Falkirk Council

2013 Air Quality Progress Report

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

October 2013

Local Authority Officer	Author: Jon Flitney. Reviewed by: Stuart Henderson and Alf Hillis.
Department	Environmental Health
Address	Abbotsford House, David's Loan, Falkirk, FK2 7YZ.
Telephone	01324 504950
E-mail	envhealth@falkirk.gov.uk
Report Ref:	2013 Progress Report
Status	Final version following Scottish Government appraisal. No changes to June version.
Date	October 2013

Executive Summary

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.

Table of contents

Appendices

List of Tables

List of Figures

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
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 Environmental Protection Agency
SO_2	Sulphur dioxide
TEOM	Tapered Element Oscillating Microbalance.
U&SA	Updating and Screening Assessment (Report)
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.

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 Local Air Quality Management 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.

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 micrograms 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).

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 a 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. 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 may result in an Air Quality Management Area and not the occurrence of an individual or several exceedances.

1.4 Summary of Previous Review and Assessments

A summary of work in the last four years:

Grangemouth AQMA Action Plan Update, May 2009

As recommended by the Review and Assessment Helpdesk, Falkirk Council submitted a separate report detailing the progress made with the Action Plan for the Grangemouth

AQMA. The key measures of this Action Plan include the continuation of the text alert system for SEPA and INEOS and the extension of the working group to include INEOS and the Scottish Government. In addition, work is currently underway on a revised Further Assessment, this will provide improved modelling for the Grangemouth area and discuss the SO_2 monitoring data collected by Falkirk Council.

2009 U&SA, August 2009 [1]

A review of pollutant monitoring data and atmospheric emissions sources within Falkirk Council area has been undertaken. The assessment compared the available monitoring data to national air quality standards (NAQS) in order to identify any existing exceedances of the standards.

The review of emission sources identified that emissions from shipping, rail, road traffic, domestic and industrial emissions had not changed significantly since the last round of review and assessment.

NO_2 concentrations measured during 2008 exceeded annual mean NAQS objective at some monitoring locations in Falkirk town centre. Falkirk Council is currently undertaking a consultation on the boundaries for two proposed Air Quality Management Areas (AQMAs) within Falkirk.

NO_2 concentrations measured during 2008 exceeded annual mean NAQS objective at the automatic monitoring site in Haggs. A Detailed Assessment submitted in May 2009 is currently being appraised by the Scottish Government. This report concluded that an AQMA would be required for NO_2 around the A80 slip road junction in Haggs / Banknock.

Monitoring of SO_2 within the Grangemouth AQMA indicates that the 15-minute mean SO_2 objective continues to be exceeded. In addition, the number of SO_2 exceedances has increased since 2006. The Action Plan update therefore concluded that the AQMA is still required. Monitoring of PM_{10}, benzene and 1,3-butadiene indicates that concentrations are below the NAQS objective levels and there are no predicted exceedances for the objective year of 2010.

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, July 2010

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 [2]

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 90.4^{th} 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, July 2011

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 U&SA, June 2012

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 µg/m^3 and was close to recording a breach of the daily objective with a 98th percentile concentration of 49 µg/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.

AQMAs

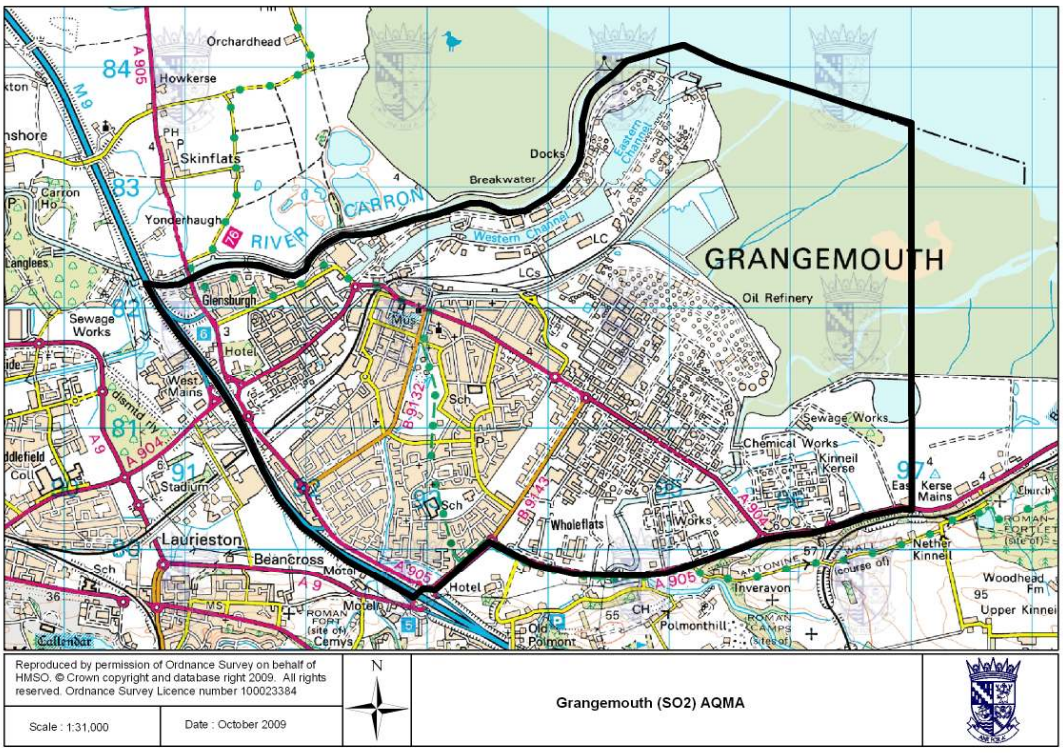
Falkirk Council has four active Air Quality Management Areas. The Grangemouth AQMA was declared for a potential breach of the 15-minute SO_2 objective. This AQMA covers the Grangemouth area and was declared in November 2005, see Figure 1.1a. This AQMA is in relation to industrial emissions.

Falkirk Council originally declared three AQMAs for NO_2 in Falkirk Town Centre and Haggs in March 2010, see Figures 1.1b to d. In January 2013 the hourly AQMA covering part of Grahams Road in Falkirk Town Centre was revoked. This was justified as the monitoring carried out at the Falkirk Grahams Road (A12) site and the modelling in the Further Assessment showed that the hourly objective was being met in the AQMA.

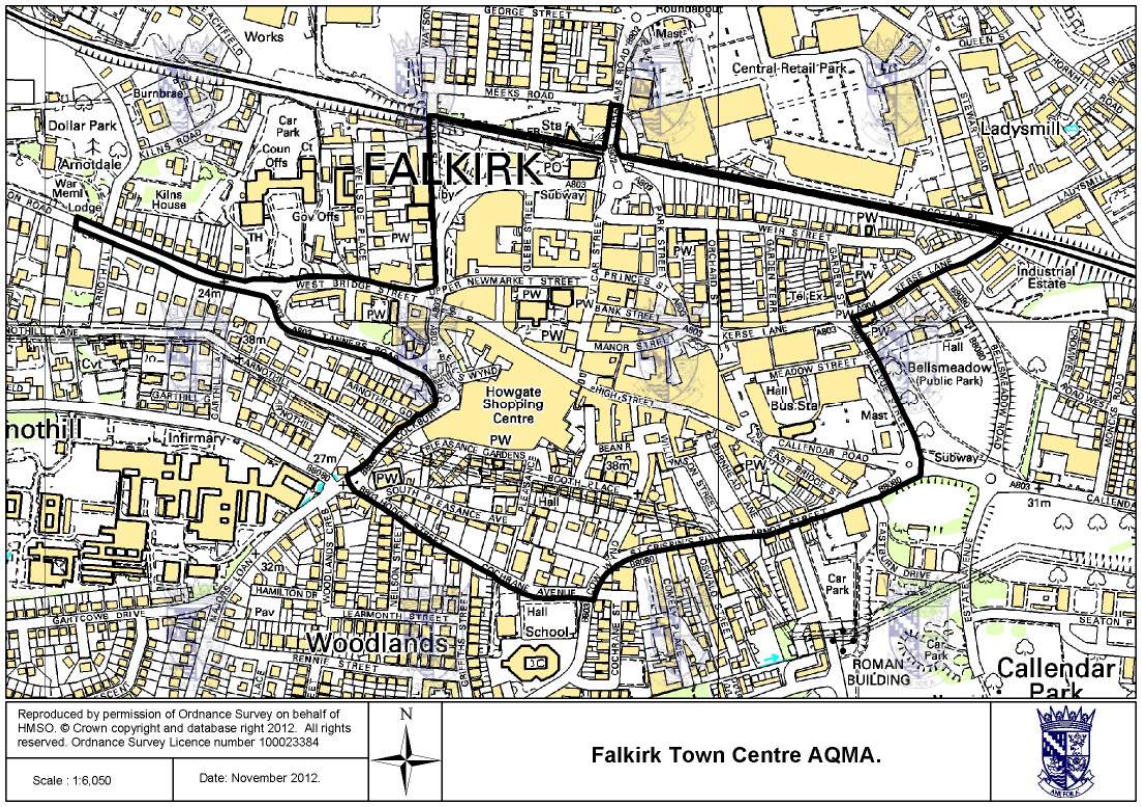
An AQMA was declared in the Banknock area in August 2011 in relation to breaches of the Scottish and potential breaches of the UK PM_{10} objectives, see Figure 1.1e.

An update on all AQMAs and / or Action Plans is given in Section 5.

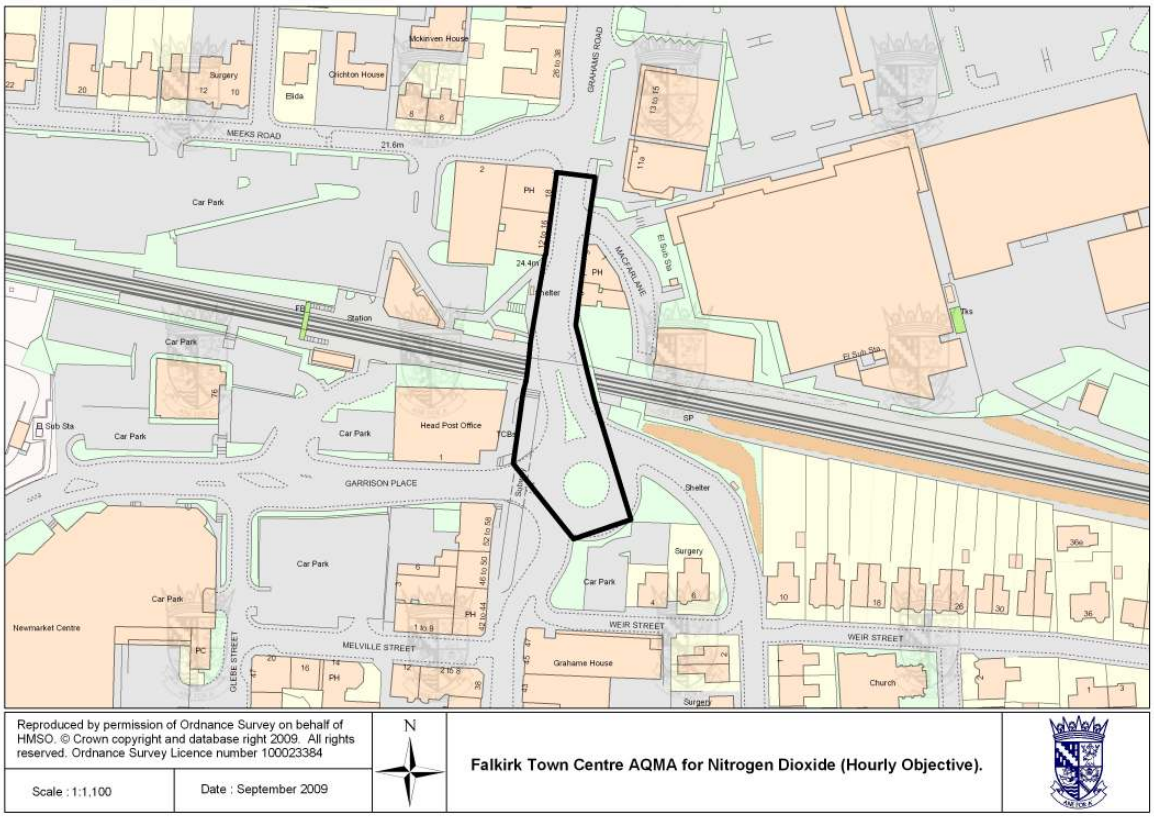
Figure 1.1 Five maps showing the boundaries of Falkirk Council's AQMAs.
a.) Grangemouth AQMA (15-minute SO_2), declared November 2005.



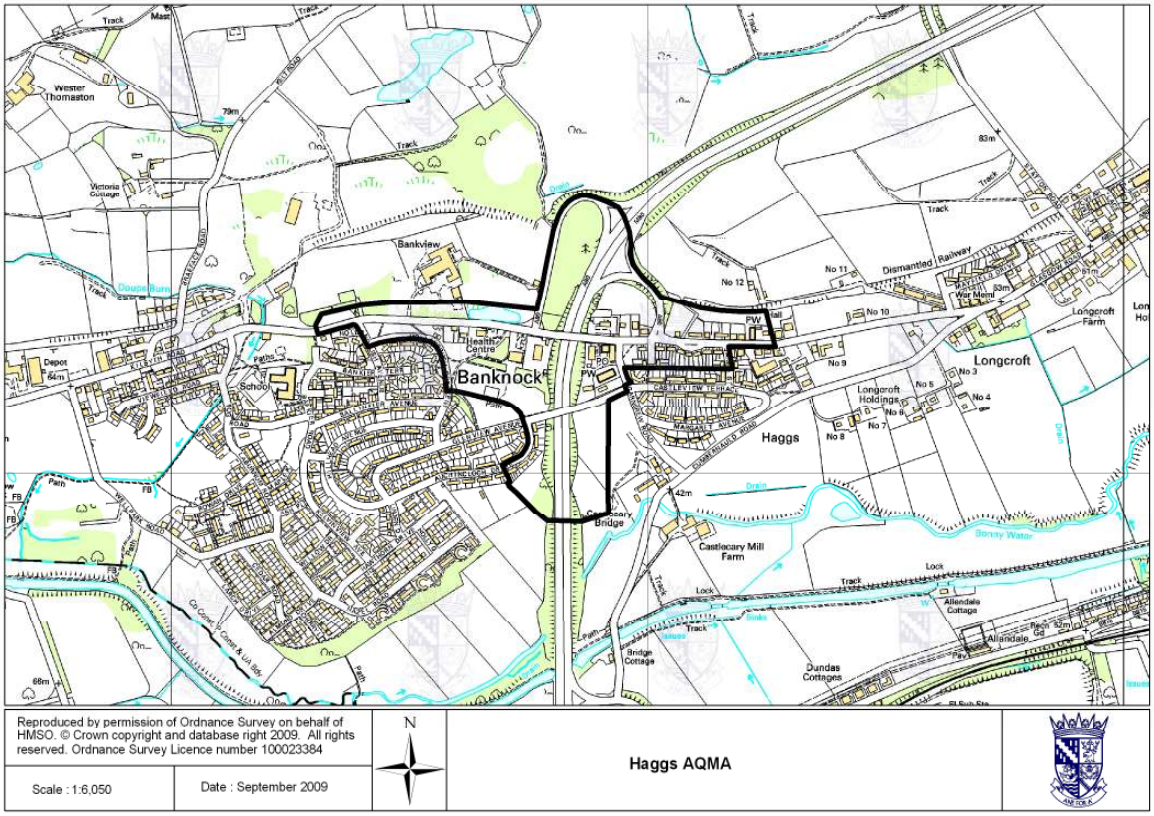
b.) Falkirk Town Centre AQMA (annual NO_2), declared March 2010 and amended in January 2013 to include PM_{10} (2010 annual and daily objectives).



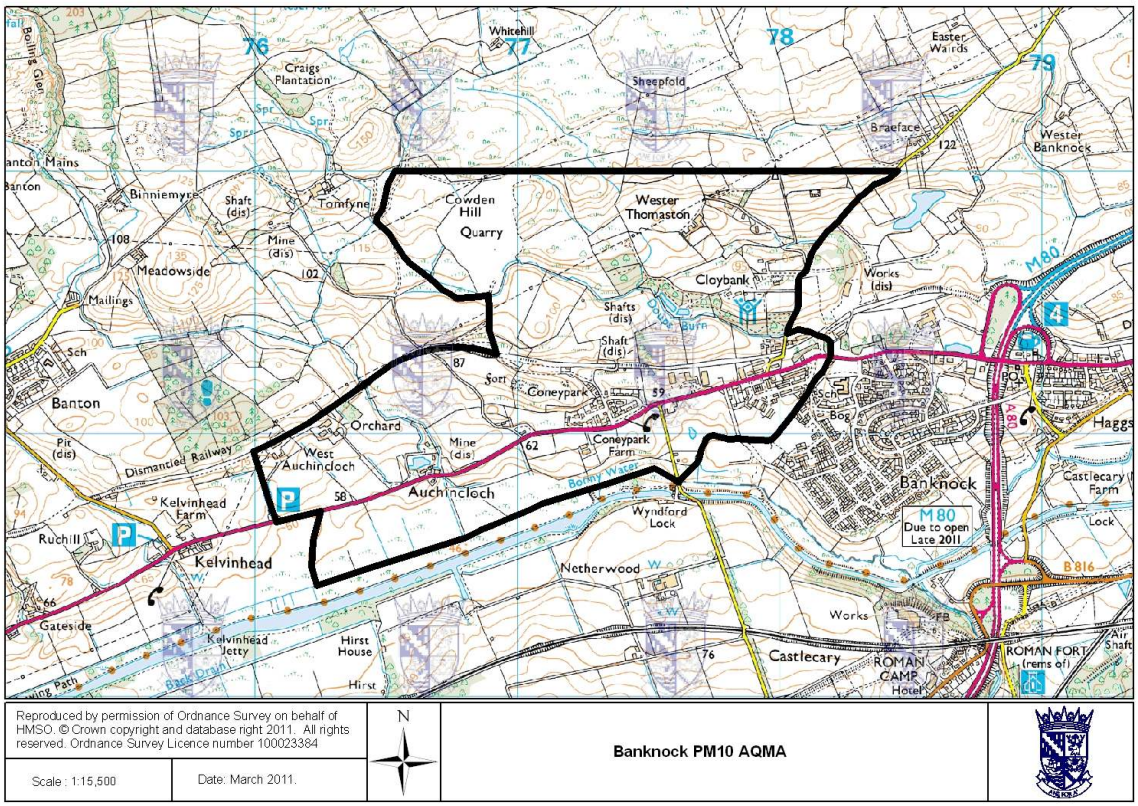
c.) Falkirk Town Centre AQMA (hourly NO_2), declared March 2010 and revoked January 2013.



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



e.) Banknock AQMA (PM_{10}), declared August 2011.



2 New Monitoring Data

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

In 2012 Falkirk Council operated automatic monitoring stations at 12 locations from Banknock in the west to Bo'ness in the east. The automatic monitoring was conducted for $PM_{2.5}$, 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 data from AURN sites is used as part of the UK's reporting to the EU in terms of compliance with the European objectives.

In 2012 the remaining analyser at the Grangemouth Moray site (SO_2) and five other monitoring sites (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 (Bo'ness, Polmont and Banknock 1 and 2) were 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 2012:

- Falkirk Grahams Road (A12): The installation of a PM_{10} (TEOM) was discussed in the 2012 U&SA. This unit commenced operation on the 20th December 2011 and this report therefore includes a full year of results for this analyser.
- Banknock 1 (A2): This site (PM_{10}, Osiris) ceased operation at this location on the 8th October. This is because the site has been replaced by the Banknock 2 site (PM_{10}, TEOM).
- Banknock 2 (A13): A PM_{10} (TEOM) unit was installed on the 17th November 2012, with data available from the 14th December 2012 following initial problems. The data for 2012 is included in this report and has been annualised, but should be treated with caution bearing in mind the short period of monitoring. This site was affiliated to the Scottish Air Quality Network in January 2013. Please note this site will be called 'Falkirk Banknock' on the SAQN website.
- Falkirk Haggs (A4): The Further Assessment for this AQMA recommended that PM_{10} monitoring be conducted in the Haggs area. A TEOM commenced operation at the existing automatic monitoring site on the 4th December 2012. The data for 2012 is included in this report and has been annualised, but should be treated with caution bearing in mind the short period of monitoring. This analyser was affiliated to the Scottish Air Quality Network in January 2013.
- Polmont (A11): The 2012 U&SA proposed that this site (SO_2) cease operation as only one 15-minute exceedance was recorded during the two years of monitoring.

* Defra / DA owned analysers.

Therefore the site ceased operation on the 2nd October 2012. The three sites that monitor SO_2 outside the AQMA are considered to give a good coverage of background SO_2 concentrations. In addition, they help to confirm the boundaries of the Grangemouth (15-minute) AQMA.

- In addition a trial of a new data logger has been conducted at the Grangemouth AURN site. This uses a GPRS data connection rather than a 56k modem link. This significantly improves the speed and ease of data acquisition. It is hoped during 2013 that this or a similar system can be used at other sites in the automatic monitoring network.

The following change to the automatic monitoring network is outstanding:

- The Osiris unit previously located at Banknock 1 (A2) is to be located at a background site (i.e. away from the A803) in the Banknock PM_{10} AQMA. This site will be called Banknock 3.

Figure 2.1 A map showing the new automatic monitoring site in Falkirk Council area in 2012, Banknock 2 (A13). (Banknock 1 (A2) is shown for reference.)

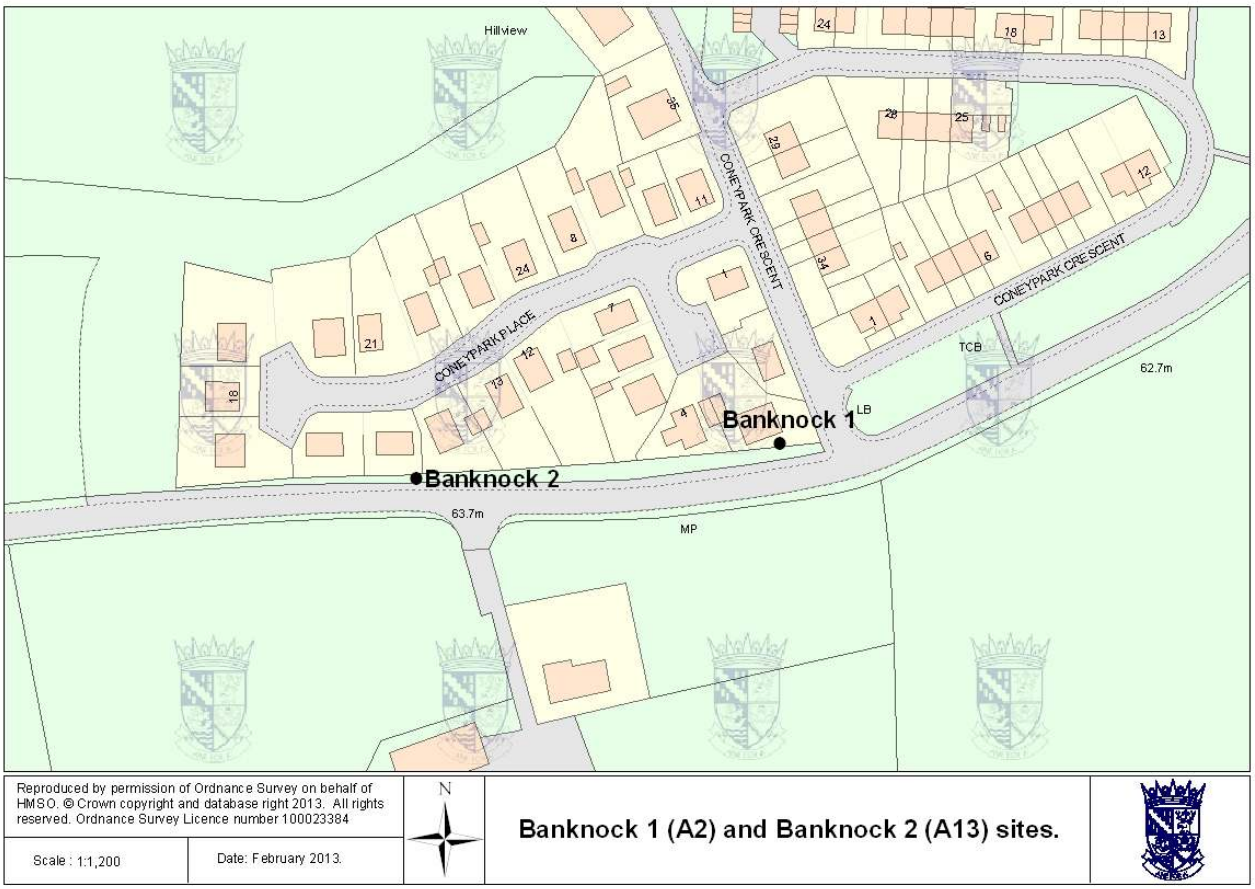


Table 2.1 Details of automatic monitoring sites in the Falkirk Council area.

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?
A2. Banknock 1	Roadside.	277348	679037	PM_{10}	Osiris	Y (PM_{10})	Y (1 m)	6 m	N
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.	NO_x and 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.	SO_2 and NO_x: 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
A11. Polmont	Urban background.	293483	678963	SO_2	SO_2: ML.	N	Y (1 m)	35 m *	N #
A12. Falkirk Grahams Rd	Roadside.	288823	680242	PM_{10}	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

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 2012 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. passive diffusion tubes). The non-automatic monitoring network remained relatively stable in 2012. The diffusion tubes have achieved good data capture across the year, with only the new site (NA106) not achieving an annual data capture of 75%. In addition, a pumped benzene diffusion tube (Defra / DA equipment) was also in operation at the Grangemouth AURN (A8) site as part of the AURN non-automatic hydrocarbon network.

The details of the tubes used and the QA / QC for the non-automatic monitoring are given in the Appendix, A2. The following non-automatic sites have ceased operation since the 2012 U&SA:

- NA90, Grahams Road east (NO_2): This site ceased operation in January 2012. The site has been discontinued as this site was within the objective and the area is covered by two other diffusion tubes.
- NA105, Stirling Road, Larbert (NO_2): This tube was originally sited following the opening of Forth Valley Royal Hospital. The site has been discontinued as the 2012 result is within the objective.

The following diffusion tube sites have commenced operation since the 2012 U&SA. The location of NA106 is shown in Figure 2.2 and NA107 will be shown in the 2014 Progress Report:

- NA106, North Broomage (NO_2): This site will provide monitoring near the new M876 slip roads that have opened at Glenbervie (Junction 2).
- NA107, Main Street, Bainsford (east) (NO_2): to aid understanding of NO_2 concentrations along this street. This site commenced February 2013.

Falkirk Council carried out two triplicate studies in 2012. This involves three NO_2 diffusion tubes being co-located along with an automatic monitoring station. This enables the diffusion tube results to be bias adjusted and so accounts for their difference to the results from an automatic monitor in the same location. 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' (formerly Harwell Scientifics). The bias sheets from Grangemouth MC, Falkirk Park St along with 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 used the R&A helpdesk factor for the 2012 results as there are a mixture of roadside and background sites. In 2012 the Falkirk Park St (0.86) and Grangemouth MC (0.91) factors were fairly similar to each other. The R&A bias factor for these tubes in 2012 was 0.79. (Note; the data submitted to the R&A Helpdesk

uses provisional data for the second half of the year as the helpdesk factor is compiled prior to ratification.)

Figure 2.2 A map of the new non-automatic monitoring site in the Falkirk Council area in 2012.

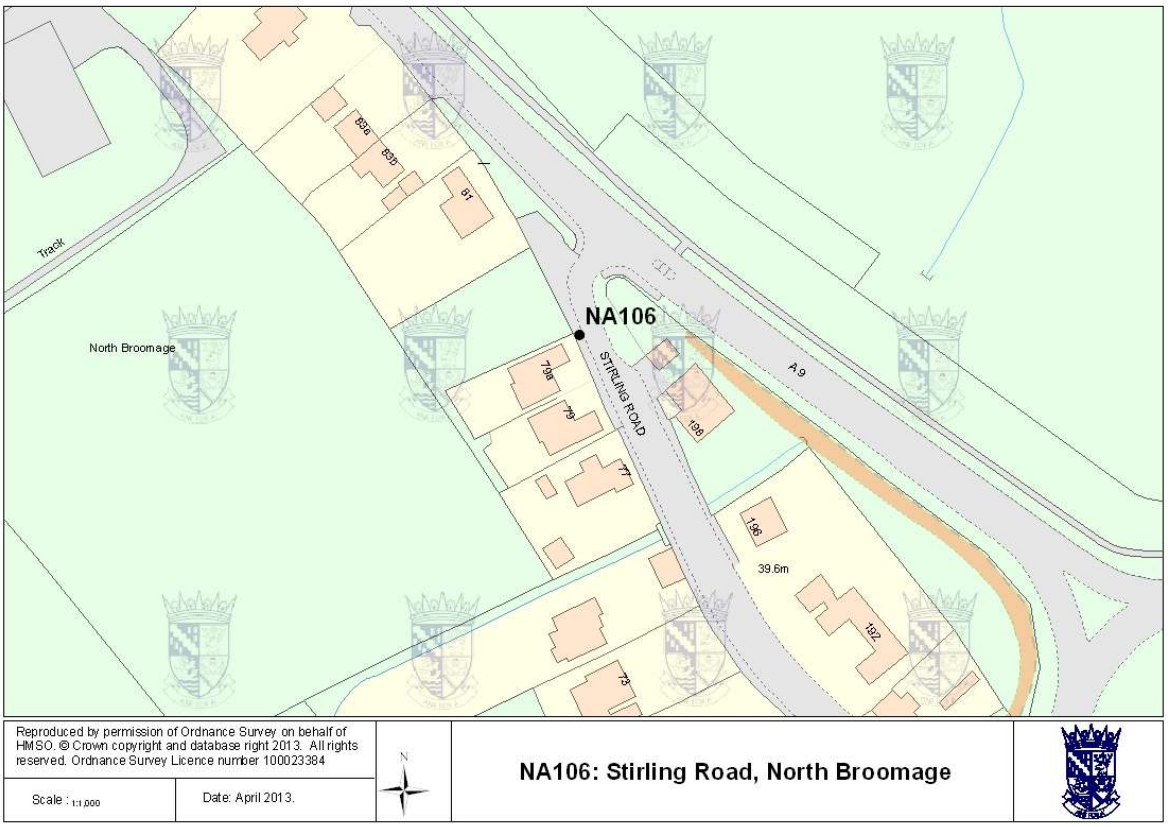


Table 2.2 Details of non-automatic monitoring sites

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.	289022	679990	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
NA97	Stirling Road, Larbert	Roadside.	285239	683263	NO_2.	N	Y (11.2 m)	3.3	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

2.2 Comparison of Monitoring Results with Air Quality Objectives

2.2.1 Nitrogen Dioxide

Automatic Monitoring Data

In 2012 Falkirk Council operated seven automatic sites monitoring nitrogen dioxide (NO_2). Across these sites there has been a slight increase in concentrations compared to 2011, whether at background or roadside locations. The concentrations at the roadside sites increased by 1.5 µg/m^3 to 35.9 µg/m^3 at Haggs and at the Falkirk West Bridge St site by 7.5 µg/m^3 to 43.4 µg/m^3. This followed an unusually large decrease in concentrations between 2010 and 2011. The Falkirk West Bridge St result has not been annualised as the missing data is, with the exception of two weeks in June, mostly spread throughout the year.

The only automatic monitoring site to breach the NO_2 annual objective in 2012 was the Falkirk West Bridge St site. This monitoring site is within the Falkirk Town Centre AQMA. In 2012 no exceedances of the hourly NO_2 limit value were recorded, therefore there were no breaches of the hourly NO_2 objective. In January 2013 the hourly NO_2 AQMA, that encompassed part of Grahams Road in Falkirk Town Centre, was revoked.

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

Site	Location	Within NO_2 AQMA?	Data Capture 2012, %	Annual Mean Concentration µg/m^3			
				2009	2010	2011	2012
A4	Falkirk Haggs	Y	93.5	37.6 *	**42.5**	34.4	35.9
A5	Falkirk Hope St	Y	99.3	23.8	27.7	24.1	25.1
A6	Falkirk Park St	Y	99.1	29	32.9	28.5	33.2
A7	Falkirk West Bridge St	Y	84.4	38.2	**43.8**	35.9 * #	**43.4***
A8	Grangemouth AURN	N	95.1	17.7	19.3 *	15.1	16.2
A9	Grangemouth Moray	N	97.8	19.3	23.3	17.3	19.6
A10	Grangemouth MC	N	95.1	22.8	26	21.6	24.1

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

Site	Location	Within NO_2 AQMA?	Data Capture 2012, %	Number of Exceedances of Hourly Mean (200 µg/m^3), (99.8th percentile in brackets).			
				2009	2010	2011	2012
A4	Falkirk Haggs	Y	93.5	1 (159) *	1 (164)	0 (142)	0 (141)
A5	Falkirk Hope St	Y	99.3	0 (88)	0 (109)	0 (111)	0 (133)
A6	Falkirk Park St	Y	99.1	0 (107)	0 (107)	0 (97)	0 (107)
A7	Falkirk West Bridge St	Y	84.4	0 (120)	0 (126)	0 (113) *	0 (124) *
A8	Grangemouth AURN	N	95.1	0 (103)	0 (124) *	0 (78)	0 (92)
A9	Grangemouth Moray	N	97.8	0 (94)	0 (134)	0 (84)	0 (86)
A10	Grangemouth MC	N	95.1	0 (104)	0 (136)	0 (86)	0 (103)

Notes for Table 2.3 a and b:

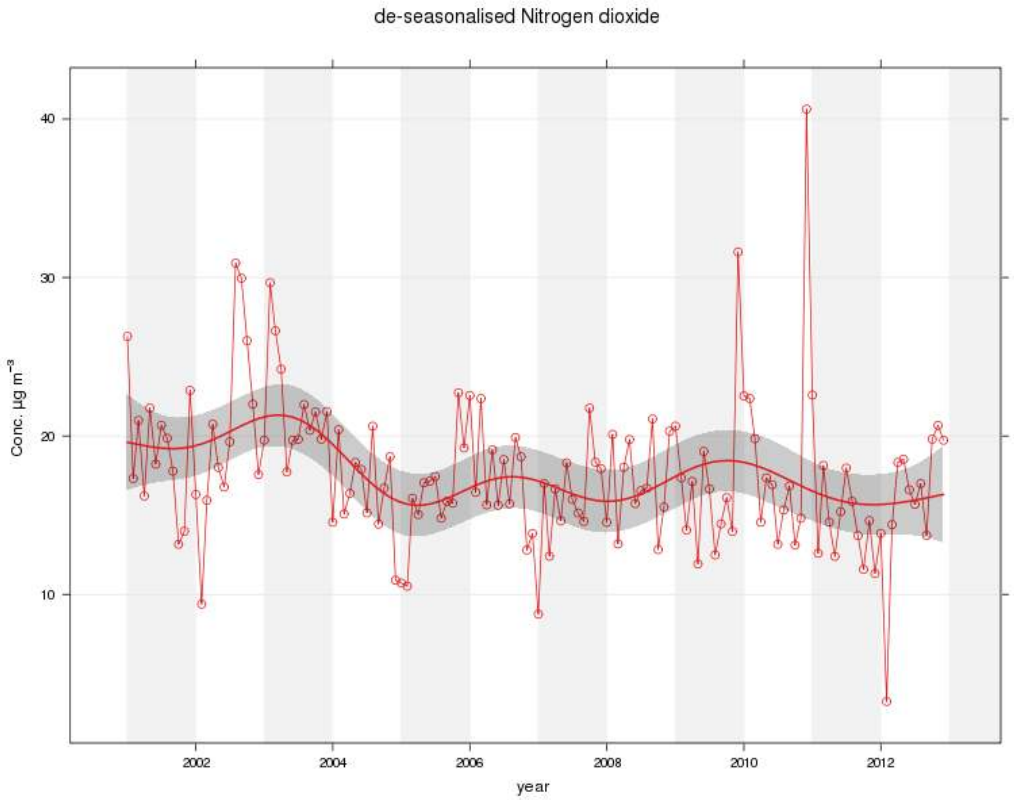
- * Less than 90% data capture.
- # For annual concentrations result has been annualised.
- Falkirk West Bridge St (A7) has not been annualised for 2012 as most of the missing data (except two weeks in June) is spread across the year.

The technical guidance requires concentrations to be reported for calendar years. 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. The graphs show that there is a slight long-term decrease in NO_2 concentrations at the background Grangemouth AURN site between 2001 and 2012.

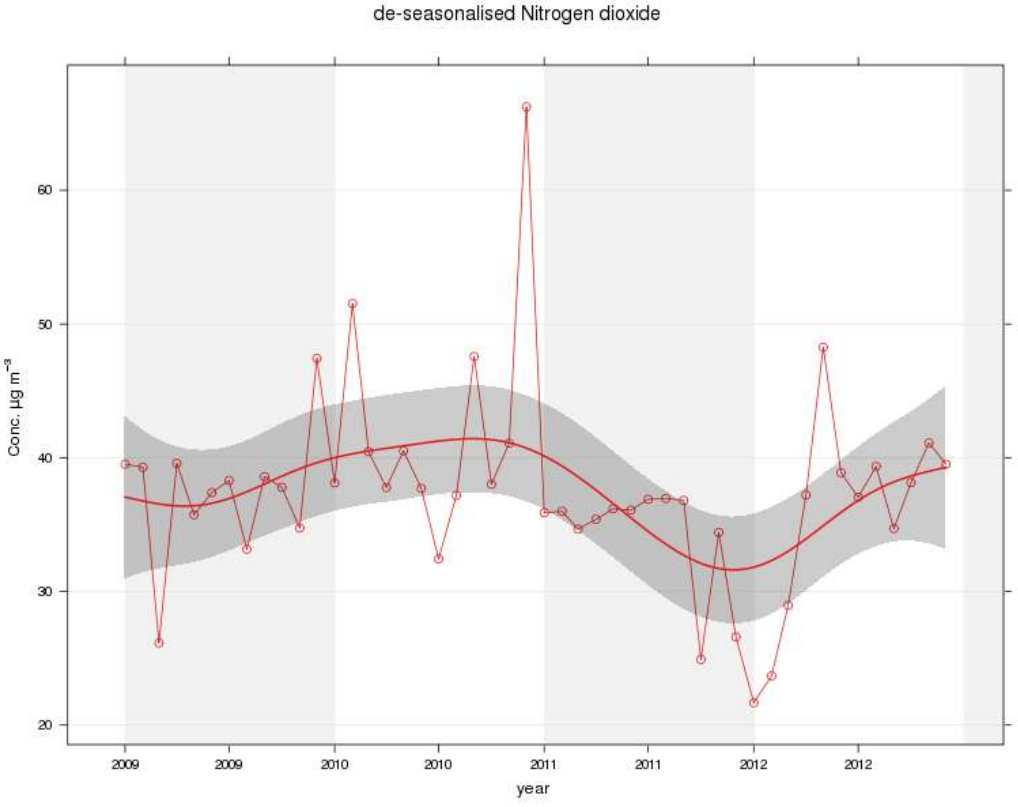
There is overall a slight long-term increase in NO_2 concentrations at the Falkirk West Bridge St site between 2009 and 2012. The Haggs site shows a notable decrease (as reflected in the annual concentrations) between 2010 and 2011, although there is no overall trend between 2009 and 2012.

Figure 2.3 A smooth trend plot of NO_2 concentrations at a.) Grangemouth AURN, b.) Falkirk Haggs and c.) Falkirk West Bridge St.

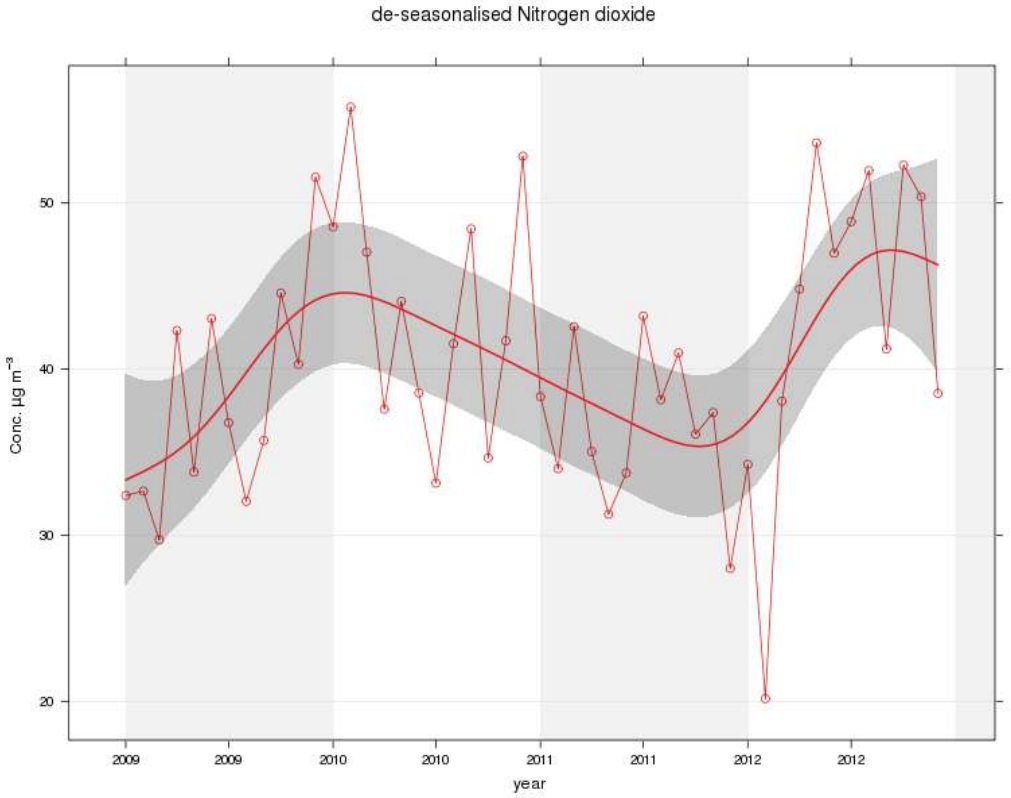
a.)



b.)



c.)



Diffusion Tube Monitoring Data

Table 2.5 shows the annual concentrations in 2012 for Falkirk Council's NO_2 diffusion tubes and the results for 2009 to 2011. The only NO_2 diffusion tube that did not achieve a data capture of 75% in 2012 was NA106 (Stirling Road, North Broomage). This was because the site began operation in November. The results in Table 2.5 have not been distance corrected. This is carried out as necessary for the tubes that require it, with the calculations shown in Table A1.

The following diffusion tubes recorded a concentration greater than the annual NO_2 objective of 40 µg/m^3 in 2012 (with the application of the R&A bias factor):

- NA27 West Bridge St, Falkirk: This site is in the Falkirk Town Centre AQMA and is close to the Falkirk West Bridge St site (A7). The tube has recorded a concentration greater than 60 µg/m^3 which may indicate a breach of the hourly objective. However, it was noticed in early 2013 that this tube was on the kerb-side of the lamp post rather than its normal position of the footpath side of the street. This was rectified at the next tube changeover. This ties in well with the significant increase from the consistent concentrations recorded between 2009 and 2011. It is also considered that the site, particularly if facing the kerb, is not representative of receptors in relation to the hourly objective and so no Detailed Assessment or adjustment to the Falkirk Town Centre AQMA is required.
- NA36 Kerr Crescent, Haggs: This site is in the Haggs AQMA.
- NA63 Camelon Road, Falkirk: This site in on the boundary of the Falkirk Town Centre AQMA.

- NA83 Main St, Bainsford: The concentration recorded at this tube, with the R&A bias factor applied, was 41 µg/m^3. When the distance to the nearest receptor is calculated (see Appendix A1) this decreases to 37.5 µg/m^3. In line with the 2012 U&SA it is therefore considered that no Detailed Assessment is required. An additional tube (NA107) has been placed on the opposite (east) side of Main Street to ensure that the NO_2 objectives are being met along this road.

The following diffusion tubes recorded a concentration close to the objective (36 to 40 µg/m^3) in 2012:

- NA19 Kilsyth Road, Banknock: This site is in the Haggs AQMA.
- NA24 Kerse Lane, Falkirk: This site is in the Falkirk Town Centre AQMA.
- NA62 Arnot St, Falkirk: This site is in the Falkirk Town Centre AQMA.
- NA69 Kerse Lane, Falkirk: This site is in the Falkirk Town Centre AQMA.
- NA71 Park St, Falkirk: This site is in the Falkirk Town Centre AQMA.
- NA87 M80 slip south, Haggs: This site is in the Haggs AQMA.
- NA94, Glensburgh Road, Grangemouth: This site has been discussed in previous R&A reports. The concentration at the location of the tube has increased slightly from 37 µg/m^3 in 2011 to 38 µg/m^3 in 2012. (Although it should be noted that the 2011 result was annualised due to data capture being lower than 75%. In 2012 data capture was good at 91.7%.) The concentration calculated for the receptor (see Appendix A1) has also increased slightly from 36.1 µg/m^3 in 2011 to 36.6 µg/m^3 in 2012. The other tube (NA101) on the opposite side of the road met the objective in 2012. A new retail distribution site is now open close to this tube location and accordingly both diffusion tubes (NA94 and NA101) will continue to operate. The operator of the distribution store, Asda, is a 5* member of the Falkirk ECO Stars scheme.

Table 2.4 Results of nitrogen dioxide diffusion tubes for 2012.

Site	Location	Within NO_2 AQMA?	Data Capture for Monitoring Period, %	Data Capture for 2012, %	Annual mean concentrations (µg/m^3)			
					2009 (0.81)	2010 (0.85)	2011 (0.84)	2012 (0.79)
NA3	Tinto Drive, Grangemouth.	N	n/a	100	21	23	21	21
NA5	Copper Top pub, Camelon.	N	n/a	100	31	29	31	31
NA7	Irving Parish Church, Camelon.	N	n/a	100	22	24	21	19
NA9	Bellsdyke Rd, Larbert.	N	n/a	83.3	29	30	28	25
NA19	Kilsyth Rd, Banknock.	Y	n/a	83.3	37	34	33 *	36
NA20	Garngrew Rd, Haggs.	N	n/a	75	27	30	25	27
NA21	Grangemouth Rd, College.	N	n/a	100	36	35	33	30
NA24	Kerse Lane, Falkirk.	Y	n/a	100	37	37	40	37
NA26	Weir St, Falkirk.	Y	n/a	100	22	26	22	22
NA27	West Bridge St, Falkirk.	Y	n/a	100	**50**	**48**	**51**	**61**
NA29	Wellside Place, Falkirk.	N	n/a	91.7	22	25	21	20
NA36	Kerr Crescent, Haggs.	Y	n/a	100	**49**	**45**	**47**	**42**
NA37	Denny Town House.	N	n/a	91.7	19	21	20	20
NA38	Larbert Village Primary School.	N	n/a	91.7	25	27	21	20
NA41	Seaview Place, Bo'ness.	N	n/a	100	27	30	25	24
NA42	Municipal Chambers, Grangemouth.	N	n/a	100	22	24	22	21
NA44	Greenpark Drive, Polmont.	N	n/a	91.7	19	24	17 *	17

Table 2.4 Results of nitrogen dioxide diffusion tubes (continued)

Site	Location	Within NO_2 AQMA?	Data Capture for Monitoring Period, %	Data Capture for 2012, %	Annual mean concentrations (µg/m^3)			
					2009 (0.81)	2010 (0.85)	2011 (0.84)	2012 (0.79)
NA47	Thistle Avenue, Grangemouth.	N	n/a	100	24	29	25	25
NA48	Hayfield, Falkirk.	N	n/a	91.7	21	26	22	21
NA50	Upper Newmarket St, Falkirk.	Y	n/a	91.7	29	29	26	30
NA51	Mary St, Laurieston.	N	n/a	100	30	32	30	27
NA52	Main St, Larbert.	N	n/a	100	31	32	30	28
NA53	Denny Cross.	N	n/a	100	34	39	33	34
NA57	Inchyra Road, Grangemouth.	N	n/a	100	32	29	28	27
NA58	Callendar Rd, Falkirk.	N	n/a	100	26	25	23	23
NA59	Carron Rd, Bainsford.	N	n/a	100	34	30	32	31
NA60	Ronades Rd, Carron.	N	n/a	100	30	30	31	29
NA61	Canal Rd, Falkirk.	N	n/a	91.7	30	31	30	25
NA62	Arnot St, Falkirk.	Y	n/a	100	**41**	**46**	**43**	39
NA63	Camelon Rd, Falkirk.	On boundary NO_2.	n/a	100	**45**	39	**42**	**41**
NA64	New Hallglen Rd, Falkirk.	N	n/a	100	20	24	20	20
NA65	Redding Rd, Redding.	N	n/a	100	24	28	24	25
NA67	Queen St, Falkirk.	N	n/a	100	30	36	33	31
NA68	Bellevue St, Falkirk.	Y	n/a	100	33	32	36	35
NA69	Kerse Lane, Falkirk.	Y	n/a	100	35	34	35	38
NA70	Park St AQ station, Falkirk.	Y	n/a	100	31	32	32	30

Table 2.4 Results of nitrogen dioxide diffusion tubes (continued)

Site	Location	Within NO_2 AQMA?	Data Capture for Monitoring Period, %	Data Capture for 2012, %	Annual mean concentrations (µg/m^3)			
					2009 (0.81)	2010 (0.85)	2011 (0.84)	2012 (0.79)
NA71	Park St, Falkirk.	Y	n/a	100	39	36	**41**	38
NA72	Vicar St, Falkirk.	Y	n/a	100	31	39	34	33
NA73	West Bridge St RHS, Falkirk.	Y	n/a	100	37	40	37	34
NA76	Tyrst Road, Stenhousemuir.	N	n/a	100	25	28	24	24
NA77	Kinnaird Village.	N	n/a	100	22	32	31	25
NA78	Glen Brae, Falkirk.	N	n/a	91.7	34	39	32	31
NA80	Cow Wynd, Falkirk.	N	n/a	100	34	36	33	31
NA81	Grahams Rd, Falkirk.	N	n/a	100	35	36	34	32
NA82	Castings Ave, Falkirk.	N	n/a	100	23	27	23	22
NA83	Main St, Bainsford.	N	n/a	83.3	**46**	37	**44**	**41**
NA85	Auchinloch Dr, Banknock.	Y	n/a	100	26	33	25	25
NA86	Wolfe Rd, Falkirk.	N	n/a	92	17	23	18	19
NA87	M80 slip south, Haggs.	Y	n/a	100.0	32 *	36	36	33
NA88	Ure Crescent, Bonnybridge.	N	n/a	83.3	25 *	35	36	33
NA89	Grahams Rd/Meeks Rd, Falkirk.	N	n/a	100	32 *	32	37	34
NA90	Grahams Rd bridge east, Falkirk.	Y	n/a	100	30 *	39	37	34
NA94	A905 (Glensburgh Rd), Grangemouth.	N	n/a	91.7	37 *	**41**	37 *	38
NA97	Stirling Road, Larbert	N	n/a	83.3	n/m	n/m	29	28

Table 2.4 Results of nitrogen dioxide diffusion tubes (continued)

Site	Location	Within NO_2 AQMA?	Data Capture for Monitoring Period, %	Data Capture for 2012, %	Annual mean concentrations ($\mu g/m^3$)			
					2009 (0.81)	2010 (0.85)	2011 (0.84)	2012 (0.79)
NA98	Arnothill, Falkirk	N	n/a	91.7	n/m	n/m	26 *	26
NA99	St Crispins Place, Falkirk	Y	n/a	100	n/m	n/m	34 *	29
NA100	Oswald St, Falkirk	N	n/a	91.7	n/m	n/m	22 *	22
NA101	Glensburgh Road (2), Grangemouth	N	n/a	100	n/m	n/m	28 *	26
NA103	Merchiston Gardens	N	n/a	100	n/m	n/m	22 *	21
NA105	West of Shieldhill	N	n/a	100	n/m	n/m	11 *	10
NA106	Stirling Road, North Broomage	N	100	16.7	n/m	n/m	n/m	19 *

- * = Result annualised, see Appendix for details of the 2012 annualisations.
- 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 Falkirk Town Centre. (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).

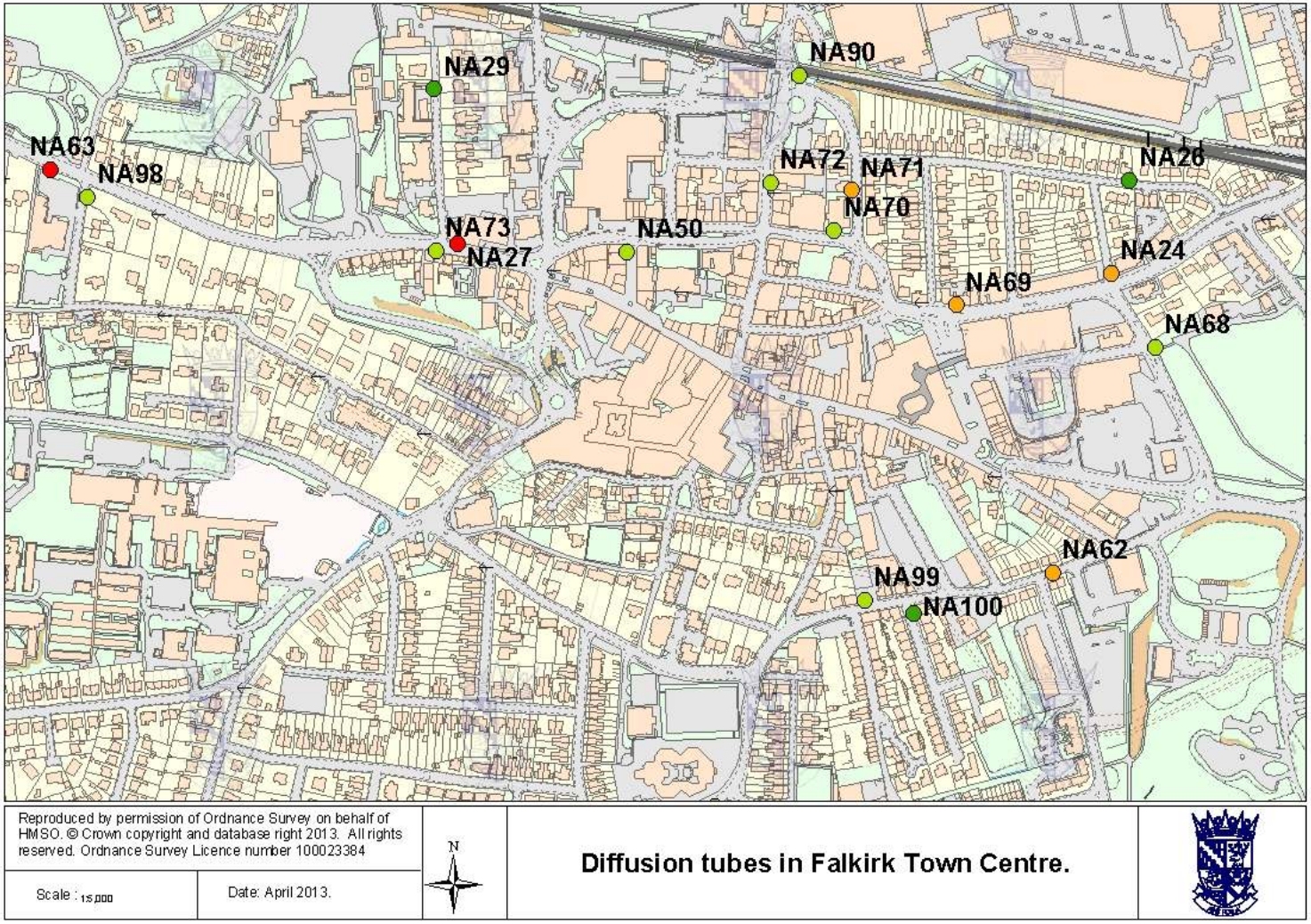
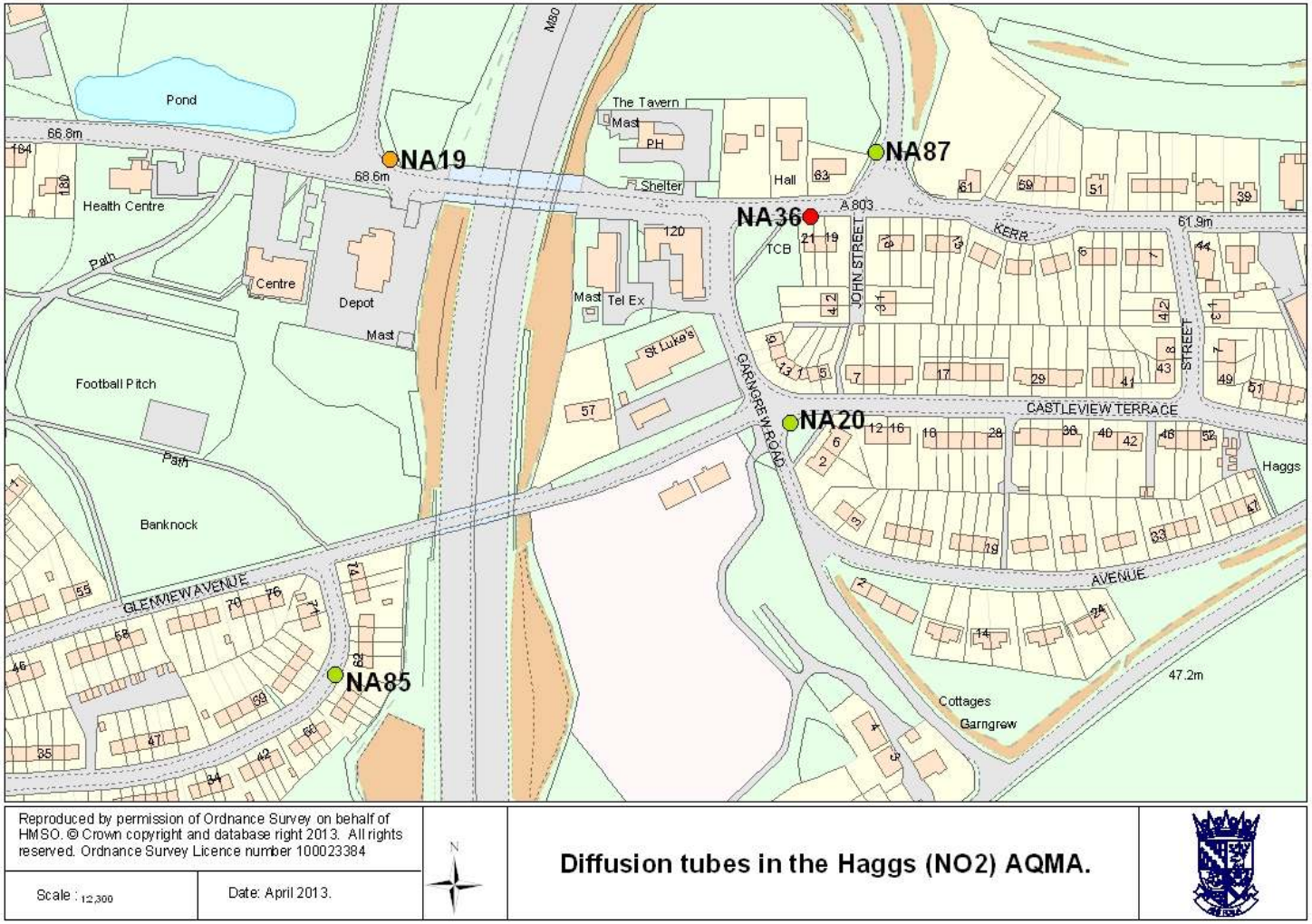


Figure 2.5 A map of the NO_2 diffusion tubes in Haggs. (Colours denote NO_2 concentrations: dark green up to 24 µg/m^3, light green 24 to 36 µg/m^3, orange 36 to 40 µg/m^3 and red > 40 µg/m^3).



2.2.2 PM_{10}

In 2012 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 numbers of daily exceedances (and 98th percentile concentrations) are shown in Table 2.5b.

The data from the Osiris at the Banknock 1 (A2) site is shown in Table 2.5 with a 1.3 and 1.14 correction factor applied. The annual and period data capture for the site was below 90%. The results from this site and the Banknock 2 (A13) site have, for 2012, been annualised to take account of the low data capture. This has not been carried out in previous years due to the potential influence of local sources which were not present in 2012.

The Banknock 1 (A2) site met the Scottish and UK objectives in 2012. The annualised result from the Banknock 2 (A13) site also indicates that the Scottish and UK objectives would have been met at this site as well. However, this conclusion for the Banknock 2 (A13) site should be treated with caution as monitoring data is only available from 14th December 2012. A full set of monitoring results will be reported in the 2014 Progress Report.

The annualised result from the Haggs (A4) site indicates that the Scottish and UK objectives were met at this site. In similarity to the Banknock sites this conclusion should be treated with caution as monitoring data is only available from 4th December 2012. A full set of monitoring results will be reported in the 2014 Progress Report.

The Falkirk West Bridge St (A7) site was near to breaching the Scottish annual objective with a concentration of 17.8 µg/m^3 in 2012 and almost breached the daily objective with six daily exceedances. All other sites met the Scottish PM_{10} objectives in 2012. The Falkirk West Bridge St, Falkirk Park St and Falkirk Grahams Road sites are in the Falkirk Town Centre AQMA. This AQMA was varied in January 2013 to include the Scottish PM_{10} objectives following monitoring results from previous years.

The PM_{10} (TEOM) at the Falkirk Grahams Road (A12) site commenced operation on the 20th December 2011. The site met the PM_{10} objectives in 2012 with an annual concentration of 16 µg/m^3 and four daily exceedances.

The UK / EU objectives (annual mean of 40 µg/m^3 and 35 daily exceedances) were met at all sites in 2012.

Table 2.5a Results of PM_{10} automatic monitoring: comparison with annual mean objective 2012.

Site	Site Type	Within PM_{10} AQMA?	Data Capture for Monitoring Period, %	Data Capture 2012, %	Reference Equivalent?	Annual mean concentration, µg/m^3			
						2009	2010	2011	2012
A2. Banknock 1	Roadside	Y	87.4	67.4	No, 1.14 [1.3] factor applied.	13.3 [15.1] * #	**20.7 [23.7] ***	15.2 [17.3] *	12.4 [14.2] * #
A4: Falkirk Haggs	Roadside	N	94.3	7.2	Y, VCM	n/m	n/m	n/m	15.9* #
A6. Falkirk Park St	Roadside.	Y	n/a	95.2	Y, VCM	15	17	15.6	14.6
A7. Falkirk West Bridge St	Roadside.	Y	n/a	97.9	Y, VCM	**22.3 ***	**21 ***	**18.7 * #**	17.8
A8. Grangemouth AURN	Urban background / industrial.	N	n/a	93.9	Y, FDMS	12.5	14.4	14.1	14.1
A10.Grangemouth Municipal Chambers	Urban background / industrial.	N	n/a	64.2	Y, VCM	14	15	15.1 * #	14.7 * #
A12. Falkirk Grahams Rd	Roadside	Y	n/a	96.8	Y, VCM	n/m	n/m	n/m	16
A13. Banknock 2	Roadside	Y	84.5	4.1	Y, VCM	n/m	n/m	n/m	12.7 * #

Table 2.5b Results of PM_{10} automatic monitoring: comparison with 24-hour mean objective 2012.

Site	Site Type	Within PM_{10} AQMA?	Data Capture for Monitoring Period %	Data Capture 2012, %	Reference Equivalent?	Number of Daily Exceedances of 50 µg/m^3 (98th percentiles)			
						2009	2010	2011	2012
A2. Banknock 1	Roadside	Y	87.4	67.4	No, 1.14 [1.3] factor applied.	0 (31) [0 (36)] * #	**18 (60) [30 (68)] ***	3 (37) [4 (42)]*	2 (38) [3 (43)] *
A4: Falkirk Haggs	Roadside	N	94.3	7.2	Y, VCM	n/m	n/m	n/m	0 (45) *
A6. Falkirk Park St	Roadside.	Y	n/a	95.2	Y, VCM	2	1 (31)	2 (38)	2 (38)
A7. Falkirk West Bridge St	Roadside.	Y	n/a	97.9	Y, VCM	0 *	7 (47) *	5 (49) *	6 (46)
A8. Grangemouth AURN	Urban background / industrial.	N	n/a	93.9	Y, FDMS	0	1 (38)	2 (38)	2 (37)
A10.Grangemouth Municipal Chambers	Urban background / industrial.	N	n/a	64.2	Y, VCM	0	0 (29)	0 (40)	2 (41) *
A12. Falkirk Grahams Rd	Roadside	Y	n/a	96.8	Y, VCM	n/m	n/m	n/m	4 (44)
A13. Banknock 2	Roadside	Y	84.5	4.1	Y, VCM	n/m	n/m	n/m	0 (18) *

Notes for Table 2.5 a and b:

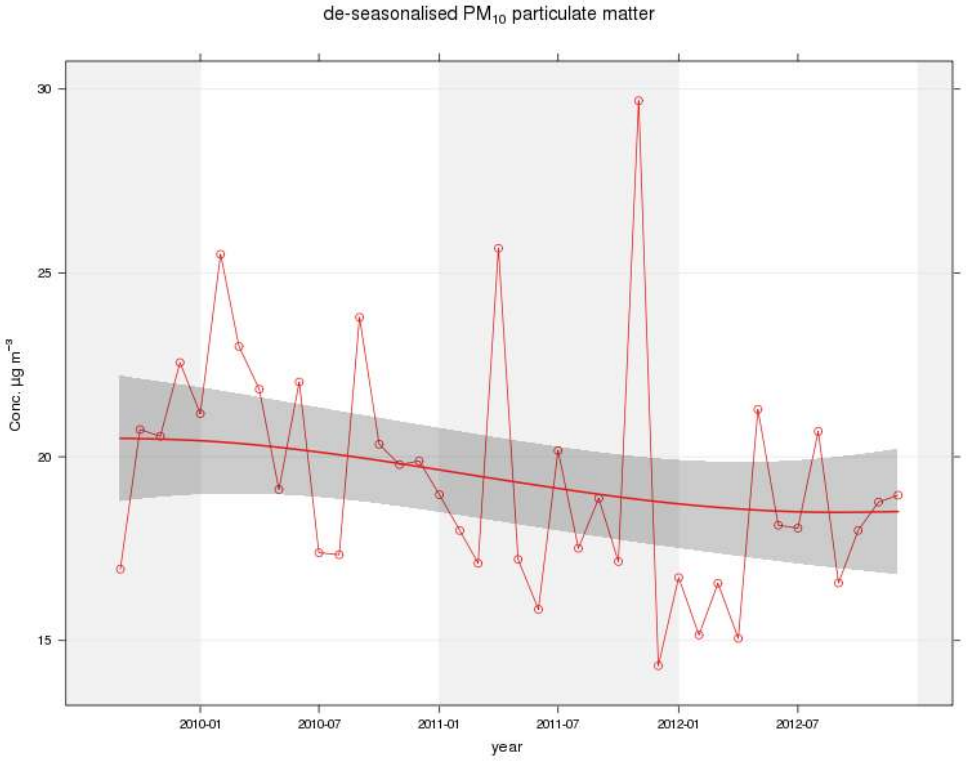
- All TEOM results are VCM corrected.
- * Less than 90% data capture.
- # Annual concentrations result have been annualised.
- 1.3 corrected results for Banknock 1 are presented in [ ].
- Unadjusted results (Table 2.5a) are: Banknock 1, 12.5 µg/m^3 [14.3 µg/m^3], Banknock 2, 11.3 µg/m^3, Haggs 16.6 µg/m^3 and Grangemouth MC 15 µg/m^3.
- Table 2.5b: Banknock 1 the 90.4th percentile concentrations (for the UK objective) with a 1.3 and 1.14 correction factor were: 27 µg/m^3 and 23 µg/m^3.

The technical guidance requires concentrations to be reported for calendar years. However, additional analysis of the data can provide a greater insight into any potential changes occurring. The annual concentrations shown in Table 2.5a demonstrate that PM_{10} concentrations at the Falkirk West Bridge St (A7) have decreased since 2009. This long-term decline is confirmed by the Openair 'smooth trend' plot in Figure 2.6a which shows the trend of PM_{10} concentrations at the Falkirk West Bridge St site. However, as shown in Table 2.5b the number of daily exceedances remains close to the objective.

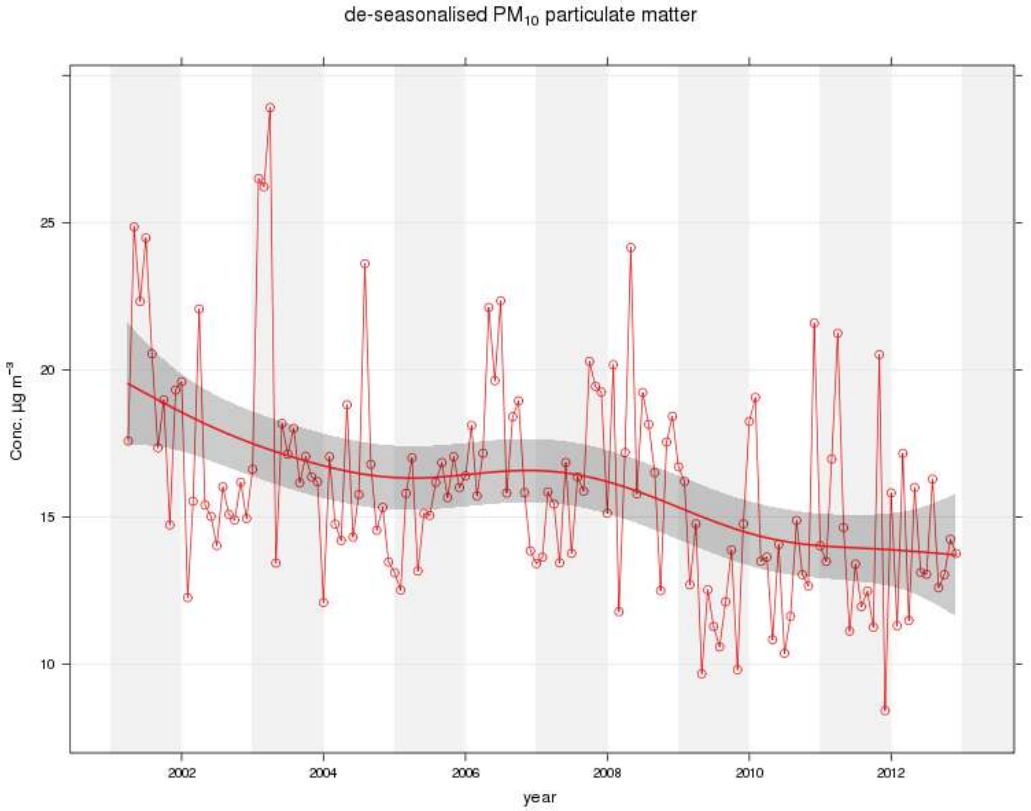
A long-term decline is also noticeable at the background Grangemouth AURN site, Figures 2.6b and c. However, this may be partly due to the change from using the TEOM analyser to using a FDMS-TEOM (the SAQN database tool that was used to create Figures 2.6b and c applies a 1.3 correction factor prior to 2009). There has been a slight increase in concentrations for the period 2009 and 2012.

Figure 2.6 A smooth trend plot of PM_{10} concentrations measured at a.) Falkirk West Bridge St, b.) Grangemouth AURN (2002 to 2012) and c.) Grangemouth AURN (2009 to 2012).

a.)



b.)


de-seasonalised PM10 particulate matter
Conc. µg m-3
25
20
15
10
2002
2004
2006
2008
2010
2012
year

c.)

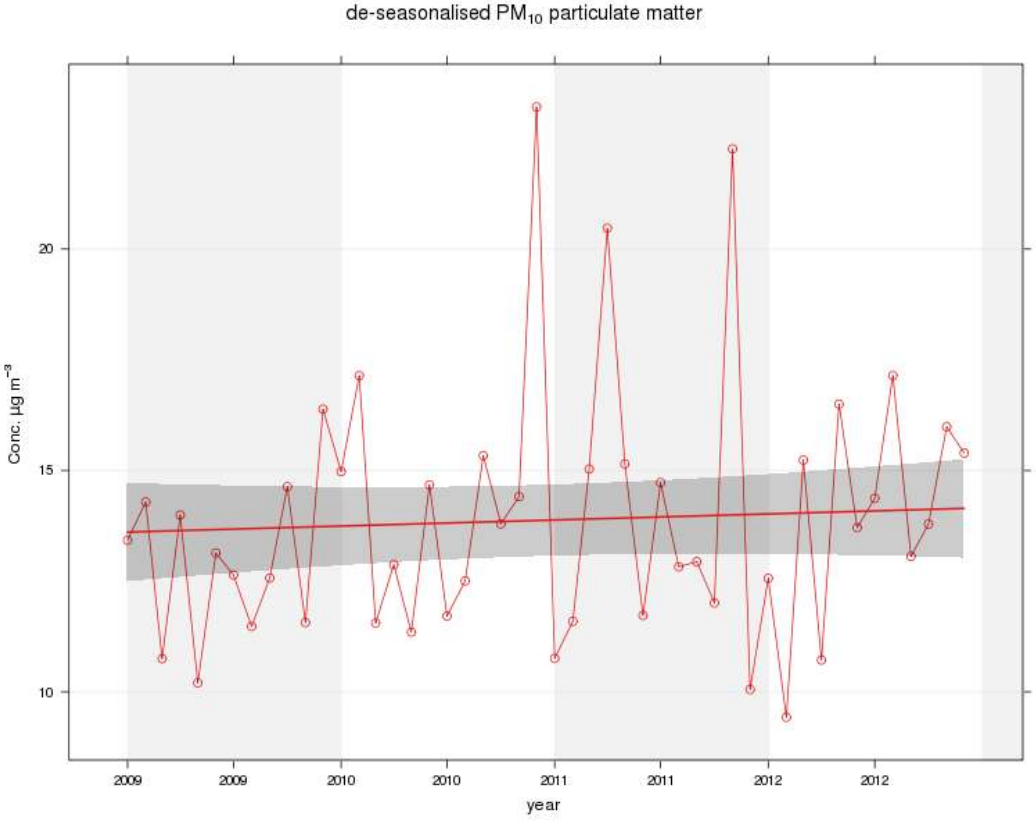

de-seasonalised PM10 particulate matter
Conc. µg m-3
20
15
10
2009
2009
2010
2010
2011
2011
2012
2012
year

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

Falkirk Council monitored SO_2 at seven locations in 2012. Three of the locations were in the Grangemouth (15-minute) AQMA with the four other sites located outside of the AQMA.

Table 2.6 shows the number of SO_2 exceedances and percentile concentrations at Falkirk Council's monitoring stations in 2012. All three sites in Grangemouth and the 15-minute AQMA (MC, Moray and the AURN site) breached the 15-minute objective in 2012. The Grangemouth Moray (A9) site recorded 92 exceedances of the 15-minute objective concentration, the Grangemouth AURN (A8) site recorded 50 exceedances and the Grangemouth MC (A10) site recorded 51 exceedances. The hourly objective continues to be met at all monitoring sites. Although more sites recorded a breach of the 15-minute objective compared to previous years no Detailed Assessment is required because all three sites are within the existing AQMA.

The Polmont site ceased operation in October 2012. The percentile concentrations for the Polmont (A11) site indicate that the objectives were achieved at this site. The data from Polmont has provided additional evidence that the Grangemouth (15-minute) AQMA does not need amending. The Grangemouth (15-minute) AQMA Action Plan is discussed in Section 5.

In previous years exceedances of the daily limit value have been recorded at some of the Grangemouth sites. However, the number of exceedances has been within the number permitted by the objective (three or fewer). In 2012 this was not the case with the Grangemouth Moray (A9) site recording four daily exceedances. If a site does not achieve

90% data capture the percentile concentration, in this case the 99th percentile, should be compared to the limit value (125 µg/m^3). The 99th percentile concentration for the Grangemouth Moray site was 129 µg/m^3 in 2012. This is marginally above the objective and so this method of comparison to the objectives also shows that the objective has been breached.

However, it is proposed that a Detailed Assessment is not required for the following reasons:

1. Commissioning of Tail Gas Treatment by Petroineos.[a]

This abatement equipment has been discussed in previous R&A reports. The Tail Gas Treatment unit was installed in September 2012 and will be fully commissioned during 2013. It has been discussed in previous reports that it is anticipated that this will reduce the number of 15-minute exceedances such that this objective is met. By definition if the number of 15-minute exceedances is reduced the daily concentrations and therefore the likelihood of a daily exceedance will also reduce.

2. Weather conditions.

There were many headlines about the unusually wet weather experienced in the UK during the 2012 summer. However, of primary interest to this AQMA are the wind conditions. While there are other meteorological factors that contribute to causing an exceedance, certain wind directions (and speeds) are usually a pre-requisite for elevated concentrations to occur at the Grangemouth sites. Figure 2.8 shows wind rose plots from the Edinburgh Gogarbank station for 2011 and 2012 [b]. The plots show that there were significantly longer periods of north-easterly and easterly winds in 2012 compared to 2011. This would be consistent with previous reports that have shown that elevated concentrations generally occur when the wind originates from the north-east through to the south-east.

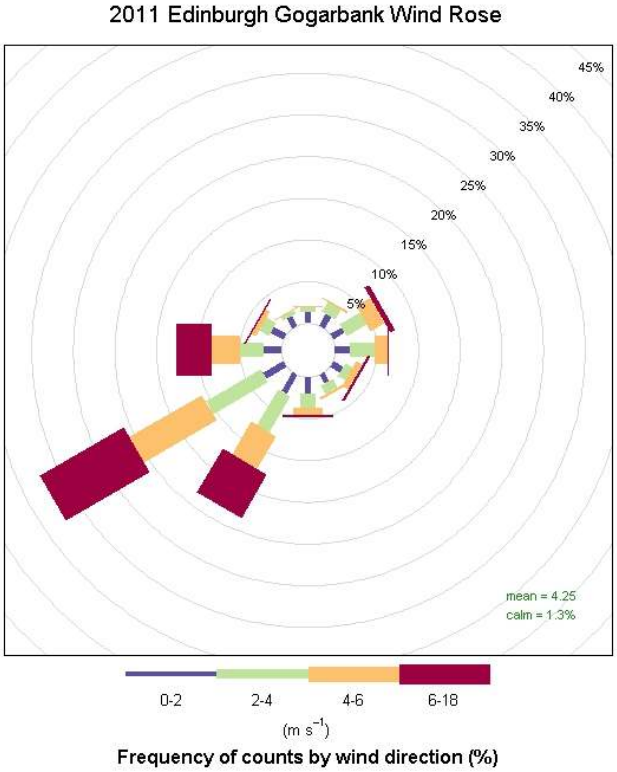
3. Operational problems.

SEPA and Petroineos were informed of the fourth daily exceedance of 2012 that occurred at the Grangemouth Moray site on the 21st December. Petroineos stated that they were unable to recover fuel gas from the flare system due to a hole caused by corrosion damage to pipe work. Although this did not impact upon total emissions the nature of the emissions did change.[3] This unusual operational issue may have caused or contributed to the fourth daily exceedance at the Grangemouth Moray site.

[a] Petroineos is the company that now operate the refining operations in Grangemouth (including tail gas treatment, the sulphur recovery plants, FCCU and refinery heaters). The other parts of the refinery site, e.g. power station, are still operated by INEOS.
[b] Issues with local data in 2012 means that a comparison of data from this site is considered appropriate.

Figure 2.8 Wind roses of Edinburgh Gogarbank meteorological data for a.) 2011 and b.) 2012.

a.)



b.)

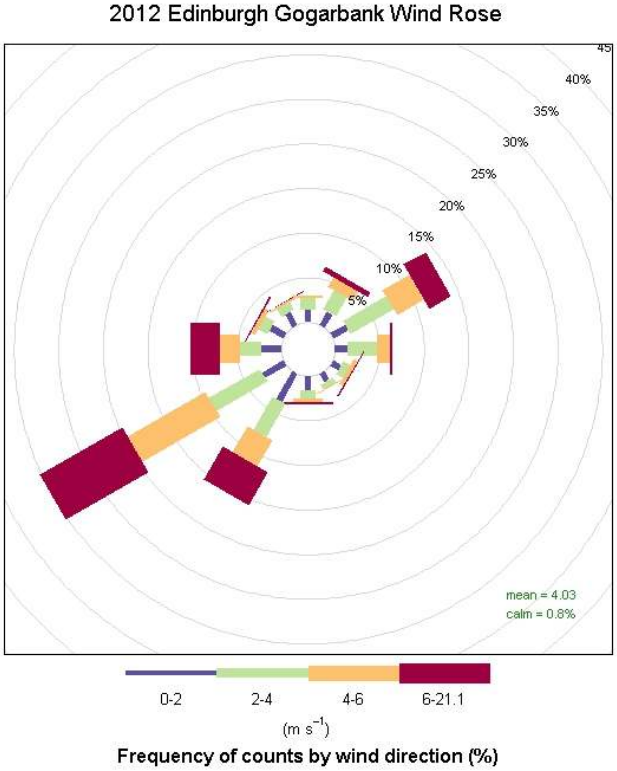


Table 2.6 Results of SO_2 automatic monitoring in 2012: comparison with objectives.

Site	Location	Within SO_2 AQMA.	Period data capture, %.	Annual Data Capture 2012, %.	Number of exceedances and (appropriate percentiles, μg/m^3).		
					15-minute objective	1-hour objective	24-hour objective
A3	Bo'ness	N	n/a	96.1	0 (91)	0 (54)	0 (19)
A5	Falkirk Hope St	N	n/a	98.6	4 (117)	0 (75)	0 (22)
A6	Falkirk Park St	N	n/a	99	2 (104)	0 (67)	0 (19)
A8	Grangemouth AURN	Y (15-min)	n/a	95.9	**50 (317)**	0 (197)	0 (83)
A9	Grangemouth Moray	Y (15-min)	n/a	88.2	**92 (314)**	1 (235)	**4 (129)**
A10	Grangemouth Municipal Chambers	Y (15-min)	n/a	99.5	**51 (279)**	0 (210)	3 (104)
A12	Polmont	N	79.5	58.1	0 (90)	0 (57)	0 (21)

2.2.4 Benzene

In 2012 Falkirk Council monitored for 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 2.9. 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 for fortnightly rather than monthly exposure periods.

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

Site	Location	Data capture, 2012, %.	Annual mean concentration, µg/m^3				
			2008	2009	2010	2011	2012
A8	Grangemouth AURN	100	1.2	1.27	1.42	1.26	1.97

The annual benzene concentrations recorded by the Grangemouth AURN pumped diffusion tube and some of the passive diffusion tubes have increased between 2011 and 2012. For the pumped diffusion tube result this increase mostly relates to an elevated result (18.59 µg/m^3) recorded during the exposure period of the 23rd July to 6th August 2012. The fortnightly results from the pumped tube are shown in Table 2.9. It is thought that this elevated result occurred due to an incident at storage tank 453 of the Petroineos refinery between the 19th July and 3rd August. In comparison to the pumped diffusion tube the increase in concentrations at the passive tubes is less clear. This can be partly explained by the difference in exposure periods. The passive tubes are exposed on a monthly basis and so would have been exposed during periods before and after the ST-453 incident. In contrast, the pumped diffusion tubes are exposed on a fortnightly basis. The two passive tubes that are close to the refinery, NA55 (Grangemouth AURN) and NA57 (Inchyra Road), did record elevated concentrations compared to the other sites in July.

Table 2.8 Fortnightly results from the pumped diffusion tube at the Grangemouth AURN (A8) site.

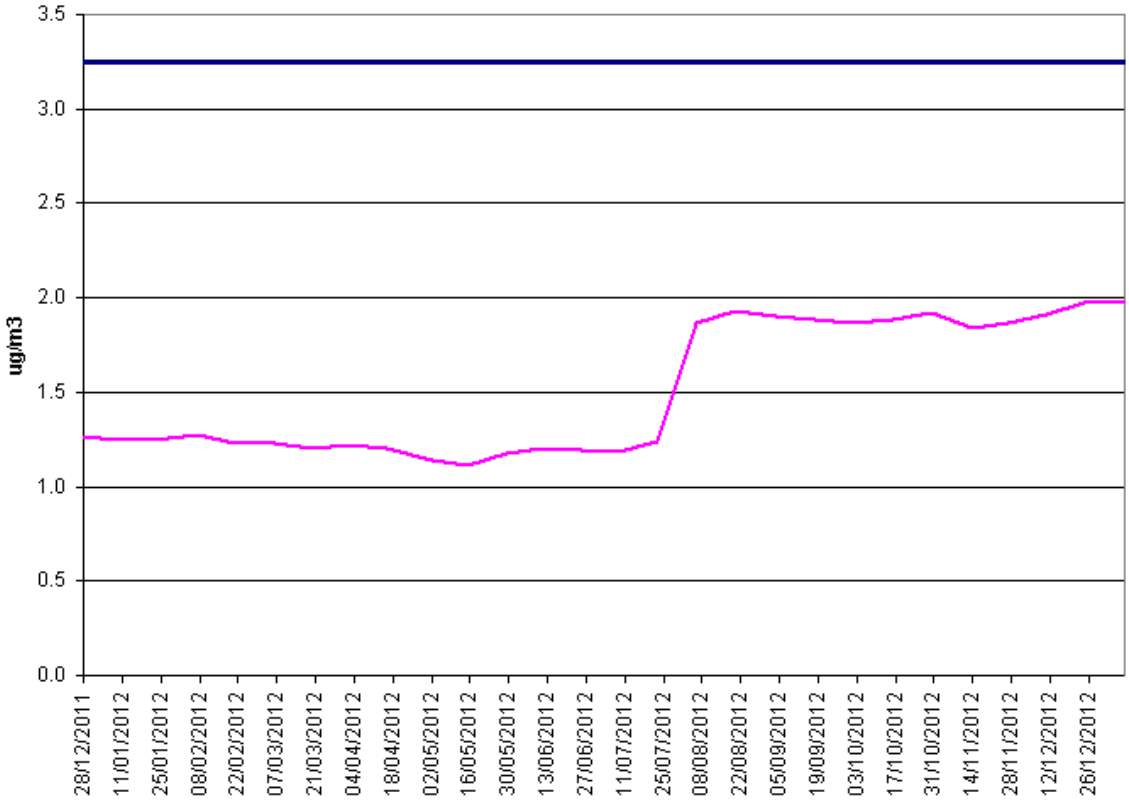
Grangemouth AURN		
Start Date	**End Date**	**Benzene**
28/12/2011	10/01/2012	0.52
10/01/2012	23/01/2012	1.31
23/01/2012	07/02/2012	1.75
07/02/2012	21/02/2012	1.15
21/02/2012	06/03/2012	0.78
06/03/2012	20/03/2012	0.42
20/03/2012	03/04/2012	1.56
03/04/2012	16/04/2012	1.04
16/04/2012	02/05/2012	1.86
02/05/2012	15/05/2012	0.74
15/05/2012	29/05/2012	1.93
29/05/2012	11/06/2012	1.68
11/06/2012	25/06/2012	1.03
25/06/2012	09/07/2012	1.28
09/07/2012	23/07/2012	2.17
23/07/2012	06/08/2012	18.59
06/08/2012	20/08/2012	2.84
20/08/2012	04/09/2012	0.84
04/09/2012	18/09/2012	0.29
18/09/2012	02/10/2012	0.91
02/10/2012	16/10/2012	0.85
16/10/2012	30/10/2012	1.47
30/10/2012	14/11/2012	1.09
14/11/2012	27/11/2012	1.15
27/11/2012	11/12/2012	1.58
11/12/2012	24/12/2012	2.48
24/12/2012	08/01/2013	0.7

The averaging period for the 3.25 µg/m^3 (Scottish) benzene objective is a running annual mean while the 5 µg/m^3 (EU) objective is an annual (i.e. calendar) mean.[c] In LAQM reports a calendar annual mean is generally calculated as there is usually little difference between this and a running annual mean. However, given the elevated result recorded at the Grangemouth AURN site the running annual mean has been calculated for the pumped diffusion tube to ensure compliance with the objective. Figure 2.9 shows the annual running mean with the date on the x-axis being the end date of the exposure period.

Figure 2.9 and Table 2.7 indicate that the 3.25 µg/m^3 objective has been met at the pumped diffusion tube at the Grangemouth AURN (A8) site throughout 2012. The running annual mean will continue to be calculated and provided to SEPA and Petroineos on a quarterly basis until the elevated calculation no longer forms part of the calculation.

[c] A running annual mean is an annual mean but it is calculated for every new data point rather than just for a calendar year.

Figure 2.9 A graph of the running annual mean concentrations from the pumped diffusion tube at the Grangemouth AURN (A8) site.



(Blue line: objective concentration of 3.25 µg/m^3, and pink line: benzene running annual mean concentration.)

The results from Falkirk Council's passive diffusion tubes are shown in Table 2.9. The tube suppliers, ESG, informed Falkirk Council that there was a potential issue with the November results for some of the passive diffusion tubes by advising that:

"Please be aware that the GC chromatograms for samples ASC/07917.001, 004, 006-008, 010, 013 and 015-016 were noted to have some potential indicators of tube deterioration within them. It has been noted by the manufacturer (Markes) that Chromosorb 106 tubes can break down after a significant number of uses, causing a possible heightening of detectable aromatic hydrocarbons. Some of the potential markers of this breakdown have been identified in the samples listed, which also seem to show elevated BTEX values.

Therefore it is possible that the results for these samples are higher than would be expected, not due to the presence of the compounds in the monitored environment, but due to breakdown of the tubes. There is no absolute way to confirm this however, because of the nature of the way that these tubes and subsequent analysis work."

With the information supplied by ESG in mind there are two sets of results shown in Table 2.9 for the passive diffusion tubes. The first set includes all the results and the second, marked #, exclude those where tube break down may have occurred.

Table 2.9 Results of benzene diffusion tubes.

Site	Location	Within benzene AQMA?	Data capture for monitoring period, %	Data capture, 2012, %.	Annual mean concentration, µg/m^3				
					2009	2010	2011	2012	2012 #
NA3	Tinto Drive,Grangemouth	N	n/a	100	n/m	n/m	1.22	1.23	n/a
NA21	Grangemouth Road, College	N	n/a	100	1.16	0.92	0.92	1.91	1.73
NA27	West Bridge Street, Falkirk	N	n/a	100	2.58	1.4	1.49	2.09	1.78
NA37	Denny Town House	N	n/a	91.7	1.55	0.69	0.87	1.38	n/a
NA38	Larbert Village Primary School	N	n/a	100	1.41	0.75	1.36	1.37	1.32
NA41	Seaview Place, Bo'ness	N	n/a	91.7	1.13	1.03	2.19	2.14	2.05
NA42	Municipal Chambers, Grangemouth	N	n/a	83.3	1.59	1.17	0.91	1.62	1.41
NA44	Greenpark Drive, Polmont	N	n/a	100	2.37	1.01	0.84	1.49	1.21
NA55	Inchyra Station	N	n/a	83.3	1.11	1.24	1.42	**3.29**	3.04
NA57	Inchyra Road, Grangemouth	N	n/a	100	1.12	1.37	1.31	2.39	n/a
NA77	Kinnaird Village	N	n/a	100	0.75	0.75	0.63	1.32	n/a
NA80	Cow Wynd, Falkirk	N	n/a	100	0.85	1.12	1.11	1.75	1.52
NA81	Grahams Road, Falkirk	N	n/a	100	2.32	1.34	1.04	1.37	n/a
NA94	A905 (Glensburgh Rd), Grangemouth	N	n/a	91.7	n/m	n/m	0.77	1.67	n/a
NA102	East Kerse Mains, Bo'ness	N	n/a	75	n/m	n/m	0.69	1.76	n/a
NA105	West of Shieldhill	N	n/a	100	n/m	n/m	0.91	1.26	1.1

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.

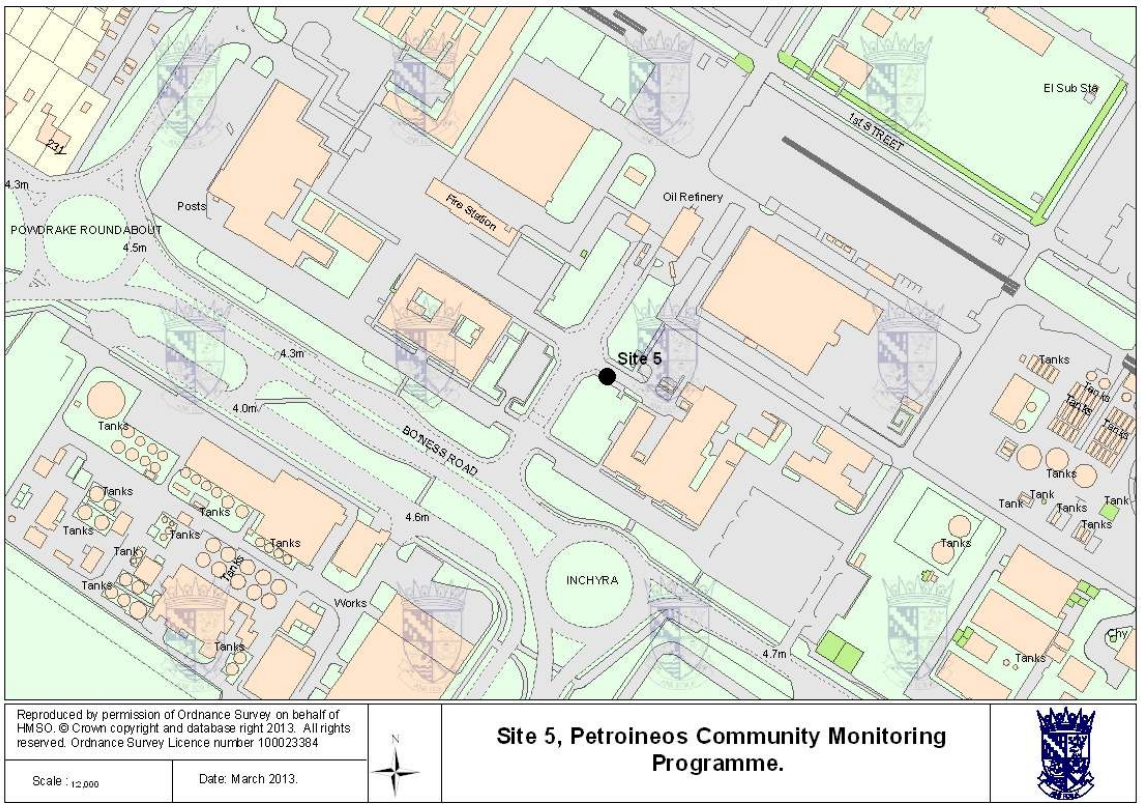
The annual mean recorded by the pumped diffusion tube at the Grangemouth AURN (A8) site was 1.97 µg/m^3 while the passive diffusion tube at the site (NA55) recorded a concentration of 3.29 µg/m^3. However, if the November result is excluded from the passive diffusion tube results (due to the potential issue highlighted by ESG) the concentration, 3.04 µg/m^3, is below the objective. Although the passive tube result at site NA55 was above or close to the Scottish objective of 3.25 µg/m^3, it is considered that a Detailed Assessment is not required because:

- The pumped tube, which operates at the same location as the NA55 passive tube, met the objective. The pumped tube method is considered more accurate than a passive tube. This is similar to NO_2 diffusion tubes. The NO_2 tubes used by Falkirk Council over-read compared to an automatic monitor, and for benzene the passive tube seems to over-read compared to the pumped diffusion tube.
- The uncertainty associated with the November result due to potential tube breakdown.

The benzene results from the ten passive tubes operated by Petroineos as part of their community monitoring programme have also been reviewed. There were two tubes that recorded a concentration greater than the benzene objective of 3.25 µg/m^3. Tube 1 recorded a concentration of 4.1 µg/m^3. However, as discussed in previous LAQM reports this site is

not representative of relevant receptors. Tube 5 recorded a concentration of 4.3 µg/m^3. This is a new location and is located at Gate 4 of the complex. However, this location, shown in Figure 2.10, is not representative of a relevant receptor for an annual mean objective. The closest receptor is 280 m away and it is therefore considered that a Detailed Assessment is not required.

Figure 2.10 A map of the location of Petroineos' diffusion tube at gate 4.



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

In 2012 Falkirk Council monitored 1,3 butadiene at three locations using passive diffusion tubes, all the annual and monthly results are 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 2009, however, the increase has occurred because the limits of detection reported have changed.

Table 2.10 Results from 1,3 butadiene diffusion tubes.

Site ID	Location	Within 1,3 butadiene AQMA?	Data capture for 2012, %.	Annual mean concentrations (µg/m^3)			
				2009	2010	2011	2012
NA41	Seaview Place, Bo'ness	N	91.7	n/m	0.41	0.85	1.19
NA55	Inchyra Station, Grangemouth	N	91.7	0.4	0.41	0.85	1.19
NA104	Powdrake Road, Grangemouth	N	91.7	n/m	n/m	1.16	1.19

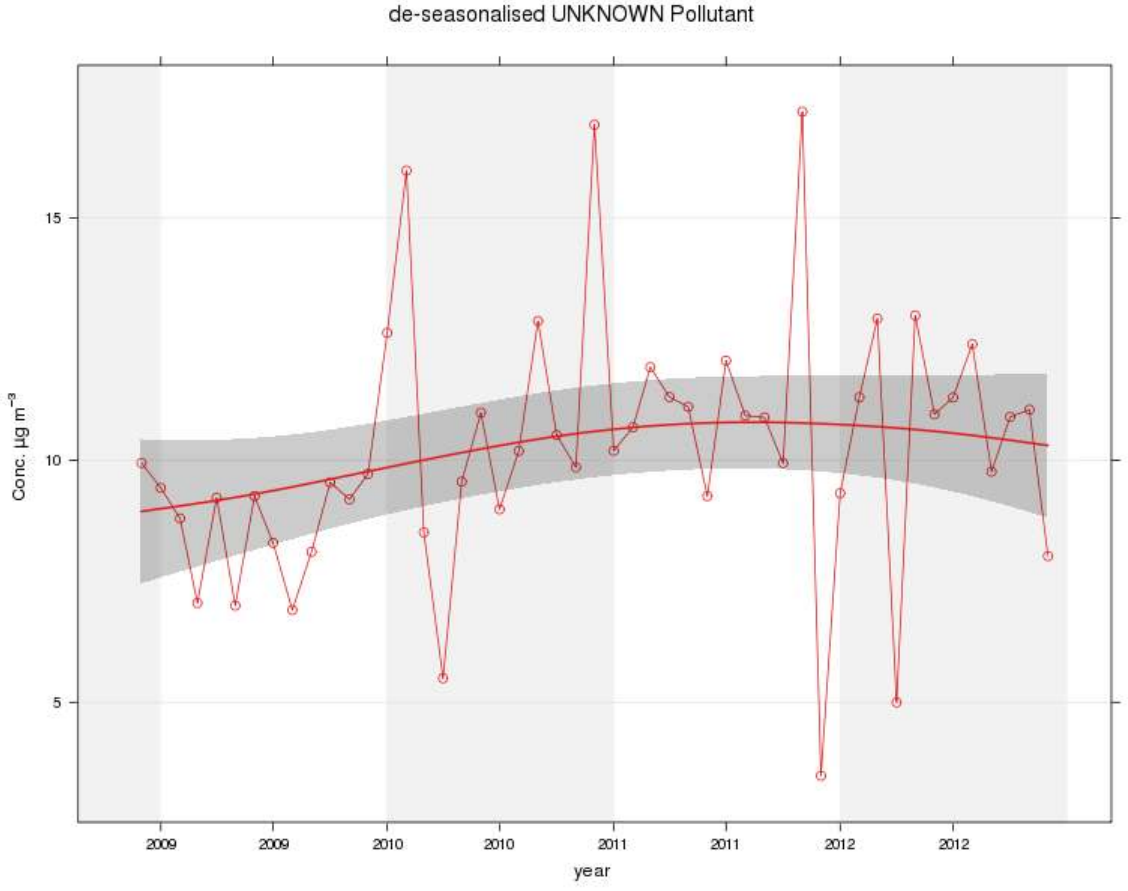
A Defra / DA owned $PM_{2.5}$ FDMS-TEOM commenced operation at Falkirk Council's Grangemouth AURN site in December 2008. Although Council's are not required to review $PM_{2.5}$, the results are included in Table 2.10 for completeness. The concentration recorded in 2012 was below the target value (12 µg/m^3) set by the Scottish Government and within the EU target and limit values of 20 and 25 µg/m^3.

Figure 2.11 shows an Openair smooth trend plot of $PM_{2.5}$ concentrations since monitoring began in December 2008. Although concentrations have shown an increase since 2009 they have started to decrease again since early 2012.

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

Site ID	Location	Data Capture for 2012, %	Annual mean concentrations (µg/m^3)			
			2009	2010	2011	2012
A8	Grangemouth AURN	97.5	8.6	11	10.9	10.5

Figure 2.11 Trend in $PM_{2.5}$ concentrations measured at Grangemouth AURN (2009 to 2012).



Background concentrations (NO_2 and PM_{10})

The modelled background concentrations for NO_2 and PM_{10} are shown in Figures 2.12 and 2.13. These are produced on behalf of the Scottish Government and according to Ricardo-AEA "combine Scottish pollutant measurement data with the spatially disaggregated emissions information from the UK's National Atmospheric Emissions Inventory (NAEI) to provide estimated pollutant concentrations for the whole of Scotland. The Scottish modelling methodology is based on the UK Pollution Climate Mapping (PCM) approach, used to model the annual mean background and roadside pollutant concentrations for the UK as a whole." There are no grid squares in the Falkirk Council area where the modelled background concentrations are greater than the NO_2 or PM_{10} objectives.

Figure 2.12 Background NO_2 concentrations for 2012 using 2010 as the base year.

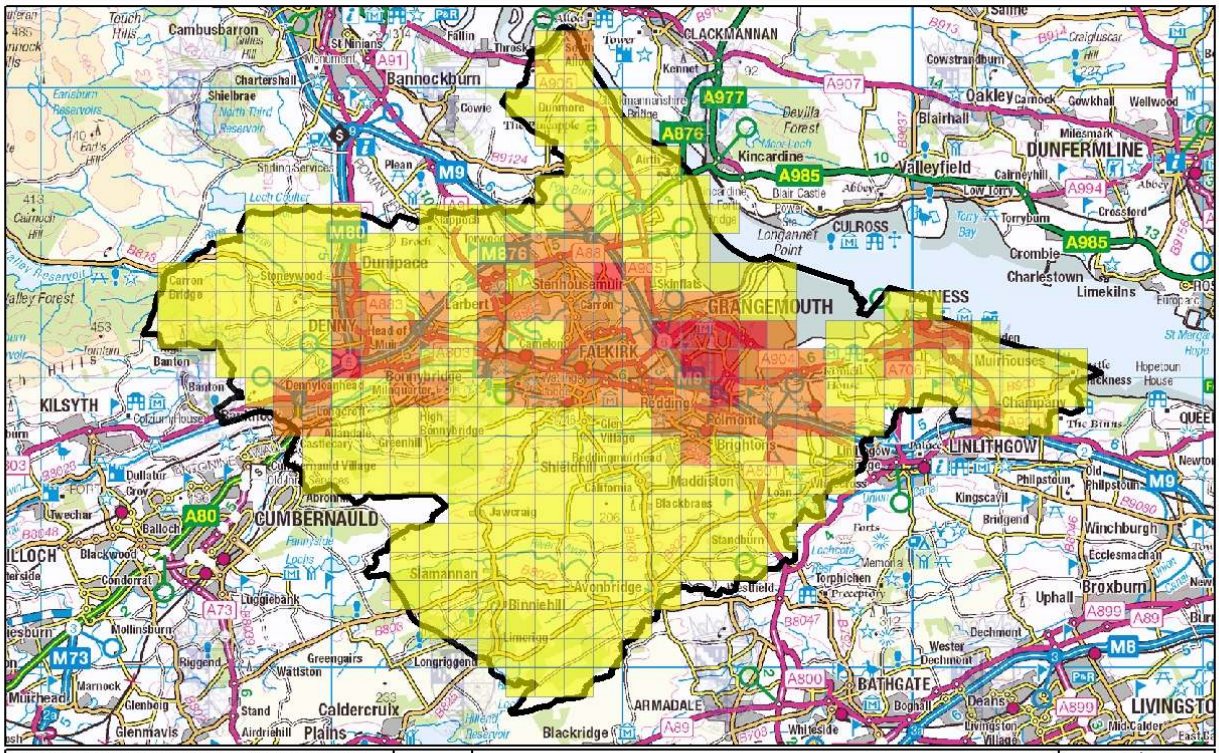
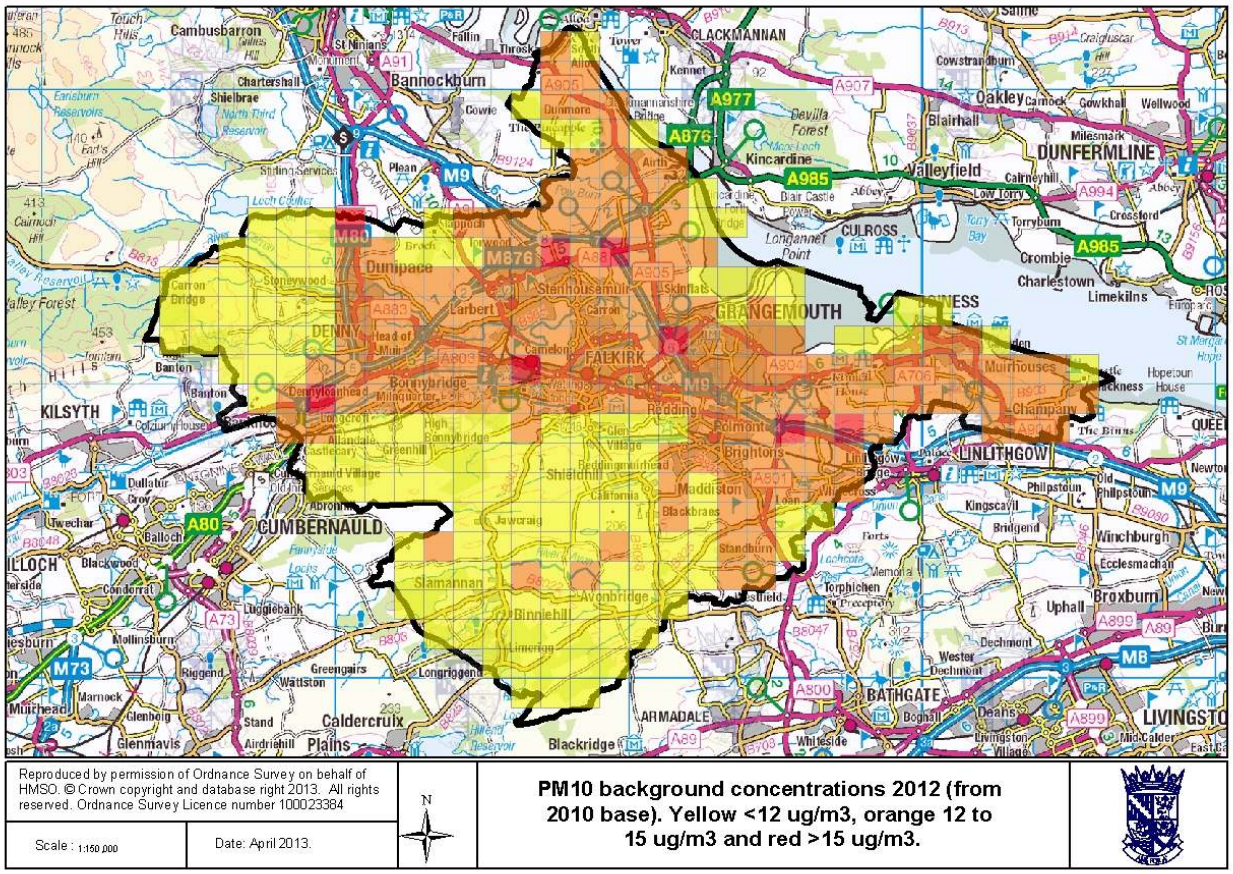


Figure 2.13 Background PM_{10} concentrations for 2012 using 2010 as the base year.



Summary of Compliance with AQS Objectives

Falkirk Council has examined its monitoring results from 2012 for the LAQM pollutants. In line with previous years a breach of the 15-minute SO_2 objective was recorded at the Grangemouth Moray site. In addition, a breach of the same objective was recorded at the Grangemouth AURN and MC sites. All three sites are within the Grangemouth AQMA, which was declared in November 2005 and for which an Action Plan is in place. The hourly objective continues to be met. The daily objective was breached at the Grangemouth Moray site. However, it considered that a Detailed Assessment is not required, primarily due to the commissioning of Tail Gas Treatment during 2013. In addition, it is likely that unusual meteorological conditions in 2012 contributed to the breach of the daily objective.

The Falkirk West Bridge Street site met, but almost breached the Scottish PM_{10} objectives in 2012. The site has shown a decline in PM_{10} levels since 2009. No Detailed Assessment is required as the Falkirk Town Centre AQMA was varied in January 2013 to include the Scottish annual and daily PM_{10} objectives.

The Banknock 1 and Banknock 2 monitoring results indicate that the PM_{10} objectives were met at these two monitoring sites in 2012. The monitoring will continue due to a proposed quarry in the nearby North Lanarkshire Council area.

All tubes recording breaches of the NO_2 annual objective do not need to be considered further as they are within AQMAs or concentrations are below the objective once the distance to the nearest receptor is taken into account. Diffusion tube monitoring has been expanded or will continue at locations that are close to the annual objective.

Elevated benzene concentrations were recorded due to an incident with a storage tank at the Petroineos refinery. The monitoring data has been reviewed and it is considered that no Detailed Assessment is required. The 1,3 butadiene objectives continue to be met.

Falkirk Council concludes that no Detailed Assessments are required for any pollutant.

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 review any changes to local and trunk roads since the 2012 U&SA report.

Local Roads

A review of the local road traffic data (links only) has been completed. A number of roads have seen an increase in flow of more than 10%. The vast majority were either below the appropriate thresholds for further consideration or were adequately represented by existing monitoring. However, four DMRB runs have been completed for other areas and the results are summarised in Table 3.1. The Main St, Camelon site was included as a diffusion tube (NA5) was used for verification of the results.

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

Road	Reason for DMRB run	NO_2 annual mean, µg/m^3	PM_{10} annual mean, µg/m^3
A803 Main Street, Camelon	> 10% increase since 2011.	29.7	15.2
A803 Glasgow Road, Camelon	Increase >10%, background PM_{10} >15 with AADT > 5000 and receptors.	31.2	16.4
B905 Main Street, Larbert	> 10% increase since 2011.	23.3	13.1
B805 Main Street, Redding	> 10% increase since 2011.	24.4	12.8

The four runs show that it is unlikely that the NO_2 or PM_{10} objectives are being breached. It is therefore concluded that no Detailed Assessments are required for these locations. However, the results will be used when future NO_2 diffusion tube locations are considered.

In addition, the following infrastructure changes have been made in the Falkirk Council area:

- The Glenbervie slip roads project was completed in August 2012. This project has created an eastbound on 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 a slight 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 showed that the objective was met in 2012 with a concentration of 19 µg/m^3, monitoring will continue in 2013.

- In February 2013 the traffic lights at the junction of Kerse Lane and Bellevue Street (in the Falkirk Town Centre AQMA) were upgraded. This included a new pedestrian crossing for Kerse Lane (west), Garden Street and Bellevue Street and will result in a capacity improvement for the junction. Tubes NA24 (Kerse Lane)[d] and NA68 (Bellevue Street) will monitor any changes to NO_2 concentrations at or near to these junctions.
- The traffic lights at the junction of Dalderse Avenue and Grahams Road were upgraded in April 2013. This completed the upgrade of the three sets of traffic lights located on the B902 that lead into Falkirk Town Centre (and its AQMA). Tube NA81 is located close to these traffic lights and so will monitor any changes to NO_2 concentrations.

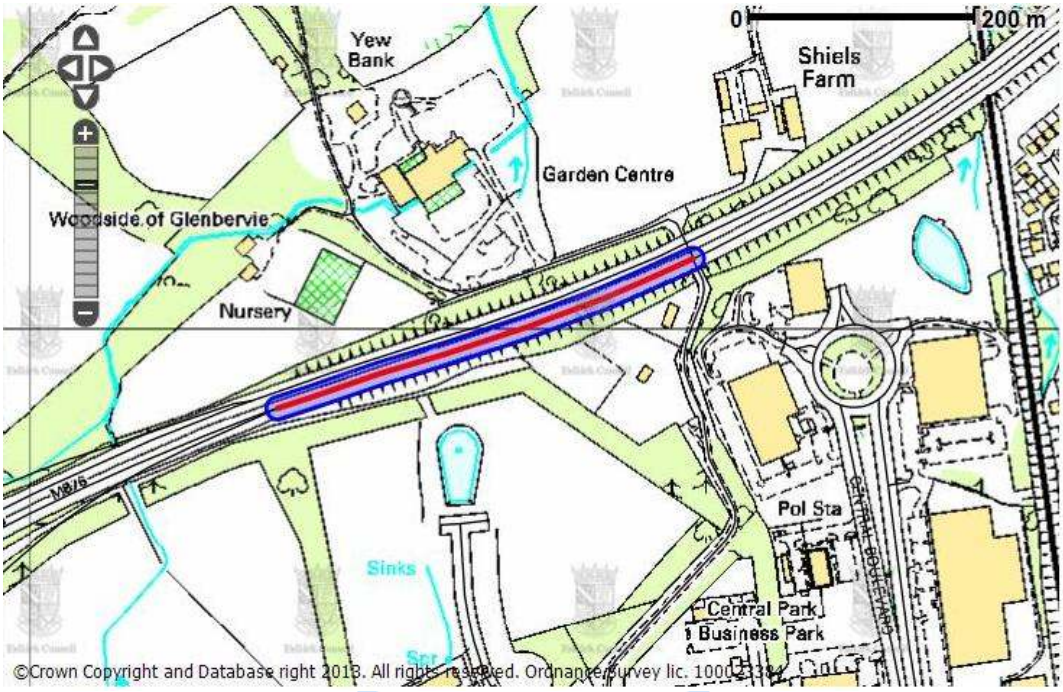
Trunk Roads

A review of the trunk road (Transport Scotland) traffic flow data for 2011 and 2012 has been completed. The existing count locations have been assessed for an increase in traffic levels. The greatest increase (20.9%) occurred on the M876 between its junction with the M9 and the A9. There are no receptors within 10 m of this link, the closest receptor is shown in Figure 3.1.

Only one site recorded a flow where the percentage of HDVs was greater than 20%. This was on the M80 at Bankhead. A diffusion tube (NA96, Sclandersburn Road, Denny) has previously operated in this area and was well within the annual NO_2 objective. It is therefore concluded that this does not need to be considered further. A significant number of new count sites are now in place following the upgrade of part of the A80 to Motorway standard, most of these count locations are in or near the Haggs AQMA.

[d] This work has resulted in the tube's location moving slightly closer to the kerb.

Figure 3.1 The area within 10 m of the link on the M876 between its junction with the M9 and A9.



The only infrastructure change associated with the trunk road network since the U&SA 2012 is the completion of the Glenbervie slip roads at the junction of the A9 and M876. This was discussed in the Local Roads part of this Section. The tube at Ure Crescent, Bonnybridge (NA88) is located next to the M876 and was within the annual NO_2 objective in 2012.

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 2011, 1,584 ships called at the docks compared to the 1,479 ships that called in 2012.[4] 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 calling the docks do not need to be considered further. In addition, the Grangemouth MC SO_2 monitor is close to the docks and elevated concentrations are usually associated with other sources in the area.

Airports

Edinburgh Airport is more than one km from the Falkirk Council boundary. There has been a 1.7% increase in passengers at the airport between 2007 and 2012. Falkirk Council is not aware of any significant changes to Cumbernauld airport, which is a small airport just outside the boundary and there are no new airports 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.

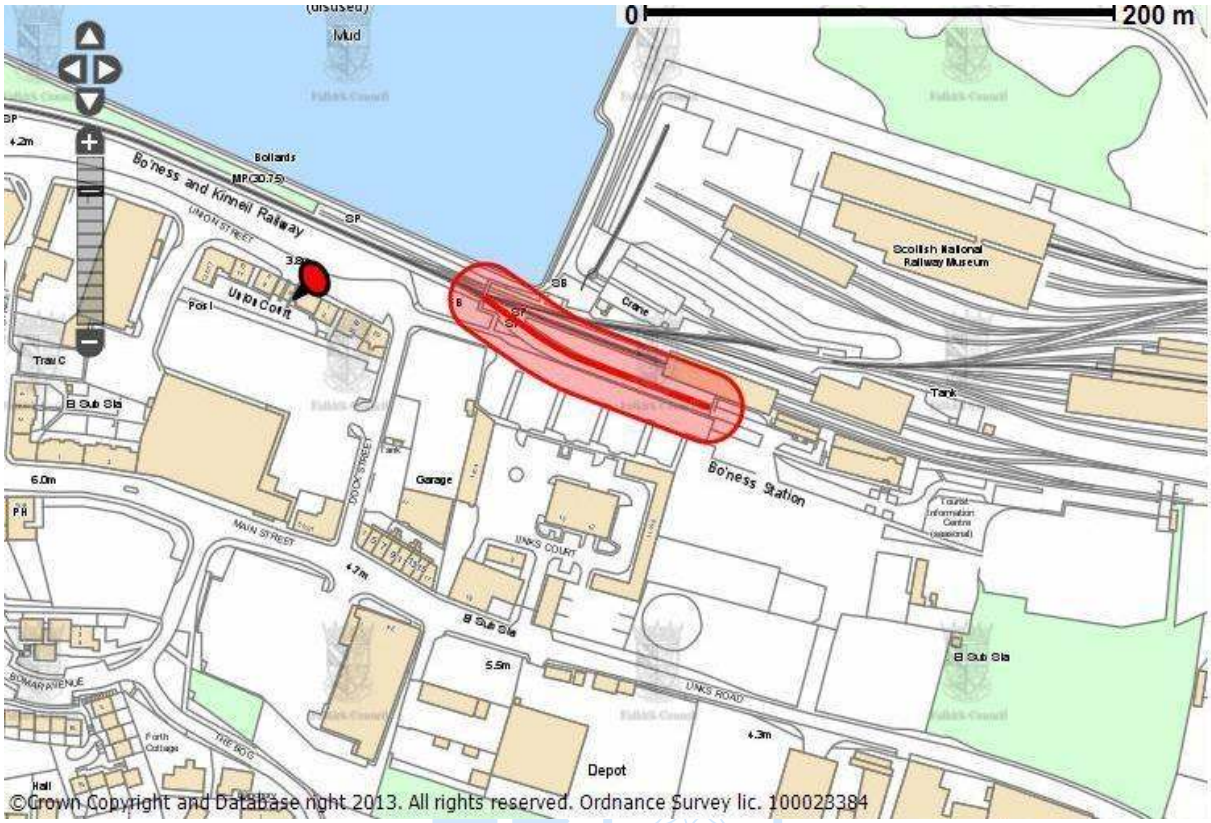
The assessment for NO_2 relates to very busy lines on which diesel locomotives run. Examples of these busy lines are those such as the railway lines into London Paddington, from Bristol Temple Meads to Bristol Parkway or Swindon to Taunton etc. In terms of nitrogen dioxide Falkirk Council was not required to assess the Glasgow to Edinburgh (via Falkirk High) line because the background NO_2 concentrations were lower than the 25 $\mu g/m^3$ as recommended by the technical guidance. However, a NO_2 diffusion tube (NA93) was previously placed near Falkirk High Station as a precaution. The results of this monitoring in 2010 showed that the concentration, 22 $\mu g/m^3$, was below the NO_2 annual mean objective. The site was therefore discontinued.

The modelled background concentrations for NO_2 in 2012 (with 2010 base year) are shown in Figure 2.12. A review of these concentrations has shown two 1km x 1km squares with a concentration of greater than 25 $\mu g/m^3$. However, the two squares are not near the Falkirk High rail line. The Falkirk High rail line is part of the Edinburgh to Glasgow improvement Programme. This will see the line electrified by 2016 and the number of diesel trains significantly reduced.

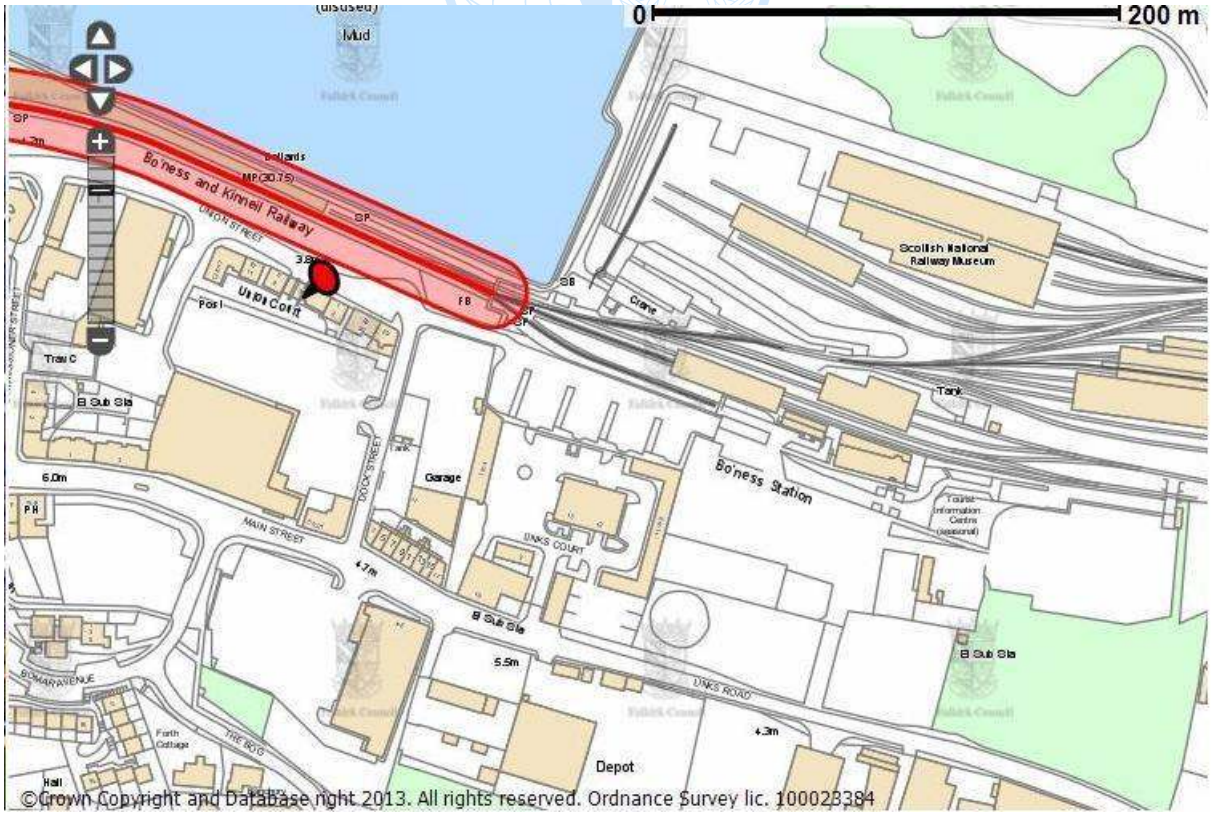
In terms of SO_2 the Scottish Rail Preservation Society line in Bo'ness has been re-assessed using the criteria in the technical guidance. Figure 3.2a shows a map of the area within 15 m of the tracks with Figures 3.2 b and c showing an aerial view of the area around the railway station. This area is mostly grass and an entrance to a car park. It is not considered that regular outdoor exposure is likely to occur within the 15 m of the railway track. Therefore in line with the technical guidance no Detailed Assessment for SO_2 is required.

Figure 3.2 a and b.) Two maps showing the area within 15 m of the track around Bo'ness railway station and c.) an aerial photo of the same area.

a.)



b.)



c.)

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.

SEPA have informed Falkirk Council of the following changes to operations with PPC permits:

- Carron Bathrooms (PPC/B/1018520) have reduced the height of the stack from their spray booths to minimise the release of styrene odours from the site. No offensive odours have been reported or detected from the site since this work was completed and SEPA will continue to monitor. (Falkirk Council comment: It should be noted that this is unlikely to have an impact on the seven LAQM pollutants, however, it is included for completeness).
- New dry cleaner in Bainsford (PPC/B/1108095).
- Biomar have a new fish meal store on Grangemouth docks (PPC/B/1103138).
- Boards Quarry (crushing and screening of aggregates, PPC/B/1003154), close to Denny, has ceased to operate.

- Dry cleaner (PPC/B/1013826) on Union Rd, Falkirk has ceased to operate.

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

In addition, the Flue Gas Desulphurisation absorber at Longannet Power Station is now fully operational on Unit 1. This was notified to SEPA on the 30th November 2012. Unit 2 is due to be operational by March 2013 and unit 3 by December 2013.[5]

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 its area in 2012.

A public inquiry was held into a biomass plant in Grangemouth in May 2012. At time of writing the inquirer's report has been passed to the Scottish Ministers for consideration but no decision has been made.

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) has been submitted. The access road will run through the Falkirk Council area to a new quarry (Tomfyne) which would be located in the North Lanarkshire Council area and is subject to a separate planning application. The Banknock 2 site (TEOM PM_{10}) is currently running in the Banknock AQMA.

A review of the road traffic flow data available for the Falkirk Council area has resulted in four DMRB runs being conducted. In addition, other forms of transport are considered, including the Bo'ness railway station that serves the Bo'ness and Kinneil (heritage) railway. PPC changes in the Falkirk Council area are discussed and do not need to be considered further. It is concluded that no Detailed Assessments are required.

4 Planning Applications

Table 4.1 shows the planning applications for 2012 which were identified as potentially having an impact on air quality or introduce new receptors in the future.

Table 4.1 Planning applications that may have an impact on local air quality pollutants in the future.

Details	Address	Granted?	Comments
550 houses, neighbourhood centre including retail and community Uses, access junctions, new access roads, provision of a nature conservation area, associated roads and infrastructure.	Land To The North Of Bankview Nursing Home Kilsyth Road Banknock	Pending Decision	In AQMA, NO_2 and PM_{10} monitoring already conducted.
(Consultation on) Application under section 36 of the Electricity Act 1989 to construct and operate a biomass renewable energy plant with a net electrical output of 100 MWe.	Site to the West of Forth Ports Plc, Central Dock Road, Grangemouth.	Planning inquiry	
Tomfyne Quarry and restoration of Cowdenhill Quarry (access via existing route).	Closest settlements Banknock, Falkirk and Kilsyth, North Lanarkshire.	Pending Consideration	In AQMA and monitoring already conducted.
Development For Coal Bed Methane Production, Including Drilling, Well Site Establishment at 14 Locations, Inter-Site Connection Services, Site Access Tracks, a Gas Delivery and Water Treatment Facility, Ancillary Facilities, Infrastructure and Associated Water Outfall Point.	Letham Moss, Falkirk, FK2 8RT.	Pending Consideration	
Proposal for 307 New Homes (Including 46 Affordable Homes) and Denny Eastern Access Road (DEAR), Including Provision of Greenspace, Sustainable Urban Drainage and Associated Infrastructure.	Land To The South Of Mydub Farm Glasgow Road Denny	Pending Consideration	Two NO_2 tubes in Denny currently meeting the objective.

The Asda distribution depot that was highlighted in the 2012 U&SA began operation in November 2012. Tubes NA94 and NA101 are already in operation in the vicinity of this development and met the annual NO_2 objective in 2012. The two diffusion tube monitoring sites will continue to operate.

At the time of writing the Scottish Government's reporter inquiry and report into the Grangemouth biomass renewable energy plant (100 MWe) with his recommendations has been completed and passed to Ministers for their consideration.

The proposed Tomfyne quarry and the Banknock AQMA are discussed in Sections 2 and 5.

The DEAR project will reduce the amount of traffic passing through Denny Town Centre. A brief air quality assessment has been requested for those (new) receptors close to the new road.

The air quality assessment for the DART energy proposal assessed nitrogen dioxide as it falls within the remit of the LAQM Review and Assessment process (see Table 1.1) and predicted that there would be no exceedances of the nitrogen dioxide air quality objectives. It is however likely that monitoring for nitrogen dioxide and benzene would be agreed should this application be granted permission.

5 Implementation of Action Plans

Banknock (PM_{10}) AQMA

The monitoring results from the Banknock 1 (A2, Osiris) monitoring site which ceased operation in October 2012, were discussed in Section 2. In December 2012 the Banknock 2 (A13, TEOM) monitoring site replaced the Banknock 1 site.

The monitoring at the Banknock 2 monitoring site will remain in place while the planning application for the new Tomfyne quarry and access road is determined. In addition, a background location (i.e. away from the A803 road) is currently being sought. The Further Assessment is therefore also currently on hold until the planning application is determined. However, the monitoring data currently being collected will contribute to this study.

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 Further Assessment for the Falkirk Town Centre and Haggs AQMAs has resulted in:

- PM_{10} monitoring ceasing at Falkirk Hope St and Grangemouth Moray.
- NO_x monitoring ceasing and PM_{10} monitoring commencing at the Falkirk Grahams Rd site.
- PM_{10} monitoring has commenced at the Falkirk Haggs site.
- The revocation of the Falkirk Town Centre (along a small part of Grahams Road) hourly NO_2 AQMA.
- The variation of the Falkirk Town Centre annual NO_2 AQMA to include the PM_{10} annual and daily Scottish daily objectives.

A draft Action Plan has been produced. A consultation is now to be carried out prior to submission to the Scottish Government.

As part of this 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 and York. 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 15 members who operate 1,146 vehicles that are either based in or operate through the Falkirk Council area.

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 hourly objective continues to be met at all sites, both inside and outside the AQMA. In 2012 a breach of the daily objective was recorded at the Grangemouth Moray site. This was discussed in Section 2.

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 6.1.

Measure 1:

Falkirk Council has seven 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 seven SO_2 analysers that were used for monitoring in relation to the Grangemouth AQMA in 2012. The data from the Bo'ness and Polmont sites are scaled in-house and are available on request.

Falkirk Council sends through provisional SO_2 and meteorological data to SEPA and Petroineos when an SO_2 exceedance is recorded at a monitoring station. In addition, a monthly summary is sent, part of which is shown in Figure 6.1. 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. As indicated by the number of exceedances 2012 was a busier than usual year for this measure, with 52 exceedance e-mails being sent. In addition, a meeting with the Falkirk East MSP was held in August 2012 to discuss the exceedances and Tail Gas Treatment.

Measure 2:

A working group meeting will be organised when the Tail Gas Treatment unit has been fully commissioned.

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 and will generally give a better distribution of Falkirk Council's SO_2 monitors in relation to the AQMA. The Polmont site has met the SO_2 objectives with only one 15-minute exceedance recorded during its operation.

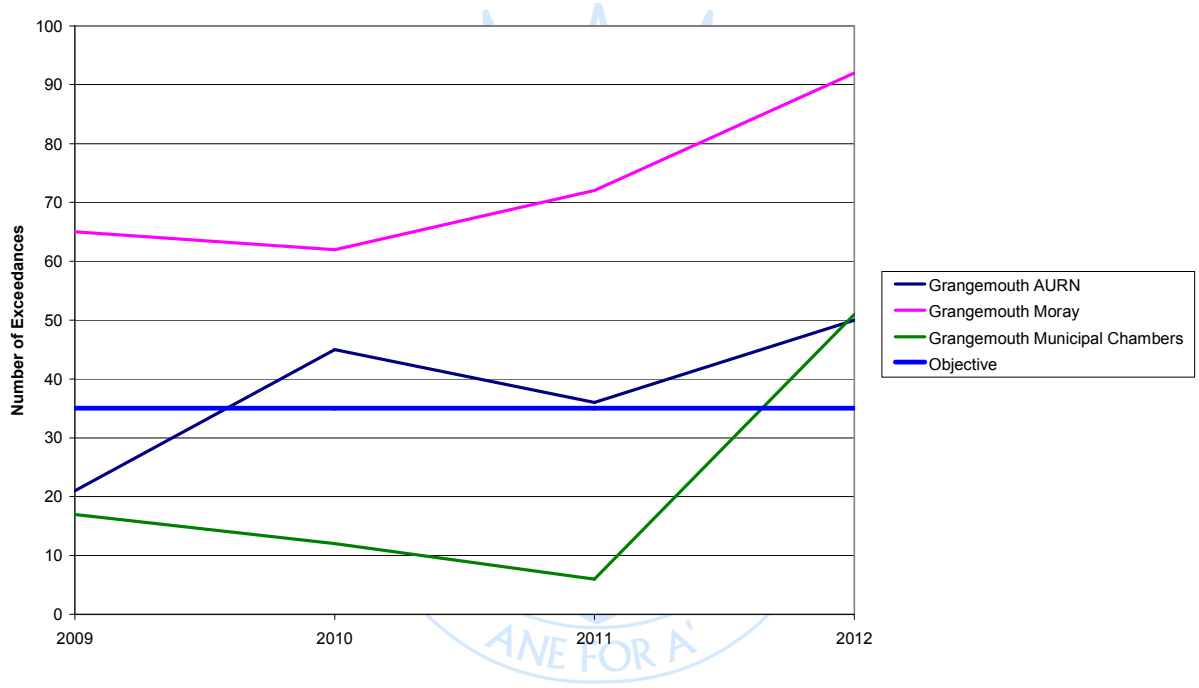
Table 6.1 Grangemouth AQMA Action Plan Progress.

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 and Petroineos.	Falkirk Council	Data sent after exceedances.	Increasing amounts of information in monthly summary. Analysis and polar plots.	Ongoing.	See comments below.
2	Working group.	Bring together FVHB, Petroineos, S.Govt, SEPA and Falkirk Council.	Falkirk Council	Modelling meeting held in August 2012.	To meet when TGT commissioned.	Ongoing.	See comments below.
3	Text alert system.	Real-time notification of exceedances.	Falkirk Council	Implemented.	Maintenance of system.	Completed and ongoing. Trial at Grangemouth AURN with e-mails.	See comments below.
4	Monitoring network.	Review monitoring network.	Falkirk Council	Grangemouth Moray SO_2 in SAQN. Monitoring conducted in Polmont.	Unit at Abbotsford House relocated to Polmont for two years.	Ongoing.	See comments below.

Figure 6.1 A part of the monthly summary of data supplied to Petroineos and SEPA.

1st January to 3rd December 2012	Number of exceedances of concentration / limit value.			Highest concentration, µg m^{-3}.			Data capture, %	Status
	15-min	Hourly	Daily	15-min	Hourly	Daily		
Grangemouth AURN	50	0	0	492	306	119	93	Ratified to end June.
Moray	77	1	3	455	378	145	86.5	Ratified to end June.
Municipal Chambers	50	0	2	359	311	156	99.4	Ratified to end June.
Bo'ness	0	0	0	207	130	30	95.8	Ratified to end June.
Falkirk Hope St	2	0	0	388	303	46	98.4	Ratified to end June.
Falkirk Park St	2	0	0	386	301	40	98.9	Ratified to end June.
Polmont	0	0	0	231	121	26	79.5	Period data capture quoted. Ratified to end of operation (2nd October).

Figure 6.2 The number of 15-minute exceedances recorded at the three sites in the Grangemouth AQMA between 2009 and 2012.



The significant increase in the number of exceedances that occurred between 2006 and 2007 was has been discussed in previous R&A reports. The Grangemouth Moray site also experienced a significant increase, however, this monitor only commenced operation in September 2006. In 2012, all three sites recorded exceedances of the 15-minute objective and with the number recorded at each site also increasing compared to 2011. However, all three sites are within the 15-minute AQMA.

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. However, it should be treated with some caution, as the local meteorological conditions will also have an impact on the number of exceedances recorded at each monitoring station. These conditions will of course vary from year to year and as discussed in Section 2 the frequency of easterly winds was greater in 2012 compared to 2011.

In SEPA's Air Quality Report for 2008 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]

The Tail Gas Treatment abatement work that has been discussed in previous reports was installed during the refinery turnaround period in September 2012. The unit will be commissioned in 2013.

6 Conclusions and Proposed Actions

6.1 Conclusions from New Monitoring Data

Falkirk Council has examined the monitoring results for its area and has concluded that:

- The SO_2 daily objective was breached at the Grangemouth Moray site in 2012. However, it is considered that a Detailed Assessment is not required. This is due to emission changes that will occur during 2013 (resulting from Tail Gas Treatment) and also unusual meteorological and operational conditions that occurred during 2012.
- There was an increase in benzene concentrations due to an incident at a storage tank. The monitoring results, particularly the pumped benzene diffusion tube, have been reviewed and it is considered that no Detailed Assessment is required.
- There is no clear trend with NO_2 concentrations across the automatic monitoring sites. However, PM_{10} concentrations at the Falkirk West Bridge St site have shown a clear decline since its installation in September 2009.

6.2 Conclusions relating to New Local Developments

A review of the local road traffic data (links only) has been completed. A number of roads have seen an increase in flow of more than 10%. The vast majority were either below the appropriate thresholds for further consideration or were adequately represented by existing monitoring. However, four DMRB runs have been completed and it is concluded that no Detailed Assessment is required. Industrial (PPC) changes in the Falkirk Council area do not need to be considered further.

6.3 Other Conclusions

Falkirk Council has provided an update on the Action Plan in relation to the Grangemouth AQMA. A breach of the 15-minute air quality objective continues to be recorded in the AQMA. However, the Tail Gas Treatment unit will be commissioned during 2013. Summaries of the Falkirk and Haggs AQMA are also provided and the actions relating to this are discussed in Sections 6.1 and 6.4.

6.4 Proposed Actions

Falkirk Council proposes to carry out the following actions:

- The work in relation to the Grangemouth (15-minute) AQMA will continue as per the Action Plan.
- Preparatory work for the Banknock PM_{10} AQMA Further Assessment will continue, but progression is dependent on the outcome of a planning application.
- Install the Osiris at a background location. The exact position of this is dependent on finding a secure location and power supply.
- Continue the Falkirk Town Centre and Haggs Action Plan work.
- Submit, subject to the LAQM review, a 2014 Progress Report.

7 References

General:

Technical Guidance LAQM.TG(09), Defra and Devolved Administrations, February 2009.

Specific:

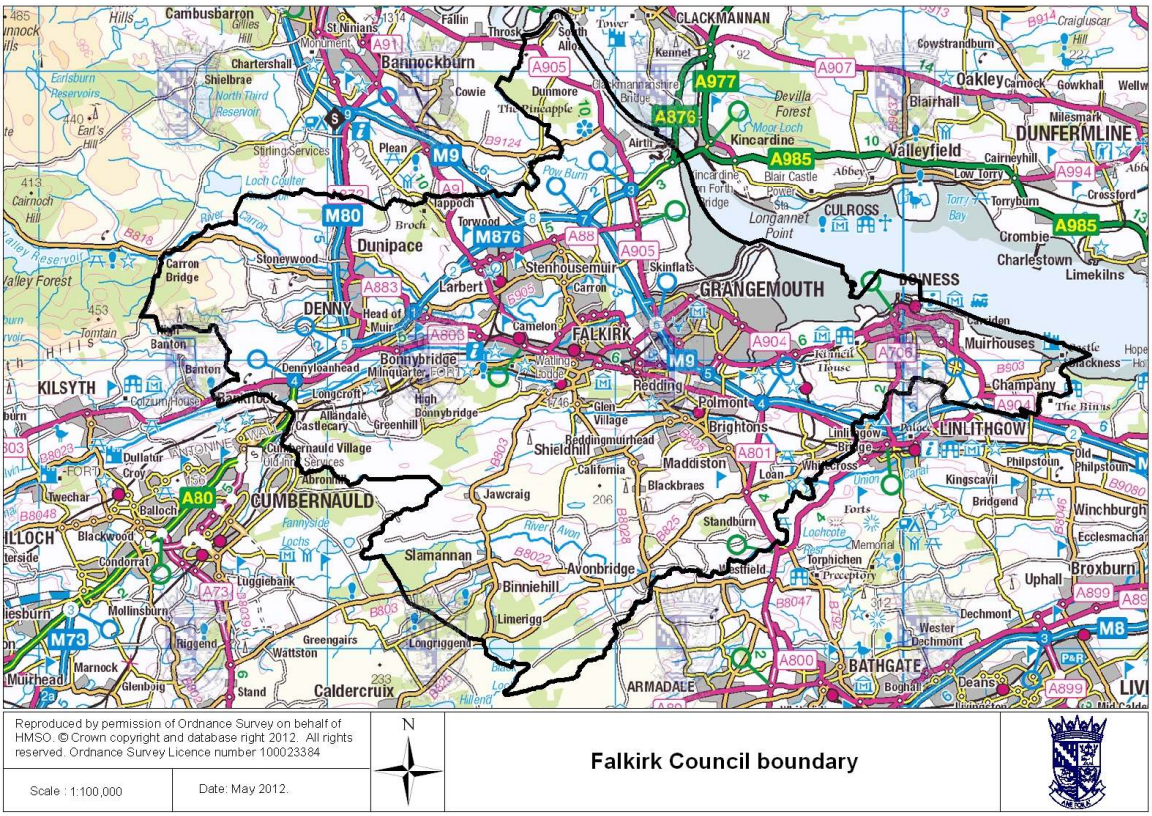
1. 2009 Updating and Screening Assessment, G_FAL_030/04-02-01, BMT Cordah.
2. Detailed Assessment of PM_{10} in Banknock, Falkirk Council, December 2010, http://www.falkirk.gov.uk/services/development/environmental_protection/air_quality/air_quality_reports.aspx
3. Personal communication, Petroineos.
4. Personal communication, Forth Ports.
5. Personal communication, Scottish Power.
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.



2012 Automatic Monitoring Locations

The location of the seven monitoring sites in the Scottish Air Quality Network can be viewed at www.scottishairquality.co.uk The location of the remaining monitoring sites are shown in Figures A2 a to c.

Figure A2a The location of the Banknock 1 (A2) and Banknock 2 (A13) monitoring sites.

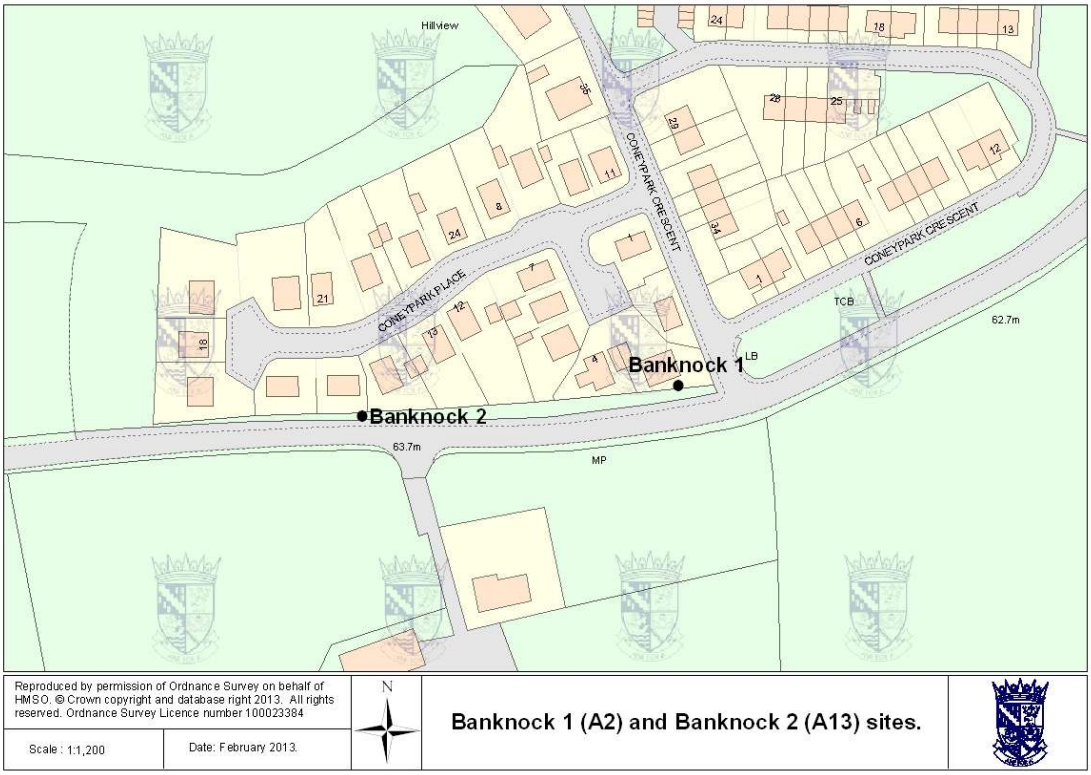


Figure A2b The location of the Bo'ness (A3) site.

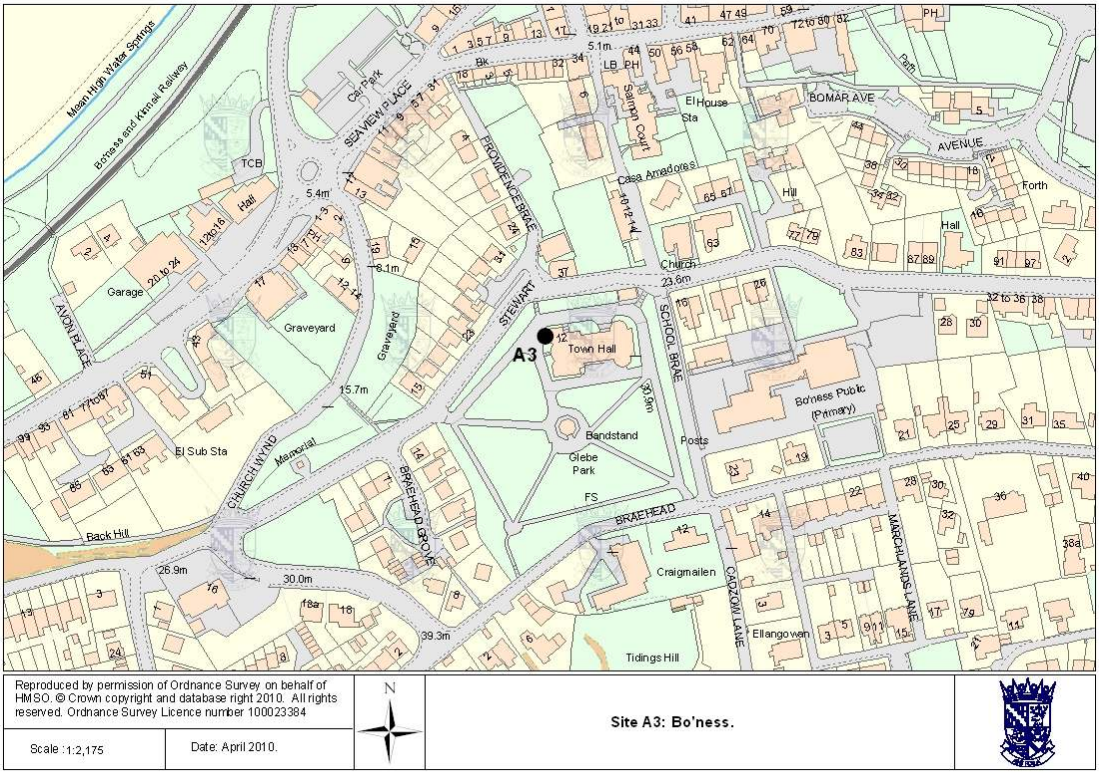
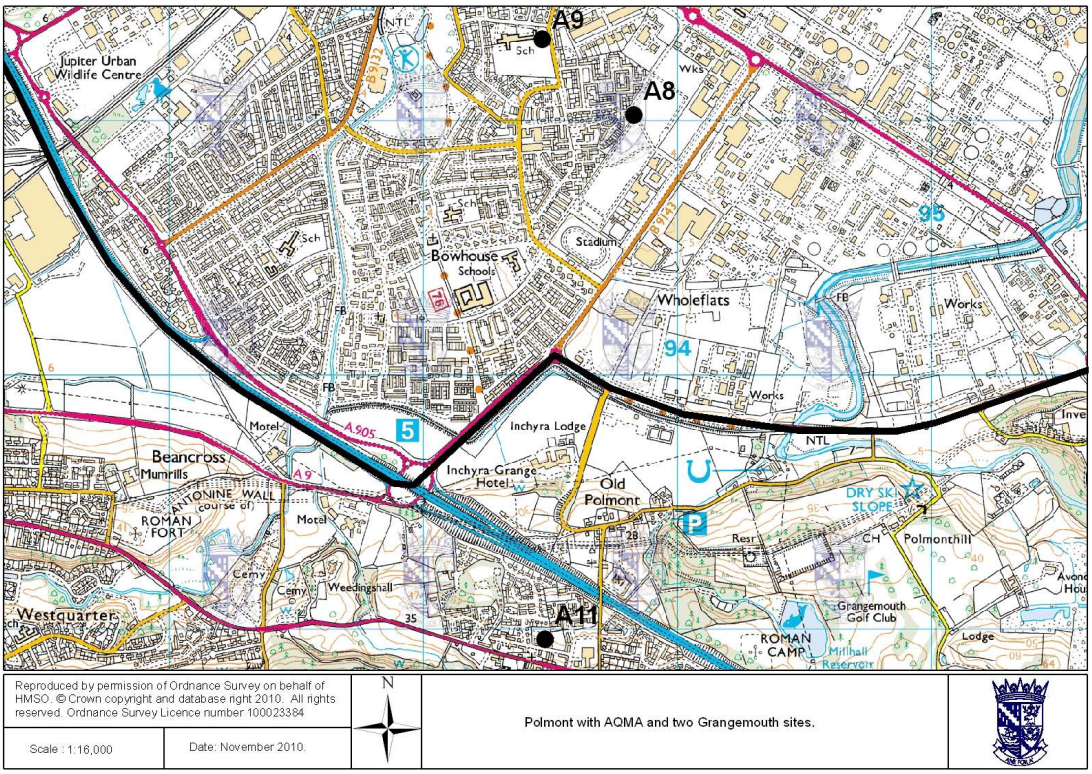


Figure A2c The location of the Polmont (A11) site.



Appendix 2: QA / QC of Data and DMRB Calculations

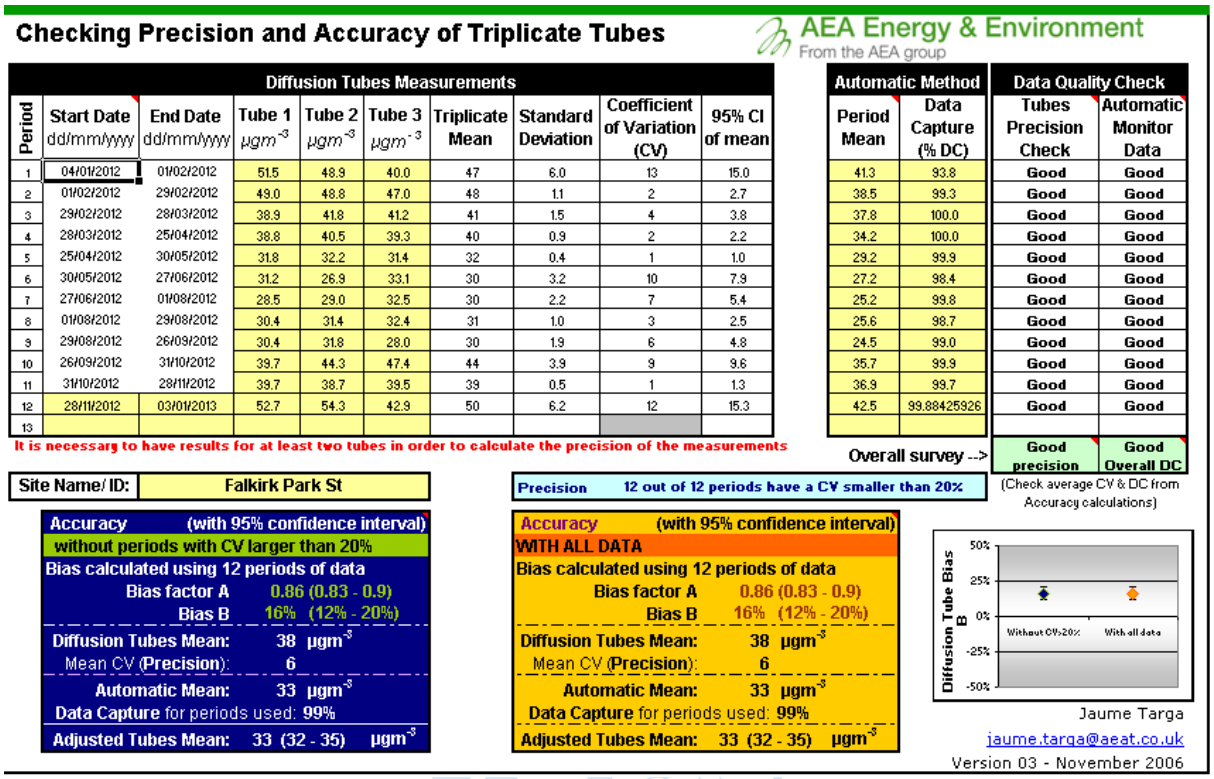
Diffusion Tube Bias Adjustment Factors

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 consists of the spreadsheets that show the local bias factors. The automatic monitoring data used was ratified for the first half and provisional for the second half of 2012.

The bias factor for the Grangemouth MC site was 0.91 and for Falkirk Park St site was 0.86. The bias adjustment factor from the R&A Helpdesk database for 2012 was 0.79. 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.

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



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

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
1	04/01/2012	01/02/2012	51.5	48.9	40.0	47	6.0	13	15.0
2	01/02/2012	29/02/2012	49.0	48.8	47.0	48	1.1	2	2.7
3	29/02/2012	28/03/2012	38.9	41.8	41.2	41	1.5	4	3.8
4	28/03/2012	25/04/2012	38.8	40.5	39.3	40	0.9	2	2.2
5	25/04/2012	30/05/2012	31.8	32.2	31.4	32	0.4	1	1.0
6	30/05/2012	27/06/2012	31.2	26.9	33.1	30	3.2	10	7.9
7	27/06/2012	01/08/2012	28.5	29.0	32.5	30	2.2	7	5.4
8	01/08/2012	29/08/2012	30.4	31.4	32.4	31	1.0	3	2.5
9	29/08/2012	26/09/2012	30.4	31.8	28.0	30	1.9	6	4.8
10	26/09/2012	31/10/2012	39.7	44.3	47.4	44	3.9	9	9.6
11	31/10/2012	28/11/2012	39.7	38.7	39.5	39	0.5	1	1.3
12	28/11/2012	03/01/2013	52.7	54.3	42.9	50	6.2	12	15.3
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
41.3	93.8	Good	Good
38.5	99.3	Good	Good
37.8	100.0	Good	Good
34.2	100.0	Good	Good
29.2	99.9	Good	Good
27.2	98.4	Good	Good
25.2	99.8	Good	Good
25.6	98.7	Good	Good
24.5	99.0	Good	Good
35.7	99.9	Good	Good
36.9	99.7	Good	Good
42.5	99.88425926	Good	Good
	Overall survey -->	Good precision	Good Overall DC

(Check average CV & DC from Accuracy calculations)

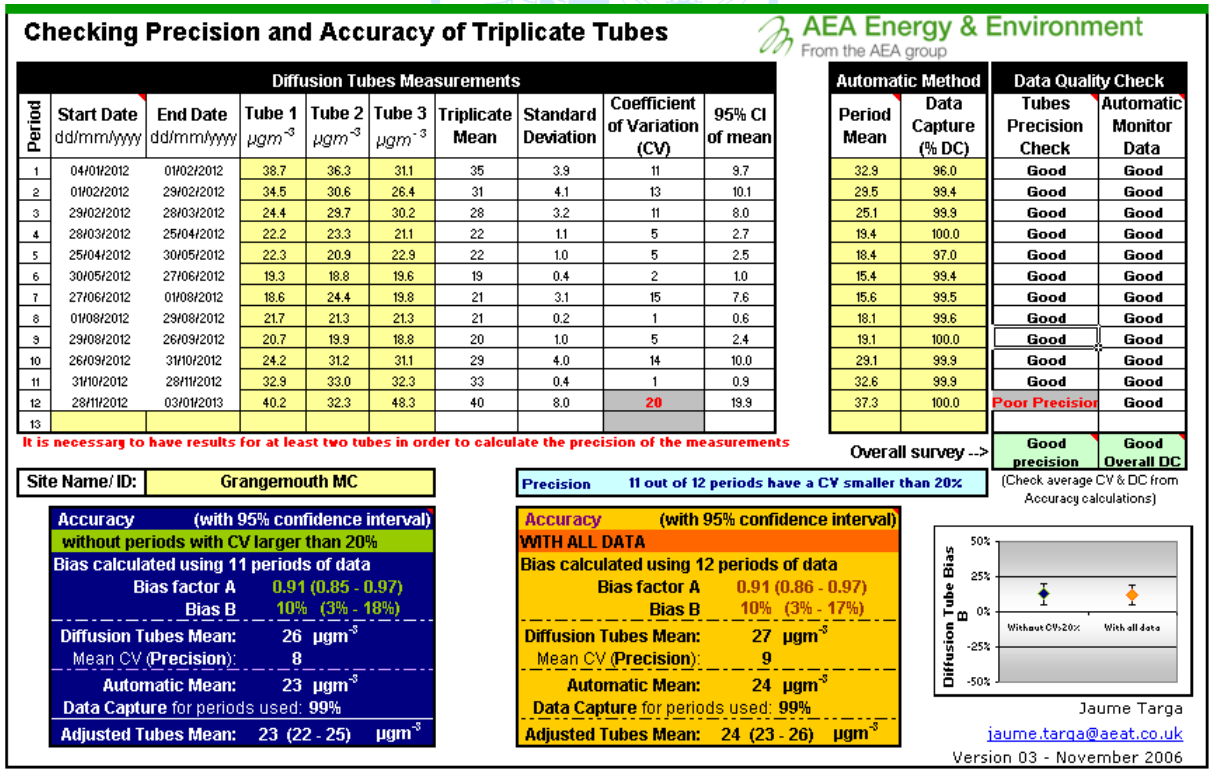
Site Name/ ID: Falkirk Park St

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

Accuracy (with 95% confidence interval) without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.86 (0.83 - 0.9)
Bias B 16% (12% - 20%)
Diffusion Tubes Mean: 38 µgm^{-3}
Mean CV (Precision): 6
Automatic Mean: 33 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 33 (32 - 35) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.86 (0.83 - 0.9)
Bias B 16% (12% - 20%)
Diffusion Tubes Mean: 38 µgm^{-3}
Mean CV (Precision): 6
Automatic Mean: 33 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 33 (32 - 35) µgm^{-3}

Jaume Targa
jaume.targa@aeat.co.uk
Version 03 - November 2006



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

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
1	04/01/2012	01/02/2012	38.7	36.3	31.1	35	3.9	11	9.7
2	01/02/2012	29/02/2012	34.5	30.6	26.4	31	4.1	13	10.1
3	29/02/2012	28/03/2012	24.4	29.7	30.2	28	3.2	11	8.0
4	28/03/2012	25/04/2012	22.2	23.3	21.1	22	1.1	5	2.7
5	25/04/2012	30/05/2012	22.3	20.9	22.9	22	1.0	5	2.5
6	30/05/2012	27/06/2012	19.3	18.8	19.6	19	0.4	2	1.0
7	27/06/2012	01/08/2012	18.6	24.4	19.8	21	3.1	15	7.6
8	01/08/2012	29/08/2012	21.7	21.3	21.3	21	0.2	1	0.6
9	29/08/2012	26/09/2012	20.7	19.9	18.8	20	1.0	5	2.4
10	26/09/2012	31/10/2012	24.2	31.2	31.1	29	4.0	14	10.0
11	31/10/2012	28/11/2012	32.9	33.0	32.3	33	0.4	1	0.9
12	28/11/2012	03/01/2013	40.2	32.3	48.3	40	8.0	20	19.9
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
32.9	96.0	Good	Good
29.5	99.4	Good	Good
25.1	99.9	Good	Good
19.4	100.0	Good	Good
18.4	97.0	Good	Good
15.4	99.4	Good	Good
15.6	99.5	Good	Good
18.1	99.6	Good	Good
19.1	100.0	Good	Good
29.1	99.9	Good	Good
32.6	99.9	Good	Good
37.3	100.0	Poor Precision	Good
	Overall survey -->	Good precision	Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Grangemouth MC

Precision 11 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval) without periods with CV larger than 20%
Bias calculated using 11 periods of data
Bias factor A 0.91 (0.85 - 0.97)
Bias B 10% (3% - 18%)
Diffusion Tubes Mean: 26 µgm^{-3}
Mean CV (Precision): 8
Automatic Mean: 23 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 23 (22 - 25) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.91 (0.86 - 0.97)
Bias B 10% (3% - 17%)
Diffusion Tubes Mean: 27 µgm^{-3}
Mean CV (Precision): 9
Automatic Mean: 24 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 24 (23 - 26) µgm^{-3}

Jaume Targa
jaume.targa@aeat.co.uk
Version 03 - November 2006

Figure A4 National diffusion tube bias adjustment factor spreadsheet for ESG (Didcot), 50% TEA in acetone for 2012.

National Diffusion Tube Bias Adjustment Factor Spreadsheet — Spreadsheet Version Number: 03/13

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 2013

LAQM Helpdesk Website

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

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

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

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

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

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

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

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

Step 4: Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor[3] shown in blue at the foot of the final column.

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

Analysed By[1]	Method To analyse your selection, choose (All) from the pop-up list	Year[2] To analyse your selection, choose (All)	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m³)	Automatic Monitor Mean Conc. (Cm) (µg/m³)	Bias (B)	Tube Precision[5]	Bias Adjustment Factor (A) (Cm/Dm)
ESG Didcot	50% TEA in acetone	2012	R	Suale Barough Council	9	44	35	25.2%	G	0.80
ESG Didcot	50% TEA in acetone	2012	R	Suale Barough Council	11	46	37	23.7%	G	0.81
ESG Didcot	50% TEA in acetone	2012	R	Vale Of White Horse Dirtrict Council	12	37	30	24.5%	G	0.80
ESG Didcot	50% TEA in acetone	2012	UB	Gravesham Barough Council	12	32	27	18.4%	G	0.84
ESG Didcot	50% TEA in acetone	2012	UB	Gravesham Barough Council	12	44	35	25.3%	G	0.80
ESG Didcot	50% TEA in acetone	2012	R	Hambleton Dirtrict Council	12	25	19	31.2%	G	0.76
ESG Didcot	50% TEA in acetone	2012	R	North East Lincolnshire Council	12	38	30	26.2%	G	0.79
ESG Didcot	50% TEA in acetone	2012	R	North East Lincolnshire Council	12	42	32	32.3%	G	0.76
ESG Didcot	50% TEA in acetone	2012	R	Falkirk Council	12	38	33	15.9%	G	0.86
ESG Didcot	50% TEA in acetone	2012	UB	Falkirk Council	12	27	24	9.9%	G	0.91
ESG Didcot	50% TEA in acetone	2012	R	Thanet Dirtrict Council	12	32	25	27.2%	G	0.79
ESG Didcot	50% TEA in acetone	2012	KS	Marylebone Road Intercomparison	11	127	95	34.1%	G	0.75
ESG Didcot	50% TEA in acetone	2012	B	Stockton on Tees	12	28	21	33.8%	G	0.75
ESG Didcot	50% TEA in acetone	2012	R	Stockton on Tees	11	22	17	29.9%	G	0.77
ESG Didcot	50% TEA in acetone	2012	SU	Thanet Dirtrict Council	12	21	18	16.6%	G	0.86
ESG Didcot	50% TEA in acetone	2012	UB	CITY OF YORK COUNCIL	12	28	24	15.3%	P	0.87
ESG Didcot	50% TEA in acetone	2012	R	CITY OF YORK COUNCIL	12	41	32	30.5%	P	0.77
ESG Didcot	50% TEA in acetone	2012	R	CITY OF YORK COUNCIL	12	37	28	31.4%	G	0.76
ESG Didcot	50% TEA in acetone	2012	R	CITY OF YORK COUNCIL	12	41	30	34.4%	G	0.74
ESG Didcot	50% TEA in Acetone	2012	KS	Suffolk Coastal Dirtrict Council	12	50	44	13.8%	G	0.88
ESG Didcot	50% TEA in acetone	2012	B	Maidstone Barough Council	12	20	14	46.2%	G	0.68
ESG Didcot	50% TEA in acetone	2012	R	Maidstone Barough Council	12	48	43	13.2%	P	0.88
ESG Didcot	50% TEA in acetone	2012	R	Armagh City and Dirtrict Council	12	40	27	45.3%	G	0.69
ESG Didcot	50% TEA in acetone	2012	R	Dumfries and Galloway Council	12	38	33	14.2%	G	0.88
ESG Didcot	50% TEA in acetone	2012	R	Cambridge City Council	12	46	35	31.5%	G	0.76
ESG Didcot	50% TEA in acetone	2012	R	Suale Barough Council	11	44	31	41.9%	G	0.70
ESG Didcot	50% TEA in acetone	2012		Overall Factor[3] (26 studies)				Use		0.79

Discussion of choice of factor to use

The overall automatic data capture and precision were good for both of the Falkirk Council triplicate studies, with only the December results at the Grangemouth MC site showing poor precision. The R&A factor has been used for NO_2 concentrations in this report as the tubes are in a variety of locations.

PM_{10} Monitoring Adjustment

All TEOM data from the Scottish Air Quality Network sites presented in this report has been adjusted using the King's College (London) Volatile Correction Model (VCM). This has been carried out by Ricardo-AEA as part of the Scottish Government's contract for the SAQN. The Grangemouth AURN site has an FDMS and so no correction factor has been applied to the data. The corrections applied to the other sites (Banknock 2, Falkirk Grahams Road and Haggs) have used the template supplied by Ricardo-AEA. This means that the same VCM adjustment has been made to all sites.

The Banknock 1 Osiris data has had an adjustment factor of 1.3 and 1.14 applied because a VCM correction is not considered valid. The Osiris output is a 15-minute average, these have been converted to an hourly and daily average using Enview software.

Short-term to long-term data adjustment

Short-term to long-term data adjustments were carried out for the Banknock 1, Banknock 2 and Haggs automatic monitoring sites as well as for two diffusion tubes. AURN background sites have been used for the corrections:

- NO_2: Grangemouth AURN (A8), Grangemouth Moray (A9) and Edinburgh St. Leonards.
- PM_{10}: only the Grangemouth AURN (A8) site has been used. In 2012 the Glasgow Centre site closed and the Edinburgh St. Leonards site had poor data capture.

Table A1 NO_2 short to long-term data adjustments.

NA106 (Stirling Road, North Broomage)	Site Type	Annual Mean (2012), µg/m^3	Period Mean, µg/m^3	Ratio
Grangemouth AURN	Urban background.	16.2	23.7	0.68
Grangemouth Moray	Urban background.	19.6	24.6	0.80
Edinburgh St. Leonards	Urban background	24.1	31.4	0.77
			Average	0.75

Banknock 1 (A2)	Site Type	Annual Mean (2012), µg/m^3	Period Mean, µg/m^3	Ratio
Grangemouth AURN (A8)	Urban background.	14.1	13.8	1.021

Banknock 2 (A13)	Site Type	Annual Mean (2012), µg/m^3	Period Mean, µg/m^3	Ratio
Grangemouth AURN (A8)	Urban background.	14.1	14.2	0.995

Falkirk Haggs (A4)	Site Type	Annual Mean (2012), µg/m^3	Period Mean, µg/m^3	Ratio
Grangemouth AURN (A8)	Urban background.	14.1	14.0	1.005

Grangemouth MC (A10)	Site Type	Annual Mean (2012), µg/m^3	Period Mean, µg/m^3	Ratio
Grangemouth AURN (A8)	Urban background.	14.1	13.5	1.042

NO_2 Distance Calculations

Main St, Bainsford (NA83):

This calculator allows you to predict the annual mean NO_2 concentration for a location ("receptor") that is close to a monitoring site, but nearer or further the kerb than the monito
The next sheet shows your results on a graph.

Air Quality CONSULTANTS

Enter data into the yellow cells

Step 1	How far from the KERB was your measurement made (in metres)?	(Note 1)	1.5	metres
Step 2	How far from the KERB is your receptor (in metres)?	(Note 1)	3	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	(Note 2)	17.7	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	(Note 2)	41	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	(Note 3)	37.5	µg/m^3

Note 1: In some cases the term "kerb" may be taken to be the edge of the trafficked road - see the FAQ at http://laqm2.defra.gov.uk/FAQs/Monitoring/Location/index.htm for further details. Distances should be measured horizontally from the kerb and assumes that the monitor and receptor have similar elevations. Each distance should be greater than 0.1m and less than 50m (In practice, using a value of 0.1m when the monitor is closer to the kerb than this is likely to be reasonable). The receptor is the location for which you wish to make your prediction. The monitor can either be closer to the kerb than the receptor, or further from the kerb than the receptor. The closer the monitor and the receptor are to each other, the more reliable the prediction will be. When your receptor is further from the kerb than your monitor, it is recommended that the receptor and monitor should be within 20m of each other. When your receptor is closer to the kerb than your monitor, it is recommended that the receptor and monitor should be within 10m of each other.

Note 2: The measurement and the background must be for the same year. The background concentration could come from the national maps published at www.airquality.co.uk, or alternatively from a nearby monitor in a background location.

Note 3: The calculator follows the procedure set out in Box 2.3 of LAQM TG(09). The results will have a greater uncertainty than the measured data. More confidence can be placed in results where the distance between the monitor and the receptor is small than where it is large.

Issue 4: 25/01/11. Created by Dr Ben Marner; Approved by Prof Duncan Laxen. Contact: benmarner@aqconsultants.co.uk

Glensburgh Road, Grangemouth (NA94):

This calculator allows you to predict the annual mean NO_2 concentration for a location ("receptor") that is close to a monitoring site, but nearer or further the kerb than the monito
The next sheet shows your results on a graph.

Air Quality CONSULTANTS

Enter data into the yellow cells

Step 1	How far from the KERB was your measurement made (in metres)?	(Note 1)	7	metres
Step 2	How far from the KERB is your receptor (in metres)?	(Note 1)	12	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	(Note 2)	30.1	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	(Note 2)	38	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	(Note 3)	36.6	µg/m^3

Note 1: In some cases the term "kerb" may be taken to be the edge of the trafficked road - see the FAQ at http://laqm2.defra.gov.uk/FAQs/Monitoring/Location/index.htm for further details. Distances should be measured horizontally from the kerb and assumes that the monitor and receptor have similar elevations. Each distance should be greater than 0.1m and less than 50m (In practice, using a value of 0.1m when the monitor is closer to the kerb than this is likely to be reasonable). The receptor is the location for which you wish to make your prediction. The monitor can either be closer to the kerb than the receptor, or further from the kerb than the receptor. The closer the monitor and the receptor are to each other, the more reliable the prediction will be. When your receptor is further from the kerb than your monitor, it is recommended that the receptor and monitor should be within 20m of each other. When your receptor is closer to the kerb than your monitor, it is recommended that the receptor and monitor should be within 10m of each other.

Note 2: The measurement and the background must be for the same year. The background concentration could come from the national maps published at www.airquality.co.uk, or alternatively from a nearby monitor in a background location.

Note 3: The calculator follows the procedure set out in Box 2.3 of LAQM TG(09). The results will have a greater uncertainty than the measured data. More confidence can be placed in results where the distance between the monitor and the receptor is small than where it is large.

Issue 4: 25/01/11. Created by Dr Ben Marner; Approved by Prof Duncan Laxen. Contact: benmarner@aqconsultants.co.uk

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 2012. A description of the procedures for each network then follows.

Table A2 QA / QC applied to automatic monitoring data in 2012.

QA / QC for 2012.		
Site	**Analyser**	**Network**
A2. Banknock 1	PM_{10} (Osiris)	Local #
A3. Bo'ness	SO_2	Local *
A4. Falkirk Haggs	NO_x	SAQN
	PM10 (TEOM)	Local *
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
A11. Polmont	SO_2	Local *
A12. Falkirk Grahams Rd	PM_{10} (TEOM)	Local *
A13. Banknock 2	PM_{10} (TEOM)	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 downloaded at site and a flow check is carried out on a fortnightly basis.
- A filter change is carried out on an approximate four weekly basis, although this is dependent on the weather and filter loading. The filters are retained for analysis.
- Some minor adjustment of the times for the data has taken place. This is because between a flow check or filter change and the next midnight hour, the Osiris records data in 15-minute blocks at say 12, 27, 42, 57 mins past the hour rather than the usual 15, 30, 45 and 00. This should have little effect on the results and permits the data to fit into the Council's monitoring database which it otherwise would not.
- 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 service agreement for any breakdowns. Unlike the other automatic analysers both are completed off-site.
- A 1.3 / 1.14 correction factor has been applied to the PM_{10} data for Banknock 1. 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 span checks and filter changes. Note the AURN sites receive a fortnightly NO_2 span check for NO_x converter efficiency but the SAQN sites do not.
- TEOM heads are cleaned and the filter changed on a four weekly basis or more frequently if the filter loading goes above 80%.
- TEOM-FDMS heads are cleaned and filters changed as directed by AURN CMCU (i.e. at 90% 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 (formerly AEA Energy and Environment) state that QA / QC is to either AURN or 'national' standards [7].

QA / QC Diffusion Tube Monitoring

The full set of monthly 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 throughout 2012, except for the final three results (see Figure A4). This matches well with Falkirk Council's results which showed poor precision at the Grangemouth MC site in December 2012.

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 (uncorrected for bias) diffusion tubes results for 2012.

a.)

		Grid Reference		January	February	March	April	May	June	July	August	September	October	November	December	**Annual average**		Annual data capture,
Site number	Location	x	y	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	**ppb**	**ug/m^3**	
3	Tinto Drive,Grangemouth	293427	680386	0.41	0.39	0.23	0.47	0.077	0.6	0.49	0.55	0.27	0.42	0.28	0.37	0.38	1.23	100.0
21	Grangemouth Road, College	290112	680500	0.66	0.54	1.1	0.43	0.13	1.2	0.18	0.21	1	0.17	1.2	0.25	0.59	1.91	100.0
27	West Bridge Street, Falkirk	288470	680040	1	0.5	0.33	0.43	0.14	0.34	0.18	0.36	1.2	0.96	1.7	0.59	0.64	2.09	100.0
37	Denny Town House	281227	682725	0.62	0.21	0.41	0.18	0.46	1.1	0.18	0.29	-	0.21	0.43	0.58	0.42	1.38	91.7
38	Larbert Village Primary School	285960	682400	0.28	0.31	0.17	0.58	0.076	1.5	0.11	0.19	0.87	0.17	0.58	0.21	0.42	1.37	100.0
41	Seaview Place, Bo'ness	299720	681600	0.86	0.72	0.7	0.43	0.17	1.4	-	0.18	1.1	0.21	0.94	0.54	0.66	2.14	91.7
42	Municipal Chambers, Grangemouth	292800	682000	0.38	0.62	0.62	0.47	0.11	0.71	0.084	-	-	0.63	1.1	0.27	0.50	1.62	83.3
44	Greenpark Drive, Polmont	293550	678860	0.31	0.47	0.56	0.62	0.15	0.37	0.12	0.36	0.67	0.23	1.4	0.23	0.46	1.49	100.0
55	Inchyra Station	293833	681014	0.35	0.22	0.18	-	-	1.6	0.75	1.5	2.5	0.97	1.7	0.36	1.01	3.29	83.3
57	Inchyra Road, Grangemouth	294028	680829	0.86	0.48	0.58	0.35	0.12	1.7	0.99	1.2	1.3	0.52	0.46	0.26	0.74	2.39	100.0
77	Kinnaird Village	286490	683775	0.62	0.33	0.16	0.37	0.21	1.8	0.1	0.19	0.47	0.17	0.23	0.23	0.41	1.32	100.0
80	Cow Wynd	288765	679456	0.098	0.21	0.58	0.21	0.13	0.18	0.2	0.17	1.8	1.1	1.3	0.47	0.54	1.75	100.0
81	Grahams Road, Falkirk	288834	680898	0.43	0.27	0.29	0.33	0.11	1.4	0.38	0.32	0.22	0.66	0.35	0.3	0.42	1.37	100.0
94	A905 (Glensburgh Rd), Grangemouth	291213	681927	0.59	0.41	0.58	-	0.2	0.99	0.26	0.21	1.2	0.63	0.24	0.33	0.51	1.67	91.7
102	East Kerse Mains, Bo'ness	297968	680684	-	-	0.45	0.21	0.077	0.28	-	0.23	1.9	0.43	0.9	0.39	0.54	1.76	75.0
105	West of Shieldhill	288284	676881	0.2	0.25	0.43	0.31	0.15	1.4	0.18	0.14	0.31	0.14	0.94	0.2	0.39	1.26	100.0

b.)

Site No.	Address	Grid reference, x	Grid reference, y	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Average (no bias applied)	R&A bias 2012 (March 2013)	Data capture, %
3	Tinto Drive, Grangemouth	293427	680386	33.6	36.7	31.1	25.4	19.1	22.8	18.8	21.7	19.7	31.7	28.1	32.1	**27**	**21**	100.0
5	Copper Top Pub, Camelon	287332	680333	51.6	49.5	43	33.5	29.6	36.2	30.1	36.1	24.1	41.6	49.1	46.5	**39**	**31**	100.0
7	Irving Parish Church, Camelon	287324	680442	32.7	30.1	24	19	20.6	17	19.7	22.1	14.9	27	25.7	39.4	**24**	**19**	100.0
9	Bellsdyke Road, Larbert	286048	683542	-	-	34.9	24.4	29	25.7	25.5	28.1	28.4	36.1	41	48.1	**32**	**25**	83.3
19	Kilsyth Road, Banknock	278779	679301	48.9	43.9	48.3	49.7	-	46.7	35.9	42.3	-	36.4	43.5	61.1	**46**	**36**	83.3
20	Garngrew Road, Haggs	278975	679172	-	42.7	40.3	-	28.4	25.3	20.7	-	26.2	35.6	36	50.3	**34**	**27**	75.0
21	Grangemouth Road, College	290112	680500	48.8	40.2	40.7	26.7	29.2	37	32.5	34.5	29.8	44.2	38.9	56.8	**38**	**30**	100.0
24	Kerse Lane, Falkirk	289187	680024	63.4	56.5	58.1	41.4	33.7	39.3	32.7	42.6	39.6	50.6	45.5	58.3	**47**	**37**	100.0
26	Weir Street, Falkirk	289207	680123	31	32.3	28	22.1	21.7	23.1	19.5	21.8	16.9	33.6	33.2	46.7	**27**	**22**	100.0
27	West Bridge Street, Falkirk	288490	680055	73.3	66.6	65	72	73.2	90.2	63.1	76.6	61.1	83.3	95.8	109.8	**78**	**61**	100.0
29	Wellside Place, Falkirk	288465	680220	35.3	30.2	21	19.5	-	20.4	25.2	19.3	13.6	27.3	28.7	35.2	**25**	**20**	91.7
36	Kerr Crescent, Haggs	278985	679273	65.7	63.5	57.3	51.1	52.6	41.1	42.9	46.4	42	41.5	66.2	63.7	**53**	**42**	100.0
37	Denny Town House	281226	682526	32.6	28.3	-	17.7	23.1	24.5	19.5	23.7	14.4	26.3	32.9	37.7	**26**	**20**	91.7
38	Larbert Village Primary School	285930	682318	32	-	30.8	21.3	18.5	18.1	19.6	22.2	14.9	28	34.4	40.5	**25**	**20**	91.7
41	Seaview Place, Bo'ness	299722	681594	36.5	35.6	33.2	28.4	23.5	25.2	22.1	27.1	21	27.8	30.4	46.2	**30**	**24**	100.0
42	Municipal Chambers, Grangemouth	292817	682000	38.7	34.5	24.4	22.2	22.3	19.3	18.6	21.7	20.7	24.2	32.9	40.2	**27**	**21**	100.0
42				36.3	30.6	29.7	23.3	20.9	18.8	24.4	21.3	19.9	31.2	33	32.3			100.0
42				31.1	26.4	30.2	21.1	22.9	19.6	19.8	21.3	18.8	31.1	32.3	48.3			100.0
44	Greenpark Drive, Polmont	293436	678938	30.5	-	18.6	18.3	18	18.5	13.9	16.2	17.1	25.2	26.5	37.2	**22**	**17**	91.7
47	Thistle Avenue, Grangemouth	292000	680300	42.6	37.4	37.2	27	25.2	26.2	20.5	23.7	25.3	33.3	37.6	43.4	**32**	**25**	100.0
48	Hayfield, Falkirk	289200	681580	37.8	32.1	26.4	22.8	-	25	21.6	11.2	24.3	29.4	27.4	36.8	**27**	**21**	91.7
50	Upper Newmarket Street	288671	680047	39.3	31.7	34.7	36	43.1	46.9	36.1	34.1	-	36	31.8	42	**37**	**30**	91.7
51	Mary Street, Laurieston	290965	679490	43	40.3	33.2	27.2	26.7	29.1	22.5	28.9	48.4	37.2	42.2	35	**34**	**27**	100.0
52	Main Street, Larbert	285866	682356	45.5	40.8	38	31.8	33.5	28.3	28	29.5	24.8	36.7	46.5	42.1	**35**	**28**	100.0
53	Denny Cross	281211	682727	48	39.4	33.7	44.7	51.4	43.8	44.8	36.4	31.8	43.4	44.2	52.6	**43**	**34**	100.0
57	Inchyra Road, Grangemouth	294028	680829	45.3	38.2	37.9	22.1	33.2	30.3	28.7	31	23.1	34.6	29.6	49.8	**34**	**27**	100.0
58	Callendar Road, Falkirk	289667	679724	37.6	32.5	32.5	25.4	30	25.3	18.4	22.8	21.3	23.8	34.1	42.1	**29**	**23**	100.0
59	Carron Road, Bainsford	288392	681931	53.7	45.9	39.1	33.4	31.9	30.1	29.1	33.3	24.7	32.7	48.3	63.9	**39**	**31**	100.0
60	Ronades Road, Carron	288133	681587	47.2	41.3	38.7	32.2	31.4	27.1	21.4	33.8	26	38.1	41	60.3	**37**	**29**	100.0
61	Canal Rd, Falkirk	287976	680656	-	40.8	38.5	29.9	26.2	25.9	25.7	23.3	26.1	35.3	40.1	33.9	**31**	**25**	91.7
62	Arnot Street, Falkirk	289125	679705	62.3	54.7	58.6	45.1	44.3	45.3	39.9	42.3	37.5	52.6	45.4	71.3	**50**	**39**	100.0
63	Camelon Road, Falkirk	288055	680134	64	54.2	54.2	46.3	47	49.2	44.5	46.5	39.7	55.4	53.6	68.8	**52**	**41**	100.0
64	New Hallglen Road, Hallglen	288807	678422	25.3	27.2	27.5	24.8	24.8	25.2	19.4	17.8	18.8	33.6	24	29.6	**25**	**20**	100.0
65	Redding Road, Redding	291356	678644	41.1	36.2	31.5	31.9	27	29.3	22.6	23.8	21.7	36.3	35.3	36.8	**31**	**25**	100.0
67	Queen Street, Falkirk	289430	680433	39.5	38.6	44.1	36.5	37.3	32.7	31.1	36.1	27.9	40.4	45.2	56.8	**39**	**31**	100.0
68	Belluvue Street Falkirk	289234	679945	51.1	59.1	54.7	40.5	26.5	32.2	34.4	30.2	34.7	46.6	56	59.4	**44**	**35**	100.0
69	Kerse Lane, Falkirk	289022	679990	55.9	46.6	47.1	58.2	45.1	59	38.7	40	34.5	47.3	49.4	51.7	**48**	**38**	100.0
70	Park Street AQ station, Falkirk	288892	680070	51.5	49	38.9	38.8	31.8	31.2	28.5	30.4	30.4	39.7	39.7	52.7	**38**	**30**	100.0
70				48.9	48.8	41.8	40.5	32.2	26.9	29	31.4	31.8	44.3	38.7	54.3			100.0
70				40	47	41.2	39.3	31.4	33.1	32.5	32.4	28	47.4	39.5	42.9			100.0
71	Park Street, Falkirk	288910	680112	48	47.2	54.1	42.8	34.5	37.2	32.8	42.4	37.1	57.4	55.9	82.1	**48**	**38**	100.0
72	Vicar Street, Falkirk	288824	680120	47.4	43.8	43.1	40.6	41.8	39.4	31.3	39.6	31.1	40.5	50.1	49.8	**42**	**33**	100.0
73	West Bridge Street, RHS,Falkirk	288467	680048	56.4	43.2	44.1	42.2	46.5	43.7	44.8	45.1	29.8	44.4	46.3	31.4	**43**	**34**	100.0
76	Tryst Road, Stenhousemuir	286851	683229	43.4	40.7	32.5	25	21.3	18.4	19.4	23.3	23.7	29.8	36.4	50.6	**30**	**24**	100.0
77	Kinnaird Village	286490	683775	49.1	41.3	28.5	21.2	24.2	23	21.8	27.7	24.8	32.5	40.7	48.3	**32**	**25**	100.0
78	Glen Brae, Falkirk	288525	678991	43.3	49.5	40.6	37.2	32.2	33.8	28.9	39.8	31.6	47.8	-	42	**39**	**31**	91.7
80	Cow Wynd, Falkirk	288765	679456	48.8	46.1	43	37.6	25.6	26.8	23.4	32.5	29.6	44.5	47.3	59.4	**39**	**31**	100.0
81	Grahams Road, Falkirk	288834	680898	49.9	47.5	44.5	40	41.4	38.5	33	36.2	22.6	33.6	35.9	68.3	**41**	**32**	100.0
82	Castings Ave, Falkirk	288858	681036	38	28	28	20.5	19.1	20.6	25.3	22.2	18	28.1	31.7	54.3	**28**	**22**	100.0
83	Main Street, Bainsford	288614	681415	65.6	67	61.1	47.3	36.9	45.6	39.6	-	40.2	58.2	58.3	-	**52**	**41**	83.3
85	Auchincloch Drive, Banknock	278752	679049	31.3	32	29.2	31.6	38.5	30.3	26.5	25.1	18.1	32	34.9	46.8	**31**	**25**	100.0
86	Wolfe Rd, Falkirk	289667	679871	33.3	27.8	26.1	19.5	17.7	19.5	-	16.8	15.2	23.4	26.4	35.2	**24**	**19**	91.7
87	M80 slip south, Haggs	279017	679305	48.2	40.7	45.3	31.6	33.5	35.9	35.3	41.4	36.8	46.4	48.2	54.3	**41**	**33**	100.0
88	Ure Crescent, Bonnybridge	282444	681074	48.8	53.6	46.5	-	-	35.1	28.3	33.4	34.6	46.1	49.6	46.5	**42**	**33**	83.3
89	Grahams Rd/Meeks Rd, Falkirk	288853	680328	53.6	49.9	47.6	39.1	38.7	31.4	35.1	43.4	31.4	47.5	50.5	50.3	**43**	**34**	100.0
90	Grahams Rd bridge east, Falkirk	288855	680234	54.1	54.7	47.8	42.8	29.6	39	34.6	41.4	34	36.8	44.3	55.3	**43**	**34**	100.0
94	A905 (Glensburgh Rd), Grangemouth	291213	681927	-	65.5	42.7	48.5	37	29.1	36.7	43.5	42.3	46.5	68.3	69.7	**48**	**38**	91.7
97	Stirling Road, Larbert	285239	683263	55.2	52.4	43.1	31.4	25.4	24.2	24	29.5	29.5	39.2	-	-	**35**	**28**	83.3
98	Arnothill, Falkirk	288095	680105	40.9	-	33.6	29.6	28.1	33.8	27	28	21.7	33.1	35.3	48.1	**33**	**26**	91.7
99	St Crispins Place, Falkirk	288924	679675	48.4	43	42.7	33.3	30.2	32.4	27.1	27.5	26.3	40.1	42.2	46.5	**37**	**29**	100.0
100	Oswald St, Falkirk	288977	679662	26.8	33.4	28.2	30.8	27.3	27.5	23.4	19.7	25.4	29.9	-	38.2	**28**	**22**	91.7
101	Glensburgh Road, Grangemouth (2)	291127	682007	47	39.8	31.9	29.7	30.5	25.5	22.7	30.3	22.7	32.8	38.5	46.2	**33**	**26**	100.0
103	Merchiston Gardens	288270	680989	35.1	32.7	30	19.9	18.4	23.1	16.6	21.5	17.6	34	28.8	48.2	**27**	**21**	100.0
105	West of Shieldhill	288292	676889	13.5	13.5	9.2	11.6	10.7	11.4	11.8	8.2	6.5	17.6	12.4	20.5	**12**	**10**	100.0
106	Stirling Road, North Broomage	284975	683532	-	-	-	-	-	-	-	-	-	-	30.3	31.8	**31**	**25**	16.7

The diffusion tubes are scheduled to be changed as per the diffusion tube calendar. A few tubes are changed slightly earlier (especially during winter) due to the length of the route, but otherwise are well within the +/- 2 days allowed by the calendar.

Table A4 a.) Dates of diffusion tube changeovers and b.) ESG Didcot precision in 2012.

a.)

Monitoring calendar for 2012.		
Start Date	Start date	Duration (weeks)
January	04/01/2012	4
February	01/02/2012	4
March	29/02/2012	4
April	28/03/2012	4
May	25/04/2012	5
June	30/05/2012	4
July	27/06/2012	5
August	01/08/2012	4
September	29/08/2012	4
October	26/09/2012	5
November	31/10/2012	4
December	28/11/2012	5
January	02/01/2013	4

b.)

ESG Didcot, 50% TEA in Acetone.	
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	G
2012	P
2012	P
2012	P

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	2012 background concentration, µg/m^3		
	NO_x	NO_2	PM_{10}
A803 Main Street, Camelon	30.2	17.8	13.2
A803 Glasgow Road, Camelon	34.7	19.8	15
B905 Main Street, Larbert	23.2	14.2	12
B805 Main Street, Redding	23.9	14.4	11.6

Table A6 Other input data to the DMRB runs.

Link	%HGV	Mean speed, mph	85th percentile speed, mph	Mean speed, kph	85th percentile speed, kph	Distance (closest) receptor to centre link, m	AADT
A803 Main Street, Camelon	3.6%	25.1	n/a	40.4	n/a	11	21,351
A803 Glasgow Road, Camelon	3.6%	29.4	n/a	47.3	n/a	11	17,454
B905 Main Street, Larbert	5.0%	n/a	n/a	45.0	n/a	11	12,962
B805 Main Street, Redding	5.0%	n/a	n/a	45.0	n/a	9	13,381

Table A7 Verification for DMRB runs.

Verification	Background NO_2	Monitored NO_2	Modelled NO_2	NO_2 difference, %
A803, Camelon Road tube NA5.	17.8	31	24.8	-20.2

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