London Borough of Richmond upon Thames Air Quality Annual Status Report for 2016
Date of publication: 24th April 2017

This report provides a detailed overview of air quality in the London Borough of Richmond Upon Thames during 2016. It has been produced to meet the requirements of the London Local Air Quality Management statutory process1.

[1] LLAQM Policy and Technical Guidance 2016 (LLAQM.TG(16)). https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/working-boroughs

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Executive Summary

The London Borough of Richmond upon Thames is committed to improving air quality in the Borough. As such 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 2016 Annual Status Report reviews recent air quality monitoring in the Borough in accordance with Defra LAQM guidance. In so doing 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 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.

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Abbreviations

AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQO	Air Quality Objective
BEB	Buildings Emission Benchmark
CAB	Cleaner Air Borough
CAZ	Central Activity Zone
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} (milligrammes 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	Objective (UK)	Averaging Period	Date[1]
Nitrogen dioxide - NO_2	200 μg m^{-3} not to be exceeded more than 18 times a year	1-hour mean	31 Dec 2005
	40 μg m^{-3}	Annual mean	31 Dec 2005
Particles - PM_{10}	50 μg m^{-3} not to be exceeded more than 35 times a year	24-hour mean	31 Dec 2004
	40 μg m^{-3}	Annual mean	31 Dec 2004
Particles - $PM_{2.5}$	25 μg 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

Note: [1]by which to be achieved by and maintained thereafter

1. Air Quality Monitoring

The latest monitoring results for 2016 confirm that air pollution in the LBRuT still exceeds the Government Air Quality objectives, and therefore there is still a need for LBRuT to be designated as an AQMA and to pursue improvements in air quality.

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.

1.1 Locations

Automatic Monitoring Sites

The continuous monitors collect real time data, which are stored as 15-minute means and can be converted into the various averages. This type of equipment provides accurate readings 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 London Air Quality Network, as is the site at the National Physical Laboratory (NPL) which is also part of the government's UK Automatic Urban and Rural Network (AURN). Richmond also has a mobile Air Quality monitoring unit, which was stationed at 3 different sites during 2016. Annual averages are not possible and it has therefore been decided to omit data from this site for 2016.

All data undergo 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 King's College London. Further details of the sites can be found at www.londonair.org.uk.

Table B. Details of Automatic Monitoring Sites for 2016

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	177165	Roadside	Y	8m	3m	2.35m	NO2, PM10	Chemiluminescent; TEOM
RI2	**Wetlands Centre**, Barnes	522991	176495	Suburban	Y	Children in ajacent play area/people attending Wetlands Centre	N/A	3.2m	NO2, PM10,O3	Chemiluminescent; TEOM
RH*(varies)	**Mobile** Air Quality Unit	Changes	Changes	Mostly roadside locations	Y	Varies dependent on location	Varies dependent on location	2.9m	NO2, PM10,O3	Chemiluminescent; TEOM
TD0	**NPL -** Teddington AURN	515542	170420	Suburban	Y	N/A	N/A		NO2,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 way of monitoring, which therefore allows samples to be taken across the whole LBRuT and gives a Borough-wide view. The results provide 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 the bias adjusted, with data from the more accurate continuous monitors. The Council had a network of 64 diffusion tube sites across the Borough in 2016. Three of the diffusion tubes sites

are triplicate and collocated with automatic monitoring sites. One automatic monitoring site, the Air Quality mobile unit, was stationed at 3 different sites during 2016, so no annual averages are possible. It has therefore been omitted from this report.

Table C. Details of Non-Automatic Monitoring Sites for 2016

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. Oldfield Rd)	513229	169712	roadside	Y	1.3m	3.0m	2.2m	NO2	N
3	Uxbridge Rd, Hampton (nr. Arundel Close)	513850	171040	roadside	Y	1.5m	10.7m	2.2m	NO2	N
4	Hampton Rd, Teddington (nr. Bushy Pk Gardens)	514882	171155	kerbside	Y	0.6m	9.8m	2.2m	NO2	N
6	Kingston Rd, Teddington (nr.	517266	170031	kerbside	Y	0.7m	6.5m	2.2m	NO2	N

	Woffington Close)									
7	Broad St, Teddington (Boots)	515624	170975	kerbside	Y	0.8m	2.5m	2.2m	NO2	N
9	Hampton Rd, Twickenham	514842	172346	kerbside	Y	0.6m	2.0m	2.2m	NO2	N
10	Twickenham Rd, Twickenham (opp. Fulwell golf course)	513278	172199	kerbside	Y	0.6m	7.2m	2.2m	NO2	N
11	Percy Rd, Whitton (nr. Percy Way)	514050	173189	kerbside	Y	0.6m	9.1m	2.2m	NO2	N
12	Hanworth Rd, Whitton	512600	173404	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
14	Cross Deep, Twickenham (nr Poulett Gardens)	516133	173051	kerbside	Y	0.3m	2.7m	2.2m	NO2	N
15	Richmond Rd, Twickenham (opp. Marble	517197	173939	kerbside	Y	0.6m	1.8m	2.2m	NO2	N

	Hill Pk)									
16	St Margarets Rd, St Margarets (nr. Bridge Rd)	517558	174369	roadside	Y	1.2m	3.1m	2.2m	NO2	N
17	Red Lion Street, Richmond	517822	174755	kerbside	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)	518637	176161	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
21	Lower Richmond Rd, Mortlake (nr. Kingsway)	520053	175826	roadside	Y	2.0m	7.0m	2.2m	NO2	N
22	Castelnau, Barnes (nr. Hammersmith Bridge)	522845	177904	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
24	Lonsdale Road, Barnes (nr. Suffolk Rd)	521750	177056	kerbside	Y	0.3m	6.3m	2.2m	NO2	N
25	URRW, (nr. Sheen School)	521130	175450	roadside	Y	2.3m	2.5m	2.2m	NO2	N
26	URRW, Sheen (nr. Courtland Estate)	519031	175021	roadside	Y	0.6m	11.8	2.2m	NO2	N
27	Queens Rd, Richmond (nr. Russell Walk)	518663	174208	roadside	Y	0.7m	6.8m	2.2m	NO2	N
28	Holly Lodge, Richmond Pk	519467	173993	urban background	Y	2175m	N/A	2.2m	NO2	N
29	Petersham Rd, Ham (nr. Sandy Lane)	517967	172543	kerbside	Y	0.6m	3.6m	2.2m	NO2	N
30	German School, Petersham Rd	518003	173233	roadside	Y	1.9m	1.3m	2.2m	NO2	N
31	A316 (nr. Chudleigh Rd)	515438	174048	roadside	Y	1.0m	6.4m	2.2m	NO2	N

32	Kings St, Twickenham	516226	173195	roadside	Y	1.7m	3.8m (2.8m pavement café)	2.2m	NO2	N
33	Heath Rd, Twickenham	515927	173129	roadside	Y	3.3m	6.9m	2.4m	NO2	N
34	Thames St, Hampton	513552	169498	roadside	Y	1.4m	1.3m	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), Sheen Lane	520510	175393	kerbside	Y	0.9m	2.2m	2.2m	NO2	N
37	Wetlands, Barnes (static site)	522989	176727	urban background	Y	1160m	230m	2.2m	NO2	Y
39	Richmond Rd, nr. Richmond Bridge, East Twickenham	517592	174404	roadside	Y	1.2m	2.7m	2.2m	NO2	N
40	Staines Rd, Twickenham	514278	172521	kerbside	Y	1.0m	11.4m	2.2m	NO2	N

41	Paradise Rd, Richmond	518102	174854	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	517771	174701	kerbside	Y	0.7m	1.6m	2.2m	NO2	N
44	Sheen Rd, Richmond (near shops)	518458	175042	kerbside	Y	0.5m	0.5m	2.2m	NO2	N
45	154 High St, Teddington,	516383	171154	kerbside	Y	0.5m	3.3m	2.2m	NO2	N
47	Causeway, Teddington	515829	170967	roadside	Y	1.8m	2.7m	2.2m	NO2	N
48	Stanley Rd, Teddington (junc. Strathmore Rd)	515059	171758	roadside	Y	0.7m	5.8m	2.2m	NO2	N
49	URRW War Memorial, Sheen Lane, Sheen	520505	175390	kerbside	Y	0.9m	2.9m	2.2m	NO2	N
50	URRW, nr. Clifford Av, Sheen	519962	175321	kerbside	Y	0.7	2.7	2.2m	NO2	N

51	Sheen Lane, Sheen (railway crossing)	520497	175790	kerbside	Y	0.4m	1.3m	2.2m	NO2	N
52	Clifford Av, Chalkers Corner	519776	175746	kerbside	Y	0.5	2.2	2.2m	NO2	N
53	co-located on mobile Air Quality unit	3 sites	3 sites	roadside	Y	varies	varies	2.2m	NO2	Y
54	Mortlake Road, adjacent to West Hall Road, Kew	519585	176492	kerbside	Y	0.6	1.4	2.2m	NO2	N
55	Mortlake Road, adjacent to Cemetery Gates, Kew	519793	176142	kerbside	Y	0.6	4.1	2.2m	NO2	N
56	A316 (St Magarets)	516791	174521	kerbside	Y	7.3m	9.6m	2.2m	NO2	N
57	A316 (Lincoln Avenue)	513915	172899	kerbside	Y	1.00m	16.4m	2.2m	NO2	N
58	London Road, Twickenham	516039	173766	kerbside	Y	0.7m	6.4m	2.2m	NO2	N
59	Whitton Rd, Twickenham (near Twickenham bridge)	515980	173758	kerbside	Y	0.6m	1.4m	2.2m	NO2	N

60	Waldegrave Rd, Teddington	515894	171148	kerbside	Y	0.5m	2.2m	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	514181	173875	kerbside	Y	0.8m	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	kerbside	Y	2.1m	3.3m	2.2m	NO2	N
Rut 01	Civic Centre, York St, Twickenham	516356	173365	roadside	Y	2.9m	3.0m	3.5m	NO2	N
Rut 02	George Street, Richmond	517917	174928	kerbside	Y	0.7m	2.2m	2.2m	NO2	N

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, the details of which are described in Appendix A.

Table D. Annual Mean NO2 Ratified and Bias-adjusted Monitoring Results (µgm-3) For results that indicate the exposure estimate, calculated for the nearest residential façade see Table M.

Site ID	Site type	Valid data capture for monitoring period %	Valid data capture 2016 %	Annual Mean Concentration (µgm^{-3})						
				2010	2011	2012	2013	2014	2015	2016
Castelnau Library, Barnes (RI1)	Roadside	100%	97%	**43**	39	37	39	37	34	36
Wetlands Centre, Barnes (RI2)	Suburban	100%	96%	30	26	25	24	25	21	25
NPL - Teddington AURN (TD0)	Suburban	N/A	57%	24	21	36	21	27	19	22
1	Roadside	100	92	**51**	**44**	**45**	**47**	**49**	**41**	**56**
2	Roadside	100	100	39	31	34	32	33	28	31
3	Roadside	100	100	**44**	35	**44**	**44**	**44**	**41**	**42**
4	Kerbside	100	92	39	38	**44**	**44**	**44**	36	**40**
5	Kerbside	closed	closed	38	32	33	closed	closed	closed	closed

6	Kerbside	100	100	**48**	34	**43**	**43**	**41**	36	37
7	Kerbside	100	100	**69**	**49**	**59**	**61**	**54**	**47**	**49**
8	Kerbside	closed	closed	39	30	34	closed	closed	closed	closed
9	Kerbside	100	100	**55**	**47**	**50**	**49**	**48**	**42**	**45**
10	Kerbside	100	100	**47**	**36**	**44**	**46**	**47**	**43**	**44**
11	Kerbside	100	100	**52**	**46**	**54**	**49**	**48**	**44**	**48**
12	Kerbside	100	100	**52**	**41**	**45**	**49**	**46**	**41**	**45**
13	Kerbside	100	100	**53**	**42**	**48**	**48**	**47**	**42**	**42**
14	Kerbside	100	100	**52**	**38**	**48**	**46**	**45**	39	**40**
15	Kerbside	100	100	**53**	**41**	**44**	**40**	40	37	**41**
16	Roadside	100	100	**48**	38	**45**	**44**	**43**	41	**42**
17	Kerbside	100	100	**79**	**65**	**70**	**68**	**68**	**63**	**69**
18	Kerbside	100	100	**70**	**66**	**68**	**71**	**66**	**67**	**56**
19	Kerbside	100	100	**46**	**50**	**56**	**53**	**55**	**48**	**49**
20	Kerbside	100	100	**54**	**40**	**53**	**51**	**55**	**48**	**47**
21	Roadside	100	92	**47**	39	**43**	**44**	**41**	37	39
22	Kerbside	100	100	**55**	**46**	**51**	**57**	**59**	**53**	**65**
23	Roadside	100	100	**43**	35	38	39	38	35	35
24	Kerbside	100	100	**42**	36	**40**	**40**	**40**	35	37
25	Roadside	100	100	**42**	32	**47**	**51**	**51**	**45**	**46**
26	Roadside	100	92	**46**	**40**	**42**	**43**	**42**	**40**	**40**
27	Roadside	100	100	**44**	38	**41**	**40**	38	37	**43**
28	Urban background	100	100	24	20	22	21	18	17	21
29	Kerbside	100	92	39	37	**43**	39	36	30	32
30	Roadside	100	92	**41**	33	36	38	34	29	33
31	Roadside	100	100	**53**	**50**	**59**	**61**	**62**	**54**	**54**

32	Roadside	100	100	**102**	**75**	**77**	**74**	**73**	**62**	**64**
33	Kerbside	100	100	**66**	**47**	**58**	**62**	**69**	**61**	**61**
34	Roadside	100	100	**42**	36	39	38	40	33	36
35	Roadside	100	100	**54**	**46**	**50**	**52**	**48**	**43**	**46**
36	Kerbside	100	92	**60**	**46**	**54**	**56**	**56**	**49**	**50**
37	Urban background	100	100	28	26	25	25	22	21	25
38	Kerbside	closed	closed	**40**	35	closed	closed	closed	closed	closed
39	Kerbside	100	100	**70**	**58**	**62**	**56**	**56**	**52**	**55**
40	Kerbside	100	92	31	37	**43**	**41**	**40**	36	**45**
41	Kerbside	100	100	**49**	38	**45**	**42**	**41**	38	39
42	Roadside	100	100	**69**	**53**	**56**	**58**	**54**	**47**	**82**
43	Kerbside	100	100	**82**	**74**	**78**	**87**	**80**	**80**	**85**
44	Kerbside	100	100	**49**	**42**	**46**	**45**	**45**	39	**42**
45	Kerbside	100	100	**48**	**44**	**43**	**48**	**45**	35	37
46	Kerbside	closed	closed	**48**	36	**41**	closed	closed	closed	closed
47	Roadside	100	92	**49**	33	**40**	40	37	32	33
48	Roadside	100	100	**54**	**43**	**42**	45	**45**	39	**41**
49	Kerbside	100	100	**50**	39	**47**	45	**45**	39	**44**
50	Kerbside	100	100	**64**	**49**	**63**	**61**	**60**	**57**	**55**
51	Kerbside	100	100	39	32	36	34	34	28	32
52	Kerbside	100	100	**71**	**52**	**59**	**59**	**62**	**55**	**57**
53	varies	100	N/A	**55**	**51**	**46**	**48**	**48**	N/A	N/A
54	Roadside	100	92	**62**	**44**	**55**	**54**	**56**	**51**	**49**
55	Roadside	100	100	**59**	**41**	**48**	**52**	**55**	**50**	**50**
56	Kerbside	100	92	**41**	35	**41**	**46**	38	37	**51**

57	Kerbside	100	100	35	24	38	39	36	33	**44**
58	Kerbside	100	92	Not open	**43**	**52**	**58**	**50**	**46**	**50**
59	Kerbside	100	100	Not open	Not open	**44**	**46**	**42**	**40**	**44**
60	Kerbside	100	100	Not open	Not open	**40**	32	32	27	29
61	Roadside	100	100	Not open	Not open	**55**	**58**	**54**	**48**	**49**
62	Kerbside	100	100	Not open	Not open	Not open	**54**	**52**	**46**	**51**
63	Kerbside	100	100	Not open	Not open	Not open	**43**	**42**	38	**41**
64	Kerbside	100	100	Not open	Not open	Not open	**54**	**60**	**55**	**53**
65	Kerbside	75	75	Not open	Not open	Not open	Not open	Not open	Not open	**75**
66	Kerbside	75	75	Not open	Not open	Not open	Not open	Not open	Not open	**49**
Rut 01	Kerbside	100	100	**70**	**48**	**53**	**60**	**56**	45	**50**
Rut 02	Kerbside	100	92	**106**	93	95	94	**88**	**88**	**96**
RUT 03	Background	closed	closed	32	26	closed	closed	**42**	closed	closed
RUT 04	Background	closed	closed	29	29	closed	closed	**60**	closed	closed

Notes: Exceedance of the NO_2 annual mean AQO of 40 μgm^{-3} are shown in **bold**.
NPL site TD0 has a data capture of 57%. This site is not managed by LBRUT. Due to insufficient information this site cannot be annualised by LBRUT. Data should be treated with caution.
NO_2 annual means in excess of 60 $\mu g\ m^{-3}$, indicating a potential exceedance of the NO^2 hourly mean AQS objective are shown in bold and underlined.
The bias adjustment factor used for all roadside/kerbside sites is 0.98 calculated using the Castelnau site. The bias adjustment factor for background sites 28 and 37 is 1.08 calculated using the Wetlands site.

From 6/1/16 sites 40, 42, 48, 56 and 57 were moved up the road by approx. a lamp post mainly due to overgrown vegetation, missing tubes or a marginally better monitoring location.. See our 2015 Annual Status Report for earlier coordinates..

Diffusion Tube Monitoring Data

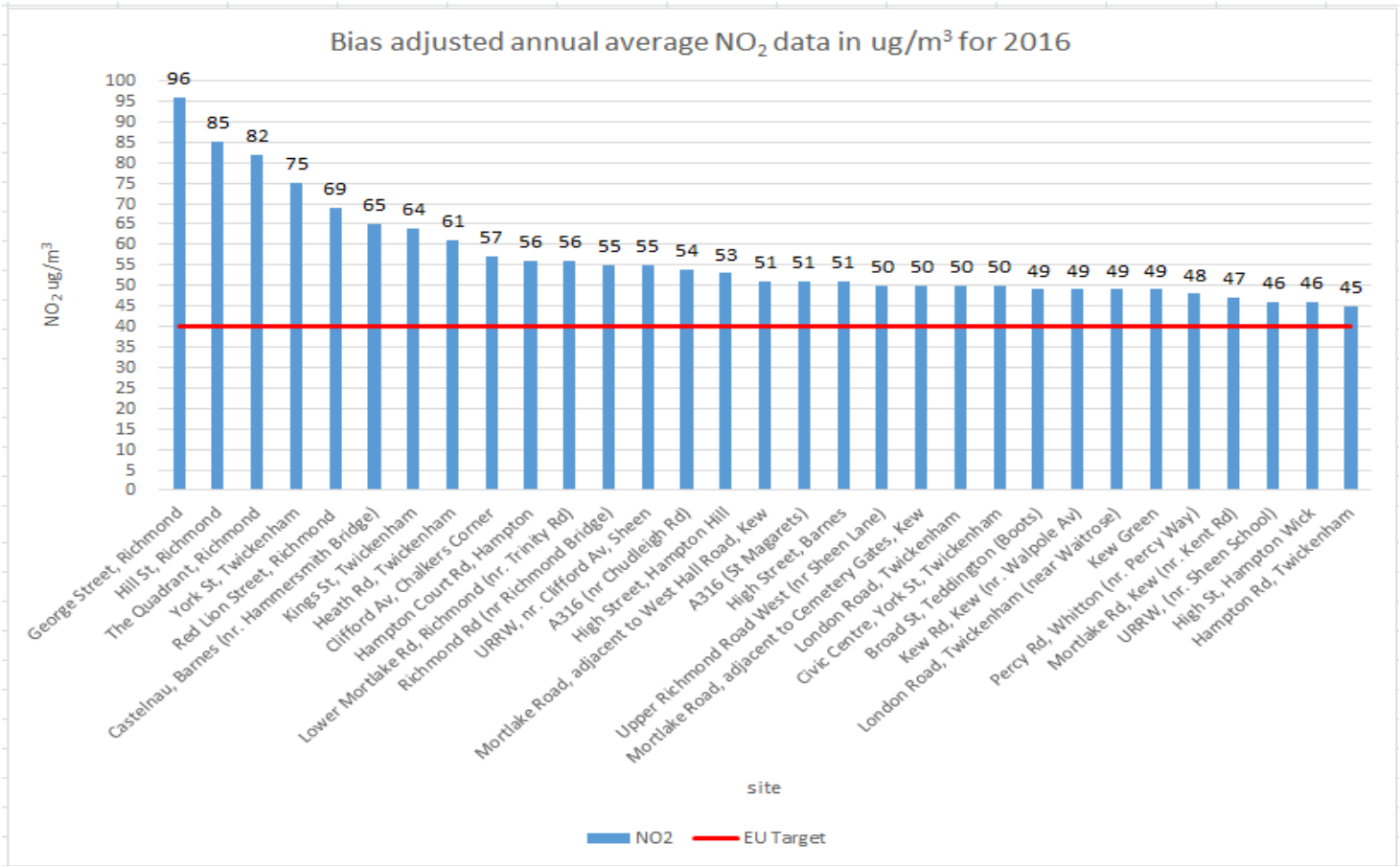
Table D shows the NO2 diffusion tube monitoring results, with bias corrected values for each year from 2010 to 2016. (Note – see Table N for the unbiased monthly data for 2016 and Table M for the distance corrected). The results in bold indicate an exceedance of the annual mean objective of 40 μg m-3 and the results underlined indicate NO2 annual means in excess of 60 μg m-3 indicating a potential exceedance of the NO2 hourly mean AQS objective.

The data capture for the sites was very good, with an overall data capture of 98.5%. No site had a data capture less than 75%, therefore annualising of data was not required.

The total number of sites where monitoring was undertaken was 64. The results from the 2016 monitoring show that the objective of 40 μg m-3 was exceeded at 48 sites. Seven of these sites also exceeded an annual mean of 60 μg m-3 which indicates that the 1 hour-mean objective may also have been exceeded at these locations. This represents very little change in levels of NO2 over the last seven years in the London Borough of Richmond Upon Thames. 2010 saw slightly higher levels at many sites and 2011 and 2015 saw slightly lower levels but overall at most sites across the borough there are no significant trends either upwards or downwards; levels of NO2 have remained fairly static. As is well known, Euro VI standards have failed to deliver the forecast reductions in NO2 levels in real world driving conditions that were predicted. The proportion of diesel cars in the fleet mix has continued to increase over this period together with the number of vehicles on the road; both have hindered reductions in NO2. The LEZ , which has encouraged the use of Euro IV or better for mainly commercial vehicles , applicable along the A316, does seem to have resulted in some benefits as indicated by slightly lower trend data at sites 18 though no trend is applicable to site 31. The data for 2016 indicates that 75% of the sites exceed the objective of 40 μg m-3 with 3 sites recording at least double the objective. After the distance correction, the annual mean objective is exceeded at 31 sites, with 5 of them exceeding the annual mean concentration of 60 μg m-3. These sites are George Street, Richmond (Rut 2), Hill Street, Richmond (43), The Quadrant, Richmond (42), Red York Street, Twickenham (65) and Lion Street, Richmond (17). There was only a small variation between the locations for the different years; this was due to some of the sites being closed or moved. For all years 2010 – 2016, other than 2015 and 2011, the number of sites exceeding the objective was more than 46.

The overall monitoring results for the Borough therefore show that NO2 concentrations exceeded the UK annual mean objective (as it has done for each year since 2005). This is also in line with the modelling prediction of the Borough (reported in the 2015 Annual Status Report). Improvements are still required.

Figure 1: Nitrogen Dioxide Bias Adjusted Annual Average Concentrations for all sites for 2016 (split over 2 graphs)



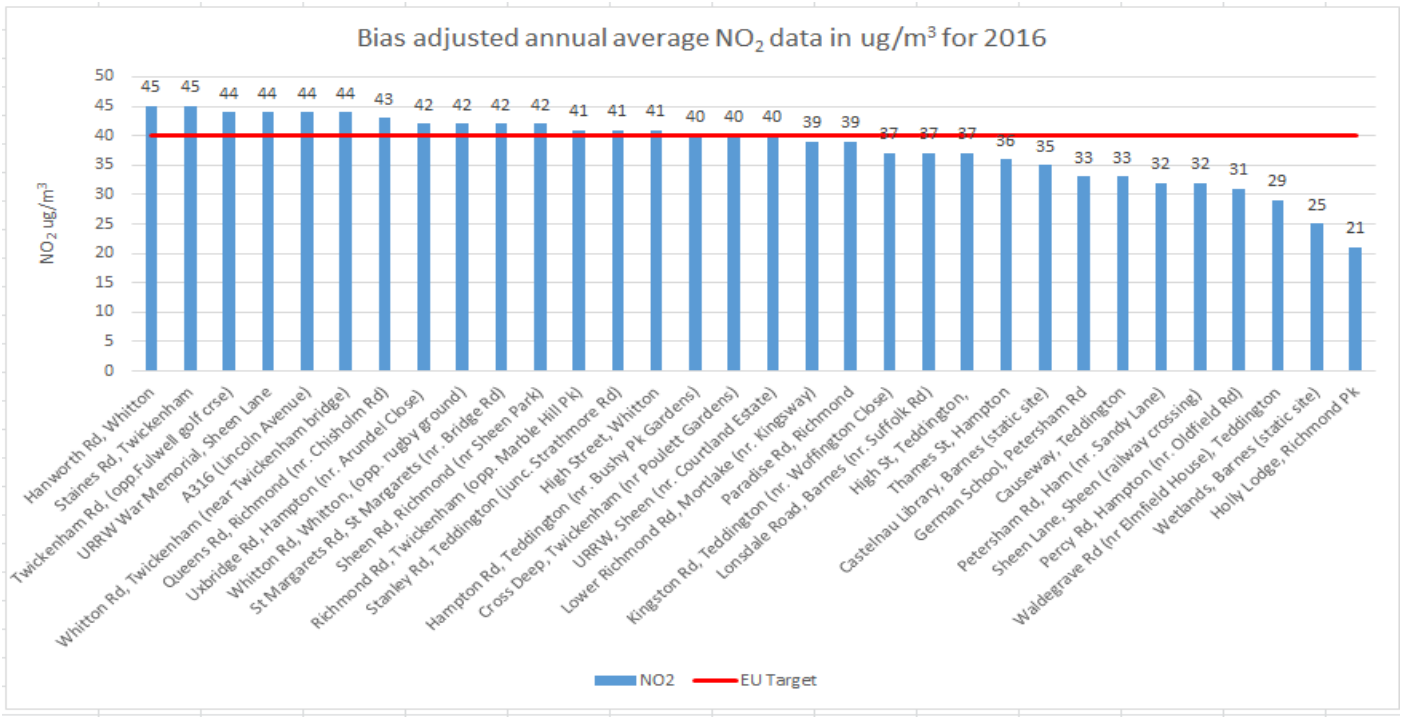

Bias adjusted annual average NO2 data in ug/m3 for 2016
NO2 ug/m3
50
45
40
35
30
25
20
15
10
5
0
45 45 44 44 44 44 43 42 42 42 42 41 41 41 40 40 40 39 39 37 37 37 36 35 33 33 32 32 31 29 25 21
Hanworth Rd, Whitton
Staines Rd, Twickenham
Twickenham Rd, (opp.Fulwell golf crse)
URRW War Memorial, Sheen Lane
A316 (Lincoln Avenue)
Whitton Rd, Twickenham (near Twickenham bridge)
Queens Rd, Richmond (nr. Chisholm Rd)
Uxbridge Rd, Hampton (nr. Arundel Close)
Whitton Rd, Whitton, (opp. rugby ground)
St Margarets Rd, St Margarets (nr. Bridge Rd)
Sheen Rd, Richmond (nr Sheen Park)
Richmond Rd, Twickenham (opp. Marble Hill Pk)
Stanley Rd, Teddington (junc. Strathmore Rd)
Hampton Rd, Teddington (nr. Bushy Pk Gardens)
Cross Deep, Twickenham (nr Poulett Gardens)
High Street, Whitton
URRW, Sheen (nr. Courtland Estate)
Lower Richmond Rd, Mortlake (nr. Kingsway)
Kingston Rd, Teddington (nr. Woffington Close)
Lonsdale Road, Barnes (nr. Suffolk Rd)
Paradise Rd, Richmond
High St, Teddington,
Thames St, Hampton
Castelnau Library, Barnes (static site)
German School, Petersham Rd
Causeway, Teddington
Petersham Rd, Ham (nr. Sandy Lane)
Sheen Lane, Sheen (railway crossing)
Percy Rd, Hampton (nr. Oldfield Rd)
Waldegrave Rd (nr Elmfield House), Teddington
Wetlands, Barnes (static site)
Holly Lodge, Richmond Pk
NO2
EU Target

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

Site ID	Valid data capture for monitoring period %	Valid data capture 2016 %	Number of Hourly Means > 200 µgm^{-3}						
			2010	2011	2012	2013	2014	2015	2016
Castelnau Library, Barnes (R1)	97	97	0	0	0	2	0	0	0
Wetlands Centre, Barnes (R2)	96	96	0	0	0	0	0	0	0
NPL - Teddington AURN (TD0)	57	57	0	0	0	0	0	0	0

Notes: Exceedance of the NO_2 short term AQO of 200 µgm^{-3} over the permitted 18 days per year are shown in **bold**.

Automatic Monitoring Site data

The NO_2 monitoring results for the three LBRuT automatic sites are compared directly to the annual mean and hourly mean objectives. The data for 2016 is fully ratified. The Mobile Air Quality Unit was located at 3 sites during 2016. It has therefore been decided not to include results in this report.

The 2016 NO_2 data capture for Castlenau and Wetlands was good, representing more than 97% data capture for the R1 (Castelnau), and 96% for R2 (Wetlands) The AURN site at NPL (National Physic Laboratory) in Teddington site TD0 was 57%.

Table E provides the results of automatic monitoring for NO_2 for the 1-hour mean objective of 200 $\mu g\ m^{-3}$. This objective is less stringent than the annual mean and it was met at all sites and for every year reported with the exception of Castelnau where this standard was exceeded twice in 2013.

Table D provides the 2016 results of the NO_2 automatic monitoring and a comparison with the annual mean objective.

The 2016 results show that all three sites met the objective of 40 $\mu g\ m^{-3}$. The 2016 annual mean for the R2 (Wetlands) and TD0 (Teddington) sites were 25 and 22 $\mu g\ m^{-3}$ respectively. These sites are both backgrounds sites and therefore representative of low pollution in the Borough. The annual mean at the R1 (Castelnau) roadside site was 36 $\mu g\ m^{-3}$, a slightly higher concentration than in 2015 but, as noted in the Annual Status Report 2015, 2015 generally saw slightly lower levels of NO2. There does seem to be a very slight downward trend at Castlenau. It should be noted that from Saturday 28 May 2016 in order to preserve the lifespan of Hammersmith Bridge, sited at the end of Castlenau, it was necessary to limit the number of buses using the structure. Strengthening works are intended. It should also be noted that pollution levels at Castlenau roadside site are generally lower than at many other roadside and kerbside sites around the borough. Consideration has been given to relocating the site. On balance, for data continuity and trend data purposes, it has been decided to leave it in situ.

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

Site ID	Valid data capture for monitoring period % [a]	Valid data capture 2016 %	Annual Mean Concentration (μgm^{-3})						
			2010	2011	2012	2013	2014	2015	2016
Castelnau Library, Barnes (RI1)	100	98	21	23	21	22	20	22	20
Wetlands Centre, Barnes (RI2)	100	87	19	22	18	20	18	17	16

Notes: Exceedance of the PM_{10} annual mean AQO of 40 μgm^{-3} are shown in **bold**.

PM_{10}

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 King's College London, when they process our monitoring data. As mentioned in section 1, PM_{10} is a specified pollutant for the whole Borough AQMA.

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 2010 to 2016 inclusive. The data for each year is fully ratified.

PM10 measurement was undertaken at two sites and the data capture was good. The R1 Castelnau site achieved 98% and the R2 Wetlands site 87%.

Table F provides results of automatic monitoring of PM10 and a comparison with annual mean objective. The objective of 40 μg m-3 was met at each site for every year reported.

The 2016 annual mean for PM10 at the background site at the Wetlands Centre in Barnes was fractionally lower than in the last seven years. This is encouraging and could be a downward trend. It is however only fractional and may creep up again in 2017. The roadside site at Castlenau recorded the same value as in 2014 which is the lowest recorded over the past seven years. We will reassess this in next years' Report to see whether levels are really falling.

Table G provides the comparison with 24-hour mean objective. The objective of no more than 35 days exceeding 50 μg m-3 was met at each site for all years reported. All sites however exceeded this daily standard at least once for all years reported. The number of days exceeding the daily standard at each site was low in 2010, 2014, 2015 and 2016.

For 2011 the sites had an increased number of days that exceeded compared to previous years. This was mainly as a result of the episodes that arose in the early part of the year and also during November. These peaks in PM10 concentrations occur during periods of stable conditions, specifically during winter when London sources can dominate concentrations, at other times high pressure systems can lead to imported transboundary PM10 from elsewhere in the UK and Europe.

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

Table G. PM_{10} Automatic Monitor Results: Comparison with 24-Hour Mean Objective

Site ID	Valid data capture for monitoring period %	Valid data capture 2016 %	Number of Daily Means > 50 µgm^{-3}						
			2010	2011	2012	2013	2014	2015	2016
Castelnau Library, Barnes (R1)	100	98	2	15	14	10	4	5	7
Wetlands Centre, Barnes (R2)	100	87	1	17	13	6	3	1	3

Notes: Exceedance of the PM_{10} short term AQO of 50 µg m^{-3} over the permitted 35 days per year or where the 90.4th percentile exceeds 50 µg m^{-3} are shown in **bold**. Where the period of valid data is less than 90% of a full year, the 90.4th percentile is shown in brackets after the number of exceedances.

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

Site ID	Valid data capture for monitoring period %	Valid data capture 2016 %	Annual Mean Concentration (µgm^{-3})						
			2010	2011	2012	2013	2014	2015	2016
NPL Teddington	N/A	N/A	14	17.5	11.5	16.7	N/A	N/A	N/A

2. Action to Improve Air Quality

Table J. Commitment to Cleaner Air Borough Criteria

Theme	Criteria		Achieved (Y/N)	Evidence
1. Political leadership	***1.a***	Pledged to become a Cleaner Air for London Borough (at cabinet level) by taking significant action to improve local air quality and signing up to specific delivery targets.	Y	Richmond has established a cross-party Scrutiny Committee to review and monitor measures to improve air pollution in the Borough. Richmond has very strong Cabinet Member support for the air quality agenda, with many air quality initiatives and campaigns driven by political leadership Richmond has been signed up to Cleaner Air for London in April 2013 and maintains this commitment.
	1.b	Provided an up-to-date Air Quality Action Plan (AQAP), fully incorporated into LIP funding and core strategies.	Y	Richmond is currently redrafting an AQAP for 2017-22 to represent the importance of air quality to the borough and focus on our priorities. This will be available for consultation in May
2. Taking action	**2.a**	Taken decisive action to address air pollution, especially where human exposure and vulnerability (e.g. schools, older people, hospitals etc) is highest.	Y	We have an ongoing Cleanerair4schools project, funded through MAQF. We have established a new project which looks at auditing 3 schools in areas of poor air quality and the interaction of local pollutants to the pupils inside, outside and the journey to & from school. This will report directly back to the AQ Scrutiny Committee and will make a number of recommendations for protecting the boroughs school children. Cycling has been encouraged through various initiatives; a new cycle hub has been installed at Teddington station, Council support has been given to Quietways 21 from Teddington to Ham;

				3 cycle hangars have been installed in the Borough in 2016, with a view for 6 more in 2017; a Council Cycle Strategy has been drawn up and accepted in 2016 to be adopted in summer 2017. Electric Vehicle Charging Strategy adopted in November 2016, setting out proposals to add over 200 new chargepoints in the borough across 80 locations by 2025/26 to encourage takeup of electric cars in the borough. Trialling of streetlight mounted chargepoints to allow overnight charging in residential areas for residents with no off-road parking available.
	2.b	Developed plans for business engagement (including optimising deliveries and supply chain), retrofitting public buildings using the RE:FIT framework, integrating no engine idling awareness raising into the work of civil enforcement officers, (etc etc)	Y	We have drafted a new Code of Practice for the boroughs construction industry which incorporates NRMM & dust and emission controls, as well as embedding the best practice of construction logistics. We have developed London Wide NRMM guidance for Planners and EH professionals As part of the 2016 Cycling and business engagement project we worked closely with businesses and developed pollution free cycling Maps for the borough. The Council has participated in a trial that involves liaising with businesses to explore the poss bility of retiming deliveries to off peak periods in two of the Council's district and local centres (Hampton Hill and St Margarets) This has been well receieved and will be made permanent in 2017. .
	2.c	Integrated transport and air quality, including by improving traffic flows on borough roads to reduce stop/start conditions	Y	The borough works with TfL to identify junctions where traffic signal timings can be improved to help smooth traffic flows. As part of any wider transport schemes, opportunities are also taken to review signal timings and junction layouts where congestion is an issue, for instance at Hospital Bridge Road / Powdermill Lane, along Kingston Road and through the application of

				the 'SCOOT' system in Twickenham Town Centre. The borough has also implemented a range of schemes to help encourage sustainable transport, which in turn will help reduce reliance on the private car helping to ease congestion.
	2.d	Made additional resources available to improve local air quality, including by pooling its collective resources (s106 funding, LIPs, parking revenue, etc).	Y	The Council makes use of a range of funding sources to help deliver its transport schemes which in turn deliver air quality benefits. Sources include TfL LIP funding, other TfL funding streams (such as Borough Cycle Programme and Incubator funding), s106 funding, Council uplift funding, Council revenue funding and Mayor's Air Quality funding. The Council has continued to support a project in schools to raise awareness of air quality issues, which was initially funded through a combination of LIP and MAQF funding. MAQF has now ceased but the project continues with LIP funding.
3. Leading by example	**3.a**	Invested sufficient resources to complement and drive action from others	Y	Total revenue budget of £65,000 including maintenance contracts
	3.b	Maintained an appropriate monitoring network so that air quality impacts within the borough can be properly understood	Y	All of the Councils monitoring network has been maintained and is continually updated. We also maintain mobile monitoring equipment that can be deployed for specific projects or loaned to other partner authorities.
	3.c	Reduced emissions from council operations, including from buildings, vehicles and all activities.	Y	LBRUT has installed solar panels on the roof of the Civic Centre to help reduce emissions, upgraded Council fleet and set conditions for

				contractor fleet through procurement.
	3.d	Adopted a procurement code which reduces emissions from its own and its suppliers activities, including from buildings and vehicles operated by and on their behalf (e.g. rubbish trucks).	Y	50% of the fleet are Euro 4 50 % of fleet are Euro 5/6
4. Using the planning system	**4.a**	Fully implemented the Mayor's policies relating to air quality neutral, combined heat and power and biomass.	Y	All approved planning applications meet the Mayor's requirements relating to AQ neutral and CHPs
	4.b	Collected s106 from new developments to ensure air quality neutral development, ***where possible***	y	£25,000. The borough is also finalising a new Richmond specific AQ SPD focused on the councils priorities for new developments, including formalising the Section 106 conditions.
	4.c	Provided additional enforcement of construction and demolition guidance, with regular checks on medium and high risk building sites.	Y	Strict planning conditions for construction and demolition applied to all major sites. Complaints responded to.
5. Integrating air quality into the public health system	**5**	Included air quality in the borough's Health and Wellbeing Strategy and/or the Joint Strategic Needs Assessment	Y	Health and Wellbeing Strategy includes air quality as a key theme.
6. Informing the public	**6.a**	Raised awareness about air quality locally	Y	airTEXT is promoted on the website and at local events. Campaign aimed at anti idling run by local schools and aimed at level crossings in the borough. Campaign around wood burning and Clean Air Zones in the borough aimed at businesses and fuel suppliers. Lessons are given to local schools to raise awareness for air quality.

2.1 Air Quality Action Plan Progress

Table K provides a brief summary of Richmond's progress against the Air Quality Action Plan, showing progress made this year. The current Action Plan has been updated every year since it's inception in 2002. Some of the original measures within it are generally completed, no longer relevant or ongoing. Measures which are still active have been updated in Table K together with some new actions which have been initiated through the Local Implementation Plan and Mayors AQ Fund.

An updated draft AQAP has been produced and is currently subject to review by the AQ Steering Group before public consultation in summer 2017. The AQAP will cover the period from 2017 – 2022 and will reflect changes in air quality policy and identify specific measures to tackle pollution in the AQ Focus Areas and local 'hot-spots' within the borough. It will include measures to incentivise the uptake of low emission transport; encourage modal shift to active travel options and address the council's new $PM_{2.5}$ role. Adopted measures will include Key Performance Indicators wherever possible.

The updated AQAP, once finalised and approved, will be supported by the departmental Heads of Service for Environmental Health, Transport, and Planning; the Director of Public Health and Cabinet members.

Table K. Delivery of Air Quality Action Plan Measures

A. Londonwide And Regional Measures
B. Boroughwide Measures
C. Local Measures

A LONDONWIDE AND REGIONAL MEASURES

Measure	Action	Progress	Further information
1	Participate in the development of a low emission zone (LEZ) and engage with TfL for further measures to reduce pollution in London.	LBRUT has engaged fully with the Mayor and TfL in the implementation of the LEZ Following public consultations in 2016 the Mayor has announced the Introduction of the T (toxicity) charge in the central congestion charging zone in October	The LEZ has forced the most polluting commercial diesel vehicles driving in London to become cleaner. The introduction of the T charge in 2017 and the ULEZ in 2019 will help further. The Council has actively taken part in all

Measure	Action	Progress	Further information
		2017 Further consultations in 2016 and 2017 have been organized regarding the introduction of a new ULEZ for central London and possibly Greater London.	engagement meetings with TfL and responded to every consultation, for LEZ, T charge and ULEZ. It is very keen to improve air quality but concerned at possible disbenefits of an expanded ULEZ. The Council will continue to be an active participant in the consultation procedure.
2	Encourage BAA to take actio reduce emissions at Heathro from surface access traffic, s traffic, aircraft and other sources.	The Airports White Paper identified AQ as a material consideration which could delay the building of a 3rd runway. This continues to be the case in 2016. The Council is actively opposing the building of a 3rd runway partly on grounds of the disbeneits in air quality that it believes the borough would experience due to increased traffic for the delivery of people, services and supply products that a 3rd runway would necessitate.	Our concern remains that a new runway, intensified runway use will lead to increases in aircraft movements in the sky, and increases in road traffic movements on the ground, both leading to greater pollution emissions We oppose increased capacity at the expense of keeping any gains in air quality and noise improvements. We will continue to do this.
3	Lobby the Mayor of London to ensure that, as a minimum buses and taxis meet the LEZ EURO III and IV criteria	This standard has now been met. The bus fleet continues to improve. Zero carbon capable taxis only will be registered from October 2018. LBRUT has concerns regarding the contribution of emissions from buses and taxis in town centres, particularly in Richmond and will continue to encourage early upgrades through the tendering process..	Areas with a concentration of buses and taxis should obtain a significant local benefit.

Measure	Action	Progress	Further information
4	Lobby the Mayor to achieve London-wide improvements for pedestrians, cyclists and public transport where there will be local benefits.	Through the 2016 LIP Funding process we have delivered a number of successful cycling, walking & bus schemes. LBRUT engaged in joint projects with Network Rail to identify additional cycle parking at stations throughout 2016. This resulted in the installation of a cycle hub for Teddington station in 2016 3 cycle hangars have been installed in the Borough in 2016, with a view for 6 more in 2017 Better facilities for pedestrians through improved street scape in Hampton Hill were approved in 2015, partly delivered in 2016 to be completed in 2017.	A new cycle strategy was drawn up and accepted in 2016 to be adopted in summer 2017 . A Brompton docking station for Twickenham is planned for May 2017 The delivery of Quietway 21 from Teddington to Ham will be delivered by December 2017. A feasibility study for a second Quiet way will be undertaken in 2017.
5	Work with other SW London Boroughs in SWELTRAC Schemes	The SWELTRAC partnership came to an end in 2011 It was replaced by a South London Transport Partnership and the South London Transport Strategy Board. One of the most important developments is the setting up and running of EV charge points by	LBRUT will be installing 5 EVCPs in Old Deer park public car park in 2017.

Measure	Action	Progress	Further information
		Source London. LBRUT adopted an Electric Vehicle Charging Strategy in November 2016, setting out proposals to add over 200 new chargepoints in the borough across 80 locations by 2025/26 and to encourage takeup of electric cars in the borough. Trialling of streetlight mounted chargepoints to allow overnight charging in residential areas for residents with no off-road parking is available.	
6	Work with the adjacent Boroughs and West London Alliance local authorities, to develop co-ordinated AQAPs across the region.	The shared service of LBRUT and LB Merton has led the NRMM program to address pollution from development sites across 12 LA's. In 2016 they visited 150 development sites. Joint working with both South and West London authorities is ongoing and in 2014/15 resulted in the Clean air4schools program funded by the MAQF This was continued in LBRUT in 2016 through LIP funding.	LBRUT and LB Merton will continue to lead the NRMM program in 2017. This will have a significant effect on improving air quality in the local area around each development site and contribute to the improvement in air quality in London. LIP funding will continue to support the Cleanair4schools program in 2017 which will include community members to improve awareness of air quality issues...

B BOROUGHWIDE MEASURES

Measure	Action	Progress	Further information
8	Continue to pursue land use policies within the saved UDP and Local Development Framework to encourage travel choice with the aim of reducing emissions and to ensure that major new developments are accessible to public transport. The LDF will take such policies forward.	These actions have been completed A new Air Quality SPD and Air Quality Action Plan was drafted in 2016 to be approved and implemented in 2017.	An updated draft Air Quality Action Plan has been produced and is currently subject to review by the AQ Steering Group before public consultation. The AQAP will cover the period from 2017 – 2022 and will reflect changes in air quality policy and identify specific measures to tackle pollution in the AQ Focus Areas and local 'hot-spots' within the borough. It will include measures to incentivise the uptake of low emission transport; encourage modal shift to active travel options and address the council's new PM2.5 role.
11	Promote the Council Travel Plan for the Council employees	Throughout 2016 the Council encouraged the use of Oyster cards for business travel on public transport and the use of personal cycles. Cycle facilities on Twickenham campus include showers and changing	The Council continues to promote healthier travel habits for its staff, including walking, cycling and using public transport which will help reduce emissions. .

Measure	Action	Progress	Further information
		rooms 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.	
12	Promote Travel Plans for schools Encourage both public and private sector schools to adopt school travel plans and associated walking and cycling initiatives Set up database to monitor progress of all Travel Plans	We provide cycle, pedestrian and scooter training for school children and enjoy a very good take-up. We provide a Junior Citizenship week twice a year which includes promoting walking, cycling and public transport. LBRUT strongly supports the TfL In school travel plan accreditation scheme – STARS. It rewards schools for their engagement with the school community and for carrying out initiatives which result in more pupils and staff travelling sustainably to school...	Richmond Council continues to support school travel plans which are part of the Education Strategy through the development control process. Applications for additional parking permits must be accompanied by up to date travel plans.

Measure	Action	Progress	Further information
16	To continue to press for and promote travel choice through improvements for pedestrians, cyclists and to public transport in terms of increased capacity, reliability, accessibility and quality	The Borough continues to promote www.Walkit.com through its website and advice from Officers. Please see measure 4 for cycle and pedestrian improvements.	Sustainable travel choices are promoted through the planning process. Many ongoing cycle projects to improve cycle facilities and increase a modal shift towards cycling throughout 2016 and planned for 2017/18. Please see measure 4
21	Concern for low emission vehicles to be used on Council business extends to the use of vehicles by contractors. The Council seeks to control emissions from contractor's vehicles by checking that their environmental policy includes specifically its use of transport.	Euro emissions on all fleet vehicles are euro IV or above. All contractor vehicle emissions are controlled through procurement.	
24	To continue to promote the Council's 'Smoke Control	An awareness raising campaign on correct fuels to burn in smoke control areas was	In 2017 all retail outlets selling fuel were written to by LBRUT and asked to display posters regarding correct fuel to be burnt in smoke

	Zone'	drafted in 2016 and launched in 2017.Guidance is given about smoke control on the Council's website	control areas. A campaign was launched on social media, through e letters to community groups and on the website.
25	To continue to promote composting in preference to bonfires	The Council encourages people to avoid bonfires as they cause air pollution and the emissions can be harmful to health or a nuisance. There is advice for residents on the Council's website.	Poor air quality due to a bonfire may be very localized but can cause considerable distress to neighbours.
26	To continue to inspect and enforce clean air requirements at 'Part B' processes in the Borough.	Annual inspections of premises producing industrial emissions. The database of premises for control is routinely updated.	Maintain established benefits of controlling emissions from certain industrial processes within the borough identified as 'Part B' of the Regulations.
28	Support the development and use of 'Car Clubs' in new residential developments, by station interchanges and in town centres.	On-going with support from the Council. Car free developments have already been secured in the borough through the development control process. Future car free developments will include the use of car clubs. The Council uses a car club for essential staff car journeys in preference to using pool cars.	Car clubs operate throughout the borough and are positively endorsed by the Council. Use and siting of car club bays is under ongoing scrutiny. If car club bays are proved not to be used their space is withdrawn, in agreement with the car club. In 2016 there were 71 car club bays in operation.

C. LOCAL MEASURES

Measure	Action	Progress	Further information
29	Refuse planning consent for activities, which are likely to lead to a significant worsening of air pollution in 'hot spot' areas.	All major planning applications are considered for air quality impacts and conditioned for required mitigation. Section 106 monies are requested. Consideration is also given to the cumulative effect of nearby developments. A draft Air Quality Special Planning Document is awaiting approval. Biomass and CHP are generally discouraged.	Robust procedures for planning applications will be in place during 2017.
31	To consider ways to further reduce the impact of road traffic and parking problems on Twickenham RFU days.	"No engine idling" for taxis and PHV encouraged by ad hoc Officer intervention on major match days at RFU during 2016/17. EVCP required for new conference space for RFU planning application received in 2016	Support given to proposals by RFU to encourage non-car use as part of Travel Plan
33	Consider controls for coach parking in Kew and Hampton Court, to protect residents, workers and visitors from the impact of vehicle emissions	On-going discussions with Kew Gardens in 2016 to ensure continued monitoring of no idling by coaches.	Summer of 2016 spot checks made by Council Officer to ensure driver compliance with no engine idling policy. Drivers spoken to by Officer. 100% compliance observed.

3. Planning Update and Other New Sources of Emissions

Table L. Planning requirements met by planning applications in The London Borough of Richmond Upon Thamesin 2016

Condition	Number
Number of planning applications reviewed for air quality impacts	*145*
Number of planning applications required to monitor for construction dust	30
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	12
Number of AQ Neutral building and/or transport assessments undertaken	26
Number of AQ Neutral building and/or transport assessments not meeting the benchmark and so required to include additional mitigation	4
Number of planning applications with S106 agreements including other requirements to improve air quality	1
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 at www.nrmm.london 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.	15 conditions included 5 registered/ fully compliant 4 registered / actively working towards compliance (being chased) 1 registered/construction not started 5 with which we have yet to make contact

All major developments are passed to the Noise and Air Quality Officers in Environmental Health for comment. We have 2 designated Officers who assess all major sites for NRMM compliance, visit sites and check the NRMM data base on a regular basis. The requirement to register on the NRMM

is a standard planning condition which has been added to all major development applications since Summer 2016. We are currently working on a draft SPD for Air Quality planning conditions.

3.1 New or significantly changed industrial or other sources

No new sources identified.

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 every two weeks by the local authority Air Quality Officer. 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 Enviro Technology Services plc and also audited by NPL every six months as part of the King's LAQN QA/QC procedure, to ensure optimum data quality.

Teddington (AURN) monitoring station at NPL is part of the AURN and the QA/QC for this station is managed by AEA Technology. 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 on-going performance of the monitor is checked on-line, by the King's College London Duty Officer. 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 King's College London, prior to dissemination of the data.

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

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 data 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 NO_2 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 NO_2 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 (April 2015 – February 2017)

- Summary of Precision Scores for 2014 - 2016

- UKAS schedule of accreditation (January 2017)

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 (April 2015 – February 2017).

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 for every month in 2016 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 2016 is covered by rounds AR007 to AR018 of the AIR-PT scheme. For 2016 the laboratories results were deemed to be good for 98 participating local authorities, satisfactory for 6 and poor for 9 participating local authorities based upon a z score of ≤ ± 2. In 2016, 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 15 participating local authorities and poor for one participating local authority. Precision was good for The London Borough of Richmond Upon Thames for 2014, 2015 and 2016.

Table 1a Laboratory summary performance for AIR NO_2 PT rounds AR007, 9, 10, 12, 13, 15, 16 and 18

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 AR007**	**AIR PT AR009**	**AIR PT AR010**	**AIR PT AR012**	**AIR PT AR013**	**AIR PT AR015**	**AIR PT AR016**	**AIR PT AR018**
Round conducted in the period	April – May 2015	July – August 2015	October – November 2015	January – February 2016	April – May 2016	July – August 2016	September – October 2016	January – February 2017
Aberdeen Scientific Services	100 %	75 %	100 %	100 %	100 %	100 %	100 %	100 %
Cardiff Scientific Services	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]
Edinburgh Scientific Services	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Environmental Services Group, Didcot [1]	100 %	100 %	100 %	100 %	75 %	75 %	100 %	100 %
Exova (formerly Clyde Analytical)	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]
Glasgow Scientific Services	100 %	100 %	100 %	75 %	100 %	0 %	100 %	100 %
Gradko International [1]	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Kent Scientific Services	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]
Kirklees MBC	100 %	100 %	100 %	100 %	100 %	100 %	NR [2]	NR [2]
Lambeth Scientific Services	100 %	100 %	100 %	100 %	100 %	100 %	75 %	100 %
Milton Keynes Council	100 %	100 %	100 %	50 %	100 %	100 %	75 %	100 %
Northampton Borough Council	100 %	100 %	100 %	50 %	100 %	NR [2]	75 %	0 %
Somerset Scientific Services	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
South Yorkshire Air Quality Samplers	100 %	100 %	75 %	100 %	100 %	75 %	100 %	100 %
Staffordshire County Council	100 %	75 %	75 %	75 %	75 %	100 %	NR [2]	100 %
Tayside Scientific Services (formerly Dundee CC)	NR [2]	NR [2]	NR [2]	100 %	NR [2]	100 %	NR [2]	100 %
West Yorkshire Analytical Services	75 %	75 %	75 %	75 %	100 %	NR [2]	50 %	100 %

[1] Participant subscribed to two sets of test samples (2 x 4 test samples) in each AIR PT round.
[2] NR No results reported
[3] Kent Scientific Services, Cardiff Scientific Services and Exova (formerly Clyde Analytical) no longer carry out NO_2 diffusion tube monitoring and therefore did not submit results.

2014 - 2016 Summary of Precision Results for Nitrogen Dioxide Diffusion Tube Collocation Studies for Gradko Laboratory 50% TEA in Acetone

Gradko, 50% TEA in Acetone	
2014	G
2014	G
2014	G
2014	G
2014	G
2014	G
2014	G
2014	G
2014	G
2014	P
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2015	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	G
2016	P

2014 Results of study carried out in 2014

2015 Results of study carried out in 2015

2016 Results of study carried out in 2016

Numerical results for this data are contained in the National Bias Adjustment Spreadsheet version 03/17.

P Poor Precision

G Good Precision

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

2187

Accredited to ISO/IEC 17025:2005

Gradko International Ltd
(Trading as Gradko Environmental)

Issue No: 019 **Issue date:** 04 September 2015

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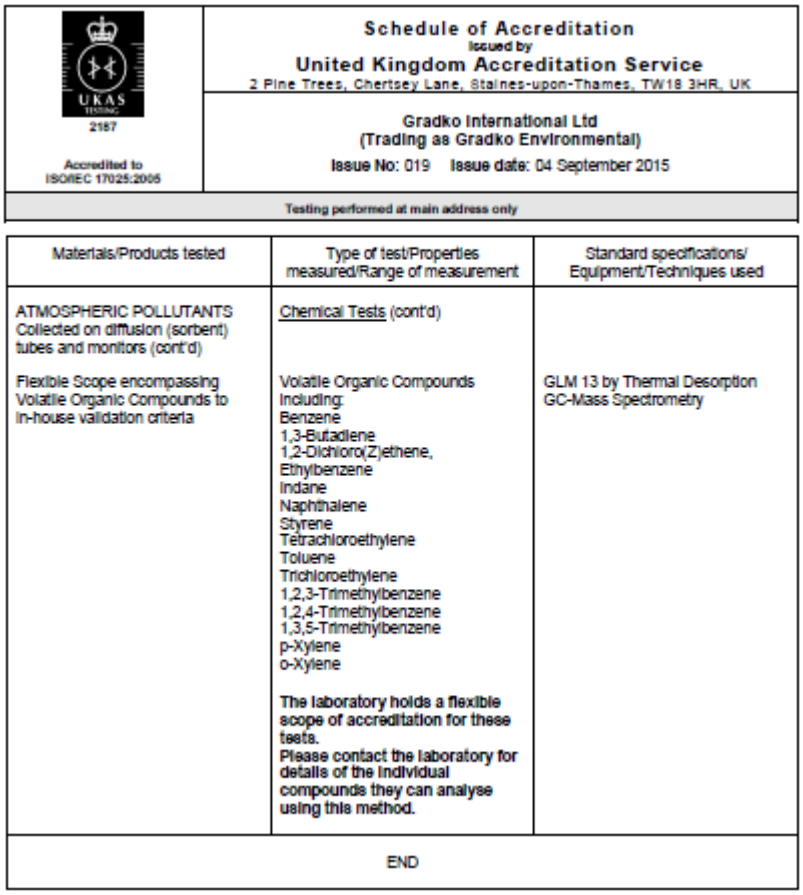
Website: www.gradko.co.uk

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	GLM 8 by Ion Chromatography
	Benzene Toluene Ethyl benzene Xylene	GLM 4 by Thermal Desorption/ FID Gas Chromatography
	Hydrogen chloride Nitrogen dioxide Sulphur dioxide Hydrogen fluoride	GLM 3 by Ion Chromatography
	Hydrogen sulphide	GLM 5 by Colorimetric determination (UV Spectrophotometry)
	Ozone	GLM 2 by Ion Chromatography
	Nitrogen Dioxide	GLM 7 by Colorimetric determination (UV Spectrophotometry)
	Nitrogen Dioxide (as Nitrite)	GLM 9 by continuous flow colorimetric analyser
	Sulphur dioxide	GLM 1 by Ion Chromatography
	Formaldehyde	GLM 18 by HPLC



Schedule of Accreditation
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United Kingdom Accreditation Service
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2187

Accredited to ISO/IEC 17025:2005

Gradko International Ltd
(Trading as Gradko Environmental)

Issue No: 019 Issue date: 04 September 2015

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)	
Flexible Scope encompassing Volatile Organic Compounds to in-house validation criteria	Volatile Organic Compounds including: Benzene 1,3-Butadiene 1,2-Dichloro(Z)ethene, Ethylbenzene Indane Naphthalene Styrene Tetrachloroethylene Toluene Trichloroethylene 1,2,3-Trimethylbenzene 1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene p-Xylene o-Xylene **The laboratory holds a flexible scope of accreditation for these tests. Please contact the laboratory for details of the individual compounds they can analyse using this method.**	GLM 13 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 2 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.

Discussion of Choice of Factor to Use

Diffusion Tube Bias Adjustment Factors from Local Co-location Studies

In 2016 the Borough undertook co-location studies at two continuous NO_2 monitoring sites, together with 3 x NO_2 diffusion tubes at each of the following the locations:

- **Richmond 1 Castelnau (site 23):** a roadside site, used to bias adjust all other kerbside and roadside sites in the borough. In 2016 the annual average for the Castelnau diffusion

tubes (№ 23) was 36.38 μg m^{-3}; for the continuous site (R1) it was 36 μg m^3. The bias adjustment factor is **0.98**

- **Richmond 2 Barnes Wetlands (site 37):** a suburban site used to bias adjust the two background sites, 28 and 37. In 2016 the annual average for the Wetlands diffusion tubes (№ 37) was 23.15 μg m^{-3}; for the continuous site (R2) it was 25 μg m^3. The bias adjustment factor is **1.08**
- **The National bias adjustment factor** for Gradko using 50% TEA in acetone for 2016 was **1.03.**

The overall precision and data capture for this co-location study was very good, as it has been over recent years. So, it was decided to use local adjustment figures, 1) as they are more representative of local conditions and 2) in the interests of consistency, since local adjustment figures have been used since 2002 for all annual Air Quality Reports for Defra.

Factor from Local Co-location Studies

The local bias adjustment factors for the Borough are provided in Table A.1 for 2011 to 2016. From 2011 to 2016 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. All background sites in the Borough are bias adjusted using the factor from the local suburban co-location site at the Richmond 2 Barnes Wetlands. This is with the exception of 2014 data when 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 2014.

The methodology for calculating the bias adjustment was followed using the guidance on the AEA spreadsheet. The co-location questionnaire was also completed and submitted to Nick Martin at NPL to be included in the National Diffusion Tube Bias Adjustment Factor Spreadsheet.

Table A.1 2011 to 2016 NO_2 diffusion tube bias adjustment factors for the Borough

Source of bias adjustment factor	2011	2012	2013	2014	2015	2016
Local roadside co-location study at Richmond 1 Castelnau	0.92	1.06	0.96	0.95	0.92	0.98
Local background co-location study at Richmond 2 Wetlands Barnes	1.03	1.04	0.95	1.09	1.00	1.08
National factor (not used)	0.95	1.01	1.01	0.97	0.96	1.03

A.3 Adjustments to the Ratified Monitoring Data

Distance Adjustment

Table M. Annual Mean NO2 Ratified and Bias-adjusted Monitoring Results (**3)** The results in brackets indicate the exposure estimate, calculated for the nearest residential façade following the procedure as specified in LLAQM.TG(16).

Site ID	Site type	Annual Mean Concentration (µgm^{-3})						
		2010[c]	**2011**	**2012**	**2013**[c]	**2014**[c]	**2015**[c]	**2016**[c]
		(Bias Adjustment Factor = 1.06)	**(Bias Adjustment Factor = 0.92)**	**(Bias Adjustment Factor = 1.06)**	**(Bias Adjustment Factor = 0.96)**	**(Bias Adjustment Factor = 0.97)**	**(Bias Adjustment Factor = 0.92)**	**(Bias Adjustment Factor = 0.98)**
1	roadside	**51 (50)**	**44 (43)**	**45 (46)**	**47 (46)**	**49 (48)**	**41 (41)**	**56 (56)**
2	roadside	39 (36)	31 (29)	34 (34)	32 (31)	33	28 (28)	31 (30)
3	roadside	**44** (33)	35 (28)	**44 (40)**	**44** (33)	**44** (37)	**41** (35)	**42 (34)**
4	kerbside	39 (31)	38 (30)	**44 (40)**	**44** (34)	**44** (35)	36 (31)	**40** (32)
5	kerbside	38 (31)	32 (27)	33 (33)	closed	closed	closed	closed
6	kerbside	**48** (38)	34 (29)	43 (40)	**43** (35)	**41** (35)	36 (32)	37 (32)
7	kerbside	**69 (59)**	**49 (43)**	**59 (54)**	**61 (53)**	**54 (48)**	**47 (42)**	**49 (44)**
8	kerbside	39 (31)	30 (26)	34 (34)	closed	closed	closed	closed
9	kerbside	**55 (48)**	**47 (42)**	**50 (47)**	**49 (44)**	**48 (43)**	**42** (39)	**45 (41)**
10	kerbside	**47** (37)	36 (33)	**44 (42)**	**46 (42)**	**38**	**43** (35)	**44** (35)
11	kerbside	**52** (38)	**46** (35)	**54 (46)**	**49** (38)	**48** (38)	**44** (35)	**48** (36)
12	kerbside	**52** (39)	**41** (32)	**45 (41)**	**49** (37)	**46** (37)	**41** (34)	**45** (35)
13	kerbside	**53 (42)**	**42** (34)	**48 (43)**	**48** (38)	**47** (39)	**42** (36)	**42** (35)
14	kerbside	**52 (42)**	38 (32)	**48 (44)**	**46** (38)	**45** (39)	39 (35)	**40** (35)
15	kerbside	**53 (47)**	**41 (40)**	**44 (42)**	**40** (37)	**40** (37)	37 (35)	**41** (38)
16	roadside	**48 (43)**	38 (35)	**45 (42)**	**44** (38)	**43 (40)**	**41** (38)	**42** (39)
17	kerbside	**79 (67)**	**65 (55)**	**70 (59)**	**68 (57)**	**68 (58)**	**63 (54)**	**69 (65)**
18	kerbside	**70 (52)**	**66 (47)**	**68 (48)**	**71 (49)**	**66 (48)**	**67 (48)**	**56 (41)**
19	kerbside	**46** (37)	**50** (35)	**56** (38)	**53** (36)	**55** (39)	**48** (35)	**49** (34)
20	kerbside	**54 (42)**	**40** (36)	**53 (45)**	**51 (43)**	**55 (47)**	**48 (42)**	**47 (41)**
21	roadside	**47 (42)**	39 (35)	**43** (38)	44 (38)	**41** (37)	37 (34)	**39** (35)
22	kerbside	**55 (46)**	**46** (38)	**51 (41)**	**57 (45)**	**59 (47)**	**53 (43)**	**65 (50)**
23	roadside	**43 (40)**	35 (32)	38 (35)	39 (35)	38	35 (33)	35 (32)
24	kerbside	**42** (36)	36 (30)	**40** (33)	**40** (32)	**40** (34)	35 (31)	37 (31)
25	roadside	**42 (42)**	32 (32)	**47 (47)**	**51 (51)**	**51 (51)**	**45 (45)**	**46 (46)**
26	roadside	**46** (37)	**40** (31)	**42** (33)	**43** (33)	**42** (34)	**40** (32)	**40 (31)**
27	roadside	**44 (41)**	38 (35)	**41** (38)	**40** (37)	37	37 (35)	**43** (35)

28	urban background	24 (24)	20 (20)	22 (22)	21 (21)	18	17	21
29	kerbside	39 (39)	37 (37)	**43 (43)**	39 (39)	36	30 (30)	32 (33)
30	roadside	**41 (42)**	33 (34)	36 (36)	38 (39)	34	29 (29)	33 (35)
31	roadside	**53 (42)**	**50 (40)**	**59 (50)**	**61 (47)**	**62 (49)**	**54 (44)**	**54 (43)**
32	roadside	102 (88)	**75 (66)**	**77 (70)**	**74 (65)**	**73 (68)**	**62 (56)**	**64 (58)**
33	kerbside	66 (53)	**47** (39)	**58 (51)**	**62 (50)**	**69 (56)**	**61 (50)**	**61 (54)**
34	roadside	42 (42)	36 (36)	39(39)	38 (38)	**40 (40)**	33 (33)	36 (37)
35	roadside	**54 (54)**	**46 (46)**	**50 (50)**	**52 (52)**	**48 (48)**	**43 (43)**	**46 (46)**
36	kerbside	**60 (55)**	**46 (42)**	**54 (49)**	**56 (50)**	**56 (51)**	**49 (45)**	**50 (46)**
37	urban background	28	26	25	25	22	21	25
38	kerbside	40 (34)	35 (30)	closed	closed	closed	closed	closed
39	kerbside	**70 (62)**	**58 (52)**	**62 (58)**	**56 (51)**	**56 (51)**	**52 (48)**	**55 (51)**
40	kerbside	31 (27)	37 (28)	**43** (39)	**41** (31)	**40** (33)	36 (30)	**45** (35)
41	kerbside	**49 (42)**	38 (33)	**45** (38)	**42** (36)	**41** (36)	38 (38)	39 (34)
42	roadside	**69 (73)**	**53 (55)**	**56 (59)**	**58 (61)**	**54 (56)**	**47 (49)**	**82 (68)**
43	kerbside	**82 (73)**	**74 (66)**	**78 (70)**	**87 (77)**	**80 (72)**	**80 (72)**	**85 (76)**
44	kerbside	**49 (49)**	**42 (42)**	**46 (46)**	**45 (45)**	**45 (45)**	39 (39)	**42 (43)**
45	kerbside	**48 (40)**	**44 (37)**	**43 (41)**	**48 (40)**	**45** (39)	35 (32)	37 (33)
46	kerbside	**48** (39)	36 (31)	**41** (39)	closed	closed	closed	closed
47	roadside	**49 (44)**	33 (32)	**40 (40)**	**40** (39)	37	32 (31)	33 (33)
48	roadside	**54 (46)**	**43 (37)**	**42 (40)**	**45 (39)**	**45 (40)**	39 (36)	**41** (34)
49	kerbside	**50 (45)**	39 (36)	**47 (42)**	**45 (40)**	**45 (41)**	39 (36)	**44 (40)**
50	kerbside	**64 (55)**	**49 (42)**	**63 (53)**	**61 (52)**	**60 (52)**	**57 (49)**	**55 (48)**
51	kerbside	39 (37	32 (30)	36 (34)	34 (32)	34	28 (28)	32 (31)
52	kerbside	**71 (60)**	**52 (45)**	**59 (50)**	**59 (50)**	**62 (53)**	**55 (47)**	**57 (49)**
53	varies	**55 (45)**	**51 (43)**	**46(43)**	**48 (40)**	**48** (38)	N/A	N/A
54	roadside	**62 (57)**	**44 (41)**	**55 (50)**	**54 (49)**	**56 (52)**	**51 (47)**	**51 (48)**
55	roadside	**59 (49)**	**41** (35)	**48 (40)**	**52 (42)**	**55 (45)**	**50 (42)**	**50 (43)**
56	kerbside	**41** (39)	35 (30)	**41 (41)**	**46 (44)**	38	37 (36)	**51** (39)
57	kerbside	24 (23)	38 (38)	39 (38)		36	33 (32)	**44** (33)
58	kerbside	**43** (39)	**52 (49)**	**58 (51)**		**50 (40)**	**46** (38)	**50** (39)
59	kerbside	Not open	Not open	**44 (41)**	**46 (43)**	**42 (40)**	**40** (38)	**44 (42)**
60	kerbside	Not open	Not open	**40** (39)	32 (30)	32	27 (27)	29 (27)
61	roadside	Not open	Not open	**55 (47)**	**58 (51)**	**54 (49)**	**48 (44)**	**49 (45)**

62	kerbside	Not open	Not open	Not open	**54 (45)**	**52 (45)**	**46 (40)**	**51 (43)**
63	kerbside	Not open	Not open	Not open	**43** (38)	**42** (38)	38 (35)	**41** (37)
64	kerbside	Not open	Not open	Not open	**54 (48)**	**60 (53)**	**55 (49)**	**53 (48)**
65	kerbside	Not open	Not open	Not open	Not open	Not open	Not open	**75 (61)**
66	kerbside	Not open	Not open	Not open	Not open	Not open	Not open	**49 (47)**
Rut 01	kerbside	**70 (70)**	**48 (48)**	**53 (53)**	**60 (60)**	**62 (62)**	**45 (45)**	**50 (52)**
Rut 02	kerbside	**106 (90)**	**93 (78)**	**95 (80)**	**94 (79)**	**96 (81)**	**88 (75)**	**96 (82)**
RUT 03	Background	32	26	closed	closed	closed	closed	closed
RUT 04	Background	29	29 (36)	closed	closed	closed	closed	closed

Appendix B Full Monthly Diffusion Tube Results for 2016

Table N. NO_2 Diffusion Tube Results

Site ID	Valid data capture for monitoring period % [a]	Valid data capture 2016 % [b]	Annual Mean NO_2													
			Jan	Feb	March	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Annual mean – raw data [c]	Annual mean – bias adjusted [d]
1	100	92	53.67	44.71	53.78	54.20	51.43	57.90		47.42	65.05	56.00	65.49	74.88	**57**	**56**
2	100	100	34.03	35.21	29.46	28.00	27.87	28.06	24.98	22.76	30.49	35.92	41.20	45.64	32	31
3	100	100	52.26	44.75	41.60	36.10	34.22	36.85	37.01	33.19	43.62	42.66	48.73	58.76	**42**	**42**
4	100	92	39.49	40.76	36.44	35.65	40.27	40.50	30.36	32.21		44.63	48.42	57.26	**41**	**40**
6	100	100	40.62	39.04	37.03	31.71	35.98	37.58	31.20	37.82	40.94	41.69	47.19	37.94	38	37
7	100	100	42.44	52.45	51.90	50.28	54.59	49.84	40.06	42.14	47.77	61.73	55.99	56.34	**50**	**49**
9	100	100	50.94	45.25	39.37	39.43	43.48	40.09	33.77	31.08	48.28	46.86	49.89	79.85	**46**	**45**
10	100	100	51.12	50.36	37.51	37.56	43.06	37.45	43.70	41.28	42.62	40.68	50.07	60.21	**45**	**44**
11	100	100	48.56	50.93	51.57	41.43	41.47	46.64	40.38	38.86	45.60	48.20	64.59	72.92	**49**	**48**
12	100	100	47.42	48.07	41.86	41.65	42.31	44.43	37.63	37.45	49.79	46.01	56.45	63.08	**46**	**45**
13	100	100	48.52	50.46	40.76	36.78	44.29	36.48	31.10	31.94	41.31	41.23	50.58	65.88	**43**	**42**
14	100	100	38.91	39.64	36.99	36.60	35.51	36.93	31.28	35.62	47.54	45.51	54.14	51.27	**41**	**40**
15	100	100	42.31	43.61	35.36	36.75	37.18	35.57	40.35	40.34	49.38	38.94	51.09	51.38	**42**	**41**
16	100	100	49.83	55.95	38.94	36.11	39.12	37.93	36.59	30.56	42.40	39.67	47.75	57.03	**43**	**42**
17	100	100	73.71	73.83	60.12	62.83	67.44	63.23	69.47	63.82	76.90	65.91	84.66	77.11	**70**	**69**
18	100	100	60.35	68.56	71.09	56.43	10.15	62.54	68.26	59.59	67.22	63.26	20.76	77.32	**57**	**56**

19	100	100	64.52	59.10	47.24	44.20	37.64	43.72	46.23	39.73	49.63	45.55	52.05	66.03	**50**	**49**
20	100	100	58.74	55.85	40.49	39.81	44.49	38.95	44.53	42.62	51.46	39.31	53.73	67.17	**48**	**47**
21	100	92	40.94	43.15	36.37	34.16	41.26	35.38	30.53	30.75		43.32	51.03	53.25	**40**	**39**
22	100	100	71.19	53.22	47.14	51.72	55.48	61.28	77.40	61.80	89.47	60.69	80.89	82.86	**66**	**65**
23	100	100	41.32	41.87	36.87	33.84	35.38	34.19	23.40	26.68	36.60	35.66	40.79	50.52	36	35
24	100	100	43.27	41.93	32.36	33.70	37.24	34.80	27.76	27.72	31.92	44.71	41.98	53.56	38	37
25	100	100	47.95	51.28	42.01	42.14	47.67	46.40	40.60	40.11	43.74	52.73	46.60	56.31	**46**	**46**
26	100	92	42.26		41.23	37.14	39.50	35.01	37.16	33.22	40.80	41.73	49.52	56.87	**41**	**40**
27	100	100	39.66	36.01	36.13	44.76	46.02	43.19	39.17	32.94	41.20	46.48	63.16	59.35	**44**	**43**
28	100	100	21.47	24.12	18.64	15.66	17.63	17.00	12.17	13.81	17.14	21.74	27.14	31.13	20	21
29	100	100	35.91	34.44	31.18	26.17	32.67	30.71	25.26	21.24	28.94	37.90	42.26	45.88	33	32
30	100	92	31.33	35.67	35.42	27.04	33.75	28.80	19.52		28.30	38.21	43.52	47.94	34	33
31	100	100	66.31	58.86	50.62	49.82	52.56	49.03	45.32	43.92	59.81	50.10	58.13	75.30	**55**	**54**
32	100	100	69.69	72.42	62.76	34.31	71.95	68.09	57.67	61.11	70.08	64.84	73.44	82.21	**66**	**64**
33	100	100	58.07	70.42	62.18	62.70	61.80	61.50	49.91	51.73	56.61	68.79	72.88	66.44	**62**	**61**
34	100	100	37.03	43.38	38.29	33.30	32.77	32.32	29.51	31.30	30.96	37.43	46.39	50.70	37	36
35	100	100	51.46	55.62	40.33	40.15	45.74	38.16	42.15	40.42	53.78	40.66	48.62	60.10	**46**	**46**
36	100	92	47.17	51.79	51.63	37.18	58.79		38.75	41.42	48.89	57.65	62.32	63.92	**51**	**50**
37	100	100	26.54	26.15	21.86	19.18	22.53	19.68	36.87	16.37	20.38	25.71	30.25	34.40	23	25
39	100	100	53.78	59.11	53.82	52.55	54.14	51.32	55.70	55.04	59.24	58.95	59.59	65.87	**57**	**55**
40	100	92	46.40	47.07	38.99	44.83	44.18	41.72	43.94	40.07		48.32	51.57	56.07	**46**	**45**
41	100	100	43.20	45.33	37.03	32.53	38.20	37.47	34.20	32.62	38.82	38.96	45.33	51.51	**40**	39
42	100	100	43.11	53.82	47.55	79.89	99.38	90.96	106.90	100.95	112.78	80.65	93.03	99.05	**84**	**82**
43	100	100	91.93	87.59	70.88	84.81	89.97	73.13	97.10	76.64	95.13	77.07	84.53	106.41	**86**	**85**
44	100	100	45.41	47.13	40.44	35.04	42.07	35.14	36.10	35.62	42.42	44.04	54.87	55.19	**43**	**42**
45	100	100	39.97	40.81	33.46	35.08	35.34	32.16	35.46	30.05	40.82	36.27	44.41	53.77	38	37

47	*100*	*92*		36.26	32.98	31.82	31.73	28.92	25.50	27.37	30.90	39.10	42.84	42.24	*34*	*33*
48	*100*	*100*	45.47	43.16	40.42	33.20	35.60	37.52	36.85	35.83	46.60	40.72	47.75	60.54	***42***	***41***
49	*100*	*100*	44.51	47.09	59.80	37.24	51.09	40.92	31.78	34.82	40.79	44.57	58.36	53.82	***45***	***44***
50	*100*	*100*	54.27	60.60	50.93	48.11	64.71	49.62	52.15	55.66	56.55	58.38	60.57	67.28	***57***	***55***
51	*100*	*100*	36.04	36.13	30.65	27.42	32.11	28.71	25.15	24.27	31.69	33.53	41.83	47.98	*33*	*32*
52	*100*	*100*	53.82	61.90	57.65	48.23	62.41	62.25	49.17	47.62	60.40	66.28	60.14	70.30	***58***	***57***
54	*100*	*92*	54.72	53.86	44.49	40.19	47.24	47.02	49.22	46.99		51.44	61.13	72.28	***52***	***51***
55	*100*	*100*	53.82	58.66	47.85	49.99	49.24	48.38	43.84	40.52	49.15	48.15	59.50	63.05	***51***	***50***
56	*100*	*92*	38.89	45.74	41.64	44.11	56.90	53.66	54.17	49.84	52.40		70.70	63.47	***52***	***51***
57	*100*	*100*	40.73	45.62	35.15	49.01	38.62	41.95	37.98	36.30	42.91	52.70	60.12	61.74	***45***	***44***
58	*100*	*92*	49.04	48.50	47.25	39.74	45.59	52.27	48.36	46.46		56.43	63.77	60.67	***51***	***50***
59	*100*	*100*	39.86	49.61	42.93	36.26	47.89	45.54	36.11	37.61	45.19	49.01	53.60	51.60	***45***	***44***
60	*100*	*100*	30.31	30.59	29.39	24.99	29.12	24.85	23.78	22.53	29.69	31.75	36.00	40.50	*29*	*29*
61	*100*	*100*	54.14	56.23	47.07	45.31	44.74	51.51	42.84	42.83	47.98	46.37	56.72	62.13	***50***	***49***
62	*100*	*100*	55.25	51.51	48.71	46.35	55.13	47.66	46.06	49.67	52.47	52.76	54.04	63.32	***52***	***51***
63	*100*	*100*	45.67	42.91	39.87	36.84	36.61	41.76	31.61	28.60	43.62	44.04	50.00	57.79	***42***	***41***
64	*100*	*100*	50.96	57.55	56.12	52.85	55.79	43.24	36.40	55.48	54.91	58.66	60.74	61.83	***54***	***53***
65	*75*	*75*	not open	not open	not open	64.26	79.50	44.20	71.68	91.67	82.52	87.35	81.74	87.80	***77***	***75***
66	*75*	*75*	not open	not open	not open	46.86	48.77	33.35	56.49	45.74	53.72	46.16	54.39	63.74	***50***	***49***
Rut 01	*100*	*100*	47.94	44.93	41.36	46.57	50.35	49.49	41.59	51.98	59.64	49.69	70.86	63.66	***52***	***50***
Rut 02	*100*	*92*	80.95	93.11	80.62	89.41	90.24	99.22	113.15	106.90	108.33	105.50		107.34	***98***	***96***

Exceedance of the NO_2 annual mean AQO of 40 μgm^{-3} are shown in **bold**.

[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%)

[c] Means should be "annualised" in accordance with LLAQM Technical Guidance, if valid data capture is less than 75%

[d] The bias adjustment factor used for all roadside/kerbside sites is 0.98 which is calculated using the Castlenau site. The bias adjustment factor for both background sites is 1.08 calculated using Wetlands