IPSWICH BOROUGH COUNCIL

~ ENVIRONMENTAL PROTECTION SERVICES ~

AIR QUALITY
FURTHER UPDATE ASSESSMENT
AND PROGRESS REPORT

September 2005

EXECUTIVE SUMMARY

Ipswich Borough Council has statutory duties for local air quality management under the Environment Act 1995. As part of an ongoing process of reviewing air quality in the Borough, the Council is required to carry out three-yearly "Updating and Screening Assessments" for air quality and produce progress reports between such assessments.

The Council last completed an Updating and Screening Assessment in December 2003. This identified a source of particulate pollution and also three areas of poor air quality (due to road traffic), which required a more detailed assessment. The detailed assessment was recently completed and has been reported separately to the Government's Department for Environment, Food and Rural Affairs.

This report advises on progress to date of all these matters and outstanding work which will be completed by the next 'Updating and Screening Assessment'. This report also presents the Council's first annual progress report detailing new air quality monitoring data since 2003 and developments that may have an impact on air quality objectives.

For further information on this report, please contact:

David Harrold
Environmental Health Officer
Civic Centre
Civic Drive
Ipswich
IP1 2EE

Tel: 01473 433039
Email: david.harrold@ipswich.gov.uk

CONTENTS

1. INTRODUCTION

1.1 Air Quality Management

Local Authorities have statutory duties for local air quality management under the Environment Act 1995. They are required to carry out 3-yearly Updating and Screening Assessments for air quality across their districts, against pollution objectives in the Government's 'National Air Quality Strategy. The objectives are listed in Appendix 1 to this report and are based on the recommendations of medical and scientific experts. They are health related and exceedances of pollution objectives are generally accepted to have an impact on the health and well being of those people affected.

1.2 Further Update Assessment

The Council's Environmental Protection Service completed a full review of air quality in December 2003 – the Updating and Screening Assessment. This report concluded that further detailed assessment of Nitrogen Dioxide from road traffic sources and particulate matter from an industrial source was required to determine whether the relevant targets would be exceeded. An initial detailed study of three major roads, which previously had been identified as approaching objective levels, has now been completed and is dealt with in Part 1 of this report, together with one industrial source.

1.3 Progress Report

The Department for Environment, Food and Rural Affairs (DEFRA) also requires that authorities should submit annual air quality progress reports in-between the 3-yearly Updating and Screening Assessments, in order to provide a means for communicating air quality information to members of the public and a timely indication of the need for further measures to improve air quality, rather than delaying until the next full round of reviews and assessments.

The content of Progress Reports is laid down in statutory guidance by DEFRA (LAQM.PRG(03), DEFRA 2003). It is considered that the above aim can best be achieved by addressing two matters:

- New monitoring and air quality modelling results and,
- New local developments that might affect local air quality.

The above matters are addressed in the progress report at Part II of this document. The following optional items have also been included in the Progress Report:

- An assessment of the monitoring data in relation to air quality objectives
- New local developments that may affect local air quality.
- Planning applications that have the potential to affect local air quality
- Relevant updates on planning policies that relate specifically to air quality.

PART I

FURTHER UPDATE ASSESSMENT

1. TARMAC QUARRY PRODUCTS (SOUTHERN) LTD

Tarmac Quarry Products (Southern) Ltd is a roadstone coating process, located at Ipswich Works, South West Quay, The Docks, Ipswich, Suffolk, IP3 0BM (grid reference 616891 243445).

The process is regulated by the Borough Council under the Environmental Protection Act 1990 and Local Authority Pollution Prevention Control Permit. Coal, coke, blast furnace slag and aggregates are stored and screened within the site boundary. Following unloading from ships at the quayside, materials are processed and stored prior to discharge to road vehicles.

PM_{10} emissions from the site were modelled using AAQuire. The model requires emission rate of PM_{10}, the stack height and diameter, and the exit velocity and temperature. These data are listed below.

Site	Tarmac Coating Plant
Location	(616875, 243377
Emission rate/g/s	0.001
Stack height/m	26.5
Diameter/m	1.2
Gas temperature/r	338
Exit velocity/m/s	10.35
Percentage time operational	75%

A large number of small sources of air pollution exist, which individually may not be significant but collectively, over a large area, need to be considered as part of the above modelling process. The UK National Air Quality Information Archive provides estimates of background PM_{10} concentrations nationwide, with spatial resolution of $1km^2$. The background concentrations applied to the model are those listed for the grid square on (620500, 243500). The concentrations for future years were determined by following the method outlined in DEFRA's Technical Guidance Note, LAQM TG(03).

Annual Mean Concentration PM_{10} μg/m for 2004 and 2010 respectively, 20.1 and 18.4.

Figures (7) and (8) in Appendix 2 depict the PM_{10} concentration contours resulting from emissions from the industrial site operated by Tarmac. Both the 2004 and 2010 results are below the objective limits and it can be clearly seen that emissions from the main stack have very limited impact on surrounding PM_{10} concentrations. The 2010 results are approximately 1.7 $\mu g/m^3$ lower than the 2004 results because of the predicted reduction in the background concentration.

2. **ROAD TRAFFIC IN ST MARGARET'S STREET, STAR LANE AND NORWICH ROAD**

The Council's Updating and Screening Assessment (December 2003) confirmed that further detailed assessment was required to study the impact of traffic on concentrations of nitrogen dioxide across the borough. The council has now collated up to date road traffic data and prioritised its detailed assessment.

Faber Maunsell was commissioned to undertake a Detailed Air Quality Assessment as part of the second round review and assessment process. The assessment was limited to three areas of high priority where it was anticipated that air quality objectives for nitrogen dioxide would not be met.

The assessment was performed using the Aaquire 6.1.1 regional dispersion model, which has been independently and extensively validated, and widely used for the past 12 years. Traffic and meteorological data, and background concentrations of pollutants were input into the model to produce NO_2 and PM_{10} concentration plots for the required years.

Verification of the model was achieved using data from the Council's continuous nitrogen dioxide monitor located at Pipers Court. This data is discussed in Part 2 of this report and attached as Appendix 4.

The results of the NO_2 assessment indicate that the annual mean objective will be exceeded along most of the roads in the study area in 2005. Concentrations greater than 40 $\mu g/m^3$ are predicted to extend up to 50m from the kerb.

Faber Maunsell have recommended that the Council declare Air Quality Management Areas where the air quality objectives have not been met. The detailed report will be sent to Defra for scrutiny and confirmation of the requirement to declare an AQMA.

Further work on screening and modelling air quality using current road traffic data will be completed during 2005/06 and reported to Defra in subsequent update reports.

PART II

PROGRESS REPORT

3. NEW MONITORING RESULTS

Nitrogen Dioxide Monitoring

Nitrogen dioxide (NO_2) and nitric acid (NO) are both oxides of nitrogen, and are collectively referred to as nitrogen oxides (NO_x). All combustion processes produce NO_x emissions, largely in the form of nitric oxide, which is gradually converted in the atmosphere to nitrogen dioxide, mainly as a result of reaction with ozone. It is nitrogen dioxide that is associated with adverse effects upon human health. It can be a respiratory irritant and may exacerbate respiratory conditions such as asthma.

Ipswich Borough Council has been monitoring nitrogen dioxide concentrations throughout the borough, close to busy main roads and in background locations, to allow overall comparisons to be made.

The results of the monitoring programme need to be compared against the National Air Quality Objectives for nitrogen dioxide.

- Hourly Mean Objective: 200 $\mu g/m^3$ not to be exceeded more than 18 times per year, to be achieved by 2005.

- Annual Mean Objective: 40 $\mu g/m^3$ to be achieved by 31 December 2005.

The first Air Quality Daughter Directive also sets limit values for nitrogen dioxide, which has been transposed into U.K. legislation. The Directive replicates the above standards and sets a target for compliance of 2010.

Continuous Monitoring Station

In July 2003 the Council commissioned a continuous real time NO_x monitor located at Pipers Court on St Margaret's Street. This location had been identified as having nitrogen dioxide concentrations closest to the objective level at the last round of air quality reviews. The monitor was located at the façade of residential properties in a street canyon-type location. A map depicting its location is shown in Appendix 3. There were no significant changes during 2003/04, such as diversions or roadworks which may have affected the results.

Data Summary (01.01.04 – 31.12.04)
Ratified data capture of 60% was reported for NO_x over the ratification period. Data capture during this monitoring period failed to meet the DEFRA target of 90% for ratified data sets. Where data capture targets are not met, comparisons of the descriptive statistics with the legislative objectives need to be treated with some degree of caution. Significant data losses with the continuous monitor during the above period were:

- 20 days NO_x data deleted between 14.06.04 and 24.06.04 due to an analyser fault
- 77 days of NO_x data deleted between 15.07.04 and 30.09.04 due to an analyser fault
- 69 days of NO_x data deleted between 01.09.04 and 08.11.04 due to an analyser fault

Nitrogen dioxide concentrations remained in the DEFRA low band throughout the monitoring period. The maximum hourly mean concentration was 139 μg/m³ below the hourly objective value of 200 μg/m³. The mean concentration of 49 μg/m³ was above the mean objective level of 40 μg/m³.

Data Summary (01.07.03 – 31.12.03)
Ratified data capture of 89.7% was reported for NO_x over the data ratification period. The maximum hourly mean concentration was 344 μg/m³ and occurred on 28 days and was above the 200 μg/m³ objective level. The mean concentration 73 μg/m³ was above the mean objective level of 40 μg/m³.

Detailed and ratified data sets are attached to this report as Appendix 4. All data has been ratified by Netcen, as part of a calibration club. Findings of audits carried out on 23 February, 15 July and 7 December 2004 are attached to this report as Appendix 5.

Assessment of Results

In assessing the results it is important to remember that data capture has been variable and only approaching 90% for July to December 2003. Also emissions for nitrogen dioxide from road traffic are predicted to fall over the next few years due to improvements in vehicle technology and fuels. However, results for 2003 and 2004 indicate that the Annual Mean Objective limit of 40 μg/m³ will be exceeded. Unratified data for 1 January 2005 to 12 April 2005 indicated an average mean of 56 μg/m³ and exceedence of the 'hourly mean' of less than 200 μg/m³ on nine occasions over four days.

Defra's Technical Guidance (LAQM, TG(03)) provides correction factors to apply to measured data from roadside monitors to enable annual mean nitrogen dioxide levels to be predicted in 2010 (derived from the assumptions on improved vehicle and fuel technology). The predicted mean concentration for Pipers Court in 2010 will be 0.78 (correction factor) x 73 μg/m³ (year 2003 mean) = 56.94 μg/m³. (This does not allow for further correction of seasonal variation on 6 month data set).

Diffusion Tube Network

Diffusion tubes are simple and effective devices, widely used throughout the country to obtain a monthly average measurement of nitrogen dioxide. The Council has used this method to monitor concentrations at up to 12 different locations in the borough. All tubes are approximately 5cms in length and are attached to street furniture or the façade of buildings and exposed to the atmosphere for approximately one month. Upon collection the tubes are sealed and delivered to a laboratory for analysis. Appendix 6 provides details of their location.

Ipswich Borough Council also participates in the UK nitrogen dioxide network and adheres to strict change-over dates to enable inter comparisons between different local authorities. For this reason the quality assurance procedures detailed in Appendix 7 are followed, and diffusion tube results have been validated against the results from the Council's continuous monitor. This comparison generates a correction or bias factor, against which diffusion tube results can be scaled. The bias factor produced by Netcen for the triplicate tubes collated with the continuous analyser of 1.096 compared favourably with the national studies of 1.12. Details of this correction are attached as Appendix 8.

Diffusion tube monitoring results are attached as Appendix 9. All sites are road or kerbside sites, with the exception of two background sites in Tavern Street and Kings Avenue (Alexandra Park). Since the Council's continuous monitor is located at a 'kerbside' site, it may not be appropriate to apply the correction factor to these two sites.

Assessment of Results

After correction for bias, the average annual mean objective has been exceeded at Pipers Court (St Margaret's Street), Star Lane Gyratory (Fore Street) and Chevalier Street and Valley Road junction on Norwich Road. Since July 2003 the bias correction figure (1.096) has been obtained through tri-location of diffusion tubes with the nitrogen dioxide continuous monitor. Previous bias correction for 2003 figures (1.36) was based on national studies for the laboratory used in analysis/tube methodology and was significantly higher. Results for 2003 indicated that the above areas were failing to meet the annual mean target for nitrogen dioxide. Additionally, sites that exceeded the standard in 2003 were: Stoke Bridge, Wherstead Road, Heath Road, A14 (Nacton Road) junction, Crown Street, tavern Street and King Street. As Tavern Street and King Street are classified as 'urban background' sites and bias corrected values exceed the nitrogen dioxide target, the degree of correction must be treated with some degree of caution for 2003 data.

Trends in Nitrogen Dioxide Concentrations

Having commissioned one nitrogen dioxide air quality monitor, the Council is now able to fully validate results of its ongoing diffusion tube programme through the 'tri location' study and comparison. The Council will therefore be able to report with some degree of accuracy future trends in nitrogen dioxide across the borough, with 2004 forming the baseline year. It is also intended to commission two further nitrogen dioxide monitors in areas that are exceeding the annual mean objective and provide further real time continuous data for comparison.

4. NEW LOCAL DEVELOPMENTS

This section deals with any changes that have taken place since the Council's Updating and Screening Assessment in 2003. The statutory guidance requires local authorities to note any significant developments that may have an impact on air quality so that they can be considered during the next full round of reviews.

- New industrial procedures regulated for emissions under the Environmental Protection Act 1990 or the Pollution Prevention and Control Act 1999. These are:

  - Volvo Truck and Bus Ltd, Foxtail Road, Ransomes Europark. A process for the respraying of road vehicles. Emissions from this process are volatile organic compounds and particulates. Defra's Technical Guidance, LAQM. TG(03), identifies such processes as a potential source of particulates but this is likely to be small.

  - BOC Ltd, Brunel Road, Hadleigh Road Industrial Estate. A process for painting metal gas cylinders. Technical guidance identifies such a process as a potential source of particulates but this is likely to be small.

  - Holden Timber Ltd, Duke Street, Ipswich. A process for milling, cutting and shaping timber. Technical guidance does not identify this process as having any significant emissions.

  - Drift Garage, The Drift, Spring Road, Ipswich. A process for burning waste oil, which has a maximum net rated thermal input of 0.029 MW. The exhaust gases from the burner being discharged from a chimney 7.5 metres above ground level. Technical guidance identifies particulates, nitrogen oxides and sulphur as significant for this process.

Two processes have ceased operating since the last air quality review. These are:

- Compair UK Ltd, Ranelagh Road, Ipswich. A foundry process for melting metal in two 1000 H_z, 1MW induction furnaces.

- ECKA Metal Powders Ltd, Elton Park Works, Hadleigh Road. A process for melting copper and other alloys in two electric induction furnaces.

Three other processes are currently awaiting process authorisation and have applied for Local Authority Pollution Prevention Control Permits. These are:

- John Grose Group Ltd, Bluestem Road, Ransomes Europark. A process for respraying road vehicles.

- M G Kerry, Leslie Road, Ipswich. A process for respraying road vehicles.

- Euromix Concrete Limited, Arkwright Road, Hadleigh Road Industrial Estate. A process for blending cement and aggregates in order to manufacture ready mix concrete.

- New landfill sites, queries etc that have been granted planning permission and could impact on air quality. Since 2003, no such permissions have been granted in Ipswich Borough.

- New developments that have been granted planning permission and could impact on air quality, including significant developments such as new retail or road schemes. These are:

  - Cranfield Mill Redevelopment, College Street, Ipswich (IP/04/00313/FUL) comprising 332 dwelling, 3840m^2 commercial use and a hotel (80 bedrooms).

  - Burtons Warehouse, College Street, Ipswich (IP/02/01241/FUL) comprising 195 flats, commercial accommodation and car parking.

  - 'Parkside', Duke Street, Ipswich (IP/04/01290). A development of 372 dwellings in 3 – 5 storey blocks and also commercial use.

  - Pauls Malt Limited, Key Street, Ipswich (IP/05/00296/FUL) comprising 281 dwellings, 3000m^2 commercial use, theatres and car parking.

  - Eastway Business Park, Europa Way, Ipswich (IP/05/00599/FUL). A mixed use development of a food store (1,796m^2), shops (3,194m^2) and 140 residential dwellings.

- Celestian Bull Motors, Foxhall Road, Ipswich (IP/05/00290/FUL) comprising 228 dwellings and accommodation for parking and open space.

- Eagle Mill, Helena Road, Ipswich (IP/04/01173/FUL). A development of 566 residential units with community space and new vehicular access.

- 2 – 30 St Matthews Street, Ipswich (IP/04/01099/FUL) comprising a hotel (131 bedrooms), 50 residential apartments and shop units.

- 'British Rail Land', Wherstead Road (IP/04/00105/FUL). A development of 180 houses and flats with access from Sinclair Drive.

- An application to Suffolk Coastal District Council for a reconfigurations of the port of Felixstowe South to provide additional container handling and rail transport facilities, which has the potential to impact on air quality in Ipswich. (Increased rail freight through Ipswich Felixstowe mainline and road traffic along A14 close to Nacton junction and Lovetofts Drive).

5. AIR QUALITY PLANNING POLICIES

The Ipswich Local Plan (1997) sets out proposals and detailed policies for the control of development. These policies outline the Council's approach to how new development will be considered. Development that is sensitive to noise, light and air pollution, such as schools and hospitals will be considered carefully so as not to be placed where air quality could be a problem. At the same time new developments that could produce such harmful effects will be directed to locations where they would minimise the effect on the environment or amenities of neighbouring uses. Where appropriate, planning conditions may be imposed or planning obligations sought for the control of harmful pollution.

NE20 – "In considering proposals for development, regard will be had to the effects of noise and air pollution. Development which could lead to serious adverse effects on the amenity or environment of neighbouring uses will not be permitted, nor will sensitive uses be permitted where they would be likely to be materially affected by the conduct of established or potentially noise or polluting uses nearby".

REFERENCES

1. Ipswich Borough Council Report on Updating and Screening Assessment for Air Quality 2003.

2. Ipswich Borough Council detailed Air Quality Assessment, Final Report July 2005 (Faber Maunsell).

3. DEFRA 2003, Part IV of the Environment Act 1995, Local Air Quality Management. Technical Guidance, LAQM (03). DEFRA Publications.

4. DEFRA 2003, Part IV of the Environment Act 1995, Local Air Quality Management. Progress Report Guidance, LAQM. PRG(03). DEFRA Publications.

5. Department of the Environment, Transport and Regions 2000. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air. The Stationery Office.

6. Environment Act 1995, Chapter 25. HMSO

7. Ipswich Borough Council Local Plan 1997.

APPENDIX 1

NATIONAL AIR QUALITY OBJECTIVES

The Government Air Quality Strategy for England was published in January 2000. It sets objectives for eight pollutants to make sure everyone can enjoy a level of ambient air which poses no significant risks to health or quality life. Local Authorities must work towards achieving the objectives, which have been incorporated into law through the Air Quality Regulations 2000, for seven of the pollutants.

The standards to the achieved are expressed as concentrations over a period of time and a date for compliance.

These are summarised below:

Objectives included in the Air Quality Regulations 2000 and (Amendment) Regulations 2002 for the purpose of Local Air Quality Management			
Pollutant	**Air Quality Objective**		**Date to be achieved by**
	Concentration	**Measured as**	
Benzene	16.25 ug/m^3	Running annual mean	31.12.2003
	5.00ug/m^3	Annual mean	31.12.2010
1,3 Butadiene	2.25 ug/m^3	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Maximum daily 8 hour mean	31.12.2003
Lead	0.50 ug/m^3	Annual mean	31.12.2004
	0.25 ug/m^3	Annual mean	31.12.2004
Nitrogen dioxide	200 ug/m^3 not to be exceeded more than 18 times a year	Hourly mean	21.12.2005
	40 ug/m^3	Annual mean	31.12.2004
Particles (PM_{10}) (gravimetric)	50 ug/m^3 not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 ug/m^3	Annual mean	31.12.2004
Sulphur dioxide	350 ug/m^3 not to be exceeded more than 24 times a year	Hourly mean	31.12.2004
	125 ug/m^3 not to be exceeded more than 3 times a year	24 hour mean	31.12.2004
	266 ug/m^3 not to be exceeded more than 35 times a year	15 minute clean	31.12.2004

APPENDIX 2

PM_{10} CONTOURS (Figures 7 and 8)

APPENDIX 3

LOCAL MAP FOR AIR QUALITY MONITOR AND DIFFUSION TUBE SITES

( = Location Point)

APPENDIX 4

RATIFIED CONTINUOUS MONITOR DATA SETS
(excluding 1 January – 12 April 2005)

APPENDIX 5

AUDIT REPORT

Netcen
Air Monitoring Calibration Club
Ambient Air Monitoring Station: Pipers Court

Audit Dates: 23 February, 15 July and 7 December 2004

This report documents the results of quality control audits and the process of data management to the Ipswich Borough Council Pipers Court air monitoring station. The work programme is supplied under contract AEA/20645067 for the supply of audit and data management services under Netcen's Air Monitoring Calibration Club.

The next audit of the station is scheduled for June 2005. It is recommended that the equipment service be scheduled to fall shortly after these audits. In this way the audits provide a useful end point upon which subsequent data management activities can be based.

The Pipers Court ambient air monitoring station was audited on 23 February, 15 July and 7 December 2005. The equipment audits utilise procedures that are applied within the Department for Environment, Food and Rural Affairs (Defra) national automatic air monitoring network quality control programme.

Audit Results

In general the oxides of nitrogen (NO_x) analyser responded well throughout the duration of the audits. The performance of this analyser was consistent with standards laid down within the Defra national automatic air monitoring network. At both the February and July 2004 audits the NO_x converter test was slightly below the network criteria. The results were recommended for immediate attention by the ESU.

Oxides of Nitrogen Analyser

A major factor governing the performance of NO_x analysers is the ability of the analyser converter to reduce nitrogen dioxide to nitric oxide. The NO_x converter test at the February 2004 audit was found to be 86% efficient at an NO_2 concentration of 280 ppb. The July 2004 audit the converter was found to be 94% efficient at an NO_2 concentration of 250 ppb. These results are slightly below the 95% minimum criteria adopted within the national network. The analyser was reported as requiring immediate attention from the ESU. The implications of these results have been considered within the data management process for this pollutant. The test at the December 2004 audit shows the converter in this analyser to be 96% efficient at an NO_2 concentration of 280 ppb. This is a satisfactory result.

To ensure that the analyser is sampling only ambient air, the instrument was leak checked and found to be free of significant leaks. The analyser exhibited good steady state responses to both zero and span (calibration) gases with acceptable levels of variation (noise).

Based on the NO_x analyser response to the audit standard and audit zero, the concentrations of the station NO cylinder has been reassessed. This provides an indication of the site standards stability. For the purpose of these stability checks, the criteria adopted within the national network, and used here, is that the recalculated concentration should lie within 10% of the stated concentrations. The results of the recalculations are presented below:

Pipers Court – NO cylinder No. 70656				
	No_x (ppb)	**% change from stated**	**NO (ppb)**	**% change from stated**
Stated Concentration	205	--	205	--
Recalculated Concentration (23.02.04)	174	**-15.3**	136	**-33.6**

Pipers Court – NO cylinder No. 53740				
	No_x (ppb)	**% change from stated**	**NO (ppb)**	**% change from stated**
Stated Concentration	192	--	192	--
Recalculated Concentration (23.02.04)	193	+0.7	192	- 0.1
Recalculated Concentration (07.12.04)	177	-8.0	132	**-31.5**

At the February 2004 audit the NO cylinder (70656) concentrations highlight a change in the cylinder total NO_x and NO concentrations from that stated. The cylinder was replaced in July 2004. This result has been considered within the data management process for this pollutant.

The results at the July 2004 audit indicate that the site NO cylinder (53740) concentrations are stable, within the definition adopted above, and can therefore reliably be used to scale ambient data.

The December 2004 results indicate that the NO cylinder total NO_x concentration agrees well with its stated value. The recalculation of the NO indicates a drop in concentration of 32%. This is outside the network criteria of 10%. This may be an indication of oxidation in the cylinder from NO to NO_2. The previous recalculated concentrations from the July 2004 audit were within the 10% criteria. It is recommended that the cylinder be retained at the station for a further concentration assessment in June 2005. This result will then be reviewed and appropriate data management action taken.

DATA MANAGEMENT

Netcen has used the audit and routine calibration results provided by Ipswich Borough Council to scale, validate and ratify the Pipers Court ambient air quality data sets for the period 1 January 2004 through 30 June 2004.

APPENDIX 6

Location	Grid Co-ordinates	Monitoring	Site Class*	Distance from Kerbside	Site Description
Civic Drive	615999/244399	Duplicate Diffusion Tubes	Roadside	7	Monitor waste case relevant exposure
Stoke Bridge	616315/243934	Diffusion Tube	Kerbside	1	Identifying vehicle pollution blackspots
Wherstead Road	616257/242619	Diffusion Tube	Roadside	5	Monitor worst case relevant exposure
Star Lane/Fore Street	616858/244146	Diffusion Tube	Roadside	4	Monitor worst case relevant exposure
Nacton Road	618971/242329	Diffusion Tube	Roadside	5	Monitor worst case relevant exposure
A14 Nacton Road Junction	620095/241263	Duplicate Diffusion Tube	Roadside	8	Identify vehicle pollution blackspots
Heath Road	619347/245136	Diffusion Tube	Roadside	5	Monitor worst case relevant exposure
Pipers Court	616593/244748	Continuous Monitor and Triplicate Diffusion Tubes	Roadside	4	Monitor worst case relevant exposure
Valley Road/Norwich Road Junction	615339/245423	Diffusion Tube	Kerbside	1	Identify vehicle pollution blackspots and monitor worst case relevant exposure
Chevallier Street	615275/245383	Diffusion Tube	Roadside	3	Monitor worst case relevant exposure
Tavern Street	616280/244640	Diffusion Tube	Urban Centre	50	Identification of urban trends
Kings Avenue (Alexandra Park)	617303/244415	Diffusion Tube	Urban Background	30	Monitoring background trend

*As defined in DEFRA's Technical Guidance, LAQM. TG(03) 2003

APPENDIX 7

DIFFUSION TUBES AND QUALITY ASSURANCE

Preparation and Analysis

Casella Stanger NO_2 diffusion tubes are supplied and analysed by Gradko International Ltd. Diffusion tubes are prepared using the 50% v/v triethanolamine with acetone method with the subsequent analysis of exposed tubes by ultra violet spectrophotometry.

Gradko International Ltd is a UKAS accredited analytical laboratory. The company operates in accordance with a Laboratory Quality Management System that includes rigorous quality control and assurance protocols in order to maintain the highest degree of confidence in their laboratory measurements.

Quality Assurance and Quality Control

The EU Daughter Directive sets data quality objectives for nitrogen dioxide along with other pollutants. Under the Directive, annual mean NO_2 concentration data derived from diffusion tube measurements must demonstrate an accuracy of ±25%, to enable comparison with the Directive air quality standards for NO_2.

In order to ensure that NO_2 concentrations reported are of a high calibre, strict performance criteria need to be met through the execution of quality assurance and control procedures. A number of factors have been identified as influencing the performance of diffusion tubes, including the laboratory preparing and analysing the tubes and the tube preparation method[1]. Quality assurance and control procedures are therefore an integral feature of any monitoring programme, ensuring that uncertainties in the data are minimised and allowing the best estimate of true concentrations to be determined.

Gradko International Ltd conduct rigorous quality control and assurance procedures, in order to maintain the highest degree of confidence in their laboratory measurements. These are discussed in more detail below.

Gradko International Ltd participate in the Health and Safety Laboratory WASP[2] NO_2 diffusion tube scheme on a monthly basis. This is a recognised performance-testing programme for laboratories undertaking NO_2 diffusion tube analysis as part of the UK NO_2 monitoring network. The scheme is designed to help laboratories meet the European Standard EN482[3]. The laboratory performance for all months in 2003 was rated 'good', which signifies a high level of accuracy for laboratory measurements.

---

[1] Compilation of diffusion tube collation studies carried out by local authorities, prepared by Professor Duncan Laxen and Penny Wilson, 2003

[2] Health and Safety Executive, Workplace Analysis Scheme for Proficiency

[3] European Committee for Standardisation (CEN) Workplace Atmospheres, General requirements for the performance of procedures for the chemical measurement of chemical agents, EN482, Brussels, CEN 1994

Gradko International Ltd also take part in the NO_2 Network Field Inter-comparison Exercise, operated by NETCEN, which complements the WASP scheme in assessing sampling and analytical performance of diffusion tubes under normal operating conditions. This involves the regular exposure of a triplet of tubes at an Automatic Urban Network site (AUN) site. NETACEN has established performance criteria for participating laboratories. Of particular interest is the bias relative to the chemiluminescent analyser that gives an indication of accuracy. In conjunction with this, a measure of precision is determined by comparing the triplet co-located tube measurements. This value is useful for assessing the uncertainty of results due to sampling and analytical techniques. The performance targets can be seen in Table 3.

The NO_2 Field Inter-comparison Exercise has historically generated the bias and precision results for each laboratory on an annual basis. This has recently been changed to the results being reported on a monthly basis. This enables a full year's inter-comparison against performance criteria. The summary Gradko International Ltd for 2004 is shown below. The results indicate that Gradko International ltd diffusion tubes are well within the performance targets set by NETCEN.

Table 1: Summary of Monthly NO_2 Network Field Inter-comparison Results, 2004

Month	Mean Tube NO2 Conc (µg/m³)	Ref NO2 Conc (µg/m³)	Bias Correction Factor 'A'	Mean % Bias 'B'
January	22.89	30	1.31	-23.71
February	23.04	36	1.56	-36.00
March	26.88	25	0.93	7.52
April	25.83	23	0.89	12.30
May	26.90	23	0.85	16.97
June	19.75	16	0.81	23.42
July	21.57	18	0.83	19.81
August	18.40	21	1.04	-3.54
September	19.37	18	0.93	7.59
October	26.12	23	0.88	13.55
November	30.40	28	0.92	8.58
December	36.50	24	0.66	52.07

Gradko International Ltd perform their own blank exposures that serve as a quality control check on the tube preparation procedure. All results are blank subtracted before they are issued to the relevant Borough.

DIFFUSION TUBE CORRECTION FACTORS

Checking Precision and Accuracy of Triplicate Tubes

netcen

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean		Period Mean	Data Capture (DC)	Tubes Precision Check	Automatic Monitor Data Capture Check
1			48.6	51.1		50	1.8	4	15.9		55	40%	Good	Poor Data Capture
2											41	99%		Good
3			34.6	37.3	33.9	35	1.8	5	4.5		40	96%	Good	Good
4			50.1	45.9	45.9	47	2.4	5	5.9		48	100%	Good	Good
5			48.9	55.8	47.5	51	4.5	9	11.1		43	99%	Good	Good
6			44.5	50.5	45.9	47	3.1	7	7.8		49	62%	Good	Poor Data Capture
7			48.8	45.1	49.3	48	2.3	5	5.7		48	47%	Good	Poor Data Capture
8			47.2	56.0	50.0	51	4.5	9	11.2			0%	Good	Poor Data Capture
9												0%		Poor Data Capture
10			43.5	36.1	42.2	41	3.9	10	9.8			0%	Good	Poor Data Capture
11			44.9	43.1	42.6	44	1.2	3	2.9		60	77%	Good	Good
12											56	100%		Good
13														

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Overall survey --> Good precision | Poor Overall DC

(Check average CV & DC from Accuracy calculations)

Precision 9 out of 9 periods have a Coefficient of Variation smaller than 20%

Accuracy (with 95% confidence)

without periods with CV larger than 20%

Bias calculated using 4 periods of data

Bias factor A 1.096 +/- 0.350

Bias B -6 +/- 32 %

Diffusion Tubes Mean: 44 µgm^{-3}

Mean CV (Precision): 5

Automatic Mean: 48 µgm^{-3}

Data Capture for periods used: 93%

Adjusted Tubes Mean: 48 +/-15 µgm^{-3}

Accuracy (with 95% confidence)

with all the data

Bias calculated using 4 periods of data

Bias factor A 1.096 +/- 0.350

Bias B -6 +/- 32 %

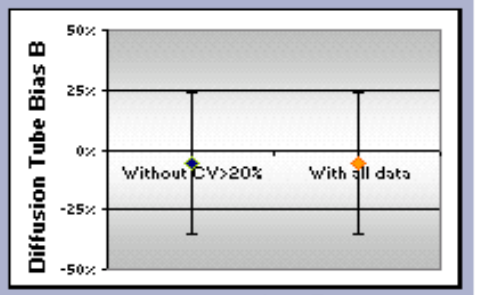
Diffusion Tubes Mean: 44 µgm^{-3}

Mean CV (Precision): 5

Automatic Mean: 48 µgm^{-3}

Data Capture for periods used: 93%

Adjusted Tubes Mean 48 +/-15 µgm^{-3}



Jaume Targa **netcen**

jaume.targa@aeat.co.uk

Beta 3 - February 2004

APPENDIX 9

DIFFUSION TUBE MONITORING RESULTS – 2003 & 2004

				2003 Nitrogen Dioxide Levels in ug/m3															
Local Authority: Ipswich Borough Council																			
Location:	**K - Kerbside**																		
	I - Intermediate																		
	B - Background																		
Diffusion Tube Data																			
Street	**Locn**	**Grid Ref**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Count**	**Min**	**Max**	**Mean**	**1.36 Bias**
Civic Drive	1 (K)	615999/244399	**24.29**	**45.98**	**35.23**		**35.8**	**31.77**	**31.1**	**29.19**	**39.02**	**32.14**	**44.37**	**25.21**	**11**	**24.3**	**45.98**	34.01	46.25
Civic Drive co-locate	2 (K)	615999/244399	**31.09**	**42.3**	**34.06**	**33.17**	**30.75**	**29.42**	**25.34**	**40.49**	**36.24**		**19.14**	**27.55**	**11**	**19.1**	**42.3**	31.78	43.22
Stoke Bridge	3 (K)	616315/243934	**31.64**		**36.49**	**48.64**		**42.35**	**43.25**				**10.45**	**34.01**	**7**	**10.5**	**48.64**	35.26	47.96
Wherestead Road	4 (K)	616257/242619	**29.21**	**52.46**	**41.79**	**39.15**	**29.81**	**31.75**		**41.85**	**37.92**	**32.86**		**30.49**	**10**	**29.2**	**52.46**	36.73	49.95
Star Lane	5 (K)	616858/244146	**36.96**	**67.8**	**52.94**	**49.85**	**36.23**	**70.16**	**50.62**	**51.89**	**66.49**	**57.92**		**54.57**	**11**	**36.2**	**70.16**	54.13	73.62
Kings Avenue	6 (B)	617303/244415	**21.9**	**36.05**	**18.82**	**19.57**	**10.56**	**16.5**	**10.93**	**150.9**	**27.75**	**25.91**	**11.32**	**26.38**	**12**	**10.6**	**150.9**	31.38	42.68
Nacton Road	7 (K)	618971/242329	**26.78**	**40.29**	**28.21**	**29.1**	**18.8**	**30.65**	**24.74**	**28.29**	**32.72**	**30.22**	**36.82**	**27.55**	**12**	**18.8**	**40.29**	29.51	40.14
A14 junction	8 (K)	620095/241263	**28.73**	**58.64**	**31.14**	**45.74**	**33.48**	**35.35**	**40.27**	**37.72**	**48.08**	**37.86**	**39.43**	**33.41**	**12**	**28.7**	**58.64**	39.15	53.25
A14 junction co-locate	9 (K)	620095/241263	**23.86**	**61.71**	**47**	**33.86**	**34.42**	**35.35**	**43.15**	**40.08**	**32.72**	**36.04**	**42.94**	**34.58**	**12**	**23.9**	**61.71**	38.81	52.78
Heath Road	10 (K)	619347/245136	**38.46**	**55.02**	**43.45**	**36.85**	**24.79**	**43.6**	**37.4**			**39.71**	**33.25**	**38.69**	**10**	**24.8**	**55.02**	39.12	53.21
Crown Street	11 (K)	616593/244748	**33.55**	**70.93**	**35.87**		**43.12**		**35.06**	**50.98**	**60.62**	**43.54**	**25.14**		**9**	**25.1**	**70.93**	44.31	60.26
Crown Street co-locate	12 (K)	616593/244748	**44.73**	**67.88**	**38.81**	**54.02**	**44.49**		**48.86**	**51.45**	**62.84**	**43.54**	**27.75**	**35.76**	**11**	**27.8**	**67.88**	47.28	64.31
Norwich Road	13 (K)	615339/245423	**39.85**	**50.2**	**48.09**	**29.15**	**34.89**	**55.96**	**40.18**	**35.91**	**59.73**	**50.08**	**34.84**	**47.47**	**12**	**29.2**	**59.73**	43.86	59.65
Chevalier Street	14 (K)	615275/245383	**44.22**	**56.94**	**48.1**		**59.67**	**47.72**	**43.62**		**49.21**	**49.36**		**42.8**	**9**	**42.8**	**59.67**	49.07	66.74
Tavern Street	15 (B)	616280/244640	**27.73**	**42.3**	**36.33**	**30.83**	**30.29**	**29.49**	**26.4**	**25.5**	**37.24**	**36.24**	**26.79**	**36.43**	**12**	**25.5**	**42.3**	32.13	43.70
Museum Street	16 (K)	616086/244571						**40.1**		**29.76**	**31.67**	**33.65**	**20.78**	**32.94**	**6**	**20.8**	**40.1**	31.48	42.82
Museum Street	17 (K)	616086/244571						**34.21**		**27.4**	**22.78**	**31.09**	**28.56**	**28.24**	**6**	**22.8**	**34.21**	28.71	39.05
Museum Street	18 (K)	616086/244571							**34.44**	**21.16**	**34.28**	**39.68**	**11.24**	**3.52**	**6**	**3.52**	**39.68**	24.05	32.71
Crown St co-locate (Aug start)	19 (K)	616593/244748									**55.3**	**46.24**	**21.61**		**3**	**21.6**	**55.3**	41.05	55.83

				2004 Nitrogen Dioxide Levels in ug/m3																
Local Authority: Ipswich Borough Council																				
Location:																				
Diffusion Tube Data		**Grid**																	**Local**	**National**
Street	**Locn.**	**Ref x/y**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Count**	**Min**	**Max**	**Mean**	**Bias**	**Bias**
																			1.10	**1.12**
Civic Drive	1	615999/244399			**28.27**			**29.3**	**30.4**	**32.28**		**30.6**	**36.3**	**33.38**	**7**	**28.3**	**36.34**	31.50	34.52	35.28
Civic Drive co-locate	2	615999/244399			**26.84**			**22.42**	**26.7**	**32.28**		**31.6**	**37**	**34.87**	**7**	**22.4**	**36.95**	30.24	33.14	33.87
Stoke Bridge	3	616315/243934	**38.1**				**36.4**	**26.46**	**30.8**	**35.67**		**35.4**	**41.7**		**7**	**26.5**	**41.65**	34.92	38.28	39.11
Wherstead Road	4	616257/242619	**33.1**		**29.13**	**38.59**	**33.9**		**26.1**	**29.23**		**32.8**	**36.2**	**31.38**	**9**	**26.1**	**38.59**	32.27	35.37	36.15
Star Lane	5	616858/244146			**37.49**	**50.67**	**53.8**	**44.26**	**42.7**	**46.36**		**41.8**	**42.1**	**44.33**	**9**	**37.5**	**53.75**	44.83	49.13	50.21
Kings Avenue	6	617303/244415	**23.5**	**31.1**	**17.92**			**14.59**	**15.7**	**17.58**			**24.4**	**27.68**	**8**	**14.6**	**31.05**	21.55	23.61	24.13
Nacton Road	7	618971/242329	**35.1**	**32.1**	**31.08**			**25.63**	**0.95**	**25.11**				**35.33**	**7**	**0.95**	**35.33**	26.46	29.00	29.64
A14 junction	8	620095/241263	**28.1**	**36.6**	**30.5**	**37.67**	**41**	**26.54**		**34.73**		**33.1**	**40**	**34.13**	**10**	**26.5**	**41.02**	34.24	37.53	38.35
A14 junction co-locate	9	620095/241263	**32.1**	**36.8**	**30.22**	**41.34**	**34.9**	**30.48**	**31.4**	**38.4**		**32.3**	**39.8**	**32.63**	**11**	**30.2**	**41.34**	34.57	37.88	38.71
Heath Road	10	619347/245136	**40.1**	**31.9**	**32.58**	**39.51**	**29.9**								**5**	**29.9**	**40.08**	34.80	38.14	38.97
Pipers Court Collocate	11	616593/244748	**48.6**		**34.58**	**50.08**	**48.9**	**44.5**	**48.8**	**47.16**		**43.5**	**44.9**		**9**	**34.6**	**50.08**	45.65	50.03	51.13
Pipers Court Collocate	12	616593/244748	**51.1**		**37.29**	**45.94**	**55.8**	**50.46**	**45.1**	**56.02**		**36.1**	**43.1**		**9**	**36.1**	**56.02**	46.77	51.26	52.38
Pipers Court Collocate	19	616593/244748			**33.9**	**45.94**	**47.5**	**45.88**	**49.3**	**50**		**42.2**	**42.6**		**8**	**33.9**	**50**	44.66	48.94	50.02
Norwich Road	13	615339/245423	**41.6**	**44.1**	**41.99**		**45.1**	**45.29**		**45.81**		**42.9**	**48.3**	**40.47**	**9**	**40.5**	**48.29**	43.95	48.17	49.22
Chevalier Street	14	615275/245383	**49.1**	**53.9**	**47.05**	**49.16**	**59.2**	**42.99**	**50**	**47.71**		**48.3**	**52.9**	**40.97**	**11**	**41**	**59.15**	49.19	53.91	55.09
Tavern Street	15	616280/244640	**30.6**	**35**	**27.46**	**31.69**	**27.9**	**20.77**	**24.4**	**27.23**		**27.2**	**32.4**	**31**	**11**	**20.8**	**34.98**	28.69	31.44	32.13
Museum Street	16	616086/244571	**38.1**		**21.14**	**39.5**	**36.5**		**29.5**	**35.72**		**33.6**	**39.9**	**32.94**	**9**	**21.1**	**39.89**	34.09	37.37	38.18
Museum Street Co-locate	17	616086/244571	**35.1**	**37.9**	**28.9**	**35.83**			**30.4**	**29.86**		**32.6**	**35.1**	**33.66**	**9**	**28.9**	**37.85**	33.26	36.45	37.25
Museum Street Co-locate	18	616086/244571	**29.1**		**34.07**	**39.5**	**40.8**		**25.8**	**33.6**		**34.9**	**34.9**	**29.68**	**9**	**25.8**	**40.81**	33.58	36.80	37.61