Belfast City Council

2018 Air Quality Updating and Screening Assessment for Belfast City Council

In fulfillment of Environment (Northern Ireland) Order 2002 - Local Air Quality Management

July 2018

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Executive Summary

Belfast City Council has completed this 2018 Updating and Screening Assessment in accordance with the provisions of the Environment (Northern Ireland) Order 2002 and the Northern Ireland Local Air Quality Management Policy Guidance document LAQM.PGNI (09).

In completing this Updating and Screening Assessment, we have undertaken a review of potentially significant sources of air pollution across the city in order to identify new sources, sources with increased emissions and locations close to air pollution sources where public exposure did not previously exist.

In addition, we have completed a review of recent ambient air quality monitoring data across the city in order to identify locations where new or existing exceedences of Air Quality Strategy objectives and European Commission limit values are occurring.

We have declared four air quality management areas across the city for exceedences of nitrogen dioxide and particulate matter short and long-term air quality strategy objectives. A review of the monitoring data for these air quality management areas indicates that there have been some recent improvements in nitrogen dioxide levels across the city. As a result, Belfast City Council considers that there may be an opportunity for revocation of the air quality management area along the Ormeau Road, where monitoring data demonstrates recent sustained improvements in annual mean nitrogen dioxide concentrations, with levels consistently below the annual mean objective. Accordingly, the council will liaise with the Department for Agriculture, Environment and Rural Affairs, Department for Infrastructure and other relevant competent authority partners before coming to a conclusion regarding the potential for revocation.

Moreover, in December 2015 the council, along with relevant partner organisations, launched a new Air Quality Action Plan (AQAP) 2015-2020 for the city that draws upon all forms of air quality and transport planning activities, including sustainable transport options as well as engineering solutions. The aim of this AQAP was to improve road vehicle operations and promote and enable a shift onto more

sustainable modes of transport to achieve compliance with the NO_2 annual mean EC limit value by 2020.

Furthermore, sustained improvements in particulate matter (PM_{10}) within the M1 Motorway / A12 Westlink air quality management area resulted in revocation for this pollutant in September 2015. This area remains however, as an air quality management area for exceedences of the annual mean objective for nitrogen dioxide.

In terms of new sources of ambient air pollution, the council has not identified any new transport sources that require a detailed assessment. In addition, it is the council's view that we do not need to proceed to a detailed assessment for any new or existing industrial processes, commercial or domestic sources within the city. Furthermore, we have assessed the impact of the fuel storage depot at Airport Road West within the Port of Belfast previously, and of the recently opened petrol stations, none meet the requirements for a detailed assessment.

Finally, the council is not aware of any new poultry farms or fugitive sources of particulate material within the city confines.

Table of contents

List of Tables

List of Tables.

List of Figures.

Appendices

1 Introduction

1.1 Description of Local Authority Area

Belfast is the capital of Northern Ireland and as such, the city, and its wider metropolitan area, is the largest settlement in the region and the second largest city on the island of Ireland with a population of around 333,871. The city lies at the head of Belfast Lough in the lower reaches of the Lagan Valley and is flanked by the Black Mountain to the west and Castlereagh Hills to the east. The Belfast City Council district area sits at the heart of the growing population of the wider Belfast Metropolitan Urban Area, which also comprises part of the surrounding district council areas of Castlereagh and Lisburn, Ards and North Down, Antrim and Newtownabbey and Mid and East Antrim.

In terms of historical air quality issues, Belfast used to experience sustained elevated levels of sulphur dioxide (SO_2) and particulate matter (PM_{10}), associated principally with the widespread use of solid fuel for domestic heating. However, through the introduction of the council's smoke control programme in the late 1960s, the Clean Air (Northern Ireland) Order 1981 and the more recent availability of natural gas to domestic, commercial and industrial sectors, levels of particulate matter and sulphur dioxide have declined substantially over recent years to the extent that we do not experience exceedences of any of the air quality strategy objectives, or indeed European Commission limit values, for sulphur dioxide. Exceedences of the objectives for particulate matter were restricted to a major arterial road transport route that traverses the city. Accordingly, the number of locations where we monitor these ambient pollutants has been reduced over recent years in accordance with the government's risk and exposure-based approach to air quality management.

As levels of sulphur dioxide and particulate matter have declined across the city over recent years, so emissions of nitrogen dioxide, associated principally with road transport, have become more prominent. This is a similar situation to that experienced in many other major cities and conurbations across the United Kingdom. Accordingly, as a result of the first round of the review and assessment process,

which was completed in 2004, Belfast City Council opted to declare four air quality management areas across the city for a combination of both modelled and monitored exceedences of nitrogen dioxide and particulate matter for short and longer-term objectives. We published our first Air Quality Action Plan for the city in 2006 and it was completed substantially in 2010 with around 90% of planned actions delivered to schedule. Of the outstanding 10% of actions, it is considered that the majority of these would have had limited additional impact within our air quality management areas.

Although Belfast City Council is directed to comply with the provisions of the Air Quality Strategy for England, Scotland, Wales and Northern Ireland via Part III of the Environment (Northern Ireland) Order 2002, the council is aware also of the pressing need to achieve European Commission air quality limit values at national level in accordance with the schedules prescribed in Directive 2008/50/EC in respect of ambient air quality and cleaner air for Europe and the 4th Daughter Directive. It should be noted that the deadline for achieving limit values for nitrogen dioxide was 1st January 2010 but unfortunately this was not achieved at all locations across the city.

In order to address elevated levels of nitrogen dioxide, the council along with relevant partners developed a new Air Quality Action Plan for the city that contains a manageable number of proven air quality mitigation measures. The new Air Quality Action Plan, covering the period 2015 -2020, was published in December 2015.

1.2 Purpose of Report

This report fulfils the requirements of the Local Air Quality Management process as set out in the Environment (Northern Ireland) Order 2002, the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 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 exceedences are 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.

The purpose of this Updating and Screening Assessment is to identify any matters that have changed which may lead to risk of an air quality objective being exceeded. A checklist approach and screening tools are used to identify significant new sources or changes and whether there is a need for a Detailed Assessment. The USA report should provide an update of any outstanding information requested previously in Review and Assessment reports.

1.3 Air Quality Objectives

The air quality objectives applicable to LAQM **in Northern Ireland** are set out in the Air Quality Regulations (Northern Ireland) 2003, Statutory Rules of Northern Ireland 2003, no. 342, and are shown in Table 1.1. 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 1.1 Air Quality Objectives included in Regulations for the purpose of LAQM in Northern Ireland

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 μg/m^3	Running annual mean	31.12.2003
	3.25 μg/m^3	Running annual mean	31.12.2010
1,3-Butadiene	2.25 μg/m^3	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 μg/m^3	Annual mean	31.12.2004
	0.25 μg/m^3	Annual mean	31.12.2008
Nitrogen dioxide	200 μg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 μg/m^3	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 μg/m^3, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004

	40 µg/m^3	Annual mean	31.12.2004
Sulphur dioxide	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

1.4 Summary of Previous Review and Assessments

As part of the review and assessment process, Belfast City Council completed a 2nd and 3rd stage review and assessment of air quality throughout the city in early 2004. This assessment concluded that modelled and monitored exceedences of short and longer-term objectives for both nitrogen dioxide and particulate matter were occurring in the city and would be likely to continue to do so in some locations beyond 2010. Consequently, in August 2004 the council, in consultation with other relevant authorities, declared four Air Quality Management Areas (AQMA), comprising the M1 Motorway and Westlink corridor, Cromac Street to the junction of Short Strand, Woodstock Link and the Albertbridge Road, the Upper Newtownards Road and the Ormeau Road.

The M1-Westlink AQMA was declared on the basis that annual and hourly-mean nitrogen dioxide concentrations would exceed the 2005 Air Quality Strategy objectives. In addition, particulate matter annual and 24-hour mean concentrations were predicted also to exceed relevant objectives in this location. The three other air quality management areas were declared on the grounds that the annual mean nitrogen dioxide objective would be exceeded in these locations during 2005 and beyond. A subsequent source apportionment study, completed for the air quality management areas, indicated that the principal cause of the exceedences was emissions emanating from road transportation.

Current air quality management areas are described and depicted in more detail as follows:

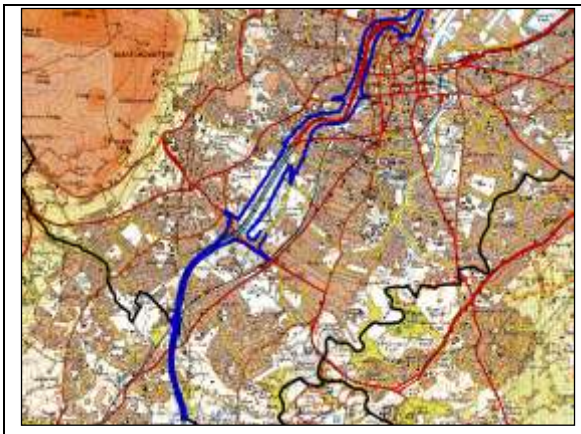
1. The M1 / Westlink corridor from the Belfast City boundary at Sir Thomas and Lady Dixon Park to the end of the Westlink at the junction with Great George's Street and York Street including Stockman's Lane and Kennedy Way. This area was declared for predicted exceedences of both the nitrogen dioxide and particulate material annual mean air quality strategy objectives as well as exceedences of the particulate matter 24-hour mean objective and the nitrogen dioxide 1-hour mean objective. The boundary of the air quality management area is denoted in blue and has been set to take account of dispersion modelling uncertainties. This area was revoked for exceedences of particulate matter in September 2015, but it continues to exceed air quality objectives for nitrogen dioxide.

2. Cromac Street to the junction with East Bridge Street and then from East Bridge Street to the junction with the Ravenhill and Albertbridge Roads and Short Strand. This area was declared for predicted exceedences of the nitrogen dioxide annual mean air quality strategy objective.

3. The Upper Newtownards Road from the North Road junction to the Belfast City boundary at the Ulster Hospital incorporating the Knock Road to the City boundary at Laburnum Playing Fields and Hawthornden Way. This area was declared for predicted exceedences of the nitrogen dioxide annual mean air quality strategy objective. The Belfast City Council boundary with Castlereagh Borough council is denoted by the solid black line.

4. The Ormeau Road from the junction with Donegall Pass to the City boundary at Galwally. This area was declared for predicted exceedences of the nitrogen dioxide annual mean air quality strategy objective.

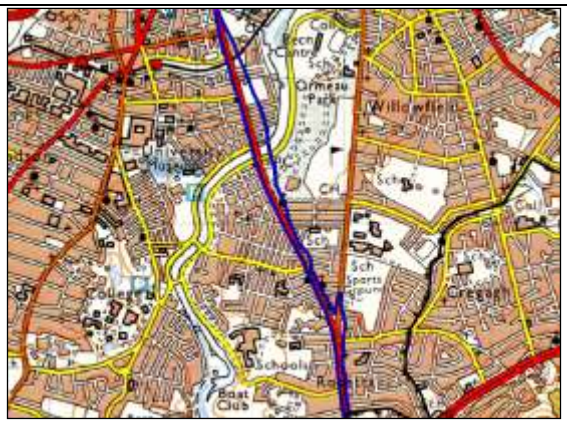
Figure 1.1 Maps of AQMA Locations and Boundaries



1. **M1-Westlink AQMA**

2. **Cromac Street and Albertbridge Street AQMA**

3. **Upper Newtownards Road AQMA**



4. **Ormeau Road AQMA**

A further detailed air quality assessment was completed by Belfast City Council in 2010, informed by the outcome of the 2009 Updating and Screening Assessment. Accordingly, the 2010 detailed assessment considered the potential for exceedences of the nitrogen dioxide objectives at a number of further locations across the city including the junction of the Sydenham Bypass with the Lower Newtownards Road, Shaftesbury Square, Donegall Road and Albertbridge Road, and at locations throughout the city centre. Although atmospheric dispersion modelling studies, undertaken as part of the detailed review and assessment process, did suggest exceedences of the nitrogen dioxide annual mean objective at some the of above-mentioned locations, the review and assessment identified also that there was no relevant public exposure at these locations during 2010. As a result, the 2010 Detailed Air Quality Assessment for Belfast City Council concluded that there was no need to declare further air quality management areas or to expand or revoke the existing AQMAs. This view was accepted by government.

Ambient air quality monitored results, presented in previous annual progress and update and assessment reports, identified sustained improvements in particulate matter within the M1 Motorway / A12 Westlink air quality management area confirming that it has been in compliance with the objective for a number of years now. This has resulted in the Westlink / M1 AQMA being revoked for particulate matter in September 2015.

For reference and additional background information, historical Belfast City Council air quality review and assessment reports are listed in the following table and are available to download from the Department of Agriculture, Environment and Rural Affairs 'Northern Ireland Air' website.

Table 1.2 Historical Belfast City Council Air Quality Reports.

Title	Publication date
2017 Progress Report	June 2017
2016 Progress Report	April 2016
2012 Updating and Screening Assessment	April 2015
2014 Progress Report	April 2014
2013 Progress Report	April 2013
2012 Updating and Screening Assessment	April 2012
2011 Progress Report	April 2011
2010 Detailed Assessment	September 2010
2010 Progress Report	April 2010
2009 Updating and Screening Assessment	April 2009
2008 Progress Report	April 2008
2007 Detailed Assessment	April 2007
2007 Progress Report	April 2007

*All Historical Belfast City Council Air Quality Reports are available at:
http://www.airqualityni.co.uk/laqm/district-council-reports

2 New Monitoring Data

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

Belfast City Council operates a number of automatic monitoring stations across the city in order to inform its air quality management processes and to provide real time information to the public in relation to pollution levels within our air quality management areas.

Accordingly, to ensure that the data from our sites is both accurate and representative, the monitors at each site are calibrated on a biweekly (Stockmans Lane AURN site) or four-weekly basis by the council's technical staff in accordance with the procedures detailed in the Defra Automatic Urban and Rural Network (AURN) local site operators' manual. In addition, data management, quality assurance and quality control and service and maintenance support are all provided by appointed contractors. The data from our sites is made available to the Department of Agriculture, Environment and Rural Affairs and is reported on the 'Northern Ireland Air' website. For consistency, all automatic monitoring data reported in this Updating and Screening Assessment report has been obtained from the 'Northern Ireland Air' website. Automatic data reported in this report relates to the calendar year (i.e. January – December) and data capture levels exceed substantially the Department's 75% data capture threshold for the calculation of annual statistics at all sites. Further information regarding our QA/QC procedures and processes can be obtained in Appendix A to this report.

In relation to data correction for our automatic data, this process is generally of principal concern with regard to the treatment of particulate matter monitoring data. The Belfast Centre site uses Filter Dynamics Measurement System (FDMS) equipped Tapered Element Oscillating Microbalance (TEOM) for particulate matter (PM_{10}) monitoring. Government equivalence tests have determined that this equipment meets the equivalence criteria, and on that basis, no correction factor needs to be applied to this monitoring data.

The Stockmans Lane site is equipped with a Beta Attenuation Monitor (BAM) with unheated inlet for monitoring particulate matter. Government technical guidance highlights that a BAM, equipped with an unheated inlet, also meets the equivalence criteria for PM_{10} monitoring, provided that the results are corrected for slope. This correction involves dividing measured concentrations by a factor of 1.21. It should be noted that the data presented on the Northern Ireland Air website and in this report, has already been corrected to the reference equivalent.

A location map for monitoring sites relative to the Greater Belfast area is shown in Figure 2.1. Site details are provided in Table 2.1.

Figure 2.1 Map of Automatic Monitoring Sites

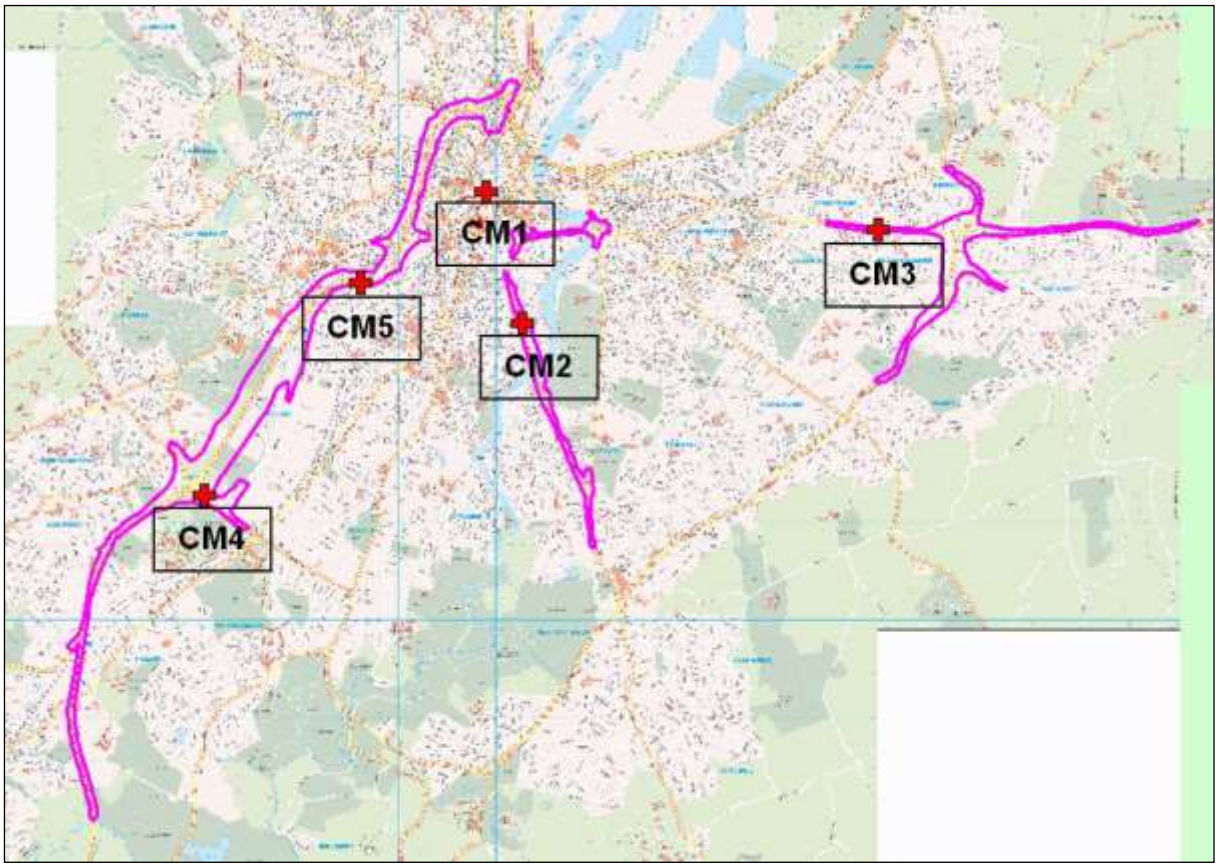


Table 2.1 Details of Automatic Monitoring Sites

Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Does this location represent worst-case exposure?
Belfast Centre AURN site Lombard Street	Urban Background	333898	374358	Nitrogen dioxide, sulphur dioxide, carbon monoxide, ozone and particulate matter (PM_{10} and $PM_{2.5}$)	N	Chemiluminescence, UV Fluorescence, IR Absorption, UV Absorption, TEOM (Tapered Element Oscillating Microbalance) with FDMS (Filter Dynamics Measurement System) Sharp Cut Cyclone for $PM_{2.5}$	Y (monitoring site is located in a city centre pedestrian precinct)	30 m	Y
Belfast Ormeau Road	Roadside	334272	373012	Nitrogen dioxide	Y	Chemiluminescence	Y (6 m)	3 m	Y
Belfast Ballyhackamore	Roadside	337911	373972	Nitrogen dioxide	Y	Chemiluminescence	Y (7 m)	1.5 m	Y
Belfast Stockman's Lane	Roadside	331010	371252	Nitrogen dioxide and Particulate matter (PM_{10})	Y	Chemiluminescence Beta Attenuation Monitor	Y (6 m to façade of housing and 1m to gardens)	2 m	Y
Belfast Westlink Roden Street	Roadside	332617	373431	Nitrogen dioxide	Y	Chemiluminescence	Y (20 m)	5 m	Y

2.1.2 Non-Automatic Monitoring Sites

The government's risk and exposure-based approach to air quality management means that Belfast City Council's principal focus has been on addressing city-wide ambient nitrogen dioxide levels over recent years. Accordingly, in order to understand how nitrogen dioxide levels are varying across the city and in addition to our automatic analysers, the council operates a range of passive diffusion tubes for monitoring nitrogen dioxide at both background and roadside locations across the city. These locations are detailed in Figure 2.2 and Table 2.2.

Diffusion tubes are comprised of a small clear plastic tube containing a chemical reagent supported on stainless steel grids that absorbs the pollutant directly from the air. In this case, triethanolamine is used to monitor levels of ambient nitrogen dioxide. Belfast City Council's diffusion tubes are exposed for successive four-week periods generally in accordance with the dates recommended by Defra and, as a result, they provide a good general indication of average nitrogen dioxide concentrations, thereby allowing a comparison with the annual mean objective.

To ensure that experimental error is minimised in the preparation and analysis of its nitrogen dioxide diffusion tubes, Belfast City Council has appointed Gradko to supply, analyse and report data for its diffusion tubes. Gradko employs a 20% triethanolamine solution for monitoring ambient nitrogen dioxide and adheres to the requirements of the government's 'Diffusion Tubes for Ambient NO_2 Monitoring: Practical Guidance for Laboratories and Users' publication.

To further ensure that its diffusion tube monitoring data is as accurate as possible, the council co-locates a number of diffusion tubes with a reference method compliant chemiluminescent nitrogen dioxide analyser at the Lombard Street, Newtownards Road, Westlink and Stockman's Lane monitoring sites. This process allows a bias adjustment factor (with a 95% confidence interval as an estimate of the uncertainty on the bias adjustment factor) to be calculated that can be used to correct the diffusion tube monitoring data. In the case of diffusion tube data presented in this report, the data has been corrected using a bias adjustment derived from the co-location study at the Belfast Centre Lombard Street AURN site. The bias calculation

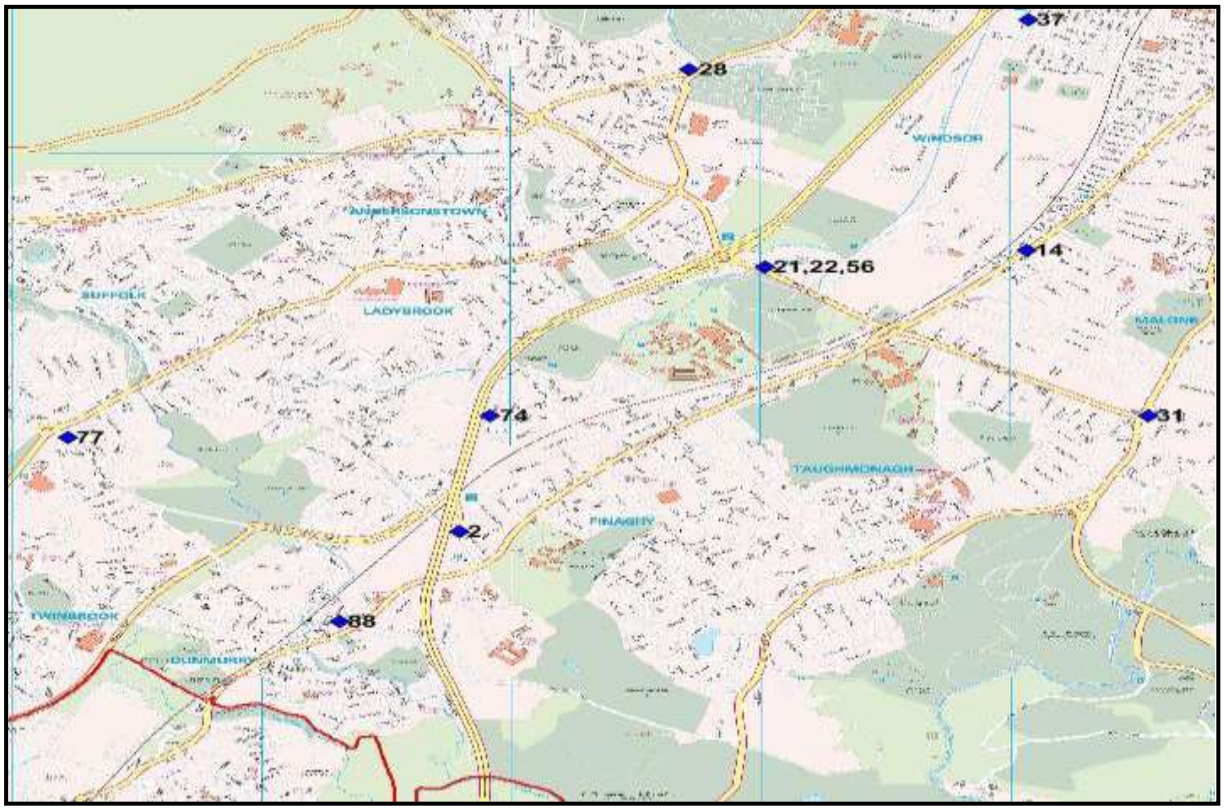
and data scaling were undertaken using Defra's 'Bias Adjustment Factor Calculation' spreadsheet. Outputs from the spreadsheet for treatment of Belfast City Council's 2017 data are included in Appendix A to this report. The outputs also show monthly nitrogen dioxide monitoring data for each diffusion tube site for 2017 where available.

Diffusion tube data has been also corrected using a national bias adjustment factor. Defra LAQM.TG(16) guidance recommends the use of a local factor over a national factor, whenever available. However, as the local adjustment factor for 2017 was much lower (0.78) than in previous years, despite the bias factor 0.78 being of good precision and acceptable within the national scheme, Belfast City Council also undertook adjustment of its diffusion tubes results using the national factor of 0.89. The purpose of this additional exercise was to identify all locations within the city where possible exceedences might occur. The overall national bias factor calculated for Gradko 20%TEA in water was 0.89. The additional calculations are included in Appendices A and B of this report.

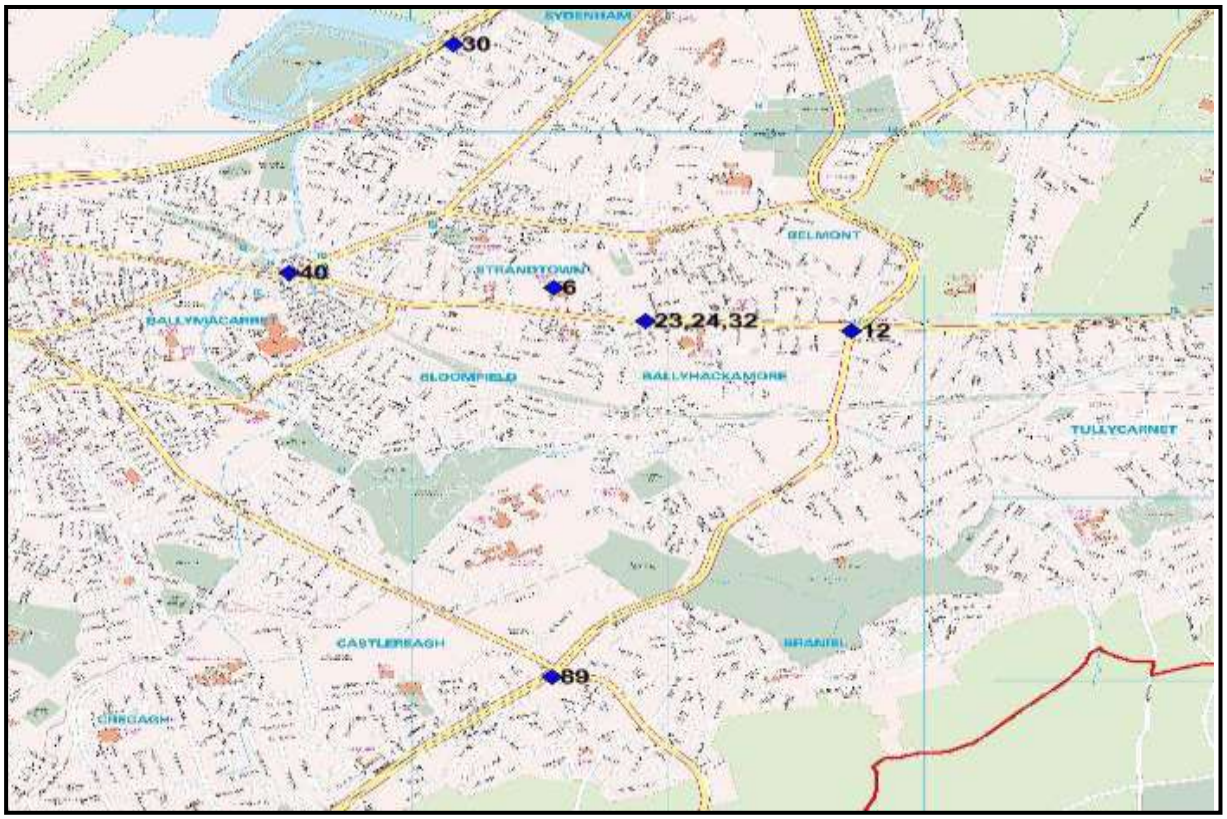
Figure 2.2 Maps of Non-Automatic Monitoring Sites

North Belfast

South Belfast



East Belfast



City Centre

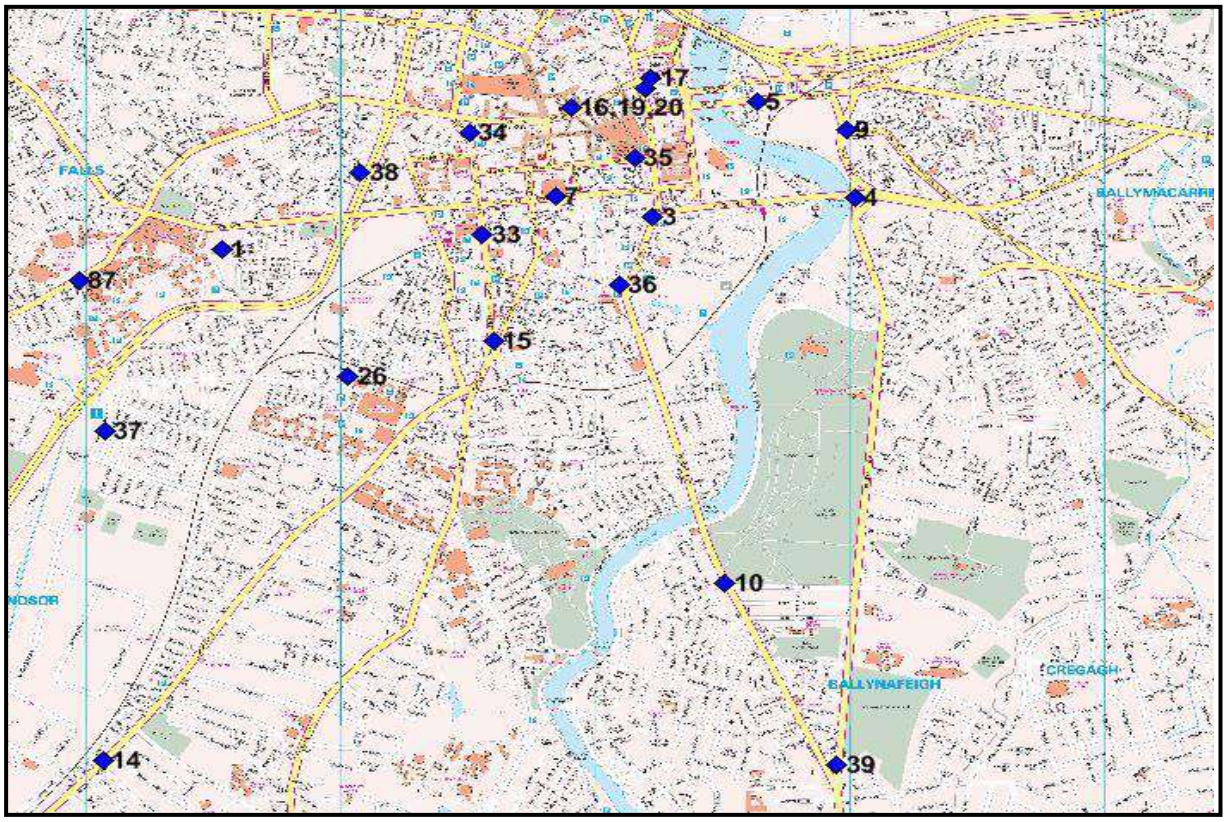


Table 2.2 Details of Non-Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Site Height (m)	Pollutants Monitored	In AQMA?	Is Monitoring Co-located with a Continuous Analyser (Y/N)	Relevant Exposure? (Y/N with distance (m) from monitoring site to relevant exposure)	Distance to Kerb of Nearest Road (m) (N/A if not applicable)	Does this Location Represent Worst-Case Exposure?
1	Royal Victoria Hospital	Urban Background	332522	373708	3.8	NO_2	N	N	>70	>80	N/A
2	Black's Road	Roadside	329782	369522	2.7	NO_2	Y	N	30	2	Y
3	61 Cromac Street	Roadside	334220	373853	3.0	NO_2	Y	N	10	3	Y
4	Ravenhill Road	Roadside	335014	373942	3.0	NO_2	Y	N	45	5	Y
5	Queen's Bridge	Roadside	334630	374385	3.0	NO_2	N	N	13	1	Y
6	North Road	Urban Background	337551	374151	3.0	NO_2	N	N	On School Wall	135	N/A
7	Donegall Square South	Roadside	333837	373950	3.5	NO_2	N	N	N	N/A	Y
9	Short Strand	Roadside	334980	374254	3.2	NO_2	N	N	28	1	Y
10	301 Ormeau Road	Roadside	334503	372176	3.0	NO_2	Y	N	25	7	Y
12	Knock Road	Roadside	338718	373918	2.5	NO_2	Y	N	27	1.5	Y
13	Great George's Street	Kerbside	333981	375102	3.0	NO_2	Y	N	40	0.5	Y
14	Lisburn Road	Roadside	332056	371364	2.7	NO_2	N	N	8	1.5	Y
15	Shaftesbury Square	Kerbside	333594	373283	2.7	NO_2	N	N	N	N/A	Y

Site ID	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Site Height (m)	Pollutants Monitored	In AQMA?	Is Monitoring Co-located with a Continuous Analyser (Y/N)	Relevant Exposure? (Y/N with distance (m) from monitoring site to relevant exposure)	Distance to Kerb of Nearest Road (m) (N/A if not applicable)	Does this Location Represent Worst-Case Exposure?
16,19,20	Lombard Street	Urban Background	333898	374358	3.5	NO_2	N	Y	N	N/A	Y
17	Albert Clock	Roadside	334212	374489	3.1	NO_2	N	N	3.5	2.5	Y
21,22,56	Stockman's Lane	Roadside	331007	371254	3.0	NO_2	Y	Y	15	2	Y
23,24,32	Ballyhackamore	Roadside	337911	373972	3.0	NO_2	Y	Y	36	1.5	Y
25	Whitewell Road	Roadside	333230	380877	2.7	NO_2	N	N	35	13	Y
26	Donegall Road	Kerbside	333022	373122	2.7	NO_2	N	N	2	1	Y
28	Falls Road and Andersonstown Road	Roadside	330707	372547	3.0	NO_2	N	N	35	2	Y
30	Station Road	Roadside	337160	375482	2.7	NO_2	N	N	28	2	Y
31	Malone Road	Roadside	332544	370283	3.0	NO_2	N	N	18	2	Y
33	Great Victoria Street	Roadside	333548	373772	3.2	NO_2	N	N	N	N/A	Y
34	College Square East	Roadside	333498	374241	3.0	NO_2	N	N	3	3	Y
35	Chichester Street	Roadside	334147	374123	3.5	NO_2	N	N	3	2	Y
36	Cromac & Ormeau Avenue	Kerbside	334085	373542	2.5	NO_2	Y	N	3	1	Y
37	Glenmachan Street	Roadside	332063	372871	3.0	NO_2	Y	N	12	2	Y

Site ID	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Site Height (m)	Pollutants Monitored	In AQMA?	Is Monitoring Co-located with a Continuous Analyser (Y/N)	Relevant Exposure? (Y/N with distance (m) from monitoring site to relevant exposure)	Distance to Kerb of Nearest Road (m) (N/A if not applicable)	Does this Location Represent Worst-Case Exposure?
38	Creche on M1/Westlink	Roadside	333069	374055	3.0	NO_2	Y	N	10	1.5	Y
39	Ormeau Road (junction with Ravenhill Road)	Roadside	334943	371342	3.0	NO_2	Y	N	10	2	Y
40	Upper Newtownards Road & Hollywood Road	Roadside	336519	374233	3.0	NO_2	N	N	40	7	Y
41	Crumlin Road	Roadside	333116	375292	3.5	NO_2	N	N	10	2	Y
42	228 Antrim Road	Roadside	333288	376143	2.7	NO_2	N	N	18	2	Y
44	Shore Road (Ivan Street end)	Roadside	334174	376384	3.0	NO_2	N	N	2.5	3.5	Y
59	York Street	Roadside	334214	375638	2.7	NO_2	Y	N	5	2	Y
63	Queens Square	Kerbside	334192	374441	2.7	NO_2	N	N	Building Façade	5	Y
74	Ardmore Park	Roadside	329908	370278	2.7	NO_2	N	N	6	1.5	Y
76	Titanic Quarter	Roadside	335073	375049	2.7	NO_2	N	N	3	1.5	Y
77	Poleglass	Roadside	328214	370138	2.7	NO_2	N	N	5	1.5	Y
87	RVH Falls Road	Roadside	331962	373560	2.7	NO_2	N	N	12	2	Y

Site ID	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Site Height (m)	Pollutants Monitored	In AQMA?	Is Monitoring Co-located with a Continuous Analyser (Y/N)	Relevant Exposure? (Y/N with distance (m) from monitoring site to relevant exposure)	Distance to Kerb of Nearest Road (m) (N/A if not applicable)	Does this Location Represent Worst-Case Exposure?
88	Dunmurry Lane	Roadside	329305	368931	2.7	NO_2	N	N	3	2	Y
89	Upper Knockbreda Rd	Kerbside	337547	372019	2.5	NO_2	N	N	18	1	Y

2.2 Comparison of Monitoring Results with Air Quality Objectives

2.2.1 Nitrogen Dioxide

Automatic Monitoring Data

Tables 2.3 and 2.4 summarise recent monitoring data from the council's nitrogen dioxide automatic analysers for 2017 and preceding years from 2013. In all cases, exceedences of the Air Quality Strategy Objectives are highlighted in bold. In addition, trends in annual mean monitoring data for nitrogen dioxide are summarised in Figure 2.3.

Annual mean concentrations at the Belfast Centre AURN site continue to remain below the 40 μ/gm^{-3} annual mean objective for nitrogen dioxide as denoted by the solid red line on the graph.

The Belfast Ormeau Road site experienced extensive problems with the air conditioning in 2012 and 2013, which prevented the monitoring equipment from working to full capacity. As this was a reoccurring problem, a decision was made towards the end of 2013 to upgrade the site infrastructure. Taking account of procurement requirements and liaison with NIE, this upgrade took a considerable length of time, to the point that data capture from this site was so low that it was not considered reliable to report for 2013. In addition, we would express some reservations about the reliability of the 2012 monitoring data as it does not appear to follow any established trends.

Following the site upgrade, the annual mean concentration has remained constant at 28 μgm^{-3} in 2014, 27 μgm^{-3} in 2015, 28 μgm^{-3} in 2016 and 25 μgm^{-3} in 2017.

On the basis of this data, which demonstrates sustained improvements in annual mean nitrogen dioxide concentrations, with levels much below the air quality objective, the council will now consider the case for revoking the Ormeau Road air quality management area for exceedence of the nitrogen dioxide annual mean

objective. Accordingly, the council will liaise with the Department for Agriculture, Environment and Rural Affairs and Department for Infrastructure before coming to a conclusion regarding the potential for revocation.

From the data in Table 2.3, it can be seen that annual mean concentrations of nitrogen dioxide along the Upper Newtownards Road have remained in the range 31 – 35 μgm^{-3} since 2014, meaning that the nitrogen dioxide annual mean objective is now being consistently achieved along the Upper Newtownards Road. However, the Knock Road roadside diffusion tube, located at the junction of the Upper Newtownards Road, Hawthornden Way and the Knock Road has recorded exceedences of the annual mean objective in previous years up until 2017. 2017 is the first year when the annual mean concentration along Knock Road was below the air quality objective. The council will therefore continue to monitor nitrogen dioxide concentrations along the Upper Newtownards Road in order to determine whether this improvement in ambient conditions is sustained and what implications it may have for the air quality management area. It is noted that the Belfast Rapid Transit Glider is scheduled to commence operation along this route from September 2018 which may have the potential to result in some short-lived impacts on traffic movements and pollution levels during the commencement phase.

Unfortunately, despite the completion of significant structural improvements to the M1 Motorway and A12 Westlink corridor, nitrogen dioxide concentrations along Stockmans Lane continue to significantly exceed the 40 μgm^{-3} annual mean objective, with levels typically averaging around 51 μgm^{-3} over the last three years. There are a number of residential premises directly adjacent to the carriageway at Stockmans Lane necessitating continuation of the air quality management area at this location.

Concentrations monitored at the Westlink Roden Street site remain below the 40 μgm^{-3} annual mean objective, with a mean annual average of 36μgm^{-3} over the last three years. The council will continue to monitor the Westlink Corridor / M1 air quality

management area until a more definitive understanding of nitrogen dioxide concentrations and trends emerge.

Historically, modelled and monitored exceedences of the 1-hour mean objective for nitrogen dioxide were encountered only in the vicinity of the M1 Motorway / A12 Westlink corridor. As a result, this is the only air quality management area within Belfast that has been declared on the basis of exceedences of the 1-hour objective.

From ambient monitoring data for Stockman's Lane, as summarised in Table 2.4, it can be seen that the number of exceedences of the hourly objective has substaintally decreased in the last three years, demonstrating compliance with the 200 μgm^{-3} objective, not to be exceeded more than 18 times per year. As there are residential properties located directly adjacent to the carriageway in Stockman's Lane and most of these properties have gardens facing onto the roadway, thereby providing for short-term relevant public exposure, we will continue to monitor at this locaiton in order to identify and establish trends.

Table 2.3 Results of Automatic Monitoring of Nitrogen Dioxide: Comparison with Annual Mean Objective

Site ID	Site Type	Within AQMA?	Valid Data Capture for period of monitoring %[a]	Valid Data Capture 2017 % [b]	Annual Mean Concentration μg/m^3				
					2013* [c]	2014* [c]	2015* [c]	2016* [c]	2017 [c]
Belfast Centre	Urban Background	N	99	99	31.2	30.1	29.0	29.0	25.0
Belfast Ormeau Road	Roadside	Y	99	99	**47.0**	27.0	27.0	28.0	25.0
Belfast Ballyhackamore	Roadside	Y	100	100	37.1	35.0	33.0	35.0	31.0
Belfast Stockman's Lane	Roadside	Y	99	99	**53.0**	**56.0**	**50.0**	**50.0**	**52.0**
Belfast Westlink Roden Street	Roadside	Y	100	100	38.0	35.0	34.0	39.0	34.0

[a] i.e. data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
[b] i.e. 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" as per Boxes 7.9 and 7.10 of LAQM.TG16, if monitoring was not carried out for the full year.
*Annual mean concentrations for previous years are optional.

Figure 2.3 Trends in Annual Mean Nitrogen Dioxide Concentrations measured at Automatic Monitoring Sites

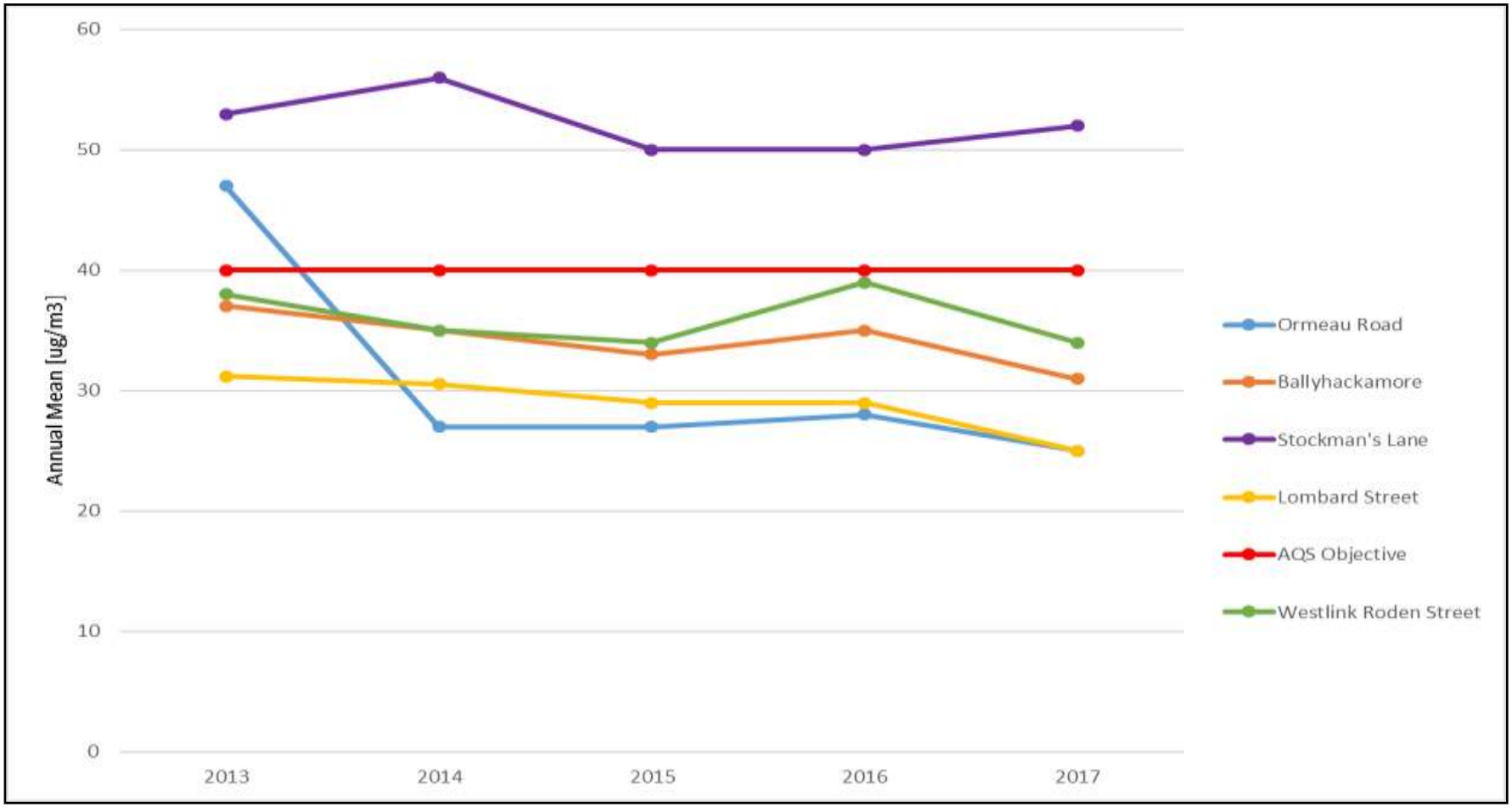


Table 2.4 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with the 1-hour mean objective

Site ID	Site Type	Within AQMA?	Valid Data Capture for period of monitoring %[a]	Valid Data Capture 2017 % [b]	Number of Exceedances of Hourly Mean (200 μg/m^3)				
					2013* [c]	2014* [c]	2015* [c]	2016* [c]	2017 [c]
Belfast Centre	Urban Background	N	99	99	2	0	0	1	1
Belfast Ormeau Road	Roadside	Y	99	99	N/A	0(98)	0	2	0
Belfast Ballyhackamore	Roadside	Y	100	100	0	2	0	1	0
Belfast Stockman's Lane	Roadside	Y	99	99	13	14	7	10	2
Belfast Westlink Roden Street	Roadside	Y	100	100	2	0	2	1	0

[a] i.e. data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
[b] i.e. 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] If the period of valid data is less than 85%, include the 99.8th percentile of hourly means in brackets
*Number of exceedences for previous years are optional.

Diffusion Tube Monitoring Data

In order to obtain a better understanding of how levels of nitrogen dioxide are varying across the city over time and to investigate those locations where previous rounds of the review and assessment process have highlighted areas of concern, Belfast City council has placed 47 diffusion tubes at 41 relevant locations across the city. Data from these tubes for 2017 has been summarised in Table 2.5 alongside historical data where it is available in Table 2.6.

In terms of the outcome of the 2017 nitrogen dioxide diffusion tube monitoring, it is noted that the concentrations have greatly improved in comparison to the previous years and currently are below the annual mean objective level at most locations. The only location which has not improved and remains above Air Quality Objective is Stockmans Lane with annual mean concentrations at 50 µg/m^3.

Stockmans Lane is located within an existing air quality management area and has been the subject of mitigation measures for some time. Defra NO_2 distance calculations have been provided for the above location to calculate concentrations at relevant receptors (Appendix B).

Defra NO_2 distance calculations have also been provided for locations with exceedences occurring as a result of the additional assessment undertaken by BCC using the national bias adjustment factor of 0.89, as explained within chapter 2.1.2. These locations are: Black's Road, Short Strand, Knock Road, Great Georges Street and Chichester Street (Appendix B).

The calculated results, as provided in Appendix B, predict that annual mean concentrations were below the objective in relation to relevant receptors at all locations. It is therefore considered unnecessary to undertake a detailed assessment for these locations**.**

Table 2.5 Results for Nitrogen Dioxide Diffusion Tubes in 2017

Site ID	Location	Site Type	Within AQMA?	Triplicate or Collocated Tube	Data Capture 2017 (Number of Months or %)	Data with less than 9 months has been annualised (Y/N)	Confirm if data has been distance corrected (Y/N)	Annual mean concentration (Bias Adjustment factor = 0.78)
								2017 (μg/m^3)
1	Royal Victoria Hospital	Urban Background	N	-	100	N/A	N	18
2	Black's Road	Roadside	Y	-	100	N/A	N	36
3	61 Cromac Street	Roadside	Y	-	100	N/A	N	31
4	Ravenhill Road	Roadside	Y	-	100	N/A	N	26
5	Queen's Bridge	Roadside	N	-	91.6	N/A	N	25
6	North Road	Urban Background	N	-	91.6	N/A	N	14
7	Donegall Square South	Roadside	N	-	91.6	N/A	N	29
9	Short Strand	Roadside	N	-	100	N/A	N	39
10	301 Ormeau Road	Roadside	Y	-	100	N/A	N	27
12	Knock Road	Roadside	Y	-	100	N/A	N	36
13	Great George's Street	Kerbside	Y	-	91.6	N/A	N	36
14	Lisburn Road	Roadside	N	-	100	N/A	N	26
15	Shaftesbury Square	Kerbside	N	-	83.3	N/A	N	31
16,19,20	Lombard Street	Urban Centre	N	Triplicate and Co-located	100	N/A	N	25
17	Albert Clock	Roadside	N	-	100	N/A	N	33
21,22,56	Stockman's Lane	Roadside	Y	Triplicate and Co-located	91.6	N/A	N	**50**
23,24,32	Ballyhackamore	Roadside	Y	Triplicate and Co-located	100	N/A	N	31
25	Whitewell Road	Roadside	N	-	83.3	N/A	N	20

Site ID	Location	Site Type	Within AQMA?	Triplicate or Collocated Tube	Data Capture 2017 (Number of Months or %)	Data with less than 9 months has been annualised (Y/N)	Confirm if data has been distance corrected (Y/N)	Annual mean concentration (Bias Adjustment factor = 0.78)
								2017 (μg/m^3)
26	Donegall Road	Kerbside	N	-	91.6	N/A	N	28
28	Falls Road and Andersonstown Road	Roadside	N	-	100	N/A	N	25
30	Station Road	Roadside	N	-	100	N/A	N	23
31	Malone Road	Roadside	N	-	75	N/A	N	35
33	Great Victoria Street	Roadside	N	-	100	N/A	N	34
34	College Square East	Roadside	N	-	100	Y	N	31
35	Chichester Street	Roadside	N	-	100	N/A	N	36
36	Cromac & Ormeau Avenue	Kerbside	Y	-	91.6	N/A	N	30
37	Glenmachan Street	Roadside	Y	-	91.6	N/A	N	28
38	Creche on M1/Westlink	Roadside	Y	-	100	N/A	N	24
39	Ormeau Road (junction with Ravenhill Road)	Roadside	Y	-	75	N/A	N	29
40	Upper Newtownards Road & Hollywood Road	Roadside	N	-	91.6	N/A	N	25
41	Crumlin Road	Roadside	N	-	100	N/A	N	26
42	228 Antrim Road	Roadside	N	-	83.3	N/A	N	29
44	Shore Road (Ivan Street end)	Roadside	N	-	100	N/A	N	28
59	York Street	Roadside	N	-	91.6	N/A	N	32
63	Queens Square	Kerbside	N	-	100	N/A	N	32

Site ID	Location	Site Type	Within AQMA?	Triplicate or Collocated Tube	Data Capture 2017 (Number of Months or %)	Data with less than 9 months has been annualised (Y/N)	Confirm if data has been distance corrected (Y/N)	Annual mean concentration (Bias Adjustment factor = 0.78)
								2017 (µg/m^3)
74	Ardmore Park	Roadside	N	-	83.3	N/A	N	31
76	Titanic Quarter	Roadside	N	-	83.3	N/A	N	21
77	Poleglass	Roadside	N	-	66.7	Y	N	24
87	RVH Falls Road	Roadside	N	-	75	N/A	N	33
88	Dunmurry Lane	Roadside	N	-	50	Y	N	23[a]
89	Upper Knockbreda Road	Kerbside	N	-	83.3	N/A	N	35

In bold, exceedence of the NO_2 annual mean AQS objective of 40µg/m^3

Underlined, annual mean > 60µg/m^3, indicating a potential exceedence of the NO_2 hourly mean AQS objective

[a] Means should be “annualised” as in Boxes 7.9 and 7.10 of LAQM.TG16, if full calendar year data capture is less than 75%

Table 2.6 Results of Nitrogen Dioxide Diffusion Tubes (2013 to 2017)

Site ID	Site Type	Within AQMA?	Annual Mean Concentration (µg/m^3) - Adjusted for Bias [a]				
			2013* (Bias Adjustment Factor = 0.94)	2014* (Bias Adjustment Factor = 0.95)	2015* (Bias Adjustment Factor = 0.96)	2016* (Bias Adjustment Factor = 0.89)	2017 (Bias Adjustment Factor =0.78)
1	Royal Victoria Hospital	N	24	23	22	22	18
2	Black's Road	Y	**43**	**42**	**43**	40	36
3	61 Cromac Street	Y	**45**	**42**	39	37	31
4	Ravenhill Road	Y	32	30	33	31	26
5	Queen's Bridge	N	33	34	31	30	25
6	North Road	N	17	15	16	17	14
7	Donegall Square South	N	38	38	34	33	29
9	Short Strand	N	**47**	**47**	**45**	**44**	39
10	301 Ormeau Road	Y	35	35	34	32	27
12	Knock Road	Y	**46**	**47**	**42**	**41**	36
13	Great George's Street	Y	**52**	**50**	**47**	**50**	36
14	Lisburn Road	N	28	30	27	28	26
15	Shaftesbury Square	N	38	38	34	34	31
16,19,20	Lombard Street	N	31	32	29	28	25
17	Albert Clock	N	**47**	**47**	**42**	38	33
21,22,56	Stockman's Lane	Y	**55**	**55**	**49**	**49**	**50**
23,24,32	Ballyhackamore	Y	37	35	34	36	31
25	Whitewell Road	N	23	33	25	23	20
26	Donegall Road	N	39	36	33	33	28

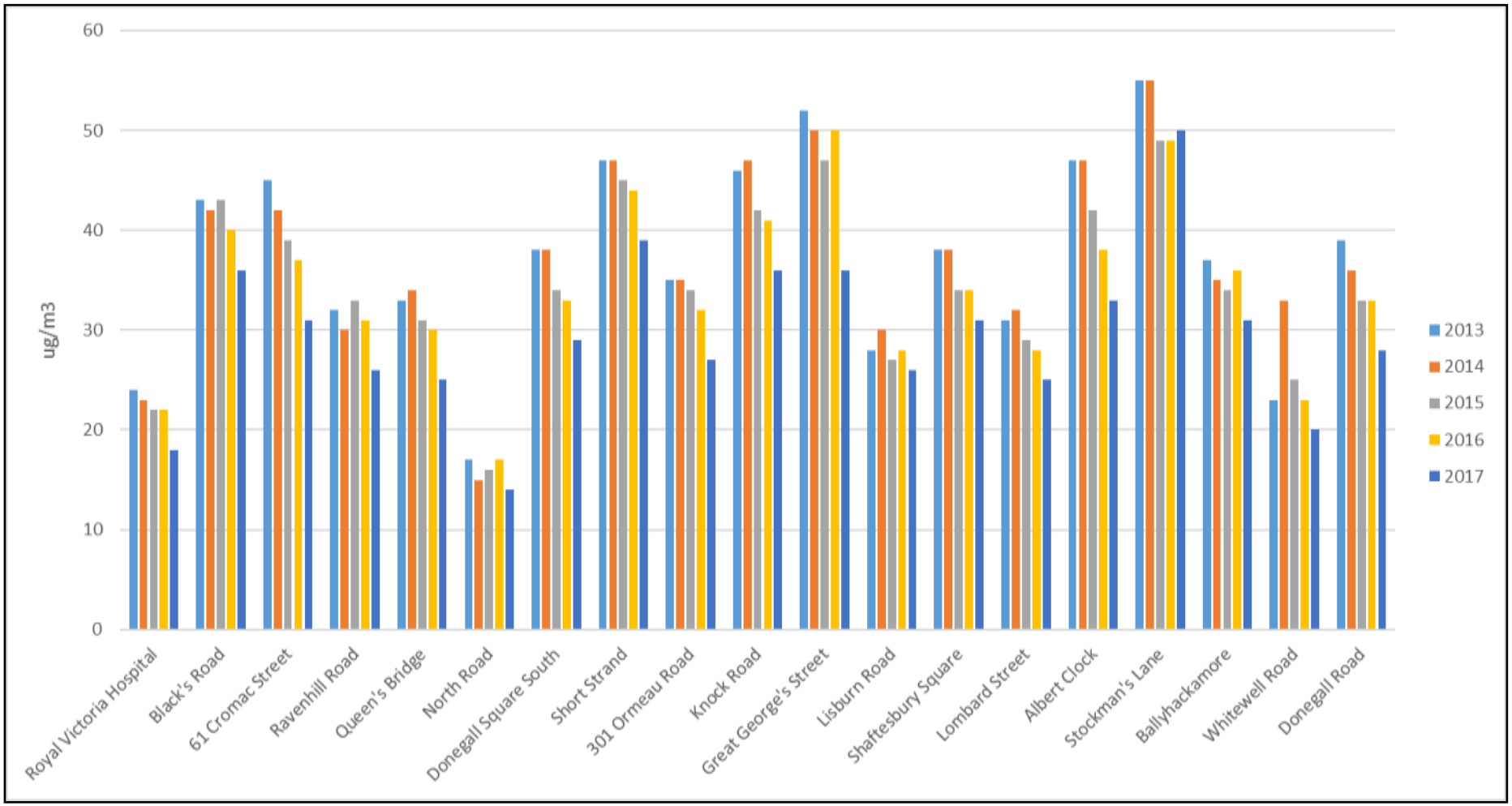
Site ID	Site Type	Within AQMA?	Annual Mean Concentration (µg/m^3) - Adjusted for Bias [a]				
			2013* (Bias Adjustment Factor = 0.94)	2014* (Bias Adjustment Factor = 0.95)	2015* (Bias Adjustment Factor = 0.96)	2016* (Bias Adjustment Factor = 0.89)	2017 (Bias Adjustment Factor =0.78)
28	Falls Road and Andersonstown Road	N	31	29	27	29	25
30	Station Road	N	23	24	25	26	23
31	Malone Road	N	**44**	**45**	39	36	35
33	Great Victoria Street	N	**42**	**42**	40	39	34
34	College Square East	N	39	40	33	32	31
35	Chichester Street	N	**46**	**49**	**43**	**44**	36
36	Cromac & Ormeau Avenue	Y	33	36	34	33	30
37	Glenmachan Street	Y	40	**43**	40	39	28
38	Creche on M1/Westlink	Y	34	35	30	34	24
39	Ormeau Road (junction with Ravenhill Road)	Y	29	30	31	32	29
40	Upper Newtownards Road & Hollywood Road	N	29	29	28	27	25
41	Crumlin Road	N	34	34	30	32	26
42	228 Antrim Road	N	37	**41**	37	36	29
44	Shore Road (Ivan Street end)	N	33	34	30	30	28
59	York Street	Y	**47**	**48**	39	**41**	32
63	Queens Square	N	**41**	40	38	36	32

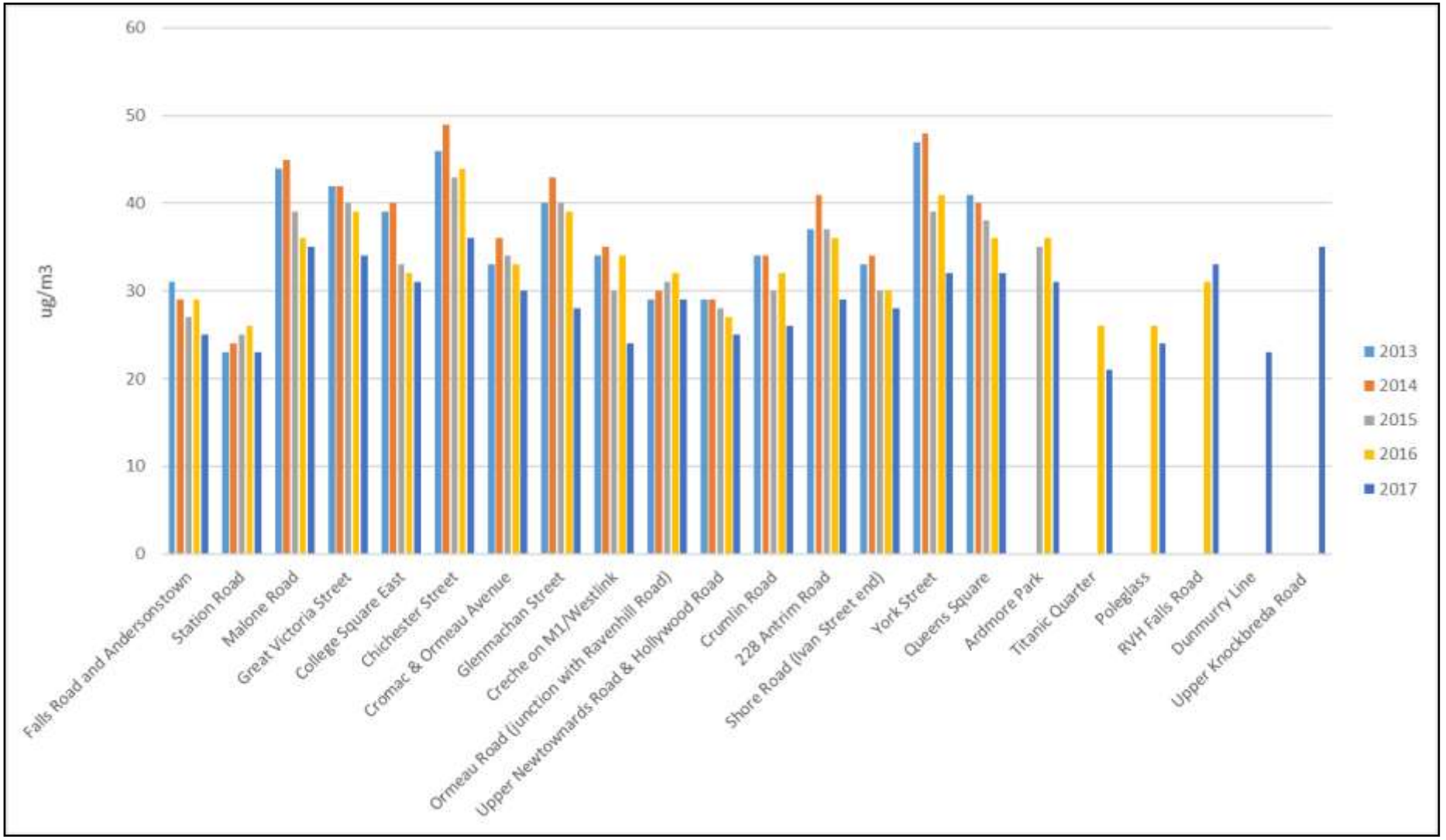
Site ID	Site Type	Within AQMA?	Annual Mean Concentration (µg/m^3) - Adjusted for Bias [a]				
			2013* (Bias Adjustment Factor = 0.94)	2014* (Bias Adjustment Factor = 0.95)	2015* (Bias Adjustment Factor = 0.96)	2016* (Bias Adjustment Factor = 0.89)	2017 (Bias Adjustment Factor =0.78)
74	Ardmore Park	N			35	36	31
76	Titanic Quarter	N				26	21
77	Poleglass	N				26	24
87	RVH Falls Road	N				31	33
88	Dunmurry Lane	N					23
89	Upper Knockbreda Road	N					35

*Optional

Figure 2.4 Trends in Annual Mean Nitrogen Dioxide Concentrations measured at Diffusion Tube Monitoring Sites

The following two graphs show trends in annual mean nitrogen dioxide diffusion tube data from 2013 where data exists.




60
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2013
2014
2015
2016
2017
Falls Road and Andersonstown
Station Road
Malone Road
Great Victoria Street
College Square East
Chichester Street
Cromac & Ormeau Avenue
Glenmachan Street
Creche on M1/Westlink
Ormeau Road (junction with Ravenhill Road)
Upper Newtownards Road & Hollywood Road
Crumlin Road
228 Antrim Road
Shore Road (Ivan Street end)
York Street
Queens Square
Ardmore Park
Titanic Quarter
Poleglass
RVH Falls Road
Dunmurry Line
Upper Knockbreda Road

2.2.2 PM_{10}

As a result of a historic reliance upon solid fuel for domestic heating, Belfast used to experience frequent exceedences of the 24-hour and annual mean objectives for particulate matter (PM_{10}) across the city. However, with completion of the city's smoke control programme and the widespread availability of natural gas to all sectors, domestic and industrial emissions of particulate matter have decreased significantly since around 2000. As a result, the council was able to decommission its Belfast East Clara Street particulate matter monitoring site in east Belfast in 2007.

However, as domestic and industrial emissions have been addressed, emissions of particulate matter from road transport along the M1 Motorway and A12 Westlink corridor gained in prominence. Upon completion of the council's first review and assessment of air quality in 2004, it was concluded that the M1 Motorway and A12 Westlink corridor should be declared as an air quality management area on the basis of modelled and monitored exceedences of the 24-hour and annual mean objectives for particulate matter.

As embodied in the subsequent 2006 Air Quality Action Plan for Belfast, a range of structural improvements, designed to relieve traffic congestion, have been completed for the M1 Motorway and A12 Westlink. As a result, monitored levels of particulate matter have declined over recent years within this air quality management area. The monitoring data for this site is summarised and reviewed in Tables 2.7, 2.8 and in Figure 2.5.

In terms of exceedences of the 40 μgm^{-3} particulate matter annual mean objective there has been no exceedences of the annual mean objective at this location since 2008. Monitoring data from the Belfast Westlink site at Roden Street, which was established in 2010 and is located also within the M1 Motorway / A12 Westlink air quality management area, indicates no exceedences in recent years. PM_{10} monitoring was discontinued at this site in 2014 but continues at the Stockmans Lane site.

Reflecting upon the particulate matter 24-hour mean objective data, as summarised in Table 2.8, the data has remained comfortably below the objective at all sites during recent years.

On the basis of previous data, which demonstrates sustained improvements in particulate matter, it should be noted that the council revoked the M1 Motorway / A12 Westlink air quality management area for exceedences of the particulate matter annual and 24-hour mean objectives in September 2015.

Table 2.7 Results of Automatic Monitoring for PM_{10}: Comparison with the annual mean objective

Site ID	Site Type	Within AQMA?	Valid Data Capture for monitoring Period %[a]	Valid Data Capture 2017 %[b]	Confirm Gravimetric Equivalent (Y or NA)	Annual Mean Concentration μg/m³				
						2013* [c]	2014* [c]	2015* [c]	2016* [c]	2017 [c]
Belfast Centre	Urban Background	N	79	79	Y	-	16	14	16	12
Belfast Stockman's Lane	Roadside	Y	97	97	Y	24	21	21	22	21
Belfast Westlink Roden Street	Roadside	Y	-	-	Y	23	-	-	-	-

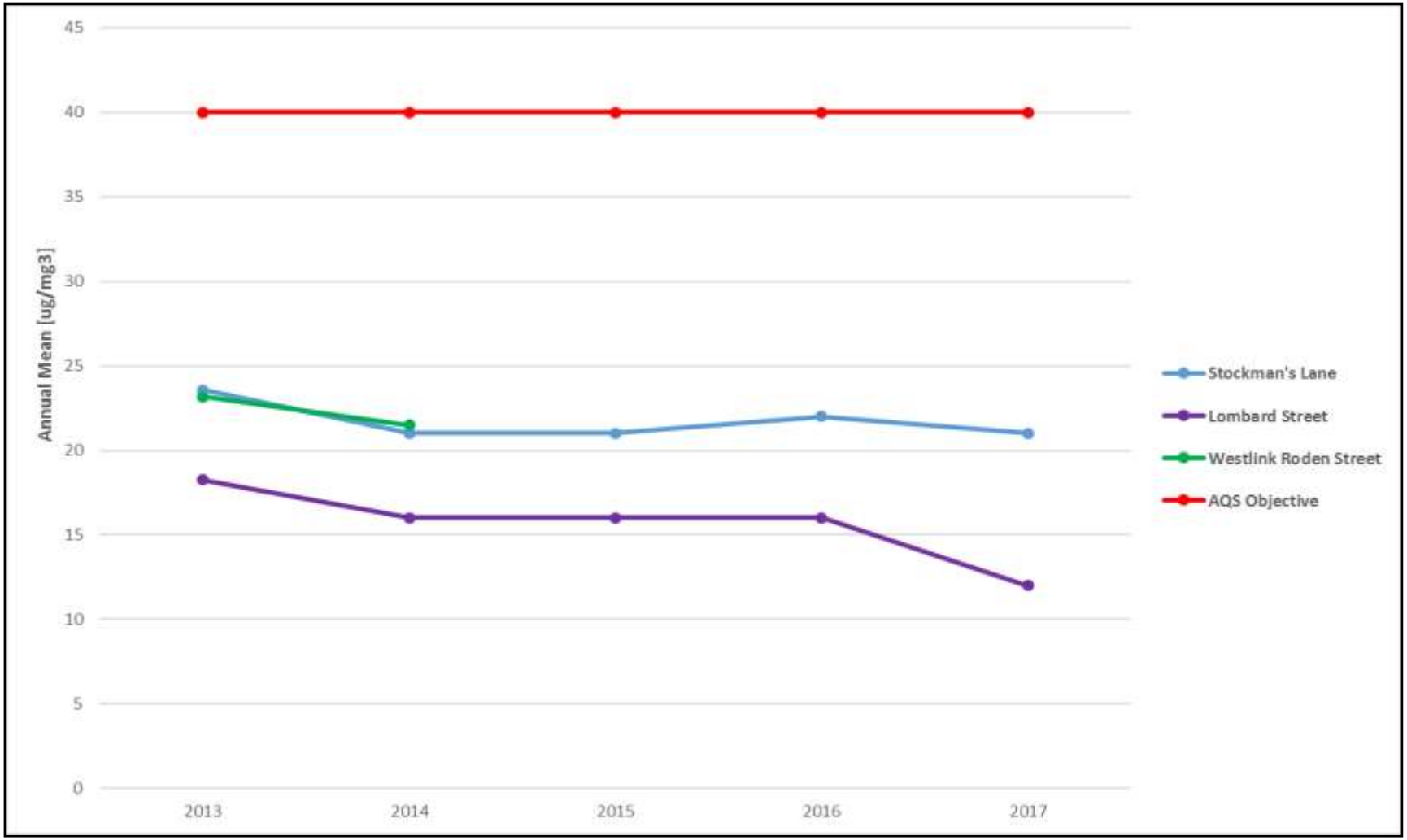
[a] i.e. data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
[b] i.e. data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%).
[c] Means should be "annualised" as in Boxes 7.9 and 7.10 of LAQM.TG16, if monitoring was not carried out for the full year.
* Optional

Table 2.8 Results of Automatic Monitoring for PM_{10}: Comparison with the 24-hour mean objective

Site ID	Site Type	Within AQ MA?	Valid Data Capture for monitoring Period %[a]	Valid Data Capture 2017 %[b]	Confirm Gravimetric Equivalent	Number of Exceedences of 24-Hour Mean (50 μg/m^3)				
						2013* [c]	2014* [c]	2015* [c]	2016* [c]	2017 [c]
Belfast Centre	Urban Background	N	79	79	Y	-	5	3	7	1 (22)
Belfast Stockman's Lane	Roadside	Y	97	97	Y	11	4	4	3	2
Belfast Westlink Roden Street	Roadside	Y	-	-	Y	13 (43)	-	-	-	-

[a] i.e. data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
[b] i.e. 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] if data capture is less than 85%, include the 90.4th percentile of 24-hour means in brackets
* Optional

Figure 2.5 Trends in Annual Mean PM_{10} Concentrations



2.2.3 Sulphur Dioxide

As a result of a historic reliance upon solid fuel for domestic heating, Belfast City used to experience frequent and widespread exceedences of the 15-minute, 1-hour and 24-hour mean objectives for sulphur dioxide. However, with completion of the city's smoke control programme and the widespread availability of natural gas to all sectors, levels of sulphur dioxide have decreased dramatically since 2000. Accordingly, there have been no exceedences of any sulphur dioxide objective in the city since 2002. Sustained low levels of sulphur dioxide have meant that the council has been able to terminate ambient monitoring for sulphur dioxide at all locations with the exception of the Belfast Centre AURN site at Lombard Street. No air quality management areas have been declared for sulphur dioxide across Belfast.

Recent sulphur dioxide monitoring data from the Belfast Centre site is summarised in Table 2.9. As indicated, no exceedences of any objectives were observed during 2017.

Table 2.9 Results of Automatic Monitoring of SO_2: Comparison with Annual Mean Objectives

Site ID	Site Type	Within AQMA?	Valid Data Capture for monitoring Period %[a]	Valid Data Capture 2017 %[b]	Number of Exceedances (percentile in bracket μg/m³) [c]		
					15-minute Objective (266 μg/m³)	1-hour Objective (350 μg/m³)	24-hour Objective (125 μg/m³)
Belfast Centre	Urban Background	N	96	96	0	0	0

[a] i.e. data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
[b] i.e. 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] if data capture is less than 85%, include the relevant percentile in brackets

2.2.4 Benzene

Benzene concentrations have been monitored at the Belfast Centre and Belfast Roadside sites since 2002. Monitoring was discontinued at the Belfast Roadside site in October 2007. The Belfast Centre site monitors benzene exposure for the City Centre whilst the Belfast Roadside site monitored benzene concentrations experienced at a roadside location. No exceedences of the 2010 National Air Quality Strategy Objective (3.25 μgm^{-3} annual mean) or the 2010 EU Limit Value (5 μgm^{-3} annual mean) for benzene have been recorded in Belfast since 2002.

Previous rounds of Review and Assessment and monitoring results dating back to 2013, provided in Table 3.0, confirm that there has been no exceedence of the benzene running annual mean of 3.25 μgm^{-3} within Belfast. Therefore, a Detailed Assessment is not considered necessary for this ambient pollutant.

Table 3.0: Results of monitoring for benzene: Annual mean concentrations for the Belfast Centre site 2013 – 2017.

Site ID	Site type	Within AQMA?	Valid Data Capture 2017 %	Running annual mean concentrations (μgm^{-3})				
				2013	2014	2015	2016	2017
Belfast Centre	Urban Background	N	100	0.60	0.64	0.54	0.49	0.46

2.2.5 Summary of Compliance with AQS Objectives

Belfast City Council has examined the results from monitoring within its district for 2017. Concentrations of ambient pollutants, as prescribed within the Air Quality Strategy for England, Scotland, Wales and Northern Ireland, outside of existing Air Quality Management Areas all remain below the objective concentrations at relevant receptor locations. It is therefore the council's view that there is no need to proceed to a Detailed Assessment for any ambient pollutant.

However, the council will continue to monitor and report ambient pollution conditions across the city in order to confirm that recent improvements in air quality are sustained and that those locations where poor air quality persists are addressed.

3 Road Traffic Sources

3.1 Narrow Congested Streets with Residential Properties Close to the Kerb

It should be noted that within Northern Ireland, the Department for Infrastructure Roads has responsibility for the transport planning and maintenance of the road network. Accordingly, DfI Roads maintains and improves the road network and infrastructure in order to keep it safe, effective and reliable. In the earlier rounds of the review and assessment process, the council obtained a copy of the Belfast road transportation model which comprised traffic data for around 5,600 road nodes across the city. In addition, the council bolstered this data through supplementary traffic counts in congested streets and we have undertaken monitoring at these locations through the use of diffusion tubes and automatic analysers. For this reason, we believe that we have a good understanding of traffic and development control patterns across the city and, on this basis, we believe that there are no newly identified congested streets with a vehicle flow above 5,000 vehicles per day and residential properties close to the kerb that have not been adequately considered either in previous rounds of the review and assessment process or by monitoring.

Belfast City Council confirms that there are no new/newly identified congested streets with a flow above 5,000 vehicles per day and residential properties close to the kerb, that have not been adequately considered in previous rounds of Review and Assessment.

3.2 Busy Streets Where People May Spend 1-hour or More, Close to Traffic

Belfast City Council confirms that there are no new / newly identified busy streets where people may spend 1 hour or more, close to traffic.

3.3 Roads with a High Flow of Buses and/or HGVs.

In earlier rounds of the review and assessment process, Belfast City Council conducted screening assessments of the Belfast road network in order to identify locations with a high incidence of buses and / or heavy goods vehicles. In accordance with government's technical guidance LAQM.TG(16), an unusually high proportion can be taken to be greater than 20% of heavy duty vehicles. The only part of the road network within Belfast that historically approached this criterion was the M1 Motorway / A12 Westlink corridor with approximately 15% of heavy duty vehicles. On this basis, a detailed review and assessment was completed, and this corridor was designated as an air quality management area for both short and longer-term exceedences of the nitrogen dioxide and particulate matter objectives. This air quality management area has been the subject of mitigation measures as part of the council's Air Quality Action Plans for Belfast.

On the basis of monitoring data, which demonstrated sustained improvements in particulate matter concentrations, the council revoked the M1 Motorway / A12 Westlink air quality management area for exceedences of the particulate matter annual and 24-hour mean objectives in September 2015. The declarations for nitrogen dioxide remain.

Since the 2017 Progress Report, there have been no newly identified roads that meet the above-mentioned criterion for high flows of buses and / or HGVs.

Belfast City Council confirms that there are no new / newly identified roads with high flows of heavy-duty vehicles.

3.4 Junctions

Belfast City Council confirms that there are no new or newly identified busy junctions or busy roads.

3.5 New Roads Constructed or Proposed Since the Last Round of Review and Assessment

Belfast City Council confirms that there are no new or proposed roads that meet the criteria for review and assessment at this time.

3.6 Roads with Significantly Changed Traffic Flows

Belfast City Council confirms that there are no new / newly identified roads with significantly changed traffic flows.

3.7 Bus and Coach Stations

Belfast City Council confirms that there are no relevant bus stations in the Local Authority area that have not been considered in previous rounds of the review and assessment process. The council therefore concludes that it will not be necessary to proceed to a detailed assessment.

4 Other Transport Sources

4.1 Airports

Belfast City Council has previously considered the air quality impact of the George Best Belfast City Airport and, on the basis of ambient monitoring data for nitrogen dioxide, concluded that an air quality management area did not need to be declared for the airport. In order to provide ongoing surety regarding the air quality impact of the airport, we have maintained a nitrogen dioxide diffusion tube at Station Road in East Belfast adjacent to the nearest residential receptors to the airport. It should be noted that the Station Road diffusion tube is located so as to take account also of the impact of nearby road traffic on the Sydenham Bypass and of the Belfast to Bangor rail line.

Annual mean levels of nitrogen dioxide at Station Road have remained consistently around 22-26 μgm^{-3} since 2007; comfortably below the annual mean objective of 40 μgm^{-3}. Therefore, we are content that any changes to airport operations over recent years have had little impact upon ambient air quality at the nearest relevant receptors. Therefore, it is considered that a further Detailed Assessment for this existing airport is not required at this juncture.

Belfast City Council confirms that there are no new airports within the Local Authority area.

4.2 Railways (Diesel and Steam Trains)

4.2.1 Stationary Trains

Belfast City Council confirms that there are no new locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m.

4.2.2 Moving Trains

Belfast City Council confirms that there are no new locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m.

4.3 Ports (Shipping)

Referring to the government's technical guidance regarding the treatment of ports and shipping, the screening assessment approach is to collect information regarding the number of ship movements per year, where such movements are confined to large ships, including cross-channel ferries, roll-on and roll-off vessels, container ships and cruise liners and movements' number between 5,000 and 15,000 per annum. This movement data is contrasted subsequently with the potential for relevant exposure within 250 metres of the shipping berths. We have obtained activity data from the Port of Belfast which has confirmed that the number of ship movements during 2017 was around 12,000. However, an analysis of the geographic location of the Port confirms that there is little potential for relevant public exposure for 15-minute periods within 250 metres. The majority of ferry terminals are now located within the Port confines at Westbank Road off Dargan Road. This area is predominantly used for industrial and commercial activities and there is no relevant exposure within 250m of the berths.

Belfast City Council confirms that there are no new ports or shipping that meet the specified criteria within the Local Authority area.

5 Industrial Sources

5.1 Industrial Installations

5.1.1 New or Proposed Installations for which an Air Quality Assessment has been Carried Out

In Northern Ireland, the permitting of prescribed industrial activities under the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013 is undertaken by both local authorities and the Industrial Pollution and Radiochemical Inspectorate (IPRI) of the Department of Agriculture, Environment and Rural Affairs. The IPRI has responsibility for the permitting of what are defined as Part A and B processes whereas district councils permit Part C processes. Part A processes have the greatest capacity to pollute and as a result can impact detrimentally upon air, land and water. For this reason, they require an integrated approach to controlling whereas Part B and Part C processes are regulated for emissions to air only.

In order to complete this 2018 Update and Screening Assessment, Belfast City Council liaised with the IPRI regarding Part A and B processes. The public register of Northern Ireland Part A and B processes is accessible on the Department of Environment website via the following web link: https://appsd.daera-ni.gov.uk/ipri/

Belfast City Council confirms that since the Last Updating and Screening Assessment in 2015, there was only one industrial installation (Part A) in the Belfast City Council area and in a neighbouring authority, for which an air quality assessment was carried out and planning permission granted.

This Combined Heat and Power Installation (7 Airport Road) was approved through the planning process in 2016. The air quality assessment in support of the installation demonstrated that the proposal would not have an adverse impact on local air quality or on relevant receptors. Therefore, there was no need to proceed to a Detailed Assessment.

In addition, the IPRI has confirmed that there have been no significant increases in the emission profiles of any existing industrial processes.

In relation to Part C processes, the council's Industrial Pollution Control Officer has confirmed also that there are no new or proposed Part C industrial installations for which planning approval has been granted within the Belfast City Council area. Neither have there been significant increases in the emission profiles of existing industrial processes or the introduction of new relevant exposure.

Belfast City Council has assessed new/proposed industrial installations and concluded that it will not be necessary to proceed to a Detailed Assessment.

5.1.2 Existing Installations where Emissions have Increased Substantially, or New Relevant Exposure has been introduced

Belfast City Council confirms that there are no industrial installations with substantially increased emissions or new relevant exposure in their vicinity within its area or nearby in a neighbouring authority.

5.1.3 New or Significantly Changed Installations with No Previous Air Quality Assessment

Belfast City Council confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area or nearby in a neighbouring authority.

5.2 Major Fuel (Petrol) Storage Depots

There is a major fuel storage depot within the Local Authority area, but its impact has been considered in previous updating and screening and review and assessment reports.

5.3 Petrol Stations

Belfast City Council confirms that there are no petrol stations meeting the specified qualifying criteria**.**

5.4 Poultry Farms

Belfast City Council confirms that there are no poultry farms meeting the specified qualifying criteria.

6 Commercial and Domestic Sources

6.1 Biomass Combustion – Individual Installations

Belfast City Council confirms that since the last Updating and Screening Assessment in 2015, there has been only one individual biomass installation located at 78 Woodvale Road within the council's area for which a screening assessment has been carried out in accordance to the government's *Local Air Quality Management Technical Guidance document LAQM.TG(16)* and supporting assessment tool: *Biomass Emissions Screening Tool*.

The assessment has demonstrated that the proposed installation will not have adverse impact on air quality in the vicinity of the site. Subsequently the planning permission has been granted in November 2015.

Belfast City Council has assessed the biomass combustion plant and concluded that it will not be necessary to proceed to a Detailed Assessment.

6.2 Biomass Combustion – Combined Impacts

Belfast City Council confirms that there is no biomass combustion plant in the Local Authority area.

6.3 Domestic Solid-Fuel Burning

Belfast City Council confirms that there are no areas of significant domestic fuel use in the Local Authority area.

7 Fugitive or Uncontrolled Sources

Belfast City Council confirms that there are no potential sources of fugitive particulate matter emissions in the Local Authority area.

8 Conclusions and Proposed Actions

8.1 Conclusions from New Monitoring Data

Belfast City Council has presented a range of monitoring data within this Updating and Screening Report that addresses a number of the pollutants prescribed within the United Kingdom Air Quality Strategy. Although these pollutants are routinely measured across the city, the council's focus remains principally upon addressing existing the air quality management areas and upon those areas of the city centre where traffic congestion might lead to further exceedences of the nitrogen dioxide annual mean or hourly objectives. There were no monitored exceedences for any of the air quality strategy objectives for sulphur dioxide, benzene and particulate matter during 2017.

Nevertheless, 2017 monitoring data for nitrogen dioxide confirms continuing exceedences of the annual mean objective for nitrogen dioxide in the vicinity of Stockman's Lane, which is located within the M1 Motorway / A12 Westlink air quality management area. However, the monitoring site at Roden Street indicates compliance with both annual and hourly mean objectives for nitrogen dioxide along this section of the A12 Westlink, suggesting that the structural improvements have reduced the number of exceedence locations along the M1 Motorway / A12 Westlink corridor to a series of nitrogen dioxide 'hot spots'.

Historical monitoring data for the Upper Newtownards Road air quality management area revealed sustained exceedences of the nitrogen dioxide annual mean objective. The last six years have demonstrated a decrease in nitrogen dioxide levels to the extent that the annual mean objective has been achieved at Ballyhackamore since 2011. The magnitude of the decrease in nitrogen dioxide levels along the Upper Newtownards Road was beyond the year-on-year reductions that might have been reasonably predicted using Defra's forward projection factors. Accordingly, the reductions in ambient nitrogen dioxide levels within this air quality management area are welcomed. However, the council will continue to maintain its monitors in this location in order to determine whether the decrease is sustained over coming years when it is considered that successful implementation of the 2015-2020 Belfast Air

Quality Action Plan measures will improve road vehicle operations, promote and enable a shift onto more sustainable modes of transport and subsequently reduce air pollution further along this busy street.

As was mentioned previously, the Belfast Ormeau Road site experienced extensive problems with the air conditioning during 2012 and 2013, preventing the monitoring equipment working to full capacity. The site enclosure was upgraded in 2014 which has resolved this problem. Following the site upgrade, the annual mean concentration has remained constant at 28 μgm^{-3} in 2014, 27 μgm^{-3} in 2015, 28 μgm^{-3} in 2016 and 25 μgm^{-3} in 2017.

On the basis of this data, which demonstrates sustained improvements in annual mean nitrogen dioxide concentrations, with levels much below the Air Quality Objective, the council is giving consideration to revoking the Ormeau Road air quality management area for exceedences of the nitrogen dioxide annual mean objective. Accordingly, the council will liaise with the Department for Agriculture, Environment and Rural Affairs, Department for Infrastructure and other relevant partners before coming to a conclusion regarding the potential for revocation.

In conclusion and although significant decreases in nitrogen dioxide annual mean concentrations were observed during 2017 at most monitoring locations across the city, Belfast City Council will nonetheless continue to monitor ambient nitrogen dioxide levels at all current monitoring locations in order to endure that recent downward trends are maintained. Furthermore, based on the monitoring data, the council will consider revoking the Ormeau Road air quality management area for exceedences of the nitrogen dioxide annual mean objectives.

Finally, Belfast City Council confirms that no new air quality management areas need to be declared for the city at this time.

8.2 Conclusions from Assessment of Sources

The assessment of new or altered sources of air pollution for 2017 has led the council to conclude that there are no new roads or road junctions within the city that require a detailed assessment. In addition, there are no new roads that have a significant proportion of heavy-duty vehicles or significantly changed traffic flows. No new bus stations have been constructed in the city and it is the council's view that the air quality impact of the George Best Belfast City Airport is well understood at relevant receptors through ambient monitoring data. There are no new locations in the city where stationary or moving trains are likely to detrimentally impact upon relevant receptors and the location of Port of Belfast means also that shipping is unlikely to impact detrimentally upon relevant receptors.

There was only one industrial installation (Part A) in Belfast City Council area and in a neighbouring authority, for which an air quality assessment has been carried out and planning permission has been granted. The air quality assessment in support of the installation demonstrated that the proposal would not have an adverse impact on localised air quality or relevant receptors. Therefore, there was no need to proceed to a Detailed Assessment.

No new major fuel storage depots have been established within Belfast since the last round of review and assessment and none of the new petrol stations that have opened, required detailed assessment through the lack of relevant exposure and the presence of emission abatement equipment.

There are no poultry farms within the city and the council is aware of only one biomass combustion plant, which was granted planning permission, but did not require a Detailed Assessment. In addition, the council is not aware of any significant new areas of domestic solid fuel use.

Finally, the council is not aware of any new sources of significant fugitive particulate matter emission within the city confines.

8.3 Proposed Actions

In conclusion, the 2018 Updating and Screening Assessment has not identified the need to proceed to a Detailed Assessment for any pollutant under consideration.

Furthermore, Belfast City Council has already highlighted that it operates an expansive air quality monitoring network across the city for nitrogen dioxide and other ambient pollutants. On this basis, the council is content that existing monitoring locations provide a detailed representation of pollution levels the city and, as a consequence, does not need to be expanded at this time.

With regard to our four air quality management areas, a review of the monitoring data for these air quality management areas indicates that there have been some recent improvements in annual mean nitrogen dioxide levels across the city. As a result, Belfast City Council will consider the revocation of the Ormeau Road AQMA, where monitored data demonstrates sustained improvements in annual mean nitrogen dioxide concentrations, with levels much below the Air Quality Objective.

Accordingly, the council will liaise with the Department for Agriculture, Environment and Rural Affairs, Department for Infrastructure and other relevant authority partners before coming to a conclusion regarding the potential for revocation.

As part of the revocation process, a detailed report in support of the revocation will be prepared by the council, as prescribed in the Defra *Local Air Quality Management Technical Guidance LAQM.TG(16).*

In terms of forward actions, the council along with relevant partners have developed a comprehensive Air Quality Action Plan that draws upon all forms of air quality and transport planning activities, including sustainable transport options as well as engineering solutions. The Air Quality Action Plan 2015-2020 was published in December 2015. It is considered that successful implementation of the measures will improve road vehicle operations and promote and enable a shift onto more sustainable modes of transport to achieve compliance with the nitrogen dioxide UK Objectives and EU Limit Value by 2020. Progress on implementing individual measures within AQAP are reported upon annually by Belfast City Council as prescribed in the Defra *Local Air Quality Management Technical Guidance LAQM.TG(16).*

9 References

Belfast City Council, 2015, Air Quality Action Plan 2015 – 2020, December 2015.
http://www.belfastcity.gov.uk/buildingcontrol-environment/pollution/pollution-about.aspx

Belfast City Council, Belfast Progress Report, April 2017.
http://www.airqualityni.co.uk/laqm/district-council-reports

Belfast City Council, Update and Screening Assessment, April 2015.
http://www.airqualityni.co.uk/laqm/district-council-reports

Defra, Local Air Quality Management: Technical Guidance 2016
http://laqm.defra.gov.uk/supporting-guidance.html

Defra 'Workplace Analysis Scheme for Proficiency (WASP) NO_2 diffusion tubes proficiency tests'.
http://laqm.defra.gov.uk/diffusion-tubes/qa-qc-framework.html

Directive 2008/50/EC in respect of ambient air quality and cleaner air for Europe
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0050:en:NOT

Environment (Northern Ireland) Order 2002.
http://www.legislation.gov.uk/nisi/2002/3153/contents/made

Northern Ireland Air – Air Quality in Northern Ireland website
http://www.airqualityni.co.uk/

Appendices

Appendix A: QA/QC Data

Non-automatic sampling data

Diffusion Tube Bias Adjustment Factors

As in previous years, we have employed a triplicate collocation study at the Belfast Centre Lombard Street AURN monitoring site in order to obtain a local diffusion tube bias adjustment factor for 'correcting' our diffusion tube monitoring data. The bias adjustment factor was calculated and our data 'corrected' using the Defra Bias Adjustment Factor Calculation spreadsheet (with a 95% confidence interval as an estimate of the uncertainty on the bias adjustment factor). Outputs from the spreadsheet are presented as follows:

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	10/01/2017	01/02/2017	42.1	45.1	37.9	42	3.6	9	9.0
2	01/02/2017	01/03/2017	35.2	33.5	34.6	34	0.9	3	2.2
3	01/03/2017	29/03/2017	38.6	36.7	39.4	38	1.4	4	3.5
4	29/03/2017	02/05/2017	25.2	26.5	22.7	25	1.9	8	4.8
5	02/05/2017	07/06/2017	26.4	28.3	27.7	27	1.0	4	2.5
6	07/06/2017	04/07/2017	24.8	23.9	24.3	24	0.4	2	1.1
7	04/07/2017	02/08/2017	24.3	24.6	23.7	24	0.5	2	1.2
8	02/08/2017	01/09/2017	25.4	25.6	25.7	26	0.1	1	0.4
9	01/09/2017	26/09/2017	30.8	31.4	30.0	31	0.7	2	1.7
10	26/09/2017	01/11/2017	36.8	34.1	33.9	35	1.7	5	4.1
11	01/11/2017	06/12/2017	41.5	45.1	36.2	41	4.5	11	11.1
12	05/12/2017	04/01/2018	36.3	35.5	35.6	36	0.4	1	1.1
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
37.2	99	Good	Good
30.5	96	Good	Good
31.2	99	Good	Good
20.0	98	Good	Good
21.4	99	Good	Good
16.9	99	Good	Good
15.9	99	Good	Good
15.9	99	Good	Good
22.0	94.5	Good	Good
24.9	99	Good	Good
31.7	99	Good	Good
32.8	99	Good	Good
Overall survey -->		Good precision	Good Overall

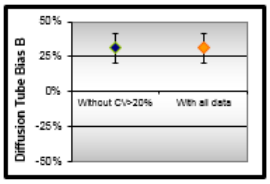
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Lombard Station 16,19,20

Precision 12 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.78 (0.72 - 0.85)
Bias B 28% (17% - 38%)
Diffusion Tubes Mean: 32 μgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 25 μgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 25 (23 - 27) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.78 (0.72 - 0.85)
Bias B 28% (17% - 38%)
Diffusion Tubes Mean: 32 μgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 25 μgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 25 (23 - 27) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Adjustment of SINGLE Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tube Measurements

Site Name/ID	Periods													Raw Mean	Valid periods	Adjusted measurement (95% confidence interval) with all the data 12 periods used in this calcuations Bias Factor A 0.78 (0.72 - 0.85) Bias B 28% (17% - 38%) Tube Precision: 4 Automatic DC: 98%
	1	2	3	4	5	6	7	8	9	10	11	12	13			
1. RVH	33.6	30.2	26.3	15.4	20.6	17.4	17.8	20.0	20.9	25.3	24.8	23.4		23.0	12	Adjusted with 95% CI 18 (17 - 20)
2. Blacks Rd	61.7	45.9	45.6	46.6	39.6	41.8	38.5	41.1	50.4	43.3	52.7	50.5		46.5	12	Adjusted with 95% CI 36 (33 - 39)
3. 61 Cromac Str	51.1	42.8	47.3	33.2	34.1	28.2	33.0	34.2	40.6	37.2	48.9	41.5		39.3	12	Adjusted with 95% CI 31 (28 - 33)
4. Ravenhill Rd	43.5	37.5	38.2	33.4	27.0	29.6	26.4	26.0	34.0	32.2	41.6	35.2		33.7	12	Adjusted with 95% CI 26 (24 - 29)
5. Queens Bridge	41.8		40.8	31.6	26.9	28.0	24.3	24.0	30.9	32.0	37.9	38.4		32.4	11	Adjusted with 95% CI 25 (23 - 28)
6. North Road	24.9	19.1	14.0	13.4	10.7	11.2	10.0	11.3	16.4		44.9	24.5		18.2	11	Adjusted with 95% CI 14 (13 - 15)
7. Donegal Sq. South	47.4	41.6	43.8	33.5	32.4		30.4	27.5	38.0	36.2	36.7	40.1		37.1	11	Adjusted with 95% CI 29 (27 - 32)
9. Short Strand	61.2	45.8	55.8	42.5	41.1	41.2	35.0	40.8	54.1	49.0	77.0	51.9		49.6	12	Adjusted with 95% CI 39 (36 - 42)
10. 301 Ormeau Rd	43.5	37.0	38.1	31.0	31.2	30.0	26.7	27.0	37.7	34.0	42.0	33.6		34.3	12	Adjusted with 95% CI 27 (25 - 29)
12. Knock Rd	57.4	47.2	59.0	38.2	38.4	38.7	36.2	36.0	46.2	42.6	67.8	47.3		46.3	12	Adjusted with 95% CI 36 (33 - 39)
13. Gr Georges Str	51.5	49.8	53.3	45.0	52.2	42.3	43.1	31.3	53.7		41.2	38.5		45.6	11	Adjusted with 95% CI 36 (33 - 39)
14. Lisburn Rd	41.4	36.6	13.9	31.8	25.2	28.5	24.4	26.3	34.1	32.0	61.6	42.0		33.1	12	Adjusted with 95% CI 26 (24 - 28)
15. Shaftesbury Sq	44.9	41.0	43.8	34.0	36.2		53.9	27.3	38.1		45.5	37.7		40.2	10	Adjusted with 95% CI 31 (29 - 34)
17. Albert Clock	55.2	48.6	45.3	36.2	42.9	36.0	36.6	34.6	45.5	46.4	35.5	43.8		42.2	12	Adjusted with 95% CI 33 (30 - 36)
25. Whitewell Rd	34.7	31.0	28.8	24.8		20.6	21.0	18.2	20.4	25.8	33.7			25.9	10	Adjusted with 95% CI 20 (19 - 22)
26. Donegal Rd	44.2	37.6	38.7	34.9	32.0	29.3	29.3	28.1	39.2		36.2	42.7		35.7	11	Adjusted with 95% CI 28 (26 - 30)
28. Falls and Andgtown	40.2	35.5	35.3	27.0	29.8	24.0	23.2	24.7	28.0	31.3	47.3	33.3		31.6	12	Adjusted with 95% CI 25 (23 - 27)
30. Station Rd	41.3	29.2	37.0	28.0	21.1	22.2	21.0	20.4	28.0	26.3	39.9	37.3		29.3	12	Adjusted with 95% CI 23 (21 - 25)
31 Newforge Lane	50.7	43.8		39.4	32.0		33.3	33.9	48.0	43.5	78.7			44.8	9	Adjusted with 95% CI 35 (32 - 38)
33 Great Victoria Street	56.9	45.8	56.3	42.1	36.7	40.7	33.7	35.6	47.7	49.1	37.0	45.3		43.9	12	Adjusted with 95% CI 34 (32 - 37)
34 College Square East	47.2	41.9	42.1	31.8	33.5	32.6	30.9	26.5	36.2	37.2	79.1	38.4		39.8	12	Adjusted with 95% CI 31 (29 - 34)
35 Chichester Street	52.3	43.6	53.8	45.2	41.4	44.7	39.9	36.5	47.5	45.8	47.8	62.3		46.7	12	Adjusted with 95% CI 36 (34 - 40)
36 Cromac/Ormeau Avenue	45.9	39.3	45.1	34.1	31.9	35.0	29.8	27.6	39.8		48.7	46.0		38.5	11	Adjusted with 95% CI 30 (28 - 33)
37 Westlink/Glenmachan Str	47.1	39.9		34.6	29.6	31.9	31.3	32.3	39.6	39.4	28.3	45.0		36.3	11	Adjusted with 95% CI 28 (26 - 31)
38 Creche on M1	39.4	36.1	40.9	23.5	30.1	24.7	24.7	21.4	25.1	28.6	42.4	29.8		30.5	12	Adjusted with 95% CI 24 (22 - 26)

The bias adjustment factor used in these calculations include all the data and no screening of data due to poor precision has been applied.

Adjustment of SINGLE Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tube Measurements

Site Name/ID	Periods													Raw Mean	Valid periods	Adjusted measurement (95% confidence interval) with all the data 12 periods used in this calcuations Bias Factor A 0.78 (0.72 - 0.85) Bias B 28% (17% - 38%) Tube Precision: 4 Automatic DC: 98%
	1	2	3	4	5	6	7	8	9	10	11	12	13			
39 Ormeau Rd/Ravenhill Rd	41.3			35.2	28.3		44.5	28.8	37.9	35.3	32.5	46.0		36.7	9	Adjusted with 95% CI 29 (26 - 31)
40 Hollywood Rd Arches	43.8	30.6	35.5	26.7	26.7		23.6	23.9	29.5	31.6	36.7	37.5		31.5	11	Adjusted with 95% CI 25 (23 - 27)
41 Crumlin Rd	45.1	37.2	37.5	31.7	31.0	26.2	23.4	26.5	32.1	32.9	38.1	36.4		33.2	12	Adjusted with 95% CI 26 (24 - 28)
42 228 AntrimRd	45.0	44.2	43.3	33.3	35.5		29.8	25.1		39.1	33.3	37.5		36.6	10	Adjusted with 95% CI 29 (26 - 31)
44 Shore Rd (Ivan St. End)	43.0	36.3	38.2	26.7	32.8	24.4	25.2	25.1	29.3	32.4	79.3	32.8		35.4	12	Adjusted with 95% CI 28 (26 - 30)
59 York Street		47.4	50.9	36.8	39.0	38.6	36.4	32.3	39.1	42.9	39.2	43.5		40.6	11	Adjusted with 95% CI 32 (29 - 34)
63 Queen's Sq	51.8	47.6	50.6	35.0	40.0	27.7	36.3	29.5	39.4	39.2	43.1	45.9		40.5	12	Adjusted with 95% CI 32 (29 - 34)
74 Ardmore Park	51.1	46.8	46.3	40.4		30.0	22.0	33.7	40.0		33.5	54.8		39.9	10	Adjusted with 95% CI 31 (29 - 34)
76 Titanic Quarter	41.7	27.5	30.0	22.9	21.8	20.5	19.8	20.7	27.5		33.1			26.6	10	Adjusted with 95% CI 21 (19 - 23)
77 Poleglass	38.7		32.7	26.1	26.9	21.0	21.0				68.0	33.4		33.5	8	Adjusted with 95% CI 26 (24 - 28)
87 RVH Falls Road	52.6	50.2		41.1	37.9	33.7	30.6		41.7	45.1	45.6			42.0	9	Adjusted with 95% CI 33 (30 - 36)
88 Dunmurry Line			39.8	28.8		22.8				27.3	32.5	34.1		30.9	6	Adjusted with 95% CI 24 (22 - 26)
89 Upper Knockbreda Rd			47.8	43.7	34.6	36.8	35.1	35.9	45.7	52.1	70.4	51.3		45.3	10	Adjusted with 95% CI 35 (33 - 39)

The bias adjustment factor used in these calculations include all the data and no screening of data due to poor precision has been applied.

Using the spreadsheet, we have determined that diffusion tube agreement with the automatic nitrogen dioxide analyser at the Belfast Centre AURN site for our Gradko supplied and analysed diffusion tubes was deemed ‘good’ for all 2017 sampling

periods. In addition, the precision checks were also deemed ‘good’ for all sampling periods apart from one. The overall bias adjustment factor was calculated as 0.78.

Discussion of the choice of factor to use.

For those local authorities that do not wish or are unable to undertake a triplicate diffusion tube colocation study, government publishes a database of bias adjustment factors derived from other local authority co-location studies throughout the United Kingdom. These factors are used subsequently to calculate a combined bias adjustment factor for a range of nitrogen dioxide diffusion tube laboratories.

The latest factors were published in March 2018 and the derived bias adjustment factor for Gradko Laboratories for a 20% solution of triethanolamine was 0.89. This factor was higher than the council’s 2017 locally derived bias adjustment factor of 0.78. The council therefore considered both factors within this assessment although our locally derived factor was acceptable by Defra and of the good precision. As we have always used our own bias adjustment factors, we will continue with the same methodology for consistency in results.

As described within chapter 2.1.2 Belfast City Council also undertook adjustment of diffusion tubes results using the national factor of 0.89. The purpose of this additional exercise was to identify all locations within the city where possible exceedences of the nitrogen dioxide annual mean objective might occur. The additional results are included within the below table.

Site ID	Location	Site Type	Within AQMA?	Triplicate or Collocated Tube	Data Capture 2017 (Number of Months or %)	Data with less than 9 months has been annualised (Y/N)	Confirm if data has been distance corrected (Y/N)	Annual mean concentration (National Bias Adjustment factor = 0.89) 2017 (μg/m^3)
1	Royal Victoria Hospital	Urban Background	N	-	100	N/A	N	20.5
2	Black's Road	Roadside	Y	-	100	N/A	N	**41.4**
3	61 Cromac Street	Roadside	Y	-	100	N/A	N	35.0
4	Ravenhill Road	Roadside	Y	-	100	N/A	N	30.0
5	Queen's Bridge	Roadside	N	-	91.6	N/A	N	28.8
6	North Road	Urban Background	N	-	91.6	N/A	N	16.2
7	Donegall Square South	Roadside	N	-	91.6	N/A	N	33.0
9	Short Strand	Roadside	N	-	100	N/A	N	**44.1**
10	301 Ormeau Road	Roadside	Y	-	100	N/A	N	30.5
12	Knock Road	Roadside	Y	-	100	N/A	N	**41.2**
13	Great George's Street	Kerbside	Y	-	91.6	N/A	N	**40.6**
14	Lisburn Road	Roadside	N	-	100	N/A	N	29.5
15	Shaftesbury Square	Kerbside	N	-	83.3	N/A	N	35.8
16,19,20	Lombard Street	Urban Centre	N	Triplicate and Co-located	100	N/A	N	25.0
17	Albert Clock	Roadside	N	-	100	N/A	N	37.6
21,22,56	Stockman's Lane	Roadside	Y	Triplicate and Co-located	91.6	N/A	N	**50.0**
23,24,32	Ballyhackamore	Roadside	Y	Triplicate and Co-located	100	N/A	N	31.0
25	Whitewell Road	Roadside	N	-	83.3	Y	N	23.1
26	Donegall Road	Kerbside	N	-	91.6	N/A	N	31.8

Site ID	Location	Site Type	Within AQMA?	Triplicate or Collocated Tube	Data Capture 2017 (Number of Months or %)	Data with less than 9 months has been annualised (Y/N)	Confirm if data has been distance corrected (Y/N)	Annual mean concentration (National Bias Adjustment factor = 0.89) 2017 (μg/m^3)
28	Falls Road and Andersonstown Road	Roadside	N	-	100	N/A	N	28.1
30	Station Road	Roadside	N	-	100	N/A	N	26.1
31	Malone Road	Roadside	N	-	75	N/A	N	39.9
33	Great Victoria Street	Roadside	N	-	100	N/A	N	39.1
34	College Square East	Roadside	N	-	100	Y	N	35.4
35	Chichester Street	Roadside	N	-	100	N/A	N	**41.6**
36	Cromac & Ormeau Avenue	Kerbside	Y	-	91.6	N/A	N	34.3
37	Glenmachan Street	Roadside	Y	-	91.6	N/A	N	32.3
38	Creche on M1/Westlink	Roadside	Y	-	100	N/A	N	27.1
39	Ormeau Road (junction with Ravenhill Road)	Roadside	Y	-	75	N/A	N	32.7
40	Upper Newtownards Road & Hollywood Road	Roadside	N	-	91.6	N/A	N	28.0
41	Crumlin Road	Roadside	N	-	100	N/A	N	29.5
42	228 Antrim Road	Roadside	N	-	83.3	N/A	N	32.6
44	Shore Road (Ivan Street end)	Roadside	N	-	100	N/A	N	31.5
59	York Street	Roadside	N	-	91.6	N/A	N	36.1
63	Queens Square	Kerbside	N	-	100	N/A	N	36.0
74	Ardmore Park	Roadside	N	-	83.3	N/A	N	35.1

Site ID	Location	Site Type	Within AQMA?	Triplicate or Collocated Tube	Data Capture 2017 (Number of Months or %)	Data with less than 9 months has been annualised (Y/N)	Confirm if data has been distance corrected (Y/N)	Annual mean concentration (National Bias Adjustment factor = 0.89)
								2017 (μg/m^3)
76	Titanic Quarter	Roadside	N	-	83.3	N/A	N	23.7
77	Poleglass	Roadside	N	-	66.7	N/A	N	27.8
87	RVH Falls Road	Roadside	N	-	75	N/A	N	37.4
88	Dunmurry Lane	Roadside	N	-	50	N/A	N	26.2
89	Upper Knockbreda Road	Kerbside	N	-	83.3	N/A	N	**40.3**

Short-term to Long-term Data Adjustment

Guidance for the treatment of diffusion tube monitoring data, as provided in Table 2.5 of this report, requires that where annual mean results are based upon monitoring data of less than 9 months sampling, these means should be "annualised" in accordance with the procedure outlined in Box 7.10 of the government's local air quality management technical guidance LAQM.TG16.

In order to complete the annualising process, councils are required to identify nearby long-term background continuous monitoring sites for nitrogen dioxide or alternatively use a number of background diffusion tube sites with 12 months of data. As there are only two such sites in Northern Ireland, historically we used data from both the Belfast Centre AURN (urban centre) and Derry City Council Brooke Park (urban background) sites. The Brooke Park background site has been re-located and the data capture for 2016 is below 85%. We only have one background diffusion tube site which has 12 months data. We contacted the LAQM Helpdesk to confirm the approach to take and were advised that it would be sufficient to use only Lombard Street to complete the annualising.

Individual adjustment factors have been calculated for two diffusion tube monitoring site, commensurate with the diffusion tube exposure periods. The adjustment ratios for our sites with less than 9 months of data is summarised as follows:

Annualising NO_2 Diffusion Tube Monitoring Data - tube 77 Poleglass (DC 67%)

Date	B1 (Lombard Station)	D1(tube)	B1 when D1 is available
Jan	37.2	38.7	37.2
Feb	30.5		
Mar	31.2	32.7	31.2
Apr	20.0	26.1	20.0
May	21.4	26.9	21.4
Jun	16.9	21.0	21.0
Jul	15.9	21.0	21.0
Aug	15.9		
Sep	22.0		
Oct	24.9		
Nov	31.7	68.0	31.7
Dec	32.8	33.4	32.8
Average	**25.0**	**33.5**	**27.0**

Am/Pm = 0.93
D1 = 33.5 * 0.93 = 31.2
D1 with Bias (0.78) =24.3

Annualising NO_2 Diffusion Tube Monitoring Data - tube 88 Dunmurry Line (DC 50%)

Date	B1 (Lombard Station)	D1(tube)	B1 when D1 is available
Jan	37.2		
Feb	30.5		
Mar	31.2	39.8	31.2
Apr	20.0	28.8	20.0
May	21.4		
Jun	16.9	22.8	16.9
Jul	15.9		
Aug	15.9		
Sep	22.0		
Oct	24.9	27.3	24.9
Nov	31.7	32.5	31.7
Dec	32.8	34.1	32.8
Average	**25.0**	**30.9**	**26.3**

Am/Pm = 0.95
D1 = 30.9 * 0.95 = 29.4
D1 with Bias (0.78) =22.9

QA/QC of Diffusion Tube Monitoring

Workplace Analysis Scheme for Proficiency (WASP) nitrogen dioxide proficiency testing.

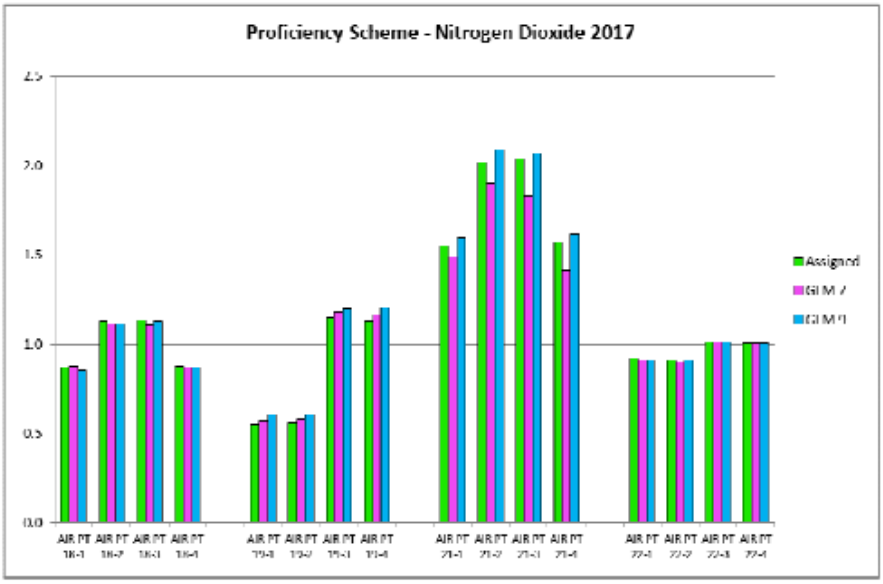
Government provides an additional layer of surety for local authorities operating nitrogen dioxide diffusion tubes through the independent analytical proficiency-testing scheme. Through the Workplace Analysis Scheme for Proficiency, laboratories are provided with a number of test samples that are designed to test their proficiency in undertaking chemical analysis of diffusion tubes. The WASP scheme is operated independently by the Health and Safety Laboratory.

For the 2017 sampling period, Gradko's performance was assessed as follows:

AIR PT Nitrogen Dioxide Proficiency Scheme Results 2017

Methods: GLM 7 – Camspec M550 Spectrophotometer, GLM 9 – QuAAtro Continuous Flow analyser

AIR PT Proficiency Scheme - Nitrogen Dioxide 2017								
Date	Round	Assigned value	Camspec M550 - GLM 7			QuAAtro - GLM 9		
			Measured concentration	z-Score	% Bias	Measured concentration	z-Score	% Bias
Feb-17	AIR PT 18-1	0.87	0.88	0.15	1.1%	0.86	-0.15	-1.1%
Feb-17	AIR PT 18-2	1.13	1.12	-0.12	-0.9%	1.12	-0.12	-0.9%
Feb-17	AIR PT 18-3	1.14	1.11	-0.35	-2.6%	1.13	-0.12	-0.9%
Feb-17	AIR PT 18-4	0.88	0.87	-0.15	-1.1%	0.87	-0.15	-1.1%
May-17	AIR PT 19-1	0.55	0.57	0.49	3.6%	0.61	1.46	10.9%
May-17	AIR PT 19-2	0.56	0.58	0.48	3.6%	0.61	1.19	8.9%
May-17	AIR PT 19-3	1.15	1.18	0.35	2.6%	1.20	0.58	4.3%
May-17	AIR PT 19-4	1.13	1.16	0.34	2.7%	1.21	0.90	7.1%
Aug-17	AIR PT 21-1	1.55	1.49	-0.49	-3.9%	1.60	0.41	3.2%
Aug-17	AIR PT 21-2	2.02	1.90	-0.79	-5.9%	2.09	0.46	3.5%
Aug-16	AIR PT 21-3	2.04	1.83	-1.28	-10.3%	2.07	0.18	1.5%
Aug-16	AIR PT 21-4	1.57	1.41	-1.29	-10.2%	1.62	0.40	3.2%
Oct-17	AIR PT 22-1	0.92	0.91	-0.14	-1.1%	0.91	-0.14	-1.1%
Oct-17	AIR PT 22-2	0.91	0.90	-0.15	-1.1%	0.91	0	0.0%
Oct-17	AIR PT 22-3	1.02	1.02	0	0.0%	1.02	0	0.0%
Oct-17	AIR PT 22-4	1.01	1.01	0.0	0.0%	1.01	0	0.0%



February 2017

QA/QC of Automatic Monitoring

As highlighted in the body of this report, Belfast City Council operates a number of automatic monitoring sites across the city. In order to ensure that our data is accurate and precise, we calibrate our sites on a biweekly or four-weekly basis, in accordance with the requirements of the Defra Site Operators Manual for the Automatic Urban and Rural Network, published in 2009.

For our automatic nitrogen dioxide analysers, we complete a two-point calibration using zero air and a nitric oxide span gas of certified concentration. We obtain our calibration gases under contract from Air Liquide who also provide similar gases to government owned AURN monitoring stations. By considering instrument operating parameters and the results of successive calibrations, we can make a determination regarding the ongoing performance of our analysers.

Where an instrument is found not to be operating within normal operating parameters, we refer the matter promptly to ‘We Care 4 Air’, who are retained by the council to provide service and maintenance support for our equipment.

Finally, the council is a member of AEA’s Calibration Club, which promotes and supports best practice in the application of quality control to automatic air-monitoring data in line with the government's local air quality management technical guidance LAQM.TG(16). AEA staff visit our sites on a six-monthly basis and compare the performance of our analysers against a range of laboratory grade standards. AEA subsequently provides a series of calibration and scaling factors that are used to correct our automatic monitoring data. These scaling procedures enable the council to robustly compare our air quality data with Air Quality Strategy Objectives and European Union Limit Values.

Appendix B: Defra NO_2 Distance Calculator Results

Black's Road Monitoring Location

Enter data into the pink cells

Step 1	How far from the KERB was your measurement made (in metres)?	2	metres
Step 2	How far from the KERB is your receptor (in metres)?	32	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	14	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	41	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	23.5	µg/m^3

Warning: your receptor is more than 20m further from the kerb than your monitor, treat result with caution

Short Strand Monitoring Location

Enter data into the pink cells

Step 1	How far from the KERB was your measurement made (in metres)?	1	metres
Step 2	How far from the KERB is your receptor (in metres)?	16	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	25.6	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	44	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	32.4	µg/m^3

Knock Road Monitoring Location

Enter data into the pink cells

Step 1	How far from the KERB was your measurement made (in metres)?	1.5	metres
Step 2	How far from the KERB is your receptor (in metres)?	15	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	13	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	41	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	26.9	$\mu g/m^3$

Great Georges Street Monitoring Location

Enter data into the pink cells

Step 1	How far from the KERB was your measurement made (in metres)?	0.5	metres
Step 2	How far from the KERB is your receptor (in metres)?	30	metres
Step 3	What is the local annual mean background NO_2 concentration (in $\mu g/m^3$)?	22	$\mu g/m^3$
Step 4	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	41	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	27.2	$\mu g/m^3$

Warning: your receptor is more than 20m further from the kerb than your monitor, treat result with caution

Stockman's Lane Monitoring Location (2016 Lombard Street NO_2 concentration used as background)

Enter data into the pink cells

Step 1	How far from the KERB was your measurement made (in metres)?	2	metres
Step 2	How far from the KERB is your receptor (in metres)?	16	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	25	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	50	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	37.8	µg/m^3

Chichester Street Monitoring Location

Enter data into the pink cells

Step 1	How far from the KERB was your measurement made (in metres)?	2	metres
Step 2	How far from the KERB is your receptor (in metres)?	5	metres
Step 3	What is the local annual mean background NO_2 concentration (in µg/m^3)?	25	µg/m^3
Step 4	What is your measured annual mean NO_2 concentration (in µg/m^3)?	42	µg/m^3
Result	The predicted annual mean NO_2 concentration (in µg/m^3) at your receptor	38.4	µg/m^3