

2018 Fine Particles (PM_{2.5}) Data Summary Report



Indiana Department of Environmental Management (IDEM)
Office of Air Quality

May 2019

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Contents

About This Report	1
What Is Particulate Matter (PM)?	1
National Ambient Air Quality Standards (NAAQS) for PM _{2.5}	2
Attaining the PM _{2.5} Standards	3
2018 PM _{2.5} Monitoring Network.....	4
2018 PM _{2.5} Monitoring Data Summary	6
PM _{2.5} Air Quality Trends, 2009-2018.....	9
Status of PM _{2.5} Designations.....	13
Additional Information.....	15
Contact IDEM's Office of Air Quality.....	15

Figures

Figure 1: Illustration of Fine Particles	1
Figure 2: History of the PM _{2.5} NAAQS.....	3
Figure 3: Annual PM _{2.5} Monitoring Network, 2018.....	5
Figure 4: 24-Hour PM _{2.5} Monitoring Network, 2018.....	6
Figure 5: Design Values, Annual PM _{2.5} Standard, 2016-2018	7
Figure 6: Design Values, 24-Hour PM _{2.5} Standard, 2016-2018.....	8
Figure 7: Areas of Indiana	9

Charts

Chart 1: PM _{2.5} Annual Mean Trends, Primary Annual Standard, 2009 Through 2018:.....	10
Chart 2: PM _{2.5} Design Value Trends, Primary Annual Standard, 2007-2009 Through 2016-2018.....	11
Chart 3: PM _{2.5} 98 th Percentile Value Trends, Primary 24-Hour Standard, 2009 Through 2018.....	12
Chart 4: PM _{2.5} Design Value Trends, Primary 24-Hour Standard, 2007-2009 Through 2016-2018.....	13

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About This Report

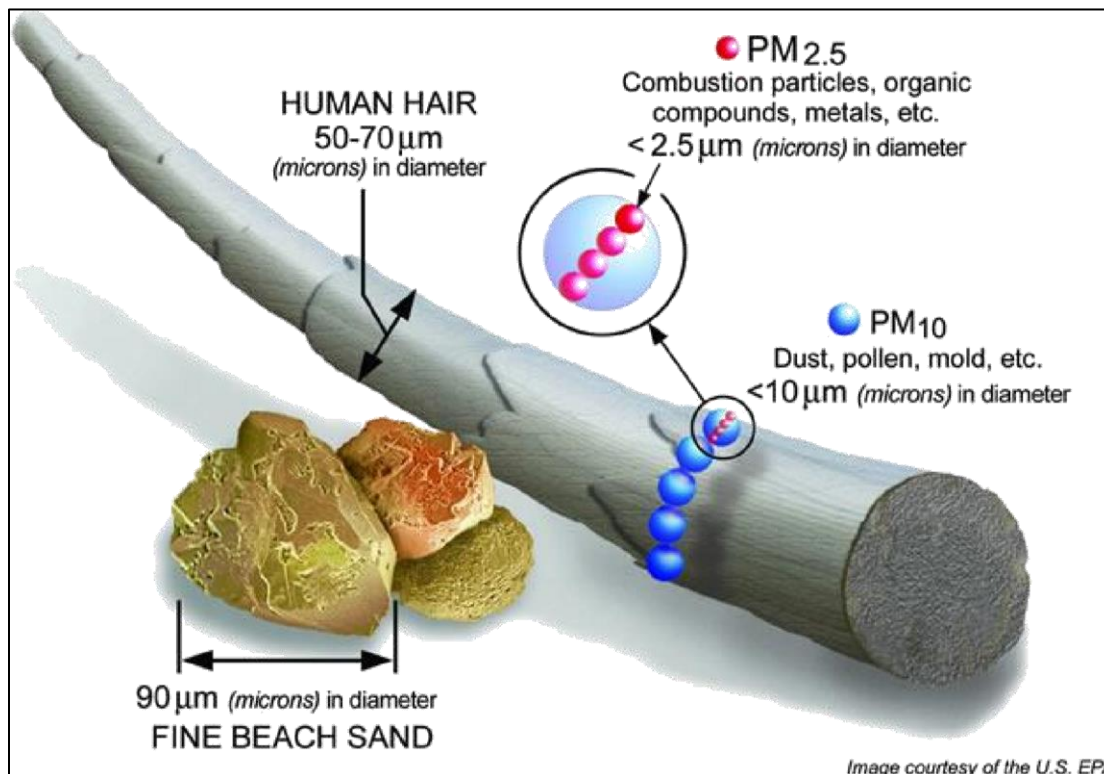
The Indiana Department of Environmental Management (IDEM) collects and analyzes air samples for regulated pollutants, including fine particles, which are referred to as PM_{2.5}. IDEM monitors for PM_{2.5} year round, as mandated by United States Environmental Protection Agency (U.S. EPA), and reports the data to U.S. EPA's Air Quality System (AQS). This **2018 Fine Particles (PM_{2.5}) Data Summary Report** provides an overview of PM_{2.5} and its impacts, national air health standards, Indiana's PM_{2.5} monitoring network, a summary of 2018 PM_{2.5} monitoring data, air quality trends over the last 10 years, and the status of PM_{2.5} designations in Indiana.

What Is Particulate Matter (PM)?

Particulate matter (PM) is a complex mixture of small particles found in the air, including dust, dirt, smoke, and liquid droplets. PM₁₀ refers to extremely small particles that are 10 micrometers, or microns, in diameter or smaller. PM_{2.5} refers to microscopic particles that are 2.5 microns in diameter or smaller.

Exposure to PM poses significant health concerns. As shown in Figure 1, PM₁₀ is many times smaller than a fine grain of sand or a human hair. PM_{2.5} is much smaller still. Because of their extremely small size, both PM₁₀ and PM_{2.5} can be inhaled deeply into the lungs and are very difficult to exhale.

Figure 1:
Illustration of Fine Particles



PM also causes adverse environmental impacts. Airborne particles can settle on ground or water, and depending on their composition, may adversely affect lakes, streams and soil, sensitive forests, crops, and ecosystems, and damage or stain buildings and monuments. PM_{2.5} particles in the air cause haze and reduce visibility.

Where does PM come from? PM is generated by all types of combustion activities. Common sources include emissions from coal-fired power plants and industrial boilers, smoke from open burning activities, and motor exhaust. PM also includes dust from unpaved roads, fields and construction sites.

What are the health effects of exposure to PM? PM is linked to adverse effects on the lungs and heart:

- Increased respiratory symptoms:
 - Irritation of the airways.
 - Coughing or difficulty breathing.
 - Decreased lung function.
 - Aggravated asthma.
 - Development of chronic bronchitis.
- Irregular heartbeats.
- Nonfatal heart attacks.
- Premature death in people with heart or lung disease.

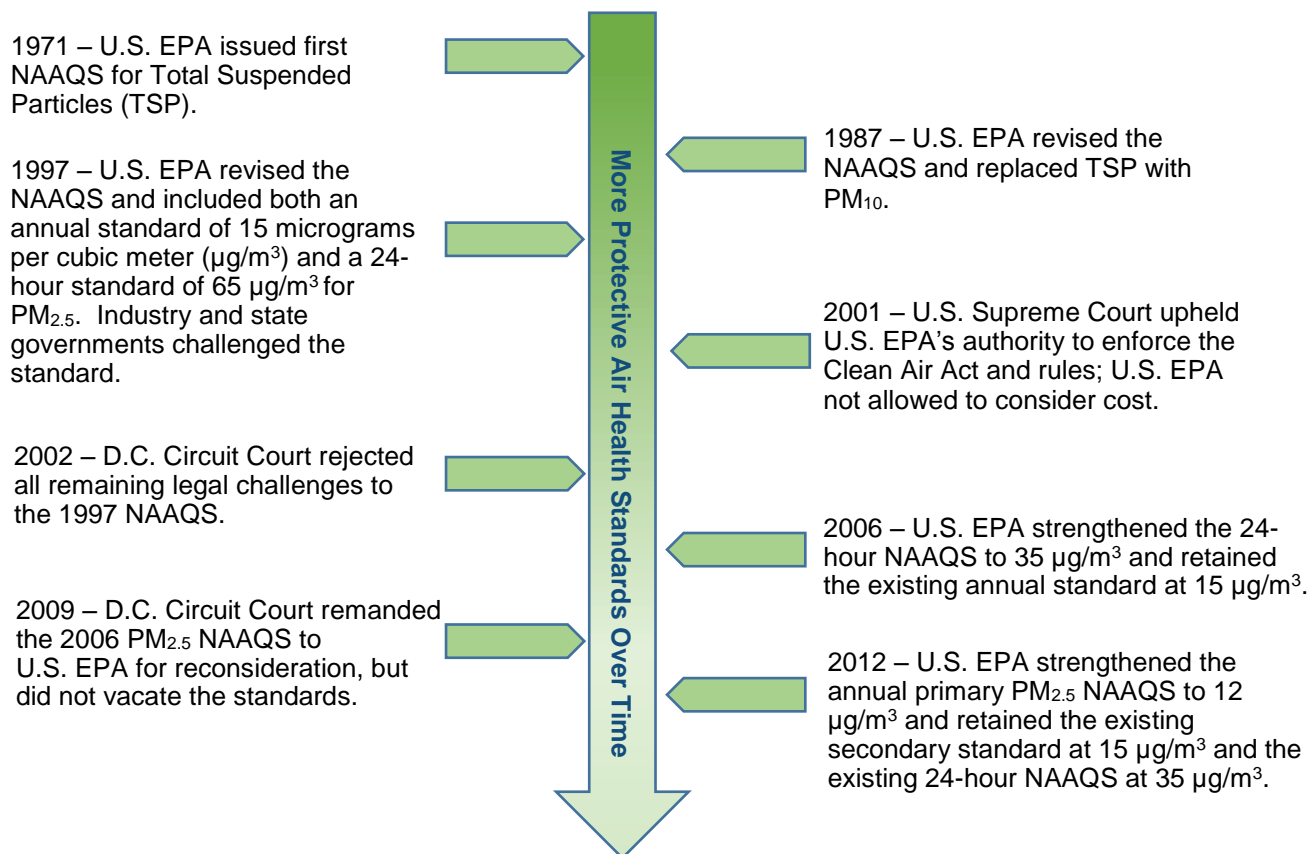
National Ambient Air Quality Standards (NAAQS) for PM_{2.5}

The federal Clean Air Act requires U.S. EPA to establish National Ambient Air Quality Standards (NAAQS) for common outdoor air pollutants, including PM_{2.5}. NAAQS, which are also known as air health standards, include:

- Primary standards for public health, which set pollutant limits to protect the most vulnerable groups such as young children, the elderly and individuals with respiratory illnesses.
- Secondary standards for public welfare, which set limits to protect visibility and prevent damage to animals, crops, vegetation, and buildings.

Primary and secondary NAAQS established in 1971 set the first limits for total suspended particles (TSP). Reviews and revisions have occurred over the years. Standards for PM₁₀ were first established in 1987. Standards for PM_{2.5} were first established in 1997. Figure 3 shows milestones in the standards' development.

**Figure 2:
History of the PM_{2.5} NAAQS**



Attaining the PM_{2.5} Standards

Air quality must meet both the annual and the 24-hour, or daily, standards for PM_{2.5}. Three complete, consecutive years of monitoring data is used to make a determination about a given area. For example, an evaluation in 2020 will be based on data from 2017 to 2019.

How does an area attain the annual PM_{2.5} NAAQS? For the annual standards, measured concentrations are averaged on an annual rolling basis. Air quality meets the primary annual standard when the annual arithmetic mean of the daily values averaged over three years does not exceed 12 micrograms per cubic meter (µg/m³). The secondary annual standard is achieved when the annual arithmetic mean averaged over three years does not exceed 15 µg/m³. The data from each monitor is evaluated.

How does an area attain the 24-hour PM_{2.5} NAAQS? For the daily standards, measured concentrations are averaged on a 24-hour rolling basis. Air quality meets the primary and secondary daily standards, which are set at the same level, when the three-year average of the 98th percentile of measured concentrations does not exceed 35 µg/m³. The data from each monitor is evaluated.

What is a design value? The three-year average is referred to as the **design value**. The annual design value is the three-year average of the weighted annual mean PM_{2.5} concentrations. The 24-hour design value is the three-year average of the 98th percentile of 24-hour concentrations.

Monitor design values are calculated at the end of the year, once all of the data has been quality assured. Where two or more monitors are located within an area, the monitor with the highest design value is used for the air quality designation.

What is the difference between an exceedance and a violation? When a monitor records a concentration above the limit established by the NAAQS, it is referred to as an **exceedance**. A monitor can have an exceedance without being in **violation** of the standard. If a monitor's three-year design value exceeds the NAAQS, the monitor is in violation.

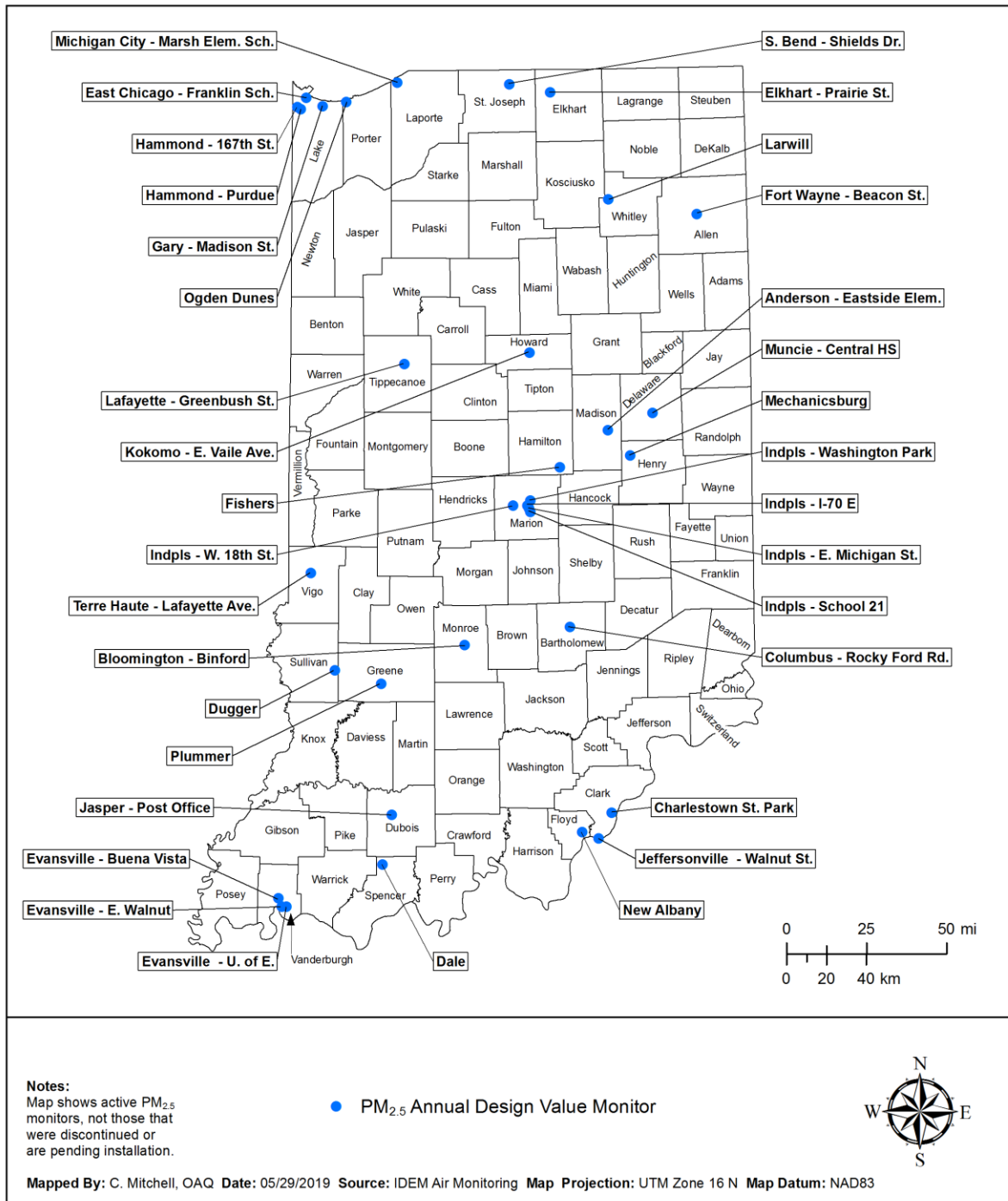
2018 PM_{2.5} Monitoring Network

PM_{2.5} monitors are placed in locations across Indiana according to U.S. EPA guidance on factors including population and manufacturing levels. The network consists of 34 annual PM_{2.5} monitoring sites in 24 counties, and 37 24-hour PM_{2.5} monitoring sites in 24 counties (three locations reflect air quality in a relatively small area, are directly influenced by a specific source, and are intended to be used for determining attainment status under the 24-hour standard only).

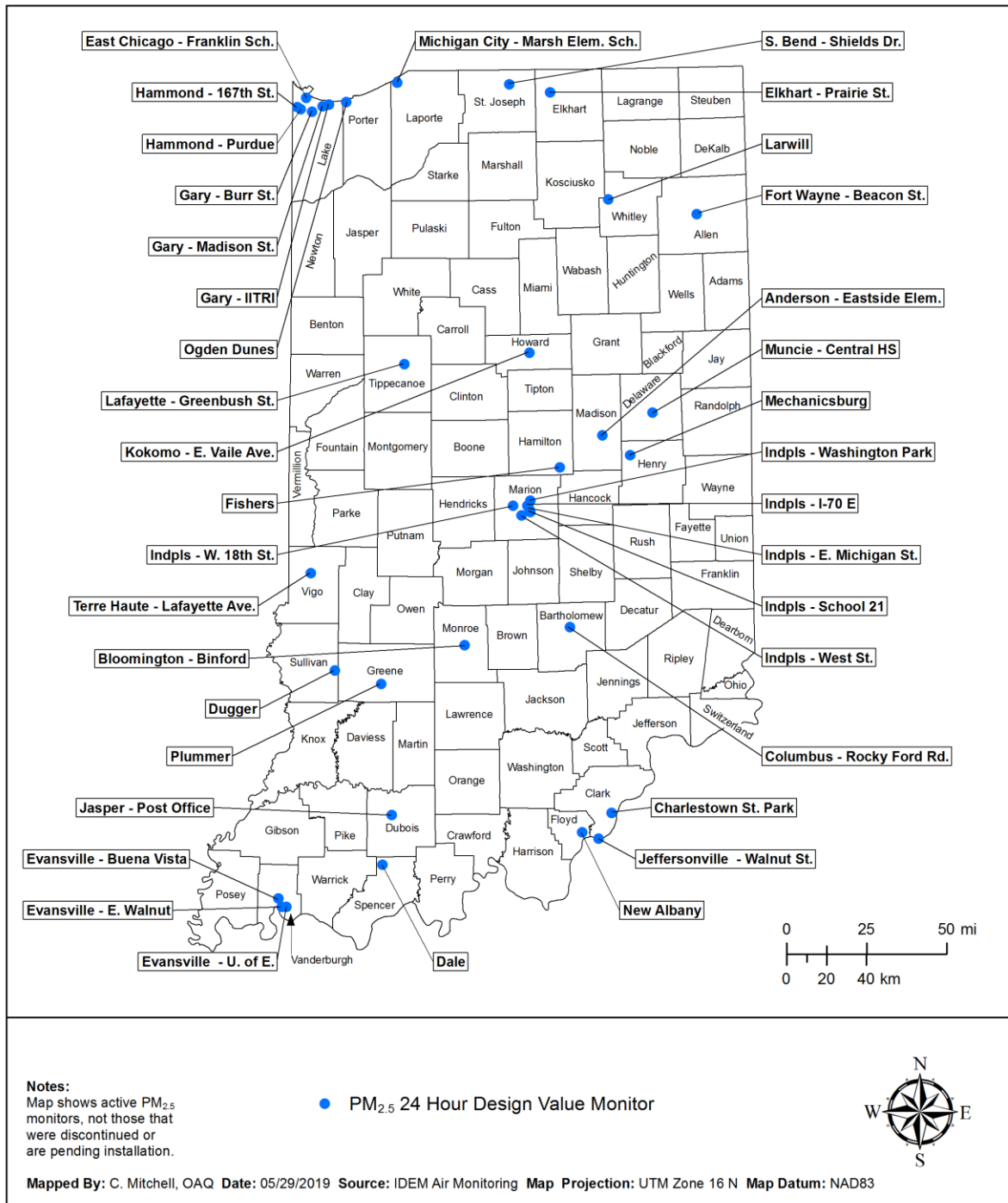
IDEM conducts annual reviews of the monitoring network, which are published each year in the *Indiana Ambient Air Monitoring Network Plan* at: <https://www.in.gov/idem/airquality/2389.htm>.

Figure 3 shows annual PM_{2.5} monitor locations and Figure 4 shows 24-hour PM_{2.5} monitor locations for 2018.

**Figure 3:
Annual PM_{2.5} Monitoring Network, 2018**



**Figure 4:
24-Hour PM_{2.5} Monitoring Network, 2018**

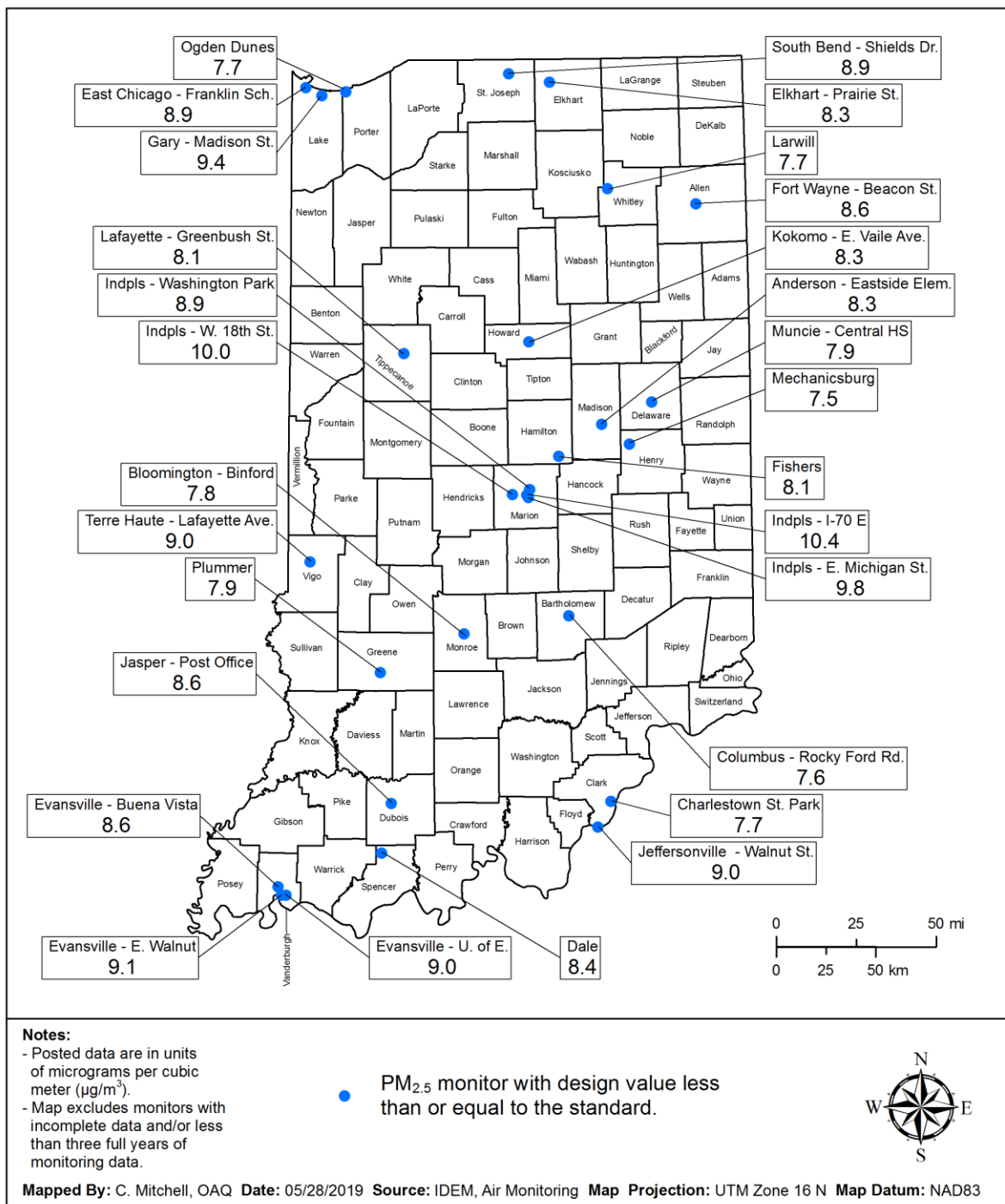


2018 PM_{2.5} Monitoring Data Summary

PM_{2.5} monitoring data has been quality assured for 2018.

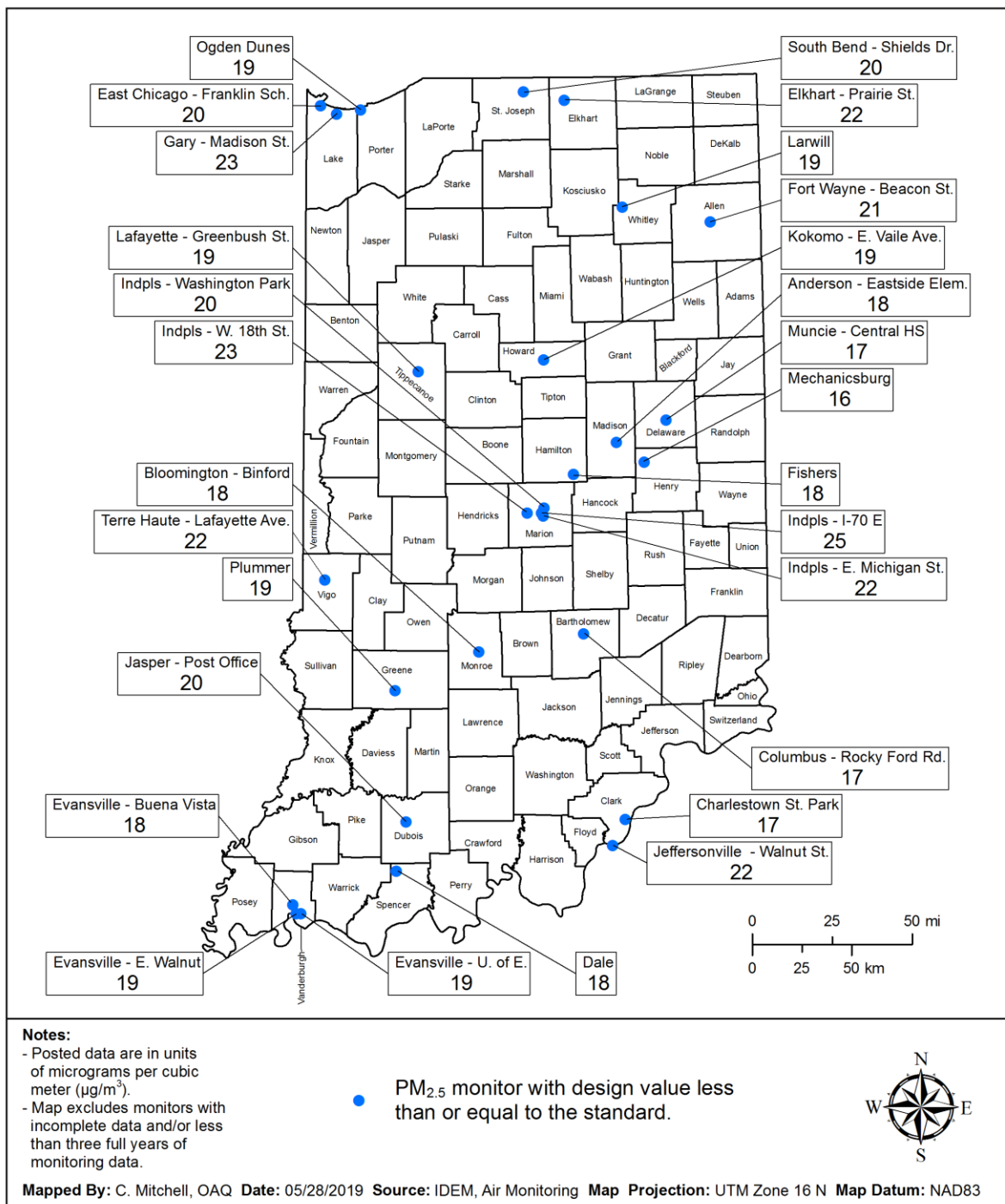
Annual Monitoring Data: No monitor had an annual mean PM_{2.5} concentration above the primary annual standard of 12 µg/m³ in 2018. All annual monitor design values were below the primary annual standard of 12 µg/m³ for 2016-2018, as shown in Figure 5.

Figure 5:
Design Values, Annual PM_{2.5} Standard, 2016-2018



24-Hour Monitoring Data: No monitor had a daily 98th percentile of 24-hour PM_{2.5} concentrations above the primary 24-hour standard of 35 µg/m³ in 2018. All 24-hour monitor design values were below the primary 24-hour standard of 35 µg/m³ for 2016-2018, as shown in Figure 6.

Figure 6:
Design Values, 24-Hour PM_{2.5} Standard, 2016-2018



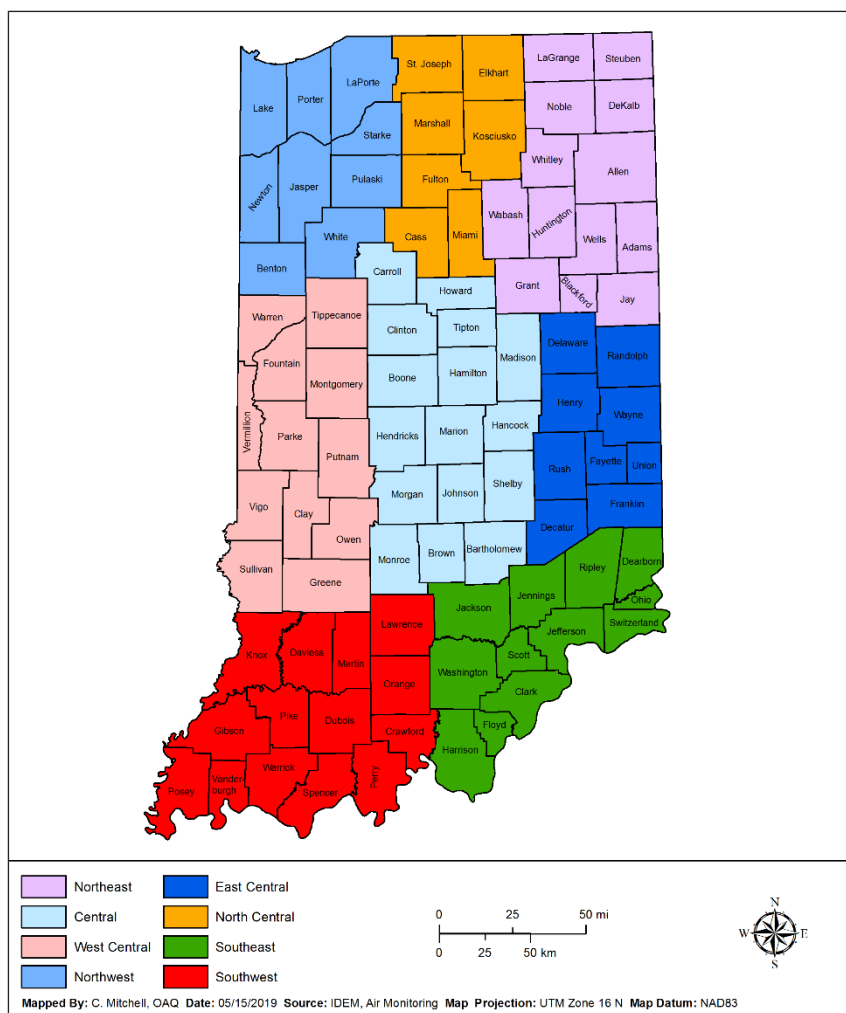
Exceedances: Exceedances of the 24-hour standard were recorded on six days in 2018, compared with three days in 2017.

Air Quality Action Days: IDEM works to analyze continuous monitoring data and issue year round air quality forecasts in coordination with local, state and regional partners. Public alerts called **Air Quality Action Days** (AQADs) are issued when unhealthy air pollution is predicted. No AQADs were issued for PM_{2.5} in 2018. The public can find daily air quality forecasts and sign up to receive email or text alerts on IDEM's website at: <https://www.in.gov/idem/airquality/pages/smogwatch/index.htm>.

PM_{2.5} Air Quality Trends, 2009-2018

An analysis of annual and daily monitoring data shows PM_{2.5} air quality trends in all areas of Indiana over the last 10 years. To present PM_{2.5} monitoring data, the state is divided into regions, as shown in Figure 7.

Figure 7:
Areas of Indiana



Data is plotted in comparison with the primary annual standard of 12 $\mu\text{g}/\text{m}^3$ in Charts 1 and 2. Annual means fluctuated during the 2009-2018 time frame but showed an overall $\text{PM}_{2.5}$ reduction, as shown in Chart 1. A statewide downward trend over the 10-year time frame is illustrated by the three year design values plotted in Chart 2.

**Chart 1:
PM_{2.5} Annual Mean Trends, Primary Annual Standard,
2009 Through 2018**

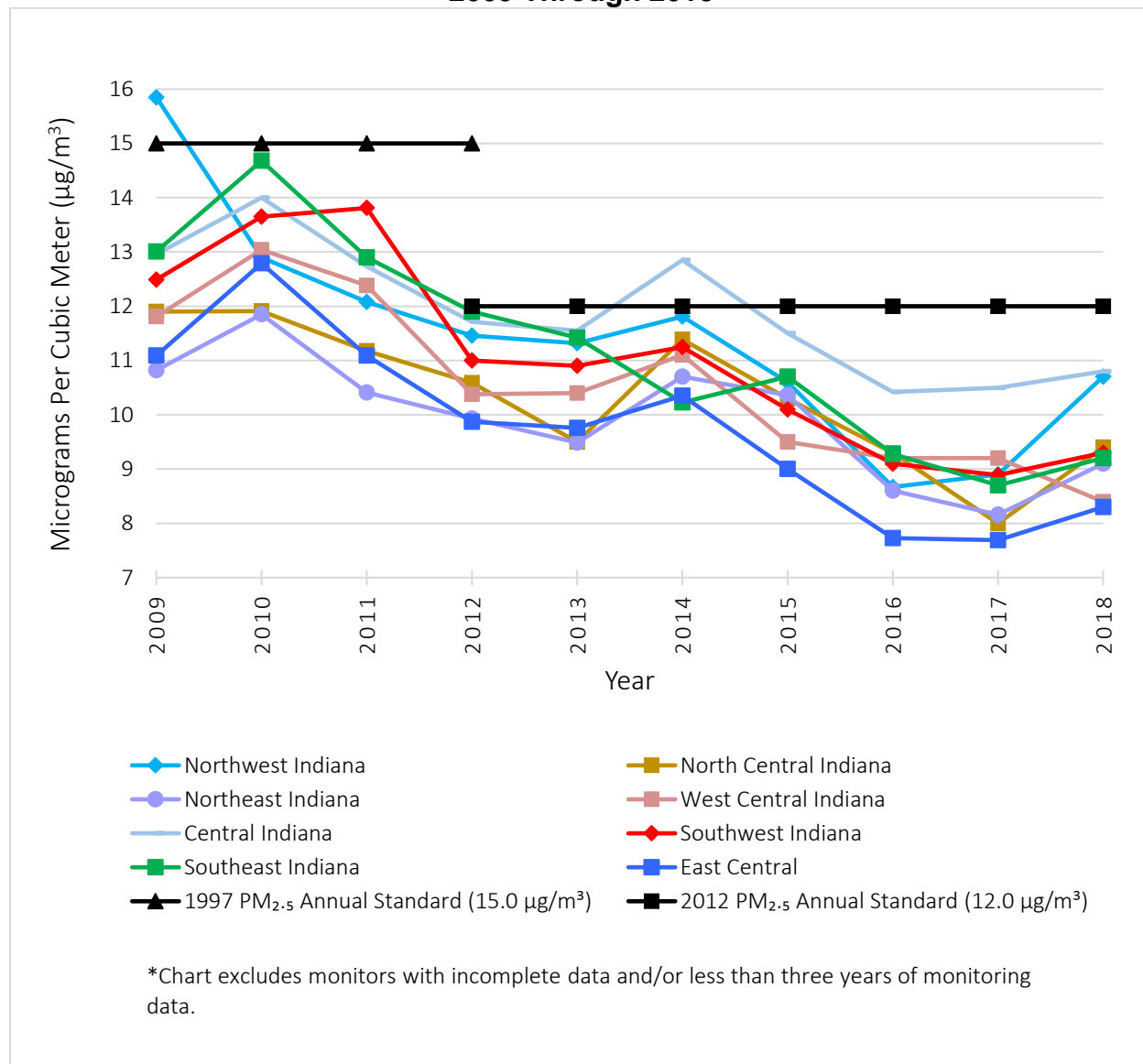
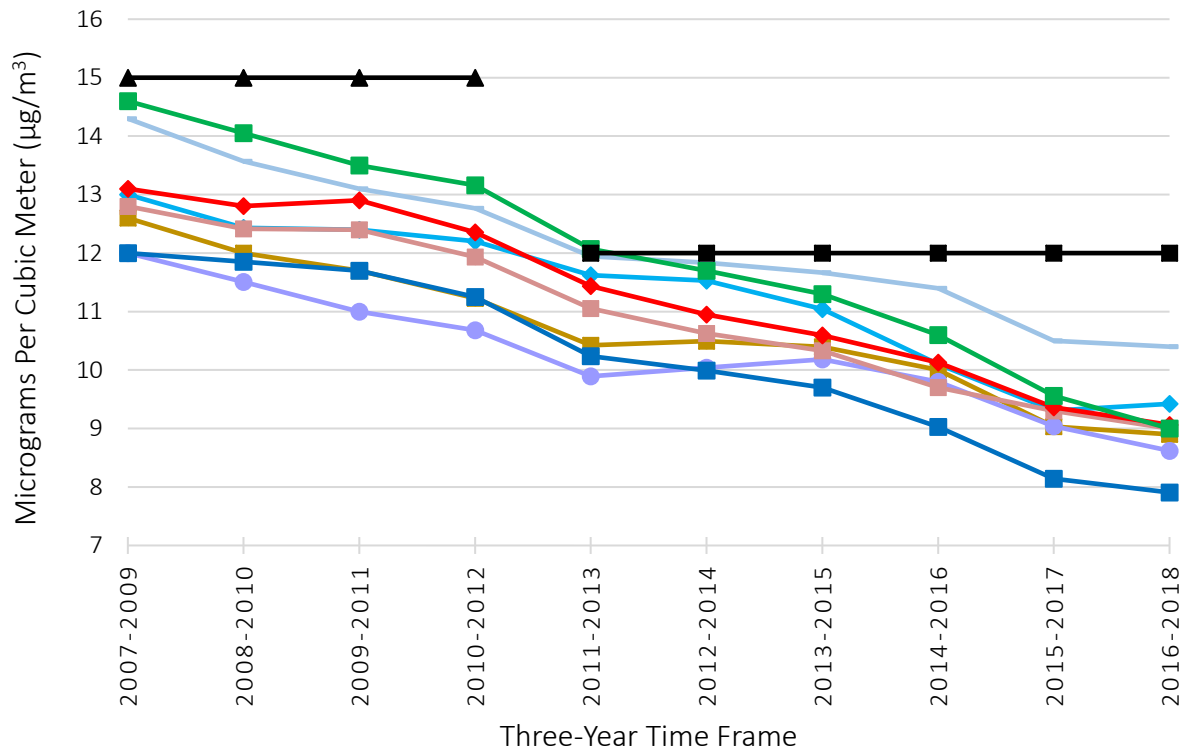


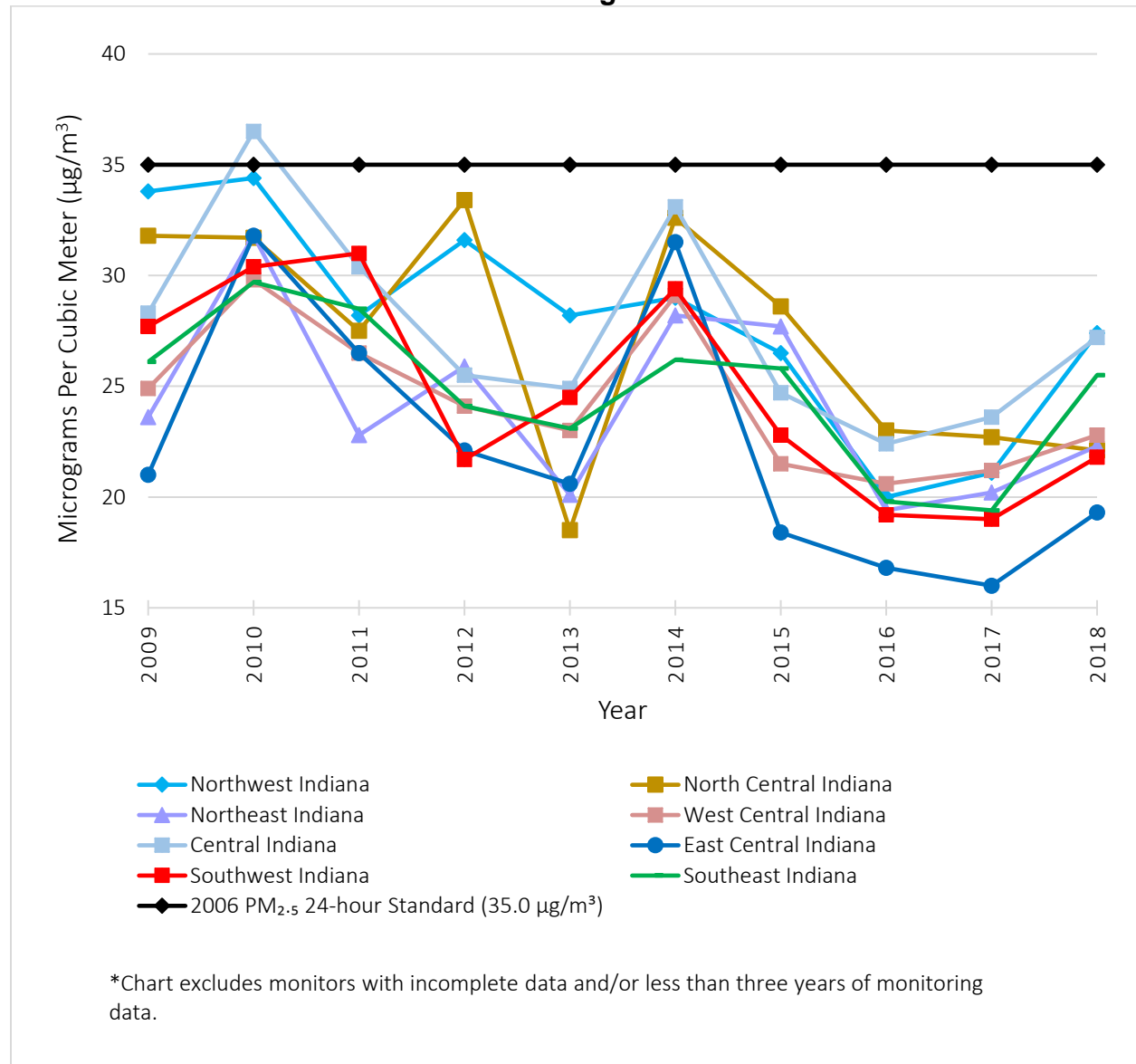
Chart 2:
PM_{2.5} Design Value Trends, Primary Annual Standard,
2007-2009 Through 2016-2018



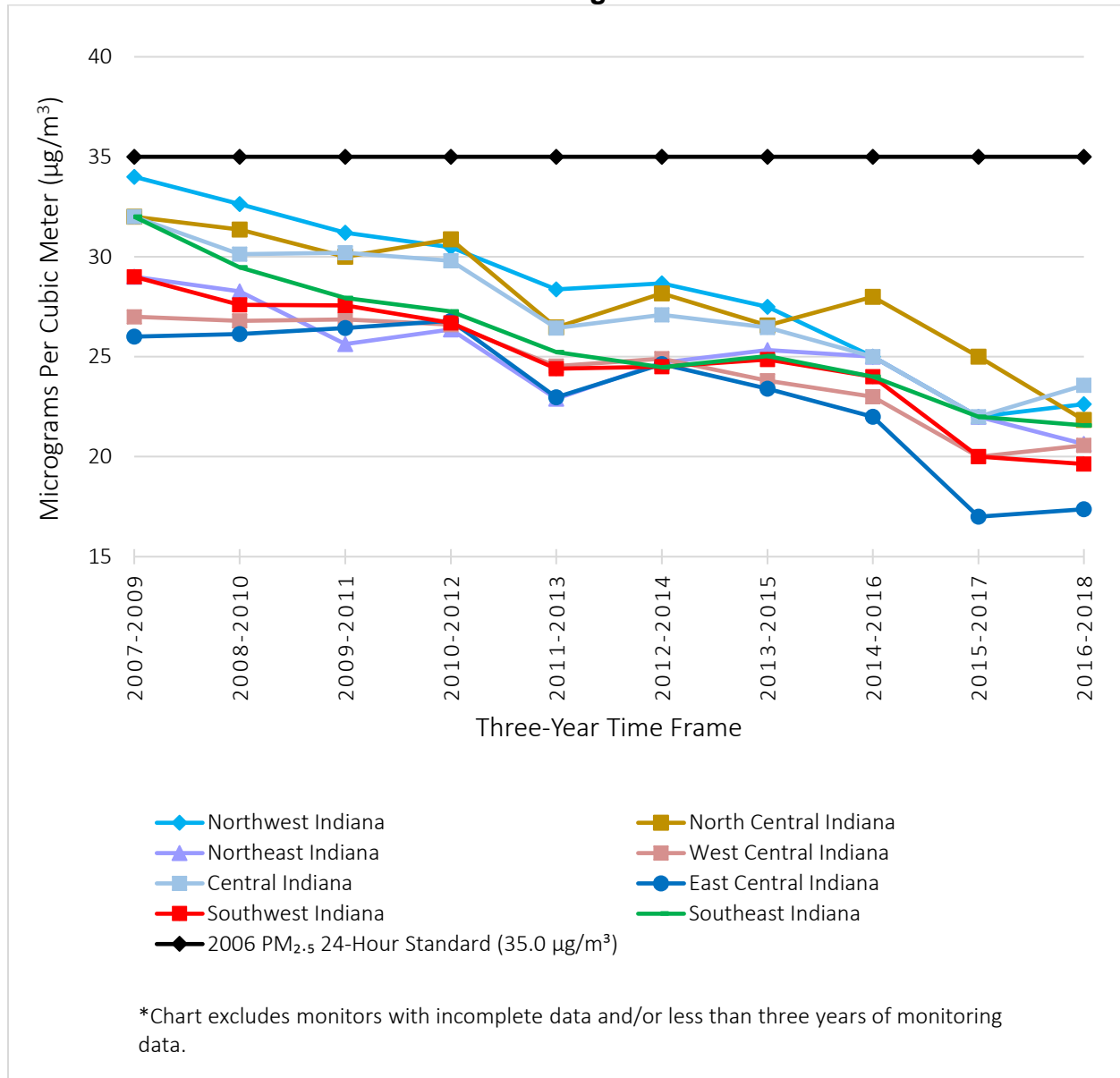
*Chart excludes monitors with incomplete data and/or less than three years of monitoring data

Values for 24-hour monitor 98th percentile values for 2009-2018 are plotted in Chart 3. A statewide downward trend over the 10-year time frame is illustrated by design values plotted in Chart 4.

**Chart 3:
PM_{2.5} 98th Percentile Value Trends, Primary 24-Hour Standard,
2009 Through 2018**



**Chart 4:
PM_{2.5} Design Values Trends, Primary 24-Hour Standard,
2007-2009 Through 2016-2018**



Status of PM_{2.5} Designations

When a NAAQS is issued, the implementation process begins. The first step is for U.S. EPA to designate air quality for all areas of the country. Areas that are not attaining the new standard and areas that are contributing to areas that are not attaining the standard are designated as nonattainment. When a nonattainment area attains the standard, IDEM ensures it is formally recognized for its compliance and redesignated to attainment status.

No areas of Indiana are designated as nonattainment under the primary annual or primary 24-hour PM_{2.5} standards.

1997 Primary Annual PM_{2.5} Standard: Designations for the 1997 primary annual PM_{2.5} NAAQS were completed several years later, in April of 2005, following the resolution of legal challenges to the new standards (70 FR 944).¹ Although most areas of the state were meeting the standard, 12 counties and five townships in Indiana were initially designated as nonattainment. As monitoring data showed compliance, Indiana submitted petitions for the redesignation of all 17 areas and all were redesignated to attainment status.²

The 1997 primary annual standard was retained following a review in 2006. It was revoked when the 2012 primary annual standard was implemented.

2012 Primary Annual PM_{2.5} Standard: U.S. EPA's most recent revision to the primary annual PM_{2.5} NAAQS occurred in 2012, when the standard was strengthened from 15 µg/m³ to 12 µg/m³. All Indiana counties are designated as attainment/unclassifiable under the 2012 primary annual standard. Most areas received the designation on December 18, 2014 (80 FR 2205); however, the following two areas required additional review prior to their attainment/unclassifiable designation on December 12, 2018 (83 FR 66631):

- Clark and Floyd counties – These counties were designated on December 18, 2014, as part of the Louisville, KY-IN nonattainment area based on 2011-2013 data showing that one monitor in the area was slightly above the standard. U.S. EPA changed the designation to unclassifiable on March 31, 2015, based on quality assured, certified 2012-2014 data submitted by Indiana showing Clark and Floyd counties to be in attainment (80 FR 18535). A determination could not be made at that time, however, due to invalid data from other monitors in the area. The December 12, 2018, attainment/unclassifiable designation was issued based on complete, quality-assured 2015-2017 data showing all area monitors to be in attainment.
- Lake and Porter counties – These counties were initially designated as part of the Chicago, IL-IN unclassifiable area on December 18, 2014. Although monitoring data for Lake and Porter counties did not indicate a violation, a determination could not be made at that time due to invalid monitoring data from other monitors in the area. The December 12, 2018, attainment/unclassifiable designation was issued based on complete, quality-assured 2015-2017 data showing all area monitors to be in attainment.

¹ Federal Register (FR) notices (cited by volume and page number) can be viewed at <https://www.federalregister.gov/>.

² See 81 FR 62390 (Clark County, Floyd County and Madison Township in Jefferson County), 82 FR 41527 (Lawrenceburg Township in Dearborn County), 76 FR 59527 (Dubois County, Montgomery Township in Gibson County, Washington Township in Pike County, Ohio Township in Spencer County, Vanderburgh County and Warrick County), 76 FR 76302 (Lake and Porter counties), and 78 FR 41698 (Hamilton, Hendricks, Johnson, Marion and Morgan counties).

24-Hour Primary Standards: Primary and secondary 24-hour standards were established in 1997 at 65 µg/m³ and revised to a more protective level of 35 µg/m³ in 2006. The level of protection set in 2006 was retained in 2012, following a U.S. EPA review. Indiana has never had any nonattainment areas for the 24-hour primary and secondary standards.

Additional Information

- Continuous monitoring data and air quality reports: <https://www.IN.gov/ideM/airquality/2346.htm>.
- Air quality designations, nonattainment plans, redesignation petitions and maintenance plans: <https://www.IN.gov/ideM/airquality/2343.htm>.
- Voluntary projects for the advancement of cleaner fuels, technology and reduced idling are highlighted on the DieselWise Indiana website: <https://www.in.gov/ideM/airquality/2561.htm>.
- U.S. EPA information about PM_{2.5} pollution and NAAQS implementation: <https://www.epa.gov/naaqs>.
- U.S. EPA AQS: <https://www.epa.gov/aqs>.

Contact IDEM's Office of Air Quality

Please feel free to direct questions or comments to Ms. Amy Smith, environmental manager with IDEM's Office of Air Quality, at (800) 451-6027 Option 4 (*toll free*), (317) 233-8211 (*direct*), or amsmith@idem.IN.gov (*email*).