Forest Heath • St Edmundsbury

West Suffolk

working together

LOCAL AIR QUALITY MANAGEMENT:

A Review of Nitrogen Dioxide levels in Brandon, Suffolk

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Executive summary

A comprehensive assessment has been undertaken to assist in Forest Heath District Council's (FHDC) obligations under Local Air Quality Management, in accordance with Part IV of the Environment Act 1995 Air Quality Review and Assessment process.

This report provides a summary of the assessment of pollution concentrations in Brandon town centre. The assessment involved monitoring concentrations of Nitrogen Dioxide (NO_2) in Brandon town centre and its immediate surroundings and comparing against monitored concentrations and national air quality objectives. Where objectives were forecast to be exceeded, then the local authority would be required to designate an air quality management area encompassing those areas of forecast exceedance.

This study included the assessment of emissions from road traffic and also emissions from other sources including commercial, domestic combustion and industrial emissions.

The assessment concluded that there are no locations affecting relevant receptors within Brandon town centre where the NO_2 annual mean objective is likely to be exceeded, and that therefore, there is no requirement at this current time to declare an Air Quality Management Area at this location.

1. Introduction

As part of Forest Heath District Council's (FHDC) obligations to the management of local air quality, the Council was required to undertake a comprehensive assessment of the ambient Nitrogen Dioxide (NO_2) concentrations in Brandon town centre, as previous monitoring indicated that there may be exceedances of the national air quality objective for NO_2 (40 µg m^{-3}, microgrammes per cubic metre of air). The assessment involved an investigation of pollution concentrations, through a review of monitoring data, covering a period of 12 months to allow for seasonal variation. The assessment particularly focused on pollutant concentrations in the vicinity of the High Street and London Road (see Figures 1 and 2 below).

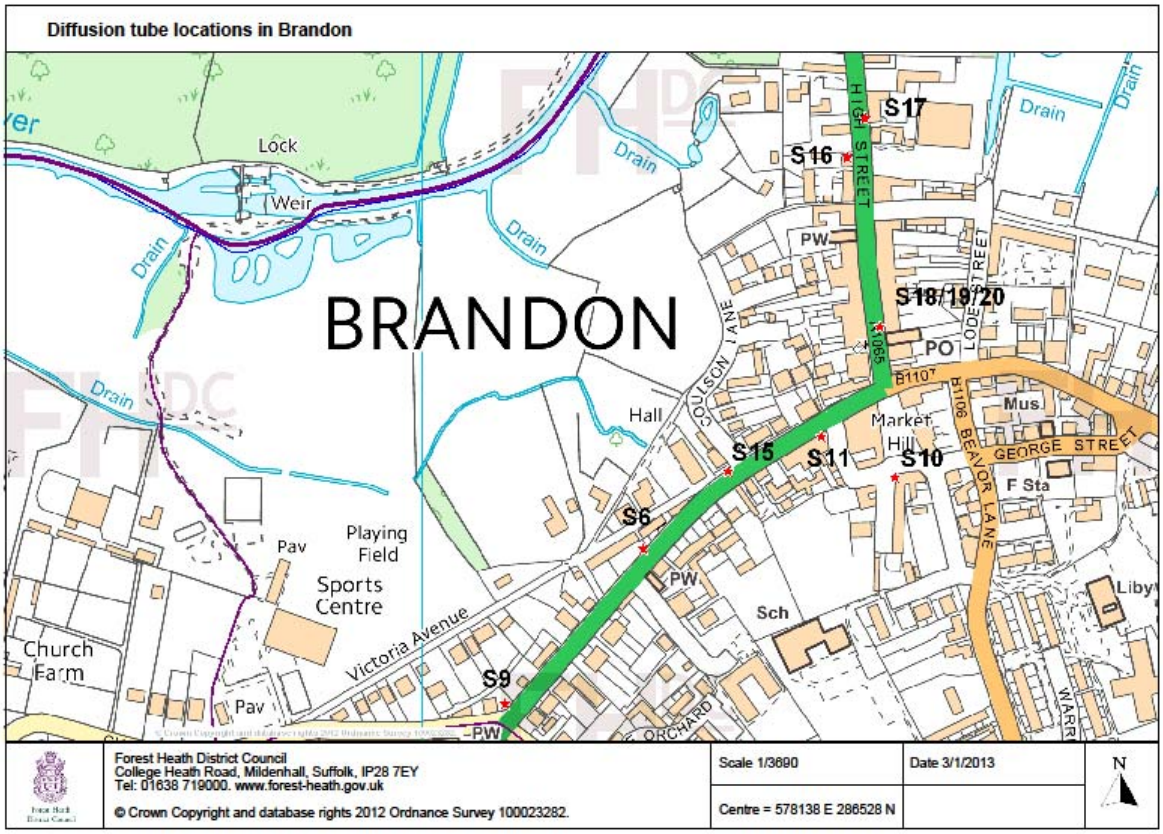

Figure 1: Brandon location map

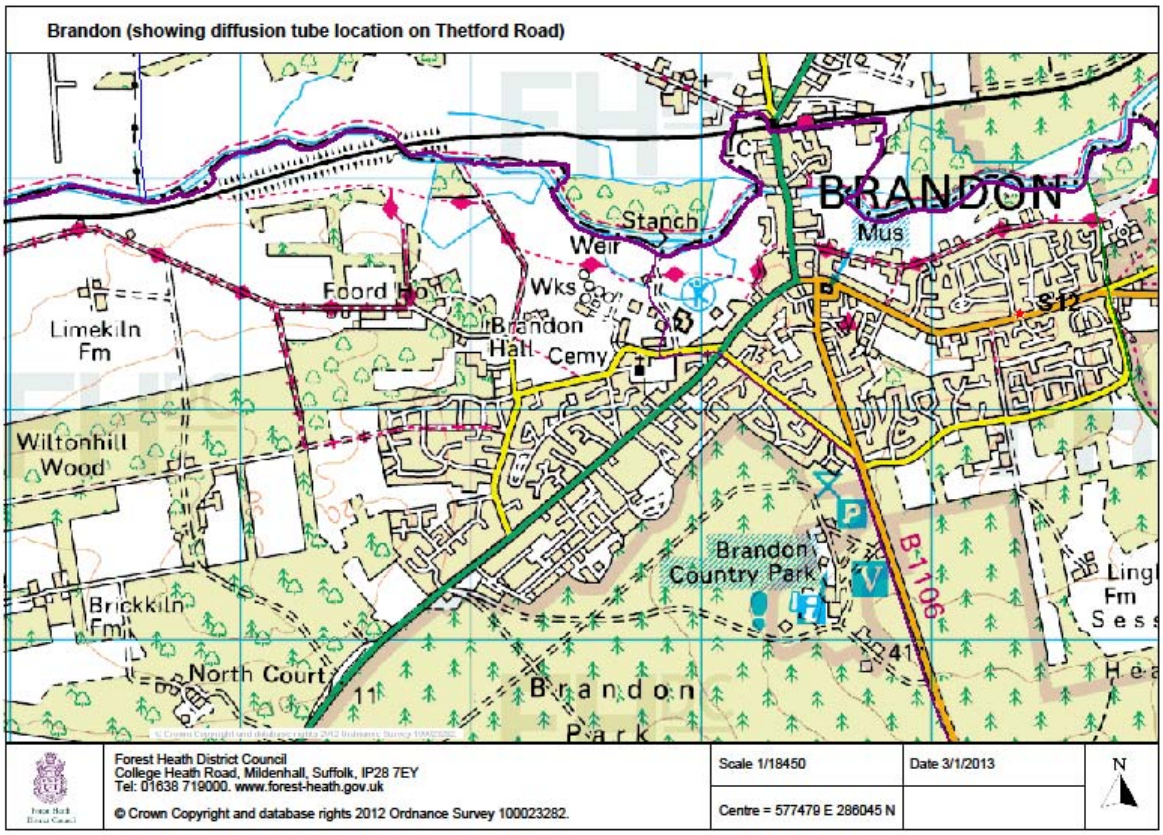

Figure 2: Brandon location map

2. Background

The Local Air Quality Management (LAQM) framework, which was introduced under Part IV of the Environment Act 1995, is designed to help local authorities review and assess current and future air quality in their areas. The LAQM framework requires local authorities to assess concentrations of various air pollutants against standards and objectives set out in the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland. The LAQM process and its associated objectives are subject to periodic review. The latest consultation was undertaken in 2006, and led to the publication of the revised AQS by Defra in 2007. The pollutants contained within the associated local air quality regulations, and their relevant objectives are presented in Defra Technical Guidance (Ref. 1).

Table 1: Air pollutants and objectives in the UK Air Quality Strategy (Defra *et al.*, 2007).

Pollutant	Objective	Compliance Date
NO_2	Hourly mean concentration should not exceed 200 µg m^{-3} more than 18 times a year. Annual mean concentration should not exceed 40 µg m^{-3}.	31 December 2005
Particulate matter, expressed as PM_{10}	24-hour mean concentration should not exceed 50 µg m^{-3} more than 35 times a year. Annual mean concentration should not exceed 40 µg m^{-3}.	31 December 2004 31 December 2005
	Scotland: 24-hour mean concentration should not exceed 50 µg m^{-3} more than 7 times a year. Annual mean concentration should not exceed 18 µg m^{-3}.	31 December 2010
Particulate matter, expressed as $PM_{2.5}$	*UK urban areas* Target of 15% reduction in concentrations at urban background.	Between 2010 and 2020
	Annual mean concentration should not exceed 25 µg m^{-3}.	31 December 2004
	Scotland: Annual mean concentration should not exceed 12 µg m^{-3}.	
Benzene	Running annual mean concentration should not exceed 16.25 µg m^{-3}.	31 December 2003
	Scotland & Northern Ireland: Running annual mean concentration should not exceed 3.25 µg m^{-3}.	31 December 2010
	England & Wales: Annual mean concentration should not exceed 5 µg m^{-3}.	31 December 2010
1,3-butadiene	Running annual mean concentration should not exceed 2.25 µg m^{-3}.	31 December 2003
CO	Maximum daily running 8-hour mean concentration should not exceed 10 mg m^{-3}. In Scotland it is expressed as a running 8-hr mean.	31 December 2003

PAHs	Annual mean concentration of B(a)P should not exceed 0.25 ng m^{-3}	31 December 2010
Lead (Pb)	Annual mean concentration should not exceed 0.5 µg m^{-3}. Annual mean concentration should not exceed 0.25 µg m^{-3}.	31 December 2004 31 December 2008
SO_2	Hourly mean of 350 µg m^{-3} not to be exceeded more than 24 times a year. 24-hour mean of 125 µg m^{-3} not to be exceeded more than 3 times a year. 15-min mean of 266 µg m^{-3} not to be exceeded more than 35 times a year.	31 December 2004 31 December 2005
Ozone (O_3)	Running 8-hour concentration of 100 µg m^{-3} not to be exceeded more than 10 times a year	31 December 2005

Annual monitoring of NO_2 in Brandon for the calendar year 2011, indicated that there were a number of locations where the annual mean air quality (AQ) objective for nitrogen dioxide was close to the national objective. On this basis FHDC, with advice from Defra, concluded that a comprehensive assessment would be required in order to confirm where practicable the most recent status of NO_2 concentrations in Brandon town centre.

2.1 Sources of nitrogen dioxide

In most urban areas road vehicles are the most common source of NO_2. Road vehicle exhaust contains both NO_2 and nitric oxide (NO), with the majority normally emitted in the form of NO. Collectively, these two gases are termed oxides of nitrogen (NOx). The majority of the NO_2 in the atmosphere is formed by the reaction of NO with ozone (O_3) (and other oxidants), and at ambient roadside locations NO_2 concentrations are generally limited by the local availability of O_3 rather than the emission of NO from vehicles.

It is evident from the earlier investigations and data observed at the monitoring locations in Brandon, that the highest pollutant concentrations are associated with the emissions from road vehicles.

3. Pollutant monitoring data

3.1 Monitoring data

In 2012, FHDC managed eleven diffusion tube sites in the Brandon town centre area. The tubes were positioned at different types of locations including kerbside, roadside and urban background locations. They were mounted on suitable street furniture, and the locations of which are shown below.

The tubes are prepared and analysed by Environmental Scientifics Group (ESG) using the 50% triethanolamine (TEA) in acetone method. The advantage of diffusion tubes is that they are relatively low cost, and thus allow measurements at multiple locations. However, they are intrinsically less precise than the continuous Chemilimuninescence approach and thus data derived from diffusion tubes should be biased adjusted. Owing to the absence of automatic monitoring in Brandon, the diffusion tubes were bias adjusted in accordance with the latest Defra guidance.

Here, the approach derives a bias adjustment factor taken to be the average from a number of collocation studies which have applied similar laboratory processing techniques. Using this approach, a bias adjustment factor of 0.83 was derived for the FHDC 2012 diffusion tube data (as published on Defra's national bias adjustment factors web page).

Monitored 2012 NO_2 concentrations in Brandon town centre using diffusion tubes are presented in Table 2. These diffusion tube data have had the bias adjustment factor of 0.83 applied.

Table 2: Monitored NO_2 diffusion tube annual mean concentrations, 2012 (bias adjusted).

Tube no	Location	Bias adjusted (µg m^{-3})	Data capture (%)
S9	London Rd/Church Rd	35.6	100
S10	Town Hall	12.0	75
S11	Estate agent's - London Rd	36.9	58
S6	52 London Rd	39.3	92
S15	London Rd/Coulson Lane	37.3	100
S16	Hellesdon House, High Street	31.2	58
S17	Riverside Lodge, High Street	32.9	83
S18	Boots	38.3	92
S19	Boots	38.9	100
S20	Boots	38.4	100
S12	Thetford Rd	22.7	67

The monitored concentrations in 2012 indicate **no exceedance** of the current NO_2 annual mean objective of 40 µg m^{-3}.

3.2 Fall-off in NO_2 concentration with distance from the road

A methodology whereby fall-off in the concentration of NO_2 with distance from the roads can be calculated (for more information, visit http://www.defra.gov.uk/environment/quality/air/air-quality/laqm) and has been used to calculate the predicted concentrations of NO_2 at the location of relevant receptors i.e. the nearest building facade. Table 3 below gives these predicted concentrations and also indicates the distance from the diffusion tubes to these locations, as measured by MapInfo GIS, a digital mapping system.

Table 3: Fall-off in NO_2 concentration with distance from the road

Tube no	Location	Distance of receptors from road (m)	Fall-off concentration ($\mu g\ m^{-3}$)
S9	London Rd/Church Rd	10.5	20.2
S10	Town Hall	roadside	12.0
S11	Estate agent's - London Rd	3.6	25.1
S6	52 London Rd	6.7	28.1
S15	London Rd/Coulson Lane	7.6	21.0
S16	Hellesdon House, High Street	2.8	31.2
S17	Riverside Lodge, High Street	3.3	25.3
S18	Boots	3.5	38.1
S19	Boots	3.5	38.1
S20	Boots	3.5	38.1
S12	Thetford Rd	9.5	16.9

Note: although the values for tubes S18 – 20 are higher, the first floor above the shop at this location is used for storage and not accommodation.

3.3 Predicted levels of NO_2 for 2013

The Technical Guidance LAQM.TG(09), published by Defra, also presents a methodology whereby future predictions of NO_2 can be calculated. This has been undertaken for 2013, using the current adjustment factors, and the results of which are shown below in Table 4.

Table 4: Predicted levels of NO_2 for 2013

Tube	Predicted level of NO_2 for 2013 ($\mu g\ m^{-3}$)
S9	34
S10	11.5
S11	35.2
S6	37.5
S15	35.6
S16	29.8
S17	31.4
S18	36.6
S19	37.1
S20	36.7
S12	21.7

4. Contributing factors

4.1 Traffic activity

Traffic activity is believed to be the source of the elevated levels of NO_2 currently being experienced. The annual average daily traffic (AADT) 5 day count as measured in 2011 on the southern entrance to Brandon on the A1065 was 12,636 vehicles per day based on data provided by Suffolk County Council. At times, heavy congestion can account for higher NO_2 levels, which is exacerbated by the frequent closure of the railway line at the northern limits of the town.

Greater Anglia provides hourly services west to Cambridge and east to Norwich, and 84,648 passengers used the station in Brandon in 2010 (N.B. Annual estimated passenger usage is based on sales of tickets in stated financial year(s) which end or originate at Brandon from Office of Rail Regulation statistics).

It is also expected that a higher number of vehicles will pass through the town during the dualling of the A11, due to road closures.

4.2 Atmospheric chemistry

The concentration of NO_2 at a given location is determined by a combination of emissions, meteorology and atmospheric chemistry. Some NO_2 is emitted directly from vehicle exhausts (primary NO_2), mainly from diesel vehicles, but NO_x vehicle emissions are primarily in the form of NO (AQEG, 2007). This NO undergoes a chemical reaction with oxidants such as ozone (O_3) to produce secondary NO_2. At a roadside location, there is routinely an excess of NO, and thus the limit to the formation of NO_2 is usually determined by the availability of O_3. Therefore, at heavily trafficked roadside locations, there is not a linear relationship between changes in NO_X emissions and NO_2 concentrations. However, current trends predict the longer term impact of improved combustion efficiencies will reduce the levels of NO_2.

5. Discussion of results

No evidence has been found by FHDC demonstrating any specific risk to the public from exposure to NO_2 and confirms that the levels of NO_2 in Brandon meet existing AQ Strategy objectives, and are likely to do so in the future.

This area is moderately populated with a number of sensitive receptors. These include some flats above the business premises located on the High Street as well as private/residential guest houses on both the High Street and London Road. The High Street also has a number of public houses which may have living accommodation attached. Consequently, utilising the data published by Defra, the risk to human health (including sensitive receptors) can be banded as low.

6. Conclusions

The following conclusions have been drawn from this assessment:

- The risk to human health from the current levels of NO_2 in Brandon is low
- At this time there is no requirement to declare an air quality management area in Brandon, as current monitored levels are below the national objective and predictions for the future and fall-off with distance from road (of relevant receptors) are also below the national objective.
- Any future monitoring until the end of 2014 is expected to indicate out of the ordinary trends due to an expected rise in vehicular movements caused by diversions through the town as road closures of the A11 during the dualling process of this major trunk road are undertaken.

References

1. **Defra (2009).** Part IV of the Environment Act 1995 Local Air Quality Management. Technical Guidance LAQM. TG(09). Department for Environment, Food and Rural Affairs. London.
2. **Defra, Scottish Executive, Welsh Assembly Government and Department of Environment Northern Ireland (2007).** The air quality strategy for England, Scotland, Wales and Northern Ireland. Volume 1. Report Cm 7169 NIA 61/06-07. The Stationery Office. London.
3. **FHDC (2012).** Forest Heath District Council LAQM Progress Report. Forest Heath District Council, Mildenhall.
4. **Defra (2007).** The Air Quality Expert Group:Trends in Primary Nitrogen Dioxide in the UK. Department for Environment, Food and Rural Affairs. London.

Appendix 1: Photographs of Brandon

Photograph 1 – London Road looking towards the junction with Church Road/Rattlers Road

Photograph 2 – from the Town Hall looking across the square to the High Street

Photograph 3 – London Road looking towards the junction with the High Street

Photograph 4 – from the London Road junction looking down the High Street

Photograph 5 – outside Boots looking north down the High Street