AIR QUALITY REVIEW AND ASSESSMENT

MONITORING OF PM10 CONCENTRATIONS AT COOLESSAN, LIMAVADY

OCT 2004 - JAN 2005

Environmental Health Department
Limavady Borough Council

Introduction

Stage 1 Review and assessment

Council's first stage review and assessment was carried out in 1998 to determine if levels of eight pollutants were within the limits set out in the National air quality objectives. These eight pollutants and their respective objective levels are set out in the table 1 below:

Table 1: 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 μgm^{-3}	Running annual mean	31.12.2003
	3.25 μgm^{-3}	Running annual mean	31.12.2010
1,3 Butadiene	2.25 μgm^{-3}	Running annual mean	31.12.2003
Carbon Monoxide	10.0 mgm^{3}	Maximum daily running 8-hour mean	31.12.2003
Lead	0.5 μgm^{-3}	Annual mean	31.12.2003
	0.25 mgm3	Annual mean	31.12.2008
Nitrogen Dioxide[1]	200 μgm^{-3} no to be exceeded more than 18 times a year	1 hour mean	31.12.2005
	40 μgm^{-3}	annual mean	31.12.2005
Particles (PM_{10})[2] **Gravimetric**[3]	50 μgm^{-3} not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 μgm^{-3}	annual mean	31.12.2004
Sulphur Dioxide	350 μgm^{-3} not to be exceeded more than 24 times per year	1 hour mean	31.12.2004
	125 μgm^{-3} not to be exceeded more than 3 times per year	24 hour mean	31.12.2004
	266 μgm^{-3} not to be exceeded more than 35 times per year	15 minute mean	31.12.2005

Notes

1. **The objectives for nitrogen dioxide are provisional.**
2. **There are likely to be new particles objectives for 2010, not in regulation at present, expected after the review of the EU's first Air Quality Daughter Directive (2004).**
3. **Measured using the European gravimetric transfer standard or equivalent.**

The Stage 1 review and assessment indicated that exceedences of the nitrogen dioxide, sulphur dioxide and particulate matter objective levels may be possible within the Borough.

This report will focus on the methodology used to establish if levels of pollutants associated with the burning of solid / smokeless fuel exceed the national air quality objectives.

Fuel Use Survey

To determine the effect the burning of solid / smokeless fuel was having on PM_{10} and SO_2 concentrations Council commissioned a fuel use survey. This was carried out on Council's behalf by Foyle Regional Energy Agency (FREA). The survey was carried out in three areas of the Borough,

Area 1: Limavady : included the wards of Coolessan, Enagh, Greystone

Area 2: Limavady: encompassed the wards of Roeside, Forest and Aghanloo

Area 3: Dungiven: Almost 90% of the village of Dungiven was included in the survey

The technical guidance contained within the original LAQM.TG4(00) stated that where more than three hundred properties within a $1km^2$ grid square were burning solid/smokeless fuel it was likely that the objective level would be exceeded. This guidance was revised and stated that if more than 50 dwellings within a $0.5km^2$ grid used solid / smokeless fuel the PM_{10} thresholds could be exceeded. The areas surveyed were three residential areas each 1km x 1km in size and comprised both private and public sector housing. Housing densities within the three areas selected varied as did the age of properties. The survey comprised a 25% sample and a 75% response rate was achieved. The results of the survey are contained in Table 2.

Table 2
Summary of fuel use survey

Area No.	Area	Area Density	Sample (25%)	Target Response rate	Achieved rate	Not at home/ refused
1	Limavady	1471	368	276	276	518
2	Limavady	663	166	126	128	290
3	Dungiven	841	210	158	164	389
	Total	2975	744	560	568	1197

Results

Area 1: Limavady

- **29% of households surveyed within this area used coal/ solid fuel as their primary fuel. This equates to approximately 426 households over the whole of area 1.**
- **66% of dwellings used oil and,**
- **the remaining 5% used electricity**

Area 2: Limavady

- **5% of dwellings used solid/smokeless fuel as their primary source of heating which equates to only 31 dwellings in the entire 1km x 1km area.**
- **93% of properties used oil as their primary heating source, and**
- **2% used electricity**

Area 3: Dungiven

- **87% of dwellings used oil as their primary source of fuel**
- **13% used coal/ smokeless fuel as their main means of heating. This equates to approximately 108 dwellings in the area burning coal or smokeless fuel.**

The former pollutant specific guidance for SO_2 stated that where the density of households burning coal/ smokeless fuel exceeds 300 per $1km^2$ there was likely to be an exceedence of the air quality

objective for SO_2. The revised technical guidance which was issued in 2003 stated that this exceedence may occur where densities of coal/ smokeless fuel burning properties were greater than 100 in a 500 x 500 m area.

On the basis of primary fuel use only it was evident that the thresholds as set out in the technical guidance were possibly exceeded in two areas, namely Area 1 in Limavady and Area 3 in Dungiven. With this guidance in mind it was felt that dispersion modelling for PM_{10} and SO_2 should be undertaken within Area 1 in Limavady and in Area 3 in Dungiven. This modelling would predict pollutant concentrations for 2005.

With regard to PM_{10} and domestic solid fuel use the first stage review and assessment suggested that further investigation was required to establish if levels were likely to be exceeded and to establish if the air quality objective could be achieved by 2005. The pollutant specific guidance for PM_{10} (as revised) advised that the risk of exceedence of the 2005 objective may arise where significant coal/smokeless fuel burning occurs. It recommends that in areas where more than 50 dwellings in 500m x 500m burn solid fuel as their primary source of heating further investigation is required. Dispersion modeling was carried out to establish if any pollutant hotspots were present within any of the two of the three areas surveyed.

Dispersion modelling

In light of the fuel use survey results dispersion modelling was conducted by NETCEN on Council's behalf to establish if significant levels of SO_2 and PM_{10} were present in Area 1 in Limavady and Area 3 in Dungiven.

Overview of the modelling approach

The dispersion model ADMS 3.1 developed by CERC was used to predict the PM_{10} and SO_2 levels in Limavady Borough. 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 volume sources 10m high. Emissions have been weighted with both seasonal and diurnal emission patterns. The seasonal pattern was calculated on a degree day basis to weight emissions to the colder periods of the year following the BREDEM model (BREDEM, BRE, 1985). Temperature data for each hour was taken from the 1999 Aldergrove meteorological data.

The modelled concentrations have then been added to estimated background concentrations (taken from the NAEI web site).

Model bias

As no continuous monitoring has been carried out within Limavady Borough a monitoring site at Springhill Park, Strabane was used as a reference site: e.g. 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 locations in Limavady. The purpose of this adjustment was to ensure that the modelled concentrations equalled the measured values at the monitoring site. A similar methodology was used in the Strabane study to Limavady.

Model validation

The calculations have not taken account of:

- **Uncertainties in the fuel use survey as only 15-20% of households were surveyed;**
- **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. It is unlikely that housing stock/ fuel use within these areas will change significantly over the next few years.

Results of modelling

Limavady: Area 1

Figure 1 shows predicted SO_2 concentrations in the Limavady Area 1. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentration will not be exceeded in any parts of the Borough. It has been assumed that domestic fuel burning in the area will not change between when the survey was carried out and 2004/5.

Figure 1 99.9 percentile 15 minute mean SO_2 concentrations for the Limavady grid (model results corrected for bias using monitoring data from Strabane)

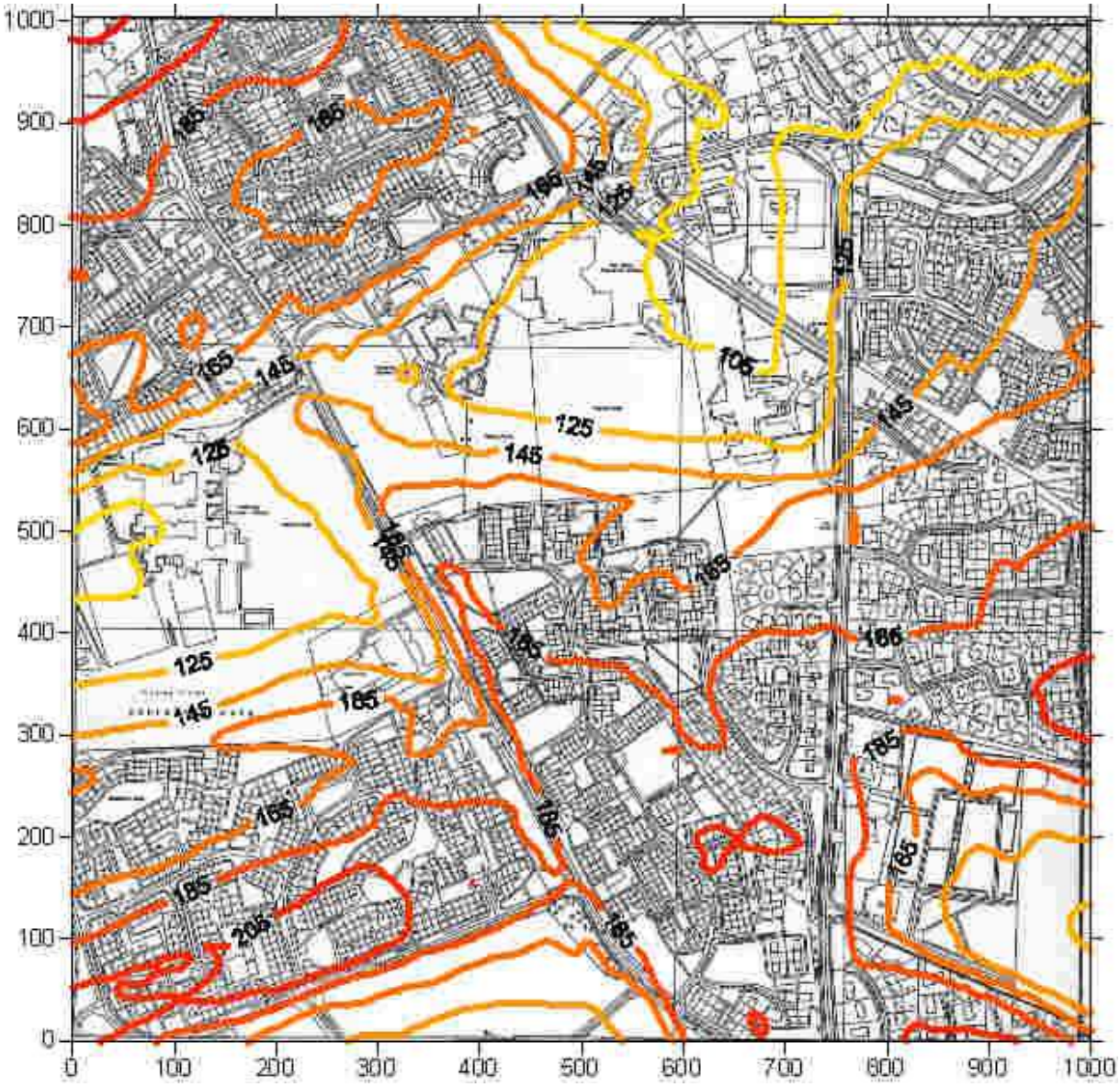
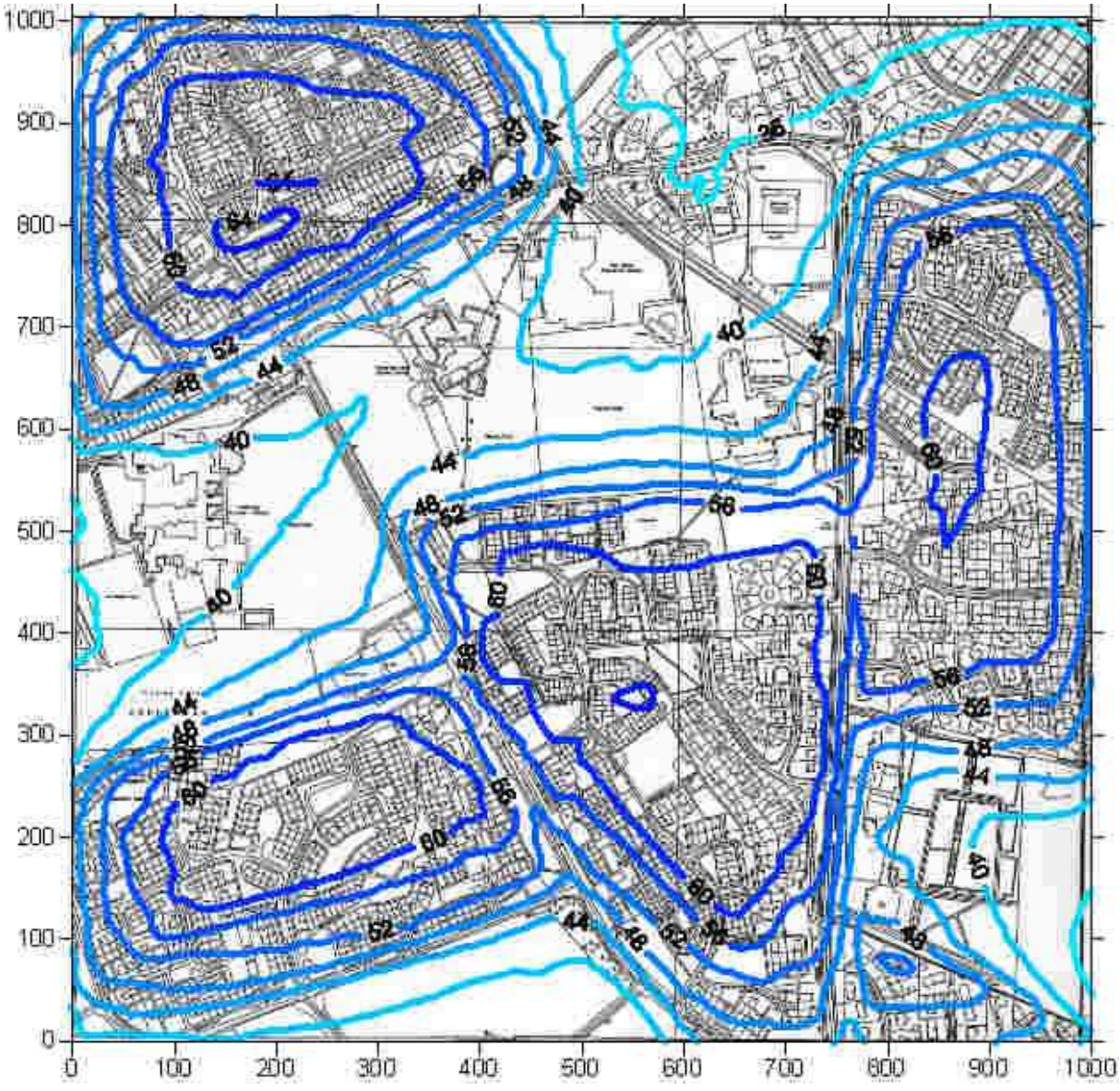


Figure 2 shows the predicted PM_{10} concentrations in the Limavady Area 1. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations in 2004 will be exceeded in some parts of this area. It has been assumed that domestic fuel burning in the area will not change between when the survey was carried out and 2004/5

Figure 2 Predicted 90.4 percentile daily mean PM_{10} concentrations for the Limavady grid (model results corrected for bias using monitoring data from Strabane in 1999)



Dungiven

Figure 3 shows modelled SO_2 concentrations in Dungiven. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentrations will not be exceeded in 2004/5.

Figure 3 99.9 percentile 15 minute mean SO_2 concentrations for the Dungiven grid (model results corrected for bias using monitoring data from Strabane)

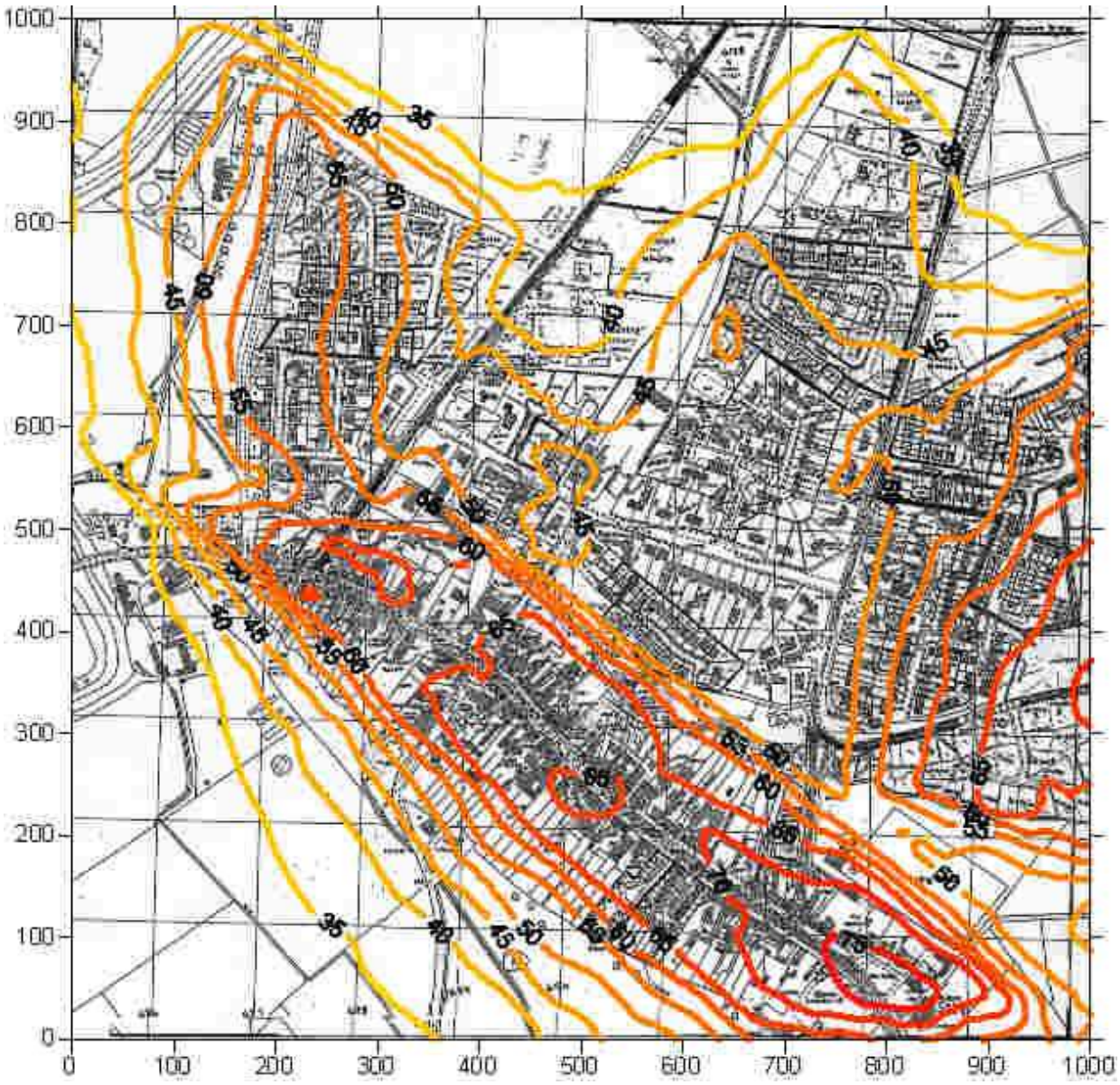
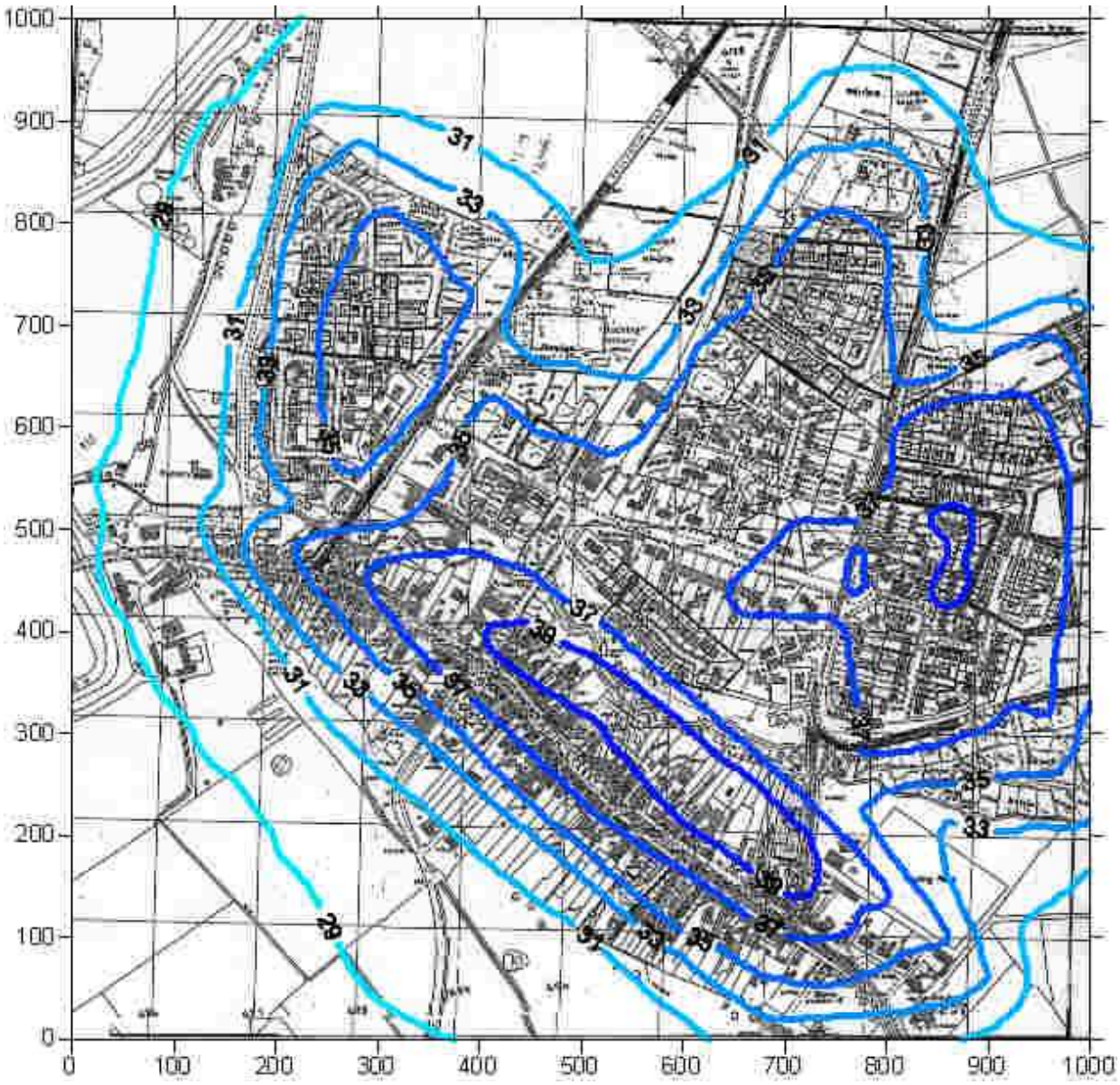


Figure 4 shows modelled PM_{10} concentrations in the Dungiven area in 1999. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will not be exceeded in this area.

Figure 4 90.4 percentile daily mean PM_{10} concentrations for the Dungiven grid (model results corrected for bias using monitoring data from Strabane in 1999)



Higher SO_2 and PM_{10} concentrations were predicted in the Limavady area because a greater proportion of households burn coal as their primary fuel source (29% of households) compared with in the Dungiven grid (13% of households) and because there is a greater total number of households situated in the Limavady area.

In summary, detailed modelling using ADMS version 3.1 has been undertaken at two locations where large amounts of solid/smokeless fuel is burnt. The modelling (corrected for bias) predicts that in both the Limavady area and in Dungiven exceedences of the SO_2 objectives are unlikely.

A comparison of the monitoring data recorded at Belfast East during April 2002 to April 2003 (when the continuous monitor at Springhill Park, Strabane was in operation) with data recorded during 1999 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.

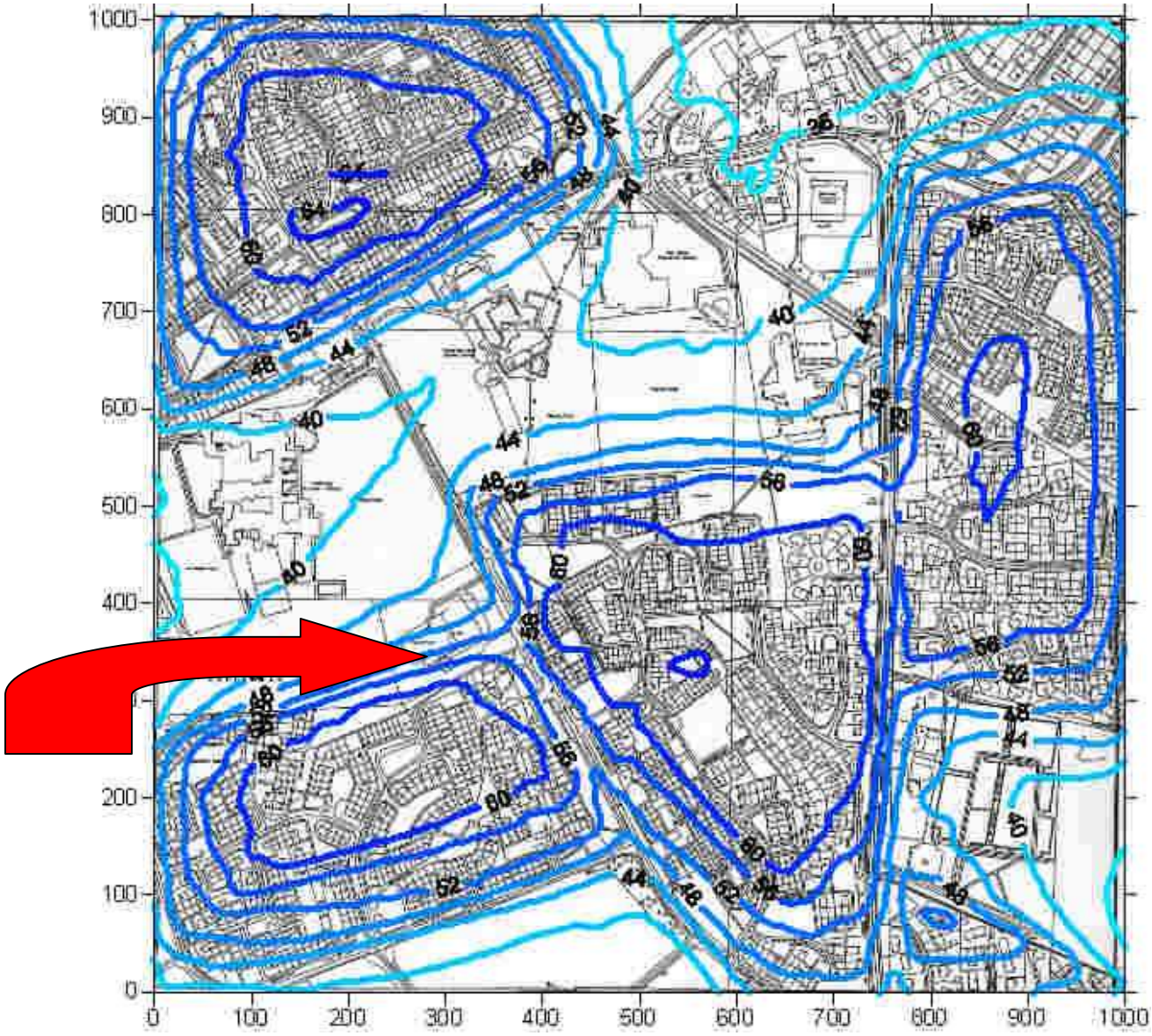
The modelling (corrected for bias) predicted that in Area 1 in Limavady an exceedence of the PM_{10} objectives in 2004 was likely. In Dungiven the model did not predict an exceedence of the objectives.

It is not recommended that an AQMA is declared for PM_{10} for Dungiven as no exceedence is expected. It is not recommended that an AQMA is declared for SO_2 in either area. However with regard to PM_{10} levels in Area 1 Limavady it was proposed to carry out continuous monitoring over a six-month winter period.

Site Selection

A TEOM was located at Council's civic amenity site which was on the periphery of one of the housing estates featured in Area 1. It was felt that this site was secure and that the positioning of the monitor would allow for capture of relevant data. Several other sites within this quadrant had been considered but were rejected as being either difficult to secure or unlikely to result in significant data. The location of the PM10 monitor is shown in Figure 5 below.

Figure 5 – Map of predicted 90.4 percentile daily mean PM_{10} concentrations for the Limavady grid (model results corrected for bias using monitoring data from Strabane in 1999) and location of PM10 monitor



Monitoring

Monitoring at the site commenced on 8 October 2004. Data has been downloaded manually at the site at regular intervals to ensure no data was lost.

Summary of results (October 2004 – January 2005)

Provisional PM_{10} data capture of 93% has been achieved over the monitoring period 07 October 2004 through 19 January 2005 (just over 3 months of data). Data capture during this period meets the DOENI target of 90% data capture for data sets used within the detailed stage of the review and assessment process.

PM_{10} concentrations remained in the DOENI "LOW" band across the monitoring period. The maximum daily mean concentration (TEOM) during the period was 28µgm^{-3}. Using the LAQM TG(03) TEOM to gravimetric default correction factor of 1.3, the maximum gravimetric equivalent daily mean concentration during the period was 36µgm^{-3} (28 x 1.3). Thus the DOE NI objective value of 50µgm^{-3} based on daily gravimetric equivalent data was not exceeded during the period. The objective allows up to 35 exceedences per year. The mean concentration of 17µgm^{-3} gravimetric equivalent (13 x 1.3) was below the DOE NI objective of 40µg m^{-3} for annual mean data.

The present data set relates to a monitoring period of just over the 3 month period. On the basis of the data recorded to date, it is judged as unlikely that either the daily mean or annual mean objectives will be exceeded at the Limavady Coolessan station.

Monitoring will continue until April 2005 but at this stage Council does not feel that the thresholds for PM_{10} will be exceeded within this area and subsequently the declaration of an AQMA is not required at this point in time. This position will be reviewed on completion of the monitoring and should the data suggest that an exceedence is likely Council will act accordingly.