Falkirk Council

2010 Air Quality Progress Report for Falkirk Council.

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

July 2010

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Executive Summary

A review of the Council's monitoring data for 2009 shows that the 15-minute objective continues 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 USA the 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 is given. The 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 is also included in this report.

No new Detailed Assessments are 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 USA.

In the next 12 months the Council will submit the following reports: Further Assessments for the Falkirk Town Centre and Haggs AQMAs, a Detailed Assessment for PM_{10} monitoring in Banknock and a 2011 Progress Report.

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Abbreviations

AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
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
SAQN	Scottish Air Quality Network
SEPA	Scottish Environmental Protection Agency
SO_2	Sulphur dioxide
TEOM	Tapered Element Oscillating Microbalance.
VCM	Volatile Correction Model

1 Introduction

1.1 Description of Local Authority Area

Falkirk Council is a unitary authority located in Central Scotland. It covers 290 square kilometres with a population of 151,570, it 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 over on the north side of the Firth of Forth.

Falkirk Council 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. This industrial area includes the Grangemouth refinery and associated chemical industry, along with the Grangemouth docks.

The main towns and population in the area are Bo'ness, Falkirk and Grangemouth, with the area around Slamannan in the south being more rural in nature.

Three motorways pass through the area, the M80, M876 and M9, with the main train line connecting Glasgow and Edinburgh passing through the area along with the lines connecting Glasgow/Edinburgh with Stirling and the north. The area is well known for the Falkirk wheel which connects two canals, the Union canal and 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 reports. Their purpose is to maintain continuity in the Local Air Quality Management process.

They are not intended to be as detailed as Updating and Screening Assessment Reports, or to require as much effort. However, if the Progress Report identifies the risk of exceedance of an Air Quality Objective, the Local Authority (LA) should undertake a Detailed Assessment immediately, 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, $\mu g/m^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) 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	Date to be achieved by
Benzene	16.25 µg/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 (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 µg/m^3	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	50 µg/m^3, not to be exceeded more than 7 times a year	24-hour mean	31.12.2010
	40 µg/m^3	Annual mean	31.12.2004
	18 µg/m^3	Annual mean	31.12.2010
Sulphur dioxide (SO_2)	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

1.4 Summary of Previous Review and Assessments

Stage 3 Review and Assessment of Air Quality in the Falkirk Council Area, June 2000

The Stage 3 review and assessment considered in detail concentrations of NO_2, SO_2 and PM_{10}.

NO_2 monitoring data from fifty-five diffusion tubes and two automatic NO_X analysers located in Grangemouth and Falkirk and the results of dispersion modelling of road traffic emissions indicated that there was no requirement for an AQMA for NO_2.

SO_2 monitoring data from Grangemouth Municipal Chambers and dispersion modelling indicated that due to current emission levels from the petro-chemical complex in Grangemouth and the Longannet power station in Fife there were predicted exceedances of the 15-minute SO_2 NAQS objective. However, insufficient emissions data were available to fully assess future emissions. The recommended AQMA boundary for Grangemouth was based upon a worst case of no reduction in emissions.

PM_{10} monitoring data from two automatic analysers located in Grangemouth and Falkirk and the results of dispersion modelling of road traffic emissions indicated that there was no requirement for an AQMA for PM_{10}.

Supplementary Report to the Stage 3 Review and Assessment of Air quality for Falkirk Council, January 2001

Additional information relating to future industrial emissions contained in the permits for industrial operators was modelled using the ADMS dispersion model. The model predicted that under normal operating conditions there was unlikely to be an exceedance of the NAQS objectives for SO_2. However; the model predicted that with the petro-chemical plant operating at maximum load, there was the potential for exceedances of the 15-minute mean and 24-hour mean objectives for SO2 to be exceeded at locations of relevant exposure in Grangemouth.

Falkirk Council decided not to declare an AQMA but to retain the extensive monitoring network for SO_2.

Advanced Air Quality Study for Falkirk Council, May 2002

The assessment considered additional modelling of industrial emissions of SO_2 from the Grangemouth petro-chemical complex and Longannet power station. The additional modelling comprised predictions of SO_2 concentrations in the Skinflats area where new monitoring data were available and an ecologically sensitive receptor was identified; inclusion of 2000 meteorological data from Grangemouth monitoring station; investigation of peak load emissions from the industrial sites; and investigation of the model sensitivity to surface roughness and fluctuations.

The study concluded that the surface roughness did have an impact upon predicted concentrations and should be included for future modelling assessments. The 2000 meteorological data for Grangemouth produced similar results to those for the 1999 data used previously with the model predicting exceedances of the 15-minute mean objective during peak operations.

Air Quality and Dispersion Climate Study within the Falkirk Council Area, June 2003

The assessment considered industrial emissions of SO_2 in the Grangemouth area. The investigation focussed on the sensitivities of model outputs to the various inputs including terrain, meteorological data and industrial emissions from flares. The study compared the outputs of two models AERMOD and ADMS. The study concluded that terrain had a significant impact upon predicted concentrations notably for an easterly wind and should be included in future modelling. Model predictions from ADMS produced a closer match to monitored concentrations than those using AERMOD. The inclusion of emissions from industrial flares was found to be essential to producing the best representation of the measured short-term exceedances of SO2.

2003 Updating and Screening Assessment, May 2003

The review of monitoring data and emission sources indicated that no further assessment was required for CO, 1,3-butadiene or lead and that a Detailed Assessment was required for:

- Industrial emissions of benzene;
- Road traffic emissions of NO_2;
- Industrial and shipping emissions of SO_2; and
- Road traffic emissions for PM_{10}.

Detailed Assessment of Air Quality, April 2004

The Detailed Assessment concluded that:

- Monitoring of benzene concentrations in industrial areas met the 2003 NAQS objectives and that it was unlikely that exceedances of the 2010 objective would occur at locations of relevant exposure but monitoring would continue.
- Diffusion tube monitoring and dispersion modelling of NO_2 in Falkirk town centre indicated that there was potential for exceedance of the 2005 and 2010 annual mean objective and that further monitoring should be undertaken to verify modelled results.
- Dispersion modelling of PM_{10} indicated that it was unlikely that there would be exceedances of either the 2004 or 2010 annual mean NAQS objectives.
- The dispersion modelling study of SO_2 emissions from the petro-chemical complex in Grangemouth indicated that it was unlikely that the 24-hour and 1-hour mean NAQS objectives would be exceeded at locations of relevant exposure.

The model did however predict exceedances of the 15-minute mean NAQS objective during certain plant operating conditions in areas surrounding the petro-chemical complex. Measured SO_2 concentrations had decreased below NAQS objective values and it was therefore concluded that an AQMA was not required.

Supplementary Report to the Detailed Assessment, November 2004

A review of monitoring data, industrial emissions from the petro-chemical complex operated by BP and a dispersion modelling study of current and future scenarios

indicated that not all exceedances recorded at the monitoring site could be attributed to the BP petro-chemical complex, that sulphur reduction measures being implemented at the plant would reduce emissions such that NAQS objectives for SO_2 would be met. It was concluded that an AQMA for SO_2 was not required.

Dispersion modelling of NO_2 emissions from road traffic in Falkirk town centre indicated a possible exceedance at locations of relevant public exposure. Monitoring data were unavailable at these locations and therefore it was recommended that additional monitoring be undertaken to confirm model predictions.

2005 Progress Report, April 2005

The progress report concluded that based on available monitoring data for 2004 there were no measured or predicted exceedances of the NAQS objectives for benzene, 1,3-butadiene, lead, CO or PM_{10}. No new emission sources were identified. It was reported that a review of NO_2 concentrations in Falkirk town centre was ongoing and that the requirement for an AQMA would be determined following further monitoring. It was concluded that the requirement for an AQMA for SO_2 in Grangemouth would be determined following further monitoring.

Declaration of Grangemouth AQMA, November 2005

After consultation with the Scottish Executive and SEPA, an AQMA for SO_2 in Grangemouth was declared. The AQMA was officially declared on 1st November 2005 in recognition of the potential for breaches of the 15-minute mean SO_2 NAQS objective. The AQMA encompasses the industrial complex, Grangemouth Docks and residential areas of Grangemouth. The location of the Grangemouth AQMA is indicated in Figure 2 in Appendix A.

2006 Updating and Screening Assessment, June 2006

The report concluded that no further assessment was required for CO, benzene, 1,3-butadiene, lead or NO_2. No exceedances of the SO_2 NAQS objectives were recorded; however the AQMA in Grangemouth remains in place. It was recommended that the monitoring network was reviewed and that additional monitoring of NO_2 be undertaken in Falkirk town centre; and that a gravimetric analyser should be co-located with the TEOM at Inchyra Park to provide a local co-location factor.

A Detailed Assessment of PM_{10} was recommended for the Cowdenhill quarry in Banknock.

Consideration of the impact upon air quality due changes to traffic flows around Falkirk town centre should be reviewed in the next assessment.

Grangemouth AQMA Further Assessment, February 2007

An inventory of SO_2 emissions in the Grangemouth area was compiled. The inventory indicated that emissions from Longannet power station in the neighbouring Fife Council area were approximately 10 times greater than INEOS who operate the

majority of the petro-chemical complex. Emissions from small industrial plants in the area were less than emissions from shipping, commercial and domestic emissions. Monitoring indicated that there were no exceedances of the SO_2 objectives recorded within the AQMA and that concentrations had declined since 2004.

Modelled emissions data predicted an exceedance of the 15-minute mean NAQS objective within the AQMA to the south of the Kinneil flare.

Greenhouse Gas Emissions Inventory, March 2007

An inventory was compiled of greenhouse gas emissions from all sources including public sector within the Falkirk Council area. The study identified industrial sources as the greatest emitters of carbon dioxide (CO_2) and waste processes as the greatest sources of methane (CH_4). The public sector buildings were estimated to contribute approximately 1% of the total CO_2 emissions for the area.

Grangemouth AQMA Action Plan, July 2007

The Action Plan contained measures to maintain and regularly review the monitoring network; set up a working group to develop better communication and working relationships between industrial operators, SEPA and Falkirk Council; development of a text alert system during periods when measured SO_2 levels are high to allow operators and regulators to identify any operations that may have resulted in the elevated concentrations of SO_2.

2007 Progress Report, July 2007

Monitoring data indicated a general decline in SO_2 concentrations. NO_2 and PM_{10} concentrations within Falkirk town centre and Haggs exceeded NAQS annual mean objectives at some locations, which were addressed in a Detailed Assessment.

There were no new industrial, domestic, or quarry sources identified, however several planned commercial developments are likely to impact upon road traffic emissions in Falkirk town centre.

Detailed Assessment of PM_{10} at Cowdenhill Quarry, September 2007

The study used the NAEI method to estimate emissions from the quarry. The assessment considered emissions from the quarry and road traffic along the main access route. The dispersion model results indicated that there was potential to exceed the 2010 annual mean NAQS objective for PM_{10} at residential properties in Banknock. Dust re-suspension from road traffic using the access roads was identified as the greatest source of PM_{10} at local receptors .The report identified that monitored data were required to verify the model and that an AQMA should not be considered until at least 6 months monitoring data corroborated the model predictions.

Detailed Review of PM_{10} concentrations in Grangemouth, August 2007

The Progress Report identified that the 2010 background concentrations of PM_{10} in the Grangemouth area were predicted to exceed the 18µg/m^3 annual mean NAQS objective for PM_{10}. The report reviewed current monitoring data and national

predictions for background concentrations of PM_{10} in 2010. It concluded that based on measured concentrations in 2006 in Falkirk and Grangemouth an exceedance of the 2010 annual mean PM_{10} NAQS objective was unlikely as the national predictions appeared to be an over-estimate.

2008 Progress Report, July 2008

Monitored exceedances of NAQS objectives for NO_2 in Falkirk town centre indicated the requirement for an AQMA. It was recommended that the Further Assessment should include PM_{10} as current levels were close to the objective but limited monitoring data were available.

Detailed Assessment of NO_2 concentrations at Banknock and Haggs, July 2008

NO_2 concentrations measured, using passive diffusion tubes, at several locations in Haggs and Banknock exceeded the annual mean NAQS objective. An automatic analyser was therefore installed during 2007. The assessment reviewed the available monitoring data and included a dispersion modelling study of road traffic emissions from the surrounding road network. The dispersion modelling study and automatic monitoring data confirmed that there were exceedances of the annual mean at roadside locations but that no exceedances were predicted at locations of relevant public exposure. It was therefore concluded that an AQMA was not required.

Detailed Assessment of NO_2 concentrations in Falkirk Town Centre, September 2008

The assessment considered monitored concentrations of NO_2 and an atmospheric dispersion modelling study of road traffic emissions in Falkirk town centre. Monitoring data indicated that the annual mean NAQS objective for NO_2 was exceeded at three locations. The modelling assessment identified that the annual mean objective for NO_2 was being exceeded at locations of relevant exposure along Cochrane Avenue; Manor Road, Vicar Street and at the Junction of Princes Street and Kerse Lane. The 1-hour mean NAQS objective for NO_2 was also predicted to be exceeded at locations of relevant public exposure on Grahams Road. It was therefore concluded that an AQMA, covering the areas of predicted exceedance, should be declared for NO_2.

Revised Detailed Assessment of Banknock, May 2009

Following the Scottish Government's appraisal of the original Banknock Detailed Assessment, a revised report was submitted. This considered emissions of PM_{10} and NO_2 from road traffic emissions in Haggs and Banknock. Following completion of a full year of automatic NO_2 monitoring at Kerr Crescent in Haggs a revised model assessment was undertaken. The revised atmospheric dispersion model included the high level of HGV traffic accessing the nearby quarry in Banknock and the traffic flows along the A80. The monitoring results and modelling assessment indicated that there were exceedances of the annual mean NO_2 objective at locations of relevant exposure in Haggs and Banknock. There were no predicted exceedances of the annual mean or 24-hour mean objectives for PM_{10}.

It was recommended that the automatic analyser at Kerr Crescent be maintained and additional diffusion tube monitoring was undertaken on the north side of Kilsyth road.

It was concluded that there was a requirement for an AQMA to reflect the exceedances of the annual mean NO_2 objective. At the time of writing the Council is awaiting the Scottish Government's appraisal of this report.

Consultation on the declaration of two AQMAs for NO_2 in Falkirk town centre, May 2009

Following analysis of the results of additional NO_2 monitoring and a Detailed Assessment of road traffic in Falkirk town centre, Falkirk Council have identified measured exceedances of the annual mean NO_2 objective and exceedances of the 1-hour mean objective for NO_2 predicted by atmospheric dispersion modelling. Falkirk Council has identified two areas within Falkirk where the annual and 1-hour mean NO_2 concentrations are expected to exceed the NAQS objectives.

Reference 1: For text in this section to this point.

Grangemouth AQMA Action Plan Update, May 2009

As recommended by the Review and Assessment Helpdesk, the Council submitted a separate report detailing the progress made with the Action Plan for the Grangemouth AQMA. A copy of this document is available on the Council's website. 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 the Council.

As no appraisal has been received for the Grangemouth AQMA Action Plan update, the Council assumes that the Scottish Government and SEPA have no issues with the Council's work in relation to this AQMA.

2009 Updating and Screening Assessment, August 2009

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 for NO_2 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 for NO_2 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.

The Council has submitted an additional Further Assessment for the Grangemouth AQMA. The executive summary of this report is shown in Section 6.

Included as part of this report were polar roses plotted by the Council via Openair, this has provided further insights into the monitoring data and were presented to the working group meeting for the AQMA in February 2010.

AQMAs

As discussed in this section, Falkirk Council declared an AQMA for a potential breach of the 15-minute SO_2 objective in the Grangemouth area in November 2005, see Figure 1.1a. This AQMA is in relation to industrial emissions. The monitoring data since this declaration has shown that a breach of the 15-minute objective has been recorded by at least one monitoring station in the AQMA in 2007, 2008 and 2009. As required an Action Plan update is given in section 6. The hourly and daily objectives continue to be met at all monitoring stations.

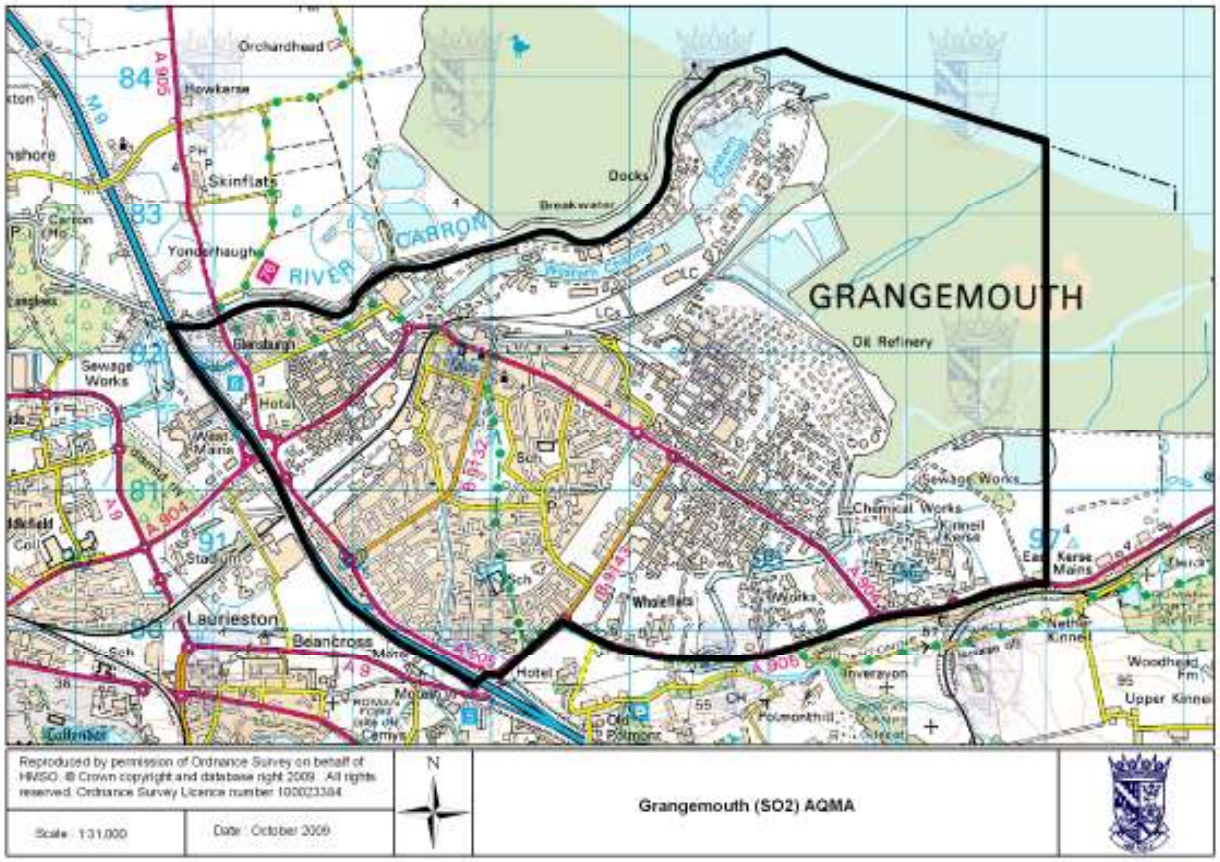
Two AQMAs were declared in Falkirk Town Centre in March 2010. The larger AQMA (Figure 1.1b) has been declared for a breach of the annual NO_2 objective. While the smaller AQMA (Figure 1.1c) has been declared for a potential breach of the hourly NO_2 objective. Copies of the declaration orders are available on the Council website, with a map of the AQMAs also available on the AQ Archive and Scottish AQ Network site.

An AQMA was declared in Banknock and Haggs for a breach of the annual NO_2 objective in March 2010, Figure 1.1d. Copies of the declaration orders are available on the Council website, with a map of the AQMAs also available on the AQ Archive and Scottish AQ Network site.

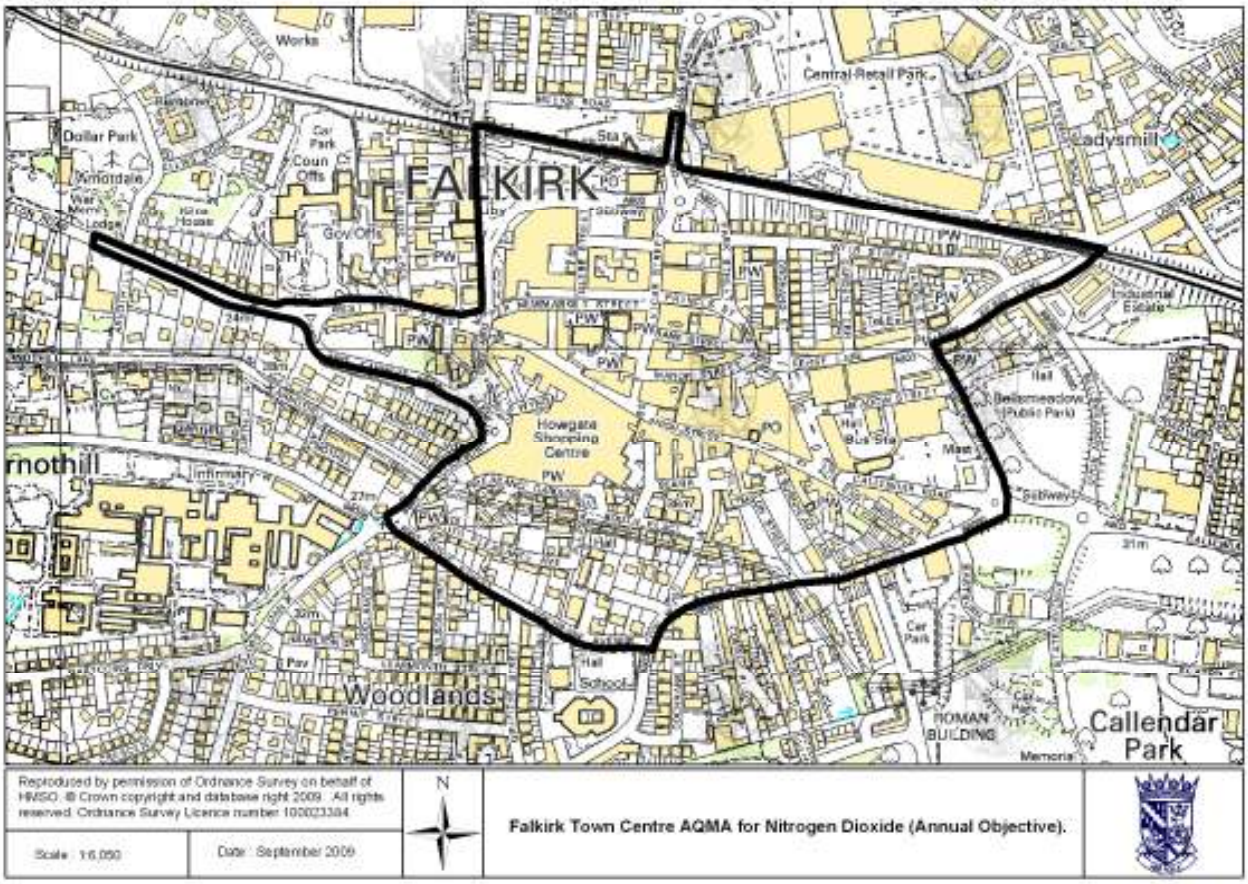
Detailed Assessment

The Council is currently monitoring for PM_{10} close to the Cowdenhill Quarry in Banknock. It is anticipated a revised Detailed Assessment will be submitted towards the end of 2010 when one year of monitoring has been completed. With the 2010 objective compliance date close, the report will concentrate on the monitoring data that is being collected.

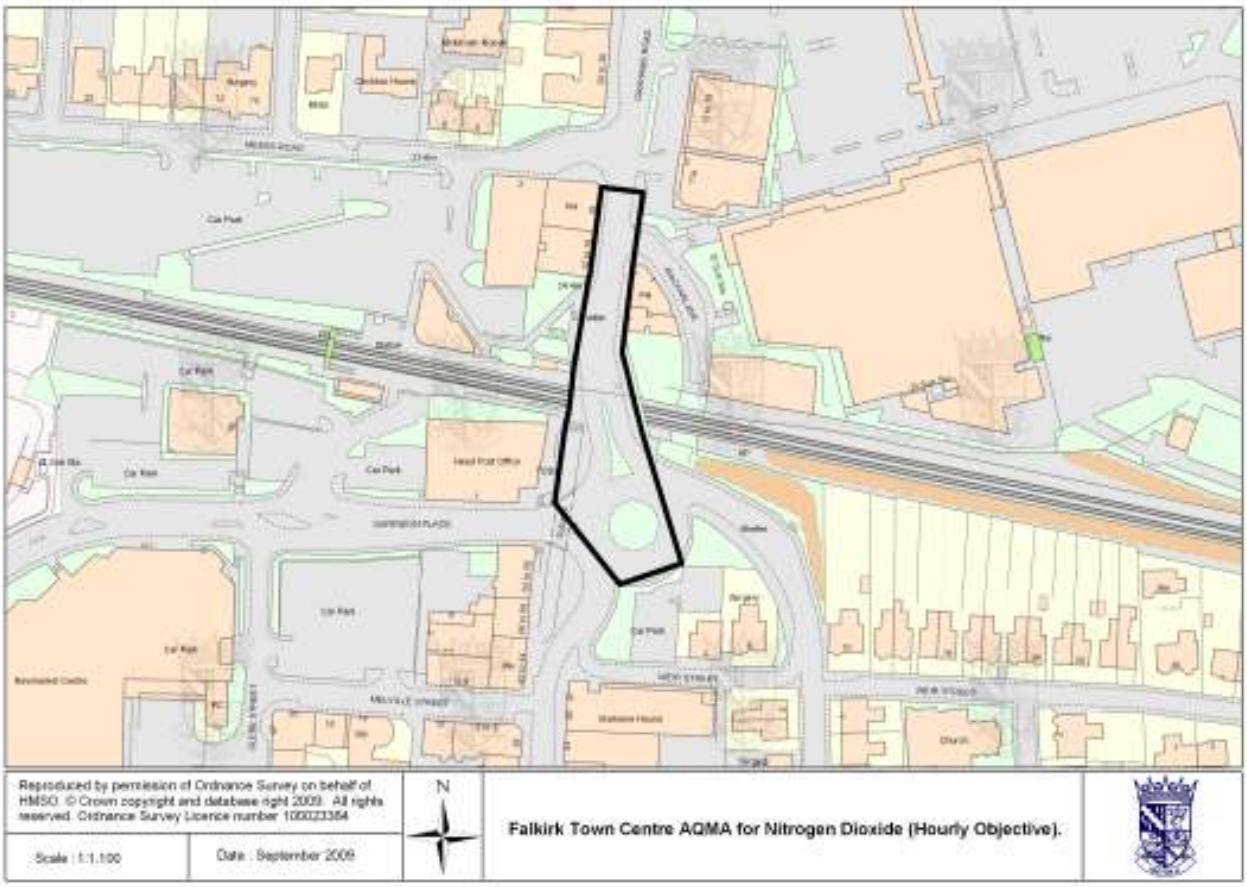
Figure 1.1 Maps of AQMA Boundaries.
a.) Grangemouth AQMA, declared November 2005.



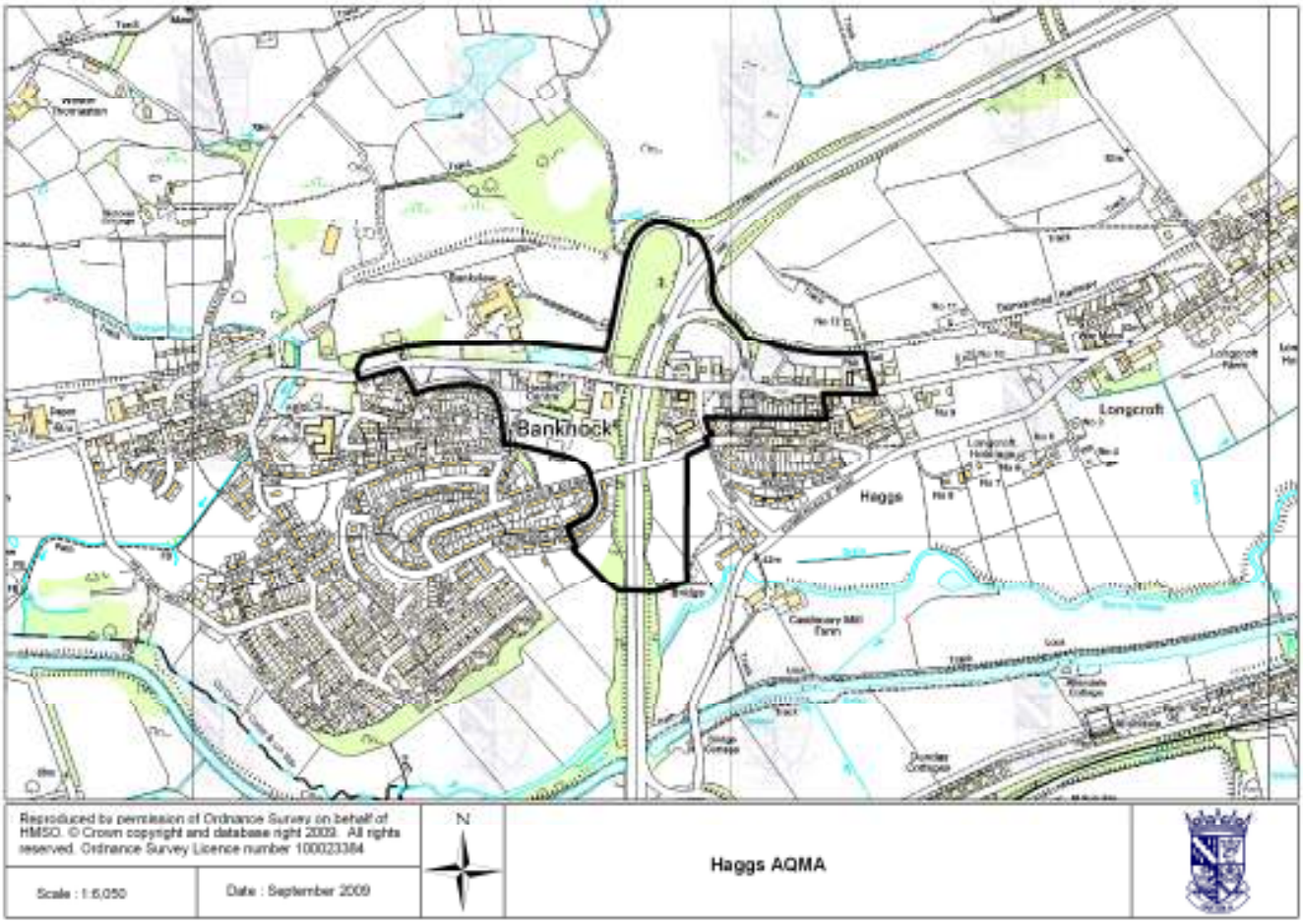
b.) Falkirk Town Centre AQMA (annual NO_2), declared March 2010.



c.) Falkirk Town Centre AQMA (hourly NO_2), declared March 2010.



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



2 New Monitoring Data

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

In 2009 the Council operated 10 automatic monitoring stations from Banknock in the west to Bo'ness in the east. The automatic monitoring included the following pollutants: $PM_{2.5}$, PM_{10}, NO_2 and SO_2.

Figures 2.1, 2.2 and A2 show the ten monitoring locations in the Falkirk Council area. The location of the seven sites in the Scottish Air Quality Network (SAQN) can also be viewed at www.scottishairquailty.co.uk

The Council operates two Automatic Urban and Rural Network (AURN) affiliate sites: the Grangemouth site (PM_{10}*, $PM_{2.5}$*, NOx, SO_2 and pumped benzene diffusion tube) and the Grangemouth Moray site (NO_x). The remaining analysers at the Grangemouth Moray site (SO_2 and PM_{10}) are affiliated to the SAQN. In 2009 the Falkirk West Bridge St and Falkirk Haggs sites also joined the SAQN. Details of the QA/QC applied to all the sites are shown in the Appendix.

The following changes have taken place to the Council's monitoring network in 2009. At the Grangemouth AURN (Inchyra) site the PM_{10} TEOM was replaced with a TEOM-FDMS. This analyser began operation on the 29th April 2010. The FDMS has been deemed equivalent to the EU reference method for measurement of PM_{10}.

At the Falkirk West Bridge St site a PM_{10} (TEOM) began operation in September 2009. The data used in this report for this site has been corrected using the volatile correction method.

On the 21st October 2009 an Osiris began monitoring for PM_{10} in Coneypark Place, Banknock. The location of the analyser is shown in Figure 2.1.

(* Defra/DA owned analysers.)

Figure 2.1 Maps of New Automatic Monitoring Sites in Falkirk Council Area

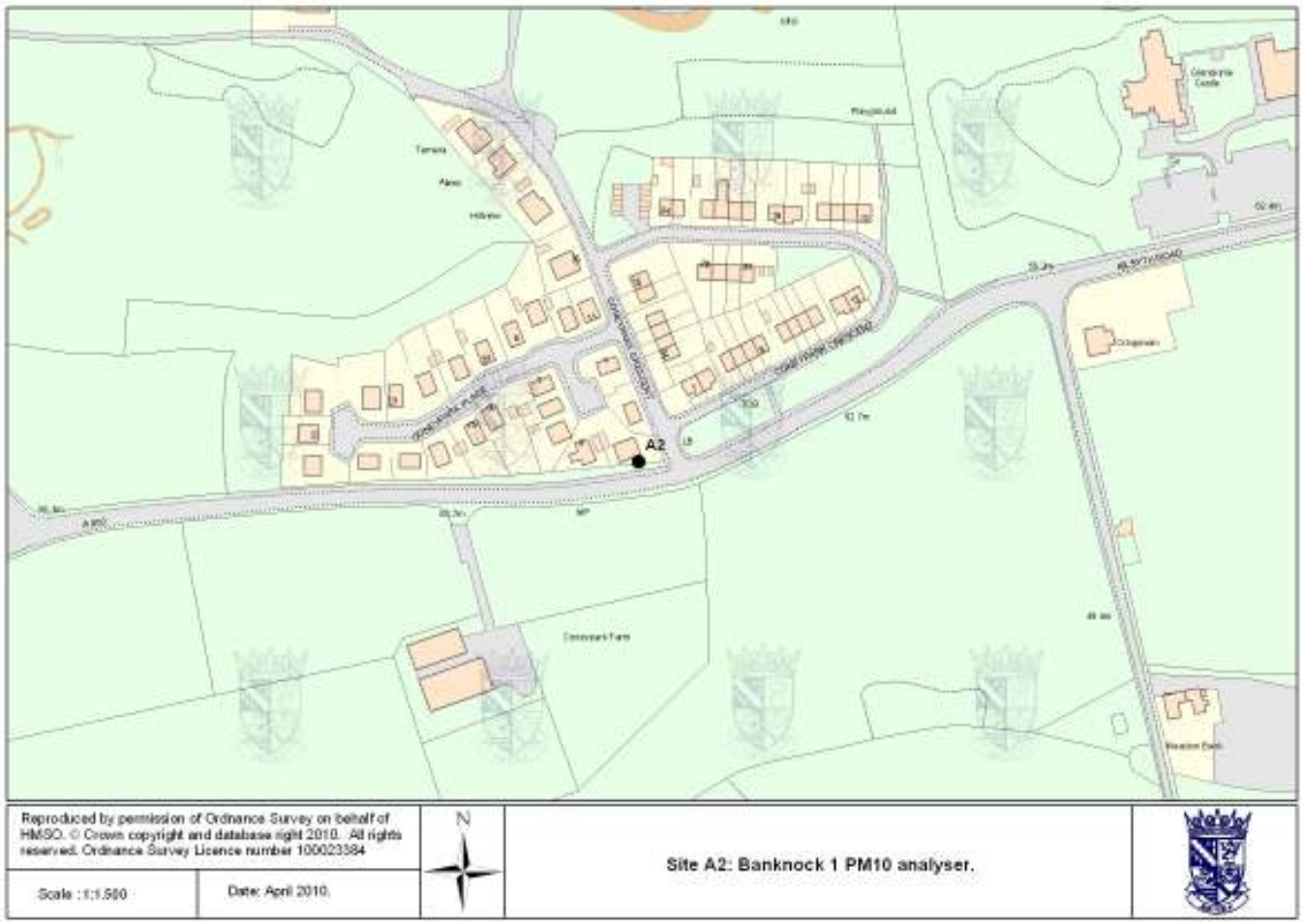


Table 2.1 Details of Automatic Monitoring Sites

Site Number and Name	Site Type	OS Grid Ref		Pollutants Monitored	Monitoring Technique	In AQMA ?	Relevant Exposure?	Distance to kerb of nearest road, m.	Represent worst-case exposure?
A1. Abbotsford House	Urban backgrd / industrial.	288976	681720	SO_2	Horiba	N	N	n/a	N
A2. Banknock 1	Roadside.	277348	679037	PM_{10}	Osiris	N (PM_{10} DA)	Y (1m)	6m	N
A3. Bo'ness	Urban backgrd / industrial.	299815	681481	SO_2	Horiba	N	Y (5m)	n/a	N
A4. Falkirk Haggs	Roadside.	278977	679271	NO_2	Monitor Europe.	Y (NO_2)	Y (5m)	2m	Y
A5. Falkirk Hope St	Roadside.	288688	680218	NO_2, PM_{10}, SO_2.	Horiba, PM_{10}: TEOM	Y (NO_2)	Y (1m)	1m	Y
A6. Falkirk Park St	Roadside.	288892	680070	NO_2, PM_{10}, SO_2.	Horiba, PM_{10}: TEOM	Y (NO_2)	Y (1m)	1m	Y
A7. Falkirk West Bridge St	Roadside.	288457	680064	NO_2, PM_{10}	Monitor Europe, PM_{10}: TEOM	Y (NO_2)	Y (1m)	1m	Y
A8. Grangemouth AURN (Inchyra)	Urban background / industrial.	293830	681022	Benzene, NO_2, PM_{10}, $PM_{2.5}$, SO_2.	Benzene (pumped tube), PM_{10} & $_{2.5}$: FDMS. NO_x/SO_2: Monitor Europe.	Y (SO_2)	Y (5m)	20m	Y
A9. Grangemouth Moray	Urban background / industrial.	293469	681321	NO_2, SO_2, PM_{10}.	Horiba, PM_{10}: TEOM.	Y (SO_2)	Y (1m)	25m	Y
A10.Grangemouth Municipal Chambers	Urban background / industrial.	292816	682009	NO_2, SO_2, PM_{10}.	Horiba, PM_{10}: TEOM.	Y (SO_2)	Y (1m)	40m	Y

Note: Banknock 1 monitor (A2): currently within area at Detailed Assessment stage for PM_{10}.

2.1.2 Non-Automatic Monitoring

In 2009 the Council monitored nitrogen dioxide using diffusion tubes at 68 locations, 21 locations were monitored for benzene using diffusion tubes and eight locations were monitored for 1,3 butadiene across the Falkirk Council area. A benzene pumped diffusion tube was also in operation in Grangemouth. Details of the type of tube used and the QA/QC are discussed in the Appendix.

In 2009 the following sites ceased operation:

- NA4, Cromwell Road, Falkirk (NO_2), as the tube was going missing regularly.
- NA18, A80 Northbound c/way, Banknock (NO_2, benzene and 1,3 butadiene). This site ceased operation as it was not representative of any relevant receptors, it was dangerous to change and the consultants used for the Haggs Detailed Assessment said it was not useful for modelling.

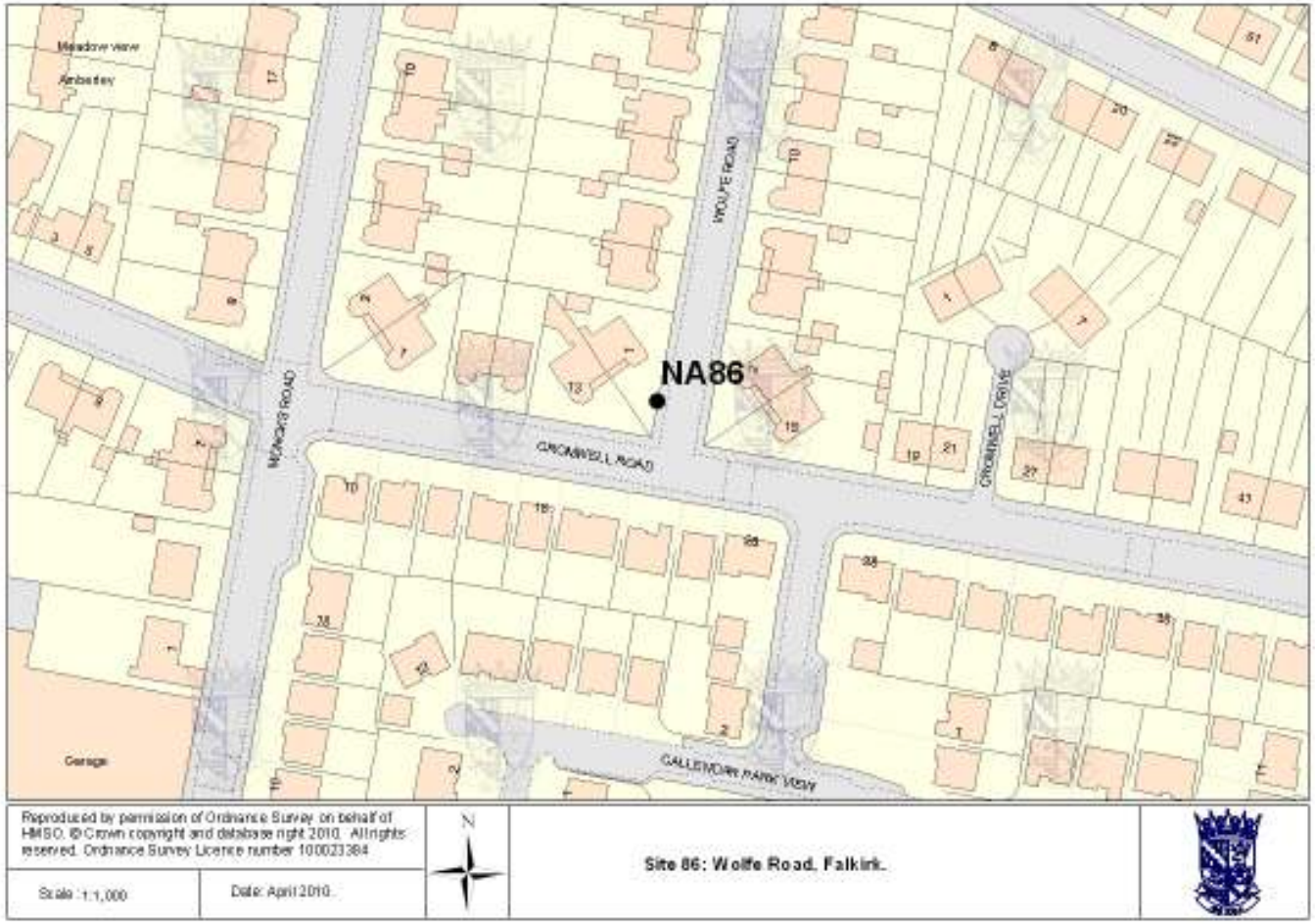
In 2009 the following sites commenced operation:

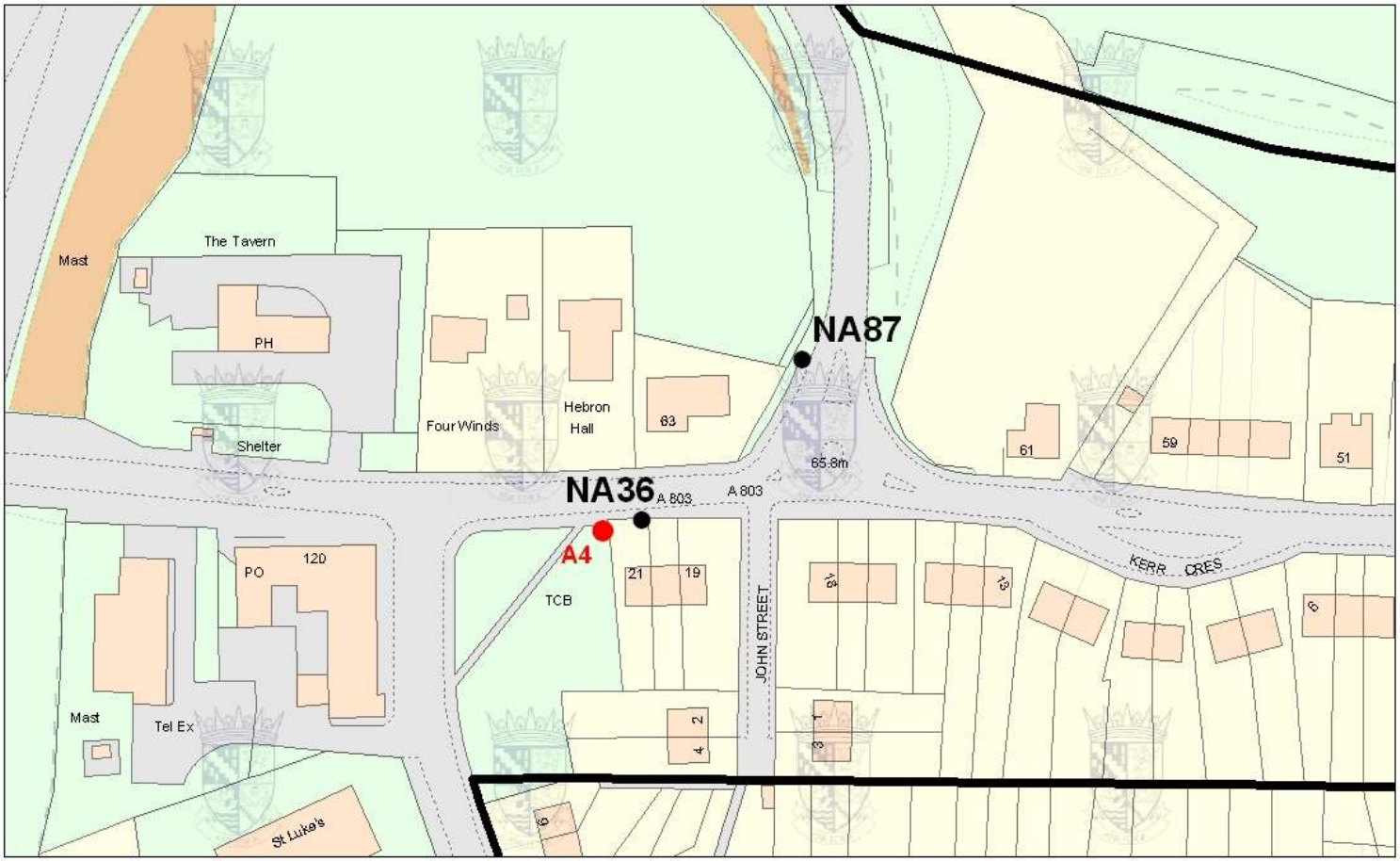
- NA86: Wolfe Rd, Falkirk in March 2009. This was the replacement location for site NA4.
- NA87: M80 slip south, Haggs in May 2009. This was a replacement location for site NA18.
- NA88: Ure Crescent, Bonnybridge in September 2009. This road is close to the M876.
- NA89: Grahams Rd / Meeks Rd, Falkirk in September 2009. This site is on the northern edge of (but outside) the Falkirk Town Centre annual and hourly NO_2 AQMAs.
- NA90: Grahams Rd bridge east, Falkirk in September 2009. This site is in the Falkirk Town Centre hourly NO_2 AQMA.
- NA91: Grahams Rd bridge west, Falkirk in September 2009. This site is in the Falkirk Town Centre hourly NO_2 AQMA.
- NA92: Cochrane Avenue, Falkirk in September 2009. This site is on the southern edge of the Falkirk Town Centre annual NO_2 AQMA.
- NA93: Falkirk High Station. This site is close to the railway line that runs from Glasgow to Edinburgh via Falkirk High station.
- NA94: A905 (Glensburgh Rd), Grangemouth in September 2009. This area was highlighted as showing the highest concentrations in the DMRB runs in the 2009 USA, though no exceedance was predicted at this location.

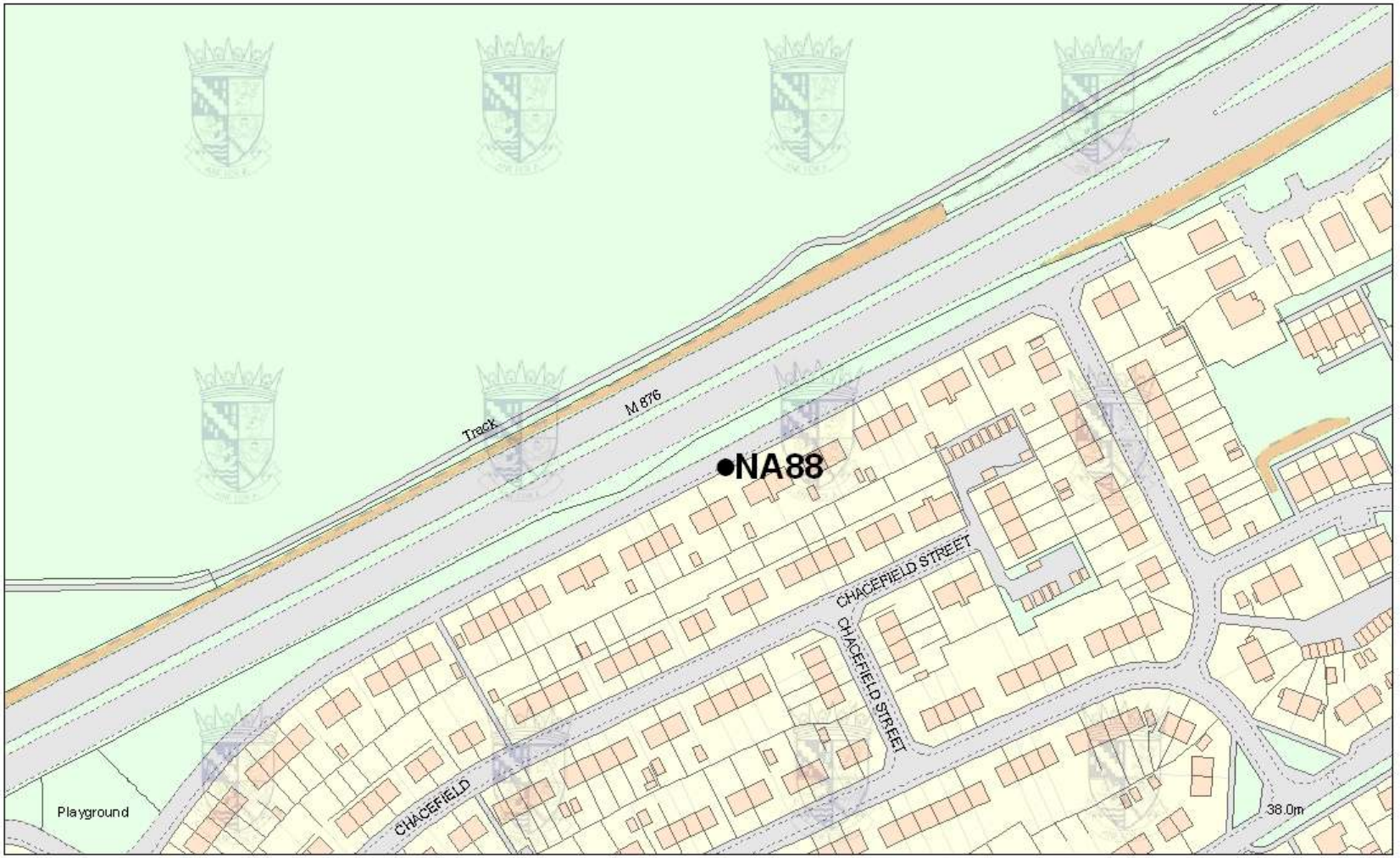
Figure 2.2 shows the locations of the new non-automatic sites. The Council carried out two triplicate studies, where three NO_2 diffusion tubes are co-located with an automatic monitoring station. One was at the Grangemouth Municipal Chambers (site NA42 / A10), an urban background site. The second was at the Falkirk Park St (site NA70 / A7), a roadside site. Results from both sites have contributed to the R&A helpdesk bias factor for Harwell Scientifics.

The local and R&A Helpdesk bias adjustment factors suggest that the diffusion tubes over-read NO_2 compared to the automatic monitors. The Council has decided to use the R&A helpdesk factor for the 2009 results. However, it should be noted that this gives a conservative result for the roadside diffusion tubes, especially for the roadside sites. See Appendix for further details.

Figure 2.2 Maps of New Non-Automatic Monitoring Sites in Falkirk Council area.




Mast
The Tavern
PH
Shelter
Four Winds
Hebron Hall
63
NA87
65.8m
61
59
51
NA36
A 803
A 803
A4
PO
120
TCB
21
19
JOHN STREET
KERR CRES
Mast
Tel Ex
St Luke's
Reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown copyright and database right 2010. All rights reserved. Ordnance Survey Licence number 100023384
N
Site 87: M80 slip south, Haggs and AQMA.
Scale : 1:1,000
Date: April 2010.



N

Scale : 1:1,750

Date: April 2010.

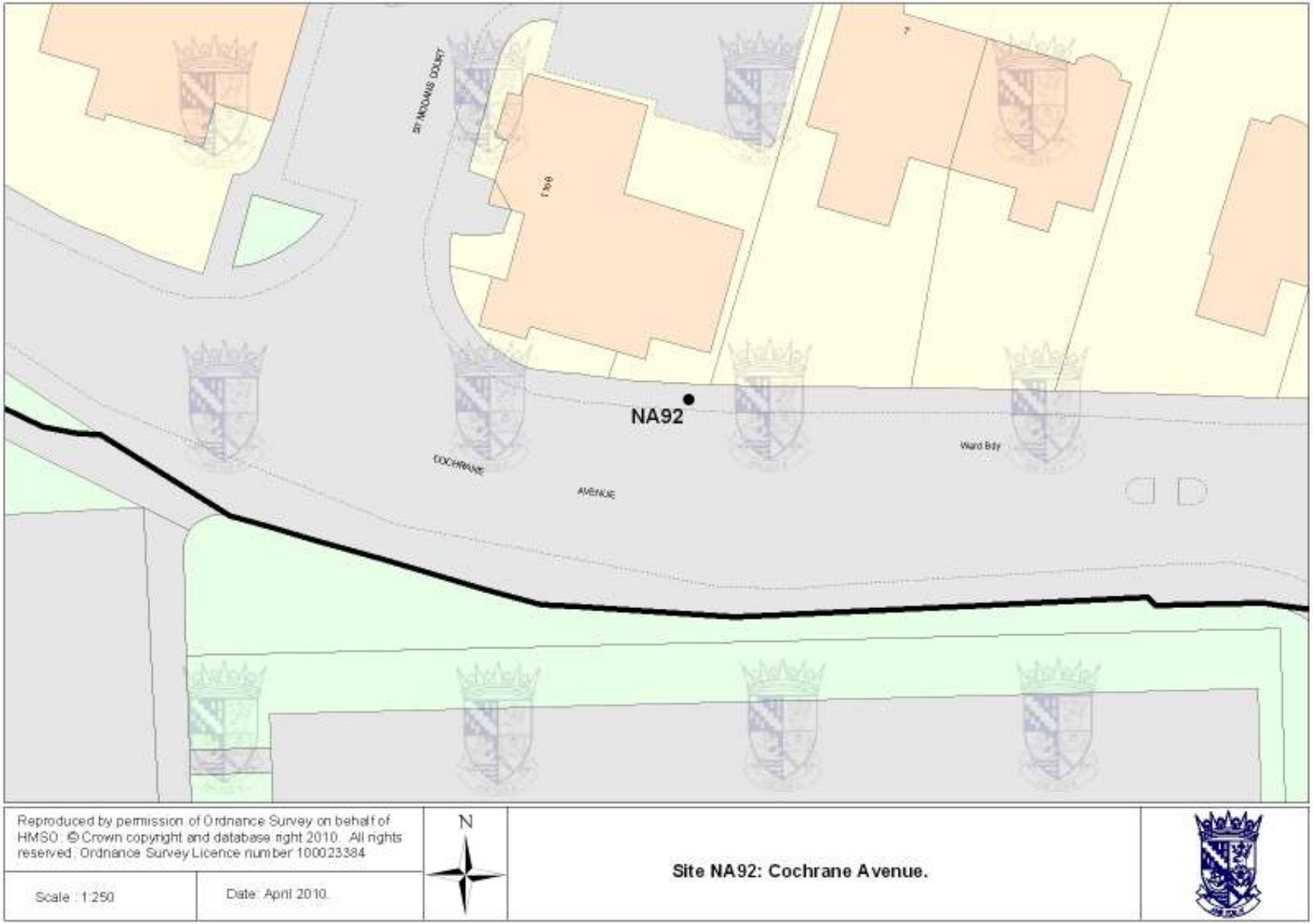
Site 88: Ure Crescent, Bonnybridge.

Scale : 1:468

Date: April 2010

N

Sites NA89, 90, 91 (and AQMAs).

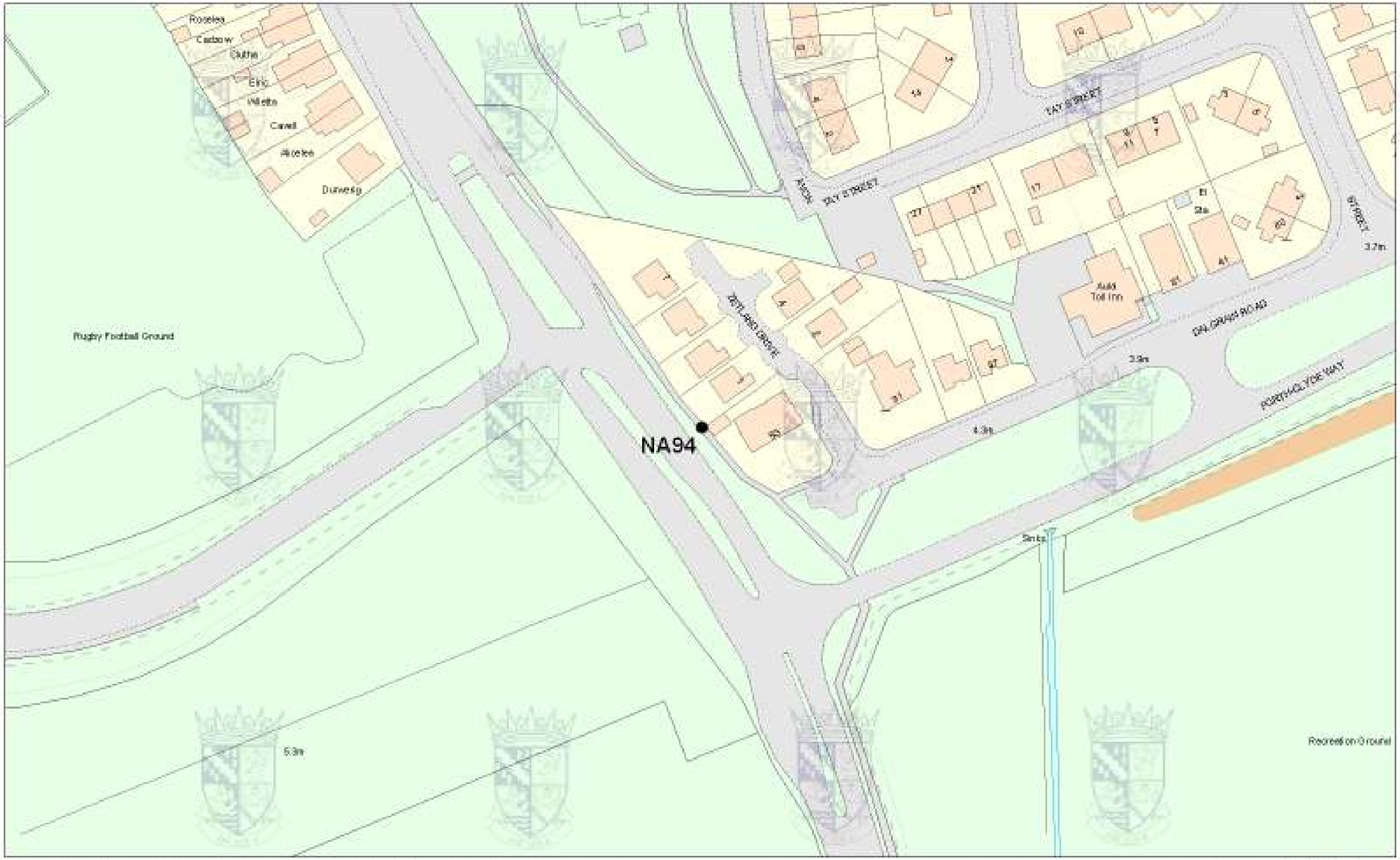

ST MODANS COURT
NA92
COCHRANE
AVENUE
Ward Bdy
Reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown copyright and database right 2010. All rights reserved. Ordnance Survey Licence number 100023384
N
Site NA92: Cochrane Avenue.
Scale : 1:250
Date: April 2010.

Scale : 1:650

Date: April 2010

N

Site NA93: Falkirk High Station.



Scale : 1:1,000

Date: April 2010

N

Site 94: A905 (Glensburgh Rd), Grangemouth.

Table 2.2 Details of Non-Automatic Monitoring Sites

Site No.	Location.	Site Type	OS Grid Ref (x, y)		Pollutants Monitored	In AQMA?	Relevant exposure?	Distance to kerb (nearest road), m.	Worst-case Location?
NA3	Tinto Drive, Grangemouth.	Urban background.	293427	680386	NO_2.	Y (SO_2).	Y (<5m)	<10m	N
NA5	Copper Top pub, Camelon.	Roadside.	287332	680333	NO_2.	N	Y (<2m)	<10m	N
NA7	Irving Parish Church, Camelon.	Urban background.	287324	680442	NO_2.	N	Y (<5m)	<10m	N
NA9	Bellsdyke Rd, Larbert.	Roadside.	286048	683542	NO_2.	N	Y (<2m)	<2m	Y
NA10	Muirhall Rd, Larbert.	Urban centre.	286025	683435	NO_2.	N	Y (<5m)	<5m	Y
NA13	Graeme High School.	Roadside.	290197	679622	NO_2.	N	Y (<2m)	<2m	Y
NA18	A80 Northbound c/way, Banknock.	Roadside.	278924	679513	Benzene, 1,3 butadiene, NO_2.	Y (NO_2).	N	<1m	Y
NA19	Kilsyth Rd, Banknock.	Roadside.	278779	679301	NO_2.	Y (NO_2).	Y (<2m)	<2m	Y
NA20	Garngrew Rd, Haggs.	Urban background.	278979	679155	NO_2.	N	Y (<5m)	<10m	N
NA21	Grangemouth Rd, College.	Roadside.	290112	680500	Benzene, NO_2.	N	Y (<2m)	<2m	Y
NA24	Kerse Lane, Falkirk.	Roadside.	289187	680024	Benzene, NO_2.	Y (NO_2).	Y (<2m)	<2m	Y

Table 2.2 Details of Non-Automatic Monitoring Sites (continued)

Site No.	Location.	Site Type	OS Grid Ref (x, y)		Pollutants Monitored	In AQMA?	Relevant exposure?	Distance to kerb (nearest road), m.	Worst-case Location?
NA26	Weir St, Falkirk.	Urban background.	289207	680123	NO_2.	Y (NO_2).	Y (<5m)	<10m	N
NA27	West Bridge St, Falkirk.	Roadside.	288490	680055	Benzene, 1,3 butadiene, NO2.	Y (NO_2).	Y (<2m)	<2m	Y
NA29	Wellside Place, Falkirk.	Urban background.	288465	680220	NO_2.	N	Y (<5m)	<10m	N
NA36	Kerr Crescent, Haggs.	Urban background.	278985	679273	NO_2.	Y (NO_2).	Y (<5m)	<10m	N
NA37	Denny Town House.	Urban centre.	281226	682526	Benzene, NO_2.	N	Y (<5m)	<5m	Y
NA38	Larbert Village Primary School.	Urban background.	285930	682318	Benzene, NO_2.	N	Y (<5m)	<10m	N
NA41	Seaview Place, Bo'ness.	Roadside.	299722	681594	Benzene, NO_2.	N	Y (<2m)	<2m	Y
NA42	Municipal Chambers, Grangemouth.	Urban centre / industrial.	292816	682009	Benzene, NO_2*.	Y (SO_2).	Y (<5m)	<10m	Y
NA44	Greenpark Drive, Polmont.	Urban background.	293436	678938	Benzene, NO_2.	N	Y (<5m)	<10m	N
NA45	N.Distributor Rd, Bainsford.	Roadside.	288444	681178	NO_2.	N	N	<2m	Y
NA46	West Bridge St traffic lights, Falkirk.	Roadside.	288543	680045	Benzene, 1,3 butadiene.	N	Y (<2m)	<2m	Y
NA47	Thistle Avenue, Grangemouth.	Roadside.	292000	680300	NO_2.	Y (SO_2).	Y (<2m)	<2m	Y
NA48	Hayfield, Falkirk.	Urban background.	289200	681580	NO_2.	N	Y (<5m)	<10m	N

Table 2.2 Details of Non-Automatic Monitoring Sites (continued)

Site No.	Location.	Site Type	OS Grid Ref (x, y)		Pollutants Monitored	In AQMA?	Relevant exposure?	Distance to kerb (nearest road), m.	Worst-case Location?
NA49	Lennox Terrace, Grangemouth.	Urban background / industrial.	293600	680250	Benzene, 1,3 butadiene, NO_2.	Y (SO_2).	Y (<5m)	<10m	Y
NA50	Upper Newmarket St, Falkirk.	Urban background.	288671	680047	NO_2.	Y (NO_2).	Y (<5m)	<10m	N
NA51	Mary St, Laurieston.	Roadside.	290965	679490	NO_2.	N	Y (1m)	<2m	Y
NA52	Main St, Larbert.	Roadside.	285866	682356	NO_2.	N	Y (<2m)	<2m	Y
NA53	Denny Cross.	Roadside.	281211	682727	NO_2.	N	Y (<2m)	<2m	Y
NA55	Inchyra Station.	Urban background / industrial.	293830	681022	Benzene, 1,3 butadiene, NO_2.	Y (SO_2).	Y (<5m)	<2m	N
NA56	Albert Avenue, Grangemouth.	Urban background / industrial.	293859	681962	Benzene, 1,3 butadiene, NO_2.	Y (SO_2).	Y (<5m)	<10m	Y
NA57	Inchyra Road, Grangemouth.	Urban background / industrial.	294028	680829	Benzene, 1,3 butadiene, NO_2.	Y (SO_2).	Y (<5m)	<10m	Y
NA58	Callendar Rd, Falkirk.	Roadside.	289667	679724	NO_2.	N	Y (<2m)	<2m	Y
NA59	Carron Rd, Bainsford.	Roadside.	288392	681931	NO_2.	N	Y (<2m)	<2m	Y
NA60	Ronades Rd, Carron.	Roadside.	288133	681587	NO_2.	N	Y (<2m)	<2m	Y
NA61	Canal Rd, Falkirk.	Roadside.	287976	680656	NO_2.	N	Y (<2m)	<2m	Y
NA62	Arnot St, Falkirk.	Roadside.	289125	679705	NO_2.	Y (NO_2).	Y (<2m)	<2m	Y
NA63	Camelon Rd, Falkirk.	Urban background.	288055	680134	NO_2.	N (on boundary NO_2).	Y (<5m)	<10m	N

Table 2.2 Details of Non-Automatic Monitoring Sites (continued)

Site No.	Location.	Site Type	OS Grid Ref (x, y)		Pollutants Monitored	In AQMA?	Relevant exposure?	Distance to kerb (nearest road), m.	Worst-case Location?
NA64	New Hallglen Rd, Falkirk.	Roadside.	288807	678422	NO_2.	N	Y (<2m)	<2m	Y
NA65	Redding Rd, Redding.	Roadside.	291356	678644	NO_2.	N	Y (<2m)	<2m	Y
NA66	Holehouse, Slamannan.	Rural.	289450	672035	Benzene, NO_2.	N	N (<20m)	<10m	N
NA67	Queen St, Falkirk.	Urban background.	289430	680433	NO_2.	N	Y (<5m)	<10m	N
NA68	Bellevue St, Falkirk.	Roadside.	289234	679945	NO_2.	Y (NO_2).	Y (<2m)	<2m	Y
NA69	Kerse Lane, Falkirk.	Roadside.	289022	679990	NO_2.	Y (NO_2).	Y (<2m)	<2m	Y
NA70	Park St AQ station, Falkirk.	Roadside.	288892	680070	NO_2.	Y (NO_2).	Y (<2m)	<2m	Y
NA71	Park St, Falkirk.	Roadside.	288910	680112	NO_2*	Y (NO_2).	Y (<2m)	<2m	Y
NA72	Vicar St, Falkirk.	Roadside.	288824	680120	NO_2.	Y (NO_2).	Y (<2m)	<2m	Y
NA73	West Bridge St RHS, Falkirk.	Roadside.	288467	680048	NO_2.	Y (NO_2).	Y (<2m)	<2m	Y
NA74	Hope St AQ station.	Roadside.	288688	680218	Benzene, NO_2.	Y (NO_2).	Y (<2m)	<2m	Y
NA75	Rae St, Stenhousemuir.	Roadside.	286793	683114	Benzene, NO_2.	N	Y (<2m)	<2m	Y
NA76	Tyrst Road, Stenhousemuir.	Roadside.	286851	683229	NO_2.	N	Y (<2m)	<2m	Y
NA77	Kinnaird Village.	Roadside.	286490	683775	Benzene, NO_2.	N	Y (<2m)	<2m	Y
NA78	Glen Brae, Falkirk.	Roadside.	288525	678991	NO_2.	N	Y (<2m)	<2m	Y
NA79	Gartcows Rd, Falkirk.	Roadside.	288491	679327	NO_2.	N	Y (<2m)	<2m	Y

Table 2.2 Details of Non-Automatic Monitoring Sites (continued)

Site No.	Location.	Site Type	OS Grid Ref (x, y)		Pollutants Monitored	In AQMA?	Relevant exposure?	Distance to kerb (nearest road), m.	Worst-case Location?
NA80	Cow Wynd, Falkirk.	Roadside.	288765	679456	Benzene, NO_2.	N	Y (<2m)	<2m	Y
NA81	Grahams Rd, Falkirk.	Roadside.	288834	680898	Benzene, NO_2.	N	Y (<2m)	<2m	Y
NA82	Castings Ave, Falkirk.	Roadside.	288858	681036	NO_2.	N	Y (<2m)	<2m	Y
NA83	Main St, Bainsford.	Roadside.	288609	681419	NO_2.	N	Y (<2m)	<2m	Y
NA84	Carriden Brae, Bo'ness.	Roadside.	301874	680592	NO_2.	N	Y (<2m)	<2m	Y
NA85	Auchinloch Dr, Banknock.	Roadside.	278752	679049	NO_2.	Y (NO_2).	Y (<2m)	<2m	Y
NA86	Wolfe Rd, Falkirk.	Urban background.	289667	679871	NO_2.	N	Y (<2m)	2m	N
NA87	M80 slip south, Haggs.	Roadside.	279017	679305	Benzene, 1,3 butadiene, NO_2.	Y (NO_2).	Y (<2m)	2m	Y
NA88	Ure Crescent, Bonnybridge.	Roadside.	282391	681045	NO_2.	N	Y (<2m)	2m (16m to M876)	Y
NA89	Grahams Rd/Meeks Rd, Falkirk.	Roadside.	288853	680328	NO_2.	N	Y (<2m)	2m	Y
NA90	Grahams Rd bridge east, Falkirk.	Roadside.	288855	680234	NO_2.	Y (NO_2).	Y (<2m)	3m	Y
NA91	Grahams Rd bridge west, Falkirk.	Roadside.	288835	680291	NO_2.	Y (NO_2).	Y (<2m)	3m	Y
NA92	Cochrane Avenue, Falkirk.	Roadside.	288743	679606	NO_2.	Y (NO_2).	Y (<2m)	2m	Y
NA93	Falkirk High Station.	Urban background.	288346	679073	NO_2.	N	Y (<2m)	2m	N
NA94	A905 (Glensburgh Rd), Grangemouth.	Roadside.	291213	681927	NO_2.	Y (SO_2).	Y (<2m)	5m	Y

2.2 Comparison of Monitoring Results with Air Quality Objectives

2.2.1 Nitrogen Dioxide

Automatic Monitoring Data

In 2009 the Council operated seven automatic NO_2 monitors in the Council area. Table 2.3a shows the annual mean concentrations for NO_2 from those automatic monitoring stations for 2007 to 2009, with Table 2.3b showing the number of exceedances of the hourly limit value. In 2009 all sites met both NO_2 objectives, with the highest concentration of 38.2 µg/m^3 recorded at the Falkirk West Bridge St site. The only site to record lower than 90% data capture was the Falkirk Haggs site.

A decrease in NO_2 concentrations was seen at the Council's four roadside sites and one background site between 2008 and 2009. The decrease is in-line with the overall decrease seen at a national level as shown by the sustainable development air quality indicator.[2]

While the Falkirk West Bridge and Falkirk Haggs automatic sites have met the air quality objectives for 2009, the results are nevertheless what would be considered close to the objective. In addition, with several of the diffusion tubes in the AQMAs continuing to record breaches of the NO_2 annual air quality objective the AQMAs remain justified. Also throughout most of 2009 the A80, which passes close to the Falkirk Haggs site, is being upgraded to motorway standard. This may have affected traffic levels and speeds in the area.

Table 2.3a Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective.

Site ID	Location	Within AQMA?	Data Capture for monitoring period %	Data Capture for full calendar year 2009 %	Annual mean concentrations (µg/m^3)		
					2007	2008	2009
A4	Falkirk Haggs	Y	n/a	85.7	n/m	**44.7**	37.6 *
A5	Falkirk Hope St	Y	n/a	95.8	25.2	24.5	23.8
A6	Falkirk Park St	Y	n/a	99.5	34.2	31.1	29.0
A7	Falkirk West Bridge St	Y	n/a	91.0	n/m	**47.2***	38.2
A8	Grangemouth AURN (Inchyra)	N	n/a	90.4	15.9	17.0	17.7
A9	Grangemouth Moray	N	n/a	99.6	n/m	16.1*	19.3
A10	Grangemouth Municipal Chambers	N	n/a	99.5	20.9*	25.0*	22.8

* less than 90% data capture.

Figure 2.3 shows the annual concentrations of NO_2 at Falkirk Park St (roadside) and the Grangemouth AURN site (urban background / industrial) from 2004 to 2009. The roadside site shows a slight long term trend of decreasing NO_2 concentrations, whilst the urban background / industrial site of Grangemouth AURN shows a slight increase in concentrations between 2005 and 2009.

Figure 2.3 Trends in Annual Mean Nitrogen Dioxide Concentration Measured at Automatic Monitoring Sites.

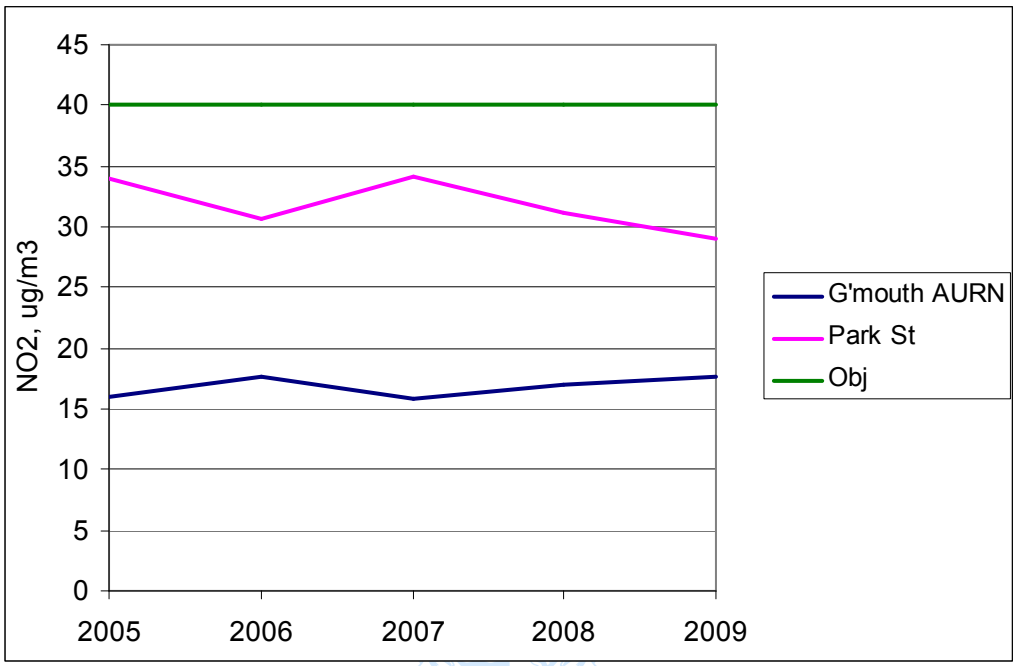


Table 2.3b Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour Mean Objective.

Site ID	Location	Within AQMA?	Data Capture for monitoring period %	Data Capture for full calendar year 2009 %	Number of Exceedances of hourly Mean (200 μg/m^3) 99.8th percentile of hourly means in brackets.		
					2007	2008	2009
A4	Falkirk Haggs	Y	n/a	85.7	n/m	2 (163)	1 (159) *
A5	Falkirk Hope St	Y	n/a	95.8	0 (102)	0 (94)	0 (88)
A6	Falkirk Park St	Y	n/a	99.5	0 (114)	0 (102)	0 (107)
A7	Falkirk West Bridge St	Y	n/a	91.0	n/m	1 (134) *	0 (120)
A8	Grangemouth AURN (Inchyra)	N	n/a	90.4	0 (88)	0 (111)	0 (103)
A9	Grangemouth Moray	N	n/a	99.6	n/m	0 (84) *	0 (94)
A10	Grangemouth Municipal Chambers	N	n/a	99.5	0 (98)	0 (126) *	0 (104)

Note: * less than 90% data capture.

Diffusion Tube Monitoring Data

The results from the Council's NO_2 diffusion tubes are shown in Table 2.4. As discussed in the Appendix it should be noted that the Council is being conservative (i.e. concentrations are potentially being over-read) by using the R&A Helpdesk factor rather than the local Park St factor.

The following diffusion tubes recorded a concentration greater than the annual NO_2 objective of 40 µg/m^3 in 2009:

- Site NA18, as discussed earlier, this site was discontinued in 2009 and was not representative of any relevant receptors.
- Site NA27, this site is in the Falkirk Town Centre annual NO_2 AQMA,
- Site NA36, this site is in the Banknock and Haggs annual NO_2 AQMA,
- Site NA45, this site is not representative of any relevant receptors, but has been used in section 3,
- Site NA62, this site is in the Falkirk Town Centre annual NO_2 AQMA,
- Site NA63, this site is on the boundary of the Falkirk Town Centre annual NO_2 AQMA,
- Site NA83, this site is outside of any AQMA. Main St in Bainsford has experienced significant changes to its traffic flows and increased congestion due to road works along the road for a significant portion of 2009. This road will be covered by the Falkirk Town Centre Further Assessment. In 2010 these road works have moved southwards on to Grahams Road, Falkirk.

No sites, other than the discontinued NA18 site, recorded a concentration above 60 µg/m^3 , which would indicate a potential breach of the hourly objective.

Of the new sites that commenced in 2009, site NA94 recorded the highest concentration of 37 µg/m^3 (annualised). This is within the annual NO_2 air quality objective, the result will be reviewed again once a full year's worth of data is available. The other sites to record a concentration close to the objective (36 to 40 µg/m^3) were sites NA19, 21, 24, 71 and 73, all within AQMAs or in areas to be covered by Further Assessments.

Although there are only three or four months worth of data from the three tubes in or close to the Falkirk Town Centre hourly NO_2 AQMA, when annualised they are all within the annual objective. They are not close to the 60 µg/m^3 level that would indicate a potential exceedance of the hourly objective. An automatic analyser is due to be installed in June 2010.

The concentration of NO_2 recorded close to the railway line at Falkirk High train station (site NA93) was 17 µg/m^3 (annualised) and is within the annual objective.

Table 2.4 Results of Nitrogen Dioxide Diffusion Tubes for 2009.

Site ID	Location	Within AQMA?	Data Capture for monitoring period, %	Data Capture for full calendar year 2009, %	Annual mean concentrations (μg/m^3)		
					2007 (0.81)	2008 (0.74)	2009 (0.81)
NA3	Tinto Drive, Grangemouth.	Y (SO_2).	n/a	100	23	23	21
NA5	Copper Top pub, Camelon.	N	n/a	100	31	32	31
NA7	Irving Parish Church, Camelon.	N	n/a	100	20	20	22
NA9	Bellsdyke Rd, Larbert.	N	n/a	92	30	27	29
NA10	Muirhall Rd, Larbert.	N	n/a	92	22	23	26
NA13	Graeme High School.	N	n/a	92	31	31	34
NA18	A80 Northbound c/way, Banknock.	Y (NO_2).	100	33	**99**	**101**	**129 ***
NA19	Kilsyth Rd, Banknock.	Y (NO_2).	n/a	83	37	35	37
NA20	Garngrew Rd, Haggs.	N	n/a	92	27	25	27
NA21	Grangemouth Rd, College.	N	n/a	100	30	36	36
NA24	Kerse Lane, Falkirk.	Y (NO_2).	n/a	100	**41**	37	37
NA26	Weir St, Falkirk.	Y (NO_2).	n/a	100	23	21	22
NA27	West Bridge St, Falkirk.	Y (NO_2).	n/a	100	**47**	**49**	**50**
NA29	Wellside Place, Falkirk.	N	n/a	100	20	21	22
NA36	Kerr Crescent, Haggs.	Y (NO_2).	n/a	100	**46**	**42**	**49**
NA37	Denny Town House.	N	n/a	100	19	18	19
NA38	Larbert Village Primary School.	N	n/a	75	20	16	25
NA41	Seaview Place, Bo'ness.	N	n/a	100	25	25	27
NA42	Municipal Chambers, Grangemouth.	Y (SO_2).	n/a	100	21	21	22
NA44	Greenpark Drive, Polmont.	N	n/a	100	18	18	19
NA45	N.Distributor Rd, Bainsford.	N	n/a	92	39	**40**	**42**
NA47	Thistle Avenue, Grangemouth.	Y (SO_2).	n/a	100	24	24	24
NA48	Hayfield, Falkirk.	N	n/a	100	22	23	21
NA49	Lennox Terrace, Grangemouth.	Y (SO_2).	n/a	100	23	24	24
NA50	Upper Newmarket St, Falkirk.	Y (NO_2).	n/a	100	29	30	29
NA51	Mary St, Laurieston.	N	n/a	100	28	28	30
NA52	Main St, Larbert.	N	n/a	100	28	28	31
NA53	Denny Cross.	N	n/a	100	30	30	34
NA55	Inchyra Station.	Y (SO_2).	n/a	100	21	21	20
NA56	Albert Avenue, Grangemouth.	Y (SO_2).	n/a	100	21	21	22

Table 2.4 Results of Nitrogen Dioxide Diffusion Tubes (continued)

Site ID	Location	Within AQMA?	Data Capture for monitoring period, %	Data Capture for full calendar year 2009, %	Annual mean concentrations (μg/m^3)		
					2007 (0.81)	2008 (0.74)	2009 (0.81)
NA57	Inchyra Road, Grangemouth.	Y (SO_2).	n/a	100	30	30	32
NA58	Callendar Rd, Falkirk.	N	n/a	92	22	23	26
NA59	Carron Rd, Bainsford.	N	n/a	83	34	31	34
NA60	Ronades Rd, Carron.	N	n/a	100	30	28	30
NA61	Canal Rd, Falkirk.	N	n/a	100	30	30	30
NA62	Arnot St, Falkirk.	Y (NO_2).	n/a	100	**41**	38	**41**
NA63	Camelon Rd, Falkirk.	N (on boundary NO_2).	n/a	67	**40**	**40**	**45**
NA64	New Hallglen Rd, Falkirk.	N	n/a	100	19	21	20
NA65	Redding Rd, Redding.	N	n/a	100	23	25	24
NA66	Holehouse, Slamannan.	N	n/a	100	10	10	11
NA67	Queen St, Falkirk.	N	n/a	100	31	29	30
NA68	Bellevue St, Falkirk.	Y (NO_2).	n/a	100	35	34	33
NA69	Kerse Lane, Falkirk.	Y (NO_2).	n/a	100	36	36	35
NA70	Park St AQ station, Falkirk.	Y (NO_2).	n/a	100	39	33	31
NA71	Park St, Falkirk.	Y (NO_2).	n/a	100	38	38	39
NA72	Vicar St, Falkirk.	Y (NO_2).	n/a	100	31	33	31
NA73	West Bridge St RHS, Falkirk.	Y (NO_2).	n/a	100	n/m	35	37
NA74	Hope St AQ station.	Y (NO_2).	n/a	100	27	26	28
NA75	Rae St, Stenhousemuir.	N	n/a	75	n/m	19	23
NA76	Tyrst Road, Stenhousemuir.	N	n/a	100	n/m	22	25
NA77	Kinnaird Village.	N	n/a	100	n/m	22	22
NA78	Glen Brae, Falkirk.	N	n/a	100	n/m	31	34
NA79	Gartcows Rd, Falkirk.	N	n/a	100	n/m	23	26
NA80	Cow Wynd, Falkirk.	N	n/a	100	n/m	27	34
NA81	Grahams Rd, Falkirk.	N	n/a	100	n/m	34	35
NA82	Castings Ave, Falkirk.	N	n/a	92	n/m	25	23
NA83	Main St, Bainsford.	N	n/a	83	n/m	37	**46**
NA84	Carriden Brae, Bo'ness.	N	n/a	100	n/m	15	17
NA85	Auchinloch Dr, Banknock.	Y (NO_2).	n/a	100	n/m	24	26
NA86	Wolfe Rd, Falkirk.	N	n/a	83	n/m	n/m	17
NA87	M80 slip south, Haggs.	Y (NO_2).	100	58	n/m	n/m	32 *
NA88	Ure Crescent, Bonnybridge.	N	100	33	n/m	n/m	25 *

Table 2.4 Results of Nitrogen Dioxide Diffusion Tubes (continued)

Site ID	Location	Within AQMA?	Data Capture for monitoring period, %	Data Capture for full calendar year 2009, %	Annual mean concentrations (μg/m^3)		
					2007 (0.81)	2008 (0.74)	2009 (0.81)
NA89	Grahams Rd/Meeks Rd, Falkirk.	N	100	33	n/m	n/m	32 *
NA90	Grahams Rd bridge east, Falkirk.	Y (NO_2).	100	33	n/m	n/m	30 *
NA91	Grahams Rd bridge west, Falkirk.	Y (NO_2).	50	17	n/m	n/m	33 *
NA92	Cochrane Avenue, Falkirk.	Y (NO_2).	100	33	n/m	n/m	26 *
NA93	Falkirk High Station.	N	100	33	n/m	n/m	17 *
NA94	A905 (Glensburgh Rd), Grangemouth.	Y (SO_2).	75	25	n/m	n/m	37 *

Notes: * Result annualised, see Appendix.
Bias adjustment result applied for each year in brackets.

2.2.2 PM_{10}

In 2009 the Council monitored PM_{10} at seven locations, of these analysers one is an FDMS, one is an Osiris and the remaining five are TEOMs. The correction of TEOM data has largely been done by the VCM, as discussed in the appendix the only exception is Grangemouth AURN data prior to the upgrade to FDMS. The annual mean concentrations recorded at these sites are shown in Table 2.5a and the number of daily exceedances is shown in Table 2.5b.

All existing PM_{10} monitors achieved data capture of 90%. The West Bridge St site achieved a period data capture (prior to the application of the VCM) of over 90% with the annual data capture low due to its installation date in September.

The period data capture for the Banknock 1 site was below 90%, with the annual data capture low due to its installation date in October. This monitor is in the area subject to a Detailed Assessment for PM_{10}. The Osiris data has had a 1.3 correction factor applied and the result has been annualised. The 98th percentile is greater than 50 μg/m^3 indicating a potential breach of the 2010 daily objective. A Detailed Assessment for this area is due for submission in 2010, which will study a year's worth of monitoring data.

A breach of the annual 2010 PM_{10} air quality objective has been recorded at the Falkirk West Bridge St site. The annualised result of 22.3 ug/m^3 is shown in Table 2.5a, the result for the period of monitoring between 16/09/2009 and 31/12/2009 was 19 ug/m^3. The annualised result in Table 2.5a was based on data from the Grangemouth AURN site and Edinburgh St. Leonards site. This annualised result may change for the Falkirk Town Centre Further Assessment following the release of hourly VCM corrected data for the Scottish Air Quality Network sites. These are likely to have a higher data capture than Edinburgh St. Leonards. This result will feed into the Further Assessment for the Falkirk Town Centre AQMAs.

All other sites met both PM_{10} objectives for 2010.

Table 2.5a Results of PM_{10} Automatic Monitoring: Comparison with Annual Mean Objective

Site ID	Location	Within AQMA?	Data Capture for monitoring period %	Data Capture for full calendar year 2009 %	Annual mean concentrations ($\mu g/m^3$)		
					2007	2008	2009
A2	Banknock 1	N (DA)	79.8	15.6	n/m	n/m	15.1 # *
A5	Falkirk Hope St	N (FA)	n/a	95.7	18.1/15.9	15.3	15
A6	Falkirk Park St	N (FA)	n/a	98.3	20.9/18.3	16.2	15
A7	Falkirk West Bridge St	N (FA)	99.1	28.4	n/m	n/m	**22.3 # ***
A8	Grangemouth AURN (Inchyra)	N	n/a	90.3	16.2/14.2	14.4	12.9 $
A9	Grangemouth Moray	N	n/a	99.4	n/m	13.9	14
A10	Grangemouth Municipal Chambers	N	n/a	97.0	18.3/16.1	15.1	14

Table 2.5b Results of PM_{10} Automatic Monitoring: Comparison with 24-hour Mean Objective

Site ID	Location	Within AQMA?	Data Capture for monitoring period %	Data Capture 2009 %	Number of Exceedances of daily mean objective (50 $\mu g/m^3$) 98th percentile of daily means in brackets.		
					2007	2008	2009
A2	Banknock 1	N (DA)	79.8	15.6	n/m	n/m	0 (57) *
A5	Falkirk Hope St	N (FA)	n/a	95.7	5 / 2	3 (41)	1
A6	Falkirk Park St	N (FA)	n/a	98.3	6 / 4	6 (46)	2
A7	Falkirk West Bridge St	N (FA)	99.1	28.4	n/m	n/m	0 *
A8	Grangemouth AURN (Inchyra)	N	n/a	90.3	1 / 0	0 (38)	0 (35) $
A9	Grangemouth Moray	N	n/a	99.4	n/m	0 (36) *	0
A10	Grangemouth Municipal Chambers	N	n/a	97.0	4 / 2	0 (41)	0

Notes for Table 2.5 a and b:
- 1.3 / 1.14 correction factors have been used for the 2007 results. 2008 and 2009 results are VCM corrected.

- $ The data for Grangemouth AURN has been merged: FDMS data from 29th April, prior to this date the TEOM data has had a 1.3 correction factor applied. This will be updated when KCL complete their VCM work for the AURN.
- #The concentration shown has been annualised.
- * Less than 90% data capture.
- 98th percentiles not available at the time of writing for sites with a VCM correction.

2.2.3 Sulphur Dioxide

The Council monitored SO_2 at seven locations in 2009. Three of the monitors are in the Grangemouth AQMA with four monitors outside the AQMA.

Table 2.6 shows the number of SO_2 exceedances recorded at the Council's monitoring stations in 2009. One site, Grangemouth Moray breached the 15-minute objective with 65 exceedances of the 15-minute objective concentration. This site is within the Grangemouth SO_2 AQMA and is consistent with breaches in previous years. The hourly and daily objectives continue to be met at all monitoring sites both in and outside the AQMA.

All SO_2 analysers achieved 90% data capture in 2009. The most significant period of data loss occurred at the Grangemouth AURN site due to cabin temperatures being too high for the new FDMSs. A new air-conditioning unit was installed at this site in December 2009.

The long-term trends and Grangemouth AQMA Action Plan are discussed in Section 6.

The Abbotsford House monitor ceased operation on the 16th April 2010 and has been re-located to Polmont.

Table 2.6 Results of SO_2 Automatic Monitoring in 2009: Comparison with Objectives.

Site ID	Location	Within AQMA?	Data Capture for monitoring period %	Data Capture 2009, %	Number of Exceedances of: (μg/m³)		
					15-minute Objective (266 μg/m³)	1-hour Objective (350 μg/m³)	24-hour Objective (125 μg/m³)
A1	Abbotsford House	N	n/a	99.1	0	0	0
A3	Bo'ness	N	n/a	98.3	4	0	0
A5	Falkirk Hope St	N	n/a	95.4	0	0	0
A6	Falkirk Park St	N	n/a	99.6	0	0	0
A8	Grangemouth AURN (Inchyra)	Y (SO_2)	n/a	94.4	21	0	0
A9	Grangemouth Moray	Y (SO_2)	n/a	99.5	**65**	1	2
A10	Grangemouth Municipal Chambers	Y (SO_2)	n/a	98.8	17	0	0

2.2.4 Benzene

In 2009 the Council monitored for benzene using diffusion tubes at 21 locations. The results are shown in Table 2.7. The highest concentration recorded was 2.58 µg/m^3 at site NA27 (West Bridge St, Falkirk). Therefore all sites were within the air quality objectives in 2009.

In addition, the Council acts as LSO for the pumped diffusion tube at the Grangemouth AURN site with results shown in Table 2.8. The site has seen a slight increase in annual concentrations from 1.08 µg/m^3 in 2007 to 1.27 µg/m^3 in 2009. However, the concentrations recorded continue to be within the air quality objectives.

Table 2.7 Results of benzene diffusion tubes.

Site ID	Location	Within benzene AQMA?	Data Capture for monitoring period %	Data Capture (calendar year 2009) %	Annual mean concentrations (µg/m^3)		
					2007	2008	2009
NA18	A80 North Bound C/way, Banknock	N	100	33	0.97	0.86	0.79
NA21	Grangemouth Road, College	N	n/a	100	1.36	1.55	1.16
NA24	Kerse Lane, Falkirk	N	n/a	100	1.16	1.05	1.04
NA27	West Bridge Street, Falkirk	N	n/a	100	2.74	1.47	2.58
NA37	Denny Town House	N	n/a	100	1.24	0.80	1.55
NA38	Larbert Village Primary School	N	n/a	100	1.10	0.67	1.41
NA41	Seaview Place, Bo'ness	N	n/a	100	1.49	1.51	1.13
NA42	Municipal Chambers, Grangemouth	N	n/a	100	1.30	0.96	1.59
NA44	Greenpark Drive, Polmont	N	n/a	100	1.41	1.13	2.37
NA46	West Bridge Street traffic lights, Falkirk	N	n/a	100	1.29	1.06	1.96
NA49	Lennox Terrace, Grangemouth	N	n/a	100	1.61	1.44	0.95
NA55	Inchyra Station	N	n/a	100	n/m	1.13	1.11
NA56	Albert Ave, Grangemouth	N	n/a	100	2.13	1.14	2.01
NA57	Inchyra Road, Grangemouth	N	n/a	100	1.36	1.19	1.12
NA66	Holehouse, Slamannan	N	n/a	100	n/m	0.72	0.57
NA74	Hope street AQ station	N	n/a	100	1.31	1.06	0.97
NA75	Rae St, Stenhousemuir	N	n/a	100	n/m	0.59	1.64
NA77	Kinnaird Village	N	n/a	100	n/m	0.85	0.75

NA80	Cow Wynd, Falkirk	N	n/a	100	n/m	1.21	0.85
NA81	Grahams Road, Falkirk	N	n/a	100	n/m	1.44	2.32
NA87	M80 slip south, Haggs	N	100	67	n/m	n/m	0.62

Note: Results have not been annualised as no automatic benzene data is collected at any of the sites.

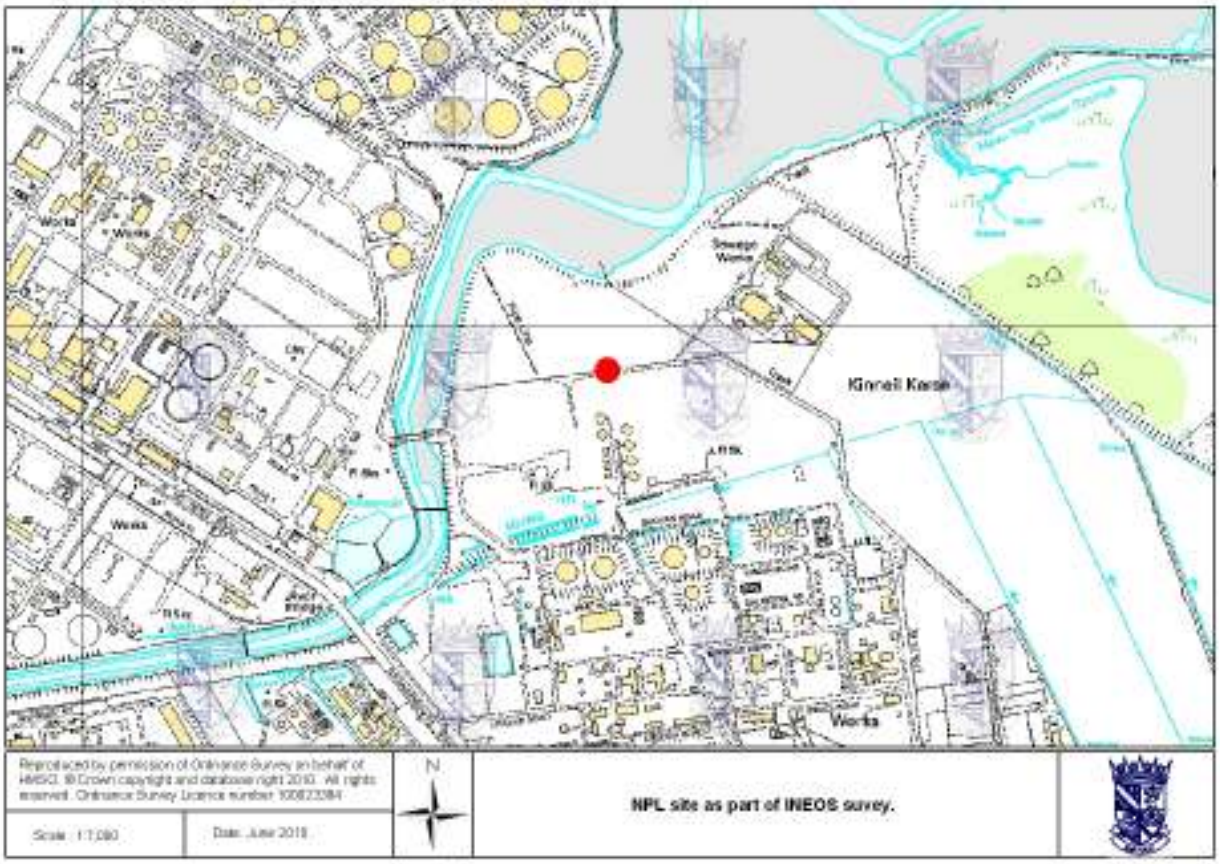
Table 2.8 Results from benzene pumped diffusion tube.

Site ID	Location	Data Capture for monitoring period %	Data Capture (calendar year 2009) %	Annual mean concentrations (µg/m^3)		
				2007	2008	2009
A8	Grangemouth AURN (Inchyra)	100	100	1.08	1.2	1.27

The Council noticed in NPL's report "UK Non-Automatic Hydrocarbon Network: Annual Report for 2009" that one of the tubes used for the INEOS commissioned survey in Grangemouth recorded a concentration of 3.9 µg/m^3 in 2009. The concentration recorded is above the 2010 Scottish objective for benzene of 3.25 µg/m^3.

The co-ordinates of the tube were obtained from NPL and the location is shown in Figure 2.4. The tube is located between BP Kinneil and a sewage works but does not have any relevant receptors. Therefore it is considered that the Council does not need to proceed to a Detailed Assessment.

Figure 2.4: Location of diffusion tube near BP Kinneil, which forms part of INEOS commissioned survey run by NPL.



2.2.5 Other pollutants monitored

In 2009 the Council monitored 1,3 butadiene at eight sites using diffusion tubes, all the results are within the air quality objective. In fact all the monthly results were at the limit of detection and so it is possible that the concentrations were lower than those stated in Table 2.9.

Site NA18 ceased operation in April 2009 for the same reasons as outlined in Section 2.2. Site 46 ceased operation as it was deemed unnecessary to have two 1,3 butadiene tubes so close together on West Bridge St. This tube was swapped for seven extra NO_2 tubes.

The number of 1,3 butadiene sites is being gradually reduced. There are no issues in Falkirk (or the UK) with 1,3 butadiene emissions in relation to road traffic, though some tubes will be maintained to reflect the small level of industrial emissions in the Council area.

Table 2.9: Results from 1,3 butadiene diffusion tubes.

Site ID	Location	Within 1,3 butadiene AQMA?	Data Capture for monitoring period %	Data Capture for full calendar year 2009 %	Annual mean concentrations (µg/m^3)		
					2007	2008	2009
NA18	A80 North Bound C/way, Banknock	N	100	33	0.54	0.40	0.43
NA27	West Bridge Street, Falkirk	N	n/a	100	0.46	0.39	0.40
NA46	West Bridge Street traffic lights, Falkirk	N	100	58	0.37	0.40	0.41
NA49	Lennox Terrace, Grangemouth	N	n/a	100	0.51	0.40	0.40
NA55	Inchyra Station, Grangemouth	N	n/a	100	0.45	0.41	0.40
NA56	Albert Avenue, Grangemouth	N	n/a	100	0.44	0.40	0.40
NA57	Inchyra Road, Grangemouth	N	n/a	100	0.44	0.40	0.40
NA87	M80 slip south, Haggs	N	100	67	n/m	n/m	0.38

Note: Tube NA46 has not been annualised as no automatic monitoring data is available and all tubes results were at the limit of detection.

As part of the UK wide role out of $PM_{2.5}$ analysers to AURN sites, a FDMS-TEOM began operation at the Grangemouth AURN site on the 3rd December 2008. Council Officers act as the LSO for this analyser. Although Council's are not required to review for $PM_{2.5}$ the results are included here for completeness.

The results are shown in Table 2.10, although the result for 2008 should be treated with caution given the installation date. The 2009 concentration is below the 12 µg/m^3 target value set by the Scottish Govt.

Table 2.10: Results from $PM_{2.5}$ monitoring.

Site ID	Location	Data Capture for monitoring period %	Data Capture for full calendar year 2009 %	Annual mean concentrations (µg/m^3)		
				2007	2008	2009
A8	Grangemouth AURN (Inchyra)	n/a	95.1	n/m	12.7*	8.6

* Annual data capture of 7%, data has not been annualised due to little other monitoring data being available in central Scotland in 2008.

Summary of Compliance with AQS Objectives

The Council has examined the monitoring results for its area and concludes that no additional Detailed Assessments are required at this time.

As in 2007 and 2008 a breach of the 15-minute SO_2 objective was recorded in 2009 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.

A breach of the 2010 annual PM_{10} objective was recorded at the Falkirk West Bridge St site in 2009. This site is within the Falkirk Town Centre AQMA for NO_2, however, the Further Assessment will include PM_{10}. Therefore the Council will wait for this report to be completed before considering whether to adjust the current AQMA.

Data from Banknock 1 indicates that the 18 $\mu g/m^3$ annual objective was met in 2009. The 98^{th} percentile was greater than 50 $\mu g/m^3$, this indicates a potential breach of the daily objective. However, as this is only based on just over two months of data, a Detailed Assessment is being submitted later in 2010 which will be based on a year's worth of data.

All tubes recording breaches of the NO_2 annual objective do not need to be considered further as they are within Further Assessment areas or are not representative of relevant receptors.

The other diffusion tubes continue to show that the benzene and 1,3 butadiene objectives were met in 2009 at locations where there are relevant receptors.

3 New Local Developments

This section will review any changes in 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 minimum requirement for a Progress Report is to log changes to local developments within the Council area. Most of the developments or changes in this section have been reviewed where sufficient information is available.

3.1 Road Traffic Sources

This section will review any changes to the following since the 2009 USA:

- Narrow congested streets with residential properties close to the kerb,
- Busy streets where people may spend one hour or more close to traffic,
- Roads with a high flow of buses and/or HGVs,
- Junctions,
- New roads constructed or proposed since the last Updating and Screening Assessment,
- Roads with significantly changed traffic flows,
- Bus or coach stations.

The main pollutants that Council's are required to assess from road traffic are NO_2 and PM_{10}. Benzene and 1,3 butadiene can also occur from road traffic emissions, though these are usually small.

Non - Trunk Roads

The traffic flow data supplied by the Council's Roads department has been reviewed. At the time of writing junction data was not available for non-trunk roads, to compensate for this, changes to the traffic flow data for trunk and non-trunk roads have been reviewed rather than just logged. In addition, a significant number of junctions will be covered by the Further Assessments.

Nine roads were identified which have shown a significant increase (>10%) in their flows since the 2009 USA:

1. A9 FND 100m West of Merchiston Roundabout,
2. A904 Grangemouth Road opposite Old Fire Station,
3. A9 FND West of Abbots Road, Falkirk,
4. B8080 Corporation Street, Falkirk,
5. A803 51m West of Orchard Farm Access,
6. A905 North of Bowtrees Roundabout,
7. A88 238m West of South Bellsdyke Roundabout,
8. A883 Broad Street, Denny,
9. A803 Tanners Road, Falkirk.

The first location is close to and on the same stretch of road as tube NA45, although this tube is not representative a receptor. Using the distance from kerb calculator the annual concentration falls to lower than 40 ug/m^3 after 2.2m, less than the distance to any receptors.

The second site falls within the area covered by the Falkirk Town Centre Further Assessment and so will not be considered in this report. The receptors for the third site are represented well by site NA48, which met the NO_2 objectives.

The 4th and 9th locations fall within the Falkirk Town Centre AQMAs and so will be considered in those Further Assessments.

The 5th and 6th locations do not need to be considered as the traffic flow and background concentrations do not meet the criteria in TG.(09). In addition, the 5th location is the same stretch of road that passes the Banknock 1 monitor. The original Detailed Assessment for this area stated that tailpipe emissions were responsible for 1.8 µg/m^3 of PM_{10} at Coneypark place.

For the 7th location there are no receptors on the stretch of road this count represents. The road for the 8th location finishes shortly after the count at the junction of Denny Cross, where site NA58 is. This site was below the air quality objective in 2009.

For a number of roads only an estimated flow was available for 2009. The roads where the 2008 flow is within the estimated range given for 2009 have not been considered further. However, the following roads had flows where the estimated range was greater than the 2008 flow:

1. A904 Falkirk Road east of Westfield Roundabout,
2. A801 South of Bowhouse Roundabout.

A request will be made to the Roads Department for a road count to be done for these two sites so that a specific figure can be used in the 2011 Progress Report.

The following locations were identified where the percentage of HDVs was above 20% in 2009:

- A803 Glasgow Road, Dennyloanhead,
- Three Bridges Park & Ride Site,
- A905 Dunmore Straight.

All three locations do not need to be considered further as the flow of HDVs is below the threshold stated in TG.(09) of 2,500 vehicles per day.

Falkirk bus station will be included in the Further Assessment for the Falkirk Town Centre AQMAs, with bus movement information currently being obtained from the operator.

The Council is not aware of any new areas where people are likely to spend more than 1-hour close to traffic or of any new residential properties in narrow congested streets.

Trunk Roads

Traffic flow data supplied by Transport Scotland was reviewed for total traffic flow and for the percentage of HDVs.

The largest increase in traffic flow between 2008 and 2009 was 17.9% with the largest decrease in traffic flow being -14.5%. Most of the sites showed a fall in traffic flow, with only one site showing an increase in flow of greater than 10%, that of 'M9E J7 Off Slip'. However, this area and site were assessed in the 2009 USA with no receptors within 20m of the centre line of the road and so does not need to be considered again.

All sites showed a decrease in the percentage of HDVs between 2008 and 2009, with the percentages of HDVs for all sites being below 20%.

Five of the sites reported no data in 2008 but did have data for 2009 so have been reviewed:

1. M80 Bankhead,
2. A876 Clackmannanshire Bridge South End,
3. A876 East of Bowtrees Junction,
4. M876 Between M9 Junction 7 and A905 Junction,
5. M876 Kinnaird (WiM).

Location 1: The site has shown a fall in traffic flow of 13.6% since 2006, which is the only other data available (8 months only). There is no exposure within 10m of the carriageway along this stretch of road, so this does not need to be considered further.

Location 2 is in the same area as the 'M9E J7 Off Slip' road and does not need to be considered further.

The closest receptor to the stretch of road represented by location 4 is at 78m and so does not need to be considered further.

Locations 3 and 5 are on the same stretch of road as other counters that will have been assessed in previous reports.

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. The main pollutants of interest for these sources are NO_2, PM_{10} and SO_2.

Ports

2,126 ships called at Grangemouth Docks in 2008, of which 10 were large (defined by Forth Ports as 20,000-50,000 deadweight range). In 2009, 1,884 ships called at

the Docks, of which 27 were large.[3] The docks are within the Grangemouth 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.

Airports

Unsurprisingly Edinburgh Airport remains more than 1 km from the Council boundary. The Council is not aware of any significant changes to Cumbernauld airport, which is just outside the Council boundary. There are no other new airports in the Council area.

Railways

In previous reports the steam railway at Bo'ness has been discussed. The Scottish Railway Preservation Society's website [4] states that passenger services have now been extended, at the southern end of the line, by 2.5 km to Manuel. The website states that there is no station at Manuel with the trains running on a loop. If the route is understood correctly then there are no extra receptors and with the relatively small number of trains that run on the line the extension does not need to be considered further.

The railway line between Polmont and Larbert runs through the Falkirk Town Centre AQMAs at Falkirk Grahamston station. Train emissions are being included within the Further Assessments for these AQMAs.

A reduction in emissions of NO_x and PM_{10} can be expected from the work that has commenced to electrify the Edinburgh to Glasgow line (via Falkirk High).[5] It is understood that as well this line, the electrification will also cover the other diversionary lines of Polmont to Larbert and Croy to Larbert. This will reduce the number of diesel passenger trains passing through Falkirk Grahamston station and the remainder of the Council area.

Although the Council was not required to assess the main Glasgow to Edinburgh rail line due to the background NO_x concentrations being less than 25 µg/m3, a NO_2 diffusion tube (NA92) was placed near Falkirk High Station as a precaution. The results to date show that concentrations are below the annual mean objective for NO_2 at 17 µg/m^3.

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,
- Poultry farms.

A list of PPC processes was supplied by SEPA to the Council. This list was compared to the list supplied for the 2009 USA and no new Part A processes were identified. The following Part B processes were identified as being new to the Falkirk area:

- PPC/B/1000119, Dem-master Demolition Ltd, mobile plant,
- PPC/B/1018533, Unit 5, Castle Crescent, D Cram Body Repairs Ltd,
- PPC/B/1005087, Northfield Quarry, Denny, Falkirk, Tillicoultry Quarries Ltd.

The Tillicoultry quarry has been operating for many years and no complaints have been received, so does not need to be considered further. The mobile plant, will by its nature be in several places, so would only need to be considered if complaints were received.

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.

Forth Valley College and the Scottish Biomass Heat Support Scheme have confirmed that no biomass plants were built or supported in the Falkirk Council area in 2009.[6]

The Council is not aware of any new significant areas of domestic solid fuel or biomass burning within the Falkirk Council area in 2009.

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.

As discussed in Section 3.3 the list of PPC processes supplied by SEPA suggests that the Northfield Quarry at Denny now has a PPC permit.

Cowdenhill Quarry remains within an area subject to Detailed Assessment for PM_{10}. The monitoring results for 2009 from the Banknock 1 monitor are shown in Tables

2.5 a and b. The PM_{10} objectives were met for this period of monitoring in 2009. A Detailed Assessment based on the monitoring currently being conducted will be submitted by the end of 2010.

Odour, but no dust, complaints have been received about the Avondale Landfill site, near Polmont. No other dust complaints have been received except in relation to complaints about temporary construction work.

Falkirk Council has identified the following new or previously unidentified local developments which may impact on air quality in Council area.

A review of the traffic flow data for roads in the Council area has shown that there have been some increases in traffic flow but there is no need to proceed to a Detailed Assessment.

A change to Bo'ness steam railway route does not need to be considered further and emissions are likely to reduce with the Glasgow to Edinburgh line being electrified.

New PPC permits in the Council area are:

- PPC/B/1000119, Dem-master Demolition Ltd, mobile plant,
- PPC/B/1018533, Unit 5, Castle Crescent, D Cram Body Repairs Ltd,
- PPC/B/1005087, Northfield Quarry, Denny, Falkirk, Tillicoultry Quarries Ltd.

4 Planning Applications

The following planning applications for 2009 were identified that may have an impact on air quality or introduce new receptors to the Council area.

Several scoping reports and masterplans for proposed developments have been submitted in late 2009 and early 2010. These will be discussed in future reports if the applications are taken further.

Planning appl no.	Details	Address	Postcode	Granted?
P/09/0278/FUL	Installation of flue at 11-23 High St, Bonnybridge, FK4 1BX.	11-23 High Street, Bonnybridge.	FK4 1BX	Granted
P/09/0231/FUL	Change of use from public house to restaurant and installation of flue.	2 Main Street, Bo'ness	EH51 9NG	Granted
P/09/0403/FUL	Extension to Public House and Installation of Flue	Brightons Inn 8 Maddiston Road Brightons Falkirk	FK2 0JP	Granted
P/09/0431/OUT	Mixed Use Development Comprising Residential and Sports Facilities	Land To The East Of Bonnybridge Hospital Bonnybridge		Pending decision.
P/09/0488/FUL	Erection of 88 Dwellinghouses and Associated Works	Redding House Overton Crescent Redding Falkirk	FK2 9TQ	Pending consideration
P/09/0508/OUT	Development of Land for Residential Use (550 units)	Land To The North Of Watson Place Glasgow Road Longcroft		Pending consideration
P/09/0727/FUL	Installation of wood burning stove and flue.	19 Craigburn Court, Falkirk.	FK1 5LA.	Granted

5 Climate Change Strategies

In August 2009, Falkirk's Community Planning Management Group discussed the need for joint working on climate change issues. It agreed to progress a number of initiatives:

- Work towards the production of a joint Climate Change Strategy (Falkirk Council to lead),
- Falkirk Council to lead on production of a Local Climate Impacts Project LCLIP with lead partners making a financial contribution,
- Development of a detailed plan for a joint staff resource to address the challenges of mitigation and adaptation to climate change (Falkirk Council to lead).

6 Implementation of Action Plans

Falkirk Town Centre and Haggs NO_2 AQMAs

The Falkirk Town Centre and Haggs NO_2 AQMAs were declared on the 18th March 2010. The Further Assessments are already under way and will be submitted in due course. The Falkirk Town Centre Further Assessment will include PM_{10}.

Grangemouth 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 breached the 15-minute objective in 2007, 2008 and 2009. The hourly and daily objectives continue to be met at all sites, both in and outside the AQMA.

In July 2007 the Council submitted its Action Plan for this AQMA to the Scottish Govt and SEPA. The Action Plan is available to view from either the AQ Archive or Scottish AQ websites. The Council is required to provide an annual update on this Action Plan, with the first submitted in May 2009. This section includes the 2010 update. Table 6.1 shows the four measures of the Action Plan and the progress that has been made with each measure, a discussion then follows.

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 INEOS.	Falkirk Council	Data sent after exceedances.	Increasing amounts of information in monthly summary. Analysis and polar plots of monitoring data.	Ongoing.	See comments below.
2	Six-monthly Working Group.	Bring together FVHB, INEOS, S.Govt, SEPA and Falkirk Council.	Falkirk Council	Meeting in November 2008.	Meetings in May 2009 and February 2010.	Ongoing, to meet annually from now on.	See comments below.
3	Text alert system.	Real-time notification of exceedances.	Falkirk Council	Implemented.	Maintenance of system.	Completed and ongoing.	See comments below.
4	Monitoring network.	Review monitoring network.	Falkirk Council	Grangemouth Moray site installed and in AURN & SAQN.	Abbotsford House monitor relocated to Polmont.	Ongoing.	See comments below.

Measure 1:
The display of data via the Council's own air quality website is on hold. This is because seven of the Council's 10 automatic monitoring stations are affiliated to either the AURN or the Scottish Air Quality Network. This includes five of the seven SO_2 analysers that are used for monitoring in relation to the Grangemouth AQMA. The data from the Abbotsford House and Bo'ness sites are available on request.

The Council sends through provisional SO_2 and met data to SEPA and INEOS when an SO_2 exceedance is recorded at any monitoring station. In addition, a monthly summary is sent, part of which is shown in Figure 6.1. The monthly email includes a summary of the data for each site that has recorded an exceedance, along with a full list of the exceedances.

Following a request from INEOS, the Council has asked AEA if the Scottish Air Quality Network email alert service can be extended to include 'moderate' concentrations (i.e. when a 15-minute exceedance occurs). The current set up only sends emails when the concentration is 'high'. This would compliment the existing text alert system.

Measure 2:
The Council organised working group meetings in May 2009 and February 2010 in relation to the Grangemouth AQMA. These meetings are attended by representatives from Falkirk Council, BMT Cordah, Forth Valley Health Board, INEOS, the Scottish Govt and SEPA.

At the February 2010 meeting the Council gave an overview of the monitoring data and network for 2009. INEOS gave an overview of the tail gas treatment work, a statement from INEOS about this work and their other SO_2 emissions reduction work is included in this update.

Measure 3:
The Council's text alert system has been implemented and is being maintained.

Measure 4:
The Abbotsford House monitor ceased operation on the 16th April 2010. This site has been relocated to Polmont. Although this location is outside of the AQMA, it is on a side of the AQMA (the south-eastern side) where no monitoring has previously been conducted and will generally give a better distribution of the Council's SO_2 monitors in relation to the AQMA.

The Grangemouth Moray site entered the AURN in June 2009 (NO_x analyser) and the Scottish AQ Network in January 2009 (SO_2 and PM_{10}).

Figure 6.1: Part of the monthly summary of data supplied to INEOS and SEPA.

Site	No. of exceedances of limit value.			Highest concentration, ug m^{-3}.			Data capture, %	Status
	15-min	Hourly	Daily	15-min	Hourly	Daily		
Grangemouth AURN (Inchyra)	31	1	0	614	410	122	88.7	Provisional
Moray	51	1	0	524	396	113	96.4	Provisional
Municipal Chambers	8	0	0	362	327	120	96.9	Provisional

Objectives		
Time period	Concentration, ug m^{-3}	Number exceedances allowed per year.
15-min	266	35
Hourly	350	24
Daily	125	3

Following the declaration of the AQMA the Council submitted a Further Assessment to the Scottish Govt. A Further Assessment is designed to identify the significant sources of emissions contributing to the exceedance in the AQMA and this report guided the production of the Action Plan.

An additional Further Assessment has now been completed and is to be submitted to the Scottish Govt in June 2010. This report is being done due to the change in the number of exceedances recorded in 2007, and in addition, the emissions data that is now available is more comprehensive. The executive summary of this report is reproduced below:

(Additional) Grangemouth Further Assessment Executive Summary:
"In November 2005, Falkirk Council declared an Air Quality Management Area (AQMA) in Grangemouth in recognition of the measured and predicted exceedences of the 15-minute mean SO2 air quality objective concentration. The AQMA covers a large part of Grangemouth including the docks, the petro-chemical plant, other industrial sites and most of the residential areas.

As part of its requirement in reviewing and addressing air quality issues Falkirk Council has undertaken a Further Assessment to look in detail at sources of SO2, measured SO2 concentrations and climatic conditions resulting measured exceedences of the SO2 objectives.

The study aimed in particular to identify contributions from each major SO2 source and climatic conditions that result in exceedences of the 15-minute mean objective limit. The study focuses on monitoring and emission data from 2007.

The major sources identified were Ineos, Longannet power station and BP. It was recognised that there are other emitters of SO2 within Grangemouth including shipping, rail traffic, other industrial operators and domestic and commercial properties. Emissions from these sources have been considered in previous assessments and therefore this report focuses on the emissions from the three largest sources in the area.

During 2007, there were a number of measured exceedences of the 15-minute SO2 objective at the monitoring sites within the Grangemouth AQMA. The number and location of these measured exceedences were, however, different from those measured in previous years.

- In order to understand the reason for the change in the measured concentrations and to help identify the source(s) causing the measured exceedences, detailed analysis of both monitoring and meteorological data was undertaken. The analysis determined that exceedences of the objective were measured under differing meteorological conditions but that the following tended to apply in 2007:

- The meteorological conditions during which exceedences are most likely to be measured are unstable conditions, for example on sunny days, with low wind speeds and no cloud cover. These conditions can result in emissions plumes grounding closer to the source than other meteorological conditions.

- Exceedences are most likely to be measured when the wind is blowing from a north-east to easterly direction.

- Exceedences at different monitoring stations can sometimes be attributed to the same pollution episode.

- Exceedences are sometimes measured when the wind is from a south-westerly direction.

Based on the analysis it was considered that the most likely emission source causing the measured exceedence would be Ineos. The wind direction analysis also, however, identified that exceedences were recorded when the wind was not from an easterly direction, indicating a source located towards the west of the monitoring locations or an upper air circulation where the wind direction at height differs from the wind direction at the monitoring station.

Potential sources could be smaller industrial operators, domestic emissions sources, railway emissions or transboundary sources. Previous modelling studies have ruled out these sources as insignificant. Another reason for exceedences being measured from a westerly direction could be localised changes in wind direction that are not picked up by the meteorological station. The main concern within the AQMA is exceedences of the 15-minute mean objective; however, the wind direction data is an hourly average. When considering short-term air quality objectives, short term changes in wind direction could be significant but will not be identifiable from a longer term averaging period.

The modelling study appeared to under-predict the number of exceedences at both Grangemouth MC and Moray automatic monitoring sites while over predicting at Inchyra. The various sources on the Ineos site, and emissions from Longannet, were modelled as individual groups to identify which source or sources may be responsible for the measured exceedences. The modelling study indicated that, while some exceedences were predicted, no individual group or group of sources, was likely to be responsible for causing an exceedence of the objective (i.e. greater than 35 exceedences) on their own. When all sources from the Ineos site were modelled as one group, the results indicated that the objective could be exceeded at numerous locations.

The conclusions from the modelling study therefore indicate that it is the combined impact of all sources on the Ineos site that is the most likely cause of the measured exceedences. The study also identified that, under certain meteorological conditions, the added contribution of emissions from Longannet, can contribute to total SO2 emissions within the AQMA.

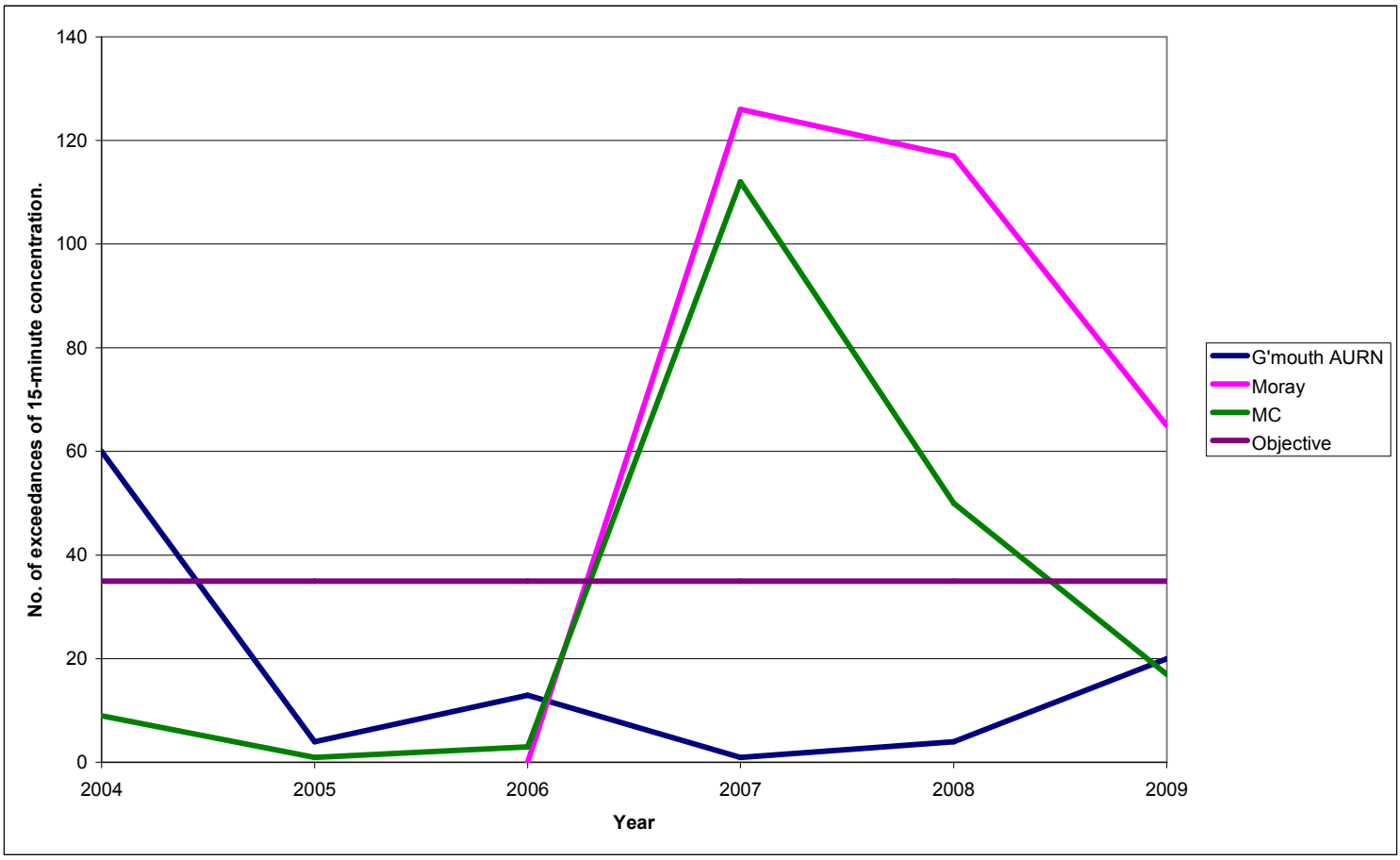
Falkirk Council has regular liaison with SEPA and Ineos during pollution events and through the text alert system that allows SEPA and Ineos' shift manager to investigate any pollution episode occurrence as it happens and subsequent emailing of both monitoring and meteorological data measured during the event. During the majority of the pollution episodes, Ineos was operating normally. The modelling study indicates that the major contributors to elevated levels of SO2 in the area from Ineos are likely to be the Sulphur Recovery Units (SRUs). However, as an isolated group, the only exceedence due to the SRUs occurs at a very small area on the site.

Considering the meteorological analysis, the modelling study, and the fact that Ineos are frequently operating normally during pollution episodes, it would appear likely that the main cause of the 15-minute mean exceedences is the combined effect of all sources within Ineos.

Overall, the investigation into particular measured exceedences, and the dispersion modelling study, indicates that the area should remain designated as an AQMA. In addition, the dispersion modelling contour plots show the extent of predicted exceedences of the 15-minute SO2 air quality objective. Considering the extent of the predicted exceedences, it is concluded that the current boundary of the AQMA is appropriate and does not need adjustment."

(Reference 7)

Figure 6.2: The number of 15-minute exceedances recorded at the sites in the Grangemouth AQMA between 2004 and 2009.



Note: Grangemouth Moray commenced operation in September 2006.

As discussed in previous reports a significant increase in the number of exceedances was recorded at the Grangemouth Municipal Chambers site between 2006 and 2007. The Grangemouth Moray site also experienced a significant increase, however, this monitor only commenced operation in September 2006. In 2009 the number of exceedances increased slightly at the Grangemouth AURN site, particularly towards the end of the year, with the MC and Moray sites seeing a decrease.

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.

This is where the percentile and pollution roses that are discussed in the Additional Further Assessment come in useful as they are able to show both average and peak concentrations filtered according to wind direction. The Council has taken this further by plotting polar roses which use the wind direction and speed data in more detail and are shown in the Further Assessment. This means that the monitoring data can be selected for particular wind directions and/or speeds and may provide additional evidence to help identify emission sources.

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. [8]

INEOS have supplied a statement to the Council for this Action Plan update. The statement is in relation to their work on reducing their SO_2 emissions and is shown in Figure 6.3.

Figure 6.3: A statement from INEOS Manufacturing Scotland Ltd in relation to their work to reduce SO_2 emissions.

"INEOS Manufacturing Scotland Ltd (IMSL) is fully committed to working with Falkirk Council to improve the air quality within the Air Quality Management Area (AQMA). As the largest industrial site in Central Scotland we have a duty to minimise our impact on the environment via constantly focusing on improvements to our operations and by the application of the products we make. We have invested hundreds of millions of pounds over the last five years in an ongoing programme that continues to deliver environmental improvements.

IMSL has completed extensive analysis and modelling of the sulphur dioxide (SO2) emissions from its Grangemouth site, and has developed an improvement plan for the reduction of these emissions. IMSL's atmospheric emissions are regulated by the Scottish Environment Protection Agency through the 'Pollution Prevention and Control (Scotland) Regulations' Permit for the Grangemouth site. This Permit reflects the IMSL SO2 improvement plan, several elements of which have already been completed and have resulted in reduced SO2 emissions from the site.

IMSL has identified that installation of a Tail Gas Unit (TGU) for the two Sulphur Recovery Units (SRUs) within the Refinery will further reduce the SO2 emissions from the site and provide an improvement within the Grangemouth SO2 AQMA. IMSL has therefore commenced a Project to install and commission a TGU. The project represents a very significant capital investment for IMSL, and the Project is currently scheduled for completion in 2013. The TGU will improve the overall sulphur recovery efficiency from 98% to greater than 99.5% across the combined SRU and TGU processes, significantly reducing the SO2 emissions to atmosphere from the SRUs." [9]

7 Conclusions and Proposed Actions

7.1 Conclusions from New Monitoring Data

The Council has examined the monitoring results for its area and concludes that no additional Detailed Assessments are required at this time.

As in previous years a breach of the 15-minute SO_2 objective was recorded in 2009 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 hourly and daily objectives were met at all sites.

A breach of the 2010 annual PM_{10} objective was recorded at the Falkirk West Bridge St site in 2009. This site is within the Falkirk Town Centre AQMA for NO_2, however, the Further Assessment will include PM_{10}. Therefore the Council will wait for this report to be completed before considering whether to adjust the current AQMA.

Data from Banknock 1 indicates that the 18 $\mu g/m^3$ annual objective was met in 2009. The 98th percentile was greater than 50 $\mu g/m^3$, this indicates a potential breach of the daily objective. However, as this is only based on just over two months of data, a Detailed Assessment is being submitted later in 2010 which will be based on a year's worth of data.

All tubes recording breaches of the NO_2 annual objective do not need to be considered further as they are within Further Assessment areas or are not representative of relevant receptors.

The other diffusion tubes continue to show that the benzene and 1,3 butadiene objectives were met in 2009 at locations where there are relevant receptors.

7.2 Conclusions relating to New Local Developments

Falkirk Council has identified the following new or previously unidentified local developments which may impact on air quality Council area.

A review of the traffic flow data for roads in the Council area has shown that there have been some increases in traffic flow but there is no need to proceed to a Detailed Assessment.

A change to Bo'ness steam railway route does not need to be considered further and emissions are likely to reduce with the Glasgow to Edinburgh line being electrified.

New PPC permits in the Council area are:
- PPC/B/1000119, Dem-master Demolition Ltd, mobile plant,
- PPC/B/1018533, Unit 5, Castle Crescent, D Cram Body Repairs Ltd,
- PPC/B/1005087, Northfield Quarry, Denny, Falkirk, Tillicoultry Quarries Ltd.

7.3 Other Conclusions

The Council has provided an update on the Action Plan in relation to the Grangemouth AQMA. This shows that a breach of the 15-minute air quality objective continues to be recorded in the AQMA. The update also included a statement from INEOS on their tail gas treatment unit and other SO_2 emission reduction work.

7.4 Proposed Actions

The Council will continue its work in relation to the Grangemouth AQMA as per the Action Plan.

The Council will submit a Detailed Assessment for PM_{10} around the Banknock area towards the end of 2010 after a year's monitoring has been completed.

The Council will submit Further Assessments for the Falkirk Town Centre and Banknock and Haggs AQMAs, which were declared in March 2010.

No new Detailed Assessments are required, any identified breaches of the air quality objectives are covered by the above Detailed Assessments, Further Assessments or AQMAs or are not at relevant receptors.

The Council will submit a Progress Report in 2011.

8 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. Air Quality Archive news item, www.airquality.co.uk/news.php?news_id=133
3. Personal communication, Forth Ports.
4. Scottish Railway Preservation Society: www.srps.org.uk
5. Transport Scotland: http://transportscotland.gov.uk/news/EGIP-first-milestone-rail-scheme-underway
6. Personal communications, Forth Valley College and the Scottish Biomass Heat Support Scheme.
7. Grangemouth AQMA – Further Assessment, G_FAL_028_Final , June 2010, BMT Cordah.
8. SEPA's National air quality report 2008: http://www.sepa.org.uk/air/air_publications.aspx
9. Personal communication, INEOS, May 2010.
10. Personal communication, Review and Assessment Helpdesk, October 2009.
11. Air Quality Archive, http://www.airquality.co.uk/kb.php?action=showpost&question_id=1385
12. Personal communication, Environmental Research Group, King's College London, November 2009.

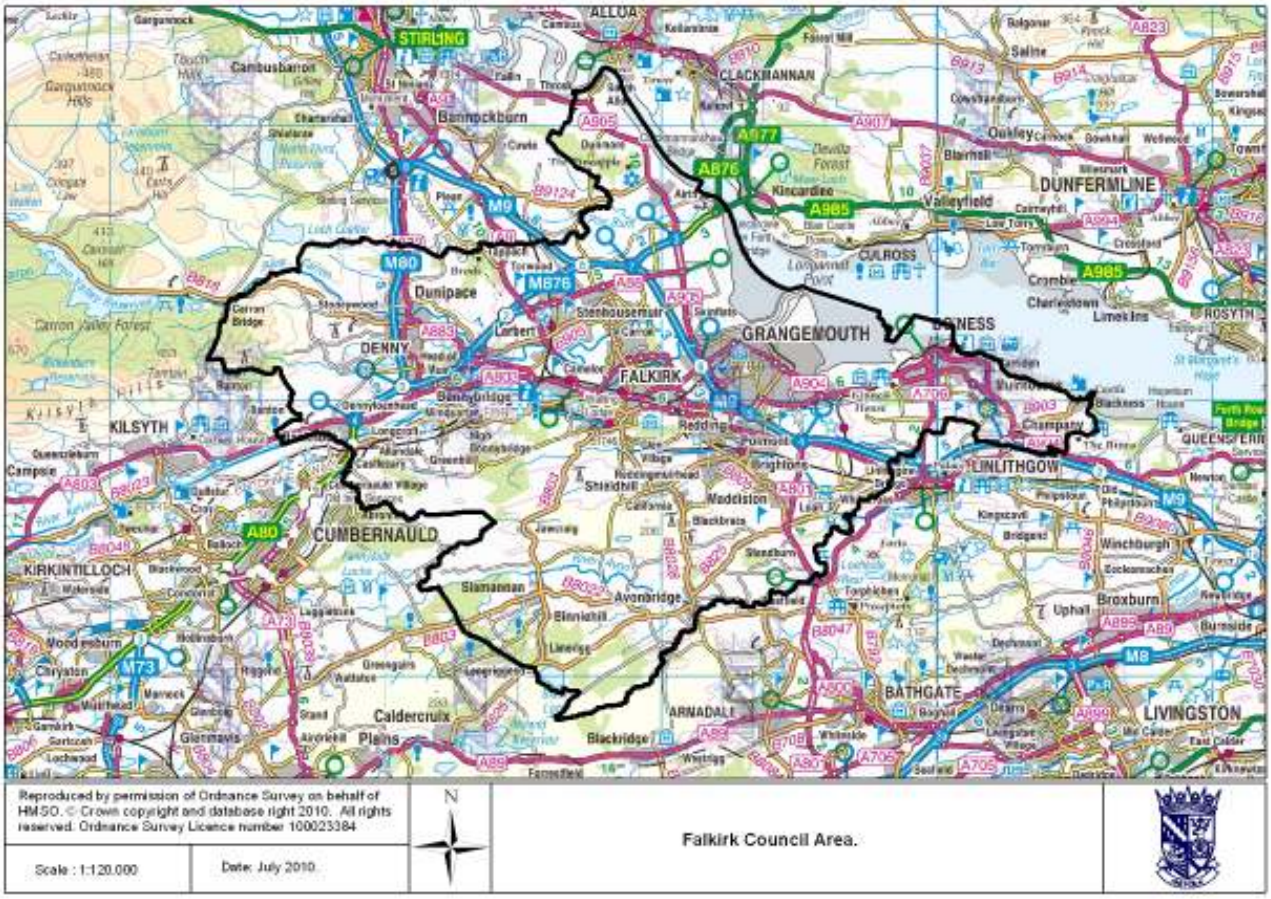
Appendices

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 Falkirk Council Area.



2009 Automatic Monitoring Locations

The location of the Falkirk Haggs monitor is shown in Figure 2.2 with the diffusion tubes close by. The location of the Banknock 1 site is shown in Figure 2.1. The other sites are shown in Figures A2 a to d.

Figure A2a: The location of the Abbotsford House site.

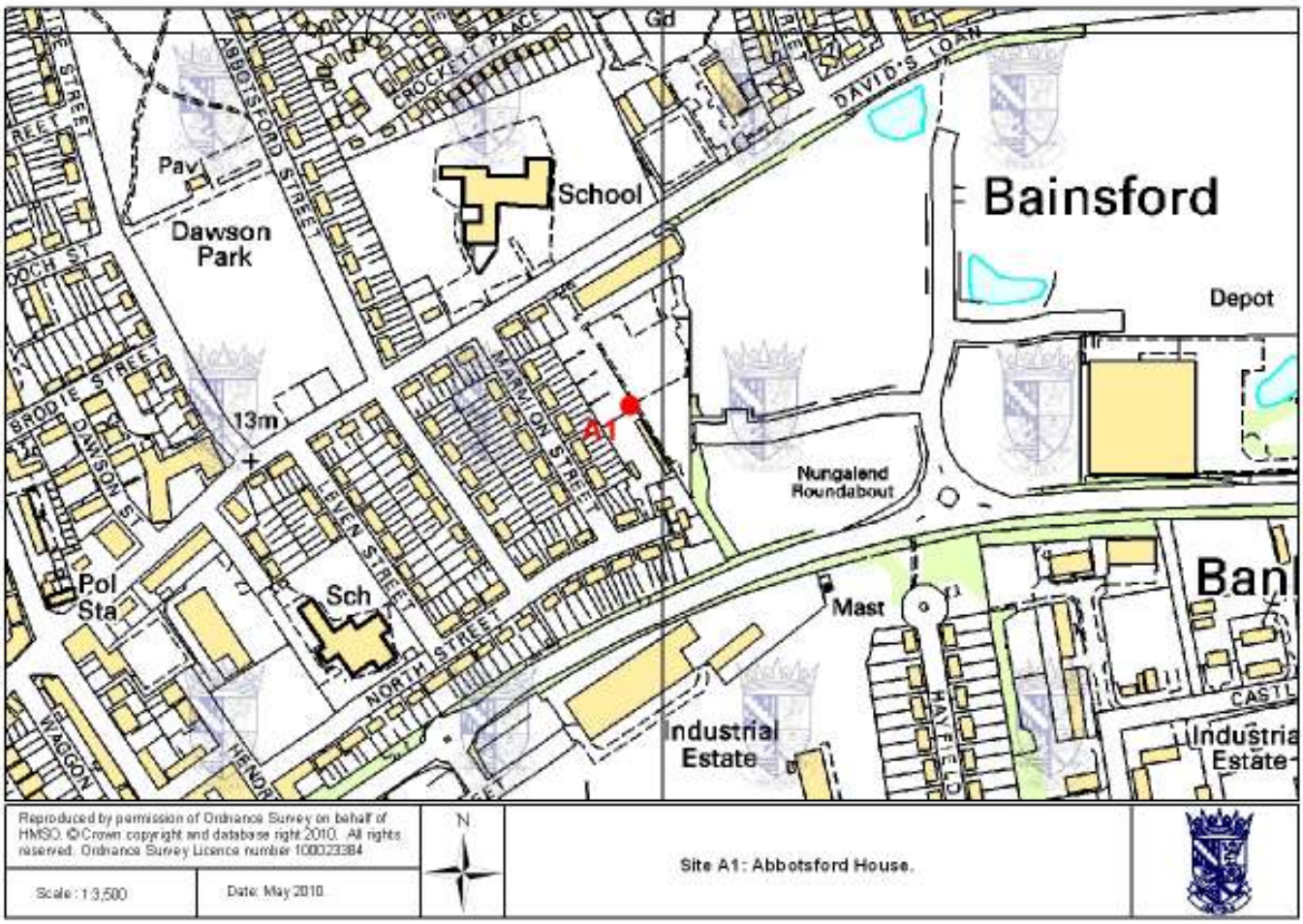


Figure A2b: The location of the Bo'ness site.

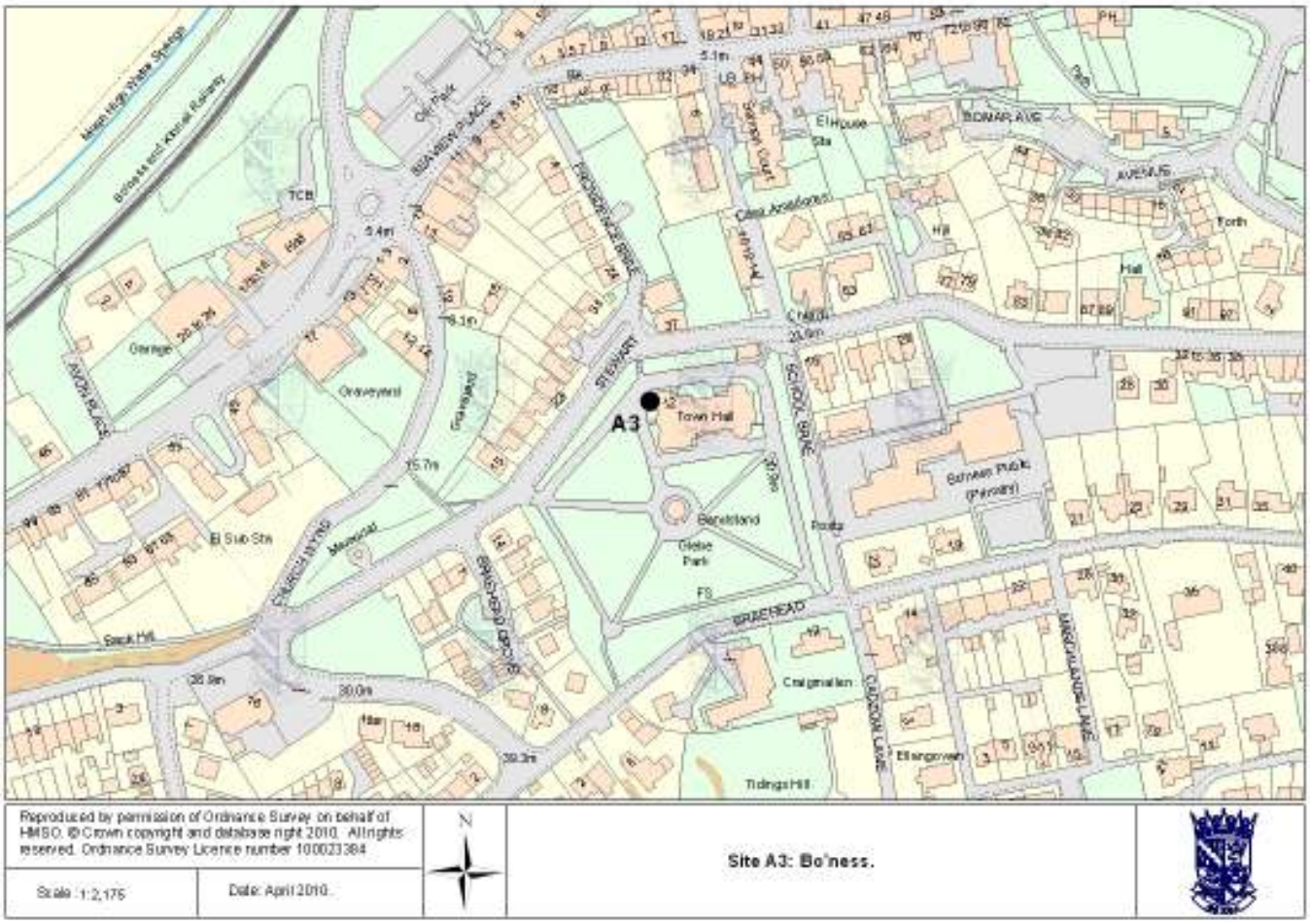


Figure A2c: The locations of the Falkirk Hope St, Park St and West Bridge St sites.

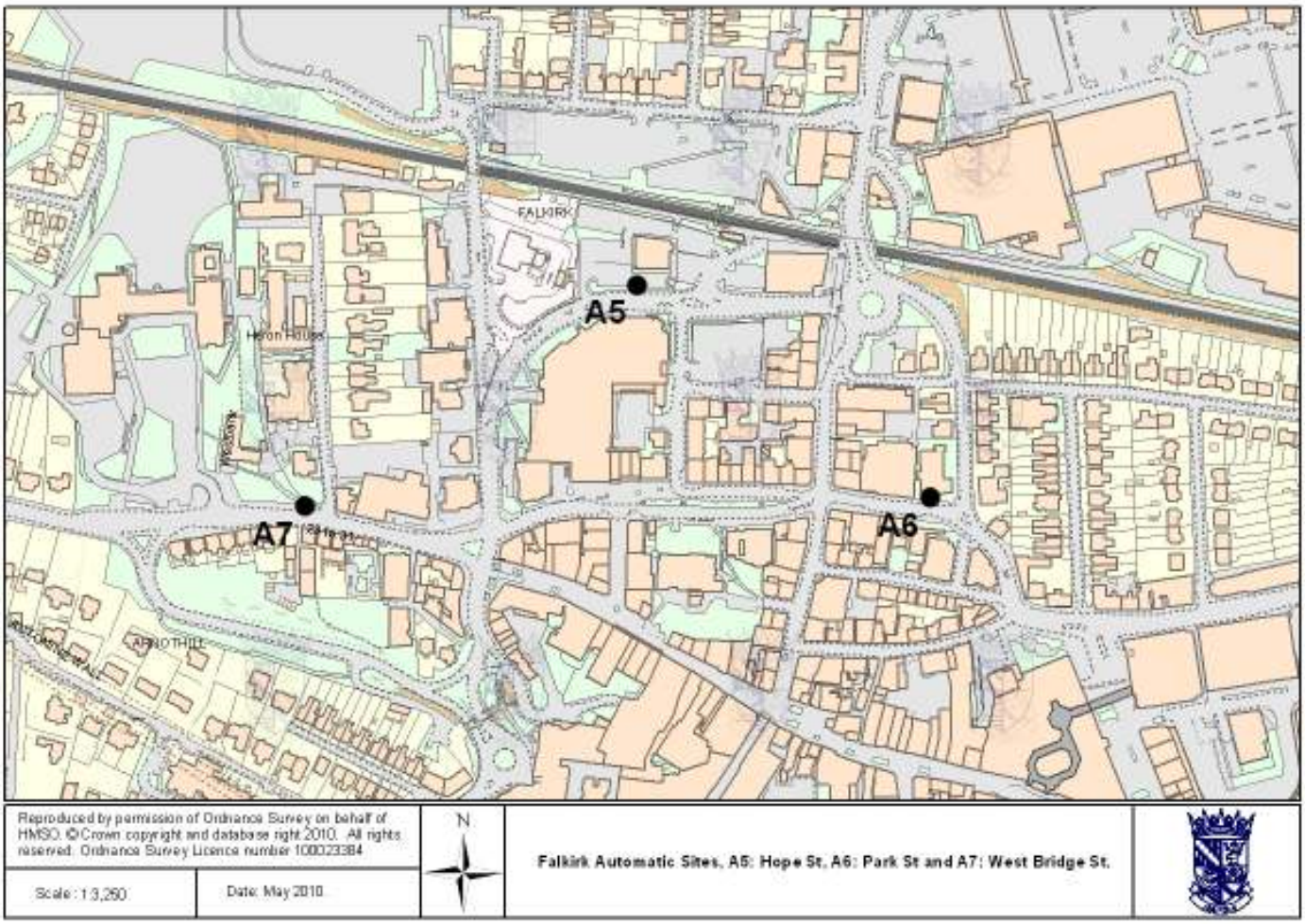
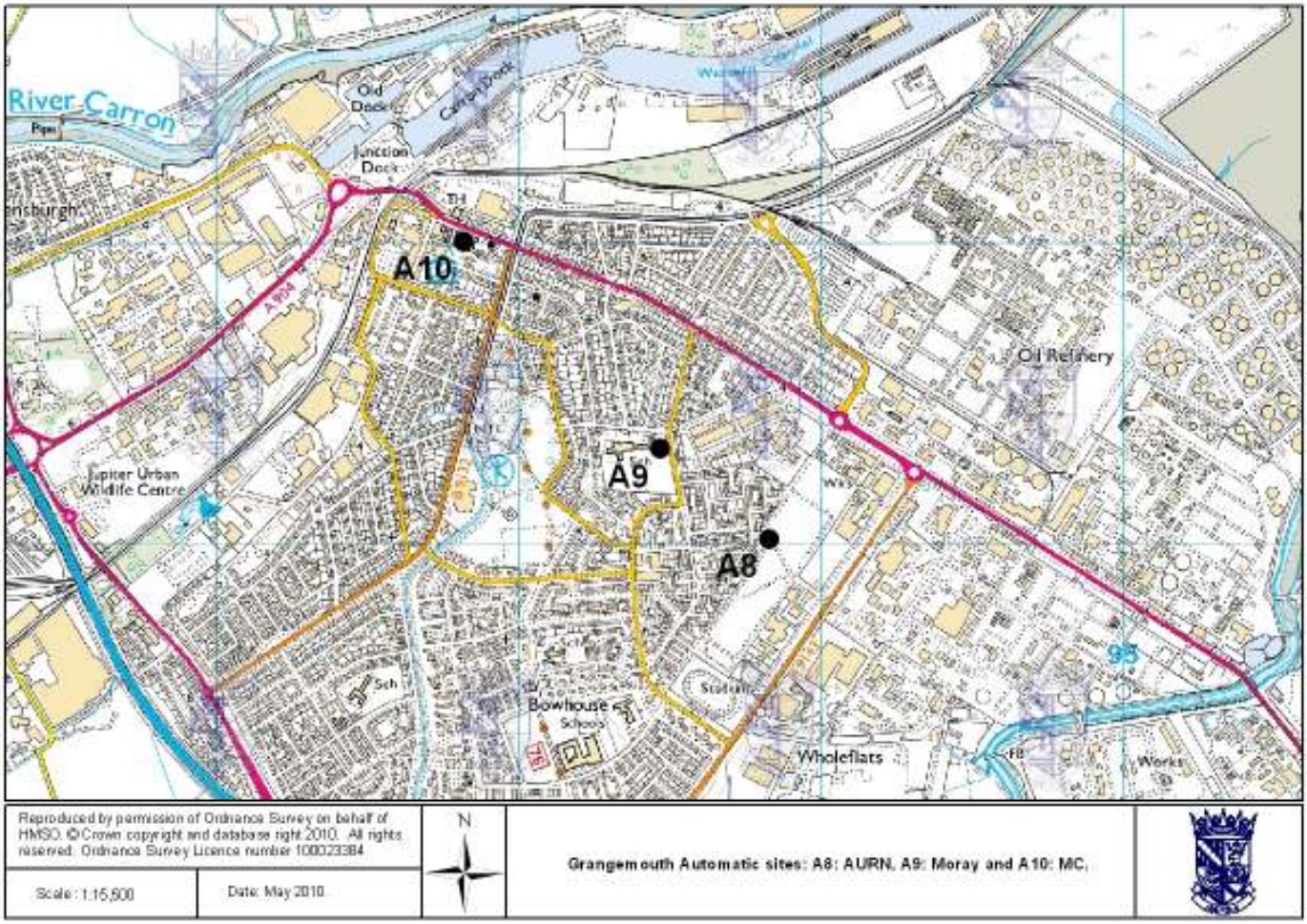


Figure A2d: The locations of the Grangemouth AURN, Moray and Municipal Chambers sites.



Appendix 2: QA/QC Data

Diffusion Tube Bias Adjustment Factors

The nitrogen dioxide, benzene and 1,3 butadiene tubes used by Falkirk Council are supplied and analysed by Harwell Scientifics. 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.

The 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 at the Falkirk Park St (NA70 / A7), a roadside site, spreadsheets showing calculations are shown in Figure A3. The automatic monitoring data used for the two sites was provisional for the second half of the year.

The bias factor for the Grangemouth MC site was 0.83 and the Falkirk Park St site was 0.69.

The bias adjustment factor from the R&A Helpdesk database for 2009 is 0.81, the two local studies carried out by Falkirk Council contributed to this factor.

Figure A3: NO_2 Bias Adjustment Factors for Grangemouth MC (A10) and Falkirk Park St (A6).

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	06/01/2009	04/02/2009	41.1	39.9	40.2	40	0.6	2	1.6
2	04/02/2009	04/03/2009	36.0	33.8	36.1	35	1.1	3	2.7
3	04/03/2009	01/04/2009	29.9	32.8	33.5	32	1.9	6	4.7
4	01/04/2009	29/04/2009	25.6	24.2	24.3	25	0.8	3	1.9
5	29/04/2009	03/06/2009	16.9	16.0	15.9	16	0.6	3	1.4
6	03/06/2009	01/07/2009	20.9	16.7	17.5	18	2.2	12	5.5
7	01/07/2009	29/07/2009	16.4	14.5	17.5	16	1.5	9	3.8
8	29/07/2009	02/09/2009	14.7	10.2	14.4	13	2.5	19	6.2
9	02/09/2009	30/09/2009	20.0	15.7	17.9	18	2.2	12	5.3
10	30/09/2009	04/11/2009	31.1	28.5	31.6	30	1.7	6	4.1
11	04/11/2009	02/12/2009	32.4	32.3	34.4	33	1.2	4	2.9
12	02/12/2009	12/01/2010	49.8	50.1	49.8	50	0.2	0	0.4
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
32.78098	99.71264368	Good	Good
30.5878	100	Good	Good
23.44843	99.55367143	Good	Good
19.11905	100	Good	Good
13	99.88095238	Good	Good
14	99.85119048	Good	Good
14	99.10714286	Good	Good
12	100	Good	Good
17	96.13095238	Good	Good
24	99.88095238	Good	Good
25.70968	99.4047619	Good	Good
44.68879	99.3902439	Good	Good
Overall survey -->		Good precision	Good Overall DC

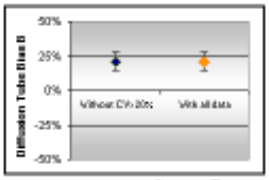
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Grangemouth MC

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	0.83 (0.79 - 0.87)
Bias B	21% (14% - 27%)
Diffusion Tubes Mean:	27 µgm^{-3}
Mean CV (Precision):	7
Automatic Mean:	23 µgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	23 (22 - 24) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.83 (0.79 - 0.87)
Bias B	21% (14% - 27%)
Diffusion Tubes Mean:	27 µgm^{-3}
Mean CV (Precision):	7
Automatic Mean:	23 µgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	23 (22 - 24) µgm^{-3}



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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	07/01/2009	04/02/2009	51.4	50.5	51.5	51	0.6	1	1.4
2	04/02/2009	04/03/2009	52.7	52.4	48.3	51	2.5	5	6.1
3	04/03/2009	01/04/2009	48.1	52.0	51.7	51	2.2	4	5.4
4	01/04/2009	29/04/2009	39.2	34.5	35.6	36	2.5	7	6.1
5	29/04/2009	03/06/2009	24.8	29.1	29.8	28	2.7	10	6.7
6	03/06/2009	01/07/2009	25.2	26.8	18.6	24	4.3	18	10.8
7	01/07/2009	29/07/2009	30.1	26.4	30.3	29	2.2	8	5.5
8	29/07/2009	02/09/2009	22.1	23.2	25.7	24	1.8	8	4.6
9	02/09/2009	30/09/2009	30.8	24.2	34.6	30	5.3	18	13.1
10	30/09/2009	04/11/2009	40.0	38.4	43.8	41	2.8	7	6.9
11	04/11/2009	02/12/2009	41.4	38.2	42.5	41	2.2	5	5.5
12	02/12/2009	12/01/2010	57.6	61.8	61.1	60	2.3	4	5.6
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
29.29464	100	Good	Good
34.00746	99.70238095	Good	Good
28.64521	99.4047619	Good	Good
27.99861	99.70238095	Good	Good
22	99.76190476	Good	Good
21	99.70238095	Good	Good
20	99.55357143	Good	Good
16	99.76190476	Good	Good
21	96.57738095	Good	Good
28	100	Good	Good
27.77395	99.4047619	Good	Good
46.77282	95.73170732	Good	Good
Overall survey -->		Good precision	Good Overall DC

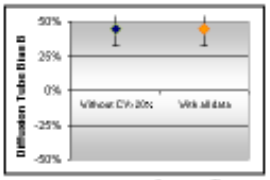
(Check average CV & DC from Accuracy calculations)

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 0.69 (0.64 - 0.75)
Bias B 45% (33% - 56%)
Diffusion Tubes Mean: 39 µgm^{-3}
Mean CV (Precision): 8
Automatic Mean: 27 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 27 (25 - 29) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.69 (0.64 - 0.75)
Bias B 45% (33% - 56%)
Diffusion Tubes Mean: 39 µgm^{-3}
Mean CV (Precision): 8
Automatic Mean: 27 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 27 (25 - 29) µgm^{-3}



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Version 03 - November 2006

Discussion of Choice of Factor to Use

The diffusion tubes precision check and automatic data capture were good for both local sites during all of 2009.

The R&A Helpdesk factor lies between the local factors recorded by the two Council sites. It is a close decision as to whether to use the Park St or R&A factor. In the 2009 USA the Falkirk Park St factor was used. As one factor needs to reflect a variety of sites from rural to roadside, therefore it was felt the R&A factor would provide more of a precautionary approach on this occasion for this Progress Report. However, it should be noted that using this factor means that the concentrations shown in this report are likely to be an over-estimate for the roadside sites and a slight under-estimate for the background sites.

PM Monitoring Adjustment

All TEOM data from the Scottish Air Quality Network sites presented in this report has been adjusted using the King's College Volatile Correction Method (VCM). This has been carried out by AEA as part of the Scottish Government's contract for the SAQN.

The exception to this is the Grangemouth AURN site, where the TEOM was operational until April 2009, with the FDMS-TEOM starting operation on the 29th April 2009. It is understood that Defra have contracted KCL to correct the AURN TEOM data for 2009. This work had not been completed at the time of writing, so the Council tried to do its own correction. However, the data capture was very low for the other AURN FDMS sites in central Scotland in early 2009. Thus the 1.3 correction

factor has been used for data upto the 29th April 2009. FDMS data does not require any adjustment.

At the time of writing there was no access to the hourly VCM corrected data for the SAQN sites; therefore certain statistics (eg. 98th percentile) are not available. It is also likely the annualised result for Falkirk West Bridge St will change once the hourly data for other FDMS sites in Scotland is available as data capture is likely to be higher.

The Banknock 1 Osiris data has had an adjustment factor of 1.3 applied, as recommended by the Government Helpdesks [10 and 11]. The Osiris output is a 15-minute average, these have been converted to an hourly and daily average using the Environment Agency macro toolbox (v2). It was confirmed with King's College that the VCM could not be applied to Osiris data. [12]

Short-term to Long-term Data adjustment

Short term to long term data adjustments were carried out for the Banknock 1 Osiris monitor, Falkirk West Bridge St (PM_{10}) monitor and for eight diffusion tubes. Note the PM_{10} corrections are likely to change once hourly data from the FDMS sites in the Scottish AQ network is available. Background AURN sites have been used for the corrections.

Table A1: Short to Long term data adjustments.

Falkirk West Bridge St (PM_{10}), 16/09/2009 to 31/12/2009.

Site	Site Type	Annual Mean	Period Mean	Ratio
Grangemouth AURN (FDMS)	Urban background	12.9	12.8	1.008
Edinburgh St. Leonards (FDMS)*	Urban background / Industrial	16.8	12.5	1.344
			Average	1.176

Note: Low period data capture of 35% at Edinburgh St. Leonards and annual data capture of 63%.

Banknock 1 (PM_{10}), 21/10/09 to 31/12/09.

Site	Site Type	Annual Mean	Period Mean	Ratio
Grangemouth AURN (FDMS from 29/04/10)	Urban background / industrial.	12.9	13.0	0.992
Edinburgh St. Leonards (FDMS)	Urban background.	16.8	12.5	1.344
			Average	1.168

Note: Low period data capture of 51% at Edinburgh St. Leonards and annual data capture of 63%.

Diffusion tubes:
NO_2, site 18, 07/01/2009 to 29/04/2009.

Site	Site Type	Annual Mean	Period Mean	Ratio
Grangemouth AURN	Urban background.	17.7	19.6	0.903
Grangemouth Moray	Urban background / Industrial	19.3	20.5	0.941
Edinburgh St. Leonards	Urban background	24.5	28.1	0.872
			Average	0.905

NO_2, site 87, 13/06/2009 to 13/01/2010.

Site	Site Type	Annual Mean	Period Mean	Ratio
Grangemouth AURN	Urban background.	17.7	18.2	0.972
Grangemouth Moray	Urban background / Industrial	19.3	21.1	0.913
Edinburgh St. Leonards	Urban background	24.5	25.1	0.975
			Average	0.953

NO_2, sites 88 to 94, 02/09/2009 to 13/01/2010.

Site	Site Type	Annual Mean	Period Mean	Ratio
Grangemouth AURN	Urban background.	17.7	23.1	0.767
Grangemouth Moray	Urban background / Industrial	19.3	27.3	0.707
Edinburgh St. Leonards	Urban background	24.5	31.3	0.782
			Average	0.752

QA/QC of automatic monitoring

Table A2 shows the status of QA/QC in the Council's air quality network in 2009. A description of the procedures for each network then follows.

Table A2: QA/QC applied to automatic monitoring data in 2009.

QA / QC for 2009.		
Site	Analyser	Network
A1.) Abbotsford House	SO_2	Local *
A2.) Banknock 1	PM10 (Osiris)	Local #
A3.) Bo'ness	SO_2	Local *
A4.) Falkirk Haggs	NO_x	Scottish AQ Network
A5.) Falkirk Hope St	NO_x	Scottish AQ Network
	PM_{10} (TEOM)	Scottish AQ Network
	SO_2	Scottish AQ Network
A6.) Falkirk Park St	NO_x	Scottish AQ Network
	PM_{10} (TEOM)	Scottish AQ Network
	SO_2	Scottish AQ Network
A7.) Falkirk West Bridge St	NO_x	Scottish AQ Network
	PM_{10} (TEOM)	Scottish AQ Network
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	To 31/05/2009: Local*. From 01/06/2009: AURN.
	PM_{10} (TEOM)	Scottish AQ Network
	SO_2	Scottish AQ Network
A10.) Grangemouth Municipal Chambers	NO_x	Scottish AQ Network
	PM_{10} (TEOM)	Scottish AQ Network
	SO_2	Scottish AQ Network

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 Council staff that 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. Span adjustments are based on the concentration that is stated on the gas cylinders. No independent check is made of these concentrations.

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 has been dependent on the weather and the filter loading for the Banknock 1 site. The filters are retained for analysis.
- All LSO site visits are carried out by Council staff.
- The Osiris is serviced on an annual basis.
- A 1.3 correction factor has been applied to the PM_{10} data. It was confirmed with King's College London that the VCM could not be applied to Osiris data.

AURN and Scottish AQ Network sites:

- All NO_x and SO_2 analysers receive fortnightly zero and span checks and filter changes.
- TEOM heads are cleaned and the filter changed on a four weekly basis or more frequently if the filter loading goes above 90%.
- TEOM-FDMS heads are cleaned and filters changed as directed by CMCU of the AURN (i.e. at 90% loading).
- All LSO site visits are carried out by Council staff that are audited to AURN standard.
- Are covered by a contract for emergency callout.
- Receive a service every six months.
- QA/QC is to AURN standards, see: http://www.airquality.co.uk/verification_and_ratification.php http://www.scottishairquality.co.uk/verification_and_ratification.php for details.
- The Council also checks the data on its systems and is in constant communication with AEA to ensure the best data quality. Unscaled data is supplied to AEA for the Scottish AQ Network sites on a six monthly basis. This usually improves data capture significantly.
- For the time that a monitor is affiliated to the AURN or SAQN, data has been downloaded from either the Air Quality Archive or the Scottish Air Quality Network.

QA/QC of diffusion tube monitoring

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

Harwell Scientifics are rated in the 'good' category for the WASP (Workplace Analysis Scheme for Proficiency) scheme. Harwell follow their internal standard operating procedure, this meets the guidelines set out in Defra's 'Diffusion Tubes For Ambient NO_2 Monitoring: Practical Guidance.' Harwell Scientifics recorded 'good' precision throughout 2008 and 2009 bar one result (see Figure A4).

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

Table A3: Monthly diffusion tubes results in full.

Benzene results 2009

Site number	Location	Grid Ref, x	Grid Ref, y	January ppb	February ppb	March ppb	April ppb	May ppb	June ppb	July ppb	August ppb	September ppb	October ppb	November ppb	December ppb	Annual average ppb	Annual average ug m-3	Annual data capture, %
18	A80 North Bound C/way, Banknock	278924	679513	0.27	0.3	0.3	0.1	-	-	-	-	-	-	-	-	0.24	0.79	33.3
21	Grangemouth Road, College	290112	680500	0.31	0.69	0.1	0.38	0.31	0.48	0.55	0.18	0.14	0.12	0.64	0.4	0.36	1.16	100.0
24	Kerse Lane, Falkirk	289187	680024	0.21	0.62	0.51	0.23	0.18	0.27	0.12	0.11	0.12	0.23	0.85	0.39	0.32	1.04	100.0
27	West Bridge Street, Falkirk	288490	680055	0.33	0.44	0.72	4.5	0.32	0.34	1	0.23	0.16	0.08	0.71	0.7	0.79	2.58	100.0
37	Denny Town House	281226	682526	0.35	0.54	0.34	2.4	0.14	0.28	0.15	0.18	0.2	0.24	0.42	0.48	0.48	1.55	100.0
38	Larbert Village Primary School	285960	682400	0.15	0.71	0.37	0.3	0.23	0.2	2.4	0.08	0.13	0.18	0.1	0.35	0.43	1.41	100.0
41	Seaview Place, Bo'ness	299722	681594	0.34	0.71	0.61	0.44	0.3	0.32	0.13	0.23	0.17	0.24	0.1	0.59	0.35	1.13	100.0
42	Municipal Chambers, Grangemouth	292871	682000	0.38	0.35	0.33	0.36	0.24	0.32	0.18	0.2	0.11	0.3	0.1	3	0.49	1.59	100.0
44	Greenpark Drive, Polmont	293436	678938	0.3	0.51	0.47	5.8	0.18	0.24	0.1	0.1	0.1	0.16	0.41	0.38	0.73	2.37	100.0
46	West Bridge Street traffic lights, Falkirk	288543	680045	0.25	0.4	0.54	3.6	0.26	0.38	0.21	0.21	0.1	0.4	0.48	0.4	0.60	1.96	100.0
49	Lennox Terrace, Grangemouth	293600	680250	0.25	0.36	0.34	0.38	0.29	0.47	0.1	0.17	0.1	0.23	0.37	0.44	0.29	0.95	100.0
55	Inchyra Station	293829	681023	0.42	0.6	0.1	0.21	0.43	0.4	0.11	0.21	0.11	0.47	0.47	0.55	0.34	1.11	100.0
56	Albert Ave, Grangemouth	293880	682000	0.4	0.69	0.46	0.56	0.31	0.74	1.3	0.08	0.1	0.53	0.35	1.9	0.62	2.01	100.0
57	Inchyra Road, Grangemouth	294028	680829	0.35	0.49	0.47	0.1	0.39	0.6	0.1	0.22	0.1	0.13	0.43	0.77	0.35	1.12	100.0
66	Holehouse, Slamannen	289450	672035	0.22	0.38	0.23	0.1	0.14	0.17	0.16	0.08	0.1	0.13	0.27	0.11	0.17	0.57	100.0
74	Hope St AQ station	288678	680218	0.33	0.39	0.1	0.37	0.22	0.1	0.21	0.23	0.16	0.08	0.42	0.62	0.30	0.97	100.0
				0.28	0.71	0.56	0.38	0.23	0.36	0.18	0.18	0.1	0.33	0.67	0.73			100.0
75	Rae St, Stenhousemuir	286793	683114	0.25	0.25	0.1	3.6	0.11	0.39	0.1	0.08	0.1	0.11	0.38	0.58	0.50	1.64	100.0
77	Kinnaird Village	286490	683775	0.21	0.36	0.29	0.29	0.19	0.2	0.1	0.16	0.1	0.21	0.38	0.28	0.23	0.75	100.0
80	Cow Wynd	288765	679456	0.27	0.45	0.1	0.3	0.22	0.1	0.19	0.23	0.1	0.23	0.48	0.48	0.26	0.85	100.0
81	Grahams Road, Falkirk	288834	680898	0.32	0.59	0.49	5.1	0.31	0.1	0.2	0.26	0.23	0.31	0.1	0.57	0.72	2.32	100.0
87	M80 slip south, Haggs	279017	679305	-	-	-	-	0.17	0.1	0.14	0.19	0.1	0.099	0.43	0.29	0.19	0.62	66.7

1,3 butadiene results 2009

Site No	Location	Grid Ref	January ppb	February ppb	March ppb	April ppb	May ppb	June ppb	July ppb	August ppb	September ppb	October ppb	November ppb	December ppb	Average ppb	Average ug m-3	Annual data capture, %
18	A80 North Bound C/way, Banknock	278924/679513	0.19	0.19	0.19	0.19	-	-	-	-	-	-	-	-	0.19	0.43	33.3
27	West Bridge Street, Falkirk	288490/680055	0.19	0.19	0.19	0.19	0.15	0.19	0.19	0.17	0.19	0.15	0.19	0.13	0.18	0.40	100.0
46	West Bridge Street traffic lights, Falkirk	288543/680045	0.19	0.19	0.19	0.19	0.15	0.19	0.19	-	-	-	-	-	0.18	0.41	58.3
49	Lennox Terrace, Grangemouth	293600/680250	0.19	0.19	0.19	0.19	0.15	0.19	0.19	0.17	0.19	0.15	0.19	0.13	0.18	0.40	100.0
55	Inchyra Station, Grangemouth	293829/681023	0.19	0.19	0.19	0.19	0.15	0.19	0.19	0.17	0.19	0.15	0.19	0.13	0.18	0.40	100.0
56	Albert Avenue, Grangemouth	293859/681962	0.19	0.19	0.19	0.19	0.15	0.19	0.19	0.17	0.19	0.15	0.19	0.13	0.18	0.40	100.0
57	Inchyra Road, Grangemouth	294028/680829	0.19	0.19	0.19	0.19	0.15	0.19	0.19	0.17	0.19	0.15	0.19	0.13	0.18	0.40	100.0
87	M80 slip south, Haggs	279017/679305	-	-	-	-	0.15	0.19	0.19	0.17	0.19	0.15	0.19	0.13	0.17	0.38	66.7

2009 NO_2 monthly results, µg/m^3

																0.81	0.69	12
Site No	Location	Grid ref, x	Grid ref, y	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Average	R&A bias 2009 (Mar 2010)	Park st bias 2009	Data capture, %
3	Tinto Drive,Grangemouth	293427	680386	39.7	28	35.4	29.4	16.8	22.5	18.2	14.9	19.8	30.5	36.1	20.9	**26**	**21**	**18**	100.0
4	Cromwell Road, Falkirk	289600	679840	-	-	-	-	-	-	-	-	-	-	-	-				0
5	Copper Top Pub, Camelon	287332	680333	55.9	34	46.4	40.7	32.2	29.7	27.4	27.9	24.1	27.2	50	65.5	**38**	**31**	**27**	100.0
7	Irving Parish Church, Camelon	287324	680442	39.2	31.9	30	26	19	20.2	12.4	16.1	18.9	24.4	32.3	48.4	**27**	**22**	**18**	100.0
9	Bellsdyke Road, Larbert	286048	683542	51.3	52.7	42.8	35.3	22.4	20.1	-	19.2	21.2	37.6	43.4	50.5	**36**	**29**	**25**	91.7
10	Muirhall Road, Larbert	286025	683435	48.3	35.7	31	31.2	-	19.1	18.3	17.7	20.4	32.1	38.8	53.9	**32**	**26**	**22**	91.7
13	Graeme High School	290197	679622	40.1	50.3	42.6	43.1	29.5	26.1	25.1	28.3	-	44.6	55.4	70.2	**41**	**34**	**29**	91.7
18	A80 North Bound C/way, Banknock	278924	679513	233.5	173.8	105.7	193.1	-	-	-	-	-	-	-	-	**177**	**143**	**122**	33.3
19	Kilsyth Raod, Banknock	278779	679301	66.3	47.2	49.1	56.5	28.3	33.8	34	-	-	23.7	53.2	67.4	**46**	**37**	**32**	83.3
20	Garngrew Road, Haggs	278979	679155	50.5	40	39.1	31.7	20	16.8	18.7	20.5	-	34	40.6	56.3	**33**	**27**	**23**	91.7
21	Grangemouth Road, College	290112	680500	60.5	48	41.5	55.2	33.1	34.5	32.5	29.3	39	44.9	53.5	65.5	**45**	**36**	**31**	100.0
24	Kerse Lane, Falkirk	289187	680024	66.4	60.3	59.4	39.8	34.8	25.6	28.7	36.2	43	43.7	46.3	66.1	**46**	**37**	**32**	100.0
26	Weir Street, Falkirk	289207	680123	42	28.5	27	31.6	21	20.7	17.4	14.8	15.2	28.2	36.4	47.2	**28**	**22**	**19**	100.0
27	West Bridge Street, Falkirk	288490	680055	69.1	68.3	52.9	76.1	53.6	67.3	44.9	33.6	42.8	63.1	68.9	97.5	**62**	**50**	**42**	100.0
29	Wellside Place, Falkirk	288465	680220	42.1	32.7	17	29.7	17.6	18.8	17.3	14.6	17	28	33.9	50.3	**27**	**22**	**18**	100.0
36	Kerr Crescent, Haggs	278985	679273	79.2	59.6	59.9	64.9	45.7	53.9	47	51.4	50	65.4	72.2	79.3	**61**	**49**	**42**	100.0
37	Denny Town House	281226	682526	28.1	29.2	27.4	25.4	17.1	19.6	16.1	16.5	15.8	27.1	19.3	42.6	**24**	**19**	**16**	100.0
38	Larbert Village Primary School	285930	682318	40.8	36.3	33.7	26.1	17.3	-	15.1	-	19.2	32.3	-	54.6	**31**	**25**	**21**	75.0
41	Seaview Place, Bo'ness	299722	681594	47.6	42.1	36.2	37.7	22.3	21	23.5	21.9	23	35.1	35.9	53	**33**	**27**	**23**	100.0
42				41.1	36	29.9	25.6	16.9	20.9	16.4	14.7	20	31.1	32.4	49.8				100.0
42	Municipal Chambers, Grangemouth	292816	682009	39.9	33.8	32.8	24.2	16	16.7	14.5	10.2	15.7	28.5	32.3	50.1	**27**	**22**	**19**	100.0
42				40.2	35.1	33.5	24.3	15.9	17.5	17.5	14.4	17.9	31.6	34.4	49.8				100.0
44	Greenpark Drive, Polmont	293436	678938	35.5	28.3	26.8	21.4	11.9	11.7	12.3	11	16.5	24.1	26.5	48.3	**23**	**19**	**16**	100.0
45	N. Distributor Road, Bainsford	288444	681178	71.7	59.1	43.4	61.1	41.2	39.2	-	37.3	38.3	53.2	49.8	72	**51**	**42**	**36**	91.7
47	Thistle Avenue, Grangemouth	292000	680300	44.9	42	31.9	32.8	23.9	15.5	18.5	17.5	18.4	32.3	38.4	41.8	**30**	**24**	**21**	100.0
48	Hayfield, Falkirk	289200	681580	43.5	18.9	26.6	25.4	19.9	17.2	14.6	12.5	19.1	27.5	34.1	55.7	**26**	**21**	**18**	100.0
49	Lennox Terrace, Grangemouth	293600	680250	37.9	32.4	25.4	37.8	26	29.2	21	17.2	11	22.5	39.4	58	**30**	**24**	**21**	100.0
50	Upper Newmarket Street	288671	680047	46.7	31.1	37.8	43.3	32.8	33.5	28.8	17.9	25.8	37.6	35.3	61.8	**36**	**29**	**25**	100.0
51	Mary Street, Laurieston	290965	679490	46.9	41.1	41	39	28.6	25.1	26.6	26.9	23.8	36.9	45.7	61.5	**37**	**30**	**25**	100.0
52	Main Street, Larbert	285866	682356	52.5	48.9	45.3	38.5	32.1	27.9	23.5	23.9	29.1	41.3	47.1	49.5	**38**	**31**	**26**	100.0
53	Denny Cross	281211	682727	62.9	47.7	35.9	34.4	33.2	35	33.2	22.6	33.5	44.2	55.6	63.4	**42**	**34**	**29**	100.0
55	Inchyra Station	293830	681022	38.5	26.3	25.4	22.2	15	17.9	16.8	10.5	15.3	25.8	30	53.3	**25**	**20**	**17**	100.0
56	Albert Ave, Grangemouth	293859	681962	39.7	35.2	24.4	25.8	16.2	23.3	16.9	15.3	20.6	28.3	34.1	51.7	**28**	**22**	**19**	100.0
57	Inchyra Road, Grangemouth	294028	680829	54.2	46.6	42.9	43.6	27	29.2	28.1	25.4	25.7	36.5	48.1	69.4	**40**	**32**	**27**	100.0
58	Callendar Road, Falkirk	289667	679724	42.8	33.1	29.8	35.6	19	25.2	-	15.7	20.6	33.7	35.8	57.4	**32**	**26**	**22**	91.7
59	Carron Road, Bainsford	288392	681931	56.6	52.3	39.1	39.9	26.8	29.4	24.8	-	-	43.7	46.6	63.2	**42**	**34**	**29**	83.3
60	Ronades Road, Carron	288133	681587	46	36.5	39.5	43.7	27.8	23.6	23	25.6	25.4	43.4	50.1	65.7	**38**	**30**	**26**	100.0
61	Canal Rd, Falkirk	287976	680656	57.4	38.7	39.2	39.5	30.1	29.3	28	19	25.3	36.5	41.2	65.6	**37**	**30**	**26**	100.0
62	Arnot Street, Falkirk	289125	679705	64	59.9	56.7	59.3	44.9	42.3	42.2	42.1	43.6	42	67.3	45	**51**	**41**	**35**	100.0
63	Camelon Road, Falkirk	288055	680134	67.4	66.4	54.2	63.3	-	-	50.3	42.4	37	61.8	-	-	**55**	**45**	**38**	66.7
64	New Hallglen Road, Hallglen	288807	678422	35	28.9	27.1	25.9	16.8	25.4	13	11	13.7	29.4	31	44.7	**25**	**20**	**17**	100.0
65	Redding Road, Redding	291356	678644	35.2	41.1	33.9	30.3	18.9	20	19.9	15.3	22.1	29	37.4	57.3	**30**	**24**	**21**	100.0
66	Holehouse, Slamannan	289450	672035	21	15.8	14.5	9.6	7	8.6	7.6	7.6	10	16.4	17.6	24.5	**13**	**11**	**9**	100.0
67	Queen Street, Falkirk	289430	680433	52	47.2	24.7	41.6	25.7	28.1	26.4	22.3	28.5	39.6	49.4	65.9	**38**	**30**	**26**	100.0
68	Belluvue Street Falkirk	289234	679945	59.7	50.6	57.9	37.5	32.6	22.6	29.5	29.5	18	38.5	54.7	65.1	**41**	**33**	**29**	100.0
69	Kerse Lane, Falkirk	289022	679990	53.4	49.4	37.5	44.1	38.8	38.4	34.5	25.7	34.7	44.1	53.3	71.8	**44**	**35**	**30**	100.0
70				51.4	52.7	48.1	39.2	24.8	25.2	30.1	22.1	30.8	40	41.4	57.6				100.0
70	Park Street AQ station, Falkirk	288892	680070	50.5	52.4	52	34.5	29.1	26.8	26.4	23.2	24.2	38.4	38.2	61.8	**39**	**31**	**27**	100.0
70				51.5	48.3	51.7	35.6	29.8	18.6	30.3	25.7	34.6	43.8	42.5	61.1				100.0
71	Park Street, Falkirk	288910	680112	60.6	64	60.7	48.5	35.5	32.5	35.2	29.7	36.9	41.9	60	79.3	**49**	**39**	**34**	100.0
72	Vicar Street, Falkirk	288824	680120	46.3	43	46.4	45.9	36.4	37.1	26.2	25.6	24.9	40.9	51.3	40.4	**39**	**31**	**27**	100.0
73	West Bridge Street, RHS,Falkirk	288467	680048	62.6	52.1	40.4	56.7	43.7	41.6	36.9	32.3	18.2	50.7	56.7	63.4	**46**	**37**	**32**	100.0
74	Hope street AQ station	288688	680218	51	36.4	37.8	43.2	18.9	29.3	22	21.2	26	37.5	45	52.1	**35**	**28**	**24**	100.0
75	Rae St, Stenhousemuir	286793	683114	-	34.6	33.2	26	18.7	18	-	12.8	34.7	27.3	-	50	**28**	**23**	**20**	75.0
76	Tryst Road, Stenhousemuir	286851	683229	54.9	44	42	28.7	19.3	14.9	16.2	20.7	19.4	34.1	34.5	41.2	**31**	**25**	**21**	100.0
77	Kinnaird Village	286490	683775	6	42.6	38.6	31.7	19.7	18.9	19.4	21.6	27.5	17	40.7	42.4	**27**	**22**	**19**	100.0
78	Glen Brae, Falkirk	288525	678991	48.9	48	46.3	44.4	33.7	32	31.6	27.5	35.6	42.9	50.3	67.1	**42**	**34**	**29**	100.0
79	Gartcows Road, Falkirk	288491	679327	27.3	38.8	36.9	37.6	22.5	20.9	19.3	19.8	25.5	33.7	46.5	60	**32**	**26**	**22**	100.0
80	Cow Wynd, Falkirk	288765	679456	56.9	50.6	46.8	46.5	30.8	25.5	27.4	30.2	25.8	45.7	50.7	63.8	**42**	**34**	**29**	100.0
81	Grahams Road, Falkirk	288834	680898	57.4	53.3	38.9	47.4	26.9	39.6	27.6	28.5	33.8	48.5	49.7	66.5	**43**	**35**	**30**	100.0
82	Castings Ave, Falkirk	288858	681036	46.5	33	-	33.3	17.8	20.8	18.8	15.4	20.8	30.5	37.3	42.6	**29**	**23**	**20**	91.7
83	Main Street, Bainsford	288609	681419	70.7	63.8	62.9	66.1	39	36.2	-	-	40	56.5	58.6	75.4	**57**	**46**	**39**	83.3
84	Carriden Brae, Bo'ness	301874	680592	27.8	28.1	25.9	18.8	11.4	13.2	15.2	10.7	16.8	20.1	23.9	36.2	**21**	**17**	**14**	100.0
85	Auchincloch Drive, Banknock	278752	679049	47.6	38.8	33.1	39.4	22.5	31	20.9	16.7	19.8	25.4	39.1	57.2	**33**	**26**	**23**	100.0
86	Wolfe Rd, Falkirk	289667	679871	-	-	23.1	22.9	9.8	15.2	13.3	10.8	14.5	25.6	25.7	48.1	**21**	**17**	**14**	83.3
87	M80 slip south, Haggs	279017	679305	-	-	-	-	-	34.8	39.9	43.1	38.2	43.8	50	44.4	**42**	**34**	**29**	58.3
88	Ure Crescent, Bonnybridge	282391	681045	-	-	-	-	-	-	-	-	23.1	33.2	43.3	67.6	**42**	**34**	**29**	33.3
89	Grahams Rd/Meeks Rd, Falkirk	288853	680328	-	-	-	-	-	-	-	-	29.2	48.3	59.6	71	**52**	**42**	**36**	33.3
90	Grahams Rd bridge east, Falkirk	288855	680234	-	-	-	-	-	-	-	-	41.9	51.1	57.7	48.6	**50**	**40**	**34**	33.3
91	Grahams Rd bridge west, Falkirk	288835	680291	-	-	-	-	-	-	-	-	-	42.4	-	64.9	**54**	**43**	**37**	16.7
92	Cochrane Avenue, Falkirk	288743	679606	-	-	-	-	-	-	-	-	27.2	37.8	43.1	63.6	**43**	**35**	**30**	33.3
93	Falkirk High Station	288346	679073	-	-	-	-	-	-	-	-	16.8	21.8	29.1	41.5	**27**	**22**	**19**	33.3
94	A905 (Glensburgh Rd), Grangemouth	291213	681927	-	-	-	-	-	-	-	-	36.2	-	67.4	80.7	**61**	**50**	**42**	25.0

The vast majority of diffusion tubes are changed as per the diffusion tube calendar. The last changeover date for the 2009 results (early January 2010) was delayed by one week due to ice and snow. A few tubes are changed slightly earlier (especially during winter) due to the length of the route, but all are well within the +/- 2 days allowed by the calendar.

Table A4: a.) Dates of diffusion tube changeovers and b.) Harwell Scientifics precision.

Month	Start date	End date
January	07/01/2009	04/02/2009
February	04/02/2009	04/03/2009
March	04/03/2009	01/04/2009
April	01/04/2009	29/04/2009
May	29/04/2009	03/06/2009
June	03/06/2009	01/07/2009
July	01/07/2009	29/07/2009
August	29/07/2009	02/09/2009
September	02/09/2009	30/09/2009
October	30/09/2009	04/11/2009
November	04/11/2009	02/12/2009
December	02/12/2009	**13/01/2010**

Harwell SS	
2008	G
2008	G
2008	G
2008	G
2008	G
2008	G
2008	G
2008	G
2008	G
2008	G
2008	G
2008	G
2008	G
2008	G
2009	G
2009	G
2009	G
2009	G
2009	G
2009	G
2009	P
2009	G
2009	G

Pumped Diffusion Tube (Grangemouth AURN)

Council Officers act as the LSOs for the pumped diffusion tube at the Grangemouth AURN site. The tubes are changed on a fortnightly basis. In 2009 analysis and QA/QC was performed by NPL under contract to Defra and the DAs. Two audits are carried out per year by NPL. The results included in this report have been downloaded from the Air Quality Archive.