



NORWICH
City Council



Norfolk County Council

ENVIRONMENT ACT 1995 PART IV

LOCAL AIR QUALITY MANAGEMENT

AIR QUALITY ACTION PLAN

City of Norwich

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Mr P. Allen
Director of Development
Norwich City Council

Mr S.A. Ralph
Director of Planning
and Transportation
Norfolk County Council

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EXECUTIVE SUMMARY

The Environment Act 1995 imposes a legal obligation on Councils to declare Air Quality Management Areas where levels of specific air pollutants are predicted to be above set Government objectives.

The statutory review and assessment of local air quality in Norwich was carried out in four stages with assistance from AEA technology to determine whether the national air quality objectives would be met by 2005. The results of these assessments indicated that there are areas of Norwich almost certain to exceed the annual mean objective for nitrogen dioxide (NO₂).

Consequently, Norwich City Council declared three Air Quality Management Areas (AQMAs) for nitrogen dioxide for St Augustines Street, Grapes Hill, and the Castle area on 1st June, 2003 (see **Figure 1**). Source apportionment exercises identified oxides of nitrogen from traffic on roads to be the most significant source of nitrogen dioxide at the three Air Quality Management Areas in Norwich.

Local authorities that have declared Air Quality Management Areas are required to carry out further air quality assessments and prepare and implement an Air Quality Action Plan. The Council then has a statutory duty to produce and implement an Action Plan to reduce local levels of the specified pollutants in those areas declared.

The Norwich Air Quality Action Plan considers a range of strategy options and feasibility to address poor air quality in Norwich from transport. The result of this undertaking is a set package of remedial air quality measures for each of the declared Air Quality Management Areas and for Norwich on an area wide basis (see **Appendix 3**).

Air quality will continue to be monitored in the areas in order to assess progress towards achieving the annual average nitrogen dioxide objectives.

In addition to these plans, Norfolk County Council will be incorporating a local air quality strategy into its next Local Transport Plan, in attempt to prevent air quality issues from arising in the future.

1. INTRODUCTION

The City of Norwich, situated in the east of England is the administrative centre of the County of Norfolk. It covers some 50 square kilometres with a population of about 120,000, although this increases to 193,000 if the immediately adjacent built up area lying outside the city boundary is taken into account.

Although the administrative area of Norwich is geographically small, the role of the City is much larger as a regional centre with an extensive catchment covering most of Norfolk and parts of the adjacent County of Suffolk. Whilst the City itself is relatively compact, it is built on a radial pattern, and with a relatively large but low-density catchment, movement patterns are essentially disparate. Reliance on car-based travel, particularly beyond the urban area is very high, and the travel to work area includes more than 367,000 people.

Norwich suffers from traffic congestion, and major routes create severance. The level of traffic creates air quality and noise problems in some locations, and can be intrusive in some residential streets. Access by non-car modes to some parts of the City is difficult.

Transport and traffic management are probably the most difficult and challenging issues facing the City. Norwich's economic prosperity depends upon large numbers of people from the surrounding areas being able to get into the City Centre for work, for shopping and for leisure or tourist visits. The preferred form of transport for such journeys for most people would currently be the car.

Norfolk County Council, in association with Norwich City Council, transport providers, local business and local communities has been working to improve accessibility for everyone around the City, as well as wider accessibility to Norfolk, the rest of the UK and Europe.

2. BACKGROUND

2.1 Introduction

Many types of air pollution are detrimental to human health and have been known to increase incidences of respiratory and lung diseases from prolonged exposure, particularly in the young and elderly.

The pollutant of most concern to Norwich and its air quality is nitrogen dioxide (NO₂), as today's levels do not meet national health-based standards and, on current trends, are unlikely to meet the Government target objectives for 2005 of 40 µg/m³. In Norwich, the most significant source of NO₂ is from emissions of oxides of nitrogen (NO_x) from road traffic.

In developing the Air Quality Action Plan (AQAP) to improve air quality in Norwich, the Council used Government guidance and the relevant publications by the National Society for Clean Air and Environmental Protection (NSCA).

The main factors taken into consideration when devising the AQAP were to ensure that air quality improvement actions remain consistent with current Norfolk County Council and Norwich City Council policies such as the City Centre Transport Plan, Norfolk Ambition, Best Value Performance Plan, the Norfolk Structure Plan, the Norwich Area Transportation Strategy and the Local Transport Plan. The AQAP therefore aims to:

- Encourage sustainable transport;
- Increase accessibility and social inclusion;
- Improve health, safety and the environment;
- Support the local economy;
- Balance costs and benefits; and
- Maintain public input and support.

2.2 Policy Context

The UK Government published its strategic policy framework for air quality management in 1995 establishing national strategies and policies on air quality, which culminated in The Environment Act 1995. The Air Quality Strategy provides a framework for air quality control through air quality management and set standards. These and other air quality standards¹ and their objectives² have been enacted through the National Air Quality Standards (NAQS) in 1997 and 2000.

The Environment Act 1995 requires Local Authorities to undertake air quality review and assessment. In areas where it is anticipated that the air quality objective will not be met, Local Authorities are required to establish Air Quality Management Areas to improve air quality.

¹ Refers to standards recommended by the Expert Panel on Air Quality Standards. Recommended standards are set purely with regard to scientific and medical evidence on the effects of the particular pollutants on health, at levels at which risks to public health, including vulnerable groups, are very small or regarded as negligible.

² Refers to objectives in the Strategy for each of the eight pollutants. The objectives provide policy targets by outlining what should be achieved in the light of the air quality standards and other relevant factors and are expressed as a given ambient concentration to be achieved within a given timescale.

On this basis, Norwich declared three Air Quality Management Areas (AQMAs) on 1st June 2003 and will be consulting on the draft action plan between April and June 2004.

The first step in this process is to undertake a review of current and potential future air quality. A minimum of two air quality reviews are recommended in order to assess compliance with air quality objectives; one to assess air quality at the outset of the National Air Quality Strategy (NAQS) and a second to be carried out towards the end of the policy timescale (2005). The number of reviews necessary depends on the likelihood of achieving the objectives. Each of these two reviews is split into components. For the first round of air quality review and assessment, there were four components: Stages 1 to 3, Stage 4 and Action Plans. Stage 4 and Action Plans are normally completed in parallel. Not all local authorities have to complete all the components.

Norwich City Council and Norfolk County Council recognises their role in achieving the revised targets set out in the NAQS. Norfolk County Council will work closely with Norwich City Council to achieve targets where Air Quality Management Areas have been declared.

2.3 Nitrogen Dioxide and Health Impacts

Nitrogen dioxide and nitric oxide are both oxides of nitrogen, which together 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. Nitrogen dioxide is mainly a secondary pollutant formed by the oxidation of nitric oxide in the atmosphere. On a national level the main sources of NO_x are road transport (48%), power generation (20%) other industry (15%) and domestic sources (4%). The remainder arises from other forms of transport and commercial heating systems. In urban environments the contribution from road traffic will be much higher and in the absence of localised point sources will account for the majority of NO_2 pollution. Measures to reduce traffic pollution will therefore play a major role in meeting the air quality objective for NO_2 .

As NO_2 has both short term and long term health effects, two objectives have been set for NO_2 concentrations. The first is an hourly objective currently set at 200 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) not to be exceeded more than 18 times a year, the second is an annual objective of 40 $\mu\text{g}/\text{m}^3$. Real time monitoring carried out in the city to date has shown that the hourly objective for NO_2 is already being met in most locations. However, the results of the real time monitoring and monthly diffusion tube surveys indicate that the annual objective is currently being exceeded at many kerbside and roadside location around the city and may continue to do so at some location by the compliance dates for the objectives.

Medical evidence indicates that between 12,000-24,000 deaths and between 14,000-24,000 hospital admissions annually in the UK are linked to air pollution. The proportion of air pollutants which comes from traffic has been increasing whilst the traditional heavy industrial pollution sources are on the decline. In Norfolk traffic is the primary source of air pollution as there is very little industrial pollution. NO combines with moisture in the lungs forming acid that can irritate the respiratory tract, reduce lung function and increase vulnerability to viral infections. NO_2 also reacts with other pollutants to form ozone.

3. AIR QUALITY REVIEW AND ASSESSMENT

3.1 Overview

The main elements of the National Air Quality Strategy (NAQS) can be summarised as follows:

- The use of a health effect based approach using national air quality standards and objectives.
- The use of policies by which the objectives can be achieved and which include the input of important actors such as industry, transportation bodies and local authorities.
- The predetermination of timescales with a target date 2005 for the achievement of objectives and a commitment to review the Strategy every three years.

NAQS provides a framework for the improvement of air quality that is both clear and workable. The strategic principles to achieve this include:

- clear Governmental aims regarding air quality;
- clear and measurable targets;
- a balance between local and national action; and
- a transparent and flexible framework.

The air quality objectives set for specific pollutants can be found in **Appendix 1**.

3.2 Methodology

Air quality in Norwich was reviewed and assessed in three stages:

- Stage 1: an initial study to identify which pollutants require further investigation;
- Stage 2: estimation, modelling or measurement of pollutants and where this indicates national objectives will not be achieved and;
- Stage 3: using advanced modelling techniques and emission inventories.

Following the above review and assessment of air quality, Air Quality Management Areas (AQMAs) must be declared where it is concluded that local air quality will not meet national targets.

For each of the pollutants identified in the AQMA a Stage 4 review and assessment must be carried out, in parallel with the development of an Air Quality Action Plan (AQAP), which will develop and implement strategies that will ultimately deliver the NAQS in these areas.

The Stage 4 review and assessment and the AQAP are to be completed within 12 months of the declaration of the AQMA, and the Action Plan to be operational within 6 months thereafter.

3.3 Results and Declaration

The Stage 1 review and assessment concluded that three pollutants required further investigation in order to ascertain whether the 2005 objectives would be achieved. These are nitrogen dioxide (NO₂), sulphur dioxide (SO₂) and particulate matter (PM₁₀).

The Stage 2 review and assessment for SO₂ and PM₁₀ concluded that objectives for 2005 would be achieved.

The review and assessment for NO₂ was taken straight to Stage 3 as it was clear from the initial review and assessment that it was unlikely to achieve the 2005 annual mean objective. The Stage 3 review and assessment subsequently confirmed that this to be the case.

As a result of the Stage 3 Review and Assessment, Norwich City Council declared three AQMAs due to potential exceedences of the 2005 NO₂ objective on 1st June 2003 at St Augustines Street, Grapes Hill and the Castle Area (see **Figure 1**).

3.4 Source Apportionment

Attributing exceedences of pollution objectives to a particular sector is necessary in order to ascertain how the problem can be rectified. Source apportionment work undertaken by AEA Technology for NO₂ concentrations identified emissions of oxides of nitrogen (NO_x) from traffic on roads close to the AQMAs as the most significant source contribution of NO₂. Emissions of NO_x from local traffic accounted for approximately 68-79% of the total modelled NO_x concentration at the most affected properties within the AQMAs.

4. AIR QUALITY MANAGEMENT AREAS

4.1 Introduction

Norwich City Council declared three Air Quality Management Areas (AQMAs) on the 1st June 2003 following the completion of the Stage 3 review and assessment for the city which confirmed that pollution levels in these areas will exceed the Government's Air Quality Strategy objective for nitrogen dioxide (NO₂).

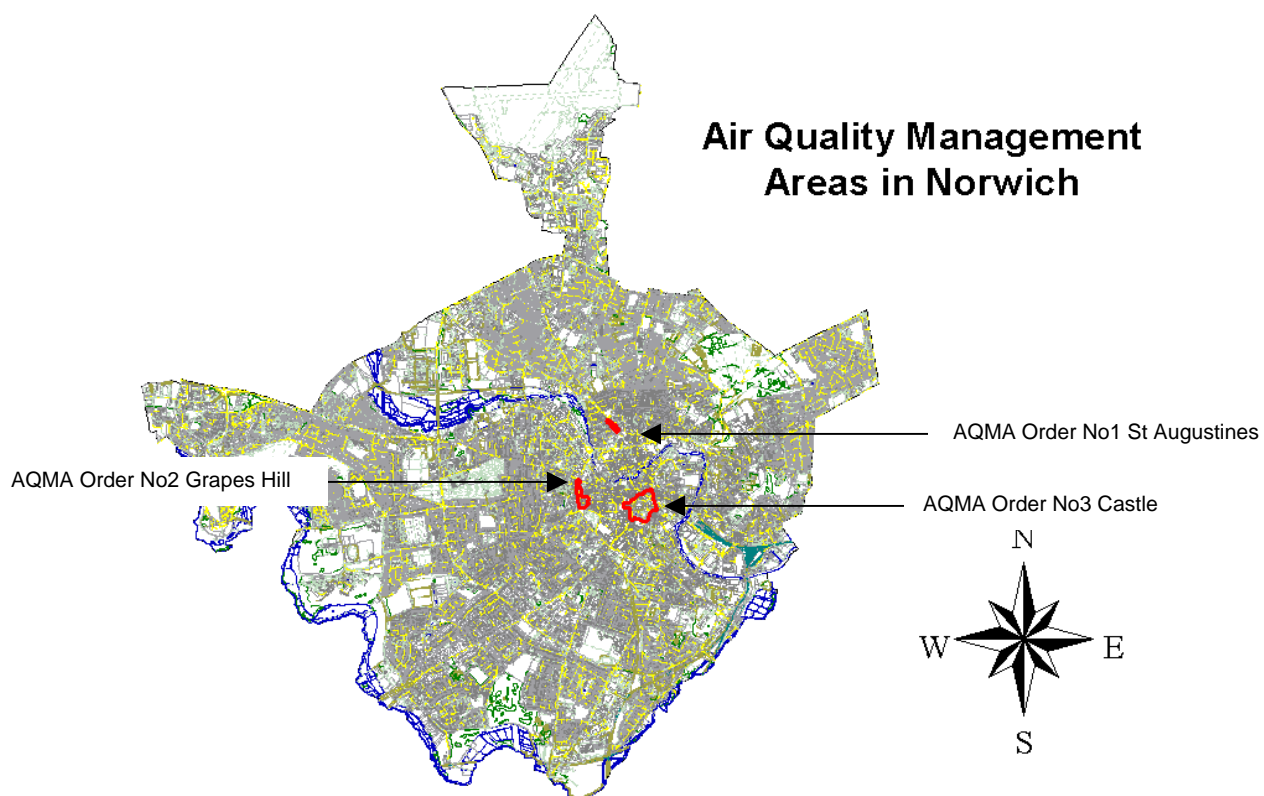
The three AQMAs are shown below, they are:

Air Quality Management Area Order No 1: St Augustines Street

Air Quality Management Area Order No 2: Grapes Hill

Air Quality Management Area Order No 3: Castle Area

Figure 1. Air Quality Management Areas in Norwich



4.2 AQMA No 1: St Augustines Street

St Augustines Street is a 422 metre track of radial "A road" feeding traffic south into the centre of Norwich via the Inner Ring Road, and is also the main route for traffic travelling to the northern stretches of the Norwich area including Hellesdon, Taverham, Drayton, Horsford and Thorpe Marriot.

St Augustines Street is a mixed-use neighbourhood, comprised of both residences and small businesses and terminates at a busy five-way junction on the north end of the street. The buildings lining St Augustines Street are taller than the road is wide, causing a canyon effect in which pollutants can build up and remain stagnant due to lack of dispersion.

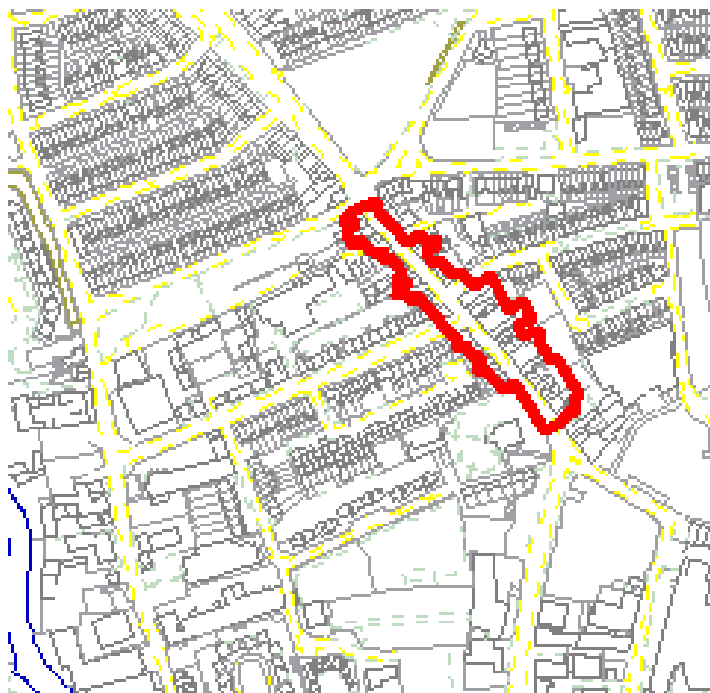
Peak hour traffic volumes regularly result in queue formation along St Augustines Street as vehicles wait to enter the five-way junction to the north or the inner ring road to the south. Daily traffic volumes currently total over 17,000 vehicles per day.

Source apportionment exercises carried out in the preliminary Stage 4 Air Quality Review and Assessment identified Light Duty Vehicles (LDVs) as accounting for 33% of NO₂ emissions on St Augustines Street, and Heavy Duty Vehicles (HDVs) 16%, with background concentrations identified at 51%.

Stage 4 also quantified the total reduction of NO₂ required for St Augustines Street to be 8 µg/m³. The following options have been put forth as a means to reduce NO₂ concentrations at the most sensitive receptors in the St Augustines AQMA:

1. A 20% reduction in total traffic;
2. A reduction in congestion at the St Crispins Road roundabout and at the junction with Waterloo Road to increase average traffic speeds to 40 kph.
3. Both of the above.

Figure 2. AQMA No 1: St Augustines Street



4.3 AQMA No 2: Grapes Hill

Grapes Hill is a segment of Norwich's Inner Ring Road, and is classified as an "A road". Grapes Hill carries southbound traffic up a steep slope to a busy roundabout, feeding traffic to and from the A47, the B1109 (Earlham Road), Unthank Road, and around other parts of the ring road.

Grapes Hill is an essential part of the Inner Ring Road system, carrying traffic into and away from the city centre. As a part of this system, Grapes Hill is therefore integral to Norwich's economic vitality, both for employment and shopping.

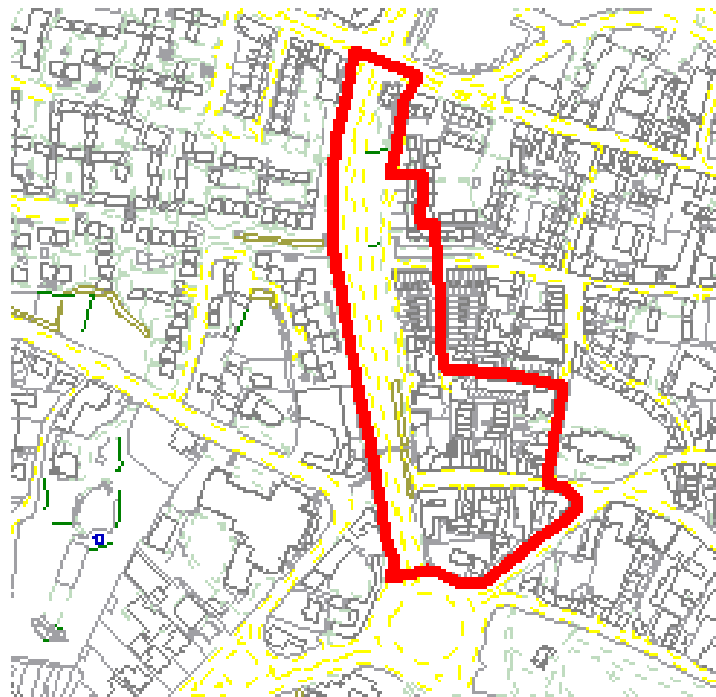
Grapes Hill is bounded on either side by private residences and several private businesses at the north end. It is also characterised by pedestrian bridge, which carries pedestrians between the "Golden Triangle" residential area and the city centre.

Traffic counts on Grapes Hill amounts to over 34,000 vehicles per day. Source apportionment exercises carried out in the preliminary Stage 4 Air Quality Review and Assessment identified Light Duty Vehicles (LDVs) as accounting for 32% of NO₂ emissions on Grapes Hill, and HDVs 14%, with background concentrations identified at 54%.

Stage 4 also quantified the total reduction of NO₂ required for Grapes Hill to be 8 µg/m³. The following options have been put forth as a means to reduce the NO₂ concentrations at the most sensitive receptors in the Grapes Hill AQMA:

1. A 20% reduction in total traffic;
2. A 40% reduction in traffic.
3. Both of the above.

Figure 3. AQMA No 2: Grapes Hill



4.4 AQMA No. 3: Castle Area

The Castle Area is an area of historical significance comprised of shopping, tourist destinations, and a few residences. There are several roads that form a ring around the Castle. Castle Meadow, Cattle Market Street, Market Avenue, Farmers Avenue, Bank Plain, and Agricultural Hall Plain have all been declared as part of the Castle AQMA.

Movement of traffic around this area is complex. Castle Meadow is restricted to general through traffic, and only allows access for buses, deliveries, and taxis. This is also one of the main bus thoroughfares in Norwich and nearly every interurban and rural bus destined for the city centre stops on this road.

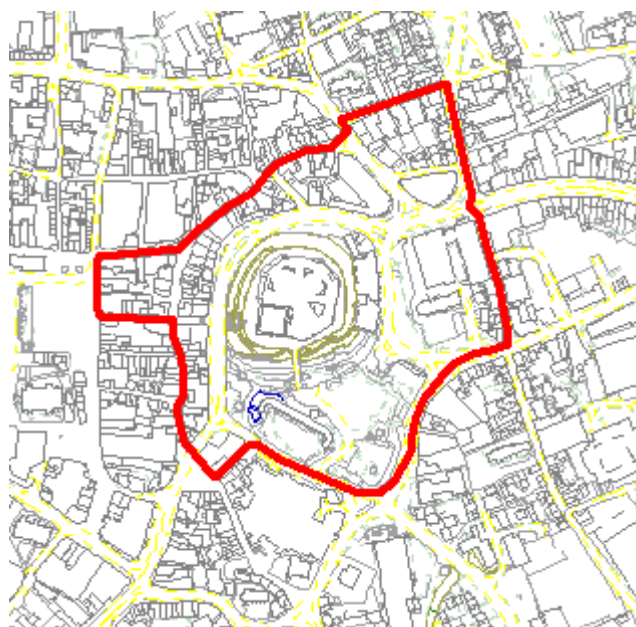
Further exacerbating traffic movements around the Castle is the fact that there is a shopping mall and underground car park beneath the castle. The car park has entrances/exits on Farmers Avenue and Market Avenue.

Source apportionment exercises carried out in the preliminary Stage 4 Air Quality Review and Assessment identified Light Duty Vehicles (LDVs) as accounting for 25% of NO₂ emissions in the Castle area, and HDVs 24%, with background concentrations identified at 51%.

Stage 4 also quantified the total reduction of NO₂ required for the Castle Area to be 8 µg/m³. The following options have been considered in order to assess their potential to reduce the NO₂ concentrations at the most sensitive receptors in the Castle AQMA:

1. Upgrade of buses (assumed 70% of HDV) to Euro IV standard;
2. Bus only zone.
3. Both of the above.

Figure 4. AQMA No 3: Castle area



5. SUMMARY OF AVAILABLE STRATEGIES AND FEASIBILITY

The following table gives a brief summary of the available transport strategy options and their feasibility for mitigating nitrogen dioxide emissions from transport in Norwich's Air Quality Management Areas. Please see **Appendix 2** for a more detailed description and discussion of the strategy options.

Strategy	Measures	Air Quality Impacts	Cost	Feasibility for AQMAs
Zoning				
	20 mph zones	Negative	Low	No
	Clear Zones	High	High	No
	Low Emission Zones	High	Low - High	Yes
	Traffic free areas/ Vehicle Bans	High	Medium	Yes
Public Transport				
	Bus Priority (PT Major)	Low - Medium	High	Yes
	Park & Ride	Low - Medium	High	Area wide
	Quality Bus Partnerships	High	Low	Yes
	Light Rail or Tram	Medium - High	High	No
	Subsidised Public Transport	Low	High	Area wide
Fiscal Measures				
	Congestion Charging/ Tolls	High	High	No
	Workplace Parking Levy	Low - Medium	Low	Area wide
	Roadside Emissions Testing	Low	Medium	No
	Parking Charges	Low - Medium	Low	Area wide
Soft Measures				
	Carsharing	Low	Low	Area wide
	Travelwise	Low	Low	Area wide
	School Travel Plans	Low	Low	Area wide
	Workplace Travel Plans	Low	Low	Area wide
Traffic Management				
	UTC	Low	High	Yes
	Dedicated Lanes/ HOV	Low	High	No
	Speed Control/Regulation	Negative	Low	No
Infrastructure Improvement				
	Pedestrianisation	Low	High	No
	Improved walking and cycling provision	Low	Medium	No
	Traffic Calming	Negative	Medium	No
	Road Layout Changes	Medium - High	High	Yes
	Bypasses and Road Building	Negative - Low	High	No

Planning				
	Land Use Planning	Low	Low	Area wide
	Car-free Residential Development	Low	Low	No
Alternative Fuels				
	Cleanup	High	Medium	Yes
	Powershift	Low	Low	Area wide
	Motorvate	Low	Low	Area wide
Leading by Example				
	Alternative Fuel Vehicle Fleet	Low	High	Area wide
	Travel Plan	Low	Medium	Area wide
	Car sharing	Low	Low	Area wide

Cost: High = >£100,000, Medium = £10,000 - £100,000, Low = < £10,000

Air Quality: Negative = < 0µg/m³, Low = 0 - 1µg/m³, Medium = 1- 3µg/m³,
High = > 3µg/m³

6. AIR QUALITY ACTION PLAN STRATEGY PACKAGES

6.1 St Augustines Air Quality Management Area

6.1.1 Urban Traffic Control

Urban Traffic Control is typically used to co-ordinate traffic signals to get traffic flowing through junctions as swiftly as possible. This action will be used to improve the timing of traffic signals in a systematic way to improve traffic flows at both ends of St Augustines Street in an effort to improve traffic flows and reduce idling, both of which contribute significantly to poor air quality in this area.

6.1.2 Road Layout Changes

Further to that, work is currently being undertaken to identify possible road layout changes in this area that would lead to improvements in air quality. A change in the way traffic flows around the St Augustines Street area to improve traffic flows and reduce congestion could lead to substantial reductions in emissions from transport in this area.

The measures proposed by the steering group for the **St Augustines AQMA** comprise a traffic gyratory system using Oak Street. This is designed to eliminate northbound traffic queues on St Augustines Street. Options being considered include, using Oak Street for northbound traffic and St Augustines for southbound, or, Oak Street for two-way traffic and St Augustines for southbound traffic.

6.2 Grapes Hill Air Quality Management Area

6.2.1 Road Layout Changes

Currently, as part of improvements to the Inner Ring Road, it is proposed to make the Grapes Hill approach to Chapelfield roundabout 3 lanes instead of 2. This may produce a more even traffic flow and reduce queuing on Grapes Hill. It is not yet possible to determine the effect this will have on air quality, but different queuing scenarios could be examined using junction modelling programs that now have a facility for evaluating emissions. This will enable us to devise a suggested improvement. However, it will be necessary to engage a consultant to determine the absolute effect and whether this meets the air quality objective.

6.3 Castle Air Quality Management Area

6.3.1 Low Emission Zone

Access is currently already restricted in part of the Castle AQMA on Castle Meadow to buses, taxis, and freight vehicles only. A Low Emission Zone on Castle Meadow would take this access restriction one step further and require that those vehicles would be required to comply with set emissions standards or fuel type. Low Emissions Zones are typically based around Euro IV emissions standards, which can reduce NO_x emissions by 15-50%.

6.3.2 Quality Bus Partnerships and Contracts

Contracts can be drawn up between the Council and local bus operators stipulating the standards required for buses operating within the Council's remit. Quality Bus Partnerships can be used to set emissions standards on bus fleets for local operators in order to assist in compliance with the proposed Low Emission Zone on Castle Meadow.

6.3.3 Bus Priority Measures - Public Transport Major Scheme

The Public Transport (PT) Major Scheme is currently being implemented and aims to improve public transport reliability in the Norwich area and to introduce infrastructure changes in order to support public transport. Completion of works is anticipated by spring 2005. The PT Major includes the following key elements:

1. A new, modern bus station in the city centre
2. A revitalised passenger transport interchange at Norwich railway station
3. On street interchange facilities at Castle Meadow and St Stephens Street
4. Bus priority measures including contra-flow bus lanes, between the railway and bus station
5. Improved bus services on route to Hospital and Colney area

The Agricultural Hall Plain contra-flow measures has resulted in a 5 minute reduction in travel time and a 626 metre reduction in distance travelled by eight different bus inter-urban bus services. This reduction in vehicle kilometres should account for a proportionally significant reduction in NO₂ emissions from the Castle AQMA.

6.4 Area Wide Measures

6.4.1 Park and Ride and Car Parking Policy

There are currently five Park and Rides sites serving Norwich. Planning consent has been granted for a sixth Park and Ride and a site has been identified for a seventh. This measure calls for the continued support for the improved provision of Park and Ride services in Norwich. This forms part of an overall parking management strategy as shown in statutory planning documents.

6.4.2 Soft Measures

Soft measures promote education and awareness in an attempt to induce modal shift. The following measures will be used to this end:

- Signage - to raise awareness that people are entering an Air Quality Management Area.
- Travelwise - an initiative which seeks to make people aware of the travel choices that are available to them and encourages people to use more sustainable modes of transport such as walking, cycling, and buses where it is reasonable to do so.
- Travel Plans - a package of practical measures for the workplace or schools to encourage those people travelling to such organisations to choose alternatives to single-occupancy car-use.
- Carsharing - when two or more people share a car and travel together. It allows people to benefit from the convenience of the car, whilst alleviating the associated problems of congestion and pollution.

6.4.3 Alternative Fuels

To support and encourage the uptake of alternative fuel vehicles and to disseminate information about grants available for converting existing vehicles or purchasing alternative fuel vehicles.

6.4.4 Land Use Planning

To continue to assess land use based on its accessibility to the transport network.

6.4.5 Leading by Example

- Alternative Fuel Vehicles: To continue conducting the Alternative Fuel Trials in order to make more informed decisions about the wider use of alternative fuels in the County Council fleet and thereby contribute to an improvement in local air quality.
- Carsharing: To continue to encourage employees to car share
- Commuter Plan: To ensure that the County Hall and City Hall Commuter Plans are updated as needed and implemented as and when resources become available.

For a table summary of the action plan strategies for each air quality management area, please see **Appendix 3**.

7. STAKEHOLDERS AND CONSULTATION

Key Stakeholders to be consulted on the Stage 4 Air Quality Review and Assessment as well as the Air Quality Action Plan can be viewed in **Appendix 4**. The consultation will aim to run for eight to twelve weeks in spring 2004. The consultation package sent to key stakeholders will include the following:

- Covering letter;
- Stage 4 Air Quality Review and Assessment report;
- Draft Air Quality Action Plan; and
- Form for comments.

8. CONCLUSIONS

Due to high levels of nitrogen dioxide emissions from road traffic, Norwich City Council declared three Air Quality Management Areas (AQMAs) at St Augustines Street, Grapes Hill, and the Castle area in June 2003. As a result, a Stage 4 Review and assessment of Air Quality and an Air Quality Action Plan were required under the Environment Act 1995.

Norwich City Council, in conjunction with Norfolk County Council, are committed to improving air quality levels in the Air Quality Management Areas in line with National Air Quality Standards by December 2005.

For the St Augustines AQMA, the Council will look to improve air quality through a combination of measures. Firstly, it will look to implement Urban Traffic Control through the use of signal timings to improve traffic flows and reduce idling. Secondly, it will consider road layout changes in order to reduce the volume of traffic travelling on St Augustines Street, while improving traffic flows and congestion in the entire area.

Improvements in air quality in the Castle AQMA will be sought through the introduction of a Low Emission Zone on Castle Meadow by incorporating minimum vehicle emissions standards into the next Quality Bus Partnership, and through bus priority measures introduced through the Public Transport Major Scheme.

Finally, the Council is committed to improving air quality around the whole of Norwich through the use of measures which cover the whole area. These include increased provision of Park and Ride services, the continued support of Norfolk's carsharing scheme, the Travelwise initiative, school and workplace travel plans, alternative fuels utilisation incentives, land use planning and through leading by example.

It is hoped that the package of transport options and measures proposed will achieve the requisite improvements in air quality in and around Norwich and that the Air Quality Action Plan will help guide the overall strategy in achieving the government objective for nitrogen dioxide.

APPENDIX 1: AIR QUALITY OBJECTIVES

Pollutant	Concentration limits		Averaging period	Objective	
	($\mu\text{g m}^{-3}$)	(ppb)		($\mu\text{g m}^{-3}$)	[number of permitted exceedences a year and equivalent percentile] date for objective
Benzene	16.25	5	running annual mean	16.25	by 31.12.2003
1,3-butadiene	2.25	1	running annual mean	2.25	by 31.12.2003
CO	11,600	10,000	running 8-hour mean	11,600	by 31.12.2003
Pb	0.5	-	annual mean	0.5	by 31.12.2004
	0.25	-	annual mean	0.25	by 31.12.2008
NO₂ (see note)	200	105	1 hour mean	200	by 31.12.2005 [maximum of 18 exceedences a year or equivalent to the 99.8 th percentile]
	40	21	annual mean	40	by 31.12.2005
PM₁₀ (gravimetric) (see note)	50	-	24-hour mean	50	by 31.12.2004 [maximum of 35 exceedences a year or ~ equivalent to the 90 th percentile]
	40	-	annual mean	40	by 31.12.2004
SO₂	266	100	15 minute mean	266	by 31.12.2005 [maximum of 35 exceedences a year or equivalent to the 99.9 th percentile]
	350	132	1 hour mean	350	by 31.12.2004 [maximum of 24 exceedences a year or equivalent to the 99.7 th percentile]
	125	47	24 hour mean	125	by 31.12.2004 [maximum of 3 exceedences a year or equivalent to the 99 th percentile]

APPENDIX 2: DISCUSSION OF AVAILABLE STRATEGIES AND FEASIBILITY

1. Zoning Measures

1.1 20 mph Zones (residential traffic zones)

Description: The introduction of 20-mph speed limits in designated residential areas.

Action: None. AQMAs declared are not strictly residential in nature. 20-mph zones would lead to an increase in emissions of NO_x from traffic.

Air Quality Impacts: Negative. Emissions from transport are related to fuel efficiency, and at 20 mph, fuel efficiency is lower than at higher speeds, leading to increased emissions.

Ancillary Effects: Reduction in noise level, potential traffic displacement, improved overall local environment and quality of life.

Cost: Low, but practical only if sufficient enforcement is provided.

1.2 Traffic free residential areas

Description: The complete removal of traffic through access restrictions from specific residential areas, although such areas usually remain accessible to traffic from residents.

Action: None. AQMAs declared within Norwich are not strictly residential in nature.

Air Quality Impacts: High. Would lead to a reduction in emissions from traffic within the traffic free zone, although traffic is most likely to be displaced elsewhere.

Ancillary Effects: Displacement could lead to increases in congestion around the traffic free area. Traffic free zones lead to a reduction in noise within the zone and also improves the overall local environment and quality of life.

Cost: Medium.

1.3 Low Emissions Zones

Description: A Low Emission Zone (LEZ) is an area which seeks to reduce emissions from road vehicles by encouraging the use of cleaner fuels, more efficient vehicles, or reducing the number of vehicles overall. This is typically done by restricting access to certain areas from vehicles that do not meet the minimum set emissions standards. An LEZ can be introduced through voluntary agreements, partnerships, and licensing arrangements, such as bus quality partnerships or taxi licensing.

Action: An LEZ is not necessarily a feasible option for Grapes Hill or St Augustines, as it would be difficult to enforce and as these are main roads without viable alternative routes at the moment. Castle Meadow, however, remains a good candidate for an LEZ. Access is already restricted on Castle Meadow to buses, taxis, and delivery vehicles only. LEZ status would take this restriction one step further by setting emissions standards for those vehicles.

Air Quality Impacts: Low - High. LEZs are typically based around Euro IV standards, which reduces emissions of NO_x by 15% FROM Euro III vehicles and 50% from Euro I vehicles.

Ancillary Effects: Displacement of traffic could lead to increased congestion elsewhere. Possibility of lost trade for businesses within the LEZ.

Cost: Low - High.

1.4 Clear Zones

Description: Clear Zones are designed to encourage solutions to traffic problems in towns and cities while ensuring town centres retain their accessibility, vitality, and economic viability and usually involves the removal of traffic or access restrictions and improved pedestrian and cycling facilities within the Clear Zone.

Action: None recommended for AQMAs.

Air Quality Impacts: High. The reduction of traffic within the Clear Zone would most likely have significant benefits to air quality within the immediate area.

Ancillary Effects: Possible loss of trade to businesses although the improved atmosphere of Clear Zones may lead to increased trade in the longer term.

Cost: High.

1.5 Vehicle Bans

Description: The banning of certain types of vehicles from specific places or roads.

Action: An HGV vehicle ban on St Augustines or Grapes Hill could lead to significant reduction in NO₂ concentrations and other emissions from transport, due to the high proportion of HGV traffic on those roads.

Air Quality Impacts: High. HGVs are typically going to be the heaviest polluters on most roads due to heavy loads and larger engines.

Ancillary Effects: Could displace HGV traffic to more residential areas which are less suited to accommodate HGVs.

Cost: Low.

2. Public Transport Measures

2.1 Public Transport Priority Schemes: Public Transport Major - Norwich City Centre Interchange and Bus Priorities

Description: The Public Transport (PT) Major Scheme is currently being implemented and aims to improve public transport reliability in the Norwich area and to introduce infrastructure changes in order to support public transport. Completion of works is anticipated by spring 2005. The PT Major includes the following key elements:

1. A new, modern bus station in the city centre
2. A revitalised passenger transport interchange at Norwich railway station
3. On street interchange facilities at Castle Meadow and St Stephens Street

4. Bus priority measures including contra-flow bus lanes, between the railway and bus station
5. Improved bus services on route to Hospital and Colney area

Action: To continue to support the Public Transport Major Scheme.

Air Quality Impacts: Low - Medium. Public transport plays a major role in the Norwich transportation system and is well placed to reduce emissions from transport and traffic congestion.

Ancillary Impacts: A degree of reduction in traffic congestion can be expected from the Agricultural Hall Plain contra-flow measures recently introduced through the PT Major. Increased public transport use supported by priority measures would also lead to CO₂ emissions reductions.

Cost: High, but already allocated.

2.2 Park and Ride

Description: Buses that pick up commuters and shoppers from a car park on the outskirts of a city and take passengers directly to a city centre without stopping. There are currently five Park and Rides sites serving Norwich. Planning consent has been granted for a sixth Park and Ride and a site has been identified for a seventh.

Action: To continue to support improved provision of Park and Ride services for Norwich.

Air Quality Impacts: Low - Medium. Higher proportions of the population using public transport could lead to a reduction in NO₂ concentrations and other emissions from transport.

Ancillary Impacts: Reductions in traffic congestion. Usually only benefits car-owners and requires land.

Cost: High.

2.3 Light rail or tram system

Description: The introduction of a light rail or tram system will provide an alternative to the existing bus system. It is more efficient in energy terms than buses and produces substantially lower emissions.

Action: None recommended at this stage. The Norwich Area Transportation Strategy is currently consulting the public on its attitudes and feelings towards such a scheme. Survey results should be available in spring 2004 and action can be revisited then.

Air Quality Impacts: Low - Medium. Light rail and trams, if utilised, would lead to significant reductions of emissions by transporting a larger number of people on a cleaner mode of transport than the private car or bus.

Ancillary Effects: Could have detrimental environmental effects associated with construction.

Cost: High.

2.4 Subsidised Public Transport

Description: Subsidisation of public transport fares on urban services to make the service less expensive and encourage more people to use. Fare subsidisation can be used on a temporary or longer-term basis to attract patronage and encourage a modal shift away from the private car to public transport where feasible.

Action: To investigate further the potential to subsidise fares either on specific routes or for specific people.

Air Quality Impacts: Low. Encouraging a modal shift away from the private car to public transport will typically lead to reductions in NO_x emissions from transport.

Ancillary Effects: Modal shift to public transport from the car would help to reduce congestion.

Cost: Low - High.

2.5 Quality Bus Partnerships and contracts

Description: Contracts between the council and local bus operators that include standards for buses used in the area, such as type of bus, level of service, and standards for vehicle emissions.

Action: To incorporate emissions standards into the next Quality Bus Partnership.

Air Quality Impacts: High. A significant proportion of the current bus fleet in Norwich is of Euro I or Euro II standard and emissions standards would guarantee significant reductions in NO_x and other emissions from buses.

Ancillary Effects: May encourage modal shift to public transport, as pollution produced by buses is a common complaint by bus users.

Cost: Low.

3. Fiscal Measures

3.1 Congestion charging/ tolls

Description: Part III of the Transport Act 2000 provides local authorities with powers to introduce road user charging where these will help reduce road congestion and pollution. Typically, motorists are charged to enter the city by car.

Action: None recommended at this stage. The Norwich Area Transportation Strategy is currently consulting the public on its attitudes and feelings towards such a scheme. Survey results should be available in spring 2004 and action can be revisited then.

Air Quality Impacts: High. On 17 May, 2003 London introduced a congestion-charging scheme and results to date show that there has been a 25% reduction in overall traffic since it began.

Ancillary Effects: Charging typically leads to a modal shift and a substantial overall reduction in traffic congestion.

Cost: High.

3.2 Workplace Parking Levy

Description: The workplace-parking levy is a charge for private, non-residential spaces, like those used by businesses for their workers. Workplace parking levies are currently being consulted on through Norwich Area Transportation Strategy.

Action: None recommended at this stage. The Norwich Area Transportation Strategy is currently consulting the public on its attitudes and feelings towards such a scheme. Survey results should be available in spring 2004 and action can be revisited then.

Air Quality Impacts: Low. Workplace parking levies could potentially increase car sharing amongst employees and also encourage a modal shift towards alternative transport options.

Ancillary Effects: Reduced congestion, journey time and possible reductions in other harmful atmospheric pollutants generated from transport. May displace parking onto nearby residential streets that are not currently covered under permit parking.

Cost: Low.

3.3 Parking Charges

Description: To limit the usage of car the car parks by commuters (long-stay) by creating a pricing structure more conducive to short-stay parking.

Action: None recommended for the AQMAs.

Air Quality Impacts: Negative. Short-stay pricing structures will encourage more frequent turnover of parking spaces in car parks which could lead to an increase in total number of trips, leading to increased emissions from transport.

Ancillary Effects: Could have beneficial effects on retail.

Cost: Low.

3.4 Roadside Emissions Testing

Description: A uniformed police officer stops vehicles at the roadside and a qualified vehicle tester will test their emissions levels, and if it fails set limits, the vehicle owner may be issued with a fixed penalty notice.

Action: None recommended for the AQMAs.

Air Quality Impacts: Low, although raises awareness of emissions from transport.

Ancillary Effects: May increase congestion if conducted on narrow roads.

Cost: Medium.

4. Alternative Fuel Utilisation Incentives

4.1 Financial Incentives

Description: Encouraging the uptake of alternative fuel use in motor vehicles in and around Norwich.

Action: The following incentives have been used successfully by other local authorities to encourage alternative fuels:

1. Council Tax rebates/ reductions for purchase of alternative fuel/conversion/ EURO IV standard vehicle purchase
2. Waiver of taxi licence fee for taxi conversion to LPG, and/ or grant assistance for conversion from Council and EST
3. Council tax incentives for non-car owning households: bus tickets, cycle discounts, trainer discounts, council tax rebates, etc.
4. Priority and/or free/discounted parking in city centre for alternative fuel/ Euro IV vehicles

Air Quality Impacts: Low. Alternative Fuel Vehicles would have an impact on lowering emissions from transport.

Ancillary Effects: None.

Cost: Variable, dependant upon how far reaching incentives are.

4.2 Cleanup

Description: Transport Energy's Cleanup programme is aimed at improving air quality in the UK by providing grants to support the fitment of pollution reducing equipment, such as catalytic converters and particulate traps, to existing vehicles, particularly heavy diesel vehicles such as buses, trucks and taxis. CleanUp only supports technologies that have demonstrated significant emissions reductions.

Action: To assist taxis, buses and hauliers in the fitment of emission reduction equipment supported by Cleanup grants either financially or by offering incentives.

Air Quality Impacts, Ancillary Effects and Costs: The table below outlines the different retrofit technologies which qualify for a Cleanup grant. Those stricken are either not cost effective, or are not environmentally beneficial for this exercise (i.e do not significantly reduce NO_x emissions). Below is an example of how these grants can be used to secure emissions reductions from public transport and heavy goods vehicles.

Cleanup Technologies available for retrofit on HGVs						
Technology	NO _x	HC	CO	PM	% grant available from Cleanup	Typical Cost (cost after grant)
Oxidation Catalyst		80%	80%	20-50%	75%	£1000 (250)
Particulate traps	10%	80%	80%	95%	75%	£3000-5000 (750-1250)
Re-Engine	40%			60%	50%	£10,000 - 15,000 (5000-7500)
Exhaust gas re-circulation (EGR)	40-50%	90%	90%	95%	75%	£10,000 (2500)
Selective catalyst reduction (SCR)	30 - 70%	90%	90%		50%	£5,000-10,000 (2500-5000)

Cleanup offers good value for money in terms of capital outlay and the air quality improvements it can achieve. Furthermore, it offers economic benefits to the vehicle operators in terms of possible reductions in fuel consumption as well as a reduction in vehicle excise duty.

Ancillary effects include the reduction of other harmful emissions from transport.

4.3 Powershift

Description: Powershift's main goal is to develop a sustainable market for vehicles that run on liquefied petroleum gas (LPG), compressed natural gas (CNG), electric, and dual fuels by providing grants assistance towards the additional cost of buying new or converting existing vehicles to run on alternative fuels. Powershift offers a grant for 40-75% of the additional cost of purchasing clean fuel vehicles, £1000 towards the purchase of a hybrid electric vehicle, and 30-50% for converting existing vehicles.

Action: To inform the public and fleet operators of the Powershift grants that are available.

Air Quality Impacts: Low.

Ancillary Impacts: Alternative fuel vehicle owners enjoy reduced vehicle excise duty rates, are exempt from London's congestion charge, and typically incur lower fuel costs.

Cost: Variable.

4.4 Motorvate

Description: The Motorvate scheme, sponsored by the DfT, assist organisations with practical advice on how to cut their fleet travel costs while also reducing the environmental impacts from corporate travel.

Action: To support Motorvate by acting as a liaison between Motorvate and local businesses in and around Norwich that operate fleets.

Air Quality Impacts: Low.

Ancillary Effects: Alternative fuel vehicle fleet enjoy reduced vehicle excise duty rates under the company car tax scheme, are exempt from London's congestion charge, and typically incur lower fuel costs.

Cost: Low.

5. Soft Measures (Promotion, education & awareness raising)

5.1 Signage

Action: To erect signage to raise awareness that people are entering an AQMA.

Air Quality Impacts: Low.

Ancillary Effects: May be seen as a visual disruption.

Cost: Low.

5.2 Travelwise

Description: Travelwise is an initiative which seeks to make people aware of the travel choices that are available to them and encourages people to use sustainable modes of transport such as walking, cycling, and buses where it is reasonable to do so.

Action: To continue to move forward with the Travelwise initiative and disseminate information to the public by raising awareness about travel choice.

Air Quality Impacts: Low.

Ancillary Effects: Modal shift to walking and cycling could bring about health benefits.

Cost: Low.

5.3 Travel Plans

Description: A travel plan is typically a package of practical measures to encourage staff to choose alternatives to single-occupancy car use and to reduce the need to travel for work.

Action: To continue to encourage and support workplace travel plans through the post of the Travel Plan Co-ordinator.

Air Quality Impacts: Low. Travel plans have the potential to reduce single-occupancy commuter car usage as well as business mileage, therefore mitigating emissions from transport.

Ancillary Effects: None.

Cost: Low.

5.4 Carsharing

Description: Car sharing is when two or more people share a car and travel together. It allows people to benefit from the convenience of the car, whilst alleviating the associated problems of congestion and pollution.

Action: To continue to support and encourage car sharing through the role of the Travel Plan Co-ordinator and as part of the Travelwise initiative.

Air Quality Impacts: Low. Maximising occupancy in vehicles should lead to a reduced number of total trips overall, therefore reducing emissions from transport.

Ancillary Effects: Reductions in traffic congestion during peak times.

Cost: Low.

6. Traffic Management

6.1 UTC

Description: Urban Traffic Control is typically used to co-ordinate traffic signals to get traffic flowing through junctions as swiftly as possible.

Action: To improve the timing of traffic signals in a systematic way to improve traffic flows around the city centre.

Air Quality Impacts: Low. Intelligent use of signal timing could improve traffic flow and reducing idling, which contributes significantly to increased emissions.

Ancillary Effects: Possible reductions in congestion.

Costs: High.

6.2 Road layout changes

Description: To change way traffic moves around a road network to improve traffic flows and reduce congestion.

Action: To investigate and identify road layout changes in the Air Quality Management Areas that could lead to improvements in air quality.

Air Quality Impacts: Low - High. Better movement and flow of traffic around the road network could lead to reductions in traffic congestion which would lower emissions from transport.

Ancillary Effects: Often disruptive to implement. Improved road layout could reduce traffic congestion.

Cost: High.

6.3 Speed control/regulation

Description: To reduce vehicle speeds through improved enforcement, lowering speed limits, or by introducing traffic calming measures.

Action: None recommended for AQMAs.

Air Quality Impacts: Negative. Reductions in speed in general will lead to increased emissions from transport due to the loss of fuel economy at lower speeds.

Ancillary Effects: May reduce ambient noise levels and improve safety on a local level.

Costs: Low.

6.4 High Occupancy Vehicle Lanes

Description: High Occupancy Vehicle lanes (HOV) are dedicated lanes that only allow utilisation by multiple occupancy vehicles, making it less congested and typically faster. HOV lanes have had considerable success in the United States at encouraging car sharing on motorways in California and Washington, D.C.

Action: None, the city centre nature of the AQMAs declared and medieval street pattern are not conducive to HOV lanes.

Air Quality Impacts: Low. HOV lanes would encourage car sharing which could lead to a reduction in the total number of cars travelling at any given time.

Ancillary Effects: Often requires a significant amount of land.

Costs: Medium.

7. Infrastructure Improvements

7.1 Pedestrianisation

Description: To remove traffic entirely from a road or area and allow access to pedestrians and cyclists only.

Action: None recommended for AQMAs.

Air Quality Impacts: Low. Reduction in emissions generated from transport.

Ancillary Effects: Economic effects in pedestrian shopping areas can be either positive or negative.

Cost: High.

7.2 Improved cycling and walking provision

Description: The improvement of provision of space for walking and cycling such as cycle lanes and pavements.

Action: None recommended for AQMAs.

Air Quality Impacts: Low. A modal shift towards cycling and walking will reduce harmful emissions from transport.

Ancillary Effects: Increases in cycling and walking could lead to health improvements.

Cost: Medium.

7.3 Traffic Calming

Description: The installation of calming measures such as speed humps, to slow traffic down.

Action: None recommended for AQMAs.

Air Quality Impacts: Negative. Reduction in speed is less fuel efficiency, leading to increases in emissions.

Ancillary Effects: Traffic calming may have a positive effect on local safety.

Cost: Medium.

7.4 Bypasses and road building

Description: Norfolk County Council currently consulting on building a Northern Distributor Road around the north of Norwich as part of the Norwich Area Transportation Strategy. It is hoped that such a road would help alleviate traffic on the outer ring road and also relieve many roads in north Norwich from motorists that cut through residential side streets to avoid congestion on main roads.

Action: None recommended at this stage. The Norwich Area Transportation Strategy is currently consulting the public on its attitudes and feelings towards such a scheme. Survey results should be available in spring 2004 and action can be revisited then.

Air Quality Impacts: Negative - Low. May lead to an overall increase in number of cars, as congestion may currently be suppressing demand, and a requisite increase in emissions. However, the NDR intends to disperse traffic more evenly along the outer ring roads, which could bring about air quality benefits from reduced traffic in the city centre.

Ancillary Effects: Possible reduction in congestion in and around Norwich.

Cost: High.

8. Planning

8.1 Development Plans (Strategic and Local)

Description: Through the choice of site, the development plan process can affect the amount of traffic generated by a development and the number of people who will use alternatives to the car.

Action: To continue to assess land use based on its accessibility.

Air Quality Impacts: Low. Better land use planning should lead to air quality improvements.

Ancillary Effects: Could potentially restrict development in appropriate areas.

Costs: Low.

8.2 Car-free residential development

Description: Developments with a restriction on owners or tenants owning cars.

Action: To encourage, where possible, car-free residential developments in the city centre.

Air Quality Impacts: Low.

Ancillary Effects: None.

Cost: Low.

9. Leading by Example

9.1 Alternative Fuel Vehicles

Norfolk County Council is currently testing a number of alternative fuels which, when used as vehicle fuels, can produce environmental benefits by reducing exhaust emission pollutants. It is hoped that by conducting these trials we will be able to make an informed decision about the wider use of alternative fuels in the County Council fleet and thereby contribute to an improvement in local air quality.

9.2 Encourage employees to car share

The Norfolk-wide internet based car share scheme, run in partnership between Norfolk County Council and Norwich City Council has become one of the most successful in the UK. Its effectiveness has been assessed and results show:

- Increasing numbers of user sessions
- Participants have a 1 in 2 chance of being matched with someone

We are now promoting it to other employers and local authorities through presentation, seminars, and marketing materials. We have concluded that it is particularly useful for towns and cities.

9.3 Implement Commuter Plan

Ensure that the County Hall and City Hall Commuter Plans are updated as needed and implemented as and when resources become available.

APPENDIX 3: ACTION PLAN STRATEGIES

AQMA	Strategies	Measures	Expected NO ₂ Reduction	Timecscales	Cost
St Augustines					
	Traffic Management	UTC	Low	Design: 04/05 Implementation: 05/06	High
		Road Layout Changes	High	Design: 04/05 Implementation: 05/06	High
Grapes Hill					
	Traffic Management	Road Layout Changes	High	Design: 04/05 Implementation: 05/06	High
Castle					
	Zoning	LEZ	High	Implementation: 05/06	Low - High
	Public Transport	Quality Bus Partnership	High	TBA	Low
		Bus Priority (PT Major)	Low - Medium	Design & Implementation: 04/05	High
Area Wide					
	Public Transport	Park & Ride	Low - Medium	Ongoing	High
	Soft Measures	Carsharing	Low	Ongoing	Low
		Travelwise	Low	Ongoing	Low
		School Travel Plans	Low	Ongoing	Low
		Workplace Travel Plans	Low	Ongoing	Low
	Alternative Fuels	Cleanup	High	Ongoing	Low
		Powershift	Low	Ongoing	Low
		Motorvate	Low	Ongoing	Low
	Planning	Land Use Planning	Low	Ongoing	Low
	Leading by example	Alternative Fuels Vehicle Fleet	Low	06/03 - 06/04	Medium
		Commuter Plan	Low	Ongoing	Medium
		Car sharing	Low	Ongoing	Low

APPENDIX 4: STAKEHOLDER CONSULTATION LIST

Enterprise Partnership
East Anglian Region
Heron House
Breckland Council
Broadland Council
Great Yarmouth Borough Council
Kings Lynn and West Norfolk Borough Council
North Norfolk Council
South Norfolk Council
Norfolk County Council
Norwich Community Power Area Forums
Norwich Environment Forum
Norwich 21 Steering Group
City Hall
Anglia Railways
English, Scottish & Welsh Railways
Central Trains
Eastern Counties Omnibus Co Ltd
Broads Authority
Norfolk Health Authority
Environment Agency
Norwich Labour Club
Norfolk County Council
DEFRA
Hackney Drivers Association
Faculty of Applied Sciences
Secretary of State