



**South Hams  
District Council**

**AIR QUALITY REVIEW AND ASSESSMENT**

**DETAILED ASSESSMENT 2007**

## DETAILED ASSESSMENT

### 1. Introduction

This Detailed Assessment (DA) is part of the Local Air Quality Management Programme (LAQM) for the South Hams. Local Authorities have a statutory duty to prepare various such assessment reports on air quality in their areas under Part iv of the Environment Act 1995. Specifically, Detailed Assessments must be submitted when a previous Updating and Screening Report (USA – see below) has demonstrated the need for one.

In the South Hams, all of the statutory air quality work, together with additional air quality duties is drawn together, organised and co-ordinated in an Air Quality Strategy (SHDC, 2002).

The second Updating and Screening Assessment (USA) undertaken by South Hams District Council and submitted to the Department for Environment, Food and Rural Affairs (Defra) in May 2006, (SHDC, 2006) concluded that a Detailed Assessment should be made for Nitrogen Dioxide levels adjacent to the A385 road at Bridgetown Hill, Totnes.

The following Detailed Assessment therefore describes the results of recent monitoring using NO<sub>2</sub> diffusion tubes and modelling using the Design Manual for Roads and Bridges (DMRB) which are the only tools available to this authority. The results obtained are compared with the annual mean objective of 40µg/m<sup>3</sup>, which is applicable for the target year of 2010. The hourly maximum objective for NO<sub>2</sub> is not assessed (neither was it investigated in the USA) as South Hams District Council (SHDC) has very limited access to continuous monitoring equipment. Furthermore, the worst annual mean levels found at this site are only just over 40µg/m<sup>3</sup>, and therefore it is extremely unlikely that the hourly objective will be exceeded, ((LAQM.TG (03)). The assessments are undertaken in line with Government Guidance as far as possible (LAQM. TG(03), Defra), and this is referred to throughout.

The diffusion tubes used by South Hams District Council are supplied and analysed by Gradko and are subject to rigorous quality control procedures (Appendix 1).

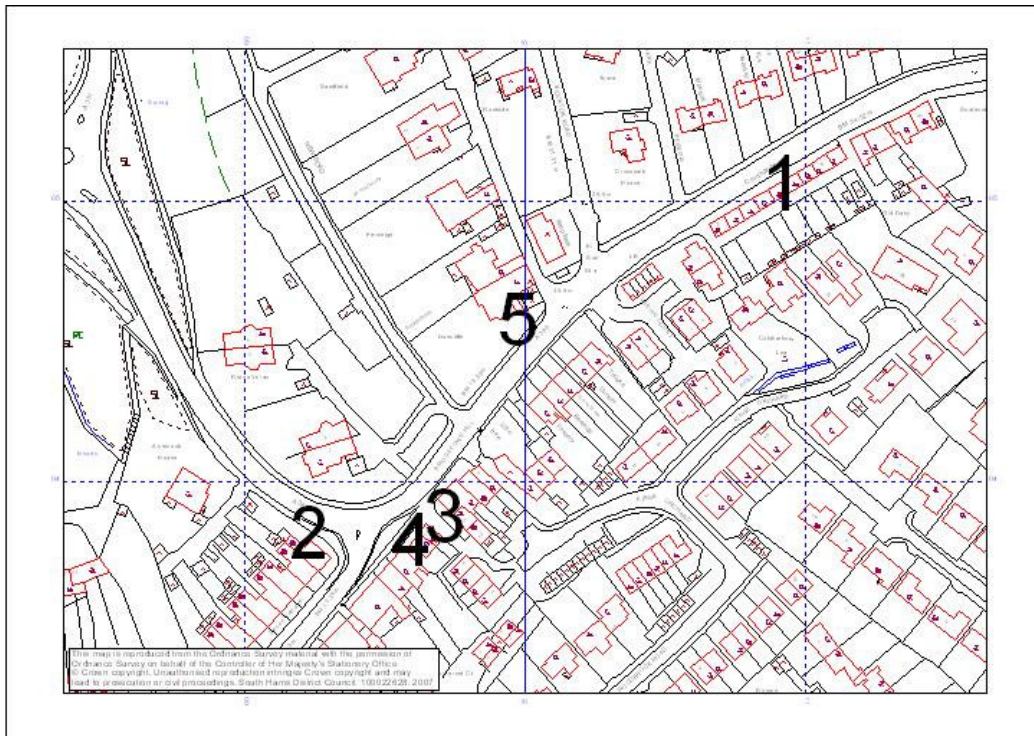
### 2. Layout of Bridgetown Hill

The A 385 at Bridgetown Hill is a two-way single carriageway road which takes traffic into and out of Totnes (Figure 1). The road itself runs between the Torbay conglomeration and Totnes and is indeed one of only two main routes out of the Torbay area.

The annual average daily traffic flow is around 20,000 (Devon County Council data, 2003, 2005 –see Appendix 2).

**Figure 1; area of Bridgetown Hill considered in this Detailed Assessment. The numbers mark the locations of the Nitrogen Dioxide**

**Diffusion tubes (see also tables 1 and 2 below).**



### **3. Conclusions of USA regarding Bridgetown Hill**

The USA concluded that a Detailed Assessment should be undertaken for Bridgetown Hill on the basis of the results of one nitrogen dioxide diffusion tube located at the façade of a terrace of houses situated close to the road (point 1 on Figure 1, above). The results used in the USA are re-stated in Table 1, below. They show an exceedance of the  $40 \mu\text{g}/\text{m}^3$  limit in 2005 though the limit is met when the results are extrapolated forward to 2010.

The bias adjustment factor used was the relevant one for 2005 from the combined study reported on the internet (spreadsheet version 03/06 at [www.uwe.ac.uk/aqm/review](http://www.uwe.ac.uk/aqm/review)).

**Table 1; 2005 NO<sub>2</sub> Results for Bridgetown Hill (taken from 2006 USA)**

<b>Tube location</b>	<b>(Bridgetown Hill, point 1 in Figure 1, above)</b>
Type of monitoring site (see Appendix A, annex 1, LAQM.PG(03))	Kerbside (U1) 1m from kerb
Does tube represent relevant exposure?	Yes
Unadjusted Annual average result for 2005	45.3 (1)
<b>Bias adjusted annual average result for 2005 (bias adjustment figure of 0.99 from combined figure)</b>	<b>44.8</b>
Projected future annual mean concentration for 2010 (see method, Box 6.7, LAQM.TG03), based on combined bias adjustment factor.	36.7

Notes

(1) average of 11 months' data as one month missing.

**4. Latest Results; NO<sub>2</sub> Diffusion Tubes, Bridgetown Hill**

During 2006 additional diffusion tubes were located around Bridgetown Hill (see figure 1) and the results of all tubes alongside this stretch of road are shown in table 2. Two of the tubes were not installed until February 2006 and one until September of that year so only limited data are available for them. The other tube location had some missing data. Therefore, the true means for these tubes have been estimated using the approach given in Box 6.5, p6-8 of the guidance (LAQM.TG(03)). This adjustment is intended for use where only short term data are available. However it was felt important to use it for all of these tube results as none had the full twelve months' worth of data and there are often significant seasonal variations in diffusion tube results (see for example figure 3 below). Once calculated, the estimated 'true' mean has to be bias adjusted and extrapolated to the objective year of 2010. Table 2 summarises the results of these calculations and Appendix 3 provides the details.

It is important to note that most of the tubes are situated at relevant locations (at the facades of houses), and that the full set of tubes detailed in table 2 covers all of the most vulnerable locations on Bridgetown Hill.

**Table 2; 2006 NO<sub>2</sub> Diffusion Tube Results, Bridgetown Hill, (results rounded to 1 dp.) Results are in µg/m<sup>3</sup>.**

	<b>Tube 1 Bridgetown Hill top</b>	<b>Tube 2 Bridgetown Hill bottom</b>	<b>Tube 3 Lodge</b>	<b>Tube 4 No 22</b>	<b>Tube 5 House</b>
<b>Relevant location?</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>No.of months' exposure In 2006</b>	<b>12 but tubes missing in May, Oct, Nov.</b>	<b>10 from March (inclusive)</b>	<b>10 from March (inclusive)</b>	<b>10 from March (inclusive)</b>	<b>4 from Sept. (inclusive)</b>
<b>Annual 2006 mean unadjusted</b>	<b>39.0</b>	<b>42.8</b>	<b>21.3</b>	<b>25.5</b>	<b>42.2</b>
<b>Adjustment to 12 month mean to account for missing data*</b>	<b>36.9</b>	<b>42.8</b>	<b>21.3</b>	<b>25.5</b>	<b>37.1</b>
<b>Bias-adjusted mean (BAF=0.98)**</b>	<b>36.2</b>	<b>41.9</b>	<b>20.9</b>	<b>25.0</b>	<b>36.4</b>
<b>Extrapolation to 2010 ***</b>	<b>31.8</b>	<b>36.9</b>	<b>18.4</b>	<b>22</b>	<b>32.0</b>

**Notes**

\* Adjustment factors for short term or missing data are based on the method in Box 6.5, p6-8 (LAQM.TG(03)) and calculations are shown in Appendix 2. For tube 1 the factor was 0.946, for tubes 2,3,4 it was 1.0 and for tube 5 it was 0.880.

\*\* BAF = Bias adjustment factor. The factor of 0.98 is used as this is the one given on the spreadsheet available at [www.uwe.ac.uk/aqm/review/](http://www.uwe.ac.uk/aqm/review/) for Gradko tubes using the 20% TEA in water method for 2006 and is the result of 10 separate co-location studies. The spreadsheet used is version 03/07.

\*\*\* Calculation based on method given in Box 6.7, p6-29, LAQM.TG(03).  
Correction factor = 0.778/.884 = 0.88

**5. Historical Results; NO<sub>2</sub> Diffusion Tubes, Bridgetown Hill**

In considering whether or not to declare an Air Quality Management Area (AQMA), it is helpful to assess the trend in NO<sub>2</sub> concentrations.

The longest running diffusion tube at Bridgetown Hill (tube 1 in figure 1 and in table 2) has only been in place since the end of 2003, so there are only three full years for which data are available. The mean concentrations for these years are given in table 3 below. Bias adjustment factors have been taken from the contemporaneous values given on the spreadsheet at [www.uwe.ac.uk/aqm](http://www.uwe.ac.uk/aqm). An adjustment for missing data has been made where 3 or more months' of data are missing within the year (as suggested in Box 6.5, LAQM.TG.03).

Figure 3 shows the monthly results (which are not bias adjusted) of NO<sub>2</sub> concentrations over the last three years. It indicates a slight downward trend in NO<sub>2</sub> levels over the three years and also highlights the seasonal variations in concentrations obtained by diffusion tubes. This is in contrast to the annual mean values which show a slight increase for 2005.

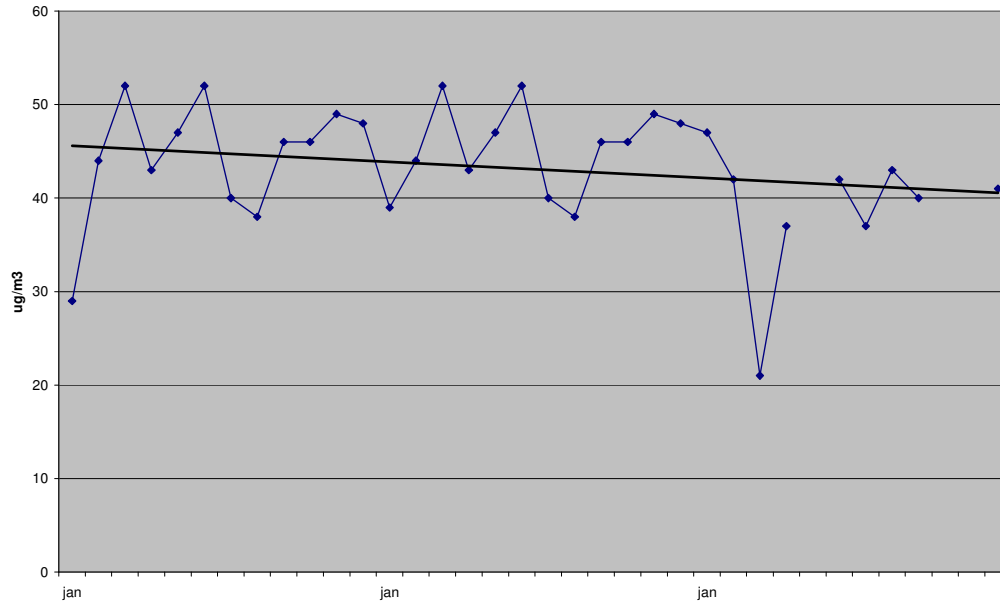
**Table 3; Last three years' diffusion tube results (tube 1) for Bridgetown Hill.**

	2004 (12 months' data)	2005 (11 months' data)	2006 (9 months' data)
Unadjusted mean	42.0	45.3	39.0
Mean adjusted for missing data*	Not necessary	Not necessary	36.9
Bias adjusted mean**	39.9 (BAF=0.95)	44.8 (BAF=0.95)	32.5(BAF=0.98)

\* see note to table 2 above

\*\* see note to table 2 above, BAF= Bias Adjustment Factor

**Figure 3; NO<sub>2</sub> at Bridgetown Hill: monthly diffusion tube results for past 3 years, (results not bias-adjusted). Results from tube at position 1 (Figure 1).**



## **6. Results of modelling using the Design Manual for Roads and Bridges (DMRB) model.**

The DMRB model was run to predict likely concentrations of NO<sub>2</sub> at the two most vulnerable locations at Bridgetown Hill which are those situated at positions 1 and 5 in figure 1 (above). Version 1.02 (November 2003) was used [www.highways.gov.uk/business/documents/dmrbscreeningmethod.zip](http://www.highways.gov.uk/business/documents/dmrbscreeningmethod.zip)

Table 4 shows the data which were input to the model and table 5 shows the results.

DMRB model runs were undertaken for two different speed scenarios as traffic can be either very slow due to congestion or completely free flowing. The congestion occurs mainly in summer periods and is due primarily to the additional volumes of holiday traffic. Location 5 is adjacent to the uphill carriageway of the road and location 1 is adjacent to the downhill carriageway. At its steepest point which is just below location 5, Bridgetown Hill has a gradient of approximately 12%. Unfortunately the model is unable to account for the effects of the gradient itself. The results do significantly underestimate the monitored results.

**Table 4; Data input to DMRB. Traffic data from counts undertaken by Devon County Council, see Appendix 3, Background NOX results from data tables available at ([www.laqmsupport.org.uk](http://www.laqmsupport.org.uk)).**

Parameter	Values used (both locations are the same distance from the road)
Background NOx	11 ug/m <sup>3</sup> (2006) 9.4 (2010)
Annual hourly average traffic	786 (2006) 850 (2010)
% Heavy Duty Vehicles	6 (2006, 2010)
Average speed	30 km/hr; 50 km/hr
Distance receptor to centre of road	5 m
Distance receptor to kerbside	2 m

**Table 5; Results from DMRB runs; results are rounded to nearest whole number. Input data for the two locations was the same, therefore results for both locations are the same. Initial results are multiplied by 2 to take account of the canyon-like nature of this stretch of road (para 6.30 ((LAQM.TG(03))).**

Results (µg/m <sup>3</sup> ) for:	Location no. 1	Location no. 2
2006 @ 30 kph	12 x 2 = 24	12 x 2 = 24
2006 @ 50 kph	12 x 2 = 24	12 x 2 = 24
2010 @ 30 kph	10 x 2 = 20	10 x 2 = 20
2010 @ 50 kph	10 x 2 = 20	10 x 2 = 20
2006 adjusted NO <sub>2</sub> tubes results for comparison	36	36

## 7. Conclusions to Detailed Assessment

The adjusted monitoring results which are available for Bridgetown Hill indicate that there is not an exceedance of the annual mean objective for Nitrogen Dioxide at relevant locations in 2006, and there should not be one in 2010. Modelling results for this location are not particularly helpful as they seem to underestimate results too much, even when the canyon effect is taken into account.

In the light of the monitoring results and of the apparent downward trend in nitrogen dioxide concentrations as measured on a month by month basis (figure 3) it is decided not to declare an Air Quality Management Area for Bridgetown Hill.

However, the situation will continue to be monitored to ensure that predicted decreases in concentrations do occur. Moreover, an automatic Nitrogen Dioxide analyser is currently being installed on the hill to obtain additional data.

## Appendix 1

### ASSURANCE AND QUALITY CONTROL OF NO<sub>2</sub> DIFFUSION TUBES.

The tubes used by South Hams District Council are supplied, prepared and analysed by Gradko International Ltd. who lay down procedures for tube handling. The preparation method used is 20% Triethanolamine (TEA) in Water.

Tube exposure periods correspond to the timetable of monthly tube changes laid down by NETCEN for the national diffusion tube survey.

Gradko have a quality assessment system in place for both the stock Triethanolamine solution and the made-up NO<sub>2</sub> diffusion tubes. In the first case, a stock solution containing a known amount of nitrite is received from AEA Technology Environment once a month. This is measured, and the results are used as part of the UK NO<sub>2</sub> Survey AQ/AC Scheme. This stock solution is used by Gradko International to check the u.v .spectrophotometer calibration graph (which is used in the tube analysis). In the second case, samples of tubes prepared for exposure are periodically spiked with known concentrations of nitrite solution and measured. Blank tube values are also monitored from each new batch of tubes prepared.

The accuracy of the lab measurements is also monitored by participation in an external Laboratory Measurement Proficiency Scheme ie. WASP (implemented by the Health and Safety Laboratory at Sheffield). In addition, Gradko NO<sub>2</sub> analysis was included within the UK NO<sub>2</sub> Field Survey Intercomparison Report co-ordinated by AEA Technology, Environment in April 2003. This survey involved comparison with chemiluminescent measurements and the results showed that Gradko achieved an average bias of measurements from the reference value of -5.17%.

Until the end of 2005 the NO<sub>2</sub> tubes located within Totnes also formed part of the National Network of NO<sub>2</sub> diffusion tubes and were thus subject to yearly additional quality control by AEA Technology, Environment, who administered that survey.

## Appendix 2

### SOURCE OF TRAFFIC DATA FOR BRIDGETOWN HILL

Two traffic counts undertaken by Devon County Council were referenced to estimate an Annual Average Daily Traffic (AADT) flow of approximately 19,000 vehicles in 2006 and 20,000 in 2010. These figures could then be converted into hourly values and read into the DMRB model.

The first of the counts was from the Automatic Traffic Count (ATC) undertaken in 2002 on Station Road, Totnes. This is the road into which Bridgetown Hill runs and there is only one other road which leads off from this (the A381 to Newton Abbot). It is estimated that traffic from this road is as likely to add to traffic on Bridgetown Hill as to subtract from it thus leaving the overall total relatively unchanged. The ATC count in 2002 gave a figure of 17,575 as the Annual Average Daily Traffic (AADT) flow. If this is extrapolated to future years assuming 2% traffic growth per year (2% is the average growth rate advised by Devon County Council) (DCC 2000); the following are obtained;

2006 = 19,022

2010 = 20,590

These count results also indicated that the proportion of HGVs on the road was 6%.

The second count is the most recent for which data are available and was undertaken by Devon County Council, also at Station Road, from January 1<sup>st</sup> 2005 to October 31<sup>st</sup> 2005. This gives annual average daily traffic flows for these 10 months of 18,474 which extrapolate to;

2006 = 18,843

2010 = 20,396

This count did not provide an indication of the proportion of HGVs.

Hourly average traffic figures have been calculated using the figures from the most recent count thus;

$$2006; \frac{18,843}{24} = 785$$

$$2010; \frac{20,396}{24} = 850$$

### Appendix 3

#### **ESTIMATION OF ANNUAL MEAN NITROGEN DIOXIDE CONCENTRATION FROM SHORT TERM MONITORING DATA (FROM THE METHOD IN BOX 6.5, LAQM.TG(03)).**

Data from two longer term tubes which had full results for the past 12 months (ie. up to February 2007) were used to make the necessary adjustments to the Bridgetwon Hill results which had missing data or were too short term. The longer term tubes were located quite close to, but not at the kerbside of, busy roads and have not been subject to any particular local effects. The tube at Barn Close is located less than a mile from Bridgetown Hill, the one at Dean Prior is around 6 miles away.

Long term site	Annual mean 2005 ( $\mu\text{g}/\text{m}^3$ ) (Am)	Period mean March-Dec 2006 ( $\mu\text{g}/\text{m}^3$ ) (Pm)	Ratio (Am/Pm)	Period mean Sept-Dec 2006 ( $\mu\text{g}/\text{m}^3$ ) (Pm2)	Ratio (Am/Pm2)	Period Mean—all year but excluding May, Oct, Nov (Pm3)	Ratio (Am/Pm3)
Barn Close	27.5	27.2	1.01	30.3	0.908	25.9	1.06
Dean Prior Farm	30.8	31.0	0.996	36.2	0.851	37.1	0.831
Average ratio			1.00		0.880		0.946

## **REFERENCES**

Devon County Council, 2000 'Devon on the Move', Local Transport Plan 2001-2006.

Devon County Council 2003; data from ATC

Devon County Council 2005; data from ATC

LAQM.TG(03) 'Local Air Quality Management', Technical Guidance, defra, 2003.

SHDC 2002 'Air Quality Strategy', Follaton House, Totnes or see [www.southhams.gov.uk](http://www.southhams.gov.uk)

SHDC 2004 'Detailed Assessment', Follaton House, Totnes, or available at [www.southhams.gov.uk](http://www.southhams.gov.uk)

SHDC 2005 'Progress Report' Follaton House, Totnes or available at [www.southhams.gov.uk](http://www.southhams.gov.uk)

SHDC 2006 '2<sup>nd</sup> Updating and Screening Assessment', Follaton House, Totnes, or available at [www.southhams.gov.uk](http://www.southhams.gov.uk)