Kentucky Division for Air Quality
2017 Annual Report

Commonwealth of Kentucky
Energy and Environment Cabinet
Department for Environmental Protection
Division for Air Quality
air.ky.gov

Kentucky Division for Air Quality
Annual Report
Fiscal Year 2017

Governor Matt Bevin **Secretary Charles G. Snavely**

This Annual Report is intended to provide a concise set of facts and measurements to support environmental decision-making. We welcome your questions and comments to the contacts below:

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The 2017 DAQ Annual Report was edited by Roberta Burnes and Jennifer Miller. We gratefully acknowledge the contributions of the staff and management of the Division for Air Quality in the production of this report.

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FROM THE DIRECTOR

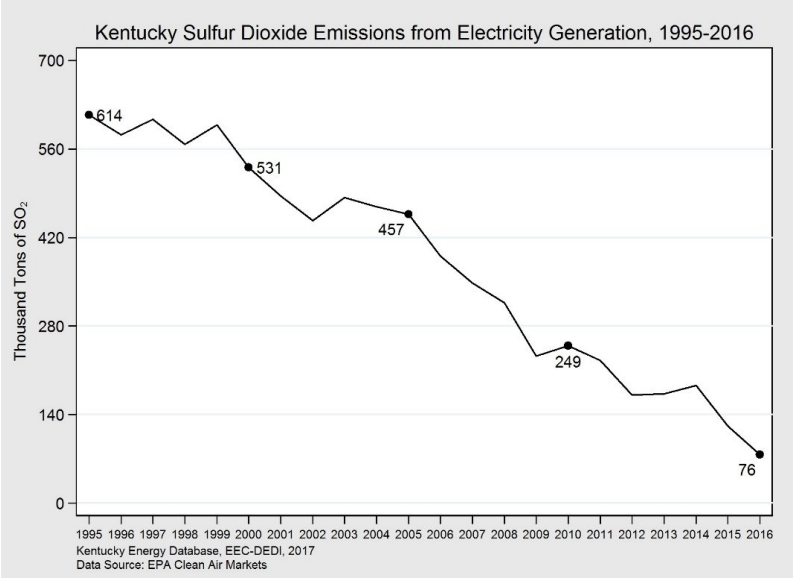
Dear Reader,

On behalf of the team members of the Division for Air Quality, thank you for taking the time to read the Division's 2017 Annual Report. The 2017 Annual Report highlights key accomplishments of the Division and details the impressive improvements in Kentucky's air quality. With your help, air quality in Kentucky will continue to improve for many years to come.

Our Commonwealth's quest for clean air began more than 65 years ago, when the Kentucky legislature authorized county-level air pollution control districts to be activated. Then in 1966, the General Assembly created the first state-wide air pollution control agency, the Kentucky Air Pollution Control Commission. The General Assembly provided the commission with broad authority to develop and carry out a comprehensive program to abate, prevent, and control emissions that pollute our air.

Much has changed since those early years. On July 20, 1967, the Air Pollution Control Commission adopted its first regulation requiring the registration of air contaminant sources. Since then, the Division for Air Quality has promulgated over 100 state-specific regulations and incorporated more than 200 federal regulations. These important regulations are necessary to protect human health and the environment, while allowing economic growth and development due to the preservation of clean air resources.

It has been said many times that environmental protection and economic growth are not mutually exclusive. Since 1970, total emissions of the most common air pollutants have dropped more than 71 percent while U.S. gross domestic product grew 246 percent. As a



manufacturing state with a robust and growing economy, it is imperative that Kentucky preserves its clean air resources for future economic growth and prosperity.

In Kentucky, emissions of sulfur dioxide (SO_2) continue a steep and steady decline. Since 1995, SO_2 emissions have been reduced more than 87 percent. To achieve these reductions, Kentucky power plants invested billions of dollars in state-of-the-art pollution control equipment. And all of us benefit from these substantial reductions in air pollution.

Similarly, emissions of nitrogen oxides (NOx) have declined significantly in recent years. Since the year 2000, NOx emissions from Kentucky power plants have decreased more than 76 percent, from 247,000 tons per year to less than 58,000 tons in 2016. The reduction of NOx reduces the formation of harmful ground-level ozone that aggravates respiratory conditions such as asthma and bronchitis.

Although air pollution levels have dropped dramatically and our air is cleaner, our work is not finished. Continued improvement of air pollution control equipment, as well as cleaner vehicles and fuels, will safeguard our air quality in the future, while allowing economic growth and development to continue. And through our individual choices and actions, each of us can help by reducing our individual impact on air quality and the environment on a daily basis.

Again, thank you for taking time to read our Division's 2017 Annual report. If you have questions, comments, or concerns, please contact us at your convenience.

Best regards,

Sean Alteri
Director

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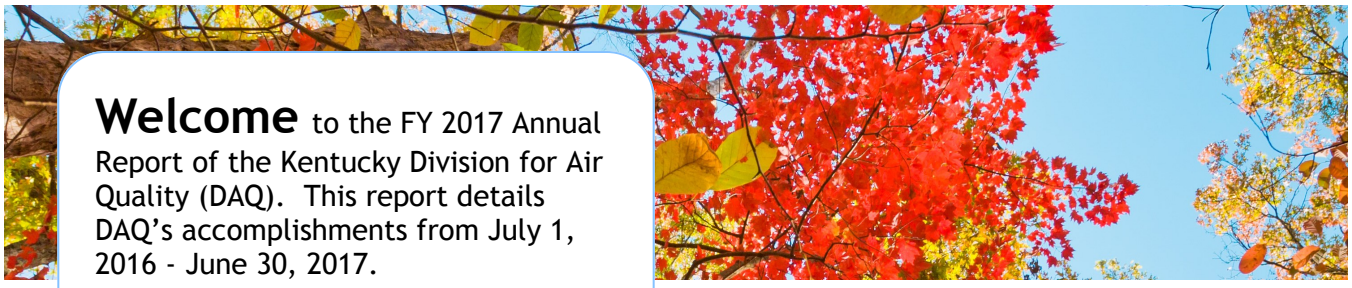


Welcome to the FY 2017 Annual Report of the Kentucky Division for Air Quality (DAQ). This report details DAQ's accomplishments from July 1, 2016 - June 30, 2017.

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
- 161 funded positions located in Frankfort and throughout the state in 8 Regional field offices
- Third largest division in the Dept. for Environmental Protection

What we do:

- Air monitoring
- Regulation development
- Permitting regulated facilities
- Ensure compliance with National Ambient Air Quality Standards (NAAQS)
- Environmental education

An early air monitoring site in Jefferson County, 1956. Photo: LMAPCD

A Brief History of Air Pollution Control in Kentucky

In 1952, the Kentucky legislature passed KRS chapter 77, which authorized the creation of county-level air pollution control districts. Then in 1966, the Kentucky Air Pollution Control Commission became the state's first air pollution control program when the Kentucky General Assembly enacted KRS 224.20-100:

"The Kentucky General Assembly hereby finds it necessary to the health and welfare of the citizens of Kentucky that there be maintained at all times both now and in the future a reasonable degree of purity of the air resources of this Commonwealth consistent with maximum employment and full industrial development necessary for the protection of the public health, the general welfare, and the property and people in this Commonwealth; and foster the comfort and convenience of its inhabitants and facilitate the enjoyment of the natural attractions of the state."

Originally operating out of the state health department, the Kentucky Air Pollution Control Commission eventually moved to the Department for Environmental Protection where it became known as the Division for Air Quality. Today, as in its beginning, air pollution control is divided among a hierarchy of state, federal, and local programs.

Federal Authority

The Clean Air Act (CAA), codified as 42 U.S.C. 7401 *et seq.*, was first enacted by Congress in 1955 with major revisions in 1970, 1977, and 1990. The Act requires the U.S. Environmental Protection Agency (EPA) to establish health-based standards for ambient (outdoor) air quality, providing deadlines and requirements for meeting those standards by state and local governments. The Act establishes federal standards for hazardous air pollutants, for ozone-depleting chemicals, and for emissions that contribute to acid rain. In addition, the Clean Air Act establishes a permitting system for major sources of air pollution.

Local Authority

KRS 224 recognizes the right of counties to develop their own air pollution control districts as provided for in KRS 77. Jefferson County (Louisville Metro Air Pollution Control District, or LMAPCD) has maintained a local air pollution control program since the late 1940s, while activities in the rest of Kentucky counties are covered by the Division for Air Quality. The LMAPCD may choose to make subtle changes or be more stringent than state and federal regulations, but it must be at least as stringent as the state and federal programs.

This photo taken in the 1980's shows DAQ scientist George Hockley working with an acid precipitation collector. Photo: DAQ

Division staff participates in several regional and national organizations.

DAQ's participation in these organizations enables the Division to stay connected to regional and national policy issues and gain valuable professional development opportunities. Often, Division staff assume leadership roles within the organizations and are members of various committees and groups. The most notable organizations that the Division routinely engages are below:

AAPCA: The Association of Air Pollution Control Agencies was formed in 2012, representing 20 states. AAPCA is a consensus-driven organization focused on assisting air quality agencies and personnel with implementation and technical issues associated with the federal Clean Air Act (CAA). AAPCA's members work collaboratively on behalf of states and the communities they protect to act as a conduit for and provide feedback to federal regulators on air quality rules that have significant impacts across the entire nation. DAQ director Sean Alteri served as AAPCA's President during FY 2017.

ECOS: The Environmental Council of the States is the national non-profit, non-partisan association of state and territorial environmental agency leaders. The purpose of ECOS is to improve the capability of state environmental agencies and their leaders to protect and improve human health and the environment of the United States of America.

KAEE: The Kentucky Association for Environmental Education is one of the nation's oldest professional associations supporting environmental and sustainability education. KAEE promotes environmental education as a tool to increase public awareness and knowledge about environmental issues and provide the skills to make informed decisions and take responsible actions. The Division is an Institutional Member of KAEE.

KAGC: The Kentucky Association of Governmental Communicators supports Kentucky professionals whose primary jobs involve communicating with media, the public, legislatures and others. KAGC's goal is to improve and enhance the expertise, public image, morale and effectiveness of governmental communicators and the work of federal, state and local agencies. DAQ education specialist Roberta Burnes served on KAGC's board of directors in 2017.

KCFC: The Kentucky Clean Fuels Coalition is a non-profit organization whose mission is to link providers and users of fuels across Kentucky to the best information and education available about clean energy technologies. DAQ administers DEP's participation in KCFC's Green Fleets of the Bluegrass program.

SEDC: The Southeast Diesel Collaborative is a voluntary, public-private partnership involving leaders from federal, state and local government, the private sector and other stakeholders throughout the southeast working to reduce diesel emissions. The Southeast Diesel Collaborative is part of the EPA's National Clean Diesel Campaign.

SESARM: Southeastern States Air Resource Managers Inc. is a non-profit corporation formed by the state air pollution control agencies located in the southeastern states of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, West Virginia, and Virginia. SESARM exists to support and supplement the work of member agencies.

UIEK: The Utility Information Exchange of Kentucky is a group comprised of utilities with electric generation and transmission facilities located in Kentucky. Among other things, UIEK encourages exchange of information about environmental regulatory developments and requirements among its members.

ENVIRONMENTAL EDUCATION

During FY 2017, the Division's Environmental Education Outreach Program reached 6,176 people in 20 counties.

Environmental education (EE) is an essential tool in promoting environmental stewardship. DAQ's EE program reaches a diverse audience across the Commonwealth including students, teachers, firefighters, businesses, solid waste coordinators, and the general public.

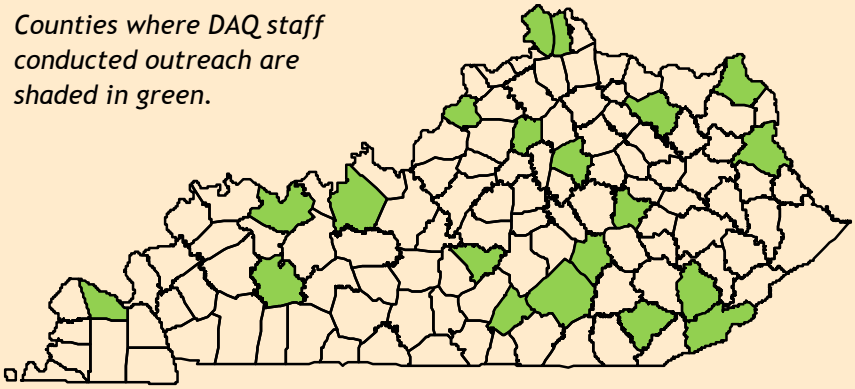
DAQ's Environmental Education Outreach Program continues to reach thousands of Kentuckians each year. DAQ staff provide presentations on outdoor and indoor air quality, transportation and idle reduction, health and environmental impacts of air pollution, energy conservation, and Kentucky's open burning regulation.

Figure 1 (Page 5) shows the numbers for each major audience reached by DAQ's outreach program. School programs drew the largest audience (3,572) as DAQ staff participated in several school-wide science and technology fairs as well as several environmental field days at regional parks and 4-H camps. The majority of these students received direct, face-to-face contact with DAQ staff presenting educational programs about air quality, energy, and careers in science.

Public programs drew the second-largest audience (1,960) as DAQ staff participated in several large spring festivals.

DAQ staff conducted educational outreach in the following counties during FY 2017:

Counties where DAQ staff conducted outreach are shaded in green.



Boone	Knox
Breckinridge	Lawrence
Daviess	Leslie
Estill	McCracken
Fayette	Muhlenberg
Fleming	Oldham
Franklin	Pulaski
Greenup	Rockcastle
Harlan	Russell
Kenton	Taylor

Air Quality Awareness Week

The first week in May is National Air Quality Awareness Week. This year, the Division again distributed daily air quality quizzes through email and social media. Quizzes explored historical air quality events, health issues, and taking action to improve air quality. Hundreds of Kentucky teachers and students took the quizzes as well as state employees and the general public.

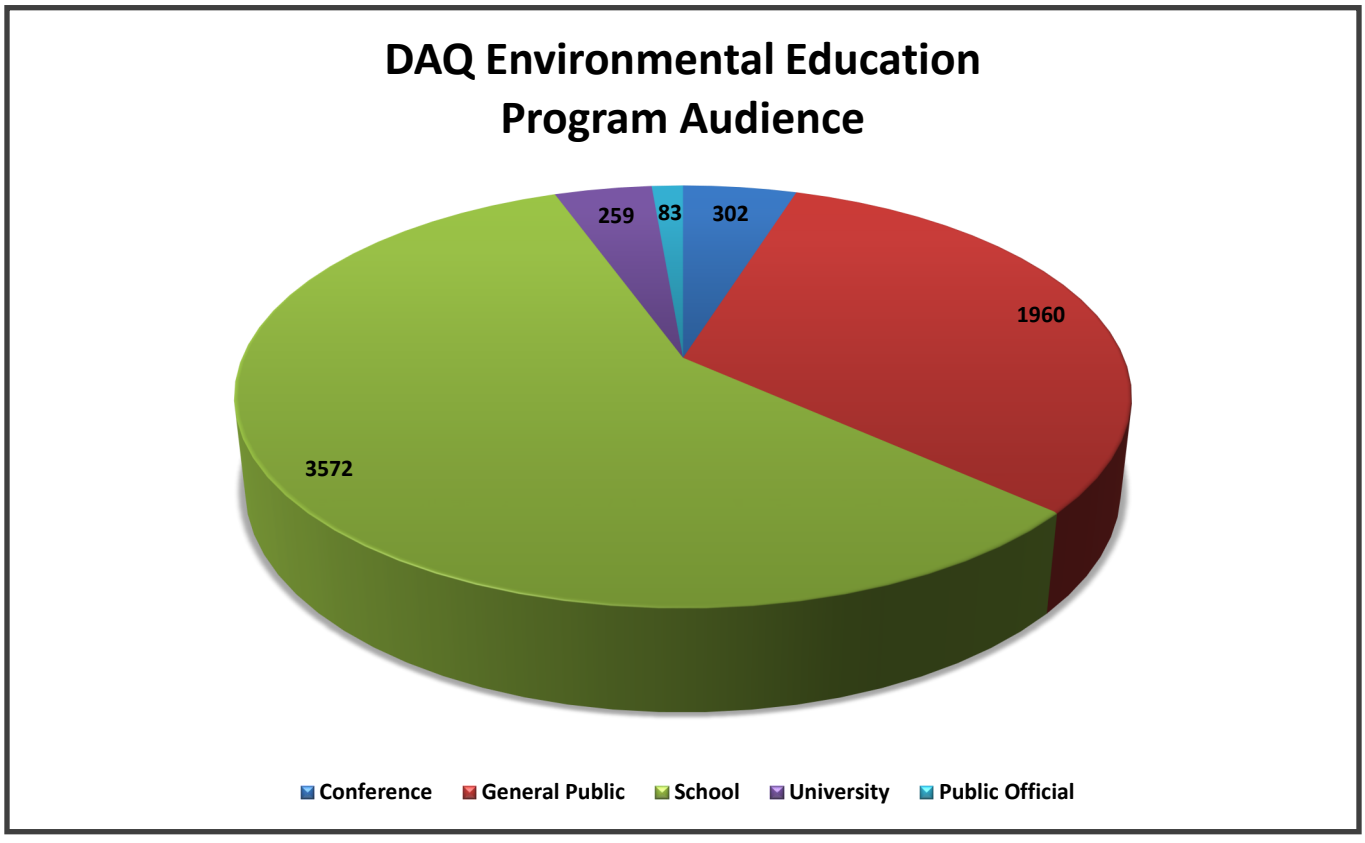


Figure 1: The Division for Air Quality's environmental education programs reached 6,176 people during FY 2017.

Open Burning

Illegal open burning continues to be a serious health concern in Kentucky. The Division promotes open burning awareness in the following ways:

- DAQ's open burning brochure is the Division's primary educational tool, summarizing Kentucky's open burning regulation in easy-to-understand language. First responders often carry DAQ's open burning brochures in their vehicles so they can distribute the information as the need arises.
- The Division's open burning web page (air.ky.gov/Pages/OpenBurning.aspx) provides a variety of educational links and resources including a PowerPoint presentation, posters, and PDFs of the open burning brochure in English and Spanish.
- The Division's Facebook page ran a spring awareness campaign around open burning that garnered more than 80,000 views.

The DAQ EE program includes:

- Teacher training
- Classroom and camp programs
- Public events and festivals
- Firefighter education
- Community forums & conferences
- Media outreach

DAQ EE program topic areas include:

- Air pollution sources & monitoring
- Open burning and waste reduction
- Energy conservation
- Indoor air quality
- Idle reduction
- Hybrid-electric vehicles

(Clockwise from above) DAQ staff and visitors at the EEC Earth Day celebration; Frankfort Homeschool students explore science & engineering principles by designing air pollution collectors as part of a DAQ classroom program.

The Field Operations Branch (FOB) is the largest branch of the Division and is currently staffed by 67 employees. The majority of FOB field staff is located in eight regional offices and have the following primary duties:

- Complete unannounced inspections to ensure that permitted facilities and non-permitted entities maintain compliance with federal and/or state air quality regulations;
- Operate and maintain 98 air monitoring units located at 27 stations scattered throughout the state to measure ambient air quality and determine whether pollutant concentrations remain within EPA established limits; and
- Investigate air quality complaints received from the general public.

For a map of DAQ's regional offices, see Page 83 of this report.

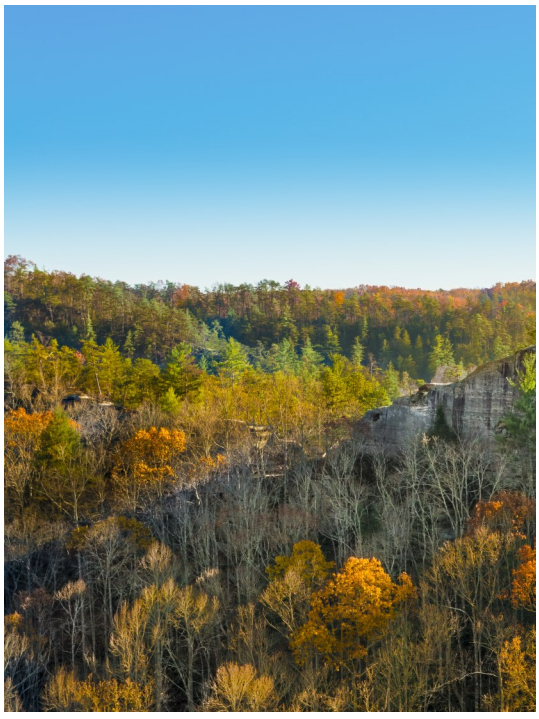
Inspections

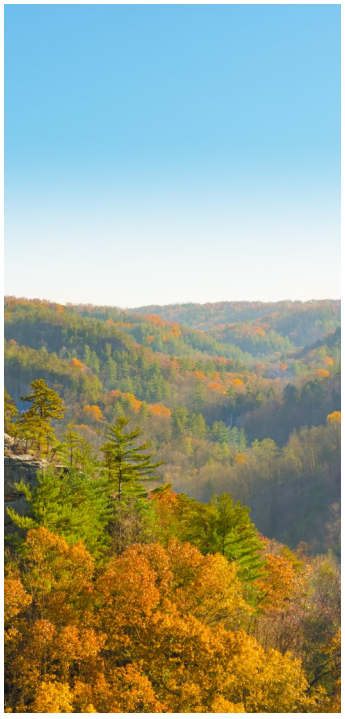
One of the primary duties of the FOB is to inspect sources of air pollution for compliance with air quality regulations and if applicable, permit conditions. The measures for the success of FOB's compliance-monitoring program are:

- Compliance rate of stationary source inspections (Figure 2)
- Number of major stationary source inspections conducted (Figure 4)
- Number of minor stationary source inspections conducted (Figure 5)
- Rate of compliance with 401 KAR 63:005 - open burning (Figure 7)
- Rate of compliance with 401 KAR 63:010 - fugitive emissions (Figure 8)
- Rate of compliance with 401 KAR 53:010 - odor (Figure 9)
- Number of asbestos inspections conducted (Figure 11)

In calendar year 2016, FOB staff completed 3,946 compliance inspections of various types at mostly permitted sources (major Title V, minor); 89 percent of inspected sources were found to be compliant (Figure 2). Types of inspections included full compliance evaluations, partial compliance evaluations, records reviews, compliance demonstrations (stack tests), asbestos inspections, follow-up inspections of documented violations, and self-initiated inspections of suspected violators.

The regional offices with more inspections for major facilities (Figure 4) are located in areas of the state with





a higher number of major permitted facilities, which include power plants, manufacturing facilities and chemical processing plants. The regional offices with more inspections for minor sources tend to be located in areas of the state with a smaller population base, leading to a higher percentage of minor pollution sources, such as auto body/paint shops, dry cleaners, non-coal mineral processing facilities, and coal-mining related activities (Figure 5).

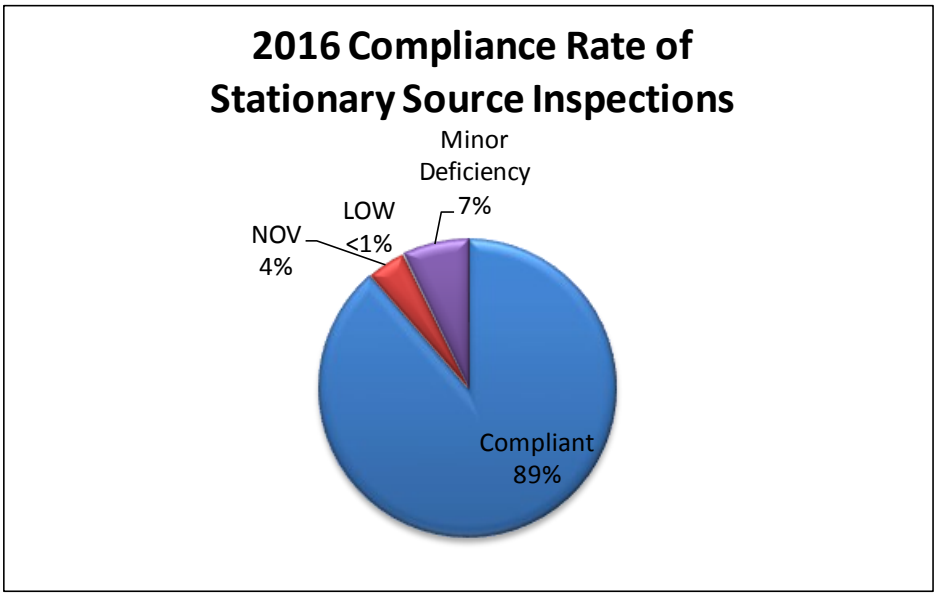


Figure 2 (left): The compliance rate of regulated stationary sources inspected by field office staff in 2016 was 89 percent. Notices of Violation (NOV) were issued to 4 percent of Kentucky's stationary sources, while Letters of Warning (LOW) were below 1 percent. About 7 percent of violations were considered non-recurrent minor violations or violations that were quickly corrected, eliminating the need for any formal enforcement action.

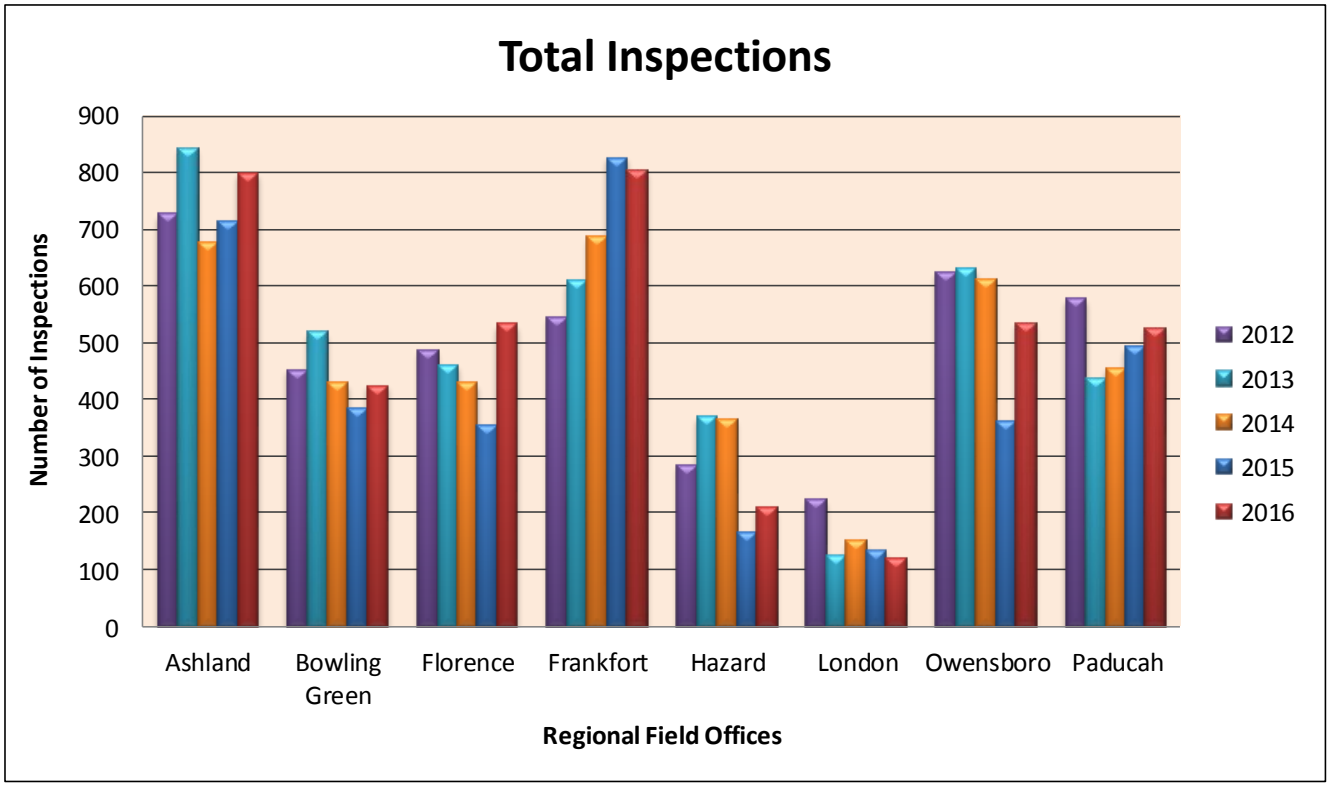


Figure 3: The total number of inspections at regulated facilities.

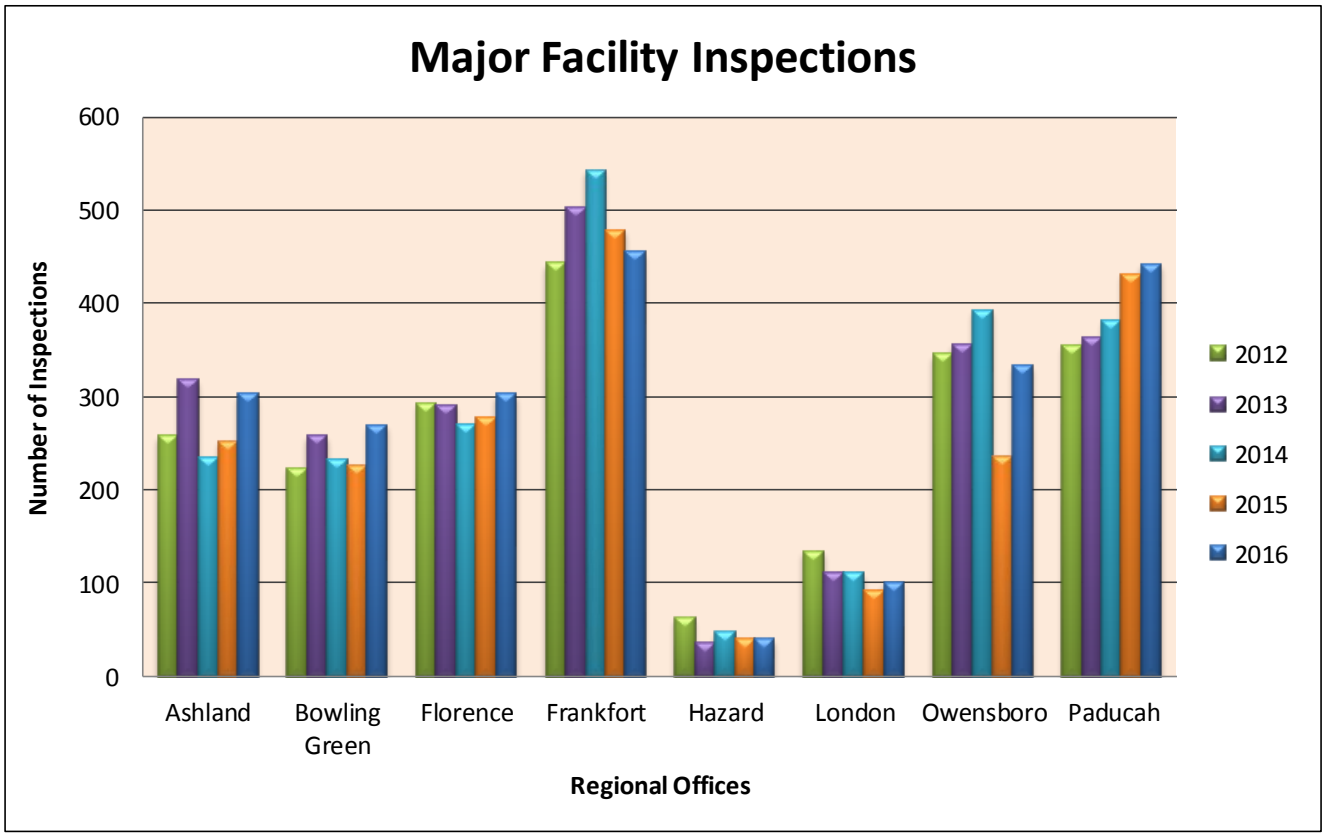


Figure 4: Number of major stationary facility inspections in Kentucky. The regional offices with more inspections are located in areas of the state with more major permitted facilities. Major permitted facilities include power plants, manufacturing facilities and chemical processing plants.

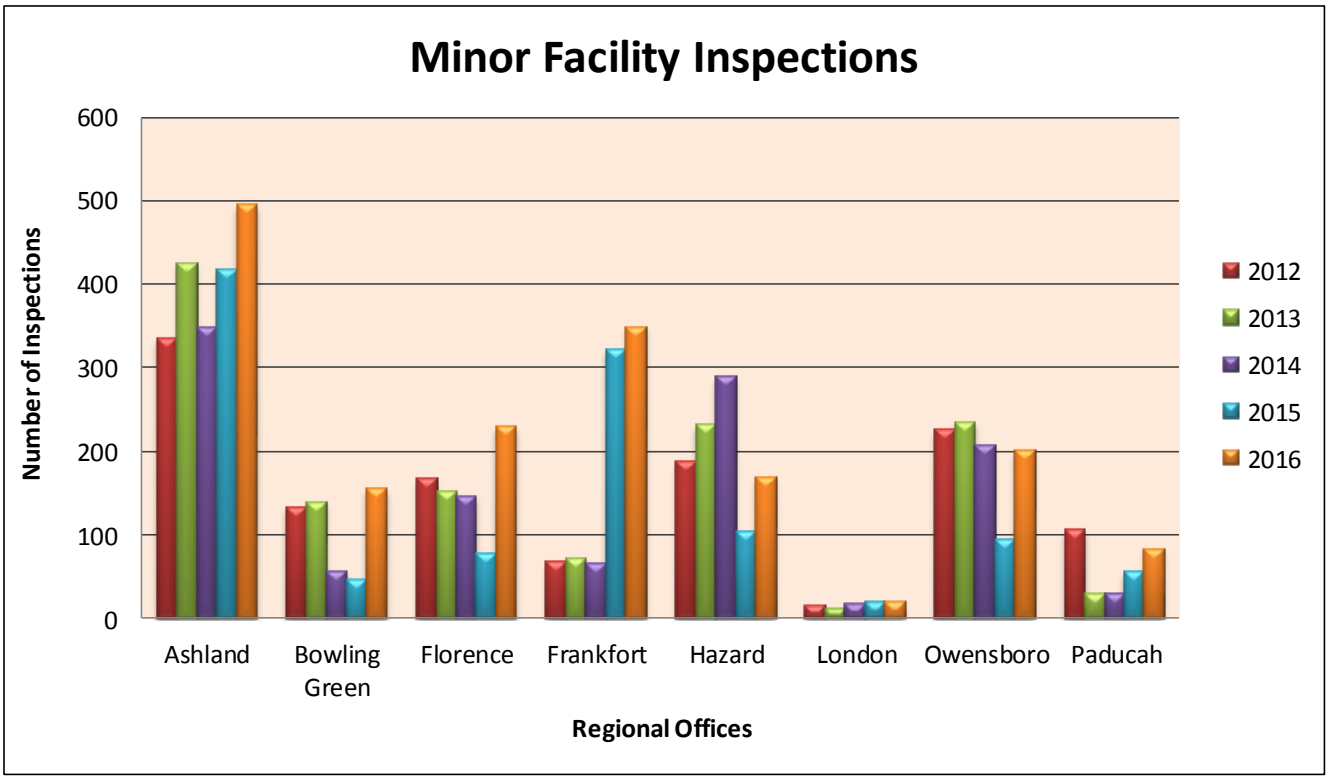


Figure 5: Number of minor stationary source inspections. Minor pollution sources include auto body paint shops, dry cleaners, and both coal and non-coal mineral processing facilities.

Complaint Investigations

Investigating complaints consumes a significant portion of field staff time. In 2016, DAQ received a total of 1,256 complaints (Figure 6). Numbers of complaints and violations resulting from investigations are included in Figures 7 - 10. The majority of complaints were about open burning, fugitive emissions, and odor.

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.

Burning illegal materials releases toxic chemicals and particulate matter into the air.

Complaint Categories

Open burning is the outdoor burning of any material without an approved burn chamber, stack, or chimney with control devices approved by KY DAQ. Open burning in Kentucky is regulated under 401 KAR 63:005.

The Division received 533 complaints about open burning in calendar year 2016. 42 percent of these complaints resulted in Notices of Violation (NOV) of the open burning regulation (Figure 7). The violation rates for illegal open burning continue to be high, since staff only responds to citizen complaints of open burning or discover them in the course of other duties. Kentucky does not have a statewide open burn permit program, so the total number of actual open burns is unknown.

Fugitive emissions are pollutants released into the air, usually by human activity — but not from smokestacks, chimneys, or ducts. Common fugitive emissions include dust released during land clearing, heavy construction operations, mining and quarrying activities, storage and transport of dusty materials (gravel, feed grain, etc.) and transportation on unpaved roads. In Kentucky, fugitive emissions are regulated under 401 KAR 63:010.

Fugitive dust from a construction site. State regulation requires control measures to reduce fugitive emissions and their impact on air quality.

Fugitive emissions complaints and violations (Figure 8) are related to yearly precipitation patterns. During periods of prolonged drought, both the number of complaints and violations generally increases. This is especially true when a drought occurs in the summer months when the heat from the sun dries up surfaces more quickly and people tend to be out doing activities that create more dust.

Odor complaints are regulated under 401 KAR 401 53:010. DAQ receives complaints concerning odor on a regular basis (Figure 9). In many instances, odors not rising to the level of a violation are corrected through cooperative efforts between the Division and the responsible party.

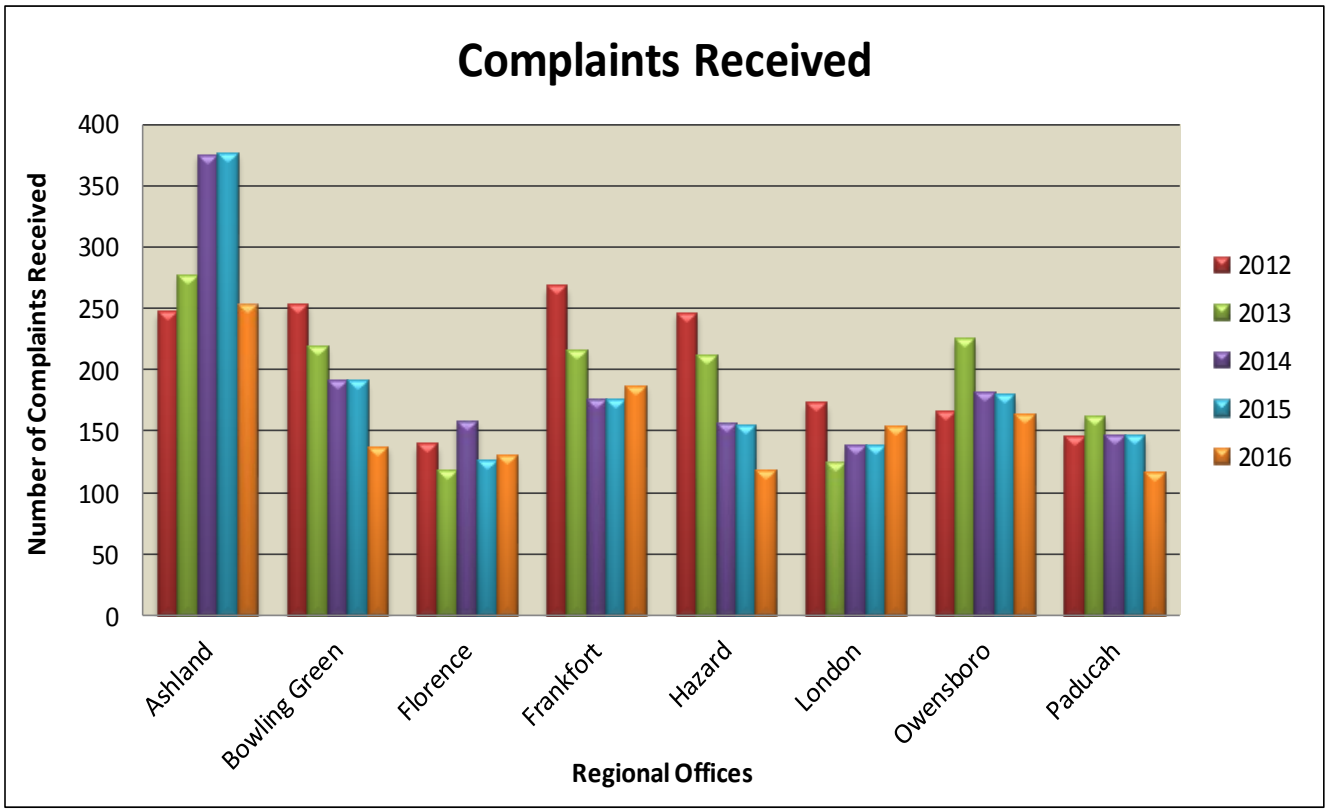


Figure 6: The numbers of complaints received during the last five years including open burning, fugitive emissions, odor, and asbestos complaints. Note that a "complaint" represents a single air quality incident about which one or more calls have been received.

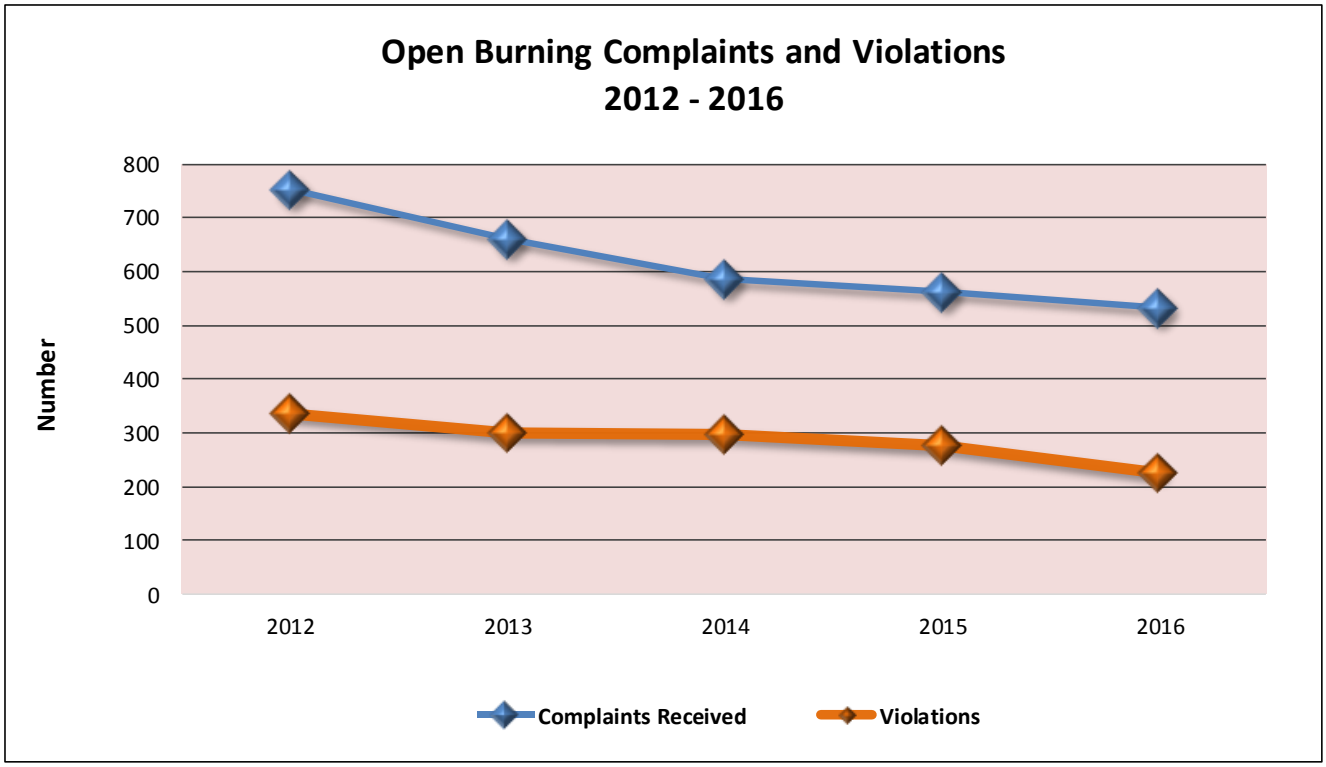


Figure 7: Complaints received about open burning and violations cited after investigation. 42 percent of open burning complaints resulted in violations in 2016. Education and outreach campaigns targeting illegal open burning may be responsible for the overall downward trend in open burning complaints.

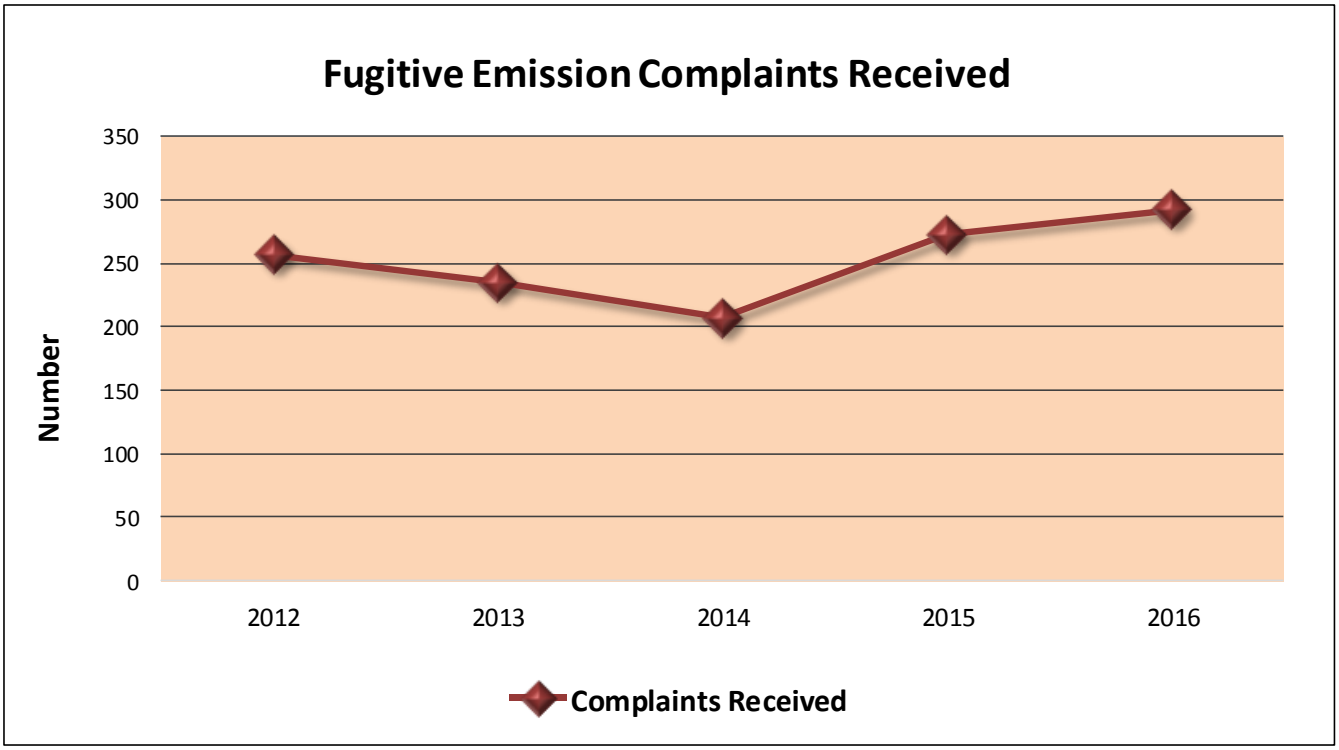


Figure 8: Fugitive Emissions Complaints

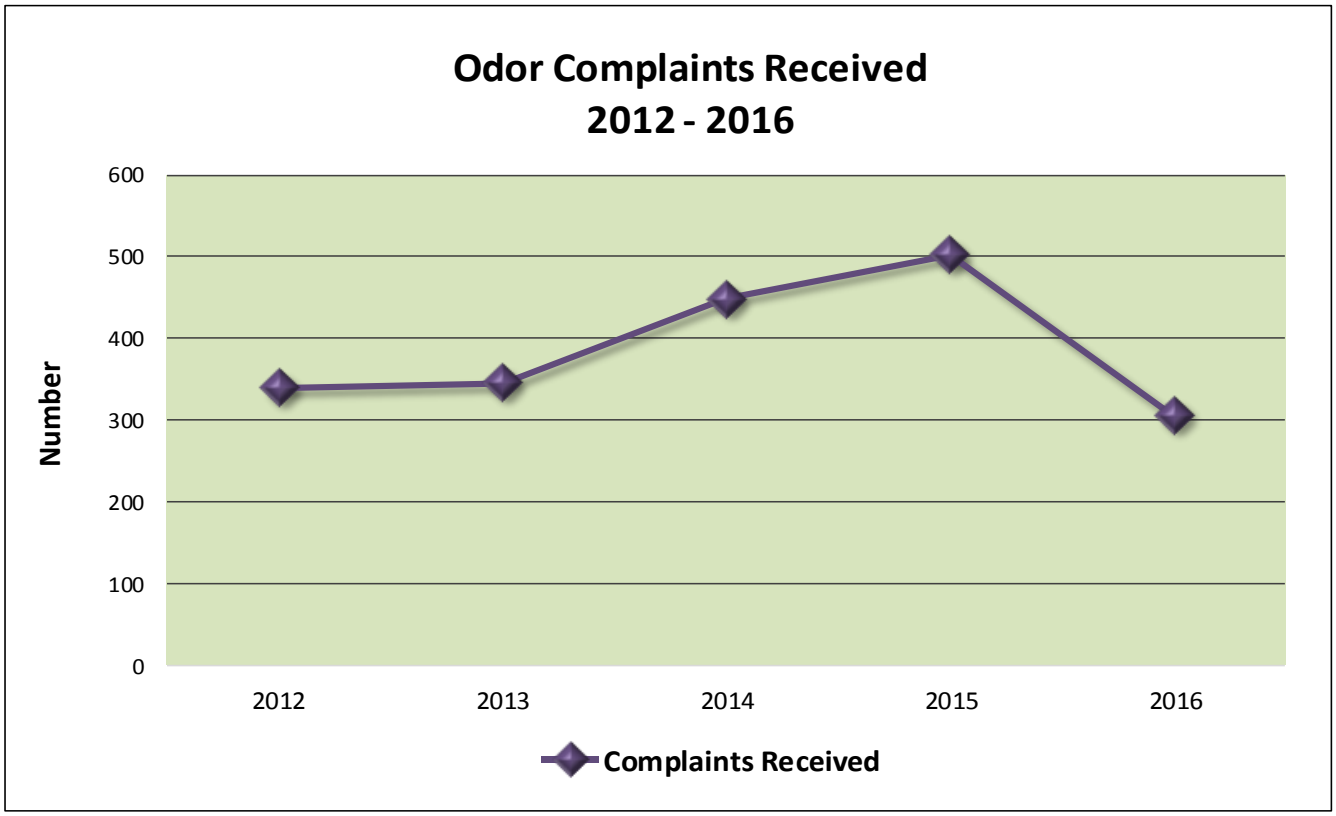


Figure 9: Odor Complaints Received. Note that a "complaint" may represent multiple calls about a single odor incident. Complaints in 2016 went down significantly after resolution of violations at one odor source.

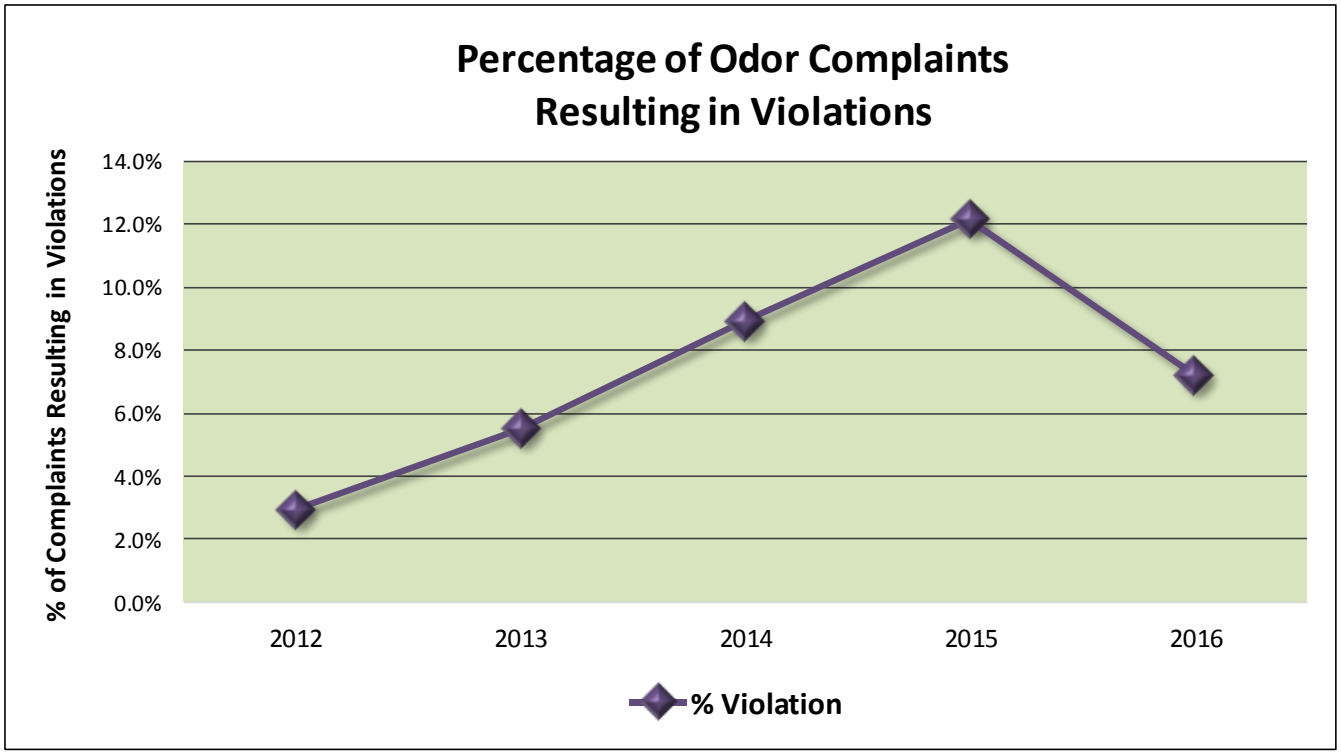


Figure 10: Percentage of Odor Complaints Resulting in Violations. Major corrective actions at one odor source in 2015 -2016 have reduced the percentage of complaints resulting in violations down to more historical levels in 2016.

Frankfort Regional Office supervisor Natasha Evans (right) demonstrates the use of a sniffing device known as a Nasal Ranger. Odor violations are documented when an inspector can smell the odor through the device, which dilutes the ambient air at a ratio of seven to one.

Strong and steady odors are often required to document a violation of the Kentucky odor standard. Many odors not rising to the level of a violation are, nevertheless, corrected through cooperative efforts between the inspector and the responsible party. *(Photo: DAQ)*

DAQ's Asbestos Inspection Program

Close-up of asbestos fibers.

Undisturbed asbestos material can be safely maintained if kept in good condition . Without proper precautions, however, renovations, demolitions, and even routine maintenance can cause asbestos-containing materials to release microscopic fibers into the air we breathe. Before renovating or demolishing a structure, it must be thoroughly surveyed for asbestos by an accredited professional. If 160 square, 260 linear, or 35 cubic feet or more of friable asbestos will be removed over a year's time, the removal must be done by a certified contractor following state and federal regulations.

Asbestos removals associated with renovations and demolitions are regulated by the Division under the National Emission Standards for Hazardous Air Pollutants (NESHAP). Increased awareness within the regulated community has improved the notification process for inspections and removals. Educational outreach to the general public has also improved the complaint process to report potential violations of the regulatory program.

Federal regulations also require schools to have their buildings thoroughly surveyed for asbestos under the Asbestos Hazard Emergency Response Act (AHERA). The results must be documented in a management plan that describes how asbestos containing building materials in the school buildings will be managed safely. The Division's compliance oversight strategy for AHERA inspections has evolved from a records review approach to an actual site inspection/records verification process.

Measures tracked by the Division to evaluate the asbestos program's success (Figure 11) are as follows:
· Number of asbestos NESHAP and AHERA inspections conducted;
· Number of asbestos complaint investigations conducted; and
· Compliance rate of NESHAP and AHERA related inspections and investigations.

Compliance with all asbestos regulations is overseen by the Field Support Section and inspectors from the regional offices. In 2016, the compliance rate for NESHAP was 78 percent (Figure 12) and the compliance rate for AHERA was 70 percent (Figure 13).

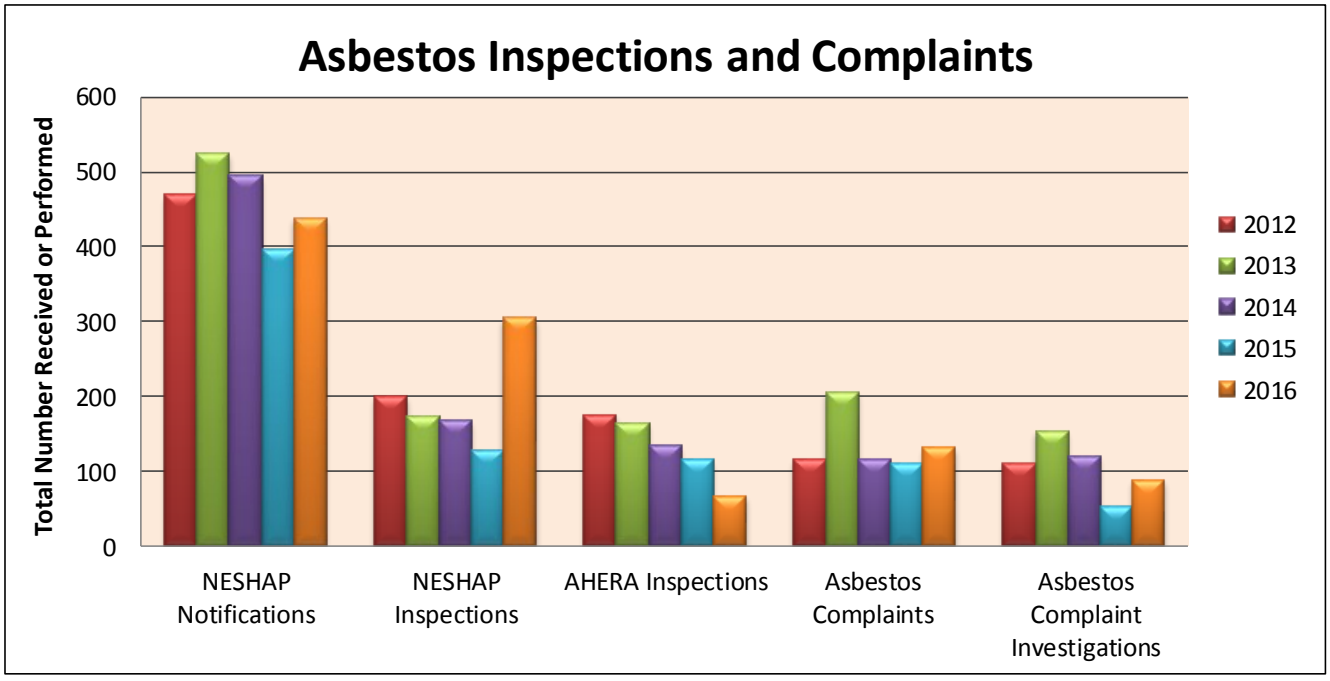


Figure 11: NESHAP notifications and inspections and AHERA inspections, complaints, and investigations.

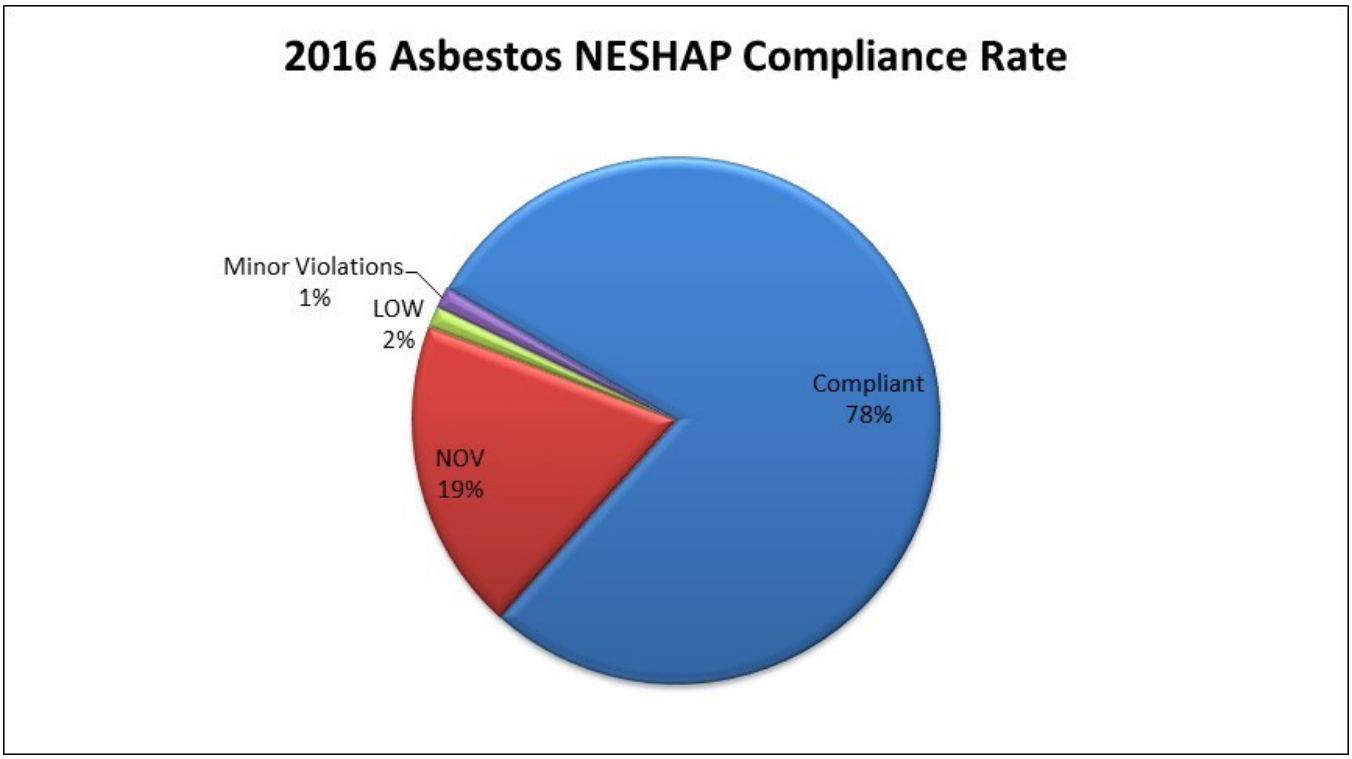


Figure 12: Compliance rate of asbestos removal and/or demolition operations regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAP). "LOW" refers to Letters of Warning, while "NOV" refers to Notices of Violation.

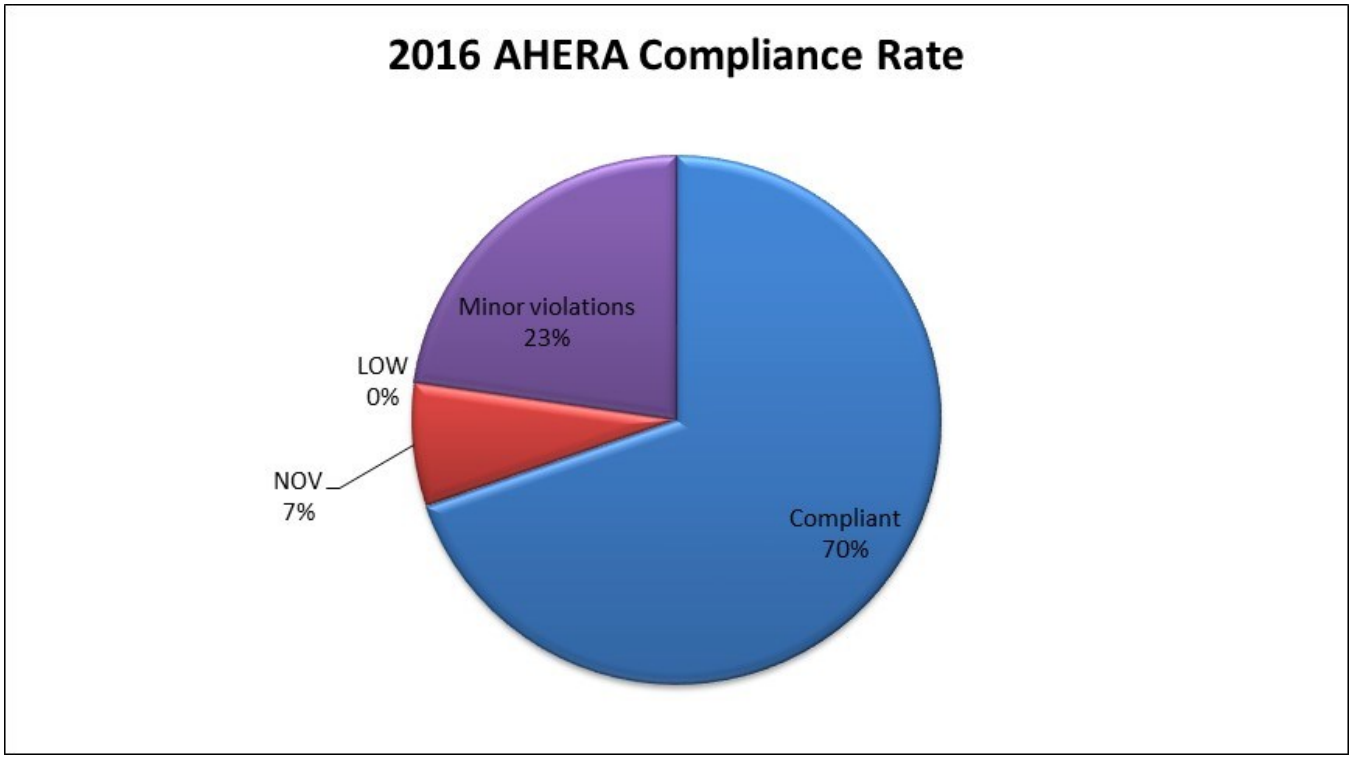


Figure 13: Compliance rate of school inspections for asbestos under the Asbestos Hazard Emergency Response Act (AHERA).

The Permit Review Branch (PRB) is divided into the following specialized sections:

- Chemical Section
- Combustion Section
- Minerals Section
- Surface Coating Section
- Metallurgy Section
- Air Dispersion Modeling
- Permit Support

Figure 14 shows the number of permits issued by section for the years 2014-2016. In calendar year 2016, PRB issued 589 permits, a 21 percent increase over 2015.

At the close of Fiscal Year 2017, PRB had 174 pending applications in-house. Only 34 of the applications were beyond regulatory timeframe.

Air Dispersion Modeling

In FY 2017, the Air Dispersion Modeling Section performed a review of modeling or refined modeling for 51 criteria pollutant and air toxic assessments. They also completed one PSD modeling protocol review and eight NAAQS modeling reviews for sulfur dioxide for state implementation planning purposes. Reviews of modeling to demonstrate attainment with the 1-hr SO2 NAAQS were submitted in January 2017.

The section frequently uses modeling to refine the initial estimates from screening analyses performed by the PRB. These refined modeling runs have yielded data which has been used to verify, adjust or establish limits in permits, justify permit conditions, and protect public health and air quality.

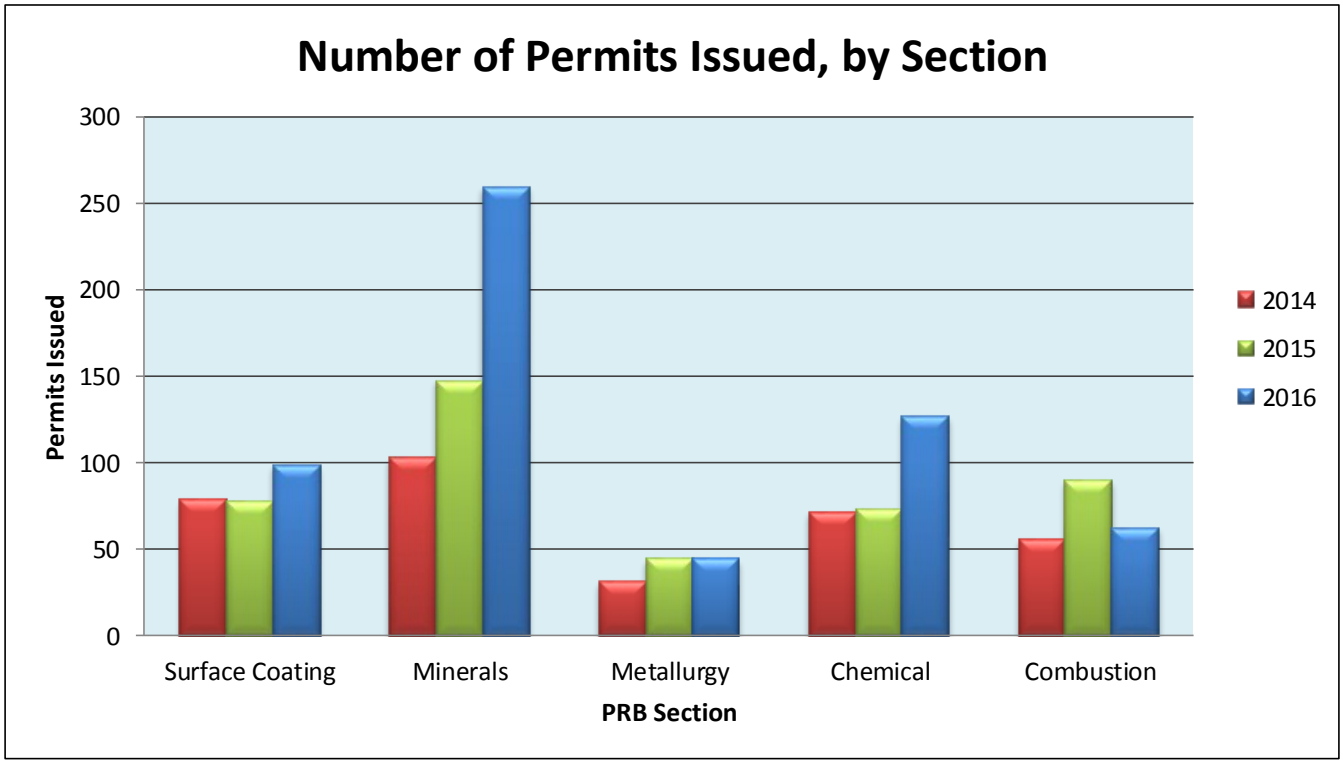


Figure 14: This chart shows the number of permits issued by section category in calendar years 2014-2016. In calendar year 2016, the Division issued 589 permits.

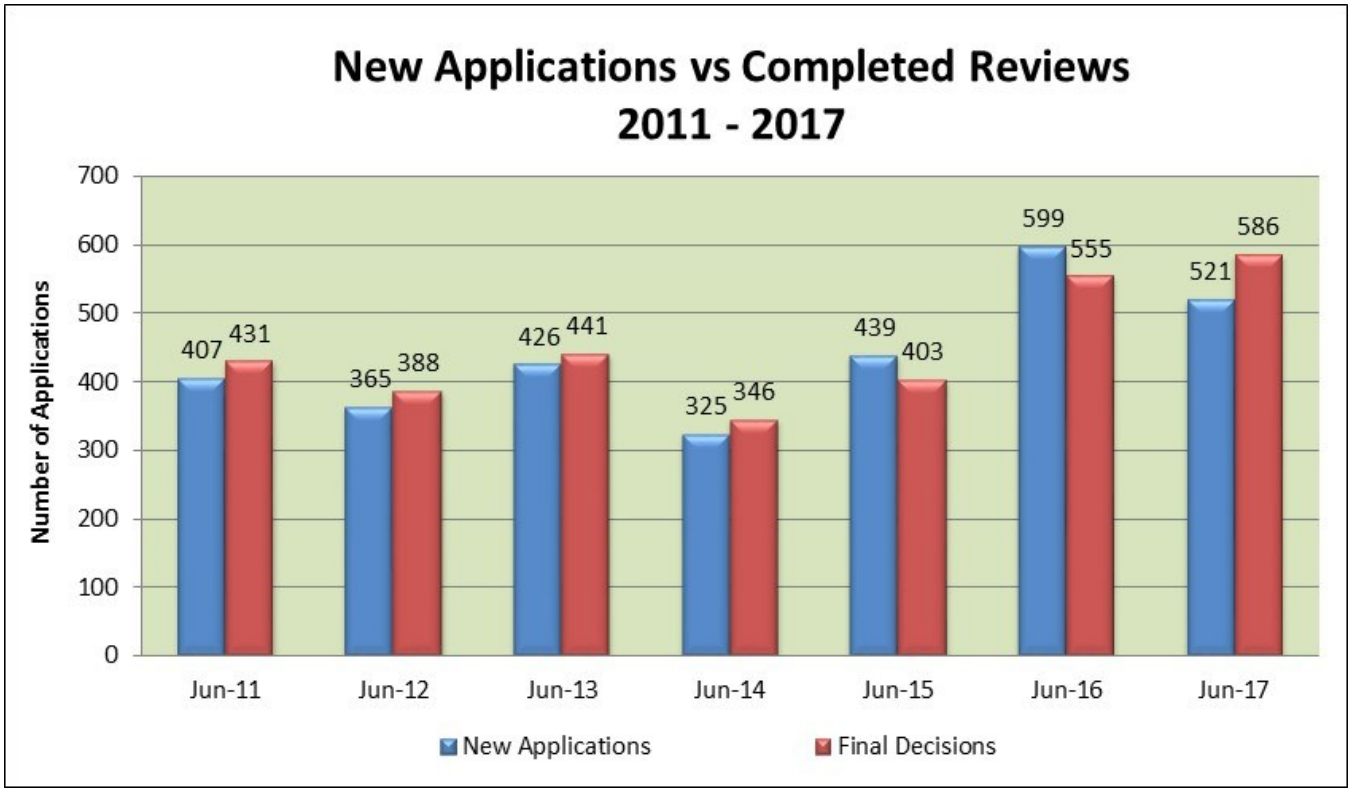


Figure 15: Numbers of completed permits versus new applications during each fiscal year, 2011-2017.

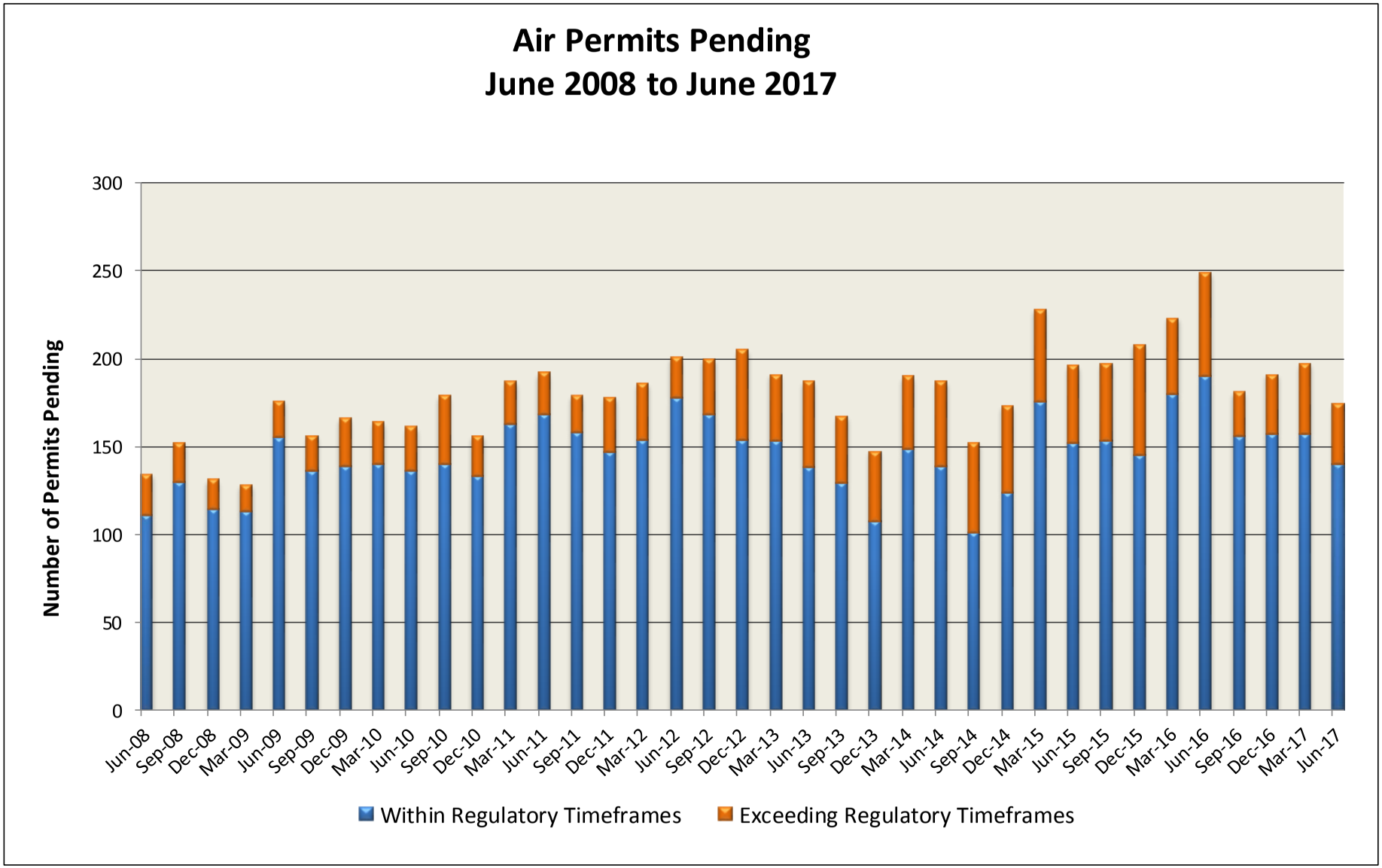


Figure 16: In June of 2017, only 34 of the 174 pending permit applications were beyond the Regulatory Time Frame (RTF), the allotted time for the complete permitting process.

The Program Planning and Administration Branch (PPAB) is the planning and implementation cornerstone of the Division. This branch is responsible for:

- Fiscal management
- Emissions inventory
- Regulation development
- State implementation plan

Fiscal Management

The Division operates primarily on Title V emissions fees and federal grant funds. As mandated by the Clean Air Act (CAA), funding under the Title V program is through air pollutant emission fees assessed to air pollution sources in the state that meet specific criteria. Further authorized in Kentucky by state statute, the Division is mandated to charge fees sufficient to cover the cost of implementing and carrying out the requirements of the Title V program.

The Division surveys permitted sources subject to the Title V fee program each year. Once the agency has determined the overall cost of the program for the fiscal year, the number of tons of pollutants emitted in Kentucky are divided into the projected operating costs to develop a per ton cost. Each source within the Title V program will then be issued a bill based on that per ton cost. Concurrently, the EPA determines a minimum cost per ton of pollutant that an agency should charge to fund the Title V permitting program. This is referred to as the *presumptive minimum*, or the minimum fee, that an agency should charge to fully fund the Title V program. Figure 17 shows the comparison between the EPA presumptive minimum and the actual cost per ton that the Division has charged.

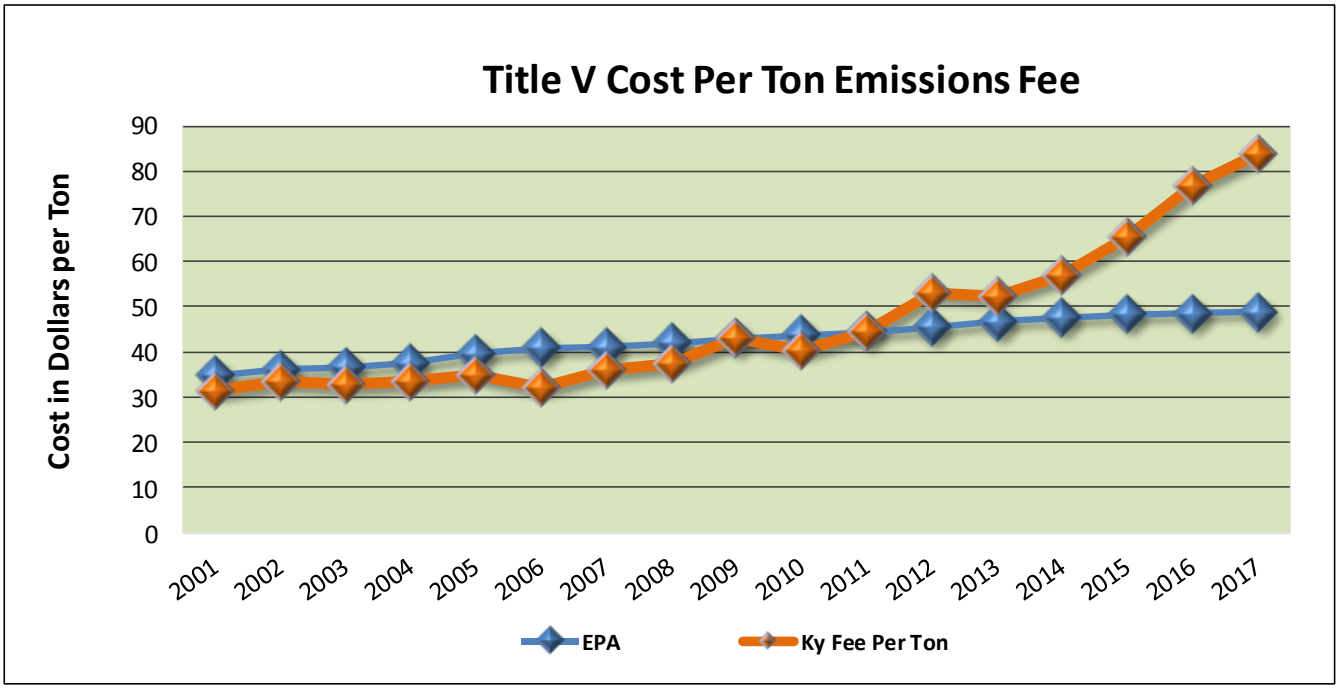


Figure 17: Title V Emission Fees Collected. This chart compares Kentucky's actual fees with EPA's "Presumptive Minimum," which is a suggested minimum fee per ton that states should charge.

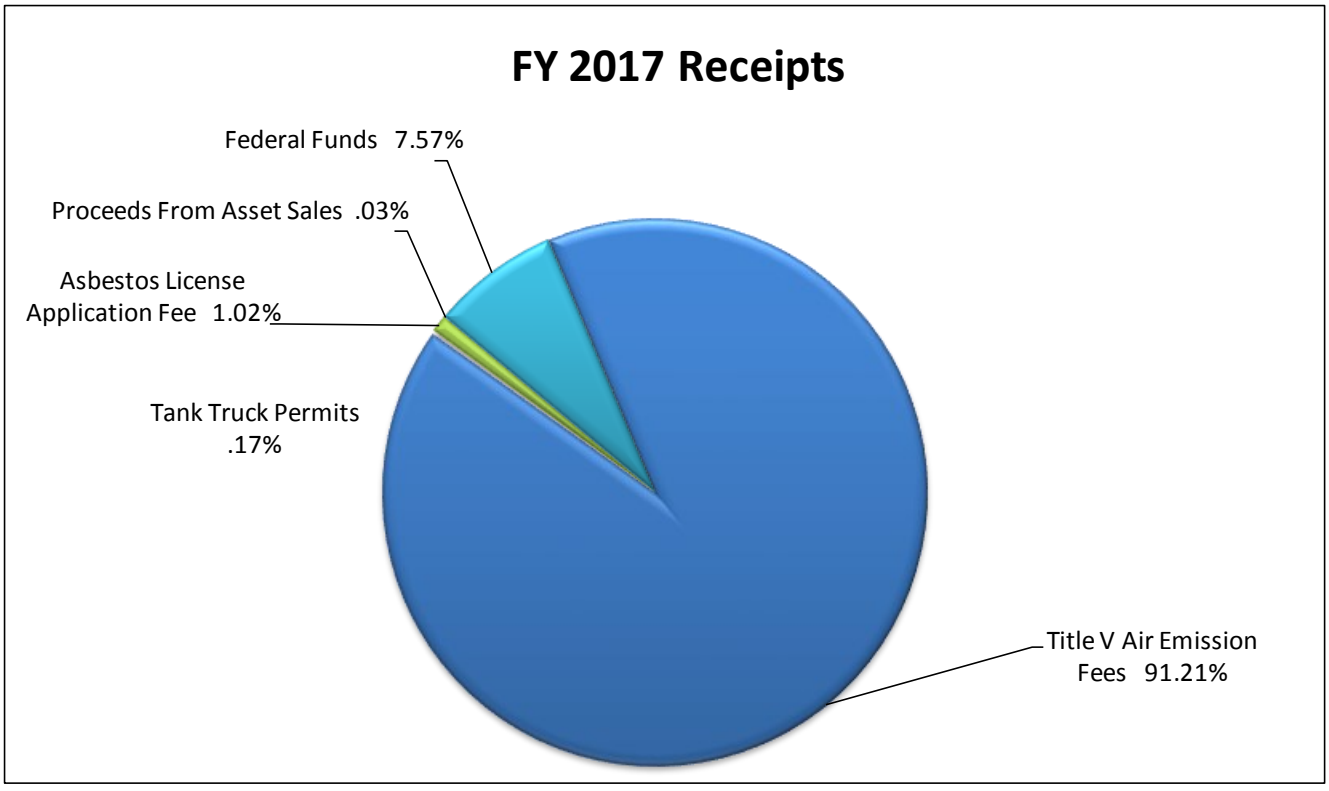


Figure 18: Division for Air Quality FY 2017 Receipts. The Division operates primarily on Title V emission fees and federal grant funds. Other funds are derived from non-state insurance recovery, proceeds from recyclable sales, and proceeds from asset sales.

A breakdown of the Division's revenue for FY 2017 is provided in Figure 18. In addition to Title V air emission fees, the Division receives funds from federal grant programs, tank truck permits, asbestos license and inspection fees.

For FY 2018, Title V emission fees are projected to exceed the federal presumptive amount in order to meet costs associated with maintaining that program and a high level of customer service.

Emissions Inventory

The emissions inventory system is designed to document and track actual and potential air pollutant emissions. The data is then used to develop air quality improvement programs when necessary. In its most basic form, an emissions inventory is a list of sources of air pollutants, and for each source or source type, the amount of each pollutant emitted, or has the potential to be emitted.

Kentucky's point source emissions inventory is maintained by the Emissions Inventory Section. The main function of this section is to continue to improve the comprehensiveness and accuracy of point source emissions information, and ensure the information is current and useable by the Administration Section for billing calculations; the Program Evaluation Section for developing and evaluating emissions control programs; and the Permit Review Branch for permitting additional large sources within a given geographic area.

The Emissions Inventory Section surveys nearly 1,200 plants per year to determine actual air pollutant emissions for the previous calendar year. Figure 19 shows the emissions inventory for 2015; at the time of publication of this report, data for calendar year 2016 was still being verified. It takes approximately nine months to verify and complete the inventory for the previous year.

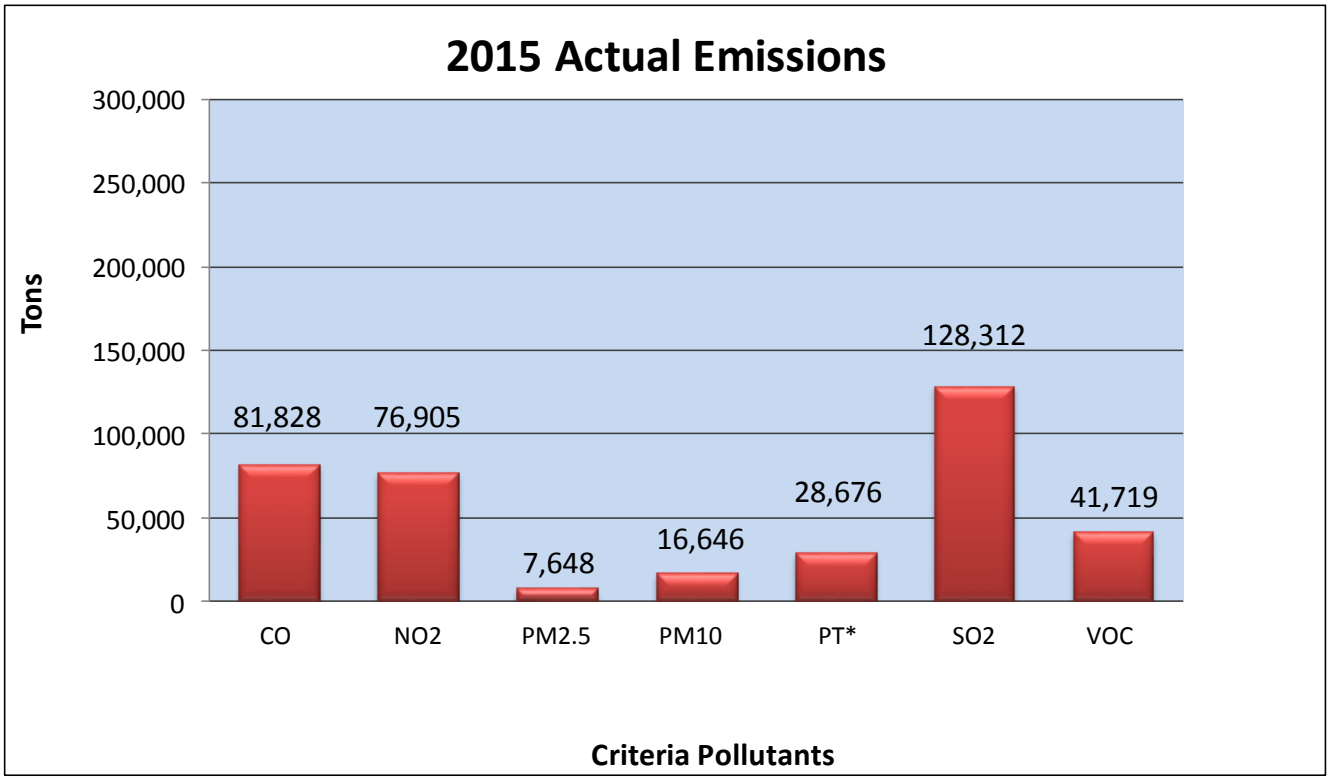


*Figure 19: Actual tons of pollutants emitted by surveyed, regulated entities in Kentucky for the calendar year 2015. Although DAQ receives inventory emission data at the beginning of each calendar year, it takes approximately nine months to verify and complete the inventory. *PT = Total Particulate Matter*

Greenhouse Gas Emissions

EPA's Greenhouse Gas Reporting Rule requires mandatory reporting of greenhouse gases (GHGs) from sources that in general emit 25,000 metric tons or more of carbon dioxide equivalent (CO2e) per year in the U.S. Most small businesses fall below the 25,000 metric ton threshold and are not required to report GHG emissions to EPA.

Though DAQ is not required to report GHG emissions on behalf of facilities, DAQ's Emissions Inventory section collects GHG data when available. Figure 20 below shows GHG emissions data from 2011 through 2015 calendar years.

Greenhouse Gas	2011 Actual Emissions (tons)	2012 Actual Emissions (tons)	2013 Actual Emissions (tons)	2014 Actual Emissions (tons)	2015 Actual Emissions (tons)
Carbon Dioxide	115,588,860	106,395,292	96,288,161	100,438,102	92,176,908
Methane	45,772	51,417	112,528	100,197	88,373
Nitrous Oxide	4,127	4,001	3,736	3,810	3,519
CO2e (metric tonnes)	106,893,062	98,624,914	90,545,487	94,096,177	86,712,303*
CO2e (tons)	117,829,437	108,715,363	99,809,319	103,723,251	95,583,925*

*Figure 20: Kentucky greenhouse gas emissions, 2011-2015. Landfills have always emitted methane but those emissions were not tracked until 2013. Emissions of GHGs are typically expressed in a common metric (CO2e) so that their impacts can be directly compared, as some gases have a higher warming potential than others. * The CO2e figures for 2015 utilize the IPCC's updated GWP factors. http://ghginstitute.org/2010/06/28/what-is-a-global-warming-potential/*

Regulation Development

The Regulation Development Section drafts and adopts regulations to control air pollution in the state. Regulations can be drafted in response to:

- Federal mandates to control air pollution or specific air pollution sources;
- A state mandate, made by either the governor or the legislature, to control air pollution within the Commonwealth; or
- An action identified by the cabinet as necessary to protect human health and the environment.

Regulations can be adopted for specific controls to address specific air quality concerns within the state. While the agency receives its authority to draft and adopt air quality regulations under KRS Chapter 224, it is also governed on the drafting of those regulations by KRS 13A, which specifies regulatory drafting procedures as well as public participation in the regulatory promulgation process.

From July 2016 through June 2017, the Regulatory Development Section filed the following administrative regulations:

July, 2016, 401 KAR 51:010. *Attainment status designations*; filed the Statement of Consideration and an Amended After Comments version;

Nov. 14, 2016, 401 KAR 60:005. *40 C.F.R. Part 60 standards of performance for new stationary sources*;

amended to adopt standards promulgated by EPA, through July 1, 2016;

Nov. 14, 2016, 401 KAR 63:002. *40 C.F.R. Part 63 national emission standards for hazardous air pollutants*; amended to adopt standards promulgated by EPA, through July 1, 2016; and

Nov. 14, 2016, 401 KAR 63:060. *List of hazardous air pollutants, petitions process, lesser quantity designations, and source category list*; amended to adopt the list of source categories and HAPs consistent with EPA.

Federal Registers relevant to the activities of the Division were reviewed and comments were compiled and submitted to the EPA on several major federal regulatory proposed actions, including:

On Aug. 9, 2016 - comments were submitted on the proposed rule, *Protection of Visibility: Amendments to Requirements for State Plans*;

On September 2,2016, comments were submitted on the proposed rule, *Clean Energy Incentive Program Design Details;* and

Apr. 6, 2016, comments were submitted regarding the *Notice of Data Availability (NODA) of the Environmental Protection Agency's Preliminary Interstate Ozone Transport Modeling Data for the 2015 Ozone National Ambient Air Quality Standard (NAAQS)*.

Finally, the Regulatory Development Section also conducted multiple research projects involving various topics designed to protect air quality throughout the Commonwealth of Kentucky, including but not limited to: granting concurrence to the regulations adopted by the Louisville-Metro Air Pollution Control District (LMAPCD), as well as several other research projects that will have a positive effect on air quality throughout the Commonwealth.

State Implementation Plan

The State Implementation Plan (SIP) is a state-specific plan to ensure attainment and maintenance of the various NAAQS within a state or region. Once regulations or programs are adopted into the SIP, they become federally-enforceable. Overall, the framework and components of the SIP are designed to ensure that states continue to move forward in achieving air quality that meets the national standards, and once achieved, that air quality continues to maintain those standards. In short, the SIP is the mechanism for air resource management. Air resource management begins with:

- A determination of existing conditions – air quality, meteorological conditions, and an inventory of emissions;
- Development of goals or objectives for an area (typically air quality standards that must be met or maintained); and
- Development of control strategies that may include emission reduction measures or measures to ensure no further degradation of air quality occurs.

A key component of air resource management, or SIP development, is coordination with the local communities who have a stake in how a plan is to be implemented.

The following section summarizes recent NAAQS revisions, area designations, and control strategies for each of the six criteria pollutants covered by the NAAQS. For a complete listing of the current NAAQS, see Appendix F beginning on Page 87.

Ozone (O_3)

Ground-level ozone is a secondary pollutant that is formed when volatile organic compounds (VOCs) and nitrogen oxides (NO_x) combine in the presence of heat and strong sunlight.

On July 20, 2012, portions of the Kentucky counties of Boone, Campbell, and Kenton were designated as nonattainment for the 2008 8-hour ozone standard of 0.075 ppm. The portions are approximately the northern half of each county. Although Kentucky did not have a violating monitor, the EPA determined that emissions from those partial counties were contributing to the violating monitor located in Hamilton County, Ohio. On May 4, 2016, EPA determined that the Cincinnati-Hamilton, OH-KY-IN area attained the 2008 Ozone NAAQS by the July 20, 2015 attainment date. The Division submitted the final package for this redesignation request to EPA on August 5, 2016. On July 5, 2017, EPA redesignated the area from nonattainment to attainment for the 2008 Ozone NAAQS.

On Oct. 26, 2015, the EPA published *National Ambient Air Quality Standards for Ozone: Final Rule* in the Federal Register. The final rule revises the level of the primary Ozone NAAQS from the current level of 0.075 ppm to 0.070 ppm. State recommendations for designations of attainment or nonattainment for areas within the Kentucky were submitted to EPA on Sept. 30, 2016. EPA is scheduled to designate areas by Oct. 1, 2017.

Fine Particulate Matter (PM_{10} and $PM_{2.5}$)

Effective Mar. 18, 2013, the EPA finalized the change in the annual $PM_{2.5}$ standard from 15 µg/m^3 to 12.0 µg/m^3, as calculated on an annual average. In a letter to the EPA, dated Dec. 5, 2013, Kentucky recommended all counties with certified air monitoring data be designated as attainment and those counties without certified monitoring data (the remaining portion of the state) be designated as attainment/unclassifiable.

In an Aug. 19, 2014 letter, the EPA notified Kentucky that Jefferson County and a portion of Bullitt County would be designated as nonattainment, indicating that the emissions from that are contributed to the violating monitor in Clark County, Indiana. Through a series of letters and additional documentation sent to the EPA, in addition to certified monitoring data from Indiana, indicating the previously violating monitor was in compliance, the EPA published final designations on Apr. 7, 2015. The final action changed the designation for the Kentucky portion of the Louisville, KY-IN area from nonattainment to unclassifiable.

On Feb. 8, 2016, the Kentucky Energy and Environment Cabinet submitted a final SIP certification letter to EPA certifying that Kentucky's existing SIP for the 2012 $PM_{2.5}$ NAAQS contains the provisions of Section 110 of the CAA that address the requirements for purposes of implementing the 2012 $PM_{2.5}$ NAAQS. The final package submitted to EPA included a response to comments document. At the time of this publication, EPA has not taken action on the submittal.

Nitrogen Dioxide (NO_2)

On Feb. 9, 2010 , the EPA strengthened the standard for nitrogen dioxide (NO_2). The new standard is set at a 1-hour level of 100 parts per billion (ppb). A Feb. 17, 2012 Federal Register designated all areas in Kentucky as unclassifiable/attainment.

Sulfur Dioxide (SO_2)

On June 22, 2010, the EPA strengthened the NAAQS for sulfur dioxide (SO_2). This standard had not been changed since 1971 and the EPA was required under a judicial consent decree to review the primary standard. On July 13, 2011, the EPA announced the proposed secondary standard, which addresses public welfare. The rule was finalized on Apr. 3, 2012.

Effective Oct. 4, 2013, a portion of Campbell County and a portion of Jefferson County were designated nonattainment for the 2010 SO_2 NAAQS. To date, the most significant emissions source remaining in the Jefferson County nonattainment area is CEMEX. The Division and LMAPCD prepared and submitted a nonattainment SIP revision to EPA on June 23, 2017. At the time of this publication, EPA had not taken action on the submittal.

On Mar. 31, 2015, Kentucky submitted a request for a Clean Data Determination (CDD) to the EPA for approval for the northern Kentucky portion of the nonattainment area. Certified monitoring data shows that the area is in compliance with the 2010 SO_2 NAAQS. The Division submitted a redesignation package to the EPA on Feb. 22, 2016, requesting designation of the Kentucky portion of the area be revised from nonattainment to attainment for the 2010 SO_2 NAAQS. On Mar. 10, 2017, EPA approved Kentucky's Clean Data Determination and redesignation request, changing the designation status of the portion of Campbell County from nonattainment to attainment.

EPA notified Kentucky by letter, on Mar. 20, 2015, that two power plants were identified for the next round of SO_2 designations: DB Wilson Generating Station in Ohio County, and John S. Cooper Power Station, located in Pulaski County. Kentucky responded with a letter on September 16, 2015, recommending that both areas be designated as attainment. EPA notified the cabinet by letter on June 30, 2016, that they would be designating Ohio and Pulaski Counties as unclassifiable.

As part of the 2010 SO_2 Data Requirements Rule (DRR), the Division reviewed sources in the state that emit 2,000 tpy or more of SO_2. On June 20, 2016, the Cabinet submitted a letter to EPA, as required by the DRR, identifying 16 sources, and the method of characterization to be used based on the DRR. On Jan. 6, 2017 the Division submitted documentation to EPA addressing the Data Requirements Rule for the 2010 1-Hour SO_2 NAAQS. The submittal and supporting documentation identifies which methods have been chosen to characterize the air quality around the 16 sources within Kentucky to which the DRR applies. One facility selected to monitor emissions rather than model, and a new monitoring site was added to the Ambient Network Plan. This site was operational by the Jan. 1, 2017 required date.

Lead

The EPA revised the NAAQS for lead to 0.15 $\mu g/m^3$ in November of 2008. In an action final on Dec. 27, 2011, the EPA also lowered the monitoring threshold from 1.0 tpy to 0.5 tpy. Kentucky has been monitoring for lead as required, and all areas are in compliance. On Jan. 5, 2015, the EPA proposed to retain the current

lead NAAQS of 0.15 µg/m^3. As of the publication of this report, no final rule had been published.

Visibility

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.

As required by the Clean Air Act and Regional Haze Rule, the Division submitted a final SIP revision that included Kentucky's Regional Haze 5-Year Periodic Report to the EPA for approval. As of the publication of this report, the EPA had not taken any action on Kentucky's submittal.

Excess Emissions during Startup, Shutdown, and Malfunction (SSM) SIP Call

On May 22, 2015, the EPA took final action on a petition for rulemaking filed by the Sierra Club (Petitioner) concerning how provisions in EPA-approved SIPs treat excess emissions during periods of SSM. Further, the EPA clarified, restated and revised its guidance concerning its interpretation of the CAA requirements with respect to treatment of excess emissions that occur during periods of SSM in SIPs. EPA evaluated existing SIP provisions for the states identified in the petition, including Kentucky, for consistency with the EPA's interpretation of the CAA. EPA issued a finding that certain SIP provisions were substantially inadequate to meet CAA requirements and thus issued a "SIP call" for each of the 36 states, including Kentucky. Corrective SIP revisions were due to EPA by Nov. 22, 2016.

On Nov. 17, 2016, Kentucky submitted a SIP Revision to address the SSM SIP Call. This SIP revision requested that EPA remove the "inadequate language" identified by EPA in 401 KAR 50:055 from the Kentucky SIP. As of the publication date of this document, EPA had not acted on the submittal.

The Technical Services Branch (TSB) oversees three essential functions of the Division:

- Source sampling to ensure compliance with emission limits
- Operation and maintenance of a state-wide ambient air monitoring network
- Data analysis and quality assurance of ambient air monitoring data

Source Sampling

Facilities throughout the Commonwealth are required by federal regulations, state regulations and permits to sample the emissions being released from identified point sources. Samples must be collected and analyzed in accordance with federally promulgated test procedures and methods.

The Source Sampling Section, in conjunction with Field Operations Branch and Permit Review Branch, reviews test protocols prior to the test to ensure proper procedures and methods will be followed. The Source Sampling Section also makes every effort to observe scheduled source tests throughout the Commonwealth. Following a test, a report is submitted to the Division where it is reviewed for accuracy and completeness. The compliance status of the facility is also determined based on the approved reported test results. Source tests are then reported to EPA's ICIS-Air database based upon data entered into the state-operated TEMPO database by the Source Sampling Section.

In 2016, the Source Sampling Section received 464 Compliance and Relative Accuracy Test Audit (RATA) test protocols by Kentucky facilities; 264 tests were scheduled compliance tests and 167 were scheduled RATA tests. The section reviewed all protocols for compliance tests that were received. The section received 40 cancellations during 2016 resulting in a total of 417 tests scheduled, as seen in Figure 21. The section observed 186 (83 percent) of the 417 scheduled compliance tests that were performed. Additionally, the Source Sampling Section received 492 RATA and Compliance test reports and completed 350 technical reviews of test reports, as seen in Figure 22.

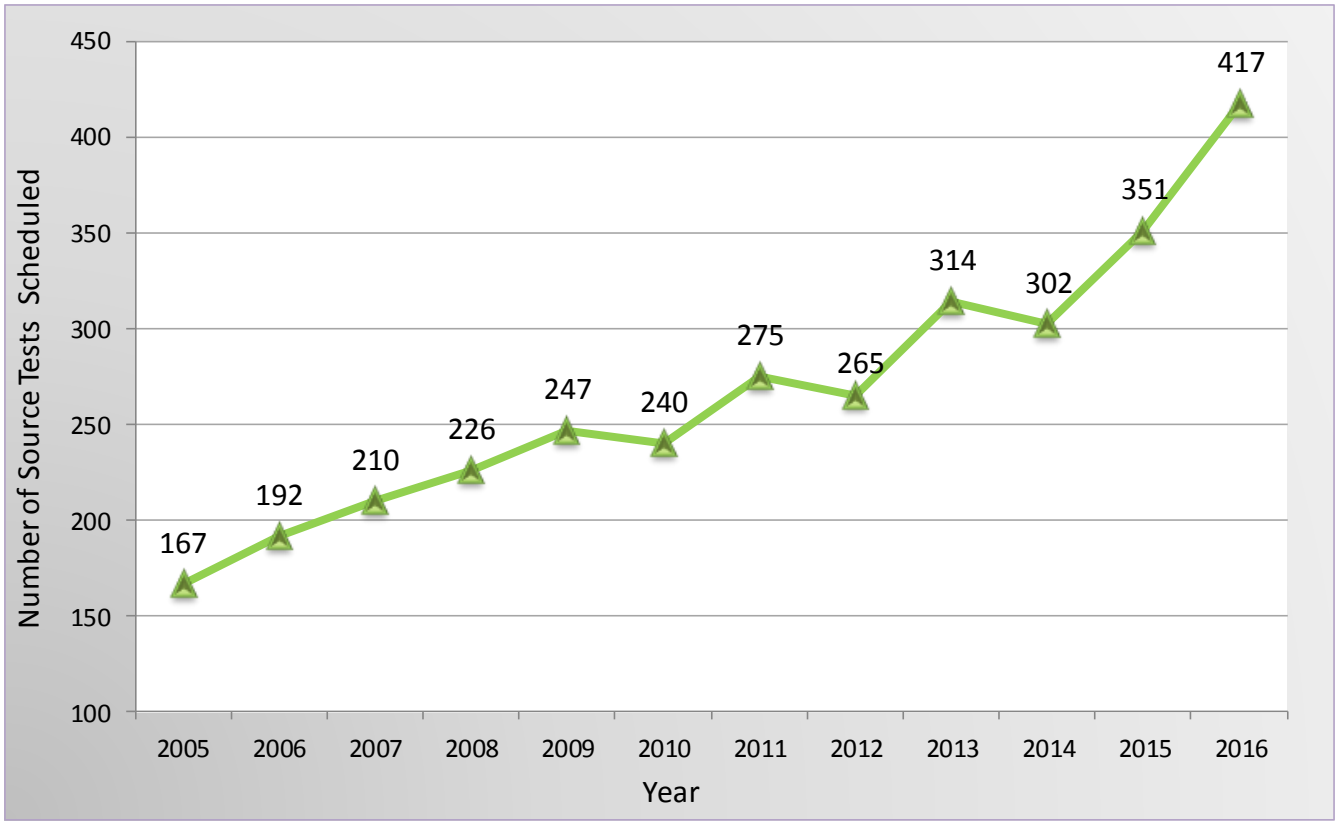


Figure 21: The last ten years have shown an overall increase in source testing throughout the state.

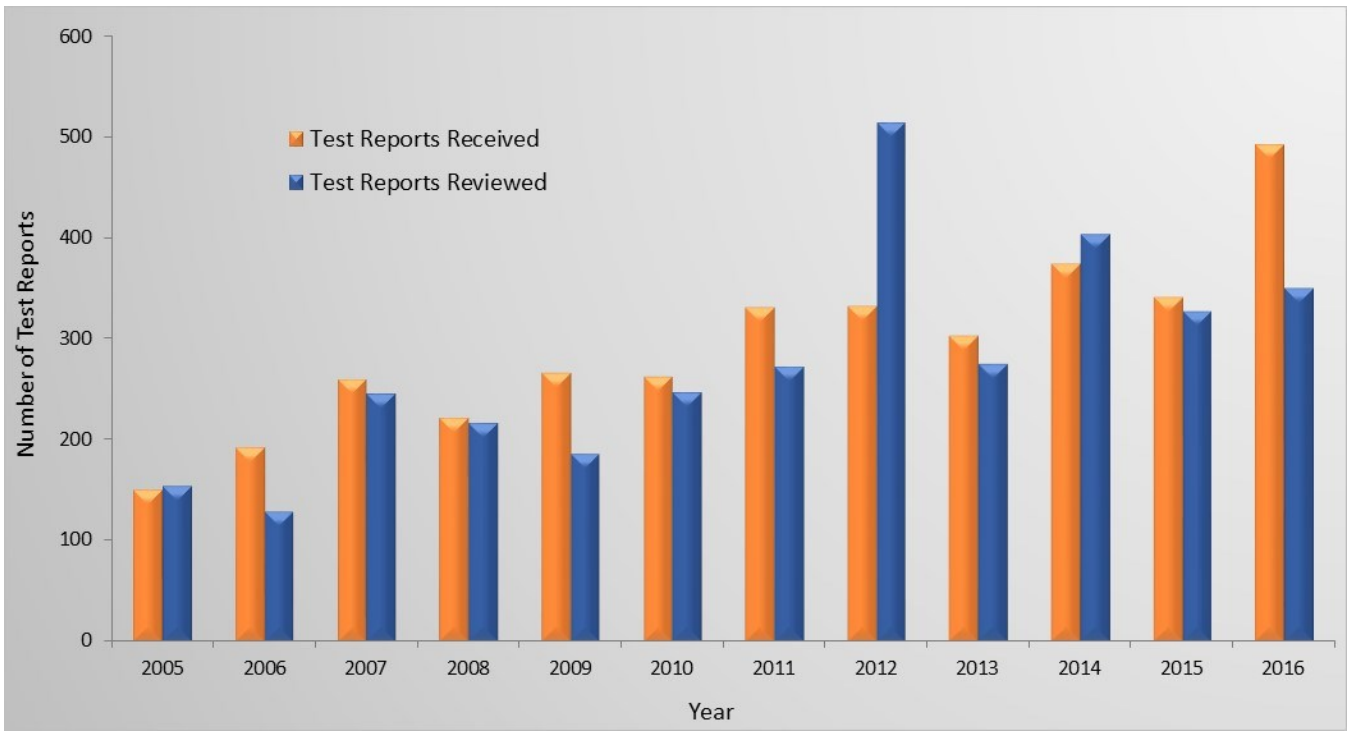


Figure 22: The Source Sampling Section successfully completed 350 technical reviews of source test report data in 2016.

Ambient Air Monitoring Network

Kentucky has operated an ambient air monitoring network since 1967. The 2016 network included 35 monitoring stations in 26 counties; this total includes monitors operated by the Louisville Metro Air Pollution Control District (LMAPCD) and the National Park Service (NPS) at Mammoth Cave.

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 sources of pollution, whether it's a busy highway or a stationary source with a smokestack. The site locations are reviewed annually to ensure that adequate coverage is being provided and regulatory requirements are met.

Each year, the Division is required to submit an annual Ambient Air Monitoring Network Plan, which describes the ambient air monitoring network in detail. The 2016 plan was submitted to the EPA by the July 1 regulatory deadline after undergoing a 30 -day public comment period. The Ambient Air Monitoring Network Plan is available for review on the Division's website at http://air.ky.gov/Pages/DivisionReports.aspx.

(Above & lower left) Air samplers at the division's Grayson Lake and Ashland monitoring sites. (Photos: DAQ)

Pages 33-74 of this annual report contain tables and graphs that summarize the concentrations of pollutants measured in Kentucky during the calendar 2016 year, as well as 2016 design values. A **design value** is a calculated metric that is used to determine compliance with each particular 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 alternate intervals of time for the calculation. For example, lead uses a 3-month rolling average and one of the two primary NAAQS for nitrogen dioxide uses an annual average.

The actual number of sites in operation in a calendar year may differ slightly from the network represented in the Network Plan. The network map on Page 31 is representative of the network, as submitted to the EPA. However, the maps of each individual pollutant network represent all monitors that collected data within the calendar year, which may differ from the network submitted to the EPA in the 2016 Ambient Air Monitoring Network Plan.

It's 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 specified amount of time.

For specific information on criteria pollutant health effects, sampling, and analysis, see Appendix B: Criteria Pollutants beginning on Page 78. For a complete listing of the current NAAQS, see Appendix F beginning on Page 87.

Any data contained in this report is subject to change. The most current quality assured dataset can be obtained through a Kentucky Open Records Act request. Instructions for requesting data can be found at http://eec.ky.gov/Pages/OpenRecords.aspx.

Data Quality Assurance

TSB validates all ambient data collected by the monitors and samplers in the network. Upon completing its review of 2016 data, the Division submitted its annual data certification request to EPA prior to the May 1 regulatory deadline. This data certification package includes reports that summarize all the hours of valid data collected and the quality control measures taken to ensure the accuracy of the data, as well as the number of annual performance evaluations completed.

TSB maintains a library of Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs) for each instrument operated in the monitoring network. In 2016, TSB finalized a new QAPP and completed revisions to one SOP. Overall, there are three active and current QAPPs, as well as 18 active SOPs, in the DAQ library.

Environmental scientist John Walker inspects a new particulate matter sampler. (Photo: DAQ)

In 2016, personnel within the TSB conducted a total of 339 performance audits of air monitoring equipment throughout Kentucky; this number includes performance audits conducted on monitors operated by Mammoth Cave National Park and the Louisville Metro Air Pollution Control District. Such audits are crucial to ensuring data quality and verifying instrument function. Additionally, a total of 39 technical systems audits were performed to ensure that operational procedures at each site were followed.

TSB staff also completed a total of 176 instrument service trips in the field and repaired an additional 82 monitors in-house in 2016. Acceptance testing was conducted on seven newly purchased instruments, in order to ensure that stated specifications were met by the manufacturer. During the year, the TSB replaced shelters at four sites and repaired existing shelters at two additional sites.

During 2016, TSB began outsourcing the gravimetric weighing of particulate matter filters to a contract laboratory. Following collection in the field, filters are sent to the contract laboratory for analysis. Each filter is analyzed in accordance with EPA-approved methods; the temperature and humidity within the weigh-laboratory are monitored with National Institute of Standards and Technology (NIST) traceable equipment to document environmental compliance. The results of analysis are returned to TSB for final review.

TSB continues to implement a robust training program, which focuses on providing Division air monitoring staff with the foundation necessary to collect and analyze ambient air data. TSB staff continue to participate in a number of local and national workgroups. Staff presented at numerous conferences and meetings during the year.

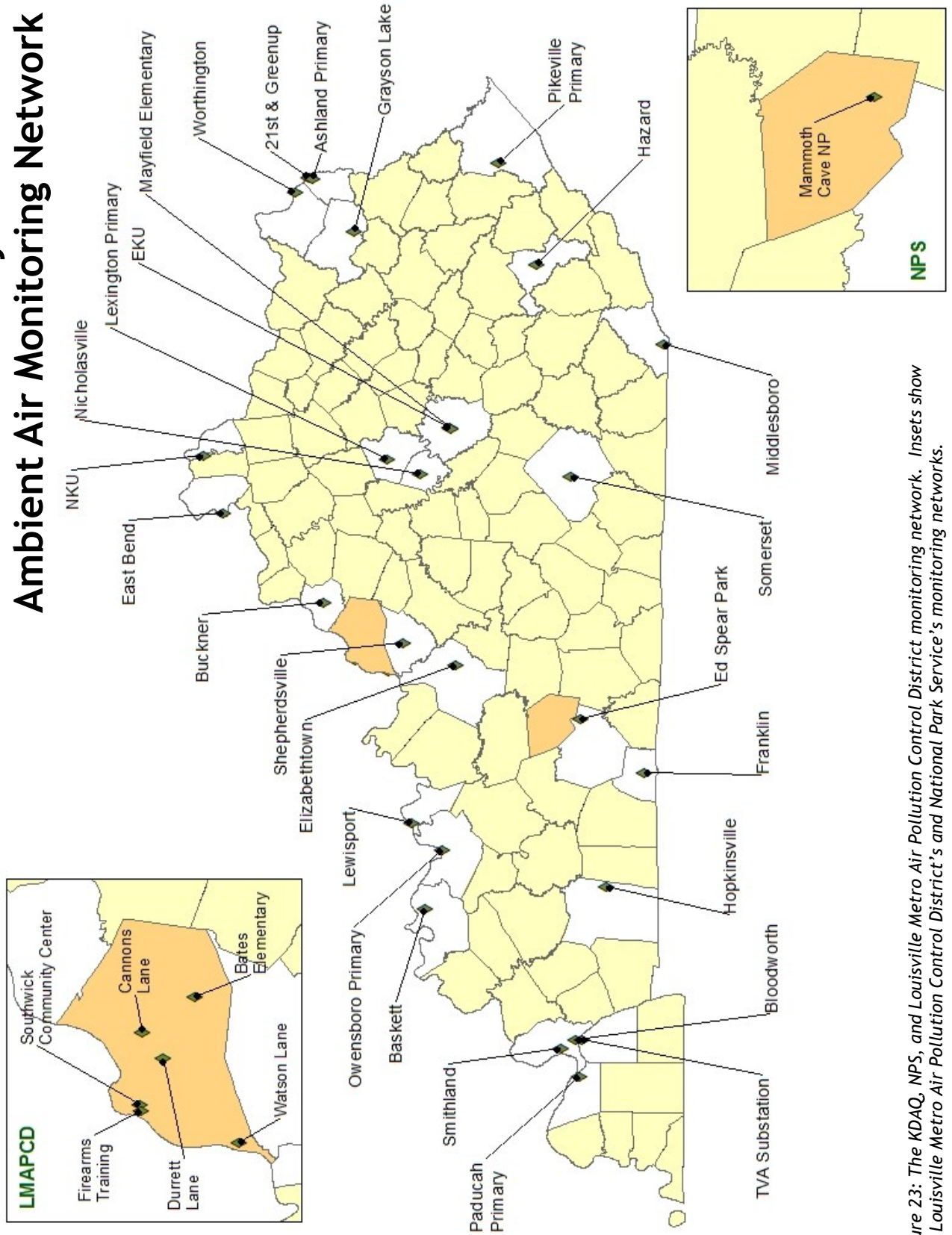


Figure 23: The KDAQ, NPS, and Louisville Metro Air Pollution Control District monitoring network. Insets show the Louisville Metro Air Pollution Control District's and National Park Service's monitoring networks.

Metropolitan Statistical Area	Site Count	$PM_{2.5}$	Continuous $PM_{2.5}$	PM_{10}	Continuous PM10	SO_2	NO_2	NOy	CO	O_3	Pb	VOC	Car-bonyl	PAH	$PM_{2.5}$ Speciation	Carbon Speciation	RadNet	Met
Bowling Green, KY	2	2^{C}	2^{i}			1		1	1	$2^{i, Max}$								1
Cincinnati-Middletown, OH-KY-IN (AQI) (PWEI)	2	1	1^{i}			1^{i}	1^{i}			2^{i}								1
Clarksville, TN-KY	1	1^{X}								1								1
Elizabethtown, KY	1	2^{C}	1							1^{Max}								
Evansville, IN-KY (PWEI)	2	1	1	1^{m}		2^{DRR}				1^{Max}								
Huntington-Ashland, WV-KY-OH (AQI) (PWEI)	3	1	1^{i}	$2^{C,m}$		2^{i}	1^{i}			$2^{i, Max}$		1						1
Lexington-Fayette, KY (AQI) (PWEI)	2	1	1^{i}	1^{m}		2^{i}	$1^{r40,i}$			$2^{i, Max}$		1					1	1
Louisville-Jefferson County, KY-IN (AQI) (PWEI)	8	$5^{n,C}$	$4^{i,B,*}$	1^{Lead}	$3^{i,,B}$	3^{i}	$2^{n,i}$	1	2^{ni}	$5^{i, Max}$					1^{U}	1^{U}	1	6^{n}
Owensboro, KY	2	1	1^{i}			1^{i}	1^{i}			$2^{i, Max}$								1
Micropolitan Statistical Area																		
Paducah, KY-IL (PWEI)	3	1	1^{i}	2^{m}		1^{i}	1^{i}			2^{i}		1					1	1
Somerset, KY	1	1								1								
Middlesboro, KY	1	1								1								1
Richmond-Berea, KY	2	1									3							
Not in a CBSA																		
Carter County	1	1^{X}		$2^{C,m}$						1		2^{D}	2^{D}	1				1
Marshall County	2											2^{C}						
Perry County	1	1	1							1								1
Pike County	1	2^{C}	1^{i}							1^{i}								
Simpson County	1									1								1
KDAQ Totals	28	18	10	8	0	9	5	0	0	22	3	7	2	1	0	0	2	11
LMAPCD Totals	6	5	4	1	3	3	2	1	2	3	0	0	0	0	1	1	1	5
NPS Totals	1	0	1	0	0	1	0	1	1	1	0	0	0	0	0	0	0	1
Total 2016 Network	**35**	**23**	**15**	**9**	**3**	**13**	**7**	**2**	**3**	**26**	**3**	**7**	**2**	**1**	**1**	**1**	**3**	**17**

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network. PWEI= PWEI SO2 Monitoring Required in MSA; r40=RA-40 Monitor; Max= Maximum O3 Concentration Site; n=Near-Road Monitor; X= Regional PM2.5 Transport or Background Monitor; B=Continuous BAM; *=BAM Eligible for NAAQS Comparisons; AQI=AQI Monitoring Required in CBSA; i=AQI Reported; m= PM10 Filter Analyzed for Metals; Lead=PM10 Filter Analyzed for Lead; C=Collocated Monitors ; D= Duplicate Channels; U= Additional Monitor Used for Weekend and Holiday Sampling; DRR= SO2 Data Requirements Rule Monitor

2016 Carbon Monoxide Ambient Air Monitoring Network
(Louisville Metro Air Pollution Control District and National Park Service)

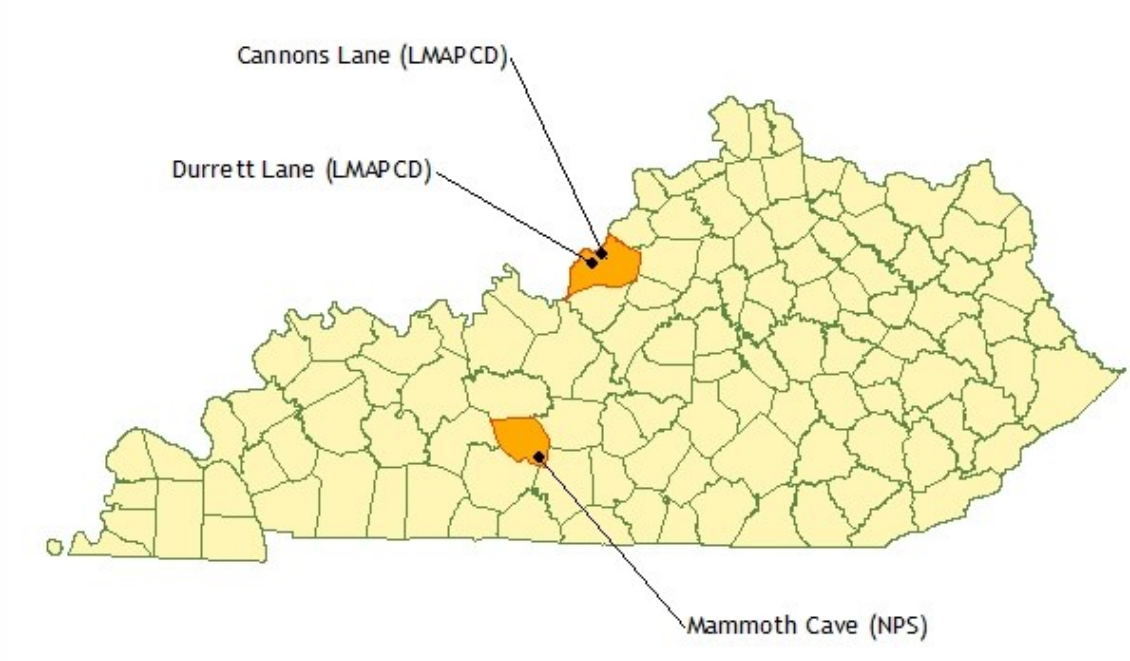


Figure 24: Carbon monoxide monitoring in Kentucky is currently only conducted by the Louisville Metro Air Pollution Control District and the National Park Service. Jefferson County historically has had higher levels of CO than elsewhere in the state, perhaps due to the high levels of vehicle traffic in the area.

Statewide Averages for Carbon Monoxide

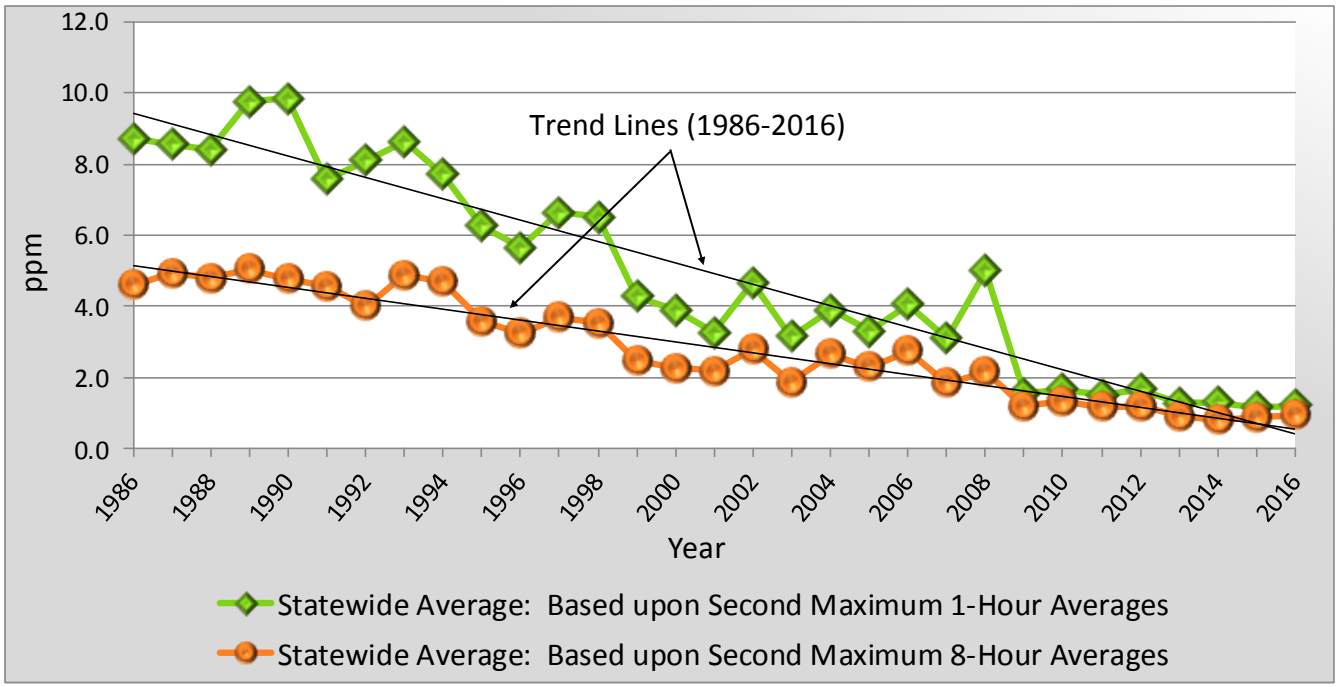


Figure 25: Statewide averages for CO monitoring indicate pollution reductions.

Carbon Monoxide Results

There were no exceedances of the CO standards in 2016. 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. In 2016, the Louisville Metro Air Pollution Control District operated two CO monitors, while the National Park Service operated one CO monitor at Mammoth Cave National Park.

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. The 2003 statewide discontinuation of CO monitors accounts for the uptrend from 2003 to 2008, as seen in Figure 26, because the annual average had been based on data only from Jefferson County. Jefferson County has historically had higher CO levels than the rest of the state. In 2009, another dramatic shift, this time downward, can be attributed to the establishment of monitoring at Mammoth Cave, a rural area with fewer mobile sources.

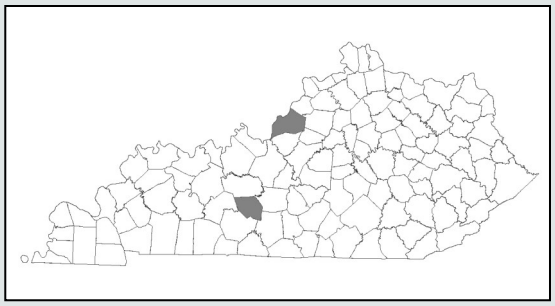
National Ambient Air Quality Standards for Carbon Monoxide

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: None

Criteria Pollutant Summary Report – 2016

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		
				1st max	2nd max	Obs> 35.0	1st max	2nd max	Obs> 9
Edmonson[1]	Alfred Cook Rd Mammoth Cave	21-061-0501	5735	0.42	0.32	0	0.3	0.3	0
Jefferson[2]	2730 Cannons Ln Louisville	21-111-0067	8414	2.47	1.67	0	1.3	1.3	0
Jefferson[2]	1517 Durrett Lane Louisville	21-111-0075	8055	1.73	1.63	0	1.2	1.2	0

[1] Monitor operated by the National Park Service.
[2] Monitor operated by the Louisville Metro Air Pollution Control District.

2016 Lead Ambient Air Monitoring Network

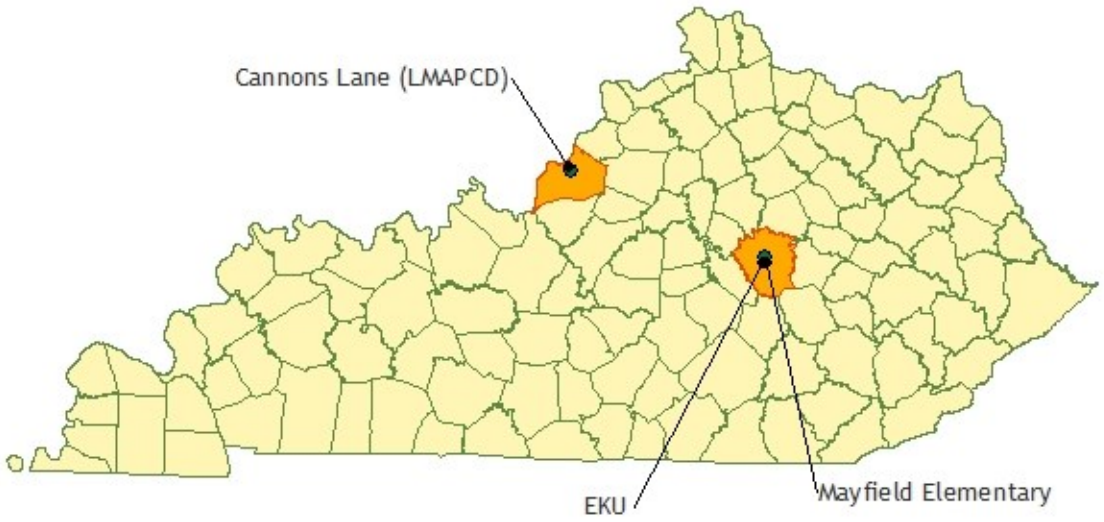


Figure 26: Lead monitoring locations in Kentucky.

Three-Month Rolling Averages for Lead

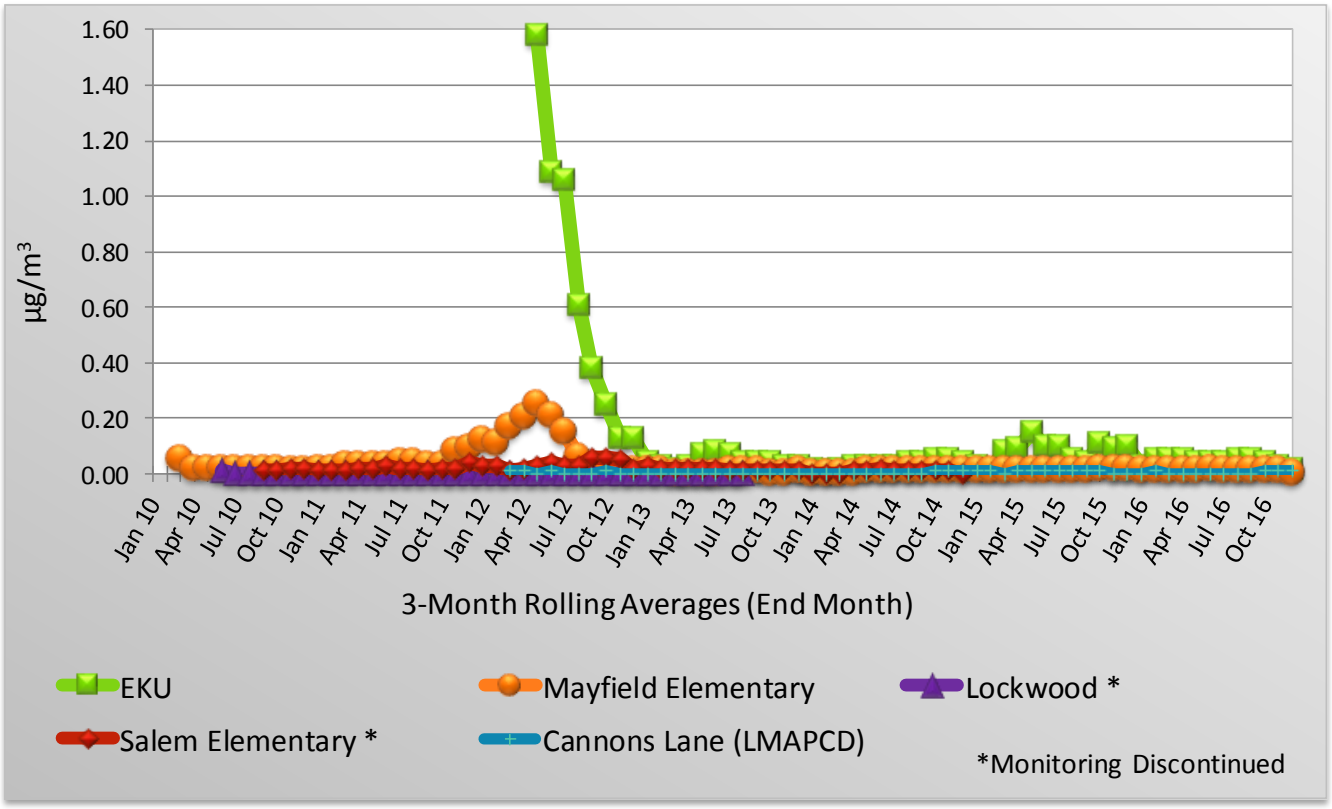


Figure 27: Three-month rolling averages for lead for each site in operation since 2010. Each three-month average is plotted on the month that the three-month period ended. Monitoring data is only available for 2010-2016.

Lead Results

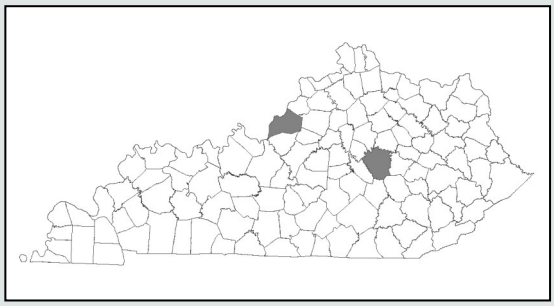
In 2012, the Mayfield Elementary and Eastern Kentucky University sites in Richmond were affected by a compliance issue with a single stationary source. Lead monitors at the two sites registered multiple three-month rolling averages above the 0.15 µg/m^3 NAAQS standard. The compliance issue was resolved, and monitoring data shows that lead concentrations have steadily decreased since that time. There were no exceedances of the three-month rolling NAAQS in 2016.

National Ambient Air Quality Standards for Lead

Primary NAAQS:	**Rolling 3-month average not to exceed 0.15 µg/m^3**
Secondary NAAQS:	**Same as primary standard**

Criteria Pollutant Summary Report – 2016

Pollutant: **Lead**
Method: High volume sampler; Inductively Coupled Plasma-Mass Spectroscopy
Data Interval: 24-hour
Units: Micrograms per cubic meter (µg/m^3)



County	Site Address	AQS-ID	# Obs	Rolling 3-Month Average				
				1st max	2nd max	3rd max	4th max	Obs > 0.15
Jefferson[1] [NCore]	2730 Cannons Ln Louisville	21-111-0067	58	0.01	0.01	0.01	0.01	0
Madison	Mayfield Elem, Bond St Richmond	21-151-0003	54	0.02	0.01	0.01	0.01	0
Madison	EKU, Van Hoose Dr Richmond	21-151-0005	53	0.05	0.05	0.05	0.05	0

[1] **Monitor operated by the Louisville Metro Air Pollution Control District.**
[NCore] **Samples collected with a low-volume manual PM_{10} sampler and analyzed via x-ray fluorescence.**

2016 Nitrogen Dioxide Ambient Air Monitoring Network

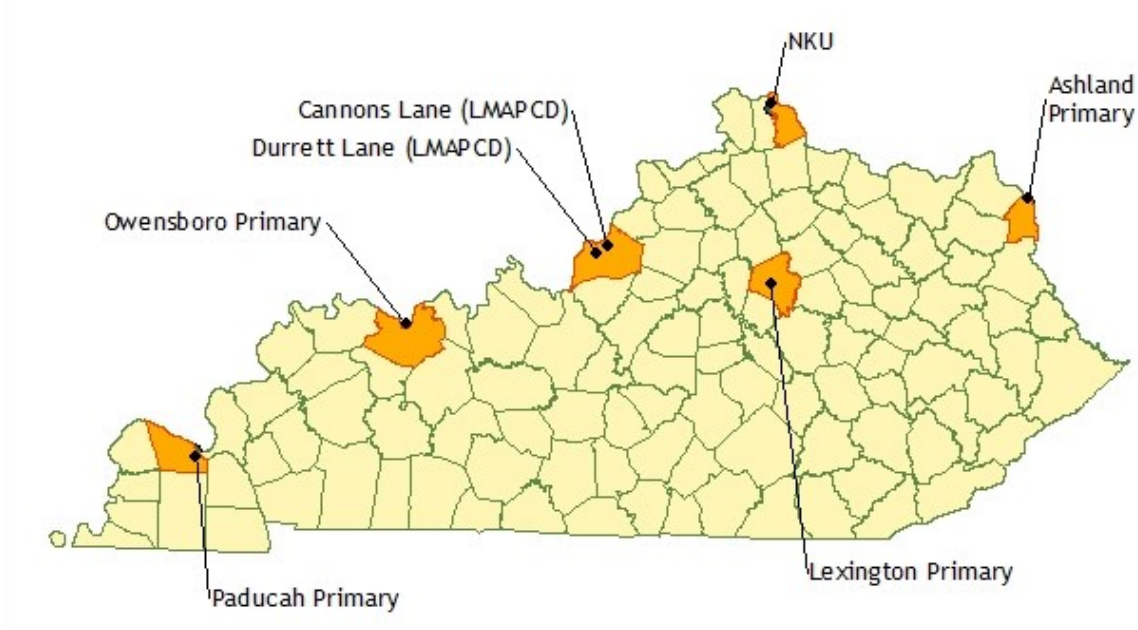


Figure 28: Nitrogen dioxide monitoring locations in Kentucky.

Statewide Averages for Nitrogen Dioxide

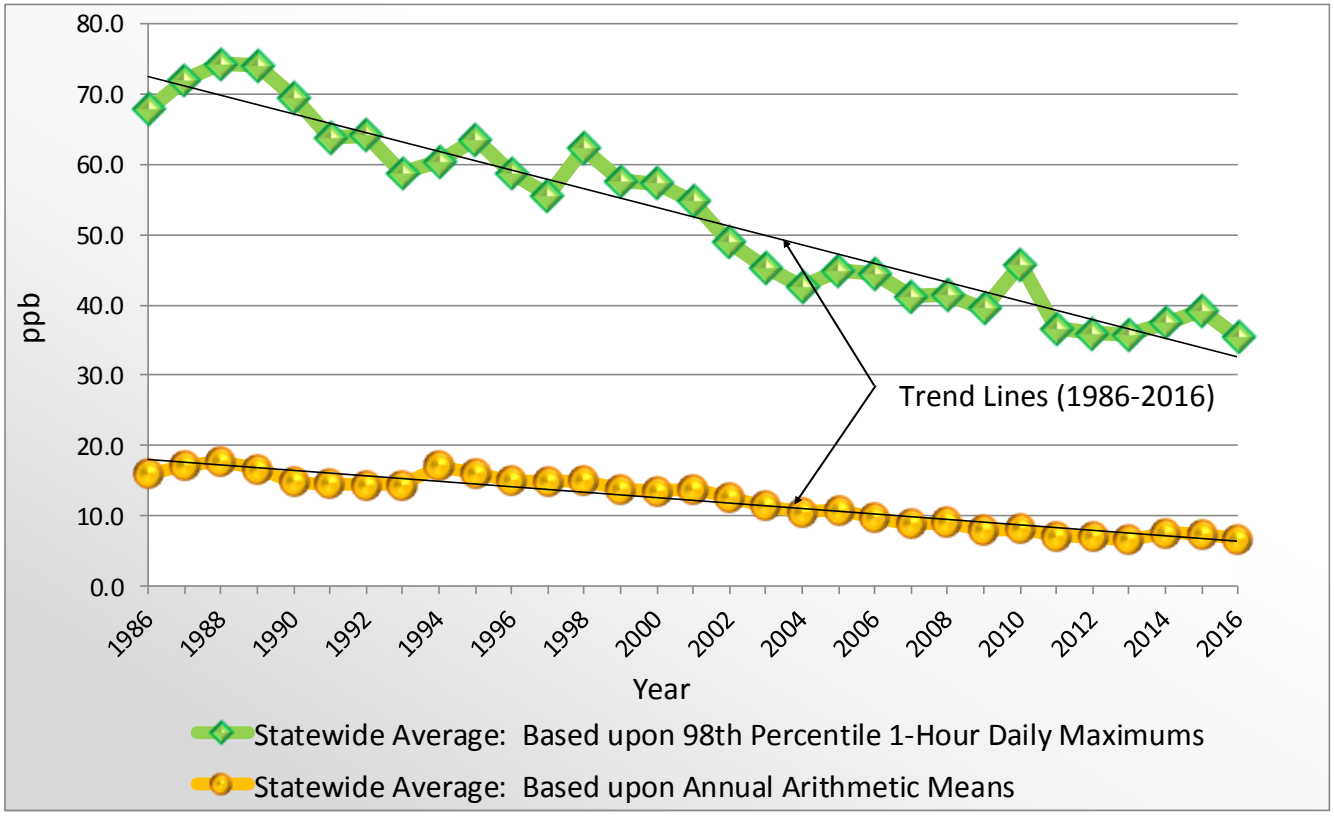


Figure 29: Statewide averages for nitrogen dioxide monitoring indicate pollution reductions.

Nitrogen Dioxide Results

There were no exceedances of the NO_2 standard in 2016. There have been no recorded exceedances of a NO_2 NAAQS since the inception of sampling in 1970. Overall, statewide nitrogen dioxide levels show a steady downward trend, primarily due to the use of pollution control devices on motor vehicles, power plants, and industrial boilers. In 2016, the Division and the LMAPCD operated seven nitrogen dioxide monitors in Kentucky.

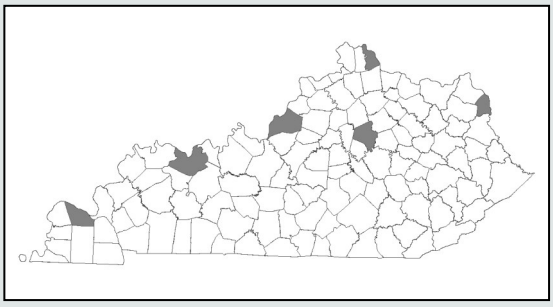
National Ambient Air Quality Standards for Nitrogen Dioxide

Primary NAAQS: Annual arithmetic mean must not exceed 53 ppb
3-year average of the 98th percentile of daily maximum one-hour averages must not exceed 100 ppb

Secondary NAAQS: Annual arithmetic mean must not exceed 53 ppb

Criteria Pollutant Summary Report – 2016

Pollutant: **Nitrogen Dioxide**
Method: Instrumental/Gas-Phase Chemiluminescence
Data Interval: Hourly
Units: Parts-per-billion (ppb)



County	Site Address	AQS-ID	# Obs	1-Hr Daily Maximum			Annual Mean
				1st max	2nd max	Obs > 100	
Boyd	2924 Holt Street Ashland	21-019-0017	8322	35.0	35.0	0	4.87
Campbell	524A John Hill Rd Highland Heights	21-037-3002	8302	35.0	29.0	0	2.31
Daviess	US60 & Pleasant Valley Rd Owensboro	21-059-0005	7903	35.0	35.0	0	4.21
Fayette	650 Newtown Pike Lexington	21-067-0012	8119	52.0	50.0	0	6.59
Jefferson[1]	2730 Cannons Ln Louisville	21-111-0067	8253	51.9	48.9	0	8.11
Jefferson[1]	1517 Durrett Ln Louisville	21-111-0075	8253	95.6	55.3	0	15.05
McCracken	2901 Powell Street Paducah	21-145-1024	8212	35.0	35.0	0	4.86

[1] **Monitor operated by the Louisville Metro Air Pollution Control District.**

NO_2 Criteria Pollutant Multi-Year Summary Report – 2016
98th Percentile Daily 1-Hour Maximum, 3-Year Average

County	Site Address	AQS-ID	98th Percentile Daily Maximum 1-Hr Averages				
			2014	2015	2016	3-Yr Avg	Obs > 100
Boyd	2924 Holt Street Ashland	21-019-0017	32.0	35.0	29.0	32	0
Campbell	524A John Hill Road Highland Heights	21-037-3002	31.0	32.0	26.0	30	0
Daviess	US 60 & Pleasant Valley Rd Owensboro	21-059-0005	31.0	33.0	29.0	31	0
Fayette	650 Newtown Pike Lexington	21-067-0012	39.0	41.0	43.0	41	0
Jefferson[1]	2730 Cannons Ln Louisville	21-111-0067	48.6*	44.0	40.4	44*	0
Jefferson[1]	1517 Durrett Ln Louisville	21-111-0075	44.5*	50.2	49.2	48*	0
McCracken	2901 Powell Street Paducah	21-145-1024	36.0	39.0	31.0	35	0

[1] **Monitor operated by the Louisville Metro Air Pollution Control District.**

*** Incomplete dataset. The mean does not satisfy summary criteria.**

2016 Ozone Ambient Air Monitoring Network

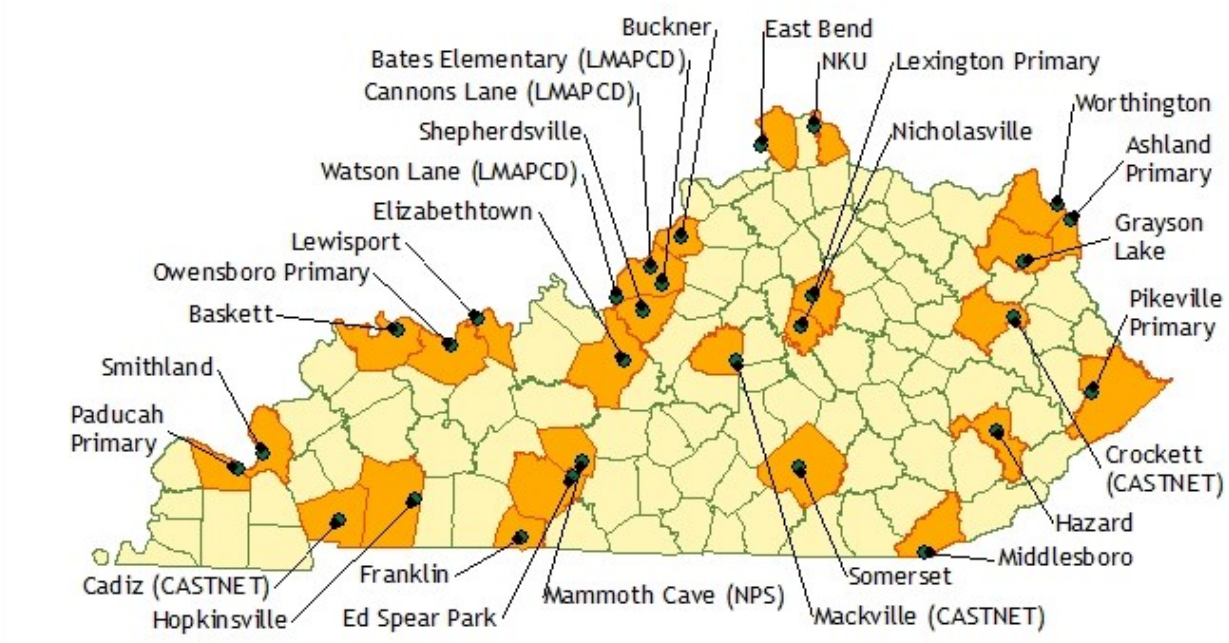


Figure 30: Ozone monitoring locations in Kentucky.

Statewide Averages for Ozone

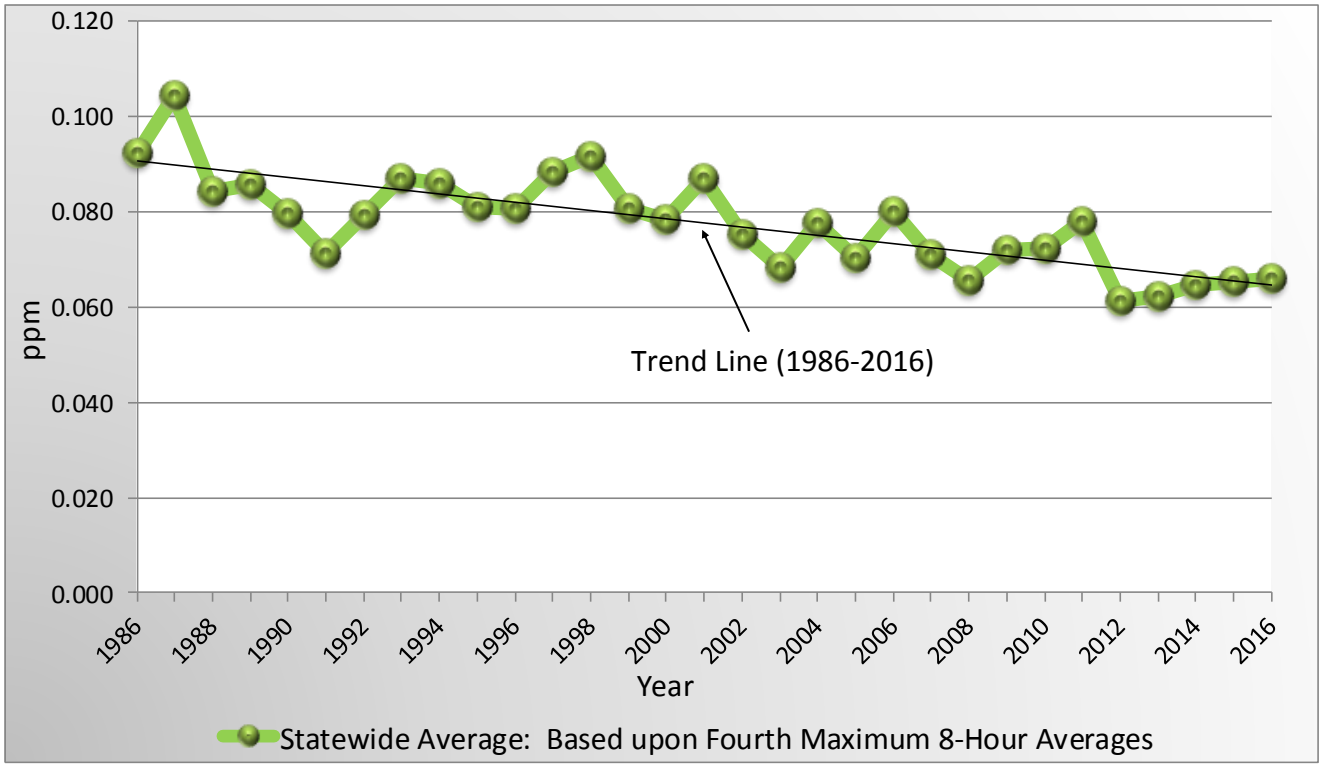


Figure 31: Statewide averages for ozone monitoring indicate pollution reductions.

Ozone Results

In October 2015, the EPA lowered the eight-hour ozone standard from 0.075 ppm to 0.070 ppm. While exceedances were measured at sixteen sites during 2016, only three of those sites recorded a fourth highest daily maximum eight-hour average greater than 0.070 ppm. In 2016, DAQ, LMAPCD, and the National Park Service at Mammoth Cave operated a total of 26 ozone monitors in Kentucky. The EPA operated an additional three sites, as a part of an independent network of CASTNET monitors.

Generally, there has been a decline in ozone levels over the past 25 years. This trend is attributable to emission controls on vehicles and a regional strategy controlling NO_x emissions from large stationary internal combustion engines, large boilers and turbines used in power plants and other industrial applications.

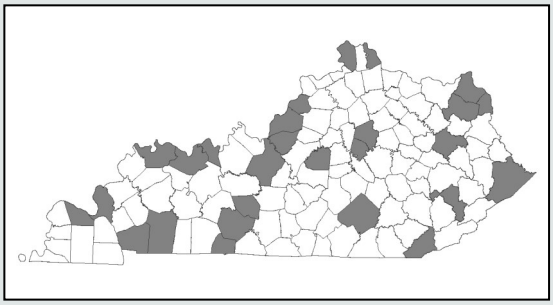
National Ambient Air Quality Standards for Ozone

Primary NAAQS: 3-year average of the 4th highest daily maximum 8-hr concentration not to exceed 0.070 ppm

Secondary NAAQS: Same as Primary Standard

Criteria Pollutant Summary Report – 2016

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



County	Site Address	AQS-ID	Valid Days	Daily Maximum 8-Hr Average				
				1st max	2nd max	3rd max	4th max	Obs> 0.075
Bell	34th & Dorchester Middlesboro	21-013-0002	242	0.065	0.064	0.063	0.062	0
Boone	KY 338 & Lower River East Bend	21-015-0003	240	0.066	0.066	0.066	0.065	0
Boyd	2924 Holt Street Ashland	21-019-0017	241	0.078	0.072	0.069	0.066	2
Bullitt	2nd & Carpenter St Shepherdsville	21-029-0006	234	0.077	0.069	0.068	0.067	1
Campbell	524A John Hill Rd Highland Heights	21-037-3002	243	0.075	0.071	0.071	0.069	3
Carter	Camp Webb Grayson Lake	21-043-0500	243	0.069	0.068	0.066	0.065	0
Christian	10800 Pilot Rock Hopkinsville	21-047-0006	240	0.067	0.063	0.063	0.061	0
Daviess	US60 & Pleasant Valley Owensboro	21-059-0005	236	0.088	0.072	0.069	0.068	2

Values in red represent an exceedance of the NAAQS.

Ozone Criteria Pollutant Summary Report – 2016 Continued

County	Site Address	AQS-ID	Valid Days	Daily Maximum 8-Hr Average				
				1st max	2nd max	3rd max	4th max	Obs> 0.075
Edmonson[1]	Alfred Cook Rd Mammoth Cave	21-061-0501	206	0.069	0.067	0.066	0.065	0
Fayette	650 Newtown Pike Lexington	21-067-0012	241	0.068	0.066	0.065	0.065	0
Greenup	Scott & Center St Worthington	21-089-0007	244	0.065	0.064	0.064	0.063	0
Hancock	2nd & Caroline Lewisport	21-091-0012	238	0.078	0.076	0.073	0.067	3
Hardin	801 North Miles St Elizabethtown	21-093-0006	241	0.071	0.070	0.069	0.068	1
Henderson	Baskett Fire Dept. Baskett	21-101-0014	241	0.074	0.073	0.072	0.072	4
Jefferson[2]	7601 Bardstown Rd Louisville	21-111-0027	213	0.081	0.074	0.073	0.073	5
Jefferson[2]	7201 Watson Lane Louisville	21-111-0051	235	0.077	0.073	0.072	0.070	3
Jefferson[2]	2730 Cannons Lane Louisville	21-111-0067	243	0.086	0.080	0.080	0.076	10
Jessamine	DOT, Wilson Drive Nicholasville	21-113-0001	243	0.078	0.067	0.066	0.066	1
Livingston	DOT, US 60E Smithland	21-139-0003	239	0.075	0.068	0.068	0.068	1
McCracken	2901 Powell Street Paducah	21-145-1024	243	0.072	0.065	0.064	0.063	1
Morgan[3] CASTNET	State Hwy 437 West Liberty	21-175-9991	244	0.074	0.072	0.066	0.066	2
Oldham	DOT, 1601 S Hwy 393 Buckner	21-185-0004	237	0.074	0.073	0.072	0.069	3
Perry	Perry Co Horse Park Hazard	21-193-0003	227	0.064	0.063	0.058	0.058	0
Pike	101 North Mayo Trail Pikeville	21-195-0002	242	0.065	0.065	0.064	0.061	0
Pulaski	Clifty Street Somerset	21-199-0003	233	0.067	0.065	0.064	0.063	0
Simpson	DOT, HWY 1008 Franklin	21-213-0004	242	0.071	0.067	0.065	0.063	1
Trigg[3] CASTNET	5720 Old Dover Road Cadiz	21-221-9991	237	0.064	0.063	0.063	0.063	0
Warren	Ed Spear Park Smiths Grove	21-227-0009	242	0.068	0.063	0.062	0.062	0
Washington[3] CASTNET	542 Weasley-Miller Road Harrodsburg	21-229-9991	233	0.067	0.067	0.065	0.065	0

[1] Monitor operated by the National Park Service. [2] Monitor operated by the Louisville Metro Air Pollution Control District.
[3] CASTNET Monitor operated by an EPA contractor and not associated with the State network.
Values in red represent an exceedance of the NAAQS.

Ozone Criteria Pollutant Multi-Year Summary Report – 2016
8-hour 4th Maximum, 3-year Average

County	Site Address	AQS-ID	4th Maximum 8-hr Average			
			2014	2015	2016	3-Yr Avg
Bell	34th & Dorchester Middlesboro	21-013-0002	0.062	0.059	0.062	0.061
Boone	KY 338 & Lower River Road East Bend	21-015-0003	0.062	0.062	0.065	0.063
Boyd	2924 Holt Street Ashland	21-019-0017	0.065	0.069	0.066	0.066
Bullitt	2nd & Carpenter Streets Shepherdsville	21-029-0006	0.065	0.067	0.067	0.066
Campbell	524A John Hill Highland Heights	21-037-3002	0.071	0.071	0.069	0.070
Carter	Camp Webb Grayson Lake	21-043-0500	0.060	0.061	0.065	0.061
Christian	10800 Pilot Rock Road Hopkinsville	21-047-0006	0.065	0.062	0.061	0.062
Daviess	US 60 & Pleasant Valley Rd Owensboro	21-059-0005	0.064	0.065	0.068	0.065
Edmonson[1]	Alfred Cook Road Mammoth Cave	21-061-0501	0.065	0.063	0.065	0.064
Fayette	650 Newtown Pike Lexington	21-067-0012	0.065	0.071	0.065	0.067
Greenup	Scott & Center Streets Worthington	21-089-0007	0.061	0.066	0.063	0.063
Hancock	2nd & Caroline Streets Lewisport	21-091-0012	0.066	0.071	0.067	0.068
Hardin	801 North Miles Street Elizabethtown	21-093-0006	0.062	0.066	0.068	0.065
Henderson	Baskett Fire Dept Baskett	21-101-0014	0.069	0.067	0.072	0.069
Jefferson[2]	7601 Bardstown Road Louisville	21-111-0027	0.065	0.071	0.073	0.069
Jefferson[2]	7201 Watson Lane Louisville	21-111-0051	0.069	0.069	0.070	0.069
Jefferson[2]	2730 Cannons Lane Louisville	21-111-1021	0.070	0.076	0.076	0.074
Jessamine	DOT, Etter Drive Nicholasville	21-113-0001	0.064	0.066	0.066	0.065
Livingston	DOT, 811 US 60 East Smithland	21-139-0003	0.065	0.063	0.068	0.065

Ozone Criteria Pollutant Multi-Year Summary Report – 2016 Continued
8-hour 4th Maximum, 3-year Average

County	Site Address	AQS-ID	4th Maximum 8-hr Average			
			2014	2015	2016	3-Yr Avg
McCracken	2901 Powell Street Paducah	21-145-1024	0.065	0.063	0.063	0.063
Morgan[3] CASTNET	State Hwy 437 West Liberty	21-175-9991	0.064	0.064	0.066	0.064
Oldham	DOT, 1601 S Hwy 393 Buckner	21-185-0004	0.068	0.073	0.069	0.070
Perry	Perry County Horse Park Hazard	21-193-0003	0.061	0.057	0.058	0.058
Pike	101 North Mayo Trail Pikeville	21-195-0002	0.063	0.058	0.061	0.060
Pulaski	Clifty Street Somerset	21-199-0003	0.063	0.062	0.063	0.062
Simpson	DOT, Hwy 1008 Franklin	21-213-0004	0.063	0.067	0.063	0.064
Trigg[3] CASTNET	5720 Old Dover Road Cadiz	21-221-9991	0.066	0.060	0.063	0.063
Warren	Ed Spear Park Smiths Grove	21-227-0009	0.063	0.061	0.062	0.062
Washington[3] CASTNET	542 Weasley-Miller Road Harrodsburg	21-229-9991	0.065	0.064	0.065	0.064

[1] Monitor operated by the National Park Service.

[2] Monitor operated by the Louisville Metro Air Pollution Control District.

[3] CASTNET Monitor operated by an EPA contractor and not associated with the State network.

Values in red represent an exceedance of the NAAQS.

2016 Particulate Matter ($PM_{2.5}$) Ambient Air Monitoring Network

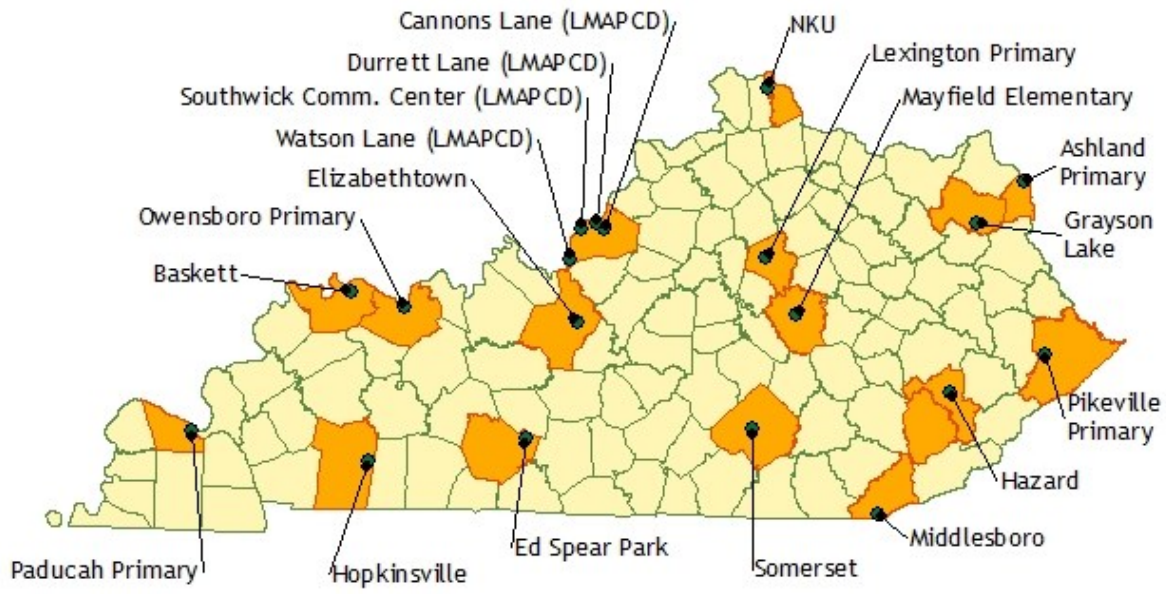


Figure 32: $PM_{2.5}$ monitoring locations in Kentucky.

Statewide Averages for $PM_{2.5}$

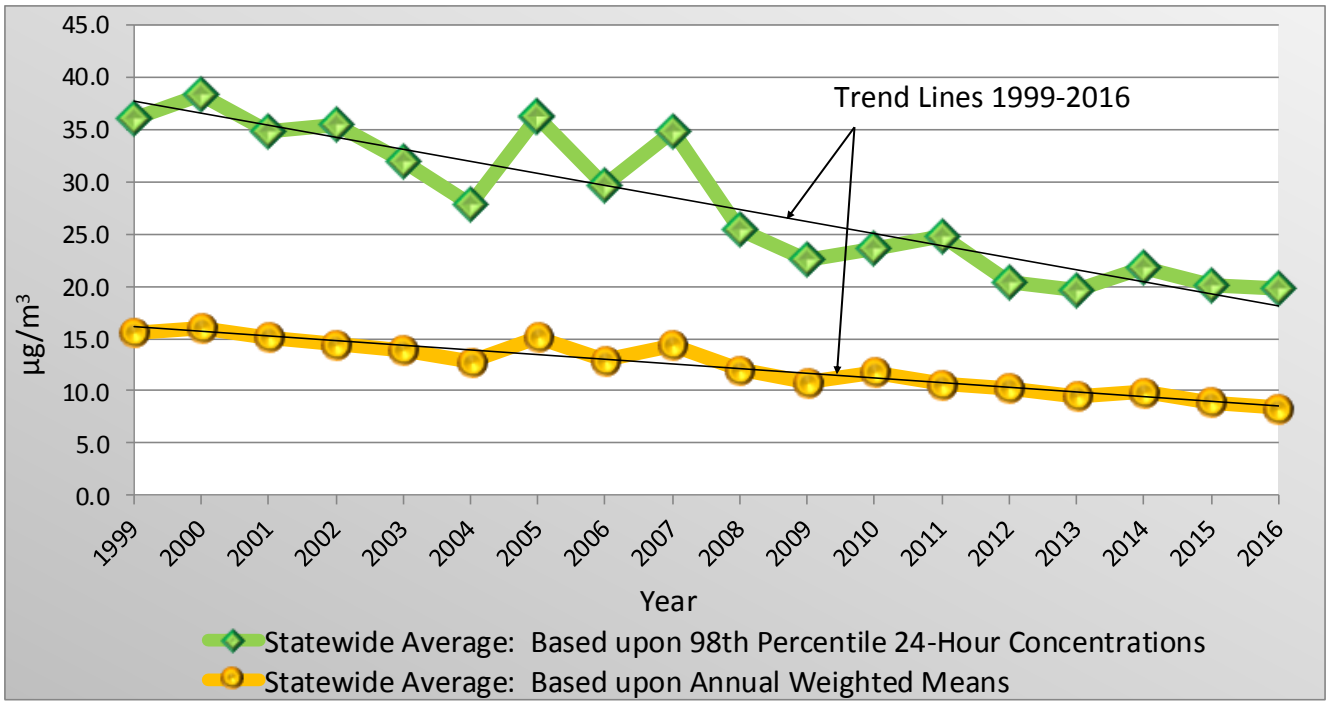


Figure 33: Statewide averages for $PM_{2.5}$ monitoring indicate pollution reductions.

$PM_{2.5}$ Results

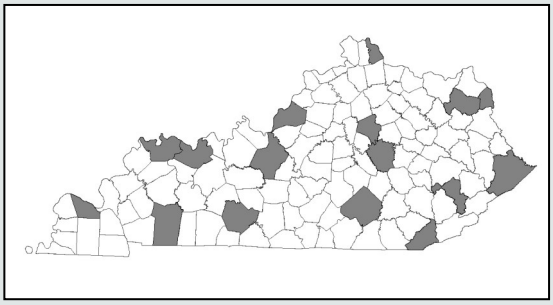
In 2016, DAQ and LMAPCD operated FRM-type samplers for NAAQS comparisons at 19 sites. As a result of an active fall wildfire season, ambient air monitors recorded higher than normal $PM_{2.5}$ concentrations at four Eastern Kentucky sites. However, only one of those sites actually experienced a violation of the 24-hour standard. Furthermore, no sampler exceeded either the three-year 24-hour standard or the three-year annual standard during the 2014-2016 averaging period. This is a significant accomplishment. Generally, statewide $PM_{2.5}$ levels declined during the 1999-2016 time period.

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

Primary NAAQS:	**3-year average of the annual weighted mean not to exceed 12.0 µg/m^3** **3-year average of the 98th percentile of 24-hour concentrations not to exceed 35 µg/m^3**
Secondary NAAQS:	**3-year average of the annual weighted mean not to exceed 15.0 µg/m^3** **3-year average of the 98th percentile of 24-hour concentrations not to exceed 35 µg/m^3**

Criteria Pollutant Summary Report – 2016

Pollutant: **Particulate Matter $PM_{2.5}$**
Method: Gravimetric
Data Interval: 24-hour
Units: Micrograms per cubic meter (µg/m^3)



County	Site	AQS-ID	# Obs	24-Hour Average					Wtd-Mean
				1st max	2nd max	3rd max	4th max	Obs> 35	
Bell	34th & Dorchester Middlesboro	21-013-0002	56	75.8	41.3	20.1	17.5	2	10.2
Boyd	2924 Holt Street Ashland	21-019-0017	122	24.5	17.0	14.8	13.4	0	7.8
Campbell	524A John Hill Rd Highland Heights	21-037-3002	118	25.2	17.8	17.5	17.5	0	8.1
Carter	Camp Webb Grayson Lake	21-043-0500	120	36.2	15.3	15.0	12.0	1	6.6
Christian	10800 Pilot Rock Hopkinsville	21-047-0006	110	20.3	18.7	17.3	15.4	0	8.3
Daviess	US60 & Pleasant Valley Rd Owensboro	21-059-0014	120	22.8	21.1	18.0	16.1	0	8.6

$PM_{2.5}$ Criteria Pollutant Summary Report – 2016 Continued

County	Site	AQS-ID	# Obs	24-Hour Average					Wtd-Mean
				1st max	2nd max	3rd max	4th max	Obs> 35	
Fayette	650 Newtown Pike Lexington	21-067-0012	109	26.3	20.2	16.7	16.0	0	8.2
Hardin	801 North Miles Street Elizabethtown	21-093-0006	118	20.0	19.7	17.2	14.7	0	8.3
Henderson	Basket Fire Dept. Baskett	21-101-0014	117	20.0	19.7	16.7	16.6	0	8.9
Jefferson[1]	37th & Southern Avenue Louisville	21-111-0043	121	19.2	18.7	17.0	15.4	0	8.3
Jefferson[1]	7201 Watson Lane Louisville	21-111-0051	122	17.8	17.6	16.2	15.3	0	7.9
Jefferson[1]	2730 Cannons Lane Louisville	21-111-0067	121	20.3	18.7	18.7	17.4	0	8.0
Jefferson[1]	1517 Durrett Lane Louisville	21-111-0075	120	27.4	22.3	18.7	17.9	0	9.2
McCracken	2901 Powell Street Paducah	21-145-1024	106	18.1	17.4	16.4	14.4	0	7.9*
Madison	Mayfield School Richmond	21-151-0003	94	30.5	21.5	20.2	16.4	0	7.9*
Perry	Perry County Horse Park Hazard	21-193-0003	60	79.8	27.8	23.2	12.6	1	8.9
Pike	101 North Mayo Trail Pikeville	21-195-0002	121	40.2	37.7	29.4	27.7	2	7.8
Pulaski	305 Clifty Street Somerset	21-199-0003	121	27.4	22.9	16.4	15.1	0	8.0
Warren	Ed Spear Park Smiths Grove	21-227-0009	115	21.4	20.5	16.9	14.5	0	8.3

[1] Monitors operated by the Louisville Metro Air Pollution Control District.

* Incomplete dataset. The mean does not satisfy summary criteria.

Values in red represent an exceedance of the NAAQS.

$PM_{2.5}$ Criteria Pollutant Multi-Year Summary Report – 2016
24-Hour 98th Percentile, 3-Year Average

County	Site	AQS-ID	24-Hour, 98th Percentile			
			2014	2015	2016	3-Yr Avg
Bell	34th & Dorchester Middlesboro	21-013-0002	16.6	19.3*	41.3	26
Boyd	2924 Holt Street Ashland	21-019-0017	20.3	23.5	14.8	20
Campbell	524A John Hill Highland Heights	21-037-3002	23.2	22.0*	17.5	21
Carter	Camp Webb Grayson Lake	21-043-0500	19.7	19.8	15.0	18
Christian	10800 Pilot Rock Road Hopkinsville	21-047-0006	23.4*	22.2	17.3	21
Daviess	US60 and Pleasant Valley Rd Owensboro	21-059-0005	25.7	21.6	18.0	22
Fayette	650 Newtown Pike Lexington	21-067-0012	21.8	18.6	16.7	19
Hardin	801 North Miles Street Elizabethtown	21-093-0006	22.5	20.5	17.2	20
Henderson	Baskett Fire Dept Baskett	21-101-0014	25.3	20.2	16.7	21
Jefferson[1]	37th & Southern Avenue Louisville	21-111-0043	24.3	22.3	19.2	22
Jefferson[1]	7201 Watson Lane Louisville	21-111-0051	26.2	22.8	16.3	22
Jefferson[1]	2730 Cannons Lane Louisville	21-111-0067	23.9	21.7	18.5	21
Jefferson[1]	1517 Durrett Lane Louisville	21-111-0075	26.0	22.1	18.7	22
McCracken	2901 Powell Street Paducah	21-145-1024	22.6	21.7*	16.4*	20
Madison	Mayfield School Richmond	21-151-0003	17.3	15.6	21.5*	18
Perry	Perry County Horse Park Hazard	21-193-0003	14.9	16.3	27.8	20
Pike	101 North Mayo Trail Pikeville	21-195-0002	18.6	16.6	29.4	22
Pulaski	305 Clifty Street Somerset	21-199-0003	21.8	18.7	16.4	19
Warren	Ed Spear Park Smiths Grove	21-227-0009	20.7	18.5	16.9	19

[1] **Monitor operated by the Louisville Metro Air Pollution Control District.**

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Values in red represent an exceedance of the NAAQS.

$PM_{2.5}$ Criteria Pollutant Multi-Year Summary Report – 2016
Annual Weighted Mean, 3-Year Average

County	Site	AQS-ID	Annual Weighted Mean			
			2014	2015	2016	3-Yr Avg
Bell	34th & Dorchester Middlesboro	21-013-0002	9.0	8.7*	10.1	9.3
Boyd	2924 Holt Street Ashland	21-019-0017	9.3	8.8	7.7	8.6
Campbell	524A John Hill Highland Heights	21-037-3002	9.7	9.4*	8.1	9.1
Carter	Camp Webb Grayson Lake	21-043-0500	8.0	7.3	6.6	7.3
Christian	10800 Pilot Rock Road Hopkinsville	21-047-0006	10.1*	9.1	8.3	9.2
Daviess	US60 and Pleasant Valley Rd Owensboro	21-059-0005	11.0	9.7	8.6	9.8
Fayette	650 Newtown Pike Lexington	21-067-0012	9.4	8.6	8.2	8.7
Hardin	801 North Miles Street Elizabethtown	21-093-0006	10.2	9.2	8.2	9.2
Henderson	Baskett Fire Dept. Baskett	21-101-0014	10.8	9.5	8.6	9.6
Jefferson[1]	37th & Southern Avenue Louisville	21-111-0043	11.0	10.4	9.5	10.4
Jefferson[1]	7201 Watson Lane Louisville	21-111-0051	12.2	10.4	8.2	10.3
Jefferson[1]	2730 Cannons Lane Louisville	21-111-0067	10.9	9.5	8.2	9.5
Jefferson[1]	1517 Durrett Lane Louisville	21-111-0075	12.0	10.0	9.2	10.4
McCracken	2901 Powell Street Paducah	21-145-1024	10.4	9.3*	7.9*	9.2
Madison	Mayfield School Richmond	21-151-0003	8.5	7.6	7.9*	8.0
Perry	Perry County Horse Park Hazard	21-193-0003	8.4	8.4	8.8	8.5
Pike	101 North Mayo Trail Pikeville	21-195-0002	8.5	7.6	7.8	8.0
Pulaski	305 Clifty Street Somerset	21-199-0003	9.3	8.1	8.0	8.5
Warren	Ed Spear Park Smiths Grove	21-227-0009	9.3	8.4	8.3	8.7

[1] **Monitor operated by the Louisville Metro Air Pollution Control District.**

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Values in red represent an exceedance of the NAAQS.

2016 Particulate Matter ($PM_{2.5}$) Speciation Ambient Air Monitoring Network

Figure 34: $PM_{2.5}$ speciation monitoring locations in Kentucky.

$PM_{2.5}$ Speciation

Efficient air quality management requires knowing which sources contribute to particle pollution. 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 comprised 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, the EPA established the Speciation Trends Network designed to assist in identifying the compounds associated with fine particulates. Sites were strategically located to address different types of land-uses, ranging from industrial, urban, and rural. 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:

- Assisting the implementation of 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 health effects to $PM_{2.5}$ constituents.
- Understanding the effect of atmospheric components on visibility impairment.
- Using the speciated particulate data to aid in monitoring network design and siting adjustment.

Speciation Results

In December 2014, the EPA defunded a number of monitors in the network, based upon an assessment which found certain sites to be unnecessary. Ultimately, three DAQ-operated monitors were discontinued in December 2014. As a result, only one $PM_{2.5}$ speciation site was in operation in Kentucky during 2016. That site is operated by the Louisville Metro Air Pollution Control District in Jefferson County.

The chart on the following page provides a visual representation of the major components of speciation data collected in 2016. The data suggests that particulates identified as sulfates, nitrates, 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. Similarly, nitrates are formed secondarily from nitrogen oxides, which are emitted during fossil fuel combustion. Organic carbon comes from a combination of mobile and stationary combustion sources.

2016 $PM_{2.5}$ Speciation: Average Concentration of Major Species

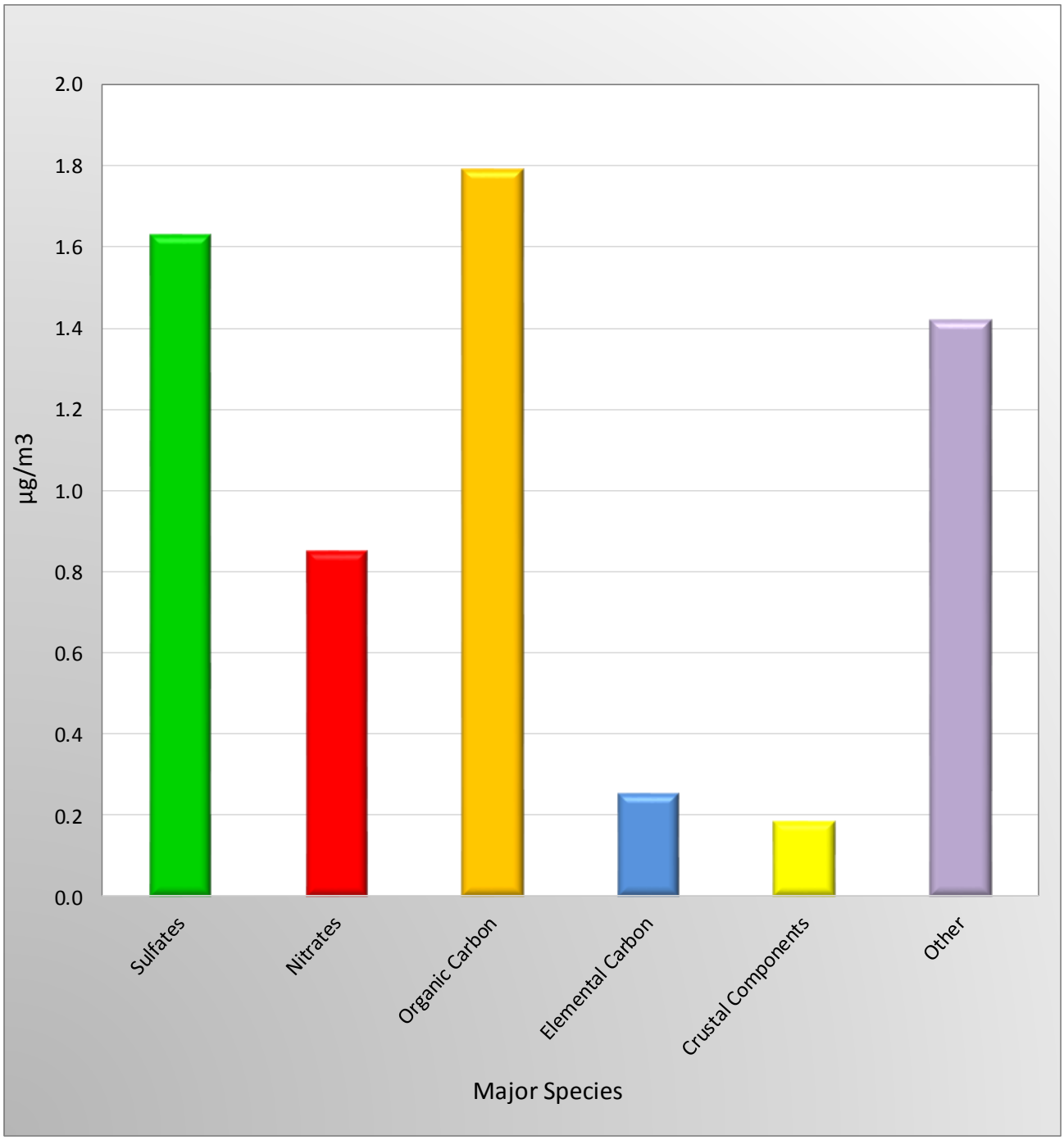


Figure 35: Average species distribution of major elements from the Louisville Metropolitan Air Pollution Control District $PM_{2.5}$ speciation monitor at the Cannons Lane site (AQS I.D.: 21-111-0067). "Other" represents a combination of trace compounds with individual concentrations too small to graphically display, which are not characterized as major elements or crustal components.

2016 Particulate Matter (PM_{10}) Ambient Air Monitoring Network

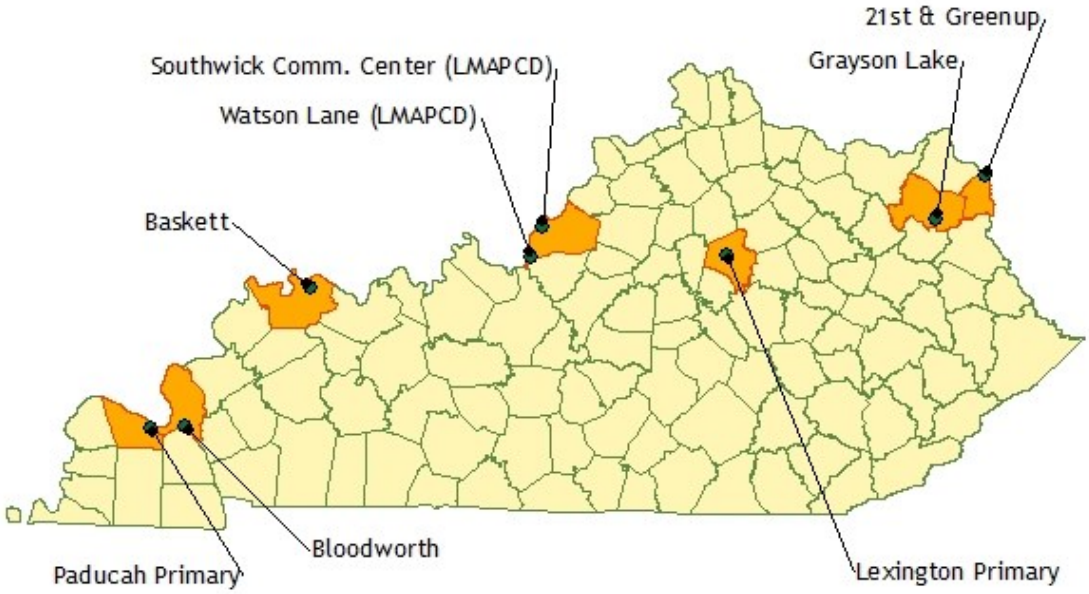


Figure 36: PM_{10} monitoring locations in Kentucky.

Statewide Averages for PM_{10}

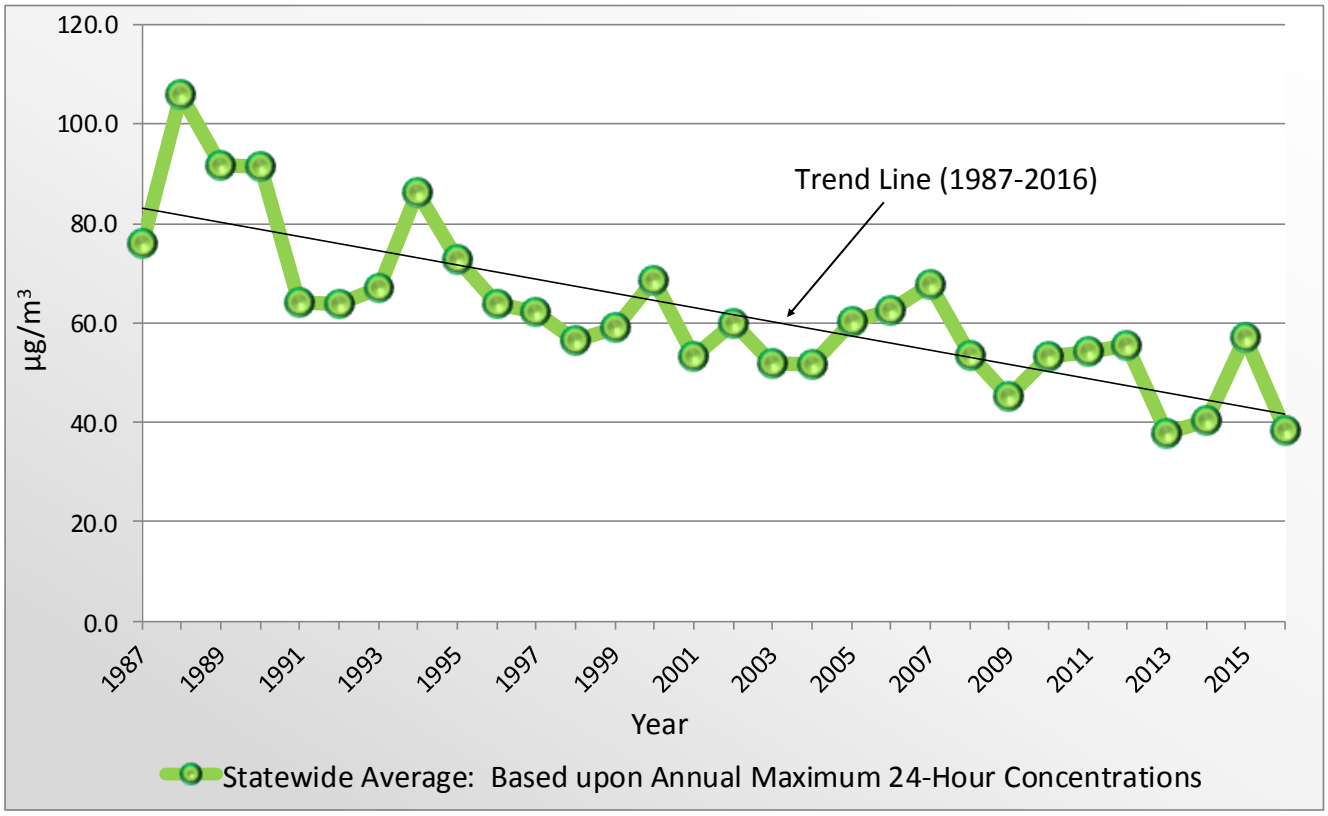


Figure 37: Statewide averages for PM_{10} monitoring indicate pollution reductions.

PM_{10} Results

In 2016, the DAQ and the LMAPCD operated a combined network of eight PM_{10} intermittent and continuous samplers in Kentucky. The annual PM_{10} standard is attained when the expected number of days per year with a 24-hour concentration greater than 150 ug/m^3 is less than or equal to one, when averaged over a three-year period. When a site collects samples everyday, the expected number of exceedances is equal to the number of actual exceedances. However, when the sampling frequency does not occur everyday, the number of days expected to be greater 150 ug/m^3 is obtained via a calculation. Poor data recovery can also impact the expected number of exceedances per year.

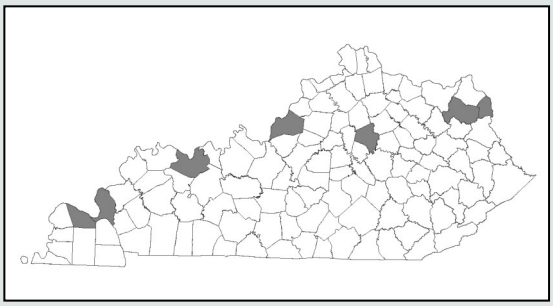
There were no exceedances of the annual PM_{10} standard in 2016. The last exceedance of the standard occurred on March 22, 2012, at the Ashland site (21-019-0002), which is located next to a metals recycler. Prior to 2012, only two previous exceedances of the PM_{10} NAAQS have been recorded. One of those exceedances occurred at a different Ashland site (21-019-0003) on Aug. 27, 1990, when a 24-hour concentration of 182 µg/m^3 was measured. The only other exceedance occurred on Jan. 7, 2000, at a Louisville site (21-111-0043) where a 24-hour sample measured 152 µg/m^3.

National Ambient Air Quality Standards for Particulate Matter (PM_{10})

Primary NAAQS:	**Expected number of days with a maximum 24-hour concentration greater than 150 µg/m^3 must be less than or equal to one, on average over three years.**
Secondary NAAQS:	**Same as Primary Standard**

Criteria Pollutant Summary Report – 2016

Pollutant: **Particulate Matter PM_{10}**
Method: Gravimetric
Data Interval: 24-hour
Units: Micrograms per cubic meter (µg/m^3) (25°C)



County	Site	AQS-ID	# Obs	24-hour Average				Act Obs > 150	Exp Obs > 150	Mean
				1st Max	2nd Max	3rd Max	4th Max			
Boyd	21st & Greenup Ashland	21-019-0002	56	59	50	48	47	0	0	21.8
Carter	Camp Webb Grayson Lake	21-043-0500	60	40	20	19	17	0	0	9.8
Fayette	650 Newtown Pike Lexington	21-067-0012	49	36	35	30	26	0	0	14.1*
Henderson	Baskett Fire Dept. Baskett	21-101-0014	60	34	29	28	26	0	0	14.4
Jefferson[1]	37th & Southern Ave Louisville	21-111-0043	8467	39	39	36	26	0	0	15.1

PM_{10} Criteria Pollutant Summary Report – 2016 Continued

County	Site	AQS-ID	# Obs	24-hour Average				Act Obs > 150	Exp Obs > 150	Mean
				1st Max	2nd Max	3rd Max	4th Max			
Jefferson[1]	7201 Watson Ln Louisville	21-111-0051	7809	39	39	38	37	0	0	15.7
Livingston	763 Bloodworth Rd Smithland	21-139-0004	61	29	26	25	25	0	0	13.5
McCracken	2901 Powell Street Paducah	21-145-1024	57	32	29	27	27	0	0	15.7

[1] Monitor operated by the Louisville Metro Air Pollution Control District.

* Incomplete dataset. The mean does not satisfy summary criteria.

PM_{10} Criteria Pollutant Summary Report – 2016
Estimated Number of Annual Exceedances, Expected 3-Year Average

County	Site	AQS-ID	Estimated Number of Exceedances			
			2014	2015	2016	Expected 3-Year Avg
Boyd	21st & Greenup Ashland	21-019-0002	0	0	0	0
Carter	Camp Webb Grayson Lake	21-043-0500	0	0	0	0
Fayette	650 Newtown Pike Lexington	21-067-0012	0	0	0*	0*
Henderson	Baskett Fire Dept Baskett	21-101-0014	0	0	0	0
Jefferson[1]	37th & Southern Ave Louisville	21-111-0043	0	0	0	0
Jefferson[1]	7201 Watson Ln Louisville	21-111-0051	0*	0	0	0*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	0*	0*	0	0*
McCracken	2901 Powell Street Paducah	21-145-1024	0	0	0	0

[1] Monitor operated by the Louisville Metro Air Pollution Control District.

* Incomplete dataset. The mean does not satisfy summary criteria.

SULFUR DIOXIDE (SO_2)

2016 Sulfur Dioxide Ambient Air Monitoring Network

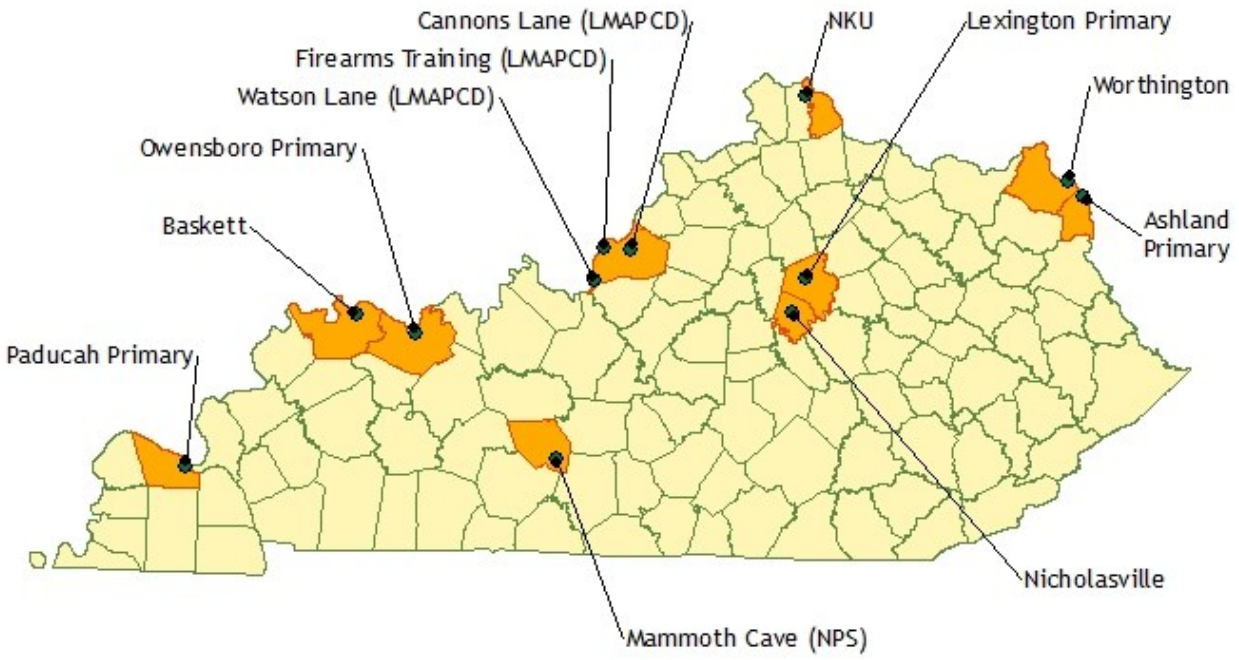


Figure 38: Sulfur dioxide monitoring locations in Kentucky.

Statewide Averages for Sulfur Dioxide

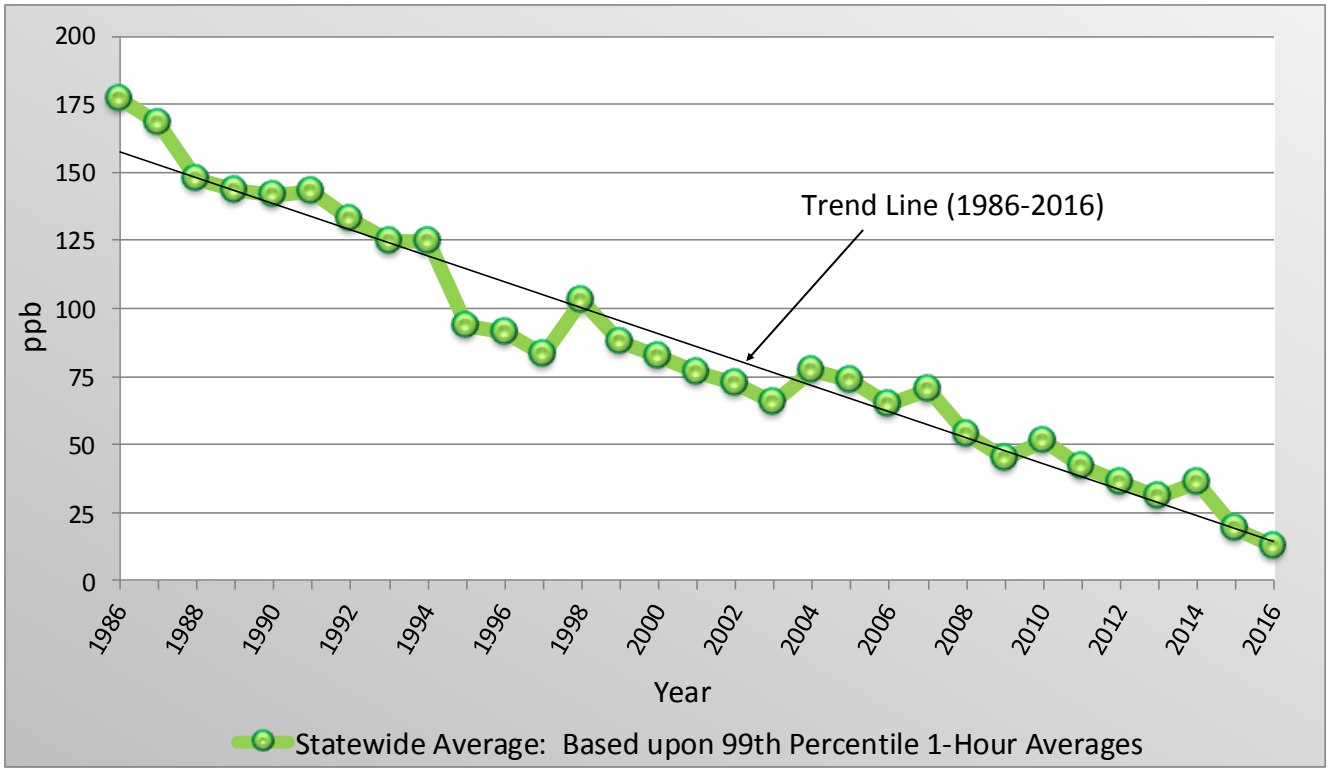


Figure 39: Statewide averages for SO_2 monitoring indicate significant pollution reductions.

Sulfur Dioxide Results

In 2016, the Division, the NPS at Mammoth Cave, and LMAPCD operated 12 SO_2 monitors in Kentucky. While there were no exceedances of any standard during 2016, one Jefferson County site remains in violation of the one-hour NAAQS, based upon the three-year average of 99th percentile daily maximum one-hour concentrations.

Statewide and regional sulfur dioxide levels have declined over the past twenty years. The SO_2 allowances component of the Acid Rain Program provides an opportunity for electric utilities to participate in a market-based trade of SO_2 emissions. An electric utility that is participating in the trading program is required to continually monitor emissions for SO_2, NO_x, and any other pollutants. The continuous monitoring of the emissions provides compliance data and credibility to the trading program. The trading allowances in the Acid Rain program have directly contributed to the decline in ambient SO_2 concentrations.

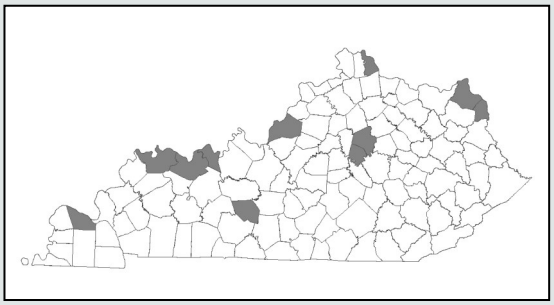
National Ambient Air Quality Standards for Sulfur Dioxide

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**

Criteria Pollutant Summary Report – 2016

Pollutant: **Sulfur Dioxide**
Method: Instrumental
Ultra-Violet Fluorescence
Data Interval: Hourly
Units: Parts-per-billion (ppb)



County	Site Address	AQS-ID	# Obs	Daily Maximum 1-Hr Avg			Annual Maximum 3-Hr Block Avg		
				1st max	2nd max	Obs > 75	1st max	2nd max	Obs > 500
Boyd	2924 Holt Street Ashland	21-019-0017	8371	9.0	8.0	0	1.6	1.3	0
Campbell	524A John Hill Rd Highland Heights	21-037-3002	8349	42.0	14.0	0	3.5	2.8	0
Daviess	US60 & Pleasant Valley Owensboro	21-059-0005	8314	60.0	39.0	0	7.7	6.8	0
Edmonson[1]	Alfred Cook Road Mammoth Cave	21-061-0501	6791	4.7	3.3	0	1.2	1.2	0

SO_2 Criteria Pollutant Summary Report – 2015 Continued

County	Site Address	AQS-ID	# Obs	Daily Maximum 1-Hr Avg			Annual Maximum 3-Hr Block Avg		
				1st max	2nd max	Obs > 75	1st max	2nd max	Obs > 500
Fayette	650 Newtown Pike Lexington	21-067-0012	8147	4.0	3.0	0	0.5	0.5	0
Greenup	Scott & Center St. Worthington	21-089-0007	8361	13.0	10.0	0	3.5	3.2	0
Henderson	Baskett Fire Dept. Baskett	21-101-0014	8339	24.0	21.0	0	7.3	5.1	0
Jefferson[2]	7201 Watson Lane Louisville	21-111-0051	8261	29.2	27.9	0	8.1	4.5	0
Jefferson[2]	2730 Cannons Lane Louisville	21-111-0067	8361	14.0	9.8	0	2.3	2.0	0
Jefferson[2]	4201 Algonquin Pkwy Louisville	21-111-1041	8248	44.5	17.2	0	3.5	3.0	0
Jessamine	KYDOT, Etter Drive Nicholasville	21-113-0001	8367	9.0	7.0	0	2.7	2.0	0
McCracken	2901 Powell Street Paducah	21-145-1024	8369	26.0	19.0	0	3.5	3.3	0

[1] **Monitor operated by the National Park Service.**

[2] **Monitor operated by the Louisville Metro Air Pollution Control District.**

SO_2 Criteria Pollutant Multi-Year Summary Report – 2016
Daily Maximum 1-hour 99th Percentile, 3-Year Average

County	Site Address	AQS-ID	Daily Maximum 1-Hr Average 99th Percentile			
			2014	2015	2016	3-Year Avg
Boyd	2924 Holt Street Ashland	21-019-0017	19	12	6	12
Campbell	524A John Hill Rd Highland Heights	21-037-3002	61	18	12	17*
Daviess	US60 & Pleasant Valley Rd Owensboro	21-059-0005	48	27*	25	33*
Edmonson[1]	Alfred Cook Road Mammoth Cave	21-061-0501	11	7	3	7
Fayette	650 Newtown Pike Lexington	21-067-0012	13	9	3*	8
Greenup	Scott & Center Streets Worthington	21-089-0007	16	13	8	12
Henderson	Baskett Fire Dept. Baskett	21-101-0014	29	19	14	21
Jefferson[2]	7201 Watson Lane Louisville	21-111-0051	149	54	26	76
Jefferson[2]	2730 Cannons Lane Louisville	21-111-0067	29	19	8	18
Jefferson[2]	4201 Algonquin Pkwy Louisville	21-111-1041	42	25	16	27
Jessamine	KYDOT, Etter Drive Nicholasville	21-113-0001	15	10	5	10
McCracken	2901 Powell Street Paducah	21-145-1024	20	15*	16	17

[1] Monitor operated by the National Park Service.

[2] Monitor operated by the Louisville Metro Air Pollution Control District.

* Incomplete dataset. The mean does not satisfy summary criteria.

Values in red represent an exceedance of the NAAQS.

2016 Hazardous Air Pollutant Ambient Air Monitoring Network

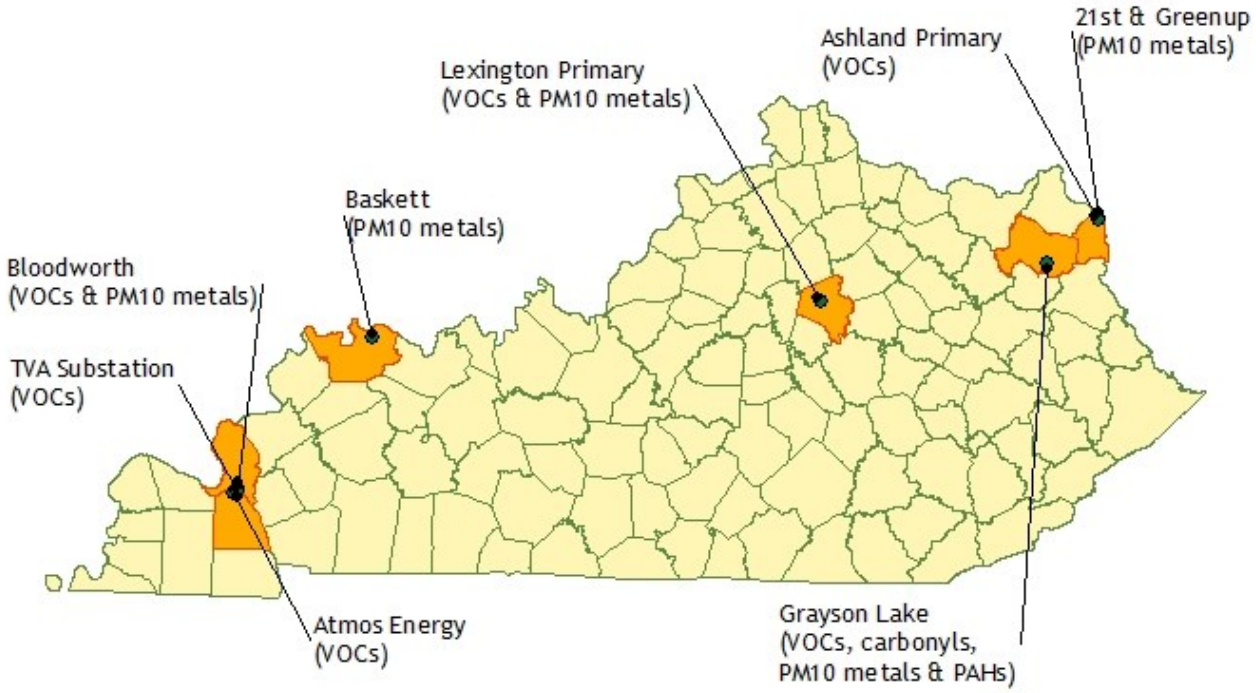


Figure 40: Hazardous air pollutant monitoring locations in Kentucky.

Hazardous air pollutants (HAPs) include 187 substances known or suspected to cause neurological, immunological, reproductive, and respiratory disorders, as well as known or suspected human carcinogens. The ultimate goal of the EPA is to eliminate unacceptable risks of cancer, other significant health problems from exposures to air toxics emissions and to substantially reduce or eliminate adverse effects 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 2016, the Division operated eight hazardous air pollutant stations throughout the Commonwealth using the NATTS monitoring objectives; however, only samplers operated at Grayson Lake are a part of the NATTS network. The EPA has identified 18 required hazardous air pollutants that are to be monitored in the National Air Toxics Trends study.

HAPS can be subdivided into five monitoring groups: carbonyls, metals, volatile organic compounds (VOC), and polycyclic aromatic hydrocarbons (PAH). The compounds are sampled using the following media:

- Carbonyls: Dinitrophenylhydrazine (DNPH) adsorbent cartridges
- PM_{10} metals: Teflon® filters
- PAHs: polyurethane foam (PUF)/XAD-2® sorbent
- Cr^{6+}: Bicarbonate-impregnated ashless cellulose filter

All samples are sent to a NATTS National Contract laboratory for analysis.

Results

Data collected from the air toxics network indicates that several of the 18 NATTS pollutants of interest are present in Kentucky's ambient air. Potential sources may be large industrial sources in the immediate area, 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. The Division continues to collect and analyze the data for trends. For more information about air toxics in Kentucky, see the Permit Review Branch section of this report.

Carbonyls

Air Toxics Summary Report - 2016

Site: Camp Webb-Grayson Lake, Carter County
AQS ID: 21-043-0500
Pollutant: Acetaldehyde
Method: TO-11A; Carbonyl sampler with DPNH cartridges
Data Interval: 24-hour
Units: Parts-per-billion (ppb)

Pollutant	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Formaldehyde	61	4.4	3.3	2.7	2.7	1.53
Acetaldehyde	61	2.8	2.7	1.8	1.8	0.95
Propionaldehyde	59	0.6	0.6	0.5	0.5	0.24
Butyraldehyde	61	0.5	0.5	0.3	0.3	0.17
Isovaleraldehyde	61	0.0	0.0	0.0	0.0	0.00
Hexanaldehyde	60	0.4	0.2	0.2	0.1	0.07
Valeraldehyde	61	0.3	0.2	0.1	0.1	0.06
Crotonaldehyde	61	3.3	2.9	2.8	0.3	0.67
Acetone	61	6.2	4.4	4.2	4.1	1.87
Methyl ethyl ketone	60	1.1	0.9	0.9	0.8	0.39
Benzaldehyde	57	0.2	0.2	0.2	0.2	0.10
Isoxylaldehyde	61	0.0	0.0	0.0	0.0	0.00
Tolualdehydes	51	0.6	0.5	0.4	0.4	0.14

Metals

Air Toxics Summary Report - 2016

Pollutant: Antimony

Method: IO-3.5; Metals low volume PM_{10} monitor

Data Interval: 24-hour

Units: Nanograms per cubic meter (ng/m^3)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	21st & Greenup Ashland	21-019-0002	39	16.40	5.00	4.40	4.30	1.93*
Carter	Camp Webb Grayson Lake	21-043-0500	43	3.61	2.62	1.59	1.18	0.62*
Fayette	650 Newtown Pike Lexington	21-067-0012	33	2.65	2.42	1.76	1.64	1.11*
Henderson	Baskett Fire Dept. Baskett	21-101-0014	43	21.50	3.02	1.71	1.67	1.18*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	44	1.34	1.30	1.23	1.02	0.52*

*** Incomplete dataset. The mean does not satisfy summary criteria.**
Metals data is only available through September 2016.

Air Toxics Summary Report - 2016

Pollutant: Arsenic

Method: IO-3.5; Metals low volume PM_{10} monitor

Data Interval: 24-hour

Units: Nanograms per cubic meter (ng/m^3)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	21st & Greenup Ashland	21-019-0002	39	3.40	3.20	3.10	2.30	1.12*
Carter	Camp Webb Grayson Lake	21-043-0500	43	2.35	2.25	1.20	1.19	0.56*
Fayette	650 Newtown Pike Lexington	21-067-0012	33	3.08	1.60	1.32	1.28	0.81*
Henderson	Baskett Fire Dept. Baskett	21-101-0014	43	2.32	2.09	2.00	2.00	0.95*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	44	1.18	1.13	1.10	1.09	0.54*

*** Incomplete dataset. The mean does not satisfy summary criteria.**
Metals data is only available through September 2016.

Metals

Air Toxics Summary Report - 2016

Pollutant: Beryllium

Method: IO-3.5; Metals low volume PM_{10} monitor

Data Interval: 24-hour

Units: Nanograms per cubic meter (ng/m^3)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	21st & Greenup Ashland	21-019-0002	39	0.10	0.00	0.00	0.00	0.00*
Carter	Camp Webb Grayson Lake	21-043-0500	43	0.02	0.01	0.01	0.01	0.00*
Fayette	650 Newtown Pike Lexington	21-067-0012	33	0.07	0.04	0.03	0.03	0.01*
Henderson	Baskett Fire Dept. Baskett	21-101-0014	43	0.04	0.03	0.03	0.02	0.01*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	44	0.03	0.02	0.02	0.02	0.01*

*** Incomplete dataset. The mean does not satisfy summary criteria.**
Metals data is only available through September 2016.

Air Toxics Summary Report - 2016

Pollutant: Cadmium

Method: IO-3.5; Metals low volume PM_{10} monitor

Data Interval: 24-hour

Units: Nanograms per cubic meter (ng/m^3)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	21st & Greenup Ashland	21-019-0002	39	6.00	1.20	1.10	0.90	0.47*
Carter	Camp Webb Grayson Lake	21-043-0500	43	0.29	0.26	0.21	0.19	0.07*
Fayette	650 Newtown Pike Lexington	21-067-0012	33	0.30	0.24	0.10	0.10	0.08*
Henderson	Baskett Fire Dept. Baskett	21-101-0014	43	0.35	0.27	0.21	0.15	0.09*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	44	0.18	0.16	0.12	0.12	0.07*

*** Incomplete dataset. The mean does not satisfy summary criteria.**
Metals data is only available through September 2016.

Metals

Air Toxics Summary Report - 2016

Pollutant: Chromium

Method: IO-3.5; Metals low volume PM_{10} monitor

Data Interval: 24-hour

Units: Nanograms per cubic meter (ng/m^3)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	21st & Greenup Ashland	21-019-0002	39	11.80	9.30	7.80	7.10	4.22*
Carter	Camp Webb Grayson Lake	21-043-0500	43	4.90	4.32	3.73	3.52	2.09*
Fayette	650 Newtown Pike Lexington	21-067-0012	33	5.08	3.70	3.56	2.85	2.32*
Henderson	Baskett Fire Dept. Baskett	21-101-0014	43	3.72	3.17	3.04	2.74	2.01*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	44	12.60	4.87	3.88	3.34	2.35*

*** Incomplete dataset. The mean does not satisfy summary criteria.**
Metals data is only available through September 2016.

Air Toxics Summary Report - 2016

Pollutant: Lead

Method: IO-3.5; Metals low volume PM_{10} monitor

Data Interval: 24-hour

Units: Nanograms per cubic meter (ng/m^3)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	21st & Greenup Ashland	21-019-0002	39	0.03	0.02	0.02	0.02	0.02*
Carter	Camp Webb Grayson Lake	21-043-0500	43	0.01	0.01	0.00	0.00	0.00*
Fayette	650 Newtown Pike Lexington	21-067-0012	33	0.00	0.00	0.00	0.00	0.00*
Henderson	Baskett Fire Dept. Baskett	21-101-0014	43	0.02	0.00	0.00	0.00	0.00*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	44	0.00	0.00	0.00	0.00	0.00*

*** Incomplete dataset. The mean does not satisfy summary criteria.**
Metals data is only available through September 2016.

Metals

Air Toxics Summary Report - 2016

Pollutant: Manganese

Method: IO-3.5; Metals low volume PM_{10} monitor

Data Interval: 24-hour

Units: Nanograms per cubic meter (ng/m^3)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	21st & Greenup Ashland	21-019-0002	39	83.00	68.30	65.30	52.30	20.31*
Carter	Camp Webb Grayson Lake	21-043-0500	43	6.48	6.03	5.34	5.20	2.48*
Fayette	650 Newtown Pike Lexington	21-067-0012	33	12.40	7.41	7.29	7.09	4.17*
Henderson	Baskett Fire Dept. Baskett	21-101-0014	43	13.80	13.10	7.12	7.10	4.02*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	44	37.30	15.80	15.40	12.60	5.24*

*** Incomplete dataset. The mean does not satisfy summary criteria.**
Metals data is only available through September 2016.

Air Toxics Summary Report - 2016

Pollutant: Nickel

Method: IO-3.5; Metals low volume PM_{10} monitor

Data Interval: 24-hour

Units: Nanograms per cubic meter (ng/m^3)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	21st & Greenup Ashland	21-019-0002	39	13.30	8.00	6.90	4.90	2.26*
Carter	Camp Webb Grayson Lake	21-043-0500	43	0.75	0.71	0.55	0.50	0.27*
Fayette	650 Newtown Pike Lexington	21-067-0012	33	1.40	1.37	0.96	0.89	0.47*
Henderson	Baskett Fire Dept. Baskett	21-101-0014	43	1.65	0.90	0.86	0.82	0.48*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	44	1.70	1.26	1.13	0.98	0.47*

*** Incomplete dataset. The mean does not satisfy summary criteria.**
Metals data is only available through September 2016.

Volatile Organic Compounds

Air Toxics Summary Report - 2016

Pollutant: 1,3-Butadiene
Method: TO-15; Passivated SUMMA Canister
Data Interval: 24-hour
Units: Parts-per-billion (ppb)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	2924 Holt Street Ashland	21-019-0017	60	0.46	0.36	0.30	0.26	0.12
Carter	Camp Webb Grayson Lake	21-043-0500	61	0.15	0.14	0.14	0.13	0.06
Fayette	650 Newtown Pike Lexington	21-067-0012	29	0.32	0.22	0.17	0.13	0.09*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	60	1.25	0.57	0.40	0.35	0.11
Marshall	TVA Substation Calvert City	21-157-0014	60	6.44	1.90	1.68	1.22	0.29
Marshall	Atmos Energy Calvert City	21-157-0016	61	0.32	0.31	0.26	0.22	0.09

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Volatile Organic Compounds

Air Toxics Summary Report - 2016

Pollutant: Chloroform
Method: TO-15; Passivated SUMMA Canister
Data Interval: 24-hour
Units: Parts-per-billion (ppb)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	2924 Holt Street Ashland	21-019-0017	60	0.06	0.06	0.05	0.05	0.03
Carter	Camp Webb Grayson Lake	21-043-0500	61	0.05	0.04	0.03	0.03	0.02
Fayette	650 Newtown Pike Lexington	21-067-0012	29	0.03	0.03	0.03	0.03	0.03*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	60	0.26	0.16	0.10	0.03	0.04
Marshall	TVA Substation Calvert City	21-157-0014	60	0.24	0.23	0.13	0.12	0.05
Marshall	Atmos Energy Calvert City	21-157-0016	61	0.18	0.07	0.07	0.06	0.03

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Volatile Organic Compounds

Air Toxics Summary Report - 2016

Pollutant: Carbon Tetrachloride
Method: TO-15; Passivated SUMMA Canister
Data Interval: 24-hour
Units: Parts-per-billion (ppb)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	2924 Holt Street Ashland	21-019-0017	60	0.13	0.13	0.13	0.13	0.10
Carter	Camp Webb Grayson Lake	21-043-0500	61	0.13	0.13	0.12	0.12	0.10
Fayette	650 Newtown Pike Lexington	21-067-0012	29	0.13	0.13	0.13	0.13	0.11*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	60	0.19	0.18	0.18	0.17	0.12
Marshall	TVA Substation Calvert City	21-157-0014	60	0.49	0.38	0.19	0.19	0.13
Marshall	Atmos Energy Calvert City	21-157-0016	61	0.19	0.15	0.14	0.13	0.11

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Volatile Organic Compounds

Air Toxics Summary Report - 2016

Pollutant: Ethylene Dichloride
Method: TO-15; Passivated SUMMA Canister
Data Interval: 24-hour
Units: Parts-per-billion (ppb)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	2924 Holt Street Ashland	21-019-0017	60	0.07	0.06	0.05	0.05	0.03
Carter	Camp Webb Grayson Lake	21-043-0500	61	0.05	0.05	0.04	0.04	0.03
Fayette	650 Newtown Pike Lexington	21-067-0012	29	0.06	0.05	0.05	0.05	0.04*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	60	22.60	5.38	2.32	2.32	0.93
Marshall	TVA Substation Calvert City	21-157-0014	60	11.24	10.24	8.88	6.76	1.74
Marshall	Atmos Energy Calvert City	21-157-0016	61	5.82	4.36	3.00	2.94	0.44

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Volatile Organic Compounds

Air Toxics Summary Report - 2016

Pollutant: Tetrachloroethylene
Method: TO-15; Passivated SUMMA Canister
Data Interval: 24-hour
Units: Parts-per-billion (ppb)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	2924 Holt Street Ashland	21-019-0017	60	0.07	0.06	0.05	0.05	0.02
Carter	Camp Webb Grayson Lake	21-043-0500	61	0.04	0.03	0.02	0.02	0.01
Fayette	650 Newtown Pike Lexington	21-067-0012	29	0.05	0.03	0.03	0.03	0.01*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	60	0.08	0.08	0.05	0.04	0.02
Marshall	TVA Substation Calvert City	21-157-0014	60	0.09	0.07	0.05	0.05	0.02
Marshall	Atmos Energy Calvert City	21-157-0016	61	0.09	0.08	0.07	0.07	0.02

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Volatile Organic Compounds

Air Toxics Summary Report - 2016

Pollutant: 1,1,2,2-Tetrachloroethane
Method: TO-15; Passivated SUMMA Canister
Data Interval: 24-hour
Units: Parts-per-billion (ppb)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	2924 Holt Street Ashland	21-019-0017	60	0.00	0.00	0.00	0.00	0.00
Carter	Camp Webb Grayson Lake	21-043-0500	61	0.00	0.00	0.00	0.00	0.00
Fayette	650 Newtown Pike Lexington	21-067-0012	29	0.03	0.00	0.00	0.00	0.00*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	60	0.43	0.22	0.18	0.09	0.02
Marshall	TVA Substation Calvert City	21-157-0014	60	0.76	0.39	0.23	0.16	0.04
Marshall	Atmos Energy Calvert City	21-157-0016	61	0.73	0.51	0.29	0.12	0.03

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Volatile Organic Compounds

Air Toxics Summary Report - 2016

Pollutant: Trichloroethylene
Method: TO-15; Passivated SUMMA Canister
Data Interval: 24-hour
Units: Parts-per-billion (ppb)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	2924 Holt Street Ashland	21-019-0017	60	0.04	0.03	0.03	0.02	0.00
Carter	Camp Webb Grayson Lake	21-043-0500	61	0.02	0.01	0.01	0.00	0.00
Fayette	650 Newtown Pike Lexington	21-067-0012	29	0.03	0.02	0.00	0.00	0.00*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	60	0.13	0.06	0.04	0.04	0.01
Marshall	TVA Substation Calvert City	21-157-0014	60	0.06	0.05	0.05	0.04	0.01
Marshall	Atmos Energy Calvert City	21-157-0016	61	0.10	0.07	0.06	0.04	0.01

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Volatile Organic Compounds

Air Toxics Summary Report - 2016

Pollutant: Vinyl Chloride
Method: TO-15; Passivated SUMMA Canister
Data Interval: 24-hour
Units: Parts-per-billion (ppb)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	2924 Holt Street Ashland	21-019-0017	60	0.04	0.04	0.04	0.04	0.01
Carter	Camp Webb Grayson Lake	21-043-0500	61	0.06	0.05	0.04	0.04	0.01
Fayette	650 Newtown Pike Lexington	21-067-0012	29	0.03	0.02	0.02	0.01	0.00*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	60	1.28	0.82	0.56	0.49	0.14
Marshall	TVA Substation Calvert City	21-157-0014	60	1.33	1.24	1.06	1.01	0.26
Marshall	Atmos Energy Calvert City	21-157-0016	61	10.24	5.96	5.30	2.68	0.66

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Volatile Organic Compounds

Air Toxics Summary Report - 2016

Pollutant: Benzene
Method: TO-15; Passivated SUMMA Canister
Data Interval: 24-hour
Units: Parts-per-billion (ppb)

County	Site	AQS-ID	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Boyd	2924 Holt Street Ashland	21-019-0017	60	3.58	3.32	2.80	2.51	1.23
Carter	Camp Webb Grayson Lake	21-043-0500	61	2.14	1.46	1.32	1.27	0.72
Fayette	650 Newtown Pike Lexington	21-067-0012	29	1.82	1.13	1.13	1.06	0.79*
Livingston	763 Bloodworth Rd Smithland	21-139-0004	60	3.00	2.26	2.24	2.00	0.93
Marshall	TVA Substation Calvert City	21-157-0014	60	3.81	3.14	2.93	2.49	1.12
Marshall	Atmos Energy Calvert City	21-157-0016	61	6.24	1.98	1.96	1.88	1.07

*** Incomplete dataset. The mean does not satisfy summary criteria.**

Polycyclic Aromatic Hydrocarbons

Air Toxics Summary Report - 2016

Site: Camp Webb-Grayson Lake, Carter County
AQS ID: 21-043-0500
Method: TO-13; PUF-ZAD2 GC-MS
Data Interval: 24-hour
Units: Nanograms per cubic meter (ng/m^3) (25 C)

Pollutant	# Obs	1st max	2nd max	3rd max	4th max	Annual Mean
Napthalene (TSP)	61	49.20	45.80	39.10	36.50	15.70
Acenapthene (TSP)	61	1.11	1.04	0.93	0.87	0.23
Acenapthtylene (TSP)	61	0.26	0.21	0.20	0.19	0.03
Fluorene (TSP)	61	2.41	1.96	1.50	1.46	0.40
Phenanthrene (TSP)	61	3.29	2.31	2.31	2.25	1.31
Anthracene (TSP)	61	0.99	0.10	0.08	0.077	0.03
Retene (TSP)	61	1.36	0.96	0.79	0.44	0.15
Fluoranthene (TSP)	61	1.05	0.81	0.72	0.68	0.40
Pyrene (TSP)	61	0.72	0.66	0.63	0.53	0.23
Chrysene (TSP)	61	0.58	0.51	0.44	0.41	0.10
Coronene (TSP)	61	0.18	0.12	0.12	0.10	0.02
Perylene (TSP)	61	0.06	0.05	0.05	0.04	0.01
Benzo (a) anthracene (TSP)	61	0.25	0.24	0.22	0.18	0.04
Benzo (b) fluoranthene (TSP)	61	0.72	0.66	0.51	0.39	0.10
Benzo (k) fluoranthene (TSP)	61	0.23	0.20	0.11	0.09	0.02

APPENDICES

APPENDIX A: AIR QUALITY INDEX (AQI)

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
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
Hazardous	> 300	Health warnings of emergency conditions. The entire population is more likely to be affected.

What is the AQI?

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 you may experience within a few hours or days after breathing polluted air. The 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 a value over 300 signifies 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.

Where can I find out about the AQI?

The Division for Air Quality reports nearly real-time AQI values on our website at air.ky.gov .

Forecasted AQI data is generated using a combination of forecasted weather data and known pollution emission values. The division does not forecast for air pollution; however, the Louisville Metro Air Pollution Control District does provide ozone and $PM_{2.5}$ forecasts for residents of Jefferson County. LMAPCD's forecasts can be accessed on their website at www.louisvilleky.gov/APCD.

Nationwide near real-time and forecasted AQI data can be accessed at the EPA's AIRNow website at airnow.gov.

Carbon Monoxide (CO)

Carbon monoxide 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 including highway and off-road vehicles, such as construction equipment. Other sources include industrial processes, and kerosene or wood burning stoves in homes.

Current Carbon Monoxide Standard
CO has two standards: an 8-hour primary standard at 9 ppm and a 1-hour primary standard at 35 ppm.

Health and 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 the sample. 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.

Lead (Pb)

Lead is a soft, blue-gray metal that occurs naturally. However, the historical use of lead in gasoline, paint, and plumbing, along with modern use in batteries, bridge paint, and plastic has caused lead to accumulate in the environment. The accumulation of lead in the environment is the reason lead can be found in everyone's body today.

Current Lead Standard
On Nov. 12, 2008, the NAAQS for lead was lowered from 1.5 $\mu g/m^3$ to 0.15 $\mu g/m^3$. Unlike the other NAAQS pollutants that monitor for area-wide impacts, the lead NAAQS required state, tribal, and local agencies to monitor near sources that emit more than one ton of lead per year. The division identified three sources that emitted over one ton of lead annually and began monitoring near the sources in 2010. In December 2010, the EPA released an updated set of monitoring requirements, which established lead monitoring near sources that emit more than 0.5 tons per year. While rule revisions orginally required lead monitoring at certain urban NCore sites, the requirement has since been eliminated. However, LMAPCD still conducts lead monitoring at the NCore site in Jefferson County.

Health and Environmental Impacts
Ingestion of lead is the first major pathway of exposure. In adults, only about 10 percent of ingested lead is absorbed into the body whereas approximately 30-50 percent of lead ingested by children is absorbed. Children also absorb lead into their system faster than an adult. Inhalation is the second leading pathway of exposure for lead; nearly all of lead inhaled is absorbed into the body.

Lead can accumulate in soil, water, and sediments through deposition from air sources. The accumulation can damage ecosystems through the loss of biodiversity, changes in community composition, and decreased growth and reproductive rates in plants and animals.

Lead contamination can cause nervous system and kidney damage, learning disabilities, poor muscle coordination, decreased bone and muscle growth, and hearing damage in children. Lead can also affect adult nervous systems. However, most adults require a much larger exposure than a child to have a negative health impact.

How is lead monitored?
At most sites, lead concentrations are determined from the analysis of suspended particulates collected by federal reference method high volume particulate samplers. These samplers use a brushless motor and a critical flow orifice in order to achieve a sampling flow rate between 1.10 and 1.70 cubic meters per minute (m^3/min) over the course of 24 hours. Samples are collected on 8x10 glass fiber filters. Upon collection, the filters are sent to an EPA-certified laboratory for analysis. The sample filters are cut into strips, acid digested according to 40 CFR Part 50, Appendix G, and analyzed by Inductively Coupled Plasma with Mass Spectroscopy Detection (ICP-MS).

Lead samples at the LMAPCD NCore site are collected using a manual PM_{10} sampler (in local conditions), which is an approved federal equivalent method for lead sampling. These low-volume instruments maintain a flow-rate of 16.7 liters per minute to collect a sample onto a PTFE filter. PM_{10} filters are first analyzed to obtain the mass-difference and are subsequently sent to a laboratory for lead analysis via x-ray fluorescence.

Nitrogen Dioxide (NO_2)

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 (NO_2) and nitrogen oxide (NO). In addition to the NO_2 produced during combustion, the NO produced may, in the presence of sunlight, undergo a photochemical reaction that will also form NO_2. The rate of reaction is dependent upon the intensity of the sunlight. Major combustion or oxidation sources that produce NO_2 include motor vehicles, power plants, incinerators, boilers, and chemical processes.

Current Nitrogen Dioxide Standard
NO_2 has two standards: a 1-hour primary standard set at 100 ppb and an annual primary and secondary combined standard at 53 ppb.

Health and Environmental Impacts
The primary health effect of NO_2 is as a lung irritant, which can cause an increase in respiratory rate, a decrease in lung function, and an increase in 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.

NO_2 is 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 NO_2 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 air stream reacts 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 NO_2 does not react with ozone, the second stream of air passes

through a catalytic converter that converts the NO_2 in the sample to NO. The second air stream then reacts with ozone, providing a total measurement of nitrogen oxides (NO_x) in the sample.

The assumption is that the majority of the NO_x value is not NO_2. By subtracting the second air stream NO concentration from the first stream NO_x concentration, an NO_2 value is obtained. Data from the analyzer is transmitted into an automated data storage system.

Ozone (O_3)

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

Current Ozone Standard

In October 2015, the EPA lowered the eight-hour ozone standard from 0.075 ppm to 0.070 ppm. However, the previous standard of 0.075 ppm remained in effect throughout the 2015 ozone monitoring season. The secondary standard to protect public welfare is the same as the primary.

Health and 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 ozone, also known as ground-level ozone, can trigger health problems at low level exposure, cause permanent lung damage after long term exposure, and can damage ecosystems.

How is O_3 monitored?

Ozone is typically monitored from March 1st through Oct. 31st each year, when meteorological conditions are most conducive to the formation of ozone; however, the LMAPCD NCore site collects ozone data year-round. 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 are transmitted into an automated data storage system.

Particulate Matter ($PM_{2.5}$)

Particulate matter is a mixture of solid particles 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 gases are transformed through chemical reactions. Sulfur dioxide, nitrogen oxides, and VOCs are all examples of gases that can transform by chemical reactions.

Current $PM_{2.5}$ Standard

$PM_{2.5}$ has two primary standards to protect human health: an annual standard set at 12 $\mu g/m^3$, and a 24-hour standard set at 35 $\mu g/m^3$. The secondary standard to protect public welfare is an annual standard set at 15 $\mu g/m^3$.

Health and Environmental Impacts

Particulate matter of 2.5 microns or less has the ability to penetrate into the deepest parts of the lungs, causing chronic respiratory symptoms in sensitive populations and premature deaths in the elderly. $PM_{2.5}$ also affects the environment by reducing visibility (up to 70 percent in some areas of the U.S.) and contributing to acid rain.

How is $PM_{2.5}$ monitored?

The division currently operates continuous Tapered Element Oscillating Microbalance (TEOM) monitors and manual intermittent Federal Reference Method (FRM) and (Federal Equivalent Method) FEM samplers.

CRITERIA POLLUTANTS, Cont'd.

However, only the FRM and FEM manual intermittent samplers are used for comparisons to the NAAQS. The TEOM monitors continuously report $PM_{2.5}$ Air Quality Index (AQI) results. The FRM and FEM manual samplers are used for calculation of the AQI for historic data. LMAPCD also operates FEM Beta Attenuation Monitors (BAM), which are usable for both NAAQS comparisons are reporting of the AQI.

The manual intermittent FRM-type monitors collect a sample over a 24-hour run cycle. While most samplers operate every third day, some samplers operate every sixth day and others operate every twelfth day. These samplers operate by drawing a measured volume of air through a pre-weighed filter. 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 weighed to determine the mass of the particulates collected.

How is $PM_{2.5}$ speciation monitored?
$PM_{2.5}$ is composed of many different components or *species*. The approach to be used for chemical speciation involves both sampling and analysis of species. 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 species, each series of species requires sample collection on the appropriate media and utilization of the appropriate analytical techniques. One instrument collects $PM_{2.5}$ speciation samples. Samples are collected on a set of two filters, one comprised of Teflon and one comprised of nylon, over a 24-hour sampling period. A second instrument collects a sample on a quartz filter over a 24-hour sampling period. The quartz filter is used to collect a speciated carbon sample.

$PM_{2.5}$ speciation samples are sent to an EPA contract laboratory for analysis. Listed below are the techniques used to analyze samples for each group of species:

- 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 species are further separated into several target chemical species. These species in turn can be linked to source categories that ultimately can be used to assist in understanding $PM_{2.5}$ composition and developing control strategies needed to reduce ambient levels.

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

Particulate Matter (PM_{10})
Particulate matter of 10 microns or less in diameter (PM_{10}) is a mixture of solid particles and liquid droplets. Some common sources of PM_{10} are prescribed fires, construction activities, agricultural practices, and smoke-stacks.

Current PM_{10} Standard
The current NAAQS for PM_{10} (both primary and secondary) is a 24-hour standard set at 150 $\mu g/m^3$. The estimated number of exceedances must be equal to or less than one, on average, over 3 years.

Health and Environmental Impacts
Exposure to particulates aggravates respiratory and cardiovascular disease, and high levels can 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. PM_{10} damages vegetation by interfering with plant photosynthesis due to the formation of a film on leaves that reduces exposure to sunlight. Particulate pollution can also produce haze, which diminishes visibility and the amount of sunlight reaching the earth.

How is PM_{10} monitored?
For PM_{10} NAAQS comparisons, both intermittent and continuous monitor types may be used because they are both FRM or FEM equivalents. Most PM_{10} samplers are the intermittent type that operates for 24 hours, every sixth day. Some intermittent samplers may operate on a more frequent schedule in order to investigate localized concerns. Intermittent 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 10 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 manually into a data storage system. The network also includes continuously operating PM_{10} samplers that provide results daily. These samplers determine sample weights electronically and transmit results by telemetry into an automated data storage system.

Sulfur Dioxide

Sulfur dioxide is a colorless gas that has a pungent odor at concentrations exceeding 0.5 ppm. SO_2 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 SO_2. Other industrial sources include petroleum refineries and paper mills.

Current SO_2 Standard
The current primary SO_2 standard is a 1-hour average set at 75 ppb. The secondary standard is a 3-hour average set at 0.5 ppm.

Health and Environmental Impacts
The primary health effect of exposure to SO_2 is the aggravation of pre-existing respiratory, cardiovascular, and pulmonary disease. Asthmatics, children, and the elderly are especially susceptible to the effects of SO_2 pollution. SO_2 can also damage the foliage of trees and agricultural crops.

Moisture in the atmosphere combines with SO_2 to form sulfuric acid (H_2SO_4), 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.

SO_2 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 SO_2 monitored?
Analyzers continuously monitor SO_2 by using the ultraviolet (UV) fluorescence method. Fluorescent analyzers irradiate an ambient air sample with ultraviolet light. SO_2 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 SO_2 molecules is proportional to the concentration of SO_2 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 into an automated data storage system.

Division for Air Quality
Regional Office Boundaries

air.ky.gov

Environmental Emergency, 24-hour; (502) 564-2380 or (800) 928-2380
Open burn complaints NEW NUMBER: (502) 782-6592

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APPENDIX D: GLOSSARY OF ABBREVIATIONS

AHERA Asbestos Hazard Emergency Response Act

AQI Air Quality Index

BACT Best Available Control Technology

CAA Clean Air Act

CO Carbon Monoxide

CO_2 Carbon Dioxide

CPT Cost per Ton

CSAPR Cross-State Air Pollution Rule

DAQ Division for Air Quality

DEP Department for Environmental Protection

DERA Diesel Emissions Reduction Act

EEC Energy and Environment Cabinet

EGU Electric Generating Unit

EPA Environmental Protection Agency

GHG Greenhouse Gas

HAP Hazardous Air Pollutant

HPV High Priority Violation

KAR Kentucky Administrative Regulation

KORA Kentucky Open Records Act

KRS Kentucky Revised Statute

LMAPCD Louisville Metropolitan Air Pollution Control District

LOW Letter of Warning

MACT Maximum Achievable Control Technology

NAAQS National Ambient Air Quality Standard

NATTS National Air Toxics Trends Stations

NESHAP National Emission Standard for Hazardous Air Pollutants

NO_x Nitrogen Oxides

NOV Notice of Violation

NPS National Park Service

NSR New Source Review

O_3 Ozone

Pb Lead

PM_{10} Particulate Matter, also known as coarse particles, measure between 2.5-10 microns in diameter

$PM_{2.5}$ Fine Particulate Matter, also known as fine particles, measuring less than 2.5 microns in diameter

PTE Potential to Emit

QAPP Quality Assurance Project Plan

RATA Relative Accuracy Test Audit

RTF Regulatory Time Frame

SEDC Southeast Diesel Collaborative

SIP State Implementation Plan

SO_2 Sulfur Dioxide

SOP Standard Operating Procedure

TEMPO Tools for Environmental Management and Protection Organizations

TPY Tons per year

TRI Toxics Release Inventory

VISTAS Visibility Improvement State and Tribal Association of the Southeast

VOC Volatile Organic Compound

APPENDIX E: GLOSSARY OF TERMS

Analyte A chemical substance that is the subject of chemical analysis.

Anion A negatively-charged particle, having more electrons than protons.

Asbestos Hazard Emergency Response Act AHERA requires schools to inventory their asbestos materials and document strategies for dealing with these materials.

Air Toxics See Toxic Air Pollutant.

Ambient air quality The level of pollution present in the air outside.

Attainment When an area meets the national air quality standard set by the federal EPA for a particular pollutant.

Cation A positively-charged particle, having more protons than electrons.

Chemiluminescence The emission of light by a substance as a result of a chemical reaction that does not involve an increase in its temperature.

Clean Air Act Federal clean air program established by Congress in 1963.

Class I Area Areas of special natural, scenic, or historic importance are known as "Class 1 Areas," and are protected to maintain long distance, panoramic views.

Criteria Pollutant A regulated air pollutant. Currently, there are six criteria pollutants under the Clean Air Act. They are carbon monoxide, lead, ozone, particulate matter, nitrogen oxides and sulfur dioxide.

Emissions Inventory A list of sources of air contaminants, containing for each source the amount of each contaminant emitted.

Exceedance (of NAAQS) One occurrence of a measured or modeled concentration that exceeds the specified concentration level of a NAAQS for the averaging period specified by that standard.

Hazardous Air Pollutant Any pollutant listed in Subsection B of Section 112 of the Clean Air Act.

Inspection A scheduled determination of compliance with an existing regulation.

Investigation A complaint driven determination of compliance with an existing regulation.

Major Source A stationary source that emits and has the potential to emit 100 tons per year or more of a regulated air pollutant.

Minor Source A stationary source that emits and has the potential to emit less than the major source threshold.

Mobile Source A *moving*, non-stationary source of air pollutants, such as motor vehicles, ships, airplanes, construction equipment, etc.

National Ambient Air Quality Standards (NAAQS) Standards established by the United States Environmental Protection Agency (EPA) under authority of the Clean Air Act (42 U.S.C. 7401 et seq.) that apply for outdoor air throughout the country.

National Emissions Standards for Hazardous Air Pollutants (NESHAP) With respect to asbestos, NESHAP governs renovation and demolition activities and requires safe handling, removal (when applicable), and disposal of asbestos from facilities (everything except for single private homes).

GLOSSARY, Cont'd.

Nonattainment The official designation for an area that does not meet the National Ambient Air Quality Standard set by the U.S. EPA for a particular pollutant.

Notification Required reporting by facilities of regulated activities. For example, facilities are required to notify DAQ of certain air emission releases or upcoming asbestos disturbance (removal/demolition activities).

Primary Standard A National Ambient Air Quality Standard which establishes limits on specific criteria pollutants to protect public health, including the health of sensitive populations such as children, asthmatics, and the elderly.

Promulgate To officially announce, publish, make known to the public; to formally announce a statute or decision by the court.

Secondary Standard A National Ambient Air Quality Standard which establishes limits on specific criteria pollutants to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

Speciation The process of determining the physical and chemical makeup of pollutants such as particulate matter, which may be composed of droplets and particles of various compounds.

Stationary Source An emission source that does not move, also known as a point source. Stationary sources include factories, power plants, cement plants, and quarries.

Synthetic Minor A facility that has the Potential to Emit (PTE) that could exceed major Title V thresholds, but they have agreed to control emissions below major threshold. Synthetic minors includes conditional major facilities.

Title V Any source that has the PTE of greater than 100 Tons of criteria pollutants or 10/25 TPY of a single HAP or any combined HAP.

Toxic Air Pollutant A subset of the pollutants listed as Hazardous Air Pollutants by the U.S. EPA.

APPENDIX F: NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

POLLUTANT	MAXIMUM CONCENTRATION	
	Primary Standard	Secondary Standard
Carbon Monoxide		
8-Hour Average	9 ppm (1)	----------
1-Hour Average	35 ppm (1)	----------
Lead		
Rolling 3-Month Average	0.15 µg/m^3 (2)	Same as primary
Nitrogen Dioxide		
Annual Average	53 ppb (3)	Same as primary
1-Hour Average	100 ppb (4)	----------
Particulate Matter (measured as PM_{10})		
24-Hour Average	150 µg/m^3 (5)	Same as primary
Particulate Matter (measured as $PM_{2.5}$)		
Annual Average	12.0 µg/m^3 (6)	15.0 µg/m^3 (6)
24-Hour Average	35 µg/m^3 (7)	Same as primary
Ozone		
8-Hour Average	0.070 ppm (8)	Same as primary
Sulfur Dioxide		
1-Hour Average	75 ppb (9)	----------
3-Hour Average	----------	0.5 ppm (1)

The National Ambient Air Quality Standard determines what levels of each pollutant are acceptable in terms of protecting human health (primary standard) and public welfare (secondary standard).

Understanding the National Ambient Air Quality Standards

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 to establish National Ambient Air Quality Standards defining maximum allowable ambient (outdoor) concentrations for criteria pollutants. Through the Clean Air Act, the Environmental Protection Agency established federal standards for six criteria air pollutants that are considered harmful to human health and the environment. Known as the National Ambient Air Quality Standards or "NAAQS" (pronounced "nacks"), the standards establish limits for each of the criteria pollutants. The term "criteria pollutants" derives from the requirement that EPA must set criteria or standards for each pollutant in the table on page 87.

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 includes 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 ($\mu g/m^3$), parts of pollutants per million (ppm) parts of air, and parts-per-billion (ppb) parts of air.

Footnotes:

(1) Not to be exceeded more than once per year.

(2) In addition to the 2008 lead standard (final rule signed Oct. 15, 2008), the 1978 lead standard (1.5 $\mu g/m^3$ as a quarterly average) also remains in effect until one year after an area is designated for the 2008 standard.

(3) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(4) To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective Jan. 22, 2010).

(5) The estimated number of exceedances must be equal to or less than one, on average over 3 years.

(6) To attain this standard, the 3-year average of weighted annual means must not exceed 12.0 $\mu g/m^3$ (final rule signed on Dec. 14, 2013; rule effective on March 18, 2013). The previous primary standard was set to 15.0 $\mu g/m^3$, as a 3-year average of annual weighted means, and was instead retained as a secondary standard.

(7) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$.

(8) To attain this standard, the weighted 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.070 ppm (effective December 28, 2015).

(9) To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb (final rule signed June 22, 2010).