Falkirk Council

2014 Air Quality Progress Report

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

July 2014

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Executive Summary

Falkirk Council has examined its air quality monitoring results and concluded that a Detailed Assessment is required in the Main Street, Bainsford area. In 2013 the annual nitrogen dioxide objective was met at all automatic monitoring sites, although some exceedances were recorded at diffusion tube sites mostly located within Air Quality Management Areas.

In 2013 the Falkirk West Bridge St and Haggs monitoring sites recorded breaches of the Scottish particulate matter (PM_{10}) annual objective. The Falkirk West Bridge St site is within the Falkirk Town Centre AQMA. The Haggs AQMA will require to be amended to include PM_{10}.

In 2013 the three sulphur dioxide monitoring sites within the Grangemouth AQMA met the hourly and daily objectives. In contrast to previous years the 15-minute objective was achieved as well. In August 2013 Petroineos commissioned the Tail Gas Unit (TGU) on the sulphur recovery units at the Grangemouth refinery. It has been anticipated that this will reduce the number of 15-minute exceedances such that the objective will be met. There were no 15-minute exceedances recorded between the TGU commissioning and the end of 2013. However, with autumn and winter being dominated by (south) westerly weather conditions this reduction in exceedances should be treated with care.

The benzene and 1,3 butadiene diffusion tubes met the relevant objectives in 2013. The three 1,3 butadiene tubes have continued operation as it is understood that this pollutant will be retained in Local Air Quality Management. The particulate matter ($PM_{2.5}$) monitor at the Grangemouth AURN site met the interim Scottish target value of 12 $\mu g/m^3$. The changes to the monitoring network that have been carried out in 2013 and the anticipated changes in 2014 are discussed.

There are no changes to emissions from existing industrial operators that require further consideration. The local and trunk road traffic data that was available has been reviewed and one DMRB run was conducted. It is not considered that any of these sources require further consideration or a Detailed Assessment.

An update on Falkirk Council's four AQMAs and (draft) Action Plans is provided.

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Abbreviations

AQMA	Air Quality Management Area
ATD	Atomic Thermal Desorption
AURN	Automatic Urban and Rural Network
DA	Devolved Administration
DMRB	Design Manual for Roads and Bridges (specifically the AQ tool)
ESG	Environmental Scientifics Group (Didcot)
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
n/a	not applicable
NA	Non-automatic site
n/m	not measured
NO_2	Nitrogen dioxide
$PM_{10/2.5}$	Particulate matter, less than 10 / 2.5 µm in diameter
QA / QC	Quality Assurance / Quality Control
PPC	Pollution, Prevention and Control (Regulations)
PR	Progress Report
R&A	Review and Assessment (Process and Helpdesk, run by Defra and DAs)
SAQN	Scottish Air Quality Network
SEPA	Scottish Environment Protection Agency
SO_2	Sulphur dioxide
TEOM	Tapered Element Oscillating Microbalance.
TGU	Tail Gas Unit
U&SA	Updating and Screening Assessment
VCM	Volatile Correction Model

1 Introduction

1.1 Description of Local Authority Area

Falkirk Council is a unitary authority located in Central Scotland, see Figure A1. The Falkirk Council area encompasses 290 square kilometres with a population of approximately 151,000. The area extends from Banknock in the west to Blackness in the east and from South Alloa in the north to Limerigg in the south. It is bordered by the local authorities of North Lanarkshire, Stirling and West Lothian, with Clackmannanshire and Fife located on the north side of the Firth of Forth.

The area contains the port of Grangemouth and depends for its prosperity on a broad industrial base which includes sizeable industrial areas in Falkirk and Grangemouth. These industrial areas are diverse and vary from an oil refinery, associated chemical industry and dockland in Grangemouth through to bus manufacturing in Camelon (Falkirk). The main towns and population base in the area are Bo'ness, Denny, Falkirk, Grangemouth and Larbert with the south of the area around Slamannan being more rural in nature.

Three motorways pass through the area, the M80, M876 and M9, in addition to the main rail line connecting Glasgow and Edinburgh and the rail lines connecting Glasgow / Edinburgh with Stirling and the north. The area also contains the Falkirk Wheel, which connects the Union canal with the Forth and Clyde canal, and the recently opened Helix Park and Kelpies statues.

1.2 Purpose of Progress Report

Progress Reports are required in the intervening years between the three-yearly Updating and Screening Assessment (U&SA) reports. Their purpose is to maintain continuity in the current Local Air Quality Management (LAQM) process.

A Progress Report is not intended to be as detailed or to require as much effort as an Updating and Screening Assessment Report. However, if the Progress Report identifies the risk of exceedance of an Air Quality Objective, the Local Authority should undertake a Detailed Assessment, and not wait until the next round of Review and Assessment.

Please note the LAQM process is under review by the Scottish Government. This may result in changes to the format of future reports.

1.3 Air Quality Objectives

The air quality objectives applicable to LAQM in Scotland are set out in the Air Quality (Scotland) Regulations 2000 (Scottish SI 2000 No 97), the Air Quality (Scotland) (Amendment) Regulations 2002 (Scottish SI 2002 No 297), and are shown in Table 1.1. This table shows the objectives in units of microgrammes per cubic metre, $\mu g/m^3$ (except for carbon monoxide

which is in milligrammes per cubic metre, mg/m^3) with the number of exceedances in each year that are permitted (where applicable).

It was announced by the Scottish Government in December 2013 that Local Authorities will be required to review $PM_{2.5}$ (particles smaller than 2.5 µm in diameter). The legislation and associated guidance has not as yet been developed. However, $PM_{2.5}$ is considered in this report at two locations. The first is Grangemouth where a $PM_{2.5}$ monitor already operates as part the AURN. The second is the Banknock AQMA. This is due to the potential benefit $PM_{2.5}$ monitoring could bring to the AQMA work.

Table 1.1 Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in Scotland.

Pollutant	Concentration	Measured as	Compliance date
Benzene	16.25 ug/m^3	Running annual mean	31/12/2003
	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	0.5 µg/m^3	Annual mean	31/12/2004
	0.25 µg/m^3	Annual mean	31/12/2008
Nitrogen dioxide	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
Particles (PM_{10}, gravimetric)	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean	31/12/2004
	40 µg/m^3	Annual mean	31/12/2004
	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
Sulphur dioxide	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean	31/12/2005
	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

There can be misunderstanding between the terms ‘exceedance’ and a ‘breach of the objective’. As an example: a monitor records a 15-minute average concentration of 300 µg/m^3 at a location that is a relevant receptor. This, for SO_2, is an ‘exceedance’ of the air quality standard because the 15-minute concentration is greater than 266 µg/m^3. However, it is not a breach of the objective. This only occurs when more than 35 exceedances are

recorded, whether through monitoring or modelling, at a specific location that is representative of a relevant receptor in a calendar year. It is only a breach of an objective that can result in an Air Quality Management Area and not the occurrence of an individual or several exceedances.

It is important to note that the method of assessment that the UK Government conducts in relation to its submission to the European Union is not the same as LAQM. In addition, not all the objectives stated in Table 1.1 originate from the EU. Thus although there an AQMA may have been declared this does not automatically translate to a breach of any objectives under EU legislation.

1.4 Summary of Previous Review and Assessments

A summary of work in the last four years:

Additional Further Assessment for the Grangemouth AQMA, April 2010

An additional Further Assessment for the Grangemouth AQMA was submitted, this executive summary was shown in Section 6 of the 2010 PR. Included as part of this report were polar roses (wind direction and speed versus concentration) plotted by Falkirk Council using Openair. This provided further insights into the monitoring data and was presented to the working group meeting for the AQMA in February 2010.

2010 Progress Report

The executive summary of the 2010 Progress Report stated:

"A review of Falkirk Council's monitoring data for 2009 showed that the 15-minute objective continued to be breached in the Grangemouth AQMA. In 2009 the Grangemouth Moray site recorded 65 exceedances. This is greater than the 35 allowed by the objective. All SO_2 monitors outside the AQMA met the 15-minute objective, with all sites meeting the hourly and daily SO_2 objectives. A breach of the 2010 annual PM_{10} objective was recorded at the Falkirk West Bridge St site in 2009. This result will be used in the Falkirk Town Centre Further Assessment. Therefore the Council will wait for this report to be completed before considering whether to adjust the current AQMA.

Since the 2009 U&SA Falkirk Council has declared three AQMAs for NO_2, two are in Falkirk Town Centre and one in the Haggs and Banknock area. In addition, the Banknock area near Cowdenhill Quarry remains subject to a Detailed Assessment for PM_{10}. An Action Plan update for the Grangemouth AQMA was given. Falkirk Council continues to work on the measures outlined in the plan. In addition, a statement by INEOS about their tail gas treatment and other SO_2 emission reduction work was also included the report.

It was concluded that no new Detailed Assessments were required, as exceedances of any objectives are covered by existing Detailed or Further Assessments, AQMAs or there are no relevant receptors.

A review of changes to local emission sources indicated that a number of roads were identified where the HDVs were above 20% or total traffic flows had increased. However, no Detailed Assessment is required for these or any other transport, industrial or domestic developments since the 2009 U&SA."

Detailed Assessment (Banknock PM_{10}), December 2010

In December 2010 Falkirk Council submitted a Detailed Assessment to the Scottish Government. The executive summary stated:

"Falkirk Council proceeded to a Detailed Assessment for particulate matter (PM_{10}) in the Banknock area of Falkirk, in proximity to Cowdenhill Quarry, as a result of local resident complaints in respect of dust and other screening criteria required by the technical guidance. PM_{10} monitoring commenced in the area in October 2009. The monitoring was carried out in the grounds of a dwelling in Coneypark Place, Banknock, Falkirk. An Osiris monitor was used. The site is named Banknock 1.

The number of daily PM_{10} exceedances recorded in the year of monitoring was 30. This is greater than the number of daily exceedances permitted by the Scottish PM_{10} daily objective but is within the 35 daily exceedances permitted by the UK PM_{10} daily objective. The annual concentration recorded was 23.5 $\mu g/m^3$. This is greater than the Scottish PM_{10} annual objective of 18 $\mu g/m^3$ but is below the UK PM_{10} annual objective of 40 $\mu g/m^3$. A correction factor of 1.3 was used, this is discussed in detail in the report.

As Banknock 1 is located at relevant receptors for both the annual (residential building façade) and daily objectives (garden of residential property) an Air Quality Management Area (AQMA) is required. The AQMA declaration will need to include the Scottish PM_{10} objectives and it is recommended that it should also include, due to the potential to breach, the two UK PM_{10} objectives. This is due to the 90.4th percentile concentration being "close to" breaching the UK PM_{10} daily objective. The monitoring was not conducted in the "worst case" modelled location due to the need to be representative of a greater number of receptors and due to limitations on issues such as power supply.

An analysis of the monitoring data has also been carried out. This highlights differences in the PM_{10} concentrations between the Banknock 1, the background Grangemouth and the roadside Falkirk West Bridge St monitoring sites which were used as a comparison. For example, the number of daily exceedances recorded at the Banknock 1 site was greater in the summer than in the winter months and the ratio of $PM_{2.5}$ to PM_{10} suggests that the particles at Banknock 1 are in the larger size fraction (2.5 to 10 µm in diameter).

The monitoring and analysis of the data adds evidence to the theory that a possible contributor to the PM_{10} concentrations at Banknock 1 relate to the activities of the nearby Cowdenhill Quarry."

The Scottish Government appraisal accepted the report and the requirement for an AQMA. The declaration of the Banknock PM_{10} AQMA was approved by elected Members and came into force in August 2011.

2011 Progress Report

The executive summary of the 2011 Progress Report stated:

"Falkirk Council has examined the monitoring results for its area and concludes that no Detailed Assessments are required for any pollutant.

As in previous years a breach of the 15-minute SO_2 objective was recorded in 2010 at the Grangemouth Moray site. This site is within the Grangemouth AQMA, which was declared in November 2005 and for which an Action Plan is in place. The Grangemouth AURN site also recorded a breach of the objective. This is understood to be the first breach of the 15-minute SO_2 objective at an AURN site. The sites outside the AQMA continue to meet the objectives, including the new Polmont site. The work in relation to the Grangemouth AQMA continues as per the Action Plan. The INEOS Tail Gas Treatment work that was described in the 2010 Progress Report was granted planning permission in December 2010.

The Falkirk Town Centre and Haggs Further Assessments have been submitted. A breach of the Scottish annual PM_{10} objective was recorded at the Falkirk West Bridge St site in 2010. As a result of these reports it is proposed that NO_x monitoring will cease and PM_{10} monitoring will commence at Falkirk Grahams Rd. PM_{10} monitoring may also commence at the Haggs site as result of the Further Assessment. At the time of writing the Scottish Government has rejected the Falkirk Town Centre Further Assessment, therefore no recommendation can be made in relation to the Falkirk Town Centre AQMAs. The development of the Action Plans for these AQMAs continues.

The benzene and 1,3 butadiene diffusion tubes continue to show that the objectives were met in 2010 at locations where there are relevant receptors. Monitoring will continue at Denny Cross and Glensburgh Road for NO_2 and an additional benzene tube has been located at Kinneil Kerse.

A review of the road traffic flow data available for the Falkirk Council area has highlighted one road that has shown an increase in traffic but according to the guidance does not need considering further. Changes to Pollution, Prevention and Control (PPC) permits in Falkirk Council area were discussed and did not need to be considered further.

An AQMA for PM_{10} in Banknock has been approved in principal by elected Members and a consultation conducted."

2012 Updating and Screening Assessment

The executive summary of the 2012 Updating and Screening Assessment stated:

"Falkirk Council has examined the monitoring results for its area and concludes that no Detailed Assessments are required for any pollutant. The Grangemouth AURN (located in Inchyra Park) and Grangemouth Moray automatic sites, both within the Grangemouth SO_2 Air Quality Management Area, breached the 15-minute objective in 2011. The hourly and daily objectives were met at these two sites. The SO2 monitoring sites outside the Grangemouth AQMA continue to meet all three objectives.

All sites except the Falkirk West Bridge St site met the Scottish PM_{10} objectives in 2011. This site recorded a concentration of 18.7 $\mu g/m^3$ and was close to recording a breach of the daily objective with a 98^{th} percentile concentration of 49 $\mu g/m^3$ (five daily exceedances were recorded). All sites met the UK / EU PM_{10} objectives in 2011. As discussed in the Further Assessment report for Falkirk Town Centre and subsequent communications with the Scottish Government it will be proposed to Falkirk Council elected Members that the Falkirk Town Centre AQMA declaration be amended to include PM_{10} and that the hourly NO_2 AQMA is revoked.

The NO_2 objectives were not breached at any of the automatic monitoring sites in 2011. Some diffusion tube sites breached the NO_2 annual objective in 2011 but most were in the Falkirk Town Centre or Haggs AQMAs. One tube, NA83, did record a breach of the objective with the R&A factor applied. However, with the more appropriate local roadside (Park St) factor and once the distance to the nearest receptor is taken account of there was no exceedance. The benzene and 1,3 butadiene non-automatic monitoring continues to show that the objectives were met in 2011 at locations where there are relevant receptors.

The Banknock PM_{10} AQMA was declared in August 2011. Skene Group has disposed of their interest in Cowdenhill Quarry with operations ceasing in July 2011. Osiris monitoring continues, with a TEOM installation and the Further Assessment under way.

The remainder of the assessment required for an Updating and Screening Assessment has shown no requirement for a Detailed Assessment. Eleven DMRB runs were conducted for road traffic emissions and showed no breaches of the NO_2 or PM_{10} objectives. Emissions from other transport sources did not require further consideration.

There were no significant changes to industrial emissions although three biomass operations are proposed (but have not been granted planning permission yet). The changes to quarry operations in the Banknock PM_{10} AQMA have been noted with monitoring continuing in the area and the Further Assessment underway. It is considered that cumulative effects of small biomass boilers do not need to be looked at further. The review found no requirement for a Detailed Assessment for any pollutant."

2013 Progress Report

The executive summary of the 2013 Progress Report stated:

"Falkirk Council has examined its air quality monitoring results and concluded that no Detailed Assessments are required for any pollutant. In 2012 the annual nitrogen dioxide objective was breached at the Falkirk West Bridge St monitoring site. This site is within the Falkirk Town Centre Air Quality Management Area (AQMA). It is concluded that a Detailed Assessment is not required for the one tube (NA83) that recorded a concentration above the nitrogen dioxide objective but is outside of an AQMA. This is because with the distance to the nearest receptor taken into account no breach of the objective is predicted.

In January 2013 the Falkirk Town Centre AQMA was amended to include the Scottish PM_{10} objectives. This was required due to breaches of the objectives at the Falkirk West Bridge St site in previous years. In 2012 all monitoring sites met the PM_{10} objectives, although the Falkirk West Bridge St site was near to breaching both the annual and daily Scottish PM_{10} objectives.

In 2012 all three Grangemouth sites within the existing AQMA recorded a breach of the 15-minute objective. In addition, the Grangemouth Moray site recorded a breach of the daily objective. However, it is concluded that a Detailed Assessment is not required. This is primarily due to changes in emissions that will result from the commissioning of Tail Gas Treatment in 2013. It is anticipated that this will reduce the number of 15-minute exceedances such that the objective will be met. In addition, it is likely that unusual meteorological conditions experienced in 2012 contributed to the breach of the daily objective.

In 2012 many of the passive benzene diffusion tubes and the pumped diffusion tube recorded increases in annual concentrations compared to 2011. This is likely to have been due to an incident at a storage tank at the Grangemouth refinery in July 2012. It is concluded from the monitoring data that a Detailed Assessment is not required. The 1,3 butadiene monitoring results met the relevant objective in 2012.

It is not considered that any changes to emissions from existing industrial operators require further consideration. The local and trunk road traffic data that was available has been reviewed. This highlighted several roads where flows have increased and four DMRB runs were therefore conducted. The railway station at Bo'ness (a heritage railway) has again been considered. It is not considered that any of these sources require a Detailed Assessment.

A draft Action Plan has been produced for the Falkirk Town Centre and Haggs AQMAs and will now be subject to consultation. In addition, in February 2013 the ECO Stars scheme was launched in the Falkirk area."

AQMAs

Falkirk Council has four active Air Quality Management Areas:

- Banknock, annual and daily Scottish PM_{10} objectives and potential breach of annual and daily UK PM_{10} objectives.
- Falkirk Town Centre, annual NO_2 objective and annual and daily Scottish PM_{10} objectives.
- Grangemouth, 15-minute SO_2 objective,
- Haggs, annual NO_2 objective.

The Grangemouth AQMA was declared for, what at the time, was considered a potential breach of the 15-minute SO_2 objective. This AQMA covers the Grangemouth area and was declared in November 2005, see Figure 1.1a. This AQMA is in relation to industrial emissions.

There are two AQMAs that have been declared due to a breach of the annual NO_2 objective. One covers an area of Falkirk Town Centre and the second surrounds a motorway junction in Haggs. They were both declared in March 2010, see Figures 1.1 b and c.

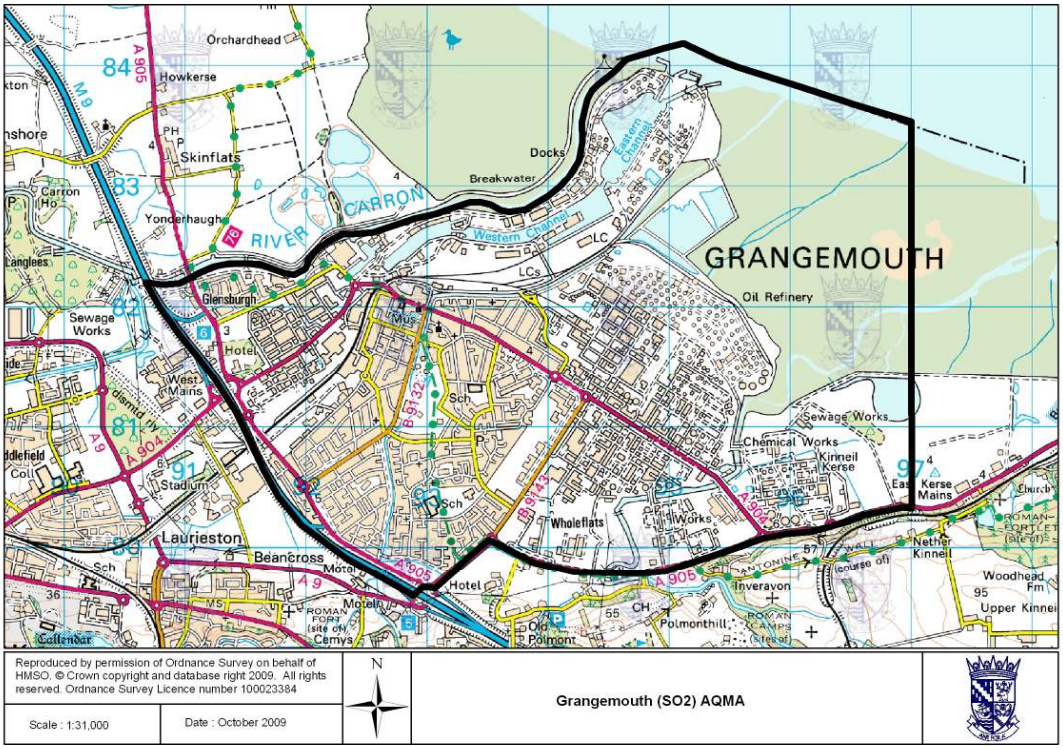
In January 2013 the hourly AQMA covering part of Grahams Road in Falkirk Town Centre was revoked and the Falkirk Town Centre AQMA amended to include the Scottish PM_{10} objectives.

An AQMA was declared in Banknock in August 2011 in relation to breaches of the Scottish and potential breaches of the UK PM_{10} objectives, see Figure 1.1d.

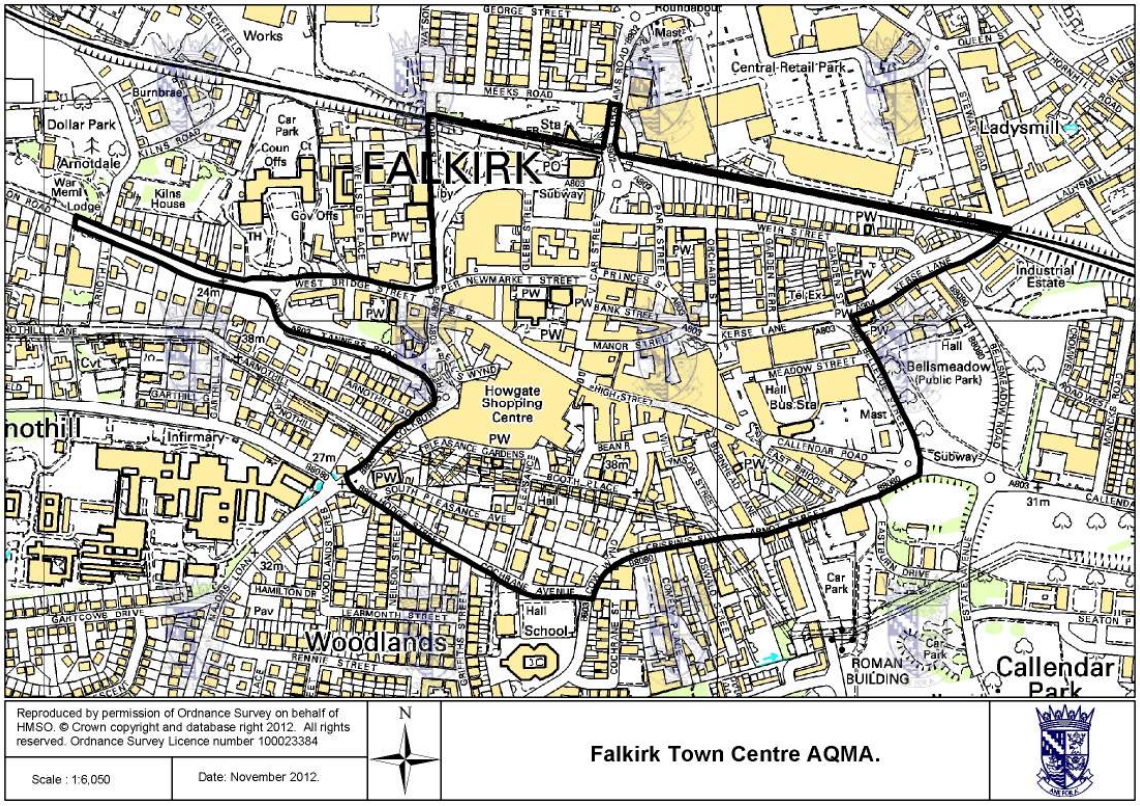
An update on all AQMAs and where appropriate Action Plans is given in Section 5.

Figure 1.1 Maps of Falkirk Council's AQMA boundaries.

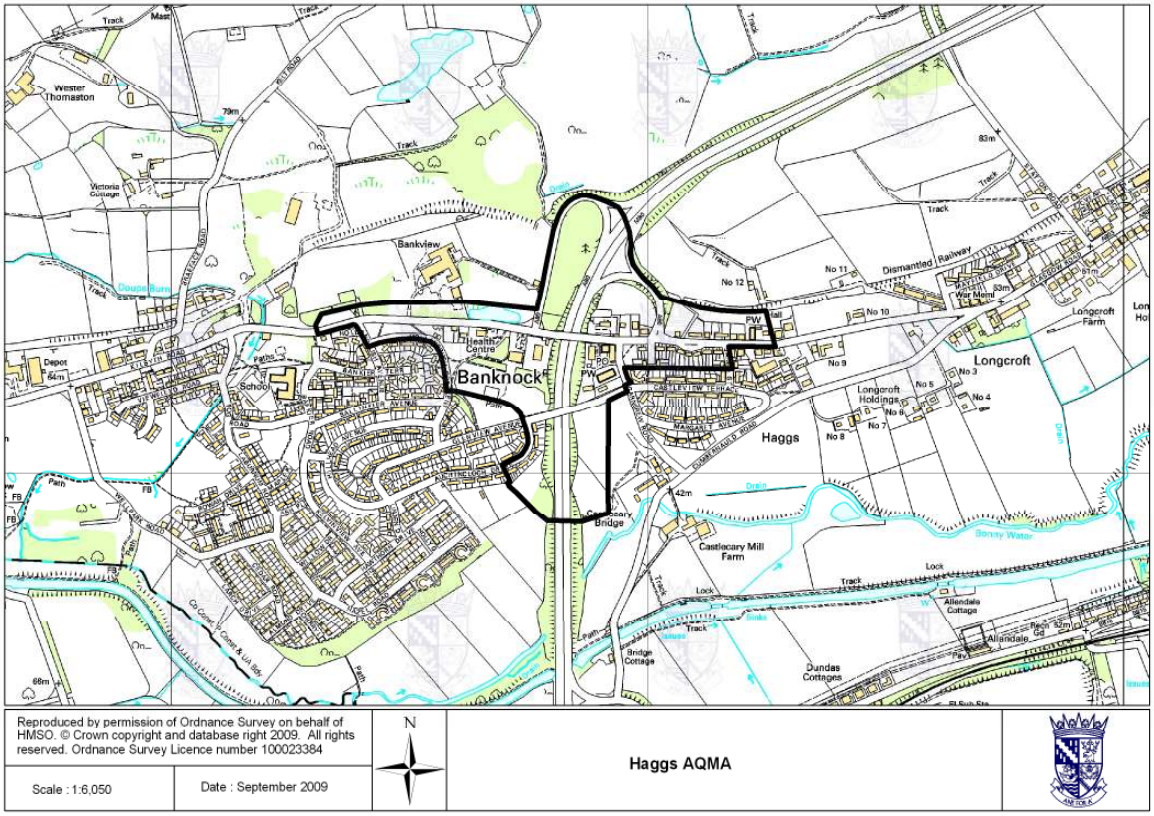
a.) Grangemouth AQMA (15-minute SO_2).



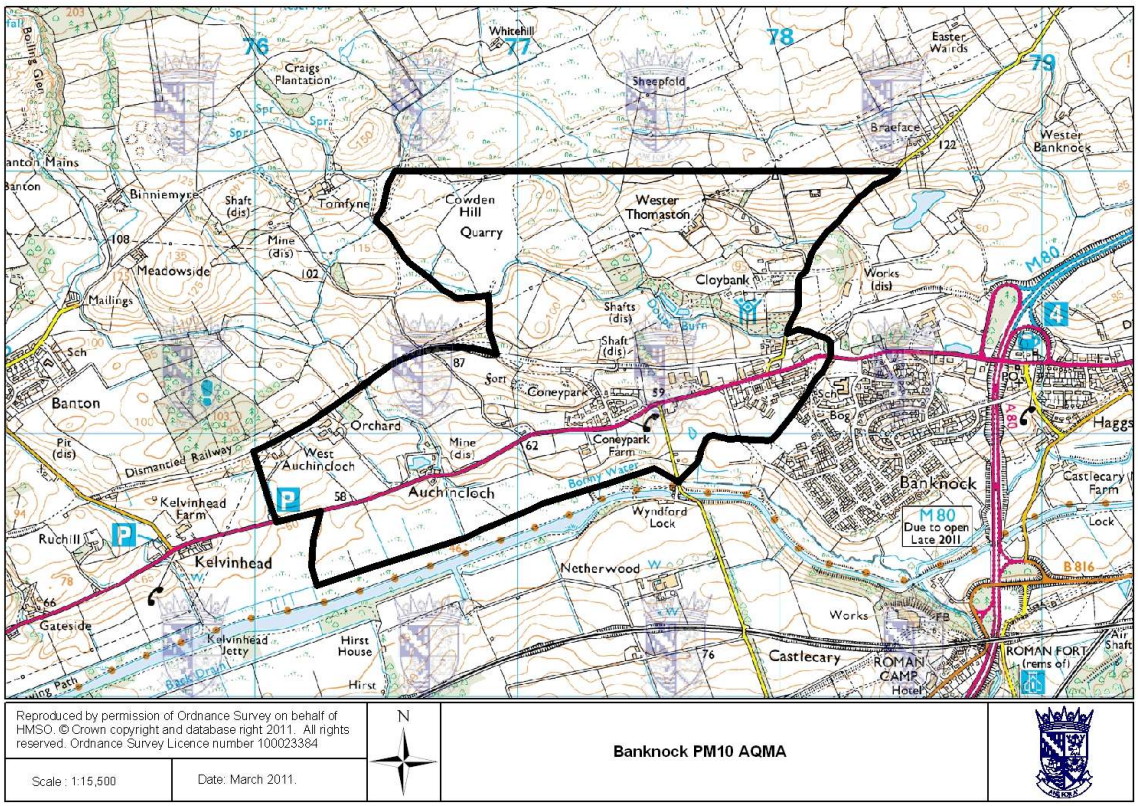
b.) Falkirk Town Centre AQMA (annual NO_2 and annual and daily PM_{10}).



c.) Haggs AQMA (annual NO_2), declared March 2010.



d.) Banknock AQMA (annual and daily PM_{10}), declared August 2011.



2 New Monitoring Data

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

In 2013 Falkirk Council operated automatic monitoring stations at 11 locations from Banknock in the west to Bo'ness in the east. The automatic monitoring measured $PM_{2.5}$, PM_{10}, NO_2 and SO_2.

Falkirk Council operates two sites that are affiliated to the UK Automatic Urban and Rural Network (AURN): the Grangemouth AURN site (NO_x, SO_2, PM_{10}*, $PM_{2.5}$* and a pumped benzene diffusion tube*) and the Grangemouth Moray site (NO_x only). The AURN data forms part of the UK's reporting to the EU in terms of compliance with the European objectives.

In 2013 the remaining analyser at the Grangemouth Moray site (SO_2) and six other monitoring sites (Banknock 2, Falkirk Hope St, Falkirk Park St, Falkirk West Bridge St, Grangemouth MC and Haggs) were affiliated to the Scottish Air Quality Network (SAQN). The remaining sites (Banknock 3, Bo'ness and Falkirk Grahams Road) are not affiliated to either network. The details of the network affiliation and QA / QC for each monitoring site and analyser are shown in the Appendix, Table A2.

The following changes have been made to the automatic monitoring network in 2013 and the first quarter of 2014:

- Banknock 2 (A13): The site was affiliated to the Scottish Air Quality Network in January 2013. Please note this site is called 'Falkirk Banknock' on the SAQN website.
- Banknock 3 (A14): The site (PM_{10}, Osiris) began operation in July 2013. It is a background location which will provide an indicative comparison to the results from the roadside Banknock 2 (A13).[i] In addition, a new modem was installed in April 2014. This has resulted in provisional data being available to view on the Turnkey website: https://www.airqweb.co.uk/Main [ii]
- Falkirk Haggs (A4): In January 2013 the PM_{10} (TEOM) analyser at the site was affiliated to the Scottish Air Quality Network.
- Falkirk West Bridge St (A7): The enclosure and NO_x analyser are to be replaced. This will improve the data capture of the NO_x analyser.
- A portable and compact NO_x analyser (AQ Mesh) has been purchased. This was initially co-located at the Grangemouth AURN (A8) site for comparison purposes. The unit records data on an hourly basis although it is not equivalent to 'AURN / national' standards.

* Scottish Government owned analysers.

[i] It should be noted that the two methods of measurement at Banknock 2 and 3 are different. This may increase uncertainties when comparing results between the sites, particularly when concentrations are low.

[ii] To maintain continuity with previous database a 1.14 correction factor is not applied to the data displayed on this website.

Figure 2.1 A map showing the new automatic monitoring site in the Falkirk Council area in 2013: Banknock 3 (A14). The existing Banknock 2 site is shown for reference.

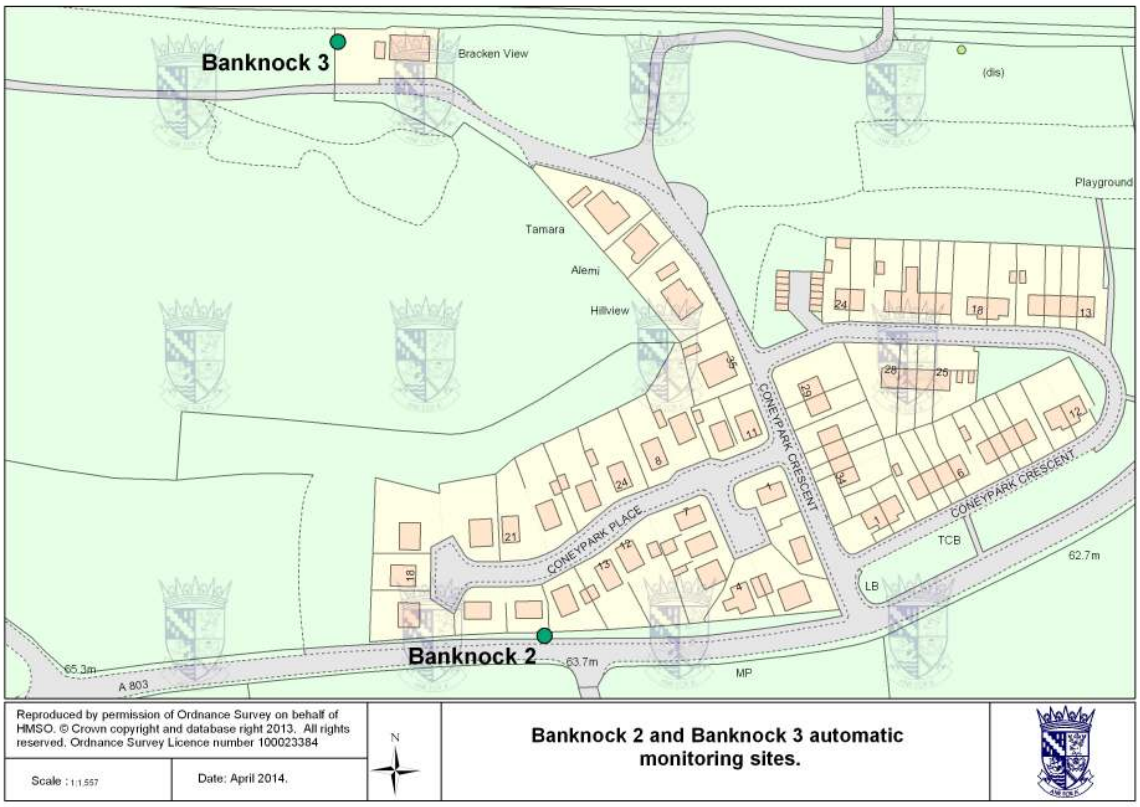


Table 2.1 Details of automatic monitoring sites that operated in 2013 in the Falkirk Council area.

Site Number and Name	Site Type	OS Grid Ref		Pollutants Monitored	Technique / Equipment Supplier	In AQMA?	Relevant exposure?	Distance to kerb of road, m.	Represent worst-case exposure?
A3. Bo'ness	Urban background / industrial.	299815	681481	SO_2	Horiba	N	Y (5 m)	22 m *	N #
A4. Falkirk Haggs	Roadside.	278977	679271	NO_2, PM_{10}	NO_x: ML, PM_{10}: TEOM.	Y (NO_2)	Y (5 m)	2 m	Y
A5. Falkirk Hope St	Roadside.	288688	680218	NO_2, SO_2.	Horiba.	Y (NO_2 and PM_{10}.)	Y (1 m)	5 m	N @
A6. Falkirk Park St	Roadside.	288892	680070	NO_2, SO_2, PM_{10}.	NO_x and SO_2: Horiba, PM_{10}: TEOM.	Y (NO_2 and PM_{10}.)	Y (1 m)	5 m	Y
A7. Falkirk West Bridge St	Roadside.	288457	680064	NO_2, PM_{10}	NO_x: ML, PM_{10}: TEOM.	Y (NO_2 and PM_{10}.)	Y (1 m)	2 m	Y
A8. Grangemouth AURN (Inchyra Park)	Urban background / industrial.	293830	681022	Benzene, NO_2, PM_{10}, $PM_{2.5}$, SO_2.	Benzene (pumped tube), PM: FDMS. NO_x and SO_2: ML.	Y (SO_2)	Y (5 m)	20 m	Y
A9. Grangemouth Moray	Urban background / industrial.	293469	681321	NO_2, SO_2.	NO_x: ML and SO_2: Horiba.	Y (SO_2)	Y (1 m)	25 m	Y
A10.Grangemouth Municipal Chambers	Urban background / industrial.	292816	682009	NO_2, SO_2, PM_{10}.	NO_x and SO_2: Horiba, PM_{10}: TEOM.	Y (SO_2)	Y (1 m)	40 m	Y
A12. Falkirk Grahams Rd	Roadside.	288823	680242	PM_{10}	TEOM.	Y (NO_2 and PM_{10}.)	Y (1 m)	10 m	N
A13. Banknock 2	Roadside.	277247	679027	PM_{10}	TEOM	Y (PM_{10})	Y (7 m)	3 m	N
A14. Banknock 3	Urban background.	277168	679254	PM_{10}	Osiris	Y (PM_{10})	Y (19 m)	17 m *	N #

Notes: * Stated but not relevant to the pollutant and / or reason for monitoring. # Location not designed to represent worst case exposure. @ Distances to relevant exposure may not apply to all pollutants (i.e. SO_2, due to shorter time period of objective).

2.1.2 Non-Automatic Monitoring

In 2013 Falkirk Council monitored nitrogen dioxide at 65 locations, benzene at 16 locations and 1,3 butadiene at three locations using non-automatic methods, i.e. diffusion tubes. The diffusion tubes have achieved good data capture across the year, with few tubes not achieving the annual data capture target of 75%. In addition, a pumped benzene diffusion tube (Defra / DA equipment) continued to operate at the Grangemouth AURN (A8) site as part of the AURN non-automatic hydrocarbon network. The details of the type of tubes used and the QA / QC of non-automatic monitoring are given in the Appendix, A2.

The following non-automatic sites have ceased operation since the 2013 Progress Report:

- NA90 (NO_2): Grahams Road bridge east, Falkirk. This was site was compliant with the objective in 2013. Suitable coverage is maintained in the area with tube NA89 operating at Grahams Rd / Meeks Rd.
- NA106 (NO_2): Stirling Road, North Broomage. This site commenced operation due to the opening of the Glenbervie M876 slip roads. The NO_2 concentration was well within the objective in 2013. Therefore this site has been discontinued.

The following diffusion tube sites have slightly changed location. This is due to lamp-post renewal or removal:

- NA20 (NO_2): Garngrew Road, Haggs.
- NA24 (NO_2): Kerse Lane, Falkirk.
- NA69 (NO_2): Kerse Lane, Falkirk.

The following diffusion tube sites have commenced operation since the 2013 Progress Report.

- NA107 (NO_2): Main Street (east), Bainsford (February 2013). To aid understanding of concentrations of NO_2 along this street and complement tube NA83.
- NA108 (NO_2): Main Street, Camelon (January 2014). This link has been subject to several DMRB runs in recent years. In line with previous reports a tube has been located to areas highlighted in DMRB runs.
- NA109 (NO_2): Carmuirs Street, Camelon (January 2014). A background site to complement tube NA107.
- NA110 (NO_2): Banknock 2 AQ station, (April 2014). A tube has been located at this monitoring site as it may aid source apportionment in the Banknock PM_{10} AQMA.

The location of NA107 is shown in Figure 2.2 and NA108 to 110 will be shown in the 2015 Updating and Screening Assessment (or other air quality report).

Falkirk Council carried out two triplicate studies in 2013. This involves three NO_2 diffusion tubes being co-located with an automatic monitoring station. This enables the diffusion tube results to be bias adjusted. This is conducted to account for the difference between results from an automatic monitor and the diffusion tubes. One study was carried at the Grangemouth MC site (NA42 / A10), an urban background site and the second study was carried at the Falkirk Park

St site (NA70 / A6), a roadside site. The results from both sites contributed to the R&A bias factor for ESG Didcot. The bias sheets from Grangemouth MC and Falkirk Park St and the R&A helpdesk summary are shown in Figures A3 and A4.

The local and R&A Helpdesk bias adjustment factors suggest that the diffusion tubes over-read NO_2 compared to the automatic monitors. Falkirk Council has applied the R&A helpdesk factor to the 2013 results as there are a mixture of roadside and background sites. In 2013 the Falkirk Park St (0.87) and Grangemouth MC (0.82) factors were reasonably similar to each other. The R&A bias factor for the ESG Didcot tubes in 2013 was 0.80. Note the data submitted to the R&A Helpdesk uses provisional data for the second half of the year as the data is compiled prior to ratification.

In addition, a sensitivity test with the local Falkirk Park St (A6) factor has been applied to the tubes that recorded a concentration greater than 36 µg/m^3 with the use of the R&A factor. The results are discussed in Section 2.2.

Figure 2.2 A map of the new non-automatic monitoring site (NA107) in the Falkirk Council area in 2013.

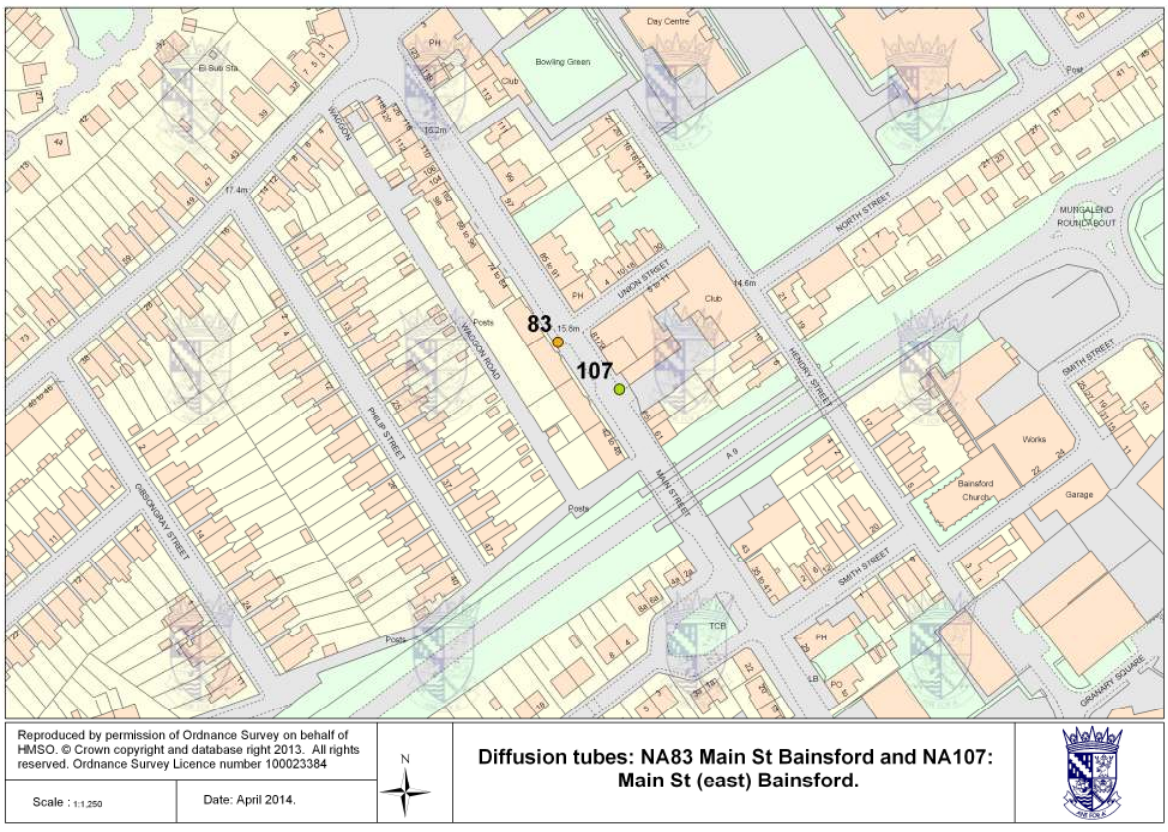


Table 2.2 Details of non-automatic monitoring sites

Site	Location	Site Type	OS Grid Ref (x, y)		Pollutants Monitored	In NO_2, benzene or 1,3 butadiene AQMA?	Relevant exposure? (m)	Distance to kerb (nearest road), m.	Worst-case Location?
NA3	Tinto Drive, Grangemouth.	Urban background.	293427	680386	Benzene, NO_2.	N	Y (<5)	<10	N
NA5	Copper Top pub, Camelon.	Roadside.	287332	680333	NO_2.	N	Y (<2)	0.6 (traffic island)	Y
NA7	Irving Parish Church, Camelon.	Urban background.	287324	680442	NO_2.	N	Y (<5)	<10	N
NA9	Bellsdyke Rd, Larbert.	Roadside.	286048	683542	NO_2.	N	Y (<2)	0.7	Y
NA19	Kilsyth Rd, Banknock.	Roadside.	278779	679301	NO_2.	Y (NO_2).	Y (<2)	2.2	Y
NA20	Garngrew Rd, Haggs.	Urban background.	278975	679172	NO_2.	N	Y (<5)	<10	N
NA21	Grangemouth Rd, College.	Roadside.	290112	680500	Benzene, NO_2.	N	Y (<2)	1.8	Y
NA24	Kerse Lane, Falkirk.	Roadside.	289187	680024	NO_2.	Y (NO_2).	Y (<2)	3	Y
NA26	Weir St, Falkirk.	Urban background.	289207	680123	NO_2.	Y (NO_2).	Y (<5)	<10	N
NA27	West Bridge St, Falkirk.	Roadside.	288490	680055	Benzene, NO_2.	Y (NO_2).	Y (<2)	0.5	Y
NA29	Wellside Place, Falkirk.	Urban background.	288465	680220	NO_2.	N	Y (<5)	<10	N
NA36	Kerr Crescent, Haggs.	Roadside.	278985	679273	NO_2.	Y (NO_2).	Y (<5)	2.1	N
NA37	Denny Town House.	Urban centre.	281226	682526	Benzene, NO_2.	N	Y (<5)	<5	Y
NA38	Larbert Village Primary School.	Urban background.	285930	682318	Benzene, NO_2.	N	Y (<5)	<10	N
NA41	Seaview Place, Bo'ness.	Roadside.	299722	681594	Benzene, 1,3 Butadiene, NO_2.	N	Y (<2)	0.1	Y
NA42	Municipal Chambers, Grangemouth.	Urban centre / industrial.	292817	682000	Benzene, NO_2*.	N	Y (<5)	<10	Y

Table 2.2 Details of non-automatic monitoring sites (continued)

Site	Location	Site Type	OS Grid Ref (x, y)		Pollutants Monitored	In NO_2, benzene or 1,3 butadiene AQMA?	Relevant exposure? (m)	Distance to kerb (nearest road), m.	Worst-case Location?
NA44	Greenpark Drive, Polmont.	Urban background.	293436	678938	Benzene, NO_2.	N	Y (<5)	<10	N
NA47	Thistle Avenue, Grangemouth.	Roadside.	292000	680300	NO_2.	N	Y (<2)	1.3	Y
NA48	Hayfield, Falkirk.	Urban background.	289200	681580	NO_2.	N	Y (<5)	<10	N
NA50	Upper Newmarket St, Falkirk.	Urban background.	288671	680047	NO_2.	Y (NO_2).	Y (<5)	<10	N
NA51	Mary St, Laurieston.	Roadside.	290965	679490	NO_2.	N	Y (1)	4.5	Y
NA52	Main St, Larbert.	Roadside.	285866	682356	NO_2.	N	Y (<2)	4.4	Y
NA53	Denny Cross.	Roadside.	281211	682727	NO_2.	N	Y (<2)	0.8	Y
NA55	Inchyra Station.	Urban background / industrial.	293830	681022	Benzene, 1,3 butadiene.	N	Y (<5)	<2	N
NA57	Inchyra Road, Grangemouth.	Urban background / industrial.	294028	680829	Benzene, NO_2.	N	Y (<5)	<10	Y
NA58	Callendar Rd, Falkirk.	Roadside.	289667	679724	NO_2.	N	Y (<2)	0.5	Y
NA59	Carron Rd, Bainsford.	Roadside.	288392	681931	NO_2.	N	Y (<2)	1.2	Y
NA60	Ronades Rd, Carron.	Roadside.	288133	681587	NO_2.	N	Y (<2)	1.6	Y
NA61	Canal Rd, Falkirk.	Roadside.	287976	680656	NO_2.	N	Y (<2)	1.5	Y
NA62	Arnot St, Falkirk.	Roadside.	289125	679705	NO_2.	Y (NO_2).	Y (<2)	1.2	Y
NA63	Camelon Rd, Falkirk.	Urban background.	288055	680134	NO_2.	On boundary NO_2.	Y (<5)	<10	N
NA64	New Hallglen Rd, Falkirk.	Roadside.	288807	678422	NO_2.	N	Y (<2)	1.7	Y
NA65	Redding Rd, Redding.	Roadside.	291356	678644	NO_2.	N	Y (<2)	0.6	Y

Table 2.2 Details of non-automatic monitoring sites (continued)

Site	Location	Site Type	OS Grid Ref (x, y)		Pollutants Monitored	In NO_2, benzene or 1,3 butadiene AQMA?	Relevant exposure? (m)	Distance to kerb (nearest road), m.	Worst-case Location?
NA67	Queen St, Falkirk.	Urban background.	289430	680433	NO_2.	N	Y (<5)	<10	N
NA68	Bellevue St, Falkirk.	Roadside.	289234	679945	NO_2.	Y (NO_2).	Y (<2)	1.7	Y
NA69	Kerse Lane, Falkirk.	Roadside.	289025	679991	NO_2.	Y (NO_2).	Y (<2)	2.3	Y
NA70	Park St AQ station, Falkirk.	Roadside.	288892	680070	NO_2.*	Y (NO_2).	Y (<2)	4.7	Y
NA71	Park St, Falkirk.	Roadside.	288910	680112	NO_2.	Y (NO_2).	Y (<2)	1.5	Y
NA72	Vicar St, Falkirk.	Roadside.	288824	680120	NO_2.	Y (NO_2).	Y (<2)	1.5	Y
NA73	West Bridge St RHS, Falkirk.	Roadside.	288467	680048	NO_2.	Y (NO_2).	Y (<2)	0.3	Y
NA76	Tyrst Road, Stenhousemuir.	Roadside.	286851	683229	NO_2.	N	Y (<2)	<2	Y
NA77	Kinnaird Village.	Roadside.	286490	683775	Benzene, NO_2.	N	Y (<2)	3.9	Y
NA78	Glen Brae, Falkirk.	Roadside.	288525	678991	NO_2.	N	Y (<2)	2.6	Y
NA80	Cow Wynd, Falkirk.	Roadside.	288765	679456	Benzene, NO_2.	N	Y (<2)	1.8	Y
NA81	Grahams Rd, Falkirk.	Roadside.	288834	680898	Benzene, NO_2.	N	Y (<2)	0.5	Y
NA82	Castings Ave, Falkirk.	Roadside.	288858	681036	NO_2.	N	Y (<2)	<2	Y
NA83	Main St, Bainsford.	Roadside.	288614	681415	NO_2.	N	Y (<2)	0.5	Y
NA85	Auchinloch Dr, Banknock.	Roadside.	278752	679049	NO_2.	Y (NO_2).	Y (<2)	<2	Y
NA86	Wolfe Rd, Falkirk.	Urban background.	289667	679871	NO_2.	N	Y (<2)	2	N
NA87	M80 slip south, Haggs.	Roadside.	279017	679305	NO_2.	Y (NO_2).	Y (<2)	1.6	Y

Table 2.2 Details of non-automatic monitoring sites (continued)

Site	Location	Site Type	OS Grid Ref (x, y)		Pollutants Monitored	In NO_2, benzene or 1,3 butadiene AQMA?	Relevant exposure? (m)	Distance to kerb (nearest road), m.	Worst-case Location?
NA88	Ure Crescent, Bonnybridge.	Roadside.	282444	681074	NO_2.	N	Y (<2)	1.7 (16 to M876)	Y
NA89	Grahams Rd/Meeks Rd, Falkirk.	Roadside.	288853	680328	NO_2.	N	Y (<2)	2.2	Y
NA90	Grahams Rd bridge east, Falkirk.	Roadside.	288855	680234	NO_2.	Y (NO_2).	Y (<2)	2.2	Y
NA94	A905 (Glensburgh Rd), Grangemouth.	Roadside.	291213	681927	Benzene, NO_2.	N	Y (7 m)	5.4	Y
NA98	Arnothill, Falkirk	Urban background.	288095	680105	NO_2.	N	Y (23 m)	1.6	N
NA99	St Crispins Place, Falkirk	Roadside.	288924	679675	NO_2.	Y (NO_2).	Y (7.6 m)	2.7	Y
NA100	Oswald St, Falkirk	Urban background.	288977	679662	NO_2.	N	Y (3.8 m)	1.5	N
NA101	Glensburgh Road (2), Grangemouth	Roadside.	291127	682007	NO_2.	N	Y (7 m)	0.9	Y
NA102	East Kerse Mains, Bo'ness	Urban background.	297968	680684	Benzene	N	N	23 m (main road)	N
NA103	Merchiston Gardens	Urban background.	288270	680989	NO_2.	N	Y (12.5 m)	1.6	N
NA104	Powdrake Road, Grangemouth	Urban background / industrial.	293788	682054	1,3 butadiene	N	Y (40 m)	1.8	Y
NA105	West of Shieldhill	Rural.	288292	676889	Benzene, NO_2.	N	N	1.7	N
NA106	Stirling Road, North Broomage	Roadside.	284975	683532	NO_2.	N	Y (4 m)	19	Y
NA107	Main Street (east), Bainsford	Roadside.	288640	681396	NO_2.	N	Y (4 m)	0.5	Y

2.2 Comparison of Monitoring Results with Air Quality Objectives

2.2.1 Nitrogen Dioxide

Automatic Monitoring Data

In 2013 Falkirk Council operated seven automatic sites monitoring nitrogen dioxide (NO_2). The sites, whether background or roadside, have all recorded a slight decrease in concentrations compared to 2012. The concentrations at the roadside sites decreased by 1.7 µg/m^3 to 34.2 µg/m^3 at Falkirk Haggs (A4) and at Falkirk West Bridge St (A7) site by 4.2 µg/m^3 to 39.2 µg/m^3. Therefore all NO_2 automatic monitoring stations met the annual NO_2 objective in 2013.

In 2013 no exceedances of the hourly NO_2 limit value were recorded therefore there were no breaches of the hourly NO_2 objective. This is consistent with previous years.

Table 2.3a Results of NO_2 automatic monitoring: comparison with annual mean objective.

Site	Location	Within NO_2 AQMA?	Data Capture 2013, %	Annual Mean Concentration µg/m^3			
				2010	2011	2012	2013
A4	Falkirk Haggs	Y	86.7	**42.5**	34.4	35.9	34.2 *
A5	Falkirk Hope St	Y	98.4	27.7	24.1	25.1	23
A6	Falkirk Park St	Y	99.8	32.9	28.5	33.2	30.4
A7	Falkirk West Bridge St	Y	91.4	**43.8**	35.9 * #	**43.4***	39.2
A8	Grangemouth AURN	N	98.3	19.3 *	15.1	16.2	14.5
A9	Grangemouth Moray	N	99.6	23.3	17.3	19.6	16.6
A10	Grangemouth MC	N	99	26	21.6	24.1	20.2

Table 2.3b Results of NO_2 automatic monitoring: comparison with 1-hour mean objective.

Site	Location	Within NO_2 AQMA?	Data Capture 2013, %	Number of Exceedances of Hourly Mean (200 µg/m^3), (99.8th percentile in brackets).			
				2010	2011	2012	2013
A4	Falkirk Haggs	Y	86.7	1 (164)	0 (142)	0 (141)	0 (138)
A5	Falkirk Hope St	Y	98.4	0 (109)	0 (111)	0 (133)	0 (94)
A6	Falkirk Park St	Y	99.8	0 (107)	0 (97)	0 (107)	0 (98)
A7	Falkirk West Bridge St	Y	91.4	0 (126)	0 (113) *	0 (124) *	0 (120)
A8	Grangemouth AURN	N	98.3	0 (124) *	0 (78)	0 (92)	0 (80)
A9	Grangemouth Moray	N	99.6	0 (134)	0 (84)	0 (86)	0 (78)
A10	Grangemouth MC	N	99	0 (136)	0 (86)	0 (103)	0 (83)

Notes for Table 2.3 a and b:

- * Less than 90% data capture.
- # Annual concentration result has been annualised. Falkirk Haggs (A4) has not been annualised in 2013 because with the exception of two weeks in April most of the missing data was spread across the year.

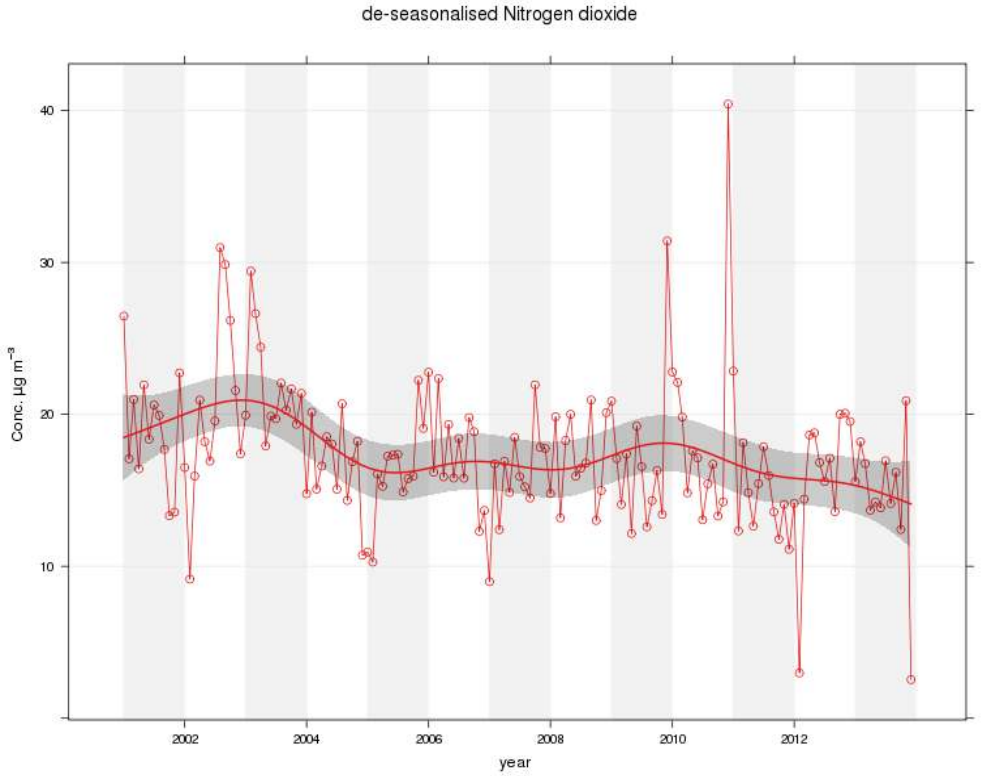
The technical guidance requires concentrations to be reported across a calendar year. However, additional analysis of the data can provide other useful information. Figure 2.3 shows the Openair 'smooth trend' plots for the Grangemouth AURN, Falkirk Haggs and Falkirk West Bridge St sites. All trends are de-seasonalised unless stated.

Figure 2.3 (ai and aii) show that there is a slight long-term decrease in NO_2 concentrations at the background Grangemouth AURN (A8) site between 2001 and 2013. The graphs show this regardless of whether the results are de-seasonalised or not. The overall trends of the highest and lowest concentrations both show a downward trend. The elevated concentrations of 2010 stand out against this trend. The Haggs (A4) site shows (Figure 2.3b) a notable decrease between 2010 and 2011. This is reflected in the annual concentrations. With the exception of the final three months of 2013 there is no overall trend between 2009 and 2013.

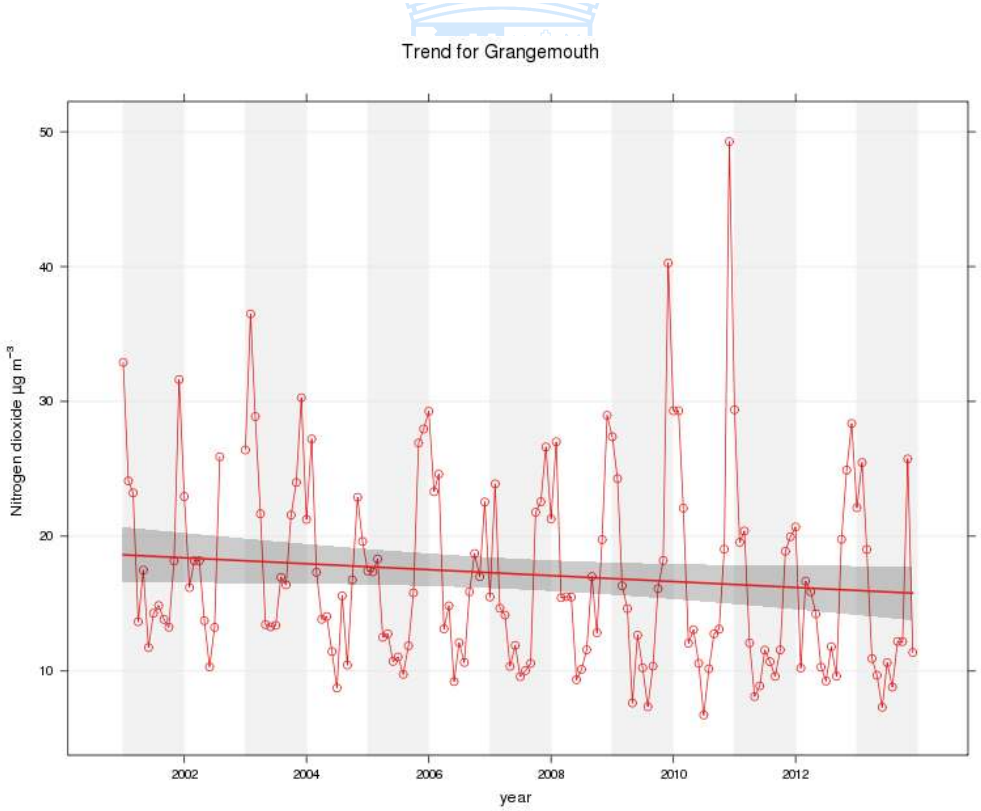
There is overall a slight long-term increase in NO_2 concentrations at the Falkirk West Bridge St site between 2009 and 2013 (Figure 2.3c), although less distinct than at the background AURN site. It is interesting to note that the variation on Wednesdays and Thursdays is much greater across the years. In contrast the other days of the week tend to follow the overall annual trend (Figure 2.3d).

Figure 2.3 A smooth trend plot of NO_2 concentrations of:
ai.) Grangemouth AURN (2001 to 2013),
aii.) Grangemouth AURN (not deseasonalised, 2001 to 2013),
b.) Falkirk Haggs (2009 to 2013), c.) Falkirk West Bridge St (2009 to 2013) and d.) Falkirk West Bridge St weekday variation (2009 to 2013).

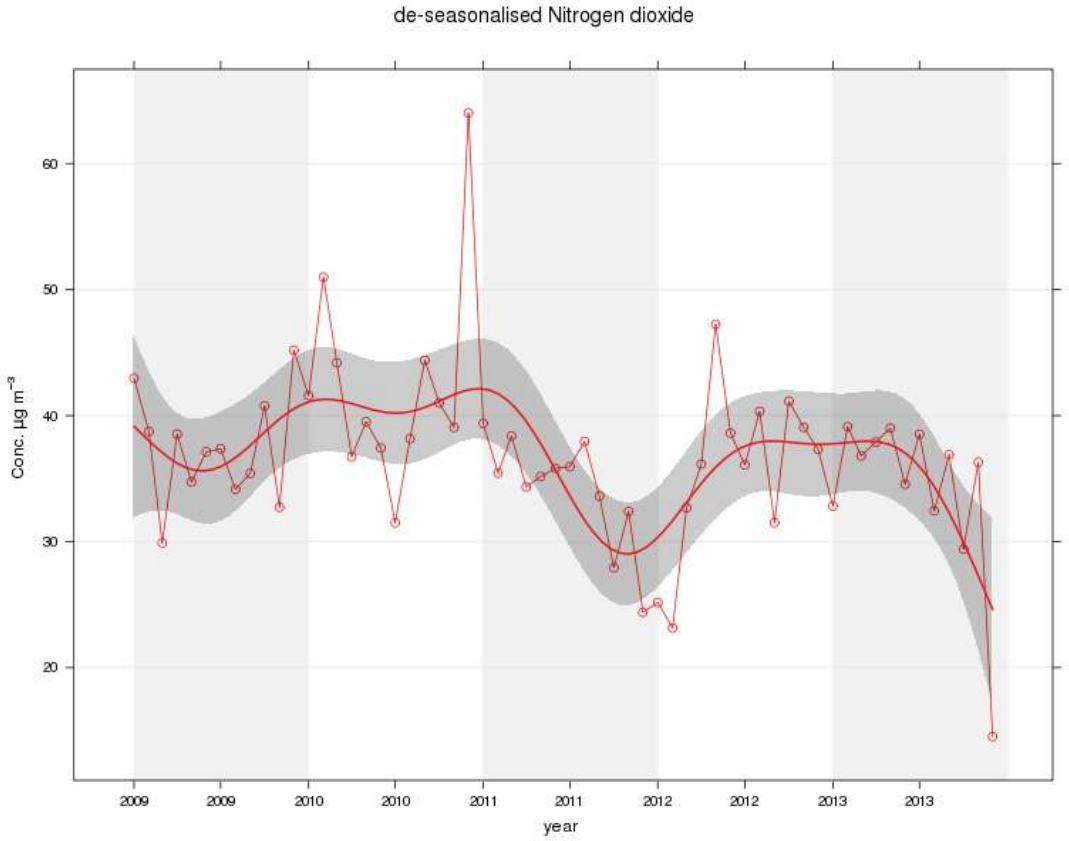
ai.)


de-seasonalised Nitrogen dioxide
Conc. µg m⁻³
40
30
20
10
2002
2004
2006
2008
2010
2012
year

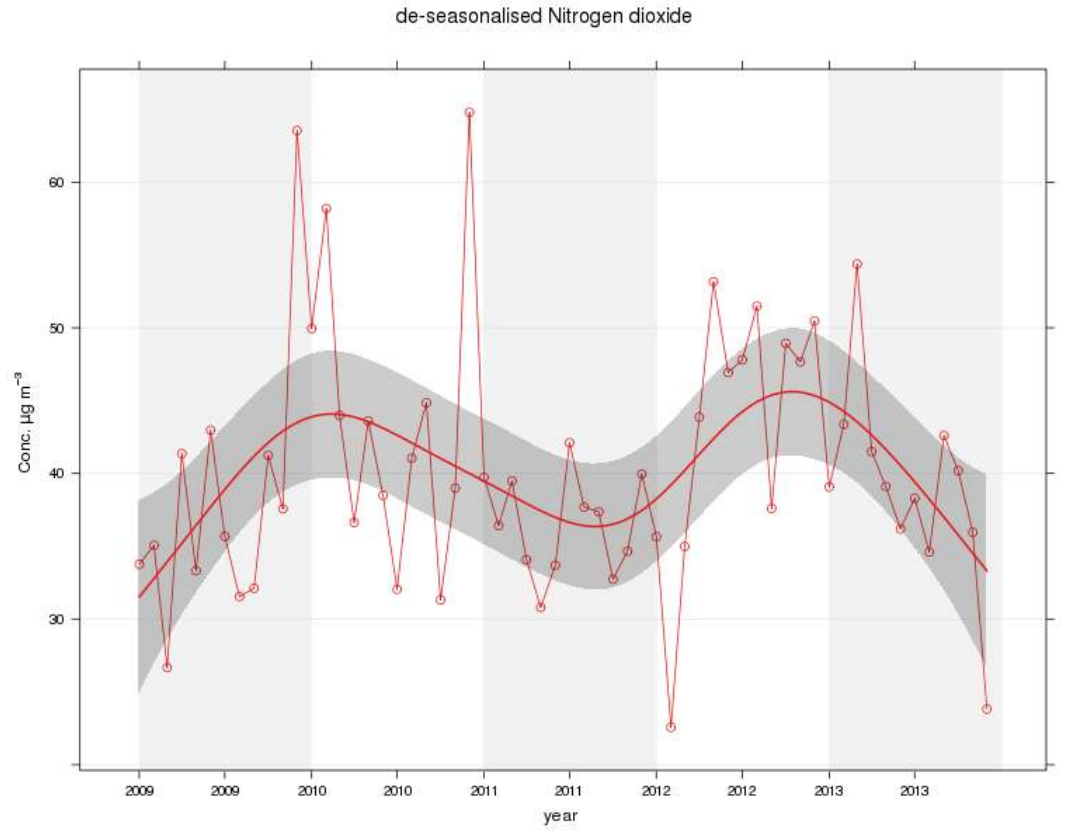
a.ii)


Trend for Grangemouth
Nitrogen dioxide µg m⁻³
50
40
30
20
10
2002
2004
2006
2008
2010
2012
year

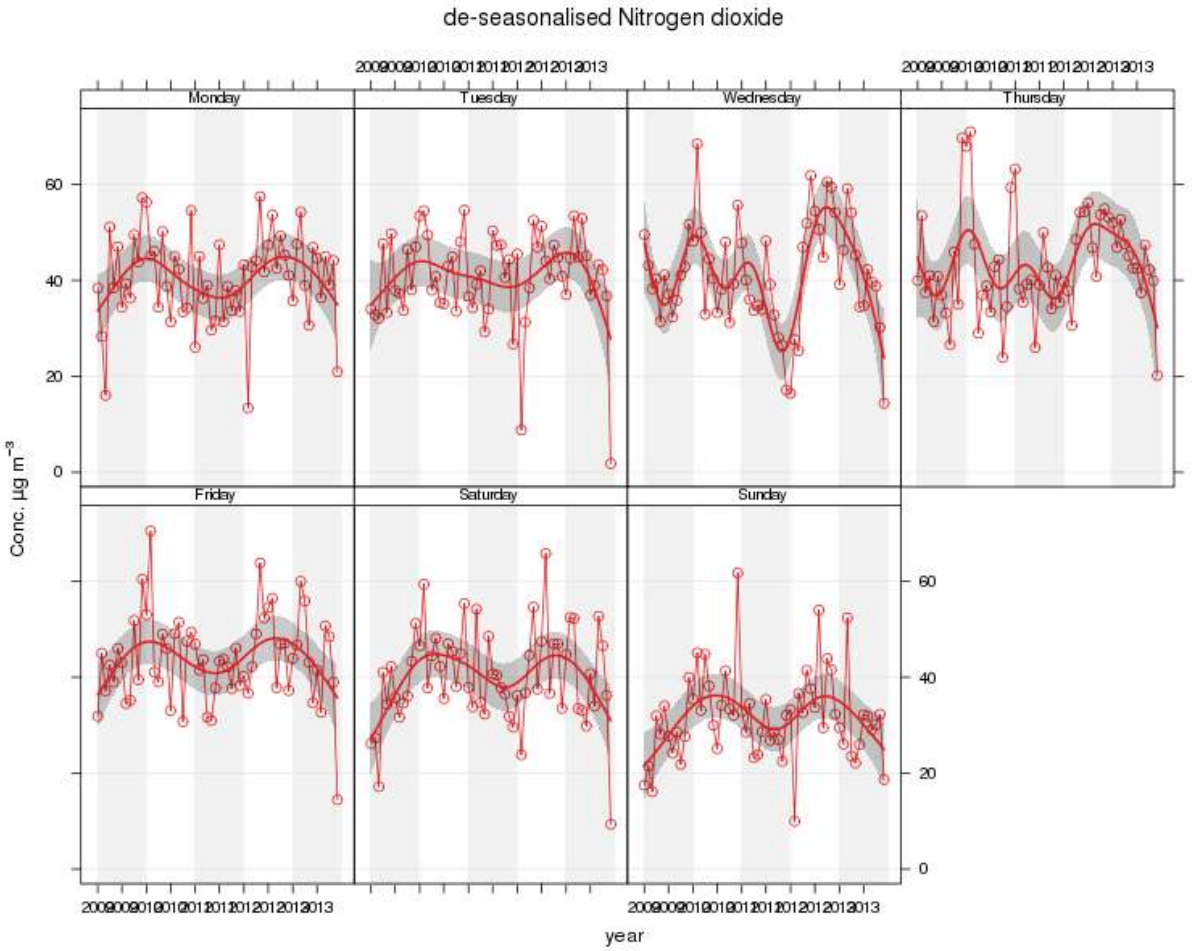
b.)


de-seasonalised Nitrogen dioxide
Conc. µg m⁻³
60
50
40
30
20
2009
2009
2010
2010
2011
2011
2012
2012
2013
2013
year

c.)


de-seasonalised Nitrogen dioxide
Conc. µg m⁻³
60
50
40
30
2009
2009
2010
2010
2011
2011
2012
2012
2013
2013
year

d.)



Diffusion Tube Monitoring Data

Table 2.5 shows the annual concentrations for Falkirk Council's NO_2 diffusion tubes and the results between 2010 and 2013. The results in Table 2.5 have not been distance corrected. This is conducted where required.

The following diffusion tubes recorded a concentration greater than the annual NO_2 objective of 40 µg/m^3 in 2013 with the application of the R&A bias factor:

- NA27 West Bridge St, Falkirk: This site is in the Falkirk Town Centre AQMA. It is located near to the Falkirk West Bridge St site (A7) but is closer to the kerb than the automatic site.
- NA24 Kerse Lane, Falkirk: This site is in the Falkirk Town Centre AQMA. The increase compared to previous years should be considered in the context of the move closer to the road described in Section 2.1.
- NA36 Kerr Crescent, Haggs (above 40 µg/m^3 when result considered to one decimal place): This site is in the Haggs AQMA.

The following diffusion tubes recorded a concentration close to the objective (36 to 40 µg/m^3) in 2013:

- NA19 Kilsyth Road, Banknock: This site is in the Haggs AQMA.

- NA62 Arnot St, Falkirk: This site is in the Falkirk Town Centre AQMA.
- NA63 Camelon Road, Falkirk: This site is on the boundary of the Falkirk Town Centre AQMA.
- NA83 Main St, Bainsford: This location is discussed later in this section.
- NA87 M80 slip road south, Haggs: This site is in the Haggs AQMA.
- NA94, Glensburgh Road, Grangemouth: This site has been discussed in previous R&A reports.

The following tubes recorded concentrations below 40 µg/m^3 in 2013 with the R&A factor (0.80) applied, but equalled or were above 40 µg/m^3 with the local Falkirk Park St (0.87) factor applied.

- NA19 Kilsyth Road, Banknock: This site is in the Haggs AQMA.
- NA62 Arnot Street, Falkirk: This site is in the Falkirk Town Centre AQMA.
- NA63 Camelon Road, Falkirk: This site is on the boundary of the Falkirk Town Centre AQMA.
- NA69 Kerse Lane, Falkirk: This site is in the Falkirk Town Centre AQMA.
- NA83 Main Street, Bainsford: This site has been discussed in previous reports. The recently elevated concentrations along this stretch of road, particularly on the west side, were initially thought to be related to traffic light replacement works. However, the elevated levels have continued with a concentration of 40.3 µg/m^3 using the local factor. With the continued elevated concentrations it is proposed that a Detailed Assessment will be conducted along this street and surrounding area for NO_2 and PM_{10}. Falkirk Council's experience in Falkirk Town Centre and Haggs suggests that in situations where the NO_2 annual objective is at risk of being breached due to road traffic, the risk of the annual Scottish PM_{10} objective also being breached is high. Therefore initially an AQMesh (compact automatic NO_x analyser) will be installed and a site for a full automatic monitoring station sought.

In terms of the monitoring results and the NO_2 AQMAs:

- Falkirk Town Centre: The automatic monitoring sites met the NO_2 objectives in 2013. The AQMA remains justified based on NO_2 diffusion tube monitoring results and that long-term automatic monitoring must demonstrate longer than one year's compliance. The Openair plots show that there is a large variance from year to year and this is important with concentrations generally close to 40 µg/m^3 at Falkirk West Bridge St. Therefore monitoring shall continue to see if the concentrations remain below the objective. Overall, the indications are that concentrations are gradually decreasing.
- Haggs: It is clear that NO_2 concentrations have decreased since 2010. There are two future developments, a quarry and houses nearby to the motorway junction, which may affect future concentrations. One diffusion tube (NA36) does remain marginally above the objective. With this and the Haggs PM_{10} results in mind (Section 2.2.2) it is proposed that the NO_2 element is retained at this time. However, this is the worst case location on the exit of the mini-roundabout.

Table 2.4 Results of nitrogen dioxide diffusion tubes in 2013.

Site	Location	Within NO_2 AQMA?	Data Capture for Monitoring Period, %	Data Capture 2013, %	Annual mean concentrations, µg/m^3			
					2010 (0.85)	2011 (0.84)	2012 (0.79)	2013 (0.80)
NA3	Tinto Drive, Grangemouth.	N	n/a	100	23	21	21	21
NA5	Copper Top pub, Camelon.	N	n/a	100	29	31	31	28
NA7	Irving Parish Church, Camelon.	N	n/a	83	24	21	19	19
NA9	Bellsdyke Rd, Larbert.	N	n/a	100	30	28	25	26
NA19	Kilsyth Rd, Banknock.	Y	n/a	75	34	33 *	36	36
NA20	Garngrew Rd, Haggs.	N	n/a	92	30	25	27	24
NA21	Grangemouth Rd, College.	N	n/a	100	35	33	30	28
NA24	Kerse Lane, Falkirk.	Y	n/a	75	37	40	37	**42**
NA26	Weir St, Falkirk.	Y	n/a	100	26	22	22	21
NA27	West Bridge St, Falkirk.	Y	n/a	92	**48**	**51**	**61**	**53**
NA29	Wellside Place, Falkirk.	N	n/a	100	25	21	20	18
NA36	Kerr Crescent, Haggs.	Y	n/a	83	**45**	**47**	**42**	**40**
NA37	Denny Town House.	N	n/a	100	21	20	20	19
NA38	Larbert Village Primary School.	N	n/a	100	27	21	20	19
NA41	Seaview Place, Bo'ness.	N	n/a	100	30	25	24	22
NA42	Municipal Chambers, Grangemouth.	N	n/a	100	24	22	21	20
NA44	Greenpark Drive, Polmont.	N	n/a	83	24	17 *	17	16

Table 2.4 Results of nitrogen dioxide diffusion tubes (continued)

Site	Location	Within NO_2 AQMA?	Data Capture for Monitoring Period, %	Data Capture 2013, %	Annual mean concentrations, µg/m^3			
					2010 (0.85)	2011 (0.84)	2012 (0.79)	2013 (0.80)
NA47	Thistle Avenue, Grangemouth.	N	n/a	92	29	25	25	24
NA48	Hayfield, Falkirk.	N	n/a	100	26	22	21	21
NA50	Upper Newmarket St, Falkirk.	Y	n/a	92	29	26	30	30
NA51	Mary St, Laurieston.	N	n/a	100	32	30	27	24
NA52	Main St, Larbert.	N	n/a	100	32	30	28	26
NA53	Denny Cross.	N	n/a	100	39	33	34	33
NA57	Inchyra Road, Grangemouth.	N	n/a	100	29	28	27	26
NA58	Callendar Rd, Falkirk.	N	n/a	100	25	23	23	22
NA59	Carron Rd, Bainsford.	N	n/a	100	30	32	31	28
NA60	Ronades Rd, Carron.	N	n/a	92	30	31	29	29
NA61	Canal Rd, Falkirk.	N	n/a	100	31	30	25	26
NA62	Arnot St, Falkirk.	Y	n/a	100	**46**	**43**	39	36
NA63	Camelon Rd, Falkirk.	On boundary NO_2.	n/a	100	39	**42**	**41**	38
NA64	New Hallglen Rd, Falkirk.	N	n/a	100	24	20	20	20
NA65	Redding Rd, Redding.	N	n/a	75	28	24	25	24
NA67	Queen St, Falkirk.	N	n/a	92	36	33	31	31
NA68	Bellevue St, Falkirk.	Y	n/a	100	32	36	35	31
NA69	Kerse Lane, Falkirk.	Y	n/a	83	34	35	38	33
NA70	Park St AQ station, Falkirk.	Y	n/a	100	32	32	30	28

Table 2.4 Results of nitrogen dioxide diffusion tubes (continued)

Site	Location	Within NO_2 AQMA?	Data Capture for Monitoring Period, %	Data Capture 2013, %	Annual mean concentrations, µg/m^3			
					2010 (0.85)	2011 (0.84)	2012 (0.79)	2013 (0.80)
NA71	Park St, Falkirk.	Y	n/a	100	36	**41**	38	35
NA72	Vicar St, Falkirk.	Y	n/a	100	39	34	33	33
NA73	West Bridge St RHS, Falkirk.	Y	n/a	100	40	37	34	35
NA76	Tyrst Road, Stenhousemuir.	N	n/a	92	28	24	24	20
NA77	Kinnaird Village.	N	n/a	92	32	31	25	24
NA78	Glen Brae, Falkirk.	N	n/a	100	39	32	31	30
NA80	Cow Wynd, Falkirk.	N	n/a	100	36	33	31	29
NA81	Grahams Rd, Falkirk.	N	n/a	67	36	34	32	32
NA82	Castings Ave, Falkirk.	N	n/a	100	27	23	22	20
NA83	Main St, Bainsford.	N	n/a	92	37	**44**	**41**	37
NA85	Auchinloch Dr, Banknock.	Y	n/a	100	33	25	25	23
NA86	Wolfe Rd, Falkirk.	N	n/a	100	23	18	19	19
NA87	M80 slip south, Haggs.	Y	n/a	100	36	36	33	32
NA88	Ure Crescent, Bonnybridge.	N	n/a	100	35	36	33	30
NA89	Grahams Rd/Meeks Rd, Falkirk.	N	n/a	100	32	37	34	34
NA90	Grahams Rd bridge east, Falkirk.	Y	100	17	39	37	34	30 *
NA94	A905 (Glensburgh Rd), Grangemouth.	N	n/a	100	**41**	37 *	38	36

Table 2.4 Results of nitrogen dioxide diffusion tubes (continued)

Site	Location	Within NO_2 AQMA?	Data Capture for Monitoring Period, %	Data Capture 2013, %	Annual mean concentrations, µg/m^3			
					2010 (0.85)	2011 (0.84)	2012 (0.79)	2013 (0.80)
NA98	Arnothill, Falkirk	N	n/a	100	n/m	26 *	26	25
NA99	St Crispins Place, Falkirk	Y	n/a	100	n/m	34 *	29	26
NA100	Oswald St, Falkirk	N	n/a	100	n/m	22 *	22	21
NA101	Glensburgh Road (2), Grangemouth	N	n/a	92	n/m	28 *	26	24
NA103	Merchiston Gardens	N	n/a	100	n/m	22 *	21	19
NA105	West of Shieldhill	N	n/a	100	n/m	11 *	10	10
NA106	Stirling Road, North Broomage	N	n/a	100	n/m	n/m	19 *	17
NA107	Main Street (east), Bainsford	N	n/a	75	n/m	n/m	n/m	31

- * = Result annualised, details in Appendix.
- The value in brackets is the bias adjustment result applied for each calendar year.

Figure 2.4 A map of the NO_2 diffusion tubes in the Falkirk Town Centre AQMA.
(Colours denote NO_2 concentrations: dark green up to 24 µg/m^3, light green 24 to 36 µg/m^3, orange 36 to 40 µg/m^3 and red > 40 µg/m^3).

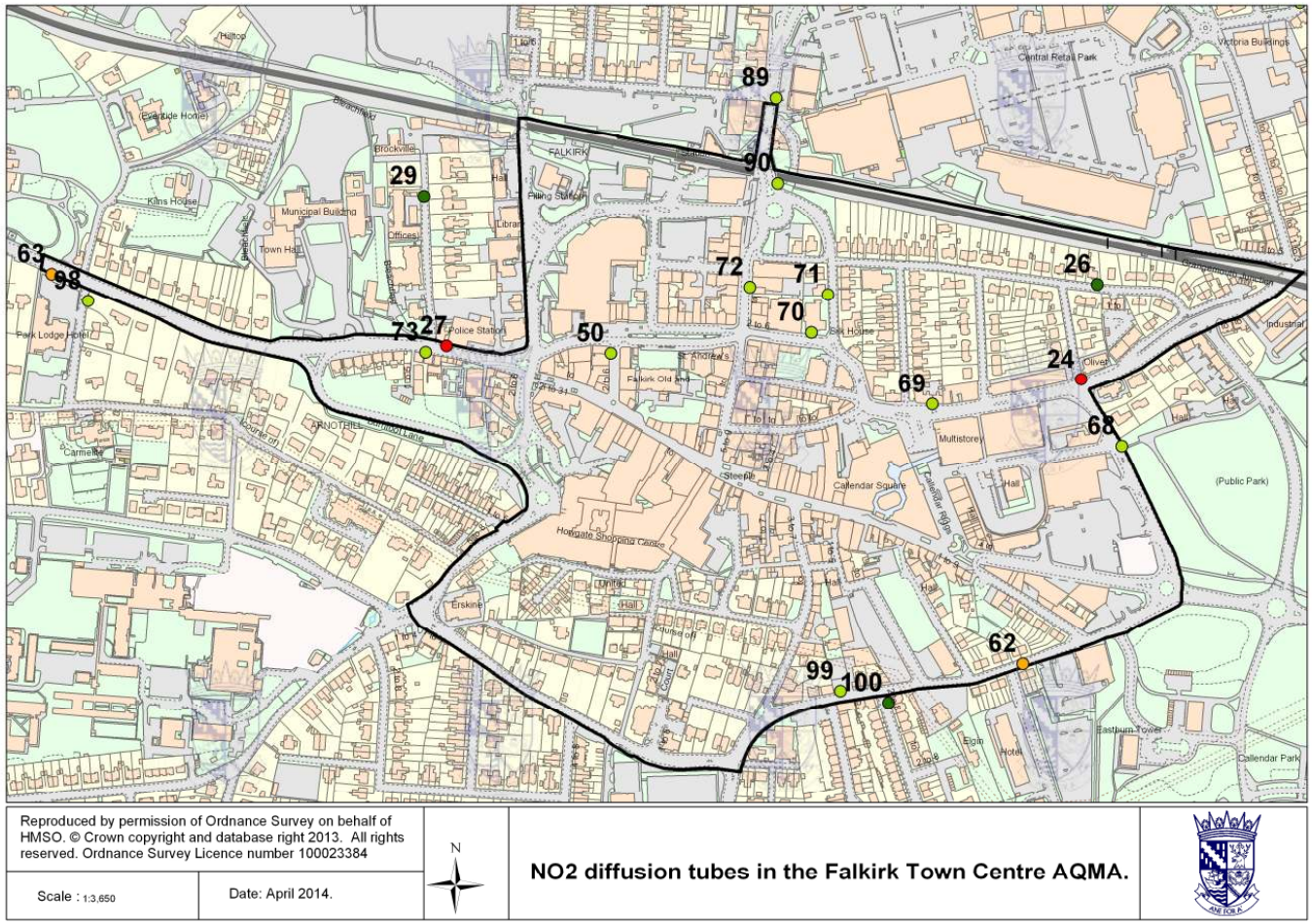
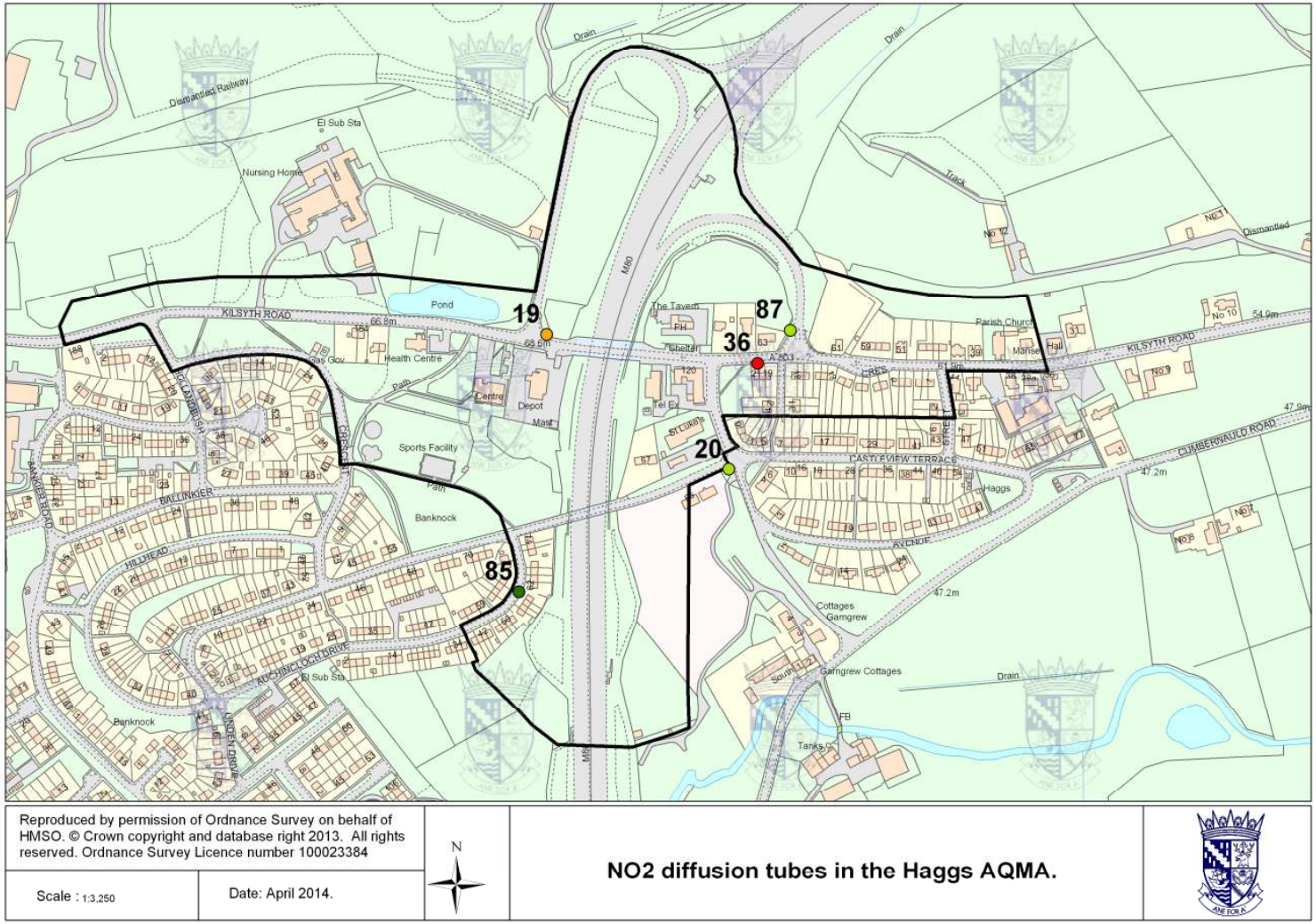


Figure 2.5 A map of the NO_2 diffusion tubes in the Haggs AQMA.
(Colours denote NO_2 concentrations: dark green up to 24 µg/m^3, light green 24 to 36 µg/m^3, orange 36 to 40 µg/m^3 and red > 40 µg/m^3).



2.2.2 PM_{10}

In 2013 Falkirk Council monitored PM_{10} at eight locations, of these analysers one is an FDMS, one an Osiris and six are TEOMs. The correction of TEOM data has been carried out using the Volatile Correction Model (VCM). This means that the data is considered to be equivalent to the EU reference method. The annual mean concentrations recorded at the sites are shown in Table 2.5a and the number of daily exceedances (and 98th percentile concentrations) are shown in Table 2.5b.

The data from the Osiris at the Banknock 3 (A14) site is shown in Table 2.5 with a 1.14 correction factor applied. The period data capture at the site was below 90% and given its installation date the annual data capture was below 90%. The purchase of a new modem has helped to reduce data loss in 2014. The results have, in 2013, been annualised to take account of the low data capture. If 90% data capture is not achieved in the future the result may not be annualised due to the potential influence of new local sources. The Banknock 2 (A2) and Banknock 3 (A14) annualised results indicate that the Scottish and UK objectives were met at both sites in the Banknock AQMA in 2013.

The first full year of data from the Haggs (A4) site indicates that the Scottish annual PM_{10} objective recorded a marginal breach (18.3 µg/m^3) at this site. The site recorded four daily exceedances. This is within the number permitted by the daily objective, although the 98th percentile was close to the objective concentration at 46 µg/m^3. It is therefore proposed that the Haggs AQMA is amended to include the Scottish PM_{10} annual and daily objectives.

The Falkirk West Bridge St (A7) site breached the Scottish annual objective with a concentration of 19.5 µg/m^3 in 2013. This is an increase compared to 2011 and 2012, although remains below the concentrations recorded in 2009 and 2010. The site recorded four daily exceedances. This is within the number permitted by the daily objective but at 49 µg/m^3 the 98th percentile remained close to the objective concentration.

The Falkirk West Bridge St (A7) site is in the Falkirk Town Centre AQMA. This AQMA was amended in January 2013 to include the Scottish PM_{10} objectives as a result of the monitoring results at Falkirk West Bridge St (A7).

All other sites met the Scottish PM_{10} objectives in 2013. The UK / EU objectives (annual mean of 40 µg/m^3 and 35 daily exceedances permitted) were met at all monitoring sites in 2013.

Table 2.5a Results of PM_{10} automatic monitoring: comparison with annual mean objective 2013.

Site	Site Type	Within PM_{10} AQMA?	Data Capture for Monitoring Period, %	Data Capture 2013, %	Reference Equivalent ?	Annual mean concentration, µg/m^3			
						2010	2011	2012	2013
A4: Falkirk Haggs	Roadside	N	n/a	95.6	Y, VCM	n/m	n/m	15.9* #	**18.3**
A6. Falkirk Park St	Roadside.	Y	n/a	96.8	Y, VCM	17	15.6	14.6	15.2
A7. Falkirk West Bridge St	Roadside.	Y	n/a	96.7	Y, VCM	**21 ***	**18.7 * #**	17.8	**19.5**
A8. Grangemouth AURN	Urban background / industrial.	N	n/a	84.5	Y, FDMS	14.4	14.1	14.1	14 * #
A10.Grangemouth Municipal Chambers	Urban background / industrial.	N	n/a	86.2	Y, VCM	15	15.1 * #	14.7 * #	15 * #
A12. Falkirk Grahams Rd	Roadside	Y	n/a	95.1	Y, VCM	n/m	n/m	16	16.3
A13. Banknock 2	Roadside	Y	n/a	95.5	Y, VCM	n/m	n/m	12.7 * #	14.6
A14. Banknock 3	Urban background	Y	71.2	31.6	N, 1.14 Osiris	n/m	n/m	n/m	12.3 * #

Table 2.5b Results of PM_{10} automatic monitoring: comparison with 24-hour mean objective 2013.

Site	Site Type	Within PM_{10} AQMA?	Data Capture for Monitoring Period %	Data Capture 2013, %	Reference Equivalent?	Number of Daily Exceedances of 50 µg/m^3 (98th percentiles)			
						2010	2011	2012	2013
A4: Falkirk Haggs	Roadside	N	n/a	95.6	Y, VCM	n/m	n/m	0 (45) *	4 (46)
A6. Falkirk Park St	Roadside.	Y	n/a	96.8	Y, VCM	1 (31)	2 (38)	2 (38)	1 (34)
A7. Falkirk West Bridge St	Roadside.	Y	n/a	96.7	Y, VCM	7 (47) *	5 (49) *	6 (46)	4 (49)
A8. Grangemouth AURN	Urban background / industrial.	N	n/a	84.5	Y, FDMS	1 (38)	2 (38)	2 (37)	0 (34) *
A10.Grangemouth Municipal Chambers	Urban background / industrial.	N	n/a	86.2	Y, VCM	0 (29)	0 (40)	2 (41) *	0 (32)*
A12. Falkirk Grahams Rd	Roadside	Y	n/a	95.1	Y, VCM	n/m	n/m	4 (44)	3 (38)
A13. Banknock 2	Roadside	Y	n/a	95.5	Y, VCM	n/m	n/m	0 (18) *	0 (33)
A14. Banknock 3	Urban background	Y	71.2	31.6	N, 1.14 Osiris	n/m	n/m	n/m	0 (22) *

Notes for Table 2.5 a and b:

- All TEOM results are VCM corrected.
- * Less than 90% data capture.
- # Annual concentration results have been annualised.
- Unadjusted results (Table 2.5a) are: Grangemouth AURN: 13.9 µg/m^3, Grangemouth MC: 15.2 µg/m^3, Banknock 3: 11.3 µg/m^3.

In terms of the monitoring results and the PM_{10} AQMAs:

- Banknock: The Banknock 2 and 3 monitoring sites met the PM_{10} objectives. However, with a new quarry granted planning permission this AQMA will remain in place. This will be the case until it is demonstrated that the objectives are being met with the new quarry operating.
- Falkirk Town Centre: The AQMA remains justified with a breach of the annual objective and the 98th percentile concentrations remaining close to the daily limit value at Falkirk West Bridge St (A7).
- Haggs: It is proposed that this AQMA is amended. This should include the PM_{10} annual objective and with a 98th percentile concentration of 46 µg/m^3 the daily objective should be included as a precaution.

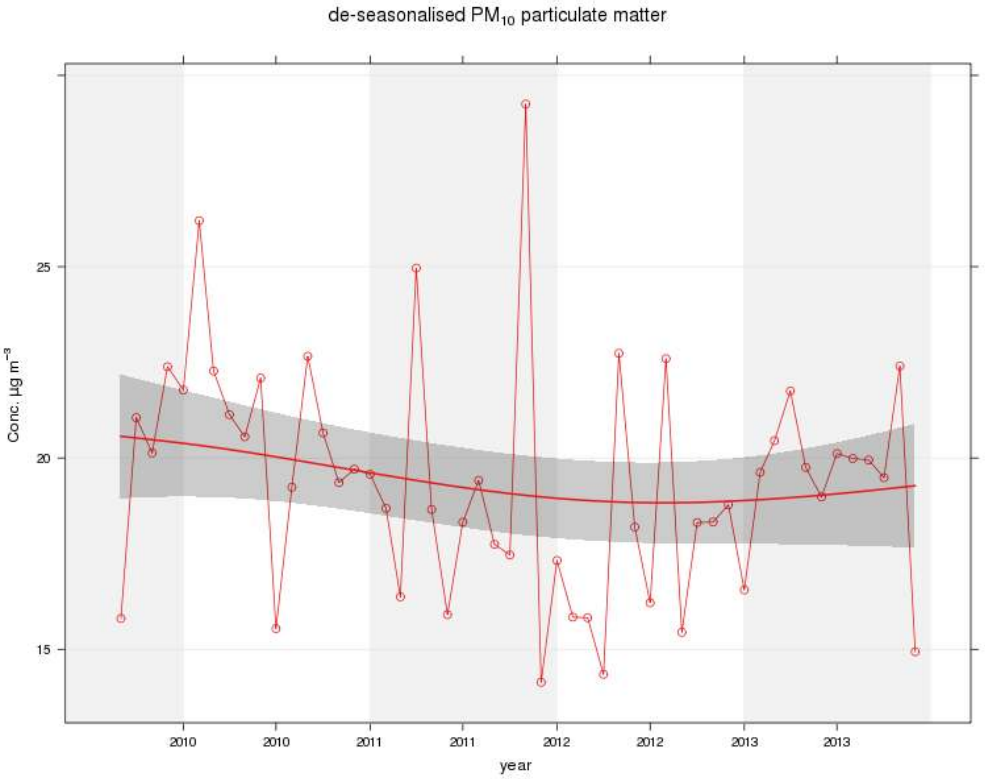
The technical guidance requires pollutants concentrations to be reported using calendar year comparisons. However, additional analysis of the data can provide a greater insight into the monitoring data. The annual concentrations shown in Table 2.5a demonstrate that PM_{10} concentrations at the Falkirk West Bridge St (A7) have decreased since monitoring commenced in September 2009. This long-term decline is confirmed by the Openair 'smooth trend' plot (all long-term plots are deseasonalised) in Figure 2.6a which shows the trend of PM_{10} concentrations at the Falkirk West Bridge St site. The decrease is less noticeable through to the end of 2013 compared to the decrease to the end of 2012 reported in the 2013 Progress Report. Table 2.5b shows that the number of daily exceedances remains close to the objective.

A long-term decline is also noticeable at the background Grangemouth AURN site, Figures 2.6b and 2.7. This may be partly due to the change from using the TEOM analyser to using a FDMS-TEOM. The SAQN database tool that was used to create Figures 2.6b only applies a 1.3 correction factor prior to 2009. There is still a slight decrease in concentrations when the 1.14 factor is applied. The rate of decrease has stalled since 2011 with concentrations remaining fairly constant at 14 µg/m^3.

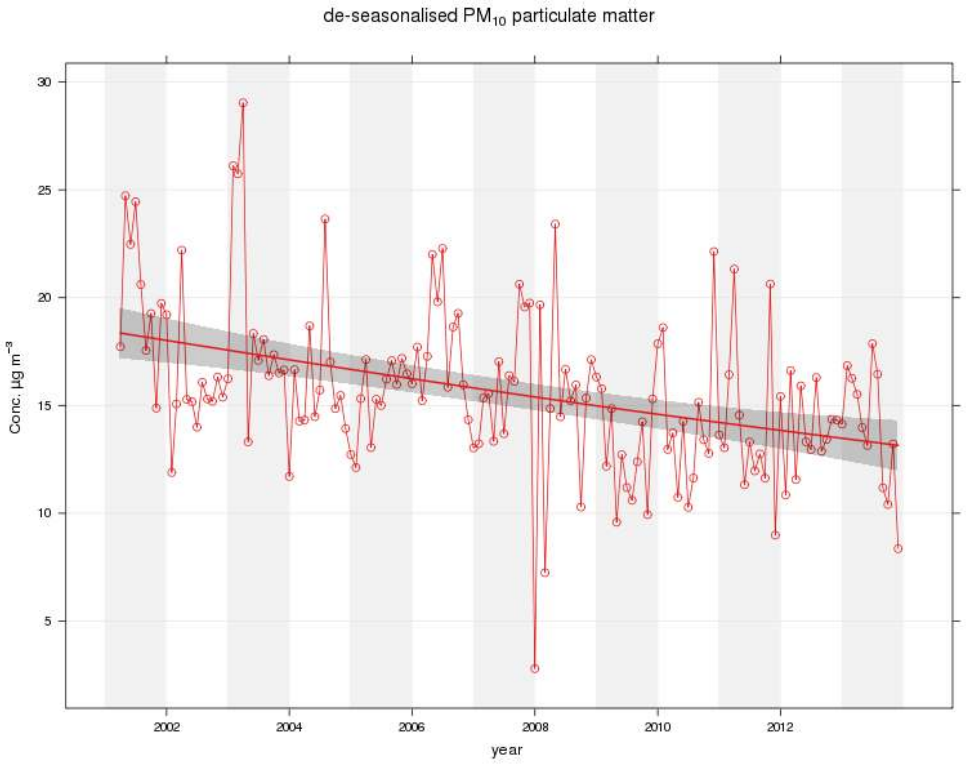
In terms of overall concentrations 2013 has generally recorded lower concentrations of NO_2 but slightly higher PM_{10} concentrations. However, this masks large differences in concentrations across the year. Figure 2.6c is a plot of monthly PM_{10} concentrations at Falkirk West Bridge St (A7). This shows that monthly concentrations were greater than 30 µg/m^3 in March yet decreased to around 15 µg/m^3 in the summer months and in late 2013. The dry and cold weather in the early months of the year is likely to have led to an increased level of re-suspended dust and grit from the roads, whilst the wet and windy autumn / winter will have aided dispersal and reduced ambient concentrations. The wet weather will affect NO_2 concentrations to a smaller extent but the overall lack of cold and still weather conditions at the end of 2013 will have partly contributed to lower concentrations.

Figure 2.6 A smooth trend plot of PM_{10} concentrations measured at a.) Falkirk West Bridge St (2009 to 2013) , b.) Grangemouth AURN (2001 to 2013) and c.) Falkirk West Bridge St (not deseasonalised, 2009 to 2013).

a.)



b.)



c.)

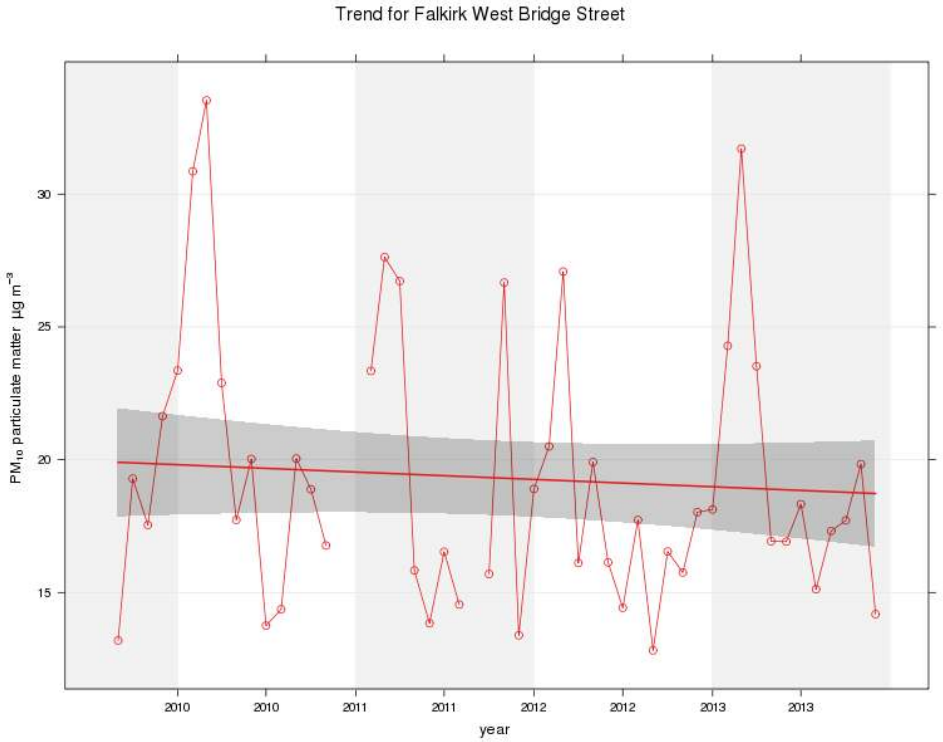


Figure 2.7 Trends in annual mean PM_{10} Concentrations at Grangemouth AURN, with both 1.3 and 1.14 correction factors applied prior to 2009.

2.2.3 Sulphur Dioxide

In 2013 Falkirk Council monitored SO_2 at six locations. Three of the locations are located in the Grangemouth (15-minute) AQMA and three sites are positioned outside of the AQMA.

Table 2.6 shows the number of SO_2 exceedances and percentile concentrations in 2013 at the six monitoring stations. All six sites recorded data capture in excess of 95%. The three sites in the Grangemouth AQMA recorded the greatest number of 15-minute exceedances with the Grangemouth Moray (A9) site recording 25 exceedances of the 15-minute objective concentration, the Grangemouth AURN (A8) site six exceedances and the Grangemouth MC (A10) site recorded zero exceedances. Thus in contrast to previous years, and particularly 2012, all six monitoring sites met all three SO_2 objectives in 2013.

This is the first time since 2006 that no breaches of the 15-minute objective have been recorded at any site in the Grangemouth AQMA. It is important to stress that although there were there were still exceedances of the air quality standard (266 µg/m^3) the number was below the maximum permitted (35) by the objective. In-line with previous years the hourly and daily objectives were met at all monitoring sites. This change in the number of SO_2 exceedances is discussed in detail in Section 5.

Table 2.6 Results of SO_2 automatic monitoring in 2013: comparison with objectives.

Site	Location	Within SO_2 AQMA?	Annual Data Capture 2013, %.	Number of exceedances and (appropriate percentiles, μg/m^3).		
				15-minute objective	1-hour objective	24-hour objective
A3	Bo'ness	N	96.5	0 (64)	0 (44)	0 (16)
A5	Falkirk Hope St	N	98.4	0 (87)	0 (51)	0 (16)
A6	Falkirk Park St	N	99.7	2 (80)	0 (48)	0 (16)
A8	Grangemouth AURN	Y (15-min)	98.5	6 (177)	0 (119)	0 (46)
A9	Grangemouth Moray	Y (15-min)	97.7	25 (245)	0 (181)	1 (94)
A10	Grangemouth Municipal Chambers	Y (15-min)	98.5	0 (181)	0 (144)	2 (97)

2.2.4 Benzene

In 2013 Falkirk Council monitored benzene at 16 locations using passive diffusion tubes and at one location with a pumped diffusion tube. The results from the pumped diffusion tube are shown in Table 2.7 with the results from the passive diffusion tubes shown in Table 2.8. A pumped diffusion tube is generally considered to be a more accurate method of measuring benzene than a passive diffusion tube. This is because a known amount of air is sampled and the tubes are exposed on a fortnightly basis rather than monthly.

The annual mean recorded by the pumped diffusion tube at the Grangemouth AURN (A8) site was 1.13 µg/m^3. This is a decrease compared to the 2012 result which was influenced by the incident at the Petroineos refinery storage tank 453 in July 2012. This event was discussed in the 2013 Progress Report.

No benzene diffusion tubes recorded a breach of the objective in 2013.

The results from the community monitoring programme conducted by INEOS have been reviewed. Their monitoring network consists of eight sites in the Falkirk Council area. No locations recorded a breach of the benzene objective in 2013.

Table 2.7 Results of pumped benzene diffusion tube (Grangemouth AURN).

Site	Location	Data capture, 2013, %.	Annual mean concentration, µg/m^3				
			2009	2010	2011	2012	2013
A8	Grangemouth AURN	100	1.27	1.42	1.26	1.97	1.13

Table 2.8 Results of benzene diffusion tubes, 2013.

Site	Location	Within benzene AQMA?	Data capture, 2013, %.	Annual mean concentration, µg/m^3				
				2010	2011	2012	2012 #	2013
NA3	Tinto Drive,Grangemouth	N	83	n/m	1.22	1.23	n/a	1.39
NA21	Grangemouth Road, College	N	100	0.92	0.92	1.91	1.73	1.25
NA27	West Bridge Street, Falkirk	N	92	1.4	1.49	2.09	1.78	1.52
NA37	Denny Town House	N	92	0.69	0.87	1.38	n/a	1.16
NA38	Larbert Village Primary School	N	75	0.75	1.36	1.37	1.32	0.85
NA41	Seaview Place, Bo'ness	N	100	1.03	2.19	2.14	2.05	1.84
NA42	Municipal Chambers, Grangemouth	N	92	1.17	0.91	1.62	1.41	1.59
NA44	Greenpark Drive, Polmont	N	92	1.01	0.84	1.49	1.21	1.16
NA55	Inchyra Station	N	92	1.24	1.42	**3.29**	3.04	1.38
NA57	Inchyra Road, Grangemouth	N	92	1.37	1.31	2.39	n/a	1.33
NA77	Kinnaird Village	N	83	0.75	0.63	1.32	n/a	1.12
NA80	Cow Wynd, Falkirk	N	92	1.12	1.11	1.75	1.52	1.53
NA81	Grahams Road, Falkirk	N	75	1.34	1.04	1.37	n/a	1.47
NA94	A905 (Glensburgh Rd), Grangemouth	N	92	n/m	0.77	1.67	n/a	1.71
NA102	East Kerse Mains, Bo'ness	N	83	n/m	0.69	1.76	n/a	1.35
NA105	West of Shieldhill	N	83	n/m	0.91	1.26	1.1	0.69

Note: # This column excludes the November result for tubes NA21, 27, 38, 41, 42, 44, 55, 80 and 105. These tubes had shown signs of tube breakdown and thus the concentration may not be representative of ambient conditions.

2.2.5 Other pollutants monitored (1,3 butadiene and $PM_{2.5}$)

In 2013 Falkirk Council monitored 1,3 butadiene at three locations using passive diffusion tubes. All the annual and monthly results were within the objective. All monthly results were at the limit of detection and thus it is likely that the concentrations were lower than those stated in Table 2.10. The reported concentrations have increased since 2010. This is due to the limits of detection increasing.

The three 1,3 butadiene diffusion tubes will remain in place. This is because the Scottish Government's reply to the LAQM consultation responses indicated that the 1,3 butadiene objective will remain. In April 2014 the 1,3 butadiene tube supply and analysis contract changed from ESG Didcot to Gradko.

Table 2.10 Results from 1,3 butadiene diffusion tubes.

Site ID	Location	Within 1,3 butadiene AQMA?	Data capture in 2013, %.	Annual mean concentrations (µg/m^3)			
				2010	2011	2012	2013
NA41	Seaview Place, Bo'ness	N	100	0.41	0.85	1.19	1.25
NA55	Inchyra Station, Grangemouth	N	100	0.41	0.85	1.19	1.25
NA104	Powdrake Road, Grangemouth	N	100	n/m	1.16	1.19	1.25

A Scottish Government owned $PM_{2.5}$ FDMS-TEOM commenced operation at Falkirk Council's Grangemouth AURN site in December 2008. The Scottish Government has announced that it wishes Local Authorities to review $PM_{2.5}$. This is in addition to PM_{10} and will result in a $PM_{2.5}$ objective being placed into legislation. Therefore in-line with previous reports the $PM_{2.5}$ results from the Grangemouth AURN (A8) site are included but considered in slightly more detail.

The concentration recorded in 2013 at the Grangemouth AURN (A8) site was 9.2 µg/m^3. This concentration is below the Scottish Government's interim target value of 12 µg/m^3. It was thus within the EU target and limit values of 20 and 25 µg/m^3 respectively. The data capture was below 90% because of elevated enclosure temperatures during the summer months. The concentration has not been adjusted due to the relatively small numbers of $PM_{2.5}$ analysers in operation in Scotland.

In addition to the annual objective, the UK is required to achieve a reduction in urban background concentrations of 15% by 2021. The value is measured as an average concentration across the years 2009 to 2011 and 2019 to 2021 at urban background sites. This can only be fully assessed when the 2019 to 2021 monitoring period has been completed, but Figure 2.11 shows an Openair deseasonalised smooth trend plot of $PM_{2.5}$ concentrations since monitoring began in December 2008. Although concentrations have shown an increase since 2009, since early 2012 a decrease can be noted.

The $PM_{2.5}$ 2013 Defra 1km * 1km background maps [c] (projected from 2011) have been reviewed. The highest $PM_{2.5}$ concentration in the Falkirk Council area is 10.9 µg/m^3, which is within the interim Scottish target, and the lowest concentration is 6.6 µg/m^3.

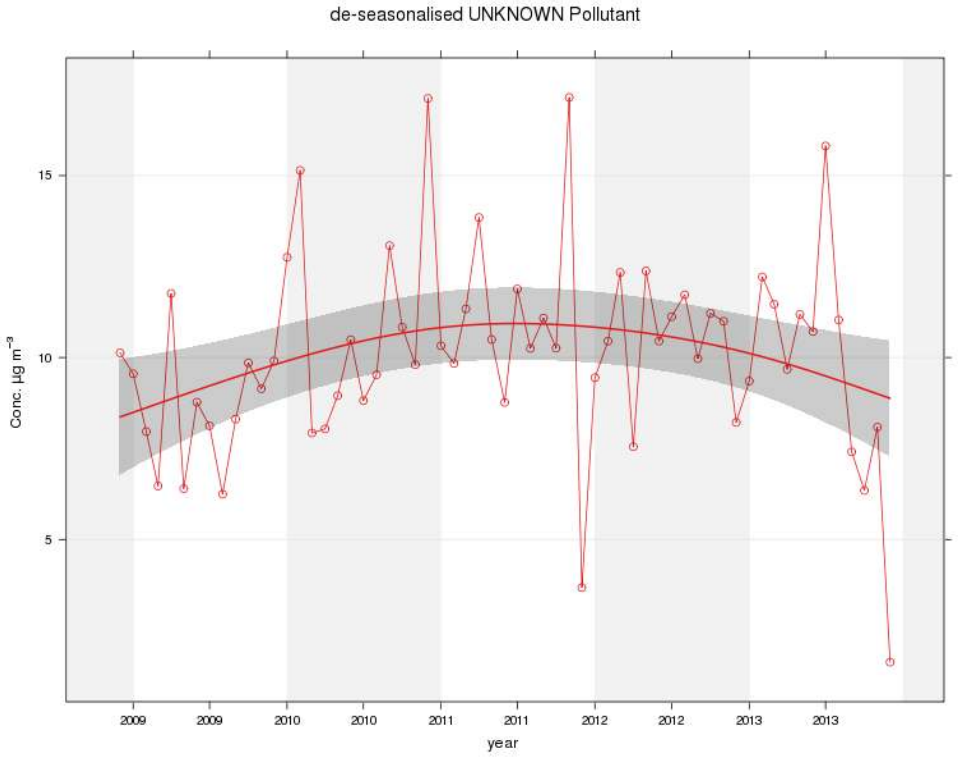
It is unclear whether the Grangemouth AURN (A8) $PM_{2.5}$ unit is included in the described urban background calculation. This is because Defra wish to remove the Grangemouth $PM_{2.5}$ analyser during the second phase of the next set of AURN changes [1] Falkirk Council is opposed to the removal because of the inclusion of $PM_{2.5}$ in the LAQM regime in Scotland. Falkirk Council will work to maintain $PM_{2.5}$ monitoring at the Grangemouth AURN (A8) site.

[c] No $PM_{2.5}$ Scottish specific background maps were available on the SAQN website.

Table 2.11 Results of automatic $PM_{2.5}$ monitoring.

Site ID	Location	Data Capture in 2013, %	Annual mean concentration (µg/m^3)			
			2010	2011	2012	2013
A8	Grangemouth AURN	72.8	11	10.9	10.5	9.2

Figure 2.11 Trend in $PM_{2.5}$ concentrations measured at Grangemouth AURN (2009 to 2013).



2.2.6 Proposed Monitoring Changes

The following changes to the automatic monitoring network are being implemented or will be considered during 2014:

- An AQ Mesh (NO_x analyser) will be installed at an appropriate location along Main St, Bainsford to support the Detailed Assessment. A full automatic unit with NO_x and PM_{10} analysers may be installed if space permits.
- The Falkirk Park St (A6) site has met the NO_2 and PM_{10} objectives for more than three years. In terms of SO_2 there has been an element of duplication with two monitoring sites in Falkirk Town Centre. This has been justifiable in the past but with the commissioning of the TGU (see Section 5) at the Petroineos refinery the focus of the SO_2 AQMA work has changed. The monitoring will focus on demonstrating areas of compliance rather than identifying areas of exceedance. In addition, Falkirk Park St conflicts with the Falkirk Townscape Heritage Initiative. It is located in a conservation

area and is in front of a listed building. It is therefore considered that this site is no longer required. The SO_2 analyser and enclosure will be relocated to a position in the southern section of the Grangemouth AQMA. This will aid the decision about amending or revoking the Grangemouth AQMA. The NO_2 and PM_{10} analysers will be utilised elsewhere.

- The replacement of the existing PM_{10} analyser at the Banknock 2 (A13) monitoring site is being considered. This will ensure that monitoring can continue into the future. In addition, to aid source identification, the introduction of $PM_{2.5}$ monitoring is being considered at this monitoring site.
- The air-conditioning unit and / or the enclosure at the Haggs site will be replaced. This will reduce the quantity of NO_x data lost due to high enclosure temperatures in the summer months.

Summary of Compliance with AQS Objectives

Falkirk Council has examined its LAQM monitoring results in 2013. All seven NO_2 automatic monitoring sites, including Falkirk West Bridge St, met the annual NO_2 objective in 2013. The Falkirk West Bridge St and Falkirk Haggs sites breached the annual Scottish PM_{10} objective of 18 µg/m^3. It is proposed that the Haggs NO_2 AQMA is amended to include the Scottish PM_{10} objectives. It is concluded that a Detailed Assessment of the Main St, Bainsford area is required.

In 2013 all six SO_2 monitoring sites met all three objectives; 15-minute, hourly and daily. This is a notable change compared to 2012. The Tail Gas Unit was fully commissioned by Petroineos in mid-August 2013. The potential impact of this abatement equipment is noted and discussed further in Section 5.

All benzene and 1,3 butadiene monitoring met the relevant objectives.

In anticipation of the inclusion of $PM_{2.5}$ in LAQM in Scotland the concentration at the Grangemouth AURN site was considered in greater detail. The concentration recorded in 2013 was below the current target value of 12 µg/m^3. The merits of $PM_{2.5}$ monitoring in Banknock in assisting the identification of sources was considered.

3 New Local Developments

This Section will review any changes in the Falkirk Council area that may affect air quality, for example new transport sources, industrial emissions or new receptors. It will focus on locations which have not been assessed during the earlier rounds, or where there has been a change to an existing installation or a new development.

The main pollutants that Council's are required to assess from road traffic are NO_2 and PM_{10}. Benzene and 1,3 butadiene emissions from road traffic are now insignificant. The minimum requirement for a Progress Report is to log changes to local developments.

3.1 Road Traffic Sources

This Section will briefly review any changes to local and trunk roads since the 2013 Progress Report.

Local Roads

A review of the local road traffic data (links only) has been completed. The following links were considered in further detail:

- Camelon Road, West of Municipal Buildings to Glenfuir Road. Increase of more than 25%. The western edge of this link is already in Falkirk Town Centre AQMA and represented by diffusion tube NA63.

- Dean Road, Bo'ness. Increase of more than 25% in traffic but flow remains below 10,000 AADT and background PM_{10} below 15 µg/m^3.

- Stirling Road, Larbert. A 29.5% increase in traffic flow, a DMRB run has been conducted due to flows being above 10,000.

- Several roads recorded very small increases in traffic flows that took them above 5,000 or 10,000 AADT. It is not considered that these small increases need to be considered in a Progress Report but are noted for the next Updating and Screening Assessment.

Table 3.1 A summary of the results (NO_2 and PM_{10}) from the DMRB runs.

Link	NO_2 annual mean, µg/m^3	PM_{10} annual mean, µg/m^3
A9 Stirling Road, Larbert	20.8	16.0

It is considered that Detailed Assessments are not required from this review of local roads. However, as in previous reports the DMRB run will be used to prioritise future locations of diffusion tubes.

The following infrastructure changes have been considered:

- The Glenbervie slip roads project was completed in August 2012. This project has created an eastbound on-slip and a westbound off slip road at junction 2 of the M876. Overall this work will remove traffic from the local road network. There

may however be an increase in traffic on a short section of Stirling Road (A9). Therefore a NO_2 diffusion tube was introduced (NA106) in November 2012 at a location representative of relevant receptors. The annualised result for this tube was 19 µg/m^3 in 2012. In 2013, with a full year of monitoring conducted, the concentration was 17 µg/m^3. The result is well below the annual NO_2 objective and thus the site has ceased operation.

- Traffic signals are in the process of being installed at the junction of the A905 and junction 6 M9 and the subsequent Earl's Gate roundabout. This is due to be completed in June 2014. In 2013 the diffusion tube located at this junction (Glensburgh Road, NA94) recorded a concentration of 36 µg/m^3 with the R&A factor and 39 µg/m^3 with the local factor. The results are below the objective without a distance to receptor correction. A Detailed Assessment is therefore not required but monitoring will continue.

Trunk Roads

A review of the trunk road (Transport Scotland) traffic flow data for 2012 and 2013 has been completed. The existing count locations have been assessed for an increase in traffic levels. The greatest increase (8.9%) occurred west-bound on the M9 between J7 and J8, with a similar level on the near-by M9. This link, along with all the other motorway links, has been assessed before and there are no receptors within 10 m of this link.

The monitoring conducted in the vicinity of the new Glenbervie slip roads was discussed in the Local Roads section.

3.2 Other Transport Sources

This Section considers the potential emissions from other types of transport. This includes airports, diesel and steam trains (both stationary and moving) and movements of ships to and from ports.

Ports

In 2013, 1,202 ships called at the docks compared to the 1,479 ships in 2012.[2] The docks are within the Grangemouth (15-minute) SO_2 AQMA and have been considered in the original Further Assessment. With a decrease in the number of ships attending, the docks do not need to be considered further. The Grangemouth MC SO_2 monitor is close to the docks and elevated concentrations are usually associated with other sources in the area.

Airports

There has been a 5.9% increase in passengers at Edinburgh airport between 2012 and 2013. [3] The airport is more than one km from the Falkirk Council boundary. Falkirk Council is not aware of any significant changes to Cumbernauld airport, which is a small airport just outside the Falkirk Council boundary. There are no new airports to consider either.

It is concluded that these airports do not need to be considered further.

Railways

The technical guidance states that NO_2 and SO_2 may need to be considered in relation to railway lines where diesel and / or steam locomotives run. The rail lines in the Falkirk Council area have been discussed extensively in previous reports.

The Edinburgh to Glasgow improvement Programme is underway. This programme will lead to the electrification of the main Falkirk High rail line and diversionary routes. The associated works has led to some road traffic diversions being in place to enable bridge raising works to be conducted. In air quality terms the changes are short-term and do not need to be considered further. Otherwise there have been no changes to the rail network since the 2013 Progress Report.

3.3 Industrial Sources

This Section considers the potential emissions from the following sources:

- Industrial installations: new or proposed installations for which an air quality assessment has been carried out,
- Industrial installations: existing installations where emissions have increased substantially or new relevant exposure has been introduced,
- Industrial installations: new or significantly changed installations with no previous air quality assessment,
- Major fuel storage depots storing petrol, petrol stations and poultry farms.

There have been two changes to the emissions of SO_2 in, or nearby, the Falkirk Council area since the 2013 Progress Report. The first is the commissioning of the Petroineos' Tail Gas Unit between May and August 2013. This is discussed in detail in Section 5. An additional report considering modelled SO_2 concentrations post-TGU commissioning was submitted to the Scottish Government and SEPA in July 2014.

In addition, the Flue Gas Desulphurisation absorbers at Longannet Power Station are now fully operational on unit 1 (commissioning completion notified to SEPA: 30th November 2012), unit 2 (26th March 2013) and unit 3 (2nd December 2013). Therefore all three FGD absorbers are operating as required. [4]

SEPA has informed Falkirk Council that there are no changes to operations with PPC permits.

3.4 Commercial and Domestic Sources

This Section considers the potential emissions from the following sources:

- Biomass combustion plant, individual installations,
- Areas where the combined impact of several biomass combustion sources may be relevant,
- Areas where domestic solid fuel burning may be relevant.

Falkirk Council is not aware of any new significant areas of domestic solid fuel or biomass burning in its area since the 2013 Progress Report.

The Forth Energy Grangemouth Biomass plant discussed in the 2013 Progress Report was granted planning permission by the Scottish Ministers in June 2013. The air quality condition states that:

"The Final Commissioning of the Development shall not commence until a scheme for monitoring air quality, within an area to be prescribed by the Planning Authority and SEPA, is submitted to and approved in writing by the Planning Authority in consultation with community statutory consultees. The scheme shall include measured location(s) within the prescribed areas from which air quality will be monitored, the equipment and methods to be used and frequency of measurements to be undertaken continuously thereafter. Monitoring air quality shall be carried out in accordance with the approved scheme, unless otherwise agreed in writing by the Planning Authority."

However, Forth Energy has stated that they do not plan to continue with the Grangemouth proposal and are looking to attract another developer to take the project forward. [5]

3.5 New Developments with Fugitive or Uncontrolled Sources

This Section considers the potential emissions from the following sources:

- Landfill sites,
- Quarries,
- Unmade haulage roads on industrial sites,
- Waste transfer stations etc,
- Other potential sources of fugitive particulate emissions.

An application (P/12/0380/FUL, Landscape Restoration of Quarry Void, Comprising Planting and Earthworks Restoration and Upgrading of Southern Section of Site Access Road Leading to the A803) was approved in October 2013. The access road will run through the Falkirk Council area to a new quarry called Tomfyne. This is located in the North Lanarkshire Council area and was subject to a separate planning application. The Banknock 2 (A13) site (TEOM PM_{10}) is currently operating at a roadside location in the Banknock AQMA and the Banknock 3 site (Osiris) began operation in July 2014 at a background site.

A review of the road traffic flow data available and the infrastructure changes in the Falkirk Council area has been conducted with one DMRB run carried out. It is concluded that no Detailed Assessments are required.

4 Planning Applications

The following planning applications were identified as potentially having an impact on air quality or introduce new receptors in the future.

The Grangemouth biomass renewable energy plant (rated at 100 MWe) is discussed in Section 3.4.

The Tomfyne quarry planning application in Banknock is discussed in Sections 2 and 5.

The DART (coal-bed methane) energy proposal is the subject to a planning appeal to the Directorate for Planning and Environmental Appeals. Therefore no comment shall be made on this application.

5 Implementation of Action Plans

Banknock (PM_{10}) AQMA

In December 2012 the Banknock 2 (A13, TEOM) monitoring site replaced the Banknock 1 site (A2, Osiris) and in July 2013 the Banknock 3 (A14, Osiris) commenced operation.

The Tomfyne quarry access road and restoration of Cowdenhill quarry was granted planning permission in October 2013.

In terms of $PM_{2.5}$ it is considered that the risk of breaching the objectives in the Banknock AQMA is low. However, an analyser measuring $PM_{2.5}$ would provide assistance is identifying current or future sources in the AQMA. Falkirk Council is investigating the options that would enable a $PM_{2.5}$ analyser to be installed at the Banknock 2 (A13) site.

Falkirk Town Centre (NO_2 and PM_{10}) and Haggs (NO_2) AQMAs

The Falkirk Town Centre and Haggs NO_2 AQMAs were declared in March 2010 (see Figures 1.1b and c).

The draft Action Plan has been subject to consultation and will be submitted to the Scottish Government in August 2014. The executive summary is reproduced in Figure 5.1.

Figure 5.1 Executive summary of Falkirk Town Centre and Haggs Action Plan

"The 1995 Environment Act and subsequent regulations made there under require Falkirk Council to produce an action plan to address air quality in their area. This follows on from the declaration of four Air Quality Management Areas for potential exceedance of national objectives in relation to annual mean Nitrogen Dioxide (NO2) and particulate matter (PM10) concentrations. Falkirk Council has declared the following AQMAs:

- 1 AQMA in Grangemouth, for the 15-minute sulphur dioxide (SO2) objective.
- 1 AQMA in Falkirk Town Centre, covering the annual mean NO2 objective and Scottish PM10 daily and annual objectives;
- 1 AQMA in Haggs, for the annual mean NO2 objective.
- 1 AQMA in Banknock, for a breach of the Scottish PM10 and a potential breach of the UK PM10 objectives.

This Air Quality Action Plan (AQAP) focuses only on Falkirk Town Centre and Haggs AQMA the other AQMAs are dealt with under other AQAPs. This AQAP intends to show how the Council, in partnership with the community and other stakeholders, will improve air quality in the Falkirk Council area. Because of the nature of the challenge facing Falkirk Council many of the actions contained are long term goals rather than attempts at short term fixes.

A draft action plan has been prepared and is available for to all stakeholders for comment.
This draft AQAP has been the product of extensive internal consultation through the steering group which has consisted of a number of interested parties within the Council and reflects the views and comments of all stakeholders. The actions detailed in the plan reflect the outcome of our consultations. They also aim to integrate, as far as possible, with existing local and national plans and strategies relating to key issues such as transport and development.

The plan currently sets out 20 actions that have been identified to reduce pollutant levels of both NO2 and PM10 within Falkirk. The actions are Council wide measures that will directly improve air quality throughout Falkirk and not just in the AQMAs. These actions aim to strike an appropriate balance between the direct and indirect costs of taking action and the benefit in terms of improved air quality. The types of actions set out in the plan are:

- reducing emissions from individual vehicles,
- promotion of ECO stars,
- planning and development measures,
- reducing demand for travel and promoting alternative modes of transport,
- educate and inform the public regarding air quality.

The plan also provides an evaluation of the actions detailed and the potential they bring to addressing Air Quality in Falkirk. Monitoring and re-evaluating these actions will be the key to the long term success of the Action Plan."

As part of the draft Action Plan in February 2013 the Falkirk ECO Stars scheme was launched at the Falkirk Stadium (www.falkirk.gov.uk/ecostars). In the UK the ECO Stars scheme also operates in Edinburgh, South Yorkshire, Thurrock, Nottinghamshire, Mid-Devon, York, North Lanarkshire and Dundee. It is an environmental fleet management recognition scheme for vans, lorries, buses and coaches. ECO Stars rates individual vehicles and overall fleet operations to recognise levels of environmental performance. It provides advice and guidance on how to improve fuel efficiency and reduce operating costs. It also aims to raise awareness among operators of commercial vehicles of the important role they can play in helping to improve local air quality (particularly in the Council's Air Quality Management Areas) and other environmental issues by enhancing their fleet performance. The scheme is voluntary and free to join and open to operators of buses, coaches, vans and trucks. The Falkirk scheme has 37 members who operate 2,449 vehicles that are either based in or operate through the Falkirk Council area.

Falkirk Council has been following the Mid-Devon taxi and private hire vehicle pilot of the ECO Stars scheme. An extension to include the taxi and private hire element within the Falkirk scheme is under consideration.

Grangemouth (15-minute) SO_2 AQMA

The Grangemouth AQMA was declared in November 2005 for what at the time was considered to be a potential breach of the 15-minute SO_2 air quality objective. The monitoring since the declaration has shown that at least one monitoring station in the AQMA has breached the 15-minute objective since 2007. The 2013 Progress Report highlighted a breach of the daily objective at the Grangemouth Moray site in 2012. However, Falkirk Council did not proceed to a Detailed Assessment because of the imminent commissioning of the Tail Gas Unit. The hourly objective has and continues to be met at all sites, both inside and outside the AQMA.

In July 2007 Falkirk Council submitted its Action Plan for this AQMA to the Scottish Government and SEPA. The Action Plan is available to view on either the Defra or Scottish AQ websites. All Council's are required to provide an annual update on their Action Plans. This update is provided in this section and summarised in Table 5.1. It is followed by a discussion of the Tail Gas Unit commissioning and monitoring since.

Measure 1

Falkirk Council has eight automatic monitoring stations affiliated to either the AURN or the Scottish Air Quality Network with the data displayed on the appropriate website. This includes five of the six SO_2 analysers that are used to monitor SO_2 in the Grangemouth AQMA. The quality control for the Bo'ness site is conducted in-house and available on request.

Falkirk Council sends provisional SO_2 and meteorological data to SEPA, Petroineos and INEOS after SO_2 exceedance(s) is recorded at a monitoring station. In addition, a monthly summary is sent, part of which is shown in Figure 5.1. The monthly e-mail includes a summary of the data for each site that has recorded an exceedance, along with a full list of the exceedances.

Measure 2

A Grangemouth working group meeting was organised in November 2013 following the full commissioning of the Tail Gas Treatment unit in August 2013.

Measure 3

Falkirk Council's text alert system has been implemented and is being maintained. An e-mail alert system has been set up for the Grangemouth AURN site.

Measure 4

The Polmont analyser commenced operation in September 2010 and ceased operation in October 2012. Although this location is outside of the AQMA, it is on the south-eastern side of the AQMA where no monitoring has previously been conducted. The Polmont site met the SO_2 objectives with only one 15-minute exceedance recorded during its two years of operation.

As discussed in Section 2 the Falkirk Park St analyser will cease operation in 2014. An alternative location is being sought which is focusing within the Grangemouth AQMA and in proximity to the southern boundary.

Table 5.1 Grangemouth AQMA Action Plan Progress.

Measure Number	Measure	Focus	Lead authority	Progress to date	Progress in last 12 months	Estimated completion date	Comments relating to emission reductions
1	Improving data access / website	Supplying monitoring data to SEPA, Petroineos and INEOS.	Falkirk Council	Data sent after exceedances.	Increasing amounts of information in monthly summary. Analysis and polar plots.	Ongoing.	See comments in this Section.
2	Working group.	Bring together FVHB, Petroineos, INEOS, S.Govt, SEPA and Falkirk Council.	Falkirk Council	Meeting held in November 2013.	TGU installed and fully commissioned in August 2013.	Completed. Proposed no further meetings unless breach of objective occurs.	Significant reduction in exceedances expected with TGU commissioned.
3	Text alert system.	Real-time notification of exceedances.	Falkirk Council	Implemented.	Maintenance of system.	Completed and ongoing. Grangemouth AURN sends e-mails.	n/a
4	Monitoring network.	Review monitoring network.	Falkirk Council	Grangemouth Moray SO_2 in SAQN. Monitoring conducted in Polmont.	Falkirk Park St to cease operation in 2013. Alternative location in AQMA being sought.	Ongoing	See comments in this and Section 2.

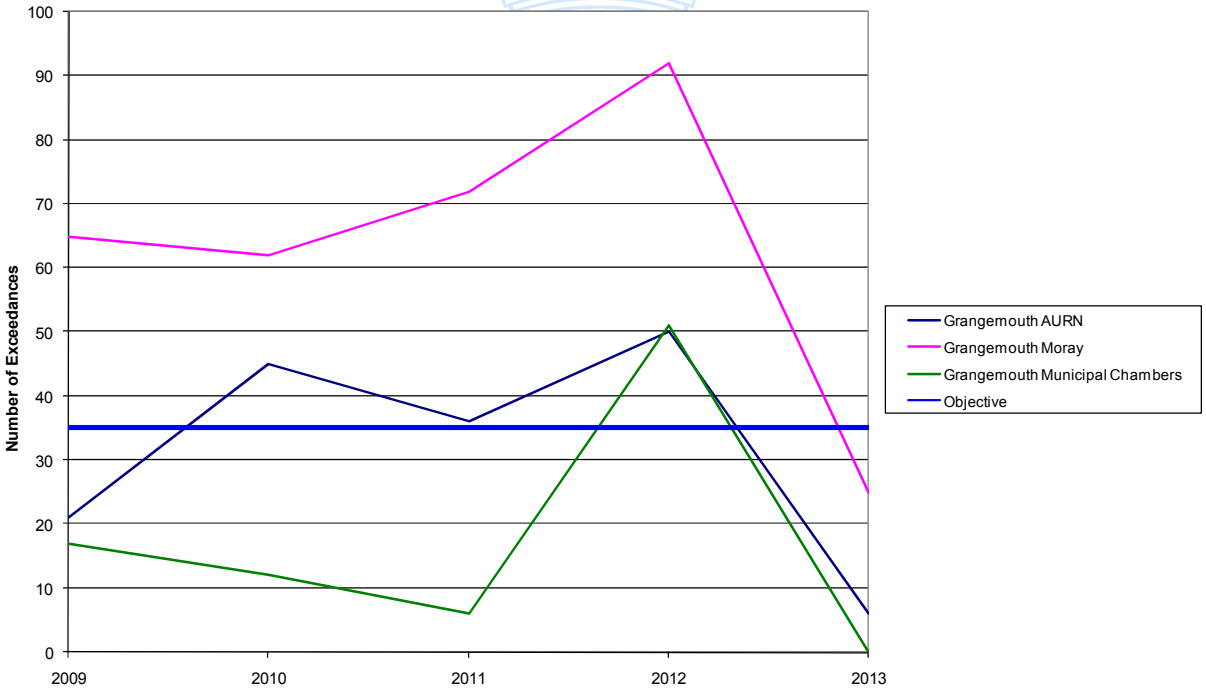
Figure 5.2 A part of the monthly summary of data supplied to Petroineos, INEOS and SEPA.

1st January to 4th December 2013.	Number of exceedances of concentration / limit value.			Highest concentration, µg m^{-3}.			Data capture, %	Date of last exceedance.	Status
	15-minute	Hourly	Daily	15-minute	Hourly	Daily			
Grangemouth AURN	6	0	0	461	248	74	98.2	11th July 2013	Ratified to end June.
Moray	25	0	1	367	314	142	97.2	6th June 2013	Ratified to end June.
Municipal Chambers	0	0	2	245	181	133	98.4	24th March 2013	Ratified to end June.
Bo'ness	0	0	0	117	73	18	96.9	15th June 2010	Ratified to end June.
Falkirk Hope St	0	0	0	152	122	26	98.2	10th August 2012	Ratified to end June.
Falkirk Park St	2	0	0	367	205	26	99.6	8th June 2013	Ratified to end June.

16th August to 4th December 2013.	Number of exceedances of concentration / limit value.			Highest concentration, µg m^{-3}.		
	15-minute	Hourly	Daily	15-minute	Hourly	Daily
Grangemouth AURN	0	0	0	175	125	16
Moray	0	0	0	210	168	26
Municipal Chambers	0	0	0	170	141	39

Objectives		
Time period	Concentration, µg m^{-3}	Number of exceedances permitted each year.
15-min	266	35
Hourly	350	24
Daily	125	3

Figure 5.3 The number of 15-minute exceedances recorded at the three sites in the Grangemouth AQMA between 2009 and 2013.



In 2013 all three sites met all three SO2 objectives. This is in contrast to 2012 when all three sites recorded breaches of the 15-minute objective and the Grangemouth Moray site recorded a breach of the daily objective. The Grangemouth Moray and Grangemouth AURN sites have recorded the most consistency in breaching the objective, whilst in the last five years the Grangemouth Municipal Chambers site has only recorded a breach of in 2012.

A direct comparison between the numbers of exceedances recorded in each year can give an indication of the trends in the number of exceedances and concentrations. Although it should be treated with some caution as the local meteorological conditions, which vary from year to year, will have an impact on the number of exceedances at each monitoring station. However, it is clear that across a whole year prior to TGU commissioning the conditions under which exceedances are recorded take place frequently enough that a breach of the 15-minute objective occurs. This is demonstrated by the breaches of the objective in the Grangemouth AQMA between 2007 and 2012.

In SEPA's 2008 Air Quality Report it is stated that the significant increase in the number of exceedances seen between 2006 and subsequent years is likely to have been due to a change in the crude oil feed used by the refinery which has increased sulphur content. [6]

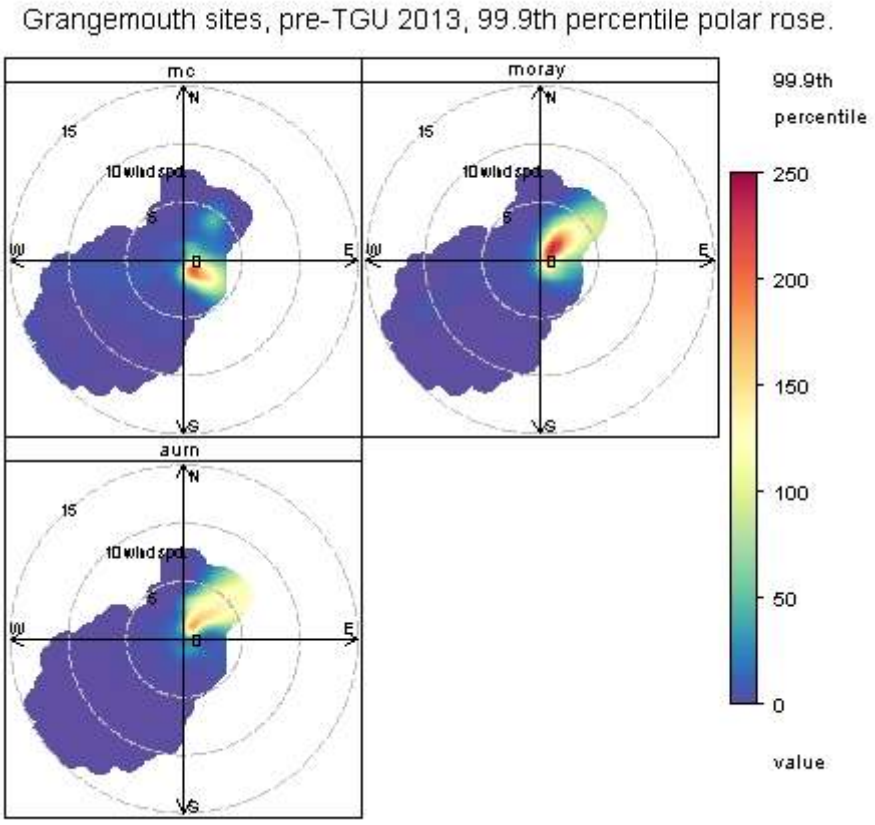
In May 2013 the £32 million Tail Gas Unit, discussed in previous reports, was commissioned by Petroineos at their Grangemouth refinery. The initial three months of operation were subject to testing. This meant the unit was not necessarily operating at full loading or taking feed from both sulphur recovery units during this period. During the testing period five 15-minute exceedances were recorded at the AURN (A8) site and five at the Moray (A9) site.

The TGU was fully commissioned in mid-August 2013. There were no exceedances recorded between the 16th August 2013 and the end of 2013. However, this statement should be treated with care. This is because the autumn and winter of 2013 / 14 was dominated by conditions (south-westerly winds) in which few, if any, exceedances occur. In addition, spring and early summer time is a period when exceedances can be most prone to being recorded. (Note: exceedances have been recorded in 2014 (provisional data), although at the time of writing the number remains within that permitted by the objective.)

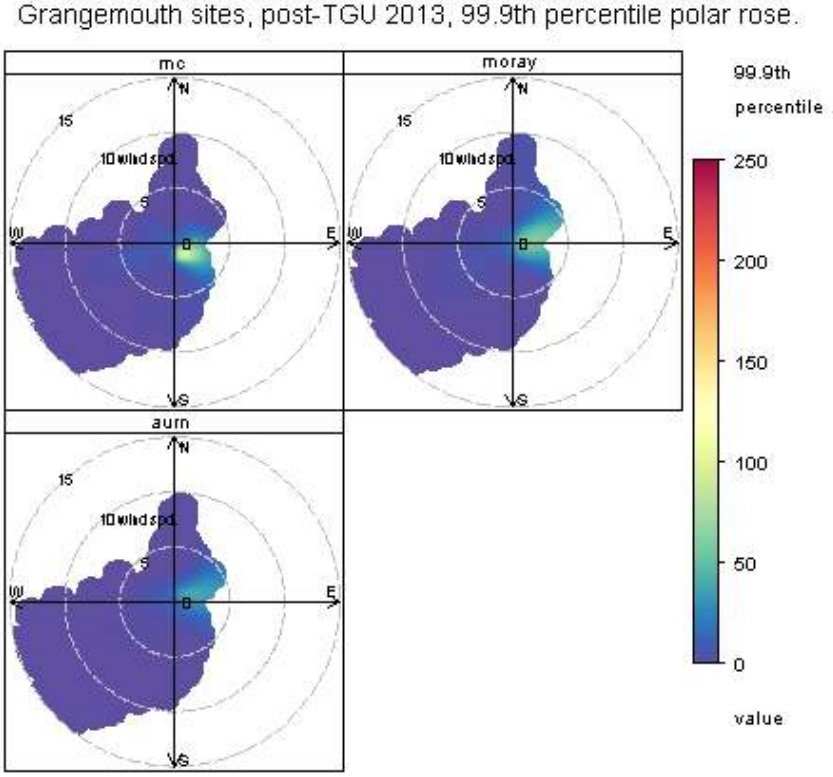
Figure 5.3 shows average concentration and 99.9th percentile polar roses using 2013 monitoring data from the three Grangemouth sites. The plots indicate that the average and 99.9th percentile concentrations have decreased following the commissioning of the TGU under similar wind conditions. There are however, wind direction and speed direction conditions in the post-TGU period which are not present in the pre-TGU period at a particular site, e.g. Grangemouth AURN, north-east and > 5 m/s. In addition, other meteorological conditions are known to contribute to exceedances. This reduction is encouraging but as stressed earlier in this section it is important to note that these comments are based on less than five months of post-TGU monitoring and must be treated with caution.

Figure 5.4: Grangemouth sites polar roses in 2013: a.) pre-TGU 99.9th percentile, b.) post-TGU 99.9th percentile, c.) pre-TGU average and d.) post-TGU average.

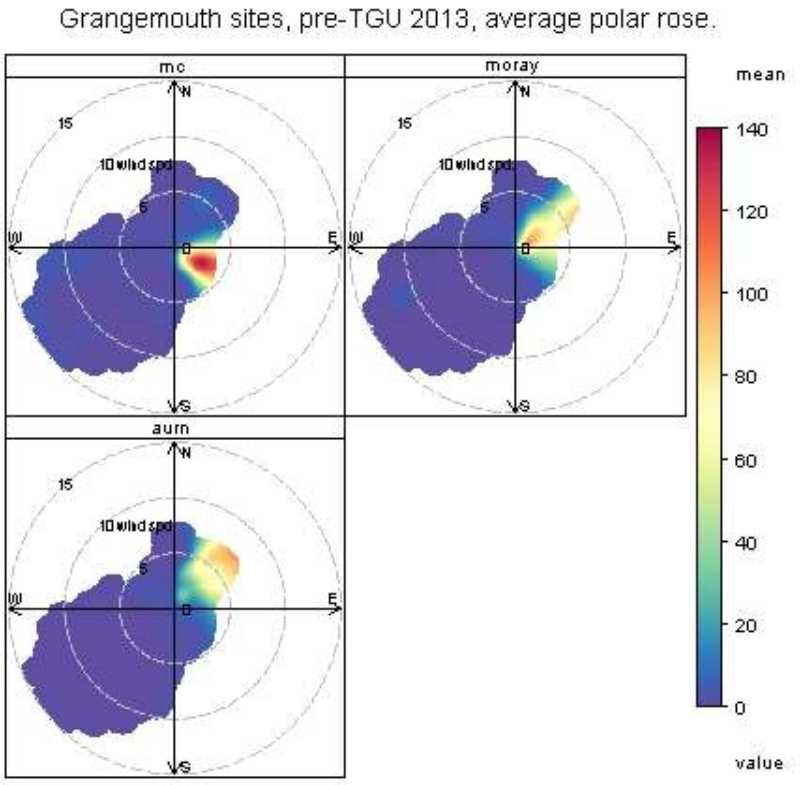
a.)



b.)



c.)


Grangemouth sites, pre-TGU 2013, average polar rose.
mc
moray
aurn
N
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15
10
10 wind spd
mean
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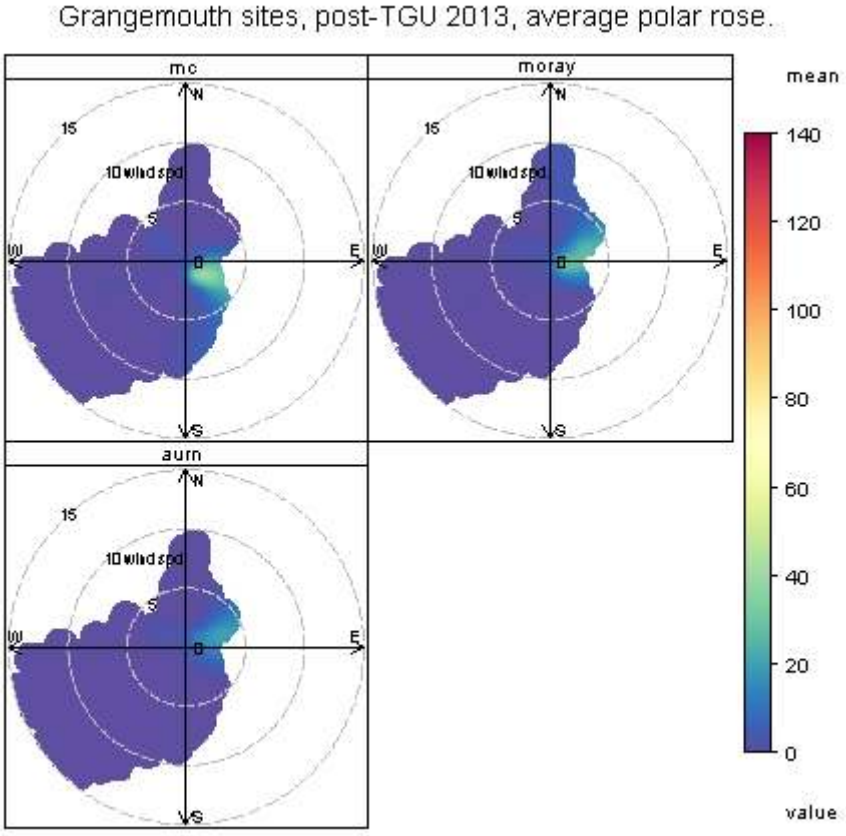
120
100
80
60
40
20
0
value

d.)


Grangemouth sites, post-TGU 2013, average polar rose.
mc
moray
aurn
N
E
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15
10
10 wind spd
mean
140
120
100
80
60
40
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0
value

In November 2013 the Grangemouth AQMA working group met following the full commissioning of the TGU. The meeting discussed the monitoring data and post-TGU modelling. It was concluded further meetings would only be held if a breach of the objective occurred.

The Grangemouth refinery and petrochemical complex operated at reduced output for two weeks in October 2013 due to an industrial dispute. There were no exceedances during this period, however, two weeks is not a particularly significant period to compare with objectives that have to be assessed over the course of a full year.

While modelling and polar roses are useful to discern changes in concentrations and exceedances it is ultimately the number of exceedances at the monitoring sites that determine whether the Grangemouth AQMA is amended or revoked. It is anticipated that the 15-minute objective will need to be met for at least three years before consideration is given to amending or revoking the AQMA.

6 Conclusions and Proposed Actions

6.1 Conclusions from New Monitoring Data

Falkirk Council has examined the monitoring results recorded in its area and concludes that:

- A Detailed Assessment of NO_2 and PM_{10} in Main Street, Bainsford is required.
- The Falkirk Town Centre AQMA (NO_2 and PM_{10}) remains justified although concentrations show an overall downward trend.
- The Falkirk Haggs (A4) monitor recorded a breach of the annual PM_{10} objective in 2013 and a 98th percentile daily concentration of 46 µg/m^3. Therefore the Haggs AQMA should be amended to include the annual Scottish PM_{10} objective, it is proposed that the daily objective is included given that the 98th percentile concentration is near to the limit value of 50 µg/m^3.
- In 2013 all six SO_2 monitoring sites met the 15-minute objective. The last time that all the Falkirk Council SO_2 monitors met the 15-minute objective was in 2006. The Petroineos Tail Gas Unit was fully commissioned in August 2013. The number of exceedances will remain under review because the concentrations and exceedances are subject to the meteorological conditions in the area.

6.2 Conclusions relating to New Local Developments

The developments discussed do not need further consideration or are already the subject of study through Air Quality Management Areas.

6.3 Proposed Actions

It is concluded from this report that Falkirk Council is required to carry out the following actions:

- The Grangemouth (15-minute) AQMA work will continue as per the Action Plan. The number of 15-minute exceedances shall continue to be reviewed following the commissioning of the Tail Gas Unit.
- It is proposed that the Haggs NO_2 AQMA is amended to include the Scottish PM_{10} objectives.
- The Falkirk Park St site will cease operation. The SO_2 analyser will be deployed to the Grangemouth area.
- Falkirk Council is investigating the replacement of the existing PM_{10} analyser at the Banknock 2 (A13) monitoring site. This will ensure that monitoring can continue into the future. In addition, to aid source identification the introduction of $PM_{2.5}$ monitoring is being considered.
- An extension to the Falkirk ECO Stars scheme to include taxis and private hire vehicles is under consideration.
- Submit a 2015 Updating and Screening Assessment or other Air Quality Report as required by the Scottish Government.

7 References

General:

- Technical Guidance LAQM.TG(09), Defra and Devolved Administrations, February 2009.
- All Openair plots produced using RStudio Version 0.98.501 – © 2009-2013 RStudio, Inc and Openair 0.9-2.

Specific:

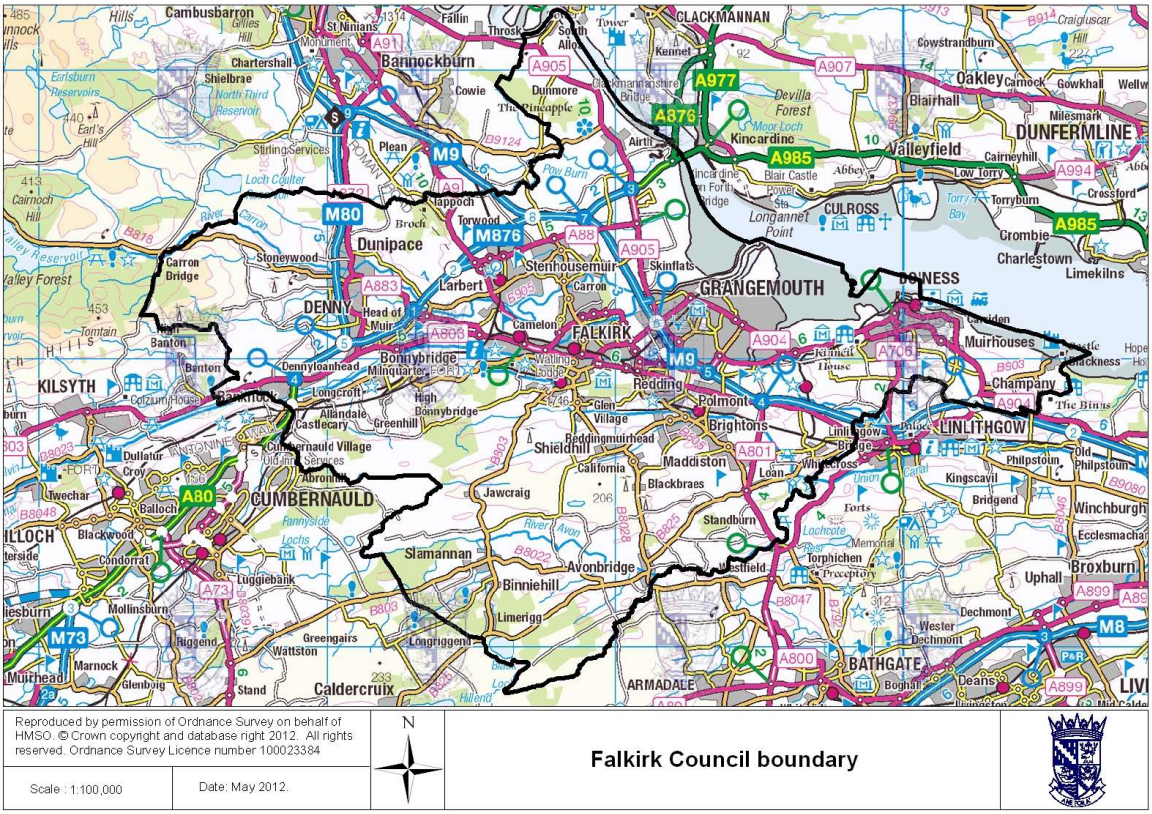
1. Air Quality Assessment Regime Review for the Ambient Air Quality Directive 2008/50/EC, Defra December 2013.
2. Personal communication, Forth Ports.
3. UK airport Statistics, CAA. http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3#Data
4. Personal communication, Scottish Power.
5. Forth Energy, http://www.forthenergy.co.uk/latest-news-20140326.asp
6. SEPA's National air quality report 2008: http://www.sepa.org.uk/air/air_publications.aspx
7. The Data Verification and Ratification Process, Scottish Air Quality Network: http://www.scottishairquality.co.uk/verification_and_ratification.php

Appendices

Appendix 1 Falkirk Council Area and Monitoring Locations.
Appendix 2 QA / QC Data.

Appendix 1 Falkirk Council Area and Monitoring Locations.

Figure A1 The boundary of the Falkirk Council area.



2013 Automatic Monitoring Locations

The location of the eight monitoring sites affiliated to the Scottish Air Quality Network can be viewed at www.scottishairquality.co.uk The location of the remaining monitoring sites are shown in Figure A2 and 2.1.

Figure A2a The location of the Bo'ness (A3) site.

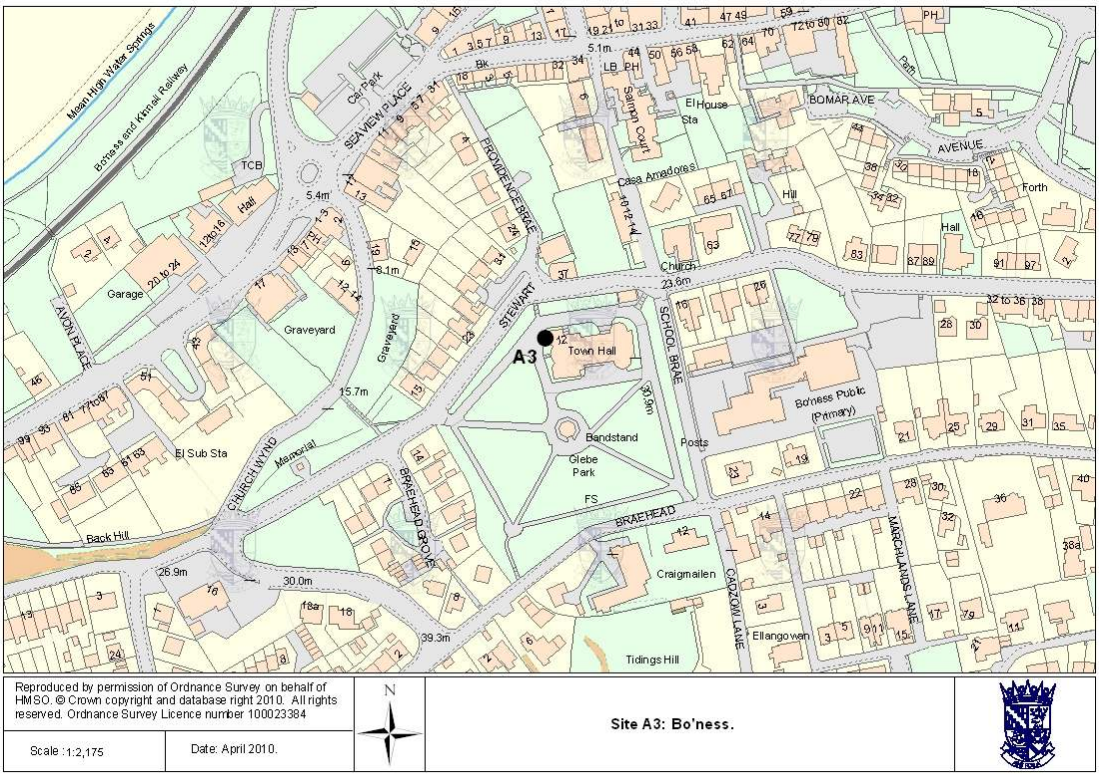
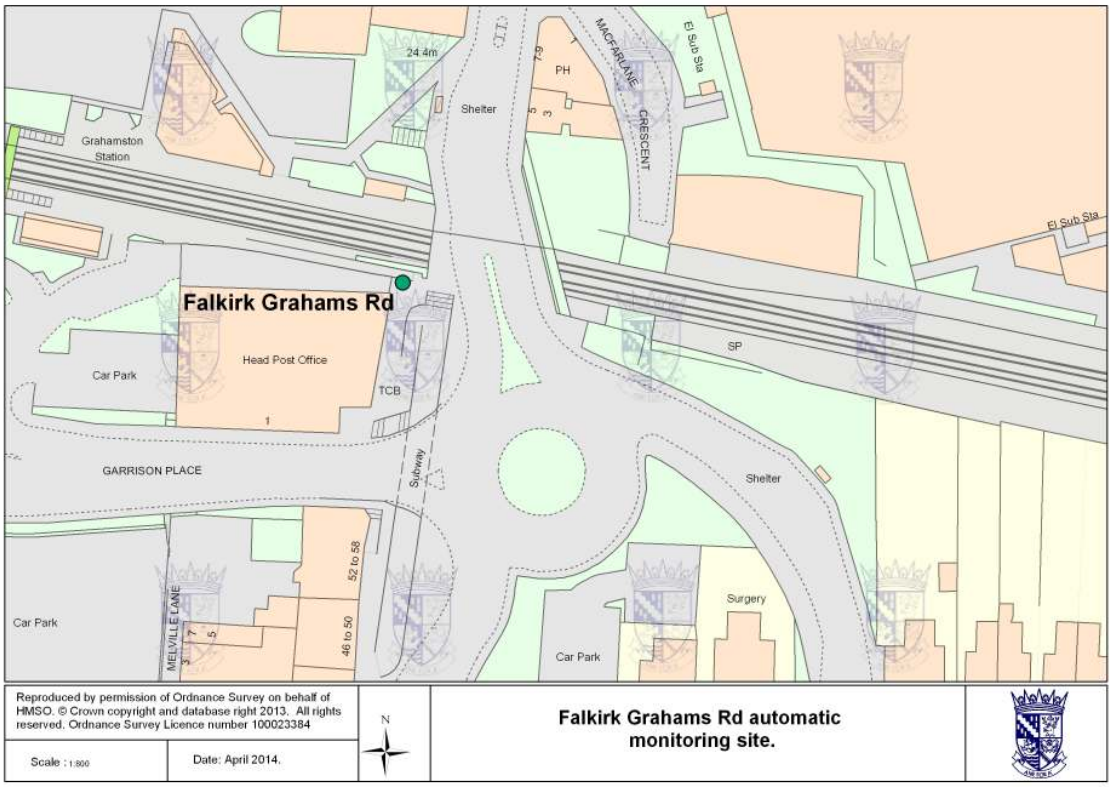


Figure A2b The location of the Falkirk Grahams Road (A12) site.



Appendix 2: QA / QC of Data and DMRB Calculations

Diffusion Tube Bias Adjustment Factors

The nitrogen dioxide, benzene and 1,3 butadiene tubes used by Falkirk Council are supplied and analysed by ESG (Didcot). The method used for the NO_2 tubes is 50% acetone and 50% tri-ethanolamine. The tubes used for benzene are Chromosorb ATD (atomic thermal desorption) tubes and for 1,3 butadiene are molecular sieve ATD tubes.

Falkirk Council carried out two triplicate studies for NO_2, the first at the Grangemouth Municipal Chambers (site NA42 / A10), an urban background site. The second site is the Falkirk Park St (NA70 / A7), a roadside site. Figure A3 shows the local bias factor spreadsheets.

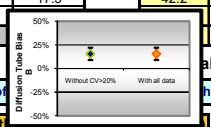
The 2013 bias factor at Grangemouth MC site was 0.82, at Falkirk Park St site was 0.87 and the R&A Helpdesk database factor was 0.80. The two local studies carried out by Falkirk Council contributed to this factor. The reasons for choosing the R&A factor were discussed in Section 2. Please note that there is a slight difference between the two Falkirk factors on the R&A database and those used in this report. This is because the two factors calculated by Falkirk Council have used ratified data in full.

Figure A3 NO_2 bias adjustment factors for Falkirk Park St (A6) and Grangemouth MC (A10).

Checking Precision and Accuracy of Triplicate T — 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	02/01/2013	30/01/2013	39.3	52.4	45.0	46	6.6	14	16.3	37.4	99.9	Good	Good
2	30/01/2013	27/02/2013	42.8	48.0	45.6	45	2.6	6	6.5	41.0	99.7	Good	Good
3	27/02/2013	27/03/2013	35.3	40.6	40.7	39	3.1	8	7.7	36.6	99.4	Good	Good
4	27/03/2013	24/04/2013	35.8	33.5	34.0	34	1.2	4	3.0	29.5	99.7	Good	Good
5	24/04/2013	29/05/2013	27.2	29.4	25.7	27	1.9	7	4.6	26.3	99.9	Good	Good
6	29/05/2013	26/06/2013	30.0	34.6	34.6	33	2.7	8	6.6	26.1	100.0	Good	Good
7	26/06/2013	31/07/2013	29.2	27.7	25.0	27	2.1	8	5.3	24.4	99.5	Good	Good
8	31/07/2013	04/09/2013	31.7	28.0	31.8	31	2.2	7	5.4	22.8	100.0	Good	Good
9	04/09/2013	02/10/2013	35.5	36.6	34.5	36	1.1	3	2.6	29.0	99.9	Good	Good
10	02/10/2013	30/10/2013	36.0	33.0	36.9	35	2.0	6	5.1	30.0	99.7	Good	Good
11	30/10/2013	04/12/2013	34.4	48.3	40.3	41	7.0	17	17.3	42.2	99.8	Good	Good
12	04/12/2013	08/01/2014	28.0	22.8	22.9	25	3.0	12			99.9	Good	Good
13													

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



all survey --> Good precision | Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Falkirk Park St

Precision 12 out of … han 20%

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.87 (0.83 - 0.93)
Bias B 14% (8% - 21%)
Diffusion Tubes Mean: 35 µgm^{-3}
Mean CV (Precision): 8
Automatic Mean: 31 µgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 30 (29 - 32) µgm^{-3}

Accuracy (with …)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.87 (0.83 - 0.93)
Bias B 14% (8% - 21%)
Diffusion Tubes Mean: 35 µgm^{-3}
Mean CV (Precision): 8
Automatic Mean: 31 µgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 30 (29 - 32) µgm^{-3}

Without CV>20%	With all data
15%	15%
6.6%	6.6%

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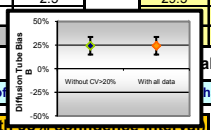
Version 03 - November 2006

Checking Precision and Accuracy of Triplicate T

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	02/01/2013	30/01/2013	36.8	41.4	40.6	40	2.5	6	6.1	32.5	99.7	Good	Good
2	30/01/2013	27/02/2013	33.7	30.6	23.4	29	5.3	18	13.1	28.9	96.0	Good	Good
3	27/02/2013	27/03/2013	31.1	41.8	38.2	37	5.4	15	13.5	29.7	99.9	Good	Good
4	27/03/2013	24/04/2013	22.6	21.3	22.4	22	0.7	3	1.7	19.5	99.0	Good	Good
5	24/04/2013	29/05/2013	14.0	16.5	16.2	16	1.4	9	3.4	15.6	99.4	Good	Good
6	29/05/2013	26/06/2013	19.6	20.5	20.9	20	0.7	3	1.7	13.9	99.9	Good	Good
7	26/06/2013	31/07/2013	17.0	16.0	15.4	16	0.8	5	2.0	13.3	94.9	Good	Good
8	31/07/2013	04/09/2013	17.3	17.3	17.8	17	0.3	2	0.7	12.3	99.9	Good	Good
9	04/09/2013	02/10/2013	23.4	24.2	22.2	23	1.0	4	2.5	18.1	100.0	Good	Good
10	02/10/2013	30/10/2013	25.2	25.7	25.0	25	0.4	1	0.9	18.1	100.0	Good	Good
11	30/10/2013	04/12/2013	37.5	35.5	36.5	37	1.0	3	2.5	29.5	99.9	Good	Good
12	04/12/2013	08/01/2014	18.0	18.4	19.5	19	0.8	4			96.7	Good	Good
13													

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



all survey --> Good precision | Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Grangemouth MC
Precision	12 out of

han 20%

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.82 (0.76 - 0.88)
Bias B	23% (13% - 32%)
Diffusion Tubes Mean:	25 µgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	20 µgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	21 (19 - 22) µgm^{-3}

Accuracy (with [illegible]) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.82 (0.76 - 0.88)
Bias B	23% (13% - 32%)
Diffusion Tubes Mean:	25 µgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	20 µgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	21 (19 - 22) µgm^{-3}

Without CV>20%	With all data
24%	24%
9.4%	9.4%

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Figure A4 National diffusion tube bias adjustment factor spreadsheet for ESG (Didcot), 50% TEA in acetone for 2013.

National Diffusion Tube Bias Adjustment Factor Spreadsheet

Spreadsheet Version Number: 03/14

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 spreadsheet 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 2014

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

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

Step 3: Select a Year from the Drop-Down

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[5] 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[2]	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µgm^{-3})	Automatic Monitor Mean Conc. (Cm) (µgm^{-3})	Bias (B)	Tube Precision[4]	Bias Adjustment Factor (A) (Cm/Dm)
ESG Didcot	50% TEA in acetone	2013	B	Gravesham Borough Council	11	33	32	4.8%	G	0.95
ESG Didcot	50% TEA in acetone	2013	B	Gravesham Borough Council	12	44	32	39.8%	G	0.72
ESG Didcot	50% TEA in acetone	2013	R	Falkirk Council	12	35	31	14.2%	G	0.88
ESG Didcot	50% TEA in acetone	2013	UB	Falkirk Council	12	25	20	22.7%	G	0.81
ESG Didcot	50% TEA in acetone	2013	B	Pembrokeshire Council	12	7	6	17.3%	P	0.85
ESG Didcot	50% TEA in acetone	2013	UB	Medway	12	24	25	-3.5%	G	1.04
ESG Didcot	50% TEA in acetone	2013	R	Medway Council	10	36	27	36.5%	G	0.73
ESG Didcot	50% TEA in acetone	2013	B	Medway	11	26	14	84.3%	P	0.54
ESG Didcot	50% TEA in acetone	2013	R	Wrexham County Borough Council	12	23	22	8.3%	G	0.92
ESG Didcot	50% TEA in acetone	2013	UI	Stockton on Tees	12	27	20	36.0%	G	0.72
ESG Didcot	50% TEA in acetone	2013	R	Stockton on Tees	12	21	16	30.5%	G	0.77
ESG Didcot	50% TEA in acetone	2013	SU	Thanet District Council	11	21	16	29.5%	P	0.77
ESG Didcot	50% TEA in acetone	2013	R	Thanet District Council	11	29	24	17.3%	P	0.85
ESG Didcot	50% TEA in acetone	2013	R	Cambridge City Council	12	46	35	33.3%	G	0.75
ESG Didcot	50% TEA in acetone	2013	R	Swale Borough Council	10	45	41	9.3%	G	0.91
ESG Didcot	50% TEA in acetone	2013	R	Swale Borough Council	12	40	34	16.0%	P	0.86
ESG Didcot	50% TEA in acetone	2013	R	Swale Borough Council	12	41	40	4.0%	G	0.96
ESG Didcot	50% TEA in acetone	2013	R	Swale Borough Council	11	53	34	54.8%	G	0.65
ESG Didcot	50% TEA in acetone	2013	R	Swale Borough Council	11	53	34	54.8%	G	0.65
ESG Didcot	50% TEA in acetone	2013	R	North East Lincolnshire Council	11	59	49	19.5%	G	0.84
ESG Didcot	50% TEA in acetone	2013	R	North East Lincolnshire Council	11	34	30	12.3%	G	0.89
ESG Didcot	50% TEA in acetone	2013	R	North East Lincolnshire Council	11	40	31	26.3%	G	0.79
ESG Didcot	50% TEA in acetone	2013	R	Rugby Borough Council	12	26	22	16.6%	P	0.86
ESG Didcot	50% TEA in acetone	2013	KS	Marylebone Road Intercomparison	12	109	81	34.8%	G	0.74
ESG Didcot	50% TEA in acetone	2013	UB	City of York Council	11	25	19	29.7%	G	0.77
ESG Didcot	50% TEA in acetone	2013	R	City of York Council	12	40	28	41.2%	G	0.71
ESG Didcot	50% TEA in acetone	2013	R	City of York Council	12	34	24	38.0%	G	0.72
ESG Didcot	50% TEA in acetone	2013	R	City of York Council	10	40	31	28.3%	G	0.78
ESG Didcot	50% TEA in acetone	2013	KS	Suffolk Coastal District Council	11	46	41	11.8%	G	0.89
ESG Didcot	50% TEA in acetone	2013		**Overall Factor[3] (28 studies)**					Use	0.80

Discussion of choice of factor to use

The overall automatic data capture and precision were good for both of the Falkirk Council triplicate studies. The R&A factor has been primarily applied to the NO_2 diffusion tubes in this report as the tubes are exposed in a variety of locations.

The local Falkirk Park St factor is then used as a sensitivity test where the results are close to the objective (36 µg/m^3). However, to only use a local factor from a single monitoring site is subject to the risk of low data capture from this site. This will be an issue in 2014 with interruptions to and likely relocation of the Falkirk Park St monitoring site.

PM_{10} monitoring adjustment

All TEOM data from the Scottish Air Quality Network sites presented in this report have been adjusted using the King's College London Volatile Correction Model (VCM). This has been carried out for the SAQN sites by Ricardo-AEA as part of the Scottish Government's contract. The Grangemouth AURN site unit is an FDMS and therefore no correction factor is required. The correction applied to Falkirk Grahams Road has used the King's College London VCM website.

Short-term to long-term data adjustment

Short-term to long-term data adjustments were carried out for the Banknock 3, Grangemouth MC and Grangemouth AURN automatic monitoring sites as well as for one diffusion tube. AURN background sites have been used for the corrections:

- NO_2: Grangemouth AURN (A8), Grangemouth Moray (A9) and Edinburgh St. Leonards sites were used.
- PM_{10}: only the Edinburgh St. Leonards site has been used. In 2013 Grangemouth AURN site did not meet the data capture requirements.

Table A1 NO_2 short to long-term data adjustments.

NA90 (Grahams Rd bridge east, Falkirk)	Site Type	Annual Mean (2013), µg/m^3	Data capture 2013, %	Period Mean, µg/m^3	Ratio
Grangemouth AURN	Urban background.	14.5	98.3	23.0	0.63
Grangemouth Moray	Urban background.	16.6	99.6	23.1	0.72
Edinburgh St. Leonards	Urban background	22.2	99.4	31.4	0.71
				Average	0.69

Table A2 PM_{10} short to long-term data adjustments.

Grangemouth AURN (A8)	Site Type	2013 Annual Mean, µg/m^3	2013 Data Capture, %	Period Mean, µg/m^3	Ratio
Edinburgh St. Leonards	Urban background.	13.6	94.4	13.5	1.005

Grangemouth MC (A10)	Site Type	2013 Annual Mean, µg/m^3	2013 Data Capture, %	Period Mean, µg/m^3	Ratio
Edinburgh St. Leonards	Urban background.	13.6	94.4	13.8	0.984

Banknock 3 (A14)	Site Type	2013 Annual Mean, µg/m^3	2013 Data Capture, %	Period Mean, µg/m^3	Ratio
Edinburgh St. Leonards	Urban background.	13.6	94.4	12.4	1.092

NO_2 Distance Calculations

None conducted.

QA / QC of Automatic Monitoring Data

Table A2 shows the QA / QC status for each automatic monitor in Falkirk Council's automatic air quality network in 2013. A description of the procedures for each network then follows.

Table A2 QA / QC applied to automatic monitoring data in 2013.

QA / QC for 2013.		
Site	**Analyser**	**Network**
A3. Bo'ness	SO_2	Local *
A4. Falkirk Haggs	NO_x	SAQN
	PM10 (TEOM)	SAQN
A5. Falkirk Hope St	NO_x	SAQN
	SO_2	SAQN
A6. Falkirk Park St	NO_x	SAQN
	PM_{10} (TEOM)	SAQN
	SO_2	SAQN
A7. Falkirk West Bridge St	NO_x	SAQN
	PM_{10} (TEOM)	SAQN
A8. Grangemouth AURN (Inchyra)	NO_x	AURN
	PM_{10} (TEOM-FDMS)	AURN
	$PM_{2.5}$ (TEOM-FDMS)	AURN
	SO_2	AURN
A9. Grangemouth Moray	NO_x	AURN
	SO_2	SAQN
A10. Grangemouth Municipal Chambers	NO_x	SAQN
	PM_{10} (TEOM)	SAQN
	SO_2	SAQN
A12. Falkirk Grahams Rd	PM_{10} (TEOM)	Local *
A13. Banknock 2	PM_{10} (TEOM)	SAQN
A14. Banknock 3	PM_{10} (Osiris)	Local #

Local * sites:

- Suspicious data or data recorded when a fault is occurring is automatically marked invalid by software. Data is also manually checked and marked invalid if it is suspicious.
- All NO_x and SO_2 analysers receive fortnightly zero and span checks and filter changes.
- All LSO site visits are carried out by Falkirk Council staff who are audited to AURN standard.
- Receive a service every six months.
- Are covered by a contract for emergency callout.
- Zero and span scaling is carried out on the data in-house based on the fortnightly site visits and additionally for the Horiba sites the auto-calibrations occurring every three days. Span adjustments are based on the concentration that is stated on the gas cylinders. No independent check is made of the cylinder concentrations, though cylinders are replaced if contamination (particularly for NO cylinders) is suspected.
- PM_{10} TEOM data is reviewed and deleted where suspect.

Local # site:

- Data is checked on a daily basis and downloaded on a weekly basis from the Turnkey AirQ website. The website displays the data without any correction factor applied.
- A flow check and filter change is carried out on an approximate four weekly basis, although this is dependent on filter loading. The filters are retained for analysis.
- All LSO site visits are carried out by Falkirk Council staff that who are audited to AURN standard.
- The Osiris is serviced on an annual basis and covered by a breakdown service agreement. In contrast to the other automatic analysers the service and repairs are conducted off-site. This does result in data capture of 90% being difficult to obtain.
- A 1.14 correction factor has been applied to the Banknock 3 PM_{10} data. It was confirmed with King's College London that the VCM could not be applied to Osiris data.

AURN and SAQN sites:

- All NO_x and SO_2 analysers receive fortnightly zero and NO span checks and filter changes. In January 2014 Defra ceased the NO_2 span checks at AURN sites.
- TEOM heads are cleaned and the filter changed when the filter loading is approaching or above 80%.
- TEOM-FDMS heads are cleaned and filters changed as directed by the AURN management team (i.e. at 90% filter loading).
- All LSO site visits are carried out by Falkirk Council staff who are audited to AURN standard.
- Are covered by a contract for emergency callout and receive a service every six months.
- Ricardo-AEA state that QA / QC is to either AURN or 'national' standards. [7]

QA / QC Diffusion Tube Monitoring

The full set of monthly raw diffusion tube results are shown in Figure A3.

ESG are rated in the 'satisfactory' category for the WASP (Workplace Analysis Scheme for Proficiency) scheme. Satisfactory is the highest grade available. ESG follow their internal standard operating procedure, this meets the guidelines set out in Defra's 'Diffusion Tubes For Ambient NO_2 Monitoring: Practical Guidance.' ESG recorded 'good' precision on 22 of 28 occasions in 2013 (see Figure A4).

Tube results are checked on a monthly basis and at the end of the year. Any results under 4 $\mu g/m^3$ are not included. If a tube is found on the ground or with a spider etc inside, an assessment is made at the end of the year as to whether the result seems appropriate for that site and time of year.

Table A3 a.) Benzene and b.) monthly NO_2 (bias uncorrected) diffusion tubes results in 2013.

a.)

		Grid Reference		January	February	March	April	May	June	July	August	Septembe	October	November	December
Site number	Location	x	y	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
3	Tinto Drive,Grangemouth	293427	680386	0.54	0.29	0.45	0.44	-	0.32	0.35	0.35	0.58	-	0.52	0.44
21	Grangemouth Road, College	290112	680500	0.17	0.3	0.33	0.49	0.92	0.29	0.32	0.21	0.44	0.31	0.52	0.33
27	West Bridge Street, Falkirk	288470	680040	0.66	0.66	0.51	0.51	0.34	0.36	0.4	-	0.59	0.58	0.16	0.39
37	Denny Town House	281227	682725	0.36	0.32	0.47	0.43	0.53	0.24	-	0.19	0.36	0.35	0.41	0.28
38	Larbert Village Primary School	285930	682318	0.52	0.1	-	0.21	-	0.28	0.25	0.18	-	0.2	0.28	0.32
41	Seaview Place, Bo'ness	299720	681600	0.43	0.54	0.7	0.33	0.27	0.26	0.51	0.37	0.5	0.39	2.1	0.4
42	Municipal Chambers, Grangemouth	292800	682000	0.34	0.31	0.81	0.49	1.1	0.3	0.33	-	0.41	0.44	0.53	0.32
44	Greenpark Drive, Polmont	293550	678860	0.32	0.23	0.52	-	0.27	0.2	0.49	0.19	0.35	0.64	0.41	0.32
55	Inchyra Station	293833	681014	0.34	0.48	0.45	0.42	0.8	0.33	0.19	-	0.51	0.36	0.42	0.37
57	Inchyra Road, Grangemouth	294028	680829	0.36	0.54	0.52	0.48	0.23	0.28	0.47	0.33	-	0.47	0.4	0.41
77	Kinnaird Village	286490	683775	0.18	0.1	0.27	0.3	-	0.98	0.24	0.19	-	0.25	0.44	0.51
80	Cow Wynd	288765	679456	0.47	0.29	0.5	0.32	1.02	0.22	0.84	0.23	0.42	-	0.51	0.35
81	Grahams Road, Falkirk	288834	680898	0.35	0.46	0.57	-	0.28	-	0.66	0.25	-	0.46	0.53	0.5
94	A905 (Glensburgh Rd), Grangemouth	291213	681927	0.17	0.26	0.47	0.22	0.9	0.26	-	2	0.4	0.3	0.46	0.34
102	East Kerse Mains, Bo'ness	297968	680684	0.29	-	0.29	0.31	0.77	-	0.27	0.31	0.4	0.66	0.54	0.31
105	West of Shieldhill	288284	676881	0.2	0.14	0.32	0.27	0.19	0.23	0.21	0.1	0.24	-	0.23	-

b.)

Site No	Address	Grid ref, x	Grid ref, y	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
3	Tinto Drive, Grangemouth	293427	680386	38.5	33.8	40.6	21.6	17.5	21.1	16	16.8	23.5	27.9	37.8	18.2
5	Copper Top Pub, Camelon	287332	680333	44.8	47.3	35.6	35.1	26.7	34.1	25.7	27.3	36.1	33.8	44.4	21.6
7	Irving Parish Church, Camelon	287324	680442	34.9	30.9	19.4	25.3	16.2	20.8	-	15.7	23.5	22.2	34	-
9	Bellsdyke Road, Larbert	286048	683542	44.9	44	36	28.4	20.6	26.5	20.6	25.9	28.7	33.7	48.1	30.9
19	Kilsyth Road, Banknock	278779	679301	58.3	34.4	56.7	52.8	32.1	42.7	-	-	-	48.5	50.9	34.2
20	Garngrew Road, Haggs	278957	679169	-	38.7	37.3	34.9	21.9	23.5	19.4	20.5	26.3	35.5	44.9	30.9
21	Grangemouth Road, College	290112	680500	40.4	49.7	46.7	35.6	23.5	30.4	27.1	27.5	36.9	32.9	49.4	18
24	Kerse Lane, Falkirk	289189	680018	55.9	-	-	49.5	37.6	54.7	47.6	53.2	47.4	51.5	77	-
26	Weir Street, Falkirk	289207	680123	36.3	37.1	33.5	22.8	17.3	20.1	16.5	15.1	24.7	22.4	38.9	25
27	West Bridge Street, Falkirk	288490	680055	116.2	102.8	60.9	75.4	52.9	64.9	34.7	-	66.5	62.7	70.5	26.8
29	Wellside Place, Falkirk	288465	680220	35.5	26	28.5	26.1	12.7	19.7	16.1	13.4	22.8	22.7	30.5	21.2
36	Kerr Crescent, Haggs	278985	679273	63.2	60.4	-	44	37.4	46.5	40.8	37.8	48.9	53.2	71.1	-
37	Denny Town House	281226	682526	34.2	33.3	34.6	26.7	16.8	21.5	16.2	15.8	16.5	26.2	32.7	16.8
38	Larbert Village Primary School	285930	682318	31.7	31.8	31.4	21.4	10.6	19.2	14.2	15.8	22	22.9	38.2	25.8
41	Seaview Place, Bo'ness	299722	681594	33.3	37.9	34.3	29.7	20.4	24.2	19.2	21.2	26.4	26.7	38.3	23.4
42	Municipal Chambers, Grangemouth	292817	682000	36.8	33.7	31.1	22.6	14	19.6	17	17.3	23.4	25.2	37.5	18
42				41.4	30.6	41.8	21.3	16.5	20.5	16	17.3	24.2	25.7	35.5	18.4
42				40.6	23.4	38.2	22.4	16.2	20.9	15.4	17.8	22.2	25	36.5	19.5
44	Greenpark Drive, Polmont	293436	678938	-	30.1	30.7	-	12.9	16.2	13.4	13.5	19.4	22.6	31.6	15.3
47	Thistle Avenue, Grangemouth	292000	680300	41.1	41.1	40.7	28.6	20.7	20.9	19.6	20	27.6	28	41.5	-
48	Hayfield, Falkirk	289200	681580	35.4	36.1	41.5	26.4	17.4	21.6	16.6	15.9	25.6	24.4	33.7	15.3
50	Upper Newmarket Street	288671	680047	42	48	59.8	47.2	23.7	39.1	21.9	-	36.2	41.4	37.6	17.2
51	Mary Street, Laurieston	290965	679490	36.9	43.1	30.2	26.1	23	30.3	20.2	26.3	22.9	30.5	43.1	24.9
52	Main Street, Larbert	285866	682356	33	37.1	38.8	34	19.8	29.2	24.1	25.9	25.2	32.1	44.5	43.5
53	Denny Cross	281211	682727	58.5	51.4	70.1	55.7	29.1	36.2	26.8	20.7	38.3	44.7	42.1	17
57	Inchyra Road, Grangemouth	294028	680829	51	43.9	40.2	30.9	22.2	27.3	21.4	22	30.6	32.9	47.4	26.6
58	Callendar Road, Falkirk	289667	679724	32	37.5	44.8	27.6	16.1	24.1	19	16.3	27.6	28.9	33.6	25.6
59	Carron Road, Bainsford	288392	681931	45.4	46.5	43.4	30	27.3	31.2	26.6	27.1	33.7	36.6	51.4	18.4
60	Ronades Road, Carron	288133	681587	50.5	45.6	47.5	33.5	21.5	29.6	23.4	22.5	32.6	36.6	52.6	-
61	Canal Rd, Falkirk	287976	680656	47.9	40.4	42.3	31.9	22.7	19.6	25	24.6	30.8	34.7	46.9	16.6
62	Arnot Street, Falkirk	289125	679705	51.7	58.6	59.8	47.4	36.9	39.9	37	39.1	46.3	48.7	63.3	17.9
63	Camelon Road, Falkirk	288055	680134	57.7	59.5	57.8	48.5	31.8	44.7	39.5	39.6	49.2	51	64.5	23.1
64	New Hallglen Road, Hallglen	288807	678422	37.6	31.4	32	24.2	14.3	22	15	14.4	26	28.9	28.3	20.8
65	Redding Road, Redding	291356	678644	39.3	-	43.1	-	18.9	27.9	18.4	22	32	31.9	-	35.2
67	Queen Street, Falkirk	289430	680433	54.7	49.8	48.1	37.4	26.9	34.2	29.6	-	42.2	34.2	50.1	20.4
68	Belluvue Street Falkirk	289234	679945	50.3	52.3	42.2	33.2	25.9	33.8	30.2	34.2	38.9	41.4	62.4	20.1

69	Kerse Lane, Falkirk	289025	679991	46.6	-	52.8	53.3	32.9	42.7	36	31.4	47.2	-	55.4	20.2
70	Park Street AQ station, Falkirk	288892	680070	39.3	42.8	35.3	35.8	27.2	30	29.2	31.7	35.5	36	34.4	28
70				52.4	48	40.6	33.5	29.4	34.6	27.7	28	36.6	33	48.3	22.8
70				45	45.6	40.7	34	25.7	34.6	25	31.8	34.5	36.9	40.3	22.9
71	Park Street, Falkirk	288910	680112	54.8	54.3	50.9	44.5	26	41.9	30.9	38.2	47.1	45.8	59.9	36
72	Vicar Street, Falkirk	288824	680120	41	49.9	50.6	36.9	28.9	38.9	30.1	28.8	41.7	44.1	47.6	51
73	West Bridge Street, RHS,Falkirk	288467	680048	63.7	55.6	49.2	52.3	33.5	41.4	39.1	34.3	41.3	44.6	51	20.4
76	Tryst Road, Stenhousemuir	286851	683229	32	41.1	-	25.3	10.6	18.1	16.9	19	23	26	45.5	16
77	Kinnaird Village	286490	683775	45.5	44.8	28.1	28	21.8	25.6	19.8	20.6	26.4	28.7	44.1	-
78	Glen Brae, Falkirk	288525	678991	54.3	48.3	43.6	36.8	25.5	38.2	30	32.1	36.7	39.5	52.4	11.9
80	Cow Wynd, Falkirk	288765	679456	41.8	25.2	37.9	37.2	29.1	36.5	31.4	27.4	35.5	41.8	56.6	33.8
81	Grahams Road, Falkirk	288834	680898	54.1	49.4	47.9	-	-	-	26.5	26.5	33.7	35.4	41.6	-
82	Castings Ave, Falkirk	288858	681036	35.6	31.2	31.5	22.5	13	18	17.4	16.4	25.1	27.3	36.8	30.7
83	Main Street, Bainsford	288614	681415	47.5	61.2	54.4	42	34.2	48.2	41.2	-	40.6	44.7	64.6	31.6
85	Auchincloch Drive, Banknock	278752	679049	38.4	41	36.5	30.8	19.1	28.3	15.1	17.7	29.3	31.3	39.9	15.6
86	Wolfe Rd, Falkirk	289667	679871	37.7	32	25	21.3	15	17.3	12.9	13.5	22	23.6	32.4	27.7
87	M80 slip south, Haggs	279017	679305	40.5	46.9	44.3	39.3	32.2	43.8	24.7	39.6	38.7	43	53.5	30.1
88	Ure Crescent, Bonnybridge	282444	681074	40.2	47.3	33.8	35.9	32.1	35.3	31.8	30.4	37.5	40.1	56.2	25.3
89	Grahams Rd/Meeks Rd, Falkirk	288853	680328	45.1	52	45.6	42.2	31.3	38.4	35.3	37.6	45.9	46.5	68	17.6
90	Grahams Rd bridge east, Falkirk	288855	680234	52	56.8	-	-	-	-	-	-	-	-		-
94	A905 (Glensburgh Rd), Grangemouth	291213	681927	50.4	51.2	54.6	34.2	37.2	39.9	37.3	37.9	46.3	42.7	69.4	36.8
98	Arnothill, Falkirk	288095	680105	41.6	43.2	43	33.6	18.2	25.6	16.8	20.8	30.8	29.7	37.6	38.5
99	St Crispins Place, Falkirk	288924	679675	39.6	45.5	34.4	34.9	19.7	29.8	24.2	26.7	33.6	38.6	50.8	18.5
100	Oswald St, Falkirk	288977	679662	33.1	35.1	35	25.1	16.9	21.6	16.3	17	25.3	27.3	32.1	24.6
101	Glensburgh Road, Grangemouth (2)	291127	682007	30.7	44.4	41.6	30	19	25.1	14.9	18.1	28.1	31.8	45.5	-
103	Merchiston Gardens	288270	680989	26.3	31.9	31.5	22.2	24.5	18.1	13.3	14.7	22.5	26.6	38.8	15.4
105	West of Shieldhill	288292	676889	14.3	18.9	11.6	10.3	7.4	10.8	6.5	7.5	11.4	13.1	18.3	14.7
106	Stirling Road, North Broomage	284975	683532	30.2	32.7	29.9	26.9	12.2	17.7	8.2	13.2	16.9	24.9	30.6	15.5
107	Main Street (east), Bainsford	288640	681395	-	-	45.7	40.7	-	36.4	15.7	28.3	43.9	45.7	52.7	38.6

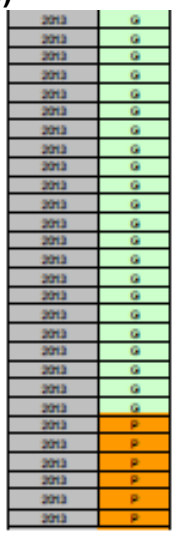
The diffusion tubes are changed as per the diffusion tube calendar. A few tubes are changed slightly earlier, especially during winter. This is due to the nature of the route and weather, but all are changed within the +/- 2 days permitted by the calendar.

Table A4 a.) Dates of diffusion tube changeovers and b.) ESG Didcot precision, 2013.

a.)

Year	Start Date	Start date	Duration (weeks)
2013	January	02/01/2013	5
	February	30/01/2013	4
	March	27/02/2013	4
	April	27/03/2013	4
	May	24/04/2013	5
	June	29/05/2013	4
	July	26/06/2013	5
	August	31/07/2013	4
	September	04/09/2013	5
	October	02/10/2013	4
	November	30/10/2013	4
	December	04/12/2013	5
2014	January	08/01/2014	5

b.)



Pumped diffusion tube (Grangemouth AURN):

Falkirk Council Officers act as the LSO for the pumped diffusion tube at the Grangemouth AURN site. The tubes are changed on a fortnightly basis with QA / QC performed by Ricardo-AEA under contract to Defra and the DAs. Two audits are carried out per year. The results included in this report have been downloaded from the UK-AIR website.

DMRB Calculations

Table A5 Background concentrations used in the DMRB runs.

Link	2013 background concentration, µg/m^3		
	NO_x	NO_2	PM_{10}
A9 Stirling Road, Larbert	17.73	12.16	13.41

Table A6 Other input data to the DMRB runs.

Link	%HGV	Mean speed, kph	Distance (closest) receptor to centre link, m	AADT
A9 Stirling Road, Larbert	5%	60	2.8	12,932

Table A7 Verification for DMRB runs.

Verification	Background NO_2	Monitored NO_2	Modelled NO_2	NO_2 difference, %
NA77 Kinnaird Village	13.32	24	16.4	-31.7

The DMRB modelled component of PM_{10} was adjusted by the NO_x ratio from the verified site.