Third Round Updating and Screening Assessment for Brent Council

May 2006

Acknowledgements

The assistance of Jennifer Barrett and colleagues from Brent Council is gratefully acknowledged in the production of this report.

Executive Summary

The role of the local authority review and assessment process is to identify areas where it is considered that the government's air quality objectives will be exceeded. The Brent Council has previously undertaken the earlier rounds of review and assessment (R&A) of local air quality management and identified areas where the objectives are exceeded and where there is relevant public exposure. As a consequence, it designated part of its area an Air Quality Management Areas (AQMAs) for the annual mean nitrogen dioxide objective and the daily mean PM_{10} objective.

This report concerns the third round Updating and Screening Assessment. Local authorities are required to review and assess air quality against the objectives in the Air Quality Regulations 2000 and the amendment regulations as part of a rolling three-year cycle ending in 2010. The air quality objectives to be assessed are for the following seven pollutants: carbon monoxide, benzene, 1,3-butadiene, lead, nitrogen dioxide, sulphur dioxide and particles (PM_{10}). This report provides a new assessment to identify those matters that have changed since the last review and assessment, and which might lead to a risk of the objective being exceeded.

The report follows the prescribed guidance given in technical guidance LAQM. TG (03) and the additional advice provided by DEFRA (as Frequently Asked Questions) for the purposes of this round of R&A. This includes guidance on the use of background pollutant concentrations, monitoring results, industrial sources, and road traffic. The guidance also requires both a phased approach and that local authorities only undertake a level of assessment that is commensurate with the risk of an air quality objective being exceeded.

The conclusions of the third round Updating and Screening Assessment are as follows:

For carbon monoxide, benzene, 1,3-butadiene, lead and sulphur dioxide there is not a significant risk of exceeding the objectives in the Council's area.

For nitrogen dioxide (NO_2) the Council has previously designated its area an AQMA. Recent bias corrected diffusion tubes results and continuous monitoring results from roadsides in the Borough confirm that concentrations continue to exceed the annual mean objective where there is relevant exposure. Additional monitoring in the Council's area indicates that the annual mean objective is exceeded outside of the AQMA.

For PM_{10} (for 2004) analysis of rolling trends based on monitoring in the Borough indicates that concentrations are not reducing from those monitored in 2001. Furthermore additional monitoring in Neasden has confirmed high concentrations of PM_{10} from sources not previously considered by the Council.

For PM_{10} (for 2010 only) there is a risk of the objectives being exceeded across parts of the Borough. The Council however is not required to undertake actions at this time in respect of this finding, other than to note it for longer term planning purposes.

Based on the above findings there is a need for the Council to undertake a Detailed Assessment for both NO_2 and PM_{10}.

The Council is therefore recommended to undertake the following action:

1. Undertake consultation on the findings arising from this report with the statutory and other consultees as required.

2. Confirm relevant exposure at the diffusion monitoring sites identified earlier and if this is confirmed to undertake a Detailed Assessment for NO_2 with a view to amending its AQMA.

3. Undertake a Detailed Assessment close to the Brent 5 monitoring site in Neasden where there relevant exposure to determine the extent and source of PM_{10} in this area.

This page has been left blank intentionally.

CONTENTS

List of Figures

List of Tables

1. Introduction

This report is the 2006 Updating and Screening Assessment of air quality for the Brent Council. The purpose of the report is to fulfil the Council's initial obligation under the third round review and assessment of air quality. In so doing it will determine whether or not there is a risk that an air quality objective will be exceeded in the Borough and therefore whether or not the Council needs to undertake a Detailed Assessment of air quality. In addition the report provides an indication as to the need for amending or revoking its existing air quality management area (AQMA).

1.1 Background

Part IV of the Environment Act 1995 introduced new responsibilities to both national and local government throughout the UK.

These responsibilities include the requirement upon the national government and devolved administrations to develop an Air Quality Strategy (AQS) for England, Wales, Scotland and Northern Ireland (DEFRA, 2000). The overall purpose of the AQS is to seek improvements in air quality for the benefit of public health. The first AQS was produced in 1997; it was amended in 2000 and is currently undergoing a further revision. A consultation on the latest review has just been released.

Local air quality management (LAQM) was also introduced by the Environment Act 1995. It requires local authorities to periodically review and assess air quality across their areas. The AQS confirms that LAQM provides a major component of the government's plan for air quality improvement across the UK.

Air quality objectives have been set for those air pollutants deemed to be of most concern and relevance by the AQS. Seven of these pollutants are included under the LAQM regime and regulations for these were introduced. The air quality objectives for the relevant pollutants are given in Table 1. Additional objectives have been set for ozone and polyaromatic hydrocarbons (PAHs), although these have been deemed the responsibility of national government and therefore not applicable to the LAQM process.

The objectives are all based on health-based standards using current scientific advice taking into account the likely cost and benefits, as well as feasibility and practicality in meeting the objectives. The objectives are mostly in line with limit values prescribed by EU Directive, although additional objectives (including bringing forward the date for compliance) have been included for some pollutants.

1.2 Third Round Review and Assessment

This report concerns the third round of LAQM review and assessment (R&A), which is part of a three yearly cycle for review and assessment ending in 2010. It follows the prescribed guidance given in Technical Guidance LAQM. TG (03) (DEFRA, 2003a) and specific amendments released by DEFRA as Frequently Asked Questions in January 2006, supported where necessary by new LAQM Tools. The guidance is designed to help local authorities undertake their duties under the Environment Act 1995 to review and assess air quality in their area from time to time.

It is recognised that whilst most of the original TG03 guidance is still relevant, some parts required revision to reflect the most up-to-date understanding, and to draw upon experience gained during the second round of Review and Assessment.

Updated guidance has been prepared to cover the following issues:

- Background pollution maps and future year calculation tools
- Emissions of sulphur dioxide from steam locomotives
- Emissions of sulphur dioxide from shipping
- Emissions of PM_{10} from poultry farms

- Data ratification procedures
- NO_x: NO_2 relationships

In addition, the Updating and Screening Assessment (USA) checklists provided in TG03 have been revised and re-issued to take account of all necessary changes.

The guidance requires a phased approach, as with the previous guidance. This requires local authorities to undertake a level of assessment that is commensurate with the risk of an air quality objective being exceeded. It is considered that not every authority will need to proceed beyond the first step of the third round of review and assessment.

The findings from the USA determine the need for the Council to undertake the next step i.e. a Detailed Assessment and then potentially progressing to the declaration/ revocation/ amendment of an AQMA.

1.3 Progress with Local Air Quality Management – Brent Council

As apart of its Local Air Quality Management (LAQM) responsibilities, Brent Council ("the Council") completed the first round review and assessment (R&A) of air quality (see the individual reports prepared between 1999 and 2003). These reports presented a staged approach whereby the seven air pollutants in the Government's Air Quality Strategy related to LAQM, were assessed and screened within the Council's area.

Benzene, 1,3 butadiene, carbon monoxide, lead and sulphur dioxide (SO_2) were considered and found not likely to lead to the air quality objectives being exceeded. As a result no further action was required.

The whole of the Council's area was assessed for the NO_2 annual mean objective and 24 hour mean PM_{10} objective. Areas across the Borough were found to exceed the objectives, mainly relating to roads. As a consequence an Air Quality Management Area (AQMA) was designated for both pollutants for part of the Borough.

The AQMA includes the entire area south of the North Circular Road and all housing, schools and hospitals along the North Circular Road, Harrow Road, Bridgewater Road, Ealing Road, Watford Road, Kenton Road, Kingsbury Road, Edgware Road, Blackbird Hill, Forty Lane, Forty Avenue and East Lane.

The Council has since undertaken the second round of review and assessment. There was no change in the findings from the USA and thus the Council maintained its AQMA.

The 2005 Progress Report (Brent, 2006) showed that the Government's air quality objectives are being exceeded widely at locations with relevant public exposure. The Council will therefore maintain its AQMA for these two pollutants.

The Council is also still implementing its Air Quality Action Plan.

1.4 Updating Screening and Assessment – important considerations

As with the second round USA, relevant considerations and sources of data include the following:

Monitoring Data

The Council's monitoring of air quality in its area provides an important source of information for understanding air quality in its area. This benefit can be further enhanced if the monitoring is undertaken as part of a wider e.g. national or regional network. It is however important to ensure that there is confidence in the data being produced and used. Hence QA/QC issues need to have been considered and the data produced also need to be properly validated and ratified.

Background Pollutant Concentrations

These are produced nationally for all local authorities in the UK and provide the estimated background annual mean air pollutant concentrations at a 1 km x 1 km grid resolution for 2004 for NO_x, NO_2, PM_{10}, PM_{10} secondary concentrations, with projected concentrations also available for NO_x (2005, 2010), NO_2 (2005, 2010), PM_{10} (2005, 2010). The data are available from http://www.airquality.co.uk/archive/laqm/tools.php?tool=background04
The methods to estimate concentrations in other years use Year Adjustment Factors, which are designed to represent typical trends.

Industrial Sources

Both the Environment Agency and the Council regulate industrial sources under the Pollution Prevention and Control Act 1999 and Environmental Protection Act 1990. The Environment Agency is responsible for the largest industrial processes (IPPC/ Part A processes), whilst the Council is mainly responsible for smaller Part B and A2 processes. Those small industrial processes that fall outside of Part B/A2 Process control can also of interest to LAQM. Details of the processes and installations are available from the Council's Public Register (see tables in the Appendix). The only Part A process in the area is E.ON UK Ltd, which is a combustion process. Emissions from the Environment Agency's Pollution Inventory indicate that emissions have not changed from this site since the last USA. There are no Part A2 installations in the Borough. There is however 42 Part B processes, including 24 petrol stations. None of these are considered to be important for the purposes of this USA.

Road Traffic

Updated details of road traffic movements across the Borough have been obtained from the London Atmospheric Emissions Inventory 2003, which has recently been produced by the GLA.

1.5 Relevant exposure

The objectives relate to public exposure to the pollutants. More specifically any areas that may exceed the objectives should relate to " the quality of air at locations which are situated outside of buildings or other man made structures above or below ground, and where members of the public are regularly present" (from the Air Quality regulations). TG03 advises further that the assessment should focus on those locations where members of the public are likely to be regularly present and are likely to be exposed over the period of the objective.

Table 1 Air quality objectives (from Air Quality Regulations 2000 and Amendment Regulations 2002)

Pollutant	Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 μg m^{-3}	Running Annual Mean	31 Dec 2003
	5 μg m^{-3}	Annual Mean	31 Dec 2010
1, 3 Butadiene	2.25 μg m^{-3}	Running Annual Mean	31 Dec 2003
Carbon Monoxide	10 mg m^{-3}	Daily Maximum Running 8 hour mean	31 Dec 2003
Lead	0.5 μg m^{-3}	Annual Mean	31 Dec 2003
	0.25 μg m^{-3}	Annual Mean	31 Dec 2008
Nitrogen Dioxide (provisional)	200 μg m^{-3} not to be exceeded more than 18 times a year	1 hour mean	31 Dec 2005
	40 μg m^{-3}	Annual Mean	31 Dec 2005
Particles (PM_{10})	50 μg m^{-3} not to be exceeded more than 35 times a year	24 hour mean	31 Dec 2004
	40 μg m^{-3}	Annual Mean	31 Dec 2004
Sulphur Dioxide	350 μg m^{-3} not to be exceeded more than 24 times a year	1 hour mean	31 Dec 2004
	125 μg m^{-3} not to be exceeded more than3 times a year	24 hour mean	31 Dec 2004
	266 μg m^{-3} not to be exceeded more than 35 times a year	15 minute mean	31 Dec 2005

Table 2 Proposed new particle objectives (from Air Quality Strategy Addendum (2003))

Pollutant	Objective		Date to be achieved by
	Concentration	Measured as	
Particles (PM_{10}) (NB the objective for London is given in brackets)	50 μg m^{-3} not to be exceeded more than 7 (10) times a year	24 hour mean	31 Dec 2010
	20 (23) μg m^{-3}	Annual Mean	31 Dec 2010

2. Carbon Monoxide

2.1 Introduction

Carbon monoxide (CO) is a colourless and odourless gas produced by the burning of fuels. Exposure to CO leads to a decreased uptake of oxygen by the lungs and can lead to a range of symptoms as the concentration increases. Early symptoms of exposure include tiredness, drowsiness, headache, pains in the chest and sometimes stomach upsets. Some people, for example those with heart disease, are at an increased risk. Exposure to very high concentrations will lead to death. However such conditions, where there are very high concentrations, are most likely to arise in confined spaces, rather than outdoors where the public are exposed and the air quality strategy (AQS) applies.

The AQS objective for CO, based on advice from the Expert Panel of Air Quality Standards (EPAQS), is as follows:

Objective		Date to be achieved by
Concentration	Measured as	
10 mg m^{-3}	Daily Maximum Running 8 hour mean	31 Dec 2003

2.2 National Perspective

The dominant source of CO in the UK remains road transport (49% of UK emissions in 2003) (DEFRA, 2005), although annual emissions are declining mainly as a result of uptake of abatement technologies (catalytic converters) following the introduction of the Euro standards for road vehicles (since 1993). Significant emissions reductions have occurred over the last decade from Euro standards, with reductions of 42% for CO relative to the no abatement scenario (DEFRA, 2004).

Monitoring results from the UK national network sites confirm that no site exceeded the objective during the period between 2001 and 2005.

Current projections are that emissions will reduce by 78% between 2000 and 2010. National modelling has further indicated that at the end of 2003, major roads will not exceed the objective.

No AQMAs were declared in the first and second rounds of R & A (although the first round was based on the previous objective of 11.6mg m^{-3}).

Based on TG03 guidance, it is considered highly unlikely that any authority will be required to proceed beyond the updating and screening assessment.

2.3 Third round assessment of CO

A checklist approach is used, based on 1) monitoring data and 2) data relating to very busy roads.

1. For this pollutant, ratified monitoring data are required at locations where there is a potential for public exposure. If the data indicate that the maximum daily running 8-hour concentration exceeds the objective then the Council will be required to proceed to the Detailed Assessment stage.

2. This relates to roads not previously considered and to annual average daily traffic flows exceeding stated flows (which are dependent on the type of road) for areas where the annual mean background is expected to be greater than 1mg m^{-3}. If there is relevant exposure within 10m of the kerb then it will be necessary to obtain additional traffic information relating to average speeds and the HGV/LGV split. The DMRB screening model can be used to predict concentrations. (Note if junctions occur along any of the roads then the flows from the roads should be added together). If the predicted annual mean concentration is greater than 2mg m^{-3} then it is necessary to proceed to the Detailed Assessment stage.

2.4 Monitoring

The Council monitors CO at its Brent 1 site, which is an urban background continuous monitoring in Kingsbury and part of the government's AURN. Details of the monitoring and data capture for the Brent 1 site are given in Table 3, along with the nearby Ealing 2 LAQN site in Acton for comparison. The results are scaled and ratified data (apart from 2005 which are still provisional).

There were no periods exceeding the CO objective at these sites over the period 2000 to 2005. Details of annual mean and maximum one-hour concentrations are also provided for information purposes. The annual mean concentrations are low in comparison with the objective.

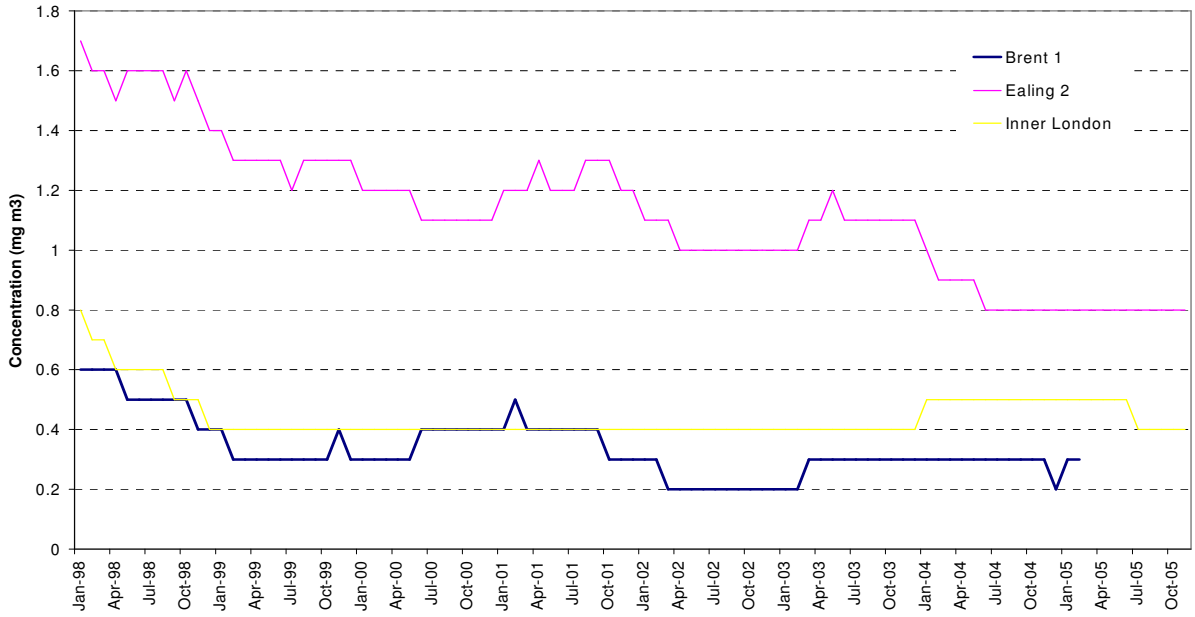
Table 3 CO statistics from Brent 1 and Ealing 2 sites (mg m^{-3})

Brent 1	2000	2001	2002	2003	2004	2005
Max 8 Hour	8.5	4.5	5.3	6.1	*3.8*	*3.7*
Annual mean	0.5	0.3	0.2	0.4	*0.4*	*0.4*
Data capture %	99	99	99	97	*86*	*56*
Max 1 Hour	12.9	8.2	7.7	10.0	*5.5*	*5.9*
Ealing 2	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Max 8 Hour	8.6	6.3	5.3	4.2	4.3	3.4
Annual mean	1.4	1.3	1.2	1.3	0.9	0.9
Data capture %	99	97	99	96	98	93
Max 1 Hour	9.5	12.5	6.5	7.7	5.5	4.4

(Note – NO indicates not in operation; italics indicates < 90% data capture)

An analysis of rolling annual mean concentrations is provided for these sites (plus a background site in inner London for comparison purposes). The analysis is for the period from 1998. Figure 1 illustrates changing concentrations over time, based on changing annual averaged hourly mean concentrations. The use of rolling annual mean concentrations in this way largely removes seasonal influences and provides a guide to changing trends over time.

Figure 1 Rolling annual mean trends for nearby sites and an inner London site (1998 to 2004)



The rolling annual mean CO concentrations for all sites largely indicate a downward trend over time in line with reductions in emissions over time. This is most noticeable for the Ealing 2 roadside and inner London background sites. All sites indicate low concentrations for the period shown, with the most notable reduction arising prior to 2000. This is as would be expected with older more polluting vehicles being replaced by Euro vehicles incorporating catalytic converters. The reduction in concentration for an average of sites in the London Air Quality Network was 56% (based over the period from 1996 to 2004) (ERG,2006).

The results of the monitoring at these nearby sites are considered representative of the Council's area. These indicate that the objective is being met and therefore a Detailed Assessment of CO based on monitoring is not required.

2.5 Very busy roads or junctions in built up areas

All roads and junctions were considered in the previous USA and none were found to exceed the criteria for the CO objective. This assessment indicated that no road and junction had flows >80,000 vehicles per day for single carriageways, >120,000 vehicles per day for dual carriageways and >140,000 vehicles per day for motorways and the estimated background concentrations were below the annual mean threshold of 1mg m^{-3} for CO. Based on these findings it is considered that the objective is very unlikely to be exceeded in the Borough as a result of road traffic emissions.

2.6 Conclusion of third round assessment of CO

There have been no significant changes to CO concentrations or emissions in the Borough since the second round USA and as a result a Detailed Assessment for CO will not be required.

This page has been left blank intentionally.

3. Benzene

3.1 Introduction

Benzene at normal ambient temperatures occurs as a liquid, but it readily evaporates and small amounts are detectable in the air. It is known from workplace studies that benzene is potentially carcinogenic, that is, exposure to it may lead to the development of cancer.

EPAQS (1994) considered that the risks associated with the levels found in the air in the UK to be small and not be measurable with any accuracy. Nevertheless, it considered that efforts continue to be made to reduce the levels even further as a precautionary measure.

The AQS objectives for benzene, based on advice from EPAQS, are as follows:

Objective		Date to be achieved by
Concentration	Measured as	
16.25 µg m^{-3}	Running Annual Mean	31 Dec 2003
5 µg m^{-3}	Annual Mean	31 Dec 2010

3.2 National Perspective

Benzene emissions arise from the evaporation and combustion of petroleum products, as benzene is a constituent of petrol. It is estimated that 11% of the total emissions from 2003 arose from fuel combustion. Benzene is also exhausted in stack emissions and as fugitive emissions from its manufacture and use in the chemical industry.

In total benzene emissions are estimated to have decreased by 71% between 1990 and 2003, to 18.3 kt in 2003 (DEFRA, 2005).

Monitoring results from national sites using pumped tubes indicated that the stricter 2010 objective was not exceeded. This network started in 2002 and the results include the period from 2002 to 2005.

Emissions from vehicles are predicted to reduce by over 90% from 1990 levels by 2010 (DEFRA, 2004).

One AQMA was declared for benzene in the UK during the second round of R & A. This was at a school, which is sited close to a busy petrol station. It was based on the 2010 objective. No AQMAs were declared during the first round.

3.3 Third round assessment of Benzene

A checklist approach is used, based on 1) monitoring data 2) data relating to very busy roads 3) industrial sources/ petrol stations/ major fuel storage depots.

1. For monitoring the data should be prioritised, based on locations near busy roads the results at building facades. Where monitoring relating to industrial and other sources is undertaken then monitoring down wind from the site is recommended. If monitoring is undertaken by diffusion tube, suitable QA/QC procedures should be used and the tubes validated and bias corrected. The results will need to be corrected to 2010. If the data indicates that the objective is exceeded then the Council will be required to proceed to the Detailed Assessment stage.

2. This relates to roads not previously considered and to 2010 only, where the 2010 annual mean background exceeds 2µg m^{-3} and the annual average daily traffic flows exceed the stated flows (which are dependent on the type of road). If there is relevant exposure within

10m of the kerb then it will be necessary to obtain additional traffic information relating to average speeds and the HGV/LGV split. The DMRB screening model can be used to predict 2010 concentrations. (Note if junctions occur along any of the roads then the flows from the roads should be added together). If the predicted concentration is greater than 5µg m^{-3} then it is necessary to proceed to the Detailed Assessment stage.

3. For new industrial and other sources listed in TG03 it is likely that an air quality assessment will have been undertaken as part of planning or authorisation/permit process. The results from this should be cited. Authorities are also asked to check information from previous rounds of R&A and if there are substantially increased emissions (>30% per annum). Where it is necessary to check industrial sources then the annual emission of benzene is needed along with the height of discharge to calculate whether the relevant threshold in the guidance has been exceeded.

   For petrol stations it is necessary to identify those stations not covered by previous reports and with a throughput of more than 2000m^3, and with nearby roads with more than 30,000 vehicles per day. If there is relevant exposure within 10m of the pumps it is necessary to proceed to a Detailed Assessment.

   For major petrol storage depots not covered by previous reports it is necessary to identify relevant exposure and annual emissions to calculate whether the relevant threshold in the guidance has been exceeded.

3.4 Monitoring

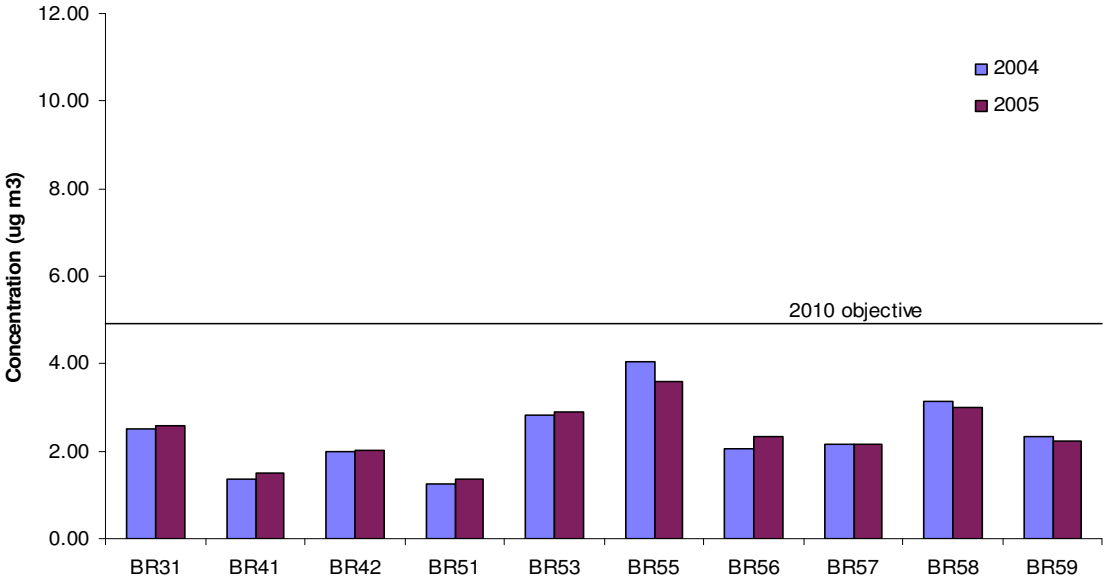
The Council undertakes benzene monitoring by diffusion tube at ten sites in its area as part of the London Wide Monitoring Programme. The results are shown in Table 4 below. This monitoring indicates that annual mean levels are well below the 2003 objective of 16.25 µg m^{-3}. Annual mean concentrations have been less than 5 µg m^{-3} at all sites. Continuous monitoring of benzene is not undertaken nearby; hence it has not been possible to undertake a co-location study to derive a bias correction factor. The details of the sites in given in Appendix 2

Table 4 Results of benzene monitoring (µg m^{-3}) in Brent (2000-2005)

Site Code	2004	2005
BR31	2.52	2.57
BR41	1.35	1.48
BR42	2.00	2.02
BR51	1.27	1.34
BR53	2.84	2.89
BR55	4.06	3.59
BR56	2.04	2.32
BR57	2.17	2.16
BR58	3.13	3.02
BR59	2.33	2.22

The results are also shown in Figure 2.

Figure 2 Results of benzene monitoring (µg m^{-3}) in Brent (2000-2005)



These monitoring results are considered representative of the Council's area. They indicate that the concentrations will not exceed the benzene objectives for 2003 and 2010 and therefore a Detailed Assessment based on monitoring is not required.

3.5 Very busy roads or junctions in built up areas

All roads and junctions were considered in the previous USA and none were found to exceed the criteria for the benzene objective. This assessment indicated that no road and junction had flows >80,000 vehicles per day for single carriageways, >120,000 vehicles per day for dual carriageways and >140,000 vehicles per day for motorways. Estimated 2010 background concentrations were also below the annual mean threshold of 2µg m^{-3} for benzene. Based on these findings it is considered that the objective is very unlikely to be exceeded in the Borough as a result of road traffic emissions.

3.6 Industrial sources

There are no new industrial processes or significant increased emissions of benzene from existing industrial processes of relevance in the Borough, or neighbouring areas.

3.7 Petrol stations

The previous USA did not identify any petrol stations where the TG03 criteria applied in the Borough and there has been no change to this position. (See Appendix 1 for list of permitted petrol stations in the Borough).

3.8 Conclusion of third round assessment of benzene

There have been no significant changes to benzene concentrations or emissions in the Borough since the second round USA and as a result a Detailed Assessment for benzene will not be required.

This page has been left blank intentionally.

4. 1,3 Butadiene

4.1 Introduction

1,3 Butadiene arises from the combustion of petroleum products and its manufacture and use in the chemical industry. It is not present in petrol but is formed as a by-product of combustion.

The AQS objective for 1,3 butadiene, based on advice from EPAQS, is as follows:

Objective		Date to be achieved by
Concentration	Measured as	
2.25 µg m^{-3}	Running Annual Mean	31 Dec 2003

4.2 National Perspective

Road transport and other machinery are the dominant sources of UK emissions (83% of the total in 2003) (DEFRA, 2005). As with other predominantly vehicle related pollutants, annual emissions are declining mainly as a result of uptake of abatement technologies (i.e. catalytic converters) following the introduction of the Euro standards for road vehicles (since 1993). This has led to a reduction in emissions of 55% relative to a "no abatement" scenario (DEFRA, 2004). Current projections are that emissions will continue to reduce by 81% in 2010.

Current monitoring indicates that all of the UK national network sites were significantly below the 2003 objective during the period between 1999 and 2004 (from TG03) apart from the Marylebone Road site in London in 1999. This site is a very busy kerbside site and concentrations at this site have greatly reduced since. Reductions in emissions from road vehicles are continuing and hence only locations close to industrial sites were expected to proceed beyond the second round updating and screening assessment for this objective.

National mapping also indicated that for all areas the 2003 objective would not be exceeded. No AQMAs were declared in the first round of R&A.

4.3 Third round assessment of 1,3 butadiene

A checklist approach is used, based on 1) monitoring data 2) new industrial sources and existing industrial sources with significantly increased emissions.

1. For monitoring the data should be prioritised and for locations near industrial sites monitoring down wind from the site is recommended. If the data indicates that the objective is exceeded then the Council will be required to proceed to the Detailed Assessment stage.

2. For new industrial processes listed in the guidance it is likely that an air quality assessment will have been undertaken as part of planning or authorisation/permit process. The results from this should be cited. Authorities are also asked to check information from previous rounds of R&A and if there substantial increases in emissions (>30% per annum). Where it is necessary to check an industrial sources then the annual emission of 1,3 butadiene is needed, along with the height of discharge, to calculate whether the relevant threshold emissions rate in the guidance has been exceeded.

4.4 Monitoring

The Council does not undertake monitoring of 1,3-butadiene.

Continuous monitoring however is undertaken at the busy central roadside London site at Marylebone Road, which is part of the government's automated network.

The maximum running annual mean results at this site for the period 2002 to 2005 are approximately 1.14 µg m^{-3} (in 2002) and 0.57 µg m^{-3} (in 2005). These results indicate that concentrations are dropping over time. The results are also less than the 2003 objective and can considered representative of the likely maximum in the Council's area, hence they indicate that the concentrations will not exceed the 1,3-butadiene objective. In view of this a Detailed Assessment is not required.

4.5 Industrial sources

There are no new industrial processes or changes relating to existing industrial processes of relevance for 1,3 butadiene in the Borough, or neighbouring areas.

4.6 Conclusion of third round assessment of 1,3 butadiene

There have been no significant changes to 1,3 butadiene concentrations or emissions in the Borough since the second round USA and as a result a Detailed Assessment for 1,3 butadiene will not be required.

5. Lead

5.1 Introduction

Lead in particulate form in air can be inhaled directly by people, and ingested indirectly following its deposition on soil and crops. Exposure to lead has been known to be harmful to people for many years, with severe adverse effects on the blood, the nervous system and the kidneys (although these effects only occur with high exposures). More subtle effects caused by lower exposure to lead can also arise, such as may occur from the presence of lead in drinking water, paint and dust, and in the ambient air. These effects include the impaired intellectual development of children. EPAQS concluded that the available evidence suggests that the risks associated with the levels found in the air in the UK are very small and cannot be measured with any accuracy (EPAQS, 1998). However, efforts to reduce the levels even further continue as a precautionary measure.

The AQS objective for lead, based on advice from EPAQS, is as follows:

Objective		Date to be achieved by
Concentration	Measured as	
0.5 µg m^{-3}	Annual Mean	31 Dec 2003
0.25 µg m^{-3}	Annual Mean	31 Dec 2008

5.2 National Perspective

Lead emissions have declined greatly in recent decades, principally as a result of the lead content in fuel (where it was used as an anti-knock additive) being reduced and subsequently phased out at the end of 1999.

Other sources include industrial processes, such as iron and steel production and waste incineration. Emissions from these sources have also decreased as a result of improved abatement measures.

Emissions in 2003 are estimated to be 0.13 kt, a decrease of 95% on the 1990 estimates, with road transport contributing only 1% to UK emissions total (DEFRA, 2005).

Current monitoring indicates that none of the UK national network sites exceeded the 2004 objective during the period between 2000 and 2004, with industrial sites having higher concentrations than urban background sites. Similarly no network sites exceeded the stricter 2008 objective during the period since 2002 (one industrial site in the Midlands exceeded this objective in 2001).

No AQMAs were declared in the first and second rounds of R&A.

Based on TG03, it is considered that only relevant locations in the vicinity of major industrial processes emitting lead will be required to proceed beyond to a Detailed Assessment.

5.3 Third round assessment of lead

A checklist approach is used, based on 1) monitoring data 2) new industrial sources and existing industrial sources with significantly increased emissions.

1. For monitoring the data should be prioritised and for locations near industrial sites monitoring down wind from the site at the nearest residential property is recommended. If the data indicates that the objective is exceeded then the Council will be required to proceed to the Detailed Assessment stage.

2. For new industrial processes listed in the guidance it is likely that an air quality assessment will have been undertaken as part of planning or authorisation/permit process. The results from this should be cited. Authorities are also asked to check information from previous rounds of R&A if there are substantial increases in emissions (>30% per annum). Where it is necessary to check industrial sources then the annual emission of lead is needed along with

the height of discharge to calculate whether the relevant threshold in the guidance has been exceeded.

5.4 Monitoring

Monitoring is undertaken at a number of sites elsewhere in London as part of the government's national network, including in Brent Park since 1995. The results (between 1999 and 2005) from the Brent and other London sites show that concentrations do not exceed the objectives for 2003 and 2008. The highest annual mean concentration was 0.038 μg m^{-3} at the kerbside site at Marylebone Road site in central London in 2000, although concentrations at the London sites have since reduced. The results are all less than the 2008 objective.

Table 5 Lead monitoring results from London (μg m^{-3})

	2000	2001	2002	2003	2004
Cromwell Rd London	0.032	0.031	0.027	0.022	0.017
Central London			0.022	0.021	0.015
London Brent	0.024	0.030	0.022	0.025	0.020
London Marylebone Road	0.038	0.036	0.028	0.028	0.0183

These monitoring results are considered representative of the likely highest concentrations in the Council's area. The results indicate that the concentrations will not exceed the 2004 and 2008 lead objectives and therefore a Detailed Assessment is not required.

5.5 Industrial sources

There are no new industrial processes or changes relating to existing industrial processes of relevance for lead in the Borough, or neighbouring areas.

5.6 Conclusion of third round assessment of lead

There have been no significant changes to lead concentrations or emissions in the Borough since the second round USA and as a result a Detailed Assessment for lead will not be required.

6. Nitrogen Dioxide

6.1 Introduction

Nitrogen dioxide (NO_2) and nitric oxide (NO) are both oxides of nitrogen, and are collectively referred to as nitrogen oxides (NO_x). All combustion processes produce NO_x emissions, largely in the form of nitric oxide, which is then converted to nitrogen dioxide, mainly as a result of reaction with ozone in the atmosphere. It is nitrogen dioxide that is associated with adverse effects upon human health. At high concentrations NO_2 causes inflammation of the lung. Long-term exposure is also considered to affect lung function and exposure to NO_2 is particularly important for people with asthma and related diseases. NO_x is also important in the formation of ozone and secondary particle formation.

The AQS objectives for NO_2 are as follows:

Objective		Date to be achieved by
Concentration	Measured as	
200 µg m^{-3} not to be exceeded more than 18 times a year	1 hour mean	31 Dec 2005
40 µg m^{-3}	Annual Mean	31 Dec 2005

6.2 National Perspective

The dominant source of NO_X in the UK remains road transport (around 40% of UK emissions in 2003) (DEFRA, 2005). Although in urban areas this proportion is higher, up to 70%. Combustion sources also emit significant amounts of NO_X, however such sources only make a small contribution to NO_2 levels. Significant emissions reductions have occurred over time primarily as a consequence of: abatement measures in road transport and power stations and the increased use of other fuels for power generation. Since 1989, total NO_X emissions are estimated to have declined by 45%

Despite the above reductions, monitoring results from across the UK continue to indicate that sites, particularly at roadside, exceed the annual mean objective. Although it is only the busiest urban roadside sites that have recorded periods where the hourly standard has been exceeded.

Further improvements are projected to 2010 (with emissions reductions of 69% for NO_X, relative to the no abatement scenario). These reductions arise as tougher Euro standards enter into force for new vehicles, and as the older vehicle fleet is retired. Further emissions reductions are also projected to occur post 2010.

As a result of high concentrations arising post 2005 more than 150 AQMAs were declared across the UK during the first and second rounds of R & A for the annual mean objective.

6.3 Third round assessment of NO_2

A checklist approach is used for the updating and screening assessment, based on 1) monitoring data 2) roads including narrow congested streets and junctions 3) bus stations 4) new industrial sources and existing ones with significantly increased emissions 5) aircraft.

1. Ratified monitoring data should be considered and if the data indicate that the concentration exceeds either objective then the Council will be required to proceed to the Detailed Assessment stage.

2. This section focuses on specific road traffic locations, not fully considered during previous rounds of R&A. For these situations, annual average daily traffic flows exceeding stated flows (which are dependent on the type of road) for different locations are required. If the indications arising from these assessments are greater than 40 µg m^{-3} then a Detailed Assessment is necessary. For any new roads a specific assessment is required based on the

DMRB screening model. Similarly roads close to the objective at the last review and assessment or roads with significantly changed flows (> 25% increase) should be re-assessed.

3. Bus stations not previously considered should be assessed, based on the numbers of bus movements and the proximity of relevant exposure (in this instance it should be judged against the 1 hour criteria). If the bus station meets these requirements then DMRB is to be used to obtain a predicted annual mean. If the predicted concentration is greater than 40 µg m^{-3} then it is necessary to proceed to the Detailed Assessment stage.

4. For new industrial sources (as listed in TG03) it is likely that an air quality assessment will have been undertaken as part of planning or authorisation/permit process. The results from this should be cited. If no assessment were undertaken then TG03 provides nomograms for an assessment. The same approach is required where there has been a substantial increase in emissions (i.e. one greater than 30%).

5. Aircraft emissions not previously considered are important if there is relevant exposure within 1000m of the airport boundary and the equivalent passenger numbers is predicted to exceed 5 million passengers per annum.

6.4 Monitoring

The Council undertakes monitoring of NO_2 using both automatic high quality continuous monitoring analysers and diffusion tubes across its area.

Continuous monitoring of NO_2 is undertaken at its urban background AURN site in Kingsbury (Brent 1), its roadside site alongside the A406 North Circular near residences (Brent 2). This site closed and has been replaced by the Brent 4 site that opened in 2003. Monitoring is also undertaken at the Brent 3 roadside site in Harlesden and at the Brent 5 site in Neasden. All sites are part of the LAQN and therefore the standards of QA/QC are similar to those of the government's AURN sites.

Regular calibrations are carried out, with subsequent data ratification undertaken by the ERG at King's College London. In all cases the data are fully ratified, apart from the 2005, which are still provisional.

The results of the monitoring at the site are given in Table 6 below.

Table 6 NO_2 continuous monitoring in Brent (2000 – 2005) (µg m^{-3})

Site		1999	2000	2001	2002	2003	2004	2005
Brent 1	Annual mean	37	36	37	29	34	29	34
	Data capture %	98	98	98	98	95	91	83
	Maximum 1 hour	193.9	169	151.7	151.7	208.6	160.8	179.5
	Exceeds	0	0	0	0	3	0	0
Brent 2	Annual mean			*65*	*69*			
	Data capture %			*41*	*64*	Closed	Closed	Closed
	Maximum			*334*	*205*			
	Exceeds			***24***	*1*			
Brent 3	Annual mean			*67*	*47*	*52*	*57*	*53*
	Data capture %			*13*	*85*	*78*	*83*	*69*
	Maximum			*187.2*	*160*	*272.3*	*272.8*	*210.1*
	Exceeds			*0*	*0*	*6*	***24***	*2*
Brent 4	Annual mean					*59*	**63**	*69*
	Data capture %					*34*	97	*84*
	Maximum					*170.3*	248.4	*231*
	Exceeds					*0*	10	*8*

Site		1999	2000	2001	2002	2003	2004	2005
Brent 5	Annual mean						48	**42**
	Data capture %						81	99
	Maximum						200.2	183.7
	Exceeds						1	0

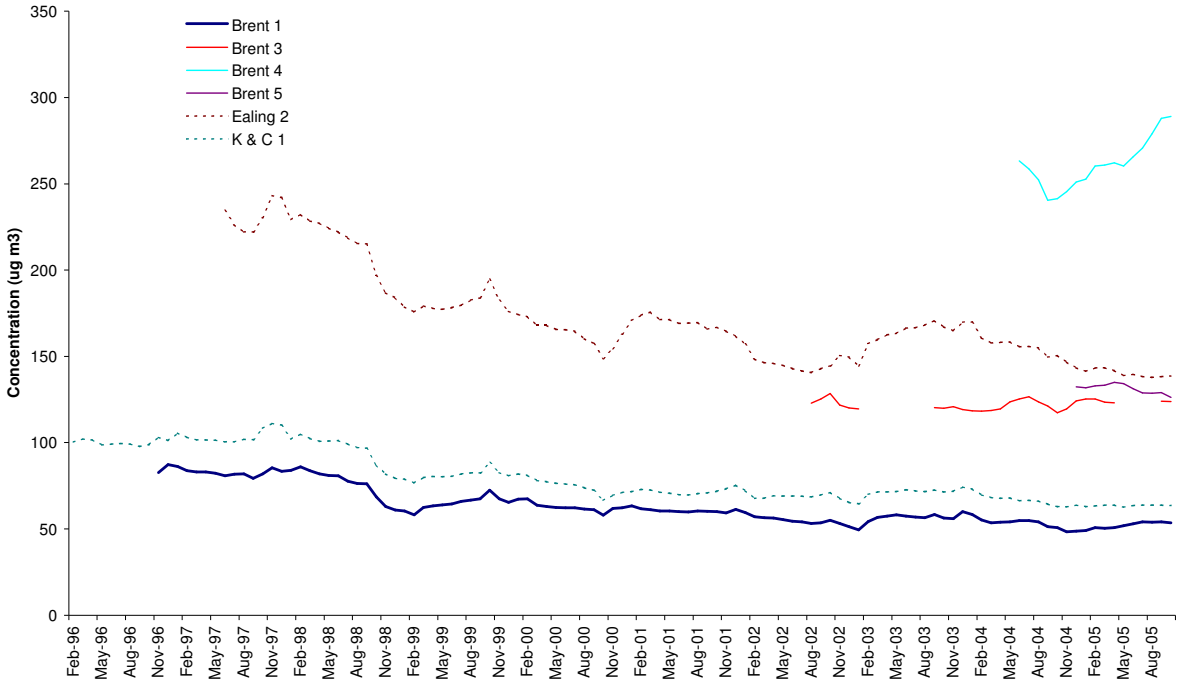
(Note – **bold** exceeds objective; *italics* < 90% data capture)

The results indicate that the annual mean objective was not exceeded at the Brent 1 site over this time period. The objective however was exceeded in 2004 and 2005 at the Brent 2 site. There was low data capture for the Brent 2, but for the period monitored the annual mean was easily exceeded. This is confirmed by the further monitoring at the Brent 4 re-located site. The monitoring at the Brent 3 site has not exceeded 90% for the years monitored although it has approached it. The results for period 2002 to 2005 inclusive indicate that the annual mean was exceeded. Similarly the results for Brent 5 also indicate that the objective has been exceeded.

The hourly mean objective has been exceeded only at two roadside sites, Brent 2 and Brent 3 in 2001 and 2004 respectively.

An analysis of rolling annual mean NO_X and NO_2 concentrations is provided for the Brent monitoring sites to indicate any trend over time. The analysis is for the period from 1996 through to 2005. Figure 3 and illustrate changing concentrations over time, based on changing annual averaged hourly mean concentrations. The use of rolling annual concentrations in this way largely removes seasonal influences and provides a guide to changing trends over time. The Ealing 2 roadside site and Kensington and Chelsea 1 background sites are added for comparison.

Figure 3 Rolling annual mean NO_X trends for Brent monitoring sites (1996 to 2005)

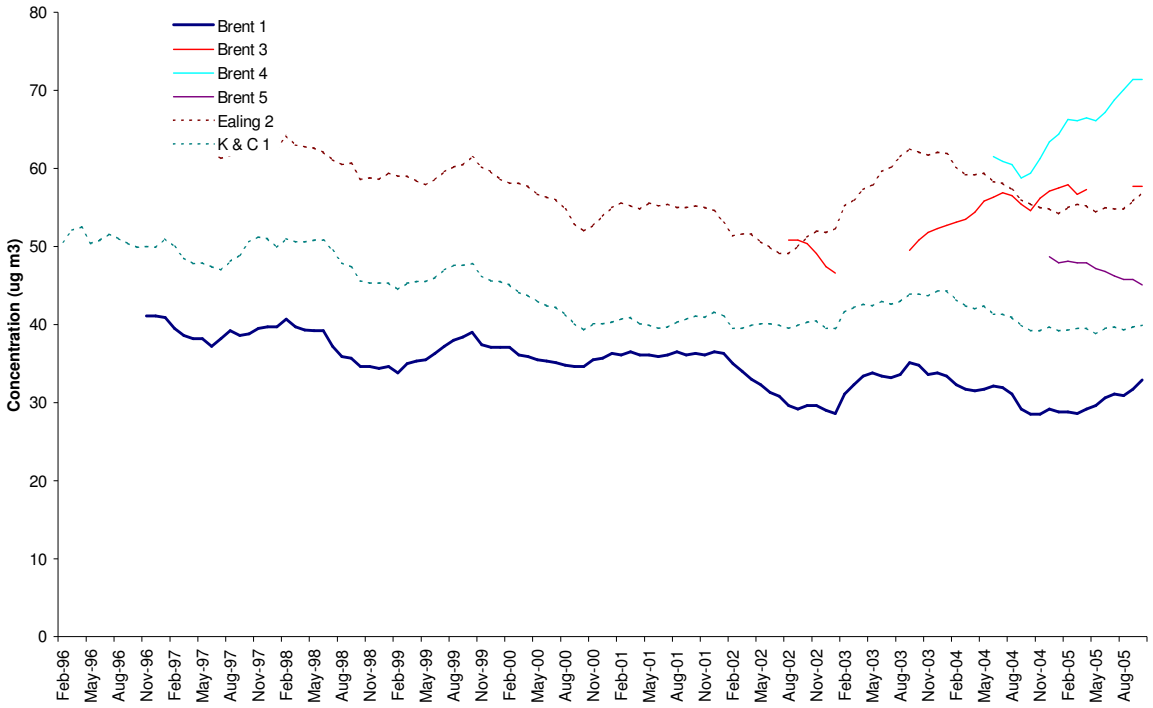


The rolling annual mean concentrations of NO_x indicate a slight downward trend at the Brent 1 site over time in line with reductions in emissions over time. The downward trend for NO_X (approximately 25 µg m^{-3}) as the primary emission is more pronounced than that for NO_2 (approximately 8 µg m^{-3}). This illustrates the difference between pollutants and the difficulty in reducing NO_2, which is mostly a secondary pollutant that is largely determined by the oxidising capacity of the atmosphere. In addition recent research (Carslaw D.C and Beevers, S. D, 2005) indicates that direct NO_2 emissions may also

be increasing. The Brent 1 site is located at a suburban background and consequently concentrations are lower than the Ealing 2 roadside site and the inner London background site.

The monitoring at the other Brent sites has not been long enough to fully indicate any trend. The impact of the higher concentrations monitored during 2003 is also clearly having an effect, suggesting that trends are increasing, however as monitoring continues it is likely that concentrations will reduce.

Figure 4 Rolling annual mean NO_2 trends for Brent monitoring sites (1996 to 2005)



The average change in rolling annual mean concentrations of NO_2 over this period at Brent 1 is in line with the average for outer London sites (ERG, 2006).

The Council also uses diffusion tubes to measure NO_2. The diffusion tubes are exposed at 49 locations in the Borough, including roadside, background and intermediate sites. The site locations are all considered to represent relevant public exposure.

The diffusion tubes used are supplied and analysed by Gradko using a preparation method of 50% TEA in acetone. Details of the sites monitored are given in Appendix 2.

A co-location study has not been undertaken, however correction factors for 2002 to 2005 (to allow for bias) have been derived from the latest default factor spreadsheet (March 2006) from DEFRA's helpdesk. These factors are derived from series of co-location studies undertaken elsewhere in the UK and are as follows:

Year	Bias factor
2004	0.96
2005	1.03

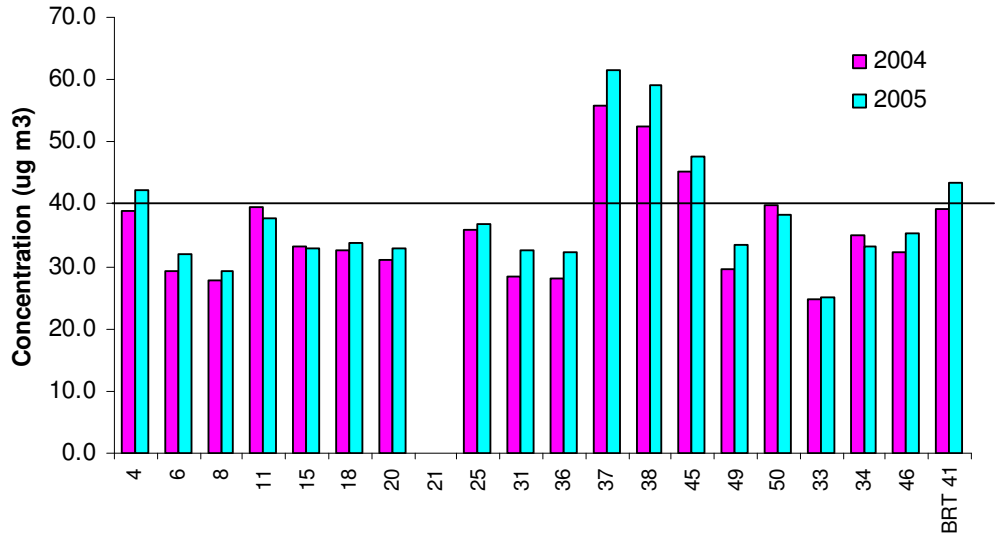
The factors indicate the diffusion tube measurements were over reading slightly in 2004 and under reading slightly in 2005, compared to continuous measurements. The results presented in Table 7 are the bias adjusted results.

Table 7 Diffusion tube monitoring from background/ intermediate sites in Brent (µg m^{-3})

Site	Type	2004	2005
4	I	38.8	42.1
6	I	29.2	31.9
8	I	27.7	29.2
11	I	39.5	37.6
15	I	33.1	32.7
18	I	32.6	33.7
20	I	31.0	32.8
21	I		
25	I	35.9	36.7
31	I	28.4	32.6
36	I	28.2	32.3
37	I	**55.8**	**61.5**
38	I	**52.4**	**59.0**
45	I	**45.4**	**47.8**
49	I	29.7	33.3
50	I	39.9	38.3
33	B	24.9	25.2
34	B	34.9	33.3
46	B	32.3	35.3
BRT 41	B	39.2	**43.5**

The results are also presented in Figure 5. The sites other than intermediate sites (37, 38, 45 and BRT 41 in 2005) all meet the 2005 objective for all years reported.

Figure 5 Bias corrected diffusion tube monitoring results from background/ intermediate sites in Brent



The results for the roadside sites are given in Table 8 and

Figure 6. These show that all roadside sites exceeded the objective for one or either years, other than sites 3, 5, 13, 16, 36, 39 and 50.

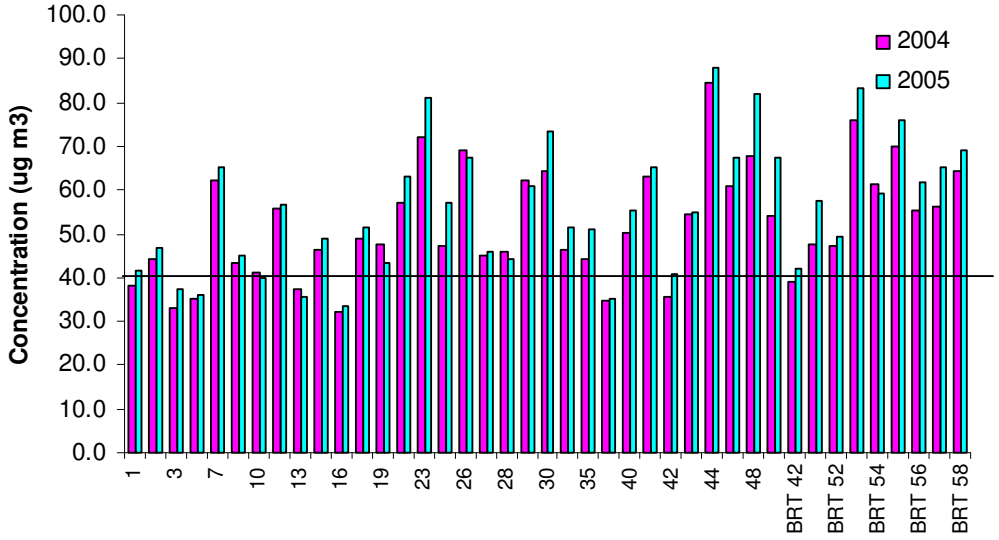
An estimate for 2010 has been derived using DEFRA adjustment factors in Table 8 and this indicates that roadside concentrations at just over half the sites will, based on the 2005 results, still exceed the 40 µg m^{-3} annual mean objective.

Table 8 Diffusion tube monitoring from roadside sites in Brent (µg m^{-3})

Site	2004	2005	2010
1	38.1	41.6	34.9
2	44.3	46.7	39.3
3	33.1	37.5	31.5
5	35.2	35.9	30.2
7	62.4	65.2	**54.8**
9	43.3	45.3	38.0
10	41.3	40.0	33.6
12	55.8	56.8	**47.7**
13	37.5	35.5	29.8
14	46.3	49.0	**41.1**
16	32.2	33.6	28.2
17	48.9	51.4	**43.2**
19	47.6	43.3	36.4
22	57.0	63.3	**53.2**
23	72.2	81.0	**68.0**
24	47.2	57.3	**48.1**
26	69.1	67.4	**56.6**
27	45.0	45.8	38.5
28	45.9	44.4	37.3
29	62.2	60.9	**51.2**
30	64.5	73.2	**61.5**
32	46.2	51.6	**43.3**
35	44.3	51.1	**42.9**
39	34.9	35.3	29.7
40	50.2	55.3	**46.5**
41	62.9	65.2	**54.8**
42	35.8	40.6	34.1
43	54.3	55.1	**46.3**
44	84.4	87.8	**73.8**
47	61.0	67.3	**56.6**
48	67.9	81.9	**68.8**
BRT 31	53.9	67.6	**56.8**
BRT 42	39.2	42.1	35.4
BRT 43	47.5	57.6	**48.4**
BRT 52	47.4	49.5	**41.6**
BRT 53	76.0	83.2	**69.9**
BRT 54	61.5	59.0	**49.6**
BRT 55	69.9	75.9	**63.7**
BRT 56	55.2	61.7	**51.8**
BRT 57	56.2	65.4	**55.0**
BRT 58	64.5	69.0	**58.0**

The diffusion tube locations include sites outside of the Council's AQMA and some of these sites exceed the annual mean objective in 2005. These include sites 2 in Sudbury, 4 in Preston, 17 near Kingsbury and 37 near Alperton. Of these site 4 did not exceed the objective in 2004.

Figure 6 Bias corrected diffusion tube monitoring results from roadside sites in Brent



6.5 Roads

Busy streets where people may spend an hour or more close to traffic were examined in the second round USA. There has been no change to the previous findings since then and no new roads have been constructed with traffic flows greater than 10,000vpd in the Council's area since the first round of R&A where there is relevant exposure arising.

The new 2003 London Atmospheric Emissions Inventory (LAEI) has been used to identify changed flows and an examination of this has confirmed that there are no roads in the area with significant changes.

6.6 Bus stations

No additional bus stations were found to need further investigation since the previous USA.

6.7 Industrial sources

There are no new industrial processes or changes relating to existing industrial processes of relevance for NO_2 in the Borough, or neighbouring areas.

6.8 Aircraft

There is not an airport in the Borough or immediate neighbouring areas.

6.9 Conclusion of third round assessment of NO_2

Recent diffusion tube monitoring results from four sites are outside the Council's existing AQMA indicate that the 2005 annual mean objective has been exceeded. The locations of these sites should be closely examined to confirm relevant exposure and if this is confirmed a Detailed Assessment undertaken.

This page has been left blank intentionally.

7. Sulphur Dioxide

7.1 Introduction

Sulphur dioxide (SO_2) is a colourless gas, produced from burning fossil fuels like coal and oil. Power stations and oil refineries are the main sources in the UK, with small releases from other industries. SO_2 is also found naturally in the air at low concentrations from natural releases such as volcanoes and forest fires. SO_2 also has role in the formation of secondary particles.

SO_2 can cause breathing difficulties at high concentrations over short periods of time, particularly to those with asthma and chronic lung disease. As a result the AQS objectives are all incident based as follows:

Objective		Date to be achieved by
Concentration	Measured as	
350 µg m^{-3} not to be exceeded more than 24 times a year	1 hour mean	31 Dec 2004
125 µg m^{-3} not to be exceeded more than3 times a year	24 hour mean	31 Dec 2004
266 µg m^{-3} not to be exceeded more than 35 times a year	15 minute mean	31 Dec 2005

7.2 National Perspective

UK emissions have decreased to approximately 1Mt in 2003, representing a decrease of 74% from 1990 (DEFRA, 2005). This is mostly as a result of reduced emissions from the industrial, particularly the electricity supply sector, arising from the decreasing use of coal and increasing use of abatement equipment. However, coal combustion still accounts for 76% of the 2003 UK SO_2 emissions.

Emissions from petroleum use also have reduced due to a decline in fuel oil use and the reduction in the sulphur content in the fuel. These have led (by 2001) to a 96% reduction in SO_2 from the transport sector.

Monitoring results from sites across most of the UK indicate that the AQS objectives are met and that concentrations have reduced in over time. Unlike other LAQM pollutants further large reductions in emissions are not expected in the coming years.

Despite most locations meeting the objectives, there are some areas and locations where high concentrations do arise from specific local sources. As a result 11 local authorities across the UK declared AQMAs during the previous rounds of R & A.

7.3 Third round assessment of SO_2

A checklist approach is used, based on 1) monitoring data 2) new industrial sources and existing ones with significantly increased emissions 3) areas of domestic coal burning 4) boilers burning coal or oil 5) shipping and 6) railway locomotives.

1. Ratified monitoring data are to be considered and if the data indicate that the concentration exceeds any of the objectives then the Council will be required to proceed to the Detailed Assessment stage.

2. For new industrial sources listed in TG03 it is likely that an air quality assessment will have been undertaken as part of planning or authorisation/permit process. The results from this should be cited. If no assessment were undertaken then TG03 provides nomograms for an

assessment. The same approach is required where there has been a substantial increase in emissions (i.e. one greater than 30%).

3. For domestic sources not previously considered there is the need to identify small areas (500 x 500m) where significant coal burning still takes place. If the density of coal burning premises exceeds 100 per 500 x 500m then a Detailed Assessment is required.

4. For boiler plant it is necessary to identify all plant >5MW(thermal) that burns coal or fuel oil and establish whether there is relevant exposure within 500m. If such boilers are found then TG03 provides nomograms for an assessment to be made.

5. For shipping not previously considered or where there is new relevant exposure, it is necessary to identify whether there is relevant exposure close to the berths and main area of manoeuvring. If this is established then the number of ship movements (relating to large ships only) should be collated and if the number exceeds more than 5000 movements per year then a Detailed Assessment is required.

6. Both diesel and coal fired locomotives emit sulphur dioxide and this is most relevant where the locomotives are stationary for periods of 15 minutes or more. It is also necessary to establish whether or not there is relevant exposure within 15m of the source. If there are more than 2 occasions when locomotives are stationary with engines running then it is necessary to go to a Detailed Assessment.

7.4 Monitoring

The Council monitors SO_2 at its at its Brent 1 urban background and Brent 2, 3 and 4 roadside monitoring sites (but the not the industrial Brent 5 site). The maximum 15-minute concentration each year at the sites are given in Table 9, along with details of data capture. In all cases the data are fully ratified, apart from the 2005, which are still provisional. The 15-minute mean standard of 266 µg m-3 was only exceeded once in 2002 at the Brent 2 site. The hourly and 24 daily mean standards were not exceeded over this period.

Table 9 SO_2 monitoring in neighbouring local authorities (2000 to 2005)

LAQN site	2000	2001	2002	2003	2004	2005
BT1	0	0	0	0	*0*	0
BT2		0	1			
BT3		0	0	*0*	*0*	*0*
BT4				*0*	*0*	*0*
Max 15 minute concentration µg m^{-3}						
BT1	128.2	93.5	125.5	144.2	*106.8*	117.5
BT2		*106.8*	*305*	Closed	Closed	Closed
BT3		*98.8*	79.7	*105.3*	*111.3*	*118.2*
BT4				*115.3*	*69.3*	*118.5*
Data capture %						
BT1	99	97	99	97	89	93
BT2		44	63			
BT3		17	90	78	86	86
BT4				33	89	79

(Note – italics indicates < 75% data capture)

These results indicate that the 15-minute objective has not been exceeded at the monitoring site; in addition the hourly and daily objectives have also not been exceeded over this period.

7.5 Industrial sources

Part A and B sources in the Borough and close to the Borough boundary were assessed previously and found not to be relevant. This position has not changed and no new sources have been introduced.

7.6 Domestic sources

This was considered in the previous USA and no areas of domestic coal burning were identified. There has been no change to this position.

7.7 Boilers

There have been no new small boilers installed within the Borough since the last USA.

7.8 Shipping

There are no local sources of shipping emissions.

7.9 Railway locomotives

Diesel trains were considered in the previous USA and found not to idle at locations close to relevant receptors. This position has not changed.

7.10 Conclusion of third round assessment of SO_2

There have been no significant changes to SO_2 concentrations or emissions in the Borough since the second round USA and as a result a Detailed Assessment for SO_2 will not be required.

This page has been left blank intentionally.

8. Particles (PM_{10})

8.1 Introduction

The PM_{10} (particles measuring 10µm or less aerodynamic diameter) standard was agreed to represent those particles likely to be inhaled by humans, accepting that the chemical and physical composition varies widely. In view of this there is a wide range of emission sources that contribute to PM_{10} concentrations in the UK. Research studies have confirmed that these sources can be divided into 3 main categories (APEG): (i) Primary particle emissions derived directly from combustion sources, including road traffic, power generation, industrial processes etc. (ii) Secondary particles formed by chemical reactions in the atmosphere, comprising principally of sulphates and nitrates. (iii) Coarse particles comprising emissions from a wide range of sources, including re-suspended dusts from road traffic, construction works, mineral extraction processes, wind-blown dusts and soils, sea salt and biological particles.

Particles are associated with a range of health effects, including effects on respiratory and cardiovascular systems, asthma and mortality. As a result, EPAQS recommended a daily standard based on the evidence reviewed with an annual mean standard to assist with policy formation.

A subgroup of the Committee on the Medical Effects of Air Pollutants (COMEAP) is currently preparing a report which will, as far as possible, quantify the benefits to health of reducing air pollution in the UK. This group have previously advised that there is strengthening evidence base that links long-term exposure to particles and mortality and are of the view that the associations reported are likely to represent causal relationships with air pollution. They are also investigating the effects on morbidity and aim to publish a detailed report later in 2006.

The AQS objectives for PM_{10} are as follows:

Objective		Date to be achieved by
Concentration	**Measured as**	
50 µg m^{-3} not to be exceeded more than 35 times a year	24 hour mean	31 Dec 2004
40 µg m^{-3}	Annual Mean	31 Dec 2004

Proposed new particle objectives were introduced by the 2003 Air Quality Strategy Addendum (DEFRA, 2003b) based on the Stage 2 limit values set in the first EU Air Quality Daughter Directive. These objectives were included as provisional pending further EU reviews. TG03 guidance confirmed that local authorities are not statutorily required to assess air quality against these, but advised that they may find it helpful to do so, to assist with longer term development planning.

Objective		Date to be achieved by
Concentration	**Measured as**	
50 µg m^{-3} not to be exceeded more than 7 (10) times a year	24 hour mean	31 Dec 2010
20 (23) µg m^{-3}	Annual Mean	31 Dec 2010

(NB the objective for London is given in brackets)

8.2 National Perspective

The main sources of primary PM_{10} are road transport (with diesel vehicles emitting a greater mass per vehicle kilometre driven than other vehicles), stationary combustion (with domestic coal combustion traditionally being a major source of emissions) and industrial processes (including bulk handling, construction, mining and quarrying).

Current UK emissions are estimated to be 0.14 Mt in 2003 (DEFRA, 2005) and emissions have declined by 51% between 1990 and 2003, partly reflecting a trend away from coal use particularly by domestic users. PM_{10} emissions from road transport have also shown a steady decline across recent years. Coal combustion and road transport together contributed 57% of UK emissions of PM_{10} in 2003.

Monitoring results from across the UK continue to indicate that sites, including busy roadside sites, exceed the current 2004 daily mean objective during some years. Concentrations of annual mean PM_{10} are generally well below the 2004 objective.

Further emissions reductions of 69% for PM_{10} improvements are projected over the period to 2010, arising as tougher Euro standards enter into force for new vehicles, and as the older vehicle fleet is replaced. Additional post 2010 emissions reductions are also projected to occur (DEFRA, 2004).

As a result of high concentrations arising post 2004 more than 50 AQMAs were declared across the UK during the first and second rounds of R & A for the daily mean objective.

8.3 Third round assessment of PM_{10}

A checklist approach is used, based on 1) monitoring data 2) roads including junctions and new roads 3) new industrial sources and existing ones with significantly increased emissions 4) areas of domestic coal burning 5) quarries, landfill sites, opencast coal, handling of dusty cargoes at ports, etc and 6) aircraft.

1. Ratified monitoring data are to be considered and if the data indicates that the concentration exceeds the 2004 objectives then the Council will be required to proceed to the Detailed Assessment stage.

2. These sections focus on specific road traffic examples not considered in the previous rounds of R&A. For busy roads with annual average daily traffic flows exceeding 10,000vpd any relevant exposure within 10m of the kerb needs to be determined. Then using DMRB screening model to predict the number of 24-hour periods exceeding 50 $\mu g\ m^{-3}$. If the number is greater than 35 then a Detailed Assessment is necessary. Similar assessments are required for roads with high numbers of HGVs and/or buses, i.e. where the proportion of this type of vehicle exceeds 20% and the HGV/ bus flow exceeds 2000vpd. For any new roads a specific assessment is required based on the DMRB screening model. Similarly roads close to the objective at the last review and assessment or roads with significantly changed flows (>25% increase) should be re-assessed.

3. For new industrial sources listed in the guidance it is likely that an air quality assessment will have been undertaken as part of planning or authorisation/permit process. The results from this should be cited. If no assessment were undertaken then TG03 provides nomograms for an assessment. The same approach is required where there has been a substantial increase in emissions (i.e. one greater than 30%).

4. For domestic sources, not previously considered, there is the need to identify small areas (500m x 500m) where significant solid fuel burning still takes place. If the density of such premises exceeds 50 houses then the nomogram in TG03 is used to determine whether or not a Detailed Assessment is required.

5. For quarries, landfill and other waste sites, and ports where dusty cargoes are handled not previously considered then it is necessary to identify whether there is relevant exposure near to any unpaved haul road, processing plant and materials handling facility. Poultry farms with known dust problems are also introduced by the new DEFRA advice. The proximity to each relates to distance, which is dependant on the annual mean background. For sites identified there is a need to use professional judgement based on complaints received and concerns with the facility.

6. Aircraft emissions are important if there is relevant exposure within 500m of the airport boundary. If the source has not been previously considered and the equivalent passenger

numbers is predicted to exceed 10 million passengers per annum (mppa) then a Detailed Assessment is required.

8.4 Monitoring

The Council monitors PM_{10} in the Borough at all of its continuous monitoring sites. The Council uses TEOM instruments at the sites and therefore the results have been factored to a gravimetric equivalent (x 1.3). The sites include:

Brent 1 (BT1) – an urban background site in Kingsbury; the site opened in 1996 and is part of the government's AURN and the LAQN

Brent 2 (BT2) - a roadside site that opened in 2001 in the grounds of the IKEA store strategically placed alongside the A406 North Circular near residences; the site closed in 2003 and was replaced by the Brent 4 site. The site was part of the LAQN

Brent 3 (BT3) - a roadside site in Harlesden; the site opened in 2003 and is part of the LAQN

Brent 4(BT4) - a roadside site that replaced Brent 2; this site is located around 300m from the old Brent 2 site. It opened in 2003 and is part of the LAQN

Brent 5 (BT5) – an industrial site in Neasden; the site opened in 2004 and is part of the LAQN.

The following table provides the results for the monitoring sites.

Table 10 PM_{10} monitoring in Brent (2000 to 2005)

		2000	2001	2002	2003	2004	2005
Brent 1	Annual mean	23	23	24	26	22	20
	Data capture %	98	99	98	96	94	85
	Maximum 1hour	198.9	317.2	863.2	253.5	495.9	118.3
	Days > 50 µg m^{-3}	6	9	11	25	5	3
Brent 2	Annual mean		38	38	Closed	Closed	Closed
	Data capture %		50	66			
	Maximum 1hour		*301.3*	*152.4*			
	Days > 50 µg m^{-3}		**37**	**37**			
Brent 3	Annual mean		20	31	34	30	30
	Data capture %		16	88	78	90	83
	Maximum 1hour		140.6	*292*	195.5	199.6	150.5
	Days > 50 µg m^{-3}		0	16	34	20	17
Brent 4	Annual mean				**41**	39	**43**
	Data capture %				40	96	91
	Maximum 1hour				186.9	320.9	551.9
	Days > 50 µg m^{-3}				**41**	**68**	**86**
Brent 5	Annual mean					**65**	**62**
	Data capture %					82	96
	Maximum 1hour					616.3	638.1
	Days > 50 µg m^{-3}					**165**	**180**

(Note – bold indicates objective exceeded; italics < 90% data capture)

The results indicate that the 2004 annual mean objective was not exceeded at the Brent 1, Brent 2 and Brent 3 sites during any of the years reported. It was however exceeded at the Brent 4 in 2005; in 2004 the annual mean concentration approached the objective and in 2003 there was insufficient data capture as the site was set up that year. For both years of monitoring at the Brent 5 sites the annual mean objective was easily exceeded.

The 24-hour mean objective was not exceeded at the Brent 1 and Brent 3 sites, although it was closely approached in 2003 at Brent 3. However the 24-hour mean standard of 50 µg m^{-3} was exceeded during each year of monitoring at all sites. It should be noted that 2003 was a year with high pollutant concentrations in many areas of the UK, due to the long periods of high pressure that arose during the hot summer months. Such periods are conducive to secondary particle formation over wide areas.

The objective was exceeded for all years monitored at the Brent 4 and Brent 5 sites, with the Brent 5 recording some of the highest concentrations in the LAQN over this period. The site is located close to a number of waste and other industrial sites and represents relevant exposure.

Based on the above results, an estimate of 2010 concentrations and number of days greater than 50 µg m^{-3} can be made using the TG03 updated guidance. These estimates are given in Table 11.

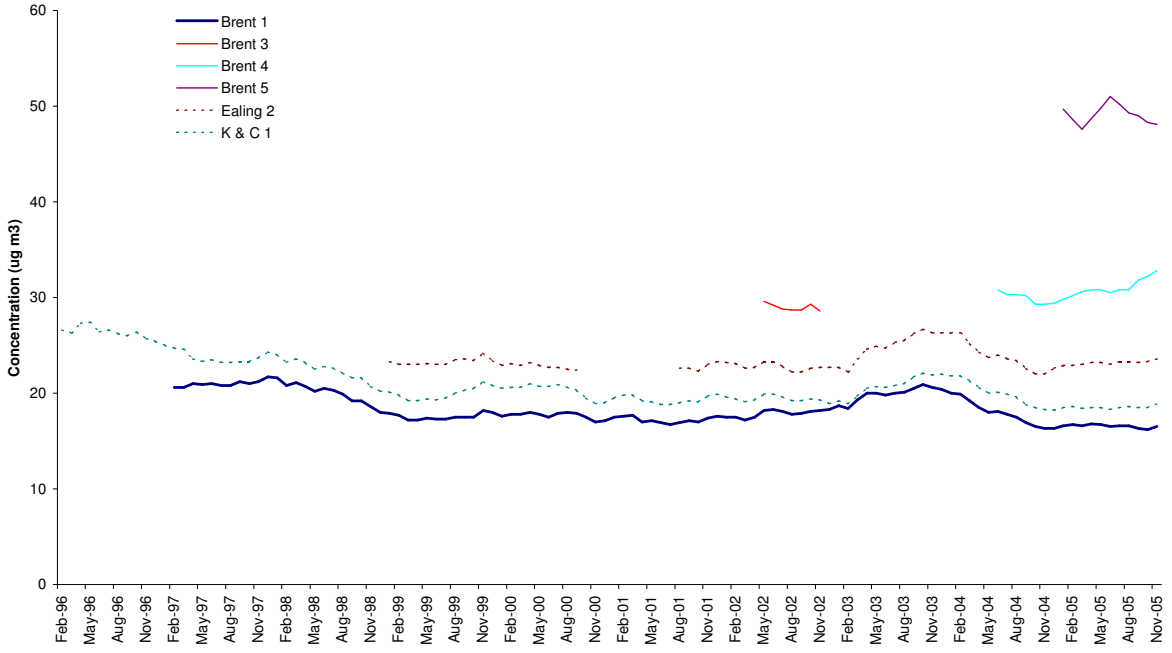
Table 11 Estimated PM_{10} results at the Brent sites for 2010 (using updated TG03 guidance)

	Annual mean (µg m^{-3})	No. of days> 50 µg m^{-3}
Brent 1	19.9	3.3
Brent 3	27.3	18.5
Brent 4	35.6	52.6
Brent 5	59.5	290.3

Despite the predicted reduction resulting from future emission changes, it is only the estimates for the suburban Brent 1 site that indicate that the provisional 2010 objectives will be met. For the roadside and industrial sites both PM_{10} provisional objectives will be exceeded based on these estimates.

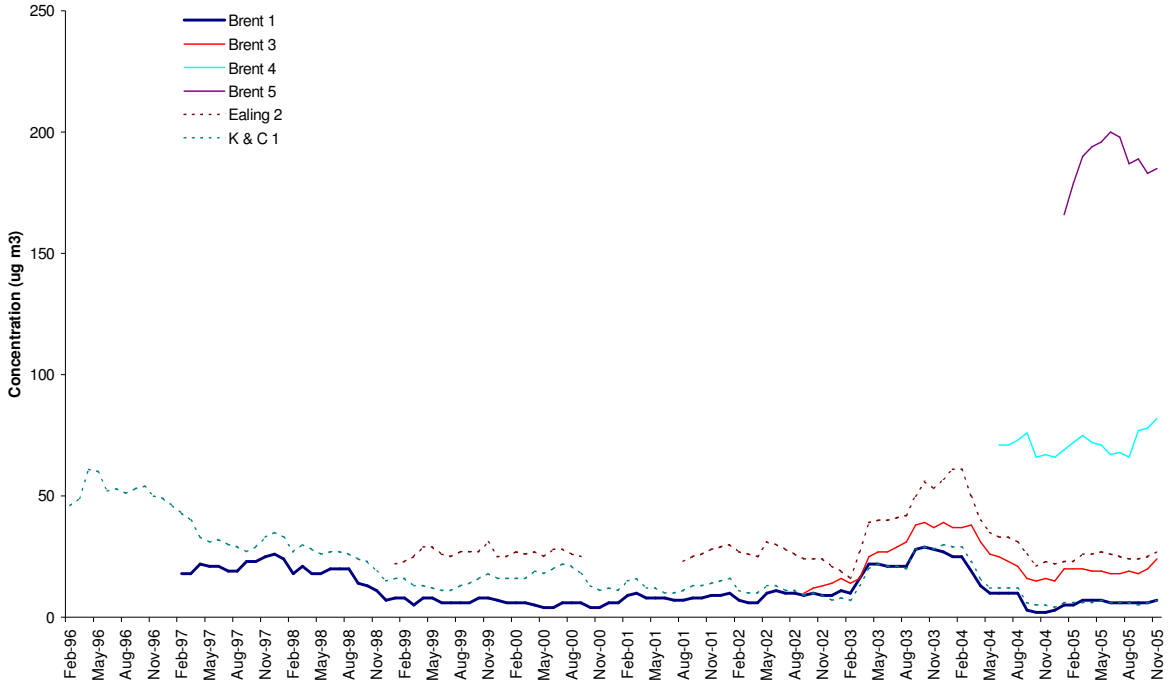
An analysis of rolling annual mean PM_{10} concentrations and daily mean PM_{10} exceedences is provided for the Brent monitoring sites to indicate any trend over time (apart from Brent 2 for which there is insufficient data). In addition other sites, including the Ealing 2 roadside and Kensington and Chelsea 1 background sites are included for comparison. The analysis is for the period from 1996 through to 2005. Figure 7 illustrates changing concentrations over time; based on changing rolling annual mean PM_{10} concentrations and the rolling daily mean PM_{10} exceedences. The use of rolling data in this way largely removes seasonal influences and thus provides a guide to changing trends over time.

Figure 7 Rolling annual mean PM_{10} trends for Brent monitoring sites (1996 to 2005)



The rolling annual mean trends for the Brent sites are consistent with the other sites shown, albeit the concentrations at Brent 1 are slightly lower than for the other sites shown. The data for the Brent 3, 4 and 5 sites are also short term and reflect the later start of operations at the sites. The use of trends in this way highlights that although concentrations have dropped in 2004, this was mainly as a result of the pollution incidents in 2003 not being repeated in 2004. Levels have dropped to pre 2003 levels and do not appear to be reducing; indeed for some sites there may be a slight increase, possibly as a result of increasing primary PM_{10} emissions (ERG, 2006) rather than the predicted decrease in emissions.

Figure 8 Rolling number of days PM_{10} > 50 µg m^{-3} for Brent monitoring sites (2000 to 2005)



The rolling trend of PM_{10} exceedences similarly shows the effect of the pollution episodes in 2003. Otherwise levels, although fluctuating, appear not to have decreased markedly over the period of time shown for these sites. Averages based on London sites for the period from 1995 to 2000 show a downward trend from around 50 days above 50 µg m^{-3} to 10 days in 2002. By the end of 2004 the number of days exceeding the standard at background sites was comparable to that measured at the start of 2001, whereas inner London roadside sites had a higher number of days exceeding in 2004 than 2001 (ERG, 2006).

8.5 Roads

The second round USA considered major roads in the area and noted that the Stage 3 and 4 reports for the previous round of R&A provided modelling of the main roads in the Council's area and addressed the following issues: junctions and high flows of HGVs and buses. The TG03 guidance also required an assessment of roads close to the objective during the first round of R&A and this was undertaken in the Stage 4 further assessment. Hence no further examination of these issues was undertaken. There is no change in this position.

Additionally no roads with unusually high proportions of heavy goods vehicles (>25%) were identified from the new 2003 London Atmospheric Emissions Inventory (LAEI) and there have been no significant increases in traffic flows. There is no change in this position since then and no new roads have been constructed or proposed since the last review.

There are also no new roads with traffic flows greater than 10,000vpd have been built in the Council's area since the first round of R&A where there is relevant exposure arising.

8.6 Industrial sources

There are no new industrial processes or changes relating to existing industrial processes of relevance for PM_{10} in the Borough, or neighbouring areas.

8.7 Solid fuel burning

This was examined in the previous USA and no areas of domestic coal burning were identified and there has been no change to this position.

8.8 Quarries, landfill sites, etc

There are no quarries within the Brent. There are however waste transfer sites within the area. As a result of dust complaints The Council established the Brent 5 site near Neasden Goods Yard in Neasden and will be undertaking a subsequent source apportionment to examine the source and extent of the pollution arising in this area.

The revisions to the TG03 guidance include a reference to potential problems from poultry farms. This guidance is not applicable to Brent Council as there are no poultry farms within the Borough.

8.9 Aircraft

There is not an airport in the Borough or immediate neighbouring areas.

8.10 Conclusion

Monitoring at the Brent 5 site in Neasden, since the previous USA, has confirmed that very high concentrations of PM_{10} arise in this area. The area is already within the Council's AQMA, however these findings have not been considered previously as part of the R&A process. On this basis the Council intends to undertake a Detailed Assessment of this area to determine the extent and source of the pollution.

9. Conclusion / Recommendations

This report follows the technical guidance (TG03 and Frequently Asked Questions) produced for this part of the third round of review and assessment. It therefore fulfils this part of the continuing LAQM process.

The results, from following this methodology, are that the Council has not identified an additional risk of the air quality objectives for carbon monoxide, benzene, 1,3-butadiene, lead, and sulphur dioxide being exceeded by the relevant years anywhere in the Council's area. Thus the Council need not proceed beyond the updating and screening assessment for these pollutants.

The Council however has previously identified a risk that the air quality objectives for NO_2 will be exceeded at locations with relevant public exposure. As a result it designated an AQMA across the Borough. Further monitoring in the area confirms that the annual mean objective has been exceeded. In addition monitoring at locations outside of the AQMA has indicated that the annual mean objective has been exceeded in 2005. As a result the location of the monitoring locations should be checked to confirm relevant exposure and if this is confirmed then a Detailed Assessment should be undertaken with a view to amending the AQMA.

The Council previously identified a risk that the air quality objective for PM_{10} (2004) was likely to be exceeded. As a result it designated part of its area an AQMA. Analysis of the rolling trends indicates that concentrations have not reduced in areas where monitoring is undertaken and on this basis that there is no need to amend or revoke its AQMA. Additional monitoring results from the Brent 5 industrial site have confirmed extremely high concentrations of PM_{10} in the area. The area is within the Council's AQMA, however these findings have not been considered previously as part of the R&A process. On this basis the Council intends to undertake a Detailed Assessment of this area to determine the extent and source of the pollution.

The Council has also identified a risk that the air quality objectives for PM_{10} (for 2010 only) will be exceeded at locations with relevant public exposure. The Council are not required to undertake a Detailed Assessment for PM_{10} at this stage. The findings for PM_{10} however will be noted for longer term planning.

The Council should note that the LAQM guidance requires that the Council produce its next air quality progress reports by the end of April 2007 (unless it undertaking a Detailed Assessment), prior to undertaking the next updating and screening assessment by the end of April 2009.

The Council is therefore recommended to undertake the following action:

4. Undertake consultation on the findings arising from this report with the statutory and other consultees as required.

5. Confirm relevant exposure at the diffusion monitoring sites identified earlier and if this is confirmed to undertake a Detailed Assessment for NO_2 with a view to amending its AQMA.

6. Undertake a Detailed Assessment close to the Brent 5 monitoring site in Neasden where there relevant exposure to determine the extent and source of PM_{10} in this area.

References

Carslaw D.C and Beevers S.D, 2005. Evidence of an increasing NO2/NOx emissions ratio from road traffic emissions. Atmospheric Environment 39, 2049-2059.

DEFRA, 2000. Air Quality Strategy for England, Scotland, Wales and Northern Ireland. DEFRA, London. Cm 4548.

DEFRA, 2003a. Local Air Quality Management, Technical guidance LAQM.TG03. DEFRA, London.

DEFRA, 2003b. Air Quality Strategy Addendum for England, Scotland, Wales and Northern Ireland. DEFRA, London.

Brent Council (2002). Stage 4 Further Assessment of Air Quality. 2002

Brent Council (2004). Local Air Quality Management – Updating and Screening Assessment 2004

Brent Council (2005) Local Air Quality Management – Air Quality Progress Report. 2005

Expert Panel on Air Quality Standards (1994 to 2002). Series of reports on benzene, 1,3 butadiene, carbon monoxide, lead, particles, nitrogen dioxide and sulphur dioxide. DEFRA, London.

DEFRA, 2005. UK Emissions of Air Pollutants 1970 to 2003. NETCEN 2005.

DEFRA, 2004. Evaluation of the Air Quality Strategy. AEA Technology December 2004.

Airborne Particles Expert Group (APEG), 1999. Source apportionment of particulate matter in the United Kingdom. HMSO.

COMEAP, 2006. Committee on the Medical Effects of Air Pollutants Interim Statement on Quantification of the Effects of Air Pollutants on Health in the UK.. 18th January 2006

ERG, 2006. Air Quality in London 2004. London Air Quality Network Report 12. ERG, King's College London 2006.

Appendix 1

Table 12 List of permitted petrol stations in the Council's area

Site	Location
BP Blackbird Hill	BP FILLING STATION, 2-12 Blackbird Hill, Wembley, London. NW9
Brentfield	Brentfield Road, London, NW10 8JP
Craven Park	2 Church Road, London, NW10 9PX
Esso Alperton	ALPERTON SERVICE STATION, 418 Ealing Road, Alperton. HA0 1JQ
Esso Dudden Hill	ESSO SERVICE STATION, Dudden Hill Lane, Neasden, London. NW10 1DE
J Sainsbury's	360 Ealing Rd, Alperton, Wembley HA0 1PF
Jet Victoria	Edgware Rd, Cricklewood, London. NW2 7XE
Malthurst	133-139 East Lane, North Wembley, Middlesex HA9 7PU
Park Royal PFS	Abbey Road, London NW10 7TS.
Safeway (Morrisons)	Honeypot Lane, Queensbury, NW9 8SD)
SAI Services (BP High Road)	341-345 High Road, Wembley, Middlesex, HA0 6AQ
Sectorsure Ltd	17-27 Cricklewood Broadway, London, NW2 3LA
Shell Neasden	369 North Circular Road, Neasden, London NW10
Shell Pine	421 Edgware Rd, The Hyde, Colindale, London. NW9
Snax 24	91 Neasden Lane, Neasden, London.NW10
Tesco Stores Ltd,	Great Central Way, Neasden, London NW10
Texaco College Park	875 Harrow Rd, London. NW10
Texaco Forty Avenue	Forty Avenue, Wembley. HA9 8QQ
Total Empire Way (Wembley Park)	Empire Way, Wembley, Middlesex, HA9 0RJ
Total Kensal	904 Harrow Road, Kensal Green, London. NW10
Total Kenton Road	609 Kenton Road, Kenton, Middlesex, HA3 9RT
Total Kilburn	TOTAL SERVICE STATION, 409 Kilburn High Road, London, NW6 7QF
Total Willesden Lane	290 Willesden Lane, Willesden, London NW2 5RB
Woodchurch	242 Church Lane, Kingsbury, London, NW9

Table 13 List of permitted Part B processes in the Council's area

Site	Process Type	Location
Abbey Coachworks	Vehicle Resprayers	ABBEY COACHWORKS, 429 Strathcona Rd, Wembley, Middlesex, HA9 8QD
Aggregate Industries	Roadstone Coating	AGGREGATE INDUSTRIES, Great Central Way, London, NW10 0JB
Alan Day	Vehicle Resprayers	ALAN DAY ACCIDENT REPAIR CENTRE, 60 Neasden Lane, London NW10
Alexandra Motor Group	Vehicle Resprayers	ABBEYDALE MOTOR COMPANY, 260 Abbeydale Road, Wembley, HA0 1TW
AST	Vehicle Resprayers	A S T Wembley, 10 Watkin Road, Wembley, HA9 0NL
AutoCrash Repairs	Vehicle Resprayers	Auto Crash Repairs, 101 Coles Green Road, Staples Corner, London NW2 7HR
Careys	Mobile Plant – concrete crusher/ screen	P.J Carey Plant Hire (Oval) Ltd, Carey House, Great Central Way, Wembley, Middlesex HA9 6BZ
Dagenham Motors	Vehicle Resprayers	374 Ealing Rd, Wembley, Middlesex, HA0 1HG
Formoss (O'Hara Bros)	Mobile Plant – concrete crusher/ screen	Atlas Rd, Wembley, Middlesex, HA9 0JH
Gemcar	Vehicle Resprayers	Unit 3, Minavil House, 2 Rosemont Road, Wembley, HA0 4PA
LB Haulage	Mobile Plant – concrete crusher/ screen	3 Hannah Close, Great Central Way, Neasden, London NW10
Lees BMW	Waste Oil Burner	Abbey Works, Wycombe Rd, Wembley HA0 1RH
London Concrete	Bulk Cement processing	LONDON CONCRETE, Great Central Way, Neasden, London, NW10 0JB
Polymark Technographics	Printworks - Manufacture of Heat Transfers	266/267 Abbeydale Rd, Wembley HA0 1LQ
RMC	Bulk Cement processing	Ready Mix Concrete, South Way, Wembley, HA9 0HB
Rustins	Coating Manufacturer	Waterloo Rd, Cricklewood, London. NW2 7TX
P. Flannery	Mobile Plant – concrete crusher/ screen	Third Way, Wembley, HA9 0EL
McCardle	Mobile Plant – concrete crusher/ screen	MCARDLE HOUSE, Great Central Way, London, HA9 0LH

Appendix 2

Table 14 Locations of Brent Council's benzene monitoring sites

LOCATION	SITE CODE	CLASSIFICATION	Grid Ref
Ikea Car Park	BR31	Roadside	520756 185142
Alperton Community School - Stanley Ave	BR41	Background	518451 184111
Kingsbury High School - Princes Avenue	BR51	Background	519562 189276
Police Station -Craven Park	BR42	Roadside	521155 184002
High Road Wembley	BR53	Kerbside	518303 185181
High Street - Harlesden	BR55	Kerbside	521743 183361
Chamberlayne Road	BR56	Kerbside	523635 183153
Kilburn Bridge	BR57	Kerbside	525461 183558
51 High Road - Willesden	BR58	Kerbside	532031 184655
Cricklewood Guest Hotel - Walm Lane	BR59	Kerbside	524167 185251

Table 15 Locations of Brent Council's NO_2 diffusion tube monitoring sites

Gradko study

SITE_CODE	Site Location	Class
BRT 31	Ikea Car Park	R
BRT 42	Police Station-Craven Park	R
BRT 43	Slip road from A406 to Pitfield Way	R
BRT 41	Alperton Community School, Stanley Avenue	B
BRT 51	Kingsbury High School- Princes Avenue	Co-located
BRT 52	Capitol Way	K
BRT 53	High Road Wembley	K
BRT 54	Brent House	R
BRT 55	High Street- Harlesden	K
BRT 56	Chamberlayne Road	K
BRT 57	Kilburn Bridge	K
BRT 58	51 High Road- Willesden	K

RPS survey

No	Site Location	Class
1	Junction of Kenton Road / Upton Gate	R
2	Junction of Greenford Rd / Harrow Rd / Sudbury Crt Dr	R
3	School, Junction of Watford Rd / Perrin Rd	R
4	Junction of Preston Rd / Shaft. Ave / Woodcock Hill	I
5	Wembley High School, Junction East Lane / Oldborough Rd	R
6	Wembley Hospital, Chaplin Rd	I
7	Junction Ealing Rd / Bridgewater Rd	R
8	School, Claremont Ave	I
9	Junction of East Lane / Wembley Hill Rd	R
10	Coronation Rd	R
11	Kingsbury Hospital, Rose Bates Drive	I

12	Junction of Honey Pot Lane / Kingsbury Way	R
13	Fulton Rd	R
14	Abbeydale Rd	R
15	Ash tree Dell	I
16	Slough Lane	R
17	Old Church Lane	R
18	School, Cambridge Close	I
19	School, Brentfield Rd	R
20	Stonebridge School, Wesley Rd	I
21	Central Middlesex Hospital, Acton Lane	I
22	Junction of Kingsbury Rd / Edgware Rd	R
23	Junction of North Circular Rd / Chartley Ave	R
24	Junction of Church Rd / High Rd	R
25	School, Dollis Hill Lane, Gladstone Park Gardens	I
26	Junction of Dudden Hill Lane / High Road	R
27	Willisden General Hospital, Robson Ave	R
28	Greyhound Rd	R
29	Junction Dollis Hill Lane / Cricklewood	R
30	School, Chichele Rd	R
31	42 Ayestone Ave	I
32	School, Junction of Willisden Ave / Mapesbury Rd	R
33	Barnhill Open Space, near pond	B
34	Gladstone Park, Dollis Hill Lane	B
35	Northwich Park (0m)	R
36	Northwich Park (25 m) R/O Main entrance. Nth Pk Hospital	I
37	Junction of Ealing Rd / Bowrons Ave	I
38	Roundabout, junction of Watford Rd / Kenton Rd	I
39	Holmstall Ave (120 m)	R
40	Roundabout, junction of Bridgewater Rd / Harrow Rd	R
41	R/O 246 Neasden Lane	R
42	Holmstall Ave (2 m)	R
43	Neasden, Brent Reservoir (2m)	R
44	Junction of A5 / A406	R
45	R/O Salisbury Primary School, Salisbury Rd	I
46	Neasden, Brent Reservoir (120 m)	B
47	IKEA, North Circular Rd	R
48	Junction of Kilburn Park Rd / Shirland Rd	R
49	School, Princes Ave	I
50	R/O Brent Town Hall, Forty Lane	I