QAQC Report for the Automatic Urban and Rural Network, October-December 2017

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Contact:

Alison Loader
Ricardo Energy & Environment
Gemini Building, Harwell, Didcot, OX11 0QR, United Kingdom

t: +44 (0) 1235 75 3632

e: alison.loader@ricardo.com

Ricardo is certificated to ISO9001, ISO14001 and OHSAS18001

Author:

Stewart Eaton

Approved By:

Alison Loader

Date:

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Executive summary

Ricardo Energy & Environment carries out the quality assurance and quality control (QA/QC) activities for the Automatic Urban and Rural Monitoring Network (AURN) on behalf of the UK Environment Agency, Department for Environment, Food and Rural Affairs (Defra), the Scottish Government, Welsh Government and Department of Agriculture, Environment and Rural Affairs (DAERA) in Northern Ireland. This report summarises the QAQC activities in the final quarter of 2017 (October to December 2017), and for the calendar year 2017 as a whole. A total of 164[1] monitoring stations in the AURN operated during the three-month period October – December 2017.

Ratified hourly average data capture for the network averaged 95.55% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the three-month reporting period October-December 2017. Average data capture for all pollutants were above 85%. There were 17 monitoring stations with data capture less than 90% for the period, of which 11 had data capture below 85%.
The target for annual data capture is 85%, which is based upon the 90% data capture target of the Air Quality Directive, with an allowance of 5% for planned maintenance. For the whole calendar year 2017, ratified hourly average data capture for the network averaged 93.56% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$). There were 20 monitoring stations with data capture less than 90% for the period, of which 13 had data capture below 85%. The main reasons for data loss were sampling faults, closures for cabin repairs, poor analyser performance and persistent temperature problems.

Ricardo Energy & Environment carried out two Network Intercalibration exercises during calendar year 2017, in winter (January - March) and summer (July - September). The data were ratified quarterly in arrears and made available via Defra's online UK Air Information Resource (UK-AIR). In addition, calibration of all ozone analysers was carried out in April and October.

The routine QA/QC procedures include checking of particulate analyser baselines. The CEN standard method for ambient particulate matter EN16450 states that action must be taken when baseline response is higher than 3 µg m^{-3} but does not state what the action should be. Up to 2017 the only agreed action was to delete the data. However, as part of ongoing improvement activities a protocol was agreed in early 2015 to enable baselines to be corrected where baseline responses exceed 3 µg m^{-3}. From 2015, the dataset has been assessed and baselines adjusted where there is evidence to suggest this is appropriate, for example, a high zero response.

[1] Note: this doesn't count the two Partisol gravimetric samplers which are co-located at sites with FDMS instruments, and treated as separate sites for data processing purposes.

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1 Introduction

1.1 Background

The UK Automatic Urban and Rural Network (AURN) was established to provide information on air quality throughout the UK for a range of pollutants. The primary function of the AURN is to provide data in compliance with EU Directives on Air Quality. However, in addition, the data and information from the AURN are required by scientists, policy makers and planners to enable them to make informed decisions on managing and improving air quality for the benefit of health and the natural environment.

A number of organisations are involved in the day-to-day running of the network. Currently, the role of Central Management and Co-ordination Unit (CMCU) for the AURN is contracted to Bureau Veritas, whilst the Environmental Research Group (ERG) of King's College London has been appointed as Management Unit for the AURN monitoring stations that are also part of the London Air Quality Network (LAQN). Ricardo Energy & Environment undertakes the role of Quality Assurance and Quality Control Unit (QA/QC Unit) for stations within the AURN. The responsibility for operating individual monitoring stations is assigned to Local Site Operators (LSOs): local organisations with relevant experience in the field under the direct management (and contract to) CMCU. Calibration gases for the network are supplied by Air Liquide (UK) Ltd and are provided with an ISO17025 certificate of calibration by Ricardo. The monitoring equipment is serviced and maintained by a number of Equipment Support Units, under contract to the CMCU.

Dissemination of the data from the AURN via UK-AIR (the UK online Air Information Resource, http://uk-air.defra.gov.uk/) and other media such as social media and freephone services is undertaken by the Data Dissemination Unit (DDU). A summary report of the data is also published annually in the "Air Pollution in the UK" series of reports, available on UK-AIR.

A total of 164 monitoring stations in the AURN operated during this quarter. This *doesn't* include the two stations where Partisol gravimetric particulate samplers were co-located with automatic particulate analysers. (The gravimetric data have historically been used in validating the performance of the automatic analysers). For data processing purposes, in these cases the gravimetric sampler is treated as a separate station; and they are shown, and counted, separately in the data capture tables in section 4. Hence, in these tables the total number of sites appears as 166. The main reasons for data loss at the stations are discussed in section 4. These were predominantly due to instrument or air conditioning faults, response instability or problems associated with the replacement of analysers and infrastructure.

1.2 What this Report Covers

This report covers the three-month period October to December 2017, or "Quarter 4" of the year. As it is the final quarterly report of the year, it also includes a summary of significant events and statistics for the full calendar year, a summary of health and safety activities, an inventory of Environment Agency-owned equipment held by the QA/QC Unit in connection with this work, and a section relating to issues of improved technologies. This report covers the main QA/QC activities; the relevant CMCU reports should be consulted for more detail on station operational issues.

1.3 Where to Find More Information

Further information on the AURN can be found in the following:

- UK-AIR at https://uk-air.defra.gov.uk/, which contains information on individual stations along with real-time hourly data, graphs and statistics.

1.4 Changes to the Network during 2017

Table 1.1 shows the new monitoring stations which were commissioned in 2017, and those that closed in 2017, as well as any additional instruments installed.

Table 1.1 Station changes in 2017

New stations	Pollutants	Date started
Plymouth Tavistock Road	NO_2	1 Jan 2017
Derby St Alkmund's Way	NO_2	20 Jan 2017
Northampton Spring Park	NO_2 O_3 $PM_{2.5}$	27 Mar 2017 NO_2 O_3) 8 May 2017 ($PM_{2.5}$)
Coventry Binley Road	NO_2	25 Apr 2017
Bristol Temple Way	NO_2 PM_{10}	4 May 2017 (NO_2) 1 Nov 2017 (PM_{10})
Ballymena Antrim Road	NO_2	13 Apr 2017
Dundee Mains Loan	NO_2	5 Oct 2017
Borehamwood Meadow Park	NO_2	18 Oct 2017
Hartlepool St Abbs Walk	NO_2	24 Oct 2017
Immingham Woodlands Avenue	NO_2	6 Nov 2017
Telford Hollinswood	NO_2	16 Nov 2017
Edinburgh Nicolson Street	NO_2	18 Dec 2017
Station closures	**Pollutants**	**Date closed**
Northampton Kingsthorpe	NO_2 O_3 $PM_{2.5}$	27 Mar 2017
London Harrow Stanmore	$PM_{2.5}$	28 Apr 2017
Birmingham Tyburn	$PM_{2.5}$ PM_{10}	6 June 2017
New analysers at existing stations	**Pollutants**	**Date started**
St Helens Linkway	PM_{10}	7 Feb 2017
Christchurch Barrack Road	$PM_{2.5}$	30 Oct 2017
Replacement analysers at existing stations	**Pollutants**	**Date started**
Hull Holderness Road	$PM_{2.5}$ (BAM replaced FDMS)	26 Jan 2017
Bournemouth	$PM_{2.5}$ (BAM replaced Partisol)	5 Dec 2017

2 Methodology

2.1 Overview of QA/QC Activities

The QA/QC activities consist of the following key parts:

- QA/QC audits of all analysers in the network every six months (three months for ozone)
- Ratification of the data on a three-monthly basis, and upload of ratified data to the Data Dissemination Unit
- Assessment of new station locations in conjunction with the CMCU, and assessment of compliance with the siting criteria in the Directive
- Investigation of instances of suspected poor-quality data.

2.2 QA/QC Audits

2.2.1 Purpose of Intercalibration

The QA/QC intercalibration audits fulfil a number of important functions:

- A “health check” on the production of provisionally scaled data, which is rapidly disseminated to the public soon after collection.
- Identification of poorly-performing analysers and infrastructure, together with recommendations for corrective action.
- A measure of network performance, by examining for example, how different NOx analysers around the network respond to a common gas standard. This test checks how “harmonised” UK measurements are; i.e. that a 200ppb NO_2 pollution episode at any given monitoring station would be reported in exactly the same way at every other station in the UK, regardless of the location or the analyser used to record the event.
- Assessment of the area around the monitoring station: has the environment changed in the last six months? Is the location still representative of the station classification?

The QA/QC audits test the following aspects of analyser performance:

1. Analyser accuracy and precision. These are basic checks to ensure analysers respond to known concentrations of gases in a reliable manner.
2. Instrument linearity. This test refines the response checks on analysers, by assessing whether doubling a concentration of gas to the analyser results in a doubling of the analyser signal response. If an analyser’s response characteristics are not linear, data cannot be reliably scaled into concentrations.
3. Instrument signal noise. This test checks that an analyser responds to calibration gases in a stable manner with time. A “noisy” analyser may not provide high quality data which may be difficult to process at lower concentrations.
4. Analyser response time. This test checks that the analyser responds quickly to a change in gas concentrations. If analyser response is too slow, data may not accurately reflect ambient concentrations.
5. Leak and flow checks. These tests ensure that ambient air reaches the analysers, without being compromised in any way. Leaks in the sampling system can affect the ability of the analyser to sample ambient air reliably.
6. NOx analyser converter efficiency. This test evaluates the ability of the analyser to measure NO_2. An inefficient converter severely compromises the data from the analyser.
7. FDMS k_0 evaluation. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine its accuracy compared to the stated value. This is only required on FDMS based particulate instruments.
8. Particulate analyser flow rate checks. These tests ensure that the flow rates through critical parts of the analyser are within specified limits. There are specific analyser flow rates that are

set to make sure particle size fractions and mass concentration calculations are performed correctly.

9. SO_2 analyser hydrocarbon interference. This test evaluates the analyser's ability to remove interfering hydrocarbon gases from the sample gas. A failed test could have implications for the measurement uncertainty.
10. Evaluation of station cylinder concentrations. These tests use a set of certified cylinders that are taken to all the stations. The concentrations of the station cylinders are used to scale pollution datasets, so it is important to ensure that the concentrations of gases in the cylinders do not change.
11. Competence of Local Station Operators (LSOs) in undertaking calibrations. As it is the calibrations by the LSOs that are used to scale pollution datasets, it is important to check that these are undertaken competently.
12. Zero "calibration" of all automatic PM analysers. This test allows the baseline performance of PM analysers to be evaluated, to determine whether any remedial action is required to the analyser or baseline to be corrected during ratification.

Once all data have been collected, a "Network Intercomparison" is conducted. This utilises the audit gas cylinders transported to each station in the Network. These cylinders are recently calibrated by the Calibration Laboratory at Ricardo Energy & Environment, and allow us to examine how different station analysers respond when they are supplied with the same gas used at other stations. For ozone analysers, the calibration is undertaken with recently calibrated ozone photometers.
The technique used to process the intercomparison results is broadly as follows:

- The analyser responses to audit gas are converted into concentrations, using provisional calibration factors obtained from the Management Units on the day of the intercalibration. These factors are also used for the provisional data supplied to UK-AIR.
- These individual results are tabulated, and statistical analyses undertaken (e.g. network average result, network standard deviation, deviation of individual stations from the network mean etc.).

These results are then used to pick out problem stations, or "outliers", which are investigated further to determine reasons and investigate possible remedies for the outliers. The definition of an outlier is an analyser result that falls outside the following limits:

- ±10% of the network average for NOx, CO and SO_2 analysers,
- ±5% of the reference standard photometer for Ozone analysers,
- ±2.5 % of the stated k_0 value for FDMS analysers,
- ±10% for particulate analyser flow rates,
- Particulate analyser average zero response within ±3.0 µg m^{-3}.
- ±10% for the recalculation of station cylinder concentrations.

Thus, the intercalibration investigates the quality of provisional data output by the Management Units for use in forecasting, interactive television services and the web. It also provides input into the ratification process by highlighting stations where close scrutiny of datasets is likely to be required. Any outliers that are identified are rigorously checked to determine the cause, and any required corrective action to be taken, if necessary. There are a number of likely main causes for outlier results, as discussed below:

- Drift of an analyser between scheduled LSO calibrations. This is by far the most common cause of an outlier result, and one that is simply corrected for during ratification of data.

- Drift of station cylinder concentrations between intercalibrations. Station cylinders can sometimes become unstable, especially at low pressures. All station cylinder concentrations are checked every six months, and are replaced as necessary.
- Erroneous calibration factors. It can occasionally happen that an analyser calibration is unsuccessful, and results in unsuitable scaling factors being used to produce pollution datasets. These are identified and corrected during ratification.
- Pressurisation of the sampling system at the audit. Occasionally, an analyser can be very sensitive to small changes in applied flow rates of calibration gas. This is more difficult to identify and correct, and may have consequences for data quality.
- Leaks, sample switching valves, etc. Outliers can be generated if an analyser is not sampling ambient air properly. It is likely that if a leaking analyser is identified, data losses will result.

Full audits of all analysers are carried out at six-monthly intervals in the winter (January-March) and summer (July-September). In addition, audits of ozone analysers are also carried out in spring (April) and autumn (October).

2.2.2 Methodology for FDMS & BAM Baseline Checks

As part of the routine QA/QC audits, particulate analysers (FDMS and BAM) have zero checks carried out every six months using filters on the inlets for a few days. This allows identification of analysers which have high baselines, often due to inefficient driers (for FDMS). The CEN standard method for ambient particulate matter EN16450 states that action must be taken when baseline response is higher than 3 µg m^{-3} but does not state what the action should be. Originally, the only agreed action was to delete the data. However, as part of ongoing improvement activities a protocol has been agreed to enable baselines to be corrected where baseline responses exceed 3 µg m^{-3}. The 2017 dataset have been assessed and baselines adjusted where there is evidence to suggest this is appropriate, for example a high zero response. This has resulted in some previously rejected data being reinstated. This protocol will continue from now onwards.

2.3 Overview of Data Ratification

Data for each station are supplied monthly by the CMCUs. Once initial monthly data files have been received, checked and loaded into Ricardo Energy & Environment's MODUS data handling system, the process of data ratification begins. This process is required to refine data scaling based on all the calibration and audit data available, and to identify, withdraw or flag anomalous data due to instrument or sampling faults or where data fall outside the Uncertainties or Limits of Detection defined by the Data Quality Objectives (DQOs) of Directive 2008/50/EC (the Air Quality Objective) and the European Union's Implementing Provisions for Reporting.

3 Intercalibration Results Summary (2017)

3.1 National Network Overview

A summary of the findings of the 2017 intercalibrations is given in Table 3.1.

Table 3.1 Summary of Network Intercalibrations, 2017

	Winter 2017			Summer 2017		
Parameter	Number of outliers	Number in network	% outliers in total	Number of outliers	Number in network	% outliers in total
NOx analyser	14	144	9.7	10	146	6.8%
CO analyser	2	7	28.6	2	7	28.6%
SO_2 analyser	9	27	33.3	3	27	11.1%
Ozone analyser	10	75	13.3 (2 more than 10%)	12 (7 more than 10% from standard)	75	16%
FDMS and BAM analysers	14 x K_0, 2 x flows (14 x zero tests)	79 PM_{10} 71 $PM_{2.5}$ FDMS		17 x k_0, 5 x flows	78 PM_{10} 73 $PM_{2.5}$	14.6%
Gravimetric PM analysers	0	14	0	0	10	-
Cylinders	9	178	5.1	7	179	3.9%
Total	60 analysers	417 analysers	14.4% of analysers	55 analysers	416 analysers	13.2% of analysers

In the spring 2017 ozone intercalibration, there were 16 analysers out by more than 5%. The figure for the autumn exercise was 15.

3.2 Calculations of Measurement Uncertainty

The uncertainty of measurement of each analyser is calculated at each intercalibration. These are presented in the January-March and July-September QA/QC reports.

3.3 Certification

Certificates of calibration for each intercalibration exercise are provided on the AURN Hub (at http://aurnhub.defra.gov.uk/login.php) and may be provided on request.

4 Data Ratification Results (4th Quarter)

4.1 Data Capture – Network Overview

4.1.1 Overall Data Capture

Ratified hourly average (daily average for Partisols) data capture for the network averaged 95.55% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the three-month reporting period October-December 2017. Data capture statistics 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 calculated. For stations starting or closing during the period, the data capture is based on the actual date starting or closing. All pollutants achieved 85% or higher data capture on average. The data capture target for the purposes of monitoring compliance with the EU Air Quality Directive (Directive 2008/50/EC) is 90% excluding planned servicing and maintenance. For practical purposes in the AURN, planned maintenance is assumed to be 5% so a target of 85% data capture is used. Data capture for each quarter is shown in Table 4.1.

Table 4.1 AURN Ratified Data Capture (%) by Quarter, 2017

Quarter	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Mean
Q1 2017	90.88	95.71	95.99	91.86	93.09	91.74	94.24
Q2 2017	97.46	95.42	97.66	91.23	93.96	91.69	93.83
Q3 2017	84.26	93.84	95.72	87.34	89.05	94.75	91.81
Q4 2017	98.00	96.54	97.51	94.73	93.36	91.22	95.55
2017	**92.67**	**95.42**	**96.94**	**90.93**	**91.40**	**93.32**	**93.56**

The data captures from previous quarters have been recalculated to reflect any data changed in subsequent quarters.

Note that the overall data capture value is the average calculated from the data captures at individual stations, these themselves being the average of all pollutants at that station.

4.1.2 Generic Data Quality Issues

The following generic data quality issues have been identified in 2017:

- The use of obsolete mass transducer filters on FDMS analysers, resulting in high analyser noise.
- The use of certain specific weights of mass transducer filter for k0 checks which gave erroneous results. The investigation is still ongoing.
- Improperly configured sampling systems which compromise the sampled air, resulting in false readings. This has been a problem in the past, and during 2017 continued to cause significant data loss, for example at Edinburgh St Leonards and London Westminster.

4.1.3 Data Precision

As part of the requirements of the INSPIRE Directive 2007/2/EC and 2011/850/EU Implementing Decision, data are reported to one decimal place (two for CO).

4.2 Data Capture and Station-Specific Issues October-December 2017- England (Excluding Greater London)

Table 4.2 shows percentage data capture for stations in England during Quarter 4 of 2017. The table is followed by details of individual station-specific issues.

Table 4.2 Data Capture – England – Quarter 4 (Oct-Dec) 2017

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Barnsley Gawber		99.86	99.68			99.86	99.80
Barnstaple A39				71.42	80.89		76.15
Bath Roadside		99.73					99.73
Billingham		99.64					99.64
Birkenhead Borough Road		99.77					99.77
Birmingham A4540 Roadside		99.68	99.86	93.25	99.77		98.14
Birmingham Acocks Green		99.95	99.91		92.53		97.46
Blackburn Accrington Road		99.77					99.77
Blackpool Marton		95.61	99.82		99.32		98.25
Borehamwood Meadow Park		96.51					96.51
Bournemouth		99.86	99.50		84.20[1]		94.46
Bradford Mayo Avenue		87.05					87.05
Brighton Preston Park		99.64	99.59		80.43		93.22
Bristol St Paul's		99.41	99.46	99.14	96.92		98.73
Bristol Temple Way		99.64		91.12			95.38
Bury Whitefield Roadside		99.64		98.69			99.16
Cambridge Roadside		98.55					98.55
Cannock A5190 Roadside		97.24					97.24
Canterbury		99.82	99.91				99.86
Carlisle Roadside		99.64		99.82	99.28		99.58
Charlton Mackrell		98.64	99.91				99.28
Chatham Roadside		99.77		99.68	99.32		99.59
Chesterfield Loundsley Green		86.64		93.70	99.64		93.33
Chesterfield Roadside		99.73		99.86	99.18		99.59
Chilbolton Observatory		99.77	99.77	99.64	99.50	95.38	98.81
Christchurch Barrack Road		99.55			85.55		92.55
Coventry Allesley		95.65	99.86		95.11		96.87

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Coventry Binley Road		99.77		99.32			99.55
Derby St Alkmund's Way		99.86					99.86
Doncaster A630 Cleveland Street		98.91					98.91
Eastbourne		99.05			98.73		98.89
Exeter Roadside		99.55	99.91				99.73
Glazebury		99.82	99.95				99.89
Hartlepool St Abbs Walk		98.79					98.79
High Muffles		99.91	97.46				98.69
Honiton		95.56					95.56
Horley		96.06					96.06
Hull Freetown		99.91	99.91		100.00	99.68	99.88
Hull Holderness Road		99.64		98.19			98.91
Immingham Woodlands Avenue		98.02					98.02
Ladybower		99.86	89.22			97.92	95.67
Leamington Spa		99.73	99.77	99.86	99.73		99.77
Leamington Spa Rugby Road		99.68		95.38	100.00		98.35
Leeds Centre	99.14	99.86	99.86	99.95	99.82	99.55	99.70
Leeds Headingley Kerbside		100.00		99.37	93.93		97.77
Leicester A594 Roadside		99.55		95.52			97.53
Leicester University		99.91	99.91		97.92		99.25
Leominster		34.33	40.17				37.25
Lincoln Canwick Road		99.73					99.73
Liverpool Speke		99.82	99.91	100.00	99.82	99.82	99.87
Lullington Heath		99.50	99.82			95.06	98.13
Luton A505 Roadside		99.86					99.86
Manchester Piccadilly		99.82	99.50		93.98	99.28	98.14
Manchester Sharston		98.60	99.82				99.21
Market Harborough		95.43	99.55				97.49
Middlesbrough		99.55	99.86	99.41	97.78	99.50	99.22

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Newcastle Centre		99.86	99.82	99.73	99.73		99.78
Newcastle Cradlewell Roadside		66.21					66.21
Northampton Spring Park		99.59	99.55		98.64		99.26
Norwich Lakenfields		99.86	99.86	99.73	98.82		99.57
Nottingham Centre		99.86	99.91	85.73	99.95	99.77	97.05
Nottingham Western Boulevard		99.82		99.46			99.64
Oldbury Birmingham Road		99.77					99.77
Oxford Centre Roadside		95.38					95.38
Oxford St Ebbes		98.78		98.10	79.94		92.27
Plymouth Centre		98.82	99.91	99.91	99.68		99.58
Plymouth Tavistock Road		99.86					99.86
Portsmouth		99.86	93.66	99.37	72.01		91.23
Preston		99.46	99.32		99.68		99.49
Reading London Road		95.65		99.14			97.40
Reading New Town		99.91	99.86	96.56	98.28		98.65
Rochester Stoke		99.68	99.86	99.64	99.28	99.68	99.63
Salford Eccles		95.47		99.05	99.64		98.05
Saltash Callington Road				91.08	99.59		95.34
Sandy Roadside		99.86		98.46	99.28		99.20
Scunthorpe Town		99.64		86.78		88.13	91.52
Shaw Crompton Way		99.55					99.55
Sheffield Barnsley Road		93.93			87.93		90.93
Sheffield Devonshire Green		99.86	99.86	99.86	100.00		99.90
Sheffield Tinsley		98.32					98.32
Sibton			99.41				99.41
Southampton A33		99.82		99.50			99.66
Southampton Centre		99.86	99.82	99.91	99.77	99.23	99.72
Southend-on-Sea		97.83	97.28		45.70		80.27
St Helens Linkway		99.77		99.46			99.62
St Osyth		93.25	99.86				96.56

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Stanford-le-Hope Roadside		98.60		99.18	98.87		98.88
Stockton-on-Tees A1305 Roadside		93.75			99.91		96.83
Stockton-on-Tees Eaglescliffe		99.23		99.86	99.82		99.64
Stoke-on-Trent A50 Roadside		98.87		91.67			95.27
Stoke-on-Trent Centre		99.77	99.77		99.00		99.52
Storrington Roadside		99.77					99.77
Sunderland Silksworth		95.20	99.95		99.82		98.32
Sunderland Wessington Way		99.55					99.55
Telford Hollinswood		97.27					97.27
Thurrock		99.59	91.98	99.68		98.60	97.46
Walsall Woodlands		99.95	99.32				99.64
Warrington		95.47		39.81	86.68		73.99
Weybourne			99.91				99.91
Wicken Fen		99.86	97.55			92.98	96.80
Widnes Milton Road		69.75					69.75
Wigan Centre		99.91	99.91		95.70		98.51
Wirral Tranmere		99.86	57.56		99.41		85.61
Worthing A27 Roadside		99.64					99.64
Yarner Wood		95.34	98.19				96.76
York Bootham		98.73		87.68	96.56		94.32
York Fishergate		93.12		99.23	99.77		97.37
Number of Stations	**1**	**103**	**49**	**44**	**51**	**15**	**107**
Number of stations < 85 %	**0**	**3**	**2**	**2**	**6**	**0**	**7**
Number of stations < 90%	**0**	**5**	**3**	**5**	**9**	**1**	**9**
Average	**99.14**	**97.32**	**97.02**	**95.50**	**95.04**	**97.63**	**96.03**

1. Bournemouth – data capture calculated from the original Partisol, and the BAM which replaced it.

Barnstaple A39

Problems with cyclic sample dew points and high volatile concentrations seen throughout much of 2017 continued this quarter. Poor air conditioning performance is likely to be the cause. The PM_{10} data were deleted up to 26th October and the $PM_{2.5}$ data to 18th October.

Bournemouth
The Partisol was replaced by a BAM during the quarter, but some BAM data were lost as a result of an incorrectly fitted tape.

Bradford Mayo Avenue
Following concerns of low data, the ESU were called out on 8th January 2018 when a blockage was found in a critical orifice. Data have been deleted from 22nd to 31st December, and on to 8th January 2018.

Brighton Preston Park
The $PM_{2.5}$ Partisol was switched off from 29th October to 15th November due to an unsafe electrical supply.

Chesterfield Loundsley Green
The NOx converter was changed twice due to suspected leaks; data were lost between 16th to 24th November. Further data were lost due to autocal run-on.

Christchurch Barrack Road
The o-ring seal on the sample head was found to be damaged on 13th October; data were lost from then until 25th October.

Ladybower
A number of spurious spikes in the O_3 data were deleted during ratification; it is assumed these were due to power supply issues.

Leominster
The site was recommissioned on 23rd November following a period of closure due to damage to the power supply from a fire nearby; however, air conditioning problems and moisture in the NOx analyser resulted in further data loss.

Newcastle Cradlewell Roadside
Following failure of the LA-owned site analyser in July, a replacement NOx analyser was installed on 31st October.

Nottingham Centre
The PM_{10} volatile concentrations were regional outliers between 3rd and 14th December; these were deleted during ratification.

Oxford St Ebbes
A power cut on 7th December caused the $PM_{2.5}$ FDMS analyser to display a number of error codes. Repair on site was unsuccessful, and a ‘hot spare’ sensor unit was installed on 11th December. The performance of this unit was very poor, with several periods of noisy data being deleted up to and beyond the end of the year.

Portsmouth
When the zero test HEPA filter was removed on 27th September, an instrument fault was observed and an ESU call out was issued. The ESU for the $PM_{2.5}$ FDMS declined to attend any call outs to this affiliate site until the air conditioning unit had been attended to by the local authority. On 5th October the ESU acknowledged an improvement in enclosure temperature and the engineer attended the callout on 6th October. On arrival the engineer reported a faulty mass flow controller. Repair at site was not possible and the system was removed for workshop investigation. A replacement hot spare

system was installed on 16th October and all available data over this period were deleted. A further pump fault resulted in the loss of data from 6th to 14th November.

Sheffield Barnsley Road
A post-audit zero check caused the loss of PM_{10} data from 23rd to 27th November.

Southend-on-Sea
Following loss of firmware on the $PM_{2.5}$ FDMS on 18th October, the analyser was removed for workshop repair and a hot spare installed. This suffered a power supply fault on 7th November; this was repaired on 20th November but failed again on 30th November. It is thought the problems were caused by supply voltage fluctuations and remedial work was completed in January 2018.

Warrington
The PM_{10} FDMS lost its firmware on 7th November. The ESU reinstalled it on 10th November but at the winter 2018 audit, the k_0 constant was found to be 49% out. The data were rescaled accordingly, but then were not in line with other regional sites and therefore data from 7th November to 31st December (and on into 2018) have been deleted. The $PM_{2.5}$ data were deleted 5th November (very negative volatile concentrations) and 10th to 19th December (very noisy data due to dirty filters).

Wirral Tranmere
The filter holder on the ozone analyser was found to be loose at the winter 2018 audit on 17th January. The analyser was found to under-read by 45% as a result of a faulty pressure sensor. Data have been deleted from 23rd November up to the ESU visit on 19th January 2018.

York Bootham
The PM_{10} was a regional outlier from 8th to 12th December, and data from this period were deleted. There were other short periods where measured PM_{10} was significantly lower than the $PM_{2.5}$ and were also deleted during ratification.

4.3 Data Capture and Station-Specific Issues October-December 2017- Greater London

Table 4.3 shows percentage data capture for stations in Greater London during Quarter 4 of 2017. The table is followed by details of individual station-specific issues.

Table 4.3 Data Capture – Greater London - Quarter 4 (Oct-Dec) 2017

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Camden Kerbside		69.84		73.73	99.77		81.11
Ealing Horn Lane				99.37			99.37
Haringey Roadside		95.65					95.65
London Bexley		98.28			86.68		92.48
London Bloomsbury		99.77	99.82	98.73	99.68	83.02	96.20
London Eltham		99.64	99.46		69.02		89.37
London Haringey Priory Park South		99.82	99.64				99.73
London Harlington		99.86	89.54				94.70
London Harlington				99.91	99.91		99.91

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
London Hillingdon		99.86	99.91				99.89
London Marylebone Road	93.21	99.23	99.32	96.51	90.58	99.32	96.36
London Marylebone Road				98.91	98.91		98.91
London N. Kensington	99.73	99.82	99.18	99.82	99.59	63.36	93.58
London Teddington Bushy Park					92.66		92.66
London Westminster		99.82			97.83		98.82
Southwark A2 Old Kent Road		91.49		87.86			89.67
Tower Hamlets Roadside		99.46					99.46
Number of Stations	**2**	**13**	**7**	**8**	**10**	**3**	**17**
Number of stations < 85 %	**0**	**1**	**0**	**1**	**1**	**2**	**1**
Number of stations < 90%	**0**	**1**	**1**	**2**	**2**	**2**	**3**
Average	**96.47**	**96.35**	**98.12**	**94.36**	**93.46**	**81.90**	**95.17**

Camden Kerbside

The LSO was asked to attend site on 30th November due to loss of communications. An analyser fault was found, and a replacement part ordered. This was fitted on 27th December and normal operation reinstated. On 10th December, a water leak was discovered on the PM_{10} FDMS inlet; the instrument was switched off to prevent damage. It took several days for the instrument to stabilise after restart.

London Bexley

The $PM_{2.5}$ data were lost between 1st and 12th December due to a broken rain jar on the inlet head.

London Bloomsbury

There were a number of ESU callouts for the SO_2 analyser during this quarter. Ultimately, a hot spare analyser was installed on 14th December, although the performance of this replacement was no better, and data have been deleted from installation up to a lamp replacement in January 2018.

London Eltham

Following a power cut at the beginning of October, the $PM_{2.5}$ FDMS developed a series of cooler faults. Data were lost from 1st to 10th October The ESU attended a number of times, and data quality improved in November, though further cooler and valve faults caused the loss of data from 30th October to 15th November. Faults persisted into 2018.

London Harlington

The O_3 data were lost 29th September to 10th October due to a broken filter holder glass.

London North Kensington

The SO_2 data between 9th October and 11th November have been deleted due to excessive baseline drift. The drift was rectified by an ESU callout.

Southwark A2 Old Kent Road

A detector fault resulted in the loss of NOx data from 14th to 22nd October. Some very noisy PM_{10} data caused by a faulty microswitch were lost from 14th to 25th October.

4.4 Data Capture and Station-Specific Issues October-December 2017– Wales

Table 4.4 shows percentage data capture for stations in Wales during Quarter 4 of 2017. The table is followed by details of individual station-specific issues.

Table 4.4 Data Capture Wales - Quarter 4 (Oct-Dec) 2017

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Aston Hill		99.46	98.10				98.78
Cardiff Centre	99.86	99.05	99.86	92.53	99.50	82.02	95.47
Chepstow A48		94.75		98.96	94.52		96.07
Cwmbran		99.82	99.64				99.73
Hafod-yr-ynys Roadside		99.64					99.64
Narberth		99.68	99.77	97.69		99.64	99.20
Newport		0.00		0.00	0.00		0.00
Port Talbot Margam				100.00			100.00
Port Talbot Margam	99.09	99.55	94.43	94.97	98.82	99.64	97.75
Swansea Roadside		99.64		96.15	99.55		98.45
Wrexham		93.30		97.83	90.22	15.58	74.23
Number of Stations	**2**	**10**	**5**	**8**	**6**	**4**	**11**
Number of stations < 85 %	**0**	**1**	**0**	**1**	**1**	**2**	**2**
Number of stations < 90%	**0**	**1**	**0**	**1**	**1**	**2**	**2**
Average	**99.48**	**88.49**	**98.36**	**84.77**	**80.43**	**74.22**	**87.21**

Cardiff Centre

The SO_2 analyser developed a lamp fault in October, and a hotspare was installed; data from 9th to 25th October have been lost.

Newport

The station was closed throughout the quarter while the enclosure was refurbished.

Wrexham

The SO_2 data were of poor quality and have been deleted from 16th October to 31st December. The data improved following the service in January 2018.

4.5 Data Capture and Station-Specific Issues October-December 2017– Scotland

Table 4.5 shows percentage data capture for stations in Scotland during Quarter 4 of 2017. The table is followed by details of individual station-specific issues.

Table 4.5 Data Capture Scotland - Quarter 4 (Oct-Dec) 2017

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Aberdeen		99.86	99.86	99.23	99.68		99.66
Aberdeen Union Street Roadside		90.04					90.04
Aberdeen Wellington Road		100.00					100.00
Auchencorth Moss			99.91	99.68	86.59		95.39
Bush Estate		99.68	96.29				97.98
Dumbarton Roadside		97.92					97.92
Dumfries		99.64					99.64
Dundee Mains Loan		98.78					98.78
Edinburgh Nicolson Street		97.83					97.83
Edinburgh St Leonards	99.37	99.73	99.64	100.00	99.73	99.73	99.70
Eskdalemuir		74.14	99.91				87.02
Fort William		99.95	99.32				99.64
Glasgow Great Western Road		99.37					99.37
Glasgow High Street		99.82		99.95	99.77		99.85
Glasgow Kerbside		99.68					99.68
Glasgow Townhead		100.00	99.82	99.73	100.00		99.89
Grangemouth		98.46		97.37	92.62	98.46	96.73
Grangemouth Moray		99.46					99.46
Greenock A8 Roadside		99.82		100.00	100.00		99.94
Inverness		99.77		88.04	90.22		92.68
Lerwick			86.78				86.78
Peebles		99.91	99.91				99.91
Strathvaich			99.91				99.91
Number of Stations	1	20	10	8	8	2	23
Number of stations < 85 %	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Number of stations < 90%	**0**	**1**	**1**	**1**	**1**	**0**	**2**
Average	**99.37**	**97.69**	**98.13**	**98.00**	**96.08**	**99.09**	**97.31**

Auchencorth Moss

The $PM_{2.5}$ data were deleted 7th to 21st October due to a failed valve motor.

Eskdalemuir

Faults with the sample pump and the sample valve resulted in the loss of some NOx data in November.

Inverness

The PM_{10} Partisol suffered a number of filter exchange faults during the quarter, and for the period 17th to 20th November it was not possible to tell which filter had been sampling.

Lerwick

The ozone concentrations seen at Lerwick became much higher than other remote stations on 20th December. Data to the end of the year have been deleted.

4.6 Data Capture and Station-Specific Issues October-December 2017- Northern Ireland

Table 4.6 shows percentage data capture for stations in Northern Ireland (also the Mace Head station in the Republic of Ireland) during Quarter 4 of 2017. The table is followed by details of individual station-specific issues.

Table 4.6 Data Capture Northern Ireland (and Mace Head) - Quarter 4 (Oct-Dec) 2017

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Mace Head			99.91				99.91
Armagh Roadside		95.61		99.55			97.58
Ballymena Antrim Road		95.61					95.61
Ballymena Ballykeel		69.93				70.15	70.04
Belfast Centre	95.61	99.64	99.77	99.91	100.00	87.73	97.11
Belfast Stockman's Lane		99.91		99.50			99.71
Derry Rosemount		98.91	99.82	99.77	100.00	99.82	99.66
Lough Navar			99.86	98.19			99.03
Number of Stations	**1**	**6**	**4**	**5**	**2**	**3**	**8**
Number of stations < 85 %	**0**	**1**	**0**	**0**	**0**	**1**	**1**
Number of stations < 90%	**0**	**1**	**0**	**0**	**0**	**2**	**1**
Average	**95.61**	**93.27**	**99.84**	**99.38**	**100.00**	**85.90**	**94.83**

Ballymena Ballykeel

The CMCU detected a change in profile of both the NOx and SO_2 data on 4th December. Remote interrogation by the ESU indicated everything was normal; however, on 14th December, the LSO discovered the sample tubes to both analysers had become detached from the inlet. Data from both analysers have been deleted for this period. Coincidentally, during this period, the SO_2 analyser developed a lamp driver board fault. As this is a LA owned instrument and the part was not covered by the service contract, a lengthy delay ensued while the repair was carried out. The analyser was finally repaired and reinstalled on 20th February 2018.

4.7 Changes to Previously Ratified Data

The following table shows data from previous quarters which have been changed as a result of the ratification process for this quarter (all dates are in 2017 unless otherwise stated).

Table 4.7 Changes Affecting Ratified Data in Previous Quarters

Monitoring Station	Pollutant(s)	Dates	Nature of Change
Aberdeen	O_3	14-30 Sep	Zero baseline adjusted
Aberdeen Union Street Roadside	NOx	9 Aug-30 Sep	Converter rescale
Birmingham A4540 Roadside	$PM_{2.5}$ & PM_{10}	24 July-30 Sep	K_0 rescale
Cannock A5190 Roadside	NOx	All of Q3	Reprocessing of zero baseline.
Charlton Mackrell	O_3	All of 2017.	Reprocessing of zeros and spans throughout 2017
Eskdalemuir	O_3	11 July-30 Sep	Slight rescale.
Exeter Roadside	O_3	24 Jan-30 Sep	Rescale.
Glasgow Townhead	$PM_{2.5}$	2 Aug-30 Sep	K_0 rescale
Glazebury	NOx	Q2 and Q3	Reprocessed.
Grangemouth	$PM_{2.5}$	14-15 Sep	Regional outlier, data deleted, also zero adjustment
Ladybower	SO_2 and NOx	Q3	SO_2: Inclusion of service calibrations and adjustment of sensitivity. NOx: zero baseline needed adjustment at end of Q3.
Leeds Centre	CO	All 2017	Reprocess zero baseline using an offset of 0.07 ppm to account for background concentration. Some Q3 data deleted.
Liverpool Speke	SO_2	All 2017	Processing reviewed and adjusted.
London Bexley	NOx	17 Aug-30 Sep	Rescale.
London Bloomsbury	NOx	Q1 and Q2 2017	Reprocessed Q1/Q2 zeros for NOx.
Lullington Heath	O_3	17 Aug-30 Sep	Rescale.
Middlesbrough	PM_{10}	24 Aug-30 Sep	K_0 rescale
Northampton Spring Park	O_3	29 to 30 Sep	Rescale
Oldbury Birmingham Road	NOx	Q2-Q3	Rescale of Q2-Q4 due to NOx converter issue.
Plymouth Centre	NOx	4 Jul-30 Sep	Ramped correction due to oxidised site cylinder.

Monitoring Station	Pollutant(s)	Dates	Nature of Change
Portsmouth	NOx	13-30 Sep	Rescale of Q3 due to NOx converter issue.
Sheffield Devonshire Green	$PM_{2.5}$	22-30 Sep	K_0 rescale
Southampton A33	NOx	Part of September around LSO calibrations on 3rd & 17th .	Reprocess.
Wicken Fen	NOx	Back to summer service	Converter rescale back into Q3.
Worthing A27 Roadside	NOx	Q1-Q3	Data processing adjusted.

Many of these actions are also relevant to Q4 2017 data and have been incorporated into the ratification process for this quarter.

A list of changes to ratified data is given at http://uk-air.defra.gov.uk/data/changes-to-ratified-data.

4.8 Zero Baseline Correction

Until 2015, the only agreed action that could be taken in the event of a zero baseline response outside the range ±3 µg m^{-3} was to reject data. However, as of 2015, as part of ongoing improvement activities a protocol has been agreed to enable PM baselines to be corrected where baseline responses exceed 3 µg m^{-3}. Baseline correction has been incorporated into the data ratification protocols as of 2015 and the 2017 dataset has also been retrospectively reviewed, and baseline corrections applied where appropriate.

5 Health and Safety Report 2017

The risk status of the following monitoring stations was raised to “High” on the Health & Safety Database during 2017. This list includes all EA monitoring networks, not just the AURN, as the QAQC contractor acts as health and safety co-ordinator for all monitoring networks. All the problems were satisfactorily resolved. Issues which were erroneously raised as “High” have been discounted.
The abbreviation “SET” stands for Site Electrical Test; the periodic inspection of fixed electrical installations. It is often referred to as the PIR, Periodic Inspection Report.

Table 5.1 Summary of High Risk Occurrences 2017

Station	Issue/Problem	Date went to 'High'	Date resolved
Sandy Roadside	Threatening behaviour by local business employee	13/02/2017	w/c 20/02/2017
London Marylebone Road	Failed SET	07/03/2017	w/c 07/03/2017
Newport	Water ingress through fragile roof.	11/08/2017	ongoing
Leominster	Fire very close by. Power supply off and no access until further notice.	18/09/2017	w/c 13/11/2017
Wrexham	Condensation problems due aircon fault.	12/12/2017	18/12/2017

6 Equipment Upgrade Requirements

6.1 Capital Purchases

No equipment upgrades are required at the present time. In early 2017 the Environment Agency made a capital purchase of the following items:

- Five Teledyne T750 ozone photometer/dilution units.
- Five Teledyne T751 zero gas generators.

6.2 Upgrade of Site Gas Regulators

As part of the ongoing maintenance of AURN monitoring stations, the gas regulators are being replaced on a rolling programme. It has been agreed that stations will be provided with selectable flow regulators. This model of regulator offers the following benefits:

- Easily controlled, repeatable flowrate minimising the waste of calibration gas.
- Critical flow orifices are not needed. This allows simplification of the sampling/gas delivery systems at stations, minimising the risk of sampling errors which can result in significant data loss.

For the convenience of the LSO, all regulators at each station should be of the same type. These regulators have been installed by the QA/QC Unit at intercalibration visits, and training offered to LSOs in their correct operation.

7 Inventory of EA-Owned Equipment

This section provides an updated list of all EA-owned equipment used by the QAQC unit. Not all equipment listed is in operational condition.

Table 8.1 Current Asset List as held by Ricardo Energy & Environment

Location	Asset	Serial number	Date in service	Operational	Purpose
Glasgow	API model M401	151	01/10/2000	Y	
Harwell - Ludbridge Mill	API model M401	245	unknown	Y	
Harwell - Ludbridge Mill	API model M401	293	01/05/2004	Y	
Glasgow	API model M703	255	01/01/2010	Y	
Glasgow	Sabio 2010 dilution calibrator	03740708	01/02/2005	N	Dilution of high concentration gases to test linearities and converter efficiencies at station calibrations
Harwell - Ludbridge Mill	Sabio 2020 dilution calibrator	02720306B	01/06/2006	N	
Harwell - Ludbridge Mill	Sabio 2020 zero air generator	02710306B	01/06/2006	N	

Location	Asset	Serial number	Date in service	Operational	Purpose
Harwell - Ludbridge Mill	Sabio 2020 zero air generator	03731208C	01/03/2006	N	
Harwell - Ludbridge Mill	Sabio 2030 ozone photometer	7820708	01/03/2008	N	
Harwell - Ludbridge Mill	Sabio 2010 dilution calibrator	02940306A	01/03/2008	Y	
Harwell - Ludbridge Mill	Drycal flow meter	107881	2006	Y	Measurement of sample flowrate of particulate analysers at station calibrations
Glasgow	Sabio 2020 zero air source	03620708b	2006	N	Dilution of high concentration gases to test linearities and converter efficiencies at station calibrations
Glasgow	Sabio 2020 zero air source	03711208c	2006	N	
Harwell - Ludbridge Mill	Sabio 2020 zero air source	03701208c	2006	N	
Harwell - Ludbridge Mill	AC31 dual chamber NOx analyser	1672	01/03/2003	Y	For ad-hoc investigations at stations as required
Harwell - Ludbridge Mill	TEI 43C SO_2 analyser	386	01/03/2003	Y	
Harwell - Ludbridge Mill	TEI 48C CO analyser	48C-77631-386	01/03/2003	Y	
Harwell - Ludbridge Mill	M265 chemiluminescent ozone analyser	066	01/03/2003	Y	
Glasgow	API fluorescent S02 Analyser Model 100A	1572	unknown	Y	
Glasgow	Thermo NO-NO2-NOx Analyser Model 42c	42c-56236-307	unknown	Y	
Harwell - Ludbridge Mill	API model M703	278	30/06/2010	Y	

Location	Asset	Serial number	Date in service	Operational	Purpose
Harwell - Ludbridge Mill	API model M703	279	30/06/2010	Y	Station ozone calibrations every three months
Harwell - Ludbridge Mill	Ozone analyser Thermo 49i	713021784	unknown	Y	For calibration of ESU photometers
Harwell - Ludbridge Mill	API model M703	254	06/01/2010	Y	Station ozone calibrations every three months
Harwell - Ludbridge Mill	API model M703	18942	06/01/2010	Y	
Harwell - Ludbridge Mill	BIOS flowmeter	132883	27/8/2013	Y	Measurement of sample flowrate of particulate
Harwell - Ludbridge Mill	BIOS flowmeter	134028	13/12/2013	Y	
Harwell - Ludbridge Mill	BIOS flowmeter	133530	13/12/2013	Y	
Harwell - Ludbridge Mill	Teledyne T750	147	01/04/2017	Y	Combined ozone photometers and dilution kits for station ozone analyser calibration and determination of analyser linearity and converter efficiency. Have associated zero air generators (T751H)
Harwell - Ludbridge Mill	Teledyne T750	148	01/04/2017	Y	
Ricardo-Manchester	Teledyne T750	149	01/04/2017	Y	
Ricardo-Glasgow	Teledyne T750	150	01/04/2017	Y	
Ricardo-Glasgow	Teledyne T750	151	01/04/2017	Y	
Harwell - Ludbridge Mill	Teledyne T751H	n/a	01/04/2017	Y	
Harwell - Ludbridge Mill	Teledyne T751H	250	01/04/2017	Y	
Ricardo-Manchester	Teledyne T751H	251	01/04/2017	Y	
Ricardo-Glasgow	Teledyne T751H	152	01/04/2017	Y	
Ricardo-Glasgow	Teledyne T751H	253	01/04/2017	Y	
Harwell-Ludbridge Mill	Teledyne T400		01/04/2017	Y	For calibration of ESU photometers

8 Improved Technology

8.1 Improvements Introduced

As shown in Table 1.1, the FDMS instrument at Hull Holderness Road and the Partisol at Bournemouth were replaced by Beta Attenuation Monitors during the course of the year. Also the FDMS analysers at London Harlington were replaced by a Fidas 200 unit as of 1st January 2017. In addition, the Fidas 200 at Greenock A8 Roadside was affiliated for both $PM_{2.5}$ and PM_{10}. The Fidas is a light-scattering device capable of measuring many separate size fractions. This instrument is less temperature-sensitive than some other measurement methods and it is hoped that data loss in warm weather will be reduced.

9 Annual Data Capture 2017

9.1 Annual Data Capture 2017

The data capture across the whole network for 2017 is given in Table 10.1.

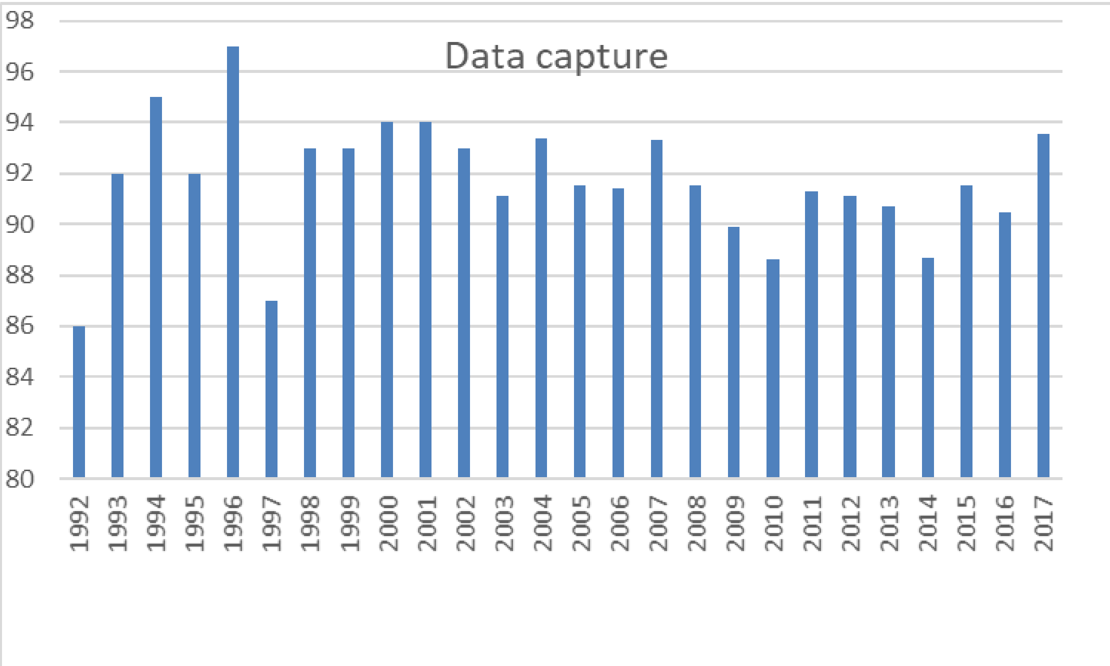
Table 10.1 Annual Data Capture, 2017

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Annual Average
2017	92.67	95.42	96.94	90.93	91.40	93.32	93.56

The network average data capture was 93.56%, with 13 stations failing to meet the target of 85% and 20 being below 90%. Principal reasons for data loss include station infrastructure upgrades, sampling faults, poor analyser performance and persistent temperature problems.

Figure 9.1 shows average data capture from the AURN from 1992-2017.

Figure 9.1 Data capture (%) 1992-2017



9.2 Stations where Data Capture was below 85%

Table 9.2 shows the stations that failed to meet the requirement for 85% data capture across all the pollutants in 2017. The data capture target for the purposes of monitoring compliance with the EU Air Quality Directive (Directive 2008/50/EC) is 90% excluding planned servicing and maintenance. For practical purposes in the AURN, planned maintenance is assumed to be 5% so a target of 85% data capture is used.

Table 9.2 Stations below 85%, 2017

Station	Annual Data capture 2017 (%)
Widnes Milton Road	84.84
York Fishergate	83.02
Sunderland Wessington Way	81.03
London Teddington Bushy Park	80.22
Dumbarton Roadside	79.78
Saltash Callington Road	78.22
Chesterfield Loundsley Green	78.02
Sandy Roadside	71.35
Leominster	69.55
Newport	52.34
Barnstaple A39	41.93
London Harrow Stanmore	28.30
Newcastle Cradlewell Roadside	22.83

Details of data loss and the causes are given in the previous quarterly reports.

10 Conclusions

Conclusions for Quarter 4 of 2017

1. During Quarter 4 of 2017 a total of 164 AURN monitoring stations operated at some point in the quarter (plus two co-located gravimetric analysers treated as separate sites for data processing purposes).
2. Data ratification for the quarter was completed by the deadline of 31st March 2017.
3. The mean data capture for ratified hourly average data was 95.55% (averaged over all pollutants O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$), for the three-month reporting period October – December 2017.
4. Mean data captures for individual pollutants were as follows: CO, 98.00%; NO_2, 96.54%; O_3, 97.51%; SO_2, 91.22%; PM_{10}, 94.73% and $PM_{2.5}$, 93.36%. The data capture target of the Air Quality Directive is 90% excluding periods of planned maintenance e.g. calibrations, audits and servicing). An allowance of 5% is made for this, hence a target of 85%. The mean data captures for all pollutants met this target in Q4 of 2017.

Conclusions for the Whole of 2017

1. During 2017, 12 new AURN monitoring stations were started up, either as part of the current AURN expansion programme or as replacements. Three monitoring stations closed down. There were therefore 164 monitoring stations in operation as of the end of the year (plus two co-located Partisol samplers).
2. Data ratification for each quarter was completed by the specified deadline.
3. The mean data capture for ratified hourly average data was 93.56% (averaged over all pollutants O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$), for the full calendar year.
4. Mean data captures for individual pollutants over the whole year were as follows: CO, 92.67%; NO_2, 95.42%; O_3, 96.94%; SO_2, 93.32%; PM_{10}, 90.93% and $PM_{2.5}$, 91.40%. The mean data capture for all pollutants therefore met the EU target of 85% (which allows for planned maintenance).
5. The uncertainty of measurement for each analyser has been determined in the summer and winter intercalibrations, to ensure compliance with the Data Quality Objective. In the winter 2017 intercalibration, 14.4% of analysers were found to be outside the required uncertainty, and in the summer intercalibration 13.2% of analysers were found to be outside the required uncertainty.

The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR
United Kingdom
t: +44 (0)1235 753000
e: enquiry@ricardo.com

ee.ricardo.com