Further Assessment of Air Quality at the Canal Street PM_{10} AQMA – Newry & Mourne District Council

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Experts in air quality management & assessment

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1 Introduction

1.1 This report is the Further Assessment of PM_{10} concentrations within the Canal Street Air Quality Management Area (AQMA), Newry & Mourne. The report is one of a series produced by, and on behalf of, Newry & Mourne District Council, which periodically review and assess air quality within the District. Newry & Mourne District Council accepts the conclusions of this report and intends to implement all recommendations.

The Air Pollutant of Concern

1.2 Fine Particles (PM_{10}) are associated with adverse effects on human health. Fine particles cause inflammation of the airways, worsening of the condition of people with heart and lung diseases, and may carry surface-absorbed carcinogenic compounds into the lungs (Defra, 2007).

The Air Quality Objectives

1.3 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality Standards Regulations (Northern Ireland) 2010. The relevant objectives for this assessment are provided in Table 1.

Table 1: Relevant Air Quality Objectives

Pollutant	Time Period	Objective
Fine Particles (PM_{10})	24-hour Mean	50 $\mu g/m^3$ not to be exceeded more than 35 times a year
	Annual Mean	40 $\mu g/m^3$

1.4 The objectives for PM_{10} were to be achieved by 2004, and continue to apply in all future years thereafter. The air quality objectives only apply where members of the public are likely to be regularly present for the averaging time of the objective (i.e. where people will be exposed to pollutants). The annual mean objectives for nitrogen dioxide and PM_{10} are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour objective for PM_{10} is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels.

Introduction to Review and Assessment

1.5 The Air Quality Strategy published by the Department of Environment Northern Ireland (DoE NI) and Department for Environment, Food, and Rural Affairs (Defra) provides the policy framework (Defra, 2007) for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

1.6 Review and Assessment is carried out as a series of rounds. Local Air Quality Management Technical Guidance (LAQM.TG(09)) (Defra, 2009) sets out a phased approach to the current round of Review and Assessment. This prescribes an initial Updating and Screening Assessment (USA), which all authorities must undertake. It is based on a checklist to identify any matters that have changed since the previous round. If the USA identifies any areas where there is a risk that the objectives may be exceeded, which were not identified in the previous round, then the Local Authority should progress to a Detailed Assessment.

1.7 The purpose of the Detailed Assessment is to determine whether an exceedence of an air quality objective is likely and the geographical extent of that exceedence. If the outcome of the Detailed Assessment is that one or more of the air quality objectives are likely to be exceeded, then an Air Quality Management Area (AQMA) must be declared. Subsequent to the declaration of an AQMA, a Further Assessment should be carried out, 1) to confirm that the AQMA declaration is justified and that the appropriate area has been declared, 2) to ascertain the sources contributing to the exceedence, and 3) to calculate the magnitude of reduction in emissions required to achieve the objective. This information can be used to inform an Air Quality Action Plan, which will identify measures to improve local air quality.

Key Findings of Previous Review and Assessment Reports

1.8 In June 2012 a Detailed Assessment was undertaken for the Canal Street area of Newry & Mourne due to monitored exceedences of the 24-hour mean objective for PM_{10}. Following this, an AQMA was designated in April 2013. The Detailed Assessment was based on analysis of monitoring data and concluded that the exceedences of the PM_{10} objective were as a result of the combined effect of traffic emissions in the street canyon and domestic heating sources. The boundary of the AQMA was thus selected based on the extent of the street canyon.

1.9 The Air Quality Action Plan is currently being drafted. The conclusions of this Further Assessment will be taken into account in the final document.

Scope

1.10 Guidance within LAQM.TG(09) (Defra, 2009) explains that a Further Assessment report allows authorities to:

- confirm their original assessment, and thus ensure they were correct to designate an AQMA in the first place;
- calculate more accurately what improvement in air quality, and corresponding reduction in emissions, would be required to attain the air quality objectives within the AQMA;
- refine their knowledge of sources of pollution, so that the air quality Action Plan may be appropriately targeted;
- take account of any new guidance issued by Defra and the Devolved Administrations, or any new policy developments that may have come to light since declaration of the AQMA;
- take account of any new local developments that were not fully considered within the earlier Review and Assessment work. This might, for example, include the implications of new transport schemes, commercial or major housing developments etc, that were not committed or known of at the time of preparing the Detailed Assessment;
- carry out additional monitoring to support the conclusion to declare the AQMA;
- corroborate the assumptions on which the AQMA has been based, and to check that the original designation is still valid, and does not need amending in any way; and
- respond to any comments made by statutory consultees in respect of the Detailed Assessment.

2 Study Area and AQMA Location

2.1 The Canal Street AQMA encompasses properties along Canal Street, from Barrack Street to Canal Quay (Figure 1). The majority of properties along Canal Street are residential, with relevant exposure for the 24-hour mean objective at ground and upper-floor levels.

2.2 In addition to the AQMA location, a number of additional locations have been assessed, these include residential properties at Erskine Street, Catherine Street, and New Street.

Figure 1: Canal Street AQMA

3 Developments since Declaration of the AQMA

New and Proposed Local Developments

3.1 A high number of heavy duty vehicles are known to use Canal Street even though there is a 7.5 ton weight limit (except for access). In 2012, some bus routes were diverted so that most buses would no longer use Canal Street.

3.2 There have recently been 10 residential properties demolished within the AQMA, which leaves land for future developments. A new school is currently being built at Catherine Street, but traffic is unlikely to significantly change as it will replace a previous school at this site.

4 New Monitoring and Modelling Data

New Monitoring

4.1 The Council maintains three automatic air quality monitoring sites within its district that measure concentrations of PM_{10}. One of these automatic monitors is situated within the AQMA at Canal Street.

Automatic Monitoring Data

4.2 The automatic monitoring locations within Newry & Mourne are shown in Figure 2. Monitoring data for 2009 to 2013 are presented in Table 2. The data from all three monitors were subject to QA/QC inspection by Netcen (AEA Technology Plc) during 2009 – 2013. The Trevor Hill and Monaghan Row instruments are R & P TEOM (FDMS) and data from these monitors have therefore not required any corrections. The Canal Street instrument is a R & P TEOM and data have been corrected using the Volatile Correction Method (VCM).

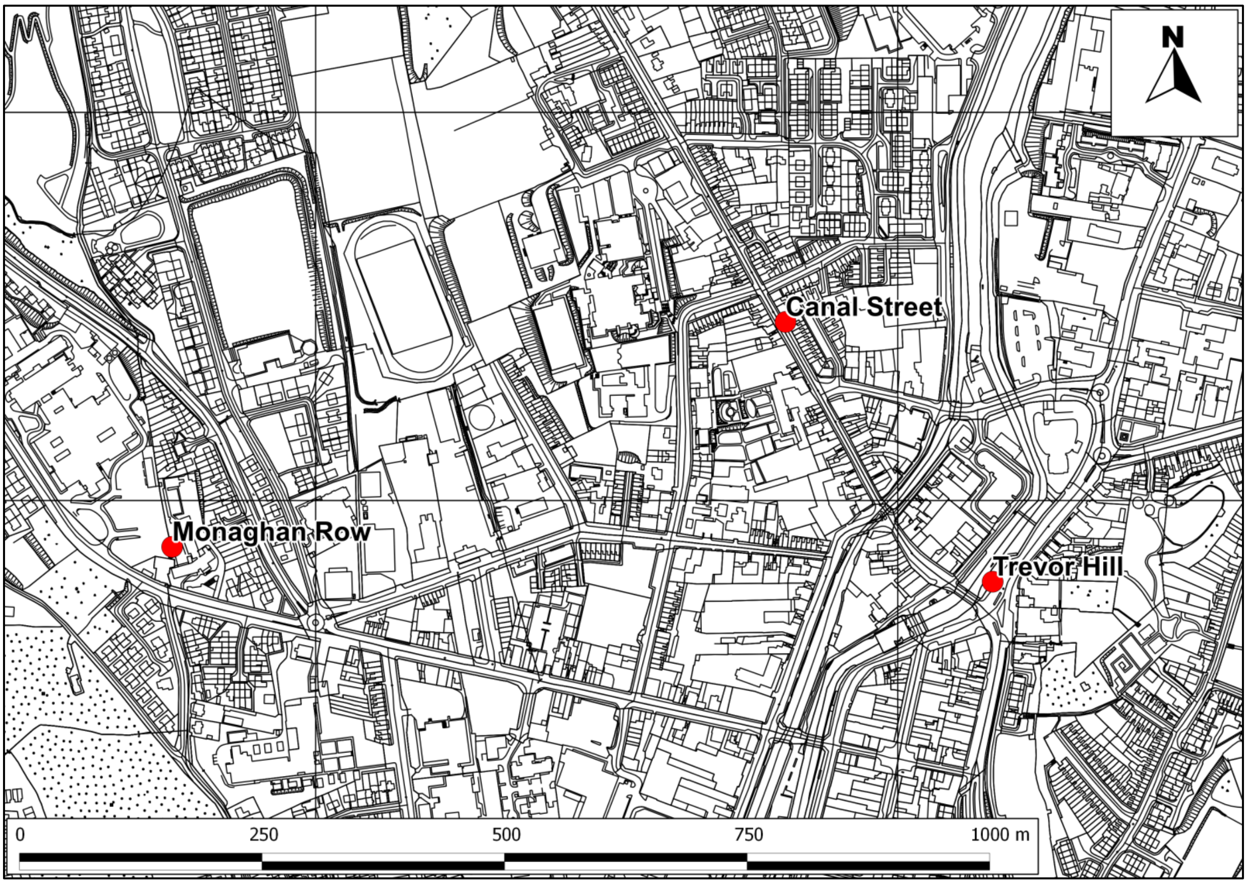

Figure 2: Monitoring locations in Newry & Mourne.

Figure 3: Canal Street Monitoring location.

Table 2: Automatic Monitoring Data within Newry & Mourne [a]

Site Name	Site Type	Within Canal Street AQMA	2013 Data Capture	2009	2010	2011	2012	2013
Annual mean PM_{10} ($\mu g/m^3$)								
Canal Street	Roadside	Y	100	31 [b]	37	30	26	29
Monaghan Row	Urban Background	N	100	14	21	14	14	18
Trevor Hill	Roadside	N	97	24	31	22	18	22
Objective				**40**				
No. of Days > 50 $\mu g/m^3$								
Canal Street	Roadside	Y	100	21 [b]	**73**	**38**	27	**42**
Monaghan Row	Urban Background	N	100	6	16	13	7	13
Trevor Hill	Roadside	N	97	6	**45**	26	10	21
Objective				**35**				

[a] Values in bold are exceedences of the objective.

[b] Values are based on only a partial year of data collection.

4.3 The Canal Street monitoring site has measured exceedences of the 24-hour mean objective within the study area in 2010, 2011 and 2013. There is relevant residential exposure at ground-floor level adjacent to this monitoring site.

4.4 Figure 4 shows the daily and seasonal variation of measured PM_{10} concentrations in 2012 at the Monaghan Row and Canal Street monitoring sites. These trends are similar to the 2011 measured concentrations presented in the 2012 Detailed Assessment for Newry & Mourne (Newry & Mourne District Council, 2012), with higher concentrations measured in the evenings in winter and lower concentrations measured in the summer. The 2012 concentrations however, show high concentrations between 6 o'clock and 9 o'clock in the morning in spring, which was not observed in the 2011 measurements.

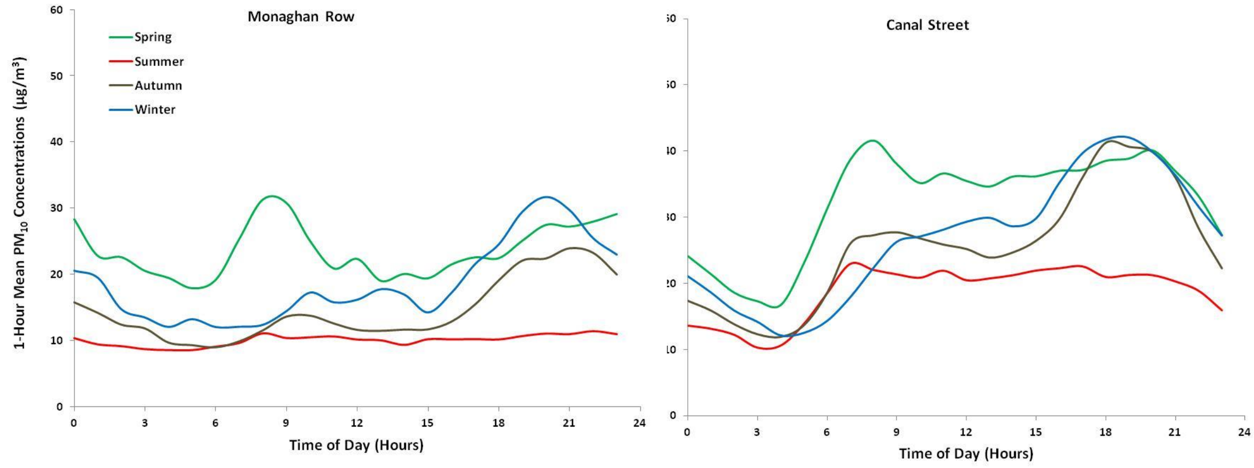

Figure 4: Seasonal Average Diurnal Profiles of 1-Hour Mean Measured PM_{10} Concentrations at Monaghan Row and Canal Street Monitoring sites.

New Modelling

4.5 24-hour mean concentrations of PM_{10} from road and domestic chimney sources in 2012 have been modelled within the study area using the ADMS dispersion models. Further details of the dispersion modelling methodology and details of the input parameters are set out below and in Appendix 1.

4.6 The model has been verified by comparing predicted 24-hour mean PM_{10} concentrations with measurements made by the Canal Street monitor, and the model output adjusted accordingly. Details of model verification are presented in paragraphs 4.12 to 4.16.

Road Traffic Impacts

4.7 The contribution of emissions from road traffic to the 24-hour mean concentrations of PM_{10} within the study area has been modelled using ADMS Roads (version 3.2). The following input data were used:

- Newry & Mourne District Council provided 15-minute traffic flows, split into a number of vehicle classes, which were used to derive AADT flows. There will be uncertainty associated with these traffic data, however, the conclusions of the assessment are unlikely to be particularly sensitive to this uncertainty. All of the traffic flows used in this assessment have been assumed to have the national urban diurnal flow profiles published by the Department for Transport (DfT, 2009);
- Detailed fleet composition data were provided, and therefore the emissions from each vehicle class were calculated using Defra's Emission Factors Toolkit (EFT) for each vehicle class

individually. The EFT includes emissions from brake wear, tyres, and road abrasion but not re-suspension[1];

- Speeds are based on the speed limit, but also take into account the road layout and proximity to a junction;
- The locations of roads and buildings (including road width) were obtained using mapping information provided by Newry & Mourne District Council; and
- Meteorological data from Glenanne for 2012 have been used. Complete wind and temperature data were available, however, cloud cover was missing for some of the time and this was provided by data from Aldergrove.

Domestic Chimney Impacts

4.8 The contribution of emissions from domestic chimneys to the 24-hour mean concentrations of PM_{10} within the study area has been modelled using ADMS (version 5). The following input data were used:

- A fuel use survey was undertaken by Newry & Mourne Council in 2014 giving details of primary and secondary fuel sources for properties within and close to the AQMA (Newry & Mourne District Council, 2014). For both the primary and secondary fuel sources, the fuel type, quantity and usage have been provided. Based on this, the average fuel use of each fuel type has been derived. However, approximately 21% of properties that use natural gas as their primary fuel source stated they used more than the upper limit of the quantities available within the survey[2]. Therefore, the average fuel use for natural gas has been calculated by taking the total number of kilowatt hours that natural gas was used in Northern Ireland in 2009 (DECC, 2011) and factoring it to the number and type of households in Newry & Mourne[3]. The total PM_{10} emission has been calculated as the average fuel use for each fuel type multiplied by the NAEI PM_{10} emission factor for each fuel type in 2011;
- Typically, a bag of 'coal' consists of various proportions of anthracite, petroleum coke, coke, bituminous coal and a binder[4]. Newry & Mourne is a smoke control area and businesses are only allowed to sell authorised fuels (Northern Ireland, 2013). The existing coal suppliers in

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1 Uncertainties in road PM_{10} emissions are accounted for through the model verification process.

2 Whilst similar upper limit issues exist with solid fuels and oil within the survey, the average fuel use calculated using data from the Department of Energy & Climate Change (DECC) and the Northern Ireland Statistics and Research Agency (NISRA) gives a sensible value slightly above the upper limit and has therefore been used as the upper limit.

3 The number and types of households in Northern Ireland have been taken from the Northern Ireland Statistics and Research Agency (NISRA, 2011). The number of households in Newry & Mourne has been taken from the 2013 district housing plan for Newry & Mourne (NIHE, 2013) and the proportion of different household types in Newry & Mourne has been taken from the fuel use survey (Newry & Mourne District Council, 2014).

4 A bag of 'coal' typically consists of a mixture of fuel types, even if the coal is all sourced from the same mine, due to the natural formation of coal. Additionally, manufactured 'coal' is often created by blending together different fuel types to create a better performing fuel (i.e. to make it burn longer and produce less smoke). For example, Ancit briquettes (manufactured by Coal Products Ltd) consists of 60-95% anthracite, up to 30% petroleum coke, up to 15% bituminous coal and an organic binder.

Newry & Mourne currently sell a wide variety of these authorised fuels. It has thus been assumed that all of these fuels are available and used by residents in Newry & Mourne. The composition of each authorised fuel is described in the Statutory Rules of Northern Ireland Clean Air Order (Northern Ireland, 2013)., The average percentage of anthracite, petroleum coke, coke, bituminous coal has been calculated for these authorised fuels, but only where more than 50% of an authorised fuel consists of bituminous coal (i.e. highly smoky). The NAEI PM_{10} emission factors for each of these fuel types have been combined proportionally according to these percentages and used as the emission factor to calculate the total PM_{10} emission for bituminous coal. Similarly, where less than 50% of an authorised fuel consists of bituminous coal (i.e. almost smokeless), the average percentage of anthracite, petroleum coke, coke, bituminous coal has been calculated for these authorised fuels. The NAEI PM_{10} emission factors for each of these fuel types have been combined proportionally according to these percentages and used as the emission factor to calculate the total PM_{10} emission for smokeless coal.

- The total emission per dwelling has then been calculated as the total of the PM_{10} emissions of each fuel type. This equates to 1.126 kg of PM_{10} per year per dwelling;
- The heating demand of domestic properties will vary throughout the year and diurnally. To take this into account, a generic heating demand profile) (University of Strathclyde, 2014) has been used to calculate a heating load for each hour of the year. The emission for an average domestic property has then been calculated for each hour of the year using the average load for each hour, and these hourly emissions have been used in the model;
- A nominal assumption has also been made regarding the number and height of chimney pots[5]. It has been assumed that each property will have two operational chimney pots[6], with a combined diameter of 0.42 m;
- A nominal temperature of 140 °C and nominal flow rate of 0.3 m^3/s has also been assumed. In practice, this temperature is likely to over-predict the temperature at the release points and thus under-predict the impacts of the fuel burning[7];
- All domestic chimneys within 100 m of the AQMA and the Monaghan Row monitoring site have been included as individual point sources within the ADMS model. All other domestic chimneys have been combined and input into the model as area sources;
- The downwash effect of emissions from chimneys over buildings has been included in the model for all buildings with chimneys adjacent to Canal Street. The locations and dimensions

[5] In the model, the PM_{10} emissions from each property are the same regardless of the number of chimney pots that are assumed to operate. The number of pots does, however, affect the initial dispersion.

[6] Most domestic properties near Canal Street are 10 m high and have chimneys with six pots. Each pot usually corresponds to a separate flue and fireplace, however it is unlikely that more than two fireplaces would be operational at any one time.

[7] Uncertainties in the chimney modelling assumptions are addressed, to some extent, through model verification.

of the buildings were obtained using mapping information provided by Newry & Mourne District Council; and

- Meteorological data from Glenanne for 2012 have been used. Complete wind and temperature data were available, however, cloud cover was missing for some of the time and this was provided by data from Aldergrove.

Modelling Uncertainty

4.9 Uncertainty is inherent in all measured and modelled data. All values presented in this report are the best possible estimates, but uncertainties in the results might cause over- or under-predictions. All of the measured concentrations presented have an intrinsic margin of error. Defra (2011a) suggests that this is of the order of plus or minus 10% for automatic measurements. This uncertainty will be increased by the use of the VCM model to adjust the TEOM results for the Canal Street monitoring site to be gravimetric equivalent. The model results rely on traffic data provided by Newry & Mourne District Council and on numerous assumptions made about domestic chimneys. Any uncertainties inherent in these data will carry into this assessment. There will be additional uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example: it has been assumed that wind conditions measured at Glenanne during 2012 will have occurred throughout the study area during 2012; and it has been assumed that the dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain. An important step in the assessment is verifying the dispersion model against the measured data. By comparing the model results with measurements, and correcting for the apparent under-prediction of the model, the uncertainties can be reduced.

4.10 The limitations to the assessment should be borne in mind when considering the results set out in the following sections. While the model should give an overall accurate picture, i.e. one without bias, there will be uncertainties for individual receptors. The results are ‘best estimates’ and have been treated as such in the discussion.

4.11 It should also be borne in mind that some bus routes were diverted in 2012 so that most buses would no longer use Canal Street. The traffic data used in this assessment is based on 2014 surveys, when there would be fewer buses than in the assessment year (2012). Therefore, this introduces a slight uncertainty with the apportionment of road traffic emissions for 2012.

Model Verification

4.12 In order to ensure that the modelling accurately predicts local concentrations, it is necessary to verify the model against local measurements. The verification methodology is described below.

4.13 The ADMS-Roads and ADMS 5 models have been run to predict hourly mean road-PM_{10} and chimney-PM_{10} concentrations, respectively, during 2012 at the Canal Street and Monaghan Row automatic monitoring sites.

4.14 The model outputs of road-PM_{10} (i.e. the component of PM_{10} coming from road traffic) and chimney-PM_{10} (i.e. the component of PM_{10} coming from chimneys) have been compared with the 'measured' total PM_{10}. It is impossible to directly disentangle the road-PM_{10} from the chimney-PM_{10} and background PM_{10} that make up the measured total PM_{10} at the Canal Street automatic monitoring site, since the monitor only measures total PM_{10} concentrations. The Monaghan Row automatic monitoring site, however, is located over 35 m from the nearest road, where the component of road-PM_{10} would be minimal and the total measured PM_{10} concentration would essentially consist of the chimney-PM_{10} component and the background PM_{10} concentration. The modelled chimney-PM_{10} concentrations have been subtracted from the total measured PM_{10} concentrations at Monaghan Row to derive background PM_{10} concentrations, which have been assumed constant throughout Newry & Mourne.

4.15 The modelled road-PM_{10} and chimney-PM_{10} concentrations at the Canal Street automatic monitoring site have been added to the derived background concentrations to get total modelled PM_{10} concentrations. Adjustment factors for road-PM_{10} and chimney-PM_{10} were determined by comparing these total modelled PM_{10} concentrations with the total measured PM_{10} concentrations at the Canal Street automatic monitoring site. The comparison of total modelled and measured PM_{10} was initially based on hour-by-hour concentrations which resulted in a large scatter (RMSE of 14.5). Therefore, percentile concentrations have been compared[8] to reduce the scatter (see Figure 4). Daily mean concentrations have been used for the percentile values to allow a direct verification against the measured 90.4^{th} percentile concentration at the Canal Street monitoring site. A 90.4^{th} percentile (>50 $\mu g/m^3$) represents the exceedence level for the PM_{10} daily mean objective.

4.16 A series of different values were applied to the road-PM_{10} and chimney-PM_{10} concentrations to determine the best fit between the adjusted modelled total PM_{10} concentrations and the measured PM_{10} concentrations at the Canal Street monitoring site. The final choice of adjustment factors has been based on two criteria; a) a high r^2 value between all the ranked concentrations and b) a high correlation in the 80^{th} and 100^{th} percentile range. Although Figure 5 shows that the adjusted modelled concentrations become higher than the measured concentrations at both small and large daily mean concentrations, the concentrations close to the 90.4^{th} percentile match very well. Since the intent is to establish whether concentrations are exceeding the objective, it is most important to ensure the agreement between modelled and measured concentrations close to the objective level (90.4^{th} percentile). This verification approach results in an adjustment factor of 7 for road-PM_{10} being used with the chimney-PM_{10} being left unadjusted. This implies that the unadjusted model is under-predicting the road-PM_{10} contribution[9], which is a common experience with air quality models, and that the modelled chimney emissions are realistic.

8 i.e. the 20^{th} percentile of daily measured PM_{10} concentrations has been compared to the 20^{th} percentile of daily modelled PM_{10} concentrations.

9 The road-PM_{10} emissions will have been slightly underestimated, in any event, due to fewer buses being included in the model than there likely would have been in 2012 (see paragraph 3.1 for details).

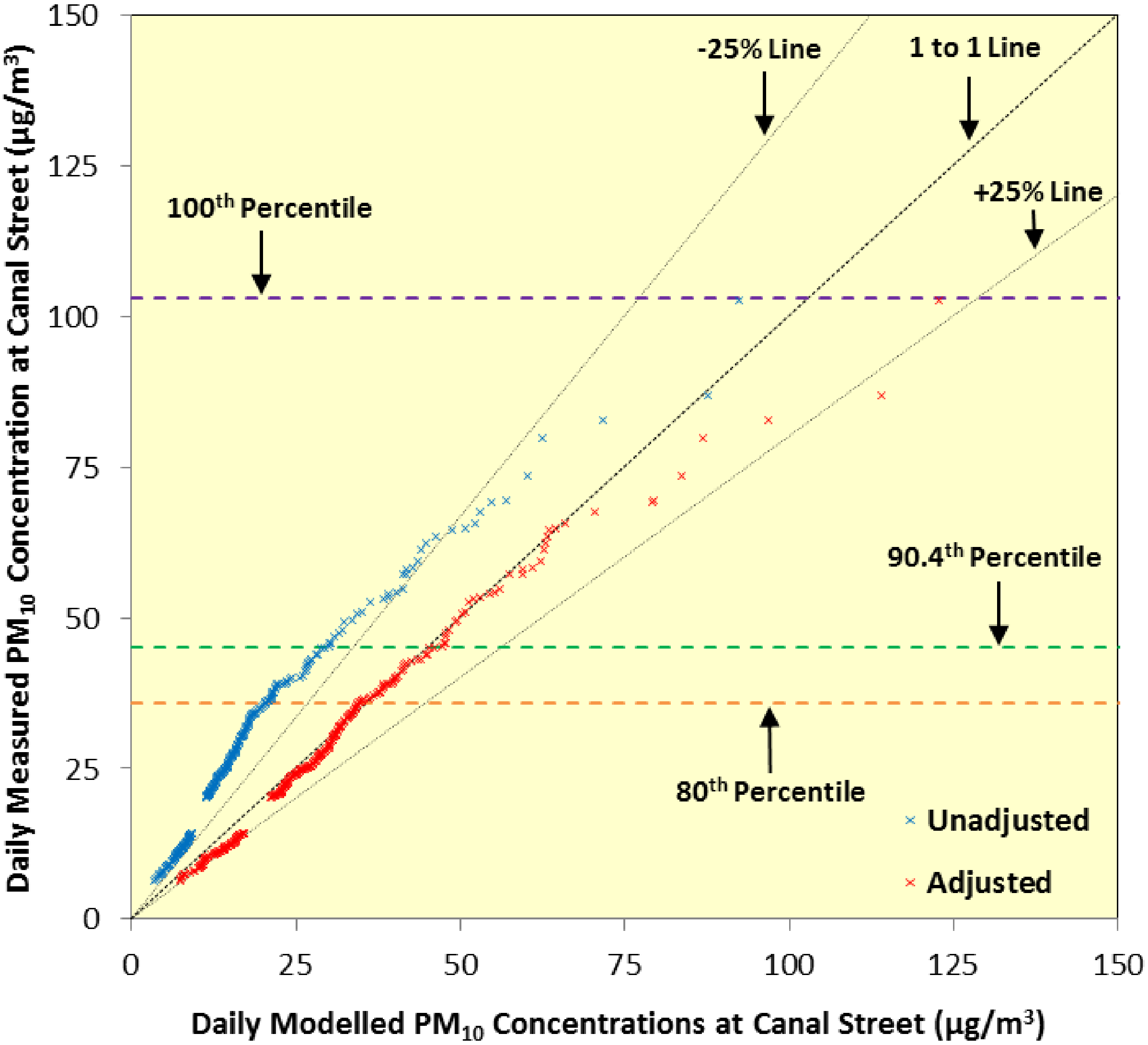

Figure 5: Comparison of Ranked Daily Measured and Modelled PM_{10} Concentrations at the Canal Street Automatic Monitoring site, Before and After Concentrations have been Adjusted.

4.17 Figure 6 shows the daily and seasonal variation of total modelled PM_{10} concentrations in 2012 at the Monaghan Row and Canal Street monitoring sites. These plots can be compared with the similar plots for measured concentrations shown in Figure 4. The very close similarity for Monaghan row is to be expected and the only difference is caused by 470 fewer hours being included in the modelled dataset (due to gaps in the meteorological dataset). The good agreement modelled and measured for Canal Street shows that the model is able to recreate the diurnal and seasonal profile in the measurements and adds confidence to the model results.

4.18 It might be argued that, despite the close agreement between the measured and the modelled concentrations, the contribution from local fuel burning may have been under-predicted and that this source has a stronger effect on both Monaghan Row and Canal Street than has been shown. If this is the case then, in subsequent sections of this report, concentrations which have been attributed to 'background' will contain some increment from local fuel burning. In any event, the background will contain the effects of fuel burning outside of the modelled study area. It should, though, be recognised that the background does not dominate the modelled profile at Canal Street (compare the data for Monaghan Row and Canal Street in Figure 6. Furthermore, objective exceedences are not being measured at Monaghan Row, only at Canal Street, where there is a strong road traffic component to the concentrations.

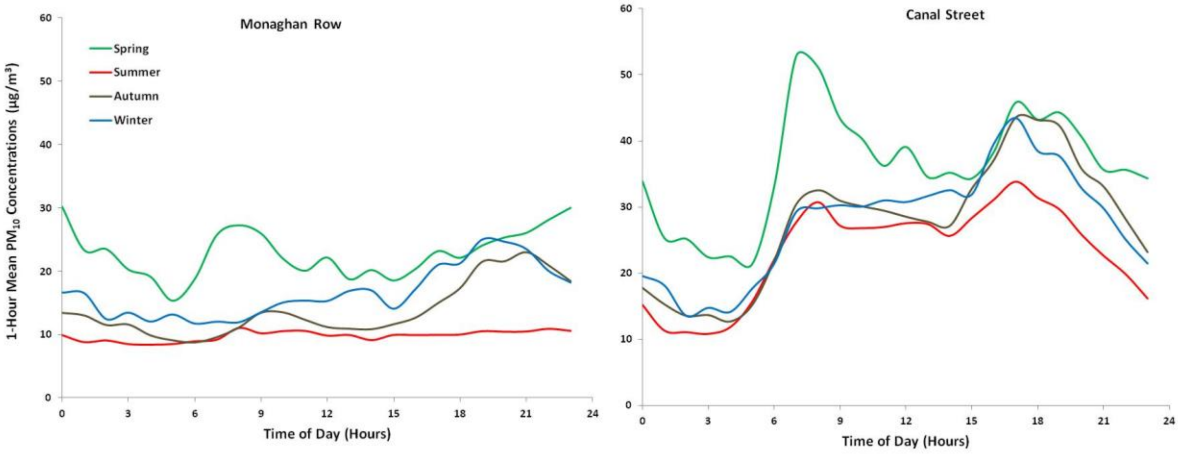

Figure 6: Seasonal Average Diurnal Profiles of 1-Hour Mean Total Modelled PM_{10} Concentrations at Monaghan Row and Canal Street Monitoring Locations.

Concentrations at Specific Receptors

4.19 Locations representing worst-case residential exposure along the road close to the Canal Street AQMA were selected for modelling. In total twenty-four residential receptor locations were selected. These receptor locations are shown in Figure 7.

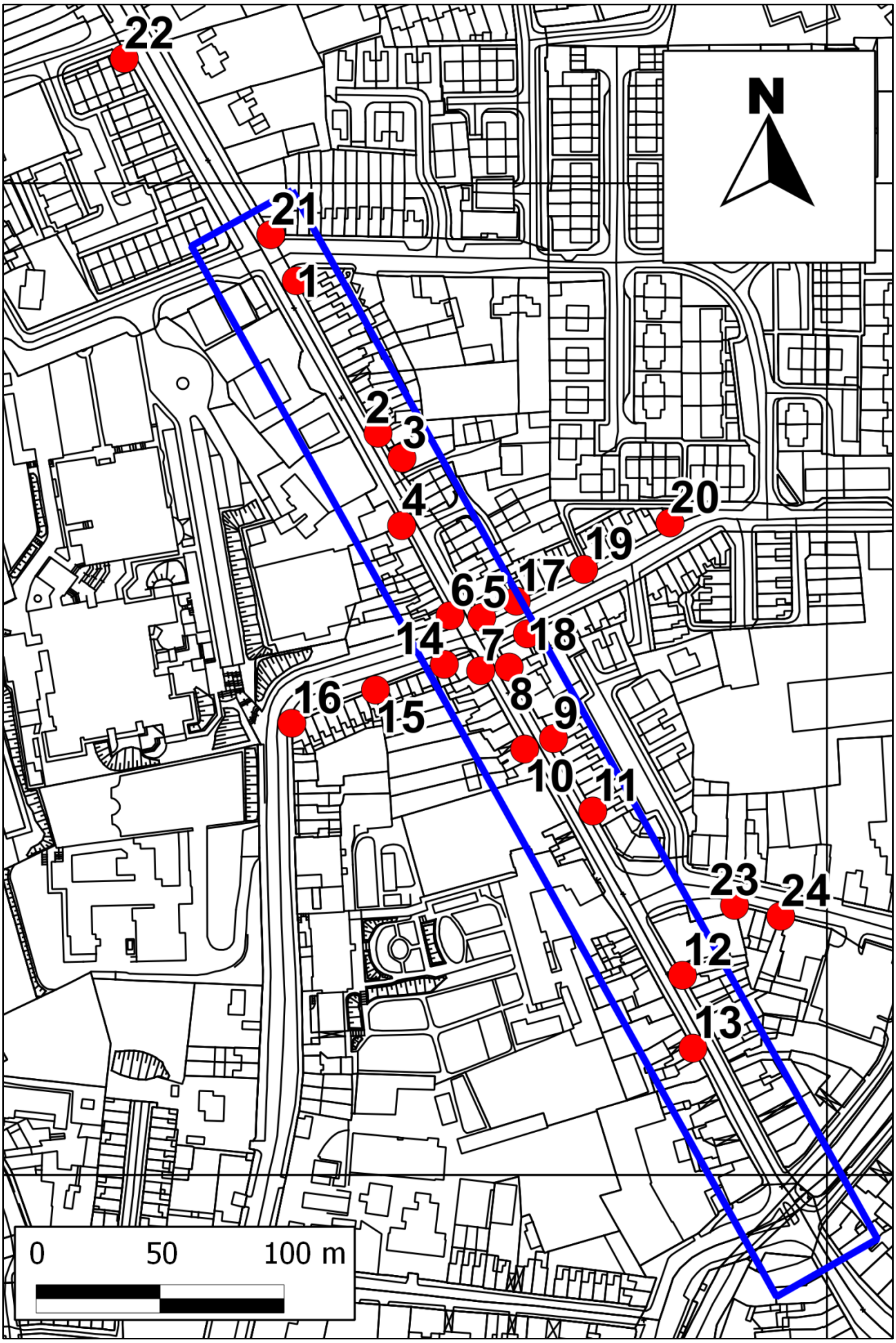

Figure 7: Receptor Locations (Red Circles) and AQMA Boundary (Blue Line).

4.20 Hourly-mean concentrations of road-PM_{10} and chimney-PM_{10} have been predicted at each receptor location for the year of 2012, at three different heights to represent the ground, first and second floors. The road-PM_{10} concentrations have been adjusted using the factor described in paragraph 4.15 and combined with the chimney-PM_{10} and the derived background concentrations to get the total predicted concentrations at each receptor location for each hour of the year. These 1-hour mean concentrations have been averaged to get daily-mean concentrations. The 90.4th percentile concentrations for each receptor have then been determined and are presented in Table 3.

4.21 The highest predicted 90.4th percentile concentration in 2012 is 53.4 µg/m^3, at Receptor 6 at the ground-floor level. Concentrations are also predicted to exceed at Receptor 7 at the ground-floor level.

4.22 Concentrations have also been predicted for a grid of receptors to enable the extent of the exceedence area to be determined (Figure 8). These confirm that the relevant locations within the current AQMA are likely to have exceeded the daily mean PM_{10} objective in 2012.

4.23 The AQMA boundary should therefore continue to include, as a minimum, those relevant locations where exceedences have been predicted along Canal Street. Due to uncertainties associated with the modelling it is advised that any relevant location within the area within the 45 µg/m^3 percentile isopleth should also be included in the AQMA. Since the current AQMA already includes these locations and is only slightly larger, based on professional judgement it is recommended that the AQMA remain unchanged.

Table 3: Modelled Concentrations of PM_{10} at Worst-case Receptors [a]

Receptor	90.4th Percentile of PM_{10} Concentrations (µg/m³)		
	Receptor Height (m)		
	1.5	4.5	7.5
1	40.0	31.8	28.3
2	38.0	30.1	28.2
3	42.8	31.7	28.6
4	38.5	32.4	28.9
5	47.6	42.9	28.3
6	**53.4**	41.8	29.1
7	**50.4**	43.0	28.2
8	49.7	44.6	43.1
9	48.4	42.7	40.9
10	44.6	42.0	40.8
11	46.9	44.4	43.4
12	49.0	44.7	43.2
13	34.7	32.0	28.2
14	33.1	31.8	27.6
15	33.9	29.4	28.0
16	31.2	29.2	28.7
17	33.8	29.6	28.4
18	33.7	32.5	30.0
19	34.0	32.8	30.0
20	31.0	30.6	29.8
21	30.1	29.8	29.2
22	39.5	31.8	28.3
23	33.4	29.4	27.9
24	43.1	37.0	28.9
25	40.9	35.9	28.8
Objective	**50**		

[a] Exceedences of the objective are shown in bold.

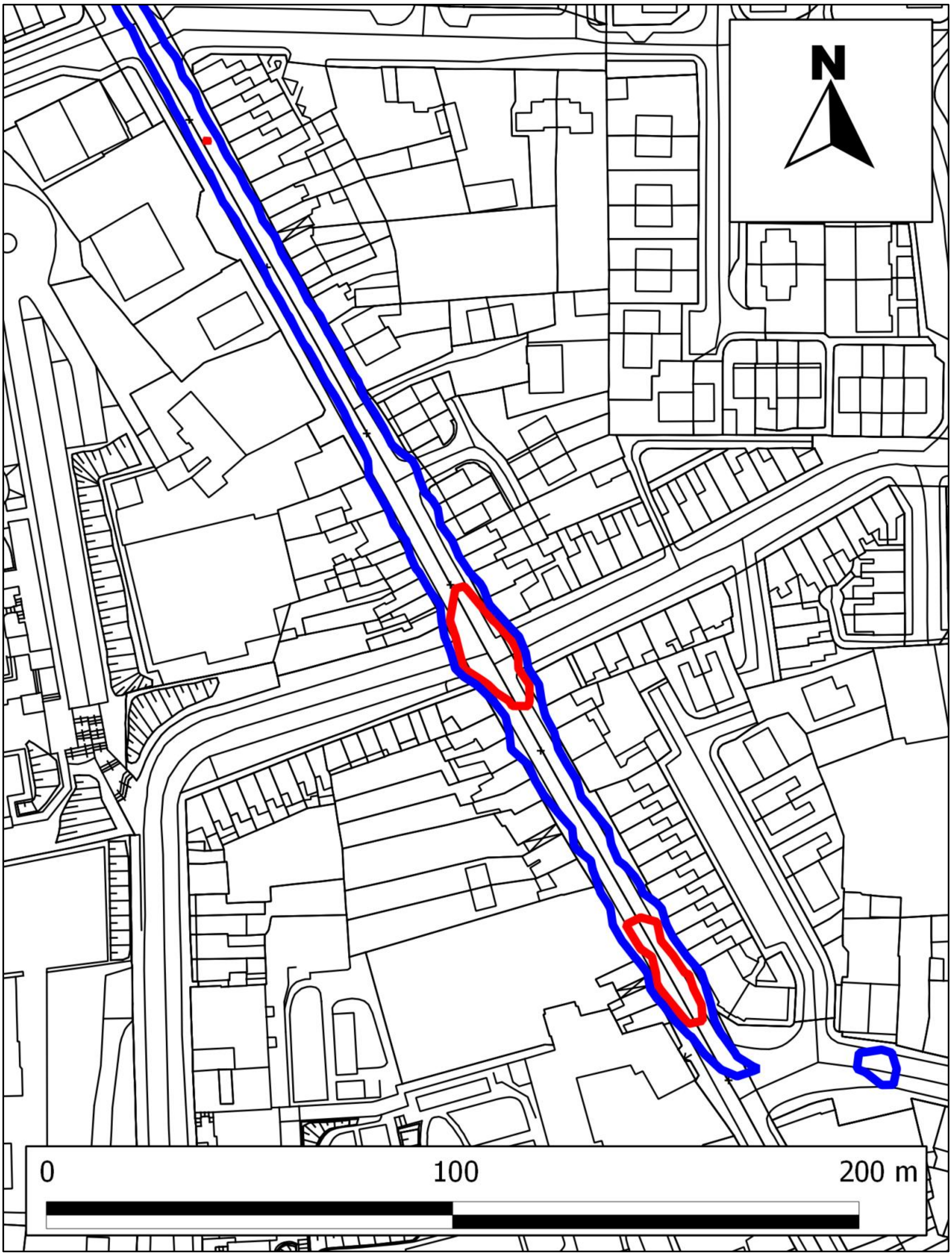

Figure 8: Extent of the Modelled 50 µg/m^3 Isopleth (red line) and 45 µg/m^3 Isopleth (blue line) of Daily Mean Concentrations in 2012 (modelled at 1.5 m).

5 Source Apportionment

5.1 In order to develop an appropriate action plan it is necessary to identify the sources contributing to the objective exceedences within the AQMA. The data presented here can be used to inform future traffic management decisions, and have been calculated in line with guidance provided in LAQM.TG(09) (Defra, 2009).

5.2 Table 4 presents the relative contributions of road-PM_{10}, chimney-PM_{10} and background-PM_{10} to the total predicted PM_{10} concentrations at each worst-case receptor at ground-floor level. This demonstrates that the chimney emissions only contribute 0.7% to the total PM_{10} concentration on average. Whilst the background concentrations contribute the most (63.9% on average), the 90.4th percentile of background concentrations is only 26.6 µg/m^3.

5.3 On days when the short-term PM_{10} objective is predicted to be exceeded, the ambient background concentrations are much higher than normal, with background concentrations close to the objective (49.8 µg/m^3 on average). The road-PM_{10} and chimney-PM_{10} contributions, however, remain similar to non-exceedence days.

5.4 The importance assigned to background concentrations must be understood in the context of the point made in Paragraph 4.18: that the 'background' will include the effect of remote fuel burning and may also include a component of local fuel burning. Emissions from road traffic are, nevertheless, an important source at Canal Street, contributing 35.4% to the total PM_{10} concentrations on average, and 25.1% on exceedence days.

5.5 Table 5 and Figure 9 set out the relative contributions of traffic emissions. The following categories have been included in the road traffic source apportionment:

- Cars;
- Light Goods Vehicles (LGVs);
- Heavy Goods Vehicles (HGVs);
- Buses and Coaches; and
- Motorcycles.

5.6 10 receptor locations have been used to provide an overview of road source contributions within the study area. Table 5 and Figure 9 show that cars contribute the most and all other vehicle types only contribute a small amount[10].

[10] Since some bus routes were diverted in 2012 and the traffic data used in the model was model on 2014 traffic surveys, the contribution of buses will have been underestimated slightly.

Table 4: Modelled Concentrations of Road-PM_{10}, Chimney-PM_{10} and Background-PM_{10} at Worst-case Receptors – Presented for All Days in the Year and just Days when the Predicted Concentration Exceeded 50 µg/m^3.

Receptor	Percentage Contribution to the Total 90.4th Percentile of PM_{10} Concentrations (µg/m^3)					
	Road-PM_{10}		Chimney-PM_{10}		Backgound-PM_{10}	
	All Days	Days > 50 µg/m^3	All Days	Days > 50 µg/m^3	All Days	Days > 50 µg/m^3
1	38.9	25.3	0.6	0.4	60.5	74.3
2	36.0	24.2	0.6	0.4	63.4	75.3
3	41.9	30.2	0.7	0.4	57.4	69.4
4	35.3	22.7	0.7	0.4	64.0	76.9
5	46.9	36.8	0.6	0.4	52.5	62.8
6	50.0	46.1	0.7	0.4	49.4	53.5
7	49.1	43.5	0.6	0.4	50.3	56.1
8	49.7	39.7	0.8	0.5	49.6	59.8
9	46.9	35.6	0.8	0.5	52.2	63.9
10	44.2	33.2	0.0	0.0	55.8	66.8
11	44.6	34.3	0.9	0.5	54.6	65.2
12	49.3	39.8	0.7	0.4	50.0	59.7
13	28.6	17.5	0.9	0.5	70.5	82.0
14	22.7	13.7	1.0	0.5	76.3	85.8
15	28.9	16.8	0.9	0.4	70.3	82.8
16	20.4	8.8	1.0	0.4	78.6	90.8
17	23.8	15.4	0.7	0.4	75.5	84.2
18	26.4	15.3	1.0	0.4	72.7	84.2
19	27.1	15.7	1.0	0.4	72.0	83.9
20	15.1	8.1	1.0	0.5	83.9	91.4
21	10.9	5.7	1.1	0.5	88.1	93.8
22	38.4	24.9	0.6	0.4	61.0	74.8
23	29.5	17.5	0.6	0.4	70.0	82.1
24	41.7	30.7	0.7	0.4	57.7	68.9
25	38.8	25.6	0.7	0.4	60.5	74.1
Average	35.4	25.1	0.7	0.4	63.9	74.5

Table 5: Percentage Contributions of Each Source Type to the Predicted 90.4th Percentile Concentrations of Road-PM_{10} – Presented for All Days

Receptor	Percentage Contributions to the 90.4th Percentile of Road-PM_{10} Concentrations				
	Car	LGV	HGV	Bus & Coach	Motorcycle
1	75.5	12.6	7.1	4.7	0.0
9	75.1	12.4	7.7	4.7	0.0
11	71.7	13.7	8.9	5.7	0.0
12	72.9	13.0	7.3	6.8	0.1
13	76.9	11.7	6.1	5.3	0.1
16	80.8	11.8	2.7	4.6	0.0
17	62.2	25.0	12.1	0.7	0.1
20	60.6	20.8	9.3	9.3	0.1
23	72.1	13.4	9.0	5.4	0.0
24	75.5	12.2	7.8	4.5	0.0

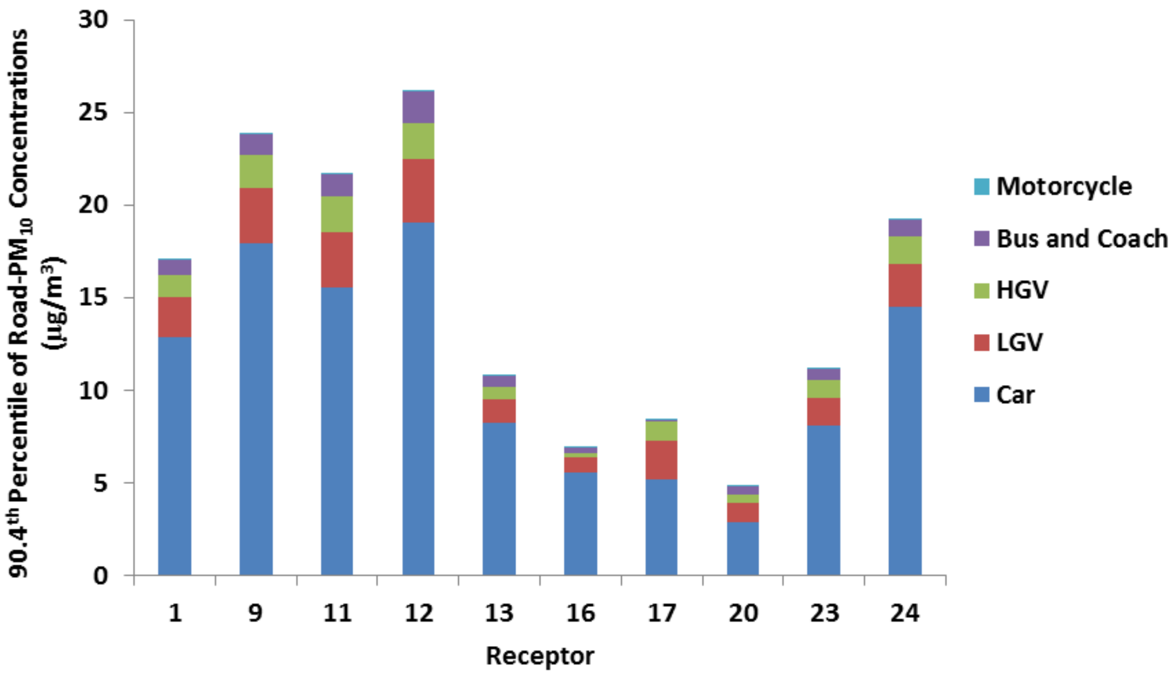

Figure 9: Relative Contribution of Each Vehicle Type to the 90.4th Percentile of Road-PM_{10} concentrations ($\mu g/m^3$) at Receptor Locations – Presented for All Days.

6 Air Quality Improvements Required

6.1 The degree of improvement needed in order for the daily mean objective for PM_{10} to be achieved is defined by the difference between the highest measured or predicted 90.4th percentile of 24-hour mean concentrations and (50 µg/m^3).

6.2 The highest 90.4th percentile of PM_{10} concentrations is that predicted at Receptor 6 (53.4 µg/m^3), requiring a reduction of 3.4 µg/m^3 in order for the objective to be achieved.

6.3 Table 6 sets out the reduction in local road traffic emissions of PM_{10} that would be required at each of the receptors where an exceedence was predicted in 2012, in order for the daily mean objective to have been achieved. At Receptor 6, local road traffic emissions would need to have been 12.7% lower in order to meet the objective.

6.4 It should be noted that concentrations in 2013 were higher than those in 2012 and thus a larger improvement would be required.

Table 6: Improvement in 90.4th Percentile Concentrations of PM_{10} and in Emissions of PM_{10} at Receptors in 2012

Receptor	Required reduction in 90.4th Percentile of PM_{10} Concentrations (µg/m^3)	Required reduction in road traffic emissions of PM_{10} from local roads (%)
6	3.4	12.7
7	0.4	1.7

7 Summary and Conclusions

7.1 PM_{10} concentrations within and around the Newry & Mourne AQMA have been assessed through automatic monitoring and detailed dispersion modelling. The results indicate that the daily mean PM_{10} objective was exceeded in 2012 within the AQMA. The measured PM_{10} concentrations in 2012 were lower than those measured in 2013, therefore the assessment will have underestimated the potential exceedence area slightly. It is therefore recommended that the AQMA should remain and monitoring should continue.

7.2 Source apportionment of the local emissions has been undertaken. This shows that ambient background concentrations contribute the largest proportion to the overall concentration, followed by emissions from cars on local roads. The contributions from domestic chimneys and other road vehicles to the overall concentration are small. This highlights the importance of local traffic emissions when contemplating measures to include within the action plan.

8 References

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9 Glossary

AADT	Annual Average Daily Traffic
ADMS	Atmospheric Dispersion Modelling System
AQMA	Air Quality Management Area
Defra	Department for Environment, Food and Rural Affairs
EFT	Emissions Factor Toolkit
Exceedence	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
LAQM	Local Air Quality Management
µg/m^3	Microgrammes per cubic metre
NAEI	National Atmospheric Emissions Inventory

Objectives A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date.

PM_{10} Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter

Standards A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal

RMSE Real Mean Squared Error

A1 Appendix 1: Traffic Data

A1.1 Traffic data were provided by Newry & Mourne District Council. A summary of the Annual Average Daily Traffic (AADT) flows entered into the model is provided in Table A1.1. Sections of Canal Street, Erskine Street and New Street have been included in the model as a ‘canyon’.

Table A1.1: Summary of AADT Flows (2013)

Road	M/C	Cars	LGV	BUS	HGV	Total
Canal Street (North of Erskine Street)	10	15,006	1,490	182	300	16,988
Canal Street (Between Erskine Street and New Street)	11	13,531	1,304	156	284	15,285
Canal Street (South of New Street)	6	4,758	429	64	80	5,337
Erskine Street	1	767	156	1	25	951
Catherine Street	2	6,767	585	75	49	7,478
New Street	7	12,359	1,162	135	260	13,922