# Air Quality Detailed Assessment for Cheshire West & Chester Council

**Frodsham - Fluin Lane / A56**

In fulfilment of Part IV of the Environment Act 1995
Local Air Quality Management

March 2014

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# 1. Executive summary

This assessment has been prepared in order to meet Cheshire West & Chester Council's duties under Part IV of the Environment Act 1995, to review and assess local air quality. The report forms part of the authority's ongoing obligations for local air quality management (LAQM).

Where an LAQM assessment identifies a risk of exceedence of a national objective the authority is obliged to undertake a Detailed Assessment. The need to undertake a Detailed Assessment for Fluin Lane / A56 Frodsham was identified in the Updating and Screening Assessment 2012 and the Progress Report 2013. Methods described in the government's revised technical guidance LAQM TG (09) have been followed in conducting the assessment.

The assessment focuses on nitrogen dioxide emissions from road traffic in Frodsham at the junction of Fluin Lane and the A56 (High Street / Bridge Lane). The study area is characterised by a street canyon in which congested traffic is a feature at peak times. Residential properties lie very close to the carriageway and a number front directly onto the pavement.

A combination of air pollution monitoring and computerised dispersion modelling techniques has been used to assess nitrogen dioxide levels at receptors adjacent to the roads.

The assessment concludes that the national annual mean standard for nitrogen dioxide ($NO_2$) is currently exceeded at fifteen residential locations in the study area. It is recommended therefore that Cheshire West & Chester council designates an Air Quality Management Area (AQMA) and commences work on developing measures intended to deliver improvements in local air quality.

# 2. Introduction

## 2.1. Description of local authority area

Cheshire West and Chester Council was formed in April 2009 and comprises the former Chester City, Ellesmere Port and Neston, and Vale Royal district councils. With a population of around 327,000 it is the fourth largest unitary authority in the northwest, covering 916 square kilometres. The borough abuts Wales to the west, and the densely urbanised areas of Wirral, Liverpool, Runcorn, Warrington and Manchester lie to the north. To the east and south are the more rural areas of Cheshire East and Shropshire. The Borough contains the key city and towns of Chester, Ellesmere Port and Neston to the west; Frodsham to the north, and Northwich and Winsford to the east.

Large parts of central and southern sections of the borough are rural, and the rural population comprises 26 percent of the total population. Chester is a centre for service industries whilst high value manufacturing in automotives and chemicals is based in Ellesmere Port. Northwich provides a high proportion of service sector employment and Winsford manufacturing and industry.

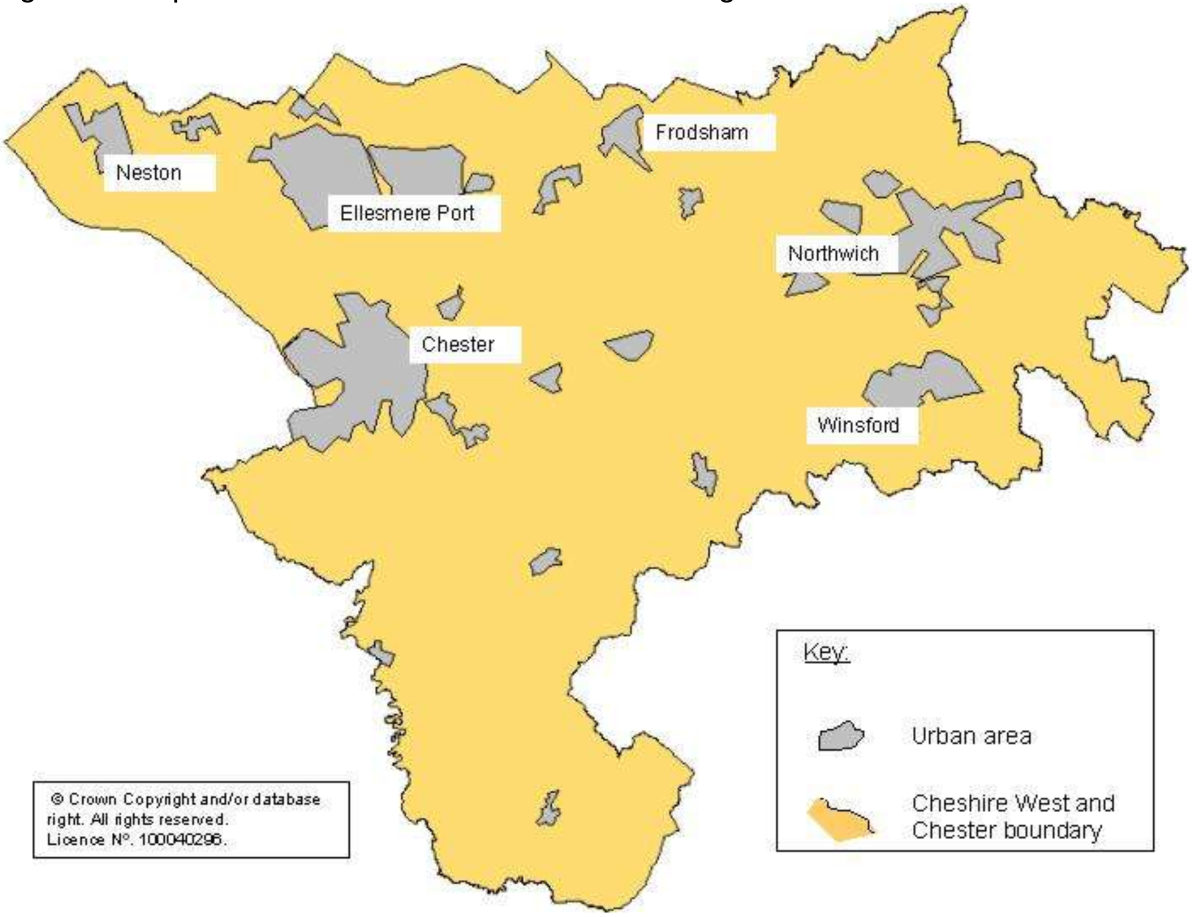
There is ready access to the national motorway network via the M6, M53 and M56 as well as major rail links running across the borough.

Industrial operations are permitted under the Environmental Permitting Regulations 2010 (EPR). Cheshire West and Chester currently issues 119 Part A2 and B environmental permits to small industrial and commercial processes for releases to air. Larger industrial processes are regulated by the Environment Agency. The Environment Agency currently issue 45 so called A1 permits to industrial installations in Cheshire West and Chester. Industrial sources are therefore a key air quality consideration in some areas.

There is a number of Smoke Control Areas (SCA) in the borough comprising parts of Ellesmere Port, Frodsham, Helsby, Northwich and Winsford. The SCAs were designated between the 1950s and the 1980s under the Clean Air Acts 1956 and 1968.

Impacts of developments on the local environment are considered through close liaison between the environmental protection unit and the planning authority. There remains a significant potential for residential and commercial development in the borough. A map of the borough is shown in Figure 1.

Figure 1: Map of Cheshire West and Chester borough




### 2.2. Air quality objectives and local air quality management

The Government's Expert Panel on Air Quality Standards (EPAQS) has prescribed health-based standards and objectives for seven key pollutants. Table 1 shows the relevant concentration to be achieved for each pollutant, along with the number of allowable exceedences where applicable. As the national air quality objectives are exposure-based, consideration only needs to be given to areas where the public is regularly exposed over the relevant averaging period of each pollutant (Table 2)

Local authorities are required under the Air Quality Regulations (2000) – as amended 2002 – to regularly review and assess current and future local air quality from industrial, transport, domestic and other sources of pollution. Local air quality management (LAQM) operates on a three-yearly cycle of assessments, commencing with an Updating and Screening Assessment (USA). Progress Reports are required in the intervening years to maintain continuity in the LAQM process.

Where the review and assessment process indicates that there is a risk of the air quality objectives not being achieved the local authority will need to carry out a Detailed Assessment (DA). The aim of the DA is to determine, with reasonable certainty, whether or not there is a likelihood of the objectives not being achieved. Where exceedences are considered likely the local authority must then declare an Air Quality Management Area (AQMA) and prepare and Air Quality Action Plan (AQAP) which sets out the measures it intends to implement to secure compliance with the objectives.

Table 1: Air quality objectives included in regulations for the purposes of LAQM in England.

| **Pollutant** | **Concentration** | **Measured as** | **Date to be achieved by** |
|---|---|---|---|
| Benzene | 16.25 $\mu g/m^3$ | Running annual mean | 2003 |
| | 5.00 $\mu g/m^3$ | Running annual mean | 2010 |
| 1,3-Butadiene | 2.25 $\mu g/m^3$ | Running annual mean | 2003 |
| Carbon monoxide | 10.0 $mg/m^3$ | Running eight-hour mean | 2003 |
| Lead | 0.5 $\mu g/m^3$ | Annual mean | 2004 |
| | 0.25 $\mu g/m^3$ | Annual mean | 2008 |
| Nitrogen dioxide | 200 $\mu g/m^3$ not to be exceeded more than 18 times a year | Hourly mean | 2005 |
| | 40 $\mu g/m^3$ | Annual mean | 2005 |
| Particles ($PM_{10}$) (gravimetric) | 50 $\mu g/m^3$, not to be exceeded more than 35 times a year | 24-hour mean | 2004 |
| | 40 $\mu g/m^3$ | Annual mean | 2004 |
| Sulphur dioxide | 350 $\mu g/m^3$, not to be exceeded more than 24 times a year | Hourly mean | 2004 |
| | 125 $\mu g/m^3$, not to be exceeded more than three times a year | 24-hour mean | 2004 |
| | 266 $\mu g/m^3$, not to be exceeded more than 35 times a year | 15-minute mean | 2005 |
| Units: $\mu g/m^3$ = micrograms per cubic metre. $mg/m^3$ = milligrams per cubic metre | | | |

Table 2: Examples of where the air quality objectives apply

| **Averaging Period** | **Objectives should apply at:** | **Objectives should generally not apply at:** |
|---|---|---|
| Annual mean | All locations where the public might be regularly exposed.<br><br>Building facades of residential properties, schools, hospitals, libraries etc. | Building facades of offices or other places of work where members of the public do not have regular access.<br><br>Gardens of residential properties.<br><br>Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term. |
| 24-hour mean and eight-hour mean | All locations where the 24 hour objective would apply.<br><br>Gardens (seating & play areas) of residential properties. | Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term. |
| Hourly mean | All locations where the annual mean and 24 and eight-hour mean objectives apply.<br><br>Kerbside sites (e.g. pavements of busy shopping streets).<br><br>Those parts of car parks, bus stations and railway stations etc which are not fully enclosed where the public might reasonably be expected to spend hourly or more. | Kerbside sites where the public would not be expected to have regular access. |
| 15-min mean | All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer. | |

### 2.3. Summary of previous reviews and assessments

The rolling programme of LAQM assessments conducted by Cheshire West and Chester Council and the legacy district authorities of Chester, Ellesmere Port and Neston and Vale Royal are summarised in Table 3 and Table 4.

There are currently two AQMAs in the borough of Cheshire West and Chester. The Whitby Road / Station Road AQMA (Figure 2) in Ellesmere Port was designated in 2005. Boughton AQMA in Chester, designated in March 2008 was extended in 2011 to include additional residential properties (Figure 3). In common with the vast majority of AQMAs nationwide, the cause of exceedences of the annual mean $NO_2$ objective is road traffic.

Table 3: Assessments completed by legacy authorities

| Assessment type | Year | Outcome (Chester) | Outcome (Ellesmere Port) | Outcome (Vale Royal) |
|---|---|---|---|---|
| Updating and Screening Assessment | 2003 | DA for $SO_2$ light rail depot and DA for $NO_2$ in Boughton | Progress to DA for industrial and road sources | Proceed to a DA for $PM_{10}$ in Northwich and Winnington. |
| Detailed Assessment | 2004 | Assessments for $SO_2$ and $NO_2$ indicated no breaches of objective. | AQMA recommended for road traffic in Ellesmere Port | Assessment showed no breaches of $PM_{10}$ objective |
| Air Quality Management Area | 2005 | n/a | AQMA declared at Whitby Rd / Station Rd for $NO_2$ from traffic | n/a |
| Progress Report | 2005 | n/a | No requirement to proceed to a DA | Proceed to a DA for $NO_2$ at Sproston |
| Updating and Screening Assessment | 2006 | Proceed to a DA for $NO_2$ in Boughton. | No requirement to proceed to a DA | No requirement to proceed to a DA |
| Progress Report | 2007 | Combined DA predicted $NO_2$ exceedences | No requirement to proceed to a DA | No requirement to proceed to a DA |
| Air Quality Management Area | 2008 | AQMA declared in Boughton gyratory for $NO_2$ from road traffic | n/a | n/a |
| Progress Report | 2008 | No requirement to proceed to a DA | Recommendation to proceed to a DA for road traffic | Proceed to DAs for $NO_2$ at Sproston and Castle |
| Updating and Screening Assessment | 2009 | Identified possible need to extend existing AQMA. Monitoring increase. | No further requirement to proceed to a DA | No further requirement to proceed to a DA |
| Detailed Assessment | 2009 | n/a | n/a | Sproston and Castle: no breaches of objectives for $NO_2$ anticipated |
| Detailed Assessment | 2009 | Canal Village, Ellesmere Port. No requirement to designate an AQMA | n/a | n/a |

Table 4: Assessments completed by Cheshire West and Chester

| **Assessment type** | **Year** | **Outcome** |
|---|---|---|
| Progress Report | 2010 | Recommendation to proceed to a DA for possible extension of Chester AQMA. |
| Detailed Assessment | 2010 | Requirement to extend the Boughton (Chester) AQMA. |
| Progress Report | 2011 | DAs required for Chester and Allostock |
| Further Assessment | 2012 | Source apportionment work found that road traffic emissions are the dominant source of NOx in the AQMA |
| Updating and Screening Assessment | 2012 | Proceed to DAs for Parkgate Rd gyratory, Chester and Fluin Lane, Frodsham. DA for Allostock discounted. |
| Progress Report | 2013 | Findings of USA 2012 confirmed |

Figure 2: AQMA (Whitby Road / Station Road, Ellesmere Port)

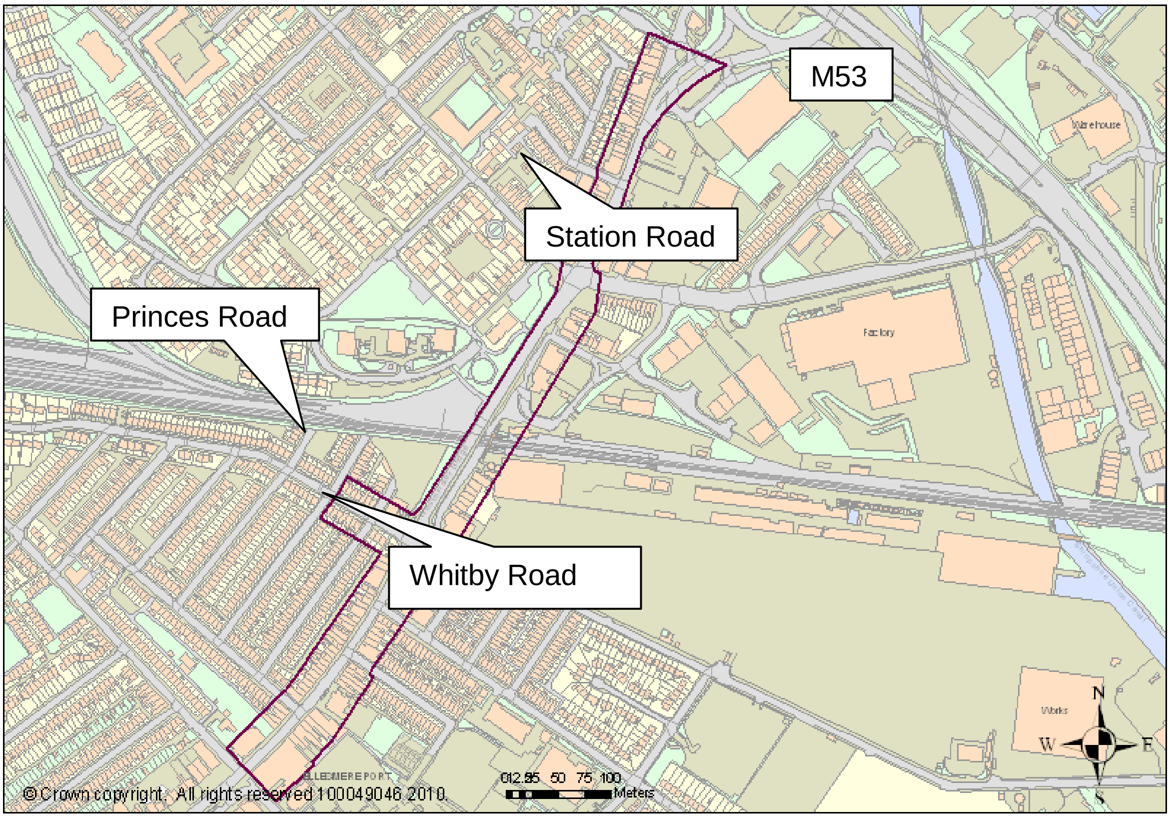
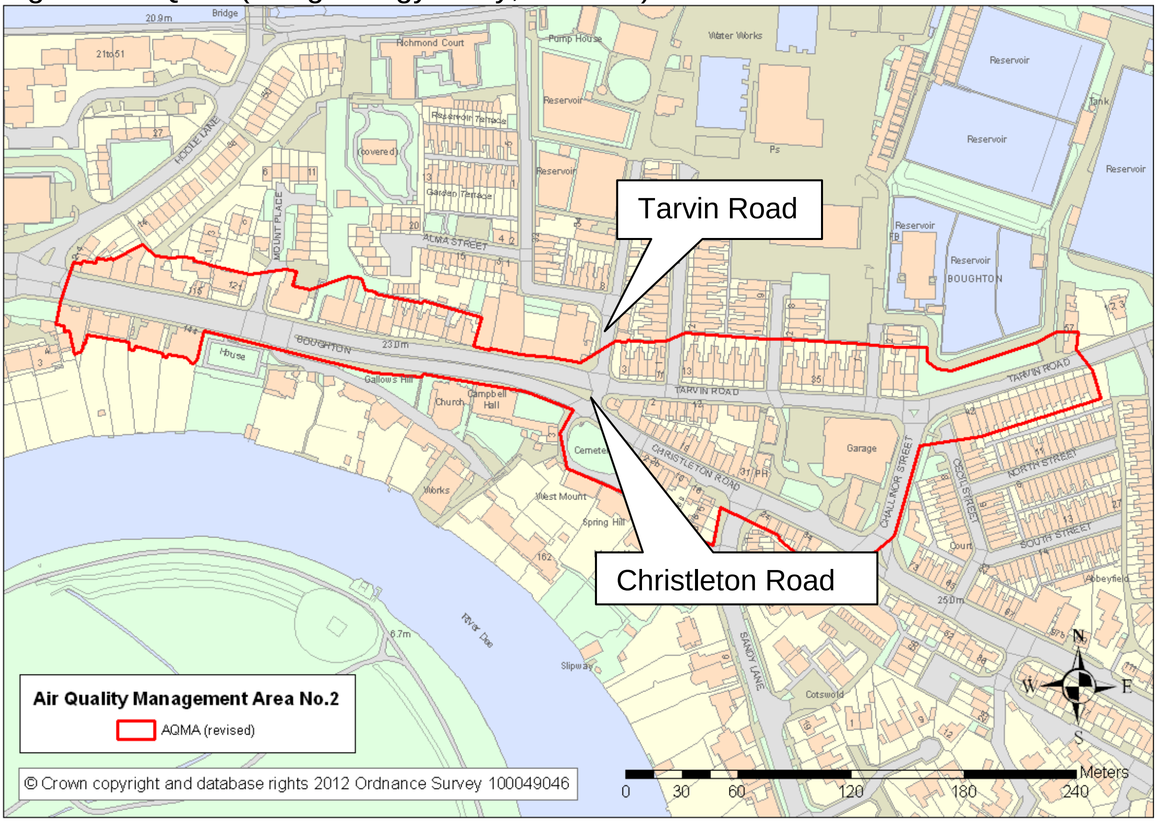


Figure 3: AQMA (Boughton gyratory, Chester)




The Updating and Screening Assessment 2012 identified the need for two DAs to be undertaken for the Liverpool Road / Parkgate Road junction in Chester, and the Fluin Lane / A56 junction in Frodsham. Nitrogen dioxide from road traffic is the cause of the problem in each case.

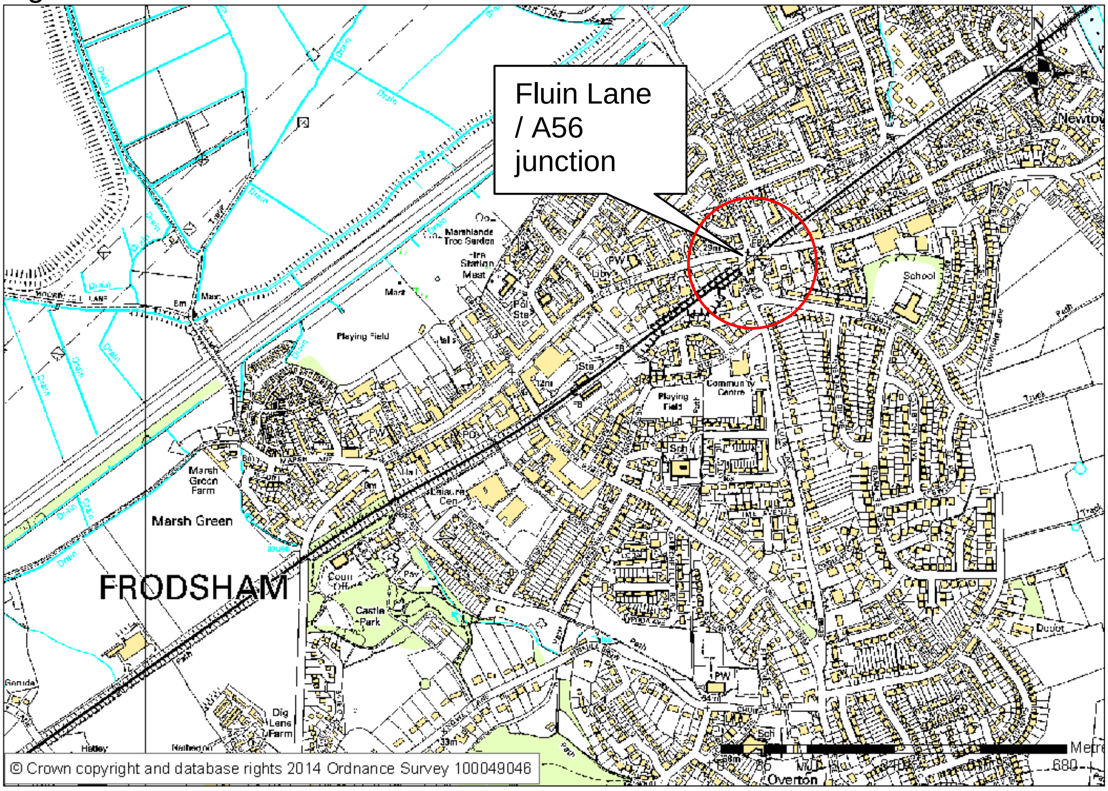
### 2.4. Scope of the Detailed Assessment for Frodsham

The focus of this assessment is the junction of the A56 and the B5439 Fluin Lane in Frodsham, which lies to the east of Frodsham town centre (Figure 4) Buildings in the area comprise a mixture of domestic and retail properties with some residential facades immediately adjacent to the narrow pavements. Traffic data supplied by the Planning & Transport Service, Cheshire West & Chester indicate that the A56 carries over 15,000 vehicles per day, while traffic figures on Fluin lane are around 5,000. However, the stretch of Fluin Lane near its junction with the A56 can be described as a street canyon due to the height of the buildings and narrowness of the road. This is important as the dispersal of air pollutions tends to be restricted in such circumstances. There are no major industrial sources in the immediate vicinity of the study area, although there are several large permitted processes along the southern banks of the Mersey estuary. Background NOx data used in modelling studies takes account of this.

Both the USA 2012 and the Progress Report 2013 confirmed that there are locations within this area that are at risk of exceeding the annual mean standard for $NO_2$ at this junction. Monitoring undertaken elsewhere in

Frodsham, including a number of locations on the A56 has found that $NO_2$ levels are within the national objectives (further details are given in earlier LAQM reports). The purpose of this DA therefore is to predict with reasonable certainty whether it may be necessary to declare an AQMA.

Figure 4: Focus of the Detailed Assessment




# 3. Air quality monitoring

## 3.1. Summary of monitoring undertaken

Cheshire West & Chester Council undertakes nitrogen dioxide monitoring at a range of locations throughout the borough using both passive diffusion tubes and automatic ‘real-time’ monitoring techniques.

There are four $NO_2$ diffusion tube sites in the vicinity of Fluin Lane: Bridge Lane (A56), which was established in 2008; two sites on Fluin Lane itself, set up in 2011; and, from 2012, a site on High Street (A56) (see Table 5). All tubes are mounted on lampposts or downspouts close to building facades and are therefore representative of residential exposure (see Table 5 and Figure 6). Each tube is exposed for four or five weeks in accordance with Defra’s diffusion tube monitoring calendar. Air quality is not presently monitored in real-time in this locale.

All $NO_2$ diffusion tubes are prepared and analysed by Gradko Ltd. Gradko’s internal analysis procedures are assessed by UKAS on an annual basis for compliance with ISO17025. The laboratory demonstrated a 100% ‘satisfactory’ performance in the workplace analysis scheme for proficiency (WASP) scheme for analysis of $NO_2$ diffusion Tubes (2012 – 2013).

Table 5 Diffusion tube monitoring sites

| **Location** | **Site code** | **Site type** | **Grid ref** | **Relevant exposure** | **Distance to kerb of nearest road (m)** | **Worst-case location?** |
|---|---|---|---|---|---|---|
| Fluin Lane (r/o 76 High Street) | FJ | Roadside | 352171 378140 | Yes (1m) | 2.0 | Yes |
| Fluin Lane (r/o 10 Manor Farm Court) | FM | Roadside | 352189 378094 | Yes (0.3m) | 2.0 | No |
| Bridge Lane (A56) | FB | Kerbside | 352544 378242 | Yes (0.4m) | 2.2 | Yes |
| 72 High Street (A56) | FH | Roadside | 352146 378139 | Yes (0.2m) | 2.0 | No |

### 3.2. Comparison of monitoring results with air quality objectives

Table 6 presents the results obtained from the diffusion tube monitoring programme for sites located in the study area. Data capture for each monitoring year was 100 per cent. Figures highlighted in red exceed the national annual mean objective of 40$\mu$g/m$^3$.

The long term monitoring site, FB, is consistently below the objective despite being situated close to the A56 carriageway. However, unlike the other tubes in the study, FB is situated away from the Fluin Lane / A56 junction itself.

Close to the junction, both FJ and FH have annual means above the objective for each valid monitoring period of monitoring. The highest recorded annual mean was 47.6$\mu$g/m$^3$ at FJ in 2012. Both of these sites are close the A56 and are also likely to be influenced by queuing traffic using the junction.

The site FM returned a result just above the objective in 2012 while results for 2011 and 2013 were compliant. Although this is in the section of Fluin Lane that experiences queuing traffic it is some 50 metres away from the junction and is therefore less influenced by traffic on the A56.

Table 6: Results of diffusion tube monitoring for nitrogen dioxide: comparison with the annual mean objective

| Location | Site code | Annual mean $NO_2$ ($\mu g/m^3$), adjusted for bias | | |
|---|---|---|---|---|
| | | 2011 | 2012 | 2013 |
| Fluin Lane (r/o 76 High Street) | FJ | 43.1 | 47.6 | 44.7 |
| Fluin Lane (r/o 10 Manor Farm Court) | FM | 37.3 | 40.9 | 36.8 |
| Bridge Lane (A56) | FB | 31.4 | 34.6 | 32.3 |
| 72 High Street (A56) | FH | - | 45.5 | 40.3 |

# 4. Air quality modelling

While monitoring results give an indication of what the air pollution levels are at a particular location, concentrations can vary significantly over relatively short distances. This is of particular significance for traffic-based emissions which tend to decline rapidly away from the carriageway. Dispersion modelling can be used to predict the spatial characteristics of pollution concentrations and also to investigate changes over time. It is a useful tool for investigating the geographical characteristics of air pollution gradients and thus for determining the boundaries of AQMAs.

## 4.1. Modelling inputs

The software ADMS-Urban includes a variety of user-defined parameters which can be adjusted to reflect the nature of the terrain being modelled. The section of Fluin Lane where it joins the A56 was set up as a street canyon due to the road being narrow, congested and closely flanked by buildings. The model takes account of the additional turbulent flow patterns occurring within street canyons. Figure 7 shows the grid sources, road sources and receptors included in the modelling runs.

Atmospheric chemistry schemes included in the model were not employed for this study as reliance was placed on the empirical $NO_x$ / $NO_2$ relationships used in the $NO_x$ to $NO_2$ converter spreadsheet (available at: http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php). The minimum Monin-Obukhov length, a measure of expected atmospheric stability, was set at 10m (small towns < 50,000 population). A surface roughness value of 0.5m (parklands / open suburbia) was used to take account of the effect of the built environment upon the horizontal wind speeds near the ground.

## 4.2. Traffic data

There are no permanent traffic count sites in the local vicinity suitable for use in the modelling study. Annual average daily traffic flows (AADF) and vehicle mix summaries were obtained via a manual count carried out by Cheshire West and Chester Council's Network Strategy unit in 2012.

In the modelling scenarios, estimates of lower speeds were used in the vicinity of the junction of the A56 and Fluin Lane (technical guidance TG09, paragraph A2.13). Time varying emissions factors were also used to represent the presence of queuing traffic during certain hours of the day on Fluin Lane itself as well as east bound on the A56 as vehicles queue to take a right turn into Fluin Lane.

## 4.3. Vehicle emissions

ADMS-Urban includes emission factors for road vehicles based on the emissions factors toolkit (EFT), which allows the model to calculate emissions based on traffic flows and speeds of different classes of vehicle. Version 5.1 of the EFT, integrated into the model, allows between two and eight vehicle classes to be specified, dependent on the traffic data available. Modelling runs performed for this assessment included flows for five vehicle classes (cars, light goods, heavy goods, buses and motorcycles). This also offers the advantage of calculating source apportionment of emissions for the purposes of action planning.

## 4.4. Background concentrations

There are no suitable automated background monitoring sites in the immediate area so background concentrations of $NO_2$ and $NO_x$ for the year 2012 have been derived from the national background maps, available at: http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html.

Table 7: Background pollutant concentrations

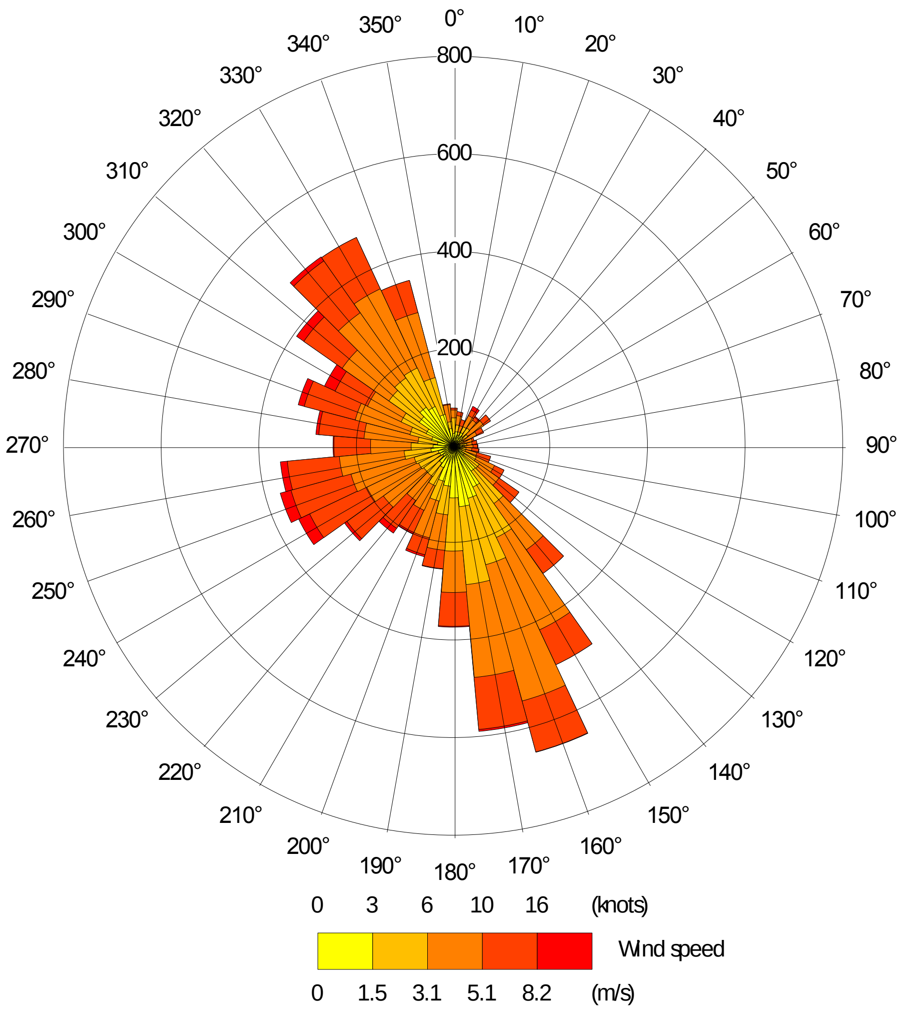
| Pollutant | Concentration ($\mu g/m^3$) |
|---|---|
| $NO_2$ | 24.26 |
| $NO_x$ | 35.48 |

## 4.5. Meteorology

Dispersal of pollutants from their source(s) depends to a large extent on prevailing weather conditions at the site in question. It is therefore necessary to use appropriate weather data (including parameters such as atmospheric stability and boundary layer height in addition to wind speed, wind direction and temperature readings) to effectively model the dispersal of air pollutants.

An hourly sequential meteorological dataset from the Hawarden airport weather station was supplied by the Meteorological Office. Hawarden, situated seven kilometres west of the study area, is the nearest station for which data is available. A wind-rose for the Hawarden 2012 dataset is shown in Figure 5 below. Prevailing winds are both south-south-easterly and north-westerly.

Figure 5: Wind-rose for Hawarden airport 2012.




### 4.6. Modelling outputs

ADMS-Urban modelling runs produce predictions of pollutant concentrations both at specified points (receptors) and as a grid of values that can be visualised on the council's ArcGIS mapping system. Grid references of $NO_2$ monitoring sites were used as specific receptors to allow for verification of the modelling outputs (see section 4.8 below). Source-orientated intelligent gridding was selected as it enhances the modelling resolution in the vicinity of road sources.

### 4.7. Model results

Several modelling runs were conducted and the inputs progressively fine-tuned to take account of queuing traffic, time varying emission factors and vehicle speeds. A contour plot of the dispersion modelling outputs for $NO_x$ is shown in Figure 8. Higher concentrations of $NO_x$ are clearly associated with the congested traffic close to the junction of Fluin Lane and the A56. Outside of this area, where traffic is typically more free-flowing and the roads have a more open aspect, NOx concentrations tend to be lower.

The map in Figure 9, shows the predicted concentrations of $NO_2$ (following application of the $NO_x$ verification adjustment factor and conversion to $NO_2$ using the empirical relationship) at selected residential receptors. In common with the monitoring results (See 3.2) it can be seen that the modelled locations at risk of exceedence of the objective lie close to the road junction. This encompasses fifteen residential properties.

### 4.8. Model verification

ADMS-Urban has been validated in a number of studies by CERC (Cambridge Environmental Research Consultants), which are available on the CERC website (http://www.cerc.co.uk/), and is therefore fit for purpose. However, a model's performance in the study area being considered is unlikely to have been undertaken by the model developers and it is therefore necessary to compare the modelled results against monitoring results at relevant locations. This is known as verification. Modelled results may differ from monitored values for a number of reasons including; estimates of background concentrations, meteorological uncertainties, traffic flow / speed data, emissions factors, input parameters such as roughness length as well as uncertainties associated with the monitoring data itself and local factors related to the built environment which are difficult to model.

Initial comparison of modelling results showed the model to be slightly over-predicting by about 10%. Following adjustment of the modelled values the comparison improved to just under six percent. The adjustment methodology shown in Defra's technical guidance TG09 (example 2) was followed, the outputs for which are shown in Figure 10, Table 9, Figure 11 and Table 10. Post adjustment, the model over-predicts by just 6%.

### 4.9. Modelling uncertainty

Uncertainties in modelling predictions can arise due to a number of factors including model configuration, input data errors, emissions estimates and meteorology as well as inherent randomness of measurements used. As recommended in the LAQM technical guidance (TG09), the modelling scenario used in this DA has been evaluated to estimate divergence of outputs from observations (see Table 8).

Root mean square error gives an estimate of the average error of the model in the same units as the observations – in this case micrograms per cubic metre ($\mu g/m^3$). The result for model run 1QCe was 2.19$\mu g/m^3$ which, at less than 10% of the annual mean objective for $NO_2$, indicates that model performance is satisfactory. Following adjustment the RMSE was reduced to 1.13$\mu g/m^3$. The correlation coefficient, a measure of the linear relationship between predicted and observed data, is shown to be very good in this instance, although the statistic is not recommended for small datasets. Fractional bias can be used to identify whether the model has a systematic tendency to under- or over-predict.

Table 8 Measures of modelling uncertainty

| Model run | Statistic | Ideal value | Result before verification and adjustment | Result after verification and adjustment | Comments |
|---|---|---|---|---|---|
| 1QCf | Root mean square error (RMSE) (μg/m$^3$ ) | 0.01 | 2.19 | 1.13 | RMSE reduced |
| | Correlation coefficient | 1.00 | 0.97 | 0.97 | Little change as regression passes through zero at all sites |
| | Fractional bias | 0.0 | -0.04 | -0.00 | Reduced towards zero |

# 5. Conclusions and recommendations

The purpose of this DA was to investigate reported exceedences of the national air quality objectives and to determine with reasonable confidence the size of the affected area. This involved a combination of air pollution monitoring and verified dispersion modelling.

Passive diffusion tube monitoring indicates that sites close to the junction of Fluin Lane and the A56 were above the objective in 2012. This is confirmed by results of the modelling exercise. The area of exceedence, however, does not extend significantly beyond the junction.

It is recommended that members give consideration to declaration of an AQMA to encompass all residential receptors (fifteen houses, estimated population 35) at which the annual mean objective is likely to be exceeded. The actual geographical extent of the AQMA may be derived from the modelling study. Current air pollution monitoring coverage should be maintained in order to track changes in $NO_2$ concentrations over time, in particular to inform the action planning process.

# Appendix 1 – Passive monitoring sites

Figure 6: Location of $NO_2$ diffusion tubes Fluin La / A56

# Appendix 2 – Air dispersion modelling

Figure 7: Dispersion modelling domain

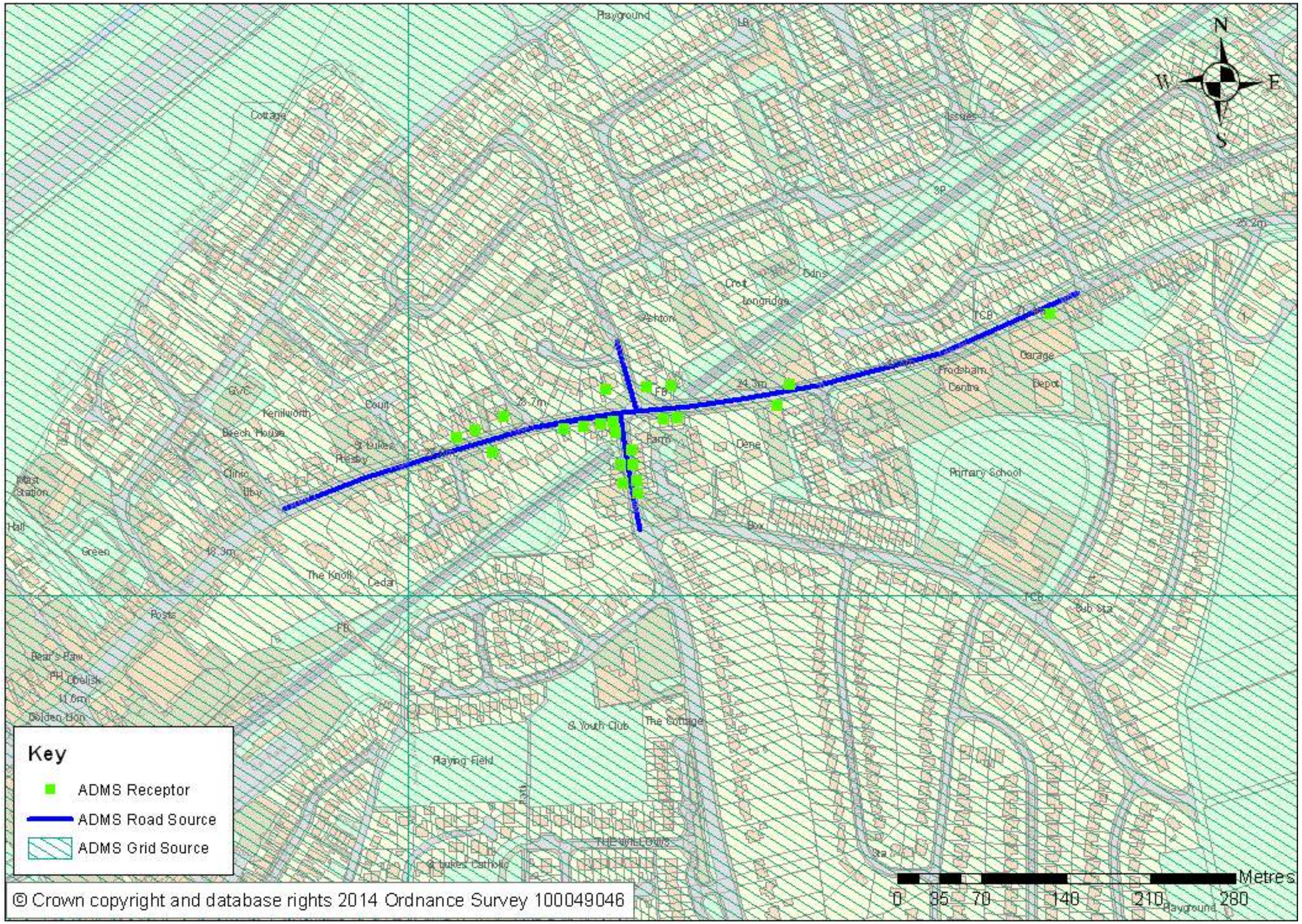


Figure 8: Contour plot of modelled NOx 2012

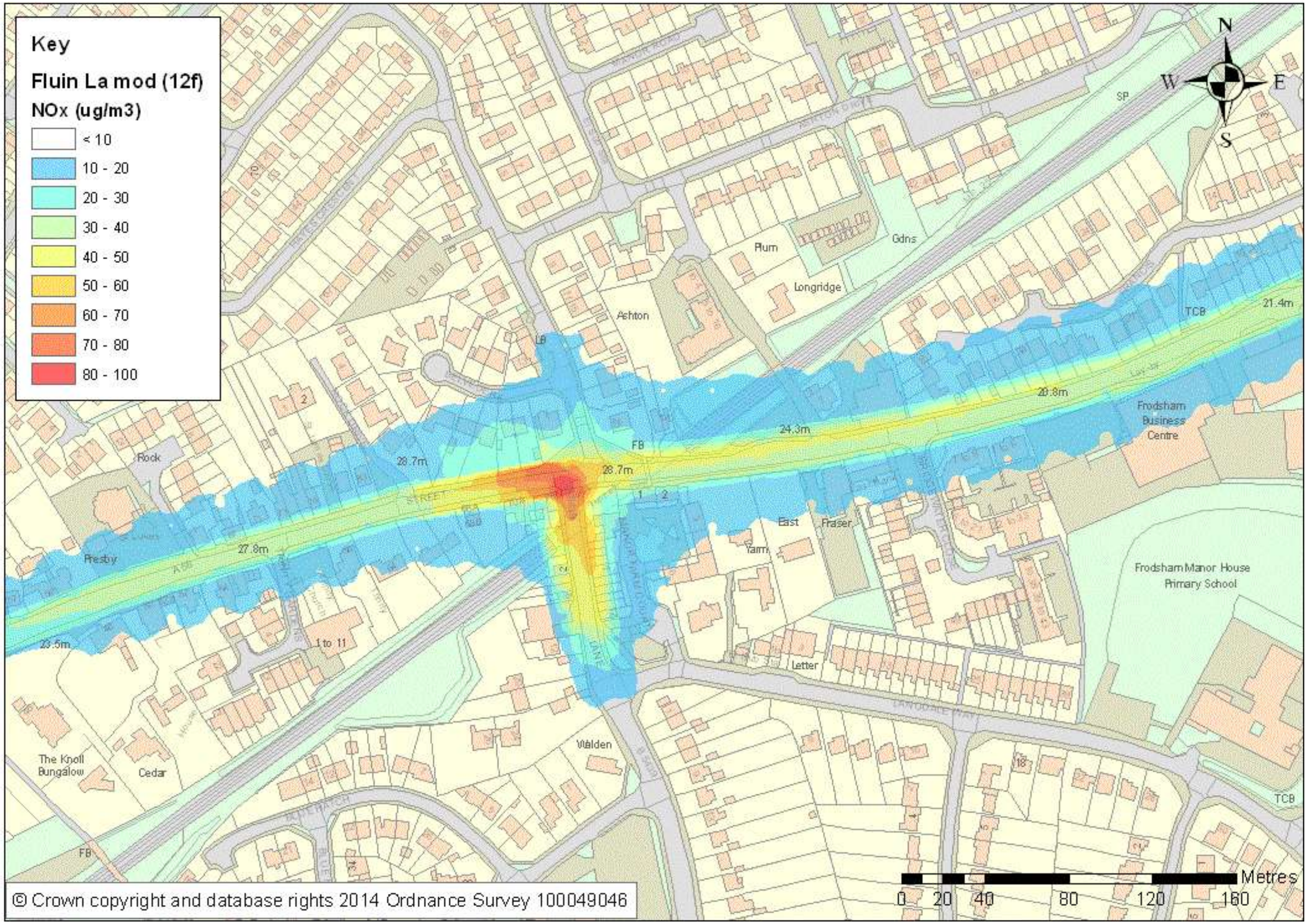


Figure 9: Modelled $NO_2$ at residential receptor locations 2012

# Appendix 3 – Adjustment of modelled concentrations

Table 9: Comparison of monitored and modelled NOx concentrations (pre adjustment).

| Site ID | Site type | Monitored total NO2 | Monitored total NOx | Back-ground NO2 | Back-ground NOx | Monitored road contribution NO2 (total - background) | Monitored road contribution NOx (not inc. bkg) [from NO2-NOx conv] | Modelled Road contribution NOx (excludes background | Modelled total NO2 (from NOx to NO2 converter) | % difference [(modelled - monitored) / monitored] |
|---|---|---|---|---|---|---|---|---|---|---|
| FJ | Roadside | 46.4 | 87.3 | 24.26 | 35.48 | 22.14 | 51.82 | 54.9 | 47.52 | 10.5% |
| FM | Roadside | 40.4 | 71.7 | 24.26 | 35.48 | 16.14 | 36.21 | 46.0 | 44.22 | 10.2% |
| FH | Roadside | 45.1 | 83.8 | 24.26 | 35.48 | 20.84 | 48.32 | 52.7 | 46.72 | 3.9% |
| FB | Roadside | 34.6 | 57.8 | 24.26 | 35.48 | 10.34 | 22.32 | 24.2 | 35.41 | 15.3% |

Table 10: Comparison of monitored and modelled NOx concentrations (pre adjustment).

| Site ID | Ratio monitored road contribution NOx / modelled road contribution NOx | Adjustment factor for modelled road contribution (from trend line of graph in sheet 2) | Adjusted modelled road contribution NOx | Adjusted modelled total NOx (inc background) | Adjusted modelled total NO2 (from NOx / NO2 converter) | Monitored total NO2 | % difference [(modelled - monitored) / monitored] |
|---|---|---|---|---|---|---|---|
| FJ | 0.94 | 0.895 [from graph 2] | 49.11 | 84.59 | 45.39 | 46.4 | 1.0% |
| FM | 0.79 | | 41.15 | 76.63 | 42.35 | 40.4 | 1.7% |
| FH | 0.92 | | 47.14 | 82.62 | 44.65 | 45.1 | -4.4% |
| FB | 0.92 | | 21.65 | 57.13 | 34.31 | 34.6 | 7.5% |

Figure 10: Graph of road contribution NOx pre-adjustment (Graph 2, Example 2)

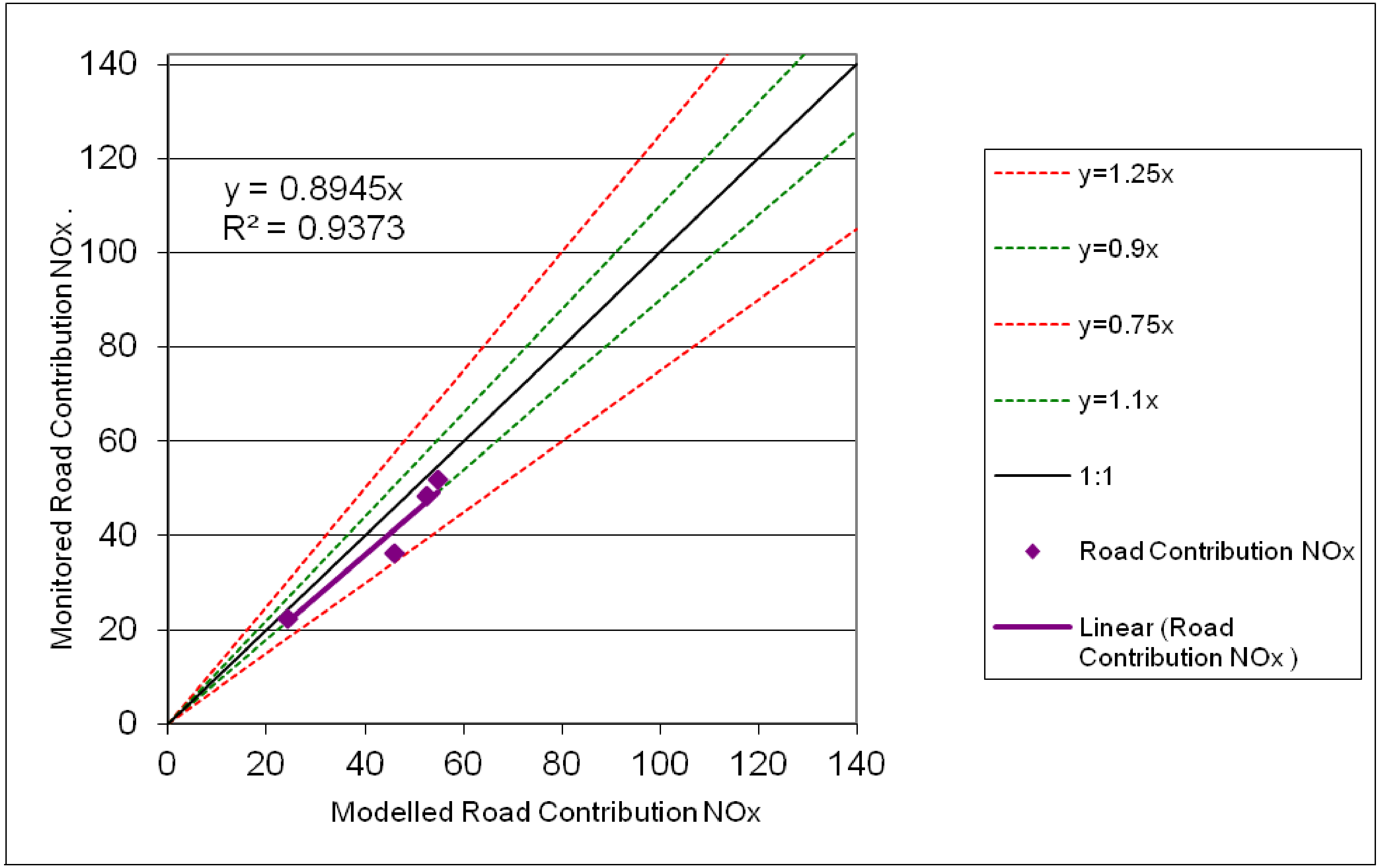


Figure 11: Graph of total $NO_2$ post-adjustment (Graph 4, Example 2)