# London Borough of Richmond upon Thames Air Quality Annual Status Report for 2017
# Date of publication: 30th May 2018

This report provides a detailed overview of air quality in the London Borough of Richmond Upon Thames during 2017. It has been produced to meet the requirements of the London Local Air Quality Management statutory process[1].

[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

**Contact details**

| | |
|---|---|
| **Local Authority Officer** | Mrs Carol Lee |
| **Department** | Pollution Team |
| **Address** | Civic Centre, York Street, Twickenham, TW1 3BZ |
| **Telephone** | 0208 891 7729 |
| **e-mail** | carol.lee@richmond.gov.uk |
| **Report Reference number** | Richmond_ASR_2018 |
| **Date** | 30th May 2018 |

# 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 2017 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 2017 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. All complied with EU limit values for a minimum of 3 years pre cessation.

### 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 three 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 have a mobile Air Quality monitoring unit, which was stationed at Chertsey Road throughout 2017. Results are included in this report.

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 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 2017**

| 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 |
| **RHG** | **Mobile** Air Quality Unit, Chertsey Rd,TW2 | 515354 | 173994 | Roadside | Y | 2.3m | 1.6m | 2.9m | NO2, PM10 | 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 2017. Three of the diffusion tubes sites are triplicate and collocated with all 3 Council automatic monitoring sites.

**Table C. Details of Non-Automatic Monitoring Sites for 2017**

| 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. Woffington Close) | 517266 | 170031 | kerbside | Y | 0.7m | 6.5m | 2.2m | NO2 | N |
| 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 Hill Pk) | 517197 | 173939 | kerbside | Y | 0.6m | 1.8m | 2.2m | NO2 | N |
| 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) | 521211 | 175457 | 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 |
| 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 | Nr 361 Upper Richmond Road West(URRW | 520540 | 175399 | kerbside | Y | 0.9m | 2.2m | 2.2m | NO2 | N |
| 37 | Wetlands, Barnes (static site) | 522989 | 176727 | urban backgro und | 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 | 520495 | 175360 | 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) | 520492 | 175695 | 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, | 519793 | 176142 | kerbside | Y | 0.6 | 4.1 | 2.2m | NO2 | N |
| 56 | A316 (St Magarets) | 516788 | 174519 | kerbside | Y | 1.0m | 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 |
| 67 | Petersham Rd opp Poppy Factory, | 518042 | 174095 | roadside | Y | 1.4m | 2.7m | 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 |

**Sites changes for 2017: sites 25, 36, 49, 51, 56 moved slightly ( < 20m) largely in response to residents requests for marginally better monitoring locations; all grid references correct for 2017. Site 30 was closed and site 67 was opened.**

### *1.2 Comparison of Monitoring Results with AQOs*

The results presented are after bias adjustment and "annualisation" where required (not required in LBRuT for 2017 see Appendix A).

**Table D. Annual Mean NO2 Ratified and Bias-adjusted Monitoring Results (□g m-3)** For results that indicate the exposure estimate, calculated for the nearest residential façade see **Appendix A3**.

| Site ID | Site type | Valid data capture for monitoring period % | Valid data capture 2017 % | Annual Mean Concentration (µgm$^{-3}$) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Castelnau** Library, Barnes (RI1) | Roadside | 100% | 99% | 39 | 37 | 39 | 37 | 34 | 36 | 31 |
| **Wetlands** Centre, Barnes (RI2) | Suburban | 100% | 100% | 26 | 25 | 24 | 25 | 21 | 25 | 21 |
| **Mobile-** Chertsey Rd, TW2 (RHG) | Roadside | 100% | 84% | **48** | **44** | **43** | **42** | N/A | N/A | 37 |
| **NPL -** Teddington AURN (TD0) | Suburban | N/A | N/A | 21 | 36 | 21 | 27 | 19 | 22 | N/A |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Roadside | 100 | 92 | **44** | **45** | **47** | **49** | **41** | **56** | **55** |
| 2 | Roadside | 100 | 100 | 31 | 34 | 32 | 33 | 28 | 31 | 29 |
| 3 | Roadside | 100 | 100 | 35 | **44** | **44** | **44** | **41** | **42** | 39 |
| 4 | Kerbside | 100 | 92 | 38 | **44** | **44** | **44** | 36 | **40** | 36 |
| 5 | Kerbside | closed | closed | 32 | 33 | closed | closed | closed | closed | closed |
| 6 | Kerbside | 100 | 100 | 34 | **43** | **43** | **41** | 36 | 37 | 30 |
| 7 | Kerbside | 100 | 100 | **49** | **59** | **61** | **54** | **47** | **49** | **43** |
| 8 | Kerbside | closed | closed | 30 | 34 | closed | closed | closed | closed | closed |
| 9 | Kerbside | 100 | 100 | **47** | **50** | **49** | **48** | **42** | **45** | **40** |
| 10 | Kerbside | 100 | 100 | **36** | **44** | **46** | **47** | **43** | **44** | **42** |
| 11 | Kerbside | 100 | 100 | **46** | **54** | **49** | **48** | **44** | **48** | **47** |
| 12 | Kerbside | 100 | 100 | **41** | **45** | **49** | **46** | **41** | **45** | **41** |
| 13 | Kerbside | 100 | 100 | **42** | **48** | **48** | **47** | **42** | **42** | **40** |
| 14 | Kerbside | 100 | 100 | 38 | **48** | **46** | **45** | 39 | **40** | 36 |
| 15 | Kerbside | 100 | 100 | **41** | **44** | **40** | 40 | 37 | **41** | 38 |
| 16 | Roadside | 100 | 100 | 38 | **45** | **44** | **43** | 41 | **42** | 38 |
| 17 | Kerbside | 100 | 100 | **65** | **70** | **68** | **68** | **63** | **69** | **60** |
| 18 | Kerbside | 100 | 100 | **66** | **68** | **71** | **66** | **67** | **56** | **58** |
| 19 | Kerbside | 100 | 100 | **50** | **56** | **53** | **55** | **48** | **49** | **49** |
| 20 | Kerbside | 100 | 100 | **40** | **53** | **51** | **55** | **48** | **47** | **45** |
| 21 | Roadside | 100 | 92 | 39 | **43** | **44** | **41** | 37 | 39 | 36 |
| 22 | Kerbside | 100 | 100 | **46** | **51** | **57** | **59** | **53** | **65** | **52** |
| 23 | Roadside | 100 | 100 | 35 | 38 | 39 | 38 | 35 | 35 | 35 |
| 24 | Kerbside | 100 | 100 | 36 | **40** | **40** | **40** | 35 | 37 | 34 |
| 25 | Roadside | 100 | 100 | 32 | **47** | **51** | **51** | **45** | **46** | 38 |
| 26 | Roadside | 100 | 92 | **40** | **42** | **43** | **42** | **40** | **40** | 36 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | Roadside | 100 | 100 | 38 | **41** | **40** | 38 | 37 | **43** | **41** |
| 28 | Urban background | 100 | 100 | 20 | 22 | 21 | 18 | 17 | 21 | 17 |
| 29 | Kerbside | 100 | 92 | 37 | **43** | 39 | 36 | 30 | 32 | 30 |
| 30 | Roadside | 100 | 92 | 33 | 36 | 38 | 34 | 29 | 33 | closed |
| 31 | Roadside | 100 | 100 | **50** | **59** | **61** | **62** | **54** | **54** | **52** |
| 32 | Roadside | 100 | 100 | **75** | **77** | **74** | **73** | **62** | **64** | **59** |
| 33 | Kerbside | 100 | 100 | **47** | **58** | **62** | **69** | **61** | **61** | **53** |
| 34 | Roadside | 100 | 100 | 36 | 39 | 38 | 40 | 33 | 36 | 35 |
| 35 | Roadside | 100 | 100 | **46** | **50** | **52** | **48** | **43** | **46** | **45** |
| 36 | Roadside | 100 | 92 | **46** | **54** | **56** | **56** | **49** | **50** | **60** |
| 37 | Urban background | 100 | 100 | 26 | 25 | 25 | 22 | 21 | 25 | 20 |
| 38 | Kerbside | closed | closed | 35 | closed | closed | closed | closed | closed | closed |
| 39 | Kerbside | 100 | 100 | **58** | **62** | **56** | **56** | **52** | **55** | **52** |
| 40 | Kerbside | 100 | 92 | 37 | **43** | **41** | **40** | 36 | **45** | **42** |
| 41 | Kerbside | 100 | 100 | 38 | **45** | **42** | **41** | 38 | 39 | 36 |
| 42 | Roadside | 100 | 100 | **53** | **56** | **58** | **54** | **47** | **82** | **89** |
| 43 | Kerbside | 100 | 100 | **74** | **78** | **87** | **80** | **80** | **85** | **78** |
| 44 | Kerbside | 100 | 100 | **42** | **46** | **45** | **45** | 39 | **42** | **41** |
| 45 | Kerbside | 100 | 100 | **44** | **43** | **48** | **45** | 35 | 37 | 35 |
| 46 | Kerbside | closed | closed | 36 | **41** | closed | closed | closed | closed | closed |
| 47 | Roadside | 100 | 92 | 33 | **40** | 40 | 37 | 32 | 33 | 31 |
| 48 | Roadside | 100 | 100 | **43** | **42** | 45 | **45** | 39 | **41** | **40** |
| 49 | Kerbside | 100 | 100 | 39 | **47** | 45 | **45** | 39 | **44** | 31 |
| 50 | Kerbside | 100 | 100 | **49** | **63** | **61** | **60** | **57** | **55** | **53** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 51 | Kerbside | 100 | 100 | 32 | 36 | 34 | 34 | 28 | 32 | 35 |
| 52 | Kerbside | 100 | 100 | **52** | **59** | **59** | **62** | **55** | **57** | **50** |
| 53 | varies | 100 | N/A | **51** | **46** | **48** | **48** | N/A | N/A | **44** |
| 54 | Roadside | 100 | 92 | **44** | **55** | **54** | **56** | **51** | **49** | **48** |
| 55 | Roadside | 100 | 100 | **41** | **48** | **52** | **55** | **50** | **50** | **45** |
| 56 | Kerbside | 100 | 92 | 35 | **41** | **46** | 38 | 37 | **51** | **50** |
| 57 | Kerbside | 100 | 100 | 24 | 38 | 39 | 36 | 33 | **44** | **42** |
| 58 | Kerbside | 100 | 92 | **43** | **52** | **58** | **50** | **46** | **50** | **47** |
| 59 | Kerbside | 100 | 100 | Not open | **44** | **46** | **42** | **40** | **44** | 39 |
| 60 | Kerbside | 100 | 100 | Not open | **40** | 32 | 32 | 27 | 29 | 29 |
| 61 | Roadside | 100 | 100 | Not open | **55** | **58** | **54** | **48** | **49** | **45** |
| 62 | Kerbside | 100 | 100 | Not open | Not open | **54** | **52** | **46** | **51** | **50** |
| 63 | Kerbside | 100 | 100 | Not open | Not open | **43** | **42** | 38 | **41** | 38 |
| 64 | Kerbside | 100 | 100 | Not open | Not open | **54** | **60** | **55** | **53** | **49** |
| 65 | Kerbside | 100 | 75 | Not open | Not open | Not open | Not open | Not open | **75** | **68** |
| 66 | Kerbside | 100 | 75 | Not open | Not open | Not open | Not open | Not open | **49** | **49** |
| 67 | Kerbside | 100 | 92 | Not open | Not open | Not open | Not open | Not open | Not open | **44** |
| Rut 01 | Kerbside | 100 | 100 | **48** | **53** | **60** | **56** | 45 | **50** | **51** |
| Rut 02 | Kerbside | 100 | 92 | **93** | **95** | **94** | **88** | **88** | **96** | **82** |
| RUT 03 | Background | closed | closed | 26 | closed | closed | closed | closed | closed | closed |
| RUT 04 | Background | closed | closed | 29 | closed | closed | closed | closed | closed | closed |

Notes: Exceedance of the $NO_2$ annual mean AQO of 40 μgm$^{-3}$ are shown in **bold (pink/red)**.
$NO_2$ 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(red).
The bias adjustment factor used for all roadside/kerbside sites is 0.97 calculated using the national Gradko bias adjustment figure for 50%TEA/ACETONE.. The bias adjustment factor for background sites 28 and 37 is 1.00 calculated using the Wetlands site.
In 2015 the taxi rank was moved from outside Richmond station to opposite Richmond station. 6/1/16 site 42 moved along Quadrant from near bus stops to near new taxi rank
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. Please see our 2016 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 2011 to 2017. (Note – see Table N for monthly data for 2017 and Table K for the distance corrected). The results in bold(pink/red) indicate an exceedance of the annual mean objective of 40 μg m-3 and the results underlined (red) 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 97.5%. 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; 3 of these were triplicates, co-located next to real time analysers. The results from the 2017 monitoring show that the objective of 40 μg m-3 was exceeded at 40 sites. Six 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 a slight decrease compared to the2016 data, the highest exceedence at any site has also decreased ( 96 ug/m3 in 2016; 89 ug/m3 in 2017) . This is encouraging. However it is too early to be sure of a downward trend in levels of NO2. There has been very little change in levels of NO2 over the last seven years in the London Borough of Richmond Upon Thames. 2011, 2015 and 2017 saw slightly lower levels but overall at most sites across the borough there is no significant trend either upwards or downwards; levels of NO2 have remained fairly static. As is well known, Euro VI/6 standards have failed to deliver the forecast reductions in NO2 levels in real world driving conditions that were predicted. The sale of diesel cars has seen a significant reduction over the last 18 months but the rental market for diesels remains buoyant and the number of vehicles on the road has continued to increase; this has hindered reductions in NO2. The LEZ, which has

encouraged the use of Euro 4 or better for commercial vehicles , applicable along the A316, does seem to have resulted in some benefits indicated by slightly lower trend data at site 18 and site 31 and also slight reductions since 2016 at sites 56 and 57 (NO2 diffusion tubes at both sites were moved slightly nearer the A316 on 2/1/16).. George Street Richmond, which has recorded the highest exceedance each year since the site began, has shown a decrease in 2017. The highest exceedance for 2017 was opposite Richmond station, The Quadrant Richmond, which is probably more a result of the new road layout, moving the taxi rank across the road. New hybrid buses have been introduced during 2017 on routes R68, R70 and 285. All sites along these routes show a small decrease – site 64 in Hampton Hill and site 45 and 7 in Teddington are particularly affected, as these routesform a significant part of the bus fleet for these areas. To some extent sites in Richmond and Twickenham also benefit but these areas are served by more routes, so this is less significant. This is encouraging and we will continue to monitor progress. The borough has lobbied the mayor for swifter upgrades across the fleet.

The data for 2017 indicates that approximately two thirds of the sites exceed the objective of 40 μg m-3 with 2 sites recording at least double the objective. After the distance correction, the annual mean objective is exceeded at 31 sites, with 6 of them exceeding the annual mean concentration of 60 μg m-3. These sites are

Site 42 -The Quadrant, Richmond (89μg m-3 )

Site Rut 2 - George Street, Richmond (82 μg m-3 )

Site 43 - Hill Street, Richmond (78μg m-3 )

Site 65 - York Street, Twickenham (68μg m-3 )

Site 17 - Red Lion Street, Richmond (60 ug/m3)

Site 36 - near 361 Upper Richmond Rd West, East Sheen (60μg m-3 )

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.

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 2017 (split over 2 graphs)**

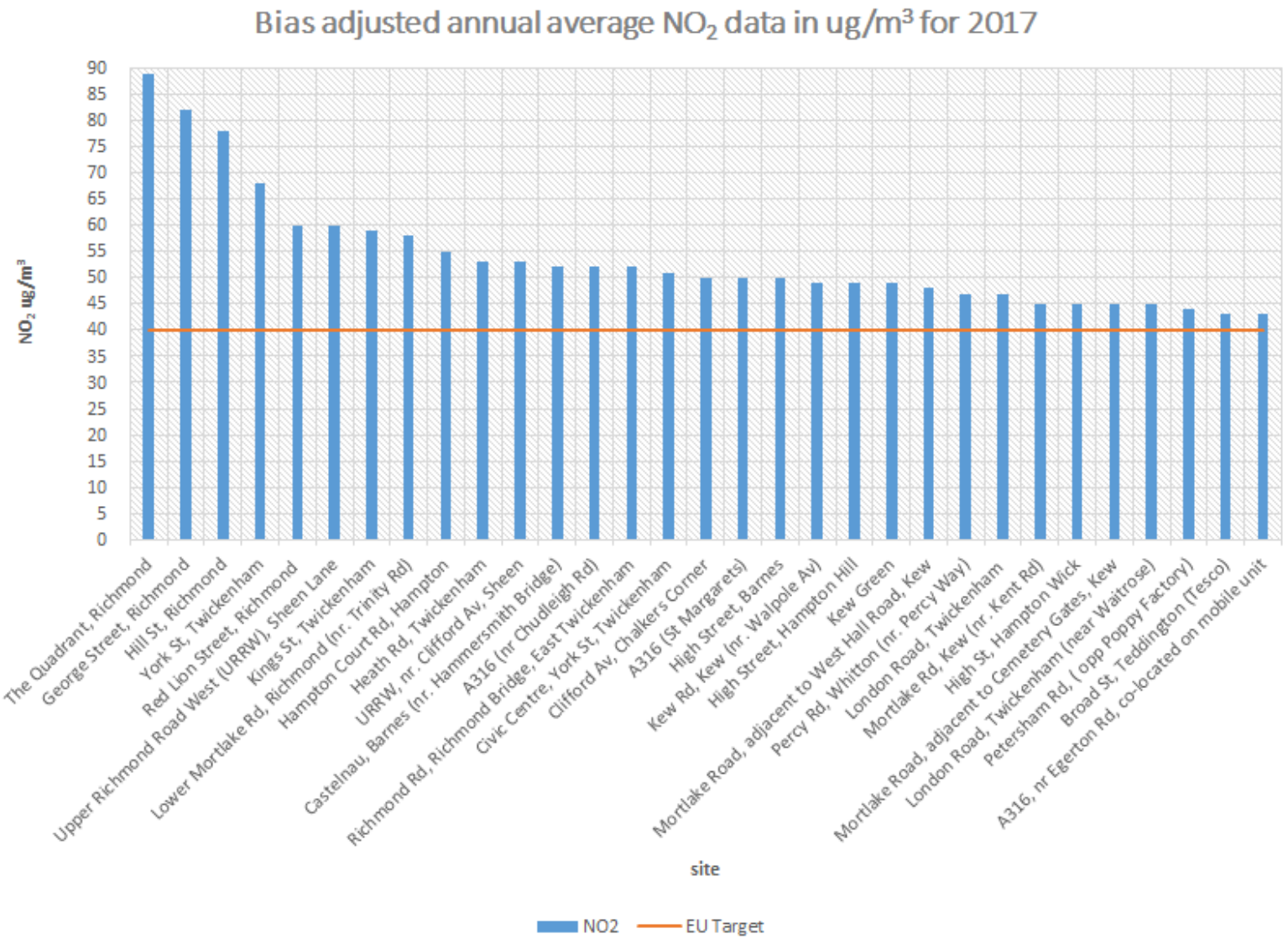

**Figure 1: Nitrogen Dioxide Bias Adjusted Annual Average Concentrations for all sites for 2017 (split over 2 graphs)**

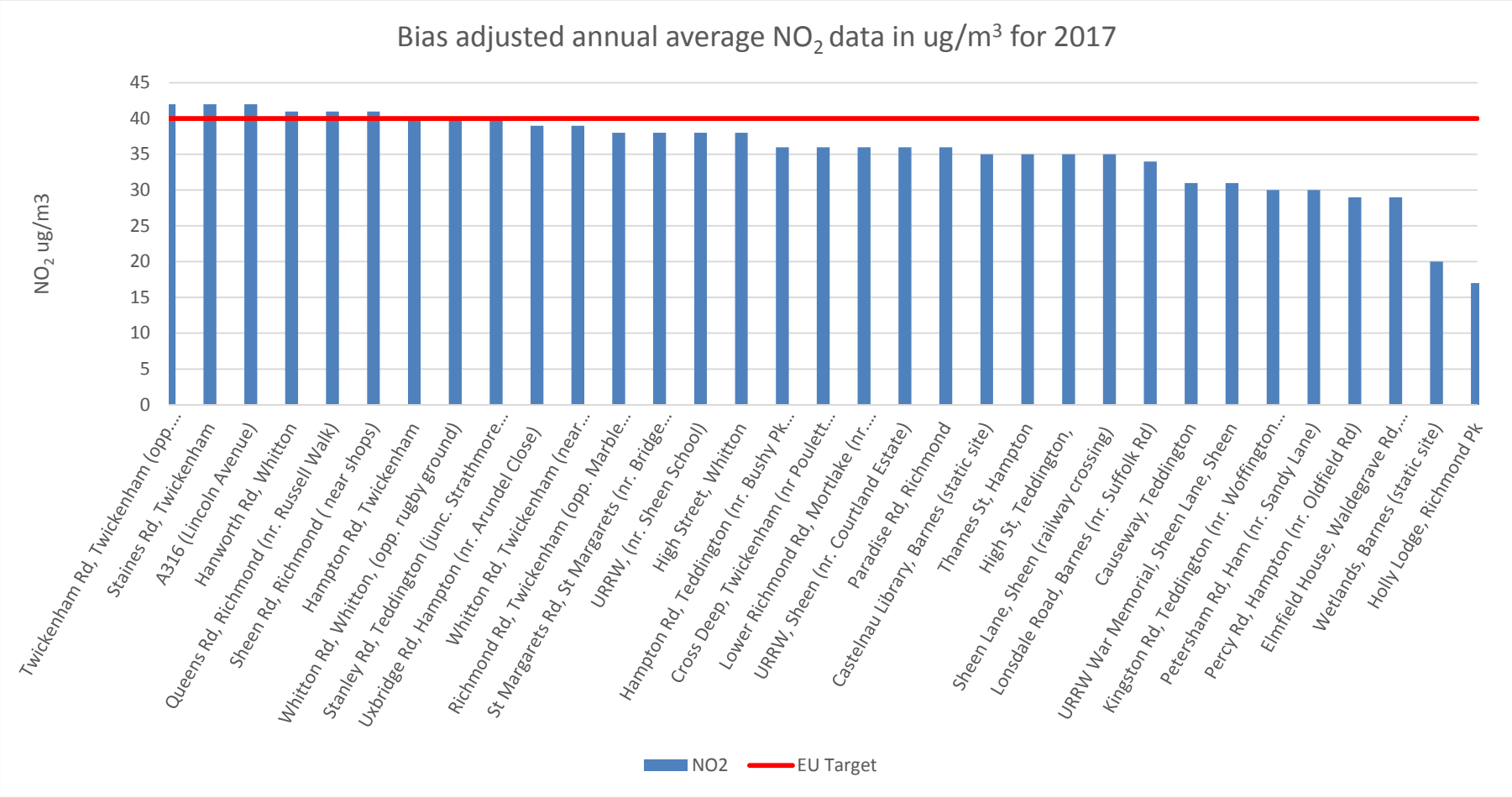

**Table E. $NO_2$ Automatic Monitor Results: Comparison with 1-hour Mean Objective**

| Site ID | Valid data capture for monitoring period % | Valid data capture 2016 % | Number of Hourly Means > 200 $\mu gm^{-3}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Castelnau** Library, Barnes (R1) | 100 | 99 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| **Wetlands** Centre, Barnes (R2) | 100 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Mobile-** Chertsey Rd, TW2 (RHG) | 100 | 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Notes: Exceedance of the $NO_2$ short term AQO of 200 $\mu gm^{-3}$ 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 2017 is fully ratified. The Mobile Air Quality Unit was located at Chertsey Rd, Twickenham throughout 2017. Data has therefore been included in this report.

The 2017 $NO_2$ data capture for Castlenau and Wetlands was very good, representing 99% data capture for the RI1 (Castelnau), and 100% for RI2 (Wetlands) The 2017 $NO_2$ data capture for the Mobile was good, representing 84% data capture Loss of data was due to equipment failure and lack of available spare parts.

Table D provides the 2017 results of the $NO_2$ automatic monitoring and a comparison with the annual mean objective.

The 2017 results show that all three sites met the objective of 40 $\mu g\ m^{-3}$. The 2017 annual mean for the RI2 (Wetlands) was 21 $\mu g\ m^{-3}$ This site is a background sites and therefore representative of low pollution in the Borough. The annual mean at the RI1 (Castelnau) and RHG Mobile site on Chertsey Rd, Twickenham, both roadside sites was 31 $\mu g\ m^{-3}$ and 37 $\mu g\ m^{-3}$ respectively. There does seem to be a very slight downward trend at all sites. It should be noted for Castlenau site that from Saturday 28 May 2016 and throughout 2017 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. HGV's are also limited – the bridge has 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. 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, following discussions with the Council and Kings College London, for data continuity and trend data purposes, it has been decided to leave it in situ. This will be reviewed annually.

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 F. Annual Mean $PM_{10}$ Automatic Monitoring Results ($\mu g\ m^{-3}$)**

| Site ID | Valid data capture for monitoring period % [a] | Valid data capture 2017 % | Annual Mean Concentration ($\mu gm^{-3}$) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Castelnau** Library, Barnes (RI1) | 100 | 99 | 23 | 21 | 22 | 20 | 22 | 20 | 18 |
| **Wetlands** Centre, Barnes (RI2) | 100 | 95 | 22 | 18 | 20 | 18 | 17 | 16 | 15 |
| **Mobile-** Chertsey Rd, TW2 (RI2) | 100 | 81 | 27 | 24 | 25 | N/A | N/A | N/A | 18 |

Notes: Exceedance of the $PM_{10}$ annual mean AQO of 40 $\mu gm^{-3}$ are shown in **bold**.
In 2014, 2015 and 2016 the mobile was sited at more than 1 site. Annual data is therefore not available.

**$PM_{10}$**

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 2011 to 2017 inclusive. The data for each year is fully ratified.

PM10 measurement was undertaken at three sites and the data capture was good. In 2017 the RI1 Castelnau site achieved 99% , the RI2 Wetlands site achieved 95% and the RHG mobile site achieved 81%.

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 2017 annual mean for PM10 at both the roadside site in Castlenau Barnes and at the background site at the Wetlands Centre in Barnes was fractionally lower than in the last seven years. The background site in particular has gone down slightly each year for the last 4 years. This is encouraging and appears to be a slight gradual downward trend. It is however only fractional and may creep up again slightly in future years, so we need to keep an eye on this. Likewise the roadside site at Castlenau does appear to be going down gradually. We will reassess this in next years' report to see whether levels are really falling. The level at the Mobile should not be compared with former years as the site moves year on year. It is however encouraging to see that this busy roadside site on the Chertsey Rd, A316, Twickenham recorded 18μg m-3. This means all sites meet both the EU limit value ( 40 μg m-3)and the much stricter WHO guidelines ( 20 μg m-3) for PM10. This is reassuring. Modelling does however indicate there are some exceedences on some sections of major roads within the borough, so vigilance is required.

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 all the last 4 years 2014, 2015, 2016 and 2017 and as a trend does appear to be falling gradually and not returning to pre 2011 levels.

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 2017 % | Number of Daily Means > 50 $\mu gm^{-3}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Castelnau** Library, Barnes (RI1) | 100 | 98 | 15 | 14 | 10 | 4 | 5 | 7 | 4 |
| **Wetlands** Centre, Barnes (RI2) | 100 | 87 | 17 | 13 | 6 | 3 | 1 | 3 | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Mobile-** Chertsey Rd (RHG) | 100 | 81 | 12 | 10 | 8 | N/A | N/A | N/A | 1 |

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 2017 % | Annual Mean Concentration (µg$m^{-3}$) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **NPL Bushy Park, Teddington (TD5)** | 100 | 94 | 17.5 | 11.5 | 16.7 | N/A | N/A | N/A | 10 |

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

Table H provides results of automatic monitoring of PM2.5 by NPL in Bushy Park and a comparison with annual mean objective. The objective of 25 µg m-3 was met for every year reported. The data capture was good (94%) but the data for 2017 is not fully ratified so should be treated with caution. 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.

## 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.<br>Political leadership changed in the May 2018 Council elections<br>The new administration pledged strong support for air quality in their manifesto.. This will be reported in 2019. Richmond 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 has redrafted an AQAP for 2018-23 to represent the importance of air quality to the borough and focus on our priorities. This has been consulted on and amendments returned to Scrutiny Committee . It was awaiting final sanction by the Directors prior to the elections. The new administration will review the AQAP and may resubmit for a new consultation. |
| **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 | Our Cleanerair4schools project, funded through MAQF finished in 2017.<br>We have continued working with schools through a new project which looked 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 was report directly back to the AQ Scrutiny Committee and resulted in a number of recommendations for protecting the boroughs school children. |

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| | | | | We have also been working with the Mayor's school audit team and have match funded a Mayor's recommendation for a new acoustic fence and green wall at East Sheen Primary School, which should be completed around June 2018. This will help protect students from pollution from the South Circular, directly outside their playground.<br><br>The cycle strategy was adopted and published in 2017. The final consultation of Quietway 21 was completed. Cycle parking is ongoing. Talks about Richmond cycle hub were initiated. The Council is working on all aspects of the cycle programme to ensure successful delivery in 2018/19 and have firm ambitions for the borough<br><br>Electric Vehicle Charging Strategy adopted in November 2016, setting out proposals to add over 200 new charge points in the borough across 80 locations by 2025/26 to encourage take-up of electric cars in the borough. 8 lamp column chargers were installed in residential roads in 2017 to allow overnight charging for residents with no off-road parking available.18 more are planned plus additional rapid and fast chargers for 2018. |
| | **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.<br><br>We have developed London Wide NRMM guidance for Planners and EH professionals<br><br>Through the Cycling and business engagement project we continue to work closely with businesses to develop pollution free cycling Maps for the borough.<br><br>Following a trial of retiming of deliveries to off peak periods in 2016, this became permanent in 2017 in St Margarets. This will be considered for |

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| | | | | extension to other town centres in 2018. |
| | **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. Chalkers Corner is being reviewed as part of the Stag Brewery planning application in 2018. 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. Recommendations from the Mayor's AQ audit for schools will be reviewed and assessed in 2018. |
| **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. |

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| | | | | 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<br><br>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** | Collect s106 from new developments to ensure air quality neutral development, ***where possible*** | y | The borough is 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.<br><br>LBRuT joined Maoy's idling action campaign in 2017 and hosted 3 very successful events in Feb/March 2018 around achools and level crossings. More events are planned for later in 2018. 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 |

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| | | | | quality. |

## 2.1 Air Quality Action Plan Progress

Table K provides a brief summary of Richmond's progress against the Air Quality Action Plan in place throughout 2017.

An updated draft AQAP was produced and went out for public consultation in September 2017. It was referred back to Scrutiny Committee and amended before being approved by members in Spring 2018. Due to the imminent Council elections and the Purdah period it was decided to wait until after the elections to approve. The May elections have resulted in a change of leadership. The new Council want to review and possibly amend/re-consult on the AQAP. The new AQAP will cover the period from 2018 – 2023 and will reflect changes in air quality policy and probably identify specific measures to tackle pollution in the AQ Focus Areas and local 'hot-spots' within the borough. It includes 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..

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 , the Director of Environment and Cabinet members. Adopted measures will include Key Performance Indicators wherever possible and will be reported in the 2019 Annual Status Report.

**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<br><br>Following public consultations in 2016 the Mayor has announced the<br><br>Introduction of the T (toxicity) charge in the central congestion charging zone in October 2017<br><br>Further consultations in 2016 and 2017 have been organized regarding the introduction of a new ULEZ for central London and possibly Greater London. | The LEZ has forced the most polluting commercial diesel vehicles driving in London to become cleaner.<br><br>The introduction of the T charge in 2017 and the ULEZ in 2019 will help further.<br><br>The Council has actively taken part in all 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 Heathrow Airport Ltd to take action to reduce emissions at Heathrow from surface access traffic, site traffic, | The topic of poor air quality continues to be of supreme concern with the evidence that many thousands of people will experience worse air pollution due to increases in air traffic and | Our concern remains that the use of an extra runway together with 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 |

| Measure | Action | Progress | Further information |
|---|---|---|---|
| | aircraft and other sources. | airport related road traffic. | emissions. We oppose any increase in airport capacity which is 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 Emission Capable taxis only ( ZEC) have been registered from 1st January 2018.<br>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 by lobbying TfL | Areas with a concentration of buses and taxis should obtain a significant local benefit. |
| 4 | Lobby the Mayor to achieve London-wide improvements for pedestrians, cyclists and public transport where there will be local benefits. | Through the 2017 LIP Funding process we have delivered a number of successful cycling, walking & bus schemes.<br>LBRUT engaged in joint projects with Network Rail to identify additional cycle parking at stations throughout 2017.LBRuT have initiated | A new cycle strategy was adopted and published in 2017<br>A Brompton docking station for Twickenham was planned for 2017. It was installed in 2018 with a view to installing a similar one for Richmond. |

| Measure | Action | Progress | Further information |
|---|---|---|---|
| | | talks with SW Trains for a Richmond cycling hub<br><br>3 cycle hangars were installed in the Borough in 2016, talks continued in 2017 with a view to installing 10 more in 2018<br><br>Paving was completely renewed in Hampton Hill High St in 2017 providing improved facilities for pedestrians .<br><br>Routes R68, R70 and 285 were all upgraded to new hybrid buses with automatic cut outs in 2017 | The delivery of Quietway 21 from Teddington to Ham will be delivered by December 2018.<br><br>A feasibility study for a second Quiet way will be undertaken in 2018. |
| 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.<br><br>One of the most important developments is the setting up and running of EV charge points by Source London.<br><br>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 lamp column mounted | 10 x trickle charge ubitricity lamp column chargers were installed in LBRuT in 2017. Rapid chargers were installed on the A316 .More trickle chargers, plus intermediate Source London chargers are planned for 2018. |

| Measure | Action | Progress | Further information |
|---|---|---|---|
| | | chargepoints to allow overnight charging in residential areas for residents with no off-road parking was introduced in 2017 available through LBRuT website delivered by ubitricity. | |
| 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 14 LA's. In 2017 they visited 250 development sites.<br><br>Joint working with both South and West London authorities is ongoing and resulted in the Clean air4schools program funded by the MAQF This was continued by Officers, in house, in LBRUT in 2017 | LBRUT and LB Merton will continue to lead the NRMM program in 2018. 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.<br><br>LIP funding continued to support an Air Quality awareness program with schools in 2017 which included members of the community |

B BOROUGHWIDE MEASURES

| Measure | Action | Progress | Further information |
|---|---|---|---|
| 8 | Continue to pursue land use policies within the saved UDPand 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<br><br>.An updated draft AQAP was produced and went out for public consultation in Sept 2017. It was amended in 2018 and is awaiting review/adoption by the new administration. A new Air Quality SPD was produced in 2017 and is also awaiting review/adoption by the incoming administration. | The draft AQAP covers the period from 2018 – 2023 and reflects changes in air quality policy and identifies specific measures to tackle pollution in the AQ Focus Areas and local 'hot-spots' within the borough. It includes 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. It will be reviewed by the new administration in 2018 |
| 11 | Promote the Council Travel Plan for the Council employees | Throughout 2017 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 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. | The Council continues to promote healthier travel habits for its staff, including walking, cycling and using public transport which will help reduce emissions.<br><br>. |

| Measure | Action | Progress | Further information |
|---|---|---|---|
| 12 | Promote Travel Plans for schools<br>Encourage both public and private sector schools to adopt school travel plans and associated walking and cycling initiatives<br>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.<br>We provide a Junior Citizenship week twice a year which includes promoting walking, cycling and public transport.<br>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... | Support for cycle and scooter training is ongoing and strongly supported by LBRuT.<br>LBRuT 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. |
| 16 | To continue to press for and promote travel choice through improvements for pedestrians, cyclists and 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.<br>Please see measure 4 for cycle and pedestrian improvements. | Sustainable travel choices are promoted through the planning process.<br>Many ongoing cycle projects to improve cycle facilities and increase a modal shift towards cycling were initiated and supported throughout 2017 and are planned for 2018. (Please see measure 4) |

| | | | |
|---|---|---|---|
| 21 | Concern for low emission vehicles to be used on Council | Euro emissions on all fleet vehicles are | |

| | | | |
|---|---|---|---|
| | 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 IV or above.<br><br>All contractor vehicle emissions are controlled through procurement. | |
| 24 | To continue to promote the Council's 'Smoke Control Zone' | An awareness raising campaign on correct fuels to burn in smoke control areas was launched in Feb/March 2017 and was repeated again in January 2018.Guidance is given about smoke control on the Council's website A bid was submitted to Defra for a more substantial smoke control campaign but was unsuccessful. | 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 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.<br><br>The Council introduced new rules for bonfires on all Council allotments from 1/3/17 limiting bonfires from March – September to one bonfire a month on one | Poor air quality due to bonfires may be very localised but can cause considerable distress to neighbours and is actively addressed. |

| | | | |
|---|---|---|---|
| | | specific morning Composting or Council green waste collection is encouraged as an alternative | |
| 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.<br><br>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 2017 there were 71 car club bays in operation. |

C. LOCAL MEASURES

| Measure | Action | Progress | Further information |
|---|---|---|---|
| 29 | Refuse planning consent for activities, which are | All major planning applications are considered for air quality impacts and conditioned for required | Following the elections in May 2018, LBRuT has changed political |

| Measure | Action | Progress | Further information |
|---|---|---|---|
| | likely to lead to a significant worsening of air pollution in 'hot spot' areas. | mitigation. Section 106 monies are requested. Consideration is also given to the cumulative effect of nearby developments.<br><br>A draft Air Quality Special Planning Document is awaiting approval.<br><br>Biomass and CHP are generally discouraged. | administration. It is hoped that robust procedures for planning applications will be in place by Dec 2018 in line with our new Local Plan |
| 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 2017/18.<br><br>EVCP required for new conference space for RFU planning application received in 2016, progressing in 2017 | 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 2017 to ensure continued monitoring of no idling by coaches. | Summer of 2017 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 K. Planning requirements met by planning applications in the London Borough of Richmond Upon Thames in 2017**

| Condition | Number |
|---|---|
| Number of planning applications where an air quality impact assessment was reviewed for air quality impacts | *122* |
| Number of planning applications required to monitor for construction dust | 26 |
| 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 | 14 |
| Number of developments requested to install Ultra-Low $NO_x$ boilers | 122 |
| Number of developments where an AQ Neutral building and/or transport assessments undertaken | |
| Number of developments where the AQ Neutral building and/or transport assessments not meeting the benchmark and so required to include additional mitigation | 26 |
| 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**<br>Number of conditions related to NRMM included.<br>Number of developments registered and compliant.<br>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. | Not applicable |
| **NRMM: Greater London (excluding Central Activity Zone and Canary Wharf)**<br>Number of conditions related to NRMM included.<br>Number of developments registered and compliant.<br>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. | During 2017 NRMM conditions were applied at all planning sites. LB Richmond and LB Merton undertook NRMM site visits:<br>**2 registered/ fully compliant**<br>**0 registered / actively working towards** |

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 have drafted an SPD for Air Quality planning conditions which will be adopted following the AQAP.

### *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).

**Factor from Local Co-location Studies**

No co-location studies were possible in Merton in 2017 due to intermittent faults with the NO2 analyser.

**Discussion of Choice of Factor to Use**

Due to lack of local co-location studies, the Gradko Laboratories 50% TEA national correction factor has been used to bias adjust all $NO_2$ diffusion tubes. For 2017 the correction factor was 0.97

### *A.3 Adjustments to the Ratified Monitoring Data*

**Short-term to Long-term Data Adjustment**

NO2 Adjustment

For monitoring sites where data capture is less than 75% of a full calendar year (less than 9 months), the mean has been "annualised" using the methodology outlined in LLAQM.TG(16) before being compared to annual mean objectives. This was necessary at site 2 only in 2017.

$PM_{10}$ 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 KCL are responsible for the daily data collection, storage, validation and dissemination via the LAQN website (www.londonair.org.uk). KCL 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 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 $NO_2$ 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 2016 – February 2018)

- Summary of Precision Scores for 2015 - 2017

- UKAS schedule of accreditation (January 2018)

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 2016 – February 2018).**

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 2017 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 2017 is covered by rounds AR013 to AR024 of the AIR-PT scheme. For 2017 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 2017, 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 20 participating local authorities and poor for two participating local authority. Precision was good for The London Borough of Richmond Upon Thames for 2015, 2016 and 2017.

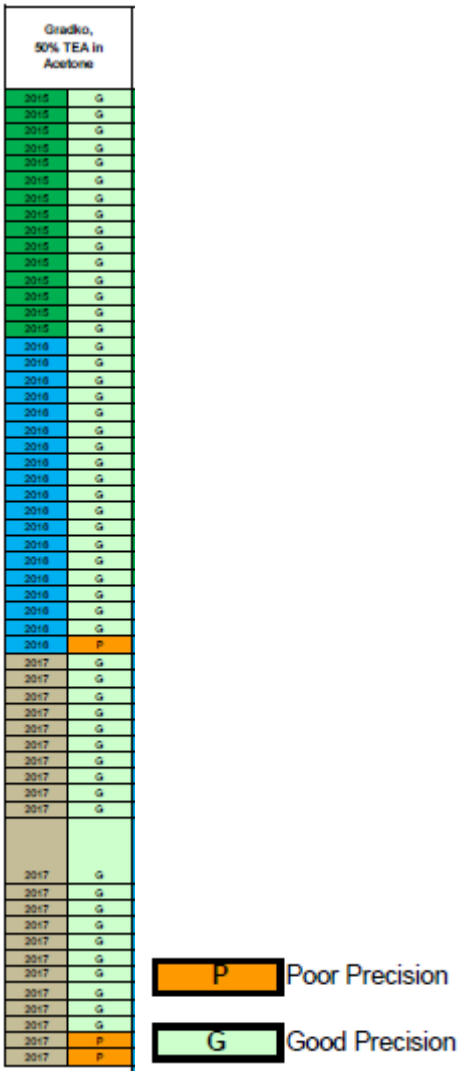
**Table 1: Laboratory summary performance for AIR $NO_2$ PT rounds AR013, 15, 16, 18, 19, 21, 22 and 24**

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 AR013 | AIR PT AR015 | AIR PT AR016 | AIR PT AR018 | AIR PT AR019 | AIR PT AR021 | AIR PT AR022 | AIR PT AR024 |
|---|---|---|---|---|---|---|---|---|
| Round conducted in the period | April – May 2016 | July – August 2016 | September – October 2016 | January – February 2017 | April – May 2017 | July – August 2017 | September – October 2017 | January – February 2018 |
| Aberdeen Scientific Services | 100 % | 100 % | 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] | 75 % | 75 % | 100 % | 100 % | 100 % | 100 % | 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 % | 0 % | 100 % | 100 % | 50 % | 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 % | NR [3] | NR [3] | NR [3] | NR [3] | NR [3] | NR [3] |
| Lambeth Scientific Services | 100 % | 100 % | 75 % | 100 % | NR [2] | NR [2] | 100 % | NR [2] |
| Milton Keynes Council | 100 % | 100 % | 75 % | 100 % | 75 % | 0 % | 75 % | 100 % |
| Northampton Borough Council | 100 % | NR [2] | 75 % | 0 % | NR [3] | NR [3] | NR [3] | NR [3] |
| Somerset Scientific Services | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % | 75 % | 100 % |
| South Yorkshire Air Quality Samplers | 100 % | 75 % | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % |
| Staffordshire County Council | 75 % | 100 % | NR [2] | 100 % | 100 % | 100 % | 100 % | 50 % |
| Tayside Scientific Services (formerly Dundee CC) | NR [2] | 100 % | NR [2] | 100 % | NR [2] | 100 % | NR [2] | 100 % |
| West Yorkshire Analytical Services | 100 % | NR [2] | 50 % | 100 % | 100 % | 100 % | 100 % | 50 % |

[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] Northampton Borough Council, Kent Scientific Services, Cardiff Scientific Services, Kirklees MBC and Exova (formerly Clyde Analytical) no longer carry out $NO_2$ diffusion tube monitoring and therefore did not submit results.

**2015 - 2017 Summary of Precision Results for Nitrogen Dioxide Diffusion Tube Collocation Studies for Gradko Laboratory 50% TEA in Acetone**




Numerical results for this data are contained in the National Bias Adjustment Spreadsheet version 03/18

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:** 021 **Issue date:** 30 January 2018


St Martins House
77 Wales Street
Winchester
Hampshire
SO23 0RH

Contact: Mr A Poole
Tel: +44 (0)1962 860331
Fax: +44 (0)1962 841338
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 | GLM 8 by Ion Chromatography |
| | Benzene<br>Toluene<br>Ethyl benzene<br>Xylene | GLM 4 by Thermal Desorption/ FID Gas Chromatography |
| | Hydrogen chloride<br>Nitrogen dioxide<br>Sulphur dioxide<br>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 |

2187

Accredited to ISO/IEC 17025:2005

**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:** 021 **Issue date:** 30 January 2018

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) | |
| | Volatile Organic Compounds including:<br>Benzene<br>Toluene<br>Ethylbenzene<br>p-Xylene<br>o-Xylene | GLM 13 by Thermal Desorption GC-Mass Spectrometry |
| | 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 |
| | 1,3-Butadiene | GLM 13-6 by Thermal Desorption GC-Mass Spectrometry |
| | 1,2-Dichloro(Z)ethene, | GLM 13-3 by Thermal Desorption GC-Mass Spectrometry |
| | Indane<br>Styrene | GLM 13-4 by Thermal Desorption GC-Mass Spectrometry |
| | Tetrachloroethylene<br>Trichloroethylene | GLM 13-2 by Thermal Desorption GC-Mass Spectrometry |
| | 1,2,3-Trimethylbenzene<br>1,2,4-Trimethylbenzene<br>1,3,5-Trimethylbenzene | GLM 13-5 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 | | |

Assessment Manager: LS

Page 2 of 2

### $NO_2$ 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 2017 the Borough undertook co-location studies at two continuous $NO_2$ monitoring sites, with 3 x $NO_2$ diffusion tubes at the following the locations:

- **Richmond 1 Castelnau (site 23):** a roadside site, in Castlenau Library Barnes. In 2017 the annual average for the Castelnau diffusion tubes (№ 23) was 35.70 μg $m^{-3}$; for the continuous site (RI1) it was 31 μg $m^3$. The bias adjustment factor is **0.90**
- **Richmond 2 Barnes Wetlands (site 37):** a suburban background site. In 2017 the annual average for the Wetlands diffusion tubes (№ 37) was 21.42 μg $m^{-3}$; for the continuous site (RI2) it was 21μg $m^3$. The bias adjustment factor is **1.00.**
- **The National bias adjustment factor** for Gradko using 50% TEA in acetone for 2017 was **0.97. This factor has been used to bias adjust all roadside sites for 2017.**

The overall precision and data capture for this co-location study was very good, as it has been over recent years. Following discussion with DEFRA and in order not to attempt to underestimate levels of NO2 throughout the borough for 2017 it was decided to employ the national Gradko bias adjustment factor of **0.97** for all roadside sites. This is slightly more conservative than the local bias adjustment factor of **0.90**

**Factor from Local Co-location Studies**

The local bias adjustment factors for the Borough are provided in Table A.1 for 2011 to 2017. 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 and 2017. In 2014 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. In 2017 the bias adjustment factor was the national bias adjustment factor for 22 studies from Gradko using the 50% TEA in acetone methodology.

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 2017 NO2 diffusion tube bias adjustment factors for the Borough**

| Source of bias adjustment factor | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| Local roadside co-location study at Richmond 1 Castelnau | 0.92 | 1.06 | 0.96 | 0.95 | 0.92 | 0.98 | 0.97a |
| Local background co-location study at Richmond 2 Wetlands Barnes | 1.03 | 1.04 | 0.95 | 1.09 | 1 | 1.08 | 1 |

[a] Gradko national bias adjustment factor 2017

### *A.3 Adjustments to the Ratified Monitoring Data*

**Short-term to Long-term Data Adjustment**

NO2 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" using the methodology outlined in LLAQM.TG(16) before being compared to annual mean objectives. This was not necessary for any site in LBRuT in 2017 as all sites achieved a data capture rate above 75%.

**$PM_{10}$ Adjustment**

Measured mean $PM_{10}$ concentration for Merton Road ME2 site for 2017 was 24µg/$m^3$ based on data capture rate of 80%. 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.3 Adjustments to the Ratified Monitoring Data*

Distance Adjustment

All NO 2 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 used in the calculation is the 'raw' value which has not been bias adjusted and the background concentration is derived from the Wetlands background site .

**Table K. Distance Adjustment - Monitored Annual Mean NO2 compared to exposure at nearest façade (□g m-3)**

| Site ID | Address | Background Conc. | Measured Annual mean Conc. | Distance Corrected Conc. |
|---|---|---|---|---|
| 1 | Hampton Court Rd, Hampton | 20.0 | **56.0** | **55.0** |
| 2 | Percy Rd, Hampton (nr. Oldfield Rd) | 20.0 | 30.0 | 28.0 |
| 3 | Uxbridge Rd, Hampton (nr. Arundel Close) | 20.0 | **41.0** | 32.4 |
| 4 | Hampton Rd, Teddington (nr. Bushy Pk Gardens) | 20.0 | 37.0 | 29.0 |
| 6 | Kingston Rd, Teddington (nr. Woffington Close) | 20.0 | 31.0 | 27.0 |
| 7 | Broad St, Teddington (Boots) | 20.0 | **44.0** | 39.0 |
| 9 | Hampton Rd, Twickenham | 20.0 | **41.0** | 37.0 |
| 10 | Twickenham Rd, Twickenham (opp. Fulwell golf course) | 20.0 | **43.0** | 33.0 |
| 11 | Percy Rd, Whitton (nr. Percy Way) | 20.0 | **49.0** | 35.0 |
| 12 | Hanworth Rd, Whitton | 20.0 | **43.0** | 33.0 |
| 13 | Whitton Rd, Whitton, (opp. rugby ground) | 20.0 | **41.0** | 33.0 |
| 14 | Cross Deep, Twickenham (nr Poulett Gardens) | 20.0 | 38.0 | 32.0 |
| 15 | Richmond Rd, Twickenham (opp. Marble Hill Pk) | 20.0 | **40.0** | 36.0 |
| 16 | St Margarets Rd, St Margarets (nr. Bridge Rd) | 20.0 | 39.0 | 35.0 |
| 17 | Red Lion Street, Richmond | 20.0 | **62.0** | **58.0** |
| 18 | Lower Mortlake Rd, Richmond (nr. Trinity Rd) | 20.0 | **60.0** | **42.0** |
| 19 | Kew Rd, Kew (nr. Walpole Av) | 20.0 | **51.0** | 33.0 |
| 20 | Mortlake Rd, Kew (nr. Kent Rd) | 20.0 | **47.0** | **40.0** |
| 21 | Lower Richmond Rd, Mortlake (nr. Kingsway) | 20.0 | 38.0 | 33.0 |
| 22 | Castelnau, Barnes (nr. Hammersmith Bridge) | 20.0 | **53.0** | **41.0** |
| 23 | Castelnau Library, Barnes (static site) | 20.0 | 36.0 | 32.0 |
| 24 | Lonsdale Road, Barnes (nr. Suffolk Rd) | 20.0 | 35.0 | 28.0 |

| | | | | |
|---|---|---|---|---|
| 25 | URRW, (nr. Sheen School) | 20.0 | 39.0 | 39.0 |
| 26 | URRW, Sheen (nr. Courtland Estate) | 20.0 | 37.0 | 28.0 |
| 27 | Queens Rd, Richmond (nr. Russell Walk) | 20.0 | **42.0** | 33.0 |
| 29 | Petersham Rd, Ham (nr. Sandy Lane) | 20.0 | 31.0 | 31.0 |
| 31 | A316 (nr. Chudleigh Rd) | 20.0 | **53.0** | **41.0** |
| 32 | Kings St, Twickenham | 20.0 | **61.0** | **54.0** |
| 33 | Heath Rd, Twickenham | 20.0 | **54.0** | **48.0** |
| 34 | Thames St, Hampton | 20.0 | 36.0 | 36.0 |
| 35 | High St, Hampton Wick | 20.0 | **47.0** | **47.0** |
| 36 | HUpper Richmond Road West(URRW), Sheen Laneigh St, Hampton Wick | 20.0 | **62.0** | **55.0** |
| 39 | Richmond Rd, nr. Richmond Bridge, East Twickenham | 20.0 | **53.0** | **48.0** |
| 40 | Staines Rd, Twickenham | 20.0 | **44.0** | 33.0 |
| 41 | Paradise Rd, Richmond | 20.0 | 37.0 | 31.0 |
| 42 | The Quadrant/Kew Rd, Richmond | 20.0 | **91.0** | **72.0** |
| 43 | Hill St, Richmond | 20.0 | **80.0** | **71.0** |
| 44 | Sheen Rd, Richmond (near shops) | 20.0 | **42.0** | **42.0** |
| 45 | 154 High St, Teddington, | 20.0 | 36.0 | 31.0 |
| 47 | Causeway, Teddington | 20.0 | 32.0 | 31.0 |
| 48 | Stanley Rd, Teddington (junc. Strathmore Rd) | 20.0 | **42.0** | 34.0 |
| 49 | URRW War Memorial, Sheen Lane, Sheen | 20.0 | 32.0 | 30.0 |
| 50 | URRW, nr. Clifford Av, Sheen | 20.0 | **54.0** | **46.0** |
| 51 | Sheen Lane, Sheen (railway crossing) | 20.0 | 36.0 | 33.0 |
| 52 | Clifford Av, Chalkers Corner | 20.0 | **52.0** | **44.0** |
| 53 | Mobile AQ unit, A316 nr Egerton Rd | 20.0 | **44.0** | **42.0** |
| 54 | Mortlake Road, adjacent to West Hall Road, Kew | 20.0 | **49.0** | **45.0** |
| 55 | Mortlake Road, adjacent to Cemetery Gates, | 20.0 | **46.0** | 37.0 |
| 56 | A316 (St Magarets) | 20.0 | **51.0** | 37.0 |
| 57 | A316 (Lincoln Avenue) | 20.0 | **43.0** | 31.0 |

| | | | | |
|---|---|---|---|---|
| 58 | London Road, Twickenham | 20.0 | **48.0** | 37.0 |
| 59 | Whitton Rd, Twickenham (near Twickenham bridge) | 20.0 | **40.0** | 37.0 |
| 60 | Waldegrave Rd, Teddington | 20.0 | 30.0 | 28.0 |
| 61 | London Road, Twickenham (near Waitrose) | 20.0 | **46.0** | **41.0** |
| 62 | High Street, Barnes | 20.0 | **52.0** | **43.0** |
| 63 | High Street, Whitton | 20.0 | 39.0 | 34.0 |
| 64 | High Street, Hampton Hill | 20.0 | **51.0** | **45.0** |
| 65 | York Street, Twickenham | 20.0 | **70.0** | **55.0** |
| 66 | South Circular, Kew Green | 20.0 | **50.0** | **47.0** |
| 67 | Petersham Rd opp Poppy Factory, | 20.0 | **46.0** | **43.0** |
| Rut 01 | Civic Centre, York St, Twickenham | 20.0 | **53.0** | **53.0** |
| Rut 02 | George Street, Richmond | 20.0 | **85.0** | **71.0** |

## Appendix B Full Monthly Diffusion Tube Results for 2017

**Table M. $NO_2$ Diffusion Tube Results**

| Site ID | Valid data capture for monitoring period % [a] | Valid data capture 2017 % [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 | 100 | 75.77 | 56.35 | 48.07 | 61.77 | 54.07 | 57.33 | 52.34 | 48.17 | 51.98 | 48.89 | 62.16 | 58.35 | **56** | **55** |
| 2 | 100 | 100 | 48.08 | 29.58 | 27.99 | 28.42 | 23.76 | 24.60 | 23.56 | 25.86 | 27.42 | 27.60 | 41.82 | 34.15 | 30 | 29 |
| 3 | 100 | 100 | 59.58 | 44.11 | 37.33 | 37.19 | 33.75 | 32.21 | 35.49 | 36.91 | 37.85 | 37.74 | 52.49 | 41.75 | **41** | 39 |
| 4 | 100 | 100 | 60.74 | 39.10 | 31.88 | 33.07 | 36.57 | 31.18 | 32.16 | 31.90 | 33.81 | 32.38 | 47.28 | 37.86 | 37 | 36 |
| 6 | 100 | 100 | 42.29 | 27.02 | 22.16 | 21.05 | 22.66 | 28.10 | 30.82 | 31.48 | 33.05 | 30.57 | 48.68 | 38.71 | 31 | 30 |
| 7 | 100 | 92 | | 47.12 | 42.19 | 47.91 | 47.19 | 43.93 | 38.60 | 39.51 | 39.43 | 39.04 | 52.52 | 45.33 | **44** | **43** |
| 9 | 100 | 100 | 63.47 | 51.22 | 36.33 | 35.53 | 40.71 | 38.71 | 33.76 | 34.26 | 37.24 | 35.83 | 48.60 | 40.66 | **41** | **40** |
| 10 | 100 | 100 | 58.82 | 44.89 | 45.08 | 39.79 | 35.91 | 39.87 | 33.90 | 37.60 | 39.11 | 39.61 | 52.39 | 47.17 | **43** | **42** |
| 11 | 100 | 100 | 74.91 | 46.48 | 52.25 | 44.11 | 40.35 | 38.94 | 36.05 | 45.12 | 44.76 | 46.16 | 62.16 | 51.86 | **49** | **47** |
| 12 | 100 | 100 | 65.91 | 50.12 | 34.18 | 40.14 | 37.61 | 37.56 | 34.33 | 37.75 | 38.06 | 39.60 | 52.40 | 45.13 | **43** | **41** |
| 13 | 100 | 100 | 69.04 | 45.77 | 37.59 | 33.04 | 39.45 | 33.96 | 30.09 | 43.14 | 37.89 | 33.56 | 48.20 | 42.36 | **41** | **40** |
| 14 | 100 | 92 | 53.59 | 39.29 | 36.76 | 29.91 | 33.71 | 29.92 | | 31.39 | 32.98 | 35.87 | 47.79 | 42.23 | 38 | 36 |
| 15 | 100 | 100 | 59.43 | 41.92 | 38.14 | 33.35 | 33.63 | 38.23 | 32.64 | 36.30 | 37.25 | 36.43 | 46.69 | 41.93 | **40** | 38 |
| 16 | 100 | 92 | | 42.25 | 43.98 | 34.98 | 33.33 | 34.81 | 30.61 | 32.96 | 36.17 | 38.13 | 52.92 | 45.76 | 39 | 38 |
| 17 | 100 | 92 | 82.58 | 54.19 | 70.04 | 60.58 | 60.22 | 61.24 | 62.59 | 64.93 | 57.03 | 49.29 | | 60.17 | **62** | **60** |
| 18 | 100 | 100 | 78.16 | 45.58 | 58.79 | 58.58 | 46.54 | 61.59 | 51.02 | 66.46 | 56.06 | 57.10 | 79.44 | 62.87 | **60** | **58** |
| 19 | 100 | 100 | 67.10 | 58.95 | 51.40 | 43.21 | 43.00 | 47.35 | 44.43 | 46.05 | 42.90 | 46.07 | 62.15 | 53.70 | **51** | **49** |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *20* | *100* | *100* | 71.34 | 47.00 | 47.68 | 41.48 | 36.88 | 43.59 | 36.83 | 41.59 | 38.81 | 42.01 | 62.22 | 49.36 | **47** | **45** |
| *21* | *100* | *100* | 60.11 | 39.90 | 36.09 | 35.62 | 29.95 | 37.37 | 26.99 | 32.75 | 34.63 | 33.35 | 47.02 | 37.29 | 38 | 36 |
| *22* | *100* | *100* | 73.83 | 61.37 | 45.68 | 51.96 | 49.99 | 51.95 | 51.17 | 48.78 | 50.05 | 31.84 | 61.03 | 60.31 | **53** | **52** |
| *23* | *100* | *100* | 52.01 | 42.07 | 31.12 | 30.18 | 34.67 | 28.54 | 27.53 | 31.89 | 32.17 | 31.09 | 37.18 | 37.22 | 36 | 35 |
| *24* | *100* | *100* | 54.70 | 43.39 | 34.72 | 30.98 | 32.84 | 30.83 | 25.85 | 29.57 | 30.30 | 31.10 | 40.36 | 38.89 | 35 | 34 |
| *25* | *100* | *100* | 54.98 | 45.06 | 46.71 | 38.75 | 36.30 | 32.27 | 31.91 | 32.36 | 34.15 | 30.86 | 47.79 | 42.15 | 39 | 38 |
| *26* | *100* | *92* | 54.30 | 43.19 | 36.33 | 32.73 | 33.32 | 31.66 | 30.54 | 32.29 | 35.25 | 32.43 | | 40.84 | 37 | 36 |
| *27* | *100* | *92* | 61.49 | 42.25 | | 33.70 | 50.03 | 43.47 | 32.30 | 30.38 | 40.67 | 39.09 | 48.27 | 40.83 | **42** | **41** |
| *28* | *100* | *100* | 29.57 | 23.91 | 15.04 | 14.04 | 14.69 | 12.44 | 11.94 | 7.84 | 15.36 | 14.64 | 23.41 | 22.20 | 17 | 17 |
| *29* | *100* | *100* | 47.09 | 36.38 | 30.85 | 25.66 | 28.64 | 25.61 | 22.80 | 26.28 | 27.18 | 28.91 | 38.19 | 35.27 | 31 | 30 |
| *31* | *100* | *100* | 79.92 | 67.68 | 42.52 | 41.50 | 44.16 | 49.46 | 42.49 | 61.63 | 45.90 | 46.52 | 63.53 | 54.63 | **53** | **52** |
| *32* | *100* | *100* | 84.89 | 72.38 | 56.82 | 51.25 | 60.35 | 67.84 | 52.54 | 59.66 | 55.38 | 48.62 | 62.49 | 54.12 | **61** | **59** |
| *33* | *100* | *100* | 69.41 | 56.92 | 58.41 | 60.69 | 60.44 | 49.78 | 49.57 | 49.35 | 48.83 | 44.05 | 59.25 | 44.98 | **54** | **53** |
| *34* | *100* | *100* | 52.99 | 38.46 | 33.80 | 32.34 | 30.60 | 32.59 | 30.71 | 32.61 | 32.73 | 30.68 | 43.89 | 37.01 | 36 | 35 |
| *35* | *100* | *100* | 64.75 | 44.89 | 39.99 | 44.37 | 41.96 | 42.14 | 39.00 | 45.73 | 45.92 | 45.23 | 58.95 | 47.49 | **47** | **45** |
| *36* | *100* | *100* | 81.79 | 62.81 | 59.46 | 55.28 | 61.21 | 73.11 | 57.57 | 58.58 | 56.12 | 58.91 | 62.39 | 51.33 | **62** | **60** |
| *37* | *100* | *100* | 36.92 | 28.87 | 21.46 | 14.48 | 19.04 | 16.08 | 13.24 | 16.33 | 19.79 | 18.39 | 27.35 | 25.08 | 21 | 20 |
| *39* | *100* | *100* | 70.77 | 52.35 | 53.38 | 52.91 | 51.01 | 53.38 | 51.54 | 50.20 | 46.13 | 43.05 | 60.12 | 54.69 | **53** | **52** |
| *40* | *100* | *100* | 68.89 | 48.29 | 45.98 | 38.59 | 38.24 | 41.63 | 36.40 | 33.83 | 36.40 | 38.00 | 52.41 | 45.40 | **44** | **42** |
| *41* | *100* | *100* | 56.82 | 38.67 | 34.71 | 37.75 | 31.65 | 30.18 | 32.38 | 35.57 | 31.24 | 34.62 | 45.41 | 40.73 | 37 | 36 |
| *42* | *100* | *100* | 105.22 | 85.68 | 85.48 | 96.76 | 94.17 | 104.37 | 99.63 | 94.39 | 87.47 | 82.82 | 82.67 | 76.63 | **91** | **89** |
| *43* | *100* | *92* | 94.11 | 71.98 | 81.66 | 71.22 | 83.64 | 87.02 | 82.01 | 82.69 | 73.17 | 72.39 | 82.81 | | **80** | **78** |
| *44* | *100* | *100* | 59.25 | 44.88 | 37.00 | 38.69 | 43.63 | 37.08 | 33.47 | 35.21 | 39.29 | 33.77 | 49.10 | 49.91 | **42** | **41** |
| *45* | *100* | *100* | 54.27 | 40.88 | 33.78 | 29.67 | 33.43 | 34.53 | 29.51 | 32.12 | 32.67 | 33.67 | 43.90 | 37.61 | 36 | 35 |
| *47* | *100* | *100* | 49.17 | 39.96 | 32.57 | 28.67 | 27.45 | 26.38 | 24.75 | 27.36 | 28.17 | 25.54 | 41.48 | 34.49 | 32 | 31 |
| *48* | *100* | *100* | 63.79 | 38.14 | 41.89 | 38.84 | 34.72 | 36.55 | 36.21 | 37.47 | 27.20 | 39.97 | 57.69 | 47.78 | **42** | **40** |
| *49* | *100* | *100* | 50.60 | 38.09 | 30.57 | 29.59 | 29.16 | 26.06 | 25.76 | 24.88 | 28.78 | 29.69 | 41.12 | 34.76 | 32 | 31 |
| *50* | *100* | *100* | 71.52 | 59.01 | 53.15 | 50.84 | 49.95 | 59.74 | 50.83 | 52.85 | 47.83 | 44.07 | 58.94 | 52.86 | **54** | **53** |
| *51* | *100* | *100* | 51.25 | 38.88 | 33.86 | 31.74 | 32.58 | 31.95 | 29.29 | 29.61 | 32.69 | 31.47 | 44.59 | 40.83 | 36 | 35 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *52* | *100* | *100* | 63.34 | 50.59 | 42.82 | 58.87 | 52.60 | 50.65 | 42.64 | 51.23 | 52.03 | 45.15 | 62.32 | 46.72 | **52** | **50** |
| *53* | *100* | *100* | 66.15 | 45.61 | 42.27 | 38.76 | 43.52 | 34.50 | 34.84 | 38.96 | 46.62 | 41.22 | 53.61 | 46.37 | **44** | **43** |
| *54* | *100* | *92* | 72.82 | 48.80 | 46.72 | 48.95 | 40.58 | 49.47 | 42.20 | 43.00 | | 41.17 | 60.81 | 48.83 | **49** | **48** |
| *55* | *100* | *100* | 66.48 | 51.97 | 40.19 | 41.18 | 42.82 | 47.65 | 39.98 | 45.44 | 41.66 | 41.14 | 53.18 | 45.62 | **46** | **45** |
| *56* | *100* | *100* | 79.77 | 57.76 | 60.81 | 55.19 | 46.06 | 46.75 | 42.93 | 41.06 | 46.22 | 38.86 | 52.85 | 46.40 | **51** | **50** |
| *57* | *100* | *100* | 66.73 | 45.95 | 34.86 | 38.15 | 40.69 | 38.79 | 37.30 | 39.44 | 38.68 | 37.07 | 57.85 | 45.41 | **43** | **42** |
| *58* | *100* | *92* | 71.58 | 51.50 | 41.29 | 46.16 | 48.43 | 41.57 | | 42.26 | 40.02 | 38.04 | 59.27 | 48.64 | **48** | **47** |
| *59* | *100* | *100* | 58.20 | 39.81 | 34.55 | 39.01 | 42.38 | 38.75 | 35.39 | 36.08 | 41.16 | 30.80 | 48.58 | 38.77 | **40** | 39 |
| *60* | *100* | *75* | 42.84 | 33.53 | 23.86 | 24.30 | 26.32 | | | | 26.17 | 26.65 | 39.11 | 29.79 | 30 | 29 |
| *61* | *100* | *92* | 64.19 | 45.02 | 46.86 | 47.01 | 41.43 | 42.55 | 40.10 | 41.23 | 45.32 | 40.85 | | 54.40 | **46** | **45** |
| *62* | *100* | *100* | 69.67 | 56.20 | 47.50 | 57.50 | 48.50 | 53.81 | 42.12 | 43.13 | 45.13 | 43.72 | 60.74 | 52.54 | **52** | **50** |
| *63* | *100* | *92* | 61.65 | 40.07 | 35.90 | 37.01 | 36.27 | | 29.74 | 36.30 | 36.88 | 35.28 | 46.09 | 38.15 | 39 | 38 |
| *64* | *100* | *83* | 64.62 | 54.58 | 46.42 | 49.15 | 43.58 | | 51.23 | 56.30 | | 43.92 | 52.49 | 47.84 | **51** | **49** |
| *65* | *100* | *75* | 78.54 | 62.20 | 62.59 | | 54.99 | | 120.16 | 57.16 | 66.23 | 63.75 | 63.70 | | **70** | **68** |
| *66* | *100* | *100* | 67.77 | 54.80 | 48.70 | 45.20 | 42.68 | 48.93 | 42.61 | 51.09 | 42.64 | 42.21 | 60.09 | 53.52 | **50** | **49** |
| *67* | *100* | *100* | 57.07 | 48.73 | 47.33 | 35.53 | 41.08 | 43.93 | 38.04 | 41.51 | 45.13 | 40.20 | 55.18 | 53.13 | **46** | **44** |
| *Rut 01* | *100* | *100* | 78.67 | 48.11 | 40.50 | 40.36 | 47.67 | 46.72 | 77.19 | 69.53 | 44.68 | 40.33 | 52.06 | 44.31 | **53** | **51** |
| *Rut 02* | *100* | *83* | 98.26 | 73.48 | 87.78 | 93.82 | | 101.45 | | 83.09 | 78.79 | 73.39 | 82.75 | 76.35 | **85** | **82** |

Exceedance of the $NO_2$ annual mean AQO of 40 $\mu gm^{-3}$ 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 0.97 which is calculated using the National Gradko 50% TEA in acetone adjustment factor for 2017. . The bias adjustment factor for both background sites 28 and 37 is 1.00 calculated using results from Wetlands

**For Triplicate sites see below**

**Triplicate NO2 diffusion tube results for sites 23, 37 and 53 in ug/m3**

| Site Code | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | 50.98 | 41.21 | 30.37 | 28.94 | 35.31 | 29.27 | 26.68 | 32.01 | 32.71 | 31.30 | 39.01 | 36.50 | 34.52 |
| 23/2 | 52.94 | 42.50 | 32.73 | 31.16 | 34.65 | 30.22 | 27.81 | 32.88 | 34.31 | 30.64 | 35.31 | 33.45 | 38.05 |
| 23/3 | 52.11 | 42.49 | 30.26 | 30.45 | 34.05 | 26.12 | 28.10 | 30.80 | 29.49 | 31.34 | 37.22 | 41.71 | 34.51 |
| Average | 52.01 | 42.07 | 31.12 | 30.18 | 34.67 | 28.54 | 27.53 | 31.89 | 32.17 | 31.09 | 37.18 | 37.22 | 35.70 |
| 37 | 38.84 | 28.05 | 21.03 | 16.41 | 18.08 | 16.58 | 12.46 | 15.88 | 19.38 | 18.55 | 27.29 | 25.12 | 21.47 |
| 37/2 | 34.30 | 30.72 | 22.47 | 14.09 | 19.58 | 15.77 | 14.10 | 16.66 | 20.91 | 18.10 | 27.65 | 25.33 | 21.64 |
| 37/3 | 37.62 | 27.84 | 20.89 | 12.92 | 19.47 | 15.87 | 13.17 | 16.45 | 19.09 | 18.53 | 27.11 | 24.80 | 21.15 |
| Average | 36.92 | 28.87 | 21.46 | 14.48 | 19.04 | 16.08 | 13.24 | 16.33 | 19.79 | 18.39 | 27.35 | 25.08 | 21.42 |
| 53 | 64.81 | 45.35 | 47.35 | 38.64 | 48.66 | 23.92 | 33.54 | 39.55 | 46.49 | 41.75 | 52.74 | 44.79 | 43.97 |
| 53/2 | 68.22 | 48.20 | 41.46 | 41.09 | 39.03 | 38.58 | 36.72 | 40.48 | 43.41 | 42.57 | 53.00 | 47.83 | 45.05 |
| 53/3 | 65.41 | 43.29 | 38.01 | 36.55 | 42.85 | 41.01 | 34.27 | 36.84 | 49.96 | 39.33 | 55.08 | 46.50 | 44.09 |
| Average | 66.15 | 45.61 | 42.27 | 38.76 | 43.52 | 34.50 | 34.84 | 38.96 | 46.62 | 41.22 | 53.61 | 46.37 | 44.37 |