



*LONDON BOROUGH OF  
RICHMOND UPON THAMES*

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# **Air Quality Report**

## **2003**

**With data up to 2002**

**Prepared by the Special Projects Team of  
Environment Planning and Review**

## Air Quality Report

2003

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## **1. Summary**

This report includes the results of air pollution monitoring data from the period from 1993 up till November 2002, concentrating in particular on nitrogen dioxide and PM10 particulates.

The long term monitoring results of nitrogen dioxide (NO<sub>2</sub>) show a downward trend, in other words the air quality has been improving at the sites monitored. The diffusion tube results show that whilst some of the busiest road locations do exceed the objective limit for NO<sub>2</sub>, many sites do not.

The mobile monitor has produced results from a number of sites across the Borough. These results are presented in Appendix B, and also in Sections 3 and 6. The mobile monitors for NO<sub>2</sub>, PM10, CO, SO<sub>2</sub> and Ozone. The fixed monitoring site at Bushy Park, Teddington shows a downward trend for NO<sub>2</sub> from 1982 to 2001. Whilst the Borough's own fixed cabin monitoring sites have not been established for long enough to show a trend for NO<sub>2</sub>, the Castelnau site did exceed the 2005 air quality limit in 2001 and 2002 (provisional result).

The dust particle (PM10) sites have again not been established for long enough to show a trend. At Castelnau the results were below the limits.

Benzene levels are well within the limit, but only until the limits moves to a more stringent standard in 2010.

The poly aromatic hydrocarbon (PAH) results do not have a formal limit yet. It is possible that the limit (to be achieved by 2010) may be established as 0.25ng/m<sup>3</sup>. The results over the last year at Castelnau have been about ten times over that limit, although 2010 is quite a long way off.

Although not part of this report, modelling work was carried out to predict air pollution levels in the Borough in the year 2005, taking into account anticipated changes in road traffic composition and volume. The modelling results indicated that air pollution levels in 2005 would exceed the permitted limits for NO<sub>2</sub> and PM10. The monitoring programme will test whether pollution levels do exceed the limits in practice.

## **2. Introduction**

Air quality monitoring in the borough was first established at Bushy Park in Teddington in 1982. Some of the Bushy Park results are included in this report at Figure 5 and Figure 12. The Borough commenced diffusion tube monitoring for NO<sub>2</sub> in 1993, and now additionally monitors for Benzene and poly aromatic hydrocarbons (PAH). Monitoring with a mobile laboratory commenced in 1995. Two fixed monitoring sites have now been established, one by the roadside in Castelnau Barnes, and one in a background location at the Wetlands Centre in Barnes. The interest in Barnes is because of the higher background levels that come from central London, making Barnes a key place to test for pollution reductions

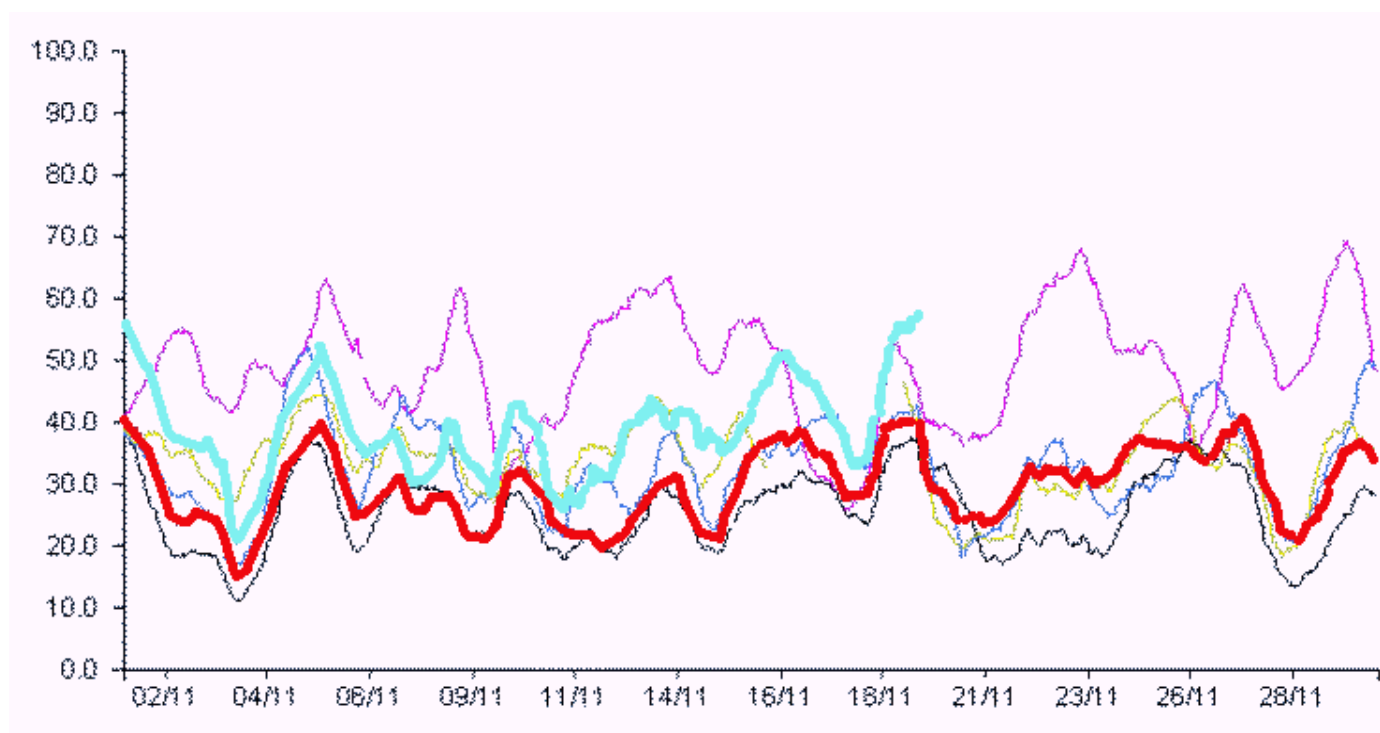
### 3 London NO2 comparison:

The graph below shows just a few of the continuous results, taken from Castelnau in Barnes and the mobile unit, when it was located in George Street, Richmond, in November 2002. The results indicate that NO2 concentrations within the Borough are similar to other sites across London, with higher concentrations in George Street than in Castelnau. The highest concentrations shown are from Marylebone Road, which has very high traffic flow rates.

#### Graph 1

##### NO2 levels from across London, November 2002

The 'one hour' limit for NO2 is 105ppb. It can be seen that none of the sites reached the limit during November 2002



Key: → Site 1 → Castelnau Richmond → Site 2 → George Street, Richmond → Site 3 → Marylebone Road London  
→ Site 4 → Heathrow Airport → Site 5 → High Street Wandsworth → Site 6 → Wallington Sutton

#### **4. Nitrogen dioxide [NO<sub>2</sub>] Diffusion Tube monitoring**

The NO<sub>2</sub> diffusion tube survey has been running for a number of years within the Borough. There are 4 sites that have been monitored continuously since 1993 as part of a nation-wide survey. The 4 sites within the borough are classified by their location; R for Roadside, I for Intermediate and B for Background. Diffusion tubes are a relatively cheap method for measuring air quality, when compared with analysers that measure air quality every few seconds. However, as the tubes have a lower accuracy, we take an interest in any results just below 21ppb as well, as they would also indicate potential 'hot spots'.

The Government has set Air Quality Objectives for all local authorities to achieve. The table of the Objectives can be seen in Appendix A (linked to Air Quality Management magazine at <http://www.air-quality-management.co.uk/2002pollutantwallchart.pdf> ). The aim is that by 31 December 2005 there will be no sites with NO<sub>2</sub> above 21 parts per billion [ppb]. Click here for a map showing the areas of the borough expected to still exceed the limit in 2005.\*\*\*.

The Roadside site is located on the Civic Centre building in York Street Twickenham. The Intermediate site was located on the Police Station in Red Lion Street, Richmond, but it was closed in January 2001, when the monitor was moved to George Street, Richmond. This was because the national survey organisers requested an additional Roadside location. The two Background sites are located in Mortlake and Teddington. As their classification implies, both sites are away from major roads.

The long term monitoring of these sites gives an indication of the trend in the NO<sub>2</sub> levels in these areas. The graph [Figure 1] shows how the general level of NO<sub>2</sub> has been falling, i.e. the air quality has improved at each site. The move of the monitor from Red Lion Street to George Street in Richmond has resulted in capturing the higher Roadside NO<sub>2</sub> concentration there. It is too early to tell whether George Street will follow the same downward trend.

In April 2000 we commenced a survey of 30 sites across the borough, to identify hot spots, where levels of NO<sub>2</sub> were not likely to meet the standards required by the year 2005. The majority of the sites were located on major roads, although some were on side streets. The graph [Figure 2] shows the 2000/01 annual averages for the 30 sites, including the 4 long-term sites.

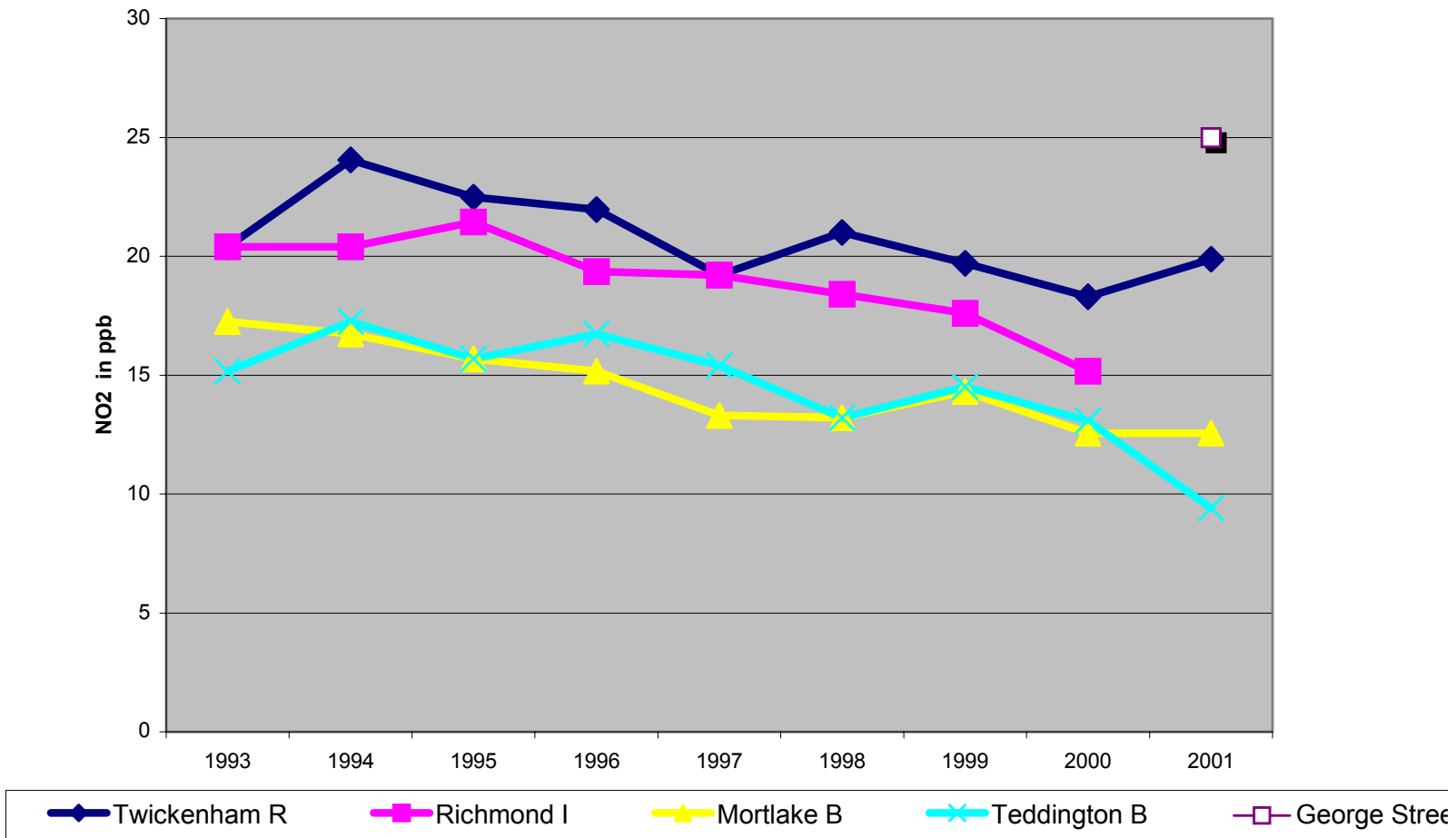
The survey has now been expanded to 56 sites, located throughout the borough at the 'hot spot' sites. These sites were set up in July 2001. The results will be used in the 'review and assessment' process required for the Air Quality Action Plan, to ensure that the air quality improves across the Borough. The results from the 56 sites are given, spread over 2 graphs [Figure 3 and 3a], to show an annual average for the sites.

Some additional work is needed on the diffusion tube results as it has been discovered that (across the country) they have been under reading, when compared with the continuous monitors. The under reading has been about 25%, so all the results shown here will end up greater. Exactly how much greater will depend on some calculations based on the results of the other monitors nearby. These corrections will be made in the near future (May 2003)

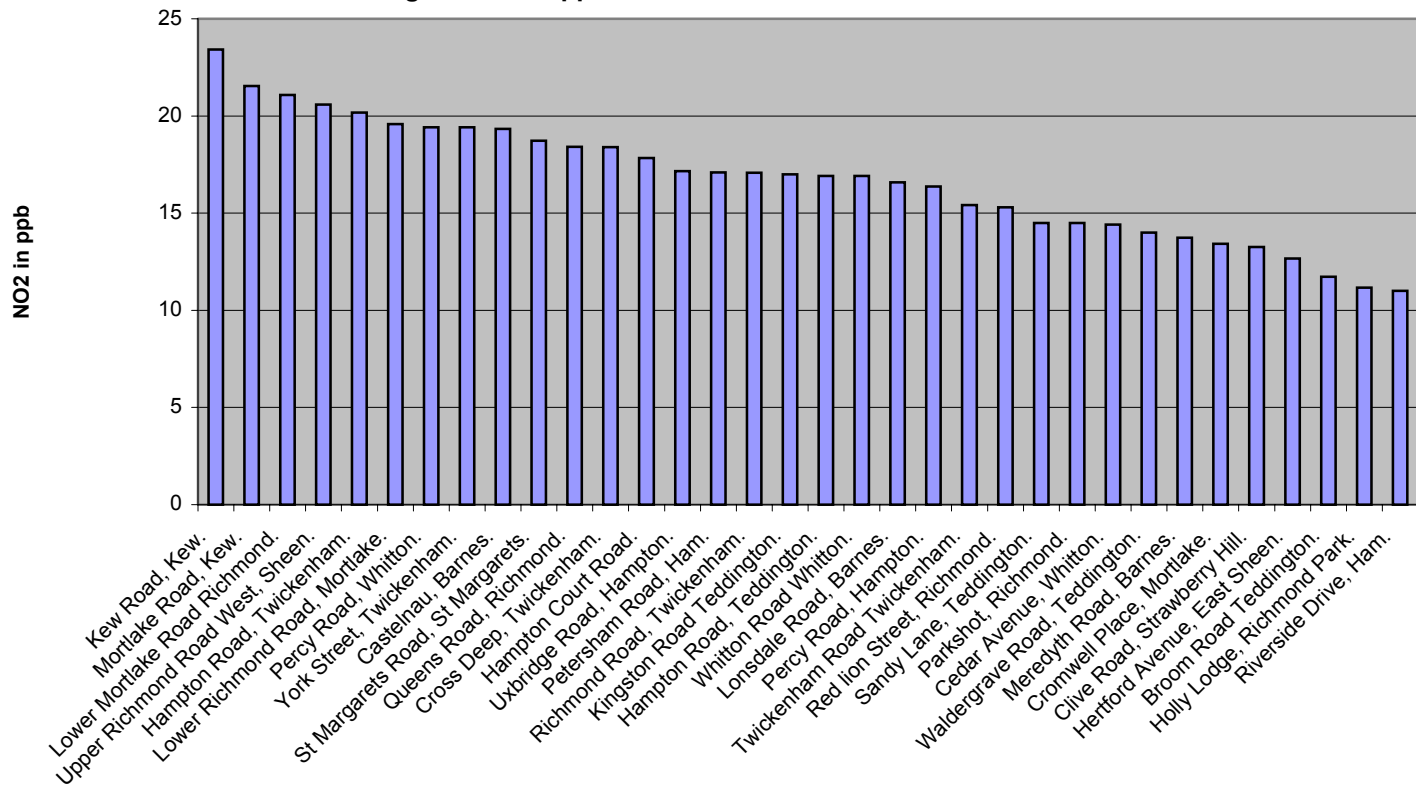
**Figure 1**

Nitrogen dioxide diffusion tube, national survey, annual averages 1993 - 2001

The annual average limit is 21ppb



**Figure 2**  
**30 site NO2 diffusion tube survey, annual averages for 2000/2001**  
**The annual average limit is 21ppb**



**Figure 3**

**First 28 sites from 56 site nitrogen dioxide diffusion tube survey, 12 month average July 2001 to July 2002 The annual average limit is 21ppb. The Castelnau continuous monitor recorded 23ppb for 2002**

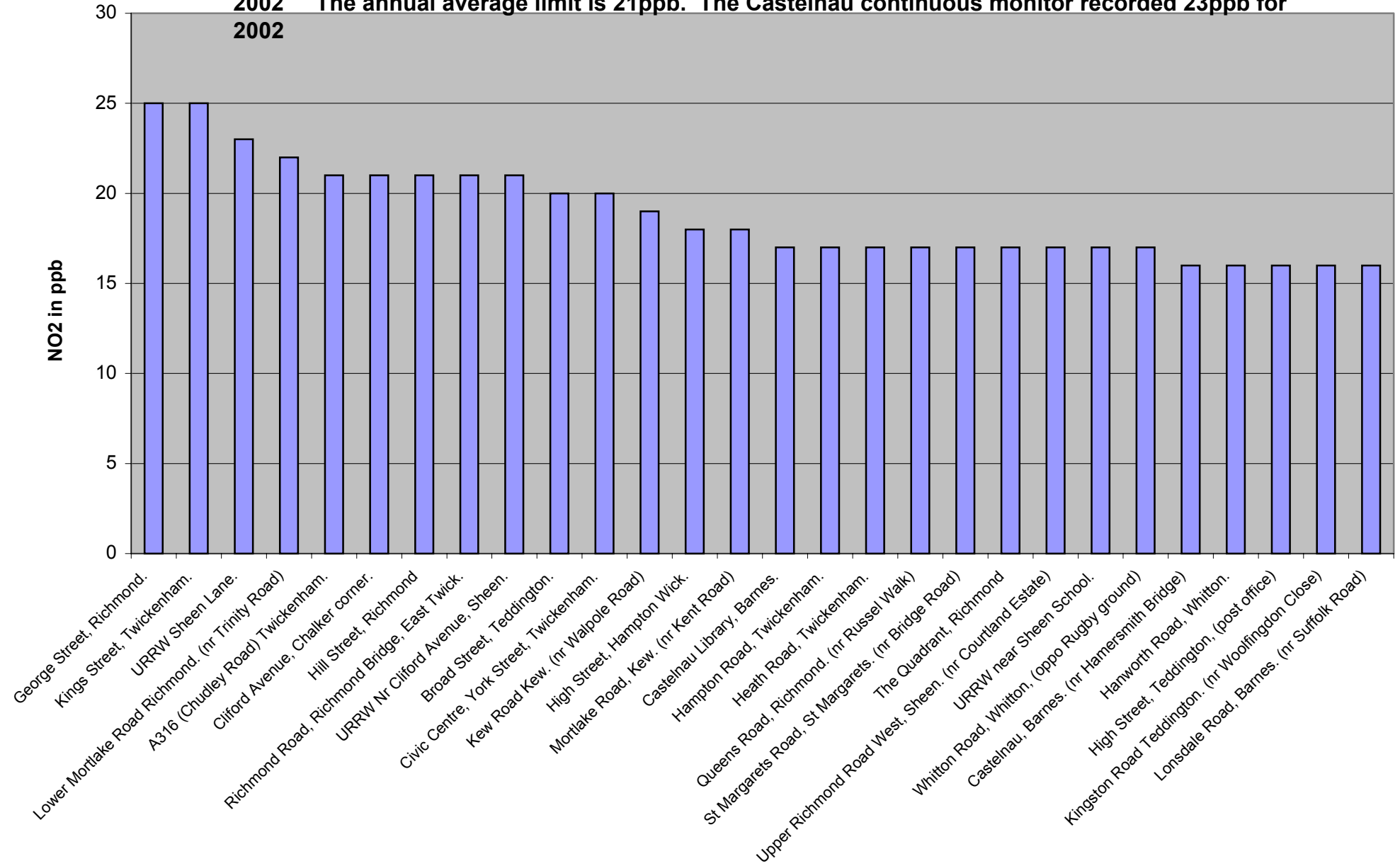
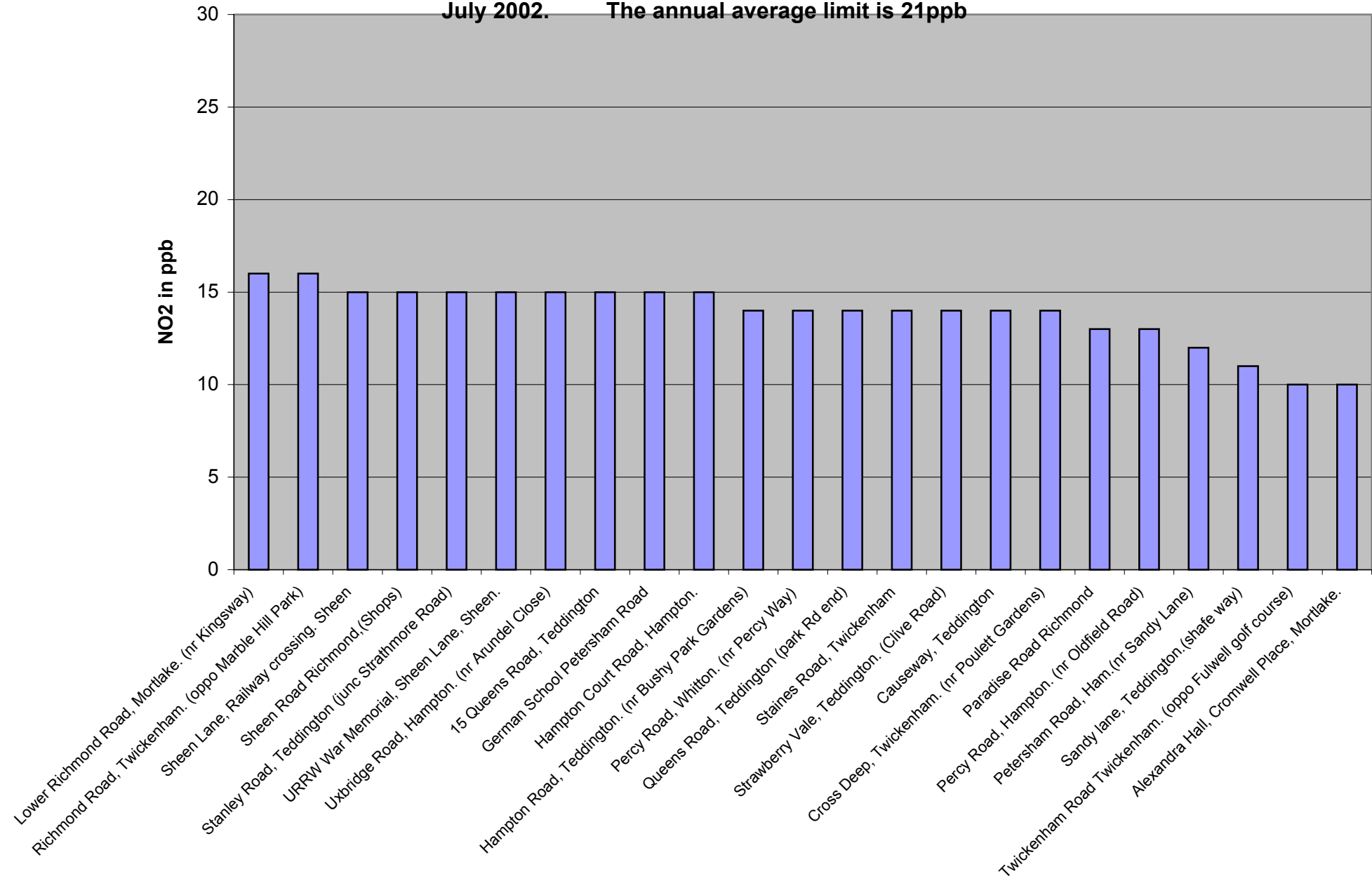


Figure 3a

Second 28 sites from 56 site nitrogen dioxide diffusion tube survey, 12 month average July 2001 to July 2002. The annual average limit is 21ppb





## 5. Continuous monitoring analysers

There are 2 static monitoring units continuously monitoring the pollution levels in the borough. They are both located in Barnes. One is on Castelnau outside the Library and the other is located in the Wetlands centre. At both sites Nitrogen dioxide [NO<sub>2</sub>] and PM<sub>10</sub>s [Particulate dust of less than 10 microns in size] are monitored. The Wetlands site also monitors Ozone [O<sub>3</sub>].



We also have a mobile air quality monitoring unit. This unit is moved to different location throughout the borough. The unit monitors NO<sub>2</sub>, PM<sub>10</sub>s, and O<sub>3</sub>, Sulphur dioxide [SO<sub>2</sub>] and Carbon monoxide [CO].



The static sites, for continuous monitoring, were located as part of the review and assessment of air quality, to monitor the effectiveness of measures both in the Borough of Richmond and of measures carried out elsewhere, but affecting air quality in the Borough. This review process is required by the Government. The Borough has now completed a 4 stage assessment and an Air Quality Action Plan.

Data from monitoring at both the static sites and from the mobile air quality monitoring unit can be seen on the Council's web site..

Originally we had 2 Mobile Air quality monitoring units. However, after setting up the 2 static monitoring sites, it was decided to combine the 2 mobiles in to one. This gave us the opportunity to carry out additional monitoring of NO<sub>2</sub> at a low level (to check at a child's push chair height). Unfortunately, due to the mobile being involved in a car accident the unit was out of action for some time but is now operational again and can be found via the web site. Some of the data from the mobile is discussed below:-.

## **6. NO<sub>2</sub> mobile unit 'high/low' monitoring results.**

We have been carrying out measurements for nitrogen dioxide (NO<sub>2</sub>) at both the standard cabin roof height and at pushchair height, using the Council's air pollution mobile monitor. These two heights were at 3m and 0.9m above the ground.

The monitoring was carried out next to the kerb at a site near the station in St Margaret's. Consequently it was very close to road traffic, and was therefore able to pick up rush hour and the long term pollution levels that would be relevant to people using the pavement or in the nearby houses i.e. with facades close to the pavement.

The results have confirmed that the pushchair height NO<sub>2</sub> was more often at a higher concentration than that found at the standard level monitor, by 16% on average; i.e. an average concentration of 23.0 ppb at the standard level against 26.8 ppb at pushchair height. These concentrations cannot be compared directly with the 'annual average limit' of 21 ppb as the monitoring was only carried out for 6 months. None of the results, even at pushchair level, exceeded the 'one hour limit' of 105 ppb, as the maximum hour recorded at the standard level was 68.1ppb and at pushchair it was 79.5ppb. Both of these fall within the same Air Quality Band of 'Low' (Level 2).

A significant point may be that the greater the concentration of NO<sub>2</sub> at the standard level, the greater was the increase at the pushchair level. So at low concentrations e.g. at night the two monitors gave similar results. However, during rush hour periods, when both monitors recorded increased pollution levels, the greatest concentrations were at the pushchair height.

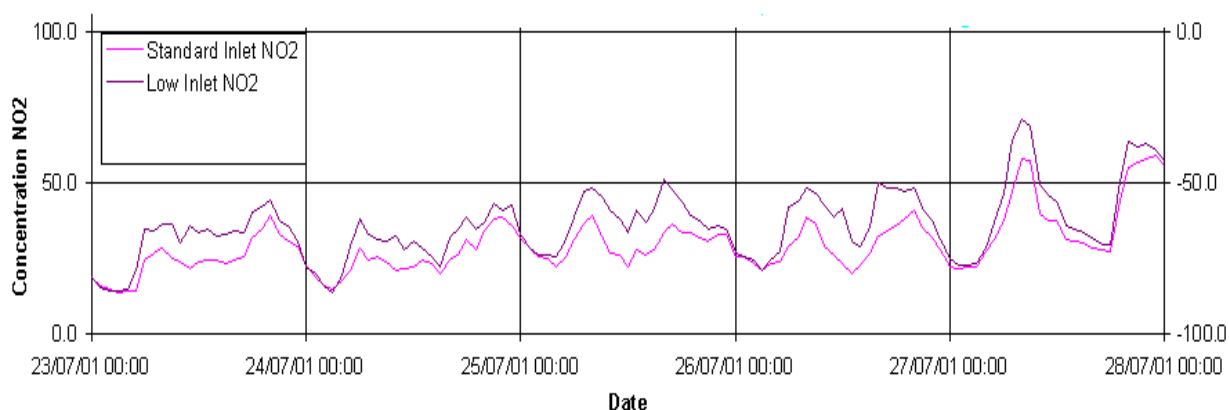
It may be useful to consider the relevance of the data in terms of the duty on the Borough to develop an Air Quality Action Plan. The 'hot spots' were identified using modelling which was aimed nearer to adult height, using the standard monitoring height of 3m. Using modelling, quite a few 'hot spots' locations were identified in the Borough. These 'hot spots' were based on the annual average for NO<sub>2</sub>, so the results would not be relevant to children in pushchairs, as they would not be on the pavement for a whole year. If we consider the one hour standard of 105 ppb, it must be true that the limit is more likely to be breached at pushchair height than at standard height. However, our monitoring did not find an instance where that limit was breached. Only 2 or 3 places in London are expected to breach the limit at the

standard monitoring height. It is not known how many sites might breach it at pushchair level.

In order to take this further, we need to continue monitoring at other sites, to see if pushchair level NO<sub>2</sub> breaches the 'one hour' limit. In addition, we would need to assess whether it was likely that a child would be in that or a similar location for an hour or more. Pavement cafés are one example where one might stay for an hour or more, near to traffic. Interestingly, in that type of location, adults would also have their heads at a similar level as a pushchair, when sitting.

A sample of the 'high/low' data is shown below (Figure 4). The two lines compare the higher and lower level NO<sub>2</sub> concentrations during a period in July. The full survey was from February to August and thus covered both winter and summer, school days and holidays.

**Figure 4**  
**Monitoring of NO<sub>2</sub> at both high and low level.**



Monitoring results for NO<sub>2</sub> (upper) and NO<sub>2</sub> (lower) values during July 2001

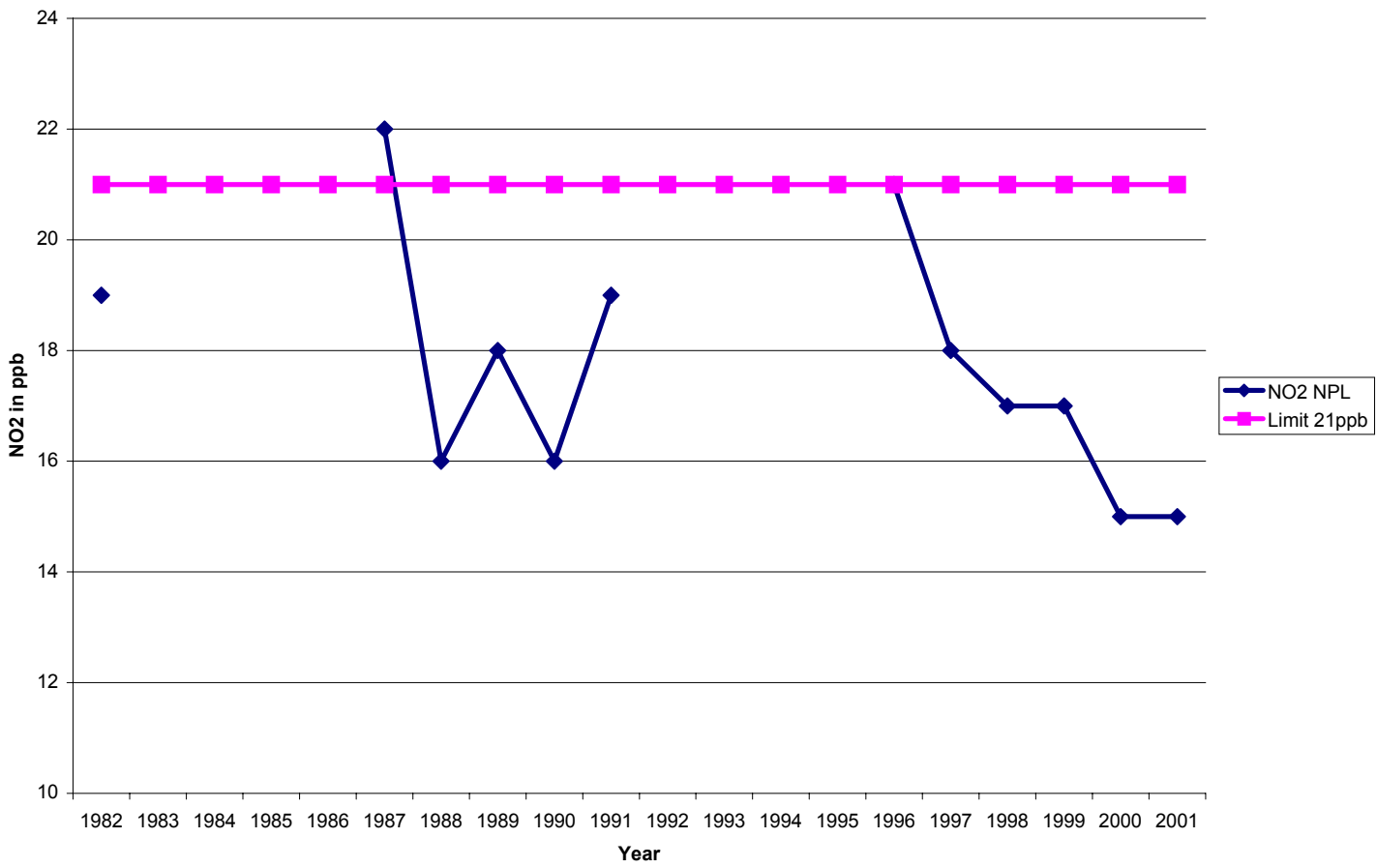
## **7. NO<sub>2</sub> in Teddington - Sustainability Indicators 1982-2001**

The air pollution indicators used by the Borough are based on the number of days per year that air pollution was recorded as moderate (or worse) per monitoring site. The monitoring site in the Borough, which has the longest data set, is the Bushy Park site in Teddington. A review of the NO<sub>2</sub> indicator shows that since 1997 there have been no days that were ranked as 'moderate' (or worse) for either nitrogen dioxide (NO<sub>2</sub>) or sulphur dioxide (SO<sub>2</sub>).

To give a clearer picture of what is happening with NO<sub>2</sub>, we need to look at the annual average results below (Figure 5). These show that the levels of NO<sub>2</sub> at Teddington (away from main roads) have been falling. This is consistent with the results found by the Council's long-term diffusion tube monitoring programme.

Figure 5

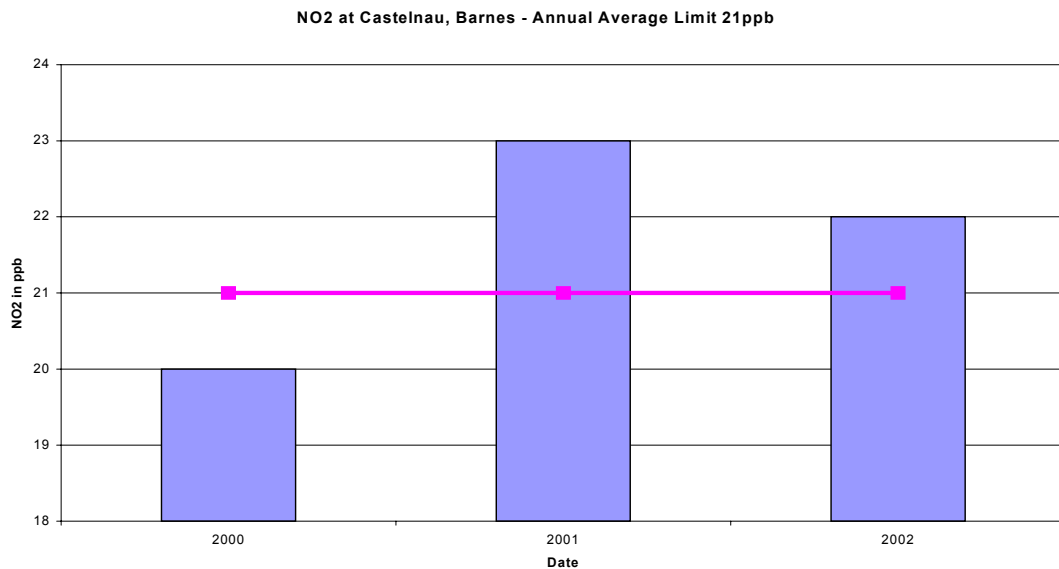
NO2 at Teddington (Bushy Park), annual averages



## 8. NO2 in Castelnau, Barnes, 2000 - 2002

The NO2 results (provisional) from the Castelnau site (Figure 6,) indicate that the NO2 concentrations were over the limit set for 2005. The aim is to reduce pollution levels below the limit by the year 2005. The results appear to agree with the modelling results for 2005, which show that the limit will continue to be breached, if pollution levels do not reduce.

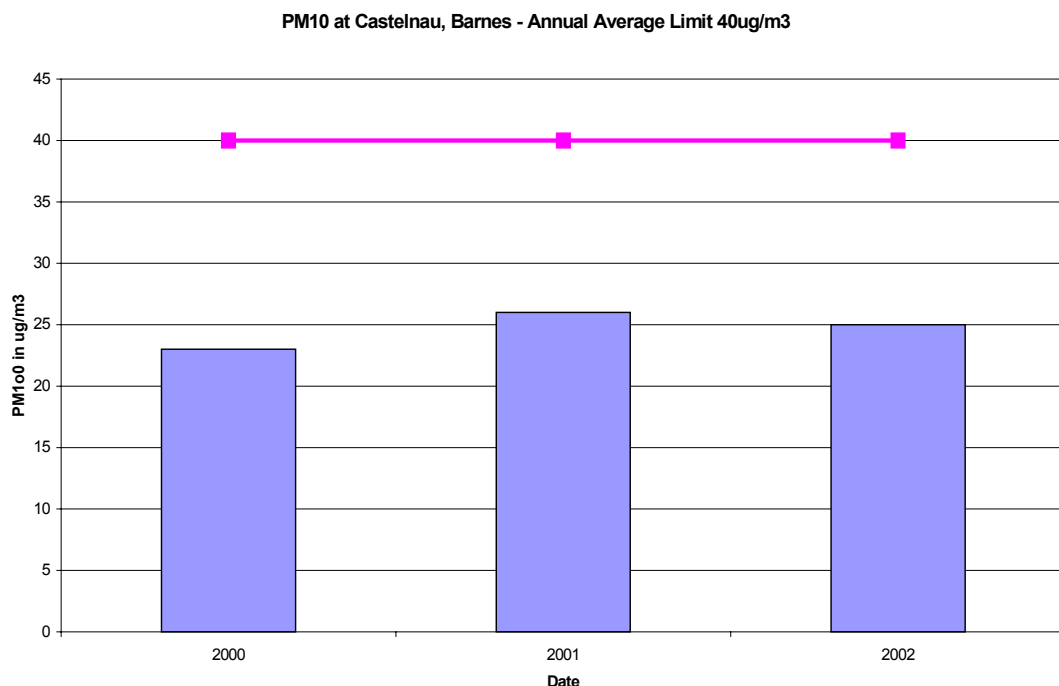
**Figure 6**



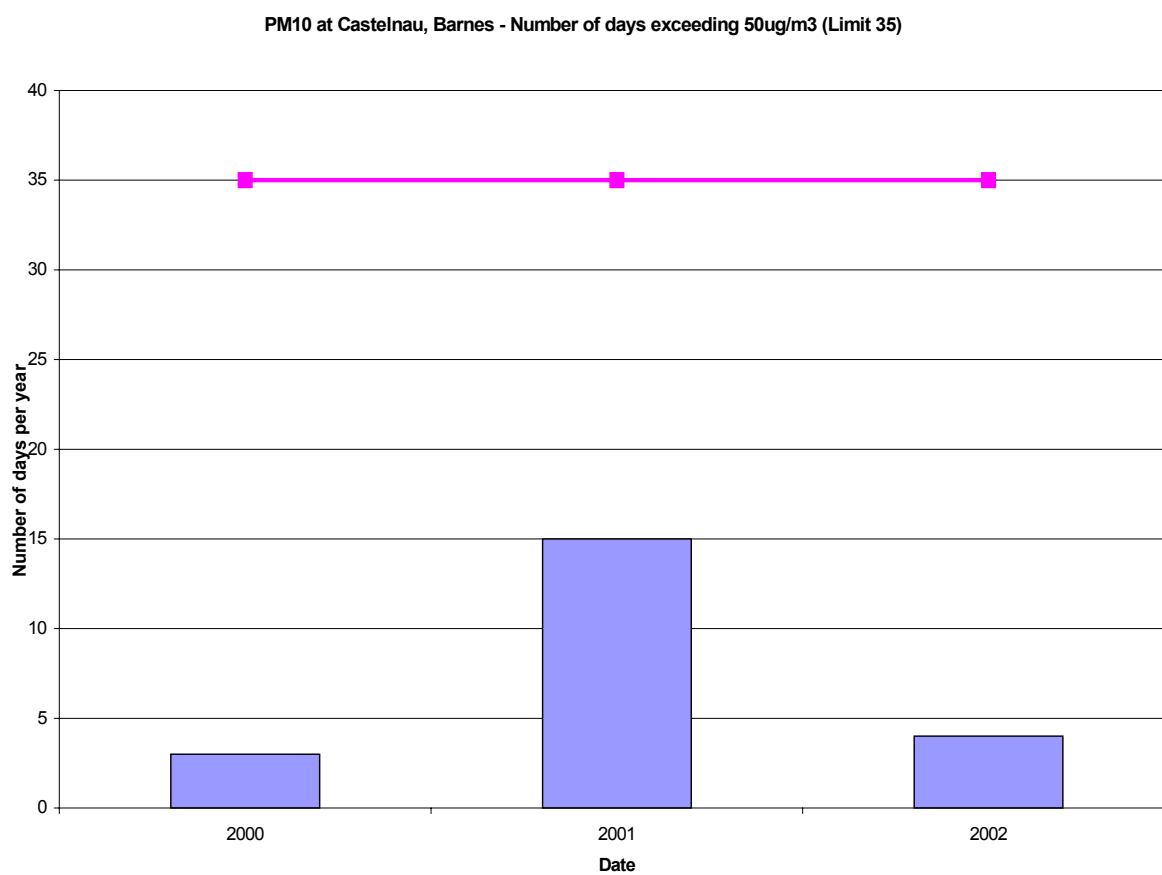
## 9. PM10 in Castelnau, Barnes, 2000 - 2002

Figures 7 and 8 show the monitoring results for PM10 particulates. From the two ways of assessing the results, we can see that the results are below the limits (to be achieved by 2004) both as an annual average and also for the number of days permitted to be over 50ug/m3.

**Figure 7**



**Figure 8**



## **10. Benzene Monitoring**

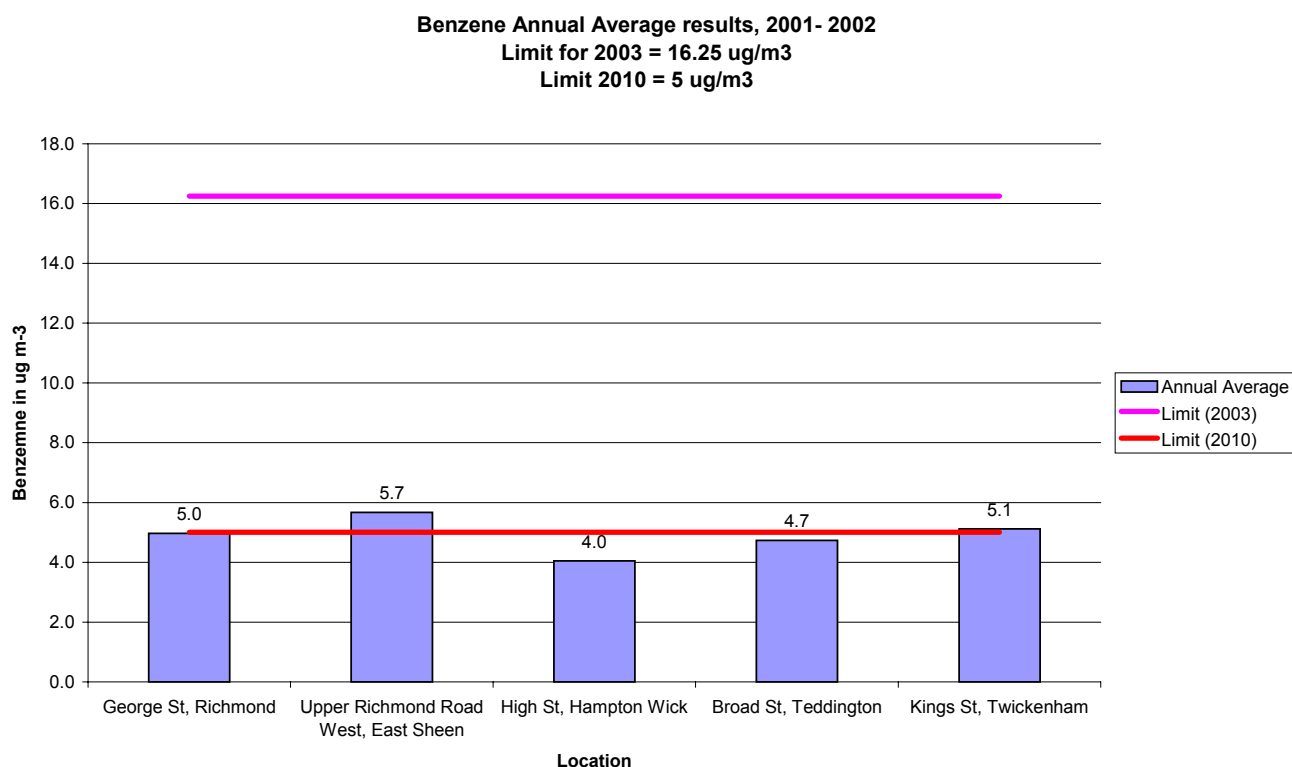
Benzene monitoring was undertaken at 5 locations within the borough starting in July 2001. The sampling was undertaken by Casella Stanger Consultants as part of the 'The London Wide Environment Programme'.

Benzene tubes are 9cm small tubes with an absorbent material, which has an affinity to benzene, and sealed at both ends with protective caps. On exposure, one of the caps is removed and replaced with a diffusion cap, this allows the air to diffuse at a constant rate into the tube. The samplers then operate on the principle of molecular diffusion. The tubes are exposed for 2 weeks.

The following graph (figure 9) represents the average of benzene concentration from July 2001 to June 2002 and is an illustration of the annual average concentrations in the borough at all five monitoring points.

The maximum annual average concentration was 5.7 ug/m<sup>3</sup> at the site at Upper Richmond Road West, while the lowest value of 4.0 ug/m<sup>3</sup> was recorded at the site at High St, Hampton Wick. The current air quality objective for benzene (by 2003) is 16.25 ug/m<sup>3</sup>, therefore as indicated in the graph below the concentrations currently being measured in the borough are within this standard. However, some sites currently fail the more stringent limit of 5 ug/m<sup>3</sup> set for 2010.

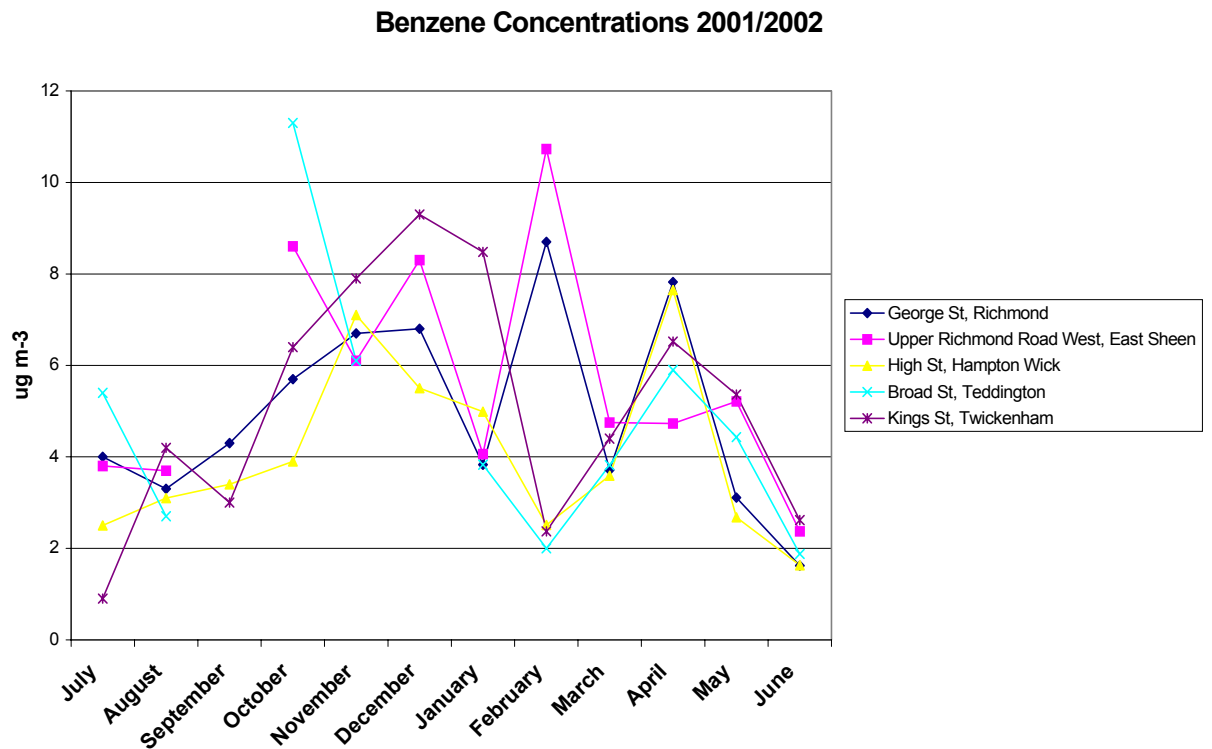
**Figure 9**



### **10.1 Temporal Variation of Benzene**

The graph below (figure 10) illustrates that there was an increase in concentration at all sites from October to December before dropping in January 2002. Between January and February benzene concentrations for both George St, Richmond and Upper Richmond Road West, East Sheen increase and peaked in February while levels at the other locations declined. Around March the concentrations at all the sites once again follow the same pattern by increasing around April before decreasing in May and June. A maximum peak level of 11.3 ug/m<sup>3</sup> was recorded in October 2001 at Broad Street, Teddington. The monthly levels cannot be compared with the proposed limits as the limits are set for an annual average.

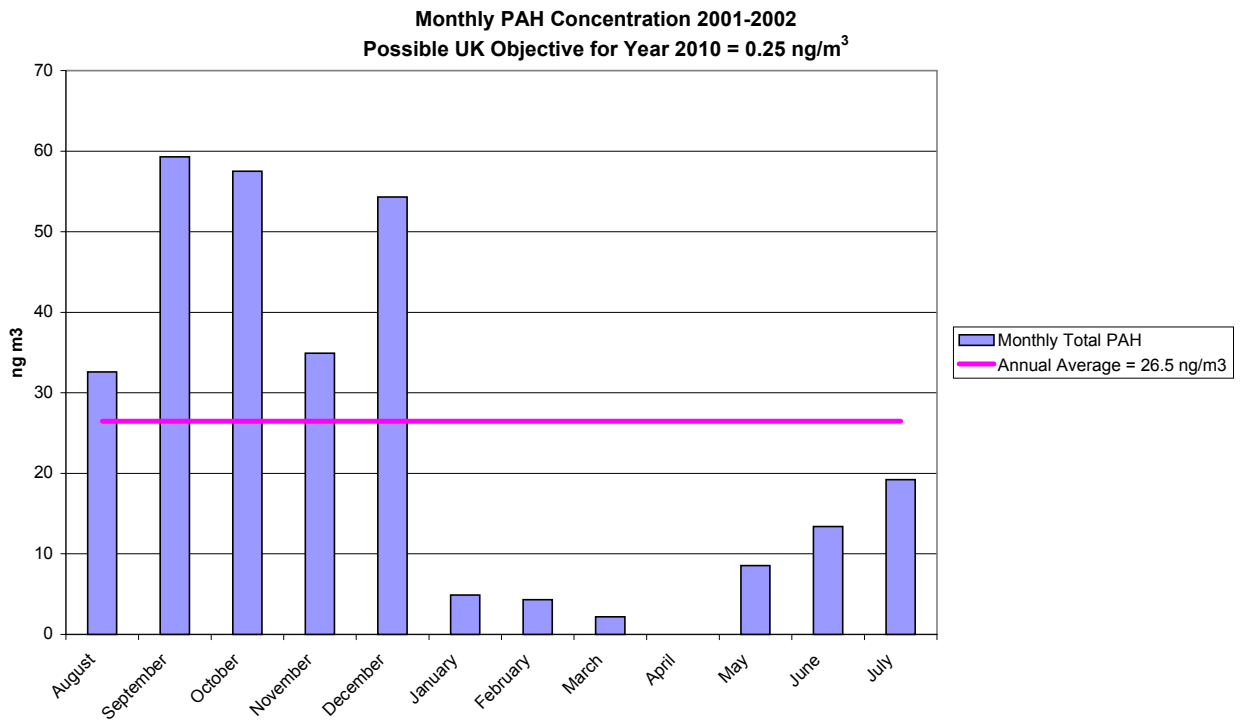
Figure 10



### 11. Poly Aromatic Hydrocarbon (PAH) monitoring 2001 - 2002

PAH monitoring has been carried out at the Castelnau site in Barnes. The method of monitoring changed in April 2002, in line with similar monitoring being carried out at other sites across the country. From the chart below it is immediately obvious that concentrations were much lower between January and July 2002 than they were before January. It is not known yet how much of this is to do with the change of method, as the results for January to March were low, but before the change in method. The annual average (covering both method types) has been plotted below. It shows the concentration in Barnes was about ten times over the 'possible' UK objective, to be achieved by the year 2010. Given the change in method and awaiting an actual standard, the PAH situation is still fluid.

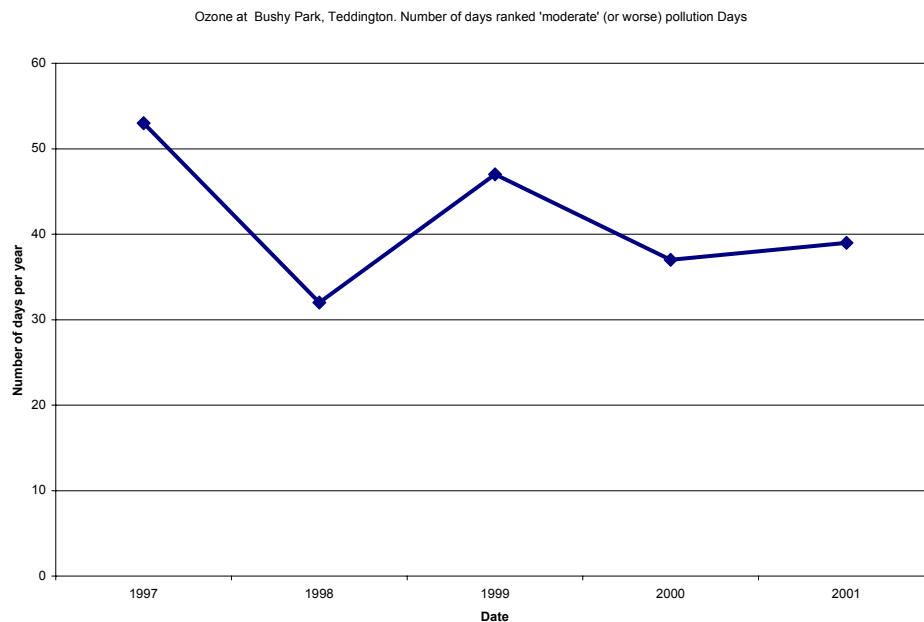
**Figure 11**



## **12. Ozone at Bushy Park**

The long term monitoring of ozone at Teddington (Bushy Park, Figure 12 below) shows a downward trend, but still with many days of 'moderate' (or worse). Ozone tends to be higher in background locations as there are lower concentrations of other pollutants to react with it and remove it. However, six months of monitoring by the roadside at St Margaret's in 2001 recorded 12 days when ozone was 'moderate' (or worse). Ozone is produced by pollutants at quite a distance away from the monitoring site, and is therefore a product of other people's pollution.

**Figure 12**



### **13. Conclusions**

This report includes the results of air pollution monitoring data for the period from 1993 up till November 2002 (with some back to 1982).

Although the long-term monitoring results of nitrogen dioxide (NO<sub>2</sub>) show a downward trend, it is anticipated that there will still be sites across the Borough which will exceed the objective limit in 2005.

The particle limit for 2004 is not breached at present, but does exceed the tighter limit for 2010.

It is still early days for the PAH and Benzene monitoring. If the draft limits are brought in, it will be difficult to comply with them. Modelling will be needed to predict future concentrations against future road traffic fleet mixes and road traffic flow rates.

### **14. Further Reports**

Further monitoring results from specific mobile locations are available in Appendix B.