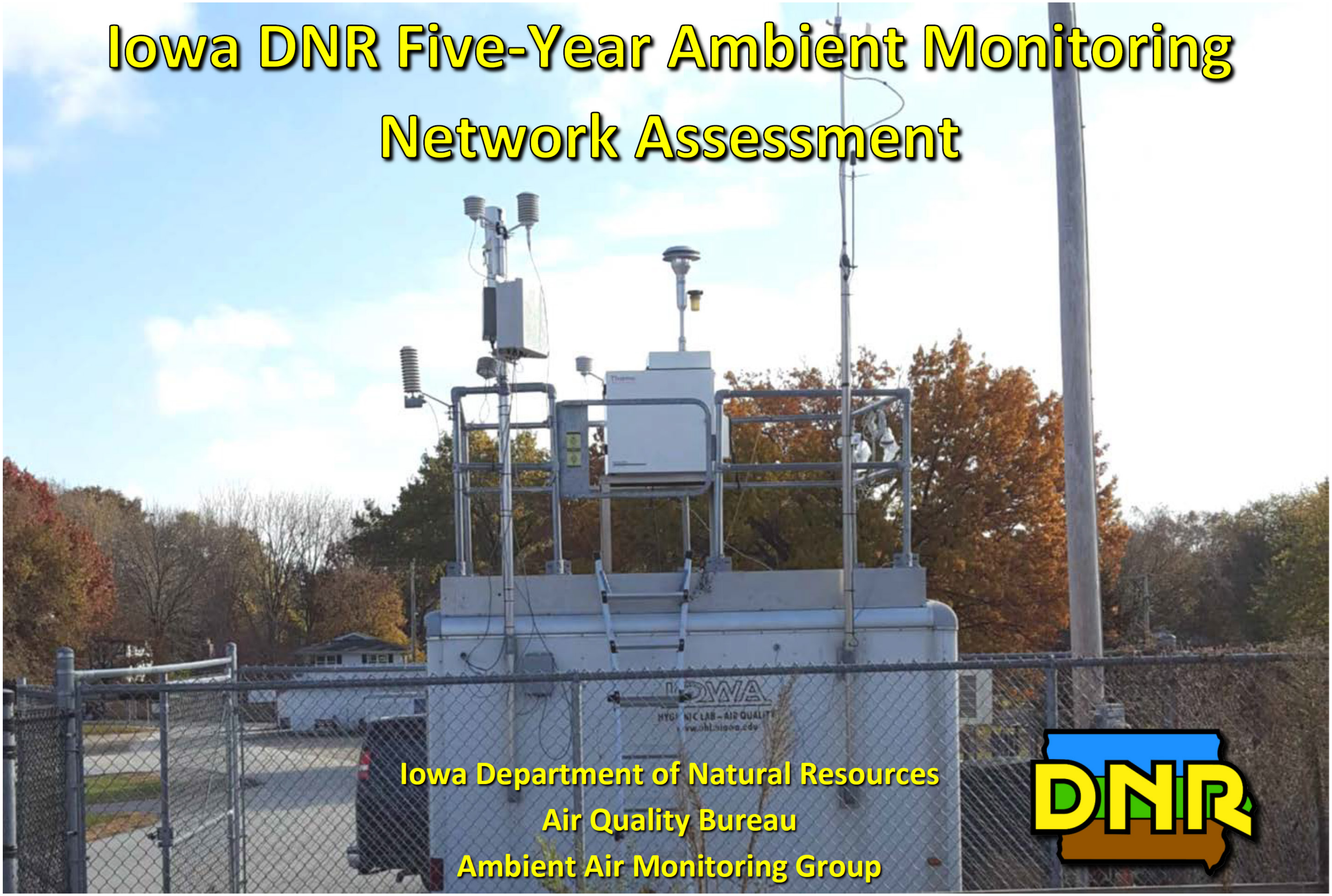
Iowa DNR Five-Year Ambient Monitoring Network Assessment



Iowa Department of Natural Resources

Air Quality Bureau

Ambient Air Monitoring Group

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The Five-Year Network Assessment: An Overview

Once every five years, federal rules require that states supplement their annual ambient air monitoring network plan with a five-year network assessment.[1] While the focus of the annual network plan is to demonstrate that a State's monitoring network meets the minimum federal requirements, the five-year assessment is intended to provide a more general explanation of how the State's air monitoring network meets the qualitative monitoring objectives established in federal monitoring rules,[2] for example, how the network protects individuals sensitive to the effects of air pollution. The five-year assessment also provides an opportunity for States to make significant changes to their long-term monitoring efforts (i.e. changes to State and Local Air Monitoring Stations or SLAMS), renew waivers of federal monitoring requirements[3] or to implement new technologies in their air monitoring network.

To the extent that important changes in the National Ambient Air Quality Standards[4] (NAAQS) are pending, and air monitoring resources are likely to be limited[5,6], we think that it is prudent to consider changes to Iowa's long term (SLAMS) monitoring efforts on the implementation schedules prescribed in the final versions of these rules.

The DNR has reviewed the tools developed by EPA for this five-year network assessment and included results from some of these tools in this document.[7] As we are not proposing any changes to the SLAMs network, we have not have attempted to utilize tools developed to evaluate scenarios for making these changes.

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[1] The federal requirement for the five-year assessment is reproduced in Appendix A.

[2] Objectives for the federal ambient air monitoring program are indicated in Appendix B.

[3] A discussion of the Department's lead monitoring requirements near certain sources is contained in Appendix C.

[4] The current NAAQS revision schedule is provided in Section 2 of Appendix D. Perhaps the most significant of the pending changes currently under consideration are changes to the $PM_{2.5}$ NAAQS. If a significantly lower $PM_{2.5}$ NAAQS is finalized, then additional federal resources are likely to be needed to establish the attainment status of previously unmonitored areas. An analysis of recent $PM_{2.5}$ levels monitored in Iowa relative to the levels under consideration for the new NAAQS is contained in Section 3 of Appendix D.

[5] For a discussion of federal funding see: https://www.epa.gov/sites/production/files/2019-03/documents/fy20_npm_guidance_-_monitoring_appendix_0.pdf.

[6] For a discussion of stakeholder recommendations for funding ambient air monitoring with permit fees, see: http://www.iowadnr.gov/Portals/idnr/uploads/air/insidednr/stakeholder/stakeholder/finalreport_stakeholder1214.pdf.

[7] The results from the network assessment tools utilized are reproduced in Appendix F.

Background: Local and Regional Pollutants

EPA has established NAAQS[8] for seven common ("criteria") pollutants: lead, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and particulate matter less than 10 microns in diameter (PM_{10}).[9]

Lead, PM_{10}, CO, NO_2, and SO_2 are considered local pollutants. These pollutants are emitted directly from air pollution sources, and ambient levels are typically highest in "hotspots" in the neighborhoods near the emissions sources. (Power plant stacks are the exception to this general rule, as stacks approaching 200 feet in height are common, and the hotspots associated with the stack emissions may be miles from the location of the stack.) For a local air pollutant, concentrations approach background levels in areas distant from the emissions sources, and these background levels are usually small compared to the level of the NAAQS.[10]

Local Air Pollutant Example. Industrial lead emissions (left) and modeled hotspot (right). The area inside the orange contour is predicted to violate the NAAQS.

$PM_{2.5}$ and ozone concentrations approaching NAAQS levels may occur during regional episodes and encompass large, multi-state areas. Such episodes are possible because under certain meteorological conditions $PM_{2.5}$ and ozone are formed in the atmosphere from chemical reactions between precursor compounds. For this reason, ozone and $PM_{2.5}$ are often referred to as regional pollutants because of the potential for background levels comparable to the NAAQS that are generated by secondary formation. $PM_{2.5}$ is also a local pollutant, as directly emitted smoke from combustion processes may also give rise to hot spots in the neighborhood of the emissions source even in the absence of an elevated background due to a regional episode.

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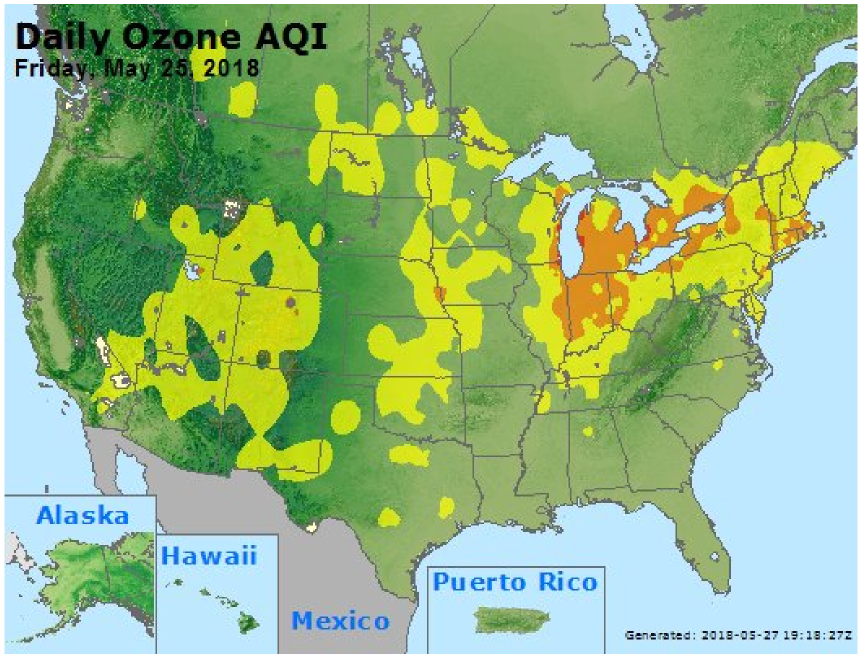
[8] A collection of resources concerning the NAAQS maybe be found at: https://www.epa.gov/naaqs.

[9] A description of the Iowa criteria pollutant monitoring network is contained in Appendix G.

[10] PM_{10} background levels in Iowa have occasionally generated NAAQS exceedances during dust storms driven by extremely high winds.



Regional Air Pollutant Example. Ozone Episode Involving Iowa Monitors. Orange areas exceed the NAAQS. Graphic Courtesy of EPA's AirNow Program.

Objectives of an Ambient Air Monitoring Network

- **The monitoring network is designed to alert the public to air pollution levels that may threaten their health.** Associated with each of EPA's NAAQS is a level that represents the threshold for adverse health effects for sensitive groups (e.g. asthmatics, children, and the elderly). When an ambient air monitor records levels that exceed this threshold, it is said to have recorded a "NAAQS exceedance". An important objective of an ambient air monitoring network is to alert individuals to air pollution levels that exceed the level of the NAAQS.[11]

- **The monitoring network is designed to identify areas where the air quality does not meet health standards, and regulatory intervention is required.** A single monitored exceedance of the NAAQS is usually not sufficient to establish that the NAAQS is violated at a monitoring site. Violation of the NAAQS typically requires multiple exceedances at a monitoring site over several years.[12] For ozone, $PM_{2.5}$ and other criteria pollutants, federal regulations specify that a statistic called the "design value" is calculated from three years of monitoring data from a monitoring site. The design value is compared to the level of the NAAQS to establish whether the monitoring data violates the NAAQS. If the air quality at a monitoring location is poor enough to violate the NAAQS, then after giving the State a year or so to try to work out the problem through its normal permitting process, EPA will formally declare the area around the monitor to be in non-attainment, and special and more stringent federal permitting rules apply within the area. The size of the non-attainment area is determined by dialog between EPA and the State; but any area that causes or contributes to the non-attainment problem at the monitor must be included in the non-attainment area. Additional monitors are often installed to articulate the non-attainment

[11] NAAQS exceedances recorded in Iowa over the past 5 years are described in Appendix H.
[12] NAAQS violations (and design values) in Iowa over the past 5 years are discussed in Appendix I.

area and establish the effectiveness of control strategies after a monitor in an area records non-attainment.

- **The monitoring network is designed to characterize pollutant levels in heavily populated areas.** One of main objectives of air monitoring is to protect human health. In large cities, there are many people affected by the air quality, and larger numbers of individuals (such as people with heart or lung ailments, children and the elderly) that are sensitive to the effects of air pollution. Certain types of air pollutant emissions, such as motor vehicle emissions, are also likely to be larger in urban areas than in outlying areas. EPA has established minimum requirements that apply to urban areas; or more precisely, areas established as metropolitan statistical areas (MSA's) by the U.S. Census Bureau.[13,14,15]

- **The monitoring network is designed to support permitting activities.** The DNR frequently conducts ambient air impact analyses as part of the permitting process.[16] Dispersion modeling is used to estimate the air pollutant levels generated from a new source. Some existing sources in the vicinity of the new source are usually included in the dispersion modeling analysis, but more distant sources are assumed to be part of the "background". Good estimates of background levels are an important part of the ambient impact analysis[17], especially in cases where background levels are significant compared to the NAAQS. Federal permitting requirements for large air pollution sources require industries to collect monitoring data if the State's air monitoring data is not adequate to characterize background levels. Currently, the State's ambient monitoring data and regional modeling is used to develop background levels for most permitting projects.

- **The monitoring network may be used to establish comparability with non-regulatory (Citizen Science) monitors.** Inexpensive monitors that measure air quality are becoming widely used.[18] Monitors in the regulatory network may be used to establish the comparability of Citizen Science and regulatory data.

Public Availability of Iowa's Air Monitoring Data

In Iowa, the Iowa Department of Natural Resources (DNR) contracts with Local Air Pollution Control Programs in Polk and Linn Counties as well as the State Hygienic Laboratory (SHL) to gather air monitoring data. Data from each of these organizations is made available to the public in two formats: real-time data, to alert the public to air quality problems as they arise, and quality-assured data suitable for environmental decision making. The DNR also places reports that describe the State's air monitoring network and summarize the State's air monitoring data on its website.

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[13] A description of Iowa's MSA's and monitors located in these MSA's is contained in Appendix J.

[14] A description of the locations where some of the Iowans that are sensitive to the effects of air pollution reside is contained in Appendix K.

[15] A discussion of population changes in Iowa is contained in Appendix L.

[16] The department's dispersion modeling procedures are available at: http://www.iowadnr.gov/InsideDNR/RegulatoryAir/Modeling/DispersionModeling.aspx.

[17] http://www.iowadnr.gov/InsideDNR/RegulatoryAir/Modeling/DispersionModeling/BackgroundData.aspx.

[18] https://www.purpleair.com/map?opt=1/mAQI/a10/cC0#6/41.848/-91.216.

- **Real-time Data.** On the local level, the SHL[19], and the Local Programs in Polk[20] and Linn[21] counties post real-time data from continuous monitors on their websites. On the national level, real-time data from all of the continuous monitors in Iowa is aggregated and disseminated by EPA's **AirNow**[22] program. EPA also provides access to real-time data to researchers via the ***AirNow API***[23]***.***

- **Finalized Monitoring Data.** Quality-assured data from continuous and non-continuous (e.g. filter samplers) monitors is loaded to EPA's Air Quality System (AQS) database by SHL and the Local Programs in a form that is suitable for environmental decision-making. In AQS, data from Iowa's air monitoring network along with the data from other States is aggregated and made available to EPA as well as the regulated and general public. This data is used for public health and air quality research,[24] to establish compliance with ambient air quality standards, and emissions reduction strategy development. AQS data is available online at EPA's ***AirData*** website[25] and through the ***AQS Data Mart***[26]***.*** Quality assured air monitoring data is also available upon request from the DNR and the Local Programs.

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[19] Available at: http://www.shl.uiowa.edu/env/ambient/data.xml.
[20] Available at: http://www.polkcountyiowa.gov/airquality/air-quality-monitoring/current-aqi-real-time-data/.
[21] Available at: http://www.linncleanair.org/ under Current Air Quality tab.
[22] Available at: https://www.airnow.gov/.
[23] Available at: https://docs.airnowapi.org/.
[24] See for example: C. Stanier, et. al, ***Understanding Episodes of High Airborne Particulate Matter in Iowa,*** 2/29/09***,*** available online at: http://www.engineering.uiowa.edu/~cs_proj/iowa_pm_project/iowa_pm.htm.
[25] Available at: https://www.epa.gov/outdoor-air-quality-data.
[26] Available at: https://aqs.epa.gov/aqsweb/documents/data_mart_welcome.html.

Appendix A: 40 CFR Part 58[27] Requiring 5-Year Network Assessments

§58.10 Annual monitoring network plan and periodic network assessment.

(a)(1) Beginning July 1, 2007, the state, or where applicable local, agency shall submit to the Regional Administrator an annual monitoring network plan which shall provide for the documentation of the establishment and maintenance of an air quality surveillance system that consists of a network of SLAMS monitoring stations that can include FRM, FEM, and ARM monitors that are part of SLAMS, NCore, CSN, PAMS, and SPM stations. The plan shall include a statement of whether the operation of each monitor meets the requirements of appendices A, B, C, D, and E of this part, where applicable. The Regional Administrator may require additional information in support of this statement. The annual monitoring network plan must be made available for public inspection and comment for at least 30 days prior to submission to the EPA and the submitted plan shall include and address, as appropriate, any received comments.

(2) Any annual monitoring network plan that proposes network modifications (including new or discontinued monitoring sites, new determinations that data are not of sufficient quality to be compared to the NAAQS, and changes in identification of monitors as suitable or not suitable for comparison against the annual $PM_{2.5}$ NAAQS) to SLAMS networks is subject to the approval of the EPA Regional Administrator, who shall approve or disapprove the plan within 120 days of submission of a complete plan to the EPA.

(3) The plan for establishing required NCore multipollutant stations shall be submitted to the Administrator not later than July 1, 2009. The plan shall provide for all required stations to be operational by January 1, 2011.

(4) A plan for establishing source-oriented Pb monitoring sites in accordance with the requirements of appendix D to this part for Pb sources emitting 1.0 tpy or greater shall be submitted to the EPA Regional Administrator no later than July 1, 2009, as part of the annual network plan required in paragraph (a)(1) of this section. The plan shall provide for the required source-oriented Pb monitoring sites for Pb sources emitting 1.0 tpy or greater to be operational by January 1, 2010. A plan for establishing source-oriented Pb monitoring sites in accordance with the requirements of appendix D to this part for Pb sources emitting equal to or greater than 0.50 tpy but less than 1.0 tpy shall be submitted to the EPA Regional Administrator no later than July 1, 2011. The plan shall provide for the required source-oriented Pb monitoring sites for Pb sources emitting equal to or greater than 0.50 tpy but less than 1.0 tpy to be operational by December 27, 2011.

(5)(i) A plan for establishing or identifying an area-wide NO_2 monitor, in accordance with the requirements of Appendix D, section 4.3.3 to this part, shall be submitted as part of the Annual Monitoring Network Plan to the EPA Regional Administrator by July 1, 2012. The plan shall provide for these required monitors to be operational by January 1, 2013.

(ii) A plan for establishing or identifying any NO_2 monitor intended to characterize vulnerable and susceptible populations, as required in Appendix D, section 4.3.4 to this part, shall be submitted as part of the Annual Monitoring Network Plan to the EPA Regional Administrator by July 1, 2012. The plan shall provide for these required monitors to be operational by January 1, 2013.

(iii) A plan for establishing a single near-road NO_2 monitor in CBSAs having 1,000,000 or more persons, in accordance with the requirements of Appendix D, section 4.3.2 to this part, shall be submitted as part of the Annual Monitoring Network Plan to the EPA Regional Administrator by July 1, 2013. The plan shall provide for these required monitors to be operational by January 1, 2014.

(iv) A plan for establishing a second near-road NO_2 monitor in any CBSA with a population of 2,500,000 persons or more, or a second monitor in any CBSA with a population of 1,000,000 or more persons that has one or more roadway segments with 250,000 or greater AADT counts, in accordance with the requirements of appendix D, section 4.3.2 to this part, shall be submitted as part of the Annual Monitoring Network Plan to the EPA Regional Administrator by July 1, 2014. The plan shall provide for these required monitors to be operational by January 1, 2015.

(6) A plan for establishing SO_2 monitoring sites in accordance with the requirements of appendix D to this part shall be submitted to the EPA Regional Administrator by July 1, 2011 as part of the annual network plan required in paragraph (a) (1). The plan shall provide for all required SO_2 monitoring sites to be operational by January 1, 2013.

(7) A plan for establishing CO monitoring sites in accordance with the requirements of appendix D to this part shall be submitted to the EPA Regional Administrator. Plans for required CO monitors shall be submitted at least six months prior to the date such monitors must be established as required by section 58.13.

(8)(i) A plan for establishing near-road $PM_{2.5}$ monitoring sites in CBSAs having 2.5 million or more persons, in accordance with the requirements of appendix D to this part, shall be submitted as part of the annual monitoring network plan to the EPA Regional Administrator by July 1, 2014. The plan shall provide for these required monitoring stations to be operational by January 1, 2015.

[27] Available online at: https://gov.ecfr.io/cgi-bin/text-idx?SID=a9ae17e22ab9eb580ac6ea0aef205b59&mc=true&node=se40.6.58_110&rgn=div8

(ii) A plan for establishing near-road $PM_{2.5}$ monitoring sites in CBSAs having 1 million or more persons, but less than 2.5 million persons, in accordance with the requirements of appendix D to this part, shall be submitted as part of the annual monitoring network plan to the EPA Regional Administrator by July 1, 2016. The plan shall provide for these required monitoring stations to be operational by January 1, 2017.

(9) The annual monitoring network plan shall provide for the required O_3 sites to be operating on the first day of the applicable required O_3 monitoring season in effect on January 1, 2017 as listed in Table D-3 of appendix D of this part.

(10) A plan for making Photochemical Assessment Monitoring Stations (PAMS) measurements, if applicable, in accordance with the requirements of appendix D paragraph 5(a) of this part shall be submitted to the EPA Regional Administrator no later than July 1, 2018. The plan shall provide for the required PAMS measurements to begin by June 1, 2019.

(11) An Enhanced Monitoring Plan for O_3, if applicable, in accordance with the requirements of appendix D paragraph 5(h) of this part shall be submitted to the EPA Regional Administrator no later than October 1, 2019 or two years following the effective date of a designation to a classification of Moderate or above O_3 nonattainment, whichever is later.

(12) A detailed description of the PAMS network being operated in accordance with the requirements of appendix D to this part shall be submitted as part of the annual monitoring network plan for review by the EPA Administrator. The PAMS Network Description described in section 5 of appendix D may be used to meet this requirement.

(b) The annual monitoring network plan must contain the following information for each existing and proposed site:

(1) The AQS site identification number.

(2) The location, including street address and geographical coordinates.

(3) The sampling and analysis method(s) for each measured parameter.

(4) The operating schedules for each monitor.

(5) Any proposals to remove or move a monitoring station within a period of 18 months following plan submittal.

(6) The monitoring objective and spatial scale of representativeness for each monitor as defined in appendix D to this part.

(7) The identification of any sites that are suitable and sites that are not suitable for comparison against the annual $PM_{2.5}$ NAAQS as described in §58.30.

(8) The MSA, CBSA, CSA or other area represented by the monitor.

(9) The designation of any Pb monitors as either source-oriented or non-source-oriented according to Appendix D to 40 CFR part 58.

(10) Any source-oriented monitors for which a waiver has been requested or granted by the EPA Regional Administrator as allowed for under paragraph 4.5(a)(ii) of Appendix D to 40 CFR part 58.

(11) Any source-oriented or non-source-oriented site for which a waiver has been requested or granted by the EPA Regional Administrator for the use of Pb-PM_{10} monitoring in lieu of Pb-TSP monitoring as allowed for under paragraph 2.10 of Appendix C to 40 CFR part 58.

(12) The identification of required NO_2 monitors as near-road, area-wide, or vulnerable and susceptible population monitors in accordance with Appendix D, section 4.3 of this part.

(13) The identification of any $PM_{2.5}$ FEMs and/or ARMs used in the monitoring agency's network where the data are not of sufficient quality such that data are not to be compared to the NAAQS. For required SLAMS where the agency identifies that the $PM_{2.5}$ Class III FEM or ARM does not produce data of sufficient quality for comparison to the NAAQS, the monitoring agency must ensure that an operating FRM or filter-based FEM meeting the sample frequency requirements described in §58.12 or other Class III $PM_{2.5}$ FEM or ARM with data of sufficient quality is operating and reporting data to meet the network design criteria described in appendix D to this part.

(c) The annual monitoring network plan must document how state and local agencies provide for the review of changes to a $PM_{2.5}$ monitoring network that impact the location of a violating $PM_{2.5}$ monitor. The affected state or local agency must document the process for obtaining public comment and include any comments received through the public notification process within their submitted plan.

(d) The state, or where applicable local, agency shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in appendix D to this part, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby states and tribes or health effects studies. The state, or where applicable local, agency must submit a copy of this 5-year assessment, along with a revised annual network plan, to the Regional Administrator. The assessments are due every five years beginning July 1, 2010.

(e) All proposed additions and discontinuations of SLAMS monitors in annual monitoring network plans and periodic network assessments are subject to approval according to §58.14.

[71 FR 61298, Oct. 17, 2006, as amended at 72 FR 32210, June 12, 2007; 73 FR 67059, Nov. 12, 2008; 73 FR 77517, Dec. 19, 2008; 75 FR 6534, Feb. 9, 2010; 75 FR 35601, June 22, 2010; 75 FR 81137, Dec. 27, 2010; 76 FR 54341, Aug. 31, 2011; 78 FR 16188, Mar. 14, 2013; 78 FR 3282, Jan. 15, 2013; 80 FR 65466, Oct. 26, 2015; 81 FR 17279, Mar. 28, 2016; 81 FR 96388, Dec. 30, 2016]

Appendix B: 40 CFR Part 58 Appendix D[28] – Monitoring Objectives

Appendix D to Part 58—Network Design Criteria for Ambient Air Quality Monitoring

1. Monitoring Objectives and Spatial Scales

The purpose of this appendix is to describe monitoring objectives and general criteria to be applied in establishing the required SLAMS ambient air quality monitoring stations and for choosing general locations for additional monitoring sites. This appendix also describes specific requirements for the number and location of FRM, FEM, and ARM sites for specific pollutants, NCore multipollutant sites, PM_{10} mass sites, $PM_{2.5}$ mass sites, chemically-speciated $PM_{2.5}$ sites, and O_3 precursor measurements sites (PAMS). These criteria will be used by EPA in evaluating the adequacy of the air pollutant monitoring networks.

1.1 Monitoring Objectives. The ambient air monitoring networks must be designed to meet three basic monitoring objectives. These basic objectives are listed below. The appearance of any one objective in the order of this list is not based upon a prioritized scheme. Each objective is important and must be considered individually.

(a) Provide air pollution data to the general public in a timely manner. Data can be presented to the public in a number of attractive ways including through air quality maps, newspapers, Internet sites, and as part of weather forecasts and public advisories.

(b) Support compliance with ambient air quality standards and emissions strategy development. Data from FRM, FEM, and ARM monitors for NAAQS pollutants will be used for comparing an area's air pollution levels against the NAAQS. Data from monitors of various types can be used in the development of attainment and maintenance plans. SLAMS, and especially NCore station data, will be used to evaluate the regional air quality models used in developing emission strategies, and to track trends in air pollution abatement control measures' impact on improving air quality. In monitoring locations near major air pollution sources, source-oriented monitoring data can provide insight into how well industrial sources are controlling their pollutant emissions.

(c) Support for air pollution research studies. Air pollution data from the NCore network can be used to supplement data collected by researchers working on health effects assessments and atmospheric processes, or for monitoring methods development work.

1.1.1 In order to support the air quality management work indicated in the three basic air monitoring objectives, a network must be designed with a variety of types of monitoring sites. Monitoring sites must be capable of informing managers about many things including the peak air pollution levels, typical levels in populated areas, air pollution transported into and outside of a city or region, and air pollution levels near specific sources. To summarize some of these sites, here is a listing of six general site types:

(a) Sites located to determine the highest concentrations expected to occur in the area covered by the network.
(b) Sites located to measure typical concentrations in areas of high population density.
(c) Sites located to determine the impact of significant sources or source categories on air quality.
(d) Sites located to determine general background concentration levels.
(e) Sites located to determine the extent of regional pollutant transport among populated areas; and in support of secondary standards.
(f) Sites located to measure air pollution impacts on visibility, vegetation damage, or other welfare-based impacts.

1.1.2 This appendix contains criteria for the basic air monitoring requirements. The total number of monitoring sites that will serve the variety of data needs will be substantially higher than these minimum requirements provide. The optimum size of a particular network involves trade-offs among data needs and available resources. This regulation intends to provide for national air monitoring needs, and to lend support for the flexibility necessary to meet data collection needs of area air quality managers. The EPA, State, and local agencies will periodically collaborate on network design issues through the network assessment process outlined in §58.10.

1.1.3 This appendix focuses on the relationship between monitoring objectives, site types, and the geographic location of monitoring sites. Included are a rationale and set of general criteria for identifying candidate site locations in terms of physical characteristics which most closely match a specific monitoring objective. The criteria for more specifically locating the monitoring site, including spacing from roadways and vertical and horizontal probe and path placement, are described in appendix E to this part.

1.2 Spatial Scales. (a) To clarify the nature of the link between general monitoring objectives, site types, and the physical location of a particular monitor, the concept of spatial scale of representativeness is defined. The goal in locating monitors is to correctly match the spatial scale represented by the sample of monitored air with the spatial scale most appropriate for the monitoring site type, air pollutant to be measured, and the monitoring objective.

(b) Thus, spatial scale of representativeness is described in terms of the physical dimensions of the air parcel nearest to a monitoring site throughout which actual pollutant concentrations are reasonably similar. The scales of representativeness of most interest for the monitoring site types described above are as follows:
(1) *Microscale*—Defines the concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters.

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[28] Available online at:
https://www.ecfr.gov/cgi-bin/retrieveECFR?n=40y6.0.1.1.6.

(2) *Middle scale*—Defines the concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometer.
(3) *Neighborhood scale*—Defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range. The neighborhood and urban scales listed below have the potential to overlap in applications that concern secondarily formed or homogeneously distributed air pollutants.
(4) *Urban scale*—Defines concentrations within an area of city-like dimensions, on the order of 4 to 50 kilometers. Within a city, the geographic placement of sources may result in there being no single site that can be said to represent air quality on an urban scale.
(5) *Regional scale*—Defines usually a rural area of reasonably homogeneous geography without large sources, and extends from tens to hundreds of kilometers.
(6) *National and global scales*—These measurement scales represent concentrations characterizing the nation and the globe as a whole.

(c) Proper siting of a monitor requires specification of the monitoring objective, the types of sites necessary to meet the objective, and then the desired spatial scale of representativeness. For example, consider the case where the objective is to determine NAAQS compliance by understanding the maximum ozone concentrations for an area. Such areas would most likely be located downwind of a metropolitan area, quite likely in a suburban residential area where children and other susceptible individuals are likely to be outdoors. Sites located in these areas are most likely to represent an urban scale of measurement. In this example, physical location was determined by considering ozone precursor emission patterns, public activity, and meteorological characteristics affecting ozone formation and dispersion. Thus, spatial scale of representativeness was not used in the selection process but was a result of site location.

(d) In some cases, the physical location of a site is determined from joint consideration of both the basic monitoring objective and the type of monitoring site desired, or required by this appendix. For example, to determine $PM_{2.5}$ concentrations which are typical over a geographic area having relatively high $PM_{2.5}$ concentrations, a neighborhood scale site is more appropriate. Such a site would likely be located in a residential or commercial area having a high overall $PM_{2.5}$ emission density but not in the immediate vicinity of any single dominant source. Note that in this example, the desired scale of representativeness was an important factor in determining the physical location of the monitoring site.

(e) In either case, classification of the monitor by its type and spatial scale of representativeness is necessary and will aid in interpretation of the monitoring data for a particular monitoring objective (e.g., public reporting, NAAQS compliance, or research support).

(f) Table D-1 of this appendix illustrates the relationship between the various site types that can be used to support the three basic monitoring objectives, and the scales of representativeness that are generally most appropriate for that type of site.

TABLE D-1 OF APPENDIX D TO PART 58—RELATIONSHIP BETWEEN SITE TYPES AND SCALES OF REPRESENTATIVENESS

Site type	Appropriate siting scales
1. Highest concentration	Micro, middle, neighborhood (*sometimes* urban or regional for secondarily formed pollutants).
2. Population oriented	Neighborhood, urban.
3. Source impact	Micro, middle, neighborhood.
4. General/background & regional transport	Urban, regional.
5. Welfare-related impacts	Urban, regional.

Appendix C: Request of Lead Monitoring Waiver

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Section 1: Summary: Emissions Based Lead Monitoring

EPA requires source-oriented SLAMS lead monitoring near industries that emit over 0.5 tons per year (tpy) of lead. This monitoring may be waived if modeling shows ambient impacts less than half the NAAQS. These waivers are renewed as an element of the five-year network assessment. [29] As indicated in the memo from the DNR Emissions Inventory Group cited in Section 2, Iowa does not currently have any industrial facilities that emit over 0.5 tpy of lead.

Section 2: Lead (Pb) Emissions Inventory Memo

Air Quality Bureau

Memo

To: Sean Fitzsimmons

From: Nick Page

CC: Pete Zayudis, Brad Ashton, Lori Hanson, Brian Hutchins, Jim McGraw

Date: 1/13/2020

Re: Lead Emissions Inventory Narrative for 2020 Ambient Monitoring Network Plan

Purpose of this Document

To identify facilities that reported actual lead emissions of greater than or equal to 0.25 tons of lead (Pb) per year for calendar year 2018. The actual lead emissions estimates, as estimated by DNR, are estimated using the most recent and best available set of facility-specific data that includes, but is not limited to, actual throughput, valid stack test data, dust analyses, engineering estimates, operating schedules, and control efficiencies.

Introduction

The Environmental Protection Agency (EPA) finalized a revised standard for Pb on November 12, 2008. The standard was revised from 1.5 micrograms per cubic meter (μg/m^3) of air, to 0.15 μg/m^3. In conjunction with strengthening the lead NAAQS, EPA identified the need for states to improve existing lead monitoring networks by requiring monitors to be placed in areas with sources that have actual Pb emissions of 1.0 ton or more per year (tpy) and in urban areas with more than 500,000 people. States will base their specific siting decisions regarding Pb monitoring on dispersion modeling results and reviews of the existing emission inventories for Pb. On December 14, 2010, EPA signed an amendment to the lead ambient air monitoring requirement to expand the lead monitoring network. This amendment reduces the actual lead emissions threshold for the site specific monitoring requirement to 0.5 tons or more per year.

Table 1: Facilities included in the 2018 NEI submittal with actual emissions estimates of 0.25 tpy or greater.

Facility Name	Facility ID	2018 Actual Emissions (Tons)
MidAmerican Energy Company – Walter Scott Jr Energy Center	78-01-026	0.309
MidAmerican Energy Company – Louisa Station	58-07-001	0.276

[29] Federal lead monitoring requirements are found in https://www.ecfr.gov/cgi-bin/retrieveECFR?n=40y6.0.1.1.6. (See appendix D, section 4.5.)

Appendix D: New and Proposed NAAQS

Table of Contents

Section 1: Summary

Changes to federal rules may affect the Iowa air monitoring network in several important ways. They may change the threshold for adverse health effects (NAAQS exceedance levels) used for real-time reporting or the regulatory intervention levels (NAAQS violation levels). They may also affect the minimum number of monitors required in state networks and the location of these monitors. Changes to the ambient air monitoring network should anticipate these regulatory changes.

Section 2 contains EPA's schedule for reviewing the NAAQS. Sections 3 examines the effects of proposed changes in the $PM_{2.5}$ NAAQS. Section 4 presents the effects of possible ranges for the ozone NAAQS.

Section 2: EPA's NAAQS Review Schedule

The Clean Air Act requires EPA to set National Ambient Air Quality Standards to protect the public against levels of exposure to air contaminants that are considered harmful to human health or welfare. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings.

EPA's current NAAQS review schedule is indicated below[30].

Pollutant	Ozone	Lead	Primary NO2	Primary SO2	Secondary (Ecological) NO2, SO2, PM1	PM2	CO
Last Review Completed (final rule signed)	Oct. 2015	Sept 2016	April 2018	Feb 2019	Mar 2012	Dec 2012	Aug 2011
Recent or Upcoming Major Milestone(s)	Summer 2019 Draft ISA[3] Early 2020 Proposal Late 2020 Final	TBD[4]	TBD[4]	TBD[4]	Timing depends on PM/O3 schedules Final ISA; draft REA/PA3	March 28, 2019 CASAC teleconference on draft ISA3 Early 2020 Proposal Late 2020 Final	TBD4

Additional information regarding current and previous NAAQS reviews is available at: https://www.epa.gov/naaqs

[1] Combined secondary (ecological effects only) review of NO_2, SO_2, and PM
[2] Combined primary and secondary (non-ecological effects) review of PM
[3] IRP – Integrated Review Plan; ISA – Integrated Science Assessment; REA – Risk and Exposure Assessment; PA – Policy Assessment
[4] TBD = To be determined

A draft Policy Assessment for the Review of the National Ambient Air Quality Standards for Particulate Matter[31] reached the preliminary conclusion that the public health protection afforded by the current primary PM_{10} standard is adequate. A draft Policy Assessment for the Review of the Ozone National Ambient Air Quality Standards[32] reached the preliminary conclusion that the current primary standard for ozone is also adequate.

[30] The schedule above is based on departmental participation on a national workgroup. A recent published version of the schedule is available on page 4 of: https://cleanairact.org/wp-content/uploads/2019/09/2-Anna-Wood-NAAQS-SIP.pdf.
[31] Available online at https://yosemite.epa.gov/sab/sabproduct.nsf/264cb1227d55e02c85257402007446a4/64C246444C9CC319852584430045E365/$File/Draft+Policy+Assessment+for+PM+NAAQS.pdf (See page 232.)
[32] Available online at: https://www.epa.gov/naaqs/ozone-o3-standards-policy-assessments-current-review https://www.epa.gov/naaqs/ozone-o3-standards-policy-assessments-current-review (See page 178.)

Section 3: Proposed $PM_{2.5}$ NAAQS and $PM_{2.5}$ Monitoring Regulations

NAAQS Violations under the Proposed Range for the $PM_{2.5}$ NAAQS: An Analysis of Historical Data

A NAAQS violation occurs when the design value is greater than the level of the standard. Although the proposed NAAQS review for $PM_{2.5}$ is not available yet, the reference below[33] (see pages 199 and 202) is indicative of levels that might be proposed. The forms of the annual and 24-hour design values described in the policy assessment[34] are the same as the definitions currently used. (Specifically the annual standard is defined as the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations. The 24-hour standard is defined as the 3-year average of the 98th percentile of 24-hour concentrations.) The most recent five years of annual and 24-hour $PM_{2.5}$ design values are shown below. For example, based on the most recent set of 2016-2018 design values; if the annual NAAQS was set at 8 µg/m^3, three sites would violate the annual NAAQS. However in the annual NAAQS were set at 9 µg/m^3, no sites would violate the annual NAAQS. Based on the most recent set of 2016-2018 design values, even if the 24-hour NAAQS were set at 30 µg/m^3, no sites would violate the 24-hour NAAQS.

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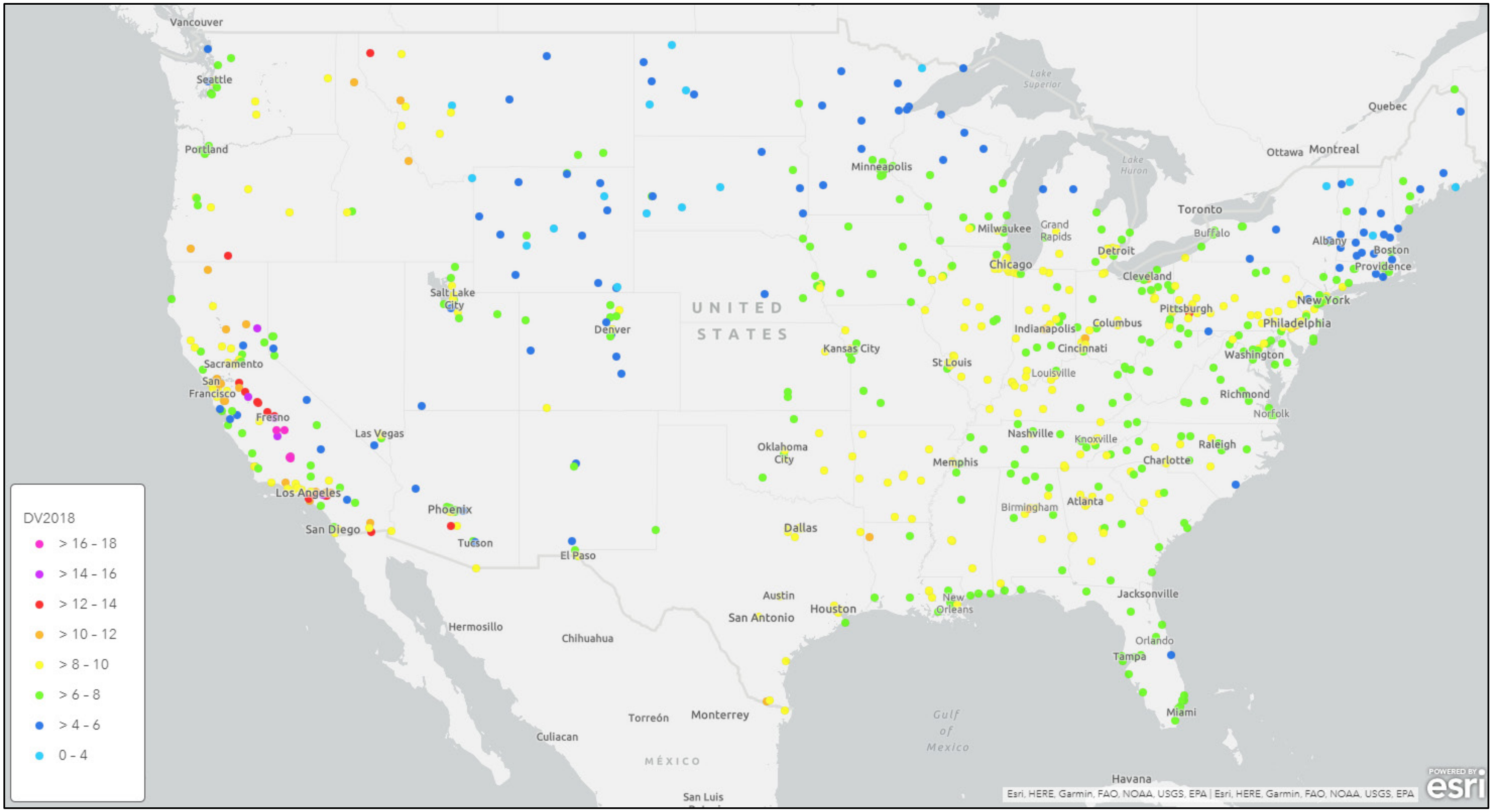
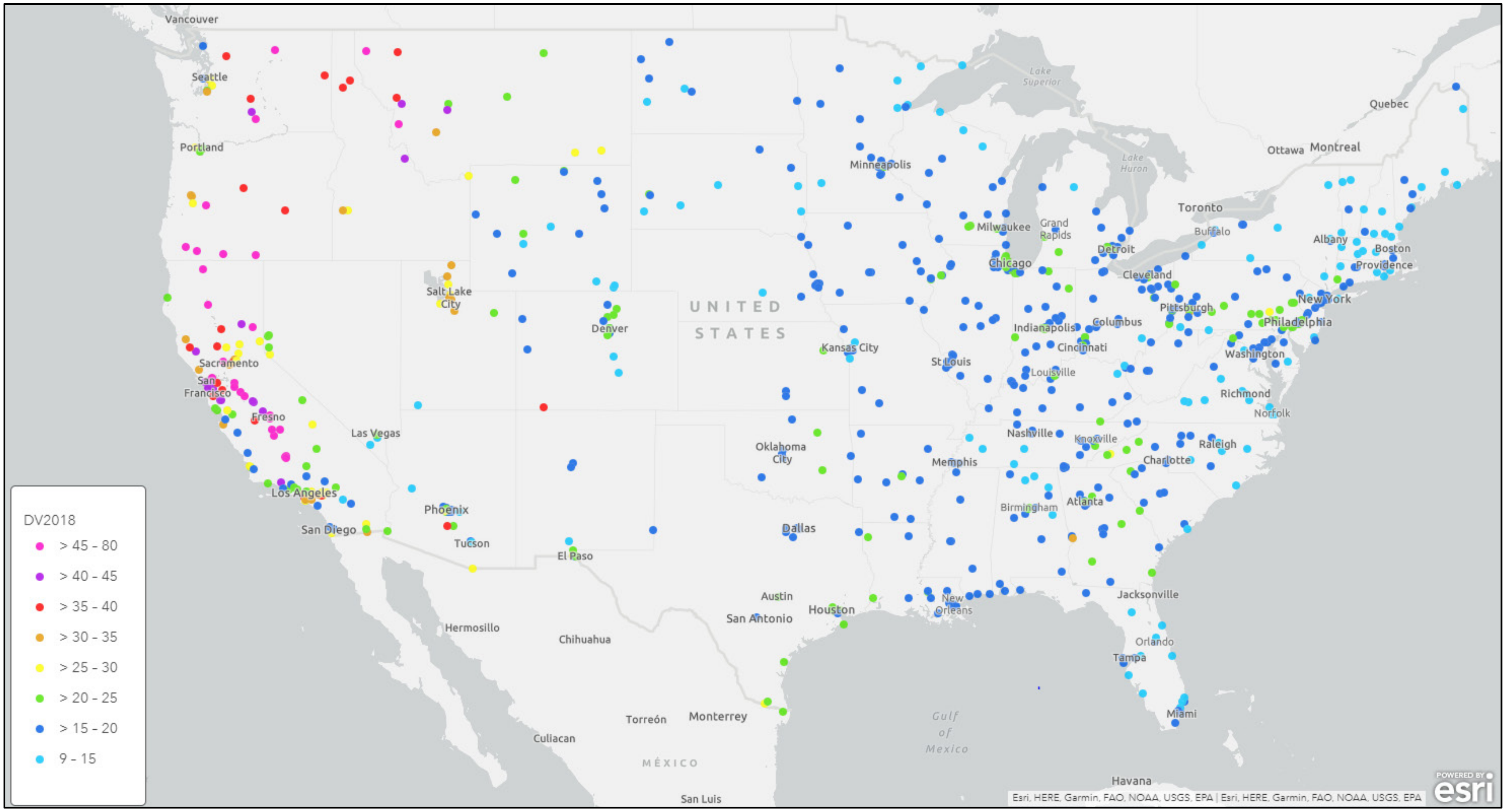
[33] Available online at https://yosemite.epa.gov/sab/sabproduct.nsf/264cb1227d55e02c85257402007446a4/64C246444C9CC319852584430045E365/$File/Draft+Policy+Assessment+for+PM+NAAQS.pdf

[34] Available online at https://yosemite.epa.gov/sab/sabproduct.nsf/264cb1227d55e02c85257402007446a4/64C246444C9CC319852584430045E365/$File/Draft+Policy+Assessment+for+PM+NAAQS.pdf (See page 192.)



2016-2018 $PM_{2.5}$ Annual Design Values for the Contiguous United States ($\mu g/m^3$)



2016-2018 $PM_{2.5}$ 24-hour Design Values for the Continuous United States ($\mu g/m^3$)

AQS ID	Site	Three-Year Period (Annual Design Value)				
		2012-2014	2013-2015	2014-2016	2015-2017	2016-2018
190130009	Waterloo, Water Tower	9.5	9.0	8.5	7.9	7.8
190450021	Clinton, Rainbow Park	9.5	9.3	8.7	8.0	7.7
190550001	Backbone State Park	9.0	8.7	8.1		
191032001	Iowa City, Hoover School	9.2	8.8	8.3	7.7	7.6
191110008	Keokuk, Fire Station	10.8	10.0	9.2	8.4	8.5
191130040	Cedar Rapids, Public Health	9.5	9.3	8.8	8.1	8.0
191370002	Viking Lake State Park	8.3	7.6	6.9	6.5	6.5
191390015	Muscatine, High School E. Campus	10.8	10.2	9.2	8.3	8.3
191390016	Muscatine, Greenwood Cemetery	9.9	9.3	8.3	7.5	7.5
191390018	Muscatine, Franklin School	10.2	9.6	8.8		
191471002	Emmetsburg, Iowa Lakes College	8.2	7.8	7.3	6.8	6.7
191530030	Des Moines, Health Dept.	8.8	8.3	7.7	7.4	7.3
191532510	Clive, Indian Hills Jr. High School	8.9	8.3	7.6	7.2	7.4
191550009	Council Bluffs, Franklin School	9.8	9.0	8.2	7.7	7.9
191630015	Davenport, Jefferson School	9.6	9.5	8.8	8.2	7.9
191630018	Davenport, Adams School	10.0	9.7	8.9		
191630020	Davenport, Hayes School	10.3	10.1	9.4	8.7	8.4
191770006	Lake Sugema	8.4	8.0	7.6	6.9	6.9
191930019	Sioux City, Bryant School	9.1	8.4			
191930021	Sioux City, Irving School					7.7

Legend (Annual)	
Color	Design Value (DV) Range
(red)	DV ≥ 12
(orange)	11 ≤ DV < 12
(pink)	10 ≤ DV < 11
(light yellow)	9 ≤ DV < 10
(light blue)	8 ≤ DV < 9
(green)	DV < 8

Annual $PM_{2.5}$ Design Values ($\mu g/m^3$) at Iowa sites; gray cells indicate monitor not operational or missing data.

AQS ID	Site	Three-Year Period (24 Hour Design Value)				
		2012-2014	2013-2015	2014-2016	2015-2017	2016-2018
190130009	Waterloo, Water Tower	21	20	21	20	20
190450019	Clinton, Chancy Park	26	26	24	21	20
190450021	Clinton, Rainbow Park	23	24	22	20	19
190550001	Backbone State Park	21	22	21		
191032001	Iowa City, Hoover Sch.	22	22	21	19	18
191110008	Keokuk, Fire Station	24	24	22	19	18
191130040	Cedar Rapids, Public Health	23	23	22	20	19
191370002	Viking Lake State Park	20	19	17	16	16
191390015	Muscatine, High School E. Campus	29	28	25	21	21
191390016	Muscatine, Greenwood Cemetery	24	24	22	19	17
191390018	Muscatine, Franklin School	24	25	23		
191390020	Muscatine, Musser Park	27	28	26	21	19
191471002	Emmetsburg, Iowa Lakes College	21	19	17	16	17
191530030	Des Moines, Health Dept.	21	20	19	18	17
191532510	Clive, Indian Hills Jr. High School	20	19	19	18	18
191550009	Council Bluffs, Franklin School	24	20	18	18	19
191630015	Davenport, Jefferson Sch.	23	24	22	20	19
191630018	Davenport, Adams School	23	25	23		
191630020	Davenport, Hayes Sch.	26	26	25	23	21
191770006	Lake Sugema	20	20	20	18	17
191930019	Sioux City, Bryant School	24	22			
191930021	Sioux City, Irving School					18

Legend (24 Hour)	
Color	Design Value (DV) Range
	DV ≥ 30
	28 ≤ DV < 30
	26 ≤ DV < 28
	24 ≤ DV < 26
	22 ≤ DV < 24
	DV < 22

24-hour $PM_{2.5}$ Design Values (µg/m^3) at Iowa sites; gray cells indicate monitor not operational or missing data.

PM$_{2.5}$ Exceedances Relative to the Possible Range for the NAAQS: An Analysis of Historical Data

A PM$_{2.5}$ exceedance day occurs when the 24-hour average for a given day exceeds the level of the standard. The table below shows the number of exceedance days that would have occurred over the past 5 years, given that the level of the standard was reduced to 30 µg/m^3, as discussed in the draft policy assessment. For example, if the level of the NAAQS drops from 35 µg/m^3 to 30 µg/m^3, the number of exceedance days in the Iowa network over the past five years would increase from 29 to 74.

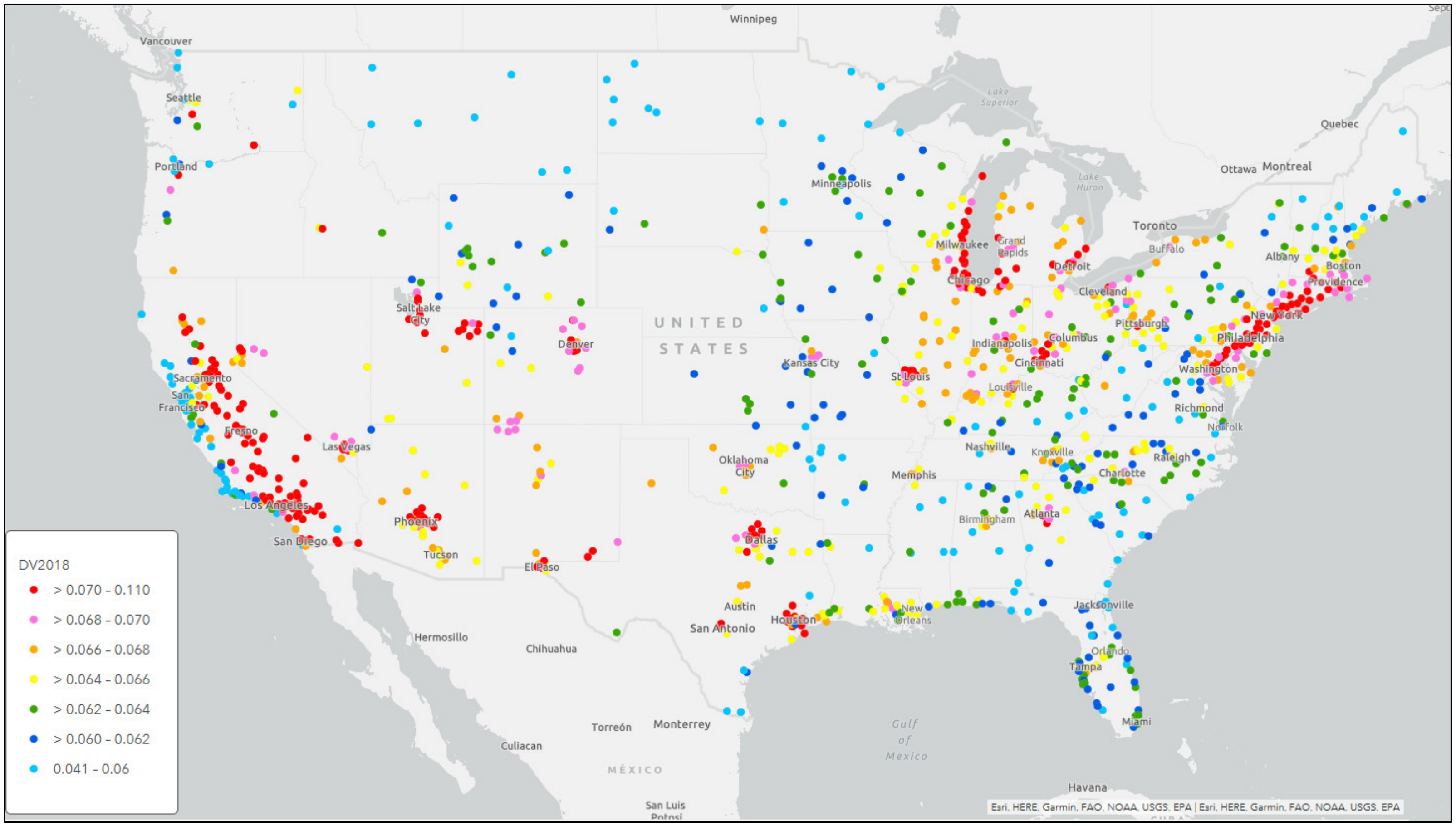
AQS ID	Possible 24 hour NAAQS Level	30 ug/m^3					32 ug/m^3					33 ug/m^3					35 ug/m^3				
	Site Name	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
190130009	Waterloo, Water Tower	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
190450019	Clinton, Chancy Park	5	1	0	0	0	3	1	0	0	0	1	1	0	0	0	1	1	0	0	0
190450021	Clinton, Rainbow Park	2	1	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	0	0	0
190550001	Backbone State Park*	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0	
191032001	Iowa City, Hoover Sch.	2	2	1	0	1	2	1	0	0	0	2	1	0	0	0	2	1	0	0	0
191110008	Keokuk, Fire Station	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
191130040	Cedar Rapids, Public Health	2	2	1	0	0	2	1	1	0	0	2	1	1	0	0	1	1	1	0	0
191370002	Viking Lake State Park	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
191390015	Muscatine, High School E. Campus	9	1	3	0	1	8	1	0	0	1	5	1	0	0	0	4	1	0	0	0
191390016	Muscatine, Greenwood Cemetery	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
191390018	Muscatine, Franklin School*	0	1	0	0		0	1	0	0		0	0	0	0		0	0	0	0	
191390020	Muscatine, Musser Park	3	1	0	0	0	3	0	0	0	0	1	0	0	0	0	1	0	0	0	0
191471002	Emmetsburg, Iowa Lakes College	1	1	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
191530030	Des Moines, Health Dept.	1	2	1	1	0	0	1	1	1	0	0	0	1	1	0	0	0	1	1	0
191532510	Clive, Indian Hills Jr. High School	1	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
191550009	Council Bluffs, Franklin School	1	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	0	0	0	1
191630015	Davenport, Jefferson Sch.	2	2	0	0	1	2	2	0	0	1	1	2	0	0	0	1	2	0	0	0
191630018	Davenport, Adams School*	1	1	0	0		0	0	0	0		0	0	0	0		0	0	0	0	
191630020	Davenport, Hayes Sch.	4	2	0	0	1	3	2	0	0	1	3	1	0	0	0	2	1	0	0	0
191770006	Lake Sugema	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
191930019	Sioux City, Bryant School	2	1				2	1				2	1				2	0			
191930021	Sioux City, Irving School			0	0	1			0	0	0			0	0	0			0	0	0
Total		**38**	**21**	**6**	**3**	**6**	**29**	**14**	**2**	**3**	**4**	**21**	**9**	**2**	**2**	**1**	**17**	**8**	**2**	**1**	**1**

PM$_{2.5}$ Exceedance Days Calculated According to the Proposed 24-Hour NAAQS

* These three sites were discontinued on 7/1/2017; exceedance counts for 2017 may be low.

Section 4: Ozone NAAQS and Ozone Monitoring Regulations

A national map of the most recent ozone design values (2016-2018) is shown below. In Iowa, the highest design value is 65 ppb. A monitor near the Northwest corner of the State, in Sioux Falls, South Dakota recorded a design value of 67 ppb, and monitors in Rockford, Illinois and Janesville Wisconsin recorded design values of 68 ppb.



2016-2018 Ozone Design Values for the Contiguous United States (ppm)

NAAQS Violations under Possible Ranges for the Ozone NAAQS: An Analysis of Historical Data

A NAAQS violation occurs when the design value is greater than the level of the standard. The following analysis assumes that form of the design value will remain unchanged: i.e. it will continue to be defined as the three-year average of the annual fourth highest daily maximum 8-hour ozone values. The most recent five years of ozone design values are shown below. For example, based on the most recent set of 2016-2018 design values if the NAAQS is set at 70 ppb, no sites would violate the NAAQS. If the NAAQS were set at 65 ppb, two sites would approach it closely, but no sites would violate it.

AQS ID	Site	Three Year Period				
		2012-14	2013-15	2014-16	2015-17	2016-18
190170011	Waverly, Airport	63	60	60	60	63
190450021	Clinton, Rainbow Park	67	62	63	62	64
190850007	Pisgah, Forestry Office	67	63	62	62	64
190851101	Pisgah, Highway Maintenance Shed	67	62	62		
191130028	Cedar Rapids, Kirkwood College	63	60	61		
191130033	Coggon Elementary School	63	60	61	61	65
191130040	Cedar Rapids, Public Health	62	59	61	61	63
191370002	Viking Lake State Park	63	59	60	60	61
191471002	Emmetsburg, Iowa Lakes College	65	63	61	61	62
191530030	Des Moines, Health Department	62	59	60	59	61
191531579	Sheldahl, Southern Crossroads				59	61
191630014	Scott County Park			63	62	65
191630015	Davenport, Jefferson School	63	59	60	61	63
191690011	Slater Elementary/City Hall	62	60	60		
191770006	Lake Sugema	66	61	60	59	61
191810022	Lake Ahquabi	63	59	58		

Legend	
Color	Design Value (DV) Range
	DV ≥ 70
	DV = 69
	DV = 68
	DV = 67
	DV = 66
	DV < 66

Ozone Design Values (ppb) at Iowa sites; gray cells indicate monitor not operational or missing data.

Ozone Exceedances Relative to the Possible Range for the NAAQS: An Analysis of Historical Data

An ozone exceedance day occurs when the highest eight-hour average in the day exceeds the level of the standard. The table below shows the number of exceedance days that would have occurred over the past 5 years, given that the level of the standard was in the 65-70 ppb range. For example, if the level of the NAAQS drops from 70 ppb to 65 ppb, the number of exceedance days in the Iowa network over the past five years would increase from 23 to 95.

AQS ID	Possible NAAQS Level	65					66					67					68					69					70				
	Site Name / Year	**14**	**15**	**16**	**17**	**18**	**14**	**15**	**16**	**17**	**18**	**14**	**15**	**16**	**17**	**18**	**14**	**15**	**16**	**17**	**18**	**14**	**15**	**16**	**17**	**18**	**14**	**15**	**16**	**17**	**18**
190170011	**Waverly, Airport**	1	0	0	1	6	0	0	0	1	6	0	0	0	1	4	0	0	0	0	3	0	0	0	0	2	0	0	0	0	2
190450021	**Clinton, Rainbow Park**	2	1	1	2	5	2	1	1	0	4	1	1	1	0	3	1	0	1	0	2	1	0	1	0	1	1	0	1	0	0
190850007	**Pisgah, Forestry Office**	1	1	0	1	5	1	1	0	0	3	0	1	0	0	2	0	1	0	0	2	0	1	0	0	2	0	1	0	0	2
190851101	**Pisgah, Highway Maintenance Shed***	0	1	0	0		0	1	0	0		0	1	0	0		0	1	0	0		0	1	0	0		0	1	0	0	
191130028	**Cedar Rapids, Kirkwood College***	1	0	2	1		1	0	1	1		0	0	0	1		0	0	0	1		0	0	0	0		0	0	0	0	
191130033	**Coggon Elementary School**	0	0	1	1	10	0	0	0	1	9	0	0	0	1	7	0	0	0	0	6	0	0	0	0	4	0	0	0	0	3
191130040	**Cedar Rapids, Public Health**	0	0	2	1	5	0	0	1	0	5	0	0	0	0	3	0	0	0	0	3	0	0	0	0	1	0	0	0	0	1
191370002	**Viking Lake State Park**	0	1	0	0	3	0	1	0	0	2	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
191471002	**Emmetsburg, Iowa Lakes College**	0	2	0	0	5	0	2	0	0	4	0	2	0	0	3	0	1	0	0	3	0	0	0	0	2	0	0	0	0	1
191530030	**Des Moines, Health Department**	1	0	0	0	3	1	0	0	0	2	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1
191531579	**Sheldahl, Southern Crossroads**				0	3				0	3				0	3				0	3				0	3				0	2
191630014	**Scott County Park**	1	1	2	2	8	0	1	2	2	7	0	0	2	0	7	0	0	2	0	6	0	0	2	0	4	0	0	2	0	4
191630015	**Davenport, Jefferson School**	0	1	1	1	3	0	1	1	1	2	0	0	1	0	2	0	0	1	0	2	0	0	1	0	0	0	0	1	0	0
191690011	**Slater Elementary/City Hall**	1	0	0			1	0	0			0	0	0			0	0	0			0	0	0			0	0	0		
191770006	**Lake Sugema**	1	0	0	0	2	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
191810022	**Lake Ahquabi***	1	0	0	0		1	0	0	0		1	0	0	0		1	0	0	0		1	0	0	0		0	0	0	0	
Total		**10**	**8**	**9**	**10**	**58**	**7**	**8**	**6**	**6**	**48**	**3**	**6**	**4**	**3**	**37**	**2**	**4**	**4**	**1**	**32**	**2**	**2**	**4**	**0**	**20**	**1**	**2**	**4**	**0**	**16**

* These three sites were discontinued in June of 2017. Therefore, exceedance counts may be low for 2017.

Ozone Exceedance Days Calculated According to possible NAAQS Levels

Appendix E: Potential Changes to the Iowa Monitoring Network over the Next Five Years

Over the next 5 years, Iowa intends to maintain and adjust the ambient monitoring network as funding allows to meet the objectives in 40 CFR Part 58, Appendix D and included as Appendix B:
1. Providing air pollution data to the general public in a timely manner.
2. Supporting compliance with ambient air quality standards (NAAQS) and emissions strategy development.
3. Supporting air pollution research studies.

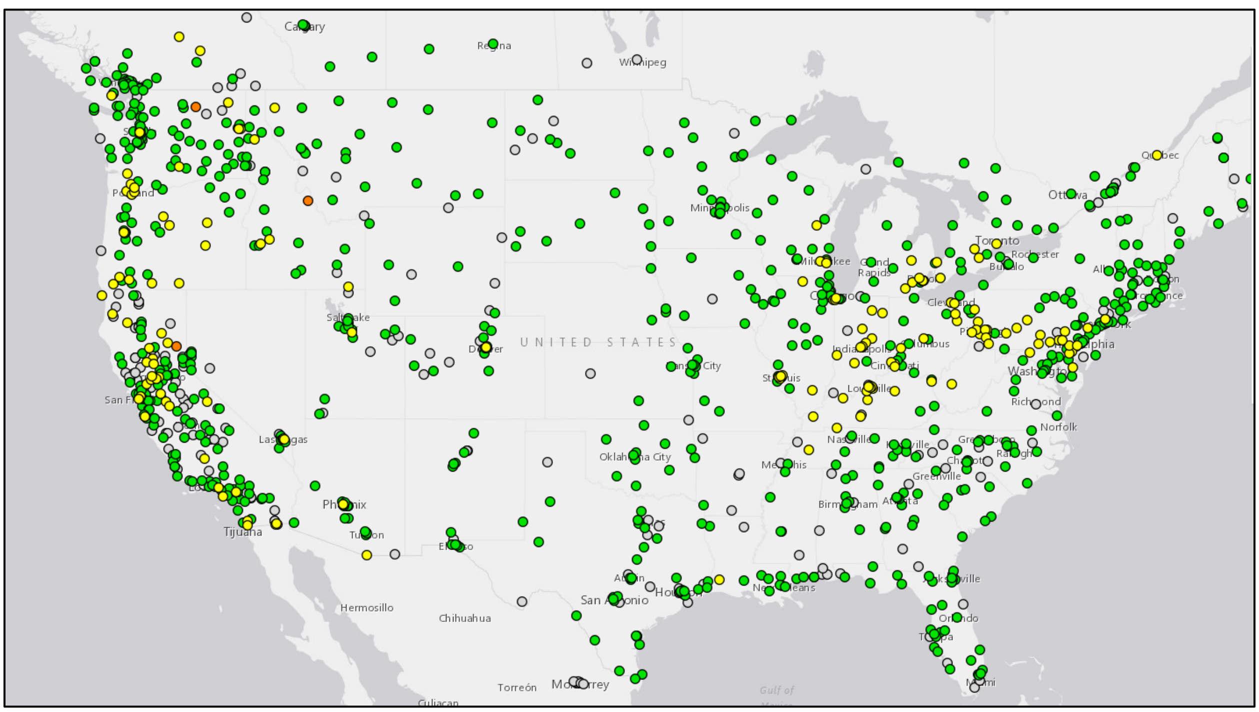
More specifically, Iowa intends to:

- **As appropriate, reduce the size of the near-source SO_2 monitoring network.**

When EPA promulgated a new more stringent SO_2 NAAQS in 2010, several monitors sited near coal burning industries recorded levels close to the new standard. Over the subsequent decade, many of these industries have transitioned from coal to natural gas, and ambient SO_2 levels near these industries have dropped precipitously. Over the next 5 years, Iowa intends to investigate potential reductions in this network.

- **As resources allow, investigate the comparability of citizen science and regulatory monitors.**

EPA uses its AirNow program to disseminate real-time data gathered by States and Local Programs.



EPA's AirNow $PM_{2.5}$ Network for the Contiguous United States (2/12/20)[35]

[35]https://gispub.epa.gov/airnow/

Recently, vendors have integrated new low cost air quality sensors with "Internet of Things" infrastructure to provide opportunities for low cost air monitoring by citizen scientists. This data is provided to the public in real-time maps. Some of these designs have become so popular that the resulting network rivals the AirNow network in the number of monitors deployed.

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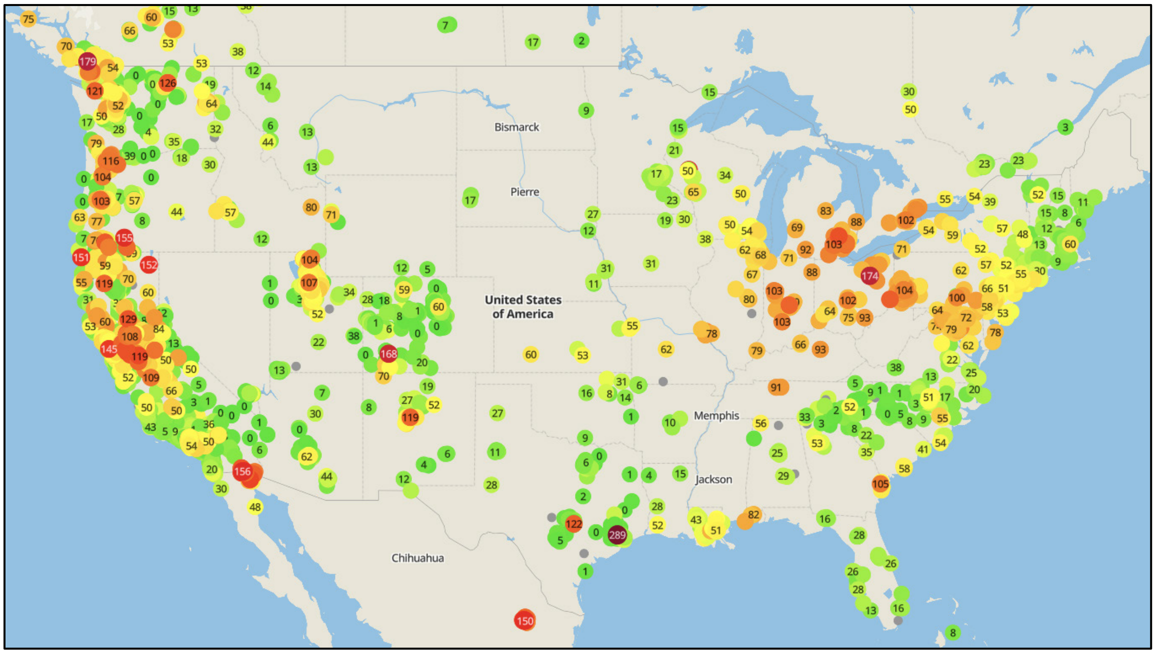

Purple Air Network for the Contiguous United States (2/12/20)[36]

To the extent that there is no national program for citizen science monitors analogous to EPA's reference and equivalent method testing and certification program for NAAQS monitoring[37,38], States have a role to play in establishing the comparability of Citizen Science and regulatory monitoring data, and in helping to develop consistency in the public health messaging from the two networks.[39] If low cost citizen science monitoring can be shown to be reliable and of sufficient quality to perform certain tasks such as air quality index reporting, then the State may be able to increase the density of its monitoring network by incorporating these types of monitors.

- **As resources allow, increase the scope of the air contaminants measured in the network.**

The scope of EPA's NAAQS program is limited to the seven criteria pollutants. There are many other air contaminants in addition to these seven. EPA's national strategy to address these additional toxic pollutants is to promulgate rules that mandate source control measures and to follow up with residual risk assessments to address the effectiveness of the source controls. States can play a role in the residual risk assessment if they can develop the infrastructure and funding to conduct monitoring for these additional toxic air contaminants.

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36 https://www.purpleair.com/map?

37 https://www.ecfr.gov/cgi-bin/text-idx?SID=2cdc61535568c329b2a95aeee97c8f6b&mc=true&node=pt40.6.53&rgn=div5

38 https://www.sciencedirect.com/science/article/pii/S2590162119300346?via%3Dihub

39 https://cleanairact.org/wp-content/uploads/2019/09/New-Tools-For-Air-Quality-Evaluation-Air-Quality-Sensors-Andrea-Clements.pdf

Appendix F: Results from Network Assessment Tools

Table of Contents

Section 1: Summary

The Data Analysis and Assessment group at EPA's Office of Air Quality Planning and Standards (OAQPS) developed a set of analytical tools "NetAssess2020" to assist states in performing their 5-year network assessments.[40]

Net Assess2020 has an "area served tool" that allows one to calculate the area and population served associated with each monitor in the seven criteria pollutant networks. To obtain these values, Net Assess creates a polygon, known as a Voronoi polygon[41], for each monitor in the network. The interior of each polygon consists of points that are closer to the associated monitor than any other monitor in the network.[42] The area of each polygon is known as the "area-served" by the monitor, and the population inside each polygon is known as the "population served" by the monitor. NetAssess2020 uses population data from the 2010 census for its population served computations. The software allows for the removal and addition of monitors and the results presented in this document reflect the current Iowa network.

It should be noted that a Voronoi polygon is a purely mathematical construct, and the scale of an air pollution monitor (i.e. the area over which the monitor readings are representative) is not related to the area of the Voronoi polygon associated with the monitor.

NetAssess2020 also has a "correlation tool" that is used to compute the correlation (R) and mean absolute difference ($|d|$) for all monitor pairs x, y in a specified region. NetAssess2020 utilizes daily air quality data gathered from each monitor over the period 2016-2018 for these computations.

If n represents the number of days when both monitor x and monitor y have valid data, the correlation coefficient between the two data sets is given by: [43,44]

$$R_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

and the mean absolute difference between the two data sets by:

$$|d|_{xy} = \frac{\sum_{i=1}^{n}|x_i - y_i|}{n}$$

The software also provides the distance between each pair of monitors.

In this document we have utilized the correlation tool to examine two pollutants, ozone and $PM_{2.5}$, that are known to have a regional character. To investigate these results more quantitatively, we cast the NetAssess outputs (R and |d|) into the form of distance metrics (also known as a dissimilarity structures). A metric (or dissimilarity structure) has the property as x and y get further apart the value of the metric

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[40] https://sti-r-shiny.shinyapps.io/EPA_Network_Assessment/
[41] http://mathworld.wolfram.com/VoronoiDiagram.html
[42] http://ima.udg.edu/~sellares/ComGeo/Vor2D_1.ppt
[43] https://mathworld.wolfram.com/CorrelationCoefficient.html
[44] https://medium.com/@ns2586/geometric-interpretation-of-the-correlation-between-two-variables-4011fb3ea18e

increases. $|d|$ already has this property; we use 1-R instead of R as our metric for correlation, so that our correlation metric also has this property.

Having defined our two metrics we use a technique known as agglomerative hierarchical clustering[45], to organize the monitor results for each metric into clusters. Clusters are just groups of monitors. The distance between two clusters can be defined in different ways[46]; for our analysis we define the distance between two clusters as the greatest metric distance between any two monitors that lie in different clusters. (This clustering rule is known as complete linkage.) Hierarchical clustering proceeds by combining the monitor pairs that are closest together into the first cluster, then calculating the metric distances between all monitors and the new cluster, and forming the second cluster from the monitors or clusters that are closest together. This process proceeds until all monitors coalesce into a single cluster. The metric distance at which a new cluster is formed is known as the height of the cluster.

Clustering results may be pictured in a tree diagram known as a dendrogram. The "roots" of the tree consist of the monitor pairs that are closest together. As the height increases, the small roots coalesce into larger "branches" (multi-monitor groups) ultimately agglomerating into a single "trunk". For any particular value of the height, one can specify the number of clusters (remaining roots) in the dendrogram.

Clustering was performed and dendrograms were generated using the statistical software ***R***. The ***R*** function hclust [47, 48] was used to generate the dendrograms. Clusters were extracted from the dendrograms using ***R***'s cutree[49] function.

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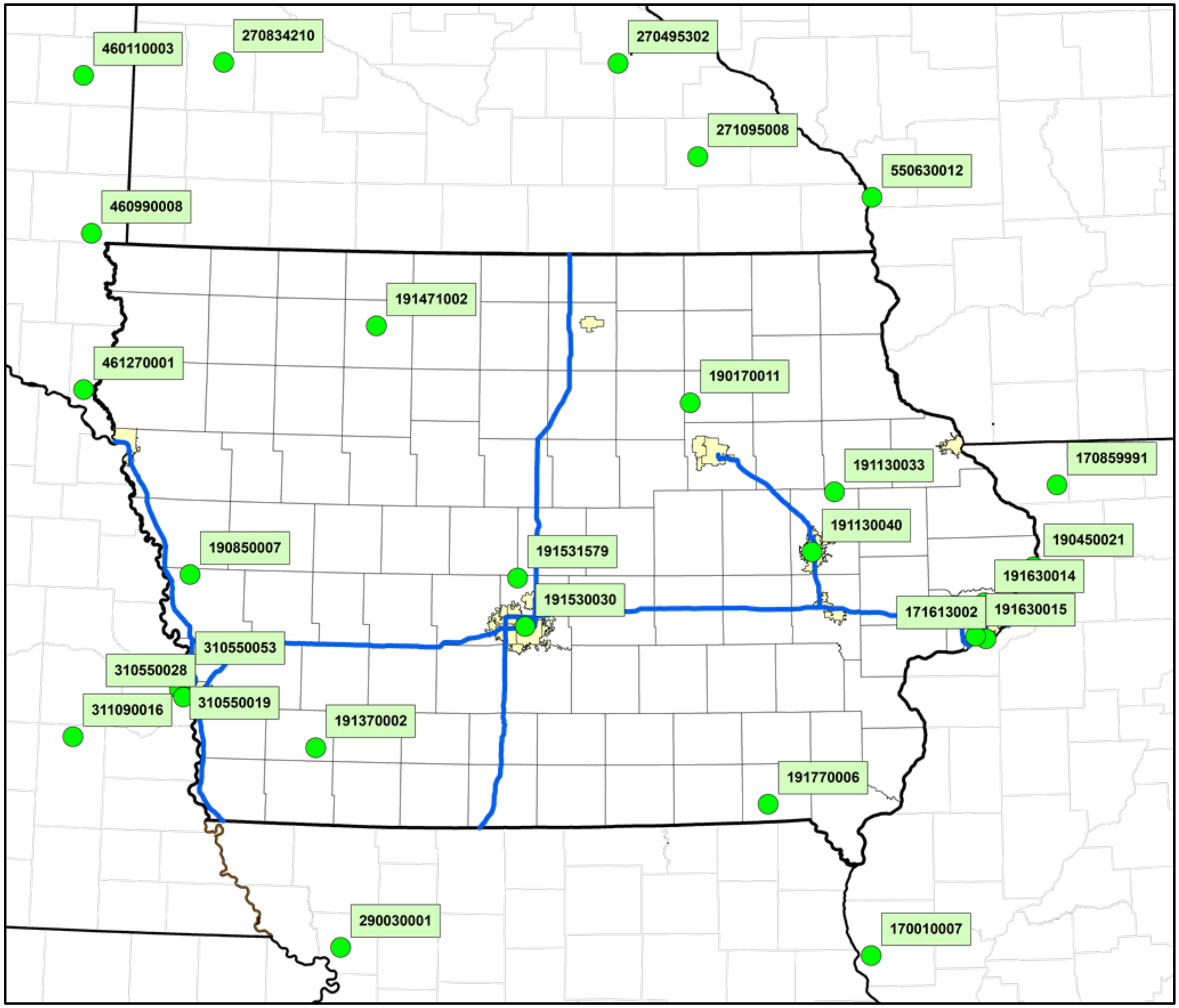
[45] https://www.datacamp.com/community/tutorials/hierarchical-clustering-R
[46] https://uc-r.github.io/hc_clustering#algorithms
[47] https://www.r-project.org/
[48] https://www.rdocumentation.org/packages/stats/versions/3.6.2/topics/hclust
[49] https://www.rdocumentation.org/packages/dendextend/versions/1.5.2/topics/cutree

Section 2: Results from the NetAssess2020 Area Served Tool

This section contains the population served and area served for each monitor in the seven criteria pollutant networks in and around Iowa. Monitors located in Iowa are always included in the analysis. Monitors located in surrounding states are included if they generate Voronoi polygons that lie partially in Iowa.



Ozone: Site Map

AQS Site ID	Local Site Name	State	City	Address	Area Served (km^2)	Population Served
170010007	John Wood Community College	IL	Quincy	1301 S. 48th St.	12,296	199,447
170859991	Stockton	IL	N/A	10952 E. Parker Rd.	8,486	228,846
171613002	Rock Island Arsenal	IL	Rock Island	32 Rodman Ave.	4,603	263,149
190170011	Waverly Airport	IA	Waverly	Waverly Airport	18,082	341,406
190450021	Rainbow Park	IA	Clinton	Roosevelt St.	5,254	126,803
190850007	Pisgah, Forestry Office	IA	N/A	206 Polk St	12,642	88,760
191130033	Coggon Elementary School	IA	Coggon	408 E. Linn St.	10,211	135,115
191130040	Public Health	IA	Cedar Rapids	500 11th St. NW	9,118	408,043
191370002	Viking Lake State Park	IA	N/A	2780 Viking Lake Rd.	17,234	110,418
191471002	Iowa Lakes Community College	IA	Emmetsburg	ILCC	28,136	250,175
191530030	Carpenter	IA	Des Moines	1907 Carpenter	16,672	634,226
191531579	Sheldahl, Southern Crossroads	IA	Sheldahl	15795 NW 58th Street	12,695	270,616
191630014	Scott County Park	IA	Davenport	Scott County park	2,807	43,852
191630015	Davenport - NCORE	IA	Davenport	10th St. & Vine St.	5,083	214,045
191770006	Lake Sugema	IA	N/A	24430 Lacey Trail	19,611	242,923
270495302	Stanton Air Field	MN	Stanton	1235 Highway 19	7,841	267,997
270834210	SW Regional Airport	MN	Marshall	W Hwy 19	25,615	183,329
271095008	Ben Franklin School	MN	Rochester	1801 9th Ave. SE	11,647	288,385
290030001	Savannah	MO	Savanah	11796 Highway 71	10,947	161,561
310550019	Omaha - NCORE	NE	Omaha	42nd & Woolworth	997	475,218
310550028	South Omaha	NE	Omaha	2411 O St.	5,187	239,997
310550053	Whitmore	NE	Omaha	1616 Whitmore	2,683	132,511
311090016	Davey	NE	Davey	1st & Maple	41,904	640,358
460110003	Research Farm	SD	Brookings	3714 Western Ave	30,780	175,825
460990008	SD School for the Deaf	SD	Sioux Falls	2001 E 8th St.	10,647	267,941
461270001	Union County #1 Jensen	SD	N/A	31986 475th Ave.	14,599	235,522
550630012	DOT Building	WI	La Crosse	3550 Mormon Coulee Rd.	14,590	321,764

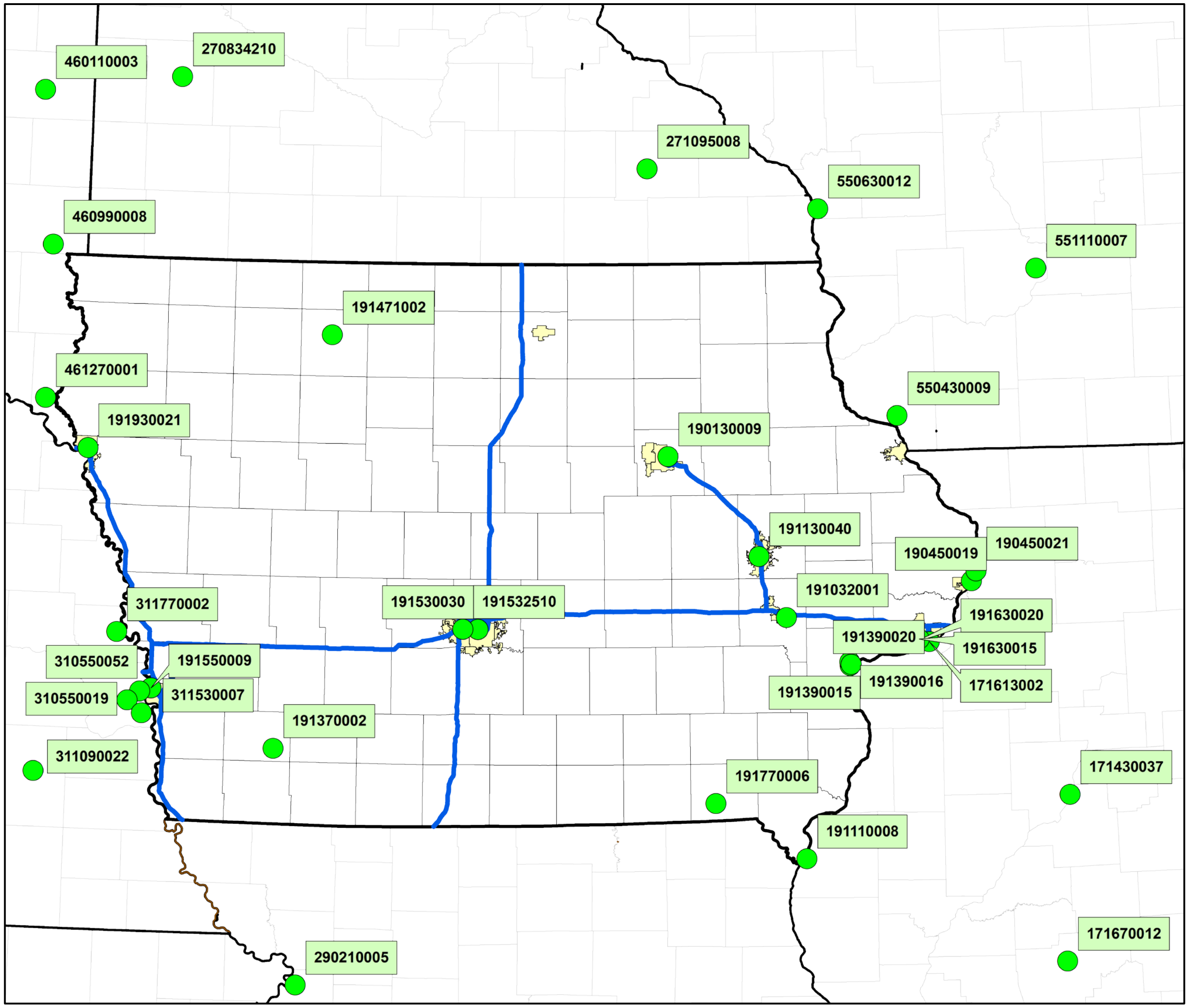
Legend for Area Served (km^2)

997 11,647 41,904

Legend for Population Served

43,852 239,997 640,358

Ozone: Area and Population Served



***PM$_{2.5}$* : Site Map**

AQS Site ID	Local Site Name	State	City	Address	Area Served (km^2)	Population Served
171430037	City Office Building	IL	Peoria	613 N.E. Jefferson	10,002	461,589
171613002	Rock Island Arsenal	IL	Rock Island	32 Rodman Ave.	4,027	251,633
171670012	Agricultural Building	IL	Springfield	State Fair Grounds	9,513	331,068
190130009	Water Tower	IA	Waterloo	Vine St. & Steely	18,115	377,995
190450019	Chancy Park	IA	Clinton	23rd & Camanche	2,796	64,547
190450021	Rainbow Park	IA	Clinton	Roosevelt St.	5,394	108,415
191032001	Hoover School	IA	Iowa City	2200 E. Court	4,288	166,400
191110008	Fire Station	IA	Keokuk	111 S. 13th St.	20,145	454,661
191130040	Public Health	IA	Cedar Rapids	500 11th St. NW	8,429	288,236
191370002	Viking Lake State park	IA	N/A	2780 Viking Lake Road	18,413	117,402
191390015	Muscatine HS - East Campus Roof	IA	Muscatine	1409 Wisconsin	3,411	31,840
191390016	Greenwood Cemetery	IA	Muscatine	Fletcher St. & Kimble St.	2,292	50,369
191390020	Musser Park	IA	Muscatine	Oregon St. & Earl Ave.	694	13,748
191471002	Iowa Lakes College	IA	Emmetsburg	Iowa Lakes Community College	29,579	278,696
191530030	Health Dept.	IA	Des Moines	1907 Carpenter	17,238	555,905
191532510	Indian Hills Jr. High School	IA	Clive	9401 Indian Hills Dr.	10,145	290,334
191550009	Franklin School	IA	Council Bluffs	3130 C Ave.	3,722	116,288
191630015	Davenport - NCORE	IA	Davenport	10th St. & Vine St.	1,179	97,523
191630020	Hayes School	IA	Davenport	622 S. Concord St.	2,396	72,873
191770006	Lake Sugema	IA	N/A	24430 Lacey Trail	22,515	245,532
191930021	Irving Elementry School	IA	Sioux City	901 Floyd Blvd.	12,768	222,830
270834210	SW Regional Airport	MN	Marshall	W Hwy 19	24,877	181,813
271095008	Ben Franklin School	MN	Rochester	1801 9th Ave. SE	16,212	350,139
290210005	St. Joseph Pump Station	MO	St. Joseph	S. Hwy 759	14,254	208,391

Legend for Area Served (km^2)

248 10,002 29,579

Legend for Population Served

13,748 222,830 555,905

***$PM_{2.5}$* : Area and Population Served (continued on the next page)**

AQS Site ID	Local Site Name	State	City	Address	Area Served (km^2)	Population Served
310550019	Omaha - NCORE	NE	Omaha	42nd & Woolworth	248	222,005
310550052	Berry Street Omaha	NE	Omaha	9225 Berry	1,720	364,867
311090022	LLCHD Building	NE	Lincoln	3140 N ST Lincoln	22,330	440,020
311530007	Golden Hills Elementary	NE	Bellevue	2912 Coffey Ave.	4,625	131,364
311770002	Good Shepard Lutheran Home	NE	Blair	2242 Wright St.	7,813	110,253
460110003	Research Farm	SD	Brookings	3714 Western Ave.	7,552	56,597
460990008	SD School for the Deaf	SD	Sioux Falls	2001 E. 8th St.	15,617	292,299
461270001	Union County #1 Jensen	SD	N/A	31986 475th Ave.	18,449	146,623
550430009	Potosi	WI	Potosi	128 Hwy 61 N	11,613	225,934
550630012	DOT Building	WI	La Crosse	3550 Mormon Coulee Rd.	13,307	301,737
551110007	Devils Lake Park	WI	Baraboo	E12886 Tower Rd.	12,775	305,811

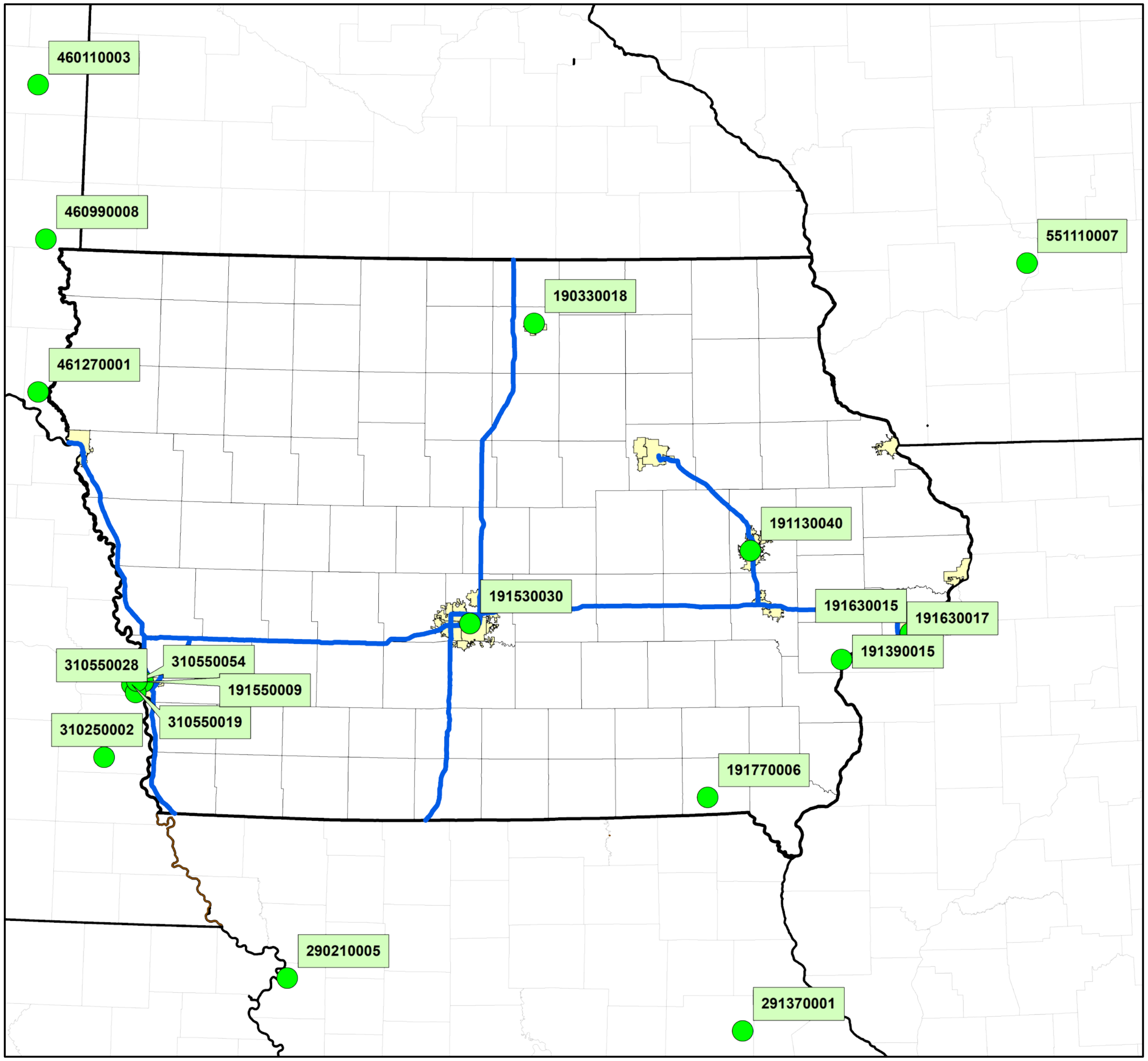
Legend for Area Served (km^2)

248 10,002 29,579

Legend for Population Served

13,748 222,830 555,905

$PM_{2.5}$: Area and Population Served (continued from the previous page)



PM_{10} : Site Map

AQS Site ID	Name	State	City	Address	Area Served (km^2)	Population Served
190330018	Holcim Cement	IA	Mason City	17th St. & Washington St.	39,461	442,212
191130040	Public Health	IA	Cedar Rapids	500 11th St. NW	25,092	708,648
191390015	Muscatine HS, East Campus Roof	IA	Muscatine	1409 Wisconsin	9,846	159,969
191530030	Health Dept.	IA	Des Moines	1907 Carpenter	37,559	970,763
191550009	Franklin School	IA	Council Bluffs	3130 C Ave.	17,676	214,560
191630015	Davenport - NCORE	IA	Davenport	10th St. & Vine St.	24,786	1,064,380
191630017	Linnwood Mining	IA	Buffalo	11100 110th Ave.	7,319	153,734
191770006	Lake Sugema	IA	N/A	24430 Lacey Trail	22,371	249,542
290210005	St. Joseph Pump Station	MO	St. Joseph	S. Hwy 759	20,952	255,302
291370001	Mark Twain State Park	MO	Stoutville	20057 State Park Office Rd.	35,851	642,876
310250002	Weeping Water City	NE	Weeping Water	102 P St.	38,373	612,017
310550019	Omaha - NCORE	NE	Omaha	42nd & Woolworth	4,787	530,355
310550028	South Omaha	NE	Omaha	2411 O St.	1,429	161,144
310550054	19th & Burt	NE	Omaha	19th St. & Burt St.	2,266	87,121
460110003	Research Farm	SD	Brookings	3714 Western Ave	23,882	164,080
460990008	SD School for the Deaf	SD	Sioux Falls	2001 E 8th St.	24,436	377,932
461270001	Union County #1 Jensen	SD	N/A	31986 475th Ave.	60,004	443,862
551110007	Devils Lake Park	WI	Baraboo	E12886 Tower Rd.	40,701	867,961

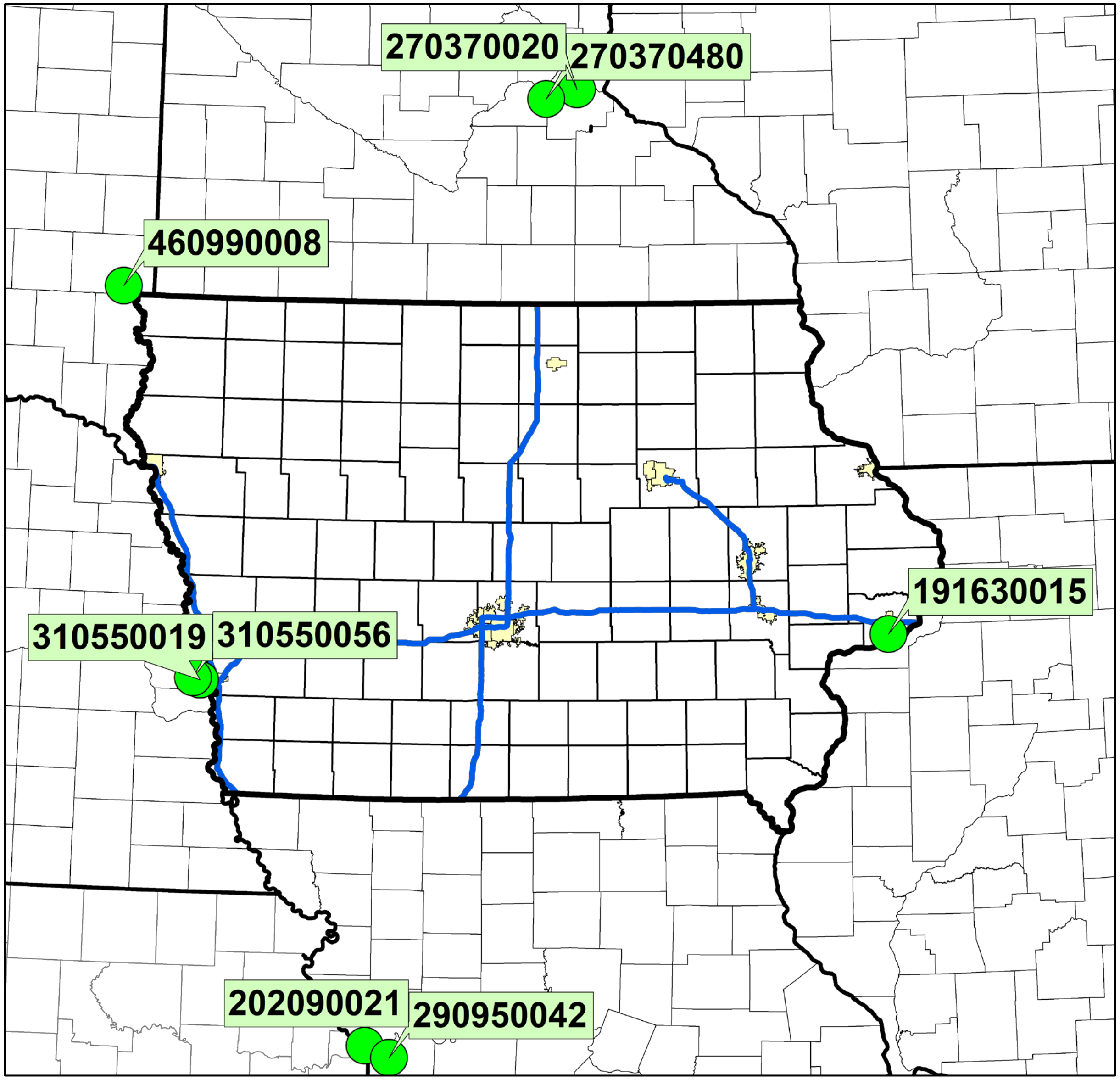
Legend for Area Served (km^2)

1,429 24,159 60,004

Legend for Population Served

87,121 410,072 1,064,380

PM_{10} : Area and Population Served


270370020
270370480
460990008
191630015
310550019
310550056
202090021
290950042

CO: Site Map

AQS Site ID	Local Site Name	State	City	Address	Area Served (km^2)	Population Served
191630015	Davenport - NCORE	IA	Davenport	10th St. & Vine St.	99,293	2,484,609
202090021	Kansas City - NCORE	KS	Kansas City	1210 N. 10th St., JFK Center	51,061	1,947,826
270370020	Flint Hills Refinery 420	MN	Minneapolis	12821 Pine Bend Trail	48,912	1,225,184
270370480	Near Road I-35	MN	Minneapolis	16750 Kenyon Ave.	41,978	1,079,286
290950042	Blue Ridge, I-70	MO	Kansas City	4018 Harvard Lane	72,481	1,634,659
310550019	Omaha - NCORE	NE	Omaha	42nd & Woolworth	49,559	1,349,137
310550056	78th & Dodge	NE	Omaha	7747 Dodge St.	106,181	1,432,545
460990008	Sioux Falls - NCORE	SD	Sioux Falls	2001 E. 8th St.	171,983	1,321,674

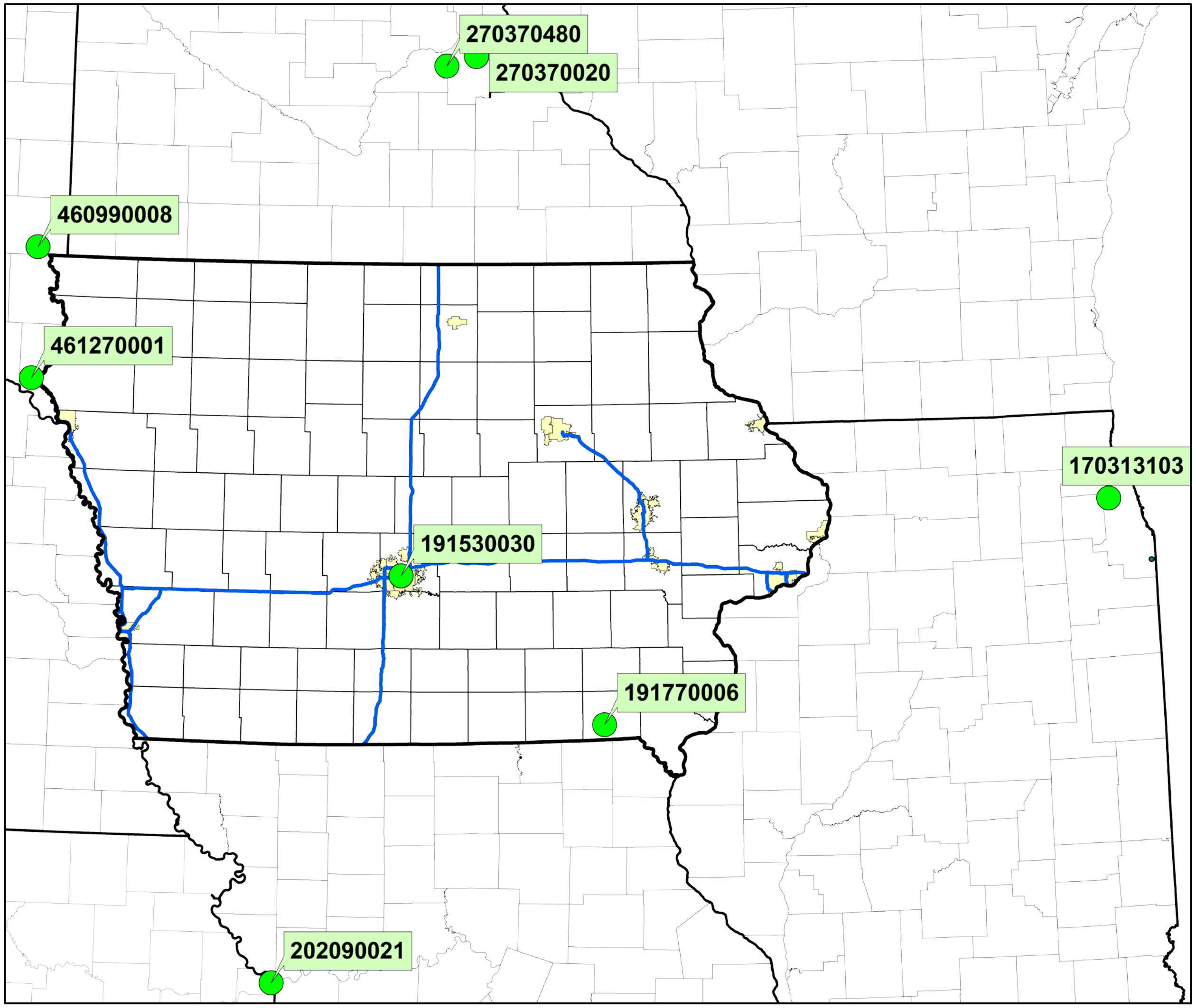
Legend for Area Served (km^2)

41,978 61,771 171,983

Legend for Population Served

1,079,286 1,390,841 2,484,609

CO: Area and Population Served


270370480
270370020
460990008
461270001
170313103
191530030
191770006
202090021

NO_2 : Site Map

AQS Site ID	Local Site Name	State	City	Address	Area Served (km^2)	Population Served
170313103	IEPA Trailer	IL	Chicago	4743 Mannheim Rd.	22,500	4,734,285
191530030	Health Dept.	IA	Des Moines	1907 Carpenter	69,040	1,364,417
191770006	Lake Sugema	IA	N/A	24430 Lacey Trail	60,594	1,523,036
202090021	Kansas City - NCORE	KS	Kansas City	1210 N. 10th St., JFK Center	39,402	1,520,780
270370020	Flint Hills Refinery 420	MN	Minneapolis	12821 Pine Bend Trail	64,135	1,371,456
270370480	Near Road I-35	MN	Minneapolis	16750 Kenyon Ave.	29,046	989,954
460990008	Sioux Falls - NCORE	SD	Sioux Falls	2001 E. 8th St.	75,815	612,602
461270001	Union County #1 Jensen	SD	N/A	31986 475th Ave.	94,970	1,850,479

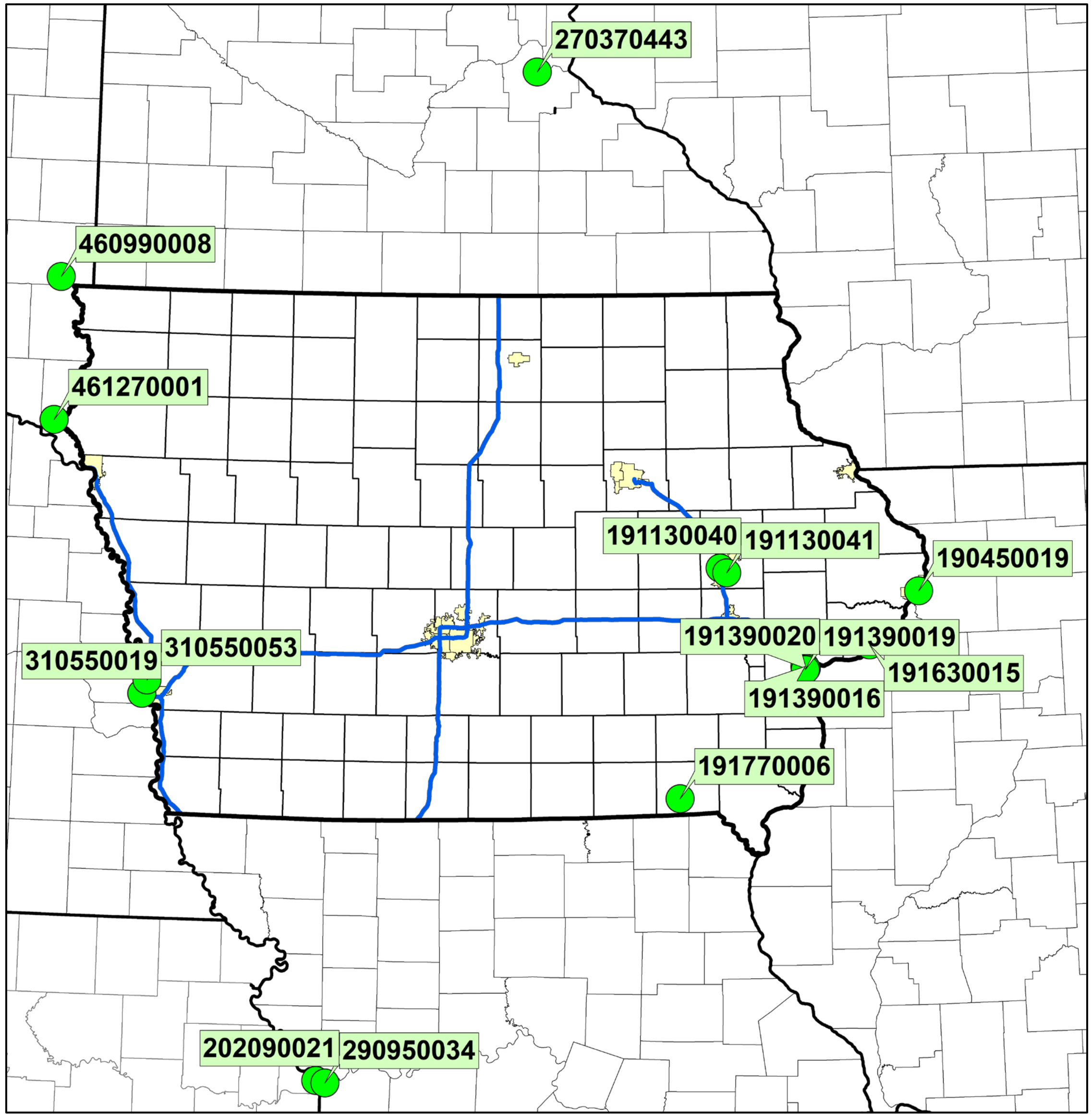
Legend for Area Served (km^2)

22,500 62,365 94,970

Legend for Population Served

612,602 1,446,118 4,734,285

NO_2 : Area and Population Served


270370443
460990008
461270001
191130040
191130041
190450019
310550053
310550019
191390020
191390019
191630015
191390016
191770006
202090021
290950034

SO_2 : Site Map

AQS Site ID	Local Site Name	State	City	Address	Area Served (km^2)	Population Served
190450019	Chancy Park	IA	Clinton	23rd & Camanche	14,332	389,205
191130040	Public Health	IA	Cedar Rapids	500 11th St NW	36,842	847,249
191130041	Tait Cummins Park (Prairie Creek)	IA	Cedar Rapids	3000 C Street SW	8,584	283,958
191390016	Greenwook Cemetary	IA	Muscatine	Fletcher St. & Kimble St.	2,606	57,626
191390019	Muscatine HS, East Campus Trailer	IA	Muscatine	1409 Wisconsin	5,895	101,485
191390020	Musser Park	IA	Muscatine	Oregon St. & Earl Ave.	1,316	17,502
191630015	Davenport - NCORE	IA	Davenport	10th St. & Vine St.	6,727	402,840
191770006	Lake Sugema	IA	N/A	24430 Lacey Trail	34,440	835,813
202090021	Kansas City - NCORE	KS	Kansas City	1210 N. 10th St., JFK Center	23,347	1,404,574
270370443	Flint Hills Refinery 443	MN	Rosemount	14035 Blaine Ave. E.	27,027	585,065
290950034	Troost	MO	Kansas City	724 Troost Ave.	37,801	1,417,672
310550019	Omaha - NCORE	NE	Omaha	42nd & Woolworth	14,020	770,633
310550053	Whitmore	NE	Omaha	1616 Whitmore	34,317	383,152
460990008	Sioux Falls - NCORE	SD	Sioux Falls	2001 E. 8th St.	76,124	619,821
461270001	Union County #1 Jensen	SD	N/A	31986 475th Ave.	54,791	420,517

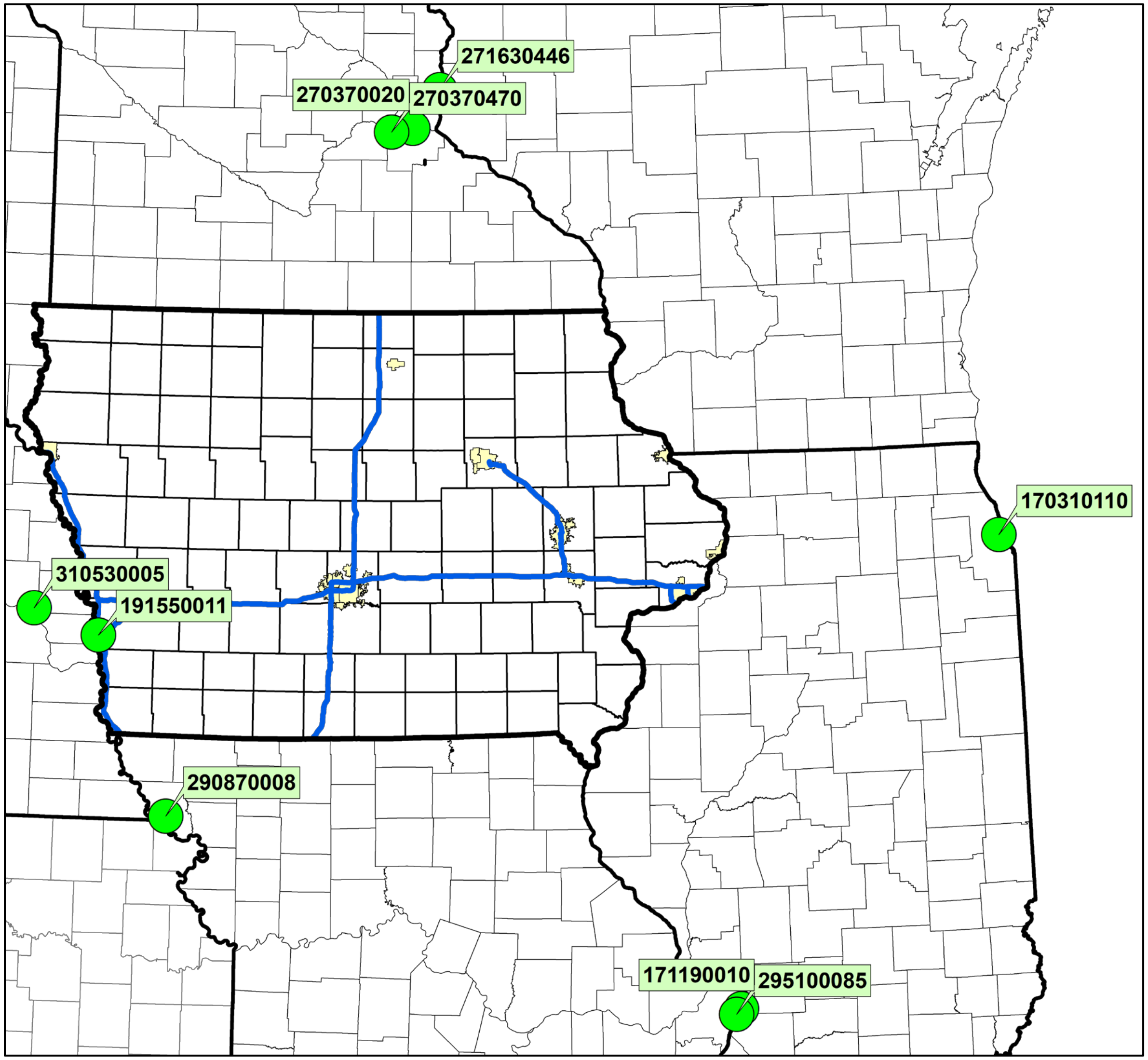
Legend for Area Served (km^2)

1,316 — 23,347 — 76,124

Legend for Population Served

17,502 — 420,517 — 1,417,672

SO_2 : Area and Population Served



Lead (Pb): Site Map

AQS Site ID	Local Site Name	State	City	Address	Area Served (km^2)	Population Served
170310110	Perez Elementary School	IL	Chicago	1241 19th St.	88,593	12,672,501
171190010	Air Products	IL	St. Louis	15th & Madison	96,555	3,169,915
191550011	Giffin Pipe	IA	Council Bluffs	8th Avenue and 27th St	47,311	1,406,484
270370020	Flint Hills Refinery 420	MN	Minneapolis	12821 Pine Bend Trail	40,804	1,003,963
270370470	Apple Valley	MN	Minneapolis	225 Garden View Drive	45,575	1,057,244
271630446	Point Road	MN	Minneapolis	22 Point Rd.	48,544	1,128,615
290870008	Forest City, Exide Levee	MO	Oregon	300 S. Washington St.	92,718	3,369,571
295100085	St. Louis - NCORE	MO	St. Louis	3247 Bair St.	21,184	1,756,300
310530005	Freemont (by Magnus Farley)	NE	Fremont	1255 Front St.	604,296	2,339,414

Legend for Area Served (km^2)

21,184 48,544 604,296

Legend for Population Served

1,003,963 1,756,300 12,672,501

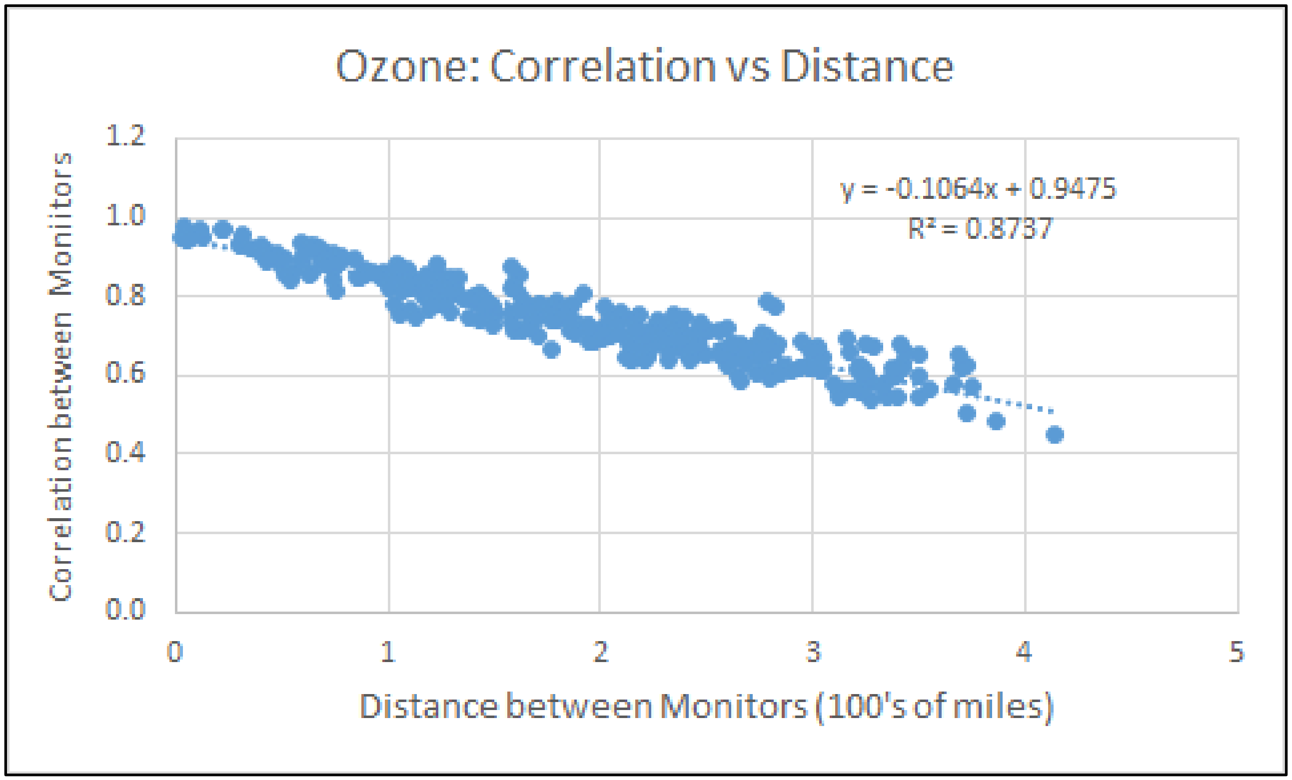
Pb: Area and Population Served

Section 3: Results from the NetAssess2020 Correlation Tool for Ozone

Results derived from the Netassess2020 correlation tool for ozone are compiled in this section.

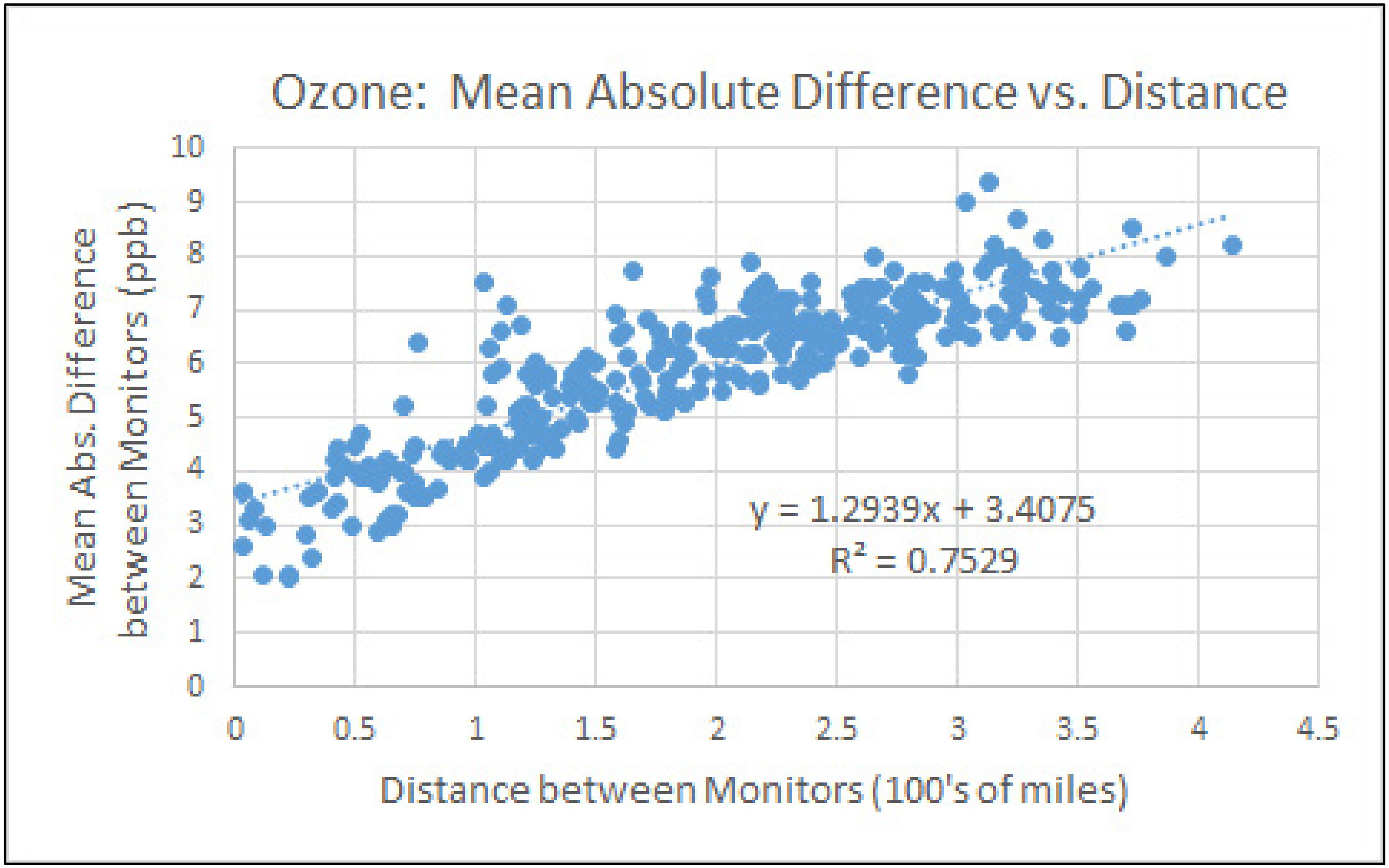
The Netassess2020 output for pairs of monitors in the network are symmetric matrices, but these are presented as lower triangular matrices for brevity. These matrices are generated for the 1-R and |d| metrics, as well as the pair counts and distance between monitoring sites.

Performing linear regression analysis on R and the distance between monitor pairs shows that the two parameters are correlated with an R^2=0.87. The correlation at zero separation is about 0.95 and decreases by about 10.6% for every 100 miles.

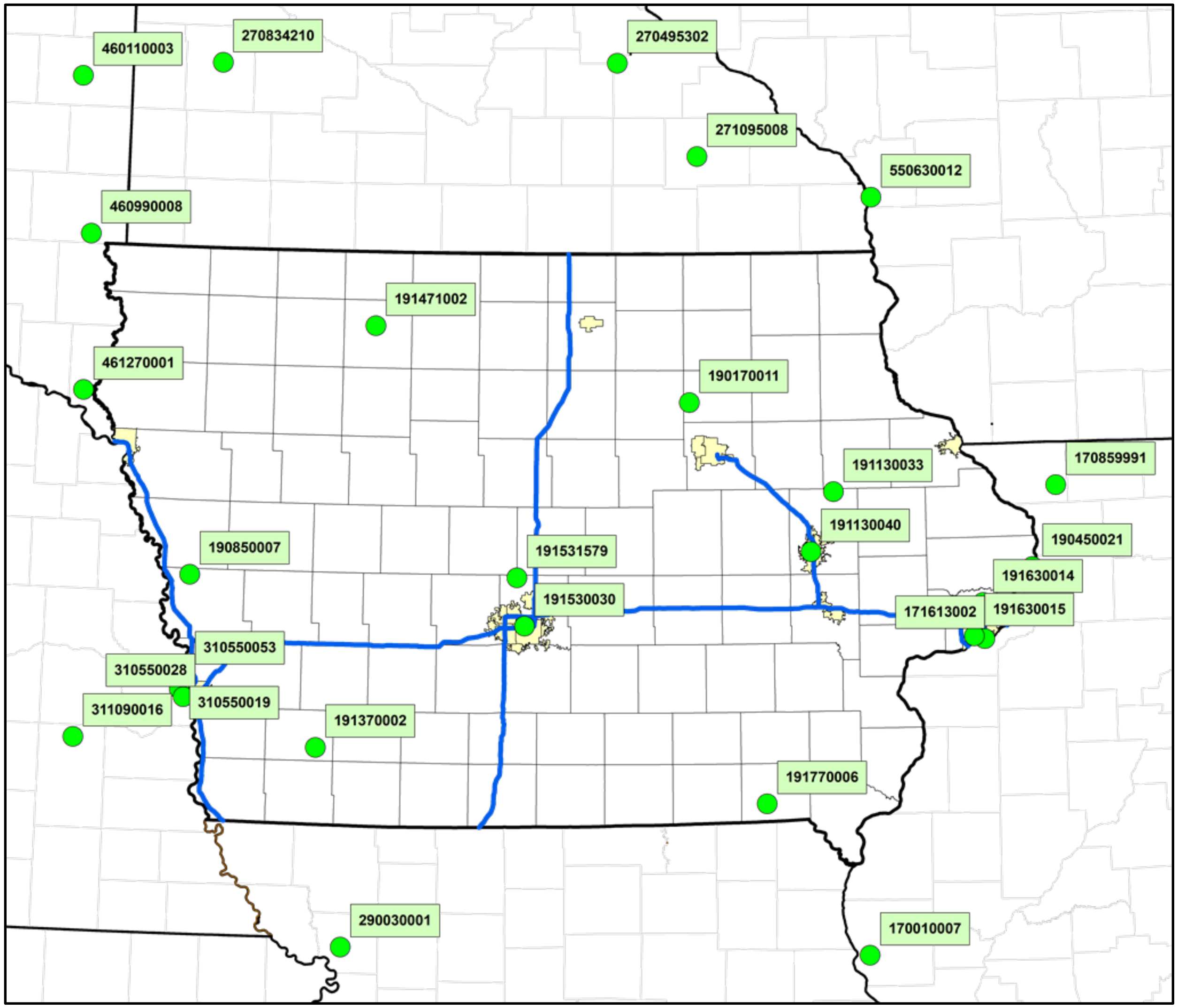


Ozone: Dependence of Correlation on the Distance between Sites

Performing linear regression analysis on |d| and the distance between monitor pairs shows that the two parameters are correlated with an R^2=0.75. The mean absolute difference at zero separation is 3.4 ppb and increases by about 1.29 ppb for every 100 miles.



Ozone: Dependence of Mean Absolute Difference on the Distance between Sites



Ozone: Site Map

AQS Site ID	Local Site Name	State	City	Address
170010007	John Wood Community College	IL	Quincy	1301 S. 48th St.
170859991	Stockton	IL	N/A	10952 E. Parker Rd.
171613002	Rock Island Arsenal	IL	Rock Island	32 Rodman Ave.
190170011	Waverly Airport	IA	Waverly	Waverly Airport
190450021	Rainbow Park	IA	Clinton	Roosevelt St.
190850007	Pisgah, Forestry Office	IA	N/A	206 Polk St
191130033	Coggon Elementary School	IA	Coggon	408 E. Linn St.
191130040	Public Health	IA	Cedar Rapids	500 11th St. NW
191370002	Viking Lake State Park	IA	N/A	2780 Viking Lake Rd.
191471002	Iowa Lakes Community College	IA	Emmetsburg	ILCC
191530030	Carpenter	IA	Des Moines	1907 Carpenter
191531579	Sheldahl, Southern Crossroads*	IA	Sheldahl	15795 NW 58th Street
191630014	Scott County Park	IA	Davenport	Scott County park
191630015	Davenport - NCORE	IA	Davenport	10th St. & Vine St.
191770006	Lake Sugema	IA	N/A	24430 Lacey Trail
270495302	Stanton Air Field	MN	Stanton	1235 Highway 19
270834210	SW Regional Airport	MN	Marshall	W Hwy 19
271095008	Ben Franklin School	MN	Rochester	1801 9th Ave. SE
290030001	Savannah	MO	Savanah	11796 Highway 71
310550019	Omaha - NCORE	NE	Omaha	42nd & Woolworth
310550028	South Omaha	NE	Omaha	2411 O St.
310550053	Whitmore	NE	Omaha	1616 Whitmore
311090016	Davey	NE	Davey	1st & Maple
460110003	Research Farm	SD	Brookings	3714 Western Ave
460990008	SD School for the Deaf	SD	Sioux Falls	2001 E 8th St.
461270001	Union County #1 Jensen	SD	N/A	31986 475th Ave.
550630012	DOT Building	WI	La Crosse	3550 Mormon Coulee Rd.

Ozone Site Information

*The Sheldahl Iowa site started on 1/1/2017, and therefore is not included in the following matrices and graphs.

1-R	170010007	170859991	171613002	190170011	190450021	190850007	191130033	191130040	191370002	191471002	191530030	191630014	191630015	191770006	270495302	270834210	271095008	290030001	310550019	310550028	310550053	311090016	460110003	460990008	461270001	550630012
170010007	0.00																									
170859991	0.33	0.00																								
171613002	0.20	0.11	0.00																							
190170011	0.30	0.18	0.19	0.00																						
190450021	0.24	0.07	0.07	0.15	0.00																					
190850007	0.35	0.39	0.32	0.23	0.31	0.00																				
191130033	0.28	0.11	0.13	0.06	0.09	0.26	0.00																			
191130040	0.26	0.14	0.11	0.08	0.10	0.25	0.03	0.00																		
191370002	0.26	0.34	0.27	0.22	0.28	0.11	0.23	0.22	0.00																	
191471002	0.40	0.35	0.33	0.16	0.29	0.13	0.22	0.22	0.22	0.00																
191530030	0.25	0.20	0.14	0.14	0.21	0.16	0.15	0.12	0.11	0.19	0.00															
191630014	0.24	0.09	0.05	0.14	0.03	0.30	0.07	0.07	0.26	0.28	0.19	0.00														
191630015	0.20	0.09	0.02	0.15	0.04	0.29	0.10	0.08	0.25	0.29	0.12	0.03	0.00													
191770006	0.14	0.24	0.14	0.19	0.18	0.25	0.16	0.13	0.17	0.30	0.13	0.16	0.14	0.00												
270495302	0.43	0.32	0.34	0.18	0.28	0.29	0.23	0.25	0.32	0.18	0.29	0.30	0.31	0.33	0.00											
270834210	0.52	0.47	0.46	0.28	0.41	0.25	0.34	0.35	0.33	0.16	0.33	0.41	0.43	0.44	0.25	0.00										
271095008	0.38	0.30	0.32	0.15	0.27	0.27	0.21	0.23	0.29	0.17	0.25	0.29	0.27	0.31	0.11	0.26	0.00									
290030001	0.25	0.37	0.29	0.29	0.31	0.21	0.28	0.26	0.12	0.32	0.19	0.29	0.27	0.18	0.39	0.46	0.39	0.00								
310550019	0.35	0.30	0.22	0.27	0.33	0.07	0.29	0.26	0.10	0.20	0.11	0.32	0.21	0.24	0.33	0.35	0.32	0.19	0.00							
310550028	0.34	0.43	0.33	0.30	0.34	0.08	0.32	0.29	0.12	0.22	0.17	0.33	0.31	0.27	0.37	0.35	0.32	0.22	0.05	0.00						
310550053	0.37	0.44	0.33	0.31	0.34	0.08	0.32	0.29	0.15	0.21	0.18	0.33	0.32	0.29	0.36	0.36	0.35	0.23	0.06	0.05	0.00					
311090016	0.39	0.44	0.38	0.33	0.38	0.09	0.34	0.32	0.15	0.23	0.20	0.37	0.34	0.32	0.36	0.36	0.33	0.23	0.09	0.09	0.10	0.00				
460110003	0.55	0.38	0.38	0.31	0.43	0.26	0.36	0.36	0.35	0.20	0.29	0.42	0.35	0.46	0.29	0.10	0.34	0.43	0.28	0.36	0.35	0.34	0.00			
460990008	0.50	0.35	0.34	0.31	0.40	0.21	0.36	0.34	0.32	0.18	0.25	0.40	0.32	0.42	0.32	0.19	0.33	0.40	0.23	0.28	0.27	0.26	0.14	0.00		
461270001	0.46	0.37	0.33	0.30	0.40	0.16	0.35	0.35	0.27	0.16	0.24	0.41	0.32	0.39	0.30	0.22	0.31	0.36	0.18	0.25	0.25	0.22	0.17	0.16	0.00	
550630012	0.41	0.20	0.29	0.15	0.20	0.32	0.15	0.18	0.32	0.25	0.27	0.21	0.24	0.31	0.18	0.36	0.14	0.40	0.37	0.38	0.38	0.38	0.41	0.40	0.40	0.00

Ozone: 1-R Metric

0.00 0.26 0.55

Mean Abs. Difference (ppb)	170010007	170859991	171613002	190170011	190450021	190850007	191130033	191130040	191370002	191471002	191530030	191630014	191630015	191770006	270495302	270834210	271095008	290030001	310550019	310550028	310550053	311090016	460110003	460990008	461270001	550630012
170010007	0.0																									
170859991	6.4	0.0																								
171613002	5.1	3.8	0.0																							
190170011	6.3	4.7	5.4	0.0																						
190450021	5.6	2.8	3.5	4.4	0.0																					
190850007	6.7	6.9	6.4	5.4	6.5	0.0																				
191130033	6.1	3.5	4.3	2.9	3.5	5.8	0.0																			
191130040	5.9	4.2	4.0	3.2	3.5	5.6	2.1	0.0																		
191370002	5.8	6.6	6.2	5.1	6.1	3.8	5.5	5.3	0.0																	
191471002	7.1	6.4	6.8	4.2	6.0	4.4	5.3	5.2	5.3	0.0																
191530030	5.8	5.5	4.9	4.2	5.3	4.6	4.4	3.9	3.7	4.9	0.0															
191630014	5.7	3.0	3.0	4.3	2.0	6.2	3.0	3.1	5.9	5.9	5.0	0.0														
191630015	5.1	3.9	2.6	4.5	2.4	6.2	3.6	3.2	5.7	6.2	4.4	2.1	0.0													
191770006	4.1	5.5	4.5	4.9	4.9	5.7	4.5	4.2	4.6	6.2	4.0	4.5	4.3	0.0												
270495302	7.8	6.7	7.5	4.7	6.4	6.6	5.7	5.9	6.6	4.7	6.3	6.6	6.6	6.9	0.0											
270834210	8.0	7.8	8.3	5.8	7.3	6.3	7.0	6.9	6.5	4.7	6.7	7.5	7.4	7.6	5.4	0.0										
271095008	7.5	6.8	7.6	4.4	6.2	6.7	5.8	5.8	6.4	5.0	6.0	6.6	6.5	6.9	3.4	5.4	0.0									
290030001	6.5	7.4	6.4	7.2	7.3	5.8	6.6	6.6	5.2	7.4	5.8	6.7	6.8	5.3	8.7	9.4	9.0	0.0								
310550019	7.0	6.9	6.1	6.3	7.0	3.3	6.5	6.2	3.9	5.5	4.2	6.8	5.8	5.7	7.4	7.5	7.4	5.8	0.0							
310550028	7.1	8.2	7.5	6.7	7.2	4.4	7.2	6.6	4.5	6.1	5.2	7.2	6.8	6.7	7.4	7.1	7.0	7.5	3.6	0.0						
310550053	7.3	7.9	7.1	6.6	7.0	3.6	6.8	6.4	4.7	5.6	5.2	6.8	6.8	6.6	7.4	7.3	7.3	6.6	3.1	3.3	0.0					
311090016	6.9	7.4	7.3	6.4	6.9	4.0	6.7	6.4	4.3	5.5	5.1	6.8	6.6	6.4	7.0	6.7	6.8	6.7	3.9	4.2	4.1	0.0				
460110003	8.2	6.6	7.1	6.0	7.2	5.7	6.6	6.5	6.6	4.8	6.3	7.1	7.1	7.2	6.1	4.0	6.7	8.0	6.7	7.4	7.1	6.6	0.0			
460990008	8.5	6.9	7.3	6.9	7.8	5.6	7.2	7.2	7.1	5.2	6.6	7.7	7.4	7.7	7.3	6.4	7.9	8.0	6.6	7.7	6.9	6.6	4.1	0.0		
461270001	7.7	6.5	6.6	6.2	7.3	4.5	6.6	6.6	6.0	4.5	6.1	7.2	7.1	7.0	6.8	6.0	7.2	7.2	5.9	7.1	6.3	5.8	4.2	3.9	0.0	
550630012	7.3	4.9	6.5	4.2	5.0	6.7	4.5	4.8	6.5	5.4	5.8	5.3	5.7	6.2	4.7	6.7	4.2	8.0	7.4	7.7	7.4	7.0	6.8	7.7	7.1	0.0

Ozone: Mean Absolute Difference Metric

0.0 6.2 9.4

Count	170010007	170859991	171613002	190170011	190450021	190850007	191130033	191130040	191370002	191471002	191530030	191630014	191630015	191770006	270495302	270834210	271095008	290030001	310550019	310550028	310550053	311090016	460110003	460990008	461270001	550630012
170010007																										
170859991	644																									
171613002	680	983																								
190170011	695	640	676																							
190450021	687	632	668	685																						
190850007	688	636	671	684	676																					
191130033	696	641	677	692	684	685																				
191130040	693	640	674	689	681	683	690																			
191370002	688	634	669	685	677	677	685	682																		
191471002	685	632	666	681	673	674	682	679	674																	
191530030	697	861	916	693	686	686	694	691	686	683																
191630014	698	643	679	694	687	687	695	692	687	684	696															
191630015	681	994	1037	677	670	670	678	675	670	668	918	680														
191770006	685	630	666	682	674	674	682	679	674	672	683	684	667													
270495302	672	630	666	668	661	661	669	666	661	659	683	671	668	658												
270834210	637	585	622	633	626	626	634	635	626	623	638	636	622	623	614											
271095008	678	636	672	674	666	667	675	672	667	666	689	677	676	664	665	626										
290030001	698	643	679	694	686	687	695	692	687	684	696	697	680	684	671	636	677									
310550019	678	979	1025	674	666	667	675	672	668	664	901	677	1035	664	664	619	670	677								
310550028	676	626	659	671	663	666	672	670	664	663	673	674	657	661	648	616	655	674	654							
310550053	664	610	645	660	652	654	661	658	653	650	662	663	648	651	638	609	646	663	646	641						
311090016	669	630	665	665	661	659	666	663	660	655	683	668	666	656	648	609	654	668	663	650	634					
460110003	671	967	1012	667	659	661	668	665	660	658	901	670	1028	657	656	626	666	670	1010	647	639	656				
460990008	694	997	1041	690	682	684	691	688	683	680	923	693	1056	681	680	636	687	693	1040	670	659	678	1031			
461270001	685	1000	1042	681	673	675	682	680	675	671	923	684	1057	671	671	626	677	684	1041	661	650	670	1032	1062		
550630012	660	625	666	656	650	649	657	658	649	646	682	660	668	646	640	609	646	659	665	637	625	631	657	681	674	

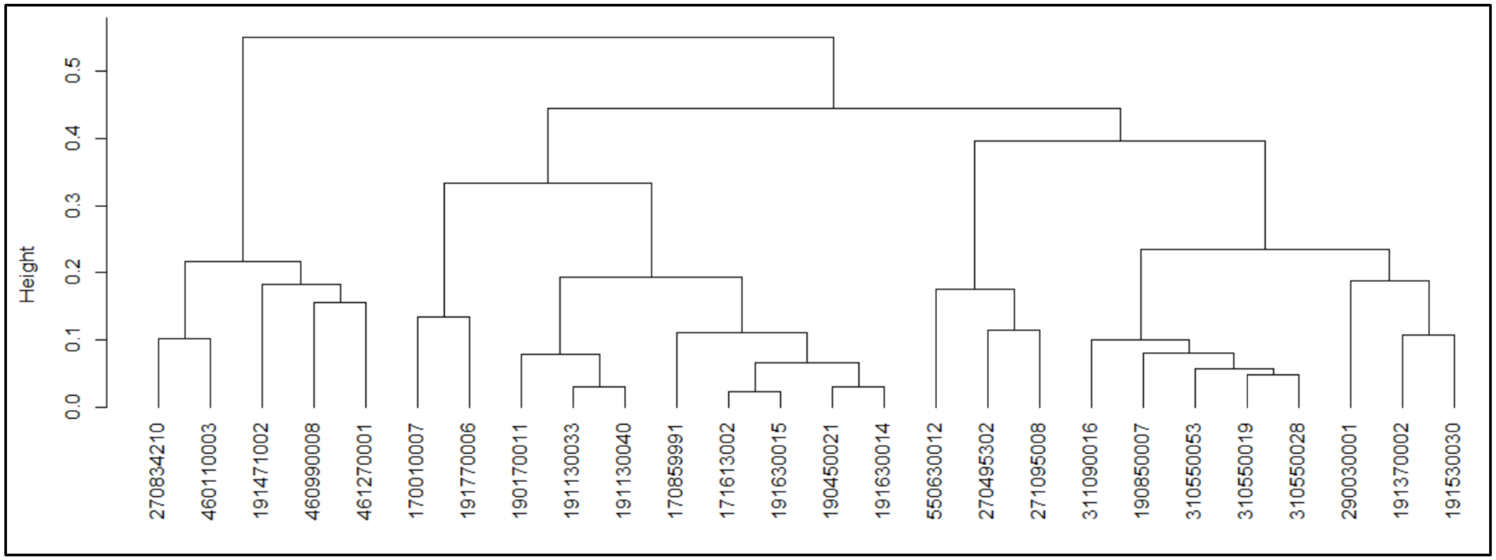
585 671 1062

Ozone: Pair Counts Matrix

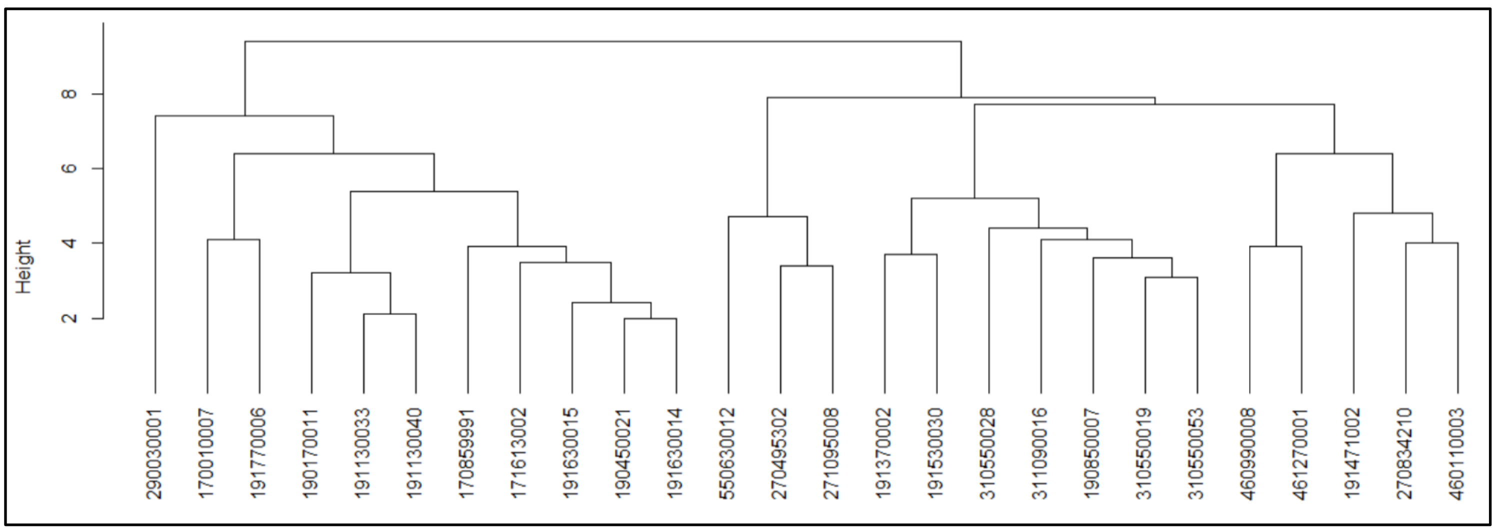
Distance (km)	170010007	170859991	171613002	190170011	190450021	190850007	191130033	191130040	191370002	191471002	191530030	191630014	191630015	191770006	270495302	270834210	271095008	290030001	310550019	310550028	310550053	311090016	460110003	460990008	461270001	550630012
170010007																										
170859991	285																									
171613002	190	96																								
190170011	328	212	213																							
190450021	237	48	49	215																						
190850007	440	491	450	298	475																					
191130033	262	125	119	96	120	366																				
191130040	230	143	110	109	125	351	36																			
191370002	334	443	382	287	417	120	326	301																		
191471002	451	394	386	182	395	175	275	277	240																	
191530030	269	310	260	157	289	191	190	167	136	189																
191630014	209	78	20	200	35	448	105	101	385	377	259															
191630015	189	97	6	208	51	444	114	104	377	380	254	19														
191770006	103	242	154	230	201	350	180	144	257	348	170	166	150													
270495302	523	344	385	196	368	376	271	297	422	202	322	368	381	426												
270834210	622	527	539	326	539	289	422	432	390	172	361	527	534	519	223											
271095008	461	275	317	139	299	371	204	232	397	205	282	299	313	367	69	273										
290030001	299	480	403	365	445	226	378	346	113	351	208	411	398	254	522	503	489									
310550019	417	508	455	330	486	65	385	365	83	233	198	456	449	338	431	354	419	171								
310550028	414	507	453	330	485	69	385	363	80	236	197	454	448	335	433	358	421	166	5							
310550053	417	503	452	323	482	56	380	360	84	224	193	452	446	336	422	346	411	177	9	13						
311090016	466	572	517	395	550	113	451	429	137	288	262	519	511	393	489	389	481	192	66	66	72					
460110003	666	596	600	389	604	288	485	491	401	218	398	589	594	564	302	79	350	512	350	355	342	373				
460990008	599	563	554	351	564	200	444	444	316	169	330	545	548	499	313	122	345	426	261	266	254	284	89			
461270001	546	551	528	342	545	120	427	421	240	169	282	522	522	451	354	201	371	346	177	182	170	195	177	88		
550630012	427	193	257	155	227	440	168	203	441	289	311	237	254	347	162	374	101	518	479	480	472	543	451	441	458	

5 334 666

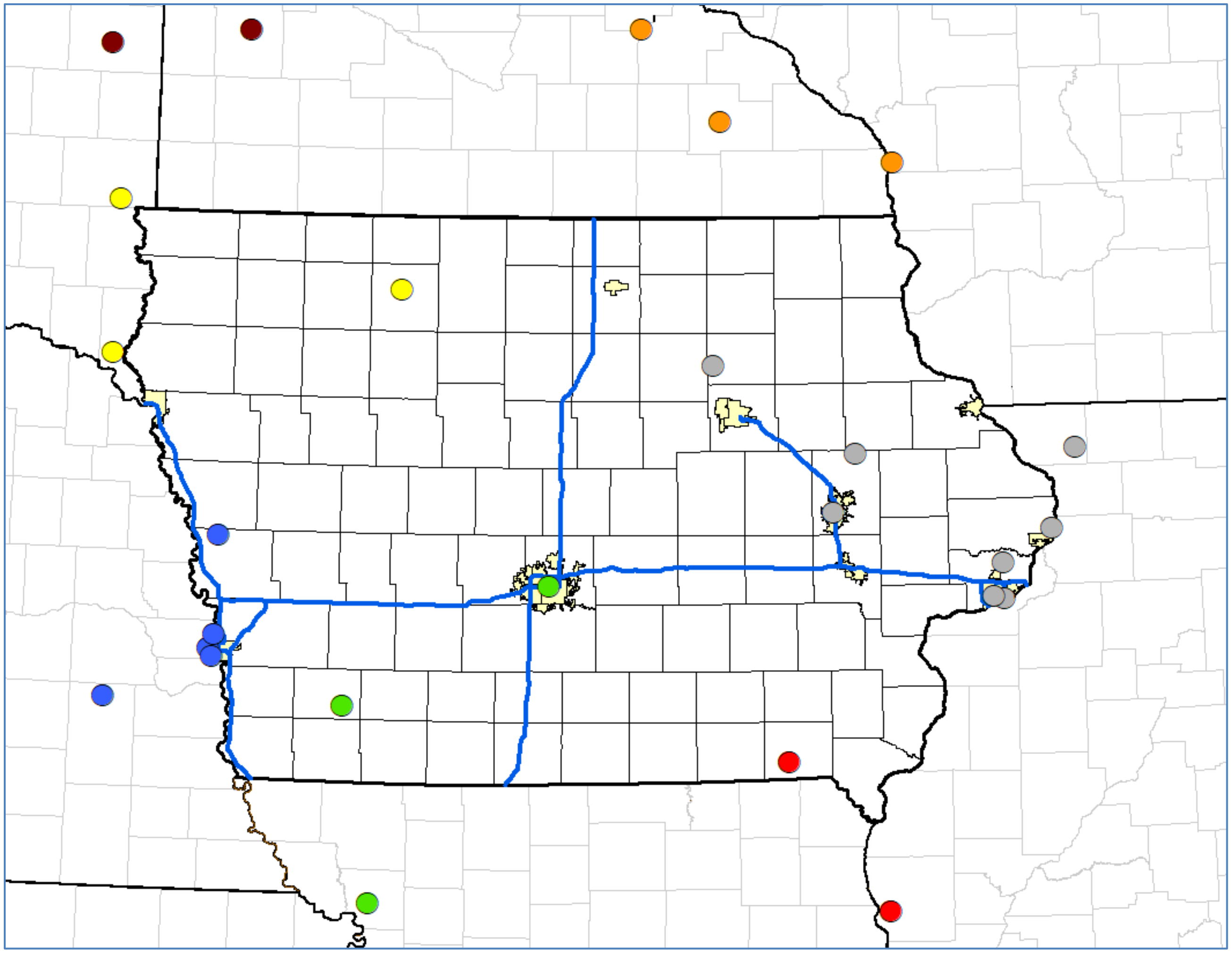
Ozone: Distance between Sites Matrix



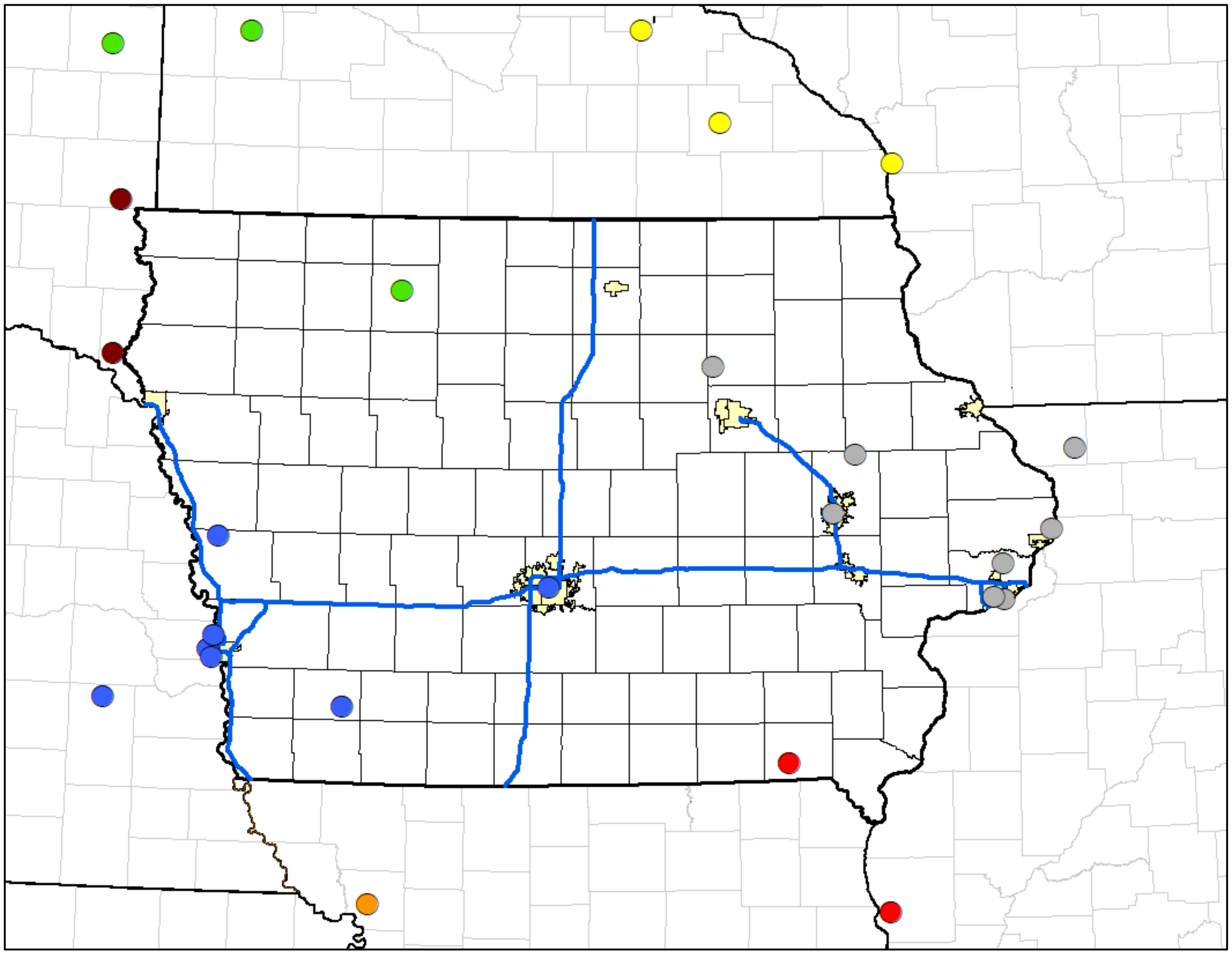
Ozone: 1-R Dendrogram



Ozone: Mean Absolute Difference Dendrogram



Ozone: 1-R Metric, Seven Clusters



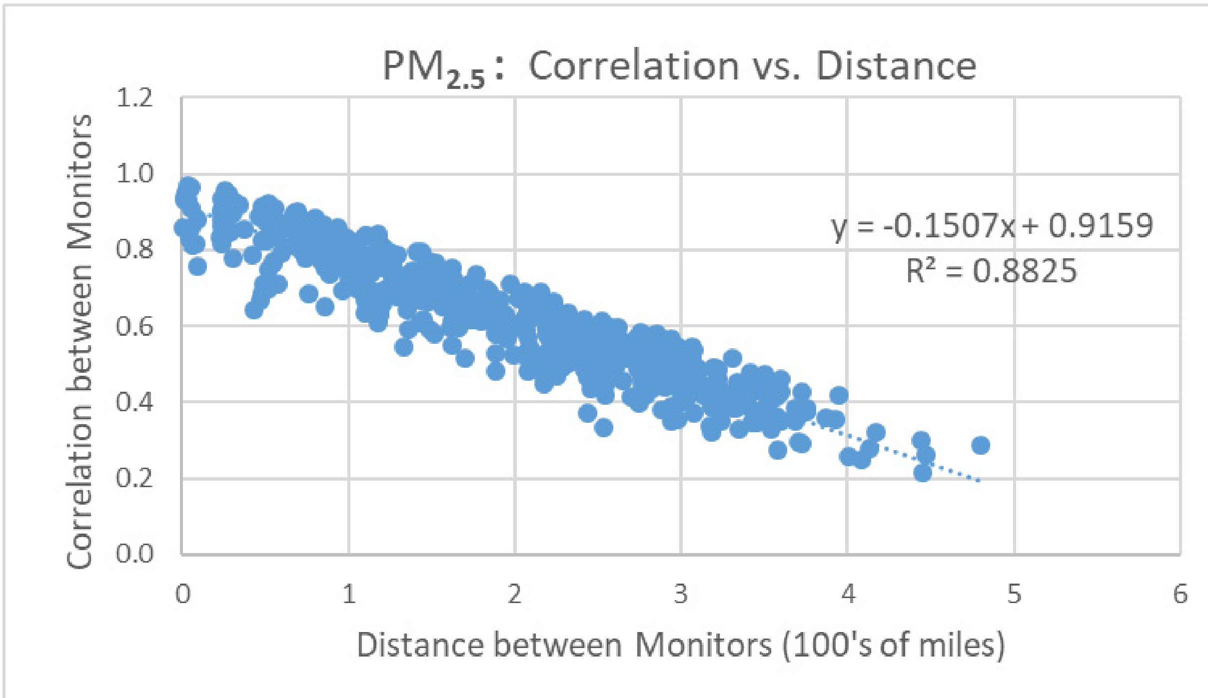
Ozone: Mean Absolute Difference Metric, Seven Clusters

Section 4: Results from the NetAssess2020 Correlation Tool for $PM_{2.5}$

Results derived from the NetAssess2020 correlation tool for $PM_{2.5}$ are compiled in this section.

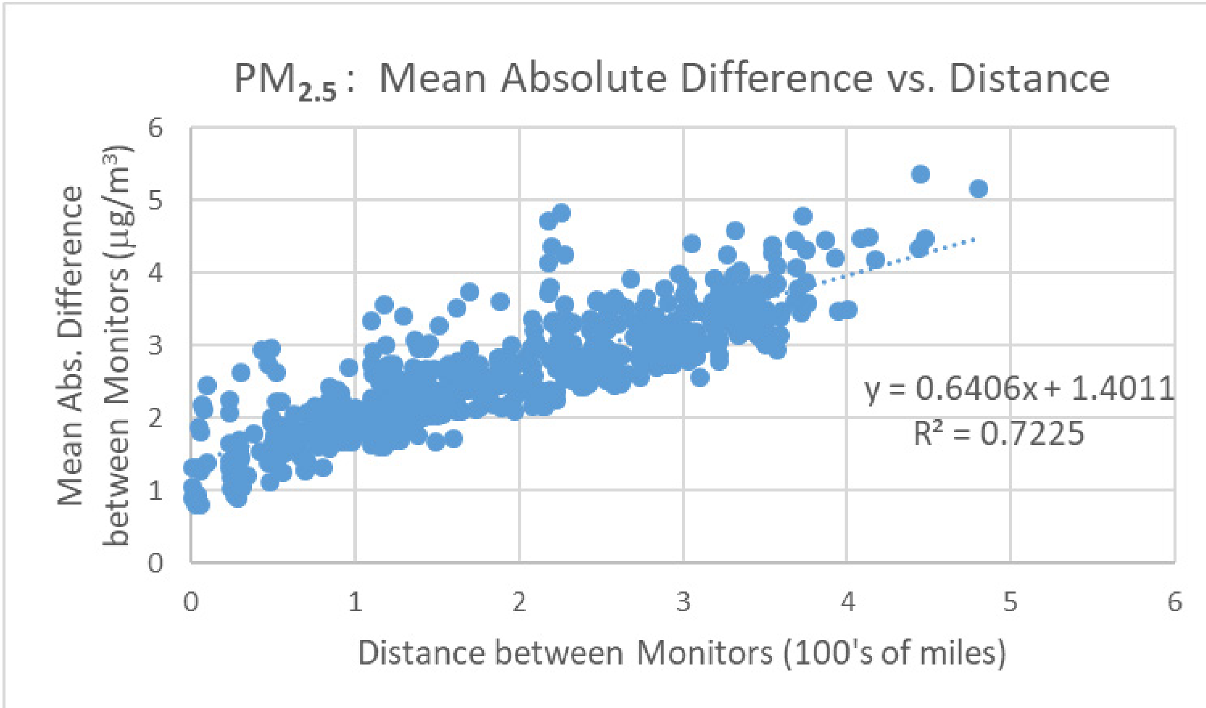
The NetAsess2020 correlation tool outputs include the correlation coefficient (R), mean absolute distance (|d|) and distance between monitor pairs.

Performing linear regression analysis on R and the distance between monitor pairs shows that the two parameters are correlated with an R^2 of about 0.88. The correlation at zero separation is about 0.92 and decreases by about 0.15 for every 100 miles.



$PM_{2.5}$: Dependence of Correlation between Monitors on the Distance between Monitors

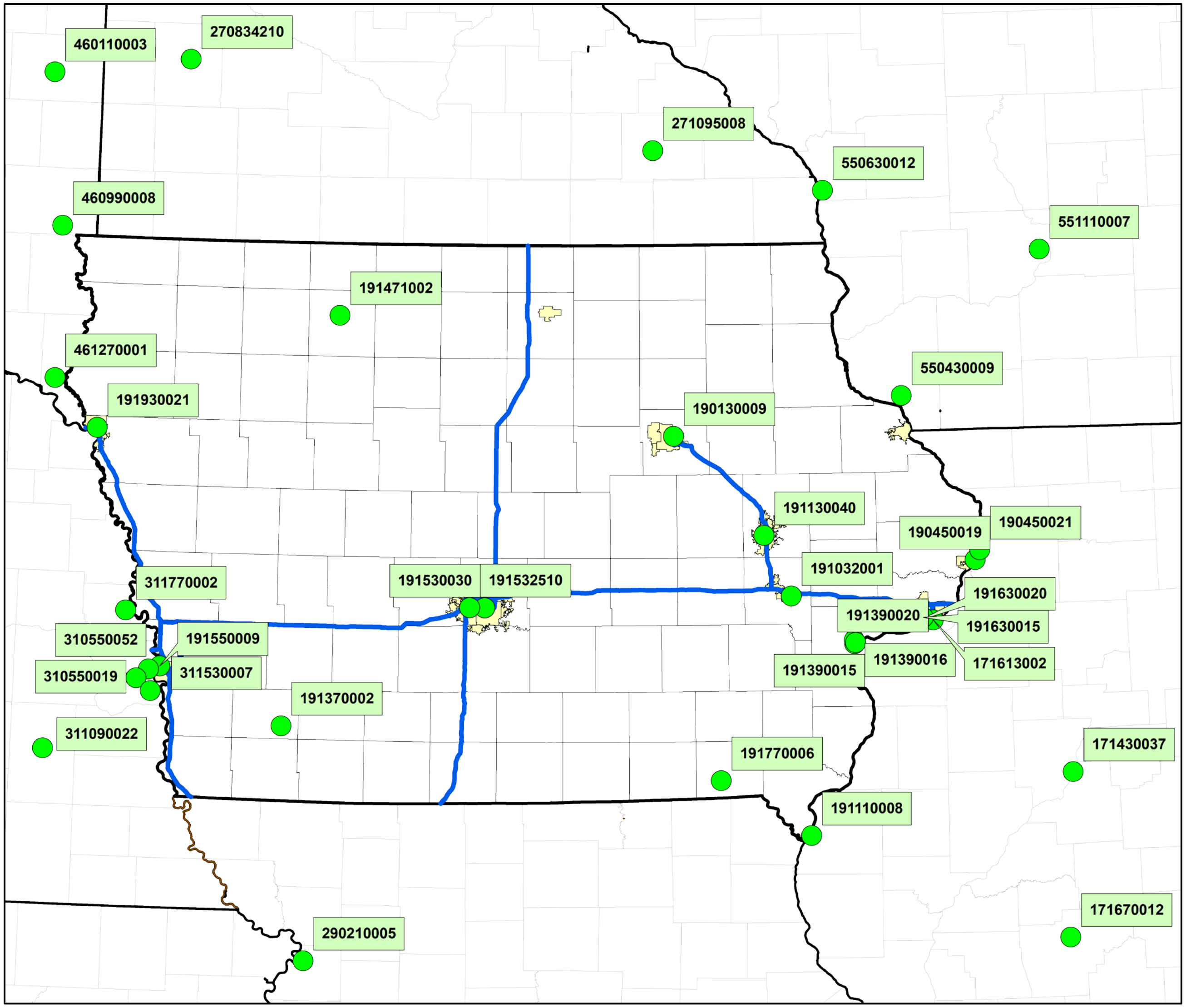
Performing linear regression analysis on |d| and the distance between monitor pairs shows that the two parameters are correlated with an R^2 of about 0.72. The mean absolute difference at zero separation is about 1.4 µg/m^3 and increases by about 0.64 µg/m^3 for every 100 miles.



$PM_{2.5}$: Dependence of Mean Absolute Difference on the Distance between Monitors

The Netassess2020 output for pairs of monitors in the network are symmetric matrices; these are presented as lower triangular matrices below for brevity. These matrices are generated for the 1-R and |d| metrics, as well as the distance and pair counts between monitoring sites.

A dendrogram and seven cluster solution is presented below for each metric.



PM$_{2.5}$ Site Map

AQS Site ID	Local Site Name	State	City	Address
171430037	City Office Building	IL	Peoria	613 N.E. Jefferson
171613002	Rock Island Arsenal	IL	Rock Island	32 Rodman Ave.
171670012	Agricultural Building	IL	Springfield	State Fair Grounds
190130009	Water Tower	IA	Waterloo	Vine St. & Steely
190450019	Chancy Park	IA	Clinton	23rd & Camanche
190450021	Rainbow Park	IA	Clinton	Roosevelt St.
191032001	Hoover School	IA	Iowa City	2200 E. Court
191110008	Fire Station	IA	Keokuk	111 S. 13th St.
191130040	Public Health	IA	Cedar Rapids	500 11th St. NW
191370002	Viking Lake State park	IA	N/A	2780 Viking Lake Road
191390015	Muscatine HS - East Campus Roof	IA	Muscatine	1409 Wisconsin
191390016	Greenwood Cemetery	IA	Muscatine	Fletcher St. & Kimble St.
191390020	Musser Park	IA	Muscatine	Oregon St. & Earl Ave.
191471002	Iowa Lakes College	IA	Emmetsburg	Iowa Lakes Community College
191530030	Health Dept.	IA	Des Moines	1907 Carpenter
191532510	Indian Hills Jr. High School	IA	Clive	9401 Indian Hills Dr.
191550009	Franklin School	IA	Council Bluffs	3130 C Ave.
191630015	Davenport - NCORE	IA	Davenport	10th St. & Vine St.
191630020	Hayes School	IA	Davenport	622 S. Concord St.
191770006	Lake Sugema	IA	N/A	24430 Lacey Trail
191930021	Irving Elementry School	IA	Sioux City	901 Floyd Blvd.
270834210	SW Regional Airport	MN	Marshall	W Hwy 19
271095008	Ben Franklin School	MN	Rochester	1801 9th Ave. SE
290210005	St. Joseph Pump Station	MO	St. Joseph	S. Hwy 759

$PM_{2.5}$ Site Information

AQS Site ID	Local Site Name	State	City	Address
310550019	Omaha - NCORE	NE	Omaha	42nd & Woolworth
310550052	Berry Street Omaha	NE	Omaha	9225 Berry
311090022	LLCHD Building	NE	Lincoln	3140 N ST Lincoln
311530007	Golden Hills Elementary	NE	Bellevue	2912 Coffey Ave.
311770002	Good Shepard Lutheran Home	NE	Blair	2242 Wright St.
460110003	Research Farm	SD	Brookings	3714 Western Ave.
460990008	SD School for the Deaf	SD	Sioux Falls	2001 E. 8th St.
461270001	Union County #1 Jensen	SD	N/A	31986 475th Ave.
550430009	Potosi	WI	Potosi	128 Hwy 61 N
550630012	DOT Building	WI	La Crosse	3550 Mormon Coulee Rd.
551110007	Devils Lake Park	WI	Baraboo	E12886 Tower Rd.

$PM_{2.5}$ Site Information (Continued)

1-R	171430037	171613002	171670012	190130009	190450019	190450021	191032001	191110008	191130040	191370002	191390015	191390016	191390020	191471002	191530030	191532510	191550009	191630015	191630020	191770006	191930021	270834210	271095008	290210005	310550019	310550052	311090022	311530007	311770002	460110003	460990008	461270001	550430009	550630012	551110007
171430037	0.00																																		
171613002	0.20	0.00																																	
171670012	0.21	0.25	0.00																																
190130009	0.35	0.23	0.43	0.00																															
190450019	0.23	0.10	0.31	0.17	0.00																														
190450021	0.25	0.10	0.33	0.16	0.03	0.00																													
191032001	0.22	0.12	0.30	0.12	0.11	0.10	0.00																												
191110008	0.23	0.23	0.28	0.30	0.21	0.23	0.21	0.00																											
191130040	0.30	0.16	0.33	0.10	0.15	0.14	0.09	0.27	0.00																										
191370002	0.44	0.44	0.49	0.33	0.44	0.45	0.34	0.38	0.37	0.00																									
191390015	0.24	0.15	0.30	0.22	0.17	0.16	0.10	0.19	0.18	0.43	0.00																								
191390016	0.22	0.10	0.28	0.17	0.08	0.09	0.05	0.17	0.13	0.36	0.07	0.00																							
191390020	0.23	0.15	0.29	0.22	0.09	0.12	0.11	0.20	0.17	0.38	0.14	0.06	0.00																						
191471002	0.52	0.47	0.56	0.26	0.43	0.44	0.33	0.46	0.34	0.23	0.42	0.39	0.43	0.00																					
191530030	0.37	0.30	0.39	0.19	0.35	0.33	0.24	0.39	0.21	0.13	0.30	0.27	0.31	0.19	0.00																				
191532510	0.36	0.35	0.42	0.17	0.30	0.31	0.21	0.34	0.23	0.12	0.30	0.26	0.29	0.17	0.04	0.00																			
191550009	0.49	0.47	0.52	0.33	0.45	0.45	0.40	0.45	0.38	0.17	0.49	0.43	0.45	0.33	0.22	0.23	0.00																		
191630015	0.19	0.07	0.26	0.16	0.07	0.07	0.08	0.18	0.13	0.40	0.12	0.04	0.09	0.42	0.28	0.29	0.44	0.00																	
191630020	0.20	0.09	0.25	0.16	0.09	0.08	0.11	0.18	0.14	0.40	0.14	0.06	0.10	0.41	0.30	0.29	0.44	0.05	0.00																
191770006	0.25	0.20	0.28	0.23	0.19	0.21	0.13	0.15	0.20	0.26	0.15	0.10	0.15	0.34	0.24	0.23	0.38	0.14	0.16	0.00															
191930021	0.57	0.53	0.58	0.35	0.51	0.51	0.44	0.52	0.41	0.27	0.50	0.47	0.51	0.25	0.28	0.28	0.19	0.48	0.49	0.45	0.00														
270834210	0.75	0.67	0.74	0.53	0.58	0.59	0.52	0.73	0.48	0.51	0.58	0.66	0.68	0.21	0.46	0.43	0.54	0.62	0.61	0.62	0.41	0.00													
271095008	0.48	0.39	0.58	0.19	0.37	0.36	0.31	0.45	0.29	0.43	0.41	0.39	0.41	0.27	0.34	0.27	0.43	0.39	0.37	0.37	0.42	0.37	0.00												
290210005	0.42	0.42	0.42	0.40	0.49	0.50	0.42	0.41	0.41	0.18	0.46	0.43	0.44	0.37	0.28	0.26	0.24	0.43	0.44	0.35	0.31	0.61	0.56	0.00											
310550019	0.60	0.56	0.65	0.41	0.58	0.57	0.50	0.57	0.51	0.25	0.54	0.51	0.56	0.38	0.30	0.31	0.17	0.55	0.56	0.47	0.26	0.51	0.51	0.37	0.00										
310550052	0.56	0.48	0.53	0.35	0.49	0.49	0.40	0.46	0.41	0.17	0.47	0.40	0.46	0.30	0.22	0.23	0.12	0.44	0.45	0.36	0.20	0.53	0.44	0.25	0.14	0.00									
311090022	0.71	0.65	0.62	0.55	0.65	0.64	0.60	0.58	0.59	0.35	0.65	0.54	0.61	0.52	0.41	0.40	0.30	0.62	0.61	0.51	0.35	0.67	0.63	0.34	0.33	0.21	0.00								
311530007	0.61	0.56	0.57	0.46	0.60	0.59	0.49	0.63	0.45	0.32	0.52	0.54	0.58	0.42	0.31	0.36	0.24	0.52	0.55	0.52	0.31	0.51	0.54	0.36	0.18	0.19	0.36	0.00							
311770002	0.55	0.47	0.54	0.33	0.46	0.46	0.39	0.48	0.39	0.16	0.47	0.40	0.46	0.28	0.21	0.21	0.12	0.44	0.44	0.37	0.13	0.48	0.43	0.26	0.17	0.09	0.29	0.22	0.00						
460110003	0.78	0.71	0.71	0.50	0.62	0.62	0.58	0.64	0.50	0.52	0.64	0.64	0.64	0.36	0.48	0.50	0.52	0.65	0.65	0.61	0.32	0.29	0.54	0.57	0.55	0.47	0.54	0.53	0.44	0.00					
460990008	0.72	0.65	0.70	0.40	0.56	0.56	0.55	0.55	0.53	0.42	0.61	0.56	0.54	0.28	0.48	0.40	0.39	0.61	0.61	0.51	0.22	0.32	0.49	0.56	0.45	0.33	0.47	0.48	0.33	0.23	0.00				
461270001	0.64	0.59	0.68	0.45	0.60	0.59	0.49	0.61	0.50	0.41	0.55	0.58	0.60	0.30	0.38	0.38	0.33	0.60	0.60	0.53	0.18	0.32	0.43	0.51	0.32	0.30	0.45	0.39	0.25	0.37	0.24	0.00			
550430009	0.32	0.17	0.39	0.16	0.14	0.13	0.15	0.29	0.19	0.39	0.24	0.16	0.20	0.39	0.38	0.29	0.43	0.19	0.21	0.23	0.48	0.51	0.25	0.51	0.62	0.46	0.61	0.56	0.43	0.59	0.57	0.56	0.00		
550630012	0.43	0.31	0.49	0.18	0.21	0.20	0.23	0.39	0.24	0.43	0.33	0.25	0.28	0.39	0.38	0.29	0.44	0.28	0.28	0.31	0.47	0.48	0.19	0.55	0.64	0.47	0.63	0.58	0.47	0.52	0.51	0.52	0.16	0.00	
551110007	0.42	0.31	0.50	0.24	0.26	0.26	0.28	0.44	0.33	0.51	0.35	0.29	0.30	0.51	0.44	0.38	0.53	0.30	0.31	0.34	0.57	0.58	0.33	0.62	0.67	0.57	0.74	0.64	0.56	0.65	0.60	0.59	0.18	0.17	0.00

$PM_{2.5}$: 1-R Metric

0.00 0.37 0.78

Mean Abs. Difference (ug/m3)	171430037	171613002	171670012	190130009	190450019	190450021	191032001	191110008	191130040	191370002	191390015	191390016	191390020	191471002	191530030	191532510	191550009	191630015	191630020	191770006	191930021	270834210	271095008	290210005	310550019	310550052	311090022	311530007	311770002	460110003	460990008	461270001	550430009	550630012	551110007
171430037	0.0																																		
171613002	2.0	0.0																																	
171670012	1.9	2.1	0.0																																
190130009	2.7	2.0	2.9	0.0																															
190450019	2.3	1.4	2.5	1.8	0.0																														
190450021	2.4	1.5	2.6	1.6	0.9	0.0																													
191032001	2.4	1.7	2.6	1.4	1.5	1.3	0.0																												
191110008	2.1	1.9	2.1	2.4	2.0	2.1	1.9	0.0																											
191130040	2.7	1.8	2.6	1.5	1.7	1.6	1.4	2.1	0.0																										
191370002	3.2	2.8	3.3	2.3	2.9	2.6	2.1	2.7	2.8	0.0																									
191390015	2.3	1.7	2.4	1.8	1.6	1.5	1.2	1.8	1.8	2.7	0.0																								
191390016	2.2	1.4	2.4	1.7	1.4	1.2	0.9	1.8	1.7	2.2	1.0	0.0																							
191390020	2.1	1.6	2.4	1.9	1.3	1.5	1.3	1.9	1.7	2.6	1.3	0.9	0.0																						
191471002	3.5	2.9	3.5	2.1	3.0	2.6	2.2	3.0	2.8	1.7	2.8	2.4	2.8	0.0																					
191530030	2.8	2.3	2.8	1.7	2.4	2.2	1.8	2.4	2.1	1.6	2.2	1.9	2.1	1.8	0.0																				
191532510	2.8	2.4	2.9	1.7	2.4	2.2	1.7	2.4	2.2	1.3	2.2	1.8	2.1	1.6	0.8	0.0																			
191550009	3.2	3.0	3.2	2.5	3.0	2.9	2.6	2.7	2.7	2.0	2.9	2.8	2.9	2.6	1.9	2.1	0.0																		
191630015	2.2	1.3	2.3	1.7	1.2	1.0	1.1	1.8	1.6	2.6	1.2	0.9	1.2	2.7	2.1	2.1	2.8	0.0																	
191630020	2.1	1.3	2.3	1.7	1.2	1.2	1.4	1.8	1.6	2.8	1.3	1.2	1.3	2.8	2.3	2.4	2.8	0.8	0.0																
191770006	2.4	2.0	2.5	2.0	2.2	1.9	1.4	1.8	2.3	1.7	1.8	1.3	1.8	2.2	1.8	1.6	2.7	1.7	2.0	0.0															
191930021	3.5	3.1	3.5	2.5	3.3	3.1	2.7	3.0	2.8	2.1	3.0	2.8	3.1	2.0	2.1	2.1	1.8	3.0	3.1	2.7	0.0														
270834210	4.5	4.0	4.5	3.3	4.0	3.6	3.3	4.1	3.9	2.6	3.9	3.4	3.9	2.1	3.2	2.9	3.8	3.7	4.0	3.1	3.1	0.0													
271095008	3.1	2.7	3.3	1.9	2.8	2.5	2.4	2.9	2.6	2.6	2.9	2.6	2.8	2.2	2.5	2.2	2.8	2.7	2.8	2.5	2.7	2.9	0.0												
290210005	3.0	2.7	2.7	2.8	3.1	3.1	2.8	2.6	2.8	2.4	2.9	3.0	2.9	3.0	2.3	2.5	2.1	2.8	2.9	2.8	2.4	4.3	3.3	0.0											
310550019	3.6	3.4	3.7	3.0	3.5	3.5	3.3	3.1	3.4	2.6	3.4	3.2	3.4	3.0	2.6	2.7	1.9	3.4	3.5	3.1	2.4	4.4	3.3	2.7	0.0										
310550052	3.2	2.9	3.2	2.4	3.1	2.9	2.4	2.7	2.8	1.5	2.8	2.4	2.8	2.0	1.7	1.7	1.4	2.7	2.9	2.2	1.7	3.1	2.6	2.3	1.8	0.0									
311090022	3.8	3.3	3.6	3.0	3.5	3.3	3.0	3.2	3.3	2.0	3.3	2.9	3.3	2.6	2.4	2.4	2.2	3.3	3.4	2.6	2.2	3.2	3.2	2.7	2.7	1.5	0.0								
311530007	3.5	3.4	3.3	3.2	3.7	3.7	3.3	3.4	3.1	3.0	3.4	3.4	3.6	3.3	2.8	3.0	2.4	3.4	3.5	3.4	2.7	4.3	3.5	2.6	2.1	2.2	3.0	0.0							
311770002	3.4	2.9	3.4	2.4	3.0	2.8	2.4	2.9	2.8	1.4	2.8	2.5	2.9	1.9	1.8	1.7	1.7	2.8	3.0	2.3	1.5	2.8	2.7	2.5	2.3	1.0	1.8	2.6	0.0						
460110003	5.4	4.8	5.2	3.6	4.3	3.9	3.7	4.5	4.4	2.9	4.4	3.8	4.3	2.7	3.6	3.3	4.1	4.1	4.4	3.3	3.4	2.0	3.7	4.6	4.7	3.3	3.2	4.8	3.0	0.0					
460990008	4.5	3.9	4.3	2.5	3.3	3.0	3.0	3.1	3.5	2.3	3.6	2.9	3.1	1.8	2.9	2.4	2.6	3.4	3.7	2.6	1.8	2.2	2.9	3.7	3.5	2.1	2.5	3.8	2.0	2.2	0.0				
461270001	4.2	3.8	4.2	2.9	3.8	3.5	3.1	3.6	3.6	2.3	3.6	3.2	3.6	2.0	2.7	2.6	2.9	3.5	3.7	2.8	2.1	2.2	2.9	3.6	3.3	2.2	2.5	3.6	2.0	2.7	1.9	0.0			
550430009	2.7	1.9	2.8	1.7	1.8	1.6	1.6	2.4	2.1	2.5	2.1	1.7	2.0	2.5	2.4	2.1	2.9	1.9	2.0	2.0	3.0	3.1	2.1	3.2	3.8	2.7	3.1	3.6	2.7	3.8	3.2	3.1	0.0		
550630012	3.4	2.7	3.4	1.9	2.3	2.0	2.0	2.8	2.5	2.6	2.6	2.1	2.4	2.3	2.5	2.1	3.0	2.3	2.5	2.3	2.9	2.8	2.1	3.5	4.0	2.8	3.2	3.8	2.8	3.3	2.9	3.0	1.7	0.0	
551110007	3.6	3.0	3.6	2.3	2.5	2.3	2.2	3.0	3.0	2.8	2.7	2.3	2.6	2.6	2.7	2.5	3.5	2.4	2.7	2.4	3.3	3.0	2.7	3.6	3.9	3.2	3.5	3.9	3.2	3.5	3.0	2.9	2.0	1.9	0.0

$PM_{2.5}$: Mean Absolute Difference Metric

0.0 2.6 5.4

Count	171430037	171613002	171670012	190130009	190450019	190450021	191032001	191110008	191130040	191370002	191390015	191390016	191390020	191471002	191530030	191532510	191550009	191630015	191630020	191770006	191930021	270834210	271095008	290210005	310550019	310550052	311090022	311530007	311770002	460110003	460990008	461270001	550430009	550630012	551110007
171430037																																			
171613002	459																																		
171670012	513	540																																	
190130009	242	304	326																																
190450019	247	322	341	353																															
190450021	242	316	337	349	692																														
191032001	526	573	625	357	704	687																													
191110008	233	294	313	319	334	330	341																												
191130040	530	576	633	362	710	693	1061	343																											
191370002	237	300	322	331	347	345	353	314	358																										
191390015	529	574	628	359	702	685	1053	340	1063	354																									
191390016	243	307	328	339	353	347	357	322	362	333	359																								
191390020	245	309	329	340	355	349	358	323	363	335	360	344																							
191471002	234	292	308	322	344	341	346	305	351	316	348	323	326																						
191530030	533	577	629	354	687	670	1042	336	1051	351	1044	354	356	347																					
191532510	233	288	311	324	333	327	332	307	337	320	334	328	330	308	331																				
191550009	241	308	327	336	357	352	363	319	366	334	362	340	343	321	359	325																			
191630015	528	571	625	361	699	687	1048	342	1052	357	1044	361	362	349	1034	336	366																		
191630020	517	562	610	344	671	655	1018	327	1026	341	1021	343	348	335	1014	321	349	1012																	
191770006	239	299	321	334	350	345	350	323	356	327	353	337	337	315	349	321	333	355	338																
191930021	245	309	331	338	351	346	357	324	362	334	358	342	345	323	352	328	340	361	344	336															
270834210	510	552	608	346	685	669	1024	327	1031	342	1023	345	345	335	1016	320	350	1016	992	339	345														
271095008	528	577	629	363	708	691	1041	345	1049	358	1041	361	363	350	1031	337	366	1033	1007	355	362	1017													
290210005	531	577	631	361	714	696	1067	343	1074	357	1066	361	362	350	1055	336	366	1058	1033	354	361	1038	1055												
310550019	501	547	601	360	711	692	1024	342	1031	357	1023	361	362	350	1012	336	365	1017	990	355	360	996	1012	1039											
310550052	240	303	322	338	347	342	346	319	351	332	347	339	341	321	344	323	337	350	335	334	339	334	352	350	350										
311090022	241	308	325	338	351	345	351	322	356	332	353	342	343	321	349	326	339	354	340	334	342	339	357	355	355	340									
311530007	510	553	610	347	691	673	1025	328	1033	345	1025	347	348	337	1016	323	352	1017	995	341	347	998	1018	1039	1009	336	341								
311770002	238	304	325	338	348	345	348	320	353	332	350	340	342	321	346	324	338	353	336	335	341	338	354	352	352	339	341	339							
460110003	529	574	628	358	706	688	1059	340	1066	354	1058	358	359	348	1047	333	363	1050	1025	351	358	1029	1047	1074	1029	347	352	1031	349						
460990008	534	579	635	363	712	694	1065	345	1073	359	1065	363	364	352	1054	338	368	1057	1031	357	363	1036	1054	1079	1036	352	357	1038	354	1071					
461270001	523	562	616	352	693	674	1039	332	1048	344	1040	350	351	339	1028	328	354	1032	1007	345	350	1013	1029	1053	1012	340	344	1012	342	1045	1053				
550430009	503	536	583	325	441	429	787	306	795	318	789	327	327	313	790	305	330	784	771	320	329	768	772	794	754	317	322	759	320	790	795	783			
550630012	518	553	612	349	476	464	827	334	835	344	829	353	353	332	829	331	355	822	808	343	353	806	812	835	794	343	347	797	344	831	834	819	789		
551110007	515	502	556	289	404	393	748	277	756	285	751	292	292	283	757	273	293	744	734	285	291	726	735	756	715	284	288	721	286	753	756	749	717	742	

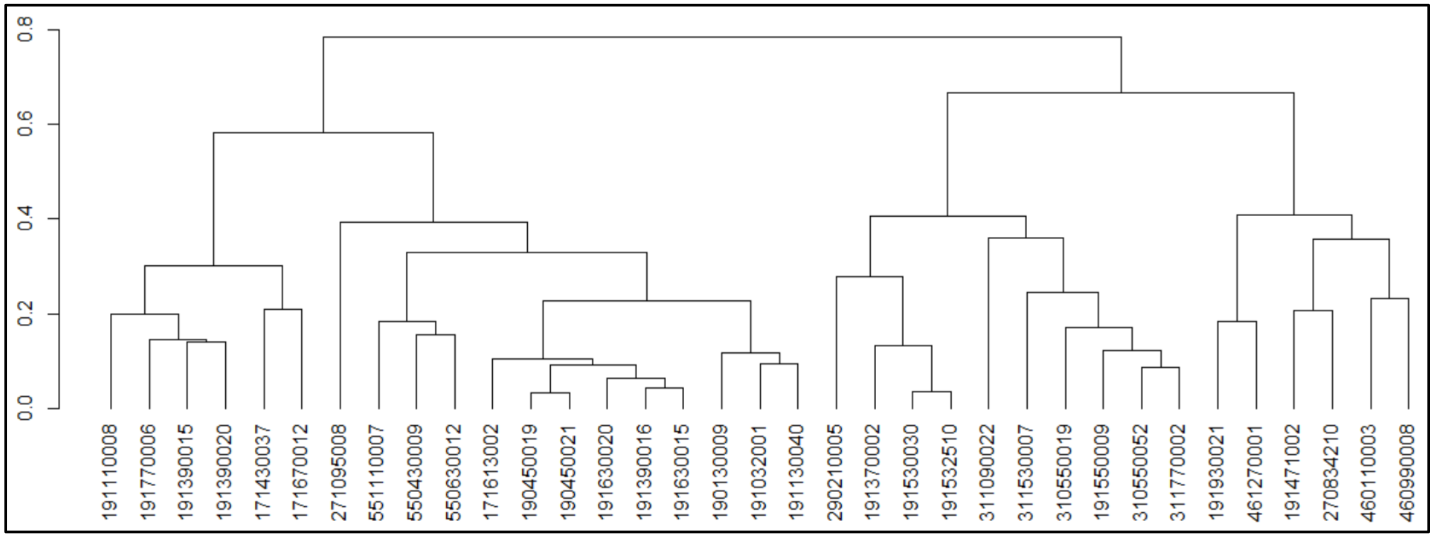
PM$_{2.5}$: Pair Counts Matrix

233	354	1079

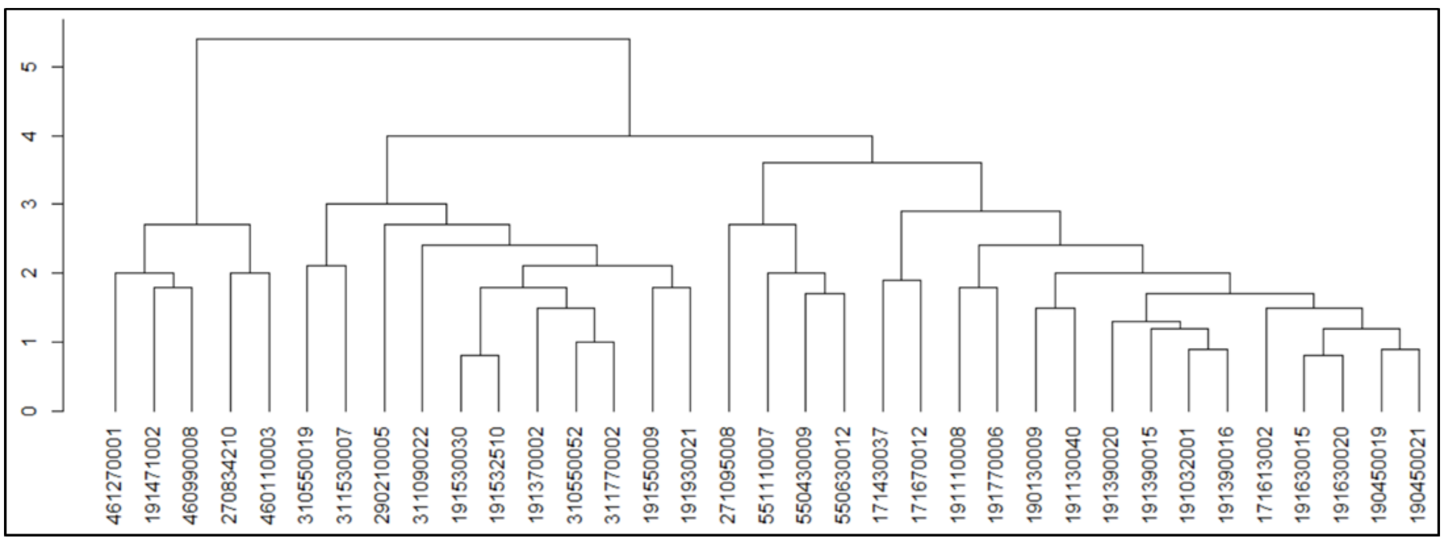
Distance (km)	171430037	171613002	171670012	190130009	190450019	190450021	191032001	191110008	191130040	191370002	191390015	191390016	191390020	191471002	191530030	191532510	191550009	191630015	191630020	191770006	191930021	270834210	271095008	290210005	310550019	310550052	311090022	311530007	311770002	460110003	460990008	461270001	550430009	550630012	551110007
171430037																																			
171613002	119																																		
171670012	96	200																																	
190130009	302	184	370																																
190450019	135	42	225	189																															
190450021	139	49	230	189	6																														
191032001	192	83	255	115	109	112																													
191110008	156	143	161	245	186	192	139																												
191130040	225	110	292	78	123	125	38	176																											
191370002	459	382	473	282	413	417	305	314	301																										
191390015	146	47	211	159	85	91	46	114	82	335																									
191390016	148	47	213	158	84	90	45	116	80	335	2																								
191390020	146	47	211	159	84	90	46	115	82	336	1	2																							
191471002	500	386	555	206	394	395	308	407	277	240	354	352	354																						
191530030	353	260	389	148	285	289	178	231	167	136	215	215	216	189																					
191532510	362	268	397	154	294	297	186	238	175	129	224	223	224	185	9																				
191550009	532	449	550	326	476	480	368	390	358	78	403	402	403	228	191	183																			
191630015	125	6	204	179	45	51	77	142	104	377	42	42	42	380	254	263	443																		
191630020	125	9	203	177	48	55	75	139	102	374	39	39	38	379	251	260	440	4																	
191770006	204	154	221	201	195	201	114	61	144	257	111	112	112	348	170	177	332	150	147																
191930021	599	497	636	334	514	516	414	476	391	203	456	455	457	155	248	240	143	491	488	415															
270834210	657	539	720	355	539	539	467	576	432	390	513	511	513	172	361	357	352	534	533	519	220														
271095008	434	317	516	166	302	299	270	407	232	397	309	307	308	205	282	285	413	313	313	367	360	273													
290210005	459	415	444	372	453	458	353	303	363	136	368	369	369	374	230	226	190	410	407	263	331	526	511												
310550019	538	455	556	333	483	486	374	396	365	83	409	409	410	233	198	189	7	449	446	338	143	354	419	191											
310550052	545	463	561	341	491	494	382	401	373	88	416	416	417	241	206	197	15	457	454	344	147	360	428	190	9										
311090022	596	521	605	407	551	554	442	448	435	138	474	474	474	304	268	260	83	515	512	393	188	408	495	194	76	68									
311530007	536	455	551	337	484	487	375	392	367	78	409	409	409	244	199	191	15	449	446	335	155	367	427	179	13	11	70								
311770002	556	468	579	333	493	496	385	418	372	112	422	422	423	211	208	199	38	462	459	359	107	321	405	227	37	40	93	49							
460110003	716	600	773	416	604	604	524	623	491	401	570	569	570	218	398	393	350	594	593	564	208	79	350	534	350	354	392	363	314						
460990008	665	554	715	375	563	564	474	560	444	316	519	518	519	169	330	324	261	548	546	499	119	122	345	448	261	265	303	274	226	89					
461270001	632	528	671	360	543	545	445	512	421	240	488	487	488	169	282	275	178	522	519	451	38	201	371	367	177	180	214	189	141	177	88				
550430009	239	131	328	134	104	100	132	260	114	407	146	144	145	329	271	279	457	129	131	246	466	456	202	476	464	472	537	467	466	526	496	490			
550630012	367	257	456	167	232	227	236	374	203	441	263	261	263	289	311	317	473	254	256	347	442	374	101	538	479	488	555	486	471	451	441	458	127		
551110007	303	223	398	238	184	177	247	364	230	519	252	251	251	407	383	390	564	224	226	359	556	504	231	593	570	579	645	575	569	580	567	575	117	130	

$PM_{2.5}$: Distance Between Sites Matrix

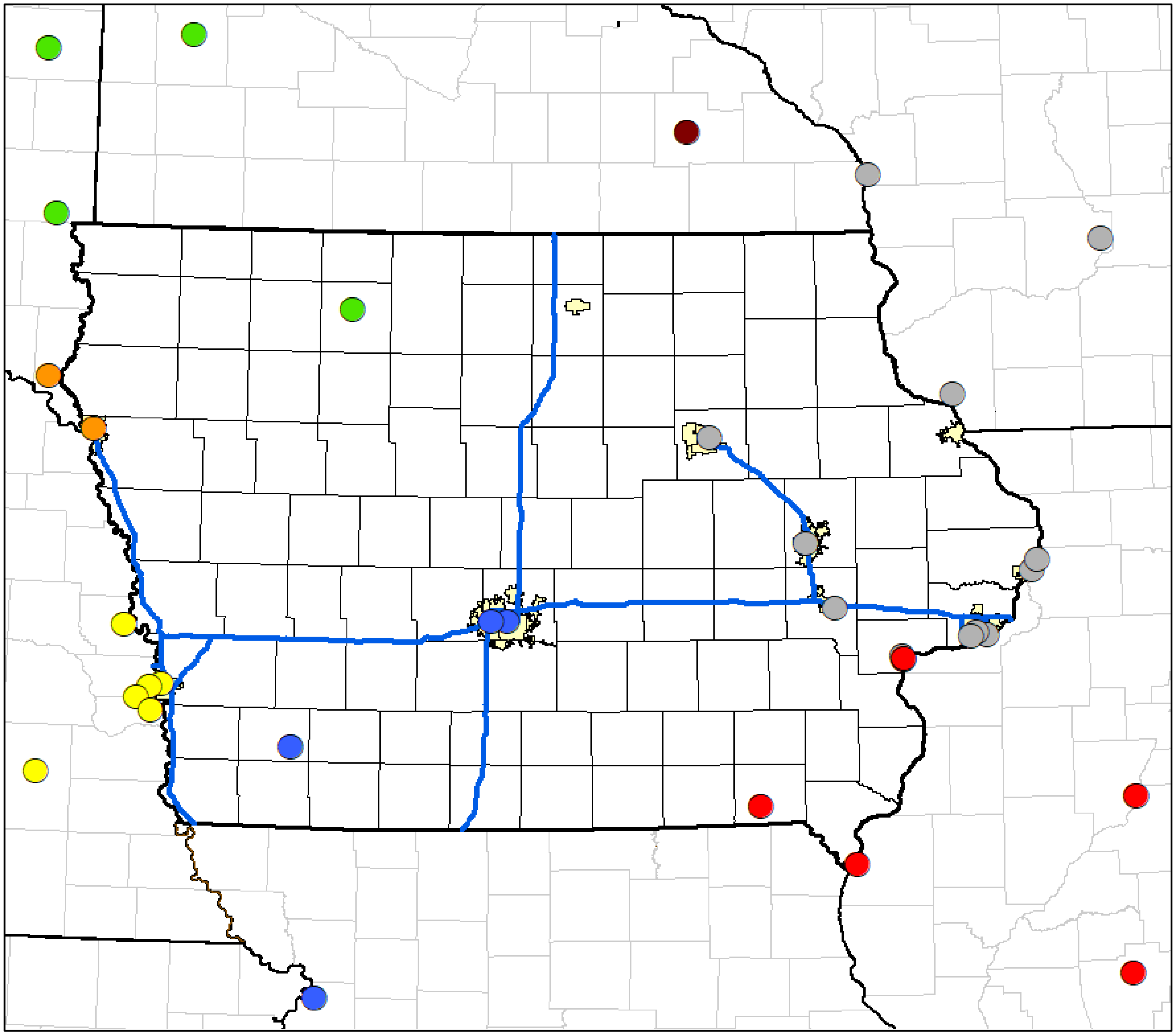
1 317 773



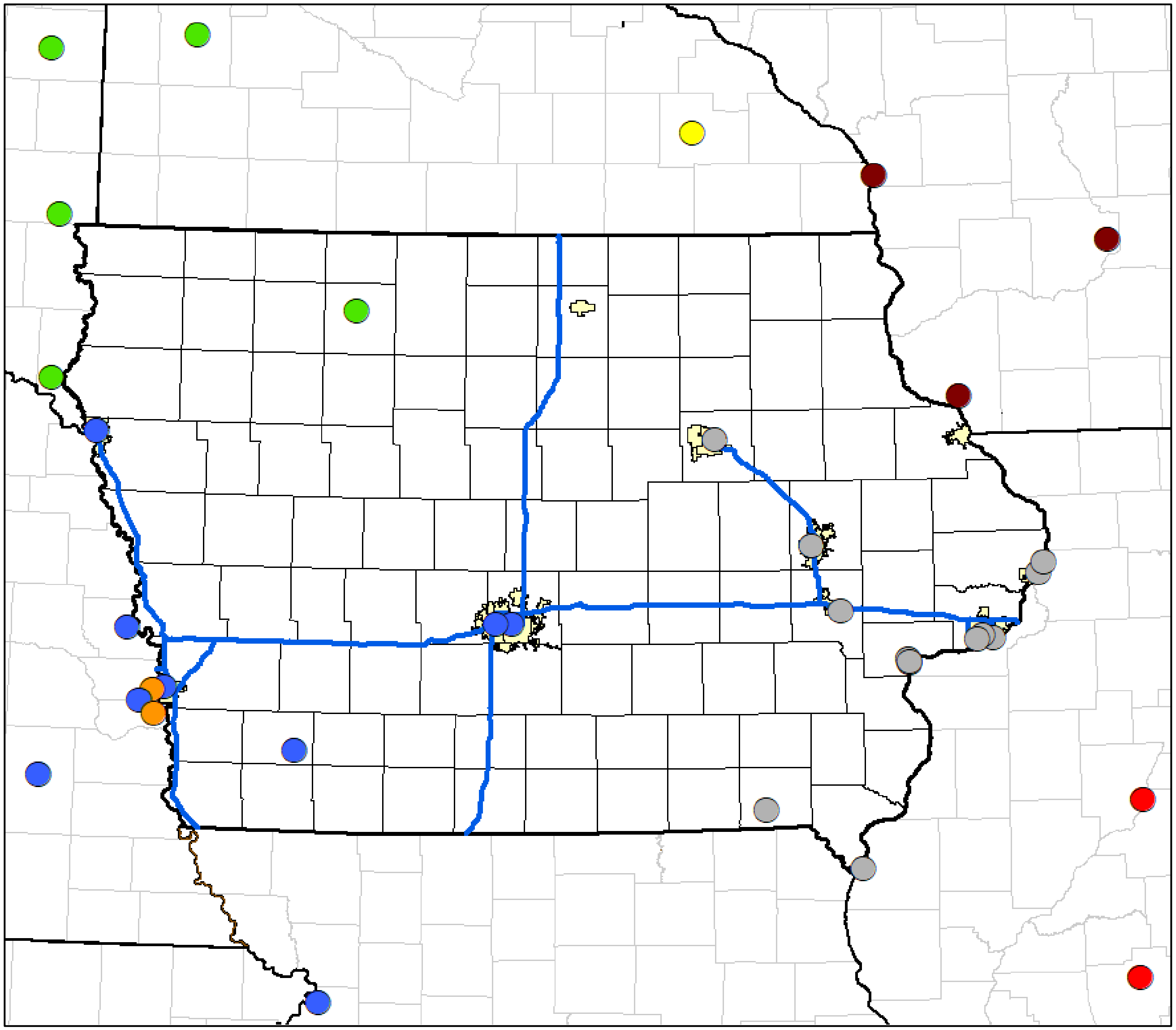
PM$_{2.5}$: 1-R Dendrogram



PM$_{2.5}$: Mean Absolute Difference Dendrogram (μg/m^3)



PM$_{2.5}$: 1-R, Seven Clusters



$PM_{2.5}$: Mean Absolute Difference, Seven Clusters

Appendix G: Current Ambient Air Monitoring Network

Table of Contents

Section 1: Summary

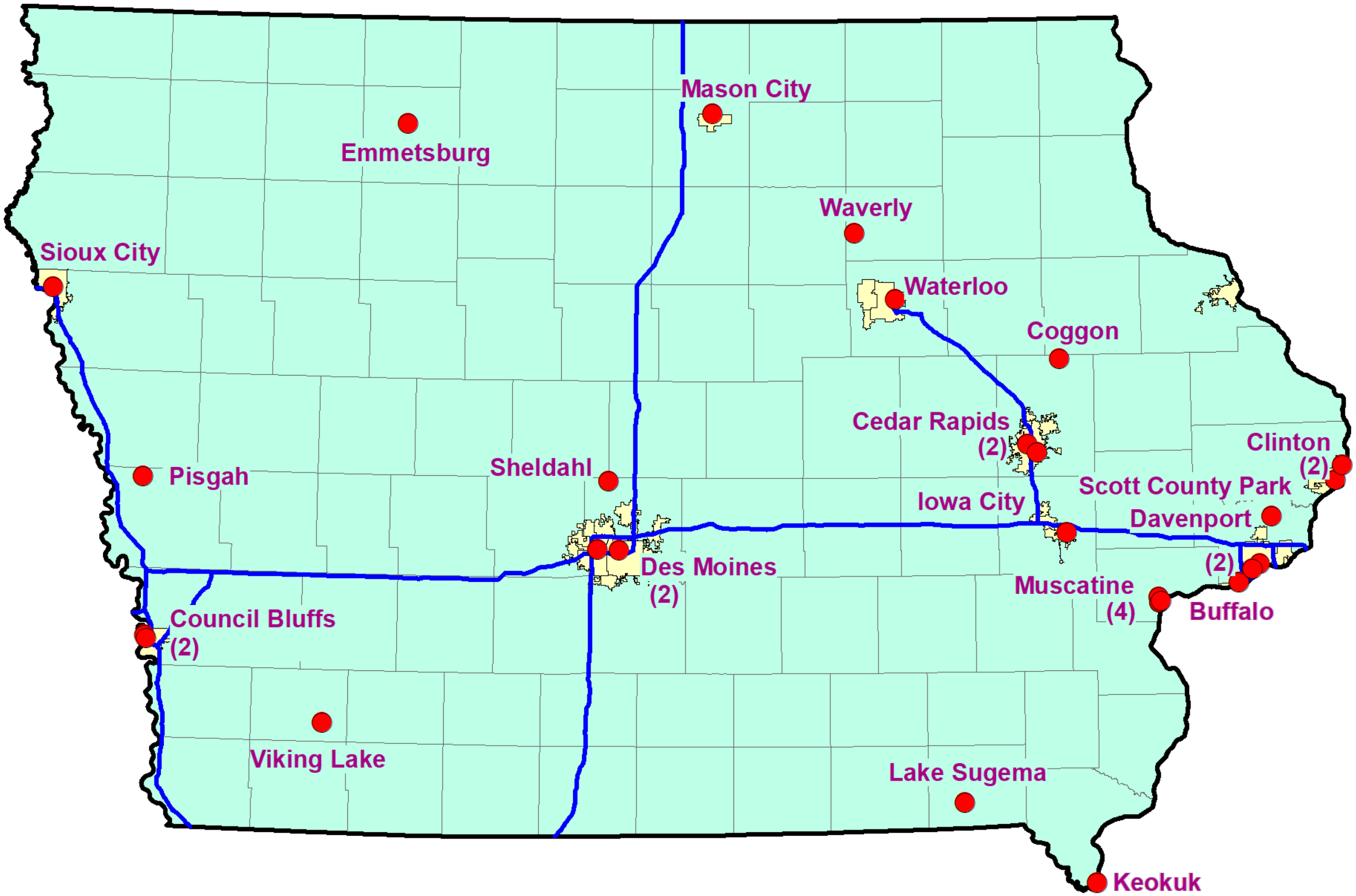
This appendix contains a description of the current (January 2020) Iowa ambient air monitoring network. A table and map of monitoring sites is shown in Section 2, and a count of monitors in the network is contained in Section 3. Section 4 compares the number of monitors for different pollutants; $PM_{2.5}$ filter samplers are the most numerous discrete samplers in the network, ozone monitors are the most numerous continuous samplers. Section 5 contains maps of monitor locations for the various pollutants. Additional information concerning Iowa's current ambient air monitoring network is contained in Iowa's *2019 Ambient Air Monitoring Network Plan*.[50]

[50] Available online at: https://www.iowadnr.gov/Environmental-Protection/Air-Quality/Monitoring-Ambient-Air.

Section 2: Current Iowa Air Monitoring Sites (January, 2020)

City	Site	Address	County	MSA	Latitude	Longitude	AQS Site ID	Responsible Agency
Buffalo	Linwood Mining	11100 110th Ave.	Scott	DMR	41.46724	-90.68845	191630017	DNR
Cedar Rapids	Public Health	500 11th St. NW	Linn	CDR	41.97677	-91.68766	191130040	Linn Local Prog.
Cedar Rapids	Tait Cummins Park (Prairie Creek)	3000 C Street SW	Linn	CDR	41.94867	-91.63954	191130041	Linn Local Prog.
Clinton	Chancy Park	23rd & Camanche	Clinton	-	41.82328	-90.21198	190450019	DNR
Clinton	Rainbow Park	Roosevelt St.	Clinton	-	41.875	-90.17757	190450021	DNR
Clive	Indian Hills Jr. High School	9401 Indian Hills	Polk	DSM	41.60352	-93.7479	191532510	Polk Local Prog.
Coggon	Coggon Elementary School	408 E Linn St.	Linn	CDR	42.28056	-91.52694	191130033	Linn Local Prog.
Council Bluffs	Franklin School	3130 C Ave.	Pottawattamie	OMC	41.26417	-95.89612	191550009	DNR
Council Bluffs	Griffin Pipe	8th Avenue and 27th St	Pottawattamie	OMC	41.25425	-95.88725	191550011	DNR
Davenport	Jefferson School	10th St. & Vine St.	Scott	DMR	41.53001	-90.58761	191630015	DNR
Davenport	Hayes School	622 South Concord St	Scott	DMR	41.51208	-90.62404	191630020	DNR
Des Moines	Health Dept.	1907 Carpenter	Polk	DSM	41.60318	-93.6433	191530030	Polk Local Prog.
Emmetsburg	Iowa Lakes College	Iowa Lakes Community College	Palo Alto	-	43.1237	-94.69352	191471002	DNR
Iowa City	Hoover School	2200 East Court	Johnson	IAC	41.65723	-91.50348	191032001	DNR
Keokuk	Fire Station	111S. 13th St.	Lee	-	40.40096	-91.39101	191110008	DNR
Mason City	Holcim Cement	17th St. & Washington St.	Cerro Gordo	-	43.16944	-93.20243	190330018	DNR
Muscatine	Greenwood Cemetery	Fletcher St. & Kimble St.	Muscatine	-	41.41943	-91.07098	191390016	DNR
Muscatine	Muscatine HS, East Campus Roof	1409 Wisconsin	Muscatine	-	41.40095	-91.06781	191390015	DNR
Muscatine	Muscatine HS, East Campus Trailer	1409 Wisconsin	Muscatine	-	41.40145	-91.06845	191390019	DNR
Muscatine	Musser Park	Oregon St. & Earl Ave.	Muscatine	-	41.4069	-91.0616	191390020	DNR
Pisgah	Forestry Office	206 Polk St.	Harrison	OMC	41.83226	-95.92819	190850007	DNR
Sheldahl	Southern Crossroads	15795 NW 58th St	Polk	DSM	41.84943	-93.69762	191531579	Polk Local Prog.
Sioux City	Irving School	901 Floyd Blvd.	Woodbury	SXC	42.499844	-96.394755	191930021	DNR
Waterloo	Water Tower	Vine St. & Steely	Black Hawk	WTL	42.50154	-92.31602	190130009	DNR
Waverly	Waverly Airport	Waverly Airport	Bremer	WTL	42.74117	-92.51285	190170011	DNR
-	Lake Sugema	24430 Lacey Trl, Keosauqua	Van Buren	-	40.69508	-92.00632	191770006	DNR
-	Scott County Park	Scott County Park	Scott	DMR	41.69917	-90.52194	191630014	DNR
-	Viking Lake State Park	2780 Viking Lake Road	Montgomery	-	40.96911	-95.04495	191370002	DNR

MSA abbreviations are as follows: DMR = Davenport, Moline, Rock Island; CDR = Cedar Rapids; DSM = Des Moines; OMC = Omaha-Council Bluffs; IAC = Iowa City; SXC = Sioux City; AMW = Ames; WTL = Waterloo. More information on MSA's is available in Appendix J.



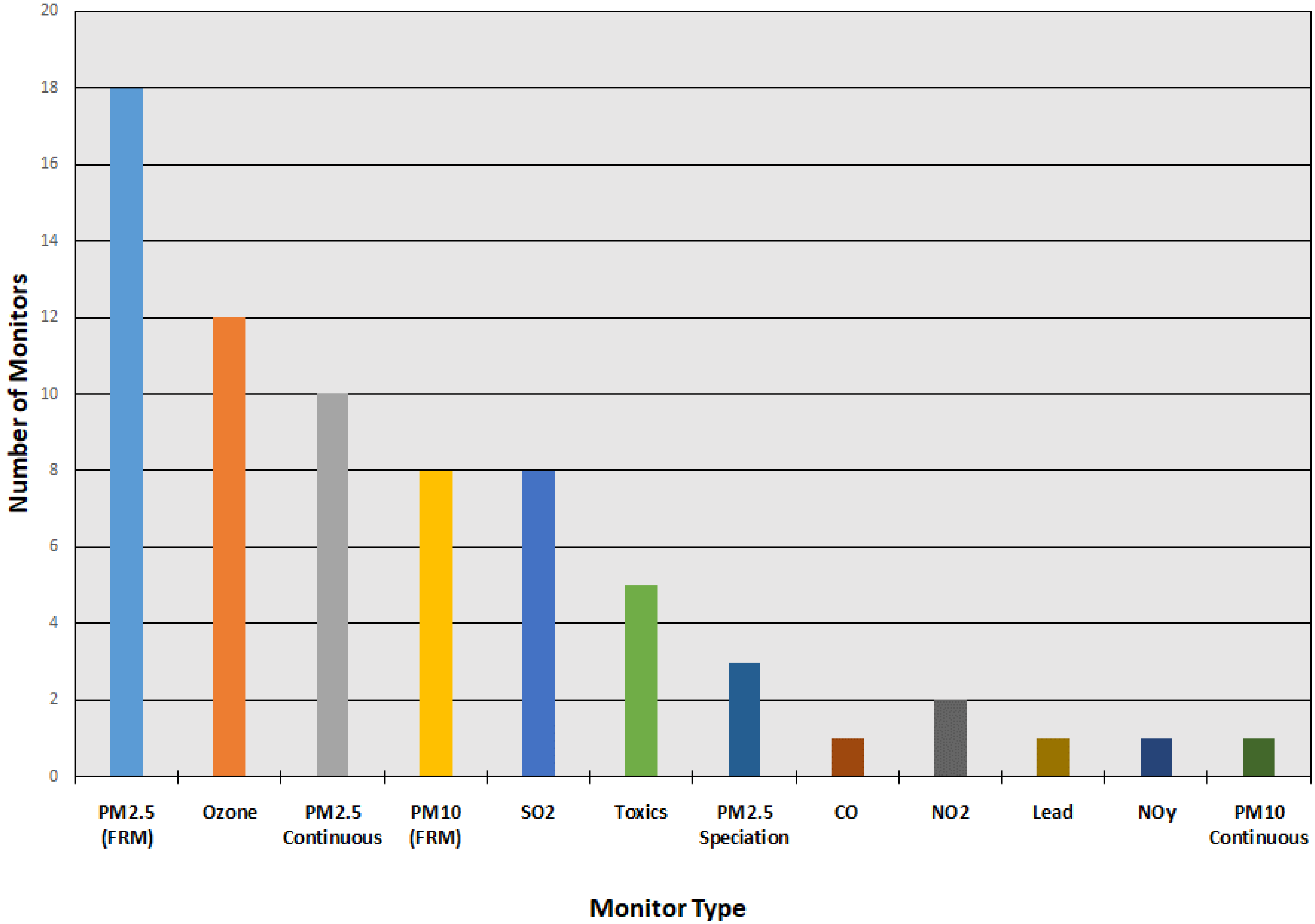
2020 Iowa Ambient Air Monitoring Network (28 sites)

Section 3: Criteria[51] Pollutant Monitors at Each Site in the Network as of January 1, 2020.

City, Site Name	$PM_{2.5}$ (FRM)	Ozone	$PM_{2.5}$ Cont.	PM_{10} (FRM)	SO_2	Toxics	$PM_{2.5}$ Spec.	CO	NO_2	Lead	NOy	PM_{10} Cont.
Buffalo, Linwood Mining				1								1
Cedar Rapids, Public Health	1	1	1	1	1	1						
Cedar Rapids, Tait Cummins Park					1							
Clinton, Chancy Park	1		1		1	1						
Clinton, Rainbow Park	1	1										
Clive, Indian Hills Jr. High School	1											
Coggon, Elementary School		1										
Council Bluffs, Franklin School	1			1								
Council Bluffs, Griffin Pipe										1		
Davenport, Hayes Sch.	1											
Davenport, Jefferson Sch.	1	1	1	1	1	1	1	1			1	
Des Moines, Health Dept.	1	1	1	1		1			1			
Emmetsburg, Iowa Lakes Coll.	1	1	1									
Iowa City, Hoover Sch.	1		1									
Keokuk, Fire Station	1											
Lake Sugema	1	1	1	1	1		1		1			
Mason City, Holcim Cement				1								
Muscatine HS, East Campus Roof	1			1								
Muscatine HS, East Campus Trailer			1		1							
Muscatine, Greenwood Cemetery	1				1							
Muscatine, Musser Park	1				1	1						
Pisgah, Forestry Office		1										
Scott County Park		1										
Sheldahl, Southern Crossroads		1										
Sioux City, Irving School	1											
Viking Lake State Park	1	1	1				1					
Waterloo, Water Tower	1		1									
Waverly Airport		1										
Totals	**18**	**12**	**10**	**8**	**8**	**5**	**3**	**1**	**2**	**1**	**1**	**1**

[51] $PM_{2.5}$ Speciation and Toxics monitors do not monitor criteria pollutants, but are an important component of the network and are included for completeness.

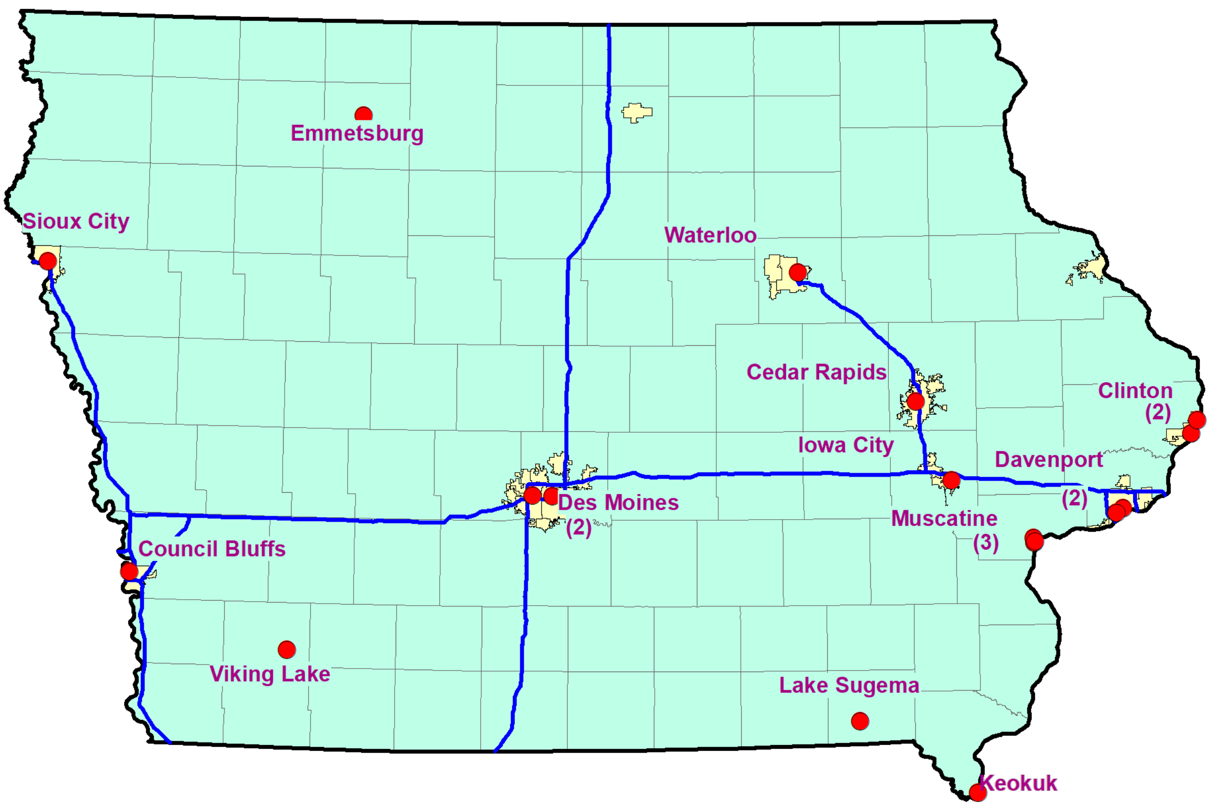
Section 4: Criteria[52] Pollutant Monitors Operated in the Current Network



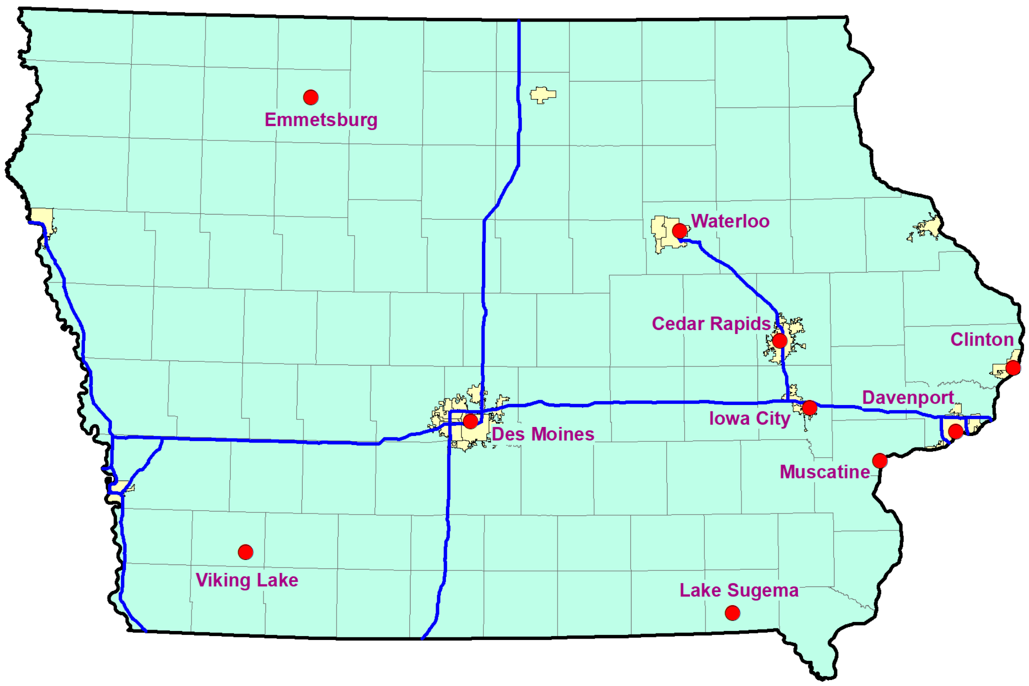
[52] $PM_{2.5}$ Speciation and Toxics monitors do not monitor criteria pollutants, but are an important component of the network and are included for completeness.

Section 5: Monitoring Network Maps

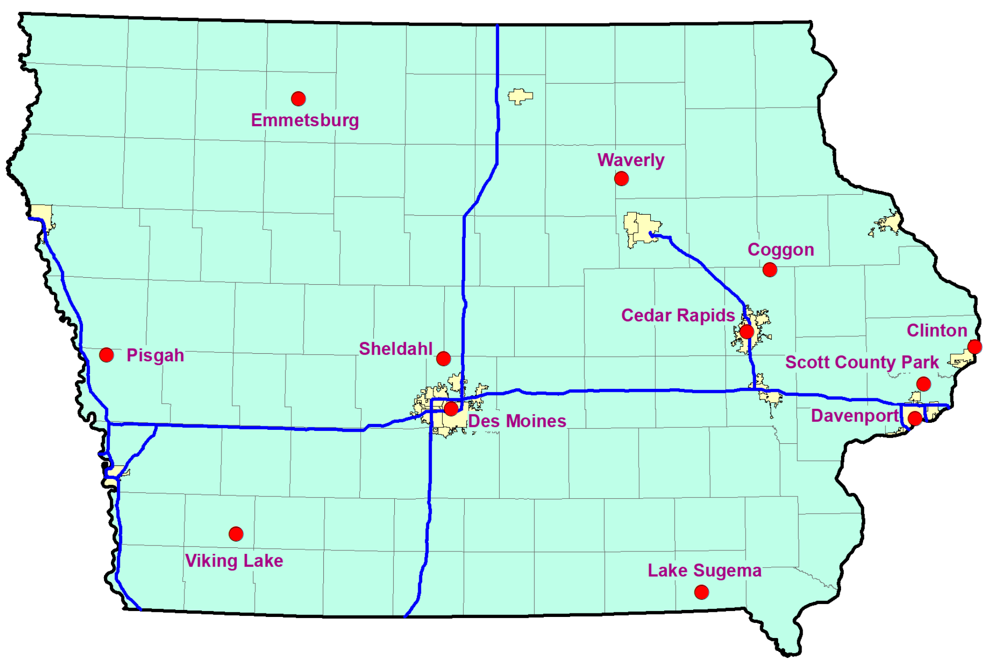
The following maps show the locations for the criteria pollutant monitors in the state of Iowa that are current as of January 1, 2020. Non-criteria pollutant maps are also included for the Toxics and Speciation monitoring networks.



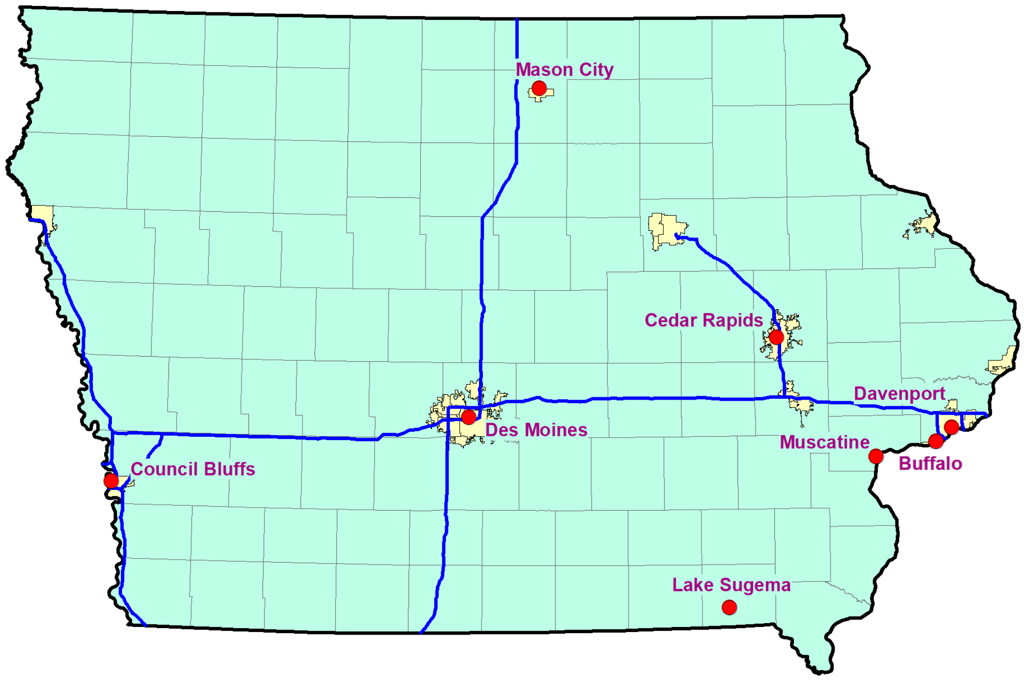
Manual $PM_{2.5}$ (FRM) Monitoring Sites



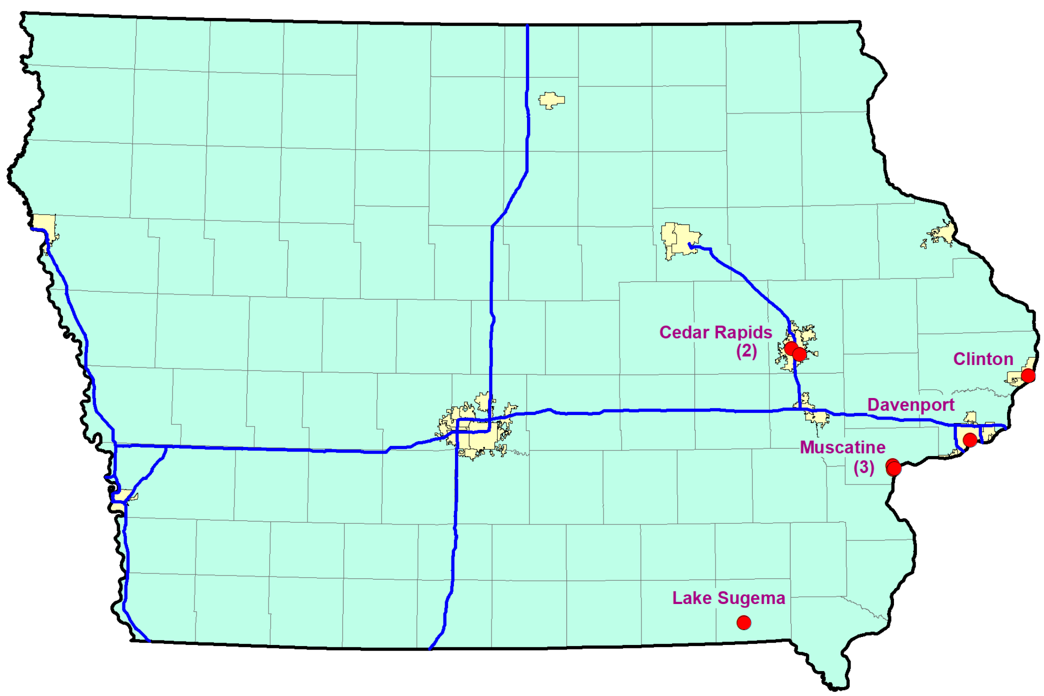
Continuous $PM_{2.5}$ (non-FRM) Monitoring Sites



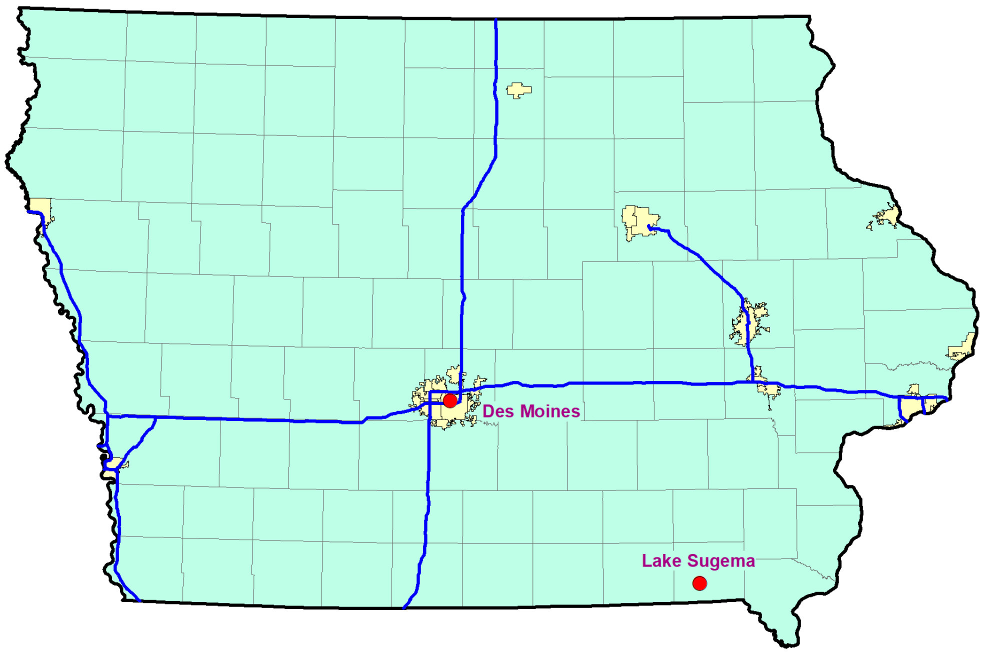
Ozone Monitoring Sites



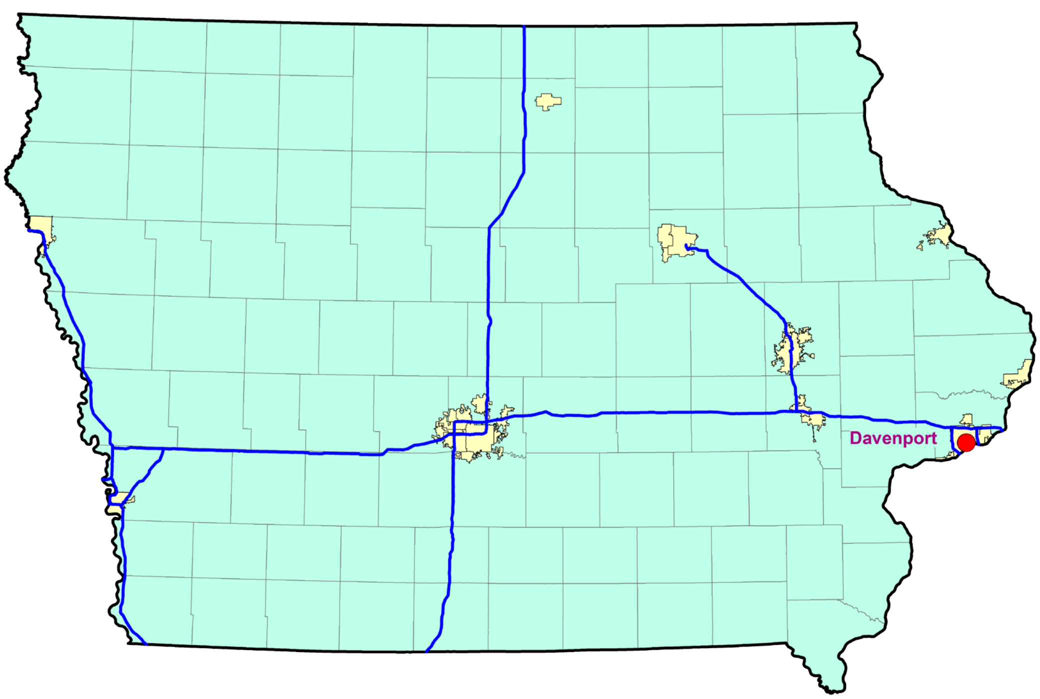
PM_{10} Monitoring Sites



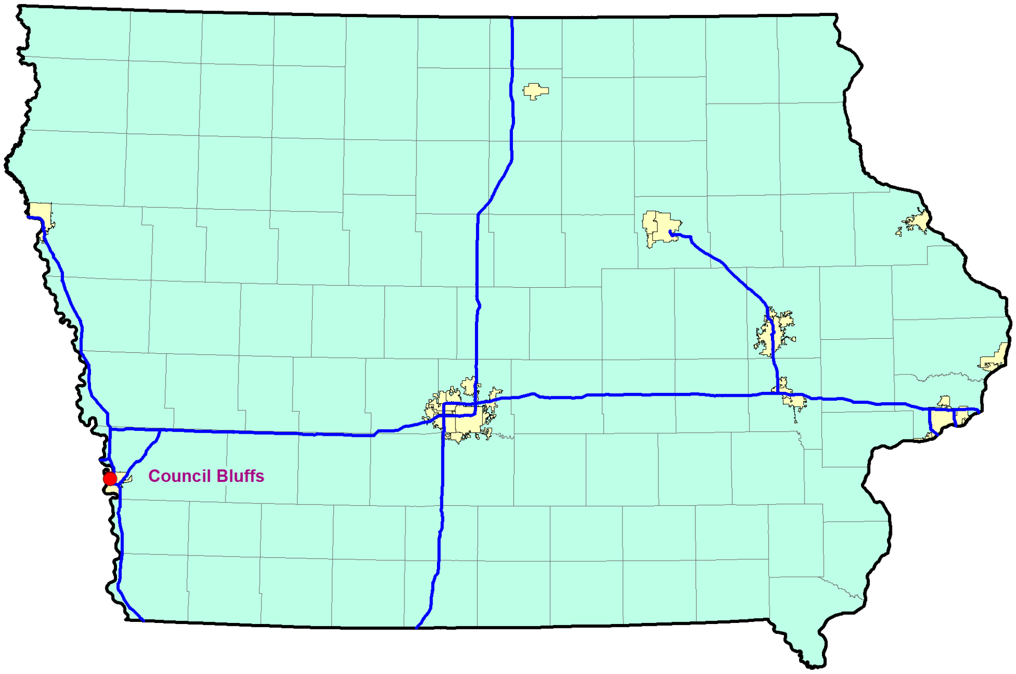
SO_2 Monitoring Sites



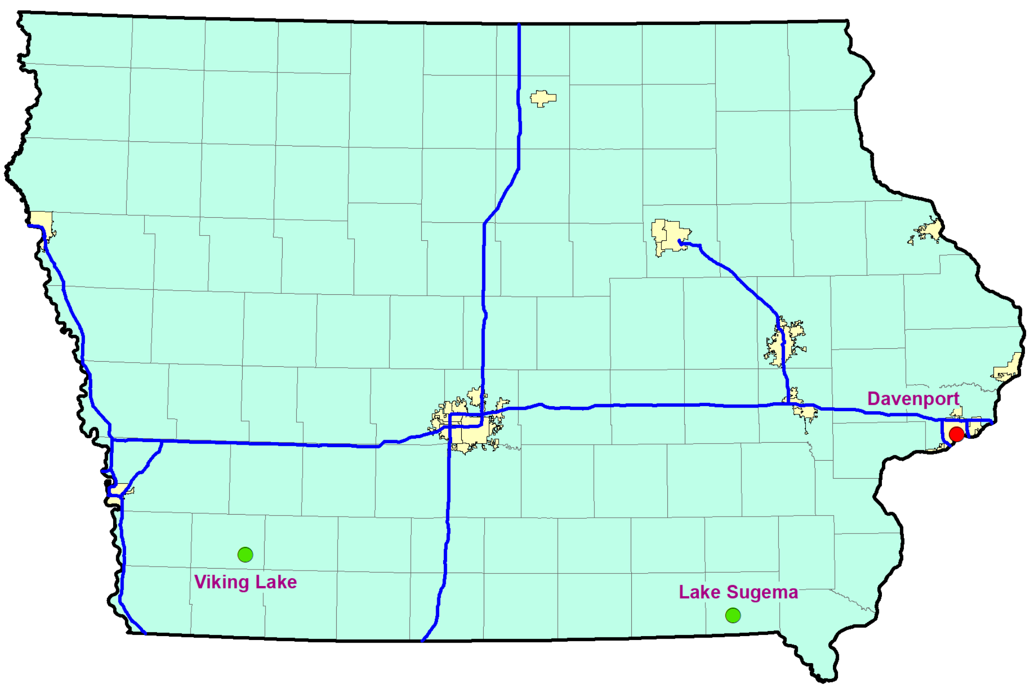
NO_2 Monitoring Sites



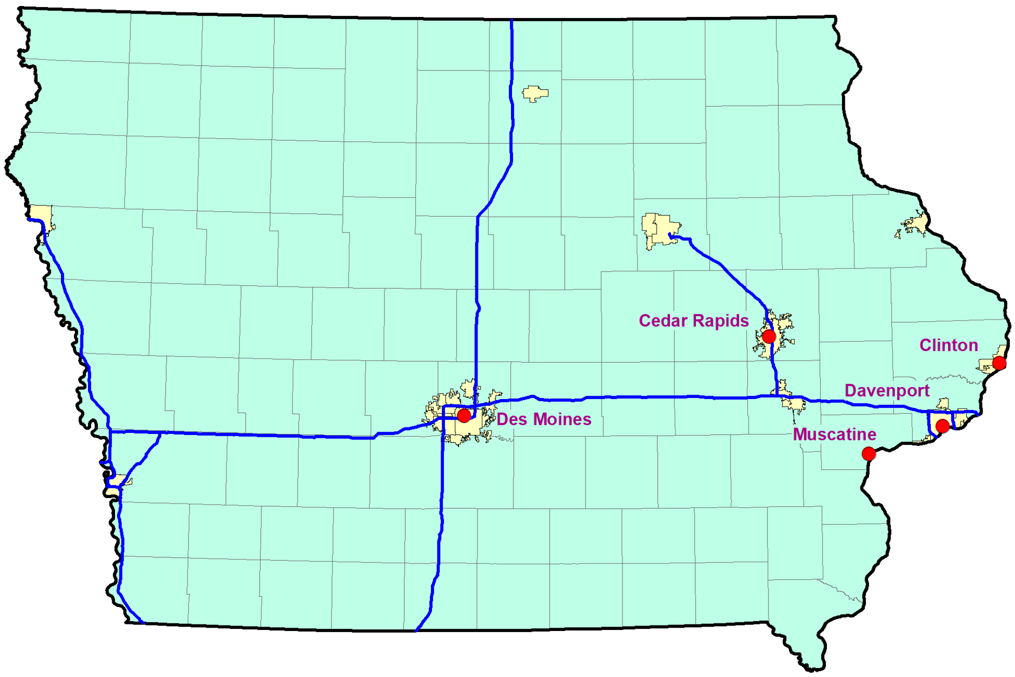
CO Monitoring Site



Lead (Pb) Monitoring Site



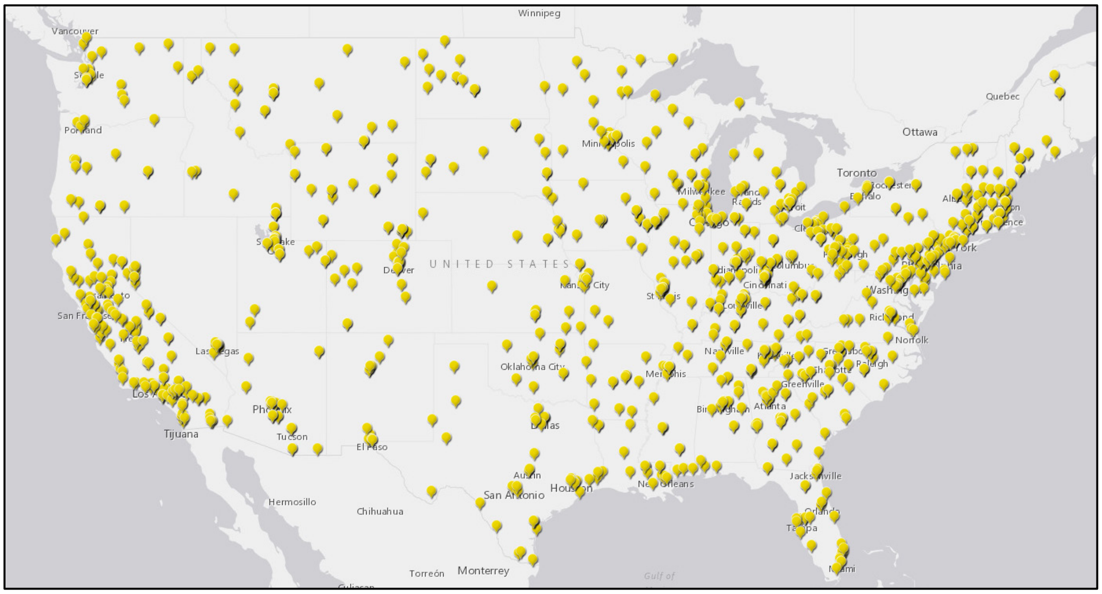
Speciation Monitors; CSN Speciation samplers are located at the red dot, IMPROVE Speciation samplers are located at the green dots.



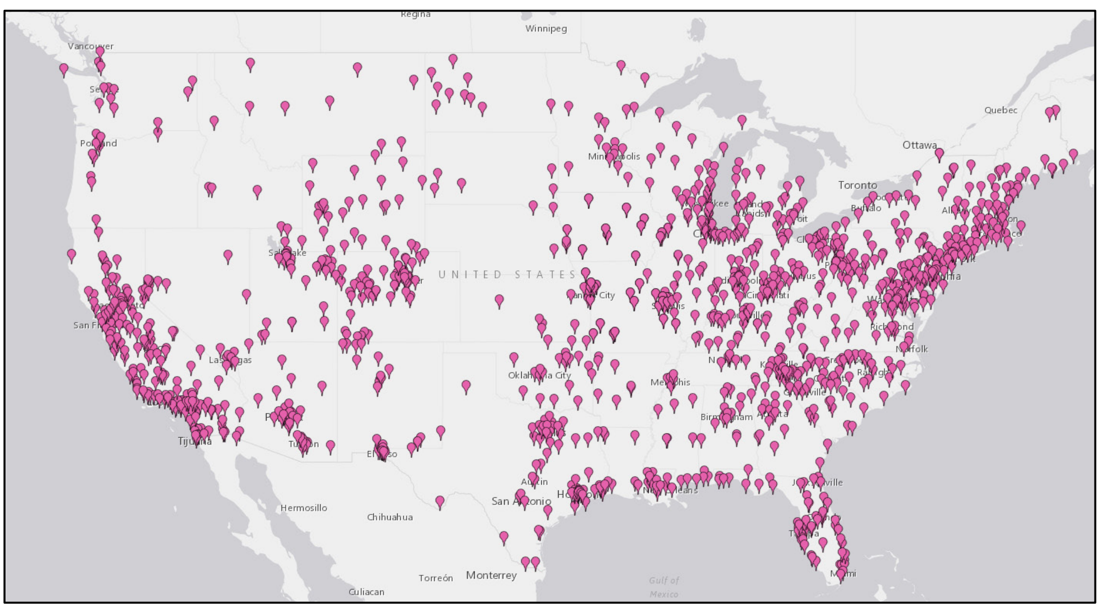
Toxics Monitoring Sites

National Maps

The following maps show the locations for the criteria pollutant monitors across the nation as of February 2, 2020. [53] Non-criteria pollutant maps are also included for the NCore, NATTs and Speciation monitoring networks.



PM$_{2.5}$ Monitoring Sites



Ozone Monitoring Sites

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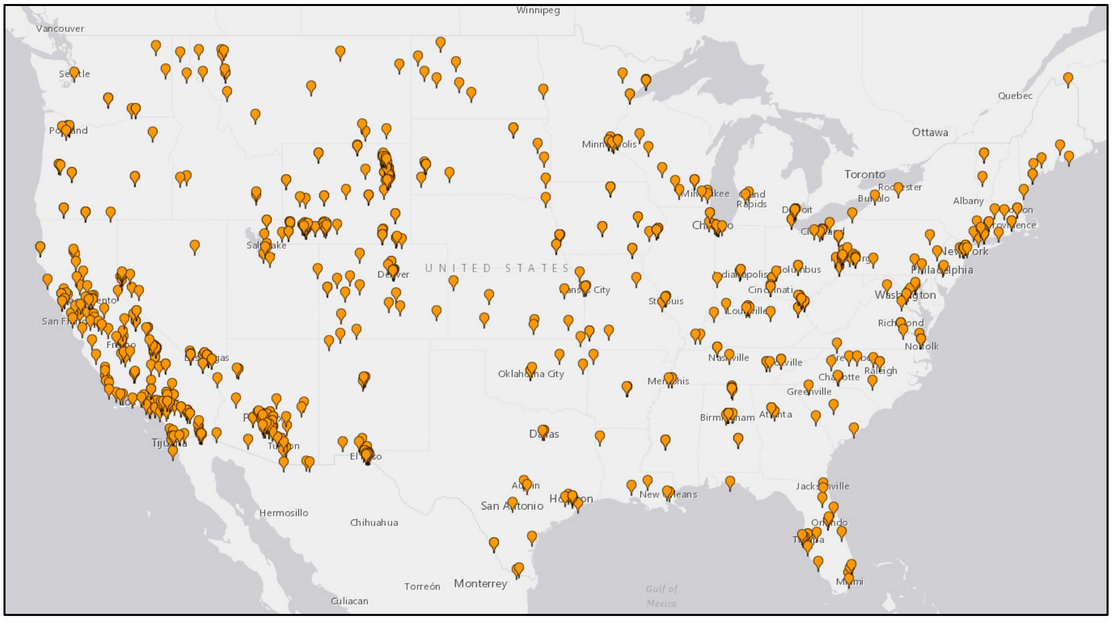
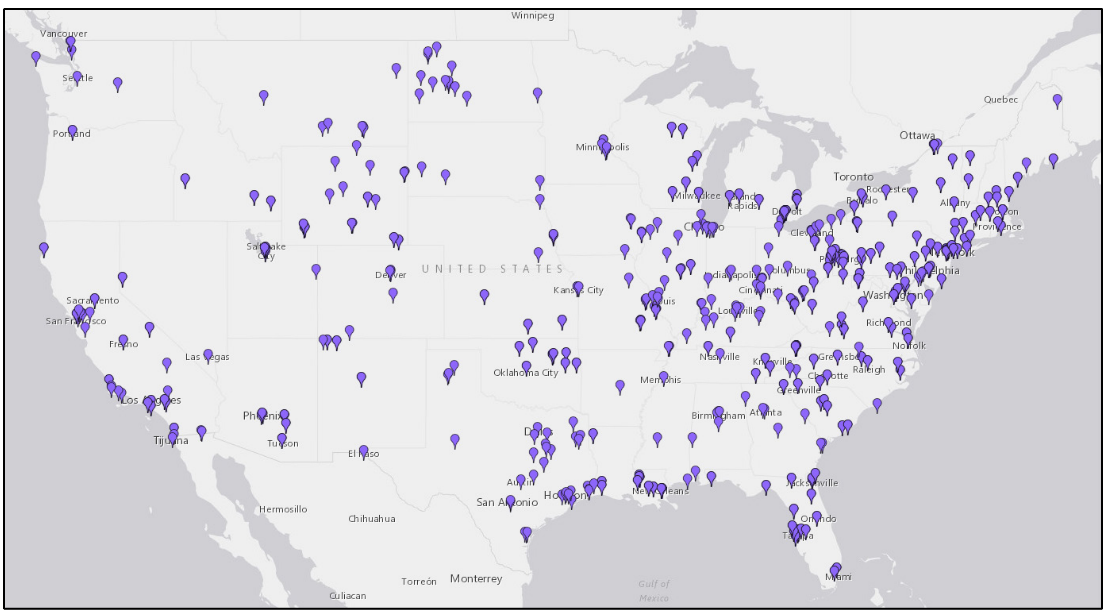
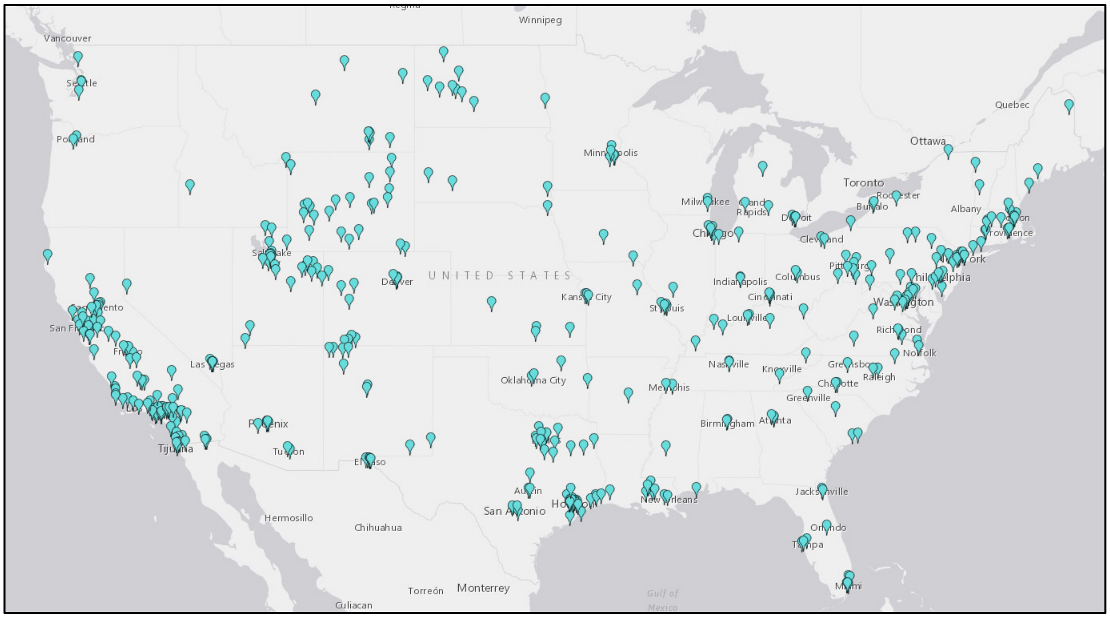
[53]Maps were generated from monitors indicated as active on 2/17/20: https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=5f239fd3e72f424f98ef3d5def547eb5.



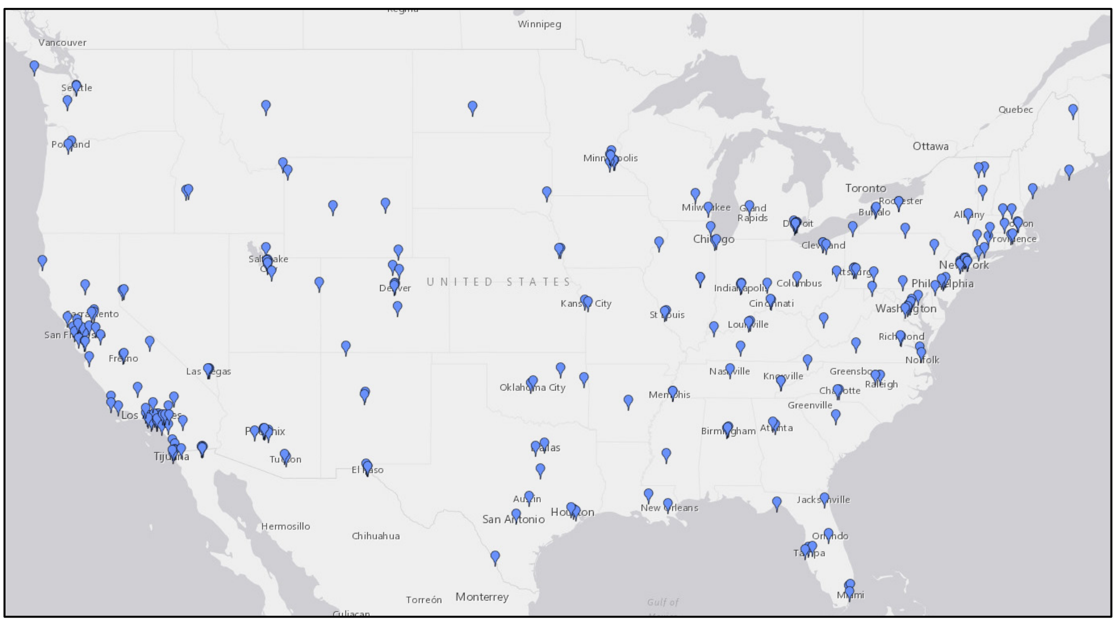
PM$_{10}$ Monitoring Sites



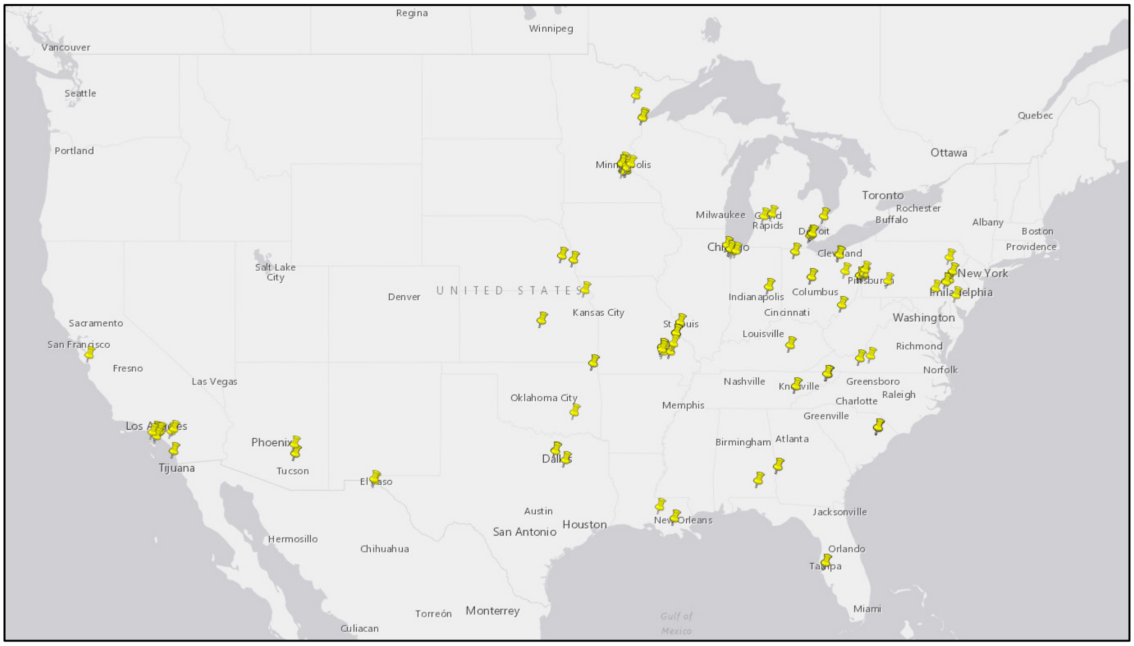
SO$_2$ Monitoring Sites



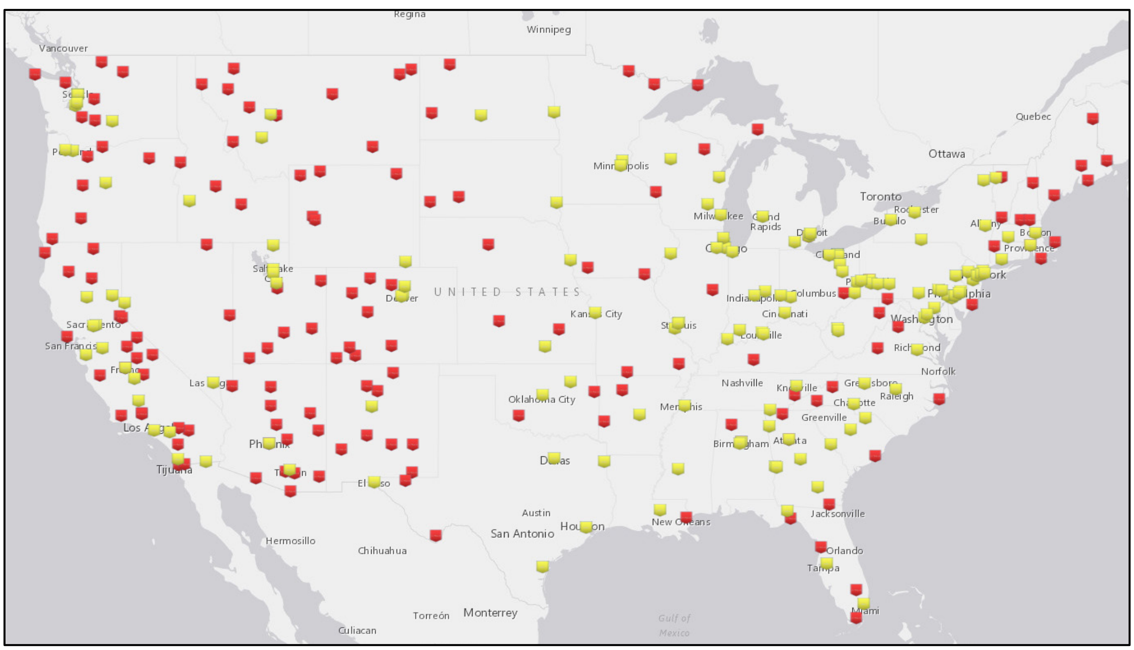
NO₂ Monitoring Sites



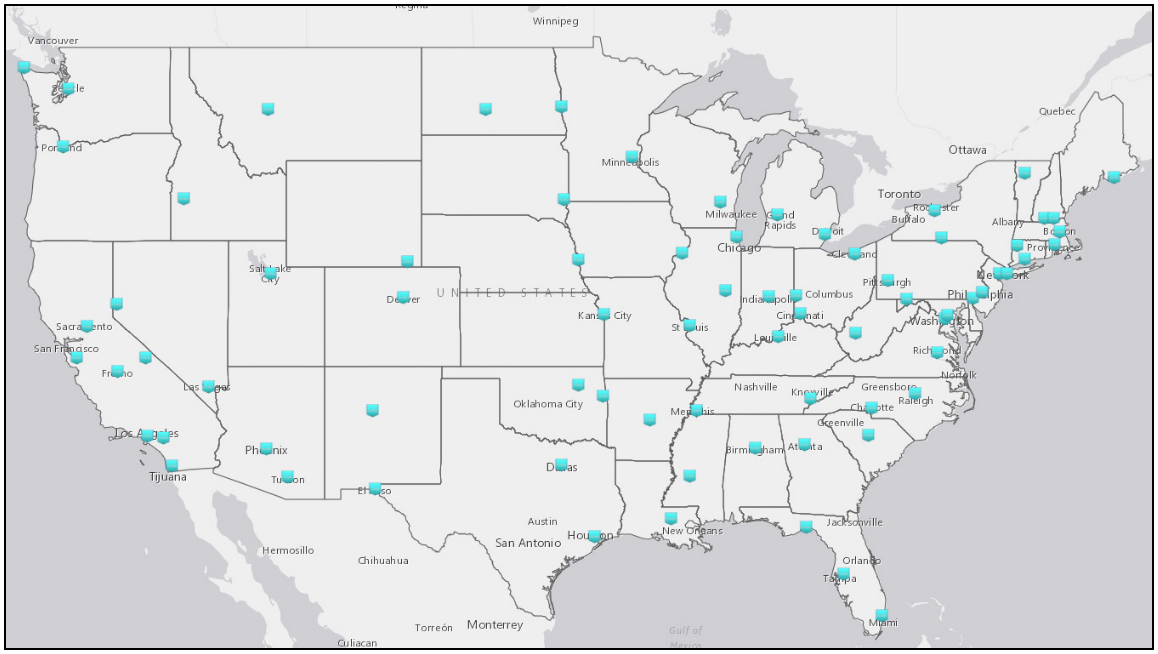
CO Monitoring Sites



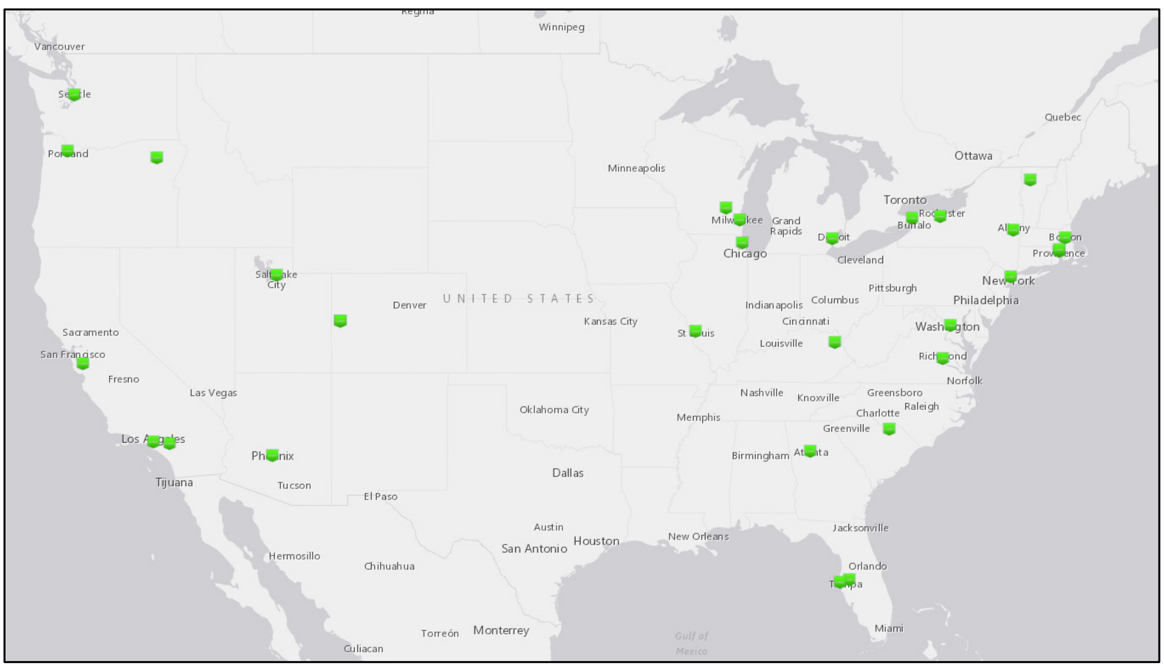
Lead Monitoring Sites



Speciation (Yellow) and IMPROVE (Red) Monitoring Sites



National Core (NCore) Multipollutant Network



National Air Toxics Trends Stations (NATTS)

Appendix H: NAAQS Exceedances

Table of Contents

Section 1: Summary

A NAAQS exceedance for a given pollutant occurs when an air monitor records a concentration that exceeds the level of the short-term, primary NAAQS.[54] When an air pollutant concentration reaches this level, sensitive groups such as children, the elderly, and those with respiratory illness may experience adverse health effects.

From 2014 to 2018, $PM_{2.5}$, ozone, and SO_2 exceedances were recorded in the Iowa network.[55] Sections 2, 3, and 4 contain tables detailing the sites and dates of these exceedances. Section 5 contains an exceedance chart and map.

Most of the exceedances that occurred over this period were caused by sulfur dioxide (SO_2). The data in Section 2 suggests that there are two types of $PM_{2.5}$ exceedances routinely recorded in the Iowa network: local exceedances and regional exceedances.[56] Local exceedances occur when a single monitor records an exceedance on a given day, usually because the wind is blowing from the direction of a nearby primary $PM_{2.5}$ emitter. Regional exceedances occur when multiple monitors over a wide (multi-county or multi-state) area record exceedances on a given day. Regional exceedances are common in Iowa during wintertime periods when a temperature inversion and stagnant air persists over much of the state, causing pollutant concentrations to build up, and secondary fine particles to form.

Section 2: 2014-2018 $PM_{2.5}$ NAAQS Exceedance Sites and Dates

The table below provides the monitoring sites and dates of $PM_{2.5}$ exceedances measured in Iowa from 2014 through 2018. Values used to compare to the short-term primary NAAQS were 24-hour average concentrations throughout this period. Concentrations greater than or equal to 35.5 µg/m^3 were considered to be exceeding the NAAQS. $PM_{2.5}$ monitors in Iowa sample on a 1 in 3 day or daily schedule, with daily sampling frequencies reserved for highly populated areas or areas that have a history of elevated $PM_{2.5}$ levels.

The table below gives the locations and dates of $PM_{2.5}$ exceedances measured in Iowa from 2014-2018. Monitors in Muscatine (Garfield School) and Clinton (Chancy Park) are located near industries that emit $PM_{2.5}$.

[54] When there is more than one short-term primary NAAQS for a given pollutant, the averaging period used to define the Air Quality Index is selected to define a NAAQS exceedance. For the period from 2014-2018, 24-hour average PM_{10} and $PM_{2.5}$, one-hour SO_2 values, one-hour NO_2 values and 8-hour average O_3 and CO values were compared to the level of the corresponding NAAQS to determine exceedance counts. Information concerning the Air Quality Index is available in 40 CFR Part 58, Appendix G available online at: https://www.ecfr.gov/cgi-bin/retrieveECFR?n=40y6.0.1.1.6 Additional guidance is available online at: https://www3.epa.gov/airnow/aqi-technical-assistance-document-sept2018.pdf.

[55] NAAQS exceedance counts for the Iowa monitoring network are available online at: http://www.iowadnr.gov/InsideDNR/RegulatoryAir/MonitoringAmbientAir.aspx.

[56] A discussion of the causes of fine particulate episodes in Iowa is available at: http://www.engineering.uiowa.edu/~cs_proj/iowa_pm_project/understanding_episodes_feb19version_all_sections.pdf.

Monitoring Site/Date	Cedar Rapids, Public Health 191130040	Clinton, Chancy Park 190450019	Clinton, Rainbow Park 190450021	Council Bluffs, Franklin School 191550009	Davenport, Hayes Sch. 191630020	Davenport, Jefferson Sch. 191630015	Des Moines, Health Dept. 191530030	Iowa City, Hoover Sch. 191032001	Muscatine HS E Campus Roof 191390015	Muscatine HS E Campus Roof 191390019	Muscatine, Musser Park 191390020	Sioux City, Bryant School 191930019	Viking Lake State Park 191370002	Count
3/6/2014				39.5								38.2	36.1	3
3/7/2014	40	38.7	38.2		37.7	36.9		38.3		36.4				7
3/27/2014											40.2			1
3/30/2014												35.8		1
4/3/2014									41.2					1
4/27/2014										44.2				1
12/5/2014										37.7				1
7/4/2015						37.6								1
7/7/2015	36.3	45.8	46.3		51.8	49.2		45.3		50.3				7
5/7/2016	35.6						43							2
7/4/2017							1							1
4/11/2018				35.5										1
6/1/2018							74							1
2014 Total	1	1	1	1	1	1	0	1	1	3	1	2	1	15
2015 Total	1	1	1	0	1	2	0	1	0	1	0	0	0	8
2016 Total	1	0	0	0	0	0	1	0	0	0	0	0	0	2
2017 Total	0	0	0	0	0	0	1	0	0	0	0	0	0	1
2018 Total	0	0	0	1	0	0	1	0	0	0	0	0	0	2
5 year Total	3	2	2	2	2	3	3	2	1	4	1	2	1	28

2014-2018 $PM_{2.5}$ NAAQS Exceedances in µg/m³. The NAAQS level is 35 µg/m³.

Section 3: 2014-2018 Ozone NAAQS Exceedance Sites and Dates

The table below provides the monitoring sites and dates of ozone exceedances measured in Iowa from 2014-2018. The primary NAAQS utilized 8-hour average ozone values throughout this period. States are required to measure ozone levels during ozone season; in Iowa ozone season runs from March through October. The NAAQS exceedance level was changed from 76 ppb to 71 ppb in October 2015. In the table below, 71 ppb has been used as the exceedance level. Exceedances were recorded in Cedar Rapids, Clinton, Coggon (downwind of Cedar Rapids), Davenport, North Davenport (Scott Co. Park), Emmetsburg, Pisgah (downwind of Omaha-Council Bluffs), Sheldahl (downwind of Des Moines), and Waverly (downwind of Waterloo).

Monitoring Site/Date	Cedar Rapids, Public Health 191130040	Clinton, Rainbow Park 190450021	Coggon, Elementary School 191130033	Davenport, Jefferson Sch. 191630015	Emmetsburg, Iowa Lakes Coll. 191471002	Pisgah, Forestry Office 190850007	Scott County Park 191630014	Sheldahl, Southern Crossroads 191531579	Waverly Airport 190170011	Count
6/13/2016							71			1
6/19/2016		72		72			74			3
5/8/2018						71				1
5/27/2018			75		73	71		72	71	5
5/28/2018							71			1
5/29/2018	74		79				73		73	4
6/1/2018							71	73		2
6/7/2018							72			1
2014 Total	0	0	0	0	0	0	0	0	0	0
2015 Total	0	0	0	0	0	0	0	0	0	0
2016 Total	0	1	0	1	0	0	2	0	0	4
2017 Total	0	0	0	0	0	0	0	0	0	0
2018 Total	1	0	2	0	1	2	4	2	2	14
5 year Total	1	1	2	1	1	2	6	2	2	18

2014-2018 Ozone NAAQS Exceedances (concentrations in ppb), NAAQS is 70 ppb

Section 4: 2014-2018 SO_2 NAAQS Exceedance Sites and Dates

The table below provides the monitoring sites and dates of SO_2 exceedances measured in Iowa from 2014 through 2018. Values used to compare to the short-term primary NAAQS were hourly concentrations throughout this period. Concentrations greater than or equal to 75.5 ppb were considered to be exceeding the NAAQS. SO_2 monitors in Iowa sample continuously.

The table below gives the locations and dates of SO_2 exceedances measured in Iowa from 2014-2018. Monitors in Muscatine (Musser Park, 49 exceedances), Cedar Rapids (Tait Cummins, 11 exceedances) and Clinton (Chancy Park, no exceedances) are located near industries that emit SO_2.

Monitoring Site/Date	Cedar Rapids, Tait Cummins Park, 191130041	Muscatine HS E Campus Trlr., 191390019	Muscatine, Greenwood Cemetery, 191390016	Muscatine, Musser Park, 191390020	Count
1/3/14	86.6			92.2	2
1/12/14				145.6	1
1/29/14	121.6				1
3/26/14	95		121.3	76	3
3/27/14				193.2	1
3/30/14			82.1	170.3	2
3/31/14	112.9			203.7	2
4/12/14				87.7	1
4/17/14				93.1	1
4/18/14		111			1
4/19/14		139.8			1
4/23/14		147.9			1
4/24/14		235.9		94	2
4/27/14		199.8			1
5/6/14		202.2			1
5/7/14				107.5	1
5/19/14			97.5	159.2	2
6/1/14				76.7	1
6/6/14			88.4		1
6/14/14			115.6	76.6	2
6/15/14			168.9	118.6	2
6/16/14			107.1	131	2
6/17/14				75.5	1
6/27/14			83.4	113.3	2

Monitoring Site/Date	Cedar Rapids, Tait Cummins Park, 191130041	Muscatine HS E Campus Trlr., 191390019	Muscatine, Greenwood Cemetery, 191390016	Muscatine, Musser Park, 191390020	Count
6/28/14				95.2	1
6/30/14				103.7	1
7/20/14			93.6	81.3	2
7/21/14			116.5		1
7/22/14	78.1			82.1	2
7/25/14	79.3			83.9	2
8/7/14		117.7			1
8/18/14				87.3	1
8/28/14		112.6			1
8/29/14				81	1
8/31/14	93.1		125.2		2
9/3/14	166.4		112	179.7	3
9/4/14	182.6			230.7	2
9/8/14				104.5	1
9/9/14				92.3	1
9/19/14	98.5			101.2	2
9/22/14		109			1
10/1/14		116.7			1
10/12/14		112.1			1
10/23/14			88.1		1
10/27/14			109.9	79.4	2
11/2/14			109.2	166.8	2
11/3/14				158.7	1
11/7/14				124.5	1

Monitoring Site/Date	Cedar Rapids, Tait Cummins Park, 191130041	Muscatine HS E Campus Trlr., 191390019	Muscatine, Greenwood Cemetery, 191390016	Muscatine, Musser Park, 191390020	Count
11/9/14				93.2	1
11/10/14				124.1	1
11/18/14				78	1
11/22/14				98.7	1
11/23/14				76.1	1
12/25/14			99.6		1
12/26/14				104.4	1
1/8/15				84.8	1
1/10/15				105.3	1
1/28/15			120.8		1
2/20/15				101.5	1
3/6/15				132.5	1
3/19/15		93.7			1
3/24/15		90.7			1
3/28/15			105.1		1
3/29/15			126.4	146.6	2
4/1/15				187.5	1
4/2/15				115.5	1
4/12/15				116	1
5/7/15			90.5	84.5	2
5/13/15		104.7			1
6/7/15				92.4	1
7/11/16	76.9				1

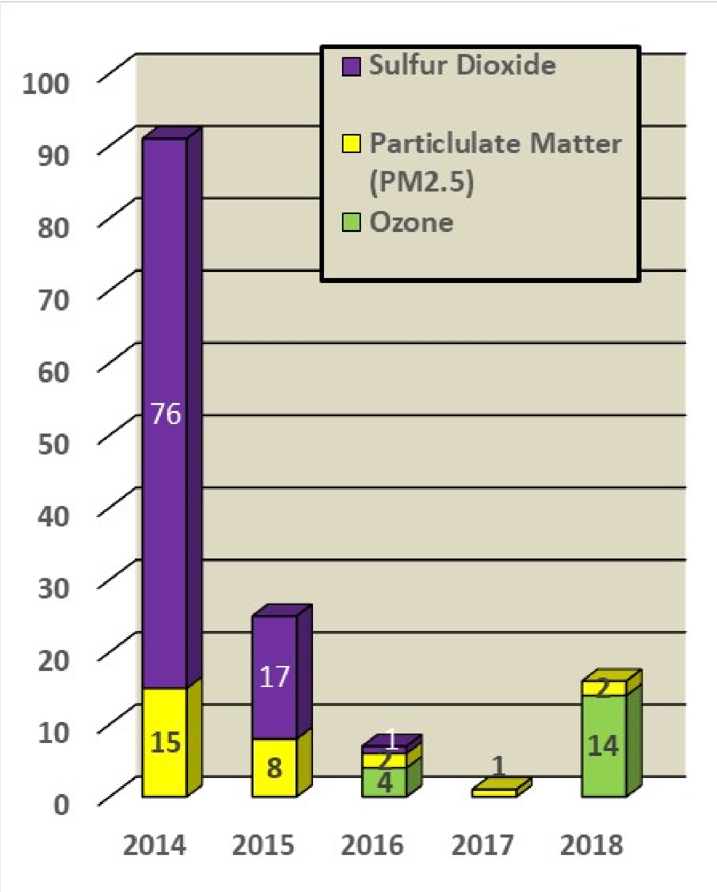
Iowa SO2 Exceedances 2014-2018 in ppb. NAAQS Level is 75 ppb.

Monitoring Site	Cedar Rapids, Tait Cummins Park, 191130041	Muscatine HS E Campus Trailer, 191390019	Muscatine, Greenwood Cemetery, 191390016	Muscatine, Musser Park, 191390020	Iowa Annual Total
2014 Totals	10	11	16	39	76
2015 Totals		3	4	10	17
2016 Totals	1				1
2017 Totals					0
2018 Totals					0
Five Year Total	11	14	20	49	94

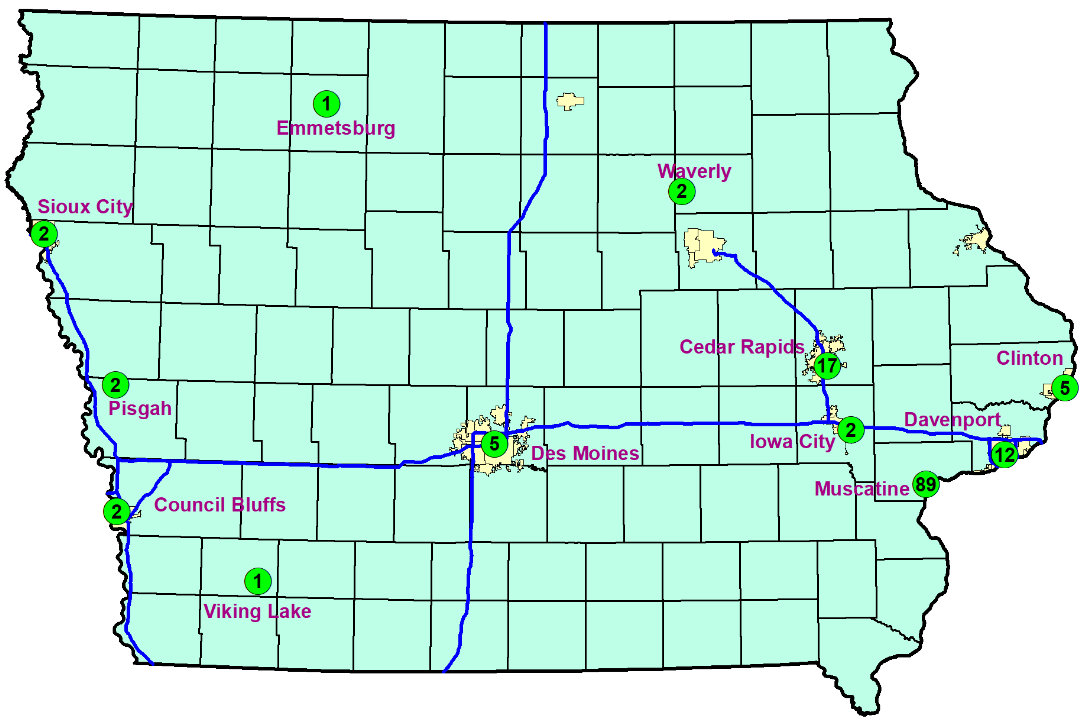
Counts by site of Iowa SO_2 Exceedances for 2014-2018

Section 5: Number and Location of NAAQS Exceedances from 2014 to 2018

The number of NAAQS exceedances in Iowa from 2014 to 2018 for the different NAAQS pollutants are shown in the chart below (left). The map (right) indicates the location where the exceedances were measured. SO_2 exceedances comprise the majority of the exceedance count, and most of these were recorded in Muscatine, Iowa. Note that the number of particulate matter exceedances recorded for a city will depend on the number of monitors in the city and the frequency at which particulate samplers in the city are operated.



Number of NAAQS Exceedances by Pollutant Type: 2014-2018



Location of NAAQS Exceedances: 2014-2018

Appendix I: NAAQS Violations and Design Values

Table of Contents

Section 1: Summary

Iowa's most recent year of monitoring data (2019) shows no monitored NAAQS violations. Appendix H provides information concerning NAAQS exceedances in Iowa for the past five years of certified monitoring data. A NAAQS exceedance is not the same as a NAAQS violation. Multiple exceedances of the NAAQS may occur at a monitoring site without violating the NAAQS. (A more precise description of the process used to establish NAAQS violations for PM_{10}, $PM_{2.5}$ and ozone monitoring data is indicated below.) When a NAAQS exceedance occurs at a monitoring site, air pollutant levels have exceeded the threshold for adverse health effects. When a NAAQS violation is recorded at a monitoring site, the State acquires additional authority under the provision of the Clean Air Act[57] to address the air quality problem around the monitor. These measures may include modifications to the State's permitting program that apply to industries with emissions that contribute to the monitored violation. [58]

The 24-hour PM_{10} NAAQS is violated at a monitoring site if the three year average of the annual number of expected exceedances is greater than one (1.05 or greater).[59] A PM_{10} NAAQS exceedance occurs when a 24-hour PM_{10} concentration is 155 $\mu g/m^3$ or greater. The annual number of expected exceedances for a given year is obtained by adding the quarterly expected exceedances for the four quarters of that year. The quarterly expected exceedances are obtained by dividing the number of exceedances in a particular quarter by the data capture rate for that quarter. Agencies typically adopt a daily sampling schedule at a PM_{10} monitoring location where an exceedance is measured and additional exceedances are likely. Owing to the form of the NAAQS, any monitoring site that records four exceedances in three years will violate the standard. A monitoring site that records three exceedances in three years is also quite likely to violate the standard, as data capture rates exceeding 95% are difficult to achieve with a filter sampler. In Iowa, over the past five years, no PM_{10} monitoring sites have recorded violations of the PM_{10} NAAQS.

For $PM_{2.5}$, ozone and other criteria pollutants, a number called the design value is computed from three years of monitoring data to compare the air quality at a monitoring site to the NAAQS.[60,61] The 8-hour design value for ozone is the annual fourth-highest daily maximum 8-hour ozone concentration averaged over three years. The $PM_{2.5}$ 24-hour design value is the annual 98th percentile 24-hour value averaged over three years. The $PM_{2.5}$ annual design value is the annual mean 24-hour value averaged over three years.

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[57] See the Clean Air Act requirements for non-attainment areas in U.S. Code Title 42, Chapter 85, Subchapter I, Part D, available online at: https://www.law.cornell.edu/uscode/text/42/chapter-85/subchapter-I/part-D

[58] See the description of permitting requirements in non-attainment areas in 40 CFR 51.165, available on line at: https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr51_main_02.tpl.

[59] Procedures for calculating PM_{10} attainment status from three years of monitoring data are contained in 40 CFR Part 50, Appendix K, available online at: https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr50_main_02.tpl.
Note that the procedure described in the text for establishing violations of the PM_{10} NAAQS is somewhat descriptive and does not apply in certain special cases.

[60] Procedures for calculating design values for $PM_{2.5}$ and Ozone are contained in 40 CFR Part 50, Appendices N and P available online at: https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr50_main_02.tpl.

[61] Design values for this report have been calculated by the department. When data capture at a monitoring site is poor, EPA has discretion in application of some of the data handling rules in the computation of design values. Official design values are calculated by the EPA and are available online at: http://epa.gov/airtrends/values.html.

Based on the most recent three year period (2016-2018) median design values for ozone in the Iowa network are 90% of the ozone NAAQS, median $PM_{2.5}$ 24-hour design values are 53% of the $PM_{2.5}$ 24-hour NAAQS, and median $PM_{2.5}$ annual design values are 64% of the $PM_{2.5}$ annual NAAQS.

For the most recent three-year period (2016-2018), no NAAQS violations have been recorded in the Iowa networks.

Sections 2 - 4 examine the ozone and $PM_{2.5}$ design values over the five-year period from 2014 to 2018.

Sections 5 - 6 examine the one-hour SO_2 and NO_2 design values for the period 2014 to 2018.

Section 7 examines the lead design values over the period from 2014 to 2018.

Section 2: Ozone Design Values

Trends in ozone design values for the period 2014-2018 are indicated below. Based on the available data the median ozone design value in the Iowa ozone network has been steady over the past five years. The largest decrease (5 ppb) was recorded by a monitor at Lake Sugema in Southeast Iowa. Fourteen (14) NAAQS exceedances were recorded in 2018.

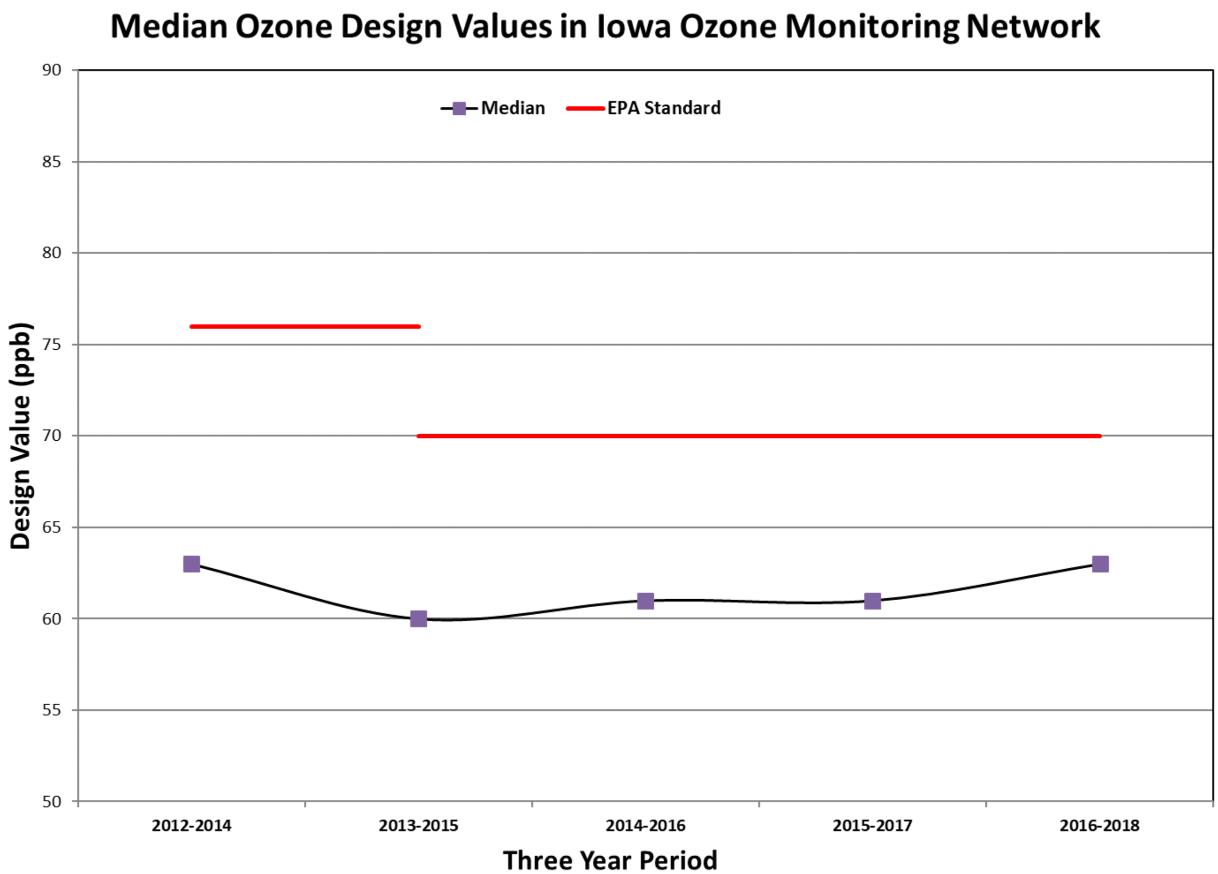
The most recent (2016-2018) monitoring data shows design values across the State ranged from 61 to 65 ppb, with a median value of 63 ppb.

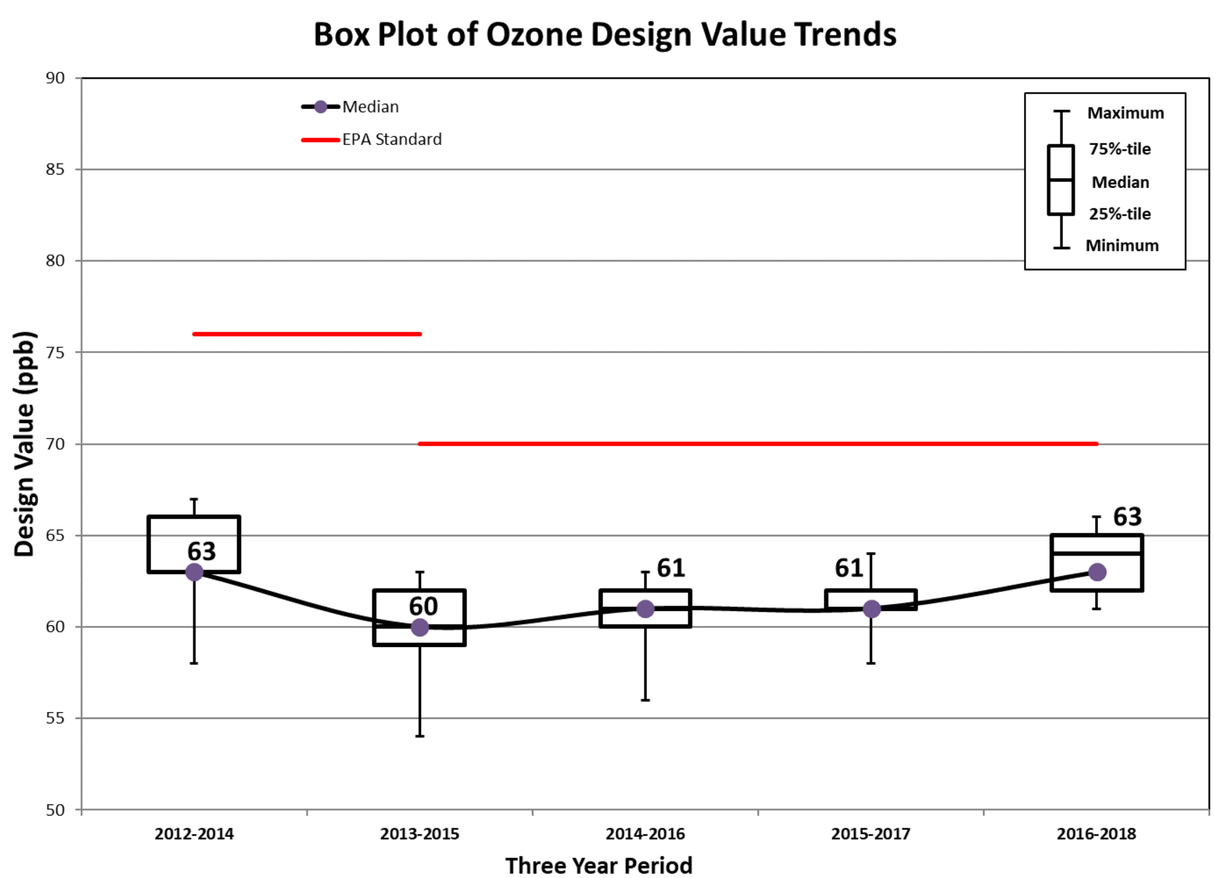
2014 – 2018 Ozone Design Values (ppb)

Three Year Period	Omaha-Council Bluffs Downwind (Pisgah, Forestry Office)	Omaha-Council Bluffs Downwind (Pisgah, Highway Maintenance Shed)	Southwest Background (Viking Lake State Park)	Northwest Background (Emmetsburg, Iowa Lakes Community College)	Des Moines Upwind (Lake Ahquabi)	Des Moines Metro (Des Moines, Health Department)	Des Moines Downwind (Slater Elementary/City Hall)	Des Moines Downwind (Sheldahl, Southern Crossroads)	Cedar Rapids Upwind (Cedar Rapids, Kirkwood College)	Cedar Rapids Metro (Cedar Rapids, Public Health)	Cedar Rapids Downwind (Coggon Elementary School)	Waterloo Downwind (Waverly, Airport)	Southeast Background (Lake Sugema)	Davenport Metro (Davenport, Jefferson School)	Davenport Downwind (Scott County Park)	Clinton Metro (Clinton, Rainbow Park)
2012-14	67	67	63	65	63	62	62		63	62	63	63	66	63		67
2013-15	63	62	59	63	59	59	60		60	59	60	60	61	59		62
2014-16	62	62	60	61	58	60	60		61	61	61	60	60	60	63	63
2015-17	62		60	61		59		59		61	61	60	59	61	62	62
2016-18	64		61	62		61		61		63	65	63	61	63	65	64

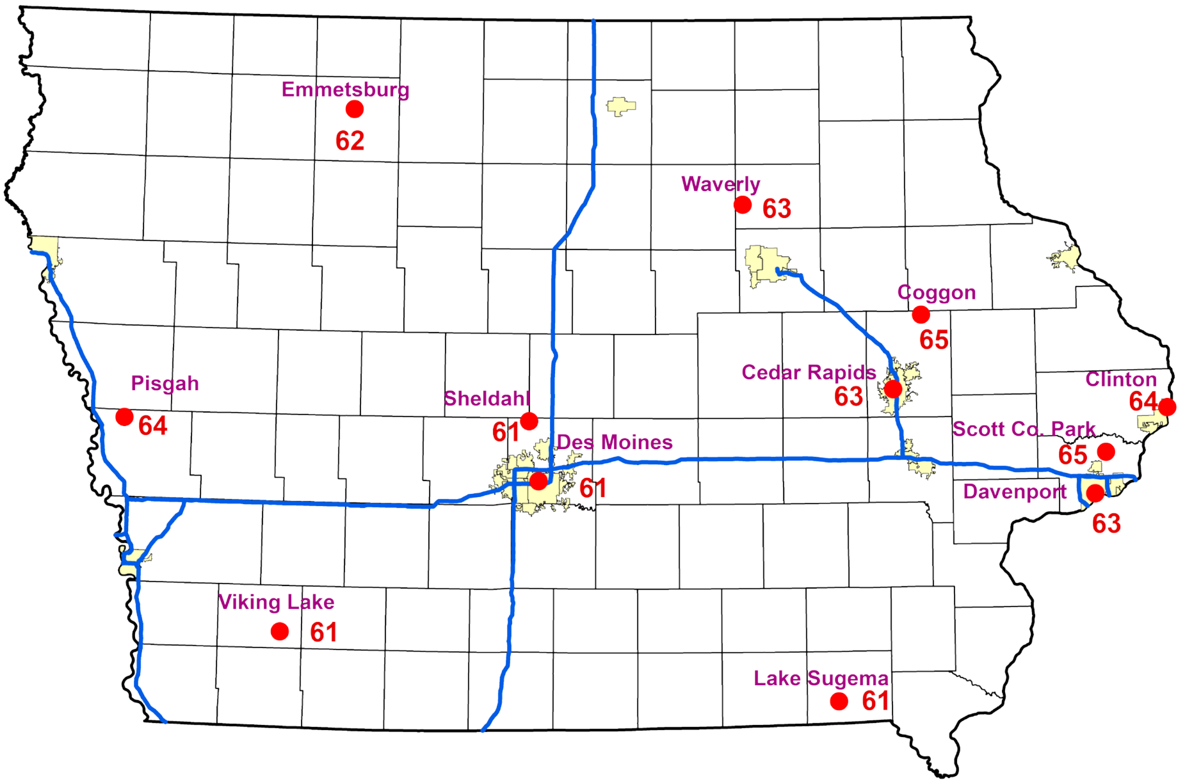
Shaded table cells indicate invalid design values as the site was not operational or did not meet data completeness requirements.

Iowa ozone design values by site and three-year period. Current NAAQS is 70 ppb.

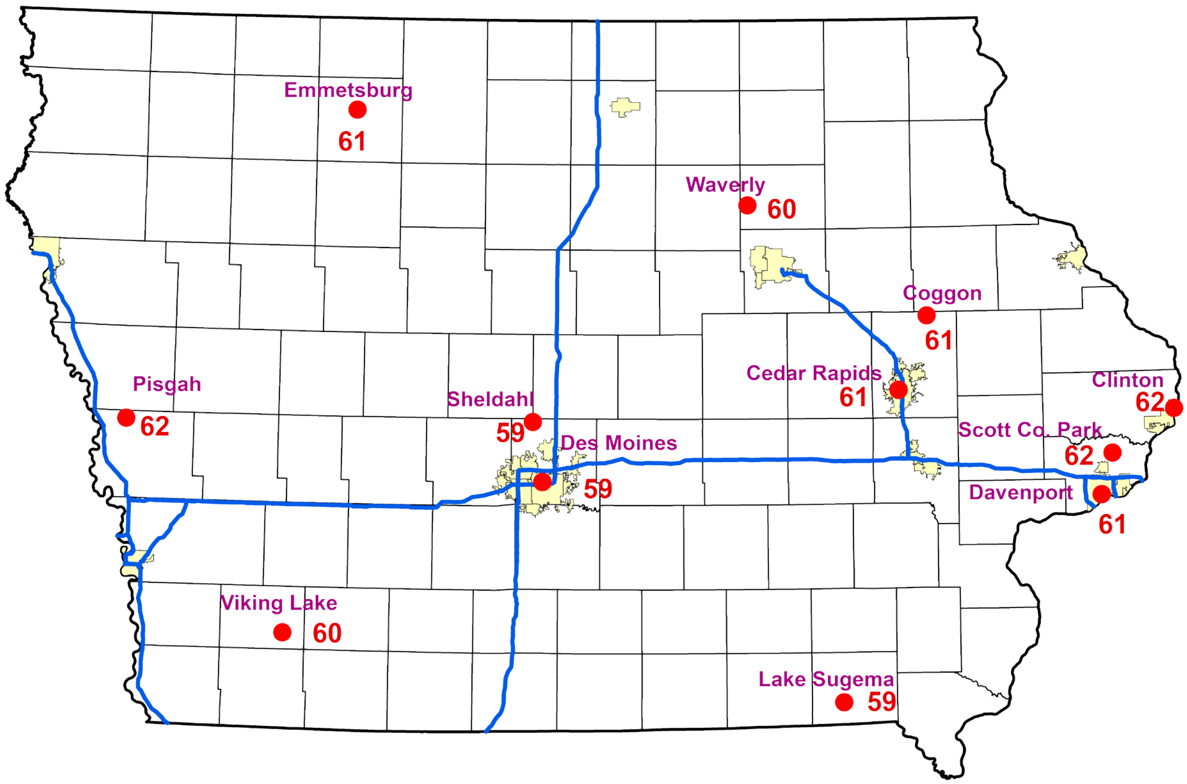

Median Ozone Design Values in Iowa Ozone Monitoring Network
Median
EPA Standard
Design Value (ppb)
90
85
80
75
70
65
60
55
50
2012-2014
2013-2015
2014-2016
2015-2017
2016-2018
Three Year Period


Box Plot of Ozone Design Value Trends
Median
EPA Standard
Maximum
75%-tile
Median
25%-tile
Minimum
Design Value (ppb)
90
85
80
75
70
65
60
55
50
63
60
61
61
63
2012-2014
2013-2015
2014-2016
2015-2017
2016-2018
Three Year Period

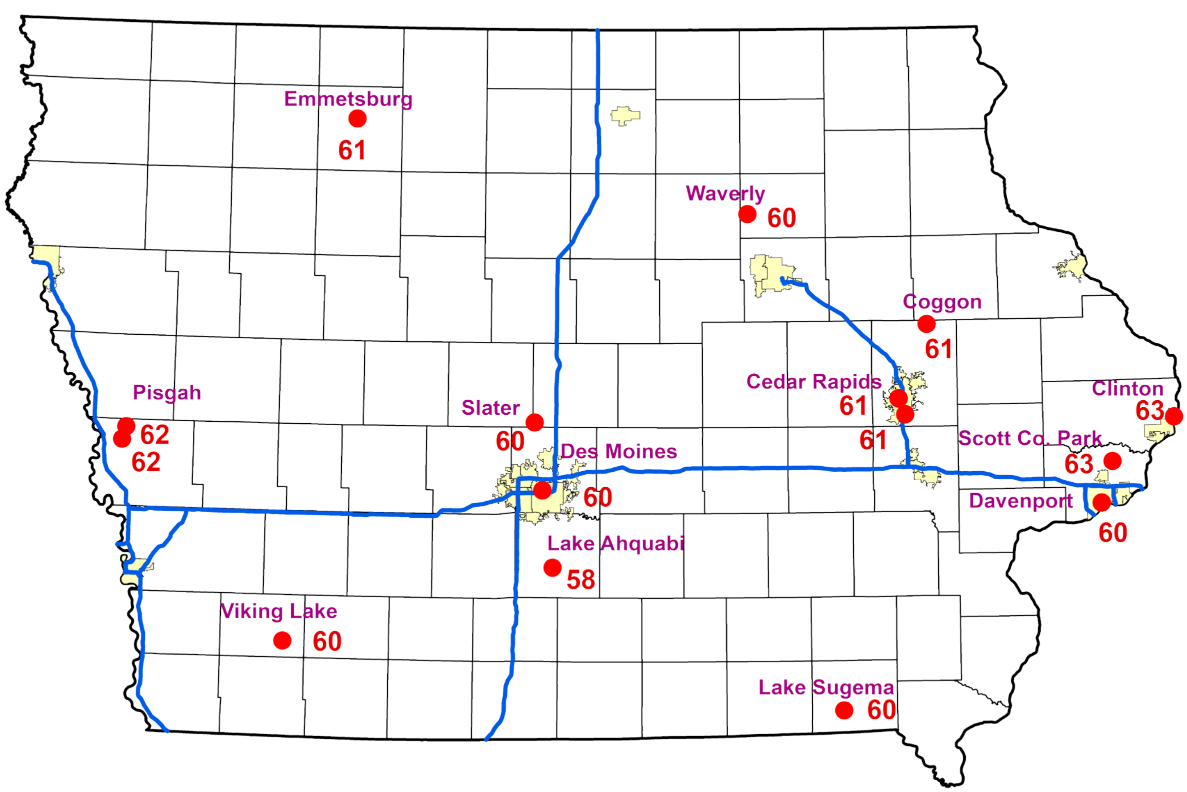
Ozone design value maps for the past five years are shown below. Three years of complete data are required to compute a design value, and only sites with complete data are indicated. The most recent (2016-2018) data shows ozone levels at monitoring sites in Linn County, Scott County, Clinton County, and Harrison County to be the highest in the network.



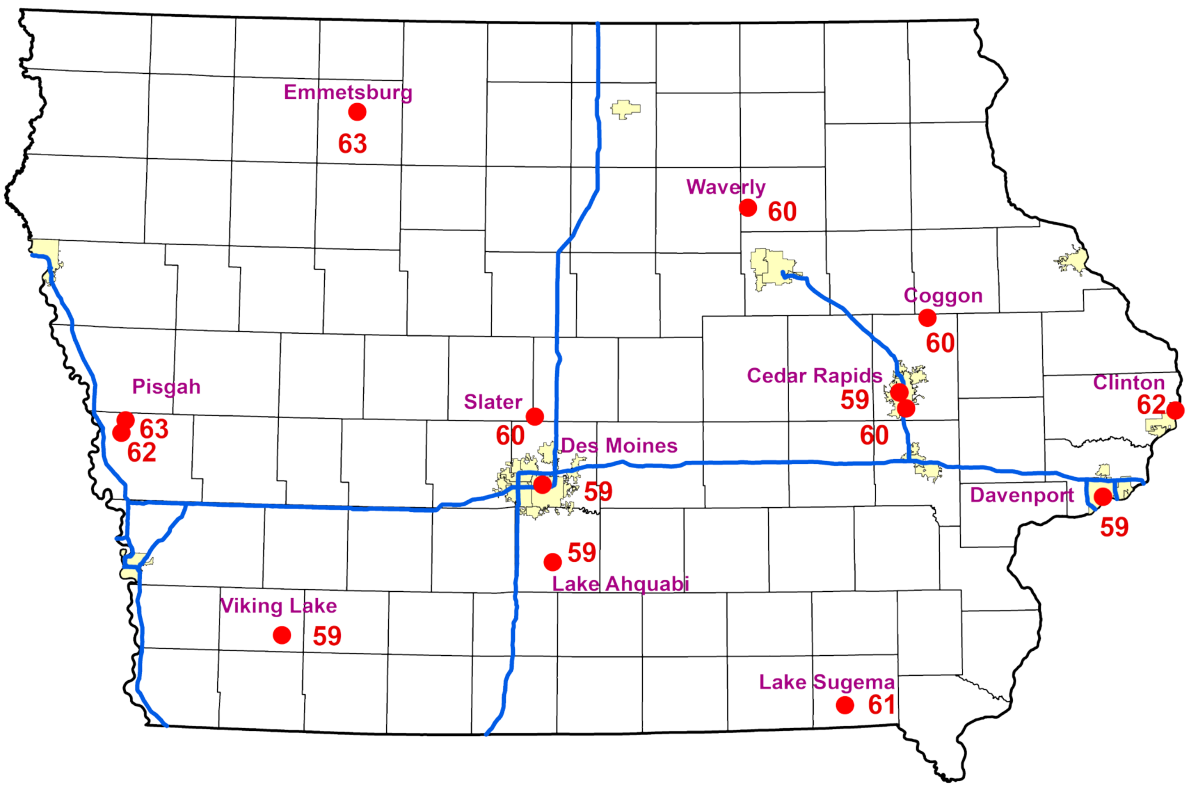
2016-2018 Ozone Design Values (ppb)



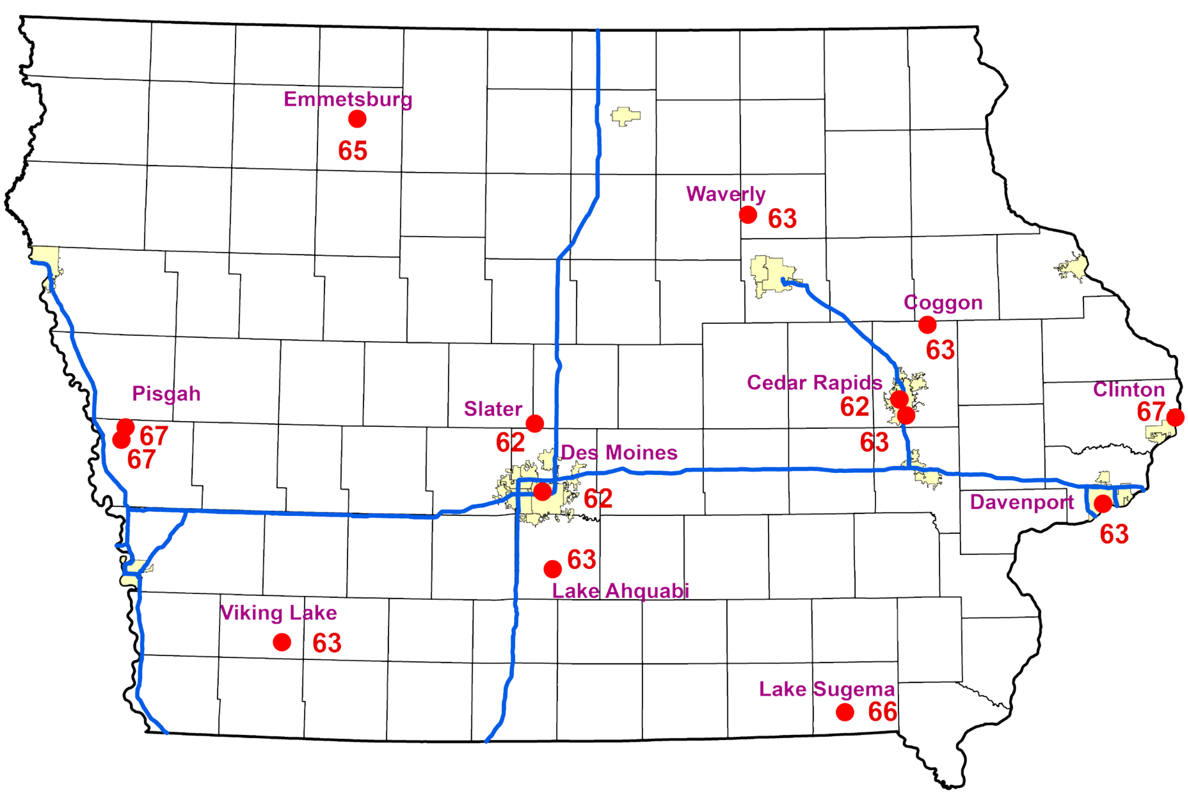
2015-2017 Ozone Design Values (ppb)



2014-2016 Ozone Design Values (ppb)



2013-2015 Ozone Design Values (ppb)



2012-2014 Ozone Design Values (ppb)

Section 3: $PM_{2.5}$ 24-Hour Design Values

Trends and maps of $PM_{2.5}$ 24-hour design values for the period 2014-2018 are provided below. The median $PM_{2.5}$ 24-hour design value in the Iowa $PM_{2.5}$ network has fallen by 4 µg/m^3 or about 17% over the past five years. During the five-year period, no violations of the NAAQS were recorded in the Iowa network.

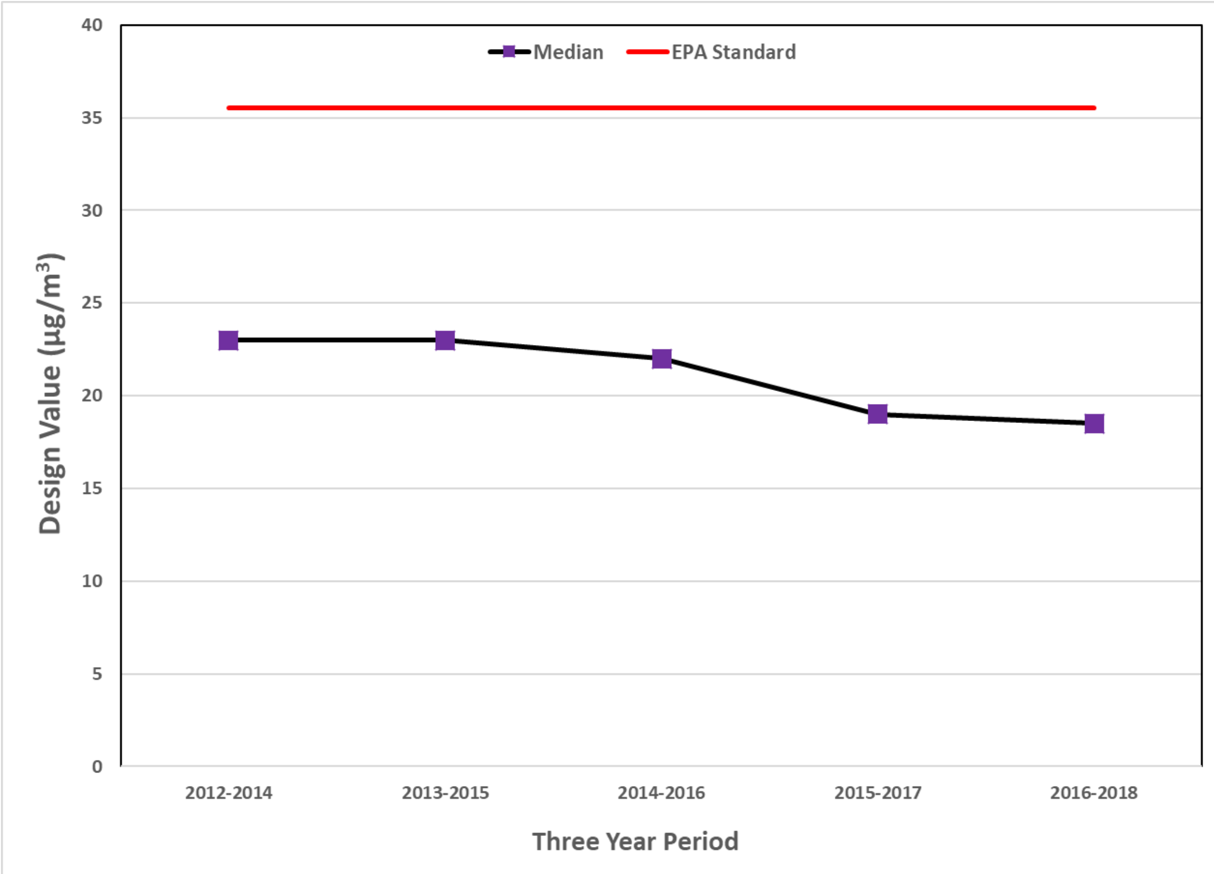
The most recent (2016-2018) monitoring data shows design values ranging from 16 to 21 µg/m^3, with a median value of 19 µg/m^3. There are three monitoring sites located in Eastern Iowa cities that are influenced by industrial $PM_{2.5}$ emitters. A monitor at Chancy Park (next to the Archer Daniels Midland Plant) in Clinton recorded levels that were 43% less than violation levels. Monitors at Muscatine High School East Campus and Musser Park (both about a quarter mile from Grain Processing Corporation) in Muscatine recorded levels about 40% and 46% under the violation level respectively.

$PM_{2.5}$ 24-Hour Design Values 2014-2018 ($\mu g/m^3$)

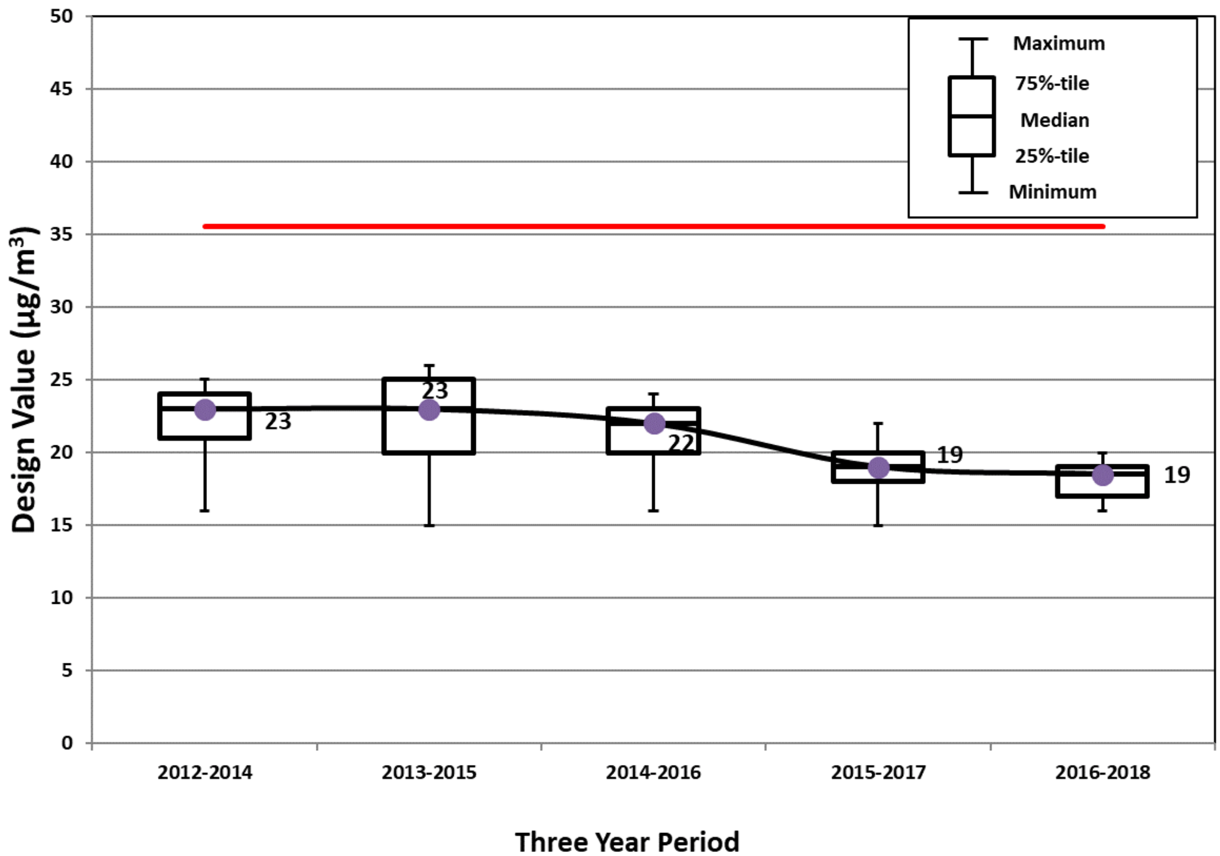
AQS ID	Site	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018
190130009	Waterloo, Water Tower	21	20	21	20	20
190450019	Clinton, Chancy Park	26	26	24	21	20
190450021	Clinton, Rainbow Park	23	24	22	20	19
190550001	Backbone State Park	21	22	21		
191032001	Iowa City, Hoover School	22	22	21	19	18
191110008	Keokuk, Fire Station	24	24	22	19	18
191130040	Cedar Rapids, Linn County Public Health	23	23	22	20	19
191370002	Viking Lake State Park	20	19	17	16	16
191390015	Muscatine, HS East Campus	29	28	25	21	21
191390016	Muscatine, Greenwood Cemetery	24	24	22	19	17
191390018	Muscatine, Franklin School	24	25	23		
191390020	Muscatine, Musser Park	27	28	26	21	19
191471002	Emmetsburg, Iowa Lakes Community College	21	19	17	16	17
191530030	Des Moines, Health Building	21	20	19	18	17
191532510	Clive, Indian Hills School	20	19	19	18	18
191550009	Council Bluffs, Franklin School	24	20	18	18	19
191630015	Davenport, Jefferson School	23	24	22	20	19
191630018	Davenport, Adams School	23	25	23		
191630020	Davenport, Hayes School	26	26	25	23	21
191770006	Lake Sugema	20	20	20	18	17
191930019	Sioux City, Bryant School	24	22			
191930021	Sioux City, Irving School					18

Shaded Cells indicate the site was not operational or had incomplete data. Current NAAQS is 35 $\mu g/m^3$.

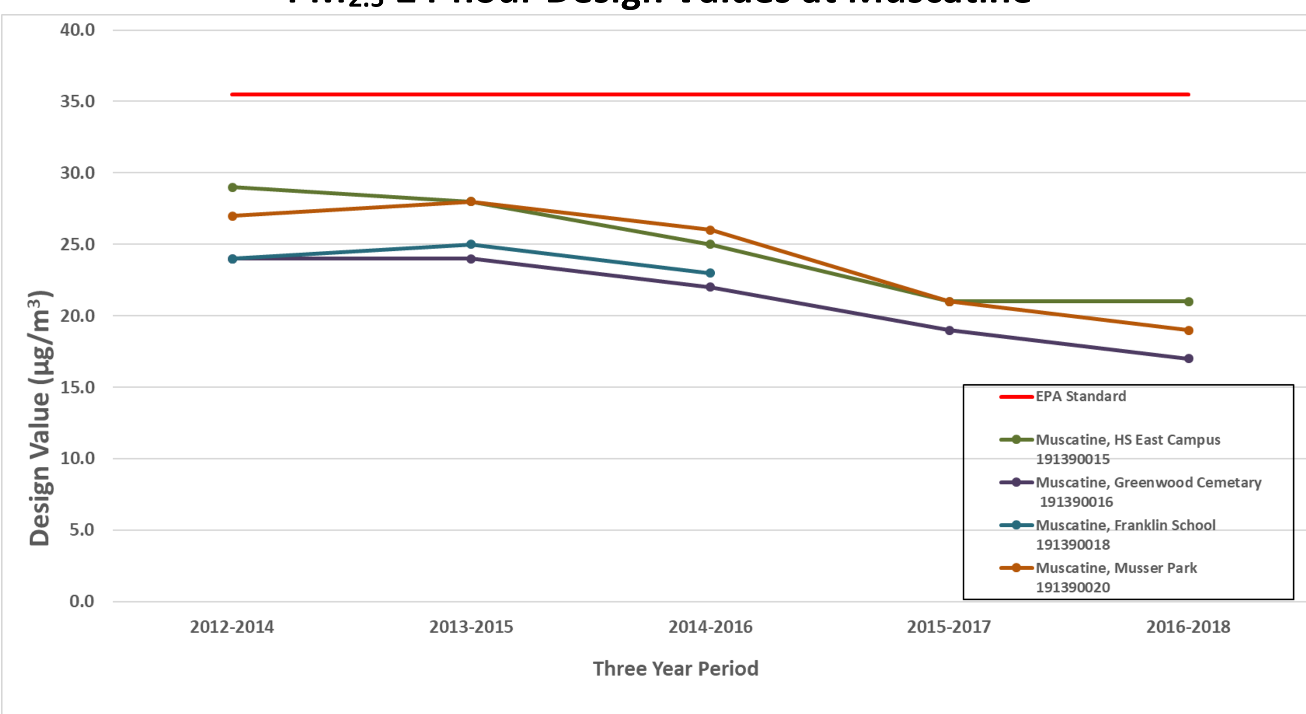
Median $PM_{2.5}$ 24-hour Design Value Trends in Iowa $PM_{2.5}$ Monitoring Network



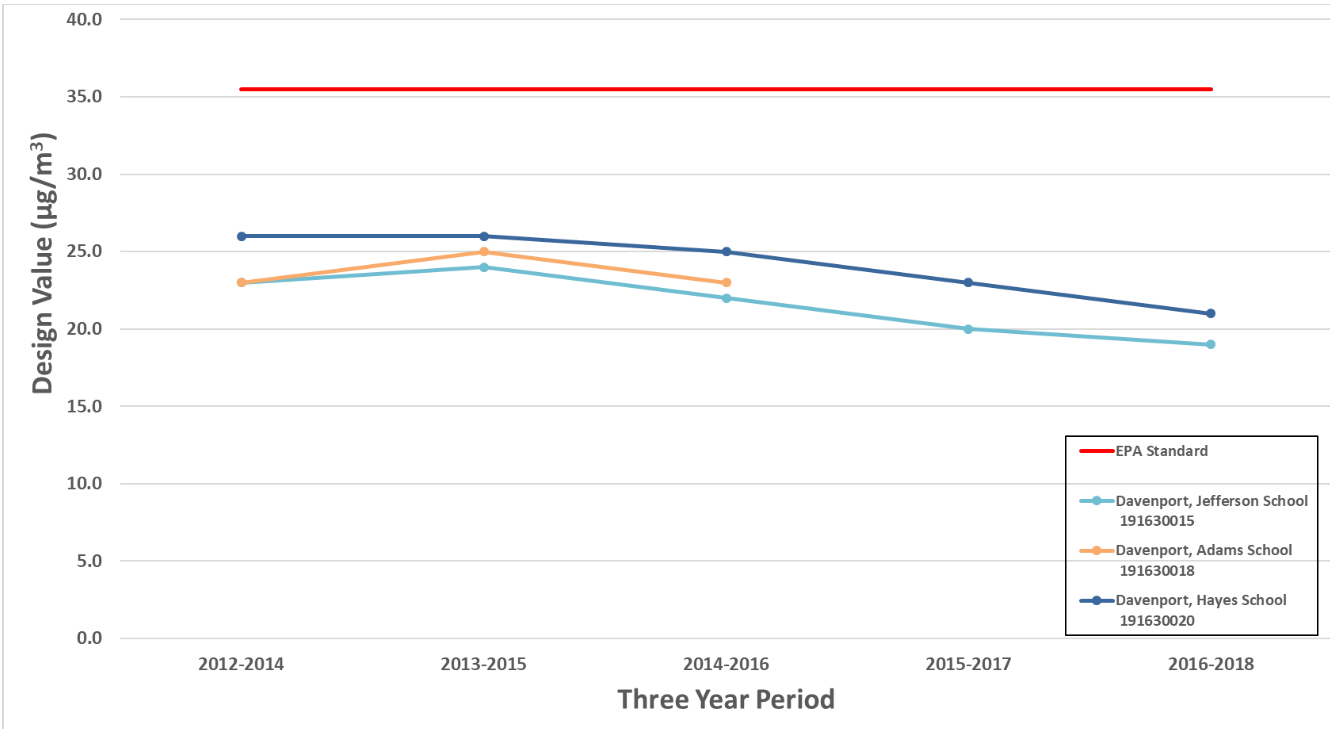
Box Plot of $PM_{2.5}$ 24-Hour Design Value Trends



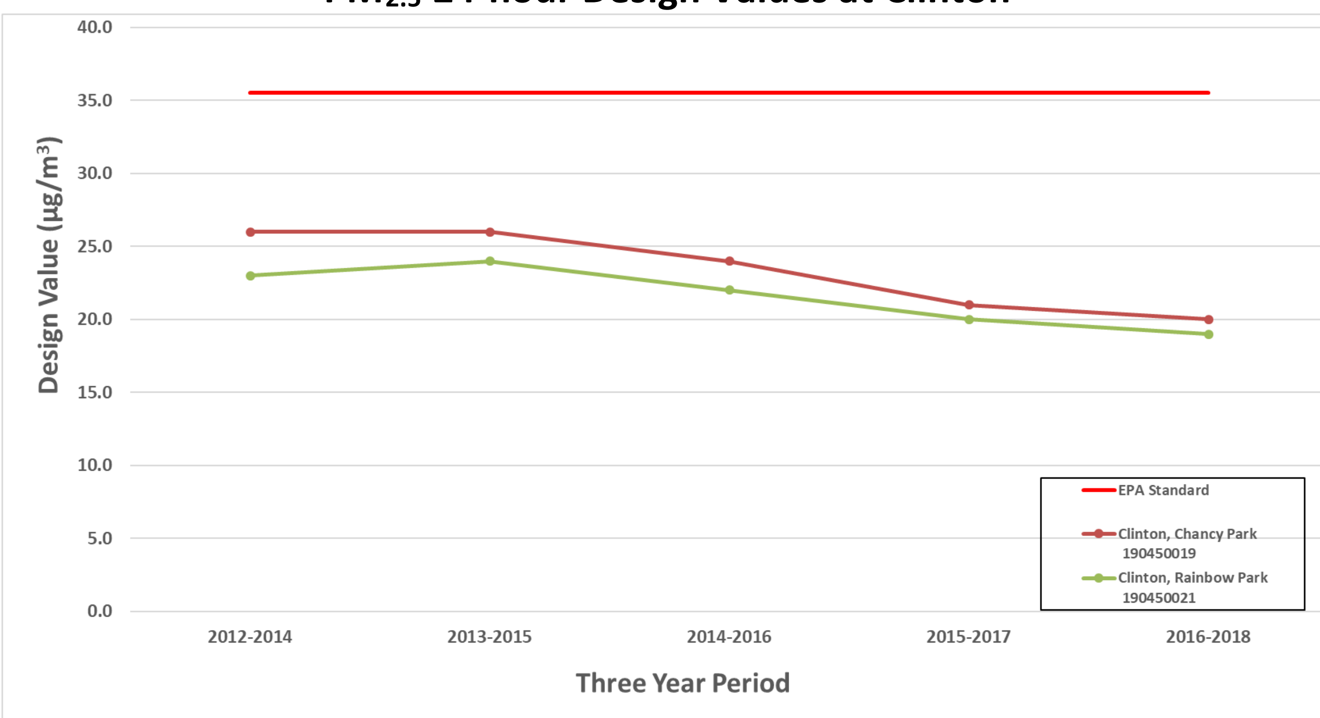
$PM_{2.5}$ 24-hour Design Values at Muscatine



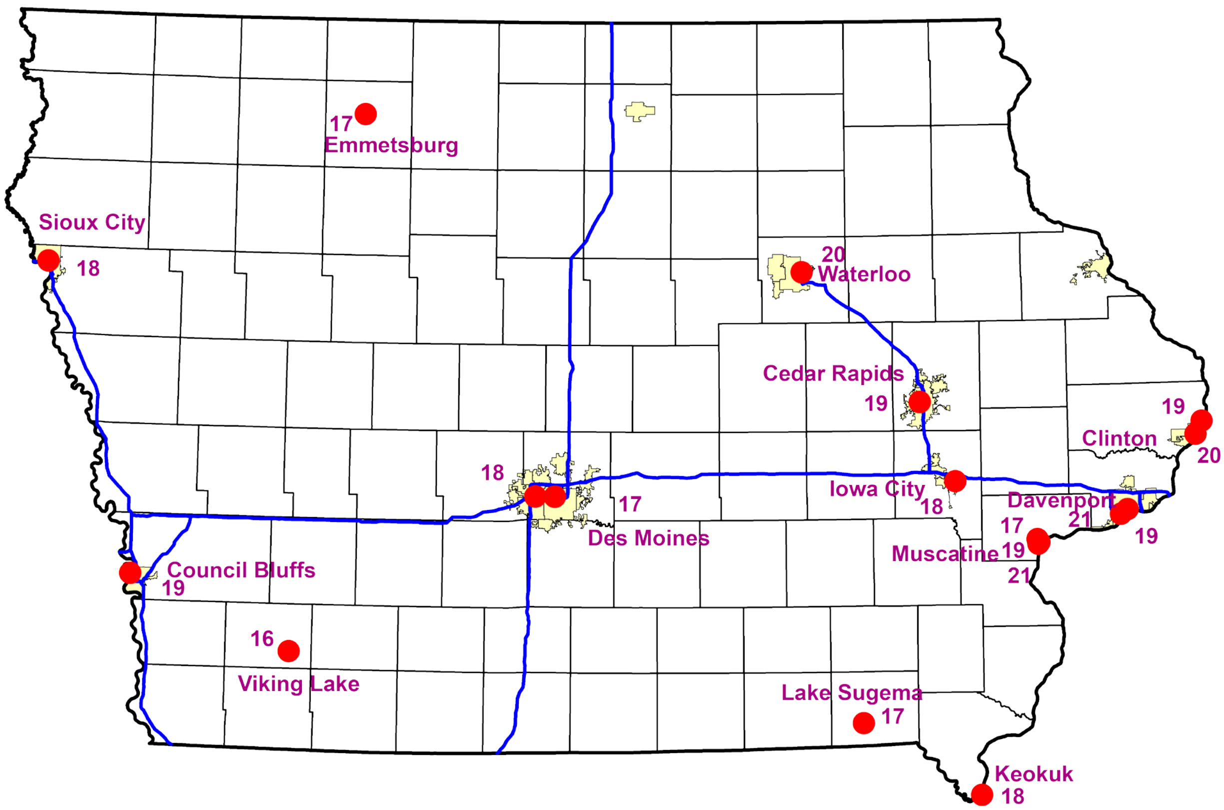
$PM_{2.5}$ 24-hour Design Values at Davenport



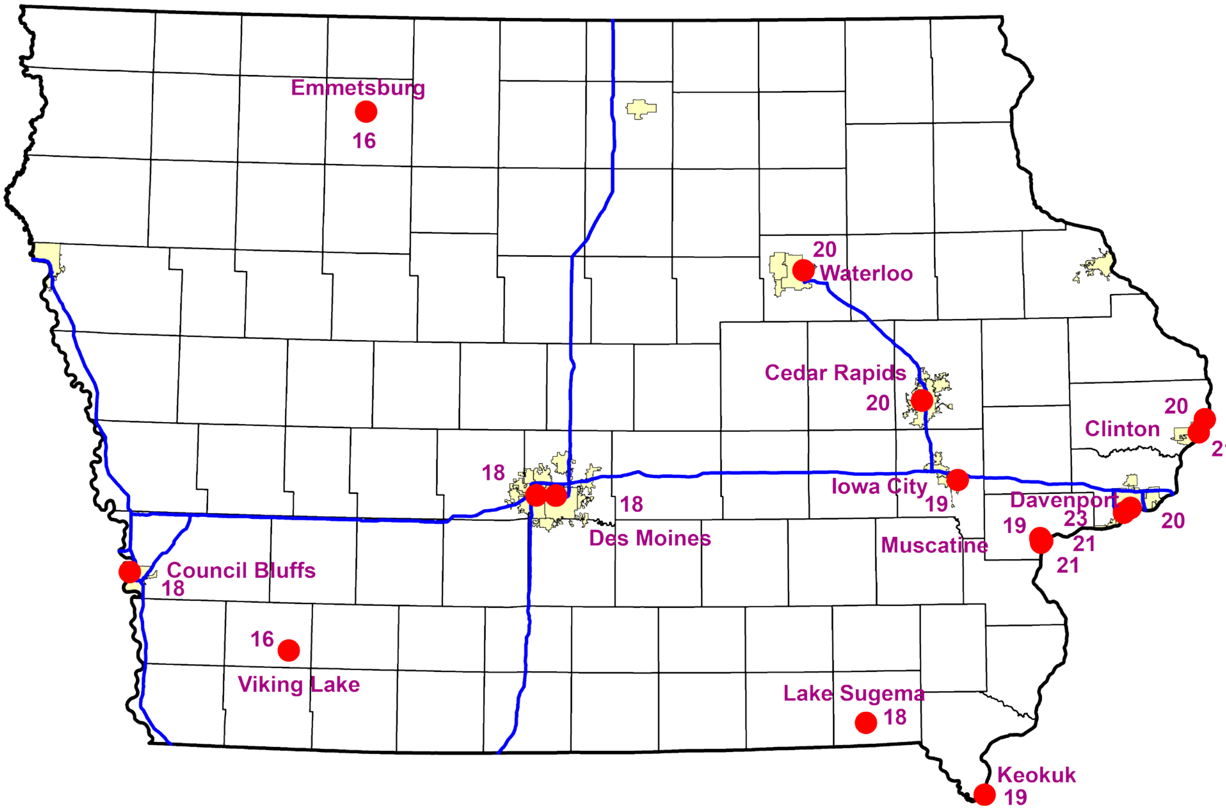
$PM_{2.5}$ 24-hour Design Values at Clinton



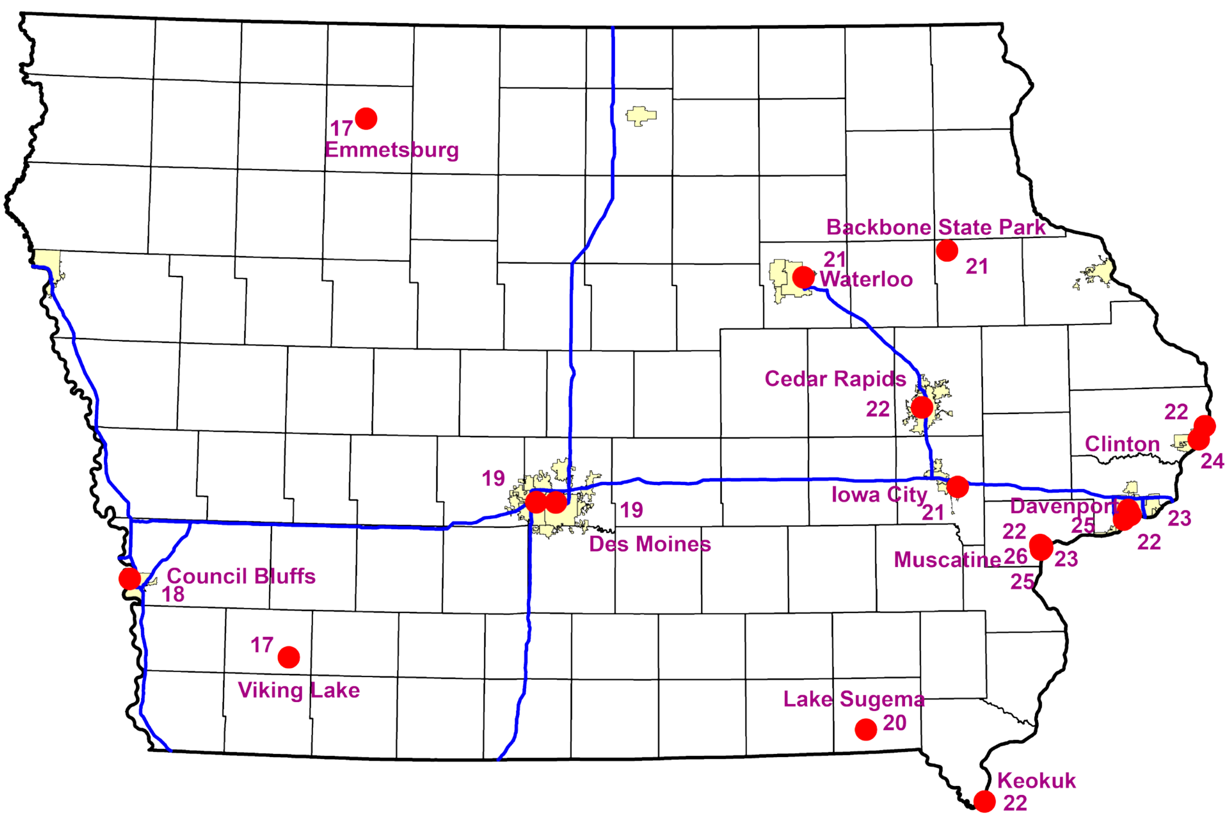
Maps of $PM_{2.5}$ 24-hour design values for the past five years are indicated below. Three years of complete data are required to compute a design value, and only sites with complete data are indicated. Monitors located near primary $PM_{2.5}$ emitters in Davenport, Clinton and Muscatine record the highest values. Monitors in the east tend to read slightly higher than those in the west. Monitors at background/ transport locations (Lake Sugema, Viking Lake, Emmetsburg) usually read less than those in more populated areas nearby.



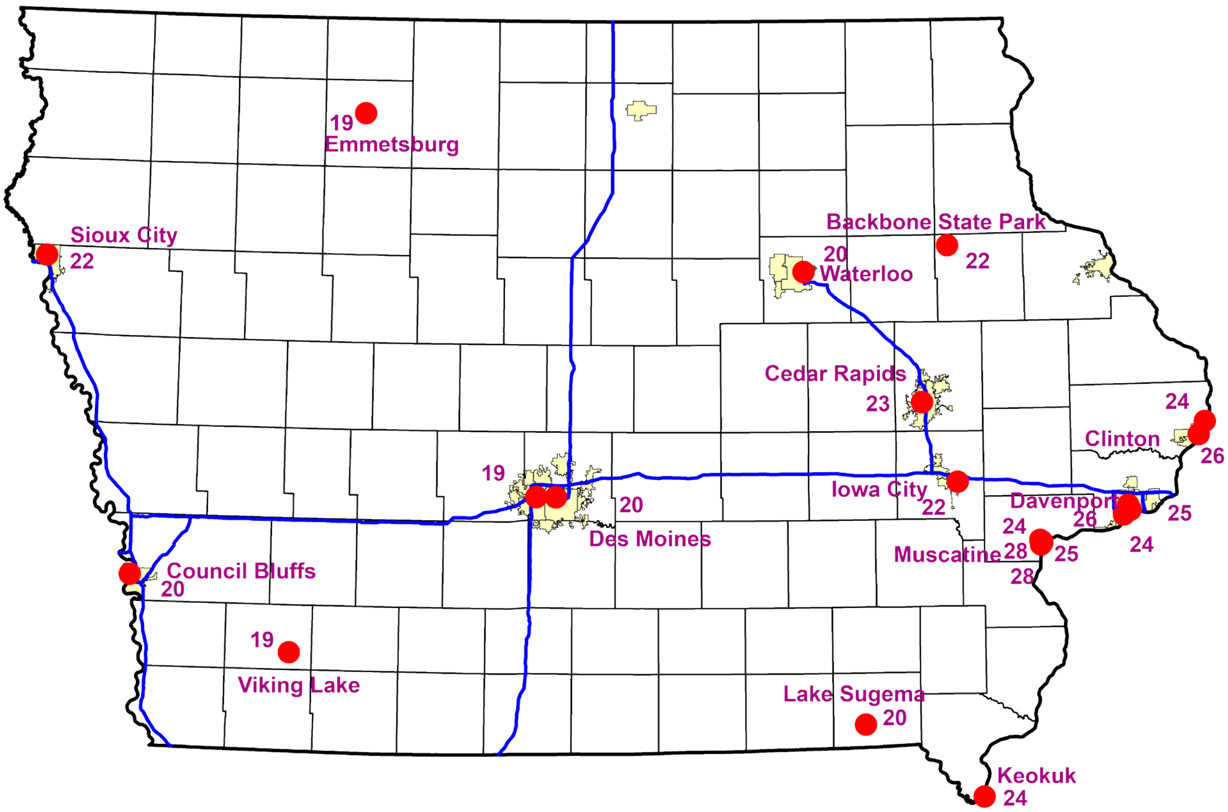
2016-2018 $PM_{2.5}$ 24-Hour Design Values ($\mu g/m^3$)



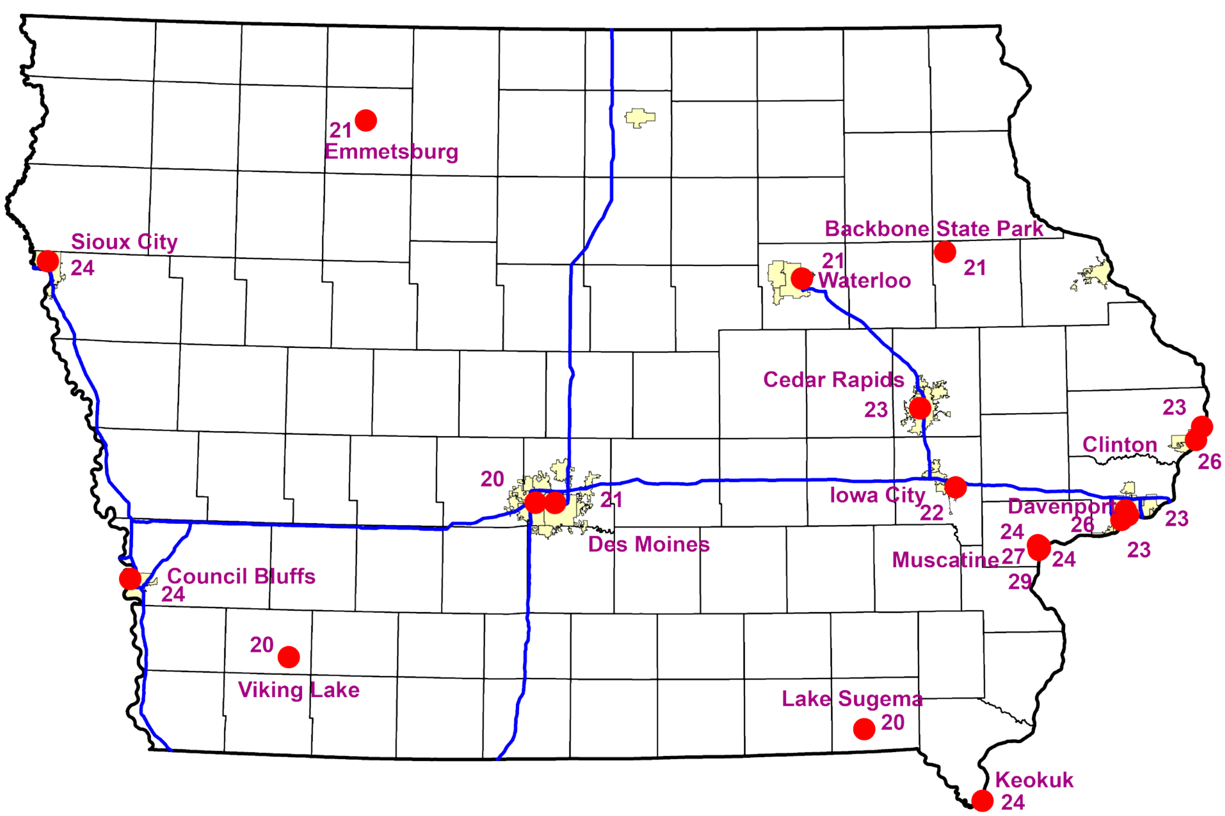
2015-2017 $PM_{2.5}$ 24-Hour Design Values (µg/m³)



2014-2016 $PM_{2.5}$ 24-Hour Design Values (µg/m³)



2013-2015 PM$_{2.5}$ 24-Hour Design Values (µg/m^3)



2012-2014 PM$_{2.5}$ 24-Hour Design Values (µg/m^3)

Section 4: PM$_{2.5}$ Annual Design Values

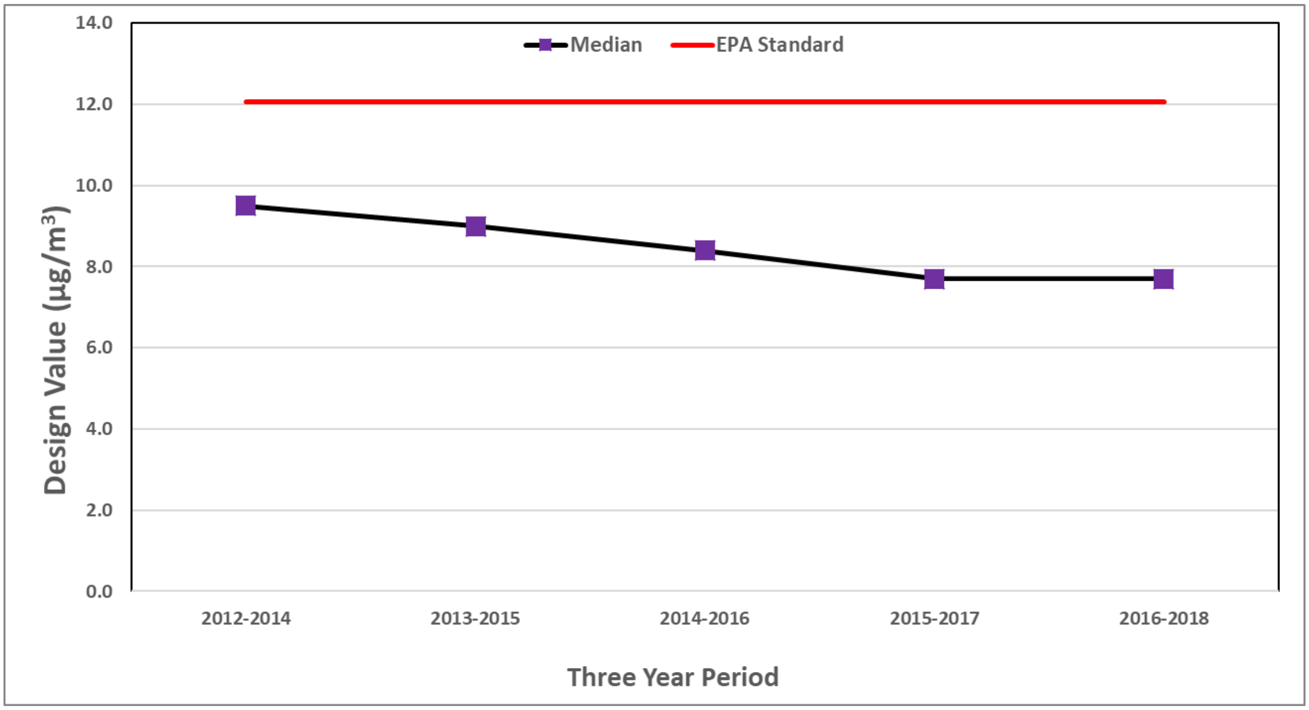
Trends and maps of PM$_{2.5}$ annual design values over the past five years are provided below. The median PM$_{2.5}$ annual design value in the Iowa PM$_{2.5}$ network has dropped by 2.0 µg/m^3 or about 20% over the past five years. No violations of the annual NAAQS were recorded anywhere in the network over this period. Monitors located next to industrial facilities that are not eligible for comparison with the annual NAAQS include Musser Park in Muscatine and Chancy Park in Clinton.

PM$_{2.5}$ Annual Design Values 2014-2018

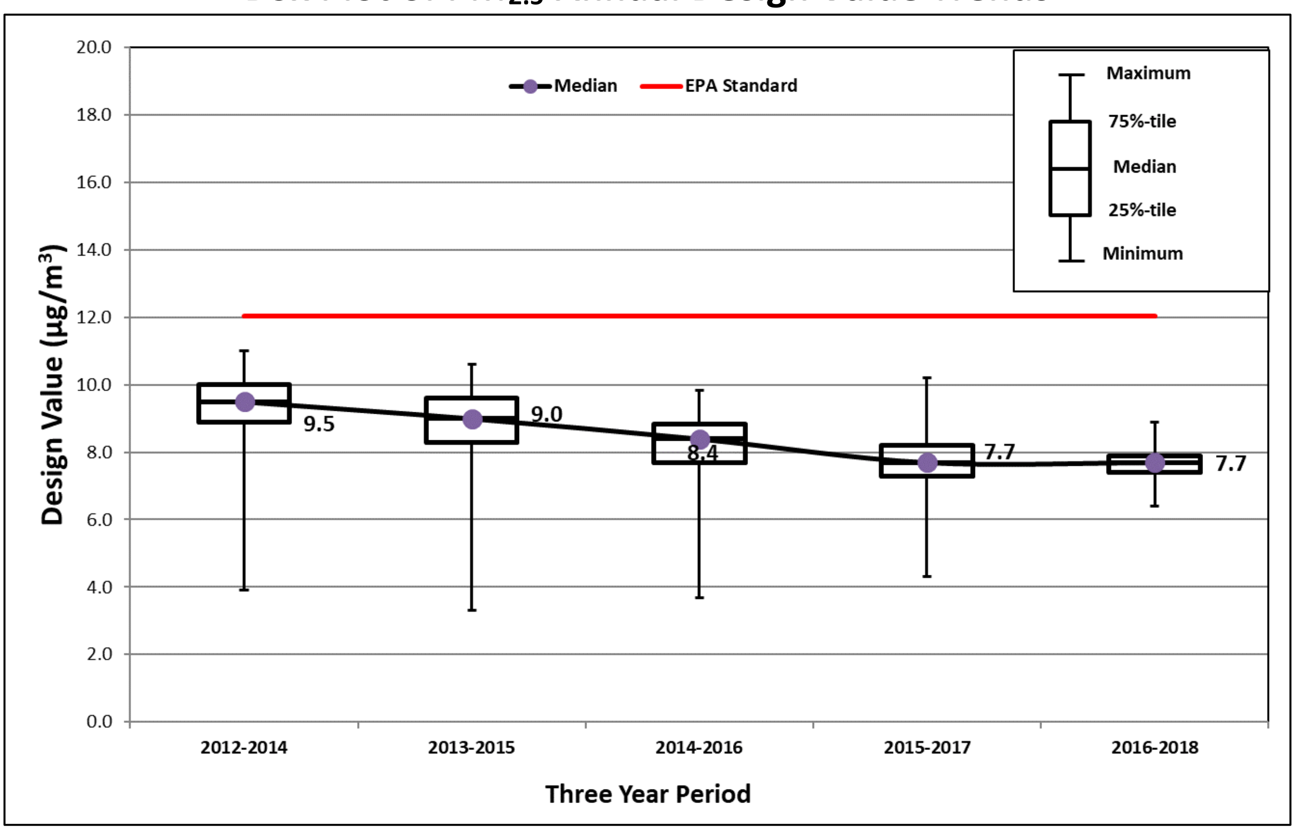
AQS ID	Site	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018
190130009	Waterloo, Water Tower	9.5	9	8.5	7.9	7.8
190450021	Clinton, Rainbow Park	9.5	9.3	8.7	8	7.7
190550001	Backbone State Park	9	8.7	8.1		
191032001	Iowa City, Hoover School	9.2	8.8	8.3	7.7	7.6
191110008	Keokuk, Fire Station	10.8	10	9.2	8.4	8.5
191130040	Cedar Rapids, Linn County Public Health	9.5	9.3	8.8	8.1	8
191370002	Viking Lake State Park	8.3	7.6	6.9	6.5	6.5
191390015	Muscatine, HS East Campus	10.8	10.2	9.2	8.3	8.3
191390016	Muscatine, Greenwood Cemetery	9.9	9.3	8.3	7.5	7.5
191390018	Muscatine, Franklin School	10.2	9.6	8.8		
191471002	Emmetsburg, Iowa Lakes Community College	8.2	7.8	7.3	6.8	6.7
191530030	Des Moines, Health Building	8.8	8.3	7.7	7.4	7.3
191532510	Clive, Indian Hills School	8.9	8.3	7.6	7.2	7.4
191550009	Council Bluffs, Franklin School	9.8	9	8.2	7.7	7.9
191630015	Davenport, Jefferson School	9.6	9.5	8.8	8.2	7.9
191630018	Davenport, Adams School	10	9.7	8.9		
191630020	Davenport, Hayes School	10.3	10.1	9.4	8.7	8.4
191770006	Lake Sugema	8.4	8	7.6	6.9	6.9
191930019	Sioux City, Bryant School	9.1	8.4			
191930021	Sioux City, Irving School					7.7

Shaded boxes indicate invalid design values as the site was not operational or did not meet data completeness requirements.

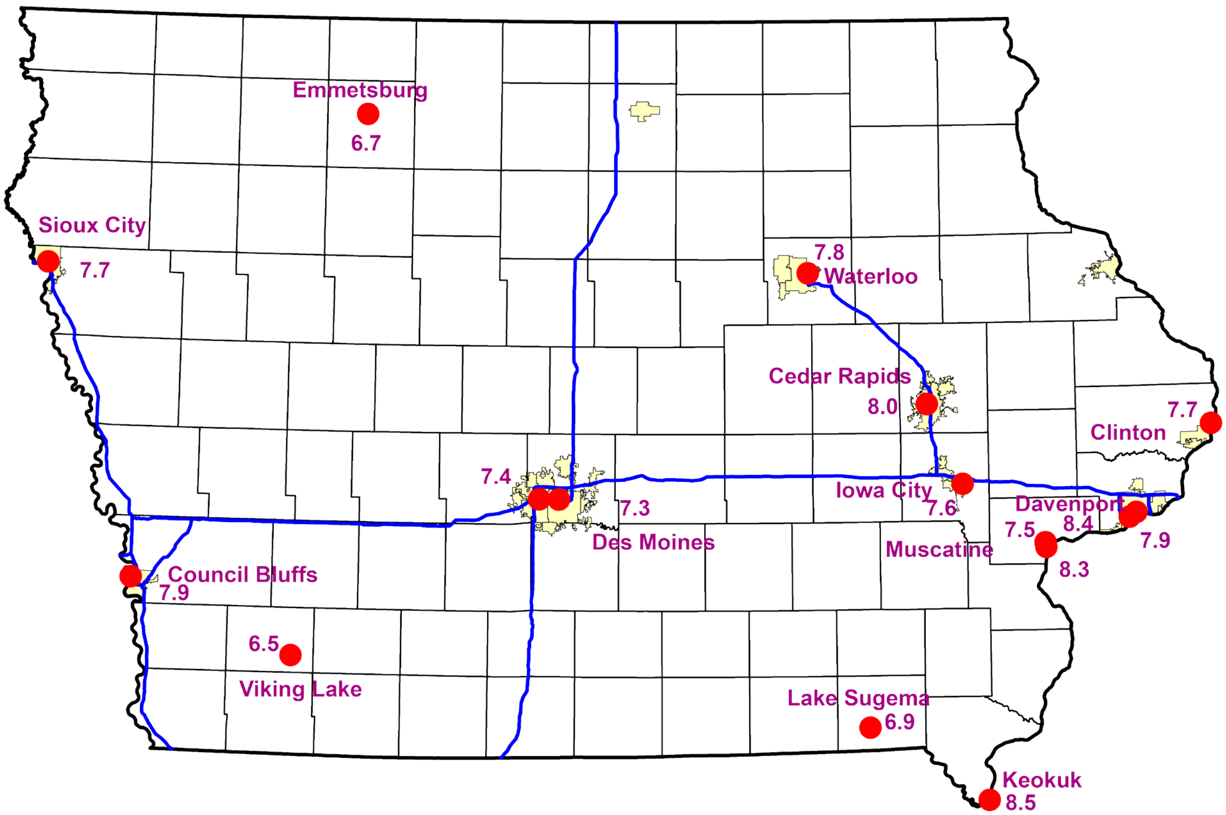
Median $PM_{2.5}$ Annual Design Value Trends In Iowa PM2.5 Monitoring Network (Source Oriented Sites are Not Included)



Box Plot of $PM_{2.5}$ Annual Design Value Trends

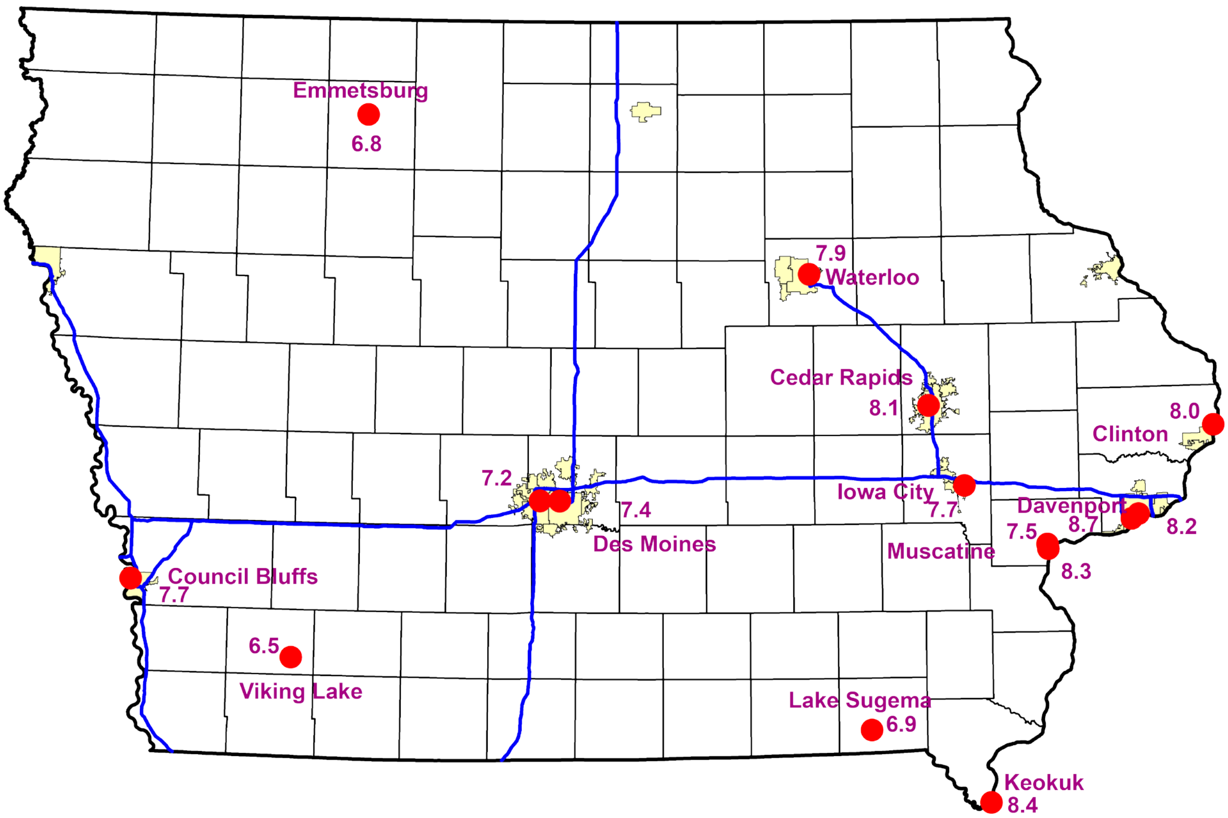


Maps of $PM_{2.5}$ annual design values for the most recent five-year period are indicated below. Three years of complete data are required to compute a design value, and only sites with complete data are indicated. Monitors in the east tend to read slightly higher than those in the west.[62] Monitors at background/transport locations (Lake Sugema, Viking Lake, and Emmetsburg) tend to read less than those in more populated areas.

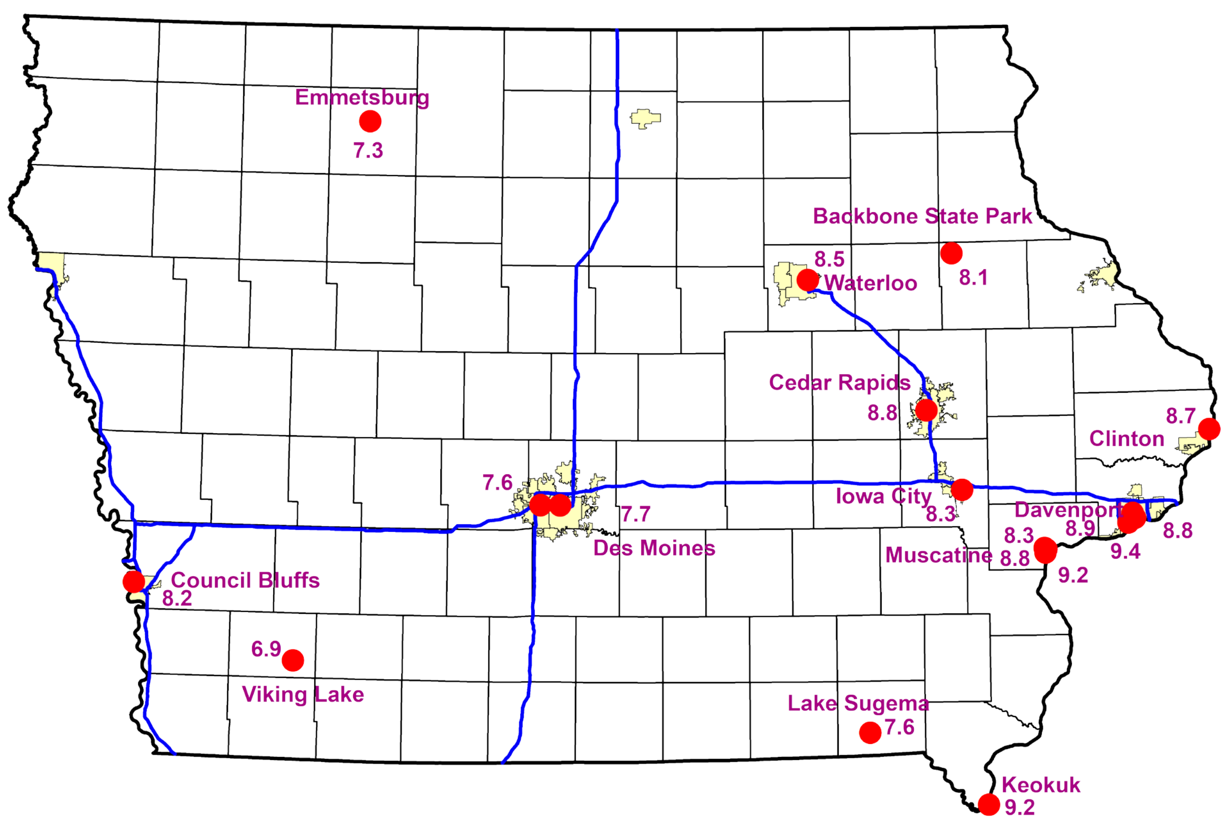


2016-2018 $PM_{2.5}$ Annual Design Values

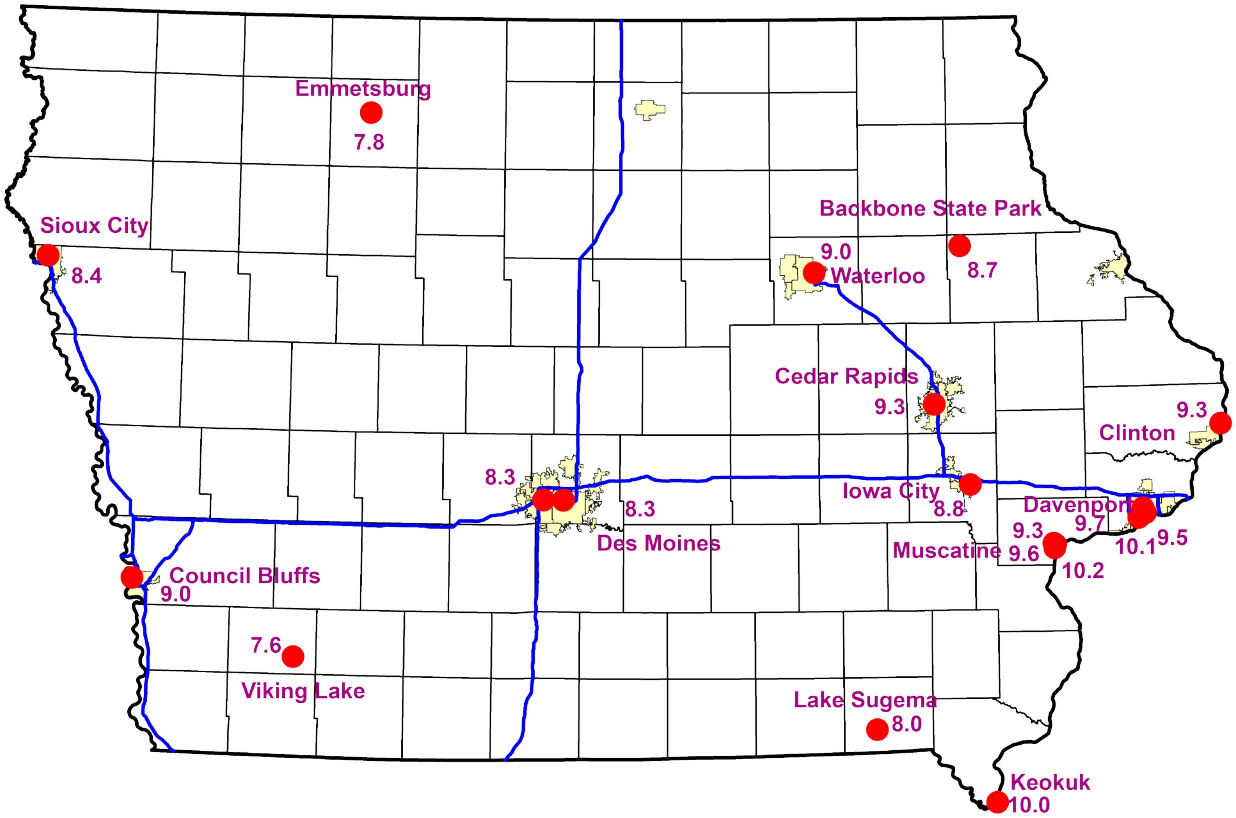
[62] The reduction in fine particle levels as one moves from the industrial Midwest to the western plains is well known; see for example: See Chapter 2 of: http://vista.cira.colostate.edu/Improve/spatial-and-seasonal-patterns-and-temporal-variability-of-haze-and-its-constituents-in-the-united-states-report-v-june-2011/.



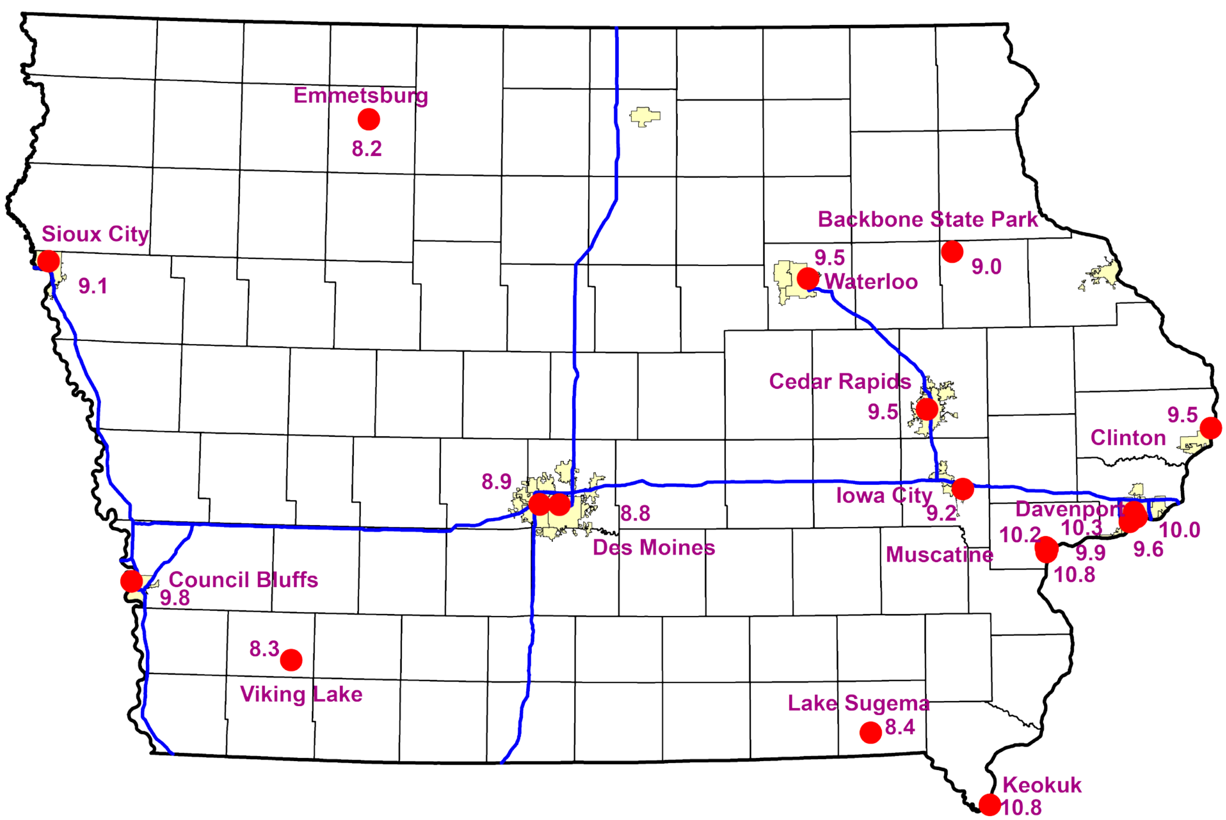
2015-2017 $PM_{2.5}$ Annual Design Values



2014-2016 $PM_{2.5}$ Annual Design Values



2013-2015 PM$_{2.5}$ Annual Design Values



2012-2014 PM$_{2.5}$ Annual Design Values

Section 5: SO_2 One-Hour Design Values

The one-hour SO_2 standard went into effect in August 2010. SO_2 one-hour design values over the most recent five years are provided below. The design values are the three year average of the annual 99th percentile daily maximum one-hour SO_2 concentrations calculated according to 40 CFR Part 50 Appendix T. A monitoring site must have a design value less than 76 ppb to attain the NAAQS.[63]

EPA declared an area of Muscatine adjacent to industrial SO_2 emitters to be in non-attainment with the SO_2 NAAQS in August of 2013.[64] Design values indicating NAAQS violations were recorded in Muscatine in 2011-2013 through 2014-2016. Iowa's State Implementation Plan (SIP) contains federally enforceable provisions to return the area to attainment no later than October of 2018. A consent decree signed in 2014 has resulted in significant SO_2 emissions reductions beginning in July of 2015.[65] No NAAQS violations have been recorded in Iowa for the 2015-2017 or the 2016-2018 periods.

The 2016-2018 median SO_2 one-hour design value in the Iowa SO_2 network is 20 ppb.

[63] Information on the SO_2 NAAQS is available at https://www.epa.gov/so2-pollution.

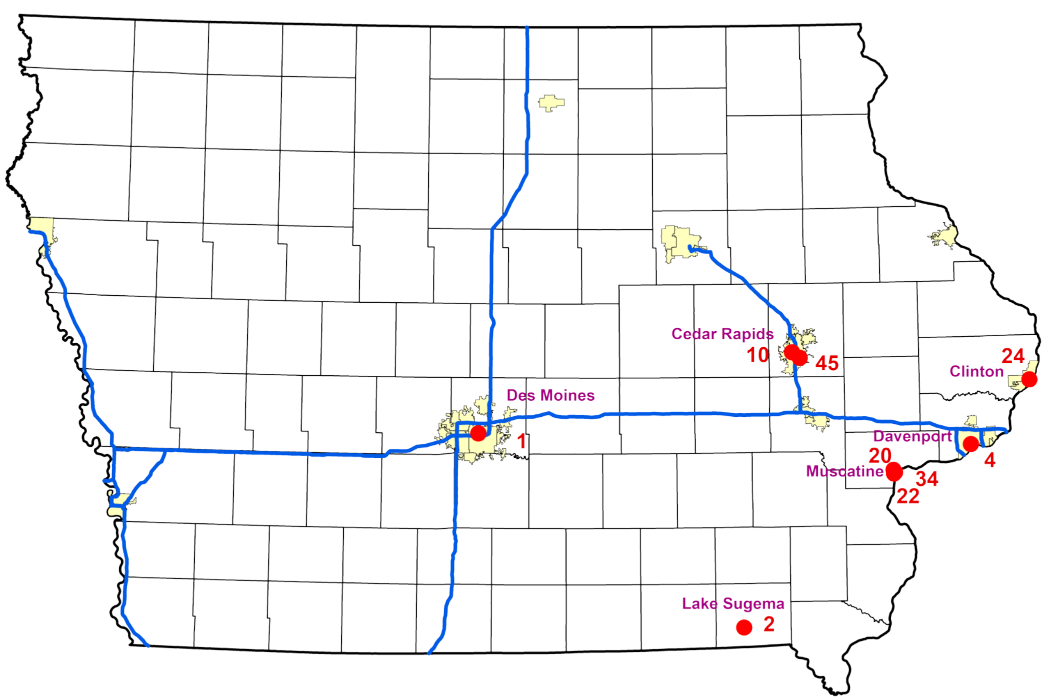
[64] This consent decree is available at: http://www.iowadnr.gov/Portals/idnr/uploads/Enforcement%20Actions/2014/enf6239.pdf.

[65] Paragraph 3(d) of 40 CFR Part 50 Appendix T of allows EPA the discretion to "consider consistency and levels of valid measurements" when it evaluates monitoring data for establishing attainment. EPA argued that the dataset from 2009-2011, although incomplete for the purposes of calculating a design value in accordance with Appendix T, was adequate to show that a complete dataset would have violated the NAAQS. Information on the Muscatine non-attainment designation is at: https://www.federalregister.gov/articles/2013/08/05/2013-18835/air-quality-designations-for-the-2010-sulfur-dioxide-so2-primary-national-ambient-air-quality#page-47200 and https://www.epa.gov/sulfur-dioxide-designations/so2-designations-round-2-iowa-state-recommendation-and-epa-response.

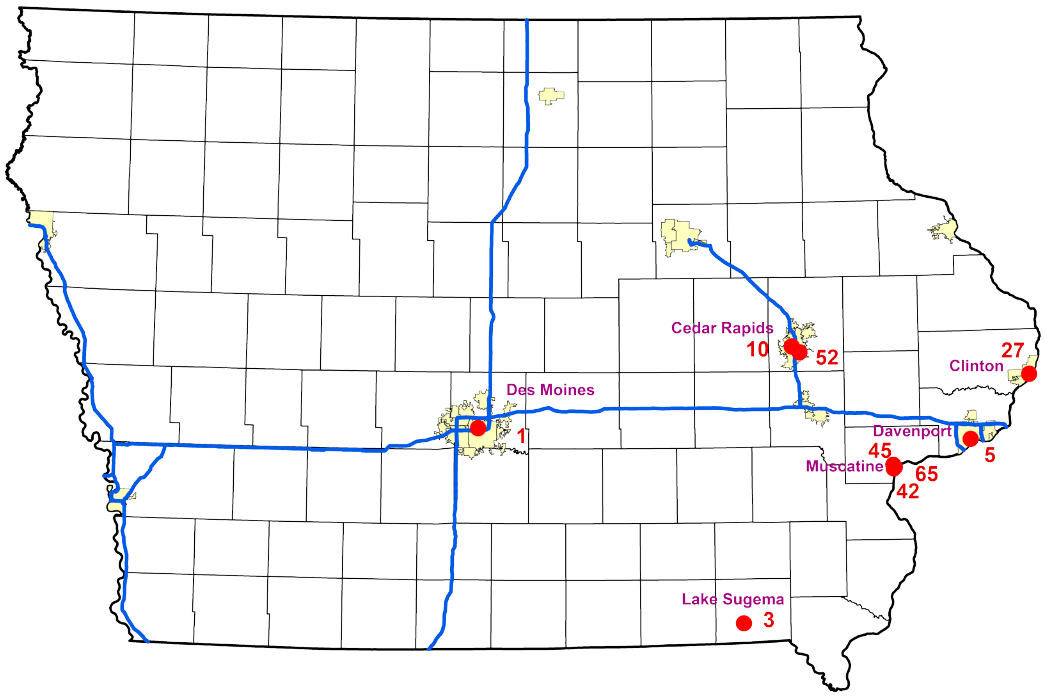
Years	Clinton, Chancy Park 190450019	Cedar Rapids, Linn County Public Health 191130040	Cedar Rapids, Tait Cummins Park 191130041	Muscatine, Greenwood Cemetery 191390016	Muscatine, High School East Campus 191390019	Muscatine, Musser Park 191390020	Des Moines, Health Department 191530030	Davenport, Jefferson School 191630015	Lake Sugema 191770006	Sergeant Bluff, George Neal North 191930020
2012-2014	39	24		101		194	1	12	3	
2013-2015	30	20		97	128	158	1	11	3	12
2014-2016	29	16	72	77	84	113	1	7	2	9
2015-2017	27	10	52	45	42	65	1	5	3	
2016-2018	24	10	45	20	22	34	1	4	2	

Shaded boxes indicate invalid design values as the site was not operational or did not meet data completeness requirements.

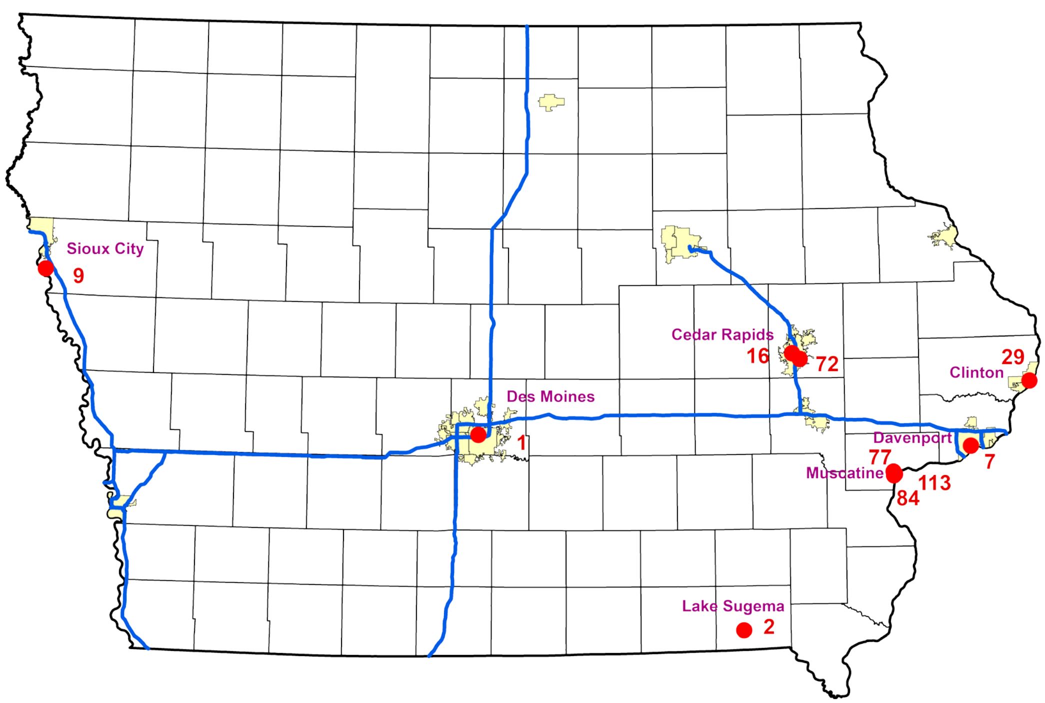
Iowa SO_2 Design Values 2014-2018. Current NAAQS is 75 ppb.



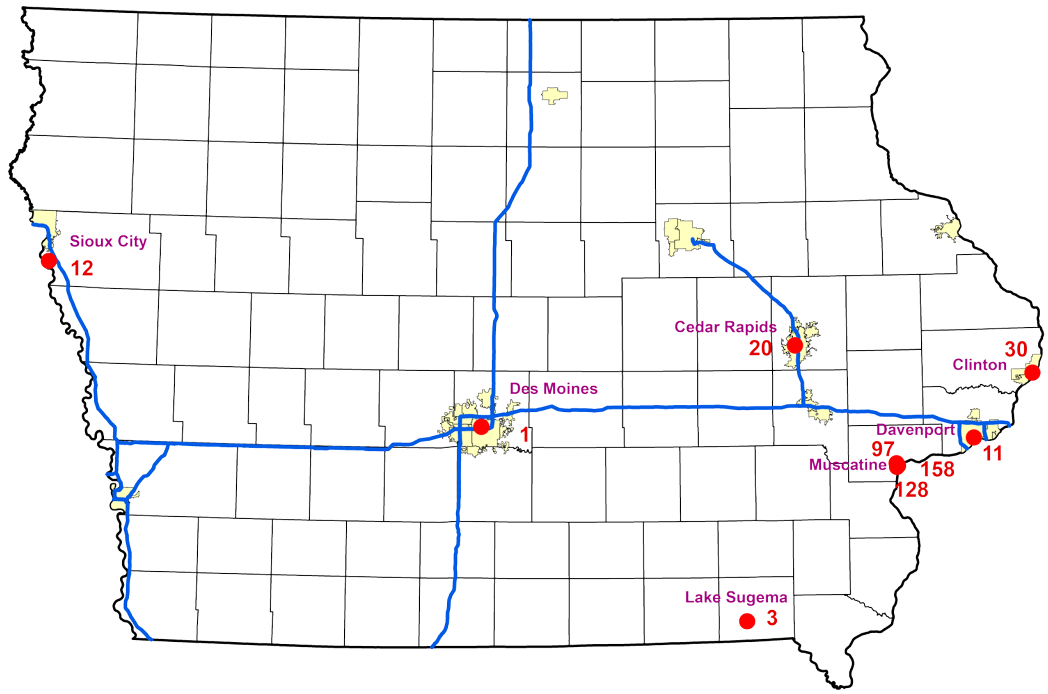
2016-2018 SO_2 One-Hour Design Values



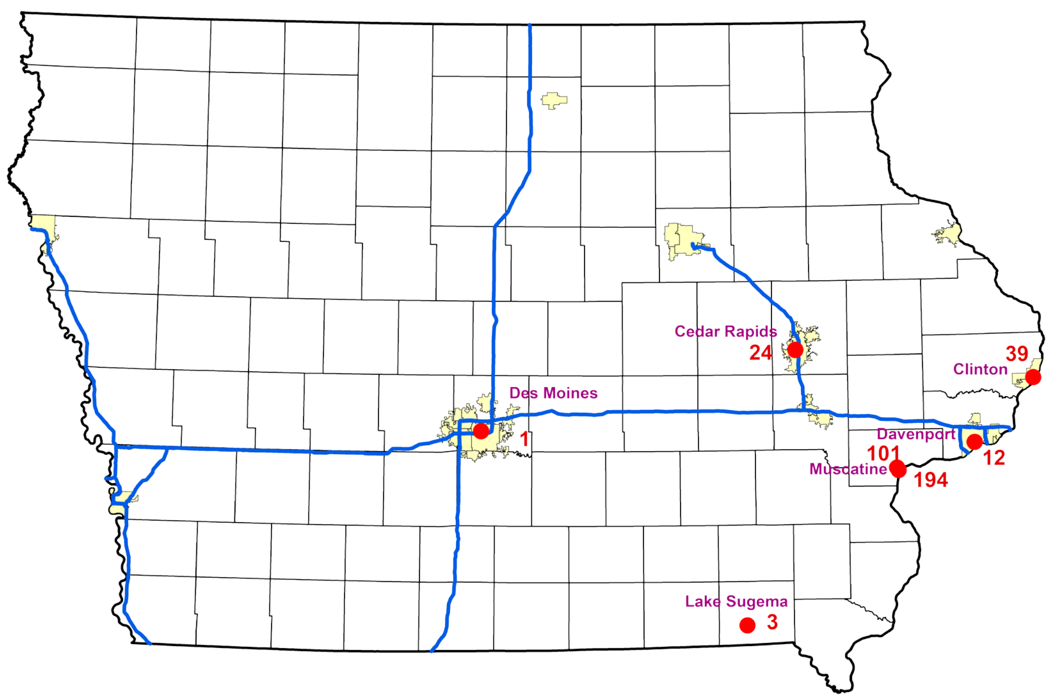
2015-2017 SO_2 One-Hour Design Values



2014-2016 SO_2 One-Hour Design Values



2013-2015 SO_2 One-Hour Design Values



2012-2014 SO_2 One-Hour Design Values

Section 6: NO_2 One-Hour Design Values

The one-hour NO_2 standard went into effect in April 2010. NO_2 one-hour design values over the most recent five years are provided below. The design values are the three year average of the annual 98th percentile daily maximum one-hour NO_2 concentrations calculated according to 40 CFR Part 50 Appendix S.[66] A monitoring site must have a design value less than 101 ppb to attain the NAAQS.[67]

The median 2016-2018 NO_2 one-hour design value in the Iowa NO_2 network is 31 ppb. No NAAQS violations were recorded.

NO_2 One-Hour Design Values

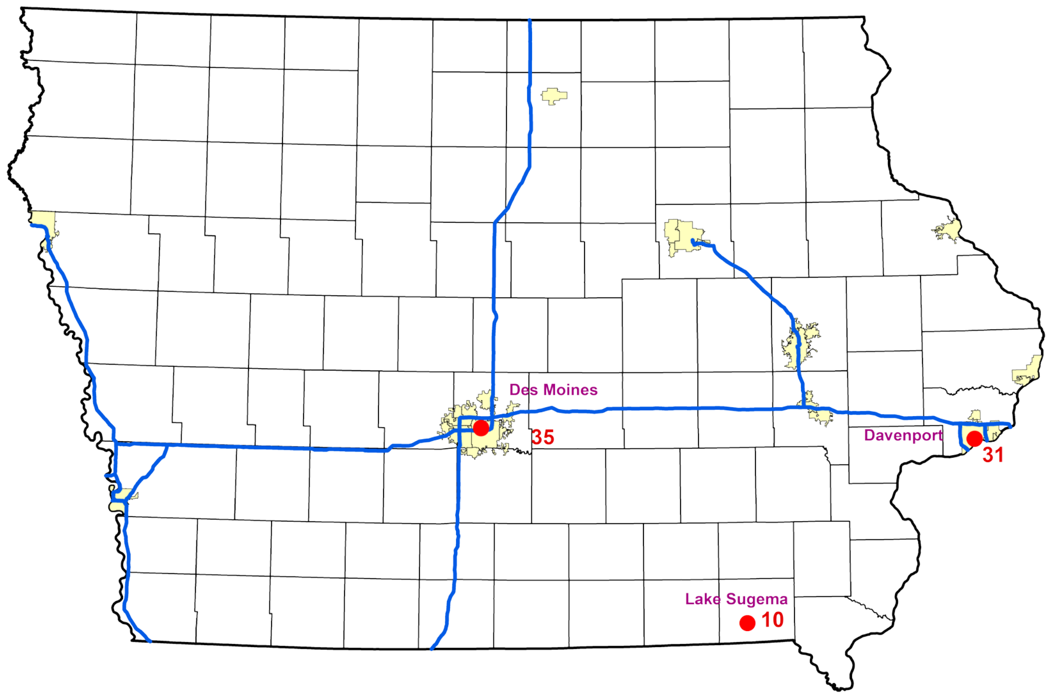
Years	Des Moines, Health Department 191530030	Des Moines, Near-Road NO2 191536011	Davenport, Jefferson School 191630015	Lake Sugema 191770006
2012-2014	**37**		**36**	**10**
2013-2015	**37**	**34**	**38**	**9**
2014-2016	**35**	**33**	**35**	**8**
2015-2017	**36**		**35**	**8**
2016-2018	**35**		**31**	**10**

Shaded boxes indicate invalid design values as the site was not operational or did not meet data completeness requirements.

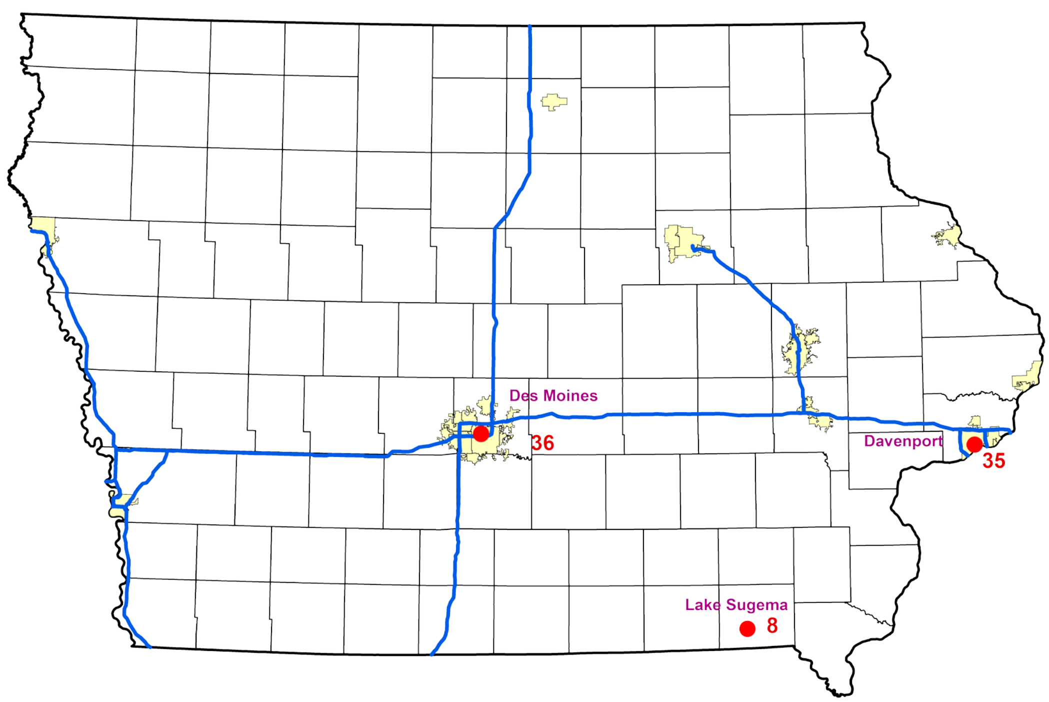
Current NAAQS is 100 ppb.

[66] 40 CFR 50 Appendix S is found at https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr50_main_02.tpl.

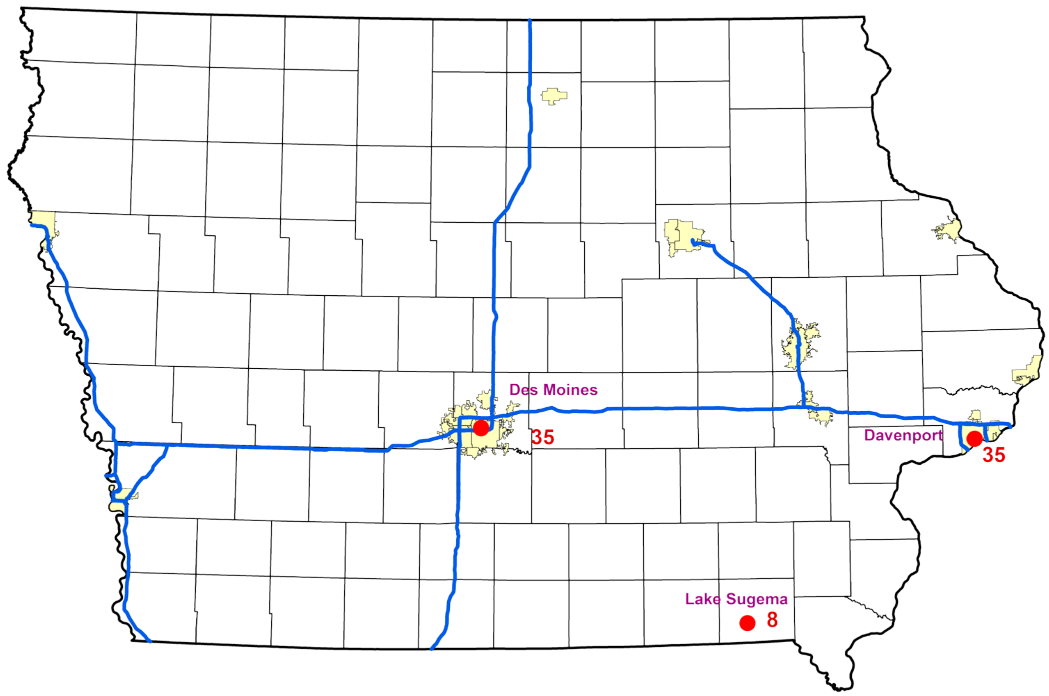
[67] Information on the NO_2 NAAQS is available at https://www.epa.gov/no2-pollution/primary-national-ambient-air-quality-standards-naaqs-nitrogen-dioxide.



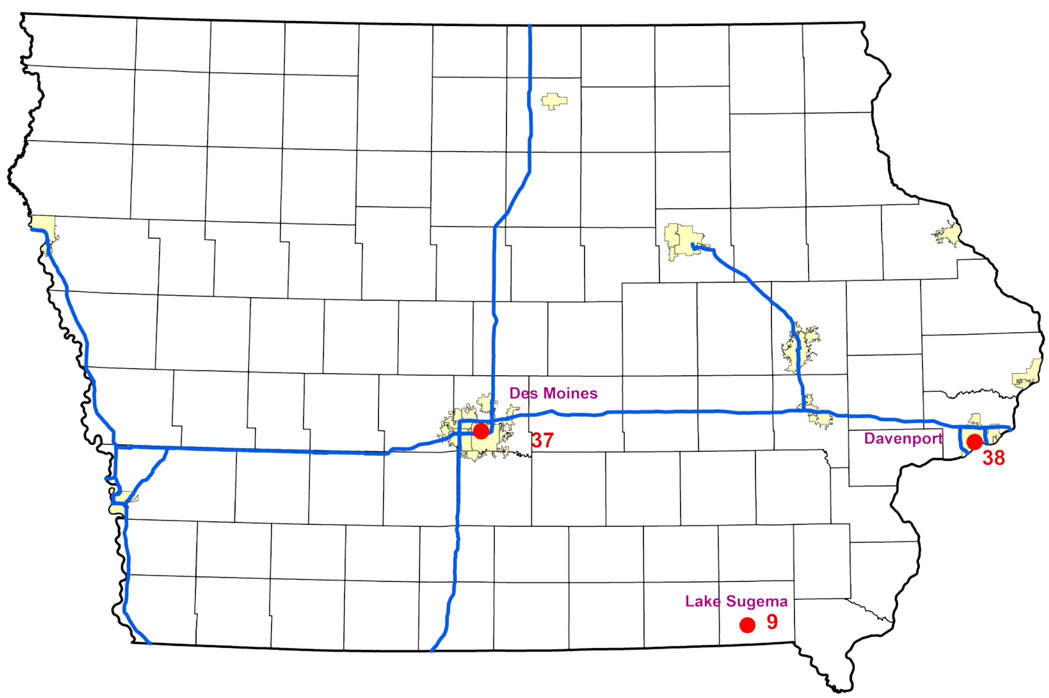
2016-2018 NO_2 One-Hour Design Values



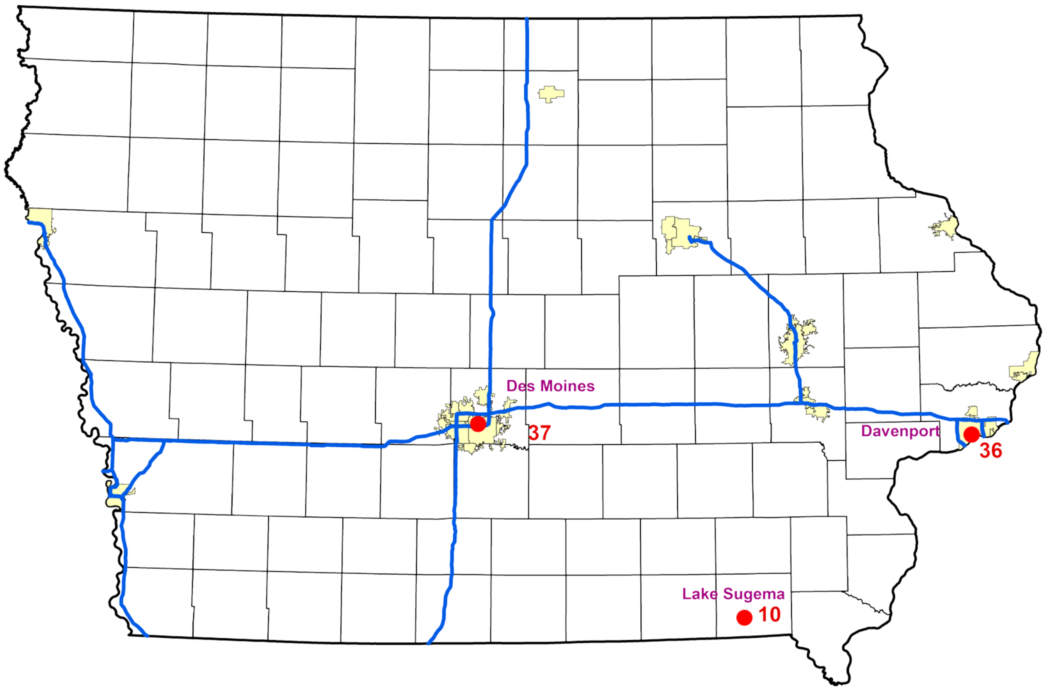
2015-2017 NO_2 One-Hour Design Values



2014-2016 NO_2 One-Hour Design Values



2013-2015 NO_2 One-Hour Design Values



2012-2014 NO_2 One-Hour Design Values

Section 7: Lead Design Values

The current lead NAAQS took effect in January 2009[68]. Trends and maps of lead design values over the past years are provided below. The lead design value at a monitoring site is the maximum 3-month rolling average over a period of 3 calendar years. A monitoring site must have a design value less than 0.155 µg/m³ to attain the NAAQS.[69]

The only lead monitor in Iowa is located in Council Bluffs near the Griffin Pipe and Alter Metal Recycling facilities. In 2010 and 2012, violations of the National Ambient Air Quality Standards for lead were recorded at the Griffin Pipe monitoring site.[70] DNR completed a State Implementation Plan (SIP) to mitigate these violations.[71] This plan includes measures to pave and regularly sweep haul roads at the Alter Metal Recycling facility adjacent to Griffin Pipe. It is expected that these measures will reduce ambient lead levels near Griffin Pipe by eliminating the re-entrainment of deposited lead-laden dust by truck traffic. Griffin Pipe announced its intention to suspend production indefinitely in March of 2014[72].

The 2014 design value for the site was 0.20 µg/m³ which violates the lead NAAQS. No additional NAAQS violations have been recorded since and the EPA re-designated the area as attainment on 10/4/2018.[73]

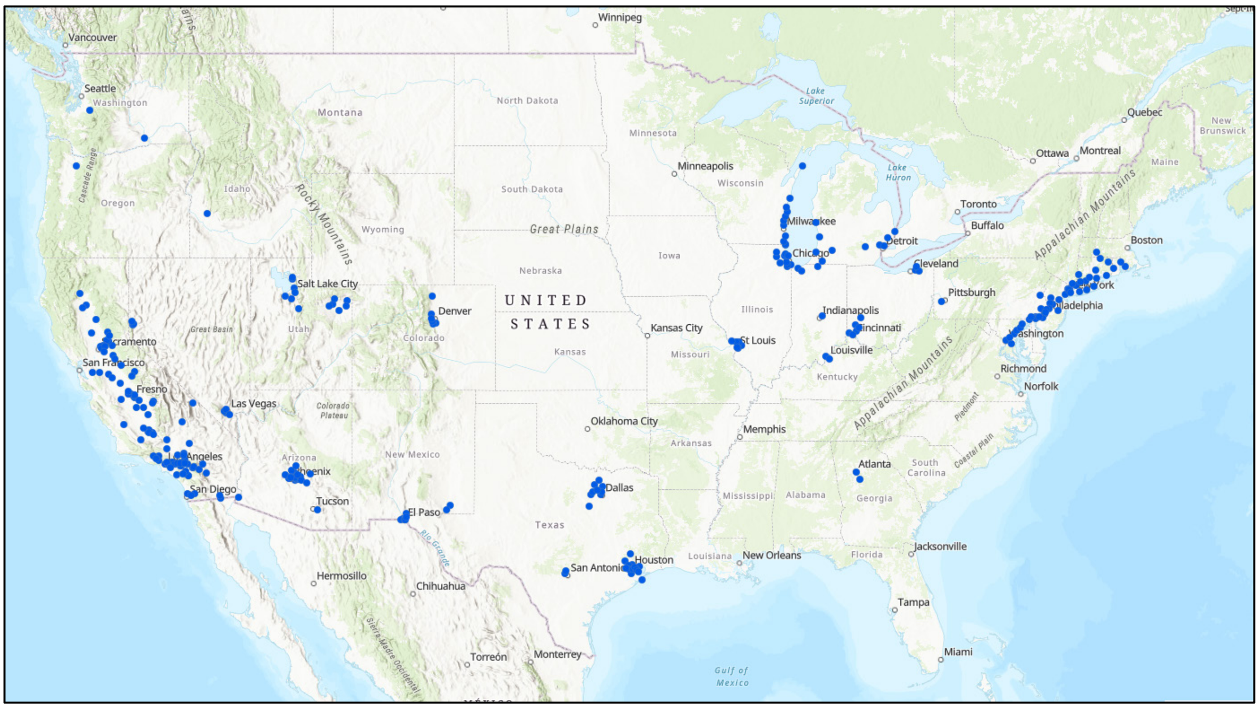
Lead Design Values 2014 – 2018 (µg/m³)
NAAQS is 0.15 µg/m³

Years	Council Bluffs, Griffin Pipe 191550011
2012-2014	0.20
2013-2015	0.13
2014-2016	0.10
2015-2017	0.07
2016-2018	0.08

[68] *Federal Register* entry: http://www.gpo.gov/fdsys/pkg/FR-2008-11-12/html/E8-25654.htm.
[69] Information on the lead NAAQS is available at https://www.epa.gov/lead-air-pollution/national-ambient-air-quality-standards-naaqs-lead-pb.
[70] Iowa Lead Design Values 2016-2018.
[71] State Implementation Plan Lead Non-Attainment Council Bluffs, Iowa.
[72] KETV: Griffin Pipe goes to skeleton crew.
[73] EPA Iowa SIP Status

Section 8: Monitors Violating the National Ambient Air Quality Standards (2016-2018)

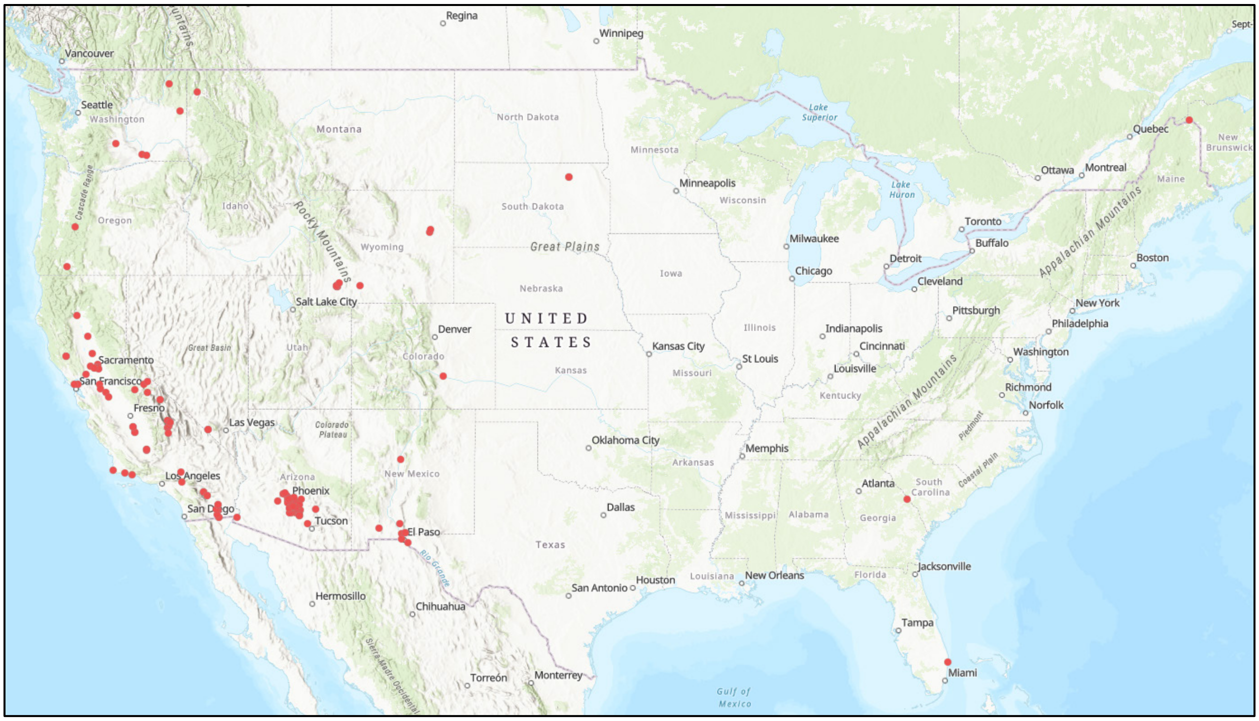
EPA placed the 2016-2018 design values for monitors eligible for NAAQS comparisons in an online geographic information system.[74,75] Maps of the location of monitors where design values exceed the NAAQS have been generated from this portal and are shown below. (There were no design values for nitrogen dioxide or carbon monoxide that exceeded the NAAQS.)



Monitors violating the 8-hour Ozone NAAQS.

[74] https://epa.maps.arcgis.com/apps/MapSeries/index.html?appid=bc6f3a961ea14013afb2e0d0e450b0d1#

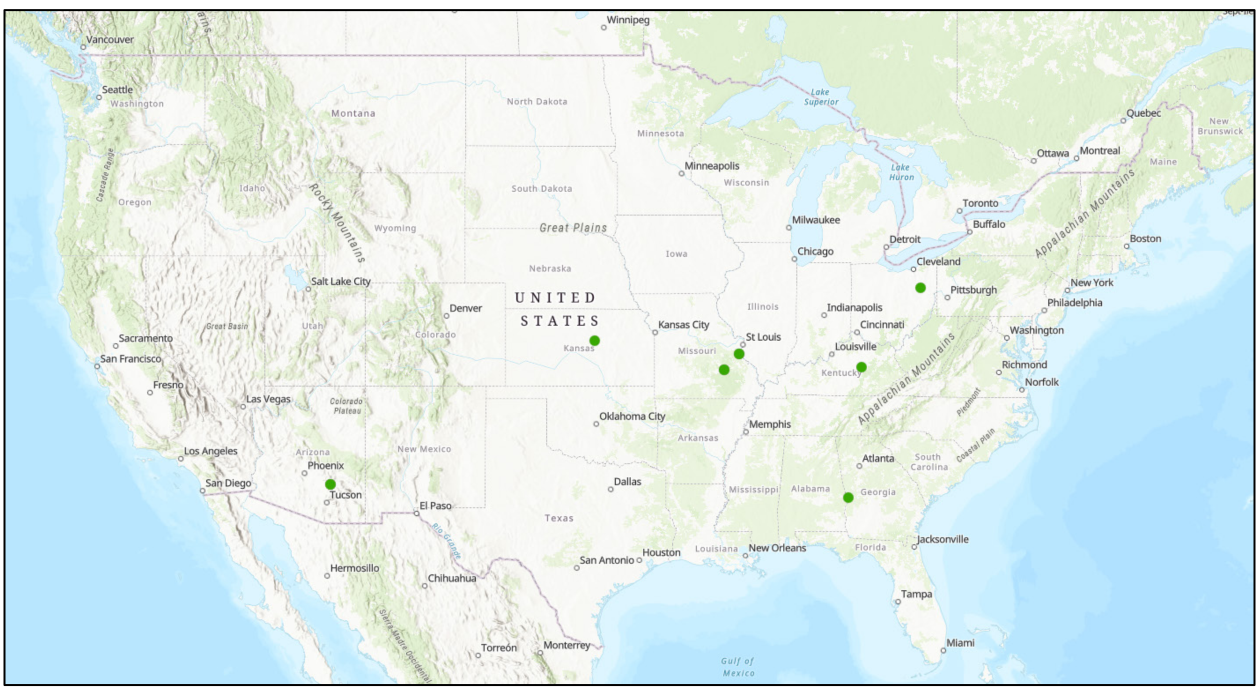
[75] http://www.arcgis.com/home/webmap/viewer.html?url=https://services.arcgis.com/cJ9YHowT8TU7DUyn/ArcGIS/rest/services/Design_Values_2016_2018/FeatureServer&source=sd



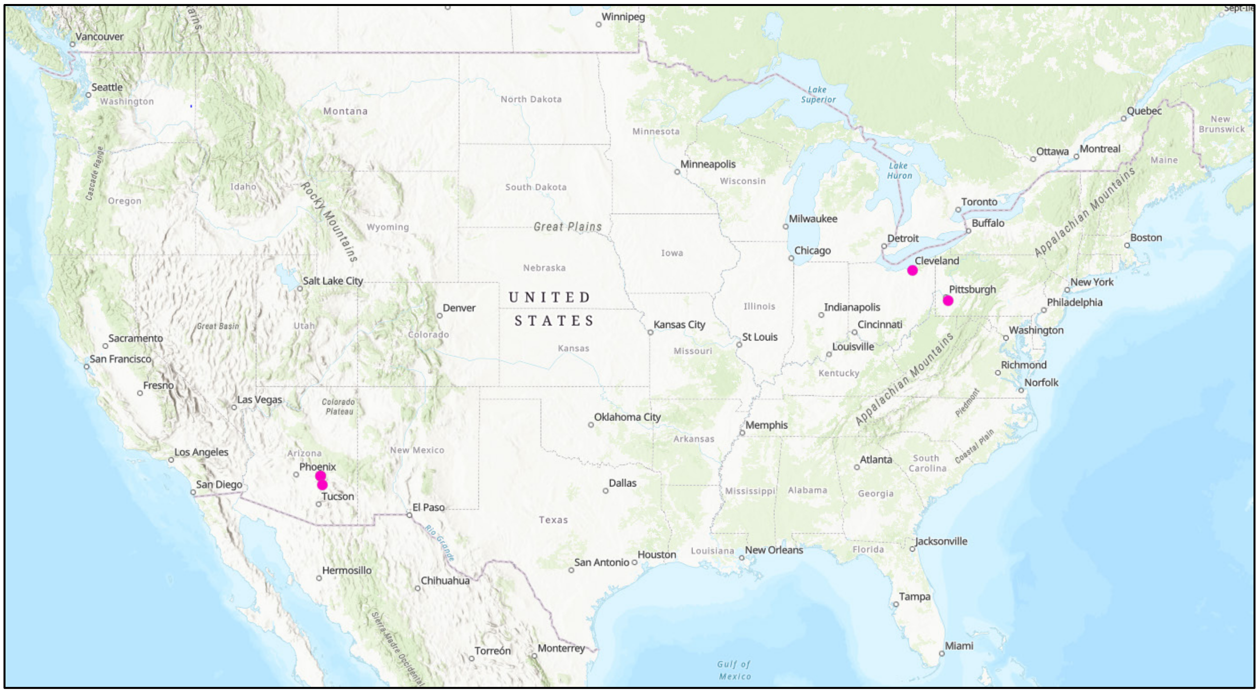
Monitors violating the 24-hour PM_{10} NAAQS.

Monitors violating the 24-hour $PM_{2.5}$ NAAQS. Two monitors in Puerto Rico and one in Alaska are not shown.

Monitors violating the Annual $PM_{2.5}$ NAAQS. One monitor in Alaska and one in Hawaii are not shown.



Monitors violating the Lead NAAQS. One monitor in Puerto Rico in not shown.



Monitors violating the 1-hour SO2 NAAQS. Two monitors in Hawaii are not shown.

Appendix J: Iowa MSA's

Table of Contents

Section 1: Summary

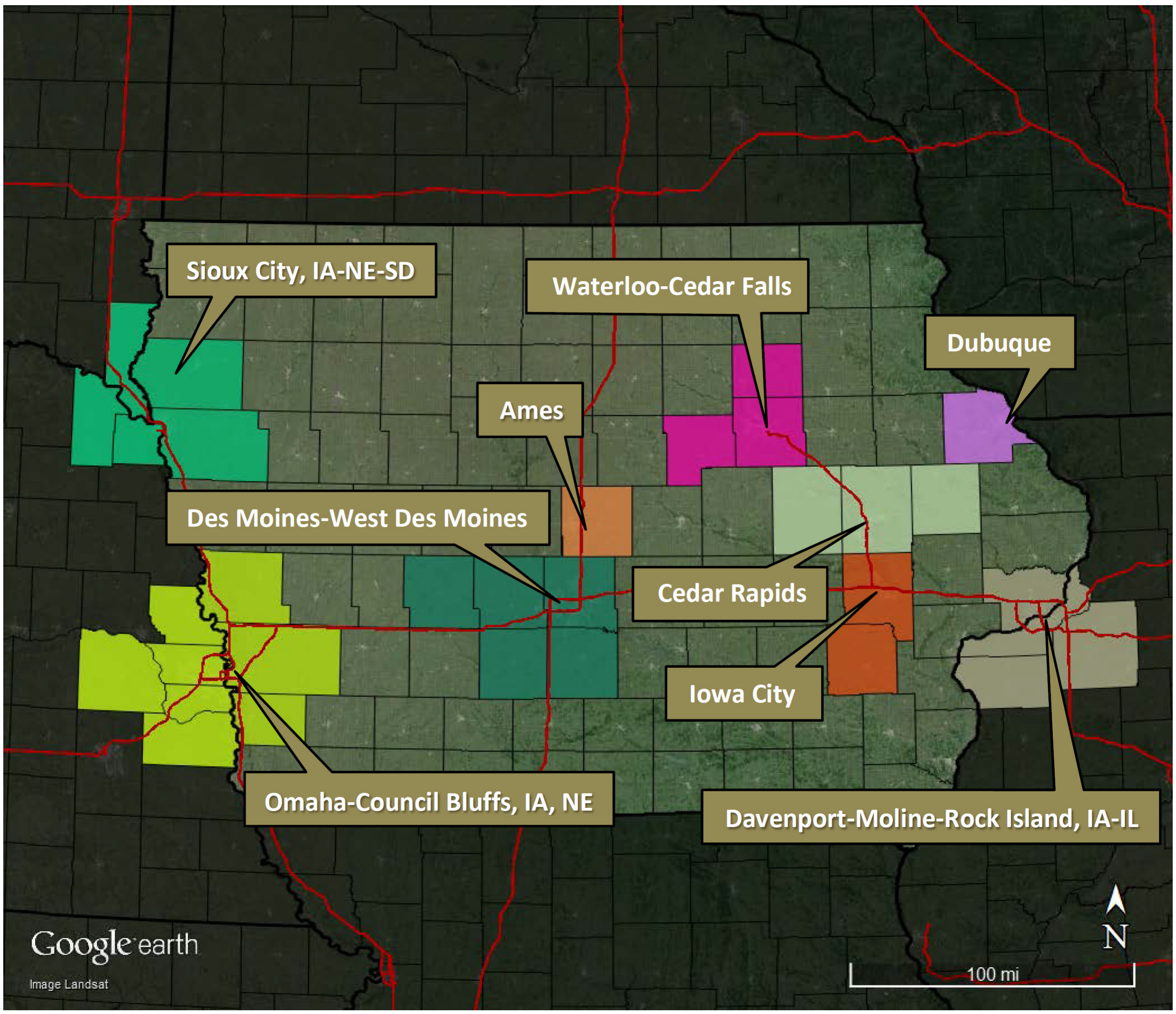
In order to protect human health, an important objective of an ambient air monitoring network is to quantify air pollution levels in heavily populated areas. Federal ambient air monitoring regulations contain minimum monitoring requirements for Metropolitan Statistical Areas (MSA's). About 60% of Iowa's population is concentrated in its MSA's, and about 61% of Iowa's ambient air monitoring sites are located in these areas.

Section 2 defines the counties in Iowa and other states that comprise these MSA's. Section 3 provides estimates of the total population of the MSA's along with the number of Iowans living in the MSA's. State and Local Air Monitoring Stations (SLAMS) monitors are important, long-term components of the state's air monitoring network. Section 4 indicates the minimum number of SLAMS monitors required by EPA for each MSA, and the number of SLAMS monitors in each MSA. Section 5 enumerates total number of Iowa monitors (SLAMS and non-SLAMS) in each MSA.

Section 2: Metropolitan Statistical Areas in Iowa

The federal Office of Management and Budget establishes and maintains the definitions of Metropolitan Statistical Areas (MSA's). Each MSA includes at least one urbanized area of 50,000 or more population. Each MSA may include adjacent counties that have a minimum of 25 percent of workers commuting to the central counties of the metropolitan statistical area.

According to the U.S. Census Bureau[76] , Iowa has 9 MSA's made up of twenty-one Iowa counties and eleven counties from other states, as indicated in the map and table below:



MSA's in Iowa

[76] United States Census Bureau maps of Metropolitan Statistical Areas are available online at: http://www2.census.gov/geo/maps/metroarea/stcbsa_pg/Feb2013/cbsa2013_IA.pdf.

MSA 's Containing Iowa Counties

MSA	Iowa Counties	Counties Outside Iowa	MSA Label (Largest Iowa City)	Abbreviation
Omaha-Council Bluffs, NE-IA	Harrison, Mills, Pottawattamie	NE: Cass, Douglas, Sarpy, Saunders, Washington	Council Bluffs	OMC
Des Moines-West Des Moines, IA	Dallas, Guthrie, Madison, Polk, Warren	-	Des Moines	DSM
Davenport-Moline-Rock Island, IA-IL	Scott	IL: Henry, Mercer, Rock Island	Davenport	DMR
Cedar Rapids, IA	Benton, Jones, Linn	-	Cedar Rapids	CDR
Iowa City, IA	Johnson, Washington	-	Iowa City	IAC
Waterloo-Cedar Falls, IA	Blackhawk, Bremer, Grundy	-	Waterloo	WTL
Sioux City, IA-NE-SD	Plymouth, Woodbury	NE: Dakota, Dixon SD: Union	Sioux City	SXC
Ames, IA	Story	-	Ames	AMW
Dubuque, IA	Dubuque	-	Dubuque	DBQ

Section 3: Population Estimates for Iowa MSA's

The U. S. Census Bureau provides updated population estimates each year. These estimates are utilized in the table below to provide estimates of the Iowa percentage of the population in multi-state MSA's. The table also contains the percentage of Iowa's total population that resides in each MSA.

MSA	Total Population of MSA[77]	Iowa Population of MSA[78]	Iowa Percentage of MSA Population	Percent of Iowa's Total Population Residing in MSA[79]
Des Moines, IA	655,409	655,409	100%	21%
Cedar Rapids, IA	272,295	272,295	100%	9%
Iowa City, IA	173,401	173,401	100%	5%
Davenport, IA	381,451	173,283	45%	5%
Waterloo, IA	169,659	169,659	100%	5%
Sioux City, IA	169,045	127,634	76%	4%
Council Bluffs, IA	942,198	122,730	13%	4%
Ames, IA	98,105	98,105	100%	3%
Dubuque, IA	96,854	96,854	100%	3%
Totals	2,958,417	1,889,370	64%	60%

Population of Iowa Metropolitan Statistical Areas (2018)

[77] July 2018 MSA population estimates for are available online at: https://www.census.gov/content/census/en/data/tables/time-series/demo/popest/2010s-total-metro-and-micro-statistical-areas.html.

[78] July 2018 County Population Estimates are available online at: https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-total.html.

[79] The percentages in this column represent the Iowa population of each MSA divided by the total population for the State of Iowa. Iowa's population is 3,156,145 people, based on the 2018 Census estimates here: State Totals.

Section 4: SLAMS Monitoring Requirements[80] and Distribution of Monitors in MSA's

MSA Label	$PM_{2.5}$ FRM	PM_{10} FRM	Ozone	$PM_{2.5}$ Continuous	SO_2	CO	NO_2	Pb
Ames	0	0	0	0	0	0	0	0
Cedar Rapids	0	0-1	1	0	0	0	0	0
Council Bluffs	1	2-4	2	1	1	0	0	0
Davenport	0	0-1	2	0	0	0	0	0
Des Moines	1	1-2	2	1	0	0	0	0
Dubuque	0	0	0	0	0	0	0	0
Iowa City	0	0	0	0	0	0	0	0
Sioux City	0	0-1	1	0	0	0	0	0
Waterloo	0	0	1	0	0	0	0	0

Required Number of SLAMs Sites in MSA's

[80] 40 CFR Part 58 Appendix D specifies the minimum number of SLAMS (State and Local Air Monitoring Stations) monitors for ozone, $PM_{2.5}$, and PM_{10} based on both population and the concentrations of these pollutants. This table represents minimum monitoring requirements based on population and concentration (as of 1/2019). It should be noted that these requirements change with time, and 40 CFR Part 58 also contains the schedules for implementation of new population-based minimum monitoring requirements. 40 CFR Part 58 Appendix D, section 3 requires each State to operate at least one NCore site. NCore sites must measure, at a minimum, $PM_{2.5}$ particle mass using continuous and integrated/filter-based samplers, speciated $PM_{2.5}$, PM10-2.5 particle mass, O_3, SO_2, CO, NO/NO_Y, wind speed, wind direction, relative humidity, and ambient temperature. Monitors in the NCORE suite are SLAMs monitors, but the NCORE requirements are not included in this table.

MSA Label	$PM_{2.5}$ (FRM)	Ozone	$PM_{2.5}$ Cont.	PM_{10} (FRM)	SO_2	$PM_{2.5}$ Spec.	CO	Lead	NO_y	PM_{10} Cont.
Ames	0	0	0	0	0	0	0	0	0	0
Cedar Rapids	1	1	0	1	1	0	0	0	0	0
Council Bluffs	3	4	2	2	3	1	2	1	1	2
Davenport	2	3	2	2	1	1	1	0	1	1
Des Moines	1	2	1	1	0	0	0	0	0	0
Dubuque	0	0	0	0	0	0	0	0	0	0
Iowa City	0	0	0	0	0	0	0	0	0	0
Sioux City	0	1	1	0	1	0	0	0	0	1
Waterloo	1	1	1	0	0	0	0	0	0	0

SLAMS Monitors operated by Iowa and Surrounding States in MSA's

MSA Label	$PM_{2.5}$ (FRM)	Ozone	$PM_{2.5}$ Cont.	PM_{10} (FRM)	SO2	$PM_{2.5}$ Spec.	CO	Lead	NOy	PM10 Cont.
Council Bluffs	0	1	0	0	0	0	0	1	0	0
Davenport	2	2	1	2	1	1	1	0	1	1
Sioux City	0	0	0	0	0	0	0	0	0	0

SLAMS Monitors operated by Iowa in Multi-State MSA's

MSA Label	$PM_{2.5}$ (FRM)	Ozone	$PM_{2.5}$ Cont.	PM_{10} (FRM)	SO_2	$PM_{2.5}$ Spec.	CO	Lead	NO_y	PM_{10} Cont.
Council Bluffs	3	3	2	2	3	1	2	0	1	2
Davenport	0	1	1	0	0	0	0	0	0	0
Sioux City	0	1	1[81]	0	1	0	0	0	0	1

SLAMS Monitors Operated by Surrounding States in Multi-State MSA's[82]

[81] The monitor operated at the Union County #1 Jensen site in South Dakota is a continuous monitor used for attainment.

[82] §58.16 of the 40 CFR Part 58 establishes that data collected during the period November 1 to December 31 does not have to be uploaded to EPA's Air Quality System (AQS) until March 31. Given this provision in federal monitoring rules, and anticipating some reasonable additional delays, it is difficult to precisely establish if monitors were shut down at the end of 2019 or are still operating. This table contains best estimates based on review of the AirNow, Air Data, and AQS EPA databases. Network plans and other publicly available information on state websites have also been used to establish these monitor counts.

Section 5: Total (SLAMS and non-SLAMS) Monitors Operated by Iowa in its MSA's

MSA Label	$PM_{2.5}$ (FRM)	Ozone	$PM_{2.5}$ Cont.	PM_{10} (FRM)	SO_2	Toxics	$PM_{2.5}$ Spec.	CO	NO_2	Lead	NO_y	PM_{10} Cont.	Monitors	Sites
Ames	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cedar Rapids	1	2	1	1	2	1	0	0	0	0	0	0	8	3
Council Bluffs	1	1	0	1	0	0	0	0	0	1	0	0	4	3
Davenport	2	2	1	2	1	1	1	1	0	0	1	1	13	4
Des Moines	2	2	1	1	0	1	0	0	1	0	0	0	8	3
Dubuque	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iowa City	1	0	1	0	0	0	0	0	0	0	0	0	2	1
Sioux City	1	0	0	0	0	0	0	0	0	0	0	0	1	1
Waterloo	1	1	1	0	0	0	0	0	0	0	0	0	3	2
Inside MSAs	9	8	5	5	3	3	1	1	1	1	1	1	39	17
Outside MSAs	9	4	5	3	5	2	2	0	1	0	0	0	31	11
Entire State	18	12	10	8	8	5	3	1	2	1	1	1	70	28

Number of Iowa Monitors by MSA

MSA Label	$PM_{2.5}$ (FRM)	Ozone	$PM_{2.5}$ Cont.	PM_{10} (FRM)	SO_2	Toxics	$PM_{2.5}$ Spec.	CO	NO_2	Lead	NO_y	PM_{10} Cont.	Monitors	Sites
Ames	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cedar Rapids	6%	17%	10%	13%	25%	20%	0%	0%	0%	0%	0%	0%	11%	11%
Council Bluffs	6%	8%	0%	13%	0%	0%	0%	0%	0%	100%	0%	0%	6%	11%
Davenport	11%	17%	10%	25%	13%	20%	33%	100%	0%	0%	100%	100%	19%	14%
Des Moines	11%	17%	10%	13%	0%	20%	0%	0%	50%	0%	0%	0%	11%	11%
Dubuque	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Iowa City	6%	0%	10%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	4%
Sioux City	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	4%
Waterloo	6%	8%	10%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	7%
Inside MSAs	50%	67%	50%	63%	38%	60%	33%	100%	50%	100%	100%	100%	56%	61%
Outside MSAs	50%	33%	50%	38%	63%	40%	67%	0%	50%	0%	0%	0%	44%	39%

Percentage of Iowa Monitors by MSA

Appendix K: Distribution of Groups Sensitive to Air Pollution by County and MSA

Table of Contents

Section 1: Summary

The Clean Air Act[83] specifies that the primary National Ambient Air Quality Standards are set to protect public health with an adequate margin of safety. This protection includes groups that are sensitive to the effects of air pollution including the elderly, children, and individuals suffering from respiratory ailments. EPA has minimum monitoring requirements that apply to large urban areas, known as Metropolitan Statistical Areas (MSA's).[84] The analysis contained in this section shows that a significant fraction of the individuals that are sensitive to the effects of air pollution reside in these MSA's.

Section 2 contains maps of populations of the elderly and children in Iowa counties. The data was obtained from the 2018 U.S. Census estimates.[85] Section 3 contains maps of the populations of individuals in Iowa counties suffering from specific respiratory illnesses. The data was obtained from the American Lung Association.[86] Section 4 consolidates data from the 2017 U.S. Census estimates, and the data from the American Lung Association to provide a breakdown of groups known to be sensitive to air pollution by Metropolitan Statistical Area (MSA).

About 60% of Iowa's population lived in MSA's in 2017. Of the groups sensitive to the effects of air pollution, 62% of children under 5, 52% of adults over 65, 60% of children with asthma, 60% of adults with asthma, 57% of individuals with COPD which includes chronic bronchitis and emphysema, and 60% of individuals with lung cancer live in MSA's.

This relationship holds for individual MSA's; the ratio of the population in any MSA to the total state's population is roughly equivalent to the ratio of the population of any sensitive group in that MSA to the total population of that sensitive group in the state.

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[83] See Section 109(b)(1) of the Clean Air Act available at: http://www.epa.gov/air/caa/title1.html#ia.

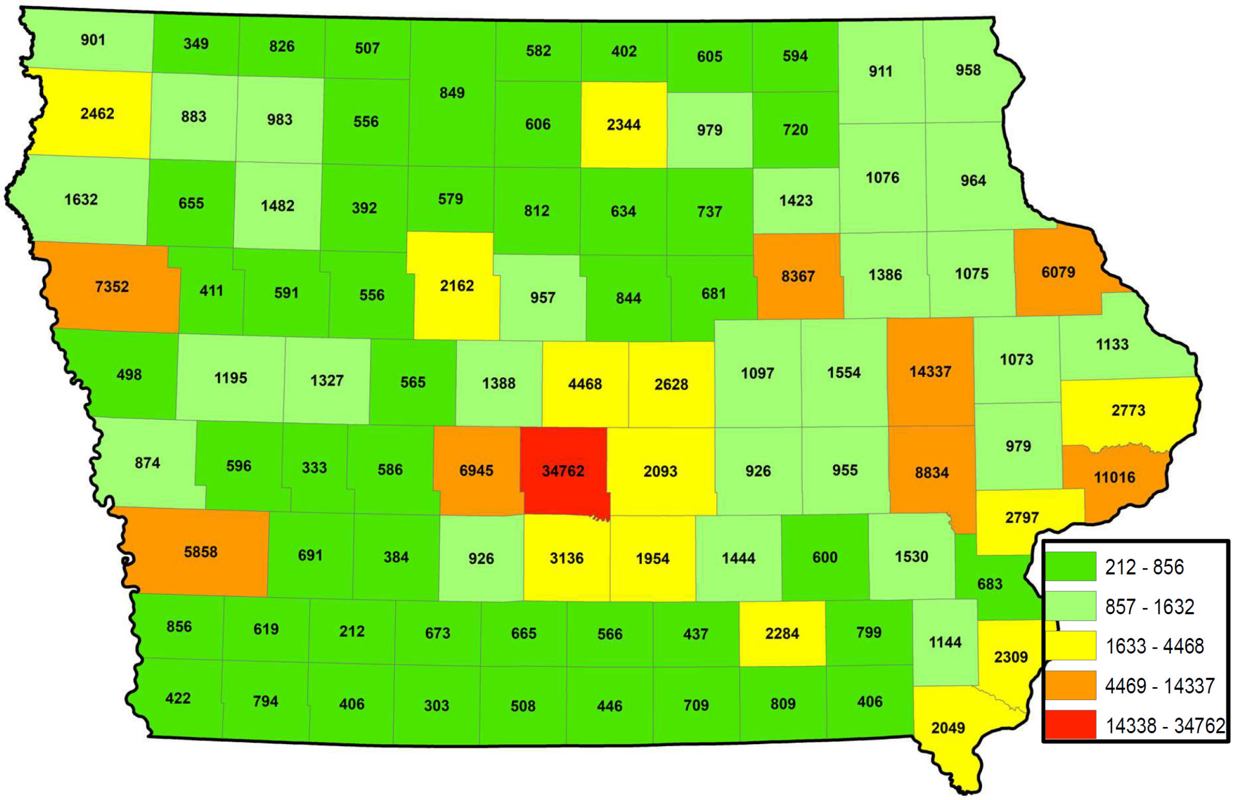
[84] 40 CFR Part 58 Appendix D available at: https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&tpl=/ecfrbrowse/Title40/40cfr58_main_02.tpl.

[85] 2010 U.S. Census Data is available at: https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-detail.html.

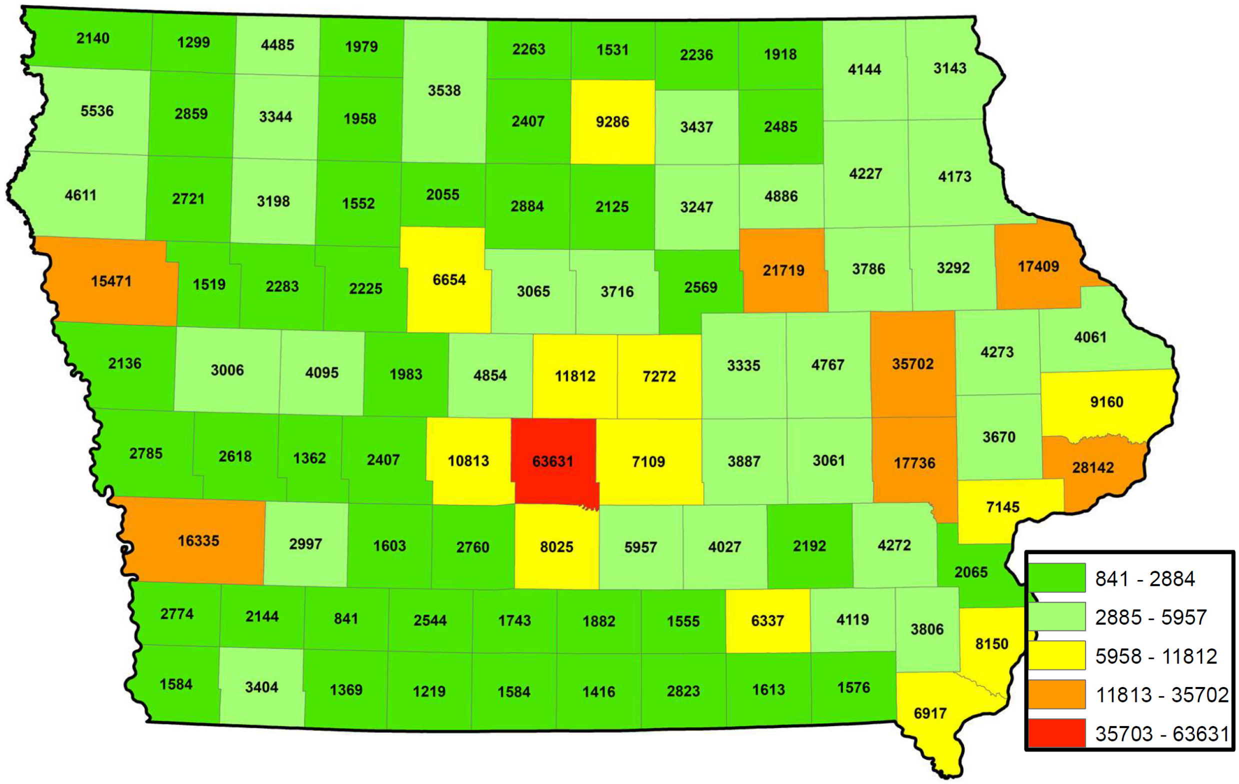
[86] *Estimated Prevalence and Incidence of Lung Disease by Lung Association Territory* available from the American Lung Association at: https://www.lung.org/our-initiatives/research/monitoring-trends-in-lung-disease/estimated-prevalence-and-incidence-of-lung-disease/.

Section 2: Children and the Elderly

The 2018 U.S. census estimates data contains demographic breakdowns of the population including defined age groups. Among those groups are children under the age of five and adults over 65 years of age. These two age groups represent those individuals in the population who are at greater risk of health issues related to poor air quality. The distribution of these groups is displayed in the maps below:



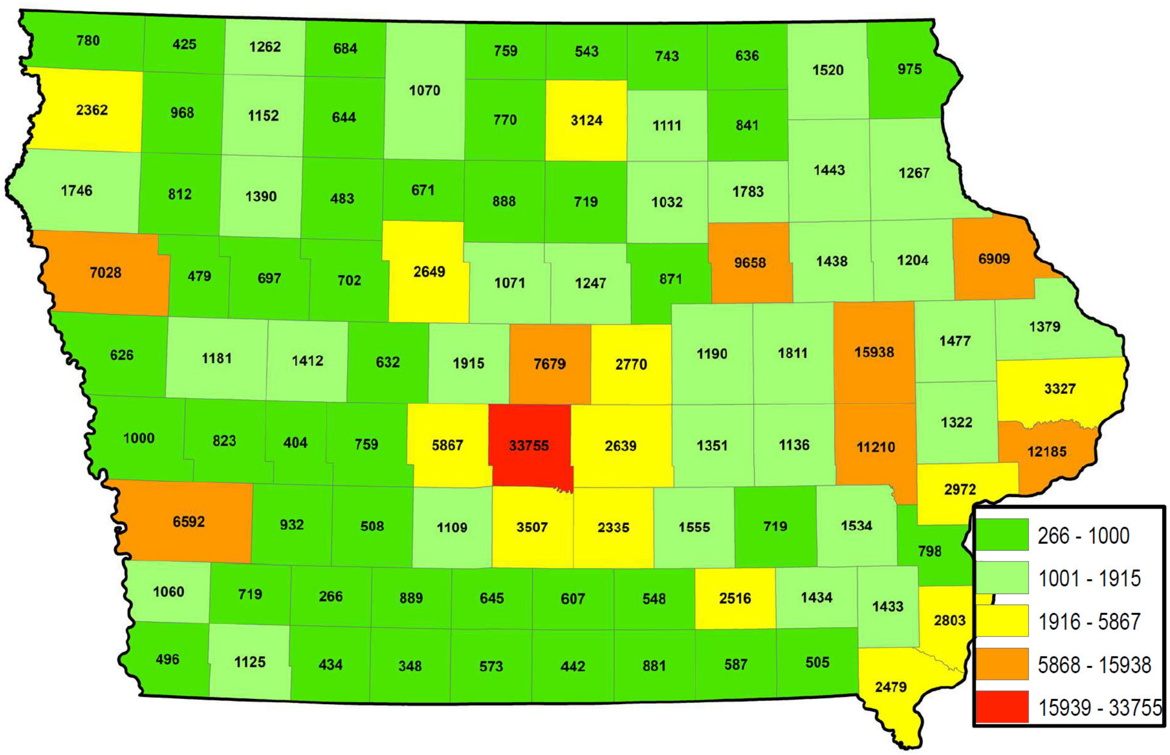
Iowa Population Under the Age of 5 by County – 2018



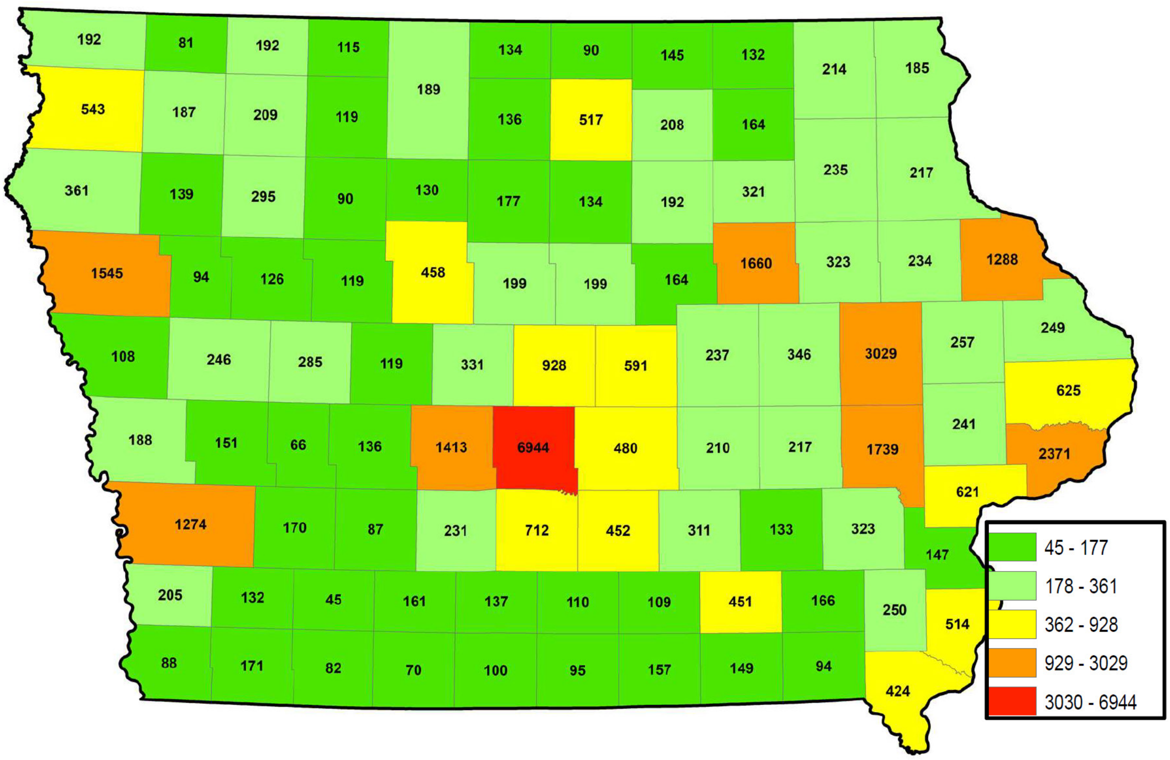
Iowa Population Age 65 and Older by County – 2018

Section 3: Respiratory Diseases

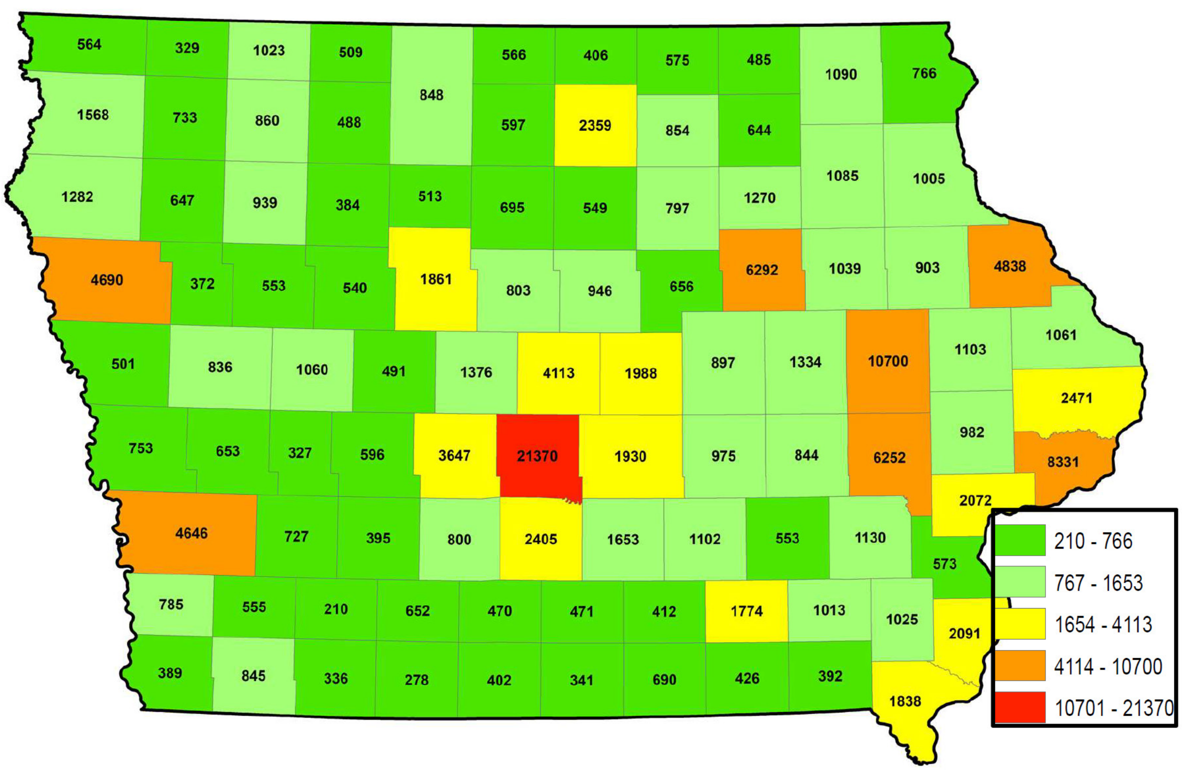
The maps below are based on the 2017 Behavioral Risk Factor Surveillance Survey and the 2018 joint report from CDC's National Program of Cancer Registries, NCI's SEER program, and state-based cancer registries as reported by the American Lung Association. The document estimates the incidence of lung diseases at the county, state, and regional levels. The county estimates are used in the following maps to display where large numbers of individuals with respiratory diseases reside.



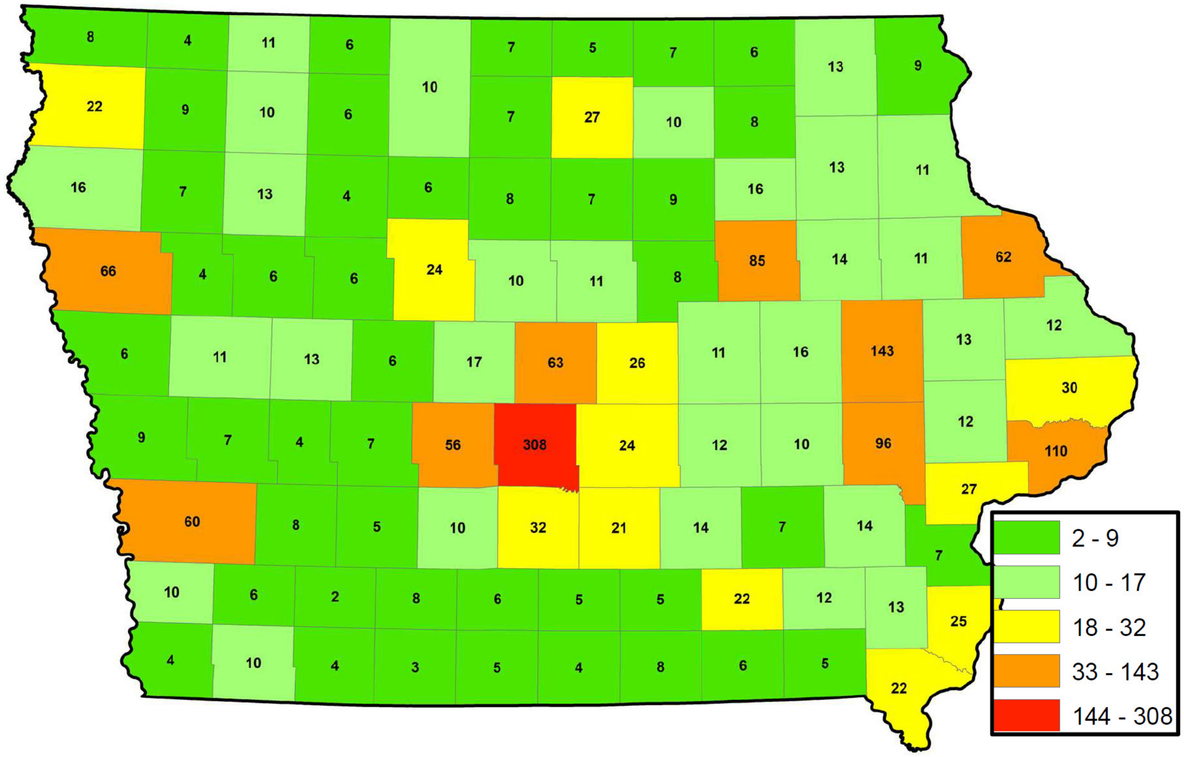
Number of Adult Asthma Cases by County



Number of Pediatric Asthma Cases by County



Number of COPD (Includes Chronic Bronchitis and Emphysema) Cases by County



Number of Lung Cancer Cases by County

Section 4: Breakdown of Groups Known to be Sensitive to Air Pollution by MSA

MSA's	MSA Label*
Ames, IA	Ames
Cedar Rapids, IA	Cedar Rapids
Dubuque, IA	Dubuque
Davenport-Moline-Rock Island, IA-IL	Davenport
Des Moines-West Des Moines, IA	Des Moines
Iowa City, IA	Iowa City
Omaha-Council Bluffs, NE-IA	Council Bluffs
Sioux City, IA-NE-SD	Sioux City
Waterloo-Cedar Falls, IA	Waterloo

*In multi-city MSAs, the largest Iowa City has been used to label the MSA

Iowa Metropolitan Statistical Area Labels

MSA Label	Population 2017	Population Under 5	Population Over 65	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer
Ames	**97260**	**4455**	**11323**	**928**	**7679**	**4113**	**63**
Cedar Rapids	**270594**	**16941**	**43303**	**3632**	**19226**	**13137**	**172**
Dubuque	**97009**	**6092**	**16905**	**1288**	**6909**	**4838**	**62**
Davenport	**172692**	**11091**	**27281**	**2371**	**12185**	**8331**	**110**
Des Moines	**645100**	**46140**	**84395**	**9436**	**44997**	**28818**	**413**
Iowa City	**171470**	**10458**	**20992**	**2062**	**12744**	**7382**	**110**
Council Bluffs	**122692**	**7636**	**21369**	**1667**	**8652**	**6184**	**79**
Sioux City	**127143**	**8995**	**19637**	**1906**	**8774**	**5972**	**82**
Waterloo	**169553**	**10621**	**28492**	**2145**	**12312**	**8218**	**109**
Inside MSAs	**1873513**	**122429**	**273697**	**25435**	**133478**	**86993**	**1200**
Outside MSAs	**1272198**	**76274**	**252225**	**16695**	**90217**	**66972**	**814**
Entire State	**3145711**	**198703**	**525922**	**42130**	**223695**	**153965**	**2014**

Iowa Population in MSA's

MSA Label	% Population 2017	% Population Under 5	% Population Over 65	% Pediatric Asthma	% Adult Asthma	% COPD	% Lung Cancer
Ames	3.1%	2.2%	2.2%	2.2%	3.4%	2.7%	3.1%
Cedar Rapids	8.6%	8.5%	8.2%	8.6%	8.6%	8.5%	8.5%
Dubuque	3.1%	3.1%	3.2%	3.1%	3.1%	3.1%	3.1%
Davenport	5.5%	5.6%	5.2%	5.6%	5.4%	5.4%	5.5%
Des Moines	20.5%	23.2%	16.0%	22.4%	20.1%	18.7%	20.5%
Iowa City	5.5%	5.3%	4.0%	4.9%	5.7%	4.8%	5.5%
Council Bluffs	3.9%	3.8%	4.1%	4.0%	3.9%	4.0%	3.9%
Sioux City	4.0%	4.5%	3.7%	4.5%	3.9%	3.9%	4.1%
Waterloo	5.4%	5.3%	5.4%	5.1%	5.5%	5.3%	5.4%
Inside MSAs	59.6%	61.6%	52.0%	60.4%	59.7%	56.5%	59.6%
Outside MSAs	40.4%	38.4%	48.0%	39.6%	40.3%	43.5%	40.4%

Percent of Iowa Population in MSA's

Appendix L: Population Trends

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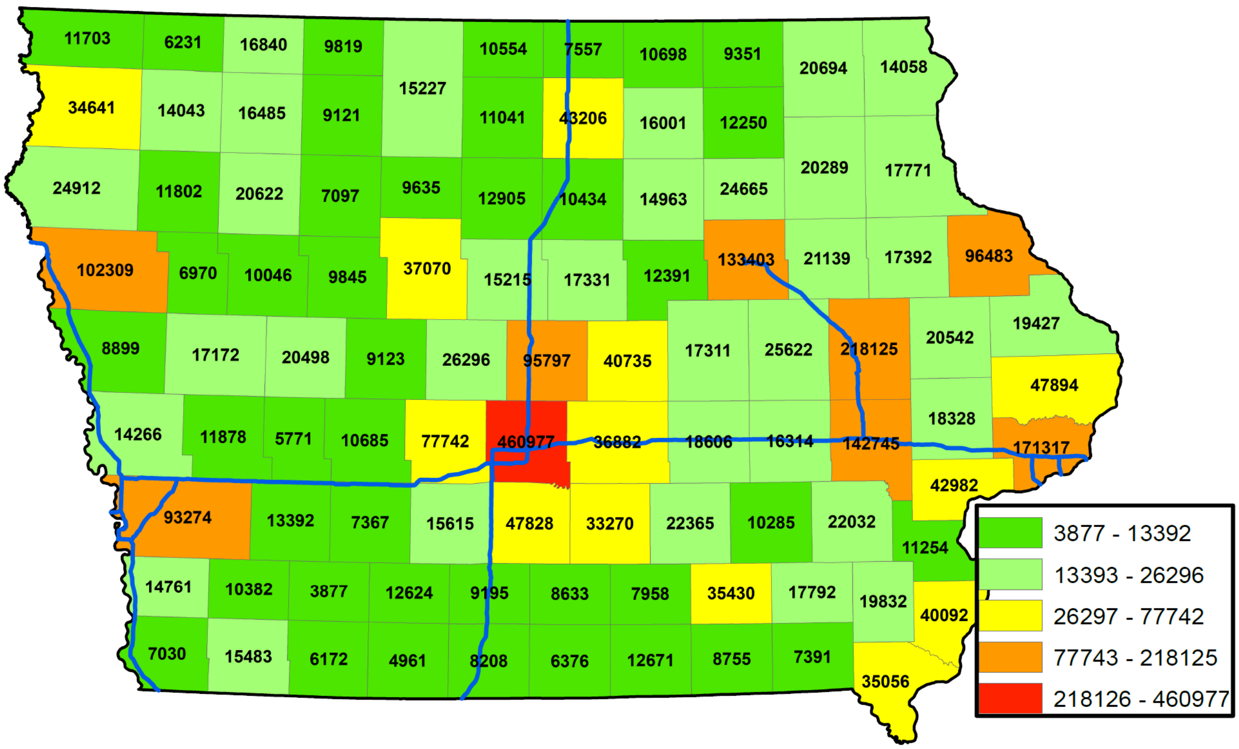
Section 1: Summary

The U.S. Census is conducted every ten years. For the years between actual censuses, the U.S. Census Bureau provides population estimates.[87] The maps in Section 2 below show county populations for 2014 and 2018, as well as the population change in each county from 2014 to 2018. Over this period, populations around Iowa's major cities (associated with MSA's) have increased, and populations in most rural areas have decreased. Section 3 contains population changes for counties at the national, Midwest and Iowa levels.

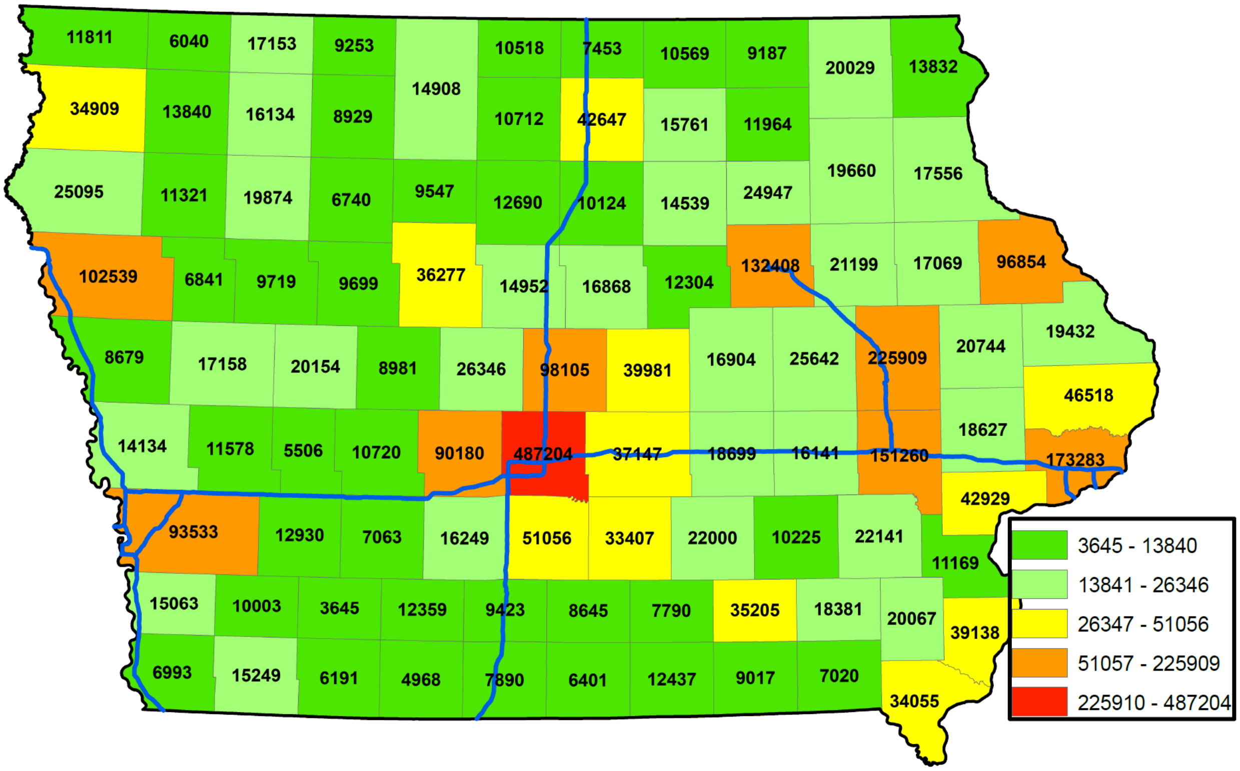
[87] The data summarized in Section 2 of this appendix is from the U.S. Census Bureau and is available at: https://www.census.gov/programs-surveys/popest/data/tables.html.

Section 2: Iowa County Population Maps

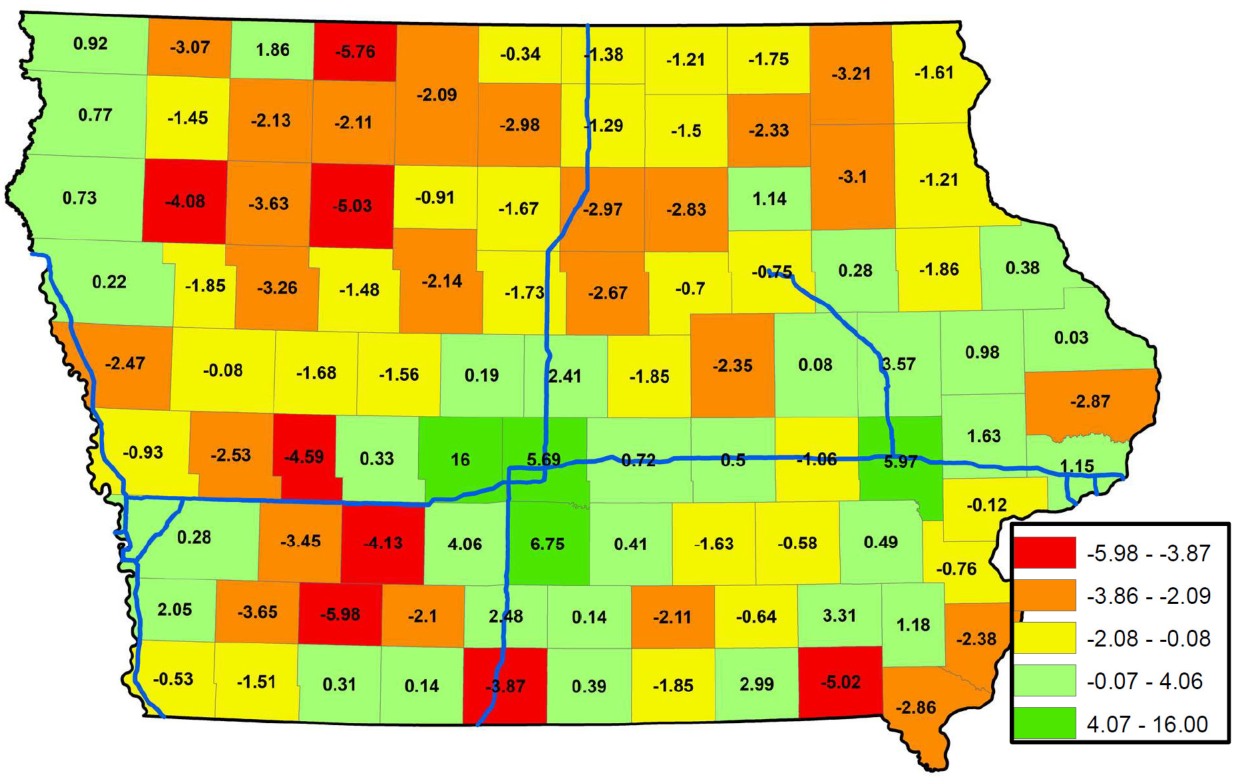
The maps below are derived from US Census estimates and indicate county population estimates for 2014 and 2018 as well as the difference between these estimates. Many of the counties containing large cities (Des Moines, West Des Moines, Ames, Iowa City, Cedar Rapids, Dubuque, and Davenport) and their surrounding counties showed large increases in population over this period. Most of the declines were noted in rural counties.



2014 Iowa Population by County



2018 Iowa Population by County



Percent Population Change of Iowa Counties from 2014 to 2018

Section 3: Maps of Changes in National and Midwestern Populations from 2010 to 2018

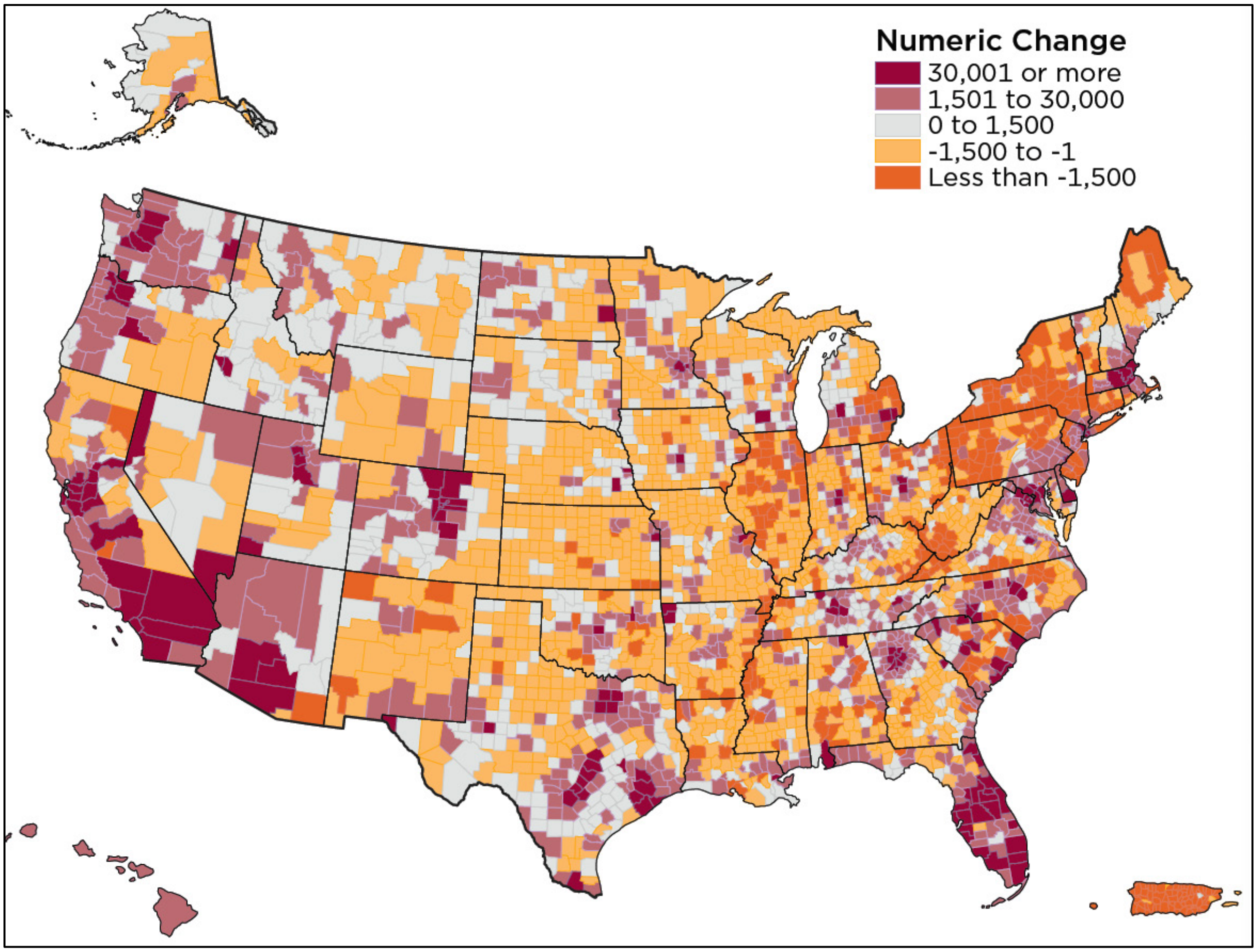
The maps below from the U.S. Census Bureau[88] show population changes within counties at national, Midwest and Iowa levels.

Nationally, there was considerable growth in the west, including significant growth in a large number of counties in Arizona, west-central California, Washington, western Oregon, eastern Nevada, western Utah, and counties north of Denver in Colorado. In the south, significant growth was experienced in in Houston, San Antonio, Austin, Dallas, and in most of Florida. Throughout the rest of the southeast, the larger MSA's tend to experience significant growth with slight losses in rural areas, in contrast to the northeast and upper Midwest, where significant growth in the larger MSAs was often accompanied by significant declines in rural areas.

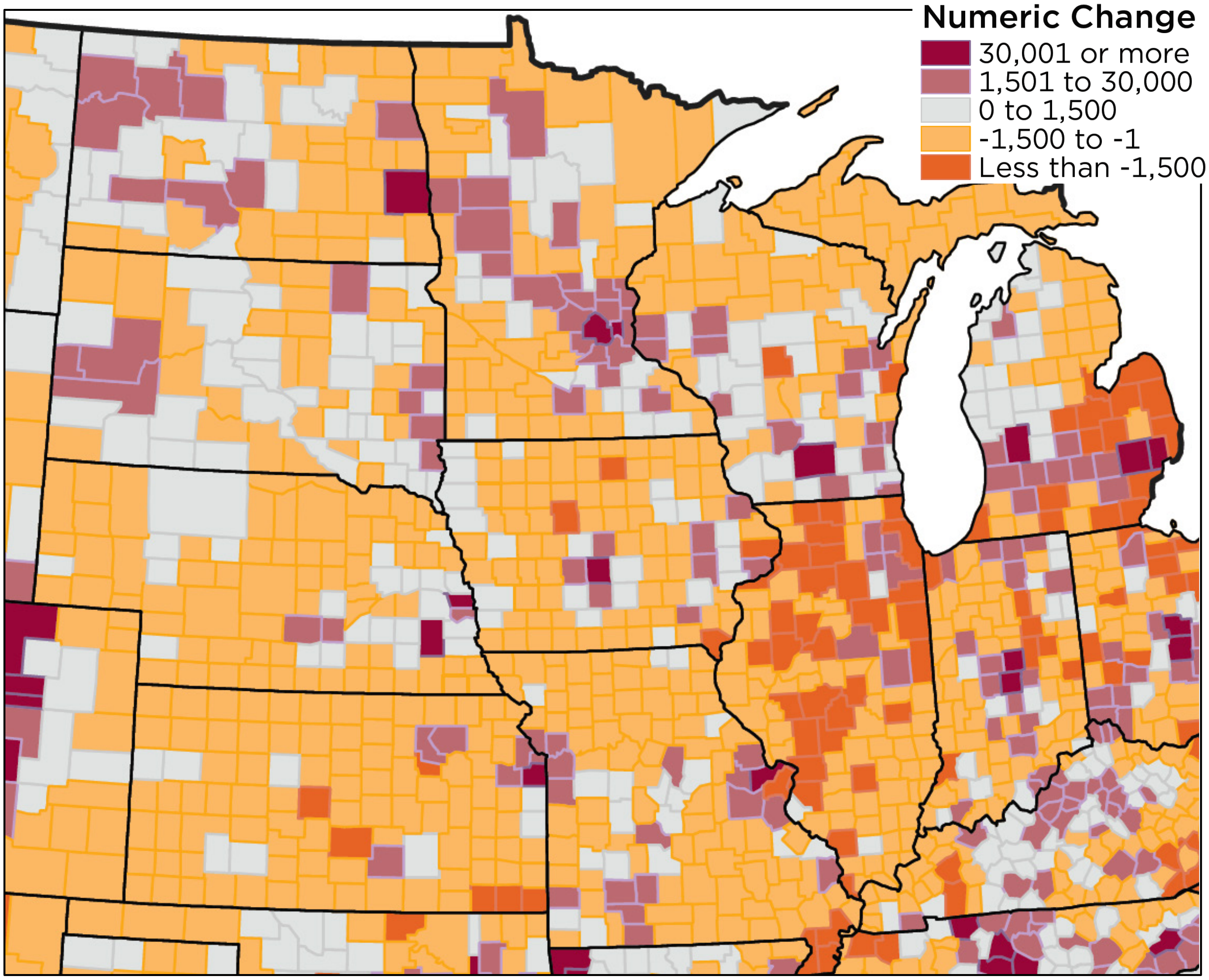
In Iowa and surrounding states, the general trend was toward slight declines in rural counties and increases in larger urban counties. There was considerable growth in one or more counties in the Kansas City KS-MO, Saint Louis MO-IL, Omaha NE-IA, Lincoln NE, Des Moines IA, Madison WI, Minneapolis MN-WI MSAs, and significant declines in many rural counties in northern and southwestern Illinois.

There was considerable growth in Iowa in Polk County, and on the Iowa border in Douglas County, Nebraska. There was moderate growth in Warren, Dallas, Story, Johnson, Linn, Dubuque, Scott and Jefferson Counties in Iowa. On the Iowa border, there was also moderate growth in Sarpy County, Nebraska, as well as Minnehaha and Lincoln Counties in South Dakota. There were considerable declines in Iowa in Clinton, Webster, Cerro Gordo and Lee Counties in Iowa and Rock Island and Whiteside Counties in Illinois.

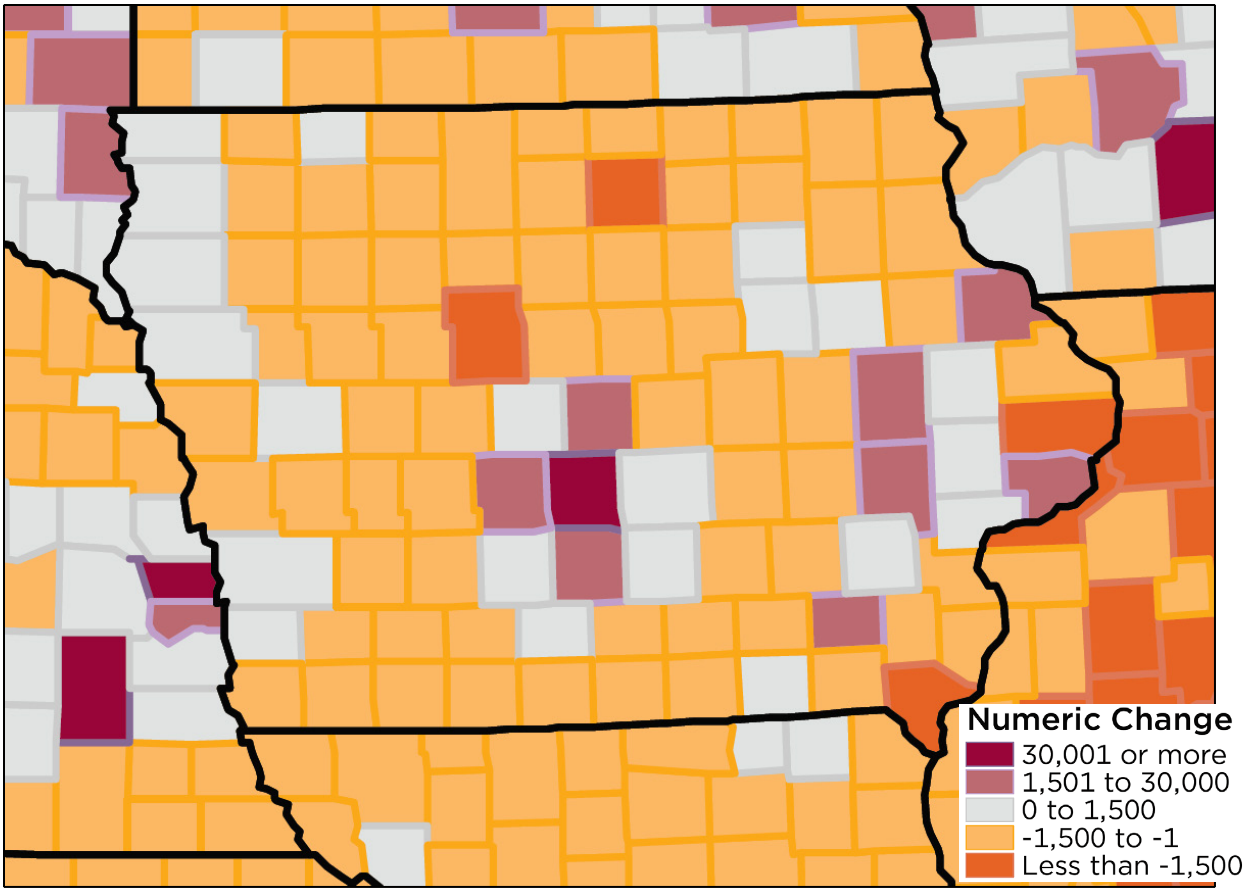
[88] https://www.census.gov/library/visualizations/2019/comm/num-pop-change-county.html



National Population Change by County 2010-2018 (U.S. Census)



Midwestern Population Change by County 2010-2018



Numeric Population Change by County 2010-2018