LAQM DETAILED ASSESSMENT FOR

Shrewsbury No 1 AQMA

(Bayston Hill, A49 south of Shrewsbury)

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Executive Summary

In 2003 Shrewsbury and Atchem Borough Council declared an Air Quality Management Area using powers under the Environment Act 1995 section 83(2)(b) 2003 over an area of Bayston Hill, a village to the South of Shrewsbury. The Air Quality Management Area (AQMA) was declared due to a likely breach of the annual mean nitrogen dioxide national air quality objective of 40 $\mu g/m^3$. It is known as Shrewsbury No 1 AQMA.

Shrewsbury and Atchem Borough Council became part of Shropshire Council when Oswestry Borough Council, Bridgnorth District Council, Shrewsbury and Atcham Borough Council, South Shropshire District Council, North Shropshire District Council and Shropshire County Council formed a unitary authority.

The report below provides monitoring data from diffusion tubes at locations representative of the AQMA and residential properties affected. Long term monitoring demonstrates that there has been a significant decrease in nitrogen dioxide concentrations within the AQMA over the past 6 years. There has been no exceedance of the air quality objective since 2010. Monitoring at all locations within and around the AQMA has found no nitrogen dioxide concentrations within a 10% buffer below the air quality objective since 2012.

It is concluded that it is not likely that the annual mean NO_2 concentration will exceed the national air quality objective in this location.

As a result it is proposed that the Shrewsbury No 1 AQMA is revoked by Order under section 83(2)(b) of the Environment Act 1995.

1. Introduction

1.1 Project Background

Shrewsbury and Atcham Borough Council completed its First Round of Review and Assessment between 1998 and 2000. It concluded that exceedances of the nitrogen dioxide (NO_2) annual mean were expected along the A49 in Bayston Hill. An AQMA was declared in 2003 using powers under the Environment Act 1995 section 83(2)(b) 2003. The Air Quality Management Area was declared due to a likely breach of the annual mean nitrogen dioxide national air quality objective of 40 $\mu g/m^3$. The AQMA covers a length of the A49 and properties with the addresses of number 1-13 Hereford Road, Bayston Hill found at the northern end of the AQMA.

Shropshire Council is a Unitary Authority and as such has a duty to comply with air quality legislation and the Local Air Quality Management regime. An Updating and Screening Assessment was carried out as part of the fifth round of reporting covering data from 2009-2015 inclusively. Monitoring results from locations within and around the Shrewsbury No 1 AQMA have been reviewed. As a result of a more thorough look at the AQMAs in place in Shropshire it was decided that a detailed assessment of all of the data for the Bayston Hill area should be conducted taking into account historic trends and new diffusion tube data from additional locations installed in 2015.

1.2 Legislative Background

The latest Air Quality Strategy (AQS) released in July 2007 provides the over-arching strategic framework for air quality management in the UK and contains national air quality standards and objectives established by the Government to protect human health. The objectives for ten pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide particulates - PM10 and PM2.5- and ozone) have been prescribed within the Air Quality Strategy based on The Air Quality Standards (England) Regulations 2007. The Objectives set out in the AQS for the protection of human health are presented in Table 1.1.

The Air Quality Standards (England) Regulations 2007 came into force on 15th February 2007 and brings together the Government's requirements to fulfil each EU Daughter Directive through a single statutory instrument.

The Environment Act 1995 gives local authorities duties and responsibilities to review and assess air quality in its area and secure improvements in air quality where required. The locations where the AQS objectives apply are defined in the AQS as locations outside buildings or other natural or manufactured structures above or below ground where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period of the AQS objective.

1.3 Air Quality Strategy Objectives

This study is interested in the annual mean nitrogen dioxide concentration as this is the objective that was thought would be likely to be breached and hence an AQMA declared. This level is 40 $\mu g/m^3$.

The air quality objectives applicable to 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), and are shown in Table 1. This table shows the objectives in units of micrograms per cubic metre $\mu g/m^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) with the number of exceedances in each year that are permitted (where applicable).

Table 1: Air Quality Objectives included in Regulations for the purpose of LAQM in England

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 $\mu g/m^3$	Running annual mean	31.12.2003
	5.00 $\mu g/m^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g/m^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu g/m^3$	Annual mean	31.12.2004
	0.25 $\mu g/m^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g/m^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g/m^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

1.4 Scope and Methodology of the Detailed Assessment

Shrewsbury No 1 AQMA was declared due to exceedances of the annual mean NO_2 objective as a result of residential receptors presenting relevant exposure in close proximity to the A49, a busy trunk road. A location map delimiting the AQMA area can be found in Appendix 1.

There are two long standing diffusion tube monitoring positions in the AQMA area. Four additional monitoring locations were added in 2015. Review of monitoring data in the recently completed Updating and Screening Assessment (USA) 2015 found the concentration of NO_2 was above the air quality objective at one monitoring location, reference 475, and concluded that the AQMA was still required.

This detailed assessment will reconsider the information presented in the latest USA. Most recent diffusion tube bias adjustment factors will be applied and distance calculations to relevant exposure areas will be carried out.

2. Data Collection

Monitoring Data

Monitoring has taken place in and around the Shrewsbury No 1 AQMA with nitrogen dioxide diffusion tubes. These tubes are placed every month and provide a monthly average nitrogen dioxide concentration for that period. The monthly data is summed and averaged to give an annual average of nitrogen dioxide for that monitoring location at the end of the year and a bias adjustment factor, supplied through the Defra air quality webpages, is applied to ensure that the result is as robust as possible.

Trend data is available for two monitoring locations referenced 400 and 452 shown in Appendix 1. Location 400 is found directly opposite the area within the AQMA where residential receptors were thought to be exposed to levels of nitrogen dioxide above the annual mean. Location 452 is found at an air quality monitoring station just outside of the AQMA. The air quality monitoring station contains a continuous PM10 monitor and finds levels below all relevant objective levels as discussed in Shropshire Councils USA 2015 and therefore PM10s require no consideration in this report.

Additional monitoring locations were installed in 2015 to capture data in and around the AQMA which is more representative of relevant exposures where possible. These locations are shown in Appendix 1 and have location references 472, 473 (the only point marked by a green dot without a reference given above), 474 and 475.

3. Results

Monitoring results

Table 2 below shows results for all monitoring location from 2009 to 2015. The numbers represent the annual mean nitrogen dioxide concentration for each location bias adjusted in line with information on Defra webpages and reported in Appendix 2.

The number in brackets under each annual result represents data capture. Results highlighted in red bold type represent results above the national objective level or within 10% below indicating that consideration should be given where necessary.

Table 2

Location	2009	2010	2011	2012	2013	2014	2015
400	**40.5** (%)	**43.7** (100%)	**38.6** (100%)	32.2 (75%)	33.3 (100%)	33.4 (92%)	26.5 (92%)
452	-	-	27.4 (50%)*	34.0 (75%)	34.4 (100%)	29.5 (100%)	25.7 (100%)
472	-	-	-	-	-	-	31.0 (92%)
473	-	-	-	-	-	-	27.3 (100%)
474	-	-	-	-	-	-	35.7 (92%)
475	-	-	-	-	-	-	**39.1** (100%)

* Data capture of 50% for the year representing the fact the location was installed in July and captured all subsequent months through to and including December 2011.

- represent no monitoring at this location in these years

For information on diffusion tube analysis and quality assurance please see Appendix 2.

Having considered the locations in relation to relevant receptors it is noted that location 400 it is found at the same distance to from the kerb as the receptors on the opposite side of the road. Monitoring location 452 is not particularly representative of relevant receptors although helps provide information of the general area. Monitoring location 473 is on a junction and closer to the side road than the receptor but further from the A49. As a result it has been decided that data from these monitoring location does not require any further amendment or distance calculation.

In contrast monitoring locations 472, 474 and 475 are closer to the kerb in all instances than the receptors they are closest to. As a result it is appropriate to carry out distance calculations of these locations. Table 3 shows distance corrected data for these monitoring locations. The results were derived using the spreadsheet provided by Bureau Veritas found on the Defra webpages via:

http://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html

Table 3: monitoring location results following drop off with distance calculations

Year	Location	Tube ref	x grid ref for background	y grid ref for background	Monitor to kerb	Receptor to Kerb	Background	Monitored result	Distance calculated result
2015	Hem Cottage	472	348500	308500	1.9	2.1	8.188009	31	30.5
2015	Whiterock Cottage	474	348500	308500	1.7	2.6	8.188009	35.7	33.1
2015	Windyridge (1)	475	348500	308500	1.7	2.2	8.188009	39.1	37.3
2015	Windyridge (2)	475	348500	308500	1.7	3.8	8.188009	39.1	33.5

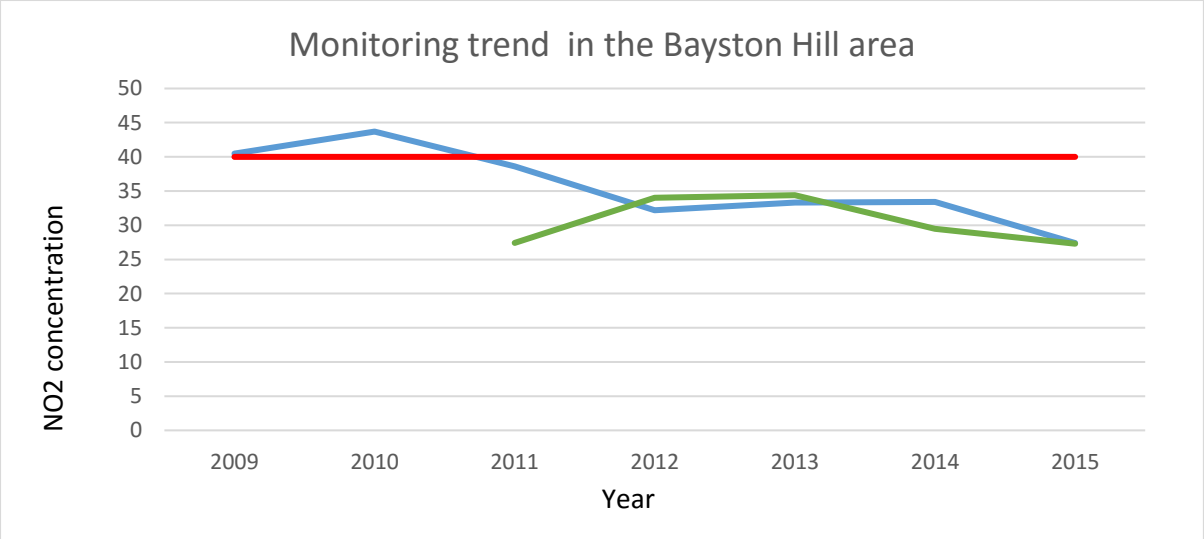
NB1: background measurement taken from Background Mapping data for local authorities – 2013 which can be found at https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2013 Data for year 2015 was used.

NB2: Windyridge (1) provides a result based on the actual distance from the receptor boundary fence to the kerb.

NB3: Windyridge (2) provides a result based on the closest a receptor can come to the kerb at this receptor as discussed in section 4.

Figure 1 below shows trend data for the two long term monitoring locations found in Table 2.

Figure 1: trend data plotted for monitoring locations 400 and 452.



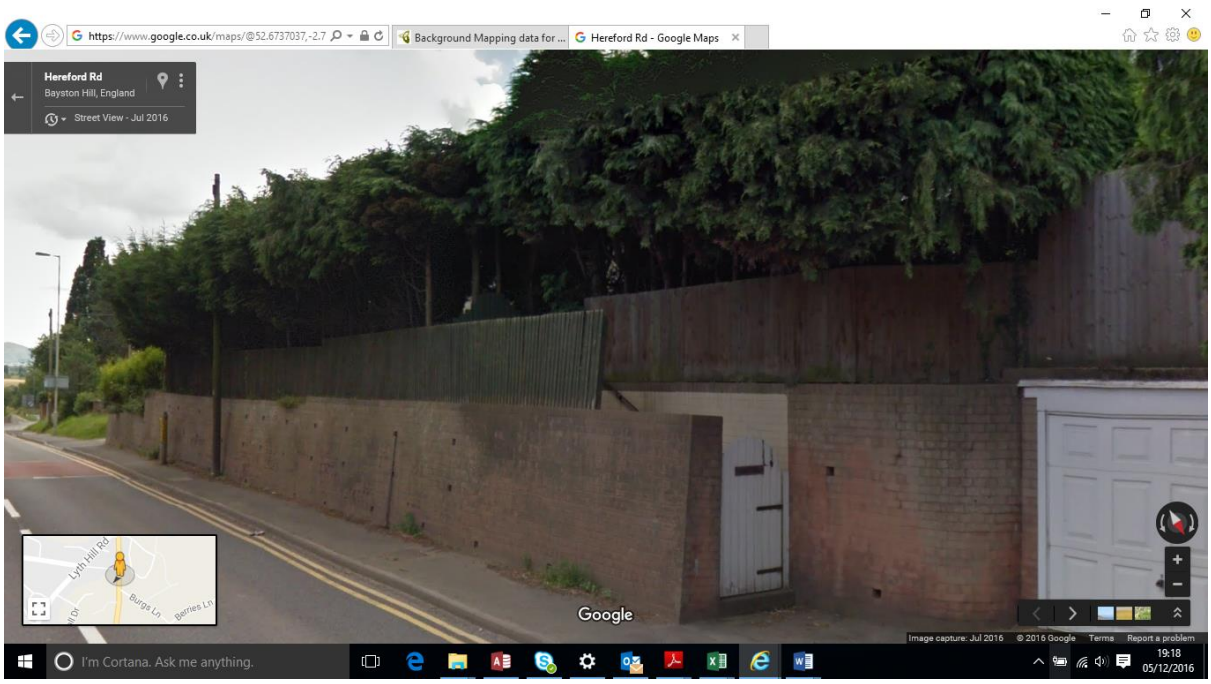
- The red line denotes the national air quality objective for annual mean nitrogen dioxide concentration of 40μg/m^3.
- The blue line plots data captured at monitoring location 400.
- The green line plots data captured at monitoring location 452.

4. Discussion

The monitoring data shows that there has been no exceedance of the national objective level at any location since 2010, see Table 2. Figure 1 indicates a downward trend in nitrogen dioxide concentration in and around the AQMA over the past 6 years.

Table two shows that there has only been one monitoring location that has recorded a nitrogen dioxide annual mean concentration within 10% of the national objective level since 2012. This location was found to be location 475 Windyridge where a concentration of 39.1μg/m^3 was found. However, when distance from the receptor boundary to the kerb is taken into consideration it is found that this concentration is reduced to 37.3 μg/m^3, see Table 3, row 4. When taking into consideration the actual scenario found outside the property known as Windyridge it is noted that not only is the relevant receptor elevated above the road, it is also elevated above the monitoring position to a point where the monitoring height is representative of a height about 30cm from the floor at relevant receptor height. In addition there is a row of continuous conifer trees along the boundary of the residential property where it adjoins the A49, see Figure 2 below.

Figure 2: google map street view image of the boundary of the residential property represented by monitoring location 475.



As a result of the above it is recognised that a relevant receptor is only able to get to a position 3.8m from the kerb behind the tree line. When taking this into account the anticipated nitrogen dioxide annual mean concentration at relevant exposure is 33.5μg/m^3.

The result of 33.5µg/m^3 at relevant exposure takes into account distance correction. It is anticipated that this will be a conservative estimate of the likely concentration. This is based on the fact that the vegetation in the tree line on the boundary of the residential property is likely to act as a sink for nitrogen dioxide, particularly as there is the start of an urban canyon in this location caused by the elevated height of the residential properties above the road (Pugh et al, 2012. Effectiveness of Green Infrastructure for Improvement of Air Quality in Urban Street Canyons, available at: http://www.greenroofs.org/resources/GreenInfrastructurePaper.pdf).

As a result of taking appropriate distance calculations as discussed above it is possible to update Table 2 to state the expected annual mean nitrogen dioxide concentrations at relevant receptors. The new table would look like Table 4 below:

Table 4: expected nitrogen dioxide concentrations where relevant exposure is found.

Location	2009	2010	2011	2012	2013	2014	2015
400	**40.5**	**43.7**	**38.6**	32.2	33.3	33.4	26.5
452	-	-	27.4	34.0	34.4	29.5	25.7
472	-	-	-	-	-	-	30.5
473	-	-	-	-	-	-	27.3
474	-	-	-	-	-	-	33.1
475	-	-	-	-	-	-	33.5

Considering the data corrected for relevant receptor distances it can be seen that there are no locations where it is anticipated that there is a likelihood of national objective levels exceeding or coming within 10% of the national objective level in any year since 2012. When considering that additional monitoring locations were installed in 2015 specifically to target information gathering at worst case locations it is therefore unlikely that there is any exceedance of national objectives within this AQMA.

Future emissions are predicted to reduce as road transport emissions reduce over time. There are no developments in the area which are likely to significantly increase the number of vehicles using the A49 significantly. No data is available on projected vehicle numbers however given the significant buffer found between expected pollutant concentrations at relevant receptors and the national air quality objective it is not considered necessary to spend resource gathering this data. Vehicle number increases are generally expected along all roads however it is anticipated that as vehicle fleet composition transitions through the Euro standards that reductions in emission output will outweigh increases from additional vehicles. This assumption is made by others e.g. Defra in their projected assessments of air quality modelled for future years when devising their air quality action plans and therefore it is considered appropriate for the same theory to be applied in this local circumstance.

5. Conclusion and recommendations

Having considered trend data and carried out additional monitoring within the AQMA in 2015 the following conclusions and recommendations are made:

- Trend data indicates **a reducing trend in nitrogen dioxide levels in and around the AQMA**

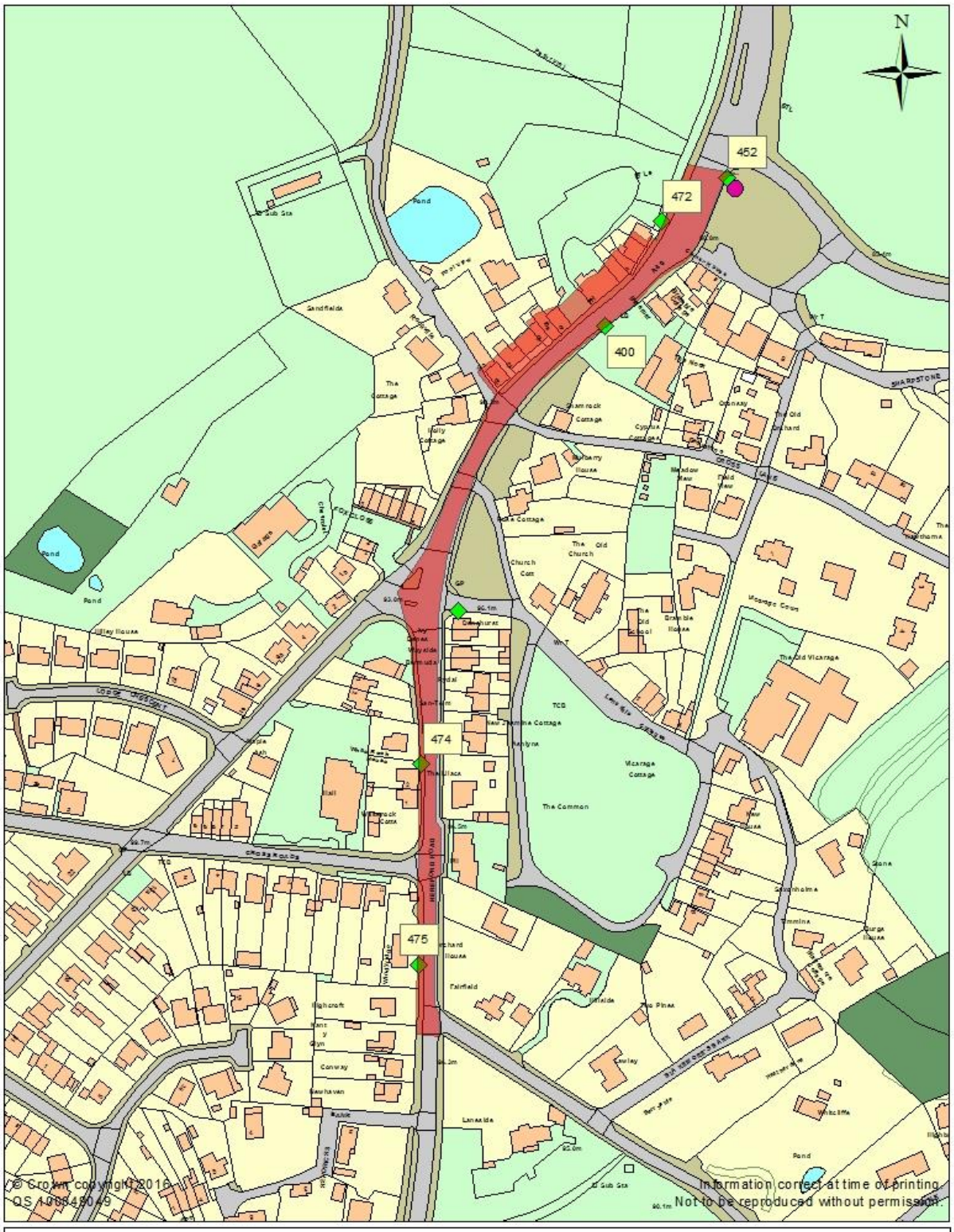
- Pollutant concentration within and flanking the AQMA have found **no likely exceedance of the National Objective Levels in the last 4 years**. Although not shown in this report monitoring data to date in 2016 (January – October) has been reviewed and it is not expected that there will be any exceedance in 2016 at any location.

- **No annual average results for any relevant receptor has been within 10% of the national objective level in the last 4 years.**

- Considering future predicted trends in traffic flows, emission outputs from road vehicles and potential development NO_2 concentration is **not likely to exceed the National Objective Level of 40µg/m3 as an annual average**.

- It is therefore recommended that **the Shrewsbury No 2 AQMA is revoked by Order under section 83(2)(b) of the Environment Act 1995**.

Appendix 1: existing AQMA boundary showing monitoring locations



Appendix 2: diffusion tube analysis data

Diffusion Tube Bias Adjustment Factors

Diffusion tubes were analysed by Gradko International Ltd. within the scope of laboratory quality procedures. The tube preparation method was a 20% TEA/water preparation. Bias correction was carried out by applying the factors specified in the National Diffusion Tube Bias Adjustment Factor Spreadsheet version number 09/13 for years 2009, 2010, 2011 and 2012 and version number 09/16 for years 2013, 2014 and 2015. NB The use of the latest bias adjustment factors for 2015 has significantly altered the data reported in the 2015 USA as the factor has altered from 0.92 in the USA to 0.87 in the latest version.

The bias adjustment factors used were:

2009: 0.90, 2010: 0.92, 2011: 0.90, 2012: 0.96, 2013: 0.95, 2014: 0.92, 2015: 0.87.

WASP/AIR-PT results

WASP results have been viewed via the DEFRA LAQM webpage links found at: http://laqm.defra.gov.uk/diffusion-tubes/qa-qc-framework.html

Gradko International were found to have 100% of samples provide satisfactory results when tested by Health and Safety Labs in the time covered by this report on all but two occasions. When tested between April – June 2010 one result out of eight was not satisfactory. In October – December 2011 five of eight samples were not found to be satisfactory. On the whole it is recognised that the vast majority of WASP testing has shown that results obtained have all been satisfactory. As a result it is concluded that the quality control and quality assurance of diffusion tube data collected, after adjustment for bias, is satisfactory. Information obtained from WASP Summary rounds 104 to 124. AIR-PT rounds from April 2013 to present day were checked.