STRABANE DISTRICT COUNCIL

Strabane
District Council
COMHAIRLE CEANTAIR
AN tSRATHA BÁIN

Environmental Health Department

Stage 2 & 3

Air Quality
Review & Assessment
Report

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Contents

Executive Summary

1.0 Introduction

1.1 Purpose Of The Study

1.2 General Approach Taken

1.3 Version Of The Pollutant Specific Guidance Used

1.4 Units Of Concentration

1.5 Structure Of The Report

2.0 Updated Air Quality Strategy

2.1 The Need For An Air Quality Strategy

2.2 Overview Of The Principles & Main Elements Of The National Air Quality Strategy

2.2.1 National Air Quality Standards

2.2.1.1 Relationship Between The UK National Air Quality Standards & EU Air Quality Limit Values

2.3 Air Quality Reviews

3.0 Findings Of The Stage 1 Review & Assessment

3.1 Assessment Of Pollutant Specific Objectives Being Exceeded

3.1.1 Benzene

3.1.2 1,3 Butadiene

3.1.3 Carbon Monoxide

3.1.4 Lead

3.1.5 Nitrogen Dioxide

3.1.6 Particles (PM10)
3.1.7 Sulphur Dioxide
3.2 Conclusions Of The Stage 1 Review & Assessment

4.0 Stage 2 Review & Assessment Of Sulphur Dioxide Emissions From Industrial Boilers
4.1 Purpose Of The Study
4.2 Approach Taken
4.3 Information Provided By Strabane District Council To Support The Assessment
4.3.1 Local Air Quality Monitoring Data
4.3.1.1 Extent Of Data Available
4.3.1.2 Part A & B Processes & >5Mw(th) Combustion Plants
4.4 Review & Assessment Of Sulphur Dioxide
4.4.1 Introduction
4.4.1.1 Standards & Objectives For Sulphur Dioxide
4.4.1.2 The National Perspective
4.4.2 Background Concentrations Of Sulphur Dioxide
4.4.3 Impact Of Industry On Concentrations Of Sulphur Dioxide
4.4.3.1 Adria Ltd
4.4.3.2 Herdmans Ltd
4.4.3.3 Leckpatrick Dairies, Artigarvan
4.4.4 Future Developments
4.4.5 Conclusions For Sulphur Dioxide Concentrations In The Strabane District Council Area Resulting From Industrial Emissions

5.0 Stage 3 Review & Assessment of PM_{10} & SO_2 From Domestic Emissions

5.1 Introduction

5.1.1 Particulate Matter (PM_{10})

5.1.2 Sulphur Dioxide

5.2 Air Quality Standards & Objectives

5.2.1 Particulate Matter (PM_{10})

5.2.2 Sulphur Dioxide

5.3 The National Perspective

5.3.1 Particulate Matter (PM_{10})

5.3.2 Sulphur Dioxide

5.4 General Approach Taken

5.5 Information Provided By Strabane District Council To Support This Assessment

5.6 Meteorological Data Used In Dispersion Modelling

5.7 Ambient Monitoring Of PM_{10}

5.7.1 Particulates (PM_{10})

5.7.2 Black Smoke

5.7.3 Comparison Of PM_{10} Monitoring Data With Derry

5.7.4 Sulphur Dioxide

5.7.5 Comparison Of SO_2 Monitoring With Belfast East Site

5.8 Fuel Use Data

5.8.1 Principal Data For Individual Grid Squares

5.8.1.1 Grid 1 – Head Of The Town Area, Strabane

5.8.1.2 Grid 2 – Ballycolman Area, Strabane

5.8.1.3 Grid 3 – Melmount Area, Strabane

5.8.1.4 Grid 4 – Newtownstewart

5.8.1.5 Grid 5 – Castlederg

5.8.1.6 Grid 6 – Sion Mills

5.8.2 Emission Factors Used In The Modelling

5.8.3 QA/QC Of Continuous Monitoring Data

5.9 Detailed Modelling

5.9.1 Meteorological Data

5.9.2 Overview Of The Modelling Approach

5.9.2.1 Model Bias

5.9.2.2 Emission Factors Used For The Modelling

5.9.2.3 Model Validation

5.9.2.4 Consideration Of The Impact From Industrial Emissions

5.9.3 Results Of Modelling

5.9.3.1 Head Of The Town, Ballycolman & Melmount Areas, Strabane

5.9.3.2 Newtownstewart

5.9.3.3 Castlederg

5.9.3.4 Sion Mills

5.10 Summary Of The Likelihood Of Exceeding The Air Quality Objectives

5.10.1 Sulphur Dioxide (SO_2)

5.10.2 Particulate Matter (PM_{10})

5.11 Improvements Required In Air Quality

5.11.1 The Improvement That Is Required – General Points

5.11.2 Magnitude Of Exceedence Of The Air Quality Objectives

5.12 Source Apportionment

5.12.1 What Is Source Apportionment?
5.12.2 Sources Of Pollution Considered
5.12.3 Key Findings Of Source Apportionment
5.13 Future Developments
5.14 Conclusions
5.15 Consultation

6.0 References

APPENDICES

Appendix 1 – Fuel Use Survey Report
Appendix 2 – Nitrogen Dioxide Diffusion Tube Results & Related Documents
Appendix 3 – QA/QC Documentation For Continuous Monitoring Equipment

List Of Tables

Table 1 Major Elements of Part III of the Environment (NI) Order 2002

Table 2 Air Quality Objectives in the Air Quality Regulations (NI) 2003 for the purpose of Local Air Quality Management

Table 3 Brief details of Stages in the Air Quality Review and Assessment process

Table 4 Specifications Of Combustion Processes At Adria Ltd

Table 5 Maximum Ground Level Concentrations of SO2 Arising From Adria Ltd

Table 6 SO2 Emissions With One Boiler In Operation At Adria Ltd

Table 7 Specifications Of Combustion Processes At Herdmans

Table 8 Specifications Of Combustion Processes At Leckpatrick Dairies

Table 9 ADMS Modelling Results For The Leckpatrick Dairies Site For 3 Different Exit Velocity Scenarios

Table 10 Statistical Analysis of Monitoring Results

Table 11 Comparison of Monitoring Results With The Air Quality Regulations (NI) 2003

Table 12 Black Smoke Results For Springhill Park, Strabane

Table 13 Comparison Of PM_{10} Concentrations In Springhill Park With The Derry Site

Table 14 Statistical Analysis of Monitoring Results For SO_2

Table 15 Comparison Of 99.9 Percentile 15 Minute Mean SO_2 Concentrations In Springhill Park With The Belfast East Site ($\mu g/m^3$)

Table 16 Estimated Number Of Houses In Each Grid Area And The Achieved Number Of Surveys

Table 17 Proportions Of Fuel Used As Main Source Of Heat

Table 18 Type of Coal/Solid Fuel Used For Heating Purposes (% of Households in Each Grid)

Table 19 % Of Households Burning Different Fuel Types In The Head Of The Town

Table 20 The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In The Head Of The Town Survey Area

Table 21 % Of Households Burning Different Fuel Types In Ballycolman

Table 22 The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In Ballycolman

Table 23 % Of Households Burning Different Fuel Types In Melmount

Table 24 The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In Melmount

Table 25 % Of Households Burning Different Fuel Types In Newtownstewart

Table 26 The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In Newtownstewart

Table 27 % Of Households Burning Different Fuel Types In Castlederg

Table 28 The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In Castlederg

Table 29 % Of Households Burning Different Fuel Types In Sion Mills

Table 30 The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In Sion Mills

Table 31 Emissions Arising From Domestic Fuel Combustion

Table 32 Main Elements Of The Reference Calculation For PM_{10}

Table 33 PM_{10} Emissions Arising From Domestic Fuel Combustion

Table 34 The Improvement In 90.4 Percentile Daily Mean PM_{10} Concentrations Required At Receptors Exposed To The Highest Predicted Concentrations (In 2004)

Table 35 Source Apportionment Of PM_{10} ($\mu g/m^3$) Within Strabane With The Greatest Predicted Exceedences Of The Daily Mean Objective In 2004 (Results Are Shown In Terms Of Annual Mean PM_{10} Concentrations)

List Of Figures

Figure 1 Background SO_2 concentrations 1996

Figure 2 Predicted 99.9 percentile 15 minute mean SO2 concentrations in μg/m3 in the Head of the town, Ballycolman and Melmount in 1999

Figure 3 Predicted 99.9 percentile 15 minute mean SO2 concentrations in μg/m3 in Newtownstewart in 1999

Figure 4 Predicted 99.9 percentile 15 minute mean SO_2 concentrations in μg/m3 in Castlederg in 1999

Figure 5 Predicted 99.9 percentile 15 minute mean SO_2 concentrations in $\mu g/m^3$ in Sion Mills in 1999

Figure 6 Predicted 90^{th} percentile daily mean PM_{10} concentrations in $\mu g/m^3$ in the Head of the town

Figure 7 Predicted 90^{th} percentile daily mean PM_{10} concentrations in $\mu g/m^3$ in Ballycolman

Figure 8 Predicted 90^{th} percentile daily mean PM_{10} concentrations in $\mu g/m^3$ in Melmount

Figure 9 Predicted 90^{th} percentile daily mean PM_{10} concentrations $\mu g/m^3$ in Newtownstewart

Figure 10 Predicted 90^{th} percentile daily mean PM_{10} concentrations $\mu g/m^3$ in Castlederg

Figure 11 Predicted 90^{th} percentile daily mean PM_{10} concentrations $\mu g/m^3$ in Sion Mills

Executive Summary

The Review & Assessment Process

The Air Quality Strategy for England, Scotland, Wales & Northern Ireland provides a framework for air quality control through air quality management and air quality standards. These and other air quality standards and their objectives have been enacted through the Air Quality Regulations (NI) 2003 in Northern Ireland. The Environment (NI) Order 2002 requires District Councils to undertake air quality reviews and assessments. In areas where the air quality objectives are not anticipated to be met by the specified dates, District Councils are required to establish Air Quality Management Areas as a means to improve air quality.

The review and assessment process has been in place in Great Britain for a number of years and is enshrined in legislation. However the situation in Northern Ireland differs somewhat in that the appropriate legislation has been progressively implemented since September 2002. The principal requirements are outlined in the following legislation and guidance documents:-

- The Environment (NI) Order 2002;
- The Air Quality Regulations (NI) 2003;
- Local Air Quality Management Policy Guidance LAQM. PGNI(03);
- Local Air Quality Management Technical Guidance LAQM. TG(03).

The current air quality regime is risk based so as to equate the complexity of the process with the risk of the air quality objectives not being achieved by the specified times. The process currently adopted in Northern Ireland is sub-divided into first, second and third stage review and assessments. This process has been further refined in GB to a two stage process including updating and screening assessments and detailed assessments.

Review & Assessment in Strabane District Council

The Environmental Health Department of Strabane District Council has undertaken and completed Stage 1 of the review and assessment process in October 2000. This report highlighted the need to carry out further reviews into the following pollution sources:-

1. Sulphur Dioxide emissions from industrial boilers;
2. PM_{10} and Sulphur Dioxide emissions from domestic fuel combustion.

A Stage 2 review and assessment was carried out into the industrial boiler emissions and it was found that they do not pose a risk of the air quality objectives being exceeded.

However due to the high prevalence of domestic coal burning in the Strabane District Council area it was decided to progress directly to a Stage 3 (detailed assessment) review and assessment for these sources. The results of modelling, monitoring and fuel usage data concluded that the air quality objectives for PM10 were likely to be exceeded (or marginally below the objective concentration) by the relevant date in 2004 at the following locations:-

1 - Head of the Town area, Strabane;
2 - Ballycolman area, Strabane;
3 - Newtownstewart;
4 - Castlederg.

It is now Strabane District Council's intention to declare air quality management areas in the above 4 areas of the district and to formulate an action plan to enable emissions to be reduced to a level where the air quality objectives can be complied with where reasonably possible. There is no risk of the air quality objectives for sulphur dioxide being exceeded by 2004/5 therefore it is not proposed to declare air quality management areas for this pollutant.

1.0 INTRODUCTION

The process of air quality review and assessment is somewhat behind the situation in GB. This delay is principally due to the absence of legislation being enacted in Northern Ireland compared to other parts of the UK. District Councils in Northern Ireland initiated the process on a voluntary basis in 1999 at the request of DOENI. Legislation in Northern Ireland came into operation from 2002 and is progressively being implemented to date. Strabane District Council completed the Stage 1 review and assessment in October 2000.

1.1 Purpose Of The Study

This report is based upon the conclusions of the stage 1 report and emphasis is given to the pollutants of concern. Where necessary issues requiring clarification at stage 1 are also dealt with. The following issues are specifically dealt with:-

- The risk of the air quality objectives for sulphur dioxide not being achieved at relevant locations due to industrial emissions from boiler plant >5Mw(th);
- The risk of the air quality objectives for sulphur dioxide not being achieved at relevant locations due to domestic fuel combustion emissions;
- The risk of the air quality objectives for PM_{10} not being achieved at relevant locations due to domestic fuel combustion emissions;
- The risk of the air quality objectives for nitrogen dioxide not being achieved at relevant locations due to vehicle emissions.

The review and assessment will demonstrate the following:-

- The identification of further actions required under Part III of the Environment (NI) Order 2002;
- The identification of areas of exceedence and their respective size;

1.2 General Approach Taken

The approach taken was to:-

- Identify all aspects of the first stage review and assessment requiring clarification or further review;
- Identify all geographical areas of concern within the Strabane District Council area which are considered to be relevant locations and unlikely to comply with any relevant air quality objective by the relevant time;
- Identify the most appropriate methods to demonstrate non-compliance with the relevant air quality objectives at the relevant locations;
- Develop, implement and manage a continuous automatic, non-automatic and passive pollutant monitoring campaign at relevant locations including appropriate QA/QC and data management procedures;
- Collect and interpret additional data to support the third stage assessment, including detailed fuel use survey data for locations where exceedences were predicted;
- Utilise the monitoring data from the Council's monitoring campaign to assess the ambient concentrations produced by domestic fuel combustion and to validate the output of the modelling studies;
- Model the concentrations of PM_{10} and SO_2 in the selected grid squares, concentrating on the locations (receptors) where people might be exposed over the relevant averaging times of the air quality objectives;
- Present the modelled concentrations as contour plots of concentrations and assess the uncertainty in the predicted concentrations;
- Determine whether the present and predicted concentrations of PM_{10} and SO_2 still have the potential to exceed the air quality objectives by the relevant date;
- Identify any further actions required resulting from the Stage 2/3 report.

1.3 Version Of The Pollutant Specific Guidance Used In This Assessment

This report has used the guidance in LAQM.TG(03), published in February 2003. Where appropriate reference has also been made to the guidance previously issued LAQM.TG4 (00).

1.4 Units Of Concentration

The units throughout this report are presented in micrograms per cubic metre ($\mu g\ m^{-3}$) and parts per billion (ppb) consistent with the presentation of the new AQS objectives, unless otherwise noted.

1.5 Structure Of The Report

This document is a Second Stage review and assessment for industrial emissions of SO_2 and a Third Stage Air Quality review and assessment for PM_{10} and SO_2 from domestic fuel combustion. This chapter, Chapter 1 has summarised the need for the work and the approach to completing the study.

Chapter 2 of the report describes the most recent developments in the UK's Air Quality Strategy (AQS). In addition, it discusses when implementation of an AQMA is required.

Chapter 3 gives a summary of the findings of the Stage 1 review and assessment and explains why the Council did not consider it necessary to proceed to a Stage 2 review and assessment for the following pollutants:-

- Benzene;
- 1,3 Butadiene;
- Carbon Monoxide;
- Lead;
- Nitrogen Dioxide.

Chapter 4 contains the approach and detail of the Stage 2 review and assessment for SO_2 emissions from industrial boilers with a capacity of more than 5Mw(th).

Chapter 5 contains details of the information used to conduct the Stage 3 review and assessment for PM_{10} and SO_2 from domestic emissions. Chapter 5 also describes the results of the Stage 2 and 3 assessments and discusses whether both the PM_{10} and sulphur dioxide objectives will be exceeded in the Strabane District Council area in 2004/5. The results of the analysis are displayed as contour plots.

2.0 THE UPDATED AIR QUALITY STRATEGY

2.1 The Need For An Air Quality Strategy

The Government published its proposals for review of the National Air Quality Strategy in early 1999 (DETR, 1999). These proposals included revised objectives for many of the regulated pollutants. A key factor in the proposals to revise the objectives was the agreement in June 1998 at the European Union Environment Council of a Common Position on Air Quality Daughter Directives (AQDD).

Following consultation on the Review of the National Air Quality Strategy, the Government prepared the Air Quality Strategy for England, Scotland, Wales and Northern Ireland for consultation in August 1999. It was published in January 2000 (DETR, 2000).

Part III of the Environment (NI) Order 2002 provides the legal framework for requiring District Councils in Northern Ireland to review and assess air quality and for implementation of Air Quality Management Areas where necessary. The main constituents of this Order are summarised in Table 1 below.

Table 1 Major elements of Part III of the Environment (NI) Order 2002

Part III Air Quality	**Commentary**
Article 10	Obliges the Department to prepare and publish a statement containing policies with respect to the assessment or management of air quality.
Article 11	Requires district councils to review air quality and to assess whether the air quality standards and objectives are being achieved. Areas where the standards or objectives are unlikely to be achieved by the relevant period must be identified.
Article 12	Requires a district council, for any area where air quality standards or objectives are not being met, to issue an order designating it an air quality management area (AQMA).
Article 13	Imposes duties on a district council with respect to AQMAs. The council must carry out further assessments and draw up an action plan specifying the measures to be carried out and the timescale to bring air quality in the area back within limits.
Article 14	Gives reserve powers to cause assessments to be made in any area and to give instructions to a district council to take specified actions. Councils have a duty to comply with these instructions.

2.2 Overview Of The Principles And Main Elements Of The National Air Quality Strategy

The main elements of the Air Quality Strategy can be summarised as follows:-

- The use of a health effects based approach using national air quality standards and objectives;
- The use of policies by which the objectives can be achieved and which include the input of important sectors such as industry, transportation bodies and local authorities;
- The predetermination of timescales with target dates of 2003, 2004, 2005, 2008 and 2010 for the achievement of objectives and a commitment to review the Strategy every three years.

It is intended that the Air Quality Strategy will provide a framework for the improvement of air quality that is both clear and workable. In order to achieve this, the Strategy is based on several principles, which include:-

- The provision of a statement of the Government's general aims regarding air quality;
- Clear and measurable targets;
- A balance between local and national action; and
- A transparent and flexible framework.

Co-operation and participation by different economic and governmental sectors is also encouraged within the context of existing and potential future international policy commitments.

2.2.1 National Air Quality Standards

At the centre of the Air Quality Strategy is the use of national air quality standards to enable air quality to be measured and assessed. These also provide the means by which objectives and timescales for the achievement of objectives can be set. Most of the proposed standards have been based on the available information concerning the health effects resulting from different ambient concentrations of selected pollutants and are the consensus view of medical experts on the Expert Panel on Air Quality Standards (EPAQS). These standards and associated specific objectives to be achieved between 2003 and 2010 are shown in Table 2. The table shows the standards in ppb and $\mu g\, m^{-3}$ with the number of exceedences that are permitted (where applicable) and the equivalent percentile.

Specific objectives relate either to achieving the full standard or, where use has been made of a short averaging period, objectives are sometimes expressed in terms of percentile compliance. The use of percentiles means that a limited number of exceedences of the air quality standard over a particular timescale, usually a year, are permitted. This is to account for unusual meteorological conditions or particular events such as November 5th. For example, if an objective is to be complied with at the 99.9th percentile, then 99.9% of measurements at each location must be at or below the level specified.

Table 2 Air Quality Objectives in the Air Quality Regulations (NI) 2003 for the purpose of Local Air Quality Management

Pollutant	Objective Concentration	Measured as	Achievement Date
Benzene	16.25μg/m^3 (5ppb)	running annual mean	31 December 2003
	3.25μg/m^3	running annual mean	31 December 2010
1,3-Butadiene	2.25 μg/m^3 (1ppb)	running annual mean	31 December 2003
Carbon Monoxide	10 mg/m^3 (8.6ppm)	maximum daily running 8 hour mean	31 December 2003
Lead	0.5μg /m^3	annual mean	31 December 2004
	0.25μg /m^3	annual mean	31 December 2008
Nitrogen Dioxide	200μg /m^3 (105ppb) not to be exceeded more than 18 times a year	1 hour mean	31 December 2005
	40μg /m^3 (21ppb)	annual mean	31 December 2005
Particles (PM_{10})	50μg /m^3 (gravimetric) not to be exceeded more than 35 times a year	24 hour mean	31 December 2004
	40μg /m^3	annual mean	31 December 2004
Sulphur Dioxide	350μg /m^3 (132ppb) not to be exceeded more than 24 times a year	1 hour mean	31 December 2004
	125μg /m^3 (47ppb) not to be exceeded more than 3 times a year	24 hour mean	31 December 2004
	266μg /m^3 (100ppb) not to be exceeded more than 35 times a year	15 minute mean	31 December 2005

2.2.1.1 *Relationship Between The UK National Air Quality Standards And EU Air Quality Limit Values*

As a member state of the EU, the UK must comply with European Union Directives.

There are three EU ambient air quality directives that the UK has transposed in to UK law. These are:-

- **96/62/EC** Council Directive of 27 September 1996 on ambient air quality assessment and management. (the Ambient Air Framework Directive);

- **1999/30/EC** Council Directive of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide, oxides of nitrogen, particulate matter and lead in ambient air. (the First Daughter Directive);

- **2000/69/EC** Directive of the European Parliament and the Council of 16 Nov 2000 relating to limit values for benzene and carbon monoxide in ambient air. (the Second Daughter Directive);

The first and second daughter directives contain air quality Limit Values for the pollutants that are listed in the framework directive. The United Kingdom (i.e. Great Britain and Northern Ireland) must comply with these Limit Values. The UK air quality strategy should allow the UK to comply with the EU Air Quality Daughter Directives, but the UK Air Quality Strategy also includes some stricter national objectives for some pollutants, for example, sulphur dioxide.

The Government is ultimately responsible for achieving the EU Limit Values. However, it is important that Local Air Quality Management is used as a tool to ensure that the necessary action is taken at local level to work towards achieving the EU Limit Values by the dates specified in those EU Directives.

For ***particulates*** (PM_{10}) new provisional objectives are as follows:-

- For **all parts of the UK**, except London and Scotland, a **24-hour mean of 50 μg/m^3 not to be exceeded more than 7 times per year** and an **annual mean of 20 μg/m^3**, both to be achieved by the end of 2010;

- For London, a 24-hour mean of 50 μg/m^3 not to be exceeded more than 10 times per year and an annual mean of 23 μg/m^3, both to be achieved by the end of 2010;

- For Scotland, a 24-hour mean of 50 μg/m^3 not to be exceeded more than 7 times per year and an annual mean of 18 μg/m^3, both to be achieved by the end of 2010.

2.3 Air Quality Reviews

A range of Technical Guidance has been issued to enable air quality to be monitored, modelled, reviewed and assessed in an appropriate and consistent fashion. This includes the Technical Guidance LAQM.TG(03), February 2003 and the previous version LAQM.TG4(00), May 2000, on 'Review and Assessment: Pollutant Specific Guidance'. This review and assessment has considered the procedures set out in the guidance.

The primary objective of undertaking a review of air quality is to identify any areas that are unlikely to meet national air quality objectives and ensure that air quality is considered in local authority decision-making processes. The complexity and detail required in a review depends on the risk of failing to achieve air quality objectives and it has been proposed therefore in Northern Ireland that reviews should be carried out in three stages. All three stages of review and assessment may be necessary and every authority is expected to undertake at least a first stage review and assessment of air quality in their authority area. The Stages are briefly described in the following table, Table 3. The latest version of the Technical Guidance TG(03) has somewhat streamlined the process into a two phase approach, namely Updating and Screening Assessments and Detailed Assessments.

Table 3 Brief Details Of Stages In The Air Quality Review And Assessment Process

Stage	Objective	Approach	Outcome
First Stage Review and Assessment	• Identify all significant pollutant sources within or outside of the authority's area.	• Compile and collate a list of potentially significant pollution sources using the assessment criteria described in the Pollutant Specific Guidance	
	• Identify those pollutants where there is a **risk** of exceeding the air quality objectives, and for which further investigation is needed.	• Identify sources requiring further investigation.	• Decision about whether a Stage 2 Review and Assessment is needed for one or more pollutants. If not, no further review and assessment is necessary.
Second Stage Review and Assessment	• Further screening of significant sources to determine whether there is a significant risk of the air quality objectives being exceeded.	• Use of screening models or monitoring methods to assess whether there is a risk of exceeding the air quality objectives.	
	• Identify those pollutants where there is a **risk** of exceeding the objectives, and for which further investigation is needed.	• The assessment need only consider those locations where the highest likely concentrations are expected, and where public exposure is relevant.	• Decision about whether a Stage 3 Review and Assessment is needed for one or more pollutants. If, as a result of estimations of ground level concentrations at suitable receptors, a local authority judges that there is no significant risk of not achieving an air quality objective, it can be confident that an Air Quality Management Area (AQMA) will not be required. • However, if there is doubt that an air quality objective will be achieved a third stage review should be conducted.

Table 3 (contd.) Brief Details Of Stages In The Review And Assessment Process

Stage	Objective	Approach	Outcome
Third Stage Review and Assessment	• Accurate and detailed assessment of both current and future air quality. Assess the **likelihood** of the air quality objectives being exceeded.	• Use of validated modelling and quality-assured monitoring methods to determine current and future pollutant concentrations.	
	• Identify the geographical boundary of any exceedences, and description of those areas, if any, proposed to be designated as an AQMA.	• The assessment will need to consider all locations where public exposure is relevant. For each pollutant of concern, it may be necessary to construct a detailed emissions inventory and model the extent, location and frequency of potential air quality exceedences.	• Determine the location of any necessary Air Quality Management Areas (AQMAs). Once an AQMA has been identified, there are further sets of requirements to be considered. • A further assessment of air quality in the AQMA is required within 12 months which will enable the degree to which air quality objectives will not be met and the sources of pollution that contribute to this to be determined. A local authority must also prepare a written action plan for achievement of the air quality objective. Both air quality reviews and action plans are to be made publicly available.

3.0 FINDINGS OF THE STAGE 1 REVIEW AND ASSESSMENT

3.1 Assessment of Pollutant Specific Objectives Being Exceeded

3.1.1 Benzene

All information currently to hand indicates that there is negligible risk of the air quality objective for benzene being exceeded either at present or by 31 December 2003 when the objective is to be met. Indeed concentrations of this pollutant are likely to be well within the objective concentration.

3.1.2 1,3 - Butadiene

All information currently to hand indicates that there is negligible risk of the air quality objective for 1,3-butadiene being exceeded either at present or by 31 December 2003 when the objective is to be met. Indeed concentrations of this pollutant are likely to be well within the objective concentration.

3.1.3 Carbon Monoxide

All information currently to hand indicates that there is negligible risk of the air quality objective for carbon monoxide being exceeded either at present or by 31 December 2003 when the objective is to be met. Indeed concentrations of this pollutant are likely to be well within the objective concentration.

3.1.4 Lead

All information currently to hand indicates that there is negligible risk of the air quality objectives for lead being exceeded either at present or by 31 December 2004 and 2008 when the objectives are to be met. Indeed concentrations of this pollutant are likely to be well within the objective concentrations.

3.1.5 Nitrogen Dioxide

The potential for exceeding the annual mean and 1 hour mean objectives for NO_2 is considered negligible even along the main traffic routes through Strabane town and Newtownstewart (A5 arterial route). Since the publication of the Stage 1 review and assessment the second phase of the Strabane bypass and the Newtownstewart bypass have

become operational. These developments have diverted a large proportion of the traffic away from sensitive properties and the resultant volume of traffic will remain at such a level so as not to prejudice the air quality objectives. Some passive monitoring of NO2, using diffusion tubes was employed during 2002-3 prior to the bypasses coming into operation to confirm that ambient pollutant concentrations did not exceed the air quality objective. The results and QA/QC procedures are available at Appendix 2. All information currently to hand indicates that there is negligible risk of the air quality objective for nitrogen dioxide being exceeded either at present or by 31 December 2005 when the objective is to be met.

3.1.6 Particulates (PM_{10})

Potential for the air quality objectives to be exceeded currently exists and may exist by 31 December 2004 when the objectives are to be met. Contributions particularly from the high proportion of domestic properties with solid fuel heating (predominantly bituminous coal fired) facilitate concentrations of PM_{10} that may exceed the air quality objectives over the averaging times of the objectives. In particular residential areas of Strabane, Newtownstewart and Castlederg are at risk. The provision of the Stage 2 Strabane bypass and the Newtownstewart bypass have facilitated a reduction in traffic contributions of PM_{10}. However a Stage 2/3 review and assessment of PM_{10} is deemed necessary for domestic sources in order to facilitate a greater degree of information in relation to PM_{10} concentrations across the district.

3.1.7 Sulphur Dioxide

The information to hand suggests that it is reasonable to assume that there is some risk of the air quality objectives for sulphur dioxide being exceeded currently. This is principally as a result of the emissions from the heavy fuel oil fired boilers at industrial installations within the district and the high concentration of domestic properties having solid fuelled heating appliances. This situation is likely to remain by 31 December 2004 and 2005 when the objectives are to be met. Further research in the form of a second stage review and assessment is deemed necessary and will now be undertaken. The principal areas of further review will be those residential areas with high numbers of properties with solid fuel heating and those in close proximity to industrial boilers using heavy fuel oil. Both of

these areas are likely to be exposed to the pollutant over the averaging times of the objectives concerned.

3.2 Conclusions of the Stage 1 Review and Assessment

Pollutants for which further review and assessment is required:-

- PM_{10} from domestic fuel combustion;
- Sulphur dioxide from industrial boilers;
- Sulphur dioxide from domestic fuel combustion.

Pollutants for which no further review and assessment is required:-

- Benzene;
- 1,3 Butadiene;
- Carbon Monoxide;
- Lead;
- Nitrogen Dioxide.

4.0 STAGE 2 REVIEW & ASSESSMENT OF SULPHUR DIOXIDE EMISSIONS FROM INDUSTRIAL BOILERS

Strabane District Council commissioned the National Environmental Technology Centre (NETCEN) in January 2002 to carry out the Stage 2 review and assessment of the industrial boilers with a thermal capacity greater than 5 megawatts that use heavy fuel oil. This study focussed solely on the sulphur dioxide emissions from the boilers in order that it could be decided if the air quality objectives are likely to be exceeded at relevant locations by the relevant dates.

4.1 Introduction

Sulphur dioxide is a corrosive acid gas, which combines with water vapour in the atmosphere to produce acid rain. Both wet and dry deposition have been implicated in the damage and destruction of vegetation and in the degradation of soils, building materials and watercourses. SO_2 in ambient air is also associated with asthma and chronic bronchitis.

The principal source of this gas is power stations burning fossil fuels, which contain sulphur. Episodes of high concentrations of SO_2 now only tend to occur in cities in which coal is still widely used for domestic heating, in industry and in power stations. As some power stations are now located away from urban areas, SO_2 emissions may affect air quality in both rural and urban areas. Since the decline in domestic coal burning in cities and in power stations overall, SO_2 emissions have diminished steadily and, in most European countries, they are no longer considered to pose a significant threat to health.

4.1.1 Standards And Objectives For Sulphur Dioxide

Two new objectives have been introduced for SO_2 in the AQS based on the limit values in the Air Quality Daughter Directive, and the three objectives are:-

- 266 μg m^{-3} as a 15 minute mean (maximum of 35 exceedences a year or equivalent to the 99.9^{th} percentile) to be achieved by the 31^{st} December 2005;
- 350 μg m^{-3} as a 1 hour mean (maximum of 24 exceedences a year or equivalent to the 99.7^{th} percentile) to be achieved by the 31^{st} December 2004;
- 125 μg m^{-3} as a 24 hour mean (maximum of 3 exceedences a year or equivalent to the 99^{th} percentile) to be achieved by the 31^{st} December 2004;

The 15 minute mean objective is the most stringent; the other two objectives will not be exceeded if this objective is not exceeded.

4.1.2 The National Perspective

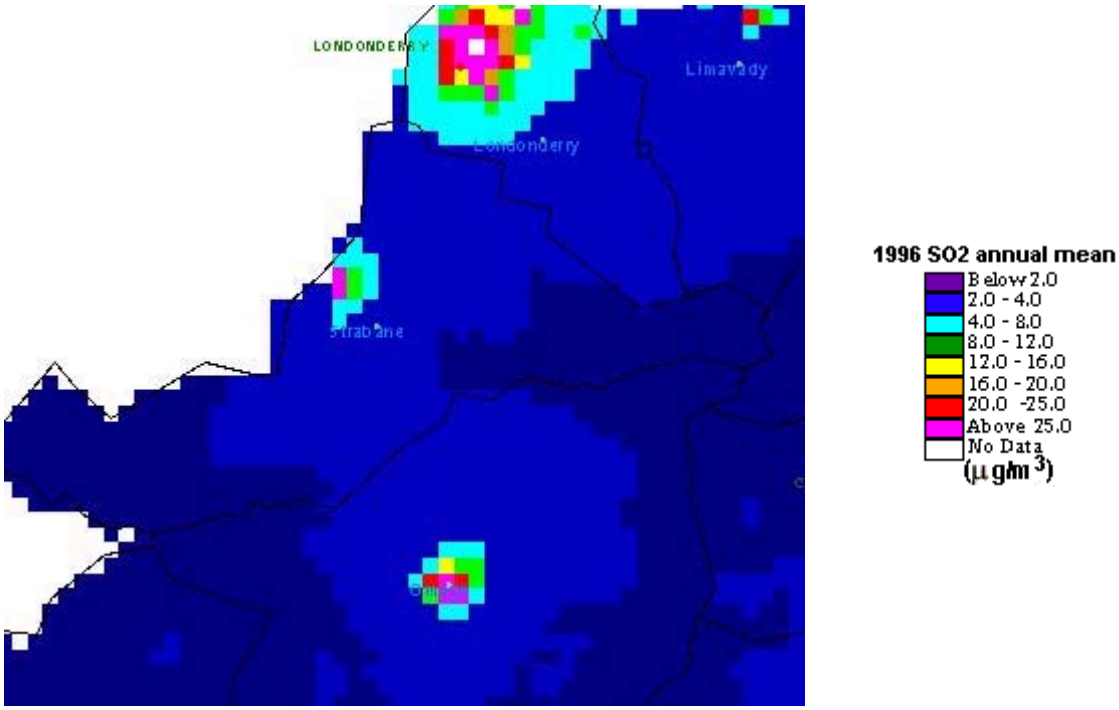
Sulphur dioxide is emitted in the combustion of coal and oil. Emissions today are dominated by fossil-fuelled power stations, which in 1997 accounted for 62% of the national total emission. Emissions from road transport are a very small fraction (2%) of the national total.

Exceedences of the 15-minute air quality standard currently occur near industrial processes for which the stack heights were designed to meet previous air quality standards and downwind of large combustion plant such as power stations. Exceedences are also possible in areas where significant quantities of coal are used for space heating. These large combustion plant are currently regulated under BATNEEC and the Environmental Protection Act 1990, and will come under the provisions of the Industrial Pollution Prevention & Control regime. The government considers that bearing in mind the envisaged change in fuel use, it does not expect exceedences of the 15-minute objective by 2005 from these sources. Sulphur dioxide concentrations are elevated at the kerbside but not sufficiently to exceed the air quality standard in the absence of other sources.

4.2 Background Concentrations Of Sulphur Dioxide

Estimates of background concentrations were obtained for the Strabane District Council area using the maps on the UK National Air Quality Information Archive web site. Figure 1 shows the estimates available, for 1996. The mean annual average background concentration for 1996 in the Strabane District Council area was 2.1 $\mu g\, m^{-3}$. The maximum annual average background concentration was 53.5 $\mu g\, m^{-3}$. Government Guidance LAQM.TG4(00) assumes that the annual mean at the end of 2004 and 2005 will be half the 1996 annual mean. However, in Northern Ireland due to the high levels of domestic coal burning the background concentration in 2004/5 has been estimated to be the three-quarters of the 1996 concentration. Thus the mean annual mean background concentration in the Strabane District Council area in 2004 is estimated to be 1.6 $\mu g\, m^{-3}$ and the maximum annual average background anywhere in the District is estimated to be 40 $\mu g\, m^{-3}$.

Figure 1. Background SO_2 concentrations 1996



4.3 Purpose Of The Study

The purpose of the study was to address the following:-

- Investigate the present and potential future air quality in the Strabane District Council area;
- Identify any actions that are likely to be required by Strabane District Council under Part IV of the GB Environment Act 1995 (Part III of the Environment (NI) Order 2002);
- Recommend actions, if necessary to control the subsequent air quality within the Strabane District Council area.

4.4 Approach Taken

The approach taken to the review and assessment is detailed below:-

1. Identify the principal sources of pollutant emissions affecting air quality in the Strabane District Council area;
2. Model expected present and potential future levels of pollutant concentrations in the Strabane District Council area and identify the areas of the district which are likely to experience the highest concentrations of pollutants;

3. Indicate whether present and predicted future air quality in the District is likely to comply with the requirements of the UK Air Quality Strategy;
4. Identify areas for further investigation.

In preparing this report the LAQM.TG4(00) version of the Government Pollutant Specific Guidance was used.

4.5 Information Provided By Strabane District Council To Support This Assessment

The following information provided by Strabane District Council was used to complete the Stage 2 review and assessment:-

- Local air quality monitoring data.
- Proposed developments.
- Part A and B processes under the Industrial Pollution Control (Northern Ireland) Order 1997.
- Large combustion sources.

4.5.1 Local Air Quality Monitoring Data

4.5.1.1 Extent Of Data Available

There has been monitoring of sulphur dioxide since September 1999 at a site situated in Strabane town. This site is part of the national network operated by NETCEN. However, this site is located in a residential area designed to provide data for the assessment of domestic coal burning emissions rather than industrial emissions. Hence, these data are not relied upon within this assessment of industrial sources. However sulphur dioxide diffusion tubes have been used to assess concentrations in the vicinity of all three boilers. Whilst diffusion tubes cannot be used to assess concentrations against the objectives they provide useful information on the likely prevailing concentrations. All the diffusion tubes have displayed very low concentrations.

4.5.1.2 Part A and B Processes and >5 MW (thermal) Combustion Plants

Part A and B processes can contribute a range of pollutants to ambient air, as can combustion plants with a thermal rating of greater than 5 MW. Three industries identified in Strabane District Council's Stage 1 Report have been assessed further to decide whether it is necessary to proceed to a Stage 3 review for this source of sulphur dioxide, these are:-

- Adria Ltd, Beechmount Avenue, Strabane;

- Herdmans Ltd, Mill Avenue, Sion Mills;
- Leckpatrick Dairies, Berryhill Road, Artigarvan.

4.6 Impact Of Industry On Concentrations Of Sulphur Dioxide

4.6.1 Adria Ltd

Adria Ltd is located on Beechmount Avenue in Strabane town. It produces Textiles (Grid Ref: 234225 396850). There are two boilers of which only one runs at a time.

This industry was considered in the Stage 1 review and assessment and the nomogram supplied in the Government Pollutant Specific Guidance (LAQM.TG4(00)) was used to determine whether a Stage 2 review and assessment would be required. It was subsequently decided that a Stage 2 review and assessment should be carried out. Therefore in this assessment, nomograms in GSS (Guidance for estimating impacts from Stationary Sources) have been used. The plant uses heavy fuel oil. Emissions data was provided by the plant assuming a sulphur content of 3% (which is pessimistic and worst case) and the calculations were checked by Netcen. There were no adjacent tall buildings (defined as 40% of the stack height).

Table 4 - Specifications Of Combustion Processes At Adria Ltd

	Adria
Temperature Of Emissions (^{0}C)	110 - 120
Stack Height (m)	30
Stack Diameter (m)	1.94
SO_2 Emissions (g/s)	22
Gas Exit Velocity (m/s)	13.2

The height of the boiler house is 8 metres. Emissions of sulphur dioxide shown in Table 4 above are if the two boilers are running at the same time. This information has been used in GSS and will therefore result in a conservative estimate and resulting concentrations are likely to be much lower than that predicted.

The background SO_2 concentration on Beechmount Avenue in Strabane town in 2004 has been estimated from the NETCEN maps to be 2.85 $\mu g/m^3$.

Using GSS, the following maximum ground level SO_2 concentrations are obtained:-

Annual Average	8.8 $\mu g/m^3$
99.9 Percentile of Hourly Means	165 $\mu g/m^3$

In order for these results to be compared against the objectives, Pollutant Specific Guidance states the following conversion factors:-

99^{th} percentile of 24 hour means = 10 * annual mean
99.7^{th} percentile of hourly means = 0.83* 99.9^{th} percentile of hourly means
99.9^{th} percentile of 15 minute means = 1.34 * 99.9^{th} percentile of 1 hour means

These relationships are based upon a conservative estimate and will tend to over-predict concentrations in most cases.

Adding the background concentrations to those emitted from the boiler gives the following maximum ground level concentrations:-

Table 5 - Maximum Ground Level Concentrations of SO_2 Arising From Adria Ltd

99^{th} percentile of the 24 hour mean	90.9 $\mu g/m^3$ (the 24 hour mean objective for SO_2 is 125 $\mu g/m^3$ as the 99^{th} percentile);
99.7^{th} percentile of the hourly mean	142.7 $\mu g/m^3$ (the hourly objective for SO_2 is 350 $\mu g/m^3$ as a 99.7^{th} percentile)
99.9^{th} percentile of the 15 minute mean	226.8 $\mu g/m^3$ (the 15 minute objective for SO_2 is 266 $\mu g/m^3$ as a 99.9^{th} percentile)

The above results show that the maximum ground level concentrations are high when compared with the objectives for sulphur dioxide. However, the above figures are for when two boilers are in operation. If only one boiler is in operation the following results are obtained:-

Table 6 – Sulphur Dioxide Emissions With One Boiler In Operation At Adria Ltd

99th percentile of the 24 hour mean	47 μg/m^3 (the 24 hour mean objective for SO_2 is 125 μg/m^3 as the 99th percentile);
99.7th percentile of the hourly mean	74 μg/m^3 (the hourly objective for SO_2 is 350 μg/m^3 as a 99.7th percentile)
99.9th percentile of the 15 minute mean	116 μg/m^3 (the 15 minute objective for SO_2 is 266 μg/m^3 as a 99.9th percentile)

The above results, which are obtained using GSS are well within the objectives. It must therefore be decided which scenario is most likely (one or two boilers). It should be noted that it is never the practice to run the two boilers simultaneously at this site therefore the results obtained for one boiler running should be considered in the assessment. Therefore there is no need to proceed to a Stage 3 review and assessment for this source.

4.6.2 Herdmans Ltd

This factory is involved in the processing and production of linen. The boiler plant consists of two boilers, both of which run continuously. The factory is not surrounded by residential properties, although a small development exists 180 metres away. (Grid Ref: 234350, 393250).

This industry was considered in the Stage 1 review and assessment and the nomogram supplied in the Pollutant Specific Guidance was used to determine whether a Stage 2 review and assessment would be required. It was subsequently decided that a Stage 2 should be carried out. Herdman's consists of two boilers both which run on heavy fuel oil. Emissions data was again provided by the plant assuming a sulphur content of 3% (again pessimistic and worst case) and calculations were checked by Netcen.

Nomograms in GSS (Guidance for estimating impacts from Stationary Sources) were not used in this assessment as the stack discharge velocity is less than 10 m/s and the tallest nearby building is 24 metres (i.e. within 40% of the stack height). Instead information provided in NRPB - R91 has been used (Clarke, 1979). This is similar to GSS in that nomograms are used to assess the likelyhood of exceeding an objective. The results showed that the arising concentrations were well within the sulphur dioxide objectives and therefore no further assessment was required.

Therefore no ADMS modelling has been carried out for Herdmans. The factory is not surrounded by residential properties and therefore there are no relevant locations of concern.

Table 7 - Specifications Of Combustion Processes At Herdmans

	Herdmans
Temperature of Emissions (^{0}C)	200
Stack Height (m)	28
Stack Diameter (m)	1.2
SO_2 Emissions (g/s)	10.8
Gas Exit Velocity (m/s)	6.09

As a conservative estimate, Pasquill stability category D for 75% of the time has been used and the effective stack height has been taken to be equal to the actual stack height. NRPB - R91 provides a maximum annual average ground level concentration of 9.7 $\mu g/m^3$ from the stack.
In order for these results to be compared against the objectives, Pollutant Specific Guidance states the following conservative conversion factor:-

99^{th} percentile of 24 hour means = 10 * annual mean

Adding the predicted background concentration of 2.85 $\mu g/m^3$ to the 99^{th} percentile of the 24 hour mean in 2005 gives a concentration of 100 $\mu g/m^3$.

The 99^{th} percentile value is obviously very close to the daily maximum value and so the value has been assumed the same and then used in Figure 7.2 of the Pollutant Specific Guidance to estimate a 99.9^{th} percentile of 15 minute means (the most stringent objective). That gives 200$\mu g/m^3$. This is within the objective so it can be assumed that the 15 minute mean objective, the most stringent, will be met. It has also become apparent since the time of writing that it is intended to cease production at this plant in May 2004, therefore there is no risk of the objectives being exceeded by the relevant dates prescribed in the regulations.

4.6.3 Leckpatrick Dairies, Artigarvan

This factory is involved in the processing of liquid milk and the production of dried milk powder and other milk concentrates. The boiler plant consists of 2 boilers, both of which run

continuously. The factory is surrounded by residential properties the closest of which are approximately 30 metres away. (Grid Ref: 238370, 401080). Emissions data was provided by the plant assuming a sulphur content of 3% (this is pessimistic and worst case) and the calculations were checked by Netcen.

This industry was considered in the Stage 1 review and assessment and the nomogram supplied in the Pollutant Specific Guidance was used to determine whether a Stage 2 would be required. It was recommended that a Stage 2 review and assessment should be carried out.

Table 8 - Specifications Of Combustion Processes At Leckpatrick Dairies

	Leckpatrick Dairies
Temperature of Emissions (^{0}C)	220
Stack Height (m)	36
Stack Diameter (m)	2
SO_2 Emissions (g/s)	18.2
Gas Exit Velocity (m/s)	n/a

The discharge velocity from the stack was not available so nomograms in GSS (Guidance for estimating impacts from Stationary Sources) could not be used. Therefore the NRPB - R91 model has been used in this assessment. A maximum ground level annual average concentration of 12.7 $\mu g/m^3$ was obtained. In order for these results to be compared against the objectives, the Pollutant Specific Guidance states the following conversion factor:-

99^{th} percentile of 24 hour means = 10 * annual mean

Adding the predicted background concentration of 2 $\mu g/m^3$ to the 99^{th} percentile of the 24 hour mean in 2005 gives a concentration of 129$\mu g/m^3$. The 99^{th} percentile value is obviously very close to the daily maximum value and so the value has been assumed to be the same and then used in Figure 7.2 of Pollutant Specific Guidance to estimate a 99.9^{th} percentile of 15 minute means (the most stringent objective). That gives 250$\mu g/m^3$.

Due to neither GSS nor NRPB - R91 being conclusive as to whether there is likely to be an exceedence it was decided to model the impact of the industry using ADMS (Air Dispersion

Modelling System). Met data from Aldergrove 1999 was used in the modelling. The building module in ADMS was utilised as there were site buildings within close proximity of the stack. ADMS requires the following input data:-

- Stack height;
- Stack Diameter;
- Stack exit temperature;
- Stack exit velocity;
- SO_2 Emission rate.

As the stack velocity was not available the model was run with 3 scenarios; 5 metres/second, 10 metres/second and 15 metres/second. These scenarios provide estimates of the potential point impacts of the stack. A background value at the point of Leckpatrick was estimated by taking the grid reference of the site and referencing it to the NETCEN mapped data, giving a value of 2.55μg/m^3. The results of the modelling exercise are shown in Table 9 below.

Table 9 - ADMS Modelling Results For The Leckpatrick Dairies Site For 3 Different Exit Velocity Scenarios

Scenario	SO2 Objective	Leckpatrick Contribution μg/m^3	Objective Value μg/m^3	Method of Background Calculation	Background Concentration μg/m^3	Total Concentration μg/m^3
5 m/sec	1 Hour Mean	150	350	2*2004 b/g	2.55	156
	24 Hour Mean	61	125	1*2004 b/g	2.55	64
	15 Min Mean	196	266	2*2005 b/g	2.55	201
10 m/sec	1 Hour Mean	93	350	2*2004 b/g	2.55	98
	24 Hour Mean	47	125	1*2004 b/g	2.55	50
	15 Min Mean	121	266	2*2005 b/g	2.55	126
15m/sec	1 Hour Mean	72	350	2*2004 b/g	2.55	78
	24 Hour Mean	40	125	1*2004 b/g	2.55	42
	15 Min Mean	85	266	2*2005 b/g	2.55	91

It is therefore concluded that as there are no exceedences predicted in any of these scenarios for any of the objectives that there is no need to consider this source further.

4.7 Future Developments

There are no known future developments likely to affect the findings of this report.

4.8 Conclusions For Sulphur Dioxide Concentrations In The Strabane District Council Area Resulting From Industrial Emissions

It is recommended no further review and assessment is necessary for sulphur dioxide from the industrial sources assessed in this study.

5.0 STAGE 3 REVIEW AND ASSESSMENT OF PM_{10} & SULPHUR DIOXIDE FROM DOMESTIC SOLID FUEL COMBUSTION

5.1 Introduction

5.1.1 Particulate Matter (PM_{10})

Airborne particulate matter varies widely in its physical and chemical composition, source and particle size. Particles are often classed as either primary (those emitted directly into the atmosphere) or secondary (those formed or modified in the atmosphere from condensation and growth). PM_{10} particles (the fraction of particulates in air of very small size, <10 μm aerodynamic diameter) can potentially pose significant health risks as they are small enough to penetrate deep into the lungs. Larger particles are not readily inhaled.

A major source of fine primary particles is combustion processes, in particular diesel combustion, where transport of hot exhaust vapour into a cooler tailpipe or stack can lead to spontaneous nucleation of "carbon" particles before emission. Secondary particles are typically formed when low volatility products are generated in the atmosphere, for example the oxidation of sulphur dioxide to sulphuric acid. The atmospheric lifetime of particulate matter is strongly related to particle size, but may be as long as 10 days for particles of about 1 μm in diameter.

Concern about the potential health impacts of PM_{10} has increased very rapidly over recent years. Increasingly, attention has been turning towards monitoring the smaller particle fraction, $PM_{2.5}$, which is capable of penetrating deepest into the lungs, or to even smaller size fractions or total particle numbers.

5.1.2 Sulphur Dioxide

Sulphur dioxide is a corrosive acid gas, which combines with water vapour in the atmosphere to produce acid rain. Both wet and dry deposition have been implicated in the damage and destruction of vegetation and in the degradation of soils, building materials and watercourses. SO_2 in ambient air is also associated with asthma and chronic bronchitis.

The principal source of this gas is power stations burning fossil fuels, which contain sulphur. Episodes of high concentrations of SO_2 now only tend to occur in cities in which coal is still widely used for domestic heating, in industry and in power stations. As most power stations are now located away from urban areas, SO_2 emissions may affect air quality in both rural and urban areas. Since the decline in domestic coal burning in cities and in power stations overall, SO_2

emissions have diminished steadily and, in most European countries, they are no longer considered to pose a significant threat to health.

5.2 Air Quality Standards And Objectives

5.2.1 Particulate Matter (PM_{10})

The government and the devolved administrations have adopted two air quality objectives for fine particles (PM_{10}), which are the equivalent to the EU Stage 1 limit values in the first Air Quality Daughter Directive. The gravimetric objectives are:-

- An annual mean of 40 $\mu g/m^3$.
- A 24 hour mean of 50 $\mu g/m^3$ not to be exceeded more than 35 days per year.

The EU has also set indicative limit values for $PM_{10,}$ which are to be achieved by 1st January 2010. These stage 2 limit values are considerably more stringent and are:-

- For England and Wales (except London), a 24 hour mean of 50 $\mu g/m^3$ not to be exceeded more than 7 days per year and an annual mean of 20 $\mu g/m^3$ to be achieved by the end of 2010;
- For London, a 24 hour mean of 50 $\mu g/m^3$ not to be exceeded more than 10 days per year and an annual mean of 23$\mu g/m^3$ to be achieved by the end of 2010. An annual mean objective of 20$\mu g/m^3$ to be achieved by the end of 2015 has also been set.

The 24 hour objective is more stringent than the annual mean objective in 2004. However, the opposite is true in 2010, and the annual mean objective is more stringent than the 24 hour objective.

5.2.2 Sulphur Dioxide

Two new objectives have been introduced for SO_2 in the Air Quality Strategy based on the limit values in the Air Quality Daughter Directive. Hence there are now three objectives:-

- 266 μg m^{-3} (100ppb) as a 15 minute mean (maximum of 35 exceedences a year or equivalent to the 99.9th percentile) to be achieved by the 31st December 2005;
- 350 μg m^{-3} (132ppb) as a 1 hour mean (maximum of 24 exceedences a year or equivalent to the 99.7th percentile) to be achieved by the 31st December 2004;
- 125 μg m^{-3} (47pb) as a 24 hour mean (maximum of 3 exceedences a year or equivalent to the 99th percentile) to be achieved by the 31st December 2004.

The 15 minute mean objective is the most stringent; the other two objectives will not be exceeded if this objective is not exceeded.

5.3 The National Perspective

5.3.1 Particulate Matter (PM_{10})

National UK emissions of primary PM_{10} have been estimated as totalling 213,000 tonnes in 1996. Of this total, around 24% was derived from road transport sources, 38% from industrial sources, 16% from power stations and 17% from domestic and other low-power combustion. It should be noted that, in general, the emissions estimates for PM_{10} are less accurate than those for the other pollutants with prescribed objectives, especially for sources other than road transport.

The Government established the Airborne Particles Expert Group (APEG) to advise on sources of PM_{10} in the UK and current and future ambient concentrations. Their conclusions were published in January 1999 (APEG, 1999). APEG concluded that a significant proportion of the current annual average PM_{10} is due to the secondary formation of particulate sulphates and nitrates, resulting from the oxidation of sulphur and nitrogen oxides. These are regional scale pollutants and the annual concentrations do not vary greatly over a scale of tens of kilometres. There are also natural or semi-natural sources such as wind-blown dust and sea salt particles. The impact of local urban sources is superimposed on this regional background. Such local sources are generally responsible for winter episodes of hourly mean concentrations of PM_{10} above 100 μg m^{-3} associated with poor dispersion. However, it is clear that many of the sources of PM_{10} are outside the control of individual local authorities and the estimation of future concentrations of PM_{10} are in part dependent on predictions of the secondary particle component.

Further advice to local authorities on review and assessment of particles has now been published in the Technical Assistance with the Review and Assessment of PM_{10} concentrations in relation to the proposed EU Stage 1 Limit Values (Moorcroft *et al.*, 1999).

5.3.2 Sulphur Dioxide

Sulphur dioxide is emitted in the combustion of coal and oil. Emissions today are dominated by fossil-fuelled power stations, which in 1997 accounted for 62% of the national total emission. Emissions from road transport are a very small fraction of the national total (2%).

Exceedences of the 15-minute air quality standard currently occur near industrial processes for which the stack heights were designed to meet previous air quality standards and downwind of large combustion plant such as power stations. Exceedences are also possible in areas where significant quantities of coal are used for space heating. These large combustion plant are currently regulated under BATNEEC and the Industrial Pollution Control (NI) Order 1997, and will come under the provisions of the Integrated Pollution Prevention and Control regime. The government considers that bearing in mind the envisaged change in fuel use, it does not expect exceedences of the 15-minute objective by 2005 from these sources.

5.4 General Approach Taken

Strabane District Council commissioned the National Environmental Technology Centre (NETCEN) in January 2003 to carry out the domestic emissions modelling aspect of the Stage 3 review and assessment of PM_{10} and sulphur dioxide. The emissions modelled were from domestic solid fuel combustion in six 1 km^2 grid squares within the Strabane District Council area. This study incorporated local monitoring data and local fuel use data provided by Strabane District Council.

The approach taken in this study was to:-

- Collect and interpret additional data to support the third stage assessment, including the detailed fuel use survey data for locations where exceedences were predicted.
- Utilise the monitoring data from the Council's monitoring campaign to assess the ambient concentrations produced by domestic fuel combustion and to validate the output of the modelling studies.

- Model the concentrations of PM_{10} and SO_2 in the selected grid squares, concentrating on the locations (receptors) where people might be exposed over the relevant averaging times of the air quality objectives.
- Present the concentrations as contour plots of concentrations and assess the uncertainty in the predicted concentrations.

This report has used the guidance in LAQM.TG(03), published in February 2003.

5.5 Information Provided By Strabane District Council To Support This Assessment

The following information provided by Strabane District Council was used to complete the Stage 3 review and assessment:-

- Local air quality monitoring data gathered at the continuous PM_{10} and SO_2 monitoring site located at Springhill Park, Strabane since April 2002.
- Local fuel use data for the 6 grid squares of concern.

5.6 Meteorological Data Used In The Dispersion Modelling

Hourly sequential data was obtained for 1999 from the Meteorological Office for the Aldergrove site for input into the ADMS dispersion model.

5.7 Ambient Monitoring OF PM_{10}

5.7.1 Particulates (PM_{10})

PM_{10} has been monitored by continuous monitoring since April 2002 at Springhill Park, Strabane (OS Grid Reference 2351 3972) in the Head of the Town area. The concentrations recorded in the period 26 April 2002 to 25 April 2003 have been used to validate the results of the modelling carried out in this report. The ratified concentrations recorded by the continuous monitor are provided below:-

Table 10 - Statistical Analysis of Monitoring Results For PM_{10}

POLLUTANT	26 April 2002 – 31 December 2002*	01 January 2003 – 31 August 2003*
Number Very High	73	49
Number High	197	266
Number Moderate	375	634
Number Low	5194	4679

Maximum 15-minute mean	-	-
Maximum hourly mean	398 µg m^{-3}	485 µg m^{-3}
Maximum running 8-hour mean	254 µg m^{-3}	282 µg m^{-3}
Maximum running 24-hour mean	175 µg m^{-3}	201 µg m^{-3}
Maximum daily mean	147 µg m^{-3}	164 µg m^{-3}
Average	38 µg m^{-3}	41 µg m^{-3}
Data capture	98.0 %	96.9 %

*PM_{10} in gravimetric units. All mass units are at 20'C and 1013mb

Table 11 - Comparison of Monitoring Results With The Air Quality Regulations (NI) 2003

Pollutant	Date Range	Air Quality Regulations (Northern Ireland) 2003	Exceedences	Days
PM_{10} Particulate Matter (Gravimetric)	26 April 2002 – 31 December 2002	Daily mean > 50 µg m^{-3} not to be exceeded on more than 35 occasions	48	48
PM_{10} Particulate Matter (Gravimetric)	26 April 2002 – 31 December 2002	Annual mean > 40 µg m^{-3}	0 (38 µg m^{-3})	-
PM_{10} Particulate Matter (Gravimetric)	01 January 2003 – 31 August 2003	Daily mean > 50 µg m^{-3} not to be exceeded on more than 35 occasions	69	69
PM_{10} Particulate Matter (Gravimetric)	01 January 2003 – 31 August 2003	Annual mean > 40 µg m^{-3}	1 (41 µg m^{-3})	-
PM_{10} Particulate Matter (Gravimetric)	26 April 2002 – 25 April 2003	Daily mean > 50 µg m^{-3} not to be exceeded on more than 35 occasions	85	85
PM_{10} Particulate Matter (Gravimetric)	26 April 2002 – 25 April 2003	Annual mean > 40 µg m^{-3}	1 (45 µg m^{-3})	-

5.7.2 Black Smoke Results

The monitoring of black smoke has been undertaken at Springhill Park, Strabane from September 1999 to the present. This site is co-located with the automatic monitoring station in one of the residential areas of Strabane in order to gather data as to the prevailing pollutant concentrations resulting from domestic emissions from solid fuel combustion. This site is part of the UK Smoke and Sulphur Dioxide Network managed by NETCEN on behalf of the government. The concentrations of black smoke in this location have been the highest in the UK in the years 1999 to 2001 as depicted in the table below:-

Table 12 - Black Smoke Results For Springhill Park, Strabane

Year	*Annual Mean ($\mu g/m^3$)*	*No. Days >50 $\mu g/m^3$*	*Maximum Daily Mean ($\mu g/m^3$)*	*98th Percentile*	*Data Capture (%)*
1999	32*	28	129	96	46
2000	27	32	129	76	88
2001	34	56	249	114	89

*Based on Winter Data (28 September 1999-31 March 2000)

5.7.2.1 QA/QC Procedures For Black Smoke/SO2 Bubbler Monitoring

The black smoke/SO2 bubbler is co-located with the automatic monitoring station in Springhill Park, Strabane. The site is operated in accordance with the 'UK Smoke and SO2 Networks instruction manual'. The site is visited on a weekly basis to avoid double exposure of the samples. The titrations and reflectometer readings are carried out upon receipt of the exposed samples. The results of the titrations and smoke stain reflectometer readings are forwarded to NETCEN on a monthly basis. NETCEN calculate the corresponding concentrations and forward the final data to Strabane District Council. The site has been audited by NETCEN staff and the procedures have been found to be satisfactory.

5.7.3 Comparison Of PM_{10} Monitoring Data With Derry

The modelling carried out for this report has used 1999 meteorological data from Aldergrove. Therefore a comparison has been made between PM_{10} concentrations recorded by the continuous monitor in Derry in 1999 with that recorded between 26th April 2002 and the 28th January 2003 when the Springhill park site was in operation. Ideally a comparison would have been done with more monitoring sites but Derry was the only site for which data was available and for which was

deemed suitable. The results are shown in Table 13 below. All results shown are in gravimetric equivalents.

Table 13 - Comparison Of PM_{10} Concentrations In Springhill Park With The Derry Site

Site	90th percentile daily mean (μg/m3) in 1999	90th percentile daily mean (μg/m3) from 26th April 2002 to 28th Jan 2003
Derry	39	37.7
Springhill Park	*	73

*It is estimated that in 1999, Springhill Park would have recorded a 90th percentile daily mean PM_{10} concentration of approximately 75.5 μg/m3. This result has been used in the modelling to correct for bias.

5.7.4 Sulphur Dioxide

Sulphur dioxide concentrations have been continuously monitored at Springhill Park in Strabane since April 2002. The site is in a dense domestic fuel burning area. A summary of the concentrations recorded at the site are shown in Table 14 below. The data has been ratified by Netcen and conform to the Defra standards.

Table 14 - Statistical Analysis of Monitoring Results For SO_2

POLLUTANT – SO_2	26 April 2002 To 31 December 2002	01 January 2003 To 31 August 2003
Number Very High	0	0
Number High	0	0
Number Moderate	0	0
Number Low	22955	22439
Maximum 15-minute mean	95 ppb	63 ppb
Maximum hourly mean	34 ppb	26 ppb
Maximum running 8-hour mean	20 ppb	17 ppb
Maximum running 24-hour mean	12 ppb	11 ppb
Maximum daily mean	11 ppb	9 ppb
Average	3 ppb	3 ppb
Data capture	93.6 %	94.4 %

The most stringent SO_2 objective is the 99.9 percentile 15 minute mean. If this objective is met then it is likely that all the other objectives will be met. The 99.9th % percentile 15 minute mean concentration at the Strabane site is well below the objective of 266 μg/m^3 (100ppb) for sulphur dioxide during the period of monitoring. Indeed none of the air quality objectives for sulphur dioxide are likely to be exceeded as demonstrated by the above data.

5.7.5 Comparison Of SO2 Monitoring Data With Belfast East Site

The modelling carried out for this report has used 1999 meteorological data from Aldergrove. Therefore a comparison has been made between SO_2 concentrations recorded by the continuous monitor at Belfast East in 1999 with that recorded between 26th April 2002 and the 28th January 2003 when the Springhill park site was in operation. Ideally a comparison would have been done with more monitoring sites but Belfast East was the only site for which data was available and for which was deemed suitable. The results are shown in Table 15 below.

Table 15 - Comparison Of 99.9 Percentile 15 Minute Mean SO_2 Concentrations In Springhill Park With The Belfast East Site (μg/m^3)

Site	1999	2000	2001	26th April 2002 to 28th Jan 2003
Belfast East	338	274	373	162
Springhill Park	*	N/A	N/A	74.5

The Belfast East site recorded far higher 99.9 percentile 15 minute mean SO_2 concentrations in 1999, 2000 and 2001 than during April 2002 to January 2003 when the Springhill site has been in operation. Therefore it is likely that although the concentrations recorded by the monitor in Strabane are well below the SO_2 15 minute mean objective, that this period of monitoring is unrepresentative of the norm.

* It is estimated that in 1999, Springhill Park would have recorded a 99.9 percentile 15 minute mean SO_2 concentration of approximately 155 μg/m^3. This figure has been used to bias correct the modelled results.

5.8 Fuel Use Data

Strabane District Council commissioned Mallett & Associates Research Consultancy to undertake a fuel usage survey in each of the 6 km grid squares known or suspected, from the Stage 1 review

and assessment, to have a high proportion of solid fuel combustion. The full findings of the report are available at Appendix 1. The survey aimed to determine the following:-

- The types and quantities of fuels used in the domestic sector.
- Seasonal use of heating fuels.
- The types of heating appliances used.
- The total number of persons who live in coal burning households in each of the six designated survey areas.
- The total number of houses that burn coal in each of the survey areas.

The six survey areas in which the survey was carried out were:-

- The head of the town area, Strabane;
- Ballycolman area, Strabane;
- Melmount area, Strabane;
- Newtownstewart area;
- Castlederg area;
- Sion Mills area.

The aim was to take a 15% random sample of households in three high density housing areas in Strabane and a 10% random sample in the lower density areas (Castlederg, Newtownstewart and Sion Mills).

Table 16 - Estimated Number Of Houses In Each Grid Area And The Achieved Number Of Surveys

Grid Area	No. Houses	Respondents	% asked
Head of town	560	81	14.5
Ballycolman	1266	187	14.8
Melmount	724	106	14.6
Newtownstewart	477	49	10.3
Castelderg	589	58	9.8
Sion Mills	505	50	9.9

The results of the survey indicated that the proportion of homes burning coal as their main source of fuel ranged from 18.9% in the Melmount area of Strabane to 61.2% in Newtownstewart. The

average proportion of homes burning coal as their main fuel across all 6 areas surveyed is 35.4% with a further 14% of all households using coal as a secondary source of heat. The results also indicated that overall oil was the most popular primary heating source in all grid areas combined (61.2% of all households). The types of the main fuel used for heating purposes in all areas is shown below in Table 17.

Table 17 - Proportions Of Fuel Used As Main Source Of Heat

	Head of the Town	Ballycolman	Melmount	Newtown-stewart	Castlederg	Sion Mills	All Areas
Oil	45.7	70.1	80.2	38.8	56.9	46.0	61.2
Coal	51.9	26.2	18.9	61.2	43.1	48.0	35.4
Electricity	1.2	3.7	0.9	0	0	6.0	2.3
Gas	1.2	0	0	0	0	0	0.2
	100%	100%	100%	100%	100%	100%	100%

The proportion of coal burning in the area where the automatic monitoring equipment is situated is 51.9%. The types of coal and solid fuel heating used in each of the areas of concern are shown in Table 18 below. This data illustrates the strong dependence on ordinary coal throughout the Strabane District Council area. Ordinary coal was the most popular form of solid fuel (38.4% of all households). It was particularly prevalent in Newtownstewart (81.6%), Sion Mills (60.0%), the Head of the Town area, Strabane (50.6%) and Castlederg (48.3%). This type of coal is also the most polluting in terms of PM_{10} emissions.

Table 18 - Type of Coal/Solid Fuel Used For Heating Purposes (% of Households in Each Grid)

	Head of the Town	Ballycolman	Melmount	Newtownstewart	Castlederg	Sion Mills	All Areas
Ordinary	50.6	26.2	15.1	81.6	48.3	60.0	38.4
Smokeless /Anthracite	2.4	10.7	20.8	0	10.4	4.0	9.8
Wood	6.5	4.3	5.4	5.0	22.2	46.7	12.4
Turf/Peat	4.3	1.4	0	0	0	13.3	2.7

5.8.1 Principal Data For Individual Grid Squares

5.8.1.1 Grid 1 - Head Of The Town Area, Strabane

In Grid square 1, there were estimated to be 560 households. The following two tables summarise the results of the survey in this grid. For further details please see Appendix 1.

Table 19 - % Of Households Burning Different Fuel Types In The Head Of The Town

Use	Oil	Gas	Electricity	Coal/Solid Fuel	Total
Main Fuel	46	1	1	52	100
Secondary Fuel	0	0	17	5	22

Table 20 - The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In The Head Of The Town Survey Area

Type	Ordinary	Smokeless	Anthracite	Wood	Turf/Peat
% Who Use	79	0	4	10	7

In the head of the town survey area, it was found that there was roughly an even split between those households burning oil as their main heating source and those that burn coal. The emission factors shown in Table 31 below have been applied to the results of the fuel survey for grid square 1 to calculate an average PM_{10} and SO_2 emission arising from the area.

5.8.1.2 Grid 2 - Ballycolman Area, Strabane

In Grid square 2, there were estimated to be 1,266 households. The following two tables summarise the results of the fuel survey in this grid. For further details please see Appendix 1.

Table 21 - % Of Households Burning Different Fuel Types In Ballycolman

Use	Oil	Gas	Electricity	Coal/Solid Fuel	Total
Main Fuel	70	0	4	26	100
Secondary Fuel	0.5	1	4	11	16.5

Table 22 - The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In Ballycolman

Type	Ordinary	Smokeless	Anthracite	Wood	Turf/Peat
% Who Use	62	0	25	10	3

In the Ballycolman survey area it was found that the majority of households burnt oil for their main heating source (70% of households). A lesser proportion burnt coal or solid fuel. The emission factors shown in Table 31 below have been applied to the results of the fuel survey for grid square 2 to calculate an average PM_{10} and SO_2 emission arising from the area.

5.8.1.3 Grid 3 - Melmount Area, Strabane

In Grid square 3, there were estimated to be 724 households. The following table summarises the results of the fuel survey in this grid. For further details please see Appendix 1.

Table 23 - % Of Households Burning Different Fuel Types In Melmount

Use	Oil	Gas	Electricity	Coal/Solid Fuel	Total
Main Fuel	80	0	1	19	100
Secondary Fuel	0	0	5	16	21

Table 24 - The Type Of Coal And/Or Solid Smokeless Fuel Used (%) In Melmount

Type	Ordinary	Smokeless	Anthracite	Wood	Turf/Peat
% Who Use	37	0	50	13	0

In survey area 3, the majority of respondents burn oil as their main fuel (80%). The emission factors shown in Table 31 below have been applied to the results of the fuel survey for grid square 3 to calculate an average PM_{10} and SO_2 emission arising from the area.

5.8.1.4 Grid 4 - Newtownstewart

In survey area 4, there were estimated to be 477 households. In this area, there is lower density housing than in the previous survey areas 1- 3. The following table summarises the results of the fuel survey in this grid 4. For further details please see Appendix 1.

Table 25 - % Of Households Burning Different Fuel Types In Newtownstewart

Use	Oil	Gas	Electricity	Coal/Solid Fuel	Total
Main Fuel	39	0	0	61	100
Secondary Fuel	6	0	0	20	27

Table 26 - The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In Newtownstewart

Type	Ordinary	Smokeless	Anthracite	Wood	Turf/Peat
% Who Use	94	0	0	6	0

In survey area 4, the majority of respondents burn coal / solid fuel as their main fuel (61%).
The emission factors shown in Table 31 below have been applied to the results of the fuel survey for grid square 4 to calculate an average PM_{10} and SO_2 emission arising from the area.

5.8.1.5 Grid 5 - Castlederg

In survey area 5, there were estimated to be 589 households. The following table summarises the results of the fuel survey in this grid. For further details please see Appendix 1.

Table 27 - % Of Households Burning Different Fuel Types In Castlederg

Use	Oil	Gas	Electricity	Coal/Solid Fuel	Total
Main Fuel	57	0	0	43	100
Secondary Fuel	0	1.7	9	19	29

Table 28 - The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In Castlederg

Type	Ordinary	Smokeless	Anthracite	Wood	Turf/Peat
% Who Use	60	0	13	27	0

The majority of households surveyed in Castlederg burn oil followed by coal/solid fuel as their main fuel source. The emission factors shown in Table 31 below have been applied to the results of the fuel survey for grid square 5 to calculate an average PM_{10} and SO_2 emission arising from the area.

5.8.1.6 Grid 6 - Sion Mills

In survey area 6, there were estimated to be 505 households. The following table summarises the results of the fuel survey in this grid 6. For further details please see Appendix 1.

Table 29 - % Of Households Burning Different Fuel Types In Sion Mills

Use	Oil	Gas	Electricity	Coal/Solid fuel	Total
Main Fuel	46	0	6	48	100
Secondary Fuel	4	0	8	12	24

Table 30 - The Type Of Coal And / Or Solid Smokeless Fuel Used (%) In Sion Mills

Type	Ordinary	Smokeless	Anthracite	Wood	Turf/Peat
% Who Use	48	0	3	38	11

In Sion Mills there is approximately an even number of households burning oil and coal/solid fuel as their main fuel source. There is a large amount of wood and turf/peat burning. The emission factors shown in Table 31 below have been applied to the results of the fuel survey for grid square 6 to calculate an average PM_{10} and SO_2 emission arising from the area.

5.8.2 Emission Factors Used in the Modelling

The SO_2 and PM_{10} emissions arising from domestic fuel combustion were taken from the UK emission factor database (www.naei.org.uk). This web site is managed by Netcen on behalf of Defra. The exception to this is the emission factor for sulphur dioxide from household coal, which has been taken from a CRE study carried out for Belfast City Council. It was felt that this locally derived emission factor maybe more representative of fuel burnt in Northern Ireland.

Table 31 - Emissions Arising From Domestic Fuel Combustion

Fuel Type	SO_2	PM_{10}	Units
Anthracite	13	3.59	kt/mt fuel burnt
Burning Oil	0.42	0.01	kt/mt fuel burnt
Coal	10*	10	kt/mt fuel burnt
SSF	16	5.6	kt/mt fuel burnt
Wood	0.03	7.9	kt/mt fuel burnt

Source: UK emission factor database (www.naei.org.uk)

SSF = solid smokeless fuel

* - Emission factor taken from CRE, 1997.

The emission factors provided in the above table have been used to derive PM_{10} and SO_2 emissions for each of the six survey areas.

5.8.3 QA/QC Of Continuous Monitoring Data

The data from the continuous monitor located at Springhill Park has been ratified by Netcen. The data conforms to the QA/QC standards used in the Defra network. A documented quality assurance and control programme was followed in order to ensure reliable and credible measurements from the automatic and non-automatic monitoring equipment. The QA/QC procedures include the following:-

- At least daily downloading of the data from the monitoring station both by NETCEN & Strabane District Council.
- Weekly visits to the site to ensure proper operation.
- Scheduled site calibrations at 2 week intervals of the Sulphur Dioxide analyser and cleaning of the PM10 inlet.
- Backup of the raw data at 2 week intervals at Strabane District Council.
- 6 monthly service visits by Enviro Technology Services plc.
- 6 monthly independent audits by NETCEN.
- A 24 hour response to analyser breakdown provided by Enviro Technology Services plc.
- Data management (including collection, verification & ratification) provided by NETCEN.
- Documentation of calibration results, service visits and audit reports.

The above documentation can be found at Appendix 3.

The QA/QC programme adopted by Strabane District Council has ensured the following have been achieved:-

- Data that is representative of ambient concentrations existing in the area under investigation. The monitoring site has been located centrally in a densely populated residential area of Strabane town, which is known to have a high proportion of coal burning houses.
- Measurements that are sufficiently accurate and precise to meet the accurate monitoring requirements of the Stage 3 assessment.
- Measurements that are consistent over time. The trends available to date have been reproducible and have shown consistent levels of PM_{10} exceedences of the air quality objectives.

5.9 Detailed Modelling

5.9.1 Meteorological Data

Hourly sequential meteorological data for 1999 for Aldergrove was obtained from the Meteorological Office. The meteorological data provided information on wind speed and direction and the extent of cloud cover for each hour of 1999.

5.9.2 Overview Of The Modelling Approach

In order to model the PM_{10} emissions digital landline data was obtained from Ordnance Survey Northern Ireland. This was used to obtain the centre co-ordinate of each of the houses within the six grids. Each co-ordinate represented a chimney through which the emissions to the air were vented. Each emission was modelled as a point source.

The Netcen proprietary LADSUrban model has then been used to predict the PM_{10} concentrations arising from domestic fuel burning in the six grids. It has been specially developed for Review and Assessments by Netcen. The model has made use of ADMS-3.1 to provide dispersion kernels over a grid. ADMS could not be used on its own as there is a limit of 100 point sources that can be modelled. In Ballycolman alone there are estimated to be 1,266 houses.

The dispersion model ADMS 3.1 developed by CERC has been used to predict the SO_2 levels in the Strabane district. ADMS is a PC-based model that includes an up-to-date representation of the atmospheric processes that contribute to pollutant dispersion and has been deemed suitable for use in the review and assessment process. This approach was initially used to model the PM_{10}

emissions also but following discussions with NETCEN it was decided that for PM_{10} it would be more appropriate to obtain the digital landline data for the 6 areas of concern. It was felt unnecessary to model the SO_2 emissions in this way as there were no exceedences predicted for this pollutant in any of the 6 areas modelled. The monitoring results for SO_2 have not displayed any exceedences for any of the objectives in the period 26 April 2002 to 31 August 2003. The SO_2 emissions arising from each survey area have been modelled as a volume source.

Emissions have been weighted with both seasonal and diurnal emission patterns. The seasonal emission pattern was obtained from the Building Research Establishment Domestic Energy Model (BREDEM, BRE, 1985). The pattern was derived using formulae that allow a degree day to be calculated. The degree day provides a method to weight emissions to the colder periods of the year. A seasonal profile was derived using the 1999 Aldergrove meteorological data. The modelled concentrations have then been added to estimated background concentrations (taken from the NAEI web site) and scaled to the year of interest where necessary.

5.9.2.1 Model Bias

The monitoring site at Springhill Park has been used as a reference site i.e. model concentrations have been adjusted by taking the ratio between the modelled concentration at the site and the predicted measured value in 1999 from the modelled values at other locations in the Strabane District Council area. The purpose of this adjustment was to ensure that the modelled concentrations equalled the measured values at the monitoring site.

Table 32 shows the main elements of the calculation for PM_{10}.

Table 32 - Main Elements Of The Reference Calculation For PM_{10}

Element	Factor Used	PM_{10} Concentration ($\mu g\ m^{-3}$)	Source of Factor or Model Used
Measured concentration Measured concentration at the Springhill Park site (April 2002 – April 2003)		45	Monitoring (annual mean)
Background concentration at monitoring site in 2003		14.2	NAEI
Modelled concentrations at Springhill Park Modelled contribution of domestic emissions at monitoring site		13.7	ADMS (annual average)
Model bias correction PM_{10} monitored minus PM_{10} background	=(45 – 14.2)	30.8	
Difference (bias in the model)	(30.8/13.7) =	2.25	Model under Predicting at the Strabane site

Note : Totals may not necessarily agree with the sum of their components due to rounding.

5.9.2.2 Emission Factors Used For The Modelling

The PM_{10} emissions arising from domestic fuel combustion were taken from the UK emission factor database (www.naei.org.uk). This web site is managed by Netcen on behalf of Defra.

Table 33 - PM_{10} Emissions Arising From Domestic Fuel Combustion

Fuel Type	PM10	Units
Anthracite	3.59	kt/mt fuel burnt
Burning Oil	0.01	kt/mt fuel burnt
Coal	10	kt/mt fuel burnt
SSF	5.6	kt/mt fuel burnt
Wood	7.9	kt/mt fuel burnt

Source: UK emission factor database (www.naei.org.uk)

SSF = solid smokeless fuel

These emission factors have been used to derive emissions arising from each house in each grid square.

5.9.2.3 Model Validation

The calculations have not taken account of:-

- Uncertainties in the fuel use survey as only 10 - 15% of households were questioned;
- Uncertainties in how the burning of domestic fuel might change in future years;
- Uncertainty resulting from year to year variations in atmospheric conditions;
- Model errors at the receptor sites;
- Model errors at the reference site;
- Uncertainty in the location of the monitor with respect to local sources;
- Monitoring over a short time period;
- Uncertainty in emission factors (See Table 33 Above).

Pollutant emissions are expected to decrease generally due to national measures (which will affect the background concentrations). However, for SO_2 in particular the background contribution is small. Concentration plots are therefore only shown for 1999, as this is the year for which modelling has been carried out and it is assumed that the results of the survey are applicable to both 1999 and 2004/5.

5.9.2.4 Consideration Of The Impact From Industrial Emissions

The three industries (Adria, Herdmans and Leckpatrick) were assessed in the Strabane Stage 2 Review and Assessment. No exceedences of the sulphur dioxide objectives were predicted and therefore no further assessment was required in the Stage 3 for these sources. Whilst the emissions from these industries have not been explicitly modelled in the Stage 3 assessment, the contribution from these sources is taken into account in the background concentration maps, which have been utilised in the domestic modelling. In addition, it is extremely unlikely that the impact from both industrial sources and domestic fuel burning for the 15 minute means will impact simultaneously at the same location due to the different nature of the sources.

Leckpatrick Dairies is not in the vicinity of any of the domestic areas modelled in the Stage 3 Review and Assessment. The absence of housing densities sufficient to give concern for the

sulphur dioxide objectives would make it very unlikely that any exceedences would occur even if the industrial emissions and domestic emissions were combined.

Herdmans located in Sion Mills is to cease production by May 2004. It is therefore not possible for the objectives to be exceeded by 31 December 2004/5. The assessment was included in the report to give an indication of the existing conditions at the time of writing.

Adria Ltd is located in Strabane town. Even assuming a sulphur content as high as 3%, Guidance on Stationary Sources predicts the 99.9 percentile 15 minute mean to be only 116 $\mu g/m^3$. The results of the domestic modelling show the 99.9 percentile 15 minute mean concentrations to be around 60 - 80 $\mu g/m^3$. Therefore even if these concentrations were combined, the sulphur dioxide 15 minute mean objective would not be exceeded.

5.9.3 Results Of Modelling

5.9.3.1 Head Of The Town, Ballycolman And Melmount Areas Of Strabane Town

Figure 2 shows modelled SO_2 concentrations in the Head of the Town, Ballycolman and Melmount areas in 1999. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentration will not be exceeded in the Head of the Town, Melmount and Ballycolman areas. The highest concentrations are predicted in the Head of the Town area. This is due to a higher proportion of households burning coal (52%) than in Ballycolman (26%) and Melmount (19%).

Due to the uncertainty in the domestic fuel burning in future years and the minute contribution of background SO_2 no attempt has been made at predicting concentrations in 2004/5. They are assumed to be similar to that modelled in 1999.

Figures 6-8 show modelled PM_{10} concentrations in the Head of the Town, Ballycolman and Melmount areas in 2004. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will be exceeded in the Head of the Town and Ballycolman areas but not in the Melmount area. The magnitude and geographical extent of the areas of exceedence are depicted as a series of contours overlaid onto the map of the area in question. Similarly where there are no exceedences predicted the ambient concentrations are depicted as contours of the 90.41 percentile daily mean PM_{10} concentration.

5.9.3.2 Newtownstewart

Figure 3 shows modelled SO_2 concentrations in Newtownstewart in 1999. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentrations will not be exceeded. However, the concentrations predicted are higher than those predicted in the Head of the Town area due to the higher proportion of coal burning as a heating source.

Figure 9 shows modelled PM_{10} concentrations in the Newtownstewart area in 2004. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will be exceeded in this area. The magnitude and geographical extent of the areas of exceedence is depicted as a series of contours overlaid onto the map of the area in question.

5.9.3.3 Castlederg

Figure 4 shows the modelled SO_2 concentrations in Castlederg in 1999. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentrations will not be exceeded.

Figure 10 shows modelled PM_{10} concentrations in the Castlederg area in 2004. The model predicts that the with the current fuel burning mix, the daily mean PM_{10} objective is not predicted to be exceeded in 2004. This is primarily due to the Castlederg area having a low number of residential houses. However the predicted concentrations are only marginally below the objective with a 90.41 percentile daily concentration of 49 $\mu g/m^3$. The magnitude and geographical extent of the 90.41 percentile of PM_{10} concentrations are depicted as a series of contours overlaid onto the map of the area in question.

5.9.3.4 Sion Mills

Figure 5 shows modelled SO_2 concentrations in Sion Mills in 1999. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentrations will not be exceeded.

Figure 11 shows modelled PM_{10} concentrations in the Sion Mills area in 2004. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will not be exceeded in the main residential areas although the objective concentration will be approached (46 $\mu g/m^3$). The magnitude and geographical extent of the 90.41 percentile of PM_{10} concentrations are depicted as a series of contours overlaid onto the map of the area in question.

Figure 2: Predicted 99.9 percentile 15 minute mean SO_2 concentrations in µg/m3 in the Head of the town, Ballycolman and Melmount in 1999

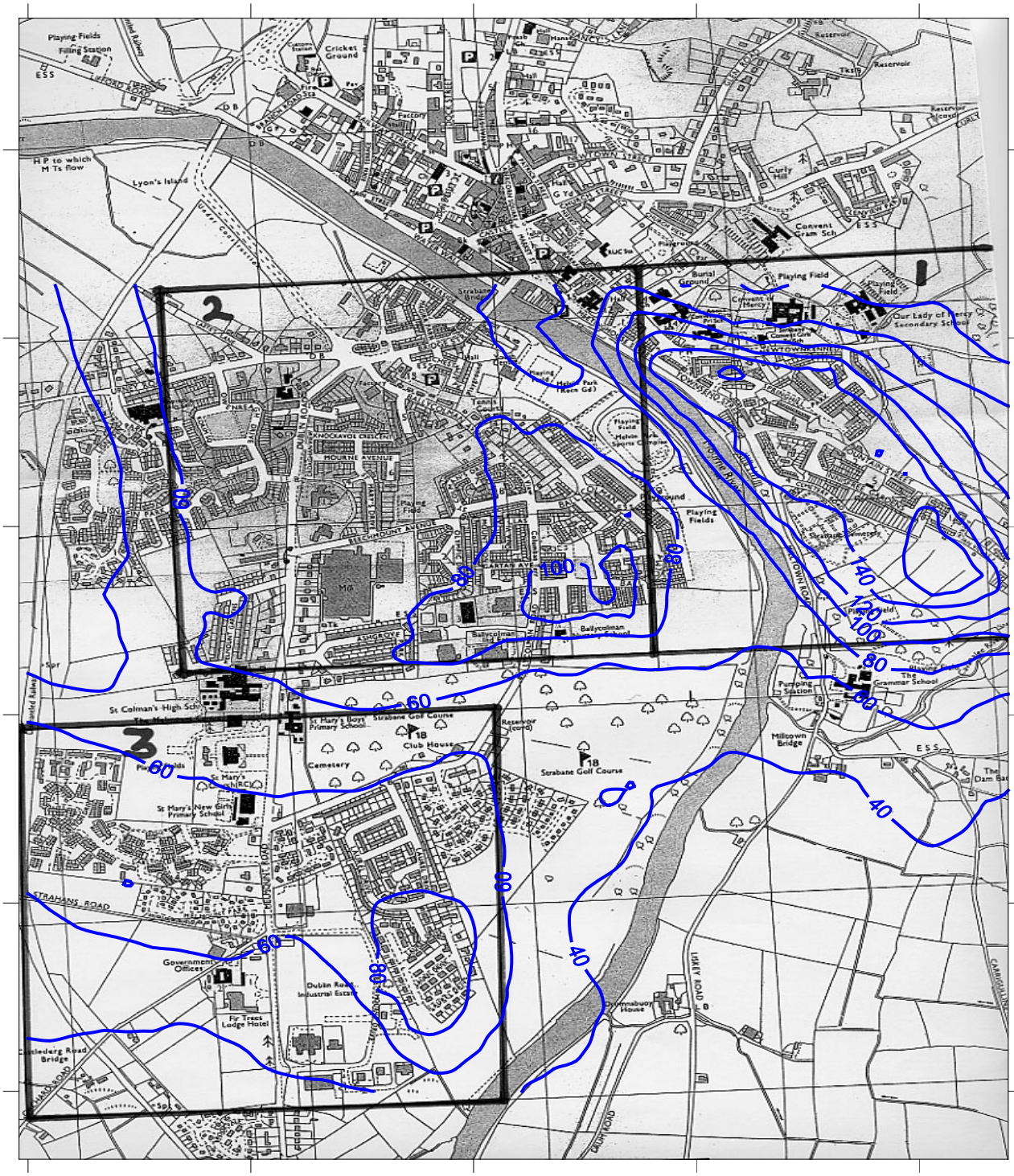


Figure 3: Predicted 99.9 percentile 15 minute mean SO_2 concentrations in µg/m3 in Newtownstewart in 1999

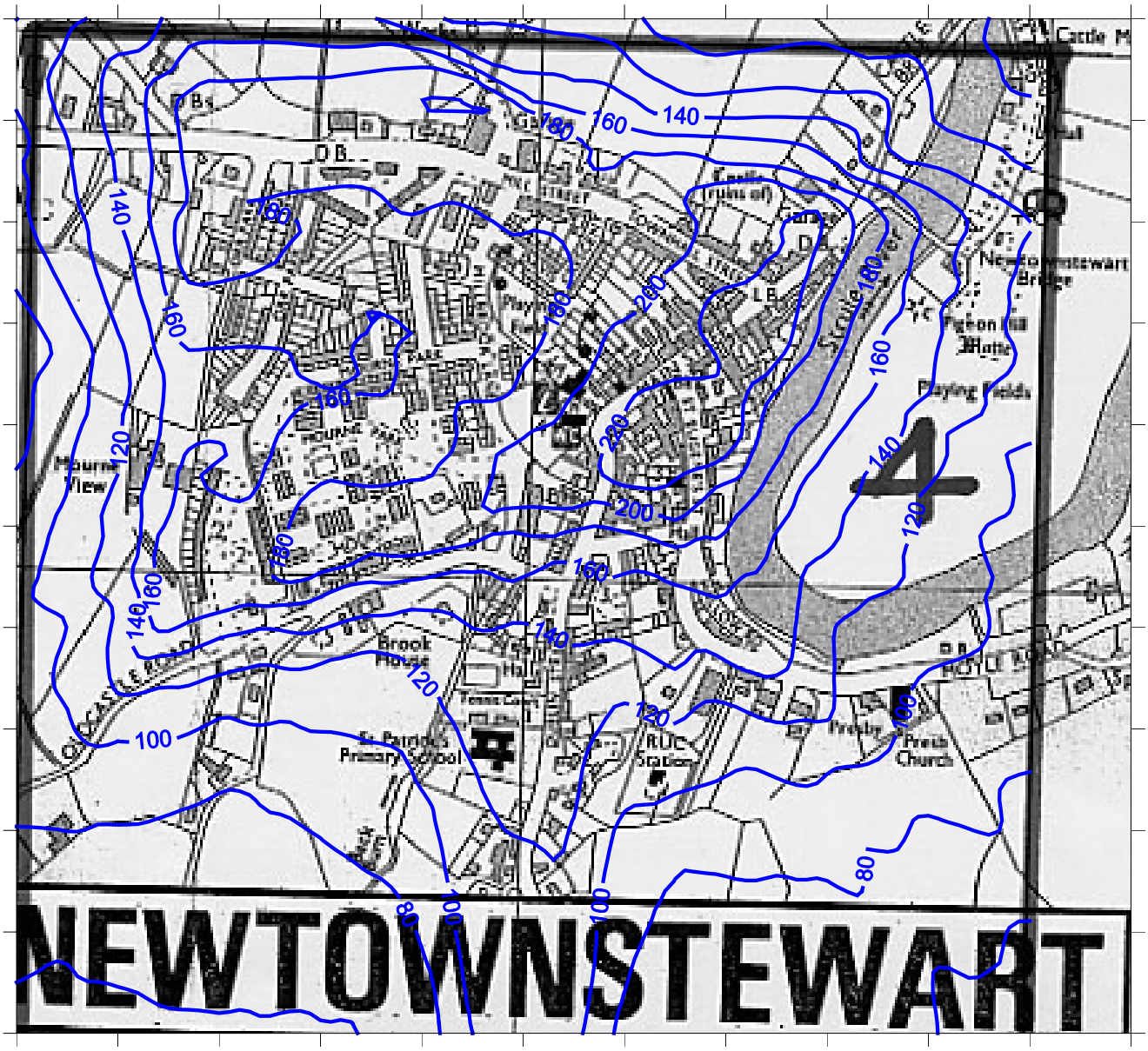


Figure 4: Predicted 99.9 percentile 15 minute mean SO_2 concentrations in µg/m3 in Castlederg in 1999

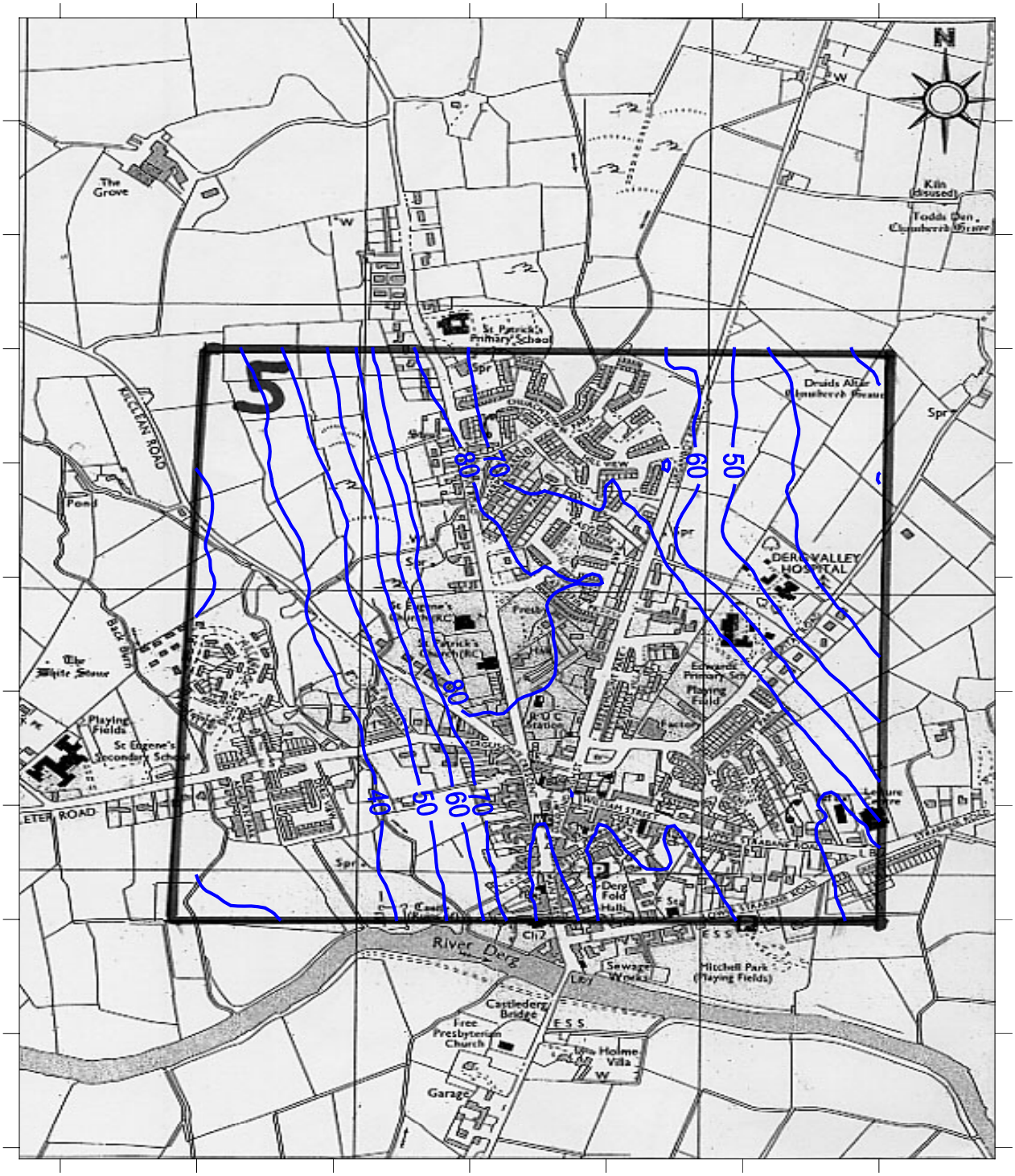
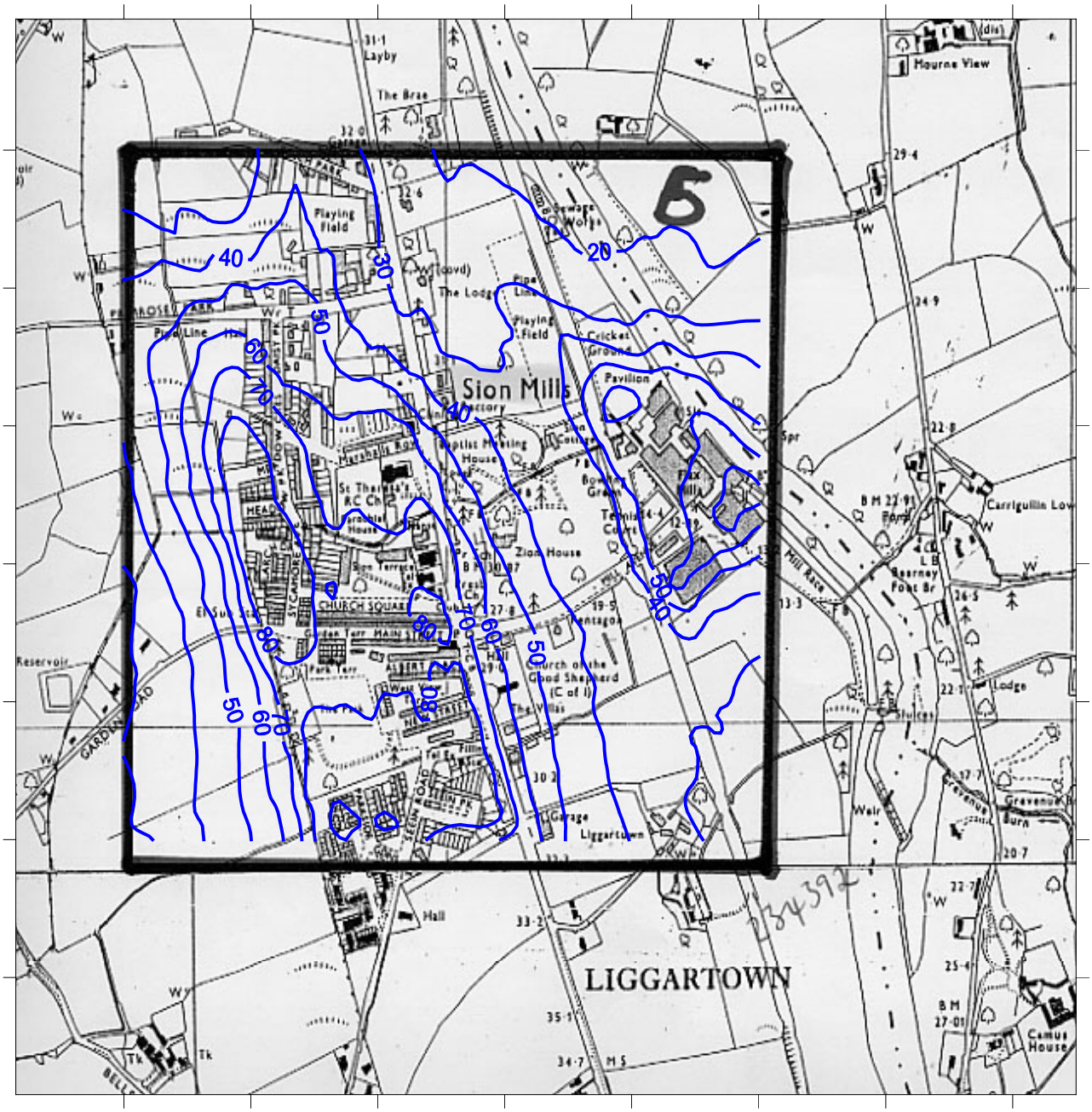


Figure 5: Predicted 99.9 percentile 15 minute mean SO_2 concentrations in µg/m^3 in Sion Mills in 1999



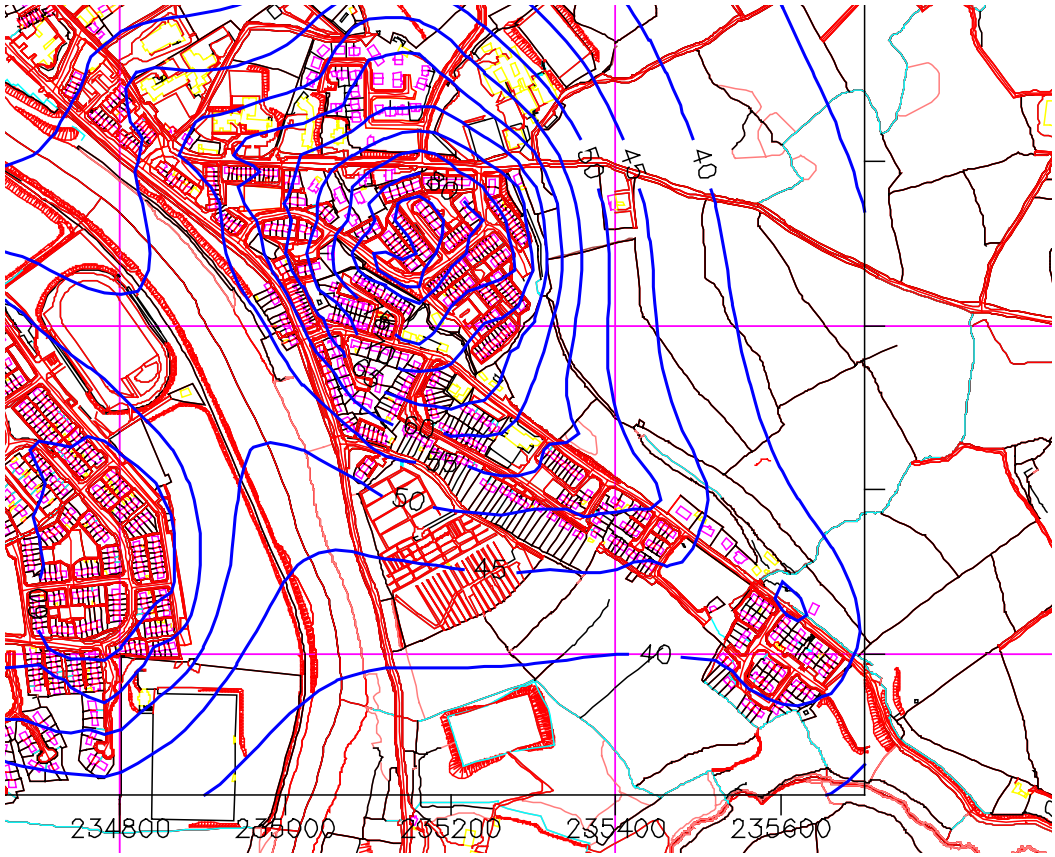


Figure 6: Predicted 90.4 percentile daily mean PM_{10} concentrations in $\mu g/m^3$ in the Head of the town

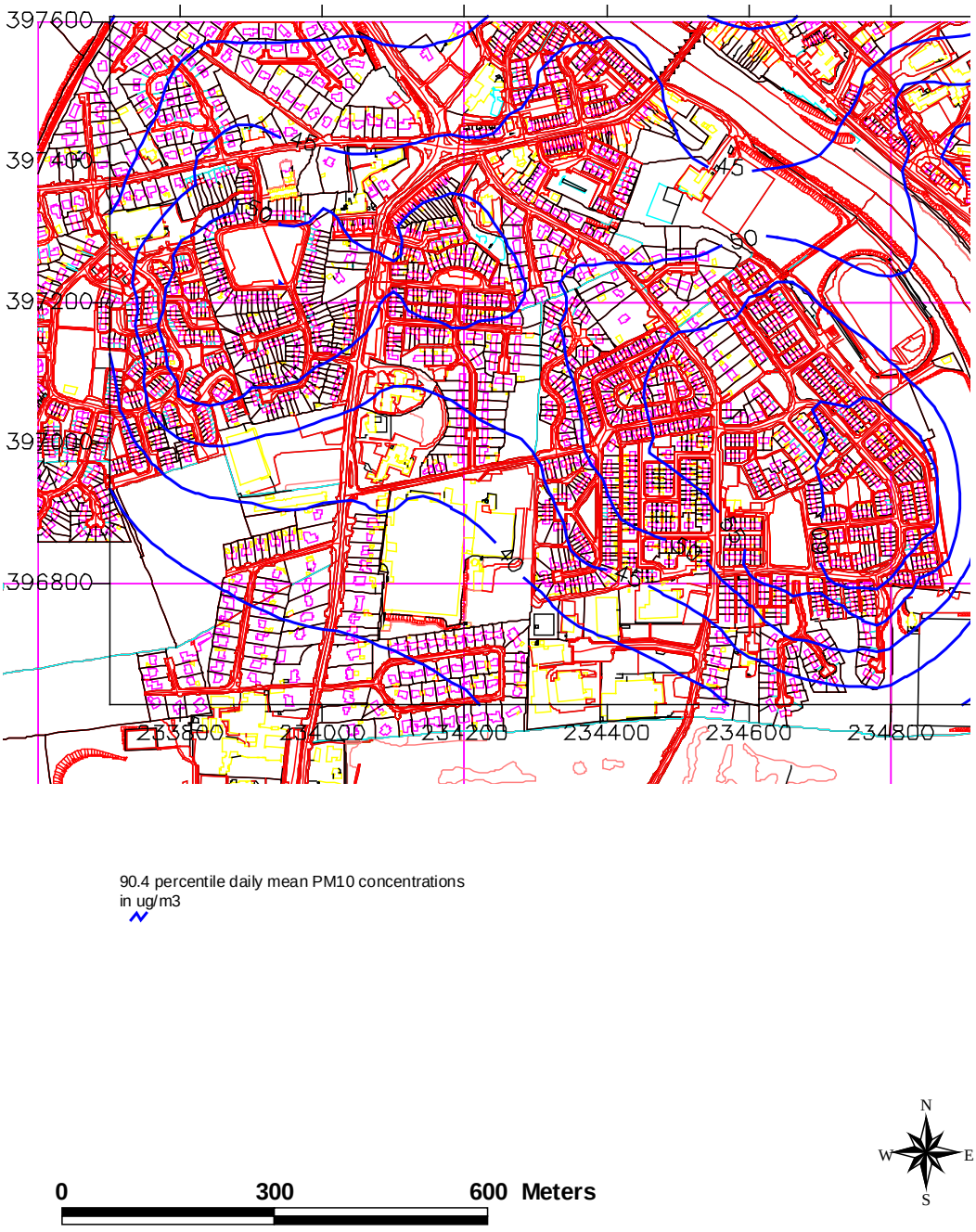


Figure 7: Predicted 90.4 percentile daily mean PM_{10} concentrations in $\mu g/m^3$ in Ballycolman

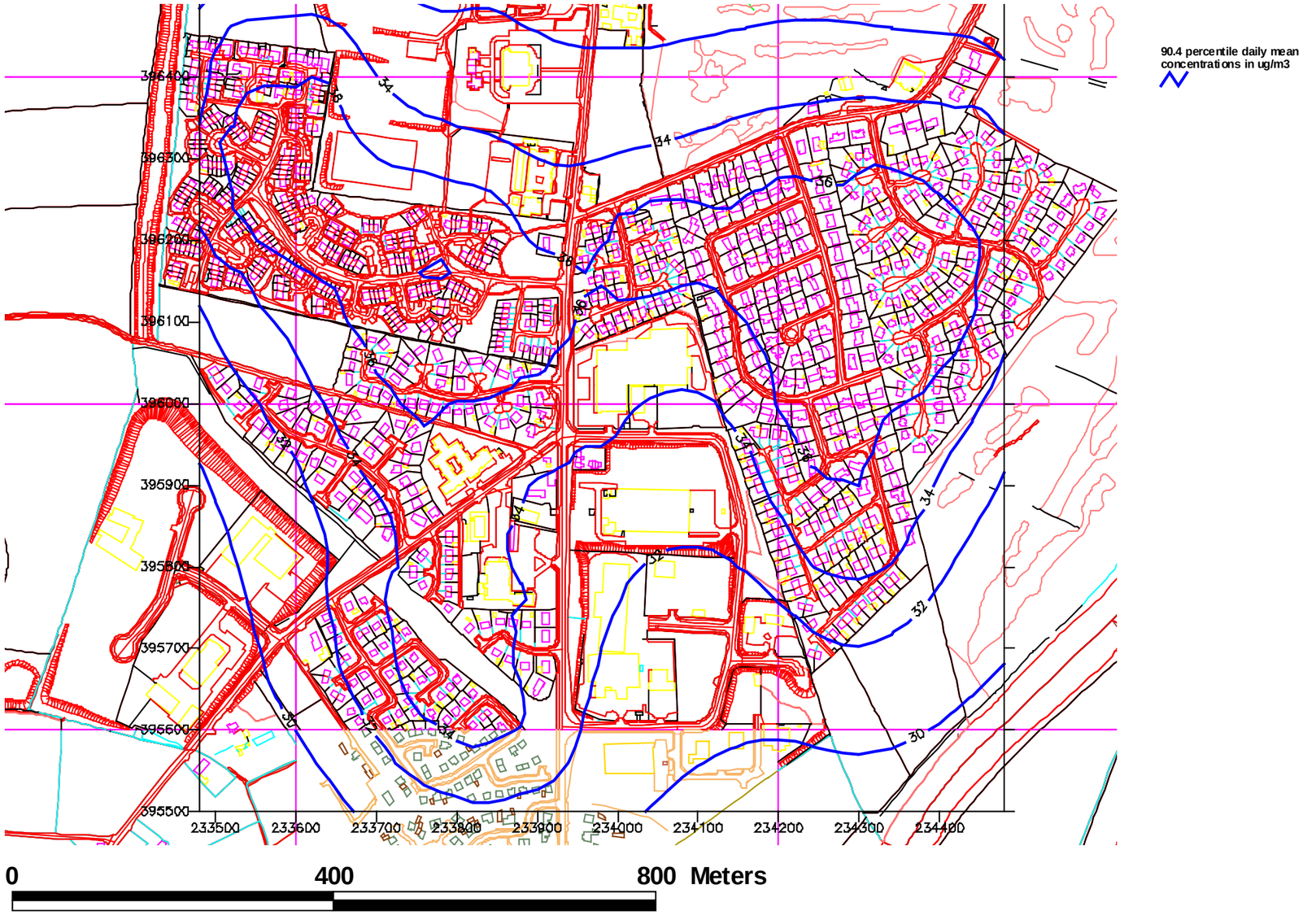


Figure 8: Predicted 90.4 percentile daily mean PM_{10} concentrations in $\mu g/m^3$ in Melmount

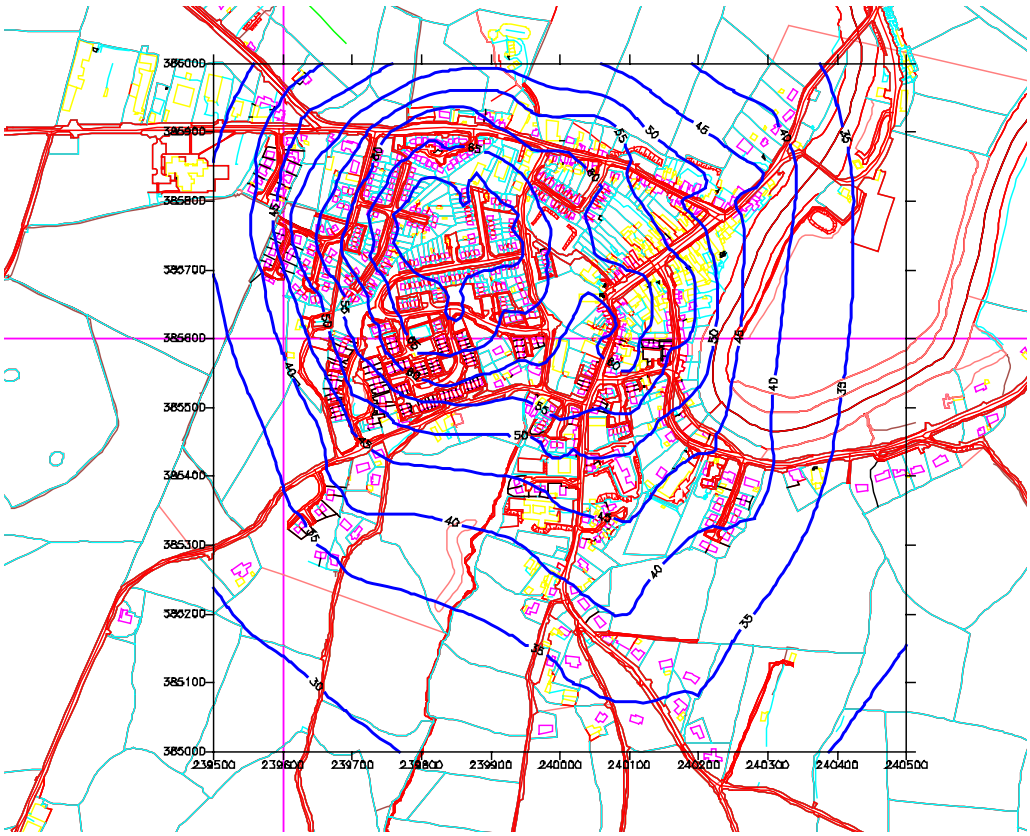


Figure 9: Predicted 90.4 percentile daily mean PM_{10} concentrations $\mu g/m^3$ in Newtownstewart

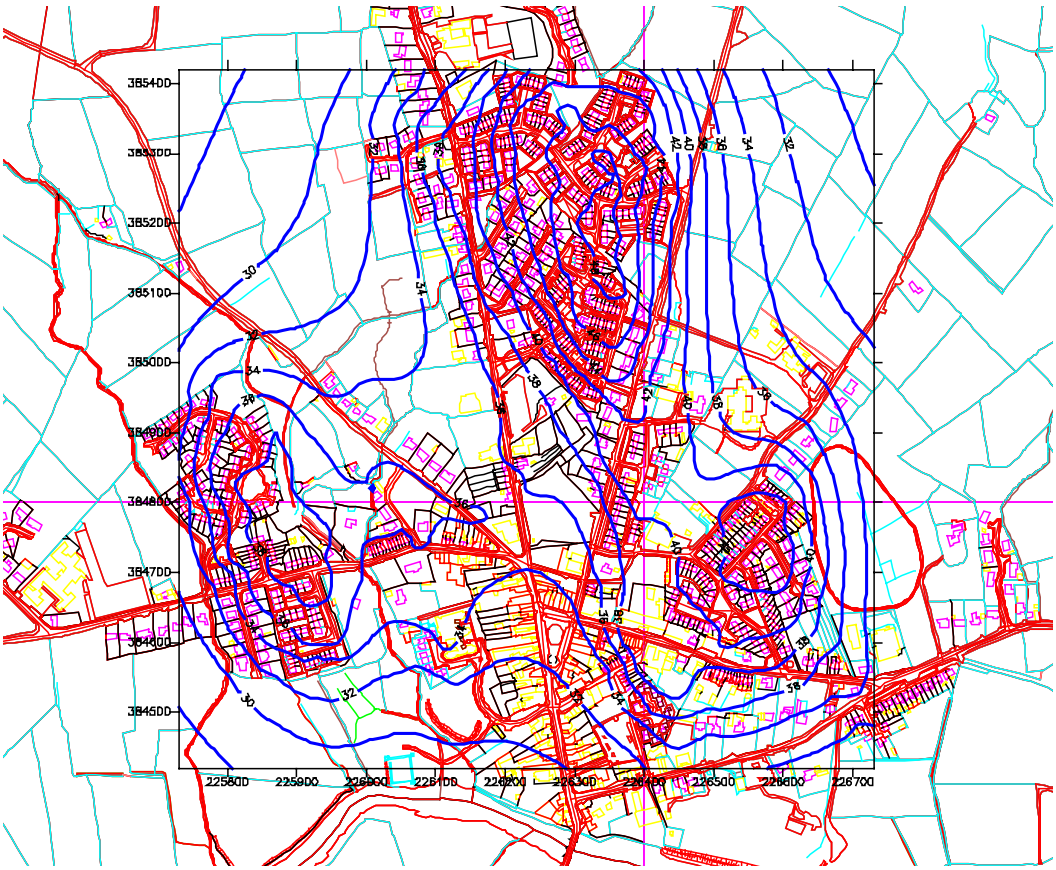


Figure 10: Predicted 90.4 percentile daily mean PM_{10} concentrations µg/m^3 in Castlederg

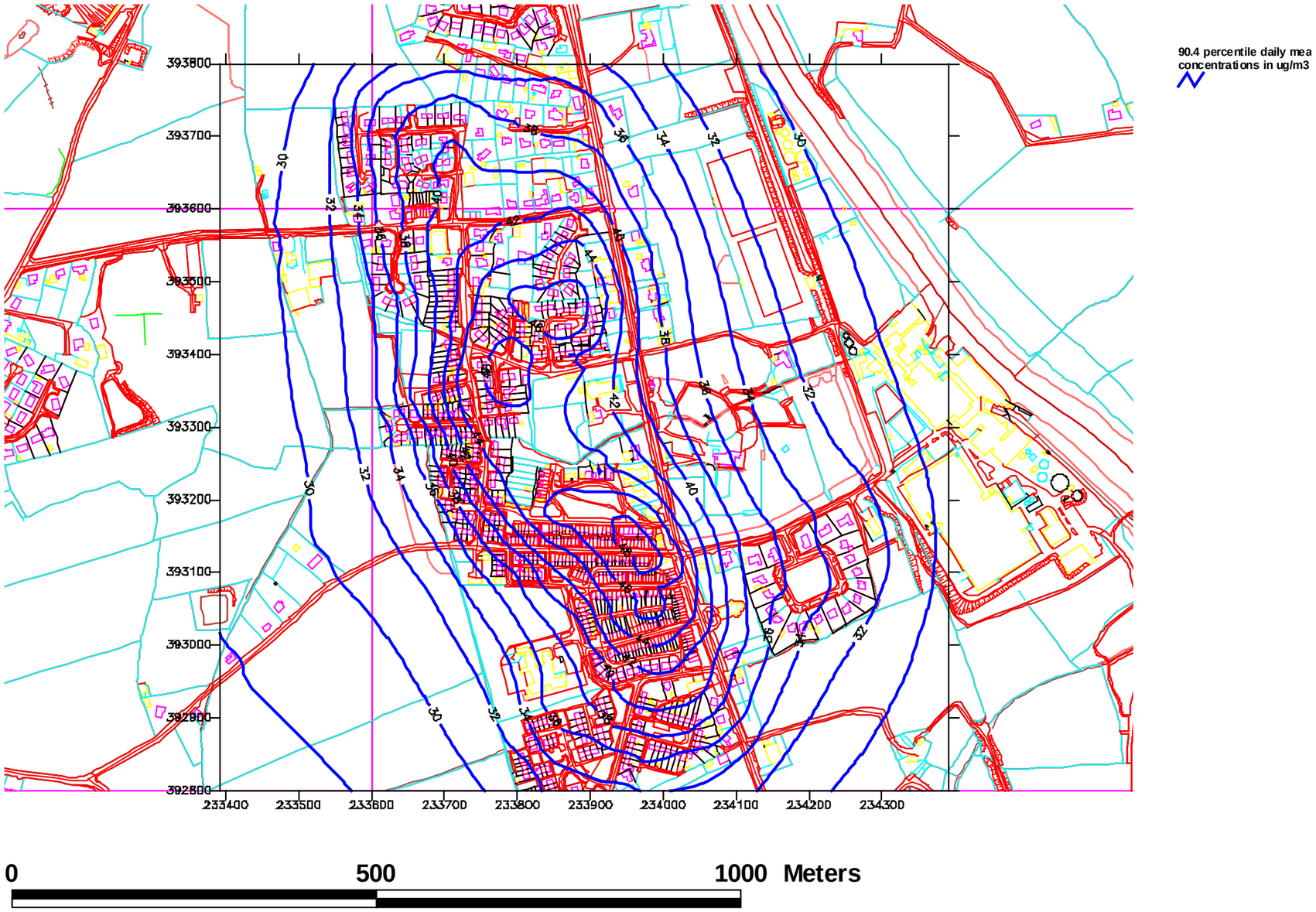


Figure 11: Predicted 90.4 percentile daily mean PM_{10} concentrations $\mu g/m^3$ in Sion Mills

5.10 Summary Of The Likelihood Of Exceeding The Air Quality Objectives

5.10.1 Sulphur Dioxide (SO_2)

Detailed modelling using ADMS version 3.1 has been undertaken at six locations where large amounts of domestic fuel burning is common. The modelling (corrected for bias) predicts that at all locations modelled exceedences of the SO_2 objectives are unlikely to be exceeded in 2004/5 when the objectives are to be met.

A comparison of the monitoring data recorded at Belfast East during April 2002 to January 2003 (when the continuous monitor at Springhill Park was in operation) with data recorded during 1999, 2000 and 2001 showed that during the time that the Strabane site has been in operation, far lower values have been recorded than in previous years. Therefore the data recorded so far at Springhill Park may not be representative of future concentrations.

5.10.2 Particulate Matter (PM_{10})

Detailed modelling using the proprietary LADSUrban model (incorporating ADMS version 3.1) has been undertaken at six locations where large amounts of domestic fuel combustion is common. The modelling (corrected for bias) predicted that at 3 of the 6 areas modelled an exceedence of the PM_{10} objectives was likely. A fourth area (Castlederg) is predicted to have concentrations marginally below the objective with a 90.41 percentile daily concentration of 49 $\mu g/m^3$.

5.11 Improvements Required In Air Quality

5.11.1 The Improvement That Is Required – General Points

A key step in the Review and Assessment process is to identify the improvements needed in air quality, when there are exceedences of the UK air quality objectives.

An important point to note is that the Local Authority does not need to attempt to improve air quality beyond the air quality objective that is being exceeded. For example, an AQMA may have been declared for PM_{10}, and for administrative reasons, the boundary of the AQMA may include houses where the concentrations of PM_{10} are not predicted to exceed the daily mean objective of 50 $\mu g/m^3$ (with 35 exceedences). In reality this could mean that some houses in

the AQMA will experience concentrations of PM_{10} possibly much lower than the daily mean PM_{10} objective.

5.11.2 Magnitude Of Exceedence Of The Air Quality Objectives – The Improvements Required

The maximum exceedence of the 90th percentile 24 hour mean PM_{10} air quality objective in each of the six areas are shown in the table below.

Table 34 - The Improvement In 90.4 Percentile Daily Mean PM_{10} Concentrations Required At Receptors Exposed To The Highest Predicted Concentrations (In 2004)

Name Of Area Modelled	Specific Receptors Identified	Max 90.4 Percentile Daily Conc. Of PM_{10} Predicted For 2004 ($\mu g/m^3$)	Improvement Required To Achieve 90.4 Percentile Daily Mean Of 50 $\mu g/m^3$ ($\mu g/m^3$)
Head of the Town	Springhill Park	85	35
Ballycolman	Ballycolman	62	12
Melmount	Carlton Drive	37	None required
Newtownstewart	Mourne Park	72	22
Castlederg	Hill View	49	None required
Sion Mills	Main Street	46	None required

Note: Figures have been rounded up to whole integers.

5.12 Source Apportionment Assessment

5.12.1 What Is Source Apportionment?

Source apportionment is the process whereby the contributions from the sources of a pollutant are determined. In this study, the relevant sources could include emissions from traffic, domestic fuel combustion, local background and industrial emissions. This process enables the most important source or sources to be identified. Once identified options to reduce ambient concentrations of pollutants can then be considered and assessed.

In the Stage 3 assessment source apportionment should achieve the following:-

- Confirm that exceedences of PM_{10} are due to domestic fuel combustion (for Strabane).
- Quantify what proportion of the exceedences of PM_{10} is due to background emissions, or, local emissions from domestic combustion in the local area. This will help determine whether local management measures could have a significant impact on reducing emissions in the area of exceedence, or, whether national measures would be a suitable approach to achieving the air quality objectives.

The source apportionment carried out in this report is in relation to the existing conditions prevailing within the Strabane District Council area at present. It therefore relates to the PM_{10} concentrations that are predicted in the absence of any measures to improve air quality in any of the six, 1 kilometre square grids identified in the Strabane District Council area deemed to be requiring assessment at this time.

5.12.2 Sources Of Pollution Considered

The effect of the following sources in this Stage 3 assessment at each of the receptors has been considered:-

- Background concentrations - general local from the National Atmospheric Emission Inventory.
- Domestic fuel combustion.

Within each of the six, one kilometre grids there are no major roads that will contribute significantly to the local annual mean and 90.4 percentile daily mean PM_{10} concentrations. The effect of any minor roads such as these will be included in the local PM_{10} background concentrations.

Table 35 - Source Apportionment Of PM_{10} ($\mu g/m^3$) Within Strabane With The Greatest Predicted Exceedences Of The Daily Mean Objective In 2004 (Results Are Shown In Terms Of Annual Mean PM_{10} Concentrations)

Name Of Area Modelled	Specific Receptors Considered	Background	Domestic Fuel Combustion	Total
Head of the Town	Houses on Springhill Park	14 (32%)	31 (68%)	45 (100%)
Ballycolman	Ballycolman	14 (43%)	19 (57%)	33 (100%)
Melmount	Carlton Drive	14 (70%)	6 (30%)	20 (100%)
Castlederg	Hillview Park	13 (34%)	25 (66%)	38 (100%)
Newtownstewart	Mourne Park	13 (50%)	13 (50%)	26 (100%)
Sion Mills	Main Street	14 (58%)	10 (42%)	24 (100%)

Note : Totals may not necessarily agree with the sum of their components due to rounding.

5.12.3 Key Findings Of The Source Apportionment

The only exceedences predicted in the Stage 3 review and assessment are for PM_{10} in residential areas within the Strabane District Council area. For PM_{10} concentrations in areas where exceedences are predicted with business as usual in 2004 (Head of the Town, Ballycolman and Newtownstewart, plus Castlederg), it is considered that the majority comes from domestic fuel combustion. Background concentrations in these areas contribute 32% to 50%. Therefore in these three areas the exceedences of the PM_{10} objectives are a problem that can be controlled locally.

As the review and assessment dealt with residential areas it is considered that only domestic emissions are responsible for the exceedence. Contributions from industrial and vehicular emissions of PM_{10} were considered in Stage 1 and were deemed to be so insignificant as to not be of concern.

5.13 Future Developments

There are no known future developments likely to affect the predictions of pollutant concentrations contained in this report. Therefore it is likely that the air quality objectives for PM_{10} are not going to be achieved by 31 December 2004 in some of the residential areas of the

Strabane District Council area, contrary to the Air Quality Strategy for England, Scotland, Wales & Northern Ireland and the Air Quality Regulations (NI) 2003.

5.14 Conclusions

- It is considered necessary to declare air quality management areas (AQMA's) in the following four areas of the Strabane District Council area modelled for PM_{10}:-

    1. Head of the Town, Strabane;
    2. Ballycolman area, Strabane;
    3. Newtownstewart;
    4. Castlederg.

- It is not considered necessary to declare air quality management areas for sulphur dioxide in any of the six areas of the Strabane District Council area modelled.

- It is considered necessary to continue the monitoring of PM_{10} and SO_2 at Springhill Park, Strabane in order that pollutant concentrations can be closely observed.

5.15 Consultation

The Stage 2 and Stage 3 Review and Assessments will now be subject to consultation involving Strabane District Council, neighbouring councils, local residents and other interested parties. Any responses received will be given due consideration and if necessary the report will be amended to reflect any relevant matters.

6.0 REFERENCES

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Appendix 1

Fuel Use Data

Appendix 2

Nitrogen Dioxide Diffusion Tube Results & Related Documents

QA/QC Of The Nitrogen Dioxide Diffusion Tube Monitoring

Diffusion tubes were used as a screening tool to confirm that the air quality objectives for nitrogen dioxide were not at risk of being exceeded at the areas where the highest traffic volumes are experienced in the Strabane District Council area. The monitoring procedures given in the UK Nitrogen Dioxide Diffusion Tube Network Instruction Manual were followed in the course the monitoring campaign.

Strabane District Council employed Ruddock & Sherratt (Public Analysts), Belfast to carry out the analysis of the diffusion tubes. The laboratory participates in the NETCEN intercomparison scheme and was awarded a QA/QC average bias of –13% in 2000. All diffusion tubes were located at roadside locations. The exposure times for each tube was documented as illustrated below prior to the sample being forwarded to the laboratory to enable the accuracy of the results to be increased.

Appendix 3

QA/QC Documentation For Continuous Monitoring Equipment