FINAL REPORT

Regional Network Assessment

States of Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin

July 1, 2010

Executive Summary

A regional assessment of monitoring networks in Region V was performed to provide the state and local agencies with information on whether their networks still meet the monitoring objectives, whether new sites are needed, whether existing sites are no longer needed, and whether new technologies are appropriate, as required by 40 CFR Part 58.10(d). The assessment's recommendations are non-binding; rather, each state/local agency will decide, as part of their annual network review, whether to make the recommended changes. Furthermore, although there is no requirement for a periodic network assessment for tribal monitoring, this information may also be helpful to Midwest tribes in evaluating their current and desired future monitoring activities.

To guide the assessment (and implementation of its recommendations), the Region V State Air Directors established the following priority order for monitoring objectives based on policy needs and concerns:

- Long-standing objectives which place a heavy emphasis on monitoring in areas of high concentration and high population, provide data to the public in a timely manner, support compliance with the NAAQS and control strategy development, and support air pollution research studies
- Multi-pollutant monitoring (e.g., EPA's new monitoring requirements for NCore)
- Source-oriented monitoring (e.g., EPA's new monitoring requirements for Pb, NO2, and SO2)
- Rural monitoring and medium-sized city monitoring (e.g., EPA's proposed new monitoring requirements for O3)
- Environmental justice monitoring
- School monitoring (e.g., air toxics)

A major concern raised by the assessment is the need for sufficient resources States are struggling to maintain high value and high quality monitoring data, due to rising operating costs, need for periodic equipment replacements, increased reporting burden for quarterly progress reports, increased staff costs and staff turn-over, increased travel costs, additional network reviews, limited ability to reduce design of network due to more stringent standards, and the demands of increasing EPA monitoring requirements. The priority order listed above will determine how to best use any resource savings associated with disinvestments (shutdowns) and new monitoring money.

The two key findings of the assessment are as follows:

(1) Existing state/local monitoring networks provide valuable data and need to be maintained. Based on our data analyses, limited improvements are recommended:

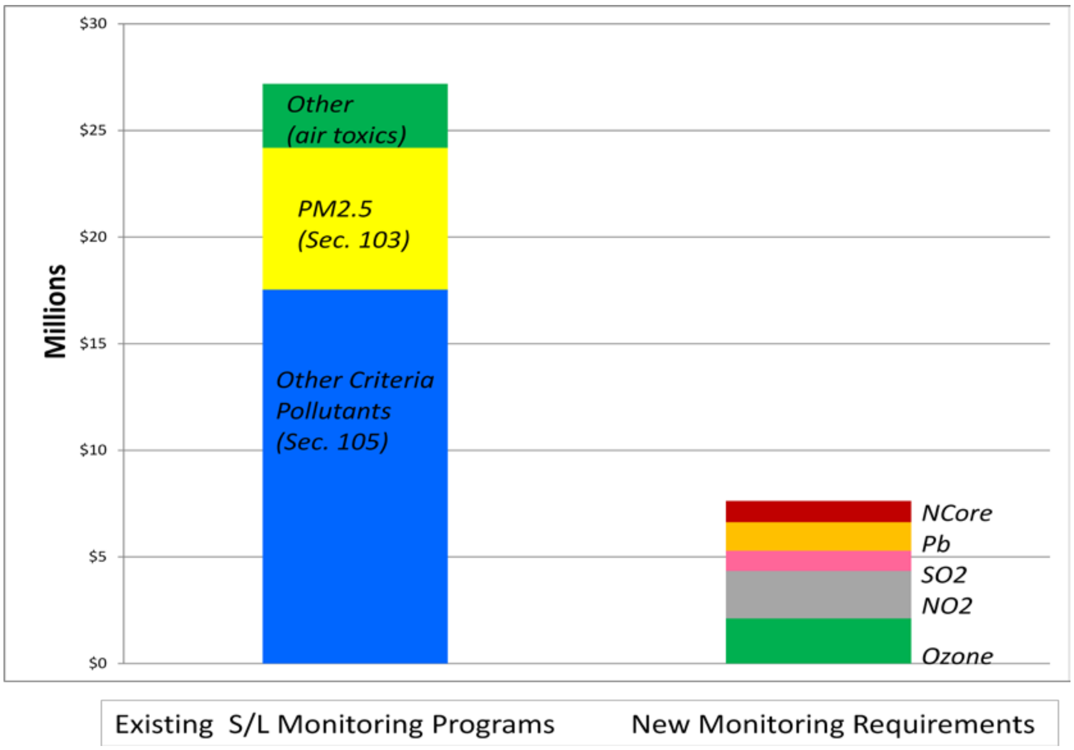
    Disinvestments (shutdowns) – e.g., remove a few "low value" sites and a few redundant PM2.5 (FRM and speciation) and O3 sites in some major urban areas

    Investments (new monitoring) – e.g., add enhanced O3 precursor monitoring in several major urban areas and enhanced rural monitoring

This assessment makes no specific recommendations on which, if any, of these sites to shutdown. This decision is left to the appropriate state/local agency to make as part of their annual network review either this year or next year.

Any resource savings associated with the shutdown of a monitor or site in a given state should be used (shifted) to cover the resource needs for new monitoring (both improvements to the current networks and new monitoring requirements) within that state.

(2) Many new EPA monitoring requirements are expected over the next several years. The annual cost for these new requirements in Region V is on the order of $7-9M, which is about 1/3 of what the states/locals are currently spending for their monitoring programs – see figure below.



Estimated annual costs in Region V for existing state/local monitoring programs and for new monitoring requirements

Potential sources of funding to pay for these new monitoring requirements include: (1) disinvestments (and associated resource shifts), such as those identified in this assessment, and (2) new money, including EPA's plans to provide an additional $15M nationally in FY2011 for new monitoring. Together, however, this funding will not approach the needed $7-9M. The recommended approach for using any resource shifts or new money is to spread-out the funding to do some of each of the new requirements. A specific decision will be deferred until we have a better understanding about: (a) the Region V funding allocation, (b) new NAAQS for O3, CO, and PM2.5, and (c) the expected change in funding for PM2.5 monitoring from section 103 to section 105 which will affect state monitoring budgets. However, it is apparent that there will not be sufficient resources to fully comply with all of the new requirements. The implications of this are unclear at this time.

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Section 1.0 Introduction

Pursuant to the U.S. Environmental Protection Agency's (EPA) monitoring regulations (40 CFR Part 58.10(d)), the Region V States and Tribes worked with the Lake Michigan Air Directors Consortium (LADCO) and EPA, Region V to conduct a regional network assessment. The state and tribal ambient air quality monitoring networks for criteria pollutants (especially, ozone, PM2.5, PM10, and their precursors) were reviewed from a regional perspective to ensure the best possible use of available resources to meet policy, regulatory, and technical needs. The assessment re-evaluated the objectives and budget for air monitoring; evaluated the existing network's effectiveness and efficiency relative to its objectives and cost; and recommends network improvements.

Oversight for the regional assessment was provided by a Steering Committee of state, local, and tribal (SLT), and federal representatives:

IL–Terry Sweitzer, Chris Price	IN–Dick Zeiler, Steve Lengerich
MI–Craig Fitzner, Mary Ann Heindorf	WI–Bart Sponseller, Joe Hoch
OH–Randy Hock, Gary Engler, Anna Kelley, Valerie Whitman, Misty Koletich	MN–Rick Strassman, Cassie McMahon, Kari Palmer, Kellie Gavin
Mille Lacs Band of Ojibwe–Charlie Lippert	Leech Lake Band of Ojibwe–Brandy Toft
Forest County Potawatomi-Natalene Cummins	Fond du Lac Band of Lake Superior Chippewa – Joy Wiecks
LADCO–Mike Koerber, Donna Kenski	EPA- Marta Fuoco, Pat Schraufnagel, Ed Delisio

Technical analyses were conducted by a Data Analysis Workgroup comprised of representatives from LADCO, EPA, Region V, and the States of Minnesota and Wisconsin.

State and local agencies are required to submit both a network assessment every five years and a monitoring network plan every year. The annual monitoring plan is the mechanism for state and local agencies to provide details for existing and proposed monitoring sites (e.g., site identification number, location, operating schedules, monitoring objective and spatial scale of representativeness, etc.). The regional assessment complements the annual monitoring plans by providing a more comprehensive examination of state and local monitoring networks across a broad geographic region.

The general schedule for the assessment consisted of:

2009	Sept	Form Steering Committee and Data Analysis Workgroup; develop workplan
	Oct – Jan	Conduct analyses
2010	Feb - March	Prepare draft recommendations and report Discuss draft recommendations with states
	April	Finalize recommendations and report
	May	Deliver final report to states for inclusion (with annual network reviews) in state public comment process
	July 1	States submit regional network assessment and annual network reviews to EPA

This document summarizes the regional network assessment, provides recommendations for network changes, and discusses implementation of the recommendations.

Section 2.0 Overview of Current Networks

Currently, the State and Local agencies in Region V operate about 430 criteria pollutant monitoring sites at a cost of over $25M. Several tribes in Minnesota, Wisconsin, and Michigan also operate air monitors. A map of the state, local, and tribal sites is provided in Figure 1. A site list is provided in Appendix I. The sites range from single pollutant sites to sites measuring as many as seven air pollutants. A summary of the existing criteria pollutant monitoring networks, including cost information, is provided in this section.

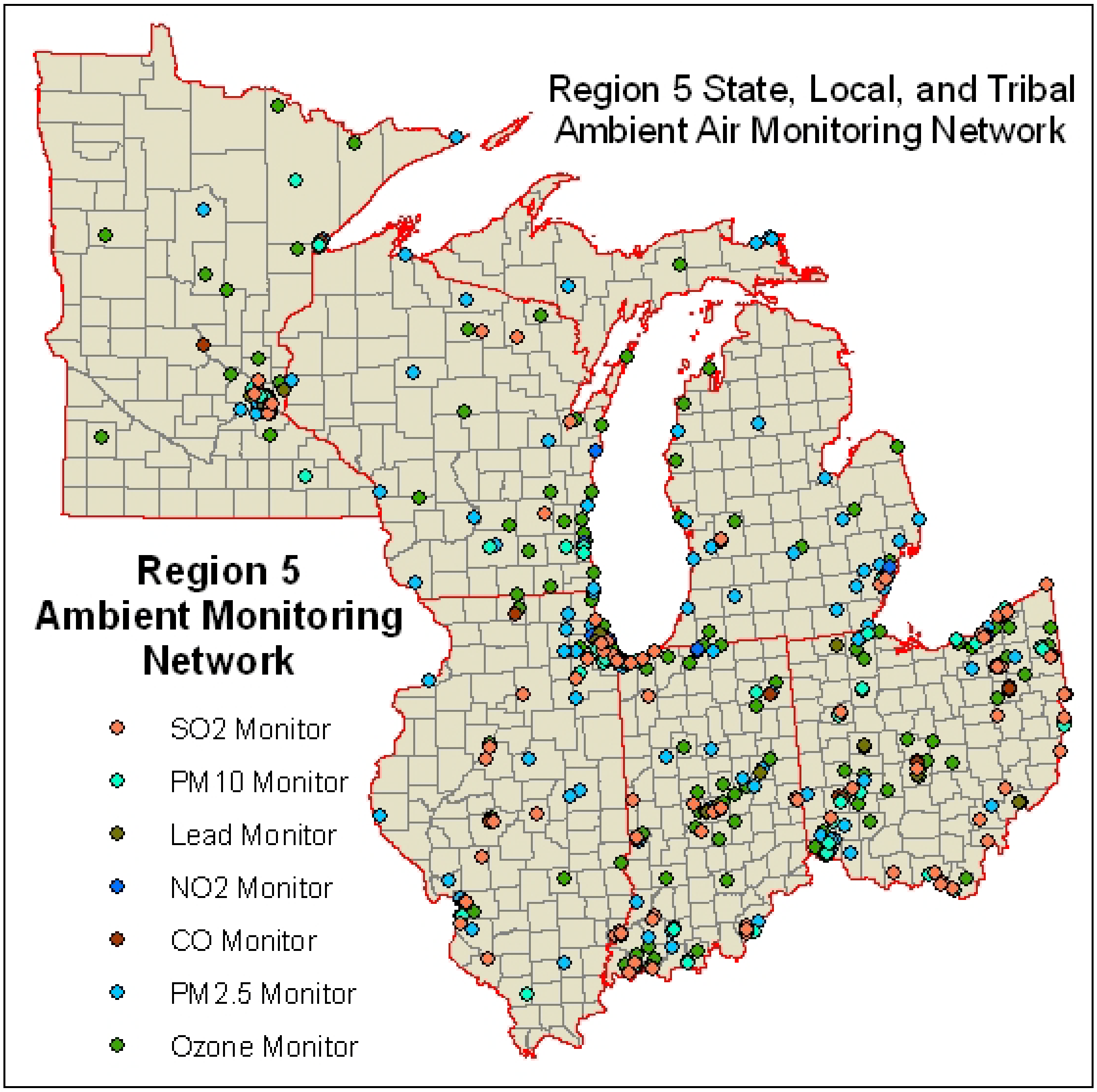

Figure 1. Monitoring sites in Region V

Maps of the monitoring sites for each criteria pollutant are shown in Figures 2 and 3.

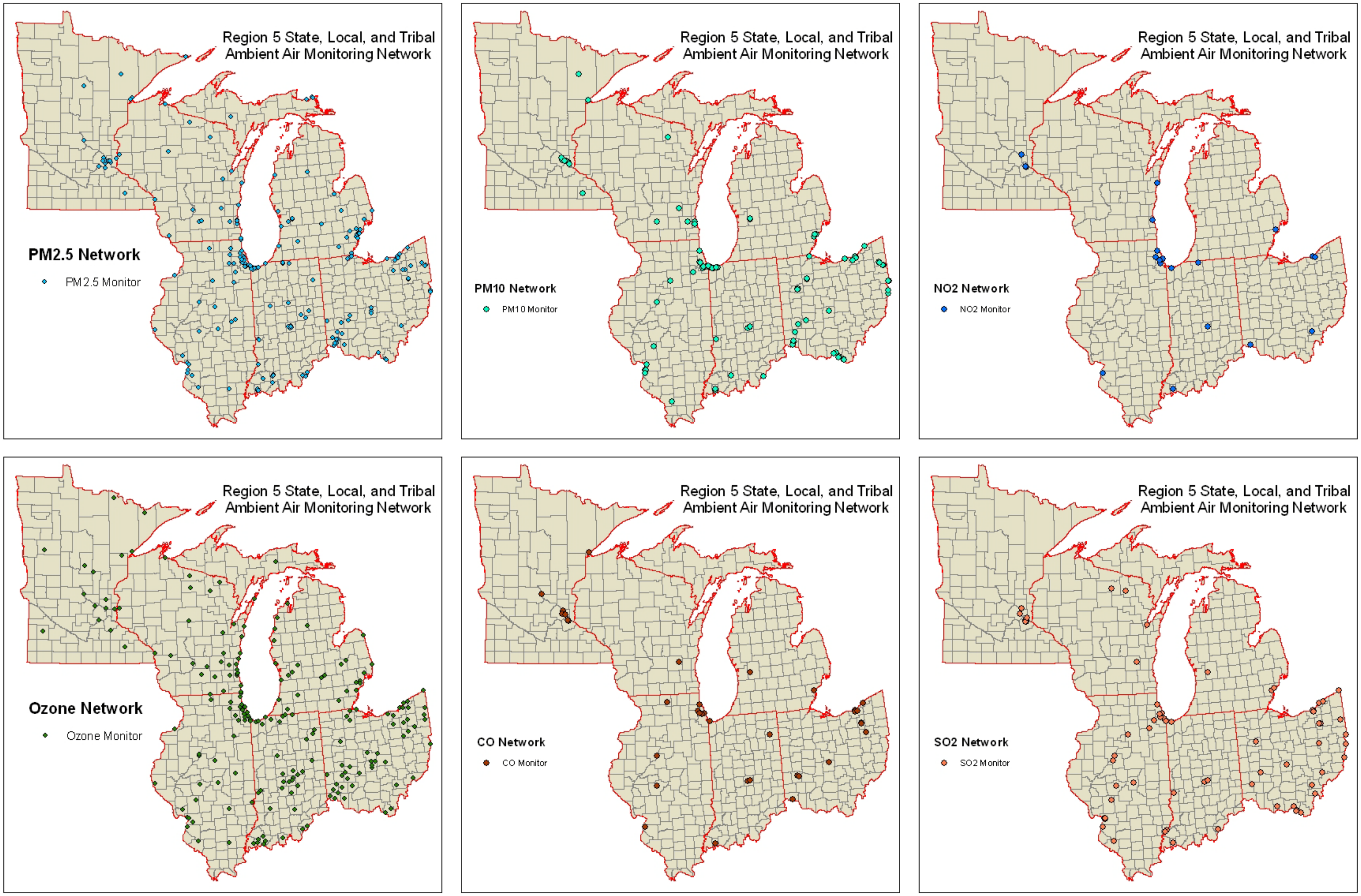

Figure 2. Criteria pollutant monitoring sites in Region V

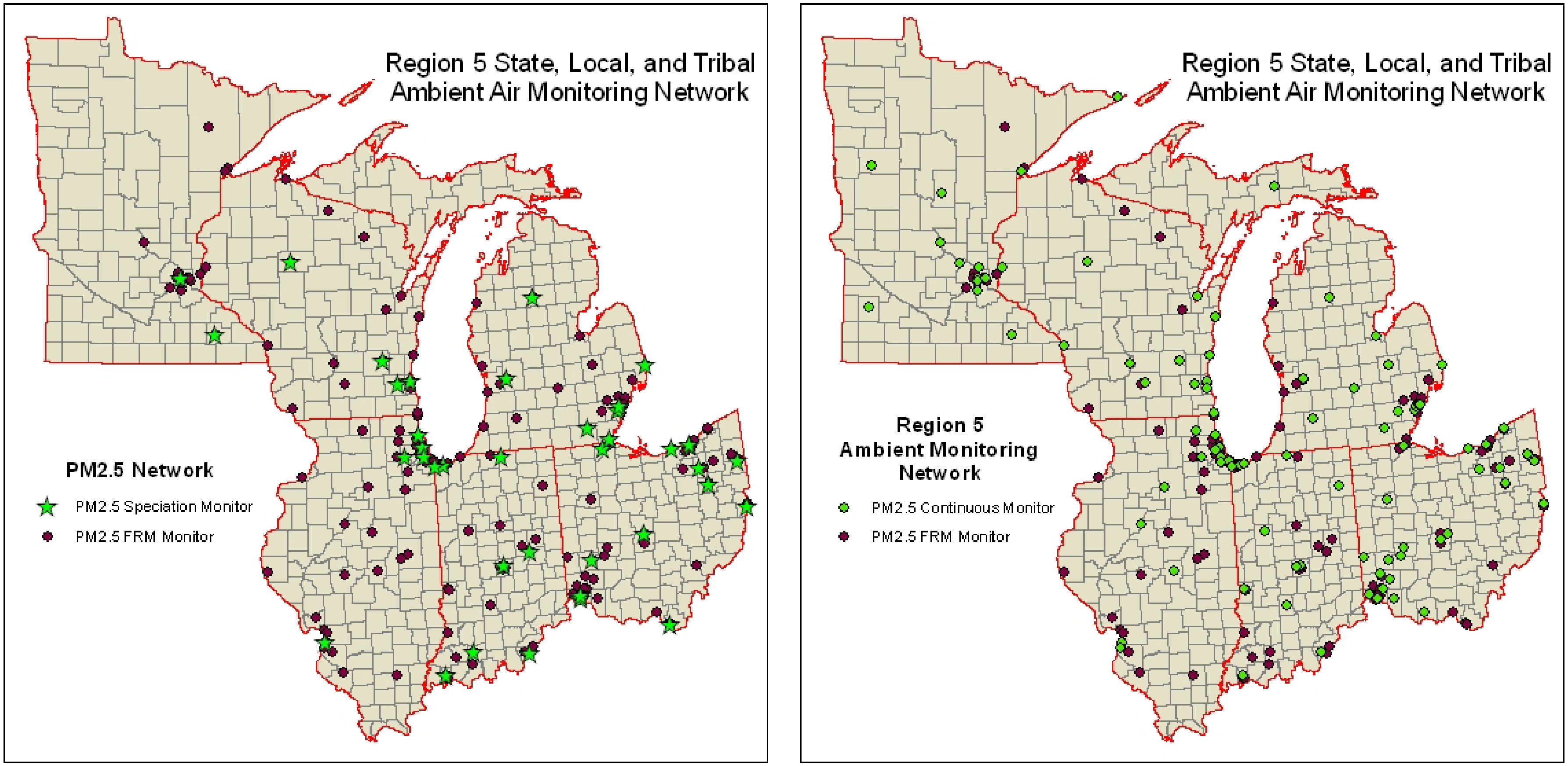

Figure 3. PM2.5 FRM/speciation (left) and FRM/continuous (right) monitoring sites in Region V

Further details on the state monitoring programs are provided in the latest annual network plan for each State:

- IL http://www.epa.state.il.us/air/monitoring/index.html
- IN http://www.in.gov/idem/5342.htm
- MI http://www.michigan.gov/deq/0,1607,7-135-3310_4195-230649--,00.html
- MN http://www.pca.state.mn.us/air/monitoringnetwork.html
- OH http://www.epa.state.oh.us/dapc/ams/plan.aspx
- WI http://dnr.wi.gov/air/aq/monitor/netreview.htm

Other networks which provide valuable data include CASTNET (ozone) and IMPROVE (PM2.5-mass, PM10-mass, and PM2.5-speciation). Further discussion of these (and other) networks is provided in Appendix II. Data from these networks were not included in the data analyses summarized in Section 4. However, sites in these networks should be taken into account in assessing the overall adequacy of the state, local, and tribal monitoring networks.

The cost of state and local agency air monitoring in Region V is summarized in Table 1. State and local agencies receive funding for monitoring activities from EPA pursuant to Section 103 (for PM2.5) and Section 105 of the Clean Air Act. Funding is also provided by the states (e.g., to meet the match requirement for Section 105 funds). The cost for criteria pollutant programs alone is estimated to be about $24M. Taking into account other monitoring (e.g., air toxics), the total cost for state and local monitoring programs in Region V is estimated to be about $27M. Additionally, the cost for tribal monitoring programs in Region V is estimated to be about $0.75M.

Table 1. State/Local Monitoring Costs

	FY2009					FY2010			
	Sec 105	Sec 103 (PM2.5, NCORE)	Other (State Air Toxics, Industry)	Total (Sec 105+103)		Sec 105	Sec 103 (PM2.5, NCORE)	Other (State Air Toxics, Industry)	Total (Sec 105+103)
	Oct 1, 2008-Sept 30, 2009	Apr 1, 2009 - Mar 31, 2010		FY2009		Oct 1, 2009-Sept 30, 2010	Apr 1, 2009 - Mar 31, 2010		FY2010
Illinois EPA	***$2,000,000***	$1,079,506		$3,079,506		***$2,000,000***	$1,069,112		$3,069,112
Indiana DEM	$2,141,242	$1,196,799		$3,338,041		$1,955,892	$1,221,754		$3,177,646
Michigan DEQ	***$1,422,407***	$1,063,272		$2,485,679		$1,422,407	$1,097,827		$2,520,234
Minnesota PCA	$839,580	$622,878	$526,602	$1,462,458		$841,255	$557,115	$419,820	$1,398,370
Ohio EPA	***$2,750,000***	$738,659		$3,488,659		***$2,750,000***	$726,328		$3,476,328
Akron		$109,264		$109,264			$107,440		$107,440
Canton		$78,216		$78,216			$76,910		$76,910
Cleveland		$203,211		$203,211			$199,819		$199,819
Hamilton County		$349,390		$349,390			$343,557		$343,557
Lake County		$31,351		$31,351			$30,828		$30,828
Mahoning-Trumbull		$82,144		$82,144			$80,773		$80,773
Portsmouth		$59,678		$59,678			$58,682		$58,682
RAPCA		$206,394		$206,394			$202,948		$202,948
Toledo		$75,202		$75,202			$73,947		$73,947
Wisconsin DNR	$1,430,267	$755,642	$590,985	$2,185,909		$1,320,171	$750,139	$647,985	$2,070,310
TOTAL	$10,583,496	$6,651,606		$17,235,102		$10,289,725	$6,597,178		$16,886,903
			tot w/ match =	**$24,326,044**				**tot w/ match =**	**$23,781,019**

Note: numbers in red italics (i.e., for Illinois and Ohio) are estimates based on cost data from the other states

Section 3.0 Regulatory Requirements

On October 17, 2006 (71 FR 61236), EPA issued final amendments to its ambient air monitoring requirements for criteria pollutants. These amendments were intended to "enhance ambient air quality monitoring to better serve current and future air quality management and research needs." The new monitoring regulations include:

- Requirements for establishment/operation of multi-pollutant monitoring stations.
- Changes in monitoring network design requirements for minimum numbers of monitors to focus on populated areas with air quality problems and to reduce requirements for criteria pollutant monitors with concentrations well below the NAAQS. Specifically, a minimum number of sites were required for ozone, PM2.5, and PM10 as a function of population and ambient concentrations; no minimum number of sites were required for CO, NO2, SO2, and Pb.
- Changes in provision regarding monitoring network descriptions, periodic assessments, quality assurance, and data certification.
- Changes in PM2.5 monitoring requirements.
- Requirements for limited $PM_{10-2.5}$ monitoring to support research and health effects studies.

The focus of this report is the periodic network assessment requirements in 40 CFR Part 58.10[1]. In particular, Paragraph (d) states that

> (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. For PM2.5, the assessment also must identify needed changes to population-oriented sites. 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 first assessment is due July 1, 2010.

An important factor in conducting this assessment is that there will be many new monitoring requirements between now and the next 5-year assessment driven by changes in the National Ambient Air Quality Standards (NAAQS) – see Table 2. These new requirements expand the long-standing monitoring objectives of monitoring in areas of high concentration and high population to include multi-pollutant monitoring, source-oriented monitoring, rural monitoring, and environmental justice monitoring. In addition, EPA has recently promoted air toxics monitoring at schools.

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[1] Paragraphs (a)-(c) address the requirement for states to submit an annual monitoring network plan. The annual network plan and the periodic (5-year) network assessment are separate, but related requirements.

Table 2. Status of NAAQS and Related Monitoring Requirements

Pollutant	Action	Proposed Standard	Final Standard	Monitor Deployment
NO2	Review of standard (primary standard)	July 2009	Jan 2010	Jan 2013
Pb	Revised standard	May 2008	Nov 2008	
	Reconsideration of monitoring rule	Dec 2009	April 2010	Jan 2010 (source-oriented) Jan 2011[2] (population-oriented) July 2011[2] (new source-oriented)
O3	Reconsideration of 2008 standard	Jan 2010	Aug 2010	
	Additional urban and rural monitors	July 2009	Aug 2010	2012
SO2	Review of standard (primary standard)	Dec 2009	June 2010	Jan 2013
CO	Review of standard	Oct 2010	May 2011	
$PM_{2.5}$, PM10	Review of standard	Feb 2011	Oct 2011	
NO2, SO2	Review of secondary standard	July 2011	Mar 2012	
Other: NCore	Multi-pollutant monitoring (NCore)	Jan 2006	Oct 2006	Jan 2011

Table 3 provides a summary of the number of existing and required monitors by pollutant and state. For some pollutants, there is no required minimum of monitors, while for others (e.g., ozone and PM2.5), the required minimum of monitors is a function of the measured design values (compared to a threshold of 85% of the NAAQS) and population. If the NAAQS for ozone and PM2.5 are tightened, then the required minimum number of monitors will increase.

In light of this increased monitoring (and changes recommended by the assessment), two concerns should be recognized. First, depending on policy priorities and Midwest air quality issues, it may be appropriate to have fewer (or more) monitors than required by EPA's monitoring regulations. As such, EPA should be flexible in granting waivers, when sufficient justification is provided. Furthermore, EPA should be willing to reconsider mandates that do not contribute to regional priorities or monitoring objectives.

Second (and perhaps most important), it is apparent that there will not be sufficient resources to fully comply with all of the new requirements. The implications of this are unclear at this time.

[2] In its December 20, 2009, proposed revision to the Pb monitoring requirements, EPA proposed to lower the emissions threshold for source-oriented monitoring from 1.0 to 0.5 TPY, and to eliminate the population-oriented monitoring requirement and instead require Pb monitors at NCORE sites.

Table 3. Number of monitors by pollutant in each state

	PM2.5-mass (FRM)			PM2.5-mass (cont.)			PM2.5-speciation			PM10			Pb		
	Current (2010) Network	Require-ments		Current (2010) Network	Require-ments		Current (2010) Network	Require-ments		Current (2010) Network	Require-ments		Current (2010) Network	Requirements	
		Current			Current			Current			Current			Current-Source	Proposed-Population
IL	38	5		14	3		5 + 1 IMPROVE	1		17	4		12	6	2
IN	37	8		14	4		8 + 1 IMPROVE	1		15	2 - 5		9	5	1
MI	26	6		13	3		7 + 2 IMPROVE	1		5	3 - 7		1	1	2
MN	10	3		13	2		2 + 4 IMPROVE	1		4			13	4	1
OH	43	19		25	10		13 + 1 IMPROVE	1		37			17	4	3
WI	21	8		13	4		4	1		4	3		2	1	1
Subtotal	**175**	49		92	26		39 + 9 IMPROVE	6		**82**			**54**	**21**	**10**
Tribes	9			1			0			1			0		
TOTAL	**184**	49		93	26		39 + 9 IMPROVE	6		**83**			**54**	**21**	**10**
**** = there are no minimum requirements for the number of monitoring sites***															

Note: additional co-located monitors are also required to meet QA requirements, so the true minimum number of required monitors is greater than indicated above.

Table 3. Number of monitors by pollutant in each state (continued)

	Ozone			VOC (PAMS)		NOx			CO		SO2				Trace CO, & SO2, and NOy (NCore)	
	Current (2010) Network	Requirements		Current (2010) Network	Require-ments	Current (2010) Network	Requirements		Current (2010) Network	Require-ments	Current (2010) Network	Requirements			Current (2010) Network	Require-ments
		Current	Prop.		Current		Current - Pop.	Current-Road.		Current			Current—PWEI			Current
IL	36	13		4	2	7	1	2	9	*	17		4		1	1
IN	42	14		1	0	5	1	1	6	*	8		5		1	1
MI	25	15		1	0	1	1	3	2	*	3		5		2	2
MN	15	2		0	0	3	1	2	5	*	7		2		1	1
OH	47	20		0	0	2	3	7	11	*	22		9		3	3
WI	31	11		3	2	3	1	2	1	*	3		3		1	1
Subtotal	**196**	75		9	4	21	8	17	34		60		28		9	9
Tribes	7			0		1			0		1					
TOTAL	**203**	75		9	4	22	8	17	34		61		28		9	9
**** = there are no minimum requirements for the number of monitoring sites***																

Note: additional co-located monitors are also required to meet QA requirements, so the true minimum number of required monitors is greater than indicated above.

An analysis was undertaken to estimate the costs for this new monitoring. Two cost scenarios were identified: (1) worst-case, which assumed establishment of new, single-pollutant sites to meet all of the new requirements, and (2) best-case, which assumed reliance on existing sites as much as possible to meet some of the new requirements. Given the diverse nature of the new requirements, coordination to achieve further efficiencies does not appear to be possible. Assumptions made in this analysis include:

NO2: EPA's final rule requires both near roadway and population-oriented monitoring. For the worst case scenario, all new monitors are assumed to be single-pollutant sites. For the best case scenarios, we will assume that all near roadway monitors are new single-pollutant sites and all population-oriented monitors are located at existing sites.

The estimated cost for establishing a new single-pollutant site is about $80,000 (capital) plus $25,000 (annual operations). The estimated cost for locating a monitor at an existing site is about $30,000 (capital) plus $15,000 (annual operations).

Pb: EPA's final rule requires both source- and population-oriented monitoring. (In its December 20, 2009, proposed revision to the Pb monitoring requirements, EPA proposed to lower the threshold for identifying point sources from 1.0 to 0.5 TPY, and to eliminate the population-oriented monitoring requirement and instead require Pb monitors at urban NCORE sites.) For this analysis, no increase in the number of source-oriented monitors is assumed, given that Region V has already used the lower threshold (0.5 TPY) to identify potential source-oriented sites. Considerable modeling was done to support a waiver of the monitoring requirement for many of these lower emission sources. All source-oriented monitors will be assumed to be new, single-pollutant sites. Population-oriented monitors are assumed only at urban NCore sites. Only two of the NCore sites (in Region V) will need to add Pb monitors: Cincinnati-Taft (OH) and Blaine (MN).

The estimated cost for establishing a new single-pollutant site is about $30,000 (capital) plus $35,000 (annual operations). The estimated cost for locating a monitor at an existing site is about $15,000 (capital) plus $35,000 (annual operations).

Ozone: EPA's proposed rule requires both rural and additional urban monitoring. For the worst case scenario, all new monitors are assumed to be single-pollutant sites. For the best case scenario, we will assume that all new urban monitors are single-pollutant sites and all new rural monitors are located at existing sites (plus there is already at least 1 rural site in each state)

The estimated cost for establishing a new, single-pollutant site is about $80,000 (capital) plus $25,000 (annual operations). The estimated cost for locating a monitor at an existing site is about $30,000 (capital) plus $15,000 (annual operations).

SO2: EPA's final rule requires both monitors in certain CBSAs based on population and emissions. For both scenarios, all new monitors are assumed to be single-pollutant sites.

The estimated cost for establishing a new single-pollutant site (or a relocated existing site) is about $80,000 (capital) plus $25,000 (annual operations).

NCore: The requirement for the National Core (NCore) multi-pollutant sites was part of EPA's October 17, 2006, revisions to the Monitoring Regulations. In Region V, there will be 10 NCore sites: 7 urban and 3 rural. All of these are existing sites which require additional instrumentation and other improvements. For this analysis, we will assume an approximate cost of $50,000 (capital) plus $50,000 (annual operations).

The attached tables summarize the cost for the two scenarios. Capital costs range from about $5M – $6.5M and annual operating costs are about $2.5M.

Table 4a. Worst Case Cost Estimate for New EPA Monitoring Requirements																
	Type	**Number of Required Sites**							**Basis**	**Assumptions**	**Capital Costs**		**Annual Operating Costs**		
		IL	**IN**	**MI**	**MN**	**OH**	**WI**	**TOTAL**			**Per Site**	**Total**	**Per Site**	**Total**	**TOTAL**
Ozone	Rural	3	3	3	3	3	3	18	7/16/09 NPR	all new single-pollutant sites	$80,000	$1,440,000	$25,000	$300,000	$1,740,000
	Urban	**2**	**2**	**5**	**2**	**2**	**2**	15	EPA (Feb S.C. mtg)	all new single-pollutant sites	$80,000	$1,200,000	$25,000	$375,000	$1,575,000
NO2	Near Roadway	2	1	3	2	7	2	17	EPA	all new single-pollutant sites	$80,000	$1,360,000	$25,000	$425,000	$1,785,000
	Population	1	1	1	1	3	1	8	EPA	all new single-pollutant sites	$80,000	$640,000	$25,000	$200,000	$840,000
SO2	PWEI	0	1	3	0	3	2	9	EPA	all new sites	$80,000	$720,000	$25,000	$225,000	$945,000
Pb	Source-Oriented	8 (7)*	4 (3)*	1 (1)*	4 (3)*	4 (4)*	1 (1)*	22	EPA	19 new sites (*)	$30,000	$570,000	$35,000	$665,000	$1,235,000
	Population	2	1	2	1	3	1	10	12/30/09 NPR	Urban Ncore only (2 new sites)	$15,000	$30,000	$35,000	$70,000	$100,000
Ncore		2	1	2	1	3	1	10	EPA	add instrumentation at existing sites	$50,000	$500,000	$50,000	$500,000	$1,000,000
												$6,460,000		**$2,760,000**	**$9,220,000**

Table 4b. Best Case Cost Estimate for New EPA Monitoring Requirements																
	Type	**Number of Required Sites**							**Basis**	**Assumptions**	**Capital Costs**		**Annual Operating Costs**		
		IL	**IN**	**MI**	**MN**	**OH**	**WI**	**TOTAL**			**Per Site**	**Total**	**Per Site**	**Total**	**TOTAL**
Ozone	Rural	3	3	3	3	3	3	18	7/16/09 NPR	2 new sites + 1 existing site per state (12 new)	$30,000	$360,000	$15,000	$180,000	$540,000
	Urban	**2**	**2**	**5**	**2**	**2**	**2**	15	EPA (Feb S.C. mtg)	all new single-pollutant sites	$80,000	$1,200,000	$25,000	$375,000	$1,575,000
NO2	Near Roadway	2	1	3	2	7	2	17	EPA	all new single-pollutant sites	$80,000	$1,360,000	$25,000	$425,000	$1,785,000
	Population	1	1	1	1	3	1	8	EPA	all new single-pollutant sites	$30,000	$240,000	$15,000	$120,000	$360,000
SO2	PWEI	0	1	3	0	3	2	9	EPA	all new sites	$80,000	$720,000	$25,000	$225,000	$945,000
Pb	Source-Oriented	8 (7)*	4 (3)*	1 (1)*	4 (3)*	4 (4)*	1 (1)*	22	EPA	19 new sites (*)	$30,000	$570,000	$35,000	$665,000	$1,235,000
	Population	2	1	2	1	3	1	10	12/30/09 NPR	Urban Ncore only (2 new sites)	$15,000	$30,000	$35,000	$70,000	$100,000
Ncore		2	1	2	1	3	1	10	EPA	add instrumentation at existing sites	$50,000	$500,000	$50,000	$500,000	$1,000,000
												$4,980,000		**$2,560,000**	**$7,540,000**

Section 4.0 Analyses for Ozone, PM2.5, and PM10

EPA's monitoring regulation (40 CFR 58.10, Appendix D) identifies three general monitoring objectives: (a) provide data to the public in a timely manner, (b) support compliance with NAAQS and control strategy development, and (c) support air pollution research studies. For each objective, several data analyses were performed to provide a technical basis for assessing the regional monitoring networks for ozone, PM2.5, and PM10 – see Table 5. (A discussion of the monitoring networks for other criteria pollutants is provided in Section 6.)

From a regional perspective, ozone and PM2.5 present the greatest threat to public health (e.g., between 2005 and 2009, at least one site in the region was above the 8-hour ozone standard on 280 days, and above the daily PM2.5 standard on 472 days). These pollutants are also the major drivers in determining the daily Air Quality Index (AQI) across the region – see Figure 4.

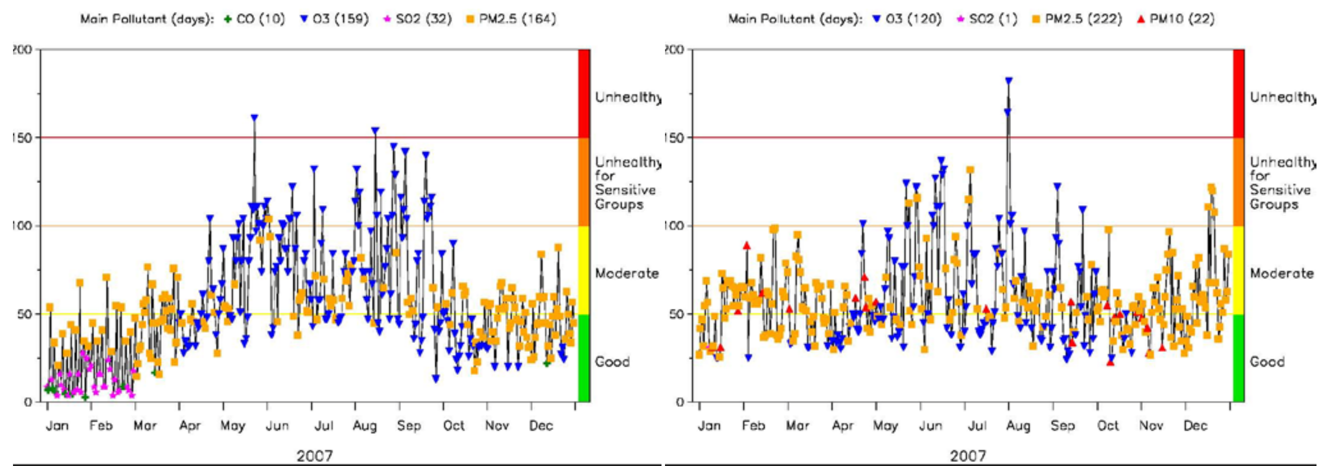


Figure 4. AQI (by pollutant) for Cincinnati (left) and Chicago (right) for 2007
Note: ozone shown in blue and PM2.5 in orange

Analyses were conducted using state, local, and tribal data for the period 2006-2008 -- data for 2005 and, to a limited degree, 2009 were also included in some analyses. The analyses were based on EPA guidance (EPA, 2007). The methodology, objective, and results for each analysis are presented below.

4.1 Monitoring Objective: Provide Data to Public in Timely Manner

4.1.1 Spatial Coverage Analyses

Methodology: Several techniques were used to assess the spatial coverage in the existing monitoring networks. First, LADCO conducted a correlation analysis and a cluster analysis to identify unique sites (low correlation) and possibly redundant sites (high correlation). The analyses were performed with 2006-2008 data.

Second, EPA developed several tools which assess spatial characteristics:

- correlation matrix: provides plot in matrix form showing the correlation between monitoring sites in a CSA or county (user can also specify the spatial area, pollutant, and years of data)
- area and population served: provides Google Earth map showing spatial area (in terms of a polygon) and associated population represented by individual monitoring sites
- removal bias: estimates the absolute difference between the actual and interpolated values (based on nearest neighbors) – a higher bias value indicates a more unique site
- new sites: analysis identifies potential areas for new sites based on user-specified criteria for correlation, distance, and concentration difference

Table 5. Data Analyses to Support Regional Network Assessment

Objective	Sub-Objective	Analysis	Responsibility
Provide data to public in a timely manner	Public reporting	Spatial coverage analyses: 1. Correlation/cluster analyses 2. removal bias analysis 3. new sites analysis 4. review "unmonitored area" analysis results	 1. LADCO/EPA 2. EPA 3. EPA 4. LADCO
		Area and population served analysis (sites are ranked based on the number of people they represent)	EPA – Region V
Support compliance with NAAQS	Attainment analysis	Measured concentration analysis (sites are ranked by concentration - i.e., sites with high design values are ranked higher than sites with low design values)	WDNR
		Deviation from NAAQS analysis (sites with design values close to the NAAQS are ranked higher than those with design values farther from NAAQS)	WDNR
Support control strategy development	Characterize regional concentrations	Spatial coverage analysis	(see above)
		Identify/establish an urban-rural monitoring pair for each major urban area	MPCA
	Track progress (trends)	Length of measurement record analysis (identify sites with long [>10 yrs] of measurements by parameter)	MPCA
		Emissions inventory analysis (gridded emission map are used to ensure monitoring in areas of high emissions)	LADCO
Support air pollution research		Number of parameters analysis (sites are ranked based on the number of parameters measured)	EPA - Region V
		Evaluate new NCORE network	EPA - Region V

These tools were developed for ozone, PM2.5, and PM10, and analyses were performed (by EPA) with 2005-2008 data. Static results and interactive tools for these analyses are available at: www.epa.gov/ttn/amtic/netassess .

Third, LADCO conducted an “unmonitored area” analysis by examining photochemical modeling results. This analysis used LADCO’s ozone and PM2.5 photochemical modeling to identify unmonitored grid cells with high concentrations which may be candidates for new monitors.

Results: LADCO’s PM2.5 correlation analysis for the 6-state region is summarized in Figure 5 and for individual states in Figure 6. Monitors that are closely correlated are generally believed to be sampling from the same air mass and provide less unique information than less correlated monitors. Monitors with very high correlations might be considered redundant and possible candidates for shutdown. Pearson correlation coefficients were calculated for monitor pairs in the Region V states, including monitors in other states near state boundaries. Figures 5 and 6 show a moderate correlation (>0.8) between sites in the same state (and nearby sites in neighboring states), consistent with the regional nature of PM2.5. A stronger correlation (>0.9) exists between sites in parts of each state (e.g., sites in the central Indiana are highly correlated with each other) due to their closer proximity to each other and because they are similarly influenced by nearby sources.

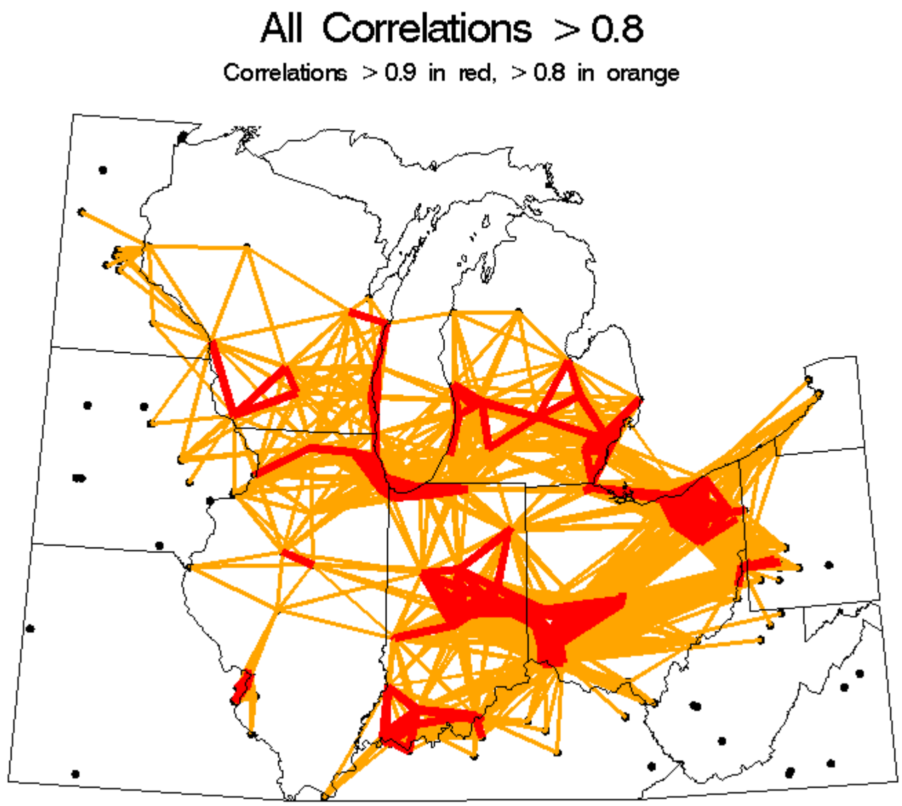


Figure 5. LADCO PM2.5 correlation results

LADCO’s PM2.5 cluster analysis for the 6-state region is summarized in Figure 7. Monitors tend to be clustered in a natural geographic pattern and monitors that are strongly influenced by local sources tend to cluster separately from other nearby monitors. The analysis produced clusters first as hierarchical trees and then as maps showing groups in each state. The maps in Figure 7 demonstrate the geographic nature of this clustering and the occasional single-monitor cluster that represents a source-oriented monitor.

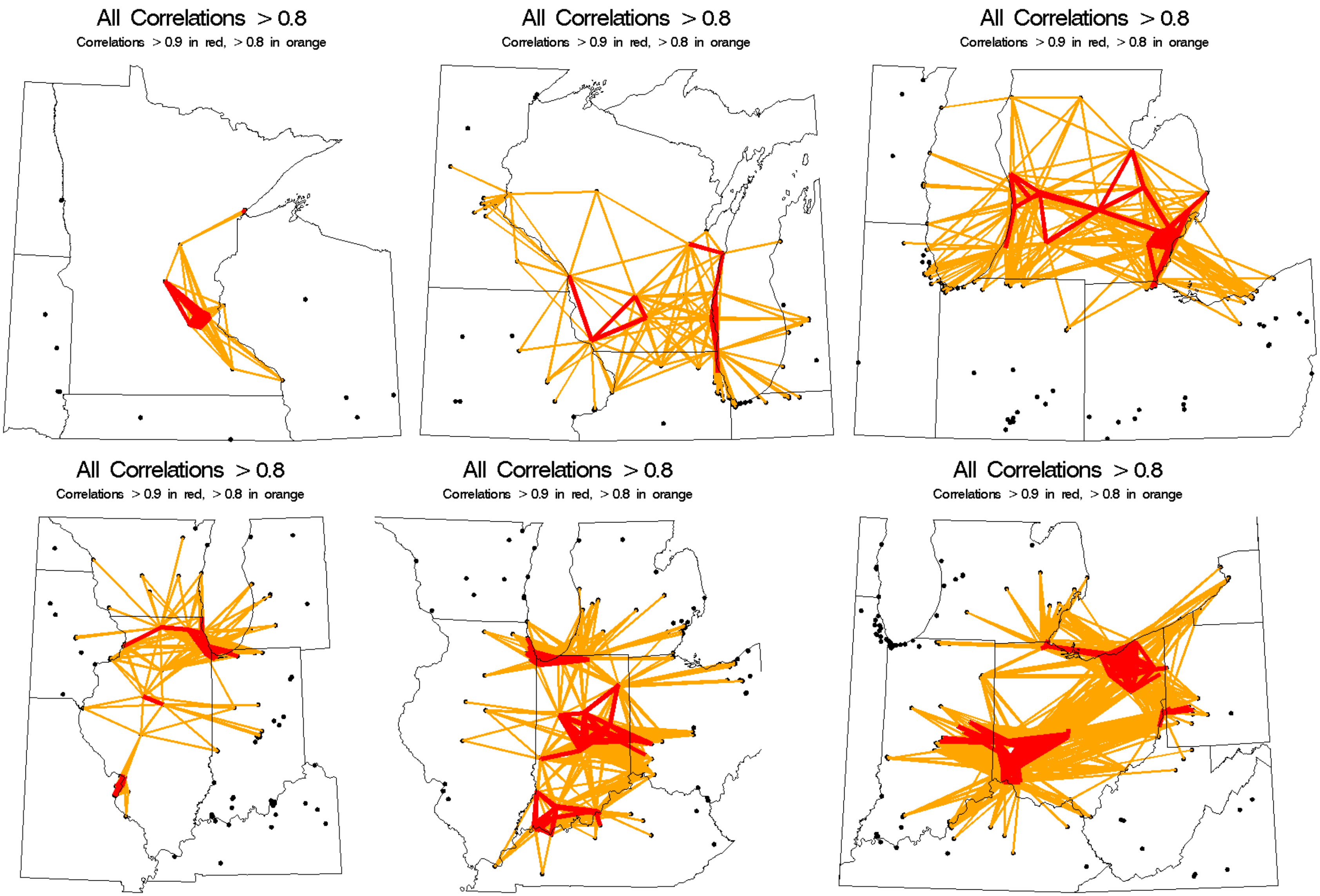


Figure 6. LADCO PM2.5 correlation analysis results: individual state maps

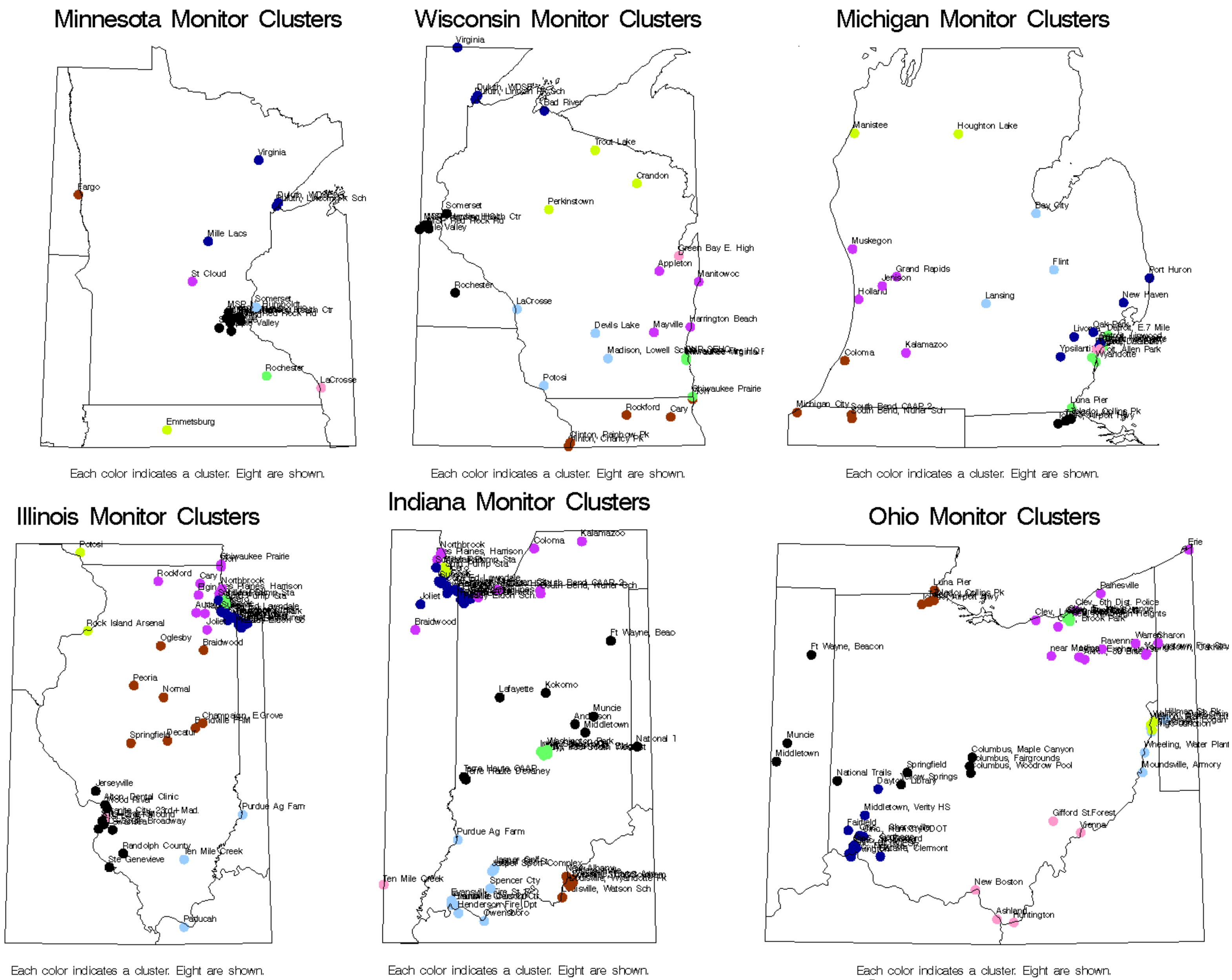


Figure 7. LADCO Correlation Analysis Results: Site with $r^2 > 0.8$

EPA applied the correlation analysis tool for pairs of sites in each CBSA to produce static analysis results. A graphical matrix plot for ozone, PM2.5 FRM/FEM, PM2.5 continuous, and PM10, and a corresponding CSV file were produced for each CBSA. Two key metrics were generated: Pearson squared correlation coefficient and average relative difference. The correlation coefficient for two sites represents the 'degree of relatedness' between the two sites, and the average relative difference represents the overall measurement similarity between the two sites.

PM2.5 FRM (3-day and 6-day sampling): Figure 8 provides example results for two cities: Chicago and Cincinnati based on 2006-2008 data. (Note, the top row shows results based on 1-in-3 day sampling and the bottom row based on 1-in-6 day sampling.) The relatively "flat" shape of most of the ellipses indicate a high degree of correlation and their yellow color indicate a low average relative difference. Several pairs are very "flat" (and yellow) indicating high correlation values (and low average relative difference).

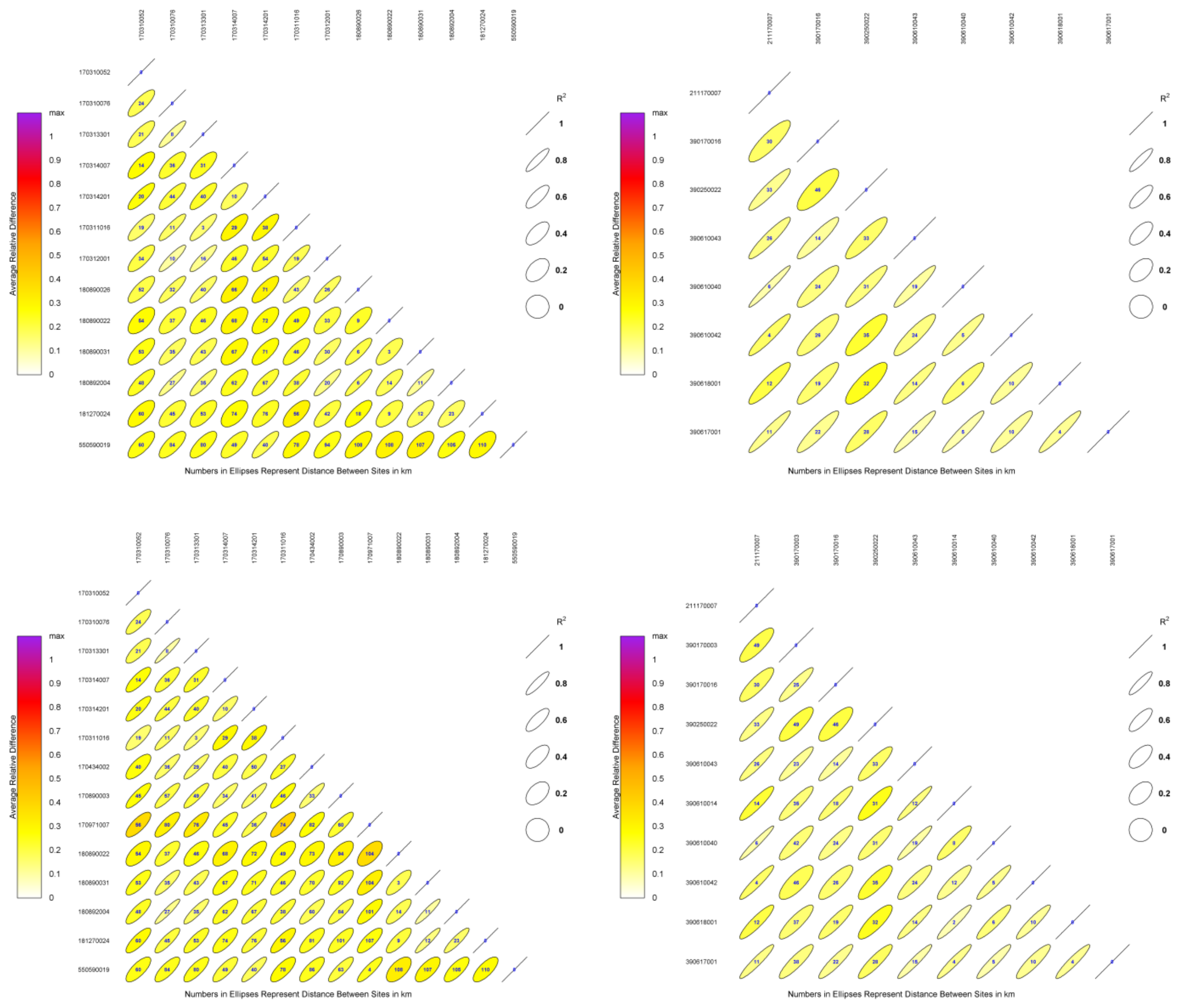


Figure 8. EPA PM2.5-FRM correlation analysis results for Chicago (left) and Cincinnati (right) for 1-in-3 day sampling (top) and 1-in-6 day sampling (bottom)

PM2.5 Continuous: Figure 9 provides example results for two cities: Chicago and Minneapolis-St. Paul based on 2006-2008. The more circular shape of most of the ellipses indicate a lower degree of correlation and their more orangish color indicate a higher average relative difference, as compared to the PM2.5 FRM results. This reflects a higher degree of variation in hourly continuous data compared to intermittent daily FRM data.

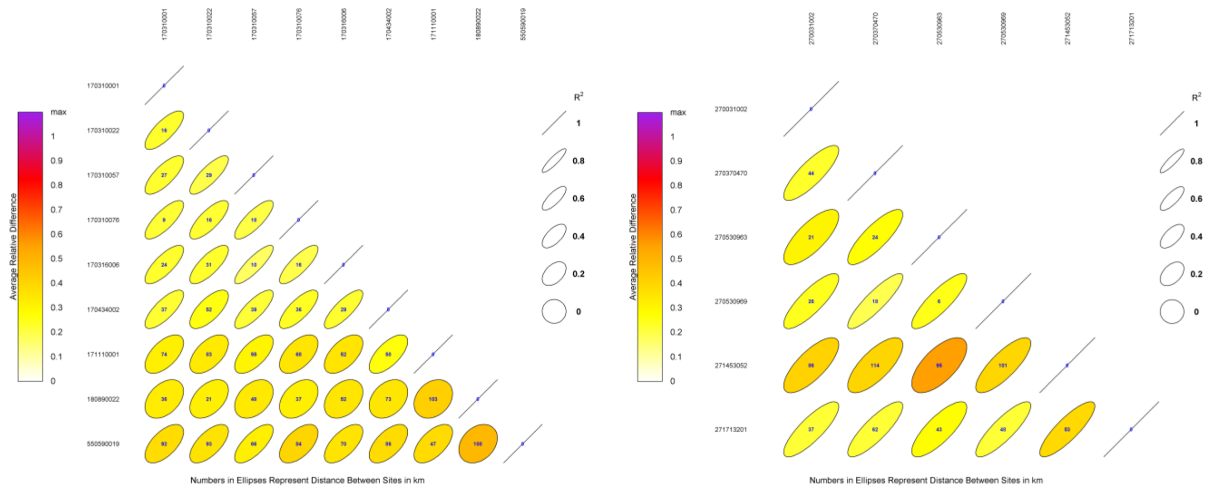


Figure 9. EPA PM2.5-continuous correlation analysis results for Chicago (left) and Minneapolis-St. Paul (right)

PM10: For the major urban areas, there were no highly correlated sites, except for two sites in Louisville. Figure 10 provides example results for two cities: St. Louis and Cleveland based on 2006-2008 data. The more circular shape of most of the ellipses indicate a low degree of correlation and their more orangish color indicate a high average relative difference. This suggests that many monitoring sites are unique due to the relatively low number of sites and the localized nature of PM10 concentrations.

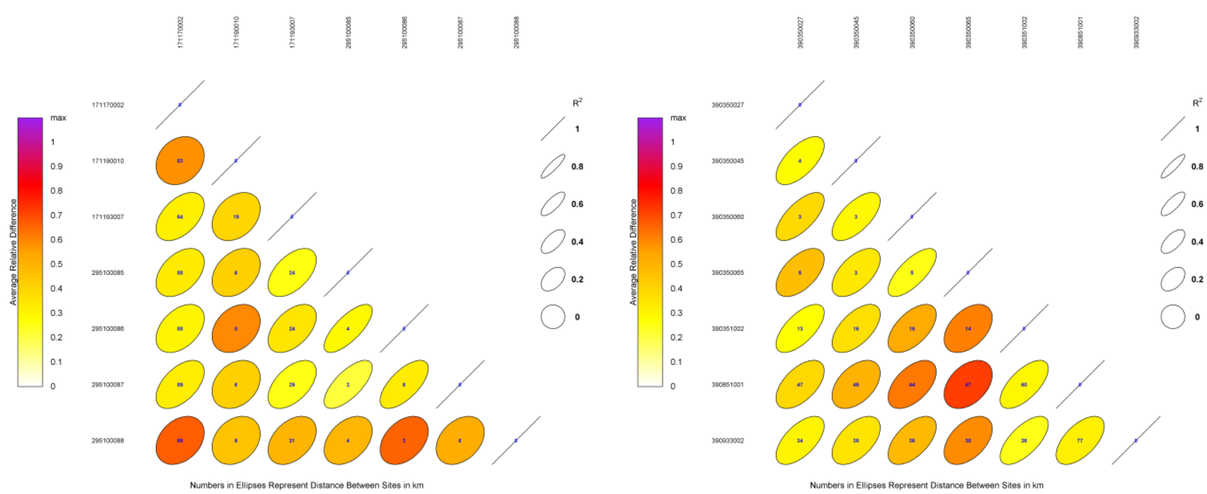


Figure 10. EPA PM10 correlation analysis results for St. Louis (left) and Cleveland (right)

A summary of the highly correlated sites for the major urban areas is provided in Table 6. The table identifies those sites with a correlation coefficient of 0.9 (or greater) for at least three years (from 2005-2008) and an average difference of 15% (or less).

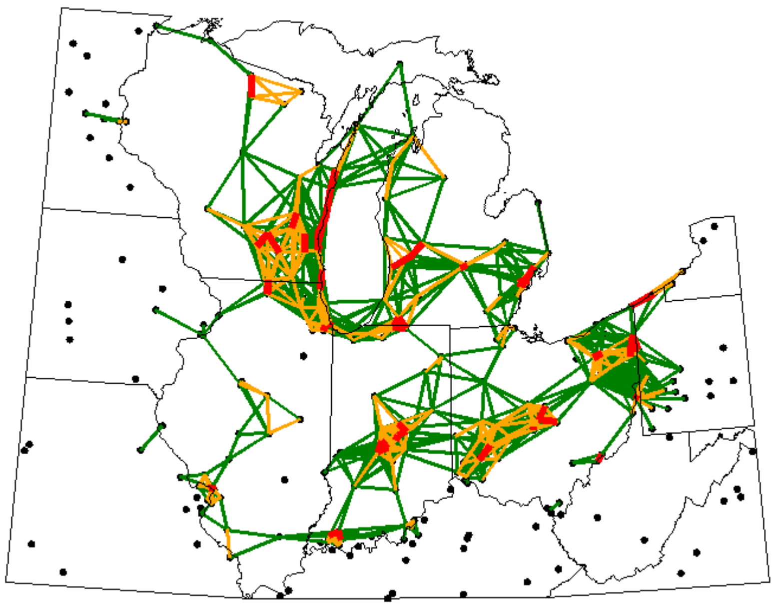
Table 6. Highly correlated monitoring sites based on EPA analysis (i.e., sites with correlation coefficient $\geq$ 0.9 and average difference $\leq$ 15% for at least three years from 2005-2008)

	Ozone	PM2.5 (6-day)	PM2.5 (3-day)	PM2.5 - CONT	PM10
Chicago	Waukegan-Zion-P.Prairie(WI) Des Plaines-Chicago Taft Des Plaines-Northbrook Cary-Elgin Lawndale-Alsip Whiting(IN)-Univ of Chicago Gary IITRI(IN)-Ogden Dunes(IN)	Lawndale-Summit Lawndale-Ogden Dunes(IN) Hammond(IN)-Ogden Dunes(IN)	Lawndale-Blue Island Lawndale-Summit Lawndale-Hammond(IN) Hammond(IN)-Griffith(IN) Hammond(IN)-*Gary/Ivanhoe*(IN)* Hammond/Clark HS(IN)-Blue Island	------	------
Milwaukee	Grafton-Bayside-SER HDQS Bayside-Harrington Beach Waukesha-Slinger	SER HDQS-Wells St SER HDQS-FAA	SER HDQS-Wells St	------	------
Minneapolis	------	Minn (Humboldt Ave)-Richfield Minn (Humboldt Ave)-Apple Valley	Richfield-Apple Valley	------	------
St. Louis	W. Alton(MO)-Alton(IL Wood River(IL)-Alton(IL)	Clayton-Arnold Clayton-S.Broadway Clayton-*Mound & 2nd**	Clayton-Arnold-S.Broadway Clayton-W.Alton Clayton-*Mound & 2nd**	------	------
Indianapolis	Ft. Harrison-Fortville Ft. Harrison-E 16th St. Monrovia-Hendricks Co.	WashingtonPark-18th St-E.Mich St WahingtonPark-West St	West St-18th St-E.Mich St West St-WashingtonPark 18th St-*75th St** E.Mich St-*75th St**	------	------
Louisville	------	Southwick-Wyndotte-N.Albany(IN) Southwick-Jeffersonville(IN) Wyandotte-Jeffersonville(IN)	Southwick-Wyndotte-*Barrett** - Jeffersonville(IN) N.Albany(IN)-Southwick N. Albany(IN)-Wyandotte N.Albany(IN)-*Barrett**	Southwick-Watson-*Barrett** Bates-*Barrett**	Southwick-Wyandotte
Cincinnati	Taft-Covington(KY)	Norwood-Taft-Murray Road Norwood-Seymour Murray Road-Seymour Murray Road-Lower Price Hill Taft-Kenton Middletown-Seymour Fairfield-Hook Field	Norwood-Shraonville-Kenton Batavia-Taft-Kenton Norwood-Seymour Norwood-Taft Sycamore-Taft Fairfield-Murray Road Fairfield-Sharonville	------	------
Columbus	New Albany-Licking Co. New Albany-Madison Co.	State Fairgrounds - Woodrow Ave.	State Fairgrounds - Woodrow Ave.	------	------
Cleveland	------	Akron (W. Exchange)-Akron (E. HS) Akron (W.Exchange)-Ravenna Akron (W. Echange)-Medina Co. E 152nd St-Dunbar E 152nd St-Barr Elementary G.T.Craig-Dunbar	Akron (W. Exchange)-Ravenna	------	------
Detroit	Oak Park-Warren-E 7 Mile	Allen Park-Linwood-Oak Park Livonia-Ypsilanti Livonia-Oak Park SWHS-Linwood	Allen Park-Ypsilanti	------	------
		** Shutdown Site*	** Shutdown Site*	** Shutdown Site*	

LADCO's ozone correlation analysis for the 6-state region is summarized in Figure 11. Individual state correlation maps are provided in Figure 12. The maps show a moderate correlation (>0.85) between sites in the distinct sub-areas of each state, consistent with the regional nature of elevated ozone concentrations. A stronger correlation (>0.9) exists between sites in (and near) major urban areas, consistent with the additional local urban contribution.

All R5 States Ozone Correlations > 0.85

Correlations > 0.95 in red, > 0.9 in orange, > 0.85 in green



All R5 States Ozone Correlations > 0.90

Correlations > 0.95 in red, > 0.9 in orange

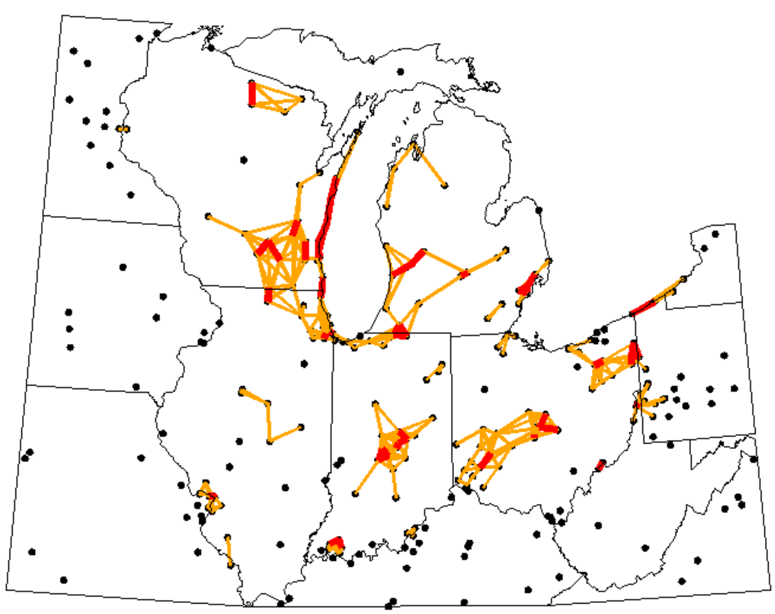


Figure 11. LADCO ozone correlation analysis results

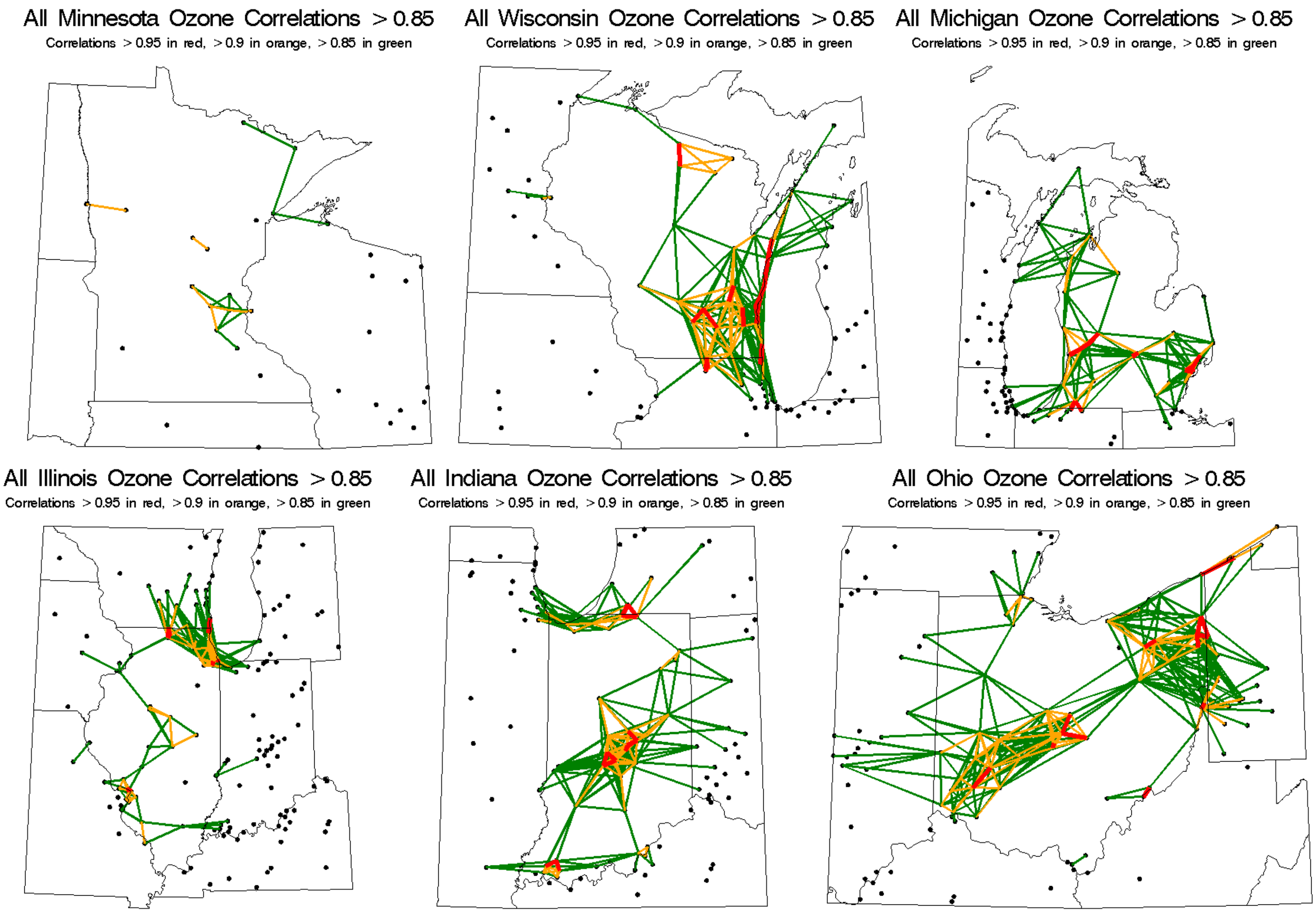


Figure 12. LADCO ozone correlation analysis results: individual state maps

Figure 13 provides example results of EPA's ozone correlation analysis for two cities: Chicago and Detroit based on 2006-2008 data. The relatively "flat" shape of most of the ellipses indicate a high degree of correlation and their yellow color indicate a low average relative difference. Several pairs are very "flat" (and yellow) indicating high correlation values (and low average relative difference).

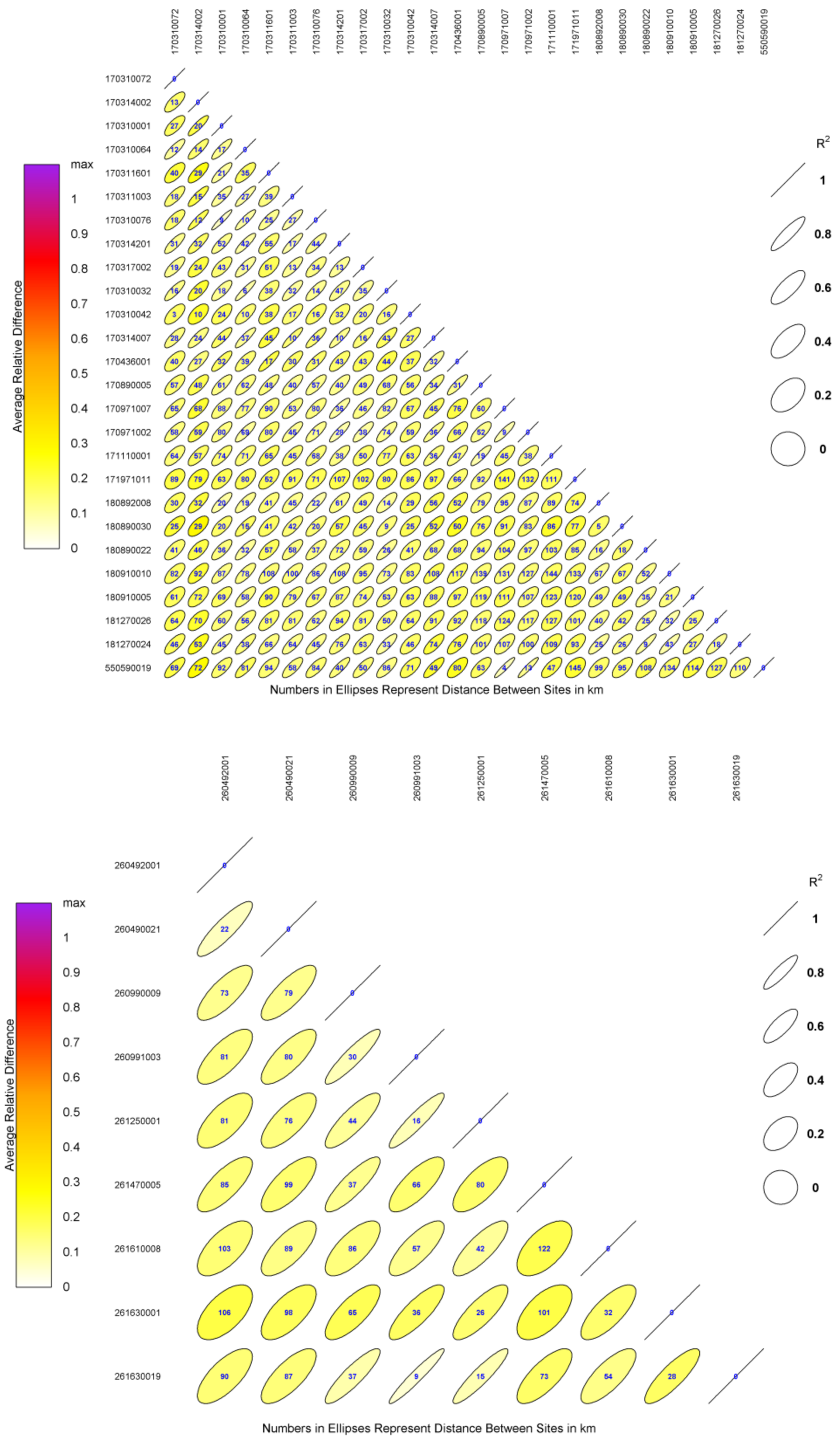


Figure 13. EPA ozone correlation analysis for Chicago (top) and Detroit (bottom)

Removal Bias Analysis: EPA applied the removal bias tool to produce static analysis results. A bias value was calculated for each day at each site by taking the difference between the estimated value (based on interpolation using the nearest neighbors) and the actual measured concentration. A students-t distribution was used to determine whether the bias value was statistically different from zero at a 95% probability.

The PM2.5 results for the upper Midwest are provided in Figure 14. Statistically significant sites (with higher bias) are shown as open circles (with red shading for those with a positive bias and blue shading for those with a negative bias). A positive bias means that the interpolated value at a given site is higher than the actual measured value, whereas a negative bias means that the interpolated value is lower than the actual measured value.

Statistically insignificant sites (with low bias), which may be redundant sites (with their nearest neighbors), are shown as solid dots.

A few observations can be made from a regional perspective:

- There is year-to-year variation (due to meteorology) in the bias values for most sites. Few sites have consistently low bias.

- Most urban areas have some low bias sites. Identification of these sites is difficult given the somewhat qualitative nature of the plots, but the analysis supports the findings of other analyses which suggest potentially redundant sites.

Although not shown, similar observations can be made for the ozone results. In general, no strong network recommendations are made based on this tool. Rather, it is recommended that this tool is more valuable to evaluate the impact of removing sites identified for possible shutdown based on other criteria.

New Sites Analysis: This tool relies on several user-specified factors to help identify where new sites could be added to provide more information to characterize air quality. The four factors are: Pearson squared correlation coefficient, distance, average relative difference, and potential of exceeding 85% of the NAAQS.

A sensitivity analysis for PM2.5 was conducted in which each of the four criteria were varied. The two factors with the most influence were the correlation coefficient and probability of exceeding 85% of NAAQS. Figure 14 shows the results using the default settings v. using adjusted values for the two most sensitive factors. Although using adjusted values indicates a few new sites in Illinois, Indiana, and Ohio, there is no strong basis for these particular values and, as such, there is no strong basis for adding the new sites.

Results for ozone using the default settings were generated by EPA (as part of the network assessment tools) and are also shown in Figure 15. A few new sites appear in Illinois, Indiana, and Ohio, but again there is no strong basis for adding the new sites.

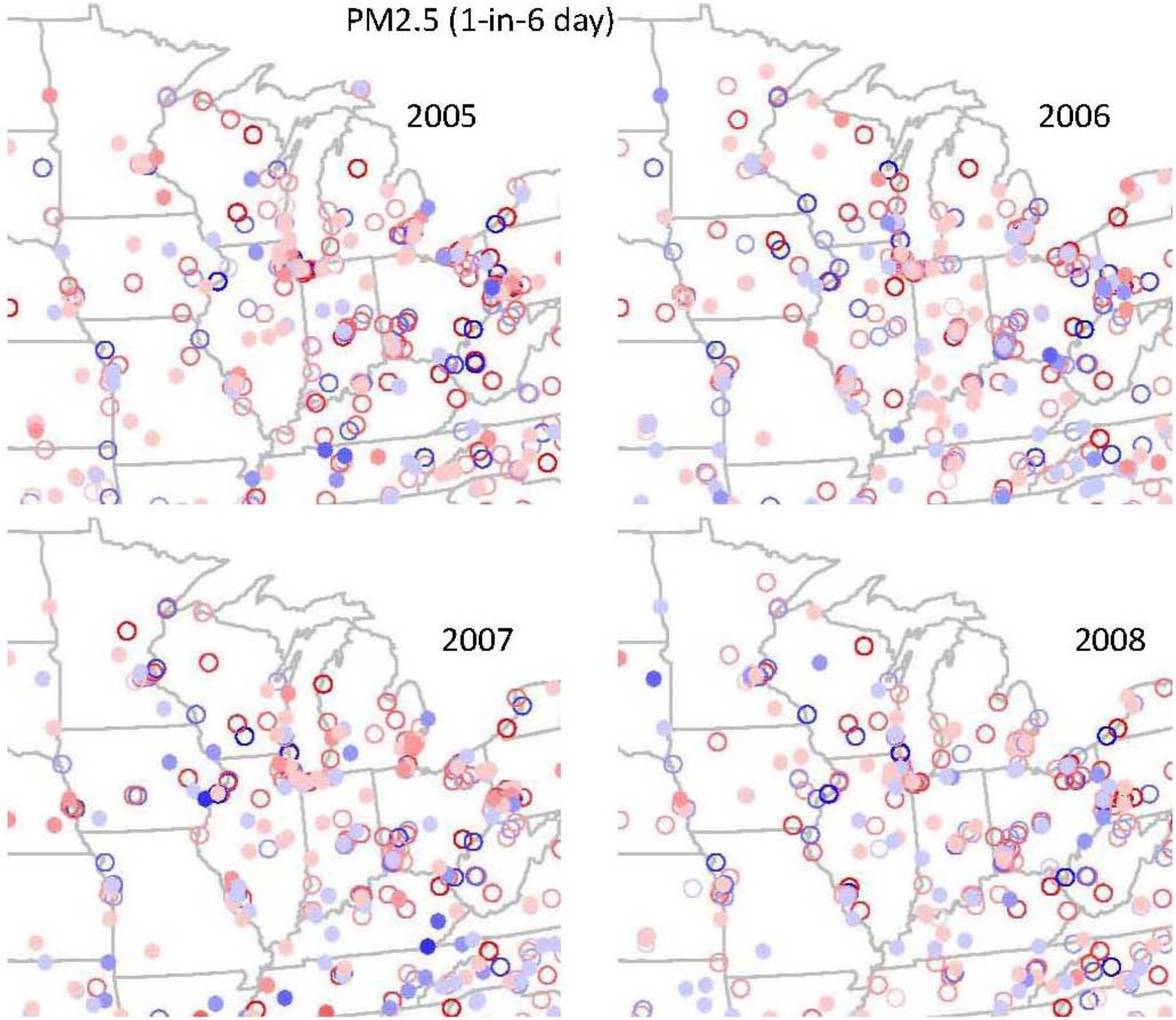
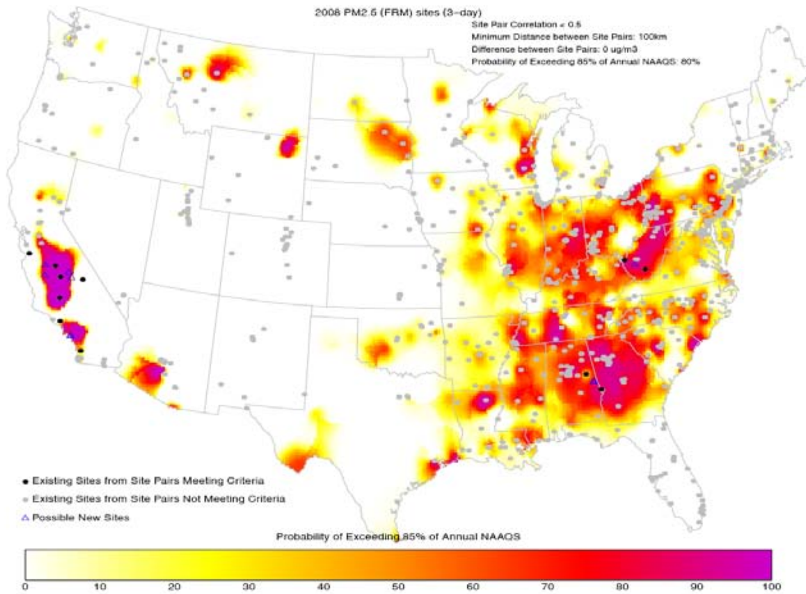
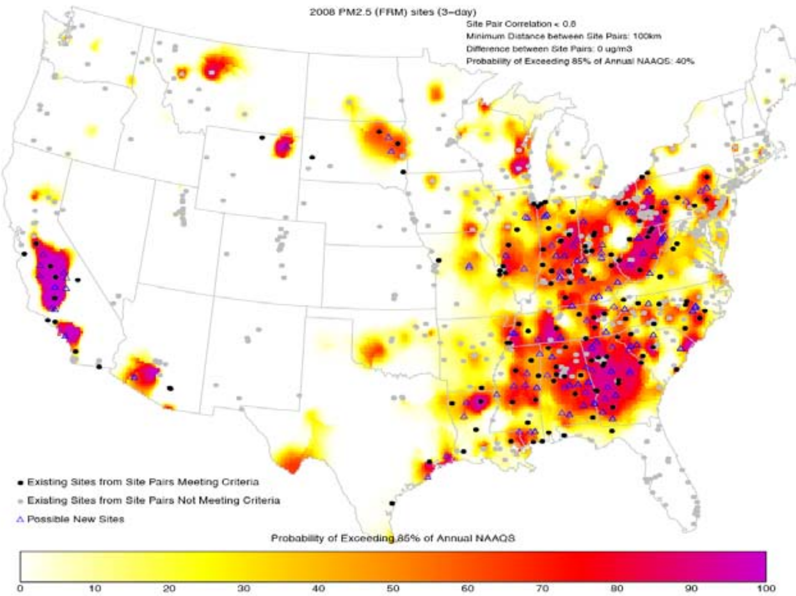


Figure 14. Removal bias analysis results for PM2.5





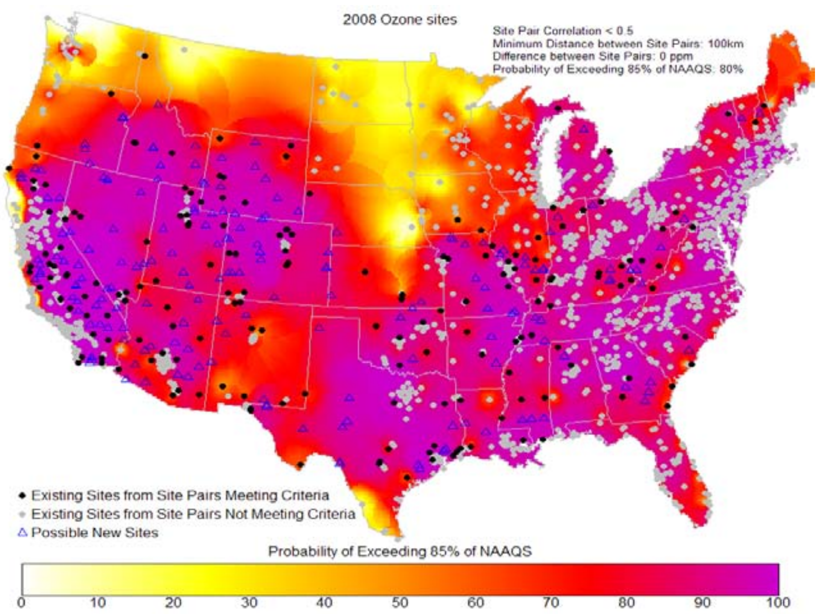


Figure 15. Results of new sites analysis for PM2.5 (top) and ozone (lower left)

Unmonitored Area Analysis: An analysis was conducted to determine if there are any unmonitored areas with potentially high concentrations. Specifically, spatial fields predicted by photochemical modeling were used in conjunction with monitoring data to identify grid cells with no monitors and high concentrations. Results for ozone (8-hour) and PM2.5 (annual and daily average) are presented below. The analysis suggests that there are a few possible unmonitored hot spots in the 6-state region.

Ozone: Figure 16 shows the estimated concentrations in unmonitored grid cells. Grid cells over water were omitted in the map. It should be noted that the absolute modeled concentration values here are likely different than concentration values derived using the relative methods recommended in EPA's modeling guidance.

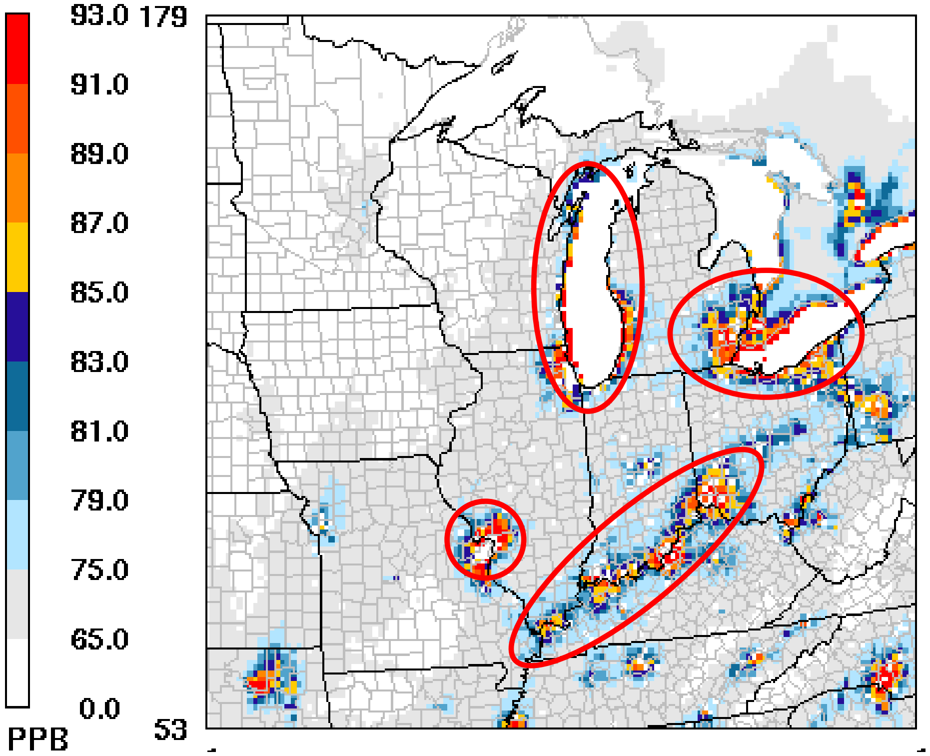


Figure 16. Estimated future year (2012) ozone design values

The results in Figures 16 indicate a few unmonitored areas with potentially high ozone concentrations, in particular: (a) Lake Michigan area - both portions of the western and eastern shores, (b) Lake Erie area - northeastern Ohio and southeastern Michigan, (c) Ohio River Valley, and (d) St.Louis area – to the northeast (downwind) in Illinois

These results suggest: (1) the importance of shoreline monitors around the Great Lakes, especially Lake Michigan and Lake Erie (i.e., none of the existing sites should be shutdown and more would be helpful), (2) importance of rural monitoring, especially between Evansville, IN and Cincinnati, OH, and (3) monitoring downwind of other urban areas in the region (e.g., St. Louis). To assess the adequacy of the current monitoring networks in the four high concentration areas, a higher resolution view of the 12 km modeling results is provided in Figure 17. In general, it appears that these areas have adequate monitoring, as indicted by the 'blanked-out' (white) grid cells. The analysis supports maintaining monitors in these areas (i.e., don't shut down and add more, if possible).

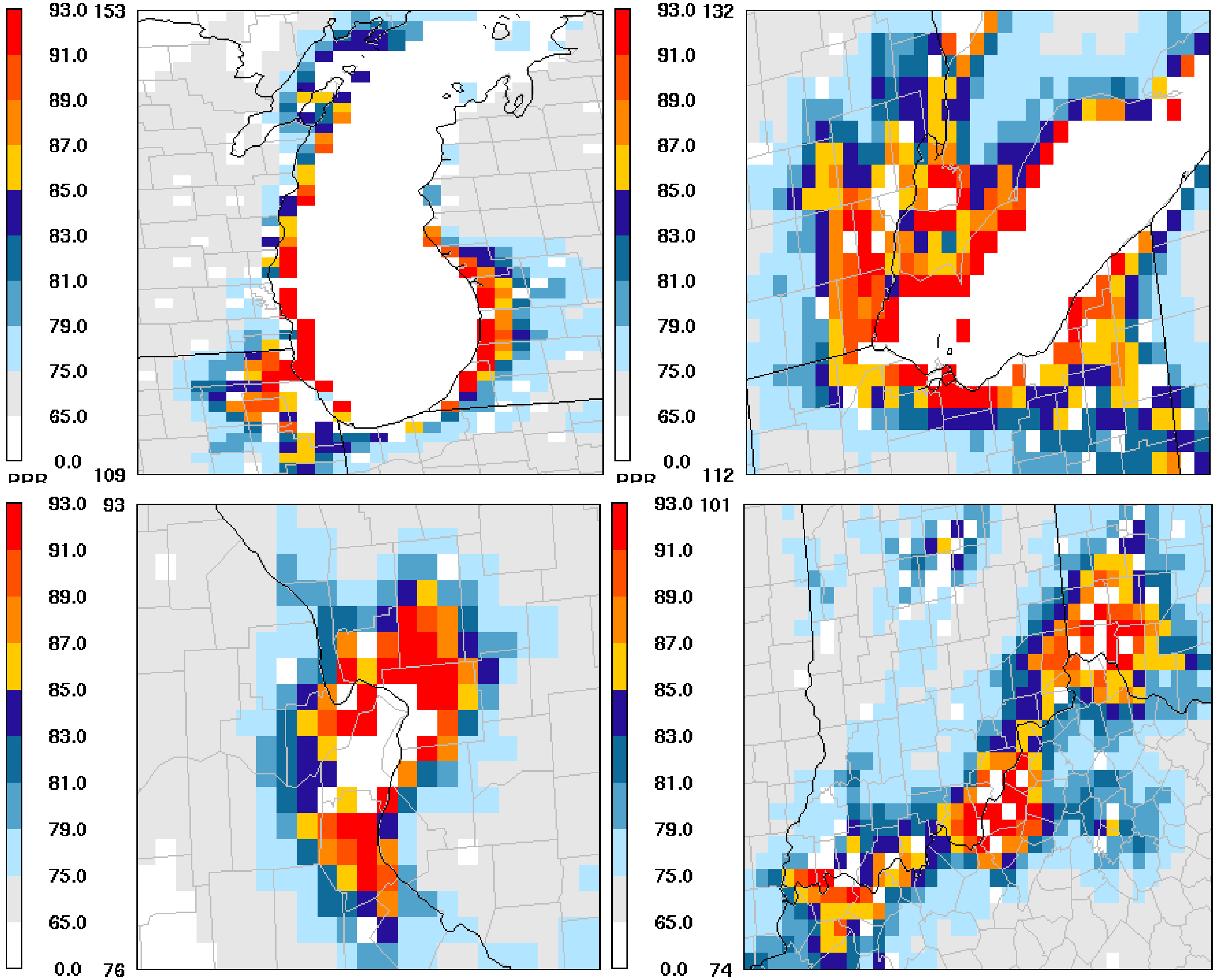


Figure 17. Estimated ozone concentration values at 12 km for Lake Michigan area (upper left), southeastern Michigan (upper right), St. Louis area (lower left), and Ohio River Valley (lower right)

PM2.5: Figure 18 shows the estimated concentrations in unmonitored grid cells – annual on the left and daily on the right. Grid cells over water were omitted in the map. It should be noted that the absolute modeled concentration values here are likely different than concentration values derived using the relative methods recommended in EPA's modeling guidance.

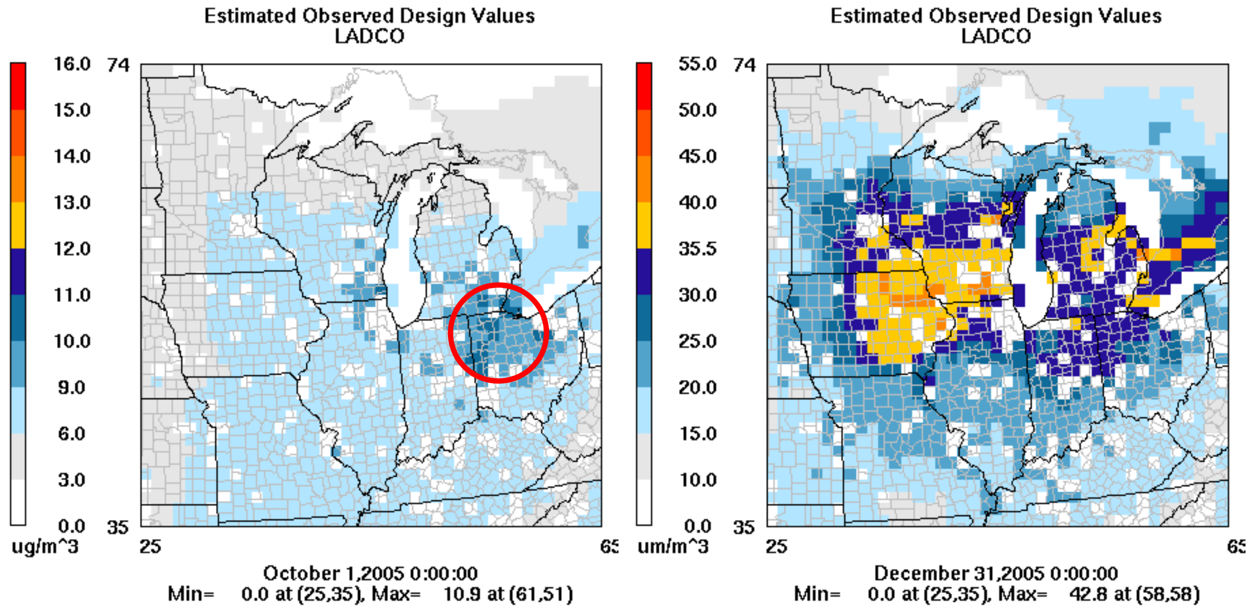


Figure 18. Adjusted observed PM2.5 design values - annual (left) and daily (right)

The results in Figure 18 indicate a few unmonitored areas with potentially high PM2.5 concentrations; in particular, in northwest Ohio, and eastern Iowa through southern Wisconsin. The eastern Iowa-southern Wisconsin area currently has adequate monitoring, as indicated by the "blanked-out" (white) grid cells in the figure above. The analysis supports maintaining monitors in this area (i.e., don't shut down and add more, if possible). Northwestern Ohio, however, does not have many monitors (i.e., few "blanked-out (white) grid cells). Consideration should be given to adding one or more new sites there.

4.1.2 Area and Population Served

The area served tool uses a spatial analysis technique (i.e., polygons) to show the area represented by a monitoring site. The shape and size of each polygon is dependent on the proximity of the nearest neighbors to a particular site. Data from the 2000 Decennial Census were used to determine which census tract centroids were within each polygon. The total tract area represented by the polygon was calculated as well as the total population and population density. These statistics were tabulated for each year for 2005 through 2008.

Maps were prepared based on EPA's national analysis for ozone, PM2.5 FRM, and PM2.5 continuous data – see Figure 19. The area and population values for each monitor were ranked and then displayed with different color shading for each 20th percentile. Not surprisingly, monitors in urban areas tend to rank high for population and low for area (given the higher density of urban monitoring), and monitors in rural areas tend to rank low for population and high for area (given the lower density of rural monitoring)

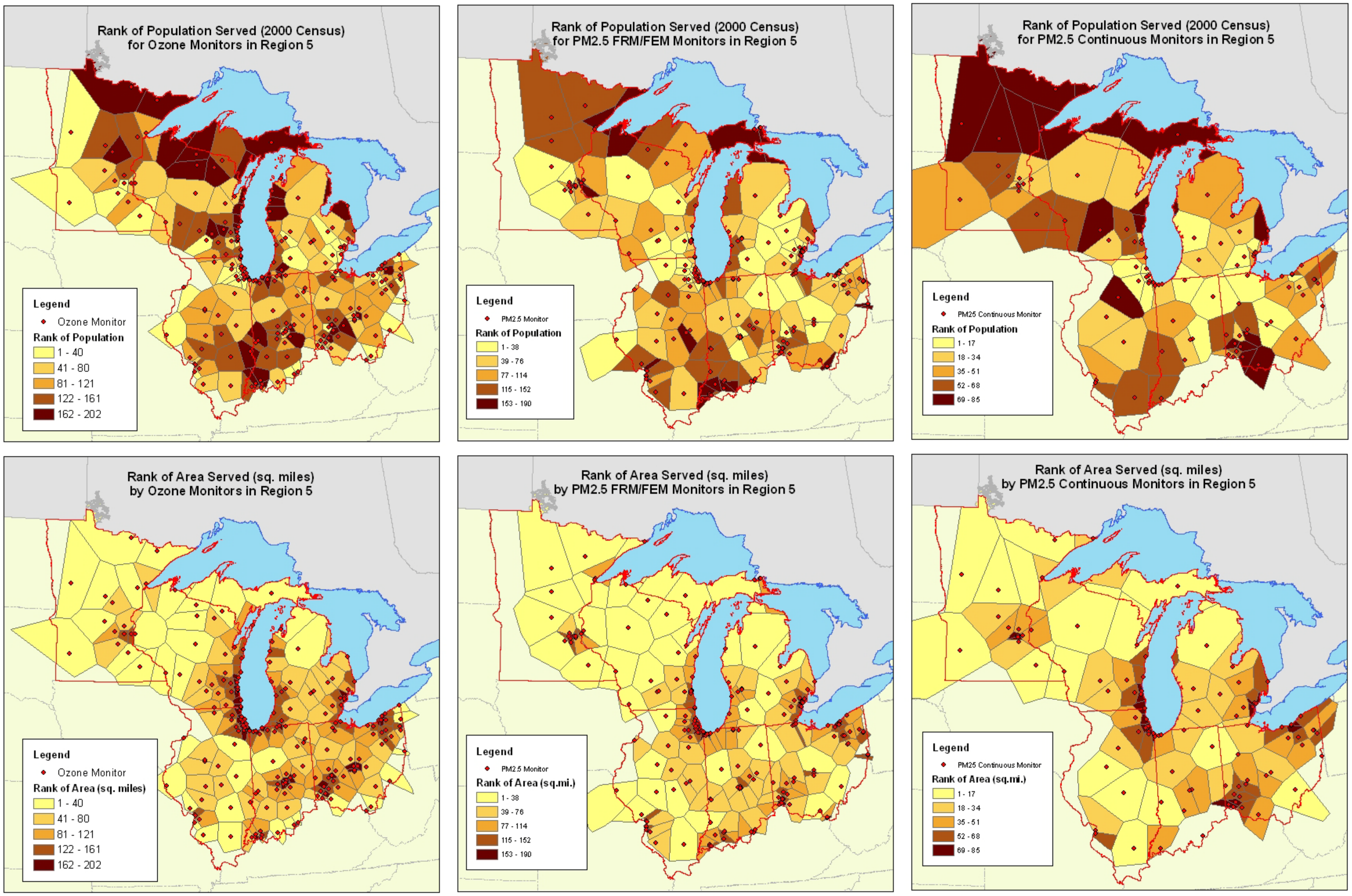


Figure 19. Population and area served analysis results for ozone, PM2.5 (FRM), and PM2.5 (continuous)

4.2 Monitoring Objective: Support Compliance with NAAQS

4.2.1 Measured Concentration

Methodology: Rank monitoring sites based on the magnitude of the design values for 2006 – 2008. The analysis gives more weight to sites with high concentrations.

For this analysis (and the deviation from NAAQS analysis), the design values were takes from EPA's airtrends website (http://www.epa.gov/airtrends/values.html). Note, design values can also be found in two other places on EPA's website – i.e., AQS Quick Look and EPA Air Data. EPA confirmed that the airtrends website provides EPA's most reliable set of design values

Results: Table 7 summarizes the number of monitoring sites in each state with current design values above the NAAQS.

Table 7. Number of monitoring sites with 2006-2008 design values > NAAQS

	Ozone	PM2.5-annual	PM2.5-daily	PM10	NO2	SO2	CO	Pb
IL	4	2	0	0	0	0	0	1
IN	13	3	0	1	0	0	0	2
MI	14	1	1	0	0	0	0	0
MN	0	0	0	0	0	0	0	1
OH	29	4	4	1	0	0	0	8
WI	3	0	4	0	0	0	0	0
	63	**10**	**9**	**2**	**0**	**0**	**0**	**12**
Total Sites	202	186	186	129	16	71	37	93
% > NAAQS	31%	5%	5%	2%	0%	0%	0%	13%

Figure 20 shows the 2006-2008 design values for ozone, PM2.5-annual, and PM2.5-daily concentrations, respectively. In general, the maps show a concentration gradient with decreasing values from south-to-north and from east-to-west.

Sites above the NAAQS are shown in Figures 21-22. High concentration sites are in areas with higher emissions (e.g., major urban areas and the Ohio River Valley), while low concentration sites are in rural areas, especially in western and northern portions of the region (i.e., Iowa, Minnesota, western half of Wisconsin and north-central and north-western part of Illinois). These results, combined with the unmonitored area analysis above, indicate the importance of monitoring in these high concentration areas.

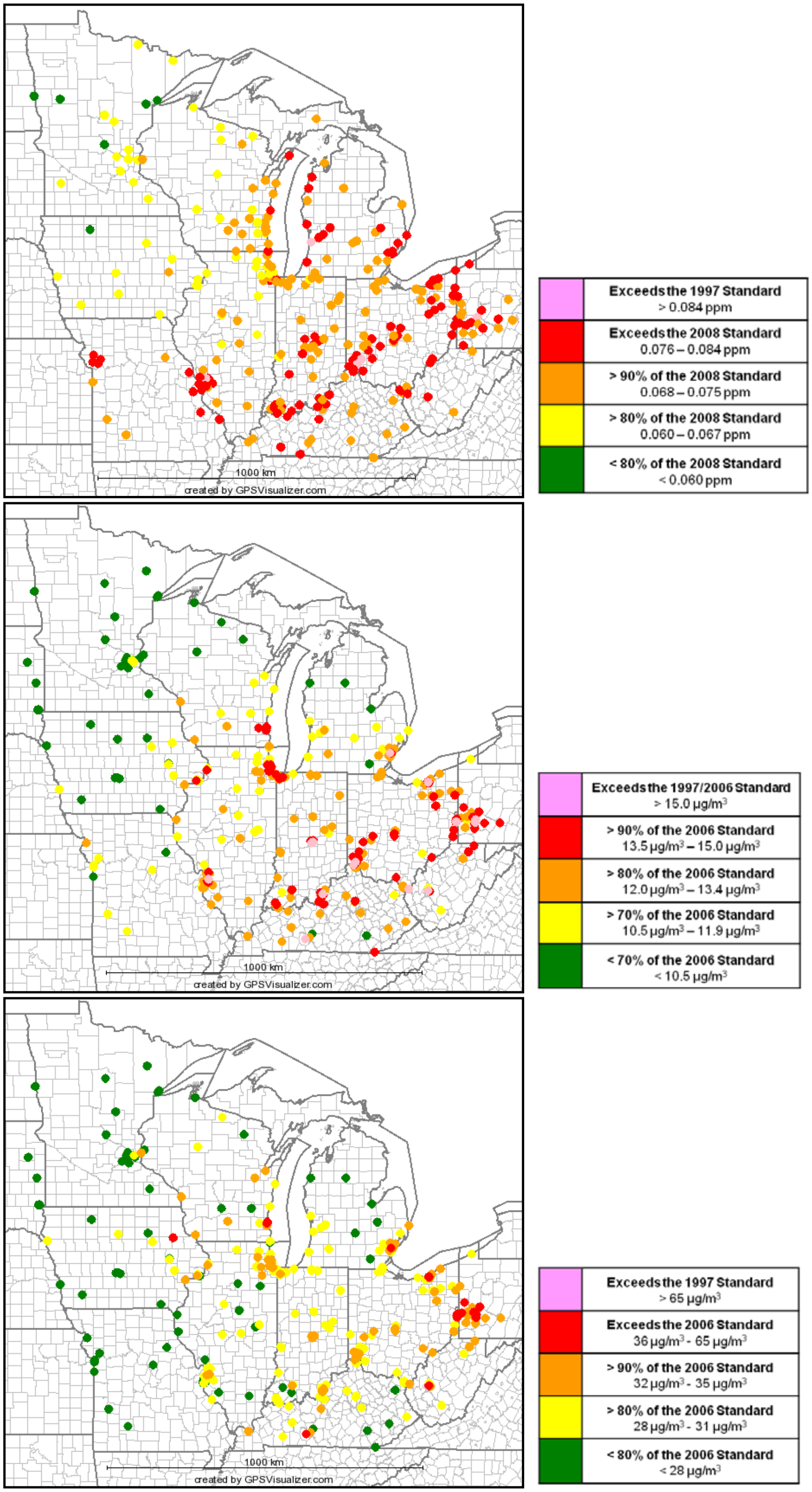


Figure 20. Design values for ozone (top), PM2.5-annual (middle), and PM2.5-daily (bottom): 2006-2008

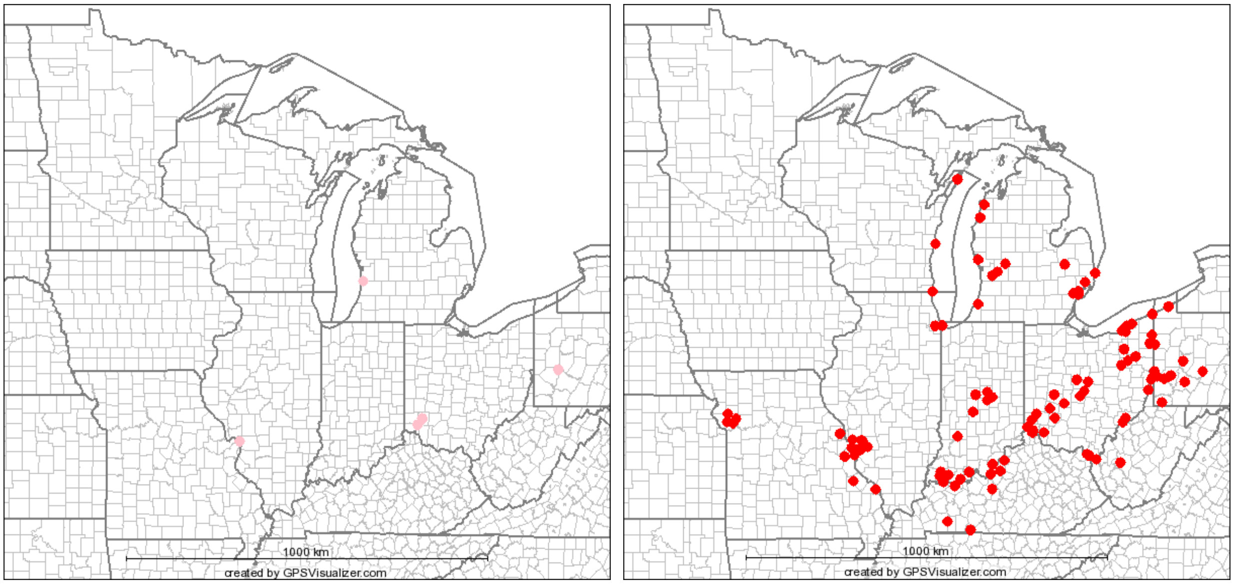


Figure 21. Monitoring sites above ozone NAAQS (2006-2008 data)

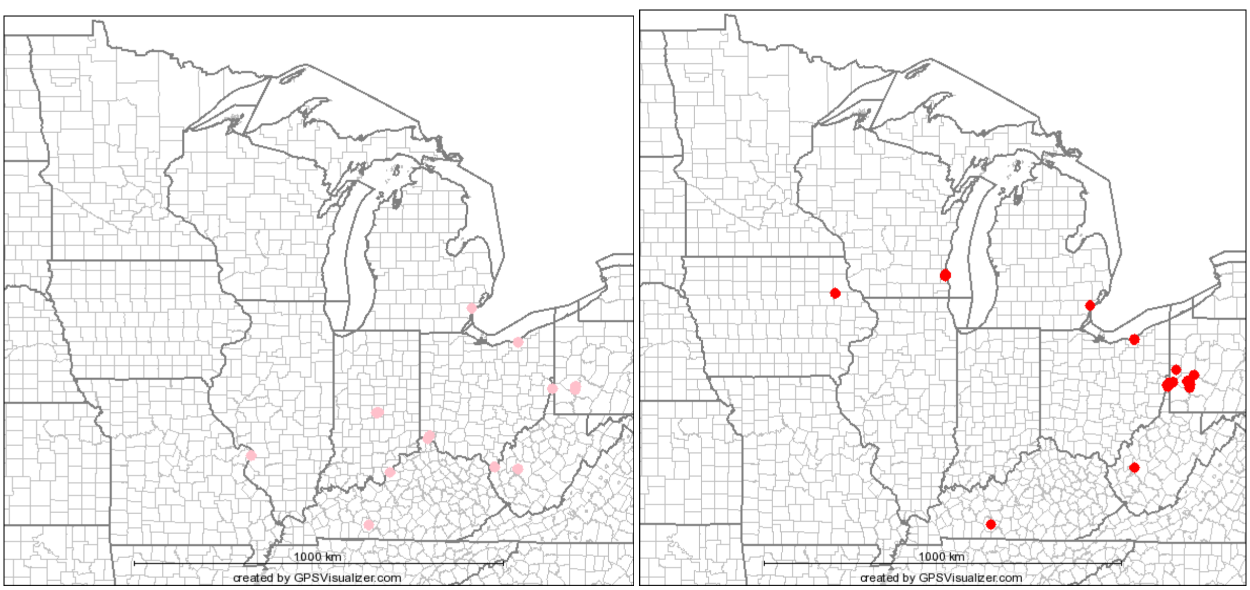


Figure 22. Monitoring sites above PM2.5 NAAQS–annual (left) and 24-hour (right) (2006-2008 data)

4.2.2 Deviation from NAAQS

Methodology: Rank monitoring sites based on closeness of design values for 2006 – 2008 to the NAAQS. The analysis gives more weight to sites with concentrations close to the NAAQS.

Results: A relatively high percentage of monitoring sites have design values close to the NAAQS for ozone and PM2.5 – see Table 8 and Figures 23 and 25. These sites are distributed throughout the region – see Figures 24 and 26. Given the large number of sites (and their wide geographic distribution), this analysis supports the maintenance of a comprehensive regional network for these regional air pollutants.

Table 8. Number of monitoring sites with 2006-2008 design values by concentration bins

PM2.5-annual	2004-2006	2005-2007	2006-2008	
<10	19	17	15	
10.0 - 12.5	29	24	60	
12.6 - 15.0	72	80	73	
15.1 - 17.5	32	35	10	
17.6 - 20.0	0	0	0	
>20	0	0	0	
Total Sites	152	156	158	
% Close to NAAQS	68%	74%	53%	
PM2.5-daily	**2004-2006**	**2005-2007**	**2006-2008**	
<25	11	15	13	
26-30	19	10	66	
31-35	59	65	70	
36-40	49	61	9	
41-45	10	6	0	
>45	0	0	0	
Total Sites	148	157	158	
% Close to NAAQS	73%	80%	50%	
Ozone	**2004-2006**	**2005-2007**	**2006-2008**	**2007-2009**
<65	9	2	14	38
66 – 70	31	13	35	54
71 – 75	50	40	69	73
76 – 80	64	70	46	25
81 – 84	14	32	13	5
>85	6	19	3	0
Total Sites	174	176	180	195
% Close to NAAQS	66%	63%	64%	50%

Note: only those sites with complete data for a given 3-year period were included

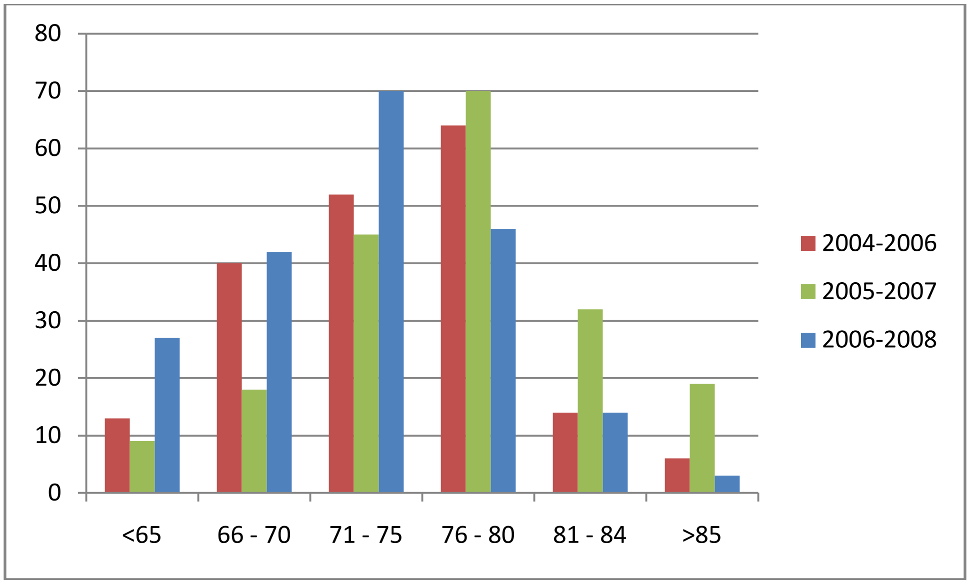


Figure 23. Distribution of ozone 8-hour design values as a function of concentration

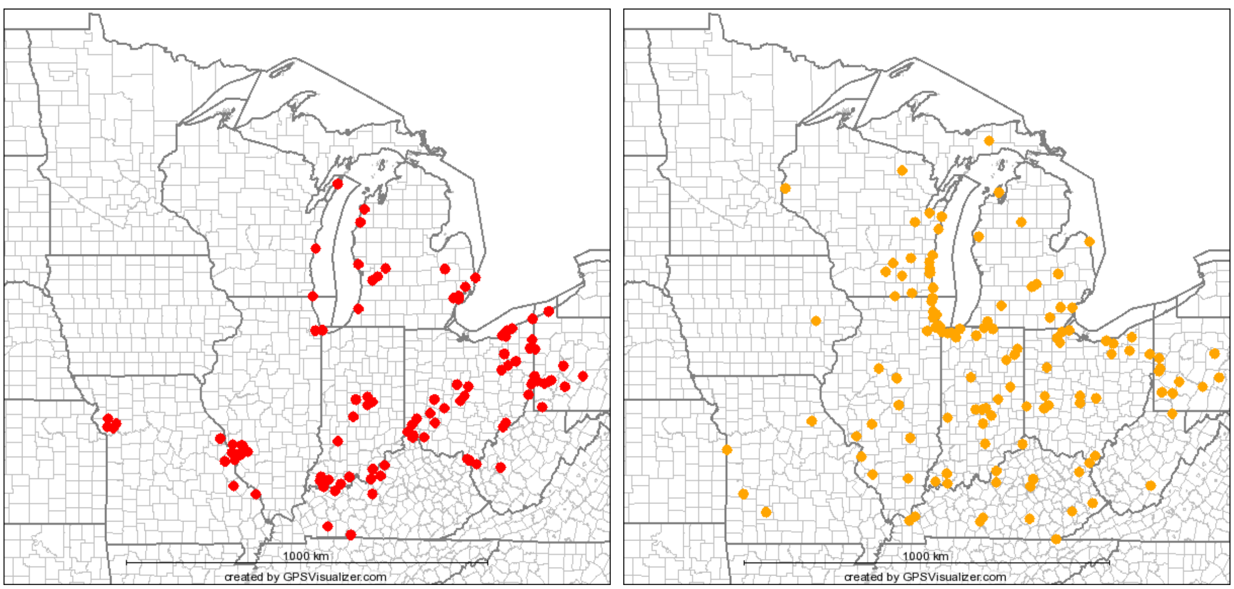


Figure 24. Sites within 10% above NAAQS (left) and within 10% below NAAQS (right)

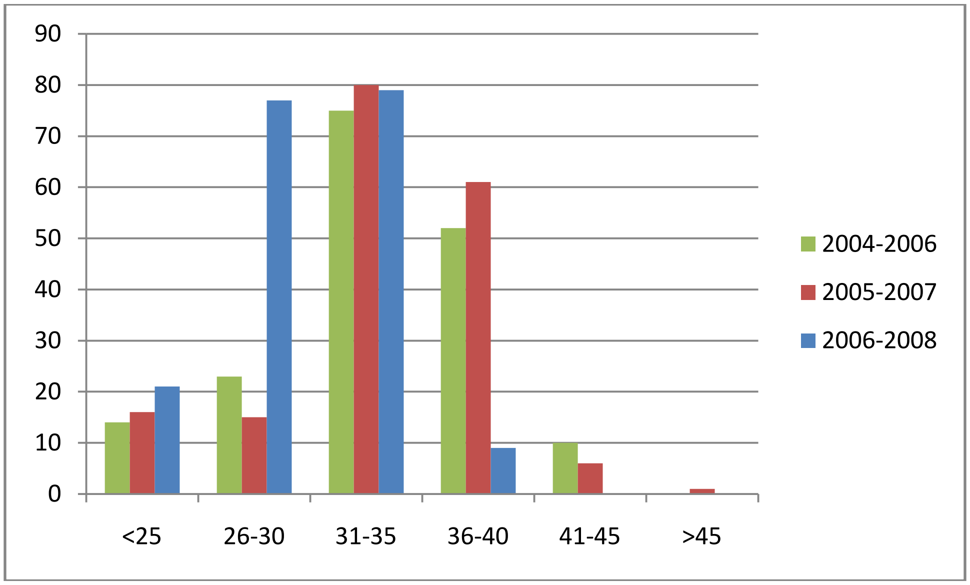


Figure 25. Distribution of PM2.5 24-hour design values as a function of concentration

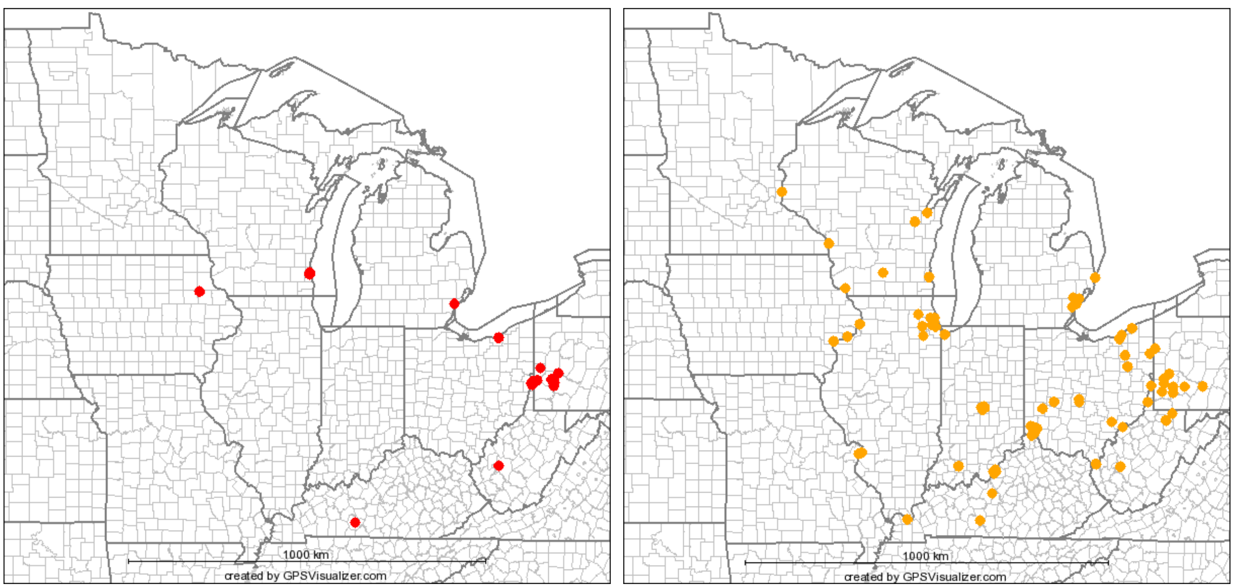


Figure 26. Sites within 10% above NAAQS (left) and within 10% below NAAQS (right)

4.3 Monitoring Objective: Support Control Strategy Development

4.3.1 Urban-Rural Pairs

Methodology: Identify the appropriate upwind site(s) for major urban areas in the region. Simple comparisons are made of (upwind) rural v. urban concentrations for 2006-2008 (e.g., time series of daily peak values or stacked bar charts). This information is used to support recommendations on the adequacy of the rural monitoring network for assessing background concentrations.

A good urban-rural pairing is useful for identifying local (urban) source contributions. As noted by STI in a recent data analysis report for LADCO, "(t)he split between local and regional contributions is very important for control strategy development" (STI, 2008)

Results: Table 9 identifies the upwind site for each major urban area (> 1 M population) in/near Region V.

Table 9. Upwind monitoring site for major urban areas in Midwest

State	Urban Area	Upwind Site
IL	Chicago	Braidwood
	St. Louis	Bonne Terre, MO (29-186-0005)
IN	Indianapolis	Plummer (18-055-0001)
	Louisville	Elizabethtown, KY (21-093-0006)
MI	Grand Rapids	Jenison (26-139-0005)
	Detroit	Tecumseh (26-091-0007)
MN	Minneapolis/St. Paul	Mille Lacs (27-095-3051)
OH	Cincinnati	Ozone: East Bend, KY (21-015-0003) PM2.5: Frankfort, KY (21-073-0006)
	Columbus	Ozone: Madison Co. 39-097-0007 PM-2.5: None
	Cleveland	Ozone: Medina Co. 39-103-0003 PM-2.5: Medina Co. 39-103-0003
WI	Milwaukee	Mayville (site being moved to Horicon)

To assess the adequacy of these upwind site identified by the states, three factors were considered:

(1) Correlation – does the site have a low correlation (and high average difference) compared to sites in the urban area?
(2) Distance – is the site outside the CBSA?
(3) Direction – is the site in the prevailing upwind direction on high concentration days?

For the first factor, the results of EPA's correlation matrix using 2006-2008 data were considered (see http://www.epa.gov/ttn/amtic/network-assessment.html). Threshold values of 0.7 (correlation coefficient) and 10% (average difference) were assumed. That is, if a lower correlation and a higher average difference was found (based on the upwind site and the urban area sites), then the upwind rural site was determined to provide data different from the rest of the urban area.

For the second factor, the maps in the two analysis documents were reviewed to determine if the upwind rural site was outside the urban area.

For the third factor, available pollution roses (for high concentration days) were reviewed to determine if the upwind rural site was located in the prevailing upwind direction.

The results of the 3-factor assessment are provided in Table 10. Key findings include:

- For Chicago, Grand Rapids, Detroit, Cincinnati, and Cleveland, the identified upwind rural site is appropriate. These sites are important and should be maintained.

- For St.Louis, Columbus, and Indianapolis, the identified upwind rural site is appropriate for ozone, but is missing PM2.5 data. Consideration should be given to establishing a PM2.5 FRM monitor at these sites.

- For Milwaukee and Minneapolis, the identified upwind rural site is not appropriate because it is not in the right upwind direction. In the case of Milwaukee, however, there are other sites in the prevailing upwind direction (e.g., Chiwaukee Prairie), which can be used to provide a good assessment of the local (Milwaukee) contribution. It is not clear if there is a viable alternative site for Minneapolis. If not, then consideration should be given to establishing an appropriate upwind rural site.

Table 10. Summary of Assessment of Urban-Rural Pairings

	Ozone						PM2.5				
	Upwind Site	Low Corr, High Ave Diff?	Distance - Outside CBSA?	Direction - Prevailing Upwind Dir?	Good Site?		Upwind Site	Low Corr, High Ave Diff?	Distance - Outside CBSA?	Direction - Prevailing Upwind Dir?	Good Site?
Chicago	Braidwood	Y	Y (almost)	Y	Y		Braidwood	---	Y (almost)	Y	Y
St. Louis	Bonne Terre, MO	---	Y	Y	Y		no PM2.5 site identified				
Indianapolis	Plummer	---	Y	Y	Y		no PM2.5 site identified				
Louisville	Elizabethtown, KY	Y	Y	Y	Y		Elizabethtown, KY	Y	Y	???	
Grand Rapids	Jenison	N	Y	Y	Y		Jenison	Y	Y	Y	Y
Detroit	Tecumseh	Y	Y	Y	Y		Tecumseh	Y	Y	Y	Y
Minneapolis-St.Paul	Mille Lacs	---	Y	N	**N**		Mille Lacs	---	Y	N	**N**
Cincinnati	East Bend, KY	Y	Y (almost)	Y	Y		Frankfort, KY	---	Y	Y	Y
Columbus	Madison Co.	Y	Y (almost)	Y	Y		no PM2.5 site identified				
Cleveland	Medina Co.	Y	Y (almost)	Y	Y		Medina Co.	Y	Y (almost)	Y	Y
Milwaukee	Mayville	---	Y	N	**N**		Mayville	---	Y	N	**N**

4.3.2 Length of Record

Methodology: Rank monitoring sites based on the duration of the continuous monitoring record. Sites with many years of data score high in this analysis.

Results: Table 11 shows the number of monitoring sites with a data record of a particular length for each pollutant.

Table 11. Number of monitoring sites with data record of a particular length for each pollutant

No. of Years	lead	co	so2	no2	o3	pm10	pm2.5
<5	14	8	13	7	20	26	46
5-10	19	4	13	9	40	19	69
11-15	2	2	6	8	28	27	111
16-20	10	11	8	5	41	15	0
21-25	11	5	8	1	18	39	0
26-30	7	7	15	3	30	7	0
31-35	5	4	23	1	26	0	0
>35	4	1	3	0	4	0	0
TOTAL	72	42	89	34	207	133	226
% > 10yrs	**54%**	**71%**	**71%**	**53%**	**71%**	**66%**	**49%**
% < 5 yrs	**19%**	**19%**	**15%**	**21%**	**10%**	**20%**	**20%**

Several observations on this information should be noted:

- The PM2.5 network is the newest major network, which began in 1999 in response to the 1997 promulgation of the standard. This network continued to evolve over the next several years, such about half of the sites are relatively new (i.e., < 10 years).

- The Pb and NO2 networks are also fairly new, with about 45% of the sites with < 10 years of data.

- The ozone, PM10, SO2, and CO networks are all relatively older; each having about 70% of the sites operating more than 10 years.

Sites with longer operating records are valuable for trends analyses. Time series plots of regional PM2.5-annual and 8-hour ozone concentrations show a noticeable improvement in air quality in the upper Midwest, especially for ozone over the past decade – see Figure 27.

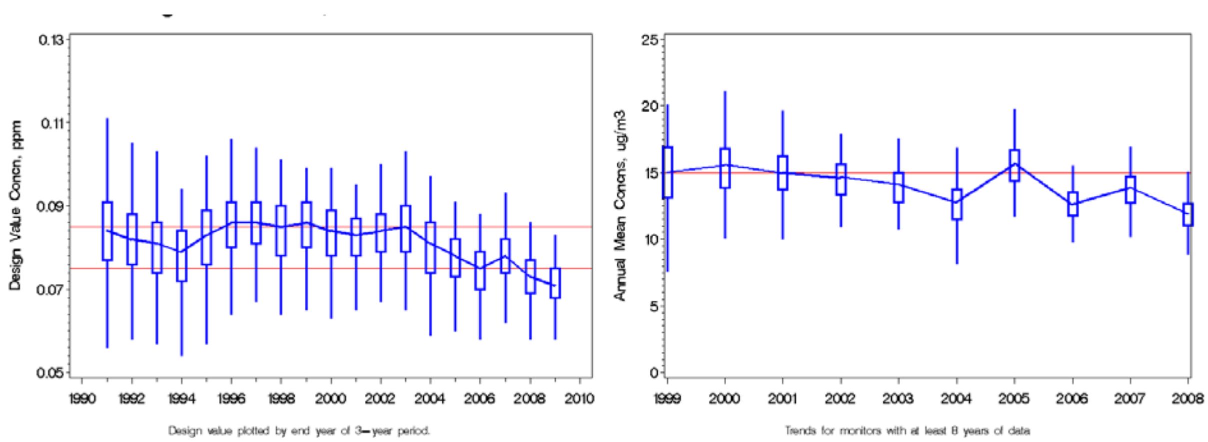


Figure 27. Regional trends in ozone (left) and PM2.5 (right) concentrations

An important factor in interpreting trends is the year-to-year variability in meteorology. Met-adjusted trends were prepared for ozone (Figure 28) and PM2.5 (Figure 29). The met-adjusted trends for ozone are consistently downward; thus, confirming that other factors, such as emission reductions, are responsible for the improvement in ozone levels.

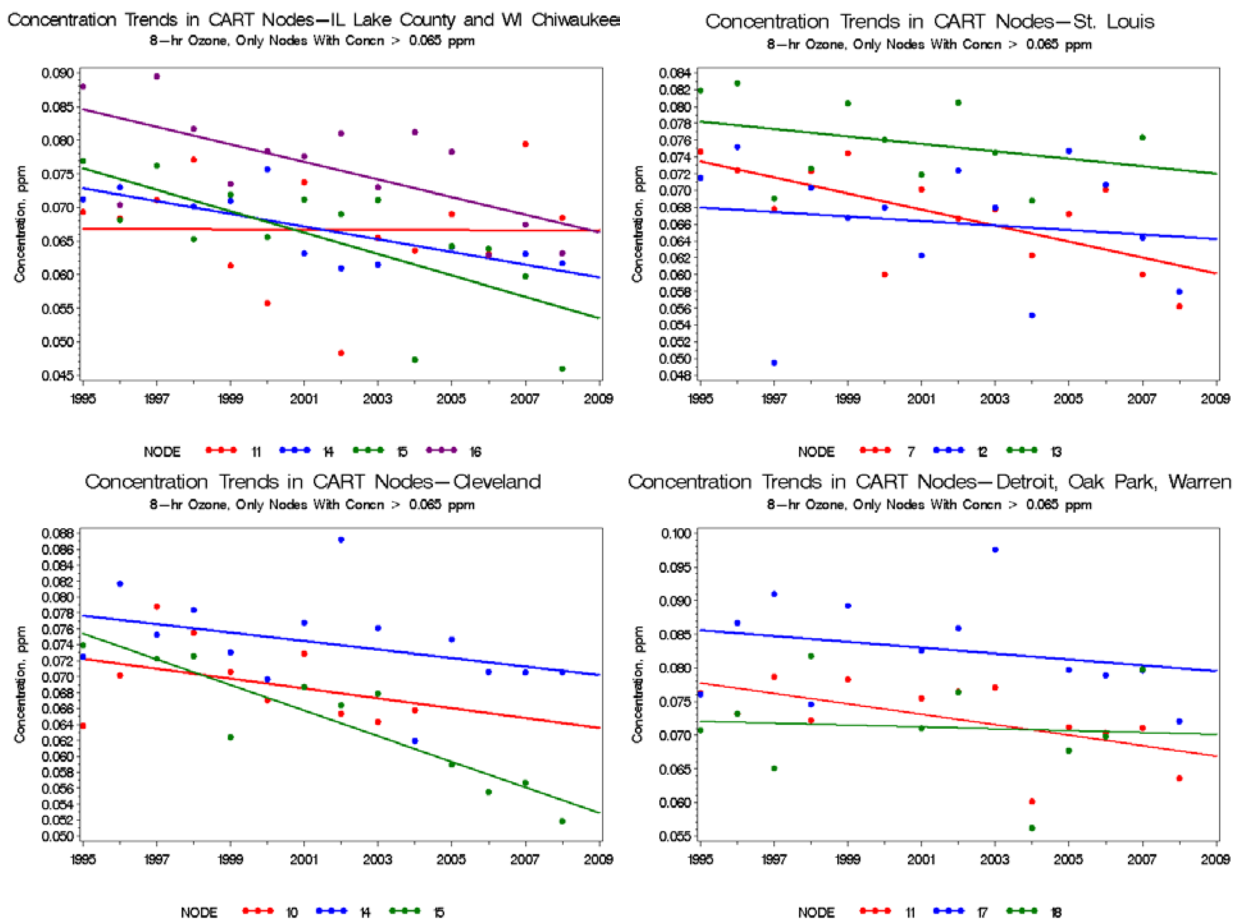


Figure 28. Met-adjusted trends for ozone for four urban areas in the Midwest

The met-adjusted trends for PM2.5, however, are much flatter, suggesting that meteorology has played a role in the improvement in PM2.5 levels.

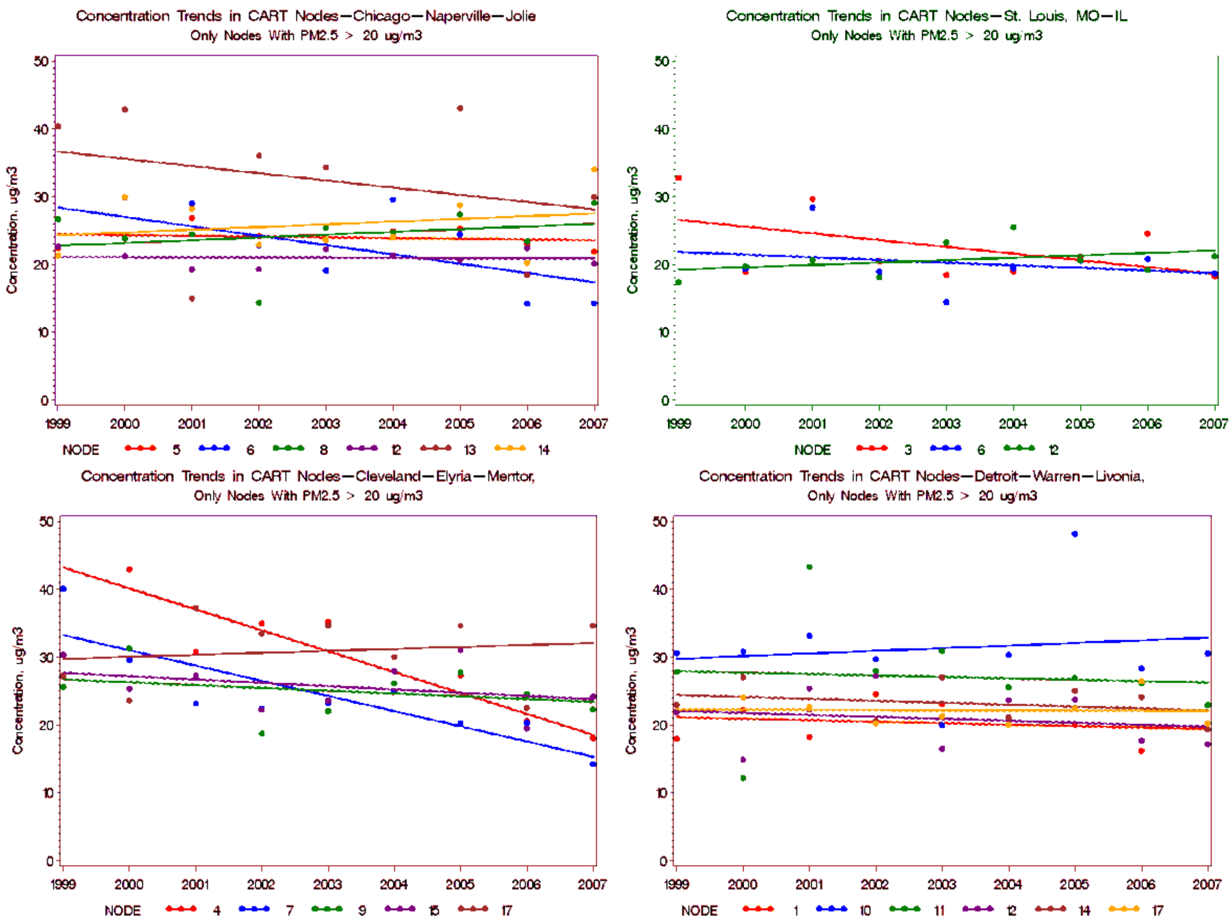


Figure 29. Met-adjusted trends for PM2.5 for four urban areas in the Midwest

4.3.3 Emissions Inventory

Methodology: Maps of gridded emissions are compared to monitoring sites to determine if there is adequate monitoring in areas of maximum primary or precursor emissions.

Results: Regional emission density maps for NOx, VOC, and PM2.5 are provided in Figure 30. The maps are based on low-level emissions in LADCO's 2005 base year inventory. Areas of high emissions density are evident in Chicago, Milwaukee, Minneapolis-St. Paul, St. Louis, Cleveland, Cincinnati, and Detroit. Higher resolution emission maps for these cities (plus Indianapolis) are provided below. These maps also show existing monitor locations. The VOC maps show PAMS sites as a large black dot and air toxics sites, which provide a partial set of VOC species, as a smaller black dot.

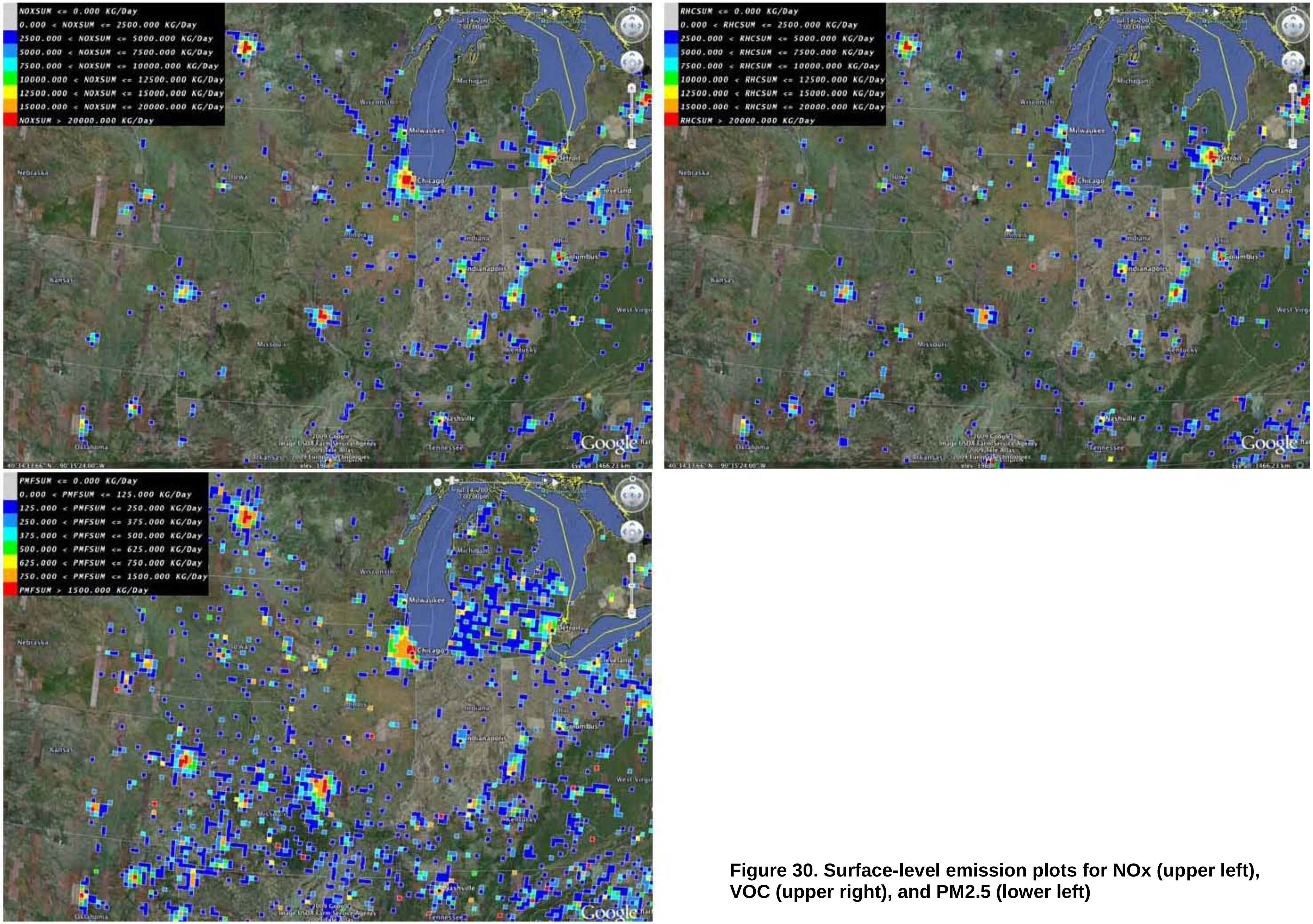


Figure 30. Surface-level emission plots for NOx (upper left), VOC (upper right), and PM2.5 (lower left)

Ozone: NOx and VOC maps were examined to determine the adequacy of the existing monitoring sites relative to areas of high emissions density.

Chicago/Gary/Milwaukee PAMS area: In Chicago, the monitor coverage in the high emissions density area is not sufficient. (This is consistent with the findings discussed in Section 4.8.) The Northbrook PAMS (170324201) is too far north of the high emissions density area and the Jardine PAMS site (170310072) no longer measures VOCs. It is recommended that a new site be established in the high emissions density area. (If this happens, then the Jardine site can be terminated.) In Milwaukee, the monitor coverage in the area of high emissions density is sufficient (not shown).

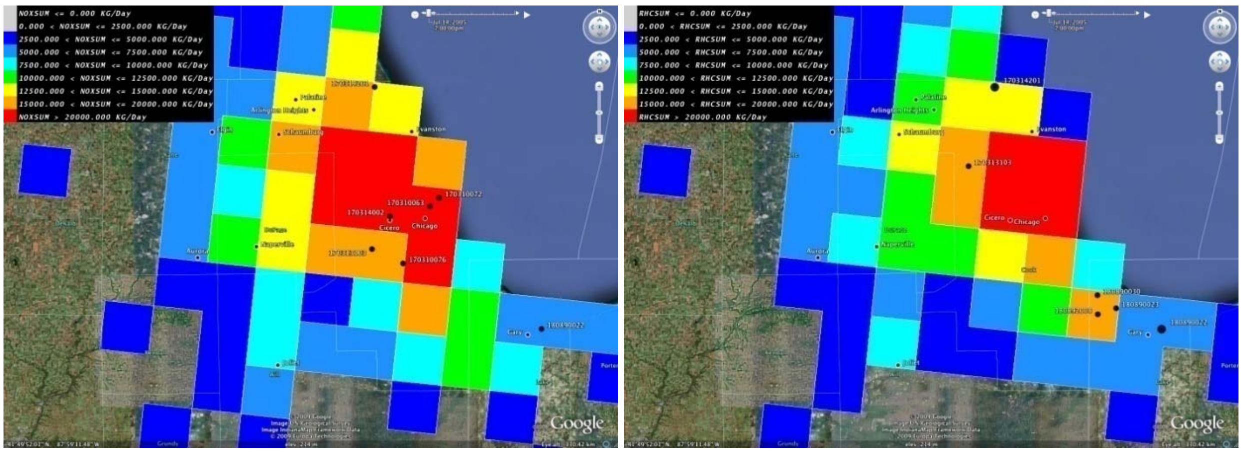


Figure 31. Emissions plot for Chicago – NOx (left) and VOC (right)

Cincinnati: This urban area has the highest ozone design values in the region for the past several years. Monitor coverage in the area of high emissions density is not sufficient. Although this city is not subject to the PAMS monitoring requirements, given its elevated ozone levels, precursor monitoring is desirable. (Note also that a recommendation in Section 4.8 is to revisit identification of PAMS areas based on current air quality levels.)

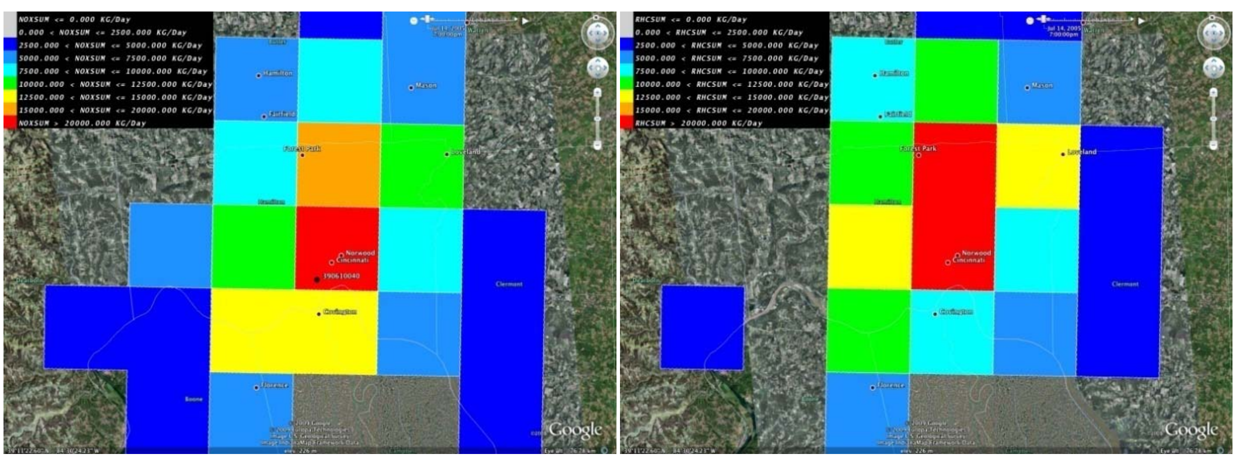


Figure 32. Emissions plot for Cincinnati– NOx (left) and VOC (right)

Cleveland, Detroit, and St. Louis: These cities have the next highest ozone design values in the region (after Cincinnati and Chicago/Gary/Milwaukee) for the past several years. Suggested improvements to the ozone precursor monitoring in these cities include additional NOx monitors in Detroit and the establishment of a continuous total hydrocarbon (THC) monitor in each city.

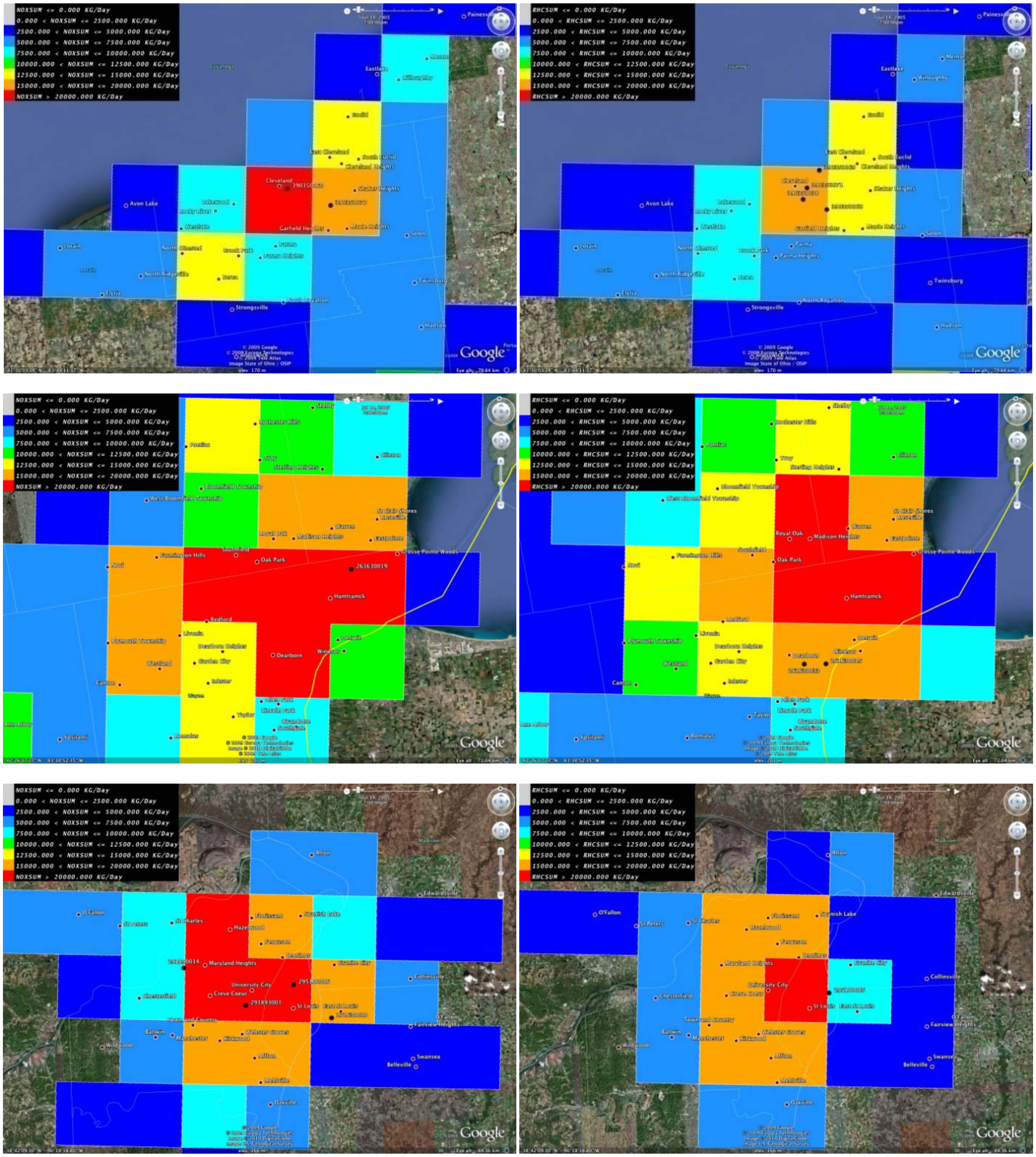


Figure 33. Emissions plots for Cleveland (top), Detroit (middle), and St. Louis (bottom) – NOx (left) and VOC (right)

In the other two cities (Indianapolis and Minneapolis-St. Paul), less scrutiny was given to the NOx and VOC monitoring, given the lower design values there.

PM2.5: Only a handful of the existing monitoring sites are classified as source-oriented. The emissions plots, however, indicate that several other monitoring sites are located in the proximity of the higher emissions density grid cells. In general, there are enough PM2.5 monitoring sites to provide good coverage in the higher emission areas.

4.4 Monitoring Objective: Support Air Pollution Research

4.4.1 Number of Parameters

Methodology: Rank monitoring sites based on the number of parameters measured at each site. Sites with a large number of parameters score high in this analysis.

Results: Table 12 identifies the 18 monitoring sites with measurements for at least four pollutants (and, thus, provide considerable value in terms of co-located, multi-pollutant data):

Table 12. Monitoring sites with at least four multiple pollutant measurements in Region V

			CO	Pb	NO2	SO2	O3	PM2.5-mass	PM2.5-spec	PM10
IL	**170314201**	**Northbrook**	x		x	x	x	x	x	x
	170310076	Chicago-Lawndale			x	x	x	x	x	
	170314002	Cicero	x		x	x	x			
	171193007	Wood River				x	x	x		x
	171630010	E. St. Louis	x		x	x	x	x		x
IN	180890022	Gary – IITRI			x	x	x	x	x	x
	180970073	Indianapolis-Naval	x		x	x	x			x
	181630012	Vanderburgh County			x	x	x	x	x	
	181670018	Vigo County				x	x	x		x
MI	**260810020**	**Grand Rapids**	x			x	x	x	x	x
	261630001	**Allen Park**	x			x	x	x	x	x
MN	270370020	Rosemount-Pine Bend	x	x	x	x				
	270370423	Inver Grove Heights	x	x	x	x				
OH	**390610040**	**Cincinnati-Taft Rd**			x		x	x	x	x
	390350038	**Cleveland-G.T. Craig**		x		x		x	x	x
	390350060	Cleveland-St. Tikhon			x	x		x	x	x
	390810017	Steubenville				x	x	x		x
WI	**550270007**	**Mayville**[3]	x			x	x	x	x	x
	550410007	Crandon			x	x	x			x

Note: NCore sites are highlighted in bold.

[3] Site moved to Horicon in early 2010.

4.4.2 New NCORE Monitoring Network

In its October 17, 2006, revisions to the monitoring regulations, EPA adopted a requirement for states to establish and operate a long-term network of National Core (NCore) multi-pollutant monitoring stations (71 FR 61236). The NCore network is to consist of approximately 75 stations and must be operational by January 1, 2011. The sites are expected to operate for many years in their respective locations.

The NCore multi-pollutant stations are intended to:

- track long-term trends for accountability of emissions control programs and health assessments that contribute to ongoing reviews of the NAAQS;
- support development of emissions control strategies through air quality model evaluation and other observational methods;
- support scientific studies ranging across technological, health, and atmospheric process disciplines;
- support ecosystem assessments, and
- provide data for use in attainment and nonattainment designations and for public reporting and forecasting of the AQI.

Generally, at least one NCore station is required in each state - nine states, including Illinois, Michigan, and Ohio must have two stations. Urban NCore stations are to be generally located at urban- or neighborhood-scale to provide representative concentrations of exposure expected throughout the metropolitan area. Rural NCore stations are to be located at a regional- or larger-scale away from any large local emission source.

The NCore monitoring plans for the Region V States were included as part of the States' July 1, 2009, annual monitoring plan submittal. EPA is acting on these plans on a state-by-state basis.

Figure 34 below shows a map of the approved NCore sites in Region V. Further detail is provided in Table 13.

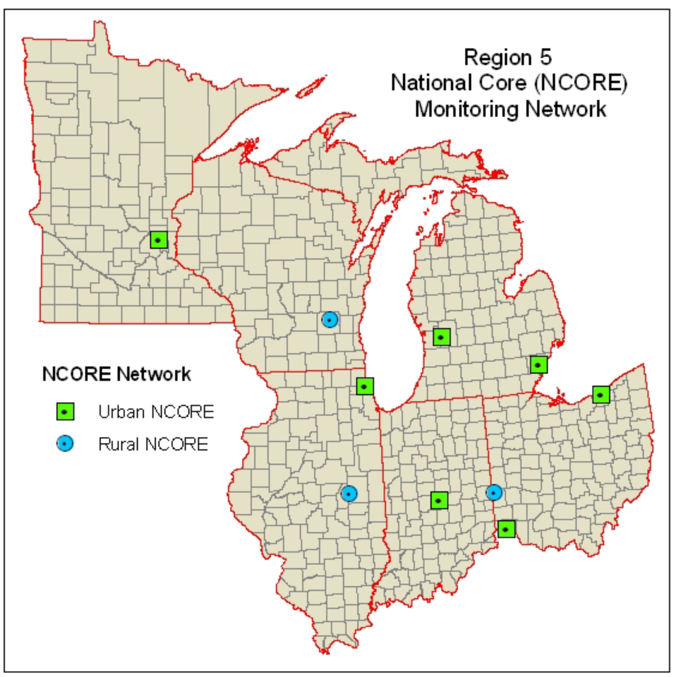


Figure 34. Region V NCore Monitoring Network

Table 13. NCore Monitoring Sites in Region V

Name	AQS ID	State	County	Start Date	Loc. Setting Land Use Type	Other Network	PM2.5 Measurements	Other Particle Measurements	Gaseous Measurements	Met	Other
Northbrook Water Plant	170314201	Illinois	Cook	3/20/97	Suburban Residential	PAMS, NATTS	FRM, Continuous, Speciation-1:6 (STN)	PM10, BC, Pb(TSP)	SO2, O3, NOx Trace SO2, CO, NOy VOC, carbonyls	x	Hg, Metals, TSP, PAHs, Open Path, NO2, O3, SO2, formaldehyde
ISWS Climate Station (Bondville)	170191001	Illinois	Champaign	1/1/99	Rural Agricultural	IMPROVE, CASTNET	FRM				NH3 (passive)
Indianapolis - Washington Park	180970078	Indiana	Marion	3/7/99	Suburban Residential		FRM, Continuous, Speciation-1:3 (STN)	PM-coarse, BC, Pb(TSP)	O3, NOy Trace SO2, CO VOC, carbonyls	x	Metals, Continuous sulfate
Allen Park	261630001	Michigan	Wayne	1/1/71	Suburban Commercial		FRM, Continuous, Speciation-1:3 (STN)	PM10, PB(TSP)	SO2, O3 Trace CO		NH3 (passive)
Grand Rapids	260810020	Michigan	Kent		Urban, Center City Commercial		FRM, Continuous, Speciation-1:6 (STN)	PM10, Pb(TSP)	O3, NOy Trace SO2, CO	x	
Blaine	270031002	Minnesota	Anoka	5/1/79	Suburban Commercial		FRM, Continuous, Speciation	PM-coarse	O3, NOx Trace SO2, CO, NOy	x	
Cincinnati - Taft	390610040	Ohio	Hamilton	4/1/99	Urban, Center City Commercial		FRM, Continuous, Speciation-1:3	PM10, PM-coarse, BC	SO2, O3, NOx Trace SO2, CO, NOy	x	continuous PM10, NO2, NH3 (passive)
New Paris - National Trail High School	391351001	Ohio	Preble		Rural Agricultural		FRM, Continuous, Speciation-1:3		SO2, O3, NOx Trace SO2, CO, NOy	n	
Cleveland - G.T. Craig	390350060	Ohio	Cuyahoga	1/8/93	Urban, center city		FRM, Continuous, Speciation-1:3 (STN)	PM10-cont., PM-coarse, Pb(TSP)	CO, SO2, O3, NOx Trace SO2, CO, NOy	x	PMCoarse for OAQPS study; Nephelometer, OAQPS ChemVol study
Horicon Marsh	550270001	Wisconsin	Dodge		Rural Marshland	NATTS	FRM, Continuous, Speciation-1:3 (STN)	PM-coarse	SO2, O3, NOx Trace SO2, CO, NOy VOC, carbonyls	x	Hg, Metals, PAHs, NH3 (passive)

4.5 Composite Score Analysis

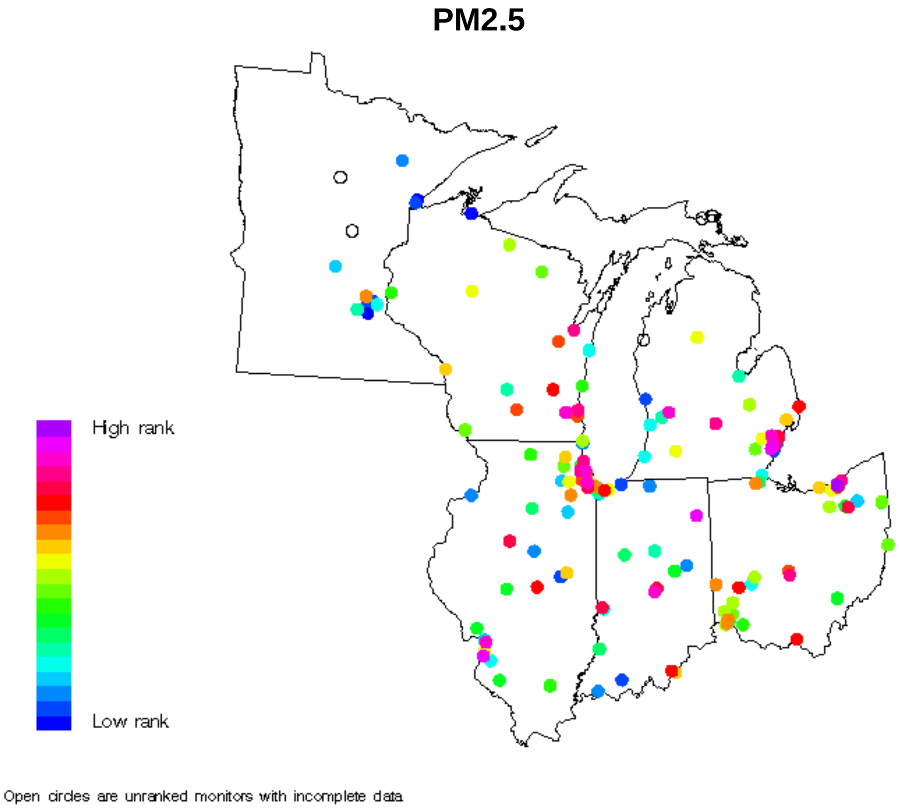
Results from several of the individual analyses were combined in an attempt to provide an overall assessment. Separate metrics were developed for the ozone and the PM2.5 monitors. Analyses that were incorporated into this composite analysis were as follows: monitor-to-monitor correlations; design value (2006-2008); population served by the monitor; area covered by the monitor; total number of parameters measured at the site; and number of years.

Composite scores were calculated separately for ozone and PM2.5 monitors by averaging the standardized scores for correlation, design value, population, area, number of parameters, and number of years. These overall scores are presented in Figure 35. Other weighting schemes can be implemented by adjusting the scores for each factor, as desired. Note that the scores for area served, which ranks monitors higher for greater area, will naturally tend to value rural monitors most highly, because the rural network is sparse and each rural monitor is intended to represent a large area. In contrast, the scores for population served will tend to value urban monitors more highly, because they are sited in areas of greatest population density. To some extent, these two scores will cancel each other, although they are not perfect inverses. Weighting one or the other of these in particular may have a significant effect on the composite score

Figure 35 shows a handful of low value sites in each state, plus notable clusters of low value sites, including:

Ozone	N Central Indiana
	E Central Indiana
	SW Indiana
	NW Michigan
	S Central Wisconsin
PM2.5	N Wisconsin
	W Michigan
	NE Minnesota

These States may wish to review these clusters of low value sites and determine whether any shutdowns are appropriate.



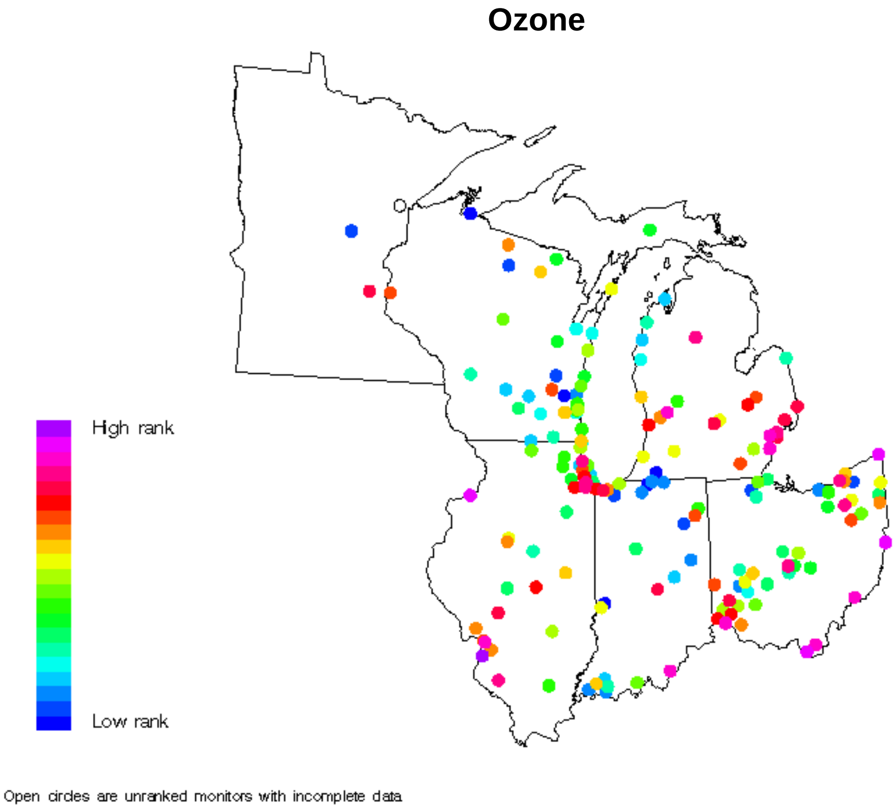


Figure 35. Overall ranking of PM2.5 (left) and ozone (right) monitors

4.6 New Ozone Monitoring Requirements

On July 16, 2009 (74 FR 34525), EPA proposed to revise the monitoring network design requirements for ozone, in response to the new 0.075 ppm ozone standard[4]. Specifically, EPA proposed to modify minimum monitoring requirements in urban areas, add new minimum monitoring requirements in non-urban areas, and modify the length of the required ozone monitoring season in some states.

Urban Monitoring: Currently, the minimum number of ozone monitors required in an MSA ranges from 0 (for an area with a population between 50,000 and 350,000, and no recent history of an ozone design value > 85 percent of the NAAQS) to 4 (for an area with a population of greater than 10 million, and an ozone design value greater than 85 percent of the NAAQS). An analysis by EPA found a "reasonable likelihood" that monitors placed in unmonitored MSAs (with a population below 350,000) would measure concentrations greater than 85 percent of the new standard. To ensure that potential NAAQS violations are measured, EPA proposed to require 1 monitor in MSAs with a population between 50,000 and 350,000, and no history of ozone monitoring within the previous 5 years indicating a design value < 85 percent of the NAAQS. Nationally, EPA estimated that approximately 109 new ozone monitors (including 15 in Region V) would be needed, unless an existing site is satisfactorily located or relocated.

Rural Monitoring: Currently, existing ozone monitoring requirements are focused on urban areas, where there are large populations and, traditionally, the highest concentrations have been measured. To provide better characterization of ozone exposures to ozone-sensitive vegetation and ecosystems in rural areas, assess elevated ozone levels in smaller communities, and assess the location and severity of maximum ozone concentrations in non-urban areas, EPA proposed to require 3 non-urban ozone monitors in each state (i.e., one in located in areas, such as federal, state, or tribal lands; one in an MSA with a population between 10,000 and 50,000; and one in the area of maximum concentration outside of any MSA). Nationally, EPA estimated that approximately 159 new ozone monitors (including 18 in Region V) would be needed, unless an existing site is satisfactorily located or relocated. In particular, EPA recognized that existing CASTNET sites could be counted to meet this requirement, if a state enters into an agreement with the site operators to maintain the site in accordance with 40 CFR Part 58 monitoring regulations.

Length of Ozone Monitoring Season: Currently, ozone monitoring is required during the seasons of the years conducive to ozone formation, which varies in length from place to place. An analysis by EPA found concentrations > 80 percent of the new standard in several states outside the current required monitoring season. Proposed changes in Region V are:

	Current	**Proposed**	**Changes**
Illinois	Apr – Oct	Apr – Oct	none
Indiana	Apr – Sept	Mar – Oct	2 mos. longer
Michigan	Apr – Sept	Apr – Sept	none
Minnesota	Apr – Oct	Apr – Sept	1 mo. shorter
Ohio	Apr – Oct	Apr – Oct	none
Wisconsin	Apr 15 – Oct 15	Apr – Oct	1 mo. longer

[4] On January 6, 2010, EPA proposed to revise the ozone NAAQS. In this action, EPA referenced its July 2009 proposed monitoring revisions, but did not make any changes to that proposal. EPA did note that it expected to finalize the monitoring requirements in late summer 2010.

4.7 PM2.5 Speciation

The results of several data analyses were considered to assess the adequacy of the existing PM2.5-speication monitoring network in the region. Based on this assessment, two key findings should be noted:

- The overall network is well-sited and should be maintained. Coverage in both urban areas with higher PM2.5 mass concentrations and in rural areas, in particular, is good.

- A few improvements to the existing network should be considered, including removing one or two redundant sites (in northwestern Ohio - southeastern Michigan, and in northeastern Illinois – northwestern Indiana) and adding one (or more) new site(s) (in Wisconsin).

Currently, there are 48 PM2.5 speciation monitors operating in the region:

	CSN (STN)		IMPROVE
	Urban	Rural	(or IMPROVE-protocol)
IL	5		1
IN	7	1	1
MI	5	2	2
MN	2		4
OH	12	1	1
WI	2	2	
	33	6	9

Figure 36 shows the location of current (and past) speciation sites in the region.

Do the existing speciation monitors provide adequate representation of urban areas with high PM2.5 (FRM) concentrations? Are there redundancies? Are there gaps?

Based on an examination of annual and daily PM2.5 design values for FRM sites in the region (see "Measured Concentration Analysis") and Figure 36, several points should be noted:

- Speciation monitors are located in most urban areas and at most high FRM concentration sites. Thus, the overall network is well sited and, as such, should be maintained.

- The most noticeable redundancies in the speciation network include:

Site Pair	Separation	PM2.5 Corr.[5]
Toledo, OH and Luna Pier (Monroe, MI)	13 miles	0.88
Chicago-Lawndale, IL and Hammond, IN	16 miles	0.92

These states should review these sites and determine whether one site (in each pair) can be eliminated.

[5] Based on 2006-2008 PM2.5 mass concentrations.

- There is no speciation monitor in the following urban area with high concentrations (i.e., > 90% of NAAQS):

Green Bay, WI	2006-2008 DV = 35 ug/m3
Madison, WI	2006-2008 DV = 34 ug/m3

- A few existing speciation monitors are located in the following urban areas with relatively low concentrations (i.e., < 90% of NAAQS):

Elkhart, IN	2006-2008 DVs = 12.3, 31 ug/m3
Grand Rapids, MI	2006-2008 DVs = 11.8, 29 ug/m3
Monroe, MI	2006-2008 DVs = 12.4, 31 ug/m3
Minneapolis, MN	2006-2008 DVs = 9.6, 23 ug/m3
Rochester, MN	2006-2008 DVs = 9.6, 27 ug/m3

  All of these sites, except possibly Monroe (see above), should be maintained: Elkhart is the only site in northeastern Indiana-northwestern Ohio (an area of higher modeled PM2.5 concentrations – see "Unmonitored Area Analysis"); Grand Rapids is an NCore site; and the two Minnesota sites are located in areas of occasional high daily PM2.5 concentrations.

- Most of the speciation sites have operated at least five years and should continue to build up a long term record of data to support SIP development and trends analyses (see "Length of Record Analysis"). The few sites in operation less than five years are located in areas of high concentration (i.e., > 90% of NAAQS) and, as such, should also be maintained.

- There are 13 speciation sites (i.e., the 10 NCore sites plus three other sites – Chicago Lawndale, Gary-IITRI, and Vanderburgh County, Indiana) with a high number of pollutant measurements (see Ncore review in Section 4.4.2 and "Number of Parameters Analysis"). Given the importance of mulit-pollutant measurements, these sites have particular value.

Do the existing speciation monitors provide adequate representation of rural areas in the region?

Figure 36 shows IMPROVE and IMPROVE-protocol sites in the U.S., as well as additional state-operated rural sites in the region (white stars). In general, the coverage is rural areas is good and should be maintained.

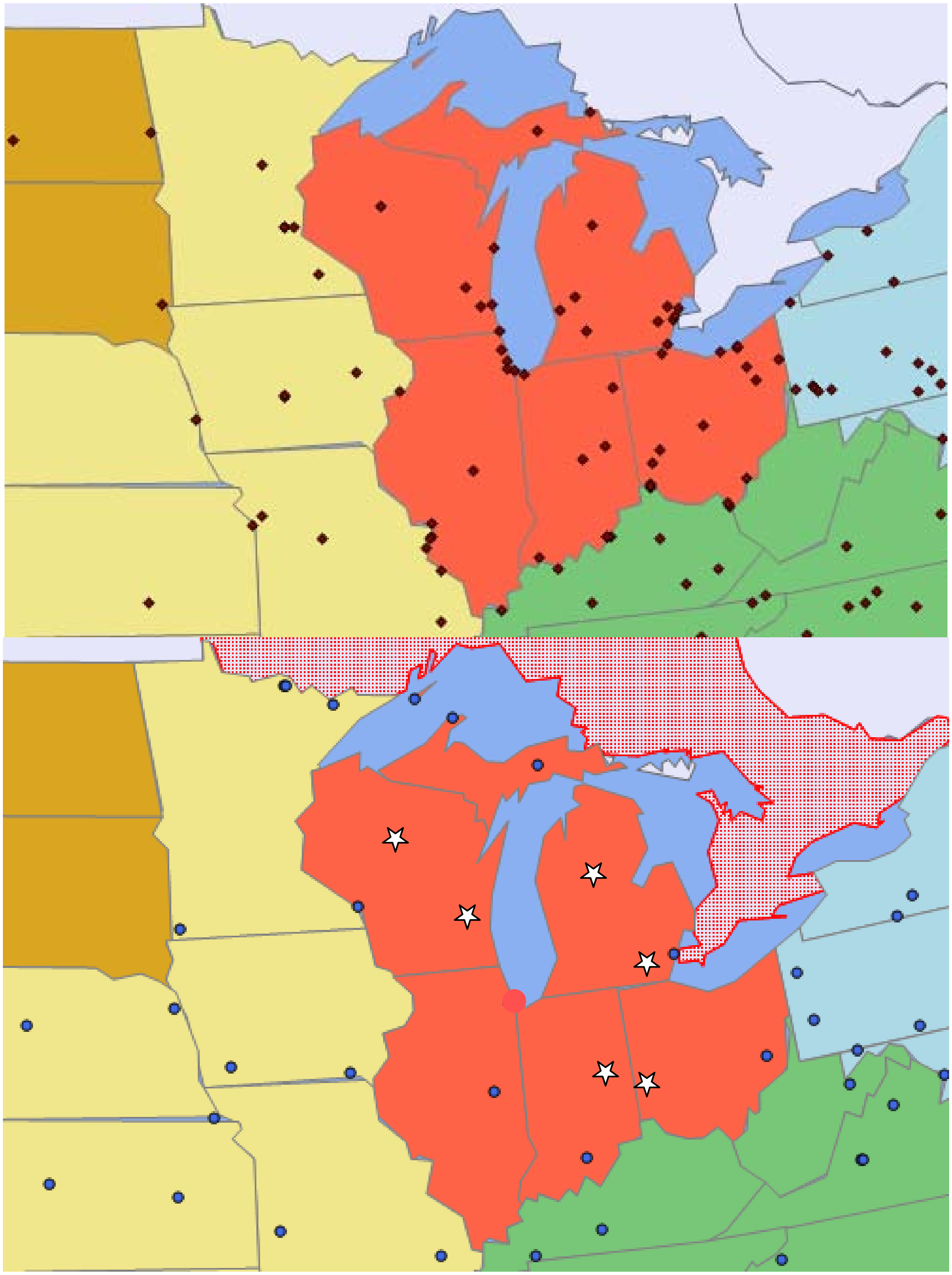


Figure 36: PM2.5 speciation sites – current and past CSN sites (top) and rural CSN/IMPROVE sites (bottom)

4.8 PAMS

Section 182 of the 1990 Clean Air Act Amendments required EPA to promulgate regulations for the enhanced monitoring of ozone and its precursors, and for the affected states to incorporate the requirements as a part of their SIPs. Pursuant to this requirement, in 1993, EPA revised its ambient monitoring regulations in 40 CFR Part 58 to include provisions for enhanced monitoring of ozone, its precursors (i.e., NOx, VOCs, and selected carbonyl compounds), and meteorological parameters. The revisions required states to establish Photochemical Assessment Monitoring Stations (PAMS) in ozone nonattainment areas classified as serious, severe, or extreme based on the 1-hour ozone standard (58 FR 8452). Objectives of PAMS monitoring include better characterizing the nature and extent of the ozone problem, aiding in tracking VOC and NOx emission inventory reductions, assessing air quality trends, making attainment/nonattainment decisions, and providing a more definitive database for evaluating photochemical model performance.

On August 12, 1993, the four Lake Michigan States submitted a regional PAMS network plan to USEPA, Region V. A regional plan was proposed for several reasons: (a) provides for the most efficient use of available resources, (b) consistent with the regional nature of the ozone problem in the Lake Michigan area, (c) consistent with the regional data base from the 1991 Lake Michigan Ozone Study field program, which provides the underlying basis for the States' regional ozone attainment demonstration, and (d) provides some of the essential elements of the data base needed to support regional photochemical modeling. A map of the Lake Michigan PAMS network is provided in Figure 37. Although the PAMS monitoring requirement only applied to the States of Illinois, Indiana, and Wisconsin, the State of Michigan joined in the submittal (and the regional plan) contingent on it receiving a portion of the federal PAMS funding, along with additional State funding required to operate one site in western Michigan. On February 16, 1994, EPA approved the regional plan.

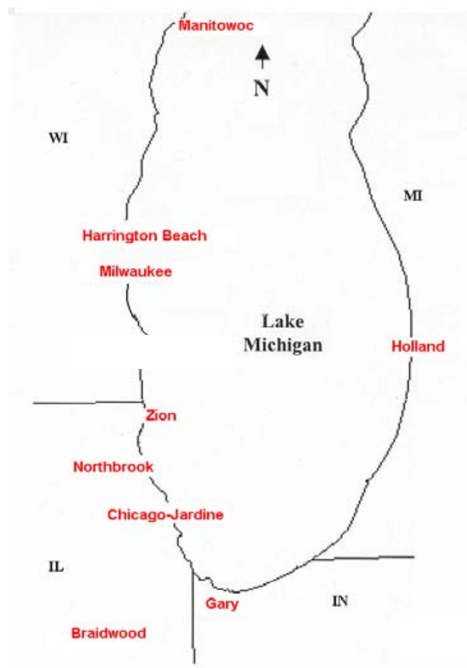


Figure 37. Map of Lake Michigan regional PAMS network

In its October 17, 2006, revisions to its ambient monitoring requirements, EPA made the following changes in the PAMS program:

- Two daily VOC sites – at least one Type 2
- CO at Type 2
- Upper air meteorology – at least one site
- NOx at Type 2, NOy at Type 1 or 3
- Ozone and surface meteorology – all sites

In 2007, EPA formed a workgroup of EPA, state, and local agency personnel to assess how well the current PAMS network is meeting its monitoring objectives; determine which sites are most useful for meeting these objectives; identify potentially redundant, ineffective, or unnecessary sites; and assess other enhanced ozone monitoring activities that may prove useful. (LADCO participated on the workgroup on behalf of its member states.) A contractor (Sonoma Technology, Inc. [STI]) was hired to conduct a number of data analyses to support the PAMS network assessment. A draft report was provided by STI in September 2008 (STI, 2008).

Using the results of STI's data analyses, LADCO consulted with its member states to develop recommendations on improving the regional PAMS network. These recommendations, which are summarized below, are included in Section 4.5.3 of the September 2008 draft report:

> Identification of PAMS Areas: Given the change in the ozone standard from a 1-hour average to an 8-hour average, EPA needs to determine if the original list of areas (based on the 1-hour standard) is still appropriate. If not, then a reasonable concentration threshold for identifying PAMS areas (based on the 8-hour standard) needs to be established.
>
> Funding: Region V receives $1,250,268 of the national allocation of $14,022,502 for PAMS monitoring and data analysis. Ozone, especially for the new 8-hour standard, remains a pervasive problem in the eastern half of the country, and in California. The PAMS program provides valuable information to support SIP development and tracking. As such, funding level should be maintained or even increased
>
> Network Recommendations: The current PAMS network for the Lake Michigan area meets the minimum requirements of the October 17, 2006 revisions to the monitoring regulations. Nevertheless, based on the analyses performed by STI to support the PAMS Network Assessment, several changes to the Lake Michigan regional network are appropriate.

Another important consideration is that since the PAMS program was established in the mid-1990s, there have been changes in ozone precursor emissions and ambient ozone levels in Region V. In the mid-1990s, the highest ozone levels in Region V were in the Lake Michigan area. Currently, the top five areas with high ozone concentrations are as follows:

Area	**Peak D.V.**	**# sites>0.075 ppm**
Cincinnati	0.082 ppm	7
Lake Michigan Area	0.081	6
Detroit	0.080	4
St. Louis	0.078	4
Cleveland	0.080	3

In light of these changes, ozone precursor measurements are needed in several high ozone urban areas in Region V (see also recommendations in Section 4.3.3).

Section 5.0 Tribal Monitoring

Ten tribal organizations in Region V are collecting ambient monitoring data for a variety of pollutants – see Table 14 and Figure 38. Tribal data were obtained from EPA's Air Quality System (AQS). As discussed below, data capture and data quality for some sites did not meet EPA criteria and, thus, were not used in the data analyses.

Another view of the full Region V state/local/tribal monitoring network (which was presented in Figure 2) is provided in Figure 39 back-dropped by the combination of the old Northwest Territories districts, treaty areas, treaty subareas and NAGPRA areas, with muted State boundaries for reference. The tribal areas were clipped to at the Region V boundaries. The spatial coverage across these areas is quite variable.

A previous assessment of tribal monitoring data in the upper Midwest was performed by a consultant for LADCO ("Analysis of Air Quality Data Collected Near Tribal Lands in Minnesota, Wisconsin, and Michigan", MACTEC Engineering and Consulting, Inc., January 2004). That assessment examined tribal data collected in 2001 and 2002 from nine (9) sites, in conjunction with data from several federal and state networks in the upper Midwest and southern Ontario. Principal findings from the assessment demonstrate that air quality for criteria pollutants is generally quite good on tribal lands and reflects compliance with federal air quality standards. Furthermore, measured concentrations across the northern portions of Minnesota, Wisconsin, and Michigan (where tribal lands are located) are lower in comparison to those across the southern tier of Region V states (Illinois, Indiana, and Ohio). Nonetheless, as EPA lowers the federal air quality standards, even monitors located in (and near) tribal lands measure concentrations approaching the new standards.

The previous assessment also examined atmospheric deposition measurements for sulfur, nitrogen, and mercury, which showed lower values at northern sites. Recent information from NADP's NTN and MDN networks confirm this south-to-north gradient – see figures in Appendix II. Mercury deposition, however, is a concern for tribes given that nearby lakes have consumption advisories for fish, which is an important traditional food source for tribes.

Based on the previous assessment and the data analyses above, several comments on the regional tribal monitoring program should be noted:

- Data capture and quality need to be improved. Data from some tribal monitors were not used in the current data analyses because either it did not meet data capture criteria or data quality was suspect.

- Data submittal to AQS needs to be improved. Although tribes are not subject to the same reporting requirements as state and local agencies, more timely data submittal to AQS is recommended to ensure that the data are publicly available.

- Although air quality concentrations on tribal lands for most criteria pollutants are generally in compliance with current federal air quality standards, it should be recognized that traditional food sources may put tribal members at increased risk of exposure. A well-structured, coordinated tribal monitoring network is, therefore, desirable to provide adequate spatial resolution in northern portions of the region (especially, in the vicinity of Class I areas), provide information on air quality levels for tribal members (especially, in the absence of modeling programs), assert tribal authority, provide information on nearby emission sources, and address tribal air quality goals and objectives.

- A comprehensive report on air quality in tribal lands should be prepared at least every five years, in conjunction with the regional network assessment. Such a report would both ensure that the network assessment considers the latest tribal monitoring data and inform tribes on the state of their air quality.

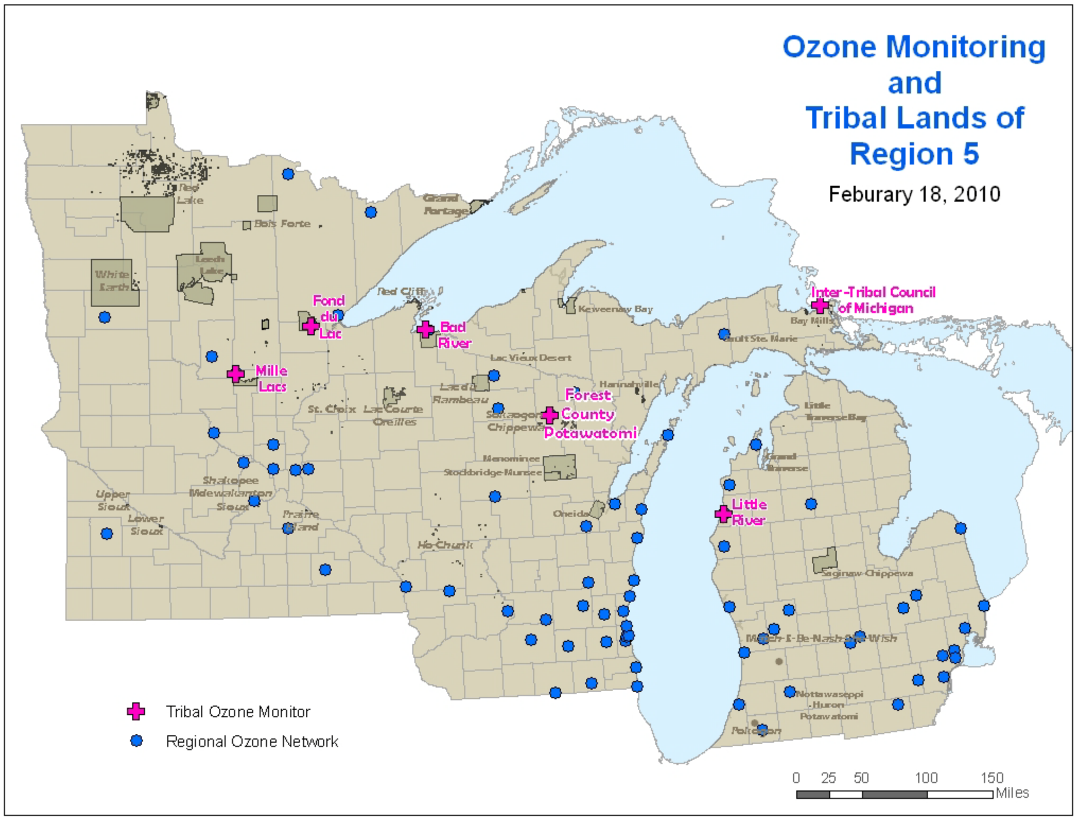
Table 14. Recent tribal monitoring sites in Region V

State	PQAO	Support Agency	Site ID	O3	CO	NO2	SO2	PM2.5 -FRM	PM2.5 -Cont.	PM10	Pb	VOC
MI	0685[1]	Grand Traverse Band of Ottawa And Chippewa Indians	26-089-0001	Yes								
MI	0685	Little River Band of Ottawa Indians	26-101-0922	Yes				Yes				
MI	W44	Little Traverse Bay Band	26-047-0004					Yes[2]				
MI	W44	Inter-tribal Council of Michigan	26-033-0903					Yes				
MI	W44	Inter-tribal Council of Michigan	26-033-0902					Yes				
MI	W44	Inter-tribal Council of Michigan	26-033-0901	Yes[3]				Yes		Yes		Yes
MN	0700	Fond du Lac Band of Lake Superior Chippewa	27-017-7416	Yes		Yes						
MN	407	Leech Lake Band of Ojibwe	27-021-0001					Yes				
MN	700	Grand Portage Band of Lake Superior Chippewa	27-031-0001						Yes			
MN	0700	Mille Lacs Band of Ojibwe	27-095-3051	Yes				Yes				
WI	1175	Bad River Band of Lake Superior Tribe of Chippewa Indians	55-003-0010	Yes				Yes				
WI	1175	Forest County Potawatomi Community	55-041-0007	Yes		Yes	Yes	Yes		Yes		

1 Last data submitted Oct 2008 – site is shut down

2 PM2.5 monitoring began in 2009

3 Ozone monitoring started in 2010



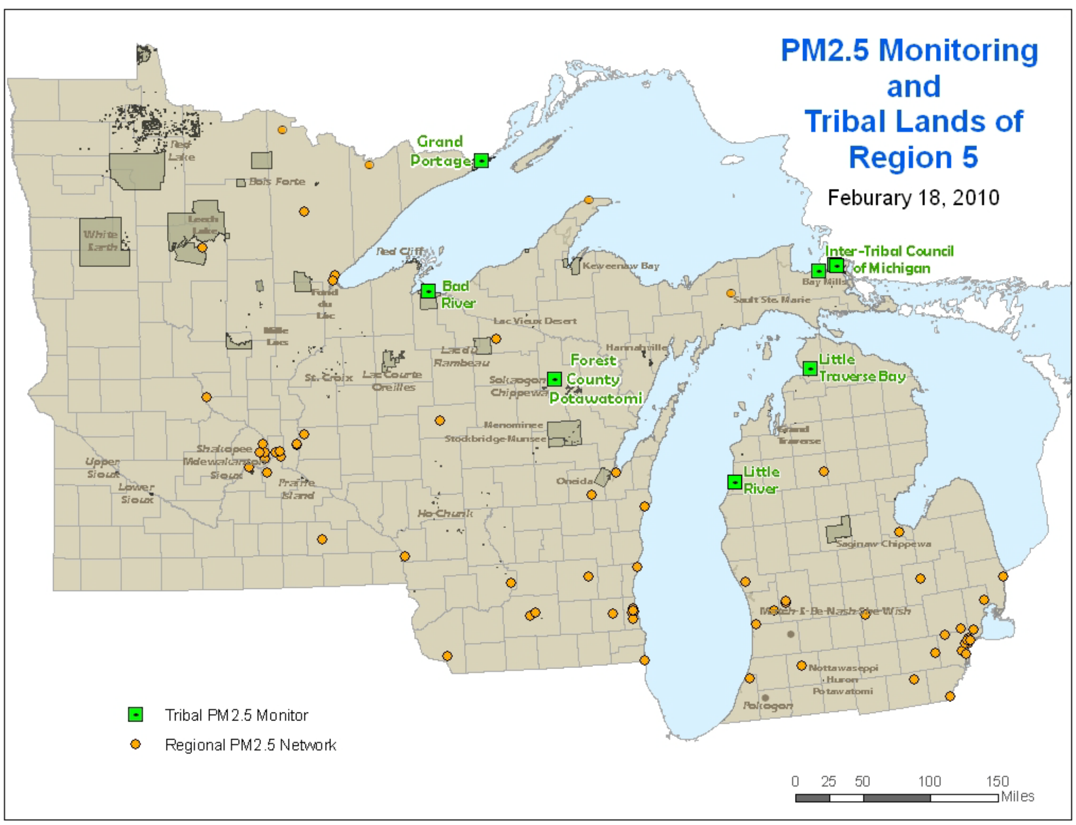


Figure 38. Tribal monitoring sites for ozone and PM2.5 as of February 2010

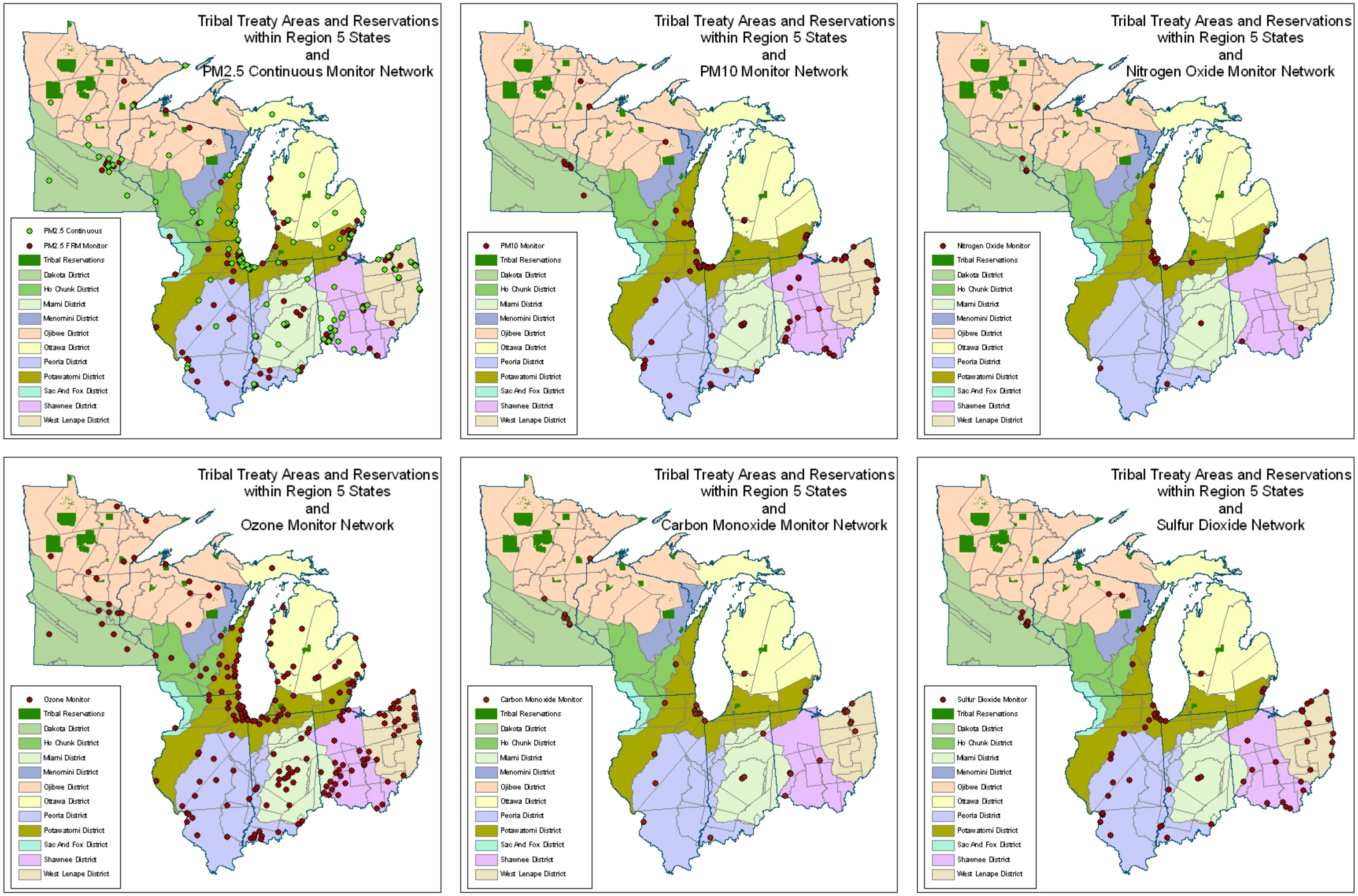


Figure 39. Criteria pollutant monitoring sites in Region V

Section 6.0 Discussion for Other Criteria Pollutants

This regional assessment focuses on ozone, PM2.5, PM10, and their precursors. With respect to other criteria pollutants (i.e., Pb, NOs, SO2, and CO), the NAAQS and associated monitoring requirements either have recently changed or will be changing. Only a cursory evaluation was conducted for these pollutants.

6.1 Pb

On November 12, 2008 (73 FR 66964), EPA revised the primary and secondary air quality standards for lead (Pb). The primary standard was revised from 1.5 micrograms per cubic meter (µg/m3) to 0.15 µg/m3, measured as total suspended particles (TSP), and the secondary standard was revised to be identical to the primary standard. The averaging time for the standard is a rolling 3-month period with a maximum (not-to-be-exceeded) form, evaluated over a 3-year period.

In conjunction with strengthening the lead NAAQS, EPA also improved the existing lead monitoring network by requiring monitors to be placed in areas with sources such as industrial facilities that emit 1 ton or more per year (tpy) of lead and in urban areas with a population of 500,000 or more.[6] According to EPA's 2002 emission estimates, 135 sources meet this criterion. EPA is requiring lead to be monitored as lead in TSP. EPA will allow the use of lead-PM10 monitors instead of lead-TSP monitors under certain limited circumstances: where lead is not expected to occur as large (ultra-coarse) particles; and where 3-month average lead concentrations are not expected to be greater than or equal to 0.10 µg/m3.

EPA estimates that 236 new or relocated monitoring sites will be necessary to satisfy the new monitoring requirements. The source-oriented Pb monitors must be operational by January 1, 2010, and the population-oriented monitors by January 1, 2011. In addition, some existing lead monitors will be left in place and will continue to be used as part of the lead monitoring network. In Region V, the number of source-oriented monitors are as follows:

State	New	Existing	Total
IL	6	1	6
IN	3	1	5
MI	1		1
MN	3	1	4
OH	4		4
WI	1		1
	19	3	21

[6] On December 30, 2009, EPA proposed changes to the monitoring requirements for Pb (74 FR 69050). For source-oriented monitoring, including airports, EPA proposed to: (a) lower the monitoring threshold 1.0 tpy to 0.5 tpy, (b) allow monitoring agencies additional time to update monitoring plans,(c) require monitors near sources emitting between 0.5 and 1.0 tpy to be operational within one year of the final rule, and (d) monitors near sources emitting > 1.0 tpy must still be operational by Janary1, 2010. For non-source-oriented monitoring, EPA proposed to: (a) require Pb monitors at all NCore sites, and (b) monitors must be operational by January 1, 2011. EPA also solicited comments on a number of issues, including a 2-step phase-in of the source-oriented monitors, requiring Pb monitoring at all or only large urban area NCore sites, and additional airport data.

A map of the current lead monitoring sites in Region V is provided in Figure 40.

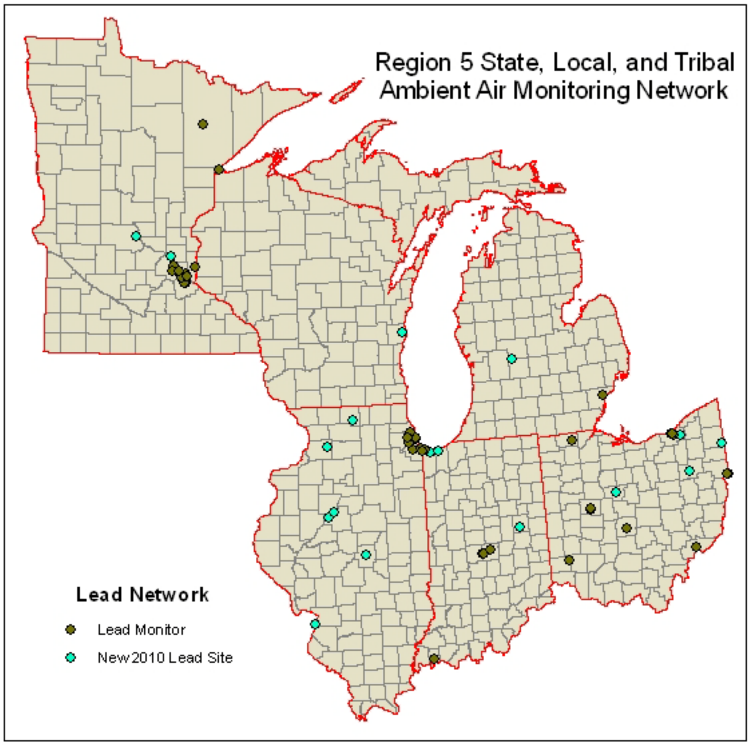


Figure 40. Lead monitoring network in Region V

The number of population-oriented monitoring is uncertain at this time (i.e., it may depend on the results of EPA's reconsideration of the lead monitoring requirements). Once EPA has finalized its reconsideration of the monitoring requirements for Pb, then further analyses will be undertaken by the States and EPA to determine the exact number and location of new monitoring sites. This will be done as part of the States' annual network review due by July 1, 2011.

To support the new Pb monitoring requirements, EPA provided states with a 1-time allocation of $23K per site for set-up and quality assurance plus a state-wide amount of $7K for network design. For the 19 new sites in Region V, EPA provided a total of about $480K. Based on the cost estimate in Table 4, this amount should be enough to cover most of the capital (start-up) costs for the 19 new sites, but will not cover annual operating costs. Additional (new) funding is needed to pay for operating costs, as well as any additional source-oriented sites that may be required.

6.2 NO2

The October 17, 2006 monitoring regulations specify the network design criteria for NO2. There are no minimum monitoring requirements for NO2, with the exception of NCORE and PAMS (i.e., NO2 monitors are required as part of the NCORE and PAMS networks). The regulations do, however, require continued operation of existing SLAMS NO2 sites until discontinuation is approved by the Regional Administrator.

On January 25, 2010, EPA revised the primary air quality standard for nitrogen dioxide (NO_2). EPA set a new short-term NO_2 standard at a level of 100 ppb based on the 3-year average of the 98th percentile of 1-hour daily maximum concentrations. The current annual standard of 53 ppb was retained. Figure 41 shows the 2005 – 2007 1-hour NO_2 design values in the region. One county in the region (Cook County, IL) has a design value above the standard.

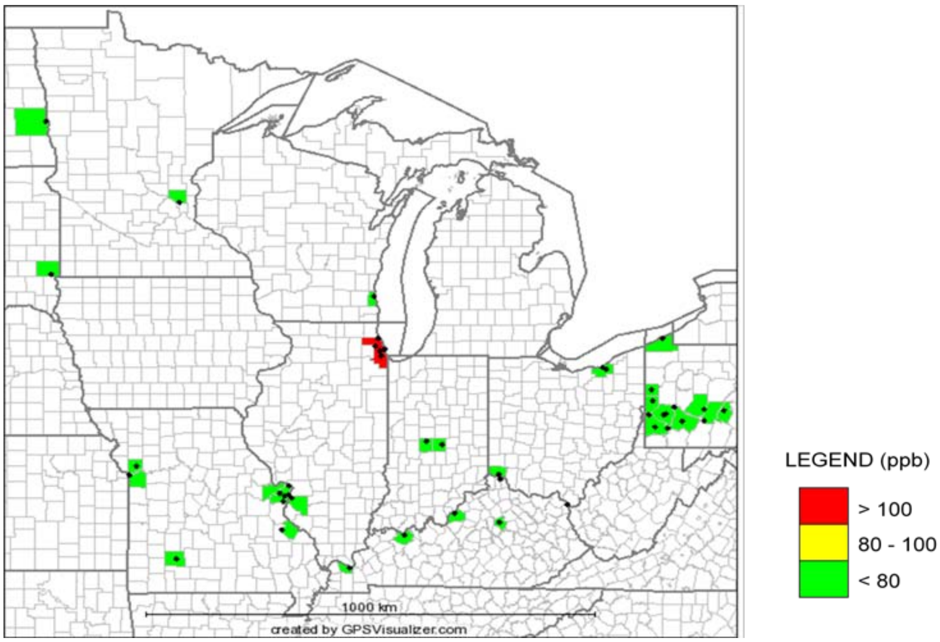


Figure 41. Measured 1-hour NO2 design values (2005-2007 data)

EPA also made changes to the NO_2 monitoring requirements: (1) at least one monitor near a major road (i.e., no more than 50 m away from the nearest traffic lane) in any urban area with a population greater than or equal to 500,000 people and a second monitor near a major road in areas with either population greater than or equal to 2.5 million people, or one or more road segment with an annual average daily traffic (AADT) count greater than or equal to 250,000 vehicles; and (2) a minimum of one monitor would be placed in any urban area with a population greater than or equal to 1 million people to assess communitywide concentrations. In addition, EPA will site at least 40 additional monitors to protect communities that are susceptible and vulnerable to NO_2-related health effects. All monitors are to be operational by January 1, 2013.

EPA estimates that the NO_2 monitoring requirements would require approximately 126 NO_2 monitoring sites near major roads in 102 urban areas. An additional 53 monitoring sites would be required to assess community-wide levels in urban areas. In Region V, the number of near-roadway and community sites are as follows:

State	Near-Roadway	Population	Total
IL	2	1	3
IN	1	1	2
MI	3	1	4
MN	2	1	3
OH	7	3	10
WI	2	1	3
	17	8	25

Of the approximately 400 existing NO2 monitoring sites operating nationally, EPA believes that most reflect neighborhood-, urban- or regional-scale impacts (and, as such, may meet the community monitoring requirement), while only a handful reflect micro-scale impacts.

According to the cost estimate in Table 5, the capital (start-up) costs for the new NO2 monitors are on the order of \$1.6 – 2.0M. Annual operating costs are estimated to be \$0.5 – 0.6M. Additional (new) funding is needed to pay for these capital and operating costs.

6.3 SO2

The October 17, 2006 monitoring regulations specify the network design criteria for SO2. There are no minimum monitoring requirements for SO2, with the exception of NCORE (i.e., SO2 monitors are required as part of the NCORE network). The regulations do, however, require continued operation of existing SLAMS SO2 sites until discontinuation is approved by the Regional Administrator.

On June 2, 2010, EPA revised the primary air quality standard for SO2. EPA replaced the existing annual and 24-hour primary standard for SO2 with a new 1-hour standard set at a level of 75 ppb. Figure 42 shows the 2006 – 2008 1-hour SO2 design values in the region.

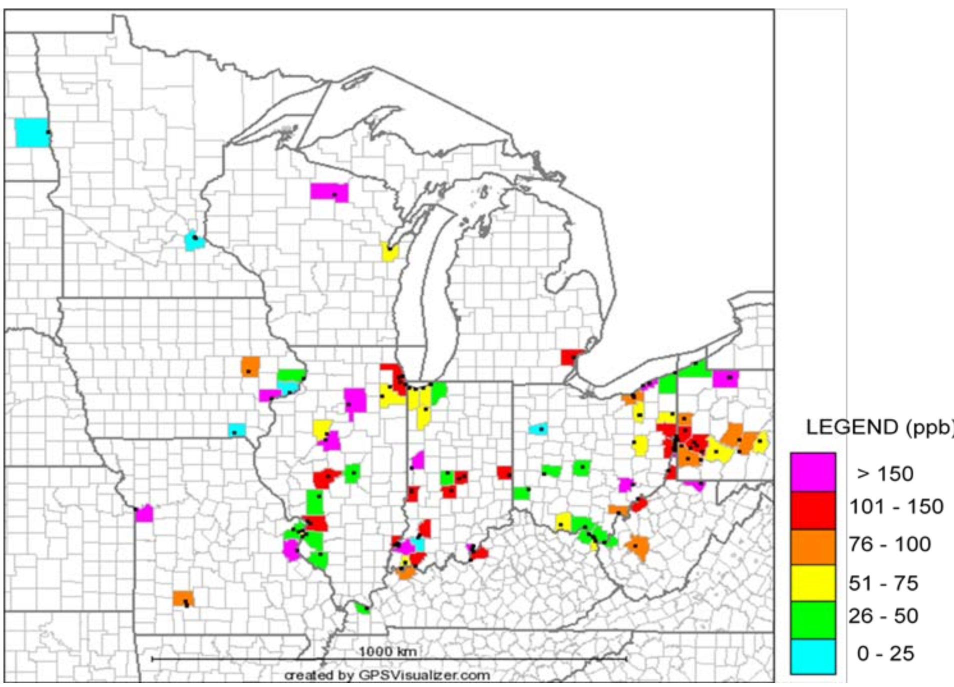


Figure 42. Measured 1-hour SO2 design values (2006-2008 data)

EPA also made changes to the SO2 monitoring requirements. Specifically, EPA adopted a hybrid approach involving both modeling and monitoring for the purpose of assessing compliance with the new short-term 1-hour standard. The final monitoring regulations require 163 monitors to be placed in Core Based Statistical Areas (CBSAs) based on a population weighted emissions index for the area:

3 monitors in CBSAs with index values of 1,000,000 or more
2 monitors in CBSAs with index values less than 1,000,000 but greater than 100,000
1 monitor in CBSAs with index values greater than 5,000.

During 2009, approximately 470 SO2 monitors operatied nationwide. Some of these existing SO2 monitors meet the siting requirements of the final rule. EPA estimates that 41 new monitoring sites will need to be established nationwide. States may, with EPA approval, relocate some of the existing SO2 monitors. All newly sited SO2 monitors must be operational by January 1, 2013.

In Region V, the number of monitor sites is as follows:

State	Required	New Sites
IL	4	0
IN	5	1
MI	5	3
MN	2	0
OH	9	3
WI	3	2

According to the cost estimate in Table 5, the capital (start-up) costs for the new SO2 monitors are about $0.72M. Annual operating costs are estimated to be $0.225M. Additional (new) funding is needed to pay for these capital and operating costs.

6.4 CO

EPA is in the process of reviewing the NAAQS for carbon monoxide (CO). As part of its review, EPA completed a draft report entitled "*Integrated Science Assessment (ISA) for Carbon Monoxide"* First External Review Draft, March, 2009, and released a planning document entitled "C*arbon Monoxide National Ambient Air Quality Standards: Scope and Methods Plan for Health Risk and Exposure Assessment".* These documents were released to seek consultation with the Clean Air Scientific Advisory Committee (CASAC) and to solicit public comments. EPA expects to issue a notice of proposed rulemaking on the CO NAAQS in late 2010. Pending that action, no changes are recommended in this regional network assessment for CO.

Section 7.0 Findings and Recommendations

The purpose of this section is to identify the key findings of the data analyses and provide recommendations for improving the state/local/tribal monitoring networks from a regional perspective. An important aspect of synthesizing the data analysis results is to make sure this information is viewed holistically and to understand that no one analysis stands alone. Implementation of any improvements are subject to funding availability and EPA approval.

7.1. Key Findings and Recommendations

Based on the assessment, the following key findings and recommendations should be noted:

1. Need for Sufficient Resources: States are struggling to maintain high value and high quality monitoring data, due to rising operating costs, need for periodic equipment replacements, staffing turn-over, and the demands of increasing EPA monitoring requirements. This assessment identifies opportunities for resource shifts to support/maintain current monitoring programs. Sufficient funding and staffing are NOT available to meet all the new EPA monitoring requirements.

   Recommendation: To guide the assessment (and implementation of its recommendations), the Region V State Air Directors established the following priority order for monitoring objectives based on policy needs and concerns:

   - Long-standing objectives which place a heavy emphasis on monitoring in areas of high concentration and high population, and provide data to the public in a timely manner, support compliance with the NAAQS and control strategy development, and support air pollution research studies
   - Multi-pollutant monitoring (e.g., EPA's new monitoring requirements for NCore)
   - Source-oriented monitoring (e.g., EPA's proposed/final new monitoring requirements for Pb, NO2, and SO2)
   - Rural monitoring (and medium-sized city monitoring) – (e.g., EPA's proposed new monitoring requirements for O3)
   - Environmental justice monitoring
   - School monitoring (e.g., air toxics)

   The priority order will determine how to best use any resource savings associated with disinvestments (shutdowns) and new monitoring money.

2. New Monitoring Requirements (and Need for Additional Funding): Over the next several years, a number of major new EPA monitoring requirements are expected. The cost for these new requirements in Region V is on the order of $7-9M, which is about 1/3 of what states/locals are currently spending for their monitoring programs. Sufficient funding is not available to implement all of these requirements. Although some cost savings may be realized by recommended disinvestments, it will not be enough to cover the cost of

the new requirements. Furthermore, these savings should be used, preferentially, to improve PM2.5 and O3 monitoring activities.

A basic operating principle in EPA's National Monitoring Strategy is that "resources available to support the ambient air monitoring program will be stable".

> Generally, this strategy implies moving resources from programs of decreasing value to those of higher value … retaining stability for the monitoring programs, and accommodating SLT flexibility). Although not guaranteed, the strategy assumes that resources will remain level, with no significant decrease in funding to support ambient monitoring initiatives. This "zero-sum" constraint implies a reconfiguration of monitoring networks. (Ambient Air Monitoring Strategy for State, Local, and Tribal Air Agencies, December 2008)

The reality, however, is that available funding is declining for the reasons noted above (e.g., rising operating costs, need for periodic equipment replacements, increased reporting burden for quarterly progress reports, increased staff costs and staff turn-over, increased travel costs, additional network reviews, and limited ability to reduce design of network due to more stringent standards). This assessment seeks to ensure that any recommended new monitoring activities (investments) are balanced by sufficient disinvestments. Additional (new) funding will be necessary to support the new EPA monitoring requirements. To its credit, EPA did provide start-up (capital) funding for new source-oriented Pb monitors and is pursuing additional funding ($15M) in FY2011 State and Tribal Air Grant funds.

An additional concern is that the new requirements create a major shift from the long-standing monitoring objectives of monitoring in areas of high concentration and high population to now include multi-pollutant monitoring, source-oriented monitoring, rural monitoring, and environmental justice monitoring. In addition, EPA has recently promoted air toxics monitoring at schools.

Recommendation: Potential sources of funding to pay for these new monitoring requirements include: (1) disinvestments (and associated resource shifts), such as those identified in this assessment, and (2) new money, including EPA's plans to provide an additional $15M nationally in FY2011 for new monitoring. Together, however, this funding will not approach the needed $7-9M. The recommended approach for using any resource shifts or new money is to spread-out the funding to do some of each of the new requirements. A specific decision will be deferred until we have a better understanding about: (a) the Region V funding allocation, (b) new NAAQS for O3, CO, and PM2.5, and (c) the expected change in funding for PM2.5 monitoring from section 103 to section 105 which will affect state monitoring budgets. However, it is apparent that there will not be sufficient resources to fully comply with all of the new requirements. The implications of this are unclear at this time.

3. Priority Air Pollutants: States/locals/tribes collect ambient air quality data for a number of criteria and hazardous air pollutants. From a regional perspective, nonattainment of the PM2.5 and ozone standards is the most important air quality problem (e.g., current [2007-2009] design value for about 5% of PM2.5 monitoring sites and over 30% of ozone monitoring sites exceed the NAAQS) and, as such, monitoring for these pollutants (and their precursors) should be a priority. Although elevated concentrations

for other criteria pollutants and some hazardous air pollutants in the region do occur, their spatial extent, temporal duration, and magnitude are generally lower in comparison to PM2.5 and ozone. Furthermore, recent health effects studies have found:

- "a reduction in exposure to ambient fine-particulate air pollution contributed to significant and measurable improvements in life expectancy in the United States" (Pope, et al, N. Engl. J. Med., 360; 4, January 22, 2009).

- "a significant increase in the risk of death from respiratory causes in association with an increase in O3 concentrations" (Jerret, et al, N. Engl. J. Med. 360; 11, March 12, 2009).

In addition, EPA highlighted the following health impacts associated with PM2.5 and ozone during its recent reviews of the NAAQS:

PM2.5 (Fact Sheet – Final Revisions to Particulate Matter Standards, September 21, 2006 [7])

- "Health effects associated with short-term exposure to PM2.5 include: premature death in people with heart and lung disease, non-fatal heart attacks, increased hospital admissions, emergency room visits and doctor's visits for respiratory diseases, increased hospital admission and ER visits for cardiovascular diseases, increased respiratory symptoms such as coughing, wheezing and shortness of breath, lung function changes, especially in children and people with lung diseases such as asthma, changes in heart rate variability, and irregular heartbeat."

- "Health effects associated with long-term exposure to PM2.5 include: premature death in people with heart and lung diseases, including death from lung cancer, reduced lung function, and development of chronic respiratory disease in children."

Ozone (Fact Sheet – Revisions to Ozone Standards, January 6, 2010 [8])

- "Scientific evidence indicates that adverse public health effects occur following exposure to ozone, particularly in children and adults with lung disease."

- "Breathing air containing ozone can reduce lung function and inflame airways, which can increase respiratory symptoms and aggravate asthma or other lung diseases. Ozone exposure also has been associated with increased susceptibility to respiratory infections, medication use, doctor visits, and emergency department visits and hospital admissions for individuals with lung disease."

- "Ozone exposure also increases the risk of premature death from heart or lung disease."

- "Children are at increased risk from exposure to ozone because their lungs are still developing and they are more likely to be active outdoors, which increases their exposure."

For these reasons, this assessment focused on PM2.5, ozone, and their precursors.

[7] http://www.epa.gov/oar/particlepollution/pdfs/20060921_factsheet.pdf

[8] http://www.epa.gov/air/ozonepollution/pdfs/fs20100106std.pdf

Recommendation: A comprehensive regional monitoring network for PM2.5 and ozone is a high priority. Any cost savings realized by disinvestments made in response to this assessment should be used, preferentially, to support Improvements to the monitoring programs for these two pollutants and their precursors.

4. Adequacy of Existing Monitoring Networks: Overall, the existing state/local monitoring networks provide comprehensive information on regional and urban air quality and need to be maintained. Key features of the networks include good spatial coverage, high definition in urban and high concentration areas, adequate representation of rural areas, several multi-pollutant sites, and many years of measurements. Based on the data analyses performed pursuant to this assessment, only limited improvements are recommended:

   a. Disinvestments (shutdowns):

      Correlation and cluster analyses found redundant sites for PM2.5 (FRM) in each major urban area and for O3 in some major urban areas (i.e., highly correlated pairs of sites); in particular, see Table 15. These sites may be candidates for shutdown.

      Consider eliminating redundant PM2.5-speciation sites – i.e., Luna Pier. Michigan or Toledo, Ohio; and Hammond, Indiana or Chicago (Lawndale), Illinois.

      Review clusters of "low value" PM2.5 sites (i.e., northern Wisconsin, western Michigan, northeastern Minnesota) and O3 sites (north-central Indiana, east-central Indiana, southwestern Indiana, northwestern Michigan, south-central Wisconsin) and determine whether any shutdowns are appropriate.

      Reduce the number of PM10 monitoring sites (e.g., there is a very high number in Ohio), in light of relatively low design values.

      Continue efforts to replace aging filter-based PM2.5 measurements with continuous instruments, with the understanding that equivalency of current continuous instruments needs further research (see Finding 7 below).

      This assessment makes no specific recommendations on which, if any, of these sites to shutdown. Rather, this decision is left to the appropriate state/local agency to make as part of their annual network review.

   b. Investments (new monitoring):

      Improve ozone precursor monitoring in higher ozone urban areas, including Chicago, Milwaukee, Cincinnati, Cleveland, Detroit, and St. Louis

      Enhance rural monitoring by establishing/relocating/identifying an appropriate upwind (rural) background monitor for Minneapolis/St. Paul; adding PM2.5 measurements at the upwind rural monitoring site for Indianapolis, St. Louis, and Columbus; and establishing appropriate rural ozone monitoring sites (to meet the expected new monitoring requirement – see Item 2 above).

Consider adding PM2.5-speciation sites in areas with high design values– i.e., Green Bay, Wisconsin.

Add new PM2.5 monitoring site(s) in northwestern Ohio

Consider establishing passive ammonia samplers at all NCore sites (note: 4 of the 10 currently collect passive samples)

Consider deployment of ultra-fine particle monitors at a limited number of NCore sites for the purpose of collecting information to support future health effects studies.

Table 15 summarizes the recommended changes by state.

Recommendation: This assessment makes no specific recommendations on which, if any, of these sites to shutdown. This decision is left to the appropriate state/local agency to make as part of their annual network review either this year or next year.

Table 15. Summary of Recommended Network Changes

State	Recommended Ozone Changes	Recommended PM2.5 Changes	Other Recommended Changes
IL	Review pairs of redundant sites and determine whether any shutdowns are appropriate	Review pairs of redundant sites and determine whether any shutdowns are appropriate	
	Improve ozone precursor monitoring in accordance with recommendations for use of Region V PAMS funding		
IN	Review pairs of redundant sites and determine whether any shutdowns are appropriate	Review pairs of redundant sites and determine whether any shutdowns are appropriate	
	Improve ozone precursor monitoring in accordance with recommendations for use of Region V PAMS funding	Add PM2.5 at Plummer background site	
		Consider removing Hammond PM2.5-speciation measurements	
MI	Review pairs of redundant sites and determine whether any shutdowns are appropriate	Review pairs of redundant sites and determine whether any shutdowns are appropriate	
	Improve ozone precursor monitoring in accordance with recommendations for use of Region V PAMS funding	Review cluster of low value sites in W MI and determine whether any shutdowns are appropriate	
		Consider removing Luna Pier (or Toledo) PM2.5-speciation measurements	
MN	Review pairs of redundant sites and determine whether any shutdowns are appropriate	Review pairs of redundant sites and determine whether any shutdowns are appropriate	Establish appropriate background site for Minneapolis - St. Paul
		Review cluster of low value sites in NE MN and determine whether any shutdowns are appropriate	

State	Recommended Ozone Changes	Recommended PM2.5 Changes	Other Recommended Changes
OH	Review pairs of redundant sites and determine whether any shutdowns are appropriate	Review pairs of redundant sites and determine whether any shutdowns are appropriate	
	Improve ozone precursor monitoring in accordance with recommendations for use of Region V PAMS funding	Consider adding new sites(s) in NW OH	
		Add PM2.5 at Madison County background site	
		Consider removing Toledo (or Luna Pier) PM2.5-speciation measurements	
		Reduce PM10 monitoring - i.e., don't need 37 sites given low design values	
WI	Review pairs of redundant sites and determine whether any shutdowns are appropriate	Review pairs of redundant sites and determine whether any shutdowns are appropriate	
	Improve ozone precursor monitoring in accordance with recommendations for use of Region V PAMS funding	Consider adding PM2.5-speciation measurements in Green Bay	
		Review cluster of low value sites in N WI and determine whether any shutdowns are appropriate	
Other	St. Louis - Improve ozone precursor monitoring in accordance with recommendations for use of Region V PAMS funding	St. Louis - Add PM2.5 at Bonne Terre, MO background site	EPA must ensure equivalency of ozone measurements at CASTNET sites
			Consider adding ammonia and ultra-fine particle measurements at some Ncore sites

5. Importance of Multi-Pollutant Monitoring: Measurements for multiple air pollutants at the same location helps to: (a) characterize air quality, (b) provide information for local citizens, (c) provide valuable data for public health effects studies, and (d) support air quality analyses, SIP development, and control strategy tracking.

   The need for multi-pollutant monitoring was addressed recently by EPA and other groups:

   - In its October 17, 2006, revisions to the monitoring regulations, EPA adopted a requirement for states to establish and operate a long-term network of National Core (NCore) multi-pollutant monitoring stations. The NCore multi-pollutant stations are intended to: (a) track long-term trends for accountability of emissions control programs and health assessments that contribute to ongoing reviews of the NAAQS; (b) support development of emissions control strategies through air quality model evaluation and other observational methods; (c) support scientific studies ranging across technological, health, and atmospheric process disciplines; (d) support ecosystem assessments, and (e) provide data for use in attainment and nonattainment designations and for public reporting and forecasting of the Air Quality Index.

   - In a 2008 report ("The Multi-Pollutant Report: Technical Concepts and Examples"), EPA described its "transition toward a comprehensive, multi-pollutant treatment of our nation's air quality problems". With respect to ambient monitoring, EPA noted that the new NCore network will "maximize the multi-pollutant information available" and "greatly enhances the foundation for future health studies and NAAQS revisions."

   - In its 2004 report "Air Quality Management in the United States" , the National Academy of Sciences (NAS) recommended modifying current air quality management practices to integrate assessment, planning, and implementation efforts across all air quality and environmental issues—that is, a multi-pollutant (and multi-media) focus. Of particular note is that as part of its general recommendation to strengthen the scientific and technical capacity of the air quality management system, NAS called for enhanced air pollution monitoring and specifically endorsed NCore, calling it a "valuable first step in enhancing the monitoring network." In its 2005 recommendations to the Clean Air Act Advisory Committee, EPA's Air Quality Management Workgroup supported this NAS recommendation by recommending that EPA, in conjunction with states/local/tribes and affected stakeholders, should promote and improve integrated, multi-pollutant monitoring.

   - In a discussion of air quality management for PM2.5, the North American Research Strategy for Tropospheric Ozone ("Particulate Matter Science for Policy Makers", 2004) stated that "(t)he current understanding of atmospheric processes shows that PM2.5 problems are related to ground-level ozone, acid rain, and climate issues and share many of the same sources. This recognition provides the impetus for integrated and optimized management strategies that accommodate different atmospheric responses for each pollutant." From a data standpoint, NARSTO called for improvements in ambient air quality monitoring networks, including a full suite of chemical measurements.

Currently, 18 monitoring sites collect data for at least four air pollutants – see Table 12. The requirement to establish NCore monitoring sites will add four additional multi-pollutant sites in the region.

Recommendation: Maintain the 18 existing multi-pollutant monitoring sites listed below and ensure establishment of all 10 NCore sites (i.e., 6 listed below plus Bondville (IL), Indianapolis-Washington Park (IN), Blaine (MN), and New Paris (OH)).

State	Site	State	Site
IL	**170314201 Northbrook**	MN	270370020 Rosemount-Pine Bend
	170310076 Chi-Lawndale		270370423 Inver Grove Heights
	170314004 Cicero		
	171193007 Wood River		
	171630010 E. St. Louis	OH	**390610040 Cincinnati-Taft Road**
			390350038 Cleveland-G.T. Craig
IN	180890022 Gary-IITRI		390350060 Cleveland-St.Tikhon
	180970073 Indy-Naval Avionics		390810017 Steubenville
	181630012 Vanderburgh County		
	181670018 Vigo County	WI	**550270007 Horicon**
			550410007 Crandon
MI	**260180020 Grand Rapids**		
	261630001 Allen Park		
	Note: NCore sites highlighted in bold		

6. Importance of Rural Monitoring: While much attention has been placed on collecting air quality data in high concentration areas (to assess compliance with air quality standards) and in high population areas (to assess population exposures), there is emerging interest in rural monitoring. The value of rural monitoring includes improving spatial representation for regional air pollutants, especially O3 and PM2.5, and understanding source contributions (e.g., comparisons of data from rural background sites with data from urban, high concentration sites can identify the impact of urban areas).

   The need for rural monitoring has been addressed recently by EPA and other groups:

   - As part of the NCore multi-pollutant network, EPA required about 20 rural stations. The rural NCore stations were expected to leverage existing rural networks such as IMPROVE, CASTNET and, in some cases, State-operated rural sites. The rural sites are intended to be sited away from any large local emission sources, so that they represent ambient concentrations over an extensive area. EPA noted that "it is more appropriate to have monitoring in a variety of urban and rural locations to increase the diversity of areas for which chemical species data will be available to use in scientific studies."

   - In its October 17, 2006, revisions to the monitoring regulations, EPA said that it will continue to operate the Clean Air Status and Trends Network (CASTNET), which monitors for O3, PM, and chemical components of PM in rural areas across the nation. EPA is in the process of revising CASTNET to upgrade its monitoring capabilities. EPA expects that about 20 CASTNET sites will have new capabilities similar to some of the capabilities required at NCore multi-pollutant sites.

- As part of its general recommendation to strengthen the scientific and technical capacity of the air quality management system (see "Air Quality Management in the United States", 2004), NAS called for increased number and distribution of air quality monitoring stations in rural, agricultural, and remote forest areas. NAS cited several benefits of rural monitoring, such as improving characterization of air quality on a regional scale, providing information to address processes related to production of secondary pollutants (e.g., O3), and enhancing spatial coverage of the data to better support air quality modeling. In addition, NAS recommended development and implementation of networks for comprehensive ecosystem monitoring. In its 2005 recommendations to the Clean Air Act Advisory Committee, EPA's Air Quality Management Workgroup supported this NAS recommendation by recommending ecosystem protection and public welfare improvements, including appropriate enhanced monitoring.

- In its July 16, 2009, proposed revisions to the O3 monitoring requirements, EPA called for three rural O3 monitors in each state to address the following objectives: (1) provide better characterization of O3 exposures to O3-sensitive vegetation and ecosystems in rural/remote areas (to ensure that potential secondary NAAQS violations are measured), (2) assessment of population exposure due to elevated O3 levels outside of larger urban MSAs, and (3) assessment of the location and severity of maximum O3 concentrations that occur in non-urban areas (and may be attributable to upwind urban sources).

A key element of a sound regional monitoring network is a set of rural monitors consisting of IMPROVE, CASTNET, rural NCore, and other appropriate stations.

Recommendation: Enhance rural monitoring by establishing/relocating/identifying an appropriate upwind (rural) background monitor for Minneapolis/St. Paul; adding PM2.5 measurements at the upwind rural monitoring site for Indianapolis, St. Louis, and Columbus; and establishing appropriate rural O3 monitoring sites (to meet the expected new monitoring requirement – see Item 2 above). EPA should ensure that CASTNET sites meet the same quality assurance requirements as state-run monitoring sites.

7. Outstanding Issues: This assessment raised several issues which will require further cooperation between states and EPA, including:

- Equivalency of filter-based (FRM) and continuous PM2.5 measurements: Benefits of continuous measurements include more complete data record, more timely data for public reporting, and lower operator costs. Although EPA recently designated a number of continuous instruments as Federal Equivalent Methods (FEM), concerns remain in terms of the comparability between the resulting continuous measurements and FRM data. State and local monitoring agencies also require further clarity on FEM definitions, so as to properly retrofit existing continuous PM2.5 instrumentation to meet FEM requirements.

- Importance of special field studies: In recent years, LADCO has worked with its member states and contractors to conduct a number of special field studies – e.g., the Urban Organics Study in 2004, the Organic Molecular Marker Study in

2007/2008, the Biomass Burning Study in 2007/2008, the Midwest Rail Study in 2008, and the Winter Nitrate Study in 2008/2009. Although EPA has discontinued funding for such work, there is tremendous value in special field studies. In particular, the collection and analysis of the ambient measurements provide unique information to improve our understanding of key air quality problems. (Note, routine state/local/tribal monitoring is not intended and is not sufficient to explore these problems.) To support special field studies in the future, it is recommended that LADCO and its member states partner with outside groups, as necessary, to undertake special field studies.

- Monitoring to evaluate environmental successes: As noted by the NAS in its 2004 report "Air Quality Management in the United States", "most of the existing networks have been designed only to measure compliance with the existing NAAQS and reveal little about the appropriate management strategies needed to solve the problems or measure the success of various emission-control strategies. Network design should be evaluated and expanded to make air quality networks in the United States more relevant to other important objectives of monitoring." In particular, NAS recommended greater tracking and assessing of the performance of control strategies. To determine if any network improvements are needed to better track progress, it is recommended that LADCO and the States work together over the next few years on a regional air quality trends assessment taking into account available and appropriate monitoring, emissions, and meteorological data. Any spatial, temporal, or chemical limitations in the monitoring data as part of this assessment should be noted and addressed in the next (July 1, 2015) network review.

- Monitoring research: Special monitoring efforts may be needed to test new methods or assess other pollutants. Methods development has been handled by EPA, given that states do not have funding or expertise necessary to conduct this research. A strong EPA methods development program is important to improve data quality (and data capture), and achieve greater monitoring efficiencies. Also, pilot-scale monitoring programs may be desirable to collect information on other pollutants (e.g., ultrafine particles) necessary for health effects studies.

Recommendation: Over the next five years, states and EPA need to work together to address these issues. The next periodic assessment (due July 2015) should evaluate the success of these efforts.

7.2 Response to Network Assessment Questions

EPA's monitoring regulations (40 CFR 58.10, Appendix B) identify five general sets of questions to be addressed by the regional assessment. These questions and the response provided by this assessment are addressed below.

Does the regional network meet the monitoring objectives of Appendix D?
EPA's monitoring regulation (40 CFR 58.10, Appendix D) identifies three general monitoring objectives:

a. provide data to the public in a timely manner
b. support compliance with NAAQS and control strategy development
c. support air pollution research studies

For each objective, several data analyses were performed to provide a technical basis for assessing the regional monitoring networks for ozone, PM2.5, and PM10. For these and other criteria pollutants, current and possible future EPA monitoring requirements were considered.

Overall, the existing state/local monitoring networks provide valuable information on regional and urban air quality and need to be maintained. Key features of the networks include good spatial coverage, high definition in urban and high concentration areas, adequate representation of rural areas, several multi-pollutant sites, and many years of measurements. Based on the data analyses, limited improvements are recommended:

> Disinvestments (shutdowns) – e.g., a few "low value" sites and a few redundant PM2.5 (FRM and speciation) and O3 sites in some major urban areas.
>
> Investments (new monitoring) – e.g., improved ozone precursor monitoring in several major urban areas and enhanced rural monitoring.

Are new sites needed and are some existing sites no longer needed?
The data analyses suggest limited improvements to the existing state/local networks. This assessment, however, makes no specific recommendations on which, if any, of these sites to shutdown. This decision is left to the appropriate state/local agency to make as part of their annual network review either this year or next year. It may be possible to pay for some (but not all) of the improvements by shifting resources from appropriate disinvestments.

Are there new technologies that should be incorporated in the networks?
Although not new technology, continuous measurements for all pollutants are desirable. Intermittent measurements for PM2.5 mass and PM2.5 species, in particular, are still common in the region (i.e., about 2/3 of the PM2.5-mass measurements rely on filter-based technology). Although there are benefits of continuous data for scientific, public information, and health assessment reasons, concerns remain over the accuracy of the current continuous instruments (see, for example, Finding 7 above), costs for replacing the existing filter-based network, and the limited number of chemical species which can be measured continuously. A priority over the upcoming 5-year period should be to work through these concerns and, if appropriate and if financially possible, make changes in the current PM2.5 mass monitoring program.

Another consideration is air quality over the Great Lakes. The unmonitored area analysis showed higher ozone concentrations over the Great Lakes compared to shoreline sites. In the past, resources allowed aircraft and boat measurements over water which confirmed these higher concentrations. Because attainment planning does not consider such locations to be subject to the NAAQS, there is no regulatory or policy mandate to conduct special purpose monitoring over water. There are, however, technical reasons for such monitoring (e.g., to better characterize and understand transport of air pollutants). Consequently, if sufficient new funding becomes available, then this might be one possible use of the funding.

Do existing/proposed sites support characterization for areas with relatively high population of susceptible individuals (e.g., children with asthma)?

Because consistent health data were not readily available across the region, only a cursory analysis was conducted of monitoring in relation to environmental justice (EJ) areas. According to EPA, EJ means not only protecting human health and the environment for everyone, but also ensuring that all people are treated fairly and given the opportunity to participate meaningfully in the development, implementation, and enforcement of environmental regulations and policies.

Based on EPA's interim policy, a draft map of the census tracts considered EJ areas is provided below. Comparison of this map with the map of existing monitoring sites shows monitoring in (or near) many EJ areas – see Figure 43. (A closer examination for SO2 is provided in Figure 44.) Once EPA finalizes their policy (and has identified potential EJ areas of concern), then it may be worthwhile to conduct further analyses to determine whether the existing network provides sufficient representative data or whether new sites may be needed. For example, an analysis of the air pollution patterns on exposures for different population groups could be performed (see, for example, Stuart, et al, 2009).

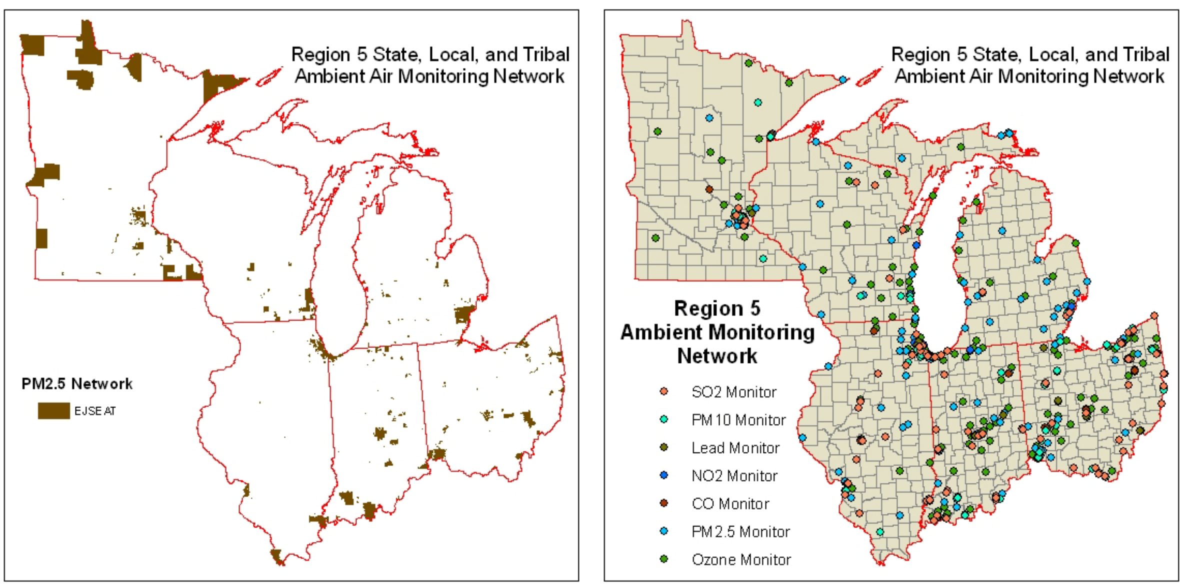


Figure 43. Maps of draft EJ areas (left) and current monitoring network (right)

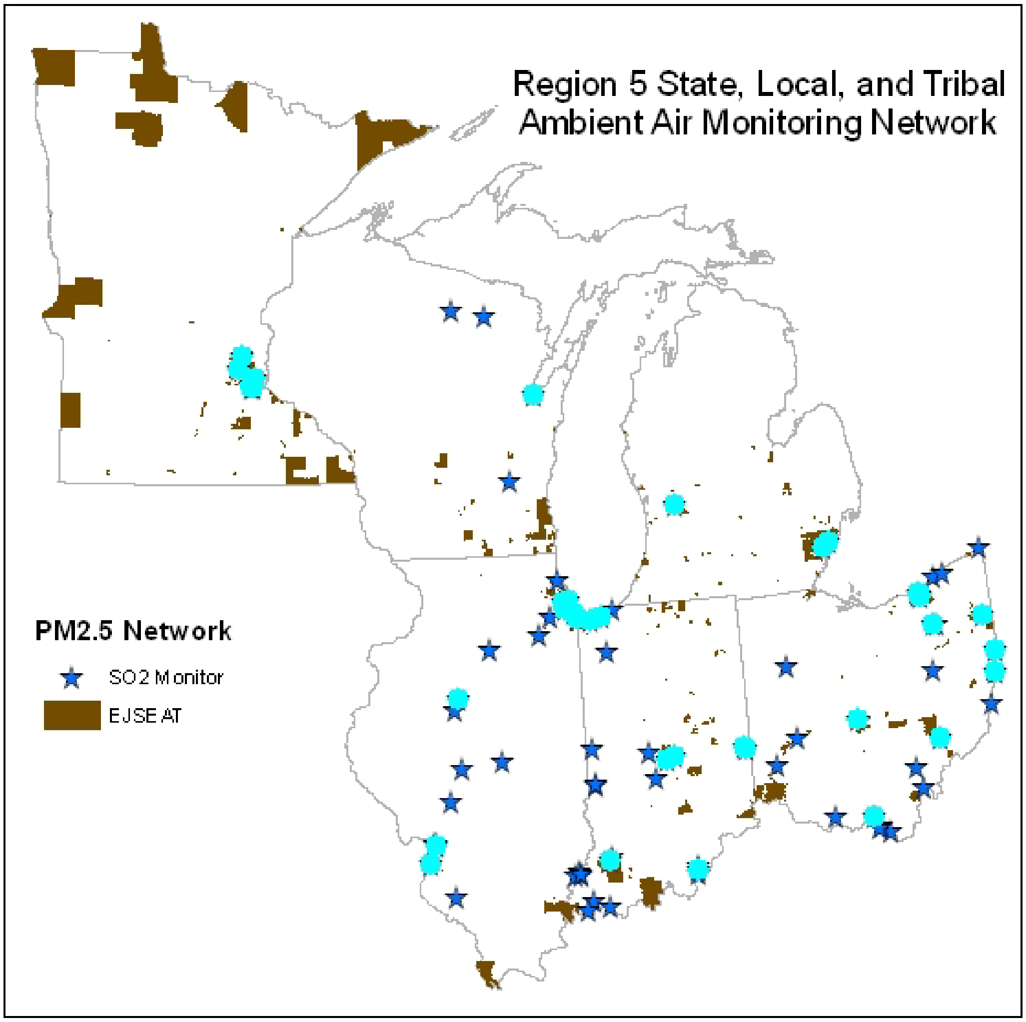


Figure 44. Maps of draft EJ areas and current SO2 network
Note: sites within 2/3 mile of an EJ area are highlighted in light blue

What, if any, is the effect on other data users of any proposed shutdown sites?
As noted above, this assessment,makes no specific recommendations on which, if any, sites to shutdown. This decision is left to the appropriate state/local agency to make as part of their annual network review. Public input will be solicited as part of that review process.

It should also be noted that limited outreach was conducted as part of this regional assessment. For example, an e-mail was sent on November 4, 2009, to more than 100 individuals on LADCO's Interested Parties list and letters were sent on November 5, 2009, to the neighboring states of Pennsylvania, Kentucky, Missouri, West Virginia, Iowa, and North Dakota. The purpose of the e-mail and letters was to notify these parties of the plans for the regional network assessment and to solicit comments. In addition, the assessment (including this draft final report) was delivered to the Region V States in time to allow them to incorporate the assessment in the public comment process for their annual network reviews for 2010.

Section 8.0 References

Region V States' Current Annual Network Plans:
IL http://www.epa.state.il.us/air/monitoring/index.html

IN http://www.in.gov/idem/5342.htm

MI http://www.michigan.gov/deq/0,1607,7-135-3310_4195-230649--,00.html

MN http://www.pca.state.mn.us/air/monitoringnetwork.html

OH http://www.epa.state.oh.us/dapc/ams/plan.aspx

WI http://dnr.wi.gov/air/aq/monitor/netreview.htm

EPA, 2007, "Ambient Air Monitoring Network Assessment Guidance: Analytical Techniques for Technical Assessments of Ambient Air Monitoring Networks", EPA-454/D-07-001, prepared for the U.S. Environmental Protection Agency by Sonoma Technology, Inc., February 2007

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National Ambient Air Quality Analyses for Ozone Attainment Analyses, December 21, 2009
National Ambient Air Quality Analyses for PM2.5 Attainment Analyses (Annual), December 21, 2009
National Ambient Air Quality Analyses for PM2.5 Attainment Analyses (24-Hour), December 21, 2009
National Ambient Air Quality Analyses for PM10 Attainment Analyses, December 21, 2009
National Ambient Air Quality Analyses for Sulfur Dioxide Attainment Analyses, December 21, 2009
National Ambient Air Quality Analyses for Nitrogen Dioxide Attainment Analyses, December 21, 2009
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LADCO, 2010, "Assess of Existing PM2.5 Speciation Network", February 24, 2010

LADCO, 2010, "Cluster Analysis"

LADCO, 2010, "Correlation Analysis"

LADCO, 2010, “Assessment of Urban-Rural Pairings”, March 1, 2010

LADCO, 2010, “New Sites Analysis”

LADCO, 2010, “Composite Score Analysis”

MACTEC, 2004, “Analysis of Air Quality Data Collected Near Tribal Lands in Minnesota, Wisconsin, and Michigan”, prepared for LADCO by MACTEC Engineering and Consulting, Inc., January 2004.

MPCA, 2009, “Length of Record Analysis”

MPCA, 2010, “Ozone Urban-Rural Pair Analysis”

MPCA, 2010, “Fine Particle Urban-Rural Pair Analysis”

Stuart, A.L., S. Mudhasakui, and W. Sriwatanapongse, “The Social Distribution of Neighborhood-Scale Air Pollution and Monitoring Protection”, J. Air & Waste Manage. Assoc., May 2009, 59:591-602.

STI, 2008a, “Network Assessment for the National Photochemical Assessment Monitoring Stations (PAMS) Program”, Draft Final Report, prepared for the U.S. Environmental Protection Agency by Sonoma Technology, Inc., September 2008.

STI, 2008b, “Data Analysis and Source Apportionment of PM2.5 in Selected Midwestern Cities”, Final Report, prepared for Lake Michigan Air Directors Consortium by STI, Inc. and Washington University, April 2008.

APPENDIX I
List of Criteria Pollutant Monitoring Sites

CO	NO2	O3	SO2	PM2.5	PM10	Pb	Site ID	Address	City	County	State
0	0	1	0	1	0	0	170010007	1301 S. 48th St.	Quincy	Adams Co	IL
0	0	1	0	1	0	0	170190004	606 E. Grove	Champaign	Champaign Co	IL
0	0	0	0	1	0	0	170191001	Twp Rd 500 E.		Champaign Co	IL
0	0	1	0	0	0	0	170230001	416 S. State St. Hwy 1/ West Union		Clark Co	IL
0	0	1	0	0	1	1	170310001	4500 W. 123rd St.	Alsip	Cook Co	IL
0	0	0	0	1	2	1	170310022	3535 E. 114th St.	Chicago	Cook Co	IL
0	0	0	0	0	0	1	170310026	735 W. Harrison	Chicago	Cook Co	IL
0	0	1	0	0	0	0	170310032	3300 E. Cheltenham Pl.	Chicago	Cook Co	IL
0	0	1	0	0	0	0	170310042	Wacker At Adams	Chicago	Cook Co	IL
0	0	0	1	1	0	0	170310050	103rd And Luella	Chicago	Cook Co	IL
0	0	0	0	1	0	1	170310052	4850 Wilson Ave.	Chicago	Cook Co	IL
0	0	0	0	1	0	0	170310057	1745 N. Springfield	Chicago	Cook Co	IL
0	0	0	0	0	1	0	170310060	13100 S. Doty	Chicago	Cook Co	IL
1	1	0	1	0	0	0	170310063	320 S. Franklin	Chicago	Cook Co	IL
0	0	1	0	0	0	0	170310064	5720 S. Ellis Ave	Chicago	Cook Co	IL
0	1	1	0	0	0	0	170310072	1000 E. Ohio	Chicago	Cook Co	IL
0	1	1	1	1	0	0	170310076	7801 Lawndale	Chicago	Cook Co	IL
0	0	1	0	0	0	0	170311003	6545 W. Hurlbut St.	Chicago	Cook Co	IL
0	0	0	0	1	2	0	170311016	50th St. And Glencoe	Mccook	Cook Co	IL
0	0	1	1	0	0	0	170311601	729 Houston	Lemont	Cook Co	IL
0	0	0	0	0	1	0	170311901	15205 Crawford Ave.	Midlothian	Cook Co	IL
0	0	0	0	1	1	0	170312001	12700 Sacramento	Blue Island	Cook Co	IL
1	1	0	0	1	0	0	170313103	4743 Mannheim Rd.	Schiller Park	Cook Co	IL
0	0	0	0	1	1	1	170313301	60th St. & 74th Ave.	Summit	Cook Co	IL
1	1	1	1	0	0	0	170314002	1820 S. 51st Ave.	Cicero	Cook Co	IL
0	0	1	0	1	0	0	170314007	9511 W. Harrison St		Cook Co	IL
1	2	2	1	1	1	0	170314201	750 Dundee Road	Northbrook	Cook Co	IL

0	0	0	0	0	0	1	170316003	1500 Maybrook Dr.	Maywood	Cook Co	IL
1	0	0	0	0	0	0	170316004	1505 S. First Avenue	Maywood	Cook Co	IL
0	0	0	0	1	0	0	170316005	13th St. & 50th Ave.	Cicero	Cook Co	IL
0	0	1	0	0	0	0	170317002	531 E. Lincoln	Evanston	Cook Co	IL
0	0	0	0	1	0	0	170434002	400 S. Eagle St.	Naperville	DuPage Co	IL
0	0	1	0	0	0	0	170436001	Rt. 53		DuPage Co	IL
0	0	1	0	0	0	0	170491001	Route 45 South		Effingham Co	IL
0	0	1	0	1	0	0	170650002	State Route 14		Hamilton Co	IL
0	0	0	0	0	1	0	170770004	607 E. College	Carbondale	Jackson Co	IL
0	0	1	0	1	0	0	170831001	Liberty St. & County Rd.	Jerseyville	Jersey Co	IL
0	0	0	0	1	0	0	170890003	258 Lovell St.	Elgin	Kane Co	IL
0	0	1	0	0	0	0	170890005	665 Dundee Rd.	Elgin	Kane Co	IL
0	0	0	0	1	0	0	170890007	1240 N. Highland Ave.	Aurora	Kane Co	IL
0	0	1	0	0	0	0	170971002	Golf & Jackson Sts.	Waukegan	Lake Co	IL
0	0	1	0	1	0	0	170971007	Illinois Beach State Park	Zion	Lake Co	IL
0	0	0	1	1	2	0	170990007	308 Portland Ave.	Oglesby	La Salle Co	IL
0	0	1	0	1	0	0	171110001	First St. & Three Oaks Rd.	Cary	McHenry Co	IL
0	0	1	0	1	0	0	171132003	Main & Gregory	Normal	McLean Co	IL
0	0	1	1	1	0	0	171150013	2200 N. 22nd	Decatur	Macon Co	IL
0	0	1	1	0	1	0	171170002	Heaton & Dubois	Nilwood	Macoupin Co	IL
0	0	1	0	0	0	0	171190008	409 Main St.	Alton	Madison Co	IL
0	0	0	0	0	1	0	171190010	15th & Madison	Granite City	Madison Co	IL
0	0	0	0	1	0	0	171190024	2100 Madison Avenue	Granite City	Madison Co	IL
0	0	0	0	1	2	0	171191007	23rd & Madison	Granite City	Madison Co	IL
0	0	1	0	0	0	0	171191009	200 W. Division	Maryville	Madison Co	IL
0	0	0	1	0	0	0	171191010	Michigan St.	South Roxana	Madison Co	IL
0	0	0	0	1	0	0	171192009	1700 Annex St.	Alton	Madison Co	IL
0	0	1	1	1	1	0	171193007	54 N. Walcott	Wood River	Madison Co	IL
0	0	0	1	0	0	0	171193009	1710 Vaughn Rd	Wood River	Madison Co	IL
0	0	1	1	0	0	0	171430024	Hurlburt & Macarthur	Peoria	Peoria Co	IL
1	0	0	0	0	0	0	171430036	1005 N. University	Peoria	Peoria Co	IL
0	0	0	0	1	1	0	171430037	613 N.E. Jefferson	Peoria	Peoria Co	IL

0	0	1	0	0	0	0	171431001	508 E. Glen Ave.	Peoria Heights	Peoria Co	IL
0	0	1	1	1	0	0	171570001	Hickory Grove & Fallview		Randolph Co	IL
0	0	1	0	1	0	0	171613002	32 Rodman Ave.	Rock Island Arsenal	Rock Island Co	IL
1	1	1	1	1	1	0	171630010	13th & Tudor	East Saint Louis	St. Clair Co	IL
0	0	0	0	1	0	0	171634001	1500 Caseyville Ave.	Swansea	St. Clair Co	IL
0	0	0	1	0	0	0	171670006	3300 Mechanicsburg Rd.	Springfield	Sangamon Co	IL
1	0	0	0	0	0	0	171670008	6th & Monroe	Springfield	Sangamon Co	IL
0	0	1	0	0	0	0	171670010	2875 N. Dirksen Pkwy.	Springfield	Sangamon Co	IL
0	0	0	0	1	0	0	171670012	State Fair Grounds		Sangamon Co	IL
0	0	0	1	0	0	0	171790004	272 Derby	Pekin	Tazewell Co	IL
0	0	0	1	0	0	0	171850001	Division St. South Of Sewage Treat. Pt.	Mount Carmel	Wabash Co	IL
0	0	0	1	0	0	0	171851001	1/2 Mile South Of S.R.-1		Wabash Co	IL
0	0	0	1	0	0	0	171970013	Rte. 6 & Young Rd.		Will Co	IL
0	0	0	0	1	1	0	171971002	Midland & Campbell Sts	Joliet	Will Co	IL
0	0	1	0	1	0	0	171971011	36400 S. Essex Rd.		Will Co	IL
1	0	0	0	0	0	0	172010011	425 E. State	Rockford	Winnebago Co	IL
0	0	0	0	1	0	0	172010013	201 Division St	Rockford	Winnebago Co	IL
0	0	1	0	0	0	0	172012001	1405 Maple Ave.	Loves Park	Winnebago Co	IL
9	**8**	**38**	**20**	**38**	**21**	**6**					
9	7	37	20	38	17	6					
0	0	1	0	0	0	0	180030002	14600 Amstutz Rd., Leo	Leo-Cedarville	Allen Co	IN
0	0	1	0	1	0	0	180030004	2022 North Beacon	Fort Wayne	Allen Co	IN
1	0	0	0	0	0	0	180030011	203 E. Douglas St.	Fort Wayne	Allen Co	IN
0	0	1	0	0	0	0	180110001	3900 E. 300 S, Whitestown		Boone Co	IN
0	0	1	0	0	0	0	180150002	481 S. 150 W. / Flora Airport	Flora	Carroll Co	IN
0	0	0	0	1	1	0	180190006	Jeffersonville Pfau- 719 Walnut St	Jeffersonville	Clark Co	IN
0	0	1	0	1	0	0	180190008	12500 St. Rd. 62-Charlestown State Park/		Clark Co	IN
0	0	0	0	1	0	0	180350006	801 N. Walnut St.-Muncie Central High	Muncie	Delaware Co	IN
0	0	1	0	0	0	0	180350010	700 W. State St./ Albany Elementary	Albany	Delaware Co	IN
0	0	0	0	1	0	0	180370004	1401 12th Ave-Jasper Sport Complex		Dubois Co	IN
0	0	0	0	1	0	0	180370005	1729 Jackson St.-Jasper Golf	Jasper	Dubois Co	IN

0	0	0	0	1	1	0	180372001	200 W 6th St	Jasper	Dubois Co	IN
0	0	1	0	0	0	0	180390007	705 Indiana Ave./ Bristol Elementary	Bristol	Elkhart Co	IN
0	0	0	0	1	0	0	180390008	2745 Prairie St./ South Well Field	Elkhart	Elkhart Co	IN
0	0	1	1	2	0	0	180431004	2230 Green Valley Road/Green Valley Elem	New Albany	Floyd Co	IN
0	0	0	0	1	0	0	180510012	Oakland City/ New Lake Park 2205 S. 1350		Gibson Co	IN
0	0	1	0	0	0	0	180550001	2500 S. 275 W, Plummer		Greene Co	IN
0	0	1	0	0	0	0	180570005	1685 N. 10th Street, Noblesville	Noblesville	Hamilton Co	IN
0	0	1	0	0	0	0	180590003	714 E. Broadway, Municipal Bdg.	Fortville	Hancock Co	IN
0	0	1	0	0	0	0	180630004	7203 E. Us Highway 36, Avon		Hendricks Co	IN
0	0	0	0	1	0	0	180650003	7354 W. Us 36/ Shenandoah H.S.- Middleto	Middletown	Henry Co	IN
0	0	0	0	1	0	0	180670003	215 W. Superior St.- Kokomo Fs	Kokomo	Howard Co	IN
0	0	1	0	0	0	0	180690002	423 West Vine Street - Roanoke	Roanoke	Huntington Co	IN
0	0	1	0	0	0	0	180710001	225 W & 300 N, Brownstown	Brownstown	Jackson Co	IN
0	0	1	0	0	0	0	180810002	200 W. Pearl St., Trafalgar		Johnson Co	IN
0	0	0	0	1	0	0	180830004	Sw Purdue Ag Farm - Us 41 4369 N. Purdue		Knox Co	IN
0	0	0	0	1	2	0	180890006	Benjamin Franklin Elem School- 2400 Card	East Chicago	Lake Co	IN
1	0	0	0	0	0	0	180890015	901 East Chicago Ave/ East Chicago Post	East Chicago	Lake Co	IN
0	1	1	1	1	1	0	180890022	201 Mississippi St., Iitri Bunker	Gary	Lake Co	IN
0	0	0	0	0	1	1	180890023	Water Filtration Plant	East Chicago	Lake Co	IN
0	0	0	0	1	0	0	180890026	25th And Burr Street	Gary	Lake Co	IN
0	0	0	0	1	0	0	180890027	Ready Eldon School, 1345 N. Broad St.	Griffith	Lake Co	IN
0	0	1	0	0	0	0	180890030	1751 Oliver St/ Whiting High School	Whiting	Lake Co	IN
0	0	0	0	2	2	0	180890031	Gary Water/ In American Water Company: 6	Gary	Lake Co	IN
0	0	0	0	1	0	0	180892004	Purdue Univ Calumet-Powers Building 6937	Hammond	Lake Co	IN
0	0	1	1	0	0	2	180892008	1300 141 St Street	Hammond	Lake Co	IN
0	0	0	0	1	1	0	180892010	1921 Davis St., Robertsdale, Clark H.S.	Hammond	Lake Co	IN
0	0	1	0	0	0	0	180910005	NIPSCO Substation	La Porte	LaPorte Co	IN
0	0	1	0	0	0	0	180910010	2011 E. Lincolnway	La Porte	LaPorte Co	IN
0	0	0	0	1	0	0	180910011	Marsh Elem. Sch, 400 E. Homer St.	Michigan City	LaPorte Co	IN
0	0	0	0	1	0	0	180950009	44 W. 5th Street- Anderson Fs	Anderson	Madison Co	IN
0	0	1	0	0	0	0	180950010	East Elem. Sch., 893 E. Us 36, Pendleton		Madison Co	IN
0	0	0	0	1	1	0	180970043	1735 South West Street	Indianapolis	Marion Co	IN

0	0	1	0	0	0	0	180970050	Fort Harrison State Park	Indianapolis	Marion Co	IN
0	0	1	1	0	0	0	180970057	1321 South Harding	Indianapolis	Marion Co	IN
0	0	0	0	0	0	2	180970063	7601 Rockville Road	Indianapolis	Marion Co	IN
0	0	0	0	1	1	0	180970066	3302 Englist Ave., Seal Products Bldg.	Indianapolis	Marion Co	IN
0	0	0	0	0	2	0	180970071	1415 Drover, National Printing Plate	Indianapolis	Marion Co	IN
1	0	0	0	0	0	0	180970072	50 North Illinois Street	Indianapolis	Marion Co	IN
1	1	1	1	0	2	0	180970073	Naval Avionics Center, 6125 E. 16th St.	Indianapolis	Marion Co	IN
0	0	0	0	0	0	1	180970076	230 South Girls School Road	Indianapolis	Marion Co	IN
0	0	0	0	1	0	1	180970078	3120 E. 30th St., Washington Park	Indianapolis	Marion Co	IN
0	0	0	0	2	0	0	180970081	3351 W. 18th St., School 90	Indianapolis	Marion Co	IN
0	0	0	0	1	0	0	180970083	2302 E. Michigan St., School 15	Indianapolis	Marion Co	IN
0	0	0	0	1	0	0	181050003	Binford Elem School	Bloomington	Monroe	IN
0	0	1	0	0	0	0	181090005	135 S. Chestnut, Monrovia High School		Morgan Co	IN
0	0	1	0	0	0	0	181230009	19856 Old St Rd 37/Perry Central Hs/ Leo		Perry Co	IN
0	0	0	0	0	1	0	181270023	Hwy 12 Waste Lagoon	Portage	Porter Co	IN
0	0	1	0	1	1	0	181270024	84 Diana Rd/ Water Treatment Plant	Ogden (Wickliffe)	Porter Co	IN
0	0	1	0	0	0	0	181270026	1000 Wesley/ Valparaiso Water Dept.	Valparaiso	Porter Co	IN
0	0	1	0	0	0	0	181290003	2027 S. St. Phillips Rd.		Posey Co	IN
0	0	1	0	0	0	0	181410010	25601 State Rd. 4/ Potato Creek State Pa		St. Joseph Co	IN
0	0	0	0	1	0	0	181410014	Nuner Elem. Sch., 2716 Pleasant St.	South Bend	St. Joseph Co	IN
0	1	1	0	2	0	0	181410015	2335 Shields Dr/ South Bend Caap 2	South Bend	St. Joseph Co	IN
0	0	1	0	0	0	0	181411007	12481 Anderson Rd./ Harris Twp Fire Stat	Granger	St. Joseph Co	IN
0	0	1	0	0	0	0	181450001	4774 W. 600 N, Fairland		Shelby Co	IN
0	0	0	0	1	0	0	181470009	105 S. Dunn St.- David Turnham Sch	Dale	Spencer Co	IN
0	0	0	0	2	0	0	181570008	Lafayette Cinergy Substation/ 3401 Green	Lafayette	Tippecanoe Co	IN
0	0	0	0	2	1	1	181630006	1 Nw Martin Luther King Jr. Blvd.- Evans	Evansville	Vanderburgh Co	IN
0	1	1	1	1	2	0	181630012	425 West Mill Road/ Fire Station #17	Evansville	Vanderburgh Co	IN
0	0	1	0	0	0	0	181630013	14940 Old State Road/ Scott Elementary	Evansville	Vanderburgh Co	IN
0	0	0	0	1	0	0	181630016	University Of Evansville - Carson Center	Evansville	Vanderburgh Co	IN
1	0	0	0	0	0	0	181630019	3013 N. 1st Ave/ Harwood Middle School	Evansville	Vanderburgh Co	IN
0	0	1	1	1	2	0	181670018	961 N. Lafayette Ave.	Terre Haute	Vigo Co	IN
0	0	0	0	1	0	0	181670023	Devaney School, 1011 S. Brown Ave.	Terre Haute	Vigo Co	IN

0	0	1	0	0	0	0	181670024	7597 N. Stevenson Rd/ Sandcut		Vigo Co	IN
0	0	1	0	0	0	0	181730008	300 N. 1st St./ Boonville High School	Boonville	Warrick Co	IN
0	0	1	0	0	0	0	181730009	5244 State Rd 68/ Tecumseh High School		Warrick Co	IN
0	0	1	0	0	0	0	181730011	Dayville- 3488 Eble Rd		Warrick Co	IN
5	**4**	**40**	**7**	**44**	**16**	**8**					
5	4	40	7	38	16	6					
0	0	1	0	1	0	0	260050003	966 W 32nd	Holland	Allegan Co	MI
0	0	0	0	1	0	0	260170014	1101 Jennison Street	Bay City	Bay Co	MI
0	0	1	0	0	0	0	260190003	1060 West St., Benzonia Twp.	Benzonia	Benzie Co	MI
0	0	1	0	1	0	0	260210014	Paw Paw Wwtp, 4689 Defield Rd.	Coloma	Berrien Co	MI
0	0	1	0	0	0	0	260270003	Ross Beatty High School, 22721 Diamond C	Cassopolis	Cass Co	MI
0	0	1	0	0	0	0	260370001	8562 E Stoll Rd	Lansing	Clinton Co	MI
0	0	1	0	1	0	0	260490021	Whaley Park, 3610 Iowa	Flint	Genesee Co	MI
0	0	1	0	0	0	0	260492001	Lakeville Middle School, G11107 Washburn	Otisville	Genesee Co	MI
0	0	1	0	0	0	0	260630007	1172 S.M25,Sand Beach Twp.	Harbor Beach	Huron Co	MI
0	0	1	0	1	0	0	260650012	220 N Pennsylvania	Lansing	Ingham Co	MI
0	0	1	0	2	0	0	260770008	Fairgrounds, 2500 Lake St	Kalamazoo	Kalamazoo Co	MI
0	0	0	0	1	1	0	260810007	509 Wealthy	Grand Rapids	Kent Co	MI
1	0	1	1	2	1	0	260810020	1179 Monroe Nw	Grand Rapids	Kent Co	MI
0	0	1	0	0	0	0	260810022	10300 14 Mile Rd Ne #B		Kent Co	MI
0	0	1	0	0	0	0	260890001	3155 W. Peshawbestown Rd.		Leelanau Co	MI
0	0	1	0	1	0	0	260910007	6792 Raisin Center Highway	Tecumseh	Lenawee Co	MI
0	0	1	0	1	0	0	260990009	57700 Gratiot	New Haven	Macomb Co	MI
0	0	1	0	0	0	0	260991003	Warren Fire Station 29900 Hoover At Comm	Warren	Macomb Co	MI
0	**0**	**1**	**0**	**1**	**0**	**0**	**261010922**	**3031 Domres Rd.**	**Manistee**	**Manistee Co**	**MI**
0	0	1	0	0	0	0	261050007	525 W Us10	Scottville	Mason Co	MI
0	0	1	0	1	0	0	261130001	1769 S Jeffs Rd		Missaukee Co	MI
0	0	0	0	1	0	0	261150005	3229 East Dean Rd, Erie, Mi	Luna Pier	Monroe Co	MI
0	0	1	0	0	0	0	261210039	1340 Green Creek Road	Muskegon	Muskegon Co	MI
0	0	0	0	1	0	0	261210040	199 E Apple Ave	Muskegon	Muskegon Co	MI
0	0	1	0	1	0	0	261250001	13701 Oak Park Blvd.	Oak Park	Oakland Co	MI

0	0	1	0	1	0	0	261390005	6981 28th Ave. Georgetown Twp.	Jenison	Ottawa Co	MI
0	0	1	0	1	0	0	261470005	2525 Dove Rd	Port Huron	St. Clair Co	MI
0	0	1	0	0	0	0	261530001	Seney Nat'L Wildlife Refuge, Hcr2, Box 1		Schoolcraft Co	MI
0	0	1	0	2	0	0	261610008	555 Towner St	Ypsilanti	Washtenaw Co	MI
1	0	1	1	2	1	0	261630001	14700 Goddard	Allen Park	Wayne Co	MI
0	0	0	1	1	1	0	261630015	6921 West Fort	Detroit	Wayne Co	MI
0	0	0	0	1	0	0	261630016	6050 Linwood	Detroit	Wayne Co	MI
0	1	1	0	1	0	0	261630019	11600 East Seven Mile Road	Detroit	Wayne Co	MI
0	0	0	0	1	0	0	261630025	38707 Seven Mile Road	Livonia	Wayne Co	MI
0	0	0	0	1	3	2	261630033	2842 Wyoming	Dearborn	Wayne Co	MI
0	0	0	0	1	0	0	261630036	3625 Biddle Ave	Wyandotte	Wayne Co	MI
0	0	0	0	1	0	0	261630038	4045 29th Street	Detroit	Wayne Co	MI
0	0	0	0	1	0	0	261630039	2000 W. Lafayette	Detroit	Wayne Co	MI
2	**1**	**27**	**3**	**31**	**7**	**2**					
2	1	27	3	27	4	1					
1	0	0	0	0	0	0	270030600	6000 W. Moore Lake Rd.	Fridley	Anoka Co	MN
0	0	1	0	0	0	0	270031001	2660 Fawn Rd.	East Bethel	Anoka Co	MN
0	1	1	1	0	0	0	270031002	9939 Lima St	Blaine	Anoka Co	MN
0	0	1	0	0	0	0	270052013	26624 North Tower Road	Detroit Lakes	Becker Co	MN
0	**1**	**1**	**0**	**0**	**0**	**0**	**270177416**	**175 University Rd**	**Cloquet**	**Carlton Co**	**MN**
0	0	1	0	0	0	0	270353204	16384 Airport Rd	Brainerd	Crow Wing Co	MN
1	1	0	1	0	0	1	270370020	12821 Pine Bend Trail	Rosemount	Dakota Co	MN
1	1	0	1	0	0	1	270370423	2142 120th Street East	Inver Grove Heights	Dakota Co	MN
0	0	0	1	0	0	1	270370442	County Rd 42	Rosemount	Dakota Co	MN
0	0	0	1	0	0	1	270370443	14035 Blaine Ae. E., Rosemount, Mn	Rosemount	Dakota Co	MN
0	0	0	0	0	0	2	270370465	149 & Yankee Doodle Rd.	Eagan	Dakota Co	MN
0	0	0	0	1	0	0	270370470	225 Garden View Drive	Apple Valley	Dakota Co	MN
0	0	1	0	0	0	0	270495302	1235 Highway 19		Goodhue Co	MN
1	0	0	1	0	0	0	270530954	528 Hennepin Avenue	Minneapolis	Hennepin Co	MN
0	0	0	0	1	0	0	270530961	7020 12th Ave S.	Richfield	Hennepin Co	MN
0	0	0	0	1	0	1	270530963	2727 10th Ave. S.	Minneapolis	Hennepin Co	MN

0	0	0	0	0	1	1	270530966	309 2nd Ave. S.	Minneapolis	Hennepin Co	MN
0	0	0	0	1	1	1	270531007	4646 North Humboldt	Minneapolis	Hennepin Co	MN
0	0	0	0	1	0	1	270532006	5005 Minnetonka Blvd.	St. Louis Park	Hennepin Co	MN
0	0	1	0	0	0	0	270750005	Fernberg Road		Lake Co	MN
0	0	1	0	0	0	0	270834210	West Highway 19	Marshall	Lyon Co	MN
0	**0**	**1**	**0**	**1**	**0**	**0**	**270953051**	**Hcr 67 Box 194**		**Mille Lacs Co**	**MN**
0	0	1	0	1	1	0	271095008	1801 9th Ave. Se	Rochester	Olmsted Co	MN
1	0	0	0	0	0	0	271230050	1088 West University Ave.	St. Paul	Ramsey Co	MN
0	0	0	0	2	2	1	271230866	1450 Red Rock Road	St. Paul	Ramsey Co	MN
0	0	0	0	1	1	0	271230868	555 Cedar Street	St. Paul	Ramsey Co	MN
0	0	0	0	2	0	0	271230871	1540 East 6th Street	St. Paul	Ramsey Co	MN
0	0	0	0	0	1	1	271231003	2179 University Avenue	St. Paul	Ramsey Co	MN
1	0	0	0	0	0	0	271370018	314 W. Superior St.	Duluth	St. Louis Co	MN
0	0	0	0	0	2	0	271370032	37th Ave W. & Oneota St.	Duluth	St. Louis Co	MN
0	0	1	0	0	0	0	271370034	Voyageurs National Park		St. Louis Co	MN
0	0	0	0	1	1	1	271377001	327 First St. S.	Virginia	St. Louis Co	MN
0	0	1	0	2	0	0	271377550	1202 East University Circle	Duluth	St. Louis Co	MN
0	0	0	0	1	0	0	271377551	2424 W 5th St	Duluth	St. Louis Co	MN
0	0	0	0	0	0	2	271377555	Industrial Rd.	Duluth	St. Louis Co	MN
0	0	1	0	1	0	0	271390505	917 Dakota St.	Shakopee	Scott Co	MN
1	0	0	0	0	0	0	271453048	400 Second St. S.	St. Cloud	Stearns Co	MN
0	0	1	0	1	0	0	271453052	1321 University Dr.	St. Cloud	Stearns Co	MN
0	0	0	0	0	1	1	271630009	7th Ave. & 5th Street	St. Paul Park	Washington Co	MN
0	0	0	1	0	0	0	271630436	649 Fifth Street	St. Paul Park	Washington Co	MN
0	0	0	0	1	0	0	271630445	309 N. Fourth St.	Bayport	Washington Co	MN
0	0	0	0	1	0	1	271630446	22 Point Rd	Bayport	Washington Co	MN
0	0	1	0	0	0	0	271636015	11660 Myeron Rd. N.		Washington Co	MN
0	0	1	0	0	0	0	271713201	101 Central Ave. W.	St. Michael	Wright Co	MN
7	**4**	**16**	**7**	**20**	**11**	**17**					
7	4	16	7	17	9	15					
0	0	0	1	0	0	0	390010001	210 N. Wilson Dr.	West Union	Adams Co	OH

0	0	1	1	1	0	0	390030002	2650 Bible Rd.		Allen Co	OH
0	0	0	0	0	1	0	390030006	1314 Findlay Rd.	Lima	Allen Co	OH
0	0	0	0	0	1	0	390030007	Rousch Rd.	Lima	Allen Co	OH
0	0	0	0	0	1	0	390030008	North Street	Lima	Allen Co	OH
0	0	1	1	0	0	0	390071001	770 Lake Rd.	Conneaut	Ashtabula Co	OH
0	0	0	0	1	0	0	390090003	S.R. 377 Gifford State Forest		Athens Co	OH
0	1	1	1	0	0	0	390090004	7760 Blackburn Road	Athens	Athens Co	OH
0	0	0	1	0	0	0	390133002	East 40 St.	Shadyside	Belmont Co	OH
0	0	0	0	2	1	0	390170003	Bonita & St John	Middletown	Butler Co	OH
0	0	1	0	0	0	0	390170004	Schuler And Bender	Hamilton	Butler Co	OH
0	0	0	0	0	1	1	390170015	3901 Lefferson	Middletown	Butler Co	OH
0	0	0	0	1	0	0	390170016	400 Nilles Rd.	Fairfield	Butler Co	OH
0	0	1	1	0	0	0	390171004	Hook Field Airport	Middletown	Butler Co	OH
0	0	1	0	0	0	0	390230001	5171 Urbana	Springfield	Clark Co	OH
0	0	1	1	0	0	0	390230003	5400 Spangler		Clark Co	OH
0	0	0	0	1	0	0	390230005	350 N. Fountain Ave.	Springfield	Clark Co	OH
0	0	1	0	1	0	0	390250022	2400 Clermont Center Dr.	Batavia	Clermont Co	OH
0	0	1	0	0	0	0	390271002	62 Laurel Dr.	Wilmington	Clinton Co	OH
0	0	0	0	0	0	1	390290019	1250 George, Columbiana Port Authority	East Liverpool	Columbiana Co	OH
0	0	0	0	0	1	1	390290020	2220 Michigan	East Liverpool	Columbiana Co	OH
0	0	0	1	0	1	1	390290022	500 Maryland	East Liverpool	Columbiana Co	OH
0	0	0	0	1	1	0	390350027	2200 W 28th St.	Cleveland	Cuyahoga Co	OH
0	0	1	0	1	0	0	390350034	891 E. 152 St.	Cleveland	Cuyahoga Co	OH
0	0	0	1	1	1	1	390350038	2547 St Tikhon	Cleveland	Cuyahoga Co	OH
0	0	0	0	0	0	1	390350042	3136 Lorain Ave., F.S. 4	Cleveland	Cuyahoga Co	OH
0	0	0	1	1	1	0	390350045	4950 Broadway Ave.	Cleveland	Cuyahoga Co	OH
1	0	0	0	0	0	0	390350048	2026 East 9th St.	Cleveland	Cuyahoga Co	OH
0	0	0	0	0	0	1	390350049	E. 56th St.	Cleveland	Cuyahoga Co	OH
0	0	0	0	0	0	1	390350050	Grant Rd.	Cleveland	Cuyahoga Co	OH
1	0	0	0	0	0	0	390350051	1301 E. 9th St.	Cleveland	Cuyahoga Co	OH
1	0	0	0	0	0	0	390350053	4169 Pearl Rd.	Cleveland	Cuyahoga Co	OH
0	1	0	1	1	2	0	390350060	E. 14th & Orange	Cleveland	Cuyahoga Co	OH

0	0	0	0	0	0	1	390350061	W. Side Of West 3rd.	Cleveland	Cuyahoga Co	OH
0	0	1	0	0	0	0	390350064	390 Fair St.	Berea	Cuyahoga Co	OH
0	0	0	1	1	1	0	390350065	4600 Harvard Ave.	Newburgh Heights	Cuyahoga Co	OH
1	1	0	0	0	0	0	390350070	13013 Corlett Ave.	Cleveland	Cuyahoga Co	OH
0	0	0	0	1	1	0	390351002	16900 Holland Rd.	Brook Park	Cuyahoga Co	OH
0	0	1	0	0	0	0	390355002	6116 Wilson Mills	Mayfield	Cuyahoga Co	OH
0	0	1	0	0	0	0	390410002	359 Main Rd.	Delaware	Delaware Co	OH
1	0	0	0	0	0	0	390490005	1585 Morse Rd.	Columbus	Franklin Co	OH
0	0	0	0	1	1	0	390490024	State Fairgrounds	Columbus	Franklin Co	OH
0	0	0	0	1	0	1	390490025	1700 Ann St.	Columbus	Franklin Co	OH
0	0	1	0	0	0	0	390490028	2521 Fairwood	Columbus	Franklin Co	OH
0	0	1	0	0	0	0	390490029	7600 Fodor Rd.	New Albany	Franklin Co	OH
0	0	0	1	0	0	0	390490034	Korbel Ave.	Columbus	Franklin Co	OH
0	0	1	0	0	0	0	390490037	1777 E. Broad	Columbus	Franklin Co	OH
0	0	1	0	1	0	0	390490081	5750 Maple Canyon	Columbus	Franklin Co	OH
0	0	0	0	0	0	1	390510001	200 Van Buren	Delta	Fulton Co	OH
0	0	1	0	0	0	0	390550004	13000 Auburn		Geauga Co	OH
0	0	0	0	1	1	0	390570005	100 Dayton St.	Yellow Springs	Greene Co	OH
0	0	1	0	0	0	0	390570006	541 Ledbetter Rd.,	Xenia	Greene Co	OH
0	0	1	0	1	0	0	390610006	11590 Grooms Rd	Cincinnati	Hamilton Co	OH
0	0	1	0	1	0	0	390610010	6950 Ripple Rd.	Cleves	Hamilton Co	OH
0	0	0	0	2	1	0	390610014	Seymour & Vine St.	Cincinnati	Hamilton Co	OH
1	0	0	0	0	0	0	390610021	100 E. 5th St.	Cincinnati	Hamilton Co	OH
0	1	1	0	1	2	0	390610040	250 Wm. Howard Taft	Cincinnati	Hamilton Co	OH
0	0	0	0	1	0	0	390610042	2101 W. 8th St.	Cincinnati	Hamilton Co	OH
0	0	0	0	1	0	0	390610043	3254 E. Kemper Rd.	Sharonville	Hamilton Co	OH
0	0	0	0	0	1	0	390615001	101 Cooper Ave.	Lockland	Hamilton Co	OH
0	0	0	0	1	0	0	390617001	2059 Sherman Ave.	Norwood	Hamilton Co	OH
0	0	0	0	1	0	0	390618001	300 Murray Rd.	St. Bernard	Hamilton Co	OH
0	0	0	0	0	1	0	390630002	9860 C.R. 313	Findlay	Hancock Co	OH
0	0	0	0	0	1	0	390630003	9860 Cr 313	Findlay	Hancock Co	OH
0	0	0	0	0	1	0	390630004	C.R. 144	Findlay	Hancock Co	OH

0	0	0	0	0	1	0	390810001	1004 Third St. Brilliant		Jefferson Co	OH
0	0	1	1	1	1	0	390810017	618 Logan St.	Steubenville	Jefferson Co	OH
0	0	0	0	2	0	0	390811001	501 Commerical	Mingo Junction	Jefferson Co	OH
0	0	1	0	0	0	0	390830002	Water Plt, Sr. 314	Centerburg	Knox Co	OH
0	0	1	1	0	0	0	390850003	36010 Lakeshore	Eastlake	Lake Co	OH
1	0	0	0	0	0	0	390850006	8443 Mentor Ave.	Mentor	Lake Co	OH
0	0	1	1	1	0	0	390850007	177 Main Street	Painesville	Lake Co	OH
0	0	0	0	0	1	0	390851001	325 Vine St.		Lake Co	OH
0	0	1	1	2	0	0	390853002	71 E High	Painesville	Lake Co	OH
0	0	1	1	0	0	0	390870006	2120 S. 8th	Ironton	Lawrence Co	OH
0	0	0	0	1	1	0	390870010	2128 S. 9th	Ironton	Lawrence Co	OH
0	0	1	0	0	0	0	390870011	S.R. 141, Wilgus		Lawrence Co	OH
0	0	0	0	1	1	0	390870012	450 Commerce Drive	Ironton	Lawrence Co	OH
0	0	1	0	0	0	0	390890005	300 Licking View Dr.	Heath (Four Lock)	Licking Co	OH
0	0	0	0	0	0	1	390910003	1222 Superior	Bellefontaine	Logan Co	OH
0	0	0	0	0	0	1	390910006	320 Richard	Bellefontaine	Logan Co	OH
0	0	0	0	0	0	1	390910007	1205 Superior	Bellefontaine	Logan Co	OH
0	0	0	0	0	0	1	390910008	1215 Greenwood St.	Bellefontaine	Logan Co	OH
0	0	1	0	0	0	0	390930018	4706 Detroit Rd.	Sheffield	Lorain Co	OH
0	0	0	0	2	1	0	390933002	2180 Lake Breeze	Sheffield	Lorain Co	OH
0	0	1	0	2	0	0	390950024	348 S. Erie	Toledo	Lucas Co	OH
~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~390950025~~	~~600 Collins Park~~	~~Toledo~~	~~Lucas Co~~	~~OH~~
8	0	0	0	1	0	0	390950028	600 Collins Park - NEW	Toledo	Lucas Co	OH
0	0	0	0	1	0	0	390950026	4208 Airport Highway	Toledo	Lucas Co	OH
0	0	1	0	0	0	0	390950027	200 South River Rd.	Waterville	Lucas Co	OH
0	0	1	0	0	0	0	390950034	306 N. Yondota		Lucas Co	OH
0	0	0	0	0	1	0	390951003	Lee & Front	Toledo	Lucas Co	OH
0	0	1	0	0	0	0	390970007	940 Sr 38 Sw		Madison Co	OH
0	0	0	0	1	1	0	390990005	145 Madison Ave.	Youngstown	Mahoning Co	OH
0	0	0	0	0	1	0	390990006	1524 Oakland Ave.	Youngstown	Mahoning Co	OH
0	0	1	1	0	0	0	390990013	345 Oakhill	Youngstown	Mahoning Co	OH
0	0	0	0	1	0	0	390990014	345 Oakhill Ave.	Youngstown	Mahoning Co	OH

0	0	1	0	1	0	0	391030003	6364 Deerview		Medina Co	OH
0	0	0	1	0	0	0	391051001	Mulberry Ave.	Pomeroy	Meigs Co	OH
0	0	1	0	0	0	0	391090005	3825 North S. R. 589		Miami Co	OH
1	0	0	0	0	0	0	391130028	901 West Fairview Ave.	Dayton	Montgomery Co	OH
0	0	0	0	2	0	0	391130032	215 East Third St.	Dayton	Montgomery Co	OH
1	0	0	0	0	0	0	391130034	117 South Main St.	Dayton	Montgomery Co	OH
0	0	1	0	0	0	0	391130037	1401 Harshman Road	Dayton	Montgomery Co	OH
0	0	0	0	0	2	0	391137001	2728 Viking Lane	Moraine	Montgomery Co	OH
0	0	0	1	0	0	0	391150004	S.R. 83		Morgan Co	OH
0	0	0	0	1	0	0	391330002	531 Washington	Ravenna	Portage Co	OH
0	0	1	0	0	0	0	391331001	1570 Ravenna Rd.		Portage Co	OH
0	0	1	0	1	0	0	391351001	National Trails		Preble Co	OH
0	0	0	1	1	1	0	391450013	4862 Gallia	New Boston	Scioto Co	OH
0	0	0	0	0	1	0	391450019	605 Washington	Portsmouth	Scioto Co	OH
0	0	0	1	0	1	0	391450020	2840 Back Rd.	Franklin Furnace	Scioto Co	OH
0	0	0	0	0	1	0	391450021	2446 Gallia Pike	Franklin Furnace	Scioto Co	OH
0	0	0	1	0	1	0	391450022	1740 Gallia Pike	Franklin Furnace	Scioto Co	OH
0	0	1	0	0	0	0	391510016	515 25th. St.	Canton	Stark Co	OH
0	0	0	0	2	0	0	391510017	1330 Dueber	Canton	Stark Co	OH
1	0	0	0	1	0	0	391510020	420 Market	Canton	Stark Co	OH
0	0	1	0	0	0	0	391510022	45 S. Wabash Avenue, S.R 93	Brewster	Stark Co	OH
0	0	1	0	0	0	0	391514005	1175 West Vine	Alliance	Stark Co	OH
0	0	0	1	2	0	0	391530017	80 Brittain	Akron	Summit Co	OH
1	0	1	0	0	0	0	391530020	800 Patterson Ave.	Akron	Summit Co	OH
1	0	0	1	0	0	0	391530022	177 S. Broadway	Akron	Summit Co	OH
0	0	0	0	1	0	0	391530023	660 W. Exchange St.	Akron	Summit Co	OH
0	0	0	0	1	1	0	391550005	540 Laird Ave.	Warren	Trumbull Co	OH
0	0	0	0	0	1	0	391550006	Water Plant	Warren	Trumbull Co	OH
~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~1~~	~~0~~	~~391550007~~	~~2609 Draper St. S.E.~~	~~Warren~~	~~Trumbull Co~~	~~OH~~
0	0	1	0	0	0	0	391550009	6346 Kinsman-Bloomfield Rd.		Trumbull Co	OH
0	0	1	0	0	0	0	391550011	842 Youngstown-Kingsville Rd.		Trumbull Co	OH
0	0	0	1	0	0	0	391570006	527 Crescent Dr.	Sugarcreek	Tuscarawas Co	OH

0	0	1	0	1	0	0	391650007	416 Southeast St.	Lebanon	Warren Co	OH
0	0	1	0	0	0	0	391670004	2000 4th Street	Marietta	Washington Co	OH
0	0	0	0	0	0	1	391670008	S.R. 676 Washington Career Center	Marietta	Washington Co	OH
0	0	1	0	0	0	0	391730003	347 N Dunbridge	Bowling Green	Wood Co	OH
20	**4**	**50**	**27**	**59**	**42**	**16**					
12	4	50	27	50	39	16					
0	0	1	0	2	0	0	550030010	Bad River Tribal School - Odanah		Ashland Co	WI
0	0	0	1	2	0	0	550090005	East High, 1415 E. Walnut	Green Bay	Brown Co	WI
0	0	1	0	0	0	0	550090026	Uw-Green Bay, Hwys 54 & 57	Green Bay	Brown Co	WI
0	0	1	0	0	0	0	550210015	Wendt Rd, Columbus	Columbus	Columbia Co	WI
0	0	1	0	0	0	0	550250041	East High, 2302 Hoard St	Madison	Dane Co	WI
0	0	0	0	1	1	0	550250047	City Well #6, 2557 University Ave	Madison	Dane Co	WI
1	0	1	1	1	3	0	550270007	Mayville, Near N6705 Madison Rd		Dodge Co	WI
0	0	1	0	0	0	0	550290004	Newport State Park (Near Ellison Bay)		Door Co	WI
0	0	1	0	0	0	0	550370001	Popple River, Nadp Fire Station #565	Florence	Florence Co	WI
0	0	1	0	0	0	0	550390006	Fond Du Lac, N3996 Kelly Rd, Twn Byron		Fond du Lac Co	WI
0	0	1	1	2	1	0	550410007	Fire Tower Rd, Potawatomi Site	Crandon	Forest Co	WI
0	0	0	0	1	0	0	550430009	128 Hwy 61, Potosi Township		Grant Co	WI
0	0	1	0	0	0	0	550550002	Jefferson H.S. Trailer, Willow Dr.	Jefferson	Jefferson Co	WI
0	0	1	0	1	0	0	550590019	Chiwaukee Prairie, 11838 First Court	Pleasant Prairie	Kenosha Co	WI
0	0	1	0	0	0	0	550610002	Kewaunee, Route 1, Hwy 42	Kewaunee	Kewaunee Co	WI
0	0	1	0	1	0	0	550630012	3550 Mormon Coulee Rd	La Crosse	La Crosse Co	WI
0	1	1	0	1	0	0	550710007	Manitowoc/Woodlnd Dunes, 2315 Goodwin	Two Rivers	Manitowoc Co	WI
0	0	1	0	0	0	0	550730012	Lake Dubay, 1780 Bergen Rd, Bergen Tnshp		Marathon Co	WI
0	0	1	0	1	1	0	550790010	Health Center, 1337 So 16th St	Milwaukee	Milwaukee Co	WI
0	1	1	0	2	0	0	550790026	Dnr Ser Hdqrts, 2300 N M. L. King Jr Dr	Milwaukee	Milwaukee Co	WI
0	0	1	0	0	0	0	550790041	Uwm North Campus, 2114 E Kenwood Blvd	Milwaukee	Milwaukee Co	WI
0	0	0	0	1	0	0	550790043	Virginia Fire Station, 100 W Virginia St	Milwaukee	Milwaukee Co	WI
0	0	0	0	1	2	0	550790059	Federal Aviation Adm, 4942 S 16th St	Milwaukee	Milwaukee Co	WI
0	0	1	0	0	0	0	550790085	601 E. Ellsworth Lane	Bayside	Milwaukee Co	WI

0	0	0	0	1	0	0	550790099	Milw Fire Dept Hq, 711 W Wells St	Milwaukee	Milwaukee Co	WI
0	0	1	0	0	0	0	550850004	Harshaw Farm, 4398 Grace Lane, Harshaw		Oneida Co	WI
0	0	0	1	0	0	0	550850996	Rhinelander Water Tower, Lake & High St.	Rhinelander	Oneida Co	WI
0	0	1	0	1	0	0	550870009	Aal, 4432 N Meade St	Appleton	Outagamie Co	WI
0	0	1	0	0	0	0	550890008	Grafton, Hwy32 And I43	Grafton	Ozaukee Co	WI
0	0	1	0	1	0	0	550890009	Harrington Beach State Park, 531 Hwy D		Ozaukee Co	WI
0	0	1	0	0	0	0	551010017	1519 Washington Ave	Racine	Racine Co	WI
0	0	1	0	0	0	0	551050024	Cunningham, 1948 Merrill St	Beloit	Rock Co	WI
0	0	1	0	1	0	0	551091002	Hwy 64, Somerset Town Hall	Somerset	St. Croix Co	WI
0	0	1	0	2	0	0	551110007	Devils Lake State Park, E12886 Tower Rd		Sauk Co	WI
0	0	1	0	0	0	0	551170006	Kohler Andre Park, 1520 Old Park Road		Sheboygan Co	WI
0	0	0	0	1	0	0	551198001	1 Mi E. Perkinstown On Sr.M		Taylor Co	WI
0	0	1	0	0	0	0	551230008	Wildcat Mtn, Hwy 33, Ontario		Vernon Co	WI
0	0	1	0	1	0	0	551250001	Trout Lake Nursery, County Hwy M	Boulder Junction	Vilas Co	WI
0	0	1	0	0	0	0	551270005	Lake Geneva Nadp Site, Rr4 Elgin Club Rd	Lake Geneva	Walworth Co	WI
0	0	1	0	0	0	0	551310009	Slinger, Hwy 60 & Scenic, Polk Twnshp	Slinger	Washington Co	WI
0	0	1	0	1	2	0	551330027	1310 Cleveland Ave	Waukesha	Waukesha Co	WI

APPENDIX II
Summary of Other Monitoring Programs

In addition to the routine state, local, and tribal monitoring in the region, a number of other measurement programs provide air quality-related information. A summary of these other programs is provided here. These programs are considered in the main body of the report in terms of their ability to provide useful data and fill holes in the routine monitoring networks.

CASTNET

CASTNET is a regional long-term monitoring program administered by EPA's Clean Air Markets Division. Developed from the existing National Dry Deposition Network (NDDN), CASTNET was established in 1991 under the Clean Air Act Amendments. The regional network was formed to assess trends in acidic deposition due to emission reductions, such as the Acid Rain Program and the NOx Budget Trading Program. CASTNET is able to provide data needed to assess and report on geographic patterns and long-term temporal trends in ambient air pollution and dry atmospheric deposition.

Presently, there are 86 operational CASTNET sites located in or near rural areas and sensitive ecosystems (see Figure II-1). The National Park Service sponsors 27 sites located in national parks and other Class I areas. Over 40 sites have operated more than 15 years. Together with NADP/NTN (see below), these two networks provide data needed to estimate temporal and spatial trends in total deposition (wet and dry), as well as ecosystem health.

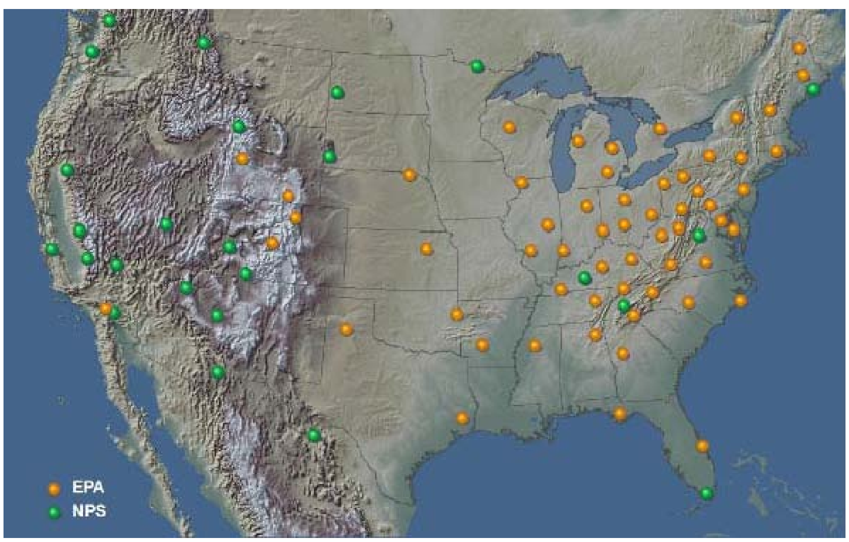

Figure II-1. Map of CASTNET monitoring sites

Measurements include weekly (7-day average) concentrations of gases (SO2 and HNO3) and particles (SO4, NO3, and HNO4), hourly (1-hour average) ozone concentrations and meteorology (e.g., temp, ws/wd, solar radiation, and precipitation). Of most interest for this regional network assessment, are CASTNET's rural ozone measurements. A concern with these data is their reliance on a different quality assurance (QA) protocols. A preliminary assessment of comparability between CASTNET and SLAMS ozone data found:

Network Precision

• Currently, two collocated pairs of CASTNET sites (one in Mackville, KY and one in Rocky Mountain National Park, CO) provide information on network precision. Based on data from these sites, network precision and is estimated to be 4-7% over the past 14 years. Based on QA precision check data, SLAMS ozone monitor precision is estimated to be 3.1% for the year 2006.

• Despite differences in how each network (CASTNET and SLAMS) determines precision and the significantly larger number of SLAMS sites in AQS the coefficient of variance (CV) as derived is rather comparable.

• Where CASTNET and SLAMS sites are collocated together (physically at the same site) the data indicate very good correlation and low relative percent difference, as demonstrated at by the Cadiz, KY site. However, monitors located just 5-6 km apart indicate more variability as demonstrated by the Beltsville, MD comparison.

CASTNET Accuracy Audit Results

• CASTNET ozone measurement accuracy as determined by CASTNET's independent site audit program provides evidence that network monitors are operating consistently with no bias compared to audit test gas concentrations. All sites are audited annually beginning in 2009.

CASTNET Transition to 40 CFR Part 58, Appendix A

A subset of EPA-sponsored CASTNET ozone monitors will meet SLAMS/AQS audit requirements this year and all ozone operations and quality assurance will meet 40CFR Part 58, Appendix A by the end of 2010.

The analysis concluded that "a more rigorous analysis of the two networks is necessary to further demonstrate the comparability of the two networks and understand the quality of each dataset however; based on the estimated network precision and direct collocated comparisons there is evidence of good overall comparability with regard to ozone measurements."

cite: "CASTNET Ozone Measurements: Network Precision, Comparability, and Transitioning to 40 CFR Part 58, Appendix A", August 20-21, 2009 Workshop, http://epa.gov/castnet/docs/workshop/Transitioning_to_40CFR.pdf)

cite: http://www.epa.gov/castnet/docs/CASTNET_factsheet_2007.pdf

IMPROVE

The Interagency Monitoring of Protected Visual Environments (IMPROVE) program is a cooperative measurement effort governed by a steering committee composed of representatives from Federal and regional-state organizations. The IMPROVE monitoring program was established in 1985 to aid the creation of Federal and State implementation plans for the protection of visibility in Class I areas as stipulated in the Clean Air Act Amendments of 1977. The network began operating in 1988 with 20 monitoring sites in Class I Areas. Currently, there are 110 aerosol visibility monitoring sites (see Figure I!-2). Additional instrumentation that operates according to IMPROVE protocols in support of the program includes: 60 aerosol samplers, 33 nephelometers, 4 transmissometers, 4 digital camera systems, 63 Webcamera systems, and 5 interpretive displays.

The objectives of IMPROVE are:

(1) to establish current visibility and aerosol conditions in mandatory class I areas;
(2) to identify chemical species and emission sources responsible for existing man-made visibility impairment;
(3) to document long-term trends for assessing progress towards the national visibility goal; and
(4) with the enactment of EPA's regional haze rule to provide regional haze monitoring representing all visibility-protected federal class I areas where practical.

IMPROVE has also been a key participant in visibility-related research, including the advancement of monitoring instrumentation, analysis techniques, visibility modeling, policy formulation and source attribution field studies.

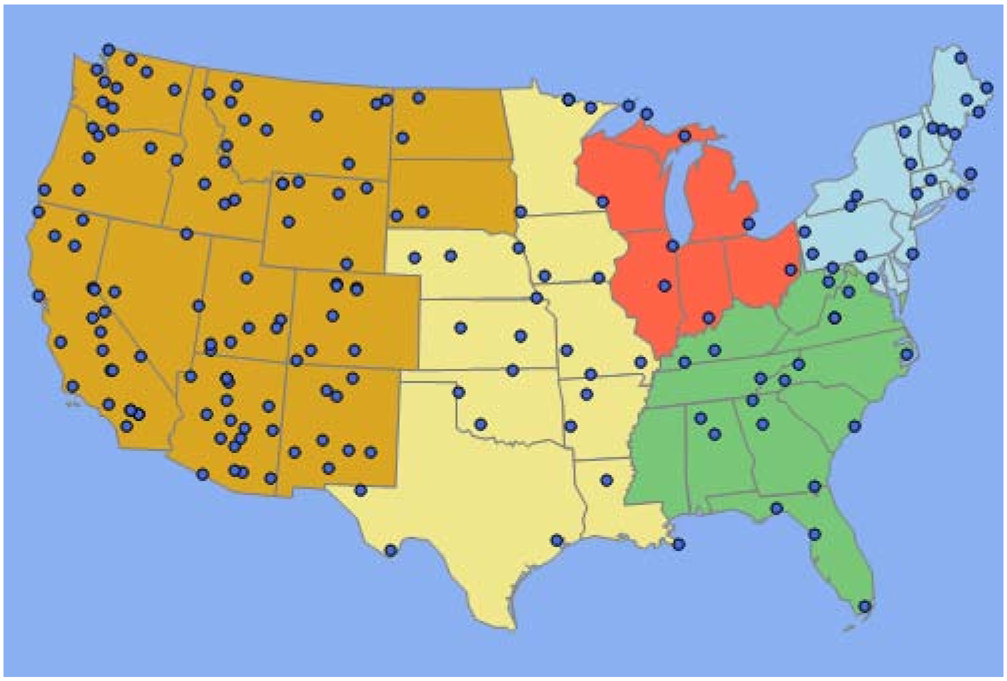

Figure II-2. Map of IMPROVE monitoring sites

Measurements include daily (24-hour average) aerosol concentrations (PM-10 mass, PM2.5 mass, sulfur, soil elements, organic mass, absorption, trace elements [Na-Pb], nitrate and chloride ions, and organic and elemental carbon) on a 1-in-3 day schedule; optical data; and hourly meteorology. Of most interest for this regional network assessment, are IMPROVE's rural aerosol measurements.

EPA's Carbon Speciation Network (CSN) replaced its carbon sampling channel with an IMPROVE-type sampler in three phases: 56 sites converted in May 2007, 62 sites converted in late 2008m and the remaining 78 sites in summer 2009. Preliminary studies indicate the new CSN carbon sampler and the IMPROVE carbon module track well. CSN data are often used in conjunction with IMPROVE data to increase spatial coverage and meet multiple data use needs. Changes in the CSN were implemented to address inconsistencies in carbon sampling and analysis procedures, between the urban CSN and rural IMPROVE programs. The new CSN carbon sampler (URG3000N) manufactured by URG Corporation, is based on the IMROVE Version II Module C. Both the CSN and IMPROVE monitoring networks also utilize the IMPROVE_A Thermal Optical Reflectance (TOR) filter analysis method.

NADP

The National Atmospheric Deposition Program operates several monitoring programs, including:

(1) National Trends Network (NTN)

The NTN is the only network providing a long-term record of precipitation chemistry across the U.S. Sites predominantly are located away from urban areas and point sources of pollution. Each site has a precipitation chemistry collector and gage. The automated collector ensures that the sample is exposed only during precipitation (wet-only-sampling). Weekly samples are collected and then analyzed for free acidity (H^+ as pH), conductance, calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), sulfate (SO_4^{2-}), nitrate (NO_3^+), chloride (Cl^-), and ammonium (NH_4^+).

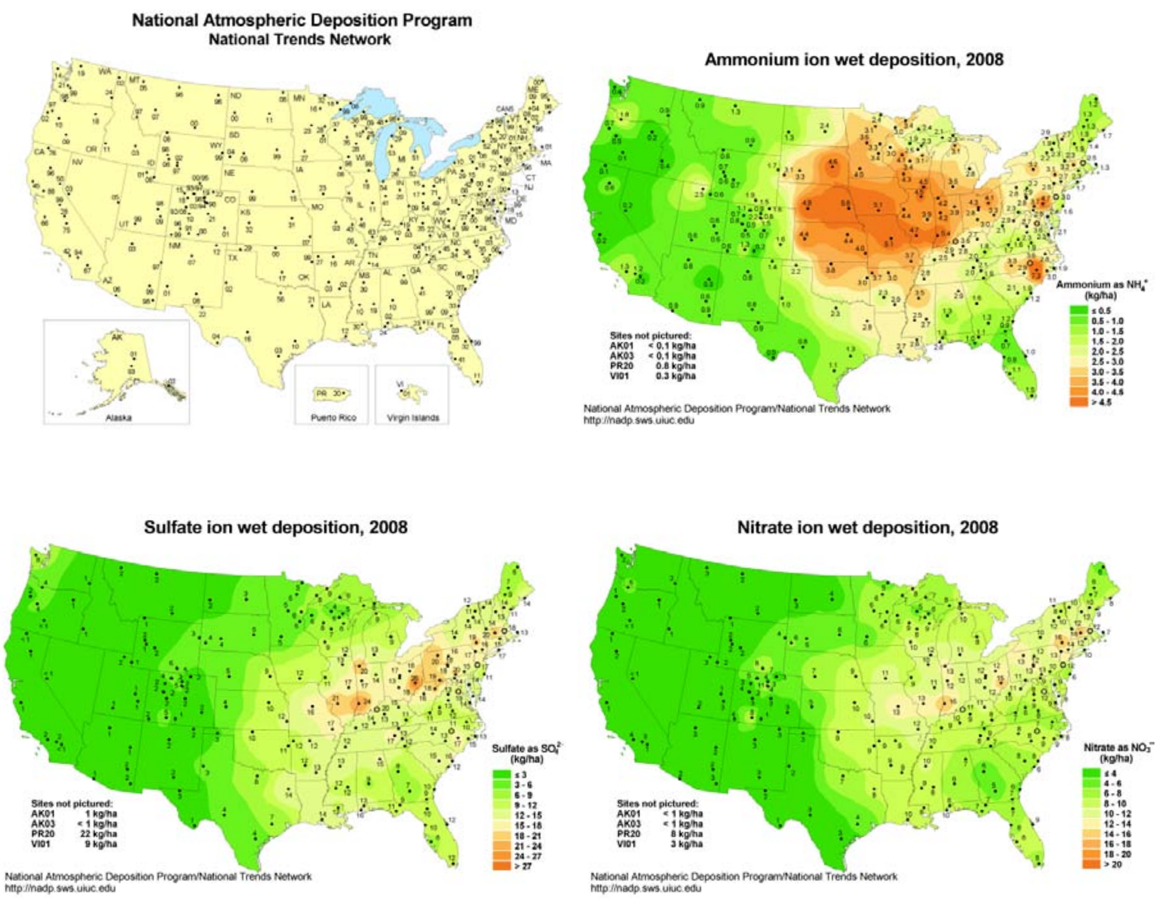

Figure II-3. Maps of NTN sites (upper left), NH4 deposition (upper right), SO4 deposition (lower left), and NO3 deposition (lower right) for 2008

(2) Mercury Deposition Network (MDN)

The MDN is the only network providing a long-term record of total mercury (Hg) concentration and deposition in precipitation in the United States and Canada.[9] Site operators collect samples Tuesday morning or daily within 24 hours of the start of precipitation. The samples are analyzed for all forms of mercury in a single measurement and reported as total mercury concentrations. At the end of 2005, 23 MDN sites also opted for methyl mercury analysis.

In 2007, a new mercury initiative began to complement the existing MDN, which measures wet-only mercury deposition. The initiative seeks to measure event-based mercury wet deposition, air concentrations of mercury in its gaseous and particulate forms, and meteorological and land-cover variables needed for estimating dry deposition fluxes. The goals are:

- facilitate the calculation of wet, dry, and total deposition;
- provide data for evaluating predictive and diagnostic models and for assessing source-receptor relationships; and
- build a data set for analyzing spatial and temporal trends.

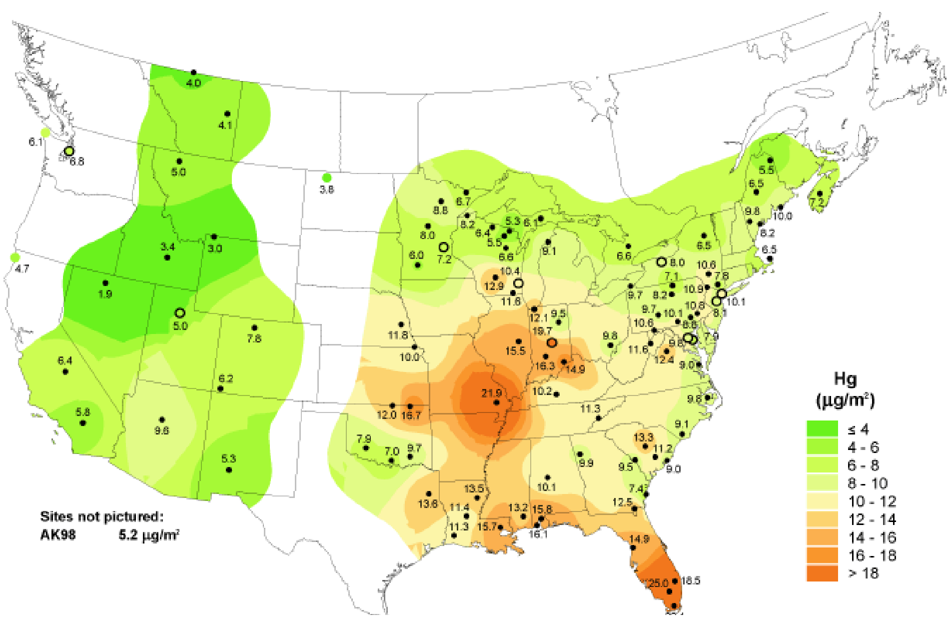

Figure II-4. Map of mercury wet deposition for 2008

(3) Atmospheric Integrated Research Monitoring Network (AIRMON)

AIRMoN joined NADP in 1992 and currently has 7 sites. Samples are collected daily within 24 hours of the start of precipitation, often providing data for all or part of a single storm.

[9] The spatial coverage of mercury network in the Midwest, as seen in the map, is inconsistent. LADCO is pursuing additional funding from the Great Lakes Commission to support a regional assessment of the mercury network.

Single-storm data facilitate studies of atmospheric processes and the development and testing of computer simulations of these processes. Making data available for these studies is a principal AIRMoN goal.

The AIRMoN sites are equipped with the same wet-only deposition collector and precipitation gage used at NADP's NTN sites. Each site also has a National Weather Service standard gage for reporting storm total precipitation. Chemical analyses and data screening procedures for AIRMoN and NTN are similar.

(4) Passive Ammonia Monitoring

Despite the importance of ammonia in atmospheric chemistry and its impacts on ecosystems, there have been no national studies or routine monitoring of ambient ammonia concentrations. In 2007, NADP initiated a special study for the purpose of developing, deploying, and operating a cost-efficient network for ambient ammonia sampling at sites across the U.S. (CASTNET has routinely measured atmospheric particulate ammonium concentrations, but not atmospheric [gaseous] ammonia.)

Specific tasks of this study are to:

- operate a network of passive ammonia samplers over the U.S. using a two week sample period (see Figure II-5), and
- test the accuracy of the Radiello-brand passive ammonia sampler against other passive sampler types and denuder-based measurements to record the accuracy, precision, and repeatability of the Radiello NH3 passive sampler.

NADP will evaluate all of the results, and consider whether this special study will become a full standing network within the NADP system.

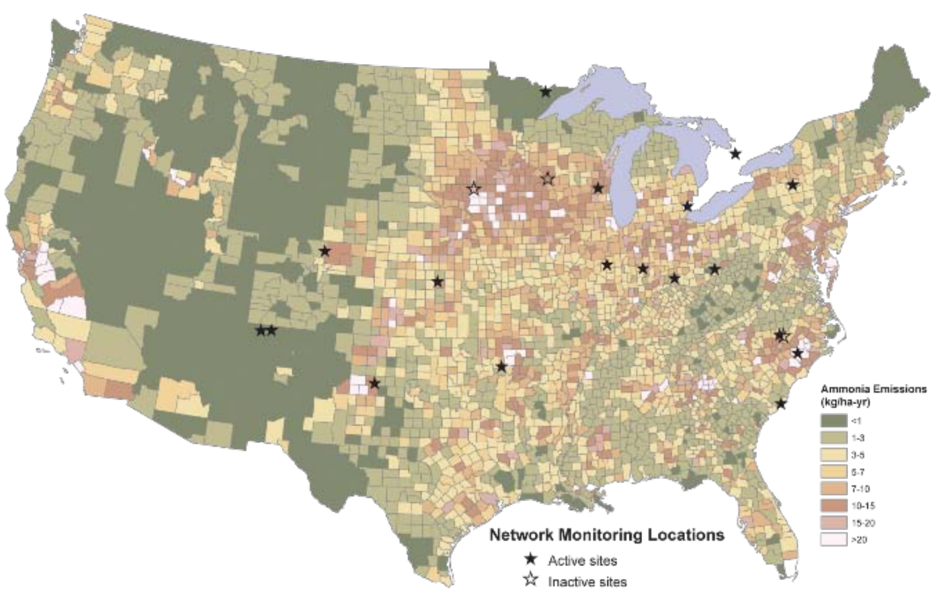

Figure II-5. Maps of passive ammonia sampling locations

cite: http://nadp.sws.uiuc.edu/NADP/networks.aspx, http://nadp.sws.uiuc.edu/nh3net/

Visibility Cameras

In 2001, the Midwest Regional Planning Organization (MRPO) established a 7-site network of visibility cameras in the Midwest. A website (mwhazecam.net) was also established to provide the public with live pictures and corresponding air quality conditions from these urban and rural locations. The images from the cameras are updated every 15 minutes. In addition, near real-time air quality data (instantaneous) and meteorological data (hourly average) are provided to distinguish natural from man-made causes of poor visibility, and to provide current air pollution levels.

In subsequent years, a number of sites were added or subtracted from the network depending on funding availability. Currently, a network of 10 cameras is operating across the upper Midwest[10] – see Figure II-6.

Figure II-6. Map of Midwest visibility cameras

The popularity of this program can be measured in terms of the number of user visits to the website. In 2008, user visits averaged about 50,000 per month (annual total > 600,000). These numbers are comparable to those for the prior 3-year period, which indicates on-going, high interest in this information.

[10] In 2009, the Mayville camera was shut down and a second Chicago camera was added.