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Introduction

The Technical Services Branch of the Kentucky Division for Air Quality produces the Ambient Air Quality Annual Report. This report presents a summary of statistical results from monitoring outdoor concentrations of air pollutants in the Commonwealth during the calendar year 2006.

The primary source of data for this report is the Air Quality Monitoring Network operated by the Kentucky Division for Air Quality. The report also contains monitoring data collected by the Louisville Metro Air Pollution Control District, the National Park Service and some industries.

Network Design and Operation

Since July 1967, the state has operated an air quality monitoring network. The 2006 network included 173 monitors in 33 counties (this total includes monitors operated by the Louisville Metro Air Pollution Control District, the National Park Service at Mammoth Cave and industries).

The monitoring station locations are selected with U.S. Environmental Protection Agency guidance (40 CFR 58, Appendix D) and, in general, are established near high population areas or air pollution sources. Each year the site locations are reviewed to ensure that adequate coverage is being provided.

Many staff hours are devoted to the operation of the monitoring network. Division staff routinely visits our sites to calibrate and maintain the monitoring equipment, collect samples, and verify and document data from the continuous monitors. Because it is imperative that the air monitoring data be accurate and precise, the Division for Air Quality has an extensive quality assurance program. Staff members audit every air monitor quarterly to ensure that each is operating properly. This audit includes monitors operated by the Louisville Metro Air Pollution Control District, the National Park Service and industrial networks.

Monitoring data is used in several ways. The data is utilized to demonstrate compliance with and/or progress made toward meeting ambient air quality standards and to identify pollution trends. The data also assists in evaluating public health impacts and the possible need to initiate emergency control procedures.

The public has access to the monitoring data through this annual report and, on a daily basis, through the Air Quality Index (AQI) message on our website: www.air.ky.gov or toll free at: 1-800-AIR-IN-KY. The AQI is a 24- hour report on Kentucky's air quality. During the summer months, the public can also access daily ozone level reports through EPA's AIRNOW website at www.epa.gov/airnow.

Report Organization

This report contains sections on each criteria pollutant with the monitoring data contained in a table arranged alphabetically by county. Wet deposition, toxics, industrial data, mercury monitoring and attainment designations are presented in separate sections. Also, there are abstracts for the twenty-three air toxics reported to the U. S. EPA located in Appendix A.

The report has been composed and arranged in an attempt to make it "user friendly." Included in the report are: a National Ambient Air Quality Standards table; a table listing monitors by county; maps indicating monitor locations; and pollutant trends graphs.

If you have suggestions or questions concerning this report, please contact Andrea Keatley, Technical Services Branch, Division for Air Quality, 803 Schenkel Lane, Frank-



Informational Websites

[The Plain English Guide to the Clean Air Act](http://www.epa.gov/air/caa/peg/)

<http://www.epa.gov/air/caa/peg/>

[40 CFR Chapter I— Environmental Protection Agency: Subchapter C: Parts 50-99](http://www.epa.gov/epacfr40/chapt-I.info/chi-toc.htm)

<http://www.epa.gov/epacfr40/chapt-I.info/chi-toc.htm>

[Kentucky Administrative Regulations Title 401, Natural Resources and Environmental Protection, Cabinet Department for Environmental Protection](http://www.lrc.ky.gov/kar/TITLE401.HTM)

<http://www.lrc.ky.gov/kar/TITLE401.HTM>

[Kentucky Revised Statutes Chapter 224 Environmental Protection](http://www.lrc.ky.gov/KRS/224-00/CHAPTER.HTM)

<http://www.lrc.ky.gov/KRS/224-00/CHAPTER.HTM>

[National Ambient Air Quality Standards \(NAAQS\)](http://www.epa.gov/air/criteria.html)

<http://www.epa.gov/air/criteria.html>

[Six common air pollutants](http://www.epa.gov/air/criteria.html)

<http://www.epa.gov/air/criteria.html>

[EPA Green Book Nonattainment Areas for Criteria Pollutants](http://www.epa.gov/air/oaqps/greenbk/index.html)

<http://www.epa.gov/air/oaqps/greenbk/index.html>

[AirData: Access to Air Pollution Data](http://www.epa.gov/air/data/)

<http://www.epa.gov/air/data/>

[Clean Air Interstate Rule](http://www.epa.gov/cair/)

<http://www.epa.gov/cair/>

[Clean Air Interstate Rule – Kentucky](http://www.epa.gov/cair/ky.html)

<http://www.epa.gov/cair/ky.html>

[National Atmospheric Deposition Program](http://nadp.sws.uiuc.edu/)

<http://nadp.sws.uiuc.edu/>

National Ambient Air Quality Standards (NAAQS)

Pollutant	MAXIMUM CONCENTRATION	
	Primary Standard	Secondary Standard
Carbon Monoxide		
8 hour average	9 ppm ⁽¹⁾	None
1 hour average	35 ppm ⁽¹⁾	None
Lead		
Calendar quarter average	1.5 µg/m ³	Same as primary
Nitrogen Dioxide		
Annual Average	0.053 ppm	Same as primary
Ozone		
8 hour average	0.08 ppm ⁽⁴⁾	Same as primary
Particulate Matter (measured as PM _{2.5})		
24 hour average (Revised December 18, 2006)	35 µg/m ³ ⁽⁵⁾	Same as primary
Annual Average	15 µg/m ³ ⁽⁶⁾	
Particulate Matter (measured as PM ₁₀)		
24 hour Average	150 µg/m ³ ⁽³⁾	
Annual Average (Revoked December 18, 2006)	50 µg/m ³ ⁽²⁾ (Revoked)	
Sulfur Oxides		
24 hour average	0.14 ppm ⁽¹⁾	_____
Annual Average	0.03 ppm	_____
3 hour average	_____	0.5 ppm

The federal Clean Air Act (42 U.S.C. 7401-7671), as amended by the U.S. Congress in 1970, 1977 and 1990, directs the U.S. Environmental Protection Agency (EPA) to establish NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS) defining maximum allowable ambient (outdoor) concentrations for criteria pollutants. The term "criteria pollutants" derives from the requirement that EPA must set criteria or standards for each.

There are two standard goal levels for each of the criteria pollutants. The PRIMARY STANDARD is designed to protect the public health. The SECONDARY STANDARD is designed to protect public welfare. Welfare covers damage to plants and animals, impairment of visibility and property damage.

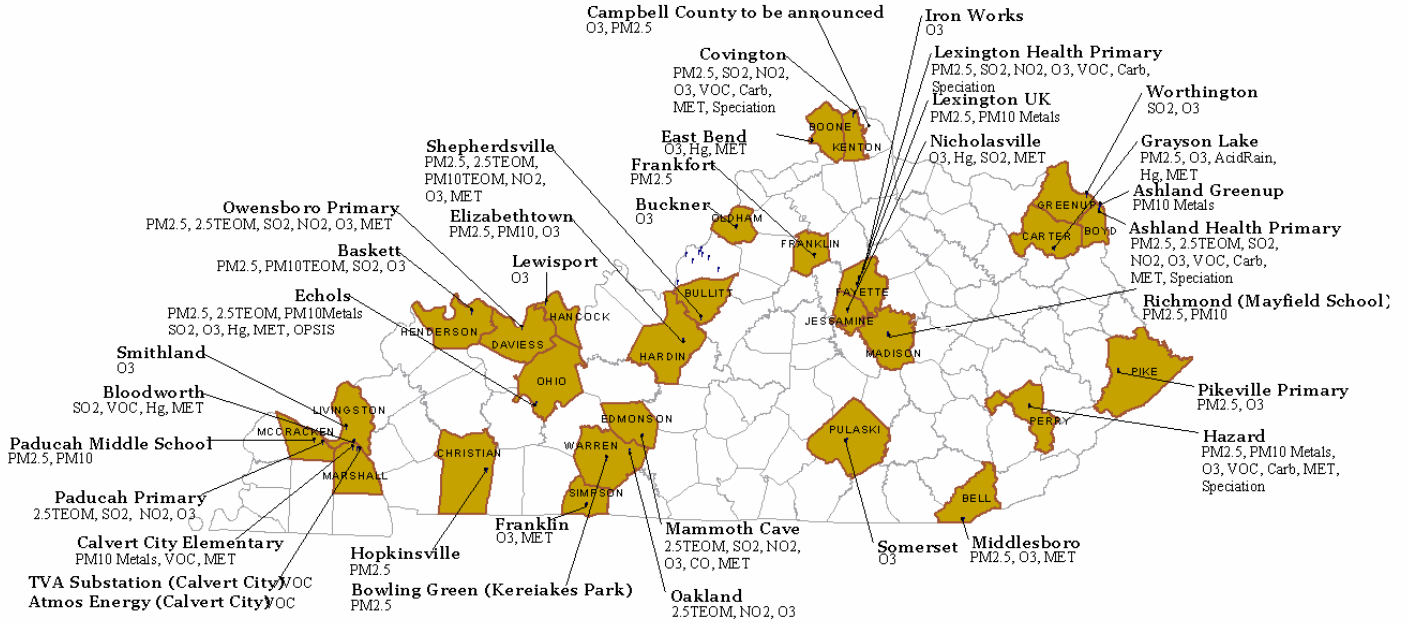
Units of measure in the chart are micrograms of pollutants per cubic meter of air (µg/m³) and parts of pollutants per million (ppm) parts of air.

Footnotes:

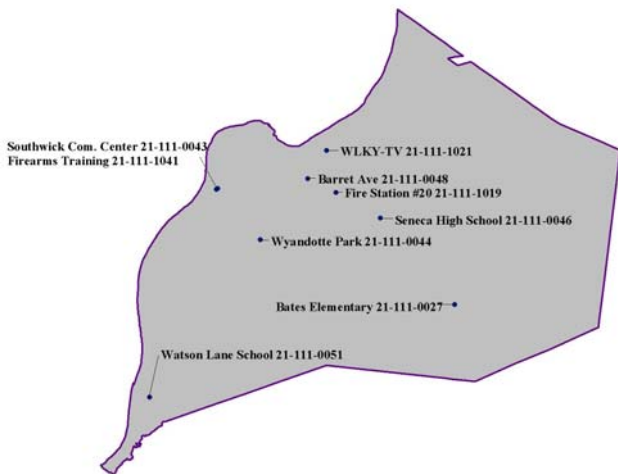
- (1) This average is not to be exceeded more than once per year.
- (2) The standard is attained when the expected annual arithmetic mean concentration is less than or equal to 50 µg/m³.
- (3) The standard is attained when the expected number of days per calendar year with a twenty-four (24) hour average concentration above 150 µg/m³ is equal to or less than one (1).
- (4) The standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average ozone concentration is less than or equal to 0.08 ppm.
- (5) The standard is attained when the 3-year average of the annual 98th percentile is less than or equal to 35 µg/m³.
- (6) The standard is attained when the 3-year average of annual means is less than or equal to 15 µg/m³.

2006 Kentucky Ambient Air Monitoring Network

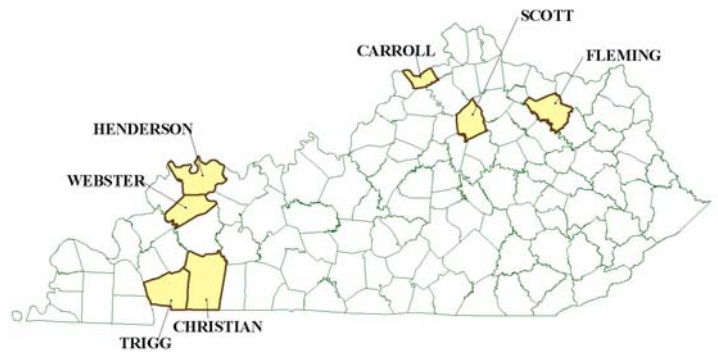
KYDAQ Air Monitoring Network



LMAPCD Air Monitoring Network



Industrial Air Monitoring Counties



2006 Kentucky Ambient Air Monitoring Network

County	PM _{2.5}	PM ₁₀	SO ₂	NO ₂	CO	O ₃	AcidRn	Species	Toxics	Hg	WS/WD
Bell*	1	1				1					1
Boone						1				1	1
Boyd	1	2	1	1		1		1	4		1
Bullitt	1	1		1		1					1
Campbell*	1	1	1	1		1					
Carroll ³		1		1							
Carter	1					1	1			1	1
Christian	1										
Christian ³						1					
Daviess*	1		1	1		1					1
Edmonson ^{1*}	1					1	1				1
Fayette	2	1	1	1		2		1	4		
Fleming ³						1					
Franklin	1										
Greenup			1			1					
Hancock						1					
Hardin	1	1				1					
Henderson	2	1	1			1					
Henderson ³			2								
Jefferson ^{2*}	9	3	2	1	2	3		1			1
Jessamine						1				1	1
Kenton	1		1	1		1		1	2		1
Laurel*	1	1									
Livingston			1			1			2	1	1
McCracken*	1	1	1	1		1					
Madison	1	1									
Marshall		1							4		1
Ohio	1	1	1			1			1	1	1
Oldham						1					
Perry	1	2				1		1	6		1
Pike	2					1					
Pulaski*		1				1					
Scott ³						1					
Simpson						1					1
Trigg ³						1					
Warren*	2		1	1		1					
Webster ³			1								
Wayne, WV ³			3	1		1					
Total	33	20	19	11	2	33	2	5	23	5	15

¹ Operated by the National Park Service

² Operated by the Louisville Metro Air Pollution Control District

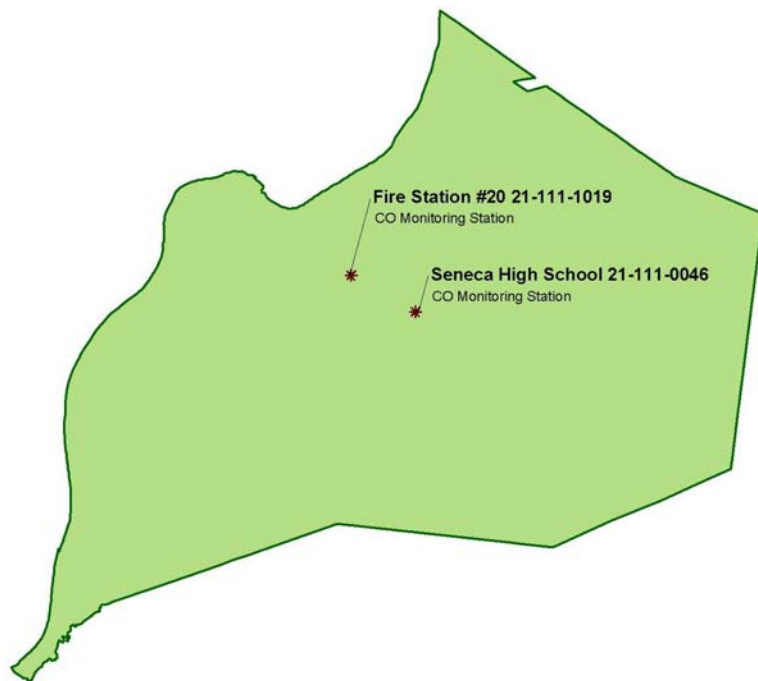
³ Industrial Air Monitoring Network

* A monitor or a site in this county was discontinued during 2006

Carbon Monoxide (CO)

- In 2006, Louisville operated 2 CO monitors.
- There were no exceedances of the CO air quality standards in 2006.
- CO averages from 1980 to 2006 on the decrease.
- The last exceedance of the CO standards in Kentucky occurred on January 7, 1998.
- Due to the substantial drop in CO, statewide monitoring discontinued in 2003.

Louisville Metro Air Pollution Control District: Carbon Monoxide Ambient Air Monitoring Network



Carbon monoxide (CO) is an odorless, colorless, poisonous gas that is produced by the incomplete combustion of carbon containing fuels. The primary source of carbon monoxide is the exhaust from motor vehicles that includes highway and off-road vehicles such as construction equipment. Other sources include industrial processes, kerosene and wood burning stoves in homes.

Environmental Impacts

The main health effect of carbon monoxide is its tendency to reduce the oxygen carrying capacity of blood. Carbon monoxide enters the bloodstream in the lungs where it binds chemically with the hemoglobin in red blood cells. Hemoglobin normally carries oxygen to organs and tissues but because CO binds with the hemoglobin over 200 times more readily than oxygen, the amount of oxygen absorbed into the bloodstream is greatly reduced when CO is present. Depending on the level of exposure, CO can cause fatigue and headaches and can impair vision and reflexes. Unconsciousness and even death may occur at high concentrations. The severity of the effects is related to the length of exposure and concentration level of CO.

How is CO Monitored?

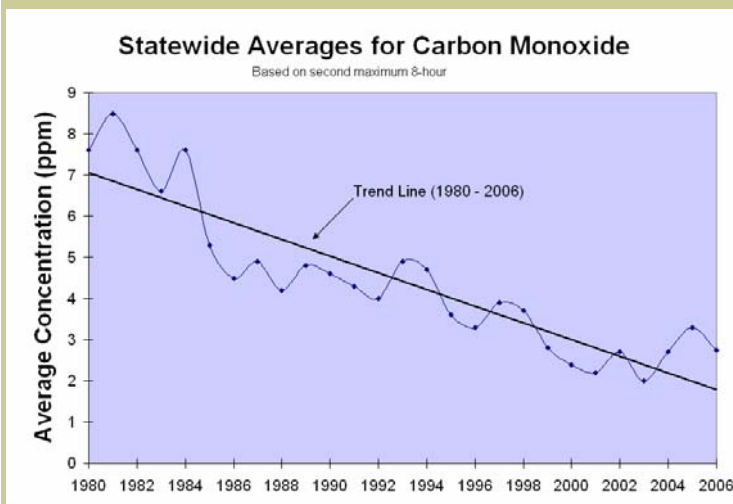
Carbon monoxide is monitored continuously by analyzers that operate using the non-dispersive infrared photometry method. In this method, ambient air is drawn into a sample cell and a beam of infrared light is passed through it. Carbon monoxide absorbs infrared light and any decrease in the intensity of the beam is due to the presence of CO. The decrease is directly related to the concentration of CO in the ambient air. A detector measures the difference between the sample cell beam and a duplicate beam passing through a reference cell with no CO present. The difference is translated into a measure of the CO present in the ambient air. Data from the analyzer is transmitted by telemetry for entry into an automated data storage system. In 2006 the Louisville Metro Air Pollution Control District operated two CO monitors in Jefferson County.

Results

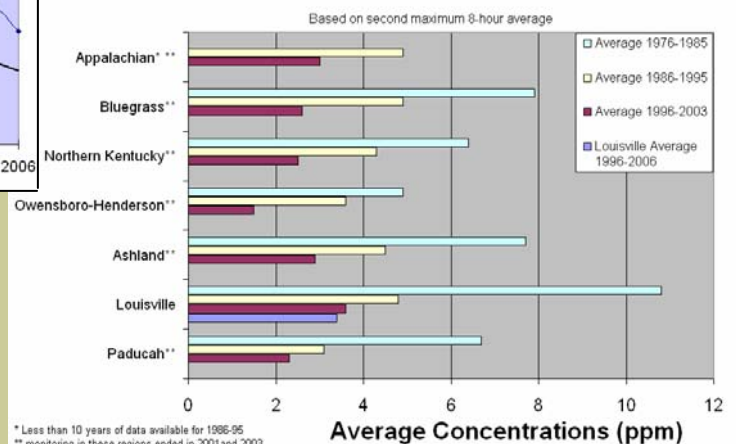
There were no exceedances of the CO standards in 2006. The last exceedance of a standard occurred on January 7, 1998 in Ashland when an 8-hour average of 11.7 ppm was recorded. All Kentucky counties are currently in attainment of the standards for carbon monoxide.

Statewide and regional carbon monoxide levels have declined substantially since 1980, primarily due to improved emission controls on motor vehicles. Due to the substantial drop in monitored levels, carbon monoxide monitoring was discontinued statewide in 2003 except for Jefferson County. This accounts for the up trend from 2004 to 2006 for the statewide average as it includes only data from Jefferson County that has historically been higher than the rest of the state. A statistical summary follows on the next page.

Carbon Monoxide Trends



Average Regional Concentrations of Carbon Monoxide



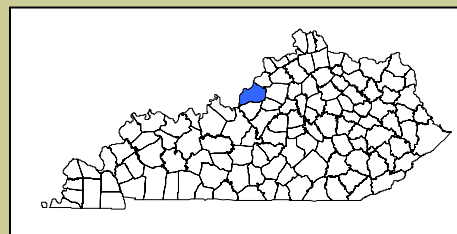
National Ambient Air Quality Standards for Carbon Monoxide

Primary NAAQS: 8-hour average not to exceed 9 ppm more than once per year.
 1-hour average not to exceed 35 ppm more than once per year.

Secondary NAAQS: Same as primary standard.

Criteria Pollutant Summary Report – 2006

Pollutant: Carbon Monoxide
Method: Instrumental/Non-Dispersive
 Infrared Photometry
Data Interval: Hourly
Units: Parts-per-million (ppm)



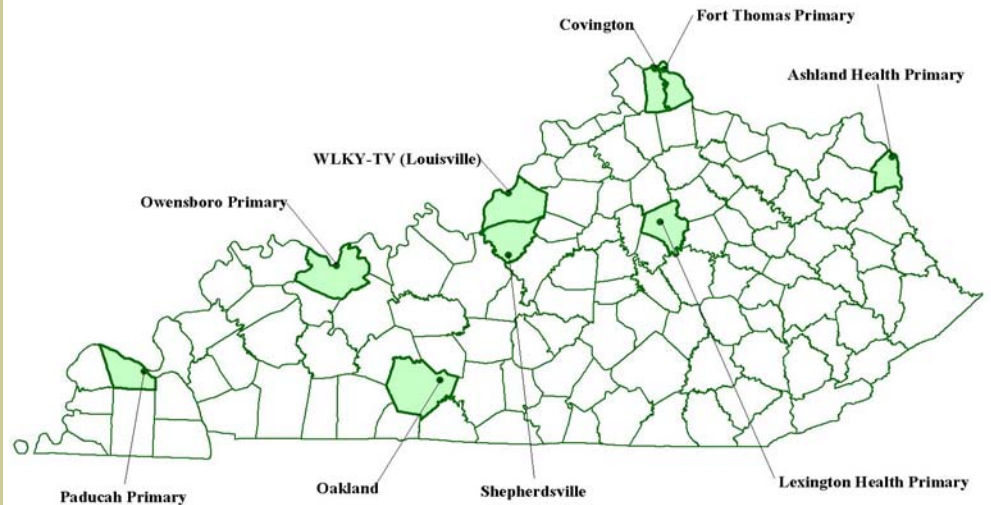
County	Site Address	AQS-ID	# Obs	1-Hr Averages			8-Hr Averages		
				1 st max	2 nd max	Obs > 35.0	1 st max	2 nd max	Obs > 9.0
Jefferson ¹	3510 Goldsmith Lane Louisville	21-111-0046	8398	4.3	3.2	0	3.1	2.7	0
Jefferson ¹	1735 Bardstown Road Louisville	21-111-1019	8598	11.4	4.9	0	3.1	2.8	0

¹ Carbon monoxide monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

Nitrogen Dioxide (NO₂)

- There were no exceedances of the NO₂ standard in 2006.
- An exceedance has never been recorded in Kentucky since the inception of NO₂ sampling in 1970.
- The NO₂ monitor at the Fort Thomas site was moved to the Covington site after the Fort Thomas site was terminated.

Nitrogen Dioxide Ambient Air Monitoring Network



Nitrogen dioxide is a reddish brown gas that is produced during high temperature combustion. During combustion, nitrogen and oxygen are combined, or oxidized, to form a family of highly reactive gases called nitrogen oxides (NO_x), which includes nitrogen dioxide (NO₂) and nitrogen oxide (NO). In addition to the NO₂ produced during combustion, the NO produced may, in the presence of sunlight, undergo a photochemical reaction that will also form NO₂. The rate of reaction is dependent upon the intensity of the sunlight. Major combustion or oxidation sources that produce NO₂ include motor vehicles, power plants, incinerators, industrial boilers and some chemical processes.

Environmental Impacts

The primary health effect of nitrogen dioxide is as a lung irritant, which can cause an increase in respiratory rate, a decrease in lung function and an increase the susceptibility of the respiratory system to infection. Nitrogen oxides are also considered detrimental to human health due to their association in the formation of ozone and the resulting health effects caused by that pollutant. Nitrogen dioxide is also a contributor to the formation of acid precipitation, which can damage plant life, aquatic life, cause the deterioration of stone/masonry-type buildings and deteriorate statues. Nitrogen oxides also react with ammonia to form ammonium nitrate, a component of PM_{2.5}. Nitrates are also a key component in regional haze that has been attributed to poor visibility in the southeast region of the United States.

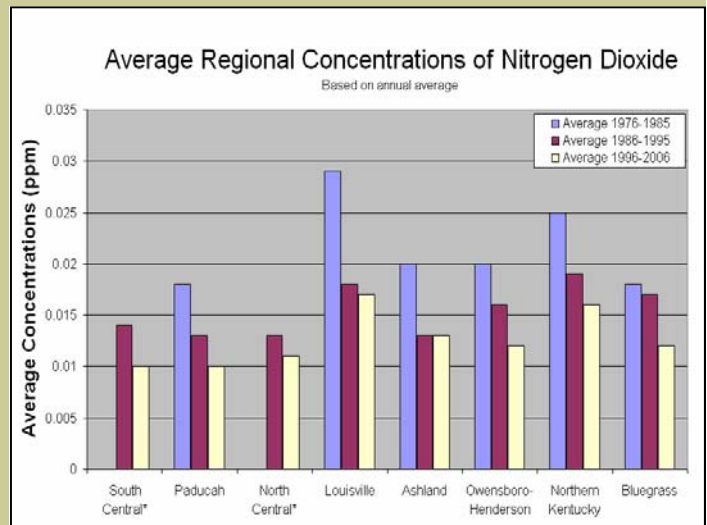
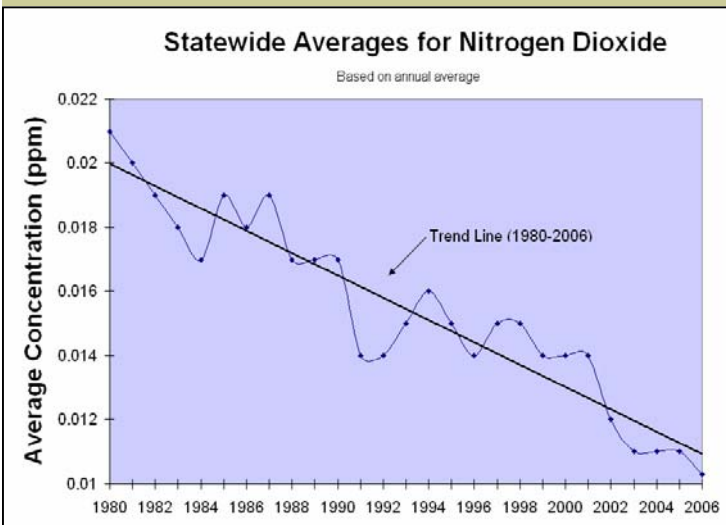
How is NO₂ monitored?

Nitrogen dioxide is monitored continuously by analyzers that utilize the principle of photometric detection of the chemiluminescence (light) resulting from the gas phase reaction of nitric oxide (NO) and ozone. When these two gases react, light at a specific wavelength is produced. In operation, sample air is drawn into the analyzer and split into two streams. The first stream is reacted directly with ozone (which is produced by a generator in the analyzer) and the light energy produced is proportional to the NO in the sample. Since NO₂ does not react with ozone, the second stream of air passes through a catalytic converter that converts the NO₂ in the sample to NO. That stream is then reacted with ozone, which will provide a total measurement of nitrogen oxides (NO_x) in the sample. The assumption is that the majority of the NO_x value is not NO₂. By subtracting the NO value obtained by the first stream from the NO_x value obtained in the second stream, a NO₂ value is obtained. Data from the analyzer is transmitted by telemetry into an automated data storage system. In 2006, the Division for Air Quality and the Louisville Metro Air Pollution Control District operated nine nitrogen dioxide monitors in Kentucky.

Results

There were no exceedances of the NO₂ standard in 2006 and there have been no recorded exceedances of the NAAQS since the inception of sampling in 1970. Statewide and regional nitrogen dioxide levels show steady downward trends, primarily due to the use of pollution control devices on motor vehicles, power plants and industrial boilers. A statistical summary of nitrogen dioxide data collected in 2006 follows on the next page.

Nitrogen Dioxide Trends



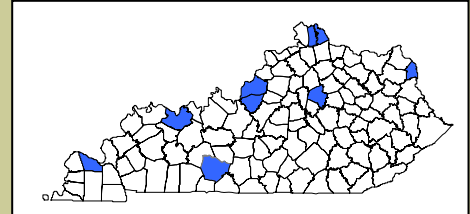
National Ambient Air Quality Standards for Nitrogen Dioxide

Primary NAAQS: Annual Arithmetic Mean 0.05 ppm.

Secondary NAAQS: Same as Primary Standard.

Criteria Pollutant Summary Report – 2006

Pollutant: Nitrogen Dioxide
Method: Instrumental/Gas-Phase
 Chemiluminescence
Data Interval: Hourly
Units: Parts-per-million (ppm)



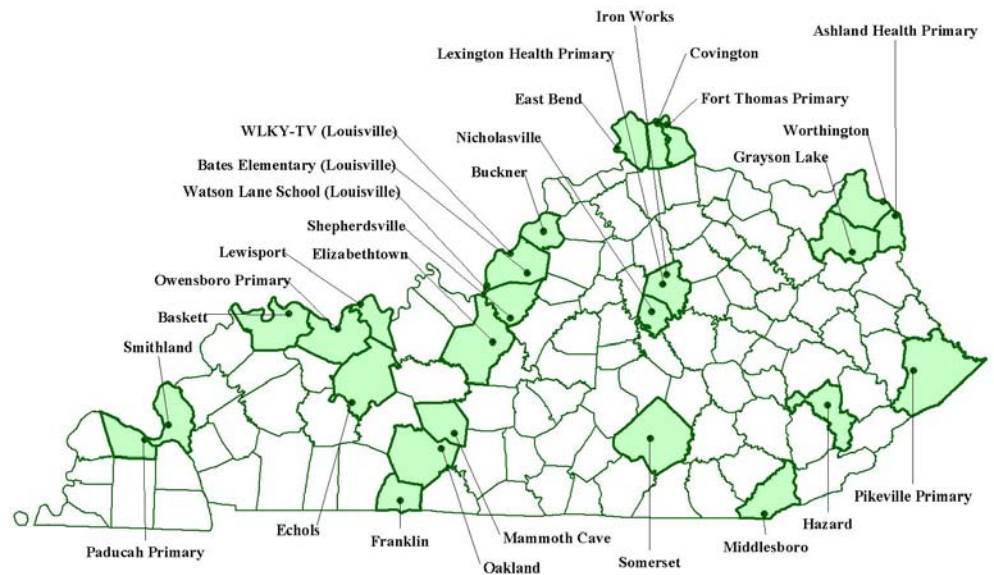
County	Site Address	AQS-ID	# Obs	Mean	1-Hr Average	
					1 st max	2 nd max
Boyd	2924 Holt Street Ashland	21-019-0017	7183	.010	.049	.043
Bullitt	2 nd & Carpenter Streets Shepherdsville	21-029-0006	7891	.008	.046	.045
Campbell Site and monitor terminated 3/15/2006	700 Alexandria Pike Fort Thomas	21-037-0003	1597	.011	.052	.048
Daviess	US 60 and Pleasant Valley Road Owensboro	21-059-0005	7928	.006	.041	.041
Fayette	650 Newtown Pike Lexington	21-067-0012	8220	.012	.061	.061
Jefferson ¹	1918 Mellwood Avenue Louisville	21-111-1021	8209	.015	.050	.050
Kenton Monitor established 3/16/2006	1401 Dixie Highway Covington	21-117-0007	6471	.014	.060	.060
McCracken	2901 Powell Street Paducah	21-145-1024	7829	.009	.051	.051
Warren	Oakland Elementary School Oakland	21-227-0008	7946	.008	.049	.048

¹ Nitrogen dioxide monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

Ozone (O₃)

- Ground level ozone can trigger health problems at low level exposures.
- O₃ is monitored from March 1—October 31.
- There has been a general decline in O₃ levels during the past 25 years.
- 8 exceedances of the 8-hour NAAQS in 2006.

Ozone Ambient Air Monitoring Network



Ozone is a colorless gas that is not emitted directly into the atmosphere from sources but forms in the atmosphere from a photochemical reaction between volatile organic compounds (VOCs) and nitrogen oxides in the presence of sunlight. Sources of volatile organic compounds include motor vehicle exhaust, dry cleaning, paint solvents, evaporation of gasoline and from storage, and fuel transfer facilities. Sources of nitrogen oxides include emissions from motor vehicles, boilers, incinerators and power plants.

Environmental Impacts

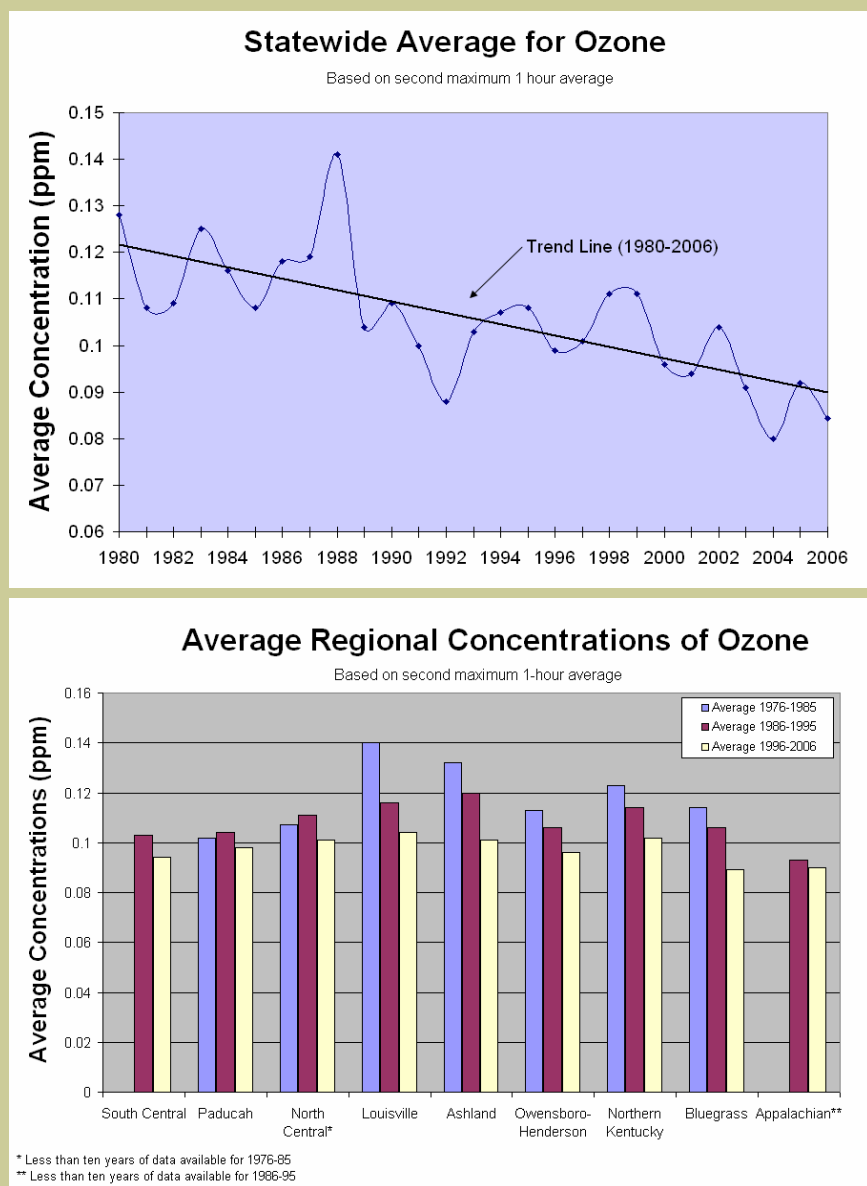
In the upper atmosphere, naturally occurring stratospheric ozone (commonly called the ozone layer), shields the earth's surface from the sun's harmful ultraviolet rays. However, tropospheric or ground level ozone can trigger health problems at low level exposure, cause permanent lung damage after long term exposure and damage ecosystems.



How is O₃ monitored?

Ozone is monitored from March 1 through October 31 each year when meteorological conditions are most conducive to the formation of ozone. Analyzers, which operate continuously, monitor ozone by using the ultraviolet photometry method. In this method, ambient air is drawn into a sample cell and a beam of ultraviolet light is passed through the cell. Ozone absorbs ultraviolet light and a decrease in the intensity of the light indicates the presence of ozone. The intensity of the light is first measured with no ozone present to determine a reference value. An ambient sample is then introduced and the intensity of the resultant light is measured by an ultraviolet detector. The amount of light absorbed by the sample indicates the level of ozone present. Data from the analyzers is transmitted by telemetry into an automated data storage system. In 2006, the Division for Air Quality, the National Park Service at Mammoth Cave and the Louisville Metro Air Pollution Control District operated a total of twenty-eight ozone monitors in Kentucky.

Ozone Trends



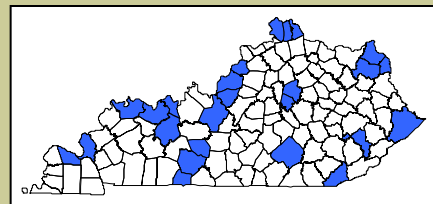
National Ambient Air Quality Standards for Ozone

Primary NAAQS: 8-Hour (3 year avg. of 4th max.) 0.08 ppm

Secondary NAAQS: Same as Primary Standard.

Criteria Pollutant Summary Report – 2006

Pollutant: Ozone
Method: Ultra-Violet Photometry
Data Interval: Hourly
Units: Parts-per-million (ppm)



County	Site Address	AQS-ID	Valid Days Meas.	8-Hr Average				
				Obs> 0.084	1 st max	2 nd max	3 rd max	4 th max
Bell	34 th & Dorchester Middlesboro	21-013-0002	245	0	.071	.070	.068	.066
Boone	KY 338 & Lower River East Bend	21-015-0003	244	0	.072	.072	.072	.071
Boyd	2924 Holt Street Ashland	21-019-0017	245	1	.087	.083	.081	.079
Bullitt	2 nd & Carpenter St Shepherdsville	21-029-0006	239	0	.078	.073	.071	.071
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	12	0	.041	.040	.038	.036
Carter	Camp Webb Grayson Lake	21-043-0500	245	0	.074	.072	.067	.065
Daviess	US 60 and Pleasant Valley Owensboro	21-059-0005	242	1	.090	.080	.075	.075
Edmonson ¹	Alfred Cook Road Mammoth Cave	21-061-0501	244	0	.074	.074	.072	.071
Fayette	Iron Works Pike Lexington	21-067-0001	244	0	.060	.059	.059	.056
Fayette	650 Newtown Pike Lexington	21-067-0012	245	0	.074	.071	.070	.068
Greenup	Scott & Center St Worthington	21-089-0007	189	1	.093	.081	.077	.077
Hancock	2 nd & Caroline Lewisport	21-091-0012	239	1	.085	.079	.078	.076
Hardin	801 North Miles St Elizabethtown	21-093-0006	245	0	.081	.079	.076	.074
Henderson	Baskett Fire Dept. Baskett	21-101-0014	238	0	.078	.074	.074	.074
Jefferson ²	7601 Bardstown Rd Louisville	21-111-0027	245	0	.078	.078	.076	.074
Jefferson ²	7201 Watson Lane Louisville	21-111-0051	236	1	.089	.082	.078	.077
Jefferson ²	1918 Mellwood Ave Louisville	21-111-1021	245	0	.081	.070	.069	.067

Ozone Criteria Pollutant Summary Report – 2006 Continued

County	Site Address	AQS-ID	Valid Days Meas.	8-Hr Average				
				Obs> 0.084	1 st max	2 nd max	3 rd max	4 th max
Jessamine	KYDOT, Etter Drive Nicholasville	21-113-0001	245	0	.078	.076	.073	.072
Kenton	1401 Dixie Highway Covington	21-117-0007	238	0	.082	.081	.079	.075
Livingston	KYDOT 811 US 60E Smithland	21-139-0003	243	0	.081	.073	.072	.071
McCracken	2901 Powell Street Paducah	21-145-1024	245	0	.084	.077	.075	.075
Ohio	Keytown Road Echols	21-183-0032	237	0	.070	.068	.068	.068
Oldham	DOT Garage, 3995 Morgan Buckner	21-185-0004	244	3	.086	.086	.085	.083
Perry	Perry Co Horse Park Hazard	21-193-0003	244	0	.075	.072	.072	.072
Pike	101 North Mayo Trail Pikeville	21-195-0002	245	0	.067	.065	.065	.063
Pulaski	Clifty Street Somerset	21-199-0003	245	0	.066	.065	.064	.064
Simpson	KYDOT, HWY 1008 Franklin	21-213-0004	243	0	.084	.081	.077	.076
Warren	Oakland Elementary School Oakland	21-227-0008	245	0	.081	.070	.070	.068

¹ Monitor operated by the National Park Service at Mammoth Cave.

² Ozone monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

Ozone Criteria Pollutant Multi-year Summary Report – 2006

8-hour 4th Maximum 3 Year Average

County	Site Address	AQS-ID	2004 4 th max	2005 4 th max	2006 4 th max	3 year Avg. 4 th max
Bell	34 th & Dorchester Middlesboro	21-013-0002	.069	.077	.066	.070
Boone	KY 338 & Lower River Road East Bend	21-015-0003	.070	.082	.071	.074
Boyd	2924 Holt Street Ashland	21-019-0017	.068	.082	.079	.076
Bullitt	2 nd & Carpenter Streets Shepherdsville	21-029-0006	.068	.080	.071	.073
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	.076	.090	.036*	NA
Carter	Camp Webb Grayson Lake	21-043-0500	.062	.081	.065	.069
Daviess	US 60 & Pleasant Valley Rd Owensboro	21-059-0005	.066	.083	.075	.074
Edmonson ¹	Alfred Cook Road Mammoth Cave	21-061-0501	.070	.075	.071	.072
Fayette	Iron Works Pike Lexington	21-067-0001	.063	.059	.056	.059
Fayette	650 Newtown Pike Lexington	21-067-0012	.063	.076	.068	.069
Greenup	Scott & Center Streets Worthington	21-089-0007	.073	.078	.077	.076
Hancock	2 nd & Caroline Streets Lewisport	21-091-0012	.071	.072	.076	.073
Hardin	801 North Miles Street Elizabethtown	21-093-0006	.068	.079	.074	.073
Henderson	Baskett Fire Dept Baskett	21-101-0014	.070	.077	.074	.073
Jefferson ²	7601 Bardstown Road Louisville	21-111-0027	.070	.079	.074	.074
Jefferson ²	7201 Watson Lane Louisville	21-111-0051	.070	.085	.077	.077
Jefferson ²	1918 Mellwood Avenue Louisville	21-111-1021	.068	.074	.067	.069
Jessamine	KYDOT, Etter Drive Nicholasville	21-113-0001	.065	.079	.072	.072
Kenton	1401 Dixie Highway Covington	21-117-0007	.073	.084	.075	.077
Livingston	KYDOT, 811 US 60 East Smithland	21-139-0003	.070	.075	.071	.072
McCracken	2901 Powell Street Paducah	21-145-1024	.067	.074	.075	.072
Ohio	Keytown Echols	21-183-0032	----	.072	.068	NA
Oldham	DOT Garage, 3995 Morgan Rd. Buckner	21-185-0004	.076	.089	.083	.082
Perry	Perry County Horse Park Hazard	21-193-0003	.067	.075	.072	.071
Pike	101 North Mayo Trail Pikeville	21-195-0002	.063	.069	.063	.065
Pulaski	Clifty Street Somerset	21-199-0003	.066	.075	.064	.068
Simpson	KYDOT, HWY 1008 Franklin	21-213-0004	.069	.079	.076	.074
Warren	Oakland Elementary School Oakland	21-227-0008	.068	.076	.068	.070

¹ Monitor operated by the National Park Service at Mammoth Cave. ² Ozone monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District. * Site and monitor terminated on 3/15/06. NA-Not applicable. There is insufficient data for a 3 year analysis.

Particulate Matter

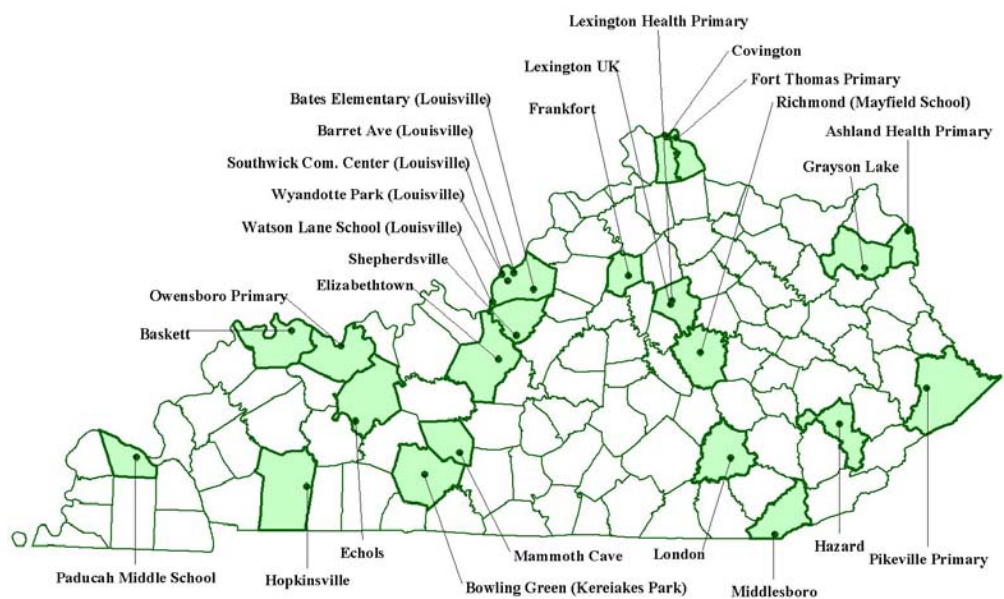
Particulate matter is a broad classification of non-gaseous pollutants that consists of very fine solid particles and liquid droplets or aerosols. Particulates are produced from many sources, including utility plants, wood burning stoves, leaf burning, vehicle exhaust, incinerators, rock quarries, coal processing, smelting, construction, farming and roadways. Particulates are also formed in the atmosphere when gases like sulfur dioxide, nitrogen oxides and volatile organic compounds are transformed by chemical reactions. Common forms of particulates include fly ash, soot, soil, minerals, fibers, metals, oil-aerosols and tire rubber. Particulate matter is categorized according to particle diameter due to the health impacts caused by particles of differing sizes. Particles that are greater than fifty microns ($50\mu\text{m}$) in diameter rapidly settle out of the air due to gravity and pose a limited health risk. Particles that are less than fifty microns in diameter remain suspended in the air for longer periods and are classified as Total Suspended Particulates (TSP). The larger of these particles (between 10 and 50 microns) rarely penetrate deeply into the human respiratory system but are trapped and removed by the body's natural defenses. Early research on the effects of smaller or "fine particulate matter" indicated that particles ten microns or less in diameter posed the greatest risk to human health. Particulate matter ten microns or less in diameter is referred to as PM_{10} and is a subset of fine particles within the TSP category. Particles in the PM_{10} range are small enough to evade the body's natural defense systems and penetrate into the lungs, where tissue is damaged and the immune system is weakened. As a result of the research on fine particulate matter, the U. S. EPA adopted a PM_{10} standard on July 1, 1987 replacing the previous TSP standard.

Medical and scientific research on the health effects of particulate matter continued after the adoption of the PM_{10} standard. As a result of further research it was determined that very fine particles in the 2.5-micron size range ($\text{PM}_{2.5}$) have a more adverse effect on human health. In response to these findings the U.S. EPA adopted a $\text{PM}_{2.5}$ standard, which became effective September 16, 1997.

Particulate Matter (PM_{2.5})

- December 18, 2006, new 24-hour average, 98th percentile averaged over 3-years, NAAQS set at 35 µg/m³.
- Four exceedances of the 24-hour, 98th percentile, standard in 2006.
- Downward trend in data from 2004 - 2006.
- One exceedance of the annual arithmetic mean in 2006.

Particulate Matter PM_{2.5} Ambient Air Monitoring Network



Particulate matter PM_{2.5} is a term used to define a mixture of solid particulates and liquid droplets that are 2.5 microns or smaller in size. Sources of PM_{2.5} include power plants, wood burning, industrial processes, and fuel combustion. Fine particulates are also formed in the atmosphere when gasses are transformed through chemical reactions. Sulfur dioxide, nitrogen oxides and VOC's are all examples of gasses that can transform by chemical reactions.

Environmental Impacts

Particulate of 2.5 microns or smaller have the ability to penetrate into the deepest parts of the lungs causing chronic respiratory symptoms and premature deaths in the elderly with compromised immune systems. PM_{2.5} also affects the environment by reducing visibility (up to 70% in some areas of the U.S.) and contributing to acid rain.

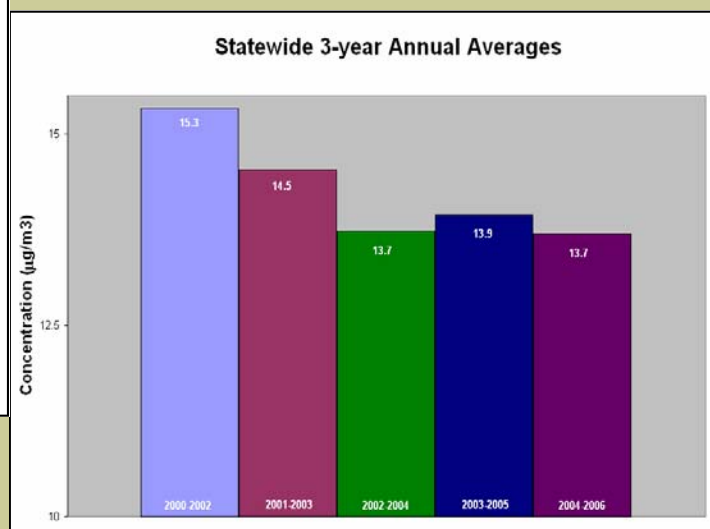
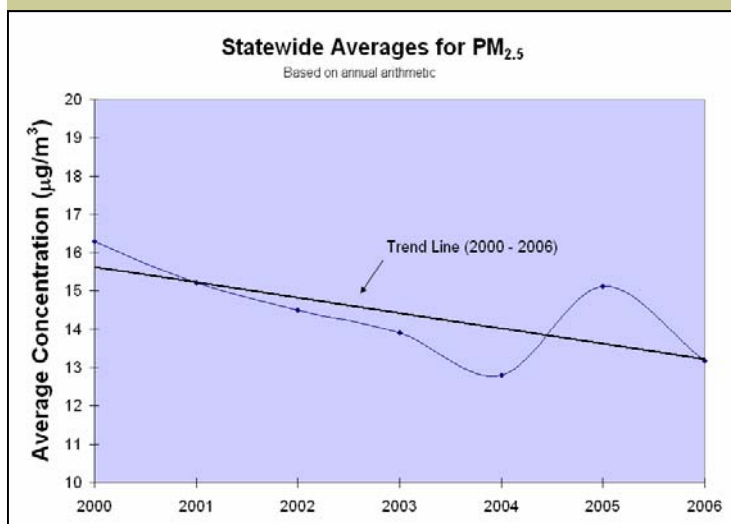
How is PM_{2.5} monitored?

Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitors must be used for NAAQS comparisons. FRM, FEM or continuous Tapered Element Oscillating Microbalance (TEOM) monitors may be used for daily PM_{2.5} Air Quality Index (AQI) results. TEOM samplers determine sample weights electronically and transmit results by telemetry into an automated data storage system. TEOM monitors are not FRM or FEM equivalent. FRM and FEM PM_{2.5} is monitored by an intermittent type sampler. The monitors collect a sample over a 24-hour run cycle. While most samplers operate every third day some operate every sixth day and some every day. These samplers operate by drawing a measured volume of air through a pre-weighed filter over a 24-hour period. Before reaching the filter, the air passes through an impaction chamber where larger particles fall out of the air stream while particles smaller than 2.5 microns pass on to the sample filter where they are collected. After completion of the sample run, the filter is removed from the sampler and reweighed to determine the mass of the particulates collected. Sample results are entered into an electronic data storage system. In 2006, the Division for Air Quality, the National Park Service at Mammoth Cave and the Louisville Metro Air Pollution Control District operated a network of thirty-three samplers.

Results

On December 18, 2006, EPA revised the PM_{2.5} 24-hour NAAQS by lowering the acceptable 24-hour average, 98th percentile averaged over 3-years, from 65 $\mu\text{g}/\text{m}^3$ to 35 $\mu\text{g}/\text{m}^3$. There were four exceedances of the 24-hour, 98th percentile, PM_{2.5} standard in 2006. A total of three samplers exceeded the three year (2004-2006) average annual standard. The three samplers were located in Jefferson county. Nonattainment designations were based on data collected from 2002-2004. Statewide PM_{2.5} levels have declined steadily over the period 2000-2006 with a slight increase in 2005. A statistical summary of 2006 FRM/FEM PM_{2.5} data appears on pages 19-20. Multi-year annual averages for 2004-2006 can be found on pages 21-22.

PM_{2.5} Trends



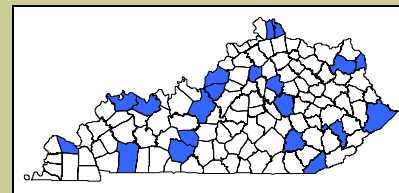
National Ambient Air Quality Standards for Particulate Matter PM_{2.5}

Primary NAAQS: Annual Arithmetic Mean not to exceed 15 mg/m³ (based on a three-year avg.).
 24-hour Concentration not to exceed 35 mg/m³. (based on a three-year average of the 98th percentiles).

Secondary NAAQS: Same as Primary Standard.

Criteria Pollutant Summary Report – 2006

Pollutant: Particulate Matter PM_{2.5}
Method: Gravimetric
Data Interval: 24-hour
Units: Micro-grams per cubic meter (mg/m³)



County	Site	AQS-ID	# Obs	Mean	24-Hour Average				
					Obs >35	1 st max	2 nd max	3 rd max	4 th max
Bell	34 th & Dorchester Middlesboro	21-013-0002	61	13.75	0	30.2	25.7	24.5	24.1
Boyd	2924 Holt Street Ashland	21-019-0017	115	13.76	1	48.6	28.9	28.6	28.0
Bullitt	2 nd & Carpenter Street Shepherdsville	21-029-0006	117	14.14	1	39.0	34.3	33.5	30.9
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	18	11.54	0	25.2	19.8	17.0	16.8
Carter	Camp Webb Grayson Lake	21-043-0500	112	11.49	1	43.2	26.3	25.5	24.9
Christian	10800 Pilot Rock Hopkinsville	21-047-0006	115	12.63	1	36.8	30.9	30.3	27.1
Daviess	US 60 and Pleasant Valley Rd Owensboro	21-059-0014	114	13.05	2	42.7	38.2	30.0	28.8
Edmonson ¹	Alfred Cook Road Mammoth Cave	21-061-0501	15	8.75	0	17.1	13.5	12.5	10.0
Fayette	650 Newtown Pike Lexington	21-067-0012	119	13.67	1	36.6	24.1	30.4	29.0
Fayette	533 South Limestone Lexington	21-067-0014	114	13.86	2	42.8	36.4	32.2	30.6
Franklin	803 Schenkel Lane Frankfort	21-073-0006	118	12.43	1	37.1	30.2	28.1	26.9
Hardin	801 North Miles Street Elizabethtown	21-093-0006	119	13.23	1	37.1	33.3	31.8	29.0
Henderson	Basket Fire Dept Baskett	21-101-0014	117	13.35	2	39.1	36.8	28.9	28.4

PM_{2.5} Criteria Pollutant Summary Report – 2006 Continued

County	Site	AQS-ID	# Obs	Mean	24-Hour Average				
					Obs >35	1 st max	2 nd max	3 rd max	4 th max
Jefferson ²	37th & Southern Avenue Louisville	21-111-0043-01	298	14.96	4	48.2	39.3	38.0	37.4
Jefferson ²	37th & Southern Avenue Louisville	21-111-0043-02	350	14.46	4	47.9	39.6	38.6	38.0
Jefferson ²	1032 Beecher Avenue Louisville	21-111-0044	339	15.18	4	48.9	38.4	38.3	38.2
Jefferson ²	850 Barret Avenue Louisville	21-111-0048	120	13.99	4	40.9	37.6	36.7	35.3
Jefferson ²	7201 Watson Lane Louisville	21-111-0051	58	13.67	0	32.8	32.5	28.4	26.2
Kenton	1401 Dixie Highway Covington	21-117-0007	115	13.29	1	36.7	32.7	32.6	32.2
Laurel	London-Corbin Airport London	21-125-0004	8	9.00	0	16.2	11.0	11.0	10.1
McCracken	342 Lone Oak Road Paducah	21-145-1004	119	13.61	3	39.3	38.9	36.7	31.4
Madison	Mayfield School Richmond	21-151-0003	118	12.31	0	32.4	28.6	28.2	26.9
Ohio	Keytown Road Echols	21-183-0032	55	12.67	0	25.0	24.2	22.6	22.5
Perry	Perry Co. Horse Park Hazard	21-193-0003	58	12.36	0	29.9	26.9	22.7	21.8
Pike	101 North Mayo Trail Pikeville	21-195-0002	120	13.44	0	32.2	30.9	29.4	28.3
Warren	Kereiakes Park Bowling Green	21-227-0007	117	13.83	2	37.3	35.0	34.8	30.6

¹ Sampler operated by the National Park Service at Mammoth Cave.

² PM_{2.5} samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

Values in blue are incomplete data sets. The mean does not satisfy summary criteria.

Values in red are a visual representation of an exceedances of the 24-hour, 98th percentile.

PM_{2.5} Criteria Pollutant Multi-year Summary Report – 2006
24-hour 98th Percentile, 3 Year Average

County	Site	AQS-ID	2004 98 th %	2005 98 th %	2006 98 th %	3 year Avg. 98 th %
Bell	34 th & Dorchester Middlesboro	21-013-0002	29.5	31.0	25.7	28.7
Boyd	2924 Holt Street Ashland	21-019-0017	30.3	36.1	28.6	31.7
Bullitt	2 nd & Carpenter Streets Shepherdsville	21-029-0006	28.9	39.0	33.5	33.8
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	27.5	38.0	25.2	NA
Carter	Camp Webb Grayson Lake	21-043-0500	24.5	37.2	25.5	29.1
Christian	10800 Pilot Rock Road Hopkinsville	21-047-0006	26.2	35.0	30.3	30.5
Daviess	US 60 and Pleasant Valley Rd Owensboro	21-059-0005	27.0	36.7	30.0	31.2
Edmonson ¹	Alfred Cook Road Mammoth Cave	21-061-0501	24.2	33.6	17.1	NA
Fayette	650 Newtown Pike Lexington	21-067-0012	29.1	35.6	30.4	31.7
Fayette	533 South Limestone Lexington	21-067-0014	29.2	35.4	32.2	32.3
Franklin	803 Schenkel Lane Frankfort	21-073-0006	26.9	38.0	28.1	31.0
Hardin	801 North Miles Street Elizabethtown	21-093-0006	27.8	35.1	31.8	31.6
Henderson	Baskett Fire Dept Baskett	21-101-0014	25.8	36.7	28.9	30.5
Jefferson ²	Bates Elementary School Louisville	21-111-0027			30.8	NA
Jefferson ²	37 th & Southern Avenue Louisville	21-111-0043	31.1	42.9	36.0	36.7
Jefferson ²	1032 Beecher Avenue Louisville	21-111-0044	30.6	40.1	36.3	35.7
Jefferson ²	850 Barrett Avenue Louisville	21-111-0048	28.8	43.2	36.7	36.2
Jefferson ²	7201 Watson Lane Louisville	21-111-0051	25.8	36.5	32.5	31.6
Kenton	1401 Dixie Highway Covington	21-117-0007	29.4	42.1	32.6	34.7
Laurel	London-Corbin Airport London	21-125-0004	21.5	29.5	16.2	NA
McCracken	342 Lone Oak Road Paducah	21-145-1004	26.5	37.1	36.7	33.4
Madison	Mayfield School Richmond	21-151-0003	28.4	32.6	28.2	29.7
Ohio	Keytown Rd. Echols	21-183-0032		34.5	24.2	NA
Perry	Perry County Horse Park Hazard	21-193-0003	24.7	31.4	26.9	27.7
Pike	101 North Mayo Trail Pikeville	21-195-0002	28.2	32.0	29.4	29.9
Warren	Kereiakes Park Bowling Green	21-227-0007	31.5	32.5	34.8	32.9

¹ Sampler operated by the National Park Service at Mammoth Cave.

² PM_{2.5} samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

Values in blue are incomplete data sets. The mean does not satisfy summary criteria.

Values in red are a visual representation of an exceedances of the 24-hour, 98th percentile.

PM_{2.5} Criteria Pollutant Multi-year Summary Report – 2006
Annual Arithmetic Mean, 3 Year Average

County	Site	AQS-ID	2004 mean	2005 mean	2006 mean	3 year Avg.
Bell	34 th & Dorchester Middlesboro	21-013-0002	13.40	14.95	13.75	14.03
Boyd	2924 Holt Street Ashland	21-019-0017	13.29	16.01	13.76	14.35
Bullitt	2 nd & Carpenter Streets Shepherdsville	21-029-0006	13.62	16.32	14.14	14.69
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	12.77	14.84	11.54	NA
Carter	Camp Webb Grayson Lake	21-043-0500	11.08	13.55	11.49	NA
Christian	10800 Pilot Rock Road Hopkinsville	21-047-0006	11.83	14.04	12.63	12.83
Daviess	US 60 and Pleasant Valley Rd Owensboro	21-059-0005	12.47	15.09	13.05	13.54
Edmonson ¹	Alfred Cook Road Mammoth Cave	21-061-0501	11.58	13.63	8.75	NA
Fayette	650 Newtown Pike Lexington	21-067-0012	13.45	15.51	13.67	14.21
Fayette	533 South Limestone Lexington	21-067-0014	14.32	16.05	13.86	14.74
Franklin	803 Schenkel Lane Frankfort	21-073-0006	12.54	14.59	12.43	13.19
Hardin	801 North Miles Street Elizabethtown	21-093-0006	12.24	14.50	13.23	13.32
Henderson	Baskett Fire Dept Baskett	21-101-0014	12.14	15.36	13.35	13.62
Jefferson ²	Bates Elementary Louisville	21-111-0027			13.62	NA
Jefferson ²	37 th & Southern Avenue Louisville	21-111-0043	14.53	16.72	14.96	15.40
Jefferson ²	1032 Beecher Avenue Louisville	21-111-0044	14.05	16.48	15.18	15.24
Jefferson ²	850 Barrett Avenue Louisville	21-111-0048	13.71	16.77	13.99	14.82
Jefferson ²	7201 Watson Lane Louisville	21-111-0051	12.63	16.48	13.67	14.26
Kenton	1401 Dixie Highway Covington	21-117-0007	13.42	15.86	13.29	14.19
Laurel	London-Corbin Airport London	21-125-0004	11.47	14.07	9.00	NA
McCracken	342 Lone Oak Road Paducah	21-145-1004	11.70	14.03	13.61	13.11
Madison	Mayfield School Richmond	21-151-0003	12.98	15.21	12.31	13.50
Ohio	Keytown Road Echols	21-183-0032		14.85	12.67	13.76
Perry	Perry County Horse Park Hazard	21-193-0003	11.94	13.87	12.36	12.72
Pike	101 North Mayo Trail Pikeville	21-195-0002	12.34	14.14	13.44	13.31
Warren	Kereiakes Park Bowling Green	21-227-0007	13.14	14.82	13.83	13.93

¹ Sampler operated by the National Park Service at Mammoth Cave.

² PM_{2.5} samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

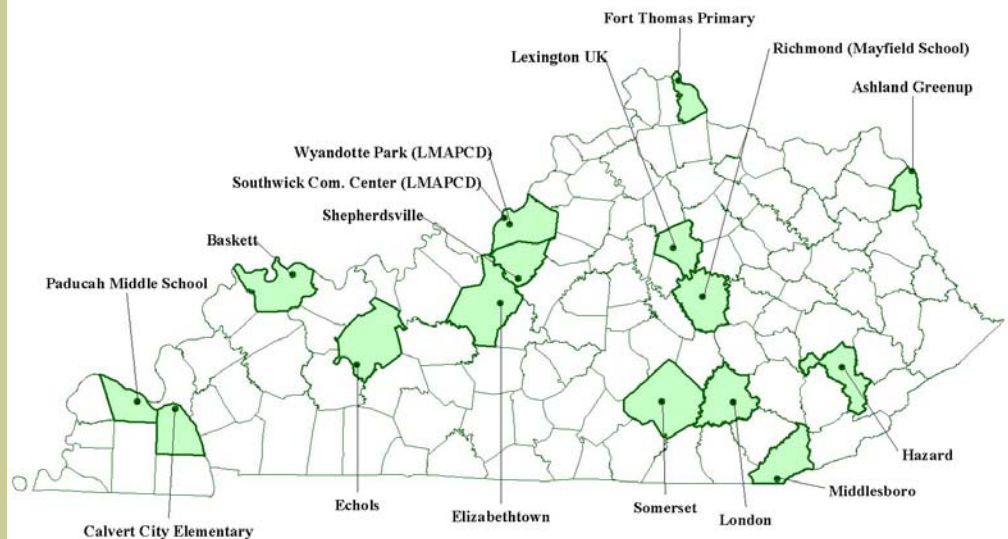
Values in blue are incomplete data sets. The mean does not satisfy summary criteria.

Values in red are a visual representation of an exceedance of the 24-hour, 98th percentile.

Particulate Matter (PM₁₀)

- On December 18, 2006, PM₁₀ NAAQS annual standard is revoked.
- PM₁₀ NAAQS is now a 24-hour standard, not to exceed 150 µg/m³.
- No exceedances of the NAAQS in 2006.
- All Kentucky counties are in attainment of the PM₁₀ Standard.

Particulate Matter PM₁₀ Ambient Air Monitoring Network



PM₁₀ is a term used to define a mixture of solid particulates and liquid droplets that are 10 microns in diameter and smaller. Particulates that range in the 10-2.5 micron size are considered “inhalable coarse particles”. Some common sources of PM₁₀ are from prescribed fires, construction activities, agricultural practices and smokestacks.

Environmental Impacts

The primary health effects of particulates are that they aggravate respiratory and cardiovascular disease and in large amounts increase the death rates of sufferers. The elderly, children, and people with chronic lung disease are especially sensitive to particulate matter. Particulate matter can soil and damage a wide range of man-made items such as building surfaces. PM₁₀ also damages vegetation by interfering with plant photosynthesis due to the formation of a film on leaves reducing exposure to sunlight. Particulate pollution can also produce haze, which diminishes visibility and the amount of sunlight reaching the earth.

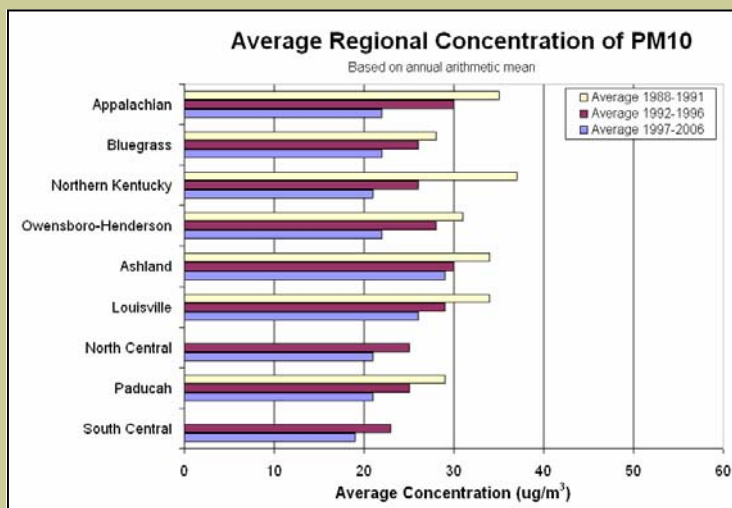
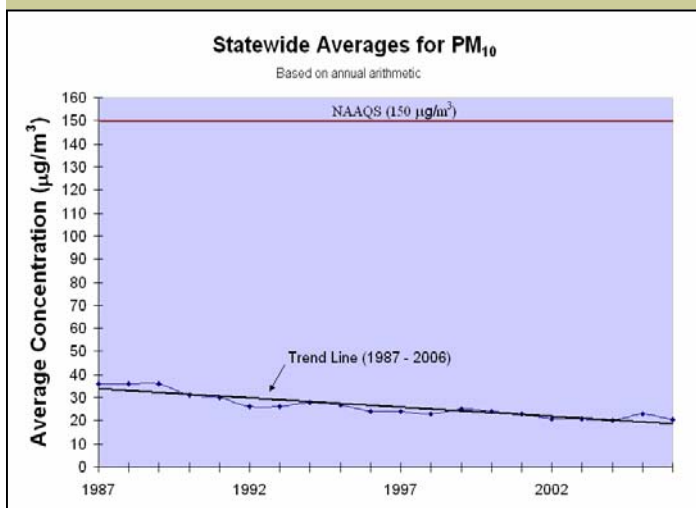
How is PM10 monitored?

For PM₁₀ NAAQS comparison, both intermittent and continuous monitor types may be used because they are FRM or FEM equivalent. Most PM₁₀ samplers are the intermittent type that operates for twenty-four hours, every sixth day. These samplers operate by drawing a measured volume of air through a pre-weighed filter over a 24-hour period. Before reaching the filter, the air passes through an impaction chamber where larger particles fall out of the air stream while particles smaller than ten microns pass on to the sample filter where they are collected. After completion of the sample run the filter is removed from the sampler and re-weighed to determine the mass of the particulates collected. Sample results are entered manually into a data storage system. The network also includes five continuously operating PM₁₀ samplers that provide results daily. These samplers determine sample weights electronically and transmit results by telemetry into an automated data storage system. In 2006, the Division for Air Quality and the Louisville Metro Air Pollution Control District operated a combined network of nineteen PM₁₀ samplers in Kentucky.

Results

On December 18, 2006, EPA revoked the PM₁₀ annual NAAQS. The 24-hour annual average, not to exceed 150 $\mu\text{g}/\text{m}^3$, is the primary NAAQS for PM₁₀. There were no exceedances of the PM₁₀ standards in 2006. The last PM₁₀ exceedance occurred on January 7, 2000, at Louisville site 21-111-0043 where a 24-hour sample of 152 $\mu\text{g}/\text{m}^3$ was measured. The only other exceedance of a PM₁₀ standard occurred on August 27, 1990, in Ashland where a 24-hour value of 182 $\mu\text{g}/\text{m}^3$ was measured. All Kentucky counties are currently in attainment with the PM₁₀ standards. Statewide and regional PM₁₀ levels have shown declining trends. This downward trend is the result of controls on industrial sources of particulate matter. A statistical summary of PM₁₀ data collected during 2006 follows on the next page.

PM₁₀ Trends



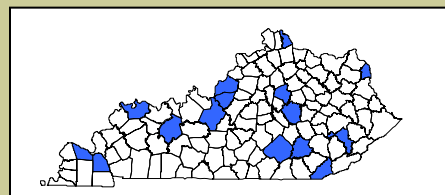
National Ambient Air Quality Standards for Particulate Matter PM₁₀

Primary NAAQS: Maximum 24-hour concentration of 150 µg/m³. Average number of expected exceedances per year not to exceed 1 over last 3 years.

Secondary NAAQS: Same as Primary Standard.

Criteria Pollutant Summary Report – 2006

Pollutant: Particulate Matter PM₁₀
Method: Gravimetric
Data Interval: 24-hour
Units: Micro-grams per cubic meter (µg/m³) (25°C)



County	Site	AIRS-ID	# Obs	Mean	24-hour Average				
					Obs >150	1 st max	2 nd max	3 rd max	4 th max
Bell Monitor terminated 2/23/2006	34 th & Dorchester Middlesboro	21-013-0002	8	18.1	0	28	24	24	23
Boyd	122 22 nd Street Ashland	21-019-0002	59	33.6	0	108	72	68	68
Bullitt	2 nd & Carpenter Street Shepherdsville	21-029-0006	329	21.6	0	65	55	54	52
Campbell Site and monitor terminated 3/15/2007	700 Alexandria Pike Fort Thomas	21-037-0003	68	13.1	0	29	27	24	24
Fayette	533 South Limestone Lexington	21-067-0014	60	20.5	0	47	36	25	33
Hardin	801 North Miles Street Elizabethtown	21-093-0006	59	17.4	0	50	31	31	31
Henderson	Baskett Fire Dept Baskett	21-101-0014	345	18.3	0	62	56	50	47
Jefferson ¹	37 th & Southern Ave Louisville	21-111-0043	8444	22.6	0	67	56	54	53
Jefferson ¹	37 th & Southern Ave Louisville	21-111-0043	8584	23.3	0	68	58	55	55
Jefferson ¹	1032 Beecher Avenue Louisville	21-111-0044	8155	22.1	0	65	51	49	48
Laurel Monitor terminated 2/24/2006	London-Corbin Airport London	21-125-0004	9	10.8	0	19	16	14	12
McCracken	342 Lone Oak Road Paducah	21-145-1004	59	19.2	0	66	38	38	35
Madison	Mayfield School Richmond	21-151-0003	60	18.2	0	48	34	34	34
Marshall	24 Main Street Calvert City	21-157-0010	54	18.1	0	64	34	33	32
Ohio Monitor established 6/1/2006	Keytown Road Echols	21-183-0032	34	20.8	0	99	31	28	28
Perry	Perry Co. Horse Park Hazard	21-193-0003	61	22.4	0	46	45	43	42
Pulaski Monitor terminated 2/23/2006	Clifty Street Somerset	21-199-0003	9	11.4	0	19	17	15	12

¹PM₁₀ samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

Values in blue are incomplete data sets. The mean does not satisfy summary criteria.

Particulate Matter (PM_{2.5}): Speciation

The promulgation of the new PM_{2.5} standards may require all future areas not meeting the standards to reduce emissions of fine particulates and their precursors. Efficient air quality management requires knowing which sources contribute to the problem and estimating how much. However, determining PM_{2.5} source contributions is complicated due to the fact that often half or more of the PM_{2.5} mass is composed of secondarily formed species, therefore hiding their point of origin. In addition, PM_{2.5} may remain in the atmosphere for several days enabling sources several hundred miles away to affect an area. Realizing this, EPA established the Speciation Trends Network designed to assist in identifying the compounds associated with fine particulates. The network is used to provide data on a target group of chemical species known to be significant contributors to PM_{2.5} mass. The data provided by the network can be used to support several areas that include:

- Helping to implement the PM_{2.5} standard by using speciated data as input to air quality modeling analyses and as indicators to track progress of controls.
- Aiding the interpretation of health studies by linking effect to PM_{2.5} constituents.
- Understanding the effect of atmospheric constituents on visibility impairment.
- Using the speciated particulate data to aid in monitoring network design and siting adjustment.

How is PM_{2.5} speciation monitored?

The approach to be used for chemical speciation involves both sampling and analysis components. The target groups of chemical species include a list of analytes that consist of an array of cations, anions, carbon species, and trace elements. Because no one sample media is capable of providing the appropriate sample collection for all of the target analytes, each series of analytes requires sample collection on the appropriate media and utilization of the appropriate analytical techniques.

PM_{2.5} Speciation (continued)

Listed below are the target analytes and the analytical techniques used:

- **Trace Elements** -X-ray fluorescence and particle induced X-ray emission
- **Anion and Cations** -Ion chromatography
- **Carbon** -Controlled-combustion/thermal optical

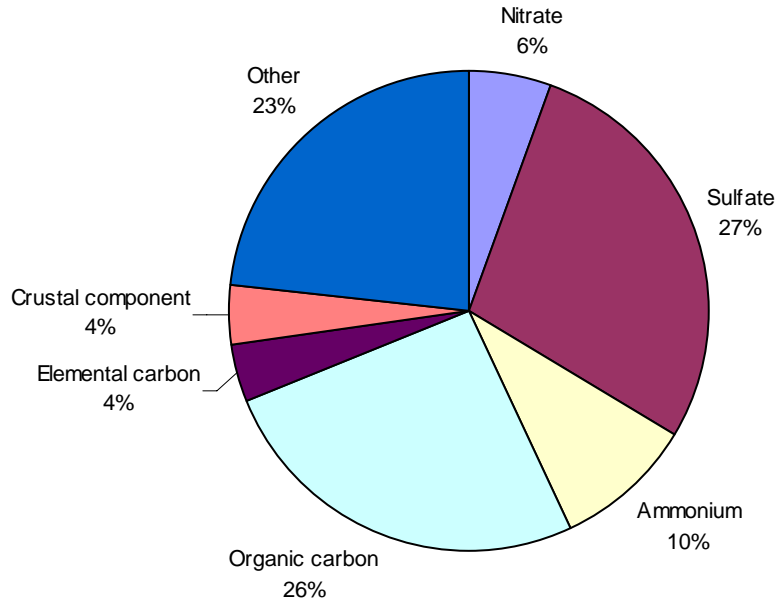
Once analysis is complete, the analytes are grouped into the target chemical species listed below. These species in turn can be linked to source categories that ultimately can be used to assist in understanding PM_{2.5} and developing control strategies needed to reduce ambient levels.

- Nitrate (total)
- Sulfate
- Ammonium
- Organic Carbon
- Elemental Carbon
- Crustal Component (trace elements, fine soil)
- Other (PM_{2.5} mass unaccounted for by analytical methods)

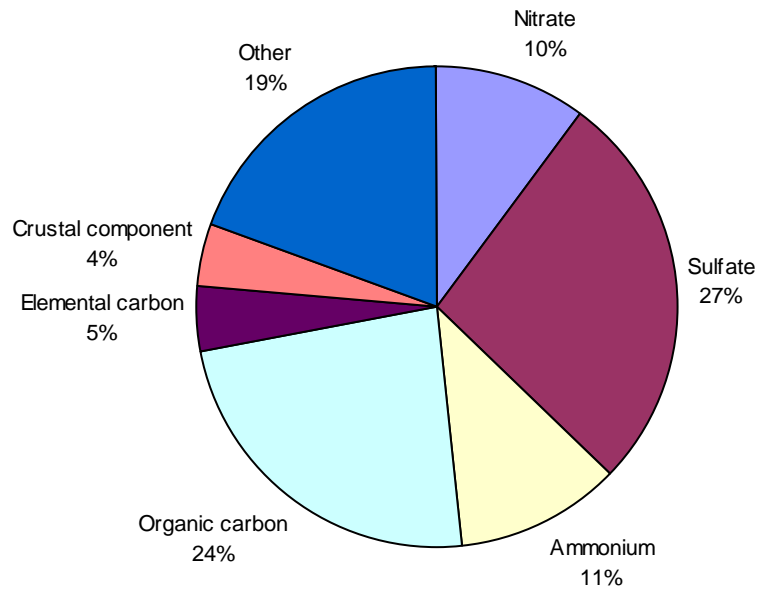
Results

In 2006, the Kentucky Division for Air Quality operated a network of four Speciation Trends Network monitors and the Louisville Metro Air Pollution Control District operated one monitor. The sites are strategically located to address different types of land use ranging from heavy industrial, urban, and rural. The charts on the following pages provide a visual representation of speciation data collected at each site during 2006. The data suggests that sulfate and organic carbon are the primary contributors to PM_{2.5} in Kentucky. Sulfates are formed from sulfur dioxide emissions with the major sources of those emissions being coal-fired power plants. Organic carbon comes from a combination of mobile and stationary combustion sources.

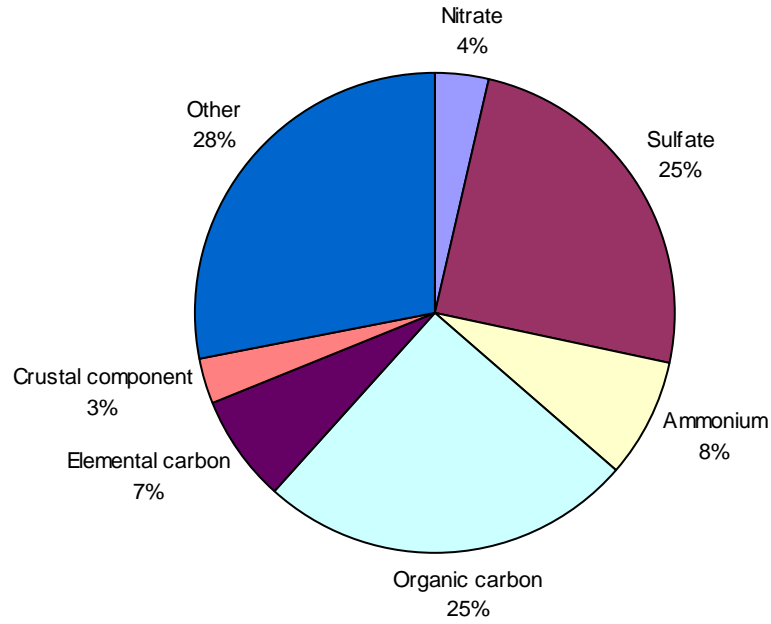
Ashland Health Department
AIRS Code 210190017 POC 5 (ROUTINE)
Date(s): 1/5/2006 - 12/31/2006
Average Concentration ($\mu\text{g}/\text{m}^3$)



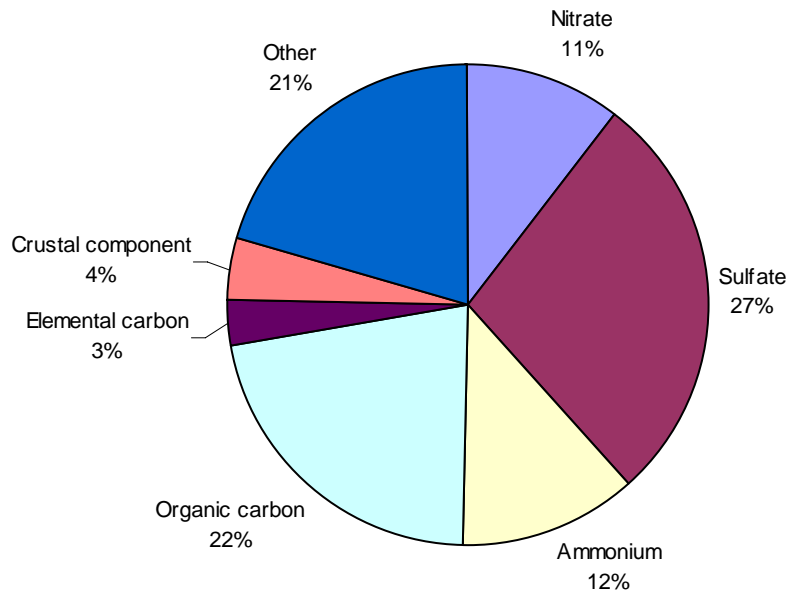
Covington - University College
AIRS Code 211170007 POC 5 (ROUTINE)
Date(s): 1/5/2006 - 12/31/2006
Average Concentration ($\mu\text{g}/\text{m}^3$)



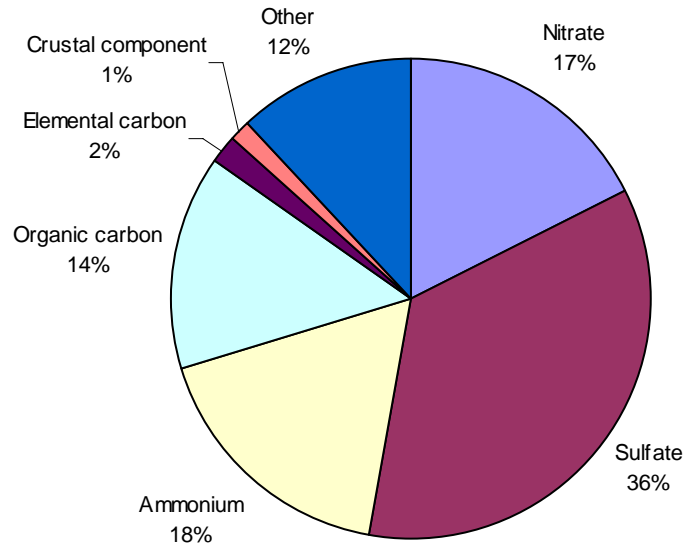
Hazard - Perry County Horse Park
AIRS Code 211930003 POC 5 (ROUTINE)
Date(s): 1/5/2006 - 12/31/2006
Average Concentration ($\mu\text{g}/\text{m}^3$)



Lexington Health Department
AIRS Code 210670012 POC 5 (ROUTINE)
Date(s): 1/5/2006 - 12/31/2006
Average Concentration ($\mu\text{g}/\text{m}^3$)



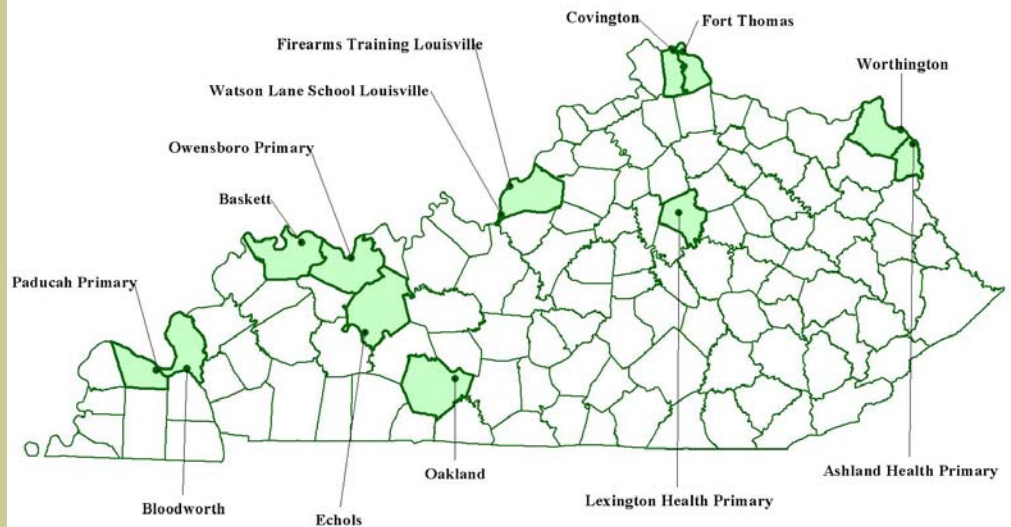
**Southwick Community Center
AIRS Code 211110043 POC 5 (ROUTINE)
Date(s): 1/5/2006 - 12/31/2006
Average Concentration ($\mu\text{g}/\text{m}^3$)**



Sulfur Dioxide (SO₂)

- **Nationwide, coal-fired power plants are the largest sources of sulfur dioxide.**
- **There were no exceedances of the sulfur dioxide NAAQS in 2006.**
- **The last exceedance of the SO₂ standard occurred in November 1981.**

Sulfur Dioxide Ambient Air Monitoring Network



Sulfur dioxide (SO₂) is a colorless gas that has a pungent odor at concentrations exceeding 0.5 ppm. Sulfur dioxide is produced by the combustion of sulfur containing fuels, ore smelting, petroleum processing and the manufacture of sulfuric acid. Nationwide, coal-fired power plants are the largest sources of sulfur dioxide. Other industrial sources include petroleum refineries and paper mills.

Environmental Impacts

The primary health effect of sulfur dioxide is the aggravation of pre-existing respiratory, cardiovascular and pulmonary diseases. Asthmatics, children and the elderly are especially susceptible to the effects of sulfur dioxide pollution. Sulfur dioxide can also damage the foliage of trees and agricultural crops. Moisture in the atmosphere combined with SO₂ form sulfuric acid (H₂SO₄), which is a component of acid precipitation. Acid precipitation causes acidification of soil and water that can deteriorate plant life, animal life, and structural surfaces. Sulfur dioxide may also be converted into sulfates. Sulfates are significant components of PM_{2.5} and regional haze. Regional haze has been attributed to poor visibility at many of the vistas in our national parks including Mammoth Cave National Park in Kentucky and the Great Smoky Mountains in Tennessee.

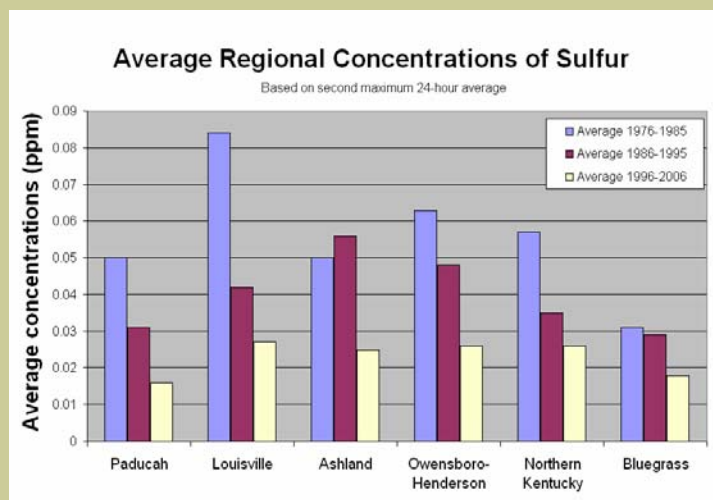
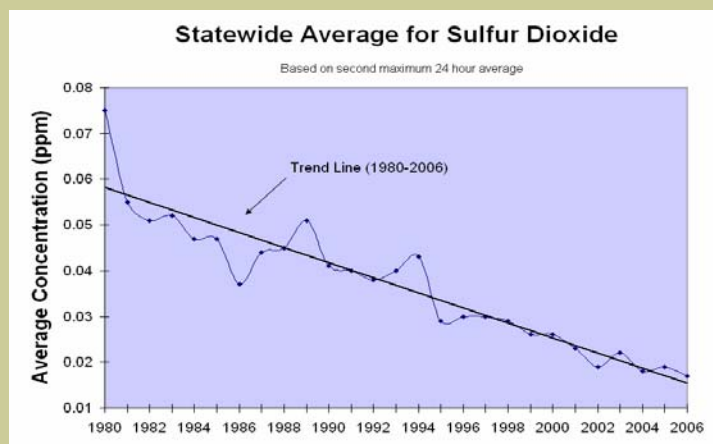
How is SO₂ monitored?

Analyzers that operate continuously monitor sulfur dioxide by using the ultraviolet (UV) fluorescence method. Fluorescent analyzers irradiate an ambient air sample with ultraviolet light. Sulfur dioxide molecules absorb a portion of this energy and then re-emit the energy at a characteristic wavelength of light. The light energy emitted by the sulfur dioxide molecules is proportional to the concentration of sulfur dioxide present in the sample. A photo multiplier cell measures the light emitted and converts it to a parts per million measurement. Data from the analyzer is transmitted by telemetry into an automated data storage system. In 2006, the Division for Air Quality and the Louisville Metro Air Pollution Control District operated thirteen SO₂ monitors in Kentucky.

Results

There were no exceedances of any of the sulfur dioxide standards in 2006. The last exceedance of a sulfur dioxide standard occurred in November 1981, when the monitor at Louisville site 21-111-0032 recorded a 24-hour average of 0.159 ppm. Statewide and regional sulfur dioxide levels have declining trends over the past twenty years. A statistical summary of sulfur dioxide data collected in 2006 follows on the next page.

Sulfur Dioxide Trends



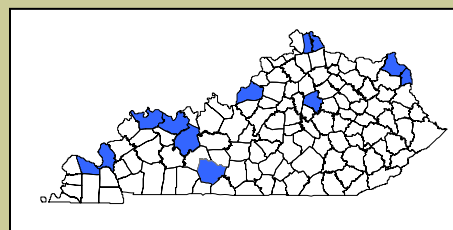
National Ambient Air Quality Standards for Sulfur Dioxide

Primary NAAQS: Annual Arithmetic Mean not to exceed 0.03 ppm.
24-hour concentrations not to exceed 0.14 ppm more than once per year.

Secondary NAAQS: 3-hour concentrations not to exceed 0.50 ppm more than once per year.

Criteria Pollutant Summary Report – 2006

Pollutant: Sulfur Dioxide
Method: Instrumental
 Ultra-Violet Fluorescence
Data Interval: Hourly
Units: Parts-per-million (ppm)



County	Site Address	AQS-ID	# Obs	Annual Mean	24-Hr Average			3-Hr Average		
					1 st max	2 nd max	Obs.>.14	1 st max	2 nd max	Obs.>.50
Boyd	2924 Holt Street Ashland	21-019-0017	8713	.004	.018	.016	0	.059	.047	0
Campbell Site and monitor terminated on 3/15/2006	700 Alexandria Pike Fort Thomas	21-037-0003	1588	.005	.015	.014	0	.053	.046	0
Daviess	US 60 and Pleasant Valley Rd, Owensboro	21-059-0005	8448	.004	.014	.013	0	.061	.042	0
Fayette	650 Newtown Pike Lexington	21-067-0012	7735	.004	.013	.013	0	.042	.031	0
Greenup	Scott & Center Streets Worthington	21-089-0007	8221	.004	.017	.016	0	.042	.033	0
Henderson	Baskett Fire Dept Baskett	21-101-0014	8704	.003	.028	.022	0	.085	.081	0
Jefferson ¹	7201 Watson Lane Louisville	21-111-0051	8207	.004	.032	.024	0	.079	.068	0
Jefferson ¹	4201 Algonquin Pkwy Louisville	21-111-1041	8612	.004	.035	.034	0	.139	.127	0
Kenton Monitor established on 3/16/2006	1401 Dixie Highway Covington	21-117-0007	6649	.004	.015	.015	0	.059	.039	0
Livingston	763 Bloodworth Road off KY 453	21-139-0004	8702	.004	.029	.024	0	.065	.059	0
McCracken	2901 Powell Street Paducah	21-145-1024	8691	.002	.007	.007	0	.019	.019	0
Ohio	Keytown Road Echols	21-183-0032	8348	.005	.024	.015	0	.063	.060	0
Warren Monitor terminated 6/30/2006	Oakland Elementary School, Oakland	21-227-0008	2153	.003	.007	.007	0	.018	.016	0

¹ Sulfur dioxide monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

Acid Rain

Wet deposition (sometimes referred to as “acid rain”) is a classification of pollutants that are precipitation borne. Snow, sleet, hail, rain or fog can combine with pollutants in the atmosphere and fall to earth as harmful acidic compounds. Acidified rainwater may contain combinations of sulfuric and nitric acids that form when water vapor and sulfur dioxide and nitrogen oxides react. Major sources of sulfur dioxide include power plants, paper and wood pulp processing plants and facilities with coal fired boilers. Nitrogen oxides are produced primarily from the combustion of fossil fuels in the engines of cars, trucks and other vehicles and from power plant emissions.

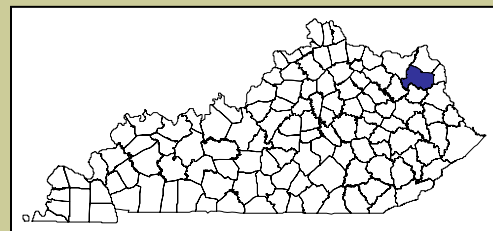
Aquatic life appears to be most sensitive to the effects of acidic precipitation. Small changes in the pH levels of lakes and streams may prevent some fish species and other aquatic life forms from reproducing. Many insects cannot survive in acidic waters; therefore, birds and mammals that depend on insects for food may suffer abnormally high mortality rates. Acidic precipitation can also alter soil chemistry and nutrient availability, in turn weakening trees and shrubs and causing them to be more vulnerable to insects, diseases and fungus infestations. Acid precipitation may also damage agricultural crops and has been blamed for deterioration of monuments and building surfaces.

Wet deposition monitoring stations operate on a weekly sampling schedule. Cumulative precipitation events occurring during a seven day period are collected in one container to represent a one-week sample. An automatic wet/dry precipitation collector is used to collect the sample. The sampler consists of two collection containers. The “wet” container is fitted with a clean plastic sample bag for collection of precipitation. The “dry” container, designed for dry particulate collection is not presently utilized for sample collection. The sampler employs a moisture sensor, which activates an electrically driven movable container lid that covers the wet container during dry periods and then moves to cover the dry container when precipitation occurs. At the end of each weekly sampling period, the wet container is removed and replaced with a new, clean container for the next sampling period. After the sample is removed, field measurements of pH and conductivity are made and recorded. The remaining sample is then shipped to Frankfort where laboratory analysis is conducted to determine levels for pH, conductivity, acidity, sulfates, nitrates, phosphates, ammonia and metal ions. In 2006, the Division for Air Quality operated one acid rain site at Grayson Lake State Park. The National Park Service at Mammoth Cave also operated a wet deposition sampler in 2006 and data from that sampler is included.

Annual pH averages for both sites have shown modest upward trends since 1985 meaning that rainfall is gradually becoming less acidic. This improvement is due at least in part to successful efforts of power plants to curb sulfur dioxide and nitrogen dioxide emissions.

Kentucky Division for Air Quality Wet Deposition Pollutants Summary Report - 2006

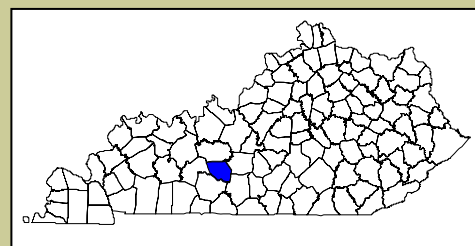
Location: Grayson Lake, KY – Camp Webb
Site Id: 21-043-0500
County: Carter
Method: Wet/Dry Collector, Laboratory Analytical



Parameter	Units	# Obs	Arithmetic Mean	1 st Max	2 nd Max	3 rd Max	4 th Max
Acidity	Mg/L	25	6.93	12.50	10.60	9.38	8.36
Ammonia	Mg/L	47	.31	.86	.73	.70	.61
Calcium	Mg/L	41	1.12	34.40	1.12	.85	.61
Chloride	Mg/L	41	.256	1.20	1.02	.58	.51
Conductivity	US/cm	47	19.18	66.10	35.20	33.40	31.30
Magnesium	Mg/L	17	.42	4.93	.23	.22	.19
Nitrate	Mg/L	48	1.58	8.20	5.32	4.31	3.14
Potassium	Mg/L	41	.56	3.52	2.10	.62	.61
Sodium	Mg/L	19	.42	2.85	.66	.56	.46
Sulfate	Mg/L	48	1.95	3.95	3.92	3.77	3.55

National Park Service Wet Deposition Pollutants Summary Report - 2006

Location: Mammoth Cave National Park, Alfred Cook Road
Site Id: KY10
County: Edmonson
Method: Wet/Dry Collector, Laboratory Analytical



Parameter	Units	# Obs	Arithmetic Mean	Max	90%	75%	50%
Acidity	Mg/L	-	-	-	-	-	-
Ammonium	Mg/L	36	.26	.68	.56	.42	.26
Calcium	Mg/L	36	.12	.45	.26	.22	.11
Chloride	Mg/L	36	.12	.51	.23	.14	.09
Conductivity	US/cm	36	13.77	45.5	29.5	18.9	14.9
Magnesium	Mg/L	36	.017	.055	.038	.021	.016
Nitrate	Mg/L	36	.88	.68	.56	.42	.26
Potassium	Mg/L	36	.024	.111	.047	.033	.016
Sodium	Mg/L	36	.065	.322	.131	.075	.042
Sulfate	Mg/L	36	1.35	5.65	2.73	1.94	1.40

Data report from the [National Atmospheric Deposition Program/National Trends Network 2006 Annual & Seasonal Data Summary for Site KY10.](#)

Mercury

Mercury (Hg) is a naturally occurring element that is found in air, water and soil. Mercury exists in several different forms: elemental, inorganic and organic. Elemental Hg is a shiny, silver-white metal that is in a liquid state at room temperature. Elemental mercury is used in thermometers, florescent lights and electrical switches. Exposed elemental mercury can become an invisible, odorless toxic gas at room temperature. Inorganic Hg compounds are mercury salts with a white powder or crystal appearance except for mercuric sulfide (cinnabar), which is red. Inorganic Hg compounds are used in fungicides, antiseptics, disinfectants, skin lightening creams and traditional medicines. Organic Hg compounds are formed when mercury combines with carbon. The most common organic mercury compound found in the environment is methyl-mercury, a highly toxic form that builds up in fish, shellfish and animals that eat fish. Methyl-mercury is formed when inorganic mercury in the air settles into water or onto land where it can be washed into water and converted into organic mercury by microorganisms. Fish and shellfish are the main sources of methyl-mercury exposure to humans.

Environmental Impacts

Mercury exposure at high levels can harm the brain, heart, kidneys, lungs, and immune system of people of all ages. Research has shown that most fish consumption does not cause an exposure to high levels of mercury in adults. However, it has been demonstrated that high levels of methylmercury in the bloodstream of unborn babies and young children may harm the developing nervous system. Kentucky is one of 31 states that have issued a statewide fish consumption advisory due to unsafe levels of mercury. The advisory is for women of childbearing age and children 6 years and younger.

How is Hg monitored?

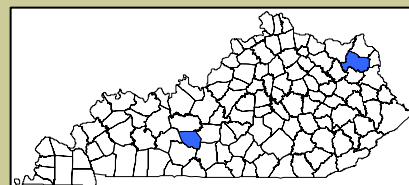
Mercury is monitored in Kentucky by three different collection methods. The first collection method is wet deposition monitoring. When a wet deposition sample is over 320 grams, there is enough sample for mercury analysis. Fifty grams or more of the excess wet deposition sample is transferred into a 250ml borosilicate glass container, five drops of hydrochloric acid is added to the sample for preservation, and shipped to Frankfort for mercury analysis. The DES laboratory performs the analysis using Method 1631, Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry.

The second method of collection for mercury is monitoring particulate-bound Hg. The PM_{2.5} speciation monitoring network is the particulate-bound method currently used by the Commonwealth. Ambient air samples are collected on a 47mm Teflon filter and shipped to the Research Triangle Institute laboratory in North Carolina for analysis. The laboratory uses Energy Dispersive X-ray Fluorescence (XRF) to determine the presence of 48 species of metals and nonmetals, including Hg, in a single scan.

The final method of Hg collection is by the use of analyzers, which operate continuously, using Cold Vapor Atomic Fluorescence Spectrometry (CVAFS). The analyzer traps Hg vapor, from an air sample, into a cartridge containing an ultra-pure gold adsorbent. The amalgamated mercury is then thermally desorbed and detected using CVAFS.

Wet Deposition Total Mercury Pollutant Summary Report 2006

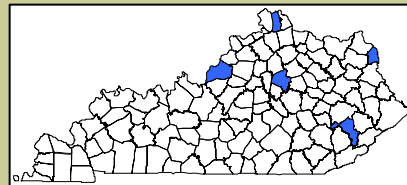
Pollutant: Mercury
Method: Cold Vapor Atomic Fluorescence Spectrometry
Data Interval: 24-hour
Units: Nano-grams per liter (ng/L)



County	Site	AQS-ID	# Obs	Annual Mean	1 st max	2 nd max	3 rd max	4 th max
Carter	Camp Webb Grayson Lake	21-043-0500	25	5.8	18.7	12.8	11.1	10.0
Edmonson	Alfred Cook Road Mammoth Cave	21-059-0005	48	10.99	35.47	31.08	26.03	22.84

Particulate-Bound Total Mercury Pollutant Summary Report 2006

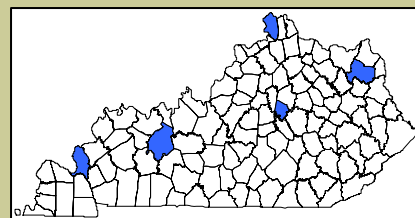
Pollutant: Mercury
Method: Energy Dispersive XRF
Data Interval: 24-hour
Units: Micro-grams per cubic meter ($\mu\text{g}/\text{m}^3$)



County	Site	AQS-ID	# Obs	Annual Mean	1 st max	2 nd max	3 rd max	4 th max
Boyd	2924 Holt St, Ashland	21-019-0017	60	.0031	.010	.010	.006	.006
Fayette	650 Newtown Pike Lexington	21-067-0012	58	.0029	.009	.008	.006	.005
Jefferson	37 th & Southern Ave. Louisville	21-111-0043	60	.0025	.005	.005	.005	.005
Kenton	1401 Dixie Hwy Covington	21-117-0007	59	.0035	.021	.020	.012	.009
Perry	Perry County Horse Park Hazard	21-193-0003	60	.0027	.008	.005	.005	.005

Continuous Total Mercury Pollutant Summary Report 2006

Pollutant: Mercury
Method: Cold Vapor Atomic Fluorescence Spectrometry
Data Interval: Hourly
Units: Nano-grams per cubic meter (ng/m^3)



County	Site	AQS-ID	# Obs	Annual Mean	1 st max	2 nd max	3 rd max	4 th max
Boone	KY 338 & Lower River Road East Bend	21-015-0003	6043	1.6	16.0	14.3	10.6	10.5
Carter	Camp Webb Grayson Lake	21-043-0500	7727	.8	2.0	1.9	1.9	1.8
Jessamine	KYDOT, Etter Drive Nicholasville	21-113-0001	7635	1.3	12.9	11.0	8.2	5.3
Livingston	763 Bloodworth Road Bloodworth	21-139-0004	7350	1.2	11.3	9.1	8.9	8.7
Ohio	Keytown Road Echols	21-183-0032	7282	1.3	35.9	20.3	18.8	15.9

National Air Toxics Trends Station - Hazard, KY

Toxic air pollutants include substances known or suspected to cause neurological, immunological, reproductive and respiratory disorders, as well as known or suspected human carcinogens. The EPA's ultimate goal is to eliminate unacceptable risks of cancer, other significant health problems from exposures to air toxics emissions and to substantially reduce or eliminate adverse effect on our natural environment. To provide a basis for decision-making with respect to these matters, the EPA developed the National Air Toxics Trends Stations (NATTS) monitoring network. In 2003, the EPA designated the Division for Air Quality's Hazard air monitoring site part of that network. The Hazard site is in the Rural Trends Network, and along with its Urban Trends counterpart, has been established to provide toxics trends data on a national basis. Data generated by these monitors are needed to understand the behavior of air toxics in the atmosphere and to develop control strategies.

The EPA has identified six required hazardous air pollutants that are to be monitored in the National Air Toxics Trends study. However, the DAQ monitors for twenty-three hazardous air pollutants at the Hazard, Kentucky site. These pollutants can be subdivided into three monitoring groups: carbonyls, metals and volatile organic compounds (VOC's). These compounds are sampled using carbonyl samplers with DNPH cartridges, low-volume PM₁₀ samplers and passivated SUMMA canisters. These samplers operate for 24-hours on every sixth day after which the samples are collected and sent to the Division for Environmental Services laboratory in Frankfort for analysis. The results of the laboratory analysis are sent to the Division for Air Quality where they are entered in the AQS data storage and retrieval system.

A statistical summary of the data collected in 2006 follows on page 40. Although in a rural area, the data indicates that several of the twenty-three hazardous air pollutants are present in ambient air. Considering there are no large industrial sources in the immediate area, these are the result of mobile emissions (cars, trucks, and school buses), and small local source emissions such as those from fueling stations, body shops/painting, dry cleaners, asphalt plants, etc.

In Appendix A you will find a brief description of each air toxic pollutant measured at the Hazard, Kentucky NATTS monitoring site. Please note that the main source of information for the chemical abstracts in Appendix A is the [Health Effects Notebook for Hazardous Air Pollutants](#) located on the U.S.EPA Technology Transfer Network Air Toxics Website: www.epa.gov/ttnatw01/hlthef/hapindex.html.

National Air Toxics Trends Station Hazard, Kentucky - 2006

Site Id: 21-193-0003
County: Perry
Location: Hazard, KY

Parameter	# of Samples	Units	1 st max	2 nd max	3 rd max	4 th max	Median Value
1,3-Butadiene	61	mg/m ³	.975	.955	ND	ND	0.0
Benzene	58	mg/m ³	2.71	2.59	2.22	2.07	1.3
Carbon tetrachloride	61	mg/m ³	1.53	1.51	1.50	1.46	.1
Chloroform	61	mg/m ³	ND	ND	ND	ND	-
cis-1,3-dichloropropene	61	mg/m ³	ND	ND	ND	ND	-
trans-1,3-dichloropropylene	61	mg/m ³	ND	ND	ND	ND	-
Ethylene dibromide	61	mg/m ³	ND	ND	ND	ND	-
Ethylene dichloride	61	mg/m ³	ND	ND	ND	ND	-
1,2 dichloropropane	61	mg/m ³	ND	ND	ND	ND	-
Methylene chloride	61	mg/m ³	2.49	1.13	.996	.875	.1
Tetrachloroethene	61	mg/m ³	ND	ND	ND	ND	-
1,1,2,2 Tetrachloroethane	61	mg/m ³	ND	ND	ND	ND	-
Trichloroethene	61	mg/m ³	ND	ND	ND	ND	-
Vinyl chloride	61	mg/m ³	ND	ND	ND	ND	-
Formaldehyde	61	mg/m ³	5.26	5.16	4.3	4.07	1.91
Acetaldehyde	61	mg/m ³	2.12	1.95	1.81	1.77	.90
Arsenic	60	ng/m ³	9.12	7.59	6.45	3.66	1.17
Beryllium	61	ng/m ³	ND	ND	ND	ND	-
Cadmium	61	ng/m ³	.89	.84	.57	.56	.09
Chromium	61	ng/m ³	.65	.64	.55	.48	.11
Lead	61	ng/m ³	27.0	14.10	11.0	10.8	4.46
Manganese	61	ng/m ³	19.1	14.0	13.3	10.8	3.95
Nickel	61	ng/m ³	23.3	1.64	1.54	1.48	.70

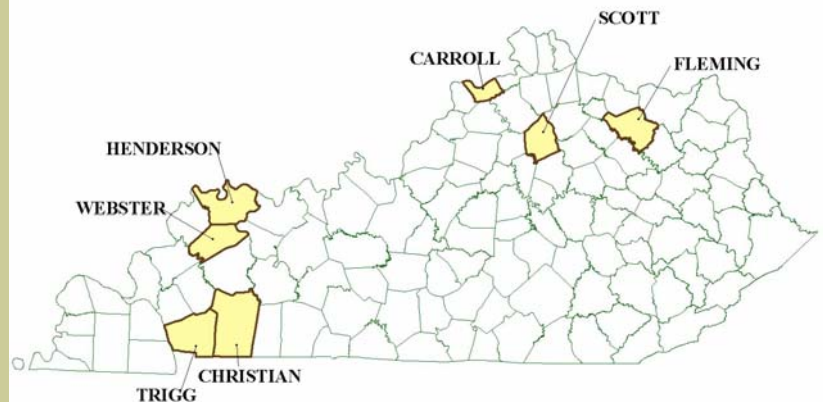
ND - Pollutant not detected at the lowest detection limit of the analyzing instrument

Industrial Ambient Air Monitoring Data

Regardless of the type of monitoring undertaken by these industrial networks, all must meet the following requirements.

- The Division must receive and approve a copy of the monitoring plan for each network prior to commencement of monitoring.
- A member of the Technical Services Branch of the Division for Air Quality must inspect the monitoring site(s) before monitoring begins to ensure that applicable siting criteria are met.
- Operators of networks with CO, SO₂, and NO₂ monitors must use gaseous standards that are traceable to National Institute of Standards and Technology (NIST) gaseous Standard Reference Materials (SRM) to generate test concentrations.
- Test concentrations of O₃ must be obtained in accordance with the UV photometric calibration procedure specified in 40 CFR 50, Appendix D, or by means of a certified ozone transfer standard.
- Flow measurements must be made with a flow measuring device that is referenced to an authoritative volume or other standard.
- All samplers and monitors used for monitoring criteria pollutants must be approved as EPA reference or equivalent methods.
- All industrial monitors are audited, once each calendar quarter, by a member of the Division's Quality Assurance Section.
- Air monitoring reports from these networks are due at the Division for Air Quality no later than 90 days after the end of each calendar quarter. These air monitoring reports are to consist of the raw data from each network (usually on a 3.5" diskette), a missing data report (explaining any gaps in the data), monitor calibrations, results from the bi-weekly precision checks carried out on each automated analyzer, audit reports, and copies of sections of the strip charts (only when requested).

Industrial Ambient Air Monitoring Counties

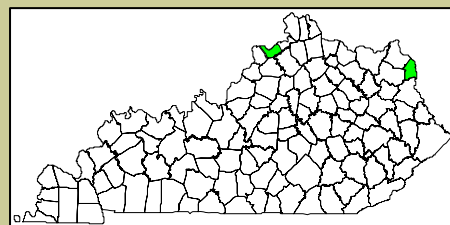


Various industries within the Commonwealth of Kentucky operate air monitoring networks and subsequently report the data from these networks to the Division for Air Quality. Monitoring activity designed to measure the background levels of selected pollutants prior to construction of a proposed source or the expansion of an existing source is termed PSD (Prevention of Significant Deterioration of air quality) monitoring. This type of network is normally set up to operate for approximately one year.

Monitoring designed to measure the impact of new or expanded sources on the air quality of an area is termed post-construction monitoring. A third type of monitoring is termed compliance monitoring and is usually set up around existing sources to demonstrate compliance with permit conditions and ambient air standards.

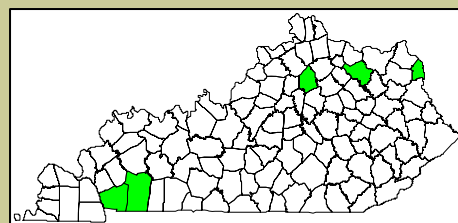
Industrial Criteria Pollutant Summary Report – 2006

Pollutant: Nitrogen Dioxide
Method: Instrumental/Gas-Phase
 Chemiluminescence
Data Interval: Hourly
Units: Parts-per-million (ppm)



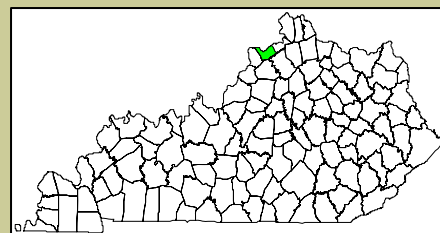
County	Site	Facility-ID	# Obs	Annual Mean	1-Hr Average	
					1 st max	2 nd max
Carroll	US Highway 42 Ghent	North American Stainless	8372	.012	.105	.100
Wayne, WV	Spring Brook Drive, Kenova, WV	Ashland-Marathon	8533	.013	.085	.082

Pollutant: Ozone
Method: Ultra-Violet Photometry
Data Interval: Hourly
Units: Parts-per-million (ppm)



County	Site	Facility-ID	# Obs	8-hour Average				
				Obs >0.08	1 st max	2 nd max	3 rd max	4 th max
Christian	10800 Pilot Rock Rd Hopkinsville	TVA	5799	0	..081	.078	.077	.076
Fleming	455 Industrial Drive Flemingsburg	East Kentucky Power	5501	0	.084	.083	.076	.075
Scott	4673 Muddy Ford Rd Oxford	Toyota	5595	0	.082	.078	.077	.076
Trigg	Old Dover Hwy Cadiz	TVA	5629	0	.080	.078	.077	.076
Wayne, WV	Spring Brook Drive Ke- nova, WV	Ashland- Marathon	8668	1	.086	.071	.071	.069

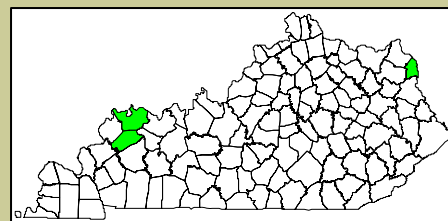
Pollutant: Particulate Matter PM₁₀
Method: Gravimetric
Data Interval: 24-hour
Units: Micro-grams per cubic meter (mg/m³)



County	Site	AIRS-ID	# Obs	Mean	24-hour Average				
					Obs >150	1 st max	2 nd max	3 rd max	4 th max
Carroll	US Highway 42 Ghent	North American Stainless	59	24	0	63	50	48	47

Industrial Criteria Pollutant Summary Report – 2006

Pollutant: Sulfur Dioxide
Method: Instrumental
 Ultra-Violet Fluorescence
Data Interval: Hourly
Units: Parts-per-million (ppm)



County	Site	Facility-ID	# Obs	Annual Mean	24-Hr Average			3-Hr Average		
					1 st max	2 nd max	Obs >.14	1 st max	2 nd max	Obs >.50
Henderson	US 41 & KY 2096 Sebree	Western KY Electric	8311	.002	.019	.019	0	.084	.068	0
Henderson	KY 2097 Sebree	Western KY Electric	8282	.004	.039	.038	0	.185	.140	0
Webster	Bell Gibson Road	Western KY Electric	8354	.003	.066	.053	0	.221	.183	0
Wayne, WV	Spring Brook Dr Kenova, WV	Ashland-Marathon	8672	.007	.068	.046	0	.225	.167	0
Wayne, WV	Route 52 Neal, WV	Ashland-Marathon	8688	.007	.036	.031	0	.098	.074	0
Wayne, WV	Big Sandy Road Neal, WV	Ashland-Marathon	8676	.005	.021	.020	0	.049	.048	.043

Air Quality Index (AQI)

Understanding the Air Quality Index (AQI)

The purpose of the AQI is to help you understand what local air quality means to your health. To make it easier to understand, the AQI is divided into six categories:

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0-50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51-100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101-150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151-200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201-300	Health alert: everyone may experience more serious health effects.
Hazardous	> 300	Health warnings of emergency conditions. The entire population is more likely to be affected.

The AQI is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health effects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health.

How Does the AQI Work?

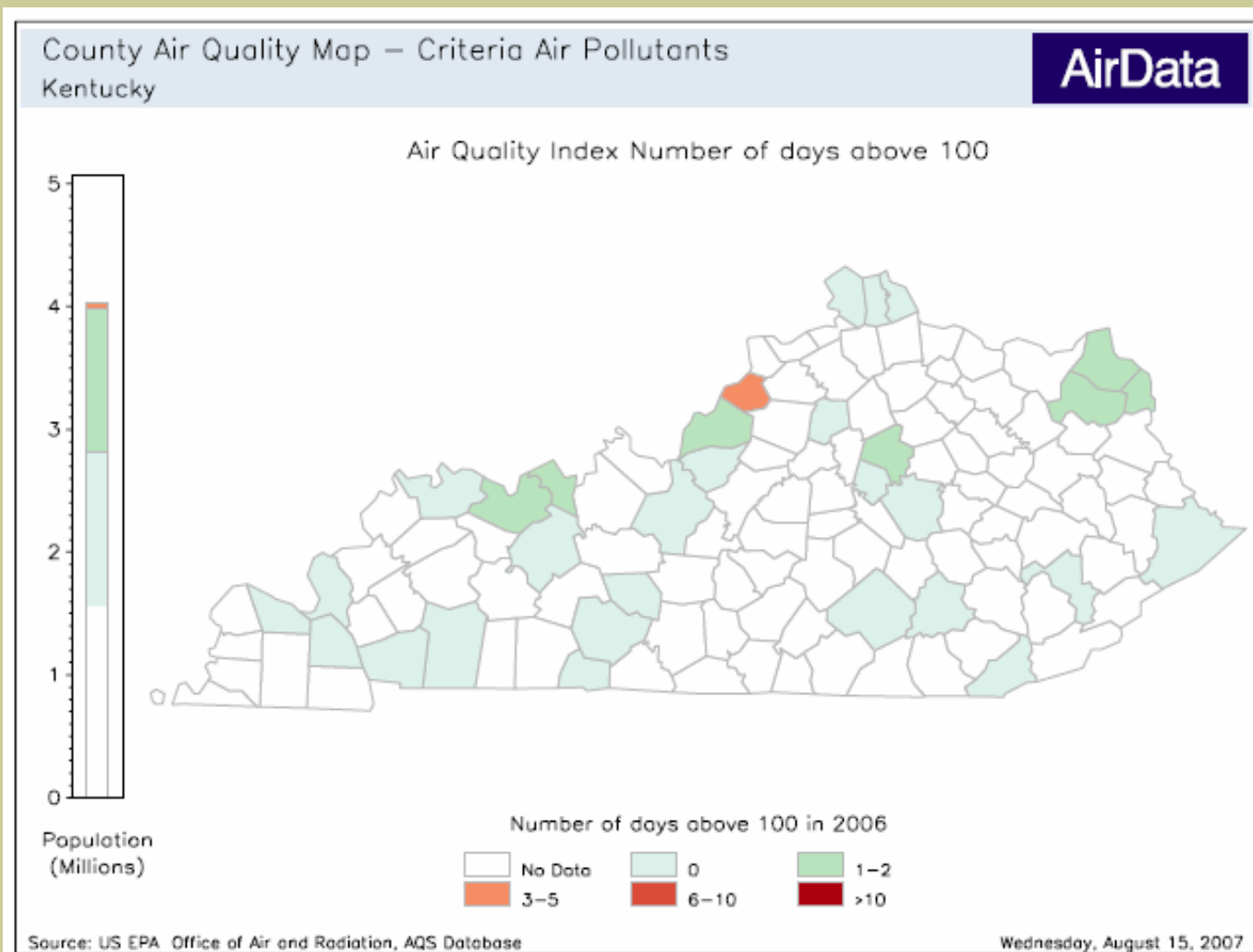
Think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 represents good air quality with little potential to affect public health, while an AQI value over 300 represents hazardous air quality.

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy; at first for certain sensitive groups of people, then for everyone as AQI values get higher.

Understanding the Air Quality Index (AQI)

- * **"Good"** Air pollution poses little or no risk.
- * **"Moderate"** People who are unusually sensitive to ozone may experience respiratory symptoms.
- * **"Unhealthy for Sensitive Groups"** Sensitive groups may experience health effects. This means they are likely to be affected at lower levels than the general public. For example, people with lung disease are at greater risk from exposure to ozone, while people with either lung disease or heart disease are at greater risk from exposure to particle pollution. The general public is not likely to be affected when the AQI is in this range.
- * **"Unhealthy"** Everyone may begin to experience health effects. Members of sensitive groups may experience more serious health effects.
- * **"Very Unhealthy"** Triggers a health alert, meaning everyone may experience more serious health effects.
- * **"Hazardous"** Triggers health warnings of emergency conditions. The entire population is more likely to be affected.

The map below is a summary of the air quality index values recorded for 2006.



Nonattainment: What does it mean for Kentucky?

When the EPA classifies an area as nonattainment it means the air quality in that area does not meet the National Ambient Air Quality Standards (NAAQS). If a state does not meet the standards, a state must draft a plan on how they will improve air quality in their region.

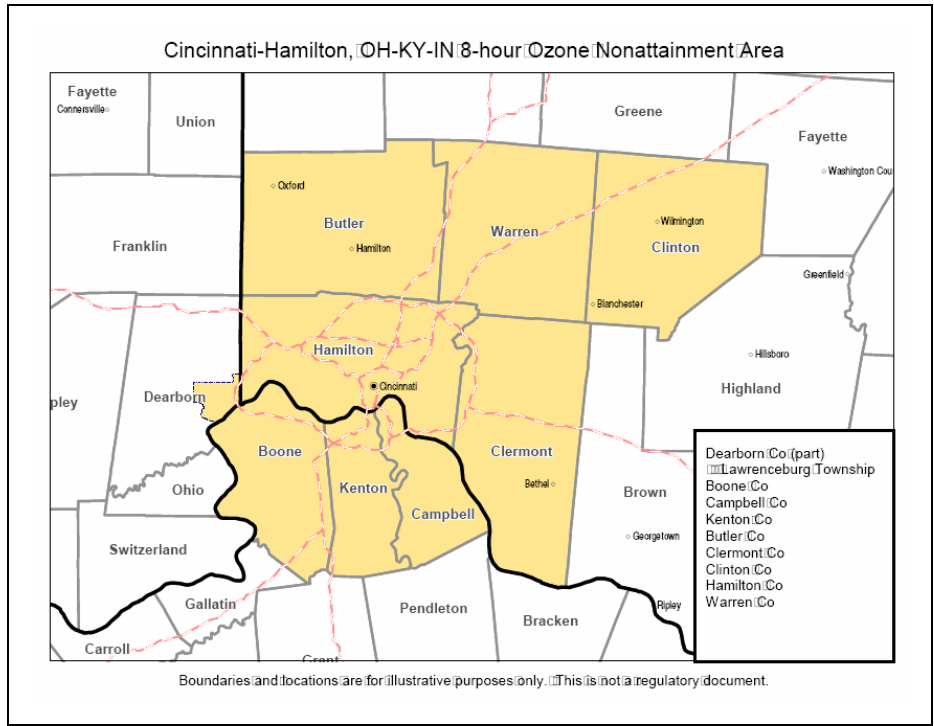
What does nonattainment mean for Kentucky?

In 2004, EPA issued a final rule designating areas not meeting the NAAQS for 8-hour ozone. Kentucky had a total of eight counties designated with a nonattainment status in 2005. The counties are Jefferson, Oldham, Bullitt, Boone, Kenton, Campbell, Boyd and Christian (see Figures 6-8). However, in January 2006, Christian county was redesignated to attainment for the 8-hour ozone National Ambient Air Quality Standard (71 FR 4047). Also in 2006, the division requested Jefferson, Bullitt, Oldham and Boyd counties to be redesignated to attainment for the 8-hour NAAQS based on the 2003-2005 ozone data demonstrating attainment. On August 6, 2007, the Kentucky portion of the Louisville area became designated in attainment for the 8-hour ozone standard. On September 4, 2007, the Kentucky portion of the Huntington-Ashland area will become designated in attainment for the 8-hour ozone standard. The new attainment status of the above mentioned areas leaves only Boone, Kenton and Campbell counties as nonattainment counties for the 8-hour ozone standard in Kentucky.

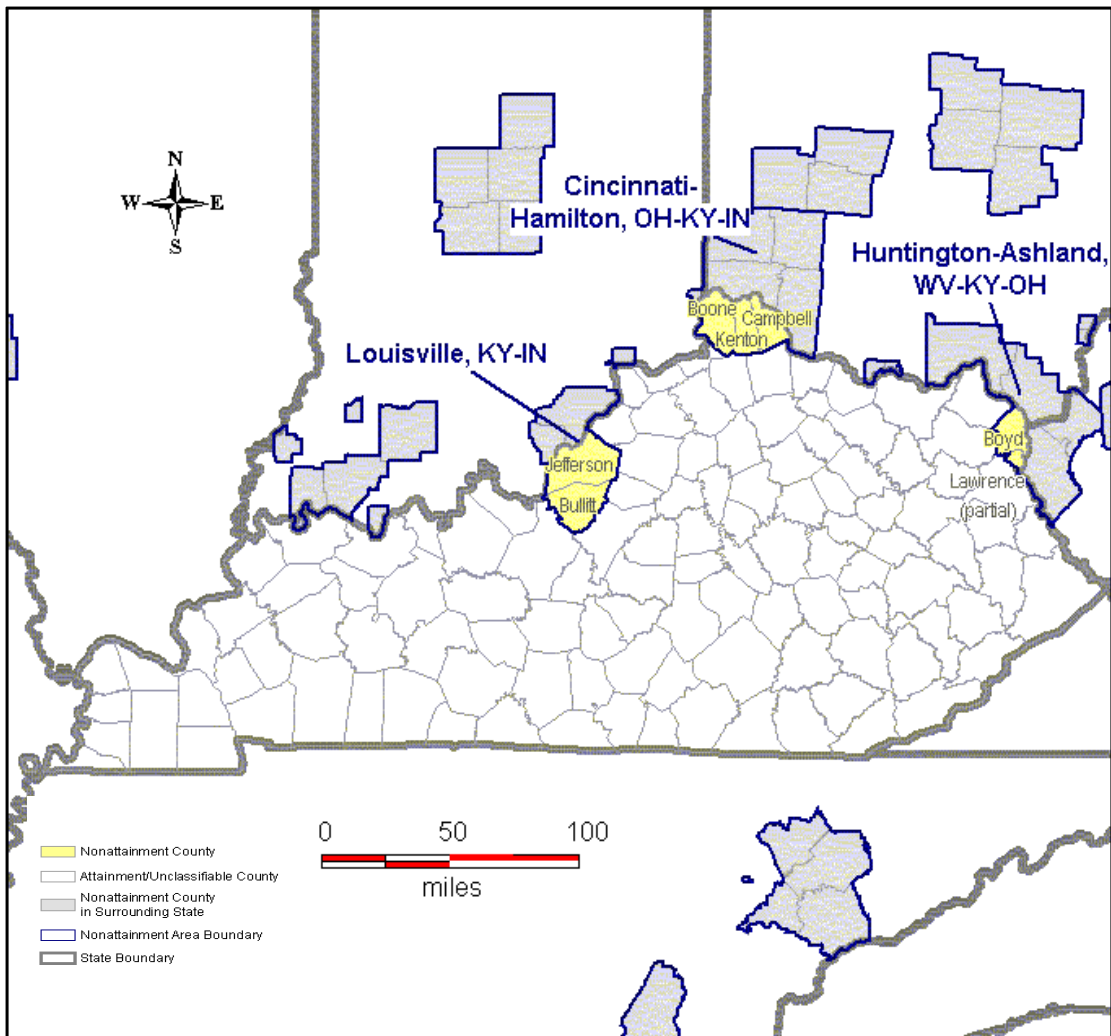
Based on data from 2002-2004, EPA considers the following counties to be nonattainment for the annual $PM_{2.5}$ standard (see Figure 11): Jefferson, Bullitt, Boone, Kenton, Campbell, Boyd and a portion of Lawrence. Although Jefferson County is the only county in Kentucky where the measured 3-year annual average exceeded the standard of $15 \mu\text{g}/\text{m}^3$, the other counties listed are part of a MSA where monitors within the MSA measured violations. Bullitt County is considered part of the Louisville (Kentucky-Indiana) MSA. Boone, Kenton and Campbell monitors are within the Cincinnati-Northern Kentucky MSA. Boyd and Lawrence monitors are within the Huntington–Ashland MSA.

A portion of Boyd County, as described in 40 CFR 81.318, was designated as nonattainment for sulfur dioxide. The Division requested Boyd County to be redesignated to attainment and has been published as attainment on May 24, 2006, in 71 FR 29792.

Boone, Kenton and Campbell counties are part of the Cincinnati-Hamilton MSA.



Kentucky PM_{2.5} designation map.

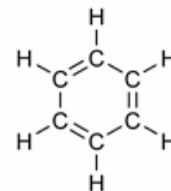


Appendix A

Air Toxic Chemical Abstracts

Volatile Organic Compounds: Benzene

CAS Number: 71-43-2



Benzene occurs as a volatile and is a colorless, highly flammable liquid that dissolves easily in water. Benzene has a sweet odor. Benzene is found in the air from emissions from burning coal and oil, gasoline service stations, and motor vehicle exhaust. Acute (short-term) inhalation exposure of humans to benzene may cause drowsiness, dizziness, headaches, as well as eye, skin, and respiratory tract irritation, and, at high levels, unconsciousness. Chronic (long-term) inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells and aplastic anemia, in occupational settings. Reproductive effects have been reported for women exposed by inhalation to high levels, and adverse effects on the developing fetus have been observed in animal tests. Increased incidence of leukemia (cancer of the tissues that form white blood cells) have been observed in humans occupationally exposed to benzene. EPA has classified benzene as a Group A, human carcinogen.

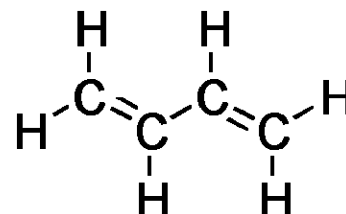
Benzene is used as a constituent in motor fuels; as a solvent for fats, waxes, resins, oils, inks, paints, plastics, and rubber; in the extraction of oils from seeds and nuts; and in photogravure printing. It is also used as a chemical intermediate. Benzene is also used in the manufacture of detergents, explosives, pharmaceuticals, and dyestuffs.

Individuals employed in industries that manufacture or use benzene may be exposed to the highest levels. Benzene is found in emissions from burning coal and oil, motor vehicle exhaust, and evaporation from gasoline service stations and in industrial solvents. These sources contribute to elevated levels of benzene in the ambient air, which may subsequently be breathed by the public. Tobacco smoke contains benzene and accounts for nearly half the national exposure to benzene.

The information for this fact sheet is copied directly from the Health Effects Notebook for Hazardous Air Pollutants located on the U.S.EPA Technology Transfer Network Air Toxics Website: www.epa.gov/ttnatw01/hlthef/hapindex.html.

1,3 Butadiene

CAS Number: 106-99-0



1,3-Butadiene is a colorless gas with a mild gasoline-like odor. Motor vehicle exhaust is a constant source of 1,3-butadiene. Although 1,3-butadiene breaks down quickly in the atmosphere, it is usually found in ambient air at low levels in urban and suburban areas. Acute (short-term) exposure to 1,3-butadiene by inhalation in humans results in irritation of the eyes, nasal passages, throat, and lungs. Epidemiological studies have reported a possible association between 1,3-butadiene exposure and cardiovascular diseases. Epidemiological studies of workers in rubber plants have shown an association between 1,3-butadiene exposure and increased incidence of leukemia. Animal studies have reported tumors at various sites from 1,3-butadiene exposure. EPA has classified 1,3-butadiene as a Group B2, probable human carcinogen.

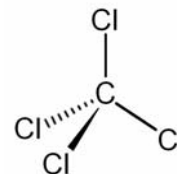
1,3-Butadiene is used in the production of rubber and plastics. It is also used in copolymers including acrylics.

Sources of 1,3-butadiene released into the air include motor vehicle exhaust, manufacturing and processing facilities, forest fires or other combustion, and cigarette smoke. 1,3-Butadiene was detected in ambient air of cities and suburban areas from 1970 to 1982 at an average level of 0.3 parts per billion (ppb). Higher levels of 1,3-butadiene may be found in highly industrialized cities or near oil refineries, chemical manufacturing plants, and plastic and rubber factories. 1,3-Butadiene has been found in drinking water and in plastic or rubber food containers, but not in food samples. Occupational exposure to 1,3-butadiene may occur in the rubber, plastics, and resins industries

The information for this fact sheet is copied directly from the Health Effects Notebook for Hazardous Air Pollutants located on the U.S.EPA Technology Transfer Network Air Toxics Website: www.epa.gov/ttnatw01/hlthef/hapindex.html.

Carbon Tetrachloride

CAS Number: 56-23-5



Carbon tetrachloride is a clear, nonflammable liquid which is almost insoluble in water. Carbon tetrachloride has a sweet characteristic odor.

Carbon tetrachloride may be found in both ambient outdoor and indoor air. The primary effects of carbon tetrachloride in humans are on the liver, kidneys, and central nervous system (CNS). Human symptoms of acute (short-term) inhalation and oral exposures to carbon tetrachloride include headache, weakness, lethargy, nausea, and vomiting. Acute exposures to higher levels and chronic (long-term) inhalation or oral exposure to carbon tetrachloride produces liver and kidney damage in humans. Human data on the carcinogenic effects of carbon tetrachloride are limited. Studies in animals have shown that ingestion of carbon tetrachloride increases the risk of liver cancer. EPA has classified carbon tetrachloride as a Group B2,

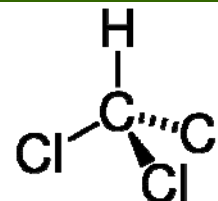
Carbon tetrachloride was produced in large quantities to make refrigerants and propellants for aerosol cans, as a solvent for oils, fats, lacquers, varnishes, rubber waxes, and resins, and as a grain fumigant and a dry cleaning agent. Consumer and fumigant uses have been discontinued and only industrial uses remain.

Individuals may be exposed to carbon tetrachloride in the air from accidental releases from production and uses, and from its disposal in landfills where it may evaporate into the air or leach into groundwater. Carbon tetrachloride is also a common contaminant of indoor air; the sources of exposure appear to be building materials or products, such as cleaning agents, used in the home. Workers directly involved in the manufacture or use of carbon tetrachloride are most likely to have significant exposures to carbon tetrachloride.

The information for this fact sheet is copied directly from the Health Effects Notebook for Hazardous Air Pollutants located on the U.S.EPA Technology Transfer Network Air Toxics Website: www.epa.gov/ttnatw01/hlthef/hapindex.html.

Chloroform

CAS Number: 67-66-3



Chloroform is a colorless liquid that is not very soluble in water and is very volatile. Chloroform has a pleasant, nonirritating odor.

The major effect from acute (short-term) inhalation exposure to chloroform is central nervous system depression. Chronic (long-term) exposure to chloroform by inhalation in humans has resulted in effects on the liver, including hepatitis and jaundice, and central nervous system effects, such as depression and irritability. Chloroform has been shown to be carcinogenic in animals after oral exposure, resulting in an increase in kidney and liver tumors. EPA has classified chloroform as a Group B2, probable human carcinogen.

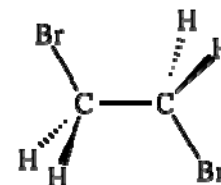
The vast majority of the chloroform produced in the United States is used to make HCFC-22. The rest is produced for export and for miscellaneous uses. Chloroform was used in the past as an extraction solvent for fats, oils, greases, and other products; as a dry cleaning spot remover; in fire extinguishers; as a fumigant; and as an anesthetic. However, chloroform is no longer used in these products.

Chloroform may be released to the air as a result of its formation in the chlorination of drinking water, wastewater and swimming pools. Other sources include pulp and paper mills, hazardous waste sites, and sanitary landfills. The background level of chloroform in ambient air in the early 1990s was estimated at 0.00004 parts per million (ppm). Human exposure to chloroform may occur through drinking water, where chloroform is formed as a result of the chlorination of naturally occurring organic materials found in raw water supplies. Measurements of chloroform in drinking water during the 1970s and 1980s ranged from 0.022 to 0.068 ppm. Chloroform may also be found in some foods and beverages, largely from the use of tap water during production processes.

The information for this fact sheet is copied directly from the Health Effects Notebook for Hazardous Air Pollutants located on the U.S.EPA Technology Transfer Network Air Toxics Website: www.epa.gov/ttnatw01/hlthef/hapindex.html.

1, 2 Dibromoethane (EDB)

CAS Number: 106-93-4



Ethylene dibromide is a colorless liquid with a mild sweet odor, like chloroform. It is also known as 1,2-dibromomethane. Ethylene dibromide is slightly soluble in water. Ethylene dibromide reacts with hydroxyl radicals in the atmosphere, with a half-life for this reaction of approximately 40 days. In water, its half-life ranges from 2.5 to 13.2 years, and in soil it was detected 19 years after it had been applied.

Ethylene dibromide is extremely toxic to humans. The chronic (long-term) effects of exposure to ethylene dibromide have not been well documented in humans. Animal studies indicate that chronic exposure to ethylene dibromide may result in toxic effects to the liver, kidney, and the testis, irrespective of the route of exposure. Limited data on men occupationally exposed to ethylene dibromide indicate that long-term exposure to ethylene dibromide can impair reproduction by damaging sperm cells in the testicles. EPA has classified ethylene dibromide as a Group B2, probable human carcinogen.

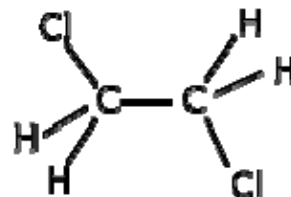
Ethylene dibromide was used in the past as an additive to leaded gasoline; however, since leaded gasoline is now banned, it is no longer used for this purpose. Ethylene dibromide was used as a fumigant to protect against insects, pests, and nematodes in citrus, vegetable, and grain crops, and as a fumigant for turf, particularly on golf courses. In 1984, EPA banned its use as a soil and grain fumigant. Ethylene dibromide is currently used in the treatment of felled logs for bark beetles and termites, and control of wax moths in beehives. Ethylene dibromide is also used as an intermediate for dyes, resins, waxes, and gums.

Possible sources of ethylene dibromide emissions to the ambient air are production and processing facilities. Exposure could occur from inhalation of ambient air near industries that use ethylene dibromide or through the ingestion of contaminated drinking water.

The information for this fact sheet is copied directly from the Health Effects Notebook for Hazardous Air Pollutants located on the U.S.EPA Technology Transfer Network Air Toxics Website: www.epa.gov/ttnatw01/hlthef/hapindex.html.

1,2 Dichloroethane (EDC)

CAS Number: 107-06-2



1,2-Dichloroethane is a common synonym for ethylene dichloride. Ethylene dichloride occurs as a colorless, oily, heavy liquid that is slightly soluble in water. Ethylene dichloride has a pleasant chloroform-like odor.

Inhalation of concentrated ethylene dichloride vapor can induce effects on the human nervous system, liver, and kidneys, as well as respiratory distress, cardiac arrhythmia, nausea, and vomiting. Chronic (long-term) inhalation exposure to ethylene dichloride produced effects on the liver and kidneys in animals. No information is available on the reproductive or developmental effects of ethylene dichloride in humans. Decreased fertility and increased embryo mortality have been observed in inhalation studies of rats. Epidemiological studies are not conclusive regarding the carcinogenic effects of ethylene dichloride, due to concomitant exposure to other chemicals. Following treatment by gavage (experimentally placing the chemical in the stomach), several tumor types were induced in rats and mice. EPA has classified ethylene dichloride as a Group B2, probable human carcinogen.

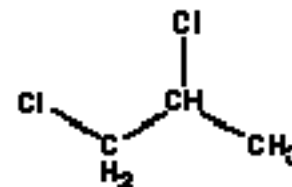
Ethylene dichloride is primarily used in the production of vinyl chloride as well as other chemicals. It is used in solvents in closed systems for various extraction and cleaning purposes in organic synthesis. It is also added to leaded gasoline as a lead scavenger. It is also used as a dispersant in rubber and plastics, as a wetting and penetrating agent. It was formerly used in ore flotation, as a grain fumigant, as a metal degreaser, and in textile and PVC cleaning.

Inhalation of ethylene dichloride in the ambient or workplace air is generally the main route of human exposure. The compound may be released during its production, storage, use, transport, and disposal. Exposure may also occur through the consumption of contaminated water. But usually ethylene dichloride will evaporate quickly into the air from the water or soil. The average levels of ethylene dichloride in the air of seven urban locations in 1980-1981 ranged from 0.1 to 1.5 parts per billion (ppb).

The information for this fact sheet is copied directly from the Health Effects Notebook for Hazardous Air Pollutants located on the U.S.EPA Technology Transfer Network Air Toxics Website: www.epa.gov/ttnatw01/hlthef/hapindex.html.

1,2 Dichloropropane

CAS Number: 78-87-5



Propylene dichloride is a colorless liquid which evaporates quickly at room temperature. It is also known as 1,2-dichloropropane. Propylene dichloride has a chloroform-like odor. Propylene dichloride has a half-life in air ranging from 16 to greater than 23 days.

Propylene dichloride is used as a chemical intermediate in several industries. Acute (short-term) inhalation exposure to high levels of propylene dichloride by humans results in effects on the lungs, gastrointestinal system, blood, liver, kidneys, central nervous system, and eyes. Limited information is available on the chronic (long-term), reproductive, developmental, and carcinogenic effects of propylene dichloride in humans. EPA has provisionally classified propylene dichloride as a Group B2, probable human carcinogen.

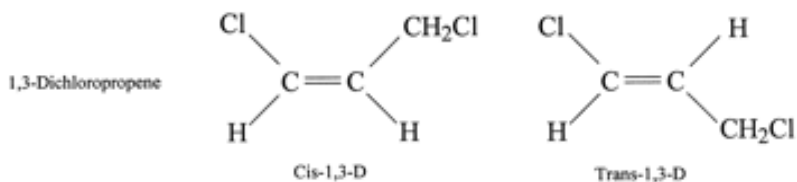
Propylene dichloride is used as a chemical intermediate in the production of chlorinated organic chemicals, as an industrial solvent, in ion exchange manufacture, in toluene diisocyanate production, in photographic film manufacture, for paper coating, and for petroleum catalyst regeneration. Propylene dichloride was used in the past as a soil fumigant for a variety of crops. This use has been discontinued, and pesticide formulations containing propylene dichloride are no longer available in the United States.

Propylene dichloride has been detected at low levels in ambient air, with an average level in air of about 0.022 parts per billion (ppb). An early 1980s nationwide survey of water supplies derived from groundwater found that 13 of 945 water supplies contained propylene dichloride at levels around 1 ppb. Occupational exposure to propylene dichloride may occur during its production, during its use in chemical reactions or as an industrial solvent, or from evaporation from wastewater that contains the chemical.

The information for this fact sheet is copied directly from the Health Effects Notebook for Hazardous Air Pollutants located on the U.S.EPA Technology Transfer Network Air Toxics Website: www.epa.gov/ttnatw01/hlthef/hapindex.html.

1,3 Dichloropropene

CAS Number: 542-75-6
cis, CAS Number: 10061-01-5
trans, CAS Number: 10061-02-6



1,3-Dichloropropene occurs as a colorless liquid that dissolves in water. 1,3-Dichloropropene has a sweet chloroform-like odor. The half-life of 1,3-dichloropropene in ambient air may range from 7 to 50 hours.

1,3-Dichloropropene is used as a component in formulations for soil fumigants. Acute (short-term) inhalation exposure of humans following a spill caused mucous membrane irritation, chest pain, and breathing difficulties. Effects on the lung have been observed in rats acutely exposed to 1,3-dichloropropene by inhalation. Chronic (long-term) dermal exposure may result in skin sensitization in humans. Damage to the nasal mucosa and urinary bladder are the primary health effects of rodents chronically exposed to 1,3-dichloropropene by inhalation. Information on the carcinogenic effects of 1,3-dichloropropene in humans is limited; two cases of histiocytic lymphomas and one case of leukemia have been reported in humans accidentally exposed by inhalation to concentrated vapors during cleanup of a tank truck spill. EPA has classified 1,3-dichloropropene as a Group B2, probable human carcinogen.

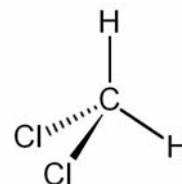
1,3-Dichloropropene is the predominant component of several formulations used in agriculture as soil fumigants for parasitic nematodes.

Workers may be occupationally exposed to 1,3-dichloropropene, dermally or by inhalation, during its manufacture, formulation, or application as a soil fumigant. The general public may be exposed via inhalation near source areas or from the consumption of contaminated drinking water from wells near some hazardous waste sites.

The information for this fact sheet is copied directly from the Health Effects Notebook for Hazardous Air Pollutants located on the U.S.EPA Technology Transfer Network Air Toxics Website: www.epa.gov/ttnatw01/hlthef/hapindex.html.

Methylene Chloride

CAS Number: 75-09-2



A common synonym for methylene chloride is dichloromethane. Methylene chloride is a colorless liquid with a sweetish odor. Methylene chloride is slightly soluble in water and is nonflammable.

The acute (short-term) effects of methylene chloride inhalation in humans consist mainly of nervous system effects including decreased visual, auditory, and motor functions, but these effects are reversible once exposure ceases. The effects of chronic (long-term) exposure to methylene chloride suggest that the central nervous system (CNS) is a potential target in humans and animals. Human data are inconclusive regarding methylene chloride and cancer. EPA has classified methylene chloride as a Group B2, probable human carcinogen.

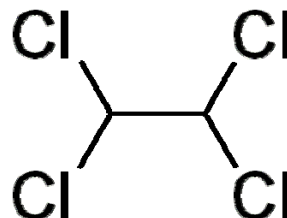
Methylene chloride is predominantly used as a solvent in paint strippers and removers; as a process solvent in the manufacture of drugs, pharmaceuticals, and film coatings; as a metal cleaning and finishing solvent in electronics manufacturing; and as an agent in urethane foam blowing. Methylene chloride is also used as a propellant in aerosols for products such as paints, automotive products, and insect sprays. It is used as an extraction solvent for spice oleoresins, hops, and for the removal of caffeine from coffee. However, due to concern over residual solvent, most decaffeinator no longer use methylene chloride. Methylene chloride is also approved for use as a postharvest fumigant for grains and strawberries and as a degreening agent for citrus fruit.

The principal route of human exposure to methylene chloride is inhalation of ambient air. Occupational and consumer exposure to methylene chloride in indoor air may be much higher, especially from spray painting or other aerosol uses. People who work in these places can breathe in the chemical or it may come in contact with the skin. Methylene chloride has been detected in both surface water and groundwater samples taken at hazardous waste sites and in drinking water at very low concentrations.

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1,1,2,2 Tetrachloroethane

CAS Number: 79-34-5



1,1,2,2-Tetrachloroethane is a colorless, dense liquid that has a sweet, chloroform like odor. The half-life in air is about 60 days.

The main effects of 1,1,2,2-tetrachloroethane are liver and neurological effects. Acute (short-term) inhalation exposure to very high levels of 1,1,2,2-tetrachloroethane has resulted in effects on the liver and respiratory, central nervous, and gastrointestinal systems in humans. Chronic (long-term) inhalation exposure to 1,1,2,2-tetrachloroethane in humans results in jaundice and an enlarged liver, headaches, tremors, dizziness, numbness, and drowsiness. EPA has classified 1,1,2,2-tetrachloroethane as a Group C possible human carcinogen.

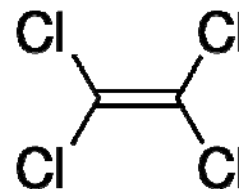
The production of 1,1,2,2-tetrachloroethane as an end-product has decreased significantly in the United States. In the past, 1,1,2,2-tetrachloroethane was used in large amounts to produce trichloroethylene, tetrachloroethylene, and 1,2-dichloroethylene. It was also used as a solvent, in cleaning and degreasing metals, in paint removers, varnishes and lacquers, in photographic films, as an extractant for oils and fats, and in pesticides.

As it is no longer widely used in the U.S. as an end-product, present sources of 1,1,2,2-tetrachloroethane are fugitive emissions or discharges when it is generated as a by-product and during chemical production activities in which it is an intermediate product. Low levels of 1,1,2,2-tetrachloroethane can be present in both indoor and outdoor air. In the early 1980s, average ambient air concentrations were around 0.005 parts per billion (ppb), and average concentrations in the indoor air of several homes measured 1.8 ppb. 1,1,2,2-Tetrachloroethane has been found, in trace amounts, in adhesives, oils, greases, and lubricants; these household products may contaminate indoor air. Limited occupational exposure to 1,1,2,2-tetrachloroethane may occur through inhalation of the vapors or through skin contact due to spills or accidents in the workplace. 1,1,2,2-Tetrachloroethane has been found at many National Priority List (i.e., Superfund) sites.

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Tetrachloroethylene

CAS Number: 127-18-4



Tetrachloroethylene is a nonflammable colorless liquid with a sharp sweet odor. Tetrachloroethylene is widely used for dry-cleaning fabrics and metal degreasing operations.

The main effects of tetrachloroethylene in humans are neurological, liver, and kidney effects following acute (short-term) and chronic (long-term) inhalation exposure. Adverse reproductive effects, such as spontaneous abortions, have been reported from occupational exposure to tetrachloroethylene; however, no definite conclusions can be made because of the limitations of the studies. Results from epidemiological studies of dry-cleaners occupationally exposed to tetrachloroethylene suggest increased risks for several types of cancer. In the mid-1980s, EPA considered the epidemiological and animal evidence on tetrachloroethylene as intermediate between a probable and possible human carcinogen (Group B/C). The Agency is currently reassessing its potential carcinogenicity.

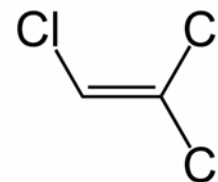
Tetrachloroethylene is used for dry cleaning and textile processing, as a chemical intermediate, and for vapor degreasing in metal-cleaning operations.

Prior to 1981, tetrachloroethylene was detected in ambient air at average levels of 0.16 parts per billion (ppb) in rural and remote areas, 0.79 ppb in urban and suburban areas, and 1.3 ppb in areas near emission sources. Tetrachloroethylene has also been detected in drinking water; one survey prior to 1984 of water supplies from groundwater sources reported a median concentration of 0.75 ppb for the samples in which tetrachloroethylene was detected, with a maximum level of 69 ppb. Occupational exposure to tetrachloroethylene may occur, primarily in dry cleaning establishments and at industries manufacturing or using the chemical.

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Trichloroethylene

CAS Number: 79-01-6



Trichloroethylene is a nonflammable colorless liquid with a sweet odor similar to ether or chloroform. Trichloroethylene is not a persistent chemical in the atmosphere; its half-life in air is about 7 days.

Acute (short-term) and chronic (long-term) inhalation exposure to trichloroethylene can affect the human central nervous system (CNS), with symptoms such as dizziness, headaches, confusion, euphoria, facial numbness, and weakness. Liver, kidney, immunological, endocrine, and developmental effects have also been reported in humans. A recent analysis of available epidemiological studies reports trichloroethylene exposure to be associated with several types of cancers in humans, especially kidney, liver, cervix, and lymphatic system. The Agency is currently reassessing the cancer classification of trichloroethylene.

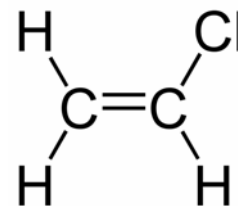
The main use of trichloroethylene is in the vapor degreasing of metal parts. Trichloroethylene is also used as an extraction solvent for greases, oils, fats, waxes, and tars, a chemical intermediate in the production of other chemicals, and as a refrigerant. Trichloroethylene is used in consumer products such as typewriter correction fluids, paint removers/strippers, adhesives, spot removers, and rug-cleaning fluids. Trichloroethylene was used in the past as a general anesthetic.

Trichloroethylene has been detected in ambient air at levels less than 1 part per billion (ppb). Ambient air measurement data from the Aerometric Information Retrieval System (which has 1,200 measurements from 25 states from 1985-1995) give a range of ambient air values from 0.01 to 3.9 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). Workers may be exposed to trichloroethylene in the factories where it is manufactured or used. In addition, persons breathing air around these factories may be exposed to trichloroethylene. Persons may also be exposed to trichloroethylene through the use of products containing the chemical and from evaporation and leaching from waste disposal sites.

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Vinyl Chloride

CAS Number: 75-01-4



Vinyl chloride is a colorless gas with a mild, sweet odor. Vinyl chloride is slightly soluble in water and is quite flammable. The half-life of vinyl chloride in air is a few hours.

Acute (short-term) exposure to high levels of vinyl chloride in air has resulted in central nervous system effects (CNS), such as dizziness, drowsiness, and headaches in humans. Chronic (long-term) exposure to vinyl chloride through inhalation and oral exposure in humans has resulted in liver damage. Cancer is a major concern from exposure to vinyl chloride via inhalation, as vinyl chloride exposure has been shown to increase the risk of a rare form of liver cancer in humans. EPA has classified vinyl chloride as a Group A, human carcinogen.

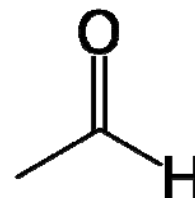
Most of the vinyl chloride produced in the United States is used to make polyvinyl chloride (PVC), a material used to manufacture a variety of plastic and vinyl products including pipes, wire and cable coatings, and packaging materials. Smaller amounts of vinyl chloride are used in furniture and automobile upholstery, wall coverings, housewares, and automotive parts. Vinyl chloride has been used in the past as a refrigerant.

Ambient air concentrations of vinyl chloride are generally quite low, with exposure occurring from the discharge of exhaust gases from factories that manufacture or process vinyl chloride, or evaporation from areas where chemical wastes are stored. Air inside new cars may contain vinyl chloride at higher levels than detected in ambient air because vinyl chloride may outgas into the air from the new plastic parts. Drinking water may contain vinyl chloride released from contact with polyvinyl pipes. Vinyl chloride is a microbial degradation product of trichloroethylene in groundwater, and thus can be found in groundwater affected by trichloroethylene contamination. Occupational exposure to vinyl chloride may occur in those workers concerned with the production, use, transport, storage, and disposal of the chemical.

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Carbonyls: Acetaldehyde

CAS Number: 75-07-0



Acetaldehyde is a colorless mobile liquid that is flammable and miscible with water. Acetaldehyde has a pungent suffocating odor, but at dilute concentrations it has a fruity and pleasant odor.

Acute (short-term) exposure to acetaldehyde results in effects including irritation of the eyes, skin, and respiratory tract. Symptoms of chronic (long-term) intoxication of acetaldehyde resemble those of alcoholism. Acetaldehyde is considered a probable human carcinogen (Group B2) based on inadequate human cancer studies and animal studies that have shown nasal tumors in rats and laryngeal tumors in hamsters.

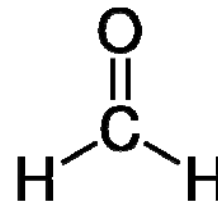
The predominant use of acetaldehyde is as an intermediate in the synthesis of other chemicals. Acetaldehyde is used in the production of perfumes, polyester resins, and basic dyes. Acetaldehyde is also used as a fruit and fish preservative, as a flavoring agent, and as a denaturant for alcohol, in fuel compositions, for hardening gelatin, and as a solvent in the rubber, tanning, and paper industries.

Acetaldehyde is ubiquitous in the ambient environment. It is an intermediate product of higher plant respiration and formed as a product of incomplete wood combustion in fireplaces and woodstoves, coffee roasting, burning of tobacco, vehicle exhaust fumes, and coal refining and waste processing. Hence, many individuals are exposed to acetaldehyde by breathing ambient air. It should be noted that residential fireplaces and woodstoves are the two highest sources of emissions, followed by various industrial emissions. In Los Angeles, California, levels of acetaldehyde up to 32 parts per billion (ppb) have been measured in the ambient environment. Exposure may also occur in individuals occupationally exposed to acetaldehyde during its manufacture and use. In addition, acetaldehyde is formed in the body from the breakdown of ethanol; this would be a source of acetaldehyde among those who consume alcoholic beverages.

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Formaldehyde

CAS Number: 50-00-0



Formaldehyde is a colorless gas with a pungent, suffocating odor at room temperature; the odor threshold for formaldehyde is 0.83 ppm. Formaldehyde is readily soluble in water at room temperature.

Acute (short-term) and chronic (long-term) inhalation exposure to formaldehyde in humans can result in respiratory symptoms, and eye, nose, and throat irritation. Limited human studies have reported an association between formaldehyde exposure and lung and nasopharyngeal cancer. EPA considers formaldehyde a probable human carcinogen (Group B1).

Formaldehyde is used predominantly as a chemical intermediate. It also has minor uses in agriculture, as an analytical reagent, in concrete and plaster additives, cosmetics, disinfectants, fumigants, photography, and wood preservation. One of the most common uses of formaldehyde in the U.S is manufacturing urea-formaldehyde resins, used in particleboard products. Formaldehyde (as urea formaldehyde foam) was extensively used as an insulating material until 1982 when it was banned by the U.S. Consumer Product Safety Commission.

Exposure to formaldehyde may occur by breathing contaminated indoor air, tobacco smoke, or ambient urban air. The highest levels of airborne formaldehyde have been detected in indoor air, where it is released from various consumer products such as building materials and home furnishings. One survey reported formaldehyde levels ranging from 0.10 to 3.68 parts per million (ppm) in homes. Higher levels have been found in new manufactured or mobile homes than in older conventional homes. Formaldehyde has also been detected in ambient air; the average concentrations reported in U.S. urban areas were in the range of 11 to 20 parts per billion (ppb). The major sources appear to be power plants, manufacturing facilities, incinerators, and automobile exhaust emissions. Smoking is another important source of formaldehyde. Formaldehyde may also be present in food, either naturally or as a result of contamination.

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Metals: Arsenic

As

CAS Number: 7440-38-2

Inorganic arsenic is a naturally occurring element in the earth's crust. Pure inorganic arsenic is a gray-colored metal, but inorganic arsenic is usually found combined with other elements such as oxygen, chlorine, and sulfur.

Acute (short-term) high-level inhalation exposure to arsenic dust or fumes has resulted in gastrointestinal effects (nausea, diarrhea, abdominal pain); central and peripheral nervous system disorders have occurred in workers acutely exposed to inorganic arsenic. Chronic (long-term) inhalation exposure to inorganic arsenic in humans is associated with irritation of the skin and mucous membranes. Chronic oral exposure has resulted in gastrointestinal effects, anemia, peripheral neuropathy, skin lesions, hyperpigmentation, and liver or kidney damage in humans. Inorganic arsenic exposure in humans, by the inhalation route, has been shown to be strongly associated with lung cancer, while ingestion of inorganic arsenic in humans has been linked to a form of skin cancer and also to bladder, liver, and lung cancer. EPA has classified inorganic arsenic as a Group A, human carcinogen.

The major use for inorganic arsenic is in wood preservation. Until the 1940s, inorganic arsenic solutions were widely used in the treatment of various diseases, such as syphilis and psoriasis. Inorganic arsenic is still used as an antiparasitic agent in veterinary medicine and in homeopathic and folk remedies in the United States and other countries.

Inorganic arsenic is found throughout the environment; it is released into the air by volcanoes, the weathering of arsenic-containing minerals and ores, and by commercial or industrial processes. For most people, food is the largest source of arsenic exposure (about 25 to 50 micrograms per day [$\mu\text{g}/\text{d}$]). Workers in metal smelters and nearby residents may be exposed to above-average inorganic arsenic levels from arsenic released into the air. Other sources of inorganic arsenic exposure include burning plywood treated with an arsenic wood preservative or dermal contact with wood treated with arsenic. Most arsenic poisoning incidents in industry have involved the production of arsine, a short-lived, extremely toxic gas.

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Beryllium

Be

CAS Number: 7440-41-7

Pure beryllium is a hard gray metal that does not occur naturally but does occur as a chemical component of certain kinds of rocks, coal and oil, soil, and volcanic dust. Pure beryllium is insoluble in water.

Acute (short-term) inhalation exposure to high levels of beryllium has been observed to cause inflammation of the lungs or acute pneumonitis (reddening and swelling of the lungs) in humans; after exposure ends, these symptoms may be reversible. Chronic (long-term) inhalation exposure of humans to beryllium has been reported to cause chronic beryllium disease (berylliosis), in which granulomatous lesions (noncancerous) develop in the lung. Human epidemiology studies are limited, but suggest a causal relationship between beryllium exposure and an increased risk of lung cancer. EPA has classified beryllium as a Group B1, probable human carcinogen.

Pure beryllium and its metal alloys have applications in electrical components, tools, structural components for aircraft, missiles, and satellites, and other metal-fabricating uses. Beryllium is also used in consumer products, such as televisions, calculators, and personal computers.

The greatest exposures to beryllium occur in the workplace (i.e., where it is mined, processed, or converted into alloys and chemicals). Individuals may also be exposed by inhalation of beryllium dust or fumes from the burning of coal or fuel oil and in tobacco smoke, by the ingestion of many fruits and vegetables and water, or through natural occurrence in soils. The average concentration of beryllium measured in the air in the United States during the 1980s was 0.03 nanograms per cubic meter (ng/m³). Ambient concentrations measured in 50 cities between 1977 and 1981 were 0.1-0.4 ng/m³.

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Cadmium

Cd

CAS Number: 7440-43-9

Cadmium is a soft silver-white metal that is usually found in combination with other elements. Cadmium compounds range in solubility in water from quite soluble to practically insoluble.

The acute (short-term) effects of cadmium in humans through inhalation exposure consist mainly of effects on the lung, such as pulmonary irritation. Chronic (long-term) inhalation or oral exposure to cadmium leads to a build-up of cadmium in the kidneys that can cause kidney disease. Cadmium has been shown to be a developmental toxicant in animals, resulting in fetal malformations and other effects, but no conclusive evidence exists in humans. An association between cadmium exposure and an increased risk of lung cancer has been reported from human studies, but these studies are inconclusive due to confounding factors. EPA has classified cadmium as a Group B1, probable human carcinogen.

Most cadmium used in the United States today is obtained as a byproduct from the smelting of zinc, lead, or copper ores. Cadmium is used to manufacture pigments and batteries and in the metal-plating and plastics industries.

The largest sources of airborne cadmium in the environment are the burning of fossil fuels such as coal or oil, and incineration of municipal waste materials. Cadmium may also be emitted into the air from zinc, lead, or copper smelters. For nonsmokers, food is generally the largest source of cadmium exposure. Cadmium levels in some foods can be increased by the application of phosphate fertilizers or sewage sludge to farm fields. Smoking is another important source of cadmium exposure. Smokers have about twice as much cadmium in their bodies as do nonsmokers.

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Chromium

Cr

CAS Number: 7440-47-3

The metal, chromium (Cr), is a steel-gray solid. Chromium has oxidation states ranging from chromium (-II) to chromium (+VI). Chromium forms a large number of compounds, in both the chromium (III) and the chromium (VI) forms. Chromium compounds are stable in the trivalent state, with the hexavalent form being the second most stable state. The chromium (III) compounds are sparingly soluble in water and may be found in water bodies as soluble chromium (III) complexes, while the chromium (VI) compounds are readily soluble in water.

The respiratory tract is the major target organ for chromium (VI) toxicity, for acute (short-term) and chronic (long-term) inhalation exposures. Shortness of breath, coughing, and wheezing were reported from a case of acute exposure to chromium (VI), while perforations and ulcerations of the septum, bronchitis, decreased pulmonary function, pneumonia, and other respiratory effects have been noted from chronic exposure. Human studies have clearly established that inhaled chromium (VI) is a human carcinogen, resulting in an increased risk of lung cancer.

The metal chromium is used mainly for making steel and other alloys. Chromium compounds, in either the chromium (III) or chromium (VI) forms, are used for chrome plating, the manufacture of dyes and pigments, leather and wood preservation, and treatment of cooling tower water. Smaller amounts are used in drilling muds, textiles, and toner for copying machines.

Chromium is a naturally occurring element in rocks, animals, plants, soil, and volcanic dust and gases. Air emissions of chromium are predominantly of trivalent chromium, and in the form of small particles or aerosols. The most important industrial sources of chromium in the atmosphere are those related to ferrochrome production. Ore refining, chemical and refractory processing, cement-producing plants, automobile brake lining and catalytic converters for automobiles, leather tanneries, and chrome pigments also contribute to the atmospheric burden of chromium.

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Lead

Pb

CAS Number: 7439-92-1

Lead is a naturally occurring, bluish-gray metal that is found in small quantities in the earth's crust. Pure lead is insoluble in water.

Lead is a very toxic element, causing a variety of effects at low dose levels. Brain damage, kidney damage, and gastrointestinal distress are seen from acute (short-term) exposure to high levels of lead in humans. Chronic (long-term) exposure to lead in humans results in effects on the blood, central nervous system (CNS), blood pressure, kidneys, and Vitamin D metabolism. Children are particularly sensitive to the chronic effects of lead, with slowed cognitive development, reduced growth and other effects reported. Reproductive effects, such as decreased sperm count in men and spontaneous abortions in women, have been associated with high lead exposure. The developing fetus is at particular risk from maternal lead exposure, with low birth weight and slowed postnatal neurobehavioral development noted. Human studies are inconclusive regarding lead exposure and cancer.

The primary use of lead is in the manufacture of batteries. Lead is also used in the production of metal products, such as sheet lead, solder (but no longer in food cans), and pipes, and in ceramic glazes, paint, ammunition, cable covering, and other products. Tetraethyl lead was used in gasoline to increase the octane rating until lead additives were phased out and eventually banned from use in gasoline in the U.S. by the EPA by 1996.

The largest source of lead in the atmosphere has been from leaded gasoline combustion, but with the phasedown of lead in gasoline, air lead levels have decreased considerably. Other airborne sources include combustion of solid waste, coal, and oils, emissions from iron and steel production and lead smelters, and tobacco smoke. Children are at particular risk to lead exposure since they commonly put hands, toys, and other items in their mouths, which may come in contact with lead-containing dust and dirt. Exposure to lead may also occur in the workplace, such as lead smelting and refining industries, steel and iron factories, gasoline stations, and battery manufacturing plants.

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Manganese

Mn

CAS Number: 7439-96-5

Manganese is a silver-colored metal that forms compounds in the environment with chemicals such as oxygen, sulfur, and chlorine. Manganese compounds are solids that do not evaporate; however, small dust particles can become suspended in air. Manganese can dissolve in water.

Manganese is essential for normal physiologic functioning in humans and animals, and exposure to low levels of manganese in the diet is considered to be nutritionally essential in humans. Chronic (long-term) exposure to high levels of manganese by inhalation in humans may result in central nervous system (CNS) effects. Visual reaction time, hand steadiness, and eye-hand coordination were affected in chronically-exposed workers. A syndrome named manganism may result from chronic exposure to higher levels; manganism is characterized by feelings of weakness and lethargy, tremors, a mask-like face, and psychological disturbances.

Metallic manganese is used primarily in steel production. Manganese compounds have a variety of uses. Manganese dioxide is used in the production of dry-cell batteries, matches, fireworks, and the production of other manganese compounds. Manganese chloride is used as a catalyst in the chlorination of organic compounds, in animal feed, and in dry-cell batteries, while manganese sulfate is used as a fertilizer, livestock nutritional supplement, in glazes and varnishes, and in ceramics. Potassium permanganate is used for water purification purposes in water and waste-treatment plants

Manganese is a naturally occurring substance found in many types of rock and soil; it is ubiquitous in the environment and found in low levels in water air, soil, and food. Manganese can also be released into the air by iron and steel production plants, power plants, and coke ovens. People who work in factories where manganese metal is produced from manganese ore or where manganese compounds are used to make steel or other products are most likely to be exposed through inhalation to higher than normal levels of manganese.

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Nickel

Ni

CAS Number: 7440-02-0

Nickel is a silvery-white metal that is found in nature as a component of silicate, sulfide, or arsenide ores. In the environment, nickel is found primarily combined with oxygen or sulfur as oxides or sulfides.

Nickel occurs naturally in the environment at low levels. Nickel is an essential element in some animal species, and it has been suggested it may be essential for human nutrition. Nickel dermatitis, consisting of itching of the fingers, hands, and forearms, is the most common effect in humans from chronic (long-term) skin contact with nickel. Respiratory effects have also been reported in humans from inhalation exposure to nickel. EPA has classified nickel refinery dust and nickel subsulfide as Group A, human carcinogens, and nickel carbonyl as a Group B2, probable human carcinogen.

Nickel is used for nickel alloys, electroplating, batteries, coins, industrial plumbing, spark plugs, machinery parts, stainless-steel, nickel-chrome resistance wires, and catalysts. Nickel carbonyl has severely limited use in nickel refining.

Nickel is a natural element of the earth's crust; therefore, small amounts are found in food, water, soil, and air. Food is the major source of nickel exposure, with an average intake for adults estimated to be approximately 100 to 300 micrograms per day ($\mu\text{g}/\text{d}$). Individuals also may be exposed to nickel in occupations involved in its production, processing, and use, or through contact with everyday items such as nickel-containing jewelry and stainless steel cooking and eating utensils, and by smoking tobacco. Nickel is found in ambient air at very low levels as a result of releases from oil and coal combustion, nickel metal refining, sewage sludge incineration, manufacturing facilities, and other sources. Given its high instability, nickel carbonyl exposure is extremely rare.

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