Second/Third Stage Review and Assessment of Local Air Quality

December 2004

EXECUTIVE SUMMARY

This report encompasses the Second and Third Stages of Review and Assessment of local air quality within the Omagh District Council area.

The First Stage Report was completed in September 2001 and concluded that a Second/Third Stage Review and Assessment was required for the following three pollutants:- Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2) and Particulate Matter (PM_{10}).

The Second Stage Assessment for NO_2 focused upon relevant locations affected by road traffic at a number of road sections/junctions. The assessment relied upon the application of the Design Manual for Roads and Bridges (DMRB) model and local diffusion tube monitoring data. The results show that it is unlikely that either the annual mean or hourly NO_2 objective will be exceeded at relevant reception locations.

A Second Stage Assessment was also carried out for PM_{10} arising from traffic sources at the respective road sections/junctions using the DMRB model. The modelling predicted no exceedences of the PM_{10} objective from traffic sources.

A number of fugitive emissions from industrial sources of PM_{10} were examined as part of the Second Stage Assessment. Based on recent findings in GB and the results of local monitoring at a hard rock quarry it was considered that it was not necessary to proceed to a Third Stage Assessment in respect of these sources.

The absence of reliable locally monitored data necessitated Omagh District Council to proceed directly to a Third Stage Assessment for SO_2 and PM_{10} in five 1km x 1km grid squares as identified from the Stage One Report. A Fuel Use Survey was commissioned to obtain estimates of PM_{10} and SO_2 emissions which were used in the modelling programme (ADMS model version 3.1). The modelling exercise suggests that it is unlikely that there will be an exceedance of the SO_2 or PM_{10} objectives in the modelled areas.

In conclusion the first round of Review and assessment procedures indicated that there is no requirement to declare an Air Quality Management Area within the Omagh District Council Area.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION TO THE AIR QUALITY REVIEW

1.1 The National Air Quality Strategy

In 1997 the UK Government, fulfilling the requirements of the Environment Act 1995, published its National Air Quality Strategy. This described its plans to improve and protect ambient air quality in the UK in the medium term and identified the roles of those who have a part to play in achieving them. It proposed new air quality standards for:

- Benzene
- 1,3-Butadiene
- Carbon Monoxide
- Lead
- Nitrogen Dioxide
- Ozone
- Particles (PM_{10})
- Sulphur Dioxide

following recommendations from the Expert Panel on Air Quality Standards (EPAQS) and objectives for each of these 8 pollutants.

Following a review of the National Strategy the Air Quality Strategy for England, Wales, Scotland and Northern Ireland (NI) was published in January 2000. In February 2003 an Addendum to the Strategy brought the objectives for carbon monoxide and benzene into line with the limits set by the second Daughter Directive (2000/69/EC) as well as setting further PM_{10} objectives for 2010. The Air Quality Regulations (NI) 2003 prescribe the air quality objectives for NI as set out in the above documents (see Appendix 1*)*. Ozone was not covered in these Regulations because, due to the nature of ozone pollution, action at local level would not be effective in tackling high concentrations.

1.2 Local Air Quality Management

The Environment (NI) Order 2002 (Part III) together with the Air Quality Regulations (NI) 2003 provides the statutory basis for district councils to undertake local air quality management (LAQM) duties in NI. One of the first steps in the LAQM process is for all District Councils to carry out a review and assessment of their local air quality. Despite the fact that these duties only became a legal requirement during 2003, this council along with the majority of district councils in NI commenced the process of assessing local air quality on a voluntary basis during 2000, following commitments given to the Environment & Heritage Service of DoE.

In line with guidance issued by the DETR, that reviews and assessments followed a three stage phased approach, all district councils were required to undertake the first stage and to proceed to subsequent stages if necessary.

Stage One

An initial screening of industrial, transport and any other sources of pollution that could have a significant impact within the council area, resulting in the likelihood of exceedances of the air quality objectives and the potential for human exposure over the specified averaging period for the pollutant.

Stage Two

A more detailed assessment of all the pollutants identified as significant locally in the first stage.

Stage Three

An accurate detailed review of pollutants using computer-modelling and monitoring techniques to predict the likelihood of exceeding the objectives and determine the nature and size of any areas involved where second stage assessment has indicated that air quality objectives will not be achieved by the relevant target dates.

1.3 Position at Completion of Stage One Review & Assessment

The Stage One report for Omagh District Council was completed in September 2001 and concluded that:

(i) No further investigation or action was required to be undertaken for the following pollutants:

- Benzene
- 1,3-Butadiene
- Lead
- Carbon Monoxide

(ii) A stage 2/3 Review and Assessment was required for the following pollutants:

- Nitrogen Dioxide
- Sulphur Dioxide
- Particulate Matter (PM_{10})

This report contains Omagh District Council's Second and Third Stage Review and Assessment of local air quality and investigates both current and potential future air quality by way of

- examination of the size and location of principal emission sources
- emissions modelling exercises
- reference to locally monitored air quality data.

2.0 SECOND STAGE REVIEW & ASSESSMENT NITROGEN DIOXIDE (NO_2)

2.1 The Second Stage Review & Assessment Process

The Second Stage Review and Assessment has been carried out using the guidance LAQM. TG4(00) issued by the DETR. Whenever possible reference was also made to the revised technical guidance issued in 2003 (LAQM. TG (03)).

It should be noted that the aim of the Second Stage Review and Assessment is to provide additional screening of pollutant concentrations in the area using simple screening and monitoring techniques. It is not intended to provide an accurate prediction of current and future air quality across the whole of Omagh District Council area. The Second Stage will focus upon those locations where the maximum impact is expected to occur, bearing in mind the potential for public exposure. If the Second Stage indicates that there is a risk that the air quality objective may not be met by the relevant future year then a more detailed and accurate Third Stage Review and Assessment will be undertaken.

Nitrogen oxides are formed during high temperature combustion processes from the oxidation of nitrogen in the air or fuel. The principal source of nitrogen oxides, nitric oxide (NO) and nitrogen dioxide (NO_2), collectively known as NO_x , is road traffic, which is responsible for approximately half the emissions in Europe. NO and NO_2 concentrations are therefore greatest in urban areas where traffic is heaviest. Other important sources are power stations, heating plant and industrial processes.

Nitrogen oxides are released into the atmosphere mainly in the form of NO, which is then readily oxidised to NO_2 by reaction with ozone. Elevated levels of NO_x occur in urban environments under stable meteorological conditions, when the air mass is unable to disperse.

Nitrogen dioxide has a variety of environmental and health impacts. It is a respiratory irritant, may exacerbate asthma and possibly increase susceptibility to infections. In the presence of sunlight, it reacts with hydrocarbons to produce photochemical pollutants such as ozone. In addition, nitrogen oxides have a lifetime of approximately 1 day with respect to conversion to nitric acid. This nitric acid is in turn removed from the atmosphere by direct deposition to the ground, or transfer to aqueous droplets (e.g. cloud or rainwater), thereby contributing to acid deposition.

2.2 Standards and objectives for nitrogen dioxide

The national air quality objectives for NO_2 are:

- An annual average concentration of 40 μg m^{-3} (21 ppb); to be achieved 31st December 2005
- 200 μg m^{-3} (105 ppb) as an hourly average with a maximum of 18 exceedences in a year to be achieved 31st December 2005

Modelling studies suggest that in general achieving the annual mean of 40 μg m^{-3} is more demanding than achieving the hourly objective. If the annual mean is achieved, the modelling suggests the hourly objectives will also be achieved.

2.3 The National Perspective

All combustion processes produce some NO_x, but only NO_2 is associated with adverse effects on human health. The main sources of NO_x in the United Kingdom are road transport, which, in 1997 accounted for about half of the emissions, power generation (20%), and domestic sources (4%). In urban areas, the proportion of local emissions due to road transport sources is larger.

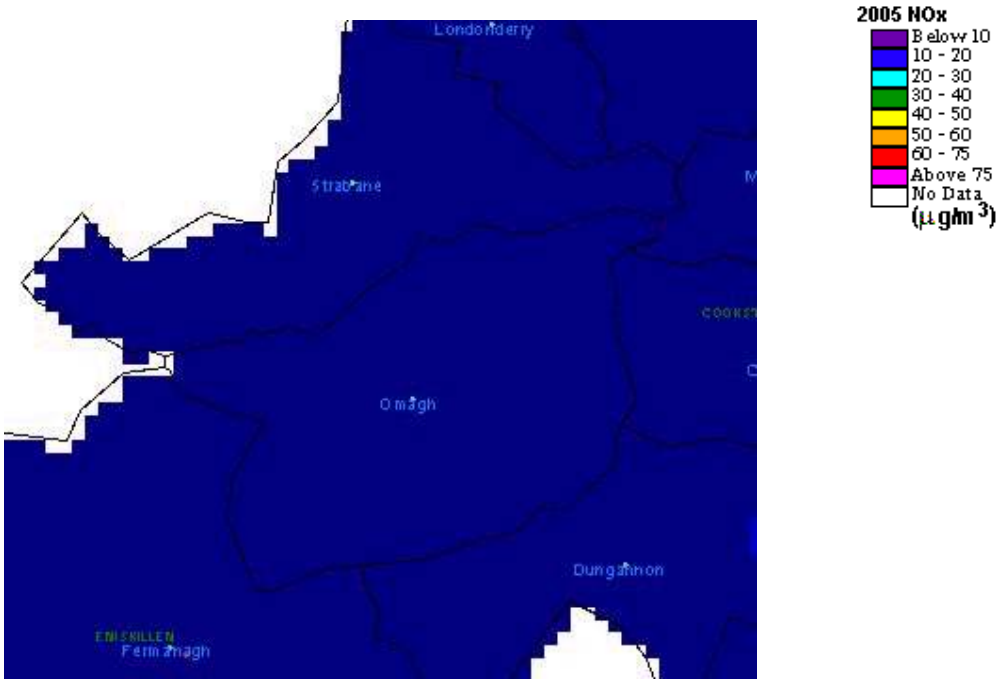
The results of the analysis set out in the National Air Quality Strategy suggest that for NO_2 a reduction in NO_x emissions over and above that achievable by national measures will be required to ensure that air quality objectives are achieved everywhere by the end of 2005. Local authorities with major roads, or highly

congested roads, which have the potential to result in elevated levels of NO_2 in relevant locations, are expected to identify a need to progress to the second or third stage review and assessment for this pollutant.

2.4 Background Concentrations of Nitrogen Dioxide

Background concentrations were obtained for the Omagh area using the maps on the UK National Air Quality Information Archive web site http://www.aeat.co.uk/netcen/airqual/home.html (Figure 1).

Figure 1. Background NO_x concentrations 2005



A maximum background NO_x estimate of 10.1 $\mu g/m^3$ has been estimated for 2005 in the Omagh District Council region.

2.5 Sources identified from First Stage Review and Assessment

Consideration was given at Stage I to existing and proposed emission sources which have the potential, singly or together, to emit significant quantities of NO_2, which are expected to be in operation by 2005 and for which there is the potential for exposure of individuals in relevant locations.

The Second Stage Review and Assessment is largely based upon the application of the Design Manual for Roads and Bridges (DMRB) and some diffusion tube monitoring data that was available.

The Stage One Review and Assessment for Omagh District Council identified a number of roads as needing further study in a Stage Two assessment. The concentrations at these roadside locations have been estimated using the Design Manual for Roads and Bridges (DMRB) using the traffic flow data provided by DOE Roads Service. The effect of junctions has been taken into account in DMRB where traffic data have been provided. The model has been used to predict nitrogen dioxide concentrations for 2005. A background NOx concentration of 10.1 $\mu g\ m^{-3}$ has been used which is a conservative estimate.

Concentrations have been assessed at traffic speeds (20 kph at road junctions in the urban areas and 32 kph on free flowing roads in urban areas) which may be lower than those considered representative. The speed of 20 kph is representative of traffic congestion in the city centre. Therefore this will give a conservative estimate. The distance from the receptor to the centre of the road and from the receptor to the kerb of the road are required by DMRB which were estimated from maps. A figure of 11% was provided by DoE Roads Service for the % of HGV on all of the roads.

Table 1 lists the annual average and 99.8th percentile of maximum hourly average kerbside concentrations (equivalent to 18 exceedences per year) of nitrogen dioxide predicted for 2005 in the Omagh District Council area. Following advice given in LAQM TG4(00), the 99.8th percentile of hourly averages has been estimated as 3.5 times the annual mean for roadside locations.

Table 1 Nitrogen dioxide concentrations at roadside locations in Omagh District Council without the by-pass.

Description of Link	Distance to nearest receptor from kerbside (m)	NO_2 Annual mean ($\mu g\ m^{-3}$) 2005	NO_2 99.8th percentile of hourly averages ($\mu g\ m^{-3}$) 2005
Dublin Rd, Omagh	7.5	39.3	137.4
Great Northern Junc. Omagh	5	**58.5**	**204.6**
Campsie Rd, Omagh	2.5	31.7	110.9
Hoggs Head Junc. Omagh	2.5	31.0	108.5
County Hall Junc. Omagh	12.5	**43.1**	150.7
Omagh District Council offices Junc.	2.5	**41.7**	145.8
Swinging Bars Rdbt, Omagh	12.5	**45.8**	160.4
Hospital Rd, Omagh	10	35.7	124.8
Tamlaght Rdbt, Omagh	21.25	35.2	123.3

At road junctions, the distance from the kerb to the nearest receptor has been given as the closest receptor to any of the road links.

For 2005, annual average concentrations of nitrogen dioxide are predicted to be over 40 $\mu g\ m^{-3}$ at four road junctions. The hourly objective was exceeded at the Great Northern Junction. At all other locations the hourly objective was predicted to be met.

2.6 Assessment of NO_2

Local information of monthly average concentrations of NO_2 have been measured with diffusion tubes at four sites in Omagh District Council since 1993. The data for 1999 (the latest available at the time of preparation of the interim NETCEN report) is summarised in Table 2 below. The monitoring period is representative of a full year and therefore the period average concentrations can be compared with the annual mean objective. Analysis of the tubes was carried out by Harwell Scientifics which was found to have a positive bias of 4.2% in 1999 relative to an automatic analyser (Bush 2000).

Table 2 Annual average concentrations measured at four locations in the Omagh area in 1999.

Site Name	Site Type	Average NO_2 μgm^{-3} uncorrected for bias	Average NO_2 μgm^{-3} corrected for bias	Prediction in 2005 μgm^{-3}
Dublin Rd	K	51.6	49.4	42
Dergmoney Place	I	17.2	16.5	14
Ardmore Dr, Tamlaght Rd	B	11.5	11	9
Gortmore Gdns, Derry Rd	B	21.0	20.1	17

K=kerbside 1-5m from a busy road
I = Between 20 - 30m from a busy road
B = background in a residential area more than 50 metres from a busy road.

In 2005, it is predicted that the diffusion tubes exposed on Dublin Road will exceed the annual mean objective for nitrogen dioxide of 40 $\mu g/m^3$. However, this site is at the kerbside rather than at the closest receptor site.

In accordance with the above results, the diffusion tubes exposed at the Great Northern Junction (shown as Dublin Road in Table 2 above) have consistently exceeded the annual mean objective since monitoring began in 1993 (see Table 2). However, using the factors in the PSG to predict diffusion tube concentrations in 2005, a figure of 42 $\mu g/m^3$ is obtained, compared to DMRB predicting 58.5 $\mu g/m^3$.

By 2005, the Omagh by-pass should have been completed. This will affect the traffic flows on roads in Omagh town. In particular traffic will be much reduced on Dublin Road. Predicted traffic flows after the by-pass has been built were available for some of the road links. Table 3 shows the estimated concentrations predicted by DMRB after the by-pass is built.

Table 3 Nitrogen dioxide concentrations at roadside locations in Omagh District Council with the by-pass

Description of Link	Distance to nearest receptor from kerbside (m)	NO_2 Annual mean ($\mu g\ m^{-3}$) 2005	NO_2 99.8th percentile of hourly averages ($\mu g\ m^{-3}$) 2005
Dublin Rd, Omagh	7.5	19.1	66.9
Great Northern Junc. Omagh	5	**49.8**	174.4
Campsie Rd, Omagh	2.5	26.2	91.7
Swinging Bars Rdbt, Omagh	12.5	**54.5**	190.8
Hospital Rd, Omagh	10	35.7	125

The above results show a predicted decrease of nitrogen dioxide concentrations along Dublin Road and Campsie Road when the by-pass is built. Traffic flows along Hospital Road are predicted to stay the same hence the same nitrogen dioxide concentrations are predicted on this road prior to and after the by-pass being built. At the two road junctions (Great Northern Junction & Swinging Bars roundabout) an exceedence is still predicted after the by-pass it built.

2.7 Conclusions for Second Stage Review and Assessment of Nitrogen Dioxide in the Omagh Council Area

With and without the by-pass, emissions arising from road transport at four road junctions in the Omagh District Council area may cause an exceedence of the AQS. In view of the foregoing Omagh District Council commenced diffusion tube monitoring at these closest receptor locations to gain a more accurate assessment of concentrations at the following road junctions:

- Great Northern Junction
- County Hall Junction
- Omagh District Council Offices Junction
- Swinging Bars Roundabout

Following this, it was recommended by the retained consultants that a more accurate percentage of HGV data is obtained and that DMRB is re-run as a Stage 3 Assessment.

3.0 SECOND STAGE REVIEW & ASSESSMENT OF SULPHUR DIOXIDE (SO_2)

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.

3.1 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 $\mu g\ m^{-3}$ 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 $\mu g\ m^{-3}$ 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 $\mu g\ m^{-3}$ 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.

3.2 The National Perspective

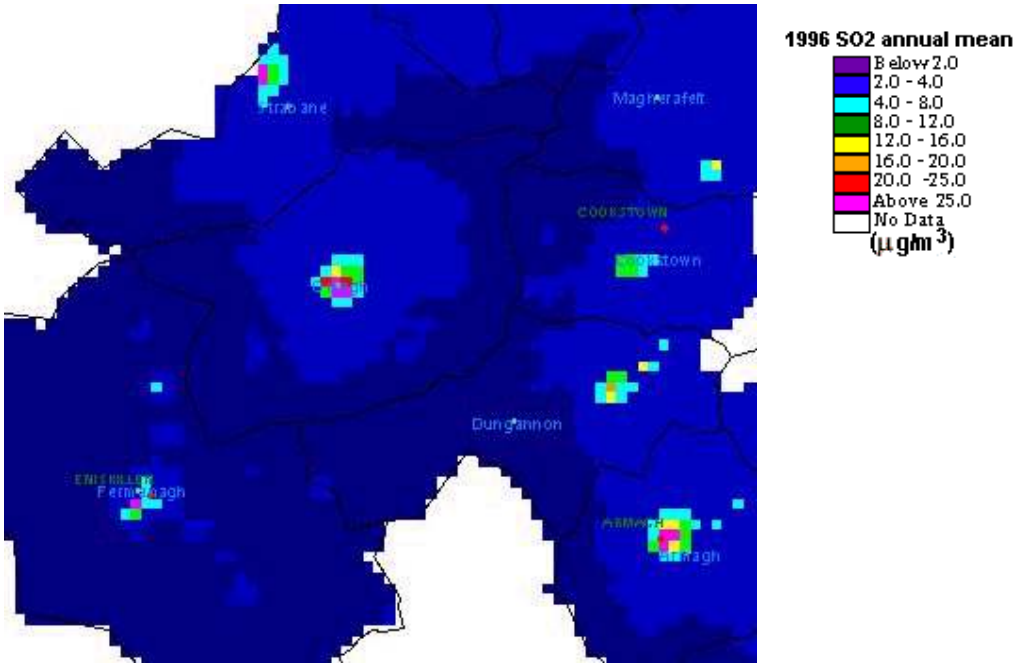
Sulphur dioxide is emitted in the combustion of coal and oil. Emissions today are dominated by fossil-fuelled power stations which in 1997 accounted for 62% of the national total emission. Emissions from road transport are a very small fraction of the national total: 2%.

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. Large combustion plants are currently regulated under BATNEEC and the EPA 1990, and will come under the provisions of the IPPC. 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.

3.3 Background Concentrations of Sulphur Dioxide

Estimates of background concentrations were obtained for the Omagh District Council area using the maps on the UK National Air Quality Information Archive web site http://www.aeat.co.uk/netcen/airqual/home.html. Figure 2 shows the most recent estimates available, for 1996. The maximum estimated background annual average concentration for 1996 in the Omagh District Council area 66.5 $\mu g/m^3$. The average background concentration was 2.6 $\mu g/m^3$. Guidance TG4 (00) assumes that the annual mean at the end of 2004 and 2005 will be half the 1996 annual mean. However, for Northern Ireland an annual mean of 0.75 times the 1996 mean has been used to reflect the high levels of domestic coal burning in the region. Thus the maximum estimated annual mean background concentration in the Omagh District Council area in 2004 will be 50$\mu g\ m^{-3}$ and the average will be 1.9 $\mu g\ m^{-3}$.

Figure 2 Background SO_2 concentrations 1996



3.4 Sources identified from First Stage Review and Assessment

Consideration was given at Stage One to existing and proposed emission sources which have the potential, singly or together, to emit significant quantities of SO_2, which are expected to be in operation by 2004/05 and for which there is the potential for exposure of individuals in relevant locations.

There are three combustion processes that were identified in the Stage One Review and Assessment as needing further assessment. They are as follows:

- Tyrone and Fermanagh Hospital
- Nestles
- Omagh meats

These are potentially significant sources of SO_2 and are likely to be in existence in 2005.

The Pollutant Specific Guidance LAQM. TG4(00) advises that the risk of exceedance of the 2005 SO_2 objective can be considered significant where the density of coal-burning (including solid smokeless fuel) houses exceeds 300 properties per 1km x 1km grid square. Omagh District Council identified five number 1 x 1 km^2 areas which represented the most densely populated areas of Omagh and a significant part of the outlying village of Fintona. It was considered highly unlikely that any other residential area within the district would require assessment. This therefore necessitated the need to proceed to a Stage 2/3 Review and Assessment of these areas.

3.5 Screening Methods used in Second Stage Review and Assessment

The three industrial sources were assessed using GSS (Guidance for Estimating the Air Quality Impact of Stationary Sources) as advised by the GB Government Pollutant Specific Guidance. To proceed with the use of this model the sources must have:

- Stacks between 20metres and 200metres tall
- Stack exit velocities between 10m/s and 25 m/s
- Releasing buoyant plumes, i.e. temperature slightly above or greater than ambient.

Tyrone & Fermanagh Hospital

Tyrone & Fermanagh hospital has not been able to provide the information necessary to complete this assessment. Without the requested information, it was impossible to eliminate this process from being likely to cause an exceedance of the air quality strategy objectives. However since the Stage One Assessment was undertaken the operations at this particular site have been significantly scaled down resulting in a considerably reduced demand on the use of the boiler plant.

Nestles

The Nestle stack does not entirely fit the profile necessary to be applied to GSS as the stack exit velocity is outside the required range. It was however entered into GSS in order to get some idea of the order of magnitude of the concentrations. GSS predicted the concentration of the SO_2 15 minute mean from the Nestle stack in combination with background SO_2 to be 120μg/m^3. This is well within the 15 minute mean objective of 266μg/m^3. The Nestle stack profile has also been entered into NRPB – R91 (Clarke, 1979) as an alternative modelling method.

The R91 model is a long established and well recognised model ("A Model for Short and Medium Range Dispersion of Radionuclides Released to the atmosphere" by the National Radiological Protection Board).

An emission rate of 2.44g/s of sulphur dioxide was calculated. The stack height was then used against the graphs in the model, in this case graph 75%D, representing the Meteorological conditions (D) in the area, 75% of the time. This then gave a figure, $4.5 \star 10^{-7}$ by which to multiply the emission rate, 2.44 g/s. This figure was multiplied by 1,000,000 to give 1.098μg/m^3 representing the annual average SO_2 concentration. GB Pollutant Specific Guidance advises that to convert the annual mean to the 99th percentile of hourly means multiply by 10 and add the background concentration:

=(1.098★10)+(50) Background is a maximum of 50μg/m^3 (according to the NETCEN concentration maps)

=60.98 μg/m^3

This calculation of hourly means is well below the 350 μg/m^{3}objective. The Pollutant Specific Guidance does not provide a conversion factor to predict the 99.9th percentile of 15 minute means from the 99th percentile of hourly means or the annual average. However, given the low predicted 99th percentile of hourly mean concentration it is anticipated that the 99.9th percentile of 15 minute mean objective would not be exceeded. Therefore, it is recommended that this site does not need to be investigated further in a stage 3 review and assessment.

Table 4 Site characteristics and modelling results of Nestle.

Stack Temperature	240□C
Stack Height	41m
Stack radius	1.0m
Exit velocity	7.5m/s
SO_2	2.44g/s
GSS 15 minute mean prediction	120□g/m^3
15 minute mean objective	266□g/m^3
R91 hourly mean prediction	61□g/m^3
Hourly mean objective	350□g/m^3

Omagh Meats

The Omagh Meats stack does not entirely fit the profile necessary to be applied to GSS as the stack exit velocity is outside the required range. It was however entered into GSS in order to obtain the likely order of magnitude. The GSS model predicts that the SO_2 15 minute mean arising from the stack in combination with background would be 196μg/m^3. This is well within the 15 minute mean objective of 266μg/m^3 .

The Omagh meats stack profile has also been entered into NRPB - R91 (Clarke, 1979) as an alternative modelling method. The R91 model is a long established and well recognised model ("A Model for Short and Medium Range Dispersion of Radionuclides Released to the atmosphere" by the National Radiological Protection Board).

An emission rate of 4.01g/s of sulphur dioxide was calculated. Graph 75%D, representing the Meteorological conditions (D) in the area, 75% of the time was utilised. This then gave a figure, $1^{\star}10^{-6}$ by which to multiply the emission rate, 4.01 g/s. This figure was multiplied by 1,000,000 to give 4.01μg/m^3 representing the annual average SO_2 concentration. GB Pollutant Specific Guidance advises that to convert the annual mean to the 99th percentile of hourly means you should multiply by 10 and add the background concentration:

=(4.01*10)+(50) Background is a maximum of 50μg/m^3 (according to the NETCEN concentration maps)

=90.1 μg/m^3

The NRBP - R91 model predicts that the hourly means is well below the 350 μg/m^{3}objective. The Pollutant Specific Guidance does not provide a conversion factor to predict the 99.9th percentile of 15 minute means from the 99th percentile of hourly means or the annual average. However, given the low predicted 99th percentile of hourly mean concentrations it is anticipated that the 99.9th percentile of the15 minute mean objective would not be exceeded. Therefore, it is recommended that this site does not need to be investigated further in a Stage 3 review and assessment.

Table 5 Site characteristics and modelling results of Omagh Meats.

Stack Temperature	226□C
Stack Height	25m
Stack radius	0.33m
Exit velocity	7.5m/s
SO_2	4.01g/s
GSS 15 minute mean	196□g/m^3
15 minute mean objective	266□g/m^3
R91 hourly mean prediction	90.1□g/m^3
hourly mean objective	350□g/m^3

In relation to the domestic emissions the Pollutant Specific Guidance LAQM. TG4(00) advises that the Second stage Review and Assessment for SO_2 from domestic sources is likely to rely upon the review of monitoring data within the local area. If existing concentrations exceed the air quality objectives the authorities should proceed to a Third Stage Review and Assessment. In the absence of any monitoring data the authority will need to proceed to a Third Stage Review and Assessment.

Monitoring of SO_2 using diffusion tubes has been undertaken by Omagh District Council at the five following locations.

- Site 1 – Meelmore Drive Omagh

- Site 2 – Hospital Road, Omagh
- Site 3 –Mullaghmore, Omagh
- Site 4 – Tamlaght Road, Omagh
- Site 5 – Ashfield Gardens, Fintona

Results for these sites are summarised in Table 6 below.

Table 6 Annual Mean Results for SO_2 Diffusion Tubes ($\mu g/m^3$)

Year	Site 1	Site 2	Site 3	Site 4	Site 5
2002	7.583	9.308	7.567	7.096	7.185
2003	32.740	9.998	10.571	10.061	10.492

Diffusion tubes for SO_2 cannot however be relied upon to give reliable quantitative results.

3.6 Conclusions for Second Stage Review and Assessment of SO_2

None of the industrial sources are considered to require to proceed to a Stage 3 assessment.

In the absence of any reliable monitoring for SO_2 Omagh District Council proceeded directly to a Third Stage Review and Assessment in respect of SO_2 from domestic fuel combustion in the five 1km x 1km grid square identified in Stage 1 Assessment.

4.0 SECOND STAGE REVIEW AND ASSESSMENT OF PARTICULATES (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.

4.1 Standards and objectives for Particulate Matter (PM_{10})

The Air Quality Strategy objectives to be achieved by 31st December 2004 are:

- An annual average concentration of 40 μg m^{-3} (gravimetric);
- A maximum 24-hourly mean concentration of 50 μg m^{-3} (gravimetric) not to be exceeded more than 35 times a year.

4.2 The National Perspective

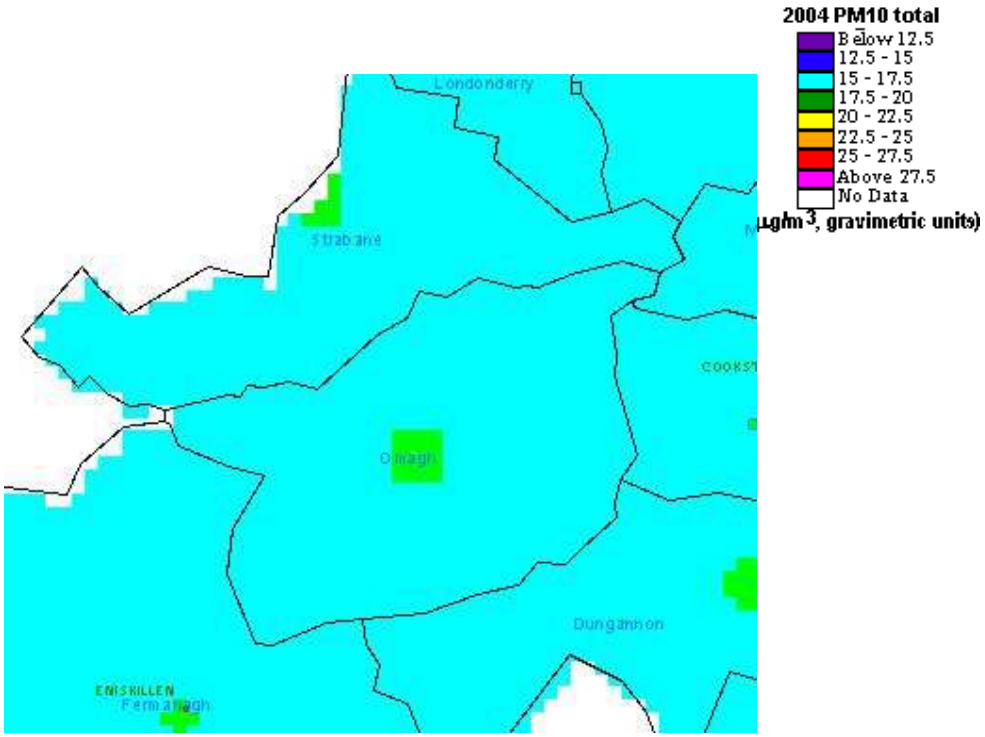
National UK emissions of primary PM_{10} have been estimated as totalling 184,000 tonnes in 1997. Of this total, around 25% was derived from road transport sources. It should be noted that, in general, the emissions estimates for PM_{10} are less accurate than those for the other pollutants with prescribed 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)[5]. 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 $\mu g\ m^{-3}$ 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.

4.3 Background concentrations of PM_{10}

Estimates of background concentrations of PM_{10} were obtained for the Omagh District Council area using the maps on the UK National Air Quality Information Archive web site http://www.aeat.co.uk/netcen/airqual/home.html. Figure 3 shows that the estimated annual average background concentration for 2004 in the Omagh District Council area was 19.2 $\mu g/m^3$ or lower.

Figure 3 Background total PM_{10} concentrations 2004 ($\mu g\ m^{-3}$)



4.4 Sources identified from First Stage Review and Assessment

4.4.1 Assessment of Road Traffic

Consideration was given at Stage One to existing and proposed emission sources which have the potential, singly or together, to emit significant quantities of PM_{10} and are expected to be in operation in 2004, and for which there is the potential for exposure of individuals in relevant locations.

The Pollutant Specific Guidance LAQM. TG4(00) provides two nomograms which can be used at Stage One to determine possible exceedances of the PM_{10} objective on roads with greater than 5,000 vehicles per day. Using this screening method no free flowing road were identified in the Omagh District Council area which would have the potential to exceed the 2004 objective.

The nomograms were not, however, appropriate where daily traffic speeds are less than 20km/hr (12.5mph) on single carriageway roads or less than 65km/hr (40mph) on dual carriageways and also where properties are closer than 2m of the kerbside of single carriageways or 10m of the kerbside of dual carriageways. Consequently a number of road sections/junctions automatically required a Stage 2/3 Review and Assessment:

- Campsie Road from Swinging Bars roundabout to market street
- Dublin Road to Market Street
- Derry Road from Castle Street to Sedan Avenue
- Dromore Road from James street to Castle Street

There was also the possibility that road traffic survey work being undertaken by DOE Roads Service would identify additional roads/junctions which would require a stage 2/3 assessment.

4.4.2 Assessment of Domestic Sources

In relation to domestic solid fuel use the Pollutant Specific Guidance LAQM. T4(00) advises that the risk of exceedance of the 2004 objective within an area may be assessed by calculating the number of people per square kilometre within coal burning households. This should then be compared with nomograms to determine possible exceedances.

The most densely populated areas of Omagh where therefore examined, namely the Tamlaght Road/Dromore Road areas and the Hospital Road areas. Application of the First Stage screening methodology to these areas suggested that there was some potential to exceed the PM10 objectives and that a stage 2/3 assessment be carried out.

It was also considered that there may be some other areas in the district that, although less densely populated may, if subjected to screening require a stage 2/3 review and assessment.

4.4.3 Assessment of Industrial Sources

There are a number of industrial sources in the Omagh District Council area which have potential to generate PM_{10} emissions arising from a variety of uncontrolled or fugitive origins. Application of the First Stage screening methodology suggested in respect of fugitive emissions three such sources:-

- Haddens Quarry Ltd, Carrickmore (now trading as RJ Maxwell and Sons Carrickmore)
- Dunaree Quarry, Drumquin (now trading as TARMAC heavy building materials UK Ltd, Drumquin)
- Haddens Quarry Ltd, Mountfield (now trading as RJ Maxwell and Sons, Mountfield)

A Second/Third Stage Review and Assessment is considered necessary for the above three potential industrial sources of PM_{10}.

4.5 Screening Methods used in Second Stage Review and Assessment.

4.5.1 Assessment of Road Traffic

The second stage review and assessment is based upon the application of modelling. This modelling work was undertaken by NETCEN on behalf of Omagh District Council during the spring of 2002 [Air quality Review and Assessment – Stage II – A report produced for Omagh District Council March 2002].

4.5.2 Impact of Road Traffic

As recommended in TG4 (00) DMRB has been used to predict PM_{10} concentrations for 2004 from road traffic but the background concentrations given within the model have been ignored. The estimated maximum background concentration for 2004 of 19.2 $\mu g\ m^{-3}$ for the Omagh District Council area has then been added to provide total predicted PM_{10} concentrations. Estimated traffic flows for 2005, (as expected traffic flows in 2004 were not available) as supplied by Omagh District Council, were used in these calculations.

Guidance TG4(00) states that the 24-hour objective is highly unlikely to be exceeded if the annual mean concentration is below 28 $\mu g\ m^{-3}$, gravimetric.

Tables 7 and 8 show the 2004 predictions that may be compared against the objectives. For 2004, the method predicts annual average concentrations of PM_{10} less than 28 $\mu g\ m^{-3}$ at all of the locations modelled. It should be noted that whilst only four roads were identified as requiring Stage 2 Assessment for PM_{10} nine roads/junctions were modelled as a consequence of the NO_2 modelling exercise being concurrently run by the consultants.

Table 7 Predicted PM_{10} concentrations at roadside locations in the Omagh District Council region without the by-pass.

Description of Link	PM_{10} Annual mean (µg m^{-3}) 2004
Dublin Rd, Omagh	22.0
Great Northern Junc. Omagh	25.0
Campsie Rd, Omagh	21.2
Hoggs Head Junc. Omagh	21.1
County Hall Junc. Omagh	22.2
Omagh District Council offices Junc.	22.6
Swinging Bars Rdbt, Omagh	22.5
Hospital Rd, Omagh	21.5
Tamlagnt Rdbt, Omagh	21.5

Table 8 Predicted PM_{10} concentrations at roadside locations in the Omagh District Council region with the by-pass.

Description of Link	PM_{10} Annual mean (µg m^{-3}) 2004
Dublin Rd, Omagh	20.0
Great Northern Junc. Omagh	23.5
Campsie Rd, Omagh	20.6
Swinging Bars Rdbt, Omagh	23.6
Hospital Rd, Omagh	21.5

4.6 Assessment of Domestic Sources

The Pollutant Specific Guidance TG4(00) advises that the assessment of the impact of domestic solid fuel can be carried out from existing black smoke data based on an empirical relationship between the annual mean black smoke measurement and the annual mean secondary PM_{10} concentration. In the absence of any monitoring data, as is the case in Omagh District area, the authority will need to proceed to a Third Stage Review and Assessment.

4.7 Assessment of Industrial Sources and Uncontrolled and Fugitive Dust Emissions

The Pollutant Specific Guidance TG4(00) advises that predication of PM_{10} concentrations arising from controlled industrial sources may be carried out using the Environment Agency's Guidance for estimating the Air Quality Impact of Stationary Sources (GSS).

The Pollutant Specific Guidance TG4(00) advises that for uncontrolled emissions there is no suitable screening approach which can be confidently applied to the Second Stage Review and Assessment and authorities may need to proceed to a Third Stage Assessment which will normally involve a detailed monitoring programme.

It was decided to focus upon the Maxwell's quarry, Carrickmore as it was located relatively close to the village of Carrickmore and had a complaint history including dust issues. It was also the view that the findings of the proposed assessment would be considered to be the 'worst case' and the results could be extrapolated to the other two similar quarries. (a view confirmed by the retained consultants NETCEN).

4.8 Conclusions of Second Stage Review and Assessment for PM_{10}

Modelling indicates that there are no predicted exceedances of the PM_{10} objective from traffic sources and hence no need to proceed to a Third Stage Review and Assessment.

In relation to domestic solid fuel use Omagh District Council will, in the absence of any monitoring data, need to proceed to a Third Stage Review and Assessment.

Monitoring of fugitive emissions is to be undertaken at Carrickmore Quarry.

5.0 THIRD STAGE REVIEW & ASSESSMENT PROCESSES

5.1 Third Stage Review & Assessment Process

The Third Stage review and assessment has been carried out using the guidance LAQM. TG4 (00) issued by DETR. Whenever possible reference was also made to the revised technical guidance issued in 2003 (LAQM. TG (03)).

This stage involves a detailed and accurate appraisal of the impacts and requires that the assumptions within the review and assessment process are considered in depth and any data which is collected or used is quality assured to a high standard. This is to ensure that there is confidence in the decisions reached at the conclusion of Stage 3.

The Third Stage also requires that authorities determine both the magnitude and geographical extent of the likelihood of any exceedances of the objective.

5.2 Third Stage Review and Assessment for NO_2

Following the advice from the consultants NETCEN it was decided to undertake a Third Stage Review of the impact of NO_2. The DMRB model has been updated since Omagh District Councils initial Stage 2 Review and Assessment and now includes a revised set of vehicle emissions factors, improved roadside dispersion curves and a new relationship to estimate NO_2 from NO_x.

The DMRB has been re-run for the following four junctions:

- The Great Northern junction
- County Hall junction
- Omagh District Council offices junction
- Swinging Bars roundabout junction

The bypass is now under construction and the results of the remodelling is presented where traffic flows are available.

Annual mean NO_2 concentrations have been predicted at the nearest relevant receptors at each road junction. A revised figure of 10% has been used for the proportion of heavy duty vehicles on all roads as provided by Roads Service. A slow traffic speed of 20 kilometres per hour has been used in the model as a conservative estimate. Estimated background concentrations have been taken from the NAEI website (www.naei.org.uk). This source is recommended in the Technical Guidance (TG(03)). The estimated concentrations are shown in Table 9 below. All results are shown in $\mu g/m^3$.

Table 9 Estimated annual mean NO_2 concentrations at the nearest relevant receptors in 2005 ($\mu g/m^3$).

Location	Estimated NO_2 annual mean in 2005
The Great Northern junction	35
County Hall junction	21
Omagh District Council offices junction	24
Swinging Bars roundabout junction	22
The Great Northern junction (with by-pass)	32
Swinging Bars roundabout junction (with by-pass)	25

Note: Results are shown to the nearest integer

The DMRB modelling results show that at no location is the annual or hourly objective predicted to be exceeded in 2005.

Nitrogen dioxide diffusion tube results

Nitrogen dioxide concentrations have been measured by diffusion tubes at 4 receptor locations in close proximity to the above road junctions. The concentrations recorded between October 2002 and September 2003 are presented in Table 10 below. Unfortunately there is no bias correction data available as there is no co-location with a continuous monitor taking place and the laboratory were unable to provide any data. A conservative bias adjustment factor of 1.25 has been

applied as suggested by experts within NETCEN's ambient monitoring team. The bias corrected results have then been predicted forward to 2005 using factors provided in the TG(03).

Table 10 Nitrogen dioxide concentrations as recorded by diffusion tubes between October 2002 and September 2003 (μg/m^3).

Location	Uncorrected for bias	Bias corrected	Prediction in 2005
Lisanelly Avenue	15	19	18
Sedan Avenue*	19	23	22
Great Northern Road	30	38	36
Swinging bars Roundabout	14	17	16

* results are shown for the period September 2002 to August 2003 as no data was available for Sept 2003.

5.3 Conclusions of Third Stage Review and Assessment of Nitrogen Dioxide for Omagh District Council

Both the results of the diffusion tube survey and the DMRB model runs show that it is unlikely that the either the annual mean or hourly nitrogen dioxide objective will be exceeded in Omagh at relevant receptor locations. There is good agreement between the DMRB modelled results and the diffusion tube results at the Great Northern Junction and County Hall Junction. At the Omagh district Council offices and Swinging Bars roundabout, DMRB predicts a higher concentration than the diffusion tube results. This may be a result of too high a % HDV figure being used.

5.4 The Third Stage Review and Assessment of Sulphur Dioxide (SO_2) and Particulates (PM_{10})

In the absence of any reliable monitoring for SO_2 or PM_{10} Omagh District Council proceeded directly to a 3rd stage review and assessment in respect of SO_2 and PM_{10} from domestic fuel consumption in 5 No. 1km x 1km grid squares identified in Stage 1. This involved detailed modelling of domestic fuel emissions using ADMS version 3.1. This work was undertaken by NETCEN on behalf of Omagh

DC [Air Quality Review and Assessment – Stage 3 Domestic Fuel Combustion Report to Omagh District Council, May 2003]. A Fuel Use survey was carried out to provide estimates of PM_{10} and SO_2 emissions required for the modelling.

The following information was used to support this assessment:-

- Hourly sequential meteorological data was obtained for 1999 from the Meteorological Office for the Aldergrove site for input into the ADMS dispersion model
- In the absence of any local monitoring data to validate/verify the modelling it is possible to use monitoring data of a nearby authority. This is the approach taken here. As Omagh District Council has no relevant monitoring data, use was made of monitoring data available from Strabane.

5.5 Assessment of Sulphur Dioxide (SO_2)

5.5.1 Monitoring Data for SO_2

Sulphur dioxide concentrations have been continuously monitored at Springhill Park in Strabane (Ordnance Survey Grid Reference 2351 3972) 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 11 below. The data has been ratified by Netcen and conforms to the Defra standards.

Table 11 Summary of continuous SO_2 data 26th April 2002 to the 28th January 2003

	SO_2 ($\mu g/m^3$)
Average	8
Maximum daily	29.3
Maximum hourly mean	90.4
99.9^{th} %ile 15 minute mean	74.5
Data capture	93.4%

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 for sulphur dioxide during the period of monitoring.

Comparison of Monitoring Data with Belfast East Site

The modelling carried out used 1999 meteorological data from Aldergrove. Therefore a comparison was made between SO_2 concentrations recorded by the continuous monitor at Belfast East in 1999 with that recorded between 26th April 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 12 below.

Table 12 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 was 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.

5.6 Assessment of Particulate Matter PM_{10}

5.6.1 Monitoring Data for PM_{10}

PM_{10} concentrations have been continuously monitored in Strabane District at Springhill Park since April 2002 (OS Grid Reference 2351, 3972).

A summary of the PM_{10} concentrations recorded by the continuous monitor (gravimetric equivalents) is provided in Table 13 below.

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.

Summary statistics

Table 15 shows the daily average measured concentrations from the 26th April 2002 until the 28th January 2003. The average concentration (ratified) for the Springhill site exceeds the annual and 24 hour objective for PM_{10}.

Table 13 Summary of continuous PM_{10} ratified data from the 26th April 2002 to the 28th January 2003 inclusively. Concentrations are in gravimetric equivalents.

	Concentration, μg m^{-3}
	PM_{10}
Average over period	43
90 %ile of 24hour mean	73
Data capture	98%

Comparison of Monitoring Data with Derry

The modelling carried out used 1999 meteorological data from Aldergrove. Therefore a comparison was made between PM_{10} concentrations recorded by the continuous monitor in Derry in 1999 with that recorded between 26th April 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 which was deemed suitable. The results are shown in Table 14 below. All results shown are in gravimetric equivalents.

Table 14 Comparison of PM_{10} concentrations in Springhill Park with the Derry site.

Site	90th percentile daily mean ($\mu g/m^3$) in 1999	90th percentile daily mean ($\mu g/m^3$) 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 $\mu g/m^3$. This result has been used in the modelling to correct for bias.

5.7 Fuel Use Survey within Omagh District Council Area

5.7.1 Background to Fuel Use Survey

Omagh District Council commissioned Market Research Northern Ireland to carry out a domestic fuel survey in five areas identified in the Stage 2 Review and Assessment (Hobson, 2002).
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 five survey areas were:

- Castleview
- Thornlea
- Townview
- Culmore
- Fintona

The aim was to survey 200 households in each zone equating to 1,000 responses. This equated to between 4.7% and 12.9% of households being questioned in each grid.

Table 15 Estimated number of houses in each grid area and the achieved number of surveys.

Grid Area	No. houses	Respondents	% asked
Castleview	678	200	29
Thornlea	686	200	29
Townview	713	200	28
Culmore	1134	200	18
Fintona	505	200	40

The results of the survey showed that overall oil was the most popular primary heating source in all grid areas combined (88% of all households). Coal / solid fuel accounted for 10% of all households as the main heating source and an additional 24% of all households reported using coal / solid fuel as a secondary source of heat.

5.7.2 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 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 as it was felt that this was more appropriate due to the sulphur content of coal varying substantially from coal mine to coal mine.

Table 16 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 five survey areas.

5.7.3 Spatial Emissions Inventory

Grid 1 – Castleview

In Grid square 1, there were estimated to be 678 households. In addition there were estimated to be an additional 60 houses in the process of being built. It was assumed that these additional houses would burn similar fuels and similar quantities of fuels as those surveyed in the region. The following two tables summarise the results of the survey in Castleview.

Table 17 The percentage of households burning different fuel types in Castleview.

Use	Oil	gas	elec	coal/SF	Total
Main fuel	92	0	1	8	100
Secondary fuel	1	7	7	30	45

SF = solid fuel

Please note that the totals may not agree with the sum of their components due to rounding.

Table 18 The type of coal and / or solid smokeless fuel used (%) in the Castleview area.

Type	Ordinary	smokeless	anthracite	Wood	turf/peat
% who use	73	4	18	4	1

In the Castleview survey area, it was found that the majority of households burnt oil as their main heating source. For households which burn solid fuel as a primary heating source, the average consumption is 58 kg per week in winter and 27 kg per week in summer.

The emission factors shown in Table 18 above 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.

Grid 2 - Thornlea

In Grid square 2, there were estimated to be 686 households. In addition, there were estimated to be a further 150 houses which are in the process of being constructed. It was assumed that these households would burn similar fuel types and similar quantities of fuel to those questioned in the survey. The following two tables summarise the results of the fuel survey in Thornlea.

Table 19 The percentage of households burning different fuel types in Thornlea.

Use	Oil	gas	elec	coal/SF	Total
Main fuel	85	0	5	11	100
Secondary fuel	1	4	11	17	33

Please note that the totals may not agree with the sum of their components due to rounding.

Table 20 The type of coal and / or solid smokeless fuel used (%) in Thornlea

Type	Ordinary	smokeless	anthracite	Wood	turf/peat
% who use	87	4	7	2	0

In the Thornlea survey area it was found that the majority of households burnt oil for their main heating source (85% of households). A lesser proportion burnt coal or solid fuel. For households which burn solid fuel as a primary heating source, the average consumption is 87 kg per week in winter and 40 kg per week in summer.

The emission factors shown in Table 20 above 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.

Grid 3 - Townview

In Grid square 3, there were estimated to be 713 households. In addition, there are two further new housing developments in Townview which have not been accounted for in the survey. These are the Kevlin Glen estate and Coolnagard. For the Kevlin Glen estate is was assumed that the households burnt similar fuel types and quantities to those questioned elsewhere in the region. For Coolnagard it was assumed that virtually all dwellings use oil fired boilers as primary heating as specified by Omagh District Council. The following table summarises the results of the fuel survey in Townview.

Table 21 The percentage of households burning different fuel types in Townview.

Use	Oil	gas	elec	coal/SF	Total
Main fuel	96	1	1	3	100
Secondary fuel	0	2	15	21	38

Please note that the totals may not agree with the sum of their components due to rounding.

Table 22 The type of coal and / or solid smokeless fuel used (%) in Townview

Type	Ordinary	smokeless	anthracite	Wood	turf/peat
% who use	78	0	22	0	0

In survey area 3, the majority of respondents burn oil as their main fuel (96%). For households which burn solid fuel as a primary heating source, the average consumption is 105 kg per week in winter and 70 kg per week in summer.

The emission factors shown in Table 22 above 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.

Grid 4 - Culmore

In survey area 4, there were estimated to be 1,134 households. In addition, there are two new housing developments that will be built in the near future. These are the New development fold association houses and Drumannon. It is estimated that there are 126 and 120 houses in each development respectively. The following table summarises the results of the fuel survey in Culmore. For further details please see Appendix 1.

Table 23 % of households burning different fuel types in Culmore.

Use	Oil	gas	elec	coal/SF	Total
Main fuel	87	0	2	12	100
Secondary fuel	0	2	4	23	29

Please note that the totals may not agree with the sum of their components due to rounding.

Table 24 The type of coal and / or solid smokeless fuel used (%) in Culmore

Type	Ordinary	smokeless	anthracite	Wood	turf/peat
% who use	81	9	10	0	0

In survey area 4, the majority of respondents burn oil as their main fuel (87%). For households which burn solid fuel as a primary heating source, the average consumption is 124 kg per week in winter and 52 kg per week in summer.

The emission factors shown in Table 24 above 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.

Grid 5 - Fintona

In survey area 5, there were estimated to be 505 households. The following table summarises the results of the fuel survey in Fintona.

Table 25 % of households burning different fuel types in Fintona.

Use	Oil	gas	elec	coal/SF	Total
Main fuel	84	0	2	15	100
Secondary fuel	0	6	8	33	47

Please note that the totals may not agree with the sum of their components due to rounding.

Table 26 The type of coal and / or solid smokeless fuel used (%) in Fintona

Type	Ordinary	smokeless	anthracite	Wood	turf/peat
% who use	95	2	0	3	0

The majority of households surveyed in Fintona burn oil followed by coal / solid fuel as their main fuel source. For households which burn solid fuel as a primary heating source, the average consumption is 150 kg per week in winter and 74 kg per week in summer.

The emission factors shown in Table 26 above 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 Detailed Emission Modelling

5.8.1 Overview of the Modelling Approach

The dispersion model ADMS 3.1 developed by CERC has been used to predict the PM_{10} and SO_2 levels in Omagh 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.

The 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).

5.8.2 Model bias

The monitoring site at Springhill Park in the neighbouring authority has been used as a reference site: e.g. model concentrations in Omagh have been adjusted by taking the ratio between the modelled concentration at the Strabane site and the predicted measured value in 1999. The purpose of this adjustment was to ensure that the modelled concentrations equalled the measured values at the monitoring site. This step provides a local correction to the modelled concentrations and allows the best possible estimates of local concentrations.

5.8.3 Model validation

Uncertainties in the modelled concentrations will depend on:

- uncertainties in the fuel use survey as only 18 - 40% 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

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.

The results of this study represent the best estimate of concentrations that we have been able to achieve.

5.9 Results of Modelling

5.9.1 Results for SO_2

Castleview

Appendix 2 shows modelled 99.9 percentile 15 minute mean SO_2 concentrations in the Castleview area in 1999. (The objective is 266 $\mu g/m^3$). The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentration will not be exceeded in the area.

Due to the uncertainty in the domestic fuel burning in future years and the small 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, which is a conservative approach.

Thornlea

Appendix 2 shows modelled SO_2 concentrations in Thornlea in 1999. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentrations will not be exceeded in the area modelled.

Townview

Appendix 2 shows modelled SO_2 concentrations in Townview in 1999. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentrations will not be exceeded in the area modelled.

Culmore

Appendix 2 shows modelled SO_2 concentrations in Culmore in 1999. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentration will not be exceeded in the area.

Fintona

Appendix 2 shows modelled SO_2 concentrations in Fintona in 1999. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentrations will not be exceeded in the area.

5.9.2 Results for PM_{10}

Castleview

Appendix 3 shows modelled PM_{10} concentrations in Castleview in 1999. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will not be exceeded in this area. (The objective is 50 $\mu g/m^3$). Due to the uncertainty in the domestic fuel burning in future years, no attempt has been made to predict PM_{10} concentrations in 2004. It is assumed that they will be similar to those predicted in 1999 and that the objective will not be exceeded.

Thornlea

Appendix 3 shows modelled PM_{10} concentrations in the Thornlea area in 1999. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will not be exceeded in the area.

Townview

Appendix 3 shows modelled PM_{10} concentrations in the Townview area in 1999. The model predicts that the daily mean 90.41 percentile of 24 hour PM_{10} concentrations will not be exceeded in the area

Culmore

Appendix 3 shows modelled PM_{10} concentrations in the Culmore area in 1999. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will be exceeded in the main central residential area. However due to the large bias applied from the Strabane study (the model was under-reading) and that concentrations are not that far above the objective, NETCEN recommended that rather declaring an air quality management area at this time, that monitoring is carried out over a six month winter period in this area.

Fintona

Appendix 3 shows modelled PM_{10} concentrations in the Culmore area in 1999. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will be exceeded in the main central area. However, due to the large bias applied from the Strabane study (the model was under-reading) and that concentrations are not that far above the objective, NETCEN recommended that rather declaring an air quality management area at this time that PM_{10} monitoring is carried out over a six month winter period in either Fintona or Culmore.

5.10 Summary of the likelihood of exceeding the objectives for SO_2 sources

Detailed modelling using ADMS version 3.1 has been undertaken at five locations where large amounts of domestic fuel burning is common. The modelling (corrected for bias) predicts that in all five grids modelled exceedences of the SO_2 objectives are unlikely.

5.11 Summary of the likelihood of exceeding the objectives for domestic PM_{10} sources

Detailed modelling using ADMS version 3.1 has been undertaken at five locations where large amounts of domestic fuel combustion is common.

The modelling (corrected for bias) predicted that an exceedence of the PM_{10} objectives was unlikely in three of the areas modelled. In Culmore and Fintona exceedences of the daily mean PM_{10} concentrations were predicted. However due to the large bias applied from the Strabane study (the model was under-reading) and that concentrations are not that far above the objective, it is recommended that rather declaring an air quality management area in these two areas at this time, that monitoring is carried out in either Fintona or Culmore. Monitoring should be carried out for a six month winter period.

5.12 Re-run of Domestic Fuel Use Model

Following the outcome from the Stage 2/3 Review it was clear that locally monitored air quality data was required to fully assess the impact of PM_{10}
It is anticipated that this data will provide information for the purposes of model verification in addition to the monitoring data previously available.

General Approach

- Collect and interpret additional data to support the third stage assessment, specifically local PM10 monitoring data, for a location where exceedences were predicted;
- Re-verify the modelled PM_{10} concentrations 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 guidance in LAQM.TG(03), published in February 2003 has been used for this assessment.
The units throughout are presented in $\mu g\ m^{-3}$ gravimetric PM_{10} (which is consistent with the presentation of the new AQS objectives), unless otherwise noted.

5.13 Ambient monitoring of PM_{10}

A 6-month winter period monitoring study was undertaken within the Tamlaght area of Omagh District Council. This is within the Omagh – Culmore grid square. Continuous monitoring of PM_{10} was undertaken using a TEOM. The model bias is calculated using this monitoring data and the model concentrations adjusted for the modelled grid squares.

PM_{10} has been measured:

- By TEOM continuous monitoring, 26 September 2003 to 10 April 2004 (OS Grid Reference (443723) in Omagh - Culmore. A factor of 1.3 has been applied to the TEOM PM_{10} data to arrive at a gravimetric equivalent dataset.

The summary of concentrations recorded by the continuous monitor is provided in the Appendix 4.

This 6 month period is a winter period and therefore captures the significant contribution of domestic fuel combustion emissions. The location of the site is relevant from a perspective of localised domestic fuel combustion and is within the Omagh – Culmore grid square where the pervious study predicted exceedances.

A comparison with Derry data was considered to correct the period to annual concentrations. However this correction would have reduced the percentile value. Therefore by not making the period to annual correction a more pessimistic view of ambient concentrations and a precautionary approach has been taken. If, using this approach, no exceedance is identified there is a greater certainty that there will not be an exceedance. If an exceedance were to be identified the necessity for this approach could be reconsidered.

All the PM_{10} concentrations presented and used in this study are in gravimetric equivalents.

The data from the continuous monitor has been ratified by NETCEN. The data conforms to the QC standards used in the Defra network.

Table 27 shows the daily measured concentrations from the 26 September 2003 to 10 April 2004. The average concentration (ratified) for the site does not exceed the annual or 24 hour objective for PM_{10}.

Table 27 Summary of continuous PM_{10} ratified data from the 26 September 2003 to 10 April 2004. Concentrations are in gravimetric equivalents.

	PM_{10}Concentration, μg m^{-3}
Average over period	24
90 %ile of 24hour mean	36
Data capture	97.3%

Background values used in the modelling have been taken from the mapped data available on the NETCEN website at http://www.airquality.co.uk/archive/laqm/tools.php?tool=background

A grid reference at the centre of each of the modelled areas was used to determine the background concentration to be used across that grid. The background values therefore were

Omagh – Culmore - 23□g m^{-3}
Fintona - 22□g m^{-3}

The dispersion model ADMS 3.1 was re-run to predict the PM_{10} levels in Omagh – Culmore and Fintona. The emissions arising from fuel use survey data were modelled as volume sources. Emissions were 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 were then added to estimate background concentrations.

5.14 Model bias

The monitoring site at Springhill Park in the neighbouring authority had previously been used as a reference site: i.e. modelled concentrations in Omagh were adjusted by taking the ratio between the modelled concentration at the Strabane site and the predicted measured value in 1999. The purpose of this adjustment was to ensure that the modelled concentrations equalled the measured values at the monitoring site. Now local monitoring data is available this model bias correction can be made using the local data, which enables the modelling approach to best take account of any geographical and source peculiarities and reduce the model uncertainty. Appendix 5 contains the subsequently revised plots.

5.15 Summary of the likelihood of exceeding objectives for domestic PM_{10} sources

The modelling has been undertaken using a precautionary approach. It is predicted that the 24 hour mean PM_{10} objective of 50µg/m^3 will not be exceeded in either of the modelled areas. As this is the most stringent objective it is also predicted that the annual mean objective of 40µg/m^3 will therefore also be met. Therefore neither of the locations considered in this report are predicted to exceed the objectives.

It is recommended that no further assessment of this source is necessary and it is <u>not</u> necessary to declare an AQMA. The next stage of assessment for Omagh District Council will therefore be a Progress Report in April 2005.

5.16 Assessment of PM_{10} Emissions from Industrial Sources

Stage 1 Review and Assessment identified 3 No hard rock quarries operating within the district to have some potential of exceeding the PM_{10} objective.

The Pollutant Specific Guidance TG4(00) advised that predictions of PM_{10} concentrations arising from controlled industrial sources may be carried out using the Environment Agency's Guidance for estimating the Air Quality Impact of Stationary Sources (GSS).

5.16.1 General Approach Taken

The approach taken to investigate the potential PM_{10} emissions is as follows:

- Collect and examine local monitored data to assess whether to progress to Third Stage Assessment, for 2 locations where exceedences were predicted.
- Assessment against the objective criteria for particulate matter to be achieved by 31st December 2004 of 50µg/m^{3}expressed as a 24 hour mean not to be exceeded more than 35 times per year.

5.16.2 Ambient Monitoring

A continuous air quality monitor was installed at No 27 Ballintrain Road, Carrickmore. The decision to locate the particulate monitor at this address was influenced primarily by the complaint history from residents in the vicinity regarding fugitive dust emissions from the neighbouring hard rock quarry. The equipment was installed for 2 seven month periods over the drier summer months when levels of particulate matter (dust) was expected to be highest.

PM_{10} was measured by

- TEOM continuous monitoring from the period 25 February 2003nto 23 September 2003 (OS Grid Reference 611721)

  Note: A factor 1.3 has been applied to the TEOM PM_{10} data to arrive at a gravimetric equivalent dataset.

The summary of concentrations recorded by the continuous monitor is provided in Appendix 4.
The appendix details the 24-hour mean values obtained over the duration of monitoring. Although there were occasions during this period when verifiable data was not collected due to technical difficulties, it is the Environmental Health Department's view that sufficient data was collected to allow a meaningful comparison to be made with the above objective.

Examination of the data reveals that there were only two recorded exceedences of the 50µg/m^3 objective level which is obviously well within the 35 permitted exceedences per year. It is recognised of course that the monitoring period does not allow for a full 12 month assessment to be made but, as previously stated, the drier summer period would have the greatest potential for elevated dust levels.

Levels of particulate matter ranged from 3.3µg/m^3 to 68.9µg/m^3 and averaged at approximately 16µg/m^3 which is comparatively low in relation to the 24 hour mean objective level.

5.17 Summary of likelihood of exceeding objectives for PM_{10}

ODC has reviewed the position regarding the three fugitive emissions sources and holds the view that the majority of dust emissions from such operations tend to be larger particle size fractions and consequently fall out of the atmosphere rapidly with increasing distance from the source. Monitoring studies completed by authorities in GB have indicated few if any exceedences of the objectives in the vicinity of quarrying activities. (The first phase Air Quality Review and Assessment Studies: D Summary – NETCEN 2000)

This view has been corroborated by the results from the monitoring exercise at Carrickmore where over a very dry summer period only six exceedences of the 24 hour mean objective level was recorded.

As previously stated it is the Department's opinion that conditions of Carrickmore are regarded as the "worst case" (Dunaree Quarry, Drumquin is currently not operational) and any findings are therefore transposed to the other sites on a precautionary principle.

It is therefore considered that it is not necessary to proceed to Stage 3 Review and Assessment in respect of these sources.

5.18 Conclusions for Third Stage Review and Assessment for SO_2 and PM_{10}

Sulphur Dioxide

The modelling results suggest that it is unlikely that there will be an exceedence of the 15 minute mean SO_2 objective in the modelled area. This is the most stringent SO_2 objective and therefore if this is predicted to be met then it is likely that the hourly and daily SO_2 objectives will also be met.

It is <u>not</u> recommended that Omagh District Council will consider declaring an AQMA for sulphur dioxide from domestic fuel burning.

PM_{10}

From the re-modelling it can be concluded that an exceedence of the 24 hour PM_{10} objective is unlikely and it is not recommended that Omagh District Council consider declaring an AQMA for PM_{10} from domestic fuel burning.

It is not recommended that Omagh District Council will consider declaring an AQMA for PM_{10} from domestic emissions.

Based on the findings at Carrickmore Omagh District Council do not consider that it is necessary to proceed to a Stage Three Review and Assessment in respect of industrial type sources, controlled or uncontrolled.

It is not recommended that Omagh District Council will consider declaring an AQMA for PM_{10} from industrial sources.

APPENDIX I

Proposed Objectives included in the Air Quality Regulations (NI) 2003 for the purpose of Local Air Quality Management

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 µg/m^3	running annual mean	31.12.2003
	3.25 µg/m^3	running annual mean	31.12.2010
1,3 Butadiene	2.25 µg/m^3	running annual mean	31.12.2003
Carbon monoxide	10.0 µg/m^3	maximum daily running 8-hour mean	31.12.2003
Lead	0.5 µg/m^3	annual mean	31.12.2004
	0.25 µg/m^3	annual mean	31.12.2008
Nitrogen dioxide[1]	200 µg/m^3 not to be exceeded more than 18 times a year	1 hour mean	31.12.2005
	40 µg/m^3	annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)[2]	50 µg/m^3 not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 µg/m^3	annual mean	31.12.2004
Sulphur dioxide	350 µg/m^3 not to be exceeded more than 24 times a year	1 hour mean	31.12.2004
	125 µg/m^3 not to be exceeded more than 3 times a year	24 hour mean	31.12.2004
	266 µg/m^3 not to be exceeded more than 35 times a year	15 minute mean	31.12.2005

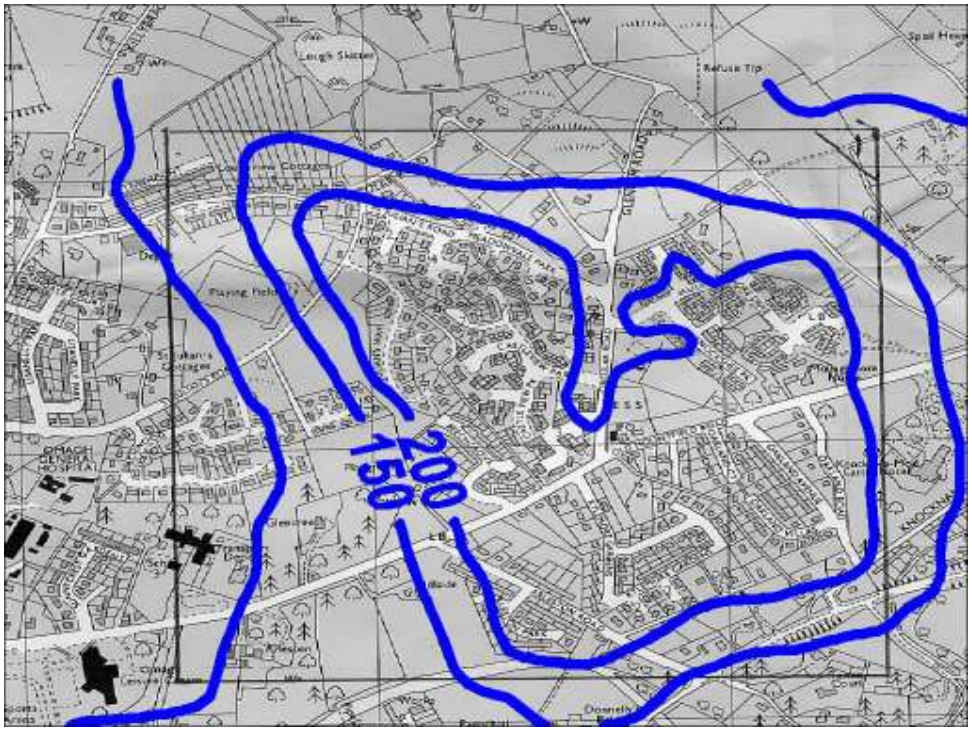
[1] The objectives for nitrogen dioxide are provisional

[2] Measured using the European gravimetric transfer standard or equivalent.

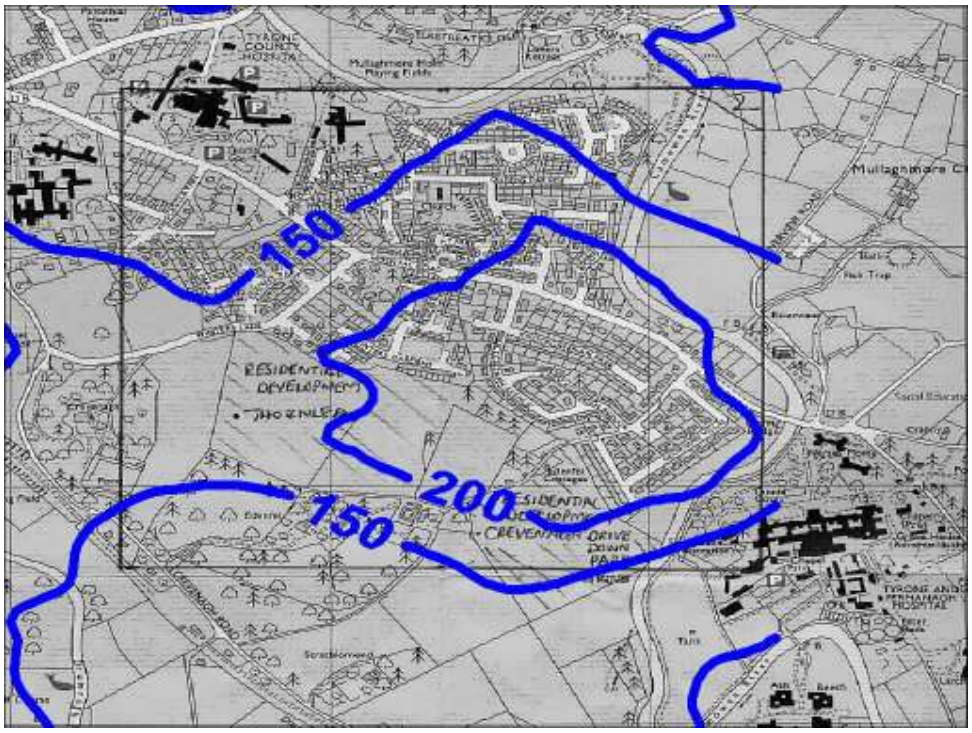
APPENDIX II

RESULTS OF MODELLING FOR SO_2

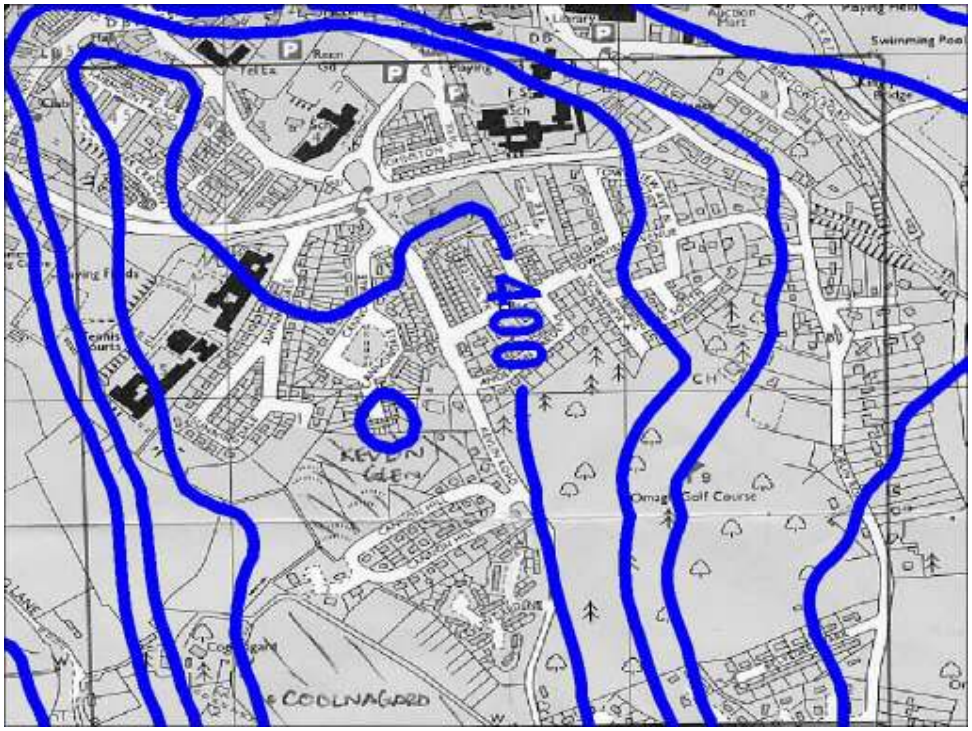
Predicted 99.9 percentile 15 minute mean SO2 concentrations in Castleview (µg/m3).



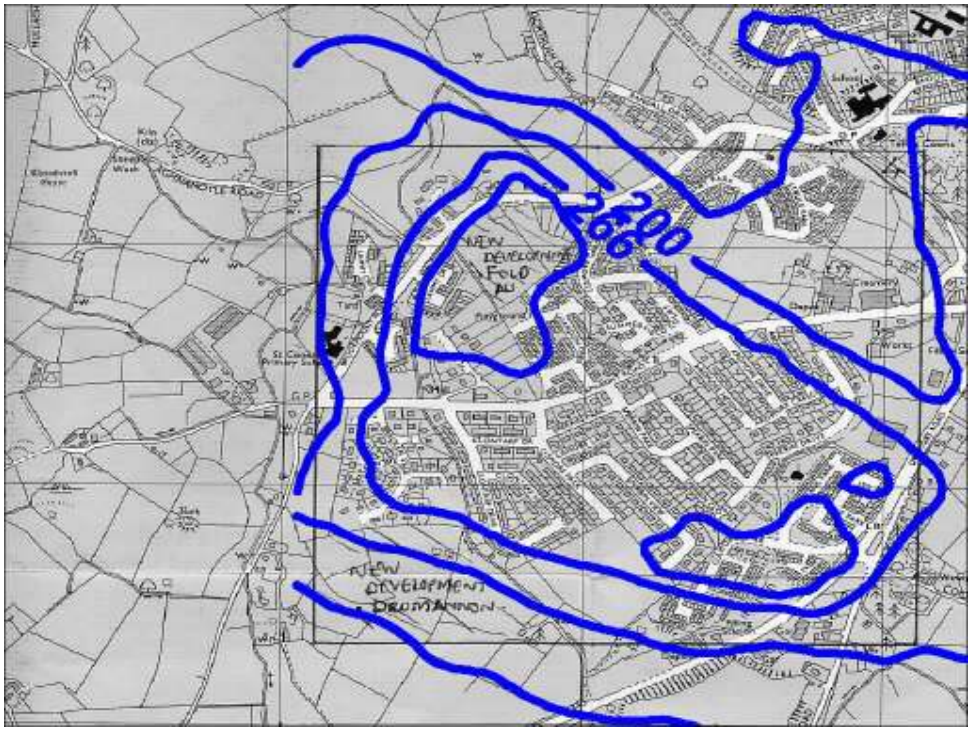
Predicted 99.9 percentile 15 minute mean SO2 concentrations in Thornlea (μg/m3).



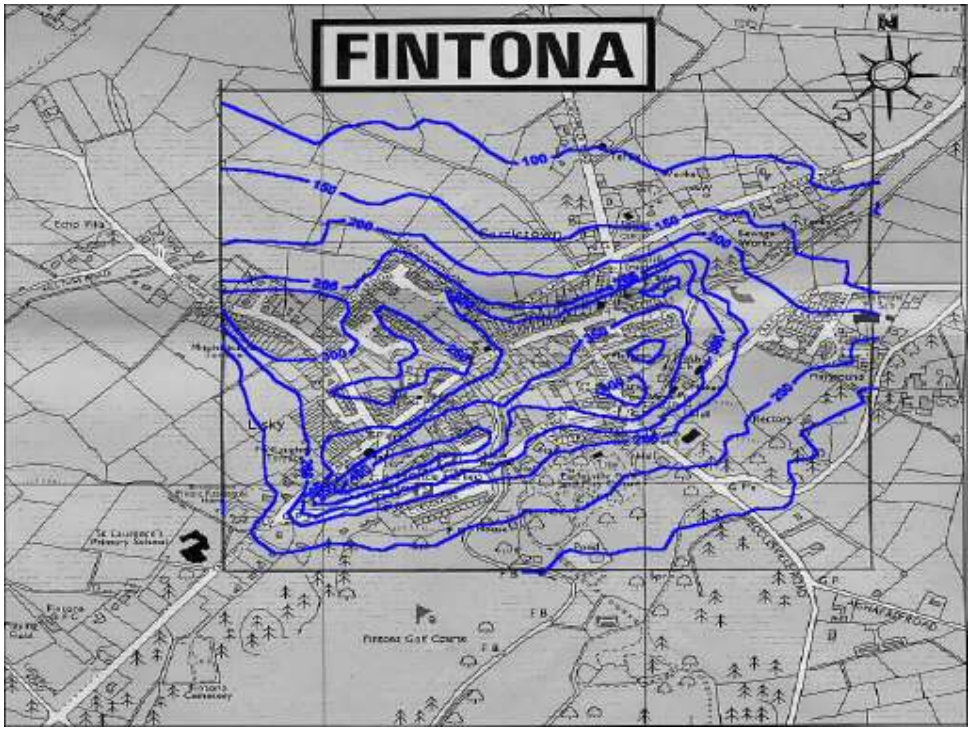
Predicted 99.9 percentile 15 minute mean SO2 concentrations in Townview (µg/m3).



Predicted 99.9 percentile 15 minute mean SO2 concentrations in Culmore (µg/m3).



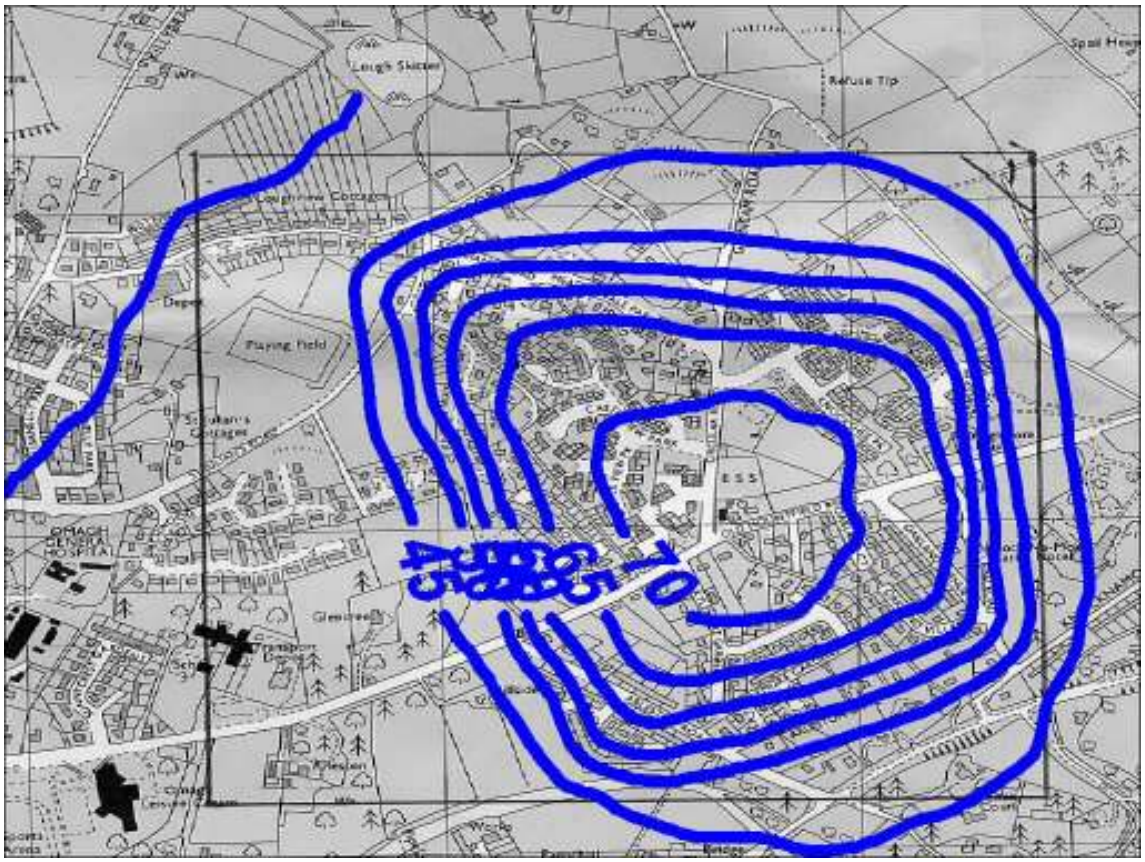
Predicted 99.9 percentile 15 minute mean SO2 concentrations in Fintona (µg/m3).



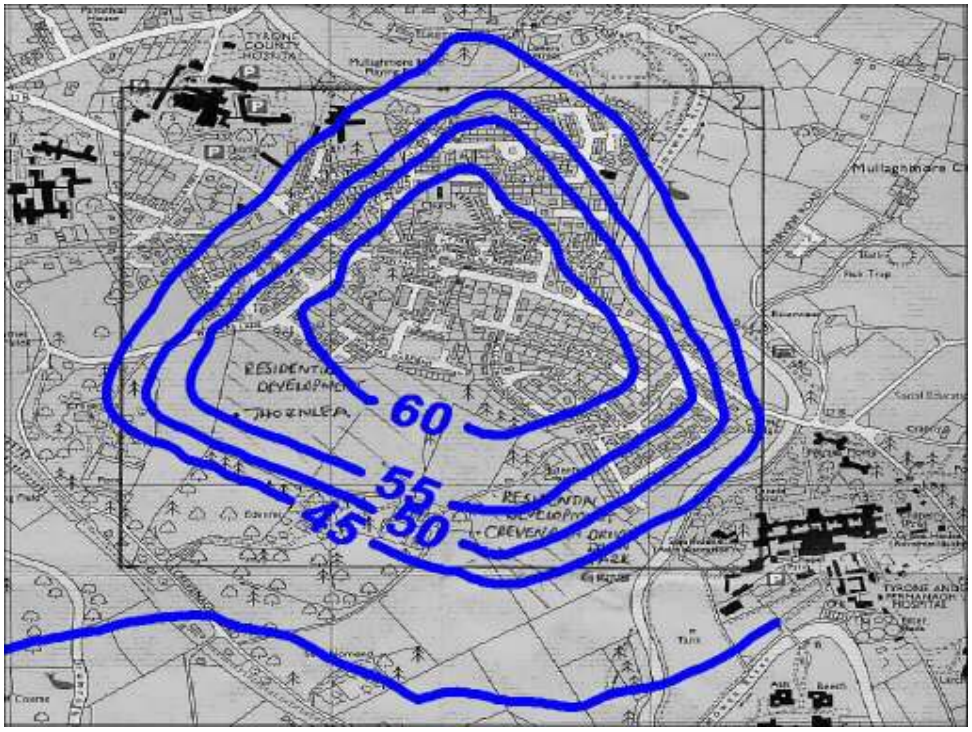
APPENDIX III

RESULTS OF MODELLING FOR PM_{10}

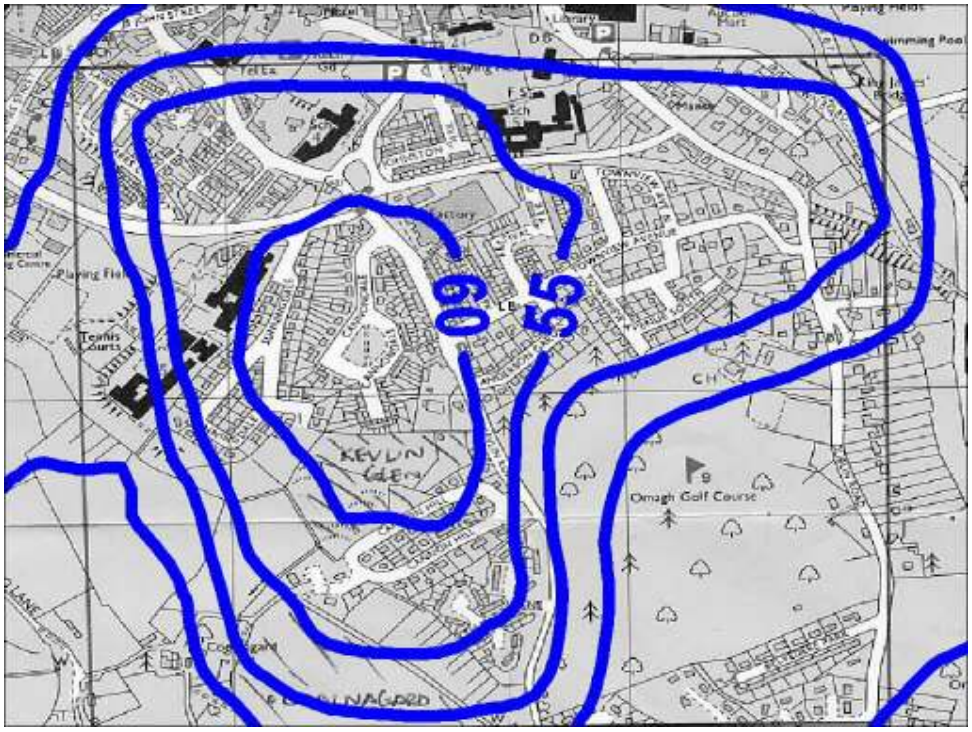
Predicted 90.4 percentile daily mean PM_{10} concentrations in Castleview ($\mu g/m^3$).



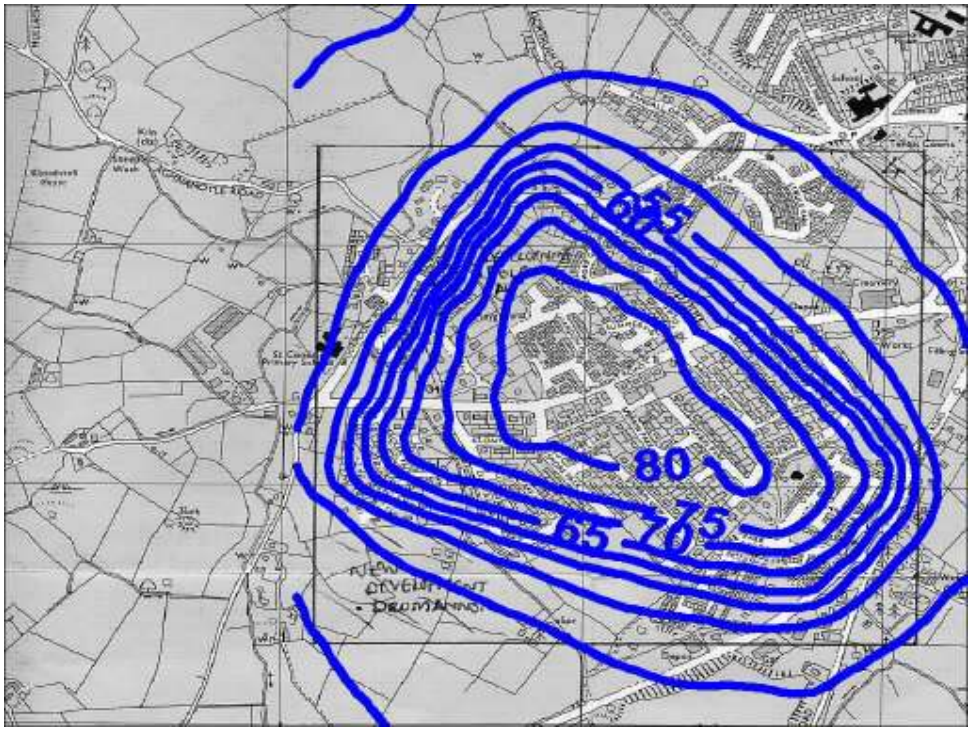
Predicted 90.4 percentile daily mean PM_{10} concentrations in Thornlea ($\mu g/m^3$).



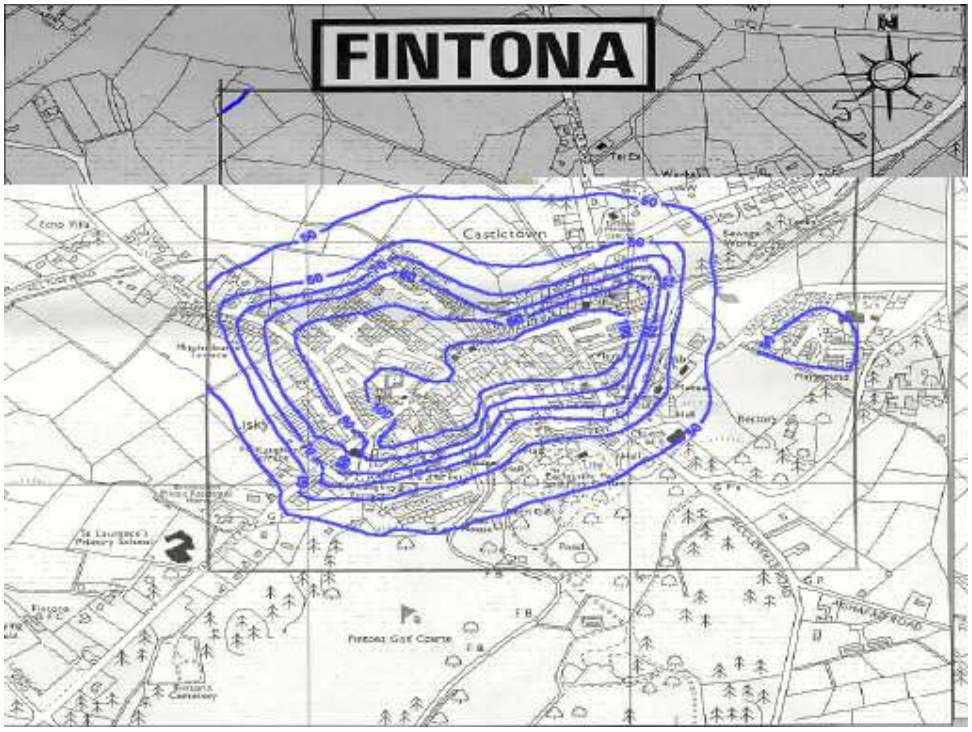
Predicted 90.4 percentile daily mean PM_{10} concentrations in Townview ($\mu g/m^3$).



Predicted 90.4 percentile daily mean PM_{10} concentrations in Culmore ($\mu g/m^3$).



Predicted 90.4 percentile daily mean PM_{10} concentrations in Fintona ($\mu g/m^3$).



APPENDIX IV

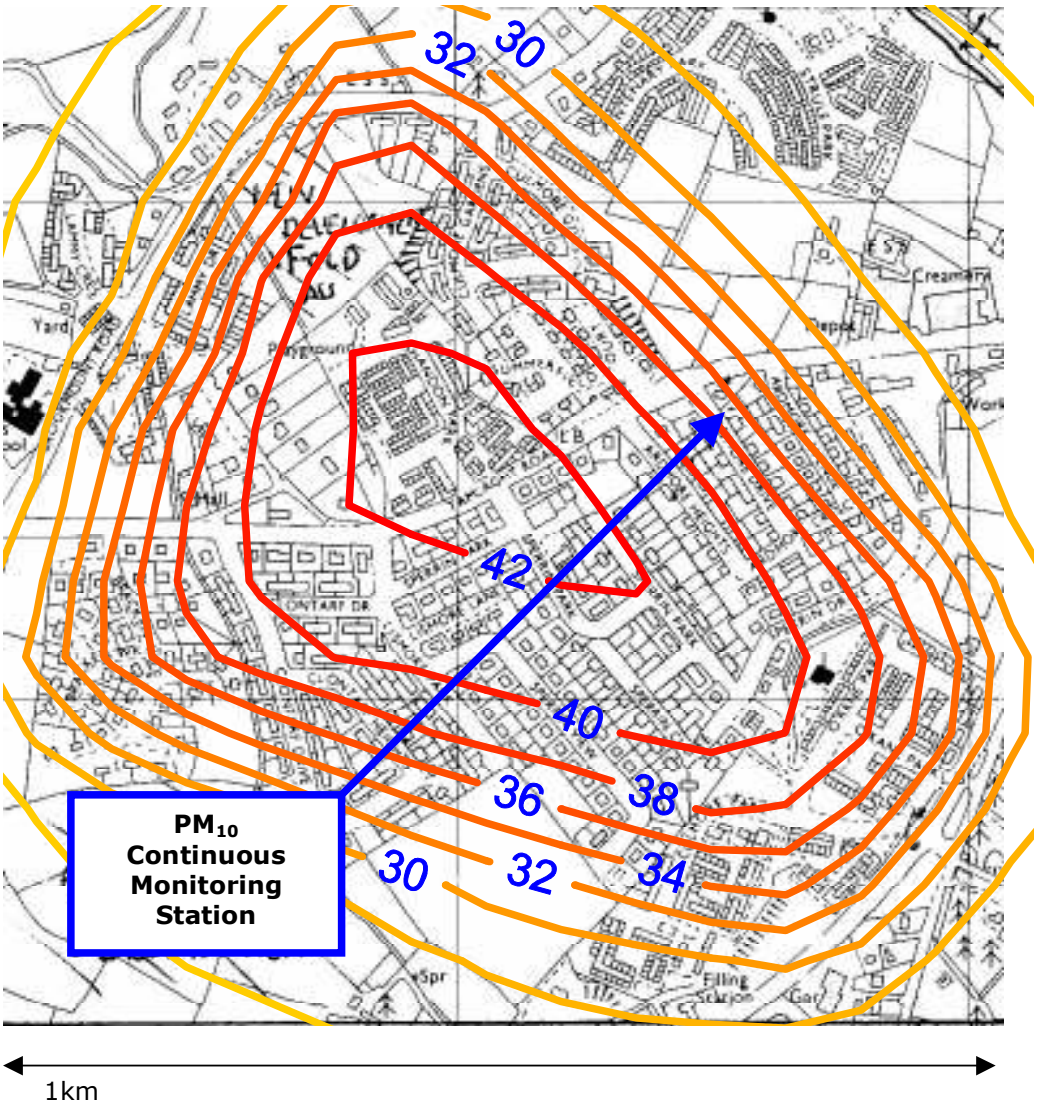
SUMMARY OF MONITORED PM_{10} CONCENTRATIONS AT CARRICKMORE

Diffusion tube results for Fermanagh			**Results in µg/m3**	
Month	**Site 1**	**2**	**3**	**4**
Apr-00	6.9	24.2	na	6.5
May-00	7.3	21.9	2.7	5.2
Jun-00	6.7	23.5	3.7	4
Jul-00	n/a	22.3	4	4
Aug-00	8.5	22.3	5.2	6.7
Sep-00	10	26.9	5	7.5
Oct-00	10.6	24.6	6	6.3
Nov-00	8.5	18.7	5.2	na
Dec-00	8.1	18.8	4	5.8
Jan-01	7.6	16.7	5.8	4.3
Feb-01	9.1	20.3	5.8	7.3
Mar-01	6.3	16.3	4	4.5
Apr-01	2.4	13.5	2.1	3.6
May-01	6.8	17.2	3.7	3.7
Jun-01	6.4	23.5	3.7	3.7
Jul-01	3.7	16.4	2.6	3
Aug-01	9	22.3	4.1	5.1
Sep-01	9.2	22.8	4.4	5.8
Oct-01	8.2	20.5	4.6	6
Nov-01		28.3	7	8.6
Average (uncorrected for bias) in 2001	7.5	19.8	4.3	5.1
Average (corrected for bias)	11.0	29.0	6.4	7.4
Prediction in 2005		26.3	5.8	6.7

APPENDIX V

RESULTS OF PM_{10} MODELLING

Remodelled PM_{10} concentrations in the Omagh - Culmore area in 1999. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will not be exceeded



Remodelled PM_{10} concentrations in the Fintona area in 1999. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will not be exceeded