



Environment Act 1995

Calderdale Air Quality Management Area (No 5)

Stump Cross Further Assessment Report

July 2009

A Plain Language Guide to the Report

In 2007 Calderdale Council declared part of Stump Cross as an Air Quality Management Area (AQMA No 5) due to the annual average levels of nitrogen dioxide, a gas associated mainly with combustion and with the chemical symbol NO₂. This brief guide gives an explanation of the contents of the report and some of terms used. It is not intended to replace a reading of the report itself.

Confirming the assessment that lead to the declaration of the AQMA

Section 2 of the report examines why the AQMA was considered necessary by reviewing the monitoring data available before the declaration was made.

The Council has continued to monitor the levels of nitrogen dioxide in Stump Cross since the declaration of the AQMA. The results of the monitoring are presented and discussed, and a possible change to the boundary of the AQMA is discussed.

What reductions in emissions are required to meet the air quality objective in the future?

In order to assist the formulation of an action plan the likely effect of changes to the composition and flow of the traffic at Stump Cross have been modelled. The results are presented and discussed in Section 4. The changes that could be considered include reductions in the proportion of vehicles such as buses and heavy goods vehicles, and smoother traffic flows at the junction.

Other Considerations for an Action Plan

This report will be used as the basis for an **Air Quality Action Plan (AQAP)** of measures to try to achieve more acceptable levels of NO₂. An AQAP is not just about reducing the pollution itself. Reducing exposure to pollution and avoiding situations that prevent the dispersion of pollution is also important.

If you have any questions about this report, please do not hesitate to contact Environmental Health Services.

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1. Introduction

Air Quality Management Area (AQMA) No 5, covering the A58/A6036 junction at Stump Cross, came into effect on 1st August 2007.

The AQMA was designated under Section 83 Environment Act 1995. The annual mean air quality objective (AQO) for Nitrogen Dioxide (NO₂) specified in the Air Quality (England) Regulations 2000 is 40µg/m³. The designation was in part due to a known exceedence of the air quality objective and in part due to modelled evidence of a likely exceedence of the objective.

Section 84(2) of the Act now requires further assessment of the AQMA. This further Assessment addresses the following issues

- Confirmation of the original assessment of air quality (Sections 2.1 and 2.2)
- Review of the existing AQMA boundary (Section 2.3)
- Review of Comments made by Statutory Consultees (Section 3)
- Calculation of the extent of improvement in air quality needed (Section 4)
- Review of additional monitoring required

This further assessment has been delayed pending the publication of revised technical guidance, TG(09).

2 Confirmation of the original assessment of air quality

This section includes

- a review of the information available leading up to declaration of the AQMA
- assessment of information available after declaration

2.1 Review of information available leading up to declaration of the AQMA

The AQMA at Stump Cross covers a small area with 10 dwellings, a semi derelict, unoccupied public house which is currently being converted to a dwelling, and a small vehicle repair garage. These are all close to the junction of the A58 Leeds Road with the A6036 Bradford Road, which carry some of the heaviest traffic volumes in the Borough. Five diffusion tubes (labelled SC1 to SC5) were deployed in stages leading up to the declaration of the AQMA, and the results were reported in the Detailed Assessment 2006.

The A58/A6036 junction was modelled using ADMS Urban 2.2 with MapInfo as the visualisation tool, and weather and traffic data inputs to compute pollutant concentrations and distribution. Modelling the junction presented some challenges, as the traffic controls lead to slow moving queues at peak times, and there is an incline at the junction, meaning that eastbound traffic has to set off uphill. Consequently, simply inputting traffic flows and daily variations, together with weather data, could not match the diffusion tube results, and guidance from the modelling helpdesk was used to get better agreement. Adjusting the model to match the output with diffusion tube results can introduce questions about whether the model is being used properly, but the results gave a good indication of the likely nitrogen dioxide levels close to the junction. This was described in the Detailed Assessment 2006.

The Council was reluctant to declare an AQMA based on diffusion tube data, and continuous monitoring was attempted. However, a national problem with the gas cylinders used for calibration meant that much of the continuous monitoring data was unusable. The diffusion tube evidence was thought strong enough to declare, but the extent of the area was decided using the modelling results.

Table 1: Diffusion Tube Results (Bias-corrected) 2003-2006 in $\mu\text{g}/\text{m}^3$			
Ref	Location	2005 ^a	2006
SC1	Lamp adjacent to A58 (eastbound)	40	32
SC2	Drainpipe, The Hough	40	35
SC3	Lamp adjacent to old post office, A58 (E)	58	62
SC4	Lamp adjacent to former Museum PH	39	31

Notes to Table 1

a based on 3 months exposure September – December 2005

In the case of the short-term exposures it would be possible to use a period correction factor, as set out in the technical guidance TG03, to adjust for the short monitoring period, but examination of the means derived from the few months of monitoring undertaken shows that the factor would have to be very small to have any impact on the conclusion.

The Council considered the data from 5 continuous monitors across Calderdale and did not feel there was evidence for mean concentrations exceeding the 200 $\mu\text{g}/\text{m}^3$ AQO at Stump Cross.

In line with Statutory Guidance LAQM.PG(03) blocks of terraced residential property were not sub-divided for the purpose of defining the Air Quality Management Area, and houses were included with their gardens. An AQMA covering the A58/A6036 junction took effect on 1st August 2007 and the boundary is shown in Figures 2 and 3.

2.2 Assessment of information available post-declaration

The diffusion tube results were reviewed and the decision made to discontinue tubes SC1 and SC2. The grounds for the decision were that in the case of SC1 there were no relevant receptors, and in that of SC2 it was clear that the mean levels were not only well below the objective but could not be used to give a background level.

Table 2: Diffusion Tube Results (Bias corrected) 2007 and 2008 in $\mu\text{g}/\text{m}^3$			
Ref	Location	Mean 2007	Mean 2008
SC1	Leeds Road / Bradford Road	30	30
SC2	The Hough	30	30
SC3	Lamp close to traffic controlled junction	58	53
SC4	Lamp adjacent to Museum PH	32	29
SC5	Terraced house, Bradford Road	47	42

A bias correction factor of 0.8 has been applied to the raw results for 2008, and a factor of 0.9 to the raw results from 2007. These factors are from the bias correction spreadsheet provided by the Review and Assessment helpdesk.

2.3 Re-consideration of the AQMA boundary

The measured NO₂ levels show that the properties close to the road junction are experiencing mean concentrations above the AQO. Tube SC5, on an elevated terraced property to the east of the junction, confirms that the nitrogen dioxide concentrations exceed the AQO, but it seems likely from the modelling results that properties on the next terrace to the east will not experience levels above the AQO. The Council deployed a diffusion tube on this terrace in June 2009 in order to test this. The results of the monitoring, and the projections considered in Section 4 of this report, may lead to changes to the AQMA boundary.

Tube SC4, on a lamp post outside the former Museum public house, is showing levels below the AQO. The model predicts higher levels and cannot be relied on at this location. The reason for this discrepancy could be the presence of the wooded area and park to the west, and this is discussed later.

3 Review of Comments made by statutory consultees

The intention to declare the A58/A6036 at Stump Cross was featured in the Detailed Assessment 2006. Subsequent investigations at Stump Cross are also featured in the Progress Report 2007, published April 2008. One response, from DEFRA, was received relating to the content of those reports.

4 Calculation of the extent of improvement in air quality needed

This section considers

- determination of a background concentration of NO₂ for Stump Cross for 2008 and projection to 2010
- consideration of possible sources of NO₂ in and around Stump Cross
- establishing local traffic data source apportionment for 2008 and model projections for 2010

4.1 Background NO₂ concentration

Stump Cross lies to the east of Halifax centre, in a wooded valley. The predominant wind direction is along the valley with overlying westerly winds.

Normally in deriving a representative background NO₂ concentration for the AQMA we consider concentrations measured in locations that could be expected to reliably represent background concentrations. As no such data exists for Stump Cross we made use of the estimated values published on the National Atmospheric Emissions Inventory (NAEI) in August 2007 (www.airquality.co.uk/archive/laqm/tools/43_2004.csv). The NAEI offers data for 4 grid reference locations around the AQMA, shown in Figure 4 below. These are at various elevations above the valley floor with grid reference 410,500 426,500 being closest to the A58.



Table 3: Ambient NO₂ (NO_x) concentrations [$\mu\text{g}/\text{m}^3$] for 2008 and 2010				
Location	Type	2005*	Projection method to year	
			NAEI 2008	NAEI 2010*
NGR 410500, 426500	rural background	18.9 (26.2)	17.3 (23.6)	15.9 (21.3)
NGR 411500, 426500	rural background	18.4 (25.0)	17.3 (23.5)	15.9 (21.3)
NGR 410500, 425500	rural background	20.6 (30.0)	19.1 (26.7)	17.7 (24.2)
NGR 411500, 425500	rural background	18.9 (26.2)	17.8 (24.5)	16.5 (22.2)

Development in the AQMA is mainly residential, with limited off street car-parking, a few light industrial premises and a public house.

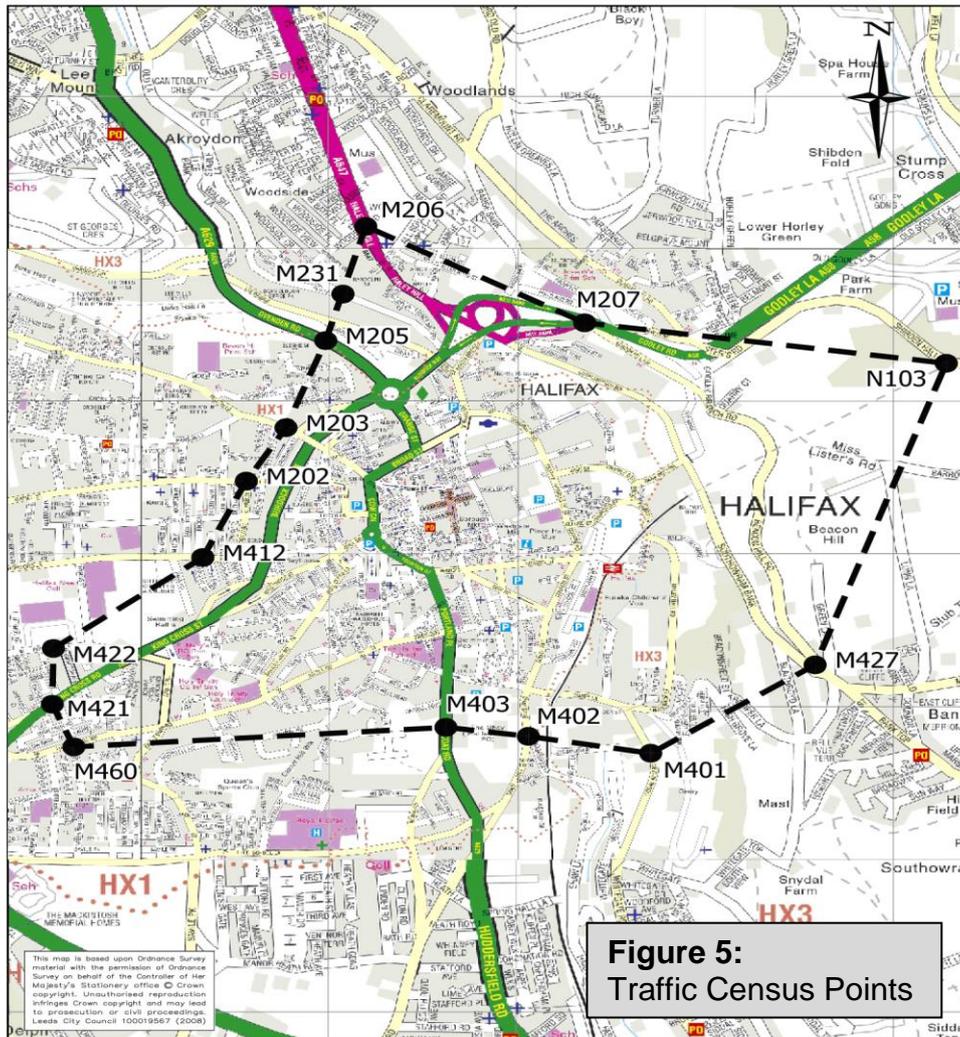
Outside the AQMA to the northwest is a large park with no significant sources of nitrogen oxides. It is possible that the low measured levels of nitrogen dioxide, as compared with the model predictions, can in part be traced to the presence of the park, which may act as a sink for nitrogen dioxide from Halifax centre.

Background concentrations for NGR 410500, 426500 are used for the remainder of this report, as this point is closest to, and down wind of, the AQMA. Our experience is that NAEI data tends to under-estimate actual background concentrations but in the absence of other data it is the best that is available. Therefore the following background levels of NO₂ and NO_x are assumed:

- for 2008: 17.3 $\mu\text{g}/\text{m}^3$ of NO₂ and 23.6 $\mu\text{g}/\text{m}^3$ of NO_x
- for 2010: 15.9 $\mu\text{g}/\text{m}^3$ of NO₂ and 21.3 $\mu\text{g}/\text{m}^3$ of NO_x

4.2 Local Traffic data

Traffic survey locations are depicted on Figure 5 below and the data obtained in Table 4 below. The data is taken from the Calderdale Monitoring report 2007.



The monitoring data for New Bank reflects the volume of through traffic at the junction at Stump Cross. The monitoring report also gives a great deal of information on the diurnal variations in traffic volumes, the proportion of heavy vehicles and the peak flows across the Borough.

Table 4	2007 WEEKDAY TRAFFIC FLOWS								
	0800 - 0900 HOURS			1700 - 1800 HOURS			24 HOURS		
	IN	OUT	2-WAY	IN	OUT	2-WAY	IN	OUT	2-WAY
M202 Gibbett Street	360	60	420	300	150	450	4140	1250	5390
M203 Pellon Lane	540	720	1260	590	800	1390	8780	11290	20070
M205 Keighley Road	1280	620	1900	830	1030	1860	13410	11290	24700
M206 Boothtown Road	690	400	1090	500	790	1290	7180	7380	14560
M207 New Bank	1320	1680	3000	1700	1420	3120	20080	19580	39660
M231 Lee Bridge	390	370	760	300	640	940	3870	5810	9680
M401 Siddal New Road	550	220	770	300	510	810	3860	3660	7520
M402 Shay Syke	720	590	1310	550	810	1360	7840	8390	16230
M403 Skircoat Road	970	700	1670	760	910	1670	11500	10930	22430
M412 Hopwood Lane	160	120	280	180	200	380	2400	2330	4730
M421 King Cross Road	650	600	1250	670	770	1440	10310	9430	19740
M422 Parkinson Road	320	390	710	320	450	770	3840	4930	8770
M427 Bank Top	640	260	900	430	500	930	4460	3860	8320
M460 Haugh Shaw Road	310	200	510	200	440	640	2710	3790	6500
N103 Shibden Hall Road	450	120	570	150	180	330	1880	1220	3100
TOTAL	9350	7050	16400	7780	9600	17380	106260	105140	211400

The A58/A6036 is the main east-west route between Halifax and Leeds via Stump Cross. Bradford traffic also tends to use this route and it offers an alternative route to Brighouse for traffic from the east of Halifax.

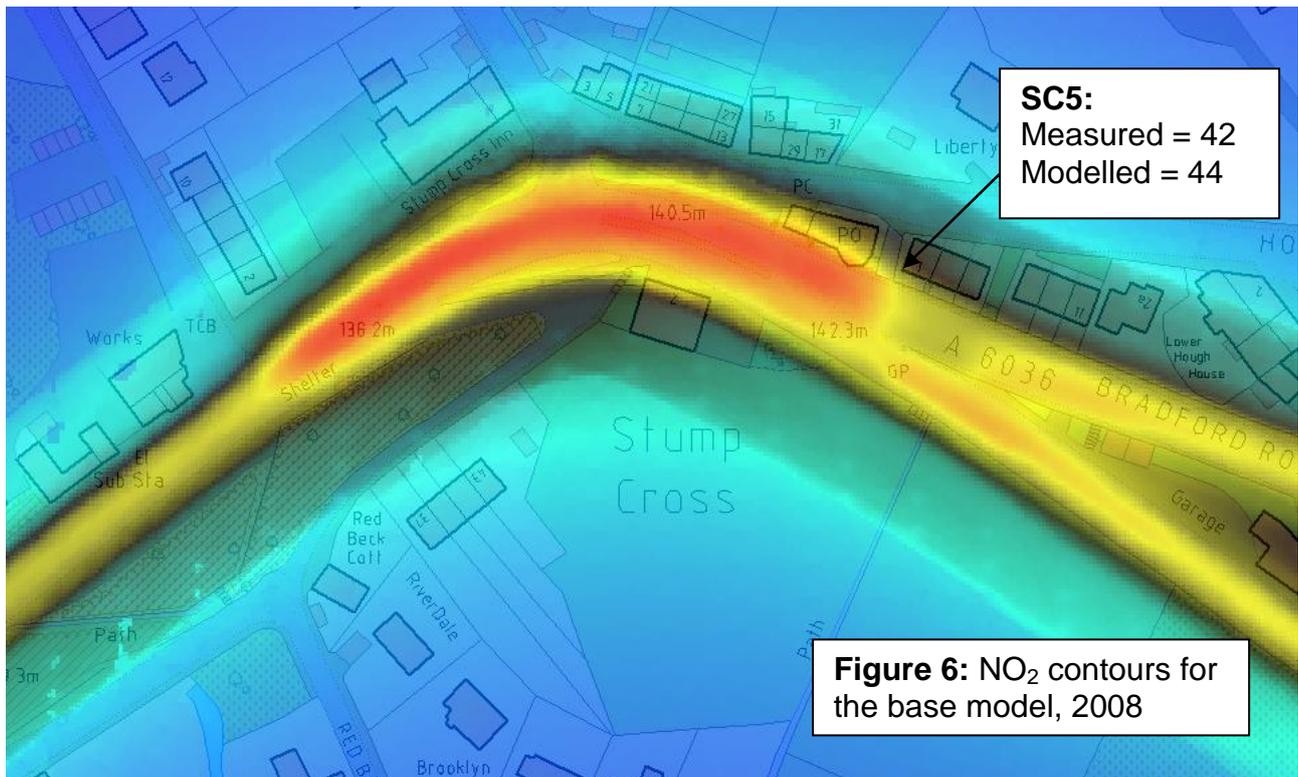
The Council also referred to information from the Department for Transport [TSB06]. This document would describe the A58/A6036 as a principal urban 'A' road, maintainable by the local authority, and offers the following in respect of such roads

- some 80% of all motor traffic is cars and taxis
- a typically motor vehicle flow for the Yorkshire and Humberside region would be between 18700 and 20000 vehicles a day
- goods vehicle traffic peaks slightly during the autumn period and mid week (Wednesdays/ Thursdays). Goods vehicle traffic is concentrated between 6am and 5pm, tailing off outside normal working hours
- car traffic on urban roads is more evenly distributed throughout the year and rises slowly from Mondays, peaking on Fridays.

4.3 Source apportionment for 2008

The predominant wind direction here is northwest to southeast, but the overlying wind direction is from the west. Nationally the main sources of NO_x are transport and electricity generation. As described in paragraph 4.1 above there is no local industrial operation involving power generation.

Stump Cross is fairly open, surrounded to the north and west by open space, and there are no significant complications due to tall buildings or narrow roads. The Leeds-Halifax - Manchester / Blackpool / Preston railway is well outside the AQMA, and is lightly trafficked. There is no rail halt at Stump Cross, and the Council considers that rail traffic would not be a significant local contributor to NO₂.



The main source of nitrogen dioxide in this AQMA is road traffic using A58/A6036 and in particular standing at, or moving off from, the traffic controlled junction.

The obvious traffic contribution and the presence of the nitrogen dioxide sink upwind suggest that we can concentrate on the relative contributions from different traffic components. An ADMS-Urban model was set up and run in order to get a 'base' model in reasonable agreement with measured nitrogen dioxide levels. The 2007 traffic monitoring data was used, and time-varying factors were used to model the diurnal variations and queues. The traffic moving off uphill proved more of a challenge to model, but guidance was sought from the CERC helpdesk and the agreement with the diffusion tube results was good.

4.4 Source apportionment calculations

The following calculation of source apportionment at Stump Cross follows the method set out in Box 7.1 of [TG09]. The relative contributions of HDVs (including buses) and LDVs (including cars and light vans) was estimated using ADMS-Urban, with traffic figures from 2007. The model was set up for HDVs only, and run to give the NO_x concentration at diffusion tube SC5. This was 42.9 $\mu\text{g m}^{-3}$. The model was run again for LDVs only, and the concentration at SC5 was 35.5 $\mu\text{g m}^{-3}$. The respective contributions are therefore HDV: 55%, LDV: 45%.

The largest contribution to nitrogen dioxide concentrations is from heavy duty vehicles.

The annual mean concentration at SC5 for 2008 was $42 \mu\text{gm}^{-3}$. We now apply the method of Box 7.1:

Step 1 The national background maps give $[\text{TB-NO}_2] = 17.3 \mu\text{gm}^{-3}$ and $[\text{TB-NO}_x] = 23.6 \mu\text{gm}^{-3}$. The regional background is $[\text{RB-NO}_x] = 7.1 \mu\text{gm}^{-3}$. Thus

$$[\text{LB-NO}_x] = [\text{TB-NO}_x] - [\text{RB-NO}_x] = 16.5 \mu\text{gm}^{-3}.$$

Step 2 The total background is apportioned to local and regional elements:

$$[\text{RB-NO}_2] = [\text{TB-NO}_2] \times ([\text{RB-NO}_x]/[\text{TB-NO}_x]) = 5.2 \mu\text{gm}^{-3}.$$

$$[\text{LB-NO}_2] = [\text{TB-NO}_2] \times ([\text{LB-NO}_x]/[\text{TB-NO}_x]) = 12.2 \mu\text{gm}^{-3}.$$

Step 3 The worst-case local NO_2 contribution is

$$[\text{L-NO}_2] = ([\text{T-NO}_2] - [\text{TB-NO}_2]) = 24.7 \mu\text{gm}^{-3}.$$

Step 4 The results from the ADMS modelling are used to find the relative contributions of heavy and light vehicles:

$$\text{NO}_2 \text{ from lorries and buses} = 55\% \times [\text{L-NO}_2] = 13.5 \mu\text{gm}^{-3}$$

$$\text{NO}_2 \text{ from light vehicles} = 45\% \times [\text{L-NO}_2] = 11.2 \mu\text{gm}^{-3}$$

The final source apportionment is:

Regional background	5.2 μgm^{-3}, (12%)
Local background	12.1 μgm^{-3} (29%)
Local traffic: buses and lorries	13.5 μgm^{-3} (32%)
light vehicles	11.2 μgm^{-3} (27%)

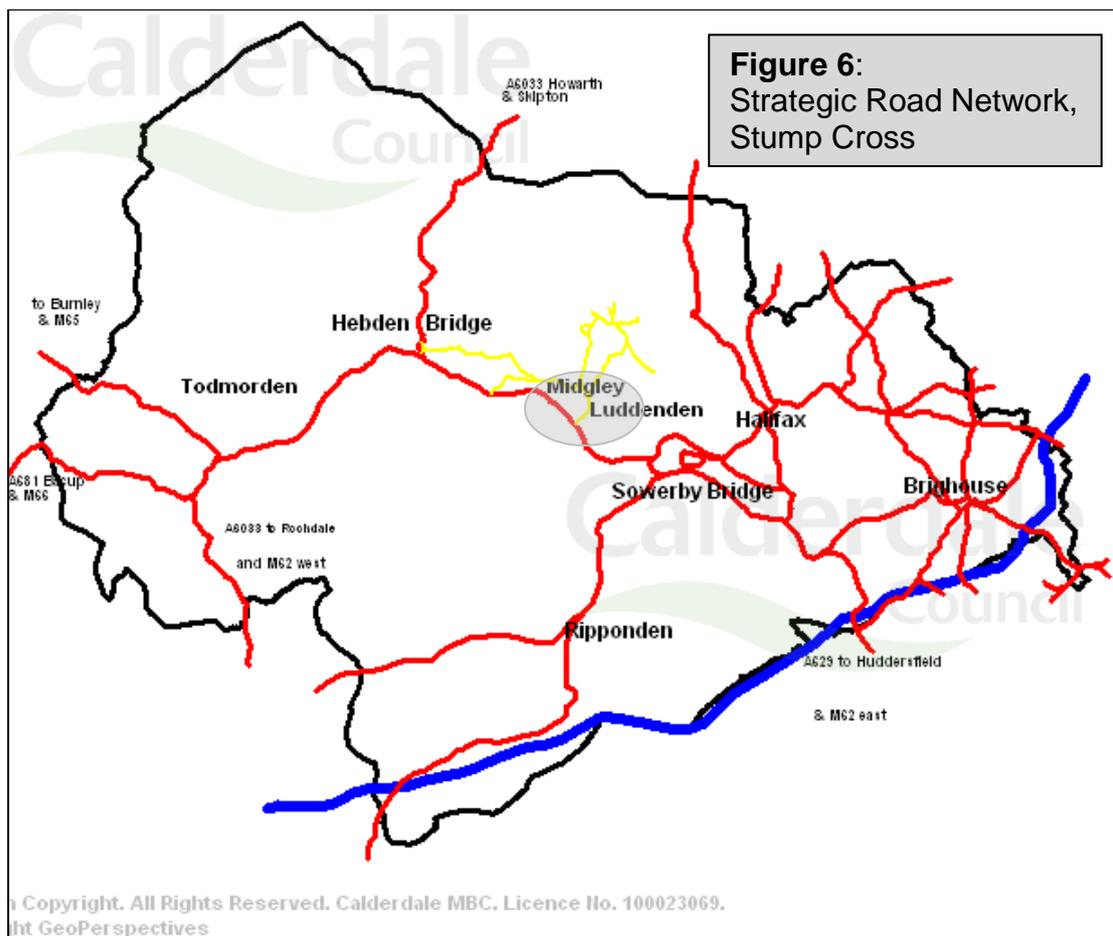
4.5 Projection to 2010

Box 2.1 of [TG09] gives projection factors for future years. The concentration measured at SC5 in 2008 was $42 \mu\text{gm}^{-3}$. Projecting to 2010 involves looking up the factors for 'Rest of UK' in Box 2.1 and multiplying:

$$\text{NO}_2[2010] = \text{NO}_2[2008] \times (0.861/0.935) = 39 \mu\text{gm}^{-3}.$$

Thus the prediction is that at SC5 the air quality objective will be met by 2010, even if no further action is taken.

The concentration at SC3, which is closest to the nearest receptor to the junction, is projected to be $48 \mu\text{gm}^{-3}$. This is still above the air quality objective, but the contribution of the road traffic at this point is difficult to model, as standing traffic sets off up an incline at the traffic light controlled junction.



5 Summary and Conclusions

This report estimates that the background concentration of Nitrogen Dioxide (NO₂) in the Stump Cross area in 2008 is 17.3µg/m³, and that this background level is presently projected to fall to about 15.9µg/m³ in 2010.

The projected annual mean concentrations fall below the air quality objective by 2010 everywhere in the AQMA except close to the traffic light controlled junction. Levels at the junction are clearly in excess of the Air Quality Objective (AQO). The overall projection is that in 2010 and beyond there will still be need to have an AQMA in the A58/A6036 corridor at Stump Cross, but that the size and shape of the AQMA could be changed.

It is further estimated that in 2008 road traffic produced nearly 27µg/m³ of the NO₂ being recorded at SC5, representing 55% of the NO₂ measured there.

As with other areas the small proportion of HGV/PSV traffic is seen as a major contributor to the annual mean concentration of NO₂ albeit in Stump Cross the conditions at the road junction presents certain challenges to modelling and to possible action. There remains a need to gain an accurate traffic breakdown with a view to minimising all road journeys and to improving traffic flow through the A58/A6036 corridor by minimising congestion.

Equally attention must be given to careful consideration of planning development in or near to the AQMA and to strengthening the council's current policy in this respect.

These matters will be more fully explored in the Air Quality Action Plan (AQAP), due in 2009.

**Environmental Health Services
Calderdale Metropolitan Borough Council**

This Assessment is open to public comment until 31st March 2011.

Comments should be made to
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Northgate House, Northgate, Halifax, HX1 1UN*

Appendix 1: Quality Control

All the monitoring data reported above was obtained using passive diffusion tubes. These tubes are provided and analysed by West Yorkshire Analytical Services. The raw data returned from the lab is saved to a secure network. Copies are made for analysis and bias correction calculations.

Calderdale contributes collocation study data to the Review and Assessment Desk bias correction spreadsheet. The data comes from three diffusion tubes collocated with a Monitor Europe continuous analyser in Sowerby Bridge. The analyser itself is maintained on a servicing contract, and regularly checked by Calderdale Council employees. Details of quality control and quality assurance are to be found in [DA06].

References

- [DA06] Detailed Assessment 2006, Calderdale MBC, 2007
- [TSB06] Transport Statistics Bulletin – Road Traffic Statistics for Great Britain 2005 – Statistics Report SB (06)28, DoT 2006
- [TG09] Technical Guidance LAQM.TG(09), DEFRA, 2009

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