

QA/QC Data Ratification Report for the Automatic Urban and Rural Network, October-December 2012, and Annual Review 2012



Report for Department for Environment, Food and Rural Affairs, The Scottish Government, The Welsh Government, The Northern Ireland Department of Environment

Ricardo-AEA/R/3364

Issue 1

Date 27 Jun 2013

Customer:

Department for Environment, Food and Rural Affairs, The Scottish Government, The Welsh Government, The Northern Ireland Department of Environment

Customer reference:

RMP 4961

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Ricardo-AEA reference:

Report no. Ricardo-AEA/R/3364 Issue 1

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Executive summary

Ricardo-AEA carries out the quality assurance and control (QA/QC) activities for the Automatic Urban and Rural Monitoring Network (AURN) on behalf of the UK Department for Environment, Food and Rural Affairs (Defra), Scottish Government, Welsh Government and Department of Environment (DoE) in Northern Ireland.

Ratified hourly average data capture for the network averaged 93.0% for all pollutants (O_3 , NO_2 , SO_2 , CO , PM_{10} and $PM_{2.5}$) during the 3-month reporting period October-December 2012. Data capture for all pollutants were above 90%. There were 24 sites with data capture less than 90% for the period. Many affiliated SO_2 and CO analysers were removed from the network at the end of this quarter.

A total of 133 monitoring sites in the AURN operated during this quarter, of which 74 are Local Authority owned sites affiliated to the national network. Some are co-located and separately named gravimetric particulate analysers at sites with automatic analysers. Many affiliated sites have additional Defra-funded analysers installed on site.

The main reasons for data loss at the sites have been provided and these were predominantly due to instrument faults, response instability or problems associated with the replacement of analysers and infrastructure. A summary of recommendations to help improve network performance is given in Appendix 1.

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SECTION A Data Ratification Report, October-December 2012

1 Introduction

This quarterly report covers the Quality Assurance and Control (QA/QC) activities undertaken by Ricardo-AEA to ratify automatic monitoring data from Defra and the Devolved Administrations' urban and rural air quality monitoring network (AURN) for the period 1 October – 31 December 2012. During this quarter there were a total of 133 operational monitoring sites in the Network of which there were 98 urban sites, 27 rural sites and a further 8 sites in the London Air Quality Monitoring Network (LAQN) which are affiliated into the national network. There were 61 Defra-funded sites and 72 affiliate sites, although many affiliate sites have fully-funded PM₁₀ and/or PM_{2.5} analysers. Eleven sites have non-automatic particulate samplers (Partisols); some of these are co-located with FDMS analysers at Auchencorth Moss, Harwell, London North Kensington and Marylebone Road for both PM₁₀ and PM_{2.5}.

1.1 Overview of Network Performance

Ratified hourly average (daily average for Partisols) data capture for the network averaged 93.0% for all pollutants (O₃, NO₂, SO₂, CO, PM₁₀ and PM_{2.5}) during the 3 month reporting period October-December 2012 (see Table 1.1). All species achieved 90% or higher data capture on average. Data capture rates are calculated using the actual data capture as hourly averages (daily for Partisol) against the total number of hours (or days) in the relevant period; service and maintenance are counted as lost data. It is permissible to discount routine service and calibration from achievable data capture targets, but this is not yet calculated. For sites starting or closing during the period, the data capture is based on the actual date starting or closing.

Table 1.1: AURN Ratified Data Capture (%) by Quarter, January-December 2012

	CO	PM ₁₀	PM _{2.5}	NO ₂	O ₃	SO ₂	Mean
Q1 2012	96.6	88.9	88.3	94.7	95.3	96.6	92.3
Q2 2012	98.8	87.6	86.8	92.6	96.3	94.4	91.5
Q3 2012	89.9	86.7	89.1	88.5	91.7	86.5	88.8
Q4 2012	96.6	91.5	93.9	92.0	94.9	95.7	93.0

Overall, 329 out of the 396 analysers (76%) achieved data capture levels above the required 90% target during this reporting period. Table 1.2 shows the number of analysers which did not meet the target.

Table 1.2: Number of Analysers with Data Capture below 90%

Total Number Of Analysers		Q1 2012 (No. below 90%)	Jan-Mar (No. below 90%)	Q2 2012 (No. below 90%)	Apr-Jun (No. below 90%)	Q3 2012 (No. below 90%)	July-Sept (No. below 90%)	Q4 2012 (No. below 90%)	Oct-Dec (No. below 90%)
CO	11		2		0		2		2
NO ₂	116		14		13		26		22
O ₃	82		8		4		14		10
PM ₁₀ ¹	67		14		22		21		16
PM _{2.5} ¹	77		26		27		22		13
SO ₂	33		4		5		12		5
Total <90%			68		71		97		68

¹ Includes FDMS, BAM and Partisol analysers.

In total, 24 out of the 133 operational network sites in the quarter (18%) had an average data capture rate below the required 90% level for the October-December 2012 period.

1.2 Changes to Ratified Data

The following data from previous quarters have been changed as a result of the ratification process for this quarter:

Bath Roadside, NO_x, 1/7/12-30/9/12, reprocessed

Chepstow A48, NO_x, 2/7/12-30/9/12, deleted

Ladybower NO_x, 1/7/12-30/9/12, reprocessed

Lerwick, 1/7/12-30/9/12, reprocessed

Liverpool Queens Drive Roadside NO_x, 25/7/12-30/9/12, deleted

Salford Eccles, O₃, 1/8/12-30/9/12, reprocessed

Scunthorpe Town, NO_x and SO₂, 1/7/12-30/9/12, reprocessed

Sheffield Centre NO_x, 10/7/12- 10/1/2013, deleted

Wirral Tranmere, NO_x and O₃, 18/5/10-19/3/13 deleted.

2 Changes in the Network for Directive Compliance

The following sites were commissioned during this period:

London Haringey Priory Park South, NO₂, O₃ 26/10/2012 (Replaced London Haringey)

3 Generic Data Quality Issues

3.1 FDMS Performance Issues

At the time of writing, there are a number of FDMS performance issues being investigated by the QA/QC unit. Most significant is the apparent baseline offset, which can result in data being higher or lower than might be expected. In order to determine this, zero checks are being carried out by placing a filter over the inlet and leaving for several days. This method does allow the determination of the analyser “zero” but requires a visit by QA/QC staff and the LSO, and therefore it will take time to complete all sites. The findings and implications of these tests are described in Section 5.

3.2 Internal Sampling

Following recommendations made by the QA/QC Unit in 2010, many sites had the sample inlet manifold removed and individual PTFE sample lines for each analyser fitted inside the sample inlet. It had come to light that under certain circumstances at some sites, air from inside the hut was being blown up the inlet tube and affecting the air being sampled. At the time, Equipment Support Units (ESUs) were instructed to seal the inlet tube around the sample lines to prevent this; however, considerable data loss occurred at Mold and Preston, for example. Further details are given in the April-June 2010 QA/QC report.

During the ratification of the October-December 2012 Wirral Tranmere dataset, elevated levels of NO₂ were noticed since 2010. Investigations on site revealed a sealing plug of Blu-Tac had dropped out allowing cabin air to leak out. Unfortunately, it is likely that both the NO₂ and ozone sampling had been compromised and both datasets have been deleted since 2010 up to the repair in January.

It is recommended that ESUs check the integrity of sample inlets at services, particularly following the replacement of the sample lines.

4 Site Specific Issues

In this section, we now discuss in turn specific site issues for sites in the following geographic groupings – London, England (excluding London), Scotland, Northern Ireland and Wales. Where analysers were commissioned during the period, the stated data capture for these instruments is calculated from the date of commissioning.

4.1 London

4.1.1 Data Capture

The data capture for sites in London (within the M25) for the period October-December 2012 is given in Table 4.1:

Table 4.1 Data Capture for London, October-December 2012

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Average
London							
Camden Kerbside	-	99.0	99.7	99.7	-	-	99.5
Haringey Roadside	-	96.0	97.4	98.6	-	-	97.3
London Bexley	99.8	-	99.8	94.3	-	98.6	98.1
London Bloomsbury	-	97.1	99.8	99.9	99.7	99.9	99.3
London Eltham	-	-	92.3	98.1	99.5	-	96.6
London Haringey	-	-	-	96.4	84.0	-	90.2
London Haringey Priory Park South	-	-	-	50.0	58.6	-	54.3
London Harlington	-	99.4	99.0	99.8	99.9	-	99.5
London Harrow Stanmore	-	-	99.4	-	-	-	99.4
London Hillingdon	-	-	-	95.7	99.9	-	97.8
London Marylebone Road	96.2	92.9	80.5	89.6	94.3	96.3	91.7
London Marylebone Road PARTISOL	-	95.7	95.7	-	-	-	95.7
London N. Kensington	99.8	98.6	99.3	99.7	99.6	99.8	99.5
London N. Kensington PARTISOL	-	100.0	100.0	-	-	-	100.0
London Teddington	-	-	99.7	77.4	71.7	-	82.9
London Westminster	-	-	84.8	98.3	98.2	-	93.8
Southwark A2 Old Kent Road	-	97.6	-	86.9	-	-	92.2
Tower Hamlets Roadside	99.7	-	-	99.7	-	-	99.7

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Average
Number of sites	4	9	13	15	10	4	18
Number of sites < 90%	0	0	2	4	3	0	2
Network Mean (%)	98.9	97.4	95.9	92.3	90.5	98.7	93.7

Shaded boxes are for data capture < 90%

Bold data captures are for data that are provisional and subject to further quality control

4.1.2 Site Specific Issues

London Haringey Priory Park South

The London Haringey site was decommissioned and moved a short distance within the Park, being commissioned on 26 October. However, the analysers were left sampling internal air up to 22 November. A further period of NO_x data from 20 to 28 December was also lost due to a faulty temperature thermistor.

London Teddington

At an engineer callout in December, it was found that the NO_x calibration system was incorrectly configured and resulted in inaccurate calibrations. Data have been deleted from 23 October to 10 December. In addition, a leaking sample valve resulted in the loss of ozone data from 14 November to 10 December.

4.2 England (excluding London)

4.2.1 Data Capture

The data capture for sites in England for the period October-December 2012 is given in Table 4.2:

Table 4.2 Data Capture for England, October-December 2012

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Average
England							
Barnsley Gawber	-	-	-	99.4	99.3	99.1	99.2
Bath Roadside	-	-	-	98.6	-	-	98.6
Billingham	-	-	-	99.9	-	-	99.9
Birmingham Acocks Green	-	-	99.2	99.9	99.7	-	99.6
Birmingham Tyburn	-	98.7	99.6	99.7	99.7	99.7	99.5
Birmingham Tyburn Roadside	-	82.8	99.0	99.6	91.7	-	93.3
Blackburn Darwen Roadside	-	-	-	99.9	-	-	99.9
Blackpool Marton	-	-	76.7	97.4	98.5	-	90.9
Bottesford	-	-	-	-	99.5	-	99.5

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Average
Bournemouth	-	-	93.5	99.8	96.7	-	96.7
Brighton Preston Park	-	-	100.0	99.8	99.8	-	99.8
Bristol St Paul's	-	84.6	95.8	99.9	100.0	-	95.1
Cambridge Roadside	-	-	-	99.7	-	-	99.7
Canterbury	-	-	-	92.0	99.8	-	95.9
Carlisle Roadside	-	97.2	97.2	89.4	-	-	94.6
Charlton Mackrell	-	-	-	99.5	99.2	-	99.4
Chatham Centre Roadside	-	95.9	95.6	99.1	-	-	96.9
Chesterfield	-	94.5	95.6	100.0	-	-	96.7
Chesterfield Roadside	-	50.5	94.3	92.3	-	-	79.0
Coventry Memorial Park	-	-	88.1	80.5	99.8	-	89.5
Eastbourne	-	82.3	87.8	99.8	-	-	89.9
Exeter Roadside	-	-	-	99.6	99.9	-	99.8
Glazebury	-	-	-	99.9	99.9	-	99.9
Great Dun Fell	-	-	-	-	99.1	-	99.1
Harwell	-	98.7	99.9	99.6	99.9	99.7	99.6
Harwell PARTISOL	-	100.0	100.0	-	-	-	100.0
High Muffles	-	-	-	99.8	99.9	-	99.8
Honiton	-	-	-	99.9	-	-	99.9
Horley	-	-	-	99.7	-	-	99.7
Hull Freetown	-	90.9	91.6	99.5	99.9	99.5	96.3
Ladybower	-	-	-	99.6	99.8	99.0	99.5
Leamington Spa	-	99.5	99.7	99.6	86.5	86.5	94.4
Leamington Spa Rugby Road	-	98.8	95.4	99.7	-	-	98.0
Leeds Centre	99.8	99.7	99.7	99.3	99.8	99.8	99.7
Leeds Headingley Kerbside	-	99.1	99.7	98.6	-	-	99.2
Leicester Centre	-	88.9	58.0	88.0	89.3	-	81.0
Leominster	-	-	-	99.7	99.8	-	99.8
Lincoln Canwick Road	-	-	-	99.1	-	-	99.1
Liverpool Queen's Drive Roadside	-	-	-	0.0	-	-	0.0
Liverpool Speke	-	99.0	99.0	77.6	98.9	97.7	94.4
Lullington Heath	-	-	-	98.6	99.2	96.6	98.1

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Average
Manchester Piccadilly	-	-	96.0	89.3	99.9	100.0	96.3
Manchester South	-	-	-	93.0	99.9	-	96.4
Market Harborough	-	-	-	95.5	95.6	-	95.5
Middlesbrough	88.7	47.5	82.3	90.4	90.9	90.6	81.8
Newcastle Centre	-	99.4	99.8	99.6	99.9	-	99.7
Newcastle Cradlewell Roadside	-	-	-	99.6	-	-	99.6
Northampton Kingsthorpe	-	-	100.0	99.7	99.9	-	99.9
Norwich Lakenfields	-	100.0	99.8	99.8	99.9	-	99.9
Nottingham Centre	-	97.2	92.2	99.6	95.8	99.5	96.9
Oxford Centre Roadside	-	-	-	96.5	-	-	96.5
Oxford St Ebbes	-	48.4	54.3	49.7	-	-	50.8
Plymouth Centre	-	99.6	99.8	99.8	99.9	-	99.8
Portsmouth	-	91.3	99.4	99.9	99.3	-	97.5
Preston	-	-	71.6	98.3	98.6	-	89.5
Reading New Town	-	98.6	99.5	95.6	99.9	-	98.4
Rochester Stoke	-	100.0	99.7	97.6	97.6	97.6	98.5
Salford Eccles	99.6	96.1	96.1	79.6	99.8	99.6	95.1
Sandy Roadside	-	92.0	99.0	99.7	-	-	96.9
Scunthorpe Town	-	99.1	-	91.2	-	83.4	91.2
Sheffield Centre	-	99.5	99.9	0.0	98.7	-	74.5
Sheffield Tinsley	-	-	-	99.0	-	-	99.0
Sibton	-	-	-	-	99.9	-	99.9
Southampton Centre	-	99.9	96.9	99.2	99.5	99.6	99.0
Southend-on-Sea	-	-	73.3	95.5	99.8	-	89.5
St Osyth	-	-	-	96.7	99.8	-	98.3
Stanford-le-Hope Roadside	-	89.6	80.3	94.8	-	99.7	91.1
Stockton-on-Tees Eaglescliffe	-	99.1	91.4	99.0	-	-	96.5
Stoke-on-Trent Centre	-	99.7	99.8	99.8	99.7	-	99.7
Storrington Roadside	-	95.7	93.3	99.6	-	-	96.2
Sunderland Silksworth	-	-	99.0	99.9	99.7	59.2	89.5
Thurrock	-	99.7	-	98.6	99.9	99.5	99.4
Walsall Woodlands	-	-	-	96.2	47.7	-	72.0

Site	CO	PM ₁₀	PM _{2.5}	NO ₂	O ₃	SO ₂	Site Average
Warrington	-	87.3	99.9	99.5	-	-	95.6
Weybourne	-	-	-	-	100.0	-	100.0
Wicken Fen	-	-	-	80.3	91.8	84.3	85.5
Wigan Centre	-	-	98.6	99.6	99.7	-	99.3
Wirral Tranmere	-	-	98.5	0.0	0.0	-	32.8
Yarner Wood	-	-	-	99.9	100.0	-	99.9
York Bootham	-	99.0	99.6	-	-	-	99.3
York Fishergate	-	98.1	93.5	99.5	-	-	97.0
Number of sites	3	39	49	75	53	20	81
Number of sites < 90%	1	9	9	11	4	4	14
Network Mean (%)	96.0	92.3	93.4	92.5	95.6	94.5	93.4

Shaded boxes are for data capture < 90%

Bold data captures are for data that are provisional and subject to further quality control

4.2.2 Site Specific Issues

Blackpool Marton

The ESU found the bypass on the FDMS disconnected from the splitter unit at the service on 11 October. It is likely this occurred at the QA/QC audit on 15 August; data between these dates have been deleted.

Chesterfield Roadside

The PM₁₀ FDMS performed poorly during the quarter. Zero checks showed high volatiles and so PM₁₀ data have been deleted from the zero checks (3 November) to drier replacement in December.

Coventry Memorial Park

As reported in the previous quarter, data were deleted from 2 August to 18 October due to poor analyser performance (unstable). Some data were also lost from the PM_{2.5} FDMS due to unstable performance.

Leicester Centre

The site was affected by a number of power cuts, one of which caused the FDMS PM_{2.5} analyser to lose its programming. Poor quality data have been deleted from 13 November to 5 December when a replacement drier was fitted.

Liverpool Queens Drive Roadside

During ratification of the October-December data, it was brought to the attention of the QA/QC Unit that the sample inlet filter holder was found to be damaged and had been leaking. The ESU had made a number of visits to attempt to remedy the problem. The NO_x data have been deleted from the Local Site Operator (LSO) calibration in May 2012 up to 4 February 2013.

Liverpool Speke

The NO_x analyser had a suspected leak between calibrations on 7 September and 9 October. The NO_x reaction cell heater failed on 19 October, and was repaired on 4 November.

Middlesbrough

A communications fault resulted in the loss of all data from 22 to 30 November. In addition, various FDMS faults, mainly leaking seals, caused the loss of PM₁₀ data from 10 October to 14 November.

Oxford St Ebbes

Problems with the site power supply resulted in a considerable loss of data during the quarter.

Preston

The PM_{2.5} analyser lost its programming on 22 October; although the engineer attended to rectify the problem, a repair was not possible, and the analyser was removed to the workshop for repair. It was returned to site on 16 November.

Sheffield Centre

At the winter 2013 QA/QC audit, the converter efficiency was found to be 128%. It was subsequently found that the setting in the software had been adjusted away from 100%. As it is not possible to rescale the NO_x data, the data have been deleted back to the service on 10 July up to the winter service on 15 January 2013.

Southend-on-Sea

The PM_{2.5} FDMS suffered from instability, probably due to a number of leaks and condensation problems experienced during the quarter. Data from 23 November to 14 December, and 22-24 December have been deleted.

Sunderland Silksworth

This site has suffered from frequent water leaks which have resulted in a number of data losses during the year. In addition, the SO₂ UV lamp was faulty leading to data loss from 30 September to 7 November.

Walsall Woodlands

At the QA/QC audit, the ozone analyser was found to have a chipped sample inlet filter glass, which allowed air to leak past the seal, giving spurious readings. Data have been deleted from 11 October to 28 November.

Wicken Fen

The site suffered from O₃ valve leaks, SO₂ lamp failure and various NO_x faults, compounded by water ingress causing noisy data.

Wirral Tranmere

The sample inlets were found to be too low in the manifold, allowing internal sampling. See Section 3.2.

4.3 Scotland

4.3.1 Data Capture

The data capture for sites in Scotland for the period October-December 2012 is given in Table 4.3.

Table 4.3 Data Capture for Scotland, October-December 2012

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Average
Scotland							
Aberdeen	-	99.5	99.0	78.2	98.7	-	93.8
Aberdeen Union Street Roadside	-	-	-	100.0	-	-	100.0
Auchencorth Moss	-	53.3	98.9	-	100.0	-	84.0
Auchencorth Moss PM ₁₀ PM ₂₅ (FDMS)	-	97.5	95.3	-	-	-	96.4
Bush Estate	-	-	-	99.9	100.0	-	99.9
Dumbarton Roadside	-	-	-	95.0	-	-	95.0
Dumfries	-	-	-	99.2	-	-	99.2
Edinburgh St Leonards	99.8	83.7	97.1	99.8	99.8	99.3	96.6
Eskdalemuir	-	-	-	98.6	98.8	-	98.7
Fort William	-	-	-	98.6	99.6	-	99.1
Glasgow Kerbside	-	59.5	63.0	76.0	-	-	66.1
Grangemouth	-	99.7	99.8	99.5	-	98.6	99.4
Grangemouth Moray	-	-	-	99.6	-	-	99.6
Inverness	-	95.7	98.9	83.9	-	-	92.8
Lerwick	-	-	-	-	46.6	-	46.6
Peebles	-	-	-	97.6	89.6	-	93.6
Strath Vaich	-	-	-	-	99.9	-	99.9
Number of sites	1	7	7	13	9	2	17
Number of sites < 90%	0	3	1	3	2	0	3
Network Mean (%)	99.8	84.1	93.1	94.3	92.6	98.9	91.8

Shaded boxes are for data capture < 90%

Bold data captures are for data that are provisional and subject to further quality control

4.3.2 Site Specific Issues

Auchencorth Moss

The PM₁₀ Partisol suffered from frequent water ingress resulting in the filters becoming waterlogged.

Glasgow Kerbside

A power cut resulted in the loss of all data from 1-22 November.

Lerwick

The analyser response changed on 5 November following a short gap, resulting in excessively high concentrations. The ESU attended on 11 December but was unable to calibrate the analyser; however the cleaning of sample lines and switching valve at this visit appears to have fixed the problem. The data between 5 November and 11 December have been deleted.

4.4 Wales

4.4.1 Data Capture

The data capture for sites in Wales for October-December 2012 is given in Table 4.4.

Table 4.4 Data Capture for Wales, October-December 2012

Site	CO	PM ₁₀	PM _{2.5}	NO ₂	O ₃	SO ₂	Site Average
Wales							
Aston Hill	-	-	-	99.9	99.5	-	99.7
Cardiff Centre	80.7	80.3	65.4	80.0	80.8	80.3	77.9
Chepstow A48	-	100.0	99.7	67.5	-	-	89.0
Cwmbran	-	-	-	99.7	99.9	-	99.8
Mold	-	-	-	7.6	99.9	-	53.7
Narberth	-	97.2	-	99.9	99.6	99.6	99.1
Newport	-	74.9	98.0	96.8	-	-	89.9
Port Talbot Margam	99.2	99.1	99.9	99.7	99.6	99.6	99.5
Port Talbot Margam PM ₁₀ PM _{2.5} (Partisol)	-	100.0	-	-	-	-	100.0
Swansea Roadside	-	99.6	98.9	99.7	-	-	99.4
Wrexham	-	82.6	96.7	82.7	-	98.2	90.1
Number of sites	2	8	6	10	6	4	11
Number of sites < 90%	1	3	1	4	1	1	4
Network Mean (%)	90.0	91.7	93.1	83.4	96.5	94.4	90.7

Shaded boxes are for data capture < 90%

Bold data captures are for data that are provisional and subject to further quality control

4.4.2 Site Specific Issues

Cardiff Centre

The site suffered a number of power cuts due to a wiring fault.

Chepstow A48

The NO calibration cylinder at Chepstow was unstable, and it was not possible to accurately scale the data during a period of erratic data. The autocalibrations were also unreliable and provide no useful information on the performance of the analyser following the service in July. The NOx data have been deleted from 20 July up to the delivery of a replacement cylinder on 25 October.

Mold

The NOx converter was found to have failed at the audit on 21 January 2013. The converter was found to be partially blocked at the following service. Data have been deleted from 8 October (where a step change in response was noted) up to the service on 21 February.

Newport

A period of six days' PM₁₀ data was deleted in December due to spuriously high volatile concentrations.

4.5 Northern Ireland (including Mace Head)

4.5.1 Data Capture

The data capture for sites in Northern Ireland (including Mace Head in the Republic of Ireland) for the period July-September 2012 is given in Table 4.5.

Table 4.5 Data Capture for Ireland, October-December 2012

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Average
N Ireland							
Armagh Roadside	-	43.3	-	92.8	-	-	68.1
Ballymena Ballykeel	-	-	-	-	-	99.9	99.9
Belfast Centre	99.7	99.9	97.3	99.6	99.6	99.7	99.3
Derry	-	94.2	94.2	99.8	99.9	98.4	97.3
Lough Navar	-	98.3	-	-	99.7	-	99.0
Ireland							
Mace Head	-	-	-	-	98.4	-	98.4
Number of sites	1	4	2	3	4	3	6
Number of sites < 90%	0	1	0	0	0	0	1
Network Mean (%)	99.7	83.9	95.8	97.4	99.7	99.4	92.7

Shaded boxes are for data capture < 90%

Bold data captures are for data that are provisional and subject to further quality control

4.5.2 Site Specific Issues

Armagh Roadside

The PM₁₀ analyser has historically been a source of problems and much of the data from the quarter have been deleted. Problems continue early in 2013 with anomalously low sample dewpoints being recorded.

4.6 Overall Data Capture

Overall data capture for each pollutant across the network for the quarter is given in Table 4.6.

Table 4.6 Overall Data Capture, October-December 2013

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Average
Number of sites	11	67	77	116	82	33	133
Number of sites < 90%	2	16	13	22	10	5	24
Network Mean (%)	96.6	91.5	93.9	92.0	94.9	95.7	93.0

5 FDMS Baseline Checks

As part of the QA/QC remit for continuous improvement, an ad hoc study of PM analyser baseline response has been undertaken for the past 2 years. This study has been coordinated following investigations of issues identified both by CMCU during routine operation and by QA/QC unit during the ratification process.

The study initially concentrated on FDMS analysers, examining the baseline profile of the reference channels and the relationship with other neighbouring monitoring stations. It has become clear that, on a daily mean basis, regional reference PM concentrations regularly reach a minimum value that approaches $0 \mu\text{g m}^{-3}$.

With this information, sites where this observation was not true were “zero calibrated” using high efficiency scrubbers installed on the sample inlets. The results of these calibrations have been used to compare against the analyser baseline responses and, in all comparisons, calibration and baseline show excellent agreement.

The detection limit is calculated by multiplying the standard deviation of the zero calibration by 3.3. Typical results show that a healthy FDMS should have a detection limit of less than $5 \mu\text{g m}^{-3}$.

Recent European guidance (CEN TS16450) provides a recommendation that zero tests on PM analysers should yield a result no higher than $3 \mu\text{g m}^{-3}$, which provides the AURN with a robust performance limit for data ratification.

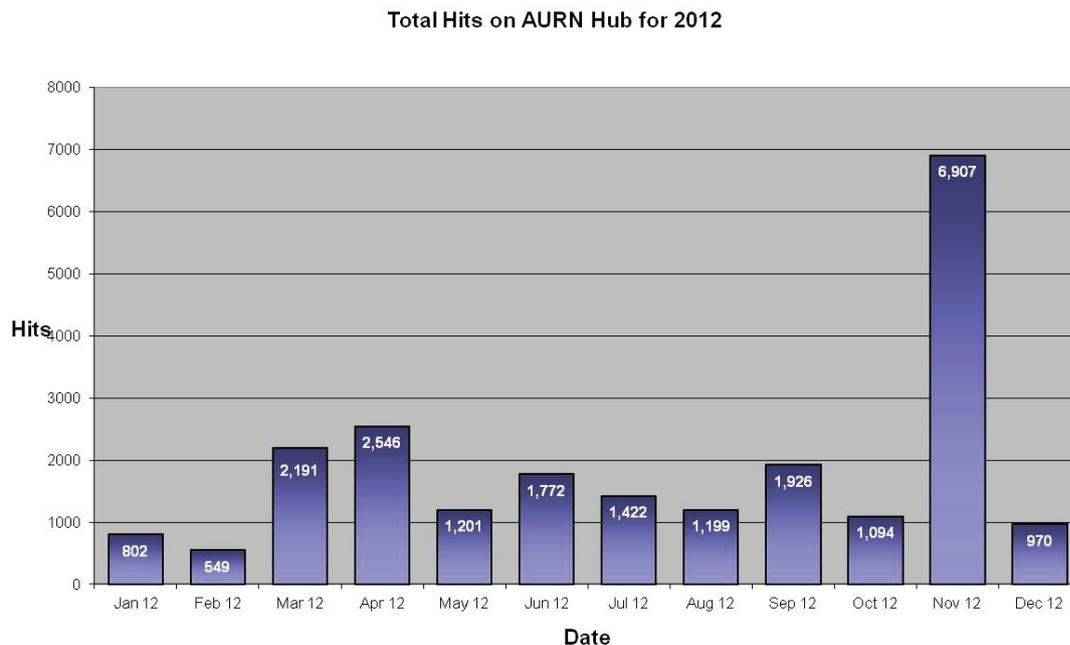
As the zero calibration and baseline correlation is so strong, QA/QC will be setting up a mechanism for calibration of PM analysers, to coincide with the routine 6 month service exercise. It is likely that this will require careful coordination of LSO CMCU and ESU effort to achieve this cost effectively, so it will not be rolled out until the summer service round.

6 LSO Manual and AURN Hub

The QA/QC Unit has revised and reissued the LSO manual in light of procedural changes and the introduction of new types of analysers employed. This manual is available via the AURN Hub at <http://uk-air.defra.gov.uk/reports/empire/lsoman/lsoman.html>

Figure 6.1 shows the number of hits on the AURN Hub during 2012.

Figure 6.1 AURN Hub Hits, 2012



Current versions of the LSO calibrations spreadsheet are also available to download from the LSO manual page of the Hub.

The hub also contains the health and safety database for Defra monitoring networks which was launched on 5 November, and is likely to be responsible for the peak in hub usage in November.

Section B - 2012 Annual Report

7 Introduction

The QA/QC Unit has produced detailed quarterly reports giving an overview of network performance, reasons for data losses and data capture statistics.

Recommendations for equipment and site upgrades and replacements have also been made. A list of the reports for 2012 is given in Table 7.1.

Table 7.1 QA/QC Data Ratification and Intercalibration Reports, 2012

	Type	Report Title	Reference
1	Ratification and Intercalibration	QA/QC Data Ratification and Intercalibration Report for the Automatic Urban and Rural Network, January-March 2012	AEAT/ENV/R/3194
2	Ratification	QA/QC Data Ratification Report for the Automatic Urban and Rural Network, April-June 2012	Ricardo-AEA/R/3331
3	Ratification and Intercalibration	QA/QC Data Ratification and Intercalibration Report for the Automatic Urban and Rural Network July-September 2012	Ricardo-AEA/R/3348
4	Ratification and Annual Review	QA/QC Data Ratification Report for the Automatic Urban and Rural Network October-December 2012 and Annual Review for 2012	Ricardo-AEA/R/3364

All reports are available on the UK Air Information Resource website (<http://uk-air.defra.gov.uk/>).

Data are routinely ratified on a 3-monthly basis. It should however be noted that there are occasionally circumstances where data which have been flagged as “Ratified” could be subject to further revision. This may be for example where:

- A QA/QC audit has detected a problem which affects data back into an earlier ratification period.
- Long-term analysis has detected an anomaly between expected and measured trends which requires further investigation and possible data correction. This was the case with 2000 –2008 gravimetric particulate monitoring data in the UK national network.
- Further research comes to light which indicates that new or tighter QA/QC criteria are required to meet the data quality objectives. This may require review and revision of historical data by applying the new criteria.

In addition, site issues found during one quarter may affect data from previous quarters, and it may be necessary on occasions to delete data which have already been reported as ratified. A list of these occurrences is given in each QA/QC report and also on UK-AIR.

8 Changes to network during 2012

8.1 Changes to Sites

The following new sites were commissioned in 2012 - see Table 8.1.

Table 8.1: Sites Added to the AURN during 2012

	Pollutants	Date started
Leamington Spa Rugby Road	NO ₂ PM ₁₀ PM ₂₅	01/06/2012
Walsall Woodlands	NO ₂ O ₃	19/06/2012
Honiton	NO ₂	21/06/2012
Northampton Kingsthorpe	NO ₂ O ₃ PM ₂₅	09/07/2012
London Haringey Priory Park South	NO ₂ , O ₃	26/10/2012

The following sites were closed in 2012:

Northampton, 09/07/12

The following analysers were removed where they were not required for Directive compliance:

Table 8.2: Analysers removed from Network, 2012

CO	SO ₂
Bristol Old Market	Barnsley 12
Bristol St Paul's	Birmingham Acock's Green
Bury Roadside	Bristol St Paul's
Glasgow Centre	Glasgow Centre
Hull Freetown	Leamington Spa
Leicester Centre	Leicester Centre
Liverpool Speke	Leominster
London Bexley	London Cromwell Road 2
London Bloomsbury	London Westminster
London Cromwell Road 2	Newcastle Centre
London Westminster	Northampton
Middlesbrough	Norwich Lakenfields
Newcastle Centre	Salford Eccles
Salford Eccles	Sheffield Centre
Sheffield Centre	Stanford-le-Hope Roadside
Southampton Centre	Sunderland Silksworth
Tower Hamlets Roadside	London Haringey

8.2 Changes to Network Operation

In order to maximise efficiencies at rural sites, it was agreed that calibration and LSO functions of NO_x, SO₂ and particle analysers would be carried out at three-monthly intervals, with those in the spring and autumn carried out by the QA/QC Unit staff whilst carrying out the quarterly ozone calibrations. The LSO would carry out the remainder as normal. This follows investigations by the QA/QC Unit which indicated sample losses resulting from increased filter loading were acceptably low.

9 Network Intercalibrations

Two complete network intercomparisons were carried out at 6-monthly intervals during 2012. In addition, all network ozone analysers are calibrated by the QA/QC Unit every three months. These are an important part of the overall QA/QC programme for the AURN network. The purpose of these intercomparisons is to determine the network measurement accuracy, consistency and intercomparability across the entire network. The latest exercise covered 127 sites plus any co-located Partisols. The procedures used, and a summary of the results obtained, are provided in the January-March and July-September QA/QC reports.

A summary of the number of analysers in the network found to be providing provisional data outwith the defined accuracy limits (the "outlier" sites) is given in Table 9.1. A full definition of what constitutes an outlier site for the different pollutants is given in the appropriate Quarterly Reports. Note also that, for the vast majority of these outlier sites, the data will have been fully corrected as part of the subsequent data ratification process.

Table 9.1 Outliers identified during 2012 intercalibration exercises.

Analyser	Winter 2012 intercalibration			Summer 2012 intercalibration		
	Number of outliers	Number in network	% outliers in total	Number of outliers	Number in network	% outliers in total
NO _x analyser	22	117	19%	20	119	17%
CO analyser	1	24	4%	1	23	4%
SO ₂ analyser	8	45	18%	9	44	20%
Ozone analyser	11	82	13%	17	82	21%
TEOM and BAM analysers	2 k ₀ , 3 flow	59 FDMS PM ₁₀ 1 BAM PM ₁₀ 67 FDMS PM _{2.5} 1 BAM PM _{2.5}	4%	2 k ₀ , 1 flow	58 FDMS PM ₁₀ 2 BAM PM ₁₀ 69 FDMS PM _{2.5} 2 BAM PM _{2.5}	2%
Gravimetric PM analysers	0 flow	9 PM ₁₀ 12 PM _{2.5}	0%	0 flow	9 PM ₁₀ 9 PM _{2.5}	0%
Total	46	417	11.0%	50	417	12.0%

Sites which have been commissioned, recommissioned in new locations or have had new analysers installed have been audited by the QA/QC Unit prior to the publication of the data from the site.

The intercalibration visits are also used to ensure information about network sites and analysers are correct and up to date. For example, at recent network intercalibration exercises, information has been gathered on the sample manifold systems used at all sites, the detailed set-up parameters for the FDMS particle analysers, and how site locations compare to the requirements listed in the Air Quality Directive.

In addition to the network intercalibrations, the QA/QC Unit carries out pre-commissioning audits on new sites and analysers introduced to the network. Although these audits are not included in the summary above, these provide a vital role in ensuring the overall data quality; data are not disseminated from new sites or analysers until a satisfactory performance has been verified by the QA/QC Unit. The installation timetable for FDMS PM₁₀ and PM_{2.5} analysers, and new CEN-compliant gas analysers has meant the QA/QC Unit has had to make numerous replicate visits to sites to ensure data may be disseminated in time for Directive Compliance, for example.

10 ESU, CMCU, LSO and QA/QC Meetings

During 2012, the QA/QC Unit continued to liaise closely with the ESUs to ensure optimal performance of the network through service and maintenance arrangements. The QA/QC Unit have provided the ESUs with spreadsheets to calculate various analyser performance parameters (eg converter efficiency, linearity) in line with the CEN requirements; ESUs have been requested to integrate the principles into their routine site tests.

All parties were in agreement that work undertaken by the ESUs is a vitally important part of the overall data quality management process for the network, and it is planned to repeat the meetings at regular intervals. Regular meetings between Defra and the devolved administrations, CMCU and the QA/QC Unit have also been initiated.

The QA/QC Unit has attended and presented at the AURN LSO meeting, and presented network updates as appropriate. These presentations are available on the AURN Hub.

The calibration gas supplier has been invited to a number of meetings with both QA/QC and the CMCUs, and a number of long-standing issues have been wholly or partly resolved.

The QA/QC Unit has continued to provide ESUs with ozone photometer calibrations prior to the start of each 6-monthly service schedule. In addition, weighed FDMS filters have been supplied to ESUs as required, to enable reliable K_o measurements to be made.

11 Network Data Capture

The overall network data capture for 2012 was 91.1%, which is just above the 90% target level. However, not all sites achieved >90% and a table of data capture for the 40 sites with less than 90% capture is given in Section 12.

A summary of data capture by pollutant for the year 2012 is given in Table 11.1

Table 11.1 Summary of data capture by pollutant, 2012

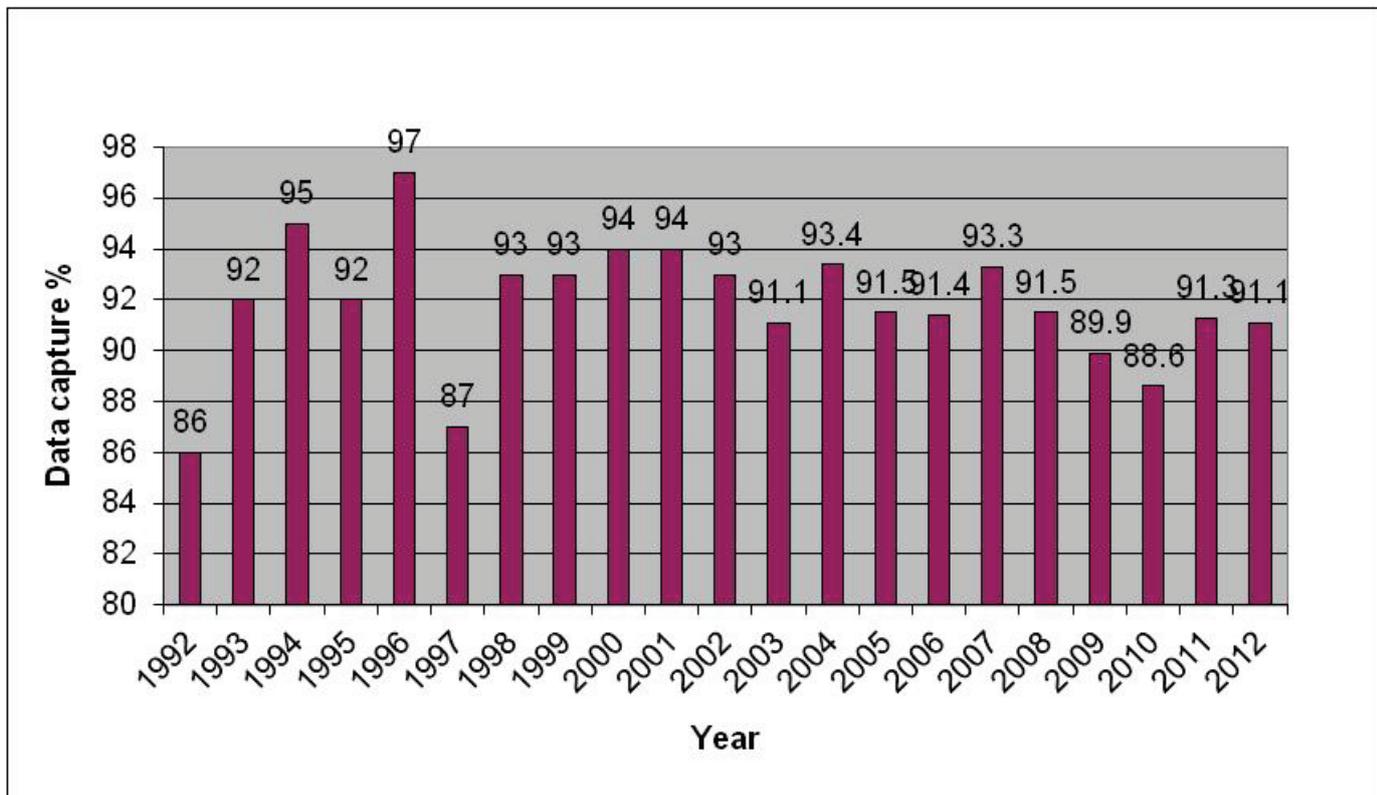
Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	
Number of sites	23	69	80	121	84	46	139
Number of sites <90%	2	29	23	29	9	9	42
Number of sites <85%	0	22	17	17	5	5	19
Network Mean (%)	96.5	88.8	89.5	91.7	94.4	92.2	91.1

For these sites, pollution statistics calculated for analysers with data capture above 75% or modelled data have to be used. However, neither of these approaches is entirely satisfactory. Hence, the QA/QC unit continues to make the recommendation that greater attention needs to be paid to minimising data loss from all sites.

For future compliance with the Air Quality Directive, data capture should exceed 85% for each site, allowing for routine calibration and maintenance.

The network annual average data capture of 91.1% is similar to the previous year. The performance has again been affected this year by long-term problems with analysers, mainly FDMS. Figure 11.1 shows the annual network data capture since the start of the AURN in 1992.

Figure 11.1 Data Capture 1992-2012



12 Significant Site Issues

12.1 Significant Data Loss

A number of sites have been identified at which the analyser performance has been below expectation, and significant quantities of data have been deleted from previous quarters. These are discussed individually below. These data from previous quarters may have been reported as ratified.

A brief description of the main sources of data loss at the 42 sites with data capture below 90% for the year is given in Table 12.1. This table shows network data capture for 01/01/2012 to 31/12/2012 from the start date of any new site, and only includes sites with average data capture < 90%.

Table 12.1 Significant data loss, 2012 – Sites with < 90% data capture only

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Avg.	Principal reason for data loss
England								
Blackpool Marton	-	-	68.0	95.4	98.9	-	87.4	FDMS auxiliary flow disconnected
Bristol Old Market	-	-	-	87.7	-	-	87.7	Site closed
Cambridge Roadside	-	-	-	80.4	-	-	80.4	Suspected sampling fault
Carlisle Roadside	-	83.1	87.0	82.3	-	-	84.1	Poor quality data, possibly temperature issues.
Chesterfield	-	51.2	91.7	97.3	-	-	80.1	Poor quality PM ₁₀ data
Coventry Memorial Park	-	-	22.1	80.1	98.9	-	67.1	FDMS removed for repair, NO _x analyser fault
Glazebury	-	-	-	76.3	89.5	-	82.9	CPU/motherboard faults on both NO _x and O ₃
Great Dun Fell	-	-	-	-	79.6	-	79.6	Sampling fault due to poor quality sample inlet
Haringey Roadside	-	93.2	88.6	80.8	-	-	87.5	Power cuts and poor quality data following service
Liverpool Queen's Drive Roadside	-	-	-	55.6	-	-	55.6	Leaking sample filter
London Bexley	97.7	-	91.6	96.7	-	72.8	89.7	SO ₂ lamp fault
London Cromwell Road 2	96.5	-	-	89.2	-	63.4	83.0	Site closed
London Haringey	-	-	-	77.6	94.7	-	86.1	Site closed
London Haringey Priory Park South	-	-	-	50.0	58.6	-	54.3	Internal sampling following relocation

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Avg.	Principal reason for data loss
London Harrow Stanmore	-	-	88.3	-	-	-	88.3	Switching valve and drier faults
London Marylebone Road PARTISOL	-	96.2	80.1	-	-	-	88.1	Water damage to PM _{2.5} Partisol
London Westminster	89.4	-	74.6	97.5	93.5	89.5	88.9	Partisol pump failure
Newcastle Cradlewell Roadside	-	-	-	89.8	-	-	89.8	Air conditioning fault
Northampton Kingsthorpe	-	-	90.9	97.7	94.1	5.5	72.1	Site relocated and SO ₂ deaffiliated
Nottingham Centre	-	55.8	90.0	97.5	95.0	97.0	87.1	PM ₁₀ regional outlier
Oxford St Ebbes	-	84.0	80.5	82.9	-	-	82.5	Power failures
Plymouth Centre	-	93.2	67.6	97.5	98.9	-	89.3	Low PM _{2.5} volatile concentrations
Sandy Roadside	-	75.6	67.0	98.5	-	-	80.3	FDMS faults
Scunthorpe Town	-	84.0	-	90.8	-	92.6	89.1	Excessively high dewpoints
Sheffield Centre	96.9	96.9	96.9	50.6	97.4	93.7	88.8	Converter setting moved away from 100% in software
Southend-on-Sea	-	-	71.6	70.7	88.4	-	76.9	Site turned off due to aircon fault
Southwark A2 Old Kent Road	-	82.1	-	80.3	-	-	81.2	Lengthy power failure resulted in loss of analyser firmware
Stanford-le-Hope Roadside	-	81.8	81.6	93.1	-	99.4	89.0	Poor quality PM data
Sunderland Silksworth	-	-	69.0	89.9	90.7	72.3	80.5	Site turned off due to water ingress
Walsall Woodlands	-	-	-	96.6	74.0	-	85.3	Leaking sample inlet filter
Wirral Tranmere	-	-	98.2	0.0	0.0	-	32.7	Internal sampling for NO _x and O ₃
N Ireland								
Armagh Roadside	-	81.5	-	96.1	-	-	88.8	Drier fault
Ballymena Ballykeel	-	-	-	-	-	83.8	83.8	Logger and lamp faults
Derry	-	50.3	94.3	99.3	99.4	98.7	88.4	Poor quality data following drier change
Lough Navar	-	75.5	-	-	95.9	-	85.7	Analyser removed for workshop repair
Scotland								
Bush Estate	-	-	-	76.4	99.2	-	87.8	Several serious analyser faults and no calibration gas.
Dumbarton	-	-	-	46.1	-	-	46.1	Data deleted due to lack of

Site	CO	PM ₁₀	PM ₂₅	NO ₂	O ₃	SO ₂	Site Avg.	Principal reason for data loss
Roadside								LSO calibrations
Edinburgh St Leonards	95.8	68.2	71.6	98.6	92.1	98.1	87.4	FDMS leaks and air con faults
Glasgow Kerbside	-	55.4	78.1	91.3	-	-	74.9	Historically poor quality data; valve leaks
Lerwick	-	-	-	-	74.2	-	74.2	Sampling fault
Wales								
Cardiff Centre	91.8	78.7	70.9	91.0	92.2	91.7	86.0	Power failures and drier faults
Mold	-	-	-	76.3	98.0	-	87.2	NOx converter fault

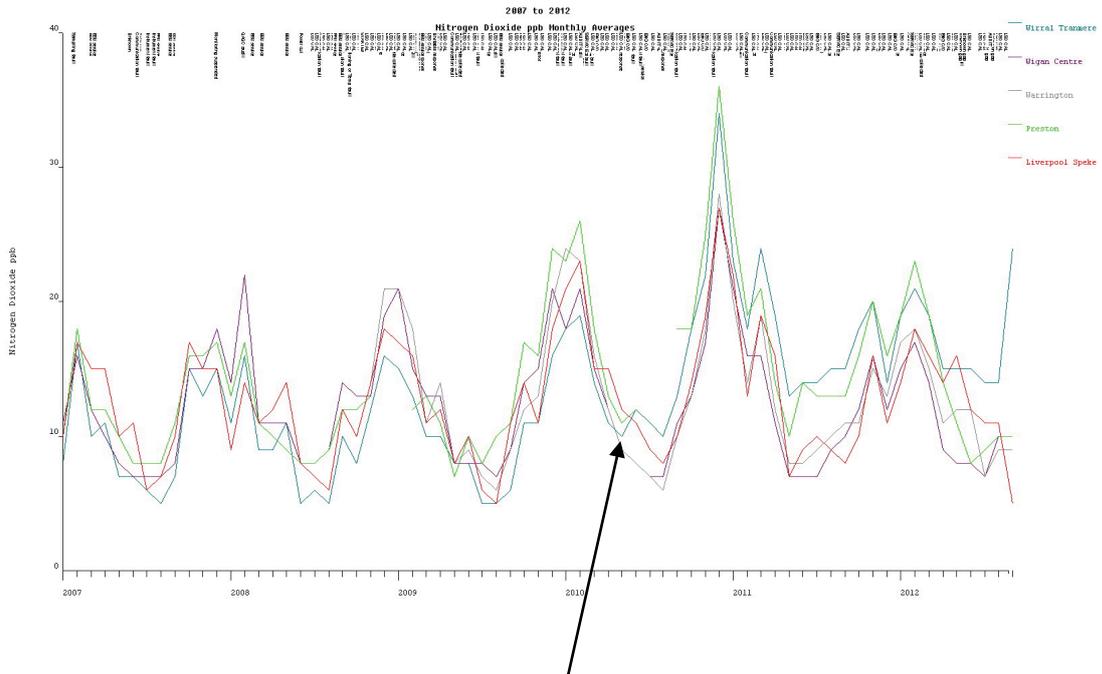
12.2 Wirral Tranmere

Concerns were raised during summer 2012 that the long-term average concentrations of NO₂ at Wirral Tranmere were rising above what might be expected for a background site. Initial investigations suggested that the problem may be related to the encroachment of vegetation, but an inspection by the QA/QC unit in January 2013 revealed the sample tubes were partly sampling internal air being blown out of the tube carrying the inlets through the roof-see Figure 12.1. On previous instruction in June 2011 by the QA/QC Unit, ESUs were instructed to ensure that these inlets were sealed to prevent contamination of the sample. Similar problems had been seen previously at Mold and Preston in 2010. The Wirral inlet was found to be partly sealed with Blu-Tac, which had dropped out of position. There appears to be a change in monthly averages in May 2010 (see Figure 12.2), and so data have been deleted from then to January 2013. As the ozone is likely to be affected, this has also been deleted. The QA/QC Unit has had to seal similar leaks at various sites over the last three years, and ESUs are reminded of the importance of ensuring the integrity of the sampling system.

Figure 12.1 Wirral Tranmere sample inlet, January 2013



Figure 12.2 Wirral Tranmere NO₂ compared to other sites



Wirral Tranmere NO_x shows a step change compared to other sites in May 2010.

Appendices

Appendix 1: Recommendations for Upgrade or Replacement of
Equipment

Appendix 2: Partisol Data – October – December 2012

Appendix 3: Information for New Sites

Appendix 1 - Recommendations for Upgrade or Replacement of Equipment

As requested by Defra, QA/QC Unit has provided a list of suggestions for equipment that may need replacing or upgrading in the network. The following provides a summary of the outstanding issues to date. Recommendations have been prioritised as follows:

Priority	Definition	Time-scale
High*	Immediate action necessary to avoid compromising data capture/quality or safety.	Within 2 weeks
Medium	Essential but not immediate	3-6 months
Low	Desirable but not essential	As appropriate

*Note – QA/QC Unit's practice is to notify CMCU immediately of any high priority issues at the time of the event.

Table A1 Recommendations.

Recommendations February 2012	Priority	Action
ESUs are reminded of the importance of supplying service records for Partisol samplers to QA/QC Unit.	High	ESU
Zero air scrubbers to be changed for zero air cylinders at all sites (where possible).	Medium	QA/QC ESU
Recommendations August 2008	Priority	Action
Many sites require modifications to permit safe roof access for measuring PM analyser flows.	High	CMCU
Recommendations January 2008	Priority	Action
It is recommended that LSOs continue to pay particular attention to the NO ₂ calibration results, to see whether the NO response is significantly higher (>10ppb) than that obtained for the zero calibration. These observations should be reported to CMCU as soon as possible.	High	LSO
It is strongly recommended that ESUs clean all NOx analyser switching valves during servicing, and ensure the valve is leak checked afterwards. Suspect leaking valves are highlighted by the QA/QC Unit during audits.	High	ESU
Recommendations January 2007	Priority	Action
ESUs to ensure all NOx converter software settings to be 100%.	High	ESUs to check at service

Appendix 2

Partisol Data: October-December 2012

Table A2 Principal Reasons for Partisol Data Loss

Site	PM ₁₀	PM ₂₅	Site Average	Principal reason for data loss
London Westminster	-	84.8	84.8	Power failures and filter exchange faults
Auchencorth Moss	53.3	98.9	76.1	Water ingress resulting in waterlogged filters
Wrexham	82.6	96.7	89.7	Power supply heater burned out

Appendix 3

Information for New Sites

Details of all site locations can be found at <http://uk-air.defra.gov.uk/interactive-map>

RICARDO-AEA

The Gemini Building
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OX11 0QR

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Fax: 01235 753001

www.ricardo-aea.com