1. Introduction

This is the eighth report to Defra and indicates the progress made to date, covering the period June - November 2003. It provides summary statistics and data capture rates. Where significant amounts of data are missing the reasons for these are given together with details of any remedial action taken.

2. Sampling Locations and Details

Instruments are located at 11 established sites, ten of which form part of Defra's Automatic Urban and Rural Monitoring Network either directly or through affiliation, and one (Harwell Organic) which is part of the Automatic Hydrocarbon Monitoring Network. The sites are:

- Belfast Centre (Urban Centre, O.S Grid ref J339744)
- Birmingham Centre (Urban Centre, O.S Grid ref SP064868)
- Glasgow Centre (Urban Centre, O.S Grid ref NS589650)
- Harwell Inorganic (Rural, O.S Grid ref SU474863)
- Harwell Organic (Rural, O.S Grid ref SU 474863)
- London Bloomsbury (Urban Centre, O.S Grid ref TQ302820)
- London Kensington (Urban Centre, O.S Grid ref TQ240817)
- London Marylebone Rd (Urban Kerbside, O.S Grid ref TQ281820)
- Manchester Piccadilly (Urban Centre, O.S Grid ref SJ843983)
- Port Talbot (Urban Centre, O.S Grid ref SS780882)
- Rochester (rural, O.S Grid ref TQ831762)

Table 1 details the location of the monitoring equipment.

Table 1 Location of monitoring equipment

Site	$PM_{2.5}$ Partisol	$PM_{2.5}$ TEOM	PM_{10} Partisol	PM_{10} TEOM	PM_{10} Sulphate	PM_{10} Carbon	$PM_{2.5}$ Nitrate	SMPS	CPC	Met Sensor
Belfast Centre	*			*	√	√	√		√	
Birmingham Centre	*			*					√	
Glasgow Centre	*		*	*					√	
Harwell (Inorganic)		√		√				√		√
Harwell (organic)					√	√	√			
London Bloomsbury		√		*				√	√	
London Kensington	*			*	√	√			√	
London Marylebone Rd		√		*	√	√		√		
Manchester Piccadilly	*		*	*					√	
Port Talbot	*			*					√	
Rochester		√		*						√ (1)

* Monitoring equipment operating under AURN contract

(1) Local authority owned equipment

3. Data Capture

3.1 TEOM

Data capture statistics for PM_{10} and $PM_{2.5}$ mass concentrations are presented in Table 2 for each of the monitoring sites.

Table 2 Monthly particle mass data capture (%)

Jun - August 2003

	PM_{10}				**$PM_{2.5}$**			
	LM[(1)]	LB[(2)]	RO	HAR	LM	LB	RO	HAR
Jun	99	88	100	100	85	91	100	100
July	98	92	100	82	100	92	99	99
Aug	97	100	96	94	98	100	96	94
Quarter	98	93	98	92	94	94	98	97

(1) PM_{10} data from Marylebone Rd is available as part of the London Network, which is operated by seiph (ERG). Casella Stanger do not report these data directly.

(2) London Bloomsbury PM_{10}, and Harwell PM_{10} are operated under DEFRA's AURN contract.

Table 2a Monthly particle mass data capture (%)

September November 2003

	PM_{10}				**$PM_{2.5}$**			
	LM[(1)]	LB[(2)]	RO	HAR	LM	LB	RO	HAR
Sept	99	99	100	100	100	99	100	100
Oct	99	100	97	100	93	97	97	100
Nov	99	96	100	100	100	100	100	100
Quarter	99	98	99	100	94	99	99	100

(1) PM_{10} data from Marylebone Rd is available as part of the London Network, which is operated by seiph (ERG). Casella Stanger do not report these data directly.

(3) London Bloomsbury PM_{10}, and Harwell PM_{10} are operated under DEFRA's AURN contract.

Data capture from the TEOM instruments was high, with few significant losses occurring with the exception of Marylebone Rd $PM_{2.5}$ which suffered flow problems, and Harwell $PM_{2.5}$, effected by the temperature and power problems during the hot summer months.

3.2 SMPS

Table 3 SMPS particle count data capture (%) at London Bloomsbury, Marylebone Rd and Harwell, Jun - August 2003

	Bloomsbury	Marylebone Rd	Harwell
Jun	61	100	3
July	80	58	0
Aug	83	53	0
Quarter	75	70	1

Table 3a SMPS particle count data capture (%) at London Bloomsbury, Marylebone Rd and Harwell, September - November 2003

	Bloomsbury	Marylebone Rd	Harwell
Sept	40	0	-
Oct	92	77	-
Nov	77	79	-
Quarter	69	52	-

Bloomsbury's instrument operated well apart from a period in June when water contamination of the inlet resulted in uneven flow. The instrument was returned to TSI Instruments for repair. A number of software related stops in September reduced data capture but the instrument operated well over the rest of the quarter.

Problems at Harwell including power interruption and fluctuating temperature due to a failed AC unit, were compounded by computer problems. Following the failure of

the onsite laptop, a replacement was installed although that too failed to operate satisfactorily and has since been replaced again. Data for the September – November period is currently unavailable due to the data being recovered from the computer following a leak in the roof of the site. SMPS data from October and November will be available shortly but were not processed at the time of writing this report.

Marylebone Road had a failed main pump at the end of August, which took a long time for the replacement to arrive from the suppliers, TSI Instruments. Data capture in June, July and the beginning of August was reasonable and good following the eventual reinstallation. The instrument is currently operating well and has provided comparison data to accompany the ultrafine particle measurement being carried out on behalf of Birmingham University.

3.3 CPC

Table 4 CPC particle count data capture (%) at the seven monitoring sites, June - August 2003

	CPC						
	Co-Loc	**Belf**	**Man Pic**	**Birm**	**Port Talbot**	**Glasgow**	**N Kens**
Jun	91	100	100	26	23	0	84
July	12	100	55	98	0	66	47
Aug	51	100	88	74	0	97	18
Quarter	51	100	81	66	8	55	100

Table 4a CPC particle count data capture (%) at the seven monitoring sites, September - November 2003

	CPC						
	Co-Loc	**Belf**	**Man Pic**	**Birm**	**Port Talbot**	**Glasgow**	**N Kens**
Sept	-	77	68	-	0	95	100
Oct	-	99	100	-	31	?	79
Nov	-	58	91	-	64	?	58
Quarter	-	78	86	-	32	?	79

Co-located CPC operated well during June, but developed an internal pump fault in early July and was returned to TSI Instruments for repair. On it's return it was relocated to Marylebone Rd. Although all appeared well with the relocated instrument it soon became apparent that data was suspect and the instrument was sent back for further investigation. Again, the internal pump was found to be at fault. Due to the time taken for repairs much of the data for the quarter has been effected.

During the September to November period the co-located unit was away for repair following the faults described above. It was not reinstalled immediately on it's return as the space and inlet at Marylebone Rd was being used for the Ultrafine and Epiphaniometer instruments by Birmingham University.

Belfast's instrument performed exceptionally well with no faults during the first quarter. High data capture was maintained during the second quarter.

A series of software problems effecting the Manchester CPC during July, reduced the otherwise excellent data capture for the quarter. Performance during the second quarter was also generally good.

Birmingham Centre experienced problems when the on site PC was replaced at the beginning of June. Problems with power management setting caused it to shutdown between sample runs. This and other computer related problems reduced data capture in June although data capture was otherwise good. Periods of flat data in August were traced to a laser fault which was repaired after the instrument was returned to TSI Instruments. The repair has taken an extraordinary length of time and the unit is still with TSI at the time of writing.

The Port Talbot CPC laptop suffered a serious disk failure and a large amount of data was lost due to failure by the Local Site Operator to return data at regular intervals. Following reinstallation in October, the unit operated well and regular updates are being received. The replacement PC stopped towards the end of November shortly after the weekly reset although the problem was not serious.

The Glasgow CPC suffered a fault which gave flat data. This problem was not identified immediately as the local operators did not supply regular data updates. This has been raised, and they now update files monthly as originally instructed. Other than this fault, the CPC has operated well during the quarter. Glasgow's data capture figures are currently unavailable for October and November due to data files not being returned. These will shortly be available.

North Kensington's instrument suffered from water ingress in July, possibly due to condensation in the inlet. This resulted in a period of flat data and the instrument being returned to TSI for repair. Following it's return, data capture has been good although a power failure in November resulted in the loss of some data.

3.4 Sulphate Partisol

Table 5 Particulate sulphate data capture (%)

June - August 2003

Site	Data capture
North Kensington	89
Marlyebone Road	39
Belfast	97
Harwell	92

Table 5a Particulate sulphate data capture (%)

September – November 2003

Site	Data capture
North Kensington	77
Marlyebone Road	67
Belfast	92
Harwell	82

Data capture is based on available exposure data, as filter analysis results are not yet available for the whole period.

Flow faults again caused Marylebone Rd instrument to halt sampling. This Partisol has been consistently unreliable and ways to stop the problem are being investigated by the equipment support unit. North Kensington's Partisol also experienced flow problems during the quarter but to a much lesser extent.

3.5 Carbon Particulate Monitor

Table 6 Carbon particulate data capture (%)
June - August 2003

Site	June	July	August	Average
Belfast Centre	33	90	96	73
Harwell	83	100	44	76
London Marylebone Road	100	99	47	82
London North Kensington	0	34	100	45

Table 6a Carbon particulate data capture (%)
September - November 2003

Site	September	October	November	Average
Belfast Centre	19	0	65	28
Harwell	33	53	0	29
London Marylebone Road	19	50	50	40
London North Kensington	100	99	0	66

Belfast Centre

Status checks showed that the CO_2 meter response was out of range, and the CO_2 Li sensor was subsequently reset by the ESU using the manufacturer's software and a two-point dynamic calibration check carried out using certified zero and span calibration gases. During the validation process it was established that this fault condition occurred on 10th June, and it was found necessary to delete all data from this date.

On 6th September the CO_2 meter output went full scale but did not show up as a fault condition either on the screen or in the data output file. Thus, according to the instrument, all data being produced were valid, and it was only established during the validation process that this was not the case. The CO_2 meter was recalibrated on 10th November, resulting in the deletion of all data from 6/9 to 10/11/03.

Harwell

During both quarters this instrument was plagued with sample heater failures and on two occasions (2/6 and 7/8/03) the unit required the replacement of a fuse and 3 tungsten lamps to restore proper operation. Further failures occurred in throughout the 2nd quarter and were compounded by a software failure in September. During most of the period June-October one of the two sample channels was working, hence some data have been recovered.

During November the instrument developed a leak in one of the two sample/analysis loops, a sample heater failure and a low collection volume due to a faulty pump. Throughout the month the instrument displayed misleading information indicating that there were no critical status conditions and that it was generating good data. However, during the validation process it was necessary to delete all data for this month.

London Marylebone Road

On 12/8/03 afterburner B temperature became high and erratic, but the instrument continued to display an 'OK' status condition. The unit operated satisfactorily on the 2nd collector until 20/8/03 when its heaters failed, thus giving 50% of valid data during this period. All failed heaters were replaced on 29/08 and the CO_2 Li sensor recalibrated. The heaters failed again and the instrument produced no valid data until 19/09, after which it continued to operate on one collector for the rest of the month.

During October and November the sample flow through one channel was slightly high at 18 l/min, but this is a non-critical fault and should not affect data quality. Throughout the period the status condition remained 'OK' suggesting that there was no problem. During subsequent data validation it was apparent that data quality was compromised and it was necessary to delete all data from channel A, resulting in 50% data capture for these months. It is not clear why the instrument displayed a satisfactory status condition and we are currently in discussion with the supplier in order to resolve the issue.

London North Kensington

The unit suffered from a complete failure of oven A thermocouple and a partial failure of oven B thermocouple, causing the instrument to go into continuous full-heat and to blow all the tungsten lamps and fuses. The excessive heat distorted collector A and degraded the rubber pinch valves, resulting in a number of pneumatic leaks.

Due to the complex nature of these faults and the restricted access available on site, the unit was removed to the workshop on 2/06/03 for repair. After re-installation, further problems developed with the operation of the pinch valves, and these had to be stripped and re-adjusted.

This major fault required considerable time resource to repair, since it necessitated a complete rebuild of the collector and pinch valve systems. The unit was not restored to proper operation until 24/07/03.

After this repair the instrument operated reliably until a power failure during December caused severe corruption of the data stored in the units data logger, resulting in the loss of all data for November.

3.6 Carbon Particulate Monitor

Table 7 Nitrate particulate data capture (%)
June - August 2003

Site	June	July	August	Average
Belfast Centre	46	67	46	53
Harwell	0	17	20	12

Table 7a Nitrate particulate data capture (%)
September - November 2003

Site	September	October	November	Average
Belfast Centre	69	65	84	73
Harwell	0	41	82	41

Belfast

During June the instrument developed a fault with the cross-flow and pressure controllers, resulting in a low sample flow to the pulse analyser which affected its response. From 17/6 to 30/6 the analyser developed a critical sample pressure problem, and data for this period were deleted during validation. This fault was rectified on 5/08 but developed again on 21/08, and was responsible for the loss of data through to 07/09.

The nitrate concentration levels recorded by the Belfast unit are very low, and are consistently lower than those recorded at Harwell. Only data flagged with the 'OK' status are included in the validated data files, and scrutiny of the range of operating parameters recorded by the instrument during its measurement process does not identify any problem that would compromise data quality. These data have therefore been included since there is no reason, on the basis of the instrument's performance, to exclude them. Full ratification of the data will require a more detailed examination, and will include the results of particulate nitrate collected using the Partisol system.

Harwell

On 05/06/03 the instrument pump failed but the engineer was unable to carry out a satisfactory repair as the pump head had corroded extensively and could not be disassembled. A replacement pump was ordered but there was a long delay from the suppliers, and it was eventually fitted on 17/07/03. This unit was still unable to pull the required vacuum to serve both the pulse generator and pulse analyser, so it was decided to fit a separate pump to the analyser. This initially proved o be effective, but soon the instrument was showing 'non-critical' flow errors which developed into a critical analyser flow problem. Further investigation revealed that condensation had collected in a pressure regulator causing a blockage and preventing the required sample flow from reaching the analyser.

This instrument also suffered from repeated failure of the flash strip, causing extensive loss of data. During the period 22/07 to 29/08/03 the flash strip was replaced six times, and on occasions only lasted for a few analytical cycles. There was no obvious reason for these failures as the method of replacement, both prior and subsequent to these events, remained the same.

On 19th September the pulse analyser diagnostic software displayed a reaction cell pressure warning, a sample flow warning and an ozone flow warning. The instrument was repaired and recalibrated on 15/10/03, with the loss of all data for this period.

There were no further problems, with excellent data capture during November.

4 Summary Data and Statistics

4.1 Particle Mass concentration

Table 8 Average particle mass concentration (μg m^{-3}), June - August 2003

	PM_{10}	$PM_{2.5}$	PM_{coarse}
Harwell	17.4	12.0	5.4
London Bloomsbury	24.3	14.0	10.3
Marylebone Road	38.4	15.9	22.5
Rochester	21.3	12.7	8.6

- PM_{coarse} is defined as $PM_{10} – PM_{2.5}$

Table 8a Average particle mass concentration (μg m^{-3}), September - November 2003

	PM_{10}	$PM_{2.5}$	PM_{coarse}
Harwell	16.5	12.7	3.8
London Bloomsbury	24.4	15.4	9.0
Marylebone Road	36.0	21.7	14.3
Rochester	19.9	12.9	6.9

- PM_{coarse} is defined as $PM_{10} – PM_{2.5}$

Course fraction shows great variation from site to site ranging from 31 – 59% of the total PM10. Interestingly, this is highest in the urban sites possibly due to re suspension during the prolonged dry period. During wetter Autumn weather, these figures drop to 23 – 40% although overall PM10 levels are relatively unchanged

4.2 CPC vs SMPS measurements (London Bloomsbury)

The CPC spent the majority of this quarter at London Bloomsbury Until it was returned to Marylebone Road at the beginning of August. Due to the problems described in Section 3.3 Figures for the comparison will therefore refer to the June data only

	CPC	**SMPS**	**Ratio**
June	11,746	12,969	1.1

The ratio shown above is consistent with previous comparisons in previous quarters, although it has been shown to vary considerably.