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Midlothian

Midlothian Council
Local Air Quality Management

Progress Report 2008

ENVIROS

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Prepared under the management of:

Steven Byrne – Project Manager

Directed, reviewed and approved by:

Dr Mark Broomfield – Project Director

Client Address:

Strategic Services
Midlothian Council
Fairfield House
8 Lothian Road
Dalkeith
Midlothian
EH22 3AA

Mark Richardson, Principal Environmental Health Officer

Tel 0131 271 7500
Email mark.richardson@midlothian.gov.uk

Web www.midlothian.gov.uk

Enviros Contact Details:

Enviros Consulting Ltd
61 The Shore
Leith
Edinburgh
EH6 6RA

Web www.enviros.com

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EXECUTIVE SUMMARY

Midlothian Council has commissioned Enviros Consulting Ltd to compile the Progress Report 2008 relating to local air quality within the Council's area. This report forms part of the Council's obligations under the Local Air Quality Management process. The Progress Report 2008 builds upon previous rounds of the Review and Assessment process and considers updated monitoring results, details of new developments with the potential to impact upon air quality and details of any relevant local strategies or plans.

This Progress Report confirms that the air quality objectives for the following substances are unlikely to be exceeded in Midlothian:

- 1, 3-butadiene;
- benzene;
- carbon monoxide;
- lead;
- particulate matter (PM_{10}), except in Pathhead;
- nitrogen dioxide; and
- sulphur dioxide.

No new significant sources of 1, 3-butadiene, benzene, carbon monoxide and lead have been identified from the brief recent review of new processes or other sources in Midlothian.

Monitoring for nitrogen dioxide, PM_{10} and sulphur dioxide is continuing in Midlothian. The results of PM_{10} monitoring confirm the declaration of the AQMA at Pathhead. This will be investigated in more detail in the Further Assessment. Measurements of sulphur dioxide are well below the air quality objectives. Some diffusion tube measurements of nitrogen dioxide were above the annual mean air quality objective. However, the diffusion tube locations are not directly representative of long term human exposure locations and concentrations at nearby residential properties are likely to be lower. Furthermore, the opening of the Dalkeith Bypass by the end of summer 2008 is anticipated to lead to a reduction in vehicles travelling through Dalkeith, leading to a reduction in traffic derived pollutants, such as nitrogen dioxide. Midlothian Council will carry out a review of the current diffusion tube locations and confirm whether the survey needs to be expanded to cover Lasswade and Bonnyrigg, where increased traffic congestion has occurred.

There have been several minor changes to industrial processes in Midlothian since the Updating and Screening Assessment 2006. There have also been other developments such as the Park and Rides, the proposed Shawfair new town and proposed re-opening of the Waverley Rail Line. The effect of these changes will be incorporated into future local air quality management assessments as they commence operation/open.

It is concluded that Midlothian Council does not need to undertake a Detailed Assessment at this time.

1. INTRODUCTION

Midlothian Council has commissioned Enviros Consulting Ltd to compile a progress report relating to local air quality within the Council's area. This report forms part of the Council's obligations under the Local Air Quality Management (LAQM) regime.

This report sets out a progress report based upon the guidance set out in the Scottish Executive guidance note LAQM.PRG(03) (Ref. 1) and has been produced on behalf of and endorsed by Midlothian Council.

The report builds on the information gathered in the previous and current rounds of LAQM assessment:

Round 1: Stage 1, 2 and 3 review and assessment of local air quality completed 1998 – 2001 (Ref. 2, 3 and 4);

Round 2: Updating and Screening Assessment, Detailed Assessment and Progress Report completed 2003 – 2005 (Ref. 5, 6 and 7).

Round 3: Updating and Screening Assessment and Detailed Assessment carried out in 2006 and 2007, respectively (Ref. 8 and 9). This report completes Round 3 of LAQM assessment.

For background and explanation of terminology, it is recommended that this report is read in conjunction with these previous reports.

This report sets out:

Chapter 2: The background to Local Air Quality Management;

Chapter 3: Monitoring aspects including new data;

Chapter 4: New local developments and other aspects including planning and transport;

Chapter 5: Discussion and recommendations;

Chapter 6: References.

This report was based on data provided by Midlothian Council. Enviros has accepted all data *de facto* and assumes that it is accurate and complete.

2. BACKGROUND TO LOCAL AIR QUALITY MANAGEMENT

Local authorities have a statutory obligation to review and assess air quality within their region under Part IV of the Environment Act 1995 (Ref. 10) and subsequent Regulations. The Air Quality Strategy for England, Wales, Scotland and Northern Ireland (AQS) (Ref. 11) sets out prescribed air quality objectives for target pollutants against which each local authority must assess air quality and establishes a framework for air quality improvements. The function of the local authority review and assessment process is to identify areas where it is considered likely that the air quality objectives will be exceeded and where they are exceeded, to put in place a management or action plan to achieve air quality in compliance of the objectives.

2.1 The Phased Approach to Review and Assessment

Local authorities completed the first round of the review and assessment process in 2001. This was based on a three stage approach, with authorities proceeding to the more detailed third stage if the risk of an air quality objective being exceeded was identified.

Under the Environment Act 1995, local authorities are required to complete ongoing review and assessment cycles of air quality within their area. In 2003 and then again in 2006, new rounds of review and assessment were commenced with an Updating and Screening Assessment report. The intention for these reports was that local authorities should have undertaken a level of assessment that was commensurate with the risk of an air quality objective being exceeded. This assessment was based on a checklist approach to identify any changes since the last phase such as new air quality objectives, new monitoring data, new sources of pollution or changes to existing sources of pollution. If any relevant changes were identified, simple screening methods were used to identify if there was a risk of an air quality objective being exceeded. If a risk was identified, then the local authority was required to complete a Detailed Assessment to provide an estimate of the likelihood of an air quality objective being exceeded at the particular location with relevant public exposure. The aim of the Detailed Assessment is to identify with reasonable certainty whether or not a likely exceedence of the air quality objectives will occur.

The final stage in the round of review and assessment is the completion of a Progress Report. These are required in years when an authority is not carrying out its three yearly Updating and Screening Assessment or carrying out a Detailed Assessment. The progress report should provide both a review and update on air quality issues, including information on new monitoring data and air quality trends; new developments in the area which might have an impact on air quality; and whether a Detailed Assessment is likely to be required, in any areas where elevated levels of airborne pollution have been identified.

2.2 Air Quality Objectives

The air quality objectives specified in the Air Quality Strategy which are relevant to this progress report are shown in Table 1.

Table 1 Relevant Air Quality Objectives

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
1, 3-butadiene	2.25 µg/m^3	Running annual mean	31st Dec 2003
Benzene	16.25 µg/m^3	Running annual mean	31st Dec 2003
	3.25 µg/m^3	Running annual mean	31st Dec 2010
Carbon monoxide	10,000 µg/m^3	Maximum daily running eight hour mean	31st Dec 2003
Lead	0.5 µg/m^3	Annual mean	31st Dec 2004
	0.25 µg/m^3	Annual mean	31st Dec 2008
Nitrogen dioxide	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31st Dec 2005
	40	annual mean	31st Dec 2005
Particles (PM_{10})[1] (gravimetric)	50 µg/m^3 not to be exceeded more than 35 times a year	24-hour mean	31st Dec 2004
	40 µg/m^3	annual mean	31st Dec 2004
	50 µg/m^3 not to be exceeded more than 7 times a year	24-hour mean	31st Dec 2010
	18 µg/m^3	annual mean	31st Dec 2010
Sulphur dioxide	350 µg/m^3 not to be exceeded more than 24 times a year	1-hour mean	31st Dec 2004
	125 µg/m^3 not to be exceeded more than 3 times a year	24-hour mean	31st Dec 2004
	266 µg/m^3 not to be exceeded more than 35 times a year	15-minute mean	31st Dec 2005

Note 1: The assessment of particulate matter is undertaken for particulate matter of ≤10µm aerodynamic diameter measured using the European gravimetric transfer sampler or equivalent (PM_{10}).

2.3 Review and Assessment Methods

The assessment of air quality is undertaken using a variety of screening, monitoring and modelling techniques. The government has issued a number of guidance documents detailing techniques for screening to identify and screen out non-significant sources of emissions, and identify sources which need to be considered further. The sources which need to be considered include heavily trafficked roads,

residential areas using solid fuel as the primary fuel source, large industrial facilities and industry in close proximity to residential areas.

Air quality monitoring can involve the use of a variety of techniques, including continuous monitoring and passive sampling techniques, using diffusion tubes. The technical complexity, cost and validity of results from these techniques vary greatly and careful consideration is required of both the siting of monitoring equipment and interpretation of the results. Air quality modelling is widely used to identify areas where the air quality objectives might not be achieved and is often used in conjunction with monitoring in areas where the objectives are predicted to be exceeded or are at levels approaching the objectives. Modelling can incorporate industrial emissions, emissions associated with traffic on major trunk roads and in busy urban areas.

With the use of forecasting tools, these assessment methods are used to build a picture of where the air quality objectives may be exceeded in the relevant objective years. In the event that there is a risk of the air quality objectives being exceeded at locations where members of the public are likely to be exposed for the relevant averaging period (for example at residential properties) the local authority is required to declare an Air Quality Management Area.

2.4 Previous Midlothian Council Review and Assessment Reports

2.4.1 First Round of Review and Assessment, 1998 – 2001

A schematic map of Midlothian showing villages, towns and roads within the district is shown in Figure 1.

The assessment of local air quality was undertaken initially as a three stage process using increasingly detailed levels of assessment.

Midlothian Council has previously completed Stages 1 to 3 of the first round of the Review and Assessment process.

The Stage 1 report concluded that further assessment of nitrogen dioxide, particulate matter, sulphur dioxide and lead was required due to emissions from traffic, industrial and domestic sources.

The Stage 2 report concluded that no further assessment was required for particulate matter, sulphur dioxide and lead. A more detailed assessment of nitrogen dioxide was recommended at Stage 3 for road traffic emissions in the centre of Dalkeith.

On the basis of continuous analyser monitoring and dispersion modelling results, the Stage 3 report concluded that the air quality objectives for nitrogen dioxide were not at risk of being exceeded at sensitive receptor locations in Dalkeith centre and therefore the declaration of an air quality management area was not required.

2.4.2 Second Round of Review and Assessment, 2003 – 2005

Updating and Screening Assessment 2003

Following completion of reports for the first phase of Review and Assessment, there were potentially a number of issues that needed to be addressed in terms of changes to the sources and emissions of pollutants that may have affected ambient air quality in local authority areas. Furthermore, new policy developments and

revisions to published guidance required consideration within the on-going assessment of air quality.

The updating and screening assessment was based on a checklist approach, whereby sources identified in the first round of Review and Assessment and any new or altered emissions sources were reviewed with regard to their current significance and any requirement for further, more detailed, assessment.

The Updating and Screening Assessment completed in early 2004 concluded that a Detailed Assessment was required for nitrogen dioxide and particulate matter levels due to road traffic emissions in Dalkeith centre. The screening assessment indicated that a survey of domestic fuel use was required for two villages in Midlothian; Cousland and Pathhead.

Detailed Assessment 2004

The Detailed Assessment report completed in 2005 by Midlothian Council concluded that particulate levels in Dalkeith centre would comply with the air quality objectives for the target years of 2004 and 2010. Nitrogen dioxide levels were also predicted not to exceed the relevant air quality objectives. However, further monitoring was recommended to provide more data of improved reliability. The updated results of this survey are set out in this report.

The survey of domestic fuel use in Cousland and Pathhead indicated a more detailed assessment of particulate and sulphur dioxide levels was required in Pathhead. Midlothian Council committed to carry out the monitoring in the winter period of September 2005 to March 2006. The results of the monitoring were incorporated into the next round (the third round) of the review and assessment process (i.e. the Updating and Screening Assessment due in 2006).

Progress Report 2005

The Progress Report submitted in 2005, and updated in 2006, provided an update on local air quality issues in Midlothian and focused on the latest monitoring results and updates to industrial processes and developments. The report concluded that there were no areas of immediate concern. The proposed Dalkeith by-pass was anticipated to lead to a considerable decrease in pollution levels in the centre of Dalkeith. It was recommended that additional monitoring be undertaken to reinforce these findings in Dalkeith and also at the village of Pathhead following the recommendations in the Detailed Assessment 2004 report.

2.4.3 Third Round of Review and Assessment, 2006 – 2008

Updating and Screening Assessment 2006

The Updating and Screening Assessment completed in 2006 provided an analysis of particulate matter monitoring results in Pathhead, and concluded that a Detailed Assessment was required. Although it was concluded that there had been no significant changes with regards to emissions of all other substances, it was recommended that the existing monitoring programme be continued.

Detailed Assessment 2007

The Detailed Assessment completed in 2007 focused on particulate matter levels in Pathhead due to domestic coal burning and road traffic emissions. The results of the monitoring campaign indicated that the levels of PM_{10} are predicted to exceed the annual mean air quality objective by the target date of 2010. Further analysis

was undertaken using dispersion modelling which confirmed the monitoring results. On this basis, Midlothian Council committed to declaring an Air Quality Management Area (AQMA) in Pathhead.

2.5 Air Quality Management Area, Further Assessment and Air Quality Action Plan

The AQMA in Pathhead came into force on 30 April 2008 and covers the entire village. Midlothian Council aims to carry out a Further Assessment within 12 months of the above date in order to confirm the original assessment, calculate the improvement required and refine its knowledge of the sources of pollution. Midlothian Council is also required to prepare an Air Quality Action Plan within 18 months of the declaration of the AQMA.

2.6 Guidance for this Report

The main government guidance of relevance to the progress report are:

- Local Air Quality Management, Progress Report Guidance, LAQM.PRG(03) (Ref. 1);
- Local Air Quality Management, Technical Guidance, LAQM.TG(03) (Ref. 12);
- Other relevant guidance, updates to the above guidance, reports and tools available at the Air Quality Review and Assessment Website (Ref. 13).

These guidance documents and sources have been used as the basis of this assessment.

3. NEW MONITORING RESULTS

Midlothian Council continues to measure levels of nitrogen dioxide, PM_{10} and sulphur dioxide at the continuous monitoring station in Dalkeith centre and PM_{10} and sulphur dioxide at the continuous monitoring station in Pathhead. Both of these monitoring stations are classified as roadside locations. The Dalkeith station is within 5m of the kerb of the High Street (A6094), close to the junction with South Street (A68). The Pathhead station is approximately 1 – 2m from the kerb of Main Street (A68). A summary of the Quality Assurance/Quality Control (QA/QC) procedures and the data management arrangements is provided in Appendix 1.

The Council also measures nitrogen dioxide levels using passive diffusion tubes at several locations across Midlothian. These locations are in the towns of Dalkeith and Penicuik and the village of Pathhead.

The location of the monitoring stations and diffusion tube measurements are shown in Figures 2, 3 and 4.

No monitoring of other pollutants has been undertaken in Midlothian. The previous local air quality management reports showed that the air quality objectives for other specified pollutants are unlikely to be exceeded and on this basis no monitoring for other pollutants was considered necessary.

3.1 Nitrogen Dioxide

3.1.1 Monitoring locations

Nitrogen dioxide concentrations were measured throughout 2006 and 2007 at the monitoring station situated in Dalkeith town centre. Monitoring of nitrogen dioxide using passive diffusion tubes was also undertaken at 14 separate locations in Midlothian. The diffusion tube locations are described in Table 2.

Table 2 Passive diffusion tube locations in Midlothian

Location	Location Reference	Description	Monitoring Location Environment
Dalkeith	J1 (1, 2 and 3) *	Triplicate tubes co-located with Dalkeith Centre monitoring station, Jarnac Court, Dalkeith	Roadside
	J2	South Street (A68), near junction with High Street (A6094), Dalkeith	Roadside
	E1 *	Elmfield Court, Dalkeith	Urban Background
	BD1	Buccleuch Street (B6373), Dalkeith	Roadside
	ED1	Edinburgh Road (A68), Dalkeith	Roadside
	ED2	Esbank Road (A6094), Dalkeith	Roadside
	X1	Old Edinburgh Road (B6373), Dalkeith	Roadside
	HD1	High Street (A6094), Dalkeith	Roadside
	ND1	Newmills Road (A68), Dalkeith	Roadside

Table 2 (cont.) Passive diffusion tube locations in Midlothian

Location	Location Reference	Description	Monitoring Location Environment
Penicuik	P1 *	Craigiebield Crescent, Penicuik	Urban Background
	P2 *	Edinburgh Road (A701), Penicuik	Roadside
	P3	Bridge Street (A701), Penicuik	Roadside
Pathhead	PD1	Main Street (A68), Pathhead	Roadside
	PD2	Main Street (A68), Pathhead	Roadside

* - tube results sent monthly to Netcen as part of the Nitrogen Diffusion Tube Network

3.1.2 Continuous Monitoring Results

Table 3 shows the results of the monitoring for 2006 and 2007.

Table 3 Nitrogen dioxide monitoring at Dalkeith Centre monitoring station

Year	Measured NO_2 Concentration		Capture Rate	Notes
	Annual Mean (µg/m^3)	Number of exceedences of 1 hour mean objective (200µg/m^3)		
2006	25.9	0	97.7%	Good data capture
2007	26.2	0	91.1%	Good data capture
Air Quality Objective	**40**	**18**		

The results indicate that the air quality objectives for NO_2 were met at the location of the monitoring station in Dalkeith town centre in 2006 and 2007.

3.1.3 Diffusion Tube Results

The diffusion tube method is open to a degree of uncertainty inherent in the method and as such the results of the survey should be treated with some caution and used as indicators of nitrogen dioxide levels only. Bias correction methods have been developed to reduce the error in the results of the diffusion tube survey. The most robust of these methods is co-location of diffusion tubes with a continuous monitor to calculate the tube bias. For this purpose, Midlothian Council has co-located triplicate diffusion tubes at the Dalkeith Centre continuous monitoring station since 2005. The results of the co-location study in 2006 and 2007 are shown in Appendix 2. The study resulted in bias adjustment factors of 0.92 and 0.93 for 2006 and 2007, respectively. This means that the diffusion tube results are slightly higher than the continuous monitoring results. The bias adjustment data and calculations are shown in Appendix 2.

The diffusion tubes are analysed by Edinburgh Scientific Services using the 50% triethanolamine (TEA) in acetone method. The bias adjustment factors reported in the Spreadsheet of Bias Adjustment Factors (version 04/08) produced by Defra and the Devolved Administrations (Ref. 14) for this laboratory and analysis method range from 0.82 – 1.24 (based on 4 studies) in 2006 and 0.98 – 1.13 (based on 2 studies) in 2007. It was decided to use the local bias adjustment factors rather

than the overall factors presented in the Defra Spreadsheet of Bias Adjustment Factors.

The factors for each year were applied to the diffusion tube results situated at roadside locations only as the co-location study is based on roadside measurements. Diffusion tubes located at urban background locations were not adjusted.

The results of the corrected diffusion tube monitoring data are presented in Table 4. Although presented in previous reports, the diffusion tube results for 2003, 2004 and 2005 are also included for information purposes. For the 2003 and 2004 data, the corrected concentrations were obtained by multiplying the uncorrected concentrations by the bias adjustment factors of 0.91 and 0.903, respectively, based on data for roadside comparisons in the most recent version of the Spreadsheet of Bias Adjustment Factors (Ref. 14) for these years. These factors represent the latest data and may be slightly different to the factors used for previous LAQM reports as more datasets have been added to the measurement database. The 2005 data were also corrected using a revised local bias adjustment factor of 0.89 rather than the factor of 0.7 used previously in the Updating and Screening Assessment 2006 (see Appendix 2).

Table 4 Summary of nitrogen dioxide diffusion tube monitoring in Midlothian 2003 – 2007

Tube Ref.	Location	Type	Bias Corrected Annual Mean Concentration (µg/m^3)					Overall Trend since 2003
			2003	2004	2005	2006	2007	
J2	South Street (A68), near junction with High Street (A6094), Dalkeith	Roadside	41.6	40.6	34.3	38.6	43.4	No significant change
E1	Elmfield Court, Dalkeith	Urban Background	12.5	12.8	11.5	12.3	14.4	No significant change
BD1	Buccleuch Street (B6373), Dalkeith	Roadside	40.0	38.1	30.3	41.0	40.8	No significant change
ED1	Edinburgh Road (A68), Dalkeith	Roadside	33.4	33.1	35.8	40.4	43.0	Increasing
ED2	Esbank Road (A6094), Dalkeith	Roadside	27.5	27.0	27.5	27.9	29.8	Increasing
X1	Old Edinburgh Road (B6373), Dalkeith	Roadside	32.3	29.7	25.1	30.5	29.7	No significant change
HD1	High Street (A6094), Dalkeith	Roadside	17.4	18.2	16.4	17.9	19.8	No significant change
ND1	Newmills Road (A68), Dalkeith	Roadside	36.5	46.7	39.6	48.8	52.5	Increasing
P1	Craigiebield Crescent, Penicuik	Urban Background	6.1	9.0	7.1	5.8	7.4	No significant change
P2	Edinburgh Road (A701), Penicuik	Roadside	29.0	22.3	22.6	28.6	27.0	No significant change
P3	Bridge Street (A701), Penicuik	Roadside	-	13.3	15.5	16.2	17.1	Increasing
PD1	Main Street (A68), Pathhead	Roadside	14.6	19.0	17.1	16.1	19.4	No significant change
PD2	Main Street (A68), Pathhead	Roadside	15.7	21.9	14.5	17.9	19.3	No significant change

The results presented in Table 4 are presented graphically in Figure 5 to illustrate any trends. The results indicate that concentrations of nitrogen dioxide measured across Midlothian are either relatively constant or slightly increasing. No decreasing trends were observed.

The measured nitrogen dioxide concentrations at several diffusion tube locations were above the annual mean air quality objective of 40µg/m^3. All these tube locations are located adjacent to the A68 or in the centre of Dalkeith and have generally measured increasing concentrations since 2005. During this period, there have been several developments and major road works in the centre of Dalkeith which have caused increased levels of congestion, especially during peak hours. The Dalkeith Bypass is due to open soon (see Section 4.3) and this is likely to reduce the number of vehicles travelling through Dalkeith town centre. Consequently, concentrations of nitrogen dioxide are expected to decrease in Dalkeith town centre. Therefore, Midlothian Council does not propose to carry out a more detailed assessment of nitrogen dioxide levels in Dalkeith town centre at this time. Measurements of nitrogen dioxide will continue as normal and the annual mean concentrations will be assessed through the LAQM process.

Another factor to take into account with regards to the measured concentrations presented in Table 4 is the diffusion tube locations. Tube location ND1 is not directly representative of long term human exposure locations such as residential properties. It is located adjacent to the A68 next to an architects practice. The nearest residential properties are on the other side of the road and are set back approximately 5 – 10m from the A68. Concentrations of nitrogen dioxide at these locations are likely to be less than at the diffusion tube location. The report produced for Defra on roadside measurements of nitrogen dioxide (Ref. 15) indicates that there is:

"...a sharp decline over the first 5-10 m from the kerb, with concentrations appearing to be close to the local background beyond about 20 m. This is most evident alongside single carriageway roads outside of major conurbations..."

The other diffusion tube locations which recorded annual mean concentrations above the air quality objective (J2, BD1 and ED1) are also not located at directly representative locations. Midlothian Council commits to reviewing the diffusion tube locations and either moving the existing tubes or using additional tubes to measure concentrations at locations representative of long term human exposure close to these locations. This will be carried out by the end of the 2008 monitoring period.

There have also been reports of increased congestion in Lasswade and Bonnyrigg which could lead to higher concentrations of pollutants. There is currently no air quality monitoring carried out at these towns. Consequently, Midlothian Council commits to reviewing the need to carry out monitoring at these locations.

3.2 PM_{10}

Monitoring of PM_{10} concentrations was carried out at the Dalkeith town centre and Pathhead monitoring stations throughout 2006 and 2007.

3.2.1 Continuous Monitoring Results, Dalkeith

Table 5 shows the results of the monitoring for Dalkeith. As per guidance issued by the Scottish Executive regarding PM_{10} measurements carried out using a TEOM,

the annual mean concentrations were adjusted using the 1.14 and 1.3 correction factors (Ref. 13). The 24-hour mean concentrations were corrected using just the 1.3 correction factor.

Table 5 PM_{10} monitoring at Dalkeith Centre monitoring station

Year	Measured PM_{10} Concentration			Capture Rate	Notes
	Annual Mean (µg/m^3)		Number of exceedences of 24-hour mean 50µg/m^3 objective value		
	TEOMx1.14	TEOMx1.3	TEOMx1.3		
2006	17.7	20.1	3	91.8%	Good data capture
2007	16.1	18.3	3	88.2%	Reasonably good data capture
2010 (factored)	15.3	17.5			
Air Quality Objective (2004)	**40**		**18**		
Air Quality Objective (2010)	**18**		**7**		

The measured concentrations are in compliance with the existing 2004 air quality objectives, regardless of the correction factor used.

The measured annual mean concentration in 2007 was factored forward to 2010 for comparison to the 2010 annual mean air quality objective using the approach specified in TG(03) as updated by LAQM guidance (Ref. 13). The concentration using the 1.3 correction factor is 17.5µg/m^3, which complies with the air quality objective. The 24-hour mean concentration also complies with the 2010 air quality objective.

3.2.2 Continuous Monitoring Results, Pathhead

Table 6 shows the results of the monitoring at Pathhead.

Table 6 PM_{10} monitoring at Pathhead monitoring station

Year	Measured PM_{10} Concentration			Capture Rate	Notes
	Annual Mean (µg/m^3)		Number of exceedences of 24-hour mean 50µg/m^3 objective value		
	TEOMx1.14	TEOMx1.3	TEOMx1.3		
2006	20.1	22.9	3	95.4%	Good data capture
2007	19.9	22.7	6	87.6%	Reasonable data capture
2010 (factored)	19.2	21.8			
Air Quality Objective (2004)	**40**		**18**		
Air Quality Objective (2010)	**18**		**7**		

The measured concentrations are in compliance with the existing air quality objectives, regardless of the correction factor used.

The measured annual mean concentration in 2007 was factored forward to 2010 for comparison to the 2010 annual mean air quality objective using the approach specified in TG(03) as updated by LAQM guidance (Ref. 13). The predicted concentration using the 1.14 and 1.3 correction factors are 19.2µg/m^3 and 21.8µg/m^3, respectively. Both of these values exceed the 2010 annual mean air quality objective. This is in line with earlier measurements and forecasts regarding the declaration of an AQMA at Pathhead. The 24-hour mean concentration complies with the 2010 air quality objective.

3.3 Sulphur Dioxide

Monitoring of sulphur dioxide concentrations was carried out at the Dalkeith town centre and Pathhead monitoring stations throughout 2006 and 2007.

3.3.1 Continuous Monitoring Results, Dalkeith

Table 7 shows the results of the monitoring for Dalkeith.

Table 7 Sulphur dioxide monitoring at Dalkeith monitoring station

Year	Number of exceedences of			Capture Rate	Notes
	15-minute mean 266µg/m^3 objective value	1-hour mean 350µg/m^3 objective value	24-hour mean 125µg/m^3 objective value		
2006	36.8	27.5	14.9	94.2%	Good data capture
2007	42.0	25.1	10.8	91.0%	Good data capture
Air Quality Objective (2005)	**35**	**24**	**3**		

The measured concentrations are in compliance with the air quality objectives.

3.3.2 Continuous Monitoring Results, Pathhead

Table 8 shows the results of the monitoring for Pathhead.

Table 8 Sulphur dioxide monitoring at Pathhead monitoring station

Year	Number of exceedences of			Capture Rate	Notes
	15-minute mean 266µg/m^3 objective value	1-hour mean 350µg/m^3 objective value	24-hour mean 125µg/m^3 objective value		
2006	75.1	73.4	30.7	95.4%	Good data capture
2007	114.9	79.8	43.6	92.9%	Good data capture
Air Quality Objective (2005)	**35**	**24**	**3**		

The measured concentrations are in compliance with the air quality objectives.

Although there were no recorded exceedences of the air quality objectives at Pathhead, the measured concentrations were higher than those measured in Dalkeith town centre. This is consistent with higher use of domestic solid fuel such as coal in Pathhead and was discussed in the Detailed Assessment 2007.

3.4 Proposed Further Monitoring

Midlothian Council will continue to monitor nitrogen dioxide, PM_{10} and sulphur dioxide as described above. The Council has committed to purchasing a Partisol gravimetric PM_{10} analyser, to be installed in close proximity to the existing TEOM unit in Pathhead. The initial monitoring results, including speciation analysis, will be included in next year's Further Assessment (2009) as well as in the proposed Air Quality Action Plan.

3.5 Summary

The continuous monitoring indicates that the concentrations of nitrogen dioxide, PM_{10} and sulphur dioxide are in compliance with the relevant air quality objectives, except for in Pathhead where the 2010 annual mean air quality objective is forecast to be exceeded. This confirms the recent declaration of the AQMA at Pathhead for this substance.

However, the concentrations of nitrogen dioxide measured by passive diffusion tubes across Midlothian demonstrate, if anything, an overall increasing trend. Exceedences of the annual mean air quality objective have been recorded at four diffusion tube locations. As described above, these four diffusion tubes are situated at locations which are not directly representative of long term human exposure and are closer to the road than nearby residential properties. There have also been several developments and road works in Dalkeith town centre which have caused higher than normal levels of congestion. When the Dalkeith Bypass opens (programmed for Summer 2008) it is anticipated that traffic flows in the town centre will be reduced. As such, Midlothian Council will continue to monitor the situation and report the findings in subsequent LAQM reports.

Midlothian Council also commits to reviewing the diffusion tube locations and investigate the need for additional monitoring at Lasswade and Bonnyrigg.

3.6 Other Pollutants

No other monitoring is currently undertaken in Midlothian. Based upon the findings of the previous assessments, the concentrations of other pollutants in Midlothian are unlikely to be in excess of the air quality objectives at any location.

The need to implement monitoring for other pollutants will be considered again in the Updating and Screening Assessment in 2009.

4. NEW DEVELOPMENTS AND OTHER ASPECTS

New developments have the potential to affect air quality in a number of ways. This can include direct emissions to atmosphere from new industrial processes; changes in traffic flow, composition and speeds associated with new residential and commercial developments; and changes in traffic flow brought about by alterations to road layouts or addition of new roads.

Within Midlothian, there have been some changes to industrial processes and new or planned developments. These are described below.

4.1 Industrial Processes

Since the publication of Midlothian Council's Updating and Screening Assessment 2006 (Ref. 8), the following changes to industrial processes regulated by the Scottish Environment Protection Agency (SEPA) have occurred or planning permission has been granted by Midlothian Council:

New Processes

- Leiths (Scotland) Ltd, Newtongrange, Roadstone coating plant;
- Scottish Coal Company Ltd, Shewington, Nr Rosewell, opencast coal site;

No large petrol vapour recovery/petrol stations have commenced operation since the publication of Midlothian Council's Updating and Screening Assessment 2006.

Future or Potential New Processes

- Moredun Group, Pentland Science Park, Bilston, planning permission granted for a waste incinerator. A Pollution Prevention and Control (PPC) Part A permit will be required and the application will include a dispersion modelling assessment;
- Scottish Coal Company Ltd, Airfield Farm, Nr Cousland, planning application will soon be submitted for a new opencast coal mining site, will include air quality assessment.

Substantially Varied Processes

- Scottish Coal Company Ltd, Newbigging opencast coal site, by Rosewell, substantial variation due to expansion.

The significance of the changes described above will be considered in Midlothian Council's forthcoming Updating and Screening Assessment report in 2009.

4.2 Commercial and Residential Developments

The Midlothian Council planning department were consulted regarding new developments in Midlothian. The main residential development in Midlothian is the planned new town of Shawfair. The town will be located on the northern boundary of Midlothian in between the villages of Danderhall and Millerhill. The town will include the construction of approximately 3500 houses and will have a projected population of approximately 8000. The development will include a sustainable transport plan and may include a localised energy scheme through the use of a

combined heat and power plant. As the plans are at an early stage it is not possible to provide more detailed information in this report.

As part of the Finalised Midlothian Local Plan (Ref. 16), it is envisaged that approximately 2,200 houses, not including the Shawfair development, are to be constructed in Midlothian, primarily along the existing transport corridors of the A7/A68 and A701. The Plan also includes provision for development of land for economic development and biotechnology/knowledge based industries.

There are also two new park and ride schemes which have either just been completed or are due to be completed soon. These are as follows:

- Sheriffhall Park & Ride – situated on the A7 between the Sheriffhall Roundabout (A720 Edinburgh City Bypass) and Danderhall. Opened March 2008;

- Straiton Park & Ride – situated on the A701 close to the junction with the A720 Edinburgh City Bypass. Due to open in October 2008.

Plans to re-develop and open the Waverley Rail Line are currently underway, with construction expected to begin in 2009. The rail line will provide a passenger transport service from Edinburgh through Midlothian to Tweedbank in the Scottish Borders. The stations in Midlothian will include Shawfair (once constructed), Eskbank, Newtongrange and Gorebridge. The line will improve the public transport link to Edinburgh and is expected to reduce car journeys and congestion on the A7/A68 transport corridor.

Any developments which have been completed or granted planning permission and could potentially affect air quality will be incorporated into the Updating and Screening Assessment in 2009.

4.3 Road Infrastructure Developments

In June 2005, Midlothian Council announced that construction of the A68 Dalkeith Bypass had been authorised to proceed by the Scottish Executive. The road is due to be completed in Autumn 2008 and the single carriageway road will go from Fordel on the A68 south of Dalkeith, bypassing the town to the east and join the A720 Edinburgh City Bypass to the east of Sheriffhall junction. As stated in the Progress Report 2005, the bypass is expected to remove up to 10,000 vehicles a day from the busy A68 route through Dalkeith town centre. This will result in a reduction of ambient levels of pollutants emitted by road traffic such as nitrogen dioxide, particulates and carbon monoxide in Dalkeith centre.

A new local road from Rosewell to the southern part of Bonnyrigg has also been approved.

4.4 Vehicle Emission Testing

Midlothian Council, in conjunction with other councils, has continued to carry out free roadside vehicle emission tests during 2007. These tests are expected to continue until 2008. The aim of the scheme is to give feedback to motorists on whether or not their vehicles meet the required emission limits and to educate and inform motorists about the importance of ensuring the vehicles they drive are well maintained and produce the minimum amount of pollutants. Advising drivers on possible causes for failing the test will allow them to have the necessary repairs and maintenance carried out which would potentially improve their vehicle's

emissions of combustion products such as 1,3-butadiene, benzene, carbon monoxide, particulates and nitrogen dioxide.

5. DISCUSSION AND RECOMMENDATIONS

This Progress Report confirms that the air quality objectives for the following substances are unlikely to be exceeded in Midlothian:

- 1, 3-butadiene;
- benzene;
- carbon monoxide;
- lead;
- particulate matter (PM_{10}), except in Pathhead;
- nitrogen dioxide; and
- sulphur dioxide.

No new significant sources of 1, 3-butadiene, benzene, carbon monoxide and lead have been identified from the brief recent review of new processes or other sources in Midlothian.

Monitoring for nitrogen dioxide, PM_{10} and sulphur dioxide is continuing in Midlothian. The results of PM_{10} monitoring confirm the declaration of the AQMA at Pathhead. This will be investigated in more detail in the Further Assessment. Measurements of sulphur dioxide are well below the air quality objectives. Some diffusion tube measurements of nitrogen dioxide were above the annual mean air quality objective. However, the diffusion tube locations are not directly representative of long term human exposure locations and concentrations at nearby residential properties are likely to be lower. Furthermore, the opening of the Dalkeith Bypass by the end of summer 2008 is anticipated to lead to a reduction in vehicles travelling through Dalkeith, leading to a reduction in traffic derived pollutants, such as nitrogen dioxide. Midlothian Council will carry out a review of the current diffusion tube locations and confirm whether the survey needs to be expanded to cover Lasswade and Bonnyrigg, where increased traffic congestion has occurred.

There have been several minor changes to industrial processes in Midlothian since the Updating and Screening Assessment 2006. There have also been other developments such as the Park and Rides, the proposed Shawfair new town and proposed re-opening of the Waverley Rail Line. The effect of these changes will be incorporated into future local air quality management assessments as they commence operation/open.

It is concluded that Midlothian Council does not need to undertake a Detailed Assessment at this time.

6. REFERENCES

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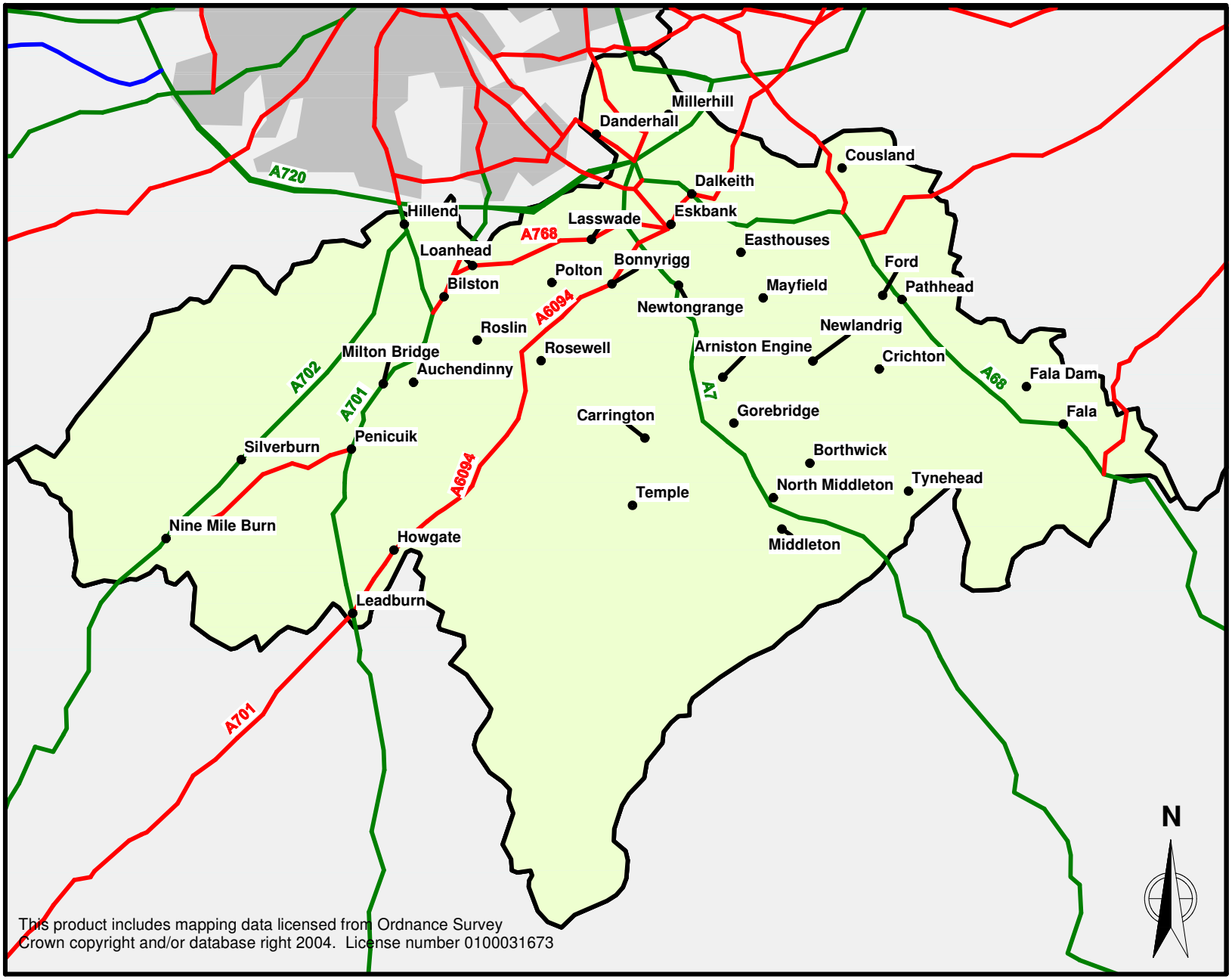
FIGURES

Figure 1 Schematic showing boundary of Midlothian, towns and significant roads



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File name: Figure 1.srf

LOCAL AIR QUALITY MANAGEMENT: PROGRESS REPORT 2008

FIGURE 1

Schematic showing boundary of Midlothian, towns and significant roads

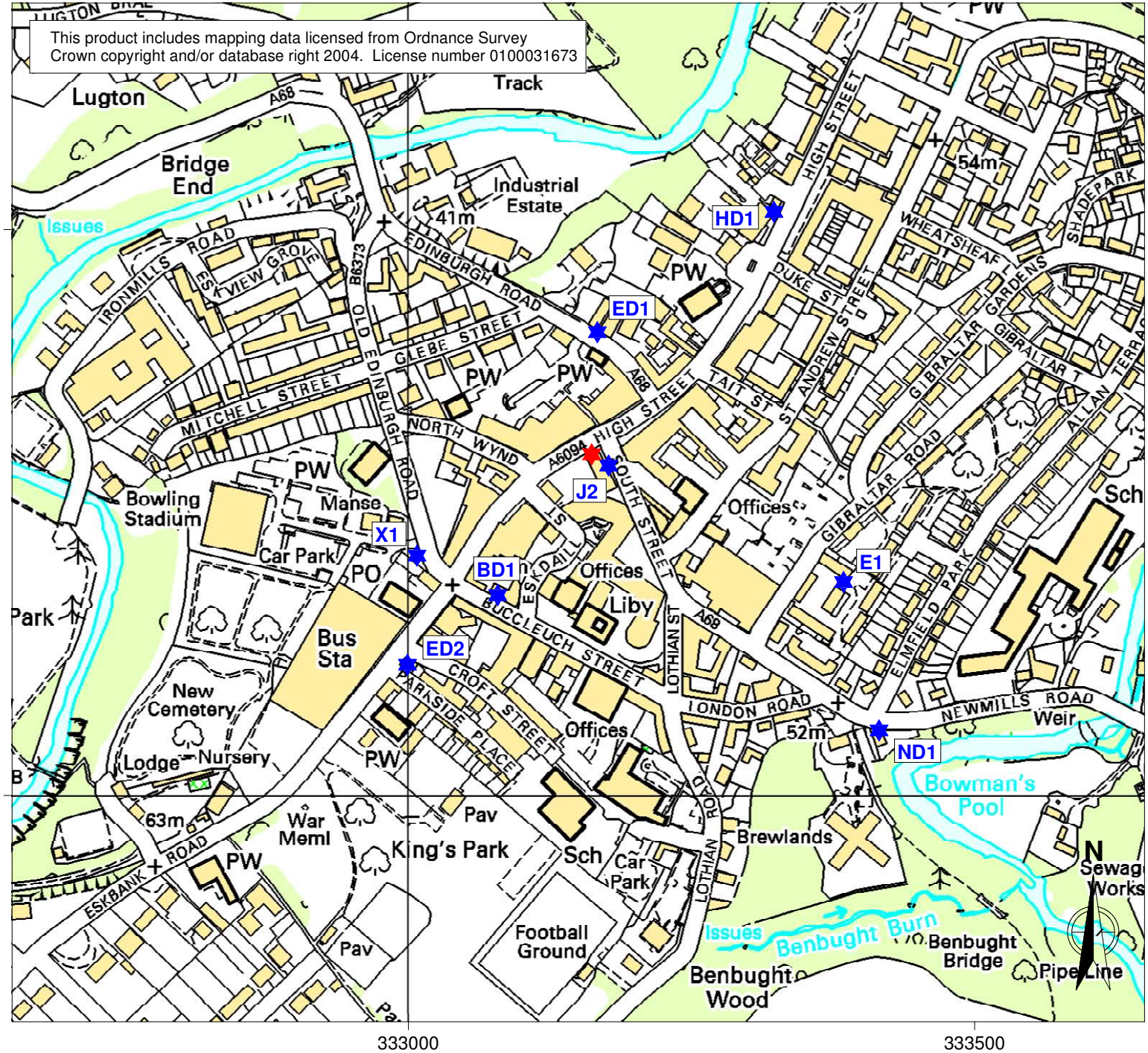
SCALE:	N/A
CONTENT:	SBY
DRAWN:	SBY
CHECKED:	DMB
CAN:	MD0080025
DATE:	AUG 2008

KEY:

Midlothian

ENVIROS

Figure 2 Location of automatic monitoring station and passive diffusion tubes in Dalkeith



LOCAL AIR QUALITY MANAGEMENT: PROGRESS REPORT 2008

FIGURE 2

Location of automatic monotoring station and passive diffusion tubes in Dalkeith

SCALE:	N/A
CONTENT:	SBY
DRAWN:	SBY
CHECKED:	DMB
CAN:	MD0080025
DATE:	AUG 2008

KEY:

- Automatic monitoring station location
- Diffusion tube location

Midlothian

ENVIROS

File name: Figure 2.srf
Produced Using Surfer
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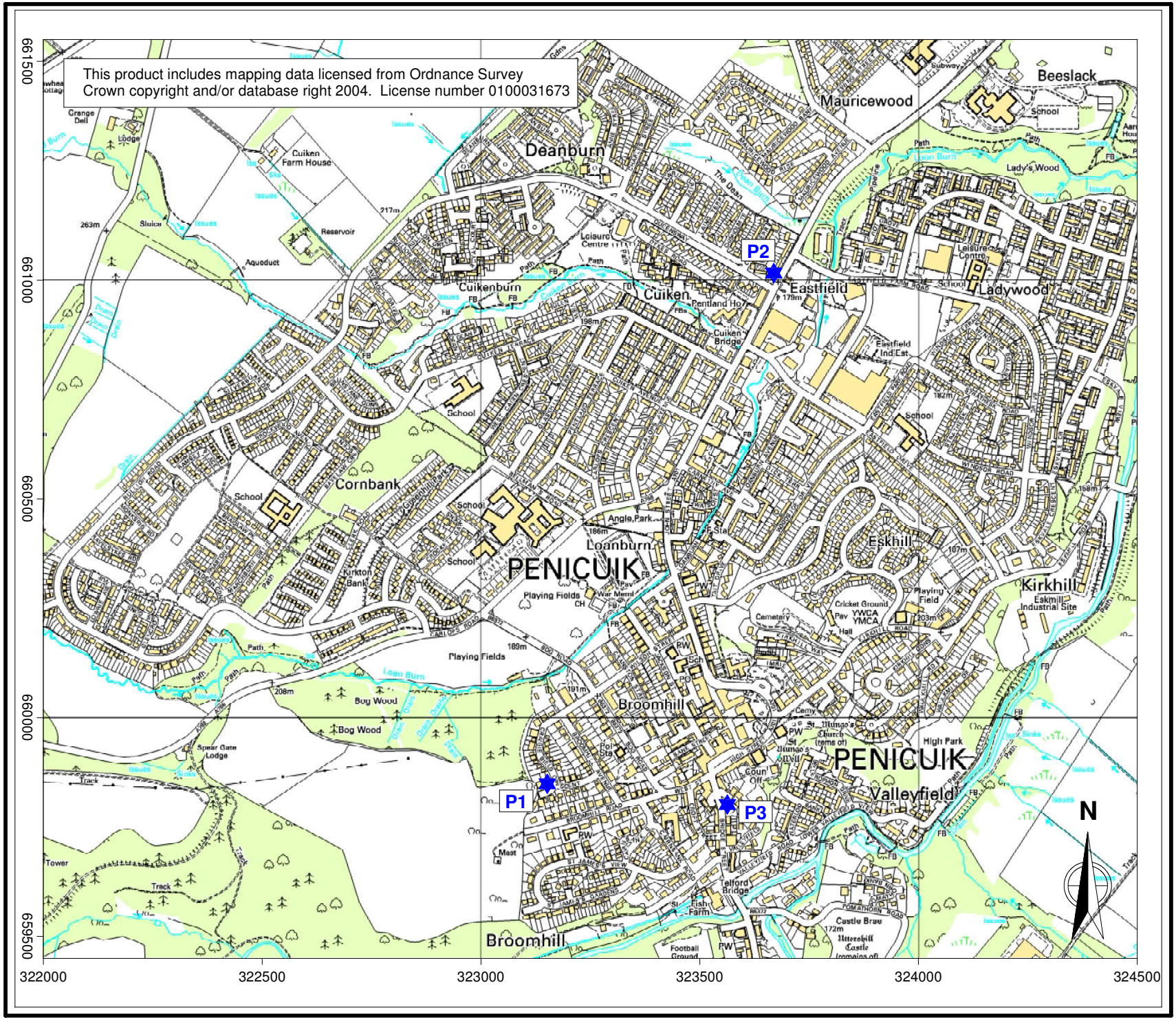
Figure 3 Location of passive diffusion tubes in Penicuik



File name: Figure 3.srf

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LOCAL AIR QUALITY MANAGEMENT: PROGRESS REPORT 2008

FIGURE 4

Location of passive diffusion tubes in Penicuik

SCALE:	N/A
CONTENT:	SBY
DRAWN:	SBY
CHECKED:	DMB
CAN:	MD0080025
DATE:	AUG 2008

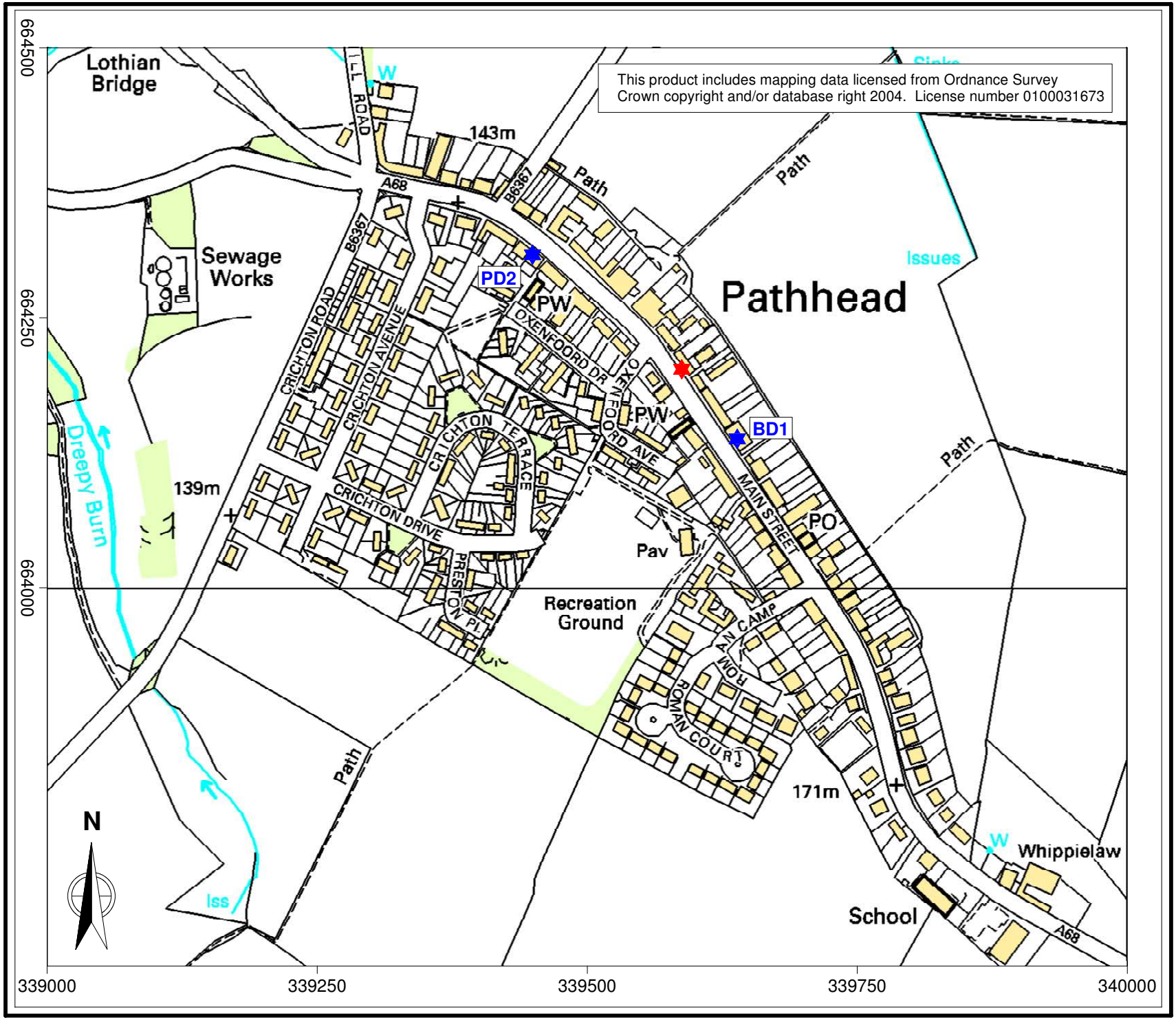
KEY:

Diffusion tube location

Midlothian

ENVIROS

Figure 4 Location of automatic monitoring station and passive diffusion tubes in Pathhead



LOCAL AIR QUALITY MANAGEMENT: PROGRESS REPORT 2008

FIGURE 4

Location of automatic monitoring station and passive diffusion tubes in Pathhead

SCALE:	N/A
CONTENT:	SBY
DRAWN:	SBY
CHECKED:	DMB
CAN:	MD0080025
DATE:	AUG 2008

KEY:

- Automatic monitoring station location
- Diffusion tube location

Midlothian

ENVIROS

File name: Figure 4.srf

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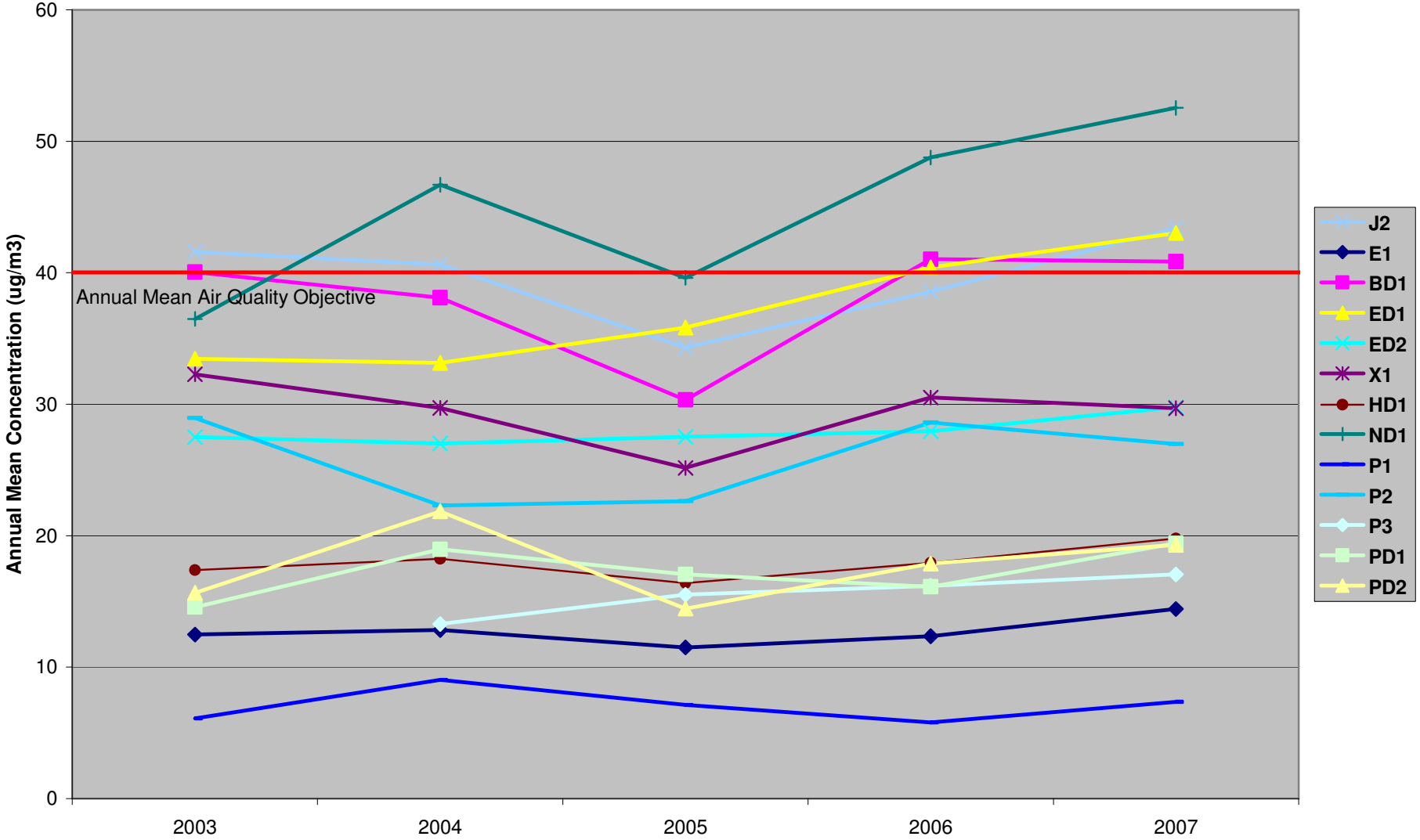
Figure 5 **Annual mean nitrogen dioxide diffusion tube concentrations in Midlothian 2003 - 2007**

Figure 5: Annual mean nitrogen dioxide diffusion tube concentrations in Midlothian 2003 – 2007



APPENDICES

1. INFORMATION ON MONITORING DATA QA/QC

Automatic Monitoring Stations

The maintenance of the two monitoring stations at Dalkeith and Pathhead is carried out by Casella ETI. This involves two routine services per year and also provision for emergency callouts. Casella ETI also has the data management contract and collects all the raw data from each of the monitoring stations. The data are checked to ensure that the data is being recorded correctly, the analysers are stable and there are no faults with the analysers. The data is then re-scaled by Casella ETI using the results of calibration and span checks which are carried out by the analyser automatically or carried out manually by Midlothian Council. The manual checks carried out by Midlothian Council include a span check in which a gas of known concentration is passed through the analysers and the measured concentrations, and other operating parameters, are recorded by the operator and sent to Casella ETI. The raw and re-scaled data are sent by Casella ETI to Midlothian Council at regular periods.

Nitrogen Dioxide Diffusion Tube Measurements

The nitrogen dioxide diffusion tubes are placed at each location by Midlothian Council for a period of approximately one month. At the end of each monthly period, the exposed tubes are replaced with new tubes and the exposed tubes are sent to the laboratory for analysis. The analysis is carried out by Edinburgh Scientific Services, part of the City of Edinburgh Council. The laboratory is UKAS accredited for the analysis and also participates in the Workplace Analysis Scheme for Proficiency (WASP) scheme. The laboratory uses the 50% v/v triethanolanine (TEA) in acetone method where the adsorbent pads are dipped into this solution, dried and then inserted into the acrylic diffusion tubes. All exposure times and dates are recorded by Midlothian Council and sent to the laboratory with the exposed tubes. Midlothian Council sends one unexposed tube with each batch to check that there has been no contamination during the analysis.

2. DIFFUSION TUBE BIAS ADJUSTMENT

Diffusion tube bias adjustment calculations, Tubes J1 (1, 2 and 3) Co-located with the Dalkeith Centre analyser.

Bias Adjustment 2005

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

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
1	06/01/2005	01/02/2005	45.0	92.0	88.0	75	26.1	35	64.7	29.1	59	Poor Precision	or Data Capture
2	01/02/2005	01/03/2005	34.0	24.0	29.0	29	5.0	17	12.4	29.4	97.2	Good	Good
3	01/03/2005	30/03/2005	50.0	30.0		40	14.1	35	127.1	28.0	99.6	Poor Precision	Good
4	30/03/2005	05/05/2005	25.0	24.0	30.0	26	3.2	12	8.0	25.8	73.7	Good	or Data Capture
5	05/05/2005	31/05/2005	23.0	14.0	24.0	20	5.5	27	13.7	22.8	95.4	Poor Precision	Good
6	31/05/2005	26/06/2005	17.0	15.0	13.0	15	2.0	13	5.0	20.8	85.4	Good	Good
7	26/06/2005	02/08/2005	26.0	23.0	21.0	23	2.5	11	6.3	19.2	99.7	Good	Good
8	02/08/2005	28/08/2005	21.0	21.0	23.0	22	1.2	5	2.9	17.6	99.4	Good	Good
9	28/08/2005	04/10/2005	26.0	28.0	29.0	28	1.5	6	3.8	19.3	100	Good	Good
10	04/10/2005	01/11/2005	33.0	33.0	36.0	34	1.7	5	4.3	24.0	99.6	Good	Good
11	No data	No data	No data	No data	No data					30.0	99.7		Good
12	29/11/2005	05/01/2006	70.0	56.0	82.0	69	13.0	19	32.3	69.3	100	Good	Good
13													

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

Overall survey --> Poor precision | Good Overall DC

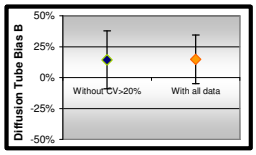
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Dalkeith Monitoring Station

Precision: 8 out of 11 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 7 periods of data
Bias factor A 0.91 (0.75 - 1.15)
Bias B 10% (-13% - 34%)
Diffusion Tubes Mean: 31 μgm^{-3}
Mean CV (Precision): 11 caution
Automatic Mean: 29 μgm^{-3}
Data Capture for periods used: 97%
Adjusted Tubes Mean: 29 (24 - 36) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 9 periods of data
Bias factor A 0.89 (0.76 - 1.08)
Bias B 12% (-8% - 32%)
Diffusion Tubes Mean: 31 μgm^{-3}
Mean CV (Precision): 15 caution
Automatic Mean: 28 μgm^{-3}
Data Capture for periods used: 97%
Adjusted Tubes Mean: 28 (24 - 34) μgm^{-3}



Jaume Targa
jaume.targa@aeat.co.uk
Version 03 - November 2006

Bias Adjustment 2006

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

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
1	05/01/2006	31/01/2006	32.0	49.0	49.0	43	9.8	23	24.4	31.7	100	Poor Precision	Good
2	01/02/2006	02/03/2006	39.0	32.0	38.0	36	3.8	10	9.4	32.1	100	Good	Good
3	28/02/2006	04/04/2006	44.0	34.0	25.0	34	9.5	28	23.6	33.6	100	Poor Precision	Good
4	04/04/2006	02/05/2006	23.0	25.0	28.0	25	2.5	10	6.3	25.0	96	Good	Good
5	02/05/2006	30/05/2006	27.0	23.0	27.0	26	2.3	9	5.7	32.3	88	Good	Good
6	30/05/2006	27/06/2006	29.0	27.0	29.0	28	1.2	4	2.9	20.5	100	Good	Good
7	27/06/2006	01/08/2006	29.0	29.0	15.0	24	8.1	33	20.1	21.3	97	Poor Precision	Good
8	01/08/2006	27/08/2006	18.0	29.0	26.0	24	5.7	23	14.1	20.2	100	Poor Precision	Good
9	27/08/2006	03/10/2006	24.0	13.0	26.0	21	7.0	33	17.4	21.2	100	Poor Precision	Good
10	03/10/2006	31/10/2006	23.0	31.0	19.0	24	6.1	25	15.2	25.6	96	Poor Precision	Good
11	31/10/2006	28/11/2006	24.0	23.0	27.0	25	2.1	8	5.2	25.5	100	Good	Good
12	28/11/2006	04/01/2007	26.0	26.0	31.0	28	2.9	10	7.2	22.4	95	Good	Good
13													

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

Overall survey --> Poor precision | Good Overall DC

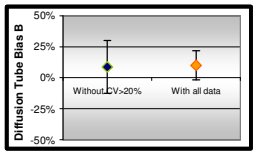
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Dalkeith Monitoring Station

Precision: 6 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 6 periods of data
Bias factor A 0.94 (0.78 - 1.18)
Bias B 6% (-15% - 28%)
Diffusion Tubes Mean: 28 μgm^{-3}
Mean CV (Precision): 9
Automatic Mean: 26 μgm^{-3}
Data Capture for periods used: 97%
Adjusted Tubes Mean: 26 (22 - 33) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.92 (0.83 - 1.03)
Bias B 9% (-3% - 21%)
Diffusion Tubes Mean: 28 μgm^{-3}
Mean CV (Precision): 18 caution
Automatic Mean: 26 μgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 26 (23 - 29) μgm^{-3}



Jaume Targa
jaume.targa@aeat.co.uk
Version 03 - November 2006

Bias Adjustment 2007

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

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
1	04/01/2007	19/02/2007	24.0	21.0	30.0	25	4.6	18	11.4	25.4	100	Good	Good
2	19/02/2007	28/02/2007	37.0	36.0	39.0	37	1.5	4	3.8	34.5	100	Good	Good
3	28/02/2007	04/04/2007	27.0	31.0	37.0	32	5.0	16	12.5	28.4	100	Good	Good
4	04/04/2007	02/05/2007	27.0	27.0	32.0	29	2.9	10	7.2	21.6	67	Good	or Data Capture
5	02/05/2007	30/05/2007	25.0	27.0	22.0	25	2.5	10	6.3	15.5	21	Good	or Data Capture
6	30/05/2007	04/07/2007	39.0	38.0	43.0	40	2.6	7	6.6	31.1	98	Good	Good
7	04/07/2007	01/08/2007	20.0	21.0	23.0	21	1.5	7	3.8	18.7	99	Good	Good
8	01/08/2007	29/08/2007	27.0	25.0	32.0	28	3.6	13	9.0	21.6	100	Good	Good
9	29/08/2007	03/10/2007	21.0	24.0	24.0	23	1.7	8	4.3	21.8	100	Good	Good
10	03/10/2007	31/10/2007	26.0	27.0	28.0	27	1.0	4	2.5	28.4	100	Good	Good
11	31/10/2007	28/11/2007	27.0	26.0	29.0	27	1.5	6	3.8	24.9	100	Good	Good
12	28/11/2007	02/01/2008	29.0	36.0	30.0	32	3.8	12	9.4	37.5	100	Good	Good
13													
										Overall survey -->		Good precision	Good Overall DC

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

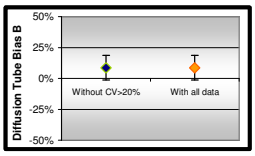
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Dalkeith Monitoring Station

Precision 12 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 10 periods of data
Bias factor A 0.93 (0.85 - 1.03)
Bias B 7% (-3% - 17%)
Diffusion Tubes Mean: 29 μgm^{-3}
Mean CV (**Precision**): 9
Automatic Mean: 27 μgm^{-3}
Data Capture for periods used: **100%**
Adjusted Tubes Mean: 27 (25 - 30) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 10 periods of data
Bias factor A 0.93 (0.85 - 1.03)
Bias B 7% (-3% - 17%)
Diffusion Tubes Mean: 29 μgm^{-3}
Mean CV (**Precision**): 9
Automatic Mean: 27 μgm^{-3}
Data Capture for periods used: **100%**
Adjusted Tubes Mean: 27 (25 - 30) μgm^{-3}



Jaume Targa
jaume.targa@aeat.co.uk
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