

# 2013 Air Quality Progress Report for Dumfries and Galloway Council

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

May 2013

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## Summary

Results of monitoring for nitrogen dioxide (NO<sub>2</sub>) show that all the concentrations meet the objectives, therefore there is no need to proceed to a detailed assessment for NO<sub>2</sub>. 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. As mentioned in previous reports it had been intended to carry out a detailed assessment for PM<sub>10</sub> at the village of Cairnryan due to the perceived increase in traffic through the village when the new Stena Line ferry at Old House Point, Cairnryan was fully operational. This has been postponed until further development at the new port has been completed.

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<sup>2</sup>, 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 Cairnryan provide links to Belfast and Larne via Loch Ryan and the Irish Sea.

## 1.2 Purpose of progress report.

This report fulfils the requirements of the Local Air Quality Management (LAQM) process as set out in Part IV of the Environment Act 1995<sup>i</sup>, 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 designate as an air quality management area the part or parts of its area in which it appears likely that exceedences will occur and prepare an air quality action plan setting out the measures it intends to put in place in pursuit of the objectives. Progress reports are required in the intervening years between the three-yearly updating and screening assessment reports. Their purpose is to maintain continuity in the local air quality management process. However, if the progress report identifies the risk of exceedence of an air quality objective, 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<sup>ii</sup> (Scottish Statutory Instrument No. 97) and the Air Quality (Scotland) (Amendment) Regulations 2002 (Scottish Statutory Instrument No. 297). Table 1 shows the objectives in units of microgrammes per cubic metre ( $\mu\text{g}/\text{m}^3$ ) apart from the carbon monoxide objective which is expressed in milligrammes per cubic metre ( $\text{mg}/\text{m}^3$ ) with the number of exceedences in each year that are permitted (where applicable). (The air quality objectives for other parts of the UK can be found in the Government's Air Quality Strategy for England, Scotland, Wales and Northern Ireland<sup>iii</sup>).

<sup>i,ii,iii</sup> See references on page 18

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

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 µg/m <sup>3</sup> (or less)	Running annual mean	31/12/2003
	3.25 µg/m <sup>3</sup> (or less)	Running annual mean	31/12/2010
1,3-butadiene	2.25 µg/m <sup>3</sup> (or less)	Running annual mean	31/12/2003
Carbon monoxide	10.0 mg/m <sup>3</sup> (or less)	Running 8-hour mean	31/12/2003
Lead	0.5 µg/m <sup>3</sup> (or less)	Annual mean	31/12/2004
	0.25 µg/m <sup>3</sup> (or less)	Annual mean	31/12/2008
Nitrogen dioxide	200 µg/m <sup>3</sup> not to be exceeded more than 18 times a year	1-hour mean	31/12/2005
	40 µg/m <sup>3</sup> (or less)	Annual mean	31/12/2005
Particles (PM <sub>10</sub> )	50 µg/m <sup>3</sup> , not to be exceeded more than 7 times a year	24-hour mean	31/12/2010
	18 µg/m <sup>3</sup> (or less)	Annual mean	31/12/2010
Sulphur dioxide	350 µg/m <sup>3</sup> , not to be exceeded more than 24 times a year	1-hour mean	31/12/2004
	125 µg/m <sup>3</sup> , not to be exceeded more than 3 times a year	24-hour mean	31/12/2004
	266 µg/m <sup>3</sup> , not to be exceeded more than 35 times a year	15-minute mean	31/12/2005

## 1.4 Summary of previous reviews and assessments<sup>iv</sup>

- 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<sub>2</sub>) 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<sub>2</sub> 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<sub>2</sub> related to shipping it was found that a detailed assessment for SO<sub>2</sub> 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<sub>10</sub> 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<sub>10</sub> levels at the monitoring site at Buccleuch Street, Dumfries indicated that the 2010 annual mean PM<sub>10</sub> objective would not be met but there was no relevant exposure at this roadside site. With regard to the marginal exceedences of the PM<sub>10</sub> 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<sub>10</sub> levels at Buccleuch Street, Dumfries were again predicted to exceed the 2010 PM<sub>10</sub> annual mean objective and after a re-assessment of relevant exposure it was decided that a detailed assessment for PM<sub>10</sub> 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<sub>10</sub> annual mean objective.

- 1.4.8 A detailed assessment for PM<sub>10</sub> 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<sub>10</sub> were modelled for 2010 using the ADMS roads dispersion model. Projections of measured PM<sub>10</sub> concentrations did not identify an exceedence at the site of the Buccleuch Street PM<sub>10</sub> monitor itself; however exceedences of the 2010 annual mean objective were predicted at all three junctions and exceedence of the 2010 PM<sub>10</sub> 24-hour mean objective was predicted at one junction (Whitesands/Buccleuch Street). It had been intended to carry out PM<sub>10</sub> monitoring at these junctions to supplement this assessment. PM<sub>10</sub> monitoring at the Buccleuch St./Whitesands junction was 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 TG(09)<sup>v</sup> 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<sub>10</sub> at Cairnryan in the event that Stena Line re-located from Stranraer to Cairnryan was reiterated.
- 1.4.10 A progress report in 2010 found that NO<sub>2</sub> levels monitored during the previous year met the relevant objectives. PM<sub>10</sub> monitoring at the junction of Whitesands and Buccleuch Street had commenced but no new PM<sub>10</sub> data were reported as the BAM monitor had only recently been set up. No new requirement to proceed to a detailed assessment was identified as a result of monitoring or new developments.
- 1.4.11 A report supplementary to the PM<sub>10</sub> detailed assessment carried out in 2008/09 detailed the results of PM<sub>10</sub> monitoring which was carried out for six months at the junction of Buccleuch Street and Whitesands in Dumfries using a BAM monitor. The results when annualised for 2010 showed an annual mean of 15.75 µg/m<sup>3</sup> and no exceedences of the 24-hour mean. Originally it had been intended to monitor at all three junctions but as the modelling had indicated a higher annual mean and more exceedences of the 24-hour mean at the Buccleuch Street/Whitesands road junction than at the other two junctions (i.e. it was the worst case) it was concluded in the report that the objectives were also being met at the other two junctions and that there was no need to designate any air quality management areas.
- 1.4.12 The progress report submitted in November 2011 concluded that the objectives for NO<sub>2</sub> were being met, that there was no requirement for a detailed assessment for NO<sub>2</sub> and that monitoring at the junction of Whitesands and Buccleuch Street, Dumfries met the objectives for PM<sub>10</sub> therefore no air quality management areas were required.
- 1.4.13 The 2012 updating and screening assessment showed that the results of NO<sub>2</sub> 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 for any pollutant.

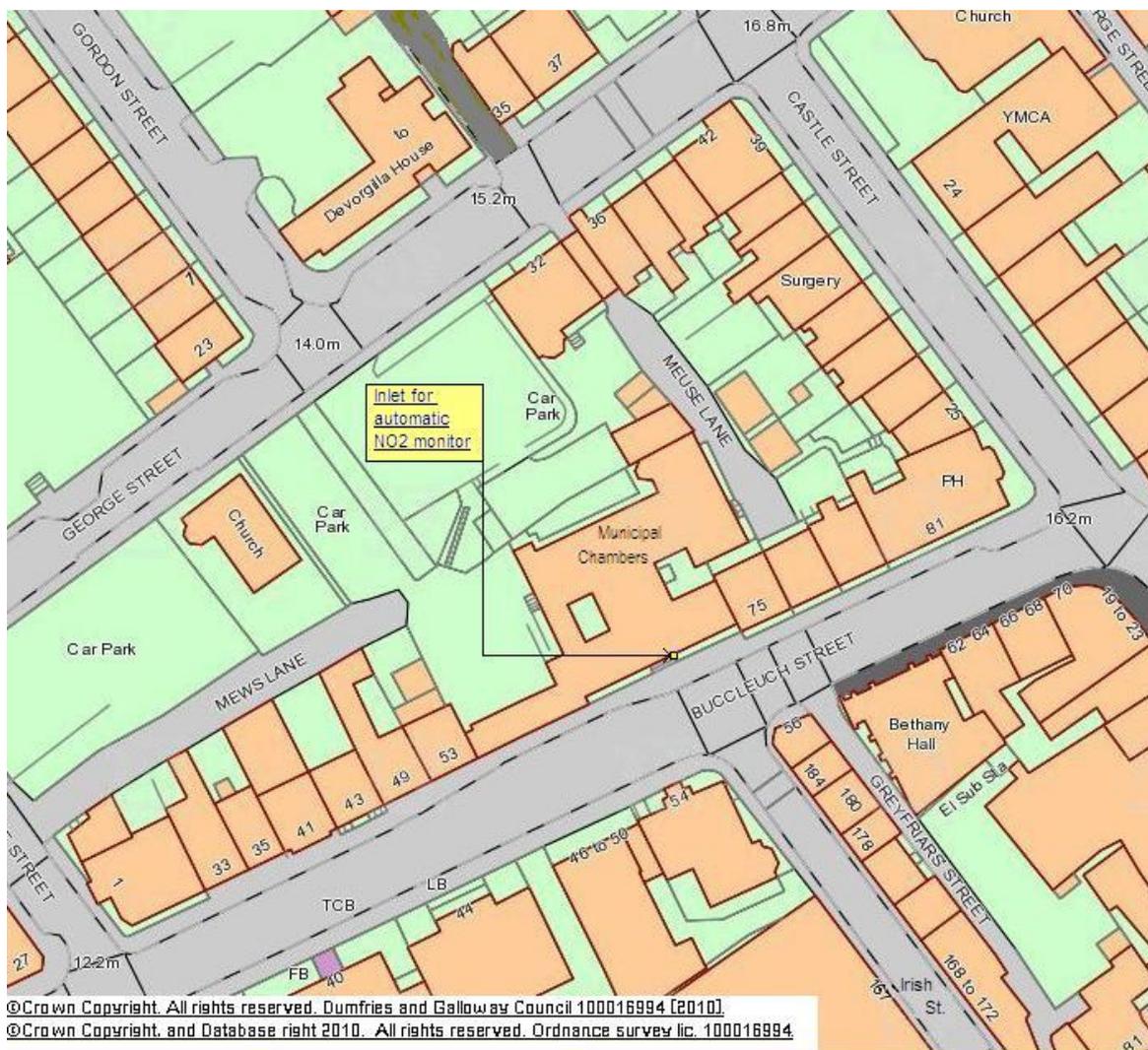
## 2. New Monitoring Data

### 2.1 Automatic monitoring

#### 2.1.1 Dumfries NO<sub>2</sub>

A continuous (chemiluminescent) NO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub>

Since December 2004 a continuous NO<sub>2</sub> monitor has been located at the Observatory at Eskdalemuir as part of the AURN. The Observatory<sup>vi</sup> is currently managed by the British Geological Society and the Met Office. Ratification is carried out by the QA/QC unit at AEA.

Figure 2 - Map of NO<sub>2</sub> automatic monitoring site at Eskdalemuir Observatory.

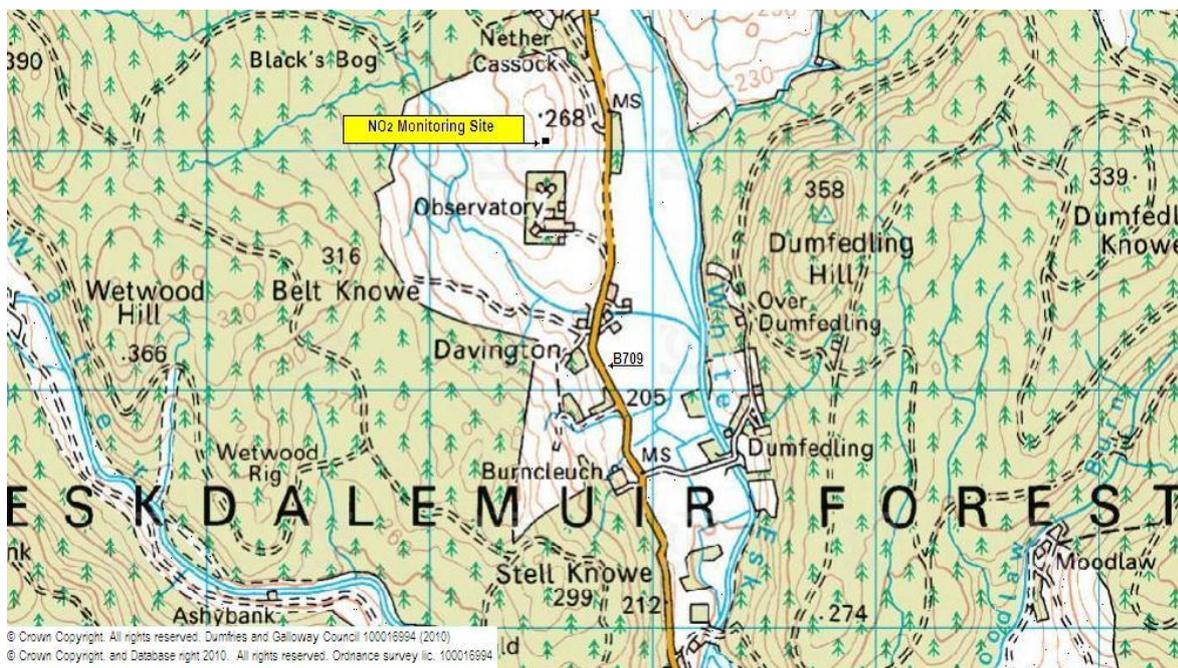


Table 2 Details of automatic monitoring sites.

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 <sub>2</sub>	Automatic	No	Yes	4.3	Yes
Eskdalemuir	Rural	323551 603022	NO <sub>2</sub>	Automatic	No	No	n/a	n/a

## 2.2 Non-automatic monitoring.

NO<sub>2</sub> 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 were prepared and analysed by Environmental Scientifics Group using 50% triethanolamine (TEA) in acetone. Environmental Scientifics Group demonstrated satisfactory performance for 2012 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<sub>2</sub> automatic monitor. The local bias-adjustment factor was 0.88 and this has been used in preference to the national bias-adjustment factor for 2012 of 0.79 (v3-13, derived by amalgamation of 26 studies including Dumfries and Galloway's). Further details of the local co-location study are provided in Appendix 1.

**Table 3** Details of NO<sub>2</sub> diffusion tube sites.  
(see maps at appendix 2)

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.

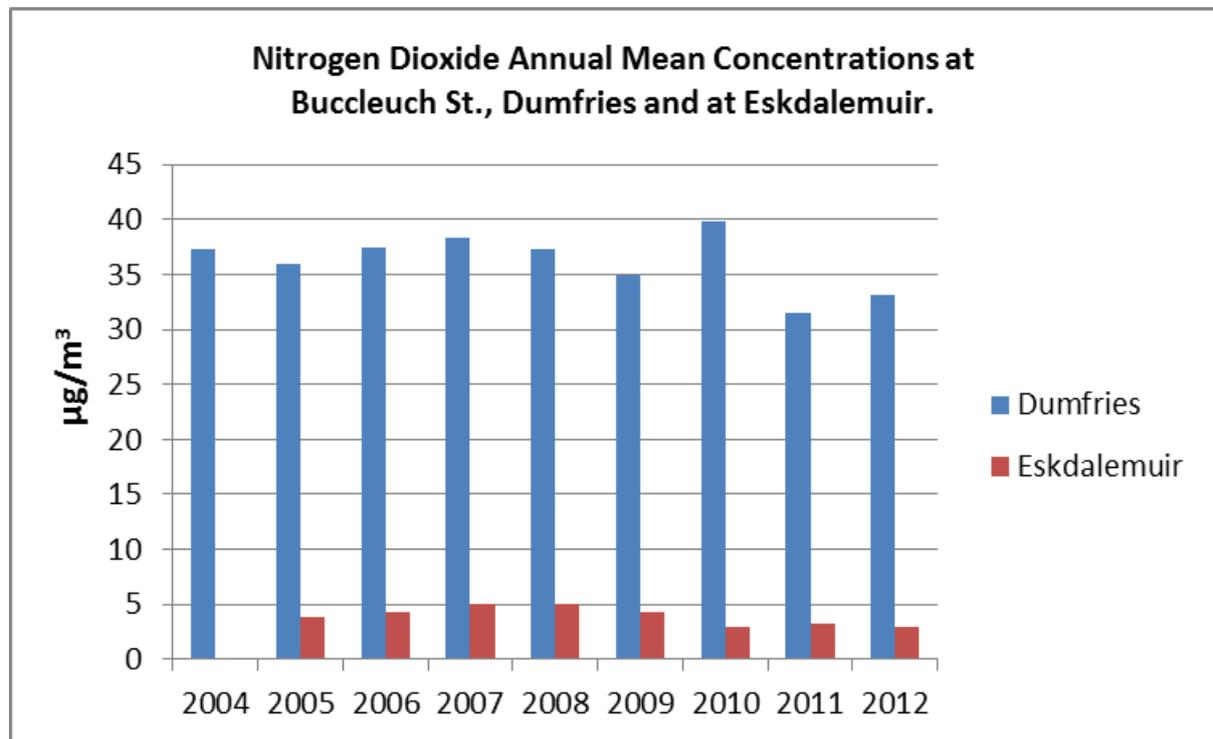
#### 2.3.1 NO<sub>2</sub> automatic monitoring data.

All NO<sub>2</sub> results from automatic monitoring meet the relevant objectives.

Table 4 Results of automatic monitoring for NO<sub>2</sub> - comparison with annual mean objective (40µg/m<sup>3</sup> or less).

Location	Within AQMA?	Data capture for full calendar year 2012 %	Annual mean concentrations (µg/m <sup>3</sup> )								
			2004	2005	2006	2007	2008	2009	2010	2011	2012
Buccleuch St Dumfries (Roadside site)	No	98.1%	37.3	35.9	37.5	38.3	37.3	35.0	39.9	31.5	33.1
Eskdalemuir (Rural site)	No	98.6%	n/a	3.8	4.3	5.0	5.1	4.3	3.0	3.2	3.0

Figure 3 Trends in annual mean NO<sub>2</sub> concentrations at automatic monitoring sites at Dumfries and at Eskdalemuir.



The above chart shows that annual mean concentrations at the roadside site at Buccleuch Street, Dumfries have stayed close to but below the annual mean objective, whereas the concentrations at the rural background site at Eskdalemuir are well below the objective.

Table 5 Results of automatic monitoring for nitrogen dioxide - comparison with 1-hour mean objective ( $200\mu\text{g}/\text{m}^3$  not to be exceeded more than 18 times).

Location	Within AQMA?	Data capture for full calendar year 2012 %	Number of exceedences of hourly mean								
			2004	2005	2006	2007	2008	2009	2010	2011	2012
Buccleuch St Dumfries (Roadside site)	No	98.1%	0	1	0	5	4	0	3	2	0
Eskdalemuir (Rural site)	No	98.6%	n/a	0	0	0	0	0	0	0	0

### 2.3.2 NO<sub>2</sub> diffusion tube monitoring data.

All bias-corrected NO<sub>2</sub> results from diffusion tube monitoring meet the annual mean objective of  $40\mu\text{g}/\text{m}^3$  or less.

Table 6 Annual mean results of nitrogen dioxide diffusion tubes 2007 to 2012.

Location		Within AQMA?	Data capture for calendar year 2012 %	Annual mean concentrations (microgrammes per cubic metre)					
				2007 (bias corrected x 1.01)	2008 (bias corrected x 0.93)	2009 (bias corrected x 0.83)	2010 (bias corrected x 0.92)	2011 (bias corrected x 0.83)	2012 (bias corrected x 0.88)
M74 Slip Road	Lockerbie	No	100%	34.0	31.1	28.2	37.0	30.6	31.6
***Buccleuch St. (E)	Dumfries	No	97%	38.1	37.3	34.2	39.8	31.5	33.1
††Buccleuch St. (W)	Dumfries	No	96%	35.5	32.4	31.3	35.2	30.0	31.4
Buccleuch St. (S)	Dumfries	No	100%	32.8	32.2	32.5	36.1	34.1	31.9
†††Buccleuch St Bridge	Dumfries	No	97%	30.2	31.6	32.3	34.0	28.2	28.8
Nith Place,	Dumfries	No	100%	n/a	32.9	30.8	35.0	26.8	30.0
Loreburn St.	Dumfries	No	92%	28.2	28.4	26.0	30.8	24.5	30.1
St Michael St.	Dumfries	No	100%	25.7	24.9	24.9	28.5	23.8	26.7
Argyll Drive	Dumfries	No	100%	13.7	12.2	11.0	12.1	10.7	12.1
Charlotte St.	Stranraer	No	92%	20.1	20.3	18.7	21.8	17.7	18.1
Port Rodie Car Park	Stranraer	No	100%	18.0	15.0	17.5	18.2	16.6	12.4
A77 Cairnryan	Stranraer	No	100%	23.4	20.6	19.2	21.6	19.6	21.5

\*\*\* 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 4 Trends in annual mean NO<sub>2</sub> diffusion tube results

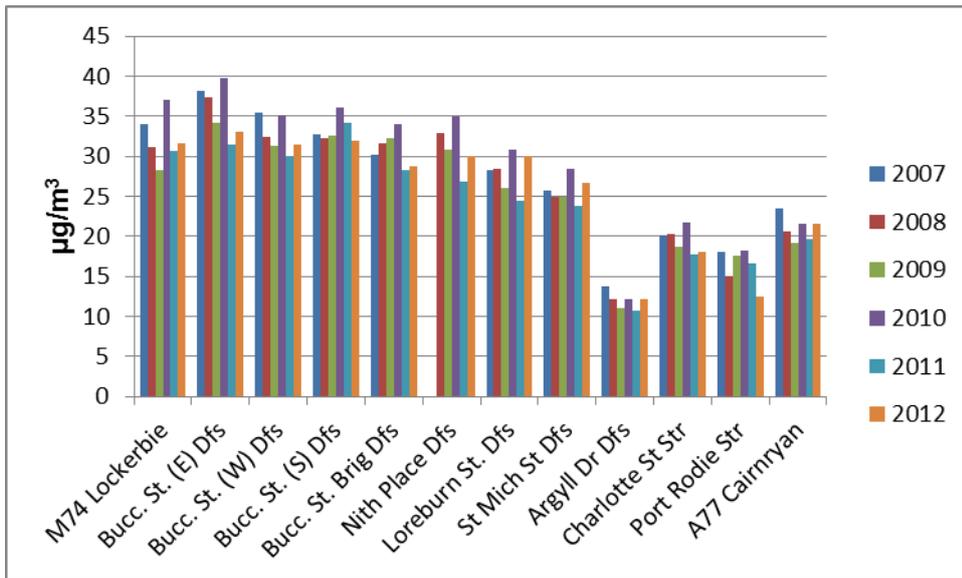
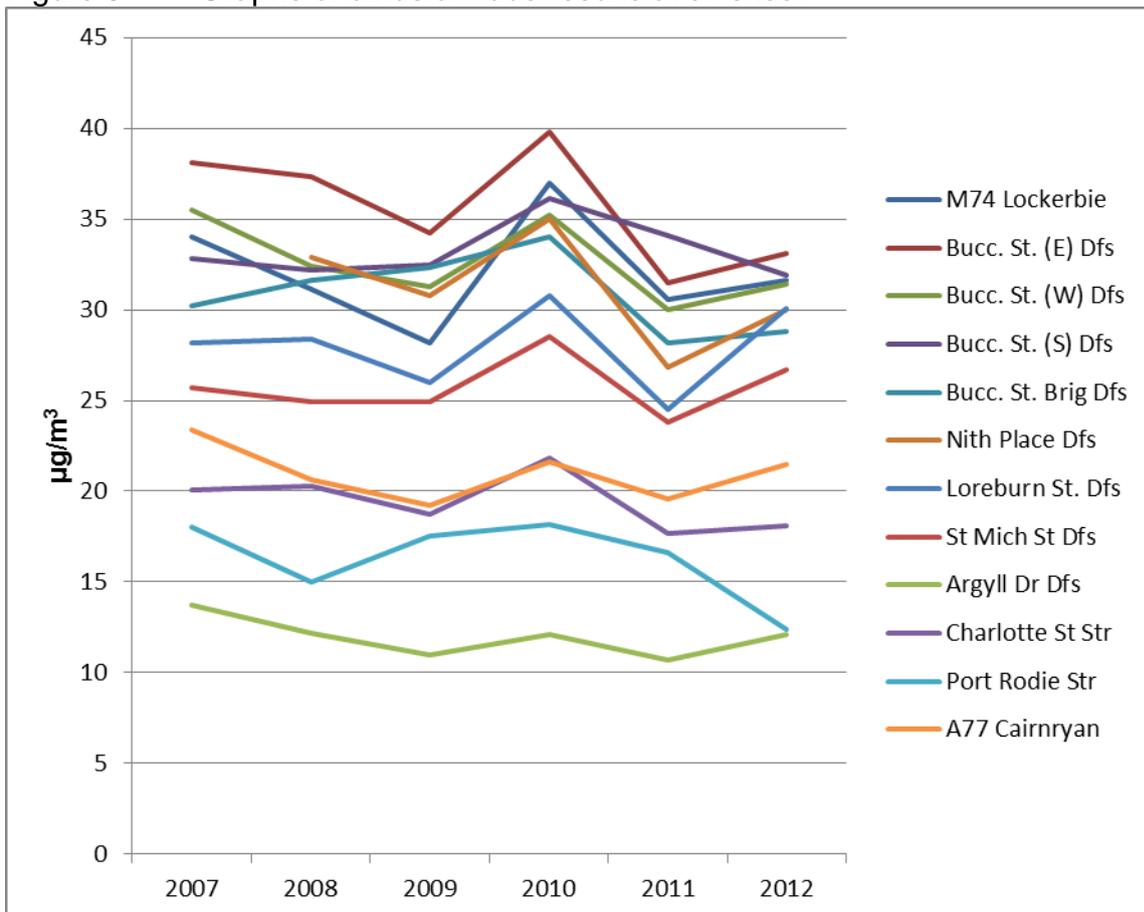


Figure 5 Graphs of diffusion tube results at all sites.



Results of monitoring for NO<sub>2</sub> in the Council-area have been examined and the results for 2012 are found to meet the objectives, therefore there is no need to proceed to a new detailed assessment.

### **3. New local developments.**

#### **3.1 Commercial and domestic sources**

Planning consent has been granted for a new 350-bed hospital at Garroch Farm, Garroch Loaning, Cargenbridge, Dumfries. An environmental statement<sup>vii</sup> has been prepared by EnviroCentre Ltd. The assessment focuses on the impacts from traffic emissions as design information on the stack associated with the operation of a CHP/biomass boiler has not yet been made available. The modelling predictions indicate that the annual average concentrations of both NO<sub>2</sub> and PM<sub>10</sub> for future year scenarios are all well below their corresponding air quality objectives at each of the identified sensitive receptors.

#### **3.2 New developments with fugitive or uncontrolled sources**

An open-cast coal mine development is proposed at land to the north and west of Rigg Farm, Kirkconnel. SLR Consulting Ltd have concluded in their environmental statement<sup>viii</sup> that the PM<sub>10</sub> objectives are unlikely to be exceeded as a result of the proposed activities but best practice measures require to be employed to ensure that dust emissions are controlled and mitigated accordingly.

The above developments will be taken into consideration in the next updating and screening assessment. Apart from the above no road traffic (or other transport) sources, industrial, commercial, or domestic sources have been identified.

## **4. Conclusions**

### 4.1 Conclusions from new monitoring data.

New NO<sub>2</sub> monitoring data indicate that the objectives for NO<sub>2</sub> are being met therefore there is no requirement for a detailed assessment for NO<sub>2</sub>.

### 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.

## **5. Proposed actions**

A previously planned detailed assessment for PM<sub>10</sub> at Cairnryan due to the predicted increase in traffic through the village following relocation of the Stena Line port from Stranraer to Old House Point, Cairnryan has been postponed pending completion of further developments at Old House Point.

## 6. References

- i. The Environment Act 1995 (UK Parliament Public General Acts).  
[http://www.opsi.gov.uk/acts/acts1995/Ukpga\\_19950025\\_en\\_1](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](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).  
<http://archive.defra.gov.uk/environment/quality/air/airquality/strategy/documents/air-qualitystrategy-vol1.pdf>
- iv. Previously published LAQM reports for Dumfries and Galloway Council are available at  
<http://www.dumgal.gov.uk/index.aspx?articleid=1733>
- v. Local Air Quality Management Technical Guidance LAQM.TG (09): DEFRA February 2009  
<http://www.defra.gov.uk/publications/files/pb13081-tech-guidance-laqm-tg-09-090218.pdf>
- vi. Eskdalemuir Observatory.  
[Eskdalemuir Magnetic Observatory](#)
- vii. Dumfries and Galloway Royal Infirmary Garroch Farm Site Environmental Statement January 2013 - EnviroCentre Ltd.
- viii. Development of a Surface Mining Scheme at Rigg North, Kirkconnel Environmental Statement February 2012

## Appendix 1 Details of NO<sub>2</sub> co-location study

Table 7 Details of co-location study at Buccleuch St., Dumfries 2012.

Date	Monthly average (continuous monitor)	Ratified/provisional data	Data capture %	Average diffusion Tube	Ratio:- continuous/diffusion tube result
January	39.93	Ratified	95.84	46.33	0.86
February	37.35	Ratified	98.96	44.23	0.84
March	36.07	Ratified	99.55	28.77	1.25
April	36.15	Ratified	99.40	38.33	0.94
May	31.68	Ratified	99.29	39.30	0.81
June	26.77	Ratified	99.42	31.20	0.86
July	22.48	Ratified	89.34	26.10	0.86
August	24.60	Ratified	98.96	30.27	0.81
September	27.34	Ratified	99.40	31.17	0.88
October	37.75	Ratified	98.57	45.20	0.84
November	35.64	Ratified	99.41	43.13	0.83
December	41.21	Ratified	99.77	48.47	0.85
Average	33.08			37.71	

*Bias-adjustment factor = continuous mean/diffusion tube mean = 33.08/37.71 = 0.88*

*Diffusion tube bias = (diffusion tube mean minus continuous mean) divided by continuous mean = (37.71 - 33.08)/33.08 = 0.14 i.e. tubes over-read by approximately 14%.*

Table 8 Diffusion tube annual averages 2012.

Location of diffusion tube(s)		A	B	C	D
		Annual average $\mu\text{g}/\text{m}^3$	Annual average bias-corrected with local bias adjustment factor x 0.88)	Annual average using AEA Energy and Environment spreadsheet	Annual average bias-corrected with national bias adjustment factor (x 0.79)
M74 Slip Road	Lockerbie	36.0	31.6	32	28
***Buccleuch St. (E)	Dumfries	37.7	33.1	33	30
††Buccleuch St. (W)	Dumfries	35.7	31.4	32	28
Buccleuch St. (S)	Dumfries	36.2	31.9	32	29
†††Buccleuch St Bridge	Dumfries	32.8	28.8	29	26
Nith Place,	Dumfries	34.1	30.0	30	27
Loreburn St.	Dumfries	34.2	30.1	30	27
St Michael St.	Dumfries	30.4	26.7	27	24
Argyll Drive	Dumfries	13.8	12.1	12	11
Charlotte St.	Stranraer	20.6	18.1	18	16
Port Rodie Car Park	Stranraer	14.0	12.4	12	11
A77 Cairnryan	Stranraer	24.4	21.5	21	19

( $\mu\text{g}/\text{m}^3$  = microgrammes per cubic metre)

\*\*\*Triplicate tubes co-located with AURN automatic monitor

††Duplicate tubes

†††Triplicate tubes

All the locally bias-corrected results in column B of Table 9 are within the objective for the NO<sub>2</sub> annual mean ( $\leq 40 \mu\text{g}/\text{m}^3$ ). Use of the national bias-adjustment factor for Environmental Scientifics of 0.79 would have given significantly lower results as shown in column D but the local factor is preferred.

Table 9 Monthly diffusion tube results for 2012

Site	Monthly diffusion tube results (microgrammes per cubic metre)													Average	Adjusted Average. (x0.88)
	j a n	f e b	m a r	a p r	m a y	j u n	j u l	a u g	s e p	o c t	n o v	d e c			
M74 Slip Road, Lockerbie	41.5	48.6	42.7	35.8	24.9	23.6	21.4	28.4	27.9	39.1	49.0	48.6	36.0	31.6	
***Buccleuch St (East), Dumfries	47.6	42.5	29.6	39.3	39.6	32.9	27.5	32.8	30.9	46.0	40.4	43.2	37.7	33.1	
	40.6	45.0	26.3	38.2	38.4	27.3	24.7	31.1	31.5	45.0	42.0	50.9			
	50.8	45.2	30.4	37.5	39.9	33.4	V	26.9	31.1	44.6	47.0	51.3			
**Buccleuch St (West), Dumfries	45.7	39.0	33.1	32.8	35.5	34.7	26.7	31.3	25.8	43.8	42.2	46.2	35.7	31.4	
	45.1	33.9	33.2	29.9	33.8	30.5	V	29.8	28.4	42.4	38.9	38.0			
Buccleuch St (South), Dumfries	44.4	44.9	31.3	25.7	31.3	40.5	26.9	35.1	24.8	40.2	36.3	53.1	36.2	31.9	
***Buccleuch St Bridge, Dumfries	41.1	42.1	30.1	19.6	28.0	28.2	28.0	36.6	21.0	33.9	41.0	41.3	32.8	28.8	
	37.2	37.0	31.5	18.6	33.6	32.7	26.3	35.3	20.6	32.3	41.5	42.1			
	38.3	40.2	41.4	19.8	24.6	29.2	V	35.4	23.4	34.0	43.8	36.5			
Nith Place, Dumfries	40.3	41.3	33.2	32.2	27.2	23.5	25.4	31.9	31.4	35.4	39.4	47.5	34.1	30.0	
Loreburn St Dumfries	36.7	35.9	54.1	30.1	31.5	34.0	23.5	29.0	23.1	V	37.2	41.3	34.2	30.1	
St Michael St Dumfries	35.8	28.8	47.9	24.4	24.0	25.9	20.4	23.9	20.0	36.0	34.8	42.6	30.4	26.7	
Argyll Drive Dumfries	20.3	18.4	20.0	7.3	6.8	7.1	6.1	10.1	10.2	17.9	19.1	21.7	13.8	12.1	
Charlotte St Stranraer	27.1	20.8	30.3	16.4	19.1	13.6	14.3	15.8	17.3	32.0	19.7	V	20.6	18.1	
Port Rodie Car Park Stranraer	21.9	13.7	20.4	6.4	7.8	9.2	8.2	10.5	11.0	19.1	16.3	24.0	14.0	12.4	
A77 Cairnryan Stranraer	30.1	32.6	19.0	20.5	21.9	20.3	22.3	22.1	21.2	25.4	31.4	26.0	24.4	21.5	

\*\*\*Triplicate tubes (co-located with automatic monitor)

\*\*Duplicate tubes

\*\*\*Triplicate tubes

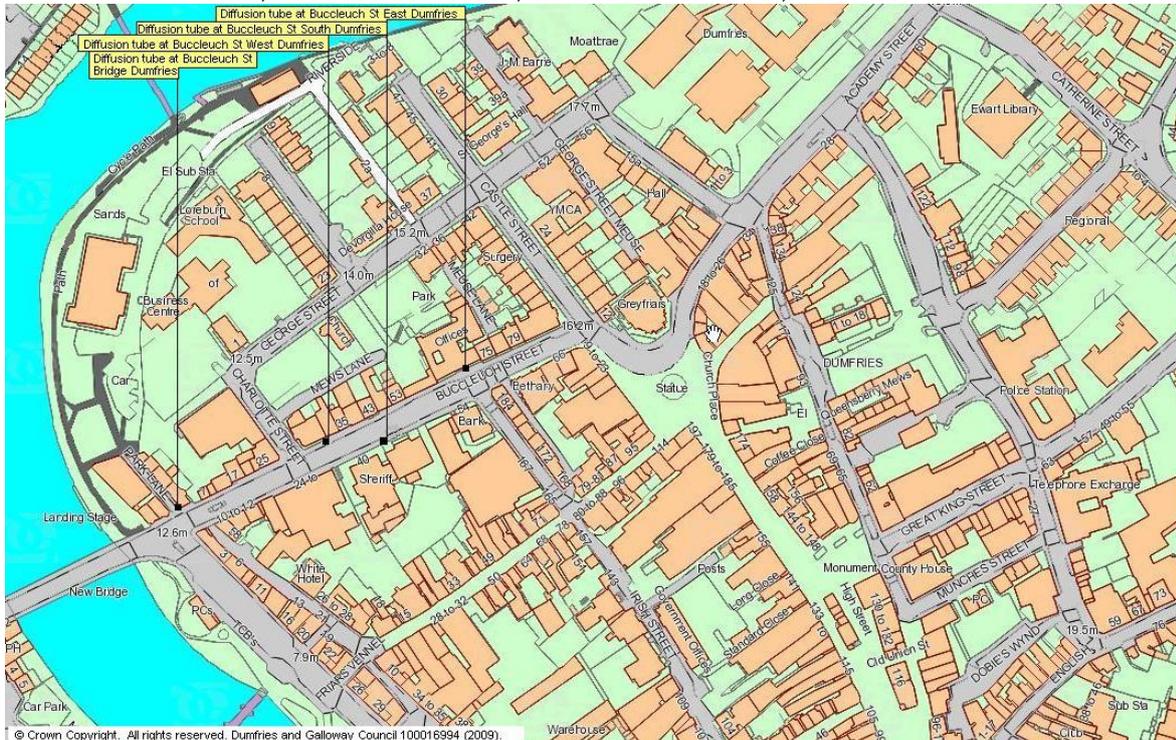
V - Tube(s) vandalised (or otherwise removed or sample tubes contaminated or result[s] rejected).

**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.

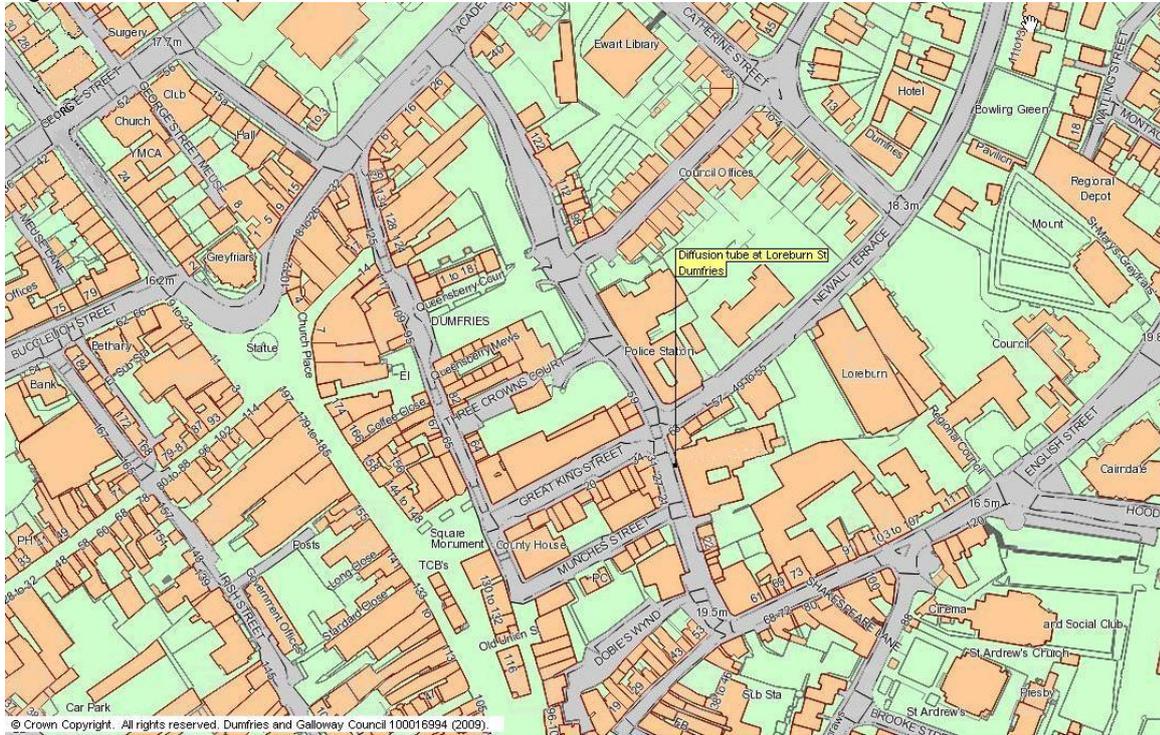
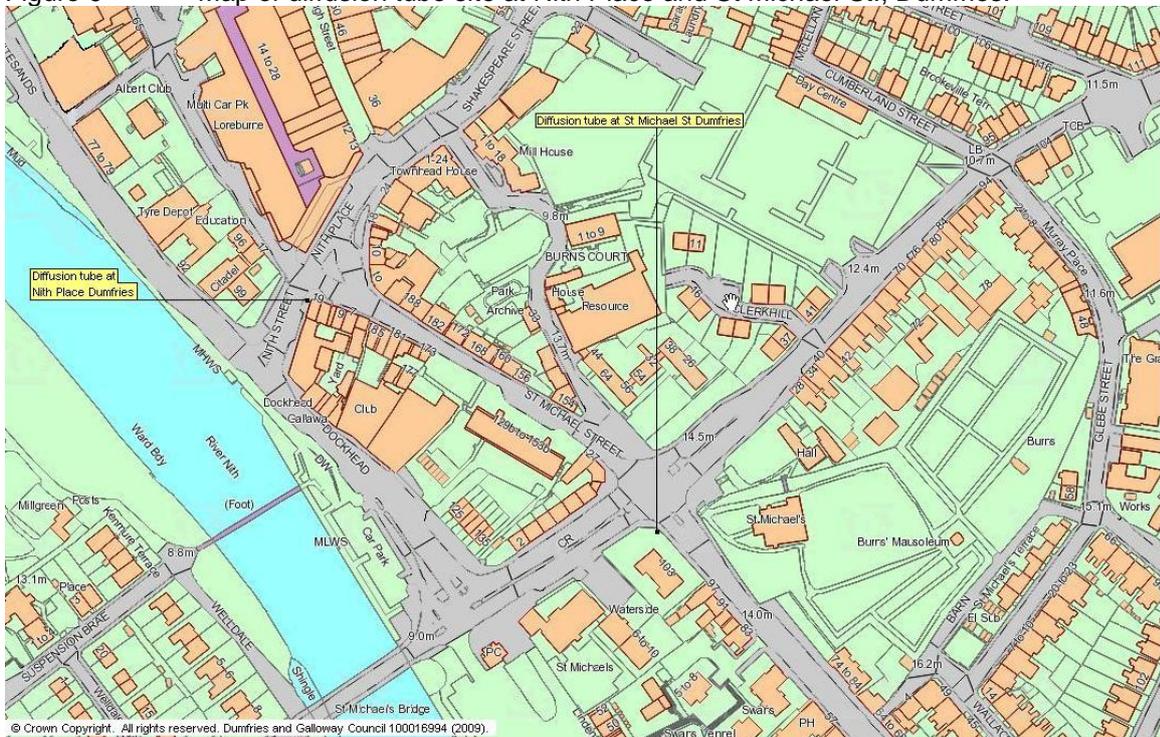


Figure 9 Map of diffusion tube site at Nith Place and St Michael St., Dumfries.



**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.

