

Oxford City Council

Environmental Health

Airwatch Annual Report 1999

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

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1 Introduction

1. This is the sixth 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 1997.
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 ₁₀
St Ebbes (urban background)	July 1997	Nitrogen dioxide, PM ₁₀
East Oxford(urban background)	July 1997	Nitrogen dioxide, PM ₁₀

3. 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 106, 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.
5. 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. Although this report covers the period of the implementation it does not assess the effect of OTS on air quality. The assessment of the effects of OTS is part of the EMITS project¹ which will report in 2001.

¹ 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>

6. Two new initiatives were introduced in 1999. A scrolling display was installed in the window of the Council's cash office at Carfax. Continually updated data is sent to the display for public information. Secondly, the department's diesel vehicle was replaced with an electric powered vehicle. The vehicle is used when servicing the sites and changing the diffusion tubes.
7. 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.

2 Air Quality Standards and Guidelines

8. Data is assessed in accordance with the air quality standards contained in the Air Quality Regulations² and the United Kingdom Air Quality Strategy³. The standards are expressed as objective levels to be achieved by the end of the year 2005.
9. 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.
10. Full details of the air quality objectives and air pollution bands used for assessing the results in this report are given in Appendix 1.

²Air Quality Regulations 1997 SI 3043.

³The United Kingdom Air Quality Strategy: Department of the Environment 1997.

3 Summary of Results

11. 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. The Air Quality Regulations 1997 set out the air quality objectives to be achieved by 31 December 2005.

Nitrogen Dioxide

12. Two air quality objective levels have been set for nitrogen dioxide, 150 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.
13. 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

14. The diffusion tube survey set up under EMITS has now been running for five years. Data for the five 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.
15. 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 eight exceeded the air quality objective level of 21ppb compared to twenty nine last year, thirty one in 1997, thirty six in 1996 and forty one 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 17% improvement from 30ppb in 1995 to 25ppb in 1999.
16. 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 (26ppb); and for Sadler Walk (16ppb) and Trinity Street (16ppb) which are 120 metres and 25 metres respectively from Oxpens Road (23ppb).

Continuous Monitoring

17. 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 mean concentration was 11ppb and the maximum hourly mean was 53ppb in May. At East Oxford the mean was 14ppb and the maximum hour was 129ppb in December.
18. The maximum hourly mean at Oxford Centre kerbside site was recorded at 120ppb in September. The mean concentration was 29ppb.
19. All three sites achieved the hourly mean air quality objective level. The East Oxford and St Ebbes sites achieved the annual mean objective level.

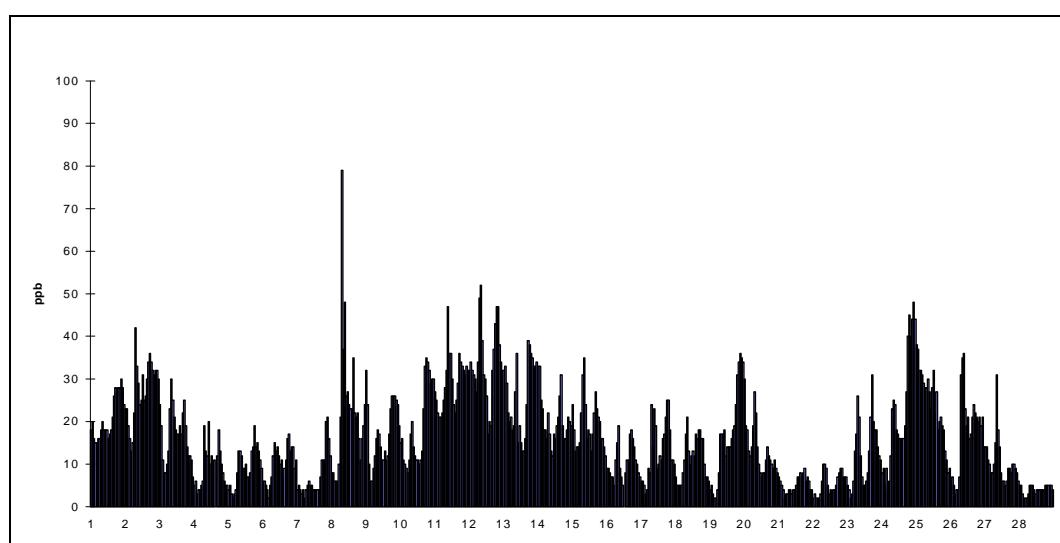


Figure 1: East Oxford hourly mean nitrogen dioxide concentrations for February

Sulphur Dioxide

20. The air quality objective level set for sulphur dioxide is 100ppb or less, when expressed as the 99.9th percentile of 15 minute means. Sulphur dioxide was monitored continuously at Oxford Centre. The 99.9th percentile of 15 minute means was 20ppb which is within the air quality objective level. The mean concentration was 2ppb, the maximum hourly mean was 34ppb in July and the maximum 15 minute mean of 45ppb occurred in March.

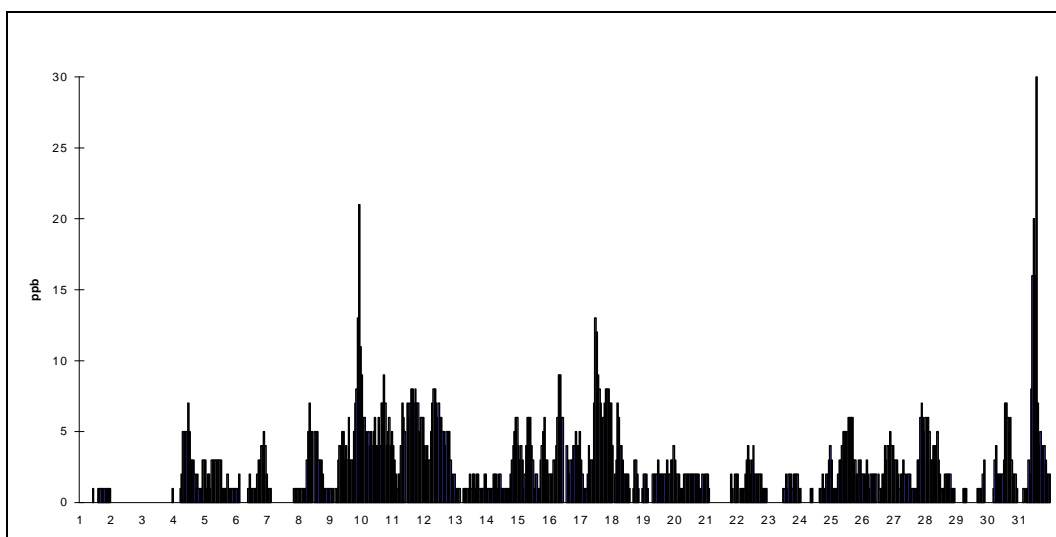


Figure 2: St Aldates hourly mean sulphur dioxide concentrations for March

Carbon Monoxide

21. The air quality objective level set for carbon monoxide is 10 parts per million (ppm) or less, when expressed as a running 8 hour mean. Carbon monoxide was monitored continuously at Oxford Centre. The mean concentration was 0.4ppm and the maximum hourly mean was 4.9ppm in April. The maximum running 8 hour mean was 3.1ppm in April which is within the air quality objective level.

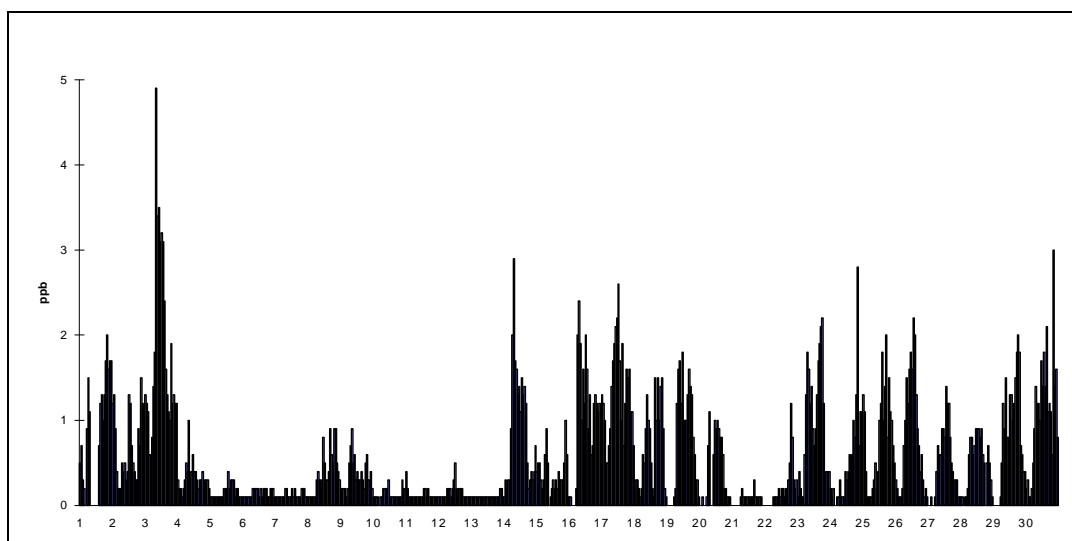


Figure 3: St Aldates hourly mean carbon monoxide concentrations for April

Ozone

22. The Air Quality Regulations 1997 did not set an objective level for ozone. However the UK National Air Quality Strategy suggested the objective level of 50ppb or less, when expressed as the 97th percentile of daily maximum running 8 hour means. Ozone was monitored continuously at St Ebbes and East Oxford. At St Ebbes the 97th percentile of daily maximum running 8 hour means was 64ppb. The mean concentration was 24ppb, the maximum hourly mean was 102ppb in August and the

maximum running 8 hour mean was 85ppb in July. At East Oxford the 97th percentile of daily maximum running 8 hour means was 62ppb. The mean concentration was 23ppb, the maximum hourly mean was 100ppb and the maximum running 8 hour mean was 87ppb both in August.

23. 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 March and September, 376 hours of moderate ozone pollution were recorded at St Ebbes and 318 hours were recorded at East Oxford. During June, July and August 7 hours of high ozone pollution were recorded at St Ebbes and 5 hours were recorded at East Oxford. The air quality objective level was exceeded at East Oxford on 26 days and St Ebbes on 31 days. The 97th percentile objective allows exceedences on 10 days a year.

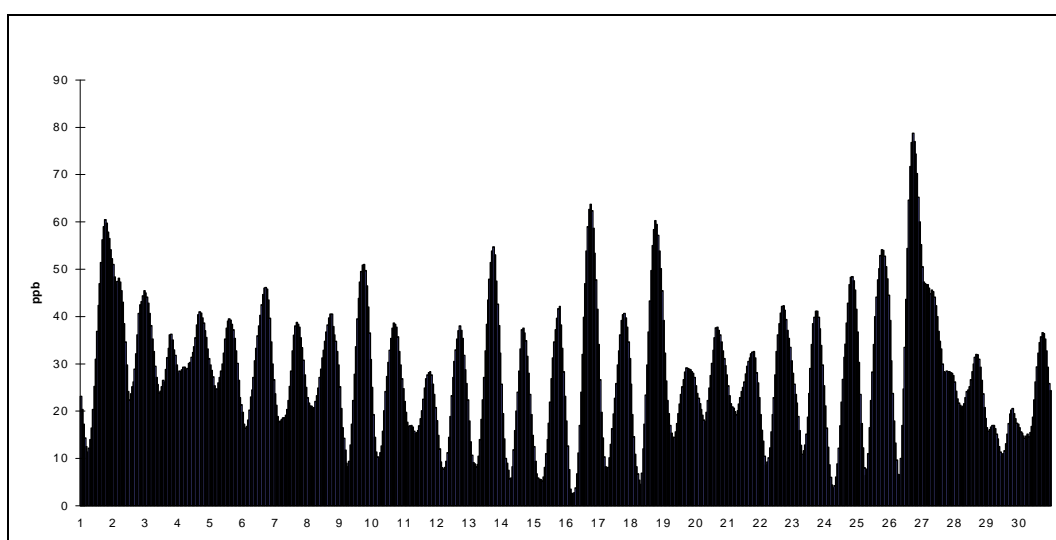


Figure 4: St Ebbes running 8 hour mean ozone concentrations for June

PM₁₀ Particulate Matter

24. The air quality objective level set for PM₁₀ is 50 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) or less, when expressed as the 99th percentile of daily maximum running 24 hour means. PM₁₀ was monitored continuously at St Ebbes, East Oxford and Cornmarket Street. At St Ebbes the 99th percentile of daily maximum running 24 hour means was $42\mu\text{g}/\text{m}^3$. The mean concentration was $15\mu\text{g}/\text{m}^3$, the maximum hourly mean was $275\mu\text{g}/\text{m}^3$ and the maximum running 24 hour mean was $49\mu\text{g}/\text{m}^3$, both in July. At East Oxford the 99th percentile of daily maximum running 24 hour means was $57\mu\text{g}/\text{m}^3$. The mean concentration was $19\mu\text{g}/\text{m}^3$, the maximum hourly mean was $260\mu\text{g}/\text{m}^3$ in August and the maximum running 24 hour mean was $63\mu\text{g}/\text{m}^3$ in September. At Cornmarket Street the 99th percentile of daily maximum running 24 hour means was $52\mu\text{g}/\text{m}^3$. The mean concentration was $23\mu\text{g}/\text{m}^3$, the maximum hourly mean was $124\mu\text{g}/\text{m}^3$ in September and the maximum running 24 hour mean was $57\mu\text{g}/\text{m}^3$ in April.

25. At East Oxford 152 hours of moderate PM_{10} pollution were recorded during May to September. At Cornmarket Street 39 hours of moderate PM_{10} pollution were recorded during March to May and 12 hours were recorded in September. The air quality objective level was achieved at St Ebbes but was exceeded at Cornmarket on 8 days and East Oxford on 16 days. The 99th percentile objective allows exceedences on 4 days a year.
26. PM_{10} is produced both locally and some distance away from the monitoring site. Because of its buoyancy, PM_{10} 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 1st June and prior to that was restricted to bus traffic. 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.

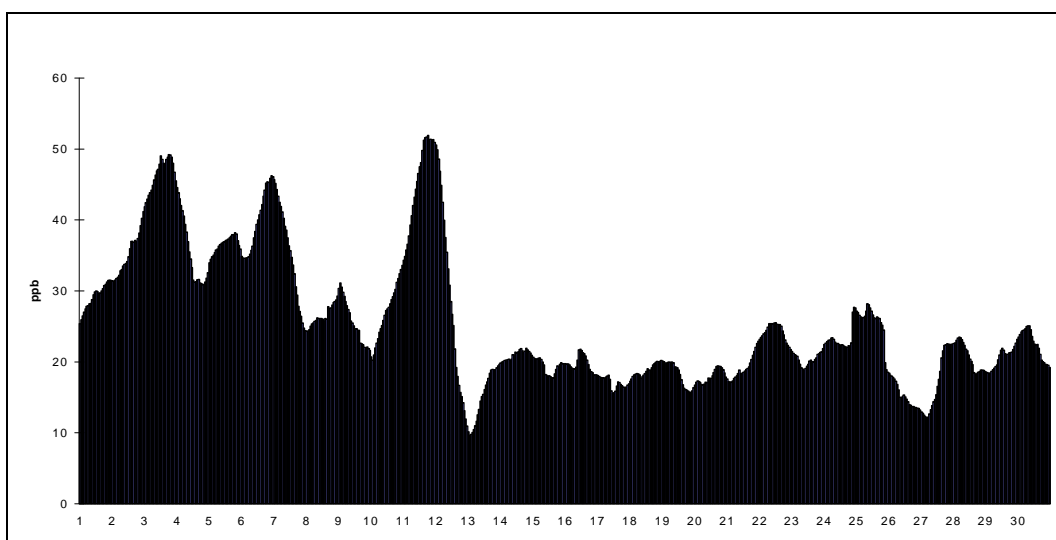


Figure 5: Cornmarket running 24 hour mean PM_{10} concentrations for September

4 Comparison with other sites

27. 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/>. Data for January to September has been validated and for October to December is provisional.

	NO2 ppb		PM10 µg/m ³		SO2 ppb		O3 ppb		CO ppm	
	1 hour		running 24 hour		15 minutes		running 8 hour		running 8 hour	
	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean
Oxford Centre (Roadside)	120	29	-	-	45	2	-	-	4.9	0.4
Oxford St Ebbes (Urban background)	53	11	49	15	-	-	85	24	-	-
Oxford East Oxford (Urban background)	129	14	63	19	-	-	87	23	-	-
Oxford Cornmarket (Roadside)	-	-	57	23	-	-	-	-	-	-
Reading (Urban background - 20 metres from A4)	64	20	49	16	148	3	73	18	2.8	0.6
Marlyebone Road (Roadside - 1m from busy main road)	170	47	147	35	70	5	45	7	7.3	1.8
Leamington Spa (Urban background - 10m from main road)	67	16	52	17	48	2	92	21	2.5	0.4
Harwell (Rural)	54	7	-	-	179	1	90	27	-	-
Bristol Centre (Urban centre - 40m from major road)	98	20	56	20	83	4	68	21	2.6	0.6
Bath Roadside (Roadside - on A4 London Rd)	130	32	-	-	-	-	-	-	4.5	1.3

5 Conclusions

28. In summary:

- results for annual diffusion tube monitoring showed that out of the original 45 sites, 28 exceeded the 2005 air quality objective level of 21ppb annual mean, compared to 29 sites last year, 31 in 1997, 36 in 1996 and 41 in 1995,
- there has been an overall reduction in annual mean concentrations of nitrogen dioxide at the diffusion tube sites over the last 5 years (average reduction 17%),
- the annual mean nitrogen dioxide air quality objective of 21ppb was achieved at St Ebbes and East Oxford,
- the hourly mean nitrogen dioxide air quality objective of 150ppb was achieved,
- the air quality objectives for sulphur dioxide, and carbon monoxide were achieved,
- the air quality objective level for ozone (50ppb 97th percentile of daily maximum 8 hour running means) was exceeded at East Oxford (62ppb) and St Ebbes (64ppb),
- the air quality objective level for PM₁₀ (50µg/m³ 99th percentile of daily maximum 24 hour running means) was exceeded at Cornmarket Street (52µg/m³), and East Oxford (57µg/m³). It was achieved at St Ebbes (42µg/m³).

6 Future Developments

29. There is increasing concern over the impact of air pollution on human health. The UK Government has adopted the approach of integrated pollution control, now encompassed in the UK National Air Quality Strategy. In progressing the strategy, the Government passed Air Quality Regulations in December 1997 initiating the system of local air quality management under Part IV Environment Act 1995. The Environment Act requires local authorities to carry out a review and assessment of air quality and where appropriate declare Air Quality Management Areas (AQMAs). The Regulations set the air quality standards and objectives for seven key pollutants. These standards and objectives are to be achieved by 31st December 2005. Local authorities will have powers to declare AQMAs where they are not likely to be achieved.
30. A review of the National Air Quality Strategy was undertaken in 1999 and a revised strategy will be published early in 2000. This will result in amendments to the air quality objectives bringing them in line with EC Directives.
31. The initial Stage 1-2 Air Quality Review and Assessment was completed in December 1998. It recommended that a third stage review and assessment should be undertaken for nitrogen dioxide and particulate matter (PM₁₀). It also recommended that a robust assessment of the small boilers in Oxford with the potential to result in exceeding the national sulphur dioxide objective should also be undertaken. Following public consultation the Stage 3 of the Air Quality Review and Assessment process is now being undertaken and will be reported in 2000. The DETR's deadline for the completion of Stage 3 is June 30th 2000.
32. We are now well into the EMITS project (see section 1) and air quality data is being used to assess the impact of the Oxford Transport Strategy (OTS) on the environment in Oxford. Air quality and health are key issues in taking the OTS forward and the Airwatch programme provided essential air quality evidence for the OTS Public Inquiry. The final report of the EMITS project will be published in 2001.
33. Improvements in the public dissemination of air quality information are being developed. A scrolling display sign was installed at Carfax in 1999 and second sign will be installed in the reception of Ramsay House in 2000. A web site is under development and will be launched in 2000.

Appendix 1 Air Quality Standards and Guidelines

Air Quality Regulations 1997.

The air quality objective levels are to be achieved by the end of 2005.

Substance	Air quality objective levels
Benzene	5ppb or less, when expressed as a running annual mean
1,3-Butadiene	1ppb or less, when expressed as a running annual mean
Carbon monoxide	10ppm or less, when expressed as a running 8 hour mean
Lead	0.5µg/m ³ or less, when expressed as an annual mean
Nitrogen dioxide	150ppb or less, when expressed as an hourly mean, and 21ppb or less, when expressed as an annual mean
PM ₁₀	50µg/m ³ or less, when expressed as the 99 th percentile of daily maximum running 24 hour means
Sulphur dioxide	100ppb or less, when expressed as the 99.9 th percentile of 15 minute means
Ozone*	50ppb or less, when expressed as the 97 th percentile of daily maximum 8 hour running means

* 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 ₁₀	50µg/m ³ or less	50-74µg/m ³	75-99µg/m ³	equal to or greater than 100µg/m ³	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 ₁₀ µg/m ³
Mean	29	0.4	-	2	-
99.9th percentile	-	-	-	20	-
15 min mean					
Max 15 min mean	-	-	-	45	-
Max Hour	120	4.9	-	34	-
Max running 8-hr mean	-	3.1	-	-	-
Data Capture %	99	99	-	97	-
DETR Band (hrs)	8647	8690	-	8356	-
Low	8647	8690	-	8356	-
Moderate	0	0	-	0	-
High	0	0	-	0	-
Very High	0	0	-	0	-
Air Quality Regulations	*	*	**	*	*
Number of exceedences	0	0	-	0	-

*Air Quality Regulations

**National Air Quality Strategy

Appendix 2 (continued)
Table 2 - Cornmarket Street Summary

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM ₁₀ µg/m ³
Mean	-	-	-	-	23
Max Hour	-	-	-	-	124
Max running 24-hr mean	-	-	-	-	57
99th percentile max daily running 24-hr means	-	-	-	-	52***
Data Capture %	-	-	-	-	92
DETR Band (hrs)	-	-	-	-	7989
Low	-	-	-	-	7938
Moderate	-	-	-	-	51
High	-	-	-	-	0
Very High	-	-	-	-	0
Air Quality Regulations	*	*	**	*	*
Number of exceedences (hours)	-	-	-	-	51
On number of days	-	-	-	-	8***

*Air Quality Regulations

**National Air Quality Strategy

***The air quality objective for PM₁₀ is 50µg/m³ when expressed as the 99th percentile of daily maximum running 24 hour means. The 99th percentile was 52µg/m³. 50µg/m³ was exceeded on 8 days, 4 days are allowed under the Air Quality Regulations.

Appendix 2 (continued)

Table 3 - East Oxford Summary

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM ₁₀ µg/m ³
Mean	14	-	23	-	19
Max Hour	129	-	100	-	260
97th percentile max daily running 8-hr mean	-	-	62***	-	-
Max running 8-hr mean	-	-	87	-	-
99th percentile max daily running 24-hr means	-	-	-	-	57****
Max running 24-hr mean	-	-	-	-	63
Data Capture %	92	-	96	-	96
DETR Band (hrs)	8038	-	8361	-	8315
Low	8038	-	8038	-	8163
Moderate	0	-	318	-	152
High	0	-	5	-	0
Very High	0	-	0	-	0
Air quality objectives	*		**		*
Number of exceedences	0	-	166	-	152
On number of days	-	-	26***	-	16****

*Air Quality Regulations

**National Air Quality Strategy

***The air quality objective for ozone is 50ppb when expressed as the 97th percentile of daily maximum running 8 hour means. The 97th percentile was 62ppb. 50ppb was exceeded on 26 days, 10 days are permitted under the National Air Quality Strategy.

****The air quality objective for PM₁₀ is 50µg/m³ when expressed as the 99th percentile of daily maximum running 24 hour means. The 99th percentile was 57µg/m³. 50µg/m³ was exceeded on 16 days, 4 days are allowed under the Air Quality Regulations.

Appendix 2 (continued)

Table 4 - St Ebbes Summary

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM ₁₀ µg/m ³
Mean	11	-	24	-	15
Max Hour	53	-	102	-	275
97th percentile max daily running 8-hr mean	-	-	64***	-	-
Max running 8-hr mean	-	-	85	-	-
99th percentile max daily running 24-hr means	-	-	-	-	42****
Max running 24-hr mean	-	-	-	-	49
Data Capture %	93	-	95	-	88
DETR Band (hrs)	8128	-	8297	-	7497
Low	8128	-	7921	-	7497
Moderate	0	-	376	-	0
High	0	-	0	-	0
Very High	0	-	0	-	0
Air quality objectives	*		**		*
Number of exceedences	0	-	197	-	0
On number of days	-	-	31***	-	0****

*Air Quality Regulations

**National Air Quality Strategy

***The air quality objective for ozone is 50ppb when expressed as the 97th percentile of daily maximum running 8 hour means. The 97th percentile was 64ppb. 50ppb was exceeded for 31 days, 10 hours are permitted under the National Air Quality Strategy.

****The air quality objective for PM₁₀ is 50µg/m³ when expressed as the 99th percentile of daily maximum running 24 hour means. The 99th percentile was 42µg/m³. 50µg/m³ was not exceeded , 4 days are allowed under the Air Quality Regulations.

Appendix 2 (continued)

Table 5 - Nitrogen Dioxide Oxford Centre

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	23	27	31	28	29	23	27	37	35	31	33	27
Max hour ppb	63	71	83	84	95	84	107	95	120	73	69	90
% Data Capture	98	100	99	99	100	98	99	94	100	99	99	100
DETR Band (hours)	730	669	739	713	741	704	736	700	718	738	714	741
Low	730	669	739	713	741	704	736	700	718	738	714	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>150ppb	0	0	0	0	0	0	0	0	0	0	0	0

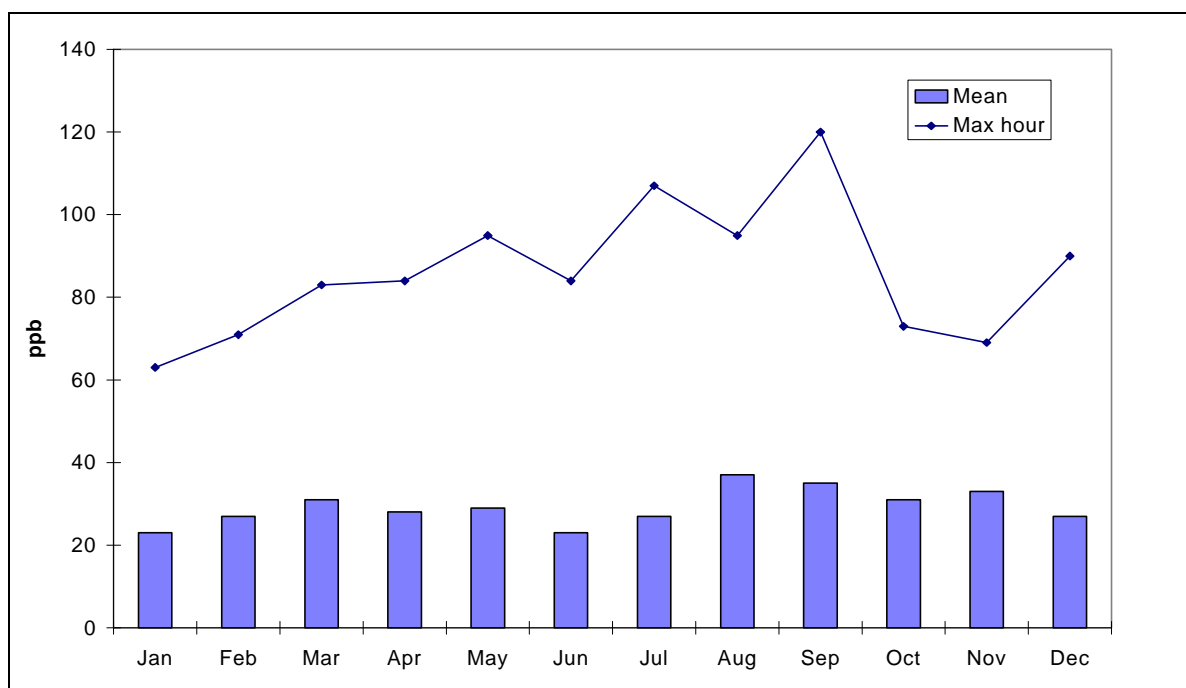


Figure 6: Oxford Centre nitrogen dioxide concentrations

Appendix 2 (continued)

Table 6 - Nitrogen Dioxide East Oxford

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	17	16	16	13	12	11	10	12	15	14	14	14
Max hour ppb	62	79	67	53	48	48	49	47	60	56	83	129
% Data Capture	90	100	93	81	95	100	99	100	96	100	58	91
DETR Band (hours)	670	670	691	581	704	717	739	742	691	741	416	676
Low	670	670	691	581	704	717	739	742	691	741	416	676
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>150ppb	0	0	0	0	0	0	0	0	0	0	0	0

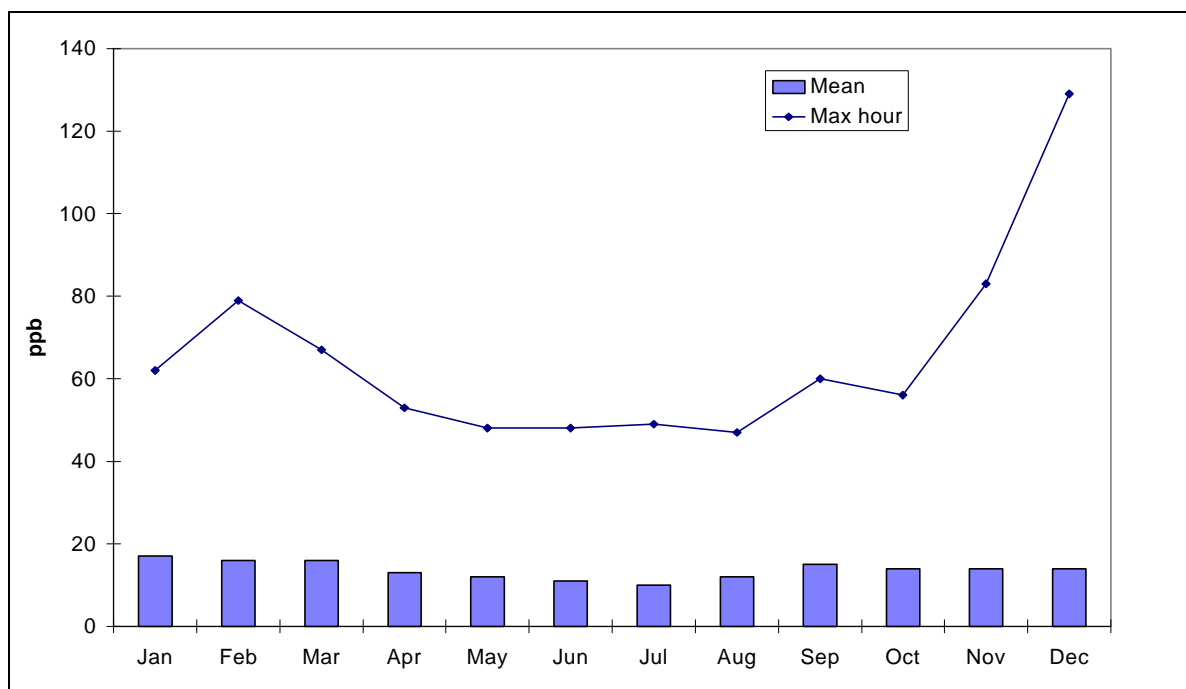


Figure 7: East Oxford nitrogen dioxide concentrations

Appendix 2 (continued)

Table 7 - Nitrogen Dioxide St Ebbes

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	13	12	13	10	11	10	8	11	11	13	14	11
Max hour ppb	43	39	48	39	53	31	53	48	53	33	32	40
% Data Capture	80	95	90	81	99	99	98	99	74	100	98	99
DETR Band (hours)	597	636	667	581	739	716	728	739	535	742	709	739
Low	597	636	667	581	739	716	728	739	535	742	709	739
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>150ppb	0	0	0	0	0	0	0	0	0	0	0	0

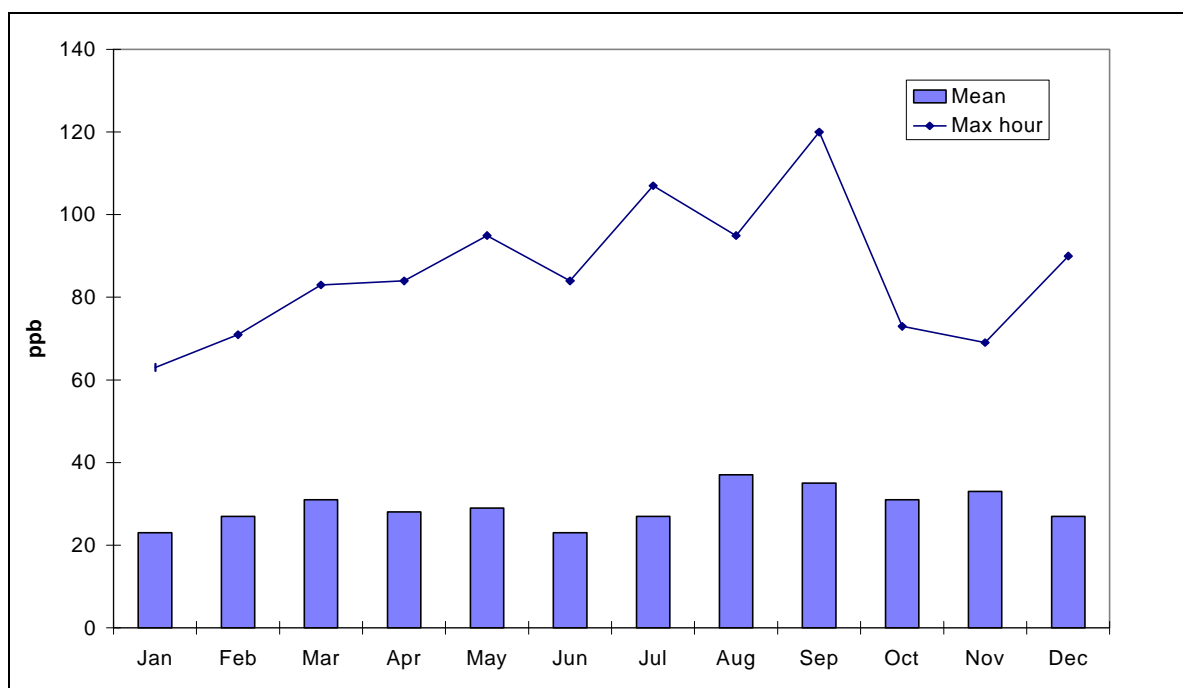


Figure 8: St Ebbes nitrogen dioxide concentrations

Appendix 2 (continued)

Table 8 - Carbon Monoxide Oxford Centre

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppm	0.5	0.5	0.7	0.6	0.5	0.2	0.2	0.3	0.3	0.3	0.2	0.2
Max hour ppm	3.7	4.2	4.1	4.9	4.5	1.8	2.0	2.0	2.6	2.8	1.9	2.5
Max running 8 hour mean ppm	2.6	2.6	3	3.1	2.5	1.1	1.2	1.2	1.5	2.0	1.2	1.6
% Data Capture	98	100	99	99	99	99	99	96	100	100	99	100
DETR Band (hours)	736	669	744	711	744	712	737	712	720	744	714	744
Low	736	669	744	711	744	712	737	712	720	744	714	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

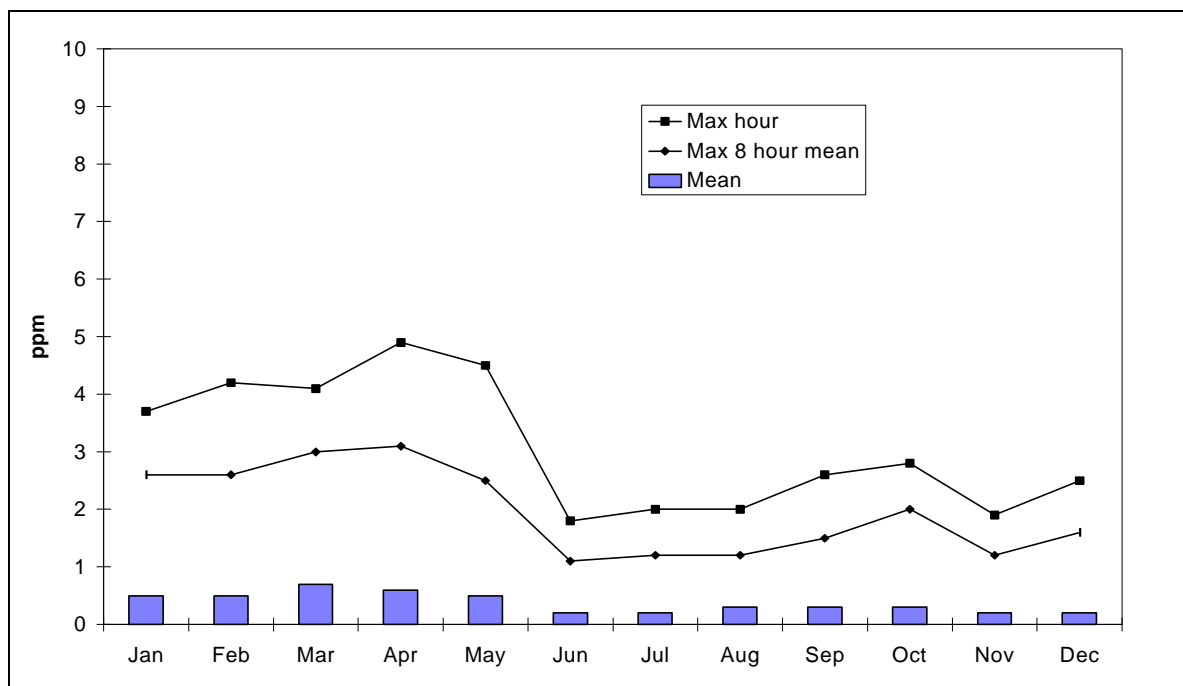


Figure 9: Oxford Centre carbon monoxide concentrations

Appendix 2 (continued)

Table 9 - Sulphur Dioxide Oxford Centre

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	2	2	2	2	2	1	2	2	2	2	2	1
Max hour ppb	19	13	30	18	14	17	34	7	15	17	9	13
Max 15 min mean ppb	28	17	45	20	15	25	41	8	30	17	9	15
% Data Capture	98	100	99	99	99	99	99	77	100	100	99	100
DETR Band (hours)	717	656	724	699	726	697	723	562	704	727	698	726
Low	717	656	724	699	726	697	723	562	704	727	698	726
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

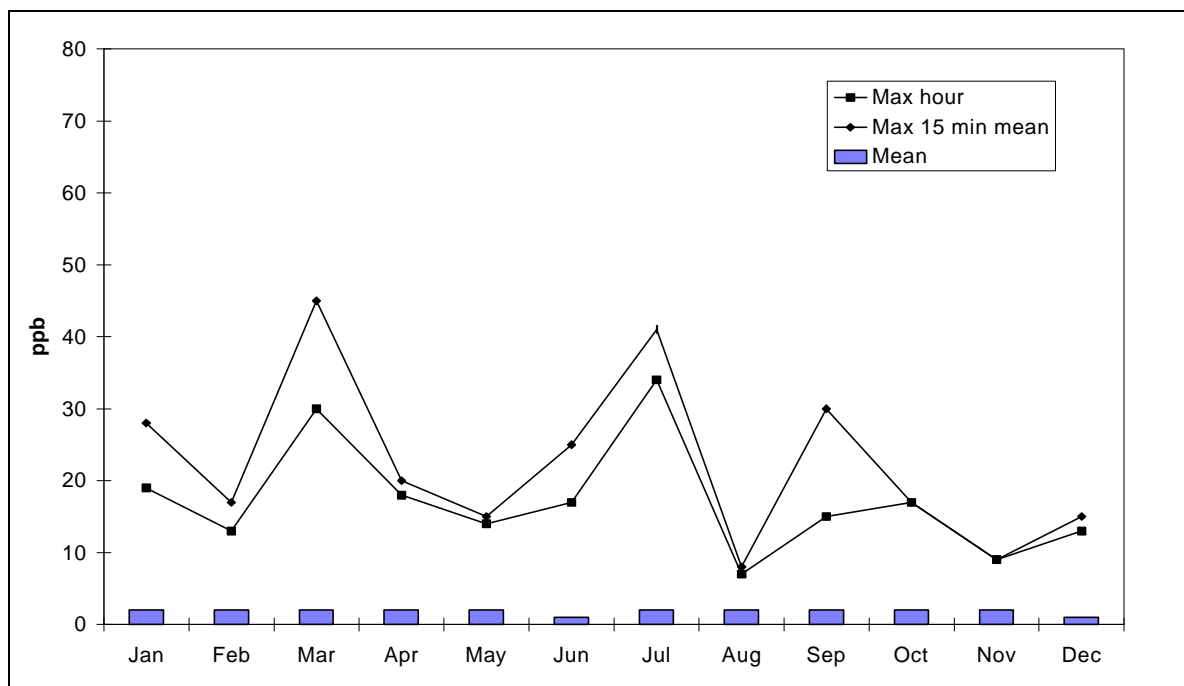


Figure 10: Oxford Centre sulphur dioxide concentrations

Appendix 2 (continued)

Table 10 - Ozone East Oxford

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	21	23	25	29	30	27	27	24	21	15	17	12
Max hour ppb	46	49	51	56	80	90	89	100	82	43	38	52
Max running 8 hr mean ppb	44	46	48	54	71	80	83	87	73	39	36	38
% Data Capture	91	98	93	81	95	99	98	100	95	100	100	100
DETR Band (hours)	671	653	691	575	705	718	719	744	677	744	720	744
Low	671	653	687	550	645	659	642	700	623	744	720	744
Moderate	0	0	4	25	60	58	77	40	54	0	0	0
High	0	0	0	0	0	1	0	4	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	11	33	30	41	23	28	0	0	0
On number of days*	0	0	0	2	5	6	6	3	4	0	0	0

*The air quality objective for ozone is based on the maximum daily running 24 hour mean. Therefore the number of days on which the objective level was exceeded is a better indicator of exceedence.

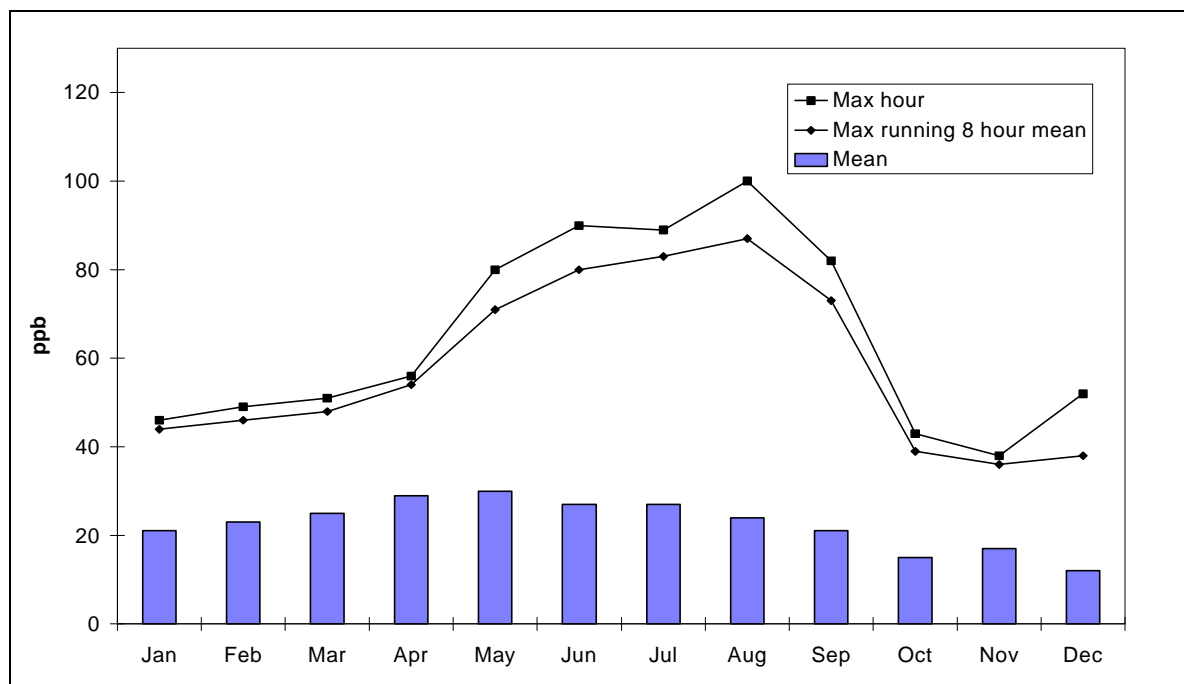


Figure 11: East Oxford ozone concentrations

Appendix 2 (continued)

Table 11 - Ozone St Ebbes

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	22	24	25	32	33	28	28	21	20	15	18	22
Max hour ppb	42	48	56	60	86	89	90	102	76	41	38	45
Max running 8 hr mean ppb	41	46	53	58	76	79	85	84	69	38	36	44
% Data Capture	92	100	94	81	100	100	99	100	75	100	100	99
DETR Band (hours)	679	672	698	555	744	729	736	744	537	744	720	735
Low	679	672	676	522	696	630	660	710	516	744	720	735
Moderate	0	0	22	53	87	90	75	28	21	0	0	0
High	0	0	0	0	0	0	1	6	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	6	20	48	51	41	19	12	0	0	0
On number of days*	0	0	1	4	7	9	6	2	2	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.

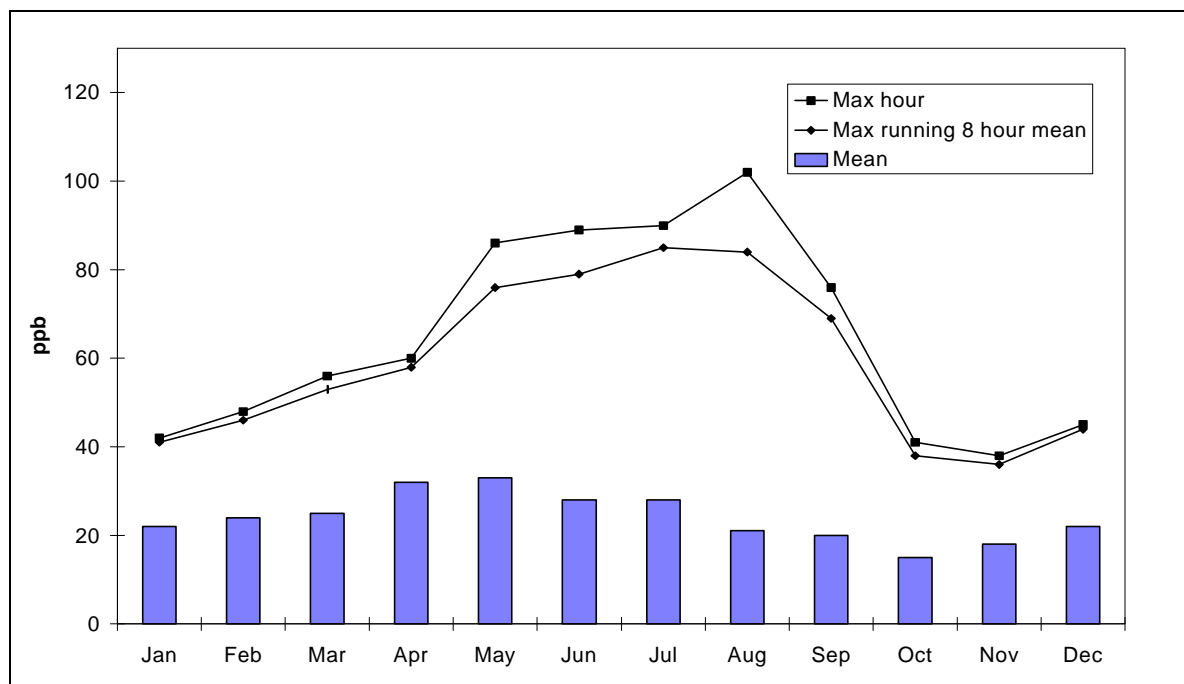


Figure 12: St Ebbes ozone concentrations

Appendix 2 (continued)

Table 12 - PM10 Cornmarket Street

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean $\mu\text{g}/\text{m}^3$	23	23	27	23	30	22	21	24	25	25	21	16
Max hour $\mu\text{g}/\text{m}^3$	96	78	121	73	93	91	56	102	124	73	117	69
Max running 24 hr mean $\mu\text{g}/\text{m}^3$	43	44	55	57	51	40	44	44	52	48	28	34
% Data Capture	100	100	97	44	66	100	94	100	100	100	100	100
DETR Band (hours)	744	672	728	304	461	720	688	744	720	744	720	744
Low	744	672	712	291	451	720	688	744	708	744	720	744
Moderate	0	0	16	13	10	0	0	0	12	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 hours running 24 hr mean $>50\mu\text{g}/\text{m}^3$	0	0	16	13	10	0	0	0	12	0	0	0
On number of days*	0	0	2	2	2	0	0	0	2	0	0	0

*The air quality objective for PM₁₀ is based on the maximum daily running 24 hour mean. Therefore the number of days on which the objective level was exceeded is a better indicator of exceedence.

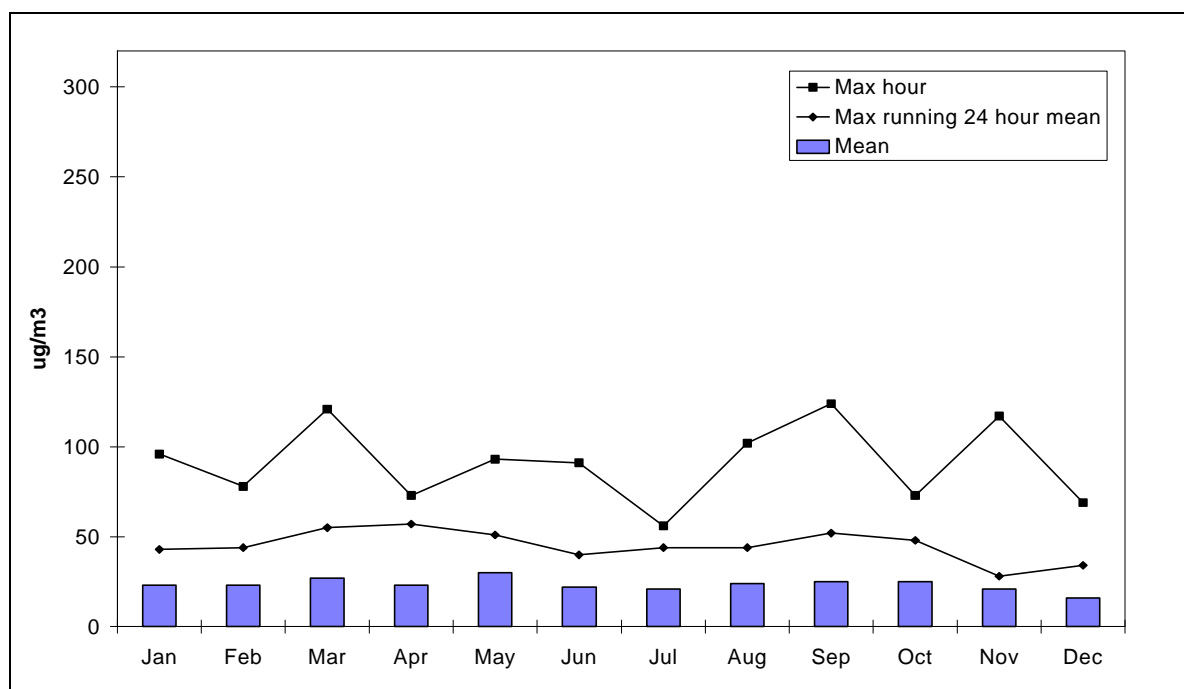


Figure 13: Cornmarket PM₁₀ concentrations

Appendix 2 (continued)

Table 13 - PM10 East Oxford

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean $\mu\text{g}/\text{m}^3$	15	16	20	19	25	21	23	22	25	21	15	12
Max hour $\mu\text{g}/\text{m}^3$	72	65	83	111	120	151	235	260	225	114	78	52
Max running 24 hr mean $\mu\text{g}/\text{m}^3$	44	33	38	45	57	54	53	56	63	41	30	29
% Data Capture	90	96	94	81	92	100	100	100	96	100	100	100
DETR Band (hours)	649	632	719	556	661	720	744	744	682	744	720	744
Low	649	632	719	556	637	699	731	726	606	744	720	744
Moderate	0	0	0	0	24	21	13	18	76	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 hours running 24 hr mean $>50\mu\text{g}/\text{m}^3$	0	0	0	0	24	21	13	18	76	0	0	0
On number of days*	0	0	0	0	2	3	2	2	7	0	0	0

*The air quality objective for PM₁₀ is based on the maximum daily running 24 hour mean. Therefore the number of days on which the objective level was exceeded is a better indicator of exceedence.

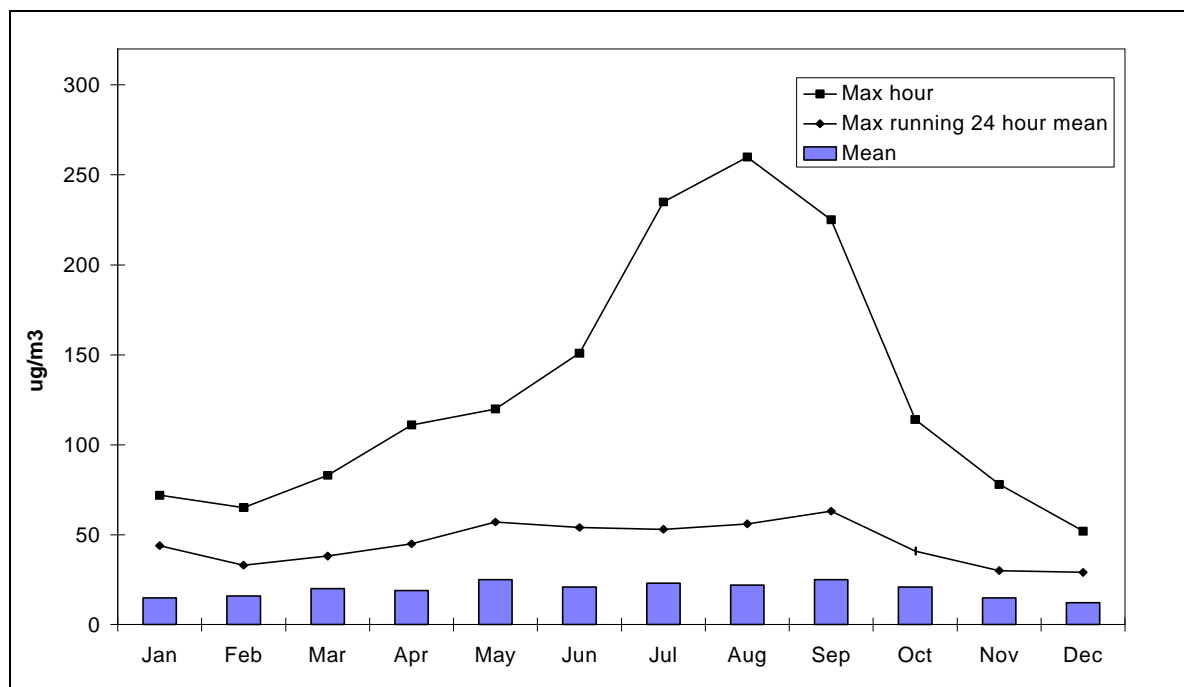


Figure 14: East Oxford PM₁₀ concentrations

Appendix 2 (continued)

Table 14 - PM10 St Ebbes

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean $\mu\text{g}/\text{m}^3$	13	14	19	14	19	15	16	14	13	16	14	11
Max hour $\mu\text{g}/\text{m}^3$	45	52	228	106	60	132	275	65	48	47	38	52
Max running 24 hr mean $\mu\text{g}/\text{m}^3$	33	28	43	46	36	32	49	27	29	31	22	27
% Data Capture	88	65	70	68	90	99	98	99	74	100	99	98
DETR Band (hours)	617	387	473	481	650	720	722	744	517	744	720	722
Low	617	387	473	481	650	720	722	744	517	744	720	722
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 hrs running 24 hr mean $>50\mu\text{g}/\text{m}^3$	0	0	0	0	0	0	0	0	0	0	0	0
On number of days	0	0	0	0	0	0	0	0	0	0	0	0

*The air quality objective for PM₁₀ is based on the maximum daily running 24 hour mean. Therefore the number of days on which the objective level was exceeded is a truer measure if exceedence.

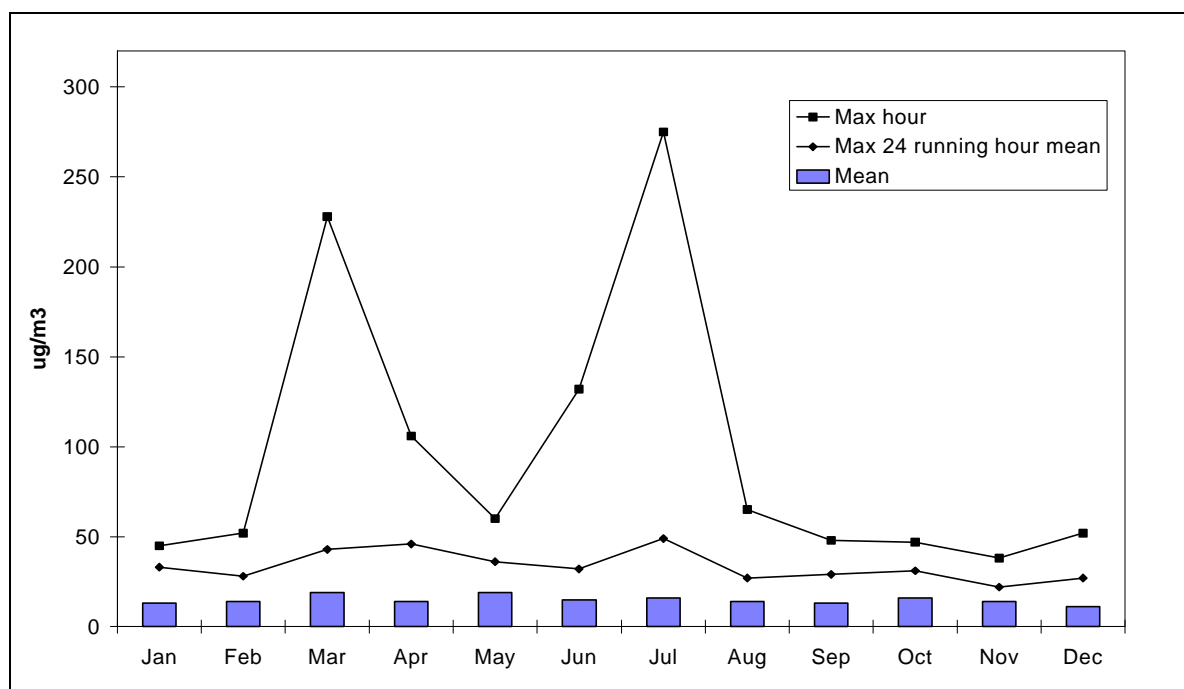


Figure 15: St Ebbes PM₁₀ concentrations

Appendix 2 (continued)

Table 15 - Nitrogen Dioxide Diffusion Tube Data

Location	Cat*	Annual mean ppb	Location	Cat*	Annual mean ppb
High Street	K	40	Broad Street	K	22
Green Road Roundabout	K	32	Norfolk Street	K	19
Cornmarket Street	I	28	Beckett Street	K	21
St Giles	K	39	Hollybush Row	K	20
St Aldate's (Town Hall)	K	31	Parks Road (Science Library)	K	23
Longwall Street	K	38	Pike Terrace	I	24
Bonn Square	K	27	Pusey Street	I	19
Thames Street	K	24	Parks Road (Wadham College)	K	21
Worcester Street	K	34	Shirelake Close	I	16
Beaumont Street	K	29	Lyndworth Close	B	19
New Road	K	32	Butterwyke Place	I	20
Speedwell Street	K	27	Woodbine Place	B	18
Rewley Road	K	31	St Cross Road	K	18
Folly Bridge	K	25	Mansfield Road	B	18
Magdalen Bridge	K	22	Duke Street	I	15
Park End Street	K	29	Beaumont Buildings	B	16
Oxpens Road	K	24	Walton Street	K	20
York Place	I	24	Trinity Street	I	15
Floyd's Row	K	24	Paradise Sq	B	17
Blue Boar Street	I	22	Sadler Walk	B	15
Iffley Road	K	22	Binsey Lane	B	9
Gloucester Street	I	22	Lenthall Road	B	10
Keble Road	K	26			
Queen Street**	K	43	St Clements Street**	K	40
George Street**	K	42	Hythe Bridge Street**	K	28
George Street / Magdalen St**	K	42	Botley Road**	K	25
High Street (RPM)**	K	41	South Parks Road**	K	22
St Aldates (opp Town Hall)**	K	41	Worcester College**	B	14

* Category Kerbside 1-5 metres from a major road, Intermediate 20-30 metres from a major road, urban Background in residential area greater than 50 metres from a major road.

** New sites.

Appendix 2 (continued)

Nitrogen Dioxide Diffusion Tube Charts

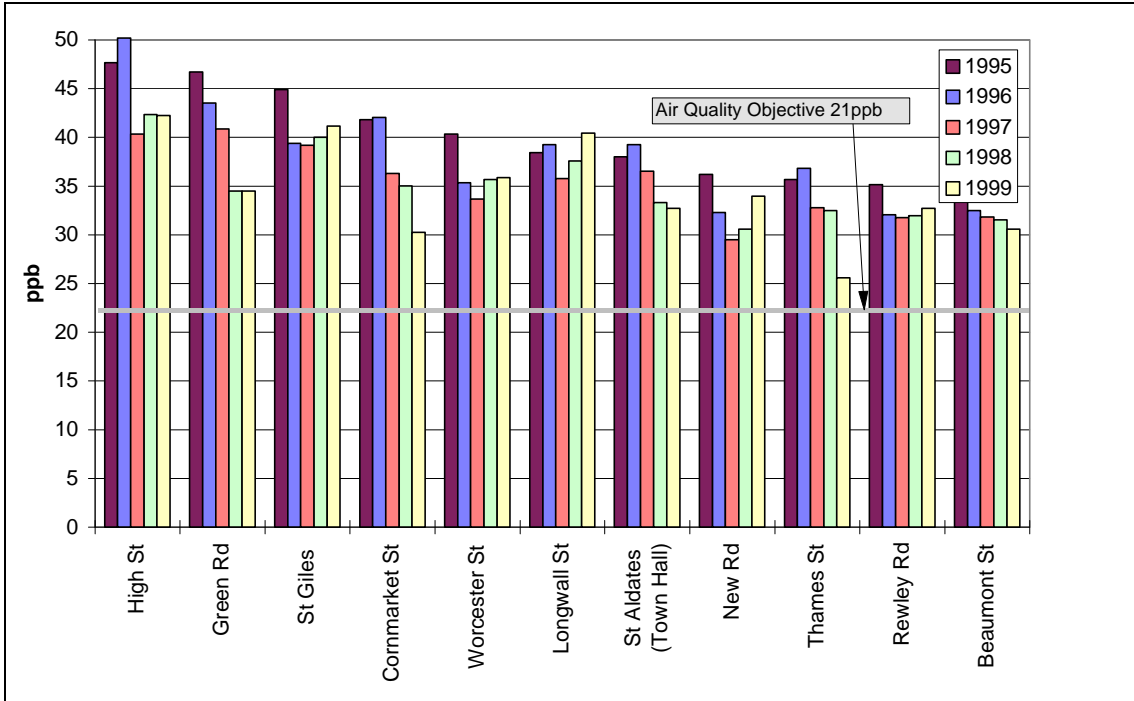


Figure 16: Annual mean nitrogen dioxide concentrations 1995-99

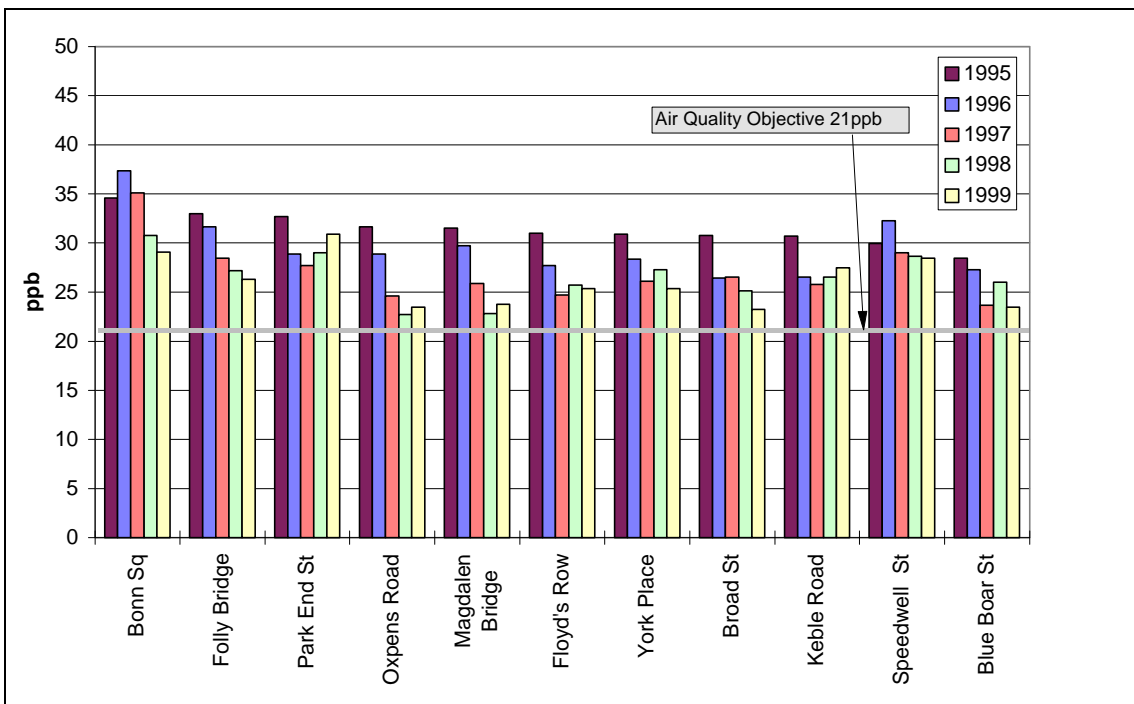


Figure 17 : Annual mean nitrogen dioxide concentrations 1995-99

Appendix 2 (continued)

Nitrogen Dioxide Diffusion Tube Data Continued

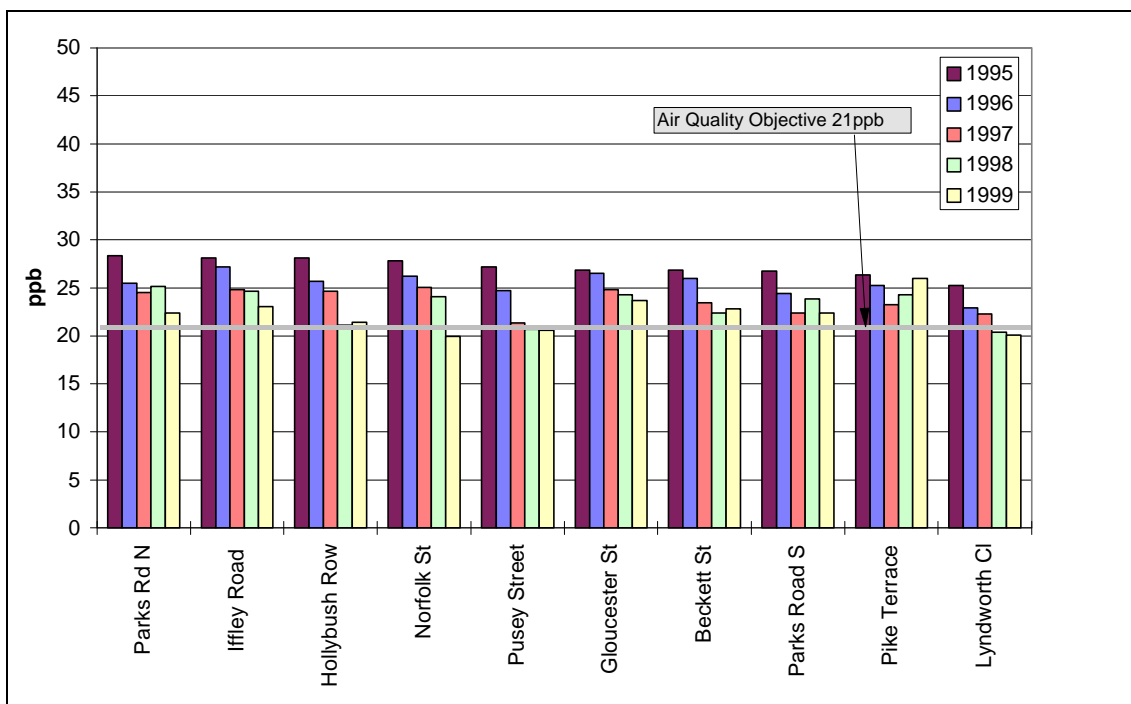


Figure 18: Annual mean nitrogen dioxide concentrations 1995-99

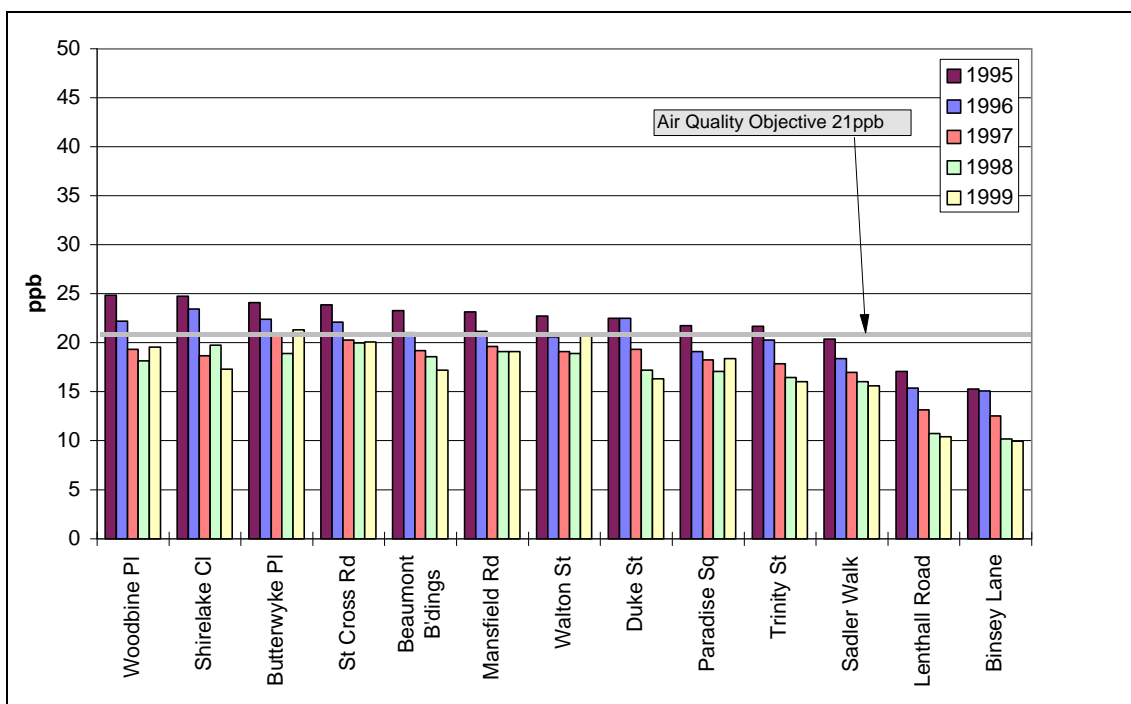


Figure 19: Annual mean nitrogen dioxide concentrations 1995-99

Appendix 2 (continued)

Nitrogen Dioxide Diffusion Tube Data Continued

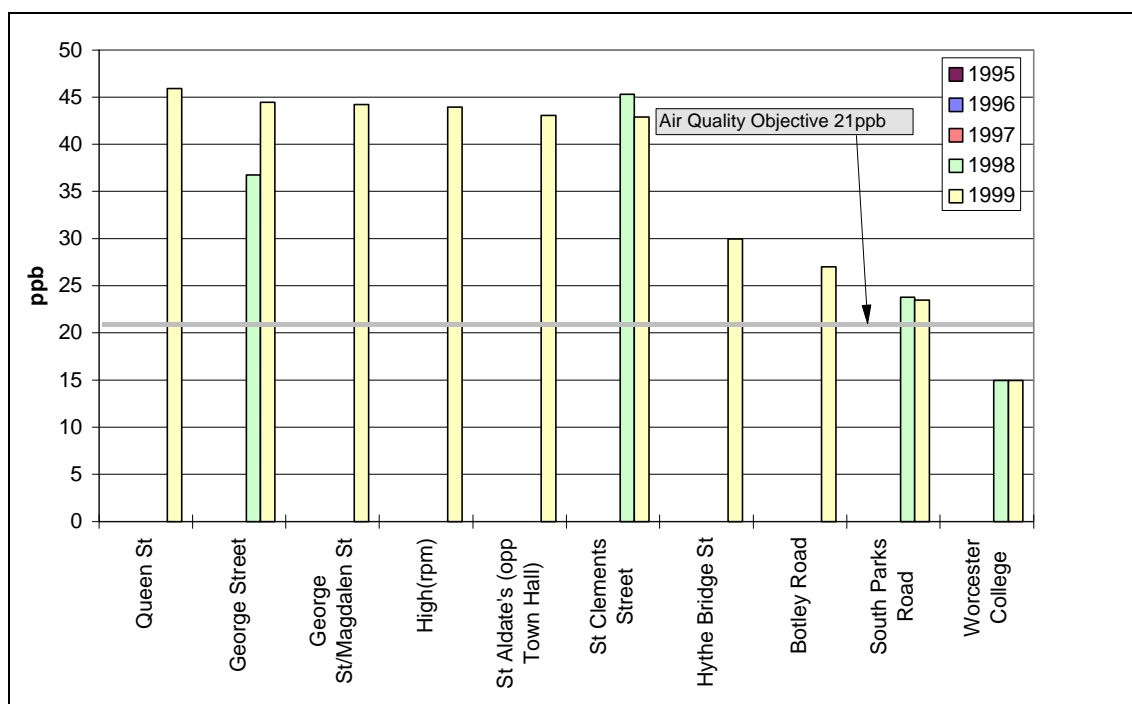


Figure 20: Annual mean nitrogen dioxide concentrations for sites introduced in 1998 and 1999

Appendix 3 Maps Showing Monitoring sites

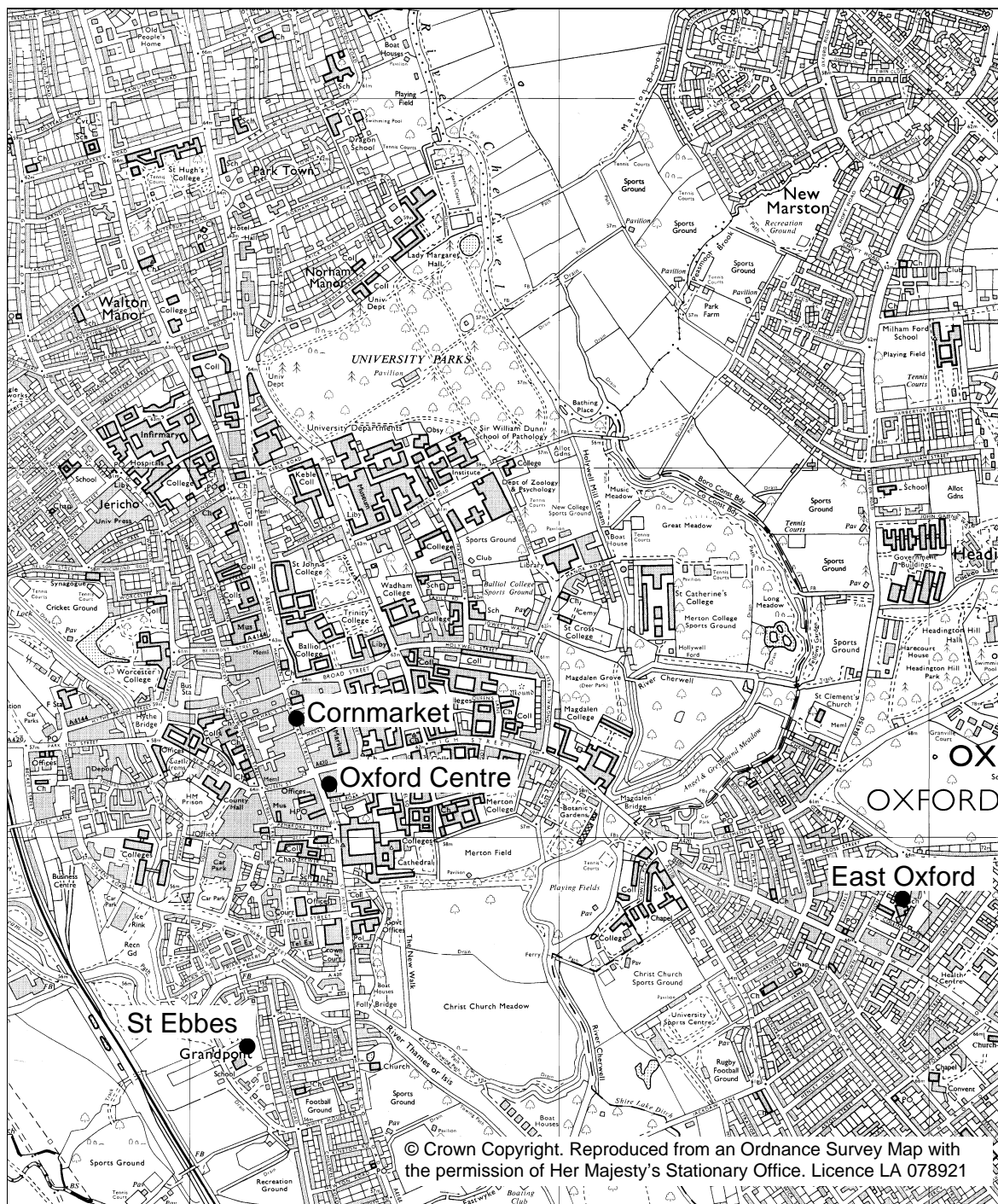


Figure 21: Continuous Monitoring Sites

Appendix 3 (continued)

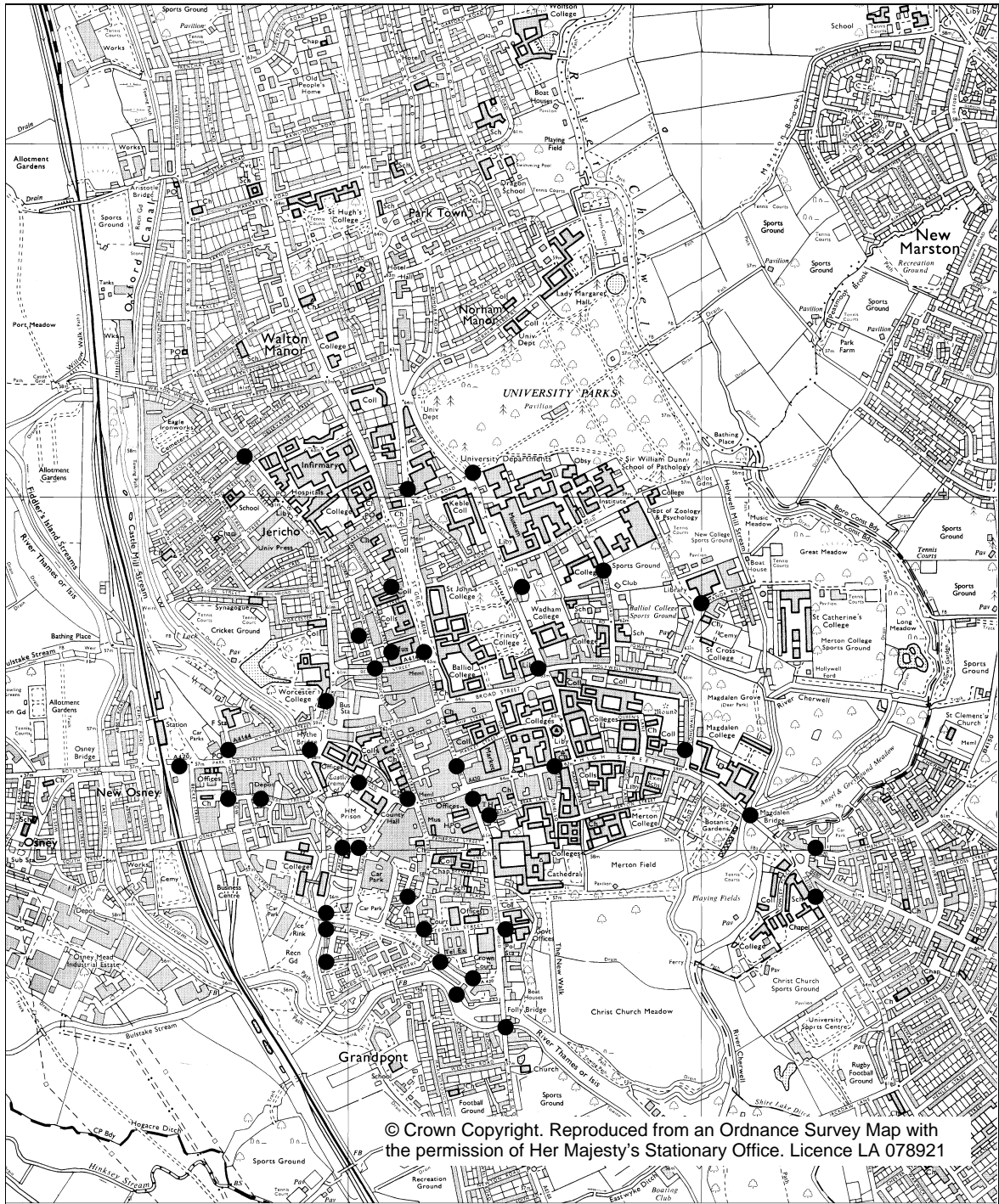


Figure 22: NO2 Diffusion Tube Sites

Appendix 4 Validation of data from continuous monitoring stations

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.

Guideline: indicates levels and durations of air pollution above which adverse effects may be produced on the health of humans or animals or on vegetation.

Guide value: target air quality standard to improve the protection of human health and contribute to the long term protection of the environment.

Limit value: legally enforceable air quality standard to help protect human beings against the effects of the pollutant in the environment.

Monitoring: measuring pollution.

Nitrogen dioxide (NO₂): acid irritant gas.

Ozone (O₃): the reactive molecular form of oxygen, it is very poisonous.

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

PM₁₀: 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.

Percentile (expressed as *n*th percentile): the level which is not exceeded for a *n* percent of the time.

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.

Running 24 hour mean: a mean which is calculated on an hourly basis, yielding one running 24 hour mean per hour. It is calculated from the hourly mean for that hour and the preceding 23 hours.

Sulphur dioxide (SO₂): colourless, acid irritant gas with a pungent odour.