# WEST DORSET DISTRICT COUNCIL

# LAQM - FURTHER ASSESSMENT OF DORCHESTER AIR QUALITY MANAGEMENT AREA

BV/AQ/AGGX3052839/EC

JANUARY 2010

BUREAU VERITAS

*Move Forward with Confidence*

This page is left blank intentionally

# DOCUMENT CONTROL SHEET

| Issue/Revision | Issue 1 | Final | | |
|---|---|---|---|---|
| Remarks | Draft for Comment | Final Version | | |
| Date | 29th January 2010 | 23rd April 2010 | | |
| Submitted to | Rebecca Brookman | Rebecca Brookman | | |
| Prepared by | Erwan Corfa | Erwan Corfa | | |
| Signature | | | | |
| Approved by | Lakhu Luhana | Lakhu Luhana | | |
| Signature | | | | |
| Project number | 3052839 | 3052839 | | |
| File reference | | | | |

<u>Disclaimer</u>



Bureau Veritas UK Limited
Great Guildford House
30 Great Guildford Street
London. SE1 0ES

Telephone: +44 (0) 207 902 6100
Fax:: +44 (0) 027 902 6149
Registered in England 1758622
www.bureauveritas.co.uk

Registered Office
Great Guildford House
30 Great Guildford Street
London. SE1 0ES

This page is left blank intentionally

# TABLE OF CONTENTS



# LIST OF TABLES



# LIST OF FIGURES

# Executive Summary

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government guidance when undertaking such work.

Based on the findings of the Detailed Assessment produced in April 2008, West Dorset District Council designated an Air Quality Management Area (AQMA) for the $NO_2$ annual mean objective in Dorchester. The AQMA area encompassed properties in High East Street between the junction with The Bow to the west and the Mill Stream to the east. The AQMA was designated on 5th May 2009.

Bureau Veritas has been commissioned by West Dorset District Council to provide a Further Assessment of air quality within the Dorchester AQMA, which will provide technical input to their Air Quality Action Plan.

The Further Assessment has been undertaken in accordance with Defra's Technical Guidance LAQM.TG(09)[1] methodology. The Further Assessment aims, through assessment of monitoring data and modelled predictions:

- to confirm the original assessment of air quality in the AQMA against the prescribed objective;
- to calculate more accurately how much of an improvement in air quality would be needed to deliver the air quality objectives within the AQMA;
- to refine knowledge of the sources of pollution so that the air quality action plan measures can be properly targeted.

The information from the Further Assessment is required to assist the preparation of action plan measures for the AQMA in order that the measures may be targeted and focused, thereby prioritising the most cost-effective approach to reducing air pollutant concentrations in the AQMA.

The findings of this report are the following:

- Monitoring data indicate exceedences of the annual mean $NO_2$ objective within, but also outside the current AQMA boundaries, although not at a location relevant of public exposure.
- Updated modelled results confirm the exceedence within the AQMA, but indicate that there is no breach of the $NO_2$ AQS objectives outside the AQMA. However, there are properties in High West Street where the $NO_2$ annual mean concentration is predicted to be below but close to the objective. Although there is no need to extend the AQMA, monitoring of $NO_2$ outside the AQMA should continue to ensure concentrations still comply with the objective in the future.
- A 23% reduction in $NO_x$ concentrations would be necessary to comply with the AQS objectives. This equates to a 14% decrease in $NO_2$ concentrations.
- $NO_x$ from road traffic represents 85% of the total $NO_x$ concentration, essentially due to cars and Heavy-goods vehicles (HGVs) on High East Street.

[1] Defra (2009), Local Air Quality Management Technical Guidance LAQM.TG(09)

# 1 Introduction

## 1.1 Project Background

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government guidance when undertaking such work. The Further Assessment is a requirement of the Third 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 previous Detailed Assessment. Bureau Veritas was commissioned by West Dorset District Council to undertake the Further Assessment of the High East Street AQMA declared in Dorchester for nitrogen dioxide ($NO_2$) on 5th May 2009.

## 1.2 Legislative Background

The significance of existing and future pollutant levels is assessed in relation to the national air quality standards and objectives, established by the Government. The revised Air Quality Strategy (AQS)[2] for the UK (released in July 2007) provides the over-arching strategic framework for air quality in the UK and contains national air quality standards and objectives established by the UK Government and devolved administrations to protect human health. The air quality objectives incorporated in the AQS and the UK Legislation are derived from the Limit Values prescribed in the EU Directives transposed into national legislation by member states.

The CAFE (Clean Air for Europe) programme was initiated in the late 1990s to draw together previous directives into a single EU Directive on air quality. The Directive 2008/50/EC[3] introduces new obligatory standards for $PM_{2.5}$ for Government but places no statutory duty on local Government to work towards achievement.

The Air Quality Standards (England) Regulations 2007[4] came into force on 15th February 2007 in order to align and bring together in one statutory instrument the Government's obligations to fulfil the requirements of the CAFE Directive.

The objectives for ten pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide ($NO_2$), sulphur dioxide ($SO_2$), particulates - $PM_{10}$ and $PM_{2.5}$, ozone and Polycyclic Aromatic Hydrocarbons (PAHs) have been prescribed within the Air Quality Strategy[2] based on The Air Quality Standards (England) Regulations 2007.

The objectives set out for pollutants in the AQS and Air Quality Regulations for the purpose of Local Air Quality Management[5] are presented in Table 1. The UK Government and the Devolved Administrations have also set new national air quality objectives for $PM_{2.5}$. These objectives have not been incorporated into LAQM Regulations, and authorities have no statutory obligation to review and assess air quality against them.

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.

---

[2] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007), Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland

[3] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

[4] The Air Quality Standards Regulations 2007, Statutory Instrument No 64, The Stationary Office Limited

[5] The Air Quality (England) (Amendments) Regulations 2002 (Statutory Instrument 3043)

**Table 1 – Air Quality Objectives included in the Air Quality Regulations for the purpose of Local Air Quality Management in England**

| Pollutant | Objective | Concentration Measured As | Date to be Achieved By and Maintained Thereafter |
|---|---|---|---|
| **Benzene** All authorities | 16.25 µg/m$^3$ | running annual mean | 31.12.2003 |
| Authorities in England and Wales only | 5.00 µg/m$^3$ | annual mean | 31.12.2010 |
| Authorities in Scotland and Northern Ireland only | 3.25 µg/m$^3$ | running annual mean | 31.12.2010 |
| **1,3 Butadiene** All authorities | 2.25 µg/m$^3$ | running annual mean | 31.12.2003 |
| **Carbon monoxide** Authorities in England, Wales and Northern Ireland only | 10.0 µg/m$^3$ | maximum daily running 8-hour mean | 31.12.2003 |
| Authorities in Scotland only | 10.0 µg/m$^3$ | running 8-hour mean | 31.12.2003 |
| **Lead** All authorities | 0.5 µg/m$^3$ | annual mean | 31.12.2004 |
| | 0.25 µg/m$^3$ | annual mean | 31.12.2008 |
| **Nitrogen dioxide** [a] All authorities | 200 µg/m$^3$, not to be exceeded more than 18 times a year | hourly mean | 31.12.2005 |
| | 40 µg/m$^3$ | annual mean | 31.12.2005 |
| **Particles ($PM_{10}$) (gravimetric)** [b] All authorities | 50 µg/m$^3$, not to be exceeded more than 35 times a year | 24 hour mean | 31.12.2004 |
| | 40 µg/m$^3$ | annual mean | 31.12.2004 |
| **Sulphur dioxide** All authorities | 350 µg/m$^3$ not to be exceeded more than 24 times a year | 1 hour mean | 31.12.2004 |
| | 125 µg/m$^3$ not to be exceeded more than 3 times a year | 24 hour mean | 31.12.2004 |
| | 266 µg/m$^3$ not to be exceeded more than 35 times a year | 15 minute mean | 31.12.2005 |

*a* EU Limit values in respect of nitrogen dioxide to be achieved by 1st January 2010. There are, in addition, separate EU limit values for carbon monoxide, sulphur dioxide, lead and PM10, to be achieved by 2005, and benzene by 2010.

*b* Measured using the European gravimetric transfer sampler or equivalent.

## 1.3 Local Air Quality Management (LAQM) Review and Assessment

As established by the Environment Act 1995 Part IV, all local authorities in the UK are under a statutory duty to undertake an air quality assessment within their area and determine whether they are likely to meet the air quality objectives set down by the Government for a number of pollutants. The process of review and assessment of air quality undertaken by local authorities is set out under the Local Air Quality Management (LAQM) regime and involves a phased three yearly assessment of local air quality. Where the results of the review and assessment process highlight that problems in the attainment of health-based objectives for air quality will arise, the authority is required to declare an Air Quality Management Area (AQMA) – a geographic area defined by high levels of pollution and exceedences of AQS objectives.

The LAQM regime was first set down in the 1997 National Air Quality Strategy (NAQS)[6] and introduced the idea of local authority 'Review and Assessment'. The Government subsequently published policy and technical guidance related to the review and assessment processes in 1998. This guidance has since been reviewed and the latest documents include Policy Guidance (LAQM.PG (09))[7] and Technical Guidance (LAQM.TG (09))[8]. The guidance lays down a progressive, but continuous, framework for the local authorities to carry out their statutory duties to monitor, assess and review air quality in their area and produce action plans to meet the air quality objectives.

Defra and the Devolved Administrations released the latest Policy and Technical Guidance in February 2009, in anticipation of the fourth round of review and assessment. The fourth round began with the Updating and Screening Assessment required to be completed by local authorities by the end of April 2009.

## 1.4 Summary of Review and Assessment in West Dorset

West Dorset District Council completed its first round of Review and Assessment in 2001. The review of the local air quality concluded that the objectives for all the seven regulatory pollutants were being met and did not require any further assessment.

The second round of Review and Assessment started with an Updating and Screening Assessment (USA) in 2003. The USA, completed in 2004, concluded that a Detailed Assessment was required for some areas in Chideock, Bridport and Dorchester having potential to exceed the AQS objectives for $NO_2$. The Detailed Assessment was completed in 2006. Based on the findings of the Detailed Assessment and comments by Defra, it was concluded to declare an AQMA in Chideock and increase monitoring in Bridport and Dorchester to confirm if an AQMA was required in these areas.

In the third round of Review and Assessment the Council submitted a Progress Report in May 2007. Based on new monitoring data for $NO_2$, the report concluded that a Detailed Assessment was required for $NO_2$ due to road traffic emissions in Bridport and Dorchester.

The Detailed Assessment was produced in 2008 based on new monitoring data collected during 2007. Conclusions were that a detailed modelling was required for East Road in Bridport, while continuing monitoring $NO_2$ in East Road, Bridport and High East Street, Dorchester. The Detailed assessment also recommended that the diffusion tube in High West Street in Dorchester be moved to a location of relevant exposure. However, after consultation with Defra, the Council decided to declare an AQMA in High East Street, Dorchester on the basis of the monitoring results.

[6] DoE, 1997, 'The United Kingdom National Air Quality Strategy', The Stationary Office

[7] Policy Guidance LAQM.PG(09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

[8] Technical Guidance LAQM.TG (09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

## 1.5 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 contributions and the different vehicle classification on the roads of concern.

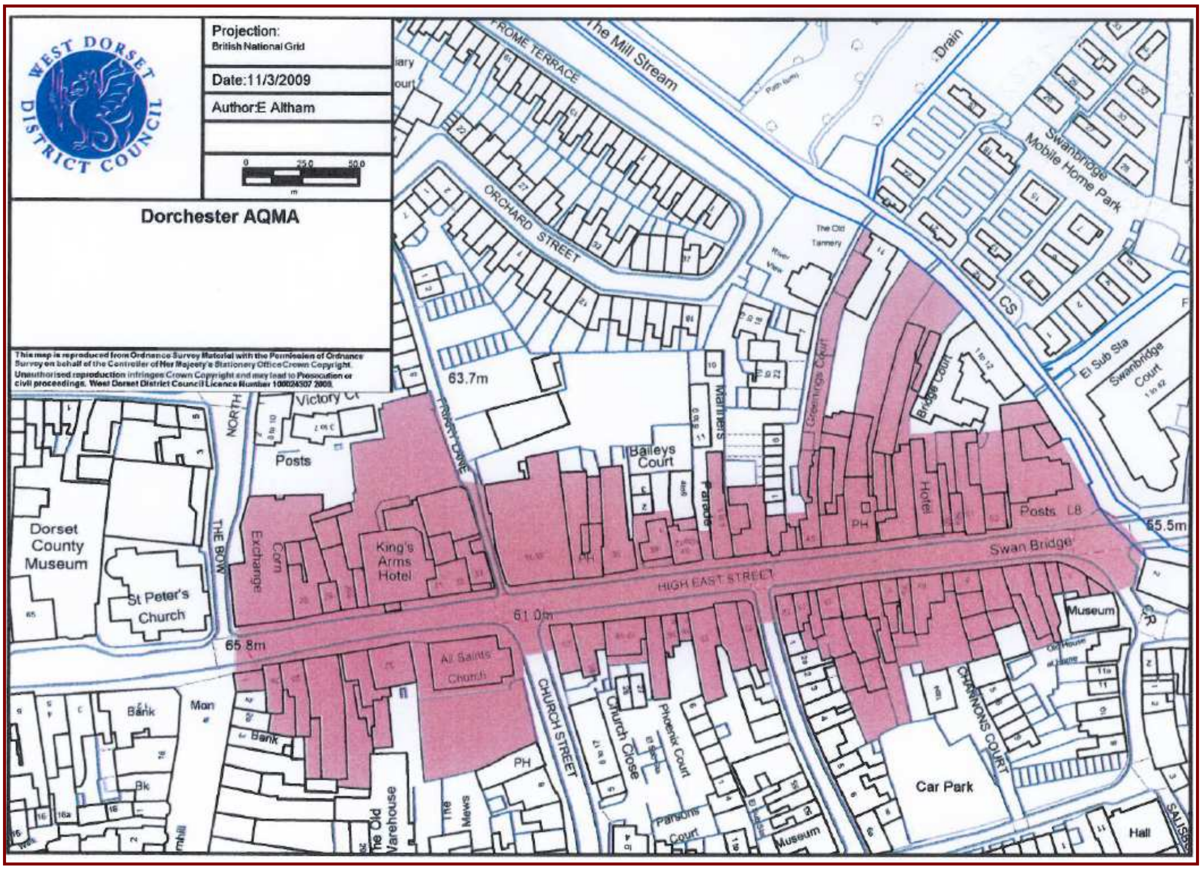
Detailed dispersion modelling was carried out as part of the Further Assessment based on the ADMS-Roads (v2.3) atmospheric dispersion model. Monitoring results from nitrogen dioxide diffusion tubes installed in the assessment area were used to verify the modelled results. The concentrations of $NO_x$ and $NO_2$ were predicted for the baseline (verification) year 2008, and future year 2010. The dispersion modelling was undertaken in accordance with the methodologies provided in the Technical Guidance (LAQM.TG(09)) for Detailed and Further Assessments.

# 2 Baseline Information

## 2.1 Dorchester High East Street Air Quality Management Area

Dorchester AQMA was declared on 5th May 2009 for the $NO_2$ annual mean. The AQMA encompasses the entire High East Street, and is bound by its junction with The Bow in the west and by The Mill Stream in the east. An action plan is currently being prepared, which will propose mitigation measures to help reduce air pollution within the AQMA with a view to meet the AQS objective. The AQMA is shown in Figure 1.

**Figure 1 - Dorchester Air Quality Management Area**



## 2.2 Traffic Data

Traffic data for the assessment were provided by Dorset County Council for the following roads:

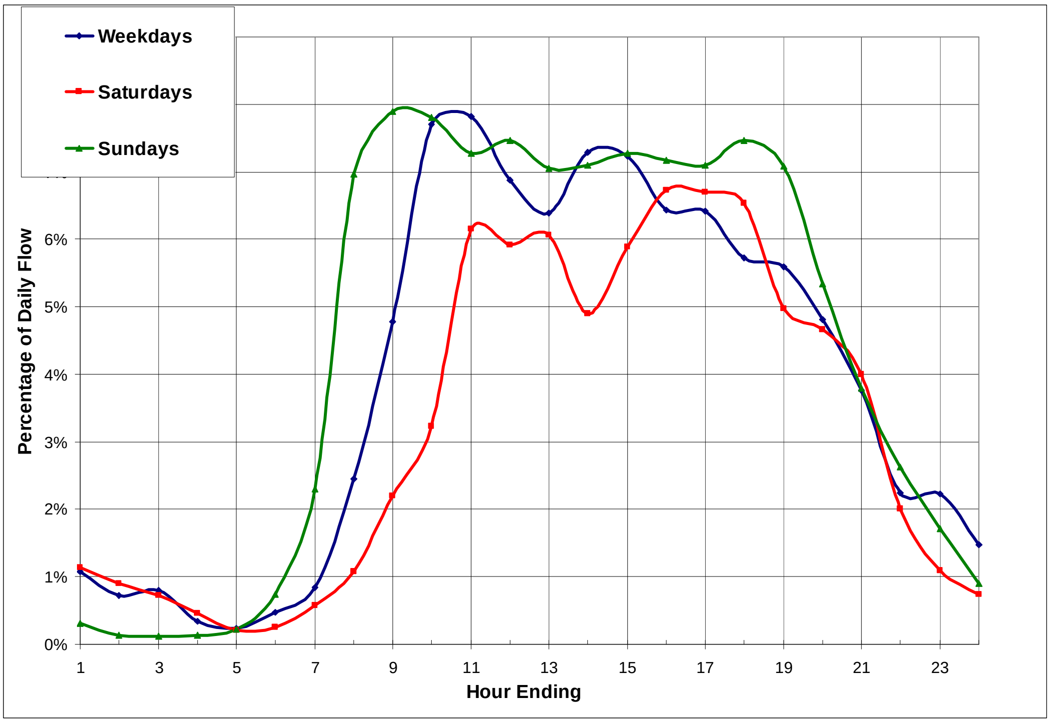
- The B3150 (High West Street, High East Street, London Road, Bridport Road)
- The B3147 (The Grove, Albert Road)
- High Street Fordington
- Church Street
- Friary Way

As data were provided for year 2002, traffic flows were projected to the years of assessment 2008 and 2010 using TEMPRO DfT model[9]. The Tempro model provided a growth factor of 1.4% between 2002 and 2008, and 0.9% between 2008 and 2010.

Traffic flows were available as 24-hour automatic traffic counts (ATCs) or 12-hour manual classified counts, converted to Annual Average Daily Traffic (AADT) flows. Data included detailed breakdown of vehicle categories, including cars, light goods vehicles (LGVs), buses and coaches, and heavy-goods vehicles (HGVs).

Diurnal patterns of traffic flows for weekday, Saturday and Sunday were determined for all modelled roads, based on hourly traffic data for High West Street. The diurnal profiles used in this assessment are provided in Figure 2 below. Traffic data used in the assessment are summarised in Appendix 1, and modelled roads are illustrated in Appendix 2.

**Figure 2 - Diurnal Pattern - Hourly Traffic as Percentage of Daily Flows**




[9] TEMPRO (Trip End Model Presentation Program) version 6.1, dataset v5.4 - Projection Factor for Dorchester (19UH3) - Department for Transport, March 2009

## 2.3 Air Quality Monitoring Data

There is currently no automatic monitoring of nitrogen dioxide is undertaken by the Council. West Dorset District Council undertook monitoring at 6 $NO_2$ diffusion tubes sites in 2008 in Dorchester. The diffusion tubes are supplied and analysed by Gradko Laboratories utilising the 50% Triethanolamine (TEA) in acetone preparation method. Gradko Laboratories participate in the Workplace Analysis Scheme for Proficiency (WASP) for $NO_2$ diffusion tube analysis and the Annual Field Inter-Comparison Exercise. These provide strict performance criteria for participating laboratories to meet, thereby ensuring $NO_2$ concentrations reported are of a high calibre. The laboratory follows the procedures set out in the Harmonisation Practical Guidance. Results from 2006 to 2009 are provided in Table 2.

**Table 2 - Dorchester $NO_2$ Diffusion Tube Annual Mean (µg/m$^3$) – 2006- 2009**

| Site Name | Site ID | OS Coordinates (X,Y) | 2006 (Bias=1.01) | 2007 (Bias=0.93) | 2008 (Bias=0.93) | % Data Capture 2008 | 2009 (Bias=0.99) | % Data Capture 2009 |
|---|---|---|---|---|---|---|---|---|
| **High West St 1** | 711 | 369121, 90726 | 37.1 | **41.1** | **41.9** | 100% | **44.6** | 100% |
| **High West St 2** | 721 | 369000, 90705 | Not Open | | 32.0 (2) | 100% | 32.8 | 92% |
| **High East St 1** | 714 | 369385, 90745 | Not Open | 39.2 | **43.0** | 100% | **46.2** | 100% |
| **High East St 2** | 713 | 369490, 90760 | **43.1** | **42.9** | 38.2 | 83% | 39.6 | 100% |
| **Tesco (1)** | 712 | 368573, 89200 | 26.6 | 28.9 | 26.8 | 100% | Closed | |
| **Trinity Street (1)** | 712 | 369170, 90711 | Not Open | | | | 32.9 | 75% |

In bold, exceedence of the $NO_2$ annual mean AQS objective (40µg/m$^3$)
(1) Tesco site was relocated to Trinity Street in 2009
(2) Site 721 installed in October 2008 – 2008 data annualised based on closest background AURN monitoring stations (Yarner Wood, Bournemouth and Bristol St Paul's)

Data capture was good at all sites in 2008 and 2009. Over the past few years, two sites exceeded the $NO_2$ annual mean AQS objective:

- site 711, located within the High East Street AQMA, near the junction with Church Street, and
- site 714 in High West Street, outside of the AQMA.

However, site 714 does not represent relevant public exposure. The Council installed a new tube in High West Street (site 721), at a location relevant of public exposure (Homechester House) in October 2008. As only 3-months worth of data were available for 2008, results have been annualised following the methodology described in LAQM.TG(09). Results indicate that the $NO_2$ annual mean AQS objective was unlikely to be breached at this site in 2008. Results for 2009 confirm this trend with a monitored $NO_2$ annual mean of 32.8µg/m$^3$, based on a 92% (11 months) data capture.

$NO_2$ concentration at site 713, also located in the AQMA in High East Street, was close but did not exceed the objective in 2008 and 2009, although the site was above the objective in 2006 and 2007.

## 2.4 Background Concentrations

Currently there is no monitoring in the area at appropriate background monitoring location, hence background maps available on the Air Quality Archive website[10] were considered to determine appropriate background for this assessment. The background concentrations from OS grid square (369500, 90500) encompassing High East Street were used for the assessment and are shown in

.

**Table 3 – Background Concentrations**

| Pollutant | 2008 Background ($\mu g/m^3$) | 2010 Background ($\mu g/m^3$) |
|---|---|---|
| $NO_x$ | 16.2 | 14.5 |
| $NO_2$ | 13.7 | 12.5 |

Based on UK Background Maps at (X,Y) = (369500, 90500)

[10] 2006-based maps

# 3 Dispersion Modelling Methodology

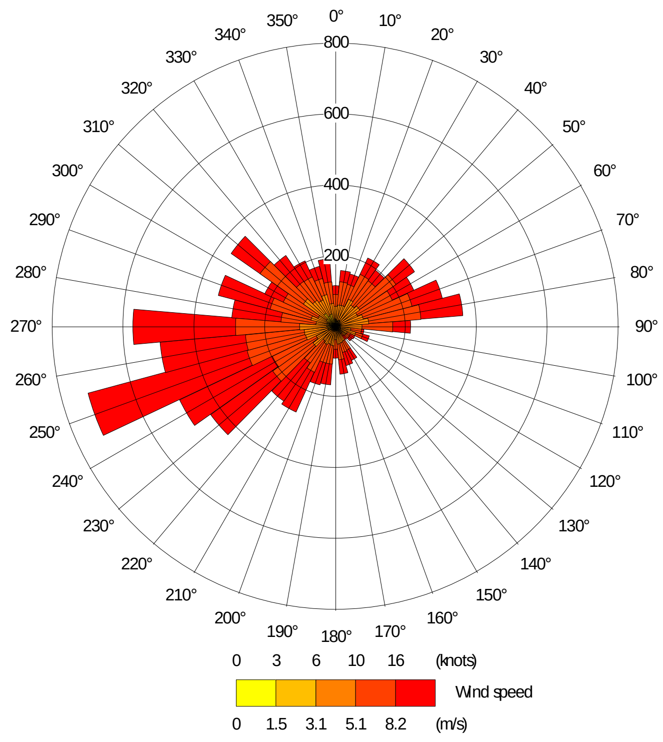
Detailed dispersion modelling of $NO_x$ was undertaken based on ADMS-Roads (version 2.3) atmospheric dispersion model from Cambridge Environmental Research Consultants (CERC). Conversion to $NO_2$ was based on the updated $NO_x/NO_2$ conversion model released by Defra in February 2009 as part of LAQM.TG(09) tools.

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 where properties on both sides are close to the road, including most of High East Street and High West Street.

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 most suitable meteorological station (Isle of Portland) was used in this assessment, based on the year 2008. The wind rose for meteorological data showing the dominant westerly to south-westerly wind direction is shown in Figure 3.

Most Gaussian-type models do not use the lines in the meteorological data set, which have calm winds in its calculations. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75 m/s. It is recommended in LAQM.TG(09) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, as this will confirm the number of missing hours and calm hours calculated by the dispersion model. This is important especially when considering predictions of high percentiles and the number of exceedences. The Isle of Portland 2008 meteorological file has 8278 lines of useable data out of a total of 8784 for the year i.e. 94% data capture. Calm conditions are applied to 46 lines of data, which represents 0.5% of the meteorological data.

**Figure 3 – Wind Rose Hourly Sequential Meteorological Data - Isle of Portland**



# 4 Results

## 4.1 Model Verification and Adjustment

Model verification at specific locations was carried out prior to predicting concentrations within the AQMAs through contour mapping. 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 monitoring data from roadside automatic monitoring sites and $NO_2$ diffusion tubes. Predicted $NO_2$ was derived based on the $NO_x/NO_2$ conversion model released by Defra in February 2009[11].

During the verification process, Bureau Veritas aim to ascertain whether all final modelled concentrations are within 25% of the monitored 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),
- Uncertainty in emissions or emission factors.

The above factors were investigated as part of the model verification process to minimise the uncertainties as far as practicable. The model verification results are provided in Table 4. The full verification methodology is shown in Appendix 3.

**Table 4 – $NO_2$ Model Verification Results**

| Site ID | Site Location | Monitored $NO_2$ 2008 (µg/m$^3$) | Predicted Total $NO_2$ 2008(µg/m$^3$) | Difference predicted / monitored 2008 (µg/m$^3$) | Difference predicted / monitored 2008 (%) |
|---|---|---|---|---|---|
| 711 | High West Street | **41.9** | **40.4** | -1.6 | -3.8% |
| 713 | High East Street | 38.2 | **42.4** | 4.2 | 11.0% |
| 714 | High East Street | **43.0** | **40.0** | -3.0 | -7.0% |
| Number of sites | | Within ±10% | | 2 | |
| | | Between ± 10-25% | | 1 | |
| | | Exceeds ±25% | | 0 | |
| | | Total | | 3 | |

In bold: exceedence of the $NO_2$ annual mean AQS objective (40µg/m$^3$)

Overall, predicted concentrations are in reasonable agreement with monitoring data, with two of the modelled concentrations within ±10% of the monitoring results. Modelled concentration at the remaining site (713 in High East Street) is over predicted by 11%, with a predicted $NO_2$ annual mean over the AQS objective while the monitoring showed that the objective was not exceeded. However, as discussed in Section 2.3, site 713 exceeded the objective in both 2006 and 2007.

[11] www.airquality.co.uk/archive/laqm/tools.php

## 4.2 Modelled $NO_2$ Concentrations

Annual average $NO_2$ concentrations were predicted for the years 2008 and 2010 at a number of specific receptors representing relevant public exposure, located at the facade of properties adjacent to the modelled roads. Only receptors relevant of public exposure have been considered. There is only one residential property at ground level in High West Street outside of the AQMA, (Homechester House, represented by receptor 14 and also diffusion tube 721); all other properties being at first floor level (receptors 7, 8, 9 and 10). Predictions were also made at a 5m-grid spacing across the exceedence areas to produce a concentration contour map for the year 2008. $NO_2$ concentrations were modelled at a height of 1.5m above ground, which represents the average respirable height of an adult, apart from those receptors representing the façade of properties at 1$^{st}$ floor level.

Predicted $NO_2$ concentrations at specific receptors are provided in Table 5. Location of specific receptors is shown in Appendix 2. The $NO_2$ concentration contours for the year 2008 are also illustrated in Figure A 2 and Figure A 3 in Appendix 4 showing the predicted areas of exceedence (above 40µg/m$^3$).

The highest concentration is predicted for receptor 6 located in the AQMA near the junction with Church Street with an annual mean of 46.3µg/m$^3$, which is above the AQS objective. Other exceedences are predicted at receptors 2, 5 and 16, which are also in the AQMA.

There is no exceedence of the objective predicted outside the boundaries of the AQMA at any other receptor, although concentrations at the façade of properties in High West Street are approaching the objective at receptors 7, 8, 9 and 10. The annual mean concentration at the façade of Homechester House in High West Street is below the objective (32.2µg/m$^3$), which is consistent with the $NO_2$ levels measured at diffusion tube 721, located at the façade of the same property (32.0µg/m$^3$ monitored in 2008 and 32.8µg/m$^3$ in 2009).

Predicted results for year 2010 show a reduction in concentrations at modelled receptors. This is due to predicted decrease in background concentrations and road traffic emissions, which compensates for expected traffic growth. The $NO_2$ annual mean objective is still predicted to be exceeded at receptors 5, 6 and 16 in 2010, all within the boundaries of the actual AQMA. No receptor is predicted to exceed the objective outside the AQMA for 2010.

**Table 5 – Predicted $NO_2$ Concentrations at Specific Receptors**

| Receptor ID | X(m) | Y(m) | Z(m) | Within AQMA? | Distance to Road Centreline (m) | $NO_2$ 2008 (µg/m$^3$) | $NO_2$ 2010 (µg/m$^3$) |
|---|---|---|---|---|---|---|---|
| **1** | 369590 | 90793 | 1.5 | N | 15 | 22.4 | 20.2 |
| **2** | 369501 | 90772 | 1.5 | Y | 5.5 | **42.7** | 39.2 |
| **3** | 369437 | 90753 | 1.5 | Y | 6.5 | 31.5 | 28.5 |
| **4** | 369425 | 90765 | 1.5 | Y | 6.5 | 30.4 | 27.5 |
| **5** | 369291 | 90745 | 1.5 | Y | 6 | **43.6** | **40.1** |
| **6** | 369345 | 90754 | 1.5 | Y | 6.5 | **46.3** | **42.6** |
| **7** | 369124 | 90712 | 3 | N | 6 | 39.9 | 36.5 |
| **8** | 369097 | 90708 | 3 | N | 7 | 39.7 | 36.3 |
| **9** | 369077 | 90706 | 4 | N | 5.5 | 39.4 | 36.0 |
| **10** | 369068 | 90704 | 4 | N | 6 | 39.5 | 36.1 |
| **11** | 368846 | 90650 | 1.5 | N | 7 | 30.6 | 27.7 |
| **12** | 368770 | 90624 | 1.5 | N | 12 | 22.9 | 20.6 |
| **13** | 368905 | 90716 | 1.5 | N | 9 | 28.1 | 25.4 |
| **14** | 368987 | 90702 | 1.5 | N | 8 | 32.2 | 29.2 |
| **15** | 368897 | 90835 | 1.5 | N | 6.5 | 26.5 | 24.0 |
| **16** | 369293 | 90733 | 1.5 | Y | 6 | **45.3** | **41.7** |

In bold, exceedence of the $NO_2$ annual mean AQS objective (40µg/m$^3$)

## 4.3 $NO_x$ Source Apportionment

The breakdown of vehicle classification was taken into account in the model set-up. This allowed determining $NO_x$ source apportionment at specific (worst case) receptors, where exceedences were predicted. The source apportionment was carried out for the following vehicle classes:

- cars,
- light goods vehicles (LGVs),
- buses/coaches, and
- heavy goods vehicles (HGVs).

To enable a detailed source apportionment of the background contribution, the modelled maps from the air quality archive have been used, as these incorporate a break down of background concentrations of $NO_X$ by source. Proportions of each background source category have been used to categorise the total background $NO_X$ and $NO_2$ in the assessment area.

Table 6 and Table 7 summarise the results at (worst case) receptors representing public exposure in the exceedence area. The source apportionment indicates that:

- Road traffic emissions are the main contributor to $NO_X$, as they account for 85% of the total $NO_x$ concentration at receptors;
- Of the road traffic sources, cars and heavy-goods vehicles (HGVs) are significant contributors, as they account for respectively 31-36% and 20-24% of the total $NO_x$ concentrations at receptors. The contribution of HGVs to the total $NO_x$ concentrations is quite significant especially if compared to the proportion of the vehicle fleet they represent (1-2% of overall traffic);
- Light goods vehicles (LGVs) contribute around 15-16% to the total $NO_x$ concentrations at receptors;
- Buses contribute around 11–14% to the total $NO_x$ concentrations at receptors
- Background concentrations account for 14% to 17% of the total $NO_x$ concentration at receptors, with 6 -7% due to regional background concentrations outside the local authority's influence;
- Similar to $NO_X$, the source apportionment of $NO_2$ indicates road traffic emissions to be the most significant contributor, contributing 67 - 70% to overall $NO_2$ concentrations. Of these, cars and HGVs are the biggest contributors, accounting for respectively 25-30% and 17-19% of the overall $NO_2$ concentration.

**Table 6 - Source Apportionment of $NO_X$ Concentrations at Specific Receptors**

| Receptor (Maximum modelled concentration) | 6 | 16 | 5 | 2 |
|---|---|---|---|---|
| Total $NO_X$ 2008 in µg/m$^3$ (Total Background + Local Road Source) | 116.9 | 112.7 | 104.9 | 101.3 |
| $NO_X$ Total Background (Local + Regional) in µg/m$^3$ | 16.2 | 16.2 | 16.2 | 16.2 |
| $NO_X$ Local Background in µg/m$^3$ | 9.0 | 9.0 | 9.0 | 9.0 |
| $NO_X$ Regional Background in µg/m$^3$ | 7.2 | 7.2 | 7.2 | 7.2 |
| Local Road Source Contributions in µg/m$^3$ | 100.8 | 96.5 | 88.7 | 85.1 |
| ▪ $NO_X$ CAR | 39.0 | 41.2 | 37.6 | 34.8 |
| ▪ $NO_X$ LGV | 19.2 | 18.4 | 17.0 | 16.3 |
| ▪ $NO_X$ HGV | 27.7 | 24.1 | 22.0 | 22.7 |
| ▪ $NO_X$ BUS | 14.9 | 12.8 | 12.1 | 11.4 |
| % Local background | 7.7% | 8.0% | 8.6% | 8.9% |
| % Regional background | 6.2% | 6.4% | 6.9% | 7.1% |
| % Road traffic | 86.2% | 85.6% | 84.6% | 84.0% |
| ▪ % due to CAR traffic | 33.4% | 36.5% | 35.9% | 34.3% |
| ▪ % due to LGV traffic | 16.4% | 16.4% | 16.2% | 16.1% |
| ▪ % due to HGV traffic | 23.7% | 21.4% | 21.0% | 22.4% |
| ▪ % due to BUS traffic | 12.7% | 11.3% | 11.5% | 11.2% |
| ▪ % CAR contribution of total road traffic | 38.7% | 42.6% | 42.4% | 40.8% |
| ▪ % LGV contribution of total road traffic | 19.0% | 19.1% | 19.2% | 19.2% |
| ▪ % HGV contribution of total road traffic | 27.5% | 25.0% | 24.8% | 26.7% |
| ▪ % BUS contribution of total road traffic | 14.8% | 13.2% | 13.6% | 13.3% |

**Table 6 - (Continued) - Source Apportionment of $NO_X$ Concentrations**

| $NO_x$ Local Background in µg/m$^3$ Includes: | $NO_x$ µg/m$^3$ | %of Total Background $NO_x$ |
|---|---|---|
| ▪ Road sources (minor roads + A-Roads outside modelled area) Primary roads have been included in the model road source contribution | 4.2 | 26.2% |
| ▪ Industry (combustion in industry, energy production, extraction of fossil fuel, and waste) | 0.6 | 3.6% |
| ▪ Domestic | 3.4 | 21.1% |
| ▪ Aircraft | 0.0012 | 0.0% |
| ▪ Rail | 0.05 | 0.3% |
| ▪ Other (ships, offroad and other emissions) | 0.7 | 4.1% |
| ▪ Point sources | 0.02 | 0.2% |

**Table 7 - Source Apportionment of $NO_2$ Concentrations at Specific Receptors**

| Receptor (Maximum modelled concentration) | 6 | 16 | 5 | 2 |
|---|---|---|---|---|
| Total $NO_2$ 2008 in µg/m$^3$ (Total Background + Local Road Source) | 46.3 | 45.3 | 43.6 | 42.7 |
| $NO_2$ Total Background (Local + Regional) in µg/m$^3$ | 13.7 | 13.7 | 13.7 | 13.7 |
| $NO_2$ Local Background in µg/m$^3$ | 7.6 | 7.6 | 7.6 | 7.6 |
| $NO_2$ Regional Background in µg/m$^3$ | 6.1 | 6.1 | 6.1 | 6.1 |
| Local Road Source Contributions in µg/m$^3$ | 32.5 | 31.6 | 29.8 | 29.0 |
| ▪ $NO_2$ CAR | 12.6 | 13.5 | 12.6 | 11.8 |
| ▪ $NO_2$ LGV | 6.2 | 6.0 | 5.7 | 5.6 |
| ▪ $NO_2$ HGV | 8.9 | 7.9 | 7.4 | 7.7 |
| ▪ $NO_2$ BUS | 4.8 | 4.2 | 4.1 | 3.9 |
| % Local background | 16.5% | 16.8% | 17.5% | 17.8% |
| % Regional background | 13.2% | 13.5% | 14.1% | 14.3% |
| % Road traffic | 70.3% | 69.7% | 68.5% | 67.8% |
| ▪ % due to CAR traffic | 27.2% | 29.7% | 29.0% | 27.7% |
| ▪ % due to LGV traffic | 13.4% | 13.3% | 13.1% | 13.0% |
| ▪ % due to HGV traffic | 19.3% | 17.4% | 17.0% | 18.1% |
| ▪ % due to BUS traffic | 10.4% | 9.2% | 9.3% | 9.0% |
| ▪ % CAR contribution of total road traffic | 38.7% | 42.6% | 42.4% | 40.8% |
| ▪ % LGV contribution of total road traffic | 19.0% | 19.1% | 19.2% | 19.2% |
| ▪ % HGV contribution of total road traffic | 27.5% | 25.0% | 24.8% | 26.7% |
| ▪ % BUS contribution of total road traffic | 14.8% | 13.2% | 13.6% | 13.3% |

## 4.4 $NO_x/NO_2$ Required Reduction

A requirement of the Further Assessment is to determine the amount of $NO_2$ reduction required at the worst-case receptors within the exceedence areas. 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 relevant of public exposure. The results are shown in Table 8.

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 90.3µg/m$^3$ $NO_x$ concentration (based on local background $NO_x$ and the $NO_x/NO_2$ conversion converter).

The maximum predicted $NO_x$ reduction required within the AQMA to comply with the $NO_2$ AQS objective is 26.7µg/m$^3$ (equivalent to a 23% decrease in $NO_x$). This equates to a 6.3µg/m$^3$ reduction in $NO_2$ (equivalent to 14% decrease in $NO_2$). This is at the worst-case location and is located in the AQMA along High East Street near the junction with Church Street.

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

**Table 8 - Required $NO_x$ and $NO_2$ Reduction to Comply With The AQS Objective**

| Receptor ID | Modelled $NO_x$ 2008 (µg/m$^3$) | Equivalent $NO_x$ Objective (µg/m$^3$) | $NO_x$ Reduction Required (µg/m$^3$) | $NO_x$ % Reduction Required | Modelled $NO_2$ (µg/m$^3$) | $NO_2$ Objective (µg/m$^3$) | $NO_2$ Reduction Required 2008 (µg/m$^3$) | $NO_2$ % Reduction Required |
|---|---|---|---|---|---|---|---|---|
| **6** | 116.9 | 90.3 | 26.7 | 23% | 46.3 | 40 | 6.3 | 14% |
| **16** | 112.7 | | 22.4 | 20% | 45.3 | | 5.3 | 12% |
| **5** | 104.9 | | 14.6 | 14% | 43.6 | | 3.6 | 8% |
| **2** | 101.3 | | 11.1 | 11% | 42.7 | | 2.7 | 6% |

# 5 Conclusions and Recommendations

As part of the Local Air Quality Management (LAQM) regime, a Further Assessment based on detailed dispersion modelling has been carried out for the Dorchester Air Quality Management Area (AQMA). The AQMA was declared in High East Street for nitrogen dioxide ($NO_2$) in May 2009 due to predicted exceedences of the $NO_2$ annual mean Air Quality Strategy objective.

This assessment is based on advanced atmospheric dispersion modelling of traffic emissions of $NO_X$, relying on background pollutant concentrations, monitoring data, traffic and meteorological data for the year 2008.

Source apportionment of pollutant contribution has been carried out to determine contributions of vehicle emissions and other sources to $NO_X$ and $NO_2$ concentrations in the exceedence areas. The $NO_x$ reduction to comply with the AQS objectives has been 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:

- Monitoring data from the diffusion tube monitoring sites indicate exceedences of the annual mean $NO_2$ objective in the AQMA in High East Street as well as at one site outside the AQMA in High West Street further west of the AQMA, although the latter does not represent relevant exposure.
- Updated modelled results indicate no exceedence outside the AQMA, although there are properties in High West Street where the $NO_2$ annual mean concentration is predicted to be below but close to the objective. In the light of these results, the AQMA should remain but it is not required to extend it. However, monitoring of $NO_2$ outside the AQMA should continue, especially in High West Street, to ensure concentrations still comply with the AQS objectives in the future.
- The maximum predicted $NO_x$ reduction required within the AQMA to comply with the $NO_2$ AQS objective is 26.7µg/m$^3$ (equivalent to a 23% decrease in $NO_x$). This equates to a 6.3µg/m$^3$ reduction in $NO_2$ (equivalent to 14% decrease in $NO_2$). This is the worst-case modelled location. All other modelled receptors require a lower reduction of $NO_x$ / $NO_2$. Consequently, the formulation of the Action Plan should aim to reduce the levels of $NO_x$ / $NO_2$ within the AQMA by up to this amount.
- Source apportionment of $NO_X$, indicates that road traffic emissions of $NO_X$ are the main contribution to total $NO_X$ concentrations, as they account for 85% of the total $NO_X$ concentrations at receptors likely to exceed the AQS objective. Cars and Heavy-goods vehicles (HGVs) contribute around 31-36% and 20-24% respectively to the total $NO_X$ concentrations at receptors. HGV contribution is especially high given the HGV proportion within the vehicle fleet in the assessment area.

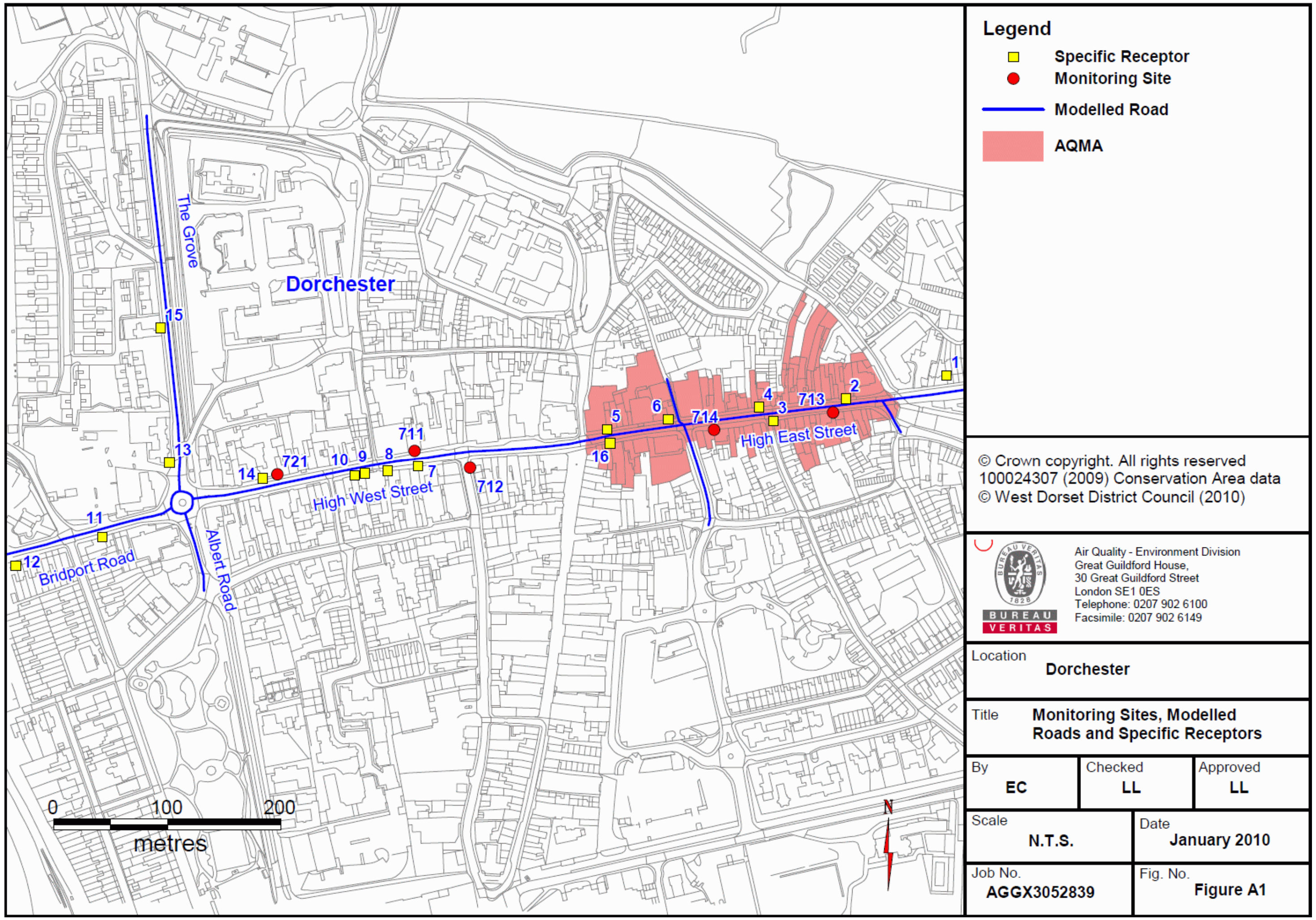
# Appendix 1 – Traffic Data

**Table A 1 – Dorchester Traffic Data**

| Road Link | OS Grid X | OS Grid Y | AADT 2008 | AADT 2010 | % Cars | % LGVs | % HGVs | % Buses |
|---|---|---|---|---|---|---|---|---|
| B3150 High West Street | 368915 | 90680 | 14263 | 14393 | 79.9% | 15.8% | 2.4% | 1.9% |
| B3150 Bridport Road | 368915 | 90680 | 13502 | 13625 | 80.5% | 15.3% | 2.3% | 1.9% |
| B3147 The Grove | 368915 | 90680 | 15365 | 15504 | 83.7% | 13.2% | 2.0% | 1.2% |
| B3147 Albert Road | 368915 | 90680 | 9589 | 9676 | 84.7% | 12.5% | 2.2% | 0.7% |
| B3150 High East Street | 369535 | 90770 | 12886 | 13003 | 81.0% | 15.2% | 2.5% | 1.3% |
| B3150 London Road | 369535 | 90770 | 12522 | 12635 | 80.9% | 15.2% | 2.6% | 1.3% |
| High Street Fordington | 369535 | 90770 | 977 | 986 | 83.7% | 14.3% | 1.3% | 0.7% |
| High East Street (E) | 369360 | 90750 | 13876 | 14003 | 81.0% | 15.4% | 2.4% | 1.2% |
| High East Street (W) | 369360 | 90750 | 15133 | 15271 | 81.8% | 14.6% | 2.2% | 1.3% |
| Church Street | 369360 | 90750 | 5928 | 5982 | 89.9% | 7.4% | 1.2% | 1.5% |
| Friary Way | 369360 | 90750 | 310 | 313 | 89.5% | 8.5% | 1.2% | 0.8% |

# Appendix 2 – Modelled Roads and Receptors (Including Monitoring Sites)

**Figure A 1 – Monitoring Sites, Modelled Roads and Specific Receptors**



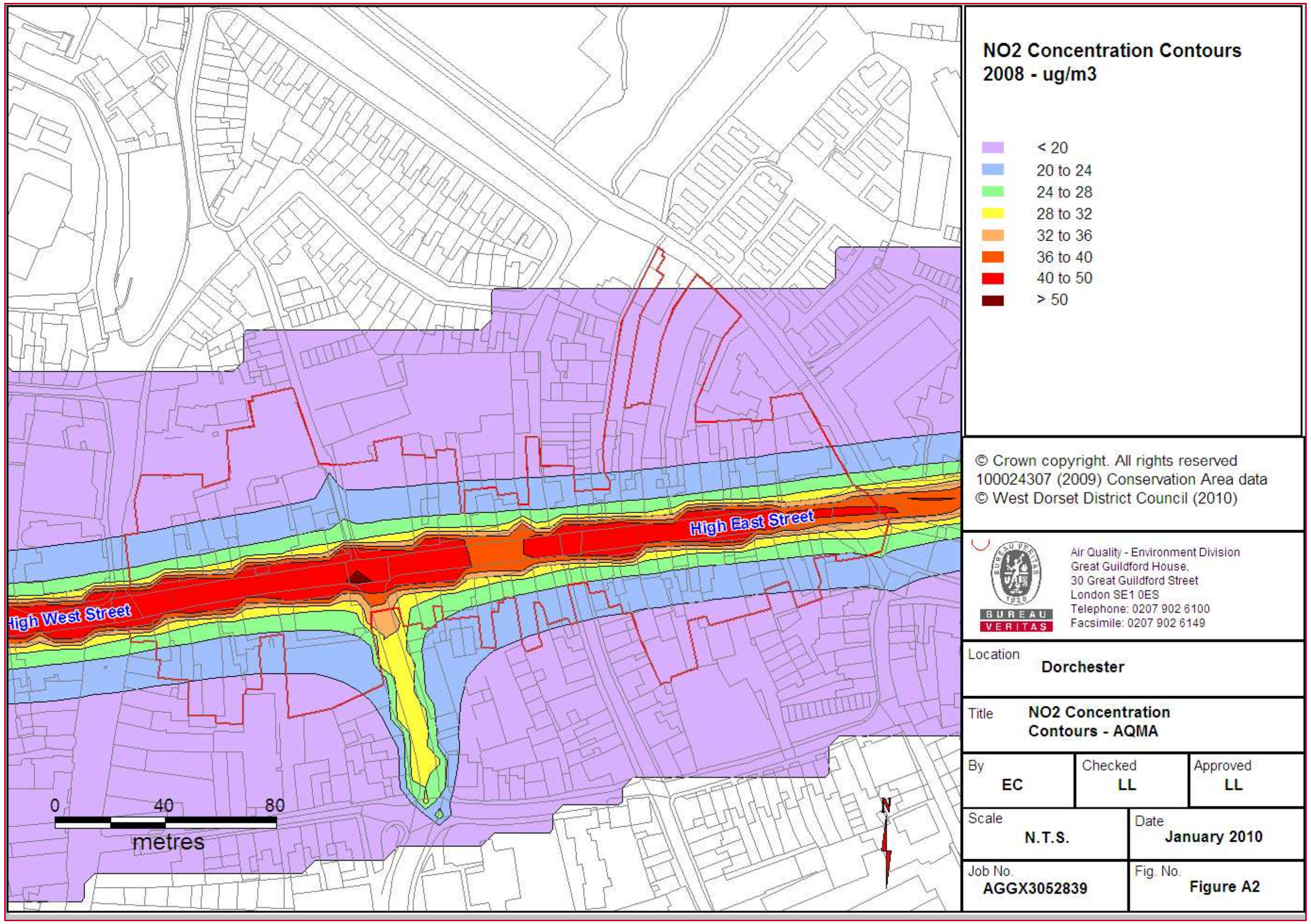
# Appendix 3 – Model Verification

**Table A 2 – Dorchester $NO_x$ / $NO_2$ Model Verification - 2008**

| 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/m$^3$) | 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] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **711** | 13.7 | 16.2 | 98.0 | 81.8 | 10.6 | 7.7 | 7.10 | 75.4 | 91.6 | 40.4 | 41.9 | -3.8% |
| **713** | | | 83.5 | 67.3 | 11.8 | 5.7 | | 83.8 | 100.0 | 42.4 | 38.2 | 11.0% |
| **714** | | | 102.5 | 86.3 | 10.4 | 8.3 | | 74.1 | 90.3 | 40.0 | 43.0 | -7.0% |

# Appendix 4 – $NO_2$ Annual Mean Concentration Contours

**Figure A 2 – $NO_2$ Annual Mean Concentration Contours – 2008 – AQMA Detail**



## Figure A 3 - $NO_2$ Annual Mean Concentration Contours – 2008 – Outside AQMA