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SOUTH EAST INSTITUTE OF PUBLIC HEALTH

Stage 1 Review and Assessment Report For the Three Rivers District Council Under Part IV of the Environment Act 1995

18 October 1998

Table 2: DETAILS OF PART A INDUSTRIAL PROCESSES IN THE GREATER LONDON AREA

Operator	Type of process	So2 t/a	Nox t/a	Co t/a	Benzene t/a_	Pm10 t/a	Grid ref.	MAP ID
London Underground G	combustion	1.8	20	0.21	0.00012	0.041	5388017810	13
London Underground G	combustion	1.8	20	0.21	0.00012	0.041	5388017810	
London Underground G	combustion	1.8	20	0.21	0.00012	0.041	5388017810	
London Underground G	combustion	0.92	10	0.1	0.000059	0.0205	5388017810	
Nestle (UK) Ltd	combustion	26	61	0.18	0	3.75	5101517925	14
Nestle (UK) Ltd	combustion	250	79	0.73	0.000234	7	5101517925	
Nestle (UK) Ltd	combustion	250	79	0.73	0.000234	7	5101517925	
Powergen PLC	combustion	3	5.8	0.71	0.000627	0.455	5209018440	15
Powergen PLC	combustion	3.1	6	0.74	0.000627	0.465	5209018440	
Tate and Lyle PLC	combustion	0.005	0.29	16	0.00099	0.063	5422517950	16
Tate and Lyle PLC	combustion	0.076	0.59	14	0.00108	0.064	5422517950	
Tate and Lyle PLC	combustion	0	0.64	0.32	0.00513	0.32	5422517950	
Tate and Lyle PLC	combustion	0.55	2.2	1.8	0.0117	0.71	5422517950	
Tate and Lyle PLC	combustion	0	0.046	0.25	0.00117	0.073	5422517950	
Tate and Lyle PLC	combustion	0	2.7	1.1	0.0135	0.83	5422517950	
Tate and Lyle PLC	combustion	0	0.047	0.085	0.000657	0.041	5422517950	
Tate and Lyle PLC	combustion	0	0.049	0.094	0.000666	0.042	5422517950	
Barking Power Ltd	combustion	0	210	160	1.35	62	5491018232	17
Barking Power Ltd	combustion	0.75	200	150	1.26	60	5491018232	
Barking Power Ltd	combustion	3.1	190	140	1.17	56	5491318255	
Barking Power Ltd	combustion	3	190	140	1.17	56	5491318255	
Barking Power Ltd	combustion	2.9	200	150	1.26	58	5491318255	
Enfield Energy Ltd	combustion	0.41	0.7	0.53	0.0045	0.21	5368019740	18
Enfield Energy Ltd	combustion	0	0.00012	0.000029	0	0.000011	5368019740	
London Underground Ltd	combustion	53	790	240	0.00222	2	5264017700	19
London Underground Ltd	combustion	34	630	200	0.00144	1.25	5264017700	
Littlebrook Power Station	combustion	6600	1600	80	0.0684	24.5	5557017650	20
Littlebrook Power Station	combustion	200	48	2.7	0.000855	0.85	5557117650	
Littlebrook Power Station	combustion	0.99	1.5	0.072	0	0.07	5557017651	
British Airways	inorganic	0	0	0	0	0.000008	5098817600	21
British Airways	inorganic	0	0	0	0	0.000008	5098817600	
British Airways	inorganic	0	0	0	0	0.000008	5098817600	
British Airways	inorganic	0	0	0	0	0.000008	5098817600	

Table 2: DETAILS OF PART A INDUSTRIAL PROCESSES IN THE GREATER LONDON AREA

Operator	Type of process	So2 t/a	Nox t/a	Co t/a	Benzene t/a_	Pm10 t/a	Grid ref.	MAP ID
Colar Fine Art & Graphics Ltd	inorganic	0	0	0	0	0.00013	5151219007	22
Colar Fine Art & Graphics Ltd	inorganic	0	0	0	0	0.00026	5151619007	
Engelhard Clar UK Ltd	inorganic	0.054	0.036	0	0	0.0455	5191816490	23
Exide Battery Ltd	inorganic	0	0	0	0	1.6	5488018285	24
Exide Battery Ltd	inorganic	0	0	0	0	0.6	5488018285	
Exide Battery Ltd	inorganic	0	0	0	0	0.41	5488018285	
Exide Battery Ltd	inorganic	0	0	0	0	0.455	5488018285	
Exide Battery Ltd	inorganic	0	0	0	0	0.0255	5488018285	
Exide Battery Ltd	inorganic	0	0	0	0	0.0075	5488018285	
Gemala Battery Co Ltd	inorganic	0	0	0	0	4.7	5489018320	25
GE Lighting Ltd	inorganic	0	0	0	0	0.0245	5344619575	26
GE Lighting Ltd	inorganic	0	0	0	0	0.9	5344619575	
GE Lighting Ltd	inorganic	0	0	0	0	0.8	5344619575	
GE Lighting Ltd	inorganic	0	0	0	0	0.0125	5344619575	
GE Lighting Ltd	inorganic	0	0	0	0	0.055	5344619575	
GE Lighting Ltd	inorganic	0	0	0	0	0.0075	5344619575	
GE Lighting Ltd	inorganic	0	0	0	0	0.01	5344619575	
GE Lighting Ltd	inorganic	0	0	0	0	0.018	5344619575	
GE Lighting Ltd	inorganic	0	0	0	0	0.09	5344619575	
GE Lighting Ltd	inorganic	0	0	0	0	0.022	5344619575	
GE Lighting Ltd	inorganic	0.47	0	0	0	0	5344619575	
GE Lighting Ltd	inorganic	0	0	0	0	0	5344619575	
GE Lighting Ltd	inorganic	0.21	0	0	0	0	5344619575	
GE Lighting Ltd	inorganic	0.3	0	0	0	0	5344619575	
GE Lighting Ltd	inorganic	0.33	0	0	0	0	5344619575	
GE Lighting Ltd	inorganic	0.45	0	0	0	0	5344619575	
GE Lighting Ltd	inorganic	0.73	0	0	0	0	5344619575	
GE Lighting Ltd	inorganic	0.3	0	0	0	0	5344619575	
GE Lighting Ltd	inorganic	0.068	0	0	0	0	5344619575	
GE Lighting Ltd	inorganic	0.016	0	0	0	0	5344619575	
Hornett Bros Co Ltd	inorganic	23	4.4	0.4	0	0.8	5513018120	27

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Operator	Type of process	So2 t/a	Nox t/a	Co t/a	Benzene t/a_	Pm10 t/a	Grid ref.	MAP ID
Johnson Matthey plc	inorganic	2.7	8.7	0.92	0	0.95	5366319679	28
Johnson Matthey plc	inorganic	0	0	0	0	0.031	5366319663	
Johnson Matthey plc	inorganic	70	110	7	0	0	5366219668	
Johnson Matthey plc	inorganic	0	0	0	0	0.0019	5366619670	
Johnson Matthey plc	inorganic	220	45	2.5	0	0	5367419658	
Johnson Matthey plc	inorganic	220	45	2.5	0	0	5367419658	
Johnson Matthey plc	inorganic	0	0.65	0	0	0	5367419647	
Johnson Matthey plc	inorganic	0.018	4.1	1	0	0.2	5366319649	
Johnson Matthey plc	inorganic	0.018	4.1	1	0	0.2	5366319650	
Jotun Polymer	inorganic	0	0.2	0	0	0.01	5276416766	29
Jotun Polymer	inorganic	0	0	0	0	0.0355	5276416766	
Jotun Polymer	inorganic	0	0.45	0.074	0	0	5276416766	
Jotun Polymer	inorganic	0	0	0	0	0.00255	5276416766	
Jotun Polymer	inorganic	0	0	0	0	0.00085	5276416766	
Jotun Polymer	inorganic	0.063	0.59	1.3	0	0.26	5276416766	
Union Miniere Oxyde (UK) Ltd	inorganic	0	0	0	0	0.445	5454018230	30
Union Miniere Oxyde (UK) Ltd	inorganic	2200	530	50	0	1.35	5455018235	
UOP Ltd	inorganic	0	0.28	0	0	0	5365019650	31
Walterisation UK Ltd	inorganic	0	0.075	0	0	0	5308016620	32
Walterisation UK Ltd	inorganic	0	0.11	0	0	0.0095	5308016620	
Walterisation UK Ltd	inorganic	0	0.34	0	0	0.095	5308016620	
Walterisation UK Ltd	inorganic	0	0	0	0	0.042	5308016620	
Croda Resins Ltd	organic	0.0066	1.1	0.23	0	0.065	5484517985	33
Croda Resins Ltd	organic	0.0036	0.6	0.12	0	0.036	5484517985	
Croda Resins Ltd	organic	0.024	5.6	1.4	0	0.275	5484517985	
Croda Resins Ltd	organic	0.018	4.2	1	0	0.205	5484517985	
Croda Resins Ltd	organic	0.006	1	0.21	0	0.06	5484517985	
Croda Resins Ltd	organic	0.006	1	0.21	0	0.06	5484517985	
Dussek Campbell Ltd	organic	0	0	0	0	0.0034	5526917571	34
Dussek Campbell Ltd	organic	0	0	0	0	0.0115	5526917571	
Dussek Campbell Ltd	organic	0.01	2.4	0.61	0	0.12	5526917571	
HPG	organic	0.0034	0.57	0.12	0	0.0345	5481218745	35
HPG	organic	0.0034	0.57	0.12	0	0.0345	5481218745	

Table 2: DETAILS OF PART A INDUSTRIAL PROCESSES IN THE GREATER LONDON AREA

Operator	Type of process	So2 t/a	Nox t/a	Co t/a	Benzene t/a_	Pm10 t/a	Grid ref.	MAP ID
Brent Smelting Works Ltd	non-ferrous and acid	3.3	0	0	0	0.0465	5232018740	42
Brent Smelting Works Ltd	non-ferrous and acid	0	0	0	0	0	5232018741	
Cohen & Co	non-ferrous and acid	8.8	1.2	12	0	23.5	5460517966	43
Cohen & Co	non-ferrous and acid	110	11	220	0	0.115	5460417961	
Delta Enfield Ltd	non-ferrous and acid	0.27	0.54	71	0	0.55	5369519705	44
Delta Enfield Ltd	non-ferrous and acid	0	0	0	0	0.335	5369519705	
European Colours Ltd	non-ferrous and acid	0	0.074	0	0	0	5455117922	45
European Colours Ltd	non-ferrous and acid	0	0.11	0	0	0	5455217923	
European Colours Ltd	non-ferrous and acid	0	0.044	0	0	0	5455317925	
European Colours Ltd	non-ferrous and acid	0	0.12	0	0	0	5455217926	
European Colours Ltd	non-ferrous and acid	0	0.063	0	0	0	5455217927	
European Colours Ltd	non-ferrous and acid	0	0.074	0	0	0	5455117925	
European Colours Ltd	non-ferrous and acid	0	0.12	0	0	0	5455117924	
European Colours Ltd	non-ferrous and acid	0	0.14	0	0	0	5455117923	
European Colours Ltd	non-ferrous and acid	0	0.16	0	0	0	5455317924	
Frys Metal Ltd	non-ferrous and acid	0	0	0	0	0.04	5304516495	46
Frys Metal Ltd	non-ferrous and acid	0	0	0	0	0.04	5304516495	
Frys Metal Ltd	non-ferrous and acid	0	1	0	0	0.0255	5304516495	
Inco	non-ferrous and acid	0	0.074	0	0	0	5210018250	47
Inco	non-ferrous and acid	0	0.022	0	0	0	5210218242	
Inco	non-ferrous and acid	0	0.074	0	0	0	5209418248	
Inco	non-ferrous and acid	0	0.074	0	0	0	5209818242	
Inco	non-ferrous and acid	0	0.074	0	0	0	5209818244	
Inco	non-ferrous and acid	0	0.074	0	0	0	5209818246	
Inco	non-ferrous and acid	0	0.074	0	0	0	5209818248	
Inco	non-ferrous and acid	0	0.074	0	0	0	5209818250	
Inco	non-ferrous and acid	0	1	0	0	0	5209318241	
Inco	non-ferrous and acid	0	0.0093	0	0	0	5209318243	
Inco	non-ferrous and acid	0	1	0	0	0	5209318245	
Inco	non-ferrous and acid	0	0	0				
Peter Tilling Plastics Ltd	non-ferrous and acid	0	0.052	0	0	0.000005	5210018243	
Tunnel Refineries	non-ferrous and acid	0.74	0	0	0	0	5179818654	48
Wilkinson Sword Ltd	non-ferrous and acid	0	0	0	0	0	5391717930	49
Thames Water Utilities Ltd.	Incineration				0	0.00435	5213018150	50
Thames Water Utilities Ltd.	Incineration						5446018180	51
							5488818014	52

Table 3: Details of Part B Prescribed Industrial Processes in the District of Three Rivers

PROCESSES NON-APPLICABLE TO FURTHER LAQM REVIEW AND ASSESSMENT

Borough	Company type	Easting	Northing	Process
Three Rivers	N/D	507100	198700	Concrete Batching Plant
Three Rivers	N/D	507200	198800	Mortar Batching Plant
Three Rivers	N/D	511600	201500	Crematoria
Three Rivers	N/D	507800	202500	Coating of Metal & Plastic
Three Rivers	N/D	503300	191100	Respraying of Road Vehicles
Three Rivers	N/D	508200	194400	Chemical Treatment of timber

social care

health and health care

professional development & training

environmental research

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Executive summary to Stage 1 Review and Assessment report

The Government has recognised the concerns expressed regarding air quality and sustainability and has provided the National Air Quality Strategy (NAQS) to map out ambient air quality policy in the UK until the year 2005, under Part IV of the Environment Act 1995.

This Act also conferred important new duties and powers on local authorities with respect to local air quality and its management in order to contribute to improving air quality in the UK. For the first time local authorities are required to:

> Review and assess air quality, against the standards and objectives of the Air Quality Regulations 1997, within their respective geographical area for both the current time and 2005
>
> Designate Air Quality Management Areas where the NAQS objectives are unlikely to be met by 2005 and prepare a written action plan for such areas

The Review and Assessment of air quality is the first part of the Local Air Quality Management (LAQM) process, and this report provides the first part of the phased Review and Assessment. The intention of the phasing is to ensure that local authorities only undertake as much work as necessary, enabling those local authorities without air quality problems the opportunity not to use up valuable resources. Specific guidance notes have provided by the DETR for the Review and Assessment.

Every local authority is required to undertake the first stage review and assessment. This consists of an initial screening of industrial, transport and other sources of pollutants, which have a significant impact within an authority's borders. This screening is undertaken for the following air pollutants: benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, fine particles (specifically PM_{10}), and sulphur dioxide. The first stage then assists local authorities in identifying the pollutants and localities, which should be the focus of the further stages of review and assessments.

This, the Stage 1 report for Three Rivers District Council, has reviewed industrial, transport and other sources considered most significant in terms of air quality in the Council's area. To do this the following main sources of data and information have been examined in accordance with the prescriptive methods of the DETR guidance:

> Industrial sources - the London Emission inventory database and Three Rivers District Council's public register of authorised processes
>
> Transport sources – the LTS database (which is a strategic transport model maintained by the Government Office for London)
>
> Other sources – monitoring data from the London Air Quality Network and the DETR website.

The Stage 1 report provides Three Rivers District Council with sufficient detailed information on specific atmospheric emissions and their sources to satisfy the initial requirements of the Environment Act 1995.

The information provided has highlighted that, for the following pollutants, no further action need be taken at the present time:

> Benzene
> 1,3-Butadiene
> Lead

However the report also concludes that further investigation is needed for the remaining pollutants for which air quality objectives for 2005 have been set:

Carbon monoxide
Nitrogen dioxide
PM_{10}
Sulphur dioxide

On the basis of these conclusions the Council is recommended to undertake Stage 2 of the Local Air Quality Management Review and Assessment process for these pollutants only.

Table 3: Details of Part B Prescribed Industrial Processes in the District of Three Rivers

PROCESSES NON-APPLICABLE TO FURTHER LAQM REVIEW AND ASSESSMENT

Borough	Company type	Easting	Northing	Process
Three Rivers	N/D	507100	198700	Concrete Batching Plant
Three Rivers	N/D	507200	198800	Mortar Batching Plant
Three Rivers	N/D	511600	201500	Crematoria
Three Rivers	N/D	507800	202500	Coating of Metal & Plastic
Three Rivers	N/D	503300	191100	Respraying of Road Vehicles
Three Rivers	N/D	508200	194400	Chemical Treatment of timber

1.0 Introduction

1.0.1 This report is intended to assist the Three Rivers District Council undertake the first stage of its first local review and assessment of air quality under the local air quality management process laid down by the Environment Act 1995.

1.0.2 Part IV of the Environment Act 1995 conferred new responsibilities, duties and powers on both the Secretary of State for the environment and local authorities. The responsibilities of the former included the production of the UK National Air Quality Strategy (NAQS), which details policies for implementing European obligations relating to the quality of air. This Strategy outlines the future of ambient air quality, as far, as is possible, in the United Kingdom until the year 2005. The NAQS is itself currently the subject of a review, which is expected to be complete by the end of this year.

1.0.3 The duties imposed upon the Three Rivers District Council include:

Reviewing and assessing air quality, against the standards and objectives of the Air Quality Regulations 1997 (SI 1997/3043), within the local authority's geographical area for both 1995 and 2005

Designating Air Quality Management Areas where the NAQS objectives are unlikely to be met by 2005 and preparing a written action plan for such areas

1.0.4 Part of this process includes consultation with adjoining local authorities, as well as other agencies and stakeholders. The timescale for undertaking this process is two years, following the introduction of the Air Quality Regulations 1997 (SI 1997/ 3043) and the bringing into force of sections 82 - 86 of the Environment Act 1995.

2.0 Development of Review and Assessment

2.0.1 The LAQM process is designed to ensure that the Three Rivers District Council and other local authorities contribute to the Government's air quality objectives as identified in the UK National Air Quality Strategy (NAQS). The purpose of the Review and Assessment, which forms part of the overall process, is to:

review current air quality across the Council's geographical area
assess the current air quality in the Council's area against the NAQS objectives
assess the air quality predicted for 2005 in the Council's area against the NAQS objectives.

2.0.2 The Review and Assessment has three stages, although it is only Stage 1 that must be undertaken by all local authorities. The next stage is to be undertaken only if Stage 1 indicates a potential for elevated levels of air pollution. Similarly Stage 3 is only to be undertaken when informed by Stage 2. The overall process for Review and Assessment is summarised in Figure 1, (with NFA indicating where no further action is required). The Government's overall intention of the phased process is that local authorities only undertake as much work as is necessary.

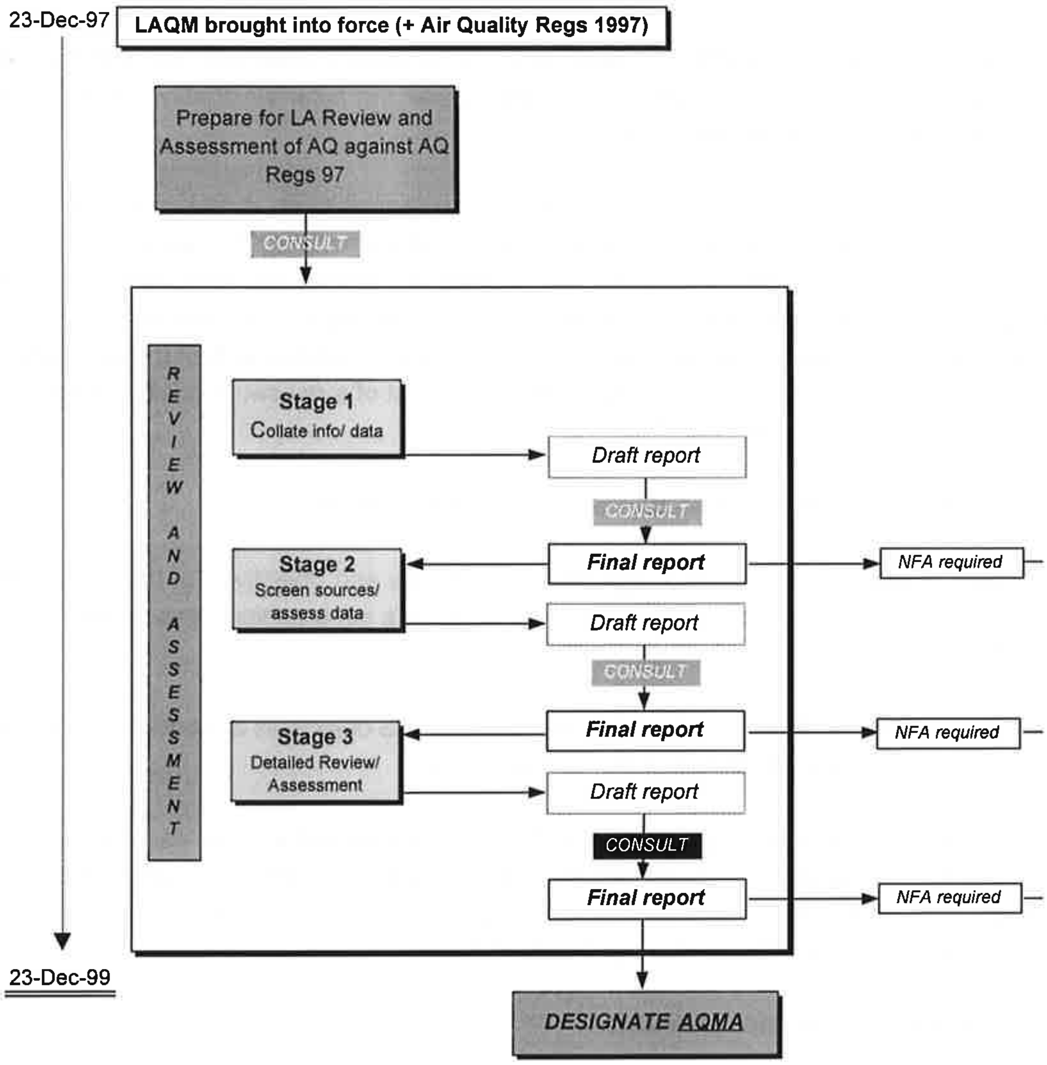


Figure 1

2.0.3 Stage 2 of the Review and Assessment is to be undertaken if areas identified by the first stage have the potential to experience elevated levels of pollution. The second stage then includes a further estimation of the areas influenced by the significant sources. This is based on assessments of air quality monitoring and air quality modelling. The latter includes the use of screening models. If the use of these enables predictions of concentrations in 2005 to be below the NAQS objectives for 2005, then it is not necessary to move to Stage 3.

2.0.4 Stage 3 is the final stage of the Review and Assessment and it is designed to be an accurate assessment of current and future air quality, requiring an assessment of the geographical extent of the areas of exceedence for each pollutant of concern. This information will then be used in the process of designating potential Air Quality Management Areas.

2.0.5 The timetable for the first Review and Assessment of the LAQM process is such that the Government expects it to be completed by the end of 1999, with Stage 1 completed by the end of 1998.

2.0.6 Paragraph 2.04 of circular 15/97 advises that the guidance is not prescriptive and that local authorities should use professional and technical judgement to decide how best to conduct an air quality review and assessment, in the light of local circumstances.

2.0.7 The guidance for LAQM provided to the Three Rivers District Council to date, includes the following:

Environment Circular 15/97 Part IV the Environment Act 1995 Local Air Quality Management - provides introduction to local air quality management

LAQM.G1 (97) Framework for review and assessment of air quality - sets out general principles of reviewing and assessing air quality

LAQM.G2 (97) Developing local air quality strategies and action plans: the principal considerations - general advice on main considerations of local air quality strategy and action plan

LAQM.G3 (97) Air quality and traffic management - advice on altering traffic management plans to contribute to improving air quality

LAQM.G4 (97) Air quality and land use planning - advice on ensuring land use planning makes contribution to improving air quality

LAQM.TG1 (98) Monitoring for air quality review and assessments - advice on techniques

LAQM.TG2 (98) Preparation and use of atmospheric emission inventories - advice on methods and practise

LAQM.TG3 (98) Selection and use of dispersion models - advice on types and use

LAQM.TG4 (98) Review and assessment: pollutant specific guidance - advice on review and assessment

3.0 Stage 1

3.0.1 The Stage 1 guidance is mainly prescriptive, requiring the Three Rivers District Council to compile and collate information on any existing or proposed significant sources of pollution. This is in consideration as to whether anyone in the Council's area may reasonably expect to be exposed to a specific atmospheric pollutant over the averaging period of the appropriate objective for that pollutant. This Stage specifically relates to any processes or activities that are either already in, or will be in, operation by the end of 2005, and for which there is potential for exposure in relevant locations.

3.0.2 The Air Quality Regulations 1997 set down the air quality objectives for the 7 pollutants identified in the NAQS. The pollutants considered are carbon monoxide, benzene, 1,3-butadiene, lead, nitrogen dioxide, PM_{10}, and sulphur dioxide. (Note - the only pollutant excepted from those listed in the NAQS is ozone). Appendix 1 summarises the air quality standards and objectives to be achieved for these pollutants. The expectation of the NAQS is that these will be achieved in much of the country by the end of 2005, although considerable uncertainties remain in a number of cases as to whether the objectives are achievable.

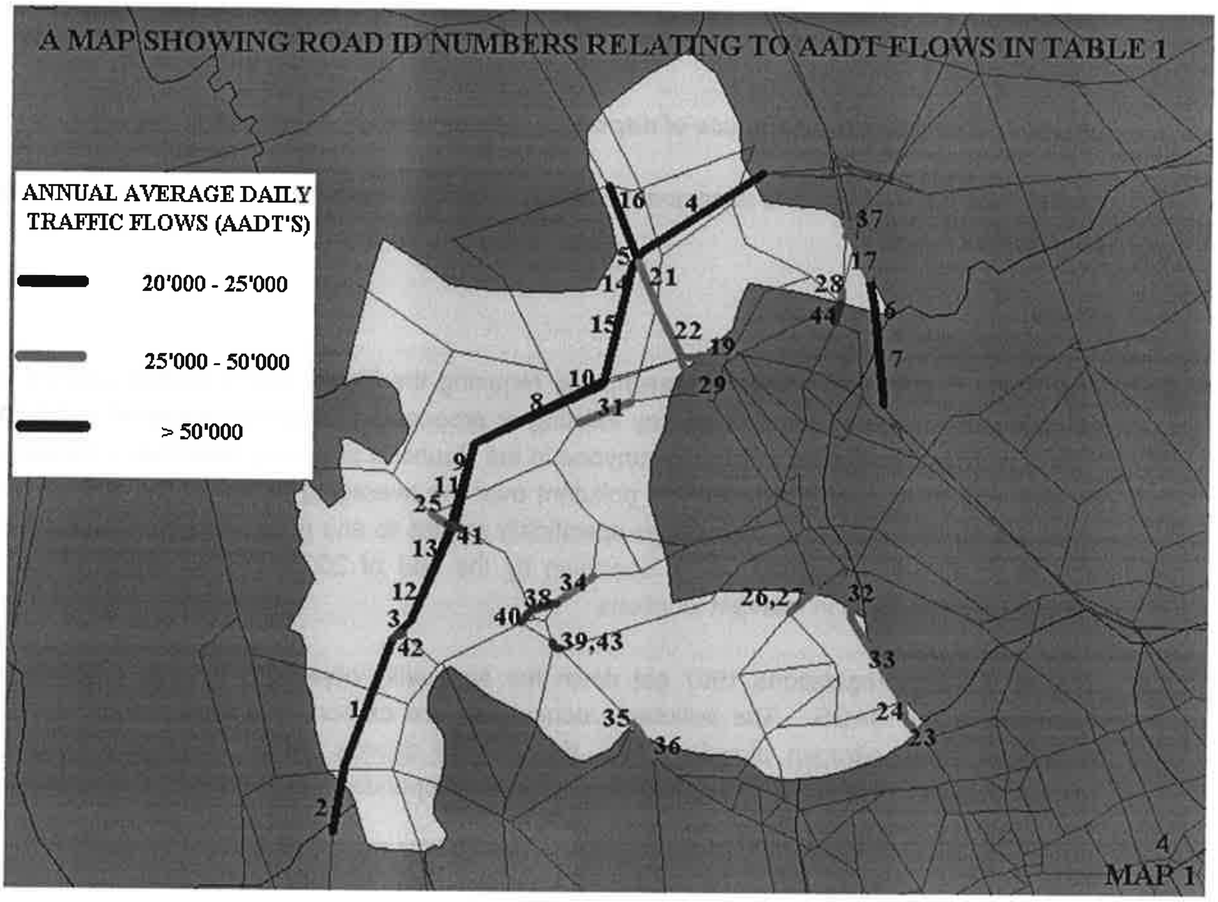
3.0.3 The DETR guidance advises that the Three Rivers District Council should have regard to locations where individuals are likely to be exposed over the averaging time of each prescribed objective. The following interim approach has been recommended:

- for objectives with short averaging times (specifically sulphur dioxide and nitrogen dioxide) the review and assessment should focus on any non-occupational, near ground level outdoor location given that exposures over such short averaging times are potentially likely:

- for objectives with longer averaging times (specifically benzene, 1,3 butadiene, carbon monoxide, PM10, lead and the annual objective for nitrogen dioxide) the review and assessment should focus on the following near ground level outdoor locations: background locations; and other areas of elevated pollutant concentrations where a person might reasonably be expected to be exposed (e.g in the vicinity of housing, schools or hospitals, etc.) over the relevant period of the objective.

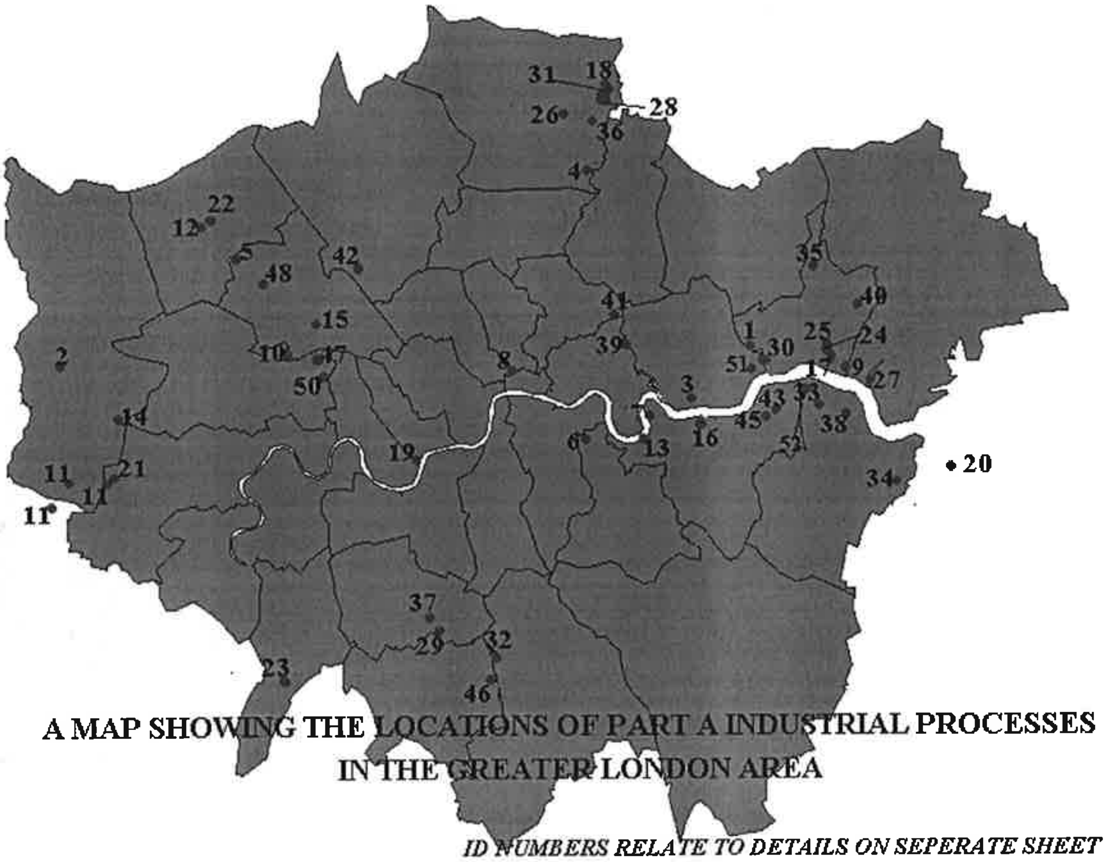
3.0.4 The guidance suggests that the information to be collated include:

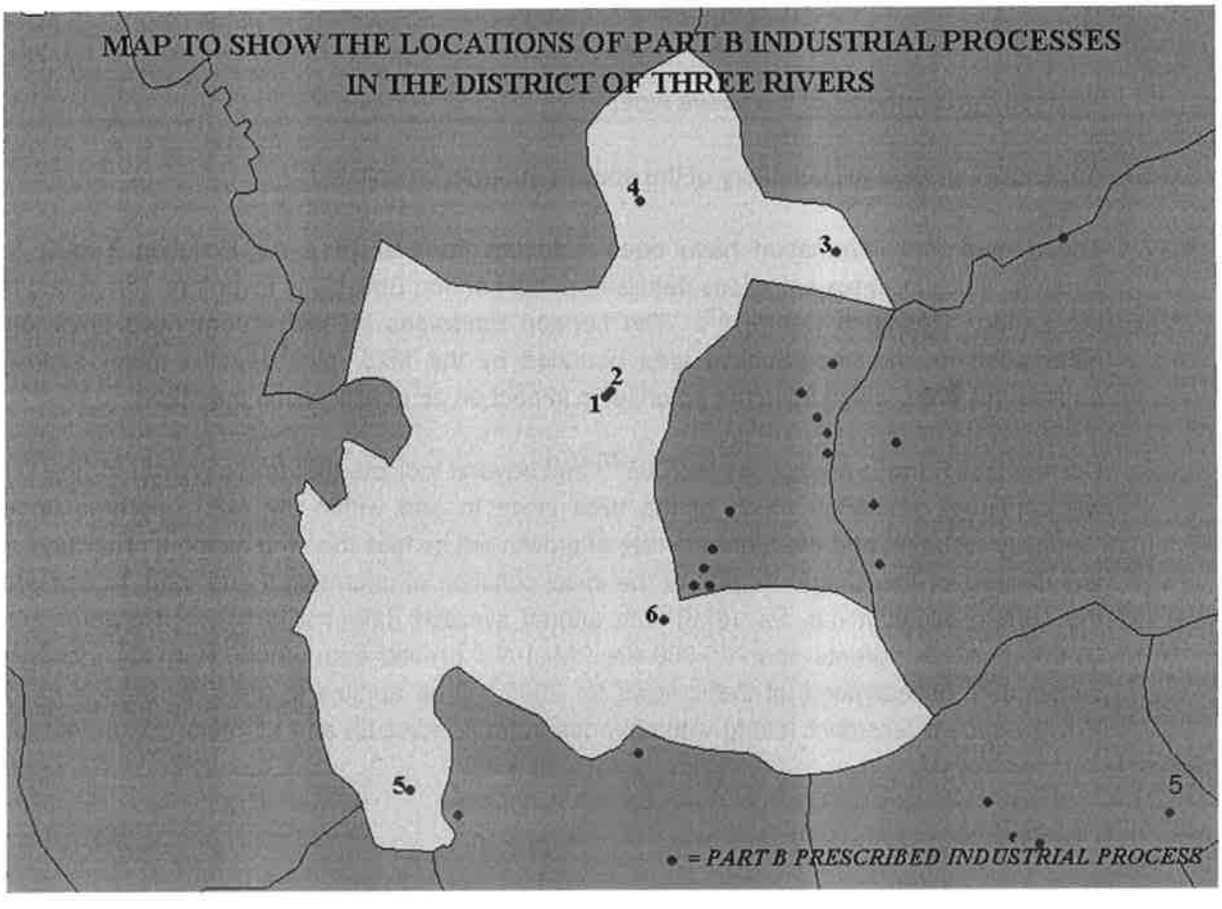
Information on current and 2005 forecast annual average daily traffic flows for major roads. See Map 1 below and Table 1 in Appendix 3.

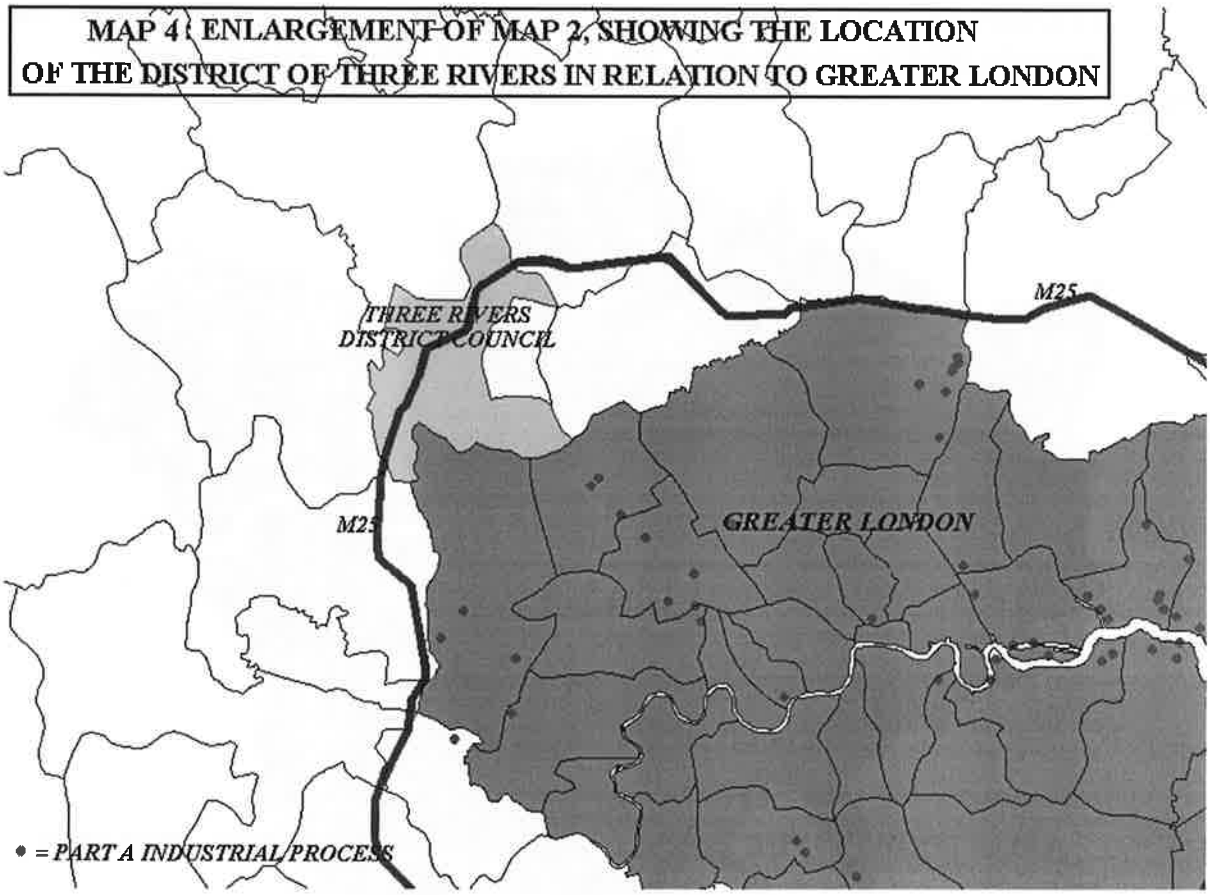


Prescribed Part A and B processes with the potential to emit significant quantities of the listed pollutants. See Maps 2 and 3 below, Map 4 overleaf and Tables 2 and 3 in Appendix 4.

MAP 2







Large solid fuel or oil fired combustion plants

Combinations of sources which could lead to significant emissions, based on a 1 km square grid

Planned developments of the above types

3.0.6 Appendix 2 gives a full summary of the specific information collated.

3.0.7 These data and information have been obtained from SEIPH's Air Pollution Toolkit for London, which includes emissions details from the London Emissions Inventory, (produced by the London Research Centre) [(1)]. The London Emissions Inventory comprises emissions information for the geographical area bounded by the M25, plus specific major sources outside this area, which have the potential to impact on air quality within the M25.

3.0.8 Current DETR traffic predictions to 2005 [(2)] and beyond indicate that traffic growth for the U.K will continue. Although much of the area close to and within the M25 operates under "capacity restraint" and therefore the rate of growth will be less than the national prediction. It is sufficient for this Stage, as part of the initial collation of information and data, to consider the current situation (i.e. for 1996) with annual average daily traffic flows of greater than 20,000 (for NO_2), greater than 25,000 (for PM_{10}) and greater than 50,000 (for CO). However subsequent assessments of traffic flows for 2005 will be applied to the later Stages of the Review and Assessment (along with changes in traffic speeds) and all major roads, not just those with traffic flows greater than those mentioned above, will be modelled for these Stage 3 assessments.

3.0.9 The traffic flows from the London Emissions Inventory are derived from the LTS transport model, which is operated and maintained on behalf of the Government Office for London. It is a well-established strategic tool for the whole of the London area, providing traffic model outputs including details of traffic flows for all the major roads in the greater London area. The roads incorporated include most roads with a traffic flow in excess of 400 vehicles per hour (a.m weekday flow).

4.0 Pollutant Specific - Stage 1 Review and Assessment

4.0.1 Interpretation of the relevant source information, together with background information for each pollutant is given in the following sections:

References

1. LRC (1997) London Atmospheric Emissions Inventory
2. DETR (1997) National Road traffic Forecasts

4.1 Benzene

Air Quality Standard and Objective

The Government has adopted a running annual average of 5ppb as an air quality standard for benzene, with an objective for the standard to be achieved by the end of 2005. The focus of an authority's review and assessment for benzene should be non-occupational near ground level outdoor locations with elevated benzene concentrations in areas where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing, schools, or hospitals, etc.). This has been based on the recommended standard proposed by the Expert Panel on Air Quality Standards [1].

4.1.1 Benzene is a colourless, clear liquid at normal ambient temperatures and is classed as a non-methane volatile organic compound (NMVOC). It therefore readily evaporates and, although small amounts are naturally present in the atmosphere, almost all the benzene detectable is as a result of human activity [1]. There are two major concerns related to benzene. The first is the chemical's carcinogenic effects. Research has shown that heavy exposure in industrial workplaces leads to a small but definite increased risk of developing certain leukaemia's [2]. The International Agency for Research on Cancer (IARC) has classed benzene as a known human carcinogen. Secondly is the role benzene plays in the production of photochemical smog of which ozone is an important constituent.

4.1.2 The major source of benzene is the motor vehicle. It is naturally present in petrol and acts as an anti-knock agent. Since 1989, it has been limited to 5% by volume in both leaded and unleaded petrol by the EC Directive COM (84) 226, although in the UK this level is actually lower with an average content of 2% by volume. The 'cracking' of other aromatic compounds in petrol within the engine and the exhaust also forms benzene. The amount emitted from motor vehicles is therefore dependent as much on the presence of these aromatic compounds, as on the actual amount of benzene present in the petrol. Industry is an additional significant source of benzene emissions, with its main use being as a raw material for the manufacture of other chemicals.

4.1.3 The concentration of benzene in the atmosphere depends not only on the emission rates but also on the effectiveness of removal processes. The major loss mechanism in the troposphere is reaction with OH radicals, which is the initial reaction leading to the formation of ozone. There is also some evidence to suggest that dry deposition at the surface is an important route. The lifetime of benzene in the atmosphere when removed by either of the above mechanisms is approximately 12 days.

4.1.4 Non continuous monitoring results from the London Boroughs suggest that concentrations have been decreasing in the capital over the last few years, although concentrations of the pollutant are affected greatly by the annual variability in weather patterns influencing general mixing and dispersion.

4.1.5 Despite this overall decline in concentration, some sites did exceed the EPAQS standard. For example, in Ealing and Greenwich approximately 20% of their samples exceeded the standard mainly at the roadside sites and petrol stations [3].

4.1.6 The reduction of benzene emissions arising from motor vehicles will have the most impact on benzene concentrations. Progress has already begun to achieve these, e.g. in 1991 EC Directive 91/441/EEC came into force setting tighter emission limits on emissions of, among other pollutants, VOCs. This required the fitting of a three-way catalytic converter to all new cars from 1 January 1993. The three-way catalysts reduce VOC emissions by approximately 75% although they are only effective once the car has warmed up [(4)]. All new cars are also fitted with small carbon canisters to capture petrol vapours from the fuel tank and the engine. The carbon absorbs VOCs, which are purged periodically and fed to the engine, reducing emissions by as much as 90% from parked cars.

4.1.7 Petrol stations are also an important source of public exposure to benzene. Petrol vapour recovery Stage I controls have been put into operation to reduce loss to the atmosphere from stored petrol, its loading, transport and unloading at refineries, distribution terminals and petrol stations. All new service stations must now be fitted with vapour recovery equipment, whilst the controls on existing stations are being phased in by 2004.

4.1.8 **Benzene sources relevant to the Three Rivers District Council Stage 1 Review and Assessment**

The DETR guidance (LAQM.TG4 (98)) advises that emissions from road transport, even at busy roadsides are expected to be below the 2005 objective and therefore do not need to be considered further in the review and assessment. This is due to the impact of three way catalytic converters as described above in (paragraph 4.1.6).

Details of large industrial processes were collated for the first stage review and assessment (see Appendix 4 and Maps 2 and 3) and from these -

No relevant Part A or Part B industrial emission sources of benzene were identified/ or are planned (using LAQM.TG4 – Annexes 1 and 2) within the Council's area or sufficiently close to impact significantly on its area.

4.1.9 **Conclusion**

The first stage review and assessment has indicated that the risk of the benzene air quality objective being exceeded by the end of 2005 is negligible, in localities where there might be exposure to the public over a year.

The Three Rivers District Council therefore need not undertake a second and/ or third stage review of benzene.

References

1. Expert Panel on Air Quality Standards (1994), Benzene.
2. DoE, (1995). Air Quality: Meeting the Challenge.
3. London Wide Benzene Monitoring Programme Annual Report 1995.
4. DoE, (1993). Reducing Emissions of VOCs and Levels of Ground Level Ozone: A UK Strategy.

4.2 1,3-Butadiene

Air Quality Standard and Objective

The Government has adopted a running annual average of 1ppb as an air quality standard for 1,3-butadiene, with an objective for the standard to be achieved by the end of 2005. The focus of an authority's review and assessment for 1,3-butadiene should be non-occupational, near ground level outdoor locations with elevated 1,3-butadiene concentrations in areas where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing, schools, or hospitals, etc.). This has been based on the recommended standard proposed by the Expert Panel on Air Quality Standards (1).

4.2.1 1,3-Butadiene is a non-methane volatile organic compound (NMVOC), which is present in the atmosphere as a gas at normal ambient temperatures. The major concerns surrounding this chemical are its known carcinogenic properties and its contribution to photochemical smog production. Evidence suggests that workers exposed to high levels of 1,3-butadiene have a marginally increased risk of developing cancers of the lymphoid system and bone marrow, lymphomas and leukaemia (1).

4.2.2 All emissions of 1,3-butadiene to the atmosphere are as a result of human activity, with the motor vehicle by far the largest source. There is little or no 1,3-butadiene present in petrol or diesel, but the chemical is formed from the 'cracking' of olefins during combustion. These higher olefins have been increasingly added to petrol over the last ten years and this has probably resulted in an increasing release of 1,3-butadiene into the atmosphere.

4.2.3 1,3-Butadiene is also an important industrial chemical used mainly as a monomer for synthetic rubbers and resins. Apart from accidental releases, however, this is a minor emission route in comparison with the emissions from petrol and diesel combustion.

4.2.4 Despite some peaks of mean concentration none of the measured values exceed the EPAQS standard of 1 ppb. However, concentrations of more than 1ppb are regularly recorded, mainly at the roadside UCL site. This, however, is not an exceedance of the EPAQS standard as the 1 ppb limit is set as a running annual average and not as an absolute value. It is only when high concentrations are prolonged that they could pose any problems to health and such episodes will be detected by the running annual mean.

4.2.5 The main target reduction measures are emissions from motor vehicle exhausts. There have been a number of measures introduced to reduce VOCs generally. These include the compulsory fitting of three-way catalysts to all new cars since 1 January 1993. These can reduce emissions of 1,3-butadiene by up to 95%(2). Additionally all new cars are being fitted with carbon canisters to capture petrol vapours from the fuel tank and from the engine. These reduce general VOC emissions from parked cars but are ineffective during general operation.

4.2.6 The petrol vapour recovery Stage I controls also require the minimisation of losses from stored petrol, its loading, transport and unloading at refineries, distribution terminals and petrol stations.

4.2.7 1,3-Butadiene sources relevant to the Three Rivers District Council Stage 1 Review and Assessment

The pollutant specific guidance (LAQM.TG4 (98)) highlights only specific major industrial processes need be collated for the purposes of the first stage review and assessment. The guidance further advises, as for benzene, that emissions from road transport, even at busy roadsides are expected to be below the 2005 objective and therefore do not need to be considered further in the review and assessment.

Details of large industrial processes were collated for the first stage review and assessment (see Appendix 4 and Maps 2 and 3) and from these -

No relevant Part A or Part B industrial emission sources of 1,3-butadiene were identified/ or are planned (using LAQM.TG4 – Annexes 1 and 2) within the Council's area or sufficiently close to impact significantly on its area.

4.2.8 Conclusion

The first stage review and assessment has indicated that the risk of the 1,3-butadiene air quality objective being exceeded by the end of 2005 is considered negligible, in localities where there might be exposure of the public over a year.

The Three Rivers District Council therefore need not undertake a second and/ or third stage review of 1,3-butadiene.

References

1. Expert Panel on Air Quality Standards (1994), 1,3-Butadiene.
2. DoE, (1993). Reducing Emissions of VOCs and Levels of Ground Level Ozone: A UK Strategy.

4.3 Carbon monoxide

Air Quality Standard and Objective

The Government has adopted an 8-hour running average of 10ppm as an air quality standard for carbon monoxide (CO), with an objective for the standard to be achieved as the maximum 8-hour running average by the end of 2005. The focus of an authority's review and assessment for CO should be non-occupational, near ground level outdoor locations: background locations; roadside locations: and other areas of elevated CO concentrations where a person might reasonably be expected to be exposed over an 8-hour period (e.g. in the vicinity of housing, schools, or hospitals, etc.). This has been based on the recommended standard proposed by the Expert Panel on Air Quality Standards [(1)].

4.3.1 Carbon monoxide is a colourless gas produced from the incomplete combustion of hydrocarbon fuels. Although it can cause death at very high concentrations these tend to be when people are exposed in physically confined situations. Outdoors in ambient air the main threat to health is a reduction in the oxygen carrying capacity of the blood that may increase the risk of problems in individuals with ischaemic heart disease.

4.3.2 In the United Kingdom the largest source of carbon monoxide is motor vehicles. This is true on both a national basis and in terms of their contribution to total emissions in urban areas. Data for London [(2)] indicate that motor vehicles were responsible for 97% of carbon monoxide emissions in 1996.

4.3.3 Carbon monoxide concentrations closely follow traffic activity patterns, with a diurnal variation due to rush-hour traffic activity, most notably in heavily trafficked areas and close to the roadside. Weather conditions also affect dispersion of carbon monoxide and these tend to produce higher concentrations in winter than during summer. For carbon monoxide this seasonal effect is enhanced by the influence of cold start emissions, an effect more significant in winter.

4.3.4 Exceedences of the EPAQS [(1)] recommended standard have occurred mainly at the roadside sites across the LAQN. Where exceedences occur at urban background sites it is generally because these sites are close to a major road or by either pedestrian crossings or traffic lights where vehicles stop and start, producing maximum carbon monoxide output. Generally, the recommended standard is exceeded every year, but mainly in heavily trafficked areas in winter.

4.3.5 The UK NAQS [(3)] show increases in concentration of approximately 3% per year in central London using measurements made by a number of sites and using a number of different techniques. Future projections of carbon monoxide emissions show a downward trend in emissions (both on a national basis and in London) from 1990 to the year 2010 (when the projections end). These are principally due to improvements in vehicle technology, which leads to Government predicting that there will be no exceedences of the EPAQS recommended standard for carbon monoxide, even under exceptional circumstances by the year 2010.

4.3.6 Carbon monoxide sources relevant to the Three Rivers District Council Stage 1 Review and Assessment

The pollutant specific guidance advises that busy roads, specific major industrial processes, areas with high levels of combined source emissions and planned developments need to be identified for the purposes of the first stage review and assessment.

Details of major roads were collated from the SEIPH's LTS database for the first stage review and assessment (see Appendix 3 and Map 1) and from these –

The road sources identified (with greater than 50,000 vehicles per day and listed in Table 1) include:

- **M25**
- **M1**
- **A41**

4.3.7 Conclusion

The first stage review and assessment has indicated that the risk of the carbon monoxide air quality objective being exceeded by the end of 2005 is **not** negligible, in localities where there might be exposure of the public over a year.

The Three Rivers District Council should therefore undertake a second stage review of carbon monoxide.

References

1. Expert Panel on Air Quality Standards (1994), Carbon Monoxide
2. London Atmospheric Emissions Inventory (1997), London Research Centre
3. Department of the Environment (1997) The United Kingdom National Air Quality Strategy

4.4 Lead

Air Quality Standard and Objective

The Government has adopted an annual average of 0.5μgm^{-3} as an air quality standard for lead, with an objective for the standard to be achieved by the end of 2005. The focus of an authority's review and assessment for lead should be non-occupational, near ground level outdoor locations with elevated lead concentrations in areas where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing, schools, or hospitals, etc.). The air quality standard and objective are based on the revised WHO guideline of an annual mean of 0.5μgm^{-3}.

4.4.1 Lead exhibits toxic biological effects in people at both high and low concentrations. In conditions of low level, long-term exposure, critical effects include those on haem synthesis, erythropoiesis, the nervous system and blood pressure. Lead in atmospheric particles is therefore of great interest due to these adverse biological and ecological effects. It was the increase in concentration, medical evidence on the adverse health effects of lead (neurological effects on children) and subsequent public concern, that caused governments to act and legislate to try and reduce the emissions of lead into the environment.

4.4.2 High lead emissions have traditionally arisen due to its application as an anti-knock agent in petrol and its emission during industrial combustion processes. In the UK the main source of lead in air is vehicle-derived, with non-ferrous metal processing the second major source to the atmosphere.

4.4.3 In the UK the common vehicle-derived lead compounds represent some 0.2% of urban particulate matter. The average urban lead concentration is less than 0.1μgm^{-3} with more than 90% found within the fine fraction [(1)]. Consequently, this concentration of lead within the sub-micrometre particulate range permits long-distance transportation within the atmosphere.

4.4.4 Since the mid-1980s the concentration of lead in air has fallen substantially at all site types in the UK. The lead concentration in urban areas has reduced from annual averages of 770 ngm^{-3} (Brent) and 646 ngm^{-3} (Central London) in 1980 to 148 ngm^{-3} and 74 ngm^{-3} respectively, in 1996. Kerbside sites have also seen an equally impressive decrease; at the Cromwell Road site concentrations have fallen from 1370 ngm^{-3} in 1983 to 151ngm^{-3} in 1996. Industrial emissions have also gradually fallen, although these areas still have higher lead concentrations than both rural and urban areas, ranging from 100- 1400ngm^{-3}.

4.4.5 The trend in ambient lead concentration is now one of steady decline. The increased penetration of vehicles equipped with catalytic converters and the use of unleaded petrol will perpetuate this trend. The DETR has estimated that by 2015 the emission to the atmosphere of lead from petrol vehicles will decrease by more than 80% of 1995 values. Thus, in areas where traffic is the major source of lead the annual average should decline. However, it is estimated that in pockets of industrial activity individual plants may introduce significant amounts of lead into the atmosphere. At present such industrial processes are subject to BATNEEC and the EPA 1990 which allow process-dependent emissions to the atmosphere.

4.4.6 Therefore, within the UK the trend in lead concentration in ambient air, where traffic is the major source, should decrease in most urban areas to 100-200 ngm^{-3}. The DETR expect the NAQS target to be realised by 2005 [(2)].

4.4.7 In the UK the lead content was reduced from 0.4 to 0.15 g/l in 1986 and fiscal measures were also introduced to reduce the cost of unleaded petrol. As a result emissions of lead from petrol-engine vehicles, decreased from 8,400 tonnes in 1973 to 2,900 tons in 1986 (a 55% reduction of total lead in petrol) [(3)]. This occurred despite a 25% increase in petrol consumption.

4.4.8 **Lead sources relevant to the Three Rivers District Council Stage 1 Review and Assessment**

The pollutant specific guidance (LAQM.TG4 (98)) advises that the only relevant sources for the purposes of the first stage review and assessment sources are certain specific major industrial processes. The guidance also advises that existing national policies are expected to deliver the prescribed objective for lead at all urban background and roadside sites by 2005.

Details of large industrial processes were collated for the first stage review and assessment (see Appendix 4 and Maps 2 and 3) and from these -

No industrial sources of lead were found in the Council's area (using LAQM.TG4 - Annex 2);

The pollutant specific guidance advises that specific major industrial processes are required for the purposes of the first stage review and assessment. Existing national policies are expected to deliver the prescribed objective for lead at all urban background and roadside sites by 2005.

4.4.9 **Conclusion**

<u>The first stage review and assessment has indicated that the risk of the lead air quality objective being exceeded by the end of 2005 is considered negligible, in localities where there might be exposure of the public over a year.</u>

<u>The Three Rivers District Council therefore need not undertake a second and/ or third stage review of lead.</u>

References

1. Committee on the Medical Effects of Air Pollution (COMEAP) (1995), Non-Biological Particles and Health
2. . Department of the Environment (1997), The United Kingdom National Air Quality Strategy
3. Department of the Environment (1996), Digest of Environmental Protection and Water Statistics No.18

4.5 Nitrogen dioxide

Air Quality Standard and Objective

The Government has adopted a 1-hour average of 150ppb as an air quality standard for nitrogen dioxide (NO_2), with an objective for the standard to be achieved as the hourly maximum by the end of 2005. The Government has also adopted an annual average of 21ppb as an air quality standard with an objective to achieve this by the end of 2005. The focus of an authority's review and assessment should be non-occupational, near ground level outdoor locations with elevated NO_2 concentrations in areas where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing, schools, or hospitals, etc.). The focus of an authority's review and assessment for the hourly objective should be non-occupational, near ground level outdoor locations given that exposures over one hour are potentially likely in these locations. The one hour standard has been based on the recommended standard proposed by the Expert Panel on Air Quality Standards [1] and the further longer-term standard/ objective has been based on the WHO guideline of 21ppb as an annual mean.

4.5.1 Nitrogen dioxide is a gas produced by the reaction of nitrogen and oxygen during combustion. The reaction usually takes place in two stages- first to form nitric oxide (NO) and secondly in time to form nitrogen dioxide (NO_2). The sum of these two compounds is referred to as oxides of nitrogen (NO_x). The majority of oxides of nitrogen emissions are in the form of nitric oxide (approximately 90-95% in motor vehicle exhaust) which is then oxidised by reaction with oxygen-containing compounds to form nitrogen dioxide. Nitric oxide is not considered harmful to people in the ambient atmosphere, nitrogen dioxide however is an irritant gas, which at high concentrations can have serious effects and even low concentrations are considered to have subtle effects on health, particularly on the respiratory system.

4.5.2 The major source of oxides of nitrogen is motor vehicles. This is reflected in the emissions inventories for both the United Kingdom as a whole and London. The amounts of emissions given in these inventories are expressed as emissions of oxides of nitrogen as a nitrogen dioxide equivalent (which should not affect any calculations). Nationally (for 1993) road transport was responsible for 49% of emissions of nitrogen oxides, with other notable contributions from power stations, other industrial combustion and shipping (including oil exploration and production)[2]. Data for London [3] show the road transport contribution to be 75%, with the other major sources being industrial and commercial emissions, other forms of transport and domestic emissions.

4.5.3 Once released to the atmosphere, nitric oxide is rapidly oxidised to form nitrogen dioxide in a reaction with ozone. It is this availability of ozone and the primary emissions of nitrogen dioxide, which controls the proportion of nitrogen dioxide in nitrogen oxides. In an urban centre or street canyon location, the rapid reaction of nitric oxide with ozone can deplete the ozone concentration. Mapping of annual mean nitrogen dioxide concentrations in London [4] showed the highest annual means were found in the centre of London during 1995, with concentrations declining towards the suburbs in all directions. Roadside and kerbside sites typically show higher annual mean nitrogen dioxide concentrations, with sites in inner London also exhibiting higher annual mean nitrogen dioxide concentrations than sites in outer London.

4.5.4 It has been suggested that there are separate mechanisms responsible for 'summer' and 'winter' nitrogen dioxide pollution episodes [(5)]. During summer, under similar conditions to those that may give rise to elevated ozone concentrations, nitrogen dioxide levels may also be enhanced. This occurs as result of the conversion of nitric oxide to nitrogen dioxide by organic peroxy radicals produced in the photochemical reactions, and also as a result of the direct reaction between nitric oxide and ozone. Such 'summer' episodes are characterised by high nitrogen dioxide/oxides of nitrogen ratios, as much of the oxides of nitrogen are in the form of nitrogen dioxide.

4.5.5 During winter episodes, the concentrations of oxides of nitrogen are high, and the ratio of nitrogen dioxide/oxides of nitrogen is only 0.1-0.3. The precise mechanism by which the high levels of nitrogen dioxide are generated is not currently fully understood, but it is thought that the reaction between nitric oxide and oxygen may play a prominent role. During winter air pollution episodes, oxides of nitrogen concentrations can increase dramatically and during one notable episode which occurred in December 1991 concentrations of nitrogen dioxide reached 423ppb at Bridge Place (near Victoria Station), the highest levels recorded since continuous measurements began. Although this was exceptional, winter episodes occur often, and are difficult to manage as they are largely driven by meteorology.

4.5.6 There was a wide range in the number of exceedences of the WHO 1-hour nitrogen dioxide guideline figure (110ppb) during 1995, with no exceedences at some sites, and over 40 at others. Higher numbers of exceedences tend to be found at sites near the centre of London, and at roadside locations. Increases in concentrations of nitrogen dioxide were reported by QUARG [(6)].

4.5.7 Reductions of nitric oxide emissions would reduce peak nitrogen dioxide winter concentrations effectively, by reducing total oxides of nitrogen concentrations, whereas, in summer, a much larger reduction of nitric oxide is likely to be needed before a significant reduction in concentration of nitrogen dioxide will result. It should be noted that any reduction in oxides of nitrogen, however, could cause the undesired effect of increasing ozone concentrations.

4.5.8 Catalytic converters significantly reduce emissions of nitrogen oxides (nitrogen dioxide equivalent) from petrol-driven vehicles. These, together with other improvements in vehicle and fuel technology, are largely responsible for the estimated reductions in emissions of oxides of nitrogen. The benefits are likely to be overcome in time by the predicted increase in number of vehicles on the road, which will increase emissions for a number of largely vehicle-derived pollutants after about 2010[(6)].

4.5.9 **Nitrogen oxide sources relevant to the Three Rivers District Council Stage 1 Review and Assessment**

The pollutant specific guidance advises that busy roads, specific Part A and B industrial processes and areas with an annual mean nitrogen dioxide urban background level greater than 30ppb need to be identified for the purposes of the first stage review and assessment.

Details of major roads were collated from the SEIPH's LTS database for the first stage review and assessment (see Appendix 3 and Map 1) and from these –

The traffic sources identified for those roads with more 20,000 vehicles annual average daily traffic flow (listed in Table 1), include:

- **M25, A41, M1, A412, A402 and the A404.**

Details of large industrial processes were collated for the first stage review and assessment (see Appendix 4 and Maps 2 and 3) and from these -

The industrial sources identified (using LAQM.TG4 - Annex 1 and 2) include:

- **Part A and B industrial sources;**

  No relevant sources were identified in or near to the Council's area

4.5.10 Conclusion

The first stage review and assessment has indicated that the risk of the nitrogen dioxide air quality objectives being exceeded by the end of 2005 is **not** negligible.

The Three Rivers District Council should therefore undertake a second stage review of nitrogen dioxide.

References

1. Expert Panel on Air Quality Standards (1994), Nitrogen dioxide
2. Department of the Environment (1995) Digest of Environmental Statistics, No 17
3. London Atmospheric Emissions Inventory (1997), London Research Centre
4. South East Institute of Public Health (1996) Air Quality in London 1995, The Third Report of the London Air Quality Network.
5. AGMAAPE (1993), Oxides of Nitrogen, HMSO, London.
6. QUARG (1993), Diesel vehicle emissions and urban air quality

4.6 PM_{10}

Air Quality standard and objective

> *The Government has adopted a running 24-hour average of 50μgm^{-3} as an air quality standard for PM_{10}, with the objective for the standard to be achieved as the annual 99th percentile of daily maximum running 24-hour averages (that is no more than four days exceeding the standard in a year), by the end of 2005. The focus of an authority's review and assessment for PM_{10} should be non-occupational, near ground level outdoor locations with elevated PM_{10} concentrations in areas where a person might reasonably be expected to be exposed over a 24 hour period (e.g. in the vicinity of housing, schools, or hospitals, etc.). This has been based on the recommended standard proposed by the Expert Panel on Air Quality Standards [(1)].*

4.6.1 Fine particulate matter, or PM_{10}, is usually defined as particulate matter with a mean aerodynamic diameter less than 10μm). Fine particulate matter can penetrate deep into the lung where no removal mechanism exists and the effects on health have been examined by epidemiological studies of populations focusing on mortality and morbidity [(1), (2), (3), (4)].

4.6.2 Particulate matter in the atmosphere may be classified as either primary or secondary. Primary particles are generated directly from sources such as fossil fuel burning, road vehicles, wind-blown dust and seaspray. Secondary particles are formed within the atmosphere by a series of chemical reactions and/or by the condensation of gases. Both weather and season affect secondary particle generation. Both primary and secondary particles have natural and anthropogenic sources. Natural sources include sea spray, natural fires, soil dust and volcanoes. The most relevant are soil dust and seaspray (seasalt is measured at most inland locations in the UK).

4.6.3 Many processes including combustion, metallurgical processes, quarrying, mining, demolition and construction produce anthropogenic particulate matter. Industrial particulate matter emissions typically consist of large particles, for example from the construction industry, where particulate matter emissions are normally caused by the abrasion of material, producing particles with high settling velocities, which travel short distances. The effect of such sources can be very marked locally.

4.6.4 In the urban environment particles from the erosion of road, pavement and other surfaces such as vehicles tyres can be suspended into the atmosphere. Particles >5μm consist mainly of sea salt, although in winter it is difficult to identify the source of some salt particles.

4.6.5 In London, road transport is the dominant source of PM_{10} although other anthropogenic sources (e.g. construction, mining or combustion processes) may also produce elevated particulate matter concentrations although these fugitive dust emissions have a more localised effect. It is important to note that emissions from these fugitive sources of PM_{10} are very difficult to estimate.

4.6.6 Very fine particles below 1 μm in diameter may remain suspended in the atmosphere for weeks, whereas those greater than 2.5 μm are removed by settling and rain in a matter of hours. The very fine particles can drift for many miles and cause pollution across national boundaries. They can also penetrate into buildings and therefore indoor environments are unlikely to provide protection from exposure.

4.6.7 Earlier studies of urban pollution have shown particles to be predominantly fine, although the chemical composition of PM_{10} in the UK is not well defined and the quantification of sources is still the subject of research.

4.6.8 In urban areas, the annual mean PM_{10} concentration is fairly uniform across the United Kingdom, falling between 15 and 35μgm^{-3}. In London and other metropolitan areas, where vehicles are a major source of PM_{10}, the annual concentration is higher. Measurements of PM_{10} at the roadside have been found to be some 2.5 to 3 times higher than background sites.

4.6.9 In 1995, the LAQN had 8 sites (Haringey, Bexley, Sutton, Westminster, Greenwich, Kensington and Chelsea, Thurrock, and Tower Hamlets) continuously monitoring PM_{10} mass concentrations. These sites were found to have closely related annual means; and 98th percentile values indicated that at these sites there is uniformity in urban PM_{10} concentrations with little variation between urban sites. There were exceedences of the EPAQS recommended standard in summer.

4.6.10 Two distinct types of seasonal (summer and winter) exceedence episodes have been identified, both of which are weather related and are characterised by anticyclonic conditions. Elevated concentrations of PM_{10} during summer were characterised by light winds, high temperatures and clear skies. In the summer, the daily profiles have a single undefined peak, which is accounted for by the increased production of secondary particles in the atmosphere. The winter months are characterised by light winds, low temperatures and shallow mixing layer depths. The winter episodes are thought to be due to two distinct sources:

a) Industrial: which should exhibit strong correlation with sulphur dioxide, carbon monoxide and PM_{10}.

b) Vehicles: which should exhibit strong correlation with nitrogen dioxide, carbon monoxide and PM_{10}.

The winter diurnal variation exhibited by roadside and urban background sites reflects the emission of primary particulates derived from vehicles. The contribution from vehicles will be in the fine particle fraction and although they may contribute greatly to the number of particles, their mass contribution will be negligible.

4.6.11 **PM_{10} sources relevant to the Three Rivers District Council's Stage 1 Review and Assessment**

The pollutant specific guidance (LAQM.TG4 (98)) advises that:
specific Part A and B industrial processes
roads with an annual average daily traffic flow of more than 25,000 vehicles
areas with emissions from low level sources greater than 10 tonnes in any single 1 km x 1km grid square (or average 5 tonnes in several adjacent grid squares)

and areas with an annual background concentration due to secondary particles greater than 8 μgm^{-3}

need to be identified for the purposes of the first stage review and assessment.

Details of large industrial processes were collated for the first stage review and assessment (see Appendix 4 and Map 2 and 3) and from these -

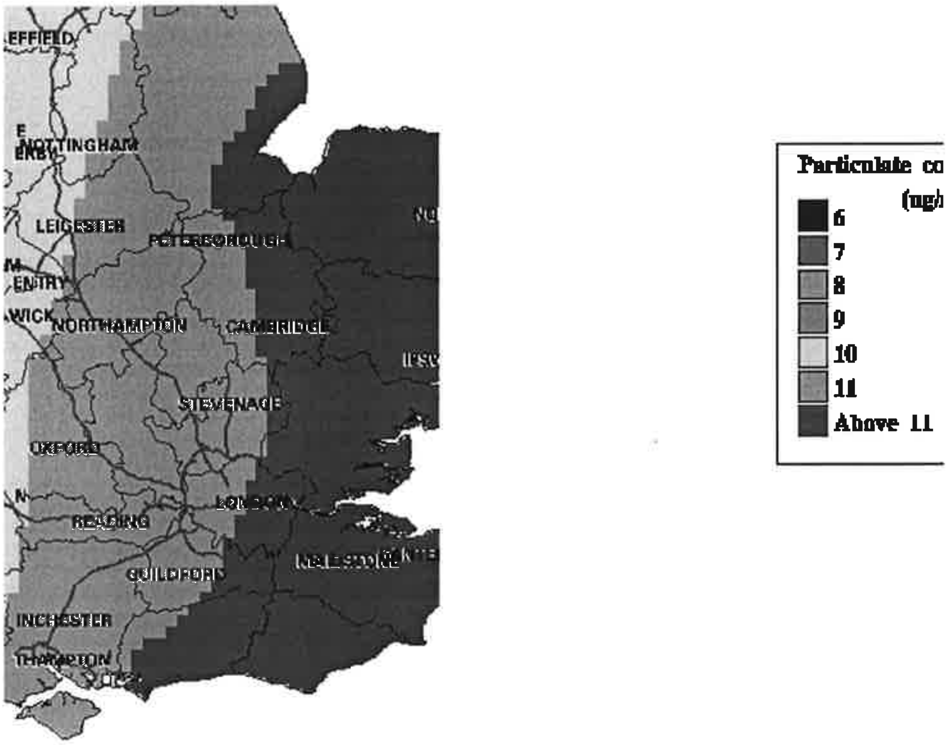
No Part A or Part B industrial processes were identified (using LAQM.TG4 – Annexes 1 and 2) within the Council's area.

Details of major roads were collated from the SEIPH's LTS database for the first stage review and assessment (see Appendix 3 and Map 1) and from these –

The roads with daily vehicle flow greater than 25,000 listed in Table 1. These include the M25, M1, A41, A412, A402 and the A404.

Details of areas with an annual background due to secondary particles greater than 8μgm^{-3} are as follows;

The following map from the DETR website (http://www.environment.detr.gov.uk/airq/aqinfo.html) **shows the concentration of secondary particles for the whole of the Council's area is greater than 8μgm^{-3}.**



4.6.12 **Conclusion**

The first stage review and assessment has indicated that the risk of the PM_{10} air quality objective being exceeded by the end of 2005 is **not** negligible, across the whole of the Council's area.

The Three Rivers District Council should therefore undertake a second stage review of PM_{10}.

The Government however considers that the PM_{10} objective will be the most difficult to achieve for most authorities, since many of the sources are outside the control of individual local authorities. The Government has also established the Airborne Particles Expert Group (APEG) to advise on sources of PM_{10} in the UK and current and future concentrations. The Group's conclusions are expected by the end of 1998.

References

1. Expert Panel on Air Quality Standards (1995), Particles
2. Committee of the Medical Aspects of Air Pollutants (COMEAP) (1995a) Report on Air Pollution and Asthma
3. Committee of the Medical Aspects of Air Pollutants (COMEAP) (1995b) The Effects of Outdoor Airborne Non-biological Particles on Health
4. Dockery, D. W. et al (1993) An association between air pollution and mortality in six US cities. N. Engl. J. Med., 329, 1753 - 1759
5. QUARG(1993), Diesel vehicle emissions and urban air quality
6. South East Institute of Public Health (1997) The AIM report and Air Quality in London 1996, The Fourth Report of the London Air Quality Network.

4.7 Sulphur dioxide

Air Quality Standard and Objective

The Government has adopted a 15-minute average of 100ppb as an air quality standard for sulphur dioxide (SO_2) with the objective for the standard to be achieved as the 99.9th percentile (that is, on all but 35 periods of 15 minutes per year), by the end of 2005. The focus of an authority's review and assessment for SO_2 should be on any non-occupational, near ground level outdoor locations given that exposures over 15 minutes are potentially likely in these locations. This has been based on the recommended standard proposed by the Expert Panel on Air Quality Standards [(1)]. There were a large number of exceedences of the recommended EPAQS standard in London during 1995[(3)].

4.7.1 Sulphur dioxide is an irritant colourless gas, which has been recorded at ambient concentrations as high as 800 μgm^{-3}. Sulphur dioxide is closely associated with particulate matter, which carries on its surface pollutants such as sulphates, nitrates and lead. Acid aerosols are an example of how particulate matter and sulphur dioxide can be closely associated. These are produced from sulphur dioxide, nitrogen dioxide and other acid gases being adsorbed onto particulate matter. Medical evidence has indicated that acid aerosols have an adverse effect upon the respiratory system. [(1)]

4.7.2 Nationally, the main sources of sulphur dioxide have changed in the past few decades. Before the 1960s the main source of sulphur dioxide emissions in urban areas was coal burning. During the 1960s, there began a shift from coal/oil towards natural gas as the main source of domestic fuel [(3)]. This change in fuel usage was coupled with a shift towards the establishment of large coal and oil burning power stations in rural areas. Thus, after the passing of the Clean Air Act 1956 and the move towards the increased use of natural gas, sulphur dioxide emissions fell considerably and altered the pattern of emissions, concentrating these in rural areas. Today, therefore, electricity generation by fossil fuel combustion is concentrated in large power stations with tall chimneys, generally situated in rural areas[(1)]. Changes in the sulphur dioxide emission pattern across the United Kingdom have been responsible for an overall decrease in sulphur dioxide concentrations of more than 50% since 1975.

4.7.3 There are many sources of SO_2 including power stations, shipping, refineries and non-combustion processes. Nationally, the main source of sulphur dioxide is from power generation; more than 70% of emissions are accounted for by electricity generation alone. The combustion of diesel fuel in motor vehicles is another source of sulphur dioxide. Nationally, this source only accounts for some 2% of sulphur dioxide emissions. In London however, the combustion of diesel fuel has a significant effect on sulphur dioxide emissions, and road transport contributes more than 20% of the sulphur dioxide emissions. Diesel engines emit more sulphur dioxide than petrol engines and the sulphur content of diesel fuels has been reduced from 0.2% by weight to less than 0.05%.

4.7.4 It is important to note that whilst large combustion sources do not represent the largest source of sulphur dioxide in London, in terms of the impact on London's air quality it may be the most important, particularly during plume grounding events. For example, the annual average concentration at the Cromwell Road kerbside site is consistently about 10 ppb higher than that at the background site at Bridge Place. This difference is thought to be due to the sulphur dioxide emissions from diesel exhaust. Peak concentrations occur at the same time at the two sites, however, indicating that there is another source, which may contribute to these peak concentrations such as the grounding of plumes from tall chimney stacks.

4.7.5 Emissions are dominated by a few large rural point sources. The pollutants from tall chimney stacks are generally emitted above the temperature inversion and thus the characteristic high concentrations of sulphur dioxide during cold winter smogs no longer occur. The long-term average concentrations in urban areas have greatly decreased. Today, sulphur dioxide pollution is characterised by short-term peak conditions, downwind from power stations where the plume reaches ground level or 'grounds'.

4.7.6 In London, the emission pattern is very different from the national situation. There is a large difference in the relative proportion of sulphur dioxide emissions between the UK as a whole and London. The maximum concentration does not seem to be affected by location because all sites are affected by similar industrial sources. Daily concentrations of sulphur dioxide are, however, more greatly influenced by road traffic emissions.

4.7.7 Generally, the effect on the London conurbation is best illustrated by comparing London urban centre and background sites. The annual mean and hourly maximum sulphur dioxide concentration is higher at the London roadside sites than at urban background locations identifying the influence of London sources on sulphur dioxide concentration. In fact the highest annual mean concentrations are found at Southwark 2, Wandsworth 2 and Barking with the lowest at Greenwich and Bexley. Mean concentrations are lower at background locations in London, and further reduce towards outer London, with lowest values being found at the rural Lullington Heath site in Sussex.

4.7.8 **Sulphur dioxide sources relevant to the Three Rivers District Council Stage 1 Review and Assessment**

The pollutant specific guidance advises that: specific Part A and B industrial processes; solid fuel combustion sources greater than 5MW thermal power; and emissions from low level sources greater than 40 tonnes in any single 1 km x 1km grid square - are required for the purposes of the first stage review and assessment.

Details of large industrial processes were collated for the first stage review and assessment (see Appendix 4 and Maps 2 and 3) and from these the following sources were identified (using LAQM.TG4 -Annexes 1 and 2):

- **Part A industrial sources(listed in Table 2):**

  No Part A industrial sources were identified within the Council's area. However, Kodak Ltd. in the LB of Harrow has the potential to emit significant quantities of pollutant, which may impact within the Council's area.

- **Part B industrial sources (listed in Table 3):**

No Part B industrial sources were identified within the Council's area, or within close enough proximity to the Council's area to have a significant impact.

4.7.10 Conclusion

The first stage review and assessment has indicated that the risk of the sulphur dioxide air quality objective being exceeded by the end of 2005 is **not** negligible.

The Three Rivers District Council should therefore undertake a second stage review of sulphur dioxide.

References

1. Expert Panel on Air Quality Standards (1995) Sulphur Dioxide
2. Department of Transport (1995) Transport Statistics Great Britain
3. South East Institute of Public Health (1996) The Third LAQN Annual Report

5.0 Conclusion and Recommendation

This report on Stage 1 of the Review and Assessment for the Three Rivers District Council provides detailed information on specific atmospheric emissions and their sources to satisfy the initial requirements of the Environment Act 1995. This then enables the Council to make decisions on the need or not to proceed with the next Stage of the Review and Assessment.

The information provided has highlighted that, for the following pollutants, no further action need be taken:

Benzene
1,3-Butadiene
Lead

However this report suggests that further investigation is needed for the remaining pollutants for which air quality objectives for 2005 have been set:

Carbon monoxide
Nitrogen dioxide
PM_{10}
Sulphur dioxide

The Council is therefore recommended to undertake Stage 2 of the Local Air Quality Management Review and Assessment process for these pollutants.

Appendices

1. List of U.K National Air Quality Strategy standards/objectives

2. Summary of Stage 1 source guidance

3. Table 1 provides details of the mapped road links

These details are provided in relation to

- ***Nitrogen dioxide***
- ***PM_{10}***
- ***Carbon monoxide***

4. i) Table 2 provides details of Part B sources
   ii) Table 3 provides details of Part A sources

These details are provided in relation to:

- ***Sulphur dioxide***
- ***Nitrogen oxides***
- ***Carbon monoxide***
- ***Lead***

Appendix 1

Pollutant	**Standard**	**Objective for 2005**
Benzene	*5ppb running annual mean*	*5ppb running annual mean*
1,3-butadiene	*1ppb running annual mean*	*15ppb running annual mean*
Carbon monoxide	*10ppm running 8 hour mean*	*10ppm running 8 hour mean*
Lead	*0.5µg/m³ annual mean*	*0.5µg/m³ annual mean*
Nitrogen dioxide	*150ppb - one hour mean* *21ppb - annual mean*	*150ppb - one hour mean* *21ppb - annual mean*
PM10	*50µg/m³ running 24 hour mean*	*50µg/m³ running 24 hour mean* *(measured as 99th percentile)*
Sulphur dioxide	*100ppb - 15 minute mean*	*100ppb - 15 minute mean* *(measured as 99.9th percentile)*
Ozone	*50ppb running 8 hour mean*	*50ppb running 8 hour mean* *(measured as 97th percentile)*

Appendix 2

Information to be collated for First Stage (from LAQM.TG4(98))

Carbon monoxide

Roads -	- links with AADT flow > 50,000
Industrial	- Part A process (as listed)
Areas	- 1 km x 1 km with low level annual emissions > 2,000tonnes in 2005

Benzene

Industrial	- Part A/B processes (as listed in Annexes 1 and 2)

1,3-butadiene

Industrial	- Part A/B processes (as listed in Annexes 1 and 2)

Lead

Industrial	- Part A/B processes (as listed in Annexes 1 and 2) - industrial or other sites with non-prescribed processes with the potential to emit significant quantities of lead

Nitrogen dioxide

Areas	- with annual mean background in 1996 >30ppb - existing sources measured >30ppb
Roads	- links with project AADT flow > 20,000 in 2005
Industrial	- Part A/B processes (as listed in Annexes 1 and 2)

PM10

Area	- urban areas for which annual average regional background due to secondary particles is > 8ug/m^3 - emissions from low level sources > 10tonnes in single 1km x 1km grid square (or over 5tonnes in several adjacent grid squares
Industrial	- Part A/B processes (as listed in Annexes 1 and 2) - industrial process that emits significant quantities of dust (as PM10) from uncontrolled or fugitive sources
Roads -	links with project AADT flow > 25,000

Sulphur dioxide

Industrial	- Part A/B processes (as listed in Annexes 1 and 2) - solid fuel or fuel oil system with thermal power greater than 5MW
Areas	- 1 km x 1 km with low level annual emissions > 40tonnes

APPENDIX 3

Details of Vehicle Flows and Junction Descriptions for Major Roads in the District of Three Rivers with AADT Flow over 20'000

MAP ID	JUNCTION DESCRIPTION 1	JUNCTION DESCRIPTION 2	AADT FLOW
1	LONG LA SLIPS/M25 FLYOVER/M25/* SCH593	M25/* SCH593 (READ FROM FILE)	148957.70
2	M25/* SCH593 (READ FROM FILE)	M25/* SCH593 (READ FROM FILE)	148957.70
3	LONG LA SLIPS/M25 FLYOVER/M25/* SCH593	M25 FLYOVER/UXBRIDGE RD SPUR SLIPS	127690.90
4	M25/M25 E'BND/M25 W'BND	M25/M25 FLYOVER/HEMPSTEAD RD SLIP	125769.00
5	M25 N'BND/M25 S'BND/M25 FLYOVER	M25/M25 FLYOVER/HEMPSTEAD RD SLIP	110423.40
6	M1 N'BND/M1 S'BND/M1	M1/*BDY WATFORD, HERTS	90011.70
7	M1/*BDY WATFORD, HERTS	M1/*BDY WATFORD, HERTS	90011.70
8	ORBITAL RD W'BND/M25 S'BND/M25 W'BND	NORTH ORBITAL RD N'BND	79465.22
9	NORTH ORBITAL RD N'BND	NORTH ORBITAL RD S'BND	79465.22
10	NORTH ORBITAL RD N'BND	ORBITAL RD E'BND/M25 N'BND/M25 E'BND	78664.10
11	NORTH ORBITAL RD N'BND	NORTH ORBITAL RD N'BND	78664.10
12	M25 FLYOVER/UXBRIDGE RD SPUR SLIPS	NORTH ORBITAL RD N'BND	73334.95
13	NORTH ORBITAL RD S'BND	M25 FLYOVER/UXBRIDGE RD SPUR SLIPS	72294.33
14	ORBITAL RD E'BND/M25 N'BND/M25 E'BND	M25 N'BND/M25 S'BND/M25 FLYOVER	65023.26
15	M25 N'BND/M25 S'BND/M25 FLYOVER	ORBITAL RD W'BND/M25 S'BND/M25 W'BND	63076.45
16	HEMPSTEAD RD/M25 SLIPS	HEMPSTEAD RD/VICARAGE LA	60365.96
17	M1 N'BND/M1 S'BND/M1	M1 N'BND/NORTH ORBITAL RD N'BND SLIP	47907.04
18	ORBITAL RD E'BND/HEMPSTEAD RD	GADESIDE/*BDY THREE RIVERS, HERTS	43662.23
19	GADESIDE/KINGSWAY SLIPS	GADESIDE/*BDY THREE RIVERS, HERTS	43662.23
20	NORTH ORBITAL RD S'BND SLIP/M1 S'BND	M1 N'BND/M1 S'BND/M1	42104.66
21	LANGLEYBURY LA/BRIDGE RD/HEMPSTEAD RD	HEMPSTEAD RD/M25 SLIPS	40206.29
22	LANGLEYBURY LA/BRIDGE RD/HEMPSTEAD RD	ORBITAL RD E'BND/HEMPSTEAD RD	38060.25
23	OXHEY LA/OLD REDDING	OXHEY LA/*NEAR JUNCTION ROWLANDS AVENUE	32491.51
24	OXHEY LA/*NEAR JUNCTION ROWLANDS AVENUE	OXHEY LA/LITTLE OXHEY LA	32491.51
25	SLIPS TO M25 (EAST)/M25 SLIPS N'BND	RICKMANSWORTH RD/SOLESBRIDGE LA	30323.12
26	BROOKDENE AV/HAMPER MILL LA/EASTBURY RD	EASTBURY RD/*BDY THREE RIVERS, HERTS	29012.68
27	EASTBURY RD/*BDY THREE RIVERS, HERTS	OXHEY RD/EASTBURY RD/DEACONS HILL	29012.68
28	NORTH ORBITAL RD S'BND	NORTH ORBITAL RD/ST ALBANS RD	28323.60
29	HEMPSTEAD RD/GROVE MILL LA	HEMPSTEAD RD/*BDY THREE RIVERS, HERTS	27563.46
30	ORBITAL RD E'BND/HEMPSTEAD RD	HEMPSTEAD RD/*BDY THREE RIVERS, HERTS	27376.86
31	RED HALL LA/FIR TREE HILL/CHANDLER'S LA	FIR TREE HILL/LANGLEYBURY LA	27113.41
32	OXHEY LA/*BDY THREE RIVERS, HERTS	PINNER RD/ALDENHAM RD	26402.91

Details of Vehicle Flows and Junction Descriptions for Major Roads in the District of Three Rivers with AADT Flow over 20'000

MAP ID	JUNCTION DESCRIPTION 1	JUNCTION DESCRIPTION 2	AADT FLOW
33	OXHEY LA/LITTLE OXHEY LA	OXHEY LA/*BDY THREE RIVERS, HERTS	26402.91
34	SCOTS HILL/THE GREEN, CROXLEY/WATFORD RD	PARK RD/RICKMANSWORTH BYPASS	26058.06
35	RICKMANSWORTH RD/LONDON RD	WHITE HILL/BATCHWORTH HEATH HILL	25517.05
36	RICKMANSWORTH RD/DUCK'S HILL RD	RICKMANSWORTH RD/LONDON RD	25517.05
37	M1 N'BND SLIP/M1 N'BND	NORTH ORBITAL RD N'BND	25512.62
38	PARK RD/RICKMANSWORTH BYPASS	CHORLEYWOOD RD/RICKMANSWORTH BYPASS	24259.28
39	HAREFIELD RD/MOOR LA	RIVERSIDE DR/MOOR LA/CHURCH ST	22596.60
40	CHORLEYWOOD RD/RICKMANSWORTH BYPASS	RECTORY RD/WENSUM WAY/RIVERSIDE DR	21534.72
41	SLIPS TO M25 (EAST)/M25 SLIPS N'BND	ORBITAL RD SLIP N'BND/RICKMANSWORTH RD	21401.34
42	LONG LA SLIPS/M25 FLYOVER/M25/* SCH593	LONG LA/M25 SLIPS/NORTH ORBITAL RD SLIPS	21266.80
43	HAREFIELD RD/MOOR LA	MOOR LA/LONDON RD	20811.39
44	ST ALBANS RD/GARSTON LA	NORTH ORBITAL RD/ST ALBANS RD	19894.97

APPENDIX 4

Table 2: DETAILS OF PART A INDUSTRIAL PROCESSES IN THE GREATER LONDON AREA

Operator	Type of process	So2 t/a	Nox t/a	Co t/a	Benzene t/a_	Pm10 t/a	Grid ref.	MAP ID
Blagden Packaging Ltd	Incineration	1.2	0	2.8	0	0	5446318308	1
Clinical Energy Ltd	Incineration	0.15	0.51	0.38	0	0	5069618215	2
The Drum Group Ltd	Incineration	1.2	6.8	1	0	0	5414518030	3
Londonwaste Ltd	Incineration	270	710	180	0	440	5357119261	4
Northwick Park Hospital Trust	Incineration	0.98	2.2	1.2	0	1.1	5165018790	5
Northwick Park Hospital Trust	Incineration	0.83	2.7	1.9	0	1.1	5165018790	
ondon Combined Heat & Powe	Incineration	39	480	11	0	8.1	5357017810	6
ondon Combined Heat & Powe	Incineration	39	480	11	0	8.1	5357017810	
AHS Emstar	combustion	0.75	300	69	0.0207	7.6	5391017930	7
AHS Emstar	combustion	0.24	350	110	0.0189	7.9	5391017930	
AHS Emstar	combustion	0.0099	2.7	0	0.0036	0.23	5391017930	
AHS Emstar	combustion	0.015	4	0	0.00531	0.33	5391017930	
AHS Emstar	combustion	0.013	3.6	0	0.00486	0.3	5391017930	
Citigen (London) Ltd	combustion	23	84	150	3.774	12.58	5316318174	8
Citigen (London) Ltd	combustion	23	84	150	3.774	12.58	5316318174	
Ford Motor Co.	Incineration	14	17	2.2	0	22	5499018190	9
Ford Motor Co.	combustion	240	52	4.5	0	7.65	5499018190	
Ford Motor Co.	combustion	260	66	5.2	0	11.22	5499018190	
Ford Motor Co.	combustion	250	92	14	0	7.14	5499018190	
Ford Motor Co.	combustion	290	94	21	0	9.18	5499018190	
Guiness Brewing Ltd	combustion	110	29	22	0.00741	2.7	5193918270	10
Guiness Brewing Ltd	combustion	81	22	17	0.005358	2.05	5193918270	
Guiness Brewing Ltd	combustion	730	91	850	0.05643	33	5193918270	
Guiness Brewing Ltd	combustion	640	80	750	0.04959	29	5193918270	
Heathrow Airport Ltd	combustion	0.81	120	29	0.3666	8.856	5064717441	11
Heathrow Airport Ltd	combustion	0.21	19	7.8	0.02886	1.2546	5074217576	
Heathrow Airport Ltd	combustion	2.7	32	7.3	0.03666	2.1402	5095217572	
Kodak Ltd	combustion	410	160	8.6	0.039536	10.48	5146418967	12
Kodak Ltd	combustion	0.99	38	31	0.13414	3.144	5146618968	
Kodak Ltd	combustion	1.3	45	37	0.16238	3.799	5146618968	