Horsham District Council

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Air Quality Partnership

Horsham District Council

Detailed Assessment Report Cowfold Air Quality

Local Air Quality Management
Environment Act 1995

March 2011

Executive Summary

Part IV of the Environment Act 1995 requiries local authorities to review and assess current and future air quality in their area against air quality objectives established in the National Air Quality Strategy. Where those objectives are not likely to be met then the local authority is required to designate an Air Quality Management Area (AQMA) at the relevant locations. The local authority must then draw up an Action Plan setting out the measures it intends to take to comply with the air quality objectives within the area covered by the AQMA.

Horsham District Council's previous air quality reports, including the Updating and Screening Assessment (2009) and Progress Report (2010), identified elevated levels of nitrogen dioxide along parts of The Street and Station Road, in Cowfold Village.

This Detailed Assessment Report presents the results of the most recent monitoring and provides an accurate assessment of the likelihood of the air quality objectives being exceeded at 'relevant' locations in the area. The report has been prepared in accordance with the Local Air Quality Management Technical Guidance Note LAQM.TG(09).

The diffusion tube monitoring carried out in 2009 and 2010 has indicated that the annual mean concentration of nitrogen dioxide along The Street and Station Road are above the air quality objective for nitrogen dioxide. Based on this detailed assessment the following concusions have been reached:

- The declaration of an Air Quality Management Area is proposed to include The Street, Station Road and Bolney Road. The area will extend along the A272 junction through Cowfold village where nitrogen dioxide concentrations are exceeding, or are close to exceeding, the air quality objectives. The declaration will be on the basis of nitrogen dioxide where exceedences of the annual mean objective are predicted at relevant receptor locations.

- The spatial extent of the Air Quality Management Area has been presented in draft form but the exact geographical extent of the AQMA will be subject to consultation with members, local residents and businesses.

- To continue monitoring nitrogen dioxide at all current monitoring locations and to expand the diffusion tube monitoring network to improve data accuracy and spatial coverage. To report on data from the new automatic monitoring station installed in October 2010.

The full conclusions and recommendations of the Detailed Assessment are contained in Section 5 of this report. A draft AQMA boundary has been drawn up for further consultation and is detailed in Section 6.

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1. Introduction

1.1 Purpose of Report

The report has been produced by the Public Health and Licensing Department to provide a detailed summary of Horsham District Council's air quality monitoring and assessment work in respect of Cowfold, West Sussex. The report has been prepared in accordance with the Council's Local Air Quality Management obligations under the Environment Act 2005 as part of the fourth round of review and assessment.

1.2 General Description of Local Authority Area

Horsham District is a predominantly rural area with a population of 126 000. The total area is 205 square miles. Horsham is the main town and the principal administrative and commercial centre within the district with a population of around 40 000.

Horsham District is well served by transport links to London, Gatwick Airport, the M25, the coast and Europe. A network of subsidiary routes connects the villages and small centres of population.

A large proportion of the district is composed of countryside with a varied landscape of woodland, heathland, downland, river valleys and meadows being represented. Areas of Outstanding Natural Beauty, Sites of Special Scientific Interest, and Sites of Nature Conservation Importance overlap the area. At the southern end of the district there is the newly designated South Downs National Park. Agriculture remains a major user of land within the District. Significant industrial premises include two major landfill sites and two brickworks.

1.3 Review and Assessment of Air Quality in Horsham District.

Under the Environment Act 1995, local authorities are required to Review and Assess (R&A) air quality on a regular basis. A review of air quality means a consideration of the levels of pollutants in the air for which objectives are prescribed in Regulations[1], and estimations of likely future levels. An assessment of air quality is the consideration of whether estimated levels for the relevant future period are likely to exceed the levels set in the objectives. A table of reports published is presented in Table 1 below.

The first review and assessment round was completed in 2000. The main conclusion was that the national air quality objectives were not likely to be exceeded at any locations in the District.

This first round of R&A constituted a benchmark against which Horsham District Council measure progress in making improvements to the local air quality. Subsequent progress reports were completed in 2004 and 2005. In 2006 an Updating and Screening Assessment was completed. In all these reports no exceedance of air quality objectives was identified or predicted.

[1] Air Quality Regulations for England (2000; Amendment Regulations 2002)

Guidance issued by the Department for Environment, Food and Rural Affairs (DEFRA) requires those local authorities, who found no exceedence of the air quality objectives in the last Updating and Screening Assessments (USA), to produce a Progress Report (PR) of local air quality.

The Progress Report submitted in 2007 identified an exceedance of the air quality objective for nitrogen dioxide in Storrington and in Cowfold in 2006. The need for a Detailed Assessment to be undertaken at both locations was indicated in the conclusions to the 2007 Progress Report. The data used for the 2007 report was based on diffusion tube monitoring from newly established sites in those locations therefore the report highlighted further monitoring at this location.

The Progress Report presented in 2008 confirmed the exceedance of the air quality objective for nitrogen dioxide at Cowfold. Additional diffusion tubes were introduced into Cowfold to supplement monitoring data and establish the extent of the exceedence.

The Updating and Screening Assessment submitted in 2009 confirmed continued exceedance of the air quality objective for Nitrogen Dioxide at Cowfold on the basis of diffusion tube monitoring results. The Report identified a need for continuous monitoring equipment in order to confirm diffusion tubes findings. Steps were taken to secure the necessary funding for the equipment, which was finally commissioned in October 2010.

The 2010 Progress Report provided an update on air quality within the District and confirmed continued exceedance of the air quality objective for Nitrogen Dioxide at Storrington and Cowfold. The report also indicated that two further areas, in Pulborough and in Horsham town, were close to exceeding the same objective and would be closely monitored during 2010.

A Detailed Assessment report for Storrington confirmed that exceedences were likely and the Council declared an AQMA in Storrington in December 2010.

In response to the 2010 Progress Report, Defra recommended that a Detailed Assessment be carried out for Cowfold based on the available diffusion tube data.

Table 1: Previously Published Reports

Year	Report	Conclusions
2000	Review and Assessment	No exceedance of air quality objectives identified or predicted
2003	Review and Assessment	No exceedance of air quality objectives identified or predicted
2004	Progress Report	No exceedance of air quality objectives identified or predicted
2005	Progress Report	No exceedance of air quality objectives identified or predicted
2006	Update and Screening Assessment	No exceedance of air quality objectives identified or predicted
2007	Progress Report	Detailed assessment required for NO_2 in Cowfold and Storrington
2008	Progress Report	Detailed assessment for NO_2 required in Cowfold and Storrington
2009	Update and Screening Assessment	Detailed assessment for NO_2 required in Cowfold and Storrington
2010	Progress Report	Detailed assessment for NO_2 required in Cowfold and Storrington
2010	Detailed Assessment for Storrington	Declaration of AQMA in Storrington

1.4 General Description of Detailed Assessment Area

Cowfold is a village and a civil parish located in the east-central part of Horsham District at the intersection of the A272 and A281 roads.

In the past Cowfold formed a part of the Wealden iron industry, due to an abundant supply of timber for smelting. Currently the village is predominantly residential in character with a population of around 1864 people. There are a small number of shops and offices in the centre of the village.

The intersection of the A272 and A281 roads form The Street, which is controlled by two mini roundabout junctions approximately 100 metres apart. The Street is formed of a combination of commercial and residential premises arranged around the historic church of St. Peters. The short stretch of road between the roundabouts and the A272 and A281 routes coming into the village suffer from congested traffic, particularly at peak times, but also carry consistently high traffic flow throughout the day.

The A272 running through Cowfold forms a link between Billinghurst to the west and Haywards Heath to the east. The A281 forms a link between Horsham town to the north and Henfield/A23 to the south.

There is a relatively high volume of heavy goods vehicles passing through the village.

The village has a traffic flow of approximately 18,000 (24 hour weekday average) The percentage of Heavy Duty Vehicles (over large Transit size) is 5.0% (annual percentage over a 5 day week). This equates to 504 heavy duty vehicles (HDV's) each week day on average.

The general location of Cowfold and it's relationship to the major road links are shown in Figures 1,2 and 3

Figure 1: Map of Cowfold Village (satellite).

Figure 2: Map of Cowfold Village.

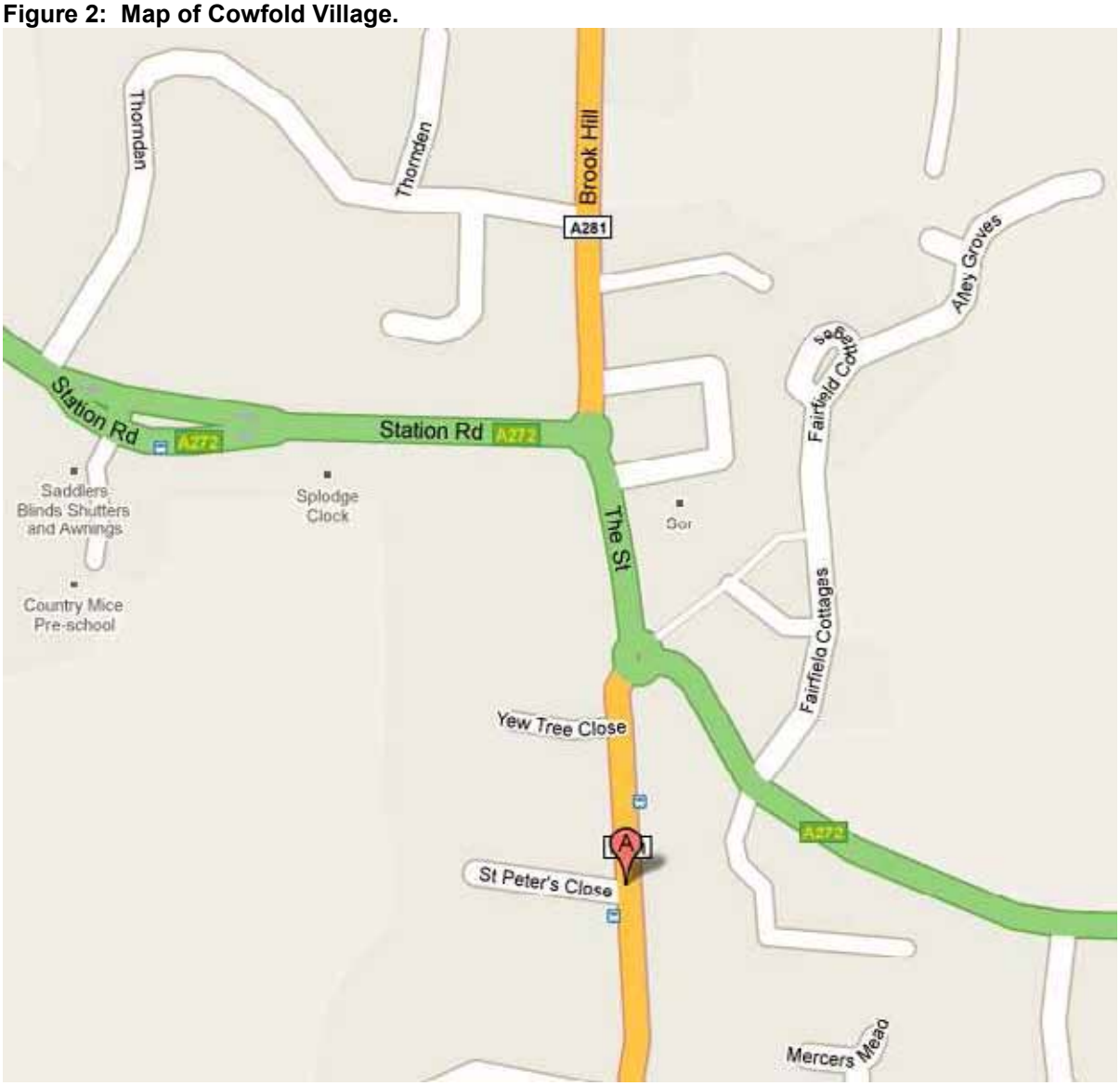


Figure 3: Map of Cowfold Local Road Network.

1.5 Requirement for a Detailed Assessment

The most recent Updating and Screening Assessment (2009) and subsequent Progress Report (2010) identified hotspots along The Street in Cowfold where nitrogen dioxide concentrations were consistently in excess of the annual mean objective. The reports examined all relevant domestic and industrial sources of nitrogen dioxide in the vicinity of the Detailed Assessment area and no significant point or fugitive sources were identified.

The most likely source of nitrogen dioxide at these locations is road traffic emissions and concentrations are likely to be elevated due to the volume and congestion of traffic and the number of heavy goods vehicles.

The purpose of this Detailed Assessment is to determine, with reasonable certainty, whether or not there is a likelihood of the objectives not being achieved in Cowfold village. Where a likely exceedence of the objectives is identified, Horsham District Council are required to determine the magnitude and geographical extent of the exceedence.

1.6 Air Quality Objectives

The air quality objectives applicable to Local Air Quality Management (LAQM) in England are set out in the Air Quality (England) Regulations 2000 (SI 928), and the Air Quality (England) (Amendment) Regulations 2002 (SI 3043). They are shown in Table 2.

This table shows the objectives in units of micrograms per cubic metre µg/m^3 (for carbon monoxide the units used are milligrammes per cubic metre, mg/m^3).

Table 2 includes the number of permitted exceedences in any given year (where applicable).

Table 2: Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	Concentration	Measured as	Date to be achieved by
Benzene	16.25 μg/m^3	Running annual mean	31.12.2003
	5.00 μg/m^3	Running annual mean	31.12.2010
1,3-Butadiene	2.25 μg/m^3	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 μg/m^3	Annual mean	31.12.2004
	0.25 μg/m^3	Annual mean	31.12.2008
Nitrogen dioxide	200 μg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 μg/m^3	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	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	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

2. Detailed Assessment – Monitoring Scope and Methodology

In order to assess, with reasonable certainty, whether an Air Quality Management Area (AQMA) should be designated, it is important that there is a high level of confidence in any monitoring data and an awareness of the assumptions and uncertainties associated with any modelling used in the assessment. The assessment needs to clearly identify the points of maximum relevant public exposure and the geographical extent of any air quality objective exceedences.

The monitoring strategy employed for the Cowfold assessment is based on the following:

- Enhanced monitoring of nitrogen dioxide by means of additional diffusion tubes.
- Enhanced monitoring of nitrogen dioxide by means of new automatic analyser.
- Retention of existing diffusion tube monitoring sites to provide continuity of data and allow trend analysis.
- Use of "BREEZE Roads" model to indicate likely extent of the area of air quality objective exceedences.

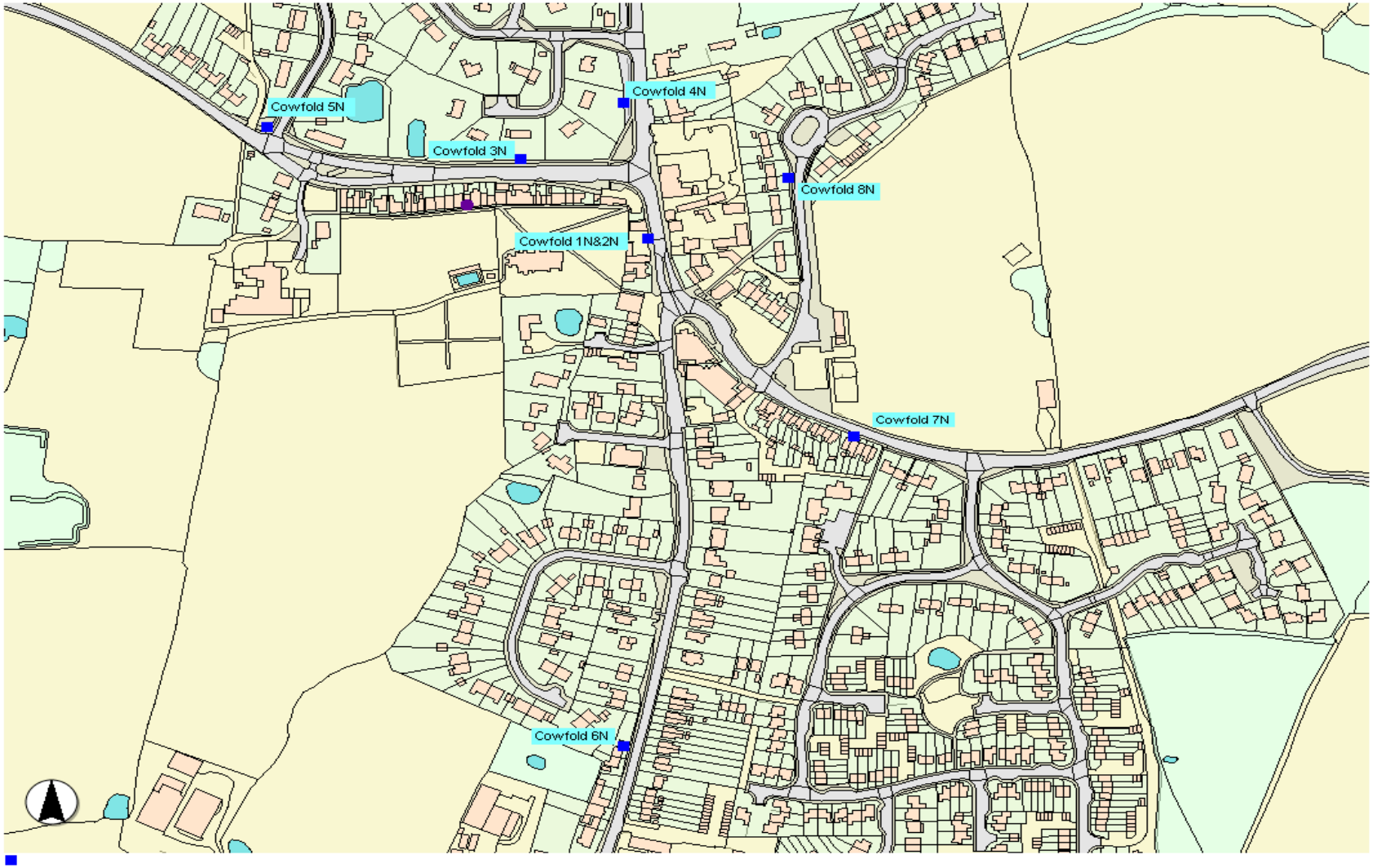
Ideally the assessment would rely, for better accuracy, on the data obtained from the automatic analyser, however the monitoring station in Cowfold was not fully commissioned until November 2010.

2.1 Previous Air Quality Monitoring in Cowfold

The Council maintains a network of passive nitrogen dioxide diffusion tubes. Originally there was one monitoring tube in Cowfold but, on the basis of the nitrogen dioxide concentrations this tube was returning, the tube network was extended to additional locations along The Street, Station Road and on the main access routes serving the village. The results from the diffusion tube survey in Cowfold were key to the decision to undertake a detailed assessment.

The locations of the diffusion tube monitoring sites are shown in Figure 4.

Figure 4: The location of diffusion tube monitoring sites in Cowfold.



2.2. Air Quality Monitoring in Cowfold for Detailed Assessment

To improve upon the detail and accuracy of the monitoring in Cowfold a new real time continuous monitoring site was established in October 2010. The station houses a nitrogen dioxide chemiluminescence analyser (Casella ML9841).

The analyser is situated at a location close to the roundabout at the south end of The Street. This is a roadside site with relevant public exposure. The location of the automatic monitoring station is shown in Figure 5.

Figure 5: Location of Cowfold air quality monitoring station

The monitoring station was installed in October 2010 and was fully commissioned in November 2010 . The collection and ratification of the data is undertaken by the Environmental Research Group through their contract with the Sussex Air Partnership, of which Horsham District Council is a member.
For the reason that the site was not fully commissioned until November 2010, data from this station is not presented in this report.

All data from the Cowfold station will be reported in the Further Assessment, however further monitoring will be needed to eliminate seasonal variations from the dataset.

3. Detailed Assessment – Monitoring Results and Analysis

3.1 Nitrogen Dioxide Diffusion Tube Monitoring

It should be noted that whilst this report was written in February 2011, the 2010 diffusion tube dataset was not complete and could not be fully bias corrected. Therefore, for the purpose of this report and for the air dispersion modelling study, the 2009 annual mean diffusion tube data was used. The uncorrected 2010 diffusion tube data has been presented for information purposes only.

There are currently eight diffusion tubes located in Cowfold, including one duplicate co-location site. A further triplicate tube site will be co-located with the new automatic analyser in March 2011 . All monitoring locations were sited at potential 'hot-spots' and all have relevant public exposure, with the exception of the Cowfold 8n site that represents a background location. The background site was set up in Febuary 2011 and results from this are not yet known.

As there was no automatic analyser data available for Cowfold in 2009, a local bias adjustment factor has been calculated from an established roadside site in Horsham town where an automatic continuous nitrogen dioxide analyser is co-located with triplicate diffusion tubes. The annual mean concentration for each site has also been corrected using the national bias correction factor derived from Air Quality Consultants Ltd database (spreadsheet version number 03/10) The full QA:QC data for the diffusion tube monitoring survey and bias adjustment factor calculations are presented in Appendix A.

The locations of the diffusion tubes in Cowfold are shown in Figure 4 and the site descriptions are in Table 3.

Table 3:Diffusion Tube Monitoring Locations – Cowfold

Site Name	Site Type	OS Grid Ref		Pollutants Monitored	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Worst-case Location
		X	Y				
Cowfold 1N	Roadside	521320	122610	NO_2	Y(3.0m)	1.65	Y
Cowfold 2N	Duplicate	521320	122610	NO_2	Y(3.0m)	1.65	Y
Cowfold 3N	Roadside	521267	122678	NO_2	Y(9.7m)	3.10	Y
Cowfold 4N	Roadside	521309	122702	NO_2	Y(9.3m)	2.00	Y
Cowfold 5N*	Roadside	521081	122699	NO_2	Y(25.0m)	3.60	Y
Cowfold 6N*	Roadside	521309	122250	NO_2	Y(4.5m)	1.80	Y
Cowfold 7N*	Roadside	521434	122484	NO_2	Y(2.0m)	1.10	Y
Cowfold 8N**	Background	521411	122667	NO_2	Y(10.0)	N/A	N
Cowfold AU **	Roadside	521356	122552	NO_2	Y(24.0)	3.90	Y

* monitoring started in September 2010
** monitoring started in January 2011

3.2 Diffusion Tube Nitrogen Dioxide Monitoring Results and Trend Analysis.

The Cowfold diffusion tube results for 2009 are shown in Table 4.

Table 4: Cowfold Diffusion Tube Results 2009

Site Ref./Location	Data Capture 2009 %	Annual mean Concentration 2009 (µg/m³) Adjusted by local bias[1]	Annual mean Concentration 2009 (µg/m³) Adjusted by national bias[2]
Cowfold 1N – Olde House, The Street.	92%	49.4	45.5
Cowfold 2N – Olde House, The Street.	100%	49.1	45.2
Cowfold 3N – Station Road 6 Margaret Cotts, A272	92%	42.5	39.1
Cowfold 4N – Brook Hill, Trelawny House, A281.	100%	38.4	35.4
[a] **Cowfold 5N –** Junction Station Road/Thorndon	n/a	n/a	n/a
[a] **Cowfold 6N –** Millers Cottage, A281	n/a	n/a	n/a
[a] **Cowfold 7N -**3 Huntscroft Gardens,A272	n/a	n/a	n/a
[a] **Cowfold 8N –** 3 Fairfield Cottages-background	n/a	n/a	n/a

[1] Local bias adjustment factor of 0.88 obtained from triplicate tube study – Park Way, Horsham.
[2] National bias adjustment factor of 0.81 obtained from UWE website.
[a] Denotes diffusion tubes that have not been in position for a sufficient period to give a reliable annual mean for 2009.

The diffusion tube results for 2009 show exceedance of the annual mean nitrogen dioxide objective at the co-location monitoring site Olde House, The Street (Cowfold 1N and 2N). Exceedence of the objective at the Margaret Cottages (Cowfold 3N) site is dependant on whether the local or national correction factor is used, however in both cases the concentration is within 5% of the objective if not exceeding it. There is close agreement between the co-located tubes at Olde House, The Street. The monitoring site at Brook Hill A281 (Cowfold 4N) located at the north end of the village on the A281 did not exceed the objective in 2009.

The Cowfold nitrogen dioxide diffusion tube concentrations for the last 4 years are shown in Table 5 below. The concentrations have been corrected using the national bias correction factor applicable to each year.

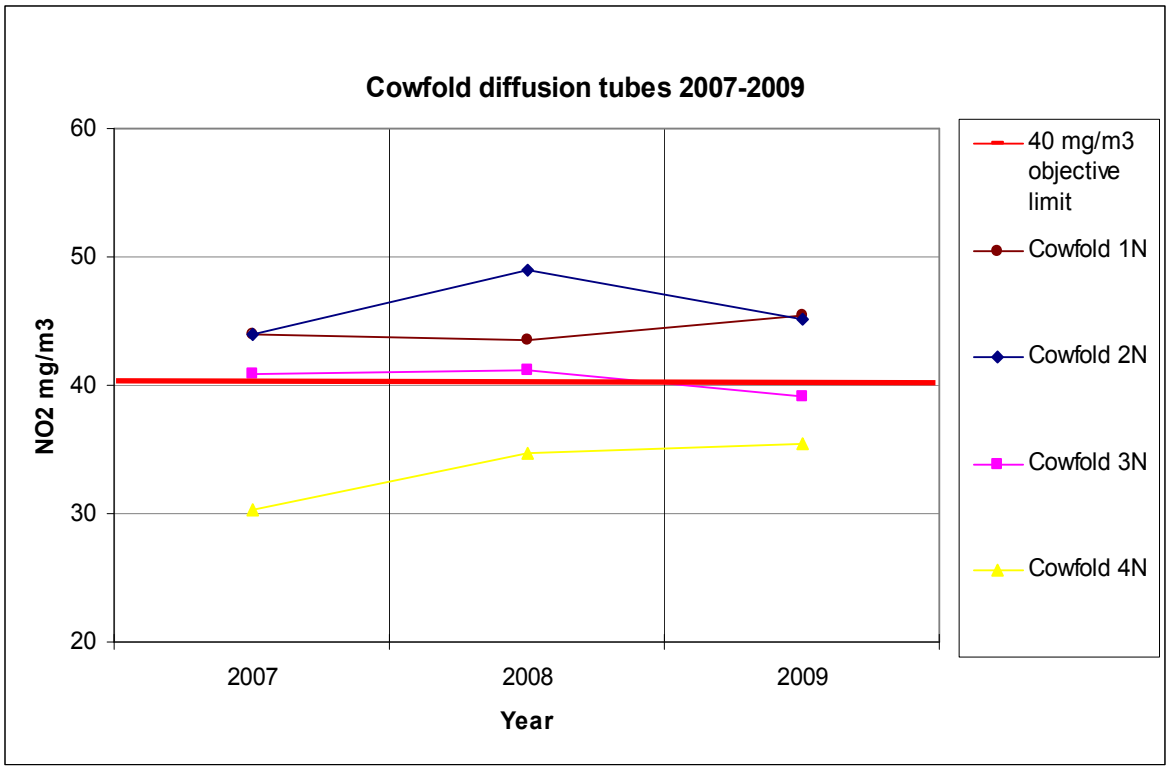
Table 5: Annual Mean Nitrogen Dioxide Concentrations Cowfold 2007-2010

Location	Data Capture 2009 %	Annual mean concentrations Adjusted for Bias+			
		2007 (ug/m³)	2008 (ug/m³)	2009 (µg/m³)	2010 (µg/m³)
Cowfold 1N – The Street	92%	44.0*	43.6	45.5	53.1 [a]
Cowfold 2N – The Street	100%	43.9*	48.9	45.2	54.0 [a]
Cowfold 3N – Station Road	92%	40.9*	41.2	39.1	44.9 [a]
Cowfold 4N – Brook Hill	100%	30.3*	34.7	35.4	41.1 [a]
*Cowfold 5N – Junction / Thorndon	n/a	n/a	n/a	n/a	37.9 [a b]
*Cowfold 6N – Millers Cottage	n/a	n/a	n/a	n/a	39.9 [a b]
*Cowfold 7N – Huntscroft Gardens	n/a	n/a	n/a	n/a	59.0 [a b]
**Cowfold 8N - 3 Fairfield Cottages	n/a	n/a	n/a	n/a	n/a
**Cowfold AU – Co-location	n/a	n/a	n/a	n/a	n/a

+ National bias correction factors: 2007 0.89
2008 0.93
2009 0.81

[a] *The 2010 diffusion tube data has not been bias corrected and should be regarded with caution.*
b Denotes diffusion tubes that have not been in position for a sufficient period to give a reliable annual mean.
*monitoring started in September 2010
** monitoring started in January 2011

Figure 6: Annual Mean Nitrogen Dioxide Concentrations Cowfold 2007-2009



Note: The 2010 diffusion tube data has not been bias corrected and for that reason data has not been considered within the graph.

The nitrogen dioxide concentrations measured at The Street site (Cowfold 1N and 2N) have consistently exceeded the objective level. The Station Road (Cowfold 3N) site has shown a slight decline in annual mean concentration between 2007and 2009, but remains close to the objective level, whilst the concentration at Brook Hill (Cowfold 4n) has shown an increase in concentration from 30.3 µg/m³ in 2007 to 35.4 µg/m³ in 2009.

3.4 Monitoring Results and Air Quality Objective Comparisons

The monitoring results from the diffusion tube survey for 2009 indicate that the annual mean concentration of nitrogen dioxide exceeded the national air quality objective at 2 monitoring sites in Cowfold.

There was an insufficient amount of data from the continuous monitoring station in Cowfold for analysis, therefore these results have not been included in this report.

4. Areas of Air Quality Objective Exceedences

Additional assessment work has been carried out to determine the probable area of nitrogen dioxide exceedence in Cowfold. The "BREEZE Roads" model has been used to establish the likely spatial extent of air quality exceedences for nitrogen dioxide using monitored results to verify the modelled data. The modelling was undertaken by the Project Development Officer for The Sussex Air Partnership on behalf of Horsham District Council, and is reproduced in full in Appendix B.

The modelling results shown below, were verified against the monitoring results in 2009, and confirmed that there is the likelihood of exceedences of the annual NO_2 limit of 40µg/m³ for the year 2009. The model was run utilising average meteorological conditions for the year 2009.

The model predicted exceedences of the annual NO_2 air quality objective value of 40µg/m³ for the year 2009 at one (pre-selected) receptor location in Cowfold, plus an additional four modelled receptor locations where the concentration of NO_2 was within 1µg/m³ (2.5%) of the UK Air Quality annual mean objective.
The locations identified by the model as likely to be in exceedence of the UK Air Quality objective limits were Whitelined House, 5 Huntscroft Gardens, 7 Huntscroft Gardens, the Post Office (1st floor residential property) and 8 Station Road.

Table 6: Modelled NO2 concentrations at locations which are predicted to have exceeded the AQO limit (40µg/m^3) for 2009.

Sensitive receptors	NO2 (total) (µg/m^3)	% of Air Quality Objective
Whitelined House	45.0	112%
5 Huntscroft Gdns	39.4	99%
7 Huntscroft Gdns	39.4	98%
Post Office (1st floor property)	39.6	99%
8 Station Rd	39.7	99%

The model also predicted that a further 10 receptors had nitrogen dioxide concentrations above 32µg/m³ (i.e. 80% of the UK air quality objective) and, given that the margin of error associated with diffusion tubes can be as high as +/- 20%, these receptors may also need to be considered as potential areas of exceedance.

The receptor with a clear exceedance of the objective and those with predicted concentrations within 1µg/m³ of the objective are highlighted in Table 7. Receptors with nitrogen dioxide concentrations within 80% of the objective are identified by an asterisk*.

Table 7: Predicted annual model results for year 2009

Receptors	Modelled results (µg/m³)	% of Air Quality Objective
2 Margaret Cott	*32.0	80%
5 Margaret Cott	31.7	79%
6 Church Path	30.5	76%
8 Church Path	*33.5	84%
2A Church Terrace	*34.8	87%
HsA281 Nth	29.5	74%
HsBrook Hill	28.9	72%
St Peter Cottage	*34.8	87%
Whitelined House	**45.0**	**112%**
Westview	23.1	58%
Hse	25.1	63%
Hse	24.9	62%
Hse A272	25.6	64%
Hse A272 East	25.4	64%
1 A272(East)	27.9	70%
5 Oakfield Cotts	*34.6	86%
2 Oakfield Cotts	*35.7	89%
2 Huntscroft Gdns	*38.7	97%
5 Huntscroft Gdns	***39.4**	**99%**
7 Huntscroft Gdns	***39.4**	**98%**
Post Office & 1st floor	***39.6**	**99%**
3 Gables	*38.8	97%
1 Gables	*37.0	92%
1-21 The Studio	31.1	78%
5-6 Fairfield Ct	30.3	76%
HsWA272Nth	22.7	57%
HS A272NW	*38.6	97%
8 Station Rd	***39.7**	**99%**

Red/Bold – Locations with concentrations exceeding the UK air quality objective of 40µg/m³
Blue/Bold – Locations with concentrations of NO_2 within 1µg/m³ (2.5%) of the UK Air Quality NO_2 annual mean objective.
* Locations with concentrations above 32 µg/m³ (i.e. 80% of the UK air quality objective)

The model concentration maps are shown in figures 7 and 8 below. The areas of exceedance clearly extend along The Street and the A272 links both east and westbound.

The maximum pollutant concentration at a relevant receptor location is 45.0µg/m³ at Whitelined House, The Street, Cowfold. The estimated number of people exposed to concentrations above the air quality objective for nitrogen dioxide is 9

individuals. This estimate is derived from the Council's current Electoral Register for the five properties identified as having a nitrogen dioxide concentration either above or within 1µg/m³ of the 40µg/m³ objective.

Figure 7: 2009 modelled annual average concentrations for NO2 (µg/m^3) at key receptors. The Street, Junctions with A281, A272 and Station Road.

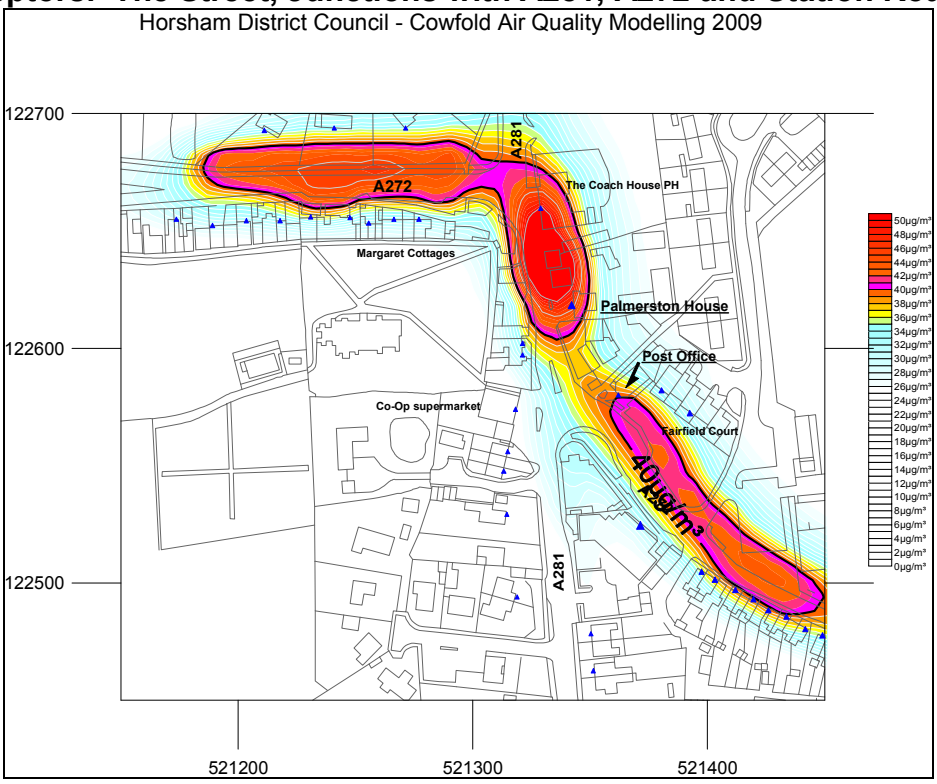
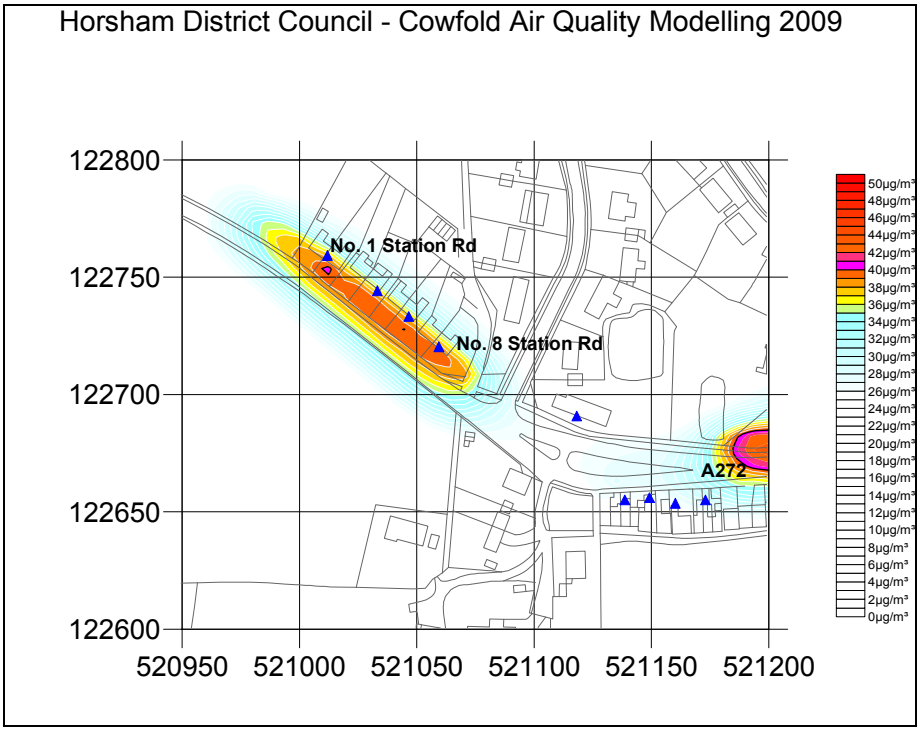


Figure 8: 2009 modelled annual average concentrations for NO2 (µg/m^3) at key receptors along Station Road (A272).



The model concentration map indicates that the modelled nitrogen dioxide concentrations primarily follow the route of the A272 link as it travels east/west through the village. This correlates with the higher traffic flow on the A272 relative to the A281 link which runs north/south.

There is a noticeable elevation in the modelled nitrogen dioxide concentrations on the north east side of each road link, which is likely to be attributable to the effect of the prevailing south westerly wind on the model outputs. This results in the modelled concentrations contradicting the measured diffusion tube concentrations at tube sites Cowfold 1N and 2N, the duplicate tube site at Olde Cottage, The Street. Here the measured diffusion tube concentration is 45.5µg/m³ and 45.2µg/m³ respectively, whereas the nitrogen concentration at the nearest modelled location (St Peters Cottage) has a predicted nitrogen dioxide concentration of 34.8µg/m³. To counter this anomaly the boundary of the proposed Air Quality Management Area (AQMA) will be drafted to include both modelled and measured areas of nitrogen dioxide exceedance, with further examination of the data at Further Assessment stage. This will allow for all potential areas of exceedance to be incorporated into the proposed AQMA, and for the modelled and measured data to be further refined with the benefit of data from the automatic analyser and additional diffusion tube monitoring sites introduced during 2010.

5. Conclusions and Recommendations

A detailed assessment has been carried out for the village of Cowfold. This area was identified in the latest Updating and Screening Assessment and Progress Report as having the potential to be in breach of the annual average objective for nitrogen dioxide.

Diffusion tube monitoring in Cowfold has indicated that concentrations of nitrogen dioxide are above the air quality objective at receptor locations along The Street and on Station Road (A272). Exceedence of the annual mean nitrogen dioxide objective has also been predicted from modelled data at other locations along The Street, Station Road and Bolney Road. The spatial extent of the exceedances can be defined with reasonable certainty and includes areas of relevant public exposure.

An automatic monitoring station has been installed at a suitable roadside location in Cowfold to provide additional real-time data. Data from the analyser will be used to verify future diffusion tube data and to refine modelled pollutant concentrations.

As a result of the above conclusions and in accordance with the Council's statutory obligations under Local Air Quality Management (LAQM) the following recommendations are made:-

1. The declaration of an Air Quality Management Area (AQMA) is proposed to include the stretch of road through the village, formed of the The Street, Station Road and Bolney Road. The area will extend along the A272 junction through Cowfold village where nitrogen dioxide concentrations are exceeding, or are close to exceeding, the air quality objectives. The area to include, as a minimum, all those areas identified as exceeding the air quality objectives, as shown in figures 7 and 8.

2. The declaration will be on the basis of nitrogen dioxide where exceedances of the annual mean objective are predicted at relevant receptor locations.

3. The geographical extent of the AQMA will be subject to further consultation with statutory consultees including local members, parish council, local residents and businesses. The consultation to be conducted within 3 months of the publication of the detailed assessment.

4. A draft boundary for the AQMA is included as part of this detailed assessment for wider consultation purposes. See Chapter 6.

5. The formal boundary of any AQMA to be finalised and the formal AQMA order completed within 4 months of the publication of this report.

6. Monitoring of nitrogen dioxide at current monitoring locations will continue in the form of the diffusion tube survey and the automatic monitoring station. This will allow any future changes in air quality to be detected and any emerging trends analysed. Ratified data from the automatic analyser will allow more accurate assessment of nitrogen dioxide concentrations.

7. Results from new diffusion tubes sites and the automatic analyser will be analysed to inform an investigation into whether the modelled concentration map is being skewed to some extent by the prevailing wind direction.

8. All additional monitoring, and in particular the real-time data from the automatic monitoring station, will be reported in a Further Assessment report, required within 12 months of designation of the AQMA. The additional data for 2010 and 2011 will be used to confirm the accuracy of the conclusion that an AQMA is required for Cowfold; to verify the assumptions on which the AQMA was based and to refine the boundaries of the AQMA should further areas of exceedance be identified.

9. Following designation of the AQMA in Cowfold, preparation of a provisional Air Quality Action Plan will commence in partnership with the Highways Department of West Sussex County Council and other consultees. The Action Plan to be completed within 18 months of designation of the AQMA.

6. Draft Air Quality Management Area Boundary

Any boundary for an AQMA must include, as a minimum, all areas of exceedance of the air quality objective; however these areas are based upon predicted pollutant concentrations derived from a dispersion model, the outputs of which carry a degree of uncertainty. In addition the input data used to generate the modelled concentrations for the Cowfold detailed assessment is from diffusion tubes which are also inherently uncertain. It is therefore unlikely that the predicted line of exceedence will exactly match the actual line of exceedance. For this reason, and for administrative and communication purposes, it can be better to define the AQMA boundary by reference to physical features.

In the case of Cowfold the exceedance relates to the long term nitrogen dioxide objective and is primarily related to traffic emissions, with little or no evidence of any industrial or residential sources of pollution. The main road through the village carries 18000 vehicles a day and has periods of traffic congestion. Monitoring results from diffusion tube sites located on roads approaching the two mini roundabout junctions at The Street, suggest that the concentration of nitrogen dioxide declines beyond these junctions, which corresponds with a split in traffic volume and increase in vehicle speeds.

The modelled predicted concentrations contradict the diffusion tube findings in a number of monitoring locations: In particular, Cowfold 1N and Cowfold 2N are the duplicate diffusion tubes at Olde Cottage, The Street. Here the measured results showed much higher concentrations in the 2009 dataset than the dispersion model predictions. To counter this anomaly the boundary of the Air Quality Management Area has been drafted to include all those receptors identified by both modelled and measured data as being within areas of nitrogen dioxide exceedance.

The modelling study also indicated areas of the village where the predicted concentrations were within 20% of the air quality objective for nitrogen dioxide, and given the accepted margin of error associated with diffusion tube data, could also

be in exceedance of the objectives. Further more detailed monitoring and modelling will seek to confirm whether this is in fact the case.

In drawing up a draft AQMA boundary the Council has had regard to both the measured and predicted areas of exceedance but also applied an element of judgment and local knowledge to inform the decision. Based on these factors the proposed boundary incorporates the main areas of exceedance along The Street, Station Road and Bolney Road essentially following the route of the A272 as it passes through Cowfold village. The draft AQMA is shown in Figure 9 below. This draft will form the basis for further consultation and possible refinement to produce a workable boundary prior to final declaration.

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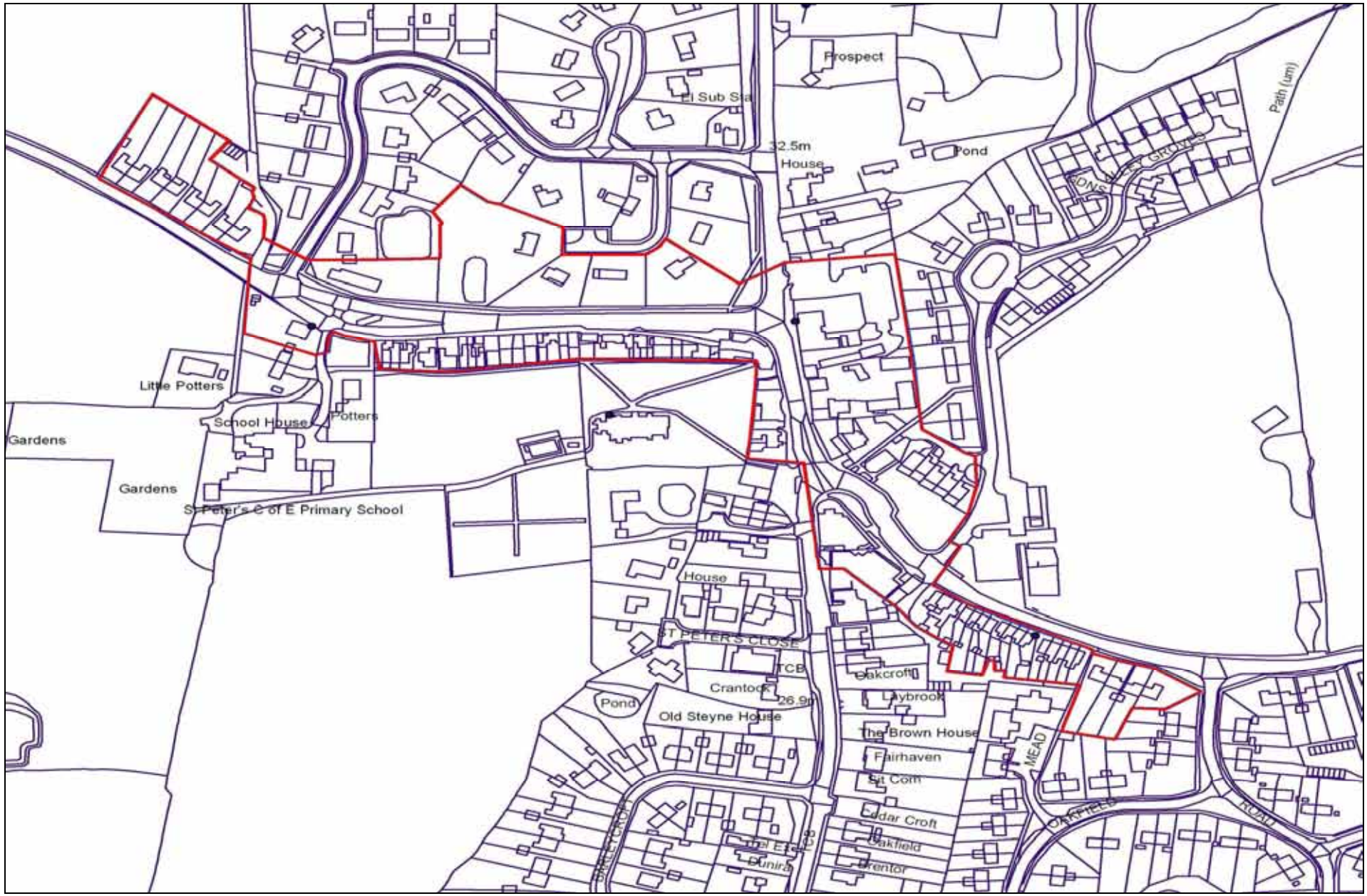
Figure 9: Cowfold Proposed Air Quality Management Area boundary



7. Consultation

The external consultation requirements for Detailed Assessment reports are set out in Chapter 5 of the Local Air Quality Management Policy Guidance document LAQM.PG(09) and for Horsham District Council are as detailed below:

External Consultees

- Secretary of State
- Defra
- Environment Agency (Sussex Area Office)
- All neighbouring local authorities: Chichester DC, Arun DC, Adur DC, Worthing BC, Mid Sussex DC, Crawley BC, Brighton & Hove CC, Waverley BC, Mole Valley DC
- West Sussex County Council (Highways Authority)

Internal consultees:

- Chief Executive
- Strategic Planning
- Development Management

For consultation in respect of the AQMA boundary and proposed Action Plan all statutory and the following non-statutory consultees will be consulted.

- Local Member of Parliament
- County / District Councillors
- Parish Council
- Sussex Health Protection Agency
- Local community groups
- Local residents
- Local businesses

8. References

AEAT (2003) UK NO2 Diffusion Tube Network Instruction Manual.
AEA (2009) WASP – Annual Performance Criteria for NO2 Diffusion Tubes used in Local Air Quality Management (LAQM), 2008 onwards, and Summary of Laboratory Performance in Rounds 103-107.
DETR (2000) - The Air Quality (England) Regulations. HMSO
DEFRA (2002) - The Air Quality (England) (Amendment) Regulations. HMSO.
DEFRA (2007) - The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Vol 1 and Vol 2
DEFRA (2009) – Local Air Quality Management Policy Guidance, LAQM.PG(09)
DEFRA (2009) - Local Air Quality Management Technical Guidance. LAQM.TG(09)
The Environment Act (1995)
EPuk (NSCA) – Air Quality Management Areas: A Review of Procedures and Practice for Local Authorities
NO2 from NOx Calculation for Air Quality. Version 2.1 (Jan 2010)
Assessments of Roads – Updated 2006

Appendix A: QA:QC Data

Diffusion Tube Bias Adjustment Factors

The Diffusion Tubes are sourced from Environmental Scientifics Group (formerly Bureau Veritas) in Glasgow using the using 20% TEA in Water preparation method. The national bias adjustment factor was obtained from Air Quality Consultants Ltd database (spreadsheet version number 03/10) based on 8 co-location studies. The bias adjustment factor given for this methodology was 0.81.

Factor from Local Co-location Study

A co-location study is undertaken at the automatic analyser station in Park Way Horsham. This is a roadside monitoring site located 2m from the kerbside. Using the AEA Precision spreadsheet tool a local bias adjustment factor of 0.88 has been calculated.

Results of the 2009 co-location study are given in Table A1 below. The results have also have been included in the national database.

Table A1. 2009 Co-location Study Data for Horsham

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	07/01/2009	04/02/2009	38.0	43.0	41.0	41	2.5	6	6.3	37.8	99.7	Good	Good
2	04/02/2009	04/03/2009	60.0	49.0	58.0	54	9.3	17	23.1	41.1	96.7	Good	Good
3	04/03/2009	01/04/2009	40.0	41.0	32.0	38	4.9	13	12.3	33.3	99.9	Good	Good
4	01/04/2009	29/04/2009	37.0	36.0	35.0	36	1.0	3	2.5	36.1	99.9	Good	Good
5	29/04/2009	03/06/2009	31.0	28.0	32.0	30	2.1	7	5.2	26	100	Good	Good
6	03/06/2009	01/07/2009	38.0	36.0	38.0	37	1.2	3	2.9	28	99.7	Good	Good
7	01/07/2009	29/07/2009	14.0	15.0	13.0	14	1.0	7	2.5	20	98.9	Good	Good
8	29/07/2009	02/09/2009	32.0	31.0	31.0	31	0.6	2	1.4	25	92.4	Good	[illegible]
9	02/09/2009	30/09/2009	36.0	34.0	37.0	36	1.5	4	3.8	30	82.3	Good	[illegible]
10	30/09/2009	04/11/2009	34.0	35.0	32.0	34	1.5	5	3.8	32	99.7	Good	Good
11	04/11/2009	02/12/2009	34.0	34.0	31.0	33	1.7	5	4.3	26.8	98.7	Good	Good
12	02/12/2009	14/01/2009	43.0		50.0	47	4.9	11	44.5	38.9	99.5	Good	Good
13													

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Overall survey --> Good precision | Good Overall DC

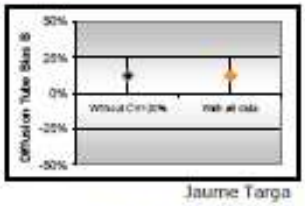
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Park Way Horsham

Precision: 12 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 10 periods of data	
Bias factor A	0.88 (0.79 - 1)
Bias B	13% (0% - 26%)
Diffusion Tubes Mean:	36 µgm^{-3}
Mean CV (Precision):	8
Automatic Mean:	32 µgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	32 (29 - 36) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 10 periods of data	
Bias factor A	0.88 (0.79 - 1)
Bias B	13% (0% - 26%)
Diffusion Tubes Mean:	36 µgm^{-3}
Mean CV (Precision):	8
Automatic Mean:	32 µgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	32 (29 - 36) µgm^{-3}



Jaume Targa
jaume.targa@aeat.co.uk
Version 03 - November 2006

Discussion of Choice of Factor to Use

For this assessment nitrogen dioxide concentrations from the diffusion tube monitoring sites have been reported using both the national and local bias adjustment factors. The decision as to which is the more appropriate depends on a number of factors. In the case of Cowfold the annual mean has been calculated from a 12 month study and a tube exposure time of 1 month. This correlates with the national database and use of the national bias adjustment. However the local bias adjustment factor is calculated from a triplicate co-location site similar to the Cowfold tube sites and the overall survey shows good precision.

In comparing the local versus national bias corrected annual mean concentrations for the Cowfold sites, the local bias corrected concentrations are higher than the nationally adjusted concentrations by 8.6%. However there is one site (Cowfold 3n) where this difference means that the concentrations reported fall either side of the objective level. At all other sites the calculated concentrations are well in exceedance or are within 10% of the objective irrespective of the bias correction factor used. At the A281 (Cowfold 4n) site the lower concentration value is within approximately 10% of the objective and therefore, for the purposes of this assessment will be deemed to represent an exceedance of the objective.

Given that the national bias adjustment factor is considered more representative for the diffusion tube survey as a whole, the bias adjustment factor of 0.81 derived from the national survey has been used to correct the diffusion tube results for 2009. The national bias adjusted data for the Cowfold diffusion tube sites has also been used for verification of the modelled pollutant concentrations.

QA/QC of Diffusion Tube Monitoring

The diffusion tube data for 2009 has been checked using the AEA Precision spreadsheet tool presented in Table A1. The results of this exercise show that good precision was achieved.

DEFRA advises that local authorities should use diffusion tubes supplied by laboratories that have demonstrated satisfactory performance under the Workplace Analysis Scheme for Proficiency (WASP).

The WASP scheme is an independent analytical performance testing program. The performance of laboratories is further assessed by AEA on behalf of DEFRA as part of the government's support for local air quality management. The list of those laboratories which have performed satisfactorily is provided to local authorities on the Local Air Quality Support web site http://www.laqmsupport.org.uk/index.php

The laboratory supplying diffusion tubes to Horsham District Council is deemed to have had good performance in 2009. (WASP rounds 103-107, Oct 2008 – Oct 2009).

Table A2: Monthly nitrogen dioxide data - Storrington diffusion tubes 2009

Site details	Address	Month (2009)												Annual Mean	Local bias corrected	National bias corrected
		1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sept	10 Oct	11 Nov	12 Dec		0.88	0.81
Cowfold 1n	Olde House, The Street, Cowfold duplicate	61	61	54	66	N/A	65	50	59	48	50	48	56	56.2	49.4	45.5
Cowfold 2n	Olde House, The Street, Cowfold duplicate	58	70	50	61	57	50	47	55	59	57	51	55	55.8	49.1	45.2
Cowfold 3n	6 Margaret Cotts, A272, Station Road Cowfold	52	64	41	52	41	58	35		56	47	35	50	48.3	42.5	39.1
Cowfild 4n	Trelawny House, A281, Horsham Road Cowfold	45	54	43	55	40	49	32	38	43	37	40	48	43.7	38.4	35.4

Appendix B:

Air quality modelling methodology (Breeze Roads) Horsham District Council, Cowfold 2009.

1. Introduction:

Modelling of air quality was undertaken for Horsham District Council to identify predicted air quality concentrations in Cowfold, West Sussex for the year 2009.

The modelling involves the use of a complex computerised model called "BREEZE Roads" to derive the annual averaged concentration of the pollutant nitrogen dioxide (NO_2), at specific locations (receptors - mainly residential properties) in Cowfold.

The modelling predicts the concentration of a pollutant, in this case nitrogen dioxide (NO_2), as determined from the input data. This data includes traffic volumes, type and speeds which determine the vehicle emissions on each road section and the model also utilises meteorological information for the period. The model then predicts the concentration of NO_2 from the main emission contributor, traffic, and adds the local background ambient concentration of NO_2 to ascertain the total concentration at a know receptor (location). These results determine whether or not, in a specific year, there may be in exceedance of the air quality objection.

Table B1: UK air quality objectives (2007 UK Air Quality Strategy)

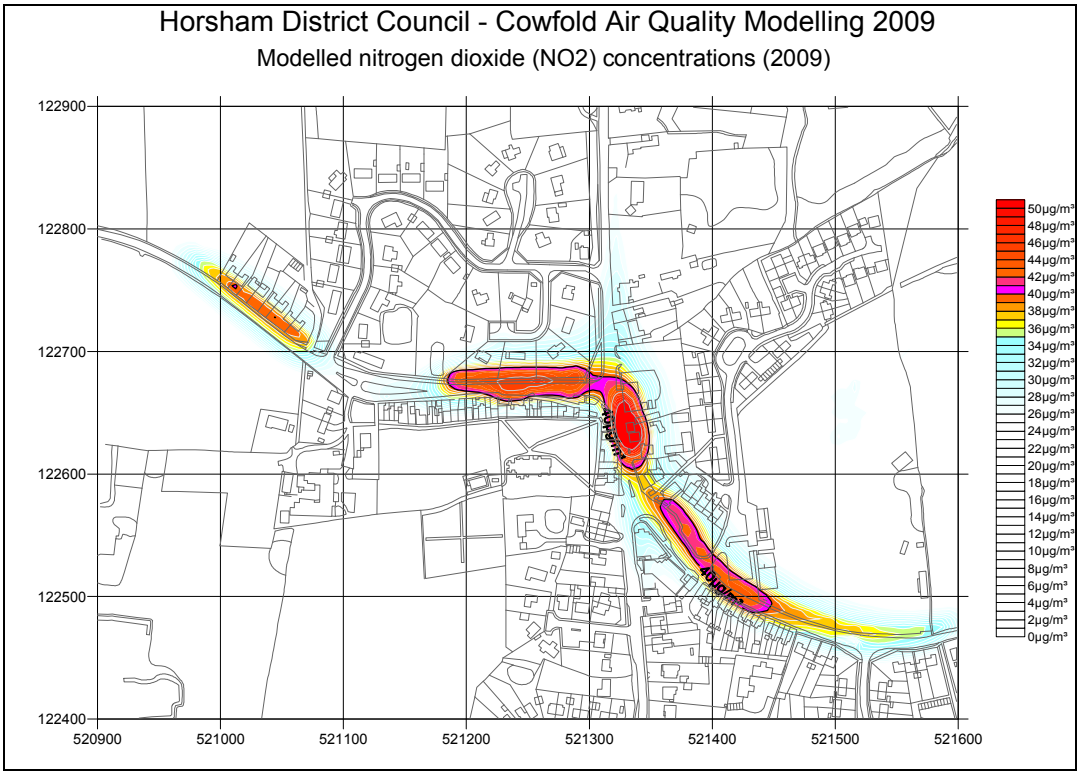
Pollutant	Air Quality Objective	Period	Achieved by
Nitrogen dioxide [NO_2]	*200 µg/m^3 not to be exceeded more than 18 times a year	1 hour mean	31.12.2005
	40 µg/m^3	**Annual mean**	**31.12.2005**

1.1 Executive Summary

Modelling of the air quality was undertaken for the village of Cowfold in West Sussex, to ascertain if there were a likelihood of air quality concentrations exceeding the national and EU air quality objectives. Monitoring with nitrogen dioxide (NO_2) diffusion tubes from 2009 indicated that there is a likely exceedance of the NO_2 likely annual standard threshold of 40 micro grams per cubic metre (µg/m³). Modelling results shown below, were verified (checked) against the monitoring results in 2009, and indicated that there is the likelihood of exceedences of the annual NO_2 air quality objective (AQO) limit of 40µgm³ . The model was run utilising meteorological conditions for the year 2009.

The model predicted likely exceedences of the annual NO_2 AQO of 40µgm³ for the year 2009 at the five (5) specific receptor locations in Cowfold. The locations identified in the modelling were Whitelined House (The Street), 5 Huntscroft Gardens (A272 East), 7 Huntscroft Gardens (A272 East), The Post Office (1st Floor property) (A272 East) and 8 Station Rd (A272 West). The model concentration map (Figure 1) illustrates the extent of the modelled nitrogen dioxide (NO2) in Cowfold for 2009. Five selected specific receptors were identified as exceeding the air quality objective for NO2, however the modelling contours indicate that there may be a further 2 to 3 properties adjacent to those receptors which are also likely exceed or be near to exceeding the annual NO_2 air quality objective for 2009.

Figure B1: 2009 modelled annual average concentrations for NO2 (µg/m^3).



2. Detailed Modelling Methodology

The Sussex Air Quality Partnership (Sussex-air) undertook modelling using the BREEZE Roads model on behalf of Horsham District Council. The following section outlines the modelling methodology and data input utilised in the modelling.

2.1. Model:

BREEZE Roads - an advanced dispersion model, which is based on Gaussian plume theory. It requires an amount of input data: site characteristics, meteorological data, traffic information, emission factors, and background pollutant concentrations.

2.2. Input Data:

2.2.1. Emissions modelling Years: 2009.

2.2.2. Meteorological data source:

- Gatwick (09)

2.2.3. Traffic data source: West Sussex County Council

2.2.4. Traffic: Annual Average Daily Traffic (AADT) scaled from 2006

2.2.5. Background pollutant source:
NOx and NO2 background concentrations were taken from the National Atmospheric Emissions Inventory (NAEI) web-site (www.naei.org.uk) for the grid squares that the specific road section was within.

2.2.6. Emission factors (EF)
Vehicle emission factors were calculated using the "Emission Factors Toolkit" (EFT V 4.2.2 (November 2010)). The emission factor for this road was determined as follows:

The EF inputs were as follows:

- Road type: Urban
- % : Cars (incl. motorcycles), LGV, HGV (rigid), HGV (artic.) and Buses (incl. coaches).
- Speed: various speeds modelled in links to simulate traffic flow into roundabouts and along roads (kph)

2.2.7. Model surface roughness co-efficient: Urban (1)

2.2.8. Canyon effect: no location in the modelled area was identified as a canyon.

3. Site characteristics:

Additional model inputs required for BREEZE Roads were:
Road type: Urban
Road width: relative to road sections
Road slope: relative to road sections
Receptor height: 1.8 m (Specific receptors may be higher or lower dependent upon which floor a residential property may be on.)
Surface roughness length: 1 m

4. Derivation of NO2 from modelled NOx results.

BREEZE Roads produces a predicted NOx concentration, sourced from the road emissions, from the model runs = NOx (road). To produce an annual averaged concentration of NO2 i.e. NO2 (total), the NOx (road) results need to be are converted to produce a NO2 (total) value. This value is then used to compare to the UK Air Quality Objective (AQO) limit to determine whether there is an exceedence or not.

5. Model verification and correction factors.

LAQM TG (09) guidance provides the methodology used to verify the modelled results and determine NO2 concentration that is to be compared to the AQO. The methodology used in this modelling follows LAQM TG (09) section A3-40 and is set-out in detail in Appendix 2.

6. Street canyon effect.

BREEZE Roads models NOx concentrations that are contributed from the road sources however there is no complex calculation for the effects of a street canyon in the model.

- No locations in the vicinity of the modelled roads were identified as a canyon.

7. Summary of results

Annual averaged concentration objective modelling:

The summary of results outlines the modelling of selected roads and identifies the predicted concentrations of NO2 at specific receptor locations. The receptor locations are those locations of residential properties adjacent to roads where people may be exposed to pollutants. The modelled predictions are expressed as the annual average concentration in micrograms per cubic meter ($\mu g/m^3$). The modelling predictions reflect the relative predicted pollutant levels at each property and identifies if any of these properties are estimated to either breach or be within a certain percentage or near breach of the UK Air Quality Objectives (AQO) for nitrogen dioxide (NO2). The annual average AQO limit for NO2 is $40\mu g/m^{3.}$

Four (4) locations/receptors have been identified as likely to have been in exceedence of the UK Air Quality Objectives (AQO) limit.

The modelling identified one location as exceeding the AQO for NO2 (Whitelined House), plus an additional four (4) modelled locations were with $1\mu g/m^3$ (2.5%) of the AQO.

Table B2: Modelled NO2 concentrations at locations which are predicted to have exceeded the AQO limit ($40\mu g/m^3$) for 2009.

Sensitive receptors	NO2 (total) ($\mu g/m^3$)	% of Air Quality Objective
Whitelined House	45.0	112%
5 Huntscroft Gdns	39.4	99%
7 Huntscroft Gdns	39.4	98%
Post Office (1st floor property)	39.6	99%
8 Station Rd	39.7	99%

The modelling results for all other sensitive receptors are given in the table B3.

1-hour averaged concentration objective modelling:

Given the difficulty of measuring exceedences of the 1-hour objective at roadside and kerbside locations and of modelling peak 1-hour concentrations, it is suggested that “it would be appropriate for local authorities to base the decision of likely exceedence of the 1-hour nitrogen dioxide objective on an exceedence of $60\mu g/m^3$ as an annual mean”. (DEFRA - Laxen & Marner[1]).

Therefore if there are no exceedences of the annual mean of 60µg/m³, then it is unlikely that the 1-hour objective will be exceeded.
There were no locations in Cowfold which exceeded 60µg/m³= no 1-hour exceedence of AQO.

Table B3: Predicted annual model results for year 2009.

Receptors	Modelled results (µg/m³)	% of Air Quality Objective
2 Marg Cott	32.0	80%
5 Marg Cott	31.7	79%
6 Church Path	30.5	76%
8 Church Path	33.5	84%
2A Ch Tce	34.8	87%
HsA281 Nth	29.5	74%
HsBrkHill	28.9	72%
St Peter Cottage	34.8	87%
Whitelined House	**45.0**	**112%**
Westview	23.1	58%
Hse	25.1	63%
HSe	24.9	62%
Hse A272	25.6	64%
Hse A272 East	25.4	64%
1 A272(East)	27.9	70%
5 Oakf Cott	34.6	86%
2 Oakf Cott	35.7	89%
2 Hunts Gdns	38.7	97%
5 Hunts Gdns	**39.4**	**99%**
7 Hunts Gdns	**39.4**	**98%**
PO & domestic	**39.6**	**99%**
3 Gables	38.8	97%
1 Gables	37.0	92%
1-21 The Studio	31.1	78%
5-6 FairF Ct	30.3	76%
HsWA272Nth	22.7	57%
HS A272NW	38.6	97%
8 Station Rd	**39.7**	**99%**

Appendix B1: Modelled concentration maps.

Figure B.2: Cowfold (centre) 2009 modelled annual average concentrations for NO2 (µg/m^3).

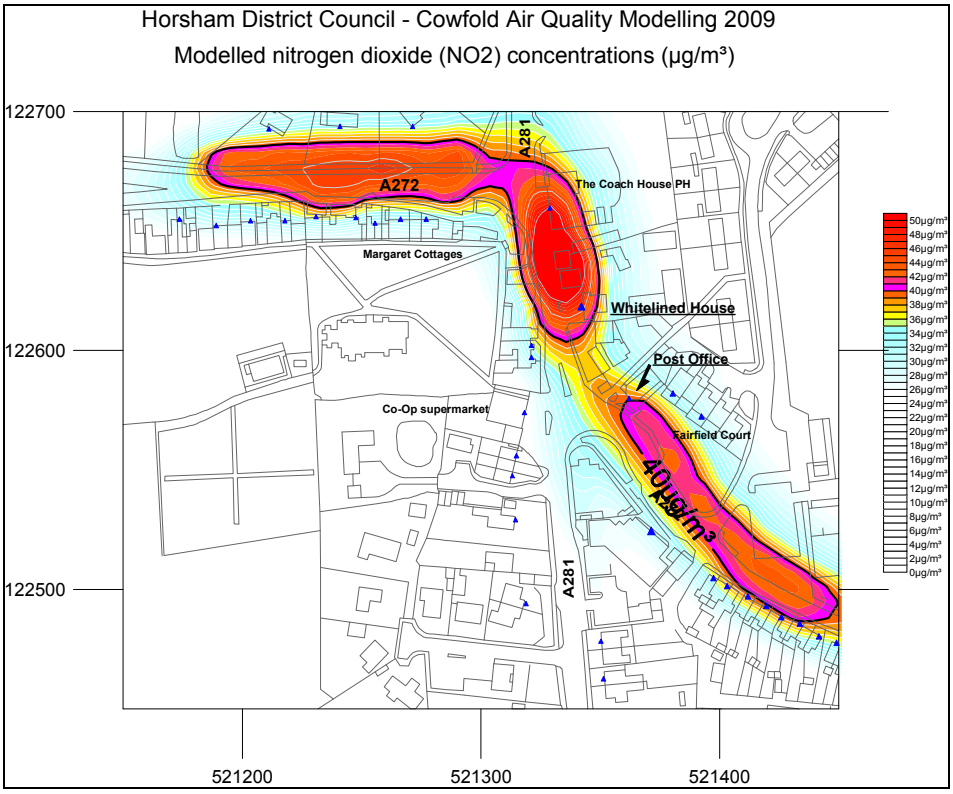


Figure B.3: Cowfold (west) 2009 modelled annual average concentrations for NO2 (µg/m^3).

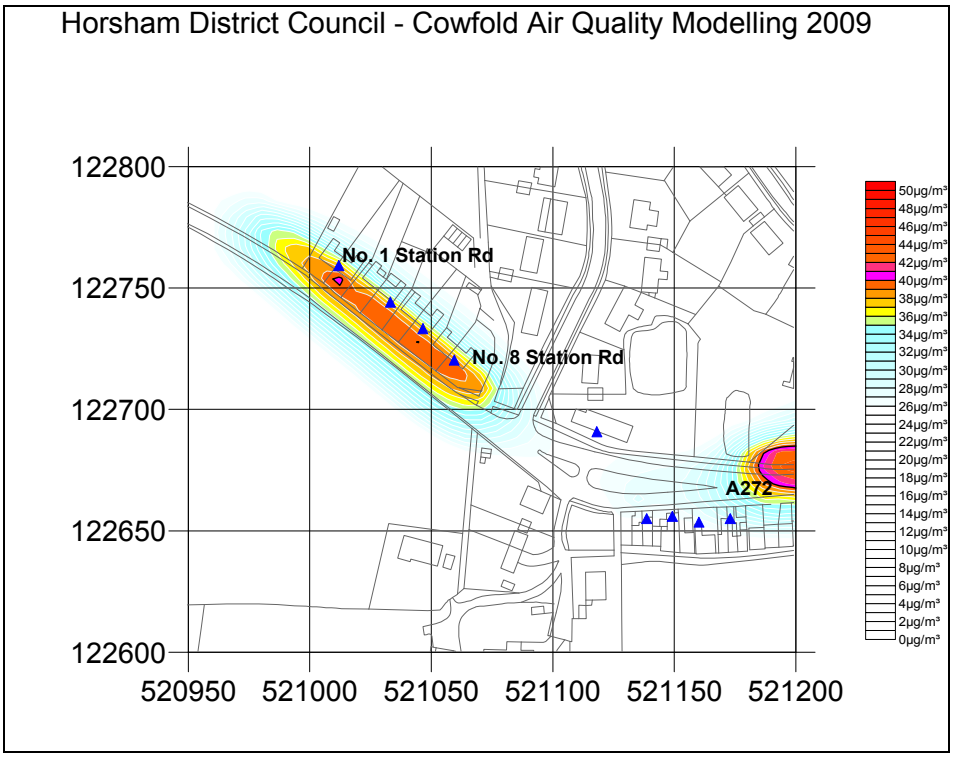


Figure B.4: Cowfold (centre) 2009 modelled (sensitive) receptor locations.

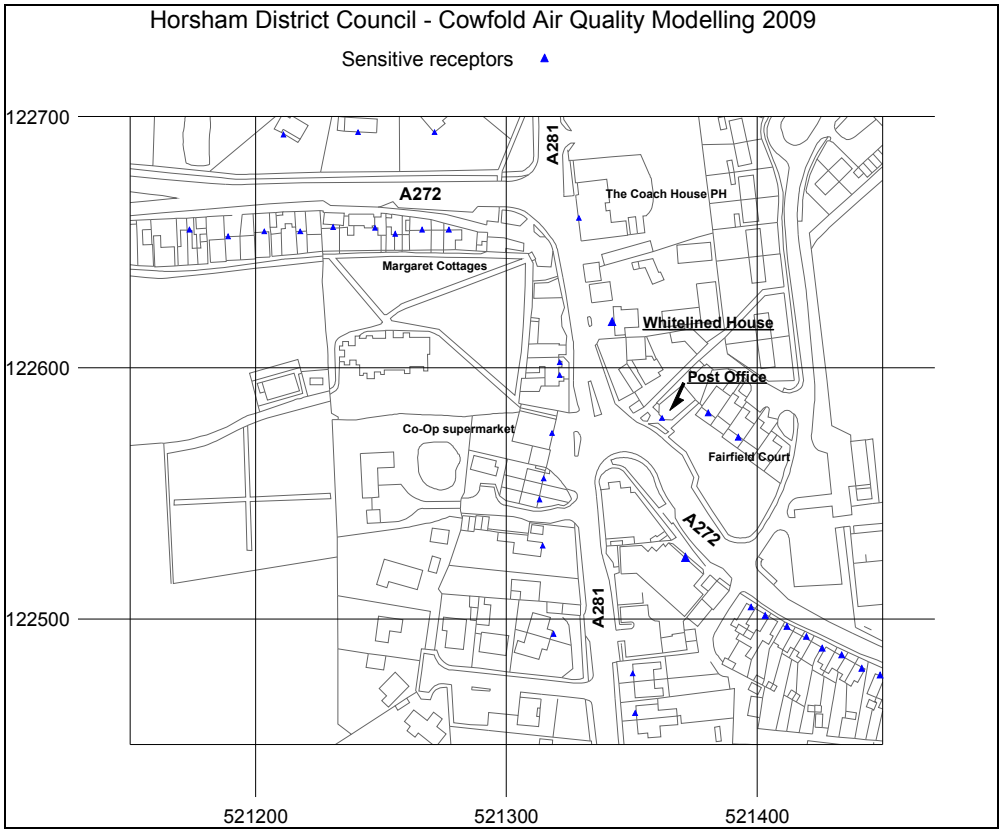
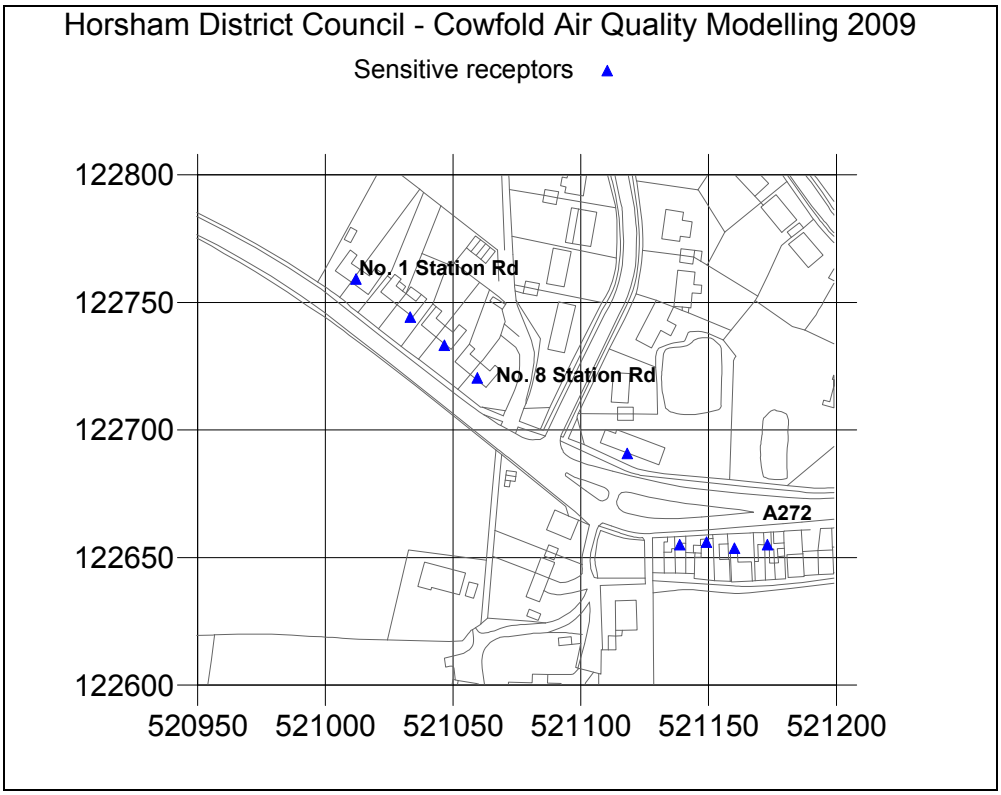


Figure B.5: Cowfold (west) 2009 modelled (sensitive) receptor locations.



Appendix B2: Model verification and correction factors.

The verification of the modelled or predicted pollutant concentrations is required to ascertain the accuracy of modelled results. A comparison of the measured versus the modelled NOx output from the model is undertaken to determine this. The methodology used to verify the modelled results follows LAQM TG (09) section A3-40. The modelled results are compared to the local measure NO2 diffusion tubes to determine the adjustment factors used for the modelled results.

In 2009 there were 2 locations in Cowfold where 3 nitrogen dioxide (NO2) diffusion tubes monitored NO2 throughout the year; one location had duplicate diffusion tubes (ID 12 & 20). These sites were road-side locations adjacent to roads. These locations were:

Table B4: 2009 NO2 diffusion tube results

ID	Reference	2009 annual bias adjusted NO2 conc. (µg/m^3)
12	85175- Cowfold 1n	45.5
20	85983-Cowfold duplicate Cowfold 2n	45.2
22	85985-Trelawny Hse Cowfold 4n	35.4

a) NOx correction factor (CF):

Following LAQM TG (09) guidance, results from the modelled NOx (road contribution) were compared to the monitored NO2 (converted to NOx (road contribution)). The monitored NO2 was converted to NOx using the LAQM "NOx to NO2 conversion spreadsheet" (Vers 1.1, J Abbott, 18 Dec 2008).

The "General inputs" for the spread sheet are as follows:

Year: 2009

Local Authority: Horsham District

Traffic mix: All other urban UK traffic

Determination of "roadside NOx (µg/m^3)" from NO2 diffusion tubes:

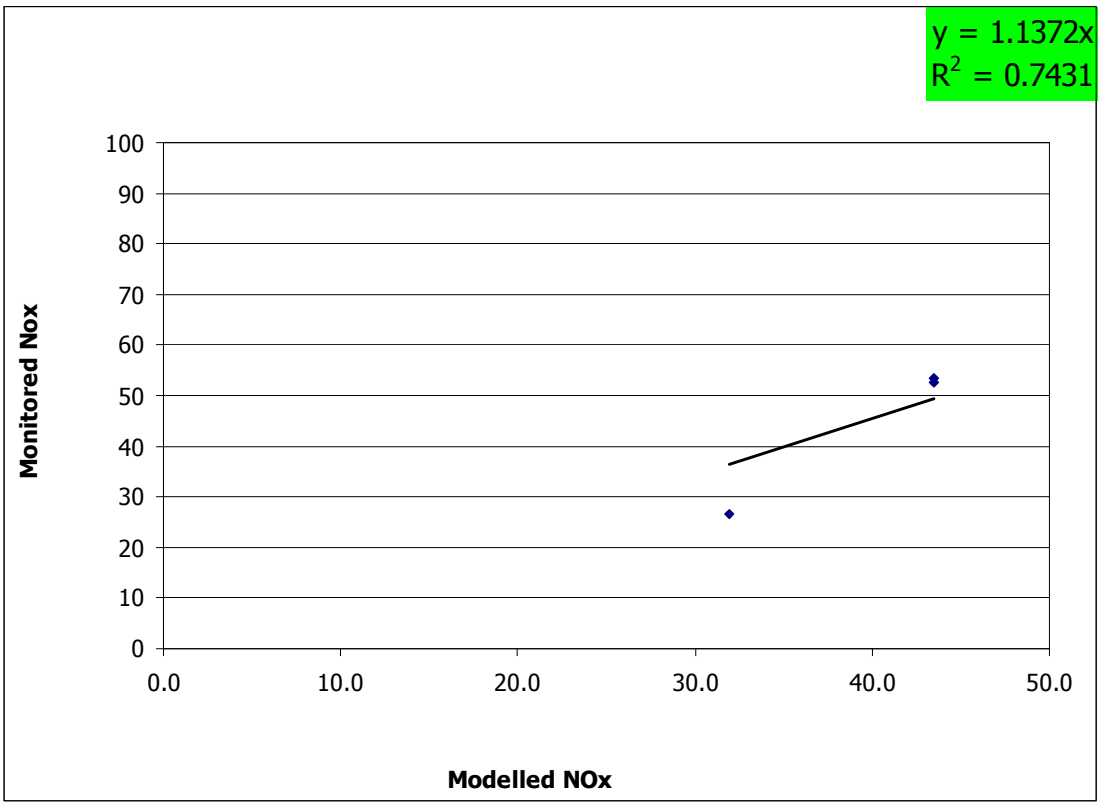
The measured annual averaged Total NO2 concentrations were converted to "roadside Nox" by removing the background NO2 (11.3µg/m^3) concentration and calculating the NOx component using the "NOx to NO2 conversion spreadsheet".

The measured roadside NOx (above) and the modelled roadside NOx was compared to determine the local NOx adjustment figure for 2009

Table B5: Measured NO2 diffusion tube conversion to measured NOx

Site ID	Total NO_2 ($\mu g/m^3$)	Background NO_2 ($\mu g/m^3$)	Road NO_2 ($\mu g/m^3$)	Road NOx ($\mu g/m^3$)	Modelled NOx ($\mu g/m^3$)
12	45.5	11.26	**20.88**	53.41	**43.5**
20	45.2	11.26	**20.88**	52.59	**43.5**
22	35.4	11.26	**16.02**	26.58	**31.9**

Graph B.6: Modelled versus monitored NOx (road) results.



The resulting regression slope in graph 1 determines the adjustment factor for the modelled output to correlate to the actual measured NOx at this location (y = 1.1372).

<u>The NOx adjustment factor = 1.1372</u>

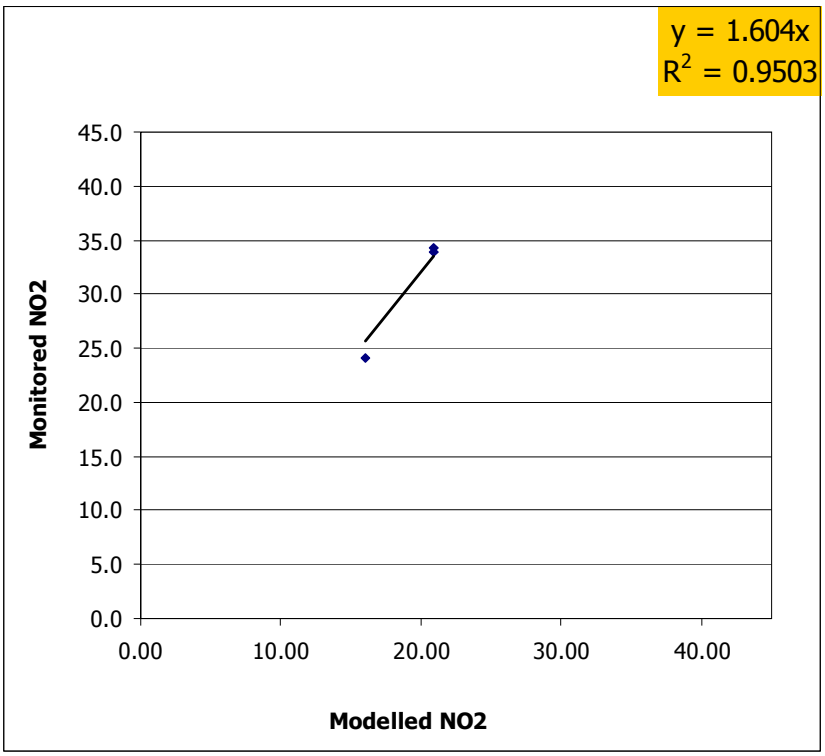
b) NO2 (secondary) adjustment factor:

The NOx adjustment factor was applied to the modelled output and then compared to the results of the 3 diffusion tubes for final verification. The following results are comparison of "adjusted modelled road NO2 contribution"(x-axis) versus "monitored road NO2 contribution"(y-axis).

Table B6: Measured versus (NOx adjusted) modelled NO2 results

Site ID	Monitored roadside NO2	Modelled roadside NO2
12	**34.2**	**20.88**
20	**34.0**	**20.88**
22	**24.1**	**16.02**

Graph B.7: Comparison of measured versus (NOx adjusted) NO2 results.



The resulting regression slope in graph 2 determines the adjustment factor for the modelled output to correlate to the actual measured NO2 at this location (y = 1.604x).

<u>The NO2 (secondary) adjustment factor = 1.604</u>

c) Full adjustment calculation

1. Modelled road contribution NOx is multiplied by NOx adjustment factor = "adjusted road-NOx".
2. Input the "adjusted road-NOx" into the "NOx to NO2 calculator" + background NOx = "road-NO2".
3. The "road NO2" is multiplied by the NO2 (secondary) adjustment factor + background NO2 = Total NO2 (adj. total)

Full adjustment calculation:

- NOx (mod)*NOx(f) = NOx(adj road)
- NOx(adj road) + Nox (bkgrd) input into "NOx to NO2" calculator = "NO2 (road)"
- "NO2 (road)" * NO2 (secondary) + NO2 (bkgrd) = NO2 (adj. total)

Appendix B3: Interpreting NO2 annual average results and 1 hour exceedences of UK objectives

Advice to LA's from DEFRA Laxen & Marner :

Given the difficulty of measuring exceedences of the 1-hour objective at roadside and kerbside locations and of modelling peak 1-hour concentrations, it is suggested that "it would be appropriate for local authorities to base the decision of likely exceedence of the 1-hour nitrogen dioxide objective on an exeedence of 60µg/m³ as an annual mean".

Therefore if there are no exceedences of the annual mean of 60µg/m³, then it is unlikely that the 1-hour objective will be exceeded.

References:

Emission Factors Toolkit	EFT V 4.2.2 (November 2010) http://laqm1.defra.gov.uk/review/tools/emissions.php
DEFRA LAQM TG (09)	Technical Guidance 2009
Defra/Laxen and Marner 2003	Analysis of the relationship between 1-hour and annual mean nitrogen dioxide at UK roadside and kerbside monitoring sites
National Atmospheric Emissions Inventory (NAEI)	www.naei.org.uk

Appendix C: Abbreviations and Glossary

AADT	Annual Average Daily Traffic (vehicles per day)
AQEG	Air Quality Expert Group
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network (air quality monitoring)
BREEZE roads	Computerised model for predicting pollutant concentrations
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EA	Environment Agency
EF	Emission Factor
FDMS	Filter Dynamics Measurement System
HDV	Heavy Duty Vehicles, ie, all vehicles more than 3.5 tonnes including Heavy Goods Vehicles and buses
HGV	Heavy Goods Vehicles greater than 7.5 tonnes in weight
LA	Local Authorities
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles (includes passenger cars and other vehicles < 3.5 gross vehicle weight).
LGV	Light Goods Vehicles
µg/m³	micrammes per cubic metre in air
NO	Nitrogen monoxide, also termed Nitric oxide
NO_2	Nitrogen dioxide
NO_X	Nitrogen oxides (NO + NO_2)
OS	Ordnance Survey
PM_{10}	Airborne particulate matter with a (equivalent aerodynamic) diameter of ten microns (10 µm) or less
$PM_{2.5}$	Airborne particulate matter with a (equivalent aerodynamic) diameter of 2.5 microns (2.5 µm) or less
QA/QC	Quality Assurance and Quality Control
TEOM	Tapered Element Oscillating Microbalance
UKAS	United Kingdom Accreditation Service
UWE	University of the West of England
WASP	Workplace Analysis Scheme for Proficiency

Appendix D: Location Photographs

Photograph 1: The Street, Cowfold looking north.

Photograph 2: Olde House, The Street, Cowfold looking north.

Photograph 3: North end of The Street looking north to A281 (Horsham Road)

Photograph 4: The Street, Cowfold looking south

Photograph 5: A272 Bolney Road from roundabout looking east.

Photograph 6: Location of automatic nitrogen dioxide analyser on Bolney Road (A272)

Photograph 7: A272 Station Road looking west. Station Road Cottages ahead to the right.