

## Ockham air quality monitoring 8th February and 22nd May 2017

### 1 Introduction

The Thames Basin Heaths Special Protection Area (TBH SPA) was set up due to the lowland heath which is one of the South East's most important natural habitats; this heath land supports the nesting areas of the three species of vulnerable ground nesting birds. The Dartford Warbler, Nightjar and Woodlark are all reliant on the habitat provided in the Ockham and Wisley Commons. The habitat that these birds are reliant upon for breeding can be affected by high concentrations of nitrogen oxide. The Dwarf Shrub Heath and coniferous woodland are both important habitats for breeding and if they are affected by high concentrations of NO<sub>x</sub> it has a potential for a negative impact on the birds due to the impact on the habitat.

The Special Protection Area (SPA) was set up in March 2005 as part of the Natura 2000 network. This network of sites was set up to protect the most seriously threatened Habitats and species. It incorporates both the Birds Directive which requires the establishment of SPA's for birds and the Habitats Directive which requires Special Areas of Conservation (SAC) to protect other species and Habitats.

A large Housing development is planned for the disused Wisley Airfield site which is adjacent to the SPA. With a potential for over 2000 extra homes the effect of the additional vehicles within the area is of concern. There is the potential for an extra 4000 vehicles traveling around the SPA. It is the developer's responsibility to ensure that they have calculated the predicted concentrations across the SPA as the proposed development is within 10km of the SPA<sup>1</sup>.

TRL installed a continuous air quality monitoring station adjacent to Ockham Bites, Ockham Common Centre to measure concentrations of oxides of nitrogen (NO, NO<sub>x</sub>, NO<sub>2</sub>). The diffusion tube monitoring was carried out across Ockham common which is a site within the Thames Basin Heaths Special Protection Area (TBH SPA).

TRL were asked to undertake three months nitrogen oxide monitoring and report on their findings in relation to the relevant legislation. Monitoring began on 8<sup>th</sup> February 2017 and was carried out on behalf of Ockham Parish Council. This report covers data collected between 8<sup>th</sup> February 2017 and 22<sup>nd</sup> May 2017.

The location of the continuous monitor was located at Site A (51.317138, -0.454050) seen on Figure 1. To complement the continuous monitoring an array of NO<sub>2</sub> diffusion tubes were deployed at 7 locations in the surrounding area. Diffusion tubes were collocated at the continuous monitor (site A) inlet and at six other selected sites (sites B-G). The locations of the seven sites are also shown in Figure 1.

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<sup>1</sup> <https://www.gov.uk/topic/environmental-management/environmental-permits>



Figure 1: Map of diffusion tube and continuous monitoring station location

## 2 Nitrogen oxides monitoring

Air quality standards and objectives are set out in the Air Quality (England) Regulations 2000 (as amended 2002) and the 2016 Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS). The limits contained within the AQS are based upon concentrations over a given period of time that is considered acceptable in terms of the effects of each pollutant on human health.

Ockham common where the monitoring was taking place is within the TBH SPA and is therefore subject to additional air quality objectives for the protection of vegetation and ecosystems.

Table 1 outlines the Air Quality objectives for NO<sub>2</sub>, as set out in the UK AQS.

**Table 1: Air Quality Strategy objectives for nitrogen dioxide (NO<sub>2</sub>) and particulates (PM<sub>10</sub> and PM<sub>2.5</sub>)**

|  |
|--|
| <b>Objective</b>   |
| <b>UK objectives for NO<sub>2</sub> set in regulations for the protection of health</b>                                  |
| Hourly average concentration of 200 µg/m <sup>3</sup> not to be exceeded more than 18 times a year                       |
| Annual mean of 40 µg/m <sup>3</sup>  |
| <b>UK objectives for nitrogen oxides (NO<sub>x</sub>) set in regulations for protection of vegetation and ecosystems</b> |
| 30µg/m <sup>3</sup> annual mean objective  |
| 75ug/m <sup>3</sup> 24-hour mean objective   |

## 2.1 Hourly graphs and statistics

Figure 2: Hourly graphs for Ockham

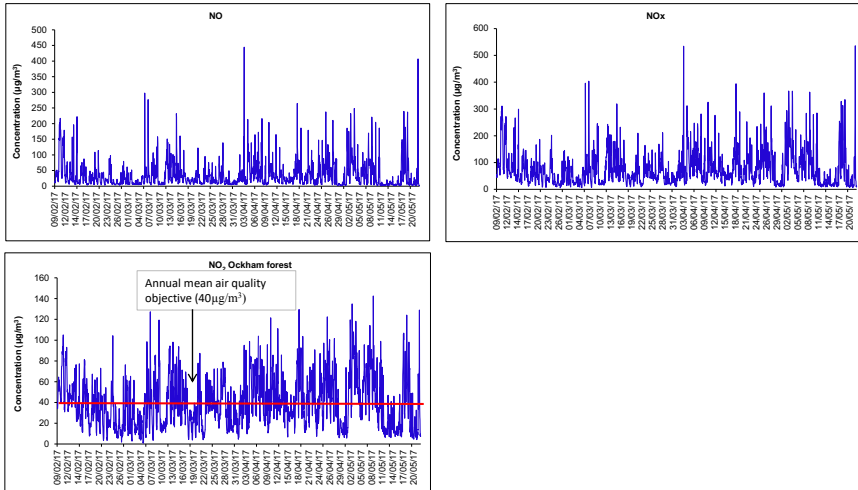


Table 2: Hourly statistics for the Ockham – 08/02/17 to 22/05/17

|   | NO    | NO <sub>x</sub> | NO <sub>2</sub> |
|---|-------|-----------------|-----------------|
| <b>NO<sub>2</sub> hourly mean objective (200 µg/m<sup>3</sup>, 18 exceedances/year)</b> |       |                 | <b>0</b>        |
| <b>Critical level 24-hour mean NO<sub>x</sub> (75µg/m<sup>3</sup>)</b>                  |       |                 |                 |
| <b>Number of exceedances</b>  |       | <b>49</b>       |                 |
| Minimum (µg/m <sup>3</sup> )  | 0.8   | 5.7             | 0.8             |
| Average (µg/m <sup>3</sup> )  | 35.0  | 74.3            | 39.3            |
| Standard deviation (µg/m <sup>3</sup> )   | 41.4  | 62.4            | 24.0            |
| Median (µg/m <sup>3</sup> )   | 20.6  | 56.5            | 35.8            |
| Maximum (µg/m <sup>3</sup> )  | 444.3 | 535.7           | 142.6           |
| Data capture (%)  | 99.8  | 99.8            | 99.8            |

## 2.2 Calculations relating to the regulations for the protection of ecosystems

The site of interest (Ockham common) is classified as a SPA. The area is of particular importance to the Dartford Warbler, Nightjar and Woodlark. These are reliant on the Dwarf Shrub Heath and coniferous woodland which are sensitive to increases in nitrogen oxide levels. Critical levels have been set  $30\mu\text{gNOx}/\text{m}^3$  annual mean and  $75\mu\text{gNOx}/\text{m}^3$  24-hour mean for these two species.

The regulations apply to an annual mean objective limit of  $30\mu\text{g}/\text{m}^3$  for nitrogen oxide concentrations. The WHO guidelines as to how these values are calculated are as follows:

WHO guidelines:

Critical levels for a 1-year period are recommended to cover relatively long-term effects. The critical level for NO<sub>x</sub> (NO and NO<sub>2</sub>, added in ppb and expressed as NO<sub>2</sub> in  $\mu\text{g}/\text{m}^3$ ) is  $30\mu\text{g}/\text{m}^3$  as an annual mean.

For the three month period the concentration of nitrogen oxides (NO<sub>x</sub>) is  $74.3\mu\text{g}/\text{m}^3$ . Only three months monitoring have been undertaken at Ockham Common site. This three month average figure is much higher than the critical annual average set out in the UK objectives for nitrogen oxides ( $30\mu\text{g}/\text{m}^3$ ).

When comparing the 24-hour mean values with the objective critical levels it was found that there were 49 exceedances of the object in the three month monitoring period.

## 2.3 Diffusion tube results

The NO<sub>2</sub> diffusion tubes comprised of 20% TEA in water and were analysed after exposure according to the UKAS methods GLM 7 and GLM 9. The average results are shown in Table 3

**Table 3: Diffusion tube results**

| Tube number | Month 1<br>(8/2/17 to<br>13/3/17)<br>NO <sub>2</sub> ( $\mu\text{g}/\text{m}^3$ ) | Month 2<br>(13/3/17 to<br>20/4/17) NO <sub>2</sub><br>( $\mu\text{g}/\text{m}^3$ ) | Month 3<br>(20/4/17 to<br>22/5/17) NO <sub>2</sub><br>( $\mu\text{g}/\text{m}^3$ ) | Time weighted<br>average NO <sub>2</sub><br>( $\mu\text{g}/\text{m}^3$ ) |
|-------------|---|--|--|--|
| Site A      | 37.96   | 28.76  | 37.68  | 34.5   |
| Site B      | 25.00   | 23.02  | 26.73  | 24.8   |
| Site C      | 22.83   | 23.84  | 22.52  | 23.1   |
| Site D      | 39.37   | 28.59  | 32.87  | 33.4   |
| Site E      | 18.06   | 15.00  | 15.54  | 16.2   |
| Site F      | 18.38   | 14.25  | 16.56  | 16.3   |
| Site G      | 12.41   | 14.53  | 13.68  | 13.6   |

### 2.3.1 Bias adjustment

The results of the collocation of the tubes with the automatic monitor can be used to derive a bias adjustment factor for the monitoring period. The tubes are under-reading compared with the automatic monitor, thus the bias adjustment factor is 1.14 (39.3/34.5). This factor is applied to the three-month mean results for each of the sites.

### 2.3.2 Annualisation

The results shown are for a period of just over 3 months (8 February 2017 to 22 May 2017). Normally, results are given over a 12 month period to allow for seasonal variations. As this data is not available for this site, then an annualisation factor has been derived by reviewing nearby monitoring data. For this, 2016 data has been used from four sites in Guildford. As the data we have covers most of February, March, April and most of May, the average of these 4 months has been compared to the annual average in the Guildford data in order to obtain an annualisation factor.

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**Table 4: Monthly monitoring data from Guildford for 2016**  
NO<sub>2</sub> data in µg/m<sup>3</sup>

|                             | GD3<br>Josephs<br>Road | GD10<br>The<br>Garth | GD13<br>YMCA |
|-----------------------------|------------------------|----------------------|--------------|
| Jan                         | 26                     | 20                   | 37           |
| Feb                         | 23                     | 23                   | 31           |
| March                       | 30                     | 23                   | 40           |
| Apr                         | 22                     | 21                   | 32           |
| May                         | 22                     | 14                   | 38           |
| June                        | 19                     | 14                   | 32           |
| July                        | 15                     | 13                   | 29           |
| August                      | 16                     | 15                   | 27           |
| Sept                        | 18                     | 13                   | 28           |
| Oct                         | 28                     | 20                   | 33           |
| Nov                         | 25                     | 25                   | 37           |
| Dec                         | 37                     | 30                   | 46           |
| <b>Feb-May average</b>      | 24.25                  | 20.25                | 35.25        |
| <b>Year average</b>         | 23.42                  | 19.25                | 34.17        |
| <b>Annualisation factor</b> | 0.966                  | 0.951                | 0.969        |
| <b>Average factor</b>       |                        | 0.962                |              |

The resulting bias adjusted and annualised average NO<sub>2</sub> concentration as shown in Table 5

**Table 5: Bias adjusted and annualised NO<sub>2</sub> data in µg/m<sup>3</sup>**

|        | Bias<br>adjusted<br>NO <sub>2</sub> | Annualised<br>NO <sub>2</sub> |
|--------|-------------------------------------|-------------------------------|
| Site A | 39.30                               | 37.80                         |
| Site B | 28.28                               | 27.20                         |
| Site C | 26.33                               | 25.33                         |
| Site D | 38.04                               | 36.59                         |
| Site E | 18.41                               | 17.71                         |
| Site F | 18.57                               | 17.86                         |
| Site G | 15.49                               | 14.90                         |

NO<sub>x</sub> concentrations have been derived for these monitoring sites using the Defra tool (NO<sub>x</sub>-NO<sub>2</sub>-Calculator, version 5.1). For this it is assumed that Site G is a background site for the area (i.e. giving background concentrations without the influence of local roads). The NO<sub>x</sub> concentration for this background site has been derived from national background maps for NO<sub>2</sub> and NO<sub>x</sub> for 2015 published by Defra (<https://uk-air.defra.gov.uk/data/gis-mapping>) by using a grid square with a NO<sub>2</sub> concentration close to 14.90 µg/m<sup>3</sup>. This is grid square 504405,162291, for which the NO<sub>2</sub> is 14.68 µg/m<sup>3</sup> and the NO<sub>x</sub> is 20.31 µg/m<sup>3</sup>. The NO<sub>x</sub>/NO<sub>2</sub> ratio (1.3835) is applied to the 14.90 µg/m<sup>3</sup> to give a background NO<sub>x</sub> of 20.61 µg/m<sup>3</sup>. The NO<sub>x</sub>-NO<sub>2</sub>-Calculator has been run for 2015 for Guildford with the calculated road NO<sub>x</sub> added to the background road NO<sub>x</sub> of 20.16. The results are shown [Table 6](#).

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**Table 6: Calculated NO<sub>x</sub> concentrations (annual-mean equivalent for 2016)**

| Site   | Annualised<br>NO <sub>2</sub><br>concentration<br>(µg/m <sup>3</sup> ) | Average NO <sub>x</sub><br>concentration<br>(µg/m <sup>3</sup> ) |
|--------|--|--|
| Site A | 37.80  | 69.0   |
| Site B | 27.20  | 45.2   |
| Site C | 25.33  | 41.3   |
| Site D | 36.59  | 66.1   |
| Site E | 17.71  | 26.0   |
| Site F | 17.86  | 26.3   |
| Site G | 14.90  | 20.3   |

### 3 Discussion

Air quality monitoring began at the Ockham Common site on 8<sup>th</sup> February 2017 and this report presents the data collected between 8<sup>th</sup> February 2017 and 22<sup>nd</sup> May 2017. The

provisional calibrated and ratified hourly data values presented in this report have been provided to Ockham Parish Council.

The data capture rate for this monitoring period has been high with a rate of 99.8% being achieved.

The average NO<sub>2</sub> concentration for the three month monitoring period is 39.3 µg/m<sup>3</sup>. This is just below the annual mean objective limit of 40 µg/m<sup>3</sup> set out in the AQS.

Hourly average statistics for nitrogen oxides at the Ockham Common site are shown in Table 2. The data show that in this monitoring period there have been no exceedances of the hourly NO<sub>2</sub> objective of 200 µg/m<sup>3</sup> set out in the AQS.

When comparing the data against the critical levels set for the protection of ecosystems the concentrations have been exceeded at the continuous monitor and were calculated as 74.3µg/m<sup>3</sup> and although this concentration is much higher than the objective, it must be treated with caution as it is calculated based on only three months monitoring data. When comparing the 24-hour means values with the objective critical levels it was found that there were 49 exceedances of the 75µg/m<sup>3</sup> objective limit in the three month monitoring period.

The NO<sub>2</sub> diffusion tube data indicate that no site exceeded the annual mean objective during the three months monitoring period. It is difficult to interpret three months diffusion tube results as the data covers a limited period for the year. With bias adjustment (based on the collocated instantaneous monitoring and diffusion tubes at site A) and annualisation (based on seasonal variation observed in sites in Guilford during 2016), the results were still within the objectives at all sites. Data results indicate that the two highest concentrations were monitored at sites A and D, located adjacent to the A3. During this period any prevailing wind from the A3 would move contributions towards these locations, producing increased concentrations. Sites B and C were located nearer to, although still some distance from, the M25 where concentrations were slightly lower. Prevailing wind directions in the UK are predominantly from the south-west. Depending on the wind direction during this period, it is likely that reduced concentrations at sites B and C may have been as a result of contributions from vehicles on the M25 being pushed away from the monitoring locations, but will also be due to the greater distances of these sites from the road than sites A and D.

The diffusion tube results are located across the SPA and using a derived factor, the NOx concentration were calculated from the NO<sub>2</sub> results and were compared to the UK objectives for nitrogen oxides (NOx) set in regulations for protection of vegetation and ecosystems. The four sites A to D located around the edge of the heathland are above the 30µg/m<sup>3</sup> annual limit. Sites E, F and G in the centre of the heathland are below the 30µg/m<sup>3</sup> objective limit.

The derived annual NOx concentrations in parts of the heathland already exceed the objectives for SPA and any increase from the cumulative effects of changes to development could cause damage to the SPA and its wildlife.

## 4 References

APIS website- <http://www.apis.ac.uk/>

World Health Organisation- *Air quality Guidelines for Europe second edition (2000)*



