LIMAVADY BOROUGH COUNCIL

LOCAL AIR QUALITY MANAGEMENT

DUNGIVEN FURTHER ASSESSMENT 2008

AUGUST 2008

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DOCUMENT CONTROL SHEET

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Executive Summary

A Further Assessment of the Air Quality Management Area (AQMA) in Main Street, Dungiven, was carried out, as required by the Second Round of Review and Assessment of air quality, as part of the UK's Local Air Quality Management regime. The Further Assessment, based on detailed dispersion modelling, provides further information on the AQMA, including source apportionment and pollutant reduction required to comply with the Air Quality Strategy (AQS) objectives.

The findings of this report are the following:

- Updated monitoring data suggest that exceedences of the objectives are likely further East along Main Street outside the AQMA. Therefore, it is recommended to extend the AQMA to encompass a larger part of Main Street.

- The source apportionment shows that, while background pollution levels contribute significantly, HGVs are the main contributors of the overall NO_x levels in the AQMA, followed by cars and LGVs.

- The maximum reduction in NO_x concentrations in the AQMA required to comply with the AQS objectives is about 68µg/m^3 (equivalent to a 42% reduction in NO_x levels). This equates to about 15µg/m^3 reduction in NO_2 (27% reduction). Consequently, measures formulated in the Local Action Plan should aim to reduce the levels of NO_x / NO_2 within the AQMA by these amounts.

1 Introduction

1.1 Project Background

Part III of the Environment (NI) Order 2002 places a statutory duty on Local Authorities to periodically review and assess the air quality within their area. The Further Assessment is a requirement of the Second Round of Review and Assessment for Local Authorities that have declared an Air Quality Management Area (AQMA). It is intended to supplement information in the AQMA gathered in the Detailed Assessment. Bureau Veritas was commissioned by Limavady Borough Council (LBC) to undertake the Further Assessment of the AQMA declared for nitrogen dioxide (NO_2) in Dungiven in March 2006.

1.2 Legislative background

The Environment (Northern Ireland) Order 2002 gives Local Authorities duties and responsibilities that are designed to secure improvements in air quality, particularly at the local level. Part III of the Order requires each local authority in Northern Ireland to periodically review and assess air quality in its area, and determine whether the prescribed objectives are likely to be achieved by the relevant future year.

The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS)[1] (along with its addendum[2]) contains national air quality standards and objectives established by the Government to protect human health. The objectives for seven pollutants have been prescribed within the Air Quality (England) Regulations 2000[3], the Air Quality (England) (Amendment) Regulations 2002[4] and the Air Quality Regulations (Northern Ireland) 2003[5] (benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide and particulates). The AQS objectives set in regulation in Northern Ireland are shown in Table 1.1.

The Air Quality Standards Regulations (Northern Ireland) 2007[6] came into force on 28th May 2007. This brings together in one statutory instrument the governments requirements to fulfil separate EU Daughter Directives through a single consolidated statutory instrument, which is fully aligned with proposed new EU Air Quality Directive (CAFE - Clean Air For Europe)[7].

The Regulations 2007 include objectives for Arsenic, Cadmium and Nickel. These are required to be assessed by Member States in response to the new EU Air Quality Daughter Directive (CAFE), however, the AQS does not contain objectives for these pollutants and local authorities are not currently required to assess against these.

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[1] DETR (2000) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working together for Clean Air, The Stationery Office

[2] Defra (2002) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Addendum, The Stationery Office

[3] DETR (2000) The Air Quality Regulations 2000, The Stationery Office

[4] Defra (2002) The Air Quality Regulations 2002,The Stationery Office

[5] Statutory Rule 2003 No. 342

[6] Statutory Rule 2007 No. 265

[7] http://ec.europa.eu/environment/air/cafe/index.htm

Table 1.1 – Air Quality Strategy Objectives and Standards for Northern Ireland

Pollutant	Objective	Measured as	Date to be achieved by and maintained thereafter	Regulations 2007
Benzene All Authorities	16.25 µg/m^3	Running Annual Mean	31-Dec-03	
Benzene Authorities in Scotland and Northern Ireland only	3.25 µg/m^3	Running Annual Mean	31-Dec-10	01-Jan-10
1,3-Butadiene	2.25 µg/m^3	Running Annual Mean	31-Dec-03	
Carbon monoxide Authorities in England, Wales and Northern Ireland only	10.0 mg/m^3	Maximum daily running 8 Hour Mean	31-Dec-03	
Lead	0.5 µg/m^3	Annual Mean	31-Dec-04	
	0.25 µg/m^3	Annual Mean	31-Dec-08	
Nitrogen dioxide [a]	200 µg/m^3 Not to be exceeded more than 18 times per year	1 Hour Mean	31-Dec-05	01-Jan-10
	40 µg/m^3	Annual Mean	31-Dec-05	01-Jan-10
Particles (PM_{10}) (gravimetric) [b] All authorities	50 µg/m^3 Not to be exceeded more than 35 times per year	24 Hour Mean	31-Dec-04	
	40 µg/m^3	Annual Mean	31-Dec-04	
Sulphur dioxide	266 µg/m^3 Not to be exceeded more than 35 times per year	15 Minute Mean	31-Dec-05	
	350 µg/m^3 Not to be exceeded more than 24 times per year	1 Hour Mean	31-Dec-04	
	125 µg/m^3 Not to be exceeded more than 3 times per year	24 Hour Mean	31-Dec-04	

The locations where the AQS objectives apply are defined in the AQS as locations outside buildings or other natural or man-made structures above or below ground, where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period of the AQS objective. Typically these include residential properties and schools/care homes for longer period (i.e. annual mean) pollutant objectives and high streets for short-term (i.e. 1-hour) pollutant objectives.

1.3 Summary of Review and Assessment

In 2000, LBC started its First Round of Review and Assessment of air quality within the Borough. Stage 1 of the assessment highlighted potential exceedences of the Air Quality Strategy (AQS) objectives for the following pollutants, in parts of Limavady and Dungiven:

- Nitrogen dioxide (NO_2), from traffic sources; and
- Sulphur dioxide (SO_2) and particulate matter (PM_{10}), from fuel burning.

A subsequent further assessment (Stage 2) based on dispersion modelling and monitoring activities showed that SO_2 and PM_{10} levels were unlikely to breach their respective AQS objectives. However, monitoring of NO_2 confirmed that there was a risk of exceeding the annual mean AQS objective of 40µg/m^3 in Dungiven. The Council therefore declared an Air Quality Management Area (AQMA) in March 2006 for NO_2, encompassing properties along Main Street between the River Roe Bridge and 89/106 Main Street in Dungiven[8].

LBC prepared an air quality Action Plan to present the measures necessary to improve air quality in the AQMA. The draft report, released in March 2008, concluded that the issue, essentially due to road traffic on Main Street, could only be tackled with the construction of a bypass, as other measures were hindered by the lack of alternate routes in and around the town. The bypass, proposed as part of a wider dualling scheme of the A6 between Belfast and Derry, forms part of the Strategic Transport Network Transport Plan (RSTN TP) 2015.

In parallel, the Second Round of Review and Assessment started in 2006 with an Updating and Screening Assessment (USA). The report, based on updated monitoring, confirmed that NO_2 levels exceeded the AQS objective in Dungiven, but concluded that all other pollutants were below the AQS objectives. This was confirmed more recently in the air quality Progress Report 2008, based on updated monitoring data for 2006 and 2007.

1.4 Scope and Methodology of the Further Assessment

The approach of the Further Assessment is to provide the Local Authority with an opportunity to supplement the information gathered in the previous LAQM reports and confirm whether the AQMA is still required or if it needs to be amended (increased or reduced).

The methodology is based on dispersion modelling and includes the following:

- Review of additional monitoring since the Detailed Assessment – including continuous monitoring and diffusion tubes,
- Assessment of reduction in pollutant concentrations that is required to meet the AQS objectives in the AQMA,
- Source apportionment of pollutants including relevance of background, industrial (if relevant), and different vehicle classification on the roads of concern, and identification of the most significant roads,
- Supply of technical justification for measures to be taken within the action plan,
- Identification of any additional policy measures that may have to be implemented after declaration,

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[8] www.airquality.co.uk/archive/laqm/aqma.php?aqma_id=436

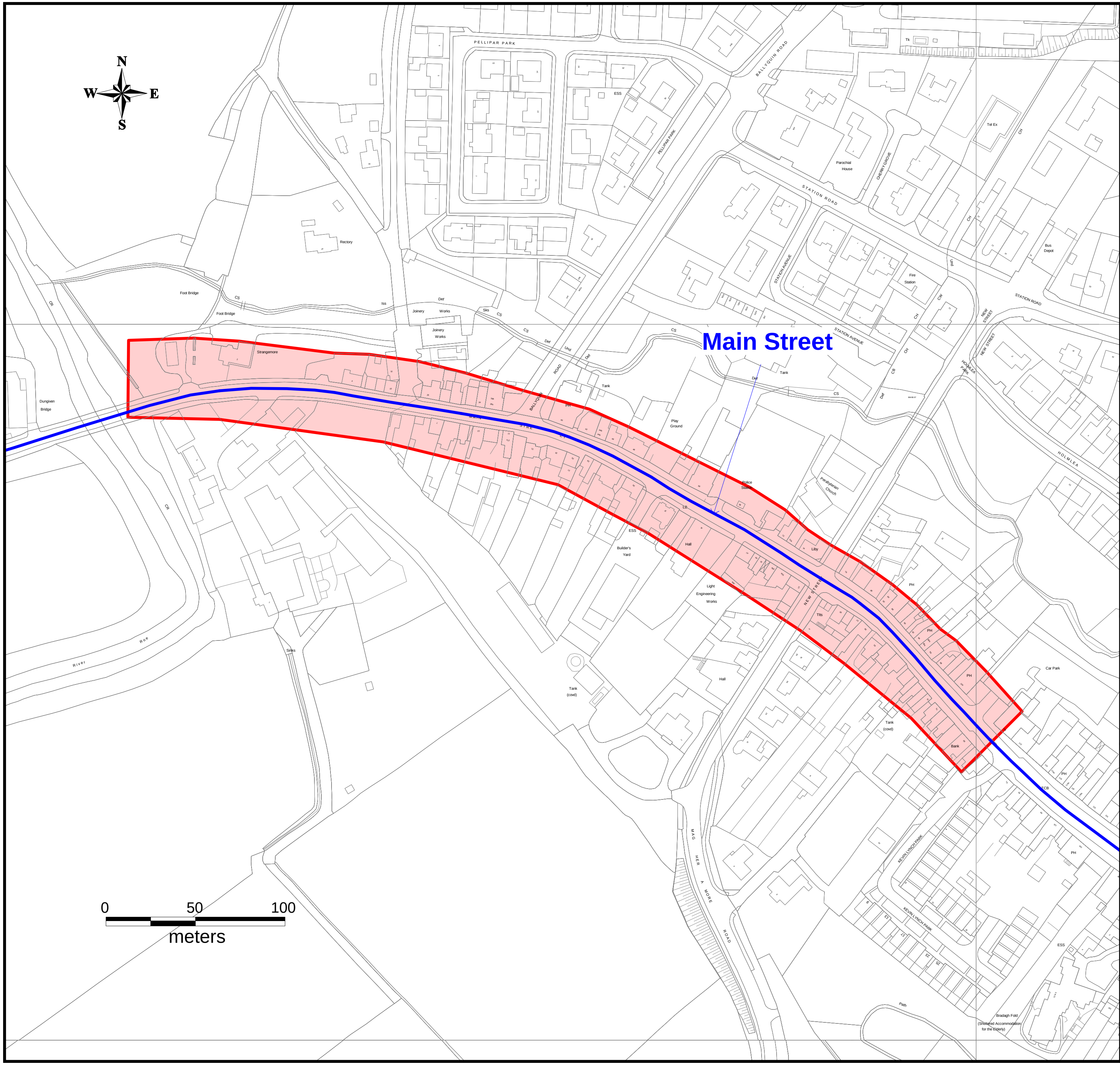
- Identification of any local developments, such as industrial, residential or road schemes that may affect future air quality within the AQMA.

Detailed dispersion modelling was carried out as part of the Further Assessment based on the ADMS-Roads (v2.3) atmospheric dispersion model. Monitoring results from nitrogen dioxide diffusion tubes installed in Dungiven were used to verify the modelled results. NO_x and NO_2 concentrations were predicted for the current year, assumed 2007, and future year 2010. The dispersion modelling was undertaken in accordance with the methodologies provided in the Technical Guidance (LAQM.TG(03)) and DoE(NI) Guidance for Detailed and Further Assessments.

2 Baseline Information

2.1 Dungiven Air Quality Management Area

In March 2006, LBC declared an AQMA in Dungiven for NO_2, in an area encompassing properties along Main Street between the River Roe Bridge to the West, and 89/106 Main Street to the East. The designated AQMA is shown in Figure 2.1.



Legend

AQMA Boundaries

Modelled Road

BUREAU VERITAS 1828

Air Quality - Environment Division
Great Guildford House,
30 Great Guildford Street
London SE1 0ES
Telephone: 0207 902 6100
Facsimile: 0207 902 6149

Location	**Dungiven**
Title	**AQMA and Modelled Roads**

By	Checked	Approved
EC	**AG**	**AG**

Scale **N.T.S.**	Date **August 2008**
Job No. **AGGX0926**	Fig. No. **Figure 2.1**

2.2 Traffic Data

Updated traffic counts for the A6 Main Street in Dungiven were provided by the Roads Service from the Department for Regional Development of Northern Ireland (DRDNI). Data included the annual average daily traffic (AADT) for year 2007 from traffic census point 306 near Dungiven, East of the B74 Feeny Road.

A detailed breakdown of traffic flows at this census point was collated from the Roads Service 2006 report[9] for the following vehicle categories[10]:

- Cars,
- Light Goods Vehicles,
- Heavy Goods Vehicles, and
- Buses and Coaches.

Traffic data were projected to 2010 based on the yearly traffic growth of 2.06% derived from 2006 and 2007 local automatic traffic count (at census point 306).

Diurnal pattern of the A6 was included in the model set up based on the hourly variations of traffic flow (averaged on year 2007), also provided by Roads Service. Free flowing vehicle speed on Main Street was assumed to be the speed limit (30mph or ~50kph). Speed was reduced near junctions with New Street, the B68 Ballyquin Road and the B64 Garvagh Road, as well as in steep sections of the road between the River Roe Bridge and junction with New Street, to account for the combined effect of congestion and terrain. The traffic data used in this assessment are summarised in Appendix 1.

2.3 New developments

Local developments may affect future air quality within the area of the AQMA and as such, it is important to account for any new residential/commercial development, road scheme, or industrial process in the Further Assessment.

There is no known development that could affect air quality within the AQMA at the present.

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[9] Traffic and Travel Information 2006 – Incorporating Annual Traffic Census and Vehicle Kilometres of Travel – Roads Service - DRDNI

[10] DoENI5 traffic classification system. As the emission factors used in the dispersion modelling rely on a different classification system (Cars, LGVs, HGVs and buses – as described in the Design Manual for Roads and Bridges - DMRB), Medium Goods Vans were assumed to be equivalent to the LGV category (Light Goods Vehicles).

2.4 Air Quality Monitoring Data

2.4.1 Nitrogen Dioxide Diffusion Tubes

The Council currently measures nitrogen dioxide in Dungiven based on a network of 15 monitoring sites. Almost all sites include duplicate passive diffusion tubes, which increase the precision of the results. All tubes are located at roadside sites on lampposts or facades of properties along Main Street, except duplicates J1 and J2, which were located in New Street to provide background information.

Currently, 11 sites are located within the AQMA, while three new sites were installed further East in Main Street in May/June 2007.

The diffusion tubes are supplied and analysed by Gradko International Ltd. They are prepared based on the 20% TEA[11] in water method. Gradko participates in the UK National Diffusion Tube Network and the Workplace Analysis Scheme for Efficiency (WASP).

As diffusion tubes K to O were installed in May/June 2007, data do not cover a full calendar year. Therefore, the results were annualised to obtain the NO_2 annual average at these sites. The technical Guidance LAQM.TG(03) suggests that the annualisation should be based on 2 to 4 background sites. However, the only NO_x/NO_2 background site available nearby is the Brooke Park AURN monitoring station located in Derry. Therefore, the annualisation was carried out based on this station only[12].

LAQM.TG(03) and the Review and Assessment Helpdesk recommend the use of a local bias adjustment factor to correct raw data from diffusion tubes (where available). This is commonly based on results from tubes co-located with real-time analysers, which provide more accurate data than passive diffusion tubes. In the absence of a local bias adjustment factor, diffusion tube results can be corrected based on a national default bias adjustment factor derived from the diffusion tube co-location survey provided by the air quality Review and Assessment Helpdesk [13].

There is no continuous monitoring station in Dungiven; therefore, the national bias correction factor was used to adjust diffusion tube results. The bias factor for year 2006 was 0.98 for this laboratory and this preparation method, and 0.89 for year 2007. Annualised and bias adjusted results for the past two years (2006 to 2007) are provided in Table 2.1. Results for 2007 are also shown in Figure 2.2.

The NO_2 annual mean AQS objective of 40µg/m^3 was exceeded at 12 of the 14 sites monitoring NO_2 in Dungiven in 2007. Ten of these sites are located within the AQMA, along Main Street. The two other sites exceeding the objective (sites L and M) are located further East in Main Street, respectively 100m and 160m from the AQMA. Although data at these sites do not cover a full year, the annualised results show similar NO_2 levels than those measured within the AQMA. This suggests that the AQMA should be extended to include properties further East in Main Street.

2007 results are consistent with those observed in 2006, as sites A to I were again all exceeding the AQS objective.

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[11] TEA = Triethanolamine

[12] Results at site N are not reported as data was too scarce to be annualised.

13 www.uwe.ac.uk/aqm/review/diffusiontube230408.xls

Projection to 2010 (based on NO_2 projection factors[14]) shows that the objective is still likely to be breached by this date at most of the sites in the AQMA as well as at site L outside the AQMA. Moreover, other sites (G, I and M) would still be close to the objective of 40µg/m^3.

[14] www.airquality.co.uk/archive/laqm/tools/Year_Adjustment_Calculator22a.xls

Table 2.1 - Diffusion Tube Results in Dungiven

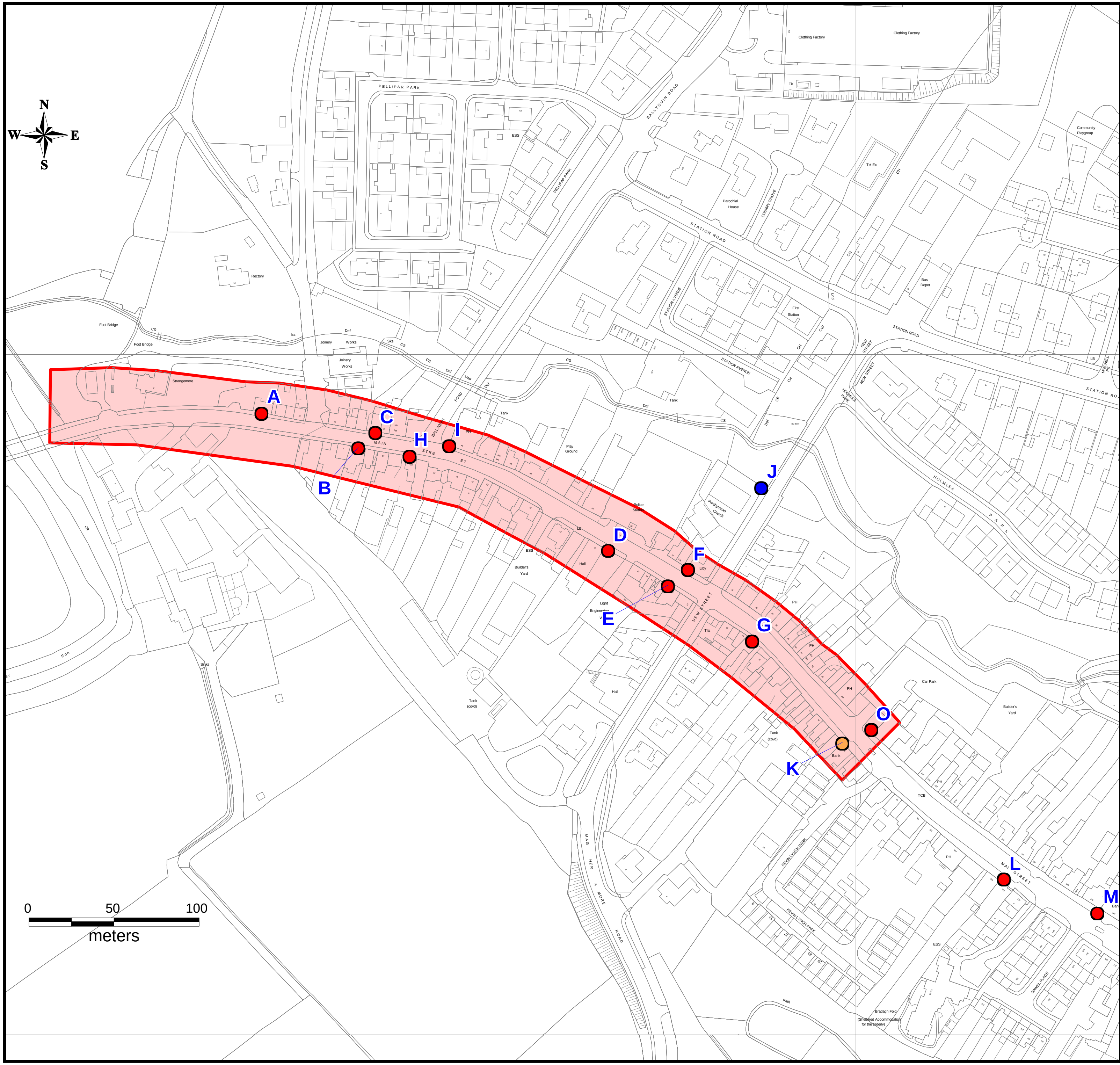
Name	OS Grid (m)		Type	Location used for verification	Within AQMA	2006 NO_2 annual mean (bias adjusted - µg/m^3)	2007 NO_2 annual mean (bias adjusted - µg/m^3)	Data Capture 2007	2007 NO_2 projected to 2010 (µg/m^3)
	X	Y							
A	268650	409566	Roadside	Y	Y	**48.6**	**48.0**	12	**42.9**
B	268707	409545	Roadside	Y	Y	**51.4**	**49.3**	10	**44.1**
C	268717	409555	Roadside	Y	Y	**53.8**	**59.4**	12	**53.2**
D	268854	409485	Roadside	Y	Y	**46.6**	**45.7**	12	**40.9**
E	268889	409464	Roadside	Y	Y	**48.0**	**49.5**	12	**44.3**
F	268901	409474	Roadside	Y	Y	**42.6**	**46.9**	11	**42.0**
G	268939	409432	Roadside	Y	Y	**45.3**	**42.4**	11	37.9
H	268737	409541	Roadside	Y	Y	**51.7**	**50.3**	10	**45.0**
I	268761	409547	Roadside	N	Y	**53.3**	**43.1**	9	38.6
J	268944	409522	Background	N	N	22.5	20.4	10	18.7
K	268992	409372	Roadside	Y	Y	-	38.6*	7	34.6
L	269087	409292	Roadside	Y	N	-	**46.0***	8	**41.2**
M	269142	409272	Roadside	Y	N	-	**44.0***	7	39.4
O	269009	409380	Roadside	Y	Y	-	**40.3***	5	36.1

* Annualised results based on Brooke Park AURN monitoring station in Derry
In bold, exceedence of the NO_2 annual mean AQS objective (40 µg/m^3)

Dungiven - NO2 Diffusion Tubes
Annual Mean 2007 - ug/m3

Above 40 (Exceeds AQS Objective)	(12)
36 to 40	(1)
32 to 36	(0)
28 to 32	(0)
Below 28	(1)

AQMA Boundaries



BUREAU VERITAS

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Location **Dungiven**		
Title **NO2 Monitoring 2007**		
By **EC**	Checked **AG**	Approved **AG**
Scale **N.T.S.**	Date **August 2008**	
Job No. **AGGX0926**	Fig. No. **Figure 2.2**	

2.4.2 Background Concentrations

Local monitoring and updated background maps[15] were considered to determine appropriate background for this assessment. NO_2 concentration from the background maps for year 2007 is 4.1µg/m^3 for Dungiven. However, this is likely to be under estimated, as the NO_2 annual mean at background site J in New Street was 20.4µg/m^3 in 2007.

Site J was deemed more representative of the local background concentration in Dungiven. An equivalent background NO_x concentration of 28.5µg/m^3 was derived from the most up-to-date NO_x/NO_2 conversion method[16].

Background NO_x and NO_2 concentrations for year 2010 were derived based on the Year Adjustment Calculator spreadsheet from the Air Quality Archive website[14].

Table 2.2 - Background Concentrations for Dungiven (µg/m^3)

Pollutant	2007 Background (µg/m^3)	2010 Background (µg/m^3)
NO_x	28.5	24.8
NO_2	20.4	18.8

3 Dispersion Modelling Methodology

Detailed dispersion modelling of NO_x was undertaken based on ADMS-Roads (version 2.3) atmospheric dispersion model from Cambridge Environmental Research Consultants (CERC). Conversion to NO_2 was based on the updated NO_X/NO_2 conversion method recommended by Defra[17].

ADMS-Roads is an advanced Gaussian dispersion model, which has been extensively used in local air quality management and has formed the basis for many AQMA declarations. A number of validation studies have been completed, showing overall good agreement between model outputs and observations at continuous monitoring sites. The street canyon option was activated for sections of Main Street where properties on both side are close to the road (see Appendix 1 for details).

Traffic flow diurnal pattern described in Section 2.2 was applied to the modelled road (Main Street). Emission factors for each modelled class of vehicle (cars, LGVs, HGVs, buses and coaches) were calculated with the help of the Emission Factors Toolkit (EFT) available on the UK Air Quality Archive website[18].

[15] Estimated Background Air Pollution Data - www.airquality.co.uk/archive/laqm/tools.php?tool=background04

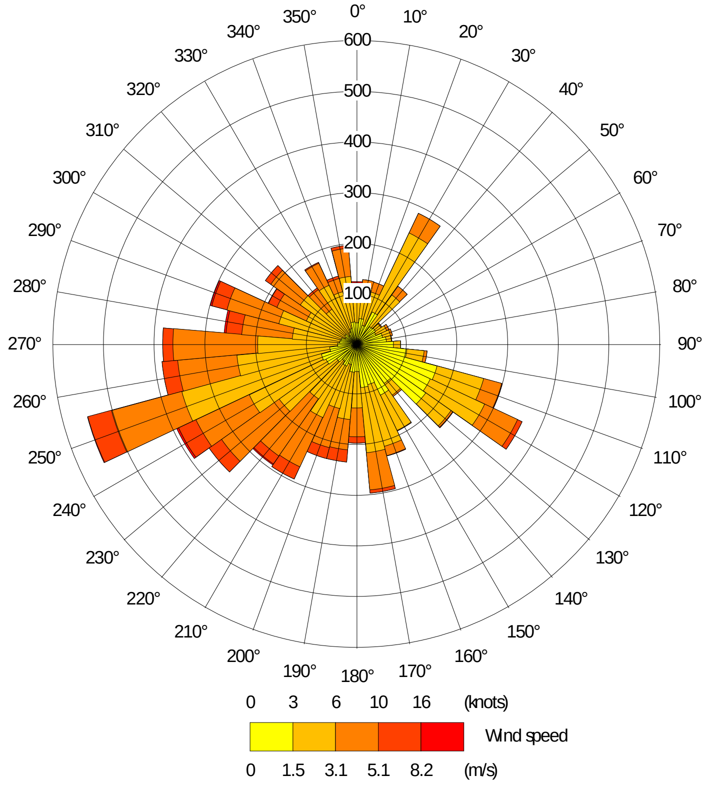
16 Air Quality Archive website - www.airquality.co.uk/archive/laqm/tools/NOxfromNO2calculator2007.xls

[17] R&A Helpdesk, 2 April 2007 - http://www.uwe.ac.uk/aqm/review/mfaqroad.html - This method supersedes the method described in LAQM.TG (03). Further information is given in Appendix 2.

[18] www.airquality.co.uk/archive/laqm/tools.php?tool=emission

Dispersal of pollutant emissions is dependent (amongst other factors like topography and street canyon effects) upon the prevailing meteorological conditions at the time of emissions release. Hourly sequential meteorological data from the closest Met Office station (Ballykelly, 10 miles North of Dungiven) was used in this assessment, based on year 2007. The wind rose for meteorological data is shown in Figure 3.1.

Figure 3.1 – Ballykelly 2007 Hourly Sequential Meteorological Data



4 Results

4.1 Model Verification and adjustment

Model verification at specific locations was carried out prior to predicting concentrations within the whole domain. The objectives of the model verification are:

- to evaluate model performance,
- to show that the baseline is well established, and
- to provide confidence in the assessment

Comparison of the modelled and monitored results was carried out based on local NO_2 monitoring data from 12 roadside diffusion tubes in Dungiven[19]. All diffusion tubes were assumed to be at 2m above ground level, which represent with reasonable accuracy the height checked during the site visit on 03/06/2008. Predicted NO_2 was derived based on the latest NO_x/NO_2 conversion method recommended by Defra[17] (see details in Appendix 2).

During the verification process, Bureau Veritas aimed to ascertain whether all final modelled NO_2 concentrations are within 25% of the monitored NO_2 concentrations. Modelled results may not compare as well at some locations for a number of reasons including:

- Errors in traffic flow and speed data estimates,
- Model setup (including street canyons, road widths, receptor locations),
- Model limitations (treatment of roughness and meteorological data),
- Uncertainty in monitoring data (notably diffusion tubes, e.g. bias adjustment factors and annualisation of short-term data).

The above factors were all investigated as part of the model verification process to minimise the uncertainties as much as practicable. Canyon width was adjusted to make sure that the diffusion tubes at façade of properties were effectively within street canyons.

The model verification results are provided in Table 4.1. Overall, predicted concentrations are in good agreement with monitoring data, as all adjusted modelled NO_2 results are within ±25% of monitored concentrations, and 7 sites out of 12 are within ±10%. The model correctly predicts an exceedence of the objective at all the sites located within the AQMA, except site O. However, it failed to reproduce the exceedences observed at sites L and M outside the AQMA, although modelled results are close to 40µg/m^3 at the latter.

[19] Site I was not included due to uncertainties in monitoring data, as the difference in measured NO_2 between 2006 and 2007 was more than 10µg/m^3.

Table 4.1 – Model verification results at monitoring sites in Dungiven

Site ID	Within AQMA	Monitored NO_2 2007 (µg/m3)	Predicted Total NO_2 2007(µg/m^3)	Difference predicted / monitored 2007 (µg/m^3)	Difference predicted / monitored 2007 (%)
A	Yes	**48.0**	**54.3**	6.3	13%
B	Yes	**49.3**	**54.6**	5.2	11%
C	Yes	**59.4**	**54.0**	-5.4	-9%
D	Yes	**45.7**	**41.2**	-4.5	-10%
E	Yes	**49.5**	**46.9**	-2.6	-5%
F	Yes	**46.9**	**47.1**	0.1	0%
G	Yes	**42.4**	**46.1**	3.7	9%
H	Yes	**50.3**	**53.6**	3.3	7%
K	Yes	38.6	37.2	-1.4	-4%
L	No	**46.0**	35.9	-10.2	-22%
M	No	**44.0**	37.7	-6.3	-14%
O	Yes	**40.3**	35.2	-5.1	-13%
Summary					
Number of sites	Within ±10%			7	
	Between ± 10-25%			5	
	Exceeds ±25%			0	
	Total			12	

In bold: exceedence of NO_2 annual mean AQS objective

4.2 Modelled NO_2 concentrations

Annual average NO_2 concentrations were predicted for the baseline year 2007 and future year 2010 at a number of specific receptors representing relevant public exposure, located at the facade of properties. Additionally, predictions were made to a 5m-grid spacing across the assessment areas to produce NO_2 concentration contour maps for year 2007. All results were predicted at 1.5m from the ground.

Table 4.2 summarises predicted NO_2 results for years 2007 and 2010 at specific receptor locations and diffusion tubes (where representative of public exposure) along Main Street. NO_2 concentration contours for year 2007 are also illustrated in Figure 4.1.

Table 4.2 – Predicted NO_2 annual mean concentrations – Specific receptors

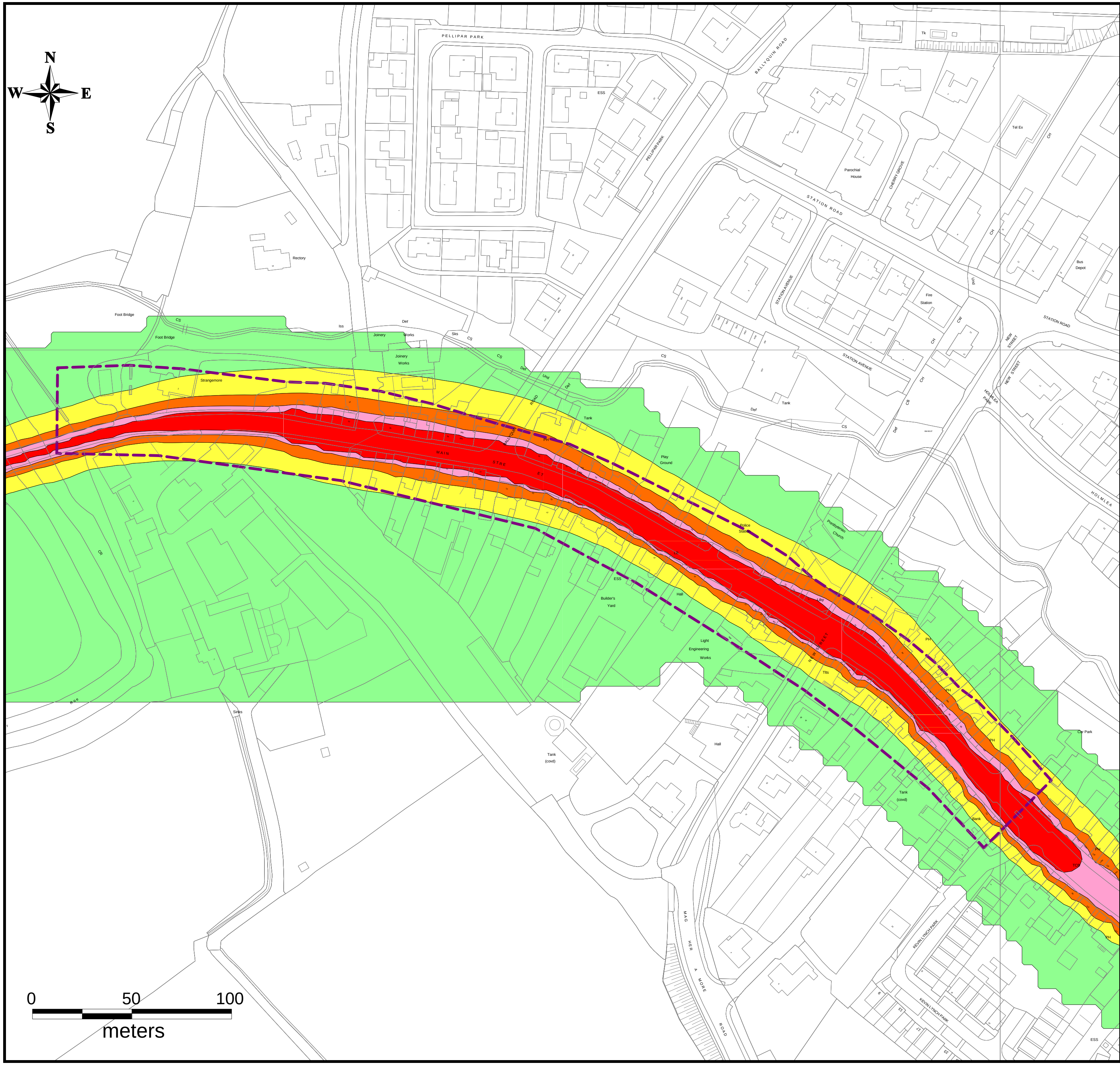
ID	X(m)	Y(m)	Within AQMA	NO_2 2007 (µg/m^3)	NO_2 2010 (µg/m^3)
Owenbeg_House	268470	409542	No	31.8	30.1
MainStreet1	268555	409552	Yes	32.3	30.6
Strangemore	268582	409577	Yes	30.5	29.6
MainStreet2	268621	409554	Yes	32.2	30.9
35_MainStreet	268805	409515	Yes	**44.5**	**42.6**
102_MainStreet	268988	409400	Yes	39.8	37.7
87_MainStreet	269007	409355	No	33.7	32.4
130_MainStreet	269094	409307	No	37.9	35.8
117_MainStreet	269150	409245	No	33.9	32.1
154_MainStreet	269207	409234	No	35.1	33.6
165_MainStreet	269271	409201	No	28.4	27.3
135_MainStreet	269223	409198	No	34.5	33.0
A	268650	409566	Yes	**54.3**	**54.4**
B	268707	409546	Yes	**54.6**	**54.1**
C	268717	409555	Yes	**54.0**	**53.8**
D	268854	409485	Yes	**41.2**	39.5
E	268890	409464	Yes	**46.9**	**46.1**
F	268901	409474	Yes	**47.1**	**46.7**
G	268939	409432	Yes	**46.1**	**44.0**
H	268737	409541	Yes	**53.6**	**53.0**
I	268761	409547	Yes	**55.1**	**55.0**
J	268944	409522	No	24.1	23.6
K	268992	409372	Yes	37.2	35.6
L	269087	409292	No	35.9	34.0
M	269142	409272	No	37.7	36.0
O	269009	409380	Yes	35.2	33.8

In bold, concentrations above the NO_2 annual mean AQS objective (40µg/m^3)

The model predicted exceedences of the AQS objective in 2007 at a number of receptors relevant of public exposure (facade of properties), within the AQMA along Main Street. Concentrations are not predicted to exceed the objective at receptors outside the AQMA, although results at a few receptors are close to 40µg/m^3 further East on Main Street (monitoring site M and receptor outside 130 Main

Street). Model verification showed that the model under predicts concentrations in this area. Therefore, it is likely that exceedences occur further East of the AQMA in Main Street as suggested by the latest monitoring data, **and it is recommended that the AQMA be extended. The extension should encompass properties along Main Street up to the junction with Garvagh Road.**

Predicted results for year 2010 show a slight decrease at most of the receptors and monitoring sites. This is due to predicted decrease in background pollution and road emissions that compensate expected traffic growth. Nevertheless, the objective is still likely to be exceeded by this date at several locations within the AQMA.



NO2 Annual Mean
2007 - ug/m3

- Under 28
- 28 to 32
- 32 to 36
- 36 to 40
- Over 40 (Exceeds AQS Objective)

AQMA Boundaries

BUREAU VERITAS
Air Quality - Environment Division
Great Guildford House,
30 Great Guildford Street
London SE1 0ES
Telephone: 0207 902 6100
Facsimile: 0207 902 6149

Location	**Dungiven**
Title	**NO2 Annual Mean 2007 Modelled Results**

By	Checked	Approved
EC	**AG**	**AG**

Scale	Date
N.T.S.	**August 2008**

Job No.	Fig. No.
AGGX0926	**Figure 4.1**

4.3 Source Apportionment

The breakdown of vehicle classification was taken into account in the model set-up. This allowed determining NO_x source apportionment at diffusion tube locations and other specific receptors in the AQMA in Dungiven. The source apportionment was carried out for the following vehicle classes:

- Cars;
- Light goods vehicles (LGVs);
- Heavy goods vehicles (HGVs); and
- Buses and coaches.

Table 4.3 summarises the results at a series of receptors representing public exposure in the AQMA in Main Street, including the monitoring sites. The source apportionment indicates that:

- Heavy-goods vehicles (HGVs) are the main contributors, as they account for at least 50% (and up to 63%) of the total NO_x concentrations at receptors showing exceedence of the AQS objective,
- Background concentration account for 20% to 30% of the total NO_x concentration in areas of exceedences,
- Cars contribute around 15% to the overall concentration at all receptors,
- Light-goods vehicles (LGVs) contribute around 3% to the total NO_x concentrations at all receptors,
- Buses contribution is not significant.

The contribution of HGVs to the total NO_x concentrations is quite significant especially if compared to the relatively small proportion of the vehicle fleet they represent (10.5%).

Table 4.3 - Source apportionment of NO_X concentrations at specific receptors

Receptor / Diffusion Tube	Type	Total Modelled NO_x 2007 (µg/m^3)	Total Modelled NO_2 2007 (µg/m^3)	NO_x Source Apportionment				
				Background	Cars	LGVs	HGVs	Buses
I	Diffusion Tube	162.6	**55.1**	18%	16%	3%	63%	0.1%
B	Diffusion Tube	160.0	**54.6**	18%	16%	3%	63%	0.1%
A	Diffusion Tube	158.6	**54.3**	18%	16%	3%	62%	0.1%
C	Diffusion Tube	157.2	**54.0**	18%	16%	3%	63%	0.1%
H	Diffusion Tube	155.4	**53.6**	18%	16%	3%	63%	0.1%
F	Diffusion Tube	124.4	**47.1**	23%	15%	3%	59%	0.1%
E	Diffusion Tube	123.9	**46.9**	23%	15%	3%	59%	0.1%
G	Diffusion Tube	120.0	**46.1**	24%	17%	4%	55%	0.1%
35_MainStreet	Specific Receptor	112.9	**44.5**	25%	17%	4%	54%	0.1%
D	Diffusion Tube	99.3	**41.2**	29%	16%	3%	52%	0.1%
102_MainStreet	Specific Receptor	93.4	39.8	31%	17%	3%	49%	0.1%
K	Diffusion Tube	83.4	37.2	34%	16%	3%	47%	0.1%
O	Diffusion Tube	75.8	35.2	38%	14%	3%	45%	0.0%
MainStreet1	Specific Receptor	65.3	32.3	44%	15%	3%	39%	0.0%
MainStreet2	Specific Receptor	64.8	32.2	44%	12%	2%	41%	0.0%
Strangemore	Specific Receptor	59.0	30.5	48%	13%	2%	37%	0.0%

4.4 NO_x reduction

A requirement of the Further Assessment is to determine the amount of NO_2 reduction required at the worst-case receptors within an AQMA. This approach highlights the maximum reduction in NO_2 required (as NO_x, in µg/m^3) to comply with the AQS objective, and assumes that other receptors will require less of a reduction. For the current assessment, the approach to estimate the required NO_2 reduction was to determine the levels of NO_x for the highest concentrations predicted at sensitive receptors (including monitoring sites, where relevant of public exposure). The results are shown in Table 4.4.

In order to determine the required reduction in NO_x, the NO_2 annual mean AQS objective of 40µg/m^3 was calculated to be equivalent to a 94.2µg/m^3 NO_x concentration (based on local background NO_x at monitoring site J and the latest NO_x/NO_2 conversion method[17]).

The maximum predicted NO_x reduction required within the AQMA to comply with the NO_2 AQS objective is 68.4µg/m^3 at monitoring site I (equivalent to a 42% improvement in NO_x). This equates to a 15.1µg/m^3 reduction in NO_2 (equivalent to 27% improvement in NO_2). Similar reduction is required at monitoring sites A, B, C and H, all of which representative of public exposure.

Consequently, the formulation of the Action Plan should aim to reduce the levels of NO_x / NO_2 within the AQMA by these amounts.

Table 4.4 – Required NO_x and NO_2 reduction

Site Name	Total Modelled NO_x 2007 (µg/m^3)	NO_x (equiv to 40µg/m^3 NO_2) µg/m^3	Reduction required		Total Modelled NO_2 2007 (µg/m^3)	NO_2 AQS objective (µg/m^3)	Reduction required	
			µg/m^3	%			(µg/m^3)	%
I	162.6	94.2	68.4	42%	55.1	40	15.1	27%
B	160.0		65.8	41%	54.6		14.6	27%
A	158.6		64.4	41%	54.3		14.3	26%
C	157.2		63.0	40%	54.0		14.0	26%
H	155.4		61.2	39%	53.6		13.6	25%
F	124.4		30.2	24%	47.1		7.1	15%
E	123.9		29.7	24%	46.9		6.9	15%
G	120.0		25.8	21%	46.1		6.1	13%
35_MainStreet	112.9		18.7	17%	44.5		4.5	10%
D	99.3		5.1	5%	41.2		1.2	3%

5 Conclusions

As part of the Local Air Quality Management (LAQM) regime, a Further Assessment of the Air Quality Management Area (AQMA) in Main Street, Dungiven, was carried out based on detailed dispersion modelling. The AQMA was declared for nitrogen dioxide (NO_2) in March 2006 following exceedences of the NO_2 annual mean Air Quality Strategy objective.

The Further Assessment is required as part of the Review and Assessment of air quality for local authorities that have declared or amended an AQMA, with the objective to supplement information gathered in the previous assessments.

This assessment was based on advanced atmospheric dispersion modelling of NO_2 traffic emissions, relying on updated background pollutant concentrations, monitoring, traffic and meteorological data for year 2007.

Source apportionment of pollutant contribution was carried out based on the following vehicle categories: cars, light goods vehicles (LGVs), buses, and heavy goods vehicles (HGVs). The NO_x reduction to comply with the NO_2 annual mean AQS objective was calculated based on the highest concentration results at sensitive receptors relevant of public exposure (facades of properties).

The findings of this report are the following:

- Updated monitoring and modelled results confirm that the AQMA is still required in Dungiven, as the AQS objective is still likely to be exceeded along Main Street. However, updated monitoring results suggest that exceedences of the objective are likely outside of the AQMA further East along Main Street. Although the model under predicted results in this area, it is recommended that the AQMA be extended to encompass a larger part of Main Street, probably up to the junction with Garvagh Road.

- The source apportionment shows that HGVs are the main contributors, and account for 50% to 60% of the total NO_x concentration in the AQMA. Cars contribute around 15% and LGVs about 3%. Background concentrations account for 20% to 30% of the total NO_x concentration in areas of exceedences, while buses contribution is not significant.

- The maximum reduction required in NO_x concentrations in the AQMA to comply with the AQS objectives is 68µg/m^3 (equivalent to a 42% reduction in NO_x levels). This equates to about 15µg/m^3 reduction in NO_2 (27% reduction). Consequently, measures formulated in the Action Plan should aim to reduce the levels of NO_x / NO_2 within the AQMA by these amounts.

6 Recommendations

Technical advice and justification of the possible measures to be taken within the Local Action Plan is not possible at this stage given the modelling of one single 'as is' scenario as within the scope of the current study.

To take further with practical application the results of the current study, Bureau Veritas recommends:

1. A scenario testing analysis of the possible actions listed within the Local Action Plan to ascertain the most efficient measures to be implemented to comply with limit values in 2010; and

2. Identification of any additional policy measures that may have to be implemented after declaration as well as links with regional initiatives/measures with potential impact on the air quality emissions registered in the study area

Appendix 1 – Traffic Data

Table A 1 – Dungiven traffic data

Road Link	Street Canyon	Speed (km/hr)	AADT 2007	% Cars	% LGVs	% HGVs	% Buses and Coaches
MainSt1	No	50	13650	83.6	5.8	10.5	0.1
MainSt2	No	25	13650	83.6	5.8	10.5	0.1
MainSt3_J	Yes	10	13650	83.6	5.8	10.5	0.1
MainSt4_J	Yes	10	13650	83.6	5.8	10.5	0.1
MainSt5	Yes	25	13650	83.6	5.8	10.5	0.1
MainSt6	Yes	25	13650	83.6	5.8	10.5	0.1
MainSt7_J	Yes	10	13650	83.6	5.8	10.5	0.1
MainSt8	Yes	25	13650	83.6	5.8	10.5	0.1
MainSt9	Yes	35	13650	83.6	5.8	10.5	0.1
MainSt10_J	Yes	20	13650	83.6	5.8	10.5	0.1
MainSt11	Yes	50	13650	83.6	5.8	10.5	0.1
MainSt12	Yes	25	13650	83.6	5.8	10.5	0.1
MainSt13	Yes	50	13650	83.6	5.8	10.5	0.1
MainSt14_J	Yes	25	13650	83.6	5.8	10.5	0.1
MainSt15	No	50	13650	83.6	5.8	10.5	0.1

Appendix 2 – NO_x/NO_2 conversion

Following recent analysis of the NO_x/NO_2 ratio at a number of roadside and kerbside monitoring sites in the UK over the past 4 years, the methodology to convert NO_x to NO_2 and vice versa was reviewed in 2007[20]. This updated empirical relationship is based on monitoring data for years 2003 to 2006, collated from the AURN, Highways Agency and LAQN monitoring networks. The report highlights that the relationship described in guidance LAQM.TG(03) is no longer applicable, as comparison with monitoring data shows that it is likely to under predict NO_2 concentration by an average of 20%. Therefore, the NO_x to NO_2 conversion in this assessment was based on the new methodology, as described below. Results are summarized in Table A2.

- First, both monitored and predicted road-NO_x concentrations are calculated by subtracting the background NO_x concentration as provided in Section 2.4.2. Estimated 'monitored' NO_x at diffusion tube sites is based on the NO_x from NO_2 calculator spreadsheet available on the UK Air Quality Archive website[21]. The ratio between monitored road-NO_x and modelled road-NO_x is then calculated[22].

- The predicted road-NO_x is adjusted based on this ratio, and the total predicted NO_x is obtained by adding the background NO_x concentration. Predicted road-NO_2 is then calculated using the following updated empirical NO_x/NO_2 relationship:

$$\text{road-}NO_2 = (-0.0719 \times \text{Ln(total-NOx)}+0.6248) \times \text{road-}NO_x$$

Finally, the total predicted NO_2 is calculated by adding the local background NO_2 concentration (as mentioned in Section 2.4.2).

Figure A1 showing modelled NO_2 versus monitored NO_2 demonstrates that the adjusted modelled results are in good agreement with the monitoring data.

20 'Deriving NO_2 from NO_x for Air Quality Assessments of Roads - Updated to 2006' - AQC, March 2007, www.uwe.ac.uk/aqm/review/NOx_NO2_Report_27_03_07.pdf

21 www.airquality.co.uk/archive/laqm/tools/NOxfromNO2calculator2007.xls

22 Based on the least square regression method – intercept at 0

Figure A1 - Adjusted Modelled NO_2 vs. Monitored NO_2 - Dungiven

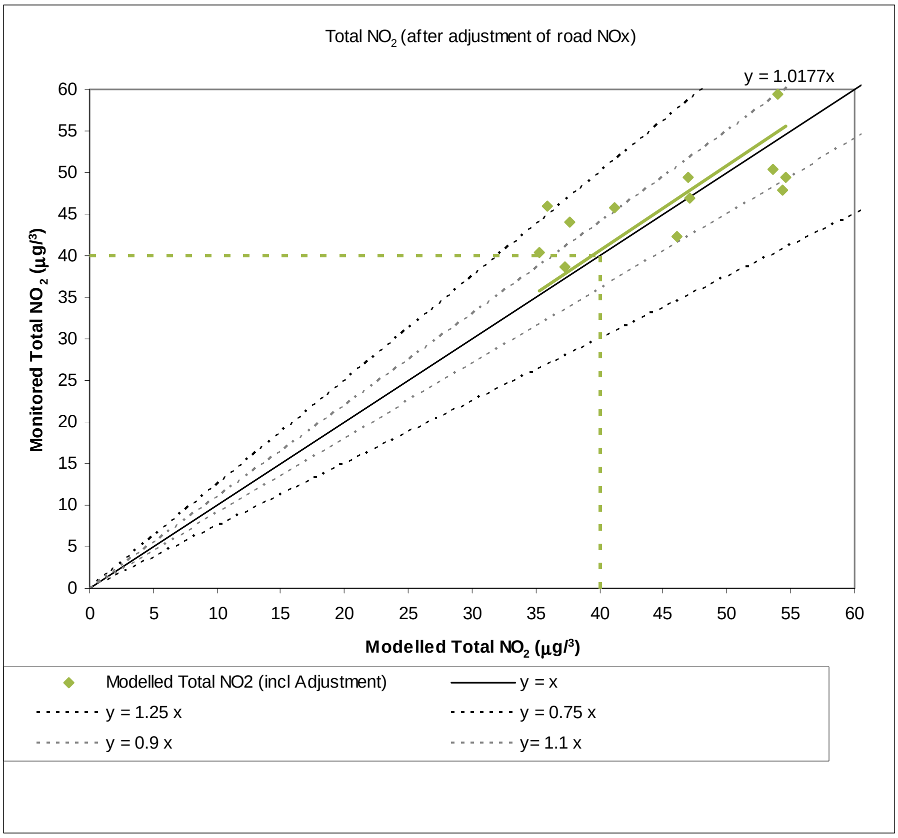


Table A2 – Model verification – Dungiven

Site ID	Background NO_2 (µg/m^3)	Background NO_x (µg/m^3)	Monitored Total NO_x (µg/m^3)	Monitored Road Contribution NO_x (µg/m3)	Modelled Road Contribution NO_x (µg/m^3)	Ratio of Monitored Road NO_x/Modelled Road NO_x	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO_x (µg/m^3)	Adjusted Modelled Total NO_x (µg/m^3)	Modelled Total NO_2 (µg/m^3)	Monitored Total NO_2 (µg/m^3)	% Difference NO_2 [(Modelled - Monitored)/ Monitored]
A	20.4	28.5	128.5	100.0	110.3	0.91	1.180	130.1	158.6	54.3	48.0	13%
B			134.8	106.3	111.5	0.95		131.5	160.0	54.6	49.3	11%
C			185.0	156.5	109.1	1.43		128.7	157.2	54.0	59.4	-9%
D			118.4	89.9	60.0	1.50		70.8	99.3	41.2	45.7	-10%
E			135.5	107.0	80.8	1.32		95.4	123.9	46.9	49.5	-5%
F			123.8	95.3	81.3	1.17		95.9	124.4	47.1	46.9	0%
G			104.1	75.6	77.5	0.98		91.5	120.0	46.1	42.4	9%
H			139.3	110.8	107.5	1.03		126.9	155.4	53.6	50.3	7%
K			88.8	60.3	46.5	1.30		54.9	83.4	37.2	38.6	-4%
L			119.8	91.3	42.1	2.17		49.7	78.2	35.9	46.0	-22%
M			110.9	82.4	48.0	1.72		56.6	85.1	37.7	44.0	-14%
O			95.6	67.1	40.1	1.67		47.3	75.8	35.2	40.3	-13%