Glasgow City Council Detailed Assessment for Local Air Quality Management 2013

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Executive Summary

Monitoring of nitrogen dioxide (NO_2) through diffusion tubes in 2010 and 2011 indicated exceedences of the annual mean objective at two areas of Glasgow outwith the existing Air Quality Management Areas. This was reported in the Glasgow City Council Updating and Screening Assessment (USA) 2012.
The areas identified are:

- Crow Road
- Great Western Road, Woodlands Road and surrounding areas.

Consequently, the conclusions of the USA indicated that a Detailed Assessment of air quality in these areas was required. This Detailed Assessment includes dispersion modelling for a base year of 2012 to determine whether breaches of the objective level are likely. Modelling was also undertaken for future years through to 2015 to determine whether any exceedences were likely to endure.

The results of the modelling exercise suggest that there is little risk that the 40 $\mu g/m^3$ annual mean objective for NO_2 will be exceeded at the locations within the study area. Modelling predicted only one marginal exceedence of the objective in 2012 at a location which is not representative of public exposure. This receptor was predicted to meet the objective from 2013 onwards. Modelling also indicated that three relevant receptors would fall within the range of 36 – 40 $\mu g/m^3$ in 2012. Future year projections indicated that all of these would fall below this range by 2015.

The monitoring results for 2012 indicate that those locations which previously exceeded the objective are now recording levels within the objective.

Given the results from the modelling and monitoring of NO_2 in the study area, there is no need at present to declare new AQMAs. However, monitoring will continue at these locations to verify this conclusion.

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Introduction

1.1 Background

The Glasgow City Council Updating and Screening Assessment (USA) 2012 identified two areas within the city where there was the possibility of exceedences of the nitrogen dioxide (NO_2) annual average Air Quality Strategy (AQS) Objective. This possibility was highlighted through results from NO_2 diffusion tubes in the respective areas for 2010 and 2011.

The areas identified were:

- Crow Road
- Great Western Road, Woodlands Road and surrounding areas.

Consequently, it was determined that a Detailed Assessment of air quality in these areas was required and dispersion modelling was therefore undertaken for a base year of 2012 to determine whether breaches of the objective level are likely. Modelling was also undertaken for future years through to 2015 to determine whether any exceedences were likely to endure.

1.2 Air Quality Legislation and Guidance

The air quality objectives applicable to LAQM in **Scotland** are set out in the Air Quality (Scotland) Regulations 2000 (Scottish SI 2000 No 97), the Air Quality (Scotland) (Amendment) Regulations 2002 (Scottish SI 2002 No 297), and are shown in Table 1.1.

Table 1.1 Air Quality Objectives for NO_2 included in Regulations for the purpose of LAQM in Scotland

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Nitrogen dioxide (NO_2)	200 µgm^{-3}	1-hour mean; not to be exceeded more than 18 times a year	31/12/2005
	40 µgm^{-3}	Annual mean	31/12/2005

2.0 Methods

2.1 Model

The air dispersion modelling was undertaken using ADMS-Urban version 3.1 supplied by Cambridge Environmental Research Consultants Ltd. The ADMS model was used to predict annual mean concentrations for NO_x over the period of 2012 to 2015.

Modelling was based on year specific traffic emission factors from the Emission Factors Toolkit version 5.2 (EFT) provided by DEFRA and the Devolved Administrations. This spreadsheet uses detailed traffic flow information to calculate NO_x emissions in a format suitable for use with ADMS-Urban.

Annual mean NO_2 concentrations were then calculated from model outputs using the NO_x to NO_2 conversion spreadsheet version 3.2 which is again provided by DEFRA and the Devolved Administrations.

2.2 Data

2.2.1 Canyons

All modelled locations were visited in order to assess building heights, canyon continuity, building use and the extent of traffic congestion. Road and canyon widths were also estimated during the site visits and confirmed using GIS mapping. Table 2.1 shows the assumed building heights used in the modelling exercise.

Table 2.1: Assumed building heights used in dispersion modelling

Type of building	Estimated typical height*
One storey building	10m
Two storey building	15m
Three storey traditional tenement / Four storey modern flats	20m
Four storey traditional tenement / Five storey modern flats	25m

*These estimates were adjusted if the buildings looked particularly tall or squat.

2.2.2 Traffic Counts and Emissions

Traffic counts were commissioned by Glasgow City Council and conducted at relevant junctions during May 2013. Counts were broken down into vehicle classifications in line with the Detailed Option 1 within the EFT spreadsheet to better understand the major contributors to air pollution at each location. The data was provided as 12 hour counts which were converted to Annual Average Daily Traffic counts using a factor of 1.22 in order to be consistent with advice from the traffic section of Glasgow City Council. Vehicle emission

rates were as calculated using the EFT spreadsheet for 2012 to be consistent with the meteorological data. Predicted concentrations for future years to 2015 were calculated in accordance with the procedures outlined in TG(09), using the relevant inputs to the EFT spreadsheet. Traffic counts were not adjusted for future years following advice from Glasgow City Council transport section that traffic levels in Glasgow have not risen significantly over the last few years.

Traffic speeds were estimated from knowledge of local conditions coupled with traffic speed surveys where this information was available. Some investigation was undertaken of estimated vehicle speed on model outputs.

2.2.3 Model Background NO_x and NO_2 Concentrations

Background concentrations for NO_2 and NO_x for the years 2012 through to 2015 were taken from the Scottish background maps provided from www.scottishairquality.co.uk. These compared favourably with background diffusion tube monitoring results where they were available for the relevant locations.

The NO_x and NO_2 concentrations in micrograms per cubic metre for each of the modelled areas are presented in Table 2.2

Table 2.2: Background NO_x and NO_2 concentrations

Modelled Area	2012		2013		2014		2015	
	NO_x	NO_2	NO_x	NO_2	NO_x	NO_2	NO_x	NO_2
Crow Rd North	30.1	17.7	28.8	17.1	27.5	16.4	26.2	15.8
Crow Rd South	37.7	21.3	36.0	20.5	34.4	19.8	32.7	19.0
Great Western Rd at Bank St	39.7	22.3	38.0	21.5	36.2	20.7	34.5	19.9
Great Western Rd East	49.4	26.4	47.2	25.5	45.0	24.6	42.8	23.7

2.2.4 Weather Data

Hourly weather data for the Glasgow Bishopton weather station was provided from the Met Office. Data from 2012 was used for direct comparison with the 2012 monitoring data for model verification. Meteorological data from 2010 and 2011 was also used to investigate the impact of various weather years on the predicted concentrations. It was found that meteorological data for 2010 produced slightly higher predicted concentrations than the other years and therefore this data was used for future year predictions to ensure a worst case scenario was followed.

Figure 2.1: Bishopton Wind Rose 2010

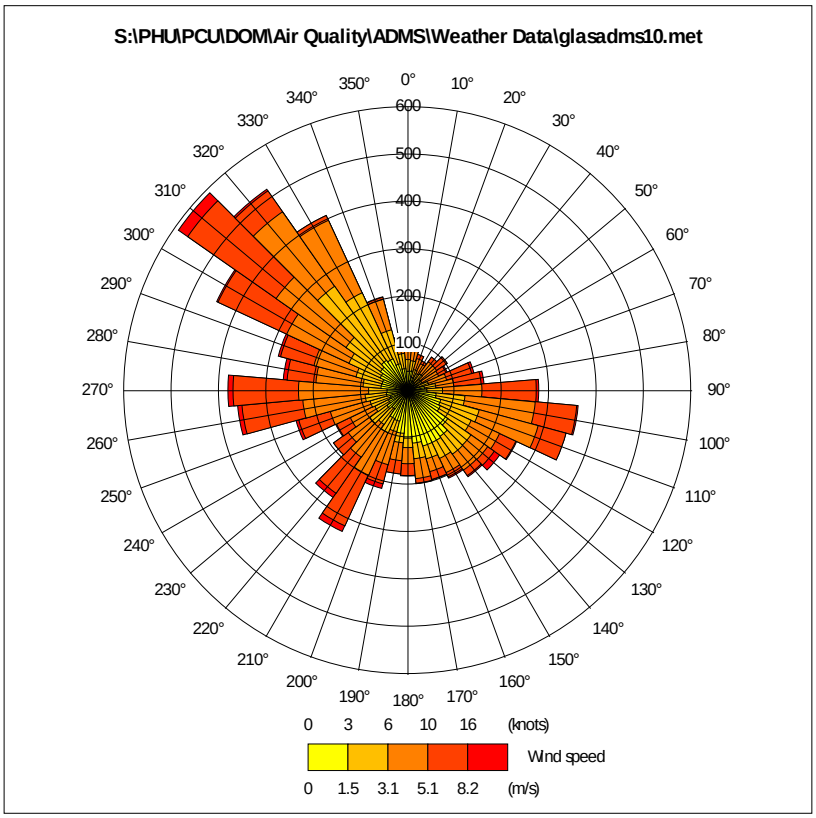


Figure 2.2: Bishopton Wind Rose 2011

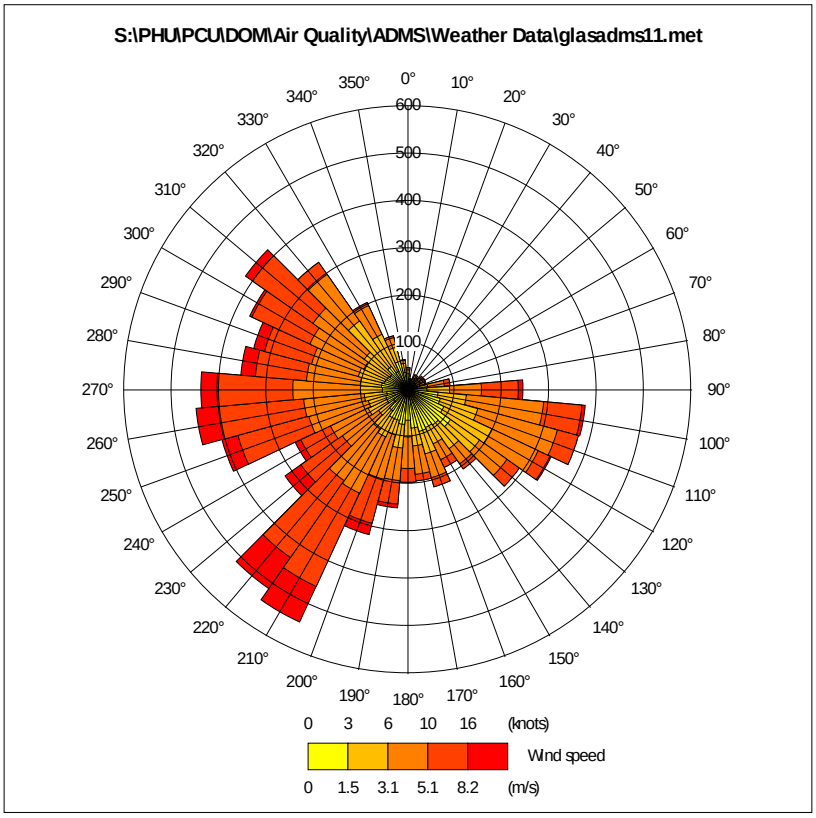
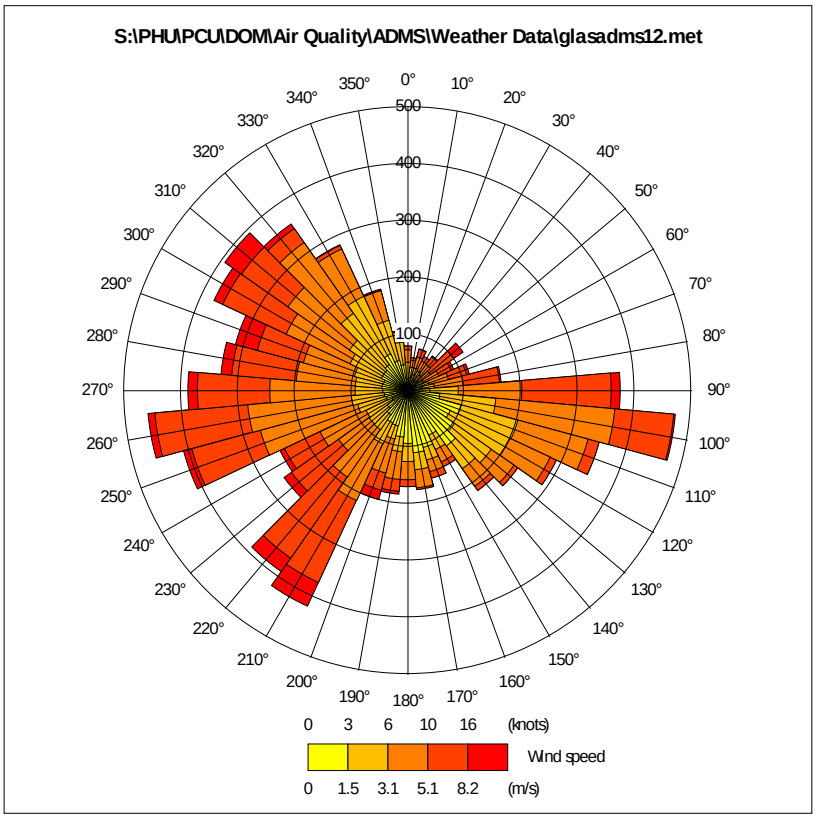


Figure 2.3: Bishopton Wind Rose 2012



2.3 Model Verification

The performance of the ADMS model was verified for NO_2 against the results of diffusion tube measurements made at relevant locations following the procedure outlined in TG(09). There was no clear under or over reading of the model and the model was therefore not adjusted. Details of the verification process are given in the results section of this report.

2.4 Road Sources and Receptors

The Crow Road area lies to the west of the city and the Crow Road itself forms a major thoroughfare linking the Anniesland Cross area to the south side of the city via the Clyde tunnel. The presence of residential properties immediately adjacent to the road increases the likelihood of relevant exposure to traffic generated air pollution.

The Great Western Road and Woodlands Road locations occupy the area in between the City Centre AQMA and the Byres Road/Dumbarton Rd AQMA. The two named streets form the major thoroughfares between these areas and as such experience high traffic flows. The general area has a large number of residential properties, mainly within tenement style buildings.

With all the studied areas, receptor height was set at the default one metre within ADMS with the exception of the Great Western Road East model run. This location is predominantly commercial properties at ground level with residential properties located above. Where this is the case the receptor height was set at either four or five metres depending on the specific building characteristics. This approach allows only exposure relevant to the objective levels to be considered.

2.4.1 Crow Road North

Figure 2.4: Crow Road North – Modelled roads and receptors

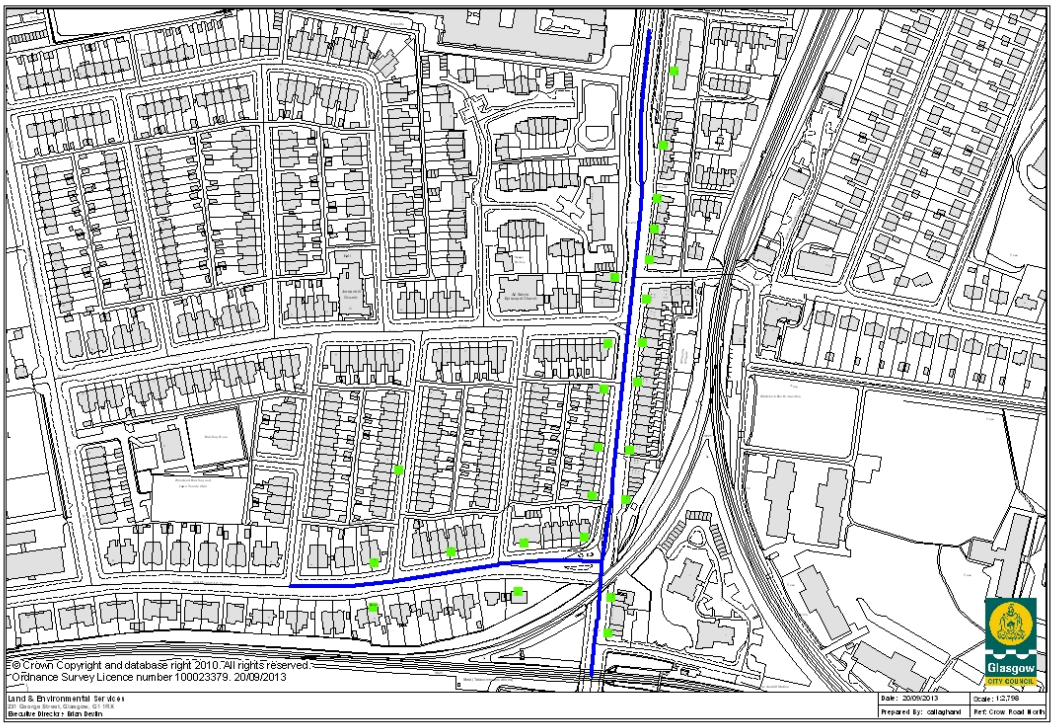


Table 2.3: Crow Road North receptors

Receptor	Location	Type	Coordinates	
			x	y
1	680 Crow Rd	Residential	254663	668406
2	662 Crow Rd	Residential	254655	668351
3	644 Crow Rd	Residential	254651	668311
4	632 Crow Rd	Residential	254648	668288
5	136 Whittinghame Dr	Residential	254645	668265
6	575 Crow Rd	Residential	254619	668252
7	620 Crow Rd	Residential	254643	668236
8	Crow Rd Tube	Residential	254639	668203
9	1 Woodend Dr	Residential	254614	668202
10	582 Crow Rd	Residential	254636	668173
11	569 Crow Rd	Residential	254611	668168
12	556 Crow Rd	Residential	254630	668122
13	555 Crow Rd	Residential	254606	668125
14	530 Crow Rd	Commercial	254627	668086
15	543 Crow Rd	Residential	254602	668088
16	2 Southbrae Dr	Residential	254596	668057
17	17 Southbrae Dr	Residential	254547	668017
18	12 Southbrae Dr	Residential	254551	668053
19	24 Southbrae Dr	Residential	254496	668046
20	33 Southbrae Dr	Residential	254437	668004
21	34 Southbrae Dr	Residential	254438	668038
22	Milner Rd Tube	Residential	254457	668107
23	522 Crow Rd	Commercial	254616	668012
24	508 Crow Rd	Commercial	254614	667986

2.4.2 Crow Road South

Figure 2.5: Crow Road South – Modelled roads and receptors

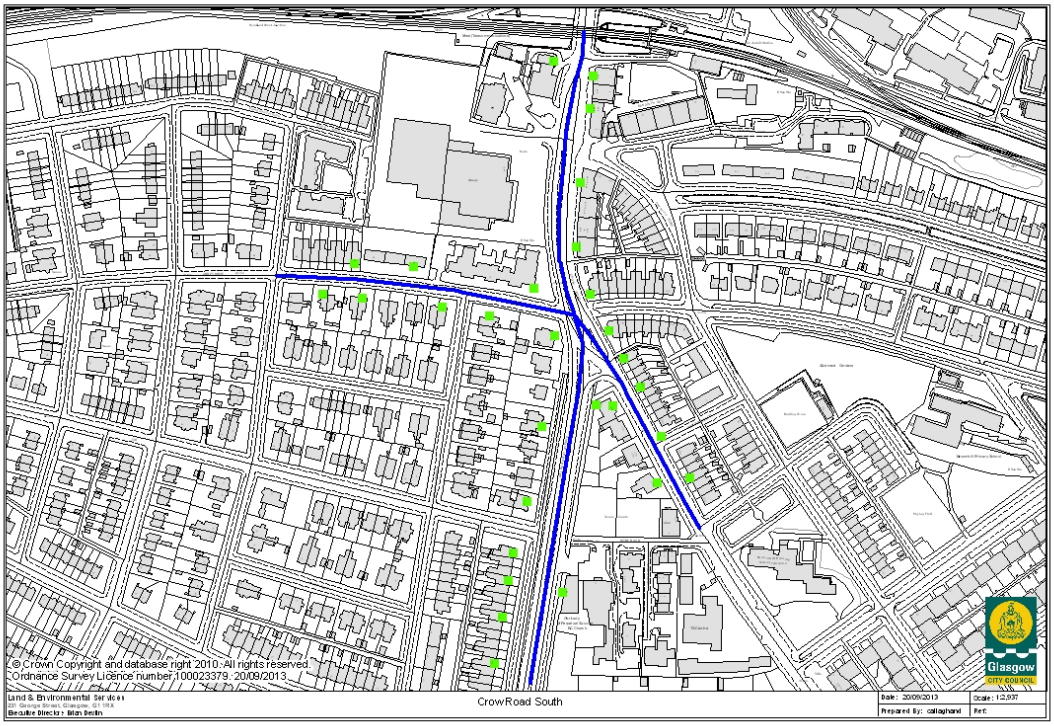


Table 2.4: Crow Road South receptors

Receptor	Location	Type	Coordinates	
			x	y
1	Crow Rd 2 Tube	Commercial ground / Residential above	254606	667894
2	Poplar Ave Tube	Residential	254662	667635
3	494 Crow Rd	Commercial ground / Residential above	254609	667919
4	480 Crow Rd	Commercial ground / Residential above	254599	667835
5	454 Crow Rd	Commercial ground / Residential above	254595	667785
6	164 Beechwood Dr	Residential	254606	667747
7	450 Crow Rd	Residential	254621	667719
8	446 Crow Rd	Residential	254633	667697
9	438 Crow Rd	Residential	254645	667674
10	420 Crow Rd	Residential	254685	667602
11	423 Crow Rd	Residential	254659	667599

12	437 Crow Rd	Residential	254624	667659
13	154 Balshagray Ave	Residential	254611	667660
14	92 Balshagray Ave	Church	254584	667512
15	111 Balshagray Ave	Residential	254531	667457
16	121 Balshagray Ave	Residential	254537	667493
17	127 Balshagray Ave	Residential	254542	667521
18	135 Balshagray Ave	Residential	254545	667544
19	139 Balshagray Ave	Residential	254556	667584
20	149 Balshagray Ave	Residential	254568	667643
21	157 Balshagray Ave	Residential	254578	667715
22	20 Abby Dr	Residential	254562	667752
23	1 Abby Dr	Residential	254527	667730
24	3 Abby Dr	Residential	254490	667737
25	15 Abby Dr	Residential	254426	667744
26	21 Abby Dr	Residential	254395	667747
27	34 Abby Dr	Residential	254421	667771
28	26 Abby Dr	Residential	254467	667769
29	501 Crow Rd	Commercial	254577	667930

2.4.3 Great Western Road at Bank St

Figure 2.6: Great Western Road at Bank St – Modelled roads and receptors

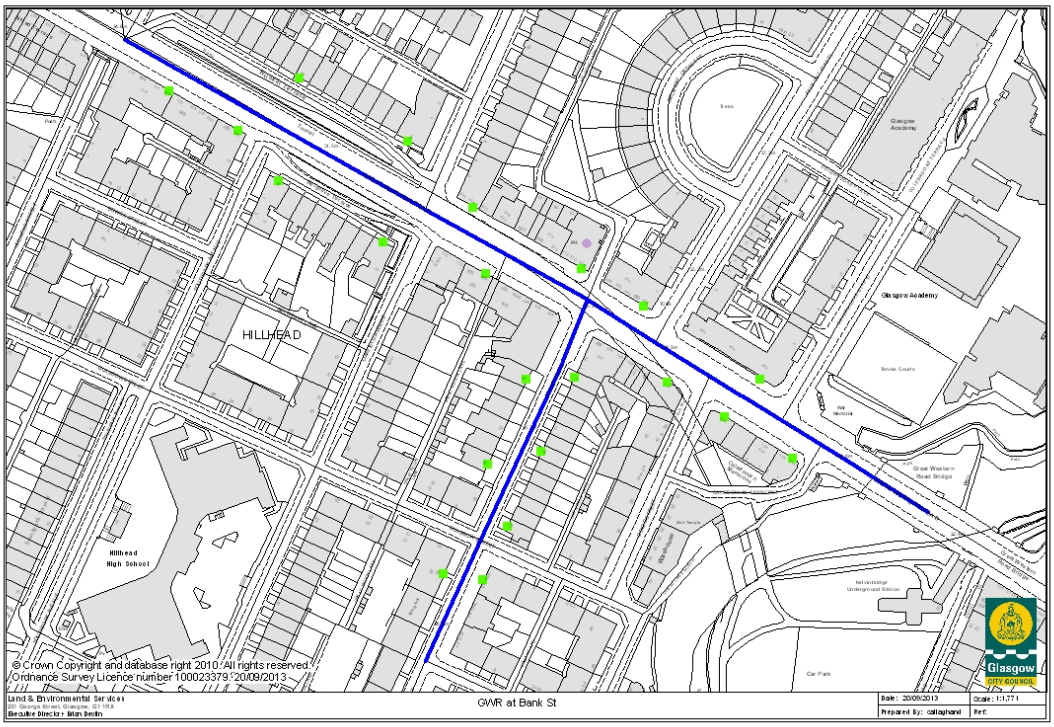


Table 2.5: Great Western Road at Bank St receptors

Receptor	Location	Type	Coordinates	
			x	y
1	GWR Tube	Commercial ground / residential above	257255	667112
2	10 Ruskin Terrace	Residential	257172	667174
3	609 GWR	Commercial ground / residential above	257110	667168
4	565 GWR	Commercial ground / residential above	257143	667149
5	3 Ruskin Terrace	Residential	257224	667144
6	8 Belgrave Terrace	Residential	257163	667125
7	1 Belgrave Terrace	Residential	257212	667096
8	525 GWR	Commercial ground / residential above	257261	667081
9	508 GWR	Commercial	257307	667083
10	3 Bank St	Residential	257303	667031
11	6 Bank St	Residential	257280	667031
12	15 Bank St	Residential	257287	666996
13	16 Bank St	Residential	257262	666990
14	27 Bank St	Residential	257271	666961
15	29 Bank St	Residential	257259	666935
16	22 Bank St	Residential	257241	666938
17	488 GWR	Commercial ground / residential above	257336	667065
18	471 GWR	Commercial	257347	667029
19	459 GWR	Commercial ground / residential above	257374	667013
20	482 GWR	Commercial ground / residential above	257391	667031
21	445 GWR	Commercial ground / residential above	257407	666993

2.4.4 Great Western Road East

Figure 2.7: Great Western Road East – Modelled roads and receptors

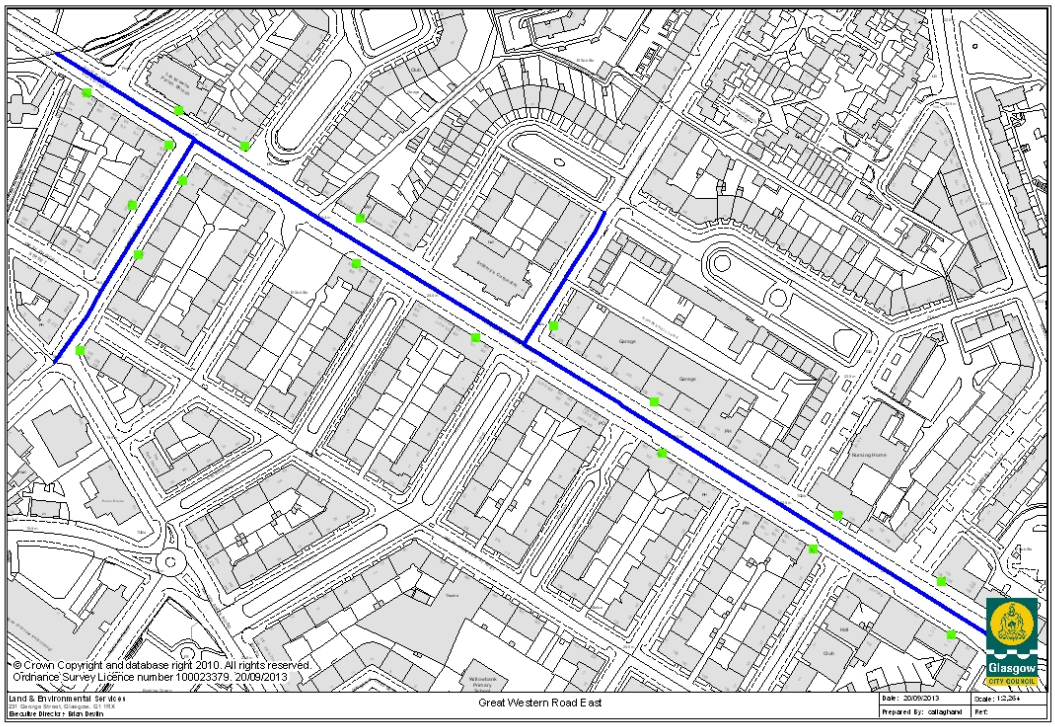


Table 2.6: Great Western Road East receptors

Receptor	Location	Type	Coordinates	
			x	y
1	Park Rd Tube	Commercial ground / residential above	257566	666879
2	Napiershall St Tube	Residential	257790	666791
3	GWR Church	Church	257563	666922
4	44 Lansdowne Cr	Commercial ground / residential above	257603	666900
5	E corner of GWR & Pa	Commercial ground / residential above	257557	666901
6	433 GWR	Commercial ground / residential above	257507	666932
7	39 Park Rd	Residential	257539	666834
8	22 Park Rd	Commercial ground / residential	257535	666864

		above		
9	63 Park Rd	Commercial ground / residential above	257503	666776
10	376 GWR	Commercial ground / residential above	257673	666856
11	333 GWR	Commercial ground / residential above	257671	666829
12	293 GWR	Commercial ground / residential above	257743	666784
13	256 GWR	Commercial ground / residential above	257852	666745
14	207 GWR	Commercial ground / residential above	257856	666714
15	174 GWR	Commercial ground / residential above	257963	666676
16	143 GWR	Commercial ground / residential above	257948	666656
17	126 GWR	Commercial ground / residential above	258026	666636
18	99 GWR	Commercial ground / residential above	258032	666604

2.4.5 Kelvin Way

Figure 2.8: Kelvin Way – Modelled roads and receptors

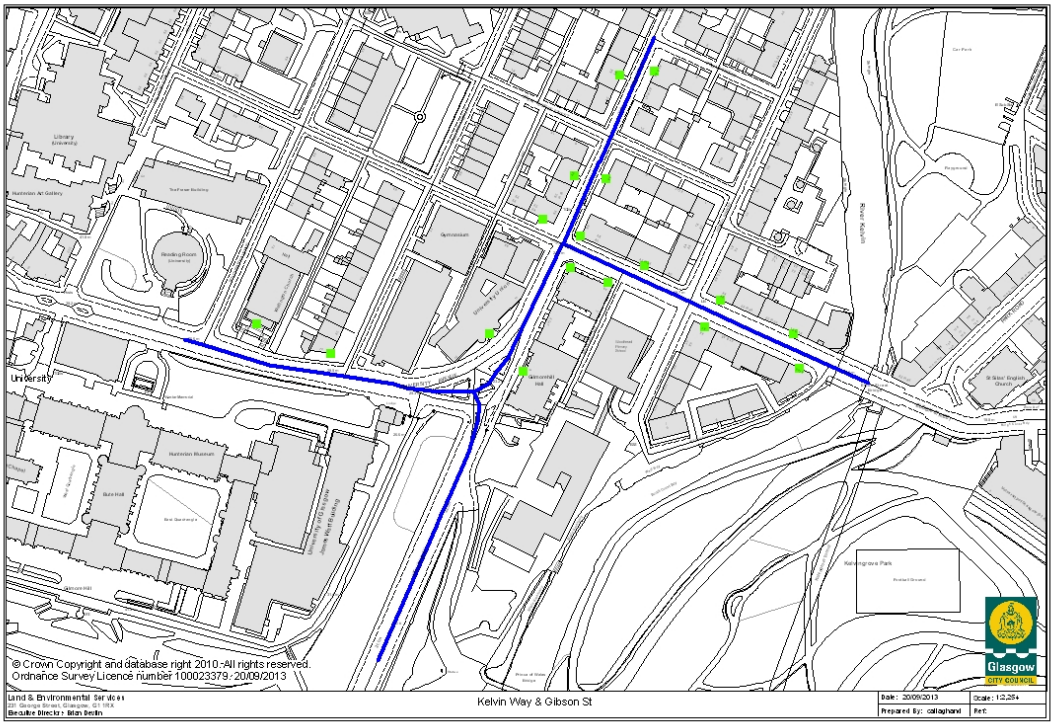


Table 2.7: Kelvin Way receptors

Receptor	Location	Type	Coordinates	
			x	y
1	Gibson St Tube	Residential	257166	666788
2	Wellington Church	Church	256993	666725
3	70 Oakfield Ave	Residential	257037	666707
4	University Union	Commercial	257134	666719
5	Gilmorehill Hall	Commercial	257154	666696
6	1 Kelvin Way	Church	257182	666759
7	48 Bank St	Residential	257185	666814
8	65 Bank St	Residential	257204	666812
9	38 Bank St	Residential	257212	666875
10	49 Bank St	Residential	257233	666877
11	50 Gibson St	Residential	257188	666778
12	42 Gibson St	Residential	257227	666760
13	49 Gibson St	Church	257205	666750
14	38 Gibson St	Commercial ground / residential above	257273	666739
15	37 Gibson St	Commercial ground / residential above	257263	666723

16	12 Gibson St	Commercial ground / residential above	257317	666719
17	3 Gibson St	Commercial ground / residential above	257321	666698

2.4.6 Woodlands Road

Figure 2.9: Woodlands Road – Modelled roads and receptors

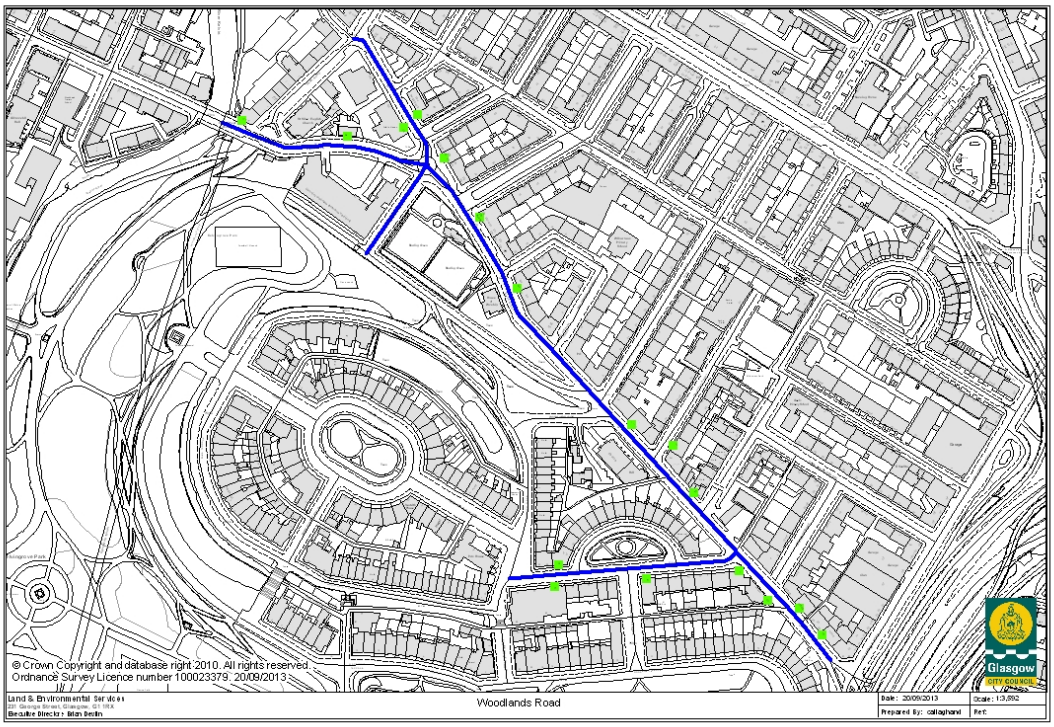


Table 2.8: Woodlands Road receptors

Receptor	Location	Type	Coordinates	
			x	y
1	W/lands Rd Tube	Residential	257550	666696
2	Arlington St Tube	Residential	257796	666378
3	52 Eldon St	Commercial ground / residential above	257381	666691
4	20 Eldon St	Residential	257482	666675
5	311 Woodlands Rd	Commercial	257537	666684
6	278 Woodlands Rd	Commercial ground / residential above	257576	666654

7	258 Woodlands Rd	Commercial ground / residential above	257610	666597
8	220 Woodlands Rd	Commercial ground / residential above	257646	666530
9	140 Woodlands Rd	Commercial ground / residential above	257756	666398
10	102 Woodlands Rd	Commercial	257816	666333
11	1 Lynedoch St	Commercial ground / residential above	257860	666257
12	19 Lynedoch St	Residential	257770	666250
13	18 Lynedoch St	Residential	257685	666263
14	31 Lynedoch St	Residential	257682	666243
15	40 Woodlands Rd	Commercial ground / residential above	257918	666222
16	18 Woodlands Rd	Commercial ground / residential above	257939	666195
17	43 Woodlands Rd	Residential	257887	666229

3.0 Results

3.1 Monitoring Results

Results from diffusion tubes for 2010 and 2011 in the areas of interest indicated that there were exceedences of the air quality objective levels. Monitoring in these areas was expanded through the use of further diffusion tubes in 2012, the results of which are shown in table 3.1 below.

Table 3.1: Results of diffusion tube monitoring for NO_2

Location	Coordinates		Annual Mean NO2 Conc (µg/m^{-3})		
	x	y	2010	2011	2012
Crow Rd	254639	668203	45.0	43.6	36.9
Napiershall St	257790	666791	40.3	30.9	29.5
Crow Rd 2	254606	667894	-	-	27.6
Milner Rd	254457	668107	-	-	30.2
Poplar Ave	254662	667635	-	-	28.8
Park Rd	257566	666879	-	41.7	31.3
Woodlands Rd	257550	666696	-	-	36.4
Gibson St	257166	666788	-	-	30.7
Great Western Rd	257255	667112	-	-	34.9

In 2012, all of the monitoring locations recorded levels of NO_2 within the objective, including those locations which had previously recorded exceedences.

3.2 Model Verification

The initial model runs were undertaken using 2012 weather data and the results compared against the monitoring data acquired for 2012 from local diffusion tubes.

Table 3.2: Comparison of modelled and monitored NO_2 concentrations

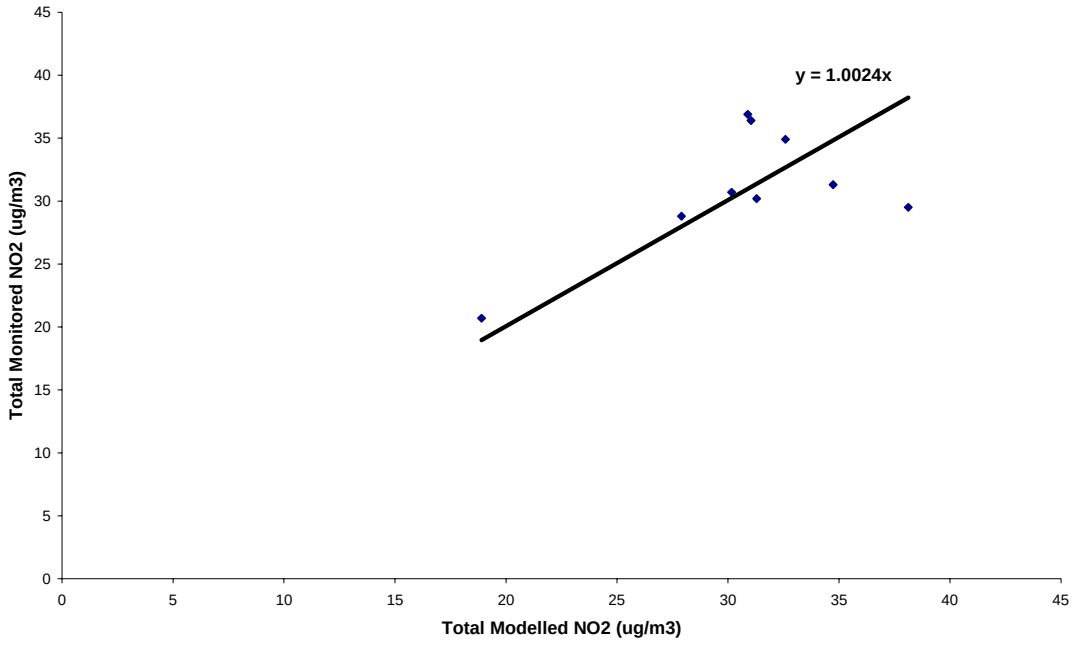
Location	Coordinates		Background NO_2 (µg/m^3)	Monitored NO_2 (µg/m^3)	Modelled NO_2 (µg/m^3)	Difference (%)
	x	y				
Crow Rd	254639	668203	17.7	36.9	30.9	-16.3
Milner Rd	254457	668107	17.7	20.7	18.9	-8.7
Crow Rd 2	254606	667894	21.3	30.2	31.3	3.6
Poplar Ave	254662	667635	21.3	28.8	27.9	-3.1
Park Rd	257566	666879	26.4	31.3	34.7	11.0
Napiershall St	257790	666791	26.4	29.5	38.1	29.2
Woodlands Rd	257550	666696	26.4	36.4	31.0	-14.7
Gibson St	257166	666788	26.4	30.7	30.2	-1.8
Great Western Rd	257255	667112	22.3	34.9	32.6	-6.6

The model results indicate that there is no systematic under or over prediction of annual mean concentrations. The majority of results are within ±25% of the monitored concentrations with just one site recording above this value.

Figure 3.1 below shows the modelled NO_2 versus monitored total NO_2 concentrations, and a linear regression line, through zero, has been derived. The equation of this line is 1.0024 indicating that the model is performing well. Therefore any further adjustment of the model would likely be so minor that it is not required.

Summary Table	
Within +10%	1
Within -10%	4
Within +-10%	5
Within +10% to +25%	1
Within -10% to -25%	2
Within +-10% to 25%	3
Over +25%	1
Under -25%	0
Greater +-25%	1
Within +-25%	8

Figure 3.1: Modelled vs monitored annual average NO_2



3.3 Sensitivity Analysis

The model was run for all locations using weather data from 2010, 2011 and 2012. Results are shown in Table 3.2

Table 3.3: Modelled results comparison using various years weather data

Location	Receptor - Description	Receptor	Modelled NO_2 Concentration		
			2010	2011	2012
Crow Rd North	680 Crow Rd	1	25.5	25.3	25.1
	662 Crow Rd	2	28.8	28.2	28.1
	644 Crow Rd	3	33.5	32.6	32.5
	632 Crow Rd	4	35.7	34.6	34.6
	136 Whittinghame Dr	5	37.8	36.3	36.4
	575 Crow Rd	6	32.3	30.9	32.3
	620 Crow Rd	7	36.5	34.8	35.0
	Crow Rd Tube	8	32.2	30.7	30.9
	1 Woodend Dr	9	29.2	27.9	29.0
	582 Crow Rd	10	33.0	31.6	31.8
	569 Crow Rd	11	28.9	27.8	28.7
	556 Crow Rd	12	33.6	32.4	32.5
	555 Crow Rd	13	29.4	28.4	29.3
	530 Crow Rd	14	37.3	35.9	36.0
	543 Crow Rd	15	32.1	31.1	32.2
	2 Southbrae Dr	16	31.6	30.6	31.7
	17 Southbrae Dr	17	21.6	20.8	21.4
	12 Southbrae Dr	18	23.1	22.9	23.2
	24 Southbrae Dr	19	20.7	20.6	20.8
	33 Southbrae Dr	20	19.4	19.0	19.3
	34 Southbrae Dr	21	19.9	19.9	20.1
	Milner Rd Tube	22	18.9	18.8	18.9
	522 Crow Rd	23	40.9	38.6	39.0
	508 Crow Rd	24	35.2	32.9	33.4
Crow Rd South	Crow Rd 2 Tube	1	32.1	31.4	31.3
	Poplar Ave Tube	2	28.5	28.0	27.9
	494 Crow Rd	3	34.6	33.9	33.7
	480 Crow Rd	4	33.8	33.0	32.9
	454 Crow Rd	5	36.4	35.9	35.5
	164 Beechwood Dr	6	36.5	36.2	35.8
	450 Crow Rd	7	34.4	34.1	33.8
	446 Crow Rd	8	32.3	31.8	31.6
	438 Crow Rd	9	30.1	29.5	29.4
	420 Crow Rd	10	26.6	26.2	26.2
	423 Crow Rd	11	26.8	25.8	26.3
	437 Crow Rd	12	31.7	30.3	30.7
	154 Balshagray Ave	13	35.8	34.2	34.5
	92 Balshagray Ave	14	31.6	30.6	30.7
	111 Balshagray Ave	15	23.7	23.2	23.7

	121 Balshagray Ave	16	24.9	24.5	24.9
	127 Balshagray Ave	17	25.3	24.9	25.3
	135 Balshagray Ave	18	25.5	25.1	25.5
	139 Balshagray Ave	19	26.6	26.0	26.5
	149 Balshagray Ave	20	28.4	27.5	28.3
	157 Balshagray Ave	21	33.4	31.8	33.1
	20 Abby Dr	22	30.0	29.1	30.0
	1 Abby Dr	23	24.8	24.4	24.8
	3 Abby Dr	24	23.5	23.2	23.5
	15 Abby Dr	25	22.6	22.5	22.6
	21 Abby Dr	26	22.4	22.3	22.4
	34 Abby Dr	27	22.7	22.6	22.7
	26 Abby Dr	28	23.1	23.0	23.2
	501 Crow Rd	29	28.4	28.3	28.5
Great Western Road at Bank St	GWR Tube	1	32.6	33.0	32.6
	10 Ruskin Terrace	2	26.9	27.2	27.0
	609 GWR	3	29.9	28.2	29.3
	565 GWR	4	30.5	28.7	29.8
	3 Ruskin Terrace	5	27.5	27.8	27.6
	8 Belgrave Terrace	6	26.8	25.7	26.3
	1 Belgrave Terrace	7	27.1	26.0	26.6
	525 GWR	8	31.8	29.8	30.9
	508 GWR	9	34.6	35.2	34.6
	3 Bank St	10	27.3	26.1	26.7
	6 Bank St	11	25.7	24.9	25.4
	15 Bank St	12	24.9	24.3	24.6
	16 Bank St	13	24.1	23.7	24.0
	27 Bank St	14	24.2	23.8	24.0
	29 Bank St	15	23.9	23.6	23.7
	22 Bank St	16	23.7	23.5	23.6
	488 GWR	17	35.6	36.1	35.6
	471 GWR	18	32.8	30.4	31.7
	459 GWR	19	31.7	29.4	30.5
	482 GWR	20	33.2	33.4	32.9
	445 GWR	21	30.0	28.2	29.1
Great Western Road East	Park Rd Tube	1	35.5	33.9	34.7
	Napiershall St Tube	2	38.5	38.5	38.1
	GWR Church	3	40.7	41.4	40.8
	44 Lansdowne Cr	4	33.6	33.8	33.6
	E corner of GWR & Park Rd	5	33.4	32.4	33.0
	433 GWR	6	30.8	30.2	30.7
	39 Park Rd	7	32.0	31.1	31.5
	22 Park Rd	8	29.6	29.2	29.5
	63 Park Rd	9	28.1	27.7	27.9
	376 GWR	10	33.7	33.8	33.6
	333 GWR	11	33.3	32.1	32.7
	293 GWR	12	33.5	32.1	32.8
	256 GWR	13	33.3	33.1	33.0

	207 GWR	14	32.3	31.1	31.7
	174 GWR	15	32.2	32.2	32.0
	143 GWR	16	31.7	30.6	31.1
	126 GWR	17	31.8	31.8	31.6
	99 GWR	18	30.8	29.7	30.2
Kelvin Way	Gibson St Tube	1	30.0	30.2	30.2
	Wellington Church	2	29.0	29.2	29.2
	70 Oakfield Ave	3	31.3	31.5	31.4
	University Union	4	31.7	31.6	31.9
	Gilmorehill Hall	5	32.9	32.0	32.2
	1 Kelvin Way	6	36.5	35.3	35.9
	48 Bank St	7	29.0	29.1	29.0
	65 Bank St	8	29.4	29.4	29.3
	38 Bank St	9	27.8	27.9	27.9
	49 Bank St	10	27.9	27.9	27.9
	50 Gibson St	11	35.9	36.6	36.2
	42 Gibson St	12	35.4	35.9	35.5
	49 Gibson St	13	34.2	32.8	33.5
	38 Gibson St	14	33.2	33.5	33.3
	37 Gibson St	15	32.2	31.0	31.6
	12 Gibson St	16	32.7	33.0	32.7
	3 Gibson St	17	31.9	30.6	31.2
Woodlands Road	W/lands Rd Tube	1	31.2	31.3	31.0
	Arlington St Tube	2	29.7	29.7	29.6
	52 Eldon St	3	32.0	32.3	32.2
	20 Eldon St	4	32.7	33.0	32.9
	311 Woodlands Rd	5	31.6	31.2	31.5
	278 Woodlands Rd	6	31.6	31.7	31.5
	258 Woodlands Rd	7	33.9	33.8	33.5
	220 Woodlands Rd	8	34.0	33.7	33.6
	140 Woodlands Rd	9	34.5	34.4	34.1
	102 Woodlands Rd	10	34.6	34.6	34.3
	1 Lynedoch St	11	34.7	33.0	34.0
	19 Lynedoch St	12	28.7	28.2	28.5
	18 Lynedoch St	13	28.6	28.7	28.7
	31 Lynedoch St	14	28.2	27.7	28.0
	40 Woodlands Rd	15	37.2	37.2	36.8
	18 Woodlands Rd	16	36.1	36.0	35.6
	43 Woodlands Rd	17	35.0	33.2	34.3

Weather data from 2010 produced slightly higher predicted concentrations and therefore this data was used for future year predictions to ensure a worst case scenario was followed.

3.4 Model Results

Table 3.4 below shows the model outputs or each receptor point for the appropriate year. 2012 has been modelled using the weather data from that year. All other years have been modelled using weather data from 2010 as indicated by the sensitivity analysis.

Table 3.4: Predicted concentrations of annual mean NO_2 ($\mu g/m^3$) at receptor locations

Location	Receptor	Modelled NO_2 Concentration			
		2012	2013	2014	2015
Crow Rd North	1	25.1	24.6	23.5	22.4
	2	28.1	27.8	26.7	25.3
	3	32.5	32.4	31.1	29.5
	4	34.6	34.7	33.3	31.6
	5	36.4	36.8	35.4	33.6
	6	32.3	31.3	30.0	28.5
	7	35.0	35.4	34.0	32.3
	8	30.9	31.1	29.8	28.3
	9	29.0	28.2	27.0	25.6
	10	31.8	31.9	30.6	29.0
	11	28.7	27.8	26.7	25.3
	12	32.5	32.5	31.2	29.6
	13	29.3	28.3	27.2	25.8
	14	36.0	36.2	34.8	33.0
	15	32.2	31.1	29.9	28.4
	16	31.7	30.6	29.4	27.9
	17	21.4	20.8	20.0	19.1
	18	23.2	22.3	21.4	20.5
	19	20.8	19.9	19.2	18.3
	20	19.3	18.8	18.0	17.3
	21	20.1	19.2	18.5	17.7
	22	18.9	18.2	17.5	16.8
	23	39.0	39.8	38.4	36.5
	24	33.4	34.1	32.8	31.1
Crow Rd South	1	31.3	31.0	29.8	28.3
	2	27.9	27.6	26.5	25.3
	3	33.7	33.5	32.2	30.6
	4	32.9	32.7	31.4	29.9
	5	35.5	35.2	33.9	32.2
	6	35.8	35.4	34.1	32.4
	7	33.8	33.3	32.0	30.5
	8	31.6	31.2	30.0	28.6
	9	29.4	29.1	28.0	26.7
	10	26.2	25.7	24.7	23.6
	11	26.3	25.9	24.9	23.8
	12	30.7	30.6	29.4	28.0
	13	34.5	34.7	33.3	31.7

	14	30.7	30.5	29.3	27.8
	15	23.7	22.9	22.0	21.1
	16	24.9	24.0	23.1	22.1
	17	25.3	24.4	23.5	22.4
	18	25.5	24.6	23.6	22.6
	19	26.5	25.6	24.6	23.5
	20	28.3	27.4	26.3	25.1
	21	33.1	32.4	31.1	29.6
	22	30.0	29.0	27.9	26.6
	23	24.8	24.0	23.0	22.1
	24	23.5	22.7	21.8	20.9
	25	22.6	21.8	21.0	20.2
	26	22.4	21.6	20.8	20.0
	27	22.7	21.9	21.0	20.2
	28	23.2	22.3	21.5	20.6
	29	28.5	27.4	26.3	25.1
Great Western Rd at Bank St	1	32.6	31.5	30.2	28.7
	2	27.0	25.9	24.9	23.8
	3	29.3	28.8	27.6	26.3
	4	29.8	29.4	28.2	26.9
	5	27.6	26.5	25.5	24.3
	6	26.3	25.8	24.8	23.7
	7	26.6	26.1	25.1	24.0
	8	30.9	30.8	29.5	28.1
	9	34.6	33.5	32.1	30.6
	10	26.7	26.3	25.3	24.2
	11	25.4	24.8	23.8	22.8
	12	24.6	24.1	23.2	22.2
	13	24.0	23.3	22.4	21.5
	14	24.0	23.4	22.5	21.6
	15	23.7	23.1	22.2	21.4
	16	23.6	22.9	22.0	21.2
	17	35.6	34.5	33.1	31.4
	18	31.7	31.7	30.4	29.0
	19	30.5	30.7	29.4	28.0
	20	32.9	32.1	30.7	29.2
	21	29.1	29.0	27.8	26.5
Great Western Rd East	1	34.7	34.4	33.1	31.6
	2	38.1	37.4	35.9	34.3
	3	40.8	39.5	38.0	36.2
	4	33.6	32.5	31.3	30.0
	5	33.0	32.4	31.2	29.8
	6	30.7	29.8	28.7	27.5
	7	31.5	31.0	29.8	28.6
	8	29.5	28.6	27.6	26.5
	9	27.9	27.1	26.2	25.2
	10	33.6	32.7	31.4	30.1
	11	32.7	32.3	31.1	29.7

	12	32.8	32.4	31.2	29.8
	13	33.0	32.2	31.0	29.7
	14	31.7	31.3	30.1	28.8
	15	32.0	31.2	30.0	28.7
	16	31.1	30.7	29.5	28.3
	17	31.6	30.8	29.6	28.4
	18	30.2	29.8	28.7	27.5
Kelvin Way	1	30.2	29.1	28.0	26.9
	2	29.2	28.1	27.1	26.0
	3	31.4	30.2	29.1	27.9
	4	31.9	30.7	29.6	28.3
	5	32.2	31.8	30.7	29.4
	6	35.9	35.4	34.1	32.6
	7	29.0	28.0	27.1	26.0
	8	29.3	28.4	27.4	26.4
	9	27.9	26.9	26.0	25.1
	10	27.9	27.0	26.1	25.3
	11	36.2	34.9	33.6	32.2
	12	35.5	34.4	33.1	31.7
	13	33.5	33.1	31.9	30.6
	14	33.3	32.2	31.0	29.7
	15	31.6	31.1	30.0	28.8
	16	32.7	31.6	30.5	29.2
	17	31.2	30.8	29.7	28.5
Woodlands Rd	1	31.0	30.2	29.1	28.0
	2	29.6	28.7	27.7	26.6
	3	32.2	30.9	29.8	28.6
	4	32.9	31.6	30.5	29.2
	5	31.5	30.6	29.5	28.3
	6	31.5	30.6	29.5	28.3
	7	33.5	32.8	31.6	30.3
	8	33.6	32.9	31.7	30.4
	9	34.1	33.4	32.2	30.8
	10	34.3	33.5	32.3	30.9
	11	34.0	33.6	32.4	31.1
	12	28.5	27.8	26.8	25.8
	13	28.7	27.7	26.7	25.7
	14	28.0	27.3	26.3	25.3
	15	36.8	36.1	34.8	33.3
	16	35.6	35.0	33.8	32.4
	17	34.3	34.0	32.8	31.4

The only receptor predicted to exceed the annual mean NO_2 objective level is the Great Western Road East receptor 3. However, this receptor is a church building and is therefore not representative of exposure for this objective.

The predicted concentrations at the majority of the receptors were significantly below the objective level. However, seven receptors are predicted to

experience NO_2 levels within 10% of the objective, three of which are residential properties. Modelling results show that predicted levels within this range are expected to fall to two instances by 2015 with neither occurring at residential properties.

4.0 Conclusions

The results of the modelling exercise suggest that there is little risk that the 40 $\mu g/m^3$ annual mean objective for NO_2 will be exceeded at the locations within the study area. Modelling predicted only one marginal exceedence of the objective in 2012 at a location which is not representative of public exposure. This receptor was predicted to meet the objective from 2013 onwards.

The monitoring results for 2012 indicate that those locations which previously exceeded the annual mean NO_2 objective are now recording levels within the objective.

Given the results from the modelling and monitoring of NO_2 in the study area, there is no need at present to declare new AQMAs based on the NO_2 annual mean objective. However, monitoring will continue at these locations to verify this conclusion.

5.0 References

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