Air Quality

Review and Assessment Progress Report
and
Air Quality Action Plan Progress Report

London Borough of Richmond upon Thames

2008

Review and Assessment Progress Report

A Review and Assessment Progress Report is required to periodically update any monitoring and modelling data of air pollution levels, and assess whether they are likely to exceed the levels set in the objectives. Pollution emissions from any new developments in the London Borough of Richmond upon Thames (LBRuT) should be included.

Abstract

The LBRuT was initially designated an Air Quality Management Area (AQMA) in December 2000, on the basis that the air pollution, nitrogen dioxide (NO_2) and particulate matter (PM_{10}) were expected to exceed the objective limits set for 2005 (NO_2) and 2004 (PM_{10}). These dates have now been passed and the Borough's 2006 Updating and Screening Assessment (USA) concluded that, as the annual mean NO_2 and daily mean PM_{10} objectives have not reduced, the AQMA should remain and not be amended or revoked. This position is not affected by the Air Quality Standards Regulations 2007 (OPSI, 2007), which came into force in February 2007, with objective limits set for 2010. The monitoring results in this Air Quality Progress Report indicate that levels of NO_2 have worsened in many parts of the LBRuT and exceeded the new objective levels. Over recent years, considerable effort has been made to address the air quality issue in the LBRuT, with good success in many aspects but clearly with more work still to do to bring actual monitored levels down. The pollution levels modelled for 2010 using London Atmospheric Emissions Inventory (LAEI) for 2003 and the meteorological year of 2003 still show exceedences, on current projections, so this needs to be addressed. In the 2009 USA, modelled pollution levels will be re-assessed based on the LAEI for 2004 and considering the affect of the Low Emissions Zone (LEZ).

Executive Summary

This progress report documents the LBRuT air quality monitoring data over the last six years, for all the pollutants monitored, namely for NO_2, PM_{10}, ozone (O_3), sulphur dioxide (SO_2), carbon monoxide (CO), Benzene (C_6H_6) and polycyclic aromatic hydrocarbons (PAH) (2002 to 2006 data only). The results indicate that both PM_{10} and NO_2 exceeded the air quality objectives for 2004/2005. Dependant on weather conditions, some years have been worse than others. Although emission rates may have not varied much, background pollution received from outside the London area sometimes affects levels significantly. In London NO_2 levels have been rising, and the reasons for this are being investigated (i.e. the recent (2008) AQEG Report on direct NO_2). It therefore remains as important as ever to find ways to reduce emissions so that air pollution levels actually improve.

In 2002, the detailed Stage 4 modelling assessment indicated that the objectives would be exceeded, mainly along the major road transport corridors. This was again confirmed by the 2006 USA assessment which identified that:

1) There was a risk of exceeding the objectives for NO_2 across the LBRuT.
2) There was a risk of exceeding the objectives for PM_{10} in parts of the LBRuT.
3) For CO, benzene, SO_2, ozone, lead (Pb) and 1,3-butadiene the risk of exceeding the objectives were not significant.

The results, reported from the monitoring of NO_2, show that the annual mean exceeded at Castelnau (roadside) for each of the last six years. Also, in 2007, the majority of the NO_2 diffusion tube monitoring sites exceeded (47 out of 57 sites). This was expected, as the tubes are mainly located at roadsides, representing residents who live near busy roads.

Both the modelling for 2010 and the recent monitoring results confirm that there is still a need for the LBRuT to be designated as an AQMA. This will be re-assessed in the 2009 USA, with modelled pollution levels based on the LAEI for 2004 and taking into account the affect of the LEZ. The Air Quality Action Plan (AQAP) Progress Report table in Appendix 6, shows that good progress is being made with the majority of the measures. We will review whether the AQAP should be updated in the coming year.

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CHAPTER 1: INTRODUCTION

1.1 The Borough of Richmond upon Thames (LBRuT) as part of London

The LBRuT is situated in the South West corner of Outer London. In air quality terms, this means that the prevailing southwesterly wind (roughly 75% of the year) brings in relatively fresh air to the LBRuT, before it blows towards the centre of London. In practice, the wind blows from all points of the compass and this includes receiving polluted air blowing out from the centre of London. This explains why the Barnes end of the LBRuT receives a higher proportion of London air, with consequent higher background pollution levels. As a result, the LBRuT is keen for the air quality to be improved not just in the LBRuT, but also across the whole of London. Some of the Action Plan actions are cross-Borough, with the West London neighbours, or are cross-London initiatives.

***Figure 1**: Location of LBRuT within Greater London.*

1.2 The statutory requirement for a Progress Report

Local Authorities have duties in respect of local air quality management (LAQM) and delivering the National Air Quality Objectives set out in the Air Quality Strategy for England, Wales and Northern Ireland (DEFRA, 2007), plus associated Regulations (i.e. OPSI, 2007). This report takes account into guidance contained in LAQM.PRG (03) 'Progress Report Guidance' (DEFRA, 2003a).

1.3 Air Quality Action Plan (AQAP) history

Summary of Air Quality progress to date:

1. Stage 1,2 and 3 assessments confirmed a need to tackle air quality in the LBRuT
2. AQMA declared for whole LBRuT, December 2000
3. Stage 4 assessment, May 2002, confirmed that air quality improvements were needed
4. AQAP consulted on and published 2002
5. USA 2004 confirmed continuing exceedence of the objectives

6. Air Quality Review and Assessment Progress Report 2005 to give updated monitoring results
7. AQAP Progress Report 2005 to give update on actions to improve air quality
8. USA 2006 confirmed continuing exceedence of the objectives
9. Air Quality Review and Assessment Progress Report 2007 to give updated monitoring results
10. AQAP Progress Report 2007 to give update on actions to improve air quality
11. Air Quality Review and Assessment Progress Report 2008 to give updated monitoring results
12. AQAP Progress Report 2008 to give update on actions to improve air quality

The LBRuT AQAP was required under Part IV of the Environment Act 1995. The Council decided to declare the whole of the LBRuT as a single AQMA. This was declared in a formal notice dated 31st December 2000 following a review and assessment of air quality in the LBRuT 'Stage 3'. The Review concluded that the National Air Quality Strategy objectives for 2005 would not be met for two pollutants, NO_2 and PM_{10}. The standards in the objectives are health based. The objectives and relevant health effect can be found in Appendices 1 and 2.

The purpose of the AQAP is to ensure that the Council can plan and manage appropriate actions to improve air quality within the LBRuT. It is not a legal requirement to actually achieve the National Air Quality Objectives; however the action must be in pursuit of achieving the objectives.

Under the Act, local authorities that have declared an AQMA are required to undertake a further 'Stage 4' assessment, to refine the detail of the previous assessment and to assist with targeting the action required to improve the air quality. The 'Stage 4' review was completed in May 2002, following a revision of the traffic forecasts and using a new emissions inventory for London.

The Stage 4 report confirmed the Stage 3 findings that the statutory objectives for both NO_2 and PM_{10} would still be exceeded in 2005. The areas predicted to exceed the targets are mainly adjacent to the major through traffic routes. The next phase was to produce an USA in 2006, which confirmed continuing exceedence of the objectives and since the USA in 2006 an Air Quality Review and Assessment, and AQAP Progress Report was produced in 2007.

In February 2007, the Air Quality Standards Regulations 2007 (OPSI, 2007) came into force with objective limits set for 2010. The limits remain the same as the PM_{10} (2004) and NO_2 (2005) limits, so the LBRuT is still obliged to try to meet those objectives.

Progress on the AQAP is reported as Appendix 6 to this report.

CHAPTER 2: AIR QUALITY MONITORING IN RICHMOND

The monitoring data in this report comes from monitoring surveys undertaken across the LBRuT. The monitoring results confirm that air pollution in the LBRuT still exceeds the 2004/2005 objectives, and the new 2010 objectives, and that therefore there is still a need for LBRuT to be designated as an AQMA and consequently there is still a need to pursue improvements in air quality.

In order to assess the air quality against the National Air Quality Objectives, Richmond Council routinely monitors against annual mean objectives and against shorter period objectives, as indicated for the pollutants below:

Nitrogen dioxide (NO_2) (1-hour mean)
Particulate matter (PM_{10}) (24-hour mean)
Sulphur dioxide (SO_2) (15-minute mean)
Ozone (O_3) (running 8-hour mean)
Carbon monoxide (CO) (running 8-hour mean)

Benzene (BTEX) (2-week monitoring mean – annual mean limit only)
Poly aromatic hydrocarbons PAH (2-week monitoring mean – annual mean limit only)

Table 1 and Figure 5 show the locations of the NO_2 diffusion tube monitors in the LBRuT. The tubes are a relatively cheap way of monitoring, which therefore allows samples to be taken across the whole LBRuT and give a Borough-wide view. The results obtained give monthly averages, and are not precise but do provide an indication of NO_2 pollution levels. The accuracy of the diffusion tube readings can be increased when their results are compared, and the bias adjusted, with data from the more accurate continuous monitors. Richmond Council has a network of 63 diffusion tubes to monitor NO_2 at 57 locations across the LBRuT (detailed in Table 1) and a further 5 sites to monitor for benzene (detailed in Table 9) and 1 site to monitor for PAH (detailed in Table 10). PAH monitoring ceased at Castelnau Library, Barnes (static site) in Spring 2007, an explanation for this is given in Section 2.5.5.

At three locations in the LBRuT there are air pollution analysers running continuously (locations given in Table 3). The continuous monitors collect real time data, which is stored as 15-minute means and can be converted into the various averages (as above). This type of equipment provides accurate readings of pollution levels but is expensive, so using them for a large coverage of LBRuT is not possible on cost grounds.

2.1 Air quality modelling

2.1.1 Stage 4 Air Quality Report, current and future trends

The 'pollution hotspot' map in Figure 2 was compiled from the Stage 4 modelling results. It identifies the areas where people will be exposed to pollution in excess of the limits, according to the modelled assessment carried out for the year 2005 (Figure 6). The designation of an exceedence 'star' (in Figure 2) indicates that one or more residential properties were within the air pollution exceedence estimate, due to the proximity of the emissions from the local traffic, not necessarily due only to the volume of traffic on the road. In that way, a risk assessment has been carried out to identify the sensitive receptors.

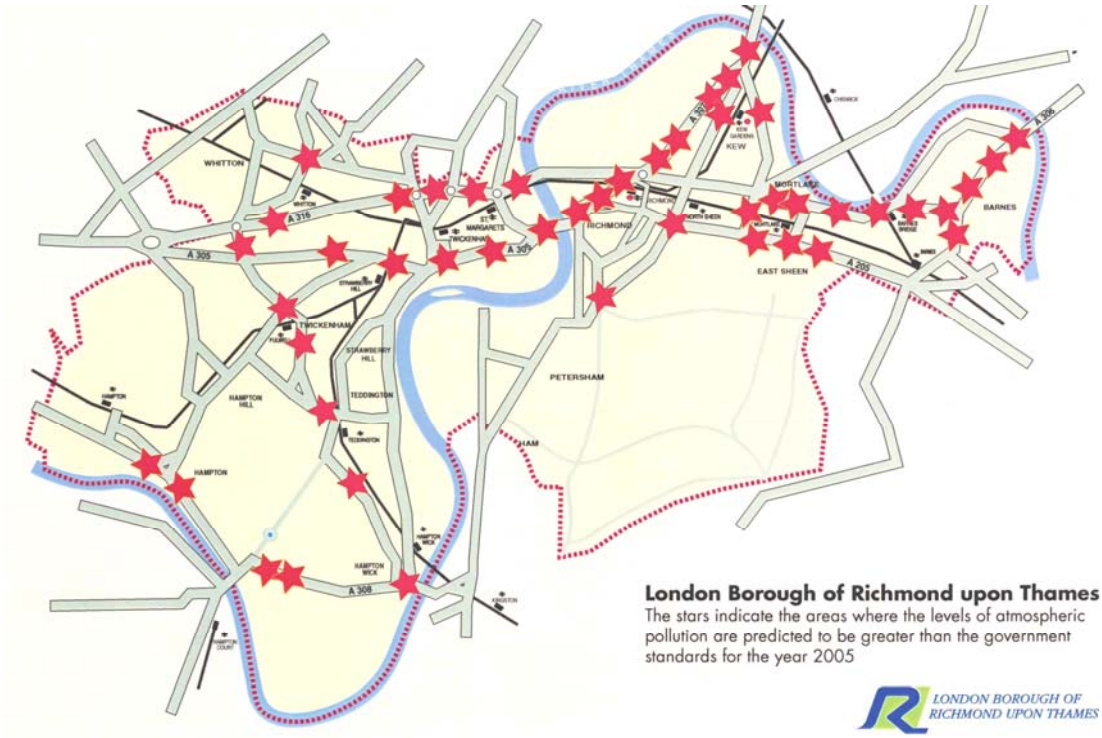

***Figure 2**: Air pollution hotspots in LBRuT, modelled for exposure to residents, for 2005.*

The Stage 4 Air Quality Report, as well as some other reports on monitoring and air quality data can be accessed on the Council web site at:

www.richmond.gov.uk/home/environment/pollution/air_pollution/air_quality_reports.htm

A 'source apportionment' assessment was made, at ten selected locations in the LBRuT and it indicated the proportion of pollution coming from heavy goods vehicles, light goods vehicles, and cars and also from the general background. Generally speaking, the results show that roughly half of the pollution at roadside sites comes from road traffic and the other half from background sources. The background sources include aircraft, all more distant roads, other areas of Britain and the air mass blowing over from continental Europe. Cars are the main source of NO_2 road traffic emissions in the Borough, accounting for more than half of the road traffic emissions (52%).

2.2 Nitrogen dioxide (NO_2) in the LBRuT

Table 1 shows the NO_2 diffusion tube monitoring results, with bias corrected values for each year from 2002 to 2007. The results in **bold** indicate an exceedence of the Air Quality Objective. Most of the NO_2 diffusion tubes are located on lamp posts at the kerbside of the road, so that the nearest relevant exposure is residential properties set back between 5 to 10 metres from the kerb. The monitoring site at Holly Lodge in Richmond Park (No. 28) and the static site at Wetlands Centre, Barnes (No. 37) are Background sites, set well away from roads.

The Air Quality Standards Regulations 2007 (OPSI, 2007) came into force in February 2007. This has shifted the objective attainment date to 1st January 2010, but with some margins of tolerance for attainment before then. The result is that NO_2 exceeded the 2005 objective limit in 2005, 2006 and 2007, but does not exceed the margins of tolerance, but does still exceed the 2010 objective limit, which is in fact still the same as the 2005 limit.

It is widely acknowledged that diffusion tubes can have inaccuracies of up to 20-30%. However, by comparing the diffusion tube data with that from the Borough's more accurate continuous monitors, it is possible to calculate an adjustment factor for the diffusion tubes, and hence end up with a more accurate result.

In accordance with Government Technical Guidance for Local Air Quality Management LAQM.TG(03) (DEFRA, 2003b), a yearly bias adjustment factor has been produced for each year from 2002 to 2007. The bias factor for 2002 is 1.44, 2003 is 1.23, 2004 is 0.97, 2005 is 1.00, 2006 is 1.03 and 2007 is 0.97. For the calculation of the NO_2 diffusion tube bias see Appendix 3 and for the NO_2 diffusion tube method see Appendix 4.

Figure 5 is a map of the LBRuT showing the location of each NO_2 diffusion tube monitoring site and Table 1 below gives the names and identity numbers for the monitoring locations on the map.

Table 1 Annual concentration in micrograms per cubic metre ($\mu g/m^3$) of NO_2, by diffusion tube sampling. The data is ranked using the 2004 data, with the most polluted sites at the top. All the data has been bias adjusted. The two following graphs (Figure 3a and Figure 3b) chart the same data.

Site Code	Location	Distance from roadside (metres)	2002	2003	2004	2005	2006	2007
RUT 02	George Street, Richmond	0.2	**94**	**131**	**106**	**118**	**115**	**113**
32	Kings Street, Twickenham	0.2	**78**	**96**	**84**	**91**	**119**	**109**
36	Upper Richmond Road West (URRW), Sheen Lane	0.2	**61**	**87**	**68**	**76**	**81**	**59**
18	Lower Mortlake Road, Richmond (nr. Trinity Road)	0.2	**68**	**79**	**65**	**62**	**76**	**58**
39	Richmond Road, Richmond Bridge, East Twickenham	0.2	**61**	**73**	**61**	**64**	**73**	**69**
7	Broad Street, Teddington (Tesco)	0.2	**55**	**86**	**60**	**68**	**88**	**78**
19	Kew Road, Kew (nr. Walpole Avenue)	0.2	**65**	**75**	**57**	**58**	**61**	**55**
31	A316	1.5	**57**	**69**	**56**	**61**	**70**	**66**
43	Hill Street, Richmond	0.2	**58**	**67**	**54**	**62**	**78**	**58**
42	The Quadrant, Richmond	0.2	**59**	**74**	**53**	**63**	**73**	**60**
50	URRW (nr. Clifford Avenue, Sheen)	0.2	**54**	**70**	**52**	**63**	**67**	**70**
25	URRW (nr. Sheen School)	0.2	**55**	**65**	**51**	**45**	**53**	**52**
52	Clifford Avenue, Chalkers Corner	0.2	**60**	**64**	**51**	**55**	**64**	**66**
9	Hampton Road, Twickenham	0.2	**49**	**59**	**51**	**52**	**60**	**56**
35	High Street, Hampton Wick	1.6	**48**	**68**	**50**	**54**	**51**	**57**
RUT 01	Civic Centre, York Street, Twickenham	1.2	**50**	**62**	**49**	**54**	**64**	**57**
15	Richmond Road, Twickenham (opp. Marble Hill Park)	0.2	**46**	**59**	**49**	**49**	**65**	**46**
22	Castelnau, Barnes (nr. Hammersmith Bridge)	0.2	**46**	**61**	**48**	**61**	**71**	**59**
6	Kingston Road, Teddington (nr. Woffington Close)	0.2	**49**	**52**	**47**	**50**	**50**	**48**
20	Mortlake Road, Kew (nr. Kent Road)	0.2	**50**	**65**	**47**	**49**	**59**	**57**
44	Sheen Road, Richmond (Shops)	0.2	**47**	**60**	**46**	**51**	**60**	**56**
33	Heath Road, Twickenham	0.2	**48**	**65**	**45**	**50**	**67**	**60**
48	Stanley Road, Teddington (junc Strathmore Road)	0.2	**50**	**51**	**45**	**48**	**57**	**50**
49	URRW War Memorial, Sheen Lane, Sheen	0.2	**48**	**61**	**45**	**47**	**60**	**49**
4	Hampton Road, Teddington (nr. Bushy Park Gardens)	0.2	**47**	**58**	**45**	**47**	**53**	**47**
1	Hampton Court Road, Hampton	1.2	**43**	**59**	**44**	**48**	**51**	**52**
26	URRW, Sheen (nr. Courtland Estate)	2.5	**50**	**58**	**44**	**48**	**56**	**48**
13	Whitton Road, Whitton, (opp. Rugby ground)	0.2	**42**	**60**	**43**	**44**	**60**	**47**
12	Hanworth Road, Whitton	0.5	**40**	**50**	**43**	**51**	**56**	**53**

16	St Margarets Road, St Margarets (nr. Bridge Road)	0.2	**47**	**55**	**43**	**47**	**49**	**46**
45	High Street, Teddington (post office)	0.2	**52**	**58**	**43**	**47**	**65**	**54**
3	Uxbridge Road, Hampton (nr. Arundel Close)	1.2	**47**	**56**	**43**	**45**	**49**	**45**
21	Lower Richmond Road, Mortlake (nr. Kingsway)	1.2	**47**	**55**	**42**	**46**	**56**	**47**
47	Causeway, Teddington	0.2	**42**	**48**	**42**	**46**	**54**	**51**
27	Queens Road, Richmond (nr. Russell Walk)	1.2	**49**	**56**	**41**	**43**	**52**	**46**
10	Twickenham Road, Twickenham (opp. Fulwell golf course)	0.2	39	**52**	**41**	**43**	**53**	**44**
11	Percy Road, Whitton (nr. Percy Way)	0.2	**42**	**54**	**40**	**46**	**53**	**48**
41	Paradise Road, Richmond	0.2	**45**	**55**	**40**	**49**	**52**	**48**
34	Thames Street, Hampton	1.6	37	**48**	39.	**40**	**46**	**44**
40	Staines Road, Twickenham	0.2	**42**	**50**	39	**42**	**53**	**41**
29	Petersham Road, Ham. (nr. Sandy Lane)	0.2	**44**	**51**	38	**42**	**52**	**41**
8	Strawberry Vale, Teddington (Clive Road)	0.2	**41**	**43**	37	39	**42**	**39**
46	15 Queen's Road, Teddington	0.2	39	**53**	37	39	**44**	**41**
24	Lonsdale Road, Barnes (nr Suffolk Road)	0.2	39	**53**	36	39	**50**	**44**
51	Sheen Lane (railway crossing), Sheen	0.2	**44**	**48**	36	39	**48**	**40**
38	Queen's Road, Teddington (Park Road end)	0.2	**43**	**50**	36	**41**	**45**	38
5	Sandy Lane, Teddington (Shaef Way)	0.2	**41**	**47**	34	**41**	**44**	36
23	Castelnau Library, Barnes (static site)	1.5	**44**	**45**	34	**42**	**49**	**41**
2	Percy Road, Hampton (nr. Oldfield Road)	1.2	38	**41**	33	38	**43**	35
14	Cross Deep, Twickenham (nr. Poulett Gardens)	0.2	**45**	**58**	33	**48**	**58**	**53**
53	Mobile Air Quality Site				32	38	**52**	38
30	German School Petersham Road	2	**43**	**44**	32	38	35	39
RUT 04	Elmfield House, Waldegrave Road, Teddington	15	30	37	30	30	30	30
RUT 03	Alexandra Hall, Cromwell Place, Mortlake	50	38	**42**	31	33	31	30
17	Parkshot, Richmond (Court)	150	34	35	27	30	**41**	30
37	Wetlands Centre, Barnes (static site)	590	35.	32	26	29	36	31
28	Holly Lodge, Richmond Park	300	32	29	23	24	32	27

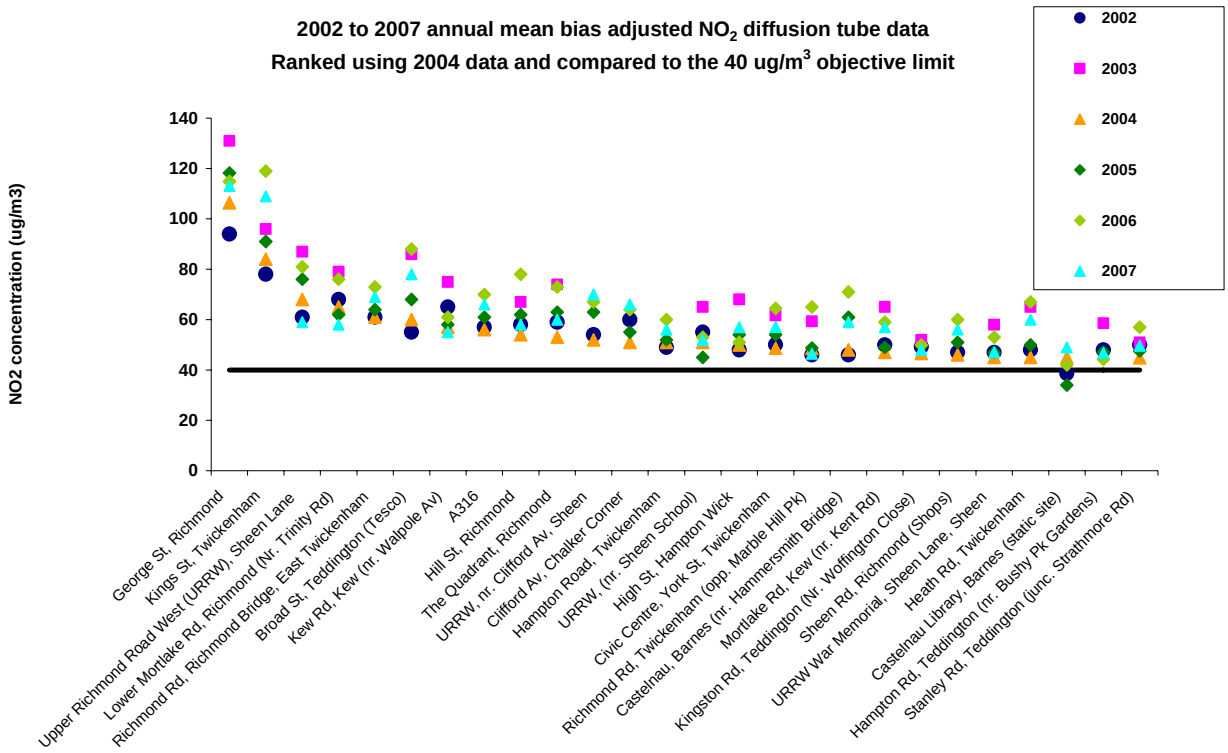

Figure 3a: *Graph comparing NO_2 diffusion tube annual means from 2002 to 2007 (one of two graphs – showing the **higher** concentrations).*

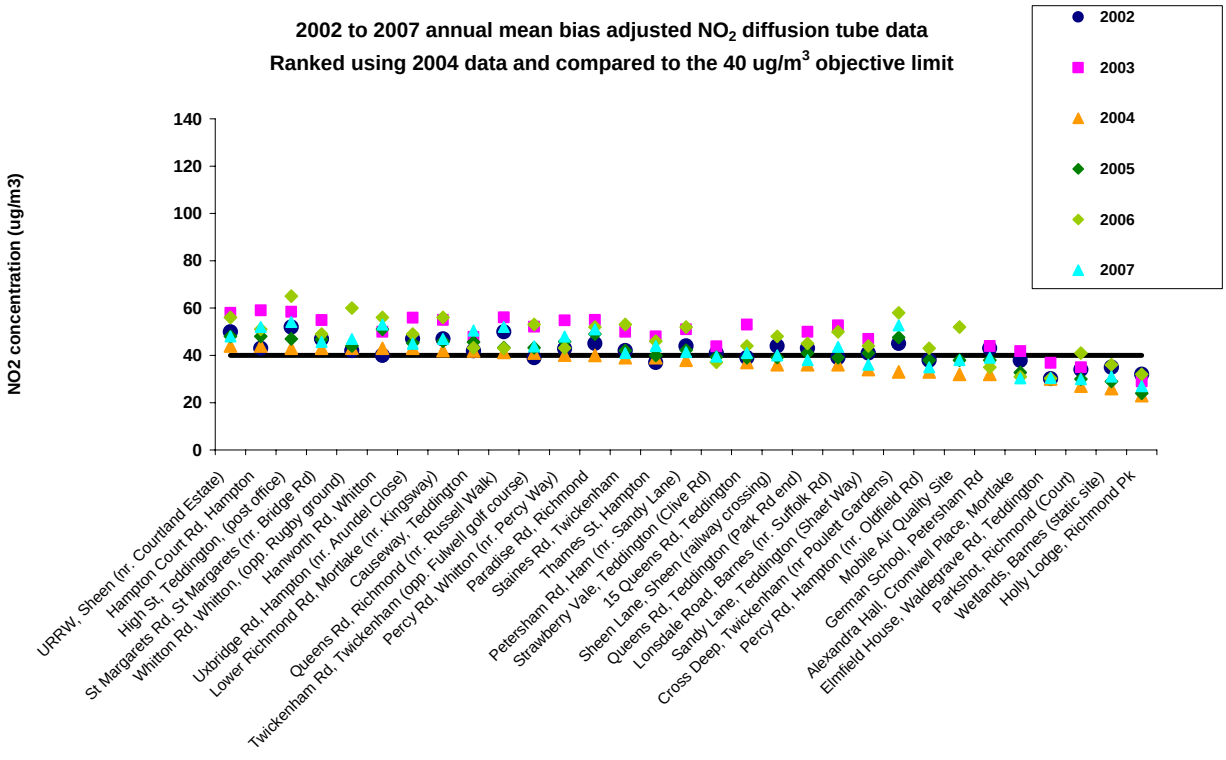

Figure 3b: *Graph comparing NO_2 diffusion tube annual means from 2002 to 2007 (one of two graphs – showing the **lower** concentrations).*

From the diffusion tube results in Table 1 and Figures 3a & 3b, we can see that 2003 was the worst of the six years. 2002 and 2004 were similar, with some improvements showing in 2004. However the 2006 and 2007 results show that there was an increase in NO_2 concentrations, with as many sites failing the Air Quality Objective as in 2003. Both in 2003 and 2006 only four sites met the Air Quality Objective of 40 $\mu g/m^3$.

Figure 4 shows the long-term trends at just 4 sites in the Borough. These sites were part of a long-term nation-wide monitoring programme and the data pre 2002 has not been bias adjusted, so caution is needed when making comparisons with bias adjusted data. After relatively lower concentrations in 2000/2001, all the sites have demonstrated increases in NO_2. The greatest increase was at George Street, with a bias corrected result of 118 $\mu g/m^3$ in 2005. An even higher bias corrected result of 131 $\mu g/m^3$ was recorded at George Street in 2006. However, 2003 was a year in which experienced higher pollution levels, due to the meteorological conditions that year.

Table 2 Annual mean NO_2 diffusion tube sampling from 1993 to 2007 in $\mu g/m^3$ (bias corrected from 2002 onwards).

	Twickenham (RUT01)	Richmond (RUT02)	Mortlake (RUT03)	Teddington (RUT04)
1993	39	39	33	29
1994	46	39	32	33
1995	43	41	30	30
1996	42	37	29	32
1997	37	37	25	29
1998	40	35	25	25
1999	38	34	27	28
2000	35	29	34	25
2001	38	52	24	18
2002	50	94	38	30
2003	62	131	42	37
2004	49	106	31	34
2005	54	118	33	30
2006	64	115	31	30
2007	57	113	30	30

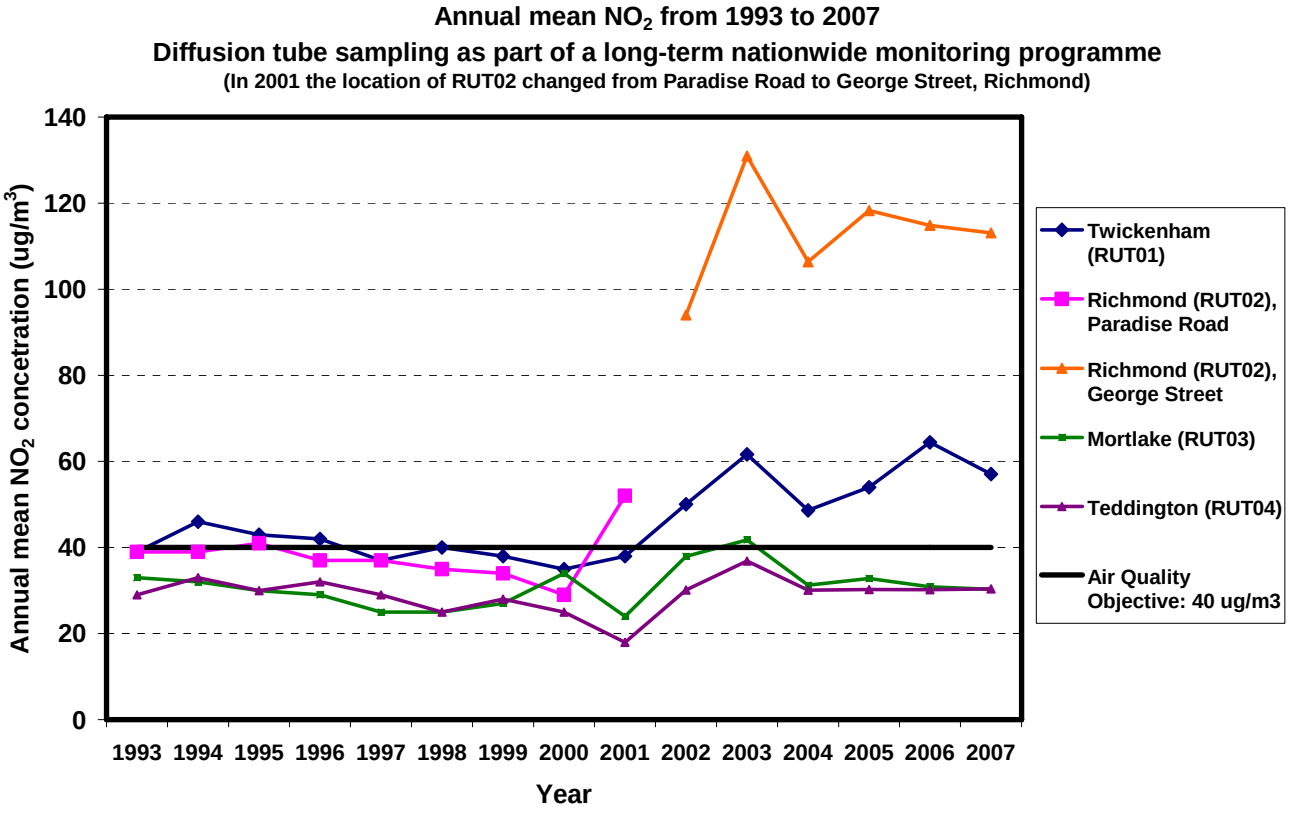

Figure 4: *Annual mean NO_2 from 1993 to 2006 (Chart of Table 2 data. Bias corrected from 2002 onwards, because there was no bias correction data available for the earlier years). Note: the Richmond site moved from Paradise Road to George Street in 2001. The higher concentrations demonstrate the impact of local traffic movements at the new site.*

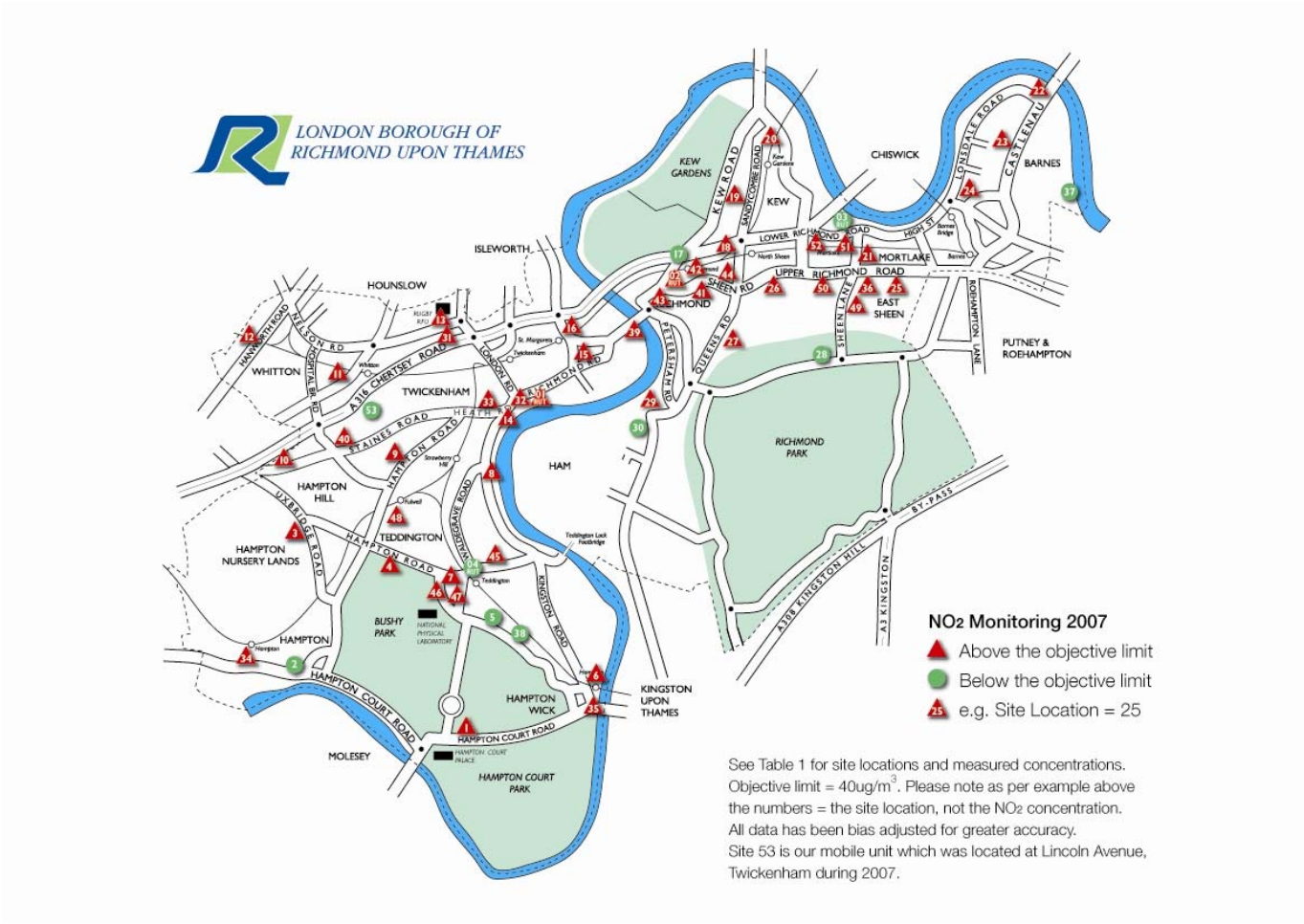

Figure 5: *Map showing the location of the NO_2 diffusion tubes and the continuous monitors.*

2.3 Continuous monitoring sites

Table 2, lists the pollutants monitored continuously at each of the four sites (1 mobile and 3 static). Richmond Council has three monitoring sites, and the National Physical Laboratory (NPL) also undertakes monitoring in the LBRuT at Teddington, this site is part of the UK Automatic Urban and Rural Network (AURN).

Table 3 Locations of the automatic monitoring sites.

Monitoring sites	Operational since	Pollutants monitored
Castelnau Library, Barnes. Static site known as Richmond 1 in the London Air Quality Network (LAQN). Roadside site, 3 meters from road with bus lane.	2000	NO_X, NO_2, and PM_{10}
Wetlands Centre, Barnes. Static site known as Richmond 2 in the LAQN. Suburban (background) site - well away from roads.	2000	NO_X, NO_2, O_3 and PM_{10}
Mobile Air Quality Unit. Mostly roadside monitoring locations. Located at Lincoln Avenue, Twickenham for the calendar year 2007, which was a roadside site.	1995	NO_X, NO_2, NO, CO, SO_2 and PM_{10}
NPL - Teddington AURN. Static suburban (background) site - well away from roads.	1996	NO_X, NO_2, NO, SO_2 and O_3

The results given below show the annual mean data, for the pollutants monitored, for the years 2002 to 2007. Each set of results is given in turn, starting with NO_2, then PM_{10}, ozone, SO_2, CO, benzene and PAH. Results in **bold** are ones which exceed the objective limits. Details on the relevant objective limits are given in Appendix 1.

For Quality Assurance/Quality Control (QA/QC) purposes, all the continuous analysers are manually checked and calibrated every two weeks, serviced every six months and audited by an independent auditor (the National Physical Laboratory) every six months. The analytical methods used by the analysers are: NO_2 (chemiluminescence); PM_{10} (TEOM); ozone (UV absorption); SO_2 (fluorescence); CO (infrared); benzene (gas chromatography/mass spectrometry) and PAH (both particle and vapour phase analysis). The relevance of quoting the percentage data capture is to demonstrate compliance with the minimum 90% required for a valid comparison with the short-term objective limits. Only the 2007 data has not been fully ratified. This was the case for the 2006 data when LBRuT submitted its progress report in 2007, so there may be some minor differences between the values for 2006 in this report compared to last year's. We are not aware of any abnormal pollution making activity during the sampling periods.

Table 4 NO_2 results from the continuous analysers, compared with the annual mean limit of 40 μg/m^3 and the number of times the levels exceeded the hourly average limit of 200 μg/m^3.

Castelnau	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Annual mean NO_2 (μg/m^3)	**44**	**48**	**41**	**42**	**42**	**42**
Number of exceedences of hourly mean	0	0	0	4	0	4
Data capture (%)	98%	96%	97%	98%	99%	96%
Wetlands	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Annual mean NO_2 (μg/m^3)	32	37	31	30	30	30
Number of exceedences of hourly mean	0	0	0	0	0	0
Data capture (%)	71%	99%	97%	93%	87%	97%
Mobile Unit	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Annual mean NO_2 (μg/m^3)						38
Number of exceedences of hourly mean	1	2	0	0	0	0
Data capture (%)						99%
NPL – Teddington AURN	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Annual mean NO_2 (μg/m^3)	25	28	25	26	23	28
Number of exceedences of hourly mean**	0	0	0	0	0	0
Data capture (%)	98%	96%	94%	95%	99%	95%

***Castelnau** - data after 10 September 2007 have not been fully ratified. **Wetlands** - data after 10 July 2007 have not been fully ratified**. Mobile Unit - Lincoln Avenue, Twickenham** - data after 2 July 2007 have not been fully ratified.
****See Table 4a for the exceedence breakdown at each Mobile Air Quality Unit deployment.

Table 4a Break down of the number of times the NO_2 levels exceeded the hourly mean limit of 200 $\mu g/m^3$ at the Mobile Air Quality Unit.

Mobile Unit location	Start date	End date	2002	2003	2004	2005	2006	2007	Site Total
Richmond Park (background)	29/04/02	11/09/02	0						0
George Street, Richmond	16/09/02	19/11/02	1						1
Kew Green, Kew	19/11/02	25/02/03	0	0					0
Richmond Road, Twickenham (opp. Orleans School)	25/02/03	20/05/03		0					0
Upper Teddington Road, Teddington	21/05/03	03/02/04		2	0				2
Somerset Road, Teddington	03/02/04	23/04/04			0				0
St Margaret's Grove, St Margaret's	27/04/04	20/07/04			0				0
Petersham Road, Ham	21/07/04	25/05/05			0	0			0
Stanley Road, Twickenham	27/05/05	19/07/05				0			0
Richmond Road, Twickenham (York House)	19/07/05	24/07/06				0	0		0
Lincoln Avenue, Twickenham	28/07/06	08/01/08					0	0	0
Calendar year total			1	2	0	0	0	0	

Table 4 shows that the annual mean for Castelnau exceeded the objective (40 $\mu g/m^3$) every year for the past six years, and there were four exceedences of the 1-hour air quality standard in 2005 and 2007 (out of 18 exceedences permitted by the objective, so the 1-hour objective was met). Table 4a shows there was one hour exceedence during the 2002 George Street, Richmond deployment of the Mobile Unit, and 2 during the 2003 Upper Teddington Road, Teddington deployment. The annual and 1-hour objectives were not exceeded at the Wetlands and NPL – Teddington AURN sites.

The results from both the NO_2 diffusion tube sampling and the continuous analysers correlate with the modelling predictions calculated by Environmental Research Group (ERG) consultants for the year 2005. The following maps (Figures 6 and 7) were taken from the 2002 Stage 4 Review and Assessment report. They indicate that the Air Quality Objectives will not be met in 2005 in the main road traffic corridors and junctions, and therefore premises close to these areas will be affected by the pollution. These modelling predictions are confirmed by the 2005, 2006, and 2007 air quality monitoring data.

Modelling by ERG, based on the London LAEI for 2003 and the meteorological year of 2003, has identified that under a repeat of those 2003 meteorological conditions, there would be widespread exceedences of the annual mean NO_2 2010 Objective across the LBRuT. Modelled exceedences of the annual mean NO_2 2010 Objective across the Borough will be re-assessed once the Greater London Authority (GLA) commissioned modelling by ERG is available. Hopefully, the revised 2010 modelling will be reported in LBRuT 2009 USA, based on the LAEI for 2004 and considering the affect of the LEZ.

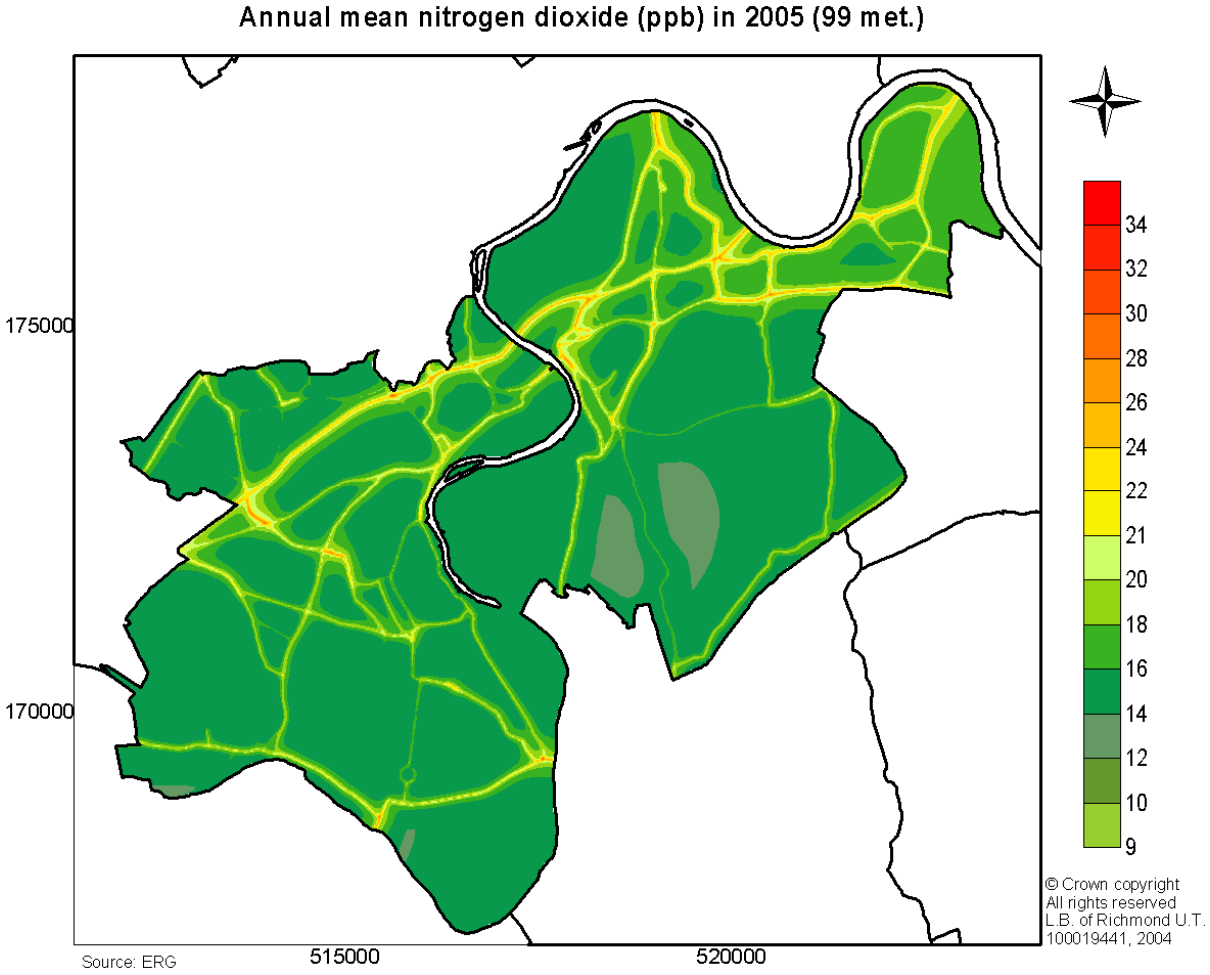

Figure 6: *Modelled NO_2 concentrations (in ppb) for 2005. Yellow and above indicates an exceedence of the air quality objectives. It assumes that the weather in 2005 would be the same weather as the year 1999. Note: do not compare the NO_2 concentrations on this map with any other data in this report which is reported in $\mu g/m^3$. To convert ppb to $\mu g/m^3$ multiply ppb by 1.9. Objective limit of 40 $\mu g/m^3$ = 21 ppb.*

2.4 Particulate matter (PM_{10}) in the LBRuT

The LBRuT uses a Tapered Element Oscillating Microbalance (TEOM) to continuously monitor PM_{10}.

Table 5 Annual mean PM_{10} results against the Objective limit of an annual mean of 40 $\mu g/m^3$ and the number of single days over 50 $\mu g/m^3$ (35 days a year permitted by the Objective).

Castelnau	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Annual mean PM_{10} ($\mu g/m^3$)	25	28	26	26	27	25
Number of exceedences of the 24-hour mean	4	29	10	6	8	17

Data capture (%)	92%	96%	94%	99%	94%	99%
Wetlands	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Annual mean PM_{10} ($\mu g/m^3$)	24	28	22	22	25	22
Number of exceedences of the 24-hour mean	6	34	5	4	17	12
Data capture (%)	64%	98%	97%	99%	99%	96%
Mobile Unit	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Annual mean PM_{10} ($\mu g/m^3$)						26
Number of exceedences of the 24-hour mean **	2	**49**	8	7	14	20
Data capture (%)						99%

*** Castelnau** – data after 18 October 2007 have not been fully ratified. **Wetlands** - data after 23 October 2007 have not been fully ratified. **Mobile Unit - Lincoln Avenue, Twickenham** - data after 2 July 2007 have not been fully ratified.
****** See Table 5a for the exceedence breakdown at each mobile unit deployment.

Table 5a Breakdown of the number of times PM_{10} levels exceeded the 24-hour limit of 50 $\mu g/m^3$ at the Mobile Air Quality Unit.

Mobile Unit location	**Start date**	**End date**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	Site Total
Richmond Park (background)	29/04/02	11/09/02	1						1
George Street, Richmond	16/09/02	19/11/02	0						0
Kew Green, Kew	19/11/02	25/02/03	1	7					8
Richmond Road, Twickenham (opp. Orleans School)	25/02/03	20/05/03		19					19
Upper Teddington Road, Teddington	21/05/03	03/02/04		23	0				23
Somerset Rd, Teddington	03/02/04	23/04/04			1				1
St Margaret's Grove, St Margaret's	27/04/04	20/07/04			1				1
Petersham Road, Ham	21/07/04	25/05/05			6	4			10
Stanley Road, Twickenham	27/05/05	19/07/05				0			0
Richmond Road, Twickenham (York House)	19/07/05	24/07/06				3	7		10
Lincoln Avenue, Twickenham	28/07/06	08/01/08					7	20	27
Calendar year total			2	**49**	8	7	14	20	

From Table 5 we can see that there were no exceedences of either of the objective limits, at Castelnau or the Wetlands.

Table 5a shows that the combined exceedences of the 24-hour limit of 50 μg/m^3 at the Mobile Air Quality Unit deployments in 2003, results in an exceedence of the 24-hour mean 2005 objective limit.

ERG modelled PM_{10} concentrations in the LBRuT, which are displayed in the following map, Figure 7.

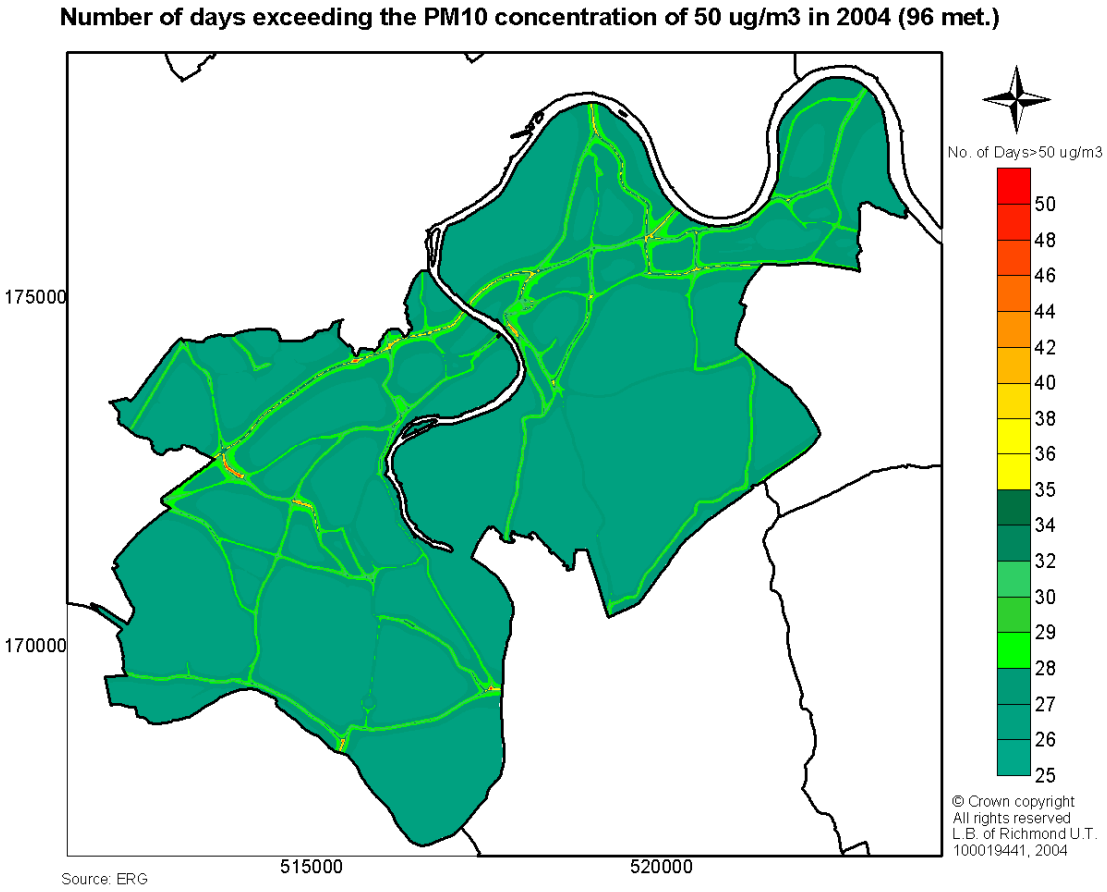

***Figure 7**: Modelled PM_{10} concentrations in LBRuT in 2004.*

Modelling from by ERG for the year 2010 (not shown) gives similar results, with exceedences mostly in the center of roads, with no sensitive receptors. The modelling needs further assessment to identify any receptors, and will be re-assessed once the Greater London Authority (GLA) commissioned modelling by ERG is available, which will be based on the 2004 LAEI and take into account the affect of the LEZ.

2.5 Other Pollutants Monitored

2.5.1 Ozone (O_3)

Currently ozone is continuously monitored at the Mobile Air Quality Unit and the static site at the Wetlands Centre, Barnes. The results from 2002 to 2007 are shown in Table 6.

Table 6 Ozone levels at the Wetlands Centre, the Air Quality Mobile Unit and at NPL - Teddington AURN. The non-legal objective limit is 10 exceedences of 100 μg/m^3 as the daily maximum of the running 8-hour mean.

Wetlands	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Number of exceedences of the running 8-hour mean	5	**49**	**24**	**17**	**29**	**15**
Data capture (%)	46%	100%	98%	99%	96%	97%
Mobile Unit	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Number of exceedences of the running 8-hour mean**	**11**	**14**	9	9	**24**	9
NPL – Teddington AURN	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Number of exceedences of the running 8-hour mean	**24**	**50**	**26**	**32**	**42**	**19**
Data capture (%)	99%	99%	96%	99%	99%	97%

*** Wetlands** - data after 23 October 2007 have not been fully ratified. **Mobile Unit - Lincoln Avenue, Twickenham** - data after 2 July 2007 have not been fully ratified.
****** See Table 6a for the exceedence breakdown at each mobile unit deployment.

Table 6a Breakdown of the number of times ozone levels exceeded the running 8-hour mean limit of 100 μg/m^3 at the Mobile Air Quality Unit.

Mobile Unit location	**Start date**	**End date**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	Site Total
Richmond Park (background)	29/04/02	11/09/02	11						11
George Street, Richmond	16/09/02	19/11/02	0						0
Kew Green, Kew	19/11/02	25/02/03	0	0					0
Richmond Road, Twickenham (opp. Orleans School)	25/02/03	20/05/03		1					1
Upper Teddington Road, Teddington	21/05/03	03/02/04		13	0				13
Somerset Rd, Teddington	03/02/04	23/04/04			1				1
St Margaret's Grove, St Margaret's	27/04/04	20/07/04			2				2
Petersham Road, Ham	21/07/04	25/05/05			6	0			6
Stanley Road, Twickenham	27/05/05	19/07/05				7			7
Richmond Road, Twickenham (York House)	19/07/05	24/07/06				2	22		24
Lincoln Avenue, Twickenham	28/07/06	08/01/08					2	9	11
Calendar year total			**11**	**14**	9	9	**24**	9	

Table 6 shows that the ozone levels at the Wetlands and NPL - Teddington AURN site in 2005, 2006 and 2007 did exceed the suggested objective (not more than 10 exceedences of 100 μg/m^3 as the daily maximum of the running 8-hour mean per year). Table 6a shows that the combined exceedences of the running 8-hour limit of 100 μg/m^3 at the Mobile Air Quality Unit deployments in 2006, resulted in an exceedence of the suggested objective. Care needs to be taken when comparing the number of exceedences at individual Mobile Unit deployments, because the Mobile Unit was not sited at locations for a full calendar year prior to 2007, so seasonal variations may cause one deployment to record higher pollution levels than another. The first deployment at Richmond Park is a background site and would be expected to record higher levels of ozone that the other deployments, which are all roadside.

The high ozone levels at all sites in 2003 were due to the extremely hot summer.

2.5.2 Sulphur dioxide (SO_2)

SO_2 is continuously monitored at our mobile air quality unit and at NPL.Table 7 shows that SO_2 monitored within the LBRuT did not exceed the 15-minute mean objective (not to exceed 266 μg/m^3 more than 35 times a year).

Table 7 SO_2 monitoring at the Mobile Air Quality Unit and at NPL - Teddington AURN. Objective limit: 15-minute mean not to exceed 266 μg/m^3 more than 35 times a year.

Mobile Unit	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Number of exceedences of 15-minute mean	0	0	0	0	0	0
NPL – Teddington AURN	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Number of exceedences of 15-minute mean	0	0	0	0	0	0
Data Capture (%)	99%	99%	96%	99%	98%	65%

*** Mobile Unit - Lincoln Avenue, Twickenham** - data after 2 July 2007 have not been fully ratified. **NPL- Teddington AURN** - data after 30 September 2007 have not been fully ratified.

2.5.3 Carbon Monoxide (CO)

The LBRuT currently continuosly monitor CO at the Mobile Air Quality Unit. Table 8 shows that the CO limit has not been exceeded over the past six years.

Table 8 CO monitoring at the Mobile Air Quality Unit. Objective limit: running 8-hour mean not to exceed 10 mg/m^3.

Mobile Unit	**2002**	**2003**	**2004**	**2005**	**2006**	**2007***
Number of exceedences of the running 8-hour mean	0	0	0	0	0	0

*** Mobile Unit - Lincoln Avenue, Twickenham** - data after 2 July 2007 have not been fully ratified.

2.5.4 Benzene (C_6H_6)

The LBRuT has five locations where it monitors for benzene, toluene, ethyl benzene, xylene (BTEX). The monitoring regime is to collect a two-week sample every month.

Table 9 Annual mean benzene concentrations. Objective limit for 2010: 5 μg/m^3.

Site Code	Location	2002	2003	2004	2005	2006	2007
7	Broad Street, Teddington	4.7	3.4	2.8	2.4	2.4	2.4
32	Kings Street, Twickenham	5.4	3.7	2.9	2.5	3.0	2.6
35	High Street, Hampton Wick	4.3	3.1	2.2	2.2	2.5	2.2
36	Upper Richmond Road West (URRW), Sheen Lane	5.6	4.1	2.9	2.9	3.1	2.3
RUT 02	George Street, Richmond	4.4	3.4	2.5	2.4	2.5	2.2

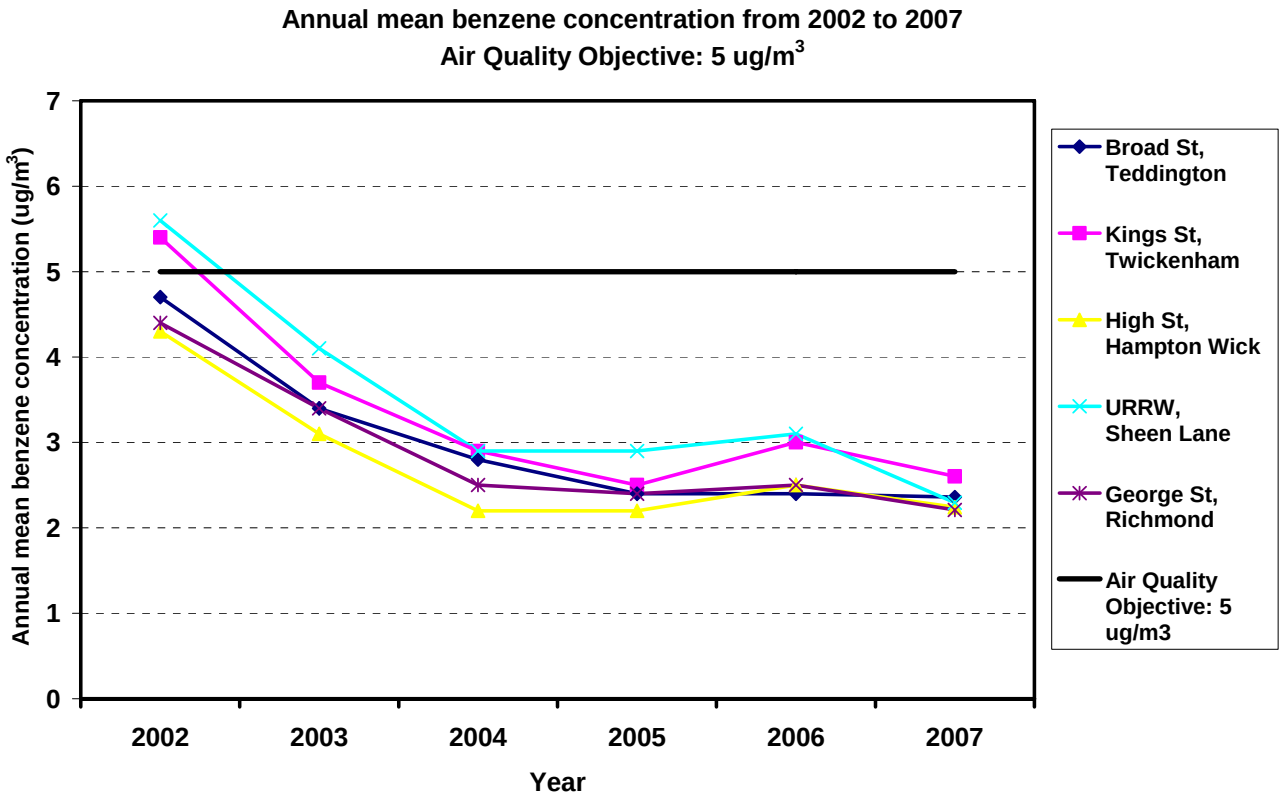

Figure 8: *Annual mean benzene diffusion tube concentrations from 2002 to 2007.*

The benzene results in Table 9 and Figure 8 show there was a general decrease in the levels from 2002 to 2004, since then levels have almost bottomed out, with some small increases in 2006. The 2010 objective annual mean of 5 μg/m^3 was met at all the sites from 2003 onwards.

2.5.5 Polycyclic aromatic hydrocarbons (PAH)

PAH was monitored at Castelnau Library, Barnes from 2002 to Spring 2007. The site is located 3 metres from a busy road. Analyses were made of both the vapour phase and particulate phase of PAHs in the air. As the sample is taken from the TEOM head, only particles up to 10 μm diameter are collected. This is representative of the particle size that is breathed into the human lung. The monitoring regime is to collect a two week sample every month.

Table 10 Annual mean PAH and benzo(a)pyrene (B(a)P) levels. B(a)P objective limit for 2010: 0.25 ng/m^3.

	2002	2003	2004	2005	2006
PAH (ng m^{-3})	11.53	15.23	20.15	15.65	16.24
B(a)P (ng m^{-3})	0.11	0.16	0.18	0.19	0.14

There are currently no national guidelines for total PAH in the UK. The UK Air Quality Strategy (DEFRA, 2007) has now adopted the Expert Panel on Air Quality Standards (EPAQS) recommendation for a limit based on just one of the PAH family called benzo(a)pyrene (B(a)P), which is used as an indicator for all PAHs. The EPAQS annual mean limit for B(a)P is 0.25 ng/m^3 by 2010.

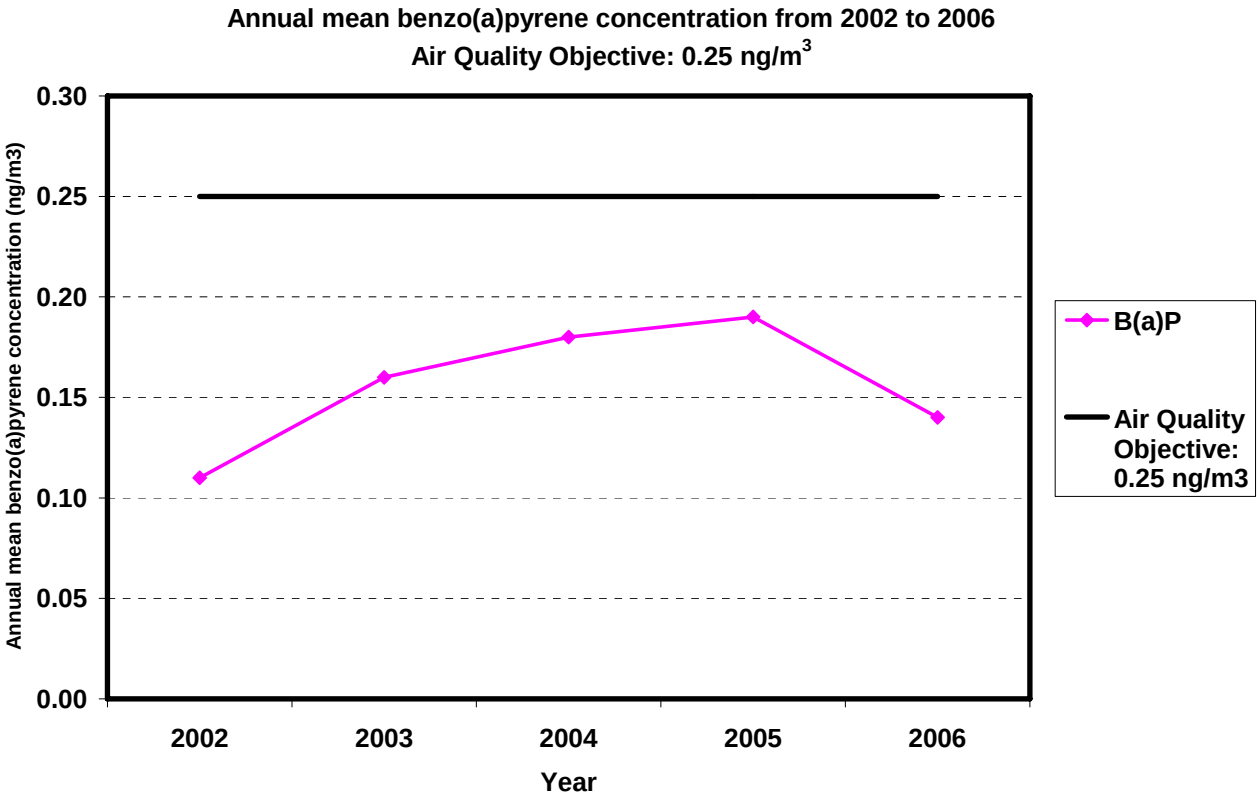

Figure 9: *Annual mean benzo(a)pyrene diffusion tube concentrations from 2002 to 2006.*

Table 10 and Figure 9 show that the recommended EPAQS B(a)P standard is being met in the LBRuT and hence the LBRuT decided to cease monitoring PAHs in Spring 2007.

CHAPTER 3: NEW DEVELOPMENTS

3.1 Industrial processes

There are currently 50 Part B processes in the LBRuT, including 15 petrol stations and 32 dry cleaners, these total numbers are the same as report LBRuT reported in 2007, however some Part B processes have closed (revoked) and some new ones have been permitted.

3.2 New developments

There have been no developments within the LBRuT that would have any significant harmful impact on the air quality e.g. by having significant increases in traffic flows. There are, however, concerns for the future, if there is significant expansion at Heathrow airport, with either the building of 3rd runway and/or and increase in aircraft movements above the current 480,000 limit. The concern is that an increase in activity at the airport will result either directly or indirectly in increases in local road traffic and hence increases in local air pollution. The LBRuT will resist any developments at Heathrow that appear likely to increase pollution levels within the Borough.

No landfills, quarries or minerals etc works have commenced operation.

CHAPTER 4: AIR QUALITY ACTION PLAN – PROGRESS REPORT

4.1 ACTION PLAN TABLE in APPENDIX 6

The LBRuT AQAP was approved by the Environment Cabinet, following a consultation process, and was published in November 2002. The Table in Appendix 6 was in the original Action Plan, but has been updated to show what progress has been made with each action. The layout has also been modified to comply with the guidance on format given in Guidance LAQM.PRG(03) (DEFRA, 2003a).

Implementation of the plan has involved liaison with several Council departments including, Transport Planning Service, Environmental Health, Traffic & Transport, Private Sector Housing, Planning Policy & Design, Recycling and the Sustainability Unit. Not all actions are the responsibility of the LBRuT. Actions such as the implementation of the LEZ are being led by the GLA, and are London wide actions. Continued progress will be dependant on the collaboration of these organisation and all the London Boroughs.

A major linkage is with the work activity of the Transport Planning Service. The work involves schemes that are identified within the Borough's Local Implementation Plan for Transport and the annual Borough Spending Plans for Transport. Many transport measures have been identified which promote joint traffic/air quality benefits such as enhancing public transport to reduce congestion, improved parking schemes and school travel plans, amongst others.

The many teams involved in tackling air pollution indicate that reducing emissions and delivering clean air are a core concern of the Council. The Council aims to develop an Air Quality Strategy to help deliver a green, safe and clean Borough.

CHAPTER 5: CONCLUSIONS

The air pollution monitoring results discussed in this Progress Report indicate that many of the pollutants monitored are below the current objective limits. This may not always be the case, if the objectives are tightened. The main pollutants of concern in terms of the exceedences are NO_2, PM_{10} and ozone, however the latter is a regional, national or international issue and not under the direct duty of the LBRuT. PM_{10} has both local and distant sources. Work is still in hand, with the ERG modelling data for 2010, to determine whether we have any receptors affected, for the relevant exposure periods and will be re-assessed once the revised modelling (based on 2004 LAEI and considering the affect of the LEZ) is available. The final main pollutant of concern is NO_2, which demonstrates widespread exceedences across the borough, both from modelling and monitoring. In spite of efforts to reduce emissions, levels of NO_2 have been rising. It is thought that this is due to the primary NO_2 content of vehicle exhausts. The Council will play its part to tackle this issue when details are known as to the best way forward with it.

Many of the pollution 'hotspots' identified by modelling and monitoring are situated on the TfL road network within the LBRuT, indicating a clear need to work with the TfL network management, the surrounding Boroughs and the Mayor of London.

On the local road network, there are also a number of 'hotspots' that need to be considered. Efforts to improve air quality will be assisted if there is sufficient public awareness of the issues. If people understand where pollution comes from, they will be able to take greater personal responsibility for their contribution to clean air.

The Council continues to seek the support of residents and other stakeholders, to help it in the development of the LBRuT AQAP, to enable cleaner air in the Borough, so the AQAP programme has been developed to include schools, businesses and the business of the Council itself.

The benefits of clean air are many. Although the Progress Report assessment has been based mainly on the need to protect human health, the benefit of less traffic congestion and the benefits for the local economy and for climate change are also important aspects.

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The regulations can be found at: www.opsi.gov.uk/si/si2007/uksi_20070064_en_1

Appendix I

Table 1 *Objectives included in the Air Quality Regulations 2000 and (Amendment) Regulations 2002 for the purpose of Local Air Quality Management (source: DEFRA, 2003b).*

Pollutant	Objective	Measured as	To be achieved by
Benzene All Authorities	16.25 µg/m^3	Running Annual Mean	31 December 2003
Benzene Authorities in England and Wales only	5 µg/m^3	Annual Mean	31 December 2010
Benzene Authorities in Scotland and Northern Ireland only	3.25 µg/m^3	Running Annual Mean	31 December 2010
1,3-Butadiene	2.25 µg/m^3	Running Annual Mean	31 December 2003
Carbon monoxide Authorities in England, Wales and Northern Ireland only	10.0 mg/m^3	Maximum daily running 8 Hour Mean	**31 December 2003**
Carbon monoxide Authorities in Scotland only	10.0 mg/m^3	Running 8 Hour Mean[a]	**31 December 2003**
Lead	0.5 µg/m^3	Annual Mean	31 December 2004
	0.25 µg/m^3	Annual Mean	31 December 2008
Nitrogen dioxide[b]	200 µg/m^3 Not to be exceeded more than 18 times per year	1 Hour Mean	31 December 2005 **AQS (2007) to be achieved by 2010**
	40 µg/m^3	Annual Mean	31 December 2005 **AQS (2007) to be achieved by 2010**
Nitrogen Oxides**	(V) 30 µg/m^3	Annual Mean	31 December 2000
Ozone[*]	100 µg/m^3	Running 8 hour Mean Daily maximum of running 8 hr mean not to be exceeded more than 10 times per year	31 December 2005
Particles (PM10) (gravimetric)[c] All authorities	50 µg/m^3 Not to be exceeded more than 35 times per year	24 Hour Mean	**31 December 2004**
	40 µg/m^3	Annual Mean	**31 December 2004**
Particles (PM10) Authorities in Scotland only[d]	50 µg/m^3 Not to be exceeded more than 7 times per year	24 Hour Mean	31 December 2010
	18 µg/m^3	Annual Mean	31 December 2010

Poly aromatic hydrocarbons[e]	0.25 ng/m^3 B(a)P	Annual Mean	31 December 2010
Sulphur dioxide	266 µg/m^3 Not to be exceeded more than 35 times per year	15 Minute Mean	31 December 2005
	350 µg/m^3 Not to be exceeded more than 24 times per year	1 Hour Mean	**31 December 2004**
	125 µg/m^3 Not to be exceeded more than 3 times per year	24 Hour Mean	**31 December 2004**
	(V) 20 µg/m^3	Annual Mean	31 December 2000
	(V) 20 µg/m^3	Winter Mean (01 October - 31 March)	31 December 2000

Notes:

a. The Quality Objective in Scotland has been defined in Regulations as the running 8-hour mean, in practice this is equivalent to the maximum daily running 8-hour mean.
b. The objectives for nitrogen dioxide are provisional.
c. Measured using the European gravimetric transfer sampler or equivalent.
d. These 2010 Air Quality Objectives for PM 10 apply in Scotland only, as set out in the Air Quality (Scotland) Amendment Regulations 2002.
e. Not included in regulations

µg/m^3 - micrograms per cubic metre, mg/m^3 - milligrams per cubic metre, *Ozone is not included in the Regulations

** Assuming NOx is taken as NO2

(V) These standards are adopted for the protection of vegetation and ecosystems. All of the remainder are for the protection of human health.

In February 2007, the Air Quality Standards Regulations 2007 came into force, these regulations simplify air quality regulation with the Air Quality Limit Values being transposed into the updated Regulations as 'Air Quality Standards' (AQS) with attainment dates in line with the European Directives. Where achieved by dates are not specified in the Air Quality Standards Regulations 2007 (OPSI, 2007), the achieved by date is the coming into force of the regulations, which was 15th February 2007 (shown above by the achieved by dates in bold). The AQS for NO_2 is to be achieved by 1st January 2010 in line with the European Directives.

Appendix II

Possible health effects from poor air quality

Poor air quality can have significant adverse impacts on the society, the environment and the economy. According to DEFRA and the EPAQS high levels of air pollutants can have the following effects on human health.

***Table 1**: Possible health effects from poor air quality (source: DEFRA, 2007 and 2008)*

POLLUTANT	HEALTH EFFECTS AT HIGH LEVELS
Nitrogen dioxide	Irritation of the airways of the lungs, increasing the symptoms of those suffering from lung diseases.
Sulphur dioxide	
Ozone	
Particles	Fine particles can be carried deep into the lungs where they can cause inflammation and a worsening of heart and lung diseases.
Carbon monoxide	Prevention of the normal transport of oxygen by the blood. This can lead to a significant reduction in the supply of oxygen to the heart, particularly in people suffering from heart disease.
Lead	Very high levels can cause damage on central nervous system. Lower concentrations can harm various organs including the kidneys and cause colicky intestinal pains.
1-3 Butadiene	Short-term human exposures to very high concentrations can cause irritation of the eyes, nose, throat and skin. Long term exposure to very high levels can possibly cause cancers of the lymphoid system and blood-forming tissues, lymphomas and leukemia
Benzene	The effect of long-term exposure to very high concentrations of benzene can possibly be leukemia.
Poly aromatic hydrocarbons (PAH's)	Possible cause of lung cancer.

With the exception of carbon monoxide, very high levels of all these pollutants can irritate the lungs and cause inflammation. People with lung diseases, especially the elderly, may feel less well than usual. In some cases their symptoms may increase to such an extent that they need a change in treatment, or admission to hospital. In addition to these effects, ozone and greenhouse gases can have significant adverse effects on ecosystems and, thus, indirect effects on human health and quality of life, through their degradation. More information can be found in:

www.defra.gov.uk/environment/airquality/publications/airpoll/index.htm
www.defra.gov.uk/environment/airquality/strategy/index.htm

Appendix III

NO_2 diffusion tube bias correction

Bias Adjustment A is calculated as follows: **A = Cm/Dm**

Cm is the annual mean of the chemiluminescence concentration (at Castelnau Library, Barnes for the years 2002 to 2006).

Dm is the annual mean diffusion tube concentration

2002
Cm = 44 μg/m^3 Dm = 30.61 μg/m^3 A = 44/30.61 = 1.44

Therefore all the monthly diffusion tube results for 2002 were multiplied by a factor of 1.44.

2003
Cm = 48 μg/m^3 Dm = 38.87 μg/m^3 A = 48/38.87 = 1.23

Therefore all the monthly diffusion tube results for 2003 were multiplied by a factor of 1.23.

2004
Cm = 41 μg/m^3 Dm = 42.34 μg/m^3 A = 41/42.34 = 0.97

Therefore all the diffusion tube results for 2004 were multiplied by a factor of 0.97.

2005
Cm = 42 μg/m^3 Dm = 41.87 μg/m^3 A = 42/41.87 = 1.00

Therefore all the diffusion tube results for 2005 were multiplied by a factor of 1.00.

2006
Cm = 41 μg/m^3 Dm = 40 μg/m^3 A = 41/40 = 1.03

Therefore all the diffusion tube results for 2006 were multiplied by a factor of 1.03.

2007
Cm = 42 μg/m^3 (Castelnau Library, Barnes) Dm = 43 μg/m^3 A = 42/43 = 0.97

Therefore all the roadside diffusion tube results for 2007 were multiplied by a factor of 0.97. The following bias correction was determined for the Wetlands Centre and applied to the Wetlands Centre and the background site at Richmond Park.

Cm = 30 μg/m^3 (Wetlands Centre, Barnes) Dm = 28 μg/m^3 A = 30/28 = 1.06

The methods we use to calculate the bias correction for our diffusion tubes are currently (April 2008) being reviewed and we are re-assessing which continuous monitoring sites are suitable to apply to the diffusion tubes deployed across the LBRuT.

Appendix IV

NO_2 diffusion tube – method of analysis

Diffusion tubes are passive monitoring devices. They are made up of a Perspex cylinder, with 2 stainless steel mesh discs, coated with triethanolamine held inside a polythene cap, which is sealed onto one end of the tube. Diffusion tubes sample NO_2 when ambient concentrations enter and pass through the tube and are absorbed by the triethanolamine (TEA), which is present on the coated discs[1]. There are three main preparation methods for diffusion tubes involving triethanolamine. The diffusion tubes employed in the LWEP programme are prepared by UKAS accredited Gradko International Ltd. using the 50% v/v triethanolamine with acetone method.

Prior to and after sampling, an opaque polythene cap is placed over the opposite end of the diffusion tube to prevent further adsorption onto the discs.

The diffusion tubes are labelled and kept refrigerated in plastic bags prior to and after exposure.

Gradko International Ltd additionally undertakes the analysis of exposed diffusion tubes, on behalf of Casella Stanger, by ultra violet spectrophotometry.

Quality assurance and quality control

The EU Daughter Directive sets data quality objectives for nitrogen dioxide along with other pollutants. Under the Directive, annual mean NO_2 concentration data derived from diffusion tube measurements must demonstrate an accuracy of $\pm$25 % to enable comparison with the Directive air quality standards for NO_2.

In order to ensure that NO_2 concentrations reported are of a high caliber, strict performance criteria need to be met through the execution of quality assurance and control procedures. A number of factors have been identified as influencing the performance of diffusion tubes including the laboratory preparing and analysing the tubes and the tube preparation method. [2] Quality assurance and control procedures are therefore an integral feature of any monitoring programme, ensuring that uncertainties in the data are minimised and allowing the best estimate of true concentrations to be determined.

Gradko International Ltd conducts rigorous quality control and assurance procedures in order to maintain the highest degree of confidence in their laboratory measurements. These are discussed in more detail below.

Workplace Analysis Scheme for Proficiency (WASP)

Gradko International Ltd participates in the Health and Safety Laboratory WASP[3] NO_2 diffusion tube scheme on a monthly basis. This is a recognised performance-testing programme for laboratories undertaking NO_2 diffusion tube analysis as part of the UK NO_2 monitoring network. The scheme is designed to help laboratories meet the European Standard EN482[4]. The laboratory performance for all months in 2003 was rated 'good' which signifies a high level of accuracy for laboratory measurements.

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[1] Source: Chemistry and Microbiology - 'Determination of Nitrogen Dioxide in Environmental Samples'; Stanger Science and Environment. 1991.

[2] Compilation of diffusion tube collation studies carried out by local authorities, prepared by Professor Duncan Laxen and Penny Wilson, 2003

[3] Health and Safety Executive, Workplace Analysis Scheme for Proficiency

[4] European Committee for Standardisation (CEN) Workplace Atmospheres, General requirements for the performance of procedures for the chemical measurement of chemical agents, EN482, Brussels, CEN 1994.

Network field inter-comparison exercise

Gradko International Ltd also takes part in the Network Field Inter-comparison Exercise, operated by NETCEN, which complements the WASP scheme in assessing sampling and analytical performance of diffusion tubes under normal operating conditions. This involves the regular exposure of a triplet of tubes at an Automatic Urban Network site (AUN) site. NETCEN have established performance criteria for participating laboratories. Of particular interest is the bias relative to the chemiluminescent analyser that gives an indication of accuracy. In conjunction with this, a measure of precision is determined by comparing the triplet co-located tube measurements. This value is useful for assessing the uncertainty of results due to sampling and analytical techniques. The performance targets can be seen in Table 3.

The Field Inter-comparison Exercise has historically generated the bias and precision results for each laboratory on an annual basis. This has recently been changed to the results being reported on a monthly basis. This enables a full year's inter-comparison against performance criteria.

Gradko International Ltd perform their own blank exposures that serve as a quality control check on the tube preparation procedure**.** All results are blank subtracted before they are issued to the relevant Borough.

Appendix V

Useful air quality links on the LBRuT website

- To see the current air quality levels in the LBRuT and in London. Please follow this link. You can use the postcode option (e.g. TW1 3BZ) to find your nearest monitoring station or go to the list of local authorities.
  www.londonair.org.uk/london/asp/home.asp

- This link will allow you to calculate air quality statistics for each monitoring location. Click on the A.Q. Objectives dot, click on next, choose a site (e.g. Castelnau), choose a year and click on fetch.
  www.londonair.org.uk/london/asp/advstats.asp

- Please use the following link to visits the LBRuT air quality page:
  www.richmond.gov.uk/home/environment/pollution.htm

- To view the LBRuT historical air quality data:
  www.richmond.gov.uk/home/environment/pollution/air_pollution/air_quality/historical_air_quality_monitoring_data.htm

- To view the LBRuT Air Quality Report 2003:
  www.richmond.gov.uk/home/environment/pollution/air_pollution/air_quality_monitoring_report_2003-2.htm

- To view the LBRuT Stage 3 Air Quality Report:
  www.richmond.gov.uk/home/environment/pollution/air_pollution/air_quality_reports/air_quality_third_stage_review_and_assessment.htm

- To view the LBRuT Stage 4 Air Quality Report:
  www.richmond.gov.uk/home/environment/pollution/air_pollution/air_quality_reports/air_quality_fouth_stage_review_and_assessment.htm

- To view the LBRuT Air Quality Action Plan 2002:
  www.richmond.gov.uk/home/environment/pollution/air_pollution/air_quality_reports/air_quality_action_plan-2.htm

- To view the LBRuT Updating and Screening Assessments for 2004 and 2006:
  www.richmond.gov.uk/home/environment/pollution/air_pollution/air_quality_reports/air_quality_update_and_screening_assessments.htm

- To view the LBRuT Progress Reports for 2005 and 2007:
  www.richmond.gov.uk/home/environment/pollution/air_pollution/air_quality_reports/air_quality_progress_reports.htm