

**A Review of Redmore Environmental's
Air Quality Monitoring Results
(May 2019), High Lane**

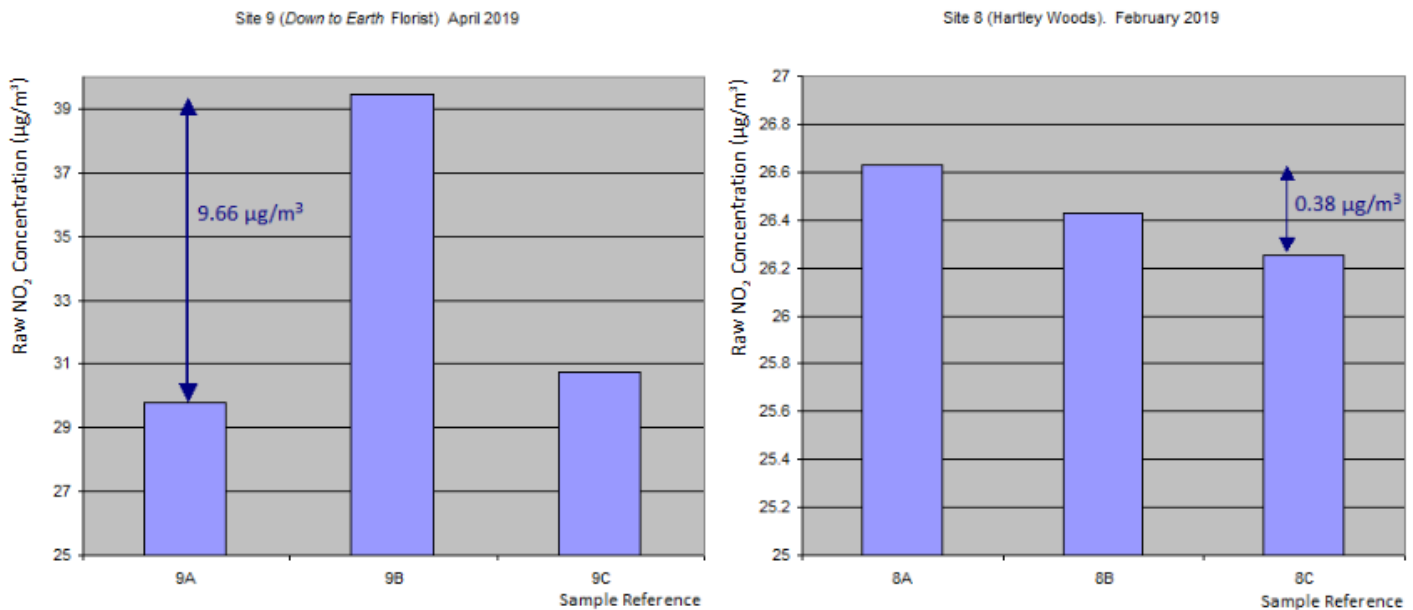
Document References

The first reference in this section is the recent air quality report produced by Redmore Environmental Limited (hereafter referred to as “Redmore”) for the High Lane area, the scrutinising of which is the focus of this paper; the second is the corresponding report produced by Atkins for measurements made in 2014/15. The remaining references are supporting references.

1. REDMORE ENVIRONMENTAL, *Air Quality Monitoring Results, High Lane, Stockport*, Ref. 2635-1r1, 22nd May 2019, <http://www.hlvnf.org/assets/files/2635-1r1%20-%20Air%20Quality%20Monitoring%20%20%20Results%20-%20High%20Lane,%20Stockport.pdf>
2. ATKINS, *A6MARR Monitoring and Evaluation Baseline Report: Appendix J. Pre-Construction Air Quality Monitoring Report*, Version 2.6, April 2016, pp. 1-29 of PDF, http://www.semmms.info/wp-content/uploads/A6MARR_BaselineReport_Final_appendixes_JtoLonly.pdf
3. DEFRA, *Local Air Quality Management Technical Guidance (TG16)*, February 2018, <https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf>
4. ENVIRONMENT AGENCY, *Technical Guidance Note M8: Monitoring Ambient Air*, Version 2, May 2011, <https://www.gov.uk/government/publications/m8-monitoring-ambient-air>
5. TARGA, J., LOADER, A., THE DEFRA WORKING GROUP ON HARMONISATION OF DIFFUSION TUBES, *Diffusion Tubes for Ambient NO2 Monitoring: Practical Guidance*, AEAT/ENV/R/2504, Issue 1a, February 2008, https://laqm.defra.gov.uk/documents/0802141004_NO2_WG_PracticalGuidance_Issue1a.pdf
6. DEFRA, *Interactive Monitoring Networks Map*, UK AIR: Air Information Resource, website viewed 5th September 2019, <https://uk-air.defra.gov.uk/interactive-map>
7. DEFRA, *Data Selector*, UK AIR: Air Information Resource, website viewed 7th September 2019, https://uk-air.defra.gov.uk/data/data_selector
8. STOCKPORT METROPOLITAN BOROUGH COUNCIL, *My Maps*, website viewed 18th August 2019, <https://maps.stockport.gov.uk/>
9. AIR QUALITY ENGLAND, *Stockport Hazel Grove (SKT5)*, website viewed 7th September 2019, https://www.airqualityengland.co.uk/site/data?site_id=STK5
10. DEFRA, *National Diffusion Tube Bias Adjustment Factor Spreadsheet*, version 09/18, <https://laqm.defra.gov.uk/assets/databasediffusiontubebiasfactorsv0918final.xlsx>

Initial Remarks

1. It is known that the measurement of nitrogen dioxide concentrations using diffusion tubes “typically results in a **low accuracy**” [ref. 3, paragraph 7.179, p. 115 of PDF]. Nevertheless, it is a cost-effective and widely used and accepted method, and the study was therefore commissioned on this basis.



The above plots illustrate the range of readings from the triplicated diffusion tubes. The first set of three are the April 2019 measurements from Location 9 (which show the greatest variation) and the second set are the February 2019 measurements from Location 8 (which show the least variation). With perfect precision, all three values within each set would be completely identical to each other. Obviously, there will be real-world variations from numerous potential sources that mean that perfect precision is unlikely to be achieved in practice, but the more samples that are taken, the better the precision can be assessed. The Redmore study used **three** passive diffusion tubes at each location [ref. 1, paragraph 3.3.1] per month; the Atkins study used only **two** [ref. 2, section 2.0, p. 5 of PDF].

Of course, even with perfect precision, there is no guarantee that the measurements will be accurate, i.e. match the true value, as there may be systematic effects, for example, that offset the measured values from their true values. But since the true values are unknown, this is the challenge of measurement-making in general. Redmore have employed a UKAS-accredited contract laboratory (Gradko International [ref. 1, paragraph 3.3.3, p. 9 of PDF]) to supply and analyse the diffusion tubes, and it is assumed that the siting and handling of these samplers was done fully in accordance with all the relevant guidelines. I have no reason to suggest anything to the contrary, other than possible doubts about the siting of some of the samplers — see Concern 1, below.

- Given the set of six locations along the A6 (five locations in High Lane and one near Windlehurst Road) in the Atkins report [ref. 2] relating to measurements in 2014/15, for ease of comparison, I would have expected this to have been the starting point for the selection of site locations in the present study [ref. 1]. I was not privy to this part of the decision-making process, but I would have hoped that the present study would have at least included the location at which exceedances were measured in 2014/15. This was not the case, however.

The following table was compiled from the Location, Roadside and Lamp Post descriptions in the Redmore report [ref. 1, Table 3, p. 8 of PDF], where I have ordered the Location numbers according to a west-to-east flow along the A6. I have cross-referenced these locations, using the given National Grid References in combination with SMBC's map of lamp post locations (by activating the **Street Light** layer in the **Transport and Streets – Highways & Street Maintenance** section, ref. 8) and also with photographs (taken over a number of years) using Google Maps' Street View, e.g. <https://www.google.co.uk/maps/@53.364088,-2.0691156,3a,43.6y,165.8h,83.24t/data=!3m6!1e1!3m4!1svieoXQ0npaVld8WMBBAnpA!2e0!7i13312!8i6656> (location 10 — lamp post 131).

Of the six local locations in the Atkins study, **only one** (Location 3, shown shaded blue in the table below) of the ten locations was included in the Redmore study.

Redmore Environmental			SMBC "My Maps": https://maps.stockport.gov.uk/		Atkins report, April 2016	Google Maps: Street View	
Loc'n	Roadside	Lamp Post	Current Lamp Post	SMBC's Map Address	Measured Aug 2014 to Jan 2015	Comments	>10 metres from bushes or trees overhanging tube?
1	247 High Lane	79	"68" (actually 79)	Richmond, Buxton Road	-	SMBC database is out of date. Google Maps Street View shows it was 68 in 2017, but is now 79	✓
2	275 High Lane	95	95	275 Buxton Road	-		✗ Nearby conifer, but not overhanging
3	6 High Lane	105	105	5 Buxton Road	MO57, "Lamp Post 95"	Was Lamp Post 94 in 2017. 5 Buxton Road is correct.	✓
5	Opposite Horseshoe Inn	-	109	Revjuven8 (former Thai Restaurant) car park	-	Was Lamp Post 8 in 2017. 2019 Google Street Map shows no number.	✗ Nearby tree, but not overhanging
4	4 Windlehurst Lane	-	-	4 Windlehurst Lane	-	Not on a Lamp Post. Seems to be near Horse Shoe Inn's car park.	✗ Nearby tree, exact tube location unclear
7	26 High Lane "Opposite MOT Centre"	-	114	26 Buxton Road	-	Opposite Hillcrest Garage	✓
6	74 High Lane	122	122	74 Buxton Road	-		✓
8	Opposite St Thomas's Church	-	?	Hartley Woods near corner of Alderdale Drive	-	Opposite St Thomas' Church. Seems to be a new, unlabelled lamp post.	✗
10	Down to Earth Florist	131	131	Opposite The Old Courthouse, Buxton Road	-	On A6 lamp post by Brookside Car Park	✓
9	157 High Lane	137	137	157 Buxton Road	5 houses away from MO56		✗

Site Locations, ordered west-to-east

Concerns

- The Redmore study claims [ref. 1, paragraph 3.1.1, p. 8 of PDF] to have been undertaken in accordance with DEFRA guidance, citing TG16 [ref. 3]. However, TG16, paragraph 7.181 (on p. 116 of PDF) states:

*The site should be open to the sky, with no overhanging vegetation or buildings. It is important to place diffusion tubes where there is free circulation of air around the tube, but the opposite extreme should also be avoided, i.e. areas of higher than usual turbulence. For this reason, the tube should not be located on the corner of a building. Care should be taken to avoid any very localised sources, sinks of NO₂ or disturbances to the airflow. For example, tubes should be mounted **greater than 10m** from the following:*

- Heater flues (particularly low level balanced flues);
- Bushes or trees overhanging or surrounding the tube location;
- Air conditioning outlets;
- Extractor vents; or
- Underground ventilation shafts.

Based on the co-ordinates given in the report, I judge this guidance to have been followed in **5 out of the 10** locations (shown in shaded green, with ticks, in the above table); in the remaining locations, however, there may be less than 10 metres from bushes or trees overhanging or surrounding the tube in some or all of these locations, although it is not possible in some of these cases to make this determination because the co-ordinates are "approximate" [ref. 1, Table 3, p. 8 of PDF].

Hence it does not seem to be true to say that the TG16 guidance has been followed in all cases. Therefore, such readings should be treated with caution.

2. The Redmore study [ref. 1, paragraph 3.3.2, page 9 of PDF] cites guidance TGN M8 [ref. 4]. However, in Table 14.7 of this reference (concerning nitrogen oxides), p. 48 of PDF, it says:

*It is recommend [sic] that the survey **includes co-location of sample tubes with an automatic NO₂ analyser** to allow a bias-adjustment factor to be calculated, and the exposure periods for the co-located tubes should be the same as the other tubes used in the survey.*

For the Atkins study [ref. 2, Appendix C, p. 16 of PDF], this was done using a relatively local site on the A6 (near Stepping Hill hospital). The Redmore study, however, did not do this; instead, as far as I can tell, it used a national spreadsheet with data up to the year 2017 [ref. 10, cited in ref. 1, paragraph 3.5.5, p. 11 of PDF], consistent with the TG16 methodology. The bias adjustment factor of 0.87 (for 2017, the latest available year from Defra at the time) happens to be one of the lowest ever years. Had the factor been 0.95 or higher, site 2 would have exceeded the EU limit.

Although other methods of deriving bias adjustment factors are possible, **the guidance recommends co-located studies**, and common sense would suggest this to be a more accurate method if it is possible.

3. The Redmore study [ref. 1, paragraph 3.5.2, p. 10 of PDF] uses **3 sites** for the **annualisation adjustments**:
- Manchester Piccadilly - [Urban Background](#)
 - Manchester Sharston (Nr. Heald Green) - [Suburban Industrial](#) (listed as Suburban Background in ref. 1)
 - Glazebury (Nr. Irlam) - [Rural Background](#)

The TG16 guidance [ref. 3, box 7.9, bullet 1, p. 112 of PDF; this box is referenced by box 7.10 (p. 119 of PDF) for NO₂ diffusion tubes] says *the **data capture** for each of these sites should be **at least 85%***. No data capture figures are quoted in the Redmore report, but using ref. 7, I have extracted the data myself for these sites (see Appendix 1 for the method) into an accompanying spreadsheet. It is not clear which dates Redmore have used for the Annualisation calculations, but using dates that have the measurement period at the end of the 365-day period, one of the sites for 2018/19 (Glazebury) has **only 75% data capture**. My figure, using these dates for the annualisation ratio, is 0.95; Redmore's is slightly different at 0.93, so it is possible that different dates have been used, so without knowing these exactly, it is not possible to be certain what the corresponding data capture percentage used by Redmore was.

Secondly, the use of 3 sites in the Redmore study contrasts with **4 sites** in the Atkins study [ref. 2, Appendix D, p. 17 of PDF], although the TG16 guidance [ref. 3, Box 7.9, p. 112 of PDF] says to use *two to four nearby, long-term, continuous monitoring sites*, so this has been complied with. The sites used by Atkins are:

- Manchester Sharston (Nr. Heald Green) - [Suburban Industrial](#) (described as Manchester South in ref. 2)
- Glazebury (Nr. Irlam) - [Rural Background](#)
- Stoke-on-Trent – [Urban Background](#) (assuming it's Stoke-on-Trent Centre)
- Wigan – [Urban Background](#)

I obtained the Environment Type classifications (shown [in blue](#)) and site details listed above from the interactive map in ref. 6.

Two sites are common to both: **Manchester Sharston** and **Glazebury**. The Redmore study additionally used **Manchester Piccadilly** for the Urban Background, whereas the Atkins study additionally used **Stoke-on-Trent** and **Wigan**.

Thirdly, it is interesting to note that if, instead of using these sites, the geographically closest continuous monitoring site (near Hazel Grove) were used instead, the results would be very different — including an **exceedance** of the limit at Location 2 ([lamp post 95](#) of the A6, near Middlewood Way), although it should be noted that during the year ending April 2019, the data capture rate (based on days with a complete set of 24 hourly measurements) was only 71.5%, i.e. below the 85% minimum level that is considered satisfactory by

TG16 [ref. 3, box 7.9, bullet 1, p. 112 of PDF]. The Hazel Grove monitoring site [ref. 9, with Time Period = 30/04/2018 to 29/04/2019] would be the most comparable (in terms of weather conditions, traffic flow, etc.) because of its proximity to High Lane.

4. The Redmore study [ref. 1] includes only 3 months' monthly readings per location, compared to 6 in the Atkins study [ref. 2]. Thus with only 3 data points per site, there is insufficient data to draw any firm conclusions.

Observations

1. The results in the Redmore report [ref. 1] summarised in Table 8, p. 11 for the Period Mean Concentration of nitrogen dioxide (i.e. the 3-month mean at each location) match the figures calculated in Table 7, pp. 9-10, as expected. However, many of the calculated monthly means are slightly different from those presented in Table 7. For example, at location 1, the calculated mean for March is $(38.37+40.84+42.90)/3 = 40.7033\dots$, which I would have expected to have been reported as 40.70, rounded to 2 decimal places; but it is listed as **41.71** in the report. Similarly, for April at this location, the mean is $(33.23+30.56+30.13)/3=31.30666\dots$, which I would have expected to have been reported as 31.31; this is listed as **31.30** — lower than measured.

Although there are another three more mean values that are reported being as lower than their true value in the report (and no more mean values that are higher), the **differences are so small as not to make any difference to the final result** with respect to the limit set in UK legislation. Nevertheless, it begs the question **“why is there a difference?”** Is it because the “raw” values in the report are themselves already rounded, and the mean values in the report are have been calculated from these higher resolution figures? If so, why is this not mentioned in the report, and why aren't *these* figures in the report? Or is there another explanation?

2. The addresses for the sampling locations in Table 3 [ref. 1, p. 8 of PDF] are listed in the report as “High Lane”, whereas they are actually “Buxton Road”.

Conclusions

1. The dataset (3 monthly readings per site) is too small to draw any firm conclusions.
2. Several aspects of the robustness of the data are questioned:
 - a. Some sites apparently contravene Defra TG16 (paragraph 7.181) guidance regarding tubes being mounted greater than 10 metres from bushes or trees overhanging or surrounding the tube location.
 - b. Bias adjustment was not done with tubes co-located at the local continuous monitoring site (by the side of the A6 near Stepping Hill hospital); instead it was done using national data from 2017 [ref. 10, cited in ref. 1, paragraph 3.5.5, p. 11 of PDF].
 - c. Annualisation adjustments include one site (Glazebury), which appears to have a low percentage (75%) of data capture for the 2018/19 period in question, i.e. below the recommended minimum of 85%.
3. The low commonality of the selected site locations between the Redmore and Atkins studies means that it is difficult to compare them.

Appendix 1 – Annualisation Adjustment Data

I checked the annualisation figures using data obtained from ref. 7 using the following settings:

- a. Search Hourly Networks
- b. Data Type = Daily Mean
- c. Date Range = Custom Date (30/04/18 to 29/04/19 for Annual, so as to include the measurement Period of 01/02/18 to 29/04/19)
- d. Monitoring Sites by → Site Name = Manchester Piccadilly, etc.
- e. Pollutants by → Pollutant Name = Nitrogen dioxide
- f. Output Type = Data to Screen

Then I saved the URL (which included my session ID), ready for use with the next monitoring site (so as to be able to edit the Site Name, keeping all the other settings intact) and clicked the “Get Data” button. The results were then pasted into a spreadsheet. This process was repeated for each site.