
Kentucky's Air
FY2022 Annual Report
Kentucky Division for Air Quality

Cover photo: James Lee Hixon

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Welcome to the Kentucky Division for Air Quality's FY2022 Annual Report.

This report details the division's accomplishments from July 1, 2021 through June 30, 2022. Due to varying schedules for data quality assurance, some data may be reported for the 2020 or 2021 calendar years.

From the Director

On behalf of the Division for Air Quality (DAQ), thank you for taking the time to read our 2022 Annual Report. Within these pages, we report on key measures our dedicated staff have taken to fulfill the division's mission, function, and commitment to protecting human health and the environment.

The past year saw some encouraging improvements in Kentucky's air quality. Air monitoring data demonstrated that six nonattainment counties — Boone, Campbell, Kenton, Jefferson, Bullitt, and Oldham — are now meeting federal clean air standards for ozone in the ambient air. As this report is being written, the Division for Air Quality is in the process of requesting those areas to be redesignated as attainment.

In 2021, EPA designated an area along the border of Webster and Henderson counties as nonattainment for sulfur dioxide. Air monitoring data show improvements there as well, and the division hopes to have data showing attainment of the National Ambient Air Quality Standard for SO2 by the end of 2022.

The division's essential work includes:

- Operation and maintenance of the air monitoring network and quality assuring air monitoring data by the Technical Services Branch
- Issuing appropriate permits containing all applicable requirements by the Permit Review Branch
- Developing effective regulations and control strategies by our Program Planning Branch
- Evaluating facilities for compliance, responding to air quality complaints, and enforcing emissions limitations by the Field Operations Branch
- Providing education and outreach through our Environmental Education program

Please take a few moments to explore the good work that so many have done in our division over the past year. I hope you find this report to be informative and educational.

Michael Kennedy
Director

Our Mission

To protect human health and the environment by achieving and maintaining acceptable air quality through:

- Operation of a comprehensive air monitoring network;
- Creating effective partnerships with air pollution sources and the public;
- Timely dissemination of accurate and useful information;
- The judicious use of program resources; and
- Maintenance of a reasonable and effective compliance assurance program.

Who We Are

- A team of environmental professionals dedicated to protecting Kentucky's air quality
- 150 funded positions located in Frankfort and throughout the Commonwealth in eight regional offices
- The third largest division within the Department for Environmental Protection

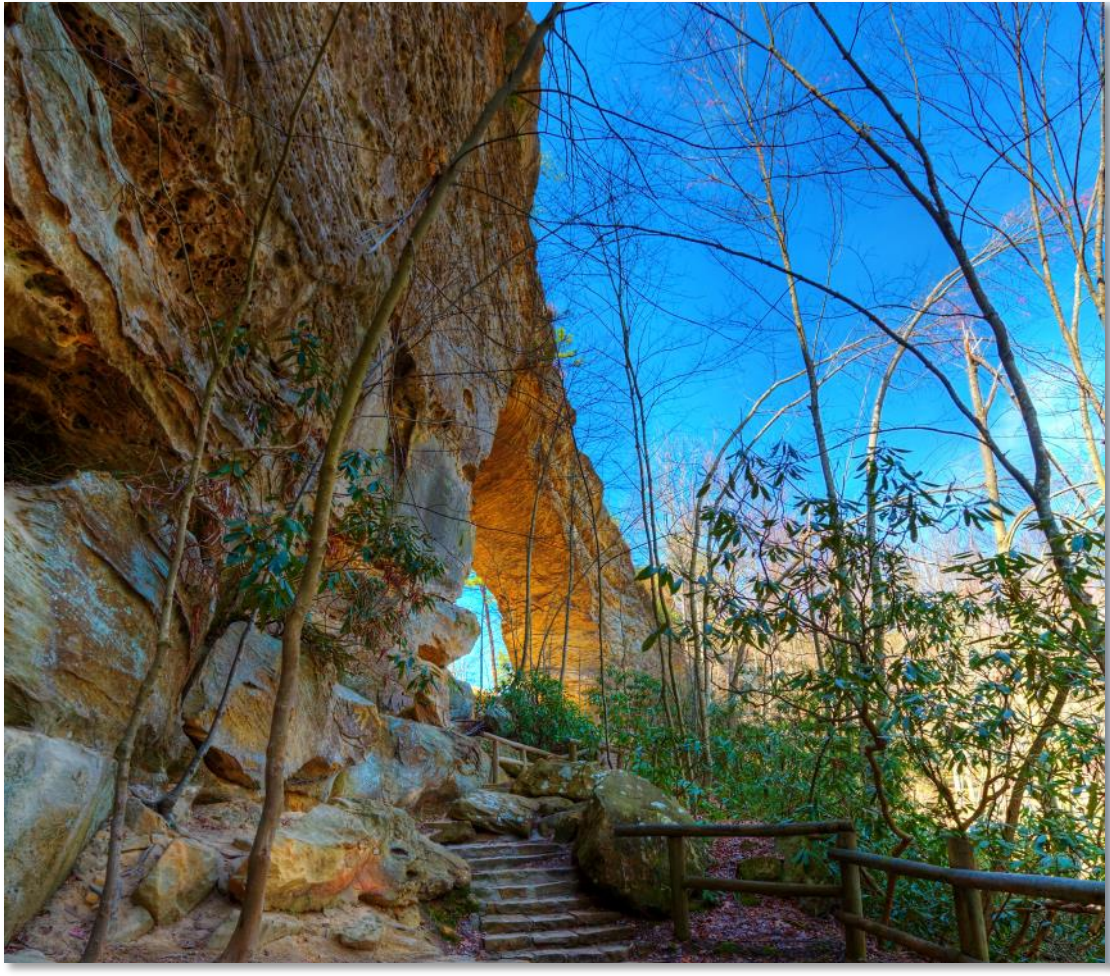
What We Do

- Air monitoring
- Regulation development
- Issue permits
- Respond to air quality complaints
- Ensure compliance with air quality regulations
- Education & outreach

Why We Do It

Protecting Human Health.

Human activities create air pollution. Too much air pollution is harmful to human health. That's why Congress enacted the Clean Air Act, which requires the U.S. Environmental Protection Agency (EPA) to set standards or "limits" for outdoor air pollutants. States, and sometimes local governments, are responsible for meeting those air quality standards.



Why We Do It

Protecting the Environment.

Air pollution also harms the environment. Some plants such as milkweed, tulip poplar and soybeans are sensitive to air pollution. Airborne sulfur oxide and nitrogen oxide pollution can cause acid precipitation, which in turn harms forests and aquatic organisms. Air pollution can even damage man-made structures such as buildings and monuments.

FY2022 Highlights

Air Quality Improvements & Challenges

Quality-assured air monitoring data demonstrated air quality improvements in several nonattainment areas. By the close of FY22, six counties designated nonattainment for ozone were meeting air quality standards, and redesignation requests were pending. In addition, a small area in Webster and Henderson counties remained designated nonattainment for sulfur dioxide.

Key accomplishments for the fiscal year include:

- 2,509 compliance inspections performed with an 83 percent compliance rate
- 1,085 air pollution complaints investigated
- 936 permitting actions
- 306 air permits issued
- 34 major economic development projects
- $294,748 in Clean Diesel grants awarded to six school districts
- 77 outreach programs reached 1,490 people across Kentucky

Division for Air Quality
Regional Office Boundaries

Environmental Emergency, 24-hour; (502) 564-2380 or (800) 928-2380

Florence Regional
Natalie Cox, Supervisor
8020 Veterans Memorial Dr.
Suite 110
Florence, KY 41042
(859) 525-4923
Fax: (859) 525-4157

Frankfort Region
Natasha Parker, Supervisor
300 Sower Blvd., 1st FL
Frankfort, KY 40601-1134
(502) 564-3358
Fax: (502) 564-5043

Louisville Metro
Air Pollution Control District
Rachael Hamilton, Director
701 W. Ormsby Ave, STE 303
Louisville, KY 40203
(502) 574-6000
Fax: (502) 574-5306

Owensboro Region
Mac Cann, Supervisor
3032 Alvey Park Dr. W.
STE 700
Owensboro, KY 42303-2191
(270) 687-7304
Fax: (270) 687-7204

Ashland Region
Karen Deskins, Supervisor
1550 Wolohan Drive, Suite 1
Ashland, KY 41102-8942
(606) 929-5285
Fax: (606) 928-1267

Hazard Region
Steven Hall, Supervisor
1332 S. KY HWY 15, STE 100
Hazard, KY 41701
(606) 435-6022
Fax: (606) 435-6230

Paducah Region
Elizabeth "Beth" Lents, Supervisor
130 Eagle Nest Drive
Paducah, KY 42003
(270) 898-8468
Fax: (270) 898-8640

Bowling Green Region
Troy Tabor, Supervisor
2642 Russellville Road
Bowling Green, KY 42101
(270) 746-7475
Fax: (270) 746-7865

London Region
Pete Rayburn, Supervisor
875 S. Main Street
London, KY 40741
(606) 330-2080
Fax: (606) 330-2097

Revised: 04/08/2022

Visit the Regional Field Offices web page on our website for a complete listing of field office locations and counties served.

Western Kentucky Tornadoes

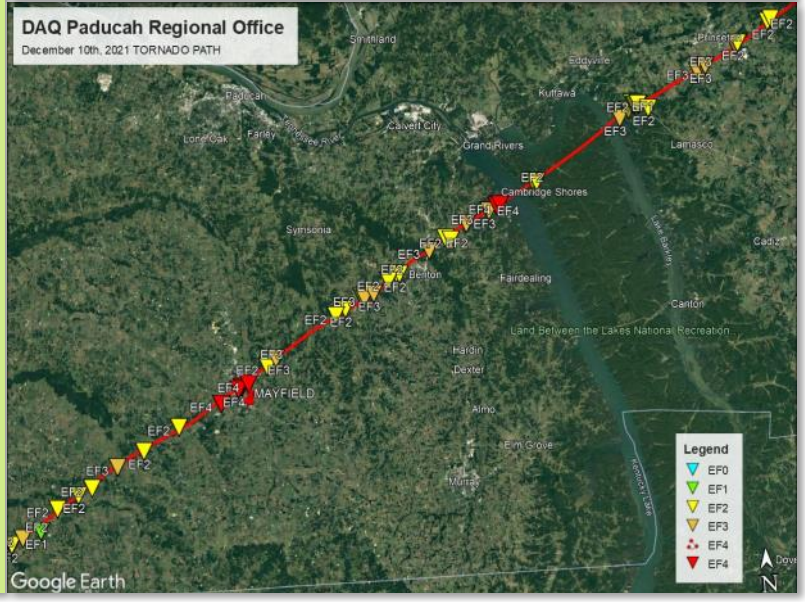
DAQ's Response

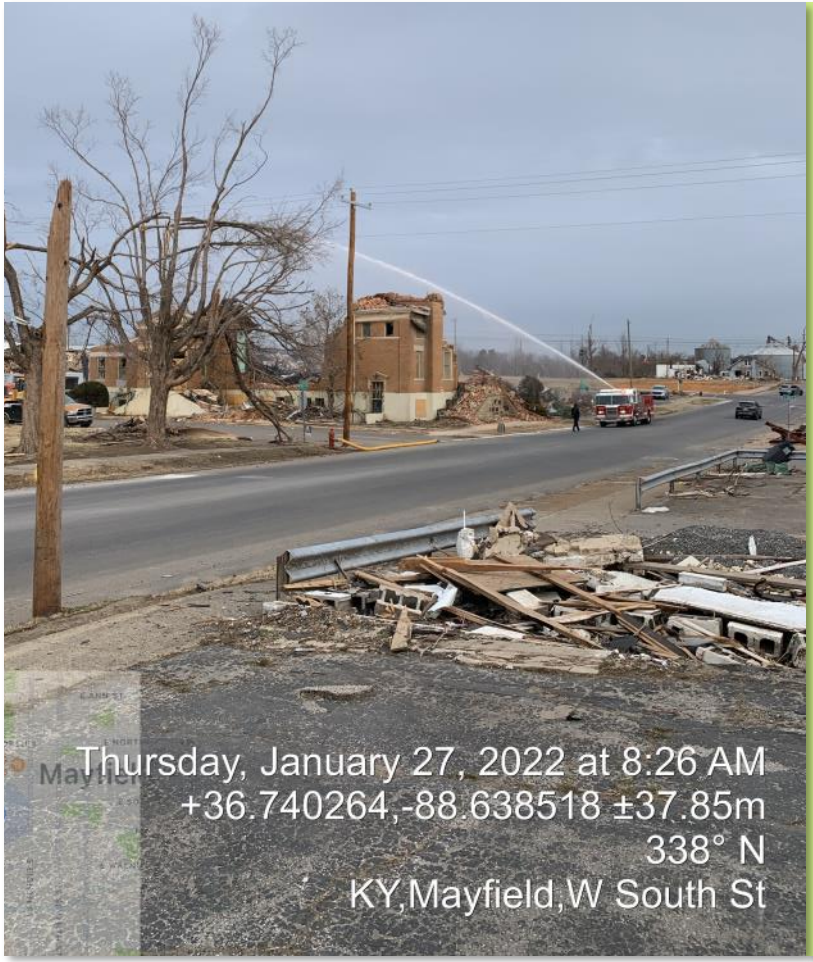
On Dec. 10, 2021, tornadoes cut a deadly path through 23 Kentucky counties. Western Kentucky communities were hardest hit, including Mayfield, Dawson Springs, Princeton, Bremen, and Bowling Green.

Several DAQ staff from Paducah, Bowling Green, and Owensboro offices were involved in immediate Emergency Response Team efforts to assess location and cleanup of hazardous materials, including electrical transformers, propane, agricultural, and industrial tanks, and other hazardous waste.

In the first few days following the event, facility inspectors from these same offices and others systematically contacted all facilities operating under an air quality permit in the impacted area. Businesses within a two-mile radius of the tornado's path were called immediately, and those outside that radius were contacted soon thereafter. While the majority of businesses experienced little to no impact, a few were far less fortunate.

DAQ worked closely with the Division of Waste Management to monitor management and disposal efforts of the estimated 4.3 million cubic yards of storm debris.





Staff from Paducah's DAQ field office visited storm debris collection sites periodically to provide oversight of debris staging and disposal. Staff also provided home and business owners with guidance on asbestos, debris disposal, and alternatives to burning.

Asbestos is a common material found in many older buildings, from roofing and siding to insulation and flooring. In an effort to minimize the release of asbestos dust, inspectors worked with local and federal response teams to keep demolition debris wet until it could be properly disposed of. Paducah's asbestos inspector, Cory Groover, provided countless hours of oversight during the cleanup that continued for months after the event.

Beth Lents is the supervisor of DAQ's Paducah regional field office. In summarizing DAQ's response to the Western Kentucky tornado outbreak, Beth recalled the heroic efforts of all of her staff.

"As I reviewed emails and files to give this summary, I came to tears," recalled Beth. "But the damp eyes were also thinking back on the incredible response by all of the DAQ team and the willingness of individuals to come in and help. I couldn't be prouder of our DAQ team for stepping up and covering the tasks … the teamwork was incredible."

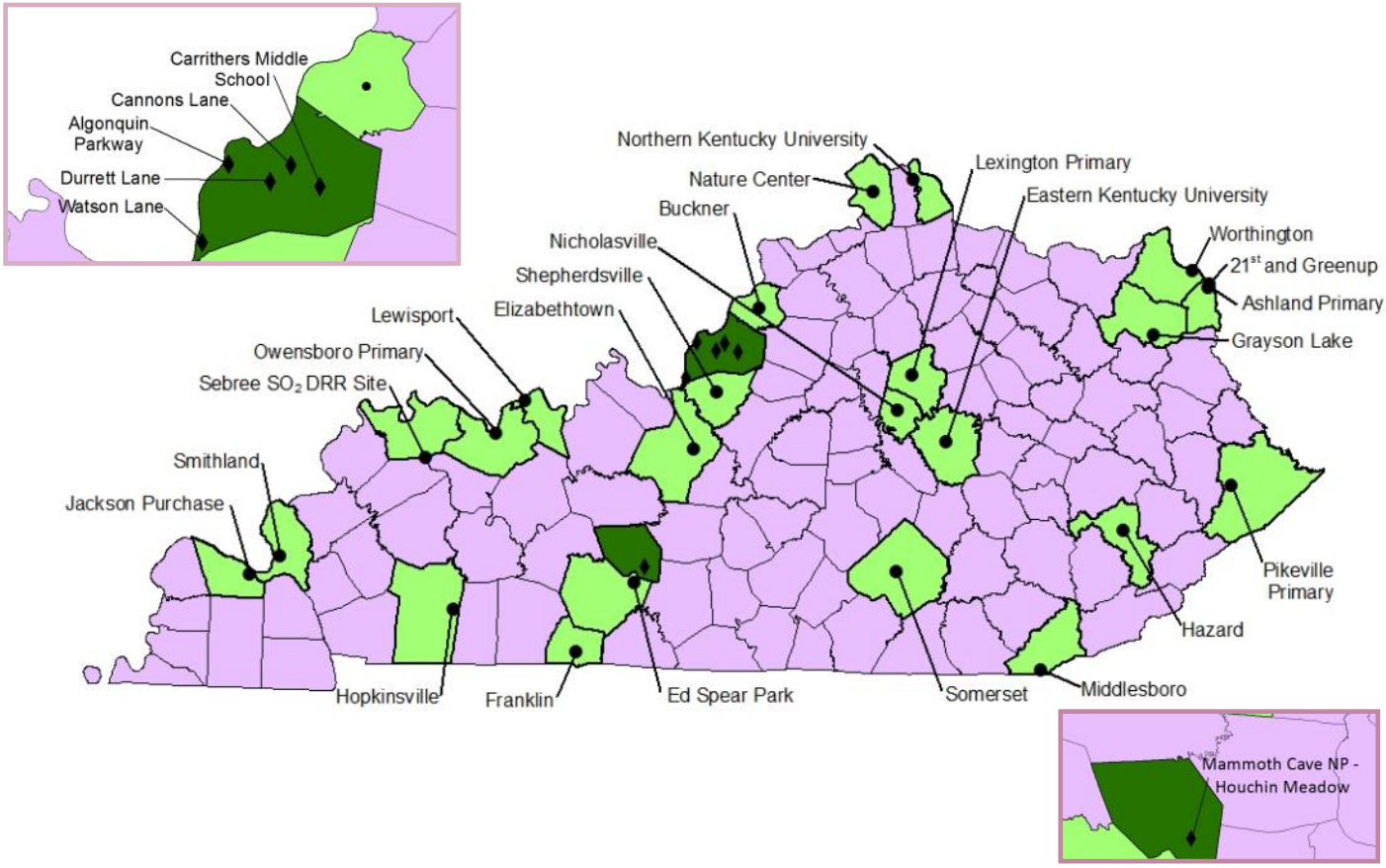
Kentucky's Air Monitoring Network

During the 2021 monitoring year, the Kentucky Division for Air Quality operated 75 instruments, including 10 meteorological stations, located at 24 ambient air monitoring sites in 23 Kentucky counties. The Louisville Metropolitan Air Pollution Control District (LMAPCD) operated an additional 32 instruments, including five meteorological stations, in Jefferson County.

When combined with the air-monitoring site operated at Mammoth Cave National Park, Kentucky's total ambient air monitoring network consisted of 112 instruments, including 16 meteorological stations, located at 30 sites across 25 counties of the Commonwealth. While not associated with the division's air monitoring network, the EPA also operates three additional CASTNET ozone monitoring stations in Kentucky.

Locations of ambient air monitoring stations are selected in accordance with EPA regulations (40 CFR 58, Appendix D). In general, monitors are placed in densely populated areas or near point sources of pollution. The site locations are reviewed annually to ensure adequate coverage is being provided and regulatory requirements are being met. See the 2022 Kentucky Ambient Air Monitoring Network Plan for more information.

2021 Ambient Air Monitoring Network Map



National Ambient Air Quality Standards

The Clean Air Act directs the U.S. Environmental Protection Agency to establish National Ambient Air Quality Standards (NAAQS) for six criteria pollutants that are considered harmful to human health and the environment. The **primary standard** is designed to protect public health. The **secondary standard** is designed to protect public welfare. Welfare includes damage to plants and animals, impairment of visibility, and property damage.

National Ambient Air Quality Standards

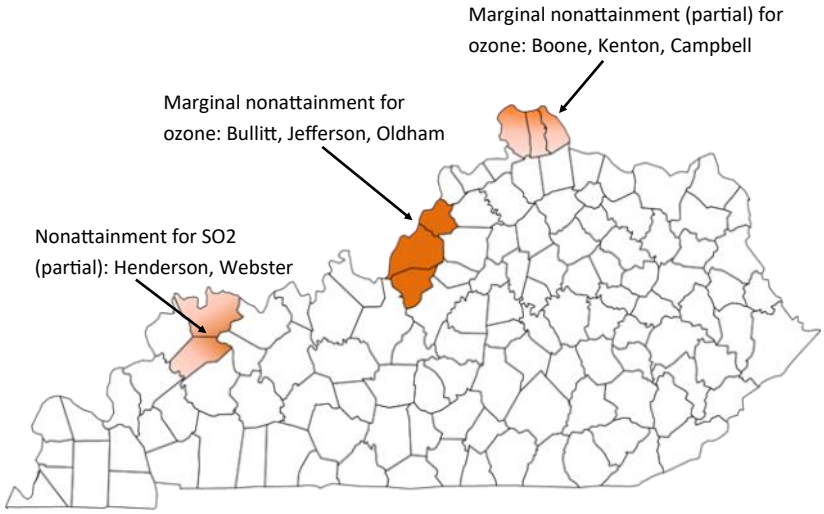
Carbon Monoxide	Primary Standard	Secondary Standard
8-Hour Average	9 ppm	none
1-Hour Average	35 ppm	none
Lead	Primary Standard	Secondary Standard
Rolling 3-Month Average	0.15 μ/m^3	Same as primary
Nitrogen Dioxide	Primary Standard	Secondary Standard
Annual Average	53 ppb	Same as primary
1-Hour Average	100 ppb	none
Particulate Matter (PM_{10})	Primary Standard	Secondary Standard
24-Hour Average	150 μ/m^3	Same as primary
Particulate Matter ($PM_{2.5}$)	Primary Standard	Secondary Standard
Annual Average	12 μ/m^3	15 μ/m^3
24-Hour Average	35 μ/m^3	Same as primary
Ozone	Primary Standard	Secondary Standard
8-Hour Average	0.070 ppm	Same as primary
Sulfur Dioxide	Primary Standard	Secondary Standard
1-Hour Average	75 ppb	none
3-Hour Average	none	0.5 ppm

Kentucky Nonattainment Areas

Effective August 3, 2018, six Kentucky counties were designated nonattainment for the 2015 ozone standard: all of Bullitt, Jefferson and Oldham counties and the northern portions of Boone, Campbell and Kenton counties. As of the publication of this report, these counties and partial counties were still designated as "marginal" nonattainment.

As FY22 came to a close, the division submitted requests to EPA to redesignate these areas as attainment. Quality-assured air monitoring data demonstrate all of these areas are now meeting the National Ambient Air Quality Standard (NAAQS) for ozone.

For the 2010 sulfur dioxide standard, portions of two Kentucky counties, Henderson and Webster, were designated nonattainment for the 2010 SO_2 standard, effective March 13, 2021. The division anticipates that the area will attain the standard with three years of clean, quality-assured ambient air quality monitoring data and has begun work on a redesignation request.



During FY22, the three shaded counties in the middle of the above map were designated marginal nonattainment for the 2015 ozone standard (Bullitt, Jefferson, & Oldham counties). The northern portions of three counties in northern KY were designated marginal nonattainment for the 2015 ozone standard. Portions of the two shaded counties in western KY (Henderson and Webster) were designated nonattainment for SO_2.

Understanding the Data

This annual report contains quality-assured data collected during calendar year 2021, as well as statewide trends for each of the criteria pollutants. The data summarizes concentrations and **design values** of pollutants measured in Kentucky during the 2021 calendar year. A design value is a calculated metric that is used to determine compliance with a particular National Ambient Air Quality Standard (NAAQS). For many pollutants, a design value is calculated for each year and then averaged over a three-year period before being compared to a standard. However, some design values use alternative time intervals for calculation. For example, lead uses a 3-month rolling average and one of the primary NAAQS for nitrogen dioxide uses an annual average.

It is important to note that an exceedance of a particular pollutant is not the same as a violation of the NAAQS for that pollutant. Violations are determined according to the formula for each standard and involve the average of multiple measured values over a specific amount of time. Any data contained in this report is subject to change. The most current quality assured data set can be obtained through a Kentucky Open Records request.

Carbon Monoxide

Primary NAAQS: 8-hour average not to exceed 9 parts per million (ppm) more than once per year; 1-hour average not to exceed 35 ppm more than once per year
Secondary NAAQS: None

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

There were no exceedances of the CO standards in 2021. The last exceedance of a standard occurred on Jan. 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.

2021 Carbon Monoxide 1-Hour Averages
Method: Instrumental/Non-Dispersive Infrared Photometry
Data Interval: Hourly
Units: Parts per Million (ppm)

Station	1st Max	2nd Max
Mammoth Cave (NPS)	0.519	0.514
Cannons Lane (LMAPCD)	2.33	1.49
Durrett Lane (LMAPCD)	1.49	1.49

LMAPCD = Louisville Metro Air Pollution Control District
NPS = National Park Service

Statewide Averages for Carbon Monoxide

Statewide averages for carbon monoxide (CO) have declined substantially since 1987, primarily due to improved emission controls on motor vehicles.

This table presents the statewide 1-hour and 8-hour averages of the second highest reading of CO from 1988 through 2021. For reference, the current 1-hour primary standard for CO is 35 parts per million (ppm) and the current 8-hour primary standard for CO is 9 ppm.

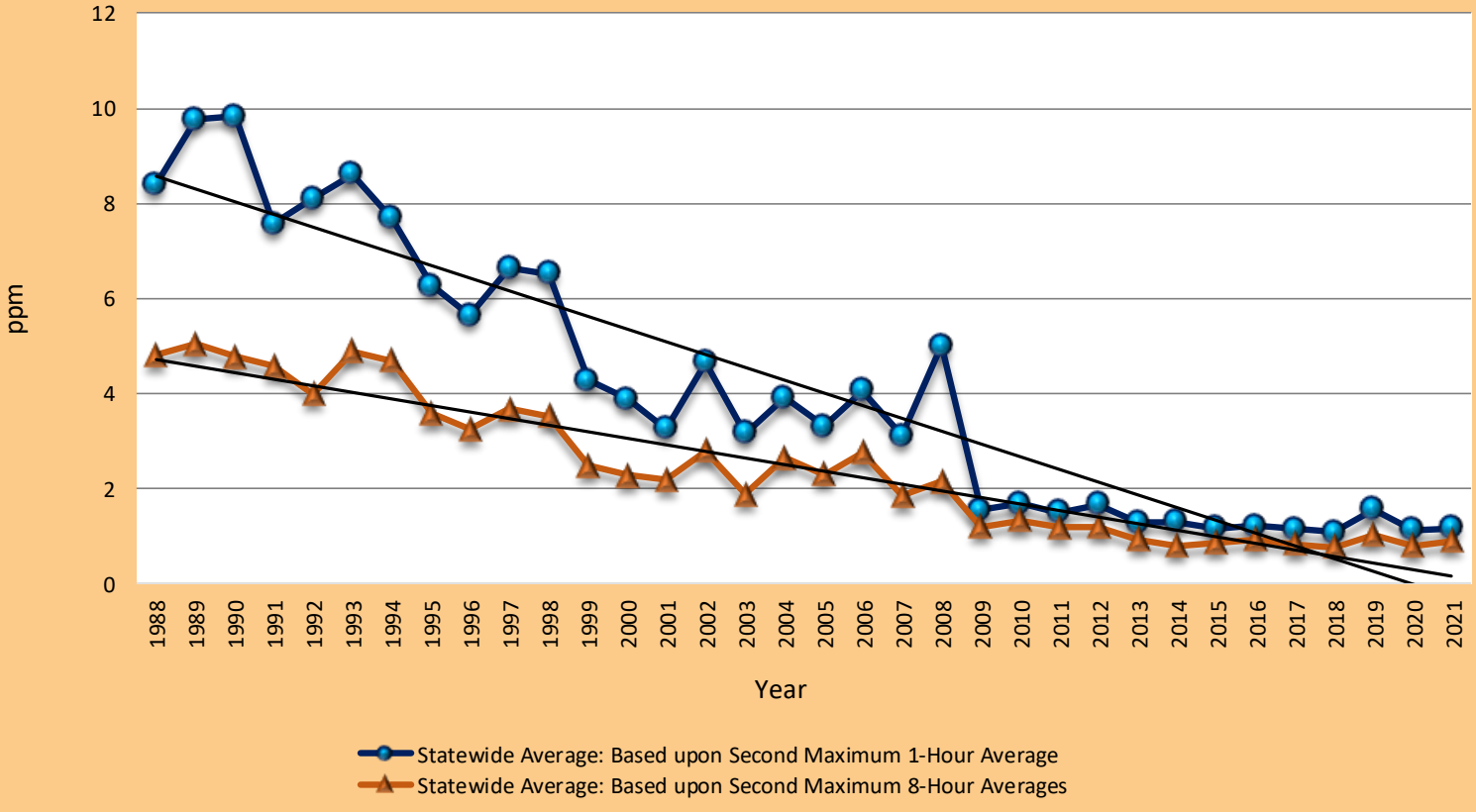
These data are graphed on the following page, with the downward trend lines marked.

Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.

Year	Statewide Average (ppm) Based upon Second Maximum 1-Hour Averages	Statewide Average (ppm) Based upon Second Maximum 8-Hour Averages
1988	8.39	4.80
1989	9.76	5.04
1990	9.83	4.77
1991	7.57	4.57
1992	8.09	3.99
1993	8.62	4.88
1994	7.69	4.68
1995	6.26	3.58
1996	5.64	3.24
1997	6.63	3.68
1998	6.51	3.53
1999	4.27	2.47
2000	3.88	2.28
2001	3.25	2.17
2002	4.66	2.79
2003	3.15	1.88
2004	3.90	2.65

Year	Statewide Average (ppm) Based upon Second Maximum 1-Hour Averages	Statewide Average (ppm) Based upon Second Maximum 8-Hour Averages
2005	3.30	2.30
2006	4.05	2.75
2007	3.10	1.85
2008	5.00	2.15
2009	1.55	1.20
2010	1.67	1.33
2011	1.50	1.17
2012	1.66	1.20
2013	1.28	0.93
2014	1.30	0.80
2015	1.16	0.87
2016	1.21	0.93
2017	1.15	0.83
2018	1.07	0.77
2019	1.56	1.03
2020	1.13	0.80
2021	1.16	0.90

Statewide Averages for Carbon Monoxide



Lead

Primary NAAQS: Rolling 3-month average not to exceed 0.15 micrograms per meter squared (µg/m3)
Secondary NAAQS: Same as primary standard

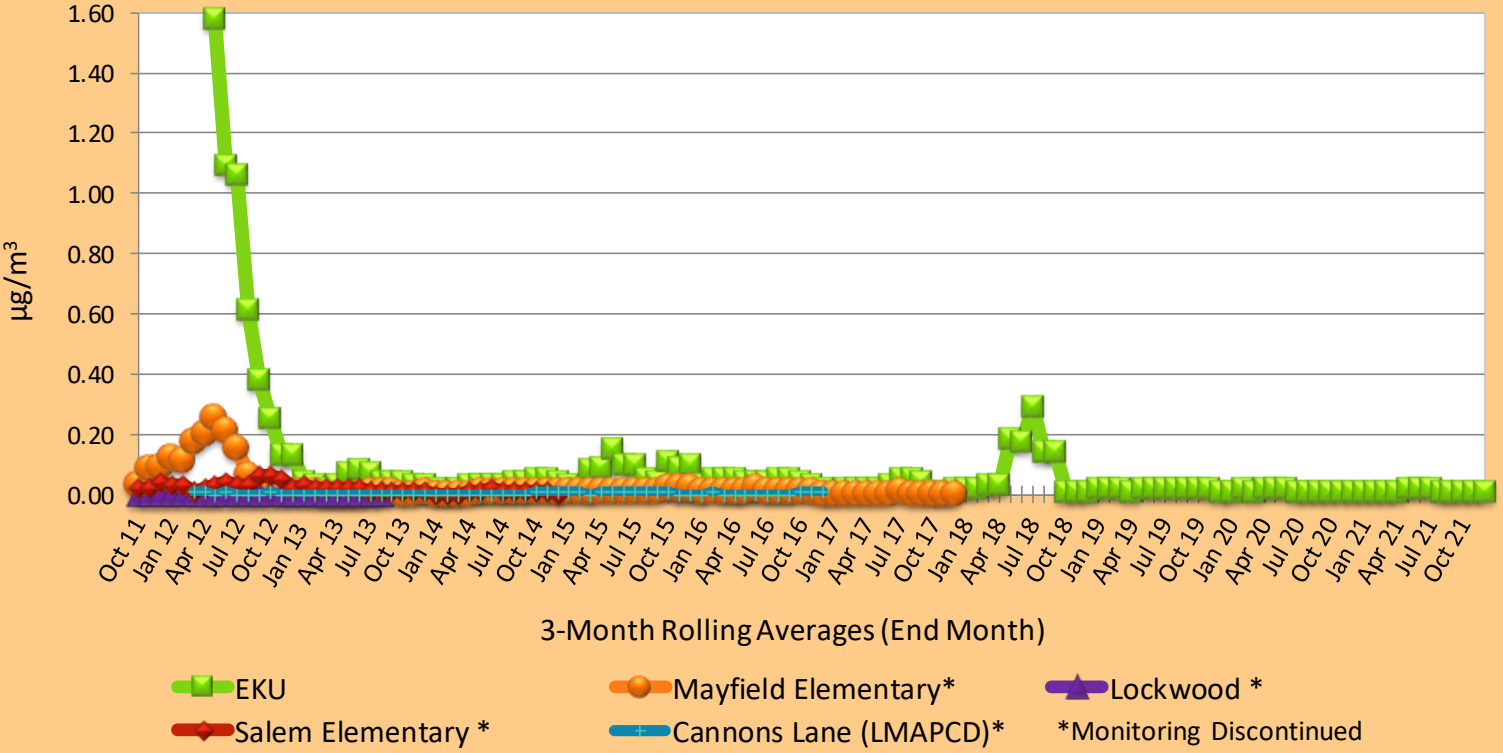
Lead is a soft, blue-gray metal that has historically been used in motor fuels, paint, plumbing and batteries. Since the 1970s when the U.S. EPA mandated the phase out of lead in gasoline, airborne lead concentrations have plummeted. By regulation, lead monitoring is now only required near major sources of lead.

In 2021, the division operated one lead monitoring site at Eastern Kentucky University. There were several exceedances of the lead NAAQS in 2012 and 2018; all were related to a compliance issue with a single stationary source.

2021 Lead Rolling Three-Month Average
Method: High Volume Sampler;
Inductively Coupled Plasma-Mass Spectroscopy
Data Interval: 24-Hour
Units: Micrograms per cubic meter (µg/m^3)

Site Name	1st Max	2nd Max	3rd Max	4th Max	Observations > 0.15
EKU	0.07	0.06	0.06	0.05	0

Three-Month Rolling Averages for Lead



Nitrogen Dioxide

Primary NAAQS:
3-year average of the 98th percentile of daily maximum one-hour averages must not exceed 100 parts per billion (ppb)

Annual arithmetic mean must not exceed 53 ppb

Secondary NAAQS: Annual arithmetic mean must not exceed 53 ppb

Nitrogen dioxide is a reddish brown gas that is produced during high-temperature combustion. During combustion, nitrogen and oxygen combine to form a family of highly reactive gases called nitrogen oxides (NOx), which include nitrogen dioxide (NO_2) and nitrogen oxide (NO). Major combustion sources that produce NO_2 include motor vehicles, power plants, incinerators, boilers, and chemical processes. NO_2 is also produced through a photochemical reaction between NO and sunlight.

There have been no recorded exceedances of an NO_2 NAAQS since the inception of sampling in 1970. All Kentucky counties are currently in attainment of the standards for nitrogen dioxide.

2021 Nitrogen Dioxide Results: Three-Year Average of 98th Percentile of Daily Maximum One-Hour Averages
Method: Chemiluminescence
Data Interval: Hourly
Units: Parts per billion (ppb)

County/Site Name	2019	2020	2021	3-Yr Avg
Boyd	27	27	26.2	27
Campbell	27	28	27.9	28
Daviess	27	26	28.9	27
Fayette	42	38	37.2	39
Cannons Lane (LMAPCD)	41.6	38.4	41.4	40
Durrett Lane (LMAPCD)	48.8	43.7	49.5	47
McCracken	32	30	30.3	31

LMAPCD = Louisville Metro Air Pollution Control District

Statewide Averages for Nitrogen Dioxide

Statewide averages for nitrogen dioxide (NO_2) show a steady downward trend over the past three decades, primarily due to the installation and use of pollution control devices on motor vehicles, power plants and industrial boilers.

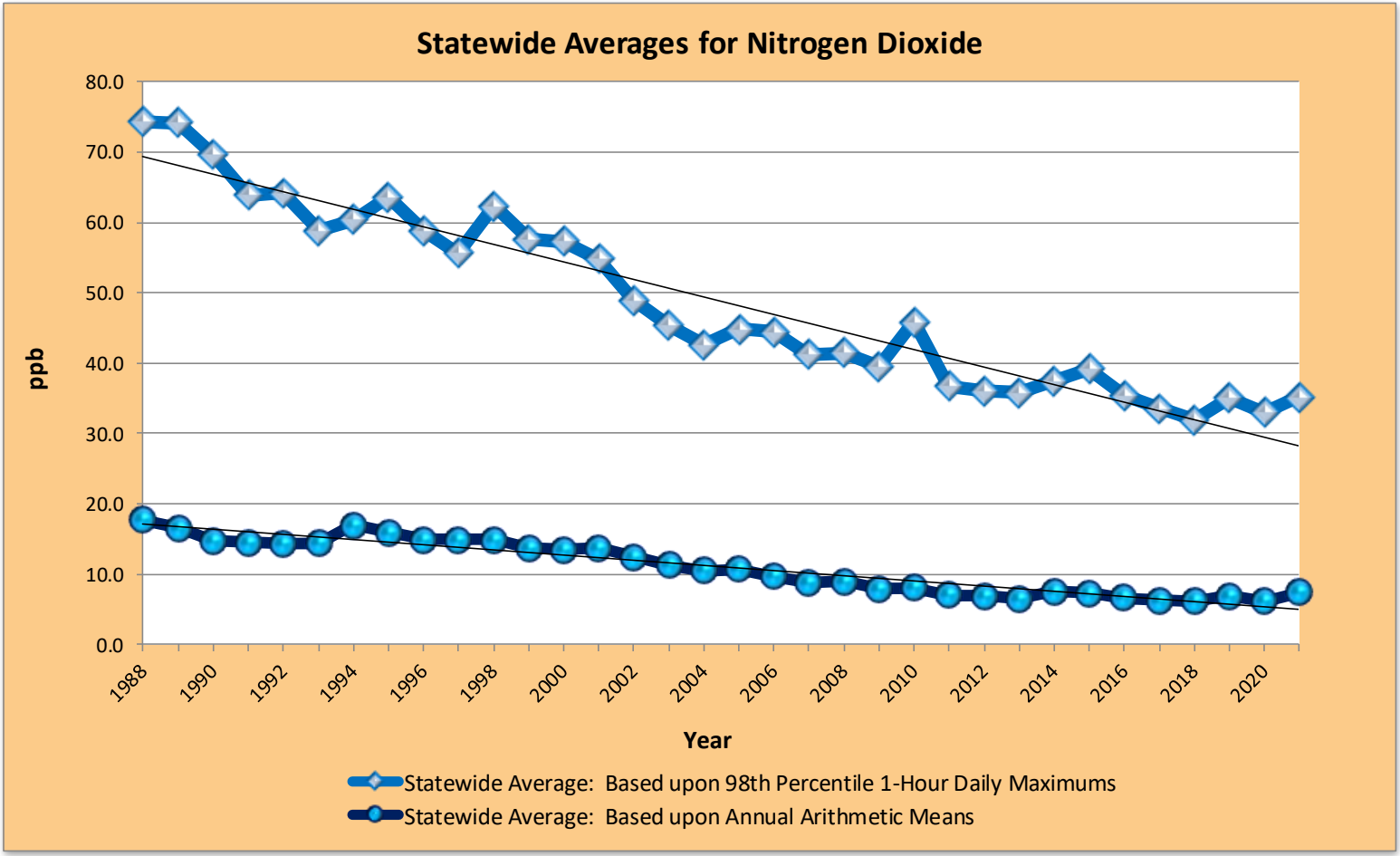
These tables present the statewide averages of NO_2 from 1988 through 2021. The data is represented in two different ways: A statewide average of the annual averages from each monitoring station; and the statewide average of the 98th percentile 1-hour daily maximums. For reference, the annual standard for nitrogen dioxide is 53 ppb and the 1-hour standard is 100 ppb.

The data from these tables are graphed on the following page, with the downward trend lines labeled.

Year	Statewide Average (ppb) Based upon Annual Arithmetic Means	Statewide Average (ppb) Based upon 98th Percentile 1-Hour Daily Maximums
1988	17.72	74.38
1989	16.61	74.14
1990	14.76	69.57
1991	14.50	63.83
1992	14.34	64.20
1993	14.40	58.85
1994	17.02	60.42
1995	15.97	63.55
1996	14.90	58.82
1997	14.88	55.64
1998	14.95	62.36
1999	13.68	57.64
2000	13.48	57.27
2001	13.72	54.77
2002	12.51	48.92
2003	11.30	45.33
2004	10.46	42.63

Year	Statewide Average (ppb) Based upon Annual Arithmetic Means	Statewide Average (ppb) Based upon 98th Percentile 1-Hour Daily Maximums
2005	10.72	44.88
2006	9.67	44.44
2007	8.78	41.20
2008	9.0	41.43
2009	7.92	39.50
2010	8.05	45.83
2011	7.04	36.68
2012	6.94	35.97
2013	6.48	35.75
2014	7.48	37.44
2015	7.35	39.17
2016	6.57	35.37
2017	6.32	33.55
2018	6.20	31.89
2019	6.88	35.06
2020	6.21	33.01
2021	7.42	35.18

Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.


Statewide Averages for Nitrogen Dioxide
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
ppb
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year
Statewide Average: Based upon 98th Percentile 1-Hour Daily Maximums
Statewide Average: Based upon Annual Arithmetic Means

Ozone

Primary & Secondary NAAQS: 3-year average of the 4th highest daily maximum 8-hr concentration not to exceed 0.070 parts per million.

Ozone is a colorless gas that is not emitted directly into the atmosphere from sources. Instead, ozone forms in the lower atmosphere from a photochemical reaction between volatile organic compounds (VOCs) and nitrogen oxides (NOx) in the presence of sunlight.

In 2021, nine sites measured 8-hour ozone concentrations greater than 0.070 ppm. The fourth highest daily maximum 8-hour ozone concentration was above the level of the standard at the Carrithers Middle School (Jefferson County) site. The 2019-2021 3-year average was below the level of the standard for all Kentucky sites.

LMAPCD = Louisville Metro Air Pollution Control District
NPS = National Park Service
CASTNET = EPA-operated monitor

2020 Ozone Results:
3-Yr Average of 4th Highest Daily Maximum 8-Hour Concentration
Method: Ultra-Violet Photometry
Data Interval: Hourly
Units: Parts-per-million (ppm)

County/Site Name	ppm
Bell	0.056
Boone	0.061
Boyd	0.059
Bullitt	0.064
Campbell	0.063
Cannons Lane (LMAPCD)	0.069
Carrithers Middle School (LMAPCD)	0.068
Carter	0.055
Christian	0.058
Daviess	0.064
Edmonson (NPS)	0.059
Fayette	0.06
Greenup	0.054
Hancock	0.063

County/Site Name	ppm
Hardin	0.06
Jessamine	0.06
Livingston	0.062
McCracken	0.063
Morgan (CASTNET)	0.057
Oldham	0.063
Perry	0.056
Pike	0.054
Pulaski	0.057
Simpson	0.059
Trigg (CASTNET)	0.06
Warren	0.057
Washington (CASTNET)	0.06
Watson Lane (LMAPCD)	0.065

Statewide Averages for Ozone

Statewide averages for ozone (O_3) have generally declined since 1987. This trend is attributable to emission controls on vehicles and a regional strategy to control NOx emissions from large stationary internal combustion engines, large boilers, and turbines used in power plants and other industrial applications.

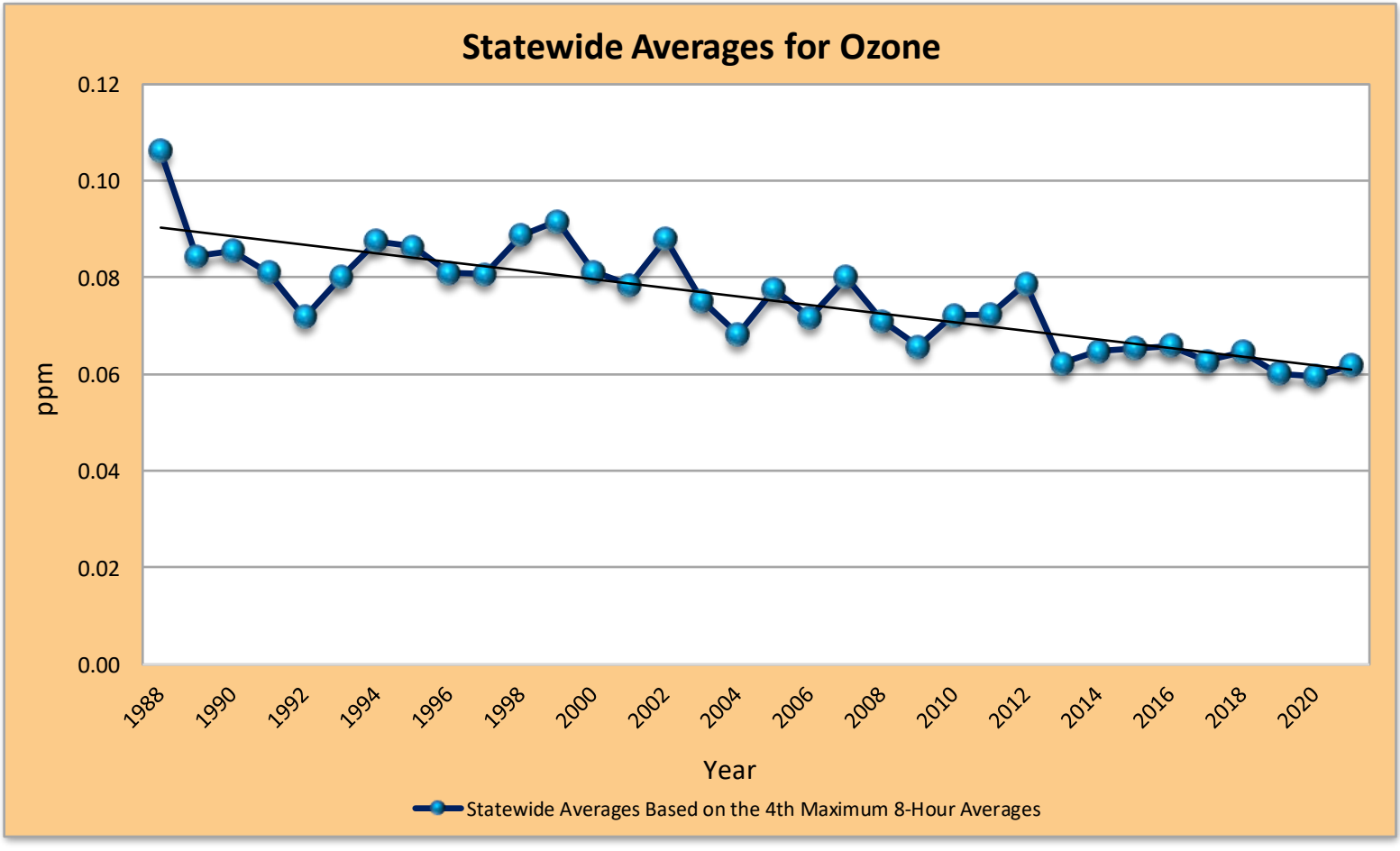
This table presents the statewide averages of ozone from 1987 through 2019. For reference, the current primary standard for ozone is a 3-year average of the 4th highest daily maximum 8-hr concentration not to exceed 0.070 ppm.

These data are graphed on the following page, with the downward trend line marked.

Year	Statewide Average: Based on Fourth Maximum 8-Hour Averages (ppm)
1988	0.106
1989	0.084
1990	0.086
1991	0.081
1992	0.072
1993	0.080
1994	0.088
1995	0.086
1996	0.081
1997	0.081
1998	0.089
1999	0.092
2000	0.081
2001	0.078
2002	0.088
2003	0.075
2004	0.068
2005	0.078
2006	0.072

Year	Statewide Average: Based on Fourth Maximum 8-Hour Averages (ppm)
2007	0.080
2008	0.071
2009	0.066
2010	0.072
2011	0.072
2012	0.079
2013	0.062
2014	0.065
2015	0.065
2016	0.066
2017	0.063
2018	0.065
2019	0.060
2020	0.060
2021	0.062

Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.


Statewide Averages for Ozone
0.12
0.10
0.08
0.06
0.04
0.02
0.00
ppm
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year
Statewide Averages Based on the 4th Maximum 8-Hour Averages

Fine Particulate Matter ($PM_{2.5}$)

Primary NAAQS: 3-year average of the annual weighted mean not to exceed 12.0 micrograms per meter cubed ($\mu g/m^3$)
3-year average of the 98th percentile of 24-hour concentrations not to exceed 35 $\mu g/m^3$

Secondary NAAQS: 3-year average of the annual weighted mean not to exceed 15.0 $\mu g/m^3$
3-year average of the 98th percentile of 24-hour concentrations not to exceed 35 $\mu g/m^3$

Fine particulate matter ($PM_{2.5}$) is a mixture of solid particles and liquid droplets that are 2.5 microns or smaller in size. Sources include power plants, wood burning, industrial processes, and combustion. Fine particulates are also formed in the atmosphere when gases such as sulfur dioxide, nitrogen oxides and VOCs are transformed through chemical reactions.

There were no exceedances of the three-year 24-hour standard nor the three-year annual standard during the 2019 - 2021 averaging period. All Kentucky counties are currently in attainment for the $PM_{2.5}$ standards.

2021 $PM_{2.5}$ Results: 3-Yr Avg. of 24-Hour 98th Percentile

Method: Gravimetric
Data Interval: 24-Hour
Units: Micrograms per cubic meter ($\mu g/m^3$)

County/Site Name	$\mu g/m^3$
Bell	19
Boyd	17
Campbell	17
Carter	14
Christian	23
Daviess	21
Fayette	16
Hardin	18
Watson Lane (LMAPCD)	23
Cannons Lane (LMAPCD)	22
Durrett Lane (LMAPCD)	25
Carrithers M.S. (LMAPCD)	22
Algonquin Parkway (LMAPCD)	22
McCracken	23
Perry	14
Pike	15
Pulaski	17
Warren	20

LMAPCD = Louisville Metro Air Pollution Control District

Statewide Averages for $PM_{2.5}$

This table presents the statewide averages of $PM_{2.5}$ from 2001 through 2021. The data is presented according to the two primary standards for $PM_{2.5}$:

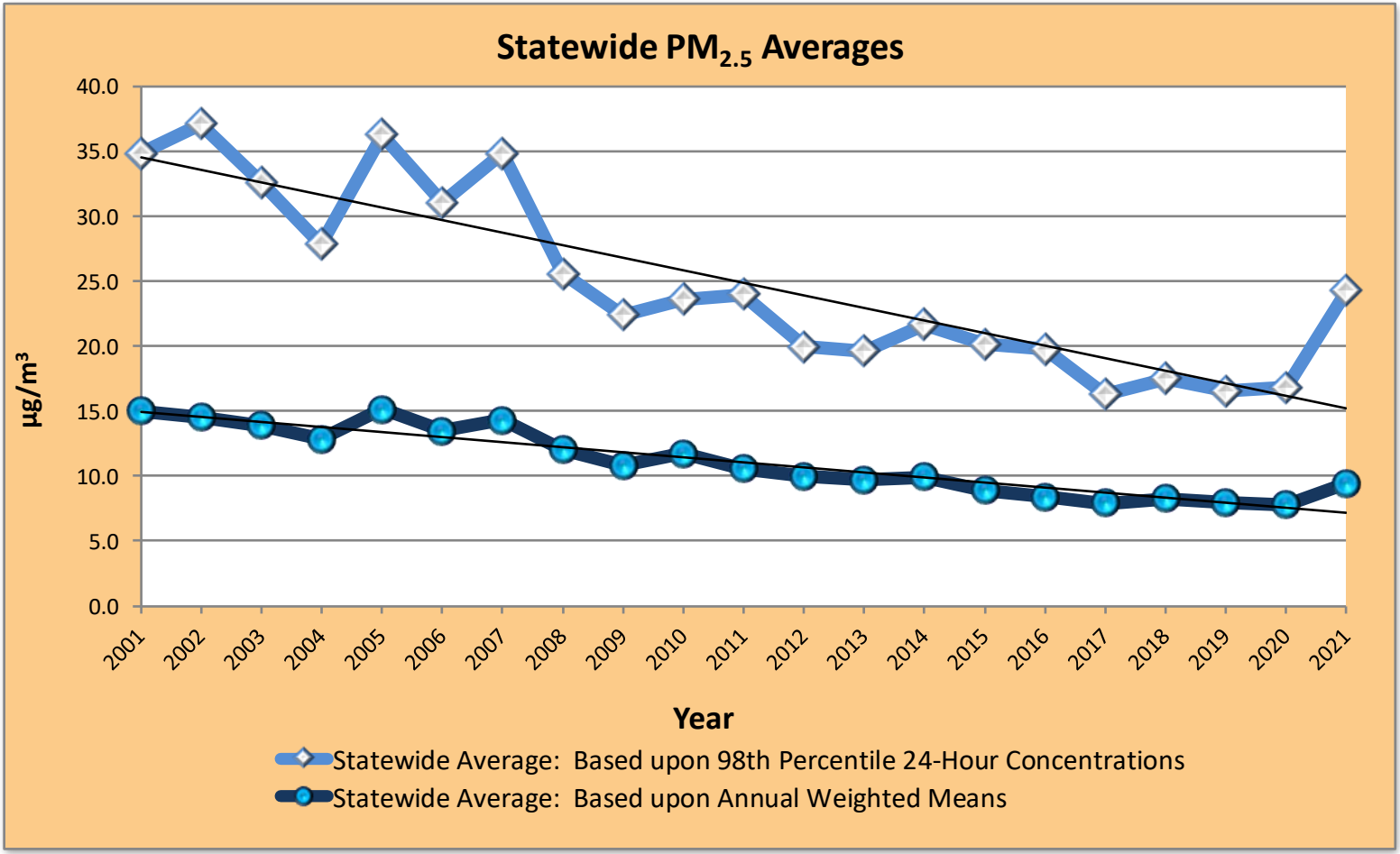
- 3-year average of the 98th percentile of 24-hour concentrations not to exceed 35 µg/m^3
- The 3-year average of the annual weighted mean, not to exceed 12.0 µg/m^3

These data are graphed on the following page, with the downward trend lines labeled.

Year	Statewide Average: Based upon 98th Percentile 24-Hour Concentrations (µg/m^3)	Statewide Average: Based upon Annual Weighted Means (µg/m^3)
2001	34.9	15.0
2002	37.1	14.6
2003	32.6	13.9
2004	27.9	12.8
2005	36.3	15.1
2006	31.0	13.5
2007	34.8	14.3
2008	25.6	12.0
2009	22.4	10.8
2010	23.6	11.7
2011	24.0	10.6
2012	20.0	9.97

Year	Statewide Average: Based upon 98th Percentile 24-Hour Concentrations (µg/m^3)	Statewide Average: Based upon Annual Weighted Means (µg/m^3)
2013	19.6	9.7
2014	21.7	9.9
2015	20.1	8.9
2016	19.8	8.4
2017	16.3	7.9
2018	17.5	8.2
2019	16.5	7.9
2020	16.8	7.8
2021	24.2	9.4

Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.


Statewide PM2.5 Averages
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
µg/m³
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year
Statewide Average: Based upon 98th Percentile 24-Hour Concentrations
Statewide Average: Based upon Annual Weighted Means

Particulate Matter (PM_{10})

Primary NAAQS: Expected number of days with a maximum 24-hour concentration greater than 150 micrograms per meter cubed ($\mu g/m^3$) must be less than or equal to one, on average over three years.
Secondary NAAQS: Same as Primary Standard

Coarse particulate matter of 10 microns or less in diameter is known as PM_{10}. Common sources of PM_{10} are prescribed fires, construction activities, agricultural practices, metal recycling, and smokestacks.

There were no exceedances of the annual PM_{10} standard in 2021. The last exceedance of the standard occurred on March 22, 2012 at the Ashland site, which is located next to a metals recycler. All Kentucky counties are currently in attainment for the PM_{10} standards.

2021 PM_{10} Results: Maximum 24-Hr Concentrations ($\mu g/m^3$)
Method: Gravimetric
Data Interval: 24-Hour
Units: Micrograms per cubic meter ($\mu g/m^3$)

County/Site Name	1st Max	2nd Max	3rd Max	4th Max
Boyd	51	46	35	32
Carter	32	20	19	18
Fayette	36	27	23	22
Algonquin Parkway (LMAPCD)	50	46	46	46
Cannons Lane (LMAPCD)	39	38	37	37
McCracken	36	29	28	27

LMAPCD = Louisville Metro Air Pollution Control District

Statewide Averages for PM_{10}

Statewide and regional PM_{10} levels show declining trends over the past several decades. This decrease is largely due to the installation of pollution controls on industrial sources for particulate matter.

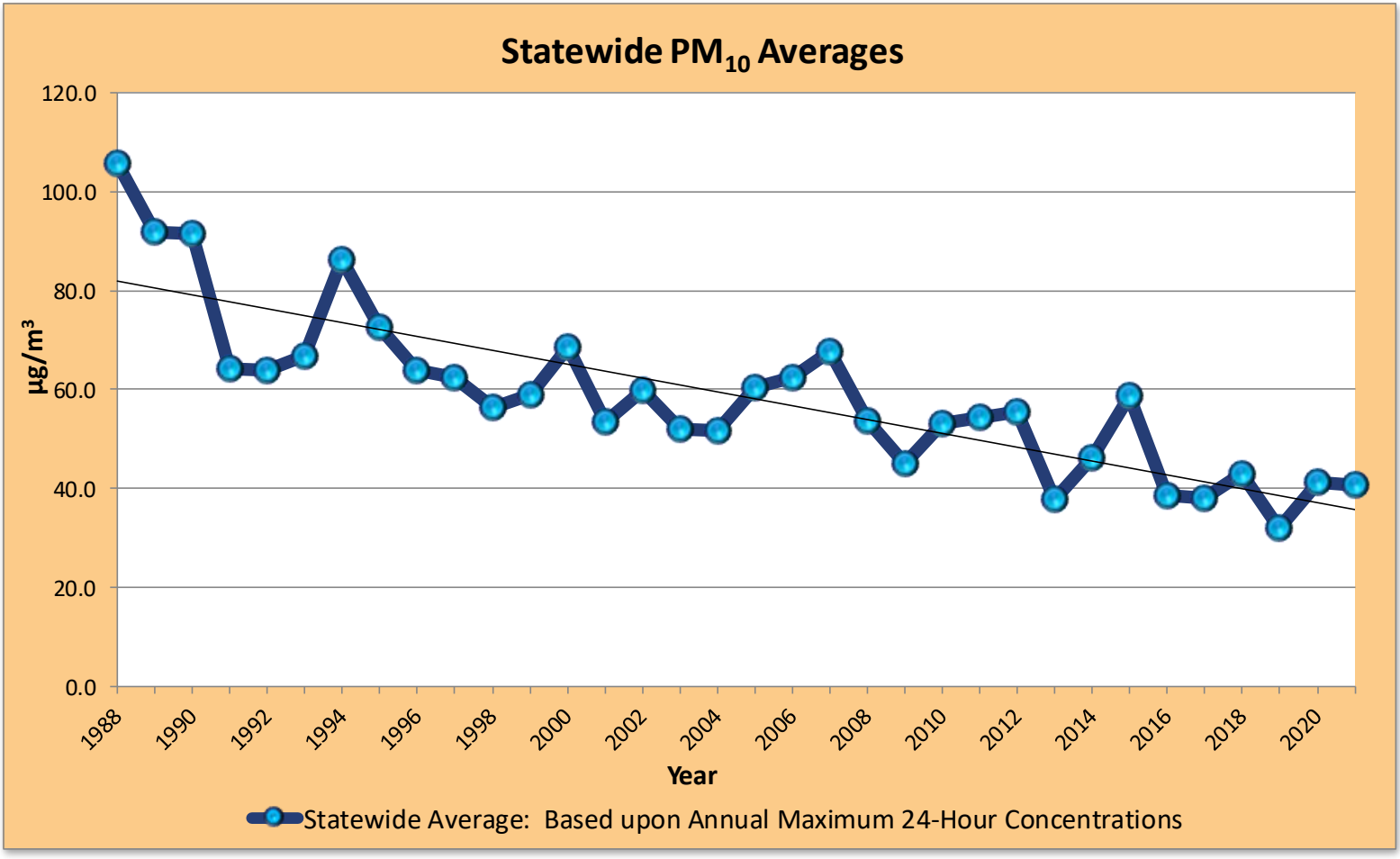
These tables show the statewide average of the annual maximum 24-hour concentration for PM_{10} from 1988 through 2021, measured in $\mu g/m^3$ (micrograms per cubic meter).

These data are graphed on the following page, with the downward trend line marked.

Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.

Year	Statewide Avg. Based upon Annual Maximum 24-Hour Concentrations ($\mu g/m^3$)
1988	105.9
1989	91.7
1990	91.5
1991	64.1
1992	63.9
1993	66.9
1994	86.1
1995	72.7
1996	63.9
1997	62.4
1998	56.4
1999	59.0
2000	68.6
2001	53.4
2002	59.8
2003	52.0
2004	51.5
2005	60.3
2006	66.2
2007	67.7
2008	53.6
2009	45.1

Year	Statewide Avg. Based upon Annual Maximum 24-Hour Concentrations ($\mu g/m^3$)
2010	53.3
2011	54.3
2012	55.5
2013	37.7
2014	46.0
2015	58.5
2016	38.5
2017	37.9
2018	42.9
2019	32.0
2020	41.3
2021	40.7


Statewide PM10 Averages
120.0
100.0
80.0
60.0
40.0
20.0
0.0
µg/m3
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year
Statewide Average: Based upon Annual Maximum 24-Hour Concentrations

Sulfur Dioxide (SO_2)

Primary NAAQS: 3-year average of the 99th percentile of the daily maximum 1-hour concentration not to exceed 75 ppb
Secondary NAAQS: 3-hour concentrations not to exceed 0.5 ppm (500 ppb) more than once per year

Sulfur dioxide (SO_2) is a colorless gas that has a pungent odor at concentrations exceeding 0.5 ppm. SO_2 is produced during the combustion of sulfur-containing fuels, ore smelting, petroleum processing, and the manufacturing of sulfuric acid. Nationwide, coal-fired power plants are the largest sources of SO_2.

During 2021, one site recorded 2 exceedances of the daily one-hour standard of 75 ppb. That site, located near Sebree, Kentucky, was established to characterize maximum hourly sulfur dioxide concentrations for specific stationary sources. No other exceedances were recorded in the state.

2021 Sulfur Dioxide Results: 3-Year Average of Annual Daily Maximum 1-Hr Averages (ppb)
Method: Instrumental, Ultra-Violet Fluorescence
Data Interval: Hourly

County	2019	2020	2021	3 Yr Avg
Boyd	4	5	5	5
Campbell	8	10	9	9
Daviess	34	12	7	18
Edmonson (NPS)	2.1	2.2	2.7	2
Fayette	4	3	5.4	4
Greenup	9	6	8	8
Henderson (Sebree)	99	73	68	80
Watson Lane (LMAPCD)	14.9	14.6	12.7	14
Cannons Lane (LMAPCD)	9.9	9.1	9.1	9
Algonquin Parkway (LMAPCD)	5.9	5.1	4.3	5
Jessamine	4	3	3.3	3
McCracken	13	7	12	11

Units: Parts-per-billion (ppb)
LMAPCD = Louisville Metro Air Pollution Control District; NPS = National Park Service

Statewide Averages for Sulfur Dioxide

The dramatic decline of sulfur dioxide levels is one of Kentucky's biggest air quality success stories. Emission controls on coal-fired power plants, as well as the trading allowances in the federal Acid Rain Program, have directly contributed to the decline in ambient SO_2 concentrations across the region.

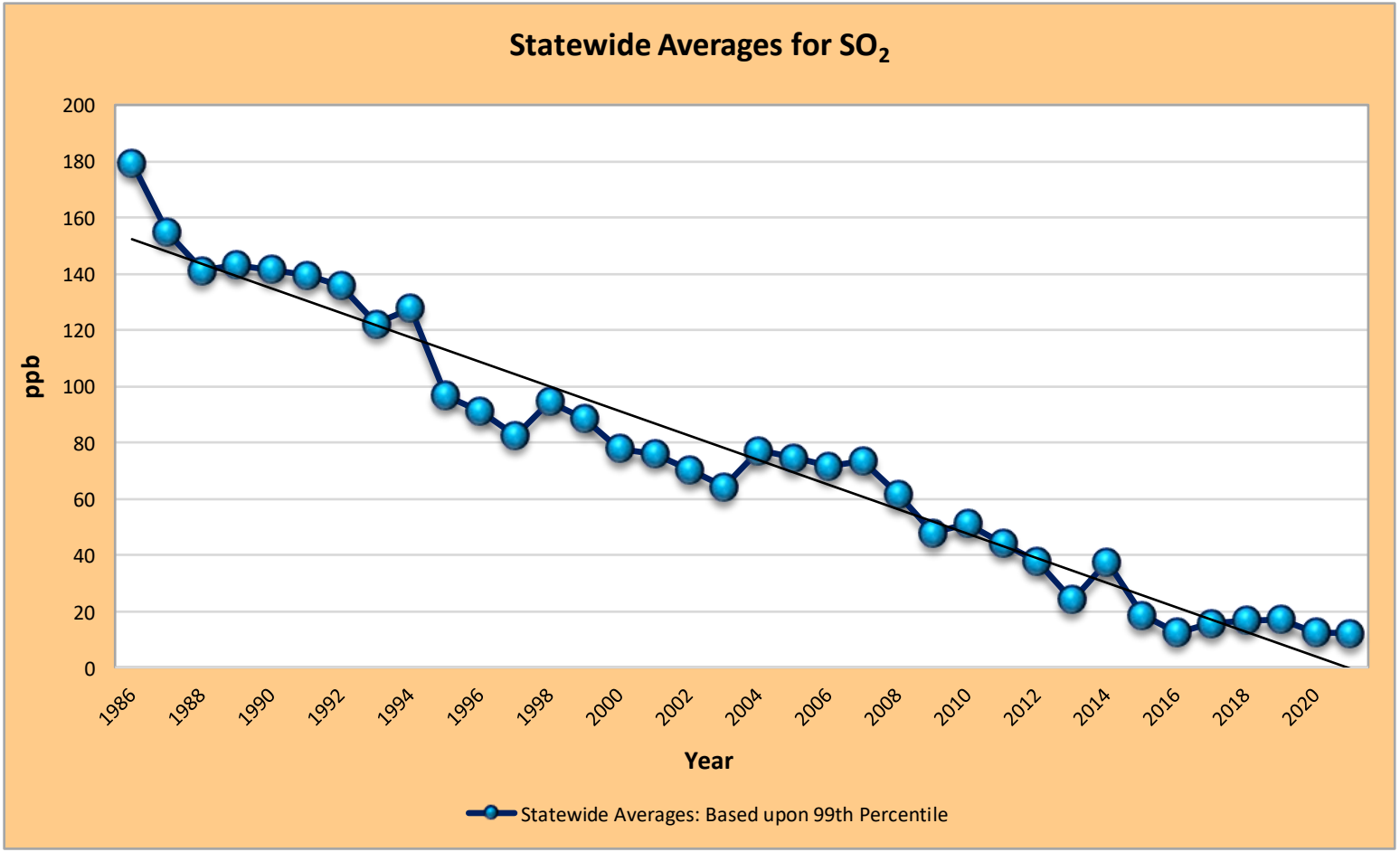
These tables show the statewide average for SO_2 from 1986 through 2021, measured in parts-per-billion (ppb). For reference, the primary standard for SO_2 is the 3-year average of the 99th percentile of the daily maximum 1-hour concentration, not to exceed 75 ppb.

These data are graphed on the following page, with the downward trend line marked.

Year	Statewide Averages: Based upon 99th Percentile (ppb)
1986	179.4
1987	154.9
1988	141.3
1989	143.3
1990	141.5
1991	139.6
1992	135.8
1993	122.3
1994	127.7
1995	96.8
1996	91.3
1997	82.7
1998	94.8
1999	88.7
2000	77.9
2001	76.1
2002	70.4
2003	64.4
2004	77.3
2005	74.6
2006	71.7
2007	73.6

Year	Statewide Averages: Based upon 99th Percentile (ppb)
2008	61.7
2009	47.9
2010	51.2
2011	44.4
2012	38.0
2013	24.2
2014	37.6
2015	18.7
2016	12.6
2017	15.8
2018	16.8
2019	17.3
2020	12.5
2021	12.2

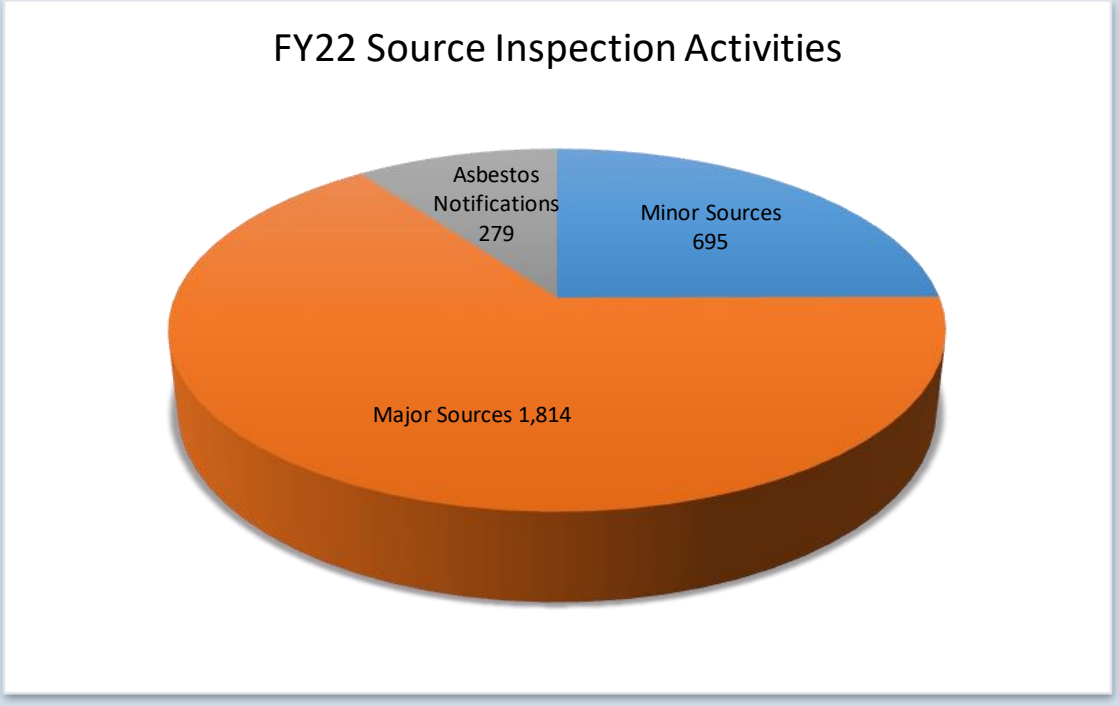
Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.


Statewide Averages for SO_2
200
180
160
140
120
100
80
60
40
20
0
ppb
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year
Statewide Averages: Based upon 99th Percentile

Inspections

During FY22, Field Operations Branch staff completed **2,509** compliance inspections of various types at mostly permitted sources (major Title V, minor). **83 percent of inspected sources were found to be compliant**.

- Inspection activities for major and minor facilities include annual certification reviews, full compliance evaluations and partial compliance evaluations.
- Asbestos inspection activities include AHERA and NESHAP inspections.
- Inspection activities include excess emissions reviews, performance test reviews, semi-annual monitoring reviews, engineering inspections, follow-ups, infrared camera inspections, performance test observations and record reviews for all permitted facilities.

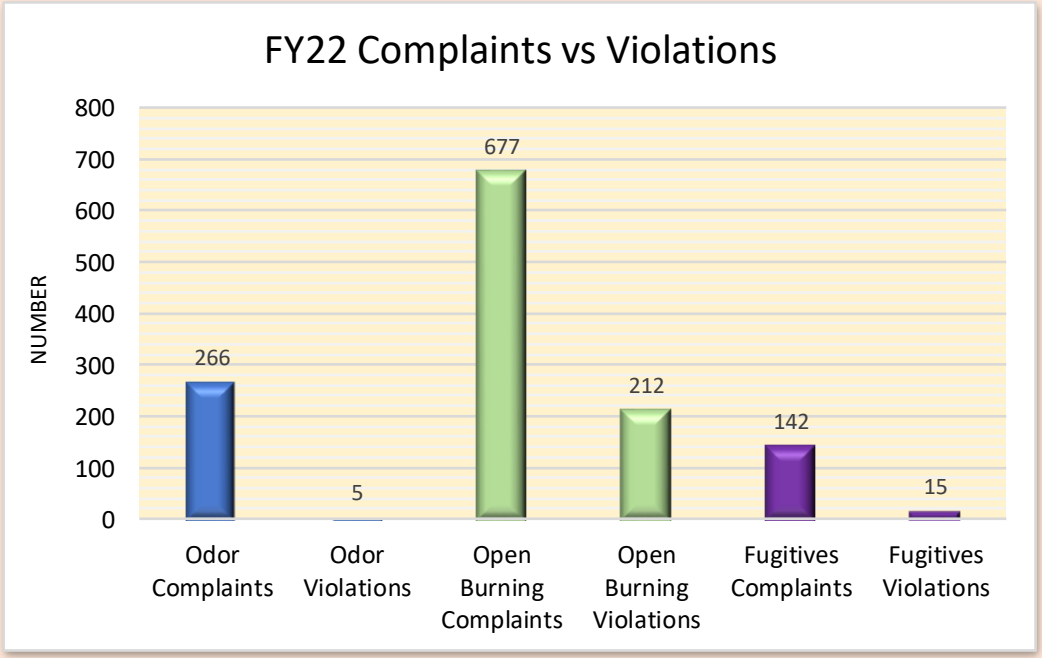


Air Pollution Complaints

During FY22, the division received a total of **1,085 complaints**. The majority of complaints were about open burning, odors, and fugitive emissions. The breakdown of complaints vs. violations follows:

- 142 complaints were about **fugitive emissions**, 15 of which resulted in notices of violation (11 percent)
- 266 complaints were about **odor**, of which 5 resulted in notices of violation (2 percent)
- 677 complaints were about **open burning**, of which 212 resulted in notices of violation (31 percent)

In general, an air quality complaint represents a single incident about which one or more calls have been received. For example, a single incident of tire burning may generate several citizen calls to DAQ. Those calls are counted collectively as a single complaint, since they refer to a single incident.

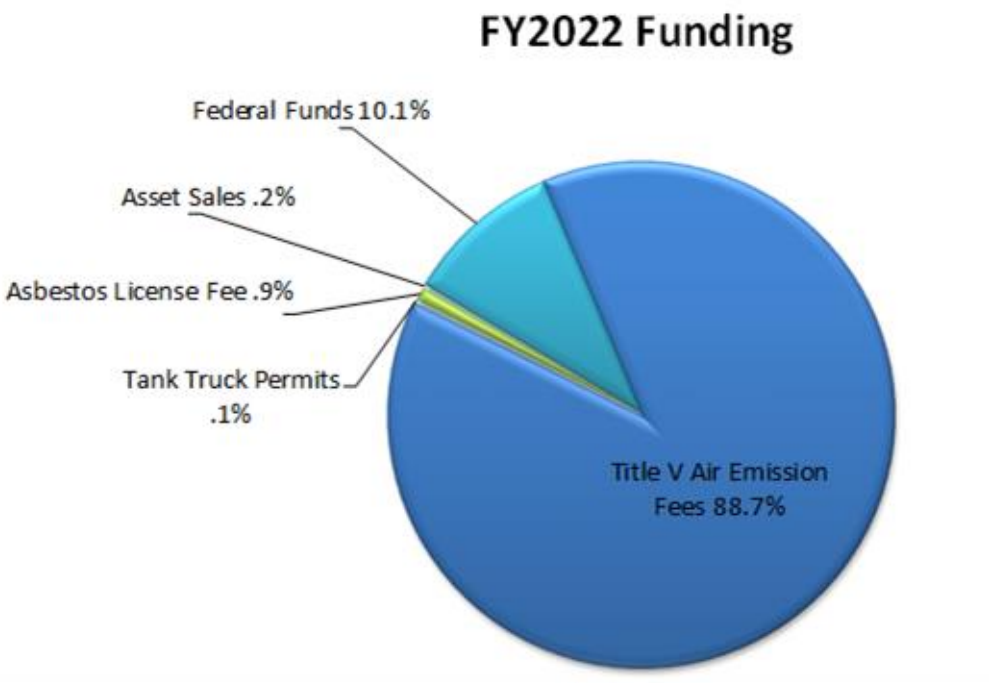


Program Funding

The division operates primarily on Title V (pronounced “Title Five”) emissions fees and federal grant funds. Funding under the Title V program mandated by the Clean Air Act is through air pollutant emission fees assessed to permitted air pollution sources in the state that meet specific criteria.

State statute authorizes the division to charge fees sufficient to cover the cost of implementing and carrying out the requirements of the Title V program.

During FY22, 88.7 percent of the division’s funding came from emissions fees under the Title V program. Another 10.1 percent came from federal grant funds. The remaining funding came from asbestos license application fees, tank truck permits, and proceeds from asset sales.



Emissions Inventory

The Emissions Inventory Section surveys nearly 1,200 plants per year to determine actual air pollutant emissions for the previous calendar year. Title V fees are generated based on actual emissions in a calendar year. Sources are surveyed annually and charged a per ton fee for emissions.

The table on this page shows data for the 2020 calendar year. At the time of publication of this report, data for the 2021 calendar year was still being verified. It takes approximately nine months to verify and complete the inventory for the previous year.

Pollutant	Tons Emitted in 2020
Carbon monoxide	69,392
Nitrogen dioxide	44,708
Particulate matter 2.5	5,663
Particulate matter 10	10,252
Sulfur dioxide	44,454
Volatile organic compounds (as an ozone precursor)	50,058

Kentucky Greenhouse Gas Emissions

Because some gases have a higher warming potential than others, emissions of greenhouse gases are typically expressed in "carbon dioxide equivalent" (CO_2e) in order to allow their impacts to be directly compared. EPA's Greenhouse Reporting Rule requires reporting of greenhouse gases from sources that emit 25,000 metric tonnes or more of CO_2e per year in the U.S.

Although the division is not required to report greenhouse gas emissions on behalf of facilities, the Emissions Inventory Section collects this data when available.

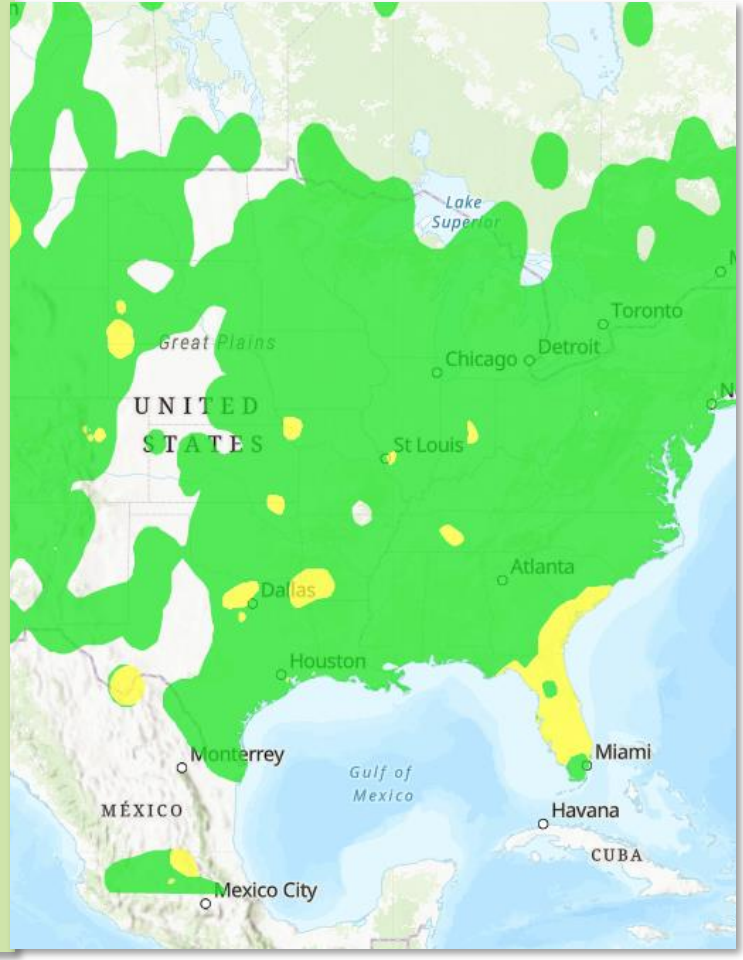
Greenhouse Gas	2016 Actual Emissions (tons)	2017 Actual Emissions (tons)	2018 Actual Emissions (tons)	2019 Actual Emissions (tons)	2020 Actual Emissions (tons)
Carbon dioxide	86,531,345	73,655,105	76,999,573	68,860,439	58,911,448
Methane	89,313	88,675	89,808	93,740	109,679
Nitrous oxide	3,891	3,190	3,369	2,788	3,156
CO2e (metric tonnes)	81,703,900	69,838,096	72,943,967	65,520,542	56,931,687
CO2e (tons)	90,063,137	76,983,327	80,406,960	72,224,035	62,756,443

Air Dispersion Modeling

Air dispersion modeling is an important tool that supports air program planning and permit review. Air modeling data is used to verify, adjust or establish limits in permits, justify permit conditions, to support the State Implementation Plan, and to protect public health and air quality.

In FY 2022, the following assessments and demonstrations were completed:

- 37 air toxics modeling demonstrations in compliance with 401 KAR 63:020 for affected facility applications that emit hazardous and/or toxic substances
- 4 PSD permit application reviews in compliance with 401 KAR 51:017 and EPA's Guideline on Air Quality Models, 40 CFR Part 51, Appendix W
- 1 lead monitoring waiver modeling demonstration for Kentucky counties
- 1 MOVES3 (Motor Vehicle Emission Simulator) model demonstration to estimate on-road emissions to support the ozone nonattainment emissions inventory SIP



Regional Haze

Regional haze is pollution that impairs natural visibility over a large region, including national parks, forests, and wilderness areas (known as "Class I" areas). As part of the Clean Air Act Amendments and further regulations adopted by the EPA, states must develop plans to restore natural visibility conditions in the 156 Class I areas throughout the nation by the year 2064. Kentucky's Mammoth Cave National Park is included in the list of areas.

Regional haze is typically caused by sources and activities emitting fine particles and their precursors, often transported over large regions. Particles affect visibility through the scattering and absorption of light. Reducing fine particles in the atmosphere is an effective method of improving visibility.

Revisions to state plans for Regional Haze are required periodically to ensure progress is being made toward long term goals. Kentucky's draft SIP revision concentrates on reducing sulfur dioxide (SO_2) emissions from facilities shown to impact Class I areas. As of the publication of this report, the draft SIP revision was undergoing internal review.

Left: The Houchins River Valley at Mammoth Cave National Park on a hazy day, with reduced visual range of around 16 miles. Photo: NPS

Regulation Development

During FY22, the Regulation Development Section finalized amendments to the following Kentucky Administrative Regulation: 401 KAR 51:010, *Attainment status designations.* This administrative regulation was updated to reflect that the counties of Henderson (partial) and Webster (partial) are nonattainment for the 2010 SO_2 NAAQS.

State Implementation Plan

During FY22, the Energy and Environment Cabinet submitted two final revisions to **Kentucky's SIP**:

December 22, 2021 – SIP revision submitted to address CAA Section 183(a)(1), Emissions Inventory requirements, for areas designated marginal nonattainment for the 2015 8-hour ozone NAAQS.

January 4, 2022 – 2010 SO_2 Data Requirements Rule Annual Report submitted to EPA.

Clean Diesel Grant

The Kentucky Clean Diesel Grant Program provides financial support for projects that protect human health and improve air quality by reducing harmful emissions from diesel school buses. The division administers this program with funding provided through the federal Diesel Emissions Reduction Act (DERA).

During FY 2022, a total of **$294,748 was awarded** to the division through DERA. School districts in six Kentucky counties were selected to receive funding through the Kentucky Clean Diesel Grant Program. The school districts will replace a total of nine older model, diesel school buses with either new diesel, or propane buses. The new buses will emit 98 percent less particulate matter and 90 percent less nitrogen oxide pollution than the older buses they replaced.

Air Permitting

The Permit Review Branch issues air permits for industrial and commercial sources that release pollutants into the air. Air permits include information on which pollutants are being released, how much may be released, and what kinds of steps the source's owner or operator is required to take to reduce the pollution. Permits also include plans to measure and report air pollution emitted.

The Permit Review Branch is divided into several specialized sections:

- **Chemical Section** - Chemical plants (organic and inorganic), petroleum refineries, coal to liquids, bulk terminals, brake manufacturing, plastic products and resins, paper mills/pulp mills, electronic components, nonwoven fabrics, rubber products, paperboard mills, pharmaceuticals, paint and allied products, carbon and graphite products, and battery manufacturers
- **Combustion Section** - brick and tile manufacturing, charcoal manufacturing, combustion (boilers), distilleries, glass manufacturing, incineration, natural gas transmission stations, power plants, sawmills, soil remediation units, tobacco processing plants, electric utilities
- **Metallurgy Section** - primary steel and aluminum producers, mini steel mills, secondary metal plants, and various surface treatments of metals

- **Minerals Section** - Asphalt plants (portable and stationary), cement storage operations, chicken feed manufacturing plants, coal preparation plants (portable and stationary), coal tipples (portable and stationary), coal terminals, concrete block plants, edible oil plants, fertilizer operations (including blending), flour mills, grain elevators, lime manufacturing plants, limestone crushing operations (portable and stationary), limestone terminals, pet food manufacturers, pre-stress concrete plants, ready mix concrete plants, sandstone crushing operations, sand and gravel operations (portable and stationary), slag coal operations, soybean extraction plants
- **Surface Coating Section** - Automobile and light-duty trucks, beverage cans, fabric, vinyl and paper, flat wood paneling, flexible vinyl and urethane, large appliances, magnet wire, magnetic tape, metal coil, metal furniture, miscellaneous metal parts and products, plastic parts for business machines, polymeric coating, pressure sensitive tape and labels, publication rotogravure and flexography printing

Permitting Actions

The Division for Air Quality's Permit Review Branch issued new air permits or permit modifications for 34 economic development-referred projects during FY22. These projects were completed in partnership with the Cabinet for Economic Development. At the close of FY22, the branch had issued 306 permits and had 265 pending applications in-house.

FY 2022 Permitting Actions

Type of Permit Action	Number
Major Permit Applications	84
Conditional Major Permit Applications	95
Minor Permit Applications	127
Registrations	586
Administrative Amendments	44

Environmental Education Outreach

The Division for Air Quality promotes environmental stewardship and public participation through environmental education programs, resources, and community partnerships.

The division's environmental education program continued to provide virtual and in-person outreach to schools, festivals, teacher workshops and conferences during FY22. Staff presented 57 air quality programs and events reaching nearly 1,500 people across the Commonwealth.

Indoor Air Quality Education

Division staff receive numerous calls from the public about indoor air quality (IAQ) throughout the year. IAQ is not regulated in Kentucky, but the division provides educational resources to help Kentuckians learn about indoor air contaminants and control measures. During FY22, division staff presented to eastern Kentucky Cooperative Extension groups about IAQ. In February, the division worked with EEC's Office of Communications to create a how-to video about a DIY indoor air cleaner known as a "Corsi-Rosenthal box". In May, the division's environmental education specialist spoke about indoor air quality to the annual meeting of the Kentucky Asthma Partnership.

Teacher Education

In June, the division's environmental education specialist provided outreach and training to educators through the KY Association for Environmental Education's Outdoor Learning Symposium and the Lexington Fayette Urban County Government's Environmental Academy for teachers.

Partnerships

Throughout the year, the division partnered with several agencies and non-profits to further environmental education and air quality communication. Those agencies included: The Kentucky Association for Environmental Education, Association of Air Pollution Control Agencies, Kentucky Asthma Partnership, University of Kentucky, Fayette County Public Schools, and the Living Arts & Science Center.

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