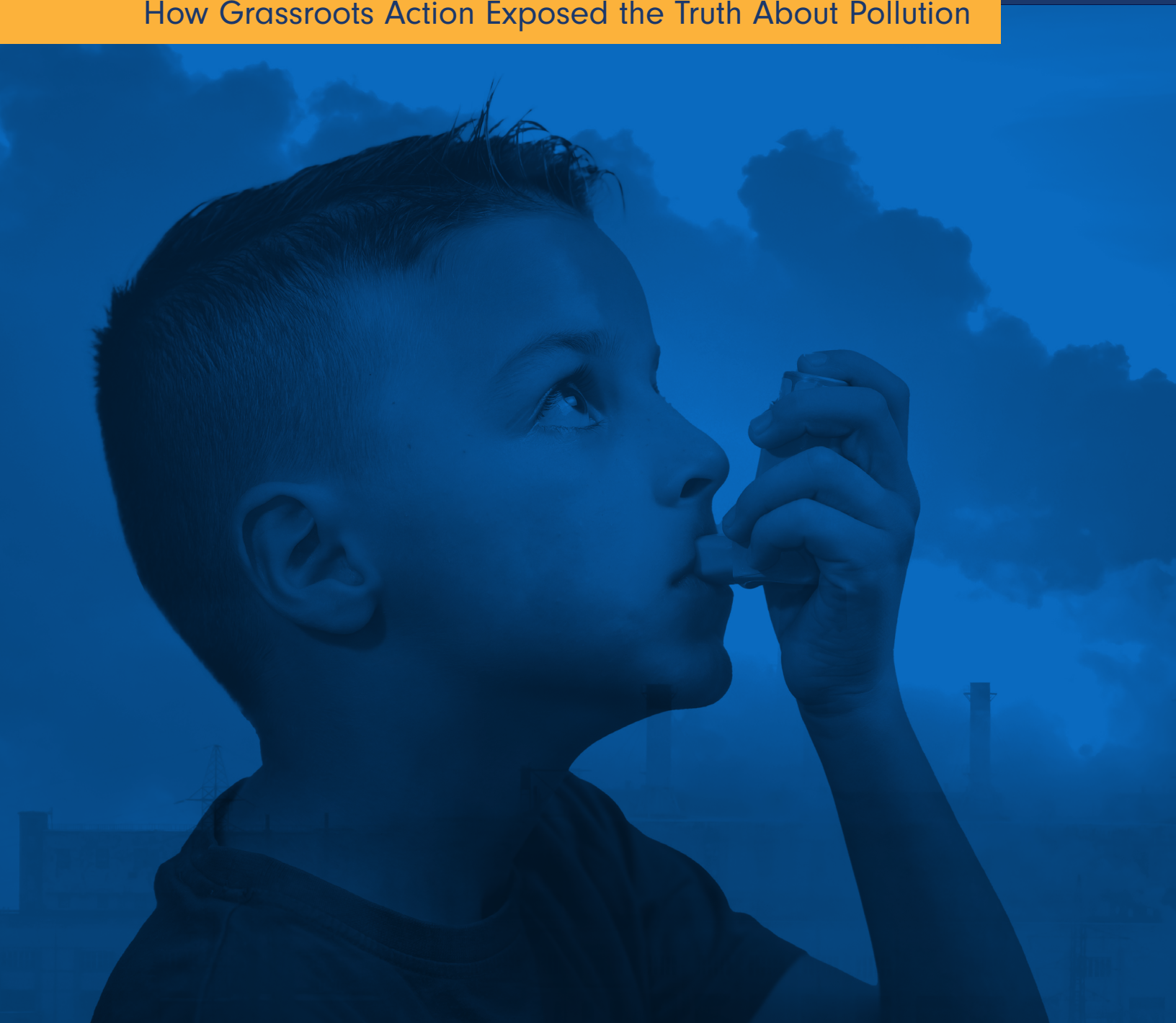
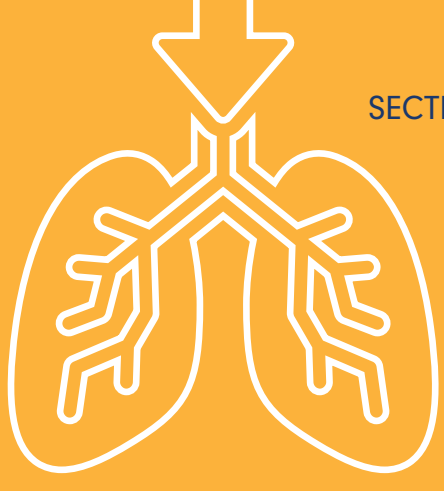
Iowa Environmental Council

AIR QUALITY IN SIOUXLAND

How Grassroots Action Exposed the Truth About Pollution



INTRODUCTION



Air surrounds us, but we can't see it, taste it, or feel it. Yet, the life-sustaining air we breathe can impact our health and how long we live. Knowing the pollution levels in the air you breathe is critical to understanding the potential impact to your health.

Air quality concerns are an issue across Iowa, but levels of pollution and the resulting adverse health effects are not felt uniformly across the state. In 2024, Woodbury County had the highest asthma rates in the state of Iowa. Air pollution from MidAmerican Energy Company's Siouxland coal-fired power plants, from 1999 to 2020, caused 1,400 premature deaths.[1] For people with asthma and other at-risk groups, access to real-time air quality information is crucial. However, existing monitoring by the Iowa Department of Natural Resources (IDNR) monitoring in Woodbury County is not continuous.

To fill in these gaps in monitoring data and to better understand the sources of air pollution contributing to the high rates of asthma, residents of Woodbury County, in partnership with the Iowa Environmental Council, installed six PurpleAir brand monitors at locations around the county in 2025. PurpleAir monitors measure levels of particulate matter 2.5 (PM2.5), a type of air pollution that is associated with the greatest proportion of adverse health effects.[2]

Beyond providing continuous readings for residents, this monitoring initiative has now also yielded more than a year's worth of air quality data. (Interested readers can see real-time air quality data by going to https://map.purpleair.com and searching for their zip code or address.) The Iowa Environmental Council has analyzed this data to better understand how observed PM2.5 concentrations correlate to emissions from nearby coal-fired power plants and other major sources of air pollution in the region. This white paper highlights our findings and provides readers with scientific information about the relationship between air pollution and adverse health effects, including elevated cancer risk. We offer recommendations to policymakers, utilities, public health professionals, and medical practitioners to strengthen air quality protections and mitigate the health effects of air pollution exposure.

In 2025, residents of Woodbury County installed six PurpleAir monitors to understand local air pollution levels and sources.

1.1 UNDERSTANDING PM2.5 AND ITS TOXIC COMPOSITION

PM2.5 is a type of air pollution, made up of microscopic liquid droplets and solid particles suspended in the atmosphere. At 2.5 microns or less in diameter — roughly 30 times smaller than a single strand of human hair — these particles are invisible to the naked eye and can only be detected via microscopy. PM2.5 is one of the

1 https://www.iaenvironment.org/webres/File/Coal%20in%20Siouxland%20-%20Final%20Report.pdf
2 https://ww2.arb.ca.gov/resources/inhalable-particulate-matter-and-health

most widespread and hazardous forms of air pollution.[3] While some PM2.5 is emitted directly from sources like wildfires, agriculture, and construction sites, the majority forms secondarily in the atmosphere. This formation occurs when precursor chemicals emitted by fossil fuel power plants, industrial facilities, and motor vehicles react chemically in the presence of sunlight and water. PM2.5 is a category based on particle size, not chemical composition. In fact, the chemical profile of PM2.5 varies significantly by source. PM2.5 directly emitted by coal plants and that is formed from byproducts of coal combustion is particularly hazardous. Direct primary emissions contain carbon black, metals, sulfur dioxide (SO_2), and nitrogen oxides (NOx); SO_2 and NOx contribute to secondary particle formation.[4] Because coal is an extracted fossil fuel, its resulting fine particulate matter is often enriched with highly toxic trace elements, including neurotoxins like mercury, and carcinogens such as arsenic, cadmium, chromium, and lead.[5]

1.2 LOCAL HEALTH AND ENVIRONMENTAL IMPACT IN SIOUX CITY

The public health consequences of this pollution are evident in Sioux City, Woodbury County's most populous city. The region has historically suffered from the highest asthma rates in Iowa, with some neighborhoods ranking in the 90th percentile statewide.[6] In addition to respiratory illnesses, Woodbury County exceeds the state average for both new cancer diagnoses and cancer-related deaths.[7]

Sioux City's overall air quality is shaped by emissions from a heavily industrialized economy, comprising significant manufacturing, food processing, agricultural operations, and large fossil-fuel combustion facilities. Prominent among these regional point sources are two major coal-fired power plants located just south of the city: the George Neal North and George Neal South generating stations owned and operated by MidAmerican Energy Company. While most types of heavy industrial facilities are not required to monitor their emissions, coal-fired power plants, including George Neal North and George Neal South, are required to have continuous emissions monitors, which measure amounts of SO_2 and NOx emitted by the plants.[8] The combination of these heavy industrial baseloads, nearby fossil fuel electricity generation, and local gasoline and diesel vehicle emissions creates a complex atmospheric mix of direct and secondary particulate matter.

1.3 THE MONITORING GAP AND REGULATORY OUTLOOK

Recent state ambient air monitoring data highlights a deteriorating trend. The three-year average of PM2.5 concentrations recorded in the Sioux City Metropolitan Statistical Area (MSA) increased from 8.1 µg/m³ during the 2022 to 2024 period to 8.3 µg/m³ for the 2023 to 2025 period.[9] With pollution levels rising, Sioux City is quickly approaching the Environmental Protection Agency's current annual limit of 9.0 µg/m³.

While the Annual Design Value serves as the regulatory benchmark for long-term compliance, three-year averages fail to reflect real-time, localized air quality or immediate public health risks. Historically, local air data could not be used to enforce federal pollution laws because of how the regional monitoring equipment was classified.[10]
To meet federal network design criteria and satisfy

3 *Id.*
4 https://www.nih.gov/news-events/nih-research-matters/deaths-associated-pollution-coal-power-plants
5 https://www.sciencedirect.com/science/article/pii/S0147651323014094
6 https://www.iaenvironment.org/webres/File/Coal%20in%20Siouxland%20-%20Final%20Report.pdf
7 https://shri.public-health.uiowa.edu/wp-content/uploads/2026/03/2026-Cancer-in-Iowa.pdf
8 https://campd.epa.gov/data/custom-data-download
9 https://www.iowadnr.gov/media/9624/download?inline=&utm_medium=email&utm_source=govdelivery
10 https://www.lung.org/getmedia/32f0646d-c5de-4501-b0ac-07cd63c974d4/State-of-the-Air-2026-Report.pdf p.10

minimum monitoring requirements, the Sioux City MSA monitoring site is transitioning from a Special Purpose Monitor (SPM) to a State and Local Air Monitoring Station (SLAMS). This shifts the site from a non-regulatory designation to a regulatory one, which means its data can be officially used to determine compliance with National Ambient Air Quality Standards (NAAQS).

Assuming the EPA's 9.0 µg/m³ annual standard is not overturned in court, these regulatory monitors are projected to be fully operational by January 1, 2027, or following the final ruling on the EPA's pending regulatory challenges, whichever occurs later.

The EPA standard differs from the World Health Organization's guideline, which was strengthened in 2021 by lowering the recommended annual PM2.5 concentration from 10 µg/m³ to 5 µg/m³.[11]

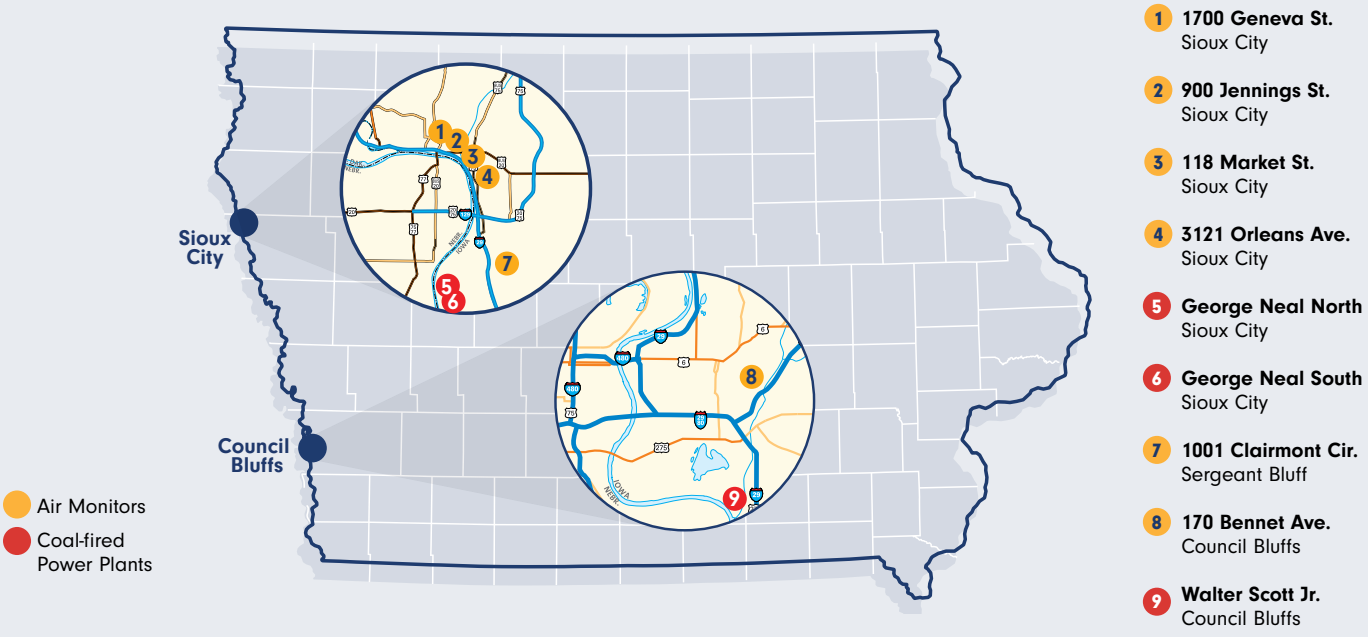
1.4 COMMUNITY-LED SOLUTIONS

This change was driven by an expanding body of evidence showing that meaningful health impacts occur even at low levels of pollution, highlighting that there is no safe threshold for PM2.5 exposure.

Faced with a historical lack of local, publicly accessible, real-time monitoring data, Sioux City residents launched a grassroots initiative to track localized air quality and to better understand the sources of air pollution in their community. In the spring of 2025, community members, with the assistance of the Iowa Environmental Council, installed six PurpleAir monitors across Greater Sioux City. This localized network fills a critical data gap by providing continuous, real-time measurements of ambient PM2.5 concentrations. The monitors allow residents to clearly spot sudden pollution spikes, turning air quality tracking into a daily tool for community health.

11 https://iris.who.int/server/api/core/bitstreams/551b515e-2a32-4e1a-a58c-cdaecd395b19/content p.19

FIGURE 1 Locations of Community-Installed Air Monitors and Nearby Coal-fired Power Plants



AIR MONITOR DATA

2.1 SPATIAL SYNCHRONIZATION OF AIR POLLUTION EVENTS

Data collected from six air monitoring sites — Market St., Orleans Ave., Geneva St., and Jennings St. in Sioux City, Clairmont Cir. in Sergeant Bluff, and Benton Ave. in Salix — reveals a highly synchronized, city-wide problem.

Rather than experiencing isolated local incidents, the entire Greater Sioux City area undergoes simultaneous, acute pollution events.

During summer and fall periods, increased PM2.5 concentrations coincided with increases in SO_2 and NOx emissions, with the PM2.5 levels frequently exceeding both the "Unhealthy for Sensitive Groups" and "Unhealthy" air quality thresholds set by the EPA.

Data from all six monitors show a correlation between increased coal plant emissions and PM2.5 levels. Chart 1 illustrates this trend for the Geneva St. monitor in Sioux City. Although this correlation does not equal causation, it does underscore the coal plants' role as a key contributor to regional particulate pollution during this timeframe.

CHART 1 **PM2.5 Concentrations Track Closely with NOx and SO_2 Emissions Associated with George Neal Plant Operations** (Geneva St., Sioux City)

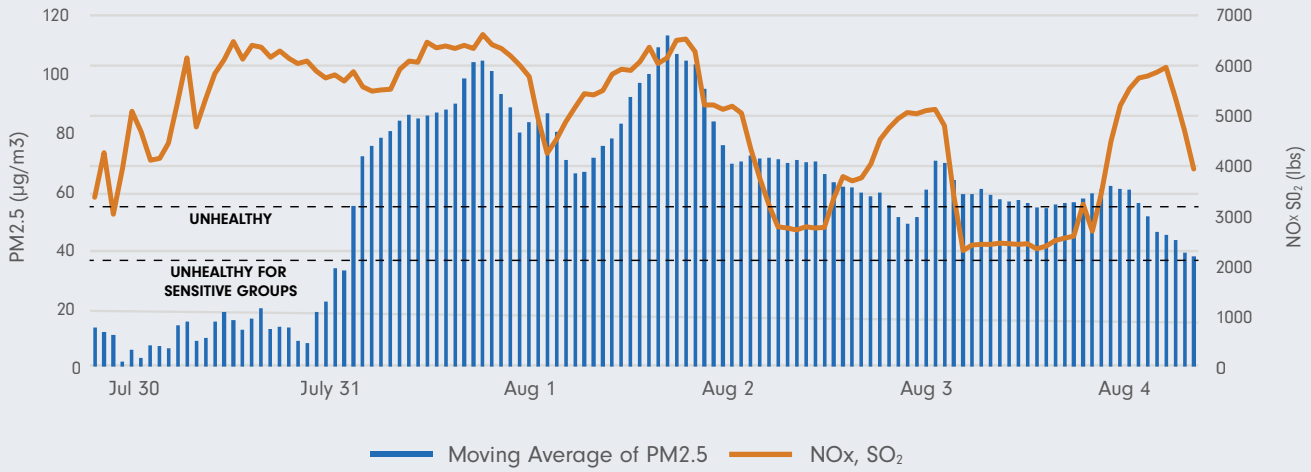


TABLE 1 **Combined 2025 Annual SO_2 and NOx Emissions from the two George Neal Facilities, Totaling over 22 Million Pounds of Major PM2.5 Precursors**

FACILITY NAME	SO_2 (lbs)	NOx (lbs)
George Neal North	7,106,118	4,703,053
George Neal South	6,677,593	3,794,149
TOTAL	**13,783,711**	**8,497,202**

As shown in Table 1, the George Neal North and South plants combined to emit 13,783,711 pounds of SO_2 and 8,497,202 pounds of NOx in 2025.[12] These gases act as the raw ingredients for fine particle pollution, transforming into PM2.5 as they drift through the atmosphere.

2.2 POLLUTION EXPOSURE DISTRIBUTION VARIABILITY

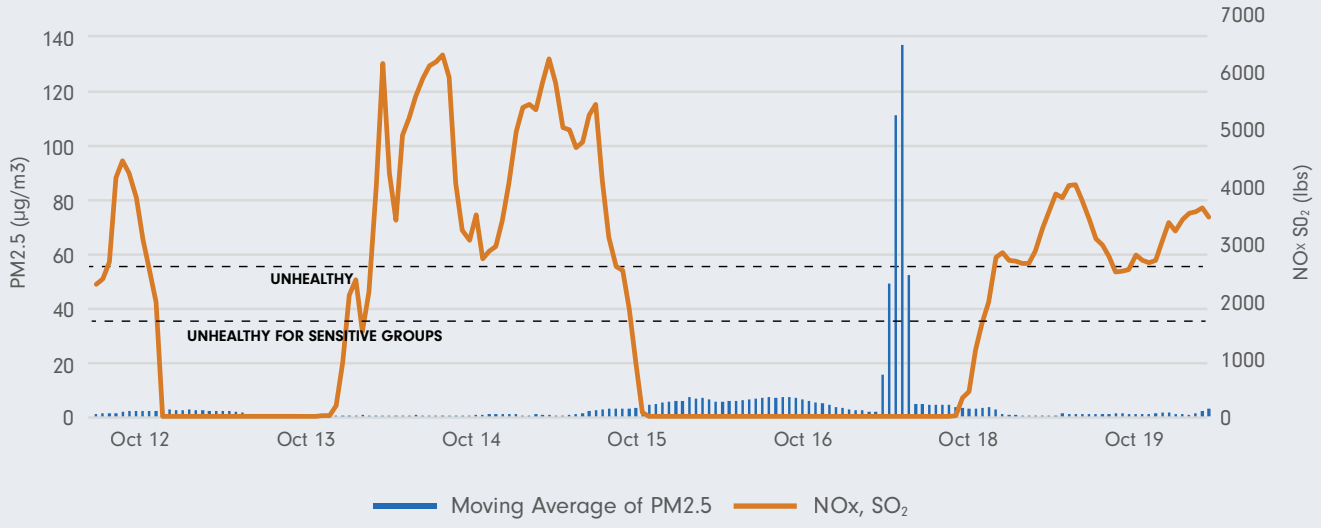
While the timing of these spikes is uniform across the city, the intensity varies by neighborhood. Notably, the Clairmont Cr. site in Sergeant Bluff is an extreme outlier, with concentrations in October peaking over 150 µg/m³ — well above the 120 µg/m³ ceilings seen at other sites.

When a coal plant is "started up" to meet peak power demand, its primary pollution controls cannot function until the equipment reaches incredibly high temperatures.[13]

During ramping periods, both ramping up and ramping down, the facility releases a massive, unmitigated pulse of raw SO_2 and NOx gases. It then takes time for these gases to react with sunlight and moisture in the sky, and to transform chemically into fine particle pollution.[14] This dual lag — mechanical and atmospheric — might explain why there exists sudden, explosive breaches of health thresholds after the plants shift operations.

12 https://campd.epa.gov/
13 https://mde.maryland.gov/programs/Regulations/air/Documents/TSD_Phase1_with_Appendix.pdf p. 12
14 https://www.sciencedirect.com/topics/engineering/smog

CHART 2 **Plant Operational Swings and Subsequent Acute Local PM2.5 Exposure** (Clairmont Cir., Sergeant Bluff)



2.3 SUSTAINED EXPOSURE TO URBAN AIR POLLUTION

The Market St. monitor in downtown Sioux City reveals a concerning pattern of long-term exposure. From spring to late summer, the PM2.5 levels do not simply spike and clear out. Instead, they form a continuous block of pollution that repeatedly exceeds both EPA's "Unhealthy" and "Unhealthy for Sensitive Groups" thresholds.

This prolonged exposure is a dangerous match for a community that regularly ranks in the 90th to 95th percentile statewide for asthma rates. For residents with chronic respiratory conditions, a single afternoon of poor air quality is a challenge, but weeks of continuous, elevated pollution exacerbates chronic conditions.

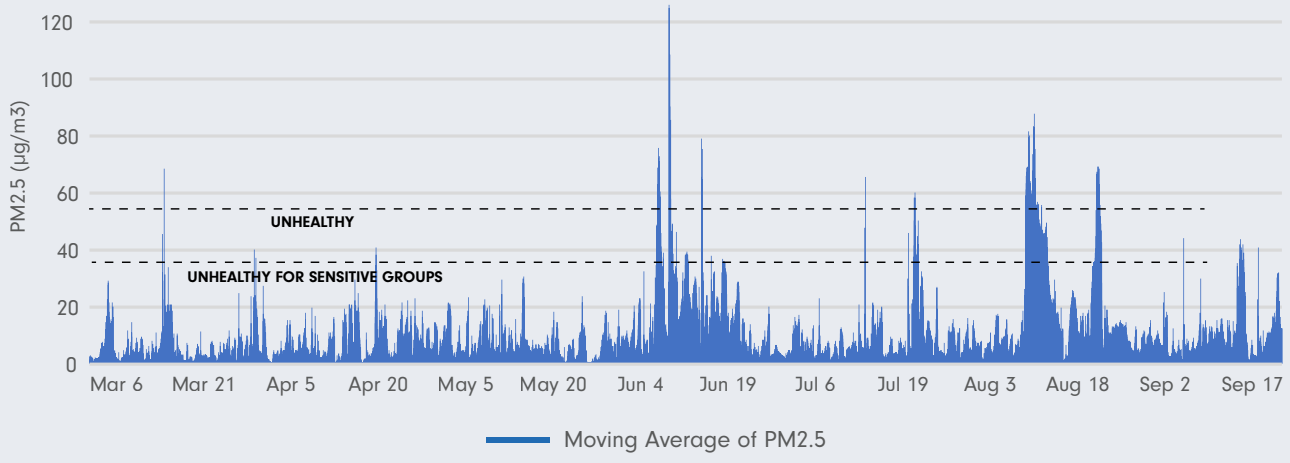
The data show that while the pollution plume is regional, certain neighborhoods bear a disproportionate localized burden. This continuous data highlights a critical public health reality that long-term regulatory averages often smooth over. On any given day during a spike, residents are breathing air that peaks two to three times above federal safety baselines.

While the community-led monitoring network offers invaluable, neighborhood-level insights, the data must be interpreted within the technical boundaries of independent monitoring networks. First, PurpleAir monitors rely entirely on hyper-local Wi-Fi networks for real-time data transmission. Occasional connectivity drops can result in data gaps. Rather than causing an inflation of the pollution threat, this limitation suggests that our findings may be conservative, as brief, acute pollution events during a network offline period would go unrecorded.

2.4 FACTORS CONTRIBUTING TO PM2.5 LEVELS

The monitoring data show a notable temporal relationship between elevated SO_2 and NOx emissions from the two coal-fired power plants and periods of increased PM2.5 concentrations across the community monitoring network. The strongest evidence is the recurring seasonal pattern observed across multiple monitoring locations, where elevated PM2.5 concentrations occur during the same periods as sustained plant emissions. While these observations do not establish a direct causal relationship, power plant emissions contribute to regional particulate matter formation and exposure.

CHART 3 **Persistent PM2.5 Spikes** (Market St., Sioux City)



It is well understood that PM2.5 concentrations are influenced by a complex combination of regional and local factors.[15] On a regional scale, seasonal wildfire smoke and meteorological conditions can impact temporary increases in fine particulate matter. These events are identifiable in the monitoring data because they generate simultaneous elevations across multiple sites throughout the network rather than isolated neighborhood-specific spikes. Several of the elevated PM2.5 episodes observed during the monitoring period exhibit this broad regional pattern.

On a local scale, industrial facilities, commercial operations, transportation corridors, and other community-based emission sources also contribute to ambient air quality. The purpose of the monitoring network is to capture the total cumulative exposure experienced by residents in their daily lives rather than attribute impacts to a single source. For 2024, major stationary sources of PM2.5 in the Sioux City area are shown in Table 2.

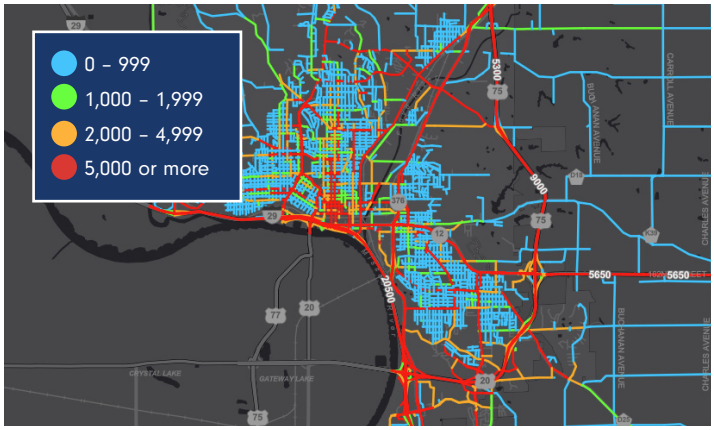
TABLE 2 Major Sioux City Area Polluters Proximate to PurpleAir Monitors

LOCAL POLLUTERS	ACTIVITY	2024 PM2.5 (POUNDS)[16]
CF Industries	Fertilizer manufacturing	185,140
Neal South	Coal plant	159,440
Neal North	Coal plant	98,160
Cargill	Soybean processing and refining	39,920
Ag Processing	Soybean processing and refining	28,960
Smithfield Foods	Meat processing	1,160
Magellan Pipeline	Petroleum terminal	700

In addition to the facility PM2.5 emissions listed in Table 2, gasoline and diesel vehicles traveling in Sioux City are significant contributors of PM2.5. In 2024, a total of over 94,000,000 gallons of gasoline and diesel (including ethanol and biodiesel) was sold in Woodbury County.[17]

Based on the annual average daily traffic in the Sioux City area shown in Figure 2, direct and secondary PM2.5 emissions from vehicle travel also contributes to the elevated PM2.5 levels seen at the PurpleAir monitors.[18]

FIGURE 2 Siouxland Annual Average Daily Traffic Levels



Source: Iowa Department of Transportation

Recognizing multiple pollution sources does not diminish the severe impact of coal emissions on community air quality.

> **Instead, the data reveal a layered environment in which coal emissions elevate baseline PM2.5 levels and stack on top of other local sources of pollution.**

Looking at pollution sources in isolation completely misses the bigger picture: It is the combined effect of regional and local air pollution that threatens overall public health.

15 https://pmc.ncbi.nlm.nih.gov/articles/PMC4515683/
16 https://www.iowadnr.gov/media/2277/download?inline
17 https://catalog.data.gov/dataset/iowa-motor-fuel-sales-by-county-and-year?from_hint=eyJrZXl3b3JkIjoibW90b3IgZnVlbCJ9
18 https://experience.arcgis.com/experience/291d4e2c64cf490a95a6660b1349a088/page/Traffic-Volume

HEALTH IMPACTS OF PM2.5 POLLUTION

3.1 DISPROPORTIONATE RISK FROM PM2.5 EXPOSURE

PM2.5 is among the most dangerous forms of air pollution because the microscopic particles are small enough to penetrate deep into the lungs and enter the bloodstream. Once inhaled, PM2.5 can trigger inflammation throughout the body, contributing to a wide range of adverse health outcomes, including respiratory illnesses, cardiovascular disease, stroke, and premature death.

Research has consistently linked both short-term and long-term exposure to PM2.5 with increased hospitalizations, chronic illness, and mortality.[19] This is particularly concerning in Woodbury County, where asthma-related emergency department visits have increased in recent years.[20] Particularly vulnerable populations include children, older adults, pregnant individuals, and people with preexisting heart or lung conditions.

CHART 4 Rising Annual Asthma Emergency Department Visits in Woodbury County

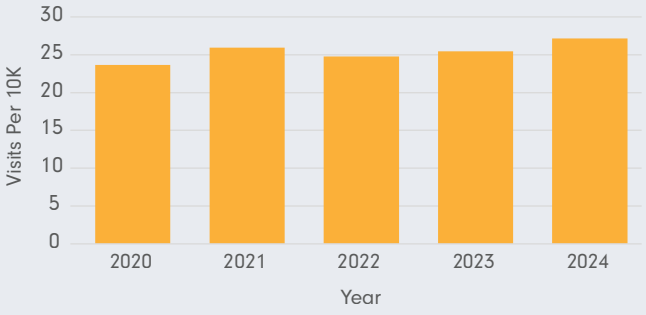


TABLE 3 Woodbury County Populations at Elevated Risk for Harm from PM2.5 Pollution[21]

CATEGORY	INDIVIDUALS AFFECTED	PERCENTAGE AFFECTED
Pediatric Asthma	1,567	6% of those under 18
Adult Asthma	7,608	7%
COPD	4,459	4%
Cardiovascular Disease	6,685	6%
Children under 18	27,229	25%
Adults 65 and Over	17,357	16%
TOTAL POPULATION	**107,257**	

As mentioned in Section 1, not all PM2.5 pollution is equally harmful. The source and chemical composition of particulate matter significantly influence its toxicity.

> **A landmark 2023 study found that PM2.5 originating from coal-fired power plants was associated with a mortality risk more than twice as high as PM2.5 from other sources.[22]**

Using nationwide Medicare and emissions data, researchers estimated that coal-related PM2.5 contributed to approximately 460,000 deaths between 1999 and 2020. Over the same period, the George Neal facilities were associated with an estimated 1,400 premature deaths, including 790 attributable to George Neal North and 610 to George Neal South.[23] Previous assessments likely underestimated the health burden associated with coal-fired power generation because they assumed all PM2.5 particles posed similar risks.

19 https://pmc.ncbi.nlm.nih.gov/articles/PMC6250783/
20 https://hhs.iowa.gov/about/data-reports/health-disease/asthma/asthma-emergency-department-visits-data
21 https://www.lung.org/research/sota/city-rankings/states/iowa/woodbury
22 https://www.science.org/doi/10.1126/science.adf4915
23 https://cpieatgt.github.io/cpie/

3.2 PM2.5 AND CANCER

A growing body of evidence links PM2.5 exposure to increased cancer risk. While air pollution has long been recognized as a cause of lung cancer, newer research suggests that fine particulate matter may contribute to cancer development through mechanisms beyond direct DNA damage.[24]

> **Scientists have found that PM2.5 can create chronic inflammation within lung tissue, activating dormant cells that already carry cancer-related mutations and promoting tumor growth.**

The study found that particulate air pollution may stimulate the growth of preexisting mutated cells through chronic inflammation in the lungs, providing a biological mechanism linking long-term PM2.5 exposure to elevated lung cancer risk.[25] These findings help explain why lung cancer can develop in individuals with little or no smoking history.

Cancer is a public health crisis in Iowa, which makes these findings particularly relevant in our state. Iowa continues to have one of the highest cancer incidence rates in the nation, with lung cancer ranking among the top three most frequently diagnosed cancers.[26] While many factors contribute to cancer risk, environmental exposures such as air pollution are increasingly recognized as important contributors.[27]

Reducing PM2.5 emissions can provide substantial public health benefits. In addition to lowering rates of heart disease, asthma, and premature mortality, reducing particulate pollution may also decrease the burden of cancer and other chronic diseases over time.[28]

24 https://www.nature.com/articles/s41586-023-05874-3
25 https://www.nature.com/articles/s41586-023-05874-3
26 https://shri.public-health.uiowa.edu/wp-content/uploads/2026/03/2026-Cancer-in-Iowa.pdf
27 https://www.iaenvironment.org/webres/File/Environmental%20Risk%20Factors%20and%20Iowa's%20Cancer%20Crisis%20-%20Report(1).pdf p.58
28 https://publications.iarc.who.int/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Outdoor-Air-Pollution-2015 p.39

RECOMMENDATIONS

Evidence from epidemiological and toxicological research shows that PM2.5 exposure is linked to a wide range of adverse health outcomes, including respiratory and cardiovascular disease, premature mortality, and cancer, with impacts occurring even at low concentrations and disproportionately affecting vulnerable populations. Emerging research also indicates that health risks vary by emission source, with combustion-related PM2.5 — particularly from coal-fired power generation — associated with greater toxicity and mortality risk.[29]

Given this evidence, coordinated action across regulatory, policy, industry, healthcare, and community stakeholders is needed to reduce emissions, improve exposure monitoring, and strengthen public health protections. The following recommendations outline key actions to address PM2.5 pollution and its health impacts.

	RECOMMENDATION	EPA	IDNR*	UTILITIES	STATE POLICYMAKERS	LOCAL POLICYMAKERS	HEALTHCARE	COMMUNITY
1	**Strengthen PM2.5 NAAQS to be consistent with WHO guidance** (5 µg/m³)[30]	✓						
2	**Expand ambient air monitoring system beyond minimum requirement**		✓					
3	**Accelerate retirement of coal generation; transition to clean energy**			✓				
4	**Implement best available pollution controls; optimize coal plant operations**			✓				
5	**Integrate health-based air quality into energy planning**			✓	✓			
6	**Incorporate air pollution exposure screening in clinical healthcare assessments**						✓	
7	**Alert the public via text message or email when Air Quality Index levels exceed EPA safety thresholds, based on IDNR data**					✓		
8	**Assist residents of communities affected by coal plant pollution with acquiring indoor air purifiers**			✓		✓		
9	**Educate the public on clinical guidance for high pollution days**					✓	✓	
10	**Comment on IDNR draft air permits, proposed rules, and air monitoring plans; participate in IUC proceedings evaluating MidAmerican electric generating sources**					✓		✓
11	**Advocate for emissions controls and clean energy investments**						✓	✓
12	**Promote the adoption and use of electric vehicles and electric vehicle infrastructure**			✓	✓	✓		✓

*Iowa Department of Natural Resources

29 https://www.science.org/doi/10.1126/science.adf4915
30 https://pmc.ncbi.nlm.nih.gov/articles/PMC9704826/

CONCLUSION

PM2.5 pollution in Sioux City and Woodbury County poses a significant and ongoing public health risk, with evidence of both widespread regional pollution events and disproportionate neighborhood-level exposures.

Community monitoring and scientific research together suggest that fossil fuel combustion, particularly from coal-fired generation, contributes meaningfully to local air quality impacts.

Considering well-established links between PM2.5 exposure and respiratory, cardiovascular, and cancer outcomes, coordinated action across regulatory, policy, utility, healthcare, and community stakeholders is urgently needed to reduce emissions and protect population health.

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