Manchester City Council - England

2009 Air Quality Updating and Screening Assessment for *Manchester City Council*

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

July 2009

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Executive Summary

Manchester City Council has completed the 2009 Air Quality Updating and Screening Assessment in fulfilment of Part IV of the Environment Act 1995 - Local Air Quality Management.

Monitoring results show that air quality objectives continue to be met for 6 out of the 7 pollutants relevant to local air quality management: lead, sulphur dioxide, 1.3 Butadiene, benzene, carbon monoxide and fine particulates (PM_{10}).

The principal pollutant of concern is nitrogen dioxide (NO_2) with exceedences of the annual objective of 40ug/m^3 particularly at the side of busy roads and in the city centre. Relevant long-term exposure for NO_2 has been newly identified at locations within 30 metres of train tracks with a large number of movements of diesel locomotives, and therefore it will be necessary to proceed to a Detailed Assessment for this pollutant. A Detailed Assessment for NO_2 was last undertaken in Manchester in 2004, based on 2001 emission inventory data. Since that time there have been many significant enhancements made to both the emission inventory and traffic modelling in Greater Manchester. Therefore it is proposed that this Detailed Assessment will be part of a Greater Manchester updated dispersion modelling exercise to be undertaken by the Greater Manchester Transportation Unit (GMTU) on behalf of the City Council in 2010. The dispersion modelling exercise will be complemented by additional monitoring for NO_2 at relevant locations near to the train tracks using diffusion tubes.

Based on assumptions given in Technical Guidance LAQM.TG (09), the possibility of potential exceedences of the 15-minute sulphur dioxide air quality objective has been identified around the platforms of Manchester Piccadilly and Manchester Victoria train stations, due to idling stationary diesel locomotives. This is a new situation in Manchester, and not one that has been found in previous rounds of review and assessment, despite being investigated. However, Manchester City Council proposes not to proceed to a Detailed Assessment for sulphur dioxide at these locations at this stage. As an alternative, it is intended that engagement and consultation with relevant stakeholders will take place in order to pursue a relatively swift resolution to the problem of idling stationary diesel locomotives. It can be argued that this course of action represents a more precautionary approach to local air quality management, rather than waiting until potential exceedences are investigated further.

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Appendices

1 Introduction

1.1 Description of Local Authority Area

The city of Manchester is located in the North West of England, and is one of 10 local authorities that form the metropolitan county of Greater Manchester, which was established in 1974. Greater Manchester is a major conurbation that has a population of almost 2.5 million. The Manchester City Council area covers an area of 116 Km^2 and has a 2007 mid year population estimate of 458,136. It is the most densely populated of the ten Greater Manchester districts at 39.6 persons per hectare.

Much of the area is urban or suburban. Major road routes include the M60 orbital motorway in the North and South of the City Council area, and the M56 motorway in the South of the city. Manchester airport is located to the south of the city, and is the third busiest airport in the country.

The Greater Manchester Authorities have worked closely with the Greater Manchester Transportation Unit (GMTU) to annually update the Emissions Inventory for Greater Manchester (EMIGMA) database, which contains information on the emissions of pollutants identified in the UK's Air Quality Strategy from all identifiable sources.

Table 1 highlights the most significant sources of local air quality management (LAQM) pollutants in Manchester, as indicated by the 2005 update of the EMIGMA database.

Table 1 Most significant sources of LAQM pollutants in Manchester

LAQM Pollutant	Most significant sources in Manchester and % contribution to total emissions
Oxides of nitrogen (NO_X)	1. Road transport (53%) 2. Combustion (24%) 3. Air travel (12.4%)
PM_{10} fraction particulate matter (PM_{10})	1. Road transport (60%) 2. Combustion (21%) 3. Boilers >2MW (6%)
Sulphur dioxide (SO_2)	1. Combustion (37%) 2. Boilers >2MW (25%) 3. Other (17%)
Benzene	1. Road transport (46%) 2. Combustion (24%) 3. Rail (18%)
Carbon monoxide (CO)	1. Road transport (80%) 2. Air travel (15%) 3. Combustion (3%)
Lead	1. Part B regulated industrial processes (87%) 2. Boilers >2MW (13%)
1,3 Butadiene	1. Road transport (77%) 2. Rail (23%) 3. Bus stations (0.4%)

1.2 Purpose of Report

This report fulfils the requirements of the Local Air Quality Management (LAQM) process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where exceedences are considered likely, the local authority must then declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives.

1.3 Air Quality Objectives

The air quality objectives applicable to LAQM **in England** are set out in the Air Quality (England) Regulations 2000 (SI 928), The Air Quality (England) (Amendment) Regulations 2002 (SI 3043), and are shown in Table 2. This table shows the objectives in units of micrograms per cubic metre $\mu g/m^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Table 2 Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene			
	16.25 $\mu g/m^3$	Running annual mean	31.12.2003
	5.00 $\mu g/m^3$	Annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g/m^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu g/m^3$	Annual mean	31.12.2004
	0.25 $\mu g/m^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g/m^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g/m^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

1.4 Summary of Previous Review and Assessments

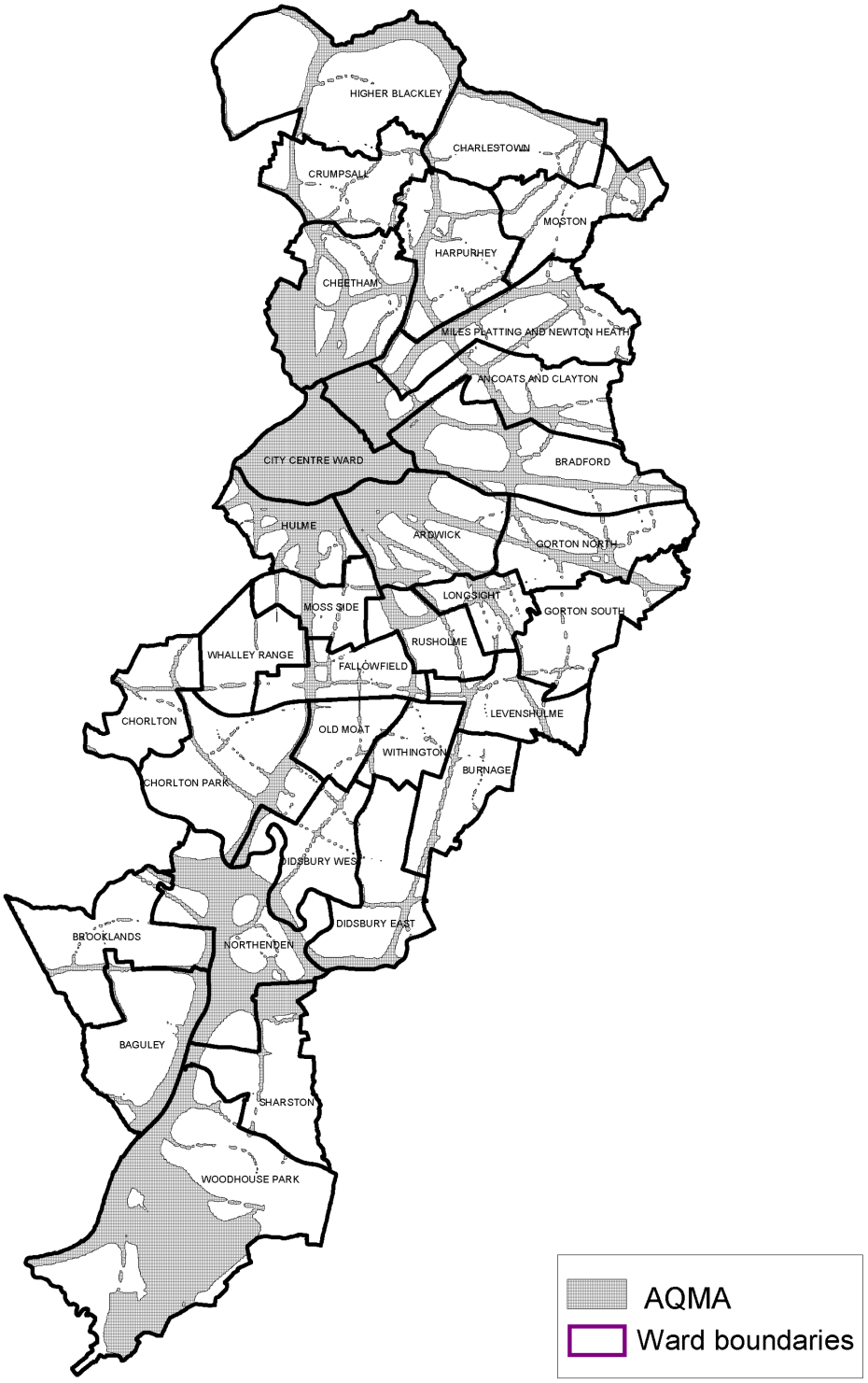
Table 3 outlines the conclusions of previous rounds of local air quality management review and assessment completed by Manchester City Council.

Table 3 Summary of previous rounds of review and assessment completed by Manchester City Council

Previous round of review and assessment	Date completed	Brief outcome of review and assessment
Stage 1 and 2	September 1999	Detailed Assessment of exceedences of the annual NO_2 and 24-hour PM_{10} air quality objectives required.
Stage 3	June 2000	Proposed declaration of air quality management area (AQMA) for the annual NO_2 objective, and to a lesser extent the 24-hour PM_{10} objective along busy roads, the city centre and the area surrounding Manchester airport. An AQMA was declared in July 2001.
Stage 4	July 2002	Stage 3 findings of June 2000 confirmed.
Phase 2 Updating and Screening Assessment	June 2003	Exceedences of NO_2 and PM_{10} objectives predicted. Detailed Assessment of exceedences of the annual NO_2 and 24-hour PM_{10} air quality objectives required.
Phase 2 Detailed Assessment	March 2004	Likely exceedences of only the annual NO_2 objective were predicted, therefore it was proposed that the boundaries of the AQMA were reviewed. An amendment to the AQMA was agreed by committee in July 2005. The AQMA was amended by variation order in November 2007 to include busy roads, the city centre and the area surrounding Manchester airport.
Progress report	July 2005	NO_2 annual objectives continue to be exceeded at certain locations.
Stage 4 Review and Assessment	July 2006	Findings of the Phase 2 Detailed Assessment of March 2004 confirmed.
Third round Updating and Screening Assessment	July 2006	NO_2 annual objectives continue to be exceeded at certain locations, but no new exposures were identified.
Progress report	July 2007	Possible exceedences of the hourly NO_2 objective identified within the AQMA along certain busy roads in the city centre, therefore more Detailed Assessment of NO_2 required.
Progress report	July 2008	Possible exceedences of the hourly NO_2 objective identified within the AQMA along certain busy roads in the city centre, therefore more Detailed Assessment of NO_2 required.

Previous rounds of review and assessment have predicted or identified exceedences of the annual NO_2 objective and the 24-hour PM_{10} objective. The most recent AQMA was officially amended in 2007 to reflect exceedences of the annual NO_2 objective only. The current AQMA is shown in Figure 1.

Figure 1 Manchester AQMA based on likely exceedences of the nitrogen dioxide annual mean air quality objective



The current AQMA shows that the areas that may exceed the annual nitrogen dioxide objective are primarily in the City Centre, the arterial traffic routes around the city and in the south of the city adjacent to the M56 motorway reflecting activity associated with Manchester Airport.

2 New Monitoring Data

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

Manchester City Council currently operates 2 automatic air quality monitoring sites (Piccadilly Gardens and Manchester South), which are detailed in Table 4. The distance indicated to any relevant exposure is the nearest distance measured using Arcview GIS to the nearest relevant exposure as determined by the averaging periods of the air quality objectives (either annual or hourly).

Table 4 Details of Automatic Monitoring Sites

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	In AQMA ?	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Worst-case Location?
Piccadilly Gardens	Urban Centre	X 384310 Y 398337	NO_X PM_{10} O_3 CO SO_2 Benzene	Y	Y (1m) for short term objectives	56m (Piccadilly)	N/A
Manchester South	Suburban	X 383904 Y 385818	NO_X O_3 SO_2	N	N (102m)	64m (Styal Road)	N/A

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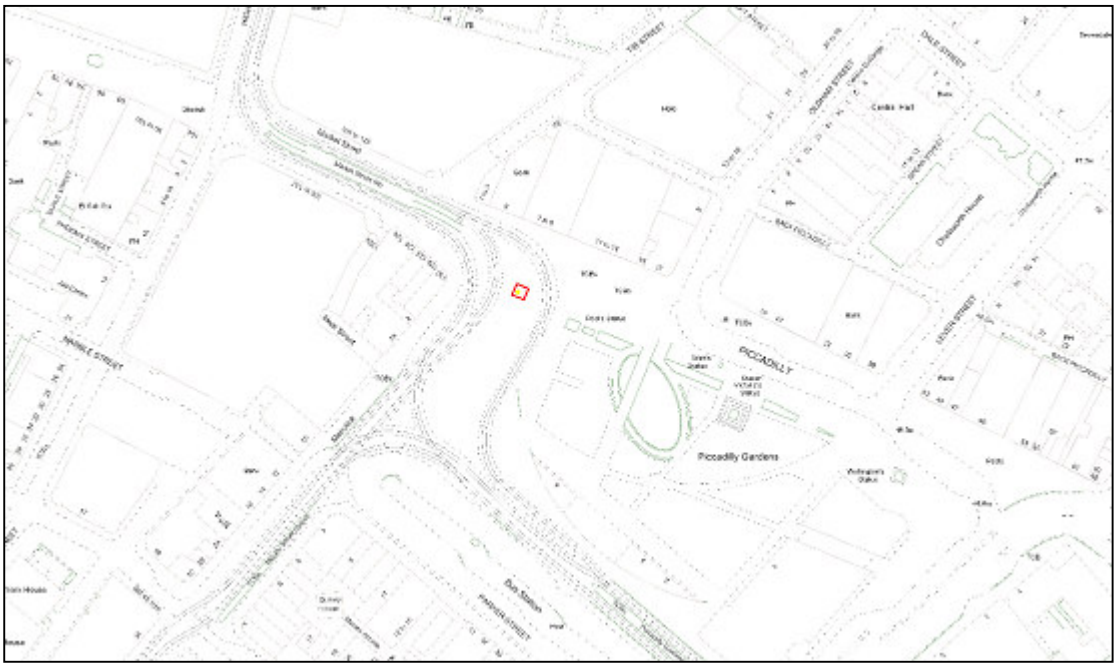
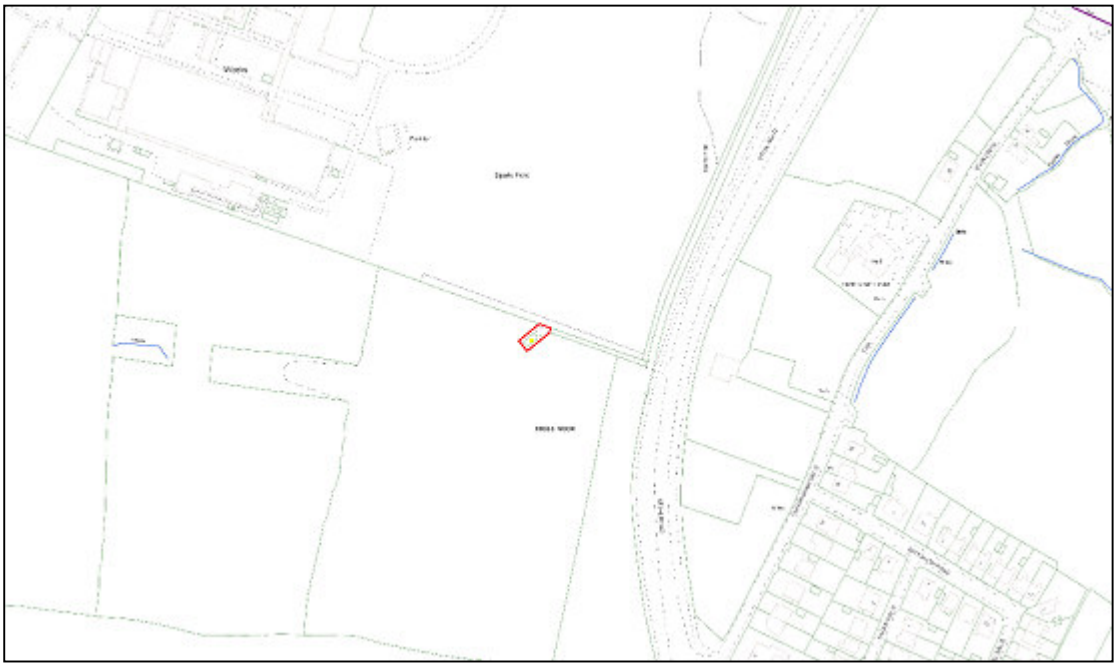
Location maps of automatic monitoring sites

1. Piccadilly Gardens



2. Manchester South



Quality assurance details of automatic monitoring site data can be found in Appendix A.

Recent changes in Manchester automatic monitoring sites

There was formerly an automatic air quality monitoring station located at Manchester Town Hall, which was part of the AURN. However, this monitoring station closed in October 2007 after a decision was made by DEFRA to restructure the national monitoring network.

2.1.2 Non-Automatic Monitoring

Manchester City Council operates 26 non-automatic monitoring sites, which are detailed in Table 5. The distance indicated to any relevant exposure is the nearest distance measured using Arcview GIS to the nearest relevant exposure as determined by the averaging periods of the air quality objectives (either annual or hourly).

Table 5 Details of Non- Automatic Monitoring Sites

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	In AQMA?	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Worst-case Location ?
Ashton Old Road	Kerbside	X 387951 Y 397430	NO_2	Y	Y (22m) for NO_2 objectives	1m (Ashton Old Rd)	Y
Burnage Community Centre	Urban Background	X 386780 Y 392651	NO_2	N	Y (4m) for NO_2 objectives	37m (Burnage Lane)	N/A
Cheetham Hill Road	Kerbside	X 383948 Y 401515	NO_2 Benzene	Y	Y (1m)	1m (Cheetham Hill Rd)	Y
Chethams School	Urban Centre	X 383971 Y 398876	NO_2	Y	Y (5m) for NO_2 objectives	59m (Station Approach)	N
Clayton Day Nursery	Urban Background	X 387656 Y 399016	NO_2	N	Y (9m) for NO_2 objectives	7m (Pioneer St)	N/A
Clayton Lane	Urban Background	X 387724 Y 397967	NO_2	Y	N (90m)	1m (Clayton Lane)	N/A
Great Ancoats Street	Roadside	X 385161 Y 398290	NO_2	Y	Y (10m) for hourly NO_2 objective	2m (Great Ancoats St)	Y
Hyde Road	Roadside	X 388602 Y 396043	NO_2	Y	Y (1m) for hourly NO_2 objective	2m (Hyde Road)	Y
Kingsway	Roadside	X 385399 Y 390093	NO_2	Y	Y (7m) for NO_2 objectives	6m (Kingsway)	N
Liverpool Road	Urban Centre	X 383218 Y 397770	NO_2	Y	Y (12m) for NO_2 objectives	1m (Liverpool Rd)	N
Lockton Close	Urban Background	X 384761 Y 397384	NO_2	Y	Y (7m) for NO_2 objectives	46m (Mancunian Way)	N/A
M56	Roadside	X 381650 Y 387520	NO_2 TSP[1]	Y	N (78m)	2m (M56 hard shoulder)	Y
Manchester South	Suburban	X 383904 Y 385818	NO_2 PM_{10} TSP[1]	N	N (102m)	64m (Styal Rd)	N/A
Newton Street	Kerbside	X 384601 Y 398303	NO_2	Y	Y (1m) for hourly objective	1m (Newton St)	Y
Oldham Road	Kerbside	X 386459 Y 400090	NO_2	Y	N (103m)	1m (Oldham Rd)	N
Oxford Street	Kerbside	X 384117 Y 397505	NO_2	Y	Y (2m) for NO_2 objectives	1m (Oxford St)	Y
Piccadilly Gardens	Urban Centre	X 384310 Y 398337	NO_2 Benzene Lead TSP[1] Black smoke	Y	Y (5m) for hourly objective	56m (Piccadilly)	N
Princess Parade Service Station	Urban industrial/ roadside	X 383906 Y 393927	Benzene	Y	N (30m)	17m (Princess Road)	Y
Princess Road	Roadside	X 382829 Y 391493	NO_2 Benzene	Y	Y (10m) for annual and hourly objectives	3m (Princess Rd)	Y
Princess Street	Kerbside	X 383954 Y 398060	NO_2	Y	Y (18m) for NO_2 objectives	1m (Princes St)	Y
Rochdale Road	Kerbside	X 385205 Y 399750	NO_2	Y	Y (7m) for NO_2 objectives	1m (Rochdale Rd)	N
Rusholme Clinic	Roadside	X 384894 Y 396075	TSP[1]	Y	Y (5m) for NO_2 objectives	15m (Oxford Rd)	Y
St Pauls School	Urban Background	X 381386 Y 387480	NO_2	Y	Y (10m) for NO_2 objectives	2m (Firbank Road)	N/A
Stockport Road	Kerbside	X 387363 Y 394617	NO_2	Y	Y (1m) for hourly objective	1m (Stockport Rd)	Y
Styal	Suburban	X 384200 Y 382958	NO_2 Acid rain	N	N (75m)	80m (Styal Rd)	N/A
Manchester Town Hall	Urban Background	X 383860 Y 398025	NO_2 Acid rain	Y	N (45m)	35m (Mount St)	N/A

[1] TSP = Total suspended particulates using a M-type sampler

For some sites (e.g. Oldham Road and Clayton Lane), it may appear as though the monitoring site is not representative of relevant exposure of the pollutant objectives (because the distance quoted to the nearest relevant exposure is significant). However, relevant exposure does exist along other sections of the road and therefore this distance may be misleading because the monitoring site may be representative of concentrations experienced at these locations. Location maps and photographs of all monitoring sites can be found in Appendix C.

QA/QC details for diffusion tube monitoring can be found in Appendix A.

2.2 Comparison of Monitoring Results with AQ Objectives

A comparison of monitoring results for local air quality management pollutants against the relevant air quality objectives is presented in the following sections of the report. Automatic and non-automatic data for each pollutant (where this exists) is presented separately. Any monitoring results that identify exceedences of the air quality objectives are highlighted.

2.2.1 Nitrogen Dioxide

Nitrogen dioxide is a gaseous pollutant, which can act as a respiratory irritant.

Both nitrogen dioxide (NO_2) and nitric oxide (NO) are emitted as waste products of combustion processes, (the burning of fossil fuels) and are collectively known as NO_X. NO is oxidised by ozone to form nitrogen dioxide. Motor vehicle exhaust gases are the principal source of NO_X emissions in the UK, and in Manchester make up 53% of the total emissions. The other most significant sources of NO_X in Manchester are from commercial and domestic combustion (for heating etc), rail and air transport.

Automatic Monitoring Data

Automatic nitrogen dioxide monitoring data is presented for 3 sites in Manchester. These sites are located at Manchester Town Hall (an urban background site - now closed), Piccadilly Gardens in the city centre (an urban centre site, representative of a busy city centre location close to heavily trafficked roads) and Manchester South (a suburban location near Manchester Airport).

Summaries of the last 3 years of nitrogen dioxide automatic monitoring data are presented in Table 6. Where the proportion of the year with valid data has been below 90%, the 99.8th percentile concentration figure has been presented.

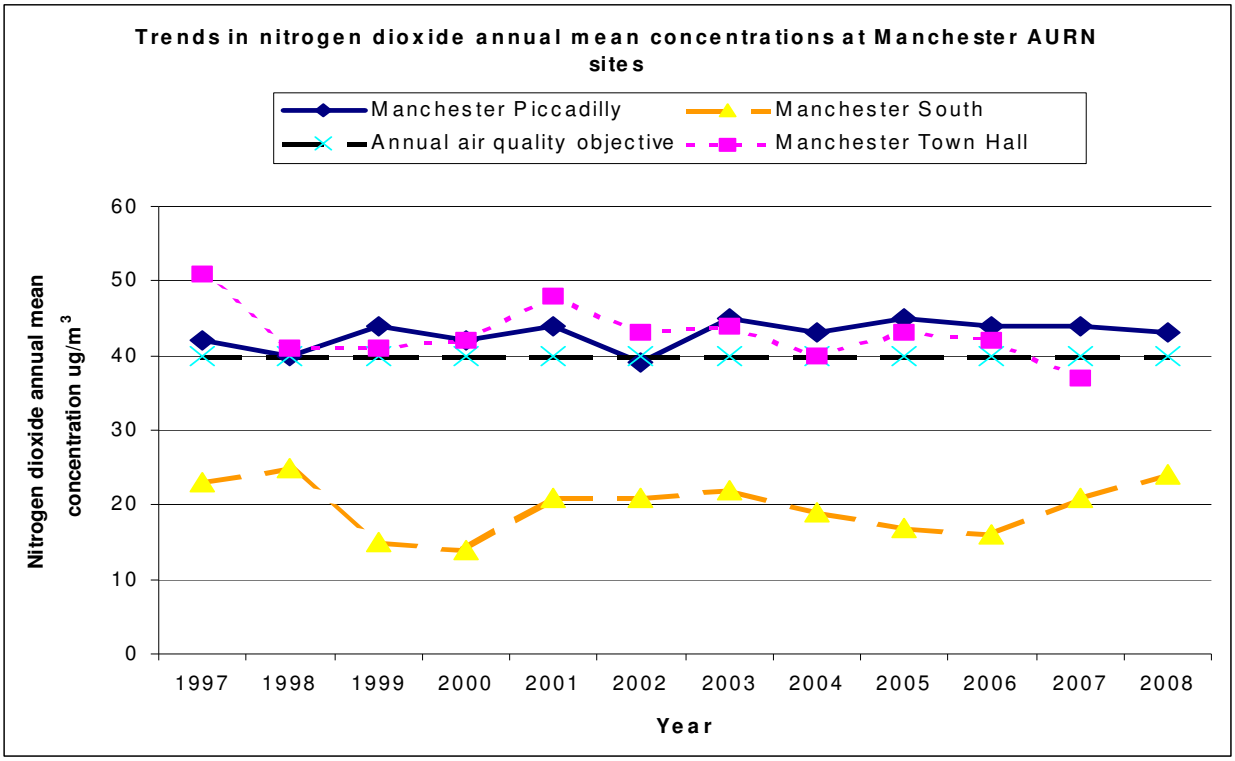
Table 6 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean and 1-hour Mean Objectives

Piccadilly Gardens - Urban Centre site located in the AQMA					
Year	Annual mean NO_2 concentration (ug/m^3)	Maximum hourly NO_2 concentration (ug/m^3)	Number of exceedences of hourly mean ($200ug/m^3$)	99.8^{th} Percentile of hourly means concentration (ug/m^3)	Proportion of year with valid data %
2006	**44**	273	2	-	97%
2007	**44**	189	0	-	96%
2008	**43**	288	12	190	78%
Manchester South - Suburban site located outside the AQMA					
Year	Annual mean NO_2 concentration (ug/m^3)	Maximum hourly NO_2 concentration (ug/m^3)	Number of exceedences of hourly mean ($200ug/m^3$)	99.8^{th} Percentile of hourly means concentration (ug/m^3)	Proportion of year with valid data %
2006	16	128	0	86	88%
2007	19	120	0	82	86%
2008	24	132	0	-	92%
Manchester Town Hall - Urban Background site located in the AQMA					
Year	Annual mean NO_2 concentration (ug/m^3)	Maximum hourly NO_2 concentration (ug/m^3)	Number of exceedences of hourly mean ($200ug/m^3$)	99.8^{th} Percentile of hourly means concentration (ug/m^3)	Proportion of year with valid data %
2006	**42**	229	3	130	87%
2007	37	145	0	120	72%
2008	N/A	N/A	N/A	N/A	N/A

The results of the automatic monitoring for nitrogen dioxide show that there has not been an exceedence of the hourly objective at any of the monitoring sites. However, there have been exceedences of the annual objective at Manchester Piccadilly and Town Hall monitoring sites, which are located in the AQMA. The Manchester Town Hall site closed in October 2007 due to changes made by DEFRA to the national AURN network, hence the relatively low data capture for 2007. The results are in agreement with the location of the current AQMA.

Summaries of annual mean NO_2 concentrations from the automatic monitoring sites over the last 10 years are presented graphically in Figure 2.

Figure 2 Long-term trends in nitrogen dioxide monitoring at Manchester automatic sites



The graph demonstrates that there is considerable year-to-year variability in average annual nitrogen dioxide concentrations, reflecting changes in local emissions and also the significant influence of meteorological conditions. However, there does not appear to be a long-term trend in either increasing or decreasing annual average concentrations.

Diffusion Tube Monitoring Data

Diffusion tube data is presented for 24 nitrogen dioxide monitoring sites across the city. Diffusion tubes provide a picture of the spatial distribution of nitrogen dioxide across the city, as well as long-term trends at particular locations.

To improve the accuracy of the diffusion tubes, the City Council has co-located some tubes with automatic analysers, and has (in line with DEFRA technical guidance) adjusted the results of the diffusion tubes so that they match those obtained from the analysers. Details of the method used to correct the diffusion tubes results are provided in Appendix A.

The exact location of the diffusion tube site will have a significant impact on the concentration measured at the site. Specifically, the distance from the nearest emissions source (usually the distance to the nearest roads in the case of nitrogen dioxide) will affect the concentration.

Table 7 provides a summary of nitrogen dioxide diffusion tube monitoring data over the last 3 years. Exceedences of the nitrogen dioxide annual objective as measured by the diffusion tubes (> 40 ug/m^3) are highlighted in bold.

A full data set of uncorrected 2008 monthly mean values can be found in Appendix A.

Table 7 Results of Nitrogen Dioxide Diffusion Tubes

Monitoring site name	Site type	Within AQMA?	Annual mean NO_2 concentrations ($\mu g/m^3$) Adjusted for bias* *Data capture for the year is included in brackets*		
			2006	2007	2008
Ashton Old Road	Kerbside	Y	**40** (100%)	**41** (92%)	**46** (83%)
Cheetham Hill Road	Kerbside	Y	**50** (100%)	**56** (100%)	**54** (92%)
Hyde Road	Kerbside	Y	-	-	**51** (92%)
Oldham Road	Kerbside	Y	**53** (100%)	**54** (92%)	**49** (100%)
Oxford Street	Kerbside	Y	**88** (100%)	**81** (100%)	**79** (83%)
Newton Street	Kerbside	Y	**88** (98%)	**74** (100%)	**66** (100%)
Princess Street	Kerbside	Y	**79** (98%)	**74** (100%)	**62** (92%)
Rochdale Road	Kerbside	Y	**49** (100%)	**50** (92%)	**42** (92%)
Stockport Road	Kerbside	Y	-	-	**56** (100%)
Great Ancoats Street	Roadside	Y	-	-	**54** (100%)
Kingsway	Roadside	Y	-	-	**41** (92%)
M56	Roadside	Y	**74** (98%)	**65** (98%)	**56** (100%)
Princess Road	Roadside	Y	**44** (92%)	**48** (100%)	**45** (100%)
Chethams School	Urban Centre	Y	**57** (98%)	**48** (100%)	**44** (100%)
Liverpool Road	Urban Centre	Y	-	-	**51** (100%)
Piccadilly Gardens	Urban Centre	Y	**54** (98%)	**46** (100%)	**43** (100%)
Burnage	Urban Background	N	35 (98%)	34 (96%)	26 (75%)
Clayton Day Nursery	Urban Background	N	34 (98%)	32 (94%)	26 (92%)
Clayton Lane	Urban Background	Y	-	-	36 (100%)
Lockton Close	Urban Background	Y	-	-	**45** (100%)
St Pauls School	Urban Background	Y	**48** (98%)	**41** (98%)	35 (100%)
Town Hall	Urban Background	Y	**55** (98%)	**47** (96%)	**40** (92%)
Manchester South	Suburban	N	28 (100%)	30 (100%)	27 (100%)
Styal	Suburban	N	22 (98%)	22 (98%)	15 (100%)

* Bias factors: 2006 = 0.97, 2007 = 0.90 and 2008 = 0.83

Nitrogen dioxide diffusion tube monitoring results outside the AQMA

Table 2.4 shows that monitoring sites outside the AQMA did not measure exceedences of the NO_2 annual objective (i.e. measured annual mean nitrogen dioxide concentrations were below 40 ug/m^3). Therefore this is in agreement with the location of the current AQMA.

Nitrogen dioxide diffusion tube monitoring results within the AQMA

Monitoring sites within the AQMA generally measured exceedences of the annual objective for NO_2. Sites that have borderline exceedences (up to 42 ug/m^3) include Rochdale Road, Kingsway and Manchester Town Hall.

NO_2 concentrations at the nearest receptor were predicted for Rochdale Road, Kingsway and Princess Road for 2008 using the calculator tool developed by Air Quality Consultants, as described in Box 2.3 of Technical Guidance LAQM.TG (09). Local background NO_2 concentrations for 2008 were obtained from the UK National Air Quality Archive.

The results of the calculated predictions are shown in Table 8.

Table 8 2008 calculated predictions of NO_2 concentrations at the nearest receptor for selected roadside monitoring sites

Site name	OS grid reference	Distance from the monitoring site to the kerb (m)	Distance from the receptor to the kerb (m)	Local annual mean background NO_2 concentration (ug/m^3)	Measured annual mean NO_2 concentration (ug/m^3)	Predicted annual mean NO_2 concentration at the receptor (ug/m^3)
Rochdale Road	X 385205 Y 399750	1	8	28.44	42	36.3
Kingsway	X 385399 Y 390093	6	14	22.49	41	36.1
Princess Road	X 382829 Y 391493	3	13	20.57	45	35.7

Table 8 indicates that for 2008, predicted concentrations at receptor points were below the annual NO_2 objective where roadside monitoring sites experienced borderline exceedence concentrations. However, it should be noted that 2008 annual concentrations are marginally lower than for other recent years.

Several kerbside monitoring sites in the city centre (Oxford Street, Newton Street and Princess Street) measured annual concentrations greater than 60 ug/m^3. Technical Guidance LAQM.TG (09) indicates that exceedences of the 1-hour objective may occur at roadside sites if the annual mean is above this concentration. Of these sites, Newton Street and Oxford Street represent relevant exposure for the 1-hour nitrogen dioxide objective.

2.2.2 PM_{10}

Particulate matter refers to microscopic pieces of airborne dust, smoke and particles, which can be inhaled.

A worsening of pre-existing heart and lung conditions may be observed when people are exposed to high concentrations of particulate matter. Other health effects can arise depending upon the exact chemical nature of the particles.

The health effects related to the inhalation of particles are strongly dependent upon the size of the particles involved. Small particles are able to penetrate further into the lungs and so cause more serious health effects, compared to large particles that are unable to penetrate the nose and mouth. Airborne particulate matter smaller than 10 microns in diameter (PM_{10}), are thought to be responsible for the worst health effects though more recent research has indicated that even smaller particles, such as $PM_{2.5}$ or PM_1 may be the particle sizes of most importance to human health.

Particulate matter is emitted by a very wide range of sources. Sea salt, soil erosion, pollen, and fungal spores are all natural sources of airborne particles. Particles are also produced by human activities. In Manchester, the most significant source of PM_{10} particulate matter is road transport, which makes up 52% of the total emissions. The other most significant sources are industrial processes, commercial boilers and commercial and domestic combustion. Other sources include construction and demolition sites.

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Particulate matter is measured in Manchester using 3 different types of monitoring equipment:

1. TEOM/ FDMS (Tapered Element Oscillating Microbalance with Filter Dynamics Measurement System) analyser - provides real time hourly PM_{10} gravimetric equivalent data, equivalent to standard reference method BS EN 12341:1999.

2. Partisol sampler - Provides daily measurements of PM_{10} particulate matter in accordance with standard reference method BS EN 12341:1999.

3. 'M-type' sampler - Provides weekly measurements of particulate matter. The sampling system is not in fact 'size selective' but previous studies have shown that the size range of the majority of airborne particulate using this method at Piccadilly Gardens is typically below 13.5 microns aerodynamic diameter. Therefore, although the system is not strictly monitoring the PM_{10} or $PM_{2.5}$ fraction of particulate matter, the results are interpreted as an indication of the airborne inhalable particulates, the majority of which are below 10 microns in diameter. This corresponds to the typical size range of particulate material that penetrates into the lower reaches of the lung.

Automatic Monitoring Data

TEOM/ FDMS monitoring data

Automatic monitoring of PM_{10} has been carried out in Manchester since 1996 using a TEOM (Tapered Element Oscillating Microbalance) analyser. TEOM analysers have been shown to under measure the concentration under certain conditions. To compensate for this, DEFRA recommended that results obtained from TEOM analysers are multiplied by a factor of 1.3 to produce 'gravimetric equivalent' results. In early 2007, the TEOM at Manchester Piccadilly was fitted with a Filter Dynamics Measurement System (FDMS) unit to overcome the potential measurement inaccuracies through the loss of volatile particulate matter. The results for the last 3 years from the instrument are shown in Table 9. Where the proportion of the year with valid data has been below 90%, the 90th percentile concentration figure has been presented.

Table 9 Results of PM_{10} Automatic Monitoring: Comparison with Annual Mean and 24-hour Mean Objectives

Piccadilly Gardens - Urban Centre site located in the AQMA					
Year	Annual mean PM_{10} concentration (ug/m^3)	Maximum 24-hour mean PM_{10} concentration (ug/m^3)	Number of 24-hour averages exceeding 50 ug/m^3	90th Percentile of hourly means concentration (ug/m^3)	Proportion of year with valid data %
2006	26.3	69.0	15	-	96%
2007	24.4	204.1	21	-	98%
2008	19.8	84.9	9	-	99%

Non-automatic Monitoring Data

Partisol sampler monitoring data

PM_{10} particulate matter has been measured at 2 sites in Manchester (Manchester Piccadilly and Manchester South) using a Partisol gravimetric sampler, which is capable of size selective measurements of the particles in the atmosphere. The results for the last 3 years from both sites are shown in Table 10. The number of PM_{10} 24-hour exceedences of 50 ug/m^3 has also been presented, as well as the 90th percentile concentration figure.

Table 10 Results of Partisol PM_{10} Non-automatic Monitoring: Comparison with Annual Mean and 24-hour Mean Objectives

Manchester South - Suburban site located outside the AQMA				
Year	Annual mean PM_{10} concentration (ug/m^3)	Number of 24-hour exceedences of 50 ug/m^3	PM_{10} 90th Percentile	Proportion of year with valid data %
2006	25.6	12	40.8	90%
2007	25.6	17	39.4	93%
2008	23.5	17	38.0	98%
Piccadilly Gardens - Urban Centre site located within the AQMA				
Year	Annual mean PM_{10} concentration (ug/m^3)	Number of 24-hour exceedences of 50 ug/m^3	PM_{10} 90th Percentile	Proportion of year with valid data %
2006	32.0	40	51.7	96%
2007	31.6	21	45.0	74%
2008	N/A	N/A	N/A	N/A

Following DEFRA changes to the AURN network, the PM_{10} Partisol sampler at Manchester Piccadilly discontinued operation in October 2007, hence the relatively low data capture for this year.

M-type sampler monitoring data

Total suspended particulate mater is currently measured at 4 sites in Manchester (Manchester Piccadilly, Manchester South, M56 and Rusholme Clinic) using an M-type sampler. Although these simple samplers cannot collect size specific particles as well as the TEOM/FDMS or Partisol sampler systems, they provide a cost effective method of weekly measurements that can be used at a number of locations to provide the spatial distribution of particles at locations across the city. To improve the accuracy of the M-type sampler results, a sampler has been co-located with the Manchester Piccadilly TEOM/ FDMS. A correction factor has been derived to allow the results from the 'M' type unit to be expressed as a PM_{10} equivalent. Detail of the correction factor applied can be found in Appendix A.

The results from the 'M-type' sampler network for the last 3 years are shown in Table 11.

Table 11 Results of M-type Particulate Non-automatic Monitoring: Comparison with Annual Mean Objective

Year	Piccadilly Gardens - Urban Centre site located within the AQMA			Manchester South - Suburban site located outside the AQMA		
	Annual Mean total suspended particulate concentration (ug/m^3)	Annual mean PM_{10} equiv (ug/m^3)	Proportion of year with valid data %	Annual Mean total suspended particulate concentration (ug/m^3)	Annual mean PM_{10} equiv (ug/m^3)	Proportion of year with valid data %
2006	24.9	26.3	92%	16.0	16.9	90%
2007	22.3	24.4	98%	15.1	16.5	100%
2008	19.5	19.9	92%	15.9	16.3	87%
Year	M56 junction 4 - Roadside site located within the AQMA			Rusholme Clinic - Roadside site located within the AQMA		
	Annual Mean total suspended particulate concentration (ug/m^3)	Annual mean PM_{10} equiv (ug/m^3)	Proportion of year with valid data %	Annual Mean total suspended particulate concentration (ug/m^3)	Annual mean PM_{10} equiv (ug/m^3)	Proportion of year with valid data %
2006	32.0	33.7	92%	-	-	-
2007	24.2	26.5	90%	-	-	-
2008	27.8	28.4	90%	18.2	18.5	94%

PM_{10} monitoring results outside the AQMA

PM_{10} monitoring outside the AQMA indicates that both the annual and 24-hour objectives are met at the monitoring locations.

PM_{10} monitoring results within the AQMA

PM_{10} monitoring outside the AQMA also indicates that both the annual and 24-hour objectives are met at the monitoring locations. The Piccadilly Gardens monitoring site is an Urban Centre site and would be representative of air pollution concentrations experienced in the city centre. The Rusholme clinic site is a roadside site that would be represent relevant exposure for the annual and 24-hour objectives.

The number of PM_{10} 24-hour exceedences of 50 ug/m^3 were also estimated for each year using the relationship in figure 8.1 of DEFRA Technical Guidance note TG(03) for the M56 and Rusholme Clinic M-type monitoring sites. The results were 22 and 2 respectively, indicating no exceedences of the 24-hour objective. Because of its location, the M56 site should represent a 'worse case' scenario for PM_{10} monitoring, although it would not represent relevant exposure. Manchester City Council are currently in the process of installing an automatic monitoring site for NO_X and PM_{10} along Oxford Road near Manchester city centre, which should also be a worse case scenario location, but would represent relevant exposure.

2.2.3 Sulphur Dioxide

Sulphur dioxide is a gaseous pollutant, which acts as a respiratory irritant. Exposure to high concentrations of sulphur dioxide can lead to a worsening of pre-existing respiratory conditions. Sulphur dioxide is emitted when sulphur bearing fuels such as coal, wood, oil, and diesel are burned. The most significant source of sulphur dioxide emissions in the UK is the burning of coal in electricity generating power stations. Power stations account for approximately 71% of sulphur dioxide emissions in the UK. In Manchester, the most significant source of sulphur dioxide emissions is domestic/ commercial combustion (37%)

and industrial boilers (25%). Industrial processes and road vehicle emissions all also make a contribution to emissions.

Sulphur dioxide is currently measured at two automatic sites in Manchester (Piccadilly Gardens and Manchester South). The results for the last 3 years are shown in Table 12.

Table 12 Results of Sulphur Dioxide Automatic Monitoring: Comparison with 15 minute, 1-hour and 24-hour Objectives

Piccadilly Gardens - Urban Centre site located within the AQMA					
Year	Max 15 minute SO_2 concentration (ug/m^3)	Number of 15 minute periods over 266 ug/m^3	Max 1 hour SO_2 concentration (ug/m^3)	Max 24 hour SO_2 concentration (ug/m^3)	Proportion of year with valid data %
2006	80	0	58	29	94%
2007	51	0	29	10	93%
2008	85	0	51	16	97%
Manchester South - Suburban site located outside the AQMA					
Year	Max 15 minute SO_2 concentration (ug/m^3)	Number of 15 minute periods over 266 ug/m^3	Max 1 hour SO_2 concentration (ug/m^3)	Max 24 hour SO_2 concentration (ug/m^3)	Proportion of year with valid data %
2006	67	0	59	13	95%
2007	56	0	51	10	96%
2008	56	0	51	15	98%

The results indicate that there have been no exceedences of any of the sulphur dioxide air quality objectives at the monitoring sites. Piccadilly Gardens is an Urban Centre site representative of locations exposed to high concentrations. Manchester South is a suburban location near Manchester Airport, which is representative of background locations away from any major sources of emissions.

2.2.4 Benzene

Benzene is a volatile organic compound, which has been shown to have carcinogenic effects.

Benzene is a constituent of petrol, and emissions from petrol stations, refineries, and petrol engined vehicles account for the majority of benzene emissions in the UK. The petrochemical industry, and other organic chemical industries also make a contribution to benzene concentrations. In Manchester, the most significant sources of benzene are road transport (contributing to 46% of the total emissions) and combustion (contributing to 24% of the total emissions).

There are no major industrial installations in Manchester that have significant emissions of benzene, and the city is not thought to be generally at risk of suffering an exceedence of the air quality objective for benzene. Nonetheless, Manchester City Council monitor benzene levels across the city, to ensure that benzene concentrations do not approach the objective level.

Benzene is measured in Manchester using two types of monitoring apparatus. The Piccadilly Gardens AURN monitoring site includes a 'pumped benzene' monitor, which forms part of the national Non-automatic Hydrocarbon Network of air quality monitors. In addition to this

monitor, the City Council also operates a network of benzene diffusion tubes, which are used to identify the geographical distribution of benzene concentrations across the city.

Results from the last 3 years for the pumped benzene sampler at Manchester Piccadilly are shown in Table 13.

Table 13 Results of Pumped Benzene Monitoring: Comparison with Annual Objectives

Year	Piccadilly Gardens - Urban Centre site located within the AQMA	
	Annual mean benzene concentration (ug/m^3)	Proportion of year with valid data %
2006	1.02	100%
2007	1.00	100%
2008	0.78	100%

Results from the last 3 years for the network of benzene diffusion tubes across the city are shown in Table 14.

Table 14 Results of Benzene Diffusion Tube Monitoring: Comparison with Annual Objectives

Monitoring site name	Site type	Within AQMA?	Annual mean benzene concentrations ($\mu g/m^3$) Adjusted for bias* *Data capture for the year is included in brackets*		
			2006	2007	2008
Piccadilly Gardens	Urban Centre	Y	1.02 (92%)	1.00 (100%)	0.78 (92%)
Cheetham Hill Road	Kerbside	Y	1.00 (100%)	1.01 (92%)	1.35 (100%)
Princess Road	Roadside	Y	0.84 (92%)	1.07 (75%)	0.93 (100%)
Princess Parade Service Station	Urban Industrial/ Roadside	Y	-	-	11.94 (58%)

* Bias factors: 2006 = 0.91, 2007 = 1.52 and 2008 = 1.30

Benzene monitoring results outside the AQMA

There are no benzene monitoring sites located outside the AQMA in Manchester.

Benzene monitoring results within the AQMA

Results from the benzene monitoring sites located within the AQMA indicate that annual mean benzene concentrations have been consistently below the 2010 air quality objective value of 5.0 ug/m^3. The only exception is the annual mean concentration measured by the Princess Parade Service Station monitoring site. However, this is located next to the petrol pumps, where petrol vapours will effect the local concentration of benzene. Concentrations of benzene measured at this site are likely to be much higher than those experienced by any Manchester residents, and would not represent relevant exposure for the annual objective. The site is in operation to demonstrate the contrast between a worse case location and concentrations likely to be experienced by Manchester residents. Monitoring commenced at the site in mid 2008, hence the relatively low data capture (58%) for the year. The Princess Road and Cheetham Hill Road monitoring sites are roadside locations, representative of highest concentrations normally experienced by residents. The Piccadilly Gardens site is representative of city centre benzene concentrations.

2.2.5 Carbon Monoxide

Carbon monoxide is a gaseous pollutant, which is released when carbon based fuel (gas, oil, coal and petrol) is burned.

Emissions from motor vehicles are the biggest source of carbon monoxide in the UK. Outdoor concentrations of carbon monoxide are highest in places very close to major roads and motorways. In Manchester, the most significant source of carbon monoxide is also motor vehicles, which accounts for 80% of the total emissions.

Carbon monoxide has been measured in Manchester at two automatic monitoring sites (Piccadilly Gardens and Manchester Town Hall). The results for the last 3 years are shown in Table 15.

Table 15 Results of Automatic Carbon Monoxide Monitoring: Comparison with Running 8-hour Mean Objective

Year	Piccadilly Gardens - Urban Centre site located within the AQMA			Manchester Town Hall - Urban Background site located in the AQMA		
	Annual mean CO concentration mg/m^3	Max running 8-hour mean CO concentration mg/m^3	Proportion of year with valid data %	Annual mean CO concentration mg/m^3	Max running 8-hour mean CO concentration mg/m^3	Proportion of year with valid data %
2006	0.31	2.70	95%	0.42	1.50	39%
2007	0.31	2.40	96%	0.28	1.50	65%
2008	0.30	3.50	97%	-	-	-

The Manchester Town Hall site closed in October 2007 due to changes made by DEFRA to the national AURN network, hence the relatively low data capture for 2007.

The results show that there have been no exceedences of the carbon monoxide objective at the monitoring locations, which are urban sites representative of the city centre. Data capture for the Town Hall monitoring site has been below 90% for some years. However, concentrations of carbon monoxide have remained relatively constant since 2001.

2.2.6 Lead

Lead is a toxic heavy metal. The long-term exposure to low concentrations of lead has been shown to impair the mental development of young children. At present, the most significant sources of lead emissions in Manchester are industrial processes, which make up 85% of the total emissions, particularly those involved in battery manufacture and the manufacture of lead roofing and beading materials that may affect the locality in which they operate. The remaining 15% of the total lead emissions in Manchester arise from industrial boilers.

Lead in air is currently measured using a 'M-type' sampler at Piccadilly Gardens in Manchester, which is an urban centre location. Results from the monitoring site are shown in Table 16.

Table 16 Results of Lead Monitoring: Comparison with Annual Mean Objective

Year	Piccadilly Gardens - Urban Centre site located within the AQMA	
	Annual mean lead concentration (ug/m^3)	Proportion of year with valid data %
2006	0.02	100%
2007	0.03	100%
2008	0.02	91%

Monitoring results for lead indicate that both the 2004 and 2008 air quality objectives are currently achieved in Manchester. The Piccadilly Gardens monitoring site is representative of concentrations experienced in the city centre.

Manchester City Council has examined the results from monitoring in the district. Concentrations outside of the AQMA are all below the objectives at relevant locations, and therefore according to Technical Guidance LAQM.TG (09) there is no requirement to proceed to a Detailed Assessment on this basis.

3 Road Traffic Sources

The aim of the road traffic sources assessment is to identify locations where air quality objectives may be exceeded that have not previously been considered in previous rounds of review and assessment.

Traffic flow data has been provided by the Greater Manchester Transportation Unit (GMTU) for the purpose of this report. Where necessary, distance from the road centre to receptor locations was measured using Arcview GIS. Background pollutant data was obtained for 2008 using the national background maps available from the UK National Air Quality Archive website.

3.1 Narrow Congested Streets with Residential Properties Close to the Kerb

A requirement of the review and assessment is to identify narrow congested streets outside the current AQMA, where traffic is slow moving with stop/ start driving and there are buildings on either side that may reduce dispersion.

Technical Guidance LAQM.TG (09) recommends identifying these locations using the following criteria:

- A daily traffic flow (AADT) of around 5,000 vehicles per day or more; and
- Slow moving traffic that is frequently stopping and starting, with an average speed of less than 25 kilometres per hour (kph); and
- Residential properties within 2 metres of the kerb, and buildings on both sides of the road.

If there are any roads meeting these criteria, it is necessary to proceed to a Detailed Assessment for nitrogen dioxide.

Data was provided by GMTU to identify roads with two-way 2008 AADT flows that were greater than 5,000 vehicles per day and had speeds that were less than 25 kph. In Manchester, 11 roads were found to meet these criteria that are outside the current AQMA.

These roads were viewed using Arcview GIS to determine the distance from the kerb to the facade of the nearest residential property and if there were buildings on both sides of the road. Local knowledge was also applied to identify narrow congested streets from those which met the flow and speed criteria. The results are shown in Table 17.

Table 17 Results of Assessment of Narrow Congested Streets with Residential Properties Close to the Kerb

Road/ Street identified meeting flow and speed criteria (> 5,000 AADT and < 25 kph outside the AQMA)	Distance from kerb to facade of nearest residential property (metres)	Buildings on both side of the road?	Detailed Assessment required for NO_2 at this location?
Smedley Lane, Cheetham	8	No	No
Wenlock Way, West Gorton	6	Not continuously along the road	No
Devonshire Street South, Ardwick	7	Not continuously along the road	No
Old Birley Street, Hulme	7	No	No
Highbank, Audenshawe	2	No	No
Birch Hall Lane, Longsight	8	Not continuously along the road	No
Mauldeth Road, Withington	9	Yes	No
Hall Lane, Wythenshawe	9	No	No
Hollyhedge Road, Wythenshawe	8	No	No
Cross Acres Road, Benchill	23	No	No
Simonsway, Wythenshawe	36	No	No

As shown by Table 17, there are no roads that meet the flow and speed criteria outside the AQMA that have residential properties within 2 metres of the kerb and also have buildings on both sides of the road.

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

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

The review and assessment process requires the identification of busy streets where individuals may regularly spend 1 hour or more close to traffic, to investigate the likelihood of exceedences of the hourly nitrogen dioxide objective.

Technical Guidance LAQM.TG (09) recommends identifying these locations using the following criteria:

- Many shops/ outdoor cafe bars, or other street locations where individuals may regularly spend 1-hour or more e.g. residential locations; and
- Relevant exposure within 5 metres of the kerb; and
- A daily traffic flow (AADT) of greater than 10,000 vehicles per day.

If these areas were considered in previous rounds of review and assessment, there is no need for further work. If newly identified locations meeting these criteria have a predicted annual mean NO_2 concentration of 60 ug/m^3 or more and there is no existing AQMA, it is necessary to proceed to a Detailed Assessment for nitrogen dioxide.

Busy streets where people may spend 1 hour or more were specifically considered in previous rounds of review and assessment. However, as a precautionary approach, data was obtained from GMTU to identify roads with two-way 2008 AADT flows that were greater than 10,000 vehicles per day that are outside the current AQMA. In Manchester, 44 roads were found to meet this criterion. These locations were viewed using Arcview GIS and local knowledge was applied to determine if they were locations where there were many shops/ outdoor cafe bars where individuals could potentially spend 1 hour or more within 5 metres of the kerb. Because the hourly mean objective for NO2 also applies at locations where the annual objective would apply, building facades of residential properties have also been considered. The result of the assessment is shown in Table 18.

Data was also provided by GMTU to identify roads with two-way 2008 AADT flows that were greater than 10,000 vehicles per day within the 60 ug/m^3 contour for annual NO_2 concentrations identified by previous detailed dispersion modelling work. Streets within this concentration contour may experience exceedences of the 1-hour objective for NO_2. In Manchester, 13 roads were found to meet this criterion. These locations were assessed using Arcview GIS and local knowledge to determine if they were locations where there were many shops/ outdoor cafe bars where individuals could potentially spend 1 hour or more within 5 metres of the kerb. The result of the assessment is shown in Table 19.

Table 18 Results of assessment of roads with > 10,000 AADT outside the current AQMA

Street name and location	Brief description of street environment	Likely street location where people could spend > 1 hour?	Distance from the kerb to relevant exposure (metres)	DMRB assessment required?
Victoria Avenue, Blackley	Predominantly residential properties	No	N/A	No
Crumpsall Lane, Crumpsall	Predominantly residential properties	No	N/A	No
Factory Lane, Harpurhey	Predominantly residential properties	No	N/A	No
Church Lane, Lightbowne	Predominantly residential properties	No	N/A	No
Northampton Rd, Harpurhey	Open area and school fields	No	25	No
Abbey Hey Lane, Gorton	Predominantly residential properties	No	N/A	No
Greenheys Lane West, Hulme	Superstore car park	Yes	5	**Yes**
Mount Rd, Gorton	Predominantly residential properties	No	N/A	No
Mount Rd, Gorton (2)	School fields	No	7	No
Moss Lane East, Hulme	Predominantly residential/ community properties	No	N/A	No
Broadfield Rd, Hulme	Predominantly residential properties and recreation ground	No	25 m to recreation ground	No
Upper Lloyd St, Hulme	Predominantly residential properties	No	N/A	No
Northmoor Rd, Longsight	Predominantly residential properties	No	N/A	No
Reddish Lane, Gorton	Predominantly residential properties	No	N/A	No
Manchester Rd, Chorlton	Predominantly residential properties	No	N/A	No
Kensington Rd, Chorlton	Predominantly residential properties	No	N/A	No

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Table 18 Continued

Street name and location	Many shops/ outdoor cafes and bars?	Likely street location where people could spend > 1 hour?	Distance from the kerb to relevant exposure (metres)	DMRB assessment required?
St Werburghs Rd, Chorlton	Predominantly residential properties	No	N/A	No
Wilbraham Rd, Whalley Range	Predominantly residential properties	No	N/A	No
Wilbraham Rd, Fallowfield	Predominantly residential properties	No	N/A	No
Alexandra Rd South, Fallowfield	Predominantly residential properties	No	N/A	No
Mauldeth Rd West, Old Moat	Predominantly residential/ community properties	No	N/A	No
Albert St, Levenshulme	Predominantly residential properties	No	N/A	No
Ladybarn Lane, Withington	Predominantly residential properties	No	N/A	No
Nell Lane, Chorlton	Predominantly residential properties	No	N/A	No
Burton Rd, West Didsbury	Some local shops and cafe bars	Yes	5	**Yes**
Parrs Wood Rd, Withington	Predominantly residential properties	No	N/A	No
Crossley Rd, Burnage	Public park	No	10 m to park	No
Barlow Moor Rd, Didsbury	Local shops	Yes	5	**Yes**
Lloyd St South, Fallowfield	Predominantly residential properties	No	N/A	No
Withington Rd, Whalley Range	Yes - local shops	Yes	3	**Yes**
Burnage Lane, Didsbury	Predominantly residential properties	No	N/A	No
Sale Rd, Northenden	Predominantly residential properties	No	N/A	No
Wythenshawe Rd, Brroklands	Predominantly residential properties	No	N/A	No
Brooklands Rd, Sale	Predominantly residential properties	No	N/A	No
Longley Lane, Northenden	Predominantly residential properties	No	N/A	No
Altrincham Rd, Brooklands	Predominantly residential properties	No	N/A	No
Hall Lane, Brooklands	Predominantly residential properties	No	N/A	No
Floatshall Rd, Baguley	Predominantly residential properties	No	N/A	No
Hollyhedge Rd, Baguley	Predominantly residential properties	No	N/A	No
Styal Rd, Cheadle	Predominantly residential properties	No	N/A	No
Simonsway, Woodhouse Park	Predominantly residential properties	No	N/A	No
Styal Rd, Woodhouse Park	Predominantly residential properties	No	N/A	No
Ringway Rd, Woodhouse Park	Predominantly residential properties	No	N/A	No
Wilmslow Rd, Woodhouse Park	Predominantly residential properties	No	N/A	No

Table 19 Results of assessment of roads with > 10,000 AADT within the 60 ug/m^3 contour for annual NO_2 concentrations

Street name and location	Many shops/ outdoor cafes and bars?	Likely street location where people could spend > 1 hour?	Distance from the kerb to relevant exposure (metres)	DMRB assessment required?
M60 motorway, Blackley	No	No	N/A	No
Rochdale Rd, Charlestown	No	No	N/A	No
Greengate, Moston	No	No	N/A	No
Mancunian Way, city	No	No	N/A	No
Mancunian Way, Hulme	No	No	N/A	No
Mancunian Way, Ardwick	No	No	N/A	No
Barlow Moor Rd, Barlow Moor	No	No	N/A	No
Princess Rd, Barlow Moor	No	No	N/A	No
M60 motorway, Northenden	No	No	N/A	No
Princess Parkway, Northenden	No	No	N/A	No
Princess Parkway, Northenden (2)	No	No	N/A	No
M56 motorway, Sharston	No	No	N/A	No
M56 motorway, Baguley	No	No	N/A	No

As shown by Tables 18 and 19, there are 4 roads that have traffic flows exceeding 10,000 vehicles per day that are outside the current AQMA where there is potentially relevant exposure of 1- hour or more close to traffic.

These 4 roads were subject to an air quality dispersion assessment using the latest version of the DMRB screening model (Version 1.03c - July 2007). The results of the assessment are shown in Appendix B.

The results table in Appendix B for busy streets where people may spend 1-hour or more close to traffic shows that all locations assessed have predicted annual mean concentrations of less than 60 ug/m^3, and therefore are unlikely to exceed the hourly objective for NO_2.

However, several of these locations have predicted annual mean concentrations close to or exceeding 36 ug/m^3, which would put them 'at risk' of exceeding the annual NO_2 objective. One of these locations (108 Withington Road) includes residential accommodation and is outside the current AQMA.

Manchester City Council has assessed new/newly identified busy streets where people may spend 1 hour or more close to traffic, that were not assessed in previous rounds of Review and Assessment. There are no locations where the annual mean NO_2 concentration is predicted to exceed 60 ug/m^3.

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

Streets that have a high proportion of buses and/ or heavy goods vehicles (HGVs) are required to be identified as part of the review and assessment process, for assessing likelihood of exceedences of the NO_2 and PM_{10} objectives.

Technical Guidance LAQM.TG (09) recommends identifying these roads using the following criteria:

- A daily traffic flow (AADT) of less than 20,000 vehicles per day.
- An unusually high proportion of buses and/ or HGVs (greater than 20%).
- An HDV flow of greater than 2,500 vehicles per day
- Relevant exposure within 20 metres.

If locations meeting these criteria have predicted concentrations that exceed the NO_2 or PM_{10} objectives, it is necessary to proceed to a Detailed Assessment for these pollutants.

Manchester City Council has specifically assessed this type of location in previous rounds of review and assessment.

However, as a precautionary approach, data was obtained from GMTU to identify roads with two-way 2008 AADT flows that were less than 20,000 vehicles per day and had a HDV proportion of greater than 20%. In Manchester, 21 links were found to meet these criteria that had an HDV flow of greater than 2,500 vehicles per day. All of these links are within the current AQMA, and have therefore been considered in previous rounds of review and assessment. Technical Guidance LAQM.TG (09) states that if these locations were considered previously then there is no need to proceed further.

Manchester City Council confirms that there are no new/newly identified roads with high flows of buses/HDVs.

3.4 Junctions

Concentrations of both PM_{10} and NO_2 are usually higher close to busy junctions due to the combined impact of heavy traffic flows and higher emissions from stopping and starting.

Technical Guidance LAQM.TG (09) recommends identifying these junctions using the following criteria:

- A daily traffic flow (AADT) of more than 10,000 vehicles per day.
- Relevant exposure within 20 metres of the kerb.

If locations meeting these criteria have predicted concentrations that exceed the NO_2 or PM_{10} objectives, it is necessary to proceed to a Detailed Assessment for these pollutants.

Manchester City Council has specifically assessed this type of location in previous rounds of review and assessment.

However, as a precautionary approach, data was obtained from GMTU to identify junctions with AADT traffic flows of greater than 10,000 vehicles per day in 2008, but less than 10,000 vehicles per day in 2005. The purpose of this was to identify junctions that may not have been considered by previous rounds of review and assessment. In Manchester, 4 of these junctions were found to be outside the current AQMA.

These locations were viewed using Arcview GIS and local knowledge was applied to determine if there is relevant exposure within 20 metres of the kerb. The result of the assessment is shown in Table 20.

Table 20 Results of assessment of junctions with > 10,000 AADT outside the AQMA

Junction name/ location	Distance from the kerb to the nearest relevant exposure (metres)	Relevant exposure within 20 metres of the kerb?	DMRB assessment required?
Hazel Bottom Rd/ Chataway Rd	6.5	Yes	**Yes**
Church Lane/ Ravin Avenue	2.5	Yes	**Yes**
St Mary's Rd/ Williams Rd	37	No	No
Withington Rd/ Mauldeth Rd West	12	Yes	**Yes**

As shown by Table 20, there are 3 junctions that have traffic flows exceeding 10,000 vehicles per day that are outside the current AQMA where there is relevant exposure within 20 metres of the kerb.

These 3 junctions were subject to an air quality dispersion assessment using the latest version of the DMRB screening model (Version 1.03c - July 2007). The results of the assessment are shown in Appendix B.

The results table in Appendix B for junctions shows that all locations assessed have predicted annual mean NO_2 concentrations of less than 40 ug/m^3, and therefore are unlikely to exceed the annual NO_2 objective. However, 2 of the receptors (1 Chataway Road and 160 Church Lane) have predicted annual mean NO_2 concentrations close to the 'at risk' concentration of 36 ug/m^3 for the annual NO_2 objective.

Predicted PM_{10} concentrations for all receptors are well within the objectives.

Manchester City Council has assessed new/newly identified junctions meeting the criteria in Section A.4 of Box 5.3 in TG(09). There are no locations where the annual mean NO_2 concentration is predicted to exceed 40 ug/m^3.

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

New roads are required to be identified as part of the review and assessment process, for assessing likelihood of exceedences of the NO_2 and PM_{10} objectives.

If exceedences of the NO_2 or PM_{10} objectives are predicted at relevant locations, it is necessary to proceed to a Detailed Assessment for these pollutants.

There have been no new roads constructed in Manchester since the third round of review and assessment, although there has been some widening of the M60 motorway between junctions 5 and 8, which partly lies within Manchester. However, these junctions lie within the current AQMA.

Manchester City Council confirms that there are no new/proposed roads within the district.

3.6 Roads with Significantly Changed Traffic Flows

If they have not already been considered in sections 3.1 to 3.5, roads with significantly changed traffic flows should be considered to assess the likelihood of exceedences of both the NO_2 and PM_{10} objectives.

Technical Guidance LAQM.TG (09) recommends identifying these roads using the following criteria:

- A daily traffic flow (AADT) of more than 10,000 vehicles per day.
- A large increase in traffic flows (greater than 25%)

If exceedences of the NO_2 or PM_{10} objectives are predicted at relevant locations, it is necessary to proceed to a Detailed Assessment for these pollutants.

Data was obtained from GMTU to identify roads with AADT traffic flows of greater than 10,000 vehicles per day, and an increase in traffic flows between 2005 and 2008 of greater than 25%. In Manchester, 1 road was found to meet these criteria. However, the road is within the current AQMA, and therefore has already been subjected to a Detailed Assessment in previous rounds of review and assessment.

As a precautionary approach, the latest version of the DMRB screening model was used to predict NO_2 and PM_{10} concentrations at the nearest receptor with relevant exposure. The results of the assessment are shown in Appendix B.

The results table in Appendix B for roads with significantly changed traffic flows shows that the location assessed has a predicted annual mean NO_2 concentration of less than 40 ug/m^3. The predicted annual mean concentration is 38 ug/m^3, which would put the location 'at risk' of exceeding the annual NO_2 objective. However, the location is already within the current AQMA.

Predicted PM_{10} concentrations for the receptor are well within the objectives.

Manchester City Council has assessed new/newly identified roads with significantly changed traffic flows. There are no locations where the annual mean NO_2 concentration is predicted to exceed 40 ug/m^3.

3.7 Bus and Coach Stations

Bus and coach stations must be considered in the review and assessment process to assess the likelihood of exceedences of the NO_2 objectives where there are areas of relevant exposure.

Technical Guidance LAQM.TG (09) recommends using the following criteria:

- Bus stations or sections of bus stations that are not enclosed and where there is relevant exposure.
- Bus movements of greater than 2,500 per day.
- Relevant exposure within 20 metres of any part of the bus station where buses are present.

If locations meeting these criteria have predicted NO_2 concentrations exceeding the objectives, it is necessary to proceed to a Detailed Assessment.

Manchester City Council has considered bus and coach stations during previous rounds of review and assessment. There have been no new relevant bus stations constructed since the previous round of review and assessment. Technical Guidance LAQM.TG (09) indicates that if these sources were considered during previous rounds of review and assessment, then there is no need to proceed further.

Manchester City Council confirms that there are no new relevant bus stations in the Local Authority area.

4 Other Transport Sources

4.1 Airports

Aircraft are potentially significant sources of nitrogen oxides (NO_X) emissions, especially during takeoff. Airports should be considered in the review and assessment process to determine the likelihood of exceedences of the NO_2 objectives.

Technical Guidance LAQM.TG (09) recommends using the following criteria:

- Relevant exposure within 1000 metres of the airport boundary.
- An equivalent passenger throughput greater than 10 million passengers per annum (mppa).
- An existing background NO_X concentration of above 25 ug/m^3.

If these criteria are met, it is necessary to proceed to a Detailed Assessment for nitrogen dioxide.

Manchester Airport is located to the south of Manchester city centre, and is the third busiest airport in the country.

Residential properties are located within 1km of the airport boundary. Figures were obtained from Manchester Airport Plc on the annual throughput of passengers and tonnes of freight for the financial year of 2008/9. Passenger numbers were 20.72 million and freight was 127,260 tonnes.

Using Box 5.4 in Technical Guidance LAQM.TG (09), the freight portion of aircraft traffic was converted to equivalent passengers per annum (100,000 tonnes of freight = 1 million passengers per annum). The freight portion is equivalent to 1.27 million passengers. Therefore the total equivalent passenger numbers for Manchester Airport in 2008 was 21.99 million.

The local background NO_X concentration obtained from the UK National Air Quality Archive for 2008 is 35.8 ug/m^3.

The passenger equivalent throughput and the local background NO_X concentration both exceed the thresholds that make it necessary to proceed to a Detailed Assessment for NO_2. However, Manchester Airport has been subject to a Detailed Assessment for nitrogen dioxide in previous rounds of review and assessment. The majority of the land within the site boundary of Manchester Airport is now within the current AQMA as a result of the Detailed Assessment.

Manchester City Council confirms that there are no new airports in the Local Authority area.

4.2 Railways (Diesel and Steam Trains)

A requirement of the review and assessment process is to consider diesel and steam locomotives, mainly in stations and depots, and also alongside some busy lines that have high numbers of these types of train movements.

4.2.1 Stationary Trains

Stationary locomotives (both diesel and coal fired), can give rise to high levels of SO_2 close to the point of emission.

Technical Guidance LAQM.TG (09) recommends using the following criteria to determine if it will be necessary to proceed to a Detailed Assessment for SO_2 for certain locations (e.g. signals, goods loops, depots or stations):

- 3 or more occasions per day when there might be a diesel or coal fired locomotive stationary with its engine running for 15 minutes or more; and
- Potential for exposure of individuals for periods of 15-minutes or more within 15 metres of the stationary locomotives. The exposure needs to be 'outdoors' in the general sense of the word.

There are numerous train stations located in Manchester. Most of these are 'through' stations used by commuters, where trains pass through local stations whilst on their way to or from the city centre. Trains do not remain stationary at these stations for any longer than the time required to load and alight passengers, as any delay in moving on would hold up trains further up the line. There is also a large train maintenance depot located at Longsight, south of the city centre. However, there is no relevant exposure within 15 metres of any stationary locomotives.

There are two 'terminus' stations in Manchester city centre (Manchester Victoria and Manchester Piccadilly), where trains stop at the end of the line. Trains could theoretically remain stationary at these two stations for periods longer than 15 minutes, when the trains reach the end of the line. The station platforms at both stations could potentially be locations of relevant exposure of 15 minutes duration, which are within 15 metres of the locomotives.

The duration of idling trains at these stations has been investigated during previous rounds of review and assessment. However, as a precautionary approach, the exercise was repeated at both stations to investigate the typical duration of idling trains on the station platforms.

1. Manchester Victoria station

A period of observation was carried out at Manchester Victoria on 14 July 2009 to time the duration of trains remaining stationary with their engines running.

There are 6 platforms at Manchester Victoria, 4 of which are 'through' platforms, (used by trains passing into one side of the station and leaving through the other end of the station), and 2 of which are 'terminus' platforms, (where the line ends, and trains must back up the way they came). These two types of platform were investigated separately. The results of the assessment can be found in Appendix D.

'Terminus' platforms (Platforms 1 and 2)

During the survey, 5 trains used the 'Terminus' platforms. All of the trains observed were diesel engine passenger locomotives. During the survey period trains stopped at the

terminus platforms with their engines running for an average of 7.8 minutes, with a maximum stationary time of 14 minutes.

'Through' platforms (Platforms 3 to 6)

During the survey, 12 trains used the 'Through' platforms. All of the trains observed were diesel engine passenger locomotives. During the survey period trains stopped at the through platforms with their engines running for an average of 8.1 minutes, with a maximum stationary time of 15 minutes.

During this survey 1 locomotive was observed to stop for 15 minutes or more, and a further 2 were observed that stopped with their engines running for approximately 14 minutes.

2. Manchester Piccadilly station

A period of observation was carried out at Manchester Piccadilly station on 14 July 2009 to time the duration of trains remaining stationary with their engines running.

There are 14 platforms at Manchester Piccadilly, 2 of which are 'through' platforms, (used by trains passing into one side of the station and leaving through the other end of the station), and 12 of which are 'terminus' platforms, (where the line ends, and trains must back up the way they came). These two types of platform were investigated separately. The results of the assessment can be found in Appendix D.

'Terminus' platforms (Platforms 1 to 12)

During the survey, 8 trains used the 'Terminus' platforms. All of the trains observed were diesel engine passenger locomotives. During the survey period trains stopped at the terminus platforms with their engines running for an average of 21.4 minutes, with a maximum stationary time of 42 minutes.

'Through' platforms (Platforms 13 and 14)

During the survey, 1 train used the 'Through' platforms. The train observed was a diesel engine passenger locomotive. During the survey period the train stopped at the through platform with its engine running for 2 minutes.

During this survey 6 locomotives were observed to stop for 15 minutes or more.

Technical Guidance LAQM.TG (09) states that it will be necessary to proceed to a Detailed Assessment for SO_2 where there might be 3 or more occasions per day when there is a stationary locomotive with its engine running for 15 minutes or more, and there is relevant exposure within 15 metres of the stationary locomotives.

The surveys at Manchester Victoria and Manchester Piccadilly were carried out over a small portion of the day (approximately 2.5 hours and 1 hour respectively), and in this time the criteria for proceeding to a Detailed Assessment for SO_2 was almost met at Victoria, and met at Manchester Piccadilly. In addition, due to practicalities not all trains entering the stations could be observed during the survey. Therefore from the survey observations it seems that it may be possible at both stations for locomotives to be stationary on the platform with their engines running on more than 3 occasions per day. This occurrence was not found in previous rounds of review and assessment, and therefore is a new situation for Manchester City Council.

However, it may be a more efficient use of resources to not proceed to a Detailed Assessment at this time for SO_2 around the station platforms, but as an alternative liaise with the train operators, station platform operators and the Greater Manchester Public Transport Executive (GMPTE) to investigate the reason for trains leaving their engines running for a significant period of time whilst remaining stationary. This would represent a precautionary approach to local air quality management by taking action and aiming to find a solution, rather than waiting until possible exceedences of the short term SO_2 objective are investigated further.

Manchester City Council has identified locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m. It is the Councils intention to liaise with relevant stakeholders to investigate the reasons for trains leaving their engines running whilst stationary, and to pursue a solution to reduce the engine idling time. This is considered to be a more preferable as first course of action at this time rather than to proceed to a Detailed Assessment.

4.2.2 Moving Trains

Recent evidence suggests that moving diesel locomotives, in sufficient numbers, can give rise to high NO_2 concentrations close to the track - the emissions can be equivalent to those from a busy road.

Technical Guidance LAQM.TG (09), Table 5.1, lists both the Manchester Piccadilly to Wigan and Manchester to Crewe lines as having a substantial number of diesel passenger trains per day, and recommends using the following criteria to determine if it will be necessary to proceed to a Detailed Assessment for NO_2 for certain locations:

- A background mean NO_2 concentration of greater than 25 ug/m^3; and
- Potential for long-term exposure (e.g. residential accommodation) within 30 metres of the edge of the track.

The sections of track located within the Manchester City Council local authority boundary between Manchester Piccadilly and Wigan, and Manchester to Crewe train stations were viewed using Arcview GIS, to first determine if there was relevant long-term exposure within 30 metres of the edge of the tracks. Where properties were located meeting this criterion, the grid reference was noted and the background NO_2 concentration found from the national background maps available from the UK National Air Quality Archive website. The results of the assessment are shown in Table 21, Table 22 and Table 23. There are 2 lines running from Manchester to Crewe - the first via Stockport and the second via Manchester Airport. Both of these lines were assessed.

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Table 21 Results of assessment of Manchester Piccadilly to Wigan line

Property Details	In AQMA?	Distance to the edge of the tracks (metres)	OS grid reference	Background NO_2 concentration (ug/m^3)
Chandos Hall of residence, Granby Row	Y	11	X=384660 Y=397679	34.1
The Salisbury Public House, Wakefield Street	Y	8	X=384096 Y=397480	34.1
58 Hewitt Street, Manchester	Y	8	X=383600 Y=397487	32.0

The above addresses represent a small sample of residential properties located within 30 metres of the edge of the tracks.

Table 22 Results of assessment of Manchester Piccadilly to Crewe line (via Stockport)

Property Details	In AQMA?	Distance to the edge of the tracks (metres)	OS grid reference	Background NO_2 concentration (ug/m^3)
10 Bennett Street, Ardwick	Y	25	X=386237 Y=396854	26.0
7 Chalcombe Grange, Longsight	N	18	X=386762 Y=395987	25.0
20 Victoria Terrace, Longsight	N	14	X=386890 Y=395835	25.0
1 Hopkins Street, Longsight	N	15	X=387029 Y=395401	23.4
29 Linwood Grove, Longsight	N	13	X=387166 Y=394817	23.7
21 Worsley Grove, Levenshulme	N	13	X=387284 Y=394328	23.7
26 Alma Road, Levenshulme	N	7	X=387356 Y=393996	23.4
9 Clare Road, Levenshulme	N	10	X=387493 Y=393606	23.4

The above addresses represent a small sample of residential properties located within 30 metres of the edge of the tracks.

Table 23 Results of assessment of Manchester Piccadilly to Crewe line (via Manchester Airport)

Property Details	In AQMA?	Distance to the edge of the tracks (metres)	OS grid reference	Background NO_2 concentration (ug/m^3)
41 Collingwood Road, Rusholme	N	17	X=386744 Y=394469	22.9
6 Peaceville Road, Rusholme	N	14	X=386593 Y=394105	22.9
38 Abergele Road, Withington	N	22	X=386405 Y=393681	22.4
62 Talbot Road, Withington	N	16	X=386276 Y=393258	22.4
14 Aubrey Road, Withington	N	13	X=386209 Y=393037	22.4
11 Southlea Road, Burnage	N	13	X=385984 Y=392232	21.1
77-92 Fog Lane, Burnage	N	15	X=385779 Y=391597	21.5
6 Gawsworth Avenue, Didsbury	N	21	X=385234 Y=390064	22.5

The northern portion of this route is the same as Manchester Piccadilly to Crewe via Stockport. The above addresses represent a small sample of residential properties located within 30 metres of the edge of the tracks.

The result of the assessment of the 3 lines indicate that there are sections of track that may have a large number of diesel locomotive movements where there is potential for long term exposure within 30 metres of the edge of the tracks and there is a background annual mean NO_2 concentration greater than 25 ug/m^3. This situation is particularly prevalent where lines are closer to the city centre, where background NO_2 concentrations are generally higher. Locations where the criteria are met seem to be within the current AQMA. However, there are locations where the background concentration is approximately 25 ug/m^3 outside the AQMA where there is long-term exposure within 30 metres of the track edges.

Manchester City Council has identified locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m, and will need to proceed to a Detailed Assessment for nitrogen dioxide.

4.3 Ports (Shipping)

If there are significant movements of large ships that burn oils with a high sulphur content in a port, then there is a risk of exceedences of the 15-minute sulphur dioxide objective. However, there are no such locations in Manchester.

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

5 Industrial Sources

5.1 Industrial Installations

Industrial processes can be significant in terms of short-term air quality objectives. Technical Guidance LAQM.TG (09) recommends that consideration be given to all of the regulated pollutants, although those most at risk are SO_2, NO_2, PM_{10} and benzene.

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

There has been 1 new installation since the previous round of review and assessment where a detailed air quality impact assessment has been carried out. The details of the installation are outlined below:

Name of installation operator:	Scottish & Newcastle UK Ltd
Installation address:	Royal Brewery, Denmark Road, Manchester, M15 6LD
Type of installation:	23 MW thermal input biomass boiler - combustion of spent grain from the brewing process and clean woodchip to generate steam and energy.

A detailed air quality impact assessment report was prepared by Enviros Consulting Ltd in March 2008 in support of an application to support the existing PPC Permit (regulated by the Environment Agency). An initial stack height assessment following the HMIP Technical Guidance Note D1 was determined, followed by detailed modelling for emissions of significant combustion gases, which considered SO_2, NO_X and PM_{10}. The air quality impact assessment report was considered sufficient for review and assessment purposes.

9 scenarios were considered (3 different pollutant abatement techniques with 3 different stack heights). The option chosen that was considered to represent the 'Best Available Technique' (BAT) was a 34-metre stack with a bag filter, bicarbonate injection and Selective Non-Catalytic Reduction (SNCR). With this option no exceedences of the relevant air quality objectives were predicted at relevant locations, and therefore the installation was considered not to have any unacceptable air quality impacts. Therefore a further Detailed Assessment for this installation is not considered necessary.

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

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

The review and assessment process recommends that Local Authorities determine whether any industrial sources identified during previous rounds of review and assessment have either:

a) experienced substantially increased emissions (greater than 30%); or
b) received new relevant exposure in their vicinity.

A review of industrial processes in Manchester has confirmed that there are none that meet these criteria.

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

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

There has been 1 new significant installation with no previous air quality impact assessment in Manchester since the last round of review and assessment. Details of the installation are outlined below:

Name of installation operator:	W. Howarth Metals Limited
Installation address:	Rondin Road, Ardwick, Manchester, M12 6BF
Type of installation:	Non-ferrous metal foundry - melting and recycling of scrap aluminium
Sector Guidance Note:	Sector Guidance Note IPPC SG4 - ' Secretary of State's Guidance for A2 Activities in the Non-ferrous Metals Sector'.

Planning permission has been granted for the above installation, although at present the melting furnaces are not in operation. Details of the stack and significant emissions were obtained from the application for a Part A2 LA-IPPC Environmental Permit. The stack height for the LA-IPPC application was determined following the HMIP Technical Guidance Note D1.

The emissions of pollutants from the furnace stack were assessed against the nomograms in Technical Guidance LAQM.TG (09), to determine whether it would be necessary to proceed to a Detailed Assessment. The results of the assessment are detailed below.

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Stack details:

Discharge height = 33 metres
Stack diameter = 1.5 metres
Discharge temperature = 105°C

Pollutant emission rates:

Pollutant	Emission rate (g/s)[1]	Emission rate (kg/hr)	Emission rate (kg/week)[2]	Emission rate (kg/year)[3]	Emission rate (Tonnes/year)
NO_X	1.3	4.68	786	37740	37.7
PM_{10}	0.1	0.36	60	2903	2.9
SO_2	1.3	4.68	786	37740	37.7
Lead	0.026	0.094	16	755	0.75
CO	1.3	4.68	786	37740	37.7

1 = Information provided in application for Part A2 LA-IPPC Environmental Permit
2 = Assuming 24 hour operation, 7 days per week
3 = Assuming 48 weeks of operation per year

Assessment of stack emissions using nomograms in Technical Guidance LAQM.TG (09):

a) Hourly NO_2 objective

The procedure was followed in paragraph 5.39 of the Technical Guidance for assessment of emissions against the hourly NO_2 objective.

Procedural step	Description	Result
1	99.8th percentile of total oxidant concentration (NO_2 + O_3 as NO_2) in ug/m^3 at Manchester Piccadilly from 2006	173 ug/m^3
2	Locally available 'headroom' (200 ug/m^3 minus 99.8th percentile of total oxidant concentration)	27 ug/m^3
3	Locally available 'headroom' divided by 0.05	540 ug/m^3
4	Result from step 3 divided by four = target concentration	135 ug/m^3
5	NO_X emission from the stack	37.7 tonnes per annum
6	NO_X emission from the stack divided by the target concentration from step 4 and multiplied by 40	11.18 tonnes per annum

The permitted emission rate using the nomogram in Figure 5.1 is approximately 120 tonnes per annum. The calculated NO_X emission from the stack (11.2 tonnes per annum) is below this threshold.

b) Annual NO_2 objective

The procedure was followed in paragraph 5.40 of the Technical Guidance for assessment of emissions against the annual NO_2 objective.

Procedural step	Description	Result
1	Identify any sensitive receptors within ten stack heights - distance to consider from the stack	330 metres
2	Background NO_2 concentrations at receptor locations from national background maps: 137 Anthony Close, Ardwick, X=366299, Y=397156 (210 metres distance from stack, nearest receptor location) 131 Ashton Old Road, Ardwick, X=386117,Y=397615 (300 metres from stack)	 26.08 ug/m^3 38.54 ug/m^3 (includes road contribution)
3	Locally available 'headroom' (40 ug/m^3 minus maximum background concentration)	1.46 ug/m^3
4	Locally available 'headroom' divided by four (minimum value for result of 0.25) = target concentration	0.37 ug/m^3
5	NO_X emission from the stack	37.7 tonnes per annum
6	NO_X emission from the stack divided by the target concentration from step 4	103 tonnes per annum

The permitted emission rate using the nomogram in Figure 5.2 is approximately 130 tonnes per annum. The calculated NO_X emission from the stack (103 tonnes per annum) is below this threshold.

c) PM_{10} objectives

The procedure was followed in paragraphs 5.43 to 5.46 of the Technical Guidance for assessment of emissions against the PM_{10} objectives.

Procedural step	Description	Result
1	PM_{10} emission from the stack	2.9 tonnes per annum
2	Permitted emission rate from nomogram in Figure 5.4 using stack diameter and height	5.5 tonnes per annum
3	Background PM_{10} concentration at stack location from national background maps	17.98 ug/m^3
4	'Background adjusted' permitted emission rate (=permitted emission rate x (32 minus background PM_{10} concentration))	77.1 tonnes per annum

The 'Background adjusted' permitted emission rate is approximately 77.1 tonnes per annum. The calculated PM_{10} emission from the stack (2.9 tonnes per annum) is below this threshold.

d) SO_2 objectives

The procedure was followed in paragraphs 5.57 to 5.59 of the Technical Guidance for assessment of emissions against the SO_2 objectives.

The permitted emission rate using the nomogram in Figure 5.12 is approximately 117 tonnes per annum. The calculated SO_2 emission from the stack (37.7 tonnes per annum) is below this threshold.

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e) Lead objectives

The procedure was followed in paragraphs 5.53 to 5.56 of the Technical Guidance for assessment of emissions against the lead objectives.

The permitted emission rate using the nomogram in Figure 5.10 is approximately 0.65 tonnes per annum. The calculated lead emission from the stack (0.75 tonnes per annum) is marginally above this threshold. However, the nomogram is designed to give a permitted emission rate of lead in tonnes per annum that will give rise to an annual mean ground level concentration of 0.025 ug/m^3 (10% of the 0.25 ug/m^3 2008 air quality objective).

Ambient air quality concentrations of lead are measured in Manchester. The 2008 annual mean concentration of lead measured at the Piccadilly Gardens monitoring site was 0.021 ug/m^3, which can be considered to be representative of background concentrations across the city. If the stack emission contribution of 0.025 ug/m^3 is added to this background concentration, a total lead concentration of 0.046 ug/m^3 is produced. This total concentration is only 18% of the 2008 air quality objective value for lead, and therefore exceedences of the objective seem highly unlikely.

In addition, the D1 stack height calculation was based on the emission rate for lead under worse case conditions, assuming that the plant was operating at the emission limit values specified in Sector Guidance Note IPPC SG4. In reality, it is anticipated that actual stack gas concentrations of lead will be lower than the emission limit value.

Therefore Manchester City Council does not consider it necessary to proceed to a Detailed Assessment for lead at this installation.

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

5.2 Major Fuel (Petrol) Storage Depots

There is some evidence that major petrol fuel depots could emit sufficient benzene to put the 2010 objective at risk of being exceeded, especially if combined with higher levels from nearby busy roads.

Technical Guidance LAQM.TG (09) Annex 2, Appendix E provides a list of the major fuel storage depots in the United Kingdom. None are located within the city of Manchester. The nearest depot is listed as Esso Petroleum Co Ltd in Trafford Park (within the Trafford Council local authority district), grid reference X=379365, Y=397779. The location of this site is approximately 3030 metres (3 km) away from the nearest part of the Manchester City Council local authority boundary, and therefore considered to be insignificant in terms of benzene emissions within Manchester.

Manchester City Council confirms that there are no major fuel (petrol) storage depots within the Local Authority area.

5.3 Petrol Stations

There is some evidence that petrol stations could emit sufficient benzene to put the 2010 objective at risk of being exceeded, especially if combined with higher levels from nearby busy roads.

Technical Guidance LAQM.TG (09) recommends using all of the following criteria for petrol stations in order to proceed to a Detailed Assessment for benzene at these locations:

- An annual throughput of more than 2000 m^3 (2 million litres) of petrol; and
- a nearby busy road that has traffic flows of greater than 30,000 vehicles per day; and
- relevant exposure within 10 metres of the petrol pumps.

Petrol stations have specifically been assessed in previous rounds of review and assessment. However, as a precautionary approach, the most recent throughput figures (from year end of 2007) for all Part B regulated petrol stations in Manchester were examined to determine if the annual threshold of 2000 m^3 was exceeded. Out of 50 petrol stations on record, 25 had petrol annual throughputs greater than 2000 m^3. These petrol stations were then viewed using Arcview GIS to determine the distance to the nearest relevant exposure. Traffic data obtained from GMTU was used to determine the traffic flows on the nearest road to the station.

The result of the assessment is shown in Table 24.

Table 24 Results of petrol stations assessment

Petrol station details	Annual throughput of petrol (million litres)	Distance to nearest relevant exposure (metres)	Traffic flow (AADT) of nearest road
Aleef Chorlton, M21 1SA	2.14	28m (2 Buckingham Rd)	14,612
Manchester Airport Terminal 1, M90 3WR	3.15	660m (1 Bretton Walk)	38,393
Asda Eastlands, M11 4BD	7.0	92m (6 The Waterfront)	28,785
Asda Harpurhey, M9 1DJ	6.20	36m (933 Rochdale Rd)	18,148
Asda Hulme, M15 5AQ	8.60	80m (130 Old Birley St)	11,625
Chorlton Motoring Centre, M21 2ER	2.15	42m (36 Anchorside Close)	19,962
Chorlton Service Station, M21 1PT	3.09	12m (78 Manchester Rd)	16,361
Civic Centre Filling Station, M22 5RG	5.20	122m (78 Robinswood Rd)	2,701
Kingsway Service Station, M19 1BW	2.65	40m (229 Kingsway)	23,814
Rusholme Express, M13 0HL	3.75	14m (261 Upper Brook St)	19,404
Mersey Lights Service Station, M20 8FZ	3.90	24m (881 Princess Rd)	84,674
Monsall Service Station, M40 5AF	4.15	45m (800 Oldham Rd)	26,591
Princess Service Station, M14 7FG	3.98	21m (56 Thelwall Avenue)	36,403
Royle Green Service Station, M22 4SY	3.40	29m (123 Longley Lane)	12,090
Sainsburys Heaton Park, M9 0GH	8.00	50m (12 Cawley Terrace)	41,533
Shell Baguley, M23 9AA	2.77	41m (1 Pitfield Gardens)	14,802
Shell Didsbury, M20 8RH	3.77	21m (43 Viceroy Court)	18,461
Shell Kingsburn, M19 1RD	6.61	21m (300 to 302 Fog Lane)	27,766

Table 24 Continued

Petrol station details	Annual throughput of petrol (million litres)	Distance to nearest relevant exposure (metres)	Traffic flow (AADT) of nearest road
Shell Levenshulme, M19 2RE	4.00	14m (8 Cringle Rd)	26,981
Shell Princess Parkway, M14 7LU	5.00	36m (311 Princess Road)	42,413
Shirley Service Station, M8 7WB	4.29	10m (3 Shirley Rd)	13,525
St Hildas Service Station, M22 4FW	2.25	11m (310 Palatine Rd)	15,059
Styal Road Service Station, M22 5WB	2.75	56m (Smithy Farm, Tedder Drive)	14,935
Tesco Baguley, M23 9TJ	11.02	112m (40 Churchstoke Walk)	26,739
Total Fallowfield, M14 6AH	2.52	18m (16 Brook Rd)	15,115

As shown by Table 24, there are no petrol stations in Manchester that meet all 3 criteria necessary to proceed to a Detailed Assessment for benzene at these locations.

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

5.4 Poultry Farms

A small number of local authorities have identified potential exceedences of the PM_{10} objectives associated with emissions from poultry farms.

Technical Guidance LAQM.TG (09) recommends using the following criteria to determine if it will be necessary to proceed to a Detailed Assessment for PM_{10} for certain locations:

- Farms housing in excess of:

  a) 400,000 birds if mechanically ventilated; or
  b) 200,000 birds if naturally ventilated; or
  c) 100,000 birds for any turkey unit; and
- Relevant exposure within 100 metres of the poultry units.

The district Environmental Health Officers in the specialist Food and Health and Safety Group of Manchester City Council's Environmental Health department were consulted with to determine whether there were any poultry farms meeting the criteria described in Technical Guidance LAQM.TG (09). It was confirmed that there are no such farms in Manchester.

Manchester City Council confirms that there are no poultry farms within the local authority boundary meeting the specified criteria.

6 Commercial and Domestic Sources

6.1 Biomass Combustion – Individual Installations

Biomass burning can lead to an increase in PM_{10} and NO_X emissions compared to conventional gas burning from the combustion process.

The procedure in Box 5.8 (D.1a) of Technical Guidance LAQM.TG (09) was followed to assess biomass burning plant in Manchester that have a maximum thermal capacity in the range of 50kW to 20MW.

Maximum emission rates for NO_X and PM_{10} were calculated using the maximum thermal capacity and EMEP/CORINAIR guidebook emission factors that are summarised in 'Technical Guidance: Screening assessment for biomass boilers' produced by AEA Energy and Environment. 'Background adjusted' emission rates for NO_X and PM_{10} were calculated using the procedures set out in paragraphs 5.78, 5.81 and 5.84 of Technical Guidance LAQM.TG (09). These 'background adjusted' emission rates were then compared to threshold emission rates in nomograms in figures 5.19 (for PM_{10}), 5.20 and 5.21 (for NO_X) to determine whether it would be necessary to proceed to a Detailed Assessment.

The result of the assessment is detailed in Table 25. The table shows that background adjusted emission rates of NO_X and PM_{10} are within the respective threshold emission rates, and therefore a Detailed Assessment is not required for the biomass plant identified.

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

Table 25 Results of individual biomass burning plant assessment

Plant details	Plant description	Fuel	Max thermal capacity (kW)	OS grid reference	Stack height (m)	Stack diameter (m)	Max height of buildings within 5 x stack heights (m)	PM_{10} background adjusted emission rate (g/s)	PM_{10} threshold emission rate for 24-hour objective (g/s)	NO_X background adjusted emission rate (g/s)	NO_X threshold emission rate for annual NO_2 objective (g/s)	NO_X threshold emission rate for hourly NO_2 objective (g/s)
Manchester Airport plc biomass boiler	Advanced automatic wood pellet boiler	Wood pellet	50	X=381133 Y=384203	13	0.3	14	0.00022	0.008	0.0011	0.025	0.1
Wythenshawe Hospital large biomass boiler (1)	Advanced automatic wood pellet boiler	Wood pellet	2000	X=380754 Y=387953	33	0.55	30	0.0084	0.1	0.026	0.3	0.5
Wythenshawe Hospital large biomass boiler (2)	Advanced automatic wood pellet boiler	Wood pellet	2000	X=380754 Y=387953	33	0.55	30	0.0084	0.1	0.026	0.3	0.5
Combination of Wythenshawe hospital large biomass boilers emissions[1]					33	0.55	30	0.0168	0.1	0.052	0.3	0.5
Wythenshawe Hospital Cardiac Centre biomass boiler	Advanced automatic wood pellet boiler	Wood pellet/ chips	200	X=380411 Y=388009	7	0.3	10	0.00086	0.003	0.0029	0.008	0.035

1 As a precautionary approach, the emission rates from the 2 large boilers at Wythenshawe Hospital were combined (because the 2 flues discharge from the same stack) as recommended by 'Technical Guidance: Screening assessment for biomass boilers' produced by AEA Energy and Environment.

6.2 Biomass Combustion – Combined Impacts

There is the potential that many small biomass combustion installations (including domestic solid fuel burning) could in combination lead to unacceptably high PM_{10} concentrations, particularly in areas where PM_{10} concentrations are close to or above the objectives.

The procedure in Box 5.8 (D.1b) of Technical Guidance LAQM.TG (09) was followed to assess combined impacts of small biomass combustion installations (including domestic solid fuel burning) in Manchester.

It should be noted that to date very few small biomass combustion installations in either the commercial or domestic sector have been identified in Manchester.

Manchester City Councils Private Sector Housing Energy Group provided a list of properties in Manchester where domestic solid fuel burning takes place. Limited information was available on the appliance and fuel type. The appliances were listed as either room heater/ stove or boiler with radiators. The fuel type was listed as coal/pearls. However, the entire Manchester City Council area has been subject to Smoke Control Orders since 1985. Therefore it was assumed that the fuel type was solid smokeless fuel and the appliance type was either a stove or boiler < 50 kW th (which both have the same estimated annual emissions per household). The addresses where solid fuel burning takes place were converted into a GIS layer to follow the procedure in the Technical Guidance.

The Local Authority area has been divided into 500m x 500m grid squares based on The National Grid grid squares. These 500m x 500m squares were viewed using Arcview GIS, and the numbers of domestic properties burning solid smokeless fuel were counted in each square. The maximum number domestic properties in the grid squares burning solid fuel as their primary source of heating was found to be 8 (which were in the Chorlton ward of Manchester). These were individual traditional properties (i.e. not part of a large new development or housing estate).

Estimated annual emissions of PM_{10} from these properties were found from Table 5.3 of Technical Guidance LAQM.TG (09). The breakdown of PM_{10} emissions is shown in Table 26.

Table 26 PM_{10} emissions from the highest density of solid fuel burning properties in Manchester

No of properties in 500m x 500m grid square	Appliance type	Fuel	PM_{10} emission per household, kg/year	Subtotal of emissions, kg/year
6	Stove	Solid smokeless fuel	6.06	36.36
2	Boiler < 50 kW th	Solid smokeless fuel	6.06	12.12

Total PM_{10} emissions from domestic properties burning solid smokeless fuel in grid square = 48.48 kg.

The 2008 background PM_{10} concentration was found to be 16.6 ug/m^3, derived from national background maps available from the UK National Air Quality Archive.

The procedure in Box 5.8 (D.1b) of the Technical Guidance includes estimating the fraction of space occupied by solid fuel burning premises or domestic properties in the 500m x 500m grid square, and then calculating an emission density based on the total emission of PM_{10} and the fraction of space occupied by the properties. However, using this methodology gives

a very high emission density if the fraction of space of individual properties is relatively very small (as is the case in Manchester). Therefore the methodology is more applicable to large developments were there are many premises containing biomass/ solid fuel burning appliances. In consultation with the Local Authority Review and Assessment Helpdesk of the University of the West of England, an alternative screening approach was followed:

The Local Authority Review and Assessment Helpdesk website contains a Frequently Asked Question (FAQ) document on assessing the combined impacts of biomass burning in a Local Authority area.

The data from the nomogram in Figure 5.22 of Technical Guidance LAQM.TG (09) have been transformed to show the minimum number of households per 500m x 500m area required to trigger the need for a Detailed Assessment. This is based on a worst-case assumption that wood is burnt in an open fireplace as the primary source of heat. The emission of PM_{10} from this type of appliance is estimated as 27.43 kg/year (taken from Table 5.3 of the Technical Guidance), which is far greater than for an appliance burning solid smokeless fuel (6.06 kg/year).

For a large town in England (e.g. Manchester), within an area where the background PM_{10} concentration is 17 ug/m^3, approximately 250 households burning wood with this type of appliance in a 500m x 500m area would be needed to trigger a Detailed Assessment. Therefore it can be concluded that a Detailed Assessment will not be required to assess PM_{10} emissions from the combined impacts of biomass combustion from domestic properties in Manchester, because:

a) the maximum number of properties identified in Manchester burning smokeless solid fuel in a 500m x 500m grid square was 8 (far lower than the 250 shown in the FAQ document nomogram); and
b) PM_{10} emissions from solid smokeless fuel burning are lower than for wood burning (6.06 kg/year from an appliance burning solid smokeless fuel compared to 27.43 kg/year from an open fireplace burning wood).

The FAQ document also contains a nomogram for commercial premises using biomass for heating. For commercial premises in a large town in England using biomass for heating, within an area where the background PM_{10} concentration is 17 ug/m^3, a floorspace of approximately 62,000m^2 within a 500m x 500m area would be required to trigger a Detailed Assessment. This is roughly equivalent to 12 large superstores, and is based on a worst-case assumption that wood is burnt in a boiler of power rating between 50kWth and 1MWth as the primary source of heat.

Since no there have been no significant commercial premises identified in Manchester using biomass for heating, it can be concluded that there is no need to proceed to a Detailed Assessment for PM_{10} emissions from this source.

Manchester City Council has assessed the combined impacts of biomass combustion plant, and concluded that it will not be necessary to proceed to a Detailed Assessment.

6.3 Domestic Solid-Fuel Burning

Exceedences of the SO_2 objective may arise where there is significant coal burning. 'Significant' is defined as any area of about 500m x 500m with more than 50 houses burning coal/ smokeless fuel as their primary source of heating.

Technical Guidance LAQM.TG (09) recommends using the following criterion to determine if it will be necessary to proceed to a Detailed Assessment for SO_2 for certain locations:

- The density of coal/ smokeless fuel burning premises exceeds 100 per 500m x 500m area.

The procedure in Technical Guidance LAQM.TG (09), Box 5.8 (D.2) was followed to assess domestic solid fuel burning in Manchester.

Manchester City Councils Private Sector Housing Energy Group provided a list of properties in Manchester where domestic solid fuel is used as the primary source of heating. These addresses were converted into a GIS layer to follow the procedure in the Technical Guidance.

The Local Authority area has been divided into 500m x 500m grid squares based on The National Grid grid squares. These 500m x 500m squares were viewed using Arcview GIS, and the numbers of domestic properties burning solid smokeless fuel as their primary source of heating were counted in each square. The maximum density of this type of domestic property in the grid squares was found to be 8 (which were in the Chorlton ward of Manchester). This number is well below the threshold of 100 domestic solid fuel burning premises per 500m x 500m area where it is necessary to proceed to a Detailed Assessment.

Manchester City Council confirms that there are no areas of significant domestic solid fuel burning in the Local Authority area.

7 Fugitive or Uncontrolled Sources

Dust emissions from a range of fugitive and uncontrolled sources can give rise to elevated PM_{10} concentrations. Examples of this include dust and dirt being tracked out from dusty sites by vehicles using public roads, the handling of dusty materials and the cutting of concrete.

Technical Guidance LAQM.TG (09) recommends using the following criteria to determine if it will be necessary to proceed to a Detailed Assessment for PM_{10} for certain locations:

- Relevant exposure near to a source of dust emissions; and
- Recent complaints about dust from the source; or
- Significant dust emissions or dust tracked out of the site onto public roads as indicated by a visual inspection.

The district Public Protection Officers of Manchester City Council's Environmental Health department were consulted with to determine whether there were any sites meeting the criteria described in Technical Guidance LAQM.TG (09). It was confirmed that there are presently no such sites in Manchester.

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

8 Conclusions and Proposed Actions

8.1 Conclusions from New Monitoring Data

Nitrogen dioxide:

Nitrogen dioxide monitoring results have not identified any potential or actual exceedences of the ambient air quality objectives outside the current AQMA. With the exception of 2 sites (Clayton Lane and St Pauls School), monitoring sites within the AQMA measured exceedences of the annual NO_2 objective in 2008. However, concentrations of NO_2 are generally lower in 2008 than for previous years at diffusion tube monitoring sites.

Several city centre roadside sites (Oxford Street, Newton Street and Princes Street) measured annual mean concentrations of NO_2 greater than 60 ug/m^3. Paragraphs 5.17 and 5.18 of Technical Guidance LAQM.TG (09) advise that there is a risk of the hourly objective being exceeded where such concentrations are measured, and that Local Authorities may choose to amend their current AQMA to reflect exceedences of the 1-hour objective, and review their Air Quality Action Plans.

Other local air quality management (LAQM) pollutants:

All other pollutants relevant to LAQM monitored within Manchester were below their respective air quality objectives.

8.2 Conclusions from Assessment of Sources

Road traffic sources:

Road traffic sources have been assessed following checklists in Technical Guidance LAQM.TG (09). According to the checklists, there are no predicted concentrations at the assessed receptor locations that would make it necessary to proceed to a Detailed Assessment. However, there are some residential locations outside the current AQMA which are 'at risk' of exceeding the annual NO_2 objective because predicted concentrations are close to or exceeding 36 ug/m^3. This could be a reflection of a wider situation, i.e. some locations where there is relevant exposure that are outside the current AQMA may be at risk or exceeding the NO_2 annual objective.

Other transport sources:

Manchester City Council has identified that there may be potential for exceedences of the 15-minute SO_2 air quality objective at Manchester Piccadilly and Manchester Victoria train stations, due to diesel trains regularly remaining stationary for periods of 15 minutes or more with their engines running where there is relevant exposure within 15 metres.

There are sections of railway track within the Local Authority boundary between Manchester Piccadilly and Wigan, and also Manchester Piccadilly and Crewe that have a large number of movements of diesel locomotives, and potential for long term relevant exposure within 30 metres of the track edges where the background NO_2 concentration is above 25 ug/m^3.

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Industrial sources:

Manchester City Council has not identified any exceedences outside the AQMA of air quality objectives from new industrial installations or from petrol stations. There are no poultry farms or major petrol storage depots in Manchester.

Commercial and domestic sources:

Manchester City Council has concluded that there are no significant sources of PM_{10} or SO_2 from commercial and domestic sources in Manchester.

Fugitive or Uncontrolled Sources:

There are no significant potential sources of fugitive particulate matter emissions in Manchester.

8.3 Proposed Actions

SO_2 emissions from idling diesel locomotives:

According to Technical Guidance LAQM.TG (09), the Updating and Screening Assessment has identified the need to proceed to a Detailed Assessment for SO_2. This would be to investigate further the likelihood of exceedences of the 15-minute SO_2 objective around Manchester Piccadilly and Manchester Victoria railway station platforms. However, Manchester City Council does not intend to proceed to a Detailed Assessment for this pollutant at this time. Alternatively, the Council intends to liaise with relevant stakeholders to investigate the reasons for trains leaving their engines running whilst stationary, and to pursue a solution to reduce the engine idling time. This is regarded as a more efficient use of resources, and takes a more precautionary approach to local air quality management. If exceedences of the 15-minute SO_2 objective were found to be likely by undertaking a Detailed Assessment, the Council would take this action in any case. A number of discussions have already taken place between the Greater Manchester Passenger Transport Executive (GMPTE) and Northern Rail (the principal train operator at both stations) regarding idling trains. It is understood that Northern Rail trains should shutdown automatically after 10 minutes of idling, but apparently the driver can override this function. Observations outlined in Appendix D of this report have been forwarded to GMPTE to help inform further discussions.

NO_2 emissions from diesel locomotives and other sources:

The Updating and Screening Assessment has identified the need to proceed to a Detailed Assessment for NO_2 along the edges of sections of railway track in Manchester, due to a high volume of diesel locomotive movements and relevant exposure within 30 metres of the track edges. Manchester City Council proposes to proceed with this Detailed Assessment to be submitted in 2010 to investigate potential exceedences of both the annual and hourly NO_2 objectives. The Detailed Assessment will include monitoring for NO_2 at relevant locations using diffusion tubes.

It is proposed that this will be part of a wider Detailed Assessment, which will involve dispersion modelling undertaken in partnership with the other 9 Greater Manchester local authorities. The reasons for proposing this Greater Manchester wide partnership approach are as follows:

Detailed emissions dispersion modelling was last undertaken for Greater Manchester (GM) as a whole in 2004, for a forecast year of 2005. ADMS-Urban was used to model the county

based on the 2001 emissions inventory database and forecasts of changes in emissions such as road traffic sources to 2005. The modelled average mean NO_2 concentrations were used to define the current AQMA by the GM authorities. Since that work was undertaken there have been a number of significant enhancements to the point and area source inventory and to traffic modelling in GM. The enhancements are described in detail below.

a) Point and area source emissions inventory enhancements:

- Emissions factors for all Part A and Part B processes have been reviewed, categorised and documented by Royal Haskoning.
- Point source data inputs have been made consistent with the emission factors using standard units.
- A web-based point source data input system has been implemented for Local Authority officers across GM for easier data entry. This also allows central administration of data entry progress, new emission factors and processes etc.
- Updating and recalculation of agricultural, electricity and domestic and commercial combustion emissions.

b) Traffic modelling enhancements:

- The 2002 link-based assignment model (implemented using the TRIPS assignment package) has been replaced by a much more accurate junction-based assignment model (implemented using the SATURN assignment package), which explicitly models the delays that occur at junctions. The scope of the network has also been expanded to include almost all roads with bus services.

- The 2002 trip matrix was built to represent a 2001 base year using an existing trip matrix (originally based on data collected in the early 1990s) supplemented by roadside interviews at 68 sites across GM undertaken in 1999 before the opening of the Denton to Middleton section of the M60. This has been replaced by a new matrix based on data from over 400 roadside interview survey sites, undertaken in the period 2001-2004, and the 2001 census journey-to-work data for commuting trips. This data reflects the trip making patterns that emerged after the completion of the M60 (in October 2000) and, a priori, is more accurate than the 2002 matrix.

- The 2002 matrix was factored to 2005 using a single factor derived from the National Road Traffic Forecast (NRTF). A new traffic demand model has been developed for Greater Manchester that forecasts growth at ward level, and any future year matrices will be factored from the present based on this forecast of ward level growth. A priori this is more accurate than the single (NRTF) growth that was used to factor the 2002 matrix to 2005.

- The 2005 forecast of emissions from traffic on minor roads was based on building an all roads network from Meridian (an Ordnance survey product) and then subtracting the flows from the roads included in the TRIPS model. This method has now been replaced by a more accurate and consistent method based on building a true minor roads network from the Integrated Transport Network (the Ordnance Survey's current road centreline product) and then assigning trips from their origins/to their destinations from the points where they meet/leave the SATURN network.

- The 2005 forecast of cold start emissions assumed that the additional emissions from a cold start were concentrated at the origin of the trip. However, using SATURN it is possible to determine the roads that vehicles will traverse as their engines warm up and then distribute the additional (cold start) emissions along these roads, thus giving a more

realistic distribution of these emissions. This approach has now been adopted as standard practice.

Taken together these enhancements, coupled with real world changes in emissions patterns since 2002, mean that there is a compelling case for repeating the dispersion modelling for GM. Accurate and updated emissions forecasts are also necessary to inform the extent of exceedences of the NO_2 objectives for the 2010 European Union air quality directive requirements and 2015/6 Local Transport Planning objectives.

With this in mind the GM Authorities have commissioned the Greater Manchester Transportation Unit (GMTU) to carry out an updated dispersion modelling exercise for GM. Initial SCA funding of £57,140 was provided by Defra in 2008, and together with additional support funding of £29,000 from the GM Authorities, GMTU are progressing stage one of the modelling project. They have also developed techniques for automatically determining average road width (a key parameter for ADMS-Urban) from the Ordnance Survey's MasterMap product. This should enhance the accuracy of the dispersion model forecasts. In addition, by October 2009 the GM Authorities should be in receipt of a 2-metre resolution Digital Surface Model (DSM) for the county and it is the intention that this should be used by GMTU to determine the average building height for each road. This will facilitate the use of the street canyon modelling facility in ADMS-Urban that will further increase the accuracy of the dispersion model forecasts.

Investigation of exceedences of hourly NO_2 objectives:

Manchester City Council is currently progressing installation of an automatic NO_X monitoring site along Oxford Road in Manchester to investigate potential exceedences of the hourly NO_2 objective at city centre roadside sites further, and also to monitor progress in terms of reducing air quality concentrations of action plan measures relating to traffic along the route.

Location of monitoring sites:

An assessment of monitoring sites in Manchester has identified that not all roadside diffusion tube sites may represent worse case locations or relevant exposure, and therefore consideration will be given to adding/ moving NO_2 diffusion tube monitoring sites within the existing monitoring programme.

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Appendices

Appendix A: QA/QC Data

Appendix B: DMRB Calculations

Appendix C: Location maps and photographs of non-automatic monitoring sites

Appendix D: Observations of idling diesel locomotives at Manchester Victoria and Manchester Piccadilly train stations

Appendix A: QA/QC Data

Diffusion Tube Bias Adjustment Factors

Laboratory supplying NO_2 diffusion tubes:	Bureau Veritas UK Ltd Queenslie Court 139 Summerlee Street Glasgow G33 4DB
Preparation method used:	10% TEA in water (up to end of 2008)
Harmonisation Practical Guidance followed:	Yes
National bias adjustment factor from R&A Helpdesk database (Version 05/09):	0.83

Factor from Local Co-location Studies

Manchester City Council undertook two NO_2 diffusion tube co-location studies in 2008. Triplicate NO_2 diffusion tubes were co-located with automatic chemiluminescent NO_X analysers at the Manchester Piccadilly and Manchester South monitoring sites. Results of the co-location studies are shown in the figures below. Results have been produced using the latest version (Version 3 - 2006) of the diffusion tube bias adjustment spreadsheet tool produced by AEA Energy and Environment.

Manchester Piccadilly - Urban Centre site:

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	02/01/2008	29/01/2008	54.0	57.0	56.0	56	1.5	3	3.8	56.24383	99.8459168	Good	Good
2	29/01/2008	26/02/2008	63.0	68.0	61.0	64	3.6	6	9.0	58.33984	91.51785714	Good	Good
3	26/02/2008	01/04/2008	50.0	52.0	51.0	51	1.0	2	2.5	36.5447	99.88095238	Good	Good
4	01/04/2008	29/04/2008	56.0	53.0	54.0	54	1.5	3	3.8	30.43134	99.70238095	Good	Good
5	29/04/2008	27/05/2008	47.0	46.0	35.0	43	6.7	16	16.5	41	30.35714286	Good	or Data Capture
6	27/05/2008	01/07/2008	35.0	43.0	43.0	40	4.6	11	11.5		0	Good	or Data Capture
7	01/07/2008	29/07/2008	32.0	41.0	37.0	37	4.5	12	11.2	25	64.43452381	Good	or Data Capture
8	29/07/2008	02/09/2008	40.0	33.0	39.0	37	3.8	10	9.4	31	99.52380952	Good	Good
9	02/09/2008	30/09/2008	44.0	46.0	48.0	46	2.0	4	5.0	39	99.85119048	Good	Good
10	30/09/2008	28/10/2008	45.0	47.0	49.0	47	2.0	4	5.0	37	99.70238095	Good	Good
11	28/10/2008	02/12/2008	64.0	59.0	55.0	59	4.5	8	11.2	47.32936	99.76190476	Good	Good
12	02/12/2008	06/01/2009	76.0	81.0	70.0	76	5.5	7	13.7	77.16296	63.92857143	Good	or Data Capture
13													
											Overall survey -->	Good precision	Poor Overall DC

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

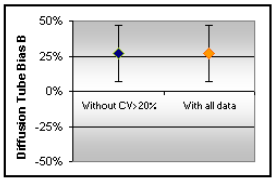
Site Name/ ID:

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 8 periods of data	
Bias factor A	0.81 (0.7 - 0.97)
Bias B	23% (3% - 43%)
Diffusion Tubes Mean:	52 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	42 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	42 (36 - 50) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 8 periods of data	
Bias factor A	0.81 (0.7 - 0.97)
Bias B	23% (3% - 43%)
Diffusion Tubes Mean:	52 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	42 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	42 (36 - 50) μgm^{-3}



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Version 03 - November 2006

Manchester City Council - England

Manchester South - Suburban site:

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	02/01/2008	29/01/2008	31.0	32.0	32.0	32	0.6	2	1.4
2	29/01/2008	26/02/2008	39.0	43.0	40.0	41	2.1	5	5.2
3	26/02/2008	01/04/2008	32.0	33.0	32.0	32	0.6	2	1.4
4	01/04/2008	29/04/2008	24.0	24.0	25.0	24	0.6	2	1.4
5	29/04/2008	27/05/2008	23.0	23.0	24.0	23	0.6	2	1.4
6	27/05/2008	01/07/2008	21.0	19.0	20.0	20	1.0	5	2.5
7	01/07/2008	29/07/2008		24.0	20.0	22	2.8	13	25.4
8	29/07/2008	02/09/2008	19.0	20.0	22.0	20	1.5	8	3.8
9	02/09/2008	30/09/2008	27.0	34.0	31.0	31	3.5	11	8.7
10	30/09/2008	28/10/2008	28.0	30.0	28.0	29	1.2	4	2.9
11	28/10/2008	02/12/2008	39.0	45.0	42.0	42	3.0	7	7.5
12	02/12/2008	06/01/2009	56.0	55.0	49.0	53	3.8	7	9.4
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
17.36874	76.88751926	Good	Good
33.43214	95.38690476	Good	Good
23.821	99.76190476	Good	Good
22.53125	100	Good	Good
24	99.4047619	Good	Good
21	79.28571429	Good	Good
18	48.96833333	Good	or Data Capture
17	98.69047619	Good	Good
26	99.55357143	Good	Good
20	99.70238095	Good	Good
27.71703	99.28571429	Good	Good
35.39021	99.88095238	Good	Good
Overall survey -->		Good precision	Good Overall DC

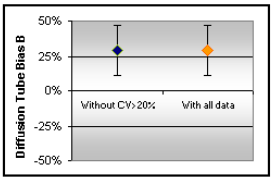
Site Name/ ID:

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 11 periods of data
Bias factor A 0.77 (0.68 - 0.9)
Bias B 29% (11% - 47%)
Diffusion Tubes Mean: 32 μgm^{-3}
Mean CV (Precision): 5
Automatic Mean: 24 μgm^{-3}
Data Capture for periods used: 95%
Adjusted Tubes Mean: 24 (21 - 28) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 11 periods of data
Bias factor A 0.77 (0.68 - 0.9)
Bias B 29% (11% - 47%)
Diffusion Tubes Mean: 32 μgm^{-3}
Mean CV (Precision): 5
Automatic Mean: 24 μgm^{-3}
Data Capture for periods used: 95%
Adjusted Tubes Mean: 24 (21 - 28) μgm^{-3}



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Version 03 - November 2006

Summary of co-location results:

Parameter	Manchester Piccadilly (Urban Centre)	Manchester South (Suburban)
NO_2 diffusion tubes annual mean ug/m^3	52	32
Automatic monitor annual mean ug/m^3	42	24
Bias adjustment factor	0.81	0.77
Precision of NO_2 diffusion tubes	Good	Good
Overall data capture for automatic analyser	Poor	Good

Discussion of Choice of Factor to Use

The national bias factor (0.83) has been applied to the 2008 NO_2 diffusion tube monitoring results. The reason for this is that overall data capture for the automatic monitor at Manchester Piccadilly was poor, and the Manchester South site bias adjustment factor may not be representative of all the monitoring sites across the city. The national bias adjustment factor is derived from a range of monitoring site locations, and is higher than the locally derived factors. Therefore this choice represents a precautionary approach.

Manchester City Council - England

QA/QC of diffusion tube monitoring

Laboratory performance data was obtained for Bureau Veritas from the Local Authority Air Quality Support Helpdesk website. WASP laboratory performance for Bureau Veritas in 2008 was found to be acceptable from January 2008 to January 2009.

Manchester City Council - England

2008 NO_2 diffusion tube monthly mean values

Site Name	Dates of monitoring period 2008												
	02/01 to 29/01	29/01 to 26/02	26/02 to 01/04	01/04 to 29/04	29/04 to 27/05	27/05 to 01/07	01/07 to 29/07	29/07 to 02/09	02/09 to 30/09	30/09 to 28/10	28/10 to 02/12	02/12 to 06/01/2009	Raw mean annual concentration
Ashton Old Road	55	61		57	52	34	37	40		59	69	88	55
Cheetham Hill Road	66	84		69	33	55	53	54	60	62	82	98	65
Hyde Road	126	69	57	65	50	39	33	36		42	68	82	61
Oldham Road	55	98	61	59	48	48	44	44	50	54	68	81	59
Oxford Street		102		104	97	91	86	77	80	93	100	122	95
Newton Street	75	89	85	83	68	79	75	68	62	92	83	86	79
Princess Street	74	92	81	73	53	67	61	69		78	86	94	75
Rochdale Road	51		52	45	43	41	37	34	43	57	63	86	50
Stockport Road	63	80	68	73	78	46	57	52	60	61	79	100	68
Great Ancoats Street	71	84	70	58	35	49	58	49	51	82	76	94	65
Kingsway	49	67	52		29	39	35	37	44	45	63	79	49
M56	66	88	71	74	60	57	55	45	59	64	77	91	67
Princess Road	59	66	69	56	32	42	37	40	51	55	49	86	54
Chethams School	52	145	51	46	34	35	31	32	43	43	55	70	53
Liverpool Road	55	75	71	66	46	52	55	49	55	54	71	90	62
Piccadilly Gardens	57	68	52	53	46	43	41	33	46	47	59	81	52
Burnage		39		30		22	21	17	28	30	41	53	31
Clayton Day Nursery	38	44	34	27	19	20	18		20	27	36	56	31
Clayton Lane	59	57	48	39	23	33	27	30	38	46	53	67	43
Lockton Close	52	63	61	51	41	40	42	38	48	72	64	74	54
St Pauls School	40	53	36	47	39	32	33	31	42	36	50	66	42
Town Hall	49	67	54	50	23		27	32	46	43	61	75	48
Manchester South	32	43	33	24	23	19	24	20	34	30	45	55	32
Styal	17	25	21	19	10	11	14	13	14	14	28	32	18
All results are expressed as ug/m^3													

Manchester City Council - England

PM_{10} 'M-type' sampler bias correction

Manchester City Council has co-located a 'M-type' sampler with a TEOM/ FDMS automatic PM_{10} analyser at the Manchester Piccadilly monitoring site. This is in an attempt to derive a correction factor for the 'M-type' sampler. A bias adjustment factor has been derived for the M-type samplers in a similar way to the nitrogen dioxide diffusion tubes. This would allow results from the 'M-type' samplers to be expressed as a PM_{10} equivalent. A comparison of the results of the TEOM unit and 'M-type' sampler are shown in the following table.

Year	TEOM/ FDMS annual mean PM_{10} concentration (ug/m^3)	TEOM/ FDMS % data Capture	'M-type' sampler annual mean total suspended particulate concentration (ug/m^3)	'M-type' % data capture	Bias factor A
1995	44.2	96%	35.3	64%	1.25
1996	34.0	98%	29.4	100%	1.16
1997	31.2	94%	29.3	98%	1.06
1998	27.7	97%	25.6	96%	1.08
1999	26.3	98%	25.8	100%	1.02
2000	27.5	98%	25.5	100%	1.08
2001	38.9	97%	38.3	29%	1.01
2002	27.7	95%	25.0	78%	1.11
2003	29.7	98%	22.7	90%	1.28
2004	24.7	98%	21.0	98%	1.18
2005	25.2	98%	22.9	100%	1.10
2006	26.3	96%	24.9	92%	1.05
2007	24.4	98%	22.3	98%	1.09
2008	19.8	99%	19.5	92%	1.02

The results show a good correlation between measured PM_{10} and total suspended particulate matter, however M-type sampler results have historically been lower than the TEOM/ FDMS.

Benzene diffusion tube bias correction

Manchester City Council has co-located 1 benzene diffusion tube with the pumped benzene sampler at Piccadilly Gardens, in an attempt to improve the accuracy of the benzene diffusion tube results. The pumped benzene sampler is a more accurate method of sampling benzene because a known volume of air is drawn through the absorbent tube, and also duplicate tubes are sampled. A bias adjustment factor has been derived for the benzene diffusion tubes in a similar way to the nitrogen dioxide diffusion tubes.

Bias adjustment results for the last 3 years from the Piccadilly Gardens monitoring site are presented in the following table.

Year	Pumped benzene sampler results		Benzene diffusion tube results		Bias factor A
	Annual mean benzene concentration (ug/m^3)	Data capture	Annual mean benzene concentration (ug/m^3)	Data capture	
2006	1.02	100%	1.12	92%	0.91
2007	1.00	100%	0.66	100%	1.52
2008	0.78	100%	0.60	92%	1.30

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Results show that there has been considerable variation of the bias adjustment factor from year to year. The benzene diffusion tubes used by Manchester City Council are supplied, prepared, and analysed by Eurofins Laboratories Ltd, who are UKAS accredited.

QA/QC of automatic monitoring

Automatic air quality analysers within the Manchester City Council area are subject to a high level of quality assurance/ quality control. Analysers are either operated as part of the national Automatic Urban and Rural Network (AURN) of air quality monitors owned by the Department of Environment, Food and Rural Affairs (DEFRA), or are part of the 'Calibration Club' scheme run by AEA Technology. Details of the QA/QC schemes that the analysers are pert of are detailed in the following table.

Monitoring site	Analyser	QA/QC scheme	Frequency of calibrations	Data captured and screened by	Data ratified by	Frequency of site audits
Manchester Piccadilly	NO_X	National AURN owned by DEFRA	Every 4 weeks	Bureau Veritas	AEA Technology	Approx every 6 months
	PM_{10}	National AURN owned by DEFRA	Every 4 weeks	Bureau Veritas	AEA Technology	Approx every 6 months
	O_3	National AURN owned by DEFRA	Every 4 weeks	Bureau Veritas	AEA Technology	Approx every 6 months
	SO_2	Calibration Club run by AEA Technology	Every 4 weeks	AEA Technology	AEA Technology	Approx every 6 months
	CO	Calibration Club run by AEA Technology	Every 4 weeks	AEA Technology	AEA Technology	Approx every 6 months
Manchester South	NO_X	National AURN owned by DEFRA	Every 4 weeks	Bureau Veritas	AEA Technology	Approx every 6 months
	O_3	National AURN owned by DEFRA	Every 4 weeks	Bureau Veritas	AEA Technology	Approx every 6 months
	SO_2	Calibration Club run by AEA Technology	Every 4 weeks	AEA Technology	AEA Technology	Approx every 6 months

Analysers that are operated as part of the AURN:

Measurements produced are subject to a high level of quality assurance/ quality control. Data is captured and screened by a third party (Bureau Veritas), and then further ratified by AEA Energy and Environment before being published on the UK Air Quality Archive internet website. In order to be deemed representative, there is a minimum data capture requirement of 90% for an annual period. Manchester City Council act as Local Site Operators (LSO's) for the site on behalf of DEFRA, and perform calibration and system checks on the analysers every 4 weeks. The City Council also performs basic fault finding duties and aims to arrive on site within 2 hours of a fault being reported. If the fault cannot be rectified by the LSO, an engineer from a designated equipment support unit will arrive on site within 2 working days of the fault being reported. AEA Technology performs periodic audits of the equipment located at the site and local site operator staff approximately every 6 months.

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Analysers that are operated as part of the 'Calibration Club':

These analysers are subject to the same level of QA/QC as for those that form part of the AURN. The only difference is that AEA Technology carries out the initial capture, as well as the ratification perform screening of the data. In addition, the data is not published on the UK Air Quality Archive internet website, as it belongs solely to Manchester City Council.

Appendix B: DMRB Calculations

DMRB model verification

The method used to convert roadside NO_X to NO_2 within the DMRB screening model was based on measurements made between 1999 and 2001. Since this time evidence has shown that the proportion of primary NO_2 in vehicle exhaust has increased, which has changed the relationship between NO_X and NO_2 used in the DMRB model. It is therefore important to verify NO_X results obtained from the DMRB model against actual monitoring results to improve the accuracy of predicted pollutant concentrations.

A comparison between the road contribution of NO_X from the DMRB screening model and monitoring data was made using the procedure set out in Technical Guidance LAQM.TG (09) Annex 3, Box A3.6. Roadside monitoring sites in Manchester were viewed using Arcview GIS, and distances from the centres of relevant road links to the sites were measured. Road traffic data for relevant road links was provided by GMTU. Monitoring sites were then treated as receptor points using the latest version of DMRB screening model to predict the total road contribution of NO_X at each location.

Example 2: 'Diffusion tubes are used to adjust the nitrogen oxides road contribution' on page A3-48 of Annex 3 in the Technical Guidance was followed to calculate an adjustment factor for the modelled road contribution of NO_X, to make results comparable to actual monitored concentrations.

Details of the calculations and adjustment factors applied are detailed in the following tables and graphs.

Comparison of monitored and unadjusted modelled NO_2 concentrations

Site ID	Monitor Type	Site Type	Site Description	Background NO_2	Monitored total NO_2	Unadjusted modelled total NO_2[2]	% difference between monitored and unadjusted modelled NO_2
Hyde Road	DT	K	Urban A Road	24.08	51	36.70	-28.04
Cheetham Hill Road	DT	K	Urban A Road	23.90	54	38.65	-28.43
Rochdale Rd	DT	K	Urban A Road	28.44	42	41.30	-1.67
Great Ancoats Street	DT	R	Urban A Road	30.22	54	41.41	-23.31
Kingsway	DT	R	Urban A Road	22.49	41	29.51	-28.02
Princess Road	DT	R	Urban A Road	20.57	45	32.56	-27.64

The table of comparisons between monitored and unadjusted modelled NO_2 concentrations shows that results of NO_2 concentrations from dispersion modelling are under-predicting at all sites. The following table gives a summary of the percentage differences between monitored and unadjusted modelled NO_2 concentrations.

Manchester City Council - England

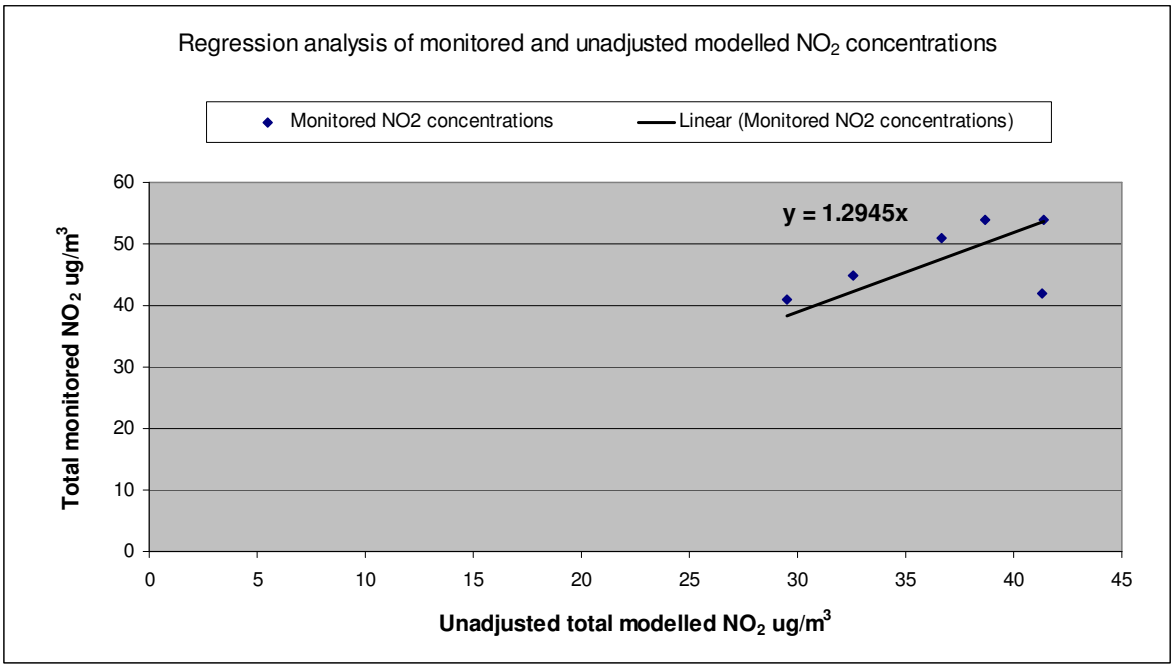
Summary of the percentage differences between monitored and unadjusted modelled NO_2 concentrations

Within + or - 10%	1
Within + or - 10 to 25%	1
Greater than + or - 25%	4

Greater than + or - 25%	4
Within + or - 25%	2

However, the Rochdale Road site shows a good comparison between monitored and modelled results. In consultation with the Local Authority Support helpdesk, it was decided that the modelled results for the Rochdale Road site would not be subject to any further adjustment, as the DMRB model is known to perform relatively well in more open locations which is a characteristic of the Rochdale Road site.

A regression analysis was performed on the monitored and unadjusted modelled NO_2 concentrations, which is represented graphically below.



The trend line shows a relationship between the 2 sets of concentrations of 1.2945, i.e. the modelled predicted concentrations of NO_2 are under-predicting.

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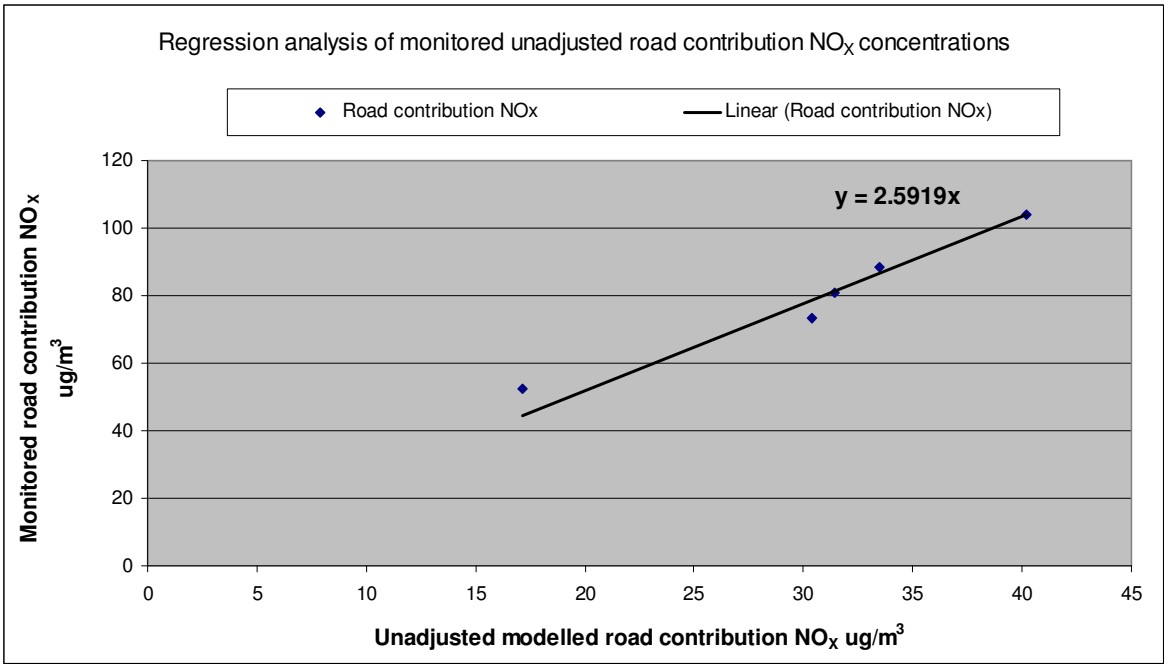
Comparison of monitored and unadjusted modelled road contribution of NO_X concentrations

Site ID	Monitored total NO_2	Monitored total NO_X	Background NO_2	Background NO_X	Monitored road contribution NO_2 (total - background)	Monitored road contribution NO_X (total - background)[3]	Modelled road contribution NO_X from DMRB (excludes background)[1]
Hyde Road	51	122.39	24.08	33.98	26.92	88.41	33.50
Cheetham Hill Road	54	136.48	23.90	32.61	30.10	103.87	40.20
Great Ancoats Street	54	127.15	30.22	46.37	23.78	80.78	31.39
Kingsway	41	83.28	22.49	31.03	18.51	52.25	17.14
Princess Road	45	101.25	20.57	27.70	24.43	73.55	30.36

A table of comparisons between monitored and unadjusted modelled road contribution of NO_X concentrations was produced, which provided the basis for a regression analysis on the 2 sets of concentrations, which is represented graphically below.



The trend line shows a relationship of 2.5919, which is used as the adjustment factor for the modelled road contribution of NO_X concentrations.

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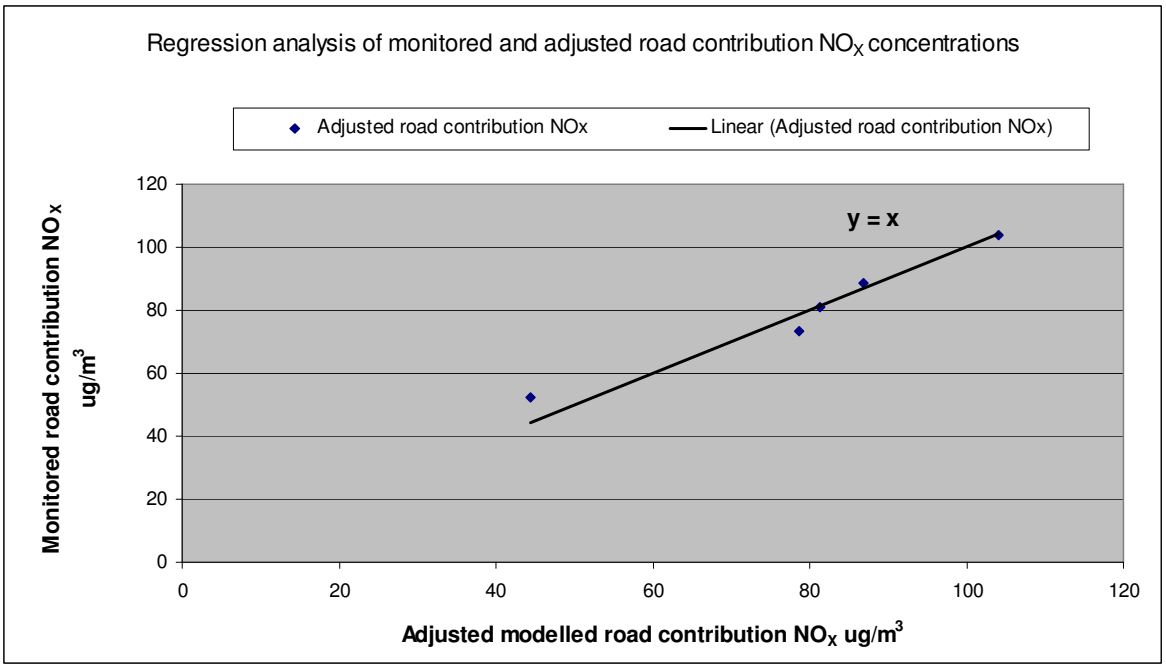
Comparison of monitored and adjusted modelled NO_X concentrations

Site ID	Ratio of monitored road contribution NO_X/ modelled road contribution NO_X	Adjustment factor for modelled road NO_X contribution (from graph of table 3 data)	Adjusted modelled road contribution NO_X	Adjusted modelled total NO_X (incl. Background NO_X)	Modelled total NO_2 (based on NO_X/ NO_2 relationship)[4]	Monitored total NO_2	% difference between monitored and modelled NO_2
Hyde Road	2.64	2.5919	86.83	120.81	50.66	51	-0.67
Cheetham Hill Road	2.58	2.5919	104.19	136.80	54.06	54	0.11
Great Ancoats Street	2.57	2.5919	81.36	127.73	54.12	54	0.22
Kingsway	3.05	2.5919	44.43	75.46	38.74	41	-5.51
Princess Road	2.42	2.5919	78.69	106.39	46.21	45	2.69

The adjustment factor of 2.5919 was applied to the unadjusted modelled road contribution of NO_X. A regression analysis was then performed on the monitored and adjusted road contribution of NO_X concentrations, which is presented graphically below.



The trend line now shows a relationship of 1, i.e. after the adjustment factor of 2.5919 has been applied to the modelled road contribution of NO_X concentrations, they are approximately equal to the monitored NO_X concentrations.

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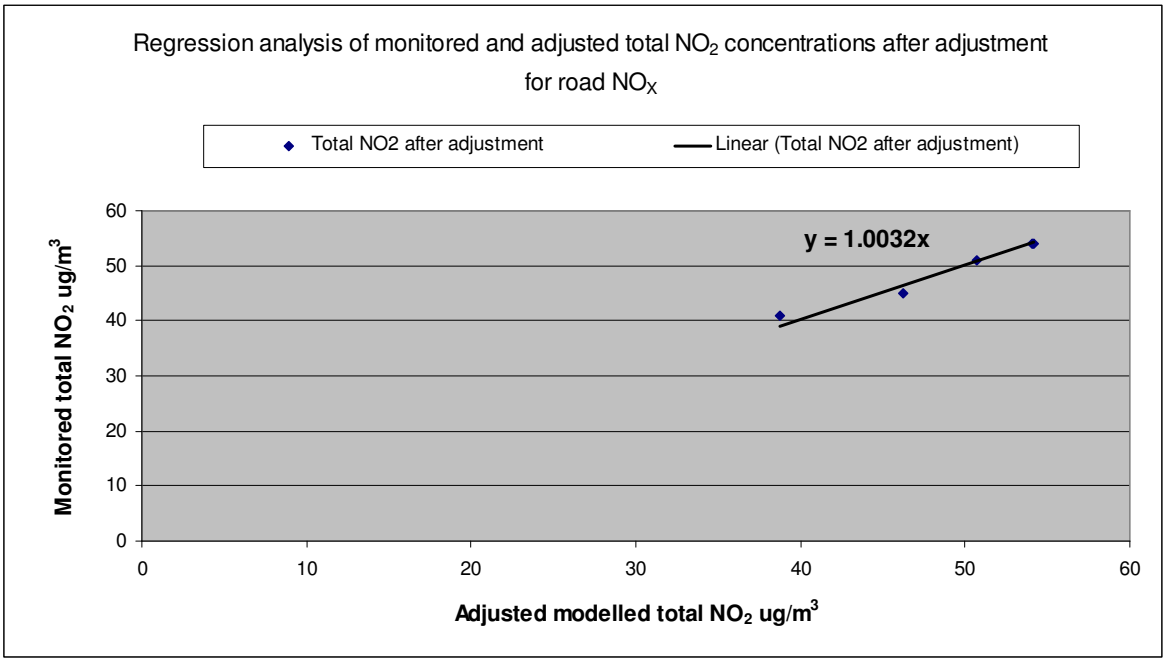
Finally, a regression analysis was performed on the monitored and adjusted total NO_2 concentrations to investigate how well the adjustment factor performs. The results are presented graphically below.



The trend line shows a relationship of 1.0023, which suggests that the adjustment factor performs well at all locations.

The table below gives a summary of the percentage differences between monitored and adjusted modelled NO_2 concentrations.

Summary of the percentage differences between monitored and adjusted modelled NO_2 concentrations

Within + or - 10%	5
Within + or - 10 to 25%	0
Greater than + or - 25%	0

Greater than + or - 25%	0
Within + or - 25%	5

The difference between the monitored and adjusted modelled results is less than 10% at all locations (actually less than 5% at all but one of the locations), and therefore will be used to adjust the modelled roadside contribution NO_X concentrations obtained from the DMRB screening model.

Notes relating to DMRB verification tables

1 From DMRB screening model spreadsheet tool, with zero entered as background NO_X and NO_2 concentrations.

2 From NO_X to NO_2 calculator, using 'All other urban UK traffic' option - DMRB modelled NO_X road contribution converted to NO_2 with background NO_2 concentrations included.

3 From NO_X to NO_2 calculator, using 'All other urban UK traffic option', using the diffusion tubes tab.

4 From NO_X to NO_2 calculator, using 'All other urban UK traffic' option - Adjusted modelled NO_X road contribution converted to NO_2 with background NO_2 concentrations included.

Busy streets where people may spend 1-hour or more close to traffic

Input Data

Location/ Receptor	Grid Ref	Background Concentrations			
		Year	NO_X	NO_2	PM_{10}
A	X=383683, Y=396234	2008	40.18	27.36	18.95
B	X=384091, Y=392434	2008	29.19	21.39	16.64
C	X=384578, Y=391283	2008	29.47	21.57	16.56
D	X=382990, Y=395177	2008	34.24	24.25	17.74

Location/ Receptor	Link number	Distance from link centre to receptor (m)	Traffic flow & speed		Traffic composition		
			AADT (combined, veh/day)	Annual average speed (km/h)	Road type (A,B,C,D)	Total % LDV (<3.5t GVW)	Total % HDV (>3.5t GVW)
A	1	15	11652	21	B	96.9	3.1
	2						
	3						
	4						
B	1	7	10040	40	B	95.8	4.2
	2	27	4208	30	B	97.5	2.5
	3						
	4						
C	1	10	11167	35	B	95.8	4.2
	2						
	3						
	4						
D	1	10	11585	17	B	97.7	2.3
	2						
	3						
	4						

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Results

Location/ Receptor	Name	Year	Rd NO_X [1]	Adj Rd NO_X [2]	Adj Total NO_X [3]	Adj Rd NO_2 [4]	Adj Total NO_2 [5]	PM_{10}	
			Annual mean $\mu g/m^3$	Annual mean $\mu g/m^3$	Annual mean $\mu g/m^3$	Annual mean $\mu g/m^3$	Annual mean $\mu g/m^3$	Annual mean $\mu g/m^3$	Days $>50\mu g/m^3$
A	North End of Asda Hulme car park	2008	10.91	28.28	68.46	10.53	37.89	20.50	4
B	136 Burton Road	2008	13.37	34.65	63.84	13.34	34.73	18.24	2
C	39 Barlow Moor Road	2008	11.75	30.45	59.92	11.91	33.48	18.00	1
D	108 Withington Road	2008	11.87	30.77	65.00	11.7	35.95	19.50	3

[1] Rd NO_X = Roadside contribution of NO_X from DMRB local output sheet (background NO_X and NO_2 concentrations entered as zero)
[2] Adj Rd NOx = Rd NOx x verification factor (2.5919)
[3] Adj Total NOx = Adj Rd NOx + Background NOx
[4] Adj Rd NO_2 = from NOx to NO_2 calculator (available LAQM Tools)
[5] Adj Total NO_2 = Adj Rd NO_2 + Background NO_2

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Junctions

Input Data

Location/ Receptor	Grid Ref	Background Concentrations			
		Year	NO_X	NO_2	PM_{10}
A	X=385168, Y=401577	2008	32.30	23.73	16.99
B	X=386564, Y=401310	2008	32.26	23.70	16.91
C	X=382978, Y=393552	2008	27.26	20.26	16.27

Location/ Receptor	Link number	Distance from link centre to receptor (m)	Traffic flow & speed		Traffic composition		
			AADT (combined, veh/day)	Annual average speed (km/h)	Road type (A,B,C,D)	Total % LDV (<3.5t GVW)	Total % HDV (>3.5t GVW)
A	1	10	10856	41.9	B	97.4	2.6
	2	10	1830	36.2	B	92.4	7.6
	3						
	4						
B	1	10	10119	38.6	B	94.6	5.3
	2						
	3						
	4						
C	1	20	6343	37.3	A	98.6	1.4
	2	17	4260	27.8	B	97.1	2.9
	3						
	4						

Results

Location/ Receptor	Name	Year	Rd NO_X [1]	Adj Rd NO_X [2]	Adj Total NO_X [3]	Adj Rd NO_2 [4]	Adj Total NO_2 [5]	PM_{10}	
			Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Days >50µg/m^3
A	1 Chataway Rd	2008	11.75	30.45	62.76	11.66	35.39	18.40	2
B	160 Church Lane	2008	11.54	29.91	62.17	11.48	35.18	18.20	2
C	438 Mauldeth Rd West	2008	7.29	18.89	46.16	7.85	28.11	17.30	1

[1] Rd NO_X = Roadside contribution of NO_X from DMRB local output sheet (background NO_X and NO_2 concentrations entered as zero)
[2] Adj Rd NOx = Rd NOx x verification factor (2.5919)
[3] Adj Total NOx = Adj Rd NOx + Background NOx
[4] Adj Rd NO_2 = from NOx to NO_2 calculator (available LAQM Tools)
[5] Adj Total NO_2 = Adj Rd NO_2 + Background NO_2

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Roads with significantly changed traffic flows

Input Data

Location/ Receptor	Grid Ref	Background Concentrations			
		Year	NOX	NO2	PM10
A	X=381460, Y=386055	2008	35.18	24.82	17.56

Location/ Receptor	Link number	Distance from link centre to receptor (m)	Traffic flow & speed		Traffic composition		
			AADT (combined, veh/day)	Annual average speed (km/h)	Road type (A,B,C,D)	Total % LDV (<3.5t GVW)	Total % HDV (>3.5t GVW)
A	1	53	34223	103.7	A	98.9	1.1
	2	75	35027	99.1	A	98.8	1.2
	3	48	6999	47.3	B	95.4	4.6
	4						

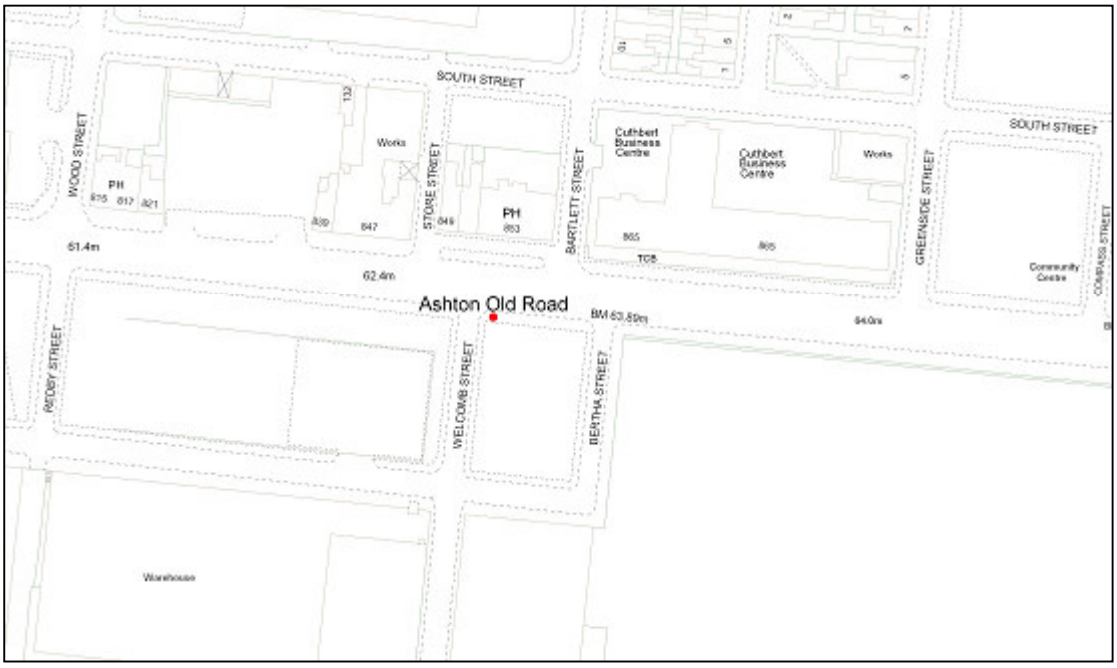
Results

Location/ Receptor	Name	Year	Rd NO_X [1]	Adj Rd NO_X [2]	Adj Total NO_X [3]	Adj Rd NO_2 [4]	Adj Total NO_2 [5]	PM_{10}	
			Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Days >50µg/m^3
A	Holly Cottage, Thorley Lane, Woodhouse Park	2008	13.77	35.69	70.87	13.22	38.04	19.50	3

[1] Rd NO_X = Roadside contribution of NO_X from DMRB local output sheet (background NO_X and NO_2 concentrations entered as zero)
[2] Adj Rd NOx = Rd NOx x verification factor (2.5919)
[3] Adj Total NOx = Adj Rd NOx + Background NOx
[4] Adj Rd NO_2 = from NOx to NO_2 calculator (available LAQM Tools)
[5] Adj Total NO_2 = Adj Rd NO_2 + Background NO_2

Appendix C: Location maps and photographs of monitoring sites

1. Ashton Old Road



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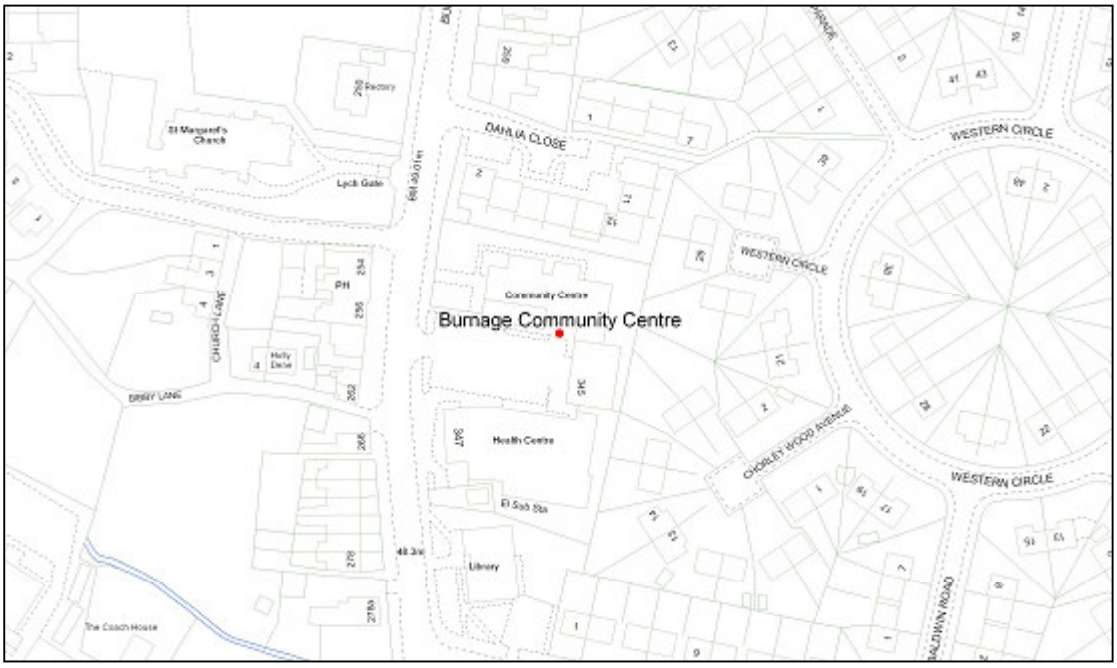
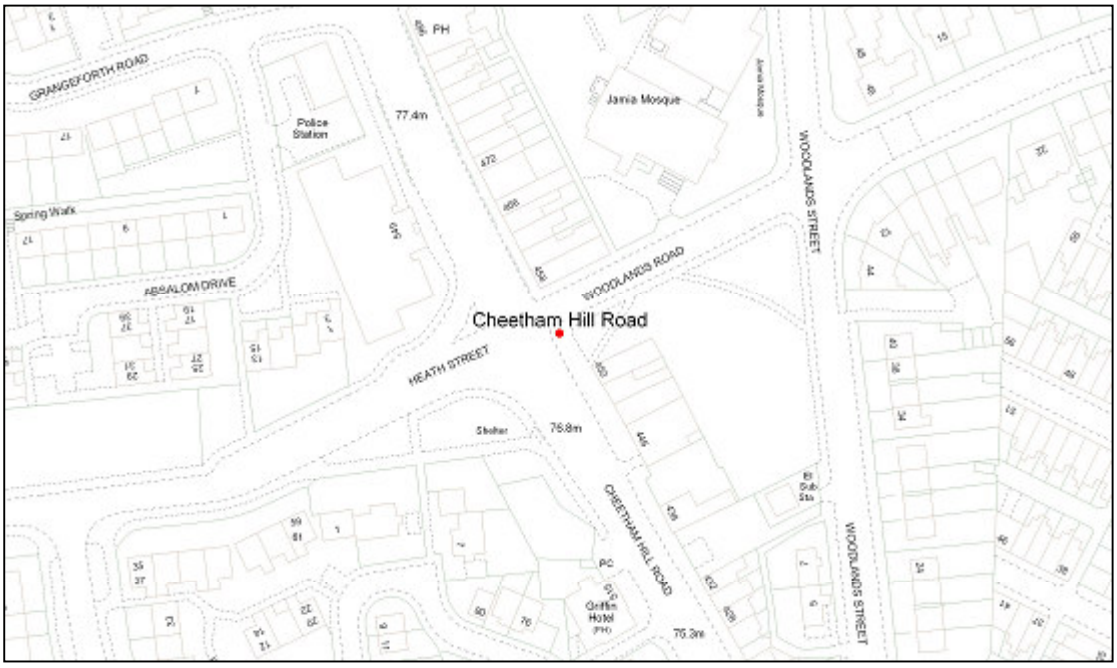
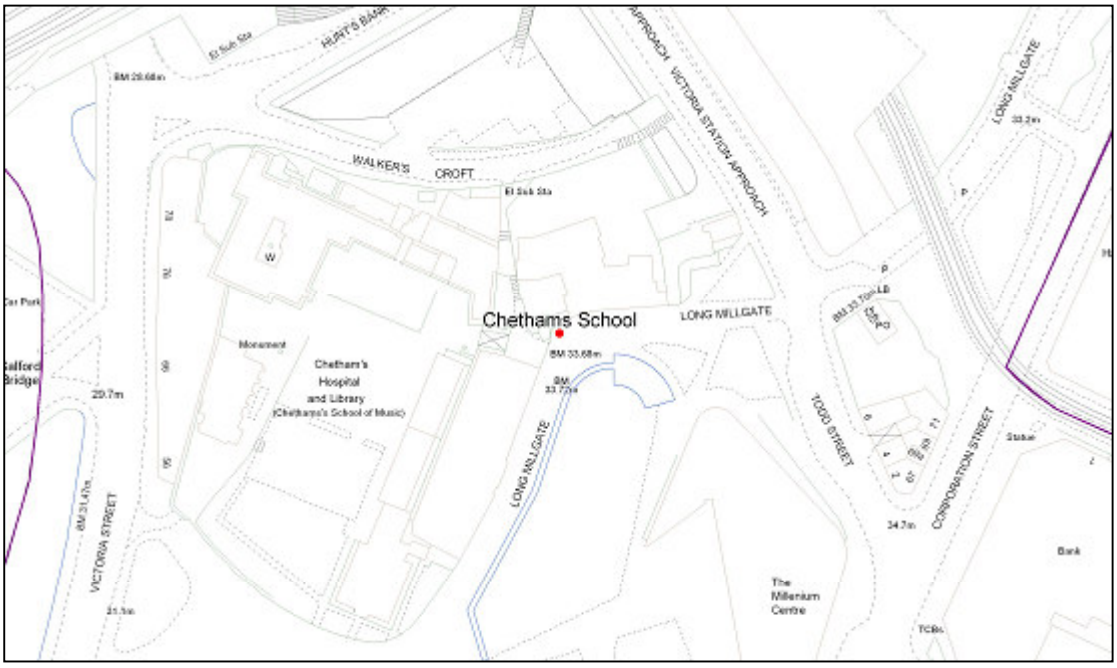
2. Burnage Community Centre



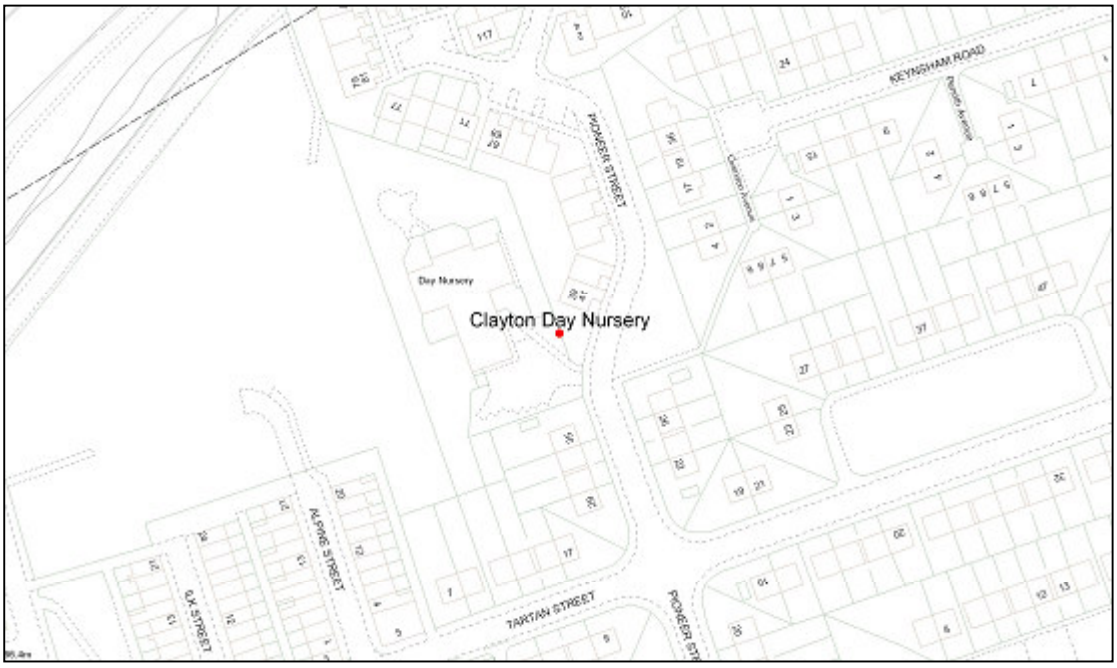
3. Cheetham Hill Road



4. Chethams School



5. Clayton Day Nursery



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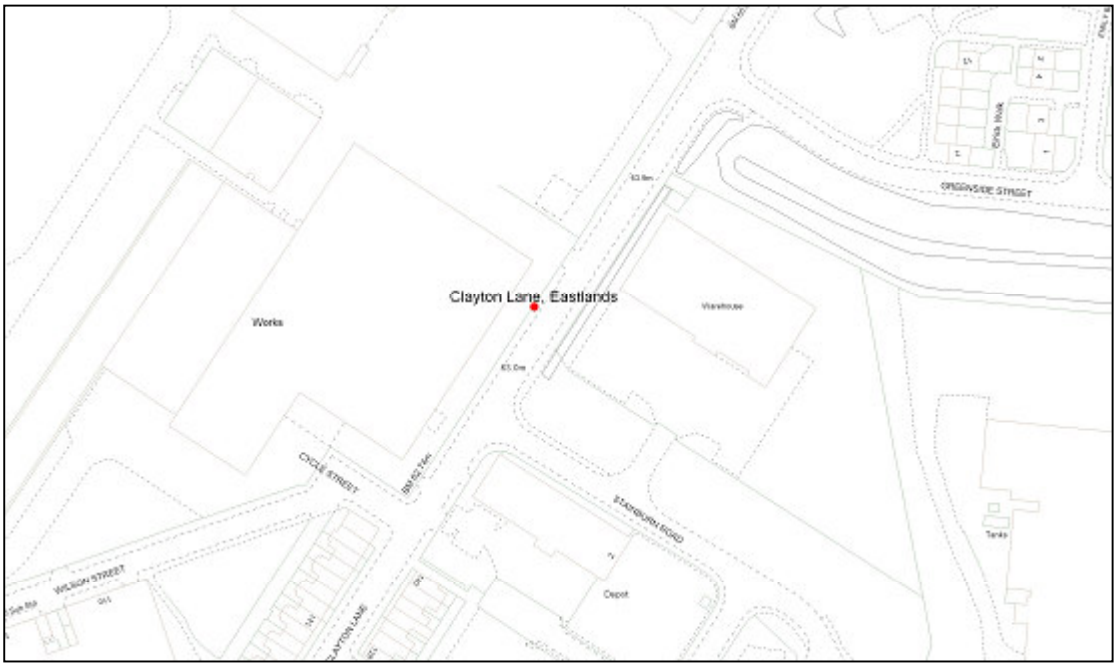
6. Clayton Lane



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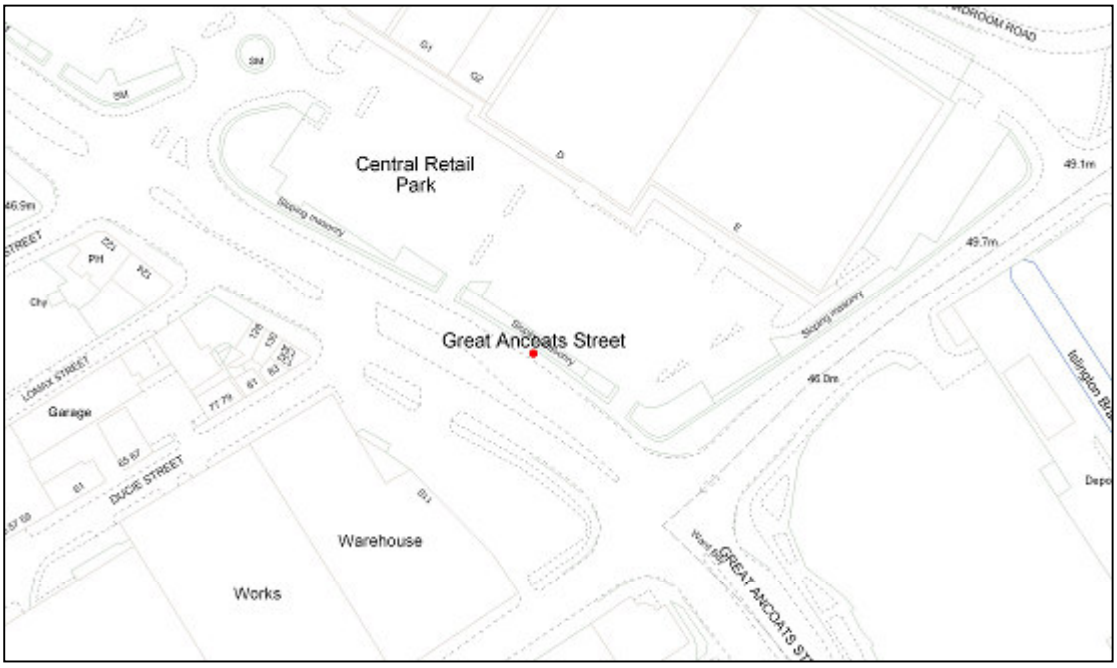
7. Great Ancoats Street



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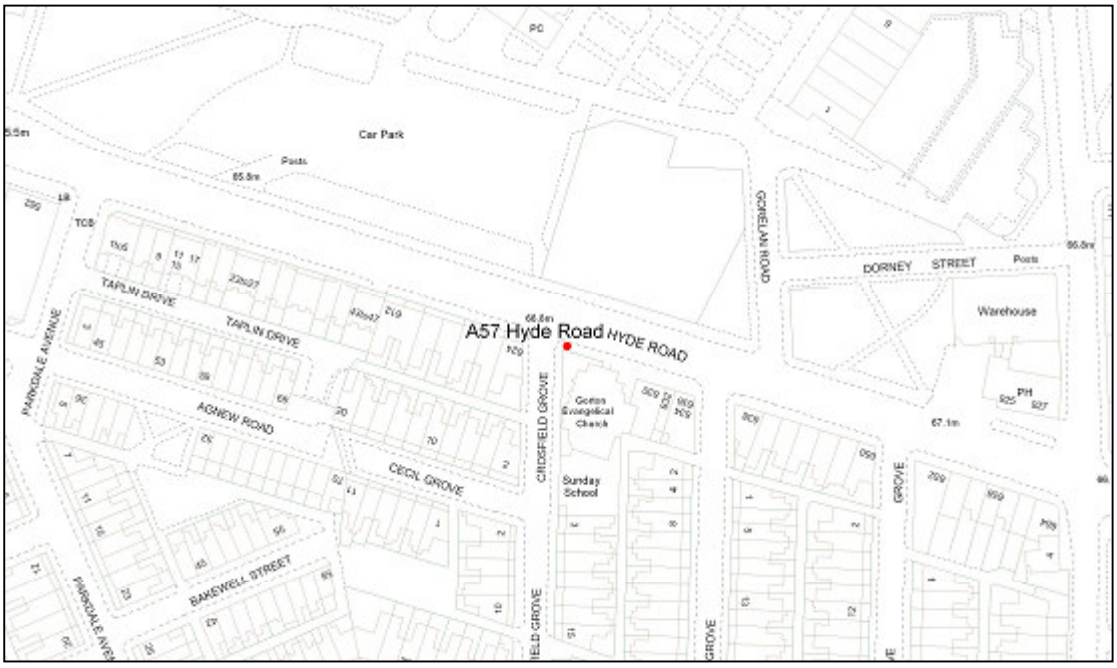
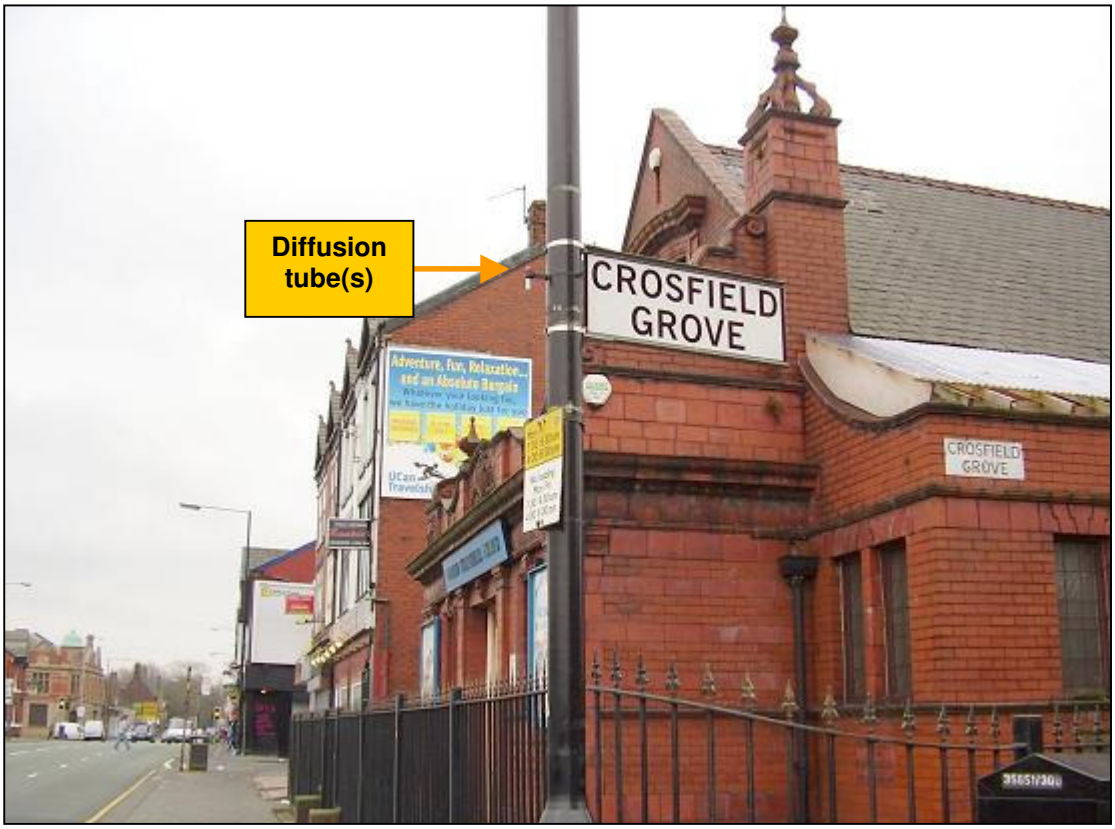
8. Hyde Road





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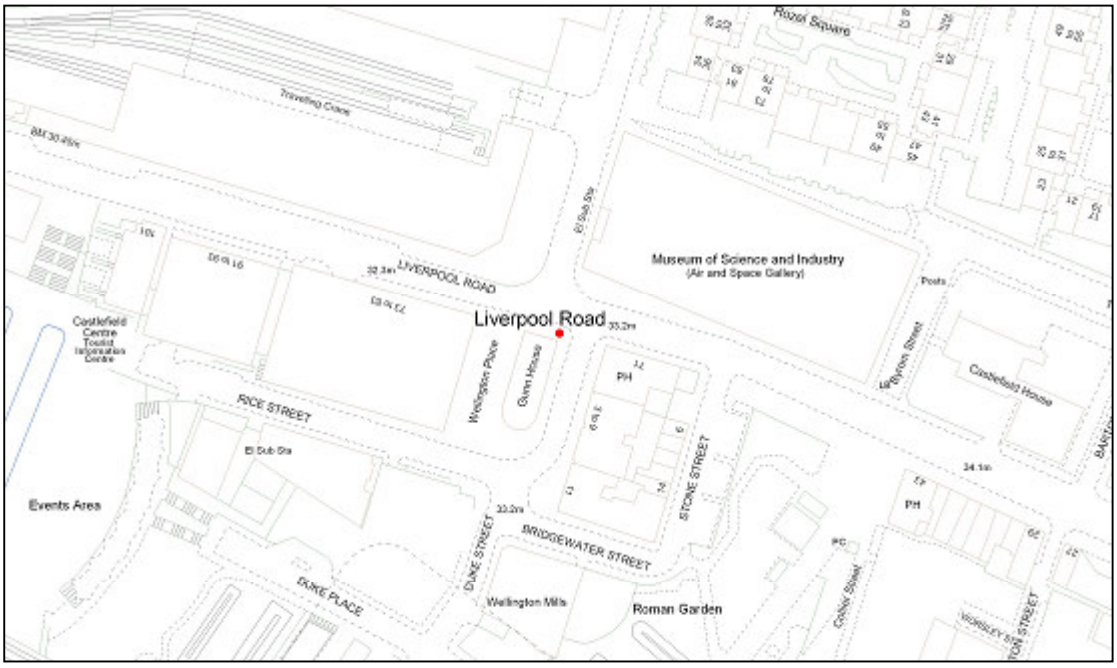
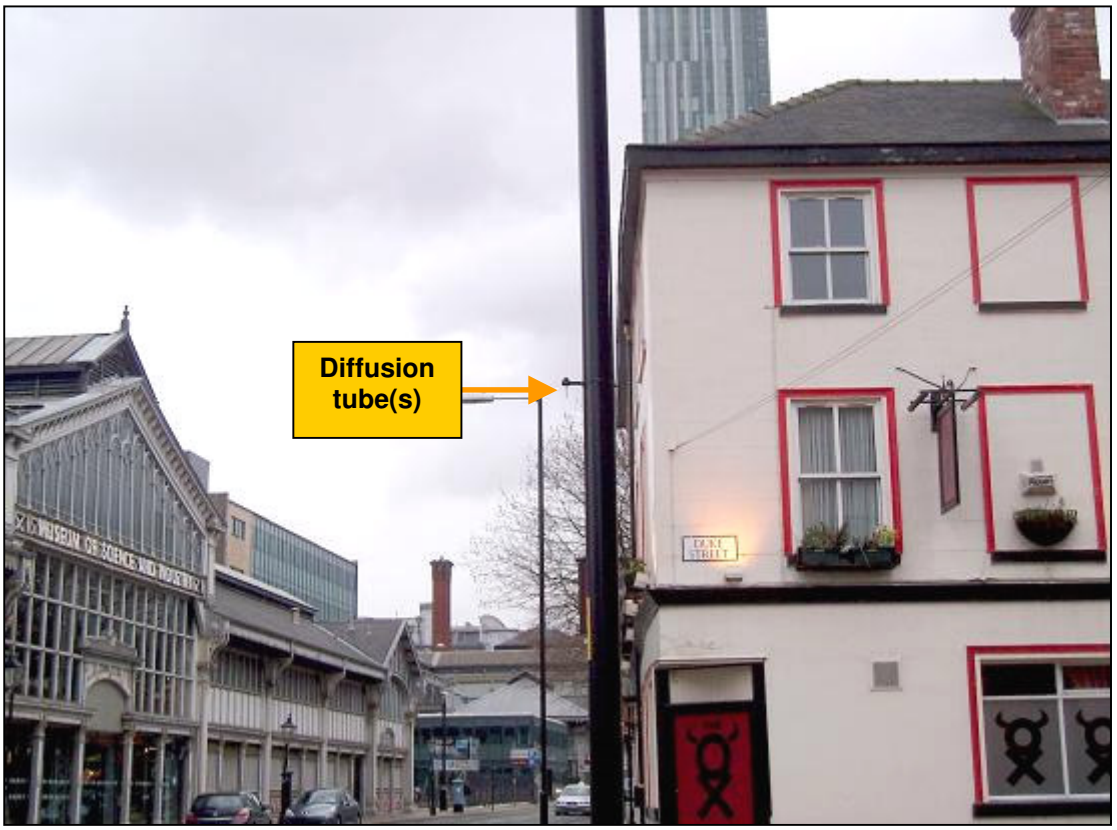
9. Kingsway

10. Liverpool Road





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11. Lockton Close

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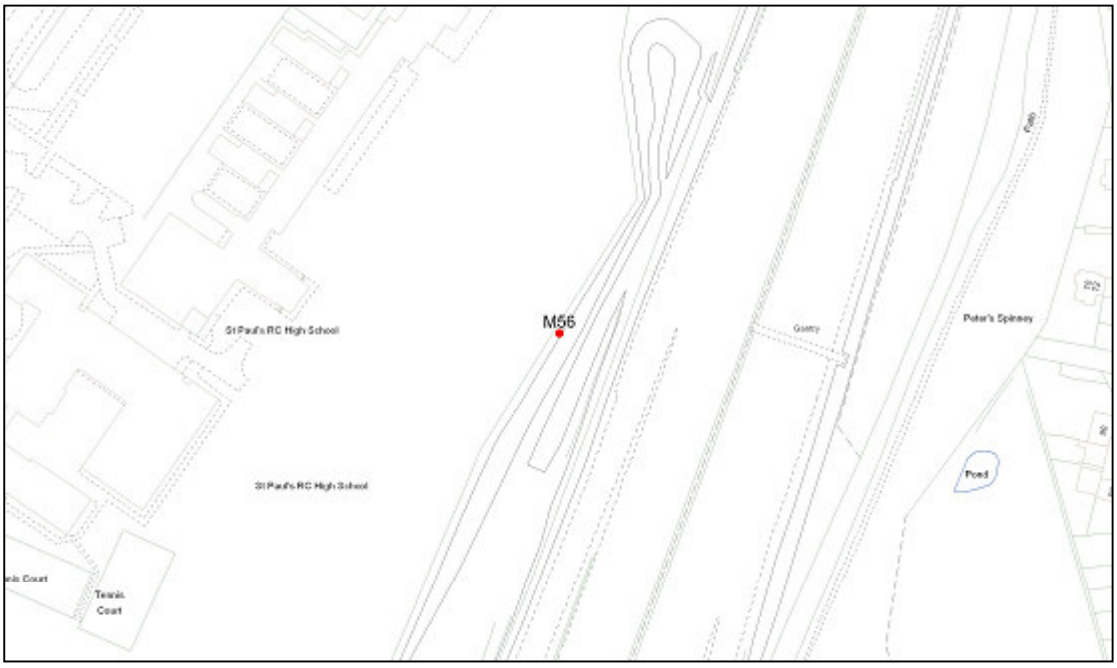
12. M56



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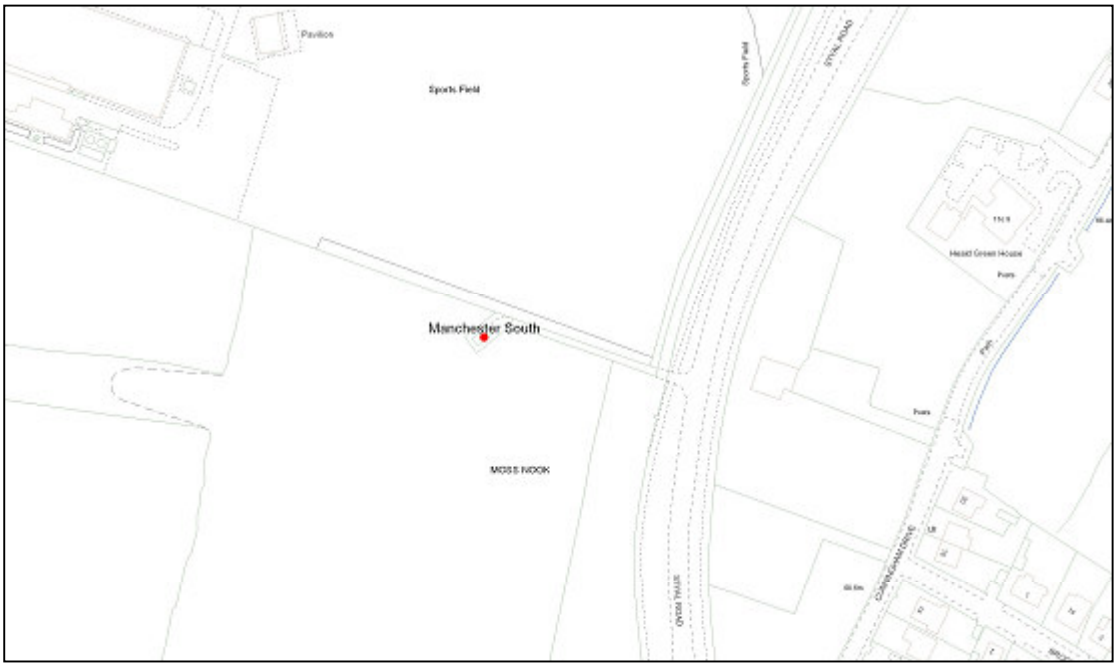
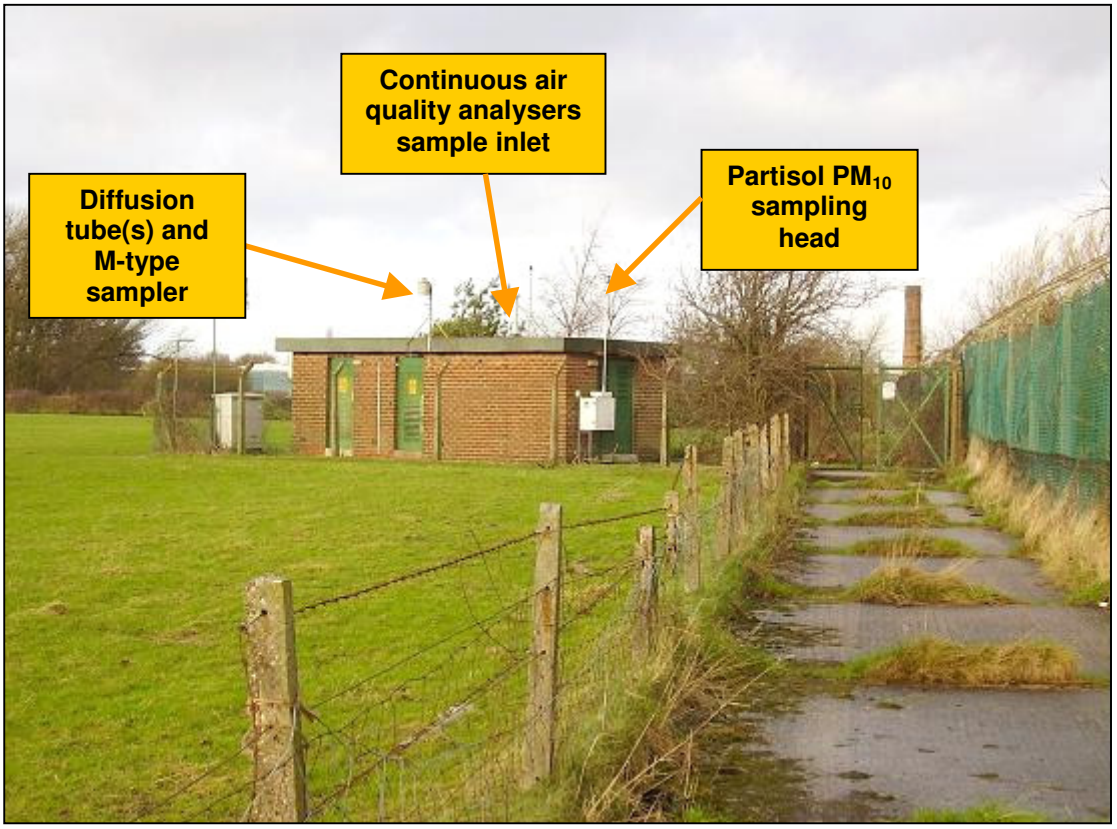
13. Manchester South





14. Newton Street

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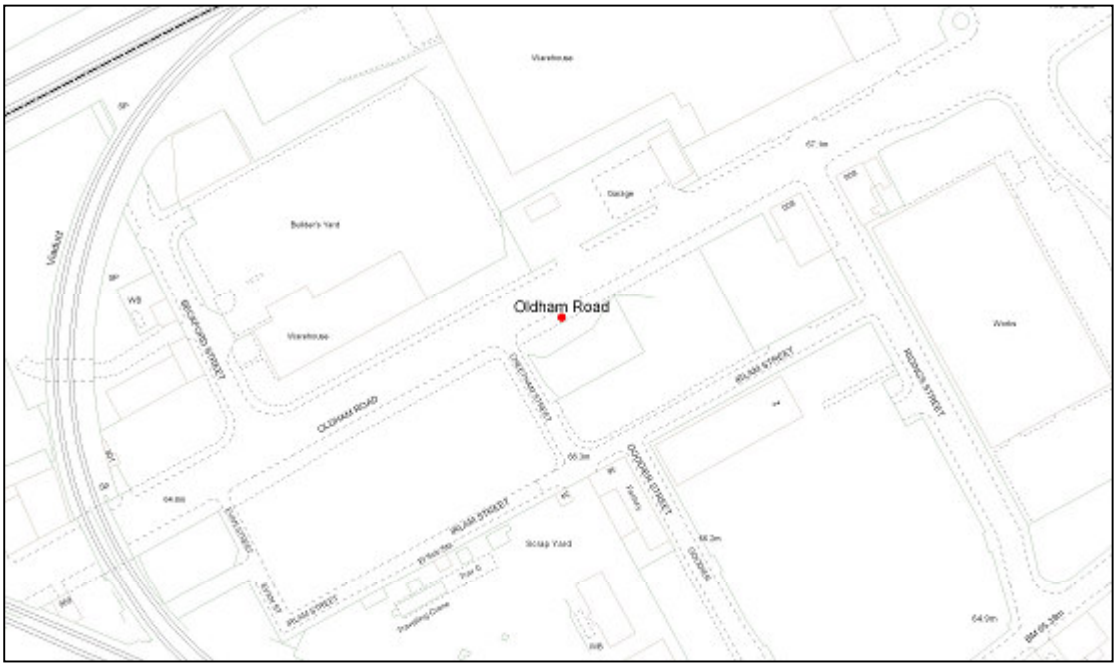
15. Oldham Road



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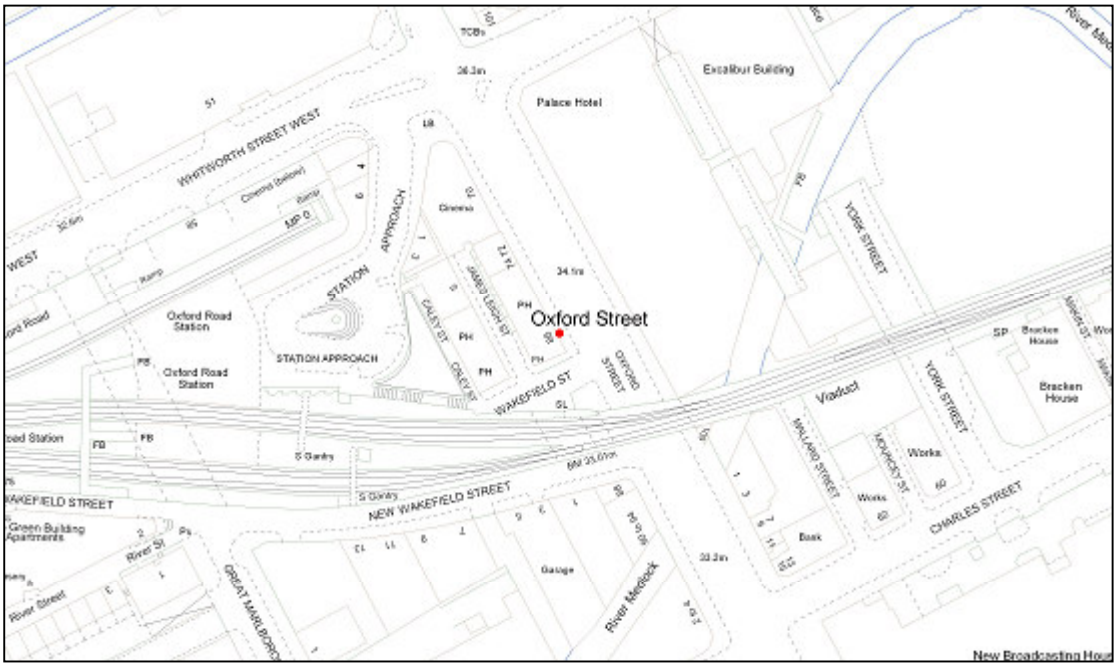
16. Oxford Street



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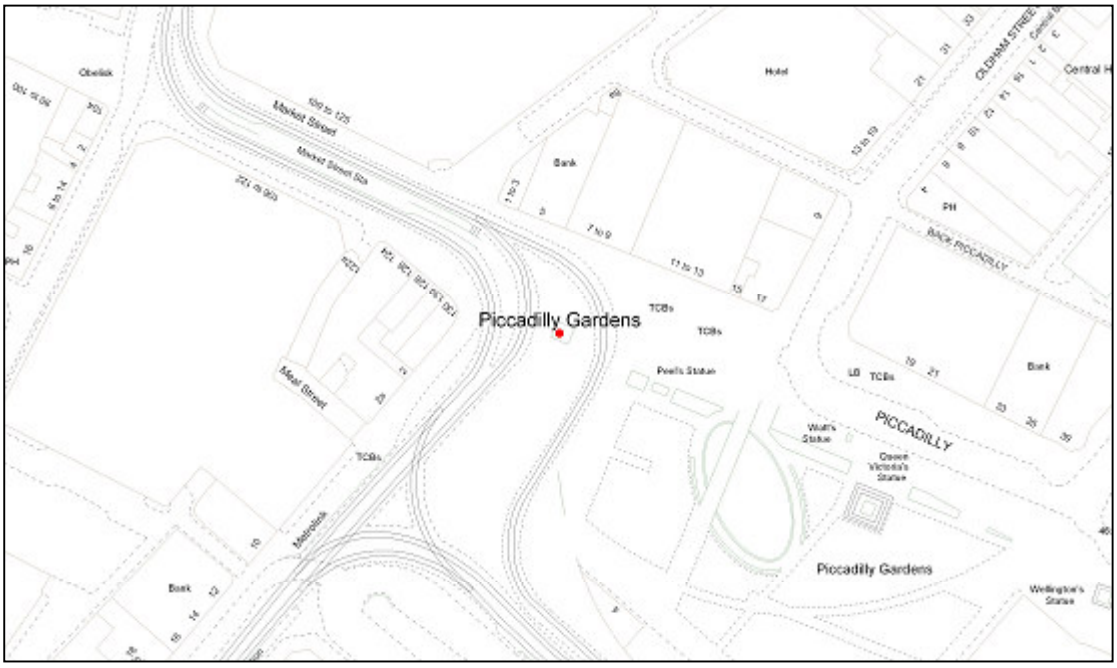
17. Piccadilly Gardens



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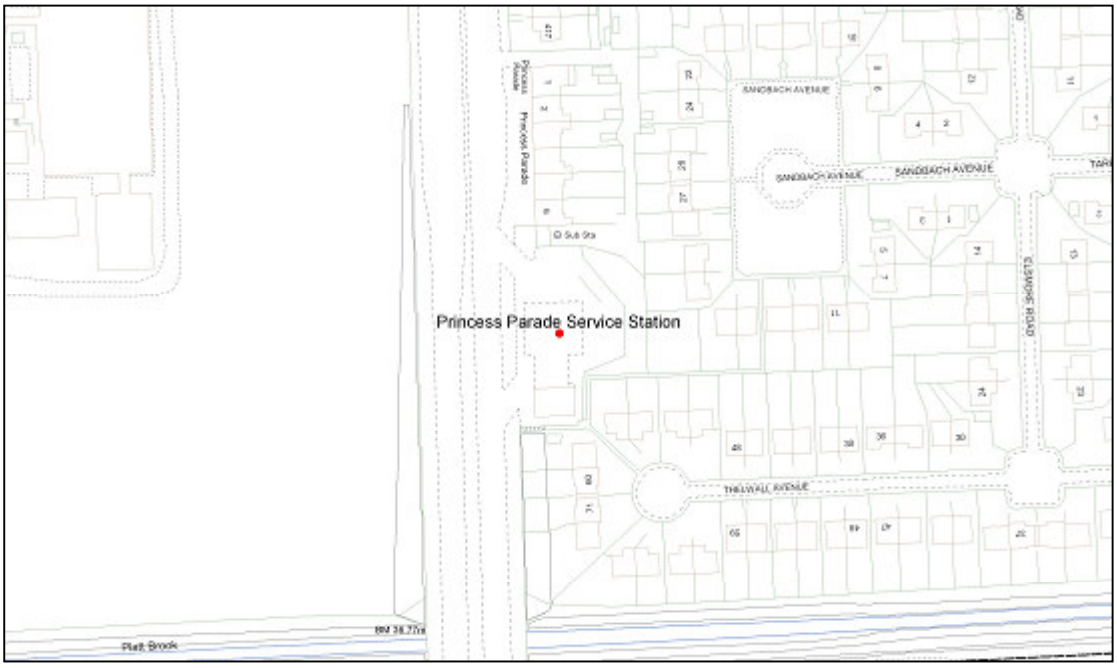
18. Princess Parade Service Station



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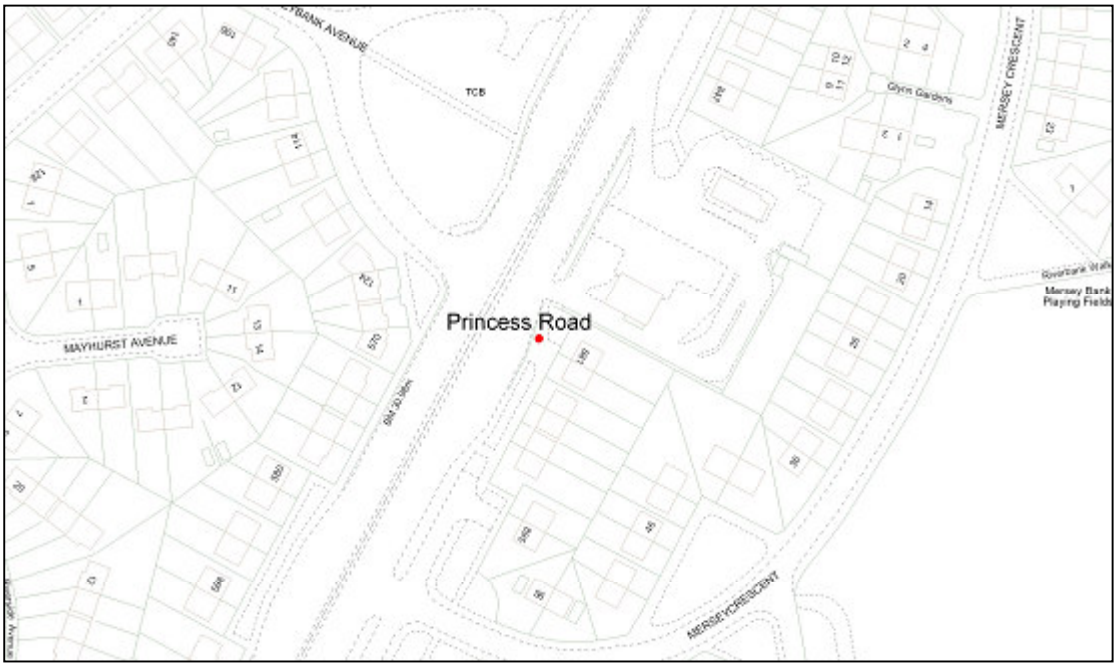
19. Princess Road



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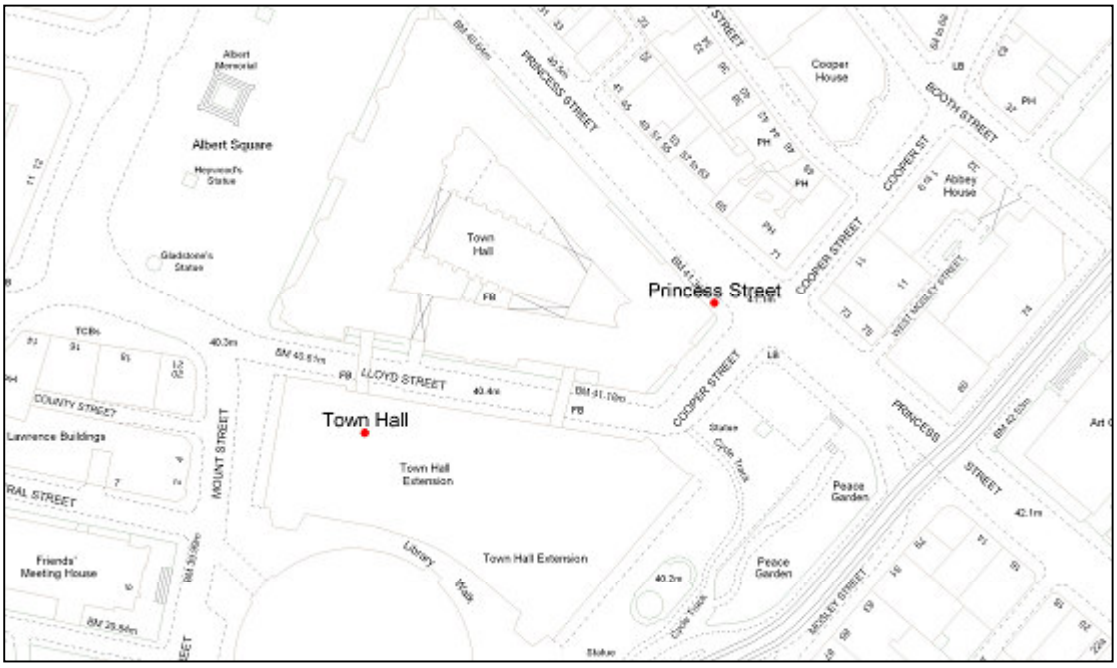
20. Princess Street



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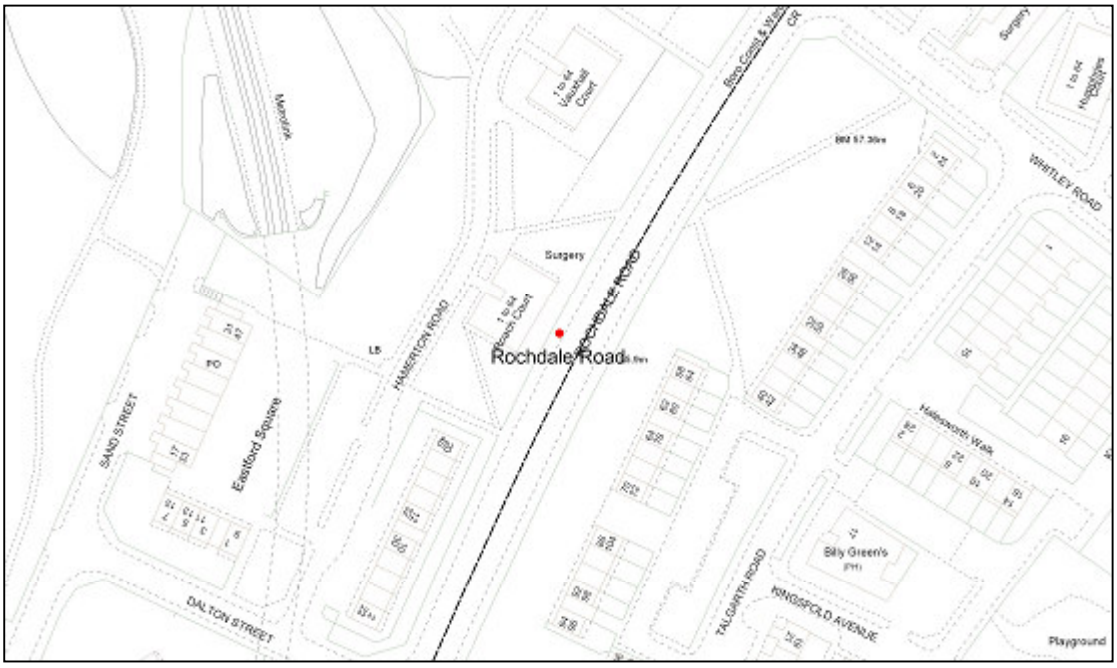
21. Rochdale Road



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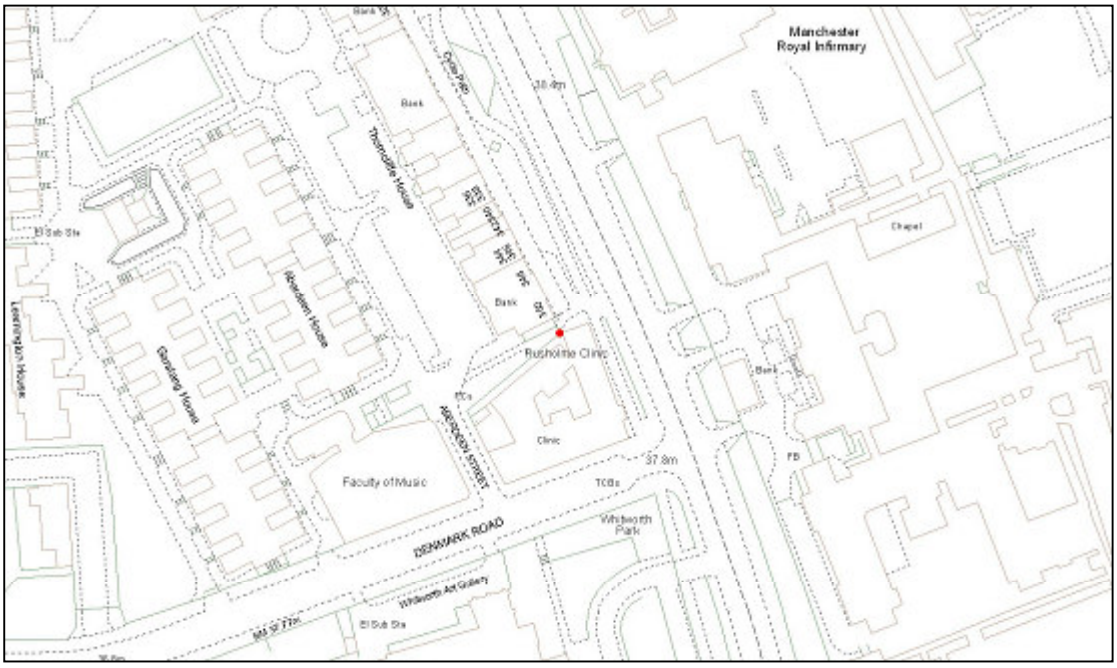
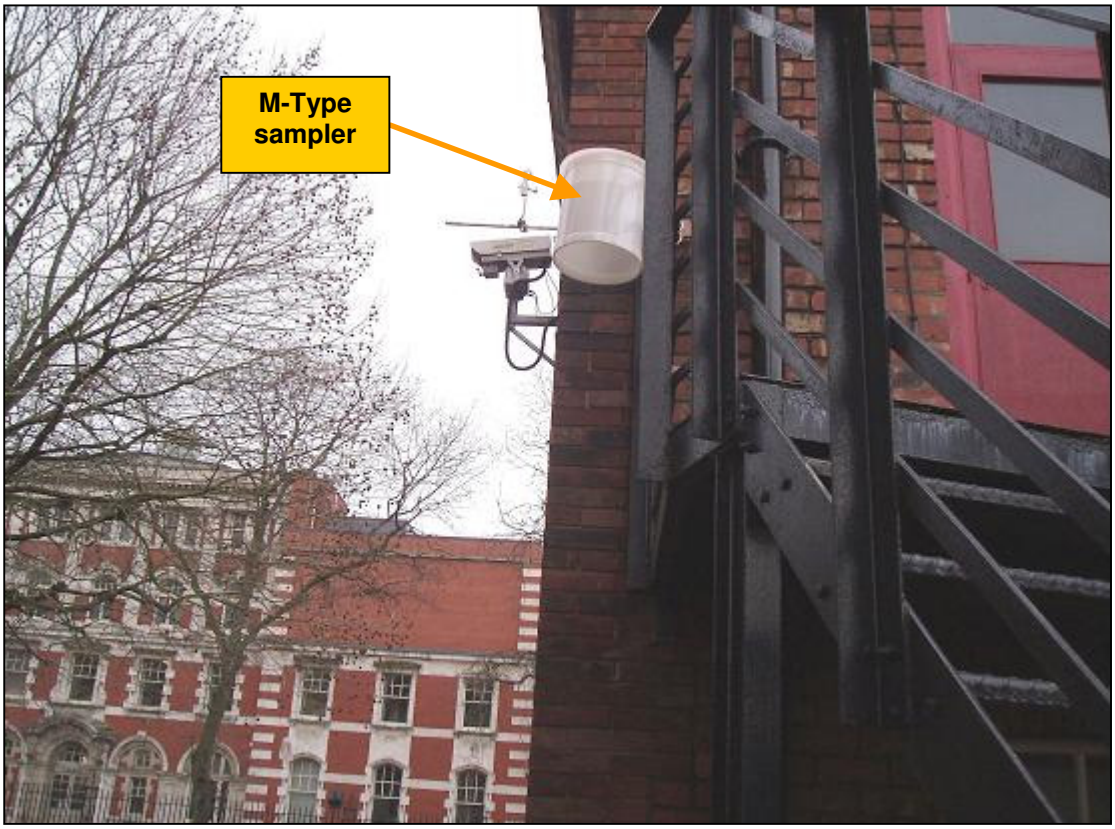
22. Rusholme Clinic





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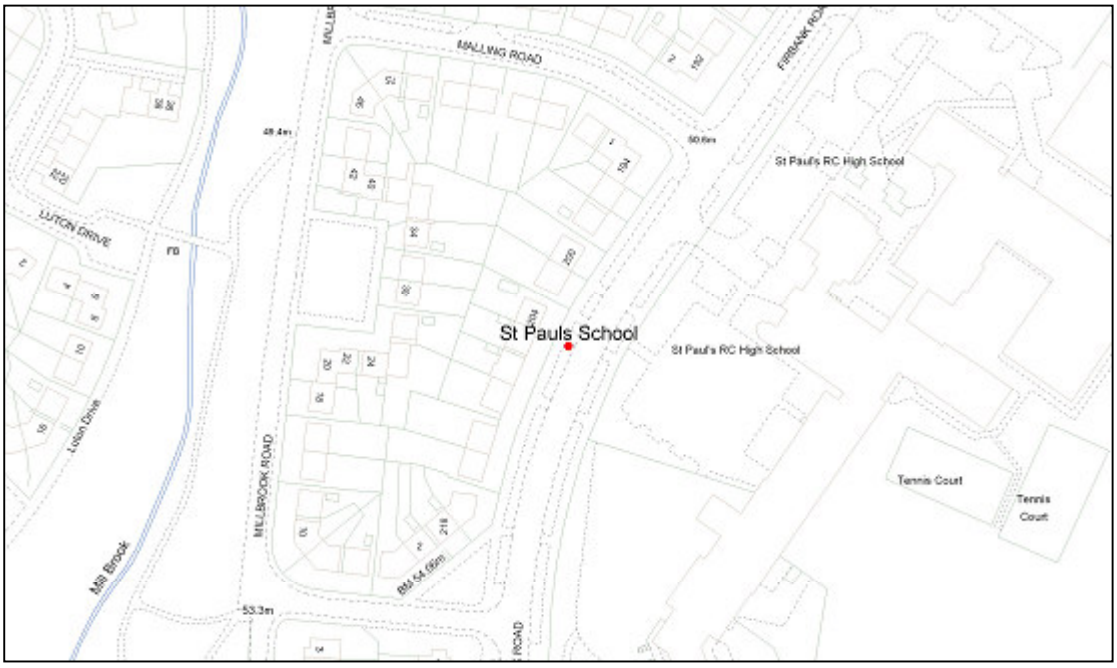
23. St Pauls School



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24. Stockport Road

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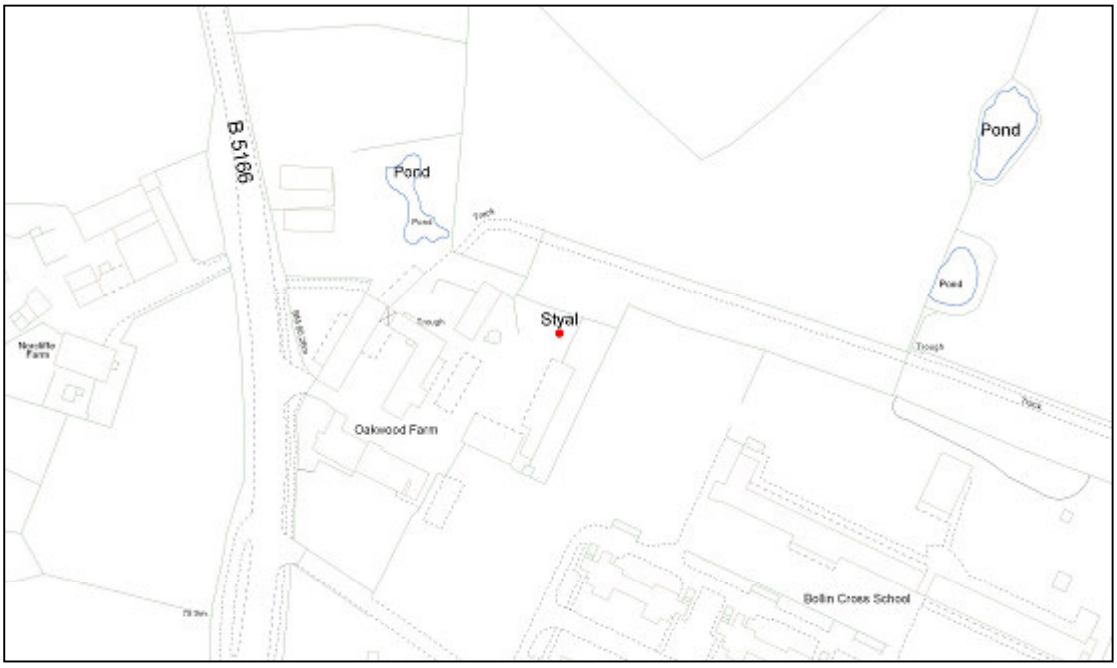
25. Styal



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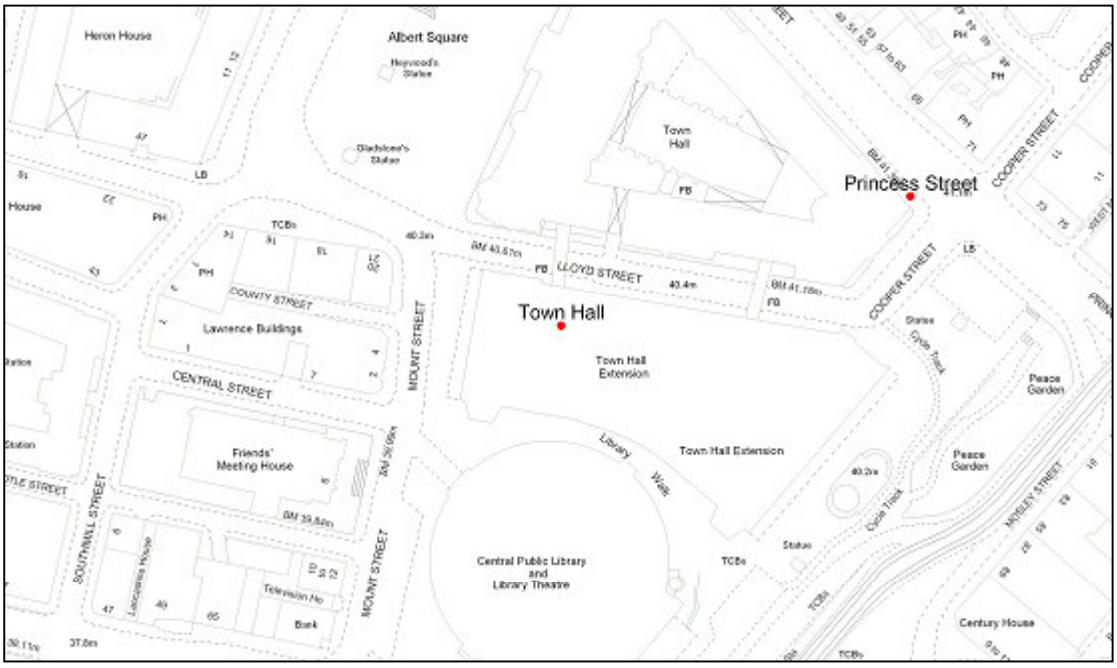
26. Manchester Town Hall



Appendix D: Observations of idling diesel locomotives at Manchester Victoria and Manchester Piccadilly train stations

Manchester Victoria

Date of observation: 14.07.2009
Time of observation: 12:38 to 15:10

Platform number and type	Duration and time train remained stationary with engine running (1)	Duration and time train remained stationary with engine running (2)	Duration and time train remained stationary with engine running (3)	Duration and time train remained stationary with engine running (4)
1 - Terminus (partly enclosed)	10 mins (12:38 to 12:48)	7 mins (12:53 to 13:00)	14 mins (13:07 to 13:21)	-
2 - Terminus (partly enclosed)	3 mins (12:46 to 12:49)	5 mins (13:04 to 13:09)	-	-
3 - Through (partly enclosed)	5 mins (13:34 to 13:39)	2 mins (13:42 to 13:44)	5 mins (14:02 to 14:07)	-
4 - Through (partly enclosed)	8 mins (13:38 to 13:46)	9 mins (13:48 to 13:57)	13 mins (14:19 to 14:32)	3 mins (14:43 to 14:46)
5 - Through (more enclosed than platforms 1 to 4)	14 mins (14:19 to 14:33)	10 mins (14:50 to 15:00)	8 mins (15:02 to 15:10)	-
6 - Through (more enclosed than platforms 1 to 4)	5 mins (14:25 to 14:30)	15 mins (14:47 to 15:02)	-	-

Manchester Piccadilly

Date of observation: 14.07.2009
Time of observation: 13:15 to 14:17

Platform number and type	Duration and time train remained stationary with engine running (1)	Duration and time train remained stationary with engine running (2)	Duration and time train remained stationary with engine running (3)
1 - Terminus	-	-	-
2 - Terminus	-	-	-
3 - Terminus	5 mins (13:41 to 13:46)	-	-
4 - Terminus	14 mins (13:31 to 13:45)	-	-
5 - Terminus	18 mins (13:20 to 13:38)	-	-
6 - Terminus	-	-	-
7 - Terminus	-	-	-
8 - Terminus	35 mins (13:15 to 13:50)	-	-
9 - Terminus	11 mins (13:40 to 13:51)	-	-
10 - Terminus	27 mins (13:26 to 13:53)	-	-
11 - Terminus	42 mins (13:35 to 14:17)	-	-
12 - Terminus	19 mins (13:45 to 14:04)	-	-
13 - Through	2 mins (13:58 to 14:00)	-	-
14 - Through	-	-	-

Not all trains entering the stations were noted, however the above observations are a deemed to be a representative sample.