

# **Oxford City Council**

## **Environmental Health**

### **Airwatch Annual Report 2000**

**Environmental Health  
Ramsay House  
10 St Ebbes Street  
Oxford  
OX1 1PT**

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## 1 Introduction

1. This is the seventh Airwatch Annual Report produced by the Environmental Health Service. Results are compared to the standards and objectives contained in the United Kingdom Air Quality Strategy and Air Quality Regulations 2000.
2. Four continuous monitoring sites are operated under the Airwatch programme. Data is independently validated by the National Environmental Technology Centre, AEA Technology.

Site	Start date	Pollutants Monitored
Oxford Centre (kerbside)	November 1997	Nitrogen dioxide, Carbon monoxide, Sulphur dioxide
Cornmarket Street (kerbside \ intermediate)	October 1997	PM <sub>10</sub>
St Ebbes (urban background)	July 1997	Nitrogen dioxide, PM <sub>10</sub>
East Oxford(urban background)	July 1997	Nitrogen dioxide, PM <sub>10</sub>

3. Data, reports and information about the monitoring programme is available on the Council's Internet site at <http://www.oxford.gov.uk>. This site is updated daily. There are two scrolling display units at Carfax Cash Office and the Community Services office reception providing up to date data from the sites. The Oxford Centre site is included in the Department of the Environment Transport and Regions (DETR) Automated Urban Network and data is presented daily on teletext page 155, ceefax pages 410 to 417 and on the Internet site <http://www.aeat.co.uk/netcen/airqual>.
4. The nitrogen dioxide diffusion tube survey involves 55 sites at kerbside, intermediate and background locations. These sites have been chosen to assess the impact of the implementation of the Oxford Transport Strategy (OTS) on traffic pollution. The diffusion tubes are changed monthly. The key elements of the OTS were the pedestrianisation of Cornmarket Street and the bus gate in High Street restricting through traffic. These measures were implemented on 1st June 1999. This report does not assess the effects of OTS on air quality. The assessment of the effects of OTS is part of the EMITS project<sup>1</sup> which will report in 2001.

<sup>1</sup> EC funded Environmental Monitoring of Integrated Transport Strategies in partnership with Oxfordshire County Council, University of Oxford, Transport Studies Unit and Heart and Lung Foundation. <http://www.oxfordshire.gov.uk/emitsidx.htm>

5. Maps showing the location of continuous monitoring and diffusion tube sites are provided in Appendix 3. Details of data validation procedures are given in Appendix 4 and a Glossary is included in Appendix 5.
6. The Review and Assessment of Air Quality for Oxford, required by the Environment Act<sup>2</sup>, was completed in 2000. The Act requires local authorities to assess whether the statutory air quality objectives are likely to be met by prescribed dates. The report concludes that it is not likely that the air quality objective for annual mean nitrogen dioxide will be met in Oxford City centre but that all other objectives will be met. The report also recommends options for Air Quality Management Areas, which, will be consulted upon in 2001. Further information about the review and assessment of air quality is available on the Council's Internet site <http://www.oxford.gov.uk>.

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<sup>2</sup> Environment Act 1995

## 2 Air Quality Standards and Guidelines

7. Data is assessed in accordance with the air quality standards contained in the Air Quality Regulations<sup>3</sup> and the Air Quality Strategy<sup>4</sup>. The standards are expressed as objective levels to be achieved by dates specified in the regulations. (Carbon monoxide 31 December 2003, PM<sub>10</sub> and sulphur dioxide 31 December 2004, nitrogen dioxide 31 December 2005)
8. In addition, measurements are compared to the air pollution bands introduced by the DETR in November 1997. Air pollution levels are categorised as low, moderate, high and very high. This banding is based on advice from the Department of Health and provides guidance as to the effects of air pollutants on health. At low levels of pollution it is unlikely that anyone will experience any adverse effects.
9. Full details of the air quality objective levels and air pollution bands used for assessing the results in this report are given in Appendix 1.

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<sup>3</sup>Air Quality (England) Regulations 2000 SI 938.

<sup>4</sup>The Air Quality Strategy for England, Scotland, Wales and Northern Ireland - Working Together for Clean Air : Department of the Environment 2000.

### **3 Summary of Results**

10. This section comments on the results for individual pollutants. More detailed data is given in Appendix 2. Results are compared to relevant air quality standards and objectives.

#### **Nitrogen Dioxide**

11. Two air quality objective levels have been set for nitrogen dioxide, 105 parts per billion (ppb) or less, when expressed as an hourly mean, and 21ppb when expressed as an annual mean. These objectives are to be measured against likely human exposure. Therefore the annual mean is more appropriate for assessing longer term exposure from background concentrations and the hourly mean for assessing short term exposure from kerbside concentrations.
12. Hourly measurements made at continuous sites can be used to assess against both objective levels. Data from diffusion tube monitoring is compared to the annual mean objective level.

#### **Diffusion Tube Survey**

13. The diffusion tube survey set up under EMITS has now been running for six years. Data for the six years has been presented together in the charts in Appendix 2. The charts show a general decrease in concentrations of nitrogen dioxide as new lower polluting catalyst cars and Euro II standard buses and goods vehicles are replacing older vehicles.
14. This part of the monitoring programme which commenced in 1995 originally comprised forty five sites at a mixture of kerbside, intermediate and background locations including areas representative of residential streets. A further ten sites were added in 1998 and 1999. Of the original forty five sites, twenty four exceeded the air quality objective level of 21ppb compared to twenty nine last year, thirty in 1998, thirty two in 1997, thirty eight in 1996 and forty two in 1995. Although the annual mean objective level should not strictly be used for kerbside locations, comparison to this standard is a good indicator of progress in the improvement of air quality. The average concentration across all sites has shown a 22% improvement from 32ppb in 1995 to 25ppb in 2000.
15. The general levels of air pollutants tend to fall significantly with distance from the roadside. This can be illustrated by data from the survey for Shirelake Close (17ppb) which is 25 metres from Thames Street (25ppb); and for Sadler Walk (14ppb) and Trinity Street (15ppb) which are 120 metres and 25 metres respectively from Oxpens Road (20ppb).

## Continuous Monitoring

16. The two sites at St Ebbes and East Oxford are both background sites and are representative of the exposure to people living in the area. At St Ebbes the annual mean concentration was 10ppb and the maximum hourly mean was 51ppb in March. At East Oxford the annual mean was 13ppb and the maximum hourly mean was 75ppb in November.
17. The annual mean concentration at the Oxford Centre kerbside site was 32ppb. The maximum hourly mean was recorded at 111ppb in December.
18. The East Oxford and St Ebbes sites achieved the annual mean and hourly mean air quality objective levels. The Oxford Centre site failed to meet the annual mean objective level and the hourly mean objective level was exceeded twice on 5 June and 7 December. 18 exceedences of the hourly mean objective are permitted under the Air Quality Regulations.

## Sulphur Dioxide

19. The air quality objective levels set for sulphur dioxide are 100ppb, when expressed as a 15-minute mean not to be exceeded more than 35 times a year, 132ppb hourly mean not to be exceeded more than 24 times a year, and 47 ppb 24-hour mean not to be exceeded more than 3 times a year. Sulphur dioxide was monitored continuously at Oxford Centre.
20. The annual mean concentration was 1ppb, the maximum hourly mean was 58ppb and the maximum 15 minute mean of 73ppb both in June. All three air quality objective levels were met.

## Carbon Monoxide

21. The air quality objective level set for carbon monoxide is 10 parts per million (ppm), when expressed as a running 8 hour mean. Carbon monoxide was monitored continuously at Oxford Centre. The mean concentration was 0.2ppm and the maximum hourly man was 3.2ppm in March. The maximum running 8-hour mean was 2.5ppm in March which meets the air quality objective level.

## Ozone

22. The Air Quality Regulations 2000 did not set an objective level for ozone. However the UK Air Quality Strategy suggested the objective level of 50ppb daily maximum running 8-hour mean not to be exceeded more than 10 times a year. Ozone was monitored continuously at St Ebbes and East Oxford. At St Ebbes the annual mean concentration was 22ppb, the maximum hourly mean was 70ppb in June and the maximum running 8-hour mean was 66ppb also in June. At East Oxford the annual mean

concentration was 22ppb, the maximum hourly mean was 70ppb in June and the maximum running 8-hour mean was 66ppb both in June.

23. The measured parameters for ozone produced the same results at both sites. Ozone is a secondary pollutant and is produced by chemical reactions in the atmosphere primarily between nitrogen oxides and hydrocarbons in the presence of sunlight. It is a transboundary pollutant and elevated concentrations are often caused in the summer months by air masses originating in Central Europe. Between April and September, 180 hours of moderate ozone pollution were recorded at St Ebbes and 193 hours were recorded at East Oxford. The air quality objective level was exceeded at East Oxford on 13 days and St Ebbes on 12 days. 10 exceedences are permitted under the UK Air Quality Strategy.

### **PM<sub>10</sub> Particulate Matter**

24. Two air quality objective levels have been set for PM<sub>10</sub>, 50 micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ) when expressed as a 24-hour mean not to be exceeded more than 35 times a year, and  $40\mu\text{g}/\text{m}^3$  when expressed as an annual mean. PM<sub>10</sub> was monitored continuously at St Ebbes and East Oxford all year and from January to March in Cornmarket Street. At St Ebbes the annual mean concentration was  $15\mu\text{g}/\text{m}^3$ , the maximum hourly mean was  $185\mu\text{g}/\text{m}^3$  and the maximum 24-hour mean was  $34\mu\text{g}/\text{m}^3$ , both in March. At East Oxford the annual mean concentration was  $18\mu\text{g}/\text{m}^3$ , the maximum hourly mean was  $469\mu\text{g}/\text{m}^3$  and the maximum 24-hour mean was  $75\mu\text{g}/\text{m}^3$  in May. At Cornmarket Street the mean concentration was  $24\mu\text{g}/\text{m}^3$ , the maximum hourly mean was  $193\mu\text{g}/\text{m}^3$  in March and the maximum 24-hour mean was  $59\mu\text{g}/\text{m}^3$  also in March.
25. At East Oxford 190 hours of moderate and 15 hours of high PM<sub>10</sub> pollution were recorded during the year. At Cornmarket Street 29 hours of moderate PM<sub>10</sub> pollution were recorded. The air 24-hour mean air quality objective level was achieved at St Ebbes but was exceeded at Cornmarket on 3 days and East Oxford on 16 days. 18 exceedences are permitted under the Air Quality Regulations. The annual mean air quality objective level was achieved at all sites.
26. PM<sub>10</sub> is produced both locally and some distance away from the monitoring site. Because of its buoyancy, PM<sub>10</sub> can be transported long distances on air masses and episodes in the UK have been attributed to air masses travelling from Central Europe. St Ebbes and East Oxford are urban background sites and Cornmarket Street is a kerbside site in a street that was pedestrianised on 1<sup>st</sup> June 1999. The East Oxford site is close to a builder's yard and although the mean is not excessive, sporadically there are very high hourly measurements.
27. The Cornmarket Street site was discontinued in March. During the first part of the year the Co-Operative store was taken over by another retailer and refurbishment work was started. A builder's skip was placed

alongside the monitor which resulted in elevated concentrations caused by building dust. This was responsible for the exceedences at this site. In June the monitoring station cabinet was knocked over by a vehicle which caused damage to the equipment and services. Cornmarket Street is in the process of undergoing environmental improvements as part its pedestrianisation and there is no place for the monitoring site in the plans for the street. An alternative site is being sought.

## 4 Comparison with other sites

28. Data from the Oxford sites is compared to selected other sites in the table below. All of the other sites are part of or affiliated to the automatic urban network and data was downloaded from the NETCEN internet site <http://www.aeat.co.uk/netcen/airqual/>.

	NO2 ppb		PM10 µg/m <sup>3</sup>		SO2 ppb		O3 ppb		CO ppm	
	1 hour		24-hour		15 minutes		running 8-hour		running 8-hour	
	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean
Oxford Centre (Roadside)	111	32	-	-	73	1	-	-	2.9	0.2
Oxford St Ebbes (Urban background)	51	10	34	14	-	-	66	22	-	-
Oxford East Oxford (Urban background)	73	13	75	18	-	-	66	22	-	-
Reading (Urban background - 20 metres from A4)	65	18	113	17	89	2	60	19	2.6	0.5
London, Marylebone Road (Roadside - 1m from busy main road)	156	48	87	38	58	6	43	7	6.5	2.0
Leamington Spa (Urban background - 10m from main road)	62	14	56	16	48	2	72	20	2.9	0.2
Harwell (Rural)	53	6	-	-	167	1	65	26	-	-
Bristol Centre (Urban centre - 40m from major road)	103	20	71	20	59	3	56	19	4.5	0.5
Bath Roadside (Roadside - on A4 London Rd)	86	29	-	-	-	-	-	-	4.2	1.2

## 5 Conclusions

29. In summary:

- results for diffusion tube monitoring showed that out of the original 45 sites, 24 exceeded the 2005 annual mean nitrogen dioxide air quality objective level (21ppb), compared to 29 sites last year, 30 in 1998, 32 in 1997, 38 in 1996 and 42 in 1995,
- there has been an overall reduction in annual mean concentrations of nitrogen dioxide at the diffusion tube sites over the last 6 years (average reduction 22%),
- the annual mean nitrogen dioxide air quality objective (21ppb) was achieved at the St Ebbes and East Oxford continuous monitoring sites, it was not achieved at Oxford Centre,
- the hourly mean nitrogen dioxide air quality objective (105ppb) was achieved at the St Ebbes and East Oxford continuous monitoring sites, at Oxford Centre it was exceeded on 2 occasions (18 occasions are permitted under the Air Quality Regulations),
- the air quality objectives for sulphur dioxide, and carbon monoxide were achieved at Oxford Centre continuous monitoring site,
- the air quality objective level for ozone (50ppb daily maximum 8-hour running mean) was exceeded at East Oxford on 13 days and at St Ebbes on 12 days (10 days are permitted under the Air Quality Strategy),
- the 24-hour mean air quality objective level for PM<sub>10</sub> (50µg/m<sup>3</sup>) was exceeded at East Oxford on 16 days (35 days are permitted under the Air Quality Regulations), it was achieved at St Ebbes,
- the annual mean air quality objective level for PM<sub>10</sub> (40µg/m<sup>3</sup>) was achieved at East Oxford and St Ebbes.

## Appendix 1 Air Quality Standards and Guidelines

### Air Quality Regulations 2000

Pollutant	Standard Measured as Concentration	Specific objective to be achieved
Carbon monoxide	116 mg/m <sup>3</sup> (10ppm) running 8-hour mean	by 31/12/03
Nitrogen dioxide	200µg/m <sup>3</sup> (104.6ppb) 1 hour mean	not to be exceeded more than 18 times a year by 31/12/05
	40µg/m <sup>3</sup> (21ppb) annual mean	by 31/12/05
Ozone*	100µg/m <sup>3</sup> (50ppb) daily maximum of running 8-hour mean	not to be exceeded more than 10 times a year by 31/12/05
Particles PM10	50µg/m <sup>3</sup> 24-hour mean	mean not to be exceeded more than 35 times a year by 31/12/04
	40µg/m <sup>3</sup> annual mean	by 31/12/04
Sulphur dioxide	266µg/m <sup>3</sup> (100ppb) 15 minute mean	not to be exceeded more than 35 times a year by 31/12/05
	125µg/m <sup>3</sup> (47ppb) 24-hr mean	not to be exceeded more than 24 times a year by 31/12/04
	350µg/m <sup>3</sup> (132ppb) hourly mean	not to be exceeded more than 3 times a year by 31/12/04

\* UK National Air Quality Strategy (not included in Air Quality Regulations)

### DETR Air Pollution Bands

Pollutant	DETR Air Pollution Bands				Measured as
	Low	Moderate	High	Very High	
Nitrogen dioxide	150ppb or less	150-299ppb	300-399ppb	equal to or greater than 400ppb	hourly mean
Ozone	50ppb or less	50-89ppb	90-179ppb	equal to or greater than 180ppb	running 8 hour mean*
Carbon monoxide	10ppm or less	10-14ppm	15-19ppm	equal to or greater than 20ppm	running 8 hour mean
Sulphur dioxide	100ppb or less	100-199ppb	200-399ppb	equal to or greater than 400ppb	15 minute mean
PM <sub>10</sub>	50µg/m <sup>3</sup> or less	50-74µg/m <sup>3</sup>	75-99µg/m <sup>3</sup>	equal to or greater than 100µg/m <sup>3</sup>	running 24 hour mean

\* Running 8 hour mean for low pollution, hourly mean for the remainder

## Appendix 2 Oxford Airwatch Results

**Table 1 - Oxford Centre Summary:**

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM <sub>10</sub> µg/m <sup>3</sup>
Mean	32	0.2	-	1	-
Max 15 min mean	-	-	-	73	-
Max hour	111	3.2	-	58	-
Max running 8-hr mean	-	2.5	-	-	-
Max 24-hour mean	-	-	-	14	-
Data Capture %	99	99	-	99	-
DETR Band (hrs)					
Low	8735	8761	-	34235***	-
Moderate	0	0	-	0	-
High	0	0	-	0	-
Very High	0	0	-	0	-
Air Quality Regulations / Strategy	*	*	**	*	*
Number of Exceedences					
15 min mean	-	-	-	0	-
Hourly mean	2****	-	-	0	-
8 hour mean	-	0	-	-	-
24 hour mean	-	-	-	0	-
Annual Mean	1	-	-	-	-

\* Air Quality Regulations.

\*\* UK Air Quality Strategy.

\*\*\* Expressed as 15 minute periods.

\*\*\*\* The air quality objective level for nitrogen dioxide is 105ppb when expressed as the hourly mean not to be exceeded more than 18 times a year.

## Appendix 2 (continued)

### Table 2 - Cornmarket Street Summary

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM <sub>10</sub> µg/m <sup>3</sup>
Mean	-	-	-	-	24
Max hour	-	-	-	-	193
Max 24hr mean	-	-	-	-	66
Data Capture %	-	-	-	-	18
DETR Band (hrs)	-	-	-	-	
Low	-	-	-	-	1534
Moderate	-	-	-	-	29
High	-	-	-	-	0
Very High	-	-	-	-	0
Air Quality Regulations / Strategy	*	*	**	*	*
Number of Exceedences					
24 hour mean	-	-	-	-	3***
Annual Mean	-	-	-	-	0

\* Air Quality Regulations.

\*\* UK Air Quality Strategy.

\*\*\* For particles (PM<sub>10</sub>) compliance with the objective level requires the use of gravimetric equivalent data (TEOM x 1.3). The 24 hour mean air quality objective level for PM<sub>10</sub> is 50µg/m<sup>3</sup> (gravimetric) not to be exceeded more than 35 times a year. The annual mean air quality objective level for PM<sub>10</sub> is 40µg/m<sup>3</sup> (gravimetric). Concentrations are reported as TEOM data and exceedences as gravimetric equivalent data.

## Appendix 2 (continued)

### Table 3 - East Oxford Summary

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM <sub>10</sub> µg/m <sup>3</sup>
Mean	13	-	22	-	18
Max hour	75	-	70	-	469
Max running 8-hr mean	-	-	66	-	-
Max 24hr mean	-	-	-	-	75
Data Capture %	98	-	98	-	99
DETR Band (hrs)					
Low	8640	-	8435	-	8495
Moderate	0	-	193	-	190
High	0	-	0	-	15
Very High	0	-	0	-	0
Air Quality Regulations / Strategy	*	*	**	*	*
Number of Exceedences					
Hourly mean	0	-	-	-	-
Running 8-hr mean	-	-	88 hours*** 13 days***	-	-
24 hour mean	-	-	-	-	16****
Annual Mean	0	-	-	-	0****

\* Air Quality Regulations.

\*\* UK Air Quality Strategy.

\*\*\* The air quality objective level for ozone is 50ppb when expressed as the daily maximum running 8 hour mean not to be exceeded more than 10 times a year. The 88 hours of exceedence were spread over 13 days.

\*\*\*\* For particles (PM<sub>10</sub>) compliance with the objective level requires the use of gravimetric equivalent data (TEOM x 1.3). The 24 hour mean air quality objective level for PM<sub>10</sub> is 50µg/m<sup>3</sup> (gravimetric) not to be exceeded more than 35 times a year. The annual mean air quality objective level for PM<sub>10</sub> is 40µg/m<sup>3</sup> (gravimetric). Concentrations are reported as TEOM data and exceedences as gravimetric equivalent data.

## Appendix 2 (continued)

### Table 4 - St Ebbes Summary

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM <sub>10</sub> µg/m <sup>3</sup>
Mean	10	-	22	-	14
Max hour	51	-	70	-	185
Max running 8-hr mean	-	-	66	-	-
Max 24hr mean	-	-	-	-	34
Data Capture %	91	-	99	-	92
DETR Band (hrs)					
Low	8008	-	8492	-	8087
Moderate	0	-	180	-	0
High	0	-	0	-	0
Very High	0	-	0	-	0
Air Quality Regulations / Strategy	*	*	**	*	*
Number of Exceedences					
Hourly mean	0	-	-	-	-
Running 8-hr mean	-	-	79 hours*** 12 days***	-	-
24 hour mean	-	-		-	0
Annual Mean	0	-		-	0

\* Air Quality Regulations

\*\* UK Air Quality Strategy

\*\*\* The air quality objective level for ozone is 50ppb when expressed as the daily maximum running 8 hour mean not to be exceeded more than 10 times a year. The 79 hours of exceedence were spread over 12 days.

**Appendix 2 (continued)**

**Table 5 - Nitrogen Dioxide Oxford Centre**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	30	29	37	39	33	32	32	31	31	26	29	31
Max hour ppb	67	73	100	104	88	109	74	88	80	66	71	111
% Data Capture	99	100	100	99	100	99	99	100	100	100	100	100
DETR Band (hours)												
Low	733	694	741	716	741	714	736	742	717	742	718	741
Moderate	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number of hours >105 ppb	0	0	0	0	0	1	0	0	0	0	0	1

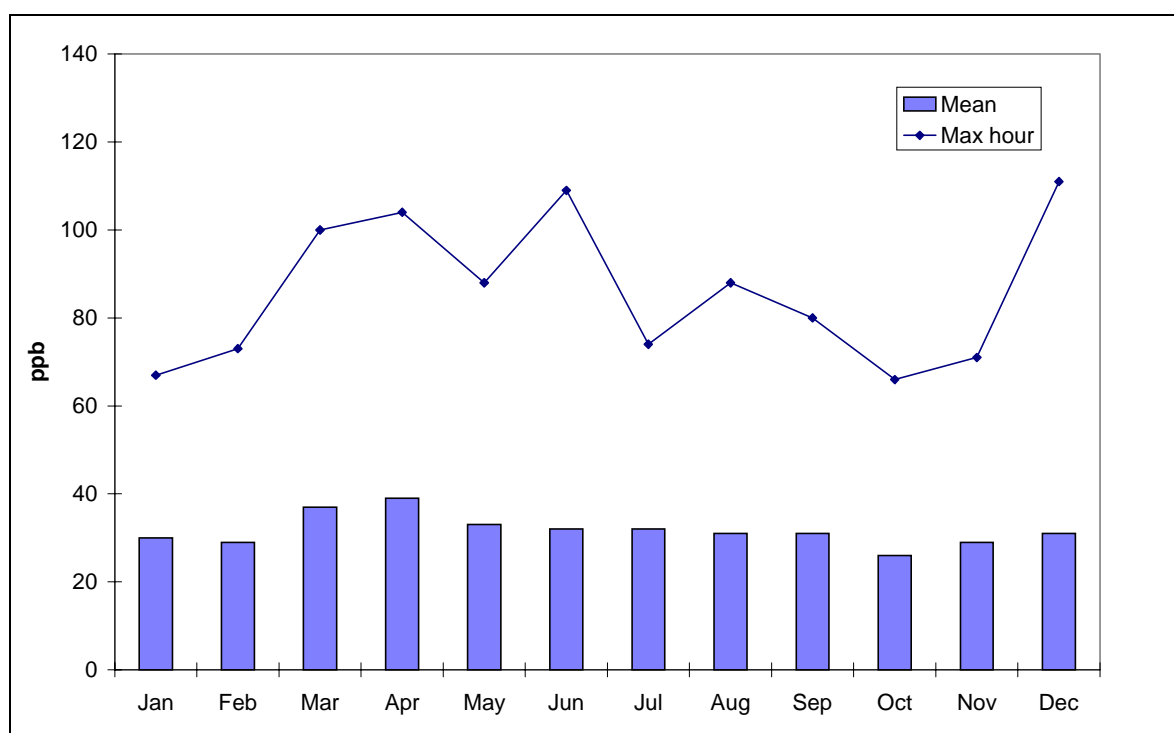
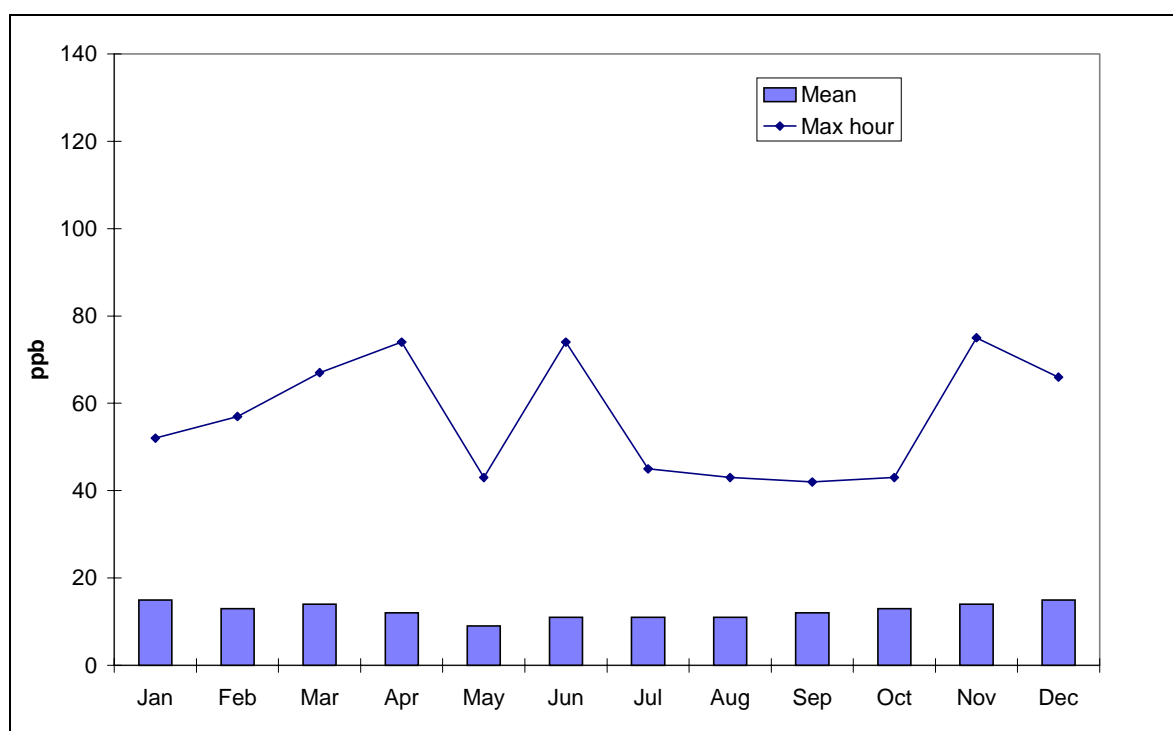


Figure 1: Oxford Centre nitrogen dioxide concentrations

**Appendix 2 (continued)**

**Table 6 - Nitrogen Dioxide East Oxford**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	15	13	14	12	9	11	11	11	12	13	14	15
Max hour ppb	52	57	67	74	43	74	45	43	42	43	75	66
% Data Capture	100	97	96	99	99	100	99	99	96	98	99	100
DETR Band (hours)												
Low	741	674	716	710	735	717	738	739	688	729	711	742
Moderate	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number of hours >105 ppb	0	0	0	0	0	0	0	0	0	0	0	0



*Figure 2: East Oxford nitrogen dioxide concentrations*

**Appendix 2 (continued)**

**Table 7 - Nitrogen Dioxide St Ebbes**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	15	7	13	11	8	8	9	10	8	8	10	14
Max hour ppb	38	36	51	43	23	41	37	43	29	27	31	35
% Data Capture	100	87	84	98	37	99	100	99	96	98	98	99
DETR Band (hours)												
Low	741	607	627	704	274	716	742	736	688	731	706	736
Moderate	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number of hours >105 ppb	0	0	0	0	0	0	0	0	0	0	0	0

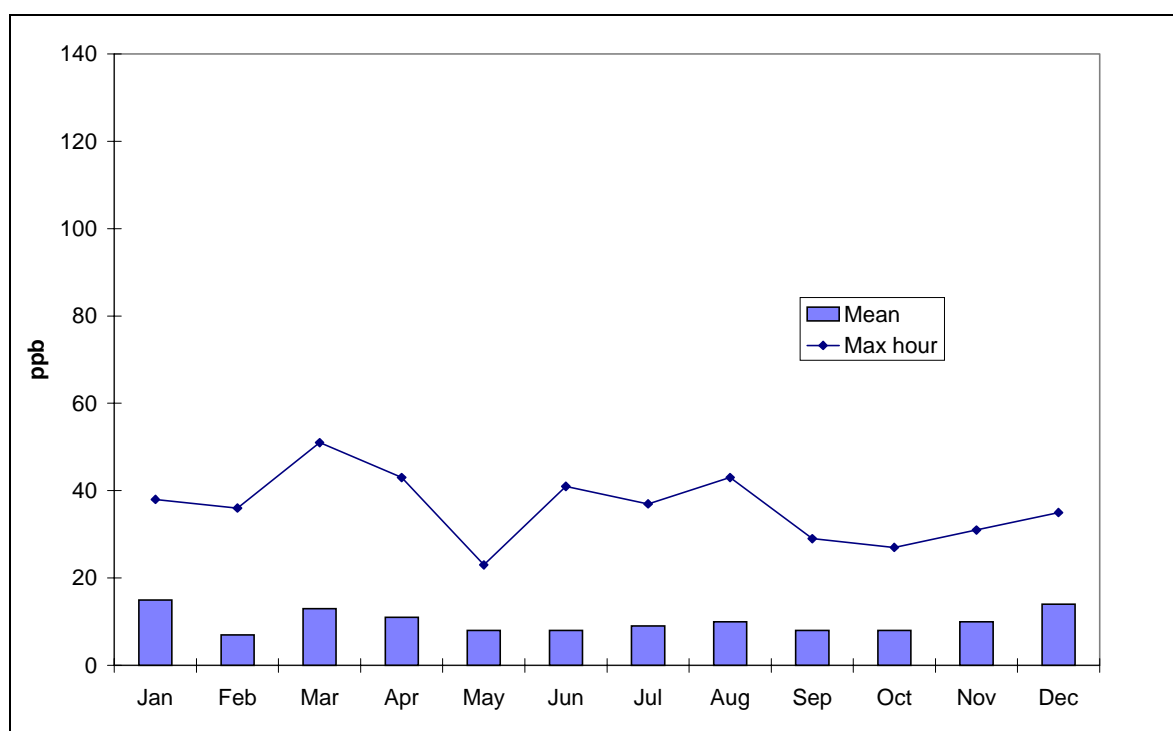
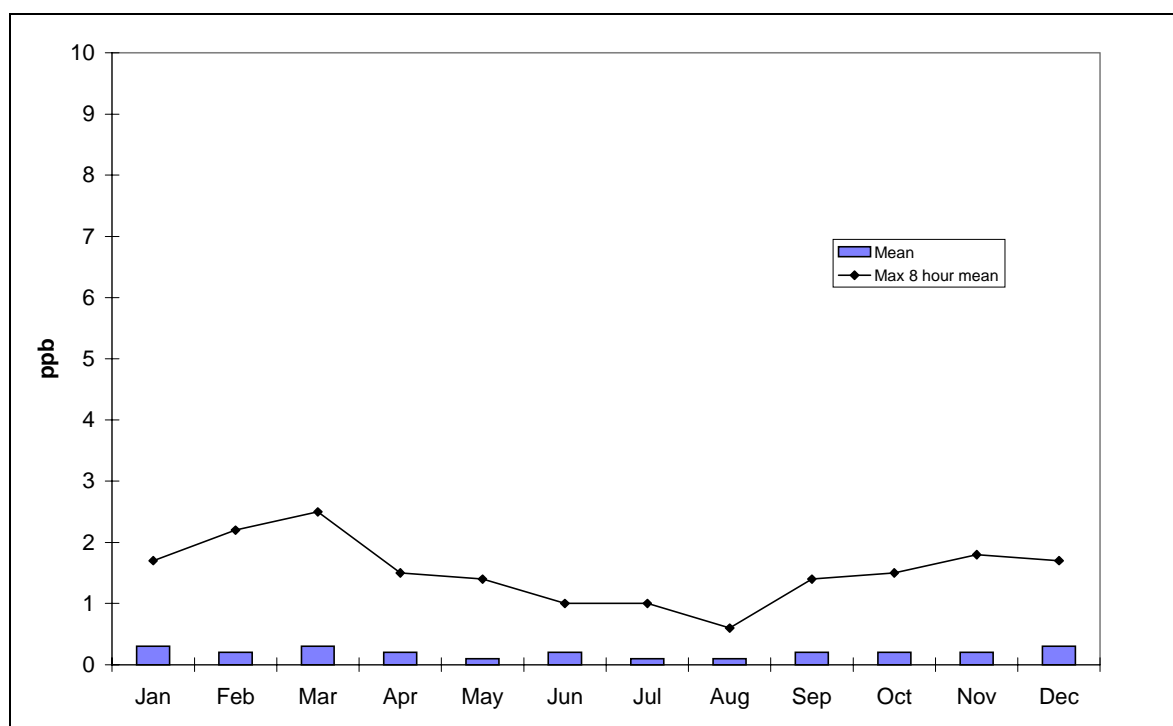


Figure 3: St Ebbes nitrogen dioxide concentrations

**Appendix 2 (continued)**

**Table 8 - Carbon Monoxide Oxford Centre**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppm	0.3	0.2	0.3	0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.3
Max hour ppm	2.1	2.8	3.2	2.1	1.7	1.6	1.1	1.1	3.1	2.6	2.4	2.5
Max running 8 hour mean ppm	1.7	2.2	2.5	1.5	1.4	1.0	1.0	0.6	1.4	1.5	1.8	1.7
% Data Capture	99	99	100	100	100	99	99	100	100	100	100	100
DETR Band (hours)												
Low	734	696	744	720	744	713	738	744	720	744	720	744
Moderate	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number of running 8-hr means >10ppm	0	0	0	0	0	0	0	0	0	0	0	0



*Figure 4: Oxford Centre carbon monoxide concentrations*

**Appendix 2 (continued)**

**Table 9 - Sulphur Dioxide Oxford Centre**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	2	1	2	2	1	1	1	1	1	1	1	1
Max hour ppb	11	11	46	24	26	58	21	23	29	12	8	9
Max 15-min mean ppb	13	16	67	35	28	73	30	28	38	15	10	13
Max 24-hour mean ppb	8	5	14	5	5	7	4	6	5	3	4	5
% Data Capture	98	100	100	100	100	99	99	100	100	100	100	100
DETR Band (15 min periods)												
Low	2874	2718	2908	2809	2908	2791	2894	2905	2809	2809	2812	2905
Moderate	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number 15 minute means >100ppb	0	0	0	0	0	0	0	0	0	0	0	0

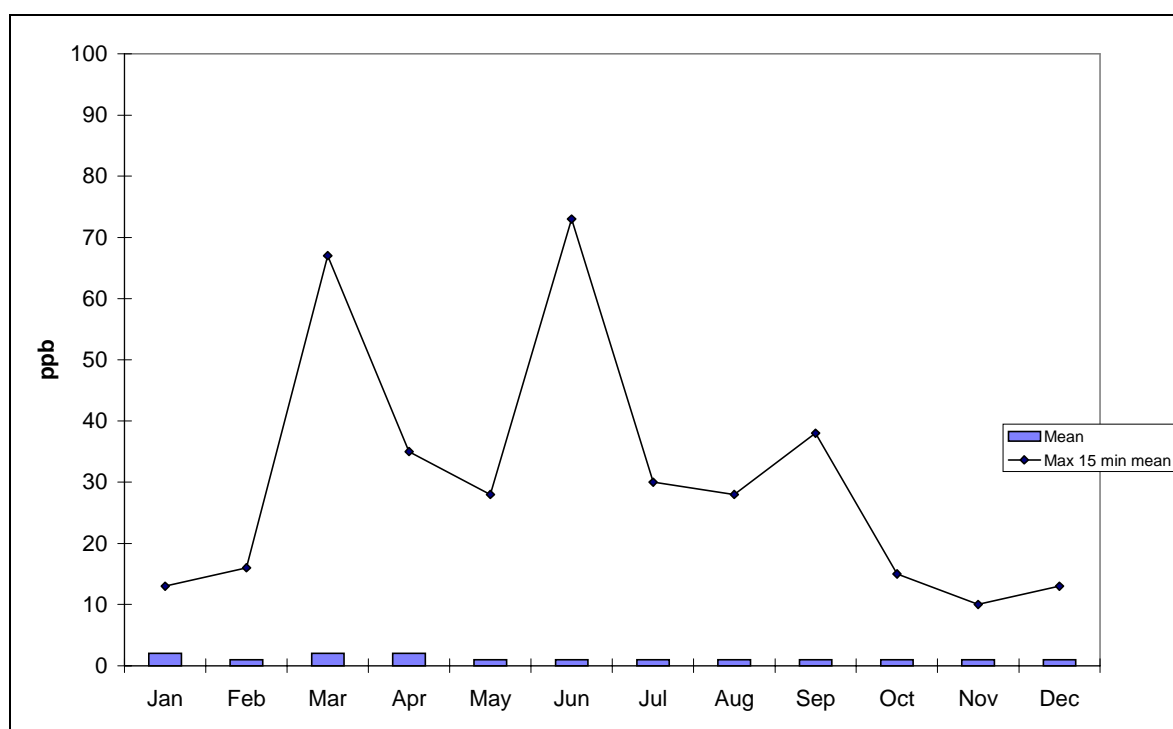


Figure 5: Oxford Centre sulphur dioxide concentrations

**Appendix 2 (continued)**

**Table 10 - Ozone East Oxford**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	16	23	23	28	32	25	23	21	17	17	17	16
Max hour ppb	41	42	45	54	67	70	64	70	53	41	40	44
Max running 8 hr mean ppb	39	40	44	48	60	66	58	59	48	37	39	41
% Data Capture	100	100	96	98	96	97	97	100	96	99	100	100
DETR Band (hours)												
Low	744	696	708	696	644	627	710	718	684	744	720	744
Moderate	0	0	0	7	61	70	26	26	3	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High												
National Air Quality Strategy												
Number of running 8 hr means >50ppb	0	0	0	0	25	44	10	9	0	0	0	0
On number of days*	0	0	0	0	4	5	2	2	0	0	0	0

\*The air quality objective for ozone is based on the maximum daily running 8 hour mean. Therefore the number of days on which the objective level was exceeded is a better indicator of exceedence.

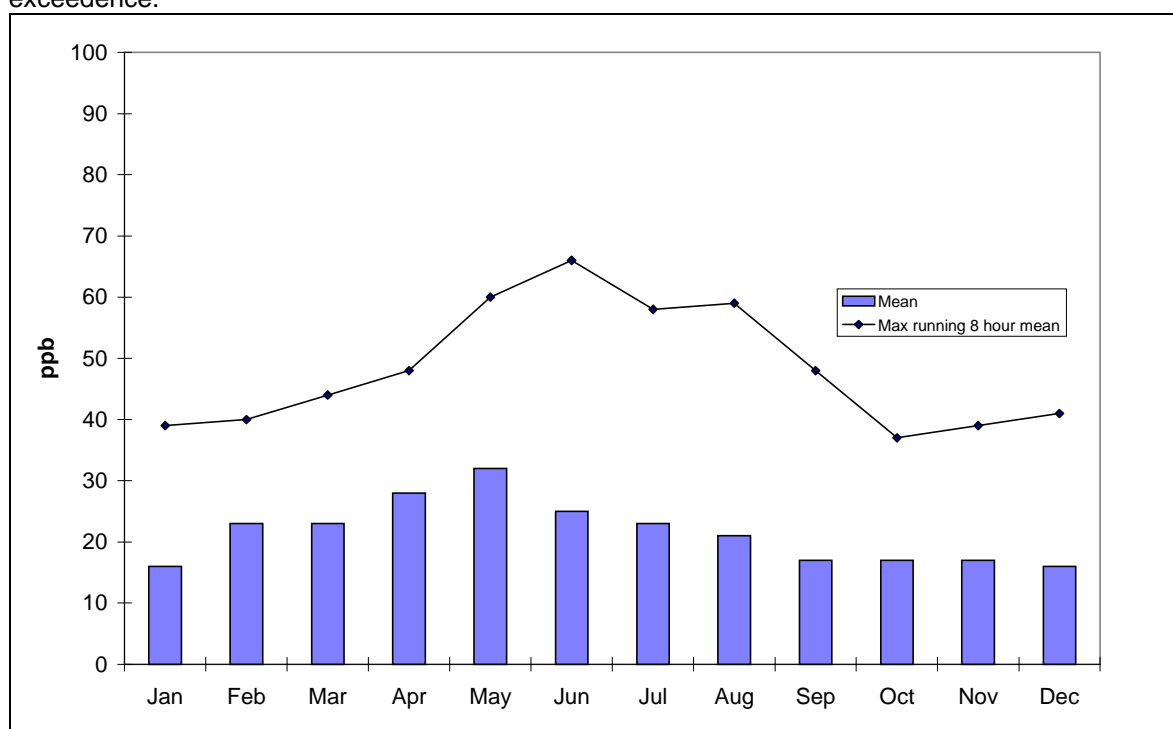


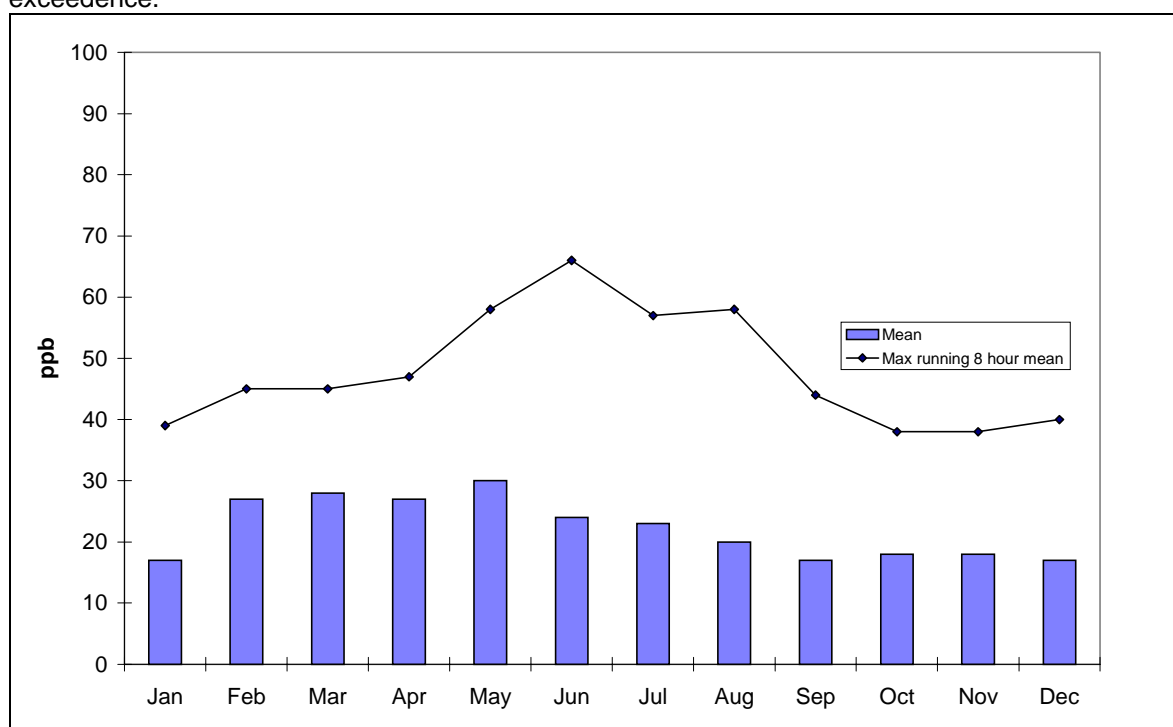
Figure 6: East Oxford ozone concentrations

**Appendix 2 (continued)**

**Table 11 - Ozone St Ebbes**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	17	27	28	27	30	24	23	20	17	18	18	17
Max hour ppb	40	46	49	53	64	70	65	65	51	44	38	41
Max running 8 hr mean ppb	39	45	45	47	58	66	57	58	44	38	38	40
% Data Capture	100	100	93	98	100	100	100	100	96	99	100	100
DETR Band (hours)												
Low	744	696	688	695	707	638	707	721	688	744	720	744
Moderate	0	0	0	6	37	76	37	23	1	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
National Air Quality Strategy												
Number of running 8 hr means >50ppb	0	0	0	0	13	46	15	5	0	0	0	0
On number of days*	0	0	0	0	2	5	3	2	0	0	0	0

\*The air quality objective for ozone is based on the maximum daily running 8 hour mean. Therefore the number of days on which the objective level was exceeded is a better indicator of exceedence.



*Figure 7: St Ebbes ozone concentrations*

**Appendix 2 (continued)**

**Table 12 - PM10 Cornmarket Street**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean $\mu\text{g}/\text{m}^3$	22	23	33									
Max hour $\mu\text{g}/\text{m}^3$	127	172	193									
Max 24 hr mean $\mu\text{g}/\text{m}^3$	39	41	59									
% Data Capture	100	100	16									
DETR Band (hours)												
Low	744	690	100									
Moderate	0	6	23									
High	0	0	0									
Very High	0	0	0									
Air Quality Regs												
Number of 24 hr means $>50\mu\text{g}/\text{m}^3$	1	1	1									

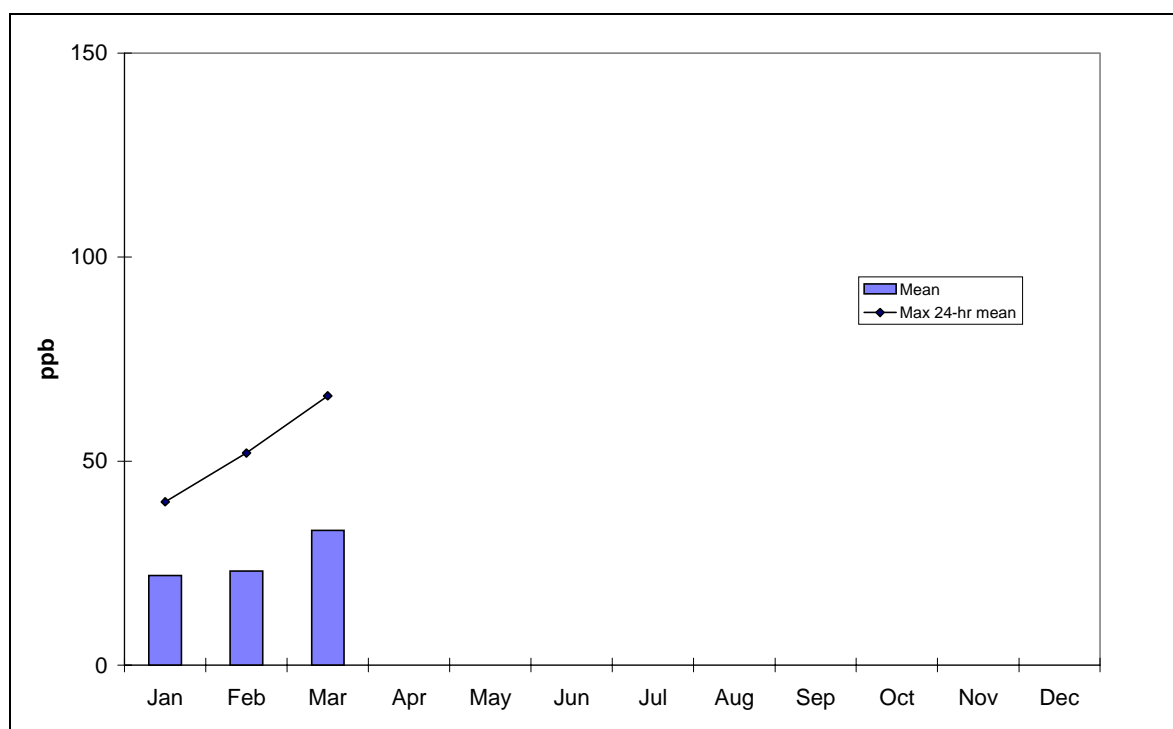


Figure 8: Cornmarket PM<sub>10</sub> concentrations

**Appendix 2 (continued)**

**Table 13 - PM10 East Oxford**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean $\mu\text{g}/\text{m}^3$	16	17	24	15	23	25	20	18	16	15	16	16
Max hour $\mu\text{g}/\text{m}^3$	59	83	188	108	230	182	306	78	85	86	469	317
Max 24-hr mean $\mu\text{g}/\text{m}^3$	30	38	60	31	75	57	53	34	37	27	65	56
% Data Capture	99	99	96	99	99	98	95	99	99	100	99	100
DETR Band (hours)												
Low	744	696	659	702	693	684	688	744	720	744	707	714
Moderate	0	0	47	0	37	36	28	0	0	0	12	30
High	0	0	0	0	14	0	0	0	0	0	1	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number 24-hr means $>50\mu\text{g}/\text{m}^3$	0	0	3	0	3	4	3	0	0	0	2	1

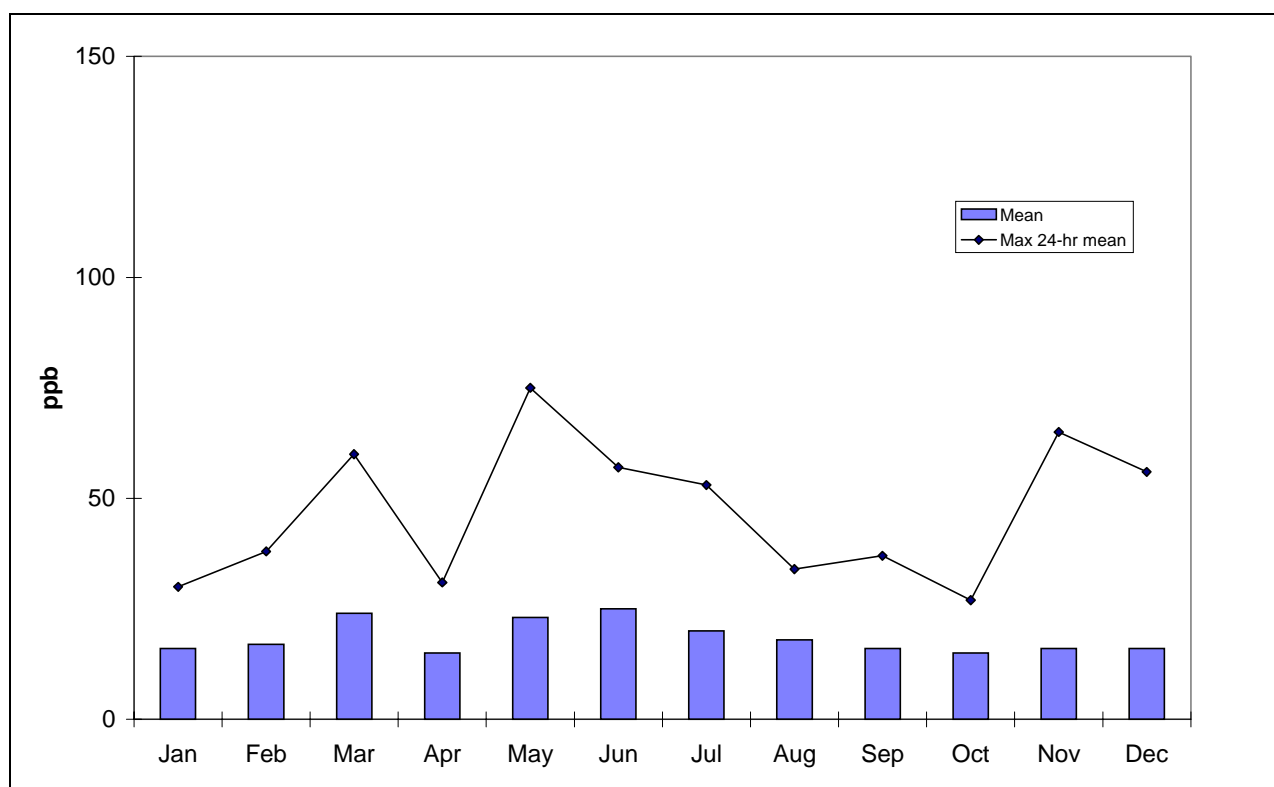


Figure 9: East Oxford PM<sub>10</sub> concentrations

**Appendix 2 (continued)**

**Table 14 - PM10 St Ebbes**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean $\mu\text{g}/\text{m}^3$	16	14	20	12	16	17	15	14	11	12	12	12
Max hour $\mu\text{g}/\text{m}^3$	64	40	185	44	54	48	43	46	34	36	41	37
Max 24-hr mean $\mu\text{g}/\text{m}^3$	29	24	34	22	33	34	31	27	23	18	21	18
% Data Capture	96	88	88	97	99	99	99	99	93	99	99	50
DETR Band (hours)												
Low	707	604	630	700	744	720	744	744	648	744	720	382
Moderate	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number 24 hr means $>50\mu\text{g}/\text{m}^3$	0	0	0	0	0	0	0	0	0	0	0	0

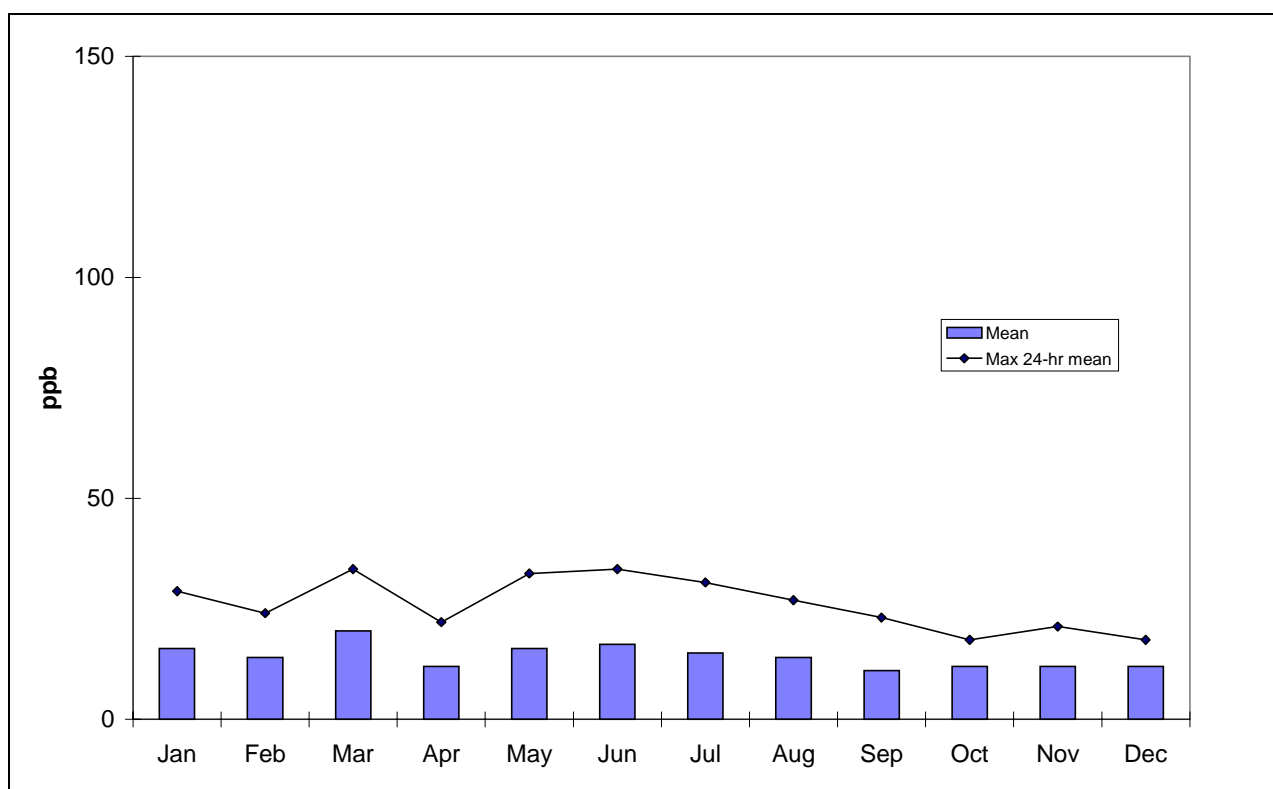


Figure 10: St Ebbes PM<sub>10</sub> concentrations

## Appendix 2 (continued)

### Table 15 - Nitrogen Dioxide Diffusion Tube Data

Location	Cat*	Annual mean ppb	Location	Cat*	Annual mean ppb
Beaumont Buildings	B	17	New Road	K	33
Beaumont Street	K	31	Norfolk Street	K	17
Beckett Street	K	20	Oxpens Road	K	20
Binsey Lane	B	9	Paradise Sq	B	15
Blue Boar Street	I	20	Park End Street	K	29
Bonn Square	K	27	Parks Road (Science Library)	K	22
Broad Street	K	20	Parks Road (Wadham College)	K	20
Butterwyke Place	I	21	Pike Terrace	I	24
Cornmarket Street	I	25	Pusey Street	I	21
Duke Street	I	17	Rewley Road	K	31
Floyd's Row	K	27	Sadler Walk	B	14
Folly Bridge	K	23	Shirelake Close	I	17
Gloucester Street	I	22	Speedwell Street	K	26.3
Green Road Roundabout	K	34	St Aldate's (Town Hall)	K	31
High Street	K	36	St Cross Road	K	19
Hollybush Row	K	22	St Giles	K	37
Iffley Road	K	22	Thames Street	K	24
Keble Road	K	23	Trinity Street	I	15
Lenthall Road	B	11	Walton Street	K	18
Longwall Street	K	35	Woodbine Place	B	17
Lyndworth Close	B	20	Worcester Street	K	33
Magdalen Bridge	K	21	York Place	I	24
Mansfield Road	B	18			
Queen Street**	K	44	St Clements Street**	K	39
George Street**	K	45	Hythe Bridge Street**	K	28
George Street / Magdalen St**	K	41	Botley Road**	K	24
High Street (RPM)**	K	41	South Parks Road**	K	22
Station Junction (bus stop)	K	37	Worcester College**	B	16

\* Category **K**erbside 1-5 metres from a major road, **I**ntermediate 20-30 metres from a major road, **B**ackground in residential area greater than 50 metres from a major road.

\*\* New sites.

Appendix 2 (continued)

Nitrogen Dioxide Diffusion Tube Charts

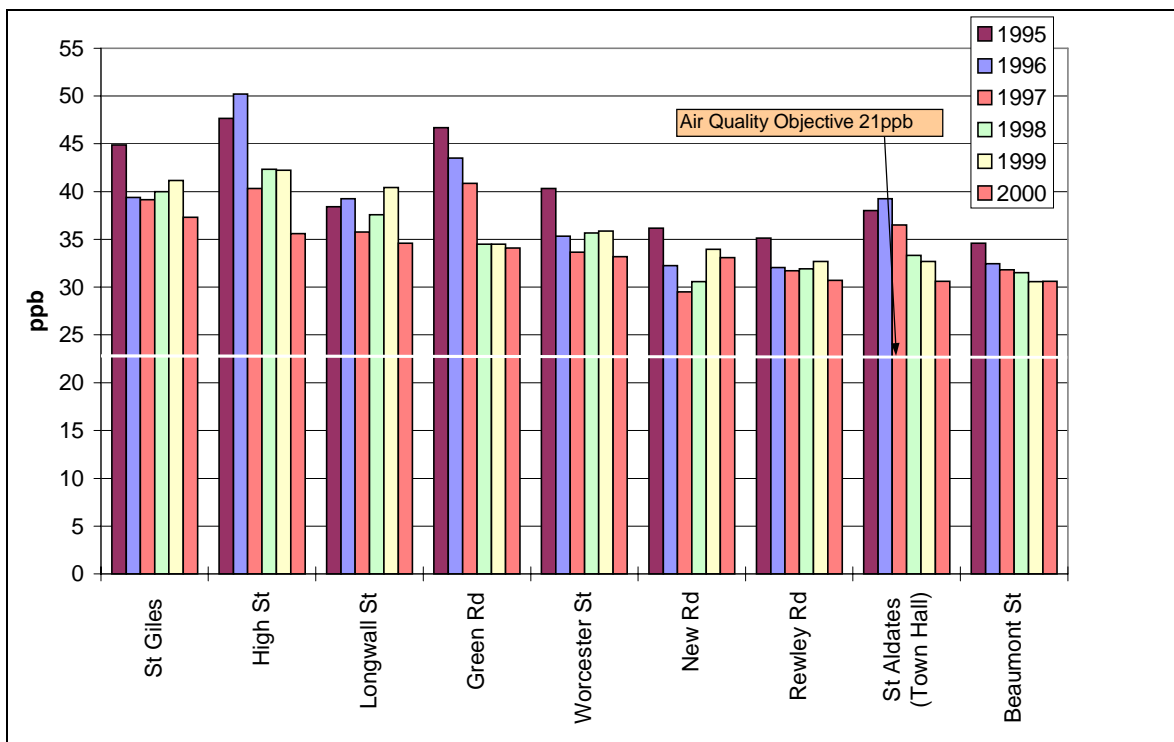


Figure 11: Annual mean nitrogen dioxide concentrations 1995-2000

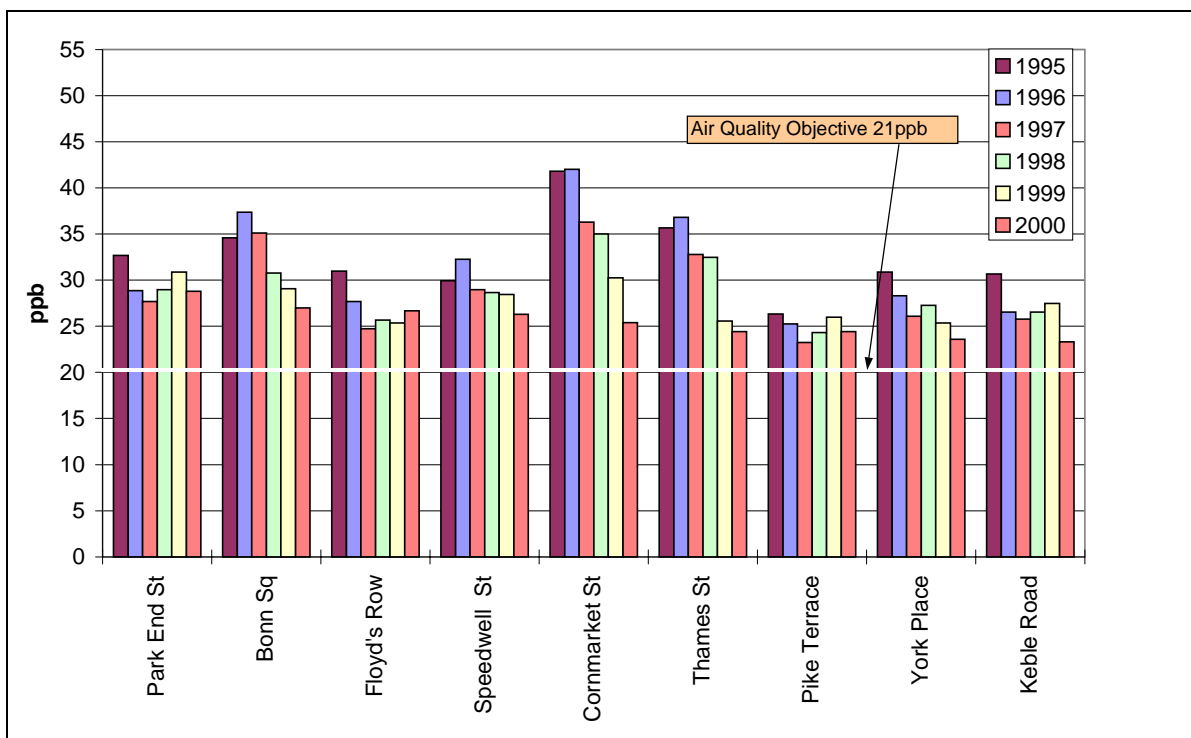


Figure 12 : Annual mean nitrogen dioxide concentrations 1995-2000

Appendix 2 (continued)

Nitrogen Dioxide Diffusion Tube Data Continued

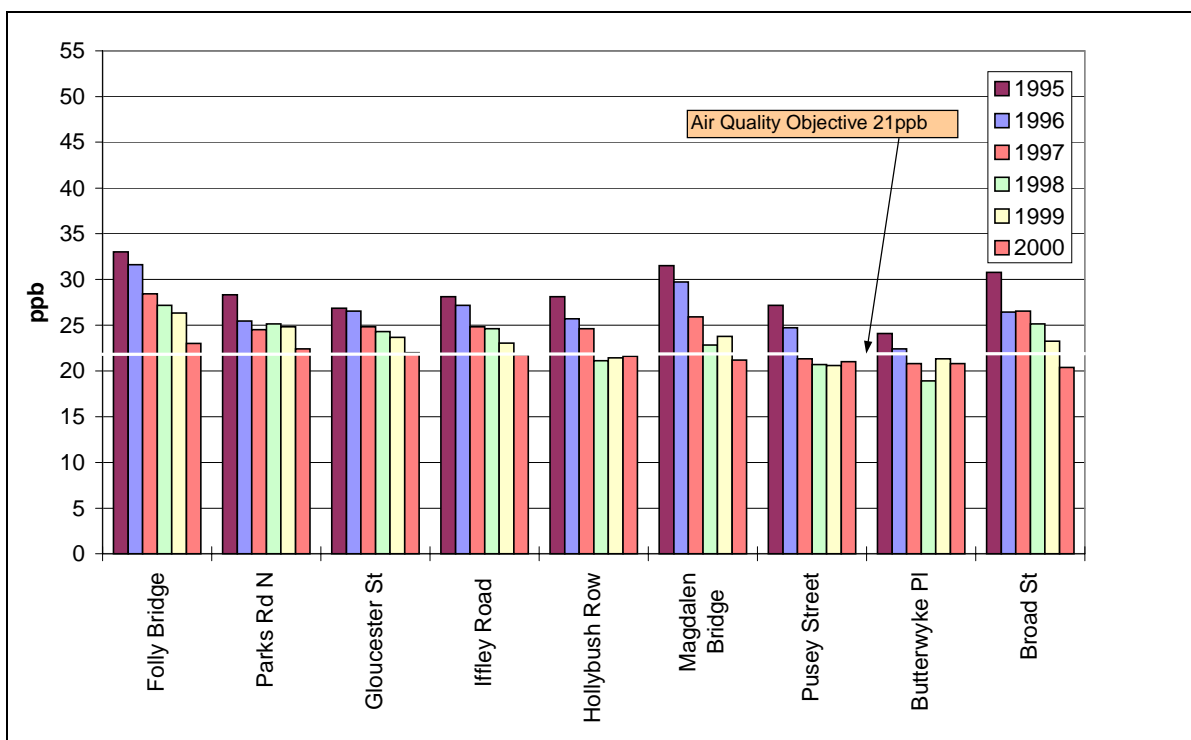


Figure 13: Annual mean nitrogen dioxide concentrations 1995 - 2000

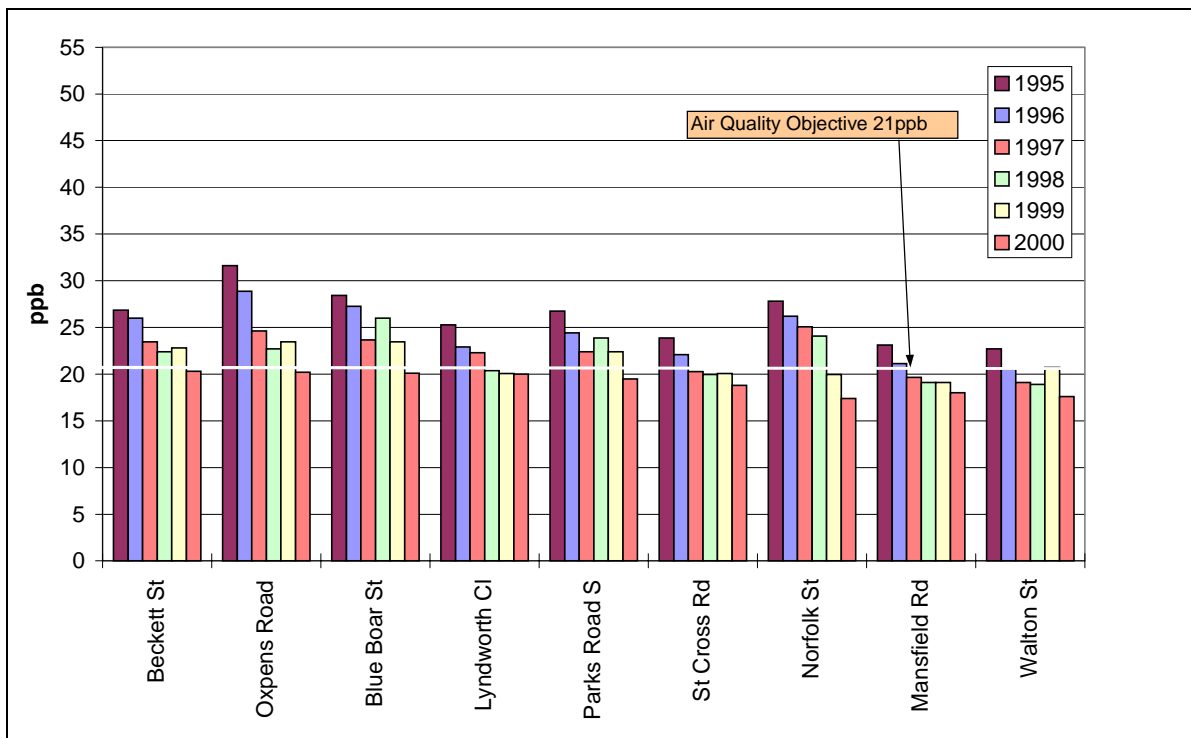


Figure 14: Annual mean nitrogen dioxide concentrations 1995 - 2000

Appendix 2 (continued)

Nitrogen Dioxide Diffusion Tube Data Continued

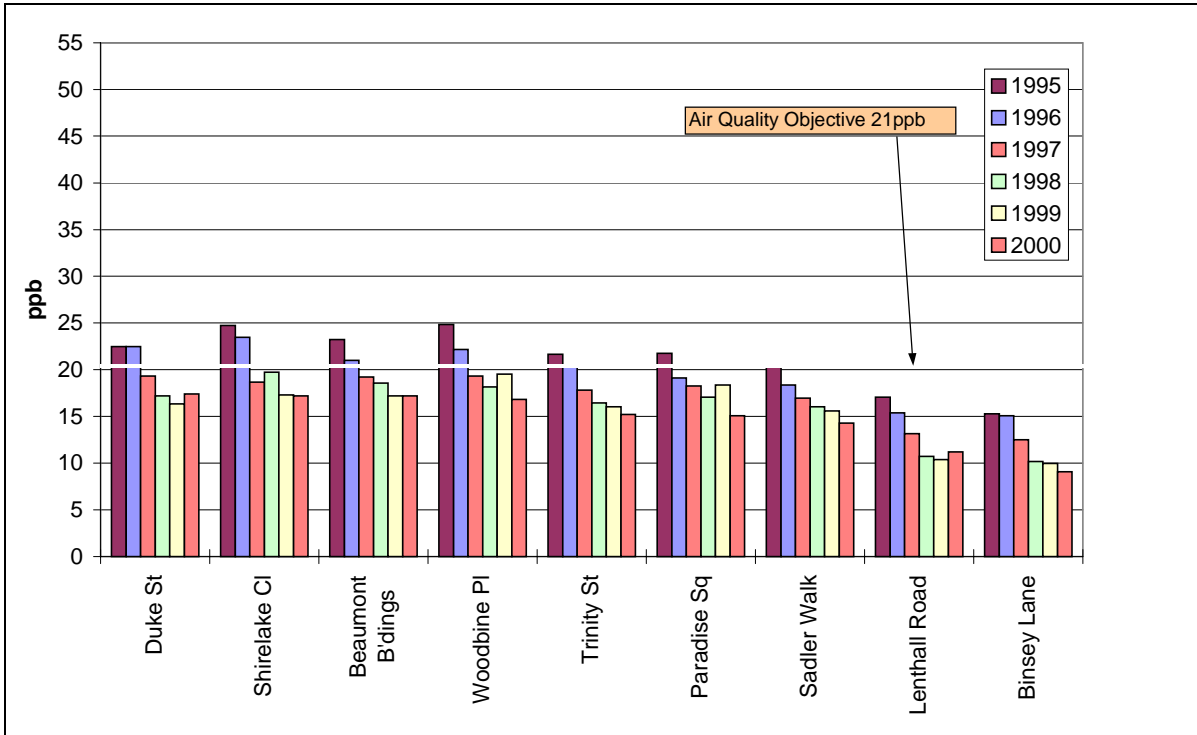


Figure 15: Annual mean nitrogen dioxide concentrations 1995 - 2000

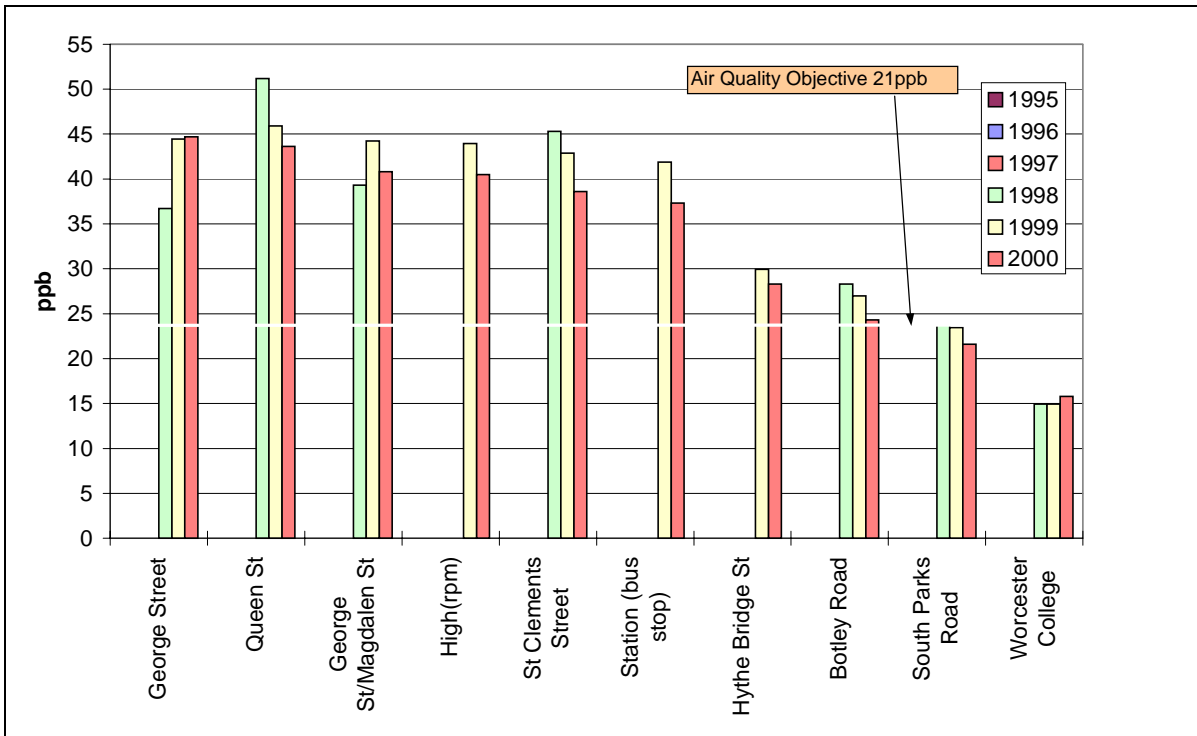


Figure 16: Annual mean nitrogen dioxide concentrations for sites introduced in 1998 and 1999

## Appendix 3 Maps Showing Monitoring sites

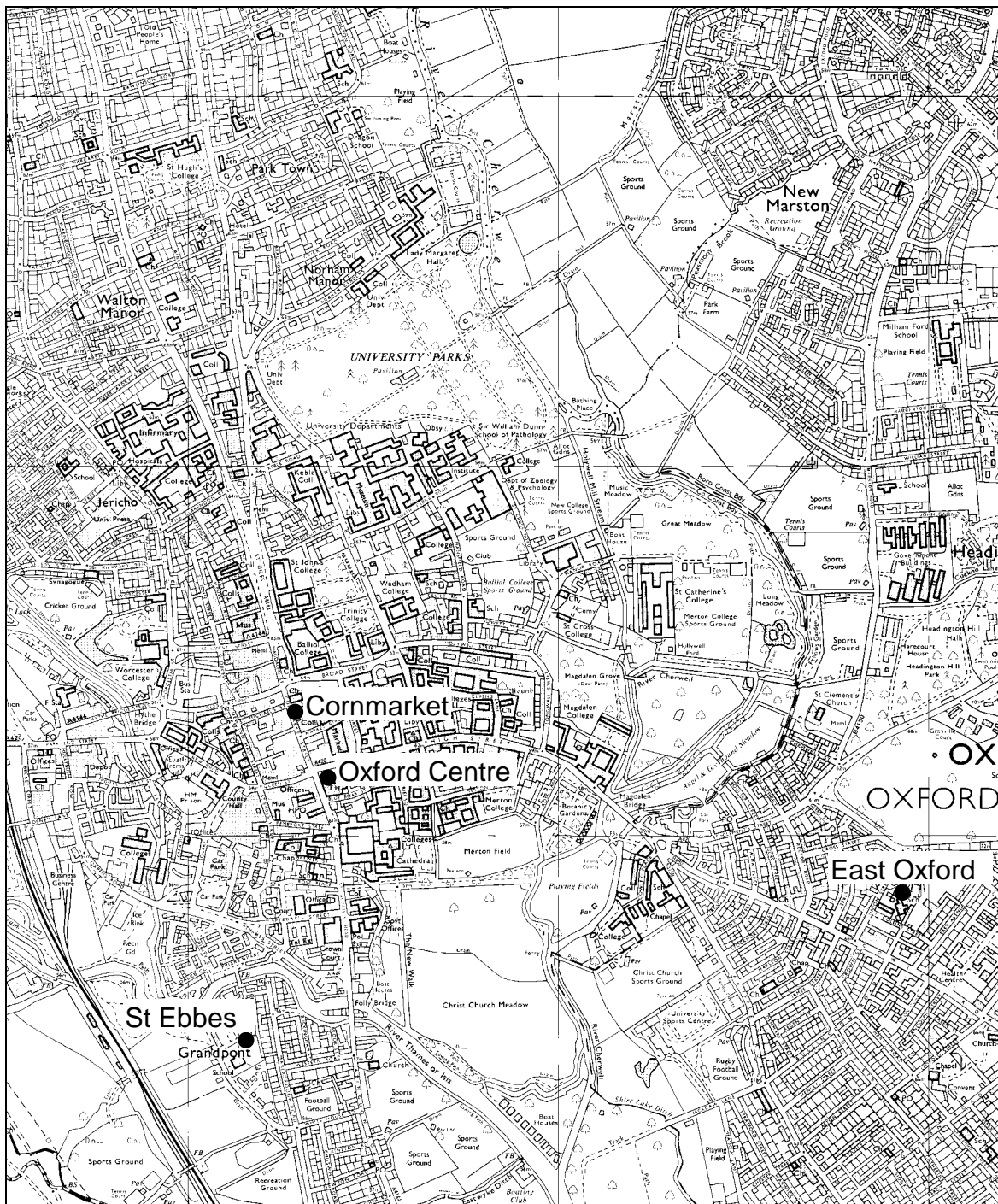


Figure 22: Continuous Monitoring Sites

Appendix 3 (continued)

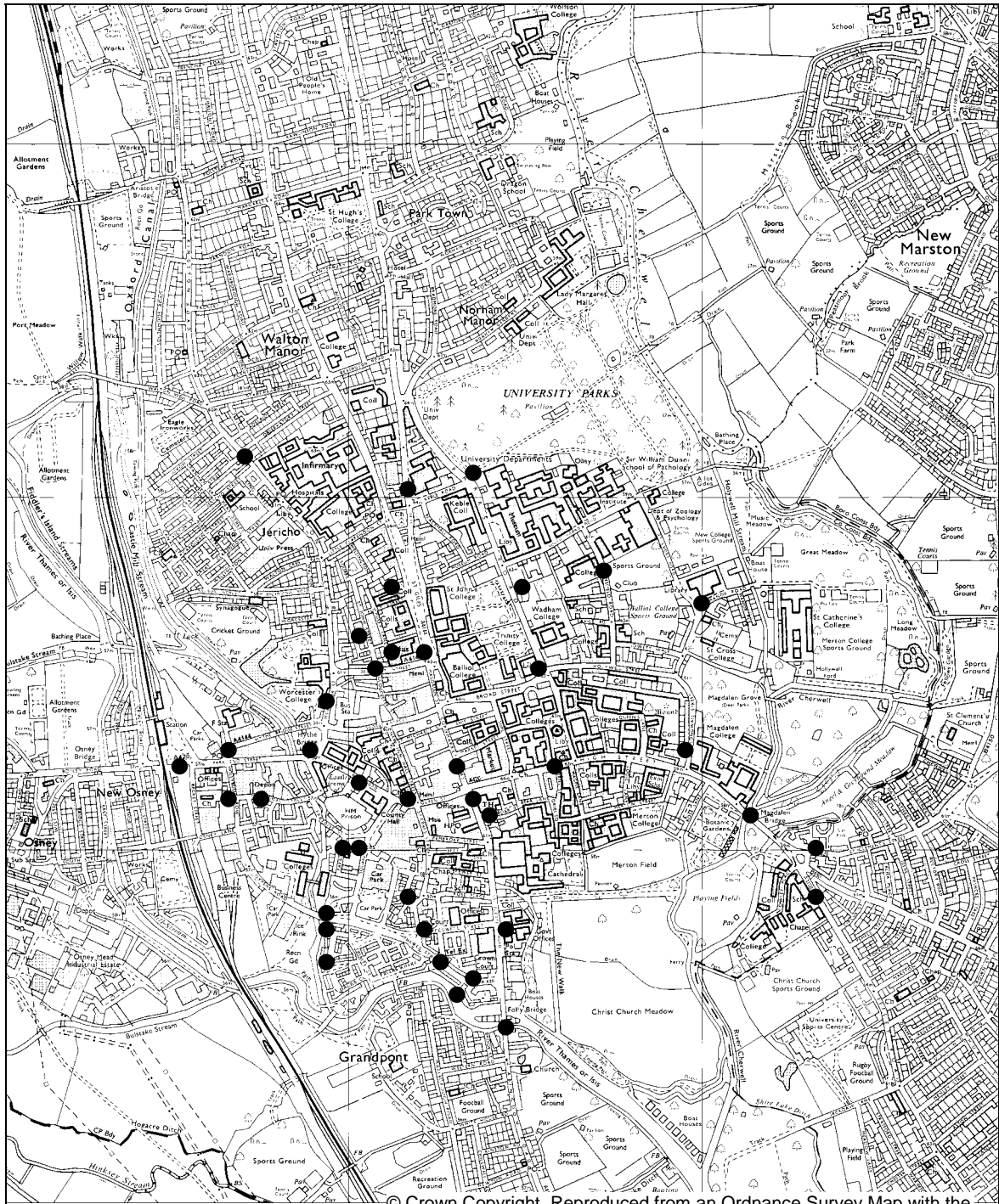


Figure 23: NO2 Diffusion Tube © Crown Copyright. Reproduced from an Ordnance Survey Map with the permission of Her Majesty's Stationary Office. Licence LA 078921

## Appendix 4 Data validation from continuous monitoring sites

1. All routine calibration and maintenance is carried and recorded in accordance with manufacturers' and Automated Urban Monitoring Network site operators' manuals.
2. Instrument drift is routinely checked by :-
  - a daily internal instrument calibration which is carried out automatically using an electronic calibration check,
  - every 2 weeks a manual external instrument calibration is carried out using gas cylinders that can be traced back to reference standards for each pollutant,
  - every 6 months an audit of instrument response is carried out by an external organisation using independent gas calibration standards.
3. The above checks enable data to be examined subsequently for instrument drift which is expected or for faulty data which is usually not expected. Instrument drift is routinely adjusted by means of the 2 weekly external gas calibrations. Scaled data is calculated using the gas calibrations for each analyser. Instrument response is also recorded on a chart recorder along with response to calibration gases. These chart records are also used to check the normal response as part of the data validation process.
4. Data from the continuous monitoring sites is collected and independently validated by the National Environmental Technology Centre, AEA Technology Environment.

## Appendix 5 Glossary

**Air quality:** usually refers to the concentration in air of one or more pollutants.

**Air quality objectives:** policy targets of what the Government intends should be achieved in the light of the air quality standards.

**Air quality standards:** the concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. Air quality standards are based on the assessment of the effects of each pollutant on health.

**Carbon monoxide (CO):** a colourless, odourless flammable gas produced by the incomplete combustion of the fuels containing carbon.

**Concentration:** the amount of substance in a given volume (for gaseous pollutants usually in parts per million or parts per billion)

**Dispersion:** the way in which pollution spreads from its point of emission and becomes diluted in the atmosphere.

**Emission:** the process of discharging into the atmosphere.

**Episode:** an air pollution incident in a given area caused by a combination of circumstances, e.g. meteorological, topographical, accidental escape of pollution from industry.

**Monitoring:** measuring pollution.

**Nitrogen dioxide (NO<sub>2</sub>):** acid irritant gas.

**Ozone (O<sub>3</sub>):** the reactive molecular form of oxygen, it is very poisonous.

**Particulate matter:** fine particles found in the air or emissions such as smoke.

**PM<sub>10</sub>:** particulate matter less than 10 microns in diameter (10 millionths of a metre).

**Parts per billion (ppb) / million (ppm):** units of volume of the pollutant for every billion (hundred million) or million units of air. For example, an ozone guideline of 50ppb would recommend a maximum volume of 50 units of ozone for every billion volume units of air.

**Running 8 hour mean:** a mean which is calculated on an hourly basis, yielding one running 8 hour mean per hour. It is calculated from the hourly mean for that hour and the preceding 7 hours.

**Sulphur dioxide (SO<sub>2</sub>):** colourless, acid irritant gas with a pungent odour.