Stag Brewery

Air Quality Monitoring Report

January 2019

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This document has been prepared and checked in accordance with Waterman Group's IMS (BS EN ISO 9001: 2008, BS EN ISO 14001: 2004 and BS OHSAS 18001:2007)

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Comments

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1. Introduction

1.1. A short-term air quality monitoring study for nitrogen dioxide (NO_2) was undertaken around Chertsey Court, Chalkers Corner in the London Borough of Richmond Upon Thames (LBRuT) (hereafter referred to as the 'Site').

1.2. The NO_2 diffusion tube monitoring study was undertaken by Waterman Infrastructure & Environment Limited ('Waterman IE') for a 6-month period, from July 2018 to January 2019. NO_2 monitoring was completed at eight locations around the Site, and at a further two monitoring locations at the approximate location of the proposed school to be introduced as part of the redevelopment proposals of the Stag Brewery development. The 10 monitoring locations are shown on **Figure 1**.

1.3. The monitoring locations were chosen to:

- Determine NO_2 concentrations at the façade of Chertsey Court to determine relevant residential exposure to traffic emissions;
- Ascertain whether NO_2 concentrations fall-off with distance from the roadside to the façade of Chertsey Court;
- Evaluate the effect of the existing landscaping at Chertsey Court on traffic emissions and thus NO_2 concentrations; and
- Ascertain the baseline conditions for the proposed school.

2. Methodology

2.1. In May 2016, Defra published the London Local Air Quality Management Technical Guidance (LLAQM.TG(16))[1] which sets out the approach to reviewing and assessing local air quality in the UK. The methodology, and processing of the results, of this monitoring are in accordance with LLAQM.TG(16).

2.2. The air quality monitoring study was undertaken for a six-month period from 9th July 2018 to 3rd January 2019 and consisted of deploying two NO_2 diffusion tubes at each of the 10 locations as shown in **Figure 1**.

2.3. At Chalkers Corner, the monitors were located on existing street furniture away from the road to form three transects (see **Figure 1**). This included:

- Three monitors at the kerbside of Chalkers Corner, located on traffic signage (IDs DT1; DT4 and DT6);
- Two monitors at the roadside of Chalkers Corner, located on the existing metal railings of Chertsey Court and facing the road (IDs DT2 and DT7);
- One monitor located in the carpark of Chertsey Court (ID DT5), located on existing signage; and
- Two monitors located on the façade of Chertsey Court on drain pipes, representative of concentrations residential users of Chertsey Court would be exposed to (ID DT3 and DT8).

2.4. The two school diffusion tubes were located on traffic signage in the carpark of the Stag Brewery Sports Club and are classified as roadside monitoring locations.

2.5. In addition to the monitoring at the Site, three tubes were deployed at the London Borough of Wandsworth (LBW) Putney automatic monitor (Grid Reference 524035, 175519) to evaluate the accuracy of the diffusion tubes (discussed further below under sub-heading 'Diffusion Tube Co-Location'). All diffusion tubes were changed monthly throughout the monitoring period, as per the guidance in LLAQM.TG(16).

2.6. The diffusion tubes were mounted approximately 2.0 metres (m) above ground level around the Site.

Diffusion Tubes

2.7. Diffusion tube monitoring is a method for screening the air quality in an area to give an indication of average air pollutant concentrations. The method consists of a tube with an appropriate absorbent material at one end, mounted on to street furniture. The preparation method used is 20% TEA (triethanolamine) in water and the tubes are exposed by removing the bottom cap to allow sampling.

2.8. Following the relevant exposure period, the cap is replaced, and the tube sent to a laboratory for analysis. For this study, the tubes were obtained from Gradko International Ltd (a UKAS Accredited laboratory) and, following exposure, were returned to Gradko for analysis.

Diffusion Tube Co-location

2.9. Diffusion tubes may systematically under or over-read NO_2 concentrations when compared to an automatic analyser. To improve accuracy, it is best practice to deploy duplicate / triplicate tubes specifically co-located with an automatic monitor to enable inter-comparison of monitored results

1 Defra, 2016, London Local Air Quality Management Technical Guidance LLAQM.(TG16)

and determine the 'bias' in diffusion tube results. This bias can then be corrected to improve the accuracy of the diffusion tube results, using a suitable bias-adjustment factor.

2.10. As part of the monitoring study, triplicate diffusion tubes were located at the LBW Putney automatic monitor to derive a local bias adjustment factor. This was the closest monitor to the Site with historic good data capture. A locally derived bias adjustment factor is more appropriate than using a national factor available from Defra[2] for the following reasons:

- The survey has not been carried out over a calendar year (the national factors have been determined on a calendar year basis); and
- NO_2 concentrations at the diffusion tube sites are significantly influenced by emissions from nearby roads. In accordance with existing diffusion tube guidance[3], the bias adjustment factors should be determined from co-location studies at similar monitoring locations.

2.11. The local bias spreadsheet tool, developed by Defra to help Local Authorities calculating precision, accuracy and bias adjustment factors[4], has been used to check the accuracy of the triplicate diffusion tubes with the Putney automatic monitor.

2.12. The spreadsheet provides a Coefficient of Variation (CV) of the diffusion tube results, which represents their precision and is an indicator of the overall performance of the diffusion tubes. Tube precision is separated into two categories, 'good' or 'poor'. Tubes are considered to have 'good' precision where the coefficient of variation of duplicate or triplicate diffusion tubes for eight or more periods during the year is less than 20%, and the average CV of all monitoring periods is less than 10%. Tubes are considered to have 'poor' precision where the CV of four or more periods is greater than 20% and/or the average CV is greater than 10%.

2.13. A summary of the data from the co-location study is presented in **Table 1** and a copy of the precision and accuracy spreadsheet presented in **Appendix A.**

Table 1: Co-location Data at Putney

Site	Diffusion Tubes		Automatic Monitor	Bias Adjustment
	Period Mean	Tube Mean CV (% Precision)	Period Mean	
Putney	33	2	32	0.97

2.14. The average CV for the co-location is less than 10%, and as such shows 'good' precision, and therefore the bias adjustment factor of **0.97** been applied to the monitoring results.

Diffusion Tube Annualisation

2.15. The short-term (6-month) sampling period is sufficient to provide a reasonable assessment of existing air quality in an area, and is a recommended monitoring duration set out in LLAQM.TG(16). However, the 6-month monitoring period is not an exact equivalent of an annual (12-month) mean, which relates to the NO_2 annual mean Air Quality Strategy (AQS) objective for the protection of human health at sensitive locations (including residential properties).

2 http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html

3 Laxen and Marner for Defra, 2006. The relationship between diffusion tube bias and distance from the road.

4 www.airquality.co.uk/archive/laqm/tools.php

2.16. Following guidance in Defra's LLAQM.TG(16) (Box 4.8), a long-term (12-month) correlation can be calculated by using the relationship between the short-term (6-month) period against the long-term (12-month) period for other local monitors. This adjustment process is known as 'annualisation'.

2.17. According to LLAQM.TG(16), to derive an annual mean concentration for the Site; data from two to four nearby long-term monitoring sites, located at urban background locations are required. It is estimated that the distance between sites should not be larger than 50 miles (80km).

2.18. There are a number of urban background automatic monitoring stations in central London, from which the following four urban background monitoring locations were selected:

- North Kensington – Kensington & Chelsea, approximately 7.2km from the Site;
- Bloomsbury - Camden, approximately 11.9km from the Site;
- Norbury Manor – Croydon, approximately 12.2km from the Site; and
- Elephant and Castle - Southwark, approximately 12.4km from the Site.

2.19. The above automatic monitors form part of the London Air Quality Network (LAQN) and monitoring data is available for all monitors for the latest full year to January 2019.

2.20. The ratio of the short-term monitoring period mean for NO_2 (9th July 2018 to 3rd January 2019) and the latest NO_2 annual mean concentration (available for 2018) at the four sites was obtained, as shown in **Table 2**.

Table 2: Adjustment Process to Estimate Annual Mean NO_2 Concentrations at the Site

Site	Annual Mean 2018	Period Mean	Ratio (AM/PM)
North Kensington, Kensington & Chelsea	27.6	26.1	1.056
Bloomsbury, Camden	36.5	32.6	1.117
Norbury Manor, Croydon	48.7	44.0	1.107
Elephant and Castle, Southwark	31.4	30.3	1.035
Average			**1.079**

2.21. The average of the four ratios between the sampling period and annual mean NO_2 concentrations was calculated as 1.079 (**Table 2**), and this was then applied to the short-term NO_2 diffusion tube results set out in **Table 3**. Following guidance in LLAQM.TG(16), given that the calculation is carried out using the ratio of the short-term monitoring period to the 2018 annual mean, the equivalent/estimated annual mean is for 2018.

3. Results

3.1. Box 1.1 of LLAQM.TG(16) set outs where the AQS objectives should apply. The following objectives and concentrations relevant to the monitoring locations are as follows:

- NO_2 annual mean of 40µg/m^3 – relevant for locations where members of the public might be regularly exposed, such as building façades of residential properties, schools, hospitals, care homes etc. For this study the annual mean AQS objective of 40µg/m^3 is relevant for the monitored concentrations at the façade of Chertsey Court and the proposed school sites only; and
- NO_2 hourly mean of 200µg/m^3 not to be exceeded more than 18 times a year. LLAQM.TG(16) states the hourly mean limit value and objective for NO_2 is unlikely to be exceeded at a roadside location where the annual-mean NO_2 concentration is less than 60µg/m^3. Relevant locations include pavements; car parks; bus stations, railway stations and any outdoor locations where members of the public might reasonably expect to spend one hour or longer. For this study the annual mean AQS objective of 60µg/m^3 (to be compared to the hourly objective) is relevant for the monitored concentrations at the kerbside, roadside and carpark sites only.

3.2. The results of the NO_2 diffusion tube monitoring are presented in **Table 3**, which shows the unadjusted collected NO_2 results; the co-location adjusted results; and the annualised results, (which are the results for consideration against the relevant AQS Objectives, as discussed above). The results in **Table 3** show:

- The monitors located on the façade of Chertsey Court (as 34.2µg/m^3 at DT3 and 32.8µg/m^3 at DT8) are below the annual mean NO_2 AQS objective of 40µg/m^3 and as such existing conditions at Chertsey Court are considered to be good;
- The highest concentrations are measured at the diffusion tubes located on the kerbside (as 43.0µg/m^3 at DT1; 42.7µg/m^3 at DT4; and 49.1µg/m^3 at DT6) due to these monitors being located directly above vehicle tailpipe emissions at Chalkers Corner. All kerbside locations are below the hourly equivalent annual mean NO_2 concentration of 60µg/m^3 and therefore the AQS objective is met at these monitoring locations;
- Similar, to the kerbside locations, monitored concentrations at the diffusion tubes located on the roadside at Chalkers Corner (as 36.9µg/m^3 at DT2; 42.1µg/m^3 at DT7; and 49.1µg/m^3 at DT6) and in the carpark of Chertsey Court (as 40.4µg/m^3) are below the hourly equivalent annual mean NO_2 concentration of 60µg/m^3 and as such the AQS objective is met at these monitoring locations;
- From the kerbside to the roadside there is an average decrease (across the three transects: DT1/DT2/DT3, DT4/DT5, DT6/DT7/DT8) in annual mean NO_2 concentrations of 5.1µg/m^3. This shows that with distance away from the road and away from direct tailpipe emissions, NO_2 concentrations rapidly improve at Chalkers Corner;
- In addition, the results show there is an average decrease in annual mean NO_2 concentrations of 12.5µg/m^3 from the kerbside to the façade of Chertsey Court (difference between DT1/DT3 and DT6/DT8) and a decrease of 6µg/m^3 from the metal railings at the roadside locations to the façade of Chertsey Court (difference between DT2/ DT3 and DT7/8). The average decrease from the kerbside and roadside monitors (DT1, DT2, DT6, DT7) to the Chertsey Court façade (DT3/ DT8) is therefore 9.3µg/m^3. The results suggest the existing landscaping is acting as a barrier to traffic emissions at Chertsey Court; and
- The monitors located at the likely façade of the school within the Stag Brewery Development (as 30.2µg/m^3 at School 1 and 30.1µg/m^3 at School 2) are below the annual mean NO_2 AQS

objective of 40µg/m^3 and as such existing conditions are good and are not a constraint for the proposed school use in this location.

Table 3: NO_2 Monitoring Results at the Site

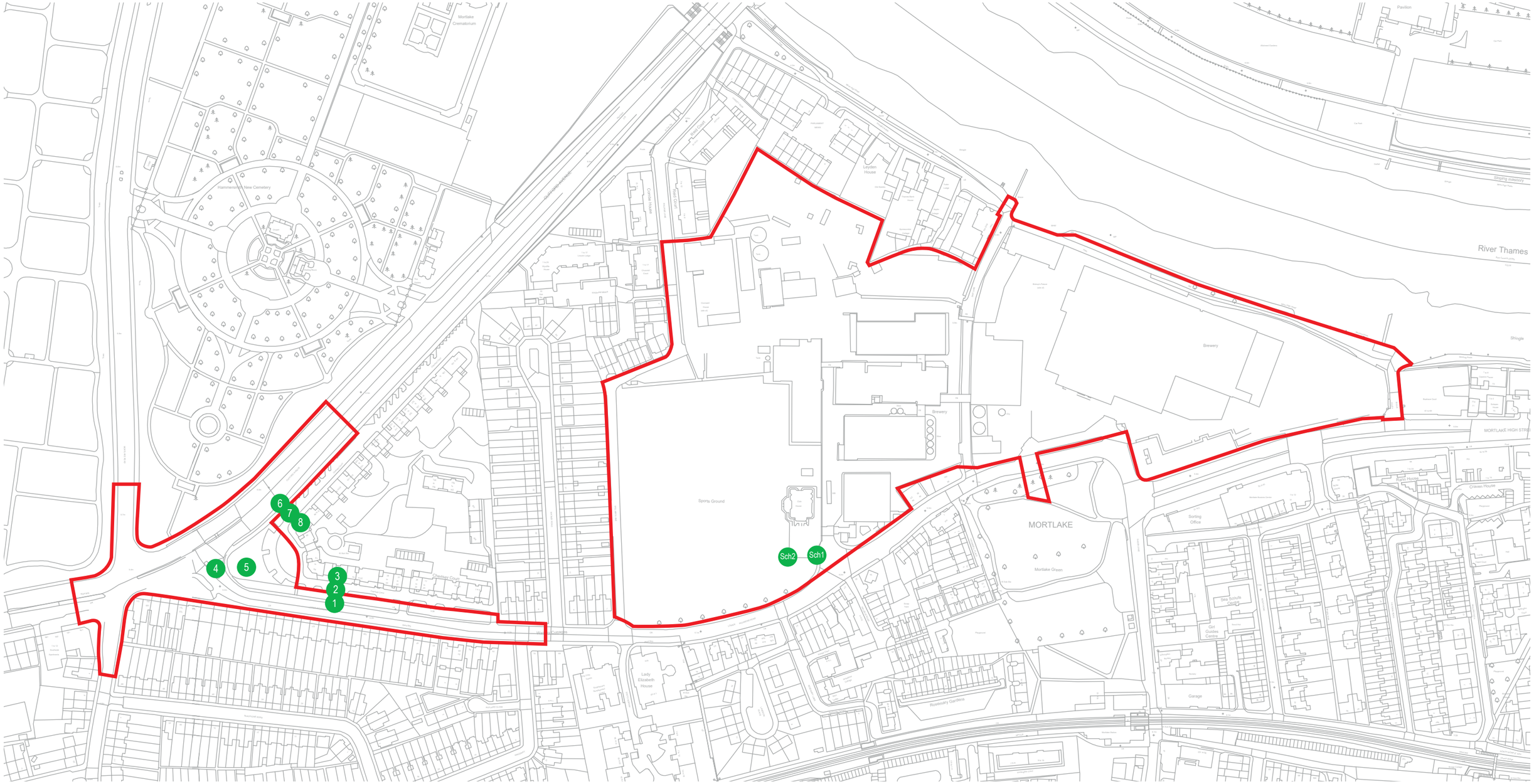
ID	Site Description	Monitor Classification[(a)]	9th July – 10th Aug 2018	10th Aug – 11th Sept 2018	11th Sept – 9th Oct 2018	9th Oct – 9th Nov 2018	9th Nov – 7th Dec 2018	7th Dec 2018 – 3rd Jan 2019	Unadjusted Average	Adjusted/Co-location Annual Mean*	Adjusted Estimated 2018 Annual Mean**
			µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
DT1	Lower Richmond Road	Kerbside	37.4	38.8	45.0	45.4	38.2	45.6	41.1	39.8	43.0
			35.4	39.4	40.3	45.0	37.1	45.4			
DT2	Chertsey Court metal railings	Roadside	34.8	31.6	34.9	38.0	37.9	43.7	35.3	34.2	36.9
			35.9	34.2	31.1	36.2	33.7	44.2			
DT3	Chertsey Court Lower Richmond Road	Façade	29.9	27.6	28.6	33.0	32.8	36.3	32.7	31.7	34.2
			27.9	26.5	31.2	35.9	31.5	38.1			
DT4	Chalkers Corner Junction	Kerbside	46.5	42.9	39.5	41.2	40.9	52.4	40.8	39.6	42.7
			46.8	40.5	44.2	42.0	41.7	49.3			
DT5	Chertsey Court	Carpark	25.1	34.5	37.4	37.7	35.1	40.1	38.6	37.4	40.4
			30.0	33.2	37.1	37.9	34.9	41.6			
DT6	Clifford Avenue	Kerbside	40.6	46.7	50.1	45.8	47.7	49.9	46.9	45.5	49.1
			39.3	43.9	44.3	50.8	49.6	54.3			
DT7	Clifford Avenue metal railings	Roadside	29.1	38.2	46.0	40.2	43.3	48.9	40.3	39.1	42.1
			27.6	35.3	32.9	46.6	48.0	47.1			
DT8	Chertsey Court Clifford Avenue	Façade	24.2	30.3	32.9	32.9	31.9	36.3	31.4	30.4	32.8
			23.7	31.1	31.8	33.9	33.1	34.4			
School 1	Stag Brewery Sports Club	Roadside	21.7	21.6	27.1	32.7	37.3	35.1	28.9	28.0	30.2
			21.9	22.3	25.0	32.3	34.3	35.4			
School 2	Stag Brewery Sports Club	Roadside	No Data	21.1	26.1	32.0	29.9	34.3	28.7	27.9	30.1
			No Data	20.4	27.4	21.8	37.4	36.8			

*Multiply previous column by 0.97 **Multiply previous column by 1.079 Exceedance of the AQS Objective shown in **BOLD**

[(a)] Classification as defined by LLAQM.TG (16) : Kerbside = monitor 1m from kerb of a road; Roadside = monitoring within 1-5m from kerb of a road; Façade = monitor on residential property and at a location of relevant residential exposure; Carpark = monitor located within am open air car park

FIGURES

Figure A1: Diffusion Tube Monitoring Locations



N

Site Boundary

X Diffusion Tube Monitoring Locations

Project Details	WIE10667-104: Stag Brewery, Mortlake
Figure Title	Figure A1: Diffusion Tube Monitoring Locations
Figure Ref	WIE10667-104_GR_AQMR_A1A
Date	January 2019
File Location	\\s-lncs\wiel\projects\wie10667\104\graphics\aqmr\issued figures

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APPENDICES

Appendix A Precision and Accuracy Spreadsheet

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements									
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
1	09/07/2018	10/08/2018	25.7	25.7		26	0.0	0	0.3
2	10/08/2018	11/09/2018	25.1	24.7	23.5	24	0.9	3	2.1
3	11/09/2018	09/10/2018	30.0	30.3	30.9	30	0.5	2	1.2
4	09/10/2018	09/11/2018	40.0	36.4	38.4	38	1.8	5	4.4
5	09/11/2018	07/12/2018	40.7	41.3	40.0	41	0.7	2	1.6
6	07/12/2018	03/01/2018	37.5	37.5	39.7	38	1.3	3	3.2
7									
8									
9									
10									
11									
12									
13									

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

Automatic Method	
Period Mean	Data Capture (% DC)
25.76364	100
18.95152	100
28.95517	100
37.10938	100
44	100
38	100

Data Quality Check	
Tubes Precision Check	Automatic Monitor Data
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good

Overall survey --> Good precision | Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:

Precision 6 out of 6 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%

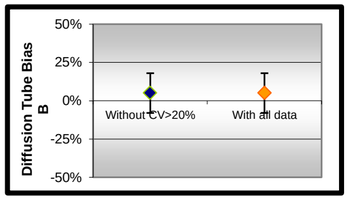
Bias calculated using 6 periods of data

Bias factor A	0.97 (0.87 - 1.12)
Bias B	3% (-10% - 16%)
Diffusion Tubes Mean:	33 µgm^{-3}
Mean CV (Precision):	2
Automatic Mean:	32 µgm^{-3}
Data Capture for periods used:	100%
Adjusted Tubes Mean:	32 (29 - 37) µgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA

Bias calculated using 6 periods of data

Bias factor A	0.97 (0.87 - 1.12)
Bias B	3% (-10% - 16%)
Diffusion Tubes Mean:	33 µgm^{-3}
Mean CV (Precision):	2
Automatic Mean:	32 µgm^{-3}
Data Capture for periods used:	100%
Adjusted Tubes Mean:	32 (29 - 37) µgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

UK and Ireland Office Locations