Silvertown Tunnel Baseline Air Quality Monitoring Report

First Year of Monitoring, 2021
The Silvertown Tunnel Order 2019 No. 413

Transport for London

Project number: 60636520

August 2022

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Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	May 22	Draft for comment	DD	David Deakin	Technical Director
2	July 22	Final Draft	DD	David Deakin	Technical Director
3	August 22	Final Report	DD	David Deakin	Technical Director

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1.2 Air pollution concentrations during 2020 and 2021 have been influenced by changes in travel behaviour and traffic flows as a result of the Covid-19 pandemic and national lockdowns as well the more recent fuel crisis situation in late 2021. The overall indications in London are that traffic flows are now returning to pre-pandemic levels so future concentrations are likely to reflect this.

Silvertown Tunnel Monitoring

1.3 This report presents the results of the first year of Nitrogen Dioxide (NO_2) monitoring for 2021 for Transport for London (TfL)s Silvertown Tunnel Scheme. Monitoring was conducted using low-cost diffusion tubes at 38 locations and at three continuous monitoring sites to provide reference standard data. These locations are shown in Appendix A.

1.4 The monitoring is required to meet the commitments TfL made as part of the Development Consent Order (DCO)[2] and Monitoring and Mitigation Strategy (MMS)[3] to conduct pre and post Scheme monitoring to compare concentrations.

1.5 In line with the MMS, this report presents NO_2 concentrations, in comparison to the Air Quality Strategy (AQS) Objective Values. Data from both Scheme and local authority monitoring sites that are likely to reflect potential impacts from the tunnel are provided. This report does not provide information on $PM_{2.5}$ or describe results against thresholds outside of the AQS as this is not part of the MMS and DCO requirements for the Scheme.

1.6 The headline results at the continuous monitoring sites show that measured NO_2 concentrations in 2021 complied with the AQS Objective values at locations close to the Scheme (see Table 1-1).

Table 1-1. Summary of 2021 NO_2 Concentrations at Continuous Monitoring Sites

Statistic	Tunnel Avenue (TL4)	Hoola Tower (TL5)	Britannia Gate (TL6)	AQS Objective
Annual Mean NO_2 (µg/m^3)	34.3	21.8	26.4	40
Number of 1-hour mean NO_2 concentrations exceeding objective value of 200 µg/m^3	0	0	0	18
Data Capture Rate showing proportion of valid measurements (%)	94.5	81.4 (99.6)*	95.8	-

*Data capture rate since monitoring began in March 2021 in brackets.

[1] https://www.london.gov.uk/sites/default/files/london_health_burden_of_current_air_pollution_and_future_health_benefits_of_mayoral_air_quality_policies_january2020.pdf
[2] https://infrastructure.planninginspectorate.gov.uk/projects/london/silvertown-tunnel/
[3] TR010021-001726-8.84 Monitoring and Mitigation Strategy R2 .pdf (planninginspectorate.gov.uk)

1.7 Of the 38 diffusion tube monitoring sites, the annual mean NO_2 concentrations complied with the AQS objectives in the vicinity of the tunnel. There were exceedances recorded at the following three sites in the wider area:

- DT3 Douglas Road, Newham Way (40.2 µg/m^3);
- DT17 East India Dock Road (42.2 µg/m^3); and
- DT24 A3 Blackheath Hill (42.6 µg/m^3).

1.8 The subsequent Scheme refreshed assessment will provide an assessment of the updated modelled results compared to those reported in the Environmental Statement (ES) for the DCO. This comparative work will be presented in the Environmental Compliance Assessment Report.

2. Introduction

Air quality in London

2.1 Tackling air pollution across the capital is a key focus for the Greater London Authority and TfL. The Mayor of London has adopted a number of policies to improve air pollution. In recent years, these have included the expansion of the ultra-Low Emission Zone (ULEZ), introduction of 12 low emission bus zones, funding more than 20 Low Emission Neighbourhoods in 15 boroughs and improvements to the TfL bus fleet. With these policies in place, the life expectancy of a child born in London in 2013 would improve by 5-6 months than without them, and overall, the population of London would gain around 6.1 million life years from 2013 to 2050[4].

2.2 Levels of air pollution are measured at more than 100 continuous monitoring and 1000's of diffusion tube sites across London to determine compliance against the UK's Air Quality Strategy (AQS) Objective Values 2010 (see Table 3-1). The World Health Organisation (WHO)[5] has developed their own guidelines for outdoor ambient air quality which are more stringent than the UK AQOs. However, the WHO guidelines have not been adopted into UK legislation. The Silvertown DCO sets out the legal requirements and commitments regarding the appropriate AQ limits in which the scheme was assessed against and will be reassessed in the refreshed assessment and reported in the Environmental Compliance Assessment.

2.3 With a combination of Mayoral policies and ongoing reductions in background pollution, the following improvements in measured air quality levels are evident across London's monitoring sites from 2016 to the end of 2019.[6]

- A reduction of the number of exceedances of the hourly mean nitrogen dioxide (NO_2) objective by 97%;
- A reduction in annual mean NO_2 concentrations by an average of 21% with a maximum reduction of 50% in Putney High Street (where the first low emission bus zone was introduced);
- A reduction in the number of monitoring sites exceeding the annual mean NO_2 objective by 40%; and
- An average reduction in annual mean particulate matter (PM_{10} and $PM_{2.5}$) concentrations by 11% and 9% respectively, with a reduction of 14% and 16% at roadside sites.

2.4 Air pollution concentrations during 2020 and 2021 have been influenced by changes in travel behaviour and traffic flows as a result of the Covid-19 pandemic and national lockdowns as well the more recent fuel crisis situation in late 2021. The overall indications in London are that traffic flows are now returning to pre-pandemic levels so future concentrations are likely to reflect this. -

Monitoring Overview

2.5 The Silvertown Tunnel Scheme (the "Scheme") involves the construction of a 1.4km twin-bore road tunnel under the Thames which will be the first in London in over 30 years. It will be a modern tunnel which will, combined with a user charge, improve cross-river public transport and will improve the reliability and resilience of the wider road network and reduce congestion on the road network. Benefits of the scheme include:

- Effectively eliminate delays and queues at the Blackwall Tunnel, with journey times up to 20 minutes faster;

[4] https://www.london.gov.uk/sites/default/files/london_health_burden_of_current_air_pollution_and_future_health_benefits_of_mayoral_air_quality_policies_january2020.pdf
[5] World Health Organization (WHO) 2021. https://apps.who.int/iris/bitstream/handle/10665/345329/9789240034228-eng.pdf?sequence=1&isAllowed=y
[6] https://www.london.gov.uk/sites/default/files/air_pollution_monitoring_data_in_london_2016_to_2020_feb2020.pdf

- Reduce the environmental impact of traffic congestion on some of London's most polluted roads; and
- Provide more opportunities to cross the river by public transport with a network of zero-emission buses offering new routes and better access to more destinations.

2.6 The scheme was subject to a full Environmental Impact Assessment at the DCO stage which was rigorously tested at the examination. However, it was determined that there was some uncertainty associated with NO_2 effects that required further monitoring closer to the scheme opening date. Following the outcomes of the Environmental Statement (ES) and as part of the DCO [7], the Monitoring and Mitigation Strategy (MMS)[8] was developed. The MMS sets out the requirements for further air quality monitoring relating to pre and post Scheme opening. The monitoring will also be used in the refreshed assessment of Scheme impacts which must be completed to:

- Set the User Charges;
- Define the requirement for and form of localised mitigation for residual effects; and
- Specify the bus network through the Silvertown Tunnel that will operate on opening.

2.7 For this process TfL are updating the relevant transport and environmental models, rerunning the models, and developing its proposals for each element in conformity with the commitments, policies and procedures set out in the relevant certified documents and any DCO requirements.

2.8 TfL has implemented a series of Air Quality monitoring programmes for the scheme, this included wider NO_2 monitoring for the ES in 2015/2016 and NO_2 monitoring in 2019 around the Hoola Tower close to the northern tunnel portal. The ES concluded that other pollutants (including particulates) complied with the relevant AQS Objectives, therefore this report presents the baseline monitoring as set out in the MMS where only NO_2 monitoring is required.

2.9 This report presents the results of the first year of NO_2 monitoring for 2021, in the context of the AQS Objective Values. Data from Scheme specific monitoring sites and selected local authority roadside monitoring sites close to the tunnel openings are reported.

Monitoring Requirements

2.10 The MMS states that NO_2 monitors should be sited as below:

a) where the Scheme is forecast to bring about a change in air quality in excess of 0.4 $\mu g/m^3$ where annual mean concentrations are above the national air quality objective value;

b) where the Scheme could lead to traffic diverting to alternative routes which were not foreseen in the original assessment; and

c) to ensure the monitoring locations are representative of relevant exposure at sensitive receptors.

2.11 The MMS also included a map of proposed AQ monitoring locations which were chosen based on the outcomes of the ES and the criteria set out in paragraph 2.10. Based on the above requirements and using the proposed monitoring locations, TfL had a number of meetings with Silvertown Tunnel Implementation Group (STIG) representatives for the five local authorities where the monitoring locations were proposed, to agree the monitoring locations. Following the agreement with STIG representatives, 38 triplicate passive diffusion tubes were installed across LB Newham, RB Greenwich, LB Tower Hamlets, LB Lewisham and LB Southwark, to provide information on NO_2 levels across the wider road network that may be affected by changes in traffic levels associated with the Scheme. The location of these diffusion tube sites is shown in Figure A1 in Appendix A.

2.12 In addition, three continuous monitoring sites (CMS) with NO_x analysers were installed close to the tunnel openings at roadside locations where Scheme impacts are likely to be greatest. The

[7] Silvertown Tunnel | National Infrastructure Planning (planninginspectorate.gov.uk)
[8] TR010021-001726-8.84 Monitoring and Mitigation Strategy R2 .pdf (planninginspectorate.gov.uk)

CMS were installed at Tunnel Avenue (TL4) in RB Greenwich, Hoola Tower (TL5) and Britannia Gate (TL6) both in LB Newham. The locations of these monitors are shown in Figure A2 in Appendix A.

2.13 In line with the MMS and DCO requirements, NO_2 will be monitored for three year's pre-Scheme opening and for a minimum of three year's post-Scheme opening in 2025 to provide data to inform baseline conditions and Scheme impacts.

2.14 As there are a number of existing local authority monitoring sites located close to the tunnel openings, data from selected sites in this area has also been included within this report to provide a fuller coverage of the baseline conditions. The locations of these selected sites are given in Figure A3 in Appendix A.

2.15 This report provides the results of the first full year of air quality baseline monitoring undertaken between 1st January 2021 and 31st December 2021. The report describes the monitoring locations and presents the results in the context of the relevant UK AQS objectives. Any exceedances of these objectives are highlighted. This report does not provide a comparison against any previous data collected by TfL. A comparative analysis will be undertaken once the updated air quality modelling work has been completed to understand the schemes effects and to address the matters outlined in the bullets in section 2.7. The environmental outcomes will be reported in the Environmental Assessment Compliance Report due in 2023.

2.16 Monitoring of construction dust and particulates is being carried out separately to the monitoring presented in this report. The construction air quality monitoring programme is managed by Riverlinx Construction Joint Venture who are contracted to complete the design and construction of the Silvertown Tunnel.

3. Air Quality Objectives

3.1 Table 3-1 sets out the UK AQS Objectives that are of relevance to the air quality monitoring programme.

3.2 The table defines the averaging period and an associated Objective that should not be exceeded. For short-term Objectives there may be an allowable number of exceedances. For example, the UK AQS Objective for 1-hour NO_2 concentrations is an hourly mean NO_2 concentration of 200 µg/m^3 to be exceeded 18 times or fewer per year. This is equivalent to the 99.79th percentile of hourly mean NO_2 concentrations.

Table 3-1. Air Quality Objectives and Guidelines

Pollutant	Averaging Period	AQS Objective (µg/m^3)	Not to be Exceeded More Than
Nitrogen dioxide (NO_2)	Annual	40	-
	1-hour	200	18 hours (99.79th percentile)

4. Air Quality Monitoring Locations

Scheme Continuous Monitoring Stations (CMS)

4.1 Details of the CMS are shown in Table 4-1, along with a link to the relevant webpages of the London Air Quality Network (LAQN), where additional information about each site can be found and monitoring data can be downloaded. The monitoring site IDs are consistent with those in the LAQN for other existing TfL CMSs (TL1-3 are existing monitors in the network).

4.2 Tunnel Avenue, Greenwich (TL4) is in the Royal Borough of Greenwich alongside the A102 Blackwall Tunnel southern approach near to the location of the southern portal for the proposed Silvertown Tunnel. Hoola Tower (TL5) is located at the northern end of the proposed tunnel opening close to Hoola West Tower and Britannia Gate (TL6) is located at the northern end of the proposed tunnel opening on Silvertown Way. Both TL5 and TL6 are located in the London Borough of Newham. The locations of these monitoring stations are shown in Figure A2 in Appendix A.

4.3 Monitoring began at site TL4 and TL6 in December 2020 and in March 2021 at TL5 due to additional work required to provide power to the monitor.

4.4 All three stations are reference standard equipped with chemiluminescence analysers for the measurement of NO_x and NO_2.

Scheme Diffusion Tube Monitoring Locations

4.5 The diffusion tubes were installed in December 2020 at roadside sites close to the tunnel openings, on the approaching road links and on key routes north and south of the River Thames. Monitoring is conducted within the boroughs of Newham, Tower Hamlets, Lewisham, Greenwich and Southwark. Three of the diffusion tube sites are co-located with the three CMS; TL4, TL5 and TL6.

4.6 The Scheme ES[9] concluded that the greatest potential air quality impact would be at residential properties at the Hoola Tower, Tidal Basin Road in Newham. An additional six diffusion tube locations were therefore placed around the Hoola Tower building to further understand the potential air quality concentrations and impacts in this specific area.

4.7 A total of 38 diffusion locations were agreed with STIG, with triplicate diffusion tubes sited at each location. Details of the sites are in Table 4-2 and their locations are shown in Figure A1 in Appendix A. The tubes were prepared and analysed by Staffordshire Highways Laboratory, using the 20% triethanolamine (TEA) in water method of analysis. The methods used for the preparation and analysis of passive diffusion tubes match those used in the Scheme specific monitoring reported in the ES.

Local Authority Monitoring Locations

4.8 There are a number of local authority run air quality monitoring sites around the tunnel openings. NO_2 concentrations from representative roadside sites within 2km of the tunnel have been included in this report to provide additional baseline data, in addition to a nearby urban background site. These locations are situated in Greenwich, Newham and Tower Hamlets, as shown in Table 4-3.

[9] TR010021-000472-Transport for London - Chapter 6 Air Quality.pdf (planninginspectorate.gov.uk)

Table 4-1. Scheme Continuous Monitoring Station Site Details

Site ID	Site Address, London Borough	Site Type	X (m)	Y (m)	Height (m)	Distance to Kerb (m)	Distance to Relevant exposure (m)	Distance to Tunnel Portal (m)	LAQN Website Link
TL4	Tunnel Avenue, Greenwich	Roadside	539223	179250	1.3	13.0	260	30	TL4
TL5	Hoola Tower, Newham	Roadside	539936	180732	1.5	2.6	10	115	TL5
TL6	Britannia Gate, Newham	Roadside	540339	180263	1.4	5.8	7	700	TL6

Table 4-2. Scheme Diffusion Tube Site Details

Site ID	Site Address, London Borough	Site Type	X (m)	Y (m)	Height (m)	Distance to Kerb (m)	Distance to Relevant exposure (m)	Distance to Tunnel Portal (km)
DT1	3 Washington Close, Tower Hamlets	Roadside	538028	182780	3.0	0.9	2.3	2.7
DT2	Tynne Court on A12 Blackwall Tunnel, Tower Hamlets	Roadside	538101	182040	2.5	0.5	5.5	2.1
DT3	Douglas Road, Newham Way, Newham	Roadside	540302	181769	2.8	3.9	5.4	1.1
DT4	1041 Newham Way, Newham	Roadside	542221	182127	2.3	3.3	11.2	2.8
DT5	Strait Road / 3 Campion Close, Newham	Roadside	542911	180913	2.9	1.6	6.7	3.1
DT6	Hanameel Street / North Woolwich Road, Newham	Roadside	540635	180130	2.8	2.9	25.1	1.0
DT7	John Wilson Street / St Mary Street, Greenwich	Roadside	543181	179034	2.3	2.6	6	3.8
DT8	Southern Way, Greenwich	Roadside	539926	178964	2.5	12.0	8.6	0.7

Site ID	Site Address, London Borough	Site Type	X (m)	Y (m)	Height (m)	Distance to Kerb (m)	Distance to Relevant exposure (m)	Distance to Tunnel Portal (km)
DT9	Westcombe Hill / Westerdale Road, Greenwich	Roadside	540257	178208	2.6	0.7	12.9	1.5
DT10	Sun-in-the-Sands, Greenwich	Roadside	540770	176945	2.4	10.3*	2.4	2.8
DT11	311 Prince Regent Lane, Newham	Roadside	541098	181646	3.0	3.1	4.7	1.6
DT12	Robin Hood Lane, Tower Hamlets	Roadside	538357	180968	2.8	0.4	2.5	1.4
DT13	46 Ming Street, Tower Hamlets	Roadside	537347	180722	2.9	7.3*	12.6	2.4
DT14	East Parkside, Greenwich	Roadside	539578	179536	2.5	>50m	125.2	0.4
DT15	45 Siebert Road, Greenwich	Roadside	540423	177707	2.4	16.0*	10.5	2.0
DT16	Switch House, Tower Hamlets	Roadside	538925	180938	2.9	0.6	20.8	0.8
DT17	East India Dock Road, Tower Hamlets	Roadside	538721	181180	2.9	1.2	7.3	1.1
DT18	13 College Approach, Greenwich	Roadside	538327	177780	2.7	1.0	0.8	1.7
DT19	8 Silvertown Way, Newham	Roadside	539498	181422	2.6	1.2	9	0.7
DT20	68 Lower Road, Southwark	Roadside	535253	179314	2.0	2.9	0	4.0
DT21	Evelyn Street, Lewisham	Roadside	537124	177699	2.7	3.5*	9.1	2.6
DT22	85 Evelyn Street, Lewisham	Roadside	536220	178443	2.5	6.1**	5.3	3.1
DT23	43 Rotherhithe Old Road, Southwark	Roadside	535676	178798	2.6	0.4	9.9	3.6
DT24	A2 Blackheath Hill, Greenwich	Roadside	538410	176743	2.8	2.6	4.6	2.6
DT25	Old Kent Road, Southwark	Roadside	534986	177422	2.6	10.0*	21	4.6
DT26	Lower Road, Southwark	Roadside	535936	178720	2.6	8.0**	7.3	3.3

Site ID	Site Address, London Borough	Site Type	X (m)	Y (m)	Height (m)	Distance to Kerb (m)	Distance to Relevant exposure (m)	Distance to Tunnel Portal (km)
DT27*	1 Silvertown Way, Newham	Roadside	539619	181203	2.3	0.8	5.8	0.5
DT28	Lanrick Road, Tower Hamlets	Roadside	538961	181331	2.5	2.2	7.3	1.0
DT29	Deptford Church Street, Lewisham	Roadside	537398	177488	2.3	8.2*	12.5	2.6
Hoola 1	Hoola Tower - 3 Tidal Basin Rd, Newham	Roadside	539905	180737	1.3	25.0	0	0.1
Hoola 2	Hoola Tower - 3 Tidal Basin Rd, Newham	Roadside	539907	180733	1.3	15.0	0	0.1
Hoola 3	Hoola Tower - 3 Tidal Basin Rd, Newham	Roadside	539909	180729	1.3	10.0	0	0.1
Hoola 5	Hoola Tower - 3 Tidal Basin Rd, Newham	Roadside	539915	180766	1.5	14.0***	0	0.1
Hoola 6	Hoola Tower - 3 Tidal Basin Rd, Newham	Roadside	539938	180749	2.7	16.8	2.8	0.1
Hoola 10	Hoola Tower - 3 Tidal Basin Rd, Newham	Roadside	539922	180730	2.5	2.5	2.8	0.1
TL4	Tunnel Avenue*, Greenwich	Roadside	539223	179250	1.3	13.0	33.5	0.0
TL5	Hoola Tower - 3 Tidal Basin Rd*, Newham	Roadside	539936	180732	1.5	2.6	10.6	0.1
TL6	Britannia Gate / Silvertown Way*, Newham	Roadside	540339	180263	1.4	5.8	5.9	0.7

DT27 was moved to an adjacent lamppost. New co-ordinates are 539642, 181158

Table 4-3 Relevant Local Authority Site Details

Site ID	Site Address, London Borough	Site Type	X (m)	Y (m)	Height (m)	Distance to Kerb (m)	Distance to Relevant exposure (m)	Distance to Tunnel Portal (km)
TH4	Blackwall Tunnel Northern Approach, Tower Hamlets	Roadside	538290	181452	3	3	28.6	1.6
GN6	John Harrison Way, Greenwich	Roadside	539687	179123	3	3	23.7	4.6
GR8	Woolwich Flyover, Greenwich	Roadside	540208	178373	3	3	9.1	1.3
GW36(11)	Boord St, Greenwich	Roadside	539319	179235	2	30	11.9	8.1
GW50	Woolwich Flyover, Greenwich	Roadside	540208	178373	2	3.5	6.8	1.3
GW51 (28)	Bugsbys Way, Greenwich	Roadside	539638	179024	2	2	41.4	4.6
GW61	John Harrison Way, Greenwich	Roadside	539687	179123	2	3.5	23.7	4.6
NM3	Wren Close, Newham	Background	539889	181469	3	N/A	15	7.4
10	Tant Avenue, Newham	Background	539747	181477	1.5	27.8	9.6	7.5
20	Canning Town Roundabout, Newham	Roadside	539687	179123	1.5	0.3	33.5	8.2
73	John Smith Mews, Tower Hamlets	Kerbside	538747	180754	2.3	0.5	12.3	1.0
85	Portree Street, Tower Hamlets	Kerbside	538890	181301	2.3	0.5	4.9	1.0
86	Newport Avenue, Tower Hamlets	Kerbside	538954	180872	2.6	0.5	15.5	8.1

5. Scheme Continuous Monitoring Results

Data Processing

5.1 All data have gone through a process of Quality Assurance/Quality Control (QA/QC) to ensure that monitoring data is fit for purpose. The CMS are calibrated every two weeks and calibration data is sent to the Environmental Research Group (ERG), who are responsible for data management, data validation and ratification as part of the LAQN. This ensures that the data collected and reported are reliable and consistent.

5.2 Data capture rates are used to determine the useability of the data. If data capture for the year is below 85% (as specified in Defra's Technical Guidance LAQM.TG(16)[10]), it is considered less precise. The automatic monitoring sites are also subject to 6 monthly external audits and servicing.

5.3 Full details of the QA/QC procedures are provided in Appendix C.

Tunnel Avenue (TL4), Greenwich

5.4 Table 5-1 summarises the results of the baseline monitoring for the period 1st January 2021 to 31st December 2021 ('the monitoring period') for the TL4 CMS.

5.5 Data capture for the monitoring period was 94.5%. This is above the recommended 85% minimum data capture defined by The Department for Environment, Food and Rural Affairs (Defra) for data quality purposes.

5.6 The annual mean NO_2 concentration was 34.3 µg/m^3. This achieves the annual mean NO_2 AQS Objective of 40 µg/m^3.

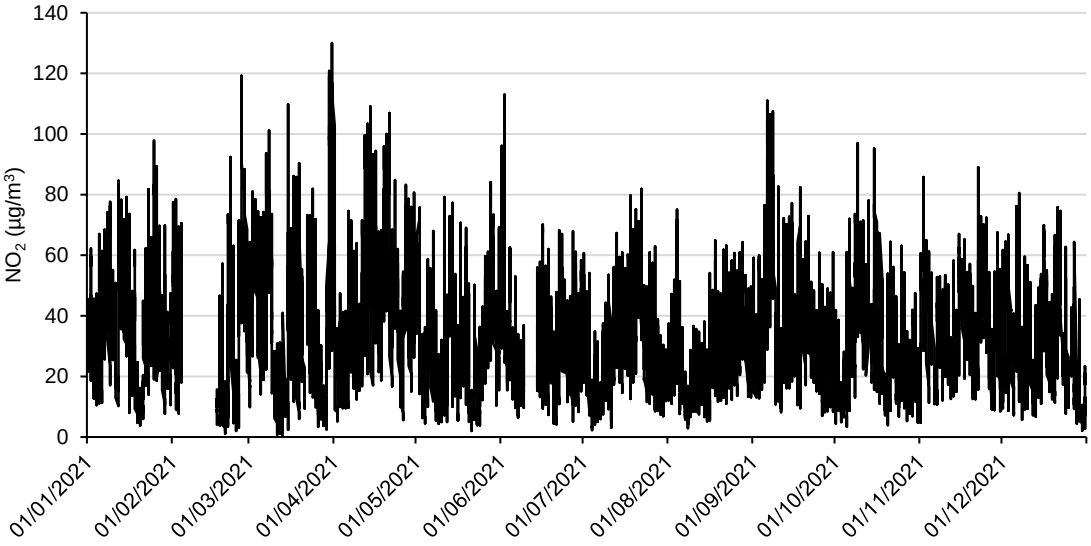
5.7 The maximum 1-hour mean NO_2 concentration was 130 µg/m^3, which meant that the 1-hour mean NO_2 AQS Objective value of 200 µg/m^3 was not exceeded during the monitoring period. This is within the 18 permitted hours of exceedance and therefore the 1-hour mean NO_2 AQS Objective was achieved.

Table 5-1. Tunnel Avenue (TL4) Air Quality Monitoring Results, 2021

Statistic	NO_x	NO	NO_2
Annual Mean (µg/m^3)	61.2	17.6	34.3
Number of 1-hour mean NO_2 concentrations exceeding objective value of 200 µg/m^3	-	-	0
Data Capture (%)	94.5	94.5	94.5

[10] LAQM-TG16-April-21-v1.pdf (defra.gov.uk)

Figure 5-1. Time Series Plot of 1-hour Mean NO_2 Concentrations at TL4 – Tunnel Avenue Greenwich, 1st January 2021 to 31st December 2021



5.8 Monitored hourly values clearly vary over the year, with higher peaks seen around April 2021, and lower concentrations observed during the summer period. The seasonal variation observed at TL4 is similar to that observed at Newham's Wren Close urban background monitoring site (Figure 7-4) and across all other roadside sites.

Hoola Tower (TL5), Newham

5.9 Table 5-2 summarises the results of the baseline monitoring for the period 8th March 2021 to 31st December 2021 ('the monitoring period') for the TL5 CMS.

5.10 Data capture for the annual monitoring period was 81.4%. This is below the recommended 85% minimum data capture defined by The Department for Environment, Food and Rural Affairs (Defra) for data quality purposes. This is because the site was not installed until March 2021 due to issues with electrical supply. Since its installation, TL5 has achieved a high level of data capture (99.6 %).

5.11 The annual mean NO_2 concentration was 21.8 µg/m^3. This achieves the annual mean NO_2 AQS Objective of 40 µg/m^3. Data from this site were not annualised as the data capture rate was above 75%.

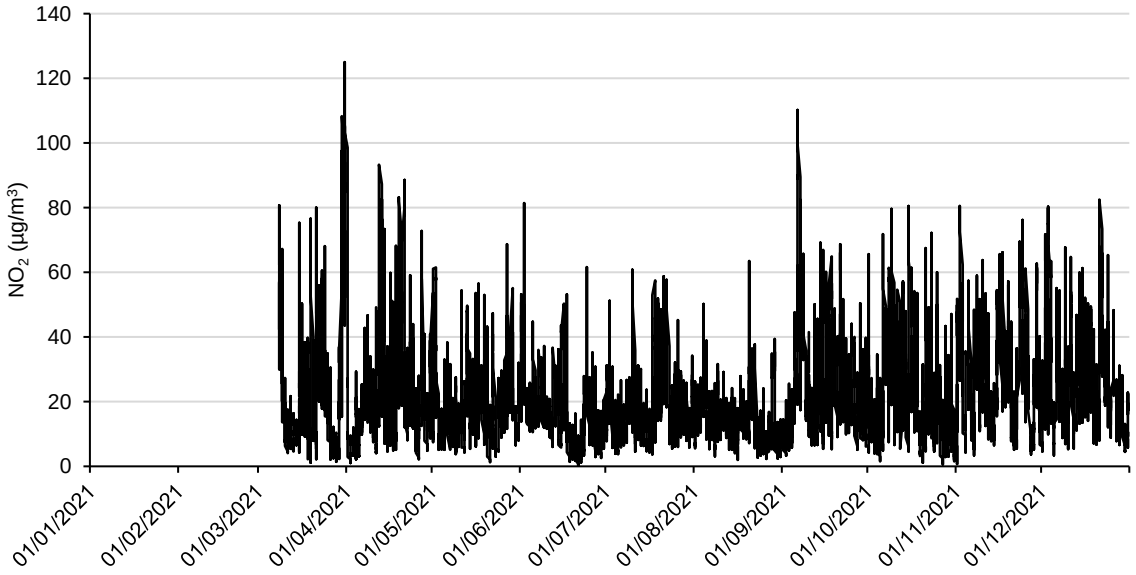
5.12 The maximum 1-hour mean NO_2 concentration was 125 µg/m^3, which meant that the 1-hour mean NO_2 AQS Objective value of 200 µg/m^3 was not exceeded during the monitoring period. This is within the 18 permitted hours of exceedance and therefore the 1-hour mean NO_2 AQS Objective was achieved.

Table 5-2. Hoola Tower (TL5) Air Quality Monitoring Results, 2021

Statistic	NO_x	NO	NO_2
Annual Mean (µg/m^3)	30.6	5.7	21.8
Number of 1-hour mean NO_2 concentrations exceeding objective value of 200 µg/m^3	-	-	0
Data Capture (%)	81.4 (99.6)*	81.4 (99.6)	81.4 (99.6)

*Capture rate since monitoring began in March 2021 in brackets.

Figure 5-2. Time Series Plot of 1-hour Mean NO_2 Concentrations at TL5 – Hoola Tower Newham, 8th March 2021 to 31st December 2021



5.13 Hourly values were highest in April and in the autumn/winter period. As indicated in Figure 7-4, the seasonal variation observed at TL5 follows a similar trend to that observed at LB Newham's Wren Close urban background monitoring site. This trend is seen across all sites. It also should be noted that Monitoring at this site commenced in March 2021 due to issues with power supply on the site, this has now been resolved.

5.14 It is noted that there are a number of idling delivery vehicles immediately outside the monitoring unit observed during site visits which may be affecting concentrations. The number of these vehicles have increased during the year.

Britannia Gate (TL6), Newham

5.15 The maximum 1-hour mean NO_2 concentration was 114 µg/m^3, which meant that the 1-hour mean NO_2 AQS Objective value of 200 µg/m^3 was not exceeded during the monitoring period. This is within the 18 permitted hours of exceedance and therefore the 1-hour mean NO_2 AQS Objective was achieved.

5.16 Table 5-3 summarises the results of the baseline monitoring for the period 1st January 2021 to 31st December 2021 ('the monitoring period') for the TL6 CMS.

5.17 Data capture for the monitoring period was 95.8%. This is above the recommended 85% minimum data capture defined by Defra for data quality purposes.

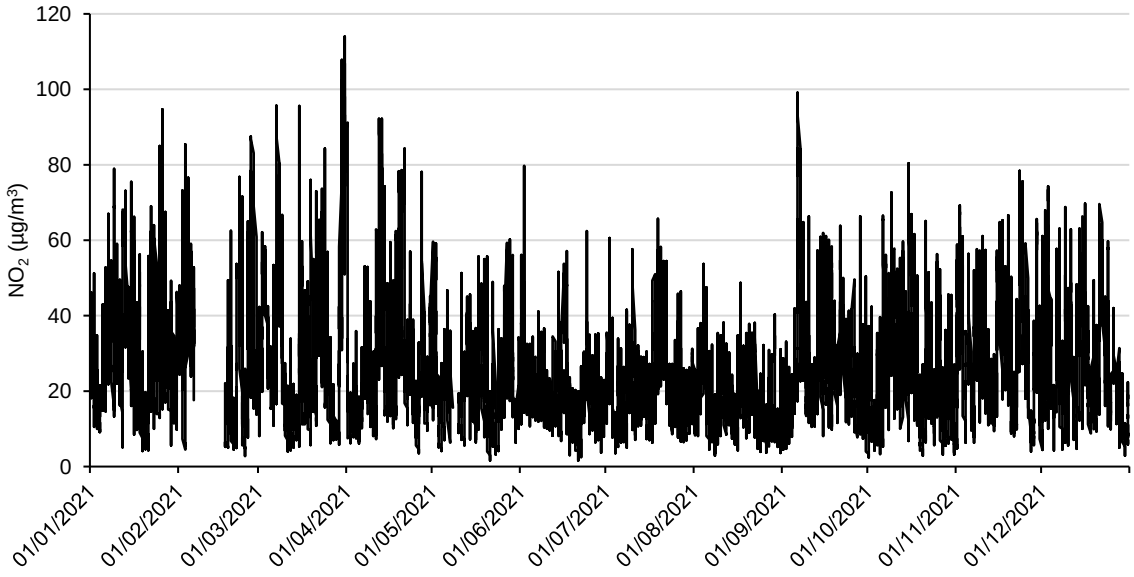
5.18 The annual mean NO_2 concentration was 26.4 µg/m^3. This achieves the annual mean NO_2 AQS Objective of 40 µg/m^3.

5.19 The maximum 1-hour mean NO_2 concentration was 114 µg/m^3, which meant that the 1-hour mean NO_2 AQS Objective value of 200 µg/m^3 was not exceeded during the monitoring period. This is within the 18 permitted hours of exceedance and therefore the 1-hour mean NO_2 AQS Objective was achieved.

Table 5-3. Brittania Gate (TL6) Air Quality Monitoring Results, 2021

Statistic	NO_x	NO	NO_2
Annual Mean (µg/m^3)	44.3	11.7	26.4
Number of 1-hour mean NO_2 concentrations exceeding objective value of 200 µg/m^3	-	-	0
Data Capture (%)	95.8	95.8	95.8

Figure 5-3. Time Series Plot of 1-hour Mean NO_2 Concentrations at TL6 – Britannia Gate Newham, 1st January 2021 to 31st December 2021



5.20 Hourly concentrations show a similar patten to the other two CMS, with higher peak values during spring and autumn/winter periods. This trend across the year is also broadly similar to the data collected at local authority monitoring sites (see Section 7).

6. Scheme Diffusion Tube Monitoring Results

Data Processing

6.1 Diffusion tube data is processed by Staffordshire Highways Laboratory using a preparation method of 20% TEA in water. In line with Defra guidance, data have been adjusted using a factor based on the difference between diffusion tube readings and readings from a continuous reference monitor, called a bias adjustment factor. Two factors have been calculated, one based on co-located tubes with the three continuous monitoring sites and a second using data from the national basis factor database which is based on multiple co-location studies for the laboratory.

6.2 Full details of the QA/QC procedure are provided in Appendix C.

Summary

6.3 The results of the diffusion tube monitoring survey for the period 6th January 2021 to 7th January 2022 are summarised in Table 6-1. The data report has been adjusted using the national bias adjustment factor as this approach is more conservative than using a locally derived factor.

6.4 The complete monthly diffusion tube data including local and nationally adjusted results for the monitoring period can be found in Appendix B.

Table 6-1. Scheme Diffusion Tube Monitoring Results, 2021

Site	Raw Annual Mean NO_2 Concentration ($\mu g/m^3$)	Triplicate Data Capture Rate (%)	National Adjusted Annual Mean NO_2 Concentration* ($\mu g/m^3$)
DT1	29.1	86.1%	25.1
DT2	**43.4**	94.4%	37.6
DT3	**46.7**	100.0%	**40.2**
DT4	35.8	97.2%	30.7
DT5	25.5	94.4%	22.2
DT6	31.1	86.1%	26.1
DT7	35.5	97.2%	30.6
DT8	33.1	100.0%	28.4
DT9	**40.9**	94.4%	35.0
DT10	33.1	100.0%	28.5
DT11	36.6	100.0%	31.5
DT12	**43.8**	94.4%	37.8
DT13	31.4	77.8%	26.9

Site	Raw Annual Mean NO_2 Concentration ($\mu g/m^3$)	Triplicate Data Capture Rate (%)	National Adjusted Annual Mean NO_2 Concentration* ($\mu g/m^3$)
DT14	27.2	97.2%	23.6
DT15	33.2	97.2%	28.5
DT16	33.2	100.0%	28.6
DT17	**49.1**	97.2%	**42.2**
DT18	**41.0**	97.2%	35.4
DT19	36.6	100.0%	31.4
DT20	30.1	83.3%	26.0
DT21	30.8	100.0%	26.5
DT22	35.0	100.0%	30.1
DT23	**42.8**	94.4%	36.8
DT24	**49.5**	94.4%	**42.6**
DT25	29.9	94.4%	25.8
DT26	27.7	100.0%	23.8
DT27	37.8	100.0%	32.5
DT28	38.2	97.2%	33.0
DT29	27.5	100.0%	23.6
TL4	37.9	88.9%	31.9
TL5	33.0	80.6%	27.6
TL6	31.5	83.3%	27.0

Notes: *Concentrations in **bold** denote exceedances of the annual mean AQS objective value.*

6.5 Throughout the monitoring period, any relevant local site-specific issues identified are recorded to assist in analysing trends. Issues noted during 2021 are outlined below:

- February 2021 - Construction work around DT16, which could have increased NO_2 levels at this location. However, monthly concentrations appear unaffected at this time;
- August 2021 – New bus stop placed directly next to site DT27. The tube was relocated to an adjacent column to reduce the contribution of emissions directly from buses. No clear influence from bus emissions were observed in the data;
- September 2021 - Placement of a new sign on the lamppost in front of DT7. The height of the tube was adjusted to avoid restricting air flow. Recorded concentrations at the location were higher in September than in August and October. However, levels were not outside the range in concentrations recorded over the course of the year; and

- End of 2021 – An increase of numbers of idling vehicles on Tidal Basin Road next to the Hoola Tower which may lead to an increase in concentrations at TL5 and co-located tubes. Concentrations at these locations seem for the most part unaffected.

6.6 All diffusion tubes achieved data capture rates above 90% for 2021, removing the requirement for annualisation.

6.7 Using the national bias adjustment factor, there were three diffusion tube locations where the adjusted period mean NO_2 concentration exceeded the 40 µg/m^3 annual mean AQS Objective. These were:

- Site DT3 (Douglas Road, Newham Way);
- Site DT17 (East India Dock Road); and
- Site DT24 (A3 Blackheath Hill).

6.8 The highest adjusted period mean NO_2 concentration was 42.6 µg/m^3 at Blackheath Hill (site DT24).

6.9 Due to the long exposure periods needed for diffusion tube sampling, it is not possible to make direct comparisons against the 1-hour mean NO_2 AQS Objective. As a proxy, Defra suggests using an annual mean NO_2 concentration of 60 µg/m^3 for diffusion tube measurements to determine the likelihood of the short-term AQS Objective being achieved or exceeded[11]. There were no diffusion tube sites where the annual mean NO_2 concentration exceeded 60 µg/m^3 and therefore the 1-hour mean NO_2 AQS Objective is expected to have been met.

6.10 The highest average monthly NO_2 concentrations were monitored during the winter months, as is consistent with the UK-wide trend. The lowest concentrations occurred between May-August 2021.

Additional Monitoring at the Hoola Tower

6.11 In addition to the monitoring locations specified within the MMS, a number of additional diffusion tubes were located around the Hoola West Tower, located on Tidal Basin Road in Newham.

6.12 There is the potential for increases in NO_2 concentrations due to the Scheme at this location given the Hoola Towers' proximity to tunnel portal and changes in road network with the Scheme. Data from these supplementary locations will provide additional information on NO_2 concentrations around the Tower.

6.13 The sites chosen replicated six of the 10 monitoring sites previously deployed by Arcadis on behalf of TfL from May 2019 to February 2020. These previous data collected by Arcadis are provided in Table 6-2 in comparison with the 2021 concentrations at the same sites.

Table 6-2. Scheme Diffusion Tube Monitoring Results at Hoola Tower, 2021

Site	Adjusted and Annualised Annual Mean 2019 NO_2 Concentration (µg/m^3)**	Raw Period Mean NO_2 Concentration (µg/m^3)	Data Capture Rate (%)	Adjusted Annual Mean 2021 NO_2 Concentration (µg/m^3)*
Hoola 1	**40.0**	28.1	91.7%	24.3
Hoola 2	39.5	29.4	91.7%	25.2
Hoola 3	**42.3**	27.3	91.7%	23.8
Hoola 5	**44.0**	30.0	100.0%	25.5
Hoola 6	**44.6**	32.2	100.0%	27.9

[11] Microsoft Word - TG_NO2 relationship_report_draft1.doc (defra.gov.uk)

Site	Adjusted and Annualised Annual Mean 2019 NO_2 Concentration ($\mu g/m^3$)**	Raw Period Mean NO_2 Concentration ($\mu g/m^3$)	Data Capture Rate (%)	Adjusted Annual Mean 2021 NO_2 Concentration ($\mu g/m^3$)*
Hoola 10	38.5	30.8	100.0%	26.7

*Notes: Concentrations in **bold** above the annal mean AQS objective value * National Bias Adjustment Factor **Results from Arcadis with National Bias Factor applied and annualised to 2019.*

6.14 The data show that the measured 2021 concentrations at all diffusion tube sites around the Hoola Tower are significantly lower than the annualised period data in 2019 by more than 50%. There may be several reasons for this reduction in concentrations, including:

- Reductions in concentrations over time due to improvements and upgrades to the vehicle fleet, for example through the expansion of the Ultra Low Emission Zone (ULEZ);
- Periods of lower road traffic levels in 2021 compared to 2019 due to the Covid-19 pandemic and associated lockdown periods; and
- 2019 data were only available for part of the year, so have been annualised to represent an annual mean.

6.15 It is noted that this reduction around the Hoola Tower between 2019 and 2021 is line with the trends seen across the borough. For example, concentrations monitored at 99 schools reduced by 27% over these three years and by more than 35% at the nearby monitoring sites; NHM-10 and 20 (see Section 7).

6.16 In 2021, NO_2 concentrations were highest at Hoola 6, located to the east of the West Tower. The concentration measured at Hoola 10 located close to Tidal Basin Road were similar to the value for the tube at TL5, co-located with the continuous monitoring site.

6.17 The data collected around the Hoola Towers show that the 2021 annual mean NO_2 concentrations are well below the AQS objective value. Concentrations have dropped by around 30-40% since 2019, which is in line with the reductions seen at local authority monitoring stations.

7. Local Authority Monitoring Results

Selected Continuous Monitoring Results

Blackwall (TH4), Tower Hamlets

7.1 Table 7-1 summarises the results of the baseline monitoring for the the monitoring period for the TH4 CMS and hourly data are provided in Figure 7-1.

7.2 Data for the monitoring period has been fully ratified and data capture for the monitoring period was 98.9%. This is above the recommended 85% minimum data capture defined by Defra for data quality purposes.

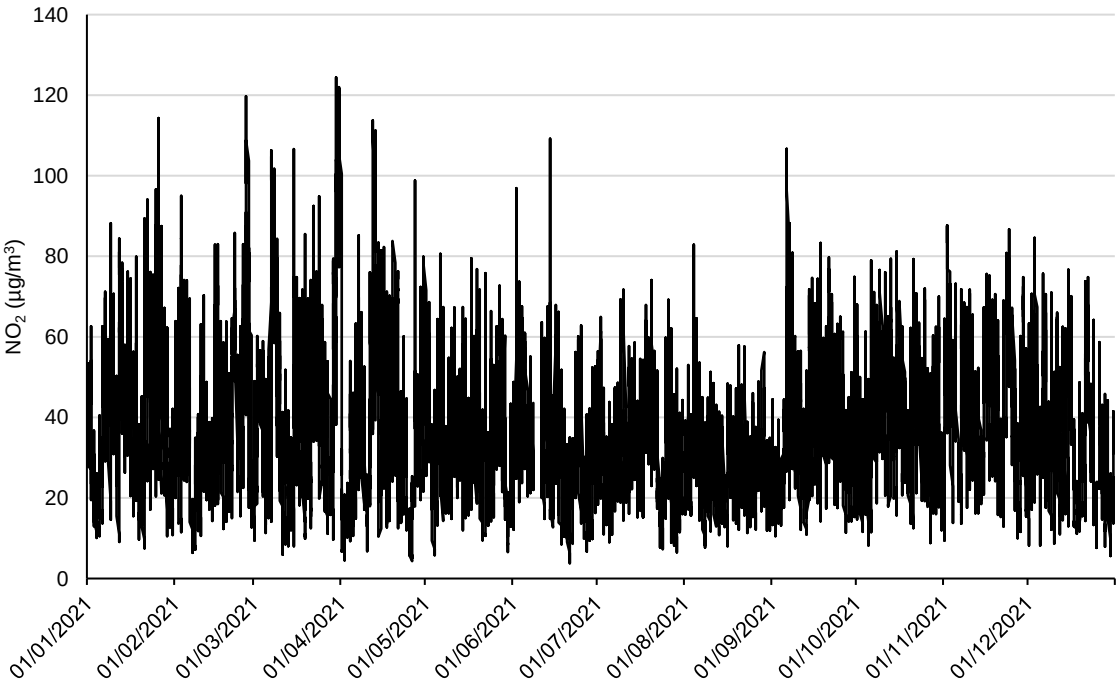
7.3 The period mean NO_2 concentration was 37.4 µg/m^3. This achieves the annual mean NO_2 AQS Objective of 40 µg/m^3.

7.4 The 1-hour mean NO_2 AQS Objective value of 200 µg/m^3 was exceeded on no occasions during the monitoring period. This is within the 18 permitted hours of exceedance and therefore the 1-hour mean NO_2 AQS Objective was achieved.

Table 7-1. Blackwall (TH4) Air Quality Monitoring Results, 2021

Statistic	NO_x	NO	NO_2
Annual Mean (µg/m^3)	75.0	24.5	37.4
Number of 1-hour mean NO_2 concentrations exceeding objective value of 200 µg/m^3	-	-	0
Data Capture (%)	98.9	98.9	98.9

Figure 7-1. Time Series Plot of 1-hour Mean NO_2 Concentrations at TH4 – Blackwall Tower Hamlets, 1st January 2021 to 31st December 2021



7.5 Trends in annual mean concentrations over the last five years at TH4 are shown in Table 7-2. The measured data show that concentrations have declined by 33% over this period and have been below the annual mean objective for the last two years.

Table 7-2. Annual mean NO_2 concentrations at Blackwall (TH4) between 2017 - 2021

Statistic	2017	2018	2019	2020	2021	Percentage change
Annual Mean (µg/m^3)	**56.1**	**50.7**	**47.4**	38.6	37.4	-33%
Data Capture (%)	96.2	98.9	98.6	98.9	98.9	-

*Note: Concentrations in **bold** above the annual mean AQS objective value*

John Harrison Way (GN6), Greenwich

7.6 Table 7-3 summarises the results of the baseline monitoring for the monitoring period for the GN6 CMS and hourly data are provided in Figure 7-2.

7.7 Data for the monitoring period has been fully ratified and the data capture for the monitoring period was 97.3%. This is above the recommended 85% minimum data capture defined by Defra for data quality purposes.

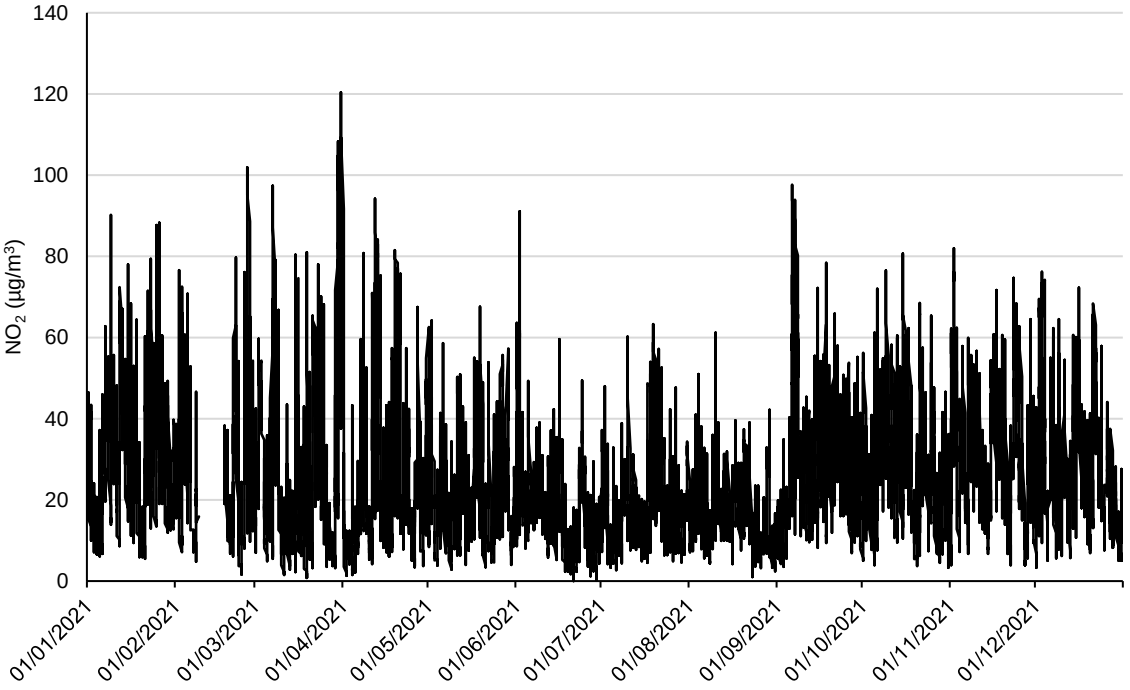
7.8 The period mean NO_2 concentration was 25.3 µg/m^3. This achieves the annual mean NO_2 AQS Objective of 40 µg/m^3.

7.9 The 1-hour mean NO_2 AQS Objective value of 200 µg/m^3 was exceeded on no occasions during the monitoring period. This is within the 18 permitted hours of exceedance and therefore the 1-hour mean NO_2 AQS Objective was achieved.

Table 7-3. John Harrison Way (GN6) Air Quality Monitoring Results, 2021

Statistic	NO_x	NO	NO_2
Annual Mean (µg/m^3)	38.8	8.8	25.3
Number of 1-hour mean NO_2 concentrations exceeding objective value of 200 µg/m^3	-	-	0
Data Capture (%)	97.3	97.3	97.3

Figure 7-2. Time Series Plot of 1-hour Mean NO_2 Concentrations at GN6 – John Harrison Way-Greenwich, 1st January 2021 to 31st December 2021



7.10 GN6 is located approximately 500 m southeast of AECOM's TL4 monitoring site. The sites are not positioned on the same road, with TL4 located on Tunnel Avenue off A102, and GN6 on John Harrison Way which is a smaller road. GN6 monitored an annual mean NO_2 concentration of 25.3 µg/m^3, whereas TL4 recorded an annual mean NO_2 concentration of 34.3 µg/m^3, likely to be because it is positioned nearer the A102.

7.11 Trends in annual mean concentrations over the last five years at GN6 are shown in Table 7-4. The measured data show that concentrations have declined by 25% over this period.

Table 7-4. Annual mean NO_2 concentrations at John Harrison Way (GN6) between 2017 - 2021

Statistic	2017	2018	2019	2020	2021	Percentage change
Annual Mean (µg/m^3)	-	33.7	32.9	25.6	25.3	-25%
Data Capture (%)	-	43.0	100.0	100.0	97.3	-

Woolwich Flyover (GR8), Greenwich

7.12 Table 7-5 summarises the results of the baseline monitoring for the monitoring period for the GR8 CMS and hourly data are provided in Figure 7-3.

7.13 Data for the monitoring period has been fully ratified and data capture for the monitoring period was 99.9 %. This is above the recommended 85% minimum data capture defined by Defra for data quality purposes.

7.14 The period mean NO_2 concentration was 40.3 µg/m^3. This exceeds the annual mean NO_2 AQS Objective of 40 µg/m^3.

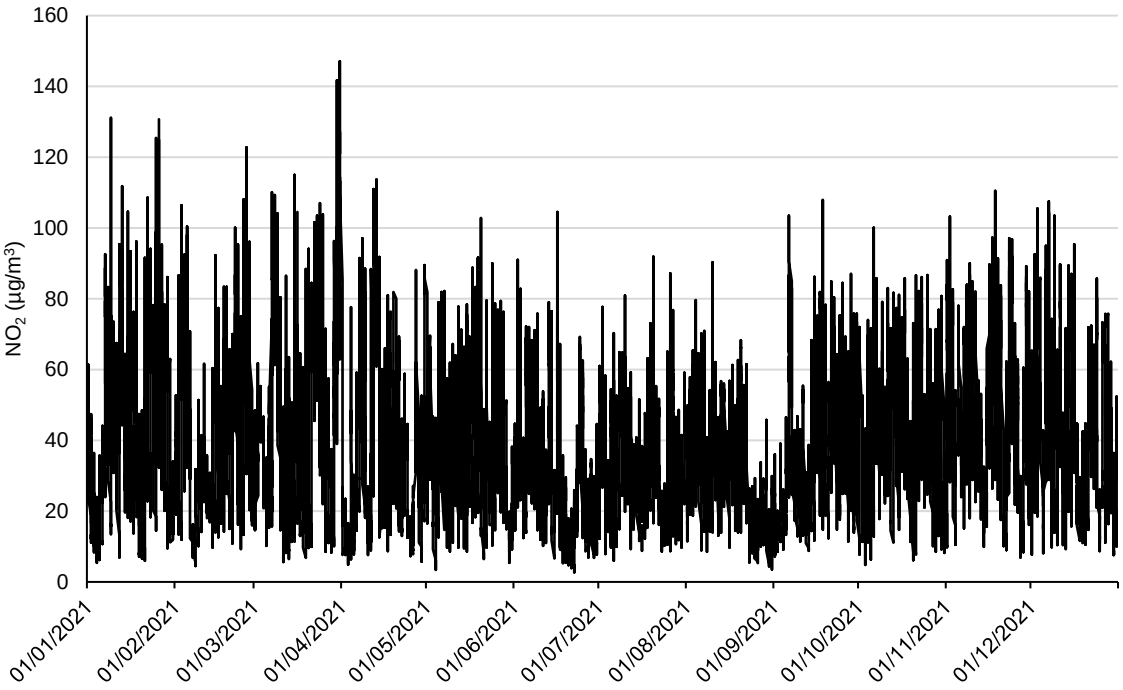
7.15 The 1-hour mean NO_2 AQS Objective value of 200 µg/m^3 was exceeded on no occasions during the monitoring period. This is within the 18 permitted hours of exceedance and therefore the 1-hour mean NO_2 AQS Objective was achieved.

Table 7-5. Woolwich Flyover (GR8) Air Quality Monitoring Results, 2021

Statistic	NO_x	NO	NO_2
Annual Mean (µg/m^3)	103.3	41.1	**40.3**
Number of 1-hour mean NO_2 concentrations exceeding objective value of 200 µg/m^3	-	-	0
Data Capture (%)	99.9	99.9	99.9

*Note: Concentrations in **bold** above the annual mean AQS objective value*

Figure 7-3. Time Series Plot of 1-hour Mean NO_2 Concentrations at GR8 – Woolwich Flyover-Greenwich, 1st January 2021 to 31st December 2021



7.16 GR8 is located 1.3 km south of AECOM's TL4 monitoring site. GR8 monitored an annual mean NO_2 concentration of 40.3 µg/m^3, whereas TL4 recorded an annual mean NO_2 concentration of 34.3 µg/m^3. Both sites are roadside monitoring locations, however TL4 is positioned further back from the road (13 m from the kerb) compared to GR8 which is located 3 m from the nearest kerb.

7.17 Trends in annual mean concentrations over the last five years at GR8 are shown in Table 7-6. The measured data show that concentrations have declined by 38% over this period but remain above the objective value.

Table 7-6. Annual mean NO_2 concentrations at Woolwich Flyover (GR8) between 2017 - 2021

Statistic	2017	2018	2019	2020	2021	Percentage change
Annual Mean (µg/m^3)	**65.3**	**56.7**	**52.3**	**43.2**	**40.3**	**-38%**
Data Capture (%)	91.8	95.6	99.7	98.4	100.0	-

*Note: Concentrations in **bold** above the annual mean AQS objective value and concentrations in bold and underlined are at risk of exceedance of the hourly mean objective value*

Wren Close (NM3), Newham

7.18 Table 7-7 summarises the results of the baseline monitoring for the monitoring period for the NM3 urban background CMS. Hourly data are provided in Figure 7-4.

7.19 Data for the monitoring period has been fully ratified and data capture for the monitoring period was 95.6%. This is above the recommended 85% minimum data capture defined by Defra for data quality purposes.

7.20 The period mean NO_2 concentration was 20.6 µg/m^3. This achieves the annual mean NO_2 AQS Objective of 40 µg/m^3.

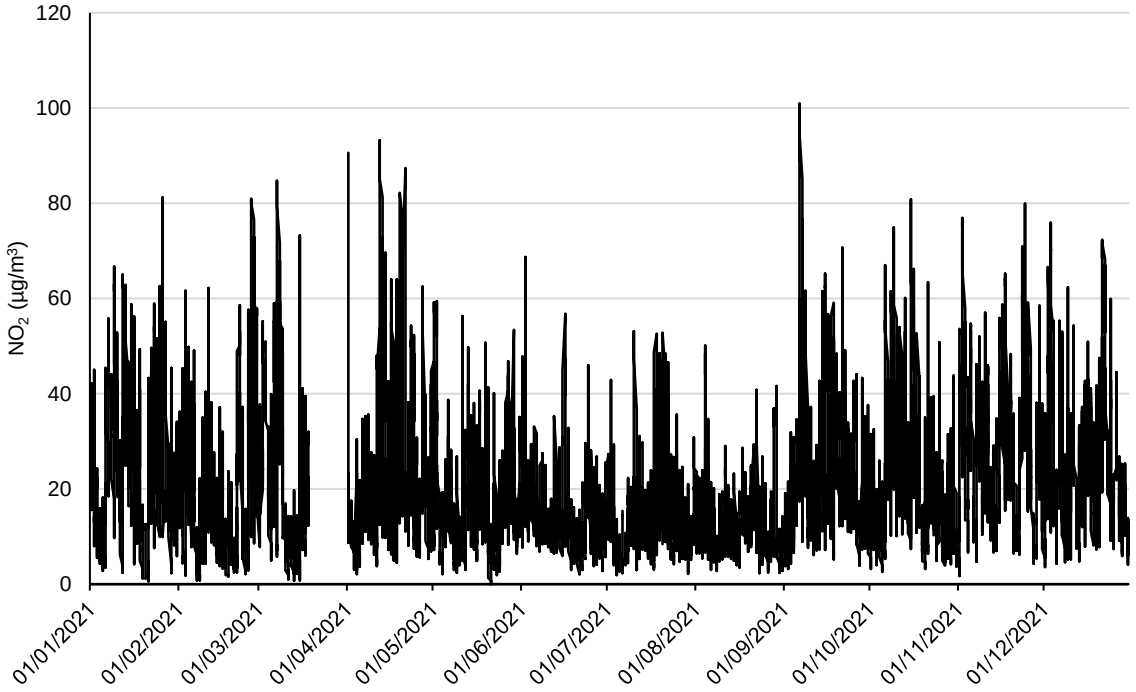
7.21 The 1-hour mean NO_2 AQS Objective value of 200 µg/m^3 was exceeded on no occasions during the monitoring period. This is within the 18 permitted hours of exceedance and therefore the 1-hour mean NO_2 AQS Objective was achieved.

7.22 The trend in recorded NO_2 concentrations over the course of 2021 at Wren Close mirror those recorded at previously mentioned roadside sites. Concentrations increased in spring and winter, with peak concentrations around April and September.

Table 7-7. Wren Close (NM3) Air Quality Monitoring Results, 2021

Statistic	NO_x	NO	NO_2
Annual Mean (µg/m^3)	26.7	4.0	20.6
Number of 1-hour mean NO_2 concentrations exceeding objective value of 200 µg/m^3	-	-	0
Data Capture (%)	95.6	95.6	95.6

Figure 7-4. Time Series Plot of 1-hour Mean NO_2 Concentrations at NM3 – Wren Close-Newham, 1st January 2021 to 31st December 2021



7.23 Trends in annual mean concentrations over the last five years at GR8 are shown in Table 7-8

7.24 . The measured data show that concentrations have declined by 7% over this period, which is a lower reduction than measured at the roadside sites.

Table 7-8. Annual mean NO_2 concentrations at Wren Close (NM3) between 2017 - 2021

Statistic	2017	2018	2019	2020	2021	Percentage change
Annual Mean (µg/m^3)	30.1	28.5	28.0	20.3	20.7	-7%
Data Capture (%)	97.5	96.7	99.7	94.0	95.1	

Selected Diffusion Tube Monitoring Results

7.25 Selected results from local authority diffusion tube monitoring surveys at roadside locations for the years 2017 - 2021 are summarised in Table 7-9. Data have been extracted from the latest Air Quality Annual Status Reports (ASRs) for Newham[12], Greenwich[13] and Tower Hamlets[14].

7.26 Of the selected results, there were two diffusion tube locations where the adjusted annual mean NO_2 concentration was greater than 40 µg/m^3 in 2020 and therefore exceeded the annual mean NO_2 UK AQS Objective. These were:

- Site GW36(11), Boord Street; and
- Site GW50, Woolwich Flyover.

7.27 Both sites are operated and maintained by Royal Borough of Greenwich.

7.28 There were no measured exceedances of the annual AQS Objective in 2021.

Table 7-9. Selected Local Authority Diffusion Tube Monitoring Results, 2017-2021

Site	Site Name and Local Authority	Distance to Road (m)	Bias Adjusted Annual Mean NO_2 Concentration (µg/m^3)					Percentage change (all years)
			2017	2018	2019	2020	2021	
GW36 (11)	Boord Street, Greenwich	30.0	**56.4**	**46.9**	**49.3**	**41.0**		-27%
GW50	Woolwich Flyover, Greenwich	3.0	**69.5**	**54.3**	**53.2**	**49.0**		-29%
GW51 (28)	Bugby's Way, Greenwich	2.0	**43.6**	37.0	39.0	30.0		-31%
GW61	John Harrison Way, Greenwich	3.0	28.1	31.9	32.8	26.0		-7%
NHM-10	Tant Avenue E16, Newham	30.0	30.0	27.0	25.0	20.0	16.0	-47%
NHM-20	Canning Town Round about, Newham	0.3	**56.0**	**58.0**	**57.0**	33.0	29.0	-48%
73	John Smith Mews, Tower Hamlets	0.5	**40.0**	32.0	31.0	24.6	26.0	-35%
85	Portree Street,	0.5	**48.0**	**45.0**	38.0	34.3	33.5	-30%

[12] London Borough of Newham (2021). Air Quality Annual Status Report for 2021. Available at: https://www.newham.gov.uk/downloads/file/4812/newham-asr-2021
[13] Royal Borough of Greenwich (2021). Air Quality Annual Status Report for 2020. Available at: https://www.royalgreenwich.gov.uk/downloads/file/5486/air_quality_annual_status_report_2020. 2021 data not yet available.
[14] London Borough of Tower Hamlets (2022). Air Quality Annual Status Report for 2021.

Site	Site Name and Local Authority	Distance to Road (m)	Bias Adjusted Annual Mean NO_2 Concentration ($\mu g/m^3$)					Percentage change (all years)
			2017	2018	2019	2020	2021	
	Tower Hamlets							
86	Newport Avenue, Tower Hamlets	0.5	33.0	30.0	28.0	21.7	24.6	-25%

*Note: Concentrations in **bold** denote exceedances of the annual mean AQS objective value and those **bold and underlined** are at risk of exceedance of the hourly mean objective. Concentrations in 2020 have been affected by the Covid-19 pandemic including lockdowns, and must be interpreted with caution.*

7.29 The data from the selected local authority sites close to the Scheme have shown a decrease in concentrations since 2017

7.30 Several of AECOM's Scheme-specific monitoring locations are situated in close proximity to local authority managed sites. A comparison against these sites shows concentrations are similar which provides confidence in the results reported for the Scheme as outlined below.

- AECOM's site DT19 is positioned on A1011 Silvertown Way, 90 m south of Newham's monitoring site NHM-20. In 2021, DT19 monitored an annual mean NO_2 concentration of 31.4 $\mu g/m^3$, which is similar to the 2020 and 2021 concentrations monitored at Newham's site NHM-20 of 29 $\mu g/m^3$.
- Tower Hamlets' site 86 is located 60 m south of AECOMs site DT16, on Newport Avenue. In 2021, DT16 monitored an annual mean NO_2 concentration of 28.6 $\mu g/m^3$, which is slightly higher than the 2021 annual mean NO_2 concentration monitored by Tower Hamlets site 86.
- AECOM's site DT28 is located on Lanrick Road, approximately 70 m from Tower Hamlets' site 85. In 2021, DT28 monitored an annual mean NO_2 concentration of 33.0 $\mu g/m^3$, which is broadly the same as the 2021 concentration of 33.5 $\mu g/m^3$ monitored at Tower Hamlets' site 85.
- Levels at two of the selected Greenwich monitoring sites still remain above the objective, despite the reductions seen in 2020 during the Covid-19 lockdown period. 2020 concentrations at GW50 and GW36 on the A102 are higher than 2021 measured data at AECOM's sites TL4 and DT9 further along the same road.

7.31 The 2021 measured NO_2 concentrations at local authority sites in the vicinity of the tunnel are broadly in line with the measured data collected for the scheme for the same year. Concentrations at all local authority sites have reduced over the last five years, by an average of 31%.

8. Summary

Overview

8.1 Transport for London (TfL) is conducting air quality monitoring to assess the environmental impact of the Silvertown Tunnel Scheme. Monitoring was conducted at 38 NO_2 diffusion tube locations and three NOx continuous monitoring sites. The results of the monitoring reported here represent the first year of baseline NO_2 monitoring results for 2021.

8.2 The 2021 monitoring data has been shared with the Silvertown Tunnel Implementation Group (STIG). An annual report will be produced for each year of monitoring to determine the baseline trends pre-Scheme opening and Scheme impacts post-opening.

8.3 The results of the diffusion tube monitoring survey during 2021 indicate that, annual mean NO_2 concentrations comply with the AQS objective at the majority of the 38 monitoring sites, including in the vicinity of the tunnel. There were exceedances of the objective recorded at the following three sites:

- DT3 Douglas Road, Newham Way (40.2 µg/m^3);
- DT17 East India Dock Road (42.2 µg/m^3); and
- DT24 A3 Blackheath Hill (42.6 µg/m^3).

8.4 All other diffusion tube monitoring locations achieve the annual mean NO_2 AQO, including all the additional sites installed around the Hoola Tower.

8.5 Three CMSs were installed in the vicinity of the Scheme:

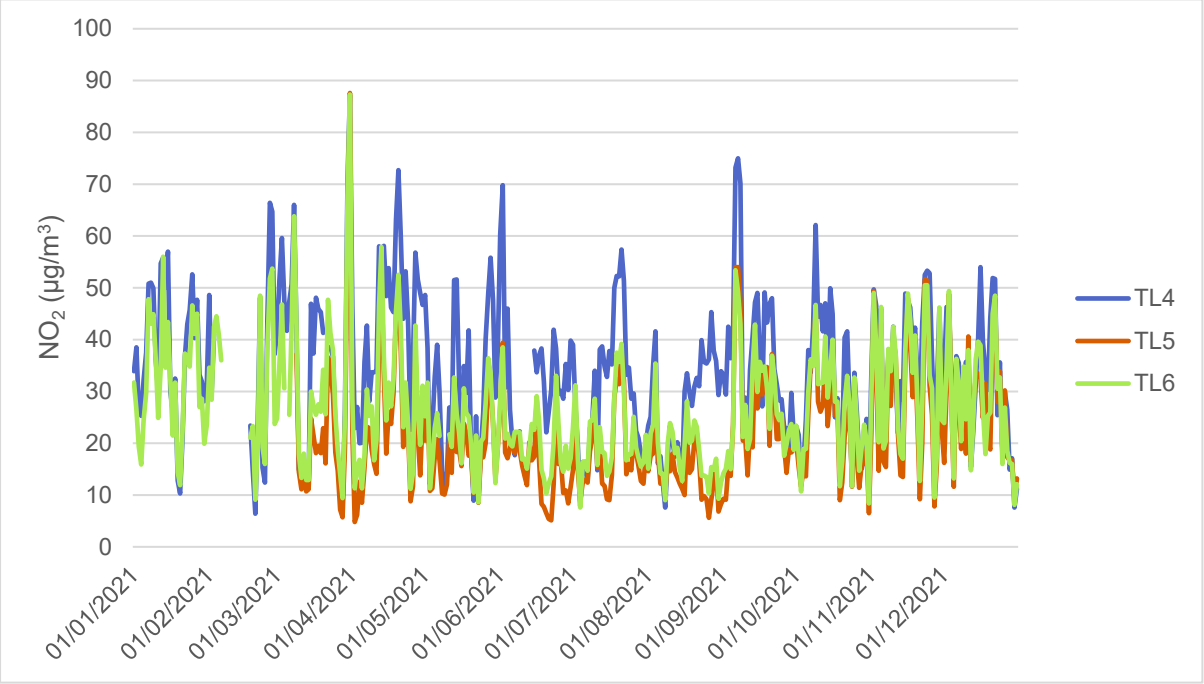
- TL4 (Tunnel Avenue, Greenwich);
- TL5 (Hoola Tower, Newham); and
- TL6 (Britannia Gate, Newham).

8.6 The annual mean NO_2 concentrations at all three continuous monitoring sites complied with the AQS objective in 2021 with a maximum concentration of 34.3 µg/m^3 recorded at TL4 (Tunnel Avenue).

8.7 Average daily concentrations follow a similar trend at all three continuous monitoring sites, as evident in Table 8-1.

8.8 It is expected that annual mean NO_2 concentrations will continue to decline due to continued vehicle fleet improvements as a results of London wide measures such as the ULEZ and wider interventions including electrification of the fleet.

Table 8-1. Daily NO_2 Concentration Data at AECOM's continuous monitoring sites, 2021



8.9 There are three local authority roadside CMSs in the vicinity of the Scheme:

- TH4 Blackwall (Tower Hamlets);
- GN6 John Harrison Way (Greenwich); and
- GR8 Woolwich Flyover (Greenwich).

8.10 In 2021, an exceedance of the annual mean objective for NO_2 was identified at one site, GR8 Woolwich Flyover.

8.11 Of the selected local authority diffusion tube monitoring locations within the study area, two exceedances of the annual mean objective for NO_2 were identified in 2020. These occurred at sites GW36(11) (Boord Street) and GW50 (Woolwich Flyover). GW50 is co-located with GR8, and GW36(11) is located approximately 100 m east of AECOM's TL4 CMS.

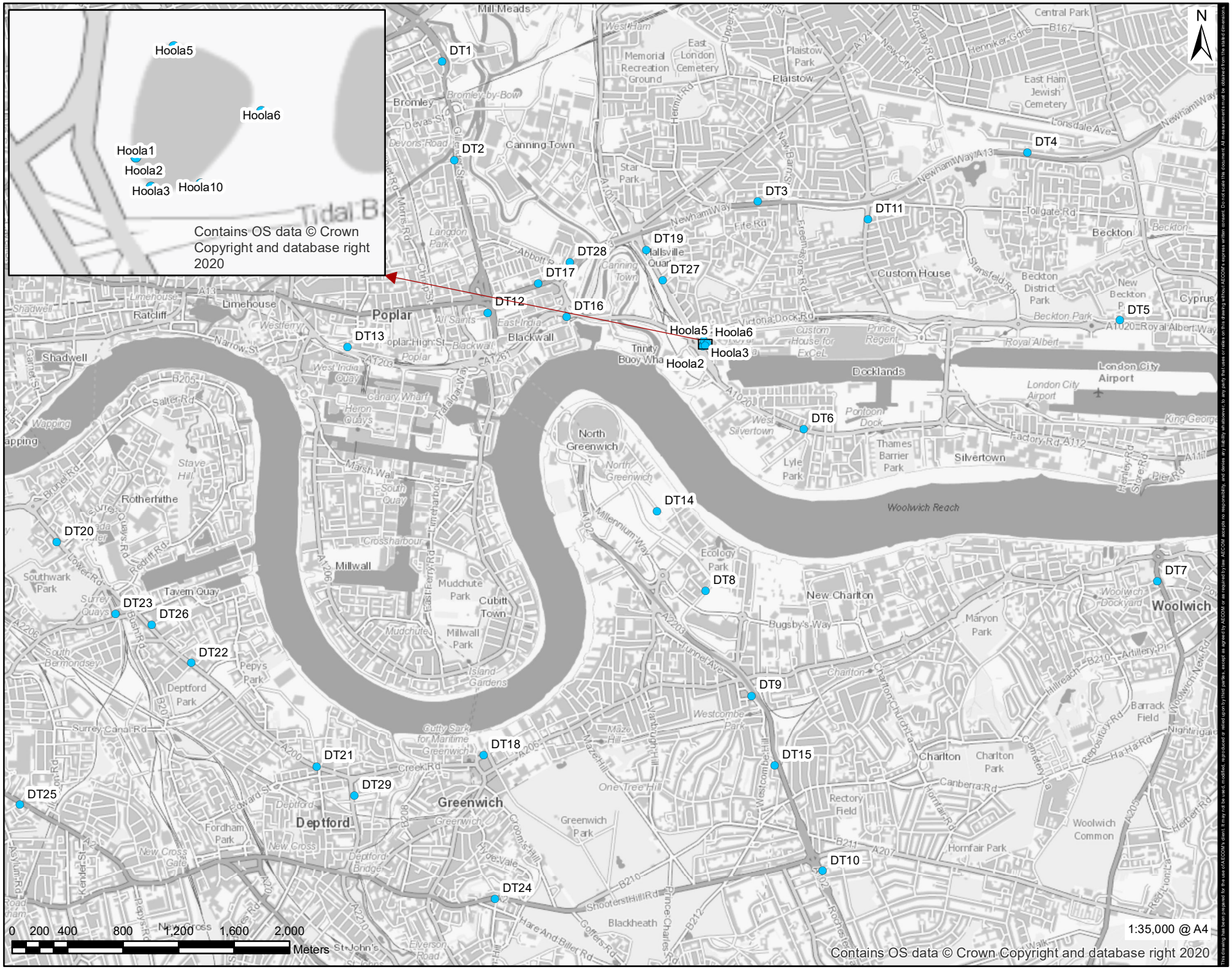
Next Steps

8.12 NO_2 monitoring will continue each year at the same sites for a minimum of three year's pre-Scheme and then for a minimum of 3 years after. Annual monitoring reports will be produced summarising yearly concentrations, and analysis will be undertaken to determine yearly trends in concentrations across sites.

8.13 Post-opening, additional analysis will be undertaken with the aim of isolating the impacts of the Scheme, which may include the use of statistical analysis, removal of seasonal and meteorological influences, consideration of wider London data and trend interpretation.

8.14 The monitoring will also be used in the refreshed assessment of Scheme impacts. The results of the refreshed assessment will be reported in the Environmental Assessment Compliance Report in 2023.

Appendix A Monitoring Locations



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LEGEND
- Scheme Diffusion Tube Monitoring Location

NOTES
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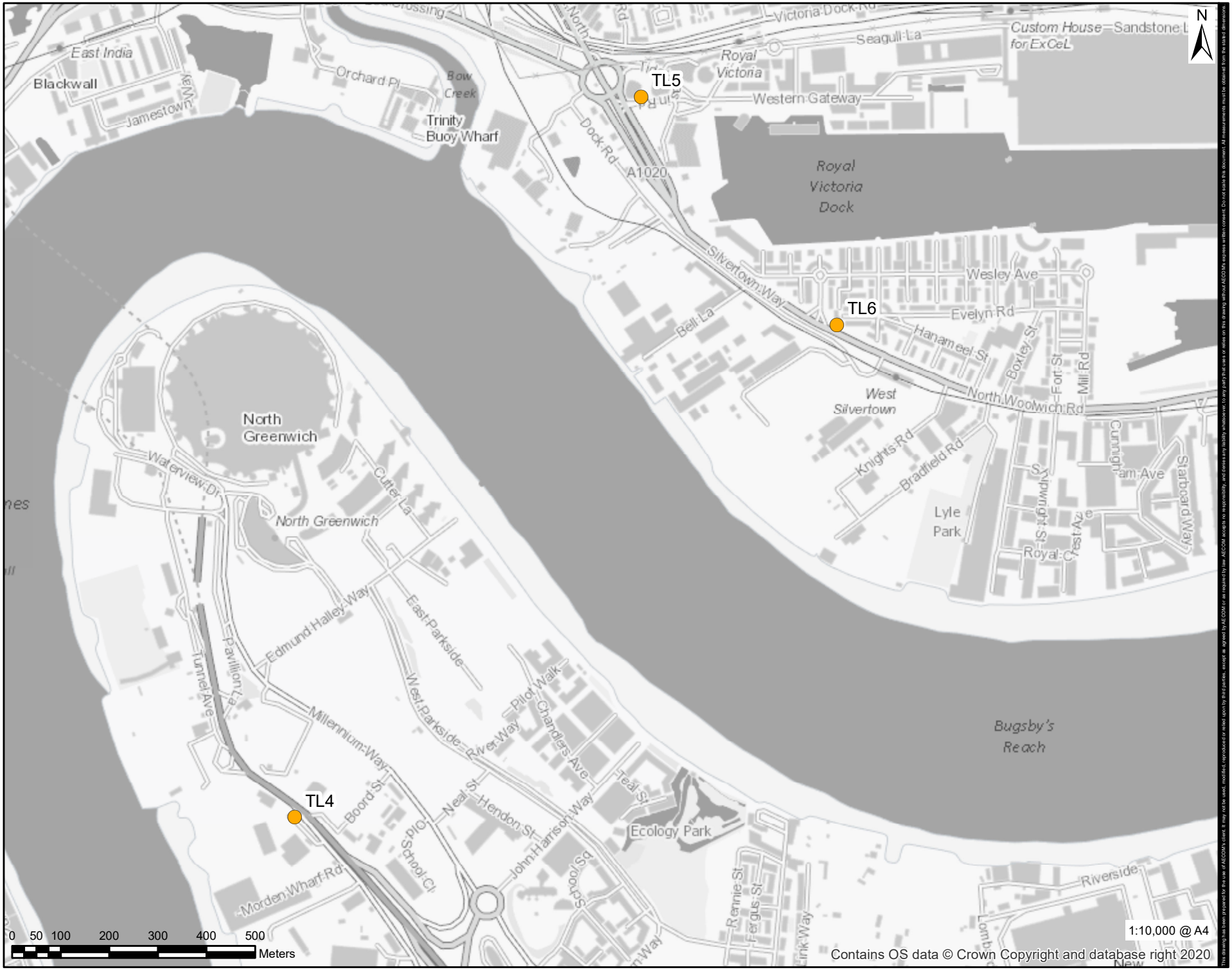
ISSUE PURPOSE
FINAL

PROJECT NUMBER
60636520

SHEET TITLE
Location of Scheme Diffusion Tubes

SHEET NUMBER
Figure A1

Filename: \\na.aecomnet.com\fs\EMEA\Croydon-UKCRD1\DCS\Projects\EGE\60636520_SilvertownTMMS\400_Technical\438_Air Quality Modelling\GIS\Report Figures\Scheme_DT.mxd
Revision: 1 Drawn: AG Checked: PF Approved: AS Date: 24/03/2022



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LEGEND
Scheme Continuous Monitor

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ISSUE PURPOSE
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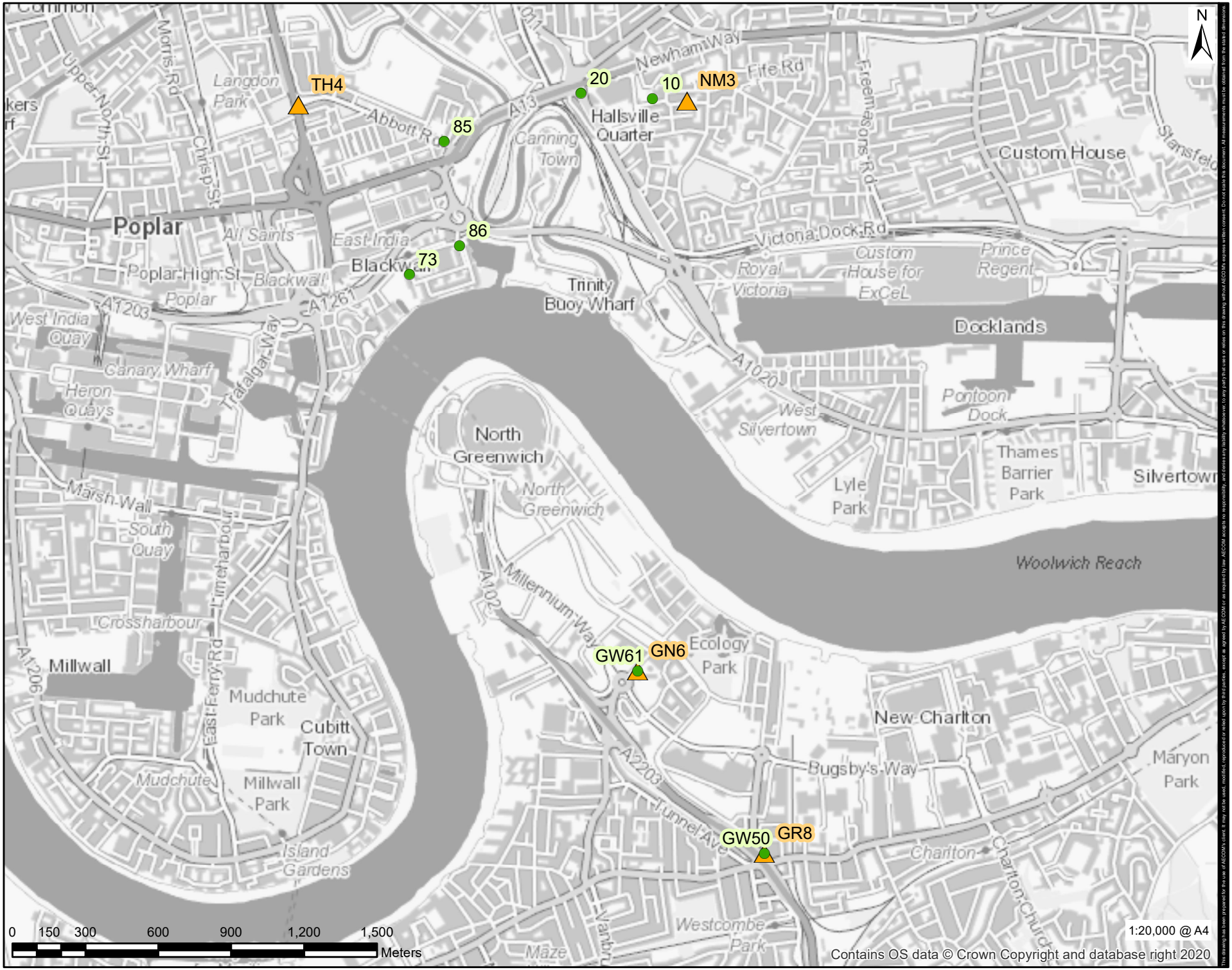
PROJECT NUMBER
60636520

SHEET TITLE
Location of Scheme Continuous Monitors

SHEET NUMBER
Figure A2

Filename: \\na.aecomnet.com\ifs\EMEA\Croydon-UKCRD1\DCS\Projects\EGE\60636520_SilvertownTMMS\400_Technical\438_Air Quality Modelling\GIS\Report Figures\Scheme_CMS.mxd
Revision: 1 Drawn: AG Checked: PF Approved: AS Date: 20/06/2022



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LEGEND

- Selected Local Authority Automatic Monitoring Location
- Selected Local Authority Diffusion Tube Monitoring Location

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ISSUE PURPOSE
FINAL

PROJECT NUMBER
60636520

SHEET TITLE
Selected Local Authority Monitoring Locations

SHEET NUMBER
Figure A3

Filename: \\na.aecomnet.com\lfs\EMEA\Croydon-UKCRD1\DCS\Projects\EGE\60636520_SilvertownTMMS\400_Technical\438_Air Quality Modelling\GIS\Report Figures\LA_Selected DT.mxd
Revision: 1 Drawn: AG Checked: PF Approved: AS Date: 20/06/2022

Appendix B Monthly Diffusion Tube Data

Site Ref	NO_2 Concentration (µg/m^3)												2021 Raw Mean	2021 Raw Triplicate Mean	2021 Local Adjusted Mean	2021 National Adjusted Mean
	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec				
DT1a	35.9	33.9	-	25.3	25.3	-	26.7	19.0	35.1	30.3	33.0	28.6	29.3			
DT1b	-	33.1	28.8	25.2	26.3	-	26.6	20.0	35.5	31.3	34.2	29.4	29.0	29.1	23.6	25.1
DT1c	32.4	31.1	26.6	22.4	27.2	-	31.1	19.4	33.4	31.4	34.5	29.6	29.0			
DT2a	-	**44.0**	**42.7**	32.6	**41.3**	**42.2**	**40.8**	37.4	**52.2**	**44.7**	**46.6**	**40.2**	**42.2**			
DT2b	**47.7**	**45.2**	**47.1**	33.1	39.3	**42.3**	39.9	38.0	**51.1**	**45.4**	**45.9**	39.3	**42.9**	**43.4**	35.3	37.6
DT2c	**60.4**	**48.4**	**45.7**	35.8	39.8	**43.5**	**43.2**	40.0	**49.8**	**45.8**	**-**	**42.2**	**45.0**			
DT3a	**52.6**	**48.5**	**49.8**	36.1	**48.5**	**41.9**	**42.3**	36.9	**56.6**	**49.6**	**46.6**	**45.1**	**46.2**			
DT3b	**54.1**	**51.5**	**50.9**	39.3	**52.0**	**44.7**	**43.6**	37.9	**57.8**	**51.0**	**51.1**	**43.3**	**48.1**	**46.7**	37.7	**40.2**
DT3c	**50.7**	**47.2**	**47.1**	37.9	**47.9**	**40.6**	**44.6**	34.2	**59.0**	**45.2**	**51.0**	**43.7**	**45.8**			
DT4a	**47.0**	36.8	32.8	27.0	34.2	31.6	32.9	28.4	**43.1**	36.8	**41.6**	36.7	35.7			
DT4b	**46.4**	37.2	34.4	29.2	34.8	32.2	-	25.4	**42.8**	37.3	36.0	35.7	35.6	35.8	28.8	30.7
DT4c	**44.6**	36.9	37.5	26.1	36.5	32.2	33.5	26.1	**44.0**	39.7	39.0	36.3	36.0			
DT5a	30.7	25.7	27.2	23.0	23.5	20.4	20.6	18.4	30.5	26.3	-	27.5	24.9			
DT5b	30.9	26.6	26.9	21.9	22.4	21.0	21.4	17.5	30.8	25.2	34.5	25.7	25.4	25.5	20.8	22.2
DT5c	38.1	-	26.1	20.8	22.0	20.3	23.1	18.8	31.7	26.6	33.0	28.6	26.3			
DT6a	39.7	31.9	29.3	26.2	27.9	25.2	-	-	35.8	-	**41.6**	29.3	31.9			
DT6b	37.1	29.4	31.4	25.5	28.0	23.5	26.7	-	35.9	32.8	**40.2**	29.4	30.9	31.1	24.4	26.1
DT6c	34.7	31.4	29.1	25.1	26.8	23.3	-	20.7	36.5	35.4	**42.0**	30.7	30.5			
DT7a	**40.2**	**43.2**	38.4	32.8	36.7	36.3	37.1	28.6	37.2	28.7	**40.4**	32.8	36.0			
DT7b	34.5	39.3	36.6	30.5	33.2	37.9	36.3	29.4	37.9	30.8	**40.1**	34.9	35.1	35.5	28.7	30.6
DT7c	**43.1**	38.3	37.5	34.8	35.9	38.0	29.6	31.0	39.3	30.4	-	31.0	35.4			
DT8a	38.5	32.0	32.1	28.1	32.1	27.6	29.5	25.0	39.1	36.4	39.5	33.9	32.8			
DT8b	38.5	33.3	37.6	26.7	34.0	25.6	27.8	26.1	38.8	35.8	39.0	35.6	33.2	33.1	26.7	28.4
DT8c	39.0	33.3	37.4	25.8	32.3	26.3	29.5	25.1	38.3	34.0	**40.5**	36.8	33.2			
DT9a	38.6	**41.1**	**41.2**	36.8	**42.1**	**45.4**	38.9	36.3	**47.2**	38.4	**43.5**	40.0	**40.8**			
DT9b	**41.2**	39.0	**41.8**	36.3	**41.1**	39.7	39.1	36.5	**48.3**	-	**46.2**	38.7	**40.7**	**40.9**	32.9	35.0
DT9c	**40.2**	39.6	**42.5**	**40.5**	**40.4**	**43.6**	39.3	33.9	**48.3**	-	**46.0**	38.6	**41.2**			
DT10a	39.2	36.9	38.0	29.3	30.7	29.0	27.3	24.8	34.4	33.7	**43.0**	33.1	33.3			
DT10b	**43.0**	33.5	38.2	25.2	30.7	29.8	27.9	26.5	35.5	33.1	**42.3**	31.5	33.1	33.1	26.7	28.5
DT10c	**41.0**	30.6	34.5	28.9	32.0	29.6	26.8	25.9	34.9	35.3	**43.3**	32.0	32.9			
DT11a	37.9	35.9	36.8	32.3	33.1	37.4	33.2	33.2	**42.7**	**40.7**	**49.6**	36.7	37.5			
DT11b	**40.1**	37.2	33.4	28.8	33.8	33.5	30.5	31.4	**40.2**	38.9	**45.4**	37.3	35.9	36.6	29.5	31.5
DT11c	**42.4**	34.0	**40.8**	25.4	33.6	33.7	31.9	31.9	**40.7**	39.0	**48.1**	37.2	36.6			

Site Ref	NO_2 Concentration (µg/m^3)												2021 Raw Mean	2021 Raw Triplicate Mean	2021 Local Adjusted Mean	2021 National Adjusted Mean
	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec				
DT12a	**48.4**	**43.8**	**43.7**	33.3	**47.5**	**42.9**	**42.8**	38.0	**55.0**	**46.0**	**49.2**	**44.6**	**44.6**			
DT12b	**44.7**	**46.2**	**45.4**	36.0	**44.8**	**41.9**	**42.5**	38.0	**53.0**	-	**46.8**	**45.1**	**44.0**	**43.8**	35.5	37.8
DT12c	**48.3**	**40.5**	**43.7**	36.9	**43.0**	**40.1**	**40.5**	34.9	**55.0**	-	**45.2**	**43.4**	**42.9**			
DT13a	38.3	33.1	28.5	27.5	30.9	33.3	**-**	20.7	38.3	-	38.4	34.6	32.4			
DT13b	36.2	35.6	-	29.0	29.7	25.9	28.6	21.1	37.9	-	35.7	32.1	31.2	31.4	25.2	26.9
DT13c	38.5	32.7	-	27.5	30.9	25.7	-	21.2	-	-	35.4	32.2	30.5			
DT14a	34.2	29.2	29.4	21.1	24.5	20.3	23.2	19.4	31.5	31.4	34.0	30.9	27.4			
DT14b	35.3	28.9	28.9	20.7	24.2	20.6	21.7	20.4	30.4	30.8	37.4	31.5	27.6	27.2	22.1	23.6
DT14c	31.5	29.5	29.7	18.8	22.7	20.9	22.5	20.0	31.3	33.2	-	31.5	26.5			
DT15a	34.3	33.1	34.6	35.2	30.0	34.8	30.9	28.5	37.8	28.4	36.1	29.4	32.8			
DT15b	29.9	35.4	36.3	33.0	32.4	34.6	30.9	28.4	38.0	27.0	36.1	28.3	32.5	33.2	26.8	28.5
DT15c	38.0	36.1	36.7	-	32.4	35.2	31.2	28.8	35.6	30.5	39.3	33.2	34.3			
DT16a	**43.4**	31.7	33.5	27.8	26.4	32.0	26.5	27.6	38.8	35.1	**42.7**	35.3	33.4			
DT16b	**41.9**	32.7	33.0	22.8	25.0	31.9	29.7	27.9	38.9	33.5	**44.8**	33.7	33.0	33.2	26.8	28.6
DT16c	38.8	31.6	28.2	29.3	22.7	38.7	31.6	28.3	38.0	33.0	**44.0**	34.7	33.2			
DT17a	**55.3**	**51.7**	**49.0**	39.2	**43.2**		**47.8**	**44.6**	**61.4**	**50.4**	**56.5**	**43.9**	**49.4**			
DT17b	**56.3**	**43.5**	**49.4**	37.1	**45.0**	**48.2**	**49.1**	**44.2**	**57.4**	**46.9**	**52.9**	**42.6**	**47.7**	**49.1**	39.5	**42.2**
DT17c	**55.7**	**48.0**	**52.7**	**44.5**	**50.2**	**48.1**	**48.6**	**44.6**	**57.2**	**49.8**	**55.9**	**45.6**	**50.1**			
DT18a	**47.6**	**41.1**	38.9	35.3	39.7	**41.5**	**40.4**	36.1	-	**42.5**	**46.8**	**40.6**	**41.0**			
DT18b	**44.1**	**40.6**	39.2	36.0	36.7	39.5	39.4	36.2	**48.3**	**40.3**	**50.5**	38.4	**40.8**	**41.0**	33.2	35.4
DT18c	**45.3**	**41.4**	**42.6**	35.2	38.5	**40.1**	**40.2**	35.2	**47.1**	**42.8**	**47.8**	38.4	**41.2**			
DT19a	**46.7**	39.6	**40.6**	30.0	29.2	34.4	34.4	30.6	**44.1**	37.3	**42.7**	36.4	37.2			
DT19b	**44.0**	38.9	34.3	29.5	28.8	35.8	35.4	29.3	**42.2**	36.0	**41.0**	36.6	36.0	36.6	29.5	31.4
DT19c	**41.2**	**40.0**	35.6	26.3	31.6	35.2	36.6	29.8	**40.8**	39.5	**42.6**	39.1	36.5			
DT20a	36.1	34.6	29.6	**-**	26.5	27.9	28.7	23.7	-	34.2	**41.0**	30.7	31.3			
DT20b	37.0	**-**	30.7	24.5	28.3	27.7	27.8	23.2	-	33.2	**-**	30.1	29.2	30.1	24.4	26.0
DT20c	37.1	30.1	30.7	24.4	27.1	28.5	26.6	23.6	-	33.1	35.2	31.3	29.8			
DT21a	37.6	35.2	28.7	24.4	30.1	23.6	24.3	27.3	37.2	35.4	39.4	30.9	31.2			
DT21b	37.3	33.9	27.5	20.6	28.7	23.6	26.4	21.8	35.7	33.8	37.4	32.4	29.9	30.8	24.8	26.5
DT21c	**47.6**	34.4	29.2	22.9	29.2	22.9	26.5	21.3	35.2	33.7	39.0	33.4	31.3			
DT22a	**40.7**	36.8	37.4	35.0	36.9	35.4	38.5	31.8	33.4	29.8	37.0	31.0	35.3			
DT22b	**41.8**	36.0	36.2	32.0	37.1	35.4	36.3	32.5	33.4	29.3	36.0	29.7	34.6	35.0	28.2	30.1
DT22c	**42.4**	39.4	35.7	32.8	34.3	35.0	35.8	32.8	33.2	29.2	38.7	32.2	35.1			

Site Ref	NO_2 Concentration (µg/m^3)												2021 Raw Mean	2021 Raw Triplicate Mean	2021 Local Adjusted Mean	2021 National Adjusted Mean
	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec				
DT23a	**43.0**	39.9	**40.9**	39.9	**45.8**	**46.7**	**46.2**	**40.4**	**55.2**	**40.1**	**47.4**	37.5	**43.6**			
DT23b	**46.6**	**42.0**	38.2	36.7	**44.3**	**43.4**	**45.8**	38.8	**56.2**	**42.2**	**44.4**	39.3	**43.2**	**42.8**	34.5	36.8
DT23c	38.0	39.4	-	39.9	-	**42.2**	**42.6**	37.6	**55.3**	40.0	**44.8**	36.4	**41.6**			
DT24a	**55.9**	**52.6**	**52.0**	34.4	**57.4**	**46.6**	**49.4**	39.5	**55.7**	**56.9**	**51.8**	**44.6**	**49.7**			
DT24b	-	**52.1**	**52.0**	32.2	**57.2**	**53.9**	**50.3**	**40.5**	**54.9**	**52.1**	**50.7**	**47.8**	**49.0**	**49.5**	**40.2**	**42.6**
DT24c	**57.5**	**51.0**	**50.0**	34.8	**60.1**	**-**	**47.4**	**41.0**	**55.8**	**49.6**	**50.3**	**49.0**	**49.7**			
DT25a		32.7		23.2	28.7	27.9	27.9	23.9	34.8	29.7	37.5	30.6	29.7			
DT25b	31.6	32.5	30.9	27.4	28.1	27.7	26.6	23.4	35.7	28.1	38.8	29.5	30.0	29.9	24.2	25.8
DT25c	35.4	31.9	31.9	22.8	28.9	27.5	25.8	23.2	35.7	28.7	36.8	29.7	29.9			
DT26a	37.2	29.9	28.4	20.3	27.7	21.5	24.3	19.1	30.8	27.7	33.8	28.9	27.5			
DT26b	38.2	30.2	31.4	21.3	25.3	21.7	24.2	19.2	30.4	28.4	37.1	30.4	28.2	27.7	22.3	23.8
DT26c	35.5	28.7	29.2	21.6	27.1	21.0	23.7	18.6	32.1	27.8	33.6	29.7	27.4			
DT27a	**43.0**	38.2	32.3	32.0	35.4	37.3	35.4	29.4	**45.3**	39.0	**45.3**	38.9	37.6			
DT27b	**44.1**	**41.2**	36.2	35.0	33.2	36.8	34.0	28.3	**43.5**	38.2	**42.8**	37.2	37.5	37.8	30.5	32.5
DT27c	**45.0**	**40.8**	36.4	31.5	34.0	39.8	37.0	28.3	**44.2**	38.9	**44.3**	37.3	38.1			
DT28a	36.9	**42.1**	**43.5**	28.0	**41.0**	31.4	**40.6**	29.0	**49.3**	**42.3**	31.9	37.4	37.8			
DT28b	**44.1**	**45.7**	39.9	30.8	**41.1**	33.7	39.3	28.6	**47.4**	**43.7**	34.9	38.8	39.0	38.2	30.9	33.0
DT28c	**42.3**	**42.4**	**-**	25.7	**40.2**	33.1	39.8	28.4	**48.9**	**42.3**	35.6	38.8	38.0			
DT29a	35.6	27.5	30.5	22.1	26.3	24.6	23.9	20.3	30.7	28.3	32.7	28.9	27.6			
DT29b	31.7	28.0	29.1	22.3	27.0	24.7	23.8	20.2	31.1	28.5	32.0	27.1	27.1	27.5	22.1	23.6
DT29c	33.5	28.2	29.6	21.9	26.0	25.0	26.0	20.6	30.8	28.1	34.4	27.6	27.6			
Hoola 1a	-	29.5	26.1	24.1	24.8	22.2	26.1	20.0	36.5	37.2	34.9	32.1	28.5			
Hoola 1b	-	28.8	25.0	25.1	22.1	21.9	26.1	17.2	34.2	34.5	33.3	34.5	27.5	28.1	22.8	24.3
Hoola 1c	-	30.0	24.7	21.4	27.1	23.7	28.5	20.4	38.1	-	35.5	32.6	28.2			
Hoola 2a	-	33.6	-	-	25.3	25.8	28.3	18.9	35.9	-	37.5	-	29.3			
Hoola 2b	-	30.8	27.5	25.4	24.7	25.7	24.1	21.7	34.3	35.0	35.1	35.6	29.1	29.4	23.6	25.2
Hoola 2c	-	28.6	28.5	-	-	23.6	26.4	18.9	36.7	35.0	37.4	33.9	29.9			
Hoola 3a	-	30.0	27.2	22.7	25.8	23.9	27.6	18.8	35.7	33.3	32.2	32.0	28.1			
Hoola 3b	-	33.2	27.7	22.5	24.6	23.7	25.0	19.4	-	-	33.0	29.4	26.5	27.3	22.4	23.8
Hoola 3c	-	34.2	26.4	24.1	25.6	22.8	25.8	20.2	32.3	31.3	31.7	26.4	27.3			
Hoola 5a	**44.7**	34.4	24.3	18.5	22.4	24.2	26.3	21.6	33.7	~~25.5~~	37.2	31.9	28.7			
Hoola 5b	38.8	**40.7**	-	20.7	28.5	25.7	20.2	21.4	-	29.8	**41.9**	-	29.7	30.0	23.9	25.5

Site Ref	NO_2 Concentration (µg/m^3)												2021 Raw Mean	2021 Raw Triplicate Mean	2021 Local Adjusted Mean	2021 National Adjusted Mean
	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec				
Hoola 5c	**43.0**	37.7	24.7	-	-	21.5	31.6	20.8	-	34.2	39.5	-	31.6			
Hoola 6a		35.9	24.5	23.3	32.1	24.7	27.4	22.7	37.0	**42.2**	**42.6**	**41.3**	32.2			
Hoola 6b	**41.6**	33.9	29.9	25.0	24.3	26.5	30.2	25.4	38.8	35.8	38.0	37.8	32.3	32.2	26.2	27.9
Hoola 6c	39.2	35.2	31.3	24.7	23.3	30.3	30.4	23.4	39.4	34.9	**41.1**	34.0	32.3			
Hoola 10a	36.9	39.0	28.5	25.1	28.1	26.9	29.9	22.7	**41.9**	35.4	33.0	32.6	31.7			
Hoola 10b	39.0	-	26.5	22.6	29.3	27.2	27.5	21.4	36.9	35.8	-	36.0	30.2	30.8	25.0	26.7
Hoola 10c	39.1	32.4	26.7	27.0	24.7	26.1	27.3	21.4	**40.7**	32.6	33.0	35.2	30.5			
TL4a	38.6	39.0	36.1	37.5	35.0	**40.7**	-	35.0	**47.0**	36.3	37.9	35.7	38.1			
TL4b	35.4	37.5	36.9	**40.9**	35.6	**42.5**	28.5	32.9	**46.8**	37.1	36.1	35.4	37.1	37.9	29.9	31.9
TL4c	36.3	38.6	38.0	35.8	-	**41.7**	-	-	**47.9**	36.1	36.3	35.5	38.5			
TL5a	**42.0**	-	27.7	22.8	27.3	24.7	-	-	**40.7**	35.6	37.6	38.6	33.0			
TL52b	**42.8**	35.0	25.5	23.0	29.5	25.3	-	-	36.8	37.9	36.3	32.0	32.4	33.0	25.9	27.6
TL5c	**41.4**	**42.5**	31.3	-	27.9	24.9	-	20.5	37.8	34.9	35.6	37.8	33.5			
TL6a	36.3	31.0	28.8	22.3	27.3	28.7	27.4	24.3	35.9	32.2	-	30.5	29.5			
TL6b	35.5	32.4	28.3	-	-	27.3	28.7	25.9	35.7	-	**50.8**	29.6	32.7	31.5	25.3	27.0
TL5c	38.2	30.8	31.3	-	28.3	27.1	22.9	24.4	37.6	-	**52.7**	30.7	32.4			

*Note: Concentrations in **bold** above the AQS objective value*

Appendix C Data Quality Assurance

C.1 Scheme Continuous Monitoring Sites

The equipment used at the three CMS are Teledyne API T200 chemiluminescence NO_x analysers. Calibrations of these continuous monitors are carried out with certified calibration gases for each analyser. Routine calibrations are undertaken manually every 2 weeks by AECOM for TL4, TL5 and TL6.

The QA/QC procedures followed by AECOM reflect those used in the UK Automatic Urban and Rural Network (AURN) and those outlined in the Technical Guidance; LAQM.TG(16).[15]

The calibration data are sent to ERG, who are responsible for data management, data validation and ratification. Independent site audits are carried out annually and includes UKAS accredited on-site gas cylinder certification and on-site testing of sampling system efficiency.

LAQM.TG(16) specifies a 85% data capture threshold for assessing compliance with limit and guidance values. If the 85% threshold is not achieved, the data are still useful, but less precise than required for formal assessment.

C.2 Scheme Diffusion Tube Sites

Diffusion tubes for NO_2 are provided by Staffordshire Highways Laboratory using a preparation method of 20% TEA in water. This method conforms to the guidelines set out in Defra's 'Diffusion Tubes for Ambient NO_2 Monitoring: Practical Guidance' document.

Staffordshire Highways Laboratory participates in the AIR-PT scheme. AIR is an independent analytical proficiency-testing (PT) scheme, operated by LGC Standards and supported by the Health and Safety Laboratory (HSL). The AIR-PT scheme started in April 2014, combining two long running PT schemes: LGC Standards STACKS PT scheme and HSL WASP PT scheme.

AIR NO_2 PT forms an integral part of the UK NO_2 Network's QA/QC and is a useful tool in assessing the analytical performance of those laboratories supplying diffusion tubes. Defra and the Devolved Administrations advise that diffusion tubes used for air quality assessments should be obtained from laboratories that have demonstrated satisfactory performance in the AIR-PT scheme. Staffordshire Laboratories have achieved this during 2021.

Diffusion Tube Annualisation

All diffusion tube monitoring locations recorded data capture of 75% or greater. Therefore, data did not need to be annualised in 2021.

Diffusion Tube Bias Adjustment Factors.

The diffusion tube data have been corrected for bias using an adjustment factor. Bias represents the overall tendency of the diffusion tubes to under or over-read relative to the reference chemiluminescence analyser. LAQM.TG16 provides guidance with regard to the application of a bias adjustment factor to correct diffusion tube monitoring. Triplicate co-location studies can be used to determine a local bias factor based on the comparison of diffusion tube results with data taken from NO_x/NO_2 continuous analysers. Alternatively, the national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method.

A national bias adjustment factor was obtained from the national Diffusion Tube Bias Adjustment Factors Spreadsheet. The national bias adjustment factor for tubes prepared by Staffordshire Scientific Services using to 20% TEA in Water preparation method for 2021 is 0.86, as depicted in Table C.1 and Figure C.1.

[15] LAQM-TG16-April-21-v1.pdf (defra.gov.uk)

Table C.1 2021 National Bias Adjustment Factor

Laboratory	Preparation Method	2021 Factor
Staffordshire Scientific Services	20% TEA in Water	**0.86**

National Diffusion Tube Bias Adjustment Factor Spreadsheet — Spreadsheet Version Number: 03/22

Follow the steps below in the correct order to show the results of relevant co-location studies
Data only apply to tubes exposed monthly and are not suitable for correcting individual short-term monitoring periods
Whenever presenting adjusted data, you should state the adjustment factor used and the version of the spreadsheet
This spreadhseet will be updated every few months: the factors may therefore be subject to change. This should not discourage their immediate use.

This spreadsheet will be updated at the end of June 2022
LAQM Helpdesk Website

The LAQM Helpdesk is operated on behalf of Defra and the Devolved Administrations by Bureau Veritas, in conjunction with contract partners AECOM and the National Physical Laboratory.

Spreadsheet maintained by the National Physical Laboratory. Original compiled by Air Quality Consultants Ltd.

Step 1: Select the Laboratory that Analyses Your Tubes from the Drop-Down List. If a laboratory is not shown, we have no data for this laboratory.

Step 2: Select a Preparation Method from the Drop-Down List. If a preparation method is not shown, we have no data for this method at this laboratory.

Step 3: Select a Year from the Drop-Down List. If a year is not shown, we have no data[2]

Step 4: Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor[3] shown in blue at the foot of the final column.

If you have your own co-location study then see footnote[4]. If uncertain what to do then contact the Local Air Quality Management Helpdesk at LAQMHelpdesk@bureauveritas.com or 0800 0327953

Analysed By[1]	Method (To undo your selection, choose (All) from the pop-up list)	Year[5] (To undo your selection, choose (All))	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m³)	Automatic Monitor Mean Conc. (Cm) (µg/m³)	Bias (B)	Tube Precision[6]	Bias Adjustment Factor (A) (Cm/Dm)
Staffordshire Scientific Services	20% TEA in water	2021	R	Newcastle under Lyme Borough Council	9	28	19	48.9%	G	**0.67**
Staffordshire Scientific Services	20% TEA in water	2021	UB	Salford City Council	12	24	23	5.4%	G	**0.95**
Staffordshire Scientific Services	20% TEA in water	2021	B	Salford City Council	12	13	12	15.1%	G	**0.87**
Staffordshire Scientific Services	20% TEA in water	2021	R	Salford City Council	12	38	35	11.0%	G	**0.90**
Staffordshire Scientific Services	20% TEA in water	2021	R	Stoke-on-Trent City Council	12	49	49	1.1%	G	**0.99**
Staffordshire Scientific Services	20% TEA in water	2021	UB	Stoke-on-Trent City Council	12	23	19	24.2%	G	**0.81**
Staffordshire Scientific Services	20% TEA in water	2021	R	Oldham Borough Council	10	34	24	40.5%	P	**0.71**
Staffordshire Scientific Services	20% TEA in water	2021	R	Trafford Council	9	28	24	17.0%	G	**0.85**
Staffordshire Scientific Services	20% TEA in water	2021	KS	Manchester City Council	12	47	43	9.8%	G	**0.91**
Staffordshire Scientific Services	20% TEA in water	2021	UC	Manchester City Council	12	29	29	-2.6%	G	**1.03**
Staffordshire Scientific Services	20% TEA in water	2021	SI	Manchester City Council	12	16	15	6.4%	G	**0.94**
Staffordshire Scientific Services	20% TEA in water	2021	KS	Marylebone Road Intercomparison	11	51	42	20.9%	G	**0.83**
Staffordshire Scientific Services	20% TEA in water	2021	UB	Wigan Council	12	21	17	24.7%	G	**0.80**
Staffordshire Scientific Services	20% TEA in water	2021	R	Wigan Council	12	28	25	11.5%	G	**0.90**
Staffordshire Scientific Services	20% TEA in water	2021		**Overall Factor[3] (14 studies)**				Use		**0.86**

Figure C.1 National Bias Adjustment Factor Derivation

A local bias adjustment factor was calculated from average the triplicate co-location of diffusion tubes at the TL4, TL5 and TL6 continuous monitoring stations. This factor is slightly lower than the national bias adjustment factor.

Calculation of the local bias adjustment factor is presented in Table C.2.

Table C.2 Local Bias Adjustment Factor Calculation

Continuous Monitor	Bias A	Bias B
TL4	0.91	0.1
TL5	0.73	0.36
TL6	0.79	0.26
Local Bias Adjustment Factor Calculation		
Average of Bias B	-	0.24
+1.00	-	1.24
Local Bias Adjustment Factor (Inverse of above)	-	**0.81**

Figures C.2, C.3 and C.4 depict the derivation of the Bias A and Bias B factors for each of TL4, TL5 and TL6, respectively.

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	06/01/2021	04/02/2021	38.6	35.4	36.3	37	1.7	4	4.1
2	04/02/2021	04/03/2021	39.0	37.5	38.6	38	0.8	2	1.9
3	04/03/2021	30/03/2021	36.1	36.9	38.0	37	1.0	3	2.4
4	30/03/2021	05/05/2021	37.5	40.9	35.8	38	2.6	7	6.5
5	05/05/2021	01/06/2021	35.0	35.6		35	0.4	1	3.8
6	01/06/2021	29/06/2021	40.7	42.5	41.7	42	0.9	2	2.2
7	29/06/2021	05/08/2021		28.5					
8	05/08/2021	01/09/2021	35.0	32.9		34	1.5	4	13.3
9	01/09/2021	30/09/2021	47.0	46.8	47.9	47	0.6	1	1.5
10	30/09/2021	02/11/2021	36.3	37.1	36.1	37	0.5	1	1.3
11	02/11/2021	01/12/2021	37.9	36.1	36.3	37	1.0	3	2.5
12	01/12/2021	07/01/2022	35.7	35.4	35.5	36	0.2	0	0.4
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
38.7301	99.137931	Good	Good
36.1518	52.827381	Good	Good
34.2182	95.99359	Good	Good
43.3651	99.884259	Good	Good
30	99.691358	Good	Good
33	82.738095	Good	Good
31	99.887387		Good
27	99.537037	Good	Good
38	99.712644	Good	Good
30	99.873737	Good	Good
37.7712	99.425287	Good	Good
29.7712	99.662542	Good	Good
Overall survey -->		Good precision	Good Overall DC

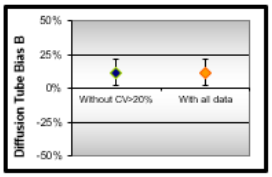
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: TL4

Precision 11 out of 11 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 0.91 (0.83 - 1)
Bias B 10% (0% - 20%)
Diffusion Tubes Mean: 38 µgm^{-3}
Mean CV (Precision): 3
Automatic Mean: 34 µgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 34 (31 - 38) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 10 periods of data
Bias factor A 0.91 (0.83 - 1)
Bias B 10% (0% - 20%)
Diffusion Tubes Mean: 38 µgm^{-3}
Mean CV (Precision): 3
Automatic Mean: 34 µgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 34 (31 - 38) µgm^{-3}



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Version 04 - February 2011

Figure C.2 Local Bias Adjustment Factor Calculation for TL4

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	07/01/2021	03/02/2021	42.0	42.8	41.4	42	0.7	2	1.7
2	03/02/2021	05/03/2021		35.0	42.5	39	5.3	14	47.6
3	05/03/2021	30/03/2021	27.7	25.5	31.3	28	2.9	10	7.3
4	30/03/2021	05/05/2021	22.8	23.0		23	0.1	1	1.3
5	05/05/2021	01/06/2021	27.3	29.5	27.9	28	1.1	4	2.8
6	01/06/2021	01/07/2021	24.7	25.3	24.9	25	0.3	1	0.8
7	01/07/2021	05/08/2021							
8	05/08/2021	02/09/2021			20.5				
9	02/09/2021	29/09/2021	40.7	36.8	37.8	38	2.0	5	5.0
10	29/09/2021	01/11/2021	35.6	37.9	34.9	36	1.6	4	3.9
11	01/11/2021	30/11/2021	37.6	36.3	35.6	37	1.0	3	2.5
12	30/11/2021	06/01/2022	38.6	32.0	37.8	36	3.6	10	8.9
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
	0	Good	Data Capture
	0	Good	Data Capture
21.3405	87.333333	Good	Good
25.0673	99.768519	Good	Good
19	99.691358	Good	Good
16	99.166667	Good	Good
19	99.642857		Good
13	99.553571		Good
27	99.228395	Good	Good
22	99.873737	Good	Good
29.5973	99.856322	Good	Good
25.0684	99.662162	Good	Good
Overall survey -->		Good precision	Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID: TL5

Precision 10 out of 10 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval) without periods with CV larger than 20%
Bias calculated using 8 periods of data
Bias factor A 0.73 (0.65 - 0.85)
Bias B 36% (17% - 55%)
Diffusion Tubes Mean: 31 µgm^{-3}
Mean CV (Precision): 5
Automatic Mean: 23 µgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 23 (20 - 27) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 8 periods of data
Bias factor A 0.73 (0.65 - 0.85)
Bias B 36% (17% - 55%)
Diffusion Tubes Mean: 31 µgm^{-3}
Mean CV (Precision): 5
Automatic Mean: 23 µgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 23 (20 - 27) µgm^{-3}

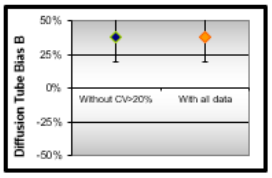

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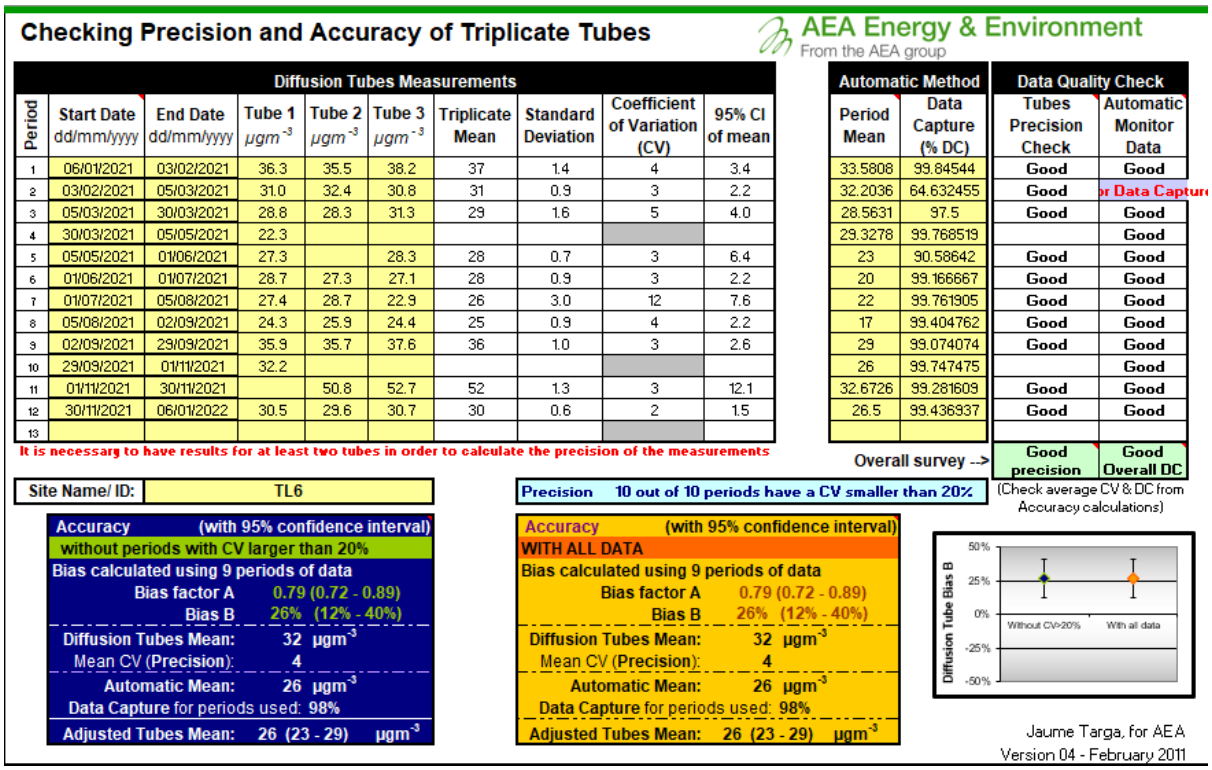
Figure C.3 Local Bias Adjustment Factor Calculation for TL5



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	06/01/2021	03/02/2021	36.3	35.5	38.2	37	1.4	4	3.4
2	03/02/2021	05/03/2021	31.0	32.4	30.8	31	0.9	3	2.2
3	05/03/2021	30/03/2021	28.8	28.3	31.3	29	1.6	5	4.0
4	30/03/2021	05/05/2021	22.3						
5	05/05/2021	01/06/2021	27.3		28.3	28	0.7	3	6.4
6	01/06/2021	01/07/2021	28.7	27.3	27.1	28	0.9	3	2.2
7	01/07/2021	05/08/2021	27.4	28.7	22.9	26	3.0	12	7.6
8	05/08/2021	02/09/2021	24.3	25.9	24.4	25	0.9	4	2.2
9	02/09/2021	29/09/2021	35.9	35.7	37.6	36	1.0	3	2.6
10	29/09/2021	01/11/2021	32.2						
11	01/11/2021	30/11/2021		50.8	52.7	52	1.3	3	12.1
12	30/11/2021	06/01/2022	30.5	29.6	30.7	30	0.6	2	1.5
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
33.5808	99.84544	Good	Good
32.2036	64.632455	Good	or Data Capture
28.5631	97.5	Good	Good
29.3278	99.768519		Good
23	90.58642	Good	Good
20	99.166667	Good	Good
22	99.761905	Good	Good
17	99.404762	Good	Good
29	99.074074	Good	Good
26	99.747475		Good
32.6726	99.281609	Good	Good
26.5	99.436937	Good	Good
Overall survey -->		Good precision	Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID: TL6

Precision 10 out of 10 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 9 periods of data
Bias factor A 0.79 (0.72 - 0.89)
Bias B 26% (12% - 40%)
Diffusion Tubes Mean: 32 µgm⁻³
Mean CV (Precision): 4
Automatic Mean: 26 µgm⁻³
Data Capture for periods used: 98%
Adjusted Tubes Mean: 26 (23 - 29) µgm⁻³

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 9 periods of data
Bias factor A 0.79 (0.72 - 0.89)
Bias B 26% (12% - 40%)
Diffusion Tubes Mean: 32 µgm⁻³
Mean CV (Precision): 4
Automatic Mean: 26 µgm⁻³
Data Capture for periods used: 98%
Adjusted Tubes Mean: 26 (23 - 29) µgm⁻³

Jaume Targa, for AEA
Version 04 - February 2011

Figure C.4 Local Bias Adjustment Factor Calculation for TL6

Royal Borough of Greenwich

Laboratory Details

- Diffusion Tubes are prepared and analysed by UKAS accredited Gradko International Ltd
- Diffusion Tubes are prepared using 50% triethanolamine with acetone
- For details attaining to 'results' – precision, bias adjustment factors; and reference methods please refer to - 'London Wide Environment Program (LWEP) Nitrogen Dioxide diffusion tube survey report, 2020.

Bias Factor

The Royal Borough of Greenwich has used the LWEP Bias Adjustment Factor for the last few years.

London Borough of Newham

Laboratory Details

- Diffusion Tubes are prepared and analysed by UKAS accredited Gradko International Ltd
- Diffusion Tubes are prepared using 50% triethanolamine with acetone

Bias Factor

A bias adjustment factor for 2021 of 0.8 (0.85 in 2020) was derived from the Local Diffusion Tube Bias Adjustment Factor with good diffusion tube precision and data capture for the 2021 monitoring period.

London Borough of Tower Hamlets

Laboratory Details

- Diffusion Tubes are prepared and analysed by UKAS accredited Socotec UK Ltd
- Diffusion Tubes are prepared using 50% triethanolamine with acetone

Bias Factor

A bias adjustment factor for 2021 of 0.78 (0.82 in 2020) was derived from the National Factor, although this was the same as the Local Factor.

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