2017 Air Quality Annual Status Report (ASR)

In fulfilment of Part IV of the
Environment Act 1995
Local Air Quality Management

June 2017

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Executive Summary: Air Quality in Our Area

Air Quality in Darlington

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children and older people, and those with heart and lung conditions. There is also often a strong correlation with equalities issues, because areas with poor air quality are also often the less affluent areas.[1,2]

The annual health cost to society of the impacts of particulate matter alone in the UK is estimated to be around £16 billion[3]. It is estimated that air pollution nationally contributes to nearly 28,000 deaths per year with an associated loss to the population of 340,000 life years[4].

Darlington Borough Council has formally reviewed and assessed air quality since year 2000, and has produced statutory annual reports to the UK Government. It has done this in co-operation with neighbouring Tees Valley Councils and the Environment Agency to give as broad a picture of air quality as possible, continuing a long history of joint co-operation between councils which recognised that air pollution transcended local authority boundaries.

Consistently, the annual report has concluded that air quality in areas in the Darlington Borough where the public may be exposed is generally good when compared with Government objectives, and there has been no need to declare any Air Quality Management Areas in which adverse health effects may exist. There is no complacency in this; Darlington Council is committed to improving air quality as policy, but the economic options are limited against this background.

Darlington Borough, in contrast with the four neighbouring Tees Valley Councils, does not have large industrial areas and is not close to those industrial areas nearer the coast. It has a densely populated central area, with main arterial roads radiating out to the rural surround, and as such has always provided a measure of air pollution from traffic sources, which with its primary emissions at ground level, is now the greatest concern for public health. A significant portion of traffic flow has always been through traffic and this has dictated major road improvements over the years. In the 1960s, the A1 Darlington by-pass to the west of the town was completed, and in the 1970s, the Darlington inner ring road was completed which gave protection to the town centre. The A66 Southern bypass was completed in 1985. More recently in 2008, the eastern transport corridor was opened, which besides providing access to new development land also alleviated traffic congestion on two of the busiest road corridors in the town, Haughton Road and Yarm Road.

[1] Environmental equity, air quality, socioeconomic status and respiratory health, 2010
[2] Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006
[3] Defra. Abatement cost guidance for valuing changes in air quality, May 2013
[4] The Committee on the Medical Effects of Air Pollutants. The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom in December 2010

Actions to Improve Air Quality

Road traffic across the UK has increased dramatically this century, most noticeably in respect of car ownership. This is also true within Darlington and neighbouring councils. For Darlington, most through traffic has been channelled onto bypasses; the main impact on public health is along commuter roads, and it is in this area that most action needs to be targeted to alleviate air pollution. Fortunately, most housing along these roads is low rise, and set back from kerbside so that there is good dispersion of air pollutants compared with older UK cities and towns. On the downside, it is recognised that public transport limitations have contributed to a higher level of commuter traffic for work purposes than in other large conurbations. In 2004, Darlington was one of three towns selected by the Department for Transport to participate in a national sustainable travel project ('Sustainable Travel Demonstration Towns'), looking at ways to tackle traffic congestion. In 2007, pedestrianisation of a large part of the town centre was completed.

National action in terms of reducing emissions from vehicles is a crucial factor in reducing air pollution alongside roads. While significant strides have been made in vehicle engine technology, and on reducing harmful emissions from large diesels engines in buses and HGV's, Government policy has tended to concentrate in recent years on reducing carbon emissions, and this has filtered down into local authority policies. There has been a major shift away from petrol engines in small vehicles to diesel, which, while contributing to lower carbon emissions per mile, has inadvertently escalated those pollutants judged to be most harmful to public health, fine particulates and nitrogen dioxide, which cannot easily be reduced as with larger diesel vehicles. This has been compounded by inadequate emission testing regulations, so that actual emissions from small diesel engines in practice can be significantly higher than test. This has meant that the expected benefit of cleaner vehicle technology has not translated into significantly lower air pollution levels, and this has been confirmed by local monitoring. It will now take time for alternative low carbon / low emission technologies such as electric / hydrogen / hybrid vehicles to become economically viable alternatives. Much of the necessary infrastructure at a nationwide scale to facilitate these emerging technologies is currently unavailable.

Darlington Borough Council's Third Local Transport plan (2011-2026) states that a specific outcome it seeks to achieve is that "everyone can play their part in reducing the impact of transport on the environment……" The Council's Fourth Local Transport plan is currently being drafted and will be published in 2018 along with the Tees Valley Strategic Transport Plan.

Local actions to reduce the impact of vehicle emissions within Darlington are principally taken in conjunction with neighbouring councils through Tees Valley Unlimited concentrating on the following areas, with further detail in the Local Transport Plan:

- Reduce traffic congestion at peak times through improved network management and road improvements.
- Encouraging local bus companies to review services with particular emphasis on access to new and emerging employment opportunities, and to renew their fleet on an on-going basis.

- Encourage wider transport choices by improving pedestrian, cycling and public transport, including rail.
- Encourage the provision of a low emission vehicle infrastructure through the planning regime.

Over time, these improvements will all contribute to further reduction in air pollution within Darlington.

Conclusions and Priorities

For measured pollutants, this year's 2017 ASR concludes that there have been no exceedances of the annual mean objective (40µg/m³) for nitrogen dioxide in any area of relevant public exposure. Previous continuous monitoring results have also consistently shown compliance with the 1 hour mean air quality objective for nitrogen dioxide (200µg/m³ not to be exceeded more than 18 times a year). The annual mean objective and 24 hour (daily) mean objective for PM_{10} has also been met in areas of relevant public exposure.

Although not currently a statutory requirement of the National Air Quality Strategy, Local Air Quality Management Policy Guidance expects local authorities to work towards reducing emissions and/or concentrations of particulate $PM_{2.5}$. The new Public Health Outcomes Framework includes particulate $PM_{2.5}$ as an air pollution indicator under domain 3.1 – 'Fraction of mortality attributed to particulate air pollution'.

Monitoring of particulate $PM_{2.5}$ is carried out within neighbouring Middlesbrough and Stockton-on-Tees Councils through the national network and it is also possible to determine likely levels in all Tees Valley Council areas, including Darlington. Government objectives are easily met where relevant public exposure exists and this is expected to continue. Even so, Darlington Borough Council will continue to co-operate with the four other Tees Valley Councils in trying to identify in more detail sources of fine particles, and see if any local action can cost effectively reduce emissions / concentrations.

Local Engagement and How to get Involved

Local Motion promotes and provides information on travelling sustainably in Darlington. It targets all age groups in a number of settings and via a variety of communication platforms. The team looks to educate people of the benefits of different transport choices and provides information on how to get involved.

For schools the Local Motion website includes travel maps showing walking times, cycle routes and bus stops near schools. For workplaces to promote 'greener' commuting Local Motion has worked with Arriva Travel club to provide offers to workplaces to make sustainable ways of commuting more accessible and appealing.

For more information visit the Local Motion webpage at: http://www.dothelocalmotion.co.uk/

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1 Local Air Quality Management

This report provides an overview of air quality in Darlington Borough Council during 2016. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by Darlington Borough Council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England can be found in Table E.1 in Appendix E.

2 Actions to Improve Air Quality

2.1 Air Quality Management Areas

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority must prepare an Air Quality Action Plan (AQAP) within 12-18 months setting out measures it intends to put in place in pursuit of compliance with the objectives.

Darlington Borough Council currently does not have any AQMAs, and can see no requirement for one. Air quality has been shown, since LAQM started in year 2000, to be consistently and generally good and this has been accepted by Defra.

2.2 Progress and Impact of Measures to address Air Quality in Darlington

Defra's appraisal of last year's 2016 ASR concluded that on the basis of the evidence provided the conclusions reached were acceptable for all sources and pollutants. It was highlighted in the comments received that Darlington Borough Council may wish to consider reviewing the diffusion tube monitoring programme to determine whether there may be any locations with relevant exposure above the objectives levels elsewhere. Three tubes out of the ten were completely relocated for the beginning of the 2016 monitoring year (see paragraph 3.1.2 for more detail) and all locations are kept under review.

Darlington Borough Council has had no requirement to declare an Air Quality Management Area, and cannot economically justify a formal action plan to address air quality issues. However, the Council is committed to improving air quality in general, and does that through joint co-operation with the four neighbouring Tees Valley Councils through Tees Valley Combined Authority (April 2016, which includes Tees Valley Unlimited), and at the environmental health level through the Tees Valley Environmental Protection Group, which also includes the Environment Agency. The Council also encourages standalone measures that may have a beneficial impact on air quality.

Measures generally impact on vehicle emission reductions, improving the transport network, changing transport attitudes through encouraging cycling and walking, and improving public transport. Examples are:

- In relation to Arriva, who operates the vast majority of bus services in Darlington: Of 90 buses in total, 75 are Euro 5 or 6 compliant (14 of which are gas buses). This means lower levels of harmful exhaust emissions such as nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbons (THC and NMHC) and particulate matter (PM). The knock-on effects of reducing these can also mean better fuel economy and lower emissions of CO2.

  All but 15 buses have an automatic engine cut off time of between 4 and 5 minutes. Timetables do not allow for idling time in the town centre, they are scheduled to leave at

particular times, which are registered with the Traffic Commissioner and the time they arrive and depart from the town centre stops is regularly monitored for punctuality and network planning purposes. Punctuality data for 2016/17 shows that 88% of bus services run on time, with the average excess waiting time for frequent services calculated as 20 seconds.

Arriva have also recently issued a staff notice to drivers, to remind them not to idle in the town centre.

- A Licensing Policy which offers a 25% reduction in licensing fees for vehicles that are fuelled by liquid petroleum gas (LPG), electric, petrol-electric and compressed natural gas (NGV).
- Promotion of electric vehicle charging points for any commercial development and public facilities that creates a car parking area with 50 or more spaces. The new Feethams Multi Storey Car Park on Beaumont Street which opened in February 2016 has 4 electric charging spaces.
- Promoting travel alternatives by encouraging use of sustainable transport via Local Motion. The promotion of workplace travel planning, use of public transport, smarter driving, car sharing and cycling schemes and to provide a network of cycle ways. During 2016/17 Sustainable Travel Transition Year Funding was used to assist with the continued expansion of the existing function of Bike Stop, Darlington and the further delivery of Groundwork led guided walks, including initiatives with local businesses. Personalised Travel Planning took place across the Tees Valley with a focus on job centres; employers; hospitals and colleges. In addition marketing was carried out across the year including bus marketing on targeted routes and specific employment sites; college campaigns and a Get into cycling campaign.
- The Council's Building Services Department has recently invested in 8 all-electric vehicles (which equates to 1/7 of the Building Services fleet). There are now four double electric charging points at the depot on Allington Way, with the infrastructure in place to accommodate more. The gardener at South Park also has an electric vehicle.

Most of these schemes have been implemented in part, and the work will continue. The schemes do not address specific air quality issues, but all will have a bearing on improving air quality.

Darlington Borough Council's Public Health team support the work done in relation to air quality and will continue to work alongside Environmental Health and other colleagues across the Council.

2.3 $PM_{2.5}$ – Local Authority Approach to Reducing Emissions and or Concentrations

As detailed in Policy Guidance LAQM.PG16 (Reference 1 - Chapter 7), local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5µm or less). There is clear evidence that $PM_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

Overview

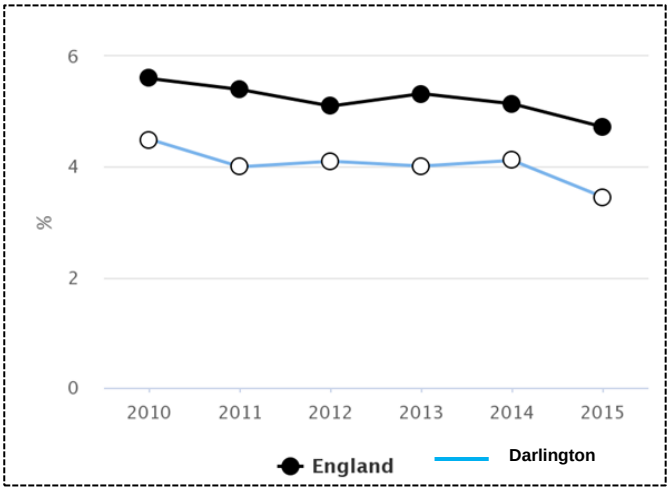
Particulates $PM_{2.5}$ are very fine particulates which are now considered to be a more significant health risk than the larger particulates PM_{10}, as they penetrate further into the respiratory system and are less easily dislodged. Recognising this, the UK Public Health Outcomes Framework (Healthy Lives: Healthy People) includes an indicator relating to fine particulate matter ($PM_{2.5}$). This indicator is 3.01 in Health Protection Domain 3 – 'Fraction of mortality attributed to particulate air pollution' – with the latest factors (2015) across the Tees Valley as follows:

	England	North East	Darlington	Hartlepool	Middlesbrough	Redcar & Cleveland	Stockton-on-Tees
Fraction (%)	4.7	3.5	3.5	3.5	3.7	3.5	3.5

For Darlington it is estimated there are 47 deaths per year attributable to particulate air pollution ($PM_{2.5}$) with an associated 481 life-years lost in the population[5].

These are estimates of the percentage of mortality attributable to long term exposure to particulate air pollution. The general range for the UK is between 2.5 and 4.0 for rural areas, up to 8 and higher in certain city areas. The trend in the proportion of adult mortality attributable to particulate air pollution is going down nationally (in England) and in Darlington. However, in Darlington this proportion is decreasing at a faster rate than that nationally (see Figure 1).

Figure 1. Fraction of mortality attributable to particulate air pollution - Darlington [6]



[5] Public Health England. Estimating Local Mortality Burdens associated with Particulate Air Pollution A M Gowers, B G Miller and JR Steadman, 2014

[6] Public Health England. Public Health Outcomes Framework. Fraction of Mortality attributable to particulate air pollution – Darlington. Available at: http://www.phoutcomes.info/public-health-outcomes-framework#page/4/gid/1000043/pat/6/par/E12000001/ati/102/are/E06000005

Particulate $PM_{2.5}$ is not yet incorporated into LAQM regulation within England. As such there is no statutory requirement on local authorities to review and assess $PM_{2.5}$ for LAQM purposes, and while $PM_{2.5}$ monitoring across the UK is desirable given the links to the Public Health Outcomes Framework, it is recognised that monitoring costs can be prohibitive on local authorities. The latest 2016 Technical Guidance (Reference 2) suggests local authorities use results from the national network of $PM_{2.5}$ monitors to assess levels, and also provides a nationally derived factor of 0.7 that can be used to estimate $PM_{2.5}$ levels from any particulate PM_{10} monitors that local authorities may have installed.

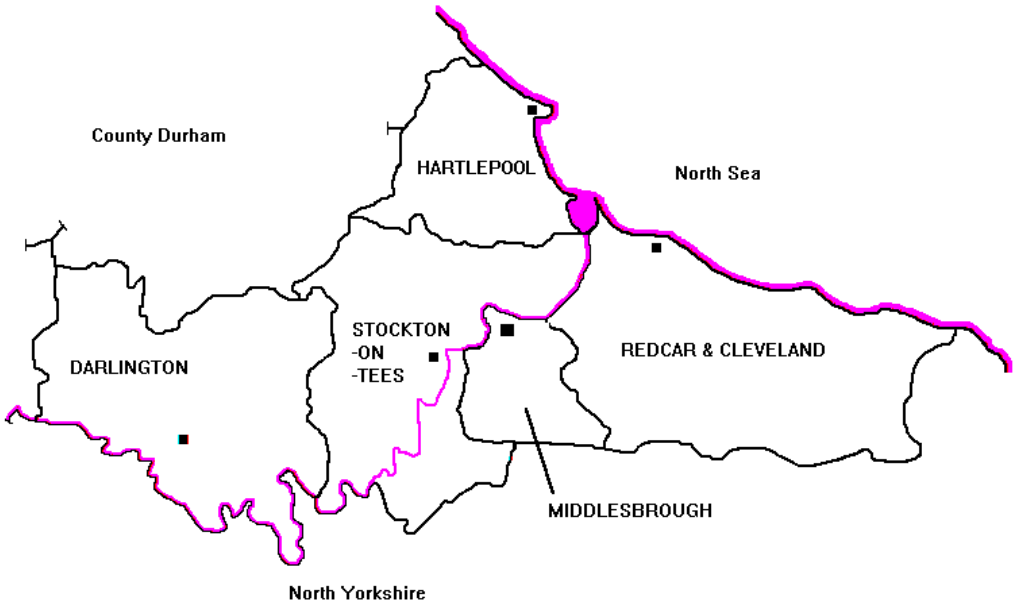
Within the Tees Valley, there are three $PM_{2.5}$ monitors as part of the national network, Middlesbrough Breckon Hill (urban industrial); Stockton Eaglescliffe (roadside); and Stockton A1035 Nelson Terrace (roadside), all giving direct $PM_{2.5}$ annual means. The Breckon Hill and Eaglescliffe stations have PM_{10} monitors alongside so that a locally derived factor of $PM_{2.5}$ to PM_{10} can be calculated and compared with the national factor and used at local PM_{10} monitors with a similar location. Annual means for $PM_{2.5}$ for within the Tees Valley as measured at the monitors (Middlesbrough Breckon Hill and Stockton Eaglescliffe, Stockton A1305 Nelson Terrace) for the last five years have ranged between 9.2 and 13.1µg/m^3, with variations year on year likely to be due to weather variations.

The UK target objective for $PM_{2.5}$ was first introduced in 2008 as an annual mean of 25µg/m^3 (gravimetric) with no exceedances and a target 15% reduction at urban background sites between 2010 and 2020. This has been consistently met across the Tees Valley. The 2016 Technical Guidance has revised this objective to give local authorities in England a new flexible role in working towards reducing emissions and concentrations of $PM_{2.5}$. This will require local authorities to better understand local $PM_{2.5}$ sources and emission levels, data which is currently only available through national estimates.

Technical Guidance recognises that due to its extremely small size, $PM_{2.5}$ can travel for long distances in the air and it is estimated that as much as 40% to 50% of the levels found in any given area can be from sources outside a local authority's direct boundary. Around a quarter of concentrations are thought to be secondary sourced, i.e. reactions between other pollutants in the atmosphere. In addition, coastal and rural areas can have higher proportions of natural sources such as salt, fine sand and pollens, the extent of which will be weather dependent. This means that locally emitted $PM_{2.5}$ will tend to be significantly less than 50% of the total burden, with road traffic and industry the principle sources.

Darlington $PM_{2.5}$

Darlington Borough Council is one of five unitary Councils forming the general area known as the Tees Valley. As shown below, it is the most westerly of these Councils and third largest in area, at 198.4 sq. km.



Darlington Borough has a densely populated central area, but is otherwise largely rural. It is a major shopping and commercial centre, and is the main railway centre for the Tees Valley. There is very little heavy industry compared with other Tees Valley Councils, and although some quarrying and other industrial processes lie just outside its boundary, they do not significantly impact on Darlington air quality.

The main A1 motorway (North – South), and the A66 trunk route (East – West) run through the Borough, but are mainly in rural areas, with no areas of relevant exposure. Within the urban area, there are some congested commuter routes, and in the absence of a northern by-pass, some heavy through traffic on the northern outskirts of the town. A major road change, completed in 2008, was the eastern transport corridor, formerly known as the cross-town route (eastern section). The main purpose of this scheme was to provide access to development land to the west of the A66 by-pass, but it has also contributed to significant reductions in traffic on two of the busiest road corridors in the town, Haughton Road and Yarm Road.

The majority of the Darlington urban area is subject to Smoke Control Orders, and natural gas is the main source of heating in all but a few rural villages. This means that air pollution from domestic and commercial sources are low. Industrial emissions are also low, leaving road transport as the most significant air pollution source.

The principle source of fine particulate pollution is likely to be from road transport, but even this is limited. Other than along the main commuter routes into the town centre, road traffic is generally light as the significant through routes are in their own transport corridors. This general view of sources is reflected in the national 1 sq km sector model data maps for Darlington based on 2013 emission source estimates (Reference 3). Typical background levels are shown as 8.4 – 11.2µg/m^3/sq. km.

The average $PM_{2.5}$ loading per sq. km in 2013 is shown as 9.2µg/m^3, reducing to 8.5µg/m^3 in 2020 as a result of planned Government / EU measures.

Therefore, at this stage of understanding of local fine particulate emissions, it is difficult to see what positive action can be economically taken by Darlington Borough Council to reduce $PM_{2.5}$ levels over the coming years, other than those actions already identified in section 2.2 of this report. A more significant impact is likely to be made by changes in Government policy with regard to diesel engines in cars and small vans. Since 1995, the proportion of diesel engine cars has risen from below 10% to over 40% today due to concentration on reducing carbon emissions. Diesel engines emit more fine particulates than petrol engines, and it is difficult to fit effective abatement measures. Of as much concern is the higher levels of nitrogen oxides emitted by diesel engines, which are a key factor in secondary fine particulate formation.

3 Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance

3.1 Summary of Monitoring Undertaken

This section sets out what monitoring has taken place and how it compares with objectives.

3.1.1 Automatic Monitoring Sites

Until recently, Darlington Borough Council had two continuous monitoring stations both sites are now closed.

St Cuthbert's Way was a Local station monitoring nitrogen oxides and particulate PM_{10} from traffic, owned and operated by Darlington Council between years 2000 and 2014, when the equipment fell into disrepair. The unit was a kerbside site on a busy inner ring road roundabout, on the edge of the main shopping centre, where traffic is generally slow moving. The unit was in an area of relevant public exposure only for the 1 hour nitrogen dioxide objective, and represented a worst case kerbside site for the whole of the Tees Valley.

The second continuous Local monitoring station for nitrogen oxides and particulate PM_{10} operated at **Cockerton Bridge** from 2004 to early April 2012, when the monitors became unserviceable and could not be economically repaired. The unit was a roadside site on one of the main radial routes into the town centre, with heavy, but relatively free flowing traffic. The monitor location was between kerbside and the nearest building façades, and was a worst-case site for all objectives relating to nitrogen oxides and particulate PM_{10} from traffic. It is noted here that a non-continuous nitrogen dioxide diffusion tube (D5 on the map Appendix D) continues to be operated at a nearby roadside location on Woodland Road to provide an on-going measure of nitrogen dioxide trends.

The locations of the two monitoring sites are shown on the map, Appendix D. Further details on how the monitors were calibrated and how the data has been adjusted are included in Appendix C.

3.1.2 Non-Automatic Monitoring Sites

Darlington Borough Council undertook non-automatic (passive) monitoring of NO_2 at 10 sites during 2016. Table A.2 in Appendix A shows the details of the sites. Three of the tube positions have been completely relocated since the 2016 ASR (D2 Darlington College moved to Haughton Road, D3 Arts Centre moved to Swinburne Road and D10 Middleton-one-Row moved to St Cuthbert's). Apart from the background diffusion tube at Swinburne Road the new locations are considered to be more reflective of worst case exposure locations.

Maps showing the location of the monitoring sites are provided in Appendix D. Further details on Quality Assurance/Quality Control (QA/QC) for the diffusion tubes, including bias adjustments and any other adjustments applied (e.g. "annualisation" and/or distance correction), are included in Appendix C. These diffusion tubes are 50% TEA in acetone, supplied and analysed by Gradko International Ltd. The results are adjusted for bias using factors from the laboratory (Gradko) overall bias factor, as there is no triple tube location study.

3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias, "annualisation" and distance correction. Further details on adjustments are provided in Appendix C.

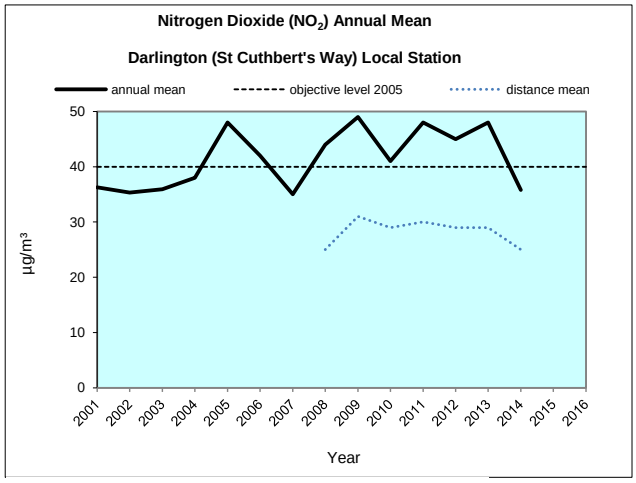
3.2.1 Nitrogen Dioxide (NO_2)

Table A.3 in Appendix A compares the ratified and adjusted monitored NO_2 annual mean concentrations (for diffusion tubes and continuous monitors when in operation) for the past 5 years with the air quality objective of 40µg/m^3. For diffusion tubes, the full 2016 dataset of monthly mean values is provided in Appendix B.

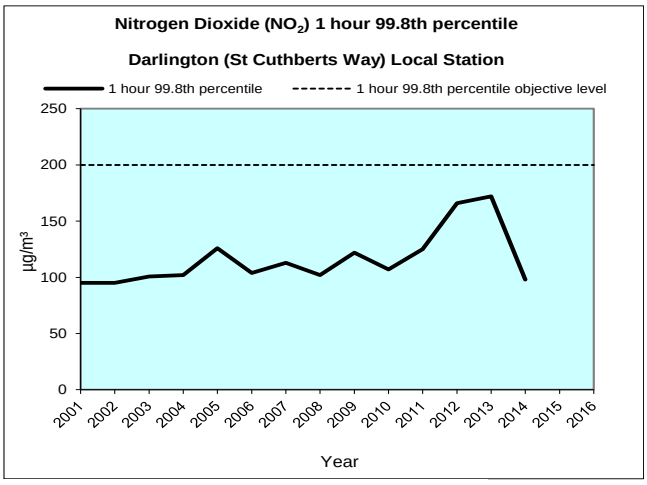
Table A.4 in Appendix A compares the ratified continuous monitored NO_2 hourly mean concentrations for the past 5 years with the air quality objective of 200µg/m^3, not to be exceeded more than 18 times per year. There have been no exceedances of the annual mean (in areas of relevant exposure) or 1 hour mean objectives at any monitoring location.

Historical nitrogen dioxide trend graphs at the Darlington St Cuthbert's Way and Cockerton Bridge continuous monitoring stations are shown below, along with the nitrogen dioxide diffusion tube trends. The blue trend line shown on the St Cuthbert's Way graph is the expected concentration at the nearest point of relevant public exposure 20 metres away, using the fall off with distance method given in the Technical Guidance (Reference 2).

St Cuthbert's Way (no relevant exposure for the annual mean)



Closed December 2014



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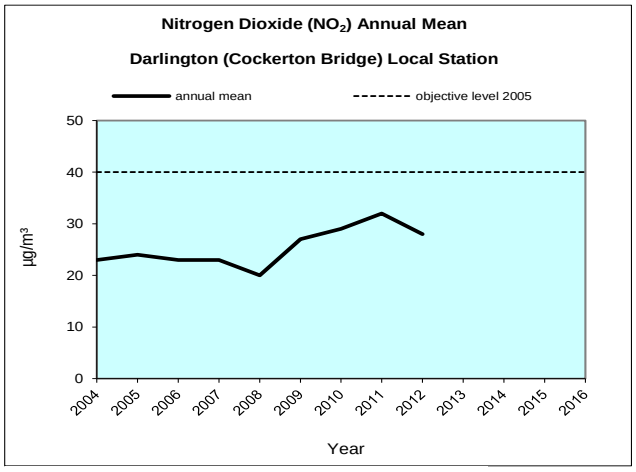
Cockerton Bridge



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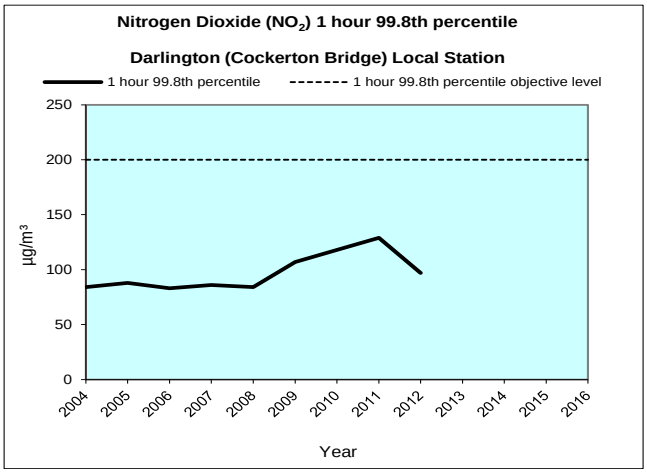

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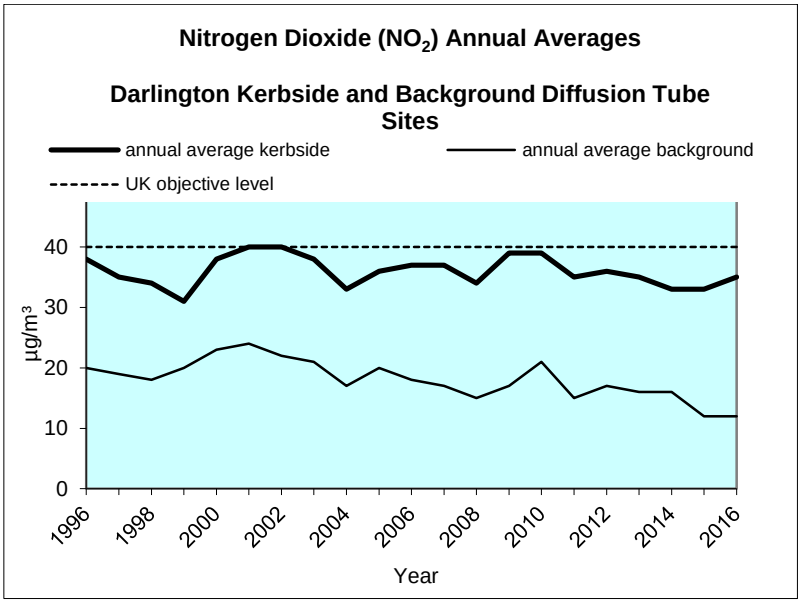
Diffusion Tube Annual Average Trends



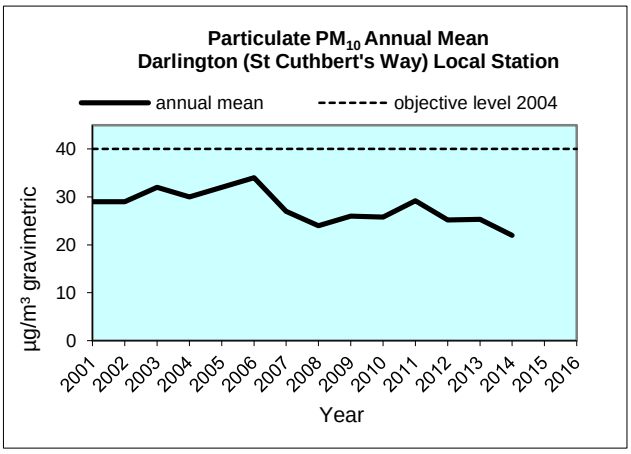
3.2.2 Particulate Matter (PM_{10})

Table A.5 in Appendix A compares the ratified and adjusted continuously monitored PM_{10} annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3.

Table A.6 in Appendix A compares the ratified continuous monitored PM_{10} daily mean concentrations for the past 5 years with the air quality objective of 50µg/m^3, not to be exceeded more than 35 times per year.

There have been no exceedances of the annual mean or daily mean objective in areas of relevant public exposure. The exceedance variations year on year at the St Cuthbert's Way site are due to weather conditions, with high pressure episodes in winter months causing rapid particulate build-up. Particulate PM_{10} trend graphs at the Darlington St Cuthbert's Way and Cockerton Bridge continuous monitoring stations are shown below and overleaf.

St Cuthbert's Way (no relevant public exposure for the annual mean or daily mean)



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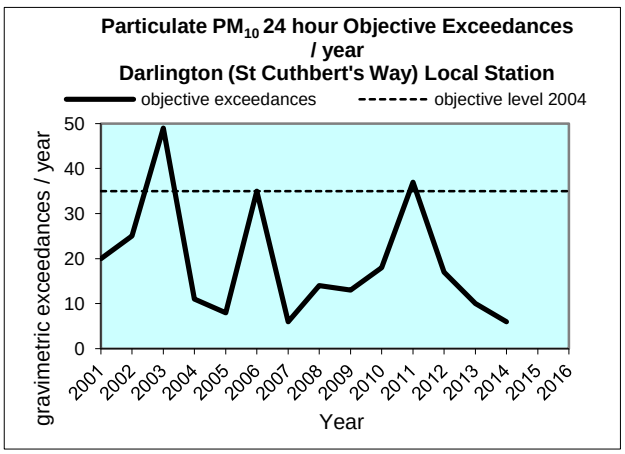
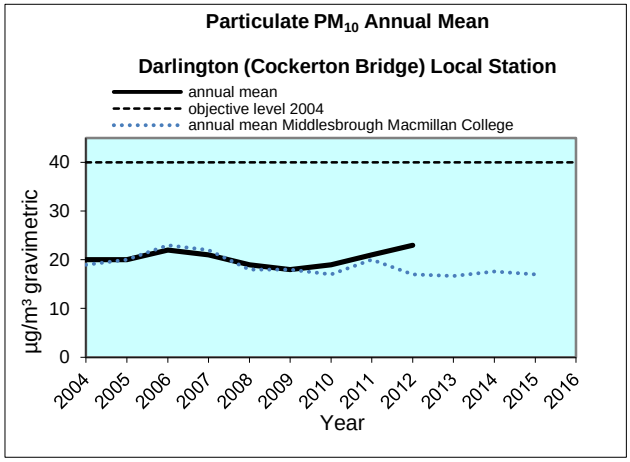
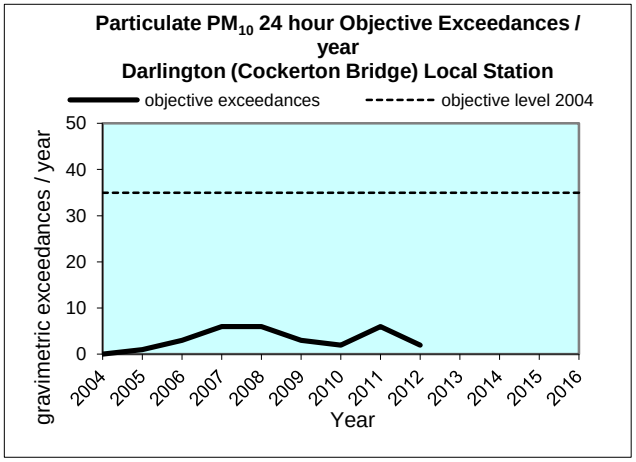


Closed December 2014

Cockerton Bridge





(Middlesbrough MacMillan College data added to indicate probable trend 2011-2015)

Closed April 2012

Closed April 2012

3.2.3 Particulate Matter ($PM_{2.5}$)

Table A.7 in Appendix A presents the derived $PM_{2.5}$ annual mean concentrations as available for the past 5 years using the nationally derived factor of 0.7 applied to the particulate PM_{10} results at the St Cuthbert's and Cockerton Bridge sites. Also shown are the annual means recorded at the Middlesbrough and Stockton AURN sites, which are located in areas of relevant public exposure, and indicative of Darlington locations.

The derived annual mean for St Cuthbert's has fallen from 20.5µg/m^3 in 2011 to 15.6µg/m^3 in 2014. This site is a kerbside site, and fully reflects road traffic emissions. There is insufficient data at the Cockerton Bridge site. The actual monitored levels at the Middlesbrough and Stockton sites range between 10.1µg/m^3 and 13.1µg/m^3 over the same period (2011-2014) and more recently from 2015-2016 ranged between 9.2µg/m^3 and 10.7µg/m^3. These stations are more representative of urban traffic and relevant public exposure locations. Weather conditions are thought to be the major influence on year by year variations.

3.2.4 Sulphur Dioxide (SO_2)

Darlington Borough Council no longer monitors sulphur dioxide concentrations, and there is no requirement in the absence of industrial sources or significant domestic coal burning. For many years, Darlington did monitor sulphur dioxide concentrations in the town centre using an 8 port sampler, but this site was closed in 2004 when sulphur dioxide concentrations fell below the limit of detection.

Sulphur dioxide monitoring results from other Tees Valley Councils with significant emissions from the chemical and steel industries, consistently show the objectives being met, and this will be the case within the Darlington Council area.

Appendix A: Monitoring Results

Table A.1 – Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
StC (closed December 2014)	St Cuthbert's Way (Local)	Kerbside	429032	514818	NO_2, PM_{10}	N	NO_2 - Chemiluminescence PM_{10} - TEOM (vcm correction)	20m	0.5m	NO_x 1.9 TEOM 2.0
Co (closed April 2012)	Cockerton Bridge (Local)	Urban Centre	427528	515309	NO_2, PM_{10}	N	NO_2 - Chemiluminescence PM_{10} - TEOM (vcm correction)	20m	10m	2.9

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property).

(2) N/A if not applicable.

Table A.2 – Details of Non-Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
D1	Northgate	Kerbside	429026	514898	NO_2	NO	N/A	<1 (0.6)	NO	2.6
D2	Haughton Road	Roadside	429351	514819	NO_2	NO	1	2.2	NO	2.5
D3	Swinburne Road	Urban Background	428232	514512	NO_2	NO	1	1.7	NO	2.3
D4	Salters Lane	Roadside	429478	517375	NO_2	NO	5	1	NO	2.8
D5	Woodland Rd	Roadside	428152	514966	NO_2	NO	20	1.6	NO	2.9
D6	Blackwell Bridge	Roadside	427734	512591	NO_2	NO	10	2.5	NO	2.6
D7	North Rd Station	Roadside	429007	515504	NO_2	NO	3	1.6	NO	3.0
D8	Haughton Green	Kerbside	430905	515918	NO_2	NO	20	<1 (0.79)	NO	2.5
D9	Yarm Road	Roadside	431299	514137	NO_2	NO	20	1	NO	2.6
D10	St Cuthbert's	Kerbside	429170	514534	NO_2	NO	N/A	<1 (0.73)	NO	2.4

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on/adjacent to the façade of a residential property). Distance to relevant exposure from monitoring position.

(2) N/A if not applicable. Distance to kerb of nearest road from monitoring position.

Table A.3 – Annual Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3)				
					2012	2013	2014	2015	2016
StC (closed December 2014)	Kerbside	Automatic	100	N/A	**44.6**(28.8) [a]	**48.4**(28.8) [a]	35.7(24.8) [a]	-	-
Co (closed April 2012)	Urban Centre	Automatic	100	N/A	27.8	-	-	-	-
				Bias factor	1.02	1.01	0.98	0.96	1.01
D1	Kerbside	Diffusion Tube	100	83	39.9	36.3	34.4	32.8	35.7
D2	Roadside	Diffusion Tube	100	67	19.3	18.3	17.5	12.9	28.5
D3	Urban background	Diffusion Tube	100	17	14.4	14.2	13.6	10.8	12.0
D4	Roadside	Diffusion Tube	100	33	36.6	34.2	30.6	29.8	26.6
D5	Roadside	Diffusion Tube	100	100	33.1	29.1	29.5	24.9	16.6
D6	Roadside	Diffusion Tube	100	75	32.4	36.9	37.7	38.0	25.1
D7	Roadside	Diffusion Tube	100	75	32.8	33.4	31.0	35.4	31.6
D8	Kerbside	Diffusion Tube	100	100	37.7	36.3	35.8	33.2	20.2
D9	Roadside	Diffusion Tube	100	75	29.4	26.2	27.0	24.2	17.5
D10	Kerbside	Diffusion Tube	100	83	10.1	10.3	9.3	8.3	35.0

(Figures in brackets for St Cuthbert's Way are the projected public exposure concentration annual means derived from the NO_2 fall off with distance calculator at 20 metres, the nearest point of relevant public exposure.)

☒ **Diffusion tube data has been bias corrected**

☒ **Annualisation has been conducted where data capture is <75%**

☒ **If applicable, all data has been distance corrected for relevant exposure**

Notes:

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **bold and underlined.**

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

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) Means for diffusion tubes have been corrected for bias. All means have been "annualised" as per Boxes 7.9 and 7.10 in LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Table A.4 – 1-Hour Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	NO_2 1-Hour Means > 200µg/m^3 (3)				
					2012	2013	2014	2015	2016
StC (closed December 2014)	Kerbside	Automatic	100	N/A	1 (166)	4 (172)	0 (98)	-	-
Co (closed April 2012)	Urban Centre	Automatic	100	N/A	0 (97)	-	-	-	-

Notes:

Exceedances of the NO_2 1-hour mean objective (200µg/m^3 not to be exceeded more than 18 times/year) are shown in **bold.**

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

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

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

Table A.5 – Annual Mean PM_{10} Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	PM_{10} Annual Mean Concentration ($\mu g/m^3$) (3)				
				2012	2013	2014	2015	2016
StC (closed December 2014)	Kerbside	100	N/A	25.2	25.3	22.8	-	-
Co (closed April 2012)	Urban Centre	100	N/A	22.8	-	-	-	-

☒ **Annualisation has been conducted where data capture is <75%**

Notes:

Exceedances of the PM_{10} annual mean objective of 40$\mu g/m^3$ are shown in **bold.**

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

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) All means have been "annualised" as per Boxes 7.9 and 7.10 in LAQM.TG16, valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Table A.6 – 24-Hour Mean PM_{10} Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	PM_{10} 24-Hour Means > 50µg/m^3 (3)				
				2012	2013	2014	2015	2016
StC (closed December 2014)	Kerbside	100	N/A	17 (43)	10 (40)	6 (37)	-	-
Co (closed April 2012)	Urban Centre	100	N/A	2 (39)	-	-	-	-

Notes:

Exceedances of the PM_{10} 24-hour mean objective (50µg/m^3 not to be exceeded more than 35 times/year) are shown in **bold.**

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

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.

Table A.7 – $PM_{2.5}$ Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2016 (%) [2]	$PM_{2.5}$ Annual Mean Concentration ($\mu g/m^3$) [3]				
				2012	2013	2014	2015	2016
StC (closed December 2014)	Kerbside	100	N/A	17.6	17.7	16.0	-	-
Co (closed April 2012)	Urban Centre	100	N/A	16.0	-	-	-	-
Stockton-on-Tees Eaglescliffe	Roadside	100	87	11.4	10.1	10.9	10.7	9.2
Stockton-on-Tees A1305 Nelson Terrace	Roadside	83	83	N/A	N/A	N/A	N/A	9.5
Middlesbrough Breckon Hill	Industrial	100	96	10.2	10.8	13.1	10.5	10.2

The Stockton-on-Tees Eaglescliffe and Middlesbrough Breckon Hill sites are national network AURN stations within Tees Valley council areas. The stations are at locations of relevant public exposure and will be representative of such locations in Darlington.

☒ **Annualisation has been conducted where data capture is <75%**

Notes:

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

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) All means have been "annualised" as per Boxes 7.9 and 7.10 in LAQM.TG16, valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Appendix B: Full Monthly Diffusion Tube Results for 2016

Table B.1 – NO_2 Monthly Diffusion Tube Results - 2016

Site ID	NO_2 Mean Concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
													Raw Data	Bias Adjusted (1.01) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
D1	-	-	37.2	32.0	36.5	38.3	18.1	29.0	35.5	39.4	41.8	45.2	35.3	35.7	N/A
D2	-	36.0	27.7	24.9	24.4	27.7	16.0	22.7	-	-	38.8	-	27.3	30.1	28.5
D3	17.4	-	14.1	-	-	-	-	-	-	-	-	-	15.8	12.0	N/A
D4	-	-	-	26.3	26.4	24.3	18.8	-	-	-	-	-	23.9	34.8	26.6
D5	29.9	27.3	24.7	20.5	17.8	14.2	11.6	19.7	18.9	23.0	31.3	34.9	22.8	23.0	16.6
D6	-	-	32.4	30.3	-	27.1	22.4	31.0	33.2	37.2	43.0	43.5	33.3	33.7	25.1
D7	-	-	36.8	34.1	39.4	36.4	24.1	33.3	36.3	-	47.4	46.9	37.2	37.6	31.6
D8	38.4	42.1	32.0	29.4	27.3	28.5	21.6	27.8	30.8	36.4	43.5	46.5	33.7	34.0	20.2
D9	-	-	26.8	23.7	23.4	-	15.3	19.2	28.0	29.4	32.5	35.1	25.9	26.2	17.5
D10	33.8	35.9	-	27.9	31.1	39.5	-	26.9	31.5	41.5	38.2	40.0	34.6	35.0	N/A

☒ **National bias adjustment factor used**

☒ **Annualisation has been conducted where data capture is <75%**

Notes:

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **bold and underlined.**

(-) indicates where tube has been missing from location or results may have been compromised

(1) See Appendix C for details on bias adjustment and annualisation.

(2) Distance corrected to nearest relevant public exposure.

Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC

Air Quality Monitoring Data QA/QC

Diffusion Tube Bias Adjustment Factors

Gradko International Ltd supply and analyse nitrogen dioxide diffusion tubes for Darlington Borough Council. Tube preparation is 50% TEA in acetone. The bias adjustment factor for 2016 has been obtained from the Diffusion Tube Bias Adjustment Factors Spreadsheet collated by DEFRA, and in June 2016, was 1.01 (Reference 4). Darlington does not have a co-location study.

PM Monitoring Adjustment

All measurements for PM_{10} at the Local stations are TEOM based. Results since 2008 have been adjusted by the vcm method to provide gravimetric equivalence.

Short-term to Long-term Data adjustment

The St Cuthbert's continuous monitoring station had 10 months data only in 2014 (the last monitoring year). The nitrogen dioxide and particulate PM10 annual means were annualised using three Tees Valley continuous monitor datasets. Calculations were included within the Darlington 2015 Updating and Screening report.

Three of the ten diffusion tubes had less than 75% data capture (less than 9 months' worth of data). The data has been annualised using the results at three Tees Valley continuous monitoring sites. Calculations are shown below in table C1.

QA/QC of automatic monitoring

The two Darlington fixed continuous Local monitoring stations (both NO_x and PM_{10}), were modern installations, operated under a comprehensive service contract with the supplier, in both cases Enviro Technology. Operators of the site received supplier training.

The Council is committed to achieving accuracy, precision, data capture, traceability and long term consistency to ensure that data is representative of ambient air quality. In common with other Tees Valley Councils, Darlington had a documented quality assurance and control programme, which includes an established schedule of regular site calibrations, validation of data, and documentation of all procedures. Details are summarised as follows:

Calibration	daily 'automatic' calibration with frequent (usually fortnightly) manual checks.
	Calibration gas obtained from approved gas standard suppliers.
Equipment	a comprehensive service agreement with the supplier.
Data capture	site operators were experienced and trained personnel, monitoring data capture on a daily basis where possible to ensure that faults are detected and corrected quickly.
Ratification	data was screened, where possible on a daily basis, to check for unusual measurements. Suspicious data was investigated fully, and if found to be faulty, was deleted from the records. Particular attention is paid to possible environmental changes in the vicinity of the analyser.
	Data was recorded monthly and compared with earlier results.

QA/QC of diffusion tube monitoring

The Darlington Borough Council nitrogen dioxide diffusion tube programme is operated through an approved laboratory (Gradko International Ltd) with formal accreditation to BS standards, and one that participates in the AIR-PT programme. Particular attention is paid to proper installation of the tubes at the site, and reliable exposure duration.

Tube precision for this laboratory is consistently shown as good (except for one result) for 2016 for tube preparation 50% TEA in acetone (Reference 5). Gradko International Ltd also demonstrated 100% satisfactory performance in the AIR-PT scheme for 2016 (Reference 6).

Tables C1 & C2 - Data Adjustment for NO_2 Diffusion Tubes

Darlington Diffusion Tube Annualisation 2016

C1. Data from continuous monitors Stockton, Redcar & Cleveland and Middlesbrough

Month	Stockton Eaglescliffe	R&C Dormanstown	Middlesbrough Breckon Hill
	Monthly averages (µg/m³)		
Jan	17.4	19.2	32.0
Feb	18.8	18.3	28.5
Mar	18.4	12.8	21.8
Apr	14.9	10.5	15.5
May	13.0	6.8	12.5
Jun	15.6	4.8	13.1
Jul	5.6	7.3	7.1
Aug	7.4	7.8	7.9
Sep	12.1	8.8	12.0
Oct	19.3	8.2	17.4
Nov	20.4	16.3	24.6
Dec	22.0	18.6	24.2
Annual mean (µg/m³)	15.4	11.6	18.1

C2. Darlington diffusion tubes requiring annualisation

Tube reference	Period means	Ratios	Average Ratio
	= an average of the months with data for specific Darlington tubes	= annual mean/period mean	=average of the ratios
D2 (8 mths)	14.3; 10.6; 16.4	1.077; 1.094; 1.104	**1.092**
D3 (2 mths)	17.9; 16; 26.9	0.860; 0.725; 0.673	**0.753**
D4 (4 mths)	12.3; 7.4; 12.1	1.252; 1.568; 1.496	**1.439**

Table C3 - Distance correction for NO_2

Tube reference	Distance of measurement position from kerb (m)	Distance of receptor from measurement position (m)	Distance of receptor from kerb (m)	Local annual mean background NO_2 concentration ($\mu g/m^3$) (measured)	Measured annual mean NO_2 concentration ($\mu g/m^3$)*	Predicted annual mean NO_2 concentration at receptor ($\mu g/m^3$)
D1	<1 (0.6)	N/A	N/A	12.0	35.7	N/A
D2	*2.2*	1	*3.2*	*12.0*	*30.1*	28.5
D3	*1.7*	1	*2.7*	*12.0*	*12.0*	N/A**
D4	*1*	5	*6*	*12.0*	*34.8*	26.6
D5	*1.6*	20	*21.6*	*12.0*	*23.0*	16.6
D6	*2.5*	10	*12.5*	*12.0*	*33.7*	25.1
D7	*1.6*	3	*4.6*	*12.0*	*37.6*	31.6
D8	*<1 (0.79)*	20	*20.79*	*12.0*	*34.0*	20.2
D9	*1*	20	*21*	*12.0*	*26.2*	17.5
D10	<1 (0.73)	N/A	N/A	12.0	35.0	N/A

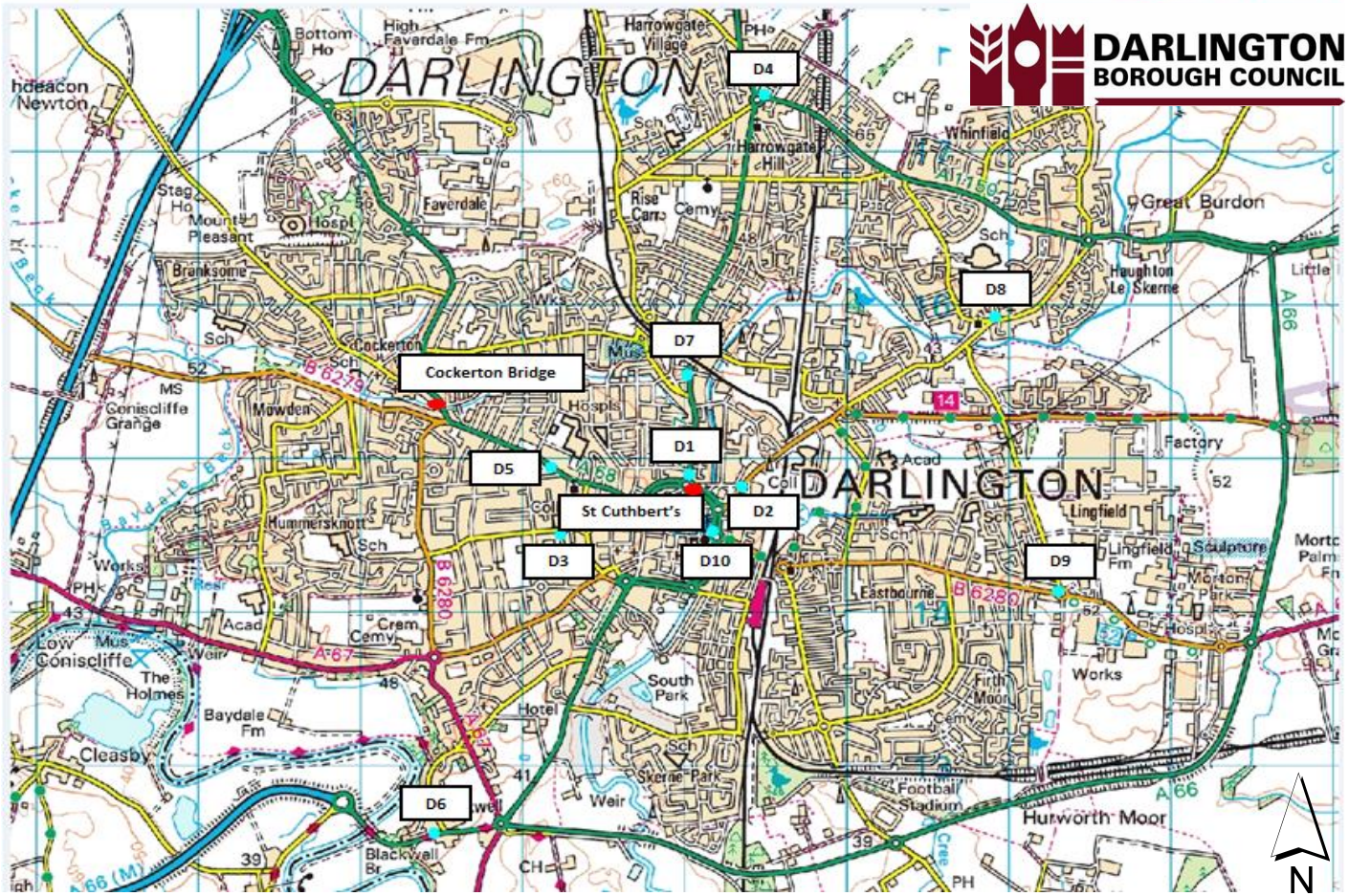
* Figures take into account annualisation and bias adjustment
** Calculator requires measured concentration to be above background

The predicated annual mean concentration at the receptor was calculated using the Nitrogen Dioxide fall off with distance calculator provided by DEFRA (Reference 7). *Data inputted is shown in green and italics.*

Appendix D: Map(s) of Monitoring Locations and AQMAs

Figure D.1 Map of Automatic and Non-Automatic Monitoring Sites in Darlington Borough Council Area

D1 Northgate	D4 Salters Lane	D7 North Road Station	D10 St Cuthbert's
D2 Haughton Road	D5 Woodland Road	D8 Haughton Green	St Cuthbert's Way
D3 Swinburne Road	D6 Blackwell Bridge	D9 Yarm Road	Cockerton Bridge



Title – Location of Automatic & Non-Automatic Monitoring Sites
Scale – 1:24,000

Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England

Pollutant	Air Quality Objective[7]	
	Concentration	Measured as
Nitrogen Dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
	40 µg/m^3	Annual mean
Particulate Matter (PM_{10})	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
	40 µg/m^3	Annual mean
Sulphur Dioxide (SO_2)	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

[7] The units are in microgrammes of pollutant per cubic metre of air (µg/m^3).

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values'
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
ASR	Air quality Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
EU	European Union
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide

References

1. LAQM Policy Guidance 2016

   Published by the Department for Environment, Food and Rural Affairs, April 2016

   Available at: https://consult.defra.gov.uk/communications/laqm_changes/supporting_documents/LAQM%20Policy%20Guidance%202016.pdf

2. LAQM Technical Guidance 2016

   Published by the Department for Environment, Food and Rural Affairs, April 2016

   Available at: https://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf

3. Particulate PM2.5 Background Data for Darlington (2013)

   Department for Environment, Food and Rural Affairs, Data Archive

   Available at: https://uk-air.defra.gov.uk/data/laqm-background-home

4. National bias adjustment factors (Diffusion Tube Bias Adjustment Factors spreadsheet)

   Department for Environment, Food and Rural Affairs

   Available at: https://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html

5. LAQM Precision and Accuracy (Precision Summary Results – Summary of Diffusion Tube Precision 2008-2016)

   Department for Environment, Food and Rural Affairs

   Available at: https://laqm.defra.gov.uk/diffusion-tubes/precision.html

6. LAQM QA QC Framework AIR-PT Rounds 7 to 18 (April 2015 – Feb 2017)

   Department for Environment, Food and Rural Affairs

   Available at: https://laqm.defra.gov.uk/diffusion-tubes/qa-qc-framework.html

7. LAQM Nitrogen Dioxide fall off with distance calculator

   Department for Environment, Food and Rural Affairs

   Available at: https://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html