ENVIRONMENT ACT 1995 PART IV LOCAL AIR QUALITY MANAGEMENT

Stage 1 Review and Assessment of the Air Quality

City of Norwich

Draft Consultation Document

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CONTENTS

FOREWORD

THE REVIEW OF THE LOCAL AIR QUALITY WITHIN THE CITY OF NORWICH

Environmental concern is now increasingly focusing on the quality of the atmosphere. Improvements in knowledge, the awareness and links with the effects of air pollution not only on human health but also its degradation of both natural and man-made environments has led to demands that enough is enough. There is a universal understanding that all Countries must take action if the air is to be protected. Everybody has the right to expect good air quality. It is a key issue of sustainability for the future and our children.

The Government has implemented the United Kingdom National Air Quality Strategy and this imposes duties upon Local Authorities to investigate the quality of air in their areas and where necessary take relevant action.

This Review and Assessment of the City's air quality satisfies the Stage 1 requirement under the above strategy.

Cllr Brian Morrey
Chair of Environmental Services Committee
January 1999

INTRODUCTION

1.1. It has been well known for many years that poor air quality can cause both acute and chronic ill health and in some cases even death. Looking back to the winter smogs (smoke and fog) of the early 1950's, several thousand deaths were attributed to one episode alone in 1952. This disastrous episode led directly to the first piece of major legislation, The Clean Air Act 1956, being enacted to control the principal cause of the problem, smoke from domestic fires. Over the years this legislation has been responsible for major improvements in air quality particularly in our cities and urban areas.

1.2. Since the 1970's however, new "smogs" have emerged. Different in make up to the former mixture of smoke and fog, but with similar ill health affects. Initially experienced in the large cities of the United States of America, such as San Francisco and Los Angeles, and then in their European equivalents, Rome and Athens, it quickly became apparent that this pollution had one particular source, the internal combustion engine.

1.3. Investigation into the pollution revealed a cocktail of gases and fine particles. Gradually in the UK, a monitoring network was built up to identify levels of pollution and to build a national picture. By the early 1990's our understanding of air pollution had progressed.

1.4. Air pollution is no respecter of boundaries and so national, European and international action was considered essential to tackle the problems. This was given added impetus at the Earth Summit at Rio de Janiero, Brazil in 1992. Out of this summit came a host of declarations, protocols and actions to tackle many environmental issues in addition to world air quality. In particular, the summit highlighted the principles of sustainability and the obligation we all have to leave the Earth in a better condition for the benefit of following generations.

1.5. Improvements to local air quality was a key objective when the Norwich City Council launched its Environmental Protection Strategy and Policy Statement in 1992. This document gives inter-alia the following objective for Pollution Control 'to protect the human, environment from the harmful effects of pollution'

1.6. Today, air quality forms part of the wider process of a sustainable Norwich through the development of Council's 'Norwich 21' process. ['Norwich 21' is the Councils corporate name for Agenda 21 which is the name given to the process of sustainability borne out of the Rio Summit]

1.7. The present Government, determined to tackle the growing problem of air quality. It incorporated new laws within Part IV of the Environment Act 1995. Two principal requirements were imposed.

1.7.1 Firstly, the Secretary of State for the Environment considered it necessary to review air standards nationally and to produce a

National Air Quality Strategy. This was duly published in March 1997 and sets air quality standards and the dates by which the standards must be achieved, i.e. objectives.

1.7.2 Secondly, the Act places a duty on Local Authorities to review the air quality in their areas and to assess whether the air quality standards and objectives of the National Strategy are being, or are likely to be achieved by 2005. Areas where standards are likely to fall short must be identified and Air Quality Management Areas designated with action plans drawn up specifying the measures to be carried out and the timescales to bring air quality back within the limits.

1.8. There have always been extensive controls over the most polluting individual industrial sources, but this is the first attempt at the formulation of a more strategic and integrated approach to air quality issues.

1.9 There are seven principal pollutants that local authorities have to assess, these are:-

Carbon Monoxide (CO)
Benzene
1,3-Butadiene
Nitrogen Oxides (NO_x)
Lead
Sulphur Dioxide (SO_2)
Fine particles or PM_{10} (Particles under 10μm in diameter)

1.10 Other pollutants have also been considered and details of these can be found in Section 11 of this report.

2.0 THE NORWICH CITY COUNCIL AREA

2.1 INTRODUCTION

2.1.1 The City of Norwich is located in the heart of Norfolk, some 32km west of Great Yarmouth and 72km east of Kings Lynn. The City covers 39 square kilometres and has a population just over 128,000. There are 49 City Councillors who represent the citizens of Norwich through 16 Wards.

2.1.2 Employment in Norwich is dominated by the Service Sector with over 82% of employed people working in this sector. Norwich has a skilled workforce particularly in the professions, education, research and development. Manufacturing, although significantly smaller in employment terms is a crucial sector of the local economy. Smaller businesses are increasingly important providing 12% of total employment but accounting for 70% of a businesses.

2.1.3 The Financial, Business and Professional Services are sited in the centre of Norwich with the Industrial and Trading Estates and the more recent innovation of Business Parks sited throughout the City.

2.2 COMMUNICATIONS

2.2.1 **Roads** The City is served by the following main roads:-

A47 eastwards to Gt Yarmouth
A47 westwards to Kings Lynn
A140 northwards to North Norfolk
A140 southwards to Ipswich
A11 south westwards to Thetford
A146 south eastwards to Lowestoft
A1067 north westwards to Fakenham
A1151 north eastwards to the Norfolk Broads

2.2.2 **Rail** Norwich Station provides Inter-City as well as local services. These are principally passenger routes.

2.2.3 **River** The river Wensum flows through the centre of the City and the principal source of traffic is holiday cruisers in the summer.

2.2.4 **Air** Norwich Airport provides passenger facilities for UK and inter-European flights, as well as heliport facilities to companies transporting workers to offshore gas and oil rig installations.

2.3 ROAD TRANSPORT AND AIR QUALITY

2.3.1 In recent decades the volume and variety of road transport has grown dramatically. Vehicle exhaust emissions have grown to match or indeed exceed other sources of the most important pollutants and today are the dominant source of pollution within most urban areas. The table below details the contributions from road transport to UK emissions.

Pollutant	1995 National Emissions (Kilotonnes)	Road Transport Contribution % of national emissions
Benzene	39	67
1, 3-Butadiene	10	77
Carbon Monoxide	5478	75
Lead	1.47	78
Nitrogen Oxides	2295	46
Particles PM_{10}	232	26
Black Smoke	356	50
Sulphur Dioxide	2365	2
Volatile Organic Compounds	2337	29

Source National Air Quality Strategy

2.3.2 All Government forecasts show that car use is likely to increase for the foreseeable future. The Department of Transport Environment and the Regions has produced local traffic forecasts based on assumptions used in the national forecasts which are in turn based on factors such as car ownership and population forecasts. The following table gives predicted local traffic increases forecast for 1996 - 2006 based on the two alternative scenarios of low and high growth.

Location	Low Growth	High Growth
National (G.B.)	8.4%	22.5%
Norfolk	7.3%	22.2%
Norwich	7.0%	24.3%
Breckland	8.7%	24.8%
Broadland	9.6%	23.8%
Great Yarmouth	4.6%	17.8%
King's Lynn and West Norfolk	7.5%	21.6%
North Norfolk	8.3%	23.0%
South Norfolk	4.9%	18.5%

2.3.3 These figures are of course generalised and individual areas within each Local Authority area may be higher or lower than the forecast. The most recent information for Norwich is detailed in Appendix 3 (source Norfolk County Council Highways)

2.3.4 With the rise in traffic it might be expected that emissions will generally increase. However, Central Government action in promoting better design by, for example, the use of catalytic converters will, it is believed, see a short term general reduction in emissions to 2005. However, as the 21st century progresses, these emissions will start to rise again due to the sheer weight of numbers of vehicles forecasted to be on the roads (assuming current day technology and fuels).

2.3.5 Given that road traffic is responsible for the majority of the polluting gases that Local Authorities are obliged to review, their contribution to the City's air quality will be assessed in greater detail later in the report under each specific pollutant.

2.3.6 It must be stressed that the City's roads do not generally suffer from continuous high levels of traffic or congestion although at times during the day, particularly rush hour, several roads can become slow moving.

2.4 AIRCRAFT, RAIL AND SHIPPING AND AIR QUALITY

2.4.1 The National Air Quality Strategy document has provided information which suggests that emissions from aircraft associated with ground movement, take off and landing cycles contribute little to overall pollution levels.

For this reason it is believed that the contribution of emissions from aircraft using Norwich Airport do not require further consideration in this review.

2.4.2 The railway system uses electric and diesel engined locomotives. Whilst emissions from the diesel engined locomotives can be an important source of pollution, the use of diesel locomotives is steadily decreasing and are used here predominantly for local services which leads the Council to conclude **that the contribution of emissions from this source requires no further consideration in this review.**

2.4.3 Emissions from the engines of cruisers on the Wensun are not thought to contribute detrimentally to the general ambient air quality of the City due to their low numbers and limited periods of use.

It is not felt therefore, that these sources need to be considered further in this Review.

2.5 INDUSTRIAL AIR POLLUTION CONTROL

2.5.1 Within the City, industry is sited mainly on the Industrial and Trading Estates, which are at the following locations:

Bowthorpe Employment Area
City Trading Estate
Fifers Lane
Hellesdon Park Industrial Estate
Norwich Airport Industrial Estate
Riverside Redevelopment Area
Salhouse Road
Sweet Briar Industrial Estate
Vulcan Road
Whiffler Road
White Lodge Trading Estate

2.5.2 The Environmental Protection Act 1990, Part I, introduced new controls over certain "prescribed processes". These processes are considered to be the most polluting and are regulated by way of prior authorisation. The Act established a dual system of enforcement. So called "Part A" processes are regulated by the Environment Agency. These processes tend to discharge pollutants to more than one medium, i.e. air, land and water courses. There 15 such processes within the City.

2.5.3 As Norwich City Council we regulate the "Part B" processes. These are processes whose emission are to the atmosphere. The processes are tightly controlled and each have targets to reduce levels of pollution which are regularly monitored and reviewed. There are 29 such processes within the City.

The Authorised Part A & B process within the City are listed in Appendix 1.

2.5.4 Many of the pollutants emitted from these companies may have a local nuisance effect only. However, emissions from some of the processes includes those of the seven principal pollutants that form this review. The contribution of these pollutants from these sources to the City's ambient air quality will be considered further in this Review under each individual pollutant.

2.6 TRANSBOUNDARY AIR POLLUTION

2.6.1 The transboundary nature of air pollutants has meant that this Review has to consider also the possible sources outside the City boundary. Each of the abutting Local Authorities ie Broadland, Breckland and South Norfolk, have been contacted and a list of each Part A and Part B process within those areas is included in Appendix 2. The contribution of each of these to the City's air quality will be considered as part of the Review of each pollutant.

2.6.2 The relationship between transboundary and local air pollution is difficult to specify. Historically local control has been exercised over sulphur dioxide and nitrogen oxides because of their transboundary effects in for example, Scandinavia with acid rain. These controls also have a local beneficial effect.

Advice from the Government is that ground level ozone episodes experienced in this Region, in the main have their origins in Europe. For this reason, it is not practical to place local controls on the levels of ozone because of the impossibility of enforcement. However, ozone precursors such as oxides of nitrogen can be controlled.

There is also a degree of transboundary movement of small particles (PM_{10}) from Europe and it is believed that often elevated levels are from European sources. It is proposed to examine the contribution in more detail under the review of that particular pollutant.

2.7 FUTURE DEVELOPMENTS TO BE CONSIDERED

Given the Local Air Quality Review and Assessment has to predict what levels of pollutant are likely in 2005, it is important to highlight known potential future developments that may have a bearing. These may include:-

a) Improvements to the trunk road system.

b) Increased use of rail freight and passenger services.

3.0 THE NATIONAL AIR QUALITY STRATEGY AND LOCAL AIR QUALITY MANAGEMENT

3.1 THE NATIONAL AIR QUALITY STRATEGY

3.1.1 Section 80 of the Environment Act 1995 obliges the Secretary of State (for the Environment) to publish a National Air Quality Strategy. That strategy was launched in March 1997.

3.1.2 The UK National Air Quality Strategy sets down standards and objectives for eight specific pollutants which the Government considers to be of concern to human health.

3.1.3 The objectives have been drawn primarily from standards which have been recommended by the Government's Expert Panel on Air Quality Standards (EPAQS) which has considered the scientific and medical evidence on the effects on health of specific pollutants. The standards are not orientated to ecological or environmental considerations such as global warming or climate change. The standards are generally set at a level which avoid significant risks to the health of the most sensitive individuals in the population. The objectives reflect costs, benefits and matters of current technical feasibility.

3.1.4 The recommended objectives laid down in the National Air Quality Strategy have been formalised in the Air Quality Regulations 1997 and are listed in Table below.

AIR QUALITY REGULATIONS 1997 : AIR QUALITY OBJECTIVES	
Substance	**Air Quality Objective levels**
Benzene	5 ppb or less, when expressed as a running annual mean
1,3-Butadiene	1 ppb or less, when expressed as a running annual mean
Carbon Monoxide	10 ppm or less, when expressed as a running 8 hour mean
Lead	0.5 micrograms per cubic metre or less per calendar year
Nitrogen Dioxide	150 ppb or less, when expressed as an hourly mean, and 21 ppb or less when expressed as an annual mean
PM10	50 micrograms per cubic metre or less when expressed as the 99th percentile of daily maximum running 24 hours means
Sulphur dioxide	100 ppb or less, when expressed as the 99.9th percentile of 15 minutes means

For interpretation of terms used see the Air Quality Regulations 1997

3.1.5 The air quality objectives in the Strategy represent the Government's present judgement of achievable air quality by the **end of 2005**.

3.1.6 Although the National Air Quality Strategy concentrates on eight specific pollutants of concern, there are other pollutants in ambient air that are targeted in different ways and some where the knowledge and legislative processes are not yet ready to deliver objectives. For example recent years have seen concern over the use of certain chlorinated hydrocarbons such as

CFC's and ground level ozone. These other pollutants will be referred to later in this review and assessment.

3.2 LOCAL AIR QUALITY MANAGEMENT

3.2.1 Section 82 of the Environment Act 1995, places a duty on Local Authorities to carry out a review and assessment of local air quality. The primary objectives of the review and assessment are to:-

i) identify those areas at local level where national policies and instruments appear unlikely to deliver the national air quality objectives by the end of 2005 as set out in the Air Quality Regulations 1997;
and
ii) ensure that air quality considerations are integrated into Local Authorities' decision making processes such as land use, planning and traffic management.

3.2.2 Where following the review of air quality, the Local Authority is of the opinion that in its assessment against the national targets, local air quality will not meet the objectives, the Local Authority will be required to declare an Air Quality Management Area and to plan strategies and take steps that will ultimately deliver the standard.

3.2.3 The Government in its circular LAQM.G1(97) "Framework for review and assessment of air quality" details the planned approach that Local Authorities should take. Stage 1 is the initial "desk top" study. In cases where specific identified pollutants require further attention, Local Authorities are recommended to move to stage 2, which will include estimation, modelling or measurement of levels of pollutants in areas influenced by road transport, industrial, or other significant sources. If the second stage predicts the national objective will not be achieved, a more detailed third stage will be carried out using more advanced modelling techniques and emission inventories.

3.2.4 The City in this review and assessment will have regard to the quality of air at outdoor locations where members of the public are regularly present. This review does not consider the quality of indoor air.

4 REVIEW AND ASSESSMENT OF CARBON MONOXIDE

INTRODUCTION

Carbon monoxide (CO) is a gas formed by the incomplete combustion of carbon containing fuels. In general, the more efficient the combustion process, the lower the carbon monoxide emissions. At very high levels, prolonged exposure to carbon monoxide can result in death. At lower levels, carbon monoxide reduces the oxygen carrying capacity of the blood which may increase the risk of heart problems in predisposed individuals.

Although the major concern over carbon monoxide in the UK relates to very high indoor concentrations arising from faulty combustion appliances causing fatalities, there is also potentially adverse effects on health from high levels in the outdoor environment.

The main source of carbon monoxide in the UK is road transport which currently accounts for almost 75% of emissions (some 4,000,000 tonnes per year). Of this road transport emission, the predominant source is petrol vehicles which accounts for approximately 70% of the UK total and 95% of all road transport emissions.

The table below details emissions of carbon monoxide in the UK from 1990 – 1995. :

Source	**Emissions (kilotonnes)** 1990	1991	1992	1993	1994	1995	**% of total in 1995**
Road Transport:							
Petrol	5364	5325	5029	4644	4278	3917	71
Diesel	181	188	182	185	194	195	4
Power Stations	294	297	300	259	240	232	4
Domestic	434	458	423	444	395	341	6
Commercial/Public Service	8	8	7	6	5	5	<1
Refineries	5	6	6	6	6	6	<1
Other Industry	990	985	940	746	741	667	12
Offshore Oil & Gas	33	35	36	44	47	48	1
Railways	12	12	12	12	11	11	<1
Aircraft	1	11	11	12	12	13	<1
Shipping	17	18	18	18	17	17	<1
Military	8	7	7	6	6	6	<1
Agriculture	20	20	20	20	20	19	<1
TOTAL	**7377**	**7370**	**6991**	**6402**	**5973**	**5478**	**100**

Source: National Air Quality Strategy

4.1.5 Emissions of carbon monoxide in the UK increased significantly from 6.5 million tonnes in 1970 to 7.4 million tonnes in 1990, an increase of approximately 13%. Emissions have, however, been decreasing since 1990 principally due to the introduction of catalytic converters on petrol vehicles.

4.1.6 The table in 4.1.4 clearly shows the main source of carbon monoxide is motor traffic and concentrations will be highest near to heavily trafficked routes. Petrol engines are designed to operate with just enough air for complete combustion of the fuel. When the engine is operating under other than ideal conditions, particularly when it is idling, when the vehicle is decelerating, or if the engine is cold or poorly maintained, it will produce more carbon monoxide. Diesel engines produce very little carbon monoxide. Monitoring carried out nationally shows concentrations to fall away fairly rapidly with distance away from roads so that carbon monoxide is a local rather than a trans-boundary pollutant. Carbon monoxide is also an indirect greenhouse gas which influences atmospheric chemistry cycles.

4.1.7 The Government has produced a series of national maps providing urban background concentrations due to dispersed road transport. These concentrations have been mathematically modelled and calculated. For the urban area of the City this average annual level is determined to be approximately 0.5 ppm.

4.2 STANDARD AND OBJECTIVE FOR CARBON MONOXIDE

4.2.1 The Government has adopted 10 parts per million (ppm) as a running 8-hour mean as the air quality standard for carbon monoxide and has adopted the objective of achieving the standard by 2005.

4.2.2 The Government has decided that the objective should apply in the following non-occupational, near-ground level, outdoor locations:- background locations; roadside locations; and other areas of elevated carbon monoxide concentrations where a person might reasonably be expected to be exposed (for example in the vicinity of housing, schools or hospitals, etc.,) over a period of 8 hours.

4.3 PRINCIPAL SOURCES OF EMISSIONS OF CARBON MONOXIDE IN THE CITY

4.3.1 ROAD TRANSPORT

4.3.1.1 Given that some 75% of UK emissions of carbon dioxide are from road transport sources, it follows that the principal traffic routes in the City will provide the highest concentrations. The A47 (E&W), A140 (N&S), A11, A146, A1067 and A1151 are the principal line sources.

4.3.1.2 The guidance from the Government identifies road links with annual average daily flows greater than 50,000 as being significant sources. The monitoring data for the City is given in Appendix 3 and there are no roads with either current or predicted AADF of over 50,000.

4.3.1.3 In addition, there are roads in the City which although probably carrying less traffic than the main A roads can become congested and slow moving and therefore emit at times increased amounts of carbon monoxide. This occurs particularly during rush hour. Roads that would fit in this category include those detailed in Appendix 3.

4.3.2 **INDUSTRIAL SOURCES**

4.3.2.1 There are seven prescribed processes within the City regulated as Part B processes under the Environmental Protection Act 1990 Part 1 which have the potential to emit quantities of carbon monoxide. These are -

1 Earlham Crematorium Earlham Road Norwich

2 Jarrold Printing Greyfriars Norwich

3 Waste Oil Burner Constitution Motors 142 Constitution Hill Norwich

4 Waste Oil Burner JR Dain Transmissions 45 Whiffler Road Norwich

5 Waste Oil Burner B Rowland Abbey Lane King Street Norwich

6 Waste Oil Burner A Williams 1-4 Abbey Lane King Street Norwich

7 Waste Oil Burner Revell Pottergate Motors Drayton Road Norwich

4.3.2.2 The Crematorium has a maximum emission value, 100 mg/m^3 as a 60 minute mean and the Printworks a maximum emission value of 100 mg/m^3 as a 30 minute mean. Current monitoring of both processes shows them to be operating well within legal limits. It is believed the both processes have a negligible effect on the overall ambient air quality within the City, and the regulatory control exerted over each should be sufficient to ensure that there is no localised adverse effects. All the waste oil burners are very small units used only during the winter months to heat workshops. Their contribution is considered to be negligible.

4.3.2.3 There are several other potential sources including non prescribed large combustion plant. However, the trend towards the use of natural gas as a fuel has reduced the amount of carbon monoxide from these sources.

4.3.2.4 Part A and Part B processes within adjoining Local Authorities have also been considered. Processes with the potential to emit carbon monoxide include the Crematorium, and the Boilers at British Sugar (Cantley) in Broadland district; the Iron and Steel Process in South Norfolk district and waste oil burners in Broadland, South Norfolk and Breckland districts.

4.3.2.5 Each of these processes is a single point, stand-alone source. In view of the isolation of each plant, the topography of the region and the distance of each from Norwich, it is not considered that any of these sources contribute significantly to the air quality of the City.

4.4 OTHER SOURCES

4.4.1 Other sources of carbon monoxide include that produced by domestic heating systems. The City Council has declared three Smoke Control Areas in the late 60's, although the trend nationally away from coal burning toward natural gas has also reduced the amount of carbon monoxide from domestic sources. It is not felt that these sources contribute significantly to the air quality in the City.

4.5 FUTURE DEVELOPMENTS

4.5.1 The predicted Traffic Counts given in Appendix 3 show that average daily traffic flows of greater than 50,000 are not likely to occur and therefore these line sources are unlikely to release significant quantities of carbon monoxide.

4.6 CONCLUSIONS FOR CARBON MONOXIDE

4.6.1 The Department of Environment, Transport and the Regions believe that existing national policies particularly with regard to improvements in vehicle technology such as greater use of catalytic converters will deliver the national air quality objective by the end of 2005. The City Council's area currently does not include, nor is it expected to see roads carrying the numbers of vehicles at slow speeds which could lead to breaches of the objective.

In conclusion, it is likely that the air quality objective for carbon monoxide will be met and it is not intended to move to a second stage review for this pollutant.

5 REVIEW AND ASSESSMENT OF BENZENE

5.1 INTRODUCTION

5.1.1 Benzene is a known human carcinogen. The effect of long term exposure which is of most concern is leukaemia. It has not been possible to demonstrate a level at which there is zero risk from exposure to benzene. Therefore policies to control benzene concentrations in the ambient air adopt a risk management approach, aiming to attain levels where the risk to health is very small.

5.1.2 In the UK the main atmospheric source of benzene is the combustion and distribution of petrol, of which it is a minor constituent, currently comprising about 2% by volume in the UK, on average. Diesel is a relatively small source. Motor vehicle exhaust gases contain some of this unburned benzene, but they also contain benzene formed from the combustion of other aromatic components of petrol. Motor vehicles are the most important single source on a national basis accounting in 1995 for 71% of total emissions, with 70% of this total arising from petrol vehicles. The refining, distribution and evaporation of petrol from vehicles accounts for about 10% of total emissions.

5.1.3 The Government has produced a series of national maps providing urban background concentrations due to dispersed road transport. These concentrations have been mathematically modelled and calculated. For the urban area of the City this average annual level is determined to be approximately 1.5 ppm.

5.1.4 Since the main sources of benzene are motor vehicles and primary emissions are dispersed and diluted, benzene is a local rather than a transboundary pollutant.

5.1.5 The following table shows the principle sources of benzene in the UK in 1995. :

Source	Emissions (kilotonnes)					% of total in 1995 **
	1990	1995	2000	2005	2010	
Petrol exhaust	30,500	23,000	11,930	7,350	5,680	66
Diesel exhaust	340	440	560	610	680	1
Petrol evaporation	2,820	1,890	2,060	1,270	1,030	5
Other Mobiles	2,540	2,500	2,040	1,730	1,730	-
Stationary Combustion	3,100	2,400	2,230	2,140	2,180	-
Extraction and Distribution of Fossil Fuels	1,480	1,290	1,000	950	910	4
Iron and steel manufacture	600	580	320	320	320	2
Industrial Processes	2,970	2,580	1,440	1,400	1,400	-
Landfill	170	160	160	160	160	1
TOTAL	**44,520**	**34,840**	**21,740**	**15,940**	**14,090**	**100**

Source: National Air Quality Strategy

* Figures rounded to nearest 10 tonnes
** Figures rounded to nearest 1%

5.2 STANDARD AND OBJECTIVE FOR BENZENE

5.2.1 The Government has adopted 5 parts per billion (ppb) or less when expressed as a running annual mean as the air quality standard for benzene and has adopted the objective of achieving the standard by 2005.

5.2.2 The Government has stated that the focus of the review 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 the long term such as in the vicinity of housing, schools or hospitals.

5.2.3 The following table shows the results of benzene monitoring in the City:

	Benzene Diffusion Tubes Annual Averages (ppb)	1997	1998 (TO OCTOBER)
1	Wendene	0.92	0.75
2	St Edmunds Close	0.81	0.64
3	Wellinton Lane	1.83	1.37
4	St Georges St	0.99	0.63
5	Unthank Road	4.10	2.77
6	Tombland	3.01	2.52
7	St Stephens	2.36	1.52
8	Elliott House	1.86	1.11
9	Guildhall	0.99	0.80
	Average	**1.87**	**1.34**

5.2.4 The above figures show that the annual averages were 1.87 & 1.34 ppb for 1997 and to October 1998 respectively. During 1996 the current mean annual background level from the Governments national map estimates the concentration to be between 1.05 – 1.5 ppb.

5.3 PRINCIPAL SOURCES OF BENZENE WITH THE CITY

5.3.1 INDUSTRIAL SOURCES

5.3.1.1 There are no known industrial processes within the City which emit benzene as a pollutant.

5.3.1.2 At present, the Unloading of Petrol into Storage at Service Stations which is a Part B prescribed process under Part I of the Environmental Protection Act 1990, is not considered a process that will be a significant source of Benzene.

5.3.1.3 The Government is currently funding research into levels of benzene around petrol stations. It is likely further guidance will be issued following completion of the research.

5.3.1.4 There are no known industrial processes within adjoining local authority areas which are known to emit Benzene.

5.3.2 ROAD TRANSPORT

5.3.2.1 Given that 67% of benzene emissions are from road traffic, it follows that the highest concentrations are likely to be near major roads.

5.3.2.2 However, as seen from Section 2.3 above, the City does not have roads suffering from continuous high levels of congestion.

5.3.2.3 Norwich City Council have carried out roadside monitoring using diffusion tubes. The kerbside levels averaged at 2.97 ppb annual mean. (Source Air Quality 1996 : NEPG)

5.3.2.4 Of the adjoining Local Authorities only Broadland have carried out monitoring at kerbside, intermediate and general background locations, The kerbside locations gave the highest readings but did not exceed the national air quality standard. (Source Air Quality 1996 : NEPG)

5.4 FUTURE DEVELOPMENTS

5.4.1 There are no future planned developments that are likely to contribute to an increase in benzene in ambient air.

5.5 CONCLUSIONS FOR BENZENE

5.5.1 The Department of the Environment, Transport and the Regions believe that existing national policies, particularly with regard to improvements in vehicle technology such as greater use of catalytic converters, are expected to deliver the national air quality objective by the end of 2005.

5.5.2 By 2005 all petrol service stations will have vapour balancing equipment installed and in use which will contribute to overall reductions in quantities of benzene in ambient air.

In conclusion, it is likely that the air quality objective for benzene will be met and it is not intended to move to a second stage review for this pollutant.

6.0 REVIEW AND ASSESSMENT OF 1,3-BUTADIENE

6.1 INTRODUCTION

6.1.1 1,3-Butadiene is a known carcinogen. As with benzene it is not possible to demonstrate a level at which there is a zero risk.

6.1.2 1,3-Butadiene is a gas at normal temperature and pressure and trace amounts are present in the atmosphere, deriving mainly from the combustion of petrol and of other materials. 1,3-Butadiene is used in industry, mainly in the production of synthetic rubber for tyres.

6.1.3 Although neither petrol nor diesel fuel contain 1,3-Butadiene it is formed in the combustion process from components in the fuel known as olefins. The proportions of these olefins in petrol have been increasing over the last decade and it is likely that the amounts of 1,3-Butadiene emitted into the atmosphere from road traffic have also been rising.

Source	**Emissions (tonnes)***	**Percentage of total ** in 1995**
Petrol Vehicles	6,390	67
Diesel Vehicles	1,030	11
Use of Butadiene as Feedstock	610	6
Butadiene Manufacturer	630	7
Gas Leakage	400	4
Landfill	510	5
TOTAL	**9,570**	**100**

Source: National Air Quality Strategy

* Figures rounded to nearest 10 tonnes
** Figures rounded to nearest 1%

6.1.4 As can be seen from the table the dominant source of 1,3-Butadiene in the UK atmosphere is the motor vehicle. In 1995 petrol vehicles contributed 67% of national emissions. It is also an important industrial chemical and is handled in bulk at a small number of industrial locations in the UK.

6.2 STANDARD AND OBJECTIVE FOR 1,3-BUTADIENE

6.2.1 The Government has adopted 1 part per billion (ppb) or less, as a running annual mean as the air quality standard for 1,3-Butadiene and has adopted the objective of achieving the standard by 2005.

6.2.2 The Government has stated that the focus of the review 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 the long term such as in the vicinity of housing, schools or hospitals.

6.3 PRINCIPAL SOURCES OF 1,3-BUTADIENE WITHIN THE CITY

6.3.1 INDUSTRIAL SOURCES

6.3.1.1 There are no known industrial process within the City which emit 1,3-Butadiene as a pollutant.

6.3.1.2 There are no known industrial processes within adjoining local authority areas that are considered to emit significant amounts of 1, 3 - Butadiene.

6.3.2 ROAD TRANSPORT

6.3.2.1 Given that 67% of 1,3-Butadiene emissions are from road traffic, it follows that the highest concentrations are likely to be near to major roads.

6.3.2.2 However, as seen from section 2 above, the City does not have heavily trafficked roads likely to give rise to high levels of 1,3-Butadiene.

6.3.2.3 There has been no monitoring of 1,3-Butadiene within the City or indeed in other Local Authorities close by. The UK monitoring programme did not commence in earnest until 1994 as the gas requires sophisticated monitoring equipment. Therefore there is little data generally available. No UK site has yet breached the national standard.

6.4 FUTURE DEVELOPMENTS

6.4.1 There are no known future planned developments that are likely to contribute significantly to an increase in 1,3-Butadiene in ambient air.

6.5 CONCLUSIONS FOR 1,3-BUTADIENE

6.5.1 The Department of Environment, Transport and the Regions expect existing national policies to deliver the national air quality objective by the end of 2005.

In conclusion, it is likely that the air quality objective for 1,3-Butadiene will be met and it is not intended to move to a second stage review for this pollutant.

7.0 REVIEW AND ASSESSMENT OF NITROGEN DIOXIDE

7.1 INTRODUCTION

7.1.1 Nitrogen dioxide (NO_2) and nitric oxide (NO) are both oxides of nitrogen and together they are referred to as NO_x. All combustion processes produce some NO_x, but only NO_2 is associated with adverse effects on human health.

7.1.2 Nitrogen dioxide is a reddish brown gas produced by the oxidation of nitric oxide in the atmosphere particularly by ozone. Elevated levels of NO_x occur in urban environments under stable meteorological conditions when the air mass is unable to disperse.

7.1.3 In the presence of sunlight it reacts with hydrocarbons to produce photochemical pollutants such as ozone. In addition, NO_x have a lifetime of approximately one day with respect to conversion to nitric acid. This in turn is removed from the atmosphere by direct deposition, possibly via rain, thereby contributing to acid deposition.

7.1.4 As can be seen from the table below, road transport emissions are the greater primary source of emissions followed by power stations. The table below shows emissions of NO_X in the UK in 1995.

Source	**Emissions (tonnes)***	**Percentage of total ** in 1995**
Power stations	498	22
Domestic	66	3
Commercial/public service	35	2
Refineries	47	2
Iron and steel	48	2
Other industrial combustion	145	6

Non-combustion processes	2	<1
Extraction and distribution of fossil fuels	112	5
Road transport	1,062	46
Railways	21	1
Civil aircraft	16	1
Shipping	114	5
Military	41	2
Off-road	81	4
Waste treatment and disposal	5	<1
Agriculture	2	<1
TOTAL	**2,293**	**100**

Source: National Air Quality Strategy

* Figures rounded to nearest 10 tonnes
** Figures rounded to nearest 1%

7.1.5 Nitrogen dioxide has a variety of environmental and health impacts. It is a respiratory irritant, may exacerbate asthma and possibly increase susceptibility to chest infections. In the presence of sunlight is reacts with hydrocarbons to produce photochemical pollutants such as ozone.

7.2 STANDARD AND OBJECTIVE FOR NITROGEN DIOXIDE

7.2.1 The Government has adopted a one hour average of 150 parts per billion as an air quality standard for nitrogen dioxide, with a specific objective for the standard to be achieved as the hourly maximum by the year 2005. The Government has also adopted an annual average of 21 ppb as an air quality standard with a specific objective to achieve this by the year 2005.

7.2.2 The results of the analysis set out in the National Air Quality Strategy suggests that for nitrogen dioxide a reduction of 5 to 10% over and above that achieved by national measures will be required to ensure that air quality objectives are achieved everywhere by the end of 2005.

7.2.3 The Government has stated that the focus of the review should be non-occupational, near ground level, outdoor locations with elevated nitrogen dioxide concentrations in areas where a person might reasonably be expected to be exposed over the long term such as in the vicinity of housing, schools or hospitals.

7.3 BACKGROUND LEVELS

7.3.1 There has been a considerable amount of monitoring for nitrogen dioxide within the City and the adjoining three Authorities. The monitoring in the City is carried out using diffusion tubes and a continuous analyser. There are 15 diffusion tube sites spread across the City and the continuous analyser which is permanently sited in Elliot House Ber Street.

7.3.2 Diffusion tubes consist of a small perspex tube and contains a stainless steel mesh which has been coated with a chemical that absorbs nitrogen dioxide when the end cap of the tube is removed and air allowed to enter. They are left out for a long period typically anything between one week and one month after which the quantity of nitrogen dioxide can be obtained in laboratory processes.

7.3.3 The following tables show the results of the diffusion tube surveys and continuous monitoring :

	NO_2 Diffusion Tube **Annual Averages** (ppb)	**1995**	**1996**	**1997**	**1998 (to Oct)**
1	Guildhall	20.4	19.9	20.5	14.3
2	Churchhill Road	19.1	17.8	14.6	11.1
3	St Augustines	27.3	31.1	36.0	30.6
4	Vulcan Road	21.0	26.3	26.7	21.7
5	Tombland	25.2	29.8	29.2	24.1
6	Colman Road	20.2	23.7	22.3	20.4
7	Gentlemans Walk	15.1	17.6	18.0	13.5
8	Exchange St	20.7	23.7	24.3	19.4
9	St Stephens	23.2	27.8	26.4	18.4
10	Surrey St	15.7	16.8	22.8	19.6
11	Ipswich Road			24.7	21.1
12	Castle Meadow			31.4	22.4
13	Riverside			27.9	20.9
14	Heartsease Lane			21.0	16.1
15	Elliott House			20.5	14.4
	Average	**20.78**	**23.44**	**24.43**	**19.21**

7.3.4 The monitoring results for Norwich shows that the diffusion tubes in St Augustines and Castle Meadow have a current annual mean of >30ppb, and the current annual mean urban background level from the Government's national map estimates the concentration in 1996 to be between 20.1 – 25 ppb.

7.4 PRINCIPAL SOURCES OF NITROGEN DIOXIDE WITHIN THE CITY

7.4.1 INDUSTRIAL SOURCES

7.4.1.1 There are seven prescribed processes within the City regulated as Part B processes under the Environmental Protection Act 1990 Part 1 which have the potential to emit quantities of Nitrogen Dioxide (NO_x) as a pollutant. These are -

1 Earlham Crematorium Earlham Road Norwich

2 Jarrold Printing Greyfriars Norwich

3 Waste Oil Burner Constitution Motors 142

Constitution Hill Norwich

4 Waste Oil Burner JR Dain Transmissions
45 Whiffler Road Norwich

5 Waste Oil Burner B Rowland
Abbey Lane King Street Norwich

6 Waste Oil Burner A Williams
1-4 Abbey Lane King Street Norwich

7 Waste Oil Burner Revell
Pottergate Motors Drayton Road Norwich

7.4.2 None of these processes has a given prescribed concentration value for nitrogen dioxide or NO_x in general. The quantities released by these processes are therefore very small and may be considered to have a negligible effect on the ambient air quality of the City.

7.4.3 There are two prescribed processes within the City regulated as Part A processes under the Environmental Protection Act 1990 Part 1 which have the potential to emit quantities of Nitrogen Dioxide or NO_x as a pollutant. These are Rhone Poulenc and National Power.

7.4.4 Possible industrial sources located in the adjoining Districts have also been considered. The only source which is considered to have the potential to emit significant quantities of Nitrogen Dioxide or NO_x as a pollutant is British Sugar at Cantley

7.5 ROAD TRANSPORT

7.5.1 Given that road transport accounted for 46% of emissions of nitrogen dioxide in 1995, it follows that the principal traffic routes into the City will provide the highest concentrations. . The A47 (E&W), A140 (N&S), A11, A146, A1067 and A1151 are the principal line sources.

7.5.2 In addition, there are roads in the City which although probably carrying less traffic than the main A roads can become congested and slow moving and therefore emit at times increased amounts of nitrogen dioxide. This occurs particularly during rush hour. Roads that would fit in this category are detailed in appendix 3

7.5.3 Information from the Government is that roads with an average daily traffic flow in excess of 20,000 vehicles emit significant quantities of NO_2 and therefore warrant further attention. The Traffic Counts in Appendix 3 show that there are 13 known roads with projected AADF of over 20,000.

7.6 CONCLUSION FOR NITROGEN DIOXIDE

7.6.1 **In view of the current monitoring results and predicted traffic flows, doubt exists as to whether the Government's objective for this pollutant will be realised therefore, it is proposed to carryout a second stage review for this pollutant.**

8 REVIEW AND ASSESSMENT OF LEAD

8.1 INTRODUCTION

8.1.1 Lead is a naturally occurring element which is found in the earth's crust. It is released naturally from the earth by a variety of processes such as uptake and subsequent release by plants, volcanic activity and the weathering of rocks. Lead is the world's second most widely used metal, the first being Iron. It is used in a variety of industrial processes, the most important of which is the manufacture of batteries which accounts for between 60% - 70% of the annual consumption of 4 million tonnes. Other uses include pigments in paints, glazes, alloys, radiation shielding, plastics and ammunition.

8.1.2 Lead has been used in an organic compound, tetraethyl lead, as a petrol additive. However, due to recognition of the harmful effects of lead this use has significantly declined since 1986 when the maximum permitted lead content of petrol was first reduced from 0.4 to 0.15 grams per litre. This reduction almost halved airborne lead levels in urban areas within months of its introduction.

8.1.3 Human bodies absorb lead through the lungs, stomach and intestines. The element therefore poses a risk when it is ingested or inhaled. The major source of lead emissions is the petrol motor vehicle. Once emitted in exhaust fumes lead particles can remain in the air for 7 to 24 days, the lead laden fumes may be inhaled or settle as dust upon crops, etc. Industrial combustion plants and processes produce the second largest emission of lead. Emissions of lead in the UK in 1995 are shown in the following table:-

Source	**Emissions (tonnes)**	**Percentage of total * 1995**
Road Transport-Petrol	1067	72
Road Transport: Diesel	1	0
Non-Ferrous Metals	140	9
Iron and Steel	46	4
Waste Related Sources	105	7
Industrial Processes	23	2
Industrial Combustion	44	3
Power Stations Combustion	28	2
Domestic Combustion	9	1
Other Combustion	5	0
T O T A L	1492	100

* Figure rounded to nearest 1%

Source: National Air Quality Strategy

8.1.4 The main source of lead intake into the human body is by ingestion with food. Lead may enter food through deposition of dust and rain, containing the metal, on crops. Soil and dust are major sources of lead exposure for children as they transfer the dust from their hands to their mouths. Lead contamination of drinking water by lead pipes and storage tanks can also add to human intake.

8.1.5 High exposure to lead, for example in an industrial environment, can have severe adverse effects on the blood, the central nervous system and the kidneys. Low level exposure to lead can result in its absorption into the body where it can build up in tissues such as bones, teeth and skin. Studies have shown that low levels of lead in blood affects brain development in children, and the central nervous system.

8.2 STANDARD AND OBJECTIVE FOR LEAD

8.2.1 The Government has specified an air quality standard of 0.5 micrograms per cubic metre of air or less per calender year for airborne lead. This is to be achieved by 2005.

8.2.2 The Government has decided that the objective should apply in non-occupational near ground level outdoor locations in areas where a person might reasonably be expected to be exposed over the long term (for example in the vicinity of housing, schools or hospitals, etc.).

8.2.3 The following table shows the results of Lead monitoring in the City:

Lead Annual Averages Micrograms/m^3	**Colman Road**	**Slobottom Park**	**Guildhall**	**Bookers**
1994	0.09	0.08	N/A	0.07
1995	0.10	0.07	0.06	0.06
1996	0.09	0.05	0.04	0.06
1997	0.07	0.05	0.03	0.05
1998(to Oct)	0.05	0.03	0.03	0.03

8.3.2.5 The monitoring results for Norwich shows that in the last five years the highest annual average recorded was 0.1 mg/m^3. During 1996 the current annual mean urban background level from the Government's national map estimates the concentration to be between 40–80 ng/m^3.

8.3 PRINCIPAL SOURCES OF EMISSIONS OF LEAD IN THE CITY

8.3.1 **Road Transport**

8.3.1.1 As the greatest emission of air bourne lead nationally is the petrol vehicle engine, it may be assumed that the principal traffic routes in the City will provide the highest concentrations; the principal line sources are the A47 (E&W), A140 (N&S), A11, A146, A1067 and the A1151.

8.3.1.2 The lead content of petrol has been gradually reduced since the 1970's so that although the number of cars on the roads rose, the total emissions from vehicles remained broadly constant in the 70's and early 80's. In the past decade however a significant decrease in air bourne lead levels has been achieved due to the change of the maximum lead content in petrol from 0.4g/L to 0.15g/L which occurred in January 1986. This change almost halved the lead levels in urban air within months of its introduction. The introduction of unleaded fuel in 1987 has caused a further decrease in lead levels as its share of the market has grown. Since 1993 all new petrol engined cars have been equipped with a catalytic converter and must run on unleaded fuel therefore further increasing that fuel's market share and a corresponding decrease in airborne lead levels. Central Government policy is designed to remove all leaded petrol by the year 2000.

8.3.2 **Industrial Sources**

8.3.2.1 At present there are two Part B processes in the City which use Lead, these are LC Jay in Oak Street and Anglia Lead Ltd in Barker Street (which is near the Bookers sampling location). However, the operations at these processes are covered by the Secretary of States Guidance Note PG6/4 entitled 'Iron, Steel and Non Ferrous Metal Foundry Processes', which are currently processes not considered to be a significant source of Lead. For Anglia Lead Ltd this is borne out by the monitoring carried out at Bookers.

8.3.2.2 There are no Part A processes in the City.

8.3.2.3 There are no known industrial processes within adjoining local authority areas that are considered to emit significant amounts of Lead.

8.4 CONCLUSION FOR LEAD

8.4.1 In view of the lack of industrial sources for lead, the supportive monitoring data and the continuing decrease in the use of leaded petrol by motor vehicles it is expected that the objective for lead will be met by 2005. It is not proposed therefore to carryout a second stage review for this pollutant.

9.0 REVIEW AND ASSESSMENT OF SULPHUR DIOXIDE (SO_2)

9.1 INTRODUCTION

9.1.1 At normal temperature and pressure Sulphur Dioxide (SO_2) is a gas. Each molecule of gas comprises one atom of sulphur combined with two atoms of oxygen. In the presence of water the gas dissolves to produce an acidic solution, this solution naturally oxidises to form sulphuric acid. Natural releases of SO_2 are generated by volcanic activity and marine organisms. Within the UK the principal source of SO_2 is the combustion of fossil fuels which naturally contain sulphur, such as coal and heavy oils.

9.1.2 When SO_2 is inhaled into the human body it dissolves on moist surfaces to form an acidic solution, this acts as an irritant as its presence stimulates nerves in the lining of noise, throat and airways of the lungs. This stimulation causes coughing and may lead to a narrowing of the airways. People exposed to high concentrations of the gas may experience breathing difficulties. Studies have shown that asthmatics and those suffering from chronic lung disease may be particularly susceptible to its affects. During pollution episodes elevated levels of the gas may provoke asthma attacks, currently approximately 4% of the UK population suffer from asthma. SO_2 can also have an adverse affect on vegetation.

9.1.3 In the nineteenth century and early part of the twentieth century dense fogs occurred in the industrial cities. These weather conditions were named “smogs”. They were caused by the combination of sooty particles and SO_2 produced by coal burning in domestic and industrial buildings which could not disperse and dilute due to weather inversions. It was noted that numbers of people with chest illnesses increased and excess deaths occurred during these episodes, particularly among those already affected by lung disease and also in the elderly population.

9.1.4 The linkage of pollution from coal burning and ill health led to the creation of the Clean Air Act of 1956. Subsequently the use of coal as a domestic and industrial fuel within industrial areas has declined. This movement lead to the siting of coal and oil burning power stations in rural areas away from heavily populated cities.

9.1.5 National emissions of sulphur dioxide have decreased by 63% since 1970 and by 52% since 1980. Emissions of sulphur dioxide in the UK in 1995 is shown in the following table:-

	Source Category	Emissions * (kilotonnes)	Percent contribution **
1.	Public Power etc.	1588	67
	Coal	1443	61
	Fuel Oil	145	6
2.	Commercial, institutional, residential combustion plants	123	5
	Domestic	68	3
	Other	55	2
3.	Industrial combustion plants	437	19
	Refineries	123	5
	Iron and Steel	62	3
	Other	352	11
4.	Road transport	51	2
	Petrol exhaust	16	1
	Diesel	35	1
5	Other transport	69	3
6	Other	97	4
	T O T A L	**2365**	**100**

* Figures rounded to nearest kilotonne
** Figures rounded to nearest %

Source: National Air Quality Strategy

9.1.6 Within Norfolk, both Norwich City Council and North Norfolk District Council regularly monitor for SO_2 using semi-automatic analysers at urban background locations.

9.1.7 In Norwich the levels recorded were in the main below 60 ppb. However, monitoring in the centre of Norwich at the Guildhall recorded levels of over 60 ppb between June and October inclusive. In North Norfolk District, monitoring throughout 1996 recorded a maximum level of just under 6 ppb for the month of August.

(Source: NEPG Report 1996)

9.2 STANDARD AND OBJECTIVE FOR SULPHUR DIOXIDE

9.2.1 The Government has adopted a 15-minute average of 100 parts per billion (ppb) as an air quality standard for Sulphur Dioxide. The Government specifies that the standard must be achieved on all but 35 periods of 15 minutes per year is achieved as the 99.9th percentile by the end of 2005. This standard is comparable with a m aximum daily average of 28ppb, when using a semiautomatic m onitoring device. (reference – Instruction Manual : UK Smoke and Sulphur Dioxide Networks AEA Technology Aug 1997)

9.2.2 The following table shows the results of sulphur dioxide monitoring in the City:

	Sulphur Dioxide Annual Averages μ/m^3(ppb)	**1995**	**1996**	**1997**
1	Churchill Road	24(9)	17(7)	7(3)
2	Hardy Road	34(13)	26(10)	16(6)
3	Tuckswood	25(10)	17(6)	18(7)
4	Rouen Road	26(10)	13(5)	15(6)
5	Guildhall	34(13)	58(22)	117(45)
	Average	**28(11)**	**26(10)**	**34(13)**

Month	**Site**	**Av SO_2.**	**Max SO_2.**	**Av SO_2**	**MaxSO_2**
		(Micg/m3)	(Micg/m3)	(ppb)	(ppb)
Jan-97	Guildhall	32	69	12	26
Feb-97	Guildhall	38	69	15	26
Mar-97	Guildhall	58	82	22	31
Apr-97	Guildhall	60	107	23	41
May-97	Guildhall	120	239	46	91
Jun-97	Guildhall	164	239	63	91
Jul-97	Guildhall	237	330	90	126
Aug-97	Guildhall	264	444	101	169
Sep-97	Guildhall	164	444	63	169
Oct-97	Guildhall	116	195	44	74
Nov-97	Guildhall	85	170	32	65
Dec-97	Guildhall	62	92	24	35

9.2.3 The monitoring results for Norwich show that the annual average for 1995, 1996 &1997 were 11, 10 &13 ppb respectively. However if we look in more detail at the invividual months for the Guildhall, it can be seen that on several occasions the level exceeds the set standard. During 1996 the current annual mean urban background level from the Government's national map estimates the concentration to be between 8.1 – 10 ppb.

9.3 PRINCIPAL SOURCES OF EMISSIONS OF SULPHUR DIOXIDE IN THE CITY

9.3.1 Road Transport

9.3.1.1 Road transport provides a relatively small source of SO_2 , diesel burning engines generate higher levels than their petrol counterparts.

9.3.1.2 National research has shown an increase in SO_2 levels at the kerbside but concentrations are not usually sufficient to exceed the air quality standard. However, monitoring of SO_2 in the City has exceeded the standard at Gaol Hill (Guildhall).

9.3.2 Industrial Sources

9.3.2.1 There is one Part B Authorised process within the City that may emit significant quantities of SO_2. This is Redland Aggregates in Old Station Road Trowse.

9.3.2.2 There is one Part A regulated processes located outside the City area which potentially could emit substantial quantities of SO_2. This is British Sugar at Cantley.

9.3.2.3 Solid fuel or heavy fuel oil boilers and furnaces with a thermal power rating greater than 5MW may produce significant quantities of sulphur dioxide. A survey by telephone of forty buisness and institutions within, and in close proximity to, the City was undertaken to identify oil fired boilers over 5MW. As yet only 4 sites have been identified with boilers of this size and these run on a dual-fuel system where by gas power is the norm except in extreme weather conditions when the Gas companies interrupt the gas supply. These are University of East Anglia (2 x 7 MW), Colmans (2 x 13.8 MW) and Norwich Corrugated Board (1 x 5.6MW & 1 x 7 MW)

9.3.3 **Domestic Sources**

9.3.3.1 Emissions of sulphur dioxide from domestic heating systems has reduced with gas replacing solid fuels and fuel oil, such that the overall concentration from this source is low and would not contribute significantly to the air quality of the City.

9.4 CONCLUSION

9.4.1 **In view of the Part A & B Processes, the current monitoring data and the Solid-Fuel / Fuel Oil Combustion systems > 5MW doubt exists as to whether the Governments objective for this pollutant will be realised therefore, it is proposed to carryout a second stage review for this pollutant.**

10.0 REVIEW AND ASSESSMENT OF FINE PARTICLES OR PM_{10}

10.1 INTRODUCTION

10.1.1 PM_{10} is defined as the total mass (per unit volume of air) or particles of medium aerodynamic diameter less than 10 μm (one micron equals 1/1,000,000 metre). These particles have the greatest likelihood of reaching the lung. It is for this reason that they are of concern.

10.1.2 Unlike the individual gaseous pollutants which are single, well defined substances, particulate matter in the atmosphere is composed of a wide range of materials arising from a variety of sources. Examples of man-made primary sources are: carbon particles from incomplete combustion; ash; recondensed metallic vapours; and so called secondary particles or aerosols, formed by chemical reactions in the atmosphere. In addition to being emitted directly from combustion sources, man-made particles can arise from: mining; quarrying and construction operations; brake and tyre wear in motor vehicles; and from road dust lifted by moving traffic or strong winds. Natural sources of particles include wind blown dust from agricultural activity and importantly for coastal authorities sea salt, and biological particles such as pollens and fungal spores.

10.1.3 The following table shows the principal sources of emissions of PM_{10} in the UK in 1995.

Source	**Emissions (kilotonnes) ***	**Percentage of Total ****
Power Stations (Fossil Fuelled)	34	15
Domestic	20	9
Commercial/public service	5	2
Refineries	7	3
Iron and Steel	20	9
Other Industrial Combustion	15	6
Construction	4	2
Industrial Processes	30	13
Mining & Quarrying	29	12
Extraction and distribution of Fossil Fuels	0	0
Solvent Use	0	0
Road Transport		
Diesel	43	18
Petrol	11	5
Non-exhaust (Tyres and Brakes)	5	2
Other Transport	7	3
Waste Treatment and Disposal	0	0
Agriculture	2	<1
T O T A L	**232**	**100**

* Figures rounded to nearest kilotonne
** Figures rounded to nearest 1%

Source: Quality of Urban Air Review Group, Airborne Particulate Matter in the United Kingdom, London, 1996

10.1.4 The dominant source of primary PM_{10} is from vehicles and in particular diesel vehicle emissions. However, added to these primary sources are secondary particles formed by the chemical reaction of gases within the atmosphere. Unlike primary particles they are less easy to ascribe to their original sources. They comprise mainly ammonium sulphate and nitrate, originating from oxidation of sulphur and nitrogen oxides to acids which are then neutralised by atmospheric ammonia derived from agricultural sources. These chemical processes are slow and their persistence in the atmosphere prolonged. They are therefore distributed more evenly throughout urban and rural areas and are important in the transboundary effects of this pollutant. Several

episodes of poor air quality have been attributed to the importation of PM_{10} from the continent.

10.2 STANDARD AND OBJECTIVE FOR PM_{10}

10.2.1 The Government has adopted 50 $\mu g/m^3$ (microgrammes per cubic metre) as a running 24-hour mean. In view of problems linked to the transboundary nature of the pollutant and to excesses of this standard for social or cultural reasons (for example bonfire night) the Government has adopted a percentile approach to the management of PM_{10} levels. The objective is $50\mu g/m^3$ running 24-hour mean as a 99th percentile (i.e. on all but four days per year assuming perfect operation of monitoring equipment with 100% data capture).

10.2.2 The Government has stated that the objective for PM_{10} should apply in the following non-occupational, near ground level outdoor locations: background locations; roadside locations; and other areas of elevated PM_{10} concentrations where a person might reasonably be expected to be exposed (e.g. in the vicinity of housing, schools or hospitals, etc.,) over a 24-hour period.

10.2.3 There has been no monitoring for PM_{10} by the Norwich City Council. However the Governments national map estimates the current annual mean urban background level for 1996 to be between 25.1 – 27.5 $\mu g/m^3$

10.3 PRINCIPAL SOURCES OF PM_{10} WITHIN THE CITY

10.3.1 Industrial Sources

10.3.1.1 There are no "Part A" processes within the City. The following "Part B" processes all have the potential to emit PM_{10}. Those with potential to emit significant quantities are highlighted in bold.

Reference	Applicant	Address	Process
EPA91/3/B1	NCC CREMATORIUM	EARLHAM ROAD NORWICH	CREMATORIUM
EPA91/5/B1	JR DAIN TRANSMISSIONS	45 WHIFFLER ROAD NORWICH	W/ OIL BURNER
EPA91/6/B1	B ROWLAND	ABBEY LANE KING STREET NORWICH	W/ OIL BURNER
EPA91/11/B1	A WILLIAMS ABBEY LANE GARAGE	1-4 ABBEY LANE KING STREET NORWICH	W/ OIL BURNER
EPA91/13/B1	REVELL POTTERGATE MOTORS	DRAYTON ROAD NORWICH	W/ OIL BURNER
EPA91/15/B1	YOUNGS DOORS LTD	CITY ROAD WORKS NORWICH	TIMBER TREATMENT

EPA92/2/B2	ANGLIA LEAD LTD	49 BARKER STREET NORWICH	FOUNDRY PROCESS LEAD

EPA 92/3/B2	**READICRETE LTD**	**1 THORPE ROAD NORWICH**	**BULK HANDLING OF CEMENT**
EPA92/5/B2	**REDLAND AGGREGATES LTD**	**OLD STATION ROAD TROWSE**	**QUARRY PROCESS: ROADSTONE PLANT**
EPA92/6/B2	LC JAY & SON LTD	19/21 OAK STREET NORWICH	FOUNDRY PROCESS
EPA93/8/B2	READY MIXED CONCRETE (UK) LTD	ATLAS AGG. LTD GUARDIAN ROAD NORWICH	MOBILE CONCRETE CRUSHING PLANT
EPA92/6/B3	LAURENCE SCOTT & ELECTROMOTORS LTD	PO BOX 25 KERRISON ROAD NORWICH	COATING OF METAL AND PLASTIC
EPA92/8/B3	JARROLD PRINTING	WHITEFRIARS NORWICH	COATING PROCESS - PRINTING INK TO PAPER
EPA95/27/B3	A & W CUSHION LTD	ST BENEDICTS SAWMILLS BARN ROAD NORWICH	TIMBER PRODUCTS &TREATMENT

10.3.1.2 There is one Part A regulated process located outside the City that may emit significant quantities of PM_{10}. This is British Sugar at Cantley.

10.3.1.3 There are several large non-prescribed industrial combustion plant which contribute an unknown quantity of PM_{10} (see 9.3.2.3). However. the move away from coal and fuel oil fired plant towards natural gas continues and with it a reduction of PM_{10} from these sources.

10.3.2 **Road Transport**

10.3.2.1 Road transport nationally is the biggest single source of PM_{10} accounting for 25% of the total. There has been no monitoring by any of the local authorities in Norfolk for $PM_{10,}$ but it follows that the principal traffic routes into the City will provide the highest concentrations. The A47 (E&W), A140 (N&S), A11, A146, A1067 and A1151 are the principal line sources.

10.3.2.2 Information from the Government suggests that roads with an average daily traffic flow in excess of 25,000 vehicles emit significant quantities of PM_{10} and therefore warrant further attention. The Traffic Counts in Appendix 3 show that there are 11 known roads with projected AADF of over 25,000.

10.3.3 **Natural Sources**

10.3.3. 1 The City comprises built up areas, opens spaces and roads, all of which produce dust that is easily picked up by the wind.

10.3.3.2 The area surrounding Norwich is characterised by large open arable fields. The relatively flat, open nature of the land allows soil and dust to be readily picked up by the wind. The arable nature of the crop also means that there is a large amount of pollen, spores and similar plant material likely to be present in the atmosphere.

10.3.3.3 Recent advice and research has found sea salt to be a very significant proportion of PM_{10} material in coastal areas. However, in view of the distance of the coast from Norwich it is not considered that this source would contribute to significantly to the air quality of the City.

10.3.4 **Other Sources**

10.3.4.1 Domestic coal burning does provide a significant proportion of PM_{10} material. However emissions of PM_{10} from domestic heating systems has reduced with gas replacing solid fuels and fuel oil, such that the overall concentration from this source is low and would not contribute significantly to the air quality of the City.

10.5 Conclusions for PM_{10}

10.5.1 The advice from the Government is that an Authority should proceed to a second stage assessment where the current annual mean rural background concentration is greater than 8 $\mu g/m^3$. Due to the transboundary nature particularly of secondary particles, the total of local PM_{10} emission should be added to the secondary particle concentrations. Advice from the Government is that a figure of 10 $\mu g/m^3$ should be added to the background figure for secondary particles. From maps produced by the Government, the background figure for the City is determined at between 25.1 – 27.5 $\mu g/m^3$. Adding 10 $\mu g/m^3$ to the figure gives a level of between 35.1 – 37.5 $\mu g/m^3$. Further information from the Government is that national policies will see a reduction in the emission of sulphur dioxide and nitrogen oxides which in turn will lead to a fall in the concentrations of secondary particles. Using 1996 background information (the most recent available) the Government believes that levels in 2005 will be 0.7 times that in 1996. This assumes no new additions of significant emitters of PM_{10}. Therefore the level likely in 2005 will be between 24.5 – 26.2 μgm^3, which is above the Government guide level of 8 $\mu g/m^3$.

The calculated level shows that it is unlikely that the Governments objectives for this pollutant will be realised therefore it is proposed to carryout a second stage review for this pollutant.

11.0 REVIEW OF OTHER POLLUTANTS

11.1 OZONE

11.1.1 Ground-level ozone (O_3), unlike other primary pollutants mentioned above, is not emitted directly into the atmosphere, but is a secondary pollutant produced by reaction between nitrogen dioxide (NO_2), hydrocarbons and sunlight. Ozone can irritate the eyes and air passages causing breathing difficulties and may increase susceptibility to infection. It is a highly reactive chemical, capable of attacking surfaces, fabrics and rubber materials. Ozone is also toxic to some crops, vegetation and trees.

11.1.2 Whereas nitrogen dioxide (NO_2) participates in the formation of ozone, nitrogen oxide (NO) destroys ozone to form oxygen (O_2) and nitrogen dioxide (NO_2). For this reason, ozone levels are not as high in urban areas (where high levels of NO are emitted from vehicles) as in rural areas. As the nitrogen oxides and hydrocarbons are transported out of urban areas, the ozone-destroying NO is oxidised to NO_2, which participates in ozone formation.

11.1.3 Sunlight provides the energy to initiate ozone formation; near ultraviolet radiation dissociates stable molecules to form reactive species known as free radicals. In the presence of nitrogen oxides these free radicals catalyse the oxidation of hydrocarbons to carbon dioxide and water vapour. Partially oxidised organic species such as aldehydes, ketones and carbon monoxide are intermediate products, with ozone being generated as a by-product.

11.1.4 Since ozone itself is split up by sunlight to form free radicals, it promotes the oxidation chemistry, and so catalyses its own formation (i.e. it is an autocatalyst). Consequently, high levels of ozones are generally observed during hot, still sunny, summer weather in locations where the airmass has previously collected emissions of hydrocarbons and nitrogen oxides (e.g. urban areas with traffic). Because of the time required for chemical processing, ozone formation tends to be downwind of pollution centres. The resulting ozone pollution or "summer smog" may persist for several days and be transported over long distances.

11.1.5 In view of the transboundary nature of ozone, unilateral action by one country will not secure improvements and the problems associated with this pollutant are being addressed at least on a European-wide scale by national Governments. Local action will however, help to reduce the quantity of ozone precursors emitted such as nitrogen dioxide and hydrocarbons. However, this is not likely to affect the ozone levels locally.

11.1.6 There is a standard adopted by the Government in its National Air Quality Strategy of 50 ppb as a running 8-hour mean. This provisional objective is to be achieved at the 97th percentile level, i.e. on all but 10 days per year (assuming perfect operation of the monitoring station with 100% data captive throughout the year) by 2005.

11.1.7 However, this standard has not been transposed in the Air Quality Regulations 1997 for action at local levels. For the foreseeable future, under the right meteorological conditions, it is expected that breaches of the Government's standard will continue.

11.2 TOXIC ORGANIC MICROPOLLUTANTS

11.2.1 These are produced by the incomplete combustion of fuels. They comprise a complex range of chemicals some of which, although they are emitted in very small quantities, are high toxic or carcinogenic. Compounds in this category include polyaromatic hydrocarbons, polychlorinated biphenyls, dioxins and furans.

11.2.2 These pollutants are emitted by point sources, the largest emitters being controlled as Part A or Part B processes. They will not be considered further in this report.

11.3 VOLATILE ORGANIC COMPOUNDS (VOC'S)

11.3.1 Compounds within this group of pollutants includes toluene, xylene and other organic chemicals which readily evaporate. These compounds and essential precursors in the formation of ozone and can cause localised odour problems.

11.3.2 The principal sources of these compounds includes evaporative loss from petrol storage tanks and unburnt fuel from for example vehicle exhausts. Other sources include industry either during the manufacture of the substances or the use of products containing VOC's. Such products are usually found in industrial coatings such as paints, lacquers, sealants, varnishes and cleaning materials.

11.3.3 The heaviest industrial users of these materials includes processes such as car and industrial painting and coating of packaging materials. These users are, in the main, controlled as Part A or Part B processes with the Government target of reducing emissions of VOC's generally. The industry itself is actively researching non-VOC alternatives, such as water-based or low solvent paints.

11.4 NUISANCE POLLUTANTS

11.4.1 This section includes such pollutants as smoke from bonfires, large particles of grit and dust and odours.

11.4.2 These are characterised by their localised, usually temporary effects. However, when persons are exposed to these pollutants their severity can cause much distress to the sufferers.

11.4.3 There are no standards for these pollutants, instead the Council has to rely on statutory nuisance action as detailed in Part III of the Environmental Protection Act 1990 and public education.

12.0 CONCLUSIONS & RECOMMENDATIONS

12.1 Conclusions

12.1.1 The first stage review has shown that within the City the Government's objectives are likely to be met for the following pollutants by 2005:

Carbon Monoxide
Benzene
1,3-Butadiene
Lead

12.1.2 **However, there are doubts as to whether the Governments objectives will be met with respect to the following pollutants:**

Nitrogen dioxide

Sulphur dioxide

PM_{10}

12.2 Recommendation

12.2.1 The Council should proceed to a Stage 2 Assessment of NITROGEN DIOXIDE, SULPHUR DIOXIDE AND PM_{10}.

13.0 Principal Sources of Information Used in this Review and Assessment

Department of Environment (1997)	*National Air Quality Strategy HMSO*
Environment Agency (1997)	*Anglian Region - State of the Environment Report*
Great Yarmouth BC (1998)	*Review and Assessment of the AirQuality of the Borough Stage 1*
Norfolk Environmental Protection Group (1997)	*Air Quality - Norfolk 1996*
Norfolk County Council (1997)	*Emissions Inventory of Pollutant Gases in Norfolk*
Department of Environment (1994)	*Expert Panel on Air Quality Standards Benzene*
Department of Environment (1994)	*Expert Panel on Air Quality Standards Ozone*
Department of Environment (1994)	*Expert Panel on Air Quality Standards 1, 3-Butadiene*
Department of Environment (1994)	*Expert Panel on Air Quality Standards Carbon Monoxide*
Department of Environment (1995)	*Expert Panel on Air Quality Standards Sulphur Dioxide*
Department of Environment (1995)	*Expert Panel on Air Quality Standards Particles*
Department of Environment (1998)	*Expert Panel on Air Quality Standards Lead*
Department of Environment (1996)	*Airborne Particulate Matter in the UK Third Report of the Quality of Urban Air Review Group*
DETR (1997 Circular 15/97)	*Local Air Quality Management*
DETR (1997) LAQM.G1(97)	*Framework for Review and Assessment of Air Quality*
DETR (1997) LAQM.G2(97)	*Developing Local Air Quality Strategies*

DETR (1997) LAQM.G3(97) *Air Quality and Traffic Management*

DETR (1997) LAQM.G4(97) *Air Quality and Land Use Planning*

DETR (1998) LAQM.TG1(98) *Monitoring for Air Quality Review and Assessment*

DETR (1998) LAQM.TG2(98) *Preparation and Use of Atmospheric Emission Inventory*

DETR (1998) LAQM.TG4(98) *Pollutant Specific Guidance*

DETR (1998) *Air Pollution in the UK 1996*

Appendix 1

NORWICH CITY COUNCIL

LIST OF AUTHORISED PRESCRIBED PROCESSES ENVIRONMENTAL PROTECTION ACT 1990

Correct as at November 1998

Part A

Reference Process	Applicant	Address	
AH 4349	Rhone-Poulenc Agriculture Ltd.	Sweet Briar Road Norwich NR6 5AP	BROMUCINAZOLE
AO 1217	Ditto	Ditto	SODAMIDE
AK 7221	Ditto	Ditto	ASYLAM
AK 7183	Ditto	Ditto	DECOQUINATE STAGES V&VI
AP 9655	Ditto	Ditto	BROMOXYNIL IOYNIL & ESTERS
AO 1195	Ditto	Ditto	CYANOETHYL BENZOIC ACID
AB 6896	Ditto	Ditto	BROMUCINAZOLE
AK 7213C	Ditto	Ditto	HERBICIDE FORMULATION
AM 0015	Ditto	Ditto	CYANONITRO-PHENOL DECOQUINATE STAGE II & NITROXHNIL
AK 7230	Ditto	Ditto	BROMOPHENOL ACETATE
AM 0058	Ditto	Ditto	BROMOXYNIL / IOXYNIL
AM 0031	Ditto	Ditto	DIFLUFENICAN
AK 7124	Ditto	Ditto	BENZOQUINONE ACETATE
AK 7108	Ditto	Ditto	CYANOPHENYL
AF 7134	Norwich Great Power Station	Hardy Road Norwich	GAS TURBINE

Part B

Reference	Applicant	Address	Process
EPA91/3/B1	NCC CREMATORIUM	EARLHAM ROAD NORWICH	CREMATORIUM
EPA91/5/B1	JR DAIN TRANSMISSIONS	45 WHIFFLER ROAD NORWICH	W/ OIL BURNER
EPA91/6/B1	B ROWLAND	ABBEY LANE KING STREET NORWICH	W/ OIL BURNER
EPA91/11/B1	A WILLIAMS ABBEY LANE GARAGE	1-4 ABBEY LANE KING STREET NORWICH	W/ OIL BURNER
EPA91/13/B1	REVELL POTTERGATE MOTORS	DRAYTON ROAD NORWICH	W/ OIL BURNER
EPA91/15/B1	YOUNGS DOORS LTD	CITY ROAD WORKS NORWICH	TIMBER TREATMENT
EPA92/2/B2	ANGLIA LEAD LTD	49 BARKER STREET NORWICH	FOUNDRY PROCESS LEAD
EPA 92/3/B2	READICRETE LTD	1 THORPE ROAD NORWICH	BULK HANDLING OF CEMENT
EPA92/5/B2	REDLAND AGGREGATES LTD	OLD STATION ROAD TROWSE	QUARRY PROCESS: ROADSTONE PLANT
EPA92/6/B2	LC JAY & SON LTD	19/21 OAK STREET NORWICH	FOUNDRY PROCESS
EPA93/8/B2	READY MIXED CONCRETE (UK) LTD	ATLAS AGG. LTD GUARDIAN ROAD NORWICH	MOBILE CONCRETE CRUSHING PLANT
EPA92/1/B3	FLORIDA SHOE FACTORY (NORWICH) LTD	DIBDEN ROAD NORWICH	ADHESIVE COATING PROCESS
EPA92/3/B3	BALLY SHOE FACTORIES (UK) LTD	HALL ROAD NORWICH	ADHESIVE COATING PROCESS
EPA92/5/B3	START RITE SHOES LTD	CROME ROAD NORWICH	ADHESIVE COATING PROCESS
EPA92/6/B3	LAURENCE SCOTT & ELECTROMOTORS LTD	PO BOX 25 KERRISON ROAD NORWICH	COATING OF METAL AND PLASTIC
EPA92/7/B3	RR FLEXO LTD	8-10 CONCORDE ROAD NORWICH	COATING OF FLEXIBLE PACKAGING
EPA92/8/B3	JARROLD PRINTING	WHITEFRIARS NORWICH	COATING PROCESS - PRINTING INK TO PAPER
EPA92/9/B3	BUSSEYS LTD	TOWER HOUSE 24 WHIFFLER ROAD NORWICH	RESPRAYING OF ROAD VEHICLES
EPA92/11/B3	HOLDEN GROUP BODY REPAIR CENTRE	4-6 WHIFFLER ROAD NORWICH	RESPRAYING OF ROAD VEHICLES

92/12/B3	R ROBINSONS & CO (MOTOR SERVICES) LTD	HEIGHAM CAUSEWAY HEIGHAM STREET NORWICH	RESPRAYING OF ROAD VEHICLES
EPA92/13/B3	MANN EGERTON & CO LTD	VULCAN ROAD NORTH NORWICH	RESPRAYING OF ROAD VEHICLES
EPA92/14/B3	HEATRAE SADIA HEATING LTD	HURRICANE WAY NORWICH	DI-ISOCYANATE PROCESS
EPA92/17/B3	LEX FORD NORWICH	591 HALL ROAD NORWICH	RESPRAYING OF ROAD VEHICLES
EPA92/18/B3	LANCASTER BODY CENTRE	WHITING ROAD NORWICH	RESPRAYING OF ROAD VEHICLES
EPA93/20/B3	START-RITE SHOES	CROME ROAD NORWICH	DI-ISOCYANATE PROCESS
EPA95/24/B3	DIAMOND H CONTROLS	VULCAN ROAD NORTH NORWICH	COATING PROCESS - NITRIC ACID
EPA95/27/B3	A & W CUSHION LTD	ST BENEDICTS SAWMILLS BARN ROAD NORWICH	TIMBER PRODUCTS &TREATMENT
EPA97/2	J SAINSBURY	QUEENS ROAD NORWICH	UNLOADING OF PETROL/SERVICE STATIONS

Appendix 2

BROADLAND DISTRICT COUNCIL

LIST OF AUTHORISED PRESCRIBED PROCESSES ENVIRONMENTAL PROTECTION ACT 1990

Part A

Applicant	Address	Process
British Sugar Plc	Cantley Norwich	Boilers and Furnaces. Production and use of organic sulphur compounds. Lime manufacture Processing of vegetable matter

Part B

Applicant	Address	Process
Norwich & Norfolk Crematorium	75 Manor Road, Horsham St Faith, Norwich	Crematoria
Blyde Barton Furniture Ltd	Reepham Road, Hellesdon, Norwich,	Timber Process
St Michael's Service Station	50 Cawston Road, Aylsham, Norwich	Waste Oil Burner
Roger Bradbury (Coltishall) Ltd	Old House, Coltishall, Norwich	Waste Oil Burner
Frettenham Service Station	Buxton Road, Frettenham, Norwich,	Waste Oil Burner
High Level Service Station	Hammond Road, Hellesdon, Norwich	Waste Oil Burner
B M Page & Son	Buxton Road, Spixworth, Norwich,	Waste Oil Burner
R G Carter Ltd	Drayton, Norwich	Crushing Plant
Aylsham Plant Hire Ltd	Old Station Yard, Banningham Road, Aylsham, Norwich	Crushing Plant

M R Ellis (Timber Ltd	The Sawmill, Cromer Road, Hevingham, Norwich	Timber Process
Mastercote Ltd	11B Wendover Road, Rackheath Industrial Estate, Norwich	Powder Coating
Pechiney Packaging Ltd	2 Salhouse Road, Sprowston, Norwich	Steel Coating
S C Pimlott & Sons	Clayhill Farm, Gt Witchingham, Norwich	Animal By-product Rendering
Barton Furniture	Reepham Road, Hellesdon, Norwich,	Timber Coating
Fleet Car Contracts	Unit 1, Broadland Car Workshops, Mile Cross Lane, Hellesdon, Norwich	Waste Oil Burner
Poly Print Mailing	Mackintosh Road, Rackheath, Norwich	Printing of Flexible Packaging
Heathwood Truck and Van Hire	Unit 7, Earl Road, Rackheath, Norwich	Waste Oil Burner
Thunder Lane Garage	Thunder Lane, Thorpe St Andrew, Norwich	Waste Oil Burner
RMC Concrete Products Ltd	Norwich Road, Lenwade, Norwich,	Blending, Packing, Loading and use of Bulk Cement
Redland Readymix Ltd	Norwich Road, Lenwade, Norwich,	Blending, Packing, Loading and use of Bulk Cement
NVWC Paint and Body Centre	Jupiter Road, Hellesdon, Norwich,	Respraying of Road Vehicles
Max Bidwell and Sons	Bidwell Road, Rackheath Industrial Estate	Respraying of Road Vehicles
ASDA Petrol Filling Station	Drayton High Road, Hellesdon, Norwich	Petrol Filling Station
Lawrences Garages (London) ltd	The Firs Service Station, Cromer Road,	Petrol Filling Station

SOUTH NORFOLK COUNCIL

LIST OF AUTHORISED PRESCRIBED PROCESSES ENVIRONMENTAL PROTECTION ACT 1990

Part A

Nil

Part B

Applicant	Address	Process
RMC CONCRETE PRODUCTS LTD	CHURCH ROAD BURGH APTON	CEMENT AND LIME PROCESS
M&C AGRICULTURE	THE GARAGE NORWICH ROAD BUNWELL	W/ OIL BURNER
BOCM PAULS	MILL LANE BURSTON	ANIMAL AND PLANT PROCESS
NEEDHAM CHALKS LTD	CAISTOR ST EDMUND QUARRY NORWICH ROAD CAISTOR ST EDMUND	OTHER MINERAL PROCESSES
READICRETE LTD	COLNEY QUARRY WATTON ROAD COLNEY	CEMENT AND LIME PROCESS
FOOD RESEARCH INSTITUTE	COLNEY LANE COLNEY	INCINERATION
NORCAST LTD	LONGWATER LANE IND EST COSTESSEY	IRON AND STEEL PROCESS
R&C BETTINSON BROS	LODGE HOUSE BUILDINGS SHELFHANGER ROAD DISS	OTHER MINERAL PROCESSES
BPC CATALOGUES (ANGLIA) LTD	1 VINCES ROAD DI SS	COATING PROCESS
LAFARGE REDLAND AGGREGATES	BATH HILLS ROAD EARSHAM	CEMENT AND LIME PROCESS
KETTERINGHAM QUARRY	HETHERSETT ROAD EAST CARLTON	CEMENT AND LIME PROCESS
ADAMS AUTOMOTIVE ENGINEERING	DEREHAM ROAD EASTON	W/ OIL BURNER
LAWRENCE GARAGES LTD	50 LONDON ROAD HARLESTON	PETROL STORAGE
DOWDESWELL (NORFOLK) LTD	MENDHAM LANE HARLESTON	COATING PROCESS
BONES APART	MAYFLOWER WAY HARLESTON	ANIMAL AND PLANT PROCESS

COLORCOTE NORFOLK LTD	6 POTASH LANE HETHEL	COATING PROCESS
LOTUS (GROUP)	POTASH LANE HETHEL	COATING PROCESS
WOOLLEYS SERVICE STATION	25 NORWICH STREET HINGHAM	W/ OIL BURNER
AC BACON ENGINEERING LTD	61 NORWICH ROAD HINGHAM	COATING PROCESS
NAYLOR CONCRETE PRODUCTS	BECK HYTHE LITTLE MELTON	CEMENT AND LIME PROCESS
BROWNE & SONS ENTERPRISE SERVICE STATION	47 BRIDGE STREET LODDON	W/ OIL BURNER
LEEDERS MILL	MORNINGTHORPE ROAD LONG STRATTON	ANIMAL AND PLANT PROCESS
C&H QUICKMIX	WOODLANDS DEREHAM ROAD NEW COSTESSTY	CEMENT AND LIME PROCESS
LAFARGE REDLAND AGGREGATES	DEREHAM ROAD NEW COSTESSTY	CEMENT AND LIME PROCESS
RMC MORTARS LTD	SANDHILL QUARRIES DEREHAM ROAD NEW COSTESSEY	CEMENT AND LIME PROCESS
EJ THOMPSON PETROL FILLING STATION	WILLIAM FROST WAY OLD COSTESSEY	PETROL STORAGE
AYTON ASPHALTE CO LTD	RINGLAND LANE OLD COSTESSEY	OTHER MINERAL PROCESSES
DUFFIELD & SONS	IPSWICH ROAD SAXLINGHAM THORPE	ANIMAL AND PLANT PROCESS
CROSS KEYS GARAGE	COMMON ROAD SHELFHANGER	W/ OIL BURNER
PAULS AGRICULTURE LTD	BARKERS MILL RIGHT UP LANE SILFIELD	ANIMAL AND PLANT PROCESS
T MATTHEWS	HARELAND TOP COMMON SPOONER ROW WYMONDHAM	OTHER MINERAL PROCESS
SURLINGHAM GARAGE	POND LANE SURLINGHAM	W/ OIL BURNER
THURTON FOUNDRIES LTD	3 THE STREET THURTON	IRON & STEEL PROCESS
RECTORY ROAD GARAGE	RECTORY ROAD TI VETSHALL ST MARY	W/ OIL BURNER
BR RIVETT	2 POUND LANE TOFT MONKS	W/ OIL BURNER
LAFARGE REDLAND AGGREGATES	WHITLINGHAM QUARRY KIRBY ROAD TROWSE	CEMENT AND LIME PROCESS
RG GOODINGS GARAGE	HIGH OAK ROAD WICKLEWOOD	W/ OIL BURNER

	WYMONDHAM	
SPRATTS COACHES LTD	WYMONDHAM ROAD WRENINGHAM	W/ OIL BURNER
POSTMILL GARAGE LTD	POSTMILL CLOSE WYMONDHAM	W/ OIL BURNER
AYTON ASPHALTE CO LTD	BROWICK ROAD WYMONDHAM	W/ OIL BURNER
HI SPAN LTD	AYTON ROAD WYMONDHAM	COATING PROCESS
BARLEY CHALU LTD	AYTON ROAD WYMONDHAM	COATING PROCESS

BRECKLAND COUNCIL

LIST OF AUTHORISED PRESCRIBED PROCESSES ENVIRONMENTAL PROTECTION ACT 1990

Part A

Reference	Applicant	Address	Process
AQ0572	HAYS	THETFORD NORFOLK	CHEMICAL MANUFACTURE
AP0844	FIBROTHERFORD LTD	THETFORD NORFOLK	POWER STATION

Part B

002	EAST COAST CASTINGS CO LTD	NORWICH ROAD CARBROOKE	FERROUS & NON FERROUS FOUNDRY
003	EAST COAST CASTINGS CO LTD	NORWICH ROAD CARBROOKE	FERROUS & NON FERROUS FOUNDRY
004	ENNEMIX LTD	LONDON ROAD SNETTERTON	BLENDING PACKING LOADING AND USE BULK CEMENT
005	ENNEMIX LTD	REED LANE LONGHAM	BLENDING PACKING LOADING AND USE BULK CEMENT
006	JENTIQUE FURNITURE LTD	SOUTH GREEN DEREHAM	MANUFACTURE OF TIMBER AND TIMBER BASED PRODUCTS
007	MAYERS AND SHAW	1-7 BUNNS BAND IND EST ATTLEBOROUGH	MANUFACTURE OF TIMBER AND TIMBER BASED PRODUCTS
008	RMC CONCRETE PRODUCTS LTD	YAXHAM ROAD DEREHAM	BLENDING PACKING LOADING AND USE BULK CEMENT
009	THERMOS LTD	THETFORD	GLASS MANUFACTURING
010	READICRETE LTD	EASTHAUGH PIT LYNG	BLENDING PACKING LOADING AND USE BULK CEMENT
011	READICRETE LTD	REYMERSTON	BLENDING PACKING LOADING AND USE BULK CEMENT
012	READICRETE LTD	LYNN ROAD SWAFFHAM	BLENDING PACKING LOADING AND USE BULK CEMENT

013	READICRETE LTD	MUNFORD ROAD THETFORD	BLENDING PACKING LOADING AND USE BULK CEMENT
014	C & H QUICKMIX LTD	BITTERING QUARRY BITTERING DEREHAM	BLENDING PACKING LOADING AND USE BULK CEMENT
015	C & H QUICKMIX LTD	THE GRAVEL PIT RICKLANDS ROAD SHROPHAM	BLENDING PACKING LOADING AND USE BULK CEMENT
016	REXAM MATALLISING	BURRELL WAY THERFORD	ADHESIVE COATING
017	TARMAC UK LTD	BITTERING QUARRY BITTERING DEREHAM	ROADSTONE COATING
020	PLASWOOD PRODUCTS LTD	GRISTON ROAD WATTON	TIMBER COATING
022	CRANE FREUHAUF	RASHS GREEN TOFTWOOD DEREHAM	VEHICLE RESPRAYING
023	JENTIQUE FURNITURE LTD	SOUTH GREEN DEREHAM	TIMBER COATING
025	BARCLAY BEALES LTD	MILEHAM GARAGE BEESTON ROAD MILEHAM KINGS LYNN	VEHICLE RESPRAYING
027	FERRISGATE LTD	BURRELL WAY THETFORD	ADHESIVE COATING
030	BCL MILLING LTD	THE MILL LARKSHALL EAST WRETHAM THETFORD	ANIMAL FOOD COMPOUNDING
031	ALLEN & PAGE LTD	NORFOLK MILL SHIPDHAM AIRFIELD IND EST SHIPDHAM	ANIMAL FOOD COMPOUNDING
032	PLASWOOD PRODUCTS LTD	GRISTON ROAD WATTON	MANUFACTURE OF TIMBER AND TIMBER BASED PRODUCTS
033	PHILIP QUANTRILL STRUCTURAL ENG LTD	CHURCH ROAD GRISTON	COATING OF METAL AND PLASTIC
034	CROWN CHICKEN LTD	GREEN FARM EDGE GREEN KENNINGHALL	ANIMAL FOOD COMPOUNDING
035	MAYERS AND SHAW	1-7 BUNNS BAND IND EST ATTLEBOROUGH	TIMBER COATING
036	FOUR LEAF ENTERPRISES LTD	SOUTHMOOR FAARM CARBROOKE	MOBILE CONCRETE CRUSHING
037	MIDAS MOULDINGS LTD	9 CHARLES WOOD ROAD RASHS GREEN IND EST DEREHAM	TIMBER COATING
039	INDUSTRIAL PLASTIC COATINGS LTD	ST HELENS WAY FISONS WAY IND EST THETFORD	POWDER COATING

040	HILBOROUGH MILL FOODS LTD	BRANDON ROAD WATTON	PET FOOD MANUFACTURE
042	TODAYBRAVE LTD	ROOSTINGHILL PIT BEETLEY DEREHAM	BLENDING PACKING LOADING AND USE BULK CEMENT
043	EAST BILNEY COACHWORKS	FAKENHAM ROAD EAST BILNEY DEREHAM	VEHICLE RESPRAYING
044	SHIRE AUTOS	UNIT 1 OLD FOUNDRY BUILDINGS NORWICH ROAD CARBROOKE	VEHICLE RESPRAYING
045	ABM TRUCKS	UNIT 16 ROUDHAM IND EST EAST HARLING	VEHICLE RESPRAYING
046	BARKING PANEL CRAFT (WATTON LTD)	UNIT 11A BERTIE WARD WAY RASHS GREEN IND EST DEREHAM	VEHICLE RESPRAYING
047	LARKSHALL EXTRUSIONS	THE MILL LARKSHALL EAST WRETHAM THETFORD	PET FOOD MANUFACTURE
048	THERMOS LTD	CAXTON WAY THERFORD	DI-ISOCYANATE USE
049	LEE & PLUMPTON LTD	BUNNS BANK ATTLEBOROUGH	MANUFACTURE OF TIMBER AND TIMBER BASED PRODUCTS
050	TRANSCO	HINCKLEY OPERATIONAL CENTRE BRICK KILN LANE COVENTRY ROAD HINCKLEY LEICESTERSHIRE	GAS ODORISATION
051	TRANSCO	HINCKLEY OPERATIONAL CENTRE BRICK KILN LANE COVENTRY ROAD HINCKLEY LEICESTERSHIRE	GAS ODORISATION
052	PAINT MOTOR SPECIALISTS	UNIT 2B ROUDHAM PARK IND EST EAST HARLING	VEHICLE RESPRAYING
053	THETFORD ACCIDENT REPAIR CENTRE	FISON WAY THETFORD	VEHICLE RESPRAYING
WOBSS11	EAST BILNEY GARAGE	EAST BILNEY DEREHAM	W/ OIL BURNER
WOBSS01	ATTLEBOROUGH MOTOR WORKS	HIGH STREET ATTLEBOROUGH	W/ OIL BURNER
WOBSS09	MORTERS GARAGE	STATION ROAD ATTLEBOROUGH	W/ OIL BURNER
WOBSS05	CPR VEHICLE DELIVERIES LTD	GREENS ROAD YAXHAM IND EST DEREHAM	W/ OIL BURNER
WOBSS04	DEREHAM CAR CARE	CROWNS ROAD DEREHAM	W/ OIL BURNER

	CENTRE		
WOBSS07	WW AUTOS	35 YAXHAM ROAD DEREHAM	W/ OIL BURNER
WOBSS02	DROME GARAGE	NORWICH ROAD WATTON	W/ OIL BURNER
WOBSS14	STUART GROUP LTD	STUART HOUSE CROWS HALL LANE ATTLEBOROUGH	W/ OIL BURNER
WOBSS16	BYWAYS	BUNWELL ROAD BESTHORPE ATTLEBOROUGH	W/ OIL BURNER
WOBSS15	HANNANT & SON LTD	NEWTON ROAD CASTLEACRE KINGS LYNN	W/ OIL BURNER
AUTHPVR001	LYNN HILL GARAGE	LONDON ROAD DEREHAM	PETROL VAPOUR RECOVERY
AUTHPVR002	SAFEWAY PETROL STATION	CASTLEACRE ROAD SWAFFHAM	PETROL VAPOUR RECOVERY
AUTHPVR003	NORWICH ROAD FILLING STATION	NORWICH ROAD SWAFFHAM	PETROL VAPOUR RECOVERY
AUTHPVR004	NECTON FILLING STATION	NORWICH ROAD NECTON	PETROL VAPOUR RECOVERY
AUTHPVR005	ALINE GARAGE	EXCHANGE STREET ATTLEBOROUGH	PETROL VAPOUR RECOVERY
AUTHPVR006	THURLOW NUNN	WESTFI ELD ROAD TOFTWOOD	PETROL VAPOUR RECOVERY
AUTHPVR007	PETROL STATION	LONDON ROAD THETFORD	PETROL VAPOUR RECOVERY
AUTHPVR008	TESCO STORES LTD	NORWICH ROAD KILVERSTONE	PETROL VAPOUR RECOVERY
AUTHPVR009	TESCO STORES LTD	YAXHAM ROAD DEREHAM	PETROL VAPOUR RECOVERY
AUTHPVR010	BP EXPRESS SHOPPING	THETFORD	PETROL VAPOUR RECOVERY
AUTHPVR011	WATTON SERVICE STATION	BRANDON ROAD WATTON	PETROL VAPOUR RECOVERY
AUTHPVR012	ESSO PETROL STATION	FISON WAY THETFORD	PETROL VAPOUR RECOVERY

Appendix 3

Traffic Counts

Data on traffic flows at 41 points in the City have been monitored by Norwich Urban Traffic Control using the SCOOT traffic management system since 5th January 1998.
These traffic counts have allowed for the calculation of average weekday flows for nineteen roads within the City for the first nine months of 1998.

In order to calculate the Annual Average Daily Flows (AADF) for these roads the following methodology was followed:

Using the COBA Manual (Vol. 13 of the Design Manual for Roads and Bridges) and DETR's TEMPRO v3.1:

1. Validity of out traffic data was established by calculating a local E-Factor (the ratio of 12 to 16hour traffic counts). The local factor for the Norwich data was calculated as 1.143 which compares very favourably with the DMRB default E-Factor of 1.15.
2. An Annual Flow for each road was then calculated using the COBA Manual methodology to convert an average weekday 16hour flow using an M-Factor based on a Seasonality Index of 1.0.
3. The AADF were then established by dividing the Annual Total Flow by 365.
4. Projected AADFs for 2005 were then calculated using values from TEMPRO v3.1. The multipliers used for traffic growth from 1998 to 2005 were LOW=1.064 HIGH=1.170.

SITE	LOCATION	16WDAY Jan-Sep 1998	98AADF	LOW2005	HIGH2005
A	DEREHAM RD/NORWICH RD	32,311	32,143	34,586	38,283
D	BRACONDALE	22,339	22,223	23,912	26,468
E	KING ST / CARROW HILL	30,518	30,360	32,668	36,159
F	THORPE RD / SALISBURY RD	16,160	16,076	17,298	19,147
G	HARVEY LANE / THORPE RD	8,399	8,356	8,991	9,952
H	BISHOPS BRIDGE RD	19,805	19,702	21,200	23,466
I	MAGDELEN RD / GURNEY RD	12,862	12,795	13,768	15,239
J	ST AUGUSTINES	19,479	19,379	20,851	23,080
K	MILE CROSS LANE / VULCAN RD	16,904	16,816	18,094	20,028
L	CROMER RD / HEATHER AVE	20,216	20,112	21,640	23,953
N	BOUNDARY RD / CITY VIEW RD	29,669	27,525	29,617	32,783
O	SWEETBRIAR RD / HELLESDON HALL ROAD	21,186	21,077	22,678	25,102
P	BARN ROAD / ST CRISPINS	37,102	36,910	39,716	43,960
Q	DEREHAM RD/ DISTILLARY SQ	16,962	16,874	18,156	20,097
R	CHAPELFIELD ROAD	29,890	29,736	31,996	35,415
S	UNTHANK RD / ESSEX ST	7,037	7,001	7,533	8,338
T	ST STEPHENS RD	32,325	32,158	34,602	38,300
U	CASTLE MEADOW	8,805	8,760	9,425	10,433
V	GOLDEN BALL STREET	14,875	14,798	15,923	17,625