UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

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MEMORANDUM

SUBJECT: Lead NAAQS Ambient Air Monitoring Network: Network Design Options Under Consideration

FROM: Kevin Cavender, OAQPS/AQAD/AAMG

TO: Lead NAAQS Review Docket (OAR-2006-0735)

This memorandum summarizes network design options being considered as part of the potential revisions to the lead (Pb) monitoring network requirements. The purpose of this memorandum is to provide a basis for consultation with the Clean Air Scientific Advisory Committee (CASAC) Ambient Air Monitoring & Methods (AAMM) Subcommittee on March 25, 2008. The following paragraphs summarize the current Pb surveillance network, existing design requirements, and network options under consideration to improve network coverage.

BACKGROUND

The existing Pb surveillance network has decreased substantially over the last few decades. In 1980 there were over 900 Pb surveillance sites. This number has been reduced to approximately 200 sites today. Figure 1 contains a map of the current Pb total suspended particulate (Pb-TSP) monitoring network. These reductions were made because of substantially reduced ambient Pb concentrations causing priorities to shift to other criteria pollutants including $PM_{2.5}$ and ozone which were believed to pose a greater health risk, consistent with the National Air Monitoring Strategy. Currently, several states have no Pb surveillance monitors resulting in large portions of the country with no data on current ambient Pb concentrations. In addition, many of the largest Pb emitting sources in the country do not have nearby monitors, and there is substantial uncertainty about ambient air Pb levels resulting from historic Pb deposits near roadways. Furthermore, as the result of the Pb NAAQS review, EPA now recognizes that Pb poses a significant health risk at lower concentrations than was believed in the past and is considering lowering the Pb NAAQS.

The current network design requirements are given in 40 CFR 58 Appendix D. The current network design requirements are for two Federal Reference Method (FRM) or Federal Equivalent Method (FEM) sites in any area where Pb concentrations exceed or have exceeded the NAAQS in the most recent 2 years. These requirements and gaps in the current network may make it difficult to develop the necessary network to properly evaluate ambient air concentrations during the designation process, especially if the NAAQS is lowered.

For these reasons, EPA indicated in the Advanced Notice of Proposed Rulemaking (ANPR, 72 FR 71488) that the existing Pb NAAQS surveillance network may not be adequate for a lowered Pb NAAQS, and that additional monitoring sites would be needed to provide adequate coverage of Pb emission sources and for characterizing ambient concentrations in large urban areas. Comments received from CASAC and other public commenters on the ANPR stated that the Pb surveillance network should be expanded in order to provide better coverage of Pb emission sources and to better understand population exposures to Pb from ambient air.

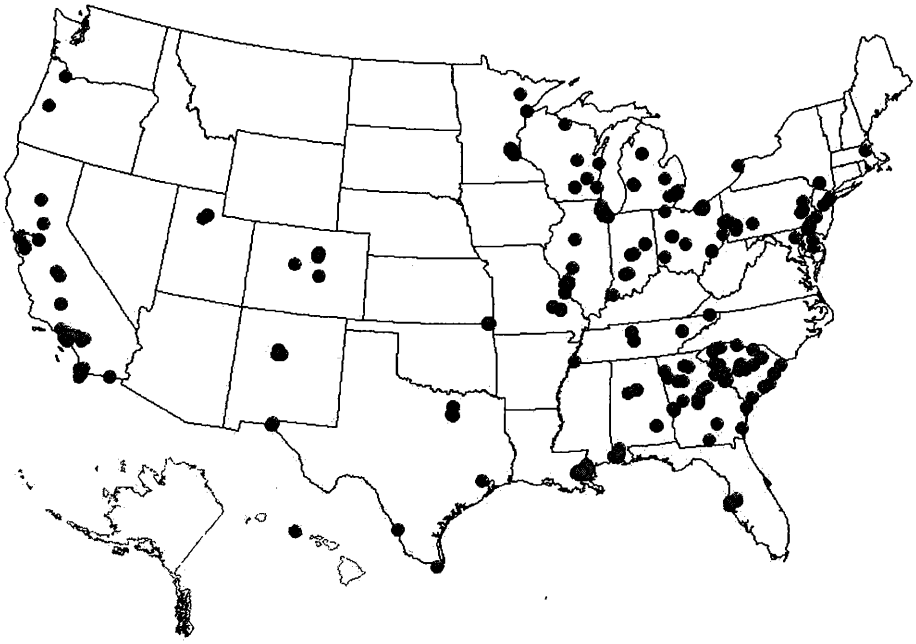

Figure 1. Map of Current Pb-TSP Monitoring Network (Some closely located sites are not visible due to the size of the symbol used to indicate locations)

NETWORK DESIGN OPTIONS UNDER CONSIDERATION

The EPA is considering a multi-layered network design for the Pb surveillance network that would include source-oriented monitoring, population monitoring, and near-roadway monitoring.

Source Oriented Monitoring

The primary objective of the Pb monitoring network is to provide data on the ambient Pb concentrations in areas where there is a potential for a violation of the NAAQS. Logically, the highest ambient concentrations are expected near Pb emission sources. This expectation is supported by an analysis of the ambient data conducted while developing the Staff Paper. As such, it is important to monitor near Pb sources. Figure 2 depicts the locations of the Pb sources identified in the 2002 National Emissions Inventory (NEI).

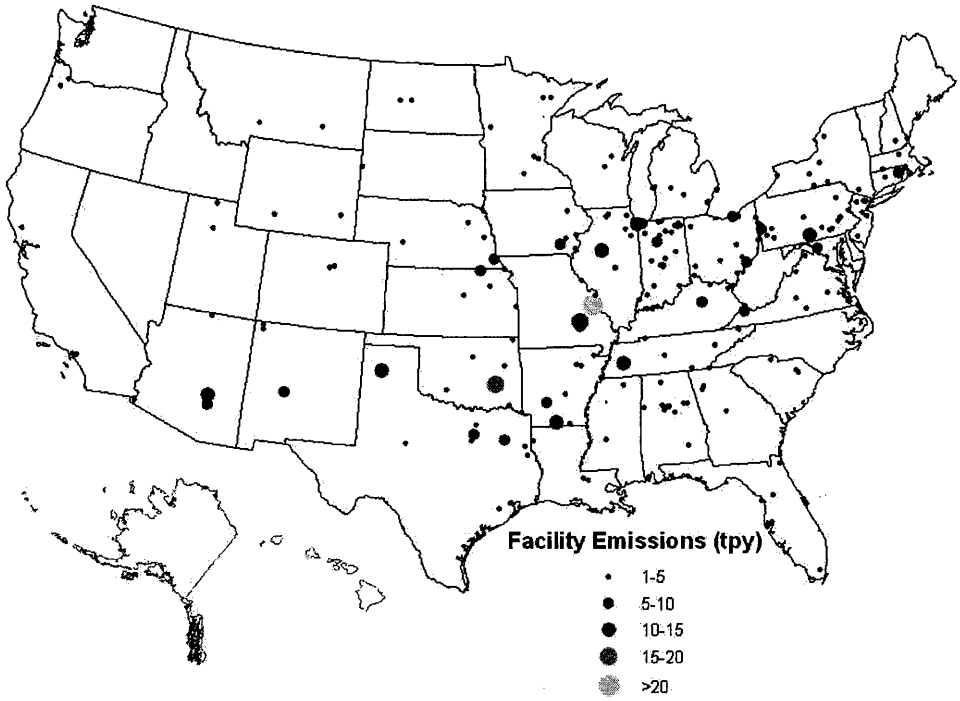

Figure 2. Map of Pb Sources in NEI with Emissions Greater than 1 tpy

It is not feasible to conduct monitoring at every Pb emission source, nor is it likely that small Pb emission sources will cause ambient concentrations to exceed the proposed NAAQS. This suggests the source-oriented monitoring requirement be linked to emission sources with an emission rate greater than some "threshold" under which there is little to no potential for the source to result in ambient concentrations above the Pb NAAQS. Clearly, this threshold would be a function of the final Pb NAAQS - the lower the level, the lower the emission threshold at which a source may potentially exceed the NAAQS. As such, a final threshold can not be established until the final NAAQS level and form are established. Nonetheless, a number of analyses were conducted that may help in determining an appropriate emission rate threshold.

For the first analysis, we considered the 5 tons per year (tpy) threshold, which existed prior to the most recent monitoring requirement revisions, that was once used to identify candidate sources for monitoring. One option would be to scale this threshold based on the current 1.5 $\mu g/m^3$ Pb NAAQS and the final Pb NAAQS selected as part of this review. Table 1 provides potential emission rate thresholds based on this approach for the various NAAQS levels suggested in the ANPR.

Table 1. Potential Thresholds Based on Scaling Historic 5 tpy Threshold

Candidate NAAQS Level ($\mu g/m^3$)	Emission Rate Threshold (tpy)
0.02	0.07
0.05	0.2
0.10	0.3
0.20	0.7
0.50	2
1.5	5

The second analysis looked at monitoring data near Pb sources. Source oriented Pb monitors within one mile of a Pb source (identified from the 2002 National Emissions Inventory, NEI) were identified. This group of sites was then narrowed down to sites near facilities emitting one tpy or more, and then to sites which were only impacted by one Pb source. Also, only the highest reading monitor was used for facilities where more than one monitor was identified within one mile. From this analysis, we identified 7 monitor-facility pairs meeting the criteria. Next we obtained a ratio of the maximum monthly average concentration to the facility annual emissions to provide an estimate of the impact from the facility in units of $\mu g/m^3$ per tpy (see Table 2). As expected, this value varied greatly by monitor-source pair. Nonetheless, a median ratio of 0.3 $\mu g/m^3$ per tpy and a maximum impact of 0.7 $\mu g/m^3$ per tpy were obtained from this list of sites. Table 3 provides potential emission rate thresholds based on this approach for the various NAAQS levels suggested in the ANPR.

Table 2. Data Used to Estimate Facility Impacts Based on Monitoring Data

AQS Id	City	State	Maximum Monthly Average Pb Concentration ($\mu g/m^3$)	NEI 2002 Facility Emission Rate (tpy)	Ratio ($\mu g/m^3$-tpy)
171190010	Granite City	IL	0.91	1.3	0.7
340231003	New Brunswick	NJ	0.19	1.7	0.1
471870100	Not in a city	TN	1.91	2.6	0.7
480850009	Frisco	TX	0.97	3.2	0.3
420110717	Not in a city	PA	0.28	4.8	0.1
011090003	Troy	AL	2.66	4.5	0.6
290990013	Not in a city	MO	3.57	58.8	0.1
Median					0.3
Max					0.7

Table 3. Potential Thresholds Based on Existing Monitoring Data

Candidate NAAQS Level ($\mu g/m^3$)	Emission Rate Threshold based on 0.3 $\mu g/m^3$ per tpy (tpy)	Emission Rate Threshold based on 0.7 $\mu g/m^3$ per tpy (tpy)
0.02	0.07	0.03
0.05	0.2	0.07
0.10	0.3	0.1
0.20	0.7	0.3
0.50	2	0.7
1.5	5	2

In the third analysis, we performed modeling utilizing EPA's SCREEN3 model. SCREEN3 is a single source Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources. Modeling parameters for this evaluation included flat terrain, no building downwash, rural mode, receptors downwind at plume center-line from 100 to 1000 meters out. Emission release parameters for the point source included 1 gram per second emission rate, 5 meter stack height, 1 meter diameter stack, 11 meter per second stack velocity, and 60 degrees C stack temperature. These screening parameters were selected to represent release characteristics with poor dispersion properties. As such, a ton of lead emitted from a source with these characteristics will cause a higher ambient concentration of Pb than most 1-ton sources. Consequently, using these characteristics will tend to give a high value for the $\mu g/m^3$ to tpy ration, resulting in a lower tpy threshold. The maximum monthly average estimate was calculated by multiplying the maximum hourly estimate provided by the model by 0.1, consistent with screening guidance[1]. Based on the model, the worst case estimated impact is 19.8 $\mu g/m^3$ at an emission rate of 1 gram per second which corresponds to an impact of 0.6 $\mu g/m^3$ per tpy. Table 4 summarizes the threshold levels estimated based on this value.

Table 4. Potential Thresholds Based on Screening Model

Candidate NAAQS Level ($\mu g/m^3$)	Emission Rate Threshold (tpy)
0.02	0.03
0.05	0.08
0.10	0.2
0.20	0.3
0.50	0.8
1.5	3

These four methods give similar results, with the second two giving slightly more conservative estimates of the emissions threshold resulting in lower thresholds. Note also, the first analysis was based on quarterly average levels (as the 5 tpy threshold was associated with the current

[1] EPA – October 1992; "Screening Procedures for Estimating the Air Quality Impact from Stationary Sources, Revised"

NAAQS which is on a quarterly average basis) while the remainder of the analyses were based on monthly averages. If EPA decides to stay with the quarterly averaging times, these thresholds would need to be re-evaluated, and would likely be slightly higher than shown here.

One option in establishing the threshold would be to use the most conservative estimate, and require monitoring near any source that emits more than this level. Table 5 summarizes the number of facilities (including airports using leaded aviation gasoline) identified in the NEI with Pb emission rates greater than several potential thresholds.

A number of factors influence the actual impact a facility has on ambient Pb concentrations (e.g., local meteorology, emission release characteristics, distance to property line, and terrain). Since these threshold estimates are based on worst case conditions, it would be appropriate to include an option to allow monitoring agencies to request the EPA Regional Administrator to waive the monitoring requirement for a source where it can be shown (through modeling, historical monitoring data, or other means) that a source is very unlikely to cause nearby ambient concentrations (including concentrations from other sources) to exceed 75% of the NAAQS during a three year period.

Table 5. Number of Facilities Reporting Pb Emissions Greater than Potential Thresholds

Potential Threshold (tpy)	Number of Facilities Emitting > Threshold (2002 NEI)
0.1	2,569
0.2	1,585
0.3	1,108
0.5	647
1	271
2	103
3	61
5	30

Non-source Oriented Monitoring

A secondary objective of the Pb surveillance network is to gather information on population exposure to Pb in ambient air. While it is expected that these non-source oriented monitors will show lower concentrations than source oriented monitors, data from these non-source oriented monitors will be helpful in understanding the risk posed by Pb to the general population, and will provide support for evaluation of spatial variation across urban areas. Data from these monitors will also be useful in determining impacts on Pb concentrations from mobile sources such as re-entrained roadway dust. Data from non-source oriented monitors could also be used in attainment determinations if high concentrations were found.

Because it is likely that the point source network requirements will result in a significant number of monitoring sites, and non-source oriented monitors are likely to show lower concentrations, a smaller non-source network than for other criteria pollutants such as ozone and $PM_{2.5}$ may be appropriate. Unlike Pb, ozone and $PM_{2.5}$ are secondary formed pollutants which are transported making the emphasis on population monitoring more appropriate for ozone and $PM_{2.5}$.

One option would be to require non-source oriented monitors in urban areas greater than some population threshold. Table 6 summarizes the number of Core Base Statistical Area (CBSA, as defined by the Census Bureau) with populations greater than various population threshold.

Table 5. Number of CBSA with Populations Greater than Cutoff

Population Cutoff	Number of CBSA > Cutoff (2000 Census)
100,000	379
200,000	195
300,000	149
400,000	113
500,000	89
750,000	63
1,000,000	50

A second option for non-source oriented monitor requirements is to base the number of required monitors on the most recent design value and the population of the urban area similar to the requirements for ozone and $PM_{2.5}$. However, because elevated Pb concentrations are primarily associated with point sources monitoring, and since we have large gaps in design values for CBSAs, it would be simpler and appropriate to exclude the design value consideration in the requirement. Table 6 summarizes an example where the number of monitors required in an urban area is based on the population of that urban area. Based on the 2002 census, the example in Table 6 would result in a required network of 334 non-source oriented monitors.

Table 6. Example of Monitor Requirements Based on Population

CBSA Population	Number of Required Monitors per CBSA	Total Number of Monitors
> 1,000,000	3	150
500,000-1,000,000	2	78
200,000-<500,000	1	150
Total		334

Near Roadway Monitors

Considerable interest has been shown by CASAC and others in the impact on ambient air for the re-entrainment of lead deposited near roadways from the historical use of leaded gasoline. In addition, mobile sources continue to emit lead from such things as Pb wheel weights (which can be ground up on the road from traffic), brake wear, and trace Pb contained in fuels (gasoline, and diesel fuel), and lube oil.

We reviewed the existing Pb monitoring sites in an effort to identify monitors that were near busy roadways and interstate roads and that were not impacted by point sources in order to evaluate the impact of roadway traffic on ambient Pb concentrations. We identified five monitoring sites that meet these criteria. Table 7 summarizes information for these sites.

Table 7. Monitoring Sites Identified to Evaluate Impact From Mobile Sources

AQS Id	City	State	Nearest Major Roadway	Average Daily Traffic Count (vehicles/day)	Maximum Monthly Pb Concentration ($\mu g/m^3$)
060651003	Riverside	CA	Arlington Ave	80,000	0.016
170310052	Chicago	IL	I-90 and I-94	273,000	0.040
291892003	Clayton	MO	I-170	100,000	0.050
080310002	Denver	CO	Broadway	44,000	< 0.05[2]
080310015	Denver	CO	I-25	108,000	0.031

These data indicate that near roadway impacts would not approach the NAAQS except for the very lowest options under consideration (<0.1 $\mu g/m^3$).

If the final NAAQS is set at levels of 0.1 $\mu g/m^3$ or lower, it may be necessary to add a specific requirement for near roadway monitors in populated areas. However, if the final NAAQS is set at levels greater than 0.1 $\mu g/m^3$, the need to specifically monitor near roadways is lessoned and it may be appropriate to include roadway monitoring as part of the non-source population monitoring requirement discussed above.

[2] Excludes 9 data points corresponding to the period during an old Pb smelter cleanup that resulted in significantly elevated ambient Pb concentrations over that period.