2010 Air Quality Progress Report for Dumfries and Galloway Council

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

November 2010

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Summary

Results of monitoring for nitrogen dioxide (NO_2) show that all the concentrations are below the objectives, therefore there is no need to proceed to a detailed assessment for NO_2. A detailed assessment for PM_{10} covering Buccleuch St., Dumfries and 3 road junctions in Dumfries was carried out in 2009. The detailed assessment predicted exceedences at all 3 junctions but as it was largely based on modelling the detailed assessment is currently being supplemented by additional site-specific PM_{10} monitoring in Dumfries; the monitoring has only recently commenced therefore there are no results available to report as yet. In previous reports the objectives for sulphur dioxide, carbon monoxide, lead, benzene and 1,3 butadiene have all been assessed as being unlikely to be exceeded in Dumfries and Galloway. Hence no requirement for a new detailed assessment has been identified from monitoring.

No new requirement to proceed to a detailed assessment for any of the relevant pollutants has been identified as a result of new local developments. A detailed assessment for PM_{10} is planned to be carried out in the village of Cairnryan when the new Stena Line ferry terminal is up and running at Old House Point, Cairnryan (estimated August 2011) due to a perceived increase in traffic through the village.

No part of the Council area has been designated as an air quality management area to date.

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1 Introduction

1.1 Description of local authority area.

Dumfries and Galloway is located in south-west Scotland. To the north, the region shares borders with South Ayrshire, East Ayrshire and South Lanarkshire; to the east with Scottish Borders; and to the south with the county of Cumbria. Lying to the north of the Solway Firth and to the east of the Irish Sea, Dumfries and Galloway occupies a land area of approximately 6,439 km^2, making it the third largest of Scotland's 32 local authorities. Its population of approximately 147,284 is projected to fall to around 146,000 over the next 10 years. The largest town is Dumfries (31,600), followed by Stranraer (10,800) and Annan (8,300), with other settlements having populations of 4,500 or fewer. The economy of the region is based primarily on agriculture and forestry with light industry and tourism making significant contributions. Some 30% of Scotland's dairy cattle come from Dumfries and Galloway, and textiles, engineering and food processing are important industries in towns such as Dumfries, Kirkcudbright, Wigtown, Newton Stewart, New Galloway, Moffat, Lockerbie, Annan, Castle Douglas and Dalbeattie. The ferry ports at Stranraer and Cairnryan provide links to Belfast and Larne via Loch Ryan and the Irish Sea.

1.2 Purpose of progress report.

Under Part IV of the Environment Act 1995[i] every local authority is required to regularly review and assess the air quality in its area to determine whether the Government's air quality objectives are being or will be met. Progress reports are required in the intervening years between three-yearly updating and screening assessment reports. The purpose of progress reports is to maintain continuity in the local air quality management process.

Progress reports are not intended to be as detailed as updating and screening assessment reports however if a risk of non-compliance with an air quality objective is identified the local authority is required to proceed to a detailed assessment in respect of the pollutant concerned.

1.3 Air quality objectives.

The air quality objectives applicable to local air quality management in Scotland are set out in the Air Quality (Scotland) Regulations 2000 and the Air Quality (Scotland) (Amendment) Regulations 2002[ii]. Table 1 shows the objectives in units of micrograms per cubic metre ($\mu g/m^3$) except for the carbon monoxide objective which is expressed in milligrammes per cubic metre (mg/m^3) with the number of exceedences in each year that are permitted (where applicable). (Air quality objectives for the UK can be found in the Government's Air Quality Strategy for England, Scotland, Wales and Northern Ireland [iii]).

[i,ii,iii] See references on page 18

Table 1 Air quality objectives prescribed in regulations for the purpose of local air quality management in Scotland.

Pollutant	Concentration	Measured as	Date to be achieved by
Benzene	16·25 µg/m^3 (or less)	Running annual mean	31/12/2003
	3·25 µg/m^3 (or less)	Running annual mean	31/12/2010
1,3-butadiene	2·25 µg/m^3 (or less)	Running annual mean	31/12/2003
Carbon monoxide	10·0 mg/m^3 (or less)	Running 8-hour mean	31/12/2003
Lead	0·5 µg/m^3 (or less)	Annual mean	31/12/2004
	0·25 µg/m^3 (or less)	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 (or less)	Annual mean	31/12/2005
Particles (PM_{10})	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean	31/12/2004
	50 µg/m^3, not to be exceeded more than 7 times a year	24-hour mean	31/12/2010
	40 µg/m^3 (or less)	Annual mean	31/12/2004
	18 µg/m^3 (or less)	Annual mean	31/12/2010
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 [iv].

1.4.1 The findings of the first review and assessment of air quality in Dumfries and Galloway (commenced in 1998) were that the air quality objectives were likely to be met. As a consequence no air quality management areas were declared (which is still the position to date).

1.4.2 In 2003, an updating and screening assessment was carried out, the results of which generally supported the conclusions of the first round. However, in line with the Department for Environment, Food and Rural Affairs' (DEFRA's) revised technical guidance (2003), it was found that a detailed assessment of sulphur dioxide (SO_2) levels at the ferry ports of Stranraer and Cairnryan would be required.

1.4.3 In 2004 a detailed assessment of the influence of shipping on SO_2 levels at Cairnryan was carried out, the conclusion of which was that an air quality management area was not required. With regard to the detailed assessment at Stranraer this was initially put on hold pending Stena Line's proposed re-location to Cairnryan but subsequent to DEFRA's amendment of their technical guidance (2006) which relaxed the screening criteria for SO_2 related to shipping it was found that a detailed assessment for SO_2 at Stranraer was no longer required.

1.4.4 In 2005 monitoring results detailed in a progress report indicated that there was no requirement to proceed to a detailed assessment for any of the relevant pollutants.

1.4.5 In 2006 the conclusions of an updating and screening assessment were that the relevant air quality objectives would be met and that consequently there was no requirement to undertake a detailed assessment. Three road junctions in Dumfries were however predicted to marginally exceed the 2010 annual mean PM_{10} objective.

1.4.6 Monitoring results detailed in the 2007 progress report showed that the current air quality objectives for the relevant pollutants were being met. Projected PM_{10} levels at the monitoring site at Buccleuch Street, Dumfries indicated that the 2010 annual mean PM_{10} objective would not be met but there was no relevant exposure at this roadside site. With regard to the marginal exceedences of the PM_{10} annual mean predicted at three road junctions in the 2006 updating and screening assessment, traffic flows would be checked at the relevant areas to see if they were in line with estimated levels.

1.4.7 The main findings of the 2008 progress report were that whilst the air quality objectives in force at the time were being met, PM_{10} levels at Buccleuch Street, Dumfries were again predicted to exceed the 2010 PM_{10} annual mean objective and after a re-assessment of relevant exposure it was decided that a detailed assessment for PM_{10} should be carried out to include Buccleuch St., Dumfries and the three road junctions in Dumfries which had previously been predicted to marginally exceed the 2010 PM_{10} annual mean objective.

1.4.8 A detailed assessment for PM_{10} was commenced in 2008 covering Buccleuch Street, and the junctions of Brooms Road/Annan Road, Glasgow Street/Galloway Street and Whitesands/Buccleuch Street, all in Dumfries. Concentrations of PM_{10} were modelled for 2010 using the ADMS roads dispersion model. Projections of measured PM_{10} concentrations did not identify an exceedence at the site of the Buccleuch Street PM_{10} monitor itself; however exceedences of the 2010 annual mean objective were predicted at all three junctions and exceedence of the 2010 PM_{10} 24-hour mean objective was predicted at one junction (Whitesands/Buccleuch Street). It is intended to carry out PM_{10} monitoring at these junctions to supplement this assessment. PM_{10} monitoring at the Buccleuch St./Whitesands junction commenced on 10/08/10.

1.4.9 In 2009 an updating and screening assessment was carried out having regard to DEFRA's further revision of their technical guidance published in February 2009. The results of monitoring together with the evaluation of new and changed sources to identify those that might give rise to a risk of an exceedence of an air quality objective did not identify any new requirement to proceed to a detailed assessment. A previous commitment to carry out a detailed assessment of PM_{10} at Cairnryan in the event that Stena Line re-located from Stranraer to Cairnryan was reiterated.

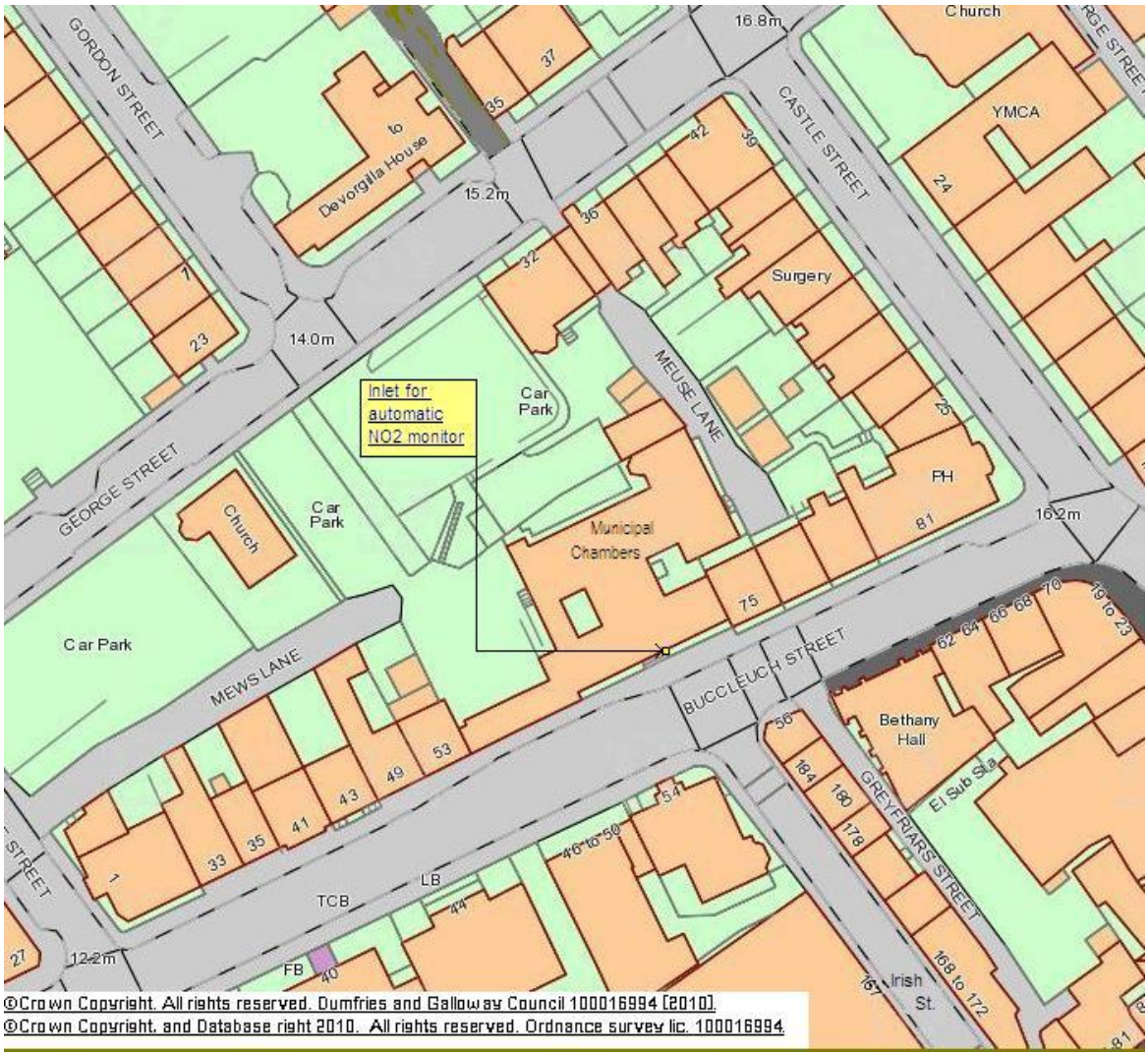
2. Monitoring data

2.1 Automatic monitoring

2.1.1 Dumfries NO_2

A continuous (chemiluminescent) NO_2 monitor (API M200a) is located at the Municipal Chambers, Buccleuch Street, Dumfries and forms part of the UK Automatic Urban and Rural Air Quality Monitoring Network (AURN). Routine calibrations of the automatic monitor are carried out fortnightly by Council staff, with six-monthly audits carried out by AEA Energy and Environment. Ratification is carried out by the Quality Assurance and Control (QA/QC) Unit at AEA Energy & Environment.

Figure 1 - Map of NO_2 automatic monitoring site at Buccleuch St., Dumfries.

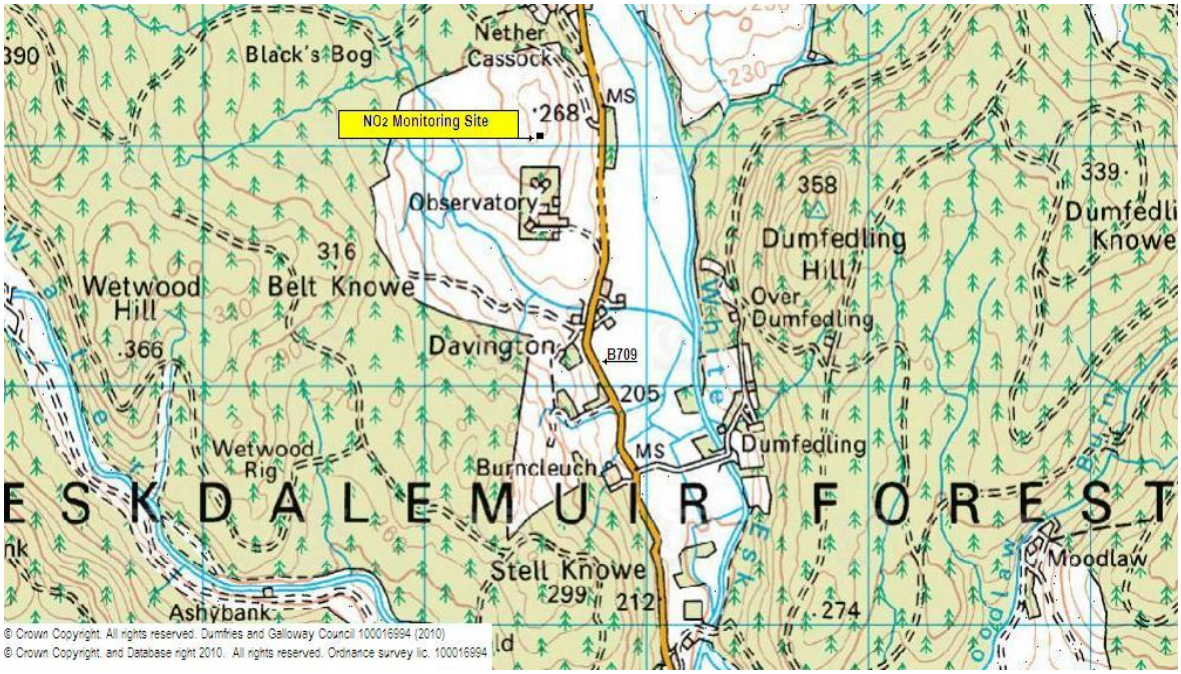


The air intake for the monitor is situated at a height of approximately 2·2 metres in the supporting framework of one of two decorative lamps on either side of the Municipal Chambers entrance The air-intake tube goes through a window to the monitor which is located in the basement of the building.

2.1.2 Eskdalemuir NO_2

Since December 2004 a continuous NO_2 monitor has been located at the Observatory at Eskdalemuir as part of the AURN. The Observatory[v] is currently managed by the British Geological Society and the Met Office. Ratification is carried out by the QA/QC unit at AEA. (Ozone is also monitored at this site).

Figure 2 - Map of NO_2 automatic monitoring site at Eskdalemuir Observatory.



2.1.3 Dumfries PM_{10}

PM_{10} monitoring using a Partisol monitor on a flat roof of a single-storey building immediately to the south-west of the NO_2 inlet site was carried out from August 2001 to March 2008 as part of the AURN and was re-commenced for a six-month period by the Council from October 2008 to April 2009. ($PM_{2.5}$ monitoring using an additional Partisol at the same site was carried out as part of a Scottish Government project[vi] from February 2007 to March 2008; both the PM_{10} and the $PM_{2.5}$ monitors are still in situ but have been switched off since April 2009 and March 2008 respectively. See Appendix 4 for $PM_{2.5}$ monitoring results).

A beta-attenuation particulate (PM_{10}) monitor (BAM) has recently been hired for six months and sited as shown in map below.

Figure 3 - Map of BAM PM_{10} monitoring site at Buccleuch St., Dumfries.

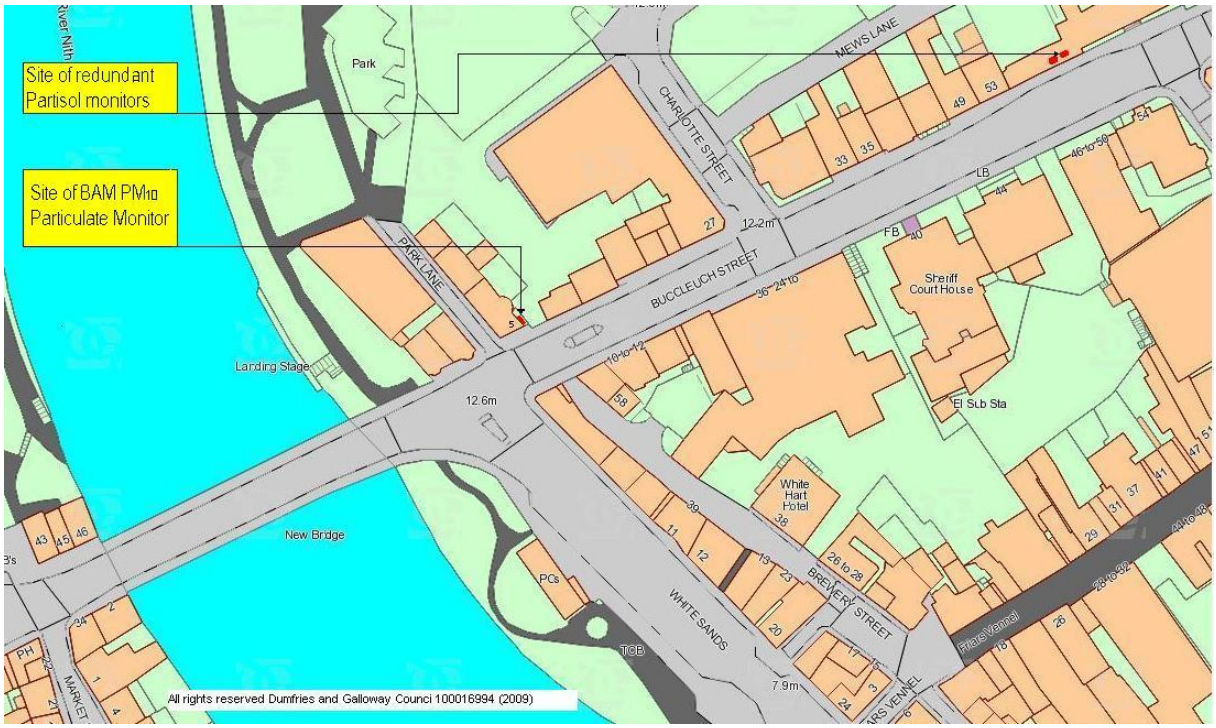


Table 2 Details of operating automatic monitoring sites**.**

Site Name	Site Type	Grid Ref.	Pollutant	Monitoring Technique	Within AQMA	Relevant Exposure?	Distance to kerb (metres)	Worst-case Exposure?
Buccleuch Street Dumfries	Roadside	297025 576259	NO_2	Automatic	No	Yes	4·3	Yes
Eskdalemuir	Rural	323551 603021	NO_2	Automatic	No	No	n/a	n/a
Buccleuch Street (BAM) Dumfries	Roadside	296873 576186	PM_{10}	Beta-attenuation mass	No	Yes	5·0	Yes

2.2 Non-automatic monitoring.

NO_2 diffusion tubes are deployed for monthly exposure periods at the twelve sites shown in Table 3. Triplicate tubes are used at two sites namely at Buccleuch Street (East), and Buccleuch Street Bridge, with duplicate tubes at Buccleuch Street (West), while the rest of the sites have single tubes. Locations of the diffusion tubes are shown in Appendix 2 Figures 6 to 13. The tubes are prepared and analysed by Environmental Scientifics Group using 20% triethanolamine in water. Environmental Scientifics Group has demonstrated good performance for 2009 in the Workplace Analysis Scheme for Proficiency (WASP) (an independent analytical performance testing scheme). The triplicate tubes at Buccleuch St., (East) are co-located with the NO_2 automatic monitor. A local bias-adjustment factor of 0·83 has been used for 2009 diffusion tube data. By comparison the national bias-adjustment factor for Environmental Scientifics Group is 0·82 (amalgamation of 9 studies including Dumfries and Galloway's). Use of the national bias-adjustment factor would therefore give marginally lower results. Further details of the local co-location study are provided in Appendix 1.

Table 3 Details of NO_2 diffusion tube sites.

Site Name	Site Type	OS Grid Ref	Number of tubes	Within AQMA	Relevant Exposure?	Distance to kerb of nearest road (metres)	Worst-case Location?
M74 Slip Rd. Lockerbie	Intermediate	NY133814	single	No	No (32m)	1·9	Yes
Buccleuch St. (E) Dumfries	Roadside	NX970763	triplicate (co-located with automatic monitor)	No	Yes (<1m)	4·3	Yes
Buccleuch St. (W) Dumfries	Kerbside	NX969762	duplicate	No	Yes (<1m)	1·0	No
Buccleuch St. (S) Dumfries	Kerbside	NX970762	single	No	Yes (<1m)	0·6	No
Buccleuch St. Bridge Dumfries	Roadside	NX968762	triplicate	No	Yes (<1m)	5·0	Yes
Loreburn St. Dumfries	Kerbside	NX974762	single	No	Yes (<1m)	1·0	No
St. Michael St. Dumfries	Roadside	NX975757	single	No	Yes (<1m)	3·1	No
Argyll Drive Dumfries	Background	NX994788	single	No	Yes (1m)	1·7	No
Nith Place Dumfries	Kerbside	NX973758	single	No	Yes (<1m)	0·7	Yes
Charlotte St. Stranraer	Kerbside	NX061608	single	No	Yes (<1m)	0·5	No
Port Rodie Car Park Stranraer	Other	NX063610	single	No	No (160m)	N/A	Yes
A77 Cairnryan	Roadside	NX072674	single	No	No (19m)	2·0	Yes

2.3 Comparison of monitoring results with air quality objectives.

2.3.1 NO_2 automatic monitoring data.

All NO_2 results from automatic monitoring meet the relevant objectives.

Table 4 Results of automatic monitoring for NO_2 - comparison with annual mean objective (*40µg/m^3 or less*).

Location	Within AQMA	Data capture for full calendar year 2009 %	Annual mean concentrations (µg/m^3)							
			2009	2008	2007	2006	2005	2004	2003	2002
Buccleuch St Dumfries	No	†81·6%	35·0	37·3	38·3	37·5	35·9	37·3	37·6	38·0
Eskdalemuir	No	93·8%	4·3	5·1	5·0	4·3	3·8	n/a	n/a	n/a

†There was a problem with the automatic monitor at Dumfries in that the NOx analyser converter efficiency was found to be below the acceptable limit of 95% at an audit on 27th July 2009. Unfortunately repairs were not completed until 24th September 2009 with the subsequent loss of 59·3 days data. (data capture over the remaining 306 days was 97·4%). (An estimate of the annual mean to compensate for loss of data is shown in Appendix 3).

Figure 4 Trends in annual mean NO_2 concentrations at Dumfries and Eskdalemuir.

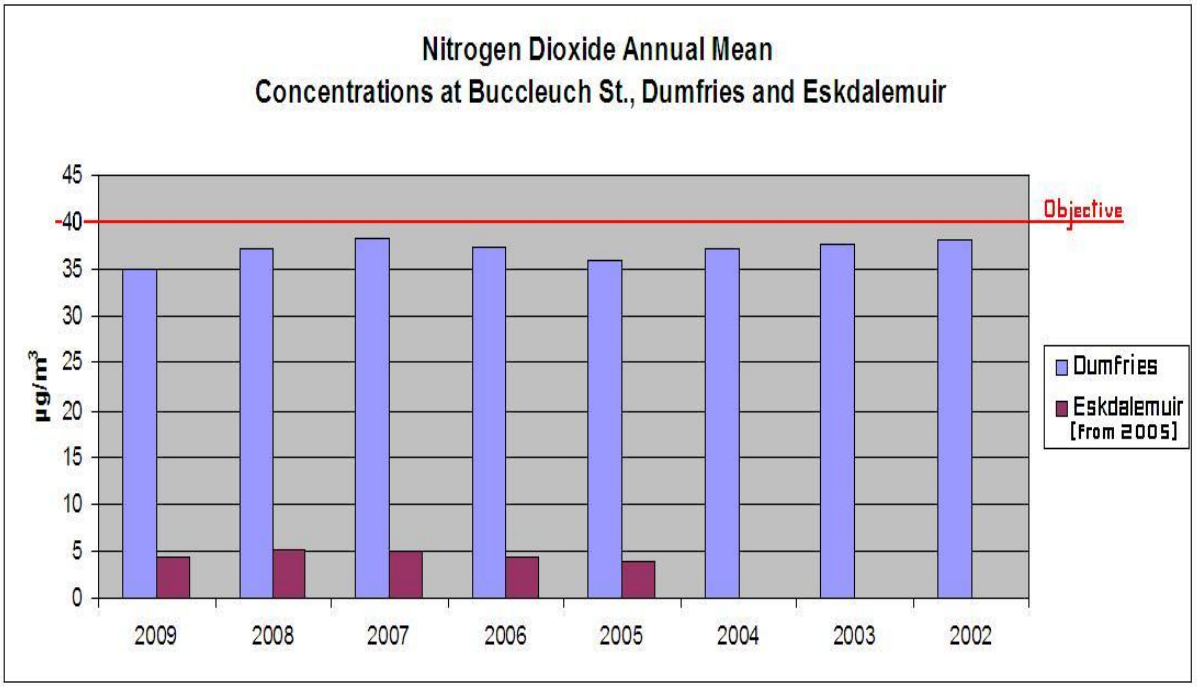


Table 5 Results of automatic monitoring for nitrogen dioxide - comparison with 1-hour mean objective *(200µg/m^3 not to be exceeded more than 18 times).*

Location	Within AQMA	Data capture for full calendar year 2009 %	Number of exceedences of hourly mean							
			2009	2008	2007	2006	2005	2004	2003	2002
Buccleuch St Dumfries	No	‡81·6%	‡0	4	5	0	1	0	2	0
Eskdalemuir	No	93·8%	0	0	0	0	0	n/a	n/a	n/a

‡99·8th percentile of hourly NO_2 concentrations for 2009 was 134 µg/m^3. (The 98th percentile is the level at or below which 98% of the hourly concentrations fell during the year.)

2.3.2 NO_2 diffusion tube monitoring data.

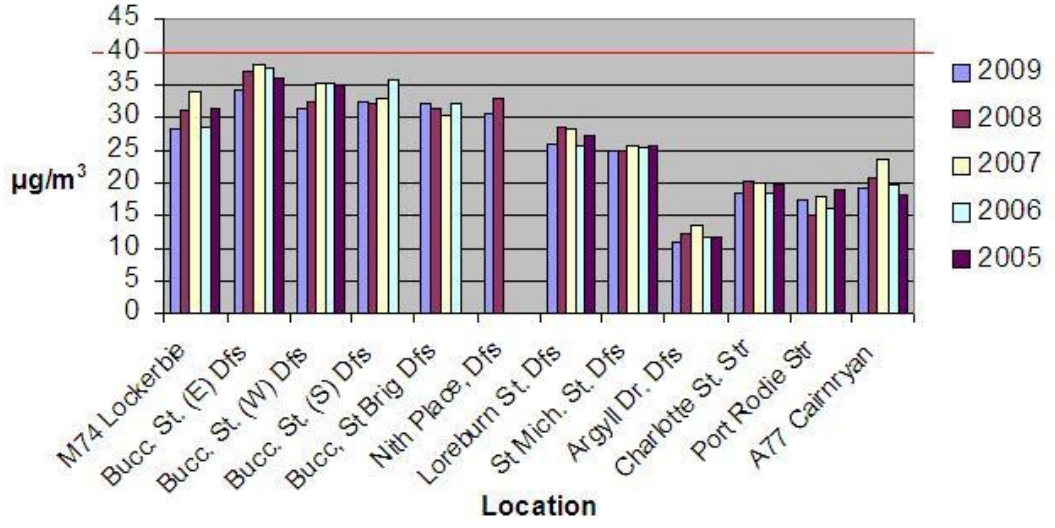
All bias-corrected NO_2 results from diffusion tube monitoring meet the annual mean objective of 40µg/m^3.

Table 6 Annual mean results of nitrogen dioxide diffusion tubes.

Location		Within AQMA	Data-capture for calendar year 2009 %	Annual mean concentrations *(micrograms per cubic metre)*				
				2009 *(bias corrected x 0·83)*	2008 *(bias corrected x 0·93)*	2007 *(bias corrected x 1·01)*	2006 *(bias corrected x 0·97)*	2005 *(bias corrected x 0·968)*
M74 Slip Road	Lockerbie	No	92%	28·2	31·1	34·0	28·4	31·5
***Buccleuch St. (E)	Dumfries	No	94%	34·2	37·3	38·1	37·5	36·2
††Buccleuch St. (W)	Dumfries	No	100%	31·3	32·4	35·5	35·2	34·9
Buccleuch St. (S)	Dumfries	No	100%	32·5	32·2	32·8	35·7	n/a
†††Buccleuch St Bridge	Dumfries	No	92%	32·3	31·6	30·2	32·2	n/a
Nith Place,	Dumfries	No	100%	30·8	32·9	n/a	n/a	n/a
Loreburn St.	Dumfries	No	100%	26·0	28·4	28·2	25·7	27·2
St Michael St.	Dumfries	No	100%	24·9	24·9	25·7	25·5	25·8
Argyll Drive	Dumfries	No	100%	11·0	12·2	13·7	11·8	11·7
Charlotte St.	Stranraer	No	92%	18·7	20·3	20·1	18·4	19·6
Port Rodie Car Park	Stranraer	No	83%	17·5	15·0	18·0	16·0	18·8
A77 Cairnryan	Stranraer	No	92%	19·2	20·6	23·4	19·6	18·1

****Triplicate tubes co-located with AURN automatic monitor*
†† Duplicate tubes ††† Triplicate tubes n/a not applicable i.e. tube not deployed at site in year shown.

Figure 5 Trends in annual mean NO_2 diffusion tube results.



2.3.3 PM_{10}

After being set up and used for several years as part of the AURN, the Partisol PM_{10} monitor at Buccleuch St., Dumfries was switched off in March 2008 following a Government review of the network. As part of a detailed assessment for PM_{10} the Partisol (which had been left in situ) was operated by the Council independently from the network from 15/10/08 to 28/04/09 using Emfab instead of quartz filters. The detailed assessment covered Buccleuch Street Dumfries together with 3 road junctions in Dumfries which had been identified in earlier reports as being at risk of exceeding the 2010 PM_{10} annual mean objective. The three junctions are Brooms Road/Annan Road, Glasgow Street/Galloway Street and Whitesands/Buccleuch Street Dumfries. Exceedences were predicted at all three junctions but as the detailed assessment was largely based on modelling it is currently being supplemented by further monitoring. To this end a beta-attenuation mass (BAM) PM_{10} monitor was installed at the Whitesands/Buccleuch Street junction on 10th August 2010 and it is hoped to get monitors set up at the other two junctions in due course.

Table 7 PM_{10} monitoring results - comparison with the 2010 annual mean objective (*18µg/m^3 or less*).

Results shown for 2003 to 2007 in Tables 7 & 8 are the corrected results as per Bureau Veritas Report "Analysis of Trends in Gravimetric Particulate Mass Measurements in the United Kingdom January 2009"[vii].

Location	Within AQMA?	Data capture for period 15/10/08 to 28/04/09	Period mean	Annual mean concentrations (µg/m^3)				
			15/10/08 to 28/04/09	2007	2006	2005	2004	2003
Buccleuch St Dumfries Partisol	No	#98·5%	‡‡16·5	18·3	20·1	18·5	16·2	21·1
Buccleuch St Dumfries BAM	No	Monitoring has only recently commenced therefore there are no results available to report as yet						

‡‡In the detailed assessment carried out in 2009 the period mean was adjusted to an annual figure for 2008 of 15·4 µg/m^3 which was projected to an annual mean of 14·1 µg/m^3 2010.
#Equivalent to 52·7% data capture over a 12-month period.

Table 8 PM_{10} monitoring results - comparison with the 2010 24-hour mean objective (*50µg/m^3 not to be exceeded more than 7 times*).

Location	Within AQMA?	Data capture for period 15/08/08 to 28/04/09	Number of exceedences of the 24-hour mean					
			15/08/08 to 28/04/09	2007	2006	2005	2004	2003
Buccleuch St Dumfries Partisol	No	98·5%	ǂ3	9	8	6	4	22
Buccleuch St Dumfries BAM	No	Monitoring has only recently commenced therefore there are no results available to report as yet						

ǂIn the detailed assessment carried out in 2009 the number of exceedences was estimated to be 0 for both 2008 and 2010.

Summary of compliance with air quality objectives.

NO_2 monitoring results in the Council-area are all below the objectives, therefore there is no need to proceed to detailed assessment for NO_2. A detailed assessment for PM_{10} based largely on modelling is currently being supplemented by site-specific PM_{10} monitoring in Dumfries.

3. New local developments.

- UK-based company Greenpark Energy Ltd., has been testing for coal-bed methane at various sites in Canonbie and has planning consent for several production hubs and one compressor station at Graystone Flow Plantation, Canonbie. In the Environmental Impact Assessment [viii] it is stated that "the impacts from nuisance dust are deemed to be negligible during all phases of the development" and "concentrations of PM_{10} are predicted to remain below the annual mean objective during all phases of the development but mitigation measures have nevertheless been recommended that will control impacts to a level where no significant effects would be expected".

- Construction of a new port at Old House Point north of Cairnryan is underway. This development has previously been assessed and is not considered likely to cause an exceedence of the sulphur dioxide objectives as it does not meet the criteria in the technical guidance [x] under which a detailed assessment for sulphur dioxide would be required. However Dumfries and Galloway Council intends to carry out a detailed assessment for PM_{10} at Cairnryan when the new ferry terminal is up and running due to the predicted increase in traffic through the village.

- A new Tesco petrol station and supermarket have opened at Annan. The petrol station does not meet the criteria in the technical guidance under which a detailed assessment for benzene would be required.

Planning consent has been granted for:-

- a former whisky distillery [ix] near Annan (in use from 1830-1924) to be brought back into use,
- a new hard rock quarry at Drumflower, Dunragit near Stranraer,
- an extension to Nether Murthat Quarry, Beattock,
- erection of concrete batching plant at Kirkburn Industrial Estate, Lockerbie,
- change of use of land to form area for crushing/re-cycling of re-claimed building materials at Dargavel, Lockerbie Road, Dumfries,
- engineering operations to form compensatory flood storage area and temporary haulage road as part of mitigation measures for proposed electricity sub-station north of Holms Farm, Beattock.

Planning applications have been lodged in respect of the following:-

- erection of a boiler-house for biomass plant at Kirkcudbright swimming pool,
- installation of additional stand-by cremator at Roucan Loch Crematorium, Collin, Dumfries,
- re-commencement of quarrying at Beattockhill Quarry, Beattock.

Any of the above developments/applications which have not been assessed already will be taken into consideration by Dumfries and Galloway Council in the next updating and screening assessment.

4. Conclusions

4.1 Conclusions from new monitoring data.

New NO_2 monitoring data indicate that the objectives for NO_2 are being met therefore there is no requirement for a detailed assessment for NO_2.

A detailed assessment for PM_{10} covering Buccleuch Street Dumfries and 3 road junctions in Dumfries is currently being supplemented by additional PM_{10} monitoring at the junction of Whitesands and Buccleuch Street, Dumfries. There are no new data to report as yet as the BAM monitor has only recently been set up.

4.2 Conclusions relating to new local developments

No new requirement to proceed to a detailed assessment for any of the relevant pollutants has been identified as a result of new local developments. A detailed assessment for PM_{10} is planned to be carried out in the village of Cairnryan when the new Stena Line ferry terminal is up and running at Old House Point, Cairnryan.

5. Proposed actions

Site-specific monitoring for PM_{10} in Dumfries will supplement the 2009 detailed assessment for PM_{10} which was largely based on modelling and may mean that part(s) of Dumfries will require to be designated as AQMA(s). Monitoring at one of the 3 road junctions which were modelled in the detailed assessment commenced in August 2010 using a BAM PM_{10} monitor hired for 6 months. If feasible monitoring at the other 2 junctions is hoped to be carried out for 6 months also.

6. References

i. The Environment Act 1995 (UK Parliament Public General Acts).
http://www.opsi.gov.uk/acts/acts1995/Ukpga_19950025_en_1

ii. The Air Quality (Scotland) Regulations 2000 Scottish Statutory Instrument (SSI) Number 97. The Air Quality (Scotland) Amendment Regulations 2002 SSI Number 297
http://www.opsi.gov.uk/legislation/scotland/ssi2000/20000097.htm
http://www.opsi.gov.uk/legislation/scotland/ssi2002/ssi_20020297_en.pdf

iii. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volumes 1&2) (July 2007).
Defra, UK - Environmental Protection - Air Quality

iv. Previously published LAQM reports for Dumfries and Galloway Council are available at
http://www.dumgal.gov.uk/index.aspx?articleid=1733

v. Eskdalemuir Observatory.
http://www.geomag.bgs.ac.uk/eskdale.html

vi. Measurement of PM_{10} and $PM_{2.5}$ in Scotland with Gravimetric Samplers. AEA June 2009
www.scottishairquality.co.uk

vii. Analysis of Trends in Gravimetric Particulate Mass measurements in the United Kingdom January 2009. Bureau Veritas UK Ltd.
http://www.airquality.co.uk/reports/cat09/0901221659_Trends_in_Gravimetric_PM_Measurements_in_the_UK_v210109.pdf

viii. Proposed Coal Bed Methane Gas Extraction at Airnlee - Environmental Statement – Greenpark Energy Ltd. 2009

ix. www.annandaledistillery.com

x. Local Air Quality Management Technical Guidance LAQM.TG (09): DEFRA February 2009
http://www.defra.gov.uk/environment/quality/air/airquality/local/guidance/documents/tech-guidance-laqm-tg-09.pdf

Appendix 1 Details of NO_2 co-location study

Table 9 Details of co-location study at Buccleuch St., Dumfries 2009.

Date	Monthly average (continuous monitor)	Ratified/ provisional data	Data capture %	Average diffusion Tube	Ratio:- continuous/ diffusion tube result
January	37·154	Ratified	78·306	41·667	0·892
February	45·221	Ratified	98·958	59·333	0·762
March	35·660	Ratified	99·256	43·000	0·829
April	34·194	Ratified	99·702	41·333	0·827
May	25·166	Ratified	99·524	32·667	0·770
June	29·664	Ratified	99·702	42·333	0·701
July	26·242	Ratified	92·113	35·667	0·736
August	No data	Ratified	0	28·667	N/A
September	28·058	Ratified	20·475	44·000	0·638
October	32·857	Ratified	99·403	37·000	0·888
November	33·660	Ratified	99·405	40·000	0·842
December	49·050	Ratified	99·421	49·000	1.001
Average	34·266			41·222	

Bias-adjustment factor = continuous mean/diffusion tube mean = 34·27/41·22 = 0·83
Diffusion tube bias = (diffusion tube mean minus continuous mean) divided by continuous mean = (41·22-34·27)/34·27 = 0·203 i.e. tubes over-read by approximately 20%.

Table 10 Diffusion tube annual averages 2009.

Location of tube		Annual average 2009 µg/m^3	Annual average 2009 *(bias corrected x 0·83)*	Annual average using AEA Energy and Environment spreadsheet
M74 Slip Road	Lockerbie	34·0	28·2	29
***Buccleuch St. (E)	Dumfries	41·2	34·2	35
†† Buccleuch St. (W)	Dumfries	37·7	31·3	32
Buccleuch St. (S)	Dumfries	39·1	32·5	33
††† Buccleuch St Bridge	Dumfries	38·9	32·3	33
Nith Place,	Dumfries	37·1	30·8	32
Loreburn St.	Dumfries	31·3	26·0	27
St Michael St.	Dumfries	30·0	24·9	26
Argyll Drive	Dumfries	13·3	11·0	11
Charlotte St.	Stranraer	22·5	18·7	19
Port Rodie Car Park	Stranraer	21·1	17·5	18
A77 Cairnryan	Stranraer	23·1	19·2	20

(µg/m^3 = *micrammes per cubic metre)*
****Triplicate tubes co-located with AURN automatic monitor*
††Duplicate tubes
†††Triplicate tubes

All the locally bias-corrected results in Table 9 are within the objective for the NO_2 annual mean ($\leq$ 40 µg/m^3). Use of the national bias-adjustment factor for Environmental Scientifics of 0·82 would give marginally lower results.

Table 11 Monthly diffusion tube results for 2009

Site	Monthly diffusion tube results (micrograms per cubic metre)													
	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	Average	Adjusted Average. (x0·83)
M74 Slip Road, Lockerbie	38	V	39	30	31	17	36	29	38	38	33	45	34·0	28·2
***Buccleuch St (East), Dumfries	44	60	43	41	32	41	35	29	40	37	39	47	41·2	34·2
	40	60	43	41	34	43	35	29	46	V	41	51		
	41	58	43	42	32	43	37	28	46	V	40	49		
††Buccleuch St (West), Dumfries	43	49	37	V	27	33	34	29	38	39	39	41	37·7	31·3
	39	53	38	37	32	41	33	29	43	39	34	40		
Buccleuch St (South), Dumfries	48	43	37	38	32	36	40	32	39	41	39	44	39·1	32·5
†††Buccleuch St Bridge, Dumfries	48	43	35	41	35	43	36	30	34	V	45	41	38·9	32·3
	47	46	32	45	38	37	36	33	36	V	42	38		
	50	46	31	43	33	42	36	24	31	V	42	44		
Nith Place, Dumfries	41	49	34	40	30	36	34	28	34	35	35	49	37·1	30·8
Loreburn St Dumfries	37	39	28	36	27	37	21	18	25	33	33	42	31·3	26·0
St Michael St Dumfries	37	40	29	29	23	30	23	20	28	29	32	40	30·0	24·9
Argyll Drive Dumfries	20	20	14	10	7	7	10	9	10	16	15	22	13·3	11·0
Charlotte St Stranraer	23	32	22	19	19	25	V	17	21	22	17	31	22·5	18·7
Port Rodie Car Park Stranraer	42	24	17	16	11	V	V	15	16	23	20	27	21·1	17·5
A77 Cairnryan Stranraer	26	30	22	24	21	25	V	24	24	21	21	16	23·1	19·2

****Triplicate tubes (co-located with automatic monitor)*
††Duplicate tubes
†††Triplicate tubes
V - Tube(s) vandalised (or otherwise removed or sample tubes contaminated or result[s] rejected).

Appendix 2 Maps of non-automatic monitoring sites.

Figure 6 Map of diffusion tube site at M74 Lockerbie.

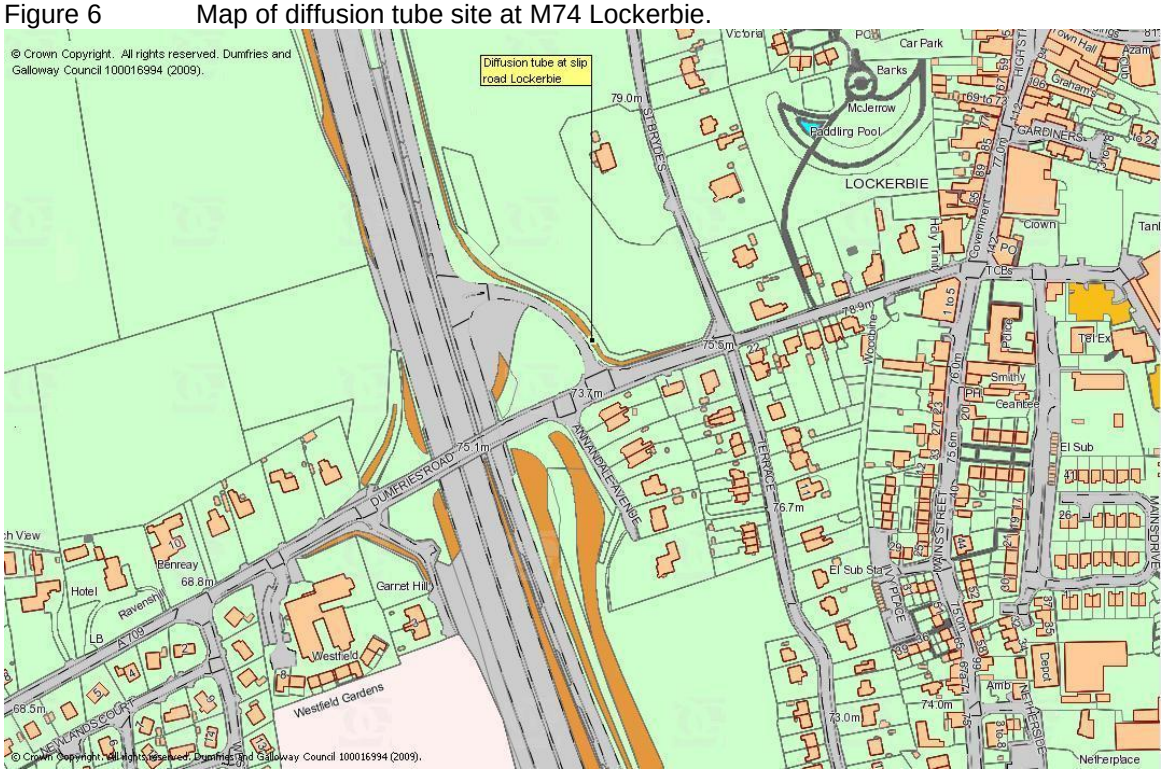
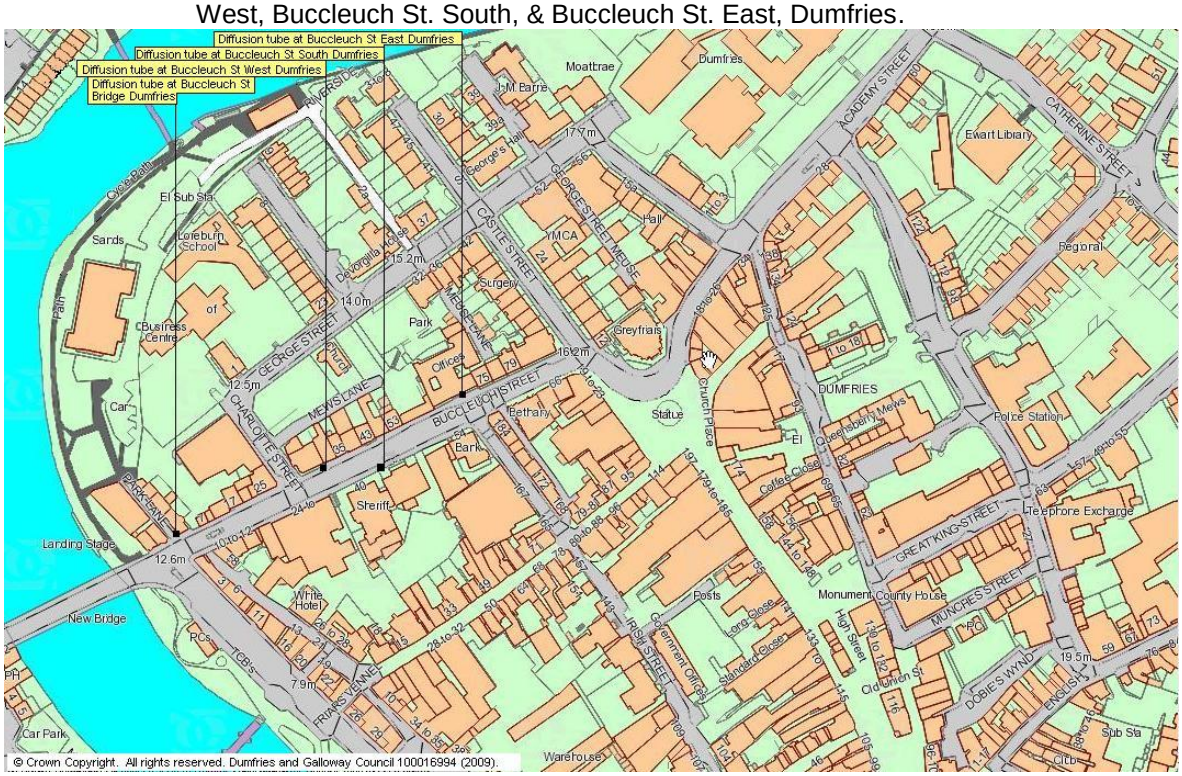


Figure 7 Map of diffusion tube sites at (from left to right) Buccleuch St. Bridge, Buccleuch St. West, Buccleuch St. South, & Buccleuch St. East, Dumfries.



Appendix 2 Maps of non-automatic monitoring sites (continued).

Figure 8 Map of diffusion tube site at Loreburn St., Dumfries.

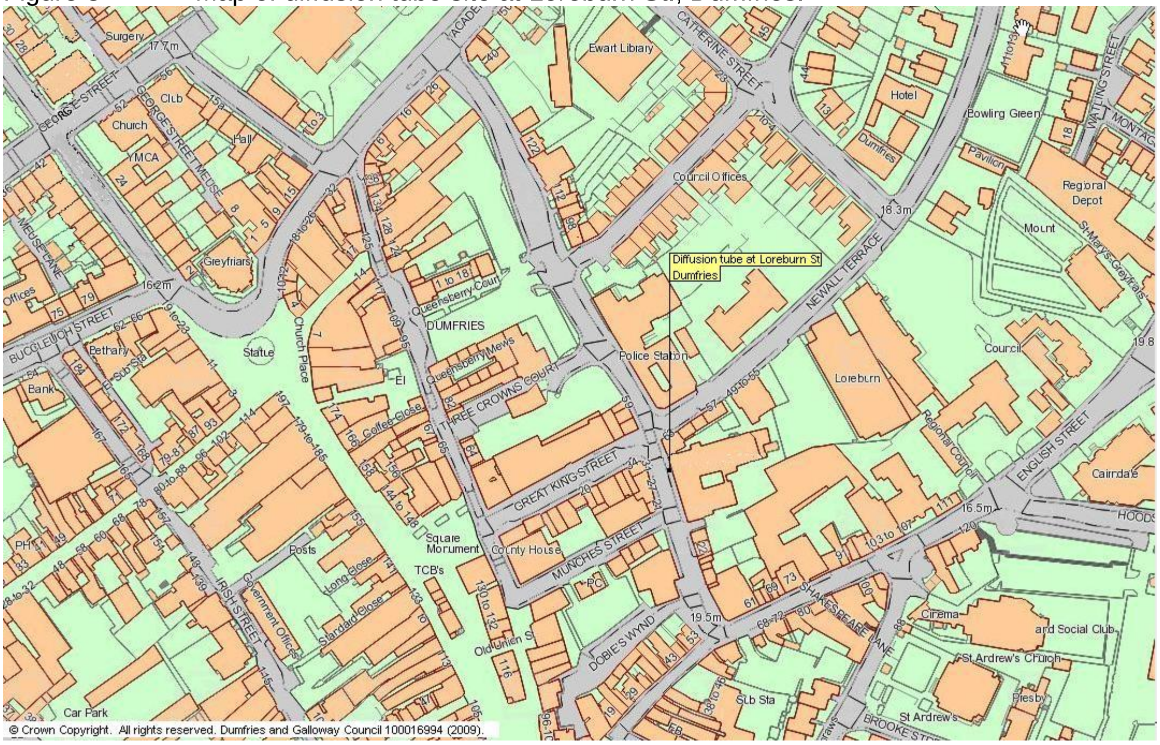
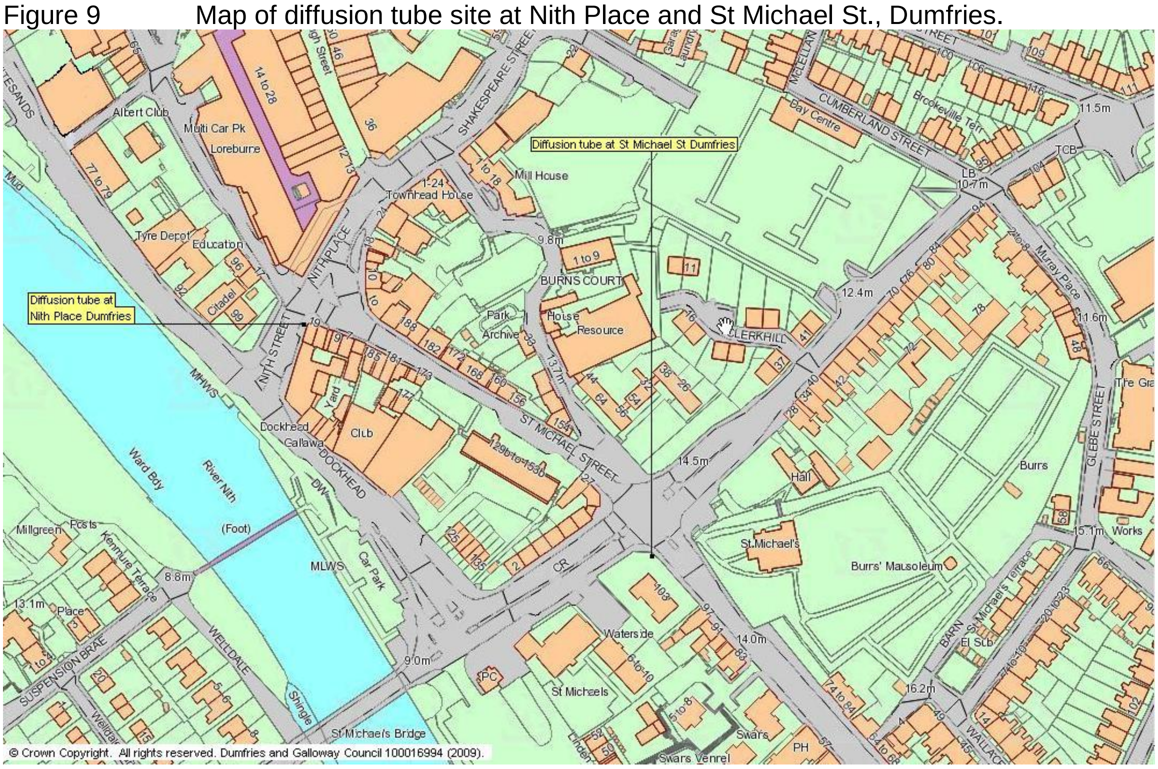


Figure 9 Map of diffusion tube site at Nith Place and St Michael St., Dumfries.



Appendix 2 Maps of non-automatic monitoring sites (continued).

Figure 10 Map of diffusion tube site at Argyll Drive, Heathhall Dumfries.

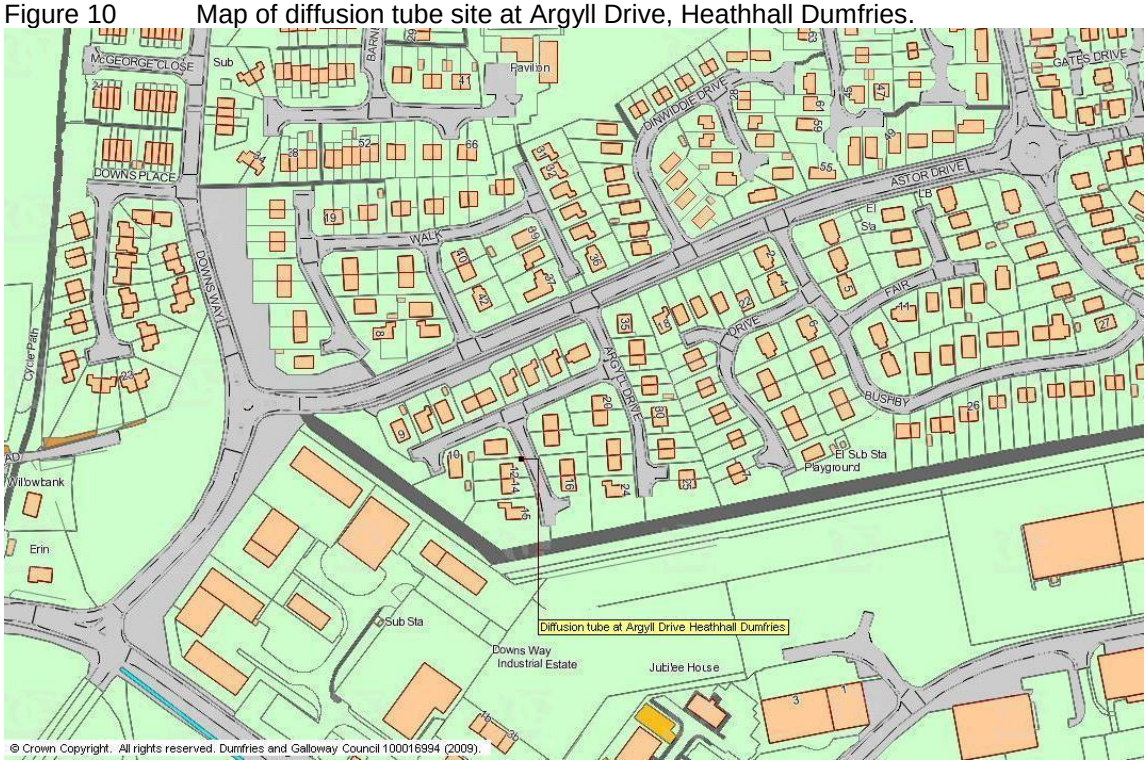
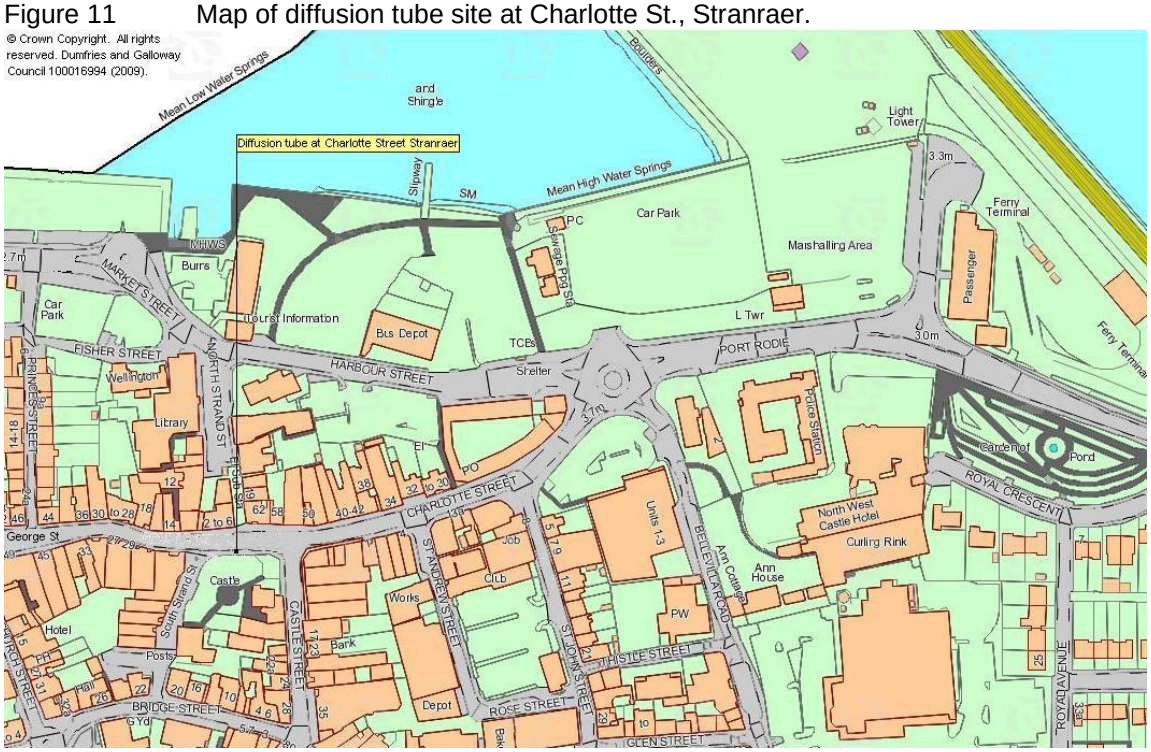


Figure 11 Map of diffusion tube site at Charlotte St., Stranraer.



Appendix 2 Maps of non-automatic monitoring sites (continued).

Figure 12 Map of diffusion tube site at Port Rodie Car Park Stranraer.

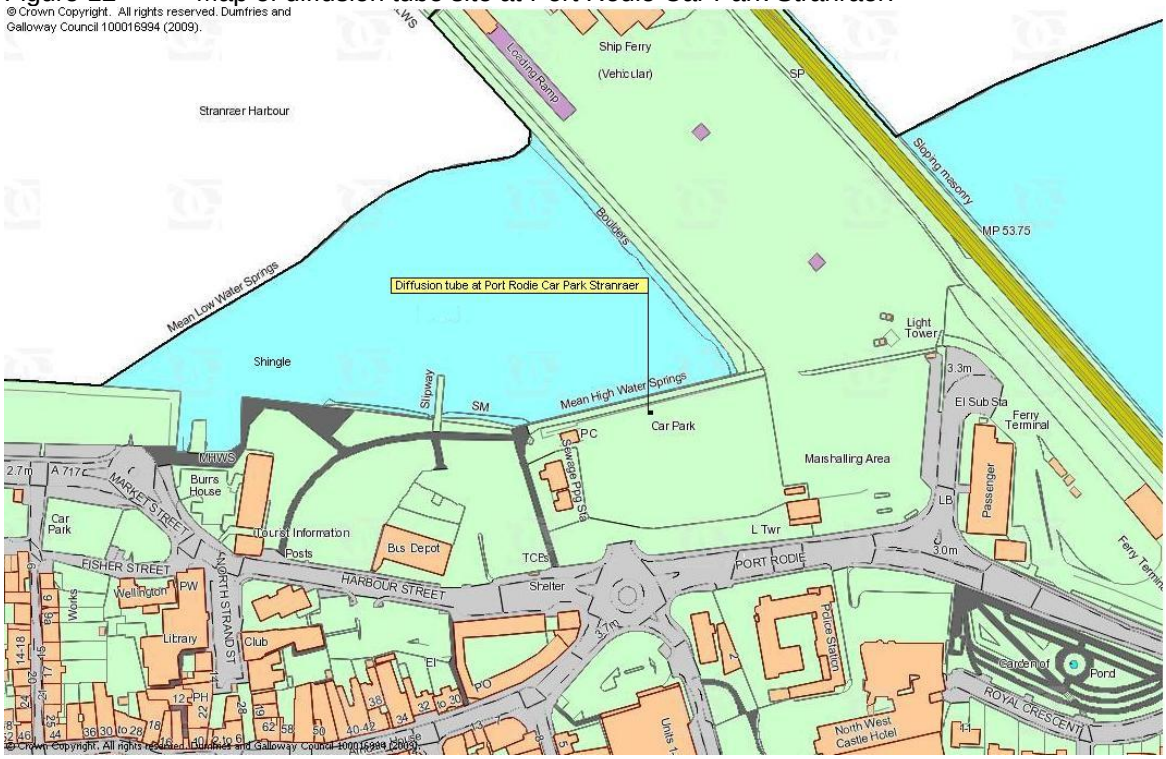
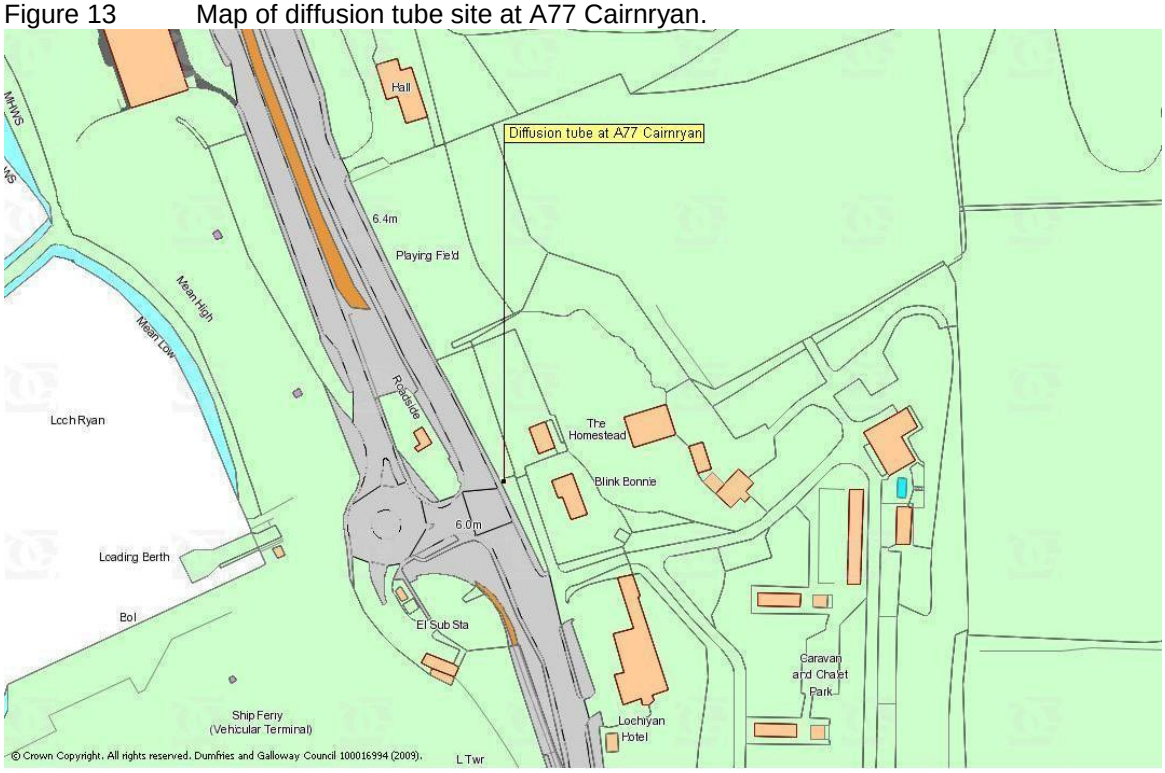


Figure 13 Map of diffusion tube site at A77 Cairnryan.



Appendix 3 Estimation of annual mean NO_2 concentration to correct for loss of data in 2009.

Table 12 Adjustment of NO_2 annual mean for 2009.

AURN site	Annual mean ($\mu g/m^3$)	Period mean excluding data from 0800 hours on 27/07/09 to 1600 hours on 24/09/09 ($\mu g/m^3$)	Ratio annual mean divided by period mean
Eskdalemuir	4·30	4·60	0·935
Edinburgh St Leonards	24·46	26·12	0·936
Inverness	20·74	21·61	0·959
		Average	0·943
Adjusted annual mean at Buccleuch St Dumfries		(35·0 x 0·943) =	33·0 $\mu g/m^3$

Appendix 4 Scottish Government Project $PM_{2·5}$ monitoring results.

$PM_{2·5}$ monitoring was carried out as part of a Scottish Government project[vi] in 2007/08. The objectives for $PM_{2·5}$ are contained in the Government's Air Quality Strategy[iii] but have not been included in the LAQM regulations[ii].

Table 13 $PM_{2·5}$ results at Buccleuch St., Dumfries and Eskdalemuir.

Site	$PM_{2·5}$ period mean 01/03/07 to 29/02/08	Objectives		
		(applicable to Scotland only)	UK urban areas	UK (except Scotland)
Buccleuch St Dumfries	*12·0 $\mu g/m^3$	12·0 $\mu g/m^3$ (Annual mean to be achieved by 2020)	15% exposure reduction in average concentrations at urban background to be achieved between 2010 & 2020	25·0 $\mu g/m^3$ (Annual mean to be achieved by 2020)
Eskdalemuir	*7·7 $\mu g/m^3$			

*Results corrected as per Bureau Veritas Report "Analysis of Trends in Gravimetric Particulate Mass measurements in the United Kingdom January 2009"[vii].

Appendix 5 Glossary

AEA Energy and Environment Spreadsheet	An Excel spreadsheet designed to calculate automatically the precision and accuracy of diffusion tubes co-located with an automatic monitor and to adjust non-co-located diffusion tube results with the bias adjustment calculated.
AQMA	air quality management area.
AURN	UK automatic urban and rural (air quality) monitoring network.
BAM PM_{10} monitor	beta-attenuation mass particulate monitor in which a small carbon-14 source emits a constant source of high-energy electrons known as beta particles, which are detected by and counted by a sensitive scintillation detector. An external pump pulls a measured amount of particulate-matter-laden air (via a particle-size-selective intake) through a filter tape. Once per hour, after the filter tape has collected some ambient particulate matter, it is automatically placed between the source and the detector thereby causing an attenuation of the beta-particle signal. The degree of attenuation of the beta particles is used to determine the mass concentration of particulate matter in the ambient air.
bias-adjustment factor	a measure of how much the diffusion tube results deviate over a period from the automatic NO_2 monitor results in a co-location study.
chemiluminescent monitor	a monitor (or analyser) that works on the basis of light emitted by NO_2 in a chemical reaction inside the monitor.
DEFRA	Department for Environment, Food and Rural Affairs.
Emfab™ filters	PTFE-coated glass-fibre filters.
exposure reduction (approach)	aims to improve air quality everywhere rather than just at local hot-spots of high pollution.
LAQM	local air quality management.
mg/m^3	milligrammes per cubic metre.
NO_2	nitrogen dioxide.
NOx	refers to nitrogen dioxide and nitric oxide.
Partisol	a brand name of particulate monitor in which particulate-matter-laden air is pumped (via a particle-size-selective inlet) through pre-weighed filters exposed for 24 hours; automatic filter exchanges take place for 14-15 days before manual re-stocking is required. Filters are re-weighed after exposure to determine the concentration of particulate matter in the ambient air.
percentile	the n^{th} percentile is the level at or below which *n*% of the results in a ranked list of results fall.
PM_{10}	mass of particles in the atmosphere with a diameter of less than 10 micrometres.
$PM_{2·5}$	mass of particles in the atmosphere with a diameter of less than 2·5 micrometres.
SO_2	sulphur dioxide.
$\mu g/m^3$	microgrammes per cubic metre
relevant exposure	where people are likely to be exposed over the averaging period of the objective.
worst-case location	a sampling location where concentrations of the pollutant monitored are expected to be highest, and where the public may be exposed over the relevant averaging period of the objective(s) or a location which is representative of such exposure.
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to