Regional Monitoring Strategy for the Upper Midwest

The purpose of this document is to present a regional strategy for ambient air quality monitoring in the Region V States of Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. The fundamental objective of the strategy is to make the best use of available monitoring resources. The strategy proposes to increase data collection efforts by providing:

- more complete sampling (e.g., establish a "core" set of multi-pollutant sampling sites around the region);
- more timely information (e.g., establish a regional $PM_{2.5}$ continuous network); and
- more air pollutants (e.g., establish a regional air toxics network)

To help pay for (and justify additional resources for) these new monitoring activities, the strategy also proposes to decrease certain data collection efforts.

I. PRINCIPLES

The regional monitoring strategy was developed consistent with the following basic principles:

- Focus on those pollutants that pose the greatest threat to public health (i.e., ozone, fine particles, and certain air toxics, such as, benzene and formaldehyde).

- Establish new "core" multi-pollutant monitoring sites to provide information on a wide variety of pollutants at the same location in major metropolitan and rural areas.

- Provide real-time reporting of air quality information by conducting continuous monitoring for ozone and fine particles, and making this information available on the internet.

- Expand use of new technology.

- Ensure that the monitoring programs are responsive to local needs.

- Reduce parts of the network for pollutants whose measured levels are no longer a concern, but retain a subset of these monitors to collect data to ensure that these pollutants do not become a problem again in the future.

II. RECOMMENDED CRITERIA POLLUTANT MONITORING CHANGES

Each state reviewed their existing criteria pollutant monitoring networks and recommended changes to be phased-in over the several years. Factors considered by each state include:

public information	public health/compliance with NAAQS
strategy development	trends/strategy evaluation
multi-pollutant sites	population-oriented sites
over/under-monitoring	low concentrations
regional/local-scale pollutants	population growth

By attempting to "think outside the box" (i.e., not bound by current federal regulations and policies), the state recommendations assume that USEPA will revise the NAMS/SLAMS regulations to accommodate the proposed changes.

The current networks and proposed changes are summarized in Attachments 1 and 2. In general, the changes reflect elimination of some existing monitors, establishment of some new monitors, and a movement toward more multi-pollutant sites. The number of monitoring sites in each state (including industrial monitors in IN and WI) before and after the recommended changes are as follows:

	O3	$PM_{2.5}$ Mass	$PM_{2.5}$ Cont	$PM_{2.5}$ Spec	PM10	TSP	Pb	CO	SO2	NO2
IL	42/35	36/29	4/14	6/6	17/12		15/6	9/7	23/14	10/8
IN	48/41	40/22	7/16	5/7	25/20		6/6	5/5	8/7	4/4
IN-ind.	1/1				6/2		4/4		24/24	1/0
MI	27/28	27/27	8/12	10/10	8/6		8/8	7/7	8/8	3/3
MN	7/17	17/15	1/12	1/8	19/9		2/2	10/7	8/6	4/4
OH	50/39	49/43	2/13	11/11	64/33		14/6	16/9	34/19	4/2
WI	38/32	28/19	3/9	6/7	6/5	19/5	0/0	5/2	5/4	4/4
WI-ind.						16/16				
Total	212/192	197/155	25/76	39/49	139/85	19/5	427/22	52/37	86/58	29/25

(Note: numbers above reflect number of sites "before" / "after")

Several comments on the recommended changes should be noted:

- The state/local agency monitoring networks are dynamic. Many changes have already occurred over, say, the past 10 years. Figure 1 below compares the number of monitoring sites (previous [1991], current [2002], and recommended) both by pollutant and by state.

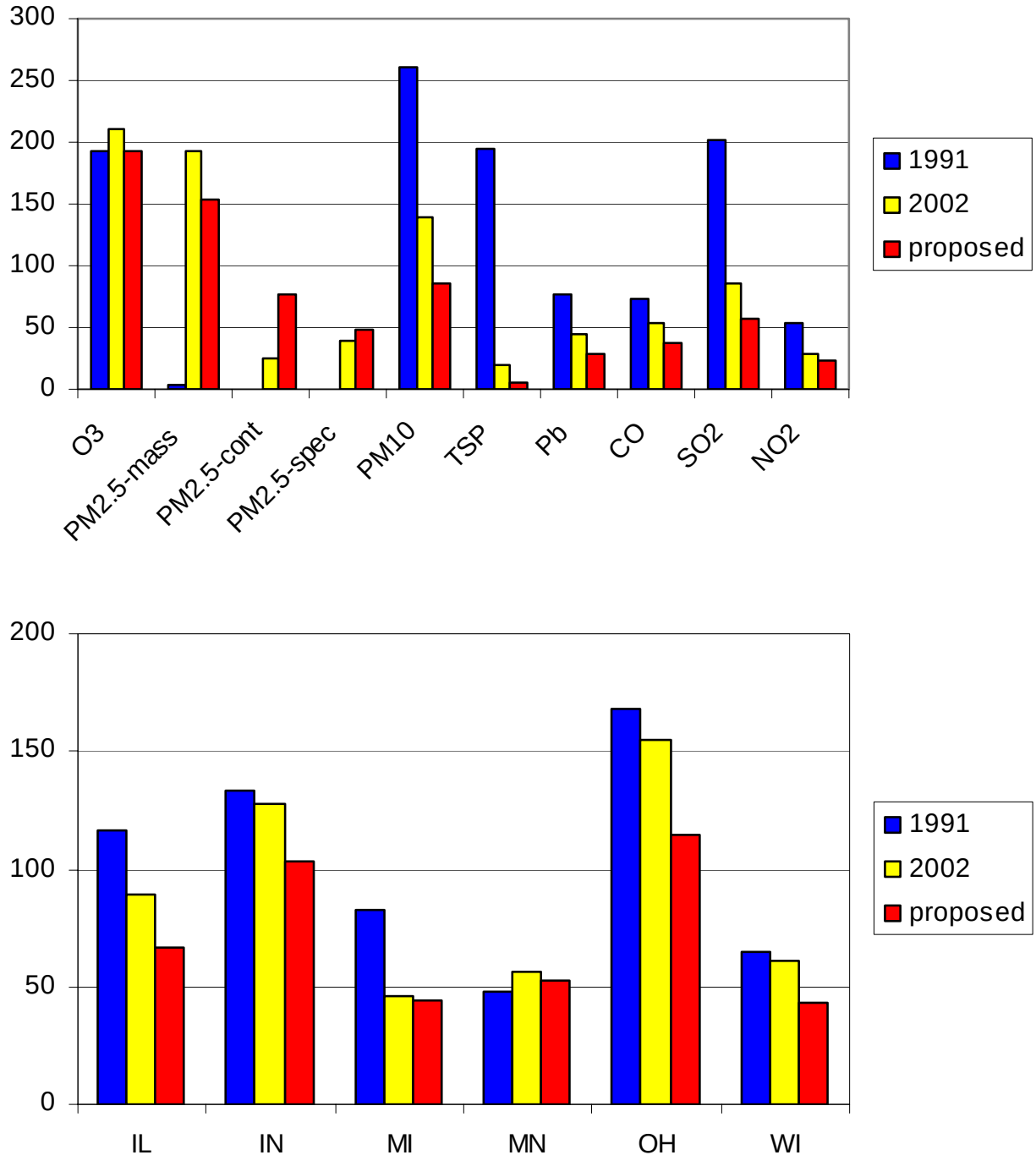


Figure 1. Number of monitors by pollutant (top) and number of monitoring sites by state (bottom)

- Only minor reductions in the existing ozone networks are proposed. This is appropriate given the current widespread 8-hour ozone problem in the region. Some of the proposed changes involve relocation of monitors to rural areas to provide information on regional ozone levels.

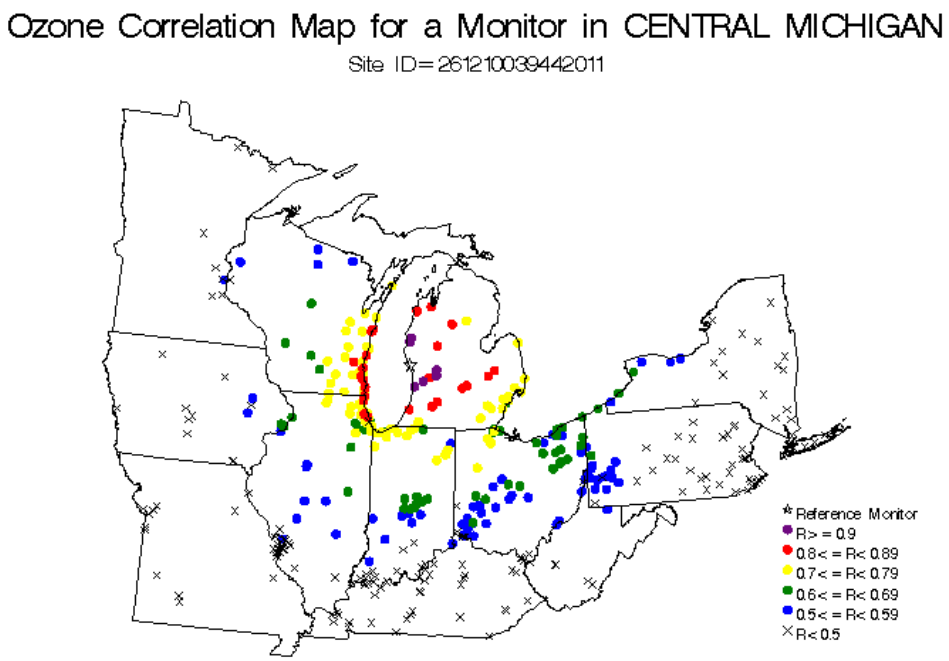
- A significant reduction in the filter-based $PM_{2.5}$ Federal Reference Method (FRM) networks is desired given that there are currently many redundant sites. In addition, more continuous monitoring for $PM_{2.5}$ is needed to support real-time reporting of the Air Quality Index (AQI). The following section provides more detail about the proposed $PM_{2.5}$ changes.

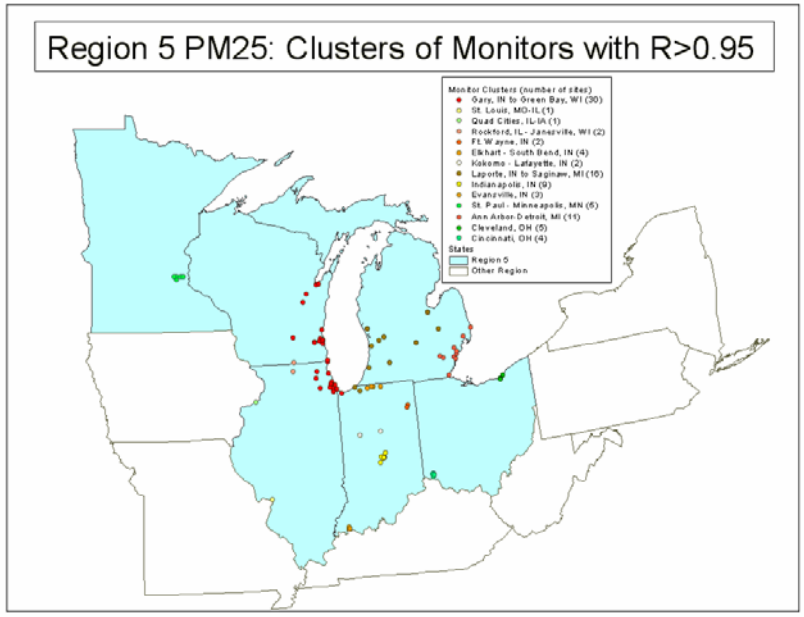
- Significant reductions in PM10, Pb, CO, SO2, and NO2 networks are proposed, consistent with the relatively low measured concentration levels for these pollutants compared to the NAAQS.

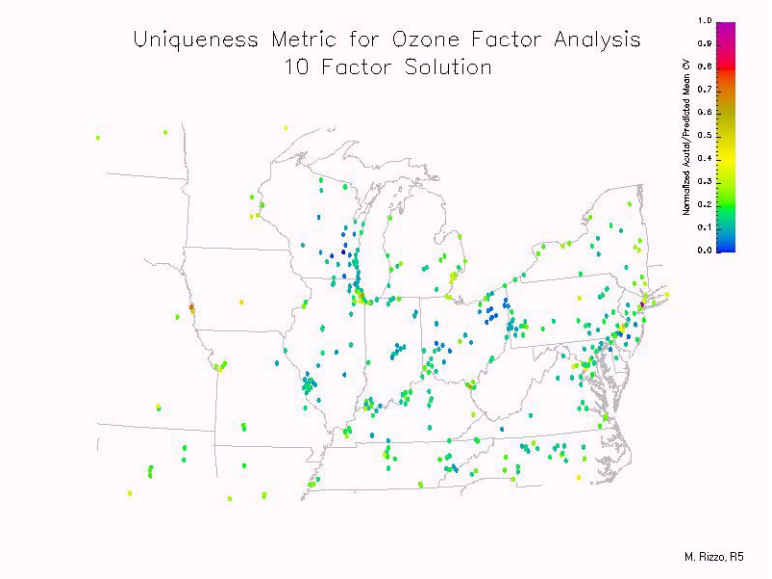
- Several graphical analyses performed by USEPA, Region V are supportive of the proposed changes (see "Technical Assessments in Support of the Regional Monitoring Strategy", December 2001). These analyses include correlation maps for ozone and $PM_{2.5}$, PMF analysis, and krieging analysis (see Figure 2). In particular, these analyses demonstrate redundancy in the existing ozone and $PM_{2.5}$ monitoring networks.

- Consistent with the emerging national monitoring strategy, an important goal of this regional monitoring strategy is the establishment of several multi-pollutant monitoring sites. These sites, which are referred to as NCore Level 2 sites in the national monitoring strategy, include a broad range of measurements and attempt to leverage existing monitoring efforts, such as $PM_{2.5}$-speciation and PAMS. Table 1 identifies the proposed NCore Level 2 sites.

Figure 2. Examples of Region V Assessments







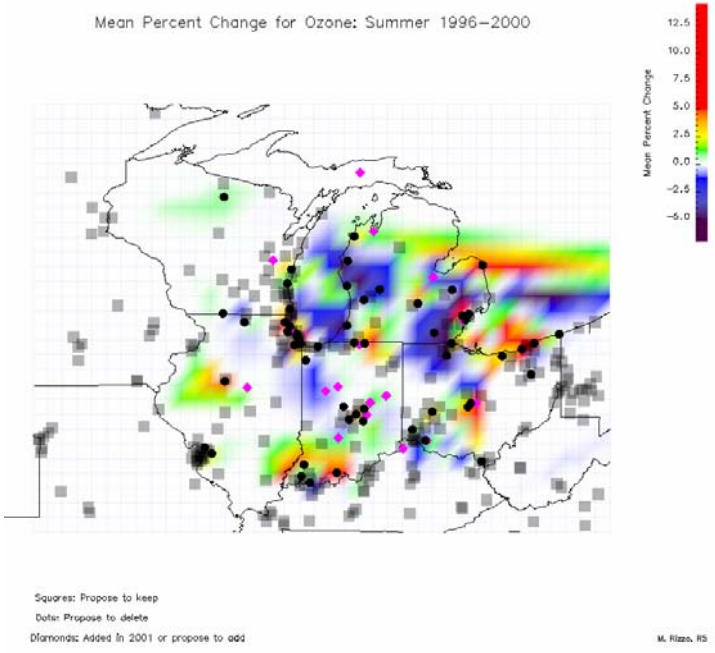


Table 1. Proposed NCore Level 2 Sites in Region V

State	Site	O3	$PM_{2.5}$ mass	$PM_{2.5}$ spec	PM10	SO2	NOx/ NOy	CO	Abs./Scat.	MET	Tox.	VOCs	Other
URBAN SITES													
IL (2)[1]	Northbrook 17-031-4201	x	x (f)	x			x			x		x (PAMS)	
	Chicago-Lawndale 17-031-0076		x (f/c)	x (f/c)									
	E. St. Louis 17-163-0010	x	x (f/c)	x (f)	x	x	x	x		x			
IN (1)[2]	Indianapolis 18-097-0078		x (c)	x	x (c)	x	x	x		x	x (V/C/M)		aethalometer
MI (2)[1]	Detroit-Dearborn 26-163-0033	x	x (f/c)	x (f)	x (c)	x			x (abs)	x	x (V/C/M-TSP & PM10)		aethalometer
	Grand Rapids 26-081-0020	x	x (f/c)	x (f)	x	x	x	x		x	x (V/C/M – TSP)		
OH (2)[3]	Cleveland 39-035-0060		x (f)	x (f)	x	x	x			x			
	Cincinnati 39-061-0040	x	x (f)	x (f)	x		x			x			vis-cam
MN (1)[2]	Minneapolis 27-053-0963		x (f/c)	x (f)						x	x (V/C/M-TSP,PM10)		
WI (1)[2]	Milwaukee-SE Hdqs 55-079-0026	x	x (f/c)	x (f)		x	x	x		x		x (PAMS)	
RURAL SITES													
IL	Bondville 17-019-1001		x (f/c)	x (f)						x			
MI	Seney NWR 26-153-0001	x	x (c)	x (f)					x (scat)	x			vis-cam
WI	Mayville 55-027-0007	x	x (f/c)	x (f)					x (scat)	x			vis-cam

[1] One in a major metropolitan area (> 1M) and one in a medium-sized metropolitan area (250-500K).
[2] One in a major metropolitan area (> 1M)
[3] One in a major metropolitan area (> 1M) and one in a large metropolitan area (500K-1M)
Note: f=filter, c=continuous, V=VOC, C=carbonyl, M=metals

- In addition to criteria pollutant monitoring, it should be noted that the States of Illinois, Indiana, Michigan, and Wisconsin support a regional PAMS network:

Site	Type	O3	NOx	NOy	Met	VOC	Carb.	$PM_{2.5}$ Spec.	Open Path	Upper Air Met
Braidwood	1	X	X		X					
Chicago_Jardine	2	X	X		X	A	X			
Northbrook	3	X	X		X	A,t	X,t	X	X	
Zion	4	X	X,s		X					X
Milwaukee-SE Hdqs	2	X	X,s	X	X	A,t	X	X		
Harrington Beach	3	X	X		X					
Manitowoc	4	X	X,s	X	X			X		
Gary-IITRI	2	X	X	X	X	A,t	X,t	X		
Holland	3	X	X	X	X		X			
Detroit (E. 7 mile)	2	X	X		X	A	X			

A = auto-GC
C = canister sampling
s = high sensitivity NOx
t = air toxics sampling (24-hour canister sample every 6th day year-round)
p = partial met (temp, rel. humidity)

- Several tribes in Region V operate monitors on their lands (see Figure 3). Some of these monitors provide valuable information on characterizing regional air quality (e.g., ozone and $PM_{2.5}$ speciation monitoring by Mille Lacs in central Minnesota, and $PM_{2.5}$ monitoring by Intertribal Council of Michigan in northern Michigan). The majority of tribal monitoring is intended to provide information to address local needs. Additional tribal monitoring which may benefit regional planning efforts include $PM_{2.5}$ sampling in the vicinity of the Class I areas in northern Michigan and Minnesota. (Note, if state assistance is needed for this monitoring, then some agreement between the state, tribe, and USEPA will be needed.)

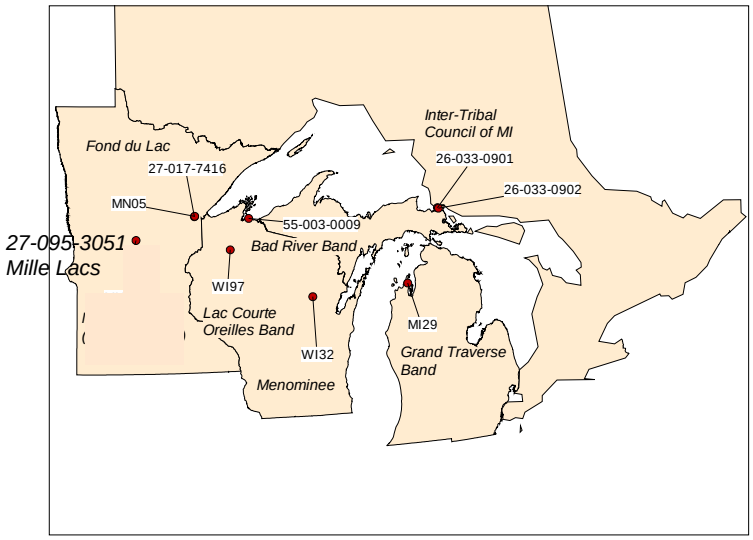


Figure 3. Tribal Monitoring Locations

III. $PM_{2.5}$ MONITORING

As noted above, the strategy includes the two significant changes for $PM_{2.5}$ monitoring in the region: establishment of a regional continuous monitoring network and elimination of existing FRM sites. These two changes are discussed further below.

Establishment of a Regional Continuous Monitoring Network: The States are currently operating a comprehensive network of FRM monitors (see Attachment 1). The primary objective of this monitoring is to determine compliance with the $PM_{2.5}$ NAAQS. The Clean Air Act Scientific Advisory Committee (CASAC) recently noted that:

> (t)he problems with the FRM samplers are that they require considerable effort to operate even on an every third-day basis and on that every third-day basis, they are not providing sufficiently detailed data on airborne particle concentrations. The availability of continuous hourly data would be extremely valuable in evaluating health effects of airborne particles as well as testing and applying the air quality models needed for air quality management strategy development. At the same time, the use of continuous monitors would reduce the cost and manpower needs to operate the current FRM network. We anticipate that such a shift to continuous monitors could be achieved without a loss of integrity of the compliance monitoring data that is needed to test attainment or non-attainment of the NAAQS for PM2.5.
> (March 1, 2002, letter from Dr. Philip Hopke, Chair, CASAC to Christine Todd Whitman, Administrator, USEPA)

To improve spatial coverage from a regional perspective and in urban areas, a number of new continuous monitors will be established (see Attachments 2 and 3).

There are several different types of continuous monitors: Tapered Element Oscillating Microbalance [TEOM] monitor, beta attenuation monitor [BAM], and continuous ambient mass monitor system [CAMMS], which provide fine mass concentrations, and other instruments, such as nephelometers, which provide reasonable surrogate information. Rather than insisting on a single monitor type, each State may deploy whatever technology they deem acceptable. To ensure consistency in these data (e.g., for reporting data to AIRNOW), however, each State will be responsible for providing FRM-like values, either through the use of appropriate technology or application of adjustment factors.[4]

Elimination of Existing FRMs: It is proposed that some existing FRM monitors be eliminated, consistent with CASAC's recommendations noted above and the data assessments. Currently, there are 197 FRMs in operation across the region: IL – 36, IN – 40, MI – 27, MN – 17, OH – 49, and WI – 28. The following considerations were used to review the existing FRM network:

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[4] TEOMs underestimate the $PM_{2.5}$ mass concentrations compared to FRMs, especially during the winter. The lower wintertime values are due to the volatilization of particulate nitrates by the heated inlet (between 30 and 50^{o}C to remove water vapor). This problem is pronounced during the wintertime because nitrate concentrations are greater during this time of the year. To address this problem, a retrofit unit (i.e., FDMS) can be used with a TEOM or adjustment factors can be developed to provide FRM-like values.

- Data Completeness: At least three complete calendar years of data are needed to determine compliance.

- Concentration Magnitude: Lower concentration sites (i.e., those which clearly indicate compliance) are candidates for elimination. Higher concentration sites (i.e., those which indicate non-compliance) should be retained, especially if it is the only site in that county. It may also be worth modifying the sampling frequency based on proximity of the annual and 24-hour concentrations to the PM2.5 NAAQS.

- Data redundancy: Comparison of data from nearby sites may show very similar concentrations, suggesting that one (or more) of these sites may be candidates for elimination. As part of the regional network assessment, Region V showed that sites across most urban areas in the region were highly correlatd.

- Other factors: A number of other factors should be taken into account, such as number of pollutants measured at a site, site access and serviceability, and travel distance).

Attachment 3 identifies the year-by-year plans for each monitoring site. The proposed number of FRMs in each State over the next several years is shown in Figure 4.

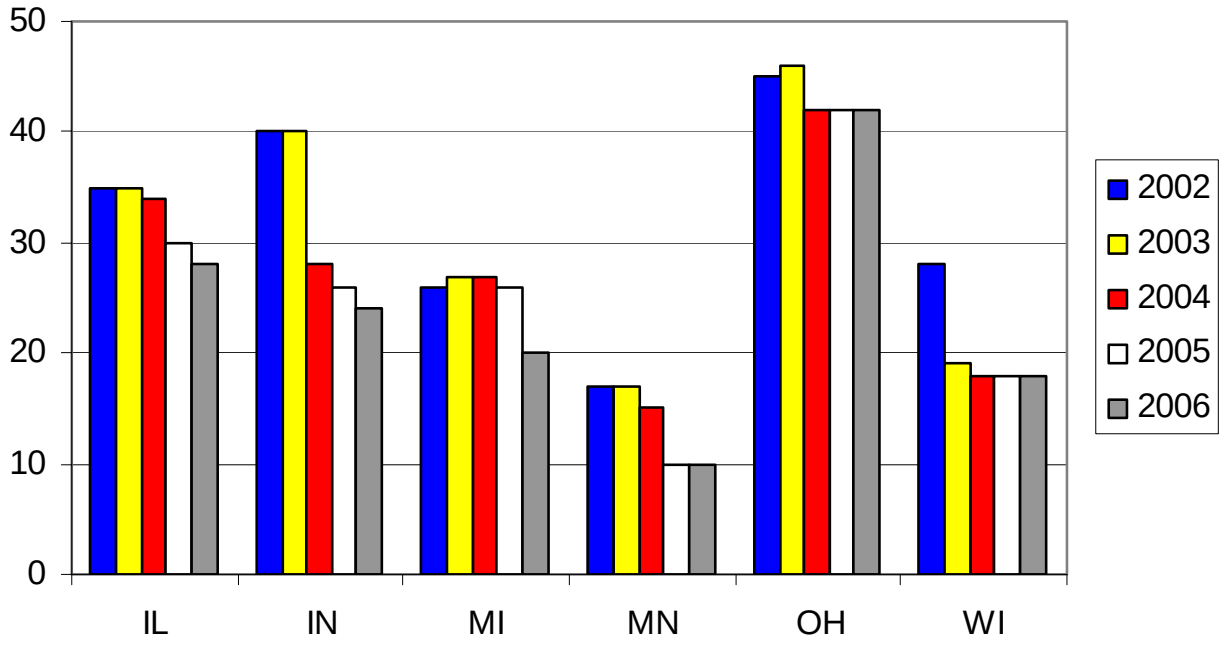


Figure 4. Number of FRMs in Region V States

IV. REGIONAL AIR TOXICS MONITORING NETWORK

The regional air toxics monitoring network builds upon the individual state air toxics monitoring programs and consists of the following 5-state network:

State	Site ID	Location
IL	17-031-3103	Schiller Park[5]
IN	18-097-0078	Indianapolis
MI	26-163-0001	Allen Park
OH	39-035-0060	Cleveland
WI	55-025-0041	Madison

This monitoring started in 2002, and is collecting data to assess "community-oriented" population exposures. The goals of the initial network are as follows:

- measure the same 18 "core" compounds identified for the FY2000 Air Toxic Pilot Program;
- sample on a 1-in-6 day schedule;
- sampling duration of 24 hours (but may be shorter or longer depending on the particular objectives and consideration of detection limits);
- similar monitor siting criteria;
- same analytical methods as in the Air Toxics Pilot Program;
- state laboratory inter-comparisons to be conducted using split samples and canister exchanges, and the results applied to historical Region V air toxics data; and
- same quality assurance practices as in the FY2000 Air Toxic Pilot Program to be employed.

Additional funding will be needed to pay for this monitoring.

V. REGULATION CHANGES

The suggested elimination of certain monitoring sites will require a waiver from various monitoring requirements in 40 CFR Part 58, Appendix D (Network Design for State and Local Air Monitoring Stations [SLAMS], National Air Monitoring Stations [NAMS], and Photochemical Assessment Monitoring Stations [PAMS]):

- Section 3.2 (SO2 Design Criteria for NAMS): waive the requirement for 2 - 4 monitors in urban areas with population > 1,000,000 and low concentrations, and for 1 - 2 monitors in urban areas with population 500,000 - 1,000,000 and low concentrations

- Section 3.3 (CO Design Criteria for NAMS): waive the requirement for a micro-scale, and/or middle or neighborhood-scale monitor in urban areas with population > 500,000

[5] IL and MI also have two National Air Toxics Trends Stations in Northbrook (IL) and Dearborn (MI).

- Section 3.4 (O3 Design Criteria for NAMS): waive the requirement for a downwind monitor for all urban areas with population > 200,000

- Section 3.5 (NO2 Design Criteria for NAMS): waive the requirement for two monitors in urban areas with population > 1,000,000

- Section 4.4 (Network Design for PAMS, Minimum Monitoring Network Requirements): waive the requirement for VOC and carbonyl sampling at Type 1, 3, and 4 sites (or accept the proposed changes as part of an "alternative" network design, as provided by section 4.2)

In addition, consideration should be given to revising the minimum quality assurance requirements. For example, 40 CFR Part 58 requires bi-weekly precision checks for automated methods. A reduction in the number of checks is recommended, especially for monitors that measure concentrations below the NAAQS.

VI. EXTRA MONITORING

The states are committed to the evaluation and deployment of new monitoring technology, especially for $PM_{2.5}$ and air toxics. Examples of such monitoring includes the following:

IL OPSIS (for formaldehyde, benzene/xylene, and mercury); continuous mercury monitor; modified auto-GC for toxics; diffusion tubes for toxics saturation monitoring; glass-lined canisters for VOCs and toxics; and tall building measurements (Sears Tower)

MI Total chromium monitors; continuous mercury with TEKRAN (w/ speciation) and LUMINUX; aethalometers in Detroit; formaldehyde (real-time), if funding available; ammonia monitoring

MN Ammonia monitoring; continuous mercury with TEKRAN monitor; black carbon with aethelometers

WI Ammonia monitoring; continuous mercury with TEKRAN analyzer; continuous speciation (URG) – cooperative study w/ UW-Madison

In addition, each state operates one (or more) visibility cameras as part of the Midwest "hazecam" network; and IL and IN are participating in a national project to test continuous $PM_{2.5}$-speciation monitors.

VII. SUMMARY OF RECOMMENDATIONS

The regional monitoring strategy recommends the following:

Increase data collection

- more complete sampling (e.g., multi-pollutant sampling sites);
- more timely information (e.g., regional $PM_{2.5}$ continuous network); and
- more air pollutants (e.g., regional air toxics network)

Decrease (plus relocate and modify) existing state criteria pollutant monitoring networks (Note: the resource savings will not be sufficient to pay for some of the increased data collection, such as the regional air toxics monitoring network. Additional funding will be needed.)

Encourage additional tribal monitoring, especially in the vicinity of the Class I areas in northern Minnesota and Michigan

Promote new technology, especially for $PM_{2.5}$ and air toxics

Conduct public outreach effort to explain and seek “buy-in” for the proposed changes to the criteria pollutant monitoring networks

Revise the existing NAMS/SLAMS regulations to relieve the states of certain monitoring requirements and to allow some of the proposed network changes

Conduct periodic assessments

ATTACHMENT 1

State Monitoring Networks – Table

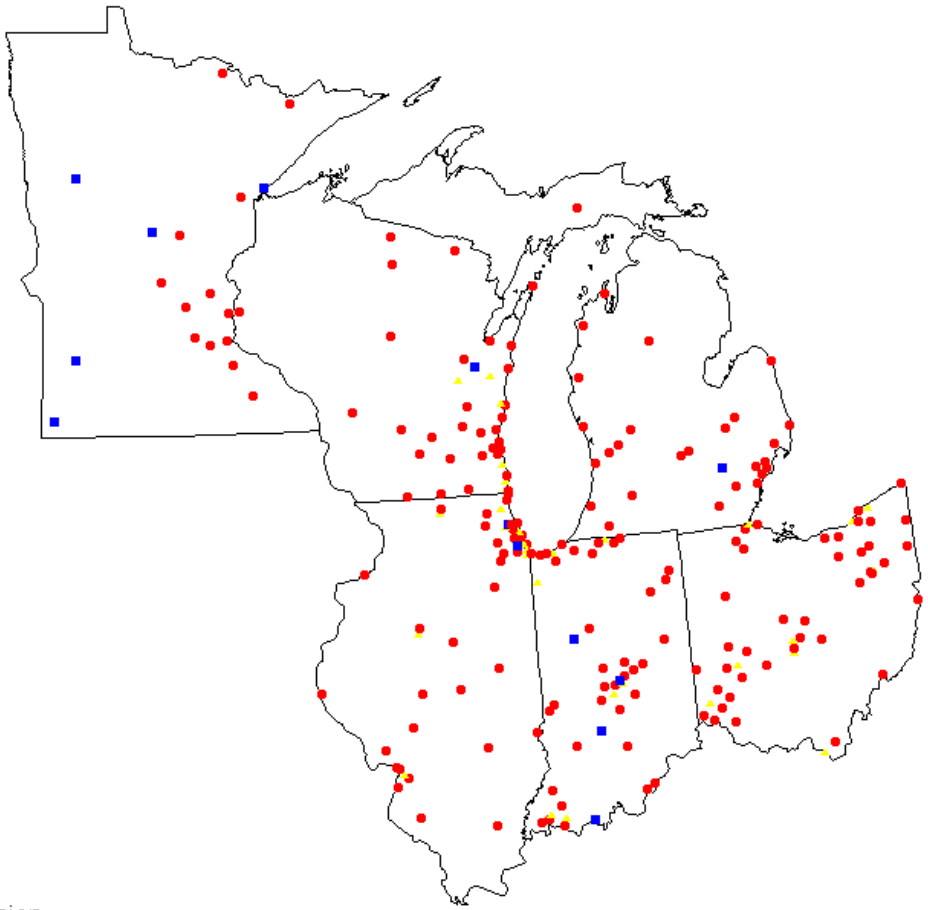
Based on 2003 networks and future year plans

(Note: x = existing site, D = deleted site, N = new site, R = roving site)

ATTACHMENT 2

State Monitoring Networks – Maps

Region 5 Ozone Monitoring Sites



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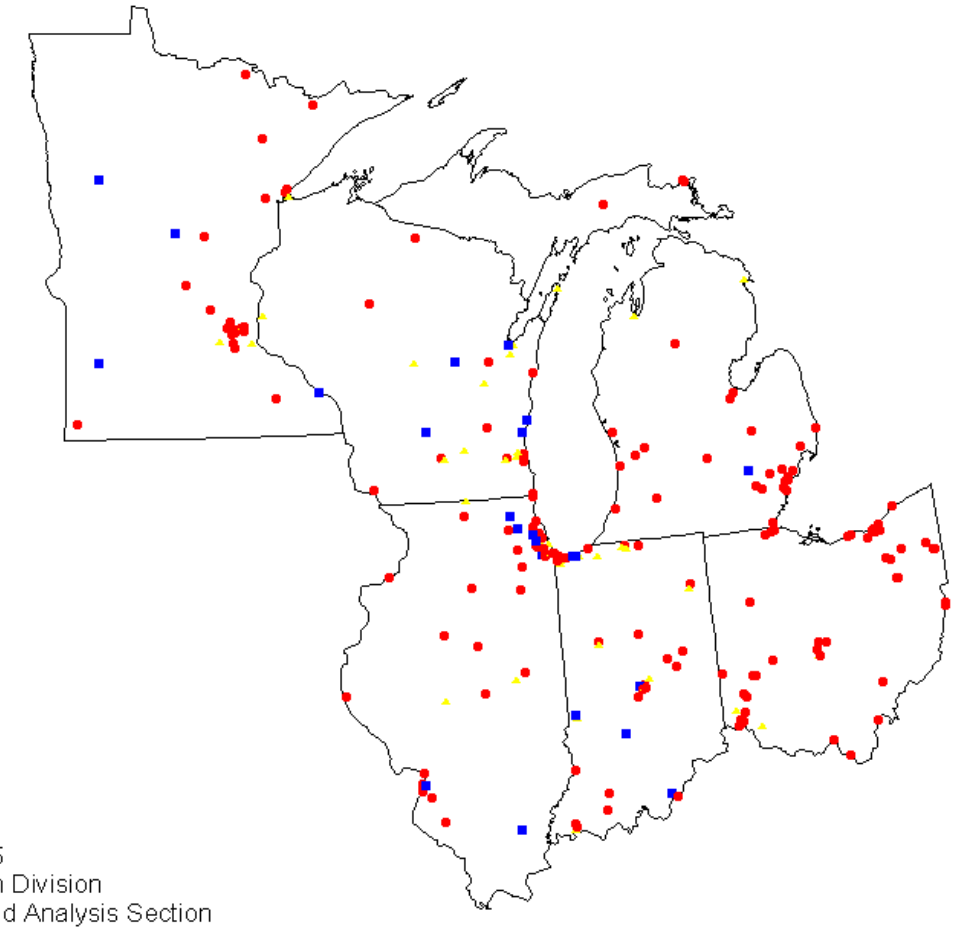
Region 5 PM2.5 Monitoring Sites



- Keep Site
- Delete Site
- New Site

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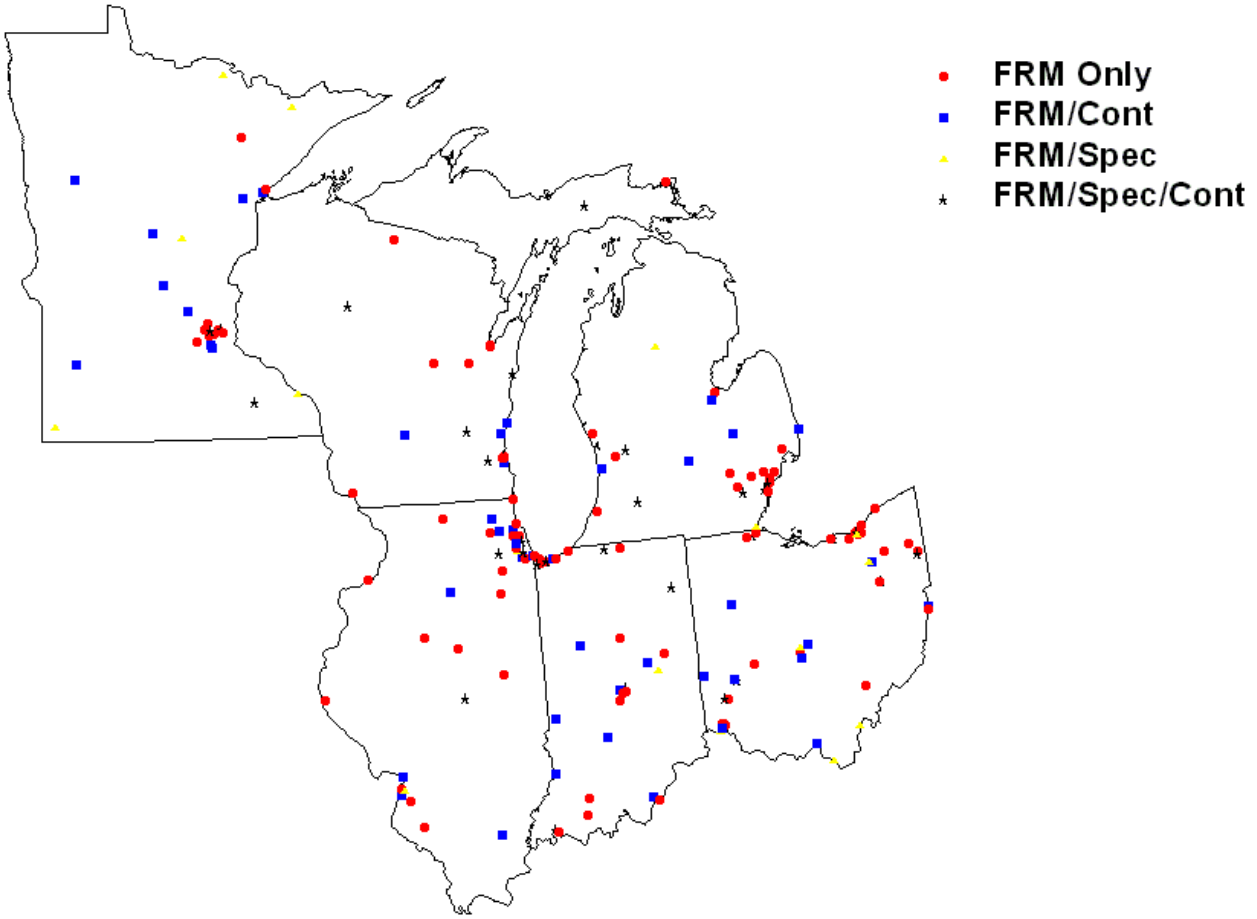
Region 5 FRM/Continuous/Speciation Sites



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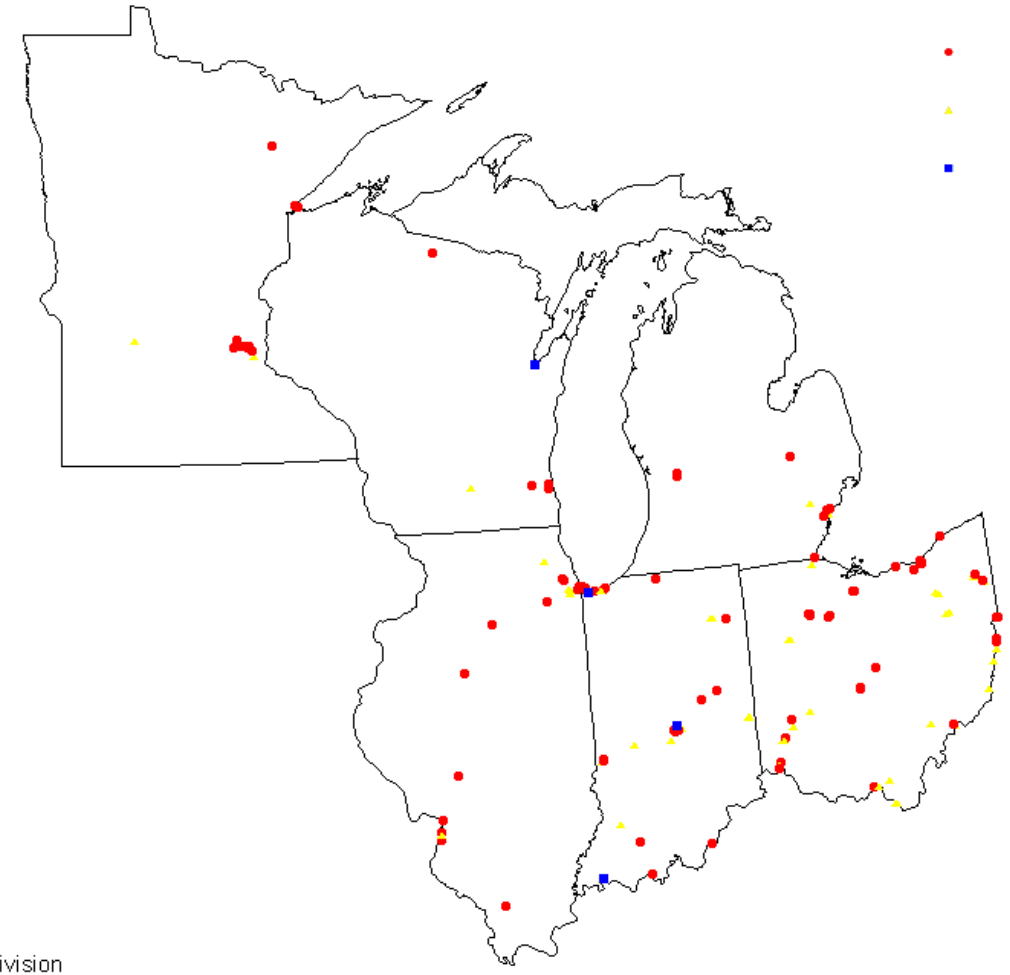
Region 5 PM10 Monitoring Sites



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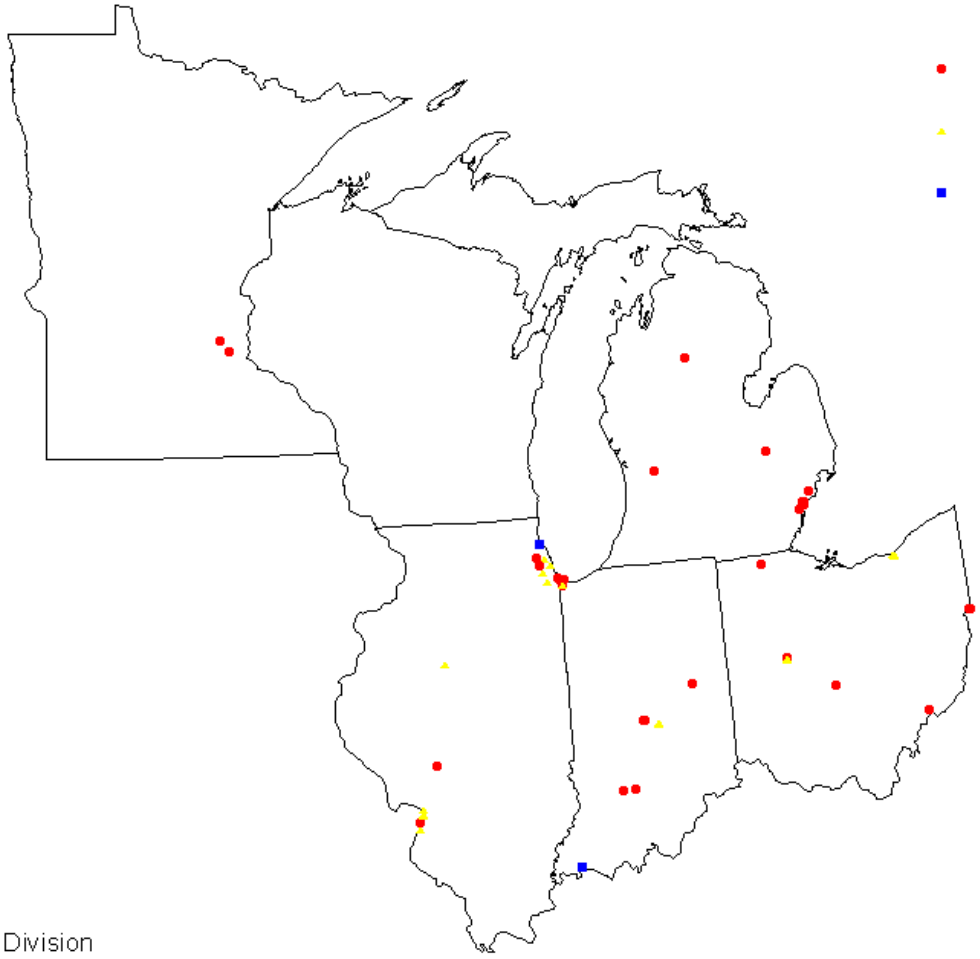
Region 5 Lead Monitoring Sites



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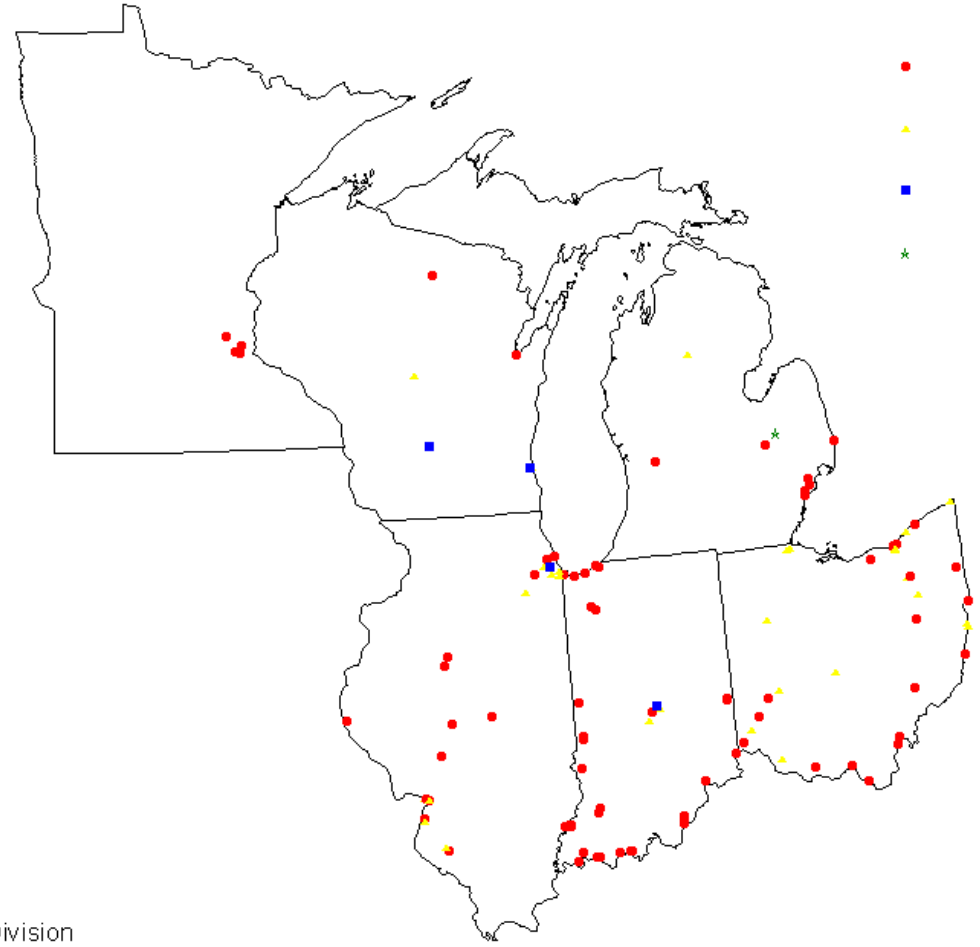
Region 5 SO2 Monitoring Sites



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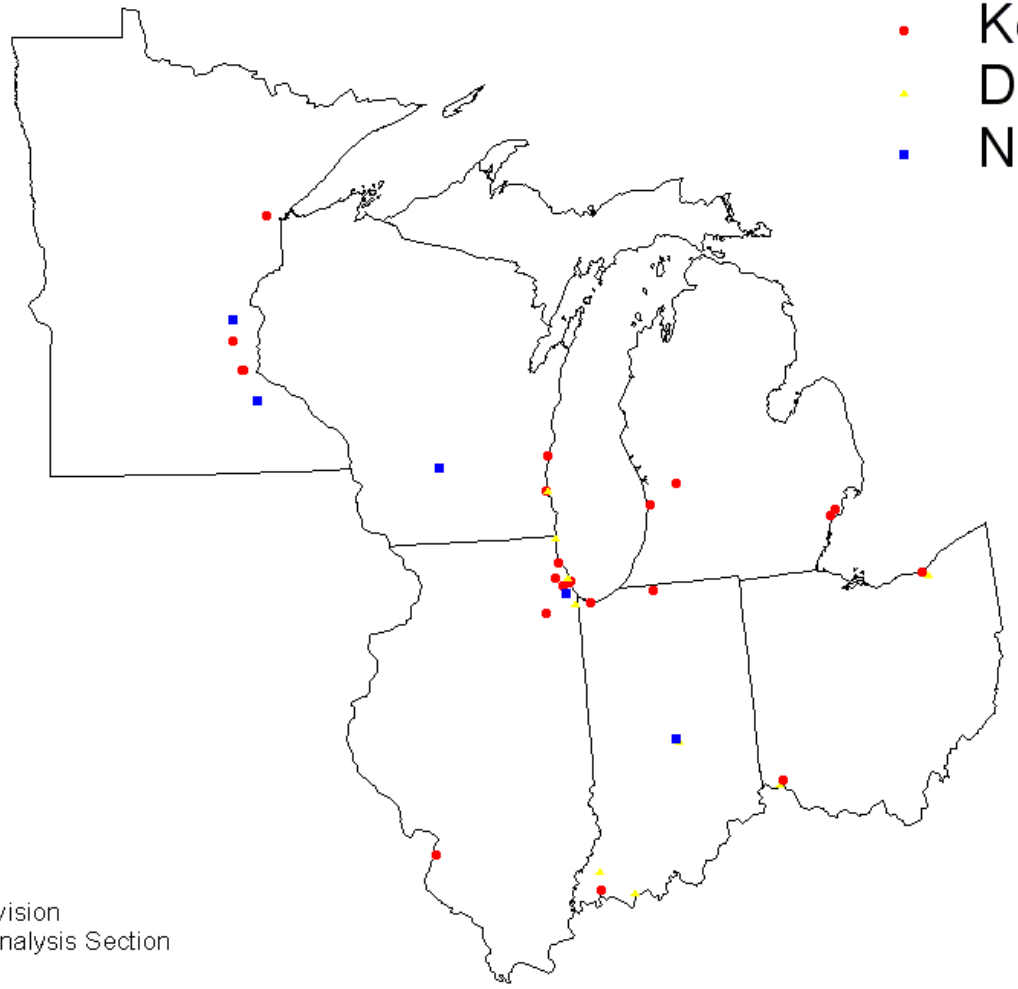
Region 5 NO2 Monitoring Sites



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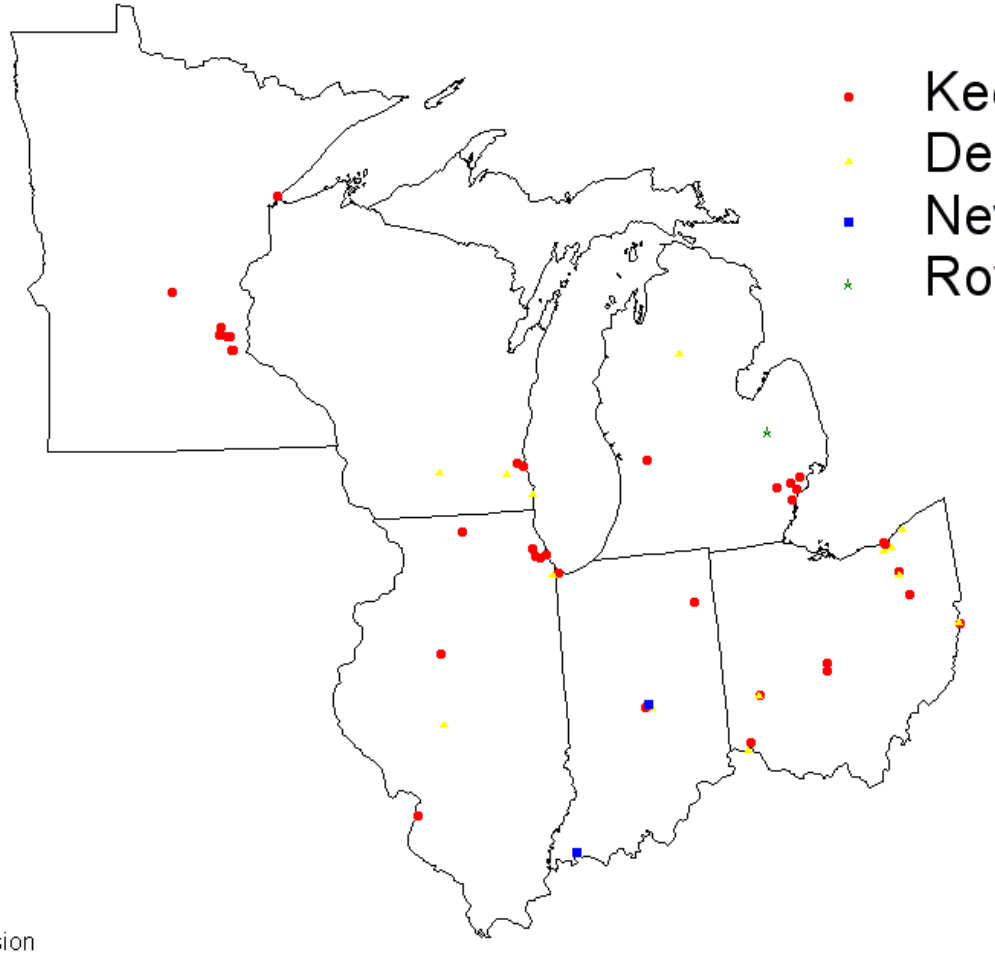
Region 5 CO Monitoring Sites



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ATTACHMENT 3

State Monitoring Networks – $PM_{2.5}$ Table

Based on 2003 networks and future year plans