

1. Introduction

This is the fourth report to DEFRA and indicates the progress made to date, covering the period July to September 2002. 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.

In addition, the report includes a brief comparison of SMPS and CPC data collected at London Bloomsbury, where the instruments have been co-located

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 PM₁₀ and PM_{2.5} mass concentrations are presented in Table 2 for each of the monitoring sites.

**Table 2 Monthly particle mass data capture (%)
 July - September 2002**

	PM ₁₀				PM _{2.5}			
	LM ⁽¹⁾	LB ⁽²⁾	RO ⁽²⁾	HAR	LM	LB	RO	HAR
July	99	94	100	99	100	94	100	95
August	99	97	45	100	100	98	100	99
September	99	96	0	100	100	99	100	100
Quarterly	99	96	49	100	100	97	100	98
Running (Oct 01 – Sep 02)	92	96	86	99	98	97	98	99

(1) PM₁₀ 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 PM₁₀, and Rochester PM₁₀ are operated under DEFRA's AURN contract.

Data capture from the TEOM instruments was high, with the only significant losses occurring from the Rochester PM₁₀ instrument. This is an affiliated local authority owned instrument, which was removed in August for repair, following a flow fault.

3.2 SMPS

Table 3 SMPS particle count data capture (%) at London Bloomsbury, Marylebone Rd and Harwell, July - September 2002

	Bloomsbury	Marylebone Rd	Harwell
July	24	45	83
August	95	71	47
September	88	83	59
Quarterly	69	66	63
Running (Oct 01 – Sept 02)	43	67	78

A large amount of data from London Bloomsbury was lost in July due to mechanical failure of the laptop. A replacement PC was installed on the 2nd August.

Data from Marylebone Rd was lost between the 14th July and 2nd August, due to problems with the logging software which resulted in the sample runs stalling between visits.

There were a number of periods of missing data at Harwell, the worst of these due to the PC failing to complete a logging cycle. The first of these periods was between the 1st and 13th of August and the second between the 27th August and 10th September. There were other smaller losses due to the interval between site visits being longer than the maximum logging period.

3.3 CPC

Table 4 CPC particle count data capture (%) at the seven monitoring sites, July - September 2002

	CPC						
	LB	Belf	Man Pic	Birm	Port Talbot	Glasgow	N Kens
July	59	82	98	100	100	76	65
Aug	18	100	87	71	100	53	86
Sep	48	100	84	100	100	-	-
Quarterly	42	94	90	90	100	43	50
Running (Oct 01 – Sept 02)	75	96	96	86	91	57	84

The CPC at London Bloomsbury suffered 2 major faults, the first resulting in loss of data between the 13th and 25th of July and the second from the 8th August to the 16th of September. On both occasions, the CPC was returned to BIRAL for repair of the internal pump which had accumulated moisture.

Birmingham lost data between the 19th and 28th August, when software failed to complete a sample run and locked up. This could have been caused by the PC, which is due for replacement shortly.

Glasgow's CPC operated very well until the 17th of August when sampling stopped. It was not restarted by the local site operator (LSO) and data is therefore unavailable after this date. LSO duties have been reassigned to a different member of staff, which should avoid such problems in the future.

At North Kensington, a small amount of data was lost between the 15th and 25th of July due to software problems. A larger period of missing data between the 27th

August and the end of the quarter was due to the instrument being returned to BIRAL to repair a faulty liquid level sensor.

3.4 Sulphate Partisol

**Table 5 Particulate sulphate data capture (%)
July - September 2002**

Site	Data capture
North Kensington	77
Marylebone Road	69
Belfast	100
Harwell	86

Data capture is based on available exposure data as filter analysis results are not yet available for the whole period. Capture was generally good for the Sulphate particulate monitoring during the report period with the exception of Marylebone Rd which suffered flow problems in July and August. Data capture at North Kensington was also reduced by memory failure in the Partisol's data logger.

3.5 Carbon Particulate Monitor

**Table 6 Carbon particulate data capture (%)
 July – September 2002**

Site	July	August	September	Average
Belfast Centre	81	64	13	53
Harwell	0	11	98	36
London Marylebone Road	97	99	99	98
London North Kensington	98	100	100	99

During July there were problems with the sample and afterburner temperatures on one of the two collector/furnace loops in the Belfast unit. Although classified by R&P as a non-critical condition, it resulted in a number of readings where the total carbon measured was less than the organic component. It is likely that some of the data may be recoverable during the ratification process by removing the smoothing function in the data processing software, which is used to calculate the running mean of measurements from both collectors.

During late August the unit developed an additional fault whereby the minimum sample volume could not be achieved through one of the collector systems. Again, much of this data may be recoverable by removing the smoothing function.

The Harwell unit suffered a number of serious faults, which resulted in the loss of much of the data during the July-August period. The major faults compromising the data were:

- Filter B temperature out of range
- Afterburner B temperature out of range
- Pinch valve not operating correctly (critical) and
- Final analysis time repeatedly defaulting to zero.

The combination and intermittent nature of these faults made diagnosis and repair difficult, and no satisfactory explanation could be offered as to why the software kept re-setting. After an intensive investigation in late August the unit was switched back on line and has been working satisfactorily since.

Both the Marylebone Road and London North Kensington units performed well during this period, with excellent data capture.

**Table 7 Carbon particulate rolling average data capture
from start of monitoring to 30 September 2002**

Site	Data capture (%)
Belfast Centre	83
Harwell	68
London Marylebone Road	78
London North Kensington	100

The Carbon Particulate monitoring start dates for each site were:

Belfast Centre:	21 November 2001
Harwell:	14 February 2002
London Marylebone Road:	13 March 2002
London North Kensington:	13 March 2002

and data capture statistics have been prepared from these dates.

3.6 Nitrate Particulate Monitor

The previous report identified two major problems with the nitrate monitor which were preventing them from providing valid data. These were:

- an inherent weakness in the design of the flash strip and
- incompatibility between the communications software and the instrument.

Modifications made by R&P to the flash strip and its fixing washers have cured the problem of premature failure. Trials carried out on the Harwell unit suggest that the new flash strip may remain functional for up to 3 months.

The problem preventing communications was not resolved during this period. However, laboratory tests have been carried out using a new analyser (purchased for this project but awaiting deployment) during which successful remote communications were established.

It is intended to install this unit at Harwell during late October, which will allow the original unit to be investigated in the workshop and returned to site once the fault has been remedied.

4 Summary Data and Statistics

4.1 Particle Mass concentration

**Table 8 Average particle mass concentration ($\mu\text{g m}^{-3}$),
 July - September 2002**

	PM₁₀	PM_{2.5}	PM_{coarse}
Harwell	13.8	8.7	5.1
London Bloomsbury	29.4	13.1	16.3
Marylebone Road	35.1	20.0	15.1
Rochester	20.6	11.2	9.4

- PM_{coarse} is defined as PM₁₀ – PM_{2.5}

Note that the PM₁₀ has increased at all sites from the previous quarter, whilst a similar increase in PM_{2.5} was not seen. The increase therefore corresponds to an increase in predominantly coarse particulate.

4.2 CPC vs SMPS measurements (London Bloomsbury)

The CPC remained at London Bloomsbury during this quarter to gather comparative data with the SMPS.

Available data show that the average total particle counts differ by a factor ranging from 1.1- 2.9. The main reason for this lies in the fact that the size ranges of the instruments are different, the CPC and SMPS sampling between 7.5 – 1000nm and 11.5 – 450nm respectively.

The SMPS will also undergo particle losses in the classifier, which may not be correctly quantified by the algorithms built into the software.

Average particle counts for the quarter are shown in the following table.

Table 9 Comparison of total particles # cm⁻³ measured at London Bloomsbury using the CPC and SMPS, July – September 2002

	CPC	SMPS	Factor
July	12,053	10,828	1.1
August	11,878	9,670	1.2
September	24,165	8,354	2.9
Quarter	18,287	9,256	2.0

Ratio during September is somewhat higher than previous months although the reason is not clear. Whilst data capture was very low for the CPC instrument during this period, further analysis is required to determine whether there are other factors influencing the ratio.

The CPC is scheduled to be moved to Harwell, where comparisons can be made with the remaining SMPS instrument. The results of this will be reviewed in next quarter's report,