London Borough of Richmond upon Thames
Air Quality Annual Status Report for 2021

Date of publication: 27th May 2022

This report provides a detailed overview of air quality in the London Borough of Richmond upon Thames during 2021. It has been produced to meet the requirements of the London Local Air Quality Management statutory process[1].

[1] LLAQM Policy and Technical Guidance 2019 (LLAQM.TG(19))

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Executive Summary

The London Borough of Richmond upon Thames is committed to improving air quality in the Borough. The Council is demonstrating its political leadership; taking action; leading by example; monitoring air quality; using the planning system; integrating air quality into the public health system; and informing the public. This 2022 Annual Status Report reviews recent air quality monitoring in the Borough in accordance with Defra LAQM guidance. In doing so, it fulfils one further aspect of this ongoing commitment.

The report identifies that:

For carbon monoxide, benzene, 1,3-butadiene, lead and sulphur dioxide there is not a significant risk of the objectives being exceeded in the Council's area.

In December 2000, the Council designated an Air Quality Management Area (AQMA) across the whole Borough for nitrogen dioxide and particles (specifically PM_{10}). The findings from this report indicate that the AQMA should be maintained.

In view of the findings from the report, the Council will undertake the following actions:

1. Undertake consultation with the statutory and other consultees as required.
2. Maintain the existing monitoring programme.
3. Update and implement its Air Quality Action Plan in pursuit of the AQS objectives.
4. Prepare for the submission of its next Air Quality report.

Tables

Abbreviations

Abbreviation	Description
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQO	Air Quality Objective
BEB	Buildings Emission Benchmark
CAB	Cleaner Air Borough
EV	Electric Vehicle
GLA	Greater London Authority
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LLAQM	London Local Air Quality Management
NRMM	Non-Road Mobile Machinery
PM_{10}	Particulate matter less than 10 micron in diameter
$PM_{2.5}$	Particulate matter less than 2.5 micron in diameter
TEB	Transport Emissions Benchmark
TfL	Transport for London

Air Quality Objectives

The air quality objectives applicable to LAQM in England are set out in the Air Quality (England) Regulations 2000 (SI 928), The Air Quality (England) (Amendment) Regulations 2002 (SI 3043), and are shown in Table A. This table shows the objectives in units of micrograms per cubic metre µg m^{-3} (milligrams per cubic metre, mg m^{-3} for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Table A. Summary of National Air Quality Standards and Objectives

Pollutant	**Standard/Objective (UK)**	**Averaging Period**	**Date[1]**
Nitrogen dioxide - NO_2	200 □g m^{-3} not to be exceeded more than 18 times a year	1-hour mean	31 Dec 2005
	40 □g m^{-3}	Annual mean	31 Dec 2005
Particles - PM_{10}	50 □g m^{-3} not to be exceeded more than 35 times a year	24-hour mean	31 Dec 2004
	40 □g m^{-3}	Annual mean	31 Dec 2004
Particles - $PM_{2.5}$	25 □g m^{-3}	Annual mean	2020
	Target of 15% reduction in concentration at urban background locations	3 year mean	Between 2010 and 2020
Sulphur Dioxide (SO_2)	266 µg m^{-3} not to be exceeded more than 35 times a year	15 minute mean	31 Dec 2005
	350 µg m^{-3} not to be exceeded more than 24 times a year	1 hour mean	31 Dec 2004
	125 µg m^{-3} mot to be exceeded more than 3 times a year	24 hour mean	31 Dec 2004

Notes:

[1] Date by which to be achieved by and maintained thereafter

1. Air Quality Monitoring

The latest monitoring results for 2021 confirm that air pollution in the London Borough of Richmond upon Thames still exceeds the Government Air Quality objectives in some locations, and therefore there is still a need for LBRuT to be designated as an AQMA and to pursue improvements in air quality. LBRUT also recognise the possibility of stricter objectives following changes to the World Health Organisation Guidelines on 22nd September 2021.

The Council (and NPL for $PM_{2.5}$) routinely monitor the pollutants below:

- NO_2
- PM_{10}
- Ozone (O_3)
- $PM_{2.5}$

The Council previously monitored SO_2 (ceased in April 2011), CO (ceased in April 2012), and Benzene (ceased in January 2012) which are not included in this report. Please see previous Council reports for further information. The LBRuT have complied with UK/EU limit values for these pollutants for a minimum of 3 years prior to cessation of monitoring.

1.1 Locations

Automatic Monitoring Sites

Our continuous monitors collect real time data, which are stored as 15-minute ‘means’ and can then be converted into the various averages. This type of equipment provides accurate measurements of pollution levels but is expensive, so using them for a large coverage of LBRuT is cost prohibitive.

The sites (see Table B) are also representative of relevant exposure either at the site or very close by. The two Richmond operated sites are part of the King's College London Air Quality Network, as is the site at the National Physical Laboratory (NPL). This site is also part of the government's UK Automatic Urban and Rural Network (AURN). Richmond also had a mobile Air Quality monitoring unit, which was stationed at Chertsey Road, TW2. Unfortunately, it was stolen during the summer of 2020. Richmond Council will replace the air quality station as soon as funding is available.

All data undergoes quality assurance and quality control (QA/QC) procedures to ensure that the data obtained is of a high quality. The standards of QA/QC at the LAQN sites are similar to those of the government's AURN sites. For QA/QC purposes, all the continuous analysers are manually checked and calibrated every two weeks, serviced every six months and audited by an independent auditor (the National Physical Laboratory) every six months. Subsequent data ratification is undertaken by Imperial College London. Further details of the sites can be found at www.londonair.org.uk.

Table B. Details of Automatic Monitoring Sites for 2019

Site ID	Site Name	X (m)	Y (m)	Site Type	In AQMA?	Distance from monitoring site to relevant exposure	Distance to kerb of nearest road (N/A if not applicable)	Inlet height	Pollutants monitored	Monitoring technique
RI1	**Castelnau Library**, Barnes	522500	177166	Roadside	Y	8m	3m	2.35m	NO2, PM10	Chemiluminescent; TEOM
RI2	**Wetlands Centre**, Barnes	522993	176731	Suburban	Y	Children in adjacent play area/people attending	N/A	3.2m	NO2, PM10,O3	Chemiluminescent; TEOM

						Wetlands Centre				
TD0	**NPL -** Teddington AURN	515542	170420	Suburban	Y	N/A	N/A	N/A	PM10, PM2.5 and O3	Chemiluminescent; FDMS

Non-Automatic Monitoring Sites

Table C lists the details of the NO2 diffusion tube monitoring locations in the LBRuT. The tubes are a relatively cheap and accurate method of monitoring, which allows samples to be taken across the whole LBRuT and gives a Borough-wide view. The results are provided as monthly averages and so provide an indication of NO2 pollution levels. The accuracy of the diffusion tube readings can be increased when their results are compared, and then bias adjusted, with data from the more accurate continuous monitors. The Council had a network of 63 permanent diffusion tube sites across the Borough in 2021. Two of the diffusion tubes sites are triplicate and co-located with both Council automatic monitoring sites. All sites are kept under constant review and a few will be amended or moved at the beginning of each year, often in response to requests for more area specific monitoring.

Table C. Details of Non-Automatic Monitoring Sites for 2020

Site ID	Site Name	X (m)	Y (m)	Site Type	In AQMA ?	Distance of tube to kerbside	Distance of receptor to kerbside	Inlet height (approx.)	Pollutants monitored	Tube co-located with an automatic monitor.
						(m)	(m)	(m)		(Y/N)
1	Hampton Court Rd, Hampton	515824	168815	roadside	Y	1.7m	1.9m	2.2m	NO2	N
2	Percy Rd, Hampton (nr. Level crossing/ Waitrose)	513217	169746	roadside	Y	1.3m	3.0m	2.2m	NO2	N
4	Hampton Rd, Hampton Hill (nr. Laurel Dene)	514607	171258	kerbside	Y	0.6m	9.8m	2.2m	NO2	N
7	Broad St, Teddington (Boots)	515695	170983	kerbside	Y	0.8m	2.5m	2.2m	NO2	N
9	Hampton Rd, Twickenham	514846	172348	kerbside	Y	0.6m	2.0m	2.2m	NO2	N
10	Twickenham Rd, Twickenham (opp. Fulwell golf course)	513390	172233	kerbside	Y	0.6m	7.2m	2.2m	NO2	N

11	Percy Rd, Whitton (nr. Percy Way)	514136	173389	kerbside	Y	0.6m	9.1m	2.2m	NO2	N
12	Hanworth Rd, Whitton	512612	173439	kerbside	Y	0.6m	7.4m	2.2m	NO2	N
13	Whitton Rd, Whitton, (opp. rugby ground)	515228	174082	kerbside	Y	0.8m	6.3m	2.2m	NO2	N
15	Richmond Rd, Twickenham (opp. Marble Hill Park)	517196	173933	kerbside	Y	0.6m	1.7m	2.2m	NO2	N
17	Red Lion Street, Richmond	517822	174755	roadside	Y	1.2m	2.0m	2.2m	NO2	N
18	Lower Mortlake Rd, Richmond (nr. Trinity Rd)	518822	175590	kerbside	Y	0.9m	9.3m	2.2m	NO2	N
19	Kew Rd, Kew (nr. Walpole Av)	518643	176156	kerbside	Y	0.7m	16m	2.2m	NO2	N
20	Mortlake Rd, Kew (nr. Kent Rd)	519205	177221	kerbside	Y	0.6m	2.8	2.2m	NO2	N
22	Castelnau, Barnes (nr. Hammersmith Bridge)	522853	177908	kerbside	Y	0.5m	4.2m	2.2m	NO2	N

23	Castelnau Library, Barnes (static site)	522502	177166	roadside	Y	3.3m	9m	2.2m	NO2	Y
25	URRW, (nr. East Sheen Prim Sch)	521199	175460	roadside	Y	2.3m	2.5m	2.2m	NO2	N
26	URRW, Sheen (nr. Courtland Estate)	519168	175055	roadside	Y	3.2m	11.8	2.2m	NO2	N
27	Queens Rd, Richmond (nr. St Elizabeth's RC Prim Sch)	518847	174513	roadside	Y	1.9m	6.8m	2.2m	NO2	N
28	Holly Lodge, Richmond Pk	519445	173991	urban backgro und	Y	2175m	N/A	2.2m	NO2	N
29	Petersham Rd, Ham (nr. Sandy Lane)	517967	172543	roadside	Y	1.9m	3.6m	2.2m	NO2	N
31	A316 (nr. Chudleigh Rd)	515434	174045	roadside	Y	1.0m	6.4m	2.2m	NO2	N
32	Kings St, Twickenham	516226	173195	roadside	Y	1.0m	3.2m (2.8m paveme nt café)	2.2m	NO2	N

33	Heath Rd, Twickenham	516098	173153	roadside	Y	3.3m	6.9m	2.2m	NO2	N
35	High St, Hampton Wick	517524	169583	roadside	Y	1.3m	1.4m	2.2m	NO2	N
36	Upper Richmond Road West (URRW) nr Sheen Lane	520540	175399	roadside	Y	2.1m	2.2m	2.2m	NO2	N
37	Wetlands, Barnes (static site)	522993	176731	urban backgro und	Y	1160m	230m	2.2m	NO2	Y
39	Richmond Rd, nr. Richmond Bridge, East Twickenham	517516	174331	roadside	Y	1.0m	1.7m	2.2m	NO2	N
40	Staines Rd, Twickenham	514068	172435	roadside	Y	1.0m	11.4m	2.2m	NO2	N
41	Paradise Rd, Richmond	518164	174872	kerbside	Y	0.9m	5.6m	2.2m	NO2	N
42	The Quadrant/Kew Rd, Richmond	518080	175259	roadside	Y	0.7m	2.9m	2.2m	NO2	N
43	Hill St, Richmond	517759	174757	kerbside	Y	0.7m	1.6m	2.2m	NO2	N

44	Sheen Rd, Richmond (near shops)	518489	175056	kerbside	Y	0.5m	2.5m	2.2m	NO2	N
45	154 High St, Teddington,	516383	171154	kerbside	Y	0.5m	3.3m	2.2m	NO2	N
50	URRW, nr. Clifford Av, Sheen	519922	175324	kerbside	Y	0.7	2.7	2.2m	NO2	N
51	Sheen Lane, E. Sheen (nr railway crossing)	520490	175695	roadside	Y	2.0m	2.1m	2.2m	NO2	N
52	Clifford Av, Chalkers Corner	519773	175795	roadside	Y	2.0m	2.1	2.2m	NO2	N
53	co-located on mobile Air Quality unit, A316 nr RUTC	513360	173995	roadside	Y	varies	varies	2.2m	NO2	Y
54	Mortlake Road, adjacent to West Hall Road, Kew	519585	176492	kerbside	Y	0.6	1.3	2.2m	NO2	N
55	Mortlake Road, adjacent to Cemetery Gates,	519793	176142	kerbside	Y	0.6	4.1	2.2m	NO2	N
56	A316 (nr St Margaret's roundabout)	516788	174519	roadside	Y	1.0m	9.6m	2.2m	NO2	N

57	A316 (Lincoln Avenue)	513915	172899	roadside	Y	1.0m	16.4m	2.2m	NO2	N
58	London Road, Twickenham	516039	173766	kerbside	Y	0.7m	6.4m	2.2m	NO2	N
61	London Road, Twickenham (near Waitrose)	516224	173444	roadside	Y	1.8m	4.3m	2.2m	NO2	N
62	High Street, Barnes	521651	176430	kerbside	Y	0.4m	2.3m	2.2m	NO2	N
63	High Street, Whitton	514188	173801	roadside	Y	1.8m	3.2m	2.2m	NO2	N
64	High Street, Hampton Hill	514484	171251	kerbside	Y	0.5m	1.6m	2.2m	NO2	N
65	York Street, Twickenham	516339	173366	kerbside	Y	0.5m	2.7m	2.2m	NO2	N
66	South Circular, Kew Green	519060	177428	roadside	Y	2.1m	3.3m	2.2m	NO2	N
67	Petersham Rd opp Poppy Factory,	518042	174095	roadside	Y	1.4m	2.7m	2.2m	NO2	N

68	Rocks Lane, Barnes	522415	176537	roadside	Y	3.2m	3.8m	2.2m	NO2	N
69	Uxbridge Rd nr Longford Cl, TW12	513494	171729	roadside	Y	2.0m	8.1m	2.2m	NO2	N
70	Stag Brewery, Lower Richmond Rd, SW14	520465	175965	roadside	Y	1.8m	2.1m	2.2m	NO2	N
71	A316, St Stephens Primary School	516574	174456	roadside	Y	2.9m	9.9m	2.2m	NO2	N
72	St Margarets Rd, nr St Margaret's station, TW1	516839	174238	kerbside	Y	0.8m	2.5m	2.2m	NO2	N
73	Hospital Bridge Rd, nr Homelink	513722	172873	roadside	Y	2.1m	8.4m	5.0m	NO2	N
74	Lower Richmond Rd (nr A316)	519856	175856	roadside	Y	2.6m	5.9m	2.2m	NO2	N
75	Hampton Rd (opp Tedd Mem Hosp)	515459	171029	kerbside	Y	0.6m	6.3m	2.2m	NO2	N
76	Manor Rd, nr Ferry Rd, TW11	516588	171357	kerbside	Y	0.4m	3.3m	2.2m	NO2	N
77	Sixth Cross Rd, nr Wellington Rd,TW2	514705	172092	roadside	Y	0.6m	4.5m	2.3m	NO2	N

78	Upper Sunbury Rd, Hampton, TW12	513527	169513	roadside	Y	1.7m	2.7m	2.5m	NO2	N
79	South St, outside Lidl, TW2	514810	172041	roadside	Y	1.0m	6.6m	2.2m	NO2	N
80	Mortlake High St, nr Post Office	520538	175926	kerbside	Y	0.8m	2.6m	2.4m	NO2	N
Rut 01	Civic Centre, York St, Twickenham	516415	173419	roadside	Y	2.9m	3.0m	5.0m	NO2	N
Rut 02	George Street, Richmond	517917	174928	kerbside	Y	0.7m	2.2m	2.2m	NO2	N

Site changes 2021: site 80, opened; site 53 and 59 closed (53 closed 6/8/20 – stolen).

1.2 Comparison of Monitoring Results with AQOs

The results presented are after adjustments for “annualisation” and for distance to a location of relevant public exposure (if required), the details of which are described in Appendix A. For results that indicate the exposure estimate, calculated for the nearest residential façade see Table N.

Table D. Annual Mean NO_2 Ratified and Bias-adjusted Monitoring Results (□g m-3)

Site ID	Site type	Valid data capture for monitoring period %[a]	Valid data capture 2021 %[b]	Annual Mean Concentration (µgm^{-3})						
				2015	2016	2017	2018	2019	2020	2021
Castelnau Library, Barnes (RI1)	Automatic Roadside	100%	98%	34	36	31	31	27	20	21
Wetlands Centre, Barnes (RI2)	Automatic Suburban	100%	85%	21	25	21	20	21	15	14
NPL - Teddington AURN (TD0)	Automatic Suburban	N/A	N/A	19	22	N/A	N/A	N/A	N/A	N/A

1	Diffusion tube (D/T) Roadside	100	100	**41**	**56**	**55**	**41**	35	25	26
2	D/T Roadside	100	100	28	31	29	32	29	21	24
3	D/T Roadside	100	Closed	**41**	**42**	39	closed	closed	closed	closed
4	D/T Kerbside	100	100	36	**40**	36	35	31	27	28
6	closed	100	Closed	36	37	30	34	closed	closed	closed
7	D/T Kerbside	100	100	**47**	**49**	**43**	**45**	39	34	37
9	D/T Kerbside	100	92	**42**	**45**	**40**	**40**	**35**	31	31
10	D/T Kerbside	100	92	**43**	**44**	**42**	**41**	**40**	33	33
11	D/T Kerbside	100	100	**44**	**48**	**47**	**46**	34	27	27
12	D/T Kerbside	100	100	**41**	**45**	**41**	**44**	**40**	31	30
13	D/T Kerbside	100	100	**47**	**42**	**42**	**40**	**39**	36	30
14	D/T Kerbside	closed	closed	39	**40**	36	36	33	closed	closed

15	D/T Kerbside	100	100	37	**41**	38	34	32	26	26
16	D/T Roadside	closed	closed	41	**42**	38	37	closed	closed	closed
17	D/T Roadside	100	75	**63**	**69**	**60**	**54**	**50**	**40**	**46**
18	D/T Kerbside	100	83	**67**	**56**	**58**	**46**	**46**	**41**	39
19	D/T Kerbside	100	100	**48**	**49**	**49**	**42**	**37**	**30**	28
20	D/T Kerbside	100	100	**48**	**47**	**45**	38	38	30	28
21 (74)	D/T Roadside	closed	closed	37	39	36	closed	closed	closed	closed
22	D/T Kerbside	100	100	**53**	**65**	**52**	**45**	32	21	22
23	D/T Roadside	100	100	35	35	35	31	26	20	21
24	D/T Kerbside	closed	closed	35	37	34	31	28	closed	closed
25	D/T Roadside	100	100	**51**	**45**	**46**	38	36	34	34
26	D/T Roadside	100	100	**42**	**40**	**40**	36	34	32	33
27	D/T Roadside	100	100	37	**43**	**41**	37	32	21	23

28	D/T Urban background	100	100	17	21	17	18	17	12	12
29	D/T Roadside	100	100	30	32	30	31	28	21	20
30	D/T Roadside	100	100	29	33	closed	closed	closed	closed	25
31	D/T Roadside	100	92	**54**	**54**	**52**	**49**	**45**	35	35
32	D/T Roadside	100	100	**62**	**64**	**59**	**56**	**47**	**40**	**40**
33	D/T Roadside	100	83	**61**	**61**	**53**	**52**	**40**	34	39
34	D/T Roadside	closed	closed	33	36	35	32	30	closed	closed
35	D/T Roadside	100	100	**43**	**46**	**45**	**42**	36	32	30
36	D/T Roadside	100	100	**49**	**50**	**60**	**63**	**61**	**56**	**55**
37	D/T Urban background	100	92	21	25	20	21	20	14	14
39	D/T Roadside	100	92	**52**	**55**	**52**	**45**	39	32	32
40	D/T Roadside	100	92	36	**45**	**42**	**41**	35	29	29
41	D/T Kerbside	closed	closed	38	39	36	34	32	closed	closed

42	D/T Roadside	100	92	**47**	**82**	**89**	**72**	**62**	**60**	**54**
43	D/T Kerbside	100	75	**80**	**85**	**78**	**59**	**46**	**41**	**43**
44	D/T Kerbside	100	100	39	**42**	**41**	**40**	37	33	32
45	D/T Kerbside	100	100	35	37	35	33	32	26	26
47	D/T Roadside	closed	closed	32	33	31	29	closed	closed	closed
48	D/T Roadside	closed	closed	39	**41**	**40**	**40**	33	closed	closed
49	D/T Kerbside	closed	closed	39	**44**	31	closed	Closed	closed	closed
50	D/T Kerbside	100	92	**57**	**55**	**53**	**52**	**50**	**45**	**46**
51	D/T Roadside	100	100	28	32	35	33	30	24	23
52	D/T Roadside	100	100	**55**	**57**	**50**	**59**	**55**	**46**	**45**
53	D/T varies	closed	closed	N/A	N/A	**44**	**43**	**41**	34	closed
54	D/T Kerbside	100	100	**51**	**49**	**48**	**40**	**40**	32	30
55	D/T Kerbside	100	92	**50**	**50**	**45**	**41**	**40**	33	29

56	D/T Roadside	100	92	37	**51**	**50**	**43**	39	31	29
57	D/T Roadside	100	100	33	**44**	**42**	**43**	37	29	29
58	D/T Kerbside	100	92	**46**	**50**	**47**	**43**	**40**	33	31
59	D/T Kerbside	closed	closed	**40**	**44**	39	**40**	34	27	closed
60	D/T Kerbside	closed	closed	27	29	29	29	closed	closed	closed
61	D/T Roadside	100	92	**48**	**49**	**45**	**43**	38	32	31
62	D/T Kerbside	100	100	**46**	**51**	**50**	**43**	**43**	32	32
63	D/T Roadside	100	100	38	**41**	38	38	33	27	27
64	D/T Kerbside	100	100	**55**	**53**	**49**	**45**	**41**	34	35
65	D/T Kerbside	100	100	Not open	**75**	**68**	**55**	**50**	**40**	**40**
66	D/T Roadside	100	100	Not open	**49**	**49**	**42**	**40**	32	30
67	D/T Roadside	100	100	Not open	Not open	**44**	**41**	32	23	23
68	D/T Roadside	100	92	Not open	Not open	Not open	**55**	**40**	31	30

69	D/T Roadside	100	92	Not open	Not open	Not open	38	31	22	23
70	D/T Roadside	100	100	Not open	Not open	Not open	Not open	**42**	33	34
71	D/T Roadside	100	100	Not open	Not open	Not open	Not open	**52**	**43**	39
72	D/T Kerbside	100	92	Not open	Not open	Not open	Not open	**42**	33	30
73	D/T Roadside	100	100	Not open	Not open	Not open	Not open	**43**	36	34
74 (21)	D/T Roadside	100	100	Not open	Not open	Not open	**50**	**52**	**43**	**44**
75	D/T Kerbside	100	92	Not open	Not open	Not open	Not open	Not open	29	29
76	D/T Kerbside	100	100	Not open	Not open	Not open	Not open	Not open	35	35
77	D/T Kerbside	100	100	Not open	Not open	Not open	Not open	Not open	38	37
78	D/T Roadside	100	100	Not open	Not open	Not open	Not open	Not open	25	24
79	D/T Kerbside	100	100	Not open	Not open	Not open	Not open	Not open	33	32
80	D/T Kerbside	100	92	Not open	Not open	Not open	Not open	Not open	Not open	30
Rut 01	D/T Roadside	100	100	45	**50**	**51**	38	36	29	27

Rut 02	D/T Kerbside	100	100	**88**	**96**	**82**	**72**	**63**	**52**	**55**

Notes:

The annual mean concentrations are presented as µg m^{-3}.

Exceedances of the NO_2 annual mean AQO of 40 µg m^{-3} are shown in orange and **bold**.

NO_2 annual means in excess of 60 µg m^{-3}, indicating a potential exceedance of the NO_2 hourly mean AQS objective are shown in red, **bold and underlined**.

Means for diffusion tubes have been corrected for bias.

All means have been "annualised" in accordance with LLAQM Technical Guidance if valid data capture for the calendar year is less than 75% and greater than 33%. In 2021 a minimum of 75% data capture was achieved at all sites borough wide so annualisation was not necessary.

Results have been distance corrected where applicable.

(a) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(b) data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%).

Maximum data capture for the monitoring period, for all diffusion tube sites was a full 12 months – 100%. Missing tubes resulted in slightly reduced data capture at individual sites.

The bias adjustment factor used for **all roadside/kerbside** sites is **0.87** calculated using the local Castelnau roadside site for 2021.

The bias adjustment factor for **background sites** 28 and 37 is **0.83** calculated using **the National bias adjustment factor** for Gradko. Data capture at Wetlands (RI2) was 85%, below the 90% required. For this reason the National bias adjustment factor for Gradko was used to bias adjust our two background sites (For information, in 2021 Wetlands bias adjustment factor was very similar - 0.82). For more information, see Appendix A.2.

Notes on sites:

From 6/1/16 site 57 was moved nearer the road, no longer behind a small section of green screening to better represent most of this section of the A316.

From 3/1/17 sites 25, 36, 49, 51, 56 were moved slightly (<20m) largely in response to residents requests for marginally better monitoring locations. All grid references are correct for 2017 monitoring onwards. Please see our 2016 Annual Status Report for earlier coordinates.

From 2/1/18 sites 3 and 49 were closed; sites 68 and 69 opened; site 21 was moved approx. 200m in response to resident's requests and is now close to the junction at Chalkers Corner, so for clarity has been renamed site 74. Site 36 and 51 were moved slightly (<20m); See Table C for correct grid references for 2018 onwards and 2017 ASR for earlier grid references.

From 9/1/19 sites 6, 16, 47 and 60 were closed; sites 70, 71, 72 and 73 were opened.

From 6/1/20 sites 14, 24, 41 were closed; sites 75, 76, 77 opened; sites 2, 4, 27 and 29 moved slightly (<20m) to better represent worst case scenario following requests from residents/officer observation. Site 34 and 48 moved > 20m so for clarity have been renamed site 78 and 79 respectively. Aug 2020 the air quality mobile was stolen – data ceased.

From 5/1/21 site 59 was closed, site 80 was opened. From Aug 2020 air quality mobile was stolen, some data recoverable for 2020, no data for 2021 onwards.

Automatic Monitoring Site data

Table D provides the 2021 results of the NO_2 automatic monitoring and a comparison with the annual mean objective.

The 2021 NO_2 data capture for RI1 Castelnau was very good, representing 98% data capture and for RI2 Wetlands 85%. We were aware of some data loss for Wetlands due to equipment failure. Unfortunately, more data was lost following ratification when some data had to be withdrawn. Defra require a 90% data capture rate to be fully representative of the full year, so results for Wetlands should be used for guidance only.

The 2021 results show that both sites met the objective of 40 $\mu g\ m^{-3}$. The 2021 annual mean for the RI2 (Wetlands) was 14 $\mu g\ m^{-3}$ This site is a background site and therefore representative of low pollution in the Borough. The annual mean at the RI1 (Castelnau) roadside site was 21 $\mu g\ m^{-3}$ though no longer representative of typical roadside sites in LBRUT - see below.

This represents a slight decrease for Wetlands and a slight increase for Castlenau from 2020 and 2021 data. All results for 2020 need to be treated with caution due to the COVID-19 pandemic, which affected traffic patterns, and in turn pollution levels. It should also be noted that Castelnau, although a roadside site, is no longer representative of typical roadside concentrations for LBRUT. This is because Hammersmith Bridge at the end of Castelnau was closed to all vehicles on 10th April 2019 for safety reasons until strengthening work is completed. This is likely to take at least 6 years. Data from 2019 reflects this indicating more significant reductions than is apparent elsewhere.

Furthermore from Saturday 28 May 2016 -2020, in order to preserve the lifespan of Hammersmith Bridge, it was necessary to limit the number of buses using the structure. HGV's were also limited – the bridge had a weight restriction of 7.5 tonnes preventing many HGV's from crossing and therefore reducing their number past the Air Quality cabin at the library. This means there has been a large reduction in the number of vehicles along Castelnau from 2016-2021 and a corresponding reduction in levels of NO2 at this

roadside site. Consideration has been given to relocating the site. On balance, following discussions with the Council and Imperial College London, for data continuity and trend data purposes, it has been decided to leave it in situ. This will be reviewed annually. It is hoped to replace the stolen air quality mobile with a static roadside automatic cabin, to be sited in Richmond town centre as soon as funding is available.

Diffusion Tube Monitoring Data

Table D shows the NO2 diffusion tube monitoring results, with bias corrected values for each year from 2015 to 2021. (Note – see Table O for monthly data for 2021 and Table N for the distance corrected). The results in **bold** (**orange/red**) indicate an exceedance of the annual mean objective of 40 μg m-3 and the results in **bold and underlined** (**red**) indicate NO2 annual means in excess of 60 μg m-3 indicating a potential exceedance of the NO2 hourly mean AQS objective. For the first year in the last 20 years of monitoring in the borough, after bias adjustment, no site has exceeded 60ug/m3, which is very good news. However site RUT2, George Street, Richmond, which had met the 60 μg m-3 before bias adjustment in 2020, failed to maintain this reduction in 2021 measuring 63 μg m-3, reduced to 55μg m-3, after bias adjustment (it measured 57μg m-3 down to 52μg m-3 in 2020). This helps demonstrate the mixed picture in 2021 for LBRUT – some sites have gone down, some have remained the same but some sites have gone up in 2021– clearly not such good news.

The data capture for 2021 for all sites was very good (96.33%). No site recorded a data capture of less than 75%, so annualisation was not necessary.

The total number of sites where monitoring was undertaken was 63; two of these were triplicates, co-located next to real time analysers. Two sites were background the remainder – 61 - were roadside or kerbside. This is down by one from our 2020 Annual Status Report. This is due to the theft of our mobile air quality monitoring unit in August 2020. It is hoped to replace this with a static site in Richmond town centre, as soon as finance is available.

The Council has carried out considerable extra monitoring in 2021 linked to proposed road changes – an LTN in East Sheen and Hampton Hill, the introduction of the extended ULEZ next to East Sheen Primary School in East Sheen, and for displacement and parks traffic in response to the proposed Movement Strategy by Royal Parks. These are not permanent sites and it was decided not to include monitoring results in this report. Data for these areas is available on the Council's website here.

The results from the 2021 monitoring show that the objective of 40 μg m-3 was exceeded at 10 sites (15.9%) and complied at 53 sites (84.1%). For comparison, in 2020, there were 64 sites - 12 that exceeded (18.75%) and 52 sites (81.25%) that complied. At first sight, this headline figure indicates a slight improvement in air quality. This is despite the resurgence of heavier traffic flows post COVID-19 in 2021 when compared to 2020. However if you analyse the data a little more closely you see that 35 (55.6%) sites recorded the same or slightly higher levels of NO2 in 2021 when compared to 2020; 28 (44.4%) recorded lower levels, albeit that many of these stayed within the Defra parameters - above or below the objective of 40 μg m-3. Significantly one site, RUT 2 - George Street, Richmond went back into the red, exceeding 60ug/m3, before bias adjustment, and increased quite significantly overall when compared with 2020. This may in part be due to the single lane traffic restrictions in George Street due to temporary pavement widening into the road throughout much of 2020 to enable social distancing under COVID.

Three sites exceeded 60ug/m3 before bias adjustment in 2021 – site RUT 2 - George St, Richmond, site 36 - Upper Richmond Road West East Sheen and site 42 opposite the station in Richmond. This is up one site from 2020 and indicates that the higher exceedences still need significant input to bring about compliance. It should be noted that all three sites were below 60ug/m3 once the bias adjustment correction factor was applied, which is the first time ever in the last 20 years. However, levels are significantly above the annual bias adjustment level of 40ug/m3, accepted as harmful to health, in both Richmond and East Sheen town centres, so more work is required.

The three sites that exceeded the annual mean concentration of 60 μg m-3, before bias adjustment in 2021 were:

Site 36 in East Sheen on the South Circular which measured an annual average of **63ug/m3, corrected to 55 ug/m3** with bias adjustment (62ug/m3 corrected to 56ug/m3 in 2020, 68ug/m3 corrected to 61ug/m3 in 2019)

Site 42 in Richmond town centre, which measured an annual average of **62ug/m3, corrected to 54 ug/m3** with bias adjustment (66ug/m3 corrected to 60ug/m3 in 2020, 69ug/m3 corrected to 62ug/m3 in 2019)

Site RUT 02 in Richmond town centre, which measured an annual average of **63ug/m3, corrected to 55 ug/m3** with bias adjustment (57ug/m3 corrected to 52ug/m3 in 2020, 70ug/m3 corrected to 63 ug/m3 in 2019).

East Sheen, site 36, is proving challenging to reduce. Significant reductions have not been seen from 2020 to 2021. This site is on the South Circular. Whilst good reductions were witnessed in local residential roads in 2020 this was less true for main arterial routes to/from/around London. Congestion along this section of the South Circular remains high, partly supplemented by diverted traffic from the closure of Hammersmith Bridge for major repairs. There is no quick fix; closure is likely to remain in place for at least 6 years. To a certain extent, this section also suffers from the closure of East Sheen Gate in Richmond Park, diverting traffic onto the South Circular. Pressure for major development nearby at the Stag Brewery site and Barnes hospital may further exacerbate matters.

The extended ULEZ to the north and south circulars came into effect on 25th October 2021. It is too early in this report to see the effects. It is hoped that this will help the whole of LBRUT, especially the northern sector. There were some concerns that in the early months/years, non-ULEZ compliant vehicles, especially local non-compliant delivery vehicles, maybe displaced to outside the ULEZ – to areas such as Richmond and Twickenham, hindering improvement in these areas. This is looking less likely. We will keep an eye on future results and update in 2023.

Richmond town centre – site 42 – near the taxi rank and opposite Richmond station, the main public transport hub in LBRUT, has seen more significant reductions in 2021. This could partly be due to a gradually upgraded taxi fleet and partly due to a lack of engine idling. A lot of work has been done throughout 2021 and the two preceding years with continued awareness raising, campaigns, anti-

idling signage and regular warnings by LBRUT traffic wardens. The rising cost of fuel in 2021 may also have contributed. Most taxis now switch off. Thanks must also go to TfL. 16 bus routes serve Richmond station so work done by TfL to clean up the bus fleet was both very important and welcome. By Feb 2021 all TfL buses, serving LBRUT either were Euro VI compliant, hybrid or retrofitted. This will have made a difference to 2021 levels and will continue so to do for years to come. However, further improvements are challenging but necessary.

George Street Richmond - site RUT 2, is of concern. It is always disappointing to achieve compliance with the 60ug/m3 level in 2020 only to return to it the following year. As mentioned, reductions in 2020 were probably due to single lane traffic restrictions in George Street due to temporary pavement widening throughout much of 2020 under COVID. Site17 in Paradise Rd and site 43 in Hill Street, both close by, also recorded increases from 2020 to 2021 from 40ug/m3 up to 46ug/m3 and from 41ug/m3 up to 43ug/m3 respectively. Traffic did appear to increase again in 2021, so this is perhaps not surprising. Monitored NO2 levels may have increased against 2020 levels but they decreased against 2019. We will watch these sites closely in 2022.

In 2020 we reported that one of the few upsides to the devastating COVID-19 pandemic, with change in behaviour/working from home and resultant effects on traffic fleet, volume and mix, were the gains made in air quality and how important it would be to try and maintain these gains. Whilst it is acknowledged that improvements for 2021 are somewhat mixed, it was feared that in 2021 they may return to nearer 2019 values. This has not been the case. This is significant since 2019 witnessed the most significant percentage decrease in measured annual NO2 in the last 20 years. In 2019, there were 64 sites, 27 sites (42.2%) exceeded the annual bias adjusted level of 40ug/m3, 37 sites (57.8%) complied and three exceeded 60 ug/m3 (which indicates that the 1 hour-mean objective may also have been exceeded). 2021 may have seen some sites increase or remain the same compared to 2020 levels, they have not seen returns to 2019 levels.

Significantly, after distance correction for nearest façade, the annual mean objective in 2021 was exceeded at 5 sites, down from 24 in 2019 and up one from 4 in 2020. None, after bias adjustment, exceeded the annual mean concentration of 60 μg m-3 in 2021. Results for 2021 have encouraging aspects.

We must remember that 2021 was a very mixed year. Early January 2021 witnessed further lockdowns. Schools returned on 8/3/21 when easing commenced followed by non-essential retail on 12/4/21. For occupations that facilitated it, COVID has changed the way many people want to work and is likely to remain so, certainly for the near future. Part working from home/part working from the office has now become commonplace. Whilst changes in traffic flows due to COVID-19 may have helped, annual decreases in air pollution have been apparent in most town centres and on most main roads since 2016. A small downward trend in levels of NO2 from 2016 to 2021 is now materialising and a return to higher levels of pre 2019, let alone pre 2016, is looking unlikely. This is very encouraging. Teddington, Hampton Hill, Whitton and Barnes High Streets all complied with UK/EU limit values in 2021, although Teddington and Hampton Hill witnessed increases compared to 2020; Twickenham, East Sheen and Richmond exceeded UK/EU limit values in 2021 – more work is needed. Some of the improvements will be down to the cleaner TfL bus fleet, reducing NOx emissions by up to 95%, which serve all town centres.

Trend graphs on p39 and p40 below, clearly demonstrate this general trend, which, despite exceptions in 2021, remains downward.

Many factors at all levels of central and local government contributed to this. Recent 2020/21/22 Euro 6 diesel cars and light vehicles are delivering improvements on the earlier Euro 6 versions which on real world driving cycles really are cleaner. The announcement by government to move forward a ban on the sale of pure internal combustion engine cars from 2040 to 2030 appears to have helped significantly. The fuel crisis in 2021 may have accelerated this. According to the SMMT (Society of Motor manufacturers and Traders), despite semiconductor shortages in the industry, 2021 was a bumper year for sales of electric

vehicles, plug-ins and hybrids. Pure electric car sales exceeded 190,000 during 2021, which accounts for one in nine new registrations with more registered in 2021 than in 2016-2020 combined.

LBRUT Council assessments for emission-based parking and a Clean Air Zone are resulting in new thought-provoking enquiries, which may influence residents when replacing vehicles. Its encouragement of the healthy streets strategy, the introduction of 14 new school streets and encouragement for modal shift away from the private car onto bikes, cargo bikes, walking and public transport will also help. Even in outer London where public transport cannot compete with central London, planning applications are assessed and encouraged to be car free. Electric vehicle charge points (EVCP's) are conditioned in all possible planning applications and are being rolled out beyond target borough wide. Lastly, idling is a political priority for LBRUT. Throughout 2021, the pollution team has promoted training, erected signage, run campaigns, and responded to all complaints on engine idling. LBRUT's traffic wardens have warned drivers on a daily basis not to idle. In 2021, they issued 12,056 warnings to drivers and in the last 3 years have issued over 31,000 warnings, which is one of the highest across London and probably within the UK. This is having a noticeable impact on driver awareness and behaviour change for engine idling.

The LEZ, which has encouraged the use of Euro 4 or better for commercial vehicles, applicable along the A316, the borough road with the highest daily traffic count, does seem to have resulted in benefits indicated by reductions or no increases in trend data at site 71, 57, 56, 31 and 18 for 2021. This meant that in 2021, for the first time, none of these sites along the A316 exceeded the annual bias adjusted value of 40ug/m3.

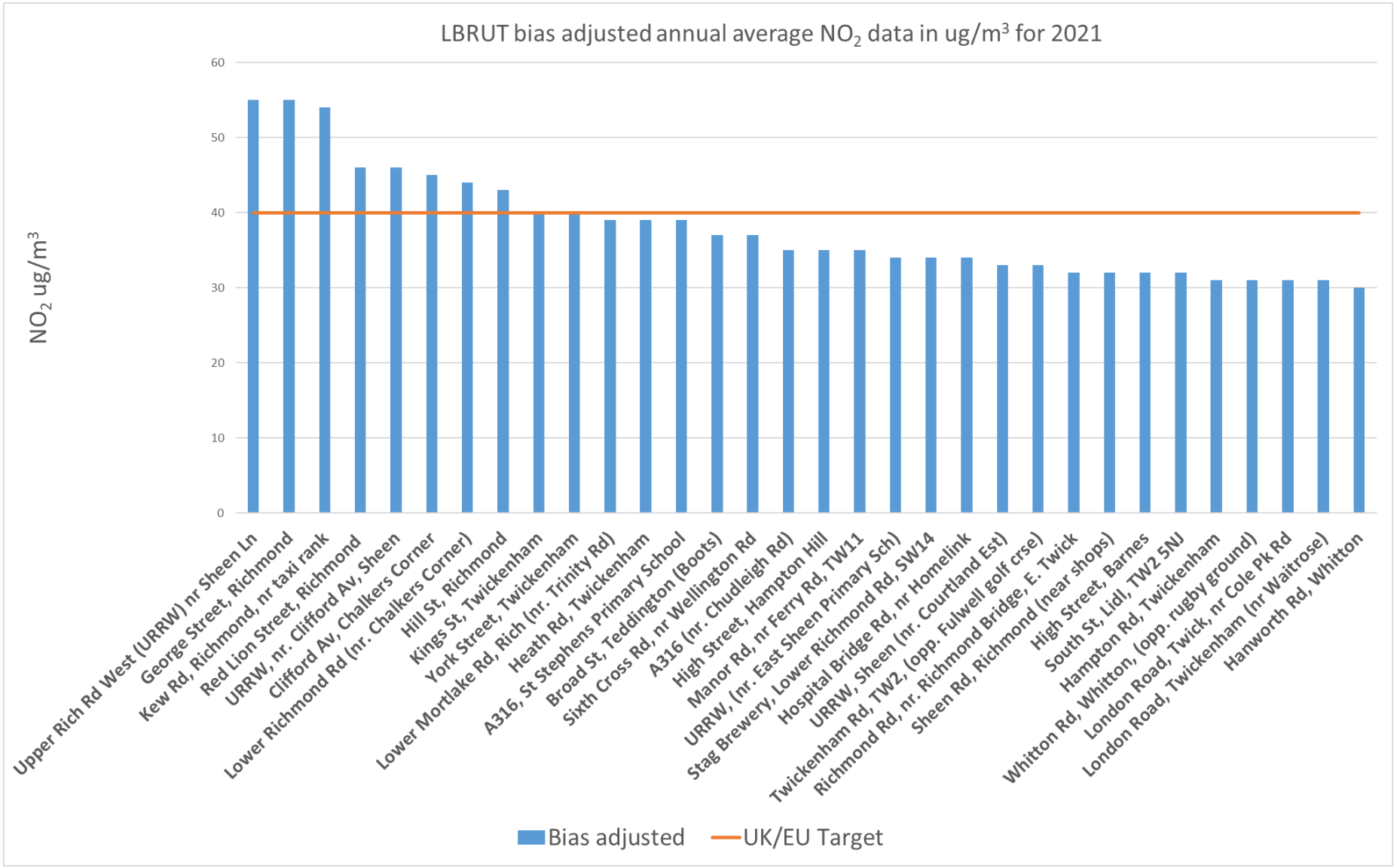
The overall monitoring results for the Borough in 2021 therefore show that NO2 concentrations exceeded the UK annual mean objective (as it has done for each year since 2002). This is also in line with the modelling prediction of the Borough. Traffic volumes on the local road network appear to be returning and may increase further. It will be interesting to see the results for 2022 as the new normal settles in and the effects of the extended ULEZ are felt. Further improvement is likely to be required.

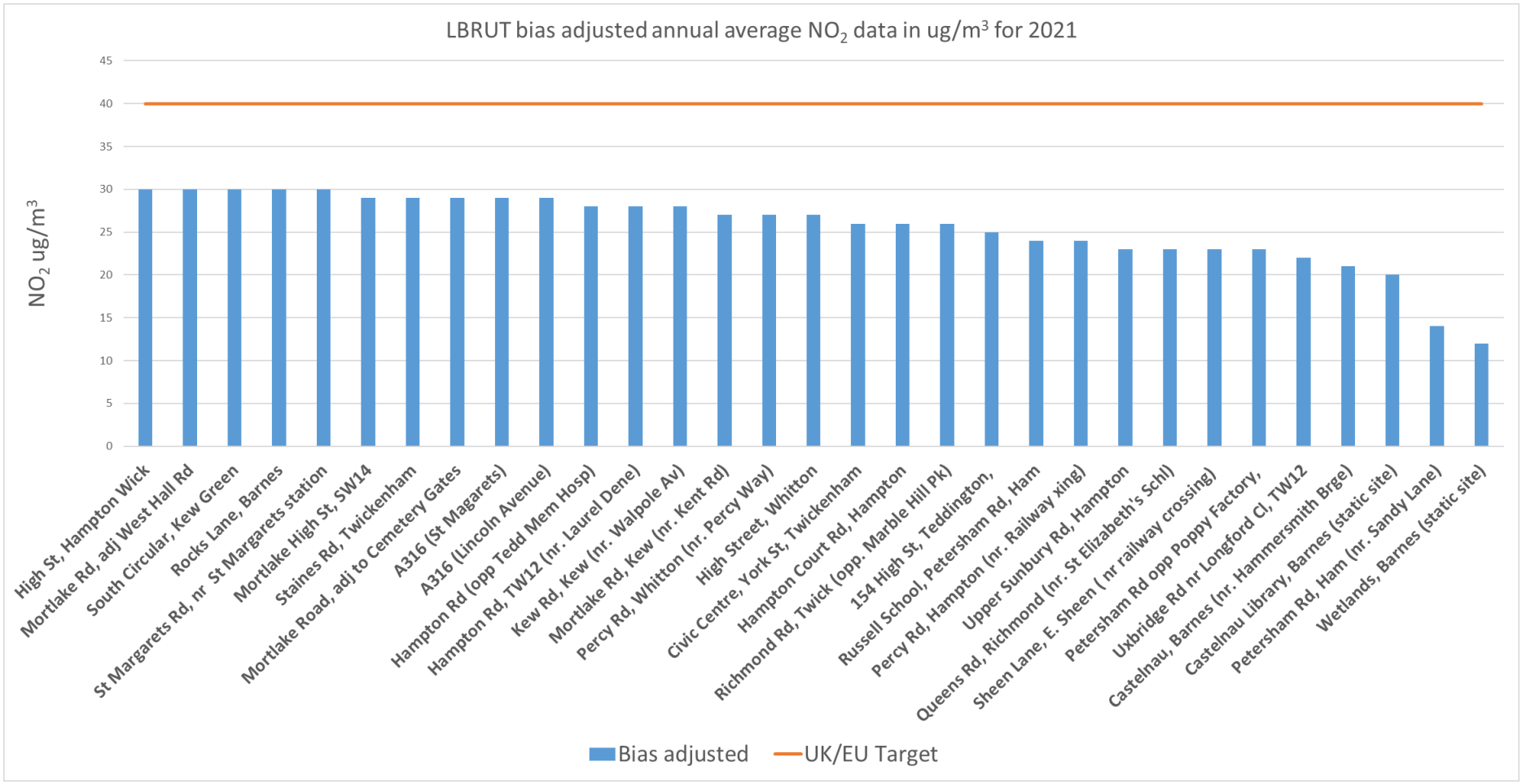
Below are charts, graphs and a map to help visualise the results.

This year we have again included bar charts of data for all sites ranked in order of exceedance and a map showing locations – indicating good coverage for the whole borough (NB LBRUT has 2x large areas of Royal Parks – Richmond and Bushy Park).

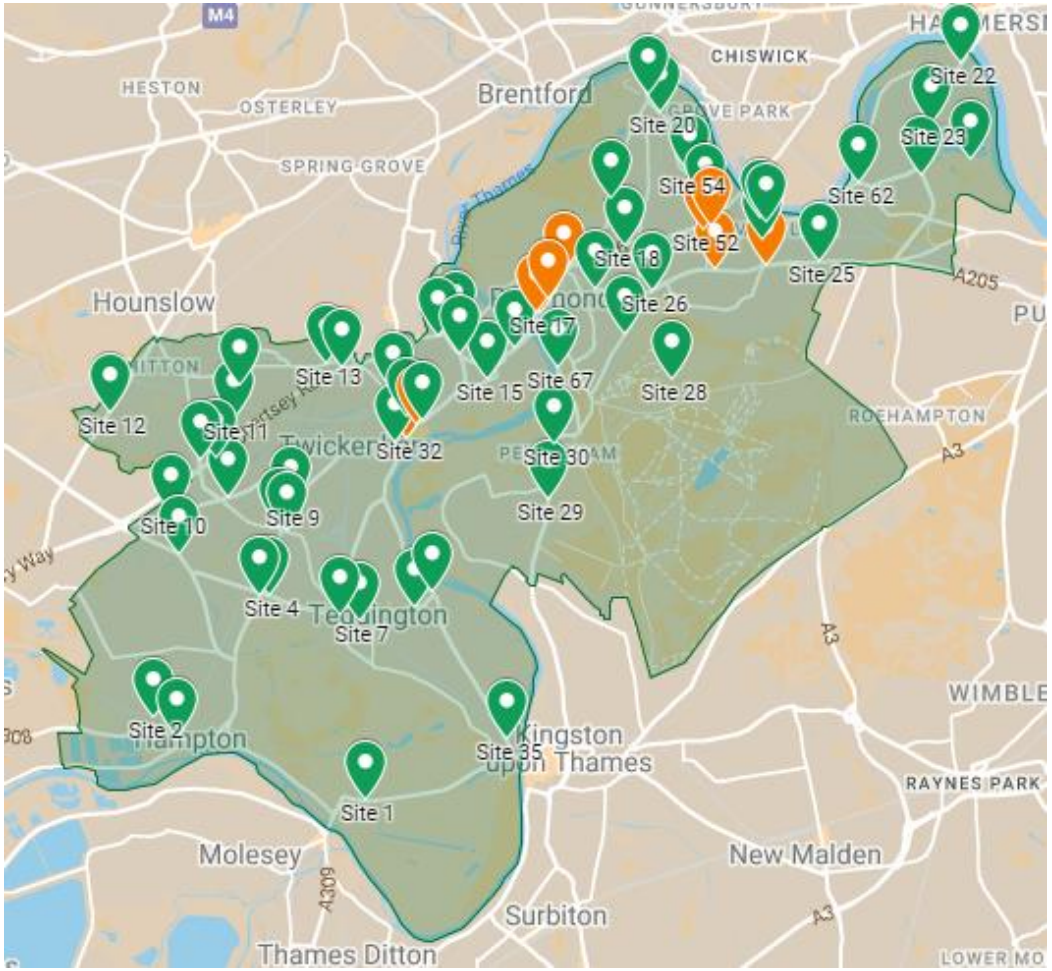
We have also looked at trends for 10 sites covering town centres, main roads, a level crossing and a background site from 2002 – 2021 to give more perspective to levels of NO2 over a long time period. We hope this is enlightening.

Figure 1: Nitrogen Dioxide Bias Adjusted Annual Average Concentrations for all sites for 2021 (split over 2 graphs)




LBRUT bias adjusted annual average NO2 data in ug/m3 for 2021
NO2 ug/m3
45
40
35
30
25
20
15
10
5
0
High St, Hampton Wick
Mortlake Rd, adj West Hall Rd
South Circular, Kew Green
Rocks Lane, Barnes
St Margarets Rd, nr St Margarets station
Mortlake High St, SW14
Staines Rd, Twickenham
Mortlake Road, adj to Cemetery Gates
A316 (St Magarets)
A316 (Lincoln Avenue)
Hampton Rd (opp Tedd Mem Hosp)
Hampton Rd, TW12 (nr. Laurel Dene)
Kew Rd, Kew (nr. Walpole Av)
Mortlake Rd, Kew (nr. Kent Rd)
Percy Rd, Whitton (nr. Percy Way)
High Street, Whitton
Civic Centre, York St, Twickenham
Hampton Court Rd, Hampton
Richmond Rd, Twick (opp. Marble Hill Pk)
154 High St, Teddington,
Russell School, Petersham Rd, Ham
Percy Rd, Hampton (nr. Railway xing)
Upper Sunbury Rd, Hampton
Queens Rd, Richmond (nr. St Elizabeth's Schl)
Sheen Lane, E. Sheen (nr railway crossing)
Petersham Rd opp Poppy Factory,
Uxbridge Rd nr Longford Cl, TW12
Castelnau, Barnes (nr. Hammersmith Brge)
Castelnau Library, Barnes (static site)
Petersham Rd, Ham (nr. Sandy Lane)
Wetlands, Barnes (static site)
Bias adjusted
UK/EU Target

Map of NO2 diffusion tube sites in LBRUT in 2021



All results are annual bias adjusted

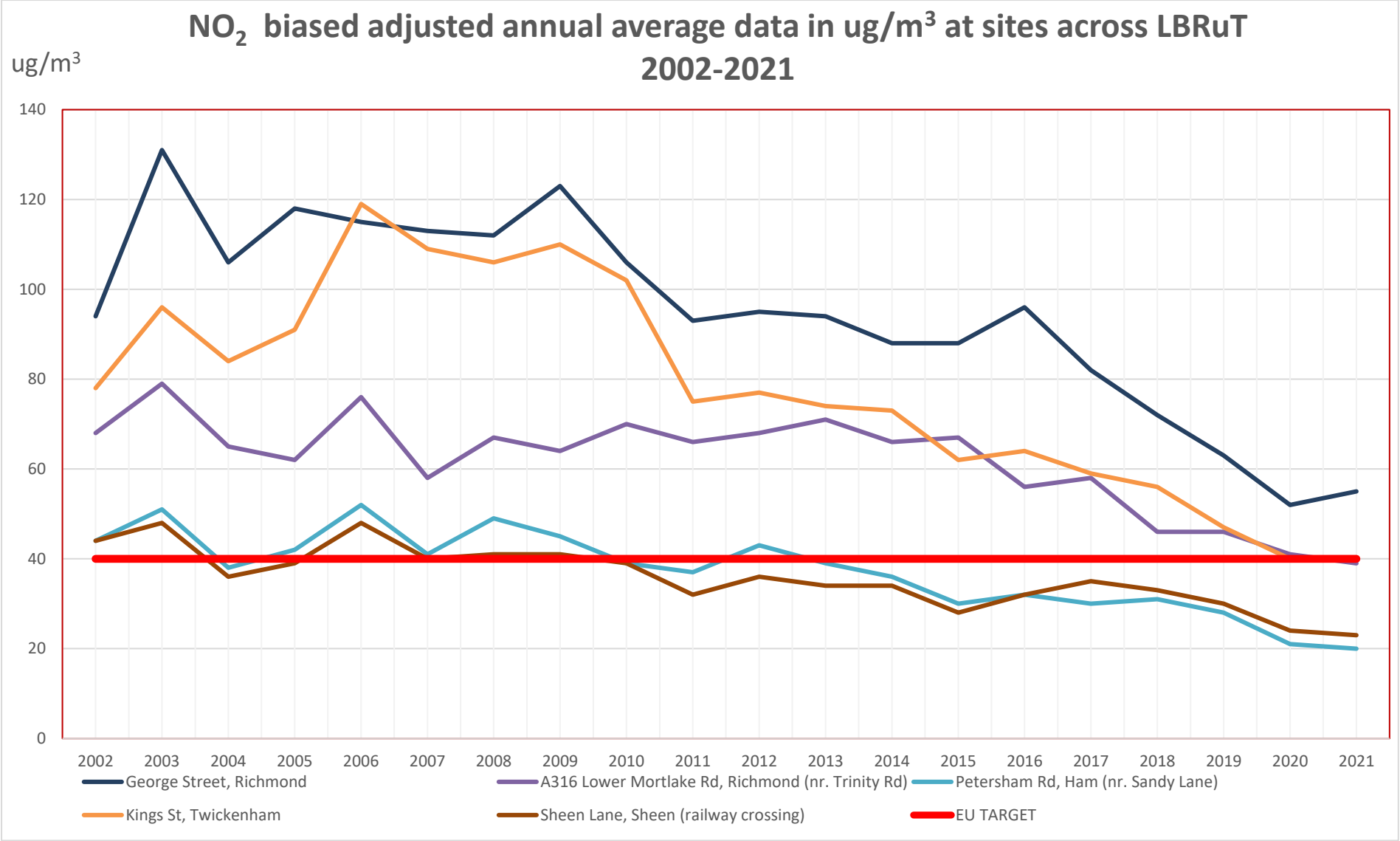
Key:

0-39 µg/m³ (complies with EU/UK annual NO2 limit value)

40-59 µg/m³ (exceeds EU/UK annual NO2 limit value)

60 µg/m³ and over (exceeds EU/UK annual NO2, likely exceeds EU/UK hourly NO2 limit value)

https://www.google.com/maps/d/viewer?mid=1FXi3kxJxhB-OJOYKU1JqQp-IiTHfcCH5&ll=51.43908395006437%2C-0.33272889246094506&z=12


NO_2 biased adjusted annual average data in ug/m^3 at sites across LBRuT 2002-2021
ug/m^3
140
120
100
80
60
40
20
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
George Street, Richmond
A316 Lower Mortlake Rd, Richmond (nr. Trinity Rd)
Petersham Rd, Ham (nr. Sandy Lane)
Kings St, Twickenham
Sheen Lane, Sheen (railway crossing)
EU TARGET

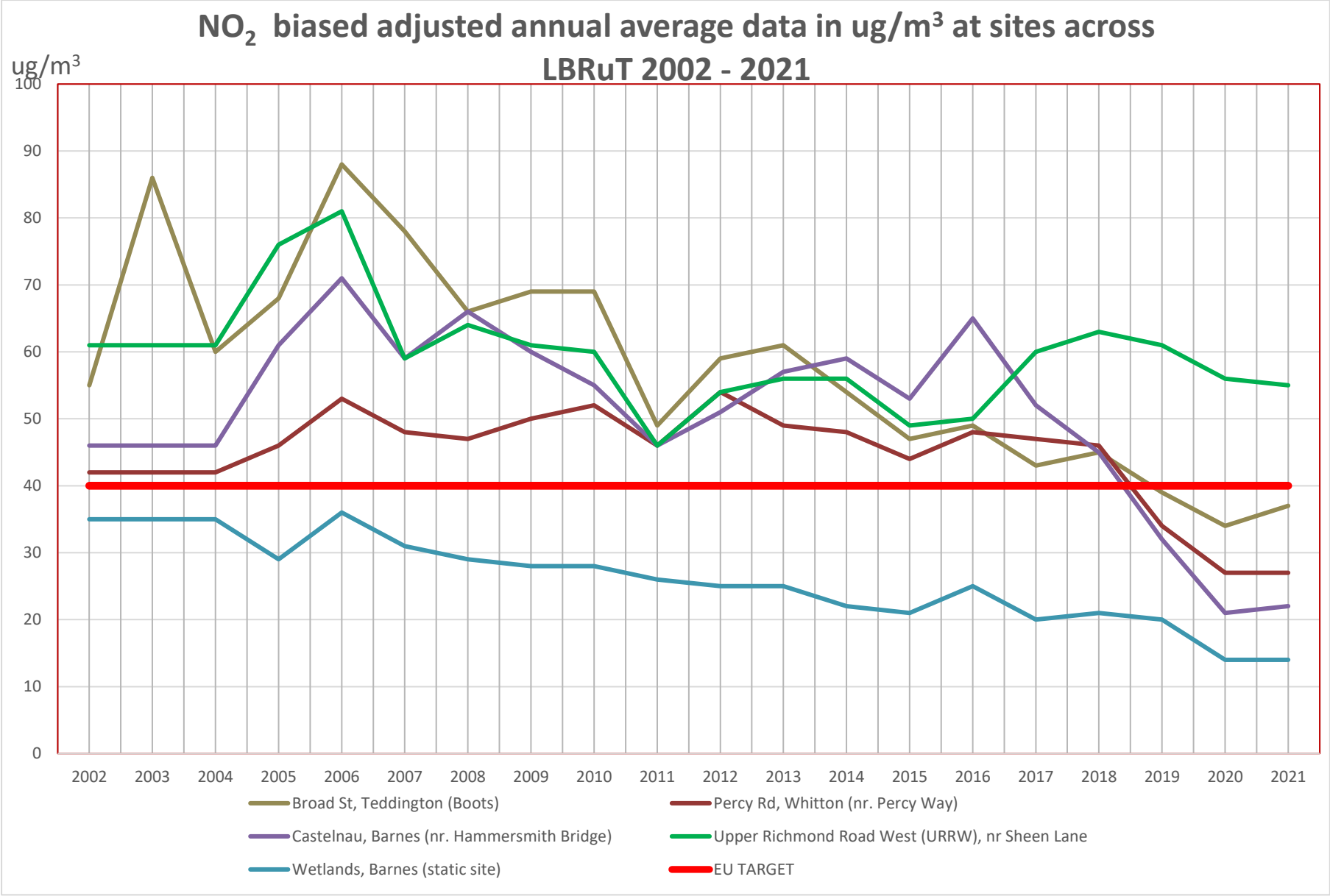

NO2 biased adjusted annual average data in ug/m3 at sites across LBRuT 2002 - 2021
ug/m3
100
90
80
70
60
50
40
30
20
10
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Broad St, Teddington (Boots)
Percy Rd, Whitton (nr. Percy Way)
Castelnau, Barnes (nr. Hammersmith Bridge)
Upper Richmond Road West (URRW), nr Sheen Lane
Wetlands, Barnes (static site)
EU TARGET

Table E. NO_2 Automatic Monitor Results: Comparison with 1-hour Mean Objective

Site ID	Valid data capture for monitoring period %([b])	Valid data capture 2021 %([b])	Number of Hourly Means > 200 µgm^{-3}						
			2015	2016	2017	2018	2019	2020	2021
Castelnau Library, Barnes (RI1)	100	98	0	0	0	0	0	0	0
Wetlands Centre, Barnes (RI2)	100	85	0	0	0	0	0	0	0

Notes

Results are presented as the number of 1-hour periods where concentrations greater than 200 µg m^{-3} have been recorded.

Exceedance of the NO_2 short term AQO of 200 µg m^{-3} over the permitted 18 hours per year are shown in **bold**.

If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets.

(a) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year

(b) Data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%)

Warning: **Barnes Wetlands - Nitrogen Dioxide achieved a capture rate less than 90% for the year (85%). Results may not be representative of the full year and should be used for guidance only.**

Table E provides the results of automatic monitoring for NO2 for the 1-hour mean objective of 200 μg m-3. It was met at all sites and for every year reported. This is encouraging news. The data for 2021 is fully ratified.

Table F. Annual Mean PM_{10} Automatic Monitoring Results (μg m^{-3})

Site ID	Valid data capture for monitoring period % [b]	Valid data capture 2021 % [b]	Annual Mean Concentration (μgm^{-3})						
			2015	2016	2017	2018	2019	2020	2021
Castelnau Library, Barnes (RI1)	100	99	22	20	18	19	15	15	16
Wetlands Centre, Barnes (RI2)	100	94	17	16	15	15	16	16	15
NPL - Teddington AURN	100	99	N/A	N/A	N/A	N/A	N/A	13	12

Notes

The annual mean concentrations are presented as μg m^{-3}.

All means have been "annualised" in accordance with LLAQM Technical Guidance, if valid data capture is less than 75% and more than 33%.

(a) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(b) Data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%).

All data for PM10 at Castelnau and Wetlands is fully ratified. Dates for ratification are unknown at NPL.

The LBRuT uses a Tapered Element Oscillating Microbalance (TEOM) to continuously monitor PM_{10}. All TEOM results are converted to reference equivalence using the Volatile Correction Method (VCM), which is administered by Imperial College London, when they process our monitoring data. As mentioned in section 1, PM_{10} is a specified pollutant for the whole Borough AQMA.

Table F provides results of automatic monitoring of PM10 and a comparison with the annual mean objective. The objective of 40 μg m-3 was met at all sites for every year reported. All data is fully ratified.

The 2021 annual mean for PM10 at the roadside site in Castelnau Barnes increased slightly from 15ug/m3 to 16ug/m3 2020 to 2021 and at the background site at the Wetlands Centre in Barnes has decreased slightly from 16ug/m3 to 15ug/m3 2020 to 2021. Wetlands has recorded 15ug/m3 or 16ug/m3 every year for the last 6 years from 2016 – 2021, despite COVID-19 and any reduction in traffic. This partly illustrates how challenging it is to reduce levels of PM. As has been pointed out under the NO2 section, Castelnau has seen significantly less traffic in 2019, 2020 and 2021 due to the closure of Hammersmith Bridge, at the end of Castelnau, to all traffic from 10th April 2019. The bridge is undergoing major repairs and is likely to remain closed for a number of years.

The PM10 monitoring results for the LBRuT automatic sites are compared directly to the annual mean and 24 hour mean objectives. Tables F and G provide results for the period from 2015 to 2021 inclusive. PM10 measurement was undertaken at three sites and the data capture was good at R12 Wetlands achieving 94% and very good at RI1 Castelnau and at TDO, Teddington NPL achieving 99% at each. As advised, PM10 data at Castelnau and Wetlands is fully ratified and dates for ratification at TDO NPL are unknown.

PM10 is proving very difficult to reduce further. Over the 7-year period from 2015 – 2021 it has gone up and down slightly one year to the next but a slight downward trend overall has been achieved. This is encouraging. However, it has gone up as well as down fractionally year on year, and for the last 3 years 2019 – 2021 has more or less remained static, so we cannot get complacent. It is particularly significant to note no decline at either site in 2020, despite reduced traffic due to COVID-19.

It should be noted that whilst all three sites meet the UK/EU limit value (40 μg m-3) they fail or struggle to meet the new, stricter WHO guidelines (15 μg m-3) for PM10. This is true for both Wetlands and Castelnau. Defra must review UK limit values by the end of 2022 and some revision is possible. Modelling indicates there are some exceedences of the UK/EU limit value (40 μg m-3) for PM10 on some sections of major roads within the borough, including near Richmond on the A316, so vigilance is required. We hope to install a new automatic monitoring station in Richmond town centre, which will monitor both PM10 and PM2.5, as soon as funding is available. We will reassess this in next years' report.

Table G. PM_{10} Automatic Monitoring Results: Comparison with 24-Hour Mean Objective, Number of PM_{10} 24-Hour Means > 50 µg m^{-3}

Site ID	Valid data capture for monitoring period %[a]	Valid data capture 2021 %[b]	Number of Daily Means > 50 µgm^{-3}						
			2015	2016	2017	2018	2019	2020	2021
Castelnau Library, Barnes (RI1)	100	99	5	7	4	1	3	0	0
Wetlands Centre, Barnes (RI2)	100	94	1	3	3	0	3	0	0

NPL - Teddington AURN	100	99	N/A	N/A	N/A	N/A	N/A	2	0

Notes

Where the period of valid data is less than 85% of a full year, the 90.4th percentile is provided in brackets.

(a) data capture for the monitoring period, in cases where monitoring was only carried out for part of the year

(b) data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%).

.

Table G provides the comparison with the 24-hour mean objective for PM10. The objective of no more than 35 days exceeding 50 μg m-3 was met at each site for all years reported. In 2021, no exceedence at all 3 sites was recorded. The number of days exceeding the daily standard remains relatively low at all sites for the last 7 years. Again, levels are going up and down year on year so vigilance is required.

The concentrations measured in Richmond are considered typical of those measured elsewhere across London (KCL, 2012).

Elevated PM10 levels can result from episodes, which are often the result of local combined with imported transboundary conditions from elsewhere in the UK and Europe.

Table H. Annual Mean $PM_{2.5}$ Automatic Monitoring Results (µg m^{-3})

Site ID	Valid data capture for monitoring period %[a]	Valid data capture 2021 %[b]	Annual Mean Concentration (µgm^{-3})						
			2015	2016	2017	2018	2019	2020	2021
NPL Bushy Park, Teddington (TD5)	100	99	N/A	N/A	10	11	12	8	N/A

Notes: The annual mean concentrations are presented as µg m^{-3}.

Exceedances of the $PM_{2.5}$ annual mean AQO of 25 µg m^{-3} are shown in **bold**.

All means have been "annualised" in accordance with LLAQM Technical Guidance, if valid data capture is less than 75% and more than 33%.

(a) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(b) Data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%).

Warning: The data for 2021 is provisional data and has not been fully ratified so should be treated with caution.

Table H provides results of automatic monitoring of PM2.5 by NPL in Bushy Park and a comparison with the annual mean objective.

Annual mean for 2021 is not available. The objective of 25 µg m-3 was met for every year reported and is likely to have been met in 2021.

This does reinforce results of compliance for particulate matter in the London Borough of Richmond upon Thames. The Council, together with many other local authorities in London, does not currently have a PM2.5 monitor.

3. Action to Improve Air Quality

3.1 Air Quality Action Plan Progress

The Council approved an updated AQAP for 2020 – 2025 on 10th March 2020. The new AQAP has involved direct consultation and engagement with community groups. The result is a more robust, more transparent, more accountable AQAP, which is public facing. Improving air quality in the borough is a top political commitment. The new AQAP reflects changes in air quality policy, creating an environment that is welcoming to sustainable transport and aimed at the pedestrian and/or cyclist, identifying specific bold and brave measures to tackle pollution in local 'hot-spots' within the borough and prioritising schools.

The updated AQAP 2020 – 2025 is supported by the departmental Heads of Service for Environmental Health, Transport and Planning, Public Health, the Director of Public Health, the Director of Environment and Cabinet members.

Table J provides a brief summary of the London Borough of Richmond upon Thames' progress against the new Air Quality Action Plan, showing progress made this year. New projects, which commenced in 2021, are shown at the bottom of the table.

Table J. Delivery of Air Quality Action Plan Measures

Measure	LLAQM Action Matrix Theme	Action	Progress • Emissions/Concentration data • Benefits • Negative impacts / Complaints
1.1	Monitoring and other core statutory duties	Maintain our monitoring regime in the borough	LBRUT believes monitoring is the backbone of air quality, essential to identifying and understanding problem areas, vital to inform solutions and interventions. Throughout 2021, LBRUT maintained 2 x automatic stations monitoring NO2, PM10 and O3 and 63 x permanent NO2 diffusion tube sites borough wide. Unfortunately it was not possible to replace our mobile air quality station which was stolen in 2020 but this will be actioned as soon as funding is available.

			LBRUT is part of the LAQN and values the work done by Imperial College to help achieve and maintain the highest possible standards. Bias adjusted annual results in ASR's are published asap online In addition, for the whole of 2021,
1.2	Monitoring and other core statutory duties	Present quarterly updates through the air quality action plan in simple to use format and ensure complete transparency	Results are continually updated and made publicly available. Latest raw data is available quarterly online here The AQAP is updated regularly and meetings held with community groups to ensure transparency and to listen to ideas and concerns. Data is regularly provided for concerned residents and Cllrs on request.
1.3	Monitoring and other core statutory duties	Continuous review and improvement of the Air Quality Network throughout the borough	Sites are reviewed and updated annually. Review is carried out in December each year; new sites commence in January to enable full 12 month data sets. The Council listens to concerns from residents. Suggestions from community groups and individuals are received throughout the year and included where possible, sometimes for short term monitoring, sometimes for permanent sites.
1.4	Monitoring and other core statutory duties	Positively encourage and support citizen science activities where these actively contribute to identifying and tackling air pollution in the borough. Including the provision of Diffusion Tubes and hand held monitoring	Target: to support 4 projects including up to 150 additional diffusion tubes for locations borough wide. The Council exceeded its target; it installed in excess of 450 x additional NO2 diffusion tubes for 4 separate projects plus ad hoc hot spot monitoring in 2021. These were mainly run and installed by LBRUT and mainly in response to concerns from residents, parents and Cllrs. In 2021, all 4 projects were around proposed road schemes – 2 proposed LTN's, one in East Sheen and one in Hampton Hill, East Sheen Primary School on the South Circular, next to the extended ULEZ, and traffic that would be effected by the Royal Parks Movement strategy - displacement and through traffic in Richmond and Bushy Parks. Hampton Hill is proving highly contentious and residents are keen to see data. It is hoped data will help inform decision-making. Trials have been extended and monitoring continued in 2022 in order to assess traffic and pollution levels as the new "normal" working patterns emerge. Work with East Sheen Primary School has continued to help measure any effects of the extended ULEZ, which started operating from 25th October 2021 outside its gates. This was in response to concerns from parents and the head teacher. Data is available on the Council website here

1.5	Monitoring and other core statutory duties	All schools in areas of poor air quality to be incorporated into our monitoring network and regime	In 2021, LBRUT continued to monitor St Stephens School on the A316 and East Sheen Primary on the South Circular. These 2 schools are sited near higher polluting roads in the borough, so we will keep a keen eye on monitoring results. Both schools were part of the Mayors air quality audits in 2018 and received funding to mitigate exposure. Both were compliant in the playground where children play and inside classrooms. From modelling, no other schools are in areas of poor air quality. Air Quality monitoring is offered to all schools...
1.6	Monitoring and other core statutory duties	Roll out monitoring to all schools in the borough to provide information	Hot spot monitoring for 1 month's NO2 at any school that requested it, was paused in 2021, due to COVID. Annual monitoring continued throughout 2021 at 6 sites at East Sheen Primary School on the South Circular. Target: 12 monitoring sites per annum in Primary Schools. It was decided in 2021 to increase this target – both the duration and the number of schools. From 2022, the Council will monitor worst-case scenario outside at least 15 Primary Schools for a whole year, for more robust data.
1.7	Monitoring and other core statutory duties	Implement a new interactive AQAP, which will be updated regularly to provide transparent and concise updates to measure our performance as a borough. Air quality data to be updated quarterly.	AQAP was finally adopted by Cabinet on 10/3/20 and the new AQAP is available on the Council website. Air quality data is now updated quarterly on the Council website here
1.8	Monitoring and other core statutory duties	Invest in new monitoring equipment as new technology moves forward. This could see enhancement to the diffusion tube network and help provide real time data	Target: 1 or 2 new monitors per year to be tested. Various products under consideration In 2019/20 LBRUT took part in Breathe London, gaining 3 x AQMesh low cost air quality sensors in Richmond and Twickenham town centres and outside East Sheen Primary School. In October 2020, it purchased 25 x personal pollution monitors for school and Council staff to help them better understand their own exposure to air pollution. In 2021, as part of the South London Partnership, LBRUT installed 45 x real time low cost air quality sensors monitoring NO2 and PM2.5's borough wide – see new actions at bottom.
2.1	Emissions from developments and buildings	New buildings and development. We have embedded air quality in our Local Plan and will produce a Supplementary Planning Document (SPD) that will help to deliver our aspirations for cleaner air in the borough. This document will cover all	Ongoing. Air Quality is now embedded in our the new Local Plan and the borough has finalised a new Richmond specific AQ SPD focused on the council's priorities for new developments, including formalising the Section 106 conditions. This was adopted by Cabinet on 02/06/20, following a small pause in Council committees due to COVID-19. The AQ SPD is now applied to all major planning applications, which reinforces the Mayor's requirements relating to AQ neutral and CHPs (a significant source of local emissions). The AQ

		areas of planning and ensure developers focus on air quality throughout the build and for the life of the development	Officer requests S106 payments wherever possible from developers as part of mitigation measures on major developments. LBRUT push for AQ positive and healthy streets approach in major developments (Stag Brewery) at the pre-app stage for maximum benefits and inclusion. Car free developments are requested wherever PTAL rates permit. If parking is required, it is requested as a block near entrance. Car club spaces as per LBRUT SPD and electric vehicle charge points as per London Plan plus robust travel and servicing plans are conditioned. Opportunities for local district heating network are identified wherever possible. Green space is important to LBRUT, so a lot of effort and negotiation both at pre-app and planning stage now takes place with developers and planners to ensure adequate, appropriate and well located green space is retained/ made available in all new developments; all mature trees are retained wherever possible, often aided by joint working of EH with Parks dept.
2.2	Emissions from developments and buildings	Delivering Cleaner Construction: demolition and construction can have a significant impact on local air quality. We will ensure that sites are regulated in accordance with the Mayor of London's Non Road Mobile Machinery (NRMM) LEZ where this is applicable. This project is currently being delivered throughout London by our joint regulatory service	LBRUT, together with LB Merton are mindful of the large proportion of emissions contributed by NRMM. All major sites are therefore visited and requirements enforced by our London wide NRMM team based in our LB Merton offices. NRMM regulations were updated in Sept 2020 and planning officers informed. In 2020 and 2021 EH at LBRUT requested from Planning that NRMM conditions be imposed on 100% of all major construction sites. Compliance rates for NRMM equipment, on arrival at inspection by the NRMM team was 78%. This demonstrates the importance of continued inspection. For NRMM details, see table K.
2.3	Emissions from developments and buildings	Continue to raise awareness of the fact that the whole borough is covered by a smoke control order and provide information to suppliers of solid fuels on restrictions within the borough. Actively press for more regulatory powers to cover the impact of wood burning appliances.	LBRUT understand that solid fuel burning is a major source of PM2.5 (23 -31% in London) that must be controlled at the local level. Addressing this source is crucial for achieving the LES target to meet WHO guideline levels for PM2.5 by 2030. Wood burning stoves and open fires are popular in LBRUT. In 2021 EH investigated all complaints on smoke control. In 2020, bonfires were banned on all Council allotments at all times. In Autumn/Winter 2019, 2020 and again in 2021 communications ran a campaign on the Council website, social media and by e-letters to residents; letters and posters were sent to all businesses who sold fuel and/or appliances and requested the poster be displayed at point of sale to educate and inform staff and customers.

			LBRUT is part of the GLA engagement group on wood burning and in Winter 2021 was part of a joint Defra bid. The bid was successful and will commence evaluating all types of internal wood burning, assessing impacts on human health in Autumn /Winter 2022. This will then inform a pan London media campaign in 2023.
2.4	Emissions from developments and buildings	Promoting and delivering energy efficiency and energy supply retrofitting projects in workplaces and homes through EFL retrofit programs such as RE:FIT, RE:NEW and through borough carbon offset funds.	The new Climate Change Emergency team at LBRUT worked on many projects throughout 2021, with an additional £1.2m of funding secured from BEIS via the Green Home Grants Local Authority Delivery Scheme to support retrofit for owner occupied and private rented homes across the borough where income is under £30k and EPC rating is D, E, F or G. This has so far delivered improvements to 63 homes in LBRUT and has secured 633.26kg of carbon savings through improvements such as insulation, new windows and doors, solar panels and heat pumps. Funding for improvements runs through until March 2023 so this project will continue to deliver for the borough. LBRUT also helped to promote Solar Together, a scheme to offer a group discount for the installation of solar panels on homes borough wide. In 2021/22, there were 248 sign ups with 55 completed installations. For 2022/23, there were 1666 sign ups with most installations to be completed 2022/23. Carbon savings will be included in our ASR in 2023. This is essential to help towards achieving the ambitious target for London to be a zero carbon city by 2050.
2.5	Emissions from developments and buildings	Reduced emissions from council operations, including from buildings, vehicles and all activities.	LBRUT has installed solar panels on the roof of the Civic Centre to help reduce emissions, insulated original windows, upgraded Council fleet and set conditions for contractor fleet through procurement. The Council fleet now consists of 1 x zero emission (EV), 59 x Euro VI, 1x Euro V, 1 X Euro IV.
3.1	Public health and awareness raising	A new communications strategy developed in partnership with the community and updated regularly to highlight initiatives and campaigns. This action plan needs to be owned by the community and not just the council. Many groups in our borough are actively tackling air pollution and raising awareness and we need to capture and promote this work	The new communications plan is updated quarterly by LBRUT communications dept. All initiatives are shared and promoted wherever possible, such as idling action awareness raising, Clean Air Day, Car Free day, Bike week, walk to school week, wood burning and more. New community webpages, as part of the AQAP, were requested by the community to discuss the draft AQAP pre-launch. Once the pages went live and going forward community updates and input on local initiatives are encouraged. It is hoped this will be a useful place to share knowledge.

3.2	Public health and awareness raising	We will actively lead in important campaigns and initiatives that raise awareness within the borough, including clean air day, car free day, airTEXT and idling action campaign events, as well as proactive measures such as the use of road closures and park-lets .	LBRUT aim for at least 4 campaigns a year. COVID-19 had a direct impact on physical events, so most went online throughout 2020 and the first half of 2021. For Clean Air Day on 17/06/21, local businesses were encouraged and advised how to reduce local air pollution; schools were encouraged to take part in online activities, such as creating maps for low air pollution walking routes to school; entering the Council poster competition themed 'the lungs of London' - 39 entries were received. For Car Free Day on 22/09/21 the Council ran a real life Air Quality and Active Travel information stall in Twickenham with Dr Bike safety checks and showcased cargo-bikes. Residents and businesses were encouraged to walk and cycle via online and social media campaigns and schools held Council supported 'golden lock' activities to promote active travel. Idling Action training was promoted online both by LBRUT and by London Idling Action. 1 school received in-person training late in the year; an online 'Engines Off' campaign was run which used tweets to raise idling awareness, and an online video for drivers, which prompted 606 views and 902 pledgers to the Richmond Idling pledge. 2 Idling Action events took place in November 2021, the first (for Officers only) engaged with 200+ people; the second, attended by volunteers and Councillors, engaged with 124 drivers. Traffic wardens warned 12,056 drivers idling their engines in 2021 and asked them to switch off. AirText, an early warning alert service for days of moderate or high air pollution levels, was supported and promoted on the Council website and in response to complaints and enquiries throughout 2021. LBRUT view AirText as a critically important service providing direct alerts to vulnerable people. Alerts are automatically forwarded to doctor's surgeries, schools and pharmacies. LBRUT consider this a low-cost way to raise awareness and reduce exposure amongst the most vulnerable. In 2021, the closure of Church Street, Twickenham to traffic from 10am - midnight daily, trialled in 2020, became permanent.
3.3	Public health and awareness raising	We will create a new Air Quality & Transport Committee specifically to look at Air Quality and actively engage with the community	A single Transport and Air Quality Committee was created to integrate transport and AQ in all decision making on a fundamental and daily basis with one cabinet member covering both departments. Officers organised community group meetings to listen to suggestions from representatives' borough wide. This helped structure the new AQAP and the two large, well-attended Air Quality and Climate Change summits in Oct 2019. This put Air Quality and Climate Change high on the political agenda and in 2021 resulted in much joint working between Air Quality and Climate Change departments on issues such as clean and green High St recovery and new e-cargo bike schemes (CAV3 and CAV4, see 4.1) and clean, electric ice cream pitches (see 7.5)

3.4	Public health and awareness raising	We will work with our Public Health partners and look at the opportunities to join up our campaigns and to deliver joint health benefits of active travel and healthy lifestyles	Towards the middle of 2021, meetings resumed with PH to deliver joint messaging for health and air quality benefits for numerous strategies around schools, dementia, and the equalities agenda. In 2021 a new training module was developed by PH, with input from the air quality team in LBRUT, to help front line NHS workers deliver joint air quality messages to vulnerable patients especially those with breathing or heart problems, in the community and schools, via "make every contact count".
3.5	Public health and awareness raising	We will work with our Communications Team to promote the use of low pollution, back roads for walking or cycling to reduce individual exposure to air pollution	The Air Quality team is working closely with Active Travel, School Travel Planner, schools, communications and via local presentations to promote low pollution walking routes. These were also promoted, alongside "golden lock "activities to schools on Clean Air Day and Car Free Day 2021.
3.6	Public health and awareness raising	We will create a joint action working group that will actively involve communities in the air quality agenda and that reports to the Chair of the new Air Quality & Transport Committee	This was created to inform and shape the new AQAP. Despite COVID, it met online in November 2020 and twice in 2021. It has also met in 2022. Useful updates and information on the air quality agenda are members are free to raise issues, which are answered or investigated by the Air Quality Team.
3.7	Public health and awareness raising	We will increase the number of schools with accredited travel plans by 20% per year with an aim to have up to 90% of all schools covered by 2024. We will encourage all schools to join TfL STARS programme.	LBRUT has a part time Travel Planning Officer to help schools draw up travel plans. LBRUT also organise road safety talks and encourage walking/cycling to school. LBRUT encourages all schools to sign up to the TfL STARS accreditation scheme. By Dec 2021, 56.6% schools in LBRUT had travel plans and were STARS accredited. All year 6 pupils receive cycling proficiency training before they leave for secondary school. LBRUT also helps schools introduce road safety schemes such as school streets. In 2020, LBRUT introduced 14 school streets, a significant increase from the 3 that were originally planned, pre COVID-19. In 2021, following consultation, 14 were made permanent school streets and more are being considered.
3.8	Public health and awareness raising	Better Legislation: We will actively campaign and participate in the call for a new Clean Air Bill that is fit for the future.	The new Environment Act was finally passed into statute on 10th November 2021. LBRUT together with other London authorities continue to attend meetings with Defra and respond to consultations, including on PM2.5's, to try to strengthen targets and standards.
3.9	Public health and awareness raising	Burning in the borough: We receive regular complaints and concerns from residents about bonfires in the borough.	We have banned bonfires on all borough allotments and may consider further restrictions. Bonfires are a major source of harmful PM2.5's. We have substantial online information, strongly discourage all forms of burning, have contact forms and a contact number and respond to all complaints about bonfires. We take swift enforcement action against builder's bonfires. LBRUT

			witnessed an 800% increase in bonfires in April 2020 when compared to April 2019 when due to COVID-19 the Council Reuse and Recycling Centre was closed. LBRUT has serious concerns regarding TfL's refusal to exempt the Council tip from the extended ULEZ in Oct 2021. The only Council tip is 0.1 mile off the South Circular in a cul-de-sac within the ULEZ. LBRUT has sought dispensation from TfL, which was refused. Whilst it is supportive of the extended ULEZ, it does not want to swap reduced NO2 in a third of the borough for increased PM's borough wide. It is too early to assess any impacts in this report.
3.10	Public health and awareness raising	The impact of burning unauthorised fuel and the use of wood burning appliances is becoming more of an issue. We will lobby Government for additional powers to control burning unauthorised fuel and the use of wood burning appliances. We will take action to address any complaint regarding unauthorised use.	The whole of LBRUT is a smoke control zone. The Council receives complaints about smoke from a chimney every year. All reported cases are investigated and enforced. Every year for the last 4 years, it has launched smoke control campaigns for residents and written to all businesses that sell fuel and/or appliances with posters to inform customers at point of sale. It did so again in 2021. LBRUT is on the newly formed GLA Wood burning Working Committee and was part of the successful Defra bid to assess health impacts in smoke control areas in Autumn/Winter 2022/23 and to use the results to inform a professional London wide awareness raising campaign in 2023/24.
3.11	Public health and awareness raising	Audit all schools in areas of poor air quality and provide financial support for measures that tackle and reduce exposure to pollution	LBRUT has a target to audit all schools in areas of poor air quality. This was paused in 2020 due to COVID. The Pollution team with the Mayor's team have completed audits at the 3 schools in areas of poorest air quality – St Stephens Primary School, East Sheen Primary School and Windham Nursery School. All received substantial reports with short, medium and long-term recommendations. The 2 x Primary Schools received £10,000 from both the Mayor and LBRUT to help deliver improvements. From modelling, no other schools are in areas that exceed UK/EU annual limit values for NO2. However, in 2021 we continued to deliver in house air quality audits at other Primary Schools in LBRUT, with a target of 1 school per term. Reducing exposure on the walk to school is also considered important. LBRUT encouraged all schools to focus on cleaner walking routes to school for Clean Air Day 2021 and post these on their websites.
4.1	Delivery servicing and freight	Develop plans for business engagement, including optimising/greening deliveries, supply chain and waste removal	In 2021, LBRUT won a 2nd DEFRA bid – Clean Air Villages 4 (CAV4) for Twickenham town centre. CAV 4 investigated at length a shared trader electric vehicle and combined waste removal with the help of partners CRP (Cross River partnership). Lack of available EV vans due to a shortage of conductors, hampered progress but LBRUT continued to support the expanding and successful Mytowns project, offering next day high street deliveries by ecargo bike borough wide – (see **new projects** 4.2 at end). It also developed a roadmap to launch Green Mark to encourage and accredit sustainable businesses for 2022.

5.1	Borough fleet	Richmond will upgrade its own fleet and that of our suppliers to the highest Euro Standards	Reducing emissions from LBRUT's own fleet and that of contractors is seen as key. LBRUT believes it is very important to lead by example, so has a target for the entire fleet to be the latest Euro standard or electric by 2024 By Dec 2021 95% of LBRUT's fleet was latest Euro VI and 1.5% of LBRUT's fleet was zero emission. LBRUT's fleet consists of 1 x zero emission, 59 x Euro VI, 1 x Euro V, 1 x Euro IV. Contractors are incentivised via procurement (see 2.5)
6.1	Localised solutions	The introduction of a borough-wide 20 mph speed limit. This will help create an environment that is welcoming and safer for pedestrians and cyclists	The installation of 20 mph speed limit in over 90 % of all LBRUT roads was completed by April 2020 (implemented in 24 segments). This has helped create an environment that is welcoming and safer for pedestrians and cyclists to help encourage and increase the mode share for walking, cycling and public transport, particularly important throughout 2021 as the nation came out of lockdown.
6.2	Localised solutions	Independent assessment of the air quality benefits of the new 20 mph speed limit - monitor 3 locations before and after 20 mph limit implemented	A report was commissioned to review impacts on air quality before and after the introduction of the borough wide 20mph speed limit. Unfortunately, due to COVID and the large number of changes in life styles, which affected traffic 2019 to 2020, it was not possible to establish either a positive or a negative effect of speed on levels of air quality. Air quality did improve generally in 2020; it has declined slightly or remained the same at more sites in 2021. Any impact from speed alone is not possible to ascertain. Speed did reduce with the new 20mph. The traffic survey in early 2021 comparing 2018 to 2020 confirmed a reduction in speed on most roads, contrary to increased speeds affecting much of London during lockdown. It is hoped that the new Breathe London sensors will permit comparison with some Vivacity monitors to compare traffic and air quality data on one graph. Work is progressing.
6.3	Localised solutions	Additional speed reduction measures at A310 Kingston Bridge to Twickenham, A305 Staines Road Corridor and A308 Hampton Court Corridor	These three corridors - A310, A305 and A308 were identified for corridor studies and are being taken forward in 2022/23. Early in 2021, Hampton Court Rd had new interim cycle facilities built outside the Palace and 20mph was introduced along part of this corridor. These corridors are still very much works in progress as funding has been limited due to both Covid and now the limited TFL funding given to boroughs. A310 – works are continuing on the cycle route install on Strawberry Vale expected to be completed by December 2022, following on from this (albeit subject to funding) LBRUT aim to consider measures on the Cross Deep and Kingston Road links along the corridor.

			A305 – funding is available 2022/3 to review the corridors and identify speed reduction measures for consultation, any funding for implementation will need to be secured. A308- this corridor continues to be reviewed with funding available for a permanent scheme arrangement directly outside of the Palace. The plan would be to continue with the adjoining sections following completion. Measures for install, which are currently funded, include a shared pedestrian/cycle path between Hampton Court roundabout and Bushy Park, a new toucan crossing and changes generally to the existing road layout.
6.4	Localised solutions	A new Clean Air Zone (CAZ) for Richmond Town Centre. This is the most polluted location in our borough and a hot spot for through traffic. We will tackle this by introducing a new Clean Air Zone with the ambition of reducing polluting vehicles and dissuading vehicles from unnecessarily using our town centre as a through route (subject to funding approvals)	LBRUT commissioned baseline data in Autumn 2019 with a view to bringing in the proposals for Richmond Town Centre by 2021. COVID 19 resulted in delays and fresh thinking. In 2021/22, LBRUT has wider plans for Richmond town centre, which are in development. A Clean Air Zone is still being considered as part of a package of wider interventions intended to improve air quality, public realm and the walking and cycling environment in Richmond town centre.
6.5	Localised solutions	Focus our policies and Local Implementation Plan on prioritising cycling and walking in the borough	Richmond Council published its Active Travel Strategy in 2020. The strategy includes a detailed list of actions that the council is pursuing to increase walking and cycling in the borough, including a strategic cycle network connecting the key town centres. Despite the pandemic, progress has already been made towards establishing this network with cycle improvements delivered on Kew Road, Hampton Court Road and Castelnau, with further improvements in development for Hampton Court Road, Hampton Wick Roundabout, Strawberry Vale and Staines Road. The target delivery date is 2024. Other works currently being assessed for cycling include a review of London Road in Twickenham in addition to a detailed assessment of the London Rd/Whitton Rd signals for cycle improvements, this is part of the strategic cycle route. Other identified measures in 2022/23 include new crossings on Broad Lane Hampton and Meadway Twickenham, a review of crossings on Friars Stile Road, Teddington High Street and Wellington Road. The target delivery date is 2024.
6.6	Localised solutions	Continuing the roll out of Electric Vehicle Charging in the borough.	Ongoing - ambition to exceed target. Target achieved in 2021. Ambition to achieve more.

		Target. of 400 EV charging points by 2025	LBRUT is keen to enable and encourage uptake of zero emission vehicles in preference to petrol or diesel vehicles. It accepts the need to provide space on borough roads and in borough car parks for an effective network of charging points of different types to cater for all users. The majority of charge-points are lamp column chargers on residential roads catering for residents without off street parking. A total of 424 public charging points (sockets) have now been installed in LBRUT including 76 new lamp column chargers in early 2022. The breakdown is 341 slow (lamp column) 78 fast (Source London) and 5 rapid (TfL). Further lamp column chargers are planned over summer 2022 and the council is continuing to investigate options with private sector providers for further fast/rapid charger provision at no cost to the Council.
6.7	Localised solutions	Investing in Cycling Infrastructure in the borough - 1000 Cycle stands, 30 Cycle Hangers, 200+ Cycle Racks by 2023	In 2021, we installed 18 bike hangars across LBRUT. We received a £27,000 grant from TfL for the installation of 68 Sheffield stands to be located on-street in various locations across the borough, providing parking spaces for 136 bikes. We are likely to exceed all cycling infrastructure targets including 1000 cycle stands by 2023. LBRUT does not monitor the number of cycle parking stands installed as part of new developments – they are conditioned as per London Plan 2021 and noted as part of the planning application but cumulative totals are not available.
6.8	Localised solutions	To reduce traffic around schools at drop off and pickup times we will be piloting 'School Streets' at selected schools with a view to extend these in the borough	LBRUT had a target of 3 school streets in March 2020. This target was significantly increased to 15 by Oct 2020 during COVID to help with both safety and social distancing around schools. In 2021, 14 School Streets were made permanent and 2 more are out for consultation.
6.9	Localised solutions	Pilot internal air quality filtration in schools and take part in GLA assessment in effectiveness of different filtration units at nursery schools	Air filtration units were piloted at 2 x primary schools 2019 – 2020. This pilot is now complete. It emerged that performance was dependent on routine maintenance - i.e. schools replacing/cleaning filters when necessary, which effected the value of the intended report. COVID and funding issues further disrupted this. In 2019, the GLA carried out an audit of 20 nursery schools in London including Windham Nursery School in LBRUT. All received reports and joint funding from the GLA and local authority to help with recommended improvements. In addition, the GLA selected 5 nursery schools for a detailed survey of 5 different air filtration systems. This resulted in a more robust report on the effectiveness of air pollution purifiers here

7.1	Cleaner transport	We will commission a Diesel Levy options paper and impact baseline for the borough. The implementation and the scope of that implementation will be considered at the Air Quality & Transport Committee. We will also benchmark against other leading boroughs that have considered and are implementing charges linked to vehicle emissions	Ongoing. An Emissions based parking levy report was completed in May 2020 looking at 5 options to address both harmful effects of traffic fumes and Climate Change Impacts to support a zero emission target for London by 2050. It reviewed a 2018 report on emission-based resident parking and considered options adopted elsewhere. LBRUT would like to incentivise and encourage a switch to cleaner vehicles. This requires further political consideration in the light of the potential of the ULEZ expansion. Officers will seek political steer during this financial year (2022/23) and further updates will follow. Decisions/progress will be updated in ASR 2023.
7.2	Cleaner transport	Anti-idling: This is a priority action for the borough and we will be working tirelessly within given resources to ensure that this is tackled for all vehicles including taxis	This is a top political priority. In 2021, traffic wardens engaged with 12,056 drivers across LBRUT, warning drivers to switch off. All drivers complied, so no FPNs were issued. This was the 3rd year of CEO enforcement and a total of over 31,000 warnings have been issued. From Autumn 2021 onwards, LBRUT restarted Idling Action events as part of the Mayor's campaign and also organised their own, some with volunteers and Cllrs. This will continue throughout 2022. LBRUT created its own pledge for engine idling for businesses and schools. It encouraged all schools to pledge not to idle and issued large banners to those that sign up, which were displayed on boundary fences. Online resources to schools were promoted. In 2021, LBRUT worked both with London Idling Action and independently contacting companies directly to raise awareness of engine idling. Toolkits and online tutorials were promoted. All complaints were responded to and additional signage requests were investigated and erected where practical. Much work has also been carried out with black cabs outside Richmond and Twickenham stations, talking to drivers, talking to TfL, publishing articles in trade magazines and Idling Action events at taxi ranks. Most taxis are now compliant.
7.3	Cleaner transport	We need to lead by example so we will be developing a 'benchmark test' to gauge the impact of internal decision making around factors such as procurement	LBRUT has developed a benchmark test for procurement to help influence and incentivise suppliers to use the cleanest vehicles possible to reduce pollution from Council/contractor logistics and servicing. Euro VI/EV's are required on new contracts. LBRUT ensured that the new 10 year waste and recycling contract, which commenced 1/4/20, used only Euro VI vehicles as soon as available. This represents a substantial improvement on the former fleet and will help reduce emissions borough wide.

7.4	Cleaner transport	Tackle Council work place emissions and promote the Council Travel Plan to the Council employees	2020/21 due to COVID-19 witnessed the biggest switch to working from home ever. The impossible became possible. Much will continue and LBRUT will encourage working from home where practical in 2022/23. This will help reduce emissions from travelling to work. Throughout 2021 the Council continued to promote healthier travel habits for its staff, including walking, cycling and where safe, using public transport for business visits. Work Oyster cards are provided for business travel/site visits on public transport. Cycle to work scheme is encouraged. Cycle facilities on Twickenham campus include showers and changing rooms. Staff cycle parking is increased by removing car parking bays as demand increases. The Council has become a corporate car club member. Parking is only provided for essential car users, usually for 2 days a week. Free parking for all other officers, of all grades, has been abolished. All initiatives will help reduce emissions.
7.5	Cleaner transport	Licensing & Idling: We have a problem in the borough with food and ice cream vans that contribute to pollution when servicing certain areas. We will seek to ban diesel emissions when serving ice cream and require all non-itinerant food vans with licensed pitches to plug into an electrical source. We will work with our partners in our Licensing Team to introduce conditions at annual license renewal that provide the above controls to tackle this idling	LBRUT introduced this policy in its AQAP in March 2020 to address a specific concern with idling ice cream vans and food vendors. In 2021, the Air Quality team progressed this action with the Licensing and Climate Change teams to try to fund free electrical plug in points for all non-itinerant mobile food vendors by 2024 and to make it a condition at annual license renewal in 2023 to plug into an electrical source. This will be phased in over several years. By December 2021, LBRUT had 5 x electrical points installed for mobile food vendors. It hopes to install another 5 in 2022. Money has been provided internally through the Climate Change fund. LBRUT would like to combine this with more business engagement, help for street vendors and help for more local businesses to recover from COVID. In their bid to the Climate Change fund, the Air Quality team have proposed dual use pitches – ice cream in summer, hot refreshments in winter for our parks and open spaces – all newcomers to be electric, clean and green from outset. Licensing will be reviewing policy by Autumn 2022 to be introduced 2023.
7.6	Cleaner transport	Support the development and use of 'Car Clubs' in new residential developments, by station interchanges and in town centres.	Car clubs operate throughout the borough and are positively endorsed by the Council. In 2021, there were 72 car club bays available to the operators Enterprise Car Club and Zipcar; however, 29 of these were unoccupied for a large part of the year due to residual demand issues and delays in supply of new vehicles caused by the global shortage of parts affecting manufacturing, primarily microchips. The operators intend re-occupying vacant spaces as and when vehicles become available. The council worked with Zipcar to launch the free-floating car club Zipcar Flex in the north of the borough from July 2021. Since launch an average 48 vehicles have been available daily, of which an average 14 have been pure electric vehicles. The most recent data show an average of 850 active members per month, making around 2000 trips each month. A full review of car clubs in Richmond is planned for later in 2022.

<table>
<tr><td>7.7</td><td>Cleaner transport</td><td>Tackle idling vehicles at schools as a priority</td><td>Traffic wardens target schools at pick up time on a regular basis. This was paused during COVID as most children worked from home. In 2021, active travel plans were encouraged and 14 school streets became permanent, encouraging more walking, scootering and cycling. This was considered a better option than targeting idling alone. However, traffic wardens and our Idling Action events, continued to target non school street schools at collection time in 2021.</td></tr>
<tr><td></td><td>New projects for 2021</td><td></td><td></td></tr>
<tr><td>1.9</td><td>Monitoring and other core statutory duties</td><td>Further Investment in new monitoring equipment as new technology moves forward. This could see enhancement to the diffusion tube network and help provide real time data</td><td>In 2021, LBRUT won a joint bid for the ‘Internet of Things’ with the South London Partnership. By October 2021, it had installed 65 x Vivacity monitors to assess vehicle, pedestrian and cycle movements. By November 2021, it had installed 45 x Breathe London air quality sensors to enhance NO2 with real time monitoring and introduce real time PM2.5 monitoring borough wide. Results are available on the breathe London website - https://www.breathelondon.org/. This was a much sought after development by residents and members and is being used to help inform policy.</td></tr>
<tr><td>4.2</td><td>Delivery servicing and freight</td><td>Develop plans for business engagement, including optimising/greening deliveries, supply chain and waste removal</td><td>In Spring 2021, following a procurement process, the business development section of LBRUT selected Mytowns to deliver an innovative online website with clean e-cargo bike next day deliveries to support a green and clean recovery from COVID-19 for local high streets. Mytowns trialled this successfully in the north of the borough in 2020. Mytowns, with the support of LBRUT, enable all independent retailers to have a great online presence quickly, easily and at no cost to themselves. Residents sign up for free and can “shop” along the high street on the website. Residents then click and collect or have all purchases combined to a single delivery, which is delivered next day on e-cargo bike. In 2021, it was successfully rolled out to Richmond, East Twickenham, Twickenham, Teddington, Whitton and Hampton. The ambition is to cover the entire borough and possibly, to have a consolidation centre in the middle of the borough, with an electric van and extend this to purchases from any high street to all areas of LBRUT. A lot of joint working has already taken place and all avenues of funding are being considered.</td></tr>
<tr><td>7.8</td><td>Cleaner transport</td><td>Participation in London E-scooter rental trial - June 2021</td><td>LBRUT is one of the participating boroughs in the TfL London e-scooter rental trials. In the first 7 months of the trial, from June 2020 to 16th Jan 2022 580,000 trips had been carried out by e-scooter across the London trial. Below is a breakdown for the e-scooter trip data (to the nearest 100) for Richmond in this period:
<table>
<tr><th>Trial Period 1</th><th>Trial Period 2</th><th>Trial Period 3</th><th>Trial Period 4</th><th>Trial Period 5</th><th>Trial Period 6</th><th>Trial Period 7</th><th>Trial Period 8</th></tr>
<tr><td>07/06/21 - 04/07/21</td><td>05/07/21 - 01/08/21</td><td>02/08/21 - 29/08/21</td><td>30/08/21 - 26/09/21</td><td>27/09/21 - 24/10/21</td><td>25/10/21 - 21/11/21</td><td>22/11/21 - 19/12/21</td><td>20/12/21 - 16/01/22</td></tr>
<tr><td>4,800</td><td>4,000</td><td>4,600</td><td>5,000</td><td>3,800</td><td>3,400</td><td>2,600</td><td>2,300</td></tr>
</table></td></tr>
</table>

			For more details see London E-scooter Rental Trial Headline Metrics - Trial Period 11 (tfl.gov.uk)

3. Planning Update and Other New Sources of Emissions

Table K. Planning requirements met by planning applications in London Borough of Richmond upon Thames in 2021

Condition	Number
Number of planning applications where an air quality impact assessment was reviewed for air quality impacts	29
Number of planning applications required to monitor for construction dust	22
Number of CHPs/Biomass boilers refused on air quality grounds	0
Number of CHPs/Biomass boilers subject to GLA emissions limits and/or other restrictions to reduce emissions	0
Number of developments required to install Ultra-Low NO_x boilers	24 (5x non combustion)
Number of developments where an AQ Neutral building and/or transport assessments undertaken	29
Number of developments where the AQ Neutral building and/or transport assessments not meeting the benchmark and so required to include additional mitigation	3
Number of planning applications with S106 agreements including other requirements to improve air quality	2
Number of planning applications with CIL payments that include a contribution to improve air quality	0
NRMM: Central Activity Zone and Canary Wharf Number of conditions related to NRMM included. Number of developments registered and compliant. Please include confirmation that you have checked that the development has been registered with the GLA through the relevant NRMM website and that all NRMM used on-site is compliant with Stage IIIB of the Directive and/or exemptions to the policy.	N/A
NRMM: Greater London (excluding Central Activity Zone and Canary Wharf) Number of conditions related to NRMM included. Number of developments registered and compliant. Please include confirmation that you have checked that the development has been registered at www.nrmm.london and that all NRMM used on-site is compliant with Stage IIIA of the Directive and/or exemptions to the policy.	10 conditions included 7 registered and compliant 2 unregistered/uncompliant 1 sites were complete upon engagement 3 site had no NRMM within scope (37-560kW)

NRMM is a standard planning condition applied to all major developments. In 2021, the Principal Air Quality Officer emailed current NRMM conditions to the Head of

Planning and ensured all Planning Officers were reminded of requirement to add NRMM to all planning applications at 2 x team meetings in April and November 2021. The RSP (LB Merton, LBRUT and LB Wandsworth) have 6 designated Officers based in Merton, who assess all major sites for NRMM compliance, visit sites and check the NRMM database for compliance in line with the Mayors Supplementary Planning Guide for Control of Dust and Emissions during Construction and Demolition.

All major developments are passed to the Noise and Air Quality Officers in Environmental Health for comment. All major developments are required to submit an AQA. All relevant national, Mayoral and LBRUT local policies are applied by Environmental Health to all responses to Planning in all cases. Sites are considered for construction dust on a case-by-case basis, monitoring required and locations agreed, where a moderate or high risk to receptors is predicted. CHP/biomass are not recommended/actively discouraged and developers urged to select non-combustion or at least ultra low NOx. More developments are proposing non-combustion, maximum insulation and renewables to increase BREEAM ratings. Requirements are as per London Plan, which meant none could be refused on grounds of AQ in 2021.

3.1 New or significantly changed industrial or other sources

No new sources identified.

4. Additional Activities to Improve Air Quality

4.1 London Borough of Richmond upon Thames Fleet

The London Borough of Richmond upon Thames has a relatively small fleet; it has no Council housing; Waste and Recycling and Parks are contracted out.

By Dec 2021 95% of LBRUT's fleet was Euro VI and 1.5% were zero emission or zero emission capable vehicles.

LBRUT's fleet consists of 1x zero emission (EV), 59x Euro VI, 1x Euro V, 1x Euro IV.

4.2 NRMM Enforcement Project

The London Borough of Richmond upon Thames continues to support the NRMM Enforcement project in 2022 – 23.

4.3 Air Quality Alerts

The London Borough of Richmond upon Thames continues to support *air*TEXT (https://www.airtext.info/) and the Mayor of London's air quality alert programme run by Imperial College London, which sends alerts to all schools, GP surgeries and care homes in LBRUT. Advice is based on Defra's national Daily Air Quality Index

Appendix A Details of Monitoring Site QA/QC

A.1 Automatic Monitoring Sites

All data undergoes quality assurance and quality control (QA/QC) procedures to ensure that the data obtained are of a high quality.

Each NO2 continuous analyser is automatically calibrated every night and also manually checked and calibrated by the contractor, TRL, employed by LBRuT for LSO visits during 2021. Regular calibration visits of between 2-4 weeks were maintained throughout 2021.There is a need for frequent calibration adjustments as the gradual build-up of dirt within the analyser reduces the response rate. This fall off in response needs appropriate correction, to ensure the recording of the true concentrations. The calibration process involves checking the monitoring accuracy against a known concentration of span gas. The span gas used is nitric oxide and is certified to an accuracy of 5%. Both the automatic and manual calibrations use this same certified span gas (i.e. the automatic overnight one does not use the less accurate permeation tube method).

The NO2 and ozone continuous analysers are serviced every six months by TRL and also audited by NPL every six months as part of the Imperial's LAQN QA/QC procedure, to ensure optimum data quality.

Teddington (AURN) monitoring station at NPL is part of the AURN and AEA Technology manages the QA/QC for this station. For more information go to www.airquality.co.uk/archive/index.php (Defra, 2009d).

PM_{10} Monitoring Adjustment

PM10 particulates are measured using Tapered Element Oscillating Microbalance (TEOM) analysers, with the data presented as the gravimetric equivalent.

No automatic or fortnightly calibrations are carried out on TEOMs. Calibrations are only carried as part of the routine servicing and regular independent audits. The Imperial College London Duty Officer checks the on-going performance of the monitor on-line. The role of the LSO at the fortnightly visits is to make more detailed

performance checks. The LSO is also on standby at other times, to change the TEOM's monitoring filter as required, depending on the filter loading.

Since 2009, TEOM data have been improved by routine adjustments, using the volatile correction method (VCM). This corrects for the loss of any volatile mass, which has been driven off by the heat applied in the TEOM's inlet column. The VCM adjustments are carried out by Imperial College London, prior to dissemination of the data.

The TEOM equipment is serviced every six months by TRL and also audited by NPL every six months as part of Imperial's LAQN QA/QC procedure, to ensure optimum data quality. Both sites are part of the LAQN and Imperial are responsible for the daily data collection, storage, validation and dissemination via the LAQN website (www.londonair.org.uk). Imperial ratifies the data periodically, viewing data over longer time periods and using the results from fortnightly checks, equipment services and equipment audits.

Measured mean PM_{10} concentration for both LBRuT's automatic monitoring sites for 2021 was 15-16µg/m3 based on data capture rates of 94% - 99%. Since this was above the 75% data capture threshold "annualisation" of data was not necessary. (This is in accordance with the procedure detailed in LLAQM Technical Guidance (TG16)).

A.2 Diffusion Tube - Quality Assurance / Quality Control

Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe (EC, 2008) sets air quality objectives for NO_2 along with other pollutants. Under the Directive, annual mean NO_2 concentration data derived from diffusion tube measurements must demonstrate an accuracy of ±25 % to enable comparison with the NO_2 air quality objectives of the Directive.

In order to ensure that NO_2 concentrations reported are of a high quality, strict performance criteria need to be met through the execution of QA and QC procedures. A number of factors have been identified as influencing the performance of NO_2 diffusion tubes including the laboratory preparing and analysing the tubes, and the tube preparation method (AEA, 2008). QA and QC procedures are therefore an integral feature of any monitoring programme, ensuring that uncertainties in the data are minimised and allowing the best estimate of true concentrations to be determined.

Our NO2 diffusion tubes are analysed for us by Gradko using 50% TEA in acetone method of preparation. Gradko take an active role in developing rigorous QA and QC procedures in order to maintain the highest degree of confidence in their laboratory measurements. Gradko were involved in the production of the Harmonisation Practical Guidance for NO2 diffusion tubes (AEA, 2008) and have been following the procedures set out in the guidance since January 2009. Since April 2014, Gradko has taken part in a new scheme AIR PT, which combines two long running PT schemes: LGC Standards STACKS PT scheme and HSL WASP PT scheme.

This section contains details of Gradko International Ltd.'s Results of laboratory precision

- Performance in AIR NO2 PT Scheme (Feb – October 2021)

- Summary of Precision Scores for 2019 – 2021

- UKAS schedule of accreditation (April 2020)

Gradko International Ltd is a UKAS accredited laboratory and participates in laboratory performance and proficiency testing schemes. These provide strict performance criteria for participating laboratories to meet, thereby ensuring NO2 concentrations reported are of a high calibre.

Summary of Laboratory Performance in AIR NO2 Proficiency Testing Scheme (February – October 2021)

Gradko participate in the AIR PT NO_2 diffusion tube scheme, which uses artificially spiked diffusion tubes to test each participating laboratory's analytical performance on a quarterly basis. The scheme is designed to help laboratories meet the European Standard. Gradko demonstrated "good" laboratory performance in 2021 for 50% TEA in Acetone.

The laboratory follows the procedures set out in the Harmonisation Practical Guidance and participates in the AIR proficiency-testing (AIR-PT) scheme. Previously to the Air-PT scheme, Gradko participated in the Workplace Analysis Scheme for Proficiency (WASP) for NO2 diffusion tube analysis. Defra and the Devolved Administrations advise that diffusion tubes used for LAQM should be obtained from laboratories that have demonstrated satisfactory performance in the AIR-PT scheme.

Laboratory performance in the AIR-PT is also assessed by the National Physical Laboratory (NPL), alongside laboratory data from the monthly NPL Field Inter-Comparison Exercise carried out at for Gradko at Marylebone Road, central London. A laboratory is assessed and given a 'z' score, a score of ± 2 or less indicates satisfactory laboratory performance. Gradko International Ltd.'s performance for 2021 is covered by rounds AR041 to AR046 of the AIR-PT scheme. For 2021 the laboratories results were deemed to be good for 101 participating local authorities and poor for 13 participating local authorities based upon a z score of ≤ ± 2.

In 2021, the tube precision for NO2 Annual Field Inter-Comparison for Gradko International using the 50% TEA in acetone method was 'good' for the results of 14 participating local authorities and poor for 0 participating local authorities.

Table 1: Laboratory summary performance for AIR NO_2 PT rounds AR0030, 31, 33, 34, 36. 37, 39, 40 and 42

The following table lists those UK laboratories undertaking LAQM activities that have participated in recent AIR NO_2 PT rounds and the percentage (%) of results submitted which were subsequently determined to be **satisfactory** based upon a z-score of ≤ ± 2 as defined above.

AIR PT Round	AIR PT AR030	AIR PT AR031	AIR PT AR033	AIR PT AR034	AIR PT AR036	AIR PT AR037	AIR PT AR039	AIR PT AR040	AIR PT AR042
Round conducted in the period	January – February 2019	April – May 2019	July – August 2019	September – November 2019	January – February 2020	May – June 2020	July – August 2020	September – October 2020	January – March 2021
Aberdeen Scientific Services	75 %	100 %	100 %	100 %	100 %	NR [3]	NR [3]	100 %	100 %
Edinburgh Scientific Services	100 %	NR [2]	100 %	25 %	50 %	NR [3]	NR [3]	100 %	25 %
SOCOTEC	87.5 % [1]	100 % [1]	100 % [1]	100 % [1]	100 % [1]	NR [3]	NR [3]	100 % [1]	100 % [1]
Glasgow Scientific Services	100 %	100 %	100 %	50 %	100 %	NR [3]	NR [3]	100 %	50 %
Gradko International	75 %	100 %	100 %	100 %	75 %	NR [3]	NR [3]	75 %	25 %
Lambeth Scientific Services	50 %	100 %	50 %	100 %	100 %	NR [3]	NR [3]	100 %	100 %
Milton Keynes Council	100 %	100 %	50 %	100 %	100 %	NR [3]	NR [3]	25 %	0 %
Somerset Scientific Services	100 %	100 %	100 %	100 %	100 %	NR [3]	NR [3]	100 %	100 %
South Yorkshire Air Quality Samplers	100 %	100 %	100 %	75 %	100 %	NR [3]	NR [3]	100 %	100 %
Staffordshire County Council	100 %	75 %	75 %	75 %	100 %	NR [3]	NR [3]	50 %	100 %
Tayside Scientific Services (formerly Dundee CC)	100 %	NR [2]	100 %	NR [2]	100 %	NR [3]	NR [3]	100 %	NR [2]
West Yorkshire Analytical Services	100 %	100 %	100 %	50 %	100 %	NR [3]	NR [3]	NR [2]	NR [2]

[1] Participant subscribed to two sets of test results (2 x 4 test samples) in each AIR PT round.
[2] NR, No results reported.
[3] Round was cancelled due to pandemic.
Cardiff Scientific Services, Exova (formerly Clyde Analytical), Kent Scientific Services, Kirklees MBC and Northampton Borough Council; these labs are not detailed as they no longer carry out NO2 diffusion tube monitoring and therefore did not submit results for any of the AIR NO_2 PT rounds listed.

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AIR PT Nitrogen Dioxide Proficiency Scheme Results 2021

Methods: GLM 7 – CARY 60 Spectrophotometer

AIR PT Proficiency Scheme - Nitrogen Dioxide 2021					
Date			Procedure GLM 7		
	Round	Assigned value	Measured concentration	z-Score	% Bias
Feb-21	AIR PT 42-1	1.71	1.13	-4.17	-33.9%
Feb-21	AIR PT 42-2	1.74	0.81	-6.29	-53.4%
Feb-21	AIR PT 42-3	1.40	0.83	-5.43	-40.7%
Feb-21	AIR PT 42-4	1.37	1.16	-1.91	-15.3%
Mar-21	AIR PT 42-1 Rpt	1.71	1.79	0.62	4.7%
Mar-21	AIR PT 42-2 Rpt	1.74	1.75	0.08	0.6%
Mar-21	AIR PT 42-3 Rpt	1.40	1.40	0	0.0%
Mar-21	AIR PT 42-4 Rpt	1.37	1.41	0.39	2.9%
May-21	AIR PT 43-1	1.19	1.23	0.35	3.4%
May-21	AIR PT 43-2	1.19	1.22	0.26	2.5%
May-21	AIR PT 43-3	2.00	1.97	-0.2	-1.5%
May-21	AIR PT 43-4	1.94	1.98	0.26	2.1%
Aug-21	AIR PT 45-1	1.58	1.58	0	0.0%
Aug-21	AIR PT 45-2	1.57	1.56	-0.08	-0.6%
Aug-21	AIR PT 45-3	2.43	2.41	-0.08	-0.8%
Aug-21	AIR PT 45-4	2.42	2.37	-0.28	-2.1%
Oct-21	AIR PT 46-1	2.7	2.77	0.33	2.6%
Oct-21	AIR PT 46-2	2.71	2.6	-0.49	-4.1%
Oct-21	AIR PT 46-3	2.17	2.06	-0.65	-5.1%
Oct-21	AIR PT 46-4	2.13	2.15	0.13	0.9%

Results from AIR-PT 42 showed a significant negative bias. An investigation was carried out and a repeat set of samples ordered (Mar-21) to confirm results.

Results from the investigation showed for AIR PT samples, extraction of nitrite was not complete and required further time on the shaker to extract all nitrite from the tubes. Successful extraction was demonstrated on the repeat Air PT samples in March 2021.

The investigation also showed that for laboratory standards and customer samples, extraction of nitrite from tubes was complete without further shaking, and there was no risk associated with results reported to customers.

For any queries please contact the Laboratory Manager at linda@gradkolab.com

Linda Gates 05/05/2022

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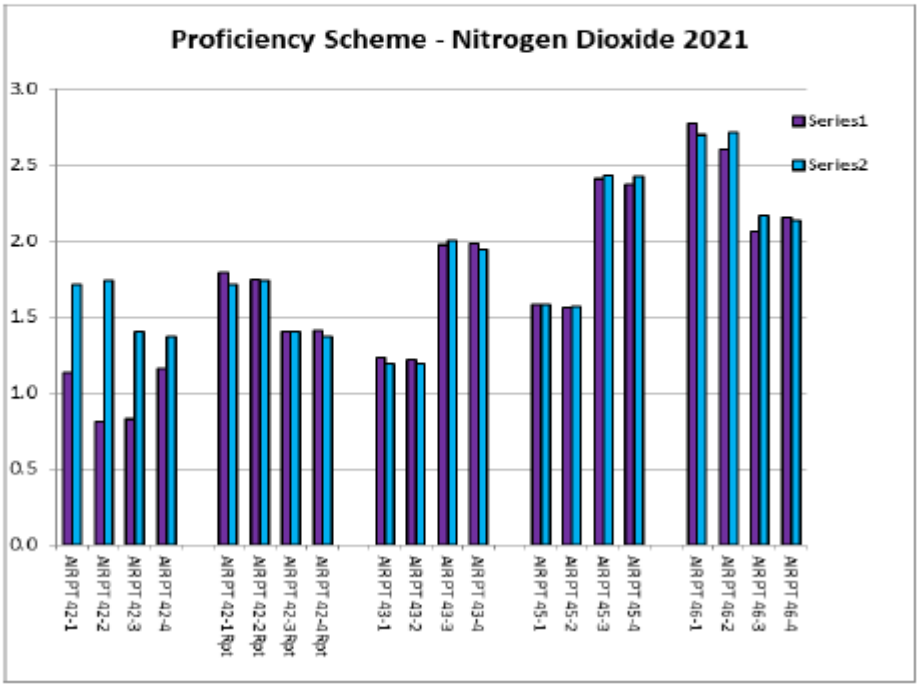

Precision Summary Results

The diffusion tube precision summary results are provided below. This details the total number of recorded good/bad precision results for the last 3 years for laboratories that currently provide diffusion tube analysis.

2019 - 2021 Summary of Precision Results for Nitrogen Dioxide Diffusion Tube Collocation Studies UK Laboratories including for Gradko Laboratory 50% TEA in Acetone

Precision Summary Table

Diffusion Tube Preparation Method	2019 Good	2019 Bad	2020 Good	2020 Bad	2021 Good	2021 Bad
Gradko, 50% TEA in Acetone	27	0	19	1	14	0
Gradko, 20% TEA in Water	30	1	27	0	32	0
ESG Didcot / SOCOTEC, 50% TEA in Acetone	40	1	24	0	20	3
ESG Didcot / SOCOTEC, 20% TEA in Water	12	0	6	0	4	1
Staffordshire Scientific Services	17	0	15	0	13	1
Glasgow Scientific Services	9	2	2	7	1	5
Edinburgh Scientific Services	4	2	4	1	1	0
Milton Keynes Council	2	0	4	0	1	0
Tayside Scientific Services	1	0	1	0	1	0
Lambeth Scientific Services	8	1	8	2	4	1
West Yorkshire Analytical Services	1	1	0	0	0	0
Aberdeen Scientific Services	6	0	7	0	7	0
South Yorkshire Air Quality Samplers	3	0	1	0	1	0
ESG Glasgow, 50% TEA in Acetone	1	0	1	0	0	1
ESG Glasgow, 20% TEA in Water	1	0	1	0	0	1
Somerset County Council	9	0	10	0	2	0

Numerical results for this data are contained in the National Bias Adjustment Spreadsheet version 03/22

Gradko is accredited by UKAS for the analysis of NO_2 diffusion tubes. It undertakes the analysis of the exposed diffusion tubes by ultra violet spectrophotometry.

Schedule of Accreditation

issued by

United Kingdom Accreditation Service

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

UKAS TESTING

2187

Accredited to ISO/IEC 17025:2017

Gradko International Ltd (Trading as Gradko Environmental)

Issue No: 024 **Issue date:** 15 April 2020

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E-Mail: diffusion@gradko.co.uk
Website: www.gradko.co.uk

Testing performed at the above address only

DETAIL OF ACCREDITATION

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
ATMOSPHERIC POLLUTANTS Collected on diffusion (sorbent) tubes and monitors	Chemical Tests	Documented In-House Methods
	Ammonia as ammonium (NH_4^+)	GLM 8 by Ion Chromatography
	Benzene Toluene Ethyl benzene Xylene	GLM 4 by Thermal Desorption/ FID Gas Chromatography
	Hydrogen chloride as chloride (Cl^-) Nitrogen dioxide as nitrite (NO_2^-) Sulphur dioxide as sulphate (SO_4^{2-}) Hydrogen fluoride as fluoride (F^-)	GLM 3 by Ion Chromatography
	Hydrogen sulphide	GLM 5 by Colorimetric determination (UV Spectrophotometry)
	Ozone as nitrate (NO_3^-)	GLM 2 by Ion Chromatography
	Nitrogen Dioxide as nitrite (NO_2^-)	GLM 7 by Colorimetric determination (UV Spectrophotometry)
	Sulphur dioxide as sulphate (SO_4^{2-})	GLM 1 by Ion Chromatography
	Formaldehyde as formaldehyde-DNPH	GLM 18 by HPLC
	Volatile Organic Compounds including: Benzene Toluene Ethylbenzene p-Xylene o-Xylene	GLM 13 by Thermal Desorption GC-Mass Spectrometry

UKAS TESTING 2187 Accredited to ISO/IEC 17025:2017	**Schedule of Accreditation** issued by **United Kingdom Accreditation Service** 2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK **Gradko International Ltd** **(Trading as Gradko Environmental)** **Issue No:** 024 **Issue date:** 15 April 2020

Testing performed at main address only

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
ATMOSPHERIC POLLUTANTS Collected on diffusion (sorbent) tubes and monitors (cont'd)	Chemical Tests (cont'd)	
	Qualitative Analysis and Estimation of Volatile Organic Compounds on diffusion (sorbent) tubes and monitors	GLM 13 by Thermal Desorption GC-Mass Spectrometry with estimations in accordance with ISO standard 16000-6
	Naphthalene	GLM 13-1 by Thermal Desorption GC-Mass Spectrometry
	Tetrachloroethylene Trichloroethylene	GLM 13-2 by Thermal Desorption GC-Mass Spectrometry
	trans-1,2-Dichloroethene cis-1,2-Dichloroethene	GLM 13-3 by Thermal Desorption GC-Mass Spectrometry
	Indane Styrene	GLM 13-4 by Thermal Desorption GC-Mass Spectrometry
	1,2,3-Trimethylbenzene 1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene	GLM 13-5 by Thermal Desorption GC-Mass Spectrometry
	1,3-Butadiene	GLM 13-6 by Thermal Desorption GC-Mass Spectrometry
	Carbon Disulphide	GLM 13-7 by Thermal Desorption GC-Mass Spectrometry
	Vinyl Chloride	GLM 13-8 by Thermal Desorption GC-Mass Spectrometry
	Flexible scope for quantitative analysis of Volatile Organic Compounds on diffusion (sorbent) tubes and monitors in accordance with methods developed and validated by in-house procedure LWI 47	LWI 47 by Thermal Desorption GC-Mass Spectrometry
END		

NO_2 diffusion tube analysis method

NO_2 diffusion tubes are passive monitoring devices. They are made up of a Perspex cylinder, with two stainless steel mesh discs, coated with TEA absorbent held inside a polythene cap, which is sealed onto one end of the tube. Diffusion tubes operate on the principle of molecular diffusion, with molecules of a gas diffusing from a region of high concentration (open end of the tube) to a region of low concentration (absorbent end of the tube) (AEA, 2008). NO_2 diffuses up the tube because of a concentration gradient and is absorbed by the TEA, which is present on the coated discs in the sealed end of the tube. All Richmond NO_2 diffusion tubes are prepared by Gradko using 50% v/v TEA with Acetone as the absorbent.

Prior to and after sampling, an opaque polythene cap is placed over the end of the diffusion tube opposite the TEA coated discs to prevent further absorption. The NO_2 diffusion tubes are labelled and kept refrigerated in plastic bags prior to and after exposure.

Factor from Local Co-location Studies

The local bias adjustment factors for the Borough are provided in Table L for 2015 to 2021. LBRUT always use a roadside correction factor for kerbside/roadside sites and a background correction factor for background sites, so for ease of understanding, we are not providing bias adjustment factors for previous years in the body of the report. Please see table L. In 2015, 2016, 2020 and again in 2021 all kerbside and roadside sites in the Borough are bias adjusted using the factor from the local roadside co-location site at Richmond 1 Castelnau. In 2019, the bias adjustment factor was the average of the three static sites in the borough – the third was the Air Quality mobile, which was at the same roadside site for the duration of 2019. In 2017 and 2018, the bias adjustment factor was the national bias adjustment factor for Gradko using the 50% TEA in acetone methodology. All background sites in the Borough for all years except 2020 and 2021 were bias adjusted using the factor from the local urban background co-location site at the Richmond 2 Barnes Wetlands. In 2020 and 2021, the National bias adjustment factor for Gradko (0.82 in 2020; 0.83 in 2021) was used for both background suites instead of Wetlands (0.83 in 2020; 0.82 in 2021) due to poor data capture rate at Wetlands. Data capture at Wetlands (RI2) was 82% in 2020 and 85% in 2021, below the 90% required.

The methodology for calculating the bias adjustment was followed using the guidance on the AEA spreadsheet.

Diffusion Tube Bias Adjustment Factors from Local Co-location Studies

In 2021, the Borough undertook co-location studies at two continuous NO_2 monitoring sites, with triplicate NO_2 diffusion tubes at the following the locations:

- **Richmond 1 Castelnau (site 23):** a roadside site, in Castelnau Library Barnes. In 2021, the annual means for the Castelnau diffusion tubes (Nº 23) was 24.4 μg m^3; for the continuous site (RI1) it was 21.3 μg m^3. The bias adjustment factor is **0.87**
- **Richmond 2 Barnes Wetlands (site 37):** a suburban background site. In 2021, the annual means for the Wetlands diffusion tubes (Nº 37) was 15.5g m^{-3}; for the continuous site (RI2) it was 13.9μg m^3. The bias adjustment factor is **0.82.**

All LBRUT data was completed and returned in time for the co-location questionnaire and is included in the database bias adjustment factors v 03/22.

Discussion of Choice of Factor to Use

The National bias adjustment factor for Gradko using 50% TEA in acetone for March 2021 (v03/22) was **0.83.** Every year we consider which bias adjustment factor is best to use. In previous years, we have used Castelnau roadside site or the National bias adjustment factor for Gradko using 50% TEA in acetone or an average of all three LBRUT sites. In 2021 it was decided to use **the Castelnau roadside site** which was **0.87** to bias adjust all roadside sites and **the National bias adjustment factor** for Gradko which was **0.83** to bias adjust both background sites (see below).

Choice of bias adjustment factor was given very careful consideration. The overall precision and data capture for Castelnau for the co-location studies was very good (98%), as it has been over recent years. These are local results for the local area. Unfortunately, data capture for the monitor at Wetlands was 85%, below the 90% required. This was because between 14th - 23rd September and from 19th November – 31st December 2021 we experienced equipment issues with the NOx/ NO_2 monitor at our Wetlands site. This meant data had to be withdrawn after ratification, which resulted in a reduced data capture of 85% for the monitored data. For this reason we decided to use the National bias adjustment factor for Gradko (0.83) to bias adjust our two background sites. In reality, having calculated results at both background sites

using both bias adjustment factors of 0.83 for the National bias adjustment factor and 0.82 for Wetlands the results were the same but this may not have been the case. In order to best assess levels of NO2 throughout the borough for 2021 it was decided to use the Castelnau bias correction figure for all roadside sites and the national Gradko bias adjustment figure for both background sites. The result is slightly more conservative than using the national Gradko biased adjustment factor for both. We wish to neither under estimate or over report levels of NO2 in the borough.

Table L. Bias Adjustment Factor

Year	Local or National	If Local, Version of National Spreadsheet	Adjustment Factor Roadside	Adjustment Factor Background
2021	Local	Mar-22	0.87	0.83
2020	Local	Mar-21	0.91	0.83
2019	Local	Mar-20	0.9	0.99
2018	National	Mar-19	0.92	0.93
2017	National	Mar-18	0.97	1
2016	Local	Mar-17	0.98	1.08
2015	Local	Mar-16	0.92	1

A.3 Adjustments to the Ratified Monitoring Data

Short-term to Long-term Data Adjustment

For monitoring sites where data capture is less than 75% of a full calendar year (less than 9 months), the mean should be “annualised” – i.e. adjusted using the methodology outlined in LLAQM.TG(19) before being compared to annual mean objectives.

In 2021, data capture at all sites for both NO2 and PM10 was very good and above 75% so this was not necessary.

NO_2 Fall off With Distance Calculations

Distance Adjustment

All NO2 diffusion tube results have been adjusted to represent exposure at the nearest façade. The concentration at the nearest receptor has been estimated using the LAQM

NO2 Fall-off with Distance Calculator (Version 4.1) in line with the procedure detailed in LLAQM.TG (16).

The methodology consists of comparing the monitored annual mean NO_2 concentrations at a given point against known relationships between NO_2 concentrations and the distance from a road source.

The monitored annual mean value has been bias adjusted and annualised where necessary and the background concentration is derived from the Wetlands background site. Wetlands achieved more than 75% data capture (85%), as per LAQM guidance.

Table N. NO_2 Fall off With Distance Calculations 2021

Monitored Annual Mean NO2 compared to exposure at nearest façade (□g m-3)

Site ID	Distance (m): Monitoring Site to Kerb	Distance (m): Receptor to Kerb	Background Concentration (µg m^{-3})	Monitored Concentration (Annualised and Bias Adjusted (µg m^{-3})	Concentration Predicted at Receptor (µg m^{-3})	Comments
1	1.7	1.9	14.0	26	25.7	
2	1.3	3.0	14.0	24	22.2	
4	0.8	2.5	14.0	28	24.9	
7	0.6	9.1	14.0	37	25.6	
9	0.8	6.3	14.0	31	24.5	
10	0.6	1.7	14.0	33	29.4	
11	1.2	2.0	14.0	27	25.6	
12	0.9	9.3	14.0	30	22.6	
13	0.7	16.0	14.0	31	21.0	
15	0.5	4.2	14.0	26	21.5	
17	2.3	2.5	14.0	**46**	**45.4**	
18	0.6	11.8	14.0	39	25.4	

19	1.9	6.8	14.0	28	23.9	
20	217.0	217.0	14.0	28	28.0	
22	0.5	4.2	14.0	22	19.1	
23	3.3	9.0	14.0	21	19.1	
25	2.3	2.5	14.0	34	33.6	
26	0.6	11.8	14.0	33	22.8	
27	0.6	6.8	14.0	23	19.0	
28	217.0	217.0	14.0	12	12.0	
29	3.6	3.6	14.0	20	20.0	
30	1.9	1.3	14.0	25	26.0	
31	1.0	6.4	14.0	35	27.1	
32	1.0	3.2	14.0	**40**	33.9	
33	3.3	6.9	14.0	39	34.1	
35	1.3	1.4	14.0	30	29.7	
36	2.1	2.2	14.0	**55**	**54.5**	
37	116.0	230.0	14.0	14	14.0	
39	1.0	1.7	14.0	32	30.1	
40	1.0	11.4	14.0	29	21.6	
42	0.7	2.9	14.0	**54**	**43.3**	
43	0.7	1.6	14.0	**43**	38.5	
44	0.5	2.5	14.0	32	26.9	
45	0.5	3.3	14.0	26	22.0	
50	0.7	2.7	14.0	**46**	37.9	
51	2	2.1	14.0	23	22.9	
52	2	2.1	14.0	**45**	**44.6**	
54	0.6	1.3	14.0	30	27.7	
55	0.6	4.1	14.0	29	23.7	
56	1.0	9.6	14.0	29	22.2	

57	1.0	16.4	14.0	29	20.5	
58	0.7	6.4	14.0	31	23.9	
61	1.8	4.3	14.0	31	27.6	
62	0.4	2.3	14.0	32	26.6	
63	1.8	3.2	14.0	27	25.3	
64	0.5	1.6	14.0	35	30.7	
65	0.5	2.7	14.0	**40**	32.2	
66	2.1	3.3	14.0	30	28.3	
67	1.4	2.7	14.0	23	21.7	
68	3.2	3.8	14.0	30	29.3	
69	2.0	8.1	14.0	23	20.1	
70	1.8	2.1	14.0	34	33.3	
71	2.9	9.9	14.0	39	31.1	
72	0.8	2.5	14.0	30	26.5	
73	2.1	8.4	14.0	34	27.4	
74	2.6	5.9	14.0	**44**	37.9	
75	0.6	6.3	14.0	29	22.6	
76	0.4	3.3	14.0	35	27.5	
77	0.6	4.5	14.0	37	28.7	
78	1.7	2.7	14.0	24	23.0	
79	1	6.6	14.0	32	25.2	
80	0.8	2.6	14.0	30	26.4	
Rut 01	2.9	3.0	14.0	27	26.9	
Rut 02	0.7	2.2	14.0	**55**	**46.2**	

Appendix B Full Monthly Diffusion Tube Results for 2021

Table O. NO_2 Diffusion Tube Results

Site ID	Valid data capture for monitoring period2021 %(b)	Valid data capture 2021 %(b)	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Annual mean – raw data	Annual mean – bias adjusted
1	100	100	35.65	25.02	30.22	35.56	26.36	28.22	26.05	23.76	30.63	21.47	39.41	30.08	29	26
2	100	100	32.32	28.11	28.68	27.40	22.98	26.41	27.03	20.41	29.43	26.54	36.55	22.75	27	24
4	100	100	33.90	36.08	30.38	33.52	29.21	29.67	26.45	20.89	34.75	31.85	44.37	32.15	32	28
7	100	100	41.84	43.26	40.22	52.00	38.86	45.80	38.52	33.42	49.48	33.56	48.99	39.97	42	37
9	100	92	38.97	43.85	37.55	37.98		33.19	29.32	25.88	38.35	33.08	40.27	32.22	36	31
10	100	92	42.41	39.26	45.30	36.57	37.36	35.47		29.45	41.90	34.35	41.26	38.61	38	33
11	100	100	34.90	35.28	32.04	31.83	29.93	24.34	24.39	25.42	35.55	29.00	40.74	34.70	32	27
12	100	100	39.77	35.73	38.21	39.50	31.92	34.54	32.46	27.69	37.11	21.46	42.79	33.07	35	30
13	100	92	44.74	42.96	35.21	36.11	31.92		28.47	23.85	39.56	34.13	42.61	30.89	35	31
15	100	100	37.65	25.51	30.94	28.81	28.01	26.73	24.97	22.85	36.12	26.37	35.73	28.79	29	26
17	100	75	47.01	49.75		50.14	56.62	52.15		49.36	61.06	53.82	57.79		53	46
18	100	83		39.57	45.14	41.46	46.94		41.71	40.47	53.69	46.52	52.77	43.01	45	39
19	100	100	37.30	35.32	32.87	32.89	29.33	27.65	28.84	23.69	36.76	31.44	38.66	36.01	33	28
20	100	100	37.12	36.29	30.55	31.81	30.10	24.70	29.67	23.44	37.54	32.46	45.68	32.32	33	28
22	100	100	34.65	37.39	29.67	25.07	19.34	16.67	19.12	13.33	24.77	22.57	33.75	26.70	25	22
23	100	100	28.22	28.43	27.09	26.28	19.91	19.39	21.95	15.04	26.71	23.01	31.23	25.51	24	21
25	100	100	43.42	39.04	43.56	40.16	40.28	46.53	33.55	27.03	41.40	31.28	43.52	37.52	39	34
26	100	100	39.80	37.34	38.06	40.25	36.54	35.04	36.51	29.44	42.33	33.09	48.04	37.47	38	33

27	100	100	26.33	29.40	32.75	25.33	26.15	26.79	25.79	19.56	29.55	24.98	33.30	23.82	27	23
28	100	100	21.67	17.00	17.03	15.99	12.52	10.57	11.60	9.19	14.63	10.86	20.44	14.28	15	12
29	100	100	24.53	24.32	24.75	23.15	20.42	20.94	19.34	19.42	24.59	21.83	30.30	25.01	23	20
30	100	100	33.10	31.56	31.09	32.12	24.39	24.37	23.79	24.13	32.56	25.49	31.82	30.60	29	25
31	100	92	37.96	38.17	36.14		38.00	36.84	35.33	32.90	53.54	41.13	57.43	40.81	41	35
32	100	100	43.01	45.85	44.86	46.41	45.31	46.64	46.44	38.69	57.46	42.85	54.40	45.75	46	40
33	100	83	44.09	44.07	48.09		42.69	48.16	41.67	39.84	51.55		53.19	39.29	45	39
35	100	100	41.08	29.07	34.55	29.92	30.63	32.23	30.13	22.04	35.78	37.02	45.41	40.57	34	30
36	100	100	64.58	64.86	62.72	53.09	70.53	65.92	36.06	54.81	84.89	70.25	72.83	57.06	63	55
37	100	92	24.90	20.64	18.70	17.57	13.61	13.36	13.71	9.24	18.33	14.68	21.76	0.00	17	14
39	100	92	43.18	36.59	40.72	35.29	33.62	33.03	30.35	27.50	35.07		49.33	41.07	37	32
40	100	92	39.93	30.80	33.88	39.97	24.28	31.50		22.82	34.08	28.34	43.41	35.25	33	29
42	100	92	55.33	55.42	56.35	55.55	65.67	63.99	66.32	65.08	72.24	59.03	64.64		62	54
43	100	75	51.00		48.75	50.72	51.23	47.14	53.19	40.74			52.32	49.50	49	43
44	100	100	37.84	35.28	34.28	37.70	32.90	35.39	36.45	32.39	45.94	35.92	46.55	36.82	37	32
45	100	100	35.18	31.55	26.75	30.85	28.32	27.91	25.41	16.95	33.06	25.45	39.15	32.11	29	26
50	100	92	52.62	49.64	52.34	54.76	53.34	51.48	46.74	44.22	67.98	48.00	59.42		53	46
51	100	100	33.94	25.65	27.62	26.11	25.62	21.61	21.87	16.34	28.75	26.34	32.63	25.86	26	23
52	58	100	54.17	51.04	58.01	48.10	45.75	53.75	51.51	48.10	51.99	50.78	59.29	44.57	51	45
54	100	100	39.62	34.45	35.75	34.07	31.56	31.01	31.95	25.57	39.04	35.05	48.96	32.02	35	30
55	100	92	36.24	35.69	33.46	36.09	33.54	31.56	33.64	29.60	35.82	30.83		27.16	33	29
56	100	92	37.66	32.63	37.64	36.50	30.66	37.45	28.27	24.20	36.43		39.21	26.43	33	29
57	100	100	40.71	29.41	41.50	36.13	27.19	30.84	28.41	25.50	39.62	30.13	42.44	31.49	34	29
58	100	92	43.21	37.67	34.14	37.35	37.62	32.03	34.11	29.43	38.85	32.17	40.81		36	31
61	100	92	42.88	30.87	34.16	31.39	36.02	36.70	32.76	29.90	34.99		47.19	30.98	35	31

62	100	100	38.69	32.80	40.82	39.97	37.04	35.03	35.56	24.60	40.81	31.50	45.50	33.40	36	32
63	100	100	40.97	21.89	31.79	31.47	25.51	27.71	26.87	22.46	35.40	32.29	43.55	32.55	31	27
64	100	100	35.64	37.16	46.24	40.18	34.96	42.94	34.57	34.98	43.54	40.48	52.05	37.92	40	35
65	100	100	47.22	47.59	46.37	43.04	44.90	45.03	43.41	38.77	54.98	44.73	55.19	43.67	46	40
66	100	100	36.86	37.79	35.44	30.49	28.65	34.77	34.29	28.45	37.54	36.84	44.29	33.89	35	30
67	100	100	26.27	29.29	26.07	27.53	21.22	23.85	23.48	17.03	32.53	26.73	31.32	27.24	26	23
68	100	92	39.03	31.30	39.56	32.54	36.60	33.53		25.67	36.33	31.59	40.91	31.93	34	30
69	100	92	31.42	27.76	29.15	30.53		21.62	20.70	17.10	25.02	22.22	35.77	28.48	26	23
70	100	100	42.33	38.89	38.05	34.40	34.81	36.08	39.11	33.62	48.06	39.28	45.38	36.25	39	34
71	100	100	49.12	45.84	43.14	43.00	42.47	46.31	41.87	36.49	53.00	39.74	62.08	35.57	45	39
72	100	92	39.82	33.37	35.67	36.04	26.24	31.48	29.91	26.53	39.73		44.49	33.82	34	30
73	100	100	46.81	43.49	43.27	35.87	31.86	32.82	36.54	30.89	42.10	39.81	44.24	40.10	39	34
74	100	100	52.10	50.37	54.19	49.35	51.34	53.10	49.09	43.94	60.07	51.25	51.80	43.71	51	44
75	100	92	39.03	32.88	32.57	33.08	33.36	29.96	28.40	22.47	34.78		45.02	35.06	33	29
76	100	100	39.97	42.64	36.48	40.92	38.59	39.39	37.30	31.60	47.97	37.92	48.44	35.09	40	35
77	100	100	39.08	54.20	42.40	44.97	44.50	39.47	37.21	33.18	46.06	40.66	46.46	35.88	42	37
78	100	100	32.11	28.68	26.88	30.32	21.24	24.87	25.91	18.10	32.98	27.81	42.38	24.13	28	24
79	100	100	42.49	39.03	38.72	39.75	35.97	37.40	31.10	25.32	38.84	31.41	46.23	36.49	37	32
80	100	92	35.64	39.36	33.21	32.25	35.42	36.00		23.70	41.06	33.78	42.27	29.61	35	30
Rut 01	100	100	33.98	27.90	33.13	34.26	29.18	27.86	28.99	25.75	41.18	34.81	20.14	32.96	31	27
Rut 02	100	100	58.62	53.50	60.45	62.67	66.10	65.88	66.19	59.08	77.09	60.60	70.09	56.27	63	55

For Triplicate sites see below.

Triplicate NO2 diffusion tube results for sites 23 and 37 in ug/m3

Site Code	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
23	29.49	25.92	28.32	25.51	19.99	19.36	22.99	15.82	26.39	22.44	32.13	24.72
23	28.07	28.75	27.78	26.61	21.08	19.87	22.38	14.22	27.74	24.30	31.98	26.08
23	27.09	30.61	25.16	26.71	18.66	18.95	20.46	15.07	25.98	22.30	29.59	25.72
Average	28.22	28.43	27.09	26.28	19.91	19.39	21.95	15.04	26.71	23.01	31.23	25.51
37	23.87		18.90	17.95	missing	12.84	14.27	9.51	17.59	14.91	22.10	missing
37/2	26.21	19.47	17.59	16.49	13.31	13.53	13.27	9.17	18.25	14.32	22.82	missing
37/3	24.61	21.81	19.63	18.27	13.92	13.70	13.59	9.05	19.15	14.80	20.34	missing
Average	24.90	20.64	18.70	17.57	13.61	13.36	13.71	9.24	18.33	14.68	21.76	0.00

Notes:

Concentrations are presented as µg m^{-3}.Exceedances of the NO_2 annual mean AQO of 40 µg m^{-3} are shown in **bold**.

NO_2 annual means in excess of 60 µg m^{-3}, indicating a potential exceedance of the NO_2 hourly mean AQS objective are shown in **bold and underlined**.

All means have been "annualised" in accordance with LLAQM Technical Guidance if valid data capture for the calendar year is less than 75% and greater than 33%.

(a) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(b) data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%