / business advertising and social media presence incorporating market research feedback;
- Forth Valley Royal Hospital bus promotion;
- Free Forth Valley Hospital staff travel;
- Walk to Westfield (Falkirk Football Club walking group);
- Walk to School campaigns delivered to fifty primary schools in the Falkirk Council area;
- The creation of an 'Active Travel' officer post for the new Forth Valley College;
- Falkirk Active Travel Hub (Forth Environment Link) is located in Falkirk town centre (203 High Street, Falkirk, FK1 1DU) and is open to the public to increase awareness of active travel throughout the region.

1.2.2 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 dedicated Climate Change and Sustainability team and webpage which outlines what the Council has completed and what they are committed to achieving. The webpage also provides links to:

- Sustainable Procurement;
- Sustainable Transport;

- Sustainable Falkirk

The webpage also provides a link to the Council's Carbon Management Plan 2015 - 2021

1.3 National Low Emission Framework (NLEF) Stage 1 Screening Appraisal for Falkirk Council

The NLEF[1], which is now part of the review and assessment process for LAQM reporting in Scotland, contributes to the CAFS strategy by aiming to improve local air quality in areas where air quality objectives are exceeded, or likely to be exceeded, primarily due to emissions from transport.

The NLEF is directly linked to AQAP for local authorities with AQMAs, and will help to identify actions to improve local air quality within AQMAs. The NLEF appraisal takes the form of a two-stage process, as summarised in Table :

Table 2.2 – NLEF Appraisal Process

Stage		Outcome	Actions Required
1	Screening	• decision on whether to proceed to stage two assessment	• screening process to identify actions that will benefit air quality within the AQMA • screening evidence should form part of the Annual Progress Report, with the decision agreed by Scottish Government and SEPA
2	Assessment	• decision to proceed with introduction of LEZ or identification of alternative transport-related measures required to improve air quality • Stage two assessment report agreed by Scottish Government and SEPA	• NMF approach to support assessment of sources of pollution and options • quantitative impact assessment (based on predicted change in pollutant concentrations) • consideration of consequential impacts (e.g. congestion, export of pollution)

[1] https://www.gov.scot/publications/national-low-emission-framework/pages/2/

The NLEF Stage 1 Screening Appraisal for Falkirk Council is detailed in Table 2.3. It is the opinion of Falkirk Council that proposed measures in the relevant AQAPs are sufficient and there is therefore no need to proceed to a Stage 2 Assessment.

As one AQMA (Banknock) will be revoked in 2020 and two AQMAs (Falkirk Town Centre PM_{10} and Haggs) will be under review and may be eligible for revocation in 2021 pending their relevant assessments. The area that requires focus (in relation to emissions from transport) is the Falkirk Town Centre AQMA, and more specifically the West Bridge Street area (due to continued NAQS exceedances of the NA27 diffusion tube) which is relatively limited in geographical size. The historical NO_2 results of this diffusion tube location are as follows:

Site ID	Site Type	Monitoring Type	Valid Data Capture 2019 (%)	NO_2 Annual Mean Concentration (µg/m^3)				
				2015	2016	2017	2018	2019
NA27	West Bridge St, Falkirk	Diffusion Tube	91	**47**	**48**	38	**44**	**47**

The Falkirk Town Centre AQAP[Ref2] (Golder Associates Report Number: 115114880001.501/B.2, June 2015) outlines relevant actions to deliver significant air quality improvements within this area, which include:

- Section 7.2.1.1: Increase in volume and use of electric and hybrid Council fleet vehicles;
- Section 7.2.2.1: Review of School Bus Contracts;
- Section 7.2.2.5 Take the Right Route;
- Section 7.2.2.5 (cont.) Infrastructure Projects (such as the Falkirk Stadium Vehicle Charging hub).

In 2020, Falkirk Council has decided to relocate its headquarters at the Municipal Buildings from the West Bridge Street location to an alternative location, which is still to be announced. In theory, this will help reduce the amount of Falkirk Council commuting road

traffic using the West Bridge Street area. Eligible Falkirk Council staff are currently working from home which will also help to reduce commuting trips within this area in the short-term.

Table 2.3 – NLEF Stage 1 Screening Appraisal

No.	NLEF Stage 1 Screening Appraisal Question	Appraisal Response
1	What is the name of the declared AQMA(s)?	Falkirk Town Centre AQMA Banknock AQMA Grangemouth AQMA Haggs AQMA
2	What pollutants are the AQMA(s) declared for?	Falkirk Town Centre AQMA: NO_2 annual mean and PM_{10} 24-hour mean and annual mean. Banknock AQMA: PM_{10} 24-hour mean and annual mean. Grangemouth AQMA: SO_2 15-min mean. Haggs AQMA: NO_2 annual mean.

No.	NLEF Stage 1 Screening Appraisal Question	Appraisal Response
3	What are the main sources of air pollution, or other factors, contributing to the declaration of the AQMA? *(If the main source is not transport–related no further screening is required).*	Falkirk Town Centre AQMA: The predominant sources of NO_2 and PM_{10} pollution were identified as road traffic emissions within a built-up town centre location. Banknock AQMA: The predominant sources of PM_{10} pollution within this area include historic local quarry operations combined with associated site and local road traffic. Grangemouth AQMA: The predominant source of SO_2 pollution within this area are from industrial sources – no further screening required. Haggs AQMA: The predominant source of NO_2 pollution was identified as road traffic emissions.
4	Are the declared AQMA(s) (and therefore area(s) of exceedance) restricted in nature geographically to a small area for which a Low Emission Zone (LEZ) would not be appropriate or proportionate (e.g. single streets, road junctions, small town centre)?	Falkirk Town Centre AQMA: The AQMA designated area extends to a reasonably large area covering the majority of the town centre road network. Banknock AQMA: The AQMA designated area extends to a reasonably small semi-rural area covering Banknock and the locations where historic quarrying had operated. Grangemouth AQMA: The AQMA designated area extends to a large area covering the town centre, shipping port and industrial area. Haggs AQMA: The AQMA designated area extends to a small area covering a section of the residential area of Haggs and a section of the M80 motorway.

No.	NLEF Stage 1 Screening Appraisal Question	Appraisal Response
5	Do the monitored concentrations within the AQMA(s) meet the air quality objective(s)? If yes, for how long has compliance been achieved? If not, what are the extent of the exceedances?	Falkirk Town Centre AQMA: All automatic stations have achieved consecutive compliance of the NAQS (PM_{10} annual mean + NO_2 24-hr and annual mean) objective limits for five years (since 2015), one (non-automatic) NO_2 diffusion tube continually breaches NAQS objective (NA27 Falkirk West Bridge Street). Banknock AQMA: Yes, the compliance has been achieved consecutively for six years and the AQMA is planning to be revoked in 2020 (see Appendix D1). Grangemouth AQMA: Yes, the SO_2 NAQS objective limit compliance has been achieved consecutively for six years. An AQMA review is to be published by Sweco in due course (see Appendix D2). Haggs AQMA: Yes, the NO_2 (annual mean) NAQS objective limit been achieved consecutively for five years (since 2019). An AQMA review is to be completed by Falkirk Council in 2020. It is likely this AQMA will be eligible for revocation.

No.	NLEF Stage 1 Screening Appraisal Question	Appraisal Response
6	What is the current trend for pollutant concentrations within the AQMA(s) (state the trend for each pollutant declared)?	Falkirk Town Centre AQMA: PM_{10} (annual mean): Increasing , NO_2 (annual mean): Decreasing. Banknock AQMA: PM_{10} (annual mean): Decreasing. Grangemouth AQMA: SO_2 (15-min mean NAQS objective exceedances): Overall decreasing trend then remaining low within the NAQS objective limit (see Figure 25). Haggs AQMA: NO_2 (annual mean): Decreasing.
7	Are there any major planned developments which could impact air quality within or surrounding the AQMA(s)?	No. All recent developments have been assessed and included in the relevant APRs.
8	What are the current trends for vehicle movements within the AQMA and surrounding areas?	Recent Department for Transport road traffic statistics has shown no significant increase or decrease in vehicle miles travelled within the Falkirk Council area. On average, the data trend has been shown to be level since 2016 until present (Approx. range: 1011 – 1015 million vehicle miles travelled)[Ref 3].

No.	NLEF Stage 1 Screening Appraisal Question	Appraisal Response
9	Provide evidence showing how the AQAP (and associated plans, programmes and strategies) will deliver significant improvements towards achieving the air quality objective(s) in as short a timescale as possible?	As one AQMA will be revoked (Banknock) in 2020 and two AQMAs are currently under review (Falkirk Town Centre PM_{10} and Haggs) and may be eligible for revocation in 2021, the area that requires focus is the Falkirk Town Centre AQMA and more specifically Falkirk West Bridge Street. This street is relatively limited / small in size. The Falkirk Town Centre AQAP[Ref 4] outlines actions to deliver significant air quality improvements within this street include: - Increase in volume and use of electric and hybrid Council fleet vehicles; - Review of school bus contracts; - Take the Right Route; - Infrastructure projects (such as the Falkirk Stadium Vehicle Charging hub).

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

Falkirk Council has taken forward a number of measures during the current reporting year of 2019 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.4. More details on these measures can be found in the AQAP relating to each AQMA. Key completed measures are:

- Measure 4: Monitoring network requirements reviewed and upgraded where necessary (upgrading the R&P TEOM PM_{10} particulate analyser at the Grangemouth Municipal Chambers site to a combined ($PM_{10+2.5}$) Palas Fidas 200 analyser and transfer of weather station to the Grangemouth Zetland Park monitoring site);
- Measure 5: New Environmental Health fully electric van (Renault Kangoo ZE33) purchased and now in use for all air quality site work within the Falkirk Council area;
- Measure 16: Continuation and increased members of the ECOStars Fleet Recognition scheme.

Falkirk Council expects the following measures to be completed over the course of the next reporting year:

- Review of Falkirk Town Centre ($PM_{10)}$ and Haggs AQMA and with potential revocation (reduction of Falkirk Council AQMAs from three to two);
- Replacement of older (NO_X and SO_2) analysers with new models (providing increased accuracy, availability of spares, less breakdowns and expensive maintenance visits etc.);
- Continuation of ECOStars Fleet Recognition Scheme with new members added (Increased fleet efficiency measures / knowledge) – Scottish Government AQAP funding dependant;
- Establishing a new roadside air quality monitoring station (including continuous automatic PM_{10}+NO_2 analysers) within the Camelon area of Falkirk.

Table 2.4 – Progress on Measures to Improve Air Quality

Meas. No.	Measure	Category	Focus	Lead Authority	Planning Phase	Impleme-ntation 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 monthly reports ongoing.	
2	Grangemouth Working Group	Policy Guidance and Developmen t 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.	
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 commenced 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.	
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 2019, the EV charging point bays increased from 40 to 107. These are located at depots and public places across the Falkirk Council area. Falkirk Council increased its electric vehicle fleet to 40 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 ZE33) van in June 2019 – further details provided in Section 'Actions to Improve Air Quality', page v

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.	
7	Review of School Bus Contracts with View to Raising EURO Engine Standards	Vehicle Fleet Efficiency	Buses	Falkirk Council	2017	2021	n/a	Anticipated reduction in NO_X and PM emissions from buses operating within the Falkirk Council area.	Meetings to be arranged in 2020/21 with Public Transport Co-ordinator and Procurement Services to discuss the feasibility of raising the EURO standards for local and school bus contracts from 2021 onwards.	2020	
8	Improvements of Traffic Lights at Bankside	Transport Planning and Infrastructure	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 Infrastructure	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.	

10	Feasibility study of West Bridge St and Town Centre Traffic Management Changes (speed limits, TROs etc.)	Transport Planning and Infrastructure	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 2019 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.	

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 2019. Expansion of the scheme expected in future years.	
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 Development 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 2019.	Completed and on-going	
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 has 227 members.	Anticipated reduction in NO_X and PM emissions due to promotion of efficient driving practices.	During 2019, 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 2019.	On-going	
17	Review of Park and Ride Facilities	Transport Planning and Infrastructure	Cars	Falkirk Council	2017	2018	Ongoing.	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	

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.	

20	Introduce Quality Bus Corridors	Transport Planning and Infrastructure	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. Air Quality Monitoring Data and Comparison with Air Quality Objectives

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

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

Falkirk Council undertook automatic (continuous) monitoring at eleven sites during 2019. Table A.1 in Appendix A shows the details of the sites. National monitoring results are available at http://www.scottishairquality.scot/.

Maps showing the location of the monitoring sites are provided in Appendix A, Figure 27 A) to G). Further details on how the monitors are calibrated and how the data has been adjusted are included in Appendix C.

2.1.2 Non-Automatic Monitoring Sites

Falkirk Council undertook non-automatic (passive) monitoring of NO_2 at sixty-one sites during 2019. Table A.2 in Appendix A shows the details of the sites.

Falkirk Council also undertook non-automatic (passive) monitoring of 1, 3 butadiene at three sites during 2019. 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 2019. 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 diffusion tubes are included in Appendix C.

2.2 Individual pollutants

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

2.2.1 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 air quality objective of 40µg/m^3.

For diffusion tubes, the full 2019 dataset of monthly mean values is 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 2019 monitoring results (as displayed in Appendix A Tables A.3 and A.4) show that all seven automatic NO_2 analysers in Falkirk Council's air monitoring network met both NO_2 NAQS objectives (1hr and annual mean). The highest NO_2 annual mean result in 2019 was recorded at Falkirk West Bridge Street site (38µg/m^3) this has decreased from 2018's result (39µg/m^3). The lowest results were recorded at the Grangemouth AURN (15µg/m^3) and Moray (15µg/m^3) sites. The Grangemouth AURN NO_2 annual mean result has increased from 14µg/m^3 and Grangemouth Moray's result has decreased from 17µg/m^3 as recorded in 2018. Overall, most fixed automatic site's NO_2 concentrations have remained the same as 2017's results however, most sites have seen a marginal decrease which is encouraging. The last exceedance in relation to NO_2 annual mean concentrations was recorded in 2014 at the Falkirk West Bridge Street site (41µg/m^3).

Over a five year period (from 2015 to 2019), three monitoring sites have recorded annual mean NO_2 concentration reductions: A4 Haggs, A5 Falkirk Hope Street and A10 Grangemouth Municipal Chambers. Three sites have recorded increased NO_2 concentrations: A7 Falkirk West Bridge Street, A8 Grangemouth AURN and A15 Main St, Bainsford. The A9 Grangemouth Moray site's NO_2 annual mean concentrations have remained the same over this period (15µg/m^3).

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 monitoring sites: A4 Haggs (Figure 1), A5 Falkirk Hope Street (Figure 2) and A10 Grangemouth Municipal Chambers (Figure 6). A8 Grangemouth AURN (Figure 4), A9 Grangemouth Moray (Figure 5) and A15 Main Street Bainsford (Figure 7) trend has largely remained at the same level. The A7 Falkirk West Bridge Street (Figure 3) site shows an overall upward increase in long-term 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 prevent excessive idling (within the Falkirk town centre area), road upgrades (M80 at Haggs) and speed limit enforcement measures (30mph on the A803). Increased ownership of hybrid and electric vehicles may also have contributed to the overall NO_2 reduction. Likely contributing factors to the increase in NO_2 at A15 Main Street, Bainsford would be frequent localised roadworks (with increased traffic idling) associated with local building developments and renovations with street canyoning to prevent effective air pollution dispersion.

Annual NO_2 Diffusion Tube Results

The 2019 annual NO_2 diffusion tube monitoring results (as displayed in Appendix A Table A.3) shows that two (non-automatic) NO_2 tubes exceeded the NAQS objective of 40µg/m^3 at NA27 Falkirk West Bridge Street (47µg/m^3) and NA114 Glasgow Road, Camelon (41µg/m^3). The remaining fifty-nine tubes in Falkirk Council's network met the NAQS objective.

Two diffusion tubes were close to the 40µg/m^3 annual limit with the highest concentrations recorded at the following sites: NA111 Falkirk West Bridge Street Air Quality Station (38µg/m^3) and NA36 Kerrs Crescent, Haggs (35µg/m^3). These tubes are located at roadside locations and are within AQMAs (NA111 Falkirk Town Centre AQMA and NA36 Haggs AQMA).

Diffusion tube NA27 is co-located with the Falkirk West Bridge Street fixed automatic monitoring station. This site contains a NO_2 reference method (Chemiluminescence) analyser (API Teledyne T200) which has recorded an annual NO_2 concentration of 38µg/m^3 during 2019 which is comparable, representative and 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 road than the NA27 tube location 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 NA98 Arnothill, Falkirk (Urban Background 13µg/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 NO_2 (chemiluminescence) reference analyser (as 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 the reference method using automatic (chemiluminescence) NO_2 analysers.

2.2.2 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, continuously 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 2019. The relevant Scottish NAQS objectives for PM_{10} were met at all eight locations.

The sites with the highest recorded annual mean PM_{10} concentrations in 2019 (but within the Scottish NAQS PM_{10} objective) were: A4 Falkirk Haggs (Roadside, 14µg/m^3), A10 Grangemouth Municipal Chambers (Urban Background / Industrial, 14µg/m^3) and A15 Main Street, Bainsford (Roadside, 14µg/m^3). Overall annual data capture was good for two of these sites (A4 Falkirk Haggs and A15 Main Street, Bainsford) at 91%. The Grangemouth Municipal Chambers site achieved 45% PM_{10} data capture using the R&P TEOM until September 2019 when this analyser was replaced by a Palas Fidas 200 combined $PM_{10+2.5}$ analyser. The Palas Fidas 200 analyser experienced significant post-installation technical communication issues which resulted in this lower annual data capture rate than other similar sites. This technical issue has since been resolved and the combined $PM_{10+2.5}$ analyser is polling data as normal.

The two sites with the lowest PM_{10} (annual mean) concentrations were: A13 Banknock 2 (Roadside, 7µg/m^3) and A14 Banknock 3 (Urban Background, 7.9µg/m^3). Data capture rates were good for both sites at 97% ad 99% respectively.

Over a five year period (from 2015 to 2019), four sites have recorded PM_{10} (annual mean) concentration reductions, these were: A4 Falkirk Haggs, A7 Falkirk West Bridge Street, A13 Banknock 2 and A14 Banknock 3. Four sites have recorded concentration increases, these were: A5 Falkirk Hope Street, A8 Grangemouth AURN, A10 Grangemouth Municipal Chambers and A15 Main Street, Bainsford.

In 2019, the A15 Main Street, Bainsford monitoring site recorded the greatest number of daily exceedances (five) which is a significant increase from 2018's result of none. Further investigation into the daily exceedances of the PM_{10} (24-hr mean) Scottish NAQS objective indicated that increased local developments with associated increased road traffic and idling from road diversions / roadworks on Main Street, Bainsford were the likely cause. The full results are shown in Appendix A, Table A.6.

Over a five year period (from 2015 to 2019), two sites have recorded PM_{10} (24-hr mean) concentration reductions: A7 Falkirk West Bridge Street (Roadside) and A13 Banknock 2 (Roadside). Five sites recorded increased concentrations: A4 Falkirk Haggs (Roadside), A5 Falkirk Hope Street (Roadside), A8 Grangemouth AURN (Urban Background / Industrial), A10 Grangemouth Municipal Chambers (Urban Background / Industrial) and A15 Main Street, Bainsford (Roadside). One site, A14 Banknock 3 (Urban Background) remained at the same PM_{10} (24-hr mean) concentration.

2.2.3 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 NAQS objective of 10µg/m^3.

$PM_{2.5}$ is measured at four locations within the Falkirk Council area, these are: A7 Falkirk West Bridge Street (Roadside), A8 Grangemouth AURN (Urban Background / Industrial), A13 Banknock 2 (Roadside) and A14 Banknock 3 (Urban Background).

During 2019 there were no exceedances of the $PM_{2.5}$ Scottish NAQS objective (10µg/m^3) at any of the four monitoring sites.

The sites with the highest recorded annual mean $PM_{2.5}$ concentrations in 2019 (within the Scottish NAQS PM_{10} objective) were: A8 Grangemouth AURN (Urban Background, 8µg/m^3) and A13 Banknock 2 (Roadside, 7µg/m^3). Annual data capture was good for both sites at 97%.

The two sites with the lowest $PM_{2.5}$ (annual mean) concentrations were: A14 Banknock 3 (Urban Background, 4.6µg/m^3), A7 Falkirk West Bridge Street (Roadside, 6µg/m^3) and A14 Banknock 3 (Urban Background, 7.9µg/m^3). Data capture rates were good for both sites at 97% and 100% respectively.

Over a five year period (from 2015 to 2019) one site, Grangemouth AURN has recorded a $PM_{2.5}$ (annual mean) concentration reduction. Two monitoring sites have recorded concentration increases, these were: A13 Banknock 2 and A14 Banknock 3. One site, A7 Falkirk West Bridge Street has remained at the same concentration over this period.

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 respectively. 2019 saw a marginal concentration increase to 8µg/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 four sites for $PM_{2.5}$ and can be shown in Appendix A, Figures 15 to 17. In general terms, there has been a long-term reduction in $PM_{2.5}$ concentrations at the Grangemouth AURN site since 2015 however, concentrations have remained the same for the A7 Falkirk West Bridge Street and A13 Banknock 2 sites since they were commissioned (2015 onwards).

To appraise compliance with the $PM_{2.5}$ NAQS objective at locations that currently do not monitor $PM_{2.5}$ concentrations, Falkirk Council has applied locally derived correction factors of 0.55 (urban roadside), 0.62 (urban background / industrial) and 0.64 (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.

During 2019, the $PM_{2.5}$ concentration estimations indicate that all four sites where the correction factor was applied met the $PM_{2.5}$ annual mean NAQS objective. A4 Falkirk Haggs recorded the highest estimated annual $PM_{2.5}$ concentration of 9µg/m^3. A10 Grangemouth Municipal Chambers recorded the second highest estimated annual concentration of 8.6µg/m^3. See Appendix A Table A.12 for a full comparison of estimated $PM_{2.5}$ annual mean concentrations against the NAQS objective.

2.2.4 Sulphur Dioxide (SO_2)

Table A.8 in Appendix A compares the ratified, continuously monitored SO_2 concentrations for 2019 with the NAQS objectives for SO_2.

In 2019, 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 this 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 2019.

The sites recording the only exceedances of the 15-minute NAQS objective during 2019 was A9 Grangemouth Moray (twelve) and Grangemouth AURN (two). There was one excedance of the 1-hour NAQS objective which was recorded at Grangemouth Moray. No other SO_2 exceedances were recorded at any of the other sites during 2019.

This is the sixth 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 were exceedances of the 15-minute and 1-hour NAQS objectives, the number of exceedances were below the maximum permitted.

The Grangemouth Emission Study which has been completed by Sweco is currently being assessed and authorised by the relevant organisations prior to it’s publication.The study report includes a review and assessment of the Grangemouth AQMA. The Sweco Technical Note summary of the above study can be shown in Appendix D2.

Polar roses displaying average SO_2 concentrations for the Grangemouth sites are shown in Appendix A Figure 24, A) to F).

2.2.5 Carbon Monoxide, Lead and 1,3-Butadiene

Carbon Monoxide

No monitoring undertaken.

Lead

No monitoring undertaken.

1, 3-Butadiene

In 2019, 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 2019, 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 Appendix A Table A.11.

All the benzene concentrations recorded by the passive diffusion tubes were within the NAQS objectives. Eleven of the sixteen benzene diffusion tubes achieved 100% data capture (NA3, NA21, NA27, NA37, NA42, NA44, NA55, NA81, NA94, NA116 and N117), four tubes achieving 91% (NA38, NA41, NA80 and NA105) and one achieving 83% (NA77).

In 2019, the pumped diffusion tube at the A8 Grangemouth AURN site recorded an annual average concentration of 0.78µg/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 0.04µg/m^3) compared to 2018's result (0.74µg/m^3).

3. New Local Developments

3.1 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 considered as congested residential streets that have not been assessed in previous APRs 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 information: the Falkirk Council automatic monitoring network recorded no exceedances of the hourly NO_2 NAQS objective concentration and there were two exceedances of the NO_2 non-automatic diffusion tube NAQS objective concentration of 40µg/m^3 at NA27 Falkirk West Bridge Street (47µg/m^3) and NA114 Glasgow Road, Camelon (41µg/m^3). The remaining NO_2 non-automatic diffusion tubes (across the Falkirk Council network) recorded 2019 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 in August 2018, additional buses are using Upper Newmarket Street. As this road has witnessed an increase in bus traffic, Falkirk Council have kept the additional NO_2 (diffusion tube) monitoring location on Glebe Street active and worked with ECSVEP to locate more prominent anti-idling signs on Upper Newmarket Street in Falkirk town centre throughout the year.

4.1.5 Junctions

There were no new road junctions constructed during 2019 within the Falkirk Council area.

4.1.6 New Roads Constructed or Proposed

There were no new roads constructed or proposed during 2019 within the Falkirk Council area.

4.1.7 Roads with Significantly Changed Traffic Flows

There were no roads with significantly changed traffic flows during 2019 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 subsequently been diverted via the Upper Newmarket Street 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.

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 2018 and 2019 have increased by 9.9% from 836,943 in 2018 to 920,098[Ref4] in 2019. 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 a 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 trains, 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

Proposed Energy from Waste Facility – Avondale Landfill Site, Falkirk

During December 2019, Falkirk Council received a planning application for a proposed development of a new energy from waste (EfW) facility at the Avondale landfill site in Polmont, Falkirk. The proposed EfW facility is designed to process up to 150ktpa of waste to deliver approx. 7.4MW of power. As described within the Isopleth Air Quality Assessment Report, Nov 2019, Ref: 01.0009.017 (v3) section 2.2 'Description of Facility':

The proposed site comprises of the following elements:

- A new access road which links internal Avondale landfill road with the proposed development site to the west;
- A reception building located to the north of the site;
- A process building located to the south of the site;
- Two 45m stacks; and
- Ancillary equipment.

The operation of the EfW facility will fall under the Pollution Prevention and Control (PPC) regulations. SEPA will have overall responsibility for site pollution regulation during operation.

It is noted in section 8.0 'Conclusions':

'Impacts (based on model assumptions) at human and ecological receptors are predicted to be below limit values at locations where the Air Quality Directive states that they must be applied: residences and locations where the public may reasonably be expected to be present'.

The Isopleth Air Quality Assessment (Ref: 01.0009.017 (v3)) did not include the displacement and subsequent dispersion of dust (and traffic impacts) during the construction, operation and decommissioning phases. All impacts shall be compared to current NAQS objectives. Construction and demolition dust management guidance, such as that published by the Institute of Air Quality Management (IAQM), should be considered within the air quality assessment. Falkirk Council requested

that a section be added to this report that considers the management of dust during these phases.

17/01/2020: The subsequent Enzygo Environmental Statement (CRM0125) was reviewed by Falkirk Council Environmental Health and was deemed satisfactory and in accordance with current and correct dust management guidance such as the stated Institute of Air Quality Management (IAQM).

The Environmental Statement concludes 'Mitigation against dust impacts should be adopted throughout the construction phase. These are detailed in the Environmental Management System (EMS) for the site.' It is unlikely that air quality / dust issues should arise if the proposed mitigation measures outlined in EMS are fully implemented with regards to the construction phase of the development.

If any air emission / dust complaints are received during the planned works, Falkirk Council have stated that they would have an obligation to investigate and ensure the stated mitigation measures are being adhered to.

4.4 Commercial and Domestic Sources

4.4.1 Biomass Combustion Plants

Falkirk Council did not receive any applications in 2019 for any proposed biomass combustion plants.

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 from domestic biomass appliances;
- 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

In 2019, Falkirk Council has received eight complaints in relation to smoke and odour from domestic biomass sources such as wood burning stoves and open garden bonfires. These complaints were investigated thoroughly and advice was provided on smoke control area rules, Department for Environment Food and Rural Affairs (DEFRA) approval of stoves including using authorised fuels, guidance on efficient stove use and recommended regular maintenance measures. Relevant and current guidance is now provided by Falkirk Council Environmental Health within the initial planning phase of new residential and commercial developments in relation to installing appliances such as wood burning stoves. This guidance includes adhering to local smoke control area rules, DEFRA approval of stoves, using authorised fuels and providing information on flue height and termination to allow effective smoke dispersal to minimise local smoke / odour nuisance.

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

Falkirk Council did not received any applications in 2019 for any CHP plant.

4.5 New Developments with Fugitive or Uncontrolled Sources

Falkirk Council did not received any applications in 2019 for any 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.

4. Planning Applications

Proposed Residential Development – Middlerigg Farm, Falkirk – Air Quality Impact Assessment – January 2019

Falkirk Council received an air quality impact assessment for a proposed residential development at Middlerigg Farm, Falkirk in January 2019. The proposed development is for the erection of one hundred and eighty dwellings of various house types and sizes. The air quality assessment report was completed by PBA Peter Brett (Stantec) on behalf of Taylor Wimpey (Ref: 40626/3005).

A preliminary air quality assessment was completed by PBA in November 2018 (in relation to the Middlerigg Farm site) which concluded that the predicted increase in traffic (generated from the proposed development) on the local road network triggered the requirement for a more detailed air quality assessment to be undertaken. The pollutants of concern that were reported upon in the 2019 report were in relation to road traffic so the pollutants focused on were nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$).

It is noted that the NO_2, PM_{10} and $PM_{2.5}$ concentrations in 2022 without and with the proposed development are below the relevant NAQS objective at all existing nearby sensitive receptor locations. The changes in predicted annual mean NO_2 concentrations range from 0–2% of the NAQS objective. The changes in PM_{10} and $PM_{2.5}$ concentrations are 1% or less at all receptor locations. Using the Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) guidance it is noted that the impacts on annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations are described as negligible at all receptor locations.

Falkirk Council recommended some amendments to the PBA January 2019 air quality impact assessment report which were rectified and therefore the report was deemed satisfactory.

Proposed Residential Development – Woodend Farm, Falkirk – Air Quality Assessment – June 2019

Falkirk Council received an air quality impact assessment for a proposed residential development at Woodend Farm, Falkirk in June 2019. The proposed development is for the erection of one hundred and eleven dwellings, ninety-nine of which will be new-build and twelve of which will be incorporated within the existing farmhouse on

the site. The air quality assessment report was completed by ITP Energised on behalf of Falkirk Council (Ref: EDI_1744).

The air quality assessment report was requested to identify the potential impact to local air quality as a result of increased traffic on the local road network due to the proposed development. The pollutants assessed within this air quality assessment were nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$).

Increased road traffic from the planned development has been fully assessed in section 3.4.7 with impacts at nearest human receptors being stated as 'negligible'. It is unlikely that air quality / dust issues should arise if the mitigation measures outlined in Appendix F 'Proposed Dust Mitigation Measures for Inclusion in a Construction Environmental Management Plan (CEMP)' are fully implemented in relation to the construction phase of the development. All legislation, policies and guidance referenced within the report are current, applicable and correct. The report was deemed satisfactory by Falkirk Council.

Proposed Residential Development – Crawfield Road, Bo'ness, Falkirk - Air Quality Assessment – November 2019

Falkirk Council received an air quality assessment for a proposed residential development at Crawfield Road, Bo'ness in November 2019. The proposed development is for the erection of two hundred and twenty-five dwellings on a vacant field immediately south of Crawfield Road and adjacent to Linlithgow Road in Bo'ness. The air quality assessment report was completed by ITP Energised on behalf of Mactaggart & Mickel (Ref: EDI_2068).

The air quality assessment report was requested to identify the potential impact to local air quality as a result of increased traffic on the local road network due to the proposed development. The pollutants that were assessed within this air quality assessment were nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$).

Increased road traffic from the planned development has been fully assessed in section 3.4.7 with impacts at nearest human receptors being stated as 'negligible'. It is unlikely that air quality / dust issues should arise if the mitigation measures outlined in Appendix E 'Construction Dust Risk Assessment' are fully implemented with regards to the construction phase of the development. All legislation, policies

and guidance referenced within the report are current, applicable and correct. The report was deemed satisfactory by Falkirk Council.

Proposed Residential Development – Carriden Brae, Muirhouses, Bo'ness - Air Quality Assessment – November 2019

Falkirk Council received an air quality assessment for a proposed residential development at Carriden Brae, Muirhouses, Bo'ness in November 2019. The proposed development is for the erection of one hundred and twenty dwellings, in a variety of house sizes. The air quality assessment report was completed by Envirocentre on behalf of Falkirk Council (Ref: 773187).

The air quality assessment report was requested to identify the potential impact to local air quality as a result of increased traffic on the local road network due to the proposed development. The pollutants that were assessed within this air quality assessment were nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$).

Increased road traffic from the planned residential development has been fully assessed in Section 6. 'Air Quality Assessment' with impacts at nearest human receptors being fully assessed. The report states in Section 6.2 'Conclusion' that 'the model predicts no significant change in NO_2, PM_{10} or $PM_{2.5}$ concentrations at all sensitive receptors on comparison of the 'with and without' development scenarios. The impact magnitude for all investigated sensitive receptors were categorised as 'negligible' for NO_2, PM_{10} and $PM_{2.5}$. All legislation, policies and guidance referenced within the report are current, applicable and correct.

Falkirk Council recommended some amendments to the November 2019 Envirocentre air quality report which were rectified and therefore the report was deemed satisfactory.

Proposed Residential Development – Former Denny High School, Falkirk - Air Quality Assessment – December 2019

Falkirk Council received an air quality assessment for a proposed residential development at the site of the former Denny High School, Falkirk in December 2019. The proposed development is for the erection of two hundred dwellings, which include a mix of forty-eight flats and fifty-three car parking spaces. The air quality assessment report was completed by ITP Energised on behalf of Falkirk Council (Ref: EDI_1447).

The air quality assessment report was requested to identify the potential impact to local air quality as a result of increased traffic on the local road network due to the proposed development. The pollutants that were assessed within this air quality assessment were nitrogen dioxide (NO_2) and particulate matter (PM_{10}).

Increased road traffic pollution (NO_2 and PM_{10}) and construction dust emissions from the planned development have been fully assessed in Section 5 'Assessment' with impacts at nearest sensitive receptors being concluded as 'negligible'. It is stated that the 'predicted short-term mean concentrations for NO_2 and PM_{10} which are relevant for short-term exposure of members of public, comply with the relevant Air Quality Standards for NO_2 and PM_{10} at all receptors.'

It is unlikely that air quality / dust issues should arise if the proposed mitigation measures outlined in Appendix F 'Construction Phase Dust Risk Assessment' are fully implemented with regards to the construction phase of the development.

All legislation, policies and guidance referenced within the report are current, applicable and correct. The report was deemed satisfactory by Falkirk Council.

Proposed Residential Development – Former Manuel Brickworks Site at Whitecross, Falkirk – Air Quality Impact Assessment – January 2020

Falkirk Council received an air quality assessment for a proposed residential development at the Former Manuel Brickworks site in Whitecross, Falkirk in January 2019. The proposed development is for the erection of four-hundred dwellings of various house types, and commercial / industrial land covering a total of 8.9 hectares.

The air quality report was submitted to Falkirk Council to provide an assessment of dust generation during the construction of the development and potential impacts of the development on existing and new residential receptors. The proposed development is not within any Air Quality Management Areas (AQMAs). The air quality assessment report was completed by Surface Property on behalf of CWC 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.

5. Conclusions and Proposed Actions

5.1 Conclusions from New Monitoring Data

Falkirk Council has assessed its automatic and non-automatic 2019 air quality monitoring data and results.

All seven automatic NO_2 analysers in Falkirk Council's network met both NO_2 NAQS objectives. Over a five year period (from 2015 to 2019), three sites have recorded annual mean NO_2 concentration reductions, these were A4 Haggs, A5 Falkirk Hope Street and A10 Grangemouth Municipal Chambers. Three sites have recorded increased NO_2 concentrations, these were A7 Falkirk West Bridge Street, A8 Grangemouth AURN and A15 Main St, Bainsford. The A9 Grangemouth Moray site's NO_2 annual mean concentrations have remained the same over this period (15µg/m^3).

The 2019 annual NO_2 diffusion tube monitoring results (as displayed in Appendix A Table A.3) show that two (non-automatic) NO_2 diffusion tubes exceeded the NAQS objective of 40µg/m^3 at NA27 Falkirk West Bridge Street (47µg/m^3) and NA114 Glasgow Road, Camelon (41µg/m^3). The remaining fifty-nine tubes in the Falkirk Council's diffusion tube network met the NO_2 NAQS objective. This is a slight decline from 2018 as one NO_2 diffusion tube in Falkirk Council's network breached the NO_2 (annual mean) NAQS objective (NA27 Falkirk West Bridge Street, 44µg/m^3). In 2019, two diffusion tubes were close to the 40µg/m^3 NO_2 NAQS annual mean objective limit with the highest recorded concentrations at the following sites: NA111 Falkirk West Bridge Street (38µg/m^3) and NA36 Kerrs Crescent, Haggs (35µg/m^3). These tubes are located at roadside locations and are within AQMAs (NA111 Falkirk Town Centre AQMA and NA36 Haggs AQMA).

The NA27 Falkirk West Bridge Street NO_2 diffusion tube has recorded exceedances of the NAQS NO_2 (annual mean) objective in 2015, 2016, 2018 and 2019 respectively. The NA114 Glasgow Road, Camelon was a site location created in 2018 and has recorded one exceedance (in 2019) over this two-year period.

Falkirk Council measured PM_{10} concentrations at eight locations during 2019. The Scottish NAQS objectives for PM_{10} were met at all eight monitoring locations.

The sites with the highest recorded annual mean PM_{10} concentrations in 2019 (but within the Scottish NAQS PM_{10} objective) were: A4 Falkirk Haggs (Roadside,

14µg/m^3), A10 Grangemouth Municipal Chambers (Urban Background / Industrial, 14µg/m^3) and A15 Main Street, Bainsford (Roadside, 14µg/m^3).

During 2019, there were no exceedances of the $PM_{2.5}$ Scottish NAQS objective (10µg/m^3) at any of the four automatic monitoring sites. The sites with the highest recorded annual mean $PM_{2.5}$ concentrations in 2019 (but within the Scottish NAQS $PM_{2.5}$ objective) were A8 Grangemouth AURN (Urban Background, 8µg/m^3) and A13 Banknock 2 (Roadside, 7µg/m^3). Annual data capture was good for both sites at 97%.

The two sites with the lowest $PM_{2.5}$ (annual mean) concentrations were: A14 Banknock 3 (Urban Background, 4.6µg/m^3) and A7 Falkirk West Bridge Street (Roadside, 6µg/m^3). Annual data capture rates were good for both sites at 97% and 100% respectively.

Over a five-year period (from 2015 to 2019) one site, Grangemouth AURN has recorded a $PM_{2.5}$ (annual mean) concentration reduction. Two sites have recorded concentration increases, these were: A13 Banknock 2 and A14 Banknock 3. One site, A7 Falkirk West Bridge Street has remained at the same concentration over this period.

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 respectively. 2019 saw a marginal concentration increase to 8µg/m^3 however this concentration remains reasonably low and within the Scottish NAQS objective.

There were no exceedances of the SO_2 objectives (15-minute, hourly or daily) recorded at any of the Falkirk Council monitoring locations during 2019.

The sites recording the only exceedances of the 15-minute SO_2 NAQS objective during 2019 was A9 Grangemouth Moray (12) and Grangemouth AURN (2). There was one excedance of the 1-hour SO_2 NAQS objective which was recorded at Grangemouth Moray. No other SO_2 exceedances were recorded at any of the other sites during 2019.

This is the sixth 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 were exceedances of the 15-minute and 1-

hour SO_2 NAQS objectives, the number of exceedances were below the maximum permitted.

In 2019, Falkirk Council monitored 1,3-butadiene at three locations using passive diffusion tubes. All the results were within the NAQS objective. 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. All the benzene concentrations recorded by the passive diffusion tubes were within the NAQS objectives. In 2019, the pumped diffusion tube at the A8 Grangemouth AURN site recorded an annual average concentration of 0.78µg/m^3. The concentration recorded continues to be within the relevant annual mean benzene NAQS objective (of 3.25µg/m^3) and is a minimal increase (of 0.04µg/m^3) compared to 2018's result (0.74µg/m^3).

Local Air Quality Policy PG (S) 16[Ref5] 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 six consecutive years; Falkirk Council considers the AQMA remains justified based upon continual exceedances of the 15min SO_2 NAQS objective concentration recorded at the A8 Grangemoith AURN, A9 Grangemouth Moray and A10 Grangemouth Municipal Chambers sites for the past five consecutive years. The Grangemouth Emission Study has been completed by Sweco and is currently being assessed and authorised by the relevant organisations prior to it's publication im 2020.The study report includes a review and assessment of the Grangemouth AQMA.

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 38µg/m^3 which is also close to the NO_2 NAQS objective limit. An additional (town centre) located diffusion tube was close to the 40µg/m^3 limit - this was NA111 Falkirk West Bridge Street (38µg/m^3). The PM_{10} annual mean and 24-hour concentrations continue to be meeting the relevant NAQS objectives.

The Banknock AQMA (PM_{10} 24-hr and annual mean) proposed revocation report has been completed (see Appendix D1) and approved by the Scottish Government and SEPA. The final stages of this AQMA revocation are being progressed and will be completed in due course.
Monitoring data for 2019 has highlighted that the Haggs AQMA will be reviewed in 2020 / 21 as the site continues to meet the NAQS objectives for traffic-related PM_{10}.

Site A15 Main St, Bainsford met all NAQS objectives for NO_2 and PM_{10} in 2019. There was a $PM_{2.5}$ (annualised-estimation) NAQS (annual mean) exceedance (12 $\mu g/m^3$) 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 (DA report contained within the 2016 APR). There is no further requirement to update the Detailed Assessment until NAQS objective breaches are recorded at the roadside automatic site.

5.2 Conclusions relating to New Local Developments

During December 2019, Falkirk Council received a planning application for a proposed development of a new energy from waste (EfW) facility at the Avondale landfill site in Polmont, Falkirk.

The operation of the EfW facility will fall under the Pollution Prevention and Control (PPC) regulations. SEPA will have overall responsibility for site pollution regulation during operation.

The Isopleth Air Quality Assessment (Ref: 01.0009.017 (v3)) did not include the displacement and subsequent dispersion of dust (and traffic impacts) during the construction, operation and decommissioning phases. All impacts shall be compared to current NAQS objectives. Construction and demolition dust management guidance, such as that published by the Institute of Air Quality Management (IAQM), should be considered within the air quality assessment. Falkirk Council requested that a section be added to this report that considers the management of dust during these phases. The subsequent Enzygo Environmental Statement (CRM0125) was reviewed by Falkirk Council and was deemed satisfactory and in accordance with current and correct dust management guidance such as the stated Institute of Air Quality Management (IAQM).

In 2019, Falkirk Council has received eight complaints in relation to smoke and odour from domestic biomass sources such as wood burning stoves and open garden

bonfires. These complaints were investigated thoroughly and advice was provided on smoke control area rules, DEFRA approval of stoves including using authorised fuels, guidance on efficient stove use and recommended annual maintenance measures. Relevant and current guidance is now provided by Falkirk Council Environmental Health within the initial planning phase of new residential and commercial developments in relation to installing appliances such as wood burning stoves. This guidance includes adhering to local smoke control area rules, DEFRA approval of stoves, using authorised fuels and providing information on flue height and termination to allow effective smoke dispersal to minimise smoke and odour nuisance.

Falkirk Council received an air quality assessment for a proposed residential development at Middlerigg Farm, Falkirk in January 2019. The proposed development is for the erection of one hundred and eighty dwellings of various house types and sizes.

Falkirk Council recommended some amendments to the PBA January 2019 air quality report which were rectified and therefore the report was deemed satisfactory.

Falkirk Council received an air quality assessment for a proposed residential development at Woodend Farm, Falkirk in June 2019. The proposed development is for the erection of one hundred and eleven dwellings, ninety-nine of which will be new-build and twelve of which will be incorporated within the existing farmhouse on the site.

The air quality assessment report was requested to identify the potential impact to local air quality as a result of increased traffic on the local road network due to the proposed development. The pollutants assessed within this air quality assessment were nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$). All legislation, policies and guidance referenced within the report are current, applicable and correct. The report was deemed satisfactory by Falkirk Council.

Falkirk Council received an air quality assessment for a proposed residential development at Crawfield Road, Bo'ness in November 2019. The proposed development is for the erection of two hundred and twenty-five dwellings on a vacant field immediately south of Crawfield Road and adjacent to Linlithgow Road in Bo'ness.

The air quality assessment report was requested to identify the potential impact to local air quality as a result of increased traffic on the local road network due to the proposed development. The pollutants that were assessed within this air quality assessment were nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$).

Increased road traffic from the planned development has been fully assessed in section 3.4.7 with impacts at nearest human receptors being stated as 'negligible'. The report was deemed satisfactory by Falkirk Council.

Falkirk Council received an air quality assessment for a proposed residential development at Carriden Brae, Muirhouses, Bo'ness in November 2019. The proposed development is for the erection of one hundred and twenty dwellings, in a variety of house sizes. Falkirk Council recommended some amendments to the November 2019 Envirocentre air quality report which were rectified and therefore the report was deemed satisfactory.

Falkirk Council received an air quality assessment for a proposed residential development at the site of the former Denny High School, Falkirk in December 2019. The proposed development is for the erection of two hundred dwellings, which include a mix of forty-eight flats and fifty-three car parking spaces. All legislation, policies and guidance referenced within the report are current, applicable and correct. The report was deemed satisfactory by Falkirk Council Environmental Health.

Falkirk Council received an air quality assessment for a proposed residential development at the former Manuel Brickworks site in Whitecross, Falkirk in January 2019. The proposed development is for the erection of four-hundred dwellings of various house types, and commercial / industrial land covering a total of 8.9 hectares.

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.

5.3 Proposed Actions

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 38µg/m^3 which is also close to the NO_2 NAQS objective limit. An additional (town centre) located diffusion tube was close to the 40µg/m^3 limit - this was NA111 Falkirk West Bridge Street (38µg/m^3). The PM_{10} annual mean and 24-hour concentrations continue to be meeting the relevant NAQS objectives. The NA114 NO_2 diffusion tube is located on Glasgow Road in Camelon, Falkirk and is outwith any AQMA. This location will be subject to a LAQM Detailed Assessment in 2020 / 21.

Although SO_2 NAQS objectives have been achieved within the Grangemouth AQMA for six consecutive years; Falkirk Council considers the AQMA remains justified based upon continual exceedances of the 15min SO_2 NAQS objective concentration recorded at the A8 Grangemoith AURN, A9 Grangemouth Moray and A10 Grangemouth Municipal Chambers sites for the past five consecutive years. The Grangemouth Emission Study has been completed by Sweco and is currently being assessed and authorised by the relevant organisations prior to it's publication im 2020.The study report includes a review and assessment of the Grangemouth AQMA

The Banknock AQMA (PM_{10} 24-hr and annual mean) revocation summary report has been completed (see Appendix D1) and approved by the Scottish Government and SEPA. The final stages of this AQMA revocation are being progressed and will be completed in due course.

Monitoring data for 2019 has highlighted that the Haggs AQMA will be reviewed in 2020 / 21 as the site continues to meet the NAQS objectives for traffic-related PM_{10}.

Site A15 Main St, Bainsford met all NAQS objectives for NO_2 and PM_{10} in 2019. 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 (DA report contained within the 2016 APR). There is no further requirement to update the Detailed Assessment until NAQS objective breaches are recorded at the roadside automatic site.

The Air Quality Progress Report (APR) as required by the Scottish Government shall be submitted in June 2021.

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: Ecotech Serinus 50, UV Fluorescence. NO_2: API Teledyne T200, Chemiluminescence. PM_{10}: Met One 1020 Beta Attenuation Monitor (BAM). $PM_{2.5}$: 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: API Teledyne T200, 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 until 22/09/19, Palas Fidas 200 (Optical) from 23/09/19 onwards	1	40	3.5
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
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

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)
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
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
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

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?
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
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
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,	Roadside	279017	679305	NO_2	Y	<2	1.6	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?
	Haggs								
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
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
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
NA116	Kersiebank Avenue, Grangemouth	Urban Background / Industrial	293671	680347	Benzene, NO_2	N	2	2.75	N
NA117	Oswald Avenue (East), Grangemouth	Urban Background / Industrial	294101	681532	Benzene, NO_2	Y	2.5	2.2	N
NA118	Glebe Street,	Roadside	288726	680096	NO_2	Y	2.5	1.6	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?
	Falkirk								
NA119	Hendry Street, Falkirk	Urban Background	288728	681383	NO_2	N	3	1.3	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 2019 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3)				
					2015	2016	2017	2018	2019
A4	Falkirk Haggs	Automatic	94	94	30	33	28	28	27
A5	Falkirk Hope St	Automatic	93	93	21	23	19	21	20
A7	Falkirk West Bridge St	Automatic	97	97	37	37	36	39	38
A8	Grangemouth AURN	Automatic	88	88	14	16	14	14	15
A9	Grangemouth Moray	Automatic	91	91	15	18	17	17	15
A10	Grangemouth Municipal Chambers	Automatic	75	75	18	21	17	18	17
A15	Main St, Bainsford	Automatic	99	99	15	24	23	22	25
NA3	Tinto Drive, Grangemouth	Diffusion Tube	100	100	20	19	18	18	19
NA5	Copper Top pub, Camelon	Diffusion Tube	83	83	27	25	24	24	27
NA7	Irving Parish Church, Camelon	Diffusion Tube	83	83	17	16	15	17	15
NA9	Bellsdyke Rd, Larbert	Diffusion Tube	100	100	26	25	24	22	23
NA19	Kilsyth Rd, Banknock	Diffusion Tube	83	83	26	33	26	28	27
NA20	Garngrew Rd, Haggs	Diffusion Tube	100	100	23	24	22	22	22
NA21	Grangemouth Rd, Falkirk College	Diffusion Tube	91	91	28	28	28	28	26
NA24	Kerse Lane, Falkirk	Diffusion Tube	100	100	38	35	39	34	33
NA26	Weir St, Falkirk	Diffusion Tube	100	100	17	18	17	20	18
NA27	West Bridge St, Falkirk	Diffusion Tube	91	91	**47**	**48**	38	**44**	**47**
NA29	Wellside Pl, Falkirk	Diffusion Tube	91	91	15	17	17	18	17
NA36	Kerr Crescent, Haggs	Diffusion Tube	91	91	37	38	35	37	35
NA37	Denny Town House	Diffusion Tube	91	91	18	17	15	17	17
NA38	Larbert Village	Diffusion Tube	100	100	16	17	15	17	16

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3)				
					2015	2016	2017	2018	2019
	Primary School								
NA41	Seaview Pl, Bo'ness	Diffusion Tube	100	100	21	21	20	22	23
NA42	Municipal Chambers, Grangemouth	Diffusion Tube	100	100	20	20	17	19	19
NA44	Harvey Av, Polmont	Diffusion Tube	100	100	12	12	16	19	18
NA48	Hayfield, Falkirk	Diffusion Tube	100	100	19	19	16	18	19
NA50	Upper Newmarket St, Falkirk	Diffusion Tube	100	100	22	24	20	24	24
NA51	Mary St, Laurieston	Diffusion Tube	100	100	19	25	22	24	24
NA52	Main St, Larbert	Diffusion Tube	100	100	24	24	21	23	22
NA53	Denny Cross	Diffusion Tube	100	100	28	29	23	26	27
NA58	Callendar Rd, Falkirk	Diffusion Tube	91	91	20	23	19	23	21
NA59	Carron Rd, Bainsford	Diffusion Tube	91	91	29	26	28	28	29
NA60	Ronades Rd, Carron	Diffusion Tube	100	100	24	26	23	24	25
NA61	Canal Rd, Falkirk	Diffusion Tube	100	100	24	24	20	24	23
NA62	Arnot St, Falkirk	Diffusion Tube	100	100	39	39	34	34	34
NA63	Camelon Rd, Falkirk	Diffusion Tube	100	100	36	36	33	35	34
NA64	New Hallglen Rd, Falkirk	Diffusion Tube	100	100	18	18	14	16	17
NA65	Redding Rd, Redding	Diffusion Tube	100	100	27	26	23	24	24
NA67	Queen St, Falkirk	Diffusion Tube	100	100	25	29	27	27	26
NA69	Kerse Lane, Falkirk	Diffusion Tube	100	100	30	34	30	32	30
NA71	Park St, Falkirk	Diffusion Tube	100	100	35	29	30	31	30
NA72	Vicar St, Falkirk	Diffusion Tube	100	100	30	32	25	26	27
NA73	West Bridge St RHS, Falkirk	Diffusion Tube	100	100	31	22	28	31	31
NA76	Tryst Rd, Stenhousemuir	Diffusion Tube	100	100	23	22	19	20	20
NA77	Kinnaird Village	Diffusion Tube	100	100	23	33	21	22	23
NA78	Glen Brae, Falkirk	Diffusion Tube	100	100	32	31	28	30	28
NA80	Cow Wynd, Falkirk	Diffusion Tube	91	91	32	27	29	28	30
NA81	Grahams Rd, Falkirk	Diffusion Tube	100	100	26	19	28	30	32

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3)				
					2015	2016	2017	2018	2019
NA82	Castings Av, Falkirk	Diffusion Tube	100	100	20	38	17	19	18
NA83	Main St, Bainsford	Diffusion Tube	83	83	35	21	31	34	34
NA85	Auchinloch Dr, Banknock	Diffusion Tube	100	100	20	16	17	19	20
NA86	Wolfe Rd, Falkirk	Diffusion Tube	100	100	18	32	15	16	16
NA87	M80 Slip South, Haggs	Diffusion Tube	100	100	32	30	27	28	31
NA88	Ure Crescent, Bonnybridge	Diffusion Tube	91	91	29	30	28	27	27
NA89	Grahams Rd / Meeks Rd, Falkirk	Diffusion Tube	100	100	31	32	28	30	30
NA94	A905 (Glensburgh Rd), Grangemouth	Diffusion Tube	100	100	24	21	30	31	30
NA98	Arnothill, Falkirk	Diffusion Tube	100	100	15	26	19	18	13
NA99	St Crispins Pl, Falkirk	Diffusion Tube	100	100	22	21	24	25	25
NA101	Glensburgh Rd (2), Grangemouth	Diffusion Tube	100	100	22	21	24	23	23
NA105	West of Shieldhill	Diffusion Tube	100	100	10	8	7	8	8
NA107	Main St (East), Bainsford	Diffusion Tube	91	91	28	30	26	27	30
NA110	Banknock 2 Air Quality Station	Diffusion Tube	100	100	19	19	16	16	16
NA111	Falkirk West Bridge St, Air Quality Station	Diffusion Tube	94	94	33	**43**	36	37	38
NA114	Glasgow Rd, Camelon	Diffusion Tube	100	100	New Location for 2018			39	**41**
NA115	Brown St, Camelon	Urban Background	83	83	New Location for 2018			18	19
NA116	Kersiebank Avenue, Grangemouth	Urban Background / Industrial	100	100	New Location for 2019				20
NA117	Oswald Avenue (East), Grangemouth	Urban Background / Industrial	100	100	New Location for 2019				20
NA118	Glebe Street, Falkirk	Roadside	100	100	New Location for 2019				23

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3)				
					2015	2016	2017	2018	2019
NA119	Hendry Street, Falkirk	Urban Background	100	100	New Location for 2019				22

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 2019 (%) (2)	NO_2 1-Hour Means > 200µg/m^3 (3)				
					2015	2016	2017	2018	2019
A4 Falkirk Haggs	Roadside	Automatic	94	94	0	0 (119)	0 (107)	0	0
A5 Falkirk Hope St	Urban Background	Automatic	93	93	0	0	0 (82)	0	0
A7 Falkirk West Bridge St	Roadside	Automatic	97	97	0 (115)	0 (107)	0	0	0
A8 Grangemouth AURN	Urban Background / Industrial	Automatic	88	88	0	0	0	0	0
A9 Grangemouth Moray	Urban Background / Industrial	Automatic	91	91	0	0	0	0	0
A10 Grangemouth Municipal Chambers	Urban Background / Industrial	Automatic	75	75	0 (86)	0 (72)	0	0	0
A15 Main St, Bainsford	Roadside	Automatic	99	99	0 (45)	0 (94)	0	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

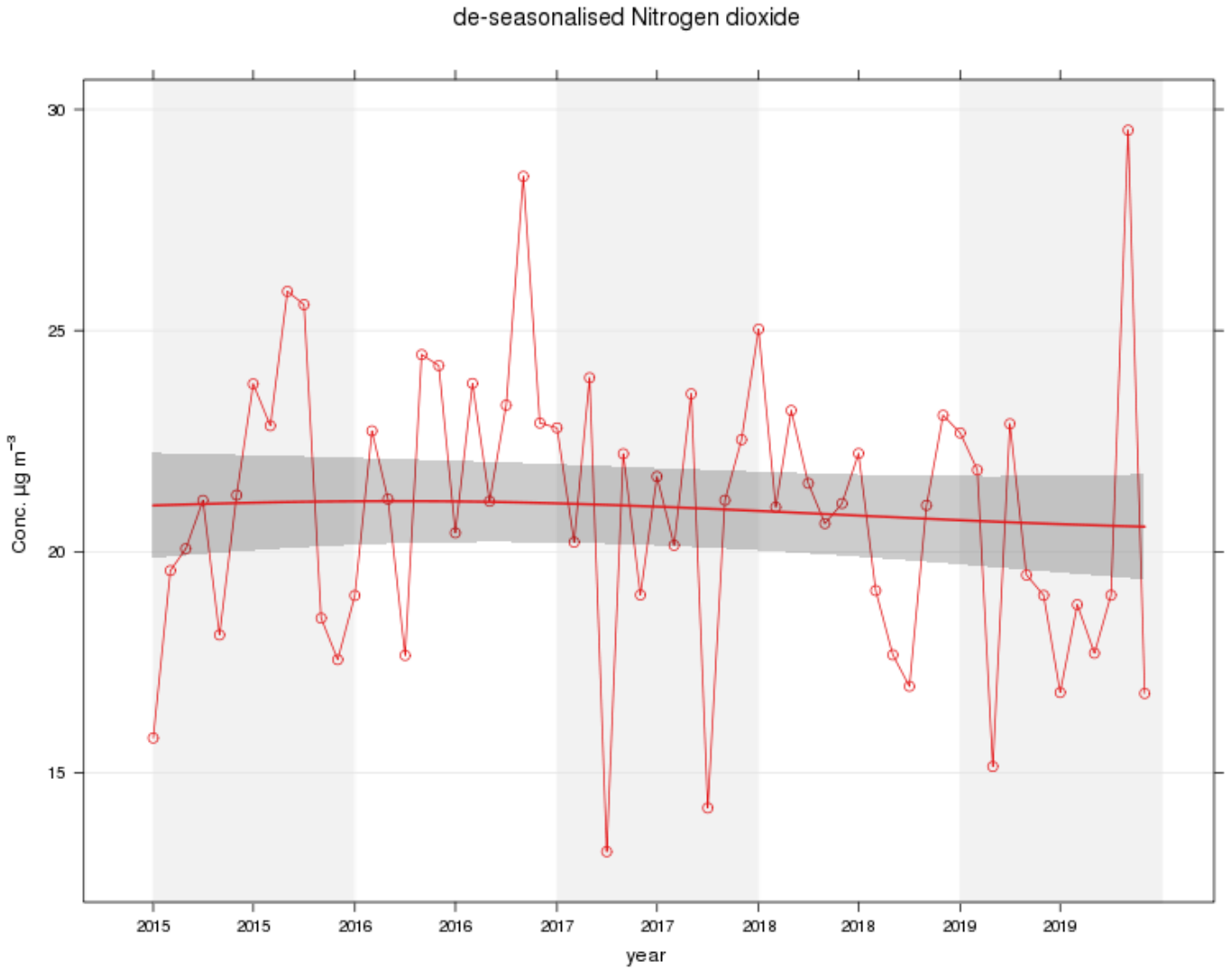


Figure 3 – A7 Falkirk West Bridge St Long Term NO_2 Concentrations

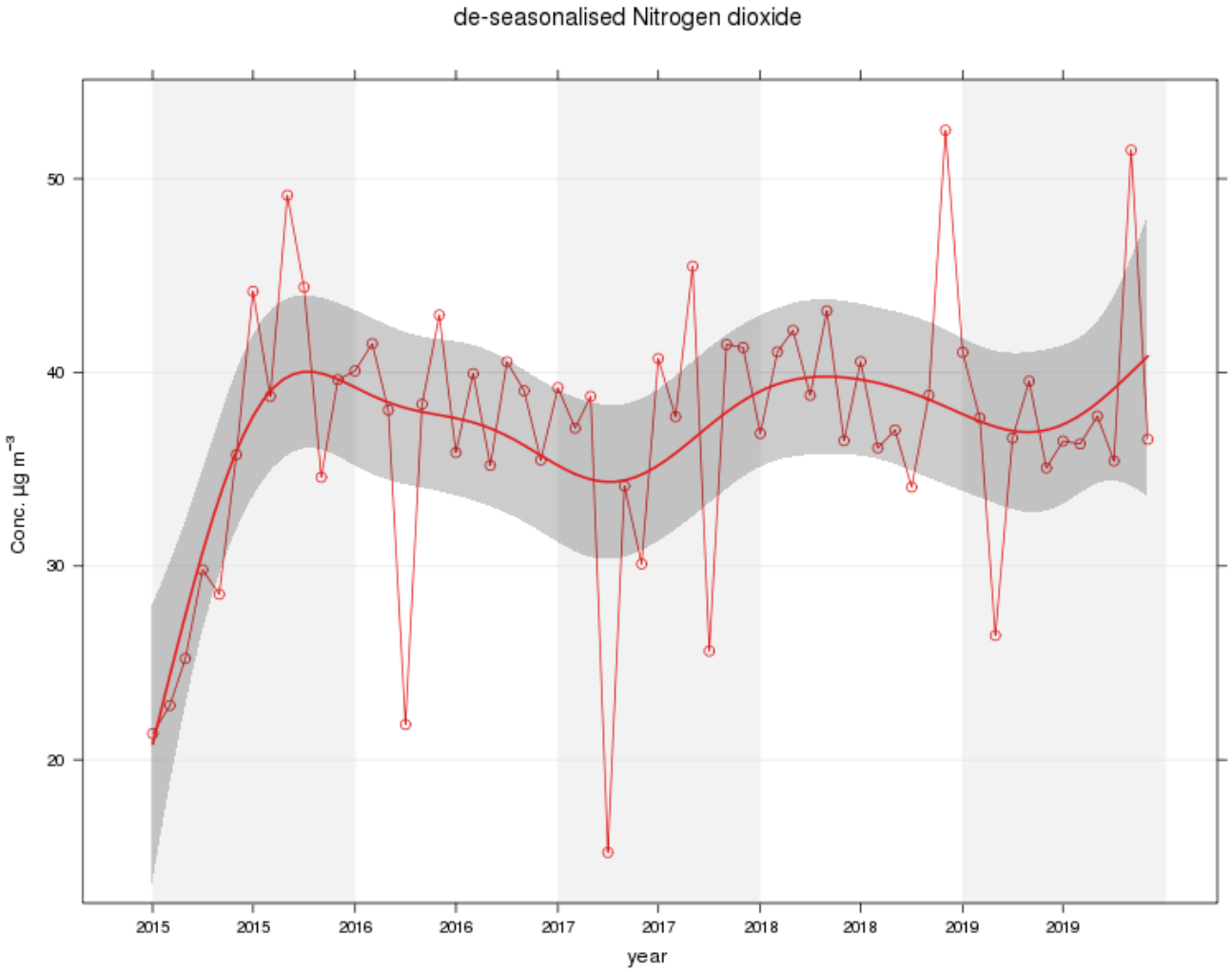


Figure 4 – A8 Grangemouth AURN Long Term NO_2 Concentrations

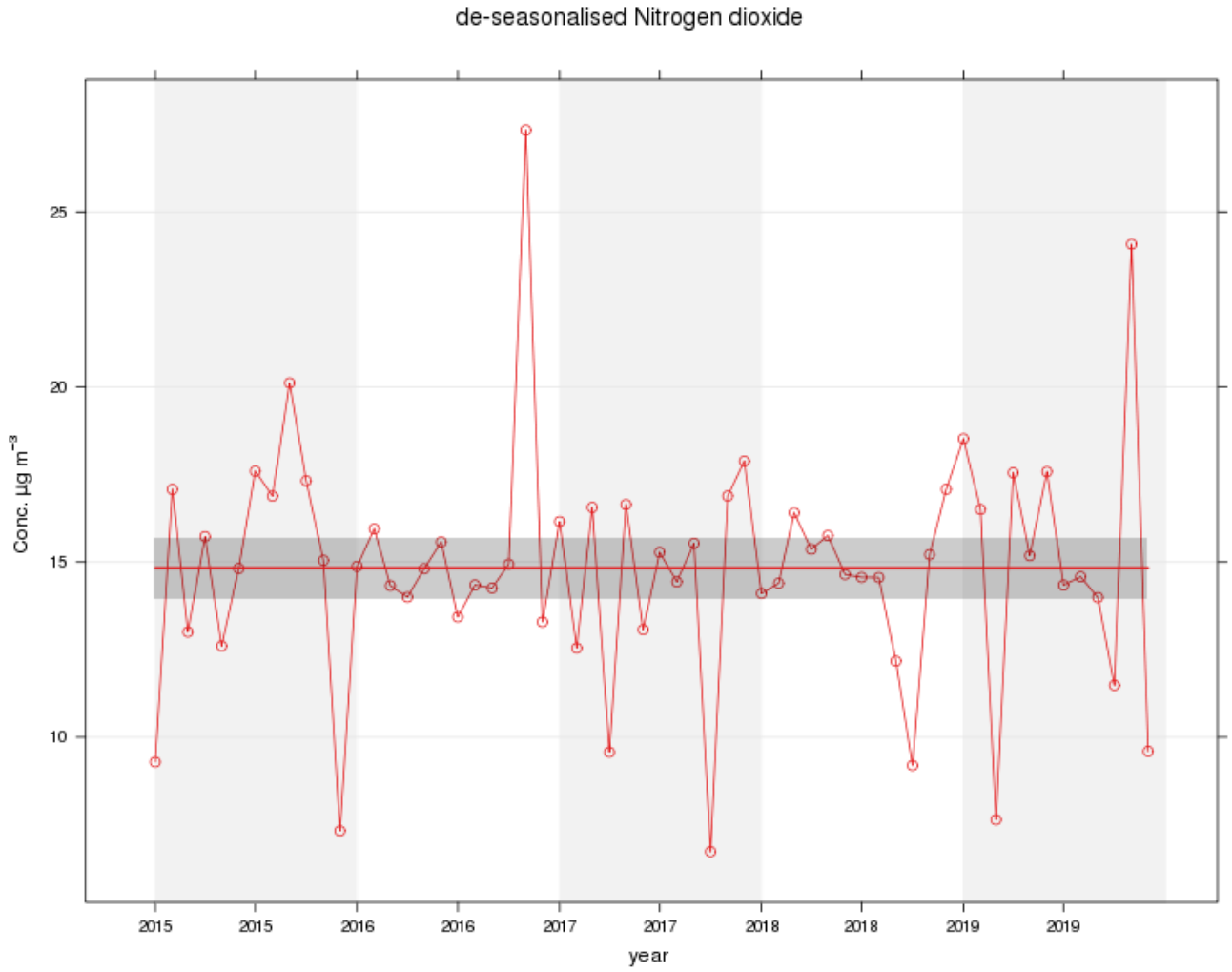


Figure 5 – A9 Grangemouth Moray Long Term NO_2 Concentrations

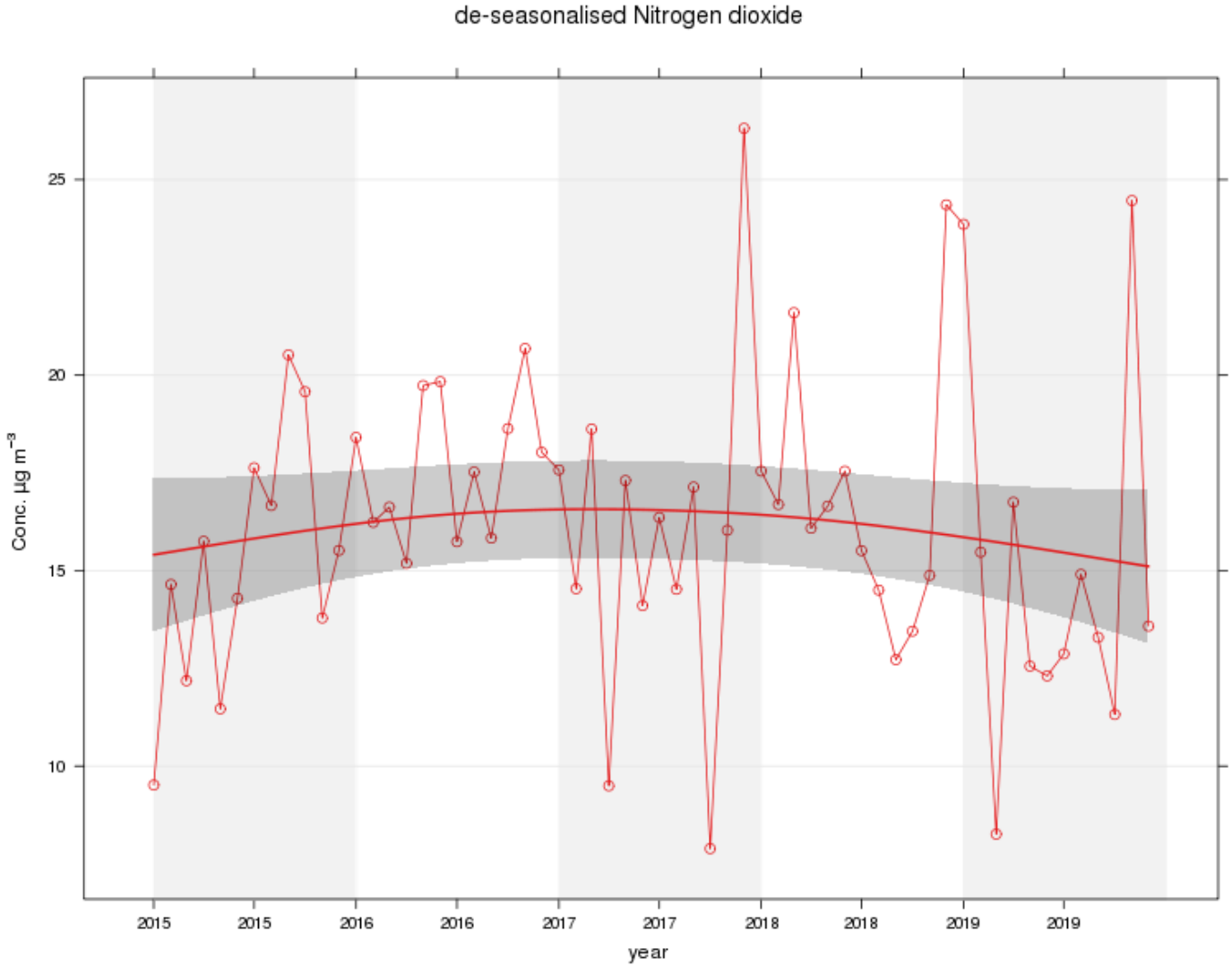


Figure 6 – A10 Grangemouth Municipal Chambers Long Term NO_2 Concentrations

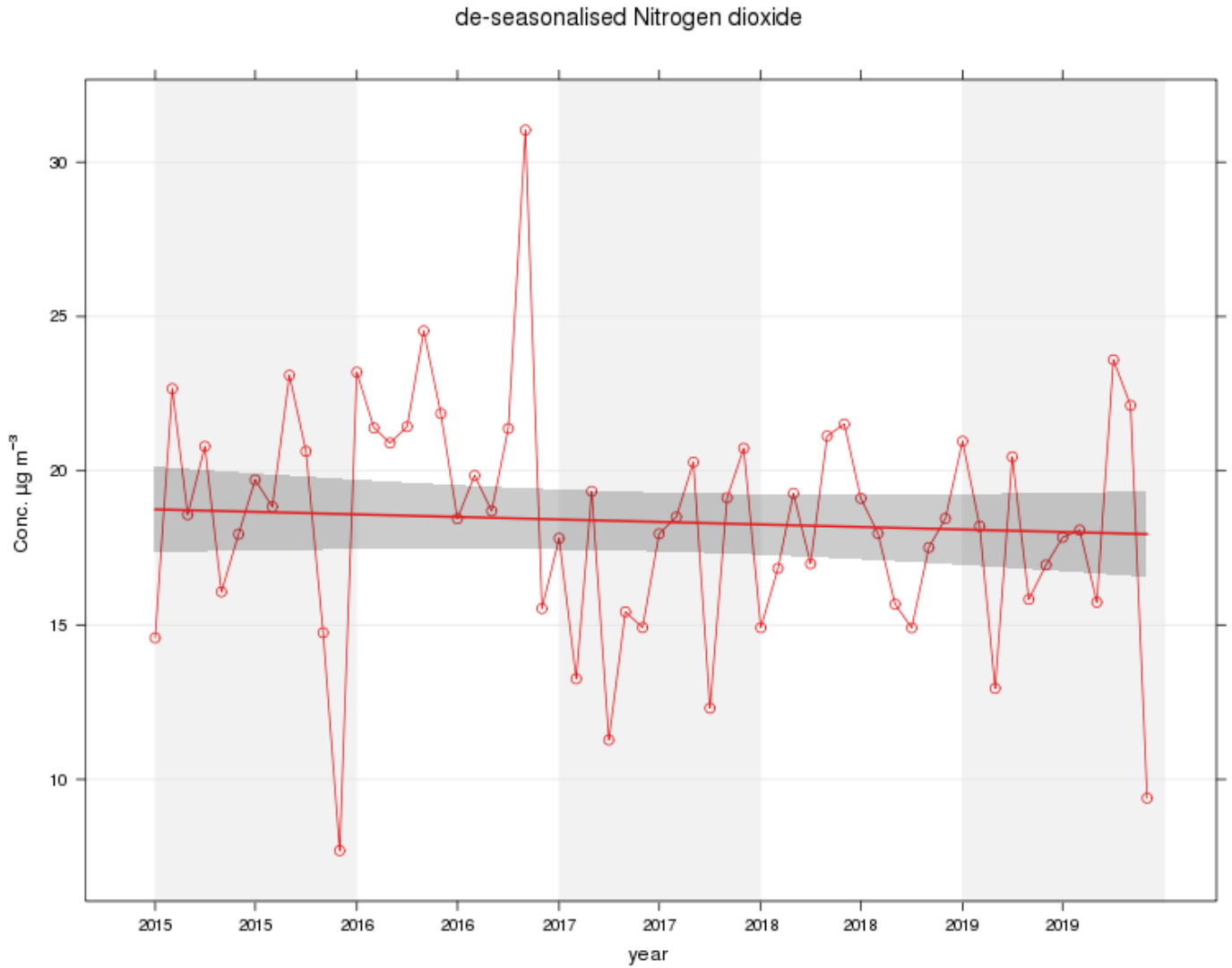


Figure 7 – A15 Main St, Bainsford Long Term NO_2 Concentrations

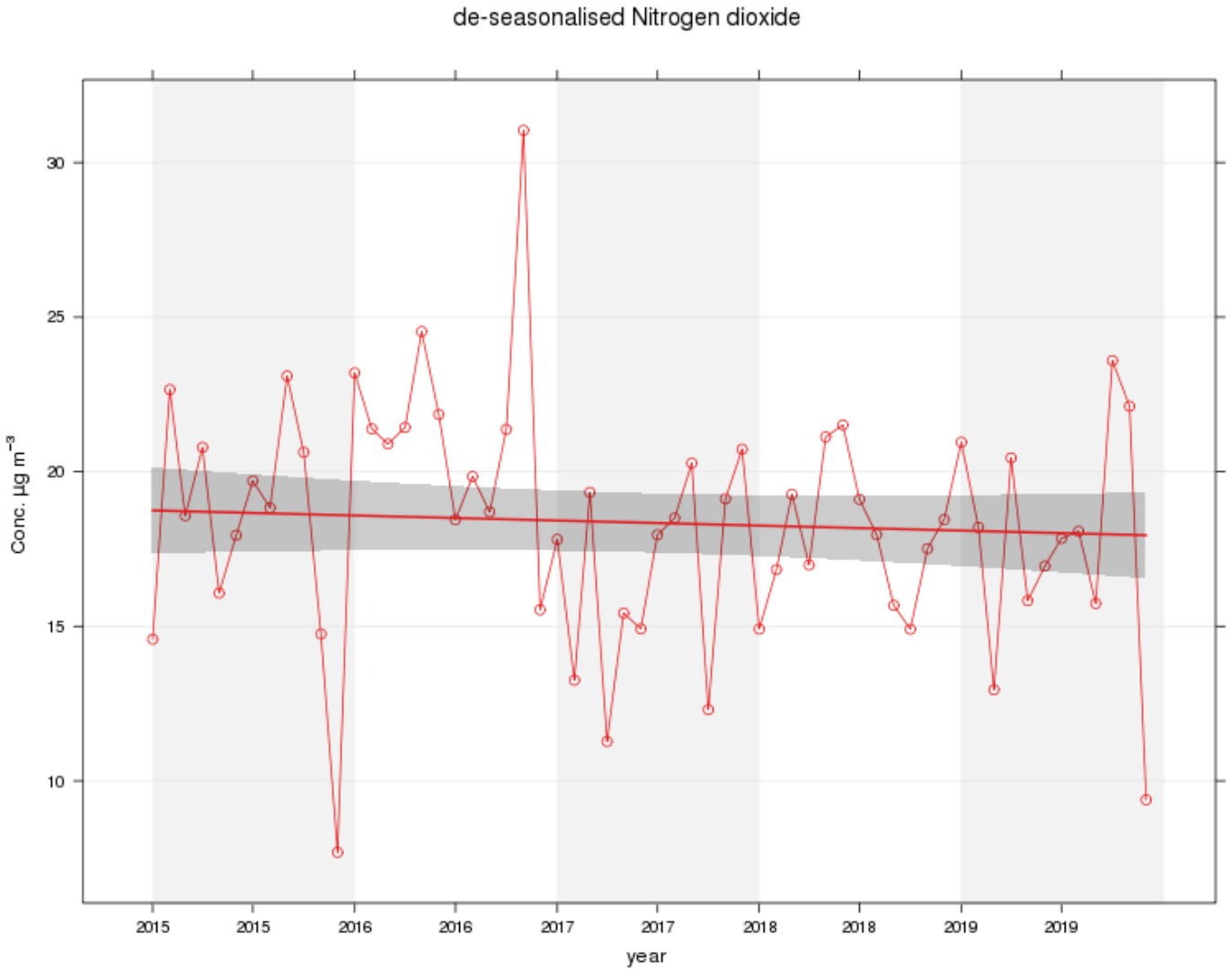


Table A.5 – Annual Mean PM_{10} Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	PM_{10} Annual Mean Concentration (µg/m^3) (3)				
				2015	2016	2017	2018	2019
A4	Falkirk Haggs	91	91	15	14	12	14	14
A5	Falkirk Hope St	70	70	PM_{10} analyser transferred from Falkirk Grahams Rd to Hope St site on 10/10/2018			11	13
A7	Falkirk West Bridge St	97	97	15	15	10	6	11
A8	Grangemouth AURN	93	93	12.2	11	9	12	13
A10	Grangemouth Municipal Chambers	45 (1)	45 (1)	13	13	12	12	14
A13	Banknock 2	97	97	11	11	13	11	7
A14	Banknock 3	99	99	8.2	n/n	7	6.9	7.9
A15	Main St, Bainsford	91	91	12.8	10	13	12	14

Notes: Exceedances of the PM_{10} annual mean objective of 18µg/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 2019 (%) (2)	PM_{10} 24-Hour Means > 50µg/m^3 (3)				
				2015	2016	2017	2018	2019
A4	Falkirk Haggs	91	91	1	0	0	0	4
A5	Falkirk Hope St	70	70	PM10 analyser transferred from Grahams Rd to Hope St on 10/10/2018			0 (30)	1
A7	Falkirk West Bridge St	97	97	2 (29)	0	0	0 (47)	1
A8	Grangemouth AURN	93	93	1 (21)	0	1	0	2
A10	Grangemouth Municipal Chambers	45 (1)	45 (1)	0	0	0	0	2
A13	Banknock 2	97	97	4	n/m	7	0	3
A14	Banknock 3	99	99	1	3	0	2 (10)	1
A15	Main St, Bainsford	91	91	0 (16)	0 (16)	0	0 (33)	5

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

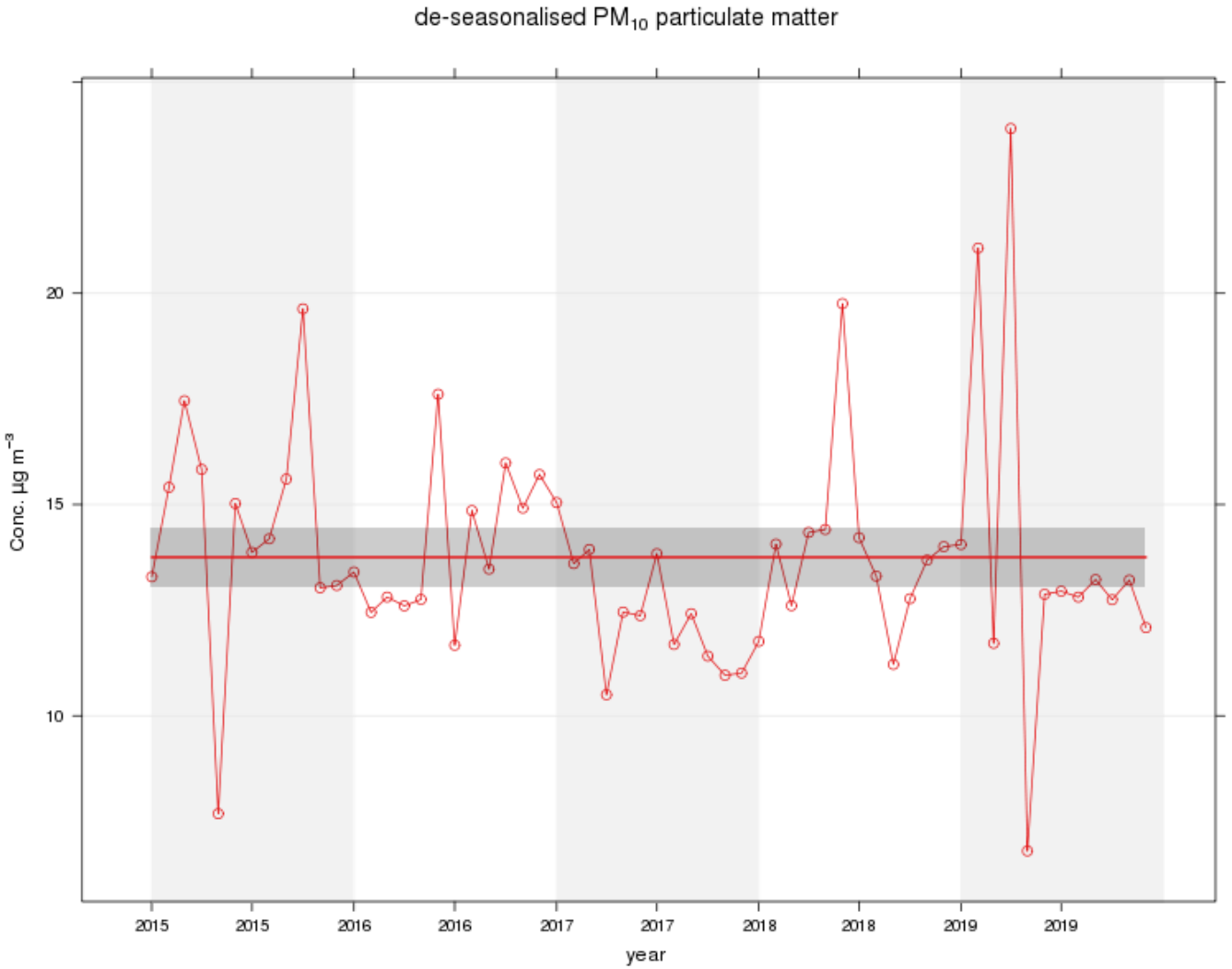


Figure 9 – A5 Falkirk Hope St Long Term PM_{10} (24-hour mean) Concentrations

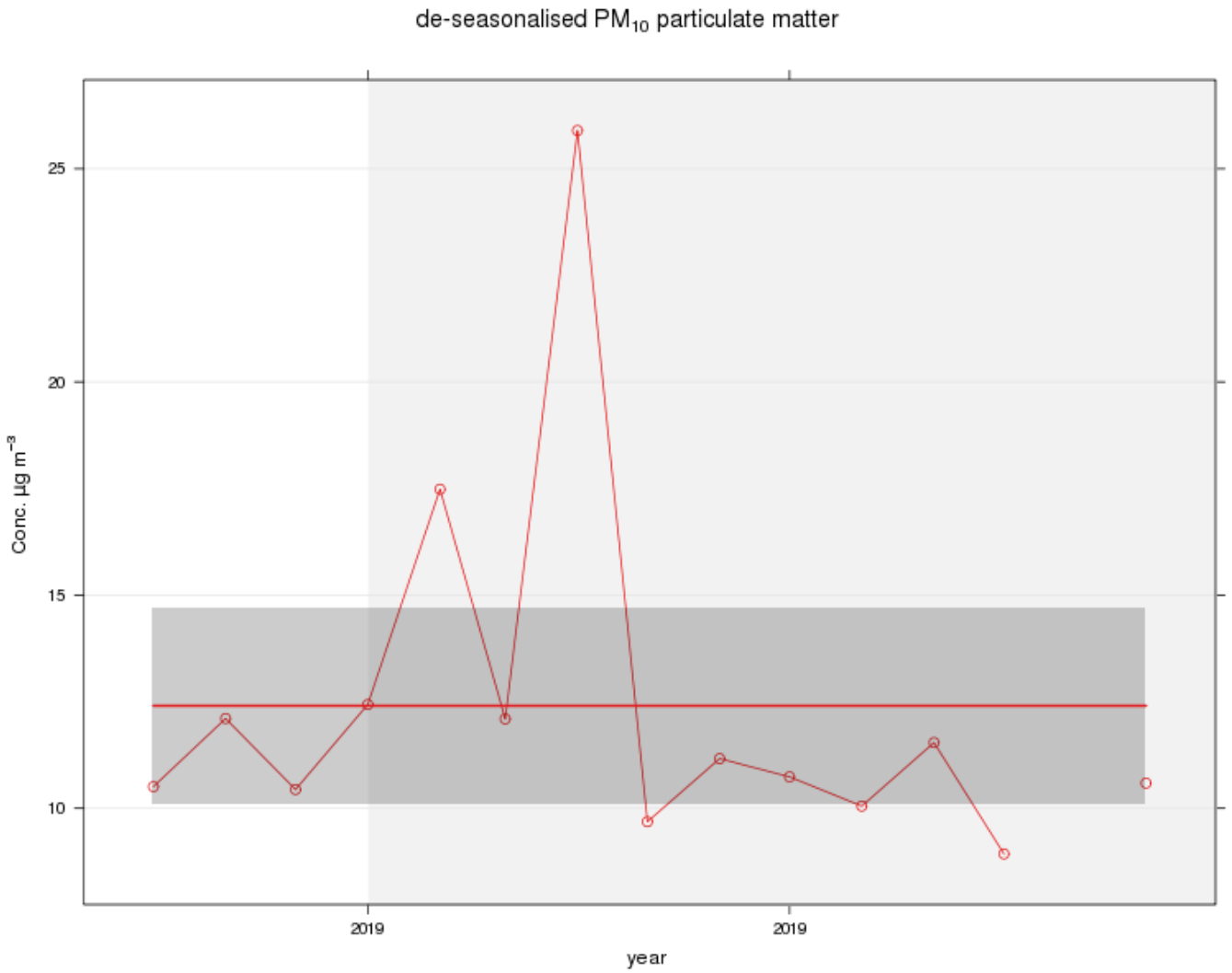


Figure 10 – A7 Falkirk West Bridge St Long Term PM_{10} (24-hour mean) Concentrations

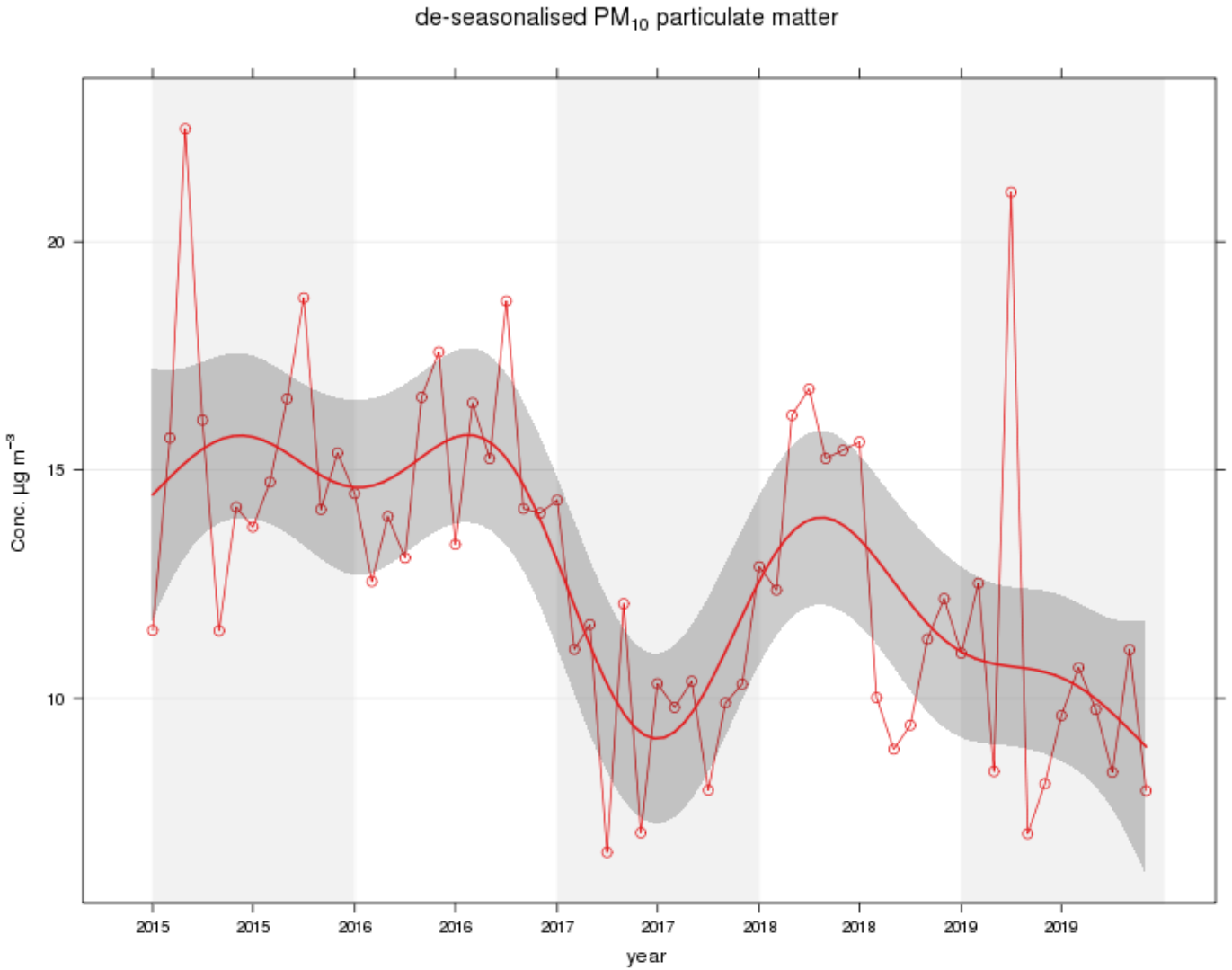


Figure 11 – A8 Grangemouth AURN Long Term PM_{10} (24-hour mean) Concentrations

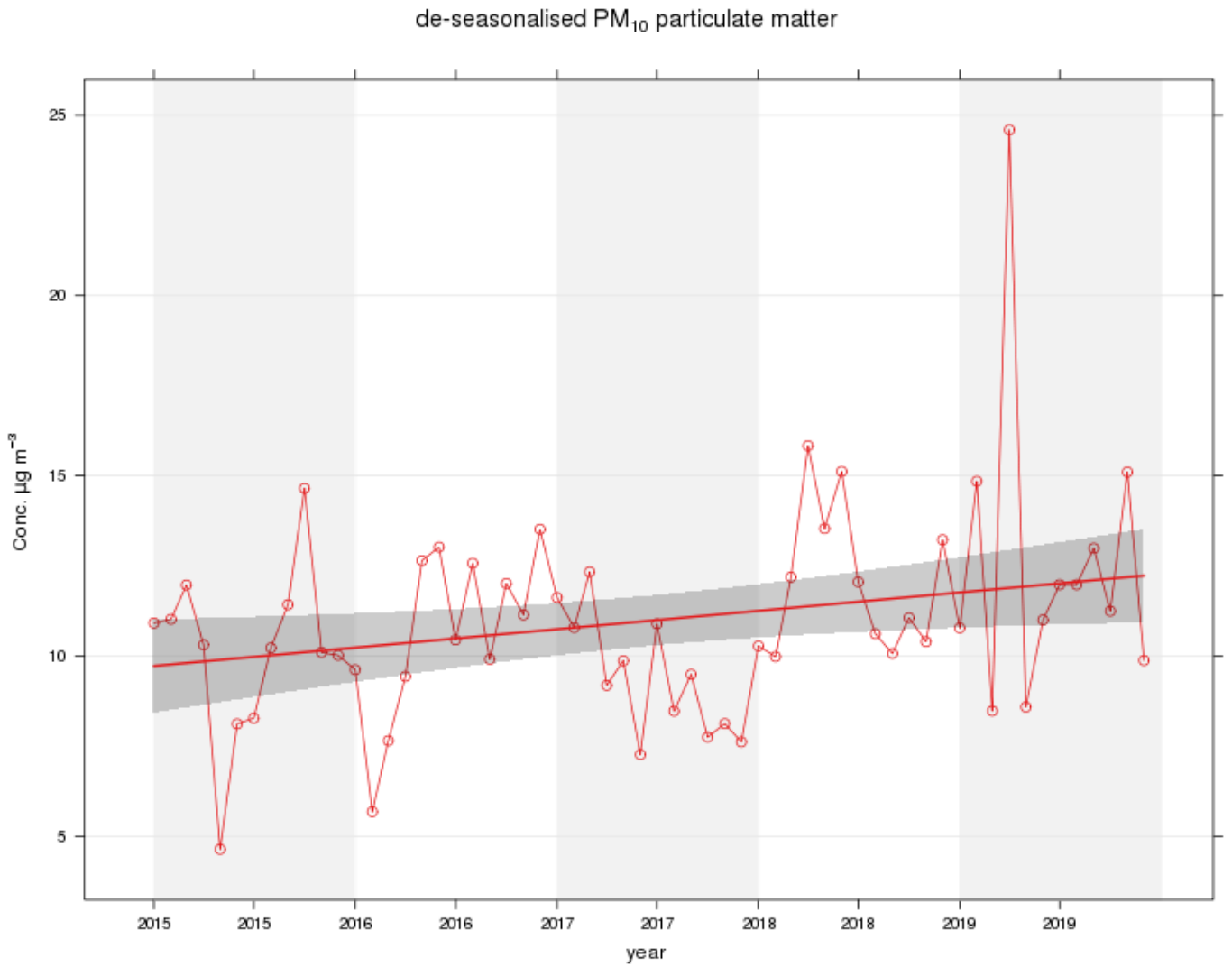


Figure 12 – A10 Grangemouth Municipal Chambers Long Term PM_{10} (24-hour mean) Concentrations

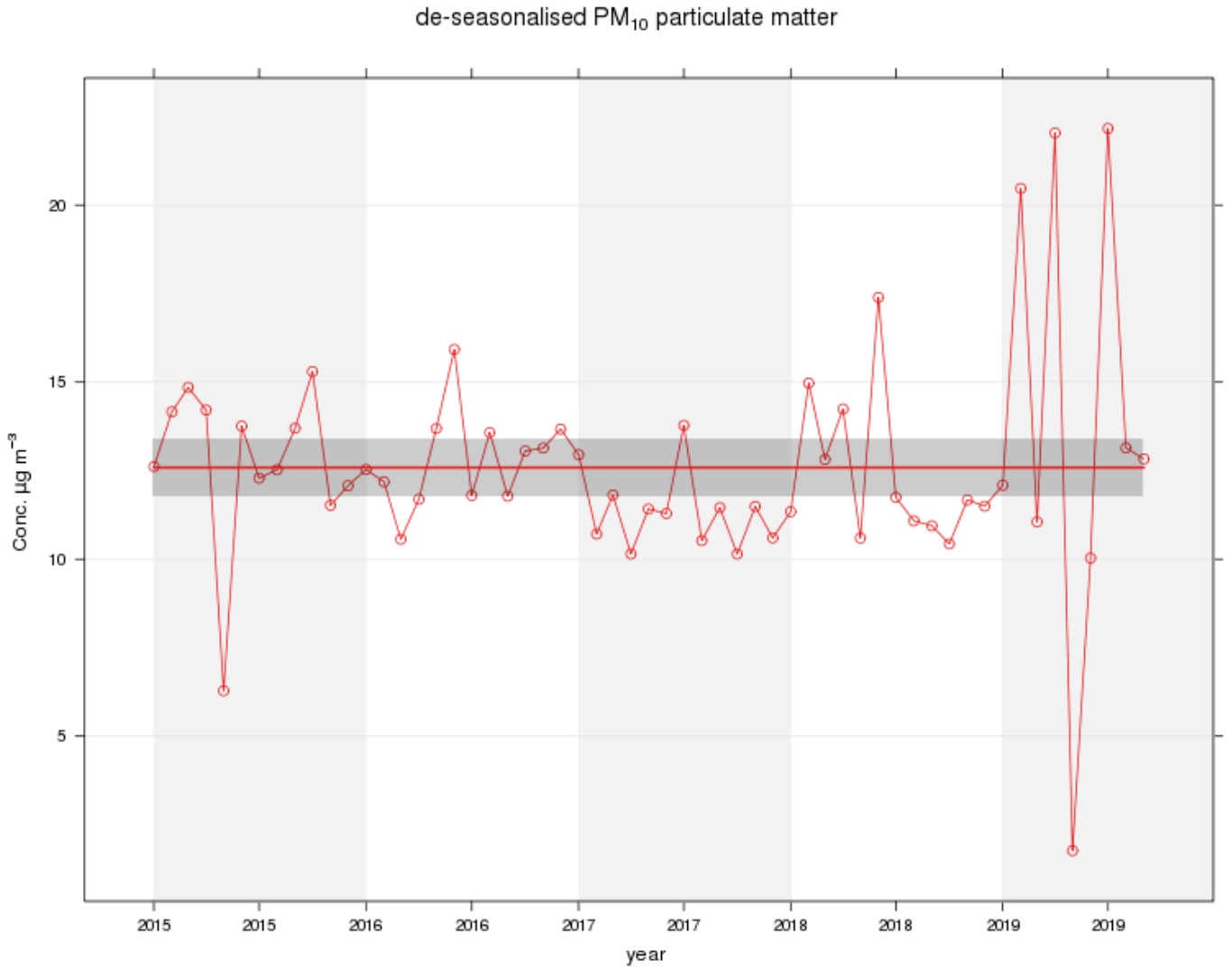


Figure 13 – A13 Banknock 2 Long Term PM_{10} (24-hour mean) Concentrations

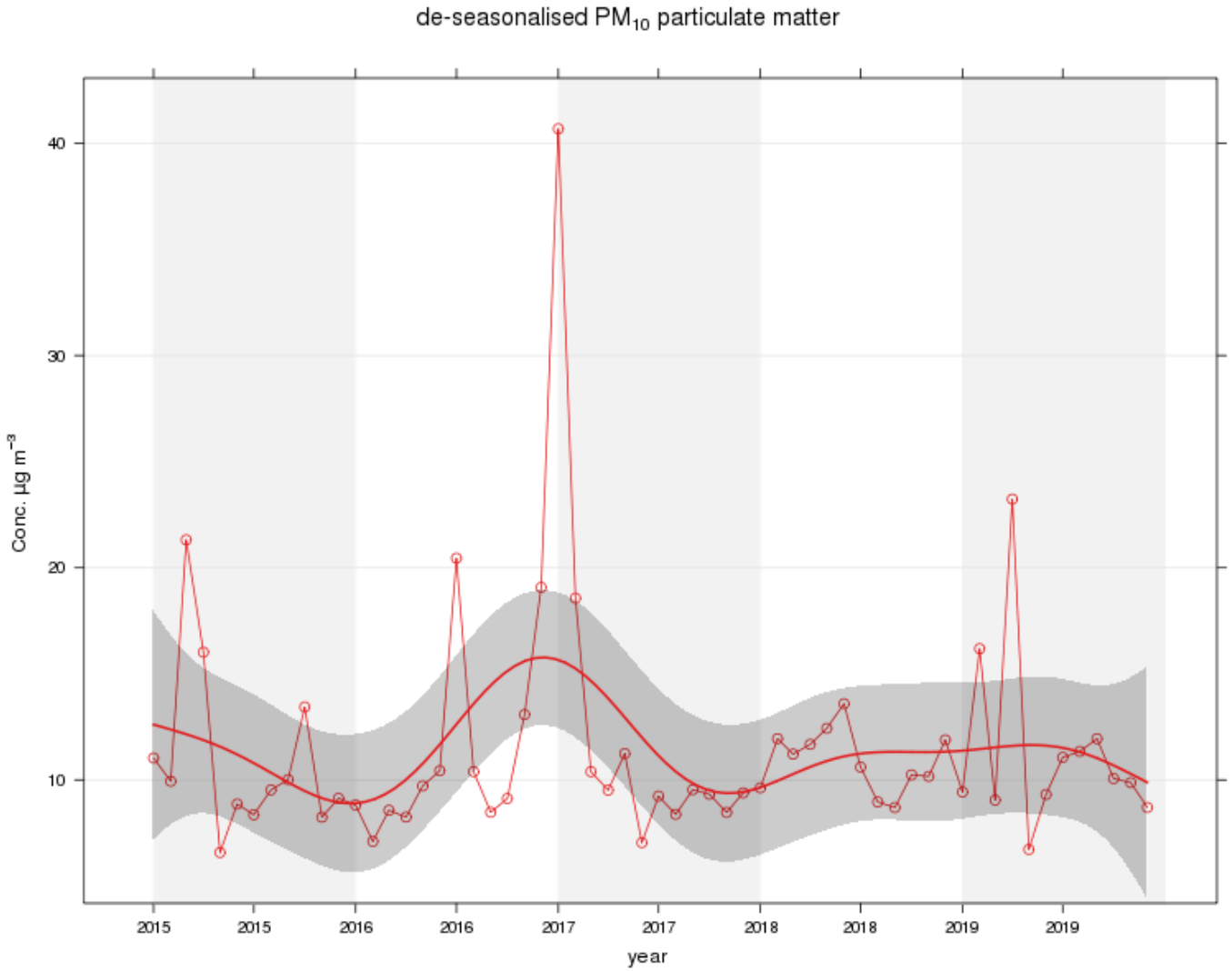


Figure 14 – A15 Main St, Bainsford Long Term PM_{10} (24-hour mean) Concentrations

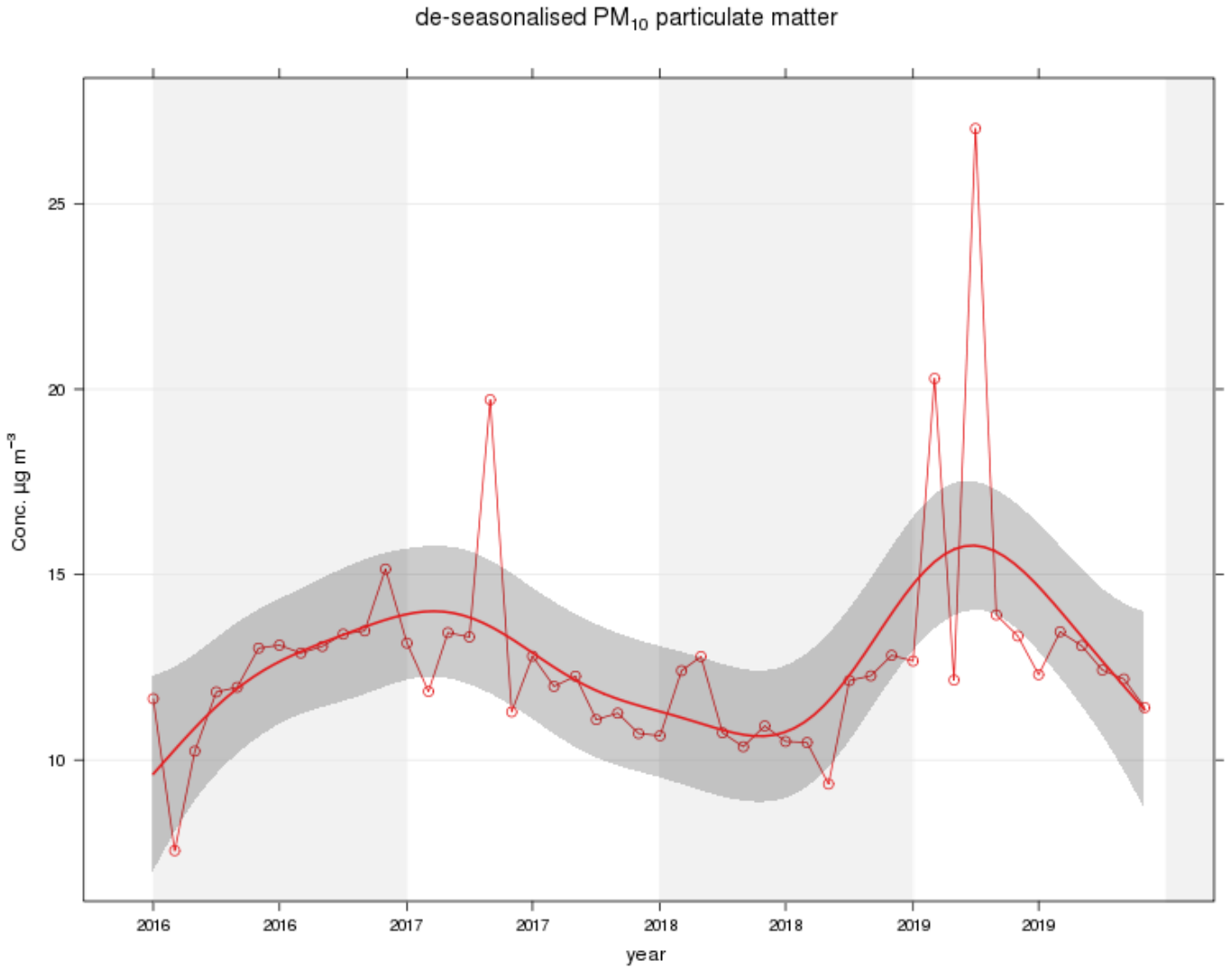


Table A.7 – Annual Mean $PM_{2.5}$ Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	$PM_{2.5}$ Annual Mean Concentration (µg/m^3) (3)				
				2015	2016	2017	2018	2019
A7	Falkirk West Bridge St	97	97	Not operating	6	6	6	6
A8	Grangemouth AURN	97	97	9.2	6	6	7	8
A13	Banknock 2	97	97	6	5	6	6	7
A14	Banknock 3	100	100	3.7	n/a	3	4	4.6

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

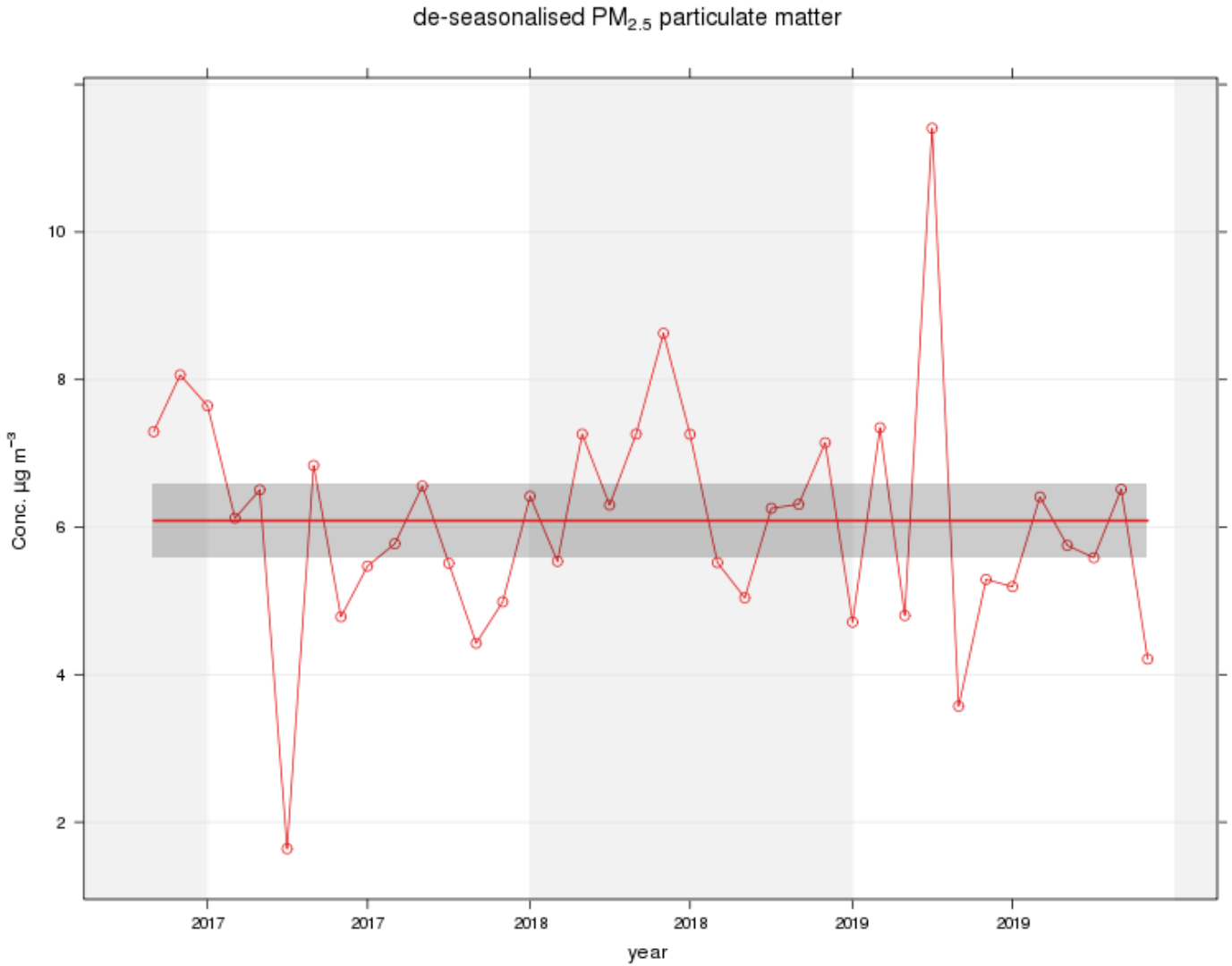


Figure 16 – A8 Grangemouth AURN Long Term $PM_{2.5}$ Concentrations

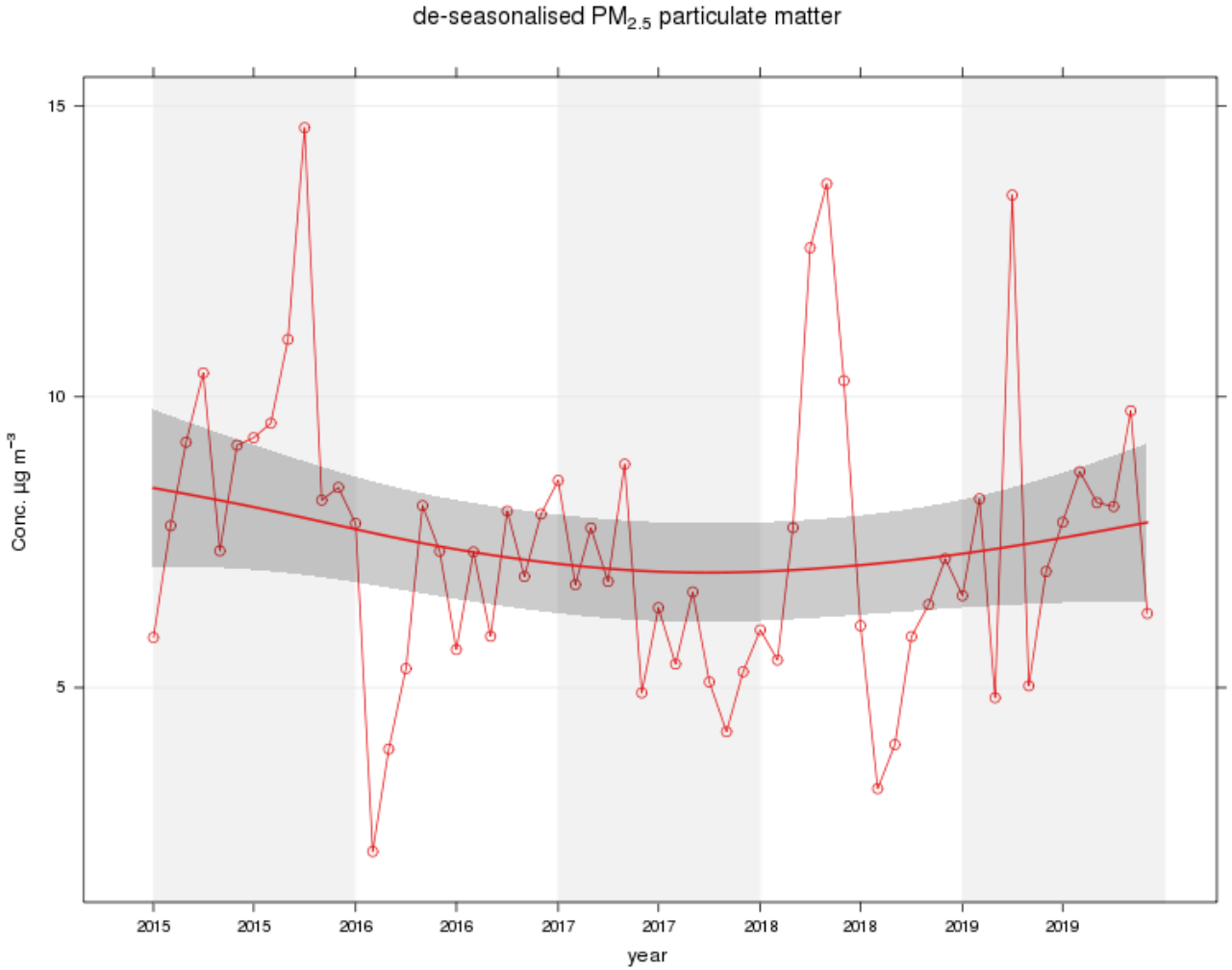


Figure 17 – A13 Banknock 2 Long Term $PM_{2.5}$ Concentrations

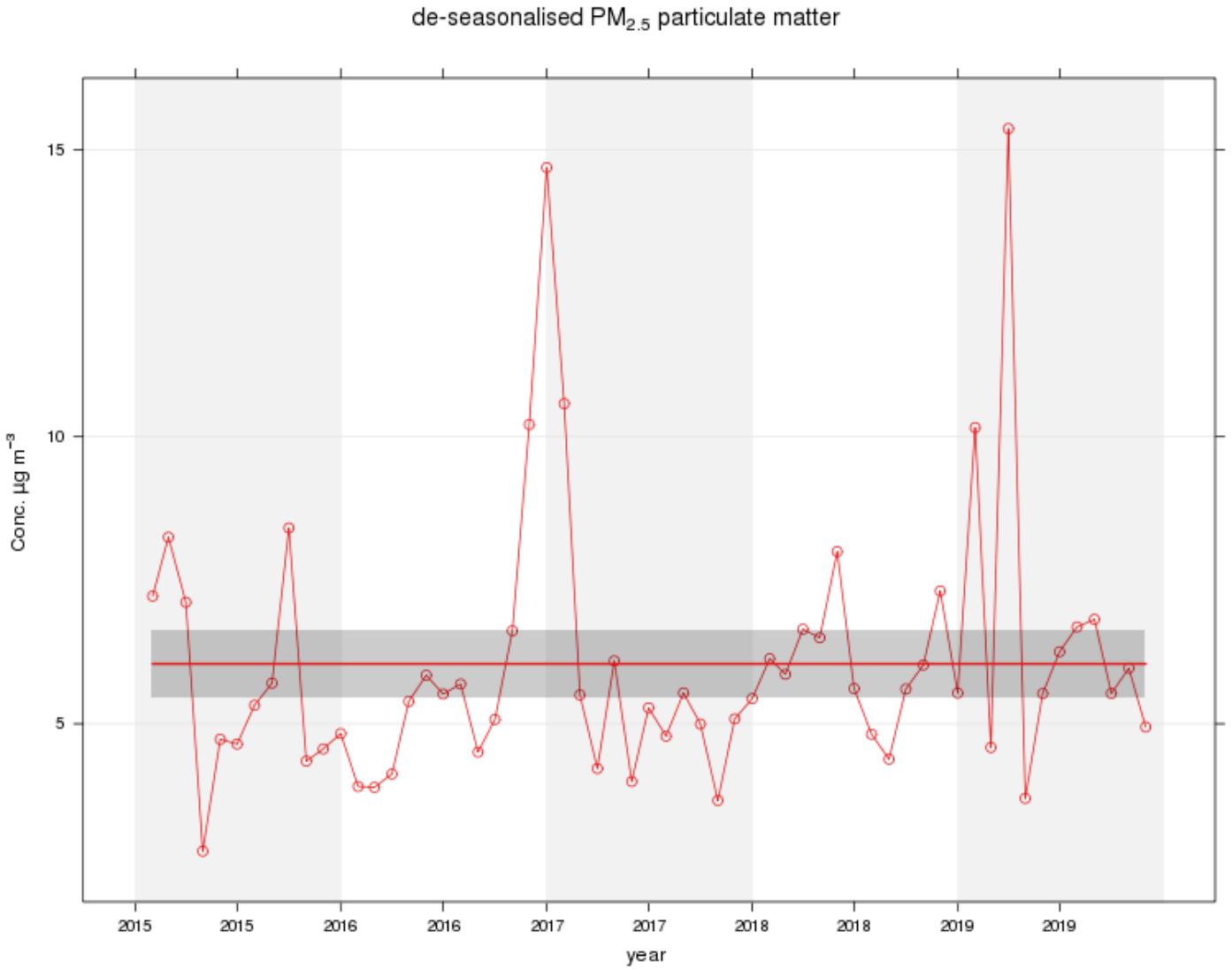


Table A.8 – SO_2 Monitoring Results

Site ID	Site Type	Valid Data Capture for monitoring Period (%) (1)	Valid Data Capture 2019 (%) (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	88	88	0	0	0
A5	Falkirk Hope St	86	86	0	0	0
A8	Grangemouth AURN	91	91	2	0	0
A9	Grangemouth Moray	95	95	12	1	0
A10	Grangemouth Municipal Chambers	81	81	0	0	0
A11	Grangemouth Zetland Park	95	95	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 18 – A3 Bo'ness Long Term SO_2 Concentrations

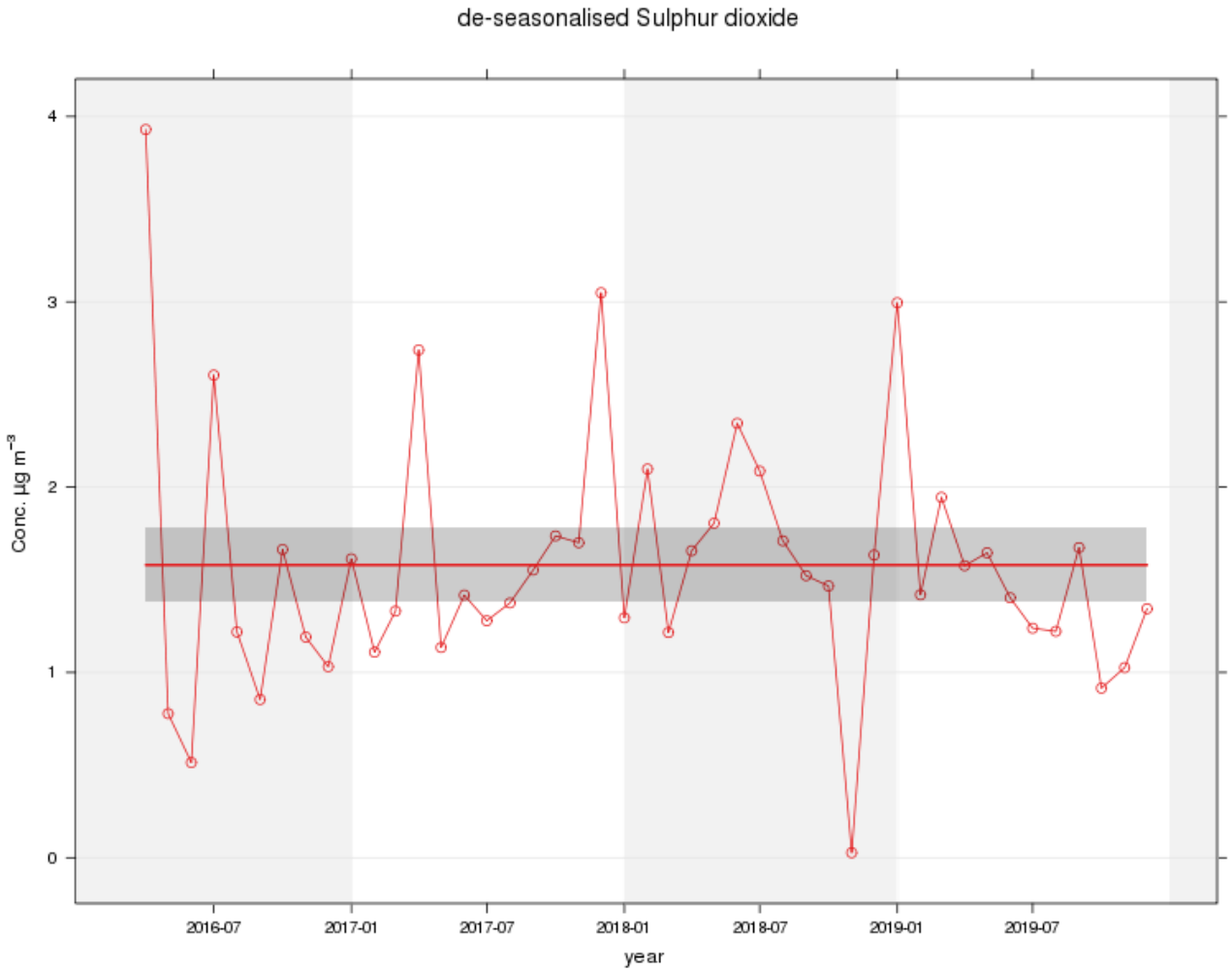


Figure 19 – A5 Falkirk Hope St Long Term SO_2 Concentrations

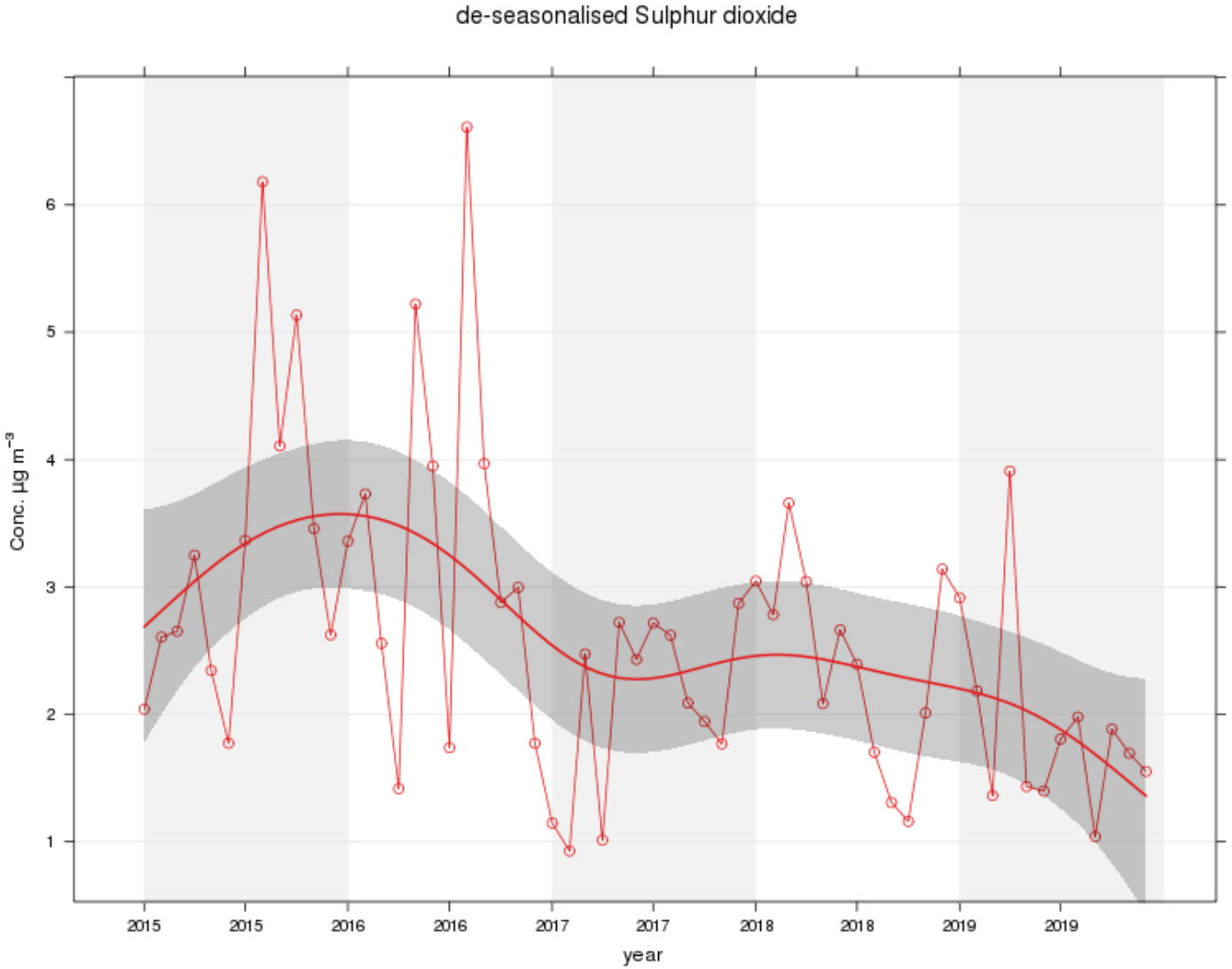


Figure 20 – A8 Grangemouth AURN Long Term SO_2 Concentrations

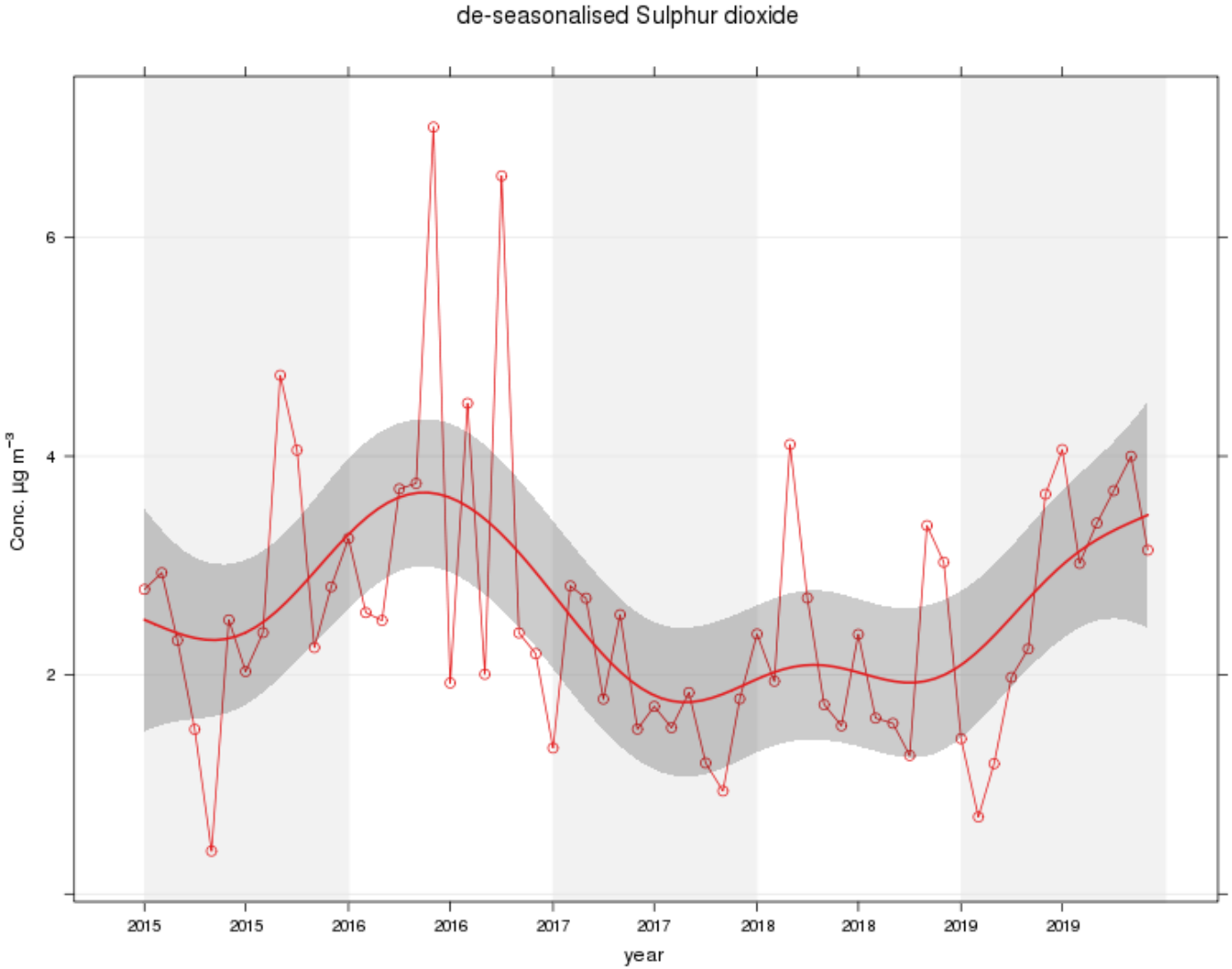


Figure 21 – A9 Grangemouth Moray Long Term SO_2 Concentrations

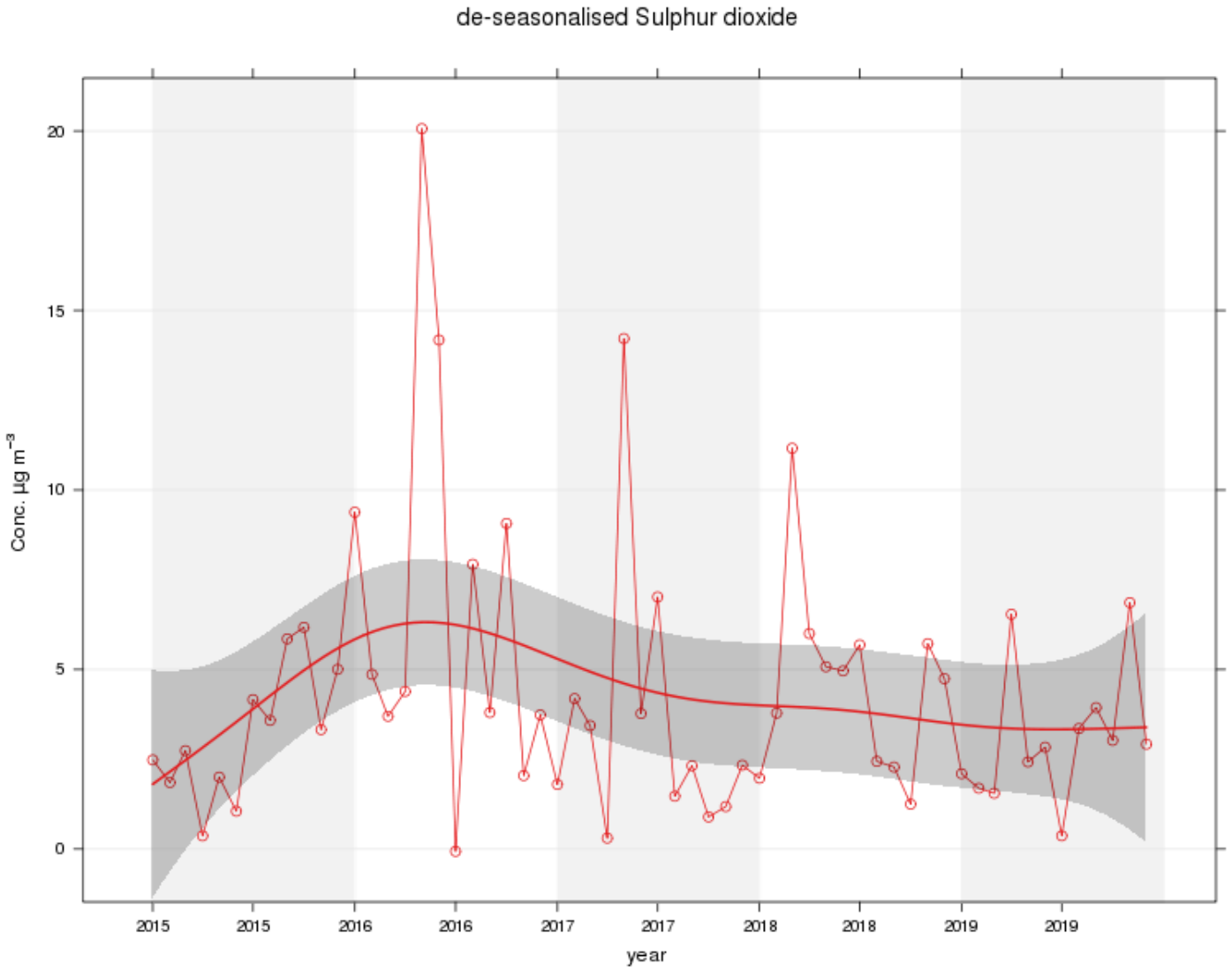


Figure 22 – A10 Grangemouth Municipal Chambers Long Term SO_2 Concentrations

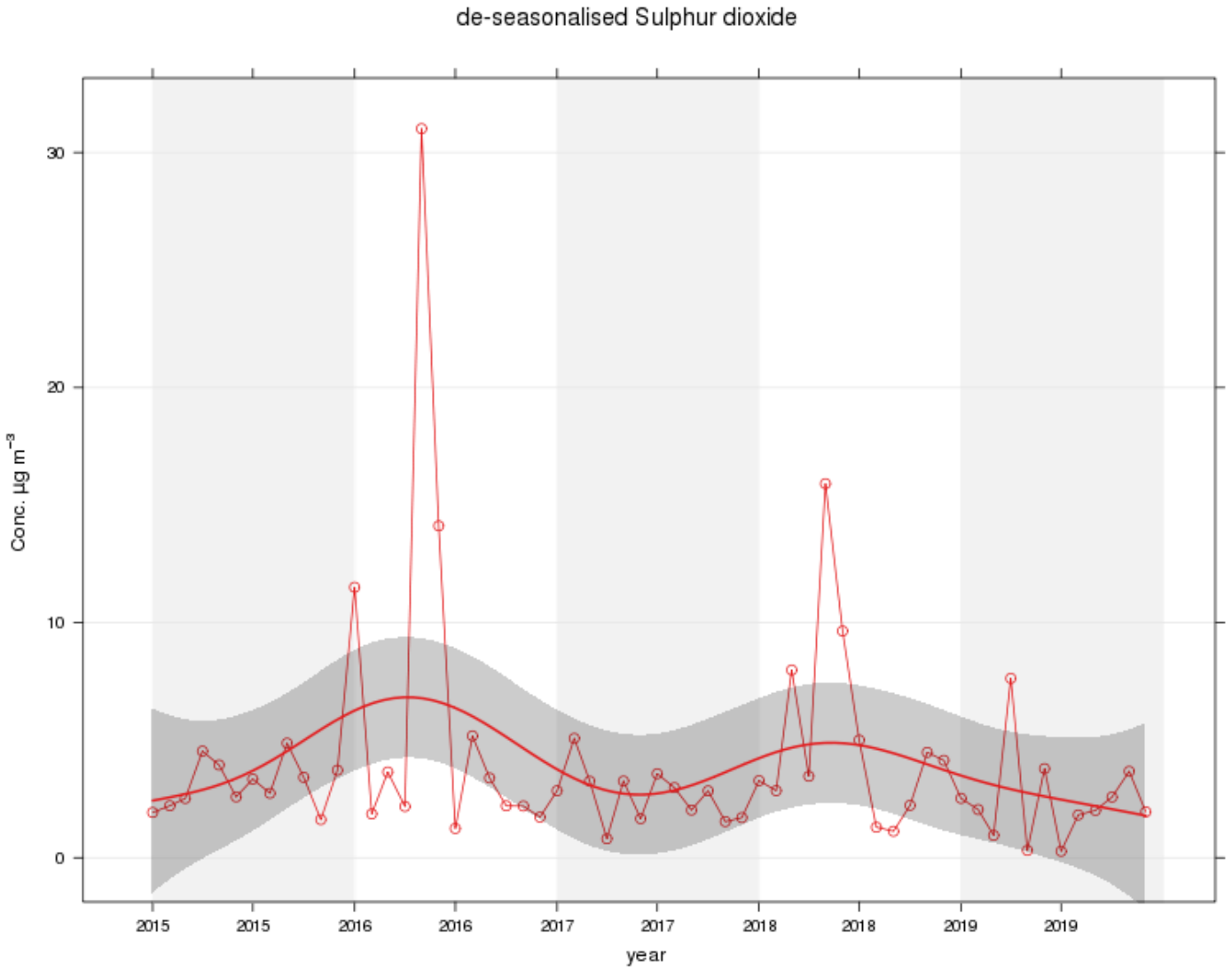


Figure 23 – A11 Grangemouth Zetland Park Long Term SO_2 Concentrations

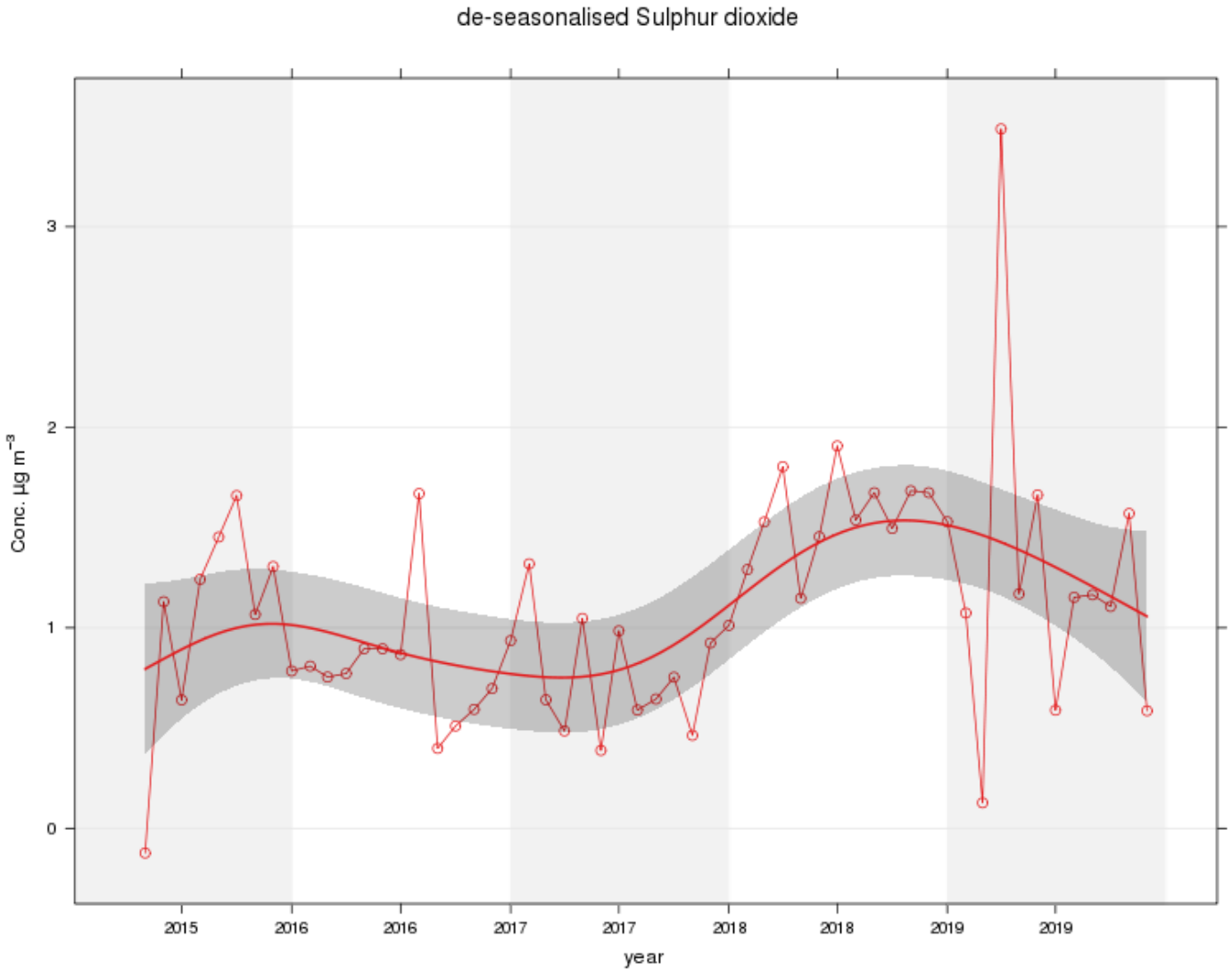
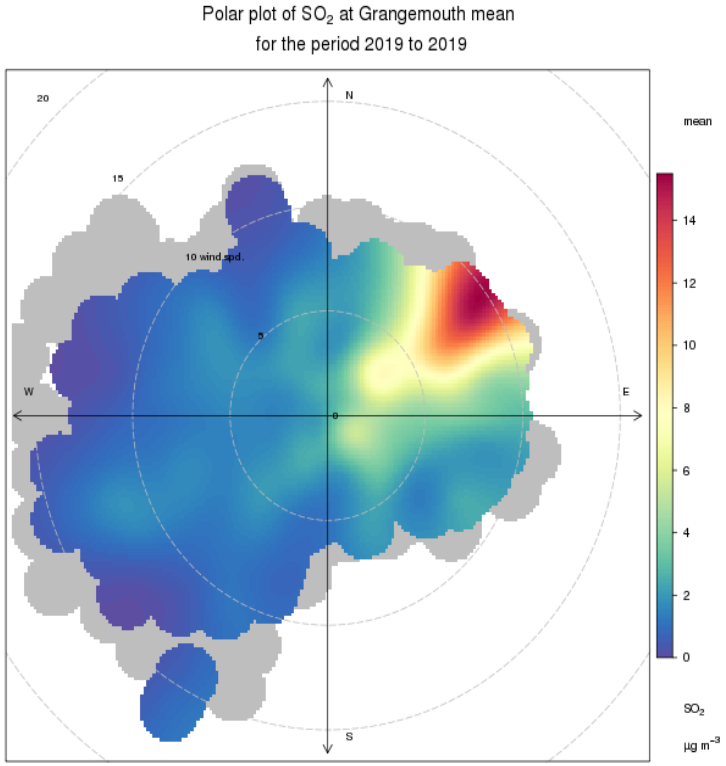
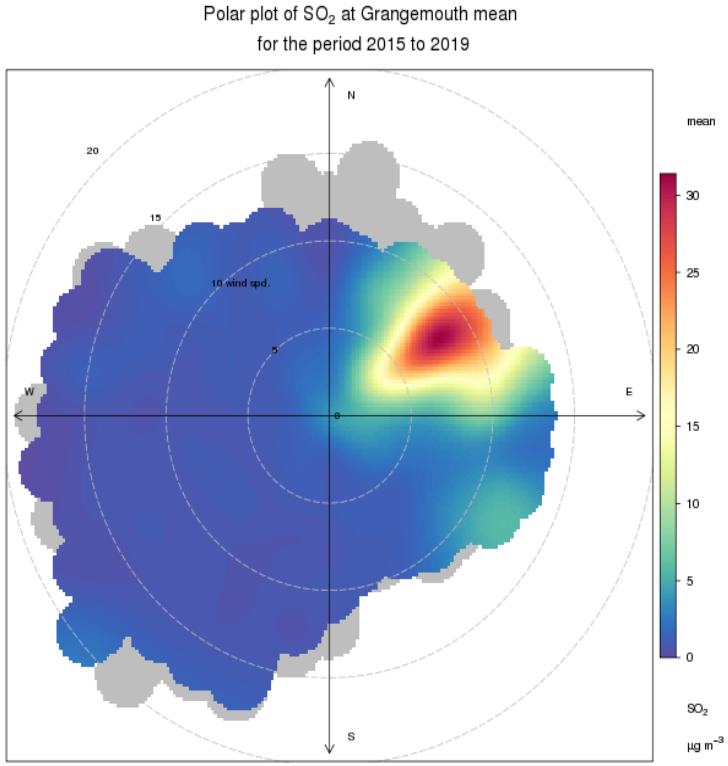


Figure 24 – Polar Plots of Average SO_2 Concentrations Recorded at the Grangemouth Sites

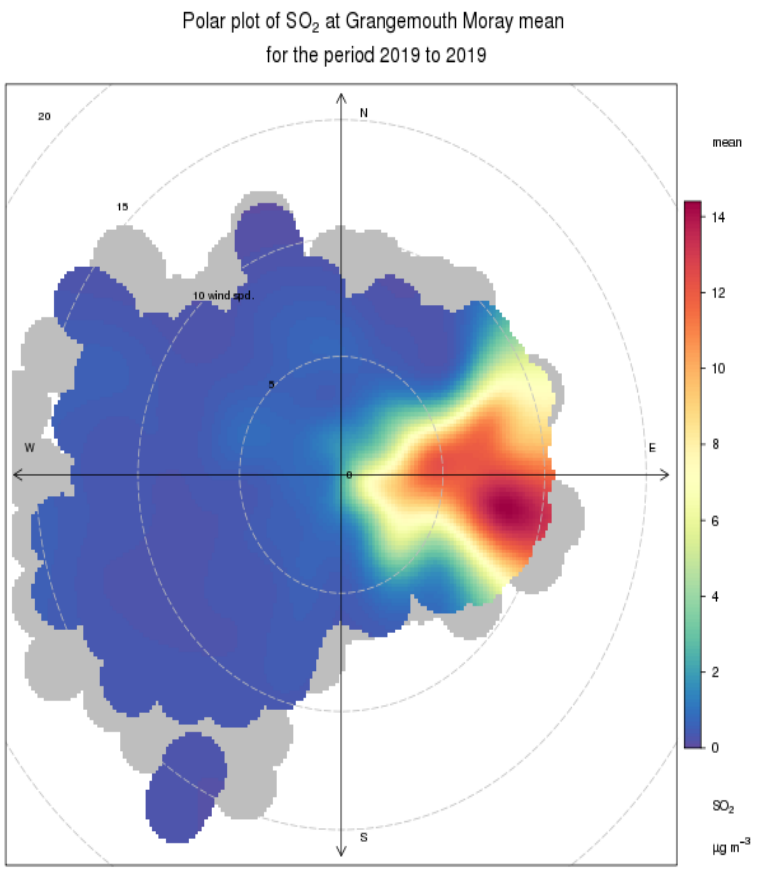
A) Grangemouth AURN: 2019



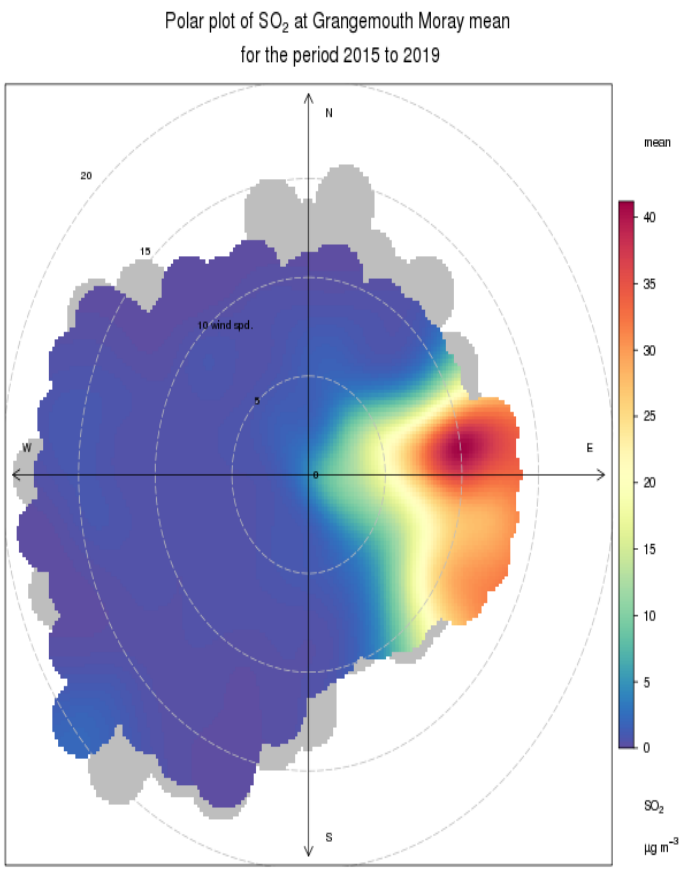
B) Grangemouth AURN: 2015 – 2019



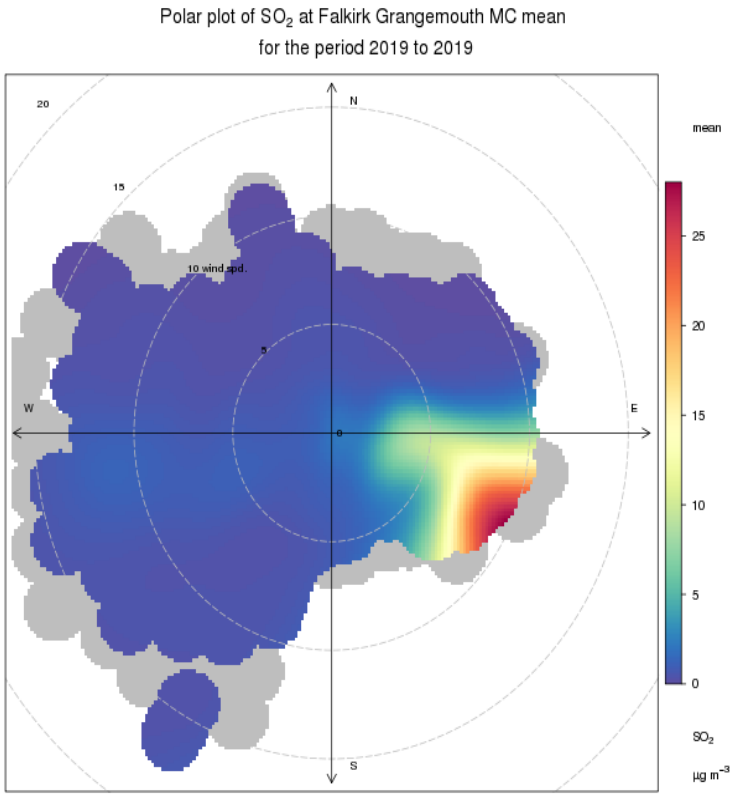
C) Grangemouth Moray: 2019



D) Grangemouth Moray 2015 – 2019



E) Grangemouth Municipal Chambers: 2019



F) Grangemouth Municipal Chambers: 2015 – 2019

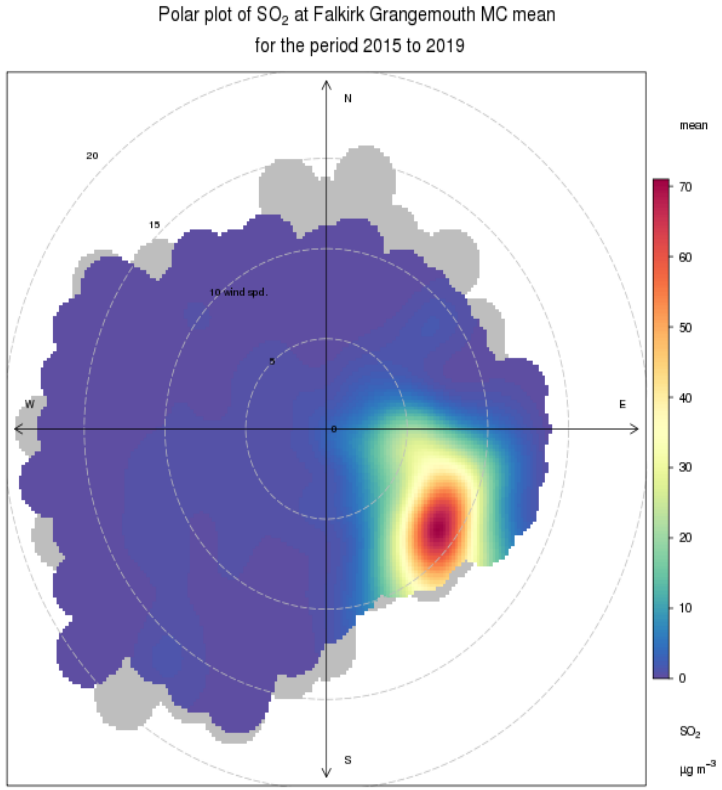


Figure 25 – Exceedances of the 15 Minute SO_2 NAQS Objective Concentration at the Grangemouth Sites 2015 – 2019

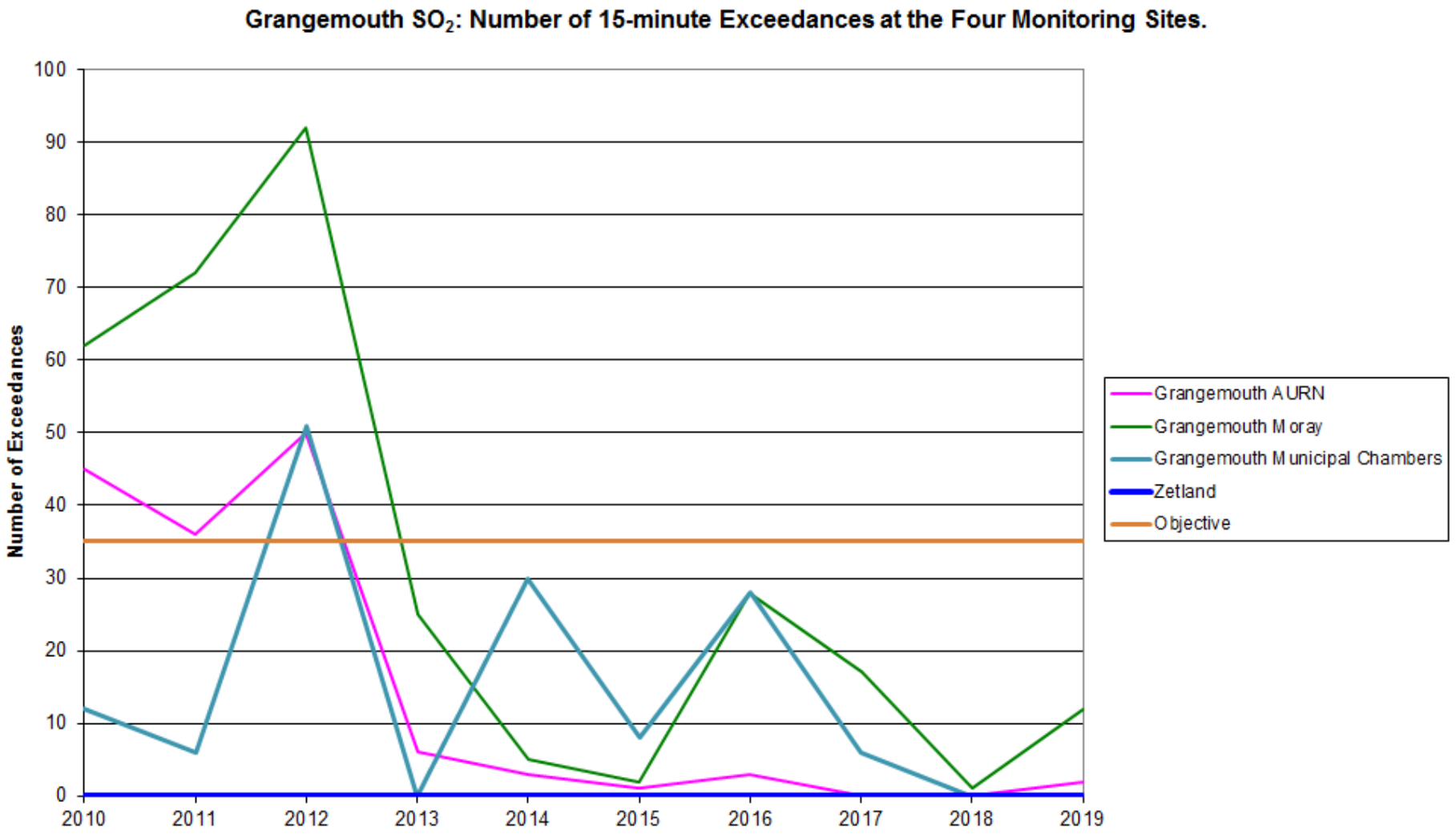


Table A.9 – 1, 3 Butadiene Annual Mean Diffusion Tube Results for 2019

Site ID	Location	Within 1, 3 Butadiene AQMA?	Data Capture in 2019, %.(1)	Annual Mean Concentrations (µg/m^3)				
				2015	2016	2017	2018	2019
NA41	Seaview Place, Bo'ness	N	100	0.11	0.10	0.1	0.06	0.05
NA55	Inchyra Station, Grangemouth	N	100	0.09	0.10	0.07	0.07	0.05
NA104	Powdrake Road, Grangemouth	N	100	0.13	0.11	0.1	0.11	0.05

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 2019

Site ID	Location	Within AQMA?	Data Capture in 2019, %.(1)	Annual Mean Concentrations (µg/m^3)				
				2015	2016	2017	2018	2019
NA3	Tinto Drive, Grangemouth	N	100	1.16	0.51	0.58	0.66	0.8
NA21	Grangemouth Road, Falkirk College	N	100	0.72	0.46	0.56	0.6	0.65
NA27	West Bridge Street, Falkirk	N	100	0.69	0.78	0.68	0.7	1.07
NA37	Denny Town House	N	100	0.59	0.58	0.56	0.49	0.77
NA38	Larbert Village Primary School	N	91.7	0.55	0.51	1.01	0.5	0.51
NA41	Seaview Place, Bo'ness	N	91.7	0.91	1.11	0.82	0.91	0.96
NA42	Municipal Chambers, Grangemouth	N	100	0.69	0.79	0.47	0.63	0.78
NA44	Harvey Avenue, Polmont	N	100	0.56	0.48	0.39	0.52	0.67
NA55	Inchyra AQ Station, Grangemouth	N	100	0.5	0.46	0.52	0.52	0.73
NA77	Kinnaird Village	N	83.3	0.65	0.44	0.51	0.44	0.59
NA80	Cow Wynd, Falkirk	N	91.7	0.81	0.56	0.57	0.52	0.66
NA81	Grahams Road, Falkirk	N	100	0.88	0.95	0.7	0.81	0.97
NA94	A905 (Glensburgh Rd), Grangemouth	N	100	0.68	0.78	0.64	0.68	0.77
NA105	West of Shieldhill	N	91.7	0.34	0.19	0.69	0.3	0.4
NA116	Kersiebank Avenue, Grangemouth	Y	100	New site for 2019				0.76
NA117	Oswald Avenue (East), Grangemouth	Y	100	New site for 2019				0.99

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 2019

Site ID	Location	Within AQMA?	Data Capture in 2019, % (1)	Annual Mean Concentrations (µg/m^3)				
				2015	2016	2017	2018	2019
A8	Grangemouth AURN	Y	100	0.73	0.64	0.65	0.74	0.78

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

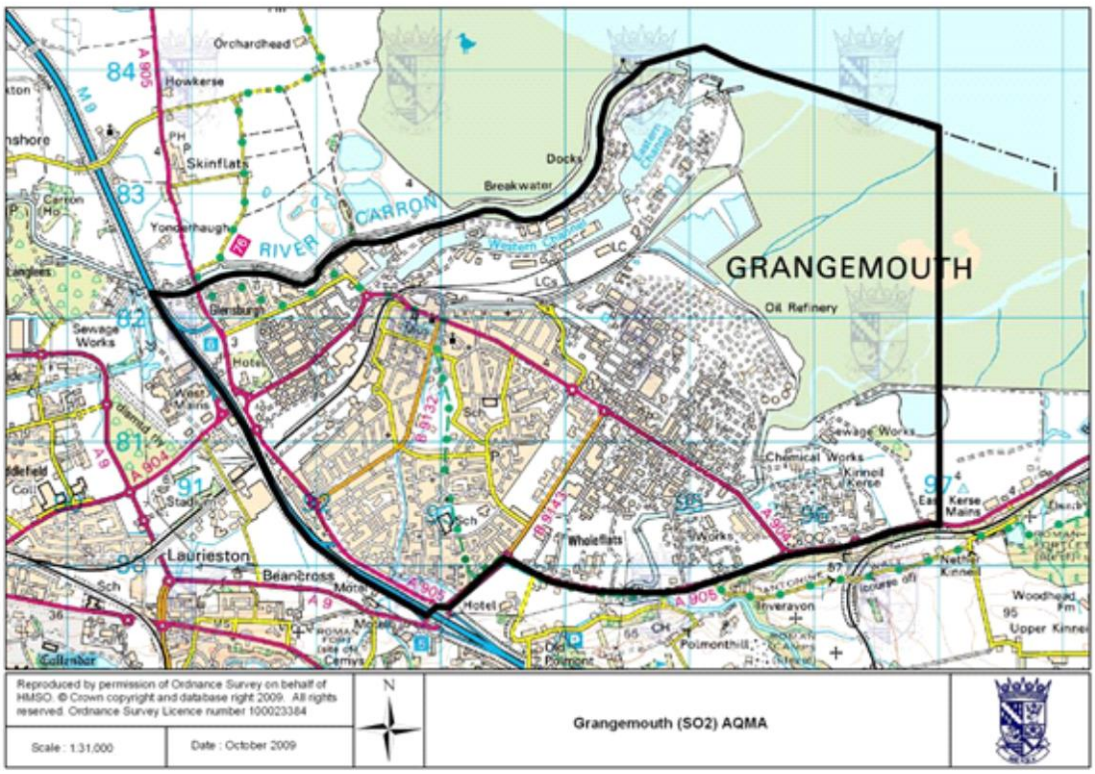
Table A.12 – Estimated Annual Mean $PM_{2.5}$ Results for 2019

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture in 2019 (%) (2)	Correction Factor	Estimated $PM_{2.5}$ Annual Mean Concentration ($\mu g/m^3$) (3)				
					2015	2016	2017	2018	2019
A4 Falkirk Haggs	Roadside (Non-urban)	91	91	0.64	6.92	6.46	5.54	7.7	9
A5 Falkirk Hope St	Roadside (Urban)	70	70	0.55	PM_{10} analyser not operating at this site			**11**	7.1
A10 Grangemouth Municipal Chambers	Urban Background / Industrial	45	45	0.62	8.67	8.67	8.00	6.96	8.6
A15 Main St, Bainsford	Roadside (Urban)	91	91	0.55	7.68	6.00	7.80	**12**	7.7

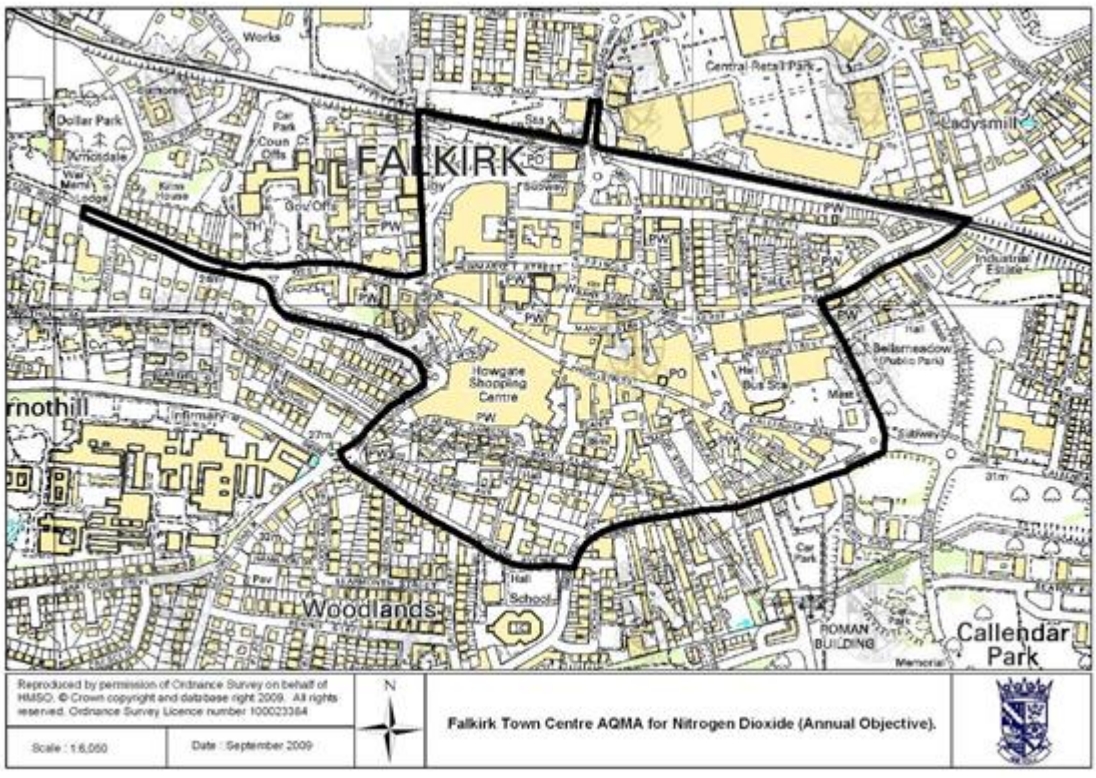
Note: Exceedences of the $PM_{2.5}$ annual mean objective of $10\mu g/m^3$ are shown in **bold.**
(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months,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

Figure 26 – Maps of the AQMA Boundaries in the Falkirk Council Area

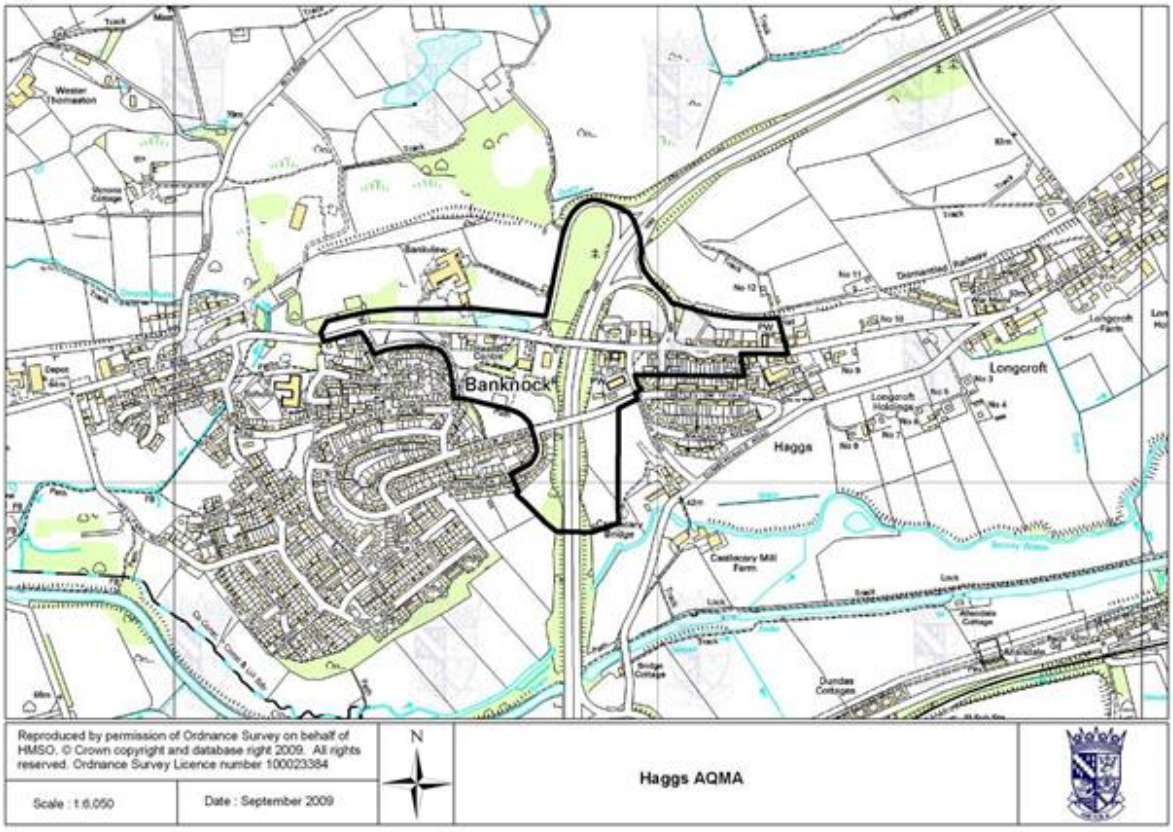
A) Grangemouth AQMA (SO_2, 15min mean), declared November 2005



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

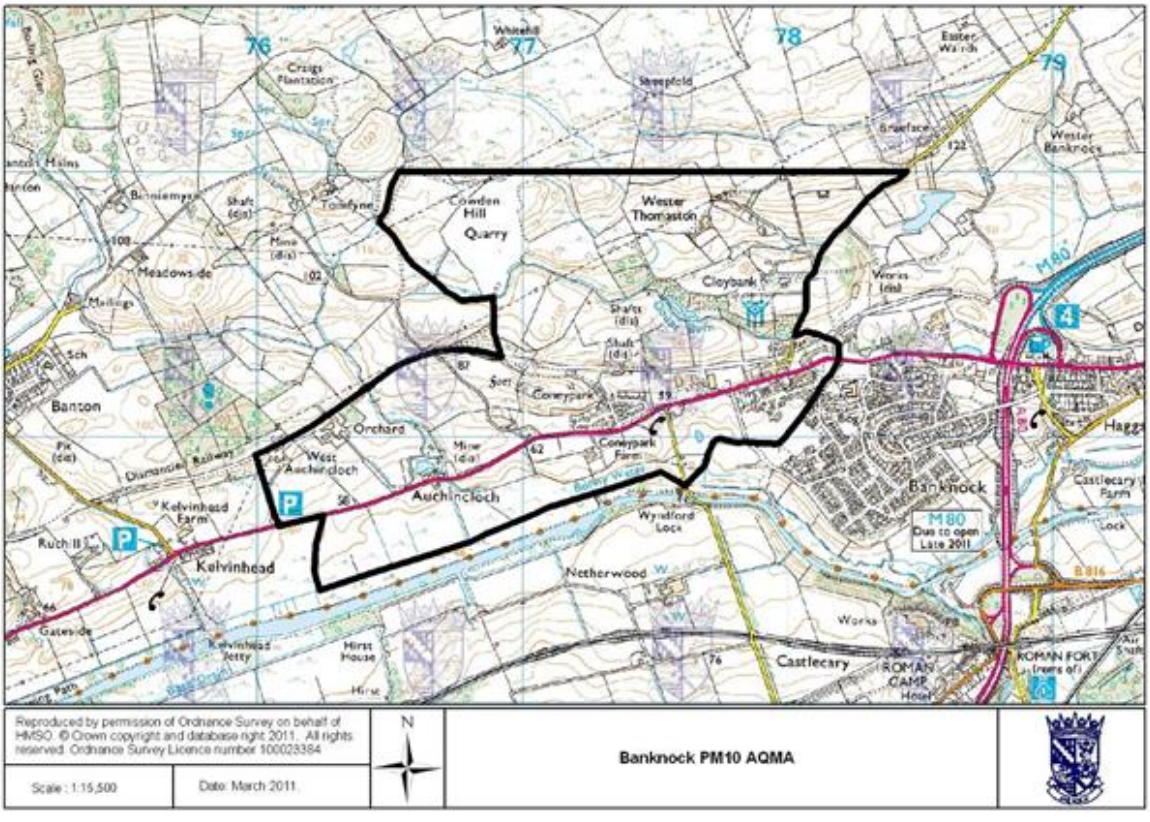
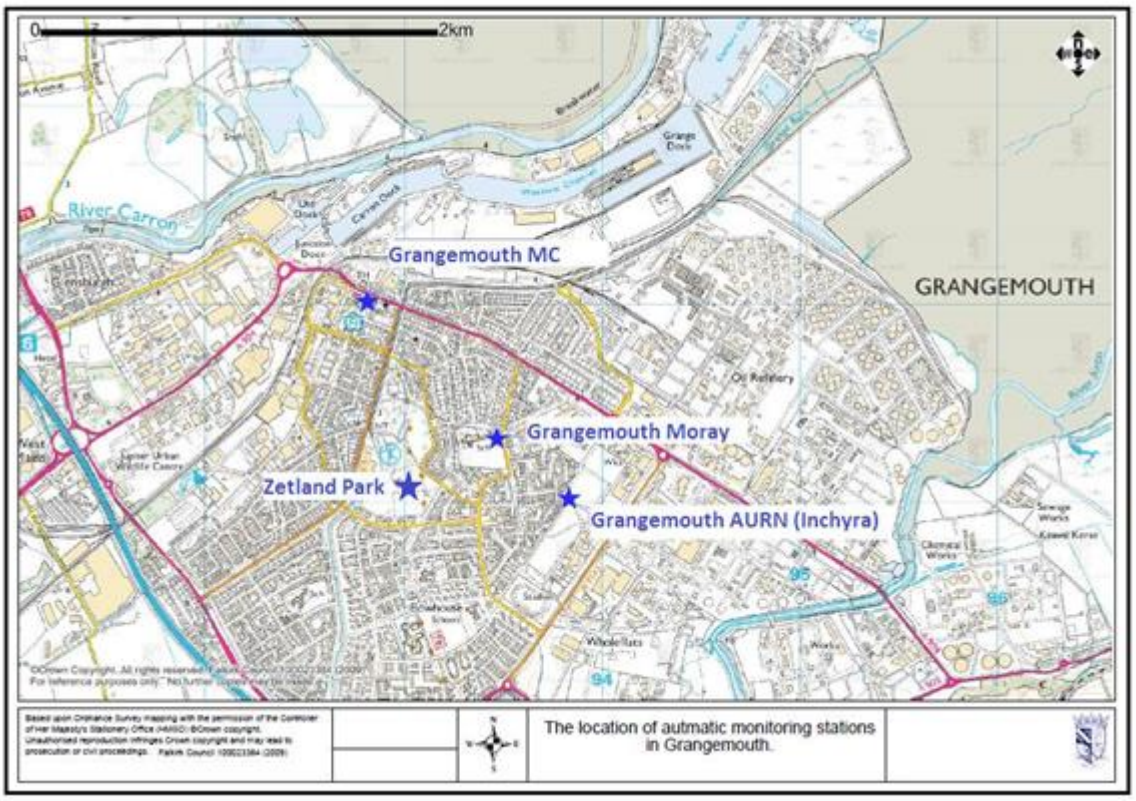
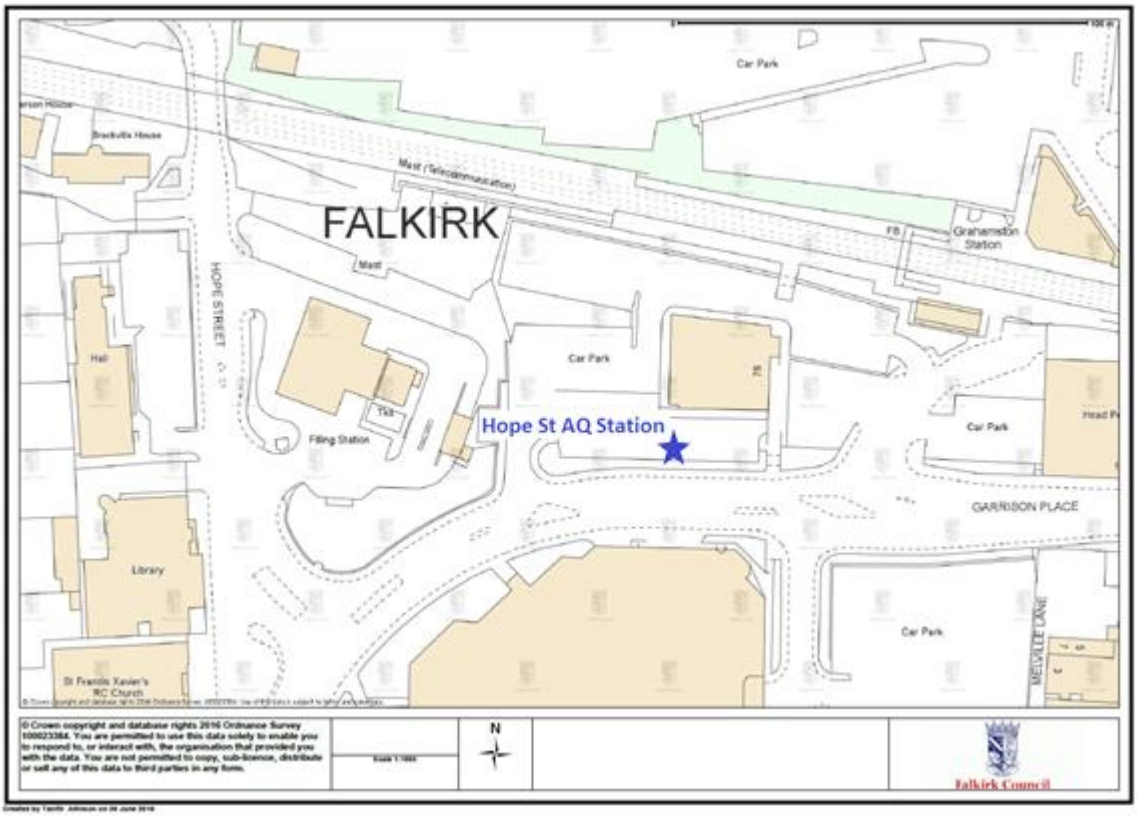


Figure 27 – Maps Showing Automatic Monitoring Locations

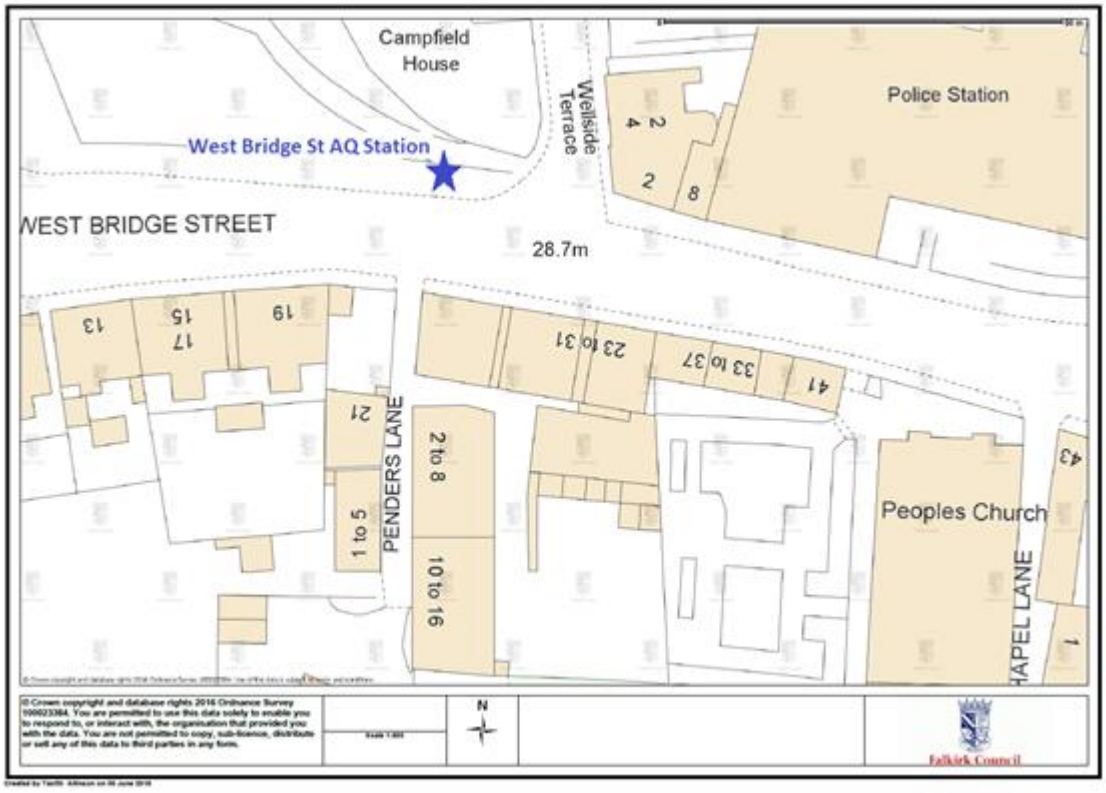
A) Grangemouth Air Quality (AQ) Stations



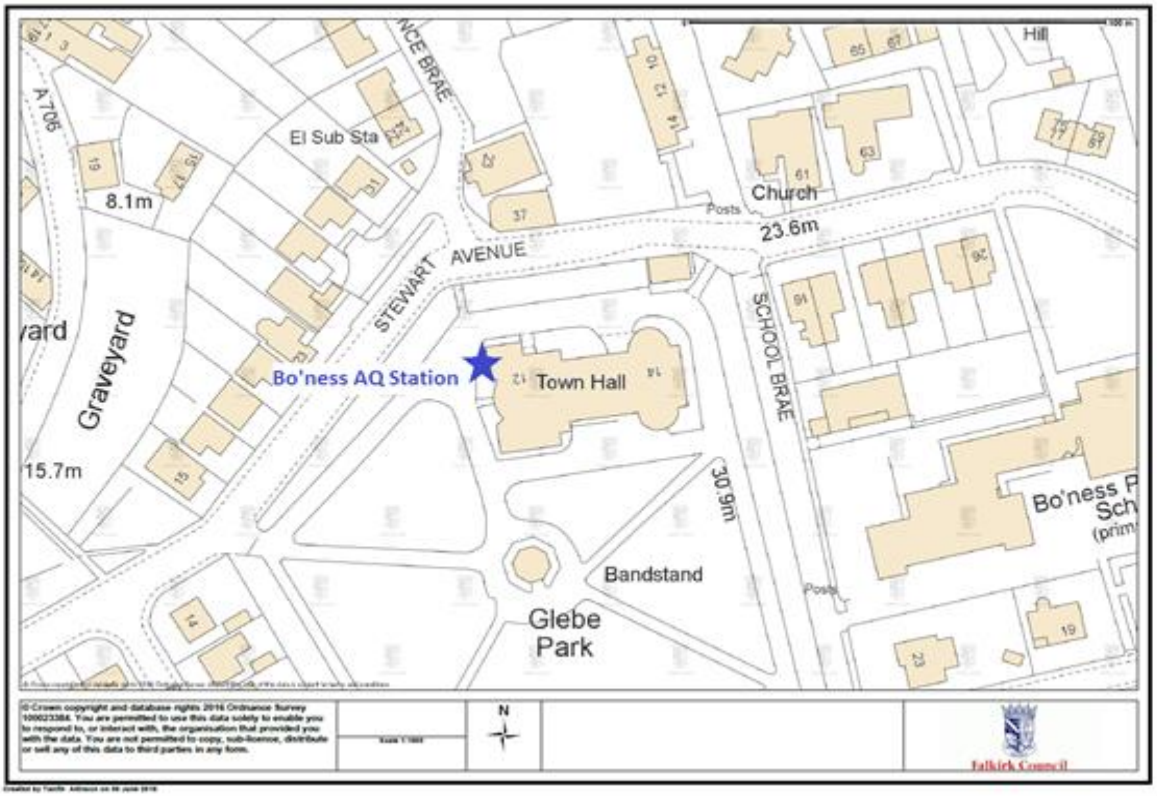
B) Falkirk Hope St AQ Station



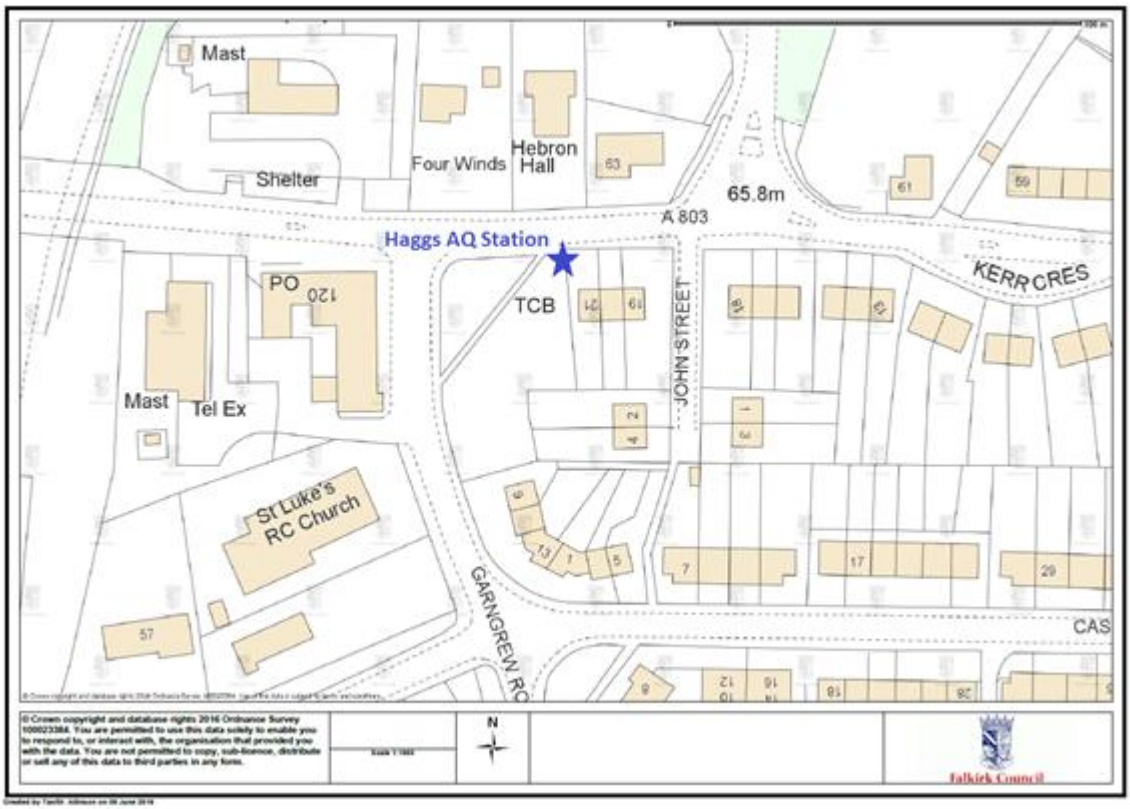
C) Falkirk West Bridge St AQ Station



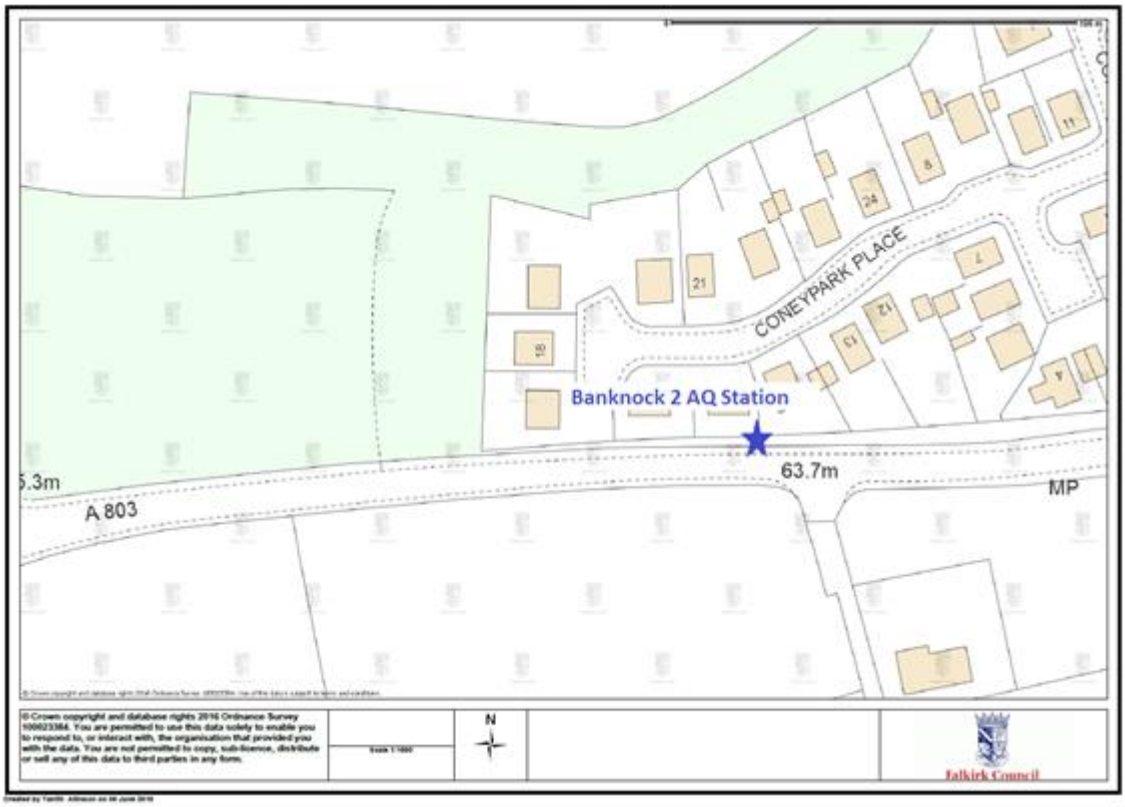
D) Bo'ness AQ Station



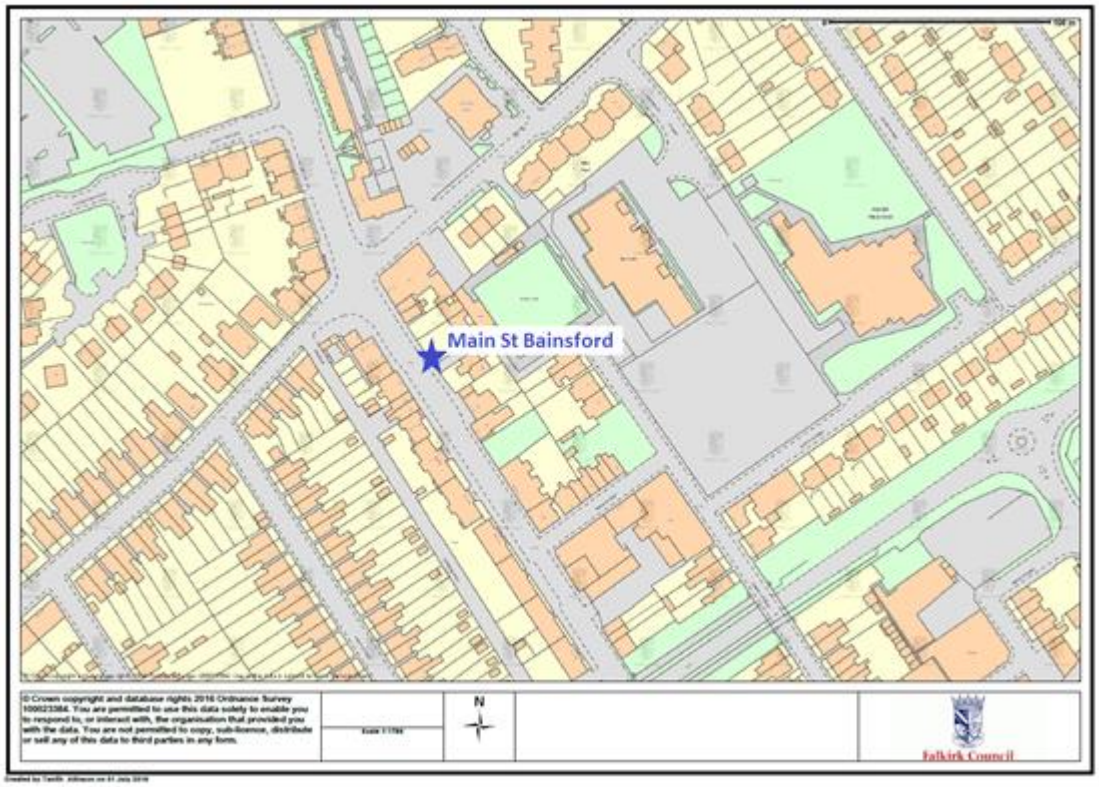
E) Falkirk Haggs AQ Station



F) Banknock 2 AQ Station



G) Main St, Bainsford, Falkirk AQ Station



Appendix B: Full Monthly Diffusion Tube Results for 2019

Table B.1 – NO_2 Monthly Diffusion Tube Results for 2019

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	27.97	26.18	17.94	22.15	17.33	13.76	12.71	10.56	16.28	25.30	31.42	22.03	20	19
NA5	43.49	34.49	24.82	26.32	-	-	20.27	15.16	24.19	29.26	37.65	31.79	29	27
NA7	29.67	20.40	15.20	17.80	11.98	13.17	11.48	10.61	14.83	18.09	-	-	16	15
NA9	33.74	28.08	24.00	23.44	20.51	19.43	17.51	12.55	23.25	26.16	37.16	26.88	24	23
NA19	40.12	36.21	25.04	35.21	28.48	27.05	-	14.99	24.46	30.70	-	28.61	29	27
NA20	39.00	30.44	22.80	17.82	11.55	17.45	15.72	16.13	21.31	25.73	35.85	27.27	23	22
NA21	35.40	33.95	24.71	36.79	26.50	22.98	23.91	13.39	27.44	30.92	-	26.55	28	26
NA24	50.65	42.12	35.32	32.77	32.61	24.66	28.88	25.32	34.70	33.92	44.49	36.77	35	33
NA26	30.33	21.93	16.77	17.66	14.22	12.37	12.86	7.94	17.01	20.67	30.40	22.19	19	18
NA27	55.75	54.56	41.09	66.37	49.92	-	40.28	29.89	44.62	49.86	78.20	43.67	**50**	**47**
NA29	26.72	25.08	13.60	21.77	13.50	12.29	12.51	6.84	-	19.51	30.17	18.62	18	17
NA36	52.23	49.08	36.15	44.43	34.73	32.89	33.48	20.56	26.98	37.62	-	37.13	37	35
NA37	25.55	22.53	13.98	20.10	-	12.04	11.88	9.95	13.92	20.16	27.17	18.90	18	17
NA38	29.16	22.20	13.48	15.80	12.53	9.26	10.17	9.97	15.03	19.76	29.02	20.02	17	16
NA41	31.90	31.78	20.95	23.26	20.00	18.29	19.20	20.62	21.48	24.46	33.32	24.01	24	23

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)	31.45	26.25	17.72	20.43	16.88	11.42	13.50	9.85	18.01	22.94	32.94	22.47	20	19
	29.83	26.48	18.63	20.49	15.73	11.40	12.80	8.28	18.77	21.47	33.39	21.90		
	30.53	25.19	16.41	22.32	16.36	11.88	12.52	8.42	18.13	20.46	29.21	18.08		
NA44	30.75	25.98	19.39	16.93	14.05	12.63	12.44	10.59	17.46	23.14	27.23	22.90	19	18
NA48	31.74	27.43	15.94	24.87	15.73	13.31	14.23	8.83	17.18	17.96	32.91	19.17	20	19
NA50	32.78	28.22	17.81	42.45	23.91	22.60	21.62	11.45	24.00	28.28	37.64	21.03	26	24
NA51	40.44	31.54	24.20	22.91	22.77	20.32	19.41	16.01	22.58	27.80	30.43	23.32	25	24
NA52	37.08	30.17	22.08	21.97	19.68	17.90	17.53	11.81	20.55	21.34	33.61	28.27	23	22
NA53	39.58	35.95	22.36	36.13	26.99	25.62	22.72	14.66	23.69	25.09	40.05	29.89	29	27
NA58	31.53	25.37	-	25.97	20.51	16.43	14.27	11.14	21.18	25.41	34.55	22.93	23	21
NA59	45.68	39.86	29.07	27.88	26.43	24.90	23.00	16.09	-	31.55	39.81	29.32	30	29
NA60	43.55	32.10	24.20	28.79	21.94	19.78	19.66	12.65	22.48	27.19	41.28	31.27	27	25
NA61	39.35	27.99	19.04	23.82	14.96	19.90	17.71	14.23	21.40	27.52	37.41	26.34	24	23
NA62	52.44	39.37	33.29	38.87	31.89	27.27	27.87	30.58	33.54	38.24	42.27	38.15	36	34
NA63	54.30	43.85	35.46	38.72	30.99	29.26	28.70	17.92	32.50	37.97	51.39	38.87	37	34
NA64	28.42	17.18	15.21	23.00	17.51	13.23	10.96	8.17	16.99	19.56	30.73	16.20	18	17
NA65	37.78	29.00	22.54	25.03	24.72	20.73	19.72	13.08	23.66	29.80	37.78	23.34	26	24
NA67	37.78	30.46	27.57	28.10	25.20	24.21	20.61	16.34	24.67	31.05	36.05	30.70	28	26
NA69	41.65	34.82	21.46	42.51	32.21	28.50	27.62	17.28	28.17	34.17	47.13	27.37	32	30
NA71	46.27	41.33	34.58	30.41	28.77	23.07	23.60	16.99	31.55	37.53	38.14	35.23	32	30

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)
NA72	43.26	35.93	27.83	34.16	16.01	24.02	24.93	13.68	26.70	33.41	37.95	30.53	29	27
NA73	40.40	45.08	29.20	37.28	31.98	25.73	29.32	19.18	28.82	33.84	44.71	35.18	33	31
NA76	34.95	27.77	18.35	17.75	14.47	14.38	13.61	14.70	17.77	24.10	32.20	24.93	21	20
NA77	39.80	30.68	21.15	19.61	19.01	16.05	17.56	12.76	23.38	27.16	37.92	27.07	24	23
NA78	36.73	36.27	29.61	33.32	28.03	23.62	25.50	13.86	26.36	34.14	36.49	28.37	29	28
NA80	43.96	42.44	30.18	27.56	27.52	-	25.13	22.22	26.50	33.30	35.71	34.71	32	30
NA81	38.55	40.25	31.02	40.01	31.15	26.38	26.31	23.56	31.41	36.85	46.47	30.94	34	32
NA82	28.00	28.69	15.77	20.26	14.76	13.19	12.68	11.18	15.70	22.98	29.64	20.23	19	18
NA83	53.71	40.28	38.43	34.72	32.61	29.66	27.04	19.14	-	-	47.86	38.21	36	34
NA85	31.00	23.74	12.94	22.51	17.48	18.54	16.04	9.97	17.30	24.07	35.33	21.49	21	20
NA86	29.95	20.54	10.36	18.10	12.32	10.96	9.78	7.27	14.31	20.26	28.21	16.59	17	16
NA87	40.56	43.28	29.74	33.58	29.68	29.29	27.85	30.77	34.99	30.37	33.62	31.27	33	31
NA88	40.46	-	31.14	26.67	30.22	22.84	21.00	13.82	28.45	33.22	38.41	28.81	29	27
NA89	46.60	41.13	30.26	34.54	26.57	24.51	26.22	16.89	29.01	33.27	38.94	33.84	32	30
NA94	46.23	44.10	34.75	28.27	27.28	22.56	26.17	16.20	32.41	35.51	40.93	34.17	32	30
NA98	1.15	25.28	3.03	22.10	16.05	14.27	13.42	0.78	17.11	0.70	31.89	19.18	14	13
NA99	39.39	30.81	26.04	30.53	23.00	14.72	19.13	19.27	24.61	29.20	37.80	30.42	27	25
NA101	30.12	33.76	18.24	31.70	19.19	18.41	16.64	16.03	21.19	26.49	35.71	23.42	24	23
NA105	12.57	9.40	6.70	5.91	7.18	5.33	5.55	4.52	7.65	9.60	18.04	7.30	8	8

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)
NA107	45.39	39.32	-	36.15	32.28	25.42	23.03	14.95	28.14	36.07	41.79	33.29	32	30
NA110	29.42	20.20	16.46	15.25	15.24	13.78	12.86	9.99	14.33	16.46	24.95	17.53	17	16
NA111 (3 tubes)	46.05	47.75	37.00	51.07	39.78	35.45	33.68	22.67	38.01	39.79	50.51	35.79	**40**	38
	49.22	48.44	38.04	46.46	40.94	38.30	35.31	18.78	38.38	40.82	48.48	38.80		
	42.30	46.42	-	51.19	34.04	39.29		16.36	39.13	42.91	54.93	36.08		
NA114	64.97	54.07	39.58	44.40	39.03	42.11	33.94	31.33	36.92	45.06	53.33	42.11	**44**	**41**
NA115	29.67	-	33.09	18.33	14.88	-	12.04	7.94	15.60	21.52	30.37	19.51	20	19
NA116	25.81	30.18	17.18	27.46	18.10	17.30	15.01	11.73	18.67	23.25	27.68	21.77	21	20
NA117	29.01	26.72	16.05	28.46	19.38	13.76	14.48	13.17	18.57	22.42	30.51	21.39	21	20
NA118	32.98	32.73	20.23	29.15	19.36	19.23	19.39	12.24	22.30	29.75	35.14	24.83	25	23
NA119	37.74	24.93	18.13	26.53	19.70	17.39	17.28	11.31	21.66	23.86	33.90	24.10	23	22

(1) See Appendix C for details on bias adjustment

Table B.2 – 1, 3 Butadiene Monthly Diffusion Tube Results for 2019

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	0.04	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.05
55	0.03	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.05
104	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.05

Table B.3 – Benzene Monthly Diffusion Tube Results for 2019

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	0.29	0.32	0.15	0.29	0.39	0.33	0.11	0.16	0.17	0.17	0.39	0.2	0.25	0.80
21	0.07	0.29	0.13	0.24	0.34	0.41	0.12	0.1	0.14	0.1	0.33	0.14	0.20	0.65
27	0.42	0.38	0.23	0.31	0.57	0.49	0.15	0.14	0.24	0.28	0.49	0.25	0.33	1.07
37	0.23	0.3	0.12	0.18	0.45	0.44	0.2	0.26	0.18	0.05	0.27	0.18	0.24	0.77
38	0.07	0.27	-	0.15	0.25	0.21	0.08	0.07	0.07	0.15	0.26	0.13	0.16	0.51
41	0.4	0.27	0.19	0.31	0.52	0.52	0.2	0.18	0.18	0.28	-	0.21	0.30	0.96
42	0.26	0.27	0.18	0.28	0.3	0.37	0.11	0.13	0.15	0.16	0.46	0.21	0.24	0.78
44	0.22	0.47	0.12	0.17	0.38	0.23	0.09	0.11	0.11	0.13	0.3	0.14	0.21	0.67
55	0.21	0.28	0.14	0.3	0.34	0.37	0.05	0.15	0.14	0.16	0.38	0.19	0.23	0.73
77	0.18	0.27	0.12	-	0.28	0.21	-	0.11	0.11	0.18	0.22	0.12	0.18	0.59
80	0.25	0.28	0.13	-	0.34	0.28	0.11	0.09	0.13	0.18	0.27	0.17	0.20	0.66
81	0.38	0.41	0.21	0.27	0.54	0.41	0.18	0.07	0.22	0.24	0.42	0.23	0.30	0.97
94	0.25	0.31	0.19	0.31	0.36	0.3	0.15	0.14	0.15	0.05	0.42	0.23	0.24	0.77
105	-	0.23	0.12	0.15	0.2	0.21	0.05	0.07	0.07	0.08	0.13	0.05	0.12	0.40
116	0.23	0.29	0.15	0.3	0.35	0.31	0.11	0.19	0.17	0.18	0.34	0.18	0.23	0.76
117	0.28	0.32	0.13	0.52	0.5	0.46	0.16	0.2	0.19	0.23	0.48	0.18	0.30	0.99

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

Diffusion Tube Monitoring QA/QC

In 2019 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 2019, 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 2019 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 2019 was **0.87**.

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	0.94
National NO_2 Bias Adjustment Factor	0.87
Difference	-0.069

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 2019 NO_2 diffusion tube results.

Figure 28 – 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	09/01/2019	06/02/2019	31.5	29.8	30.5	31	0.8	3	2.0	25	99	Good	Good
2	06/02/2019	06/03/2019	26.3	26.5	25.2	26	0.7	3	1.7	23	96	Good	Good
3	06/03/2019	03/04/2019	17.7	18.6	16.4	18	1.1	6	2.8	21	99	Good	Good
4	03/04/2019	01/05/2019	20.4	20.5	22.3	21	1.1	5	2.7	16	99	Good	Good
5	01/05/2019	05/06/2019	16.9	15.7	16.4	16	0.6	4	1.4	17	99	Good	Good
6	05/06/2019	03/07/2019	11.4	11.4	11.9	12	0.3	2	0.7	14	100	Good	Good
7	03/07/2019	07/08/2019	13.5	12.8	12.5	13	0.5	4	1.3	10	99	Good	Good
8	07/08/2019	04/09/2019	9.9	8.3	8.4	9	0.9	10	2.2	10	99	Good	Good
9	04/09/2019	02/10/2019	18.0	18.8	18.1	18	0.4	2	1.0	11	98	Good	Good
10	02/10/2019	06/11/2019	22.9	21.5	20.5	22	1.2	6	3.1	17	98	Good	Good
11	06/11/2019	04/12/2019	32.9	33.4	29.2	32	2.3	7	5.7	22	98	Good	Good
12	04/12/2019	08/01/2019	22.5	21.9	18.1	21	2.4	11	5.9	28	99	Good	Good
13													
												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

Overall survey -->

(Check average CV & DC from Accuracy calculations)

Site Name/ID:

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

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%

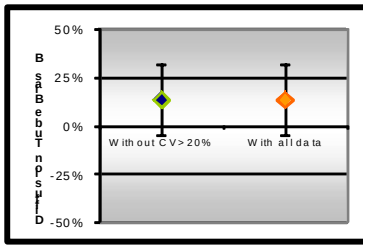
Bias calculated using 12 periods of data

Bias factor A	0.9 (0.77 - 1.08)
Bias B	11% (-7% - 29%)
Diffusion Tubes Mean:	20 µgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	18 µgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	18 (15 - 21) µgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA

Bias calculated using 12 periods of data

Bias factor A	0.9 (0.77 - 1.08)
Bias B	11% (-7% - 29%)
Diffusion Tubes Mean:	20 µgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	18 µgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	18 (15 - 21) µgm^{-3}



Jaume Targa, for AEA

Version 04 - February 2011

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	09/01/2019	06/02/2019	46.1	49.2	42.3	46	3.5	8	8.6	43	97	Good	Good
2	06/02/2019	06/03/2019	47.8	48.4	46.4	48	1.0	2	2.6	48	100	Good	Good
3	06/03/2019	03/04/2019	37.0	38.0		38	0.7	2	6.6	48	100	Good	Good
4	03/04/2019	01/05/2019	51.1	46.5	51.2	50	2.7	5	6.7	53	48	Good	or Data Captu
5	01/05/2019	05/06/2019	39.8	40.9	34.0	38	3.7	10	9.2			Good	
6	05/06/2019	03/07/2019	35.5	38.3	39.3	38	2.0	5	5.0	32	83	Good	Good
7	03/07/2019	07/08/2019	33.7	35.3		34	1.2	3	10.4	27	99	Good	Good
8	07/08/2019	04/09/2019	22.7	18.8	16.4	19	3.2	17	7.9	26	100	Good	Good
9	04/09/2019	02/10/2019	38.0	38.4	39.1	39	0.6	1	1.4	28	100	Good	Good
10	02/10/2019	06/11/2019	39.8	40.8	42.9	41	1.6	4	3.9	38	97	Good	Good
11	06/11/2019	04/12/2019	50.5	48.5	54.9	51	3.3	6	8.2	43	100	Good	Good
12	04/12/2019	08/01/2019	35.8	38.8	36.1	37	1.7	5	4.1	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:

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 10 periods of data
Bias factor A 0.98 (0.85 - 1.17)
Bias B 2% (-14% - 18%)

Diffusion Tubes Mean: 39 µgm^{-3}
Mean CV (Precision): 5

Automatic Mean: 38 µgm^{-3}
Data Capture for periods used: 98%

Adjusted Tubes Mean: 38 (33 - 46) µgm^{-3}

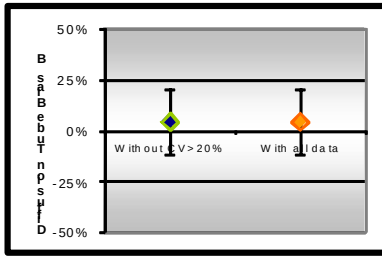
Accuracy (with 95% confidence interval)
WITH ALL DATA

Bias calculated using 10 periods of data
Bias factor A 0.98 (0.85 - 1.17)
Bias B 2% (-14% - 18%)

Diffusion Tubes Mean: 39 µgm^{-3}
Mean CV (Precision): 5

Automatic Mean: 38 µgm^{-3}
Data Capture for periods used: 98%

Adjusted Tubes Mean: 38 (33 - 46) µgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

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 Bias Adjustment factor
Bias Factor B	2	11	6.5	1.065	0.94

Figure 29 – NO_2 National Derived Bias Adjustment Factor Spreadsheet

National Diffusion Tube Bias Adjustment Factor Spreadsheet — Spreadsheet Version Number: 03/20

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 2020

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	Year [5]	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	2019	R	City of London	12	74	71	4.1%	G	**0.96**
Gradko	50% TEA in acetone	2019	UB	City of London	12	37	33	14.3%	G	**0.88**
Gradko	50% TEA in acetone	2019	KS	Marylebone Road Intercomparison	12	83	65	26.3%	G	**0.79**
Gradko	50% TEA in acetone	2019	R	London Borough of Richmond upon Thame:	12	46	35	30.4%	G	**0.77**
Gradko	50% TEA in acetone	2019	R	London Borough of Richmond upon Thame:	12	29	27	7.1%	G	**0.93**
Gradko	50% TEA in acetone	2019	B	London Borough of Richmond upon Thame:	11	21	21	1.0%	G	**0.99**
Gradko	50% TEA in acetone	2019	UB	Falkirk Council	9	18	15	18.1%	G	**0.85**
Gradko	50% TEA in acetone	2019	R	LB Newham	12	35	30	16.2%	G	**0.86**
Gradko	50% TEA in acetone	2019		**Overall Factor [3] (8 studies)**				**Use**		**0.87**

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)[Ref1] 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 2019, 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)[Ref1] 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 and A15 Main St Bainsford. Results are shown in Table A12 in Appendix A. Table C. 1 displays how the local ratios have been derived.

Table C.2 – Locally Derived $PM_{2.5}$ / PM_{10} Correction Ratio

Site	Site Type	Annual Average PM_{10} ($\mu g/m^3$), 2019	Annual Average $PM_{2.5}$ ($\mu g/m^3$), 2019	Ratio
A7 Falkirk West Bridge St	Roadside (Urban)	11	6	0.55
A8 Grangemouth AURN	Urban Background / Industrial	13	8	0.62
A13 Banknock 2	Roadside (Non-urban)	11	7	0.64

QA / QC Automatic Monitoring

Table C. 3 – Details of the QA / QC at the Automatic Monitoring Stations in 2019

QA / QC in 2019		
Site	**Analyser**	**Network**
A3. Bo'ness	SO_2	SAQN
A4. Falkirk Haggs	NO_x	SAQN
	PM_{10} (TEOM / Fidas)	
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 / Fidas)	
	SO_2	
A11. Grangemouth Zetland Park	SO_2	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
EfW	Energy from Waste
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. Golder Associates Report Number: 115114880001.501/B.2, June 2015, available on request.

3. https://roadtraffic.dft.gov.uk/local-authorities/30 Road Traffic Statistics for Falkirk Council Area, Department for Transport, Accessed August 2020.

4. Civil Aviation Authority, UK Airport Statistics, CAA, Accessed August 2020.

5. Local Air Quality Policy PG (S) 16 https://www.gov.scot/publications/local-air-quality-management-policy-guidance-pg-s-16/, The Scottish Government, 2018.

Appendix D1: Supporting Technical Information – Proposal for Revocation of Banknock Air Quality Management Area (AQMA)

Falkirk Council

Proposal for Revocation of Banknock Air Quality Management Area (AQMA)

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

2020

Local Authority Officer	Author: John Millar (Air Quality Specialist) Reviewed by: David Gray (Env. Protection Co-ordinator) and Graeme Webster (Env. Health and Trading Standards Manager)
Department	Environmental Health, Development Services
Address	Abbotsford House, David's Loan, Falkirk, FK2 7YZ
Telephone	01324 504873
E-mail	JohnA.Millar@falkirk.gov.uk
Report Ref:	Revocation Proposal, Banknock AQMA
Status	Final
Date	07/02/2020

Table of Contents

1. Introduction

The Environment Act 1995 (HM Government, 1995) required the preparation of a national air quality strategy setting Air Quality Objectives (AQOs) for specified pollutants and outlining measures to be adopted by local authorities through the system of Local Air Quality Management (LAQM) and by others to work in pursuit of the achievement of these objectives. A National Air Quality Strategy was published in 1997 and subsequently reviewed and revised in 2000, and an addendum to the Strategy published in 2002. The current Strategy[1] was published in July 2007 (Welsh Assembly Government, Scottish Executive, Department for Environment, Department for Environment Food and Rural Affairs, 2007).

The AQOs which are relevant to LAQM in Scotland and have been set into regulations, namely the Air Quality (Scotland) Regulations 2000[2], the Air Quality (Scotland) Amendment Regulations 2002[3] and the Air Quality (Scotland) Amendment Regulations 2016[4] (Scottish Government, 2016).

Falkirk Council has a responsibility to comply with the above regulations when managing local air quality. The Council completes its LAQM duties by managing an extensive air quality monitoring network, assessing results and reporting on areas of existing or anticipated poor air quality - declared via Air Quality Management Areas (AQMA).

One of the areas identified which was subject to historic poor air quality was Banknock, situated on Falkirk Council's eastern boundary (adjacent to the North Lanarkshire local authority area). This is shown in section **8. Figures** - Map 1 Banknock Area within Falkirk Council Boundary.

2. Air Quality Management Area – Particulate Material (24-hour and Annual Mean)

The Council's Detailed Assessment[5] of Particulate Material (PM_{10}) in Banknock (published in December 2010) detailed a high volume of National Air Quality Objective (NAQS) exceedances for PM_{10} (24-hour and annual mean). This Detailed Assessment led to a declaration of the AQMA on 18th August 2011 following extensive consultation. Table 1 displays the pollutant of relevance for this AQMA revocation proposal, and the Scottish AQSs which must be met for the protection of human health.

Table 1 – AQSs for Scotland applicable for this proposal

Pollutant	Concentration	Measured as
Human Receptors		
Particulate material (PM_{10})	50 µg/m^3, not to be exceeded more than 7 times a year	24-hour mean
	18 µg/m^3	Annual Mean

The Detailed Assessment identified that local quarry operations combined with associated site and local road traffic had been a significant source of dust in this area. The AQMA within Banknock is shown in section **8. Figures** – Map 2 – Banknock AQMA.

3. Local Quarry Operations

There has been an operational quarry at Cowdenhill, Banknock since as early as 1926, and this was operated by Stirlingshire County Council in the 1940's. The site has since been used intermittently for quarrying, with the Skene Group operating the quarry under modern working conditions from 2000 until July 2011. Falkirk Council Application F/99/0026 remains a live permission, allowing for the extraction of aggregate material from the site until 2024.

A nearby quarry called Tomfyne has been planned within the North Lanarkshire area which is awaiting approval. Falkirk Council is a statutory consultee on this.

The above quarries within the Banknock area are shown in section **8. Figures** – Map 4 - Locations of Cowdenhill and Tomfyne Quarries in Banknock Area.

At present, there are no plans to extract further aggregate materials from these quarries.

4. Monitoring Equipment

The following air quality monitoring equipment has been deployed in the Banknock area since 2009 until present:

Table 2: Banknock AQMA Air Quality Monitoring Stations and Equipment

AQ Monitoring Site ID:	Banknock 1	Banknock 2	Banknock 3
Site Type:	Roadside (Automatic)	Roadside (Automatic)	Rural (Automatic)
Address:	Coneypark Place	Kilsyth Road (A803), FK4 1TZ	Bracken View, Coneypark Crescent, FK4 1TR
OS Grid Ref (E / N):	277348 / 679037	277247 / 679027	277168 / 679254
Equipment:	Turnkey Osiris - TNO2777	R&P 1400 TEOM (from 06/12/2012 - 02/02/2015) Palas FIDAS 200 (from 02/02/15 until present)	Turnkey Osiris - TNO2777
Monitoring Technique	Optical, Light scattering	TEOM: Gravimetric, FIDAS: Optical, Light scattering	Optical, Light scattering
Date Installed:	22/09/2009	16/11/2012	29/07/2013
Date Removed:	29/07/2013	Still operational at this roadside location	Still operational at this rural location

The location of the Banknock 2 and 3 automatic monitoring stations can be shown in section **8. Figures** - Map 3 - Monitoring Station Locations.
The current monitoring stations and equipment for Banknock 2 and 3 stations above can be shown in Appendix 1 – Photos.

5. Monitoring Data

Falkirk Council monitors PM_{10} and other pollutants at several locations throughout the Council area using both automatic and passive sampling methods. The automatic monitoring data displayed below has been fully ratified in accordance with the Scottish Air Quality Database QA/QC Process[6].

The Council currently operates two automatic monitoring stations located within the Banknock AQMA – these are Banknock 2 and 3 (as detailed in Table 2).

The PM_{10} (24 hour and annual mean) monitoring data (as extracted from the 2019 Falkirk Council APR[7]) are displayed in Tables 3 and 4.

Table 3: Measured PM_{10} 24-Hour Mean Results 2014 – 2018

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
A13	Banknock 2	100	100	3	4	n/a	7	0
A14	Banknock 3	80	80	0 (24)	1	3	0	2 (10)

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.

Table 4: Measured PM_{10} Annual Mean Results 2014 – 2018

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	PM_{10} Annual Mean Concentration (µg/m^3)				
				2014	2015	2016	2017	2018
A13	Banknock 2	99	99	13.2	11	11	13	11
A14	Banknock 3	80	80	15	8.2	n/a	7	6.9

Notes: Exceedances of the PM_{10} annual mean objective of 18µg/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%.

6. Conclusion

The Banknock AQMA was declared on the 18th August 2011 following a high volume of National Air Quality Objective (NAQS) exceedances for PM_{10} (24-hour and annual mean). Since the AQMA was declared, measured concentrations (using automatic, referenced monitoring methods) of PM_{10} have complied with the NAQS objectives consistently over the past five years (since 2014).
A previous review and assessment report has identified that local quarry operations combined with associated site and local road traffic had been a significant source of dust in this area.
It is understood that there are no current plans to operate any aggregate quarries within the Banknock area.

As a result of the ongoing automatic air quality monitoring within the Banknock AQMA the Council has demonstrated that the 24-hour and annual mean concentrations of PM_{10} complies with the NAQS objectives. It is understood that the reduction in quarry operations in this area has led to a reduction in overall PM_{10} concentrations and thus compliance with the NAQS objectives.

As stated within the Air Quality in Scotland (LAQM) website in relation to AQMA Revocation:
'Where a local authority feels that it has sufficient evidence to justify the need to amend/revoke an AQMA at any time, it should submit that evidence to the Scottish Government for appraisal. For those authorities that have continuous monitoring, the Scottish Government would expect them to keep the AQMA under regular review, and to take action where necessary, rather than await the next round of reviews and assessments.'

Falkirk Council will continue to have a PM_{10} monitoring capability within this area until 2024 when the live planning consent of the Cowdenhill quarry expires. It is anticipated that the automatic monitoring equipment within the Banknock area could be used to focus on other areas of poor air quality within the region.

Falkirk Council is requesting the permission of the Scottish Government and Scottish Environment Protection Agency (SEPA) to revoke the Banknock AQMA. Pending permission approval, Falkirk Council will notify all other statutory consultees and publicise the revocation through local / social media, so the public and local businesses are fully aware of the situation.

7. References

1.The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 1, July 2007, Department for Environment, Food and Rural Affairs in partnership with the Scottish Executive, Welsh Assembly Government and Department of the Environment Norther Ireland)

2. The Air Quality (Scotland) Regulations 2000 (31st March 2000, The Scottish Government)

3. The Air Quality (Scotland) Amendment Regulations 2002 (11th June 2002, The Scottish Government)

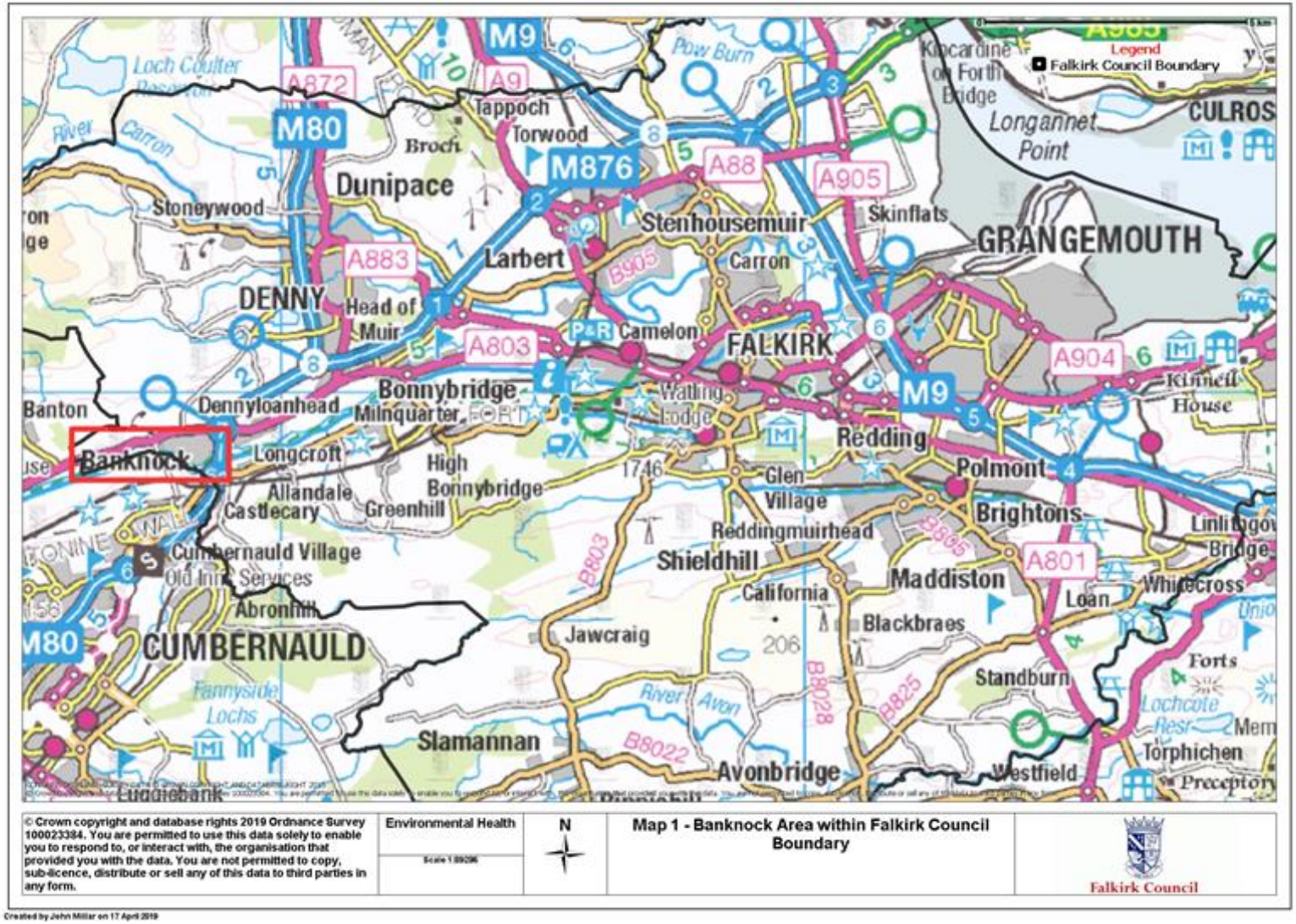
4. The Air Quality (Scotland) Amendment Regulations 2016 (1st April 2016, The Scottish Government)

5. Detailed Assessment of PM_{10} in Banknock (December 2010, Falkirk Council)

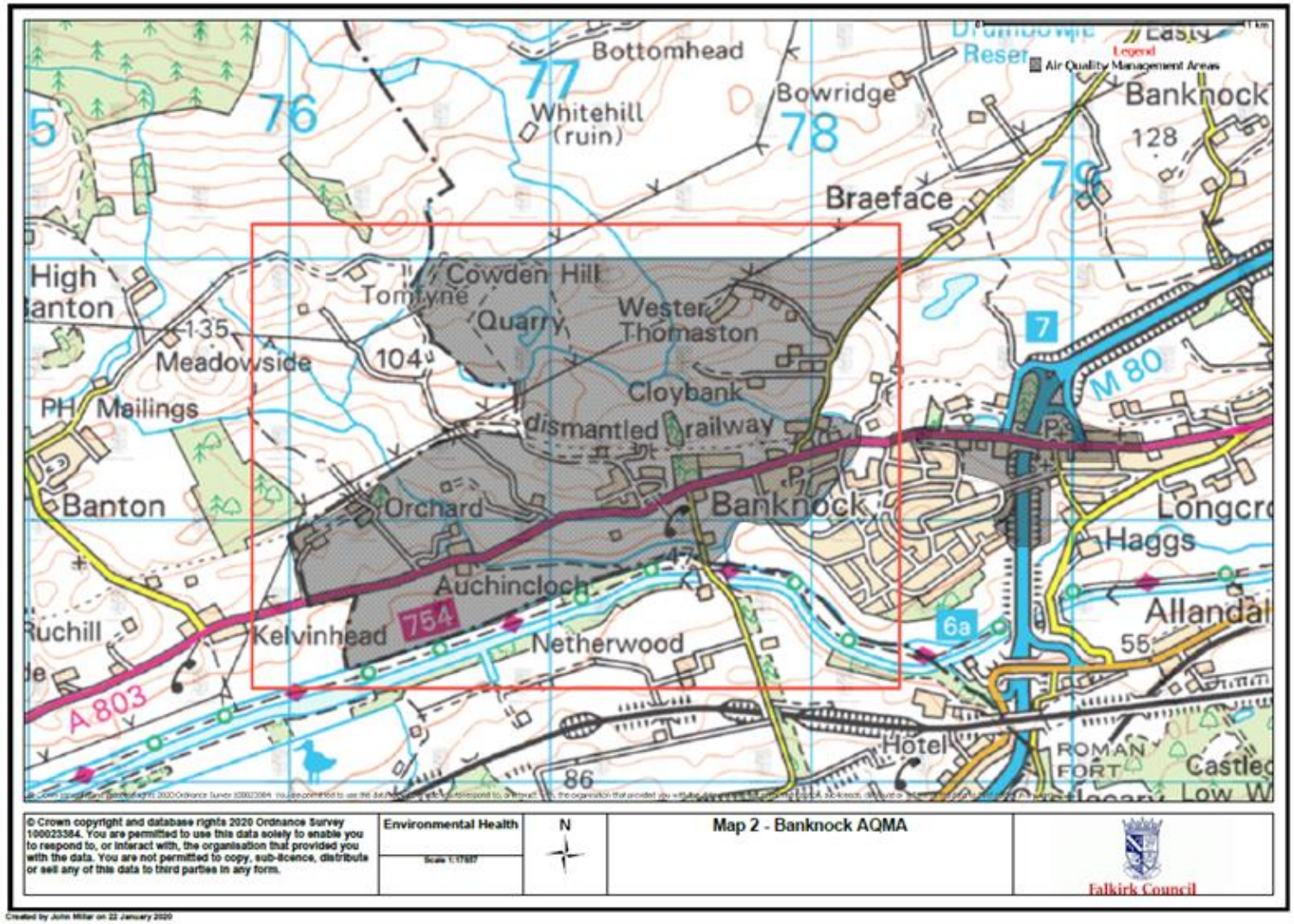
6. The Scottish Air Quality Database QA/QC Process (28th March 2012, AEA Ricardo / The Scottish Government)

7. Annual Progress Report (July 2019, Falkirk Council)

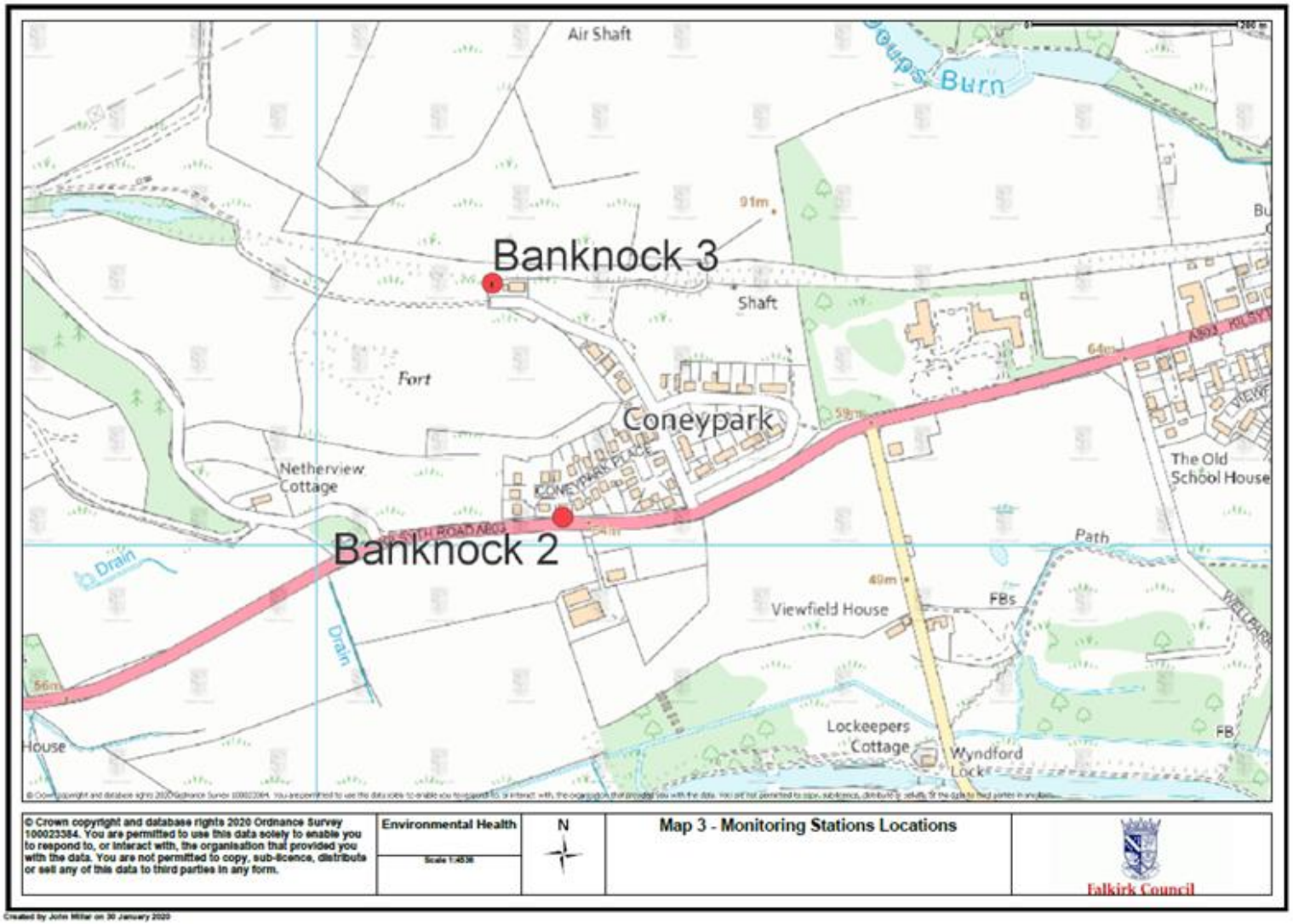
8. Figures - Map 1 - Banknock Area within Falkirk Council Boundary



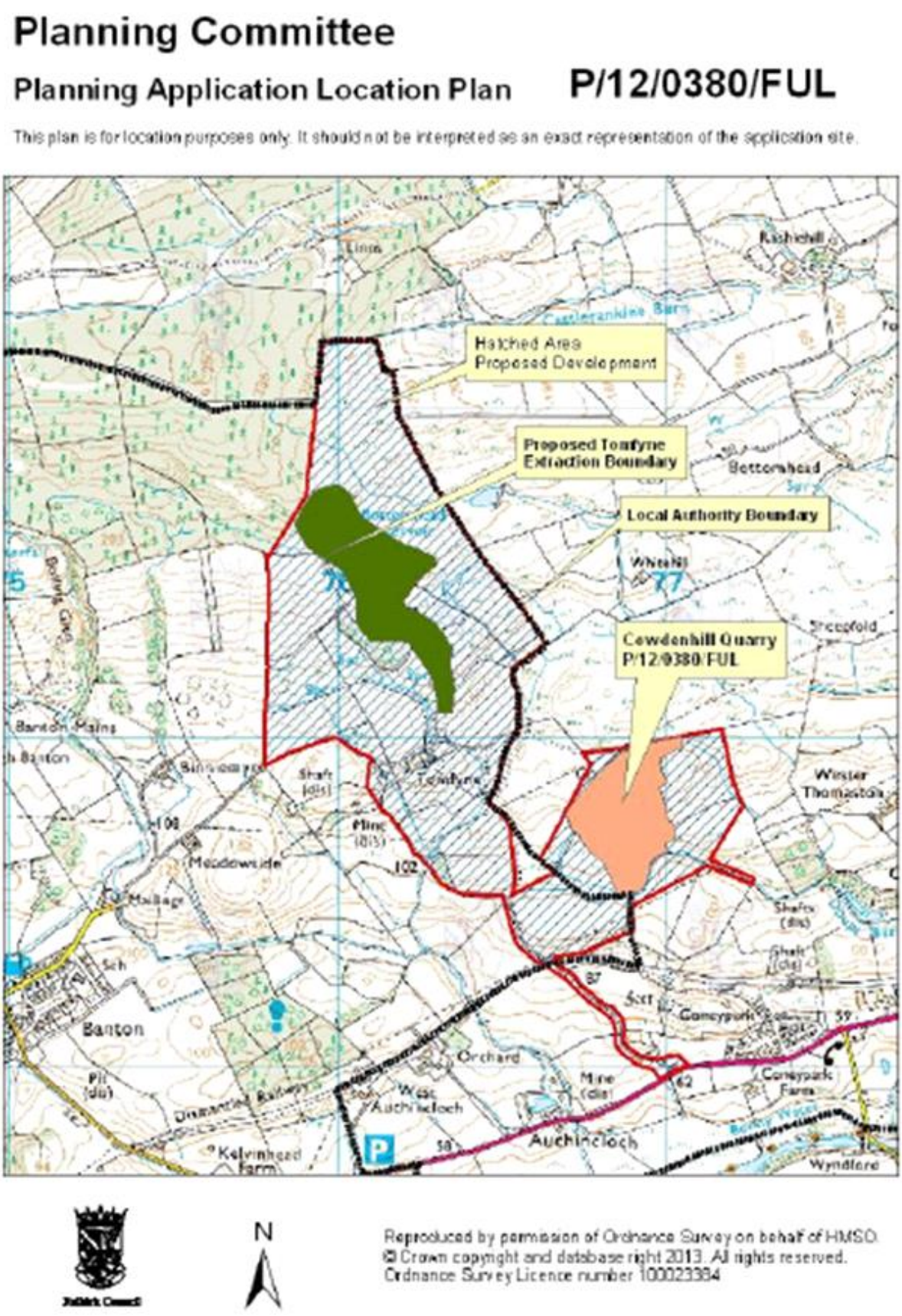
Map 2 - Banknock AQMA



Map 3 - Monitoring Station Locations



Map 4 – Locations of Cowdenhill and Tomfyne Quarries in Banknock Area



Appendix 1: Photo 1 – Banknock 2 Automatic Roadside Station

Photo 2 – Banknock 2 Automatic Roadside Station

Photo 3 – Banknock 3 Automatic Rural Station

Photo 4 – Banknock 3 Automatic Rural Station

Appendix D2: Sweco – Grangemouth Emissions Study – Technical Note

Grangemouth Emissions Study

Technical Note

Sweco UK Limited
Suite 4.2, City Park
368 Alexandra Parade
Glasgow, G31 3AU
+44 141 414 1700

08/07/2020
Project Reference: 121384
Document Reference: Technical Note
Revision: [1]
Prepared For: Falkirk Council

1 Introduction

Sweco has been appointed by Falkirk Council to provide consultancy support on behalf of them and SEPA for the following studies.

1. Produce a Review and Assessment Report of the Grangemouth AQMA including dispersion modelling of all industrial emissions. (based on 2017 data)
2. Produce a Grangemouth traffic emissions modelling study
3. Combine the results from both dispersion modelling studies into one combined model/ report.

1.1 Background

This Technical Note has been prepared for the Council to allow them to submit an overview of the work currently being undertaken by Sweco, as part of the Councils Annual Progress Report.

Grangemouth is a town within the Falkirk local authority area. Falkirk Council declared an AQMA in Grangemouth for the SO_2 15minute mean in 2005 for an area encompassing Grangemouth petrochemical complex and the adjacent area.

Previous assessment work in the AQMA has focussed on the short term SO_2 objectives in isolation. This package of work will consider the following pollutant emissions, NO_2, Particulates PM_{10} and $PM_{2.5}$, SO_2 and CO, where data are available.

At the time of commissioning this package of work 2017 emissions data were to be used for both studies. However, while the 2017 emissions inventory was being built and the models developed, new industrial emissions data were provided by SEPA for 2018. These data showed that emissions had reduced during 2018 due to new permits and BAT. Therefore, the Council and SEPA agreed that an updated 2018 emission inventory be built for both the industrial emissions and road traffic emissions.

The studies will through detailed dispersion modelling predict the various pollutant air quality concentrations within Grangemouth and detailed source apportionment modelling for all sources. This will determine which sources have the greatest influence on air quality concentrations within Grangemouth.

Since previous air quality modelling of sources within Grangemouth, there has been considerable changes to sources and their emissions.

To our knowledge, this assessment is the first assessment where both the road traffic sources and industrial sources within Grangemouth have been modelled together. By combining both the industrial and traffic emissions in a complete assessment, this will give Falkirk Council an overall understanding of all emissions and traffic sources within the Grangemouth area and inform future management of the AQMA.

At the time of preparing the APR the findings of the studies have not yet been finalised and approved by the Council or SEPA. This Technical Note provides an overview of the work currently being undertaken. Full details of the emissions inventory; model input data, model setup and model verification have not been provided as part of this Technical Note but will be provided in full within the final report.

Both studies, once approved by the Council and SEPA will be submitted to the Scottish Government.

2 Methodology

The modelling undertaken in the studies has followed best practice for both the road source modelling and the industrial source modelling. Modelling and model verification have been undertaken in accordance with LAQM TG.16.

2.1 Emissions Inventory

2.1.1 Road Traffic Emissions

A review of the road network within Grangemouth and the surrounding area was undertaken to identify the key road traffic links. As art of identifying which road links the model would include identifying the key model verification locations was key. Initially, the road traffic modelling was undertaken for 2017 using 2017 emissions and monitoring data. This was then updated to 2018 emissions data.

Falkirk Council undertakes automatic traffic counts (ATC) at a number of locations across the Council area. The Council provided Annual Average Daily Traffic (AADT) flows derived from their ATC count data for 2018. Unfortunately, not all roads within Grangemouth are currently covered by the Councils ATCs. Where ATC data were unavailable, traffic data was supplemented with Department for Transport (DfT) traffic data for 2018.

The ATC data and the DfT data provide detailed fleet split. The fleet split information for each modelled road link included where available:

- Motorcycles
- Cars
- LGV
- HGV
- Buses

2.1.2 Industrial Emissions

Given there has been several studies of SO_2 undertaken on behalf of the Council the Council and SEPA were keen that the study focussed on understanding emissions of the other key LAQM pollutants NOx PM10 and CO. Following discussions with Falkirk Council and SEPA, an initial review was undertaken of all permitted sites within the Grangemouth AQMA to determine which ones emitted these pollutants.

This initial screening identified a number of permitted sites. SEPA provided access to their reporting portal[1] which is used by each site to provide annual reporting requirements.

The next stage was to use the emissions inventory to build a dispersion model of all of the point sources identified for each site. For each point source we required all efflux parameters for each stack to allow them to be included in the model and operating in 2018.

While there were a number of point sources identified which did have the key pollutant emissions reported there were no efflux stack parameters reported and therefore these sources could not be modelled at this time.

Based on the information within the SEPA reporting portal we were able to model sources for the following sites:

- PetroIneos
- Fortrum Grangemouth
- Ineos
- Ineos Infrastructure
- Ineos Chemicals
- Ineos FPS
- Engie
- Calachem

2.2 Modelling

2.2.1 Road traffic emissions model

Emissions were calculated using the built-in EFT (EFT v9.0) in the latest version of ADMS ROADS v5. This version of the model allows for traffic induced turbulence to be calculated when the model calculates the emissions based on the numbers of vehicles, speed and the types of vehicle on each road link modelled explicitly in the model.

2.2.2 Industrial emission model

ADMS 5.2 was used to model the emissions from the point sources. From our previous experience in modelling the emissions sources in Grangemouth we know the importance of considering calm met conditions. We were also aware from the emissions inventory that there were a number of sources where the flues exited through one stack. The additional input file allowed calm conditions to be selected and for flues to be combined where applicable

2.3 Receptors

Pollutant concentrations for NOx, PM_{10} and CO were predicted at sensitive receptors across the study area where the National Air Quality Objectives (AQOs) are applicable for comparison with the annual mean and the 8 hour mean for CO. The same receptor locations were selected for both the

[1] https://beta.sepa.org.uk/publicregister/

road traffic modelling and the industrial modelling to allow for the total pollutant contributions to be summed.

3 Source Apportionment

Source apportionment is the process that quantifies the contributions of different pollutant sources to pollutant concentrations. This can allow the local authority to target specific sources when attempting to reduce pollutant concentrations in the AQMA.

In local air quality, road transport, local background concentrations, industrial, domestic and commercial sources all contribute to local air quality concentrations.

Within the road traffic study, the contributions from the different types of vehicles (e.g. cars, LGVs, HGVs and buses) have been determined to identify which vehicle types represent the most significant sources of pollution.

The source apportionment analysis was undertaken using air dispersion modelling which modelled the contributions of emissions of NOx and PM_{10} from various fleet sources. The following vehicle fleet categories were included within the source apportionment:

- Motorcycles
- Cars
- Light Good Vehicles (LGV)
- Heavy Good Vehicles (HGV)
- Buses

The source apportionment analysis was undertaken at a range of receptor locations throughout the study area. This analysis will identify the key source on each road link modelled.

3.1 Industrial Emissions

The industrial sites outlined above were included within the source apportionment. The sources were grouped within the model for each site/ facility to allow for the analysis.

The source apportionment analysis was undertaken at a range of receptor locations throughout the study area. The source apportionment analysis will identify the contribution to NOx and PM_{10} pollutant concentrations from each industrial site.

4 Results

The modelling results for both the road traffic modelling and industrial source modelling are subject to approval by the Council and SEPA. All results will be reported within the final report.