Department for Environment, Food and Rural Affairs

STATISTICAL RELEASE: 2 February 2012

AIR QUALITY STATISTICS IN THE UK, 1987 TO 2011 - PROVISIONAL

- **Urban background particulate pollution has shown long-term improvement but changed little recently:** concentrations declined from a peak of 35 micrograms per cubic metre (µg m^{-3}) in 1992 to 20 µg m^{-3} in 2011. They changed little in the past four years and were 20 µg m^{-3} in 2010.

- **Roadside particulate pollution has shown long-term improvement but changed little recently:** concentrations declined from a peak of 39 µg m^{-3} in 1997 to 23 µg m^{-3} in 2011. They changed little in the past four years and were 22 µg m^{-3} in 2010.

- **Urban background ozone pollution has shown a long-term increase:** concentrations increased from a low of 38 µg m^{-3} in 1987 to 58 µg m^{-3} in 2011 and increased from 53 µg m^{-3} in 2010 after declining from a peak of 61 µg m^{-3} in 2006.

- **Rural background ozone pollution has shown no clear long-term trend and changed little recently:** concentrations increased from a low of 58 µg m^{-3} in 1987 to 68 µg m^{-3} in 2011, but changed little in the past five years, fluctuating between 67 and 70 µg m^{-3} after declining from a peak of 74 µg m^{-3} in 2006.

- **Days of moderate or higher air pollution in urban areas have shown a long-term improvement but increased in 2011:** average pollution days declined from a peak of 59 days in 1993 to 17 days in 2011, but increased from the lowest recorded level of 8 days in 2010.

- **Days of moderate or higher air pollution for rural areas have shown no clear trend but increased in 2011:** average pollution days declined from a peak of 64 days in 2003 to 29 days in 2011, but increased from a low of 21 days in 2010.

The results presented are provisional, but provide a good early indication of the final results which will be published in April 2012.

Department for Environment, Food and Rural Affairs
Nobel House, 17 Smith Square, London, SW1P 3JR

Public enquiries: 08459 335577 or Press enquiries: 020 7238 1542
Public enquiries & user feedback: enviro.statistics@defra.gsi.gov.uk

Website: www.defra.gov.uk/statistics/environment/

Why measure air quality?

There have been significant reductions in recent decades of emissions of air pollutants from power stations, transport, household heating, agriculture and industrial processes.

Estimates of the amount of pollutants emitted into the air are made in the National Atmospheric Emissions Inventory by making highly detailed assumptions on the amount of each air pollutant generated from different fuel use and activities in the UK. These estimates are published in a separate Defra National Statistics Release: Emissions of air pollutants in the UK[i].

However, the relationship between emissions and air quality are complex and are strongly affected by weather, and in addition UK air quality can be affected by pollutants blown across from mainland Europe. Day-to-day changes in weather have a great influence on air quality. Levels of pollutants that are relatively high on a still day when dispersion is limited can be much lower the next day or even the next hour if a wind starts to blow.

In order to monitor our air quality and help assess the risks to people's health and to the environment, the concentrations of key pollutants are measured via a national network of monitoring sites, the Automatic Urban and Rural Network (AURN), which continuously captures ambient air quality levels for selected pollutants throughout the UK. Using this information air pollution warnings may be issued. The UK-AIR website provides further information and provides the most up-to-date data for all pollutants measured by Defra.

In the UK, actions taken on air quality are driven by the objectives set out in the 2007 Air Quality Strategy and are informed by the statistics derived from air quality monitoring. See Defra's air quality website for more information on this and air quality policies.

There is also substantial EU legislation (such as the Directive on Ambient Air Quality and Cleaner Air for Europe) in place to reduce pollution and to set limit and target values for air quality.

Understanding air quality statistics

The statistics presented here summarise the results from the AURN monitoring. Only sites that meet data capture criteria are included in the calculation of the statistics, and the figures presented are UK average concentrations across these sites.

[i] See statistical release: Emissions of air pollutants in the UK, 1970-2010

The statistical release covers **annual average concentrations** in the UK of:

- particulates (PM_{10}); and
- ozone (O_3)

which are the two pollutants thought to have the greatest health impacts.

In general, the smaller and lighter a particle is, the longer it will stay in the air. Larger particles (greater than 10 micrometers (μm) in diameter) tend to settle to the ground by gravity in a matter of hours. The PM_{10} (particles measuring 10μm or less) standard was designed to identify those particles likely to be inhaled by humans, and PM_{10} has become the generally accepted measure of particulate material in the atmosphere in the UK and in Europe. Chronic exposure to particulates contribute to the risk of developing cardiovascular and respiratory diseases, and there is increasing evidence suggesting that long-term exposure to even low levels of particulates may have a significant effects on health. The annual average concentrations for particulates are considered a useful measure of overall exposure to particulates at all concentrations.

The gas ozone (O_3) is not emitted directly, but is created in the air through chemical reactions between other precursor pollutants when in sunlight, with more being created on hot, still, sunny days. It can affect people's health and can damage wild plants, crops, forests and some materials. The impact of long term exposure to this gas is currently unclear, but if there is no lower limit on the levels which have a health impact then the average concentrations may give a reasonable indication of the level of exposure.

The statistical release also covers **the number of days when air pollution was 'moderate or higher'** for any one of five pollutants listed below**.** At the moderate level, the effects of pollution may start to be noticeable to people with respiratory and other health problems, with greater risks to health at higher levels. The determination of the levels being moderate or higher pollution is according to the Air Pollution Information Service bandings used in air pollution forecasting. The bandings have been updated for monitoring from the 1st January 2012 and the new bandings will be reflected in the air quality statistics for 2012. The statistics for 2011 are based on the bandings in place up to the 31st December 2011 which are shown in Table 4 at the end of the statistical release.

The five pollutants used in the assessment of air pollution levels are:

- carbon monoxide (CO)
- nitrogen dioxide (NO_2)
- ozone (O_3)
- particulates (PM_{10})
- sulphur dioxide (SO_2)

Department for Environment, Food and Rural Affairs
Nobel House, 17 Smith Square, London, SW1P 3JR

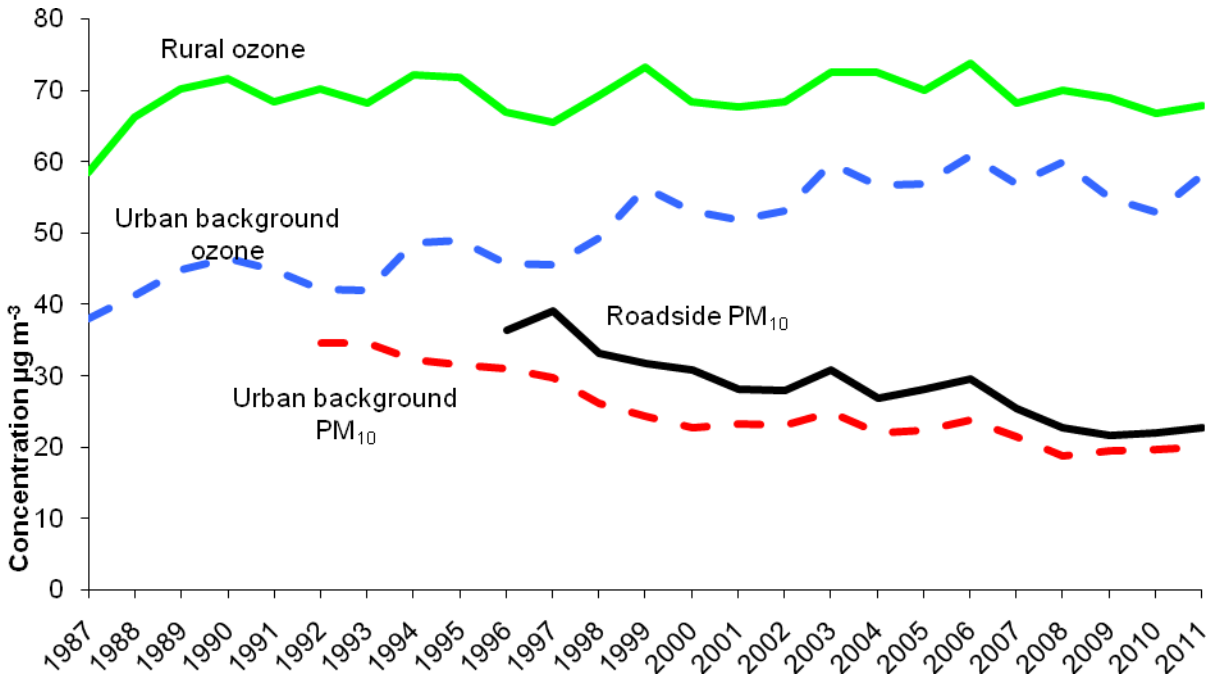
Public enquiries: 08459 335577 or Press enquiries: 020 7238 1542
Public enquiries & user feedback: enviro.statistics@defra.gsi.gov.uk

Website: www.defra.gov.uk/statistics/environment/

These can directly have adverse effects on human health, can react to form ozone or secondary particulate matter and or can cause harm to the environment through the creation of - in the case of SO_2 - acidic compounds (which can cause harm to vegetation and buildings, including as acid-rain); and - in the case of NO_2 - eutrophying compounds (which can affect the nutrient levels and diversity of species in sensitive environments).

Particulate (PM_{10}) and Ozone concentrations

Figure 1: Annual levels of PM_{10} and Ozone in the UK, 1987 to 2011 (provisional)



Notes:

The ozone index shows the annual mean of the daily maximum 8 hour running mean. The PM_{10} index shows the annual average.

- **Urban background particulate pollution has shown long-term improvement but changed little recently:** concentrations declined from a peak of 35 micrograms per cubic metre (µg m^{-3}) in 1992 to 20 µg m^{-3} in 2011. They changed little in the past four years and were 20 µg m^{-3} in 2010.

- **Roadside particulate pollution has shown long-term improvement but changed little recently:** concentrations declined from a peak of 39 µg m^{-3} in 1997 to 23 µg m^{-3} in 2011. They changed little in the past four years and were 22 µgm^{-3} in 2010.

- **Urban background ozone pollution has shown a long-term increase:** concentrations increased from a low of 38 µg m^{-3} in 1987 to 58 µg m^{-3} in 2011 and increased from 53 µg m^{-3} in 2010 after declining from a peak of 61 µg m^{-3} in 2006.

- **Rural background ozone pollution has shown no clear long-term trend and changed little recently:** concentrations increased from a low of 58 µg m^{-3} in 1987 to 68 µg m^{-3} in 2011, but changed little in the past five years, fluctuating between 67 and 70 µg m^{-3} after declining from a peak of 74 µg m^{-3} in 2006.

A table of the data are presented in Table 1 at the end of this statistical release

Emissions of PM_{10} steadily declined until around a decade ago[ii], since when they have remained largely unchanged, which is reflected in the measured urban background concentrations. The steady decline was attributable to a move away from coal to gas in both electricity generation and domestic and commercial combustion; and also the introduction of emission standards for road vehicles.

Both particulate and ozone concentrations are strongly influenced by weather, which contributes to the high variability over time and peaks such as in the hot summers of 2003 and 2006. This means that long time series are required to distinguish between weather effects and the effect of changes in pollutant emissions.

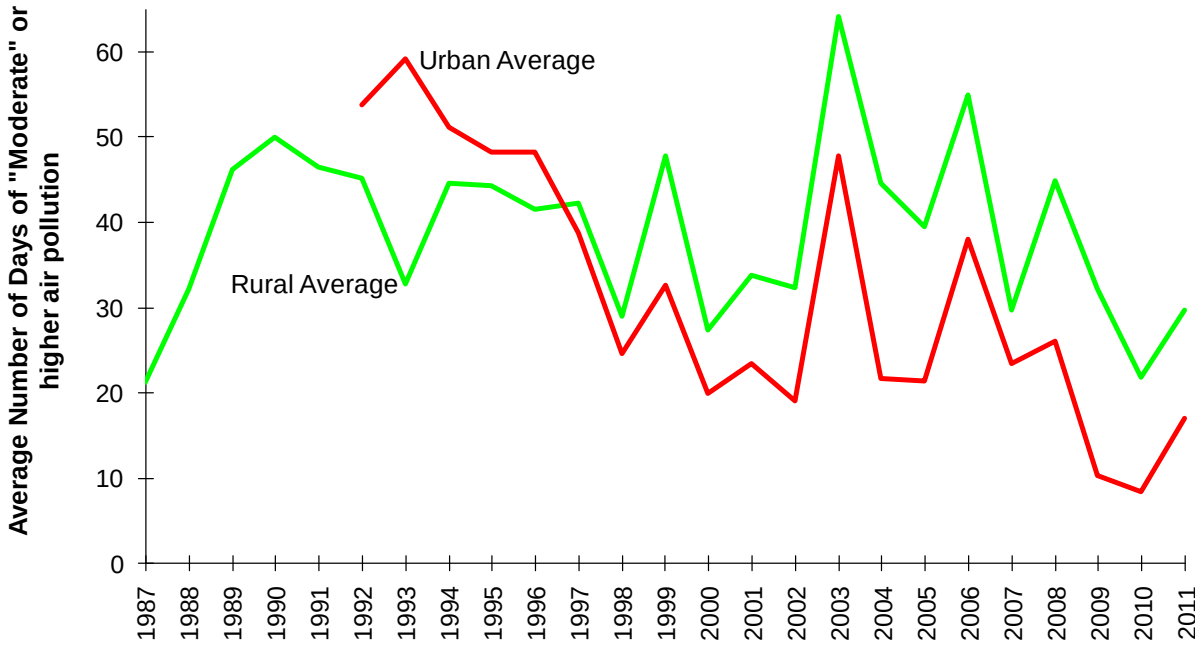
Emissions of the pollutants that are the main precursors to ozone forming (including nitrogen oxides (NO_x) and volatile organic compounds (VOCs)) have reduced substantially[iii], but this is not reflected in the long-term trend in ozone concentrations. This may be partly explained by a proportion of the ozone experienced in the UK originating from releases of precursor pollutants that are blown over from mainland Europe.

However, a similar lack of an apparent link between emissions and measured concentrations of ozone in the air is observed Europe wide. The European Environment Agency present further analysis of European air quality.

[ii] [iii] See Statistical release: Emissions of air pollutants in the UK, 1970-2010

Days with moderate or higher air pollution

Figure 2: Number of days when air pollution is moderate or higher in the UK, 1987 to 2011 (provisional)



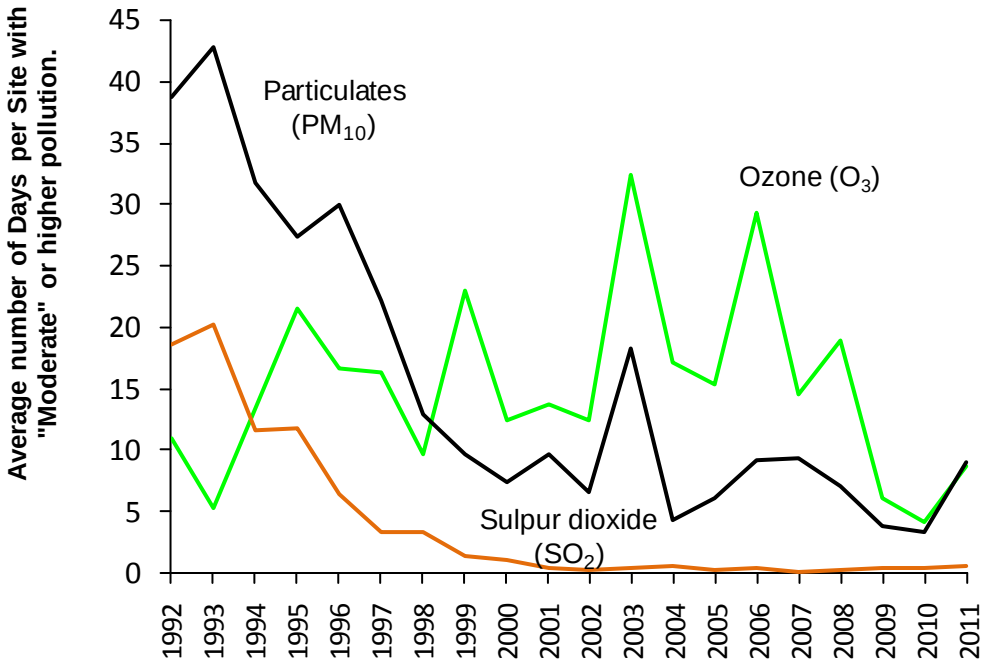
- **Days of moderate or higher air pollution in urban areas have shown a long-term improvement but increased in 2011:** average days declined from a peak of 59 days in 1993 to 17 days in 2011, but increased from the lowest recorded level of 8 days in 2010.

- **Days of moderate or higher air pollution for rural areas have shown no clear trend but increased in 2011:** average days declined from a peak of 64 days in 2003 to 29 days in 2011, but increased from a low of 21 days in 2010.

A table of the data are presented in Table 2 at the end of this statistical release

The urban results are most strongly driven by ozone and PM_{10}, and the rural results by ozone. Both these pollutants are influenced by weather, which contributes to the variability over time.

Figure 3: Average number of days when levels of ozone, particulates and sulphur dioxide were moderate or higher at urban sites in the UK, 1992 to 2011 (provisional)



Note: for the purposes of this chart, where a day is caused by more than one pollutant, it is counted for each pollutant i.e. there is double counting.

A table of the data are presented in Table 3 at the end of this statistical release

At urban sites in 2011, two of the five pollutants, ozone and particulates, caused approximately 90 per cent of the moderate or higher pollution days, either separately or in combination with each other.

Between 1992 and 2011, the average number of days of pollution at urban sites caused by particulates, solely or in combination with other pollutants, fell from an average per site of 39 days to 9 days per year.

Since 1999, ozone has caused more days of moderate or higher pollution in urban areas than particulates, as pollution by particulates has declined. However, the number of days caused by ozone pollution has no clear long-term trend. Weather conditions contribute to variability over time, with more ozone produced on hot, sunny days, as was the case during 2003 and 2006. However, low summer ozone pollution was also seen Europe-wide in 2009, despite the average temperature being similar to the hot summer in Europe in 2003. This could indicate that reductions in emissions of ozone precursors have contributed to the lower pollution days caused by ozone levels in recent years.

From 2001, sulphur dioxide has hardly caused any pollution days on average, either solely or in combination with other pollutants. This reflects the large reductions in emissions from the early 1990s. Carbon monoxide has not contributed to the number of pollution days since 1993. Nitrogen dioxide has impacted very rarely, at a maximum of 1 day per year.

For rural areas, ozone is the cause of the majority of pollution days, so a breakdown by pollutant is not presented for rural sites.

A National Statistics publication

National Statistics are produced to high professional standards set out in the Code of Practice for Official Statistics. They undergo regular quality assurance reviews to ensure they meet customer needs.

Responsible Defra statistician: Stephen Hall

Main notes

1. The banding system used for determine moderate or higher air pollution is that of the Air Pollution Information Service. The UK air quality bandings were updated from 1st January 2012. The data presented here are based on the previous bandings in place up to 31st December 2011[iv].
2. More detailed data, site metadata and information are published on the UK-AIR website .
3. Information about the health effects of air pollution can be found in the leaflet 'Air Pollution - what it means for your health'. This leaflet is available on the Defra website, along with further information on the Air Quality Strategy.
4. Further details and data relating to UK air quality are available on Defra's Environment Statistics website.

[iv] See 'Table 4: UK air quality bandings applicable until 31st December 2011' at the end of the release for more details.

Department for Environment, Food and Rural Affairs
Nobel House, 17 Smith Square, London, SW1P 3JR

Public enquiries: 08459 335577 or Press enquiries: 020 7238 1542
Public enquiries & user feedback: enviro.statistics@defra.gsi.gov.uk

Website: www.defra.gov.uk/statistics/environment/

Table 1: Annual average levels of PM_{10} and Ozone (µg m^{-3}), 1987 to 2011 (provisional), UK

Year	PM_{10}		Ozone	
	Roadside	Urban Background	Rural	Urban Background
1987	..	..	58	38
1988	..	..	66	41
1989	..	..	70	45
1990	..	..	72	46
1991	..	..	68	45
1992	..	35	70	42
1993	..	35	68	42
1994	..	32	72	49
1995	..	32	72	49
1996	36	31	67	46
1997	39	30	65	46
1998	33	26	69	49
1999	32	24	73	56
2000	31	23	68	53
2001	28	23	68	52
2002	28	23	68	53
2003	31	25	72	60
2004	27	22	73	57
2005	28	22	70	57
2006	30	24	74	61
2007	25	22	68	57
2008	23	19	70	60
2009	22 (19)[1]	19 (22)[1]	69	55
2010	23 (22)[1]	20	67	53
2011	23	20	68	58

Notes:

1.Since 2008, upgrade of numerous PM_{10} monitoring instruments has enabled correction of measurements taken from sites using older equipment, by using the Volatile Correction Model (VCM). These results are shown in parentheses. Non-VCM corrected data for 2008 and 2009 are retained here for the purpose of year-on-year comparison. VCM corrections for 2010 are currently not available.

PM_{10}: annual mean, average across all included sites.

Ozone: annual mean of the daily maximum 8 hour running mean: average across all included sites

.. not available because of insufficient data

Not every site in the automatic monitoring network is included. Sites must also meet certain data capture targets to be used in the index. For both ozone and PM10, from 1987-97 data capture should be more than or equal to 50% of the year and from 1998 onwards it should be more than or equal to 75% of the year. For ozone this applies to both the full year and the summer period in isolation.

Cardiff Centre and Manchester Piccadilly were excluded in 1994 and 2001 respectively, because stone cutting adjacent to sites caused unrepresentative results. Narberth was excluded in 2004 and 2007 due to incorrect measurements. Great Dun Fell was excluded until 2001 due to sample lines being frozen. Reading New Town has been excluded in 2008 due to low data capture for PM10 caused by faulty new measuring instruments.

Department for Environment, Food and Rural Affairs
Nobel House, 17 Smith Square, London, SW1P 3JR

Public enquiries: 08459 335577 or Press enquiries: 020 7238 1542
Public enquiries & user feedback: enviro.statistics@defra.gsi.gov.uk

Website: www.defra.gov.uk/statistics/environment/

Table 2: Average number of days of moderate or higher air pollution per site, 1987 to 2011 (provisional), UK

Year	Urban Average	Rural Average
1987	..	21.2
1988	..	32.1
1989	..	46.2
1990	..	50.0
1991	..	46.5
1992	53.8	45.2
1993	59.2	32.8
1994	51.1	44.5
1995	48.3	44.3
1996	48.3	41.5
1997	38.7	42.2
1998	24.6	29.0
1999	32.6	47.8
2000	20.0	27.3
2001	23.4	33.7
2002	19.0	32.3
2003	47.8	64.1
2004	21.7	44.5
2005	21.4	39.5
2006	38.1	54.9
2007	23.4	29.7
2008	26.0	44.8
2009	10.3	32.2
2010	8.4	21.8
2011	17.0	29.6

Notes:

.. not available because of insufficient data

Not every site in the automatic monitoring network is included. Sites must also meet certain data capture targets to be used in the index. Urban sites are required to monitor PM_{10} and rural sites are required to monitor ozone. For the required pollutants, 1987-97 data capture should be more than or equal to 50% of the year, and from 1998 onwards it should be more than or equal to 75% of the year. For ozone this applies to both the full year and the summer period in isolation.

Cardiff Centre and Manchester Piccadilly were excluded in 1994 and 2001 respectively, because stone cutting adjacent to sites caused unrepresentative results. Narberth was excluded in 2004 and 2007 due to incorrect measurements. Great Dun Fell was excluded until 2001 due to sample lines being frozen. Reading New Town has been excluded in 2008 due to initial problems with new measuring instruments.

Table 3: Average number of days of moderate or higher air pollution at urban sites caused by the each of the basket of 5 pollutants, 1992 to 2011 (provisional), UK

Year	Ozone	Nitrongen dioxide	Carbon monoxide	Sulpur dioxide	Particulates (PM_{10})
1992	11	1	1	19	39
1993	5	0	0	20	43
1994	13	1	0	12	32
1995	22	1	0	12	27
1996	17	0	0	6	30
1997	16	1	0	3	22
1998	10	0	0	3	13
1999	23	0	0	1	10
2000	12	0	0	1	7
2001	14	0	0	0	10
2002	12	0	0	0	7
2003	33	0	0	0	18
2004	17	0	0	1	4
2005	15	1	0	0	6
2006	29	0	0	0	9
2007	15	0	0	0	9
2008	19	1	0	0	7
2009	6	0	0	0	4
2010	4	1	0	0	3
2011	9	0	0	1	9

Notes:

Not every site in the automatic monitoring network is included. Sites must also meet certain data capture targets to be used in the index. Urban sites are required to monitor PM_{10} and rural sites are required to monitor ozone. For the required pollutants, 1987-97 data capture should be more than or equal to 50% of the year, and from 1998 onwards it should be more than or equal to 75% of the year. For ozone this applies to both the full year and the summer period in isolation.

Cardiff Centre and Manchester Piccadilly were excluded in 1994 and 2001 respectively, because stone cutting adjacent to sites caused unrepresentative results. Narberth was excluded in 2004 and 2007 due to incorrect measurements. Great Dun Fell was excluded until 2001 due to sample lines being frozen. Reading New Town has been excluded in 2008 due to initial problems with new measuring instruments.

Table 4: UK air quality bandings applicable until 31st December 2011

Band	Index	Ozone		Nitrogen Dioxide		Sulphur Dioxide		Carbon Monoxide		PM_{10} Particulates	
		Running 8 hourly or hourly mean*		hourly mean		15 minute mean		Running 8 hourly mean		Running 24 hour mean	
		µg m^{-3}	ppb	µg m^{-3}	ppb	µg m^{-3}	ppb	mg m^{-3}	ppm	µg m^{-3} (Grav. Equiv.)	µg m^{-3} (Ref. Equiv.)
Low											
	1	0-33	0-16	0-95	0-49	0-88	0-32	0-3.8	0.0-3.2	0-21	0-19
	2	34-65	17-32	96-190	50-99	89-176	33-66	3.9-7.6	3.3-6.6	22-42	20-40
	3	66-99	33-49	191-286	100-149	177-265	67-99	7.7-11.5	6.7-9.9	43-64	41-62
Moderate											
	4	100-125	50-62	287-381	150-199	266-354	100-132	11.6-13.4	10.0-11.5	65-74	63-72
	5	126-153	63-76	382-477	200-249	355-442	133-166	13.5-15.4	11.6-13.2	75-86	73-84
	6	154-179	77-89	478-572	250-299	443-531	167-199	15.5-17.3	13.3-14.9	87-96	85-94
High											
	7	180-239	90-119	573-635	300-332	532-708	200-266	17.4-19.2	15.0-16.5	97-107	95-105
	8	240-299	120-149	636-700	333-366	709-886	267-332	19.3-21.2	16.6-18.2	108-118	106-116
	9	300-359	150-179	701-763	367-399	887-1063	333-399	21.3-23.1	18.3-19.9	119-129	117-127
Very High											
	10	360 or more	180 or more	764 or more	400 or more	1064 or more	400 or more	23.2 or more	20 or more	130 or more	128 or more

* For ozone, the maximum of the 8 hourly and hourly mean is used to calculate the index value.

Department for Environment, Food and Rural Affairs
Nobel House, 17 Smith Square, London, SW1P 3JR

Public enquiries: 08459 335577 or Press enquiries: 020 7238 1542
Public enquiries & user feedback: enviro.statistics@defra.gsi.gov.uk

Website: www.defra.gov.uk/statistics/environment/