



# 2010 Air Quality Progress Report for *Dundee City Council*

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

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## Executive Summary

This document is the 2010 Progress Report on air quality for the Dundee City Council area. The report focuses on each of the pollutants listed in Air Quality Regulations that were monitored within the council area during 2009, these were; nitrogen dioxide (NO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>), and fine particulate matter (PM<sub>10</sub>).

Local authorities are required to assess the levels of seven pollutants that are known to have adverse health effects, on a three yearly basis. The review and assessments of air quality are carried out to determine if the pollutant levels that the public are exposed to will meet the National Air Quality Standards by the set target dates, or if additional local measures will need to be taken to address identified polluted areas.

Previous assessments of air quality established that there was no problem with the levels of some of the seven pollutants namely; benzene, carbon monoxide, 1,3-butadiene, sulphur dioxide and lead. However, exceedences of the acceptable standard for nitrogen dioxide have been identified and an Air Quality Management Area was declared for this pollutant in July 2006.

The AQMA was amended in October 2010 to include small particulates PM<sub>10</sub> as a result of potential exceedences of the PM<sub>10</sub> (2010) standard that were identified in the Detailed Assessment of PM<sub>10</sub> in 2009.

The council produced an Action Plan in January 2011, which contains 32 measures designed to improve air quality, tackle traffic emissions, educate and increase awareness. The Action Plan also presented the 2009 monitoring results contained in this report with the exception of sulphur dioxide.

This Progress Report presents the 2009 sulphur dioxide monitoring results and reproduces and discusses the 2009 NO<sub>2</sub> and PM<sub>10</sub> monitoring results. Trends will be examined in the 2011 Progress Report. It provides information to assist in other policy areas, such as transport and land use planning within the council. Each pollutant has been assessed in conjunction with the relevant guidance and the conclusions reached are:

**Nitrogen dioxide (NO<sub>2</sub>)** – analysis of the 2009 data for nitrogen dioxide has reconfirmed the need for the AQMA and development of an Action Plan. One new area of potential exceedence of the annual mean has been identified at Strathmore Avenue.

An exceedence of the hourly mean NAQS was recorded at the automatic monitoring station on Lochee Road. This may have been influenced by severe weather at the end of the year. The need for a detailed assessment / AQMA for the hourly NO<sub>2</sub> will be kept under review.

**Small Particulates (PM<sub>10</sub>)** - PM<sub>10</sub> objectives for 2004 continue to be met at all monitoring locations within the city. However, there remains a risk of exceedence of the 2010 PM<sub>10</sub> annual mean objective being exceeded at roadside sites. In addition, the 2010 PM<sub>10</sub> daily mean objective was exceeded at the Osiris monitor in Seagate using the VCM correction method, but not when the local gravimetric correction factor was applied to the data. Osiris monitoring units have a tendency to over-estimate the number of exceedences compared to TEOM monitors. The council intend to install a reference equivalent PM<sub>10</sub> analyser in this area, and the need for a detailed assessment or AQMA in relation to the daily mean will be kept under review. The detailed assessment undertaken in 2009 for PM<sub>10</sub>, also identified a risk of exceedence of the 2010 objectives at receptors adjacent to busy roads and junctions in the city centre.

**Sulphur Dioxide (SO<sub>2</sub>)** -The monitoring results for 2009 indicate that all the NAQS objectives were met at monitoring locations in Dundee. A detailed assessment is not currently required for this pollutant.

### **Proposed Actions**

Proposed actions arising from the Progress Report 2010 are as follows:

- Investigate further sources of biomass/solid fuel combustion in the local authority area to enable appropriate screening, and report findings in subsequent LAQM reports as information becomes available;
- Monitor at locations of relevant exposure for sites identified with potential exceedence of the hourly-mean NO<sub>2</sub> objective; and review the need for a detailed assessment / AQMA due to breaches of the hourly mean NO<sub>2</sub> objective once ratified 2010 monitoring data is available.
- Install reference equivalent PM<sub>10</sub> analysers in potential problem areas where possible
- Characterisation of the areas of exceedence at Strathmore Avenue and 'Broughty Ferry Road 141', including additional NO<sub>2</sub> monitoring, is required to inform additional, appropriate action plan measures that will effectively target the pollution problems at those localities; and
- Trends in pollutant concentrations will be investigated in the 2011 Annual Progress Report.

# Table of Contents

Glossary of Acronyms and Definitions	vii
<b>1 Introduction</b>	<b>9</b>
1.1 Description of Local Authority Area	9
1.2 Purpose of Progress Report	10
1.3 Air Quality Objectives	10
1.4 Summary of Previous Review and Assessments	12
<b>2 New Monitoring Data</b>	<b>17</b>
2.1 Summary of Monitoring Undertaken	17
2.1.1 Automatic Monitoring Sites	17
2.1.2 Non-Automatic Monitoring	20
2.2 Comparison of Monitoring Results with Air Quality Objectives	25
2.2.1 Nitrogen Dioxide	25
2.2.2 PM <sub>10</sub>	32
2.2.3 Sulphur Dioxide	36
2.2.4 Summary of Compliance with AQS Objectives	36
<b>3 New Local Developments</b>	<b>37</b>
3.1 Road Traffic Sources	37
3.2 Other Transport Sources	37
3.3 Industrial Sources	37
3.4 Commercial and Domestic Sources	38
3.5 New Developments with Fugitive or Uncontrolled Sources	38
<b>4 Implementation of Action Plans</b>	<b>39</b>
<b>5 Conclusions and Proposed Actions</b>	<b>40</b>
5.1 Conclusions from New Monitoring Data	40
5.2 Conclusions relating to New Local Developments	41
5.3 Other Conclusions	41
5.4 Proposed Actions	41
<b>6 References</b>	<b>42</b>

## Appendices

Appendix 1	LOCAL BIAS CO-LOCATION STUDIES	44
Appendix 2	MONTHLY DIFFUSION TUBE RESULTS 2009	48

## List of Tables

Table 1.1	Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in Scotland	11
Table 1.2	Summaries of Review and Assessment Reports	12
Table 2.1	Details of Automatic Monitoring Sites	19
Table 2.2	Details of Non-Automatic Monitoring Sites	22
Table 2.3	Nitrogen Dioxide Period Mean Adjustment	25
Table 2.4	Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective and Hourly Objective	25
Table 2.5	Results of Nitrogen Dioxide Diffusion Tubes	28
Table 2.6	PM <sub>10</sub> Period Mean Adjustment	33
Table 2.6a	Results of PM <sub>10</sub> Automatic Monitoring: Comparison with Annual Mean Objective	34
Table 2.6b	Results of PM <sub>10</sub> Automatic Monitoring: Comparison with 24-hour Mean Objective	35
Table 2.7	Results of SO <sub>2</sub> Automatic Monitoring: Comparison with Objectives	36

## List of Figures

Figure 1.1	Map Showing Boundary of AQMA for NO <sub>2</sub> and PM <sub>10</sub>	16
Figure 2.1	Details of Automatic Monitoring Sites	18
Figure 2.2	Maps of Non-Automatic Monitoring Sites (NO <sub>2</sub> Diffusion Tubes) in Dundee	21
Figure 2.3	Analysis of the Frequency of Exceedences of the Hourly NO <sub>2</sub> Objective at Automatic Monitoring Site on Lochee Road	27

## GLOSSARY OF ACRONYMS AND DEFINITIONS

AADT	Annual Average Daily Traffic Flow
ADMS	An atmospheric dispersion model
AEAEAEA	Energy & Environment
annualise	the means of estimating an annual mean from a shorter study period mean by comparison with full datasets from background AURN sites
AQ Archive	UK Air Quality Archive
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
AURN	Automatic Urban and Rural Network (Defra funded air quality monitoring network)
CHP	Combined Heat and Power
CO	Carbon Monoxide
Defra	Department for Environment, Food and Rural Affairs
DERL	Dundee Energy Recycling Ltd
DMRB	Design Manual for Roads and Bridges
EC	European Community
EHTS	Environmental Health and Trading Standards Department
EPA	The Environmental Protection Act 1990
EPAQS	Expert Panel on Air Quality Standards
EU	European Union
GF	Ground floor
GIS	Geographical Information System
HDV	Heavy goods vehicles and buses
HGV	Heavy Goods Vehicle
IPC	Integrated Pollution Control
kerbside	0 to 1 metre from the kerb
LAQM.TG(03)	Local Air Quality Management: Technical Guidance (2003)
Limit Value	An EU definition for a mandatory air quality standard of a pollutant listed in the air quality directives
MW	Mega Watts
mg/kg	Milligrams per Kilogram
mg/m <sup>3</sup>	Milligrams per cubic metre
NAEI	National Atmospheric Emission Inventory
NAQS	National Air Quality Standard
NO	Nitric Oxide
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Oxides of nitrogen
ng/m <sup>3</sup>	Nanograms per cubic metre
NRTF	National Road Traffic Forecast
OSIRIS	the brand name given by Turnkey Instruments Ltd. to their particle measuring nephelometer
P&T	Planning and Transportation
PM <sub>2.5</sub>	Particulate Matter less than 2.5µm aerodynamic diameter
PM <sub>10</sub>	Particulate Matter less than 10µm aerodynamic diameter
Pb	Lead

percentile	The percentage of results below a given value
ppb	Parts per billion
ppm	Parts per million
receptor	In this study, the relevant location where air quality is assessed or predicted (for example, houses, hospitals and schools)
roadside	1 to 5 m from the kerb
SCA	Smoke Control Area
SEPA	Scottish Environment Protection Agency
SO <sub>2</sub>	Sulphur Dioxide
Street Canyon	A relatively narrow street with buildings on both sides, where the height of the buildings is generally greater than the width of the road
TEA	Triethanolamine
TEOM	Tapered Element Oscillating Microbalance
UKAS	United Kingdom Accreditation Service
µg/m <sup>3</sup>	Micrograms per cubic metre
VOC	Volatile Organic Compound
vpd	Vehicles per day
WASP	Workplace Analysis Scheme for Proficiency



# 1 Introduction

## 1.1 Description of Local Authority Area

Dundee City is located on the north bank of the River Tay in the Tay Valley. The Dundee City Council area covers 6,300 hectares (24 square miles) and is geographically the smallest local authority area in Scotland. It is bordered by Perth and Kinross Council to the west and by Angus Council to the north and east. The former Tayside Regional Council area previously covered all three councils and Dundee continues to serve as the regional centre for this area and north-east Fife, with an estimated catchment population of some 400,000 people.

Dundee is the fourth largest city in Scotland and the most recent estimate of Dundee's population is 142,470 (General Register Office for Scotland (GROS) 2008 Mid Year Population Estimate). This equates to a population density of 2261 people per square kilometre.

Dundee is served by an airport which has daily flights to London City. Dundee also has a modern deep-water port and large harbour area. The port area has been a major industrial and commercial source of employment and wealth creation for Dundee and the Central Waterfront project is one of the key priorities in terms of re-connecting the city and its people with the river.

The City is almost entirely urban and suburban in character and is a hub for many routes. It is connected to Fife by the Tay road and rail bridges. The A92 crosses the Tay and emerges in the centre of Dundee. There is an inner ring road, the Marketgait, and five arterial routes - Broughty Ferry Road, Arbroath Road, Riverside Drive, Lochee Road and Forfar Road. There is an outer-ring road, the Kingsway, which consists of the A90(T), the main route from Edinburgh/Perth to Aberdeen, and the A972(T), the route to Arbroath. There are a significant number of busy road junctions across the City. A large proportion of roads in the City have a gradient due to a central topographical feature, an extinct volcano (height 174 metres above sea level). The main sources of pollution in the area are from the road traffic emissions from these routes, with additional emissions from industrial sources, most of the industrial processes are located around the periphery of the city and in the port area

In common with many Scottish cities the architecture consists of a significant number of 4 or 5-storey tenemental properties creating numerous street canyons. In the commercial centres, a common feature of these tenemental properties is that commercial premises are located on the ground floor with residential premises on the floors above. The main shopping area in the city is pedestrianised.

## 1.2 Purpose of Progress Report

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, and they are intended to assist local authorities by:

- providing a means for communicating air quality information to members and the public;
- maximising the usefulness and interpretation of the monitoring effort being carried out;
- maximising the value of the investment in monitoring equipment;
- helping local authorities respond to requests for up-to-date information on air quality;
- providing information to assist in other policy areas, such as transport and land use planning;
- providing a source of baseline data for strategic environmental assessments;
- providing a ready source of information on air quality for developers carrying out environmental assessments for new schemes;
- demonstrating progress with implementation of air quality Action Plans and/or air quality strategies; and
- providing a timely indication of the need for further measures to improve air quality, rather than delaying until the next full round of review and assessment.

They are not intended to be as detailed as Updating and Screening Assessment Reports. However, if the Progress Report identifies the risk of exceedence of an Air Quality Objective, the Local Authority (LA) should undertake a Detailed Assessment immediately, and not wait until the next round of Review and Assessment.

## 1.3 Air Quality Objectives

The air quality objectives applicable to LAQM in Scotland are set out in the Air Quality (Scotland) Regulations 2000 (Scottish SI 2000 No 97), the Air Quality (Scotland) (Amendment) Regulations 2002 (Scottish SI 2002 No 297), and are shown in Table 1.1. This table shows the objectives in units of microgrammes per cubic metre,  $\mu\text{g}/\text{m}^3$  (milligrammes per cubic metre,  $\text{mg}/\text{m}^3$  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 Local Air Quality Management in Scotland**

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
	3.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 $\text{mg}/\text{m}^3$	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
	0.25 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2005
Particles (PM <sub>10</sub> ) (gravimetric)	50 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	50 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 7 times a year	24-hour mean	31.12.2010
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
	18 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2010
Sulphur dioxide	350 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu\text{g}/\text{m}^3$ , 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 established by the Environment Act 1995 Part IV, all local authorities in the UK are under a statutory duty to undertake an air quality assessment within their area and determine whether they are likely to meet the air quality objectives for a number of pollutants. The process of review and assessment of air quality undertaken by local authorities is set out under the Local Air Quality Management (LAQM) regime and involves a phased three yearly assessment of local air quality. Where the results of the review and assessment process highlight that problems in the attainment of health-based objectives for air quality will arise, the authority is required to declare an Air Quality Management Area (AQMA) – a geographic area defined by high levels of pollution and exceedences of health-based standards.

The LAQM regime was first set down in the 1997 National Air Quality Strategy (NAQS) and introduced the idea of local authority 'Review and Assessment'. The Government and Devolved Administrations subsequently published policy and technical guidance related to the review and assessment processes in 1998. This guidance has since been reviewed and the latest documents include Policy Guidance (LAQM.PGS (09)) and Technical Guidance (LAQM.TG (09)). The guidance lays down a progressive, but continuous, framework for the local authorities to carry out their statutory duties to monitor, assess and review air quality in their area and produce action plans to meet the air quality objectives.

A summary of the conclusions of previous rounds of review and assessment are presented in **Table 1.2** below. A map of boundary of the Air Quality Management Area for nitrogen dioxide (NO<sub>2</sub>) and particulate matter (PM<sub>10</sub>) is shown in **Figure 1.1** below.

**Table 1.2 Summaries of Review and Assessment Reports**

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
Stage 1 (1998)	The principle conclusion of Dundee City Council's Stage 1 report was that it was necessary to proceed to the next stage of assessment for all seven of the key LAQM pollutants ( nitrogen dioxide (NO <sub>2</sub> ), particulate matter (PM <sub>10</sub> ), lead, carbon monoxide (CO), benzene, 1,3-butadiene and sulphur dioxide(SO <sub>2</sub> ). The chief reasons for this conclusion were a lack of available information relating to potentially significant traffic and industrial pollution sources within the city.
Stage 2 (2000)	Additional monitoring was carried out and additional information was obtained concerning industrial and traffic sources. Screening assessments incorporating this new information were carried out in accordance with national guidance and concluded that the National Air Quality Standards and Objectives (NAQS) would be achieved in Dundee.

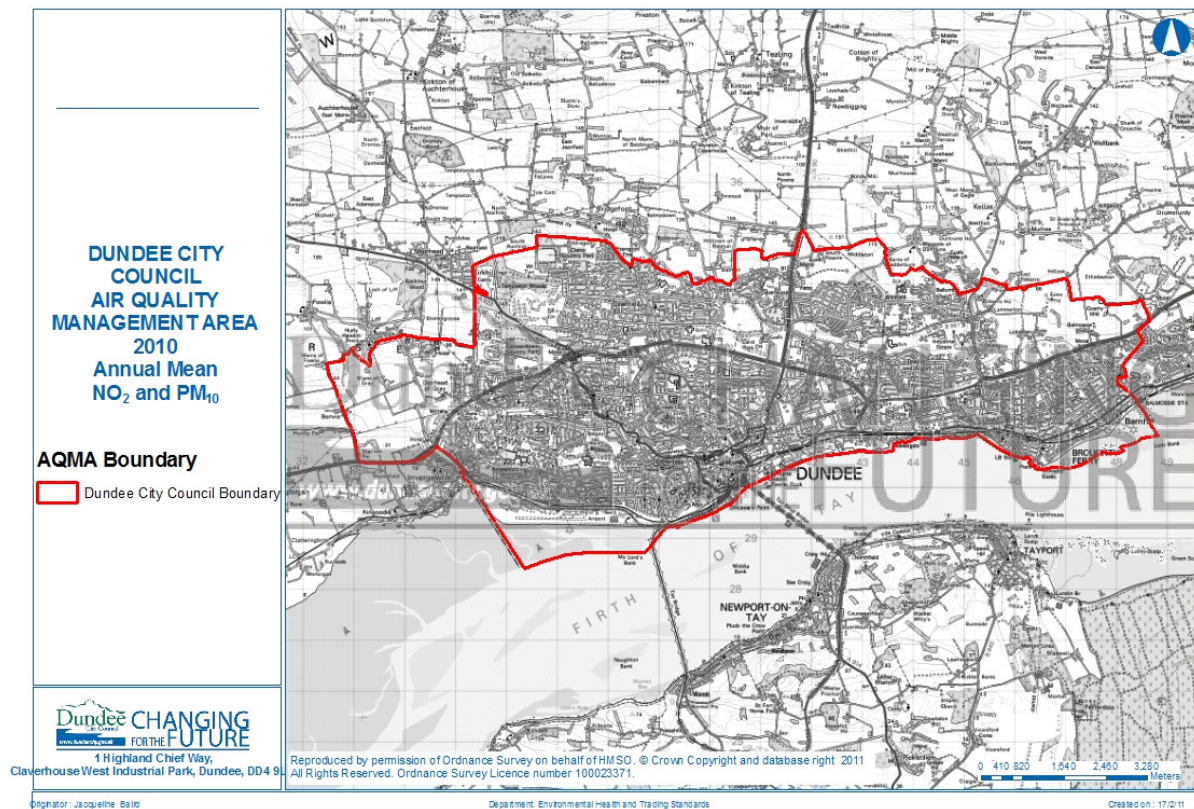
REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
Updating and Screening Assessment (2003)	<p>The imposition of stricter pollutant thresholds, changes in the technical guidance and methodologies for assessment led to an investigation of new areas. This review concluded that the NAQS for carbon monoxide, benzene, 1,3-butadiene and lead would be achieved. It was also concluded that a detailed assessment would be required as a result of potential exceedences of the NAQS for NO<sub>2</sub> and PM<sub>10</sub> at busy roads and junctions and to investigate the likelihood of exceedences of the NAQS for sulphur dioxide at new residential premises introduced close to an industrial source.</p>
Detailed Assessment (2005)	<p>The detailed assessment of NO<sub>2</sub> and PM<sub>10</sub> from traffic sources identified exceedences of the NAQS annual mean standard for NO<sub>2</sub> at relevant receptors in the city centre and along the north- west arterial route.</p> <ul style="list-style-type: none"> <li>• NO<sub>2</sub> - the detailed assessment established the need for Dundee City Council to declare an Air Quality Management Area (AQMA), carry out a further assessment of NO<sub>2</sub> and develop an Action Plan to try and reduce pollution levels in exceedence areas.</li> <li>• PM<sub>10</sub> -there was insufficient confidence in the modelled results for 2010 and it was concluded that additional monitoring and modelling would be required to determine whether an AQMA was also required for PM<sub>10</sub>.</li> <li>• SO<sub>2</sub> -the detailed assessment concluded that the NAQS would be achieved at new residential developments introduced close to an industrial source and that an AQMA was not required for this pollutant.</li> </ul>
Progress Report (2005)	<p>2004 monitoring data and new local developments with the potential to affect air quality were assessed in accordance with statutory guidance and the conclusions reached were:</p> <ul style="list-style-type: none"> <li>• <b>Benzene</b> - no AQMA required for Benzene, as a result monitoring was discontinued.</li> <li>• <b>NO<sub>2</sub></b> - identified additional areas of exceedence of the NO<sub>2</sub> annual mean at relevant receptors on the north-west arterial route. 22 exceedences of the hourly mean NAQS for NO<sub>2</sub> were recorded at the Lochee Road monitoring site. 18 of the 22 occurred during water main rehabilitation works which caused traffic congestion in the vicinity of the monitor. The results were not thought to be representative of the ambient conditions in the area and no AQMA was considered necessary at that time.</li> <li>• <b>PM<sub>10</sub></b> - the results for 2004 indicated that the 2004 and 2010 NAQS for PM<sub>10</sub> would be achieved at the Broughty Ferry Road and background monitoring sites. Exceedences of the 2010 annual mean and daily mean NAQS were recorded at the Union Street monitoring location. These were investigated and it was considered that low data capture, local demolition works and the temporary re-routing of buses along Union St during the construction of a bus-interchange in Whitehall St has contributed to these exceedences and the monitored concentrations did not represent the normal ambient concentrations.</li> <li>• <b>SO<sub>2</sub></b> - monitoring indicated that no AQMA was required.</li> </ul>

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
<p>Updating and Screening Assessment (2006)</p>	<p>The Updating and Screening Assessment (USA) 2006 marked the beginning of the third round of review and assessment and required the re-examination all of the seven LAQM pollutants. 2005 data and any significant changes in pollutant sources and public exposure to pollutants were examined in accordance with statutory guidance. The conclusions reached were:</p> <ul style="list-style-type: none"> <li>• that the NAQS for CO, benzene, 1,3-butadiene, lead and SO<sub>2</sub> would be achieved and hence no detailed assessment would be needed.</li> <li>• NO<sub>2</sub> - the report confirmed the need for the AQMA for NO<sub>2</sub> (which was declared for the whole city in July 2006) and identified an additional exceedence area in the city centre, one of the main bus corridors (Meadowside).</li> <li>• PM<sub>10</sub> - the report concluded that the only monitored PM<sub>10</sub> concentrations predicted to breach the annual mean NAQS for 2010 was the monitoring location in Union Street this was investigated and it was determined that major construction projects in the vicinity might have had an influence on the levels recorded and these may not be truly represent ambient concentrations at this location.</li> </ul>
<p>Progress Report (2007)</p>	<p>2006 monitoring data and new local developments with the potential to affect air quality were assessed in accordance with statutory guidance and the conclusions reached were:</p> <ul style="list-style-type: none"> <li>• <b>NO<sub>2</sub></b> - analysis of the 2006 data re-confirmed the need for the AQMA and the development of an Action Plan. Two new areas of potential exceedence of the annual mean NAQS were identified on the north-east arterial route. (Kingsway/Forfar Road and Albert Street/Arbroath Road).</li> <li>• <b>PM<sub>10</sub></b> - Dundee City Council operate a local Partisol/Teom co-location study which allows a local gravimetric correction factor to be calculated. This was used to correct TEOM and OSIRIS data in the monitoring network. Using this factor, exceedences of the 2010 PM<sub>10</sub> NAQS were predicted at the following monitoring locations in the city centre and the north-west arterial route: <ul style="list-style-type: none"> <li>• Victoria Road / Hilltown Junction, Seagate, Logie Street, and Lochee Road.</li> <li>• The Union Street site was also very close to exceeding the annual mean for 2010 and remains an area of concern due to increasing PM<sub>10</sub> at this city centre location. There were also potential exceedences of the daily mean NAQS predicted at the OSIRIS monitoring locations. The 2006 PM<sub>10</sub> monitoring results indicated that a detailed assessment would be required for PM<sub>10</sub>.</li> </ul> </li> <li>• <b>SO<sub>2</sub></b> - the monitoring results for 2006 indicate that all NAQS objectives were met at the monitoring locations in Dundee. Exceedences of the 15min mean NAQS occurred at the Broughty Ferry Road site, these were well below the 35 exceedences allowed and were thought to have been caused by certain shipping movements and activities. A detailed assessment of this pollutant was not required, but monitored data would be kept under review.</li> </ul>

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
<p>Further Assessment of Nitrogen Dioxide and Detailed Assessment of Particulate Matter PM<sub>10</sub> (2009 )(FA/DA)</p>	<p>The FA/DA combined the detailed assessment of PM<sub>10</sub> with a further assessment of both NO<sub>2</sub> and PM<sub>10</sub>. It examined the 2007 monitoring data and established the main sources of pollution in the exceedence areas and the reduction in pollutant levels necessary to meet the NAQS. The report confirmed the need for the existing AQMA for NO<sub>2</sub> and concluded that an AQMA should be declared for PM<sub>10</sub>. The report also estimated that 4,600 people were living in areas at risk of exceeding the NAQS for NO<sub>2</sub> and PM<sub>10</sub> and concluded that significant reductions in pollutant concentrations are required to meet the annual mean NAQS for both pollutants. The results of the source apportionment exercise are summarised below:</p> <ul style="list-style-type: none"> <li>• <b>Source apportionment of NO<sub>x</sub></b>, indicates road traffic emissions of NO<sub>x</sub> are the main contribution to total NO<sub>x</sub> concentrations, as they account for 74 - 91% of the total NO<sub>x</sub> concentrations at receptors. Heavy-duty vehicles (HDVs) contribute around 38 - 77% to the total NO<sub>x</sub> concentrations at receptors and exceed the LDV contributions. HDV contributions are disproportionately high given their proportion within the vehicle fleet in the AQMA.</li> <li>• <b>Source apportionment of PM<sub>10</sub></b>, indicates background sources of PM<sub>10</sub> make a significant contribution to total PM<sub>10</sub> concentrations, as they account for 28-59% of the total PM<sub>10</sub> concentrations at receptors, with the majority of this being made up of secondary particulates, residual and salt contributions. Road traffic contributes 41% to 72% of the total PM<sub>10</sub> concentration at receptors. Light duty vehicles (LDVs) contribute around 7 – 24 and heavy-duty vehicles (HDVs) contribute around 11-36% to the total PM<sub>10</sub> concentrations at receptors. Brake and tyre wear contribute around 13-29% to the total PM<sub>10</sub> concentrations at receptors. HDV contributions are disproportionately high given their proportion within the vehicle fleet in the AQMA. On Commercial Street and Seagate, where there are significant bus movements, the HDV contribution exceeds the LDV contribution.</li> </ul> <p>(HDV - is a collective term for heavy goods vehicles (HGV) and buses)</p>
<p>Updating and Screening Assessment 2009 (2010)</p>	<p>The Updating and Screening Assessment (USA) 2009 marked the beginning of the fourth round of review and assessment and required the re-examination all of the seven LAQM pollutants. This was carried out in accordance with revised statutory guidance and examined 2008 data and any significant changes in pollutant sources and public exposure to pollutants. The conclusions reached were:</p> <ul style="list-style-type: none"> <li>• that the NAQS for CO, benzene, 1,3-butadiene, lead and SO<sub>2</sub> would be achieved and hence no detailed assessment would be needed. NO<sub>2</sub> - the report re-confirmed the need for the AQMA for NO<sub>2</sub> (which was declared for the whole city in July 2006) and identified an additional potential annual mean exceedence area in Strathmore Avenue. Diffusion tube monitoring also indicated potential exceedences of the hourly mean NAQS in the vicinity of Victoria Road / Meadowside junction and informed the need for automatic monitoring to investigate whether an additional AQMA is required for hourly mean NAQS for NO<sub>2</sub>. Monitoring programmed to begin in 2011.</li> </ul>

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
	<ul style="list-style-type: none"> <li>• PM<sub>10</sub> - the report noted that monitored PM<sub>10</sub> concentrations at Lochee Road and Seagate breach the annual mean NAQS for 2010. Combined with the predicted exceedences of the 2010 PM<sub>10</sub> annual mean in the FA/DA, it was concluded that an AQMA should be declared. Consequently, the 2006 AQMA order was amended in October 2010 to include PM<sub>10</sub>.</li> <li>• the revised statutory guidance contained a new requirement to review and assess biomass combustion sources. The review did not identify any sources within the local authority area that met the criteria for assessment. However, it was considered there was insufficient information available to adequately assess these sources. This will be reported in subsequent review and assessment reports as information becomes available.</li> </ul>

Figure 1.1 Map Showing Boundary of AQMA for NO<sub>2</sub> and PM<sub>10</sub>.





## 2 New Monitoring Data

### 2.1 Summary of Monitoring Undertaken

#### 2.1.1 Automatic Monitoring Sites

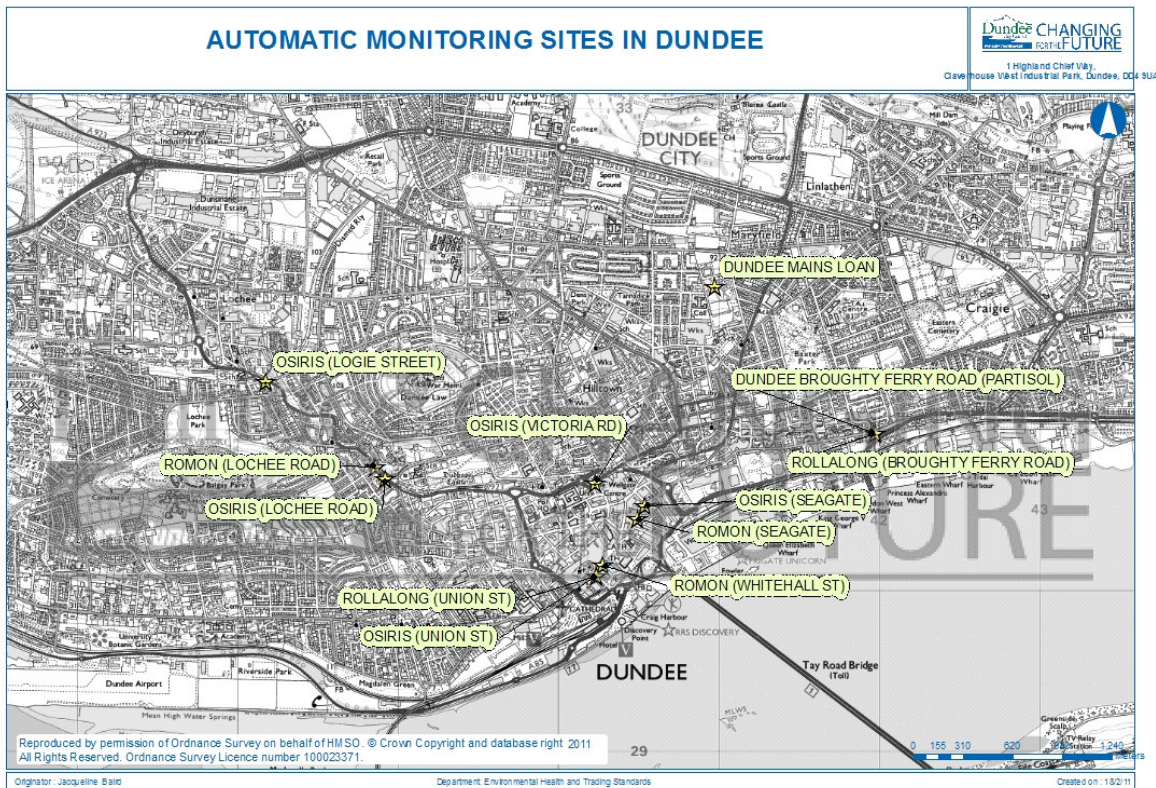
Dundee utilise several methods for monitoring particulate matter (PM<sub>10</sub>) within the city. The Partisol is a reference equivalent method and is used to determine a local correction factor for the TEOMs, which were designated as non-equivalent in 2006. In addition, five sites are monitored with Osiris analysers; these are also non-equivalent and are only indicative of particulate concentrations. Details of these monitoring locations can be found in **Table 2.1** and their locations are shown in **Figure 2.1**. Siting automatic monitoring sites in urban areas is problematic and compromises mean that monitors cannot always be situated in the worst case location. Dundee commenced a yearly study in 2005 to compare the PM<sub>10</sub> data measured with an Osiris analyser with that from a TEOM; determining that the Osiris generally over-reads compared to the TEOM.

Nitrogen dioxide chemiluminescence 'Monitor Labs 9841A' analysers are employed at four locations within the city. Sulphur dioxide is monitored by UV fluorescence using a 'Monitor Labs 9850A' at Broughty Ferry Road. All analysers are audited twice yearly by an external consultant, AEA. The gas analysers at Union Street and Broughty Ferry Road have on-site gases traceable to the National Physical Laboratory (NPL) standards (provided under contract by AEA) and are calibrated automatically every 4 days and daily respectively. The remaining gas analysers do not have on-site gases and are manually calibrated every 3 weeks by AEA using NPL traceable gas.

Dundee City Council secured funding from the Scottish Executive to commission AEA to assist with data management and ratification procedures. Dundee joined the 'Calibration Club' run by AEA at the end of 2006 and AEA have ratified all the real-time monitoring data reported (excluding the OSIRIS units), and have provided the VCM -corrections used in this report. TEOM data presented in this report is corrected using both the local gravimetric correction factor and the VCM method.

Further details and data for those monitors that are part of the 'Calibration Club' can found at [www.scottishairquality.co.uk](http://www.scottishairquality.co.uk).

Figure 2.1 Map of Automatic Monitoring Sites in Dundee



**Table 2.1 Details of Automatic Monitoring Sites**

Site Name	Site Type	OS Grid Ref (x,y)	Pollutants Monitored	In AQMA? <sup>1</sup>	Relevant Exposure? (Y/N with distance (m) to relevant exposure) <sup>3</sup>	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location? <sup>2</sup>
Broughty Ferry Road Rollalong	Urban Industrial	x=341970, y=730977	SO <sub>2</sub> , PM <sub>10</sub> (TEOM)	Yes	Y - 0m	N/A	No
Broughty Ferry Road Partisol	Urban Industrial	x=341971, y=730978	PM <sub>10</sub> (Gravimetric - Partisol)	Yes	Y - 0m	N/A	No
Lochee Road Romon	Kerbside	x=338861, y=730773	NO <sub>2</sub>	Yes	Y - 2.25m	0.6m	No
Lochee Road Osiris	Kerbside	x=338920, y=730694	PM <sub>10</sub> (Osiris)	Yes	Y - 2.2	0.6m	Yes
Logie Street Osiris	Kerbside	x=338176, y=731298	PM <sub>10</sub> (Osiris)	Yes	Y - 1.65m	0.57m	Yes
Mains Loan	Urban Background	x=340972, y=731893	PM <sub>10</sub> (TEOM)	Yes	N - 0m	N/A	No
Seagate Romon	Kerbside	x=340487, y=730446	NO <sub>2</sub>	Yes	Y - 2.0m	0.2m	No
Seagate Osiris	Kerbside	x=340539, y=730528	PM <sub>10</sub> (Osiris)	Yes	Y - 1.64m	0.63m	No
Union Street Rollalong	Roadside	x=340235, y=730091	NO <sub>2</sub> , PM <sub>10</sub> (TEOM)	Yes	Y - 3.3m	1m	Yes
Union Street Osiris	Roadside	x=340235, y=730090	PM <sub>10</sub> (Osiris)	Yes	Y - 3.1m	1.12m	Yes
Victoria Road Osiris	Kerbside	x=340230, y=730673	PM <sub>10</sub> (Osiris)	Yes	Y - 2.7m	0.3m	No
Whitehall Street Romon	Roadside	X=340278, y=730156	NO <sub>2</sub>	Yes	Y - 1.25m	3.26m	No

<sup>1</sup> The whole of Dundee is an AQMA for NO<sub>2</sub> and PM<sub>10</sub>

<sup>2</sup> Explanation provided in Box 3.1 of LAQM.TG(09): *Where results are presented for new monitoring sites, then a description of the sites should be provided. This should include the reason they were set up, for example, to represent worst-case relevant exposure alongside a particular road.*

<sup>3</sup> Explanation provided in Box 3.1 of LAQM.TG(09), *When describing sites, it should be made clear whether they represent relevant exposure. For instance, if the site is kerbside, it would be appropriate to say that "the nearest relevant exposure is residential properties set back 5 m from the kerb."*

### 2.1.2 Non-Automatic Monitoring

In addition to the continuous monitoring network, Dundee City Council operated 81 diffusion tube sites in 2009. Details of these monitoring locations can be found in **Table 2.2** and their locations are shown in **Figure 2.2**

The diffusion tubes are supplied by Gradko and analysed by Tayside Scientific Services utilising the 20% Triethanolamine (TEA) in water preparation method. Tayside Scientific Services participate in the Workplace Analysis Scheme for Proficiency (WASP) for NO<sub>2</sub> diffusion tube analysis, and the Annual Field Inter-Comparison Exercise. These provide strict performance criteria for participating laboratories to meet, thereby ensuring NO<sub>2</sub> concentrations reported are robust. The lab' follows the procedures set out in the Working Group on Harmonisation of Diffusion Tubes Practical Guidance that was published in February 2008<sup>1</sup>, and is UKAS accredited for the analysis of nitrogen dioxide.

With regard to the application of a bias adjustment factor for the diffusion tubes, the technical guidance LAQM.TG (09) and Review and Assessment Helpdesk recommends use of a local bias adjustment factor where available and relevant to diffusion tube sites.

Four local co-location studies were undertaken in 2009, which generated the following bias adjustment factors:

- Dundee Lochee Road - 0.87
- Dundee Seagate - 0.84 (insufficient data capture, i.e. less than 75%)
- Dundee Union Street - 0.82
- Dundee Whitehall Street - 0.81

These were provided to the Review and Assessment Helpdesk, who calculated the overall local bias from the three sites with sufficient data capture as:

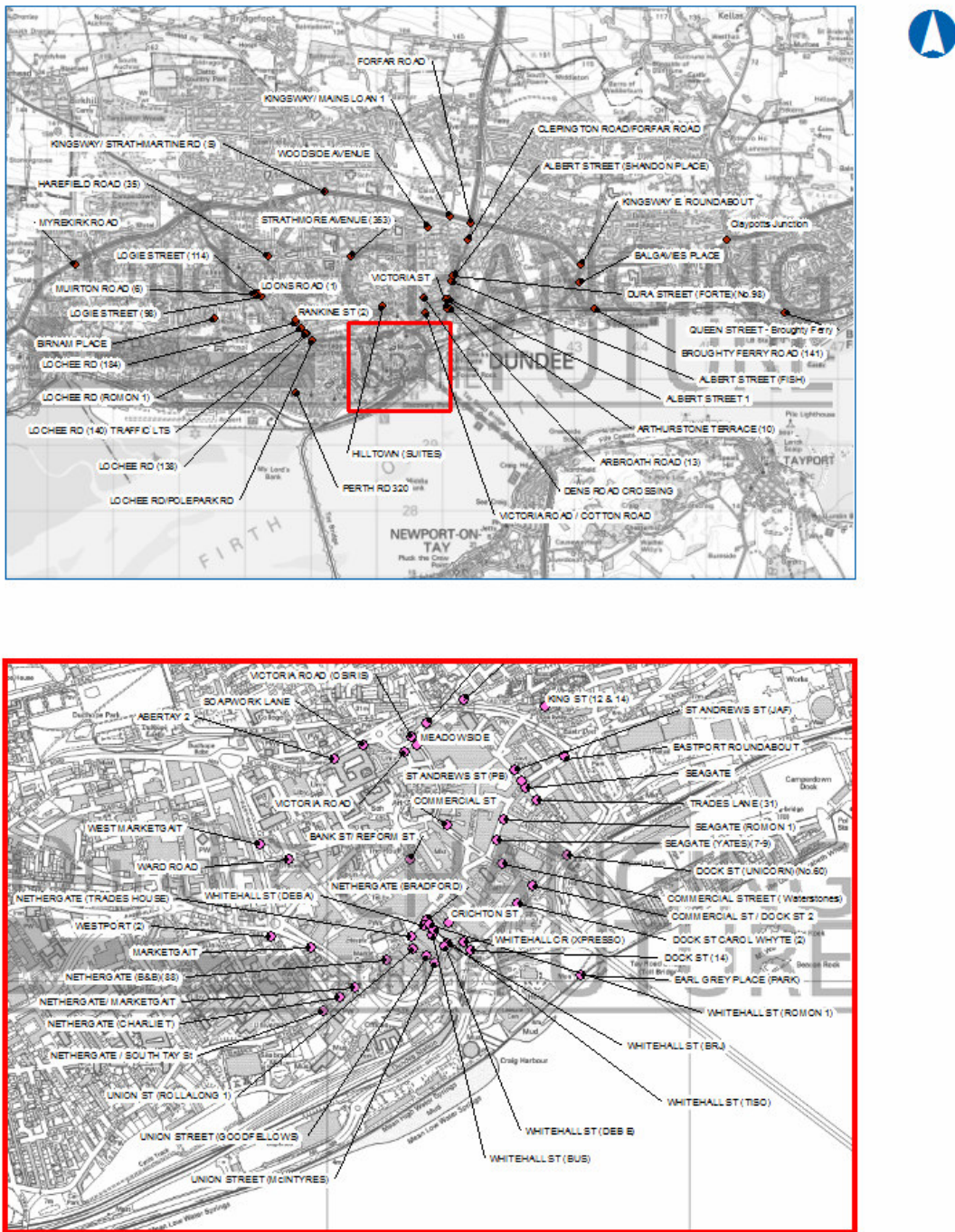
- Dundee City Council - 0.83

The national bias correction factor for Tayside Scientific Services was 0.80 (based on the above and 3 other studies). The individual calculations of bias adjustment for the roadside local co-location studies in 2009 are shown in **Appendix 1**.

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<sup>1</sup> AEA Energy & Environment (2008), Diffusion Tubes for Ambient NO<sub>2</sub> Monitoring : Practical Guidance for Laboratories and Users

Figure 2.2 Maps of Non-Automatic Monitoring Sites (NO<sub>2</sub> Diffusion Tubes) in Dundee



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 Ordnance Survey Licence number 100023371.

0 425 850 1,700 2,550 3,400 Meters

<p><b>CHANGING FOR THE FUTURE</b></p>	<p><b>NITROGEN DIOXIDE DIFFUSION TUBES IN DUNDEE</b></p> <p><b>2009</b></p>
<p>1 Highland Chief Way,          Javelhouse West Industrial Park, Dundee, DD4 5UA</p>	<p>Department: Environmental Health and Trading Standards</p>
<p>Originator: Jacqueline Baird</p>	<p>Created on: 29/3/11</p>

**Table 2.2 Details of Non- Automatic Monitoring Sites**

Location	Site Type	X	Y	Pollutant monitored	In AQMA (Y/N)? <sup>1</sup>	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (m) (N/A if not applicable)	Worst-case Location (Y/N)?
Abertay	kerbside	340047	730629	NO <sub>2</sub>	Y	N	0.66	N
Abertay 2	roadside	340019	730612	NO <sub>2</sub>	Y	N	1.95	N
Albert Street (Fish)	kerbside	341139	731476	NO <sub>2</sub>	Y	2.27	0.57	Y
Albert Street (Shandon Place)	roadside	341171	731574	NO <sub>2</sub>	Y	7.57	1.09	N
Albert Street 1	kerbside	341104	731210	NO <sub>2</sub>	Y	2.14	0.91	N
Arbroath Road (13)	kerbside	341111	731070	NO <sub>2</sub>	Y	2.52	0.73	Y
Arthurstone Terrace (10)	kerbside	341051	731203	NO <sub>2</sub>	Y	1.75	0.89	Y
Balgavies Place	urban background	343082	731465	NO <sub>2</sub>	Y	n/a	N/A	N
Bank St/ Reform St	kerbside	340228	730337	NO <sub>2</sub>	Y	1.31	0.51	Y
Birnam Place	urban background	337531	730914	NO <sub>2</sub>	Y	n/a	N/A	N
Brook Street (B.F.)	kerbside	346293	730872	NO <sub>2</sub>	Y	1.26	0.84	Y
Broughty Ferry Road (141)	roadside	343322	731073	NO <sub>2</sub>	Y	1.98	1.32	Y
Claypotts Junction	roadside	345315	732103	NO <sub>2</sub>	Y	12.00	8.00	N
Cleington Road/Forfar Road	kerbside	341385	732121	NO <sub>2</sub>	Y	8.28	0.78	Y
Commercial St	kerbside	340328	730431	NO <sub>2</sub>	Y	2.90	0.60	Y
Commercial Street (Waterstones)	roadside	340481	730325	NO <sub>2</sub>	Y	2.00	2.60	Y
Crichton St	kerbside	340331	730162	NO <sub>2</sub>	Y	4.08	0.53	Y
Dens Road Crossing	roadside	340725	731238	NO <sub>2</sub>	Y	2.49	1.20	Y
Dock St (14)	kerbside	340395	730086	NO <sub>2</sub>	Y	3.24	0.78	Y
Dock St (Unicorn)(No.60)	roadside	340659	730348	NO <sub>2</sub>	Y	1.74	3.86	Y
Dura Street (Forte) (No.98)	kerbside	341150	731576	NO <sub>2</sub>	Y	1.65	0.57	N
Earl Grey Place (Park)	urban background	340699	730019	NO <sub>2</sub>	Y	n/a	N/A	N
Eastport Roundabout	roadside	340651	730623	NO <sub>2</sub>	Y	1.56	1.00	Y
Harefield Road (35)	kerbside	338360	731855	NO <sub>2</sub>	Y	11.75	0.53	Y
Hilltown (Suites)	roadside	340088	731116	NO <sub>2</sub>	Y	0.50	1.66	N

<sup>1</sup> The whole of Dundee is an AQMA for NO<sub>2</sub> and PM<sub>10</sub>

**Table 2.2 Details of Non- Automatic Monitoring Sites**

Location	Site Type	X	Y	Pollutant monitored	In AQMA? <sup>1</sup>	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (m) (N/A if not applicable)	Worst-case Location?
King St (12 & 14)	kerbside	340598	730757	NO <sub>2</sub>	Y	1.84	0.60	Y
Kingsway E. Roundabout	roadside	343107	731740	NO <sub>2</sub>	Y	14.30	2.90	N
Kingsway/ Mains Loan 1	roadside	341124	732468	NO <sub>2</sub>	Y	15.40	6.20	Y
Kingsway/ Pitkerro Rd	roadside	341963	732303	NO <sub>2</sub>	Y	18.00	6.70	N
Kingsway/ Strathmartine Rd (S)	kerbside	339221	732836	NO <sub>2</sub>	Y	16.80	0.64	N
Lochee Rd (138)	kerbside	338936	730680	NO <sub>2</sub>	Y	2.06	0.44	N
Lochee Rd (140) Traffic Lts	roadside	338927	730685	NO <sub>2</sub>	Y	0.25	2.22	Y
Lochee Rd (184)	kerbside	338767	730856	NO <sub>2</sub>	Y	3.19	0.73	Y
Lochee Rd (Romon 1)	kerbside	338861	730773	NO <sub>2</sub>	Y	2.25	0.60	Y
Lochee Rd/Polepark Rd	kerbside	339016	730586	NO <sub>2</sub>	Y	9.21	0.95	Y
Logie Street (114)	roadside	338184	731293	NO <sub>2</sub>	Y	0.53	1.73	Y
Logie Street (98)	kerbside	338252	731258	NO <sub>2</sub>	Y	1.26	0.86	N
Loons Road (1)	roadside	338211	731293	NO <sub>2</sub>	Y	0.50	1.90	Y
Marketgait	roadside	339953	730094	NO <sub>2</sub>	Y	3.50	1.30	Y
Meadowside	roadside	340245	730651	NO <sub>2</sub>	Y	1.26	1.00	Y
Muirton Road (6)	roadside	338152	731293	NO <sub>2</sub>	Y	0.30	1.11	Y
Myrekirk Road	kerbside	335420	731733	NO <sub>2</sub>	Y	16.40	0.95	N
Nethergate (B&B)(88)	kerbside	340163	730061	NO <sub>2</sub>	Y	5.00	0.86	Y
Nethergate (Bradford)	roadside	340274	730171	NO <sub>2</sub>	Y	2.51	1.25	Y
Nethergate (Charlie T)	kerbside	340033	729957	NO <sub>2</sub>	Y	1.84	0.86	Y
Nethergate (Trades House)	roadside	340230	730124	NO <sub>2</sub>	Y	2.72	1.26	Y
Nethergate/ Marketgait	roadside	340074	729984	NO <sub>2</sub>	Y	3.60	1.33	Y
Rankine St (2)	roadside	338768	730900	NO <sub>2</sub>	Y	0.40	1.76	Y
Seagate	roadside	340545	730532	NO <sub>2</sub>	Y	0.19	1.94	N
Seagate (Romon 1)	kerbside	340487	730446	NO <sub>2</sub>	Y	1.76	0.66	Y
Seagate (Yates)(7-9)	roadside	340467	730388	NO <sub>2</sub>	Y	0.90	1.70	N
Soapwork Lane	roadside	340099	730650	NO <sub>2</sub>	Y	Facade	3.51	Y
St Andrews St (JAF)	kerbside	340516	730584	NO <sub>2</sub>	Y	1.77	0.71	Y
St Andrews St (PB)	kerbside	340532	730551	NO <sub>2</sub>	Y	2.38	0.50	Y

<sup>1</sup> The whole of Dundee is an AQMA for NO<sub>2</sub> and PM<sub>10</sub>

**Table 2.2 Details of Non- Automatic Monitoring Sites**

Location	Site Type	X	Y	Pollutant monitored	In AQMA? <sup>1</sup>	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (m) (N/A if not applicable)	Worst-case Location?
St Mary Flats	roadside	339039	730624	NO <sub>2</sub>	Y	15.00	3.00	N
Strathmore Avenue (353)	kerbside	339609	731871	NO <sub>2</sub>	Y	1.45	0.67	Y
Trades Lane (31)	kerbside	340575	730500	NO <sub>2</sub>	Y	1.82	0.44	Y
Union St (Rollalong 1)	roadside	340235	730091	NO <sub>2</sub>	Y	3.25	1.20	Y
Union Street (Goodfellows)	kerbside	340274	730069	NO <sub>2</sub>	Y	1.60	0.46	Y
Union Street (Mcintyres)	kerbside	340293	730051	NO <sub>2</sub>	Y	1.60	0.73	Y
Victoria Road	roadside	340212	730633	NO <sub>2</sub>	Y	3.00	1.22	Y
Victoria Rd(10)	roadside	340255	730667	NO <sub>2</sub>	Y	2.11	1.14	Y
Victoria Road (osiris)	kerbside	340255	730667	NO <sub>2</sub>	Y	2.7	0.3	Y
Victoria Road (60)	roadside	340375	730779	NO <sub>2</sub>	Y	0.56	2.18	Y
Victoria Road / Cotton Road	kerbside	340740	730996	NO <sub>2</sub>	Y	1.30	0.82	Y
Victoria Road/Hilltown	roadside	340274	730714	NO <sub>2</sub>	Y	2.01	1.15	N
Victoria Street	kerbside	340071	731072	NO <sub>2</sub>	Y	1.70	0.75	Y
Westport (2)	roadside	339842	730122	NO <sub>2</sub>	Y	2.50	0.46	Y
Whitehall Cr (Xpresso)	kerbside	340376	730109	NO <sub>2</sub>	Y	3.00	0.88	Y
Whitehall St (Brj)	kerbside	340330	730106	NO <sub>2</sub>	Y	3.57	0.78	Y
Whitehall St (Bus)	roadside	340289	730128	NO <sub>2</sub>	Y	3.17	2.51	N
Whitehall St (Deb A)	kerbside	340265	730153	NO <sub>2</sub>	Y	5.57	0.88	N
Whitehall St (Deb E)	kerbside	340322	730098	NO <sub>2</sub>	Y	4.55	0.75	Y
Whitehall St (Romon 1)	roadside	340278	730156	NO <sub>2</sub>	Y	1.70	3.26	N
Whitehall St (Tiso)	roadside	340293	730142	NO <sub>2</sub>	Y	2.67	3.00	Y
Woodside Avenue	urban background	340776	732307	NO <sub>2</sub>	Y	N/A	N/A	Y
Forfar Road	kerbside	341437	732360	NO <sub>2</sub>	Y	7.68	0.67	Y
Commercial St / Dock St 2	roadside	340565	730263	NO <sub>2</sub>	Y	0.17	2.78	Y
Dock St Carol Whyte (2)	roadside	340524	730216	NO <sub>2</sub>	Y	0.34	5.13	Y
Perth Rd / Hawkhill	kerbside	338742	729828	NO <sub>2</sub>	Y	4.00	0.55	Y
Nethergate / South Tay St	roadside	339987	729919	NO <sub>2</sub>	Y	0.38	2.24	Y
Perth Rd 320	kerbside	338776	729798	NO <sub>2</sub>	Y	3.78	0.42	Y
Queen St B/F	roadside	346207	731007	NO <sub>2</sub>	Y	0.00	2.85	Y
Ward Rd	roadside	339893	730336	NO <sub>2</sub>	Y	0.64	2.24	Y
West Bell St	roadside	339815	730395	NO <sub>2</sub>	Y	0.84	2.48	Y
West Marketgait	kerbside	339814	730380	NO <sub>2</sub>	Y	2.34	0.67	Y

<sup>1</sup> The whole of Dundee is an AQMA for NO<sub>2</sub> and PM<sub>10</sub>



## 2.2 Comparison of Monitoring Results with Air Quality Objectives

### 2.2.1 Nitrogen Dioxide

#### Automatic Monitoring Data

The results of the automatic monitoring stations for nitrogen dioxide are shown in **Table 2.4**. One of the automatic monitoring stations had slightly less than 9 months data in 2009, the results for this station have been annualised according to the methodology outlined in Box 3.2 of LAQM.TG(09). The urban background sites chosen for the period mean adjustment calculation and the resulting ratio is shown in **Table 2.3**. Trends in the monitored pollutant concentrations will be discussed in the 2011 Progress Report.

**Table 2.3 - Nitrogen Dioxide Period Mean Adjustment**

Long term site	Site type	Annual mean 2009 (Am)	Period mean 2009 (Pm)	Ratio (Am/Pm)
Aberdeen Errol Place	Urban background	25.6	26.2	0.980
Edinburgh St Leonards	Urban background	24.5	26.3	0.928
N Lanarkshire Coatbridge Whifflet	Urban background	24.4	26.1	0.935
Average R <sub>a</sub>				0.948

Exceedences of the annual mean NAQS for nitrogen dioxide were recorded at three stations: Lochee Road, Seagate and Union Street. These are known hotspot locations and are located within an AQMA declared as a result of exceedences of the annual mean.

**Table 2.4 - Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective and Hourly Objective**

Location	Within AQMA ? <sup>a</sup>	NAQS NO <sub>2</sub> Objectives & annual data statistics	Annual Results <sup>b,c</sup>		
			2007	2008	2009
Lochee Road	Yes	Annual mean (Objective 40µg/m <sup>3</sup> ) (µg /m <sup>3</sup> )	52.8	52.9	54.2
		Data capture (%)	93.0	92.0	87.5*
		No. of exceedences of the hourly mean (200µg/m <sup>3</sup> ), not to be breached >18 times per year	0	4	23
		99.8 <sup>th</sup> Percentile of the hourly means (µg/m <sup>3</sup> )	157.5	175.6	206.2

Location	Within AQMA ? <sup>a</sup>	NAQS NO <sub>2</sub> Objectives & annual data statistics	Annual Results <sup>b,c</sup>		
			2007	2008	2009
Seagate	Yes	Annual mean (Objective 40µg/m <sup>3</sup> ) (µg/m <sup>3</sup> )	<b>49.1</b>	<b>51.4</b>	<b>48.4</b>
		Data capture (%)	93.9	81.6*	74.3*
		No. of exceedences of the hourly mean (200µg/m <sup>3</sup> ), not to be breached >18 times per year	1	0	1
		99.8 <sup>th</sup> Percentile of the hourly means (µg/m <sup>3</sup> )	141.2	141.3	152.8
Union Street	Yes	Annual mean (Objective 40µg/m <sup>3</sup> ) (µg/m <sup>3</sup> )	35.8	<b>42.9</b>	<b>45.2</b>
		Data capture (%)	99.3	99.7	99.7
		No. of exceedences of the hourly mean (200µg/m <sup>3</sup> ), not to be breached >18 times per year	0	11	2
		99.8 <sup>th</sup> Percentile of the hourly means (µg/m <sup>3</sup> )	132.1	182.3	165.2
Whitehall Street	Yes	Annual mean (Objective 40µg/m <sup>3</sup> ) (µg/m <sup>3</sup> )	<b>42.0</b>	<b>46.7</b>	37.8
		Data capture (%)	90.6	75.6*	93.2
		No. of exceedences of the hourly mean (200µg/m <sup>3</sup> ), not to be breached >18 times per year	0	0	0
		99.8 <sup>th</sup> Percentile of the hourly means (µg/m <sup>3</sup> )	136.8	139.4	111.3

<sup>a</sup> All monitoring sites are located within an AQMA for NO<sub>2</sub> and PM<sub>10</sub> annual mean.

<sup>b</sup> Monitoring period and data capture percentage is for the full calendar year.

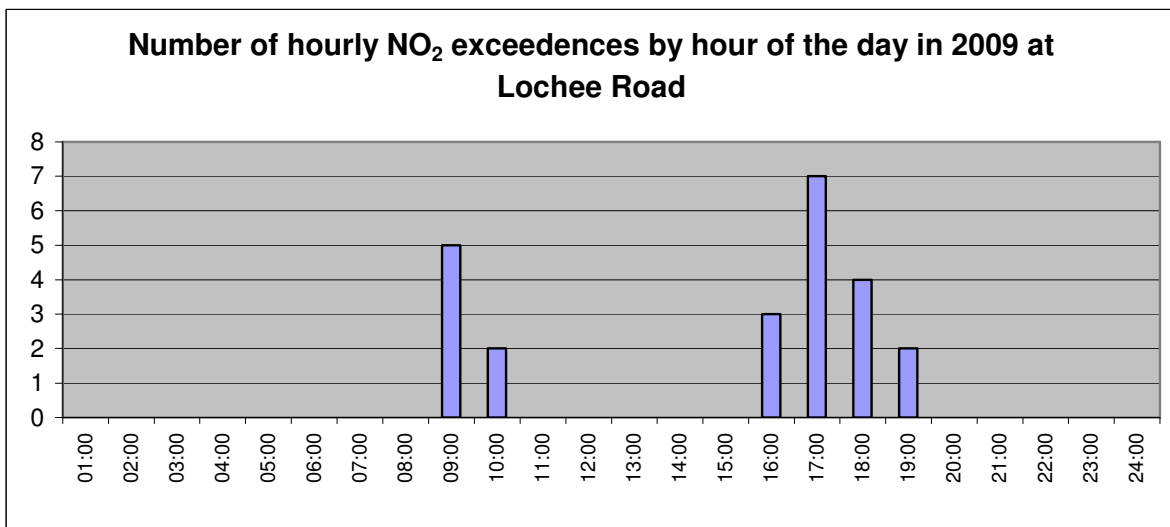
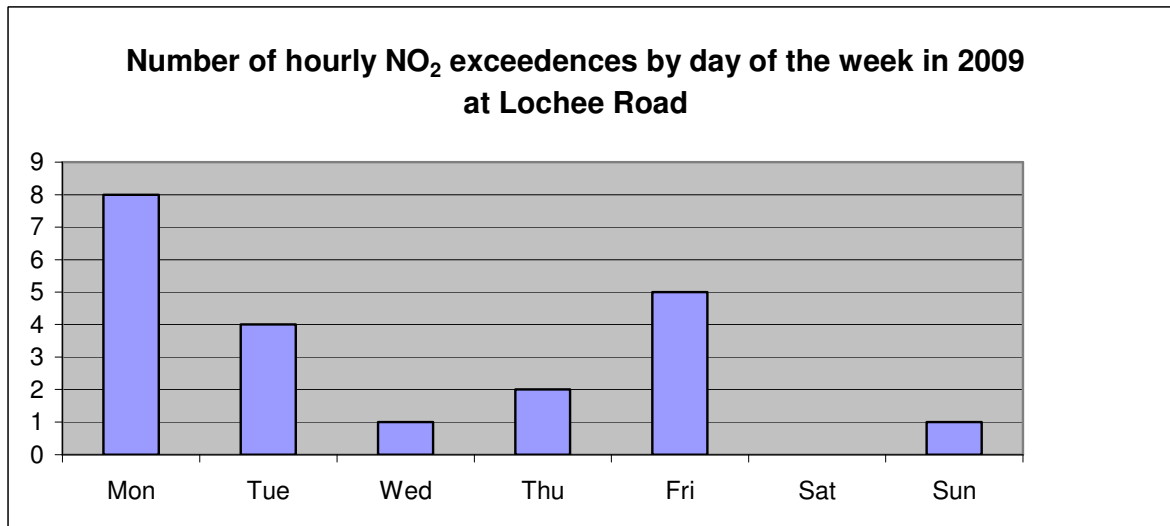
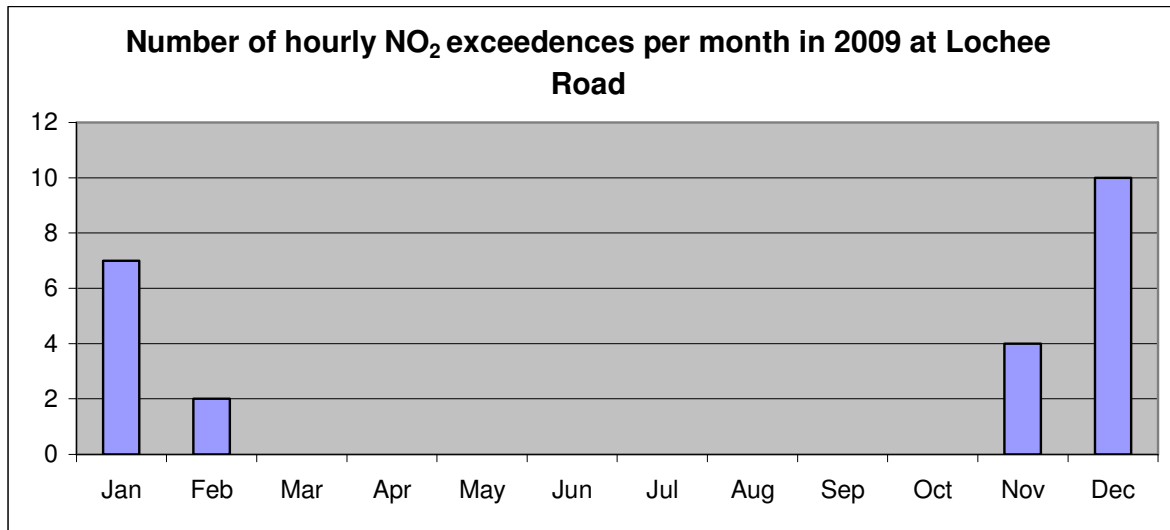
<sup>c</sup> Exceedences of the air quality objectives are shown in bold.

\* Data capture less than the recommended 90%

Results in the shaded cells have been period adjusted according to the methodology outlined in Box 3.2 of LAQM TG(09) . The period mean for Seagate was 51.0 prior to period adjustment.

The monitoring station on Lochee Road also recorded 23 exceedences of the hourly mean in 2009, only 18 are permitted in any calendar year. An analysis of the frequency of these exceedences is shown in **Figure 2.3**. This showed that the majority of the exceedences occurred during the winter months, during the morning and evening peak traffic periods and on Mondays and Fridays. Severe weather (snow and ice) during December 2009 may have contributed to some of the exceedences, the monitoring station is located on the main north-west arterial route into the city, which can become increasingly congested during adverse weather when alternative routes are difficult to for drivers to negotiate. The need for a detailed assessment will be re-examined in 2011 Progress Report to determine whether a new AQMA is required for exceedences of the hourly NO<sub>2</sub> objective.

**Figure 2.3 Analysis of the Frequency of Exceedences of the Hourly NO<sub>2</sub> Objective at Automatic Monitoring Site on Lochee Road**



### Diffusion Tube Monitoring Data

The nitrogen dioxide diffusion tube data for 2009 are summarised in the **Table 2.5** below. The full dataset (monthly mean values) are included in **Appendix 2**. None of the diffusion tube locations had less than 9 months data in 2009 and hence the results did not require to be annualised. The local bias- correction factor (0.83) derived for the Dundee sites by the Review and Assessment Helpdesk was used for the 2009 results; the Seagate co-location site was omitted from the overall local correction factor in 2009 due to low data capture.

The 2009 data show that concentrations measured at 35 diffusion tube sites exceeded the annual mean NO<sub>2</sub> Standard. As the Dundee AQMA encompasses the whole local authority area, all these locations are within the existing AQMA. Further consideration of these sites was made with regard to the likely exposure at nearest residential receptors using the LAQM distance calculator tool. Of these, the predicted concentrations were estimated to exceed the NAQS at receptors at 14 sites. All of these locations are in known areas of exceedence. Uncertainties associated with the distance calculator tool suggest that Strathmore Avenue, may be a new area of exceedence. This will be kept under review.

**Table 2.5 Results of Nitrogen Dioxide Diffusion Tubes**

Location	2007 Annual mean concentration (µg/m <sup>3</sup> ) adjusted for bias (0.86)	2008 Annual mean concentration (µg/m <sup>3</sup> ) adjusted for bias (0.87)	2009 Annual mean concentration (µg/m <sup>3</sup> ) adjusted for bias (0.83)	2009 Data capture %	2009 Predicted annual mean NO <sub>2</sub> concentration at Receptor (µg/m <sup>3</sup> )
Abertay	46.5	48.5	n/a	n/a	n/a
Abertay 2	n/a	n/a	47.2	100	n/a
Albert Street (Fish)	30.7	32.8	34.7	100	30.2
Albert Street (Shandon Place)	34.3	39	39.0	91.7	30.7
Albert Street 1	33	37.9	37.4	100	33.1
Arbroath Road (13)	38	40.2	45.4	100	38.0
Arthurstone Terrace (10)	23.1	25.4	25.2	100	24.0
Balgavies Place	17.6	18.9	18.6	100	n/a
Bank St/ Reform St	29.4	28.2	30.9	100	28.3
Birnam Place	10.8	11.7	11.0	100	n/a
Brook Street (B.F.)	22.9	23.1	n/a	n/a	n/a
Broughty Ferry Road (141)	40.4	45.3	46.9	100	41.5
Claypotts Junction	24.6	28	27.5	100	26.4
Clelington Road/ Forfar Road	36.8	38.5	40.7	100	30.7
Commercial St	33.5	36.2	34.2	100	29.4
Commercial St/Dock St 2	38.6	41.9	42.2	91.7	41.8

Location	2007 Annual mean concentration ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias (0.86)	2008 Annual mean concentration ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias (0.87)	2009 Annual mean concentration ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias (0.83)	2009 Data capture %	2009 Predicted annual mean $\text{NO}_2$ concentration at Receptor ( $\mu\text{g}/\text{m}^3$ )
Commercial Street (Waterstones)	40.2	47.4	43.2	100	39.8
Crichton St	31.6	34	33.7	100	28.2
Dens Road Crossing	35.2	36	36.6	100	32.5
Dock St (14)	46.7	43.8	43.1	100	35.6
Dock St (Unicorn)(No.60)	37.6	40.8	39.6	75	37.5
Dock St Carol Whyte (2)	37.8	37.5	38.2	100	37.8
Dura Street (Forte) (No.98)	39.4	41.6	43.0	100	37.2
Earl Grey Place (Park)	20.6	20.7	21.8	100	n/a
Eastport Roundabout	35.5	35.9	35.2	100	32.2
Forfar Road	45.7	50.2	52.6	100	37.0
Harefield Road (35)	32.6	36	32.5	100	25.1
Hilltown (Suites)	33.2	35.4	35.6	100	34.6
King St (12 & 14)	28.7	30.1	31.1	100	28.1
Kingsway E. Roundabout	40	42.6	44.9	83.3	33.2
Kingsway/ Mains Loan 1	34.1	37.8	35.1	100	28.8
Kingsway/ Pitkerro Rd	30.7	26.7	n/a	n/a	n/a
Kingsway/ Strathmartine Rd (S)	43.3	45	43.2	100	28.7
Lochee Rd (138)	52.6	57.4	56.9	100	45.6
Lochee Rd (140) Traffic Lts	53.4	57	57.2	100	56.2
Lochee Rd (184)	38.1	39.1	40.2	100	33.6
Lochee Rd (Romon) mean of 3 tubes	49.2	51.4	51.2	100	42.1
Lochee Rd/Polepark Rd	30.9	32.3	33.9	100	27.0
Logie Street (114)	52.2	58.2	57.0	100	54.7
Logie Street (98)	35.2	34.5	35.0	91.7	32.2
Loons Road (1)	39.1	45.3	43.9	100	42.6
Marketgait	33	35.8	34.7	100	30.4
Meadowside	61.4	63.5	55.8	91.7	49.8
Muirton Road (6)	28.4	29.2	30.4	100	29.9
Myrekirk Road	32.9	32.3	35.1	100	26.0
Nethergate (B&B)(88)	43.1	49.1	48.6	100	37.6
Nethergate (Bradford)	37.4	43.2	41.9	100	36.7
Nethergate (Charlie T)	39.1	38.4	38.2	100	34.0
Nethergate (Trades House)	39.6	44.6	41.8	100	36.4
Nethergate/South Tay St	29.6	30.1	29.3	100	29.0

Location	2007 Annual mean concentration ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias (0.86)	2008 Annual mean concentration ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias (0.87)	2009 Annual mean concentration ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias (0.83)	2009 Data capture %	2009 Predicted annual mean $\text{NO}_2$ concentration at Receptor ( $\mu\text{g}/\text{m}^3$ )
Nethergate/ Marketgait	36	35.2	35.4	100	30.9
Perth Rd / Hawkhill	25	22.9	n/a	n/a	n/a
Perth Rd 320	n/a	36.5	<b>39.9</b>	100	31.8
Queen St B/F	n/a	29.8	31.3	100	31.3
Rankine St (2)	39.9	<b>42.6</b>	<b>44.9</b>	91.7	<b>43.7</b>
Seagate	<b>42.3</b>	<b>45.9</b>	<b>44.9</b>	100	<b>44.3</b>
Seagate (Yates)(7-9)	<b>40.5</b>	38.3	<b>41.5</b>	100	39.4
Seagate(Romon) mean of 3 tubes	<b>47.5</b>	<b>50.8</b>	<b>51.4</b>	100	<b>43.7</b>
Soapwork Lane	35	35.8	36.9	100	n/a
St Andrews St (JAF)	34.8	<b>40.4</b>	36.9	100	32.7
St Andrews St (PB)	<b>41.5</b>	<b>41.6</b>	<b>41.5</b>	100	34.7
St Mary Flats	20.6	19.8	n/a	n/a	n/a
Strathmore Avenue (353)	38	<b>42.6</b>	<b>40.3</b>	91.7	35.8
Trades Lane (31)	36.3	33.3	32.8	100	29.0
Union St (Rollalong) mean of 3 tubes	<b>43.4</b>	<b>44.7</b>	<b>45.3</b>	100	38.2
Union Street (Goodfellows)	32.4	34.1	32.6	100	29.2
Union Street (Mcintyres)	32.7	33.2	33.5	100	30.4
Victoria Road	36.7	38.4	37.5	100	32.8
Victoria Road (10)	32.9	34	n/a	91.7	n/a
Victoria Road (60)	<b>41.1</b>	<b>43.8</b>	<b>44.0</b>	100	<b>42.6</b>
Victoria Road (OSIRIS)	n/a	n/a	38.5	91.7	31.4
Victoria Road / Cotton Road	36.6	37.4	38.1	91.7	34.7
Victoria Road/Hilltown	<b>55.8</b>	<b>60.9</b>	<b>59.5</b>	100	<b>51.1</b>
Victoria St	34.1	35.2	36.5	100	32.6
Ward Rd	n/a	34.5	35.7	100	34.7
West Bell St	n/a	36	n/a	n/a	n/a
West Marketgait	n/a	n/a	<b>44.1</b>	83.3	37.2
Westport (2)	38.9	<b>41.3</b>	<b>42.1</b>	91.7	34.7
Whitehall Cr (Xpresso)	30.3	30.6	30.4	100	27.2
Whitehall St (Brj)	36.3	37.8	35.8	100	30.4
Whitehall St (Bus)	<b>48.6</b>	<b>51.7</b>	<b>48.6</b>	100	<b>42.7</b>
Whitehall St (Deb A)	<b>43.4</b>	<b>50.3</b>	<b>46.9</b>	100	36.1
Whitehall St (Deb E)	36.9	39.6	38.3	100	31.3
Whitehall St (Romon) mean of 3 tubes	38.5	<b>42.7</b>	38.9	100	36.8
Whitehall St (Tiso)	38.8	<b>42.6</b>	<b>40.2</b>	100	36.8
Woodside Avenue	18.1	18.5	17.7	100	n/a

<sup>a</sup> All diffusion tube are located within an AQMA for  $\text{NO}_2$  and  $\text{PM}_{10}$  annual mean.

<sup>b</sup> Monitoring period and data capture percentage is for the full calendar year.

<sup>c</sup> The means shown in the highlighted cells have been "annualised" as in Box 3.2 of TG(09), the methodology was detailed in the USA 2009.

<sup>d</sup> Exceedences of the air quality objectives are shown in bold

The diffusion tubes monitoring sites where NO<sub>2</sub> concentrations exceeded the annual mean objective were assessed, using the procedures set out in LAQM.TG(09) (Box2.3) and the tool available from the Review and Assessment website, to see whether exceedences are likely to occur at the nearest relevant receptor. The average of three urban-background monitoring locations (Balgavies Place, Earl Grey Place and Woodside Avenue) was used to provide the background concentration (19.4µg/m<sup>3</sup>) for these comparisons. Of the 35 sites, which recorded an exceedence in 2009, all were located within the AQMA.

There is considerable uncertainty associated with the use of the distance calculator tool. An example of this can be illustrated using two of the diffusion tube sites on Lochee Road. Lochee Rd (138) is located at kerbside and Lochee Rd (140) is located close to (25cm) the residential facade at the same location. When the distance calculator is used to predict the drop-off in pollutant concentrations between the two tubes it calculates that pollution levels will drop from 56.9µg/m<sup>3</sup> to 46.3µg/m<sup>3</sup>, i.e. a drop off of 10.6µg /m<sup>3</sup>. The actual monitored concentration at the Lochee Rd (140) tube 57.2µg/m<sup>3</sup> was 57.2µg/m<sup>3</sup> an increase of 0.3µg/m<sup>3</sup>.

The following 14 sites exceeded the NAQS annual mean when the distance calculator tool was used to estimate concentrations at relevant receptors:

<b>Lochee Rd (140) Traffic Lts</b>	<b>56.2</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Logie Street (114)</b>	<b>54.7</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Victoria Road/Hilltown</b>	<b>51.1</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Meadowside</b>	<b>49.8</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Lochee Rd (138)</b>	<b>45.6</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Seagate</b>	<b>44.3</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Rankine St (2)</b>	<b>43.7</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Seagate(Romon) mean of 3 tubes</b>	<b>43.7</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Whitehall St (Bus)</b>	<b>42.7</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Victoria Road (60)</b>	<b>42.6</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Loons Road (1)</b>	<b>42.6</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Lochee Rd (Romon) mean of 3 tubes</b>	<b>42.1</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Commercial St / Dock St 2</b>	<b>41.8</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Broughty Ferry Road (141)</b>	<b>41.5</b>	<b>(µg/m<sup>3</sup>)</b>

A further 15 sites were close to exceeding the NAQS annual mean when the distance calculator tool was used to estimate concentrations at relevant receptors:

<b>Commercial Street (Waterstones)</b>	<b>39.8</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Seagate (Yates)(7-9)</b>	<b>39.4</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Union St (Rollalong) mean of 3 tubes</b>	<b>38.2</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Arbroath Road (13)</b>	<b>38.0</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Dock St Carol Whyte (2)</b>	<b>37.8</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Nethergate (B&amp;B)(88)</b>	<b>37.6</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Dock St (Unicorn)(No.60)</b>	<b>37.5</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Dura Street (Forte) (No.98)</b>	<b>37.2</b>	<b>(µg/m<sup>3</sup>)</b>
<b>West Marketgait</b>	<b>37.2</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Forfar Road</b>	<b>37.0</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Whitehall St (Tiso)</b>	<b>36.8</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Whitehall St (Romon) mean of 3 tubes</b>	<b>36.8</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Nethergate (Bradford)</b>	<b>36.7</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Nethergate (Trades House)</b>	<b>36.4</b>	<b>(µg/m<sup>3</sup>)</b>
<b>Whitehall St (Deb A)</b>	<b>36.1</b>	<b>(µg/m<sup>3</sup>)</b>

The Technical Guidance considers that there could be a potential risk of breaching the hourly NO<sub>2</sub> standard, where the annual mean NO<sub>2</sub> concentration is greater than (>) 60µg/m<sup>3</sup>. There were no diffusion tubes with an annual mean NO<sub>2</sub> concentration >60µg/m<sup>3</sup> in 2009.

## 2.2.2 PM<sub>10</sub>

Dundee City Council undertakes automatic monitoring of PM<sub>10</sub> at seven sites in the city. These are all located within the Dundee AQMA (NO<sub>2</sub> and PM<sub>10</sub> annual mean) with one at an urban background location and the rest either at busy roads and junctions in the city centre or by main arterial routes.

Dundee City Council uses three types of measurement methods for PM<sub>10</sub> monitoring:

- The Partisol sampler is an equivalent method with the EU reference method for measuring particulates. The Partisol gravimetric sampler collects daily samples onto a filter for subsequent weighing to determine the PM<sub>10</sub> concentration.
- The tapered element oscillating microbalance (TEOM) system determines particulate concentrations by continuously weighing particles that are deposited onto a filter. This is an approved analyser for detailed and further assessments although is not gravimetric equivalent.
- The OSIRIS particulate monitors supplied by Turnkey Instruments use a nephelometer, which sizes and counts individual particles as they pass through a laser beam. This is an indicative analyser, which is suitable as a screening tool for LAQM, but results should be treated with some caution.

Locations of the analysers across the city are:

- Partisol at Broughty Ferry Road (with TEOM co-location);
- TEOM at Union Street (with OSIRIS co-location);
- TEOM at Mains Loan, and
- Four Osiris monitors located at Seagate, Victoria Road, Lochee Road and Logie Street.

Details and locations of these monitoring stations can be found in **Table 2.1** and **Figure 2.1**, respectively.

The Partisol is considered as a gravimetric equivalent analyser in the "*UK Equivalence Programme for Monitoring of Particulate Matter*" and as such can be compared directly with the prescribed objectives. The TEOM and Osiris monitors are not gravimetric equivalent, and as such data is required to be adjusted to enable comparison with the prescribed objectives. Prior to the introduction of the LAQM.TG(09) recommended methodology of applying the volatile correction model; Dundee City Council derived local factors from co-location studies to enable adjustment of both TEOM and Osiris data. AEA were commissioned by the Scottish Government to provide VCM correction for TEOMs; from 2008, hence the 2009 dataset is also corrected using the AEA VCM correction factors.



Comparison of the equivalent daily averages in 2009 for the Partisol and TEOM co-location study at Broughty Ferry Road showed that the TEOM was under-reading compared to the Partisol and the TEOM results have therefore been factored by the local factor of **1.079**.

Comparing equivalent daily averages in 2009 for the TEOM and OSIRIS at Union Street found that the OSIRIS was over-reading compared to the TEOM. This meant the OSIRIS would need to be multiplied by a factor of **0.884** to be equivalent to the TEOM. Hence, the annual mean OSIRIS results presented in this report have been adjusted prior to gravimetric correction factors being applied. The factored monitoring results for 2009 are shown in **Table 2.6a** and **Table 2.6b**. Trends in PM<sub>10</sub> concentrations will be examined in the 2011 Progress Report.

One of the automatic monitoring stations had slightly less than 9 months data in 2009, the results for this station have been annualised according to the methodology outlined in Box 3.2 of LAQM.TG(09). The urban background sites chosen for the period mean adjustment calculation and the resulting ratio is shown in **Table 2.6**.

**Table 2.6 - PM<sub>10</sub> Period Mean Adjustment**

Long term site	Site type	Annual mean 2009 (Am)	Period mean 2009 (Pm)	Ratio (Am/Pm)
Aberdeen Errol Place	Urban background	14.8	14.7	1.007
Grangemouth Moray	Urban background	13.6	13.6	0.999
Average R <sub>a</sub>				1.003

**Table 2.6a Results of PM<sub>10</sub> Automatic Monitoring: Comparison with Annual Mean Objective**

Location (Monitor type)	Within AQMA ?	Correction factor	Data Capture for 2009 (%)	Annual mean concentrations (µg/m <sup>3</sup> )
		VCM/Local		2009
Broughty Ferry Rd (Partisol)	Y	N/A	100.0	14.2
Broughty Ferry Rd (TEOM)	Y	VCM	99.2	14.8
		<i>Local</i> (2009 - 1.079)	99.5	14.2
Mains Loan (TEOM)	Y	VCM	84.4	12.6*
		<i>Local</i> (2009 - 1.079)	84.4	11.7*
Union St (TEOM)	Y	VCM	99.2	16.5
		<i>Local</i> (2009 - 1.079)	99.7	16.0
Union St (OSIRIS)	Y	VCM	86.1	16.6*
		<i>Local</i> (2009 - 1.079)	86.3	16.1
Victoria Rd (OSIRIS)	Y	VCM	91.8	17.1
		<i>Local</i> (2009 - 1.079)	91.8	16.5
Logie St (OSIRIS)	Y	VCM	91.9	15.8
		<i>Local</i> (2009 - 1.079)	92.1	15.2
Lochee Rd (OSIRIS)	Y	VCM	87.3	18.3*
		<i>Local</i> (2009 - 1.079)	87.1	17.9*
Seagate (OSIRIS)	Y	VCM	74.2*	18.1*
		<i>Local</i> (2009 - 1.079)	74.2*	17.8*

**Notes**

Monitoring period &amp; data capture percentage is for the full calendar year

Exceedences of the air quality objectives are shown in bold

\* denotes where data capture is less than the recommended 90%. Results with data capture below 75% have been annualised as in Box 3.2 of TG(09)

The 98th percentile is shown in brackets

**Table 2.6b Results of PM<sub>10</sub> Automatic Monitoring: Comparison with 24-hour Mean Objective**

Location (Monitor type)	Within AQMA ?	Correction factor	Data Capture for 2009 (%)	Number of Exceedences of daily mean objective (50 µg/m <sup>3</sup> )
		VCM/Local		2009
Broughty Ferry Rd (Partisol)	Y	N/A	100.0	2 (34.5)
Broughty Ferry Rd (TEOM)	Y	VCM	99.2	2 (35.3)
		Local (2009 - 1.079)	99.5	1 (30.7)
Mains Loan (TEOM)	Y	VCM	84.4	0 (31.3)*
		Local (2009 - 1.079)	84.4	0 (25.2)*
Union St (TEOM)	Y	VCM	99.7	2 (33.4)
		Local (2009 - 1.079)	99.7	0 (28.5)
Union St (OSIRIS)	Y	VCM	86.3	6 (47.9)*
		Local (2009 - 1.079)	86.3	4 (43.0)*
Victoria Rd (OSIRIS)	Y	VCM	91.8	6 (47.7)
		Local (2009 - 1.079)	91.8	5 (46.8)
Logie St (OSIRIS)	Y	VCM	92.1	3 (44.7)
		Local (2009 - 1.079)	92.1	0 (38.7)
Lochee Rd (OSIRIS)	Y	VCM	87.1	4 (44.0)*
		Local (2009 - 1.079)	87.1	1 (40.2)*
Seagate (OSIRIS)	Y	VCM	74.2	<b>8 (53.5)*</b>
		Local (2009 - 1.079)	74.2	6 (51.1)*

**Notes**

Monitoring period &amp; data capture percentage is for the full calendar year

Exceedences of the air quality objectives are shown in bold

\* denotes where data capture is less than the recommended 90%.

The 98th percentile is shown in brackets

Monitoring results indicate the 2004 PM<sub>10</sub> Objectives are being met. However, there is a risk of exceedence of the 2010 PM<sub>10</sub> annual mean objective being exceeded at roadside sites. The 2010 PM<sub>10</sub> daily mean was also exceeded at the monitoring location in Seagate using the VCM corrected data, but not when the local gravimetric correction factor was applied to the data. Osiris monitoring units have a tendency to over-estimate the number of exceedences compared to TEOMs. The council intend to install a reference equivalent PM<sub>10</sub> analyser in this area, and the need for a detailed assessment or AQMA in relation to the daily mean will be kept under review. A detailed assessment undertaken in 2009 for PM<sub>10</sub>, also identified a risk of exceedence of the 2010 objectives at receptors adjacent to busy roads and junctions in the city centre.

### 2.2.3 Sulphur Dioxide

Dundee City Council measures SO<sub>2</sub> at one location within the city, at Broughty Ferry Road. The monitor is located close to residential receptors located downwind of an urban industrial facility and the port. The UV fluorescence analyser is operated under similar protocols to the AURN stations and the unit is audited twice yearly by AEA. Data are ratified with reference to the Technical Guidance (LAQM.TG09).

Data for 2009 are shown in **Table 2.7** below. Concentrations of SO<sub>2</sub> are very low and the objectives were met. The number of exceedences are given alongside the relevant percentile value in brackets.

**Table 2.7 Results of SO<sub>2</sub> Automatic Monitoring: Comparison with Objectives**

Location	Within AQMA?	Objective	2007 µg/m <sup>3</sup>	2008 µg/m <sup>3</sup>	2009 µg/m <sup>3</sup>
Broughty Ferry Road	Yes (For NO <sub>2</sub> & PM <sub>10</sub> only)	15 Minute mean > 266 µg/m <sup>3</sup> for more than 35 times a year	0 (51.0)	0 (56.0)	0 (53.0)
		Hourly mean > 350 µg/m <sup>3</sup> for more than 24 times a year	0 (35.5)	0 (36.0)	0 (34.6)
		Daily Mean > 125 µg/m <sup>3</sup> for more than 3 days a year	0 (15.7)	0 (16.8)	0 (15.6)
		Corresponding % Data Capture	97.5 99.6 99.7	95.6 97.5 97.5	91.5 93.4 93.4

\*Data for all years has been fully ratified, data capture percentages are for a full calendar year.

Exceedences are highlighted in bold. Percentiles 99.9<sup>th</sup> for 15min, 99.7<sup>th</sup> for hourly and 99.2nd percentile for 24-hour means in brackets next to exceedences.

### 2.2.4 Summary of Compliance with AQS Objectives

Dundee City Council has measured concentrations of NO<sub>2</sub> above the annual mean objective at relevant locations within the AQMA declared for NO<sub>2</sub> and PM<sub>10</sub> annual mean (i.e. the whole council area). Uncertainties associated with the distance calculator tool used to estimate pollutant concentrations at facade suggest the Strathmore Avenue may be a new potential area of exceedence; this will be kept under review.

Dundee City Council has measured concentrations of NO<sub>2</sub> above the 1-hour objective at one location (Lochee Road), this is thought to have been contributed to by the severe winter weather and the need for a detailed assessment / AQMA will be reviewed in subsequent review and assessment reports.

Dundee City Council has measured concentrations of PM<sub>10</sub> above the 24-hour objective at one location (Seagate). This was measured using an Osiris unit, which had been factored and VCM corrected to be as representative as possible of reference equivalent data. The objective was not breached when the Dundee local gravimetric correction factor was applied to the data. A reference equivalent PM<sub>10</sub> analyser is to be installed in the area and the need for a detailed assessment / AQMA will be reviewed as data becomes available.

## 3 New Local Developments

### 3.1 Road Traffic Sources

Under this section the Council is required to identify any of the following which are new since the last Updating and Screening Assessment:

- Narrow congested streets with residential properties close to the kerb.
- Busy streets where people may spend one hour or more close to traffic.
- Roads with a high flow of buses and/or HGVs.
- Junctions.
- New roads constructed or proposed since the last Updating and Screening Assessment.
- Roads with significantly changed traffic flows.
- Bus or coach stations.

Since the last USA (2009) work has begun on a new link road as part of the Whitfield Regeneration Programme, traffic on this road is not expected to exceed 5,000 vehicles per day and hence no further assessment is required.

### 3.2 Other Transport Sources

Under this section the Council is required to identify any of the following which are new since the last Updating and Screening Assessment:

- Airports.
- Locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m.
- Locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m.
- Ports for shipping.

There are no new developments since the last USA (2009) that meet the above description/criteria.

### 3.3 Industrial Sources

Under this section the Council is required to identify any of the following which are new since the last Updating and Screening Assessment:

- **Industrial installations:** new or proposed installations for which an air quality assessment has been carried out.
- **Industrial installations:** existing installations where emissions have increased substantially or new relevant exposure has been introduced.
- **Industrial installations:** new or significantly changed installations with no previous air quality assessment.
- Major fuel storage depots storing petrol.
- Petrol stations.
- Poultry farms.

There are no new developments since the last USA (2009) that meet the above descriptions.

### 3.4 Commercial and Domestic Sources

Under this section the Council is required to identify any of the following which are new since the last Updating and Screening Assessment:

- Biomass combustion plant – individual installations.
- Areas where the combined impact of several biomass combustion sources may be relevant.
- Areas where domestic solid fuel burning may be relevant.

There are no new developments since the last USA (2009) that are known to meet the above criteria. The USA concluded that there was insufficient information to adequately fulfil the requirements of this section. The Council has applied for funding from the Scottish Government under the LAQM grant scheme to take this forward.

### 3.5 New Developments with Fugitive or Uncontrolled Sources

Under this section the Council is required to identify any of the following which are new since the last Updating and Screening Assessment:

- Landfill sites.
- Quarries.
- Unmade haulage roads on industrial sites.
- Waste transfer stations etc.
- Other potential sources of fugitive particulate emissions.

There are no new developments since the last USA (2009) that meet the above description.

Dundee City Council confirms that there are no new or newly identified local developments which may have an impact on air quality within the Local Authority area.

## 4 Implementation of Action Plans

Dundee City Council produced an Air Quality Action Plan for NO<sub>2</sub> and PM<sub>10</sub> in January 2011, following the submission of a draft plan in June 2010.

Thirty two measures have been selected from the draft action plan to be taken forward; some measures have a number of separate actions within them. Actions that have been selected as high priority include:

- Introducing measures to improve bus services and reduce emissions, including investigation of Statutory Bus Quality Partnerships, Voluntary Bus Quality Partnerships, Fleet Renewal, Tackling Idling Bus Emissions, Low Emission Zones for buses
- Exploring means of reducing emissions from taxis and private car hire vehicles in AQMA
- Ensuring local air quality is fully integrated into the LDP process and development scenarios/planning applications are appropriately assessed with respect to the potential impacts on air quality
- Increase uptake and implementation of School and Workplace Travel Plans.

A copy of the Council's Air Quality Action Plan can be viewed our web-site at the following location:

[http://www.dundee.gov.uk/dundee/uploaded\\_publications/publication\\_2166.doc](http://www.dundee.gov.uk/dundee/uploaded_publications/publication_2166.doc)

## 5 Conclusions and Proposed Actions

### 5.1 Conclusions from New Monitoring Data

New monitoring data for 2009 show the objectives for SO<sub>2</sub> are being achieved. Sulphur dioxide concentrations measured at the Broughty Ferry Road monitoring location remained low and achieved the objectives during 2009.

PM<sub>10</sub> objectives for 2004 are being met at all monitoring locations within the city. However, there is a risk of exceedence of the 2010 PM<sub>10</sub> annual mean objective being exceeded at roadside sites. The 2010 PM<sub>10</sub> daily mean was also exceeded at the monitoring location in Seagate using the VCM corrected data, but not when the local gravimetric correction factor was applied to the data. Osiris monitoring units have a tendency to over-estimate the number of exceedences compared to TEOMs. The council intend to install a reference equivalent PM<sub>10</sub> analyser in this area, and the need for a detailed assessment or AQMA in relation to the daily mean will be kept under review. A detailed assessment undertaken in 2009 for PM<sub>10</sub>, also identified a risk of exceedence of the 2010 objectives at receptors adjacent to busy roads and junctions in the city centre

Exceedences of the nitrogen dioxide annual mean objective continued to occur within the existing AQMA in 2009 and, after façade projections were calculated, concentrations at fourteen sites failed to meet the annual mean standard. Uncertainties associated with the distance calculator tool used to estimate pollutant concentrations at facade suggest that Strathmore Avenue may be a new potential area of exceedence; this will be kept under review.

With respect to the hourly NO<sub>2</sub> objective, none of the diffusion tube monitoring sites in the city recorded annual mean concentrations above 60µg/m<sup>3</sup> –The diffusion tube site at the junction of Victoria Road/Hilltown measured a NO<sub>2</sub> concentration of 59.5µg/m<sup>3</sup>. Members of the public are not regularly present for more than 1-hour in these locations, however there are nearby ground floor residences on Meadowside. When projected to façade the concentrations calculated are below 60µg/m<sup>3</sup>. Keeping in view the uncertainties associated with façade projection methodology, the Council intend to monitor at sites of relevant exposure close to the identified locations to confirm if the hourly-mean of NO<sub>2</sub> is being exceeded.

There were 23 exceedences of the hourly NO<sub>2</sub> objective recorded at the automatic monitoring station on Lochee Road during 2009, an examination of the distribution of these exceedences, concluded that they occurred mostly a peak times, on Mondays and Fridays, and during the winter months. Severe weather (snow and ice) during December 2009 may have contributed to some of the exceedences: the monitoring station is located on the main north-east arterial route into the city, which can become increasingly congested during adverse weather when alternative routes are difficult to for drivers to negotiate. The need for a detailed assessment of this location in relation to exceedences of the hourly NO<sub>2</sub> objective will be re-examined in the 2011 Progress Report.



## 5.2 Conclusions relating to New Local Developments

No new local developments requiring assessment have been identified in the Progress Report 2010.

With respect to biomass combustion, Dundee City Council has not identified sources in the area, which meets the criteria. However, it is considered that biomass combustion sources require further investigation, as that there is insufficient information at present to assess this adequately. This will be reported in subsequent LAQM reports as information becomes available.

## 5.3 Other Conclusions

Dundee City Council produced an Air Quality Action Plan for NO<sub>2</sub> and PM<sub>10</sub> in January 2011. The Council have applied for funding to take forward some of the Action Plan measures this year (2011/12).

## 5.4 Proposed Actions

### Proposed Actions

Proposed actions arising from the Progress Report 2010 are as follows:

- Investigate further sources of biomass/solid fuel combustion in the local authority area to enable appropriate screening, and report findings in subsequent LAQM reports as information becomes available;
- Monitor at locations of relevant exposure for sites identified with potential exceedence of the hourly-mean NO<sub>2</sub> objective; and review the need for a detailed assessment / AQMA due to breaches of the hourly mean NO<sub>2</sub> objective once ratified 2010 monitoring data is available.
- Install reference equivalent PM<sub>10</sub> analysers in potential problem areas where possible
- Characterisation of the areas of exceedence at Strathmore Avenue and 'Broughty Ferry Road 141', including additional NO<sub>2</sub> monitoring, is required to inform additional, appropriate action plan measures that will effectively target the pollution problems at those localities; and
- Trends in pollutant concentrations will be investigated in the 2011 Annual Progress Report.

## **6 References**

This report includes references where appropriate throughout the text as footnotes.

## **Appendices**

**APPENDIX 1 - LOCAL BIAS CO-LOCATION STUDIES**

**APPENDIX 2 - MONTHLY DIFFUSION TUBE RESULTS 2009**

**APPENDIX 1 - LOCAL BIAS CO-LOCATION STUDIES**

**Checking Precision and Accuracy of Triplicate Tubes**



Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{gm}^{-3}$	Tube 2 $\mu\text{gm}^{-3}$	Tube 3 $\mu\text{gm}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	07/01/2009	04/02/2009	63.9	62.7	66.8	64	2.1	3	5.2
2	04/02/2009	04/03/2009	73.5	64.7	71.0	70	4.5	7	11.3
3	04/03/2009	01/04/2009	58.6	59.1	58.6	59	0.3	0	0.7
4	01/04/2009	29/04/2009	66.4	71.4	68.3	69	2.5	4	6.3
5	29/04/2009	03/06/2009	59.6	57.7	61.5	60	1.9	3	4.7
6	03/06/2009	01/07/2009	62.5	63.7	67.0	64	2.3	4	5.8
7	01/07/2009	29/07/2009	52.6	52.2	55.0	53	1.5	3	3.8
8	29/07/2009	03/09/2009	48.6	48.0	39.5	45	5.1	11	12.6
9	03/09/2009	30/09/2009	64.5	59.2	62.5	62	2.7	4	6.6
10	30/09/2009	04/11/2009	62.9	64.5	68.8	65	3.1	5	7.6
11	04/11/2009	02/12/2009	64.5	68.4	65.4	66	2.0	3	5.1
12	02/12/2009	05/01/2010	63.5	63.6	65.7	64	1.2	2	3.1
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
56	79.9	Good	Good
55.8	41.2	Good	Poor Data Capture
47.1	98.1	Good	Good
66.8	42.8	Good	Poor Data Capture
0	0	Good	Poor Data Capture
42.6	38.3	Good	Poor Data Capture
33.7	99.4	Good	Good
39.6	95.8	Good	Good
48.5	99.7	Good	Good
54	97.1	Good	Good
61.4	99.7	Good	Good
61.8	100	Good	Good

Overall survey --> **Good precision** **Poor Overall DC**

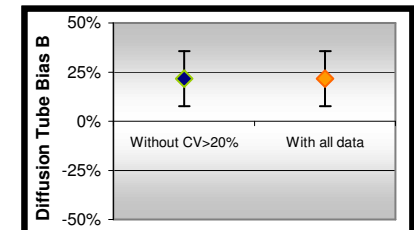
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: **Dundee Seagate**

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 8 periods of data	
Bias factor A	0.84 (0.75 - 0.95)
Bias B	19% (5% - 33%)
Diffusion Tubes Mean:	60 $\mu\text{gm}^{-3}$
Mean CV (Precision):	4
Automatic Mean:	50 $\mu\text{gm}^{-3}$
Data Capture for periods used: 96%	
Adjusted Tubes Mean:	50 (45 - 57) $\mu\text{gm}^{-3}$

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 8 periods of data	
Bias factor A	0.84 (0.75 - 0.95)
Bias B	19% (5% - 33%)
Diffusion Tubes Mean:	60 $\mu\text{gm}^{-3}$
Mean CV (Precision):	4
Automatic Mean:	50 $\mu\text{gm}^{-3}$
Data Capture for periods used: 96%	
Adjusted Tubes Mean:	50 (45 - 57) $\mu\text{gm}^{-3}$



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Version 03 - November 2006

## Checking Precision and Accuracy of Triplicate Tubes



Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{gm}^{-3}$	Tube 2 $\mu\text{gm}^{-3}$	Tube 3 $\mu\text{gm}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	07/01/2009	04/02/2009	68.6	69.2	65.8	68	1.8	3	4.5
2	04/02/2009	04/03/2009	79.7	86.3	83.8	83	3.3	4	8.3
3	04/03/2009	01/04/2009	65.9	71.5	69.3	69	2.8	4	7.0
4	01/04/2009	29/04/2009	49.2	58.8	53.0	54	4.8	9	12.0
5	29/04/2009	03/06/2009	54.5	55.7	50.5	54	2.7	5	6.8
6	03/06/2009	01/07/2009	47.3	46.2	43.0	46	2.2	5	5.5
7	01/07/2009	29/07/2009	49.2	46.0	45.1	47	2.2	5	5.4
8	29/07/2009	03/09/2009	49.2	48.0	48.1	48	0.7	1	1.7
9	03/09/2009	30/09/2009	65.9	63.6	62.1	64	1.9	3	4.8
10	30/09/2009	04/11/2009	64.0	54.1	61.6	60	5.2	9	12.8
11	04/11/2009	02/12/2009	72.6	72.4	73.8	73	0.8	1	1.9
12	02/12/2009	06/01/2010	79.5	77.2	69.2	75	5.4	7	13.4
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
63	99.9	Good	Good
61.3	86.5	Good	Good
49.9	99.4	Good	Good
48.3	86	Good	Good
43.7	91.8	Good	Good
34.8	68.2	Good	For Data Capture
38.7	46.1	Good	For Data Capture
41.9	91	Good	Good
51.9	91.5	Good	Good
56.7	92.9	Good	Good
69.7	95.1	Good	Good
75	95.8	Good	Good

Overall survey --> **Good precision** **Poor Overall DC**

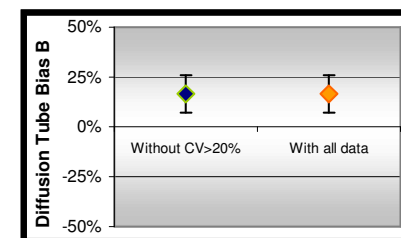
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Dundee Lochee Road
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<b>Accuracy (with 95% confidence interval)</b>	
without periods with CV larger than 20%	
Bias calculated using 10 periods of data	
Bias factor A	0.87 (0.8 - 0.94)
Bias B	15% (6% - 25%)
Diffusion Tubes Mean:	65 $\mu\text{gm}^{-3}$
Mean CV (Precision):	5
Automatic Mean:	56 $\mu\text{gm}^{-3}$
Data Capture for periods used:	93%
Adjusted Tubes Mean:	56 (52 - 61) $\mu\text{gm}^{-3}$

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

<b>Accuracy (with 95% confidence interval)</b>	
WITH ALL DATA	
Bias calculated using 10 periods of data	
Bias factor A	0.87 (0.8 - 0.94)
Bias B	15% (6% - 25%)
Diffusion Tubes Mean:	65 $\mu\text{gm}^{-3}$
Mean CV (Precision):	5
Automatic Mean:	56 $\mu\text{gm}^{-3}$
Data Capture for periods used:	93%
Adjusted Tubes Mean:	56 (52 - 61) $\mu\text{gm}^{-3}$



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## Checking Precision and Accuracy of Triplicate Tubes



Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm <sup>-3</sup>	Tube 2 µgm <sup>-3</sup>	Tube 3 µgm <sup>-3</sup>	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	07/01/2009	04/02/2009	60.6	66.7	64.4	64	3.1	5	7.7
2	04/02/2009	04/03/2009	70.2	74.8	69.5	72	2.9	4	7.2
3	04/03/2009	01/04/2009	60.8	61.4	59.9	61	0.8	1	1.9
4	01/04/2009	29/04/2009	56.4	54.6	49.4	53	3.6	7	9.0
5	29/04/2009	03/06/2009	52.4	50.2	53.4	52	1.6	3	4.1
6	03/06/2009	01/07/2009	39.4	38.8	35.8	38	1.9	5	4.8
7	01/07/2009	29/07/2009	45.3	42.8	43.2	44	1.3	3	3.3
8	29/07/2009	03/09/2009	46.8	45.2	44.7	46	1.1	2	2.7
9	03/09/2009	30/09/2009	57.9	51.1	56.0	55	3.5	6	8.7
10	30/09/2009	04/11/2009	54.3	54.2	54.5	54	0.2	0	0.4
11	04/11/2009	02/12/2009	57.4	59.0	58.3	58	0.8	1	2.0
12	02/12/2009	05/01/2010	59.0	59.8	55.0	58	2.6	4	6.4
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
55.8	99.7	Good	Good
63	99.9	Good	Good
45.1	99.4	Good	Good
40.7	99.4	Good	Good
37	99.8	Good	Good
26.6	99.6	Good	Good
35.2	99.9	Good	Good
44.6	99.8	Good	Good
42.3	100	Good	Good
44.7	99.9	Good	Good
49.5	99.1	Good	Good
54	99.9	Good	Good
Overall survey -->		Good precision	Good Overall DC

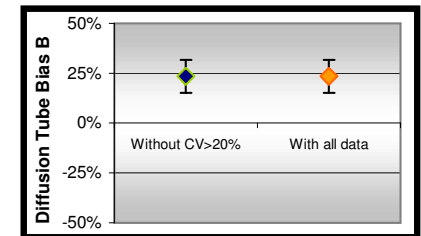
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Dundee Union Street
----------------	---------------------

<b>Accuracy (with 95% confidence interval)</b>	
without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.82 (0.77 - 0.88)
Bias B	22% (13% - 30%)
Diffusion Tubes Mean:	55 µgm <sup>-3</sup>
Mean CV (Precision):	4
Automatic Mean:	45 µgm <sup>-3</sup>
Data Capture for periods used:	100%
Adjusted Tubes Mean:	45 (42 - 48) µgm <sup>-3</sup>

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

<b>Accuracy (with 95% confidence interval)</b>	
WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.82 (0.77 - 0.88)
Bias B	22% (13% - 30%)
Diffusion Tubes Mean:	55 µgm <sup>-3</sup>
Mean CV (Precision):	4
Automatic Mean:	45 µgm <sup>-3</sup>
Data Capture for periods used:	100%
Adjusted Tubes Mean:	45 (42 - 48) µgm <sup>-3</sup>



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Version 03 - November 2006

## Checking Precision and Accuracy of Triplicate Tubes

Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{gm}^{-3}$	Tube 2 $\mu\text{gm}^{-3}$	Tube 3 $\mu\text{gm}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	07/01/2009	04/02/2009	49.0	52.2	48.7	50	1.9	4	4.8
2	04/02/2009	04/03/2009	60.0	57.5	55.7	58	2.2	4	5.4
3	04/03/2009	01/04/2009	47.0	49.1	50.3	49	1.7	3	4.1
4	01/04/2009	29/04/2009	57.8	53.8	53.9	55	2.3	4	5.7
5	29/04/2009	03/06/2009	45.9	44.2	44.5	45	0.9	2	2.3
6	03/06/2009	01/07/2009	49.2	41.9	40.5	44	4.7	11	11.6
7	01/07/2009	29/07/2009	38.6	38.3	40.7	39	1.3	3	3.2
8	29/07/2009	03/09/2009	35.9	35.9	35.5	36	0.2	1	0.6
9	03/09/2009	30/09/2009	41.5	45.7	42.5	43	2.2	5	5.5
10	30/09/2009	04/11/2009	44.8	43.9	42.7	44	1.1	2	2.6
11	04/11/2009	02/12/2009	48.6	49.0	48.7	49	0.2	0	0.5
12	02/12/2009	05/01/2010	53.1	51.9	49.8	52	1.7	3	4.1
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
43.1	100	Good	Good
45.7	84.5	Good	Good
36.9	95.4	Good	Good
47.6	89.2	Good	Good
35	95.7	Good	Good
37	94.5	Good	Good
30.4	84.7	Good	Good
28.4	95.6	Good	Good
30.5	95.7	Good	Good
35.4	92.6	Good	Good
38.5	94.1	Good	Good
44.8	88.2	Good	Good

Overall survey --> **Good precision** **Good Overall DC**

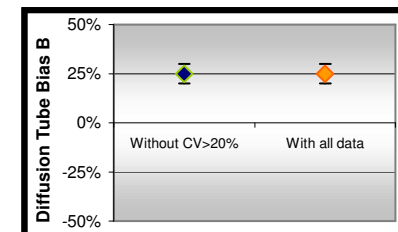
(Check average CV & DC from Accuracy calculations)

**Site Name/ ID:** Dundee Whitehall Street

**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	0.81 (0.77 - 0.84)
Bias B	24% (19% - 29%)
-----	
Diffusion Tubes Mean:	47 $\mu\text{gm}^{-3}$
Mean CV (Precision):	4
-----	
Automatic Mean:	38 $\mu\text{gm}^{-3}$
Data Capture for periods used:	93%
Adjusted Tubes Mean:	38 (36 - 39) $\mu\text{gm}^{-3}$

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.81 (0.77 - 0.84)
Bias B	24% (19% - 29%)
-----	
Diffusion Tubes Mean:	47 $\mu\text{gm}^{-3}$
Mean CV (Precision):	4
-----	
Automatic Mean:	38 $\mu\text{gm}^{-3}$
Data Capture for periods used:	93%
Adjusted Tubes Mean:	38 (36 - 39) $\mu\text{gm}^{-3}$



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Version 03 - November 2006

## APPENDIX 2 - MONTHLY DIFFUSION TUBE RESULTS 2009

LOCATION	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Mean	Bias corrected (0.83)	% Data
ABERTAY 2	64.5	57.2	45.4	60.5	51.7	57.0	48.0	45.4	53.2	61.9	73.4	64.0	56.9	47.2	100.0
ALBERT ST (SHANDON PL)	60.8	48.0	34.3	55.9	46.5	37.1		39.4	38.6	46.3	57.0	53.0	47.0	39.0	91.7
ALBERT ST (1)	53.1	50.7	41.8	47.0	40.1	43.6	34.9	36.2	39.5	45.5	53.2	55.0	45.1	37.4	100.0
ALBERT ST (FISH)	51.4	57.4	42.4	36.2	33.9	25.9	30.4	34.8	41.4	42.7	49.2	55.9	41.8	34.7	100.0
ARBROATH RD (13)	63.3	66.6	57.6	53.0	44.5	41.7	45.1	41.6	58.7	55.3	64.8	64.5	54.7	45.4	100.0
ARTHURSTONE TCE (10)	41.6	35.4	25.8	32.9	25.4	28.0	24.1	22.0	25.1	31.2	34.0	38.5	30.3	25.2	100.0
BALGAVIES PL	31.8	33.2	22.8	14.8	14.8	10.6	12.9	15.4	21.6	22.5	32.3	36.0	22.4	18.6	100.0
BANK ST/ REFORM ST	40.8	45.4	40.6	30.9	30.5	25.5	29.0	27.5	45.0	41.2	47.0	42.9	37.2	30.9	100.0
BIRNAM PL	16.9	19.4	11.2	12.5	9.8	8.3	8.0	9.4	10.1	16.1	18.4	19.3	13.3	11.0	100.0
BROUGHTY FERRY RD (141)	59.6	76.7	63.6	55.3	51.3	48.9	51.4	47.8	54.5	50.0	56.5	62.3	56.5	46.9	100.0
CLAYPOTTS JUNCTION	42.4	35.0	26.6	37.6	29.6	34.8	27.2	24.4	28.0	35.1	37.4	39.5	33.1	27.5	100.0
CLEPINGTON RD/ FORFAR RD	56.5	60.2	50.4	47.8	40.4	38.0	39.6	35.3	46.2	48.7	59.5	65.4	49.0	40.7	100.0
COMMERCIAL ST	54.2	41.4	35.0	52.8	36.0	40.0	35.7	30.6	36.8	39.4	44.9	48.2	41.3	34.2	100.0
COMMERCIAL ST (WATERSTONES)	54.5	46.3	41.9	69.1	51.7	67.0	50.7	37.7	43.7	47.6	54.5	59.2	52.0	43.2	100.0
COMMERCIAL ST /DOCK ST 2	56.2	62.1	55.9	47.1	47.5	44.7	43.1	41.5	52.0	49.1	60.1		50.8	42.2	91.7
CRICHTON ST	49.4	55.2	43.8	38.7	33.0	29.5	31.0	31.2	39.1	39.8	47.5	49.0	40.6	33.7	100.0
DENS RD (CROSSING)	45.5	53.0	42.1	43.6	40.2	31.3	36.3	38.9	42.9	44.5	53.5	57.1	44.1	36.6	100.0
DOCK ST (CAROL WHYTE) 2	47.6	61.2	49.3	44.8	38.8	35.7	38.0	33.4	47.7	47.6	50.3	57.5	46.0	38.2	100.0
DOCK ST (SHERIDANS)	57.0	69.3	55.9	50.4	45.1	43.5	41.4	40.5	53.6	52.7	54.0	59.3	51.9	43.1	100.0
DOCK ST (UNICORN)	55.2	61.9	54.6	46.2	43.0	33.3	38.8	37.5				59.2	47.7	39.6	75.0
DURA ST (FORTES)	58.3	63.6	53.4	48.5	44.0	43.8	44.1	36.9	51.0	53.0	60.4	64.1	51.8	43.0	100.0
EARL GREY PL (PARK)	34.6	39.9	24.6	21.6	17.5	15.1	16.5	14.6	26.2	32.1	33.8	39.3	26.3	21.8	100.0
EASTPORT ROUNDABOUT	49.0	55.3	42.5	42.8	34.1	37.6	34.4	31.1	37.3	42.3	48.4	53.7	42.4	35.2	100.0
FORFAR RD	65.3	81.6	67.1	58.3	56.5	48.8	52.5	53.5	66.6	61.2	77.0	72.1	63.4	52.6	100.0
HAREFIELD RD (35)	56.4	49.1	34.7	36.4	33.8	34.0	29.6	29.5	32.5	40.4	46.5	47.6	39.2	32.5	100.0



LOCATION	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Mean	Bias corrected (0.83)	% Data
HILLTOWN (SUITES)	51.4	40.7	36.5	41.8	37.7	36.3	35.7	37.5	40.4	44.0	56.3	56.4	42.9	35.6	100.0
KING ST (12/14)	47.9	53.0	38.4	28.8	31.0	23.7	26.8	31.8	38.5	40.0	45.1	45.2	37.5	31.1	100.0
KINGSWAY EAST ROUNDABOUT	60.6	65.0	47.8	54.3	52.0			46.6	51.6	52.3	55.4	55.2	54.1	44.9	83.3
KINGSWAY/ MAINS LOAN	39.8	43.7	35.3	46.2	39.4	55.8	38.2	29.3	33.8	43.6	48.7	53.0	42.2	35.1	100.0
KINGSWAY/ STRATHMARTINE RD (S)	55.4	74.0	55.2	44.0	42.4	40.8	45.8	37.7	48.3	55.8	57.3	68.4	52.1	43.2	100.0
LOCHEE RD (138)	68.4	86.9	71.2	64.1	60.8	57.4	57.9	53.5	68.8	67.9	82.7	83.0	68.6	56.9	100.0
LOCHEE RD (140 TRAFFIC LTS)	79.1	88.0	67.9	63.7	58.1	55.9	60.1	55.9	67.5	68.1	79.7	82.7	68.9	57.2	100.0
LOCHEE RD (184)	59.0	58.9	50.9	42.4	40.8	33.5	38.5	39.4	45.3	49.7	62.1	61.2	48.5	40.2	100.0
LOCHEE RD (ROMON 1)	68.6	79.7	65.9	49.2	54.5	47.3	49.2	49.2	65.9	64.0	72.6	79.5	62.1	51.6	100.0
LOCHEE RD (ROMON 2)	69.2	86.3	71.5	58.8	55.7	46.2	46.0	48.0	63.6	54.1	72.4	77.2	62.4	51.8	100.0
LOCHEE RD (ROMON 3)	65.8	83.8	69.3	53.0	50.5	43.0	45.1	48.1	62.1	61.6	73.8	69.2	60.4	50.2	100.0
LOCHEE RD/POLEPARK RD	43.4	53.3	37.6	37.1	32.3	30.8	30.2	29.2	36.5	45.0	55.6	58.5	40.8	33.9	100.0
LOGIE ST (114)	87.6	87.0	72.3	71.4	66.4	60.1	63.0	58.8	73.7	66.8	41.3	75.7	68.7	57.0	100.0
LOGIE ST (98)	50.7	54.7	47.6		33.2	29.2	31.2	29.4	38.9	39.5	51.8	57.8	42.2	35.0	91.7
LOONS RD (1)	55.2	59.1	46.8	60.8	45.8	54.8	48.0	36.3	49.1	57.0	58.4	63.8	52.9	43.9	100.0
MARKETGAIT	43.3	42.2	34.2	50.5	38.2	39.6	35.9	33.3	40.0	47.0	50.7	46.1	41.8	34.7	100.0
MEADOWSIDE	82.2	79.4	78.6	69.2	66.8	0.6		58.6	70.9	72.1	82.1	79.6	67.3	55.8	91.7
MUIRTON RD (6)	47.1	34.0	29.1	40.7	31.8	43.0	31.0	28.6	28.4	37.2	47.8	41.1	36.7	30.4	100.0
MYREKIRK RD	45.8	61.4	54.4	33.0	31.5	28.7	33.6	31.5	43.3	41.8	46.2	55.8	42.3	35.1	100.0
MYREKIRK RD (NURSERY)									18.7	27.9	33.1		26.6	22.1	25.0
NETHERGATE (B&B)	64.9	54.8	53.3	70.2	61.8	60.7	49.0	48.0	55.0	59.8	60.8	60.7	58.5	48.6	91.7
NETHERGATE (BRADFORD)	60.7	64.1	51.9	54.7	48.0	43.8	38.9	41.0	50.1	49.1	51.5	51.6	50.5	41.9	100.0
NETHERGATE (CHARLIE T)	55.8	55.3	43.3	42.8	42.1	37.2	37.3	33.5	46.1	49.2	53.4	57.0	46.1	38.2	100.0
NETHERGATE (TRADES HOUSE)	57.8	52.6	44.1	61.4	53.1	56.5	41.7	40.3	44.6	48.3	54.1	49.8	50.4	41.8	100.0
NETHERGATE/ MARKETGAIT	55.0	52.7	43.1	43.0	36.2	36.3	31.9	30.3	40.4	44.6	49.7	49.3	42.7	35.4	100.0

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NETHERGATE/SOUTH TAY ST	43.8	41.5	33.9	37.6	32.9	32.8	27.5	25.5	31.9	35.6	37.8	43.3	35.3	29.3	100.0
PERTH RD 320	57.4	61.9	48.6	45.3	47.0	40.6	36.0	38.1	50.1	49.2	52.4	50.1	48.1	39.9	100.0
QUEEN ST B/F	47.7	55.2	40.9	35.5	31.0	28.8	26.7	28.3	31.6	34.7	40.9	51.3	37.7	31.3	100.0
RANKINE ST (2)		79.2	55.6	49.7	43.1	37.3	36.3	37.8	51.3	53.3	68.5	82.6	54.1	44.9	91.7
SEAGATE	63.1	64.4	49.2	54.6	50.8	47.8	47.1	44.0	55.2	53.4	62.2	57.2	54.1	44.9	100.0
SEAGATE (ROMON 1)	63.9	73.5	58.6	66.4	59.6	62.5	52.6	48.6	64.5	62.9	64.5	63.5	61.8	51.3	100.0
SEAGATE (ROMON 2)	62.7	64.7	59.1	71.4	57.7	63.7	52.2	48.0	59.2	64.5	68.4	63.6	61.3	50.9	100.0
SEAGATE (ROMON 3)	66.8	71.0	58.6	68.3	61.5	67.0	55.0	39.5	62.5	68.8	65.4	65.7	62.5	51.9	100.0
SEAGATE (YATES)	57.7	58.4	46.5	58.9	44.5	45.0	41.0	40.7	45.5	48.6	57.4	55.7	50.0	41.5	100.0
SOAPWORK LANE	56.3	57.2	41.4	40.9	36.6	34.2	31.3	31.4	44.1	46.6	55.9	58.2	44.5	36.9	100.0
ST ANDREWS ST (JAF)	60.4	54.6	39.5	47.9	44.3	43.5	33.0	29.3	34.2	44.8	49.1	52.2	44.4	36.9	100.0
ST ANDREWS ST (PB)	61.2	63.0	50.2	53.2	45.7	40.4	39.6	40.0	46.3	49.2	52.2	58.6	50.0	41.5	100.0
STRATHMORE AVE (353)		58.2	41.3	51.6	43.6	46.0	39.9	35.1	44.2	51.9	59.0	63.5	48.6	40.3	91.7
TRADES LANE (31)	46.4	63.3	39.8	36.2	32.9	29.2	31.7	28.3	33.8	37.3	45.3	49.3	39.5	32.8	100.0
UNION ST (GOODFELLOWS)	48.3	50.0	39.1	41.5	33.6	41.3	32.1	27.1	32.8	38.6	43.1	43.3	39.2	32.6	100.0
UNION ST (McINTYRES)	41.9	50.3	40.3	46.4	33.9	40.3	33.2	28.9	35.5	42.0	45.4	46.4	40.4	33.5	100.0
UNION ST (ROLLALONG 1)	60.6	70.2	60.8	56.4	52.4	39.4	45.3	46.8	57.9	54.3	57.4	59.0	55.0	45.7	100.0
UNION ST (ROLLALONG 2)	66.7	74.8	61.4	54.6	50.2	38.8	42.8	45.2	51.1	54.2	59.0	59.8	54.9	45.6	100.0
UNION ST (ROLLALONG 3)	64.4	69.5	59.9	49.4	53.4	35.8	43.2	44.7	56.0	54.5	58.3	55.0	53.7	44.6	100.0
VICTORIA RD	54.5	51.4	36.7	53.0	35.2	42.6	35.3	31.1	41.8	45.4	56.2	59.2	45.2	37.5	100.0
VICTORIA RD (10)		60.3	44.0	52.6	40.6	41.7	41.9	30.8	39.5	46.4	54.3	57.8	46.4	38.5	91.7
VICTORIA RD (60)	56.6	58.5	49.0	61.3	46.2	48.3	47.7	41.6	49.6	57.8	57.3	61.9	53.0	44.0	100.0
VICTORIA RD / COTTON RD		63.7	48.2	44.0	44.4	28.4	34.9	38.9	50.4	48.0	54.1	50.1	45.9	38.1	91.7
VICTORIA RD / HILLTOWN	81.7	90.8	83.0	64.5	58.6	55.0	60.4	58.2	76.1	71.0	80.4	80.4	71.7	59.5	100.0
VICTORIA ST / ALBERT ST	49.2	51.9	40.2	51.3	35.8	41.0	36.6	28.0	39.2	44.7	49.0	60.6	44.0	36.5	100.0
WARD RD	53.8	48.6	40.5	45.1	40.4	37.5	32.7	34.6	42.4	44.0	54.1	42.9	43.1	35.7	100.0

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WEST BELL ST	50.8		-	-	-	-	-	-	-	-	-	-	50.8	42.2	8.3
WESTPORT (2)	58.6	58.6	55.0	48.6	50.0	32.8	38.4		53.2	50.7	60.6	52.1	50.8	42.1	91.7
WEST MARKETGAIT	-	-	50.5	54.7	50.5	52.2	41.8	38.8	54.7	61.1	65.3	61.3	53.1	44.1	83.3
WHITEHALL CR (XPRESSO)	44.4	47.4	32.7	39.1	31.1	28.3	30.7	25.9	36.4	36.5	43.6	44.0	36.7	30.4	100.0
WHITEHALL ST (BRJ)	50.3	54.3	45.1	38.2	36.4	37.7	38.6	32.3	39.8	44.2	50.4	50.6	43.2	35.8	100.0
WHITEHALL ST (BUS)	72.8	79.8	63.9	58.7	58.4	46.7	52.0	46.8	54.1	54.1	58.0	57.9	58.6	48.6	100.0
WHITEHALL ST (DEB A)	64.2	65.9	58.3	67.2	55.7	54.9	49.4	42.9	54.1	52.6	57.6	54.6	56.5	46.9	100.0
WHITEHALL ST (DEB E)	56.3	56.8	47.1	47.2	39.0	37.7	37.6	32.0	46.1	48.2	51.7	54.4	46.2	38.3	100.0
WHITEHALL ST (ROMON 1)	49.0	60.0	47.0	57.8	45.9	49.2	38.6	35.9	41.5	44.8	48.6	53.1	47.6	39.5	100.0
WHITEHALL ST (ROMON 2)	52.2	57.5	49.1	53.8	44.2	41.9	38.3	35.9	45.7	43.9	49.0	51.9	47.0	39.0	100.0
WHITEHALL ST (ROMON 3)	48.7	55.7	50.3	53.9	44.5	40.5	40.7	35.5	42.5	42.7	48.7	49.8	46.1	38.3	100.0
WHITEHALL ST (TISO)	56.6	58.2	45.9	60.5	45.9	51.3	41.4	36.6	41.6	40.6	50.4	51.8	48.4	40.2	100.0
WOODSIDE AVE	27.1	28.5	19.6	23.2	16.0	14.9	14.2	10.8	16.9	25.9	27.2	32.1	21.4	17.7	100.0