

Moderate – High Particulate Matter (PM₁₀ and PM_{2.5}) Episode 11th – 12th December 2012 – Greater Glasgow Area

On the 11th and 12th December 2012 provisional air quality monitoring data from sites throughout the Greater Glasgow urban area measured elevated concentrations of particulate Matter (both PM₁₀ and PM_{2.5}). Concentrations measured were generally in the air pollution banding Moderate (index 4 – 6) however at busy roadside sites Glasgow Kerbside (Hope Street) and Glasgow Dumbarton Road, concentrations of PM_{2.5} and PM₁₀ respectively reached air pollution banding High (index 7 – 9). Figure 1 illustrates the elevated concentrations as seen on the Scottish Air Quality Bulletin distributed via the Scottish Air Quality website. Figure 2 given below illustrates the boundaries between index points for each pollutant. Further information on air pollution banding and the health impacts associated can be found on the Scottish Air Quality website (www.scottishairquality.co.uk).

Figure 1: Scottish Air Pollution Bulletin issued during 11th and 12th December 2012

City of Glasgow					
SITE	8 Hourly Mean Ozone (µg/m ³)	Hourly Mean Nitrogen dioxide (µg/m ³)	max 15min mean Sulphur dioxide (µg/m ³)	24Hour Mean PM _{2.5} Particles (µg/m ³)	24Hour mean PM ₁₀ Particles (µg/m ³ Grav Equiv)
Glasgow Abercromby Street	N/M	N/M	N/M	N/M	56 (Moderate 4)
Glasgow Anderston	N/M	178 (Low 3)	8 (Low 1)	N/M	59 (Moderate 5)
Glasgow Broomhill	N/M	N/M	N/M	N/M	66 (Moderate 5)
Glasgow Burgher St.	N/M	141 (Low 3)	N/M	N/M	55 (Moderate 4)
Glasgow Bvres Road	N/M	223 (Moderate 4)	N/M	N/M	N/A
Glasgow Dumbarton Road	N/M	N/A	N/M	N/M	76 (High 7)
Glasgow Kerbside	N/M	197 (Low 3)	N/M	57 (High 7)	67 (Moderate 6)
Glasgow Nithsdale Road	N/M	N/M	N/M	N/M	52 (Moderate 4)
Glasgow Waukmilljalen Reservoir	24 (Low 1)	57.3 (Low 1)	N/M	N/M	28 (Low 2)

Renfrewshire					
SITE	8 Hourly Mean Ozone (µg/m ³)	Hourly Mean Nitrogen dioxide (µg/m ³)	max 15min mean Sulphur dioxide (µg/m ³)	24Hour Mean PM _{2.5} Particles (µg/m ³)	24Hour mean PM ₁₀ Particles (µg/m ³ Grav Equiv)
Paisley Central Road	N/M	204 (Moderate 4)	N/M	N/M	N/M
Paisley Glasgow Airport	N/M	187 (Low 3)	N/M	N/M	N/M
Paisley Gordon Street	N/M	159 (Low 3)	N/M	N/M	56 (Moderate 4)
Paisley St James St	N/M	N/M	N/M	N/M	57 (Moderate 4)

East Dunbartonshire					
SITE	8 Hourly Mean Ozone (µg/m ³)	Hourly Mean Nitrogen dioxide (µg/m ³)	max 15min mean Sulphur dioxide (µg/m ³)	24Hour Mean PM _{2.5} Particles (µg/m ³)	24Hour mean PM ₁₀ Particles (µg/m ³ Grav Equiv)
East Dunbartonshire Bearsden	N/M	96 (Low 2)	N/M	N/M	55 (Moderate 4)
East Dunbartonshire Bishopbings	N/M	120 (Low 2)	N/M	N/M	58 (Moderate 4)
East Dunbartonshire Kirkintilloch	N/M	21 (Low 1)	N/M	N/M	68 (Moderate 6)

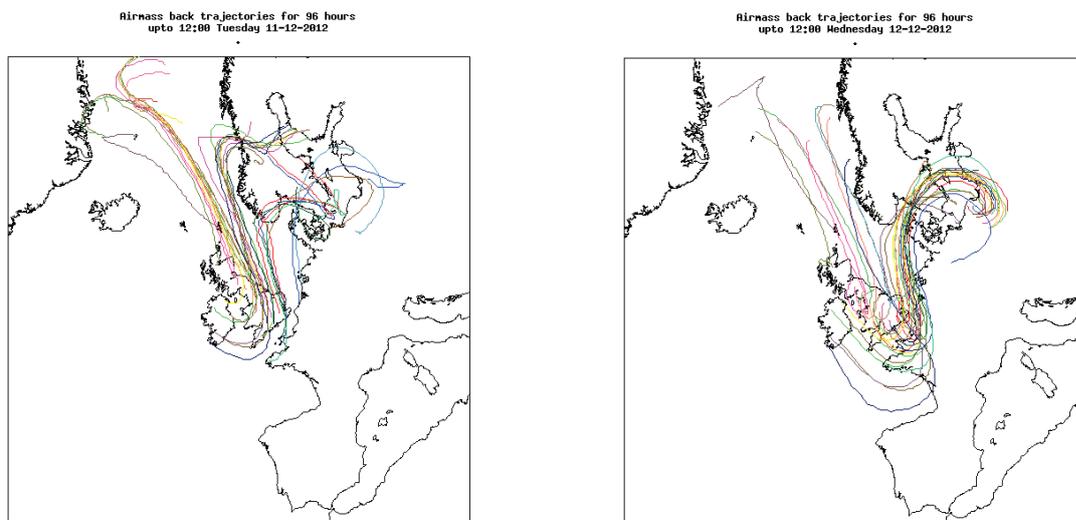
Figure 2: Boundaries between index points for each Pollutant

Boundaries Between Index Points for Each Pollutant						
Band	Index	Ozone	Nitrogen Dioxide	Sulphur Dioxide	PM _{2.5} Particles	PM ₁₀ Particles
		Running 8 hourly mean µg/m ³	hourly mean µg/m ³	15 minute mean µg/m ³	24 hour running mean µg/m ³	24 hour running mean µg/m ³ (Grav. Equiv.)
Low	1	0-33	0-66	0-88	0-11	0-16
	2	34-65	67-133	89-176	12-23	17-33
	3	66-99	134-199	177-265	24-34	34-49
Moderate	4	100-120	200-267	266-354	35-41	50-58
	5	121-140	268-334	355-442	42-46	59-66
	6	141-159	335-399	443-531	47-52	67-74
High	7	160-187	400-467	532-708	53-58	75-83
	8	188-213	468-534	709-886	59-64	84-91
	9	214-239	535-599	887-1063	65-69	92-99
Very High	10	240 or more	600 or more	1064 or more	70 or more	100 or more

A number of factors contributed to the occurrence of this episode, these included; weather conditions, topography, and emission source.

Weather conditions over the 11th and 12th December, and leading up to this time, was dominated by a high pressure system and air masses sourced from the Arctic and Scandinavia. Air masses from this direction (illustrated in Figure 3 below) normally bring in clean air however the high pressure system created very cold and dry conditions with temperatures staying around or below freezing throughout both days. It also created very little or no breeze and large pockets of freezing mist. These very poor pollution dispersion conditions caused pollutants such as Particulate Matter to re-circulate and stagnate close to their source. This in turn caused pollution levels to increase over a relatively short period of time.

Figure 3: 4 day Air Mass Back trajectories for 11th and 12 December 2012



These prevailing weather conditions affected the majority of Scotland, however, it was only in the Greater Glasgow Area that Moderate and High pollution levels were measured. This was likely due to both the topography of the area and overall size of the urban expanse, and also the high density of pollution sources within.

Glasgow and its surrounding urban areas sit within the Clyde valley which is surrounded by hills. These hills cause a basin effect which in turn helps to prevent the dispersion of pollutants in specific weather events such as that seen on the 11th and 12th December.

Sources of this pollution are most likely a combination of localised traffic, industrial processes and domestic fuel burning. Looking at the available air mass trajectories, Saharan Dust models, and other global events (i.e. forest fires) there is no evidence of any trans-boundary particulate matter being associated with this event.

Figure 4 below plots PM₁₀ concentrations at a number of sites across the Glasgow urban area and shows how levels become elevated over the 11th and 12th. Figure 5 illustrates the elevation also seen in measured NO₂ concentrations over this time period. Moderate NO₂ was measured at both Glasgow Byres Road and Paisley central road.

Figure 4: Plot of Elevated PM₁₀ concentrations across Glasgow urban area sites

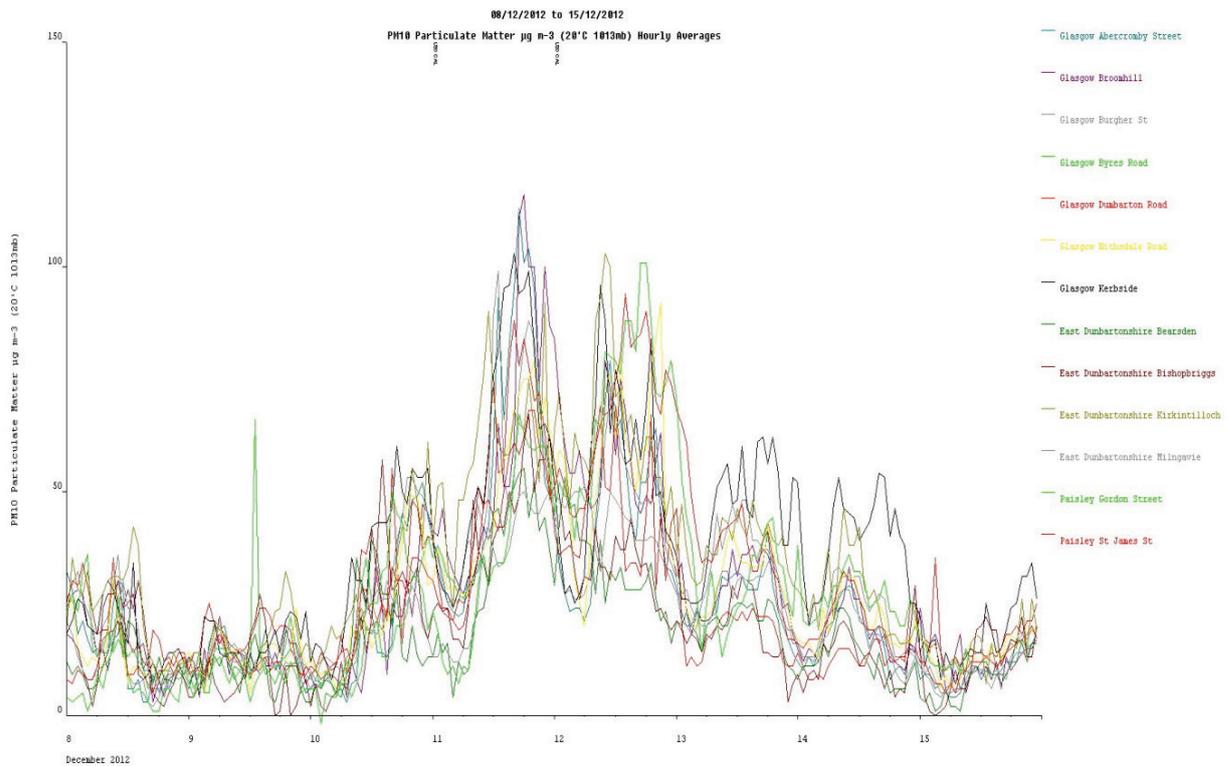
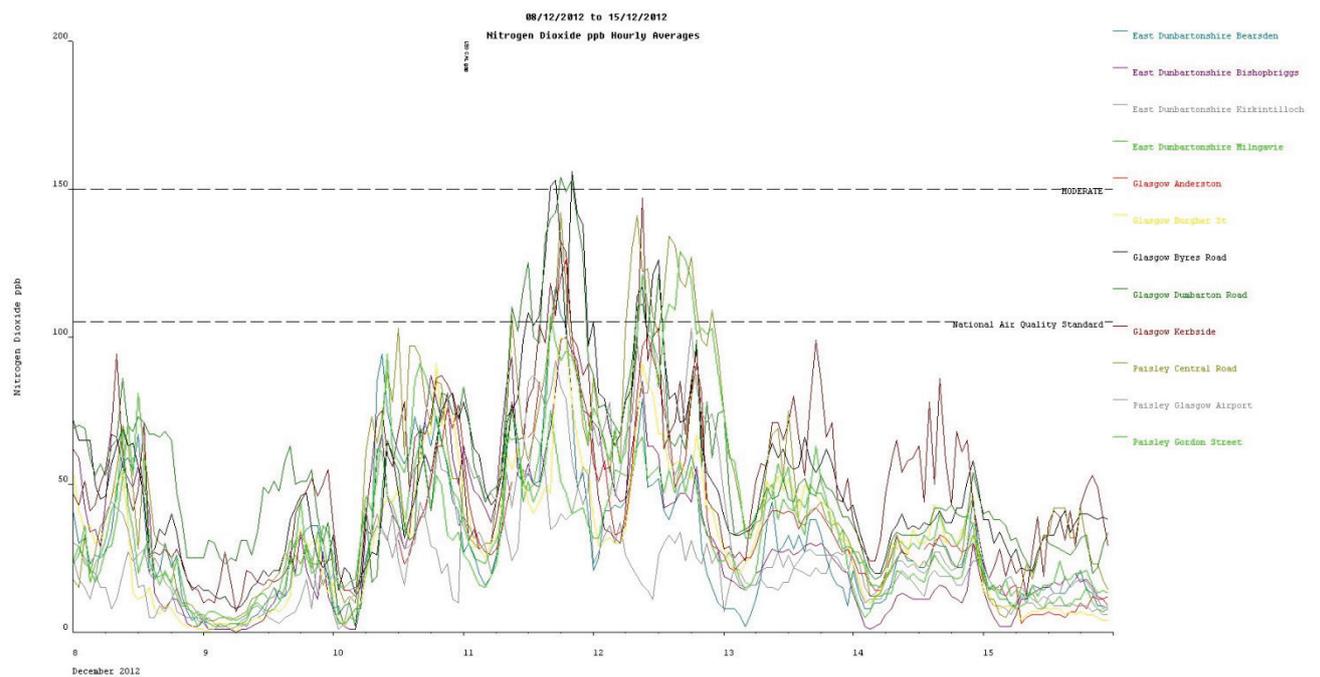


Figure 5: Plot of Elevated NO₂ concentrations across Glasgow urban area sites



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