Coarse Particulate Matter Coalition
Technical Comments Concerning the
Particulate Matter Policy Assessment (June 2010 Draft)

The Coarse Particulate Matter Coalition (Coalition) appreciates the opportunity to submit these technical comments concerning the document titled, "Policy Assessment for the Review of the Particulate Matter National Ambient Air Quality Standards, Second External Review Draft (June 2010 Draft). The Coalition includes the National Stone, Sand and Gravel Association, the National Cotton Council, the National Oilseed Processors Association, the Corn Refiners Association, and Kennecott Utah Copper LLC. Collectively these organizations represent companies that operate more than 11,000 facilities and employ more than 100,000 people. Coalition members operate sources in almost all counties and parishes in the continental U.S.

The Coalition is not opposing and has not previously opposed the promulgation of standards to regulate the ambient air levels of thoracic coarse particulate matter (coarse PM). **We continue to believe that the existing 24-hour average standard of 150 micrograms per cubic meter (μg/m^3) based on PM_{10} as an indicator of coarse-mode PM is the most appropriate limit based on the presently available health effects data and corresponding air quality data.**

The Coalition does not find technical data in the Integrated Science Assessment (ISA) or the Policy Assessment Document (June 2010 Draft) to support changing the level of the coarse mode PM 24-hour average standard to a value lower than 150 microgram per cubic meter. We have summarized the technical data and information that support our conclusion. These comments address the following seven interrelated issues.

1. The proposed change in level of the 24-hour coarse-mode NAAQS to a three-year average 98th percentile value in the range of 65 to 85 micrograms per cubic meter is inappropriate and scientifically indefensible.

2. Effective control strategies to achieve a very low 24-hour coarse PM NAAQS are not clear.

3. Arbitrary standard setting based on insufficient data will aggravate already severe unemployment, which is itself a major health problem that should be considered.

4. Spatial nonuniformity of coarse-mode particulate matter in intraurban areas introduces substantial uncertainty into the results of epidemiological studies used to evaluate the necessary NAAQS level.

5. Supporting evidence is lacking to independently confirm the results of epidemiological studies used to evaluate the necessary NAAQS level.

6. The Policy Assessment Document (June 2010 Draft) incorrectly implies that globally-transported dust from Asian and African deserts is primarily in the coarse mode.

7. The lack of coarse PM compositional data introduces substantial uncertainty into the epidemiological study results used to evaluate the necessary NAAQS level.

Some of these comments echo similar technical comments submitted by the Coalition to EPA and CASAC concerning coarse-mode PM standards. Specifically, the Coalition has consistently and emphatically recommended that EPA (1) accelerate deployment of direct-measuring coarse PM monitors in many locations in the U.S., (2) evaluate compositional differences in coarse PM throughout the U.S., and (3) evaluate the surface characteristics of urban and rural coarse PM to determine if there is any basis for the assumption of the presence of toxic material carriers on urban coarse particles. The comments and recommendations in this presentation are consistent with the Coalition's long-standing, but as yet unaddressed recommendations.

1. The proposed change in level of the 24-hour coarse-mode NAAQS to a three-year average 98th percentile value in the range of 65 to 85 micrograms per cubic meter is inappropriate and scientifically indefensible.

The Coalition believes that any change in the level of the 24-hour NAAQS for coarse-mode particulate matter is inappropriate and scientifically indefensible. We concur with the Administrator's previous conclusion summarized below in an excerpt from the Policy Assessment Document.

> *As discussed above, in the last review the Administrator retained the one-expected exceedance form of the primary 24-hour PM_{10} standard. This decision was linked to the overall conclusion that "the level of protection from coarse particles provided by the current 24-hour PM_{10} standard remains requisite to protect public health with an adequate margin of safety" (71 27 FR 61202). Because revising either the level or the form of the standard would have altered the protection provided, it was concluded that such changes "would not be appropriate based on the scientific evidence available at this time" (71 FR 21202). Therefore, the decision in the last review to retain the one-expected-exceedance form was part of the broader decision that the existing 24-hour standard provided requisite public health protection.*
> Policy Assessment Document, page 3-30.

The Coalition finds very little additional data concerning coarse-mode PM in the ISA published in December 2009 and the Policy Assessment that contradicts the above statement. The coarse mode particulate matter concentration data gaps continue to be substantial. Recent EPA analyses of PM_{10} 24-hour concentration data are technically flawed with respect to (1) the regional differences in coarse mode particulate concentrations and EPA's 98th percentile equivalency analyses, (2) the lack of consideration of background levels, and (3) the lack of consideration of localized nonattainment conditions. Each of these issues is discussed in turn.

Regional differences and EPA's 98th percentile equivalency analyses

The EPA 98th percentile equivalency analyses are summarized in Figure 3-7 (reproduced as Figure 1 below) of the Policy Assessment Document. This chart provides the foundation for EPA's conclusion that 87 micrograms per cubic meter for a 98th percentile-three year average is equivalent to 150 micrograms per cubic meter for PM_{10} data expressed on a one-exceedance per year basis.

Figure 3-7. Composite 3-year PM_{10} 98th percentile 24-hour average concentration versus the PM_{10} expected exceedance concentration-equivalent design value

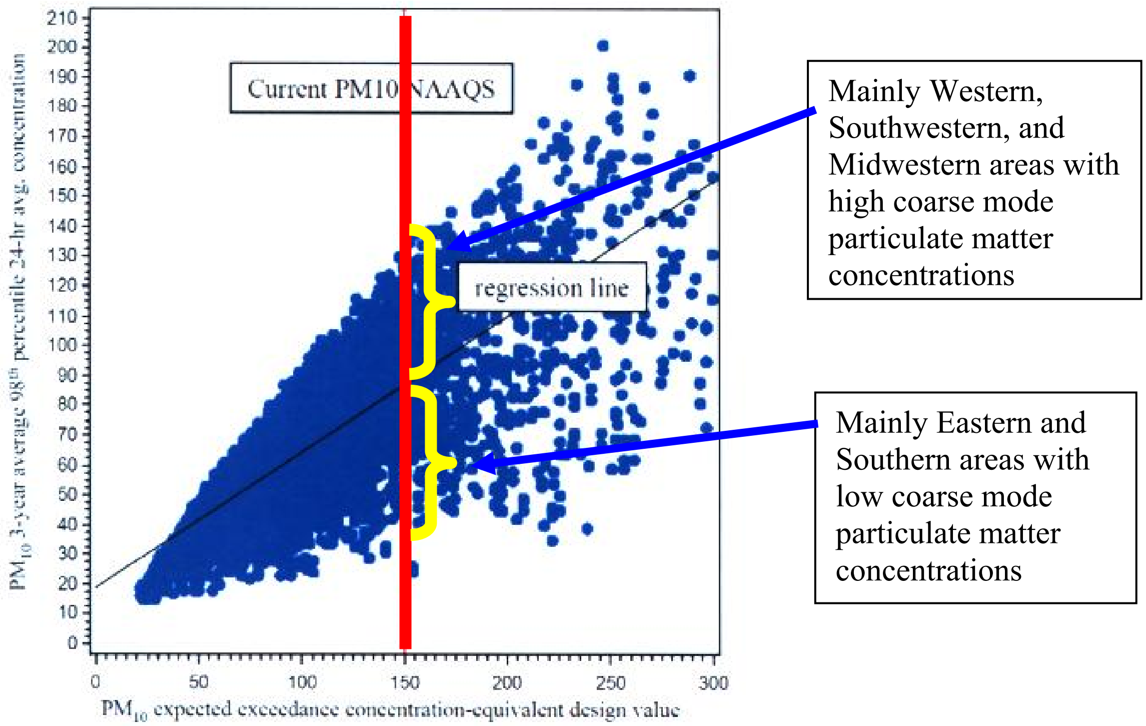

Figure 1. Reproduced Figure 3-7, Page 3-39 of the Policy Assessment Document (June 2010), Note: 150 microgram per cubic line highlighted and notes added on right

There is no clear reason to express the PM_{10} ambient air quality data using an array of PM_{10} standards on the horizontal axis—in fact, only the presently applicable NAAQS limit of 150 microgram per cubic meter concentration value is relevant. Accordingly, the Coalition has concentrated only on the distribution of PM_{10} data analysis on the 150 microgram per cubic meter line highlighted in Figure 1 above.

It is readily apparent that all of the monitored areas of the country having "equivalent 98th percentile concentrations" above EPA's regression line have equivalent concentrations well above the 87 micrograms per cubic meter value. In these areas, a revised NAAQS limit of 85 micrograms per cubic meter represents a moderate-to-significant increase in the stringency of a revised 24-hour NAAQS limit. As indicated in the EPA data summarized in Figure 2, the monitored areas with high 98th percentile PM_{10} concentrations include many urban areas in the West and Midwest. These areas have severe spiking due, in large part, to natural sources. In fact, these monitored areas in the U.S. are those areas where crustal mineral matter dominates the coarse mode particulate matter distribution.

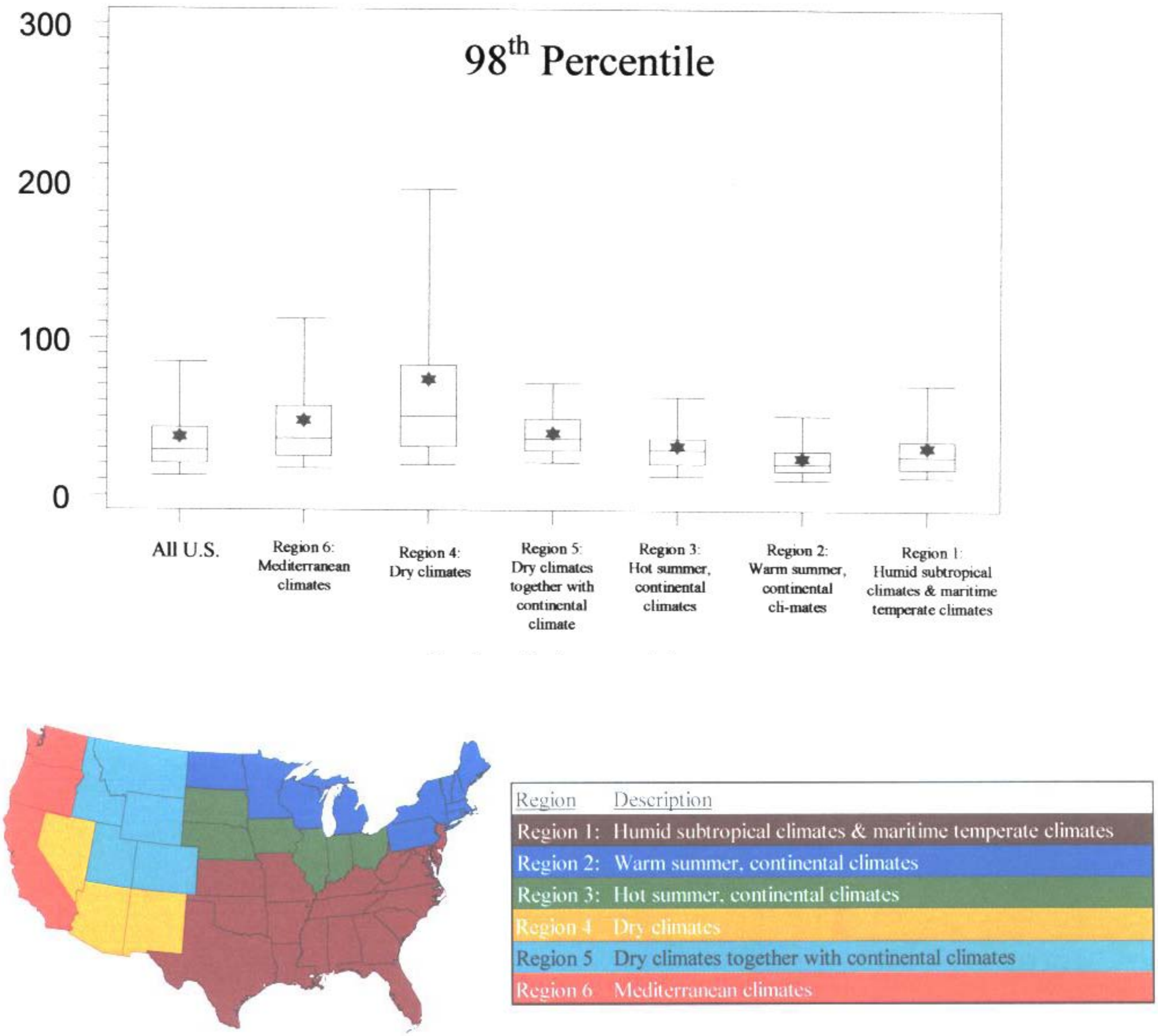

Figure 2. PM_{10} 98^{th} Percentile Values, Reproduced from Figure 3, Schmidt and Jackson (2010)

As written recently by one member of CASAC, crustal mineral material in coarse particulate matter is of less concern than coarse particles originating from or affected by combustion sources.

> *"There is consensus that resuspended crustal dust is less toxic than combustion products. There are clear regulatory implications as well. It's hard to regulate dust storms, but easier and more appropriate to regulate stationary and mobile sources."*
> *Compilation of Preliminary Pre-Meeting Comments, Dr. Joseph Brain, page 12*

However, EPA's flawed PM_{10} ambient data analyses now significantly tighten the standard on the areas in the West and Midwest dominated by "resuspended crustal dust" having lesser, if any, adverse health effects. As indicated in EPA's Figure 3-7, some areas of the West and Midwest having equivalent 24-hour 98th percentile values of more than 120 micrograms per cubic meter will be subject to a revised NAAQS in the range of 65 to 85 micrograms per cubic meter. For these areas, this proposed change is a tightening of the standard by a factor of up to 2—a major and perhaps unprecedented increase in the stringency of a NAAQS. Tightening the NAAQS focuses almost entirely on the West and Midwest where the coarse mode is dominated by resuspended crustal particulate matter that the scientific community accepts as significantly less consequential than "eastern-urban" coarse mode particulate.

Conversely, EPA's 87 microgram "equivalent" 98th percentile concentration loosens the 24-hour coarse mode particulate matter standard in areas of the East and South where the coarse particulate matter concentrations are lower, and the frequency of coarse mode particulate matter spiking is low relative to the West, Southwest, and Midwest. If, in fact, there is surface-contaminated coarse mode particulate matter as alleged by EPA, this coarse mode particulate matter is most significant in urban areas of the East and South. It is in these Eastern and Southern areas where EPA claims that coarse mode particulate matter has the greatest adverse health effects. These are the very areas for which EPA proposes a loosening of the 24-hour NAAQS for coarse mode (PM_{10} as indictor) standard.

EPA's analysis makes no sense—inherently tightening the standard in areas of the country dominated by non-consequential crustal dust and loosening the standard in areas where EPA believes the coarse mode dust is surface-contaminated coarse mode particulate matter.

In fact, national standards should not be set on some form of "average" equivalent 98th concentration as stated on page 3-38 of the Policy Assessment Document (June 2010 Draft).

> *As a consequence, while we note that a 98th percentile 24-hour PM_{10} standard with a level of 87 μg/m^3 would be expected to provide public health protection that is* ***, on average*** *[emphasis added] across the U.S., equivalent to the protection provided by the current standard, in some locations such a 98th percentile standard could be more protective than the current standard while in other locations it could be less protective than the current standard.*

EPA's analyses of PM_{10} 24-hour concentration data must go well beyond the analyses presented in the Policy Assessment Document (June 2010 Draft) and beyond the analyses include in the ISA. It would be helpful to expand upon the discussion of the distribution of results at 150 micrograms per cubic meter provided on page 3-38 and reproduced below.

> *However, as indicated in Figure 3-7, the range of equivalent concentrations varies considerably across monitoring sites (95% confidence interval ranges from 63 to 111 μg/m^3) (see Schmidt and Jenkins, 2010). Policy Assessment Document (June 2010 Draft), page 3-38.*

Specifically, it would be helpful to know the values at the upper 98th, 99th, and 99.9th percentile confidence intervals for this distribution.

The PM_{10} 24-hour concentration data analyses summarized in EPA's Figure 3-37 also raised a number of significant, but unaddressed issues. There is no summary of the areas of the country that presently do not have PM_{10} monitors and are therefore not considered in EPA's "equivalency' analyses. The Coalition is aware of many areas in the West and Midwest, especially nonurban areas, where there are no PM_{10} monitors. In fact, some of these areas are easily identified simply by comparing EPA's AIRs database information concerning the geographical distribution of PM_{10} monitors and county-average PM_{10} emissions. As indicated in the graphs included in AIRs for midwestern, southwestern and western states, there are numerous high emission areas without any nearby PM_{10} monitors. All of these areas are subject to frequent coarse mode concentration spiking due to natural dust emission sources, exceptional meteorological dust generating events, agricultural sources, and unpaved road emissions. Inclusion of these areas could significantly affect the distribution of 98th percentile equivalent concentrations. Does EPA intend to simply ignore these presently unmonitored areas and events?

It would also be helpful for EPA to include some evaluation of the sufficiency of PM_{10} 24-hour data used in preparing the equivalency evaluations. For example, have inconsistent practices by state and local agencies with respect to classification of exceptional effects affected the distribution of "98th percentile equivalent" concentrations? Have data quality problems affected the frequency of observed PM_{10} concentration spikes? These questions are relevant to any proposed change in the level of the coarse mode particulate matter NAAQS.

Lack of EPA consideration of PM_{10} background concentrations

The Coalition finds little, if any, substantial discussion in the Policy Assessment Document (June 2010 Draft) concerning the PM_{10} background concentrations in various parts of the U.S. In fact, even the ISA section 3.5 has very little substantial information.

The Coalition has significant concerns that a revised NAAQS set in the range of 65 to 85 micrograms per cubic meter, 98th percentile will be at or below the background concentrations in many parts of the West, Southwest, and Midwest. As a starting point in evaluating the existing background levels, Coalition members have reviewed the background PM_{10} 24-hour concentration values specified by various state and local agencies for dispersion modeling analyses. The Coalition acknowledges that these background levels are based on the one-exceedance data format; however, in the West, Southwest, and Midwest, the Coalition believes that the 98th percentile values and one-exceedance per year values are numerically similar. Accordingly, a review of presently stipulated background concentrations in modeling studies is entirely appropriate.

Table 1 provides a summary of the PM_{10} 24-hour background levels stipulated by the State of Utah for each county. These background levels range from a low of 28 micrograms per cubic meter to 141 micrograms per cubic meter. Most of the county background levels are in the range of 65 to 85 micrograms per cubic meter—similar to the range of values being considered by EPA as NAAQS.

Coalition members report that PM_{10} 24-hour concentration values in areas such as Phoenix are also at or above the range of values being considered by EPA as NAAQS. The PM_{10} 24-hour background concentrations in the East and South are lower—usually in the range of 25 to 45 micrograms per cubic meter. However, areas of the East and South dominated by agricultural sources and rural unpaved roads could have background levels at or above the range being considered by EPA. For example, background data required in modeling in North Carolina, South Carolina, and Georgia are provided in Table 2.

Table 1. Utah PM_{10} 24-Hour Concentration Levels

County	PM_{10}, 24-hour concentration, $\mu g/m^3$	Reference
Beaver	83	Greymont
Box Elder	96	Brigham C
Cachen	93	Logan
Carbon	67	Moab
Daggett	28	Estimate
Davis	86	Bountiful
Duchesne	63	Vernal
Emery	67	Moab
Garfield	72	Nevco
Grand	67	Moab
Iron	83	Graymont
Juab	59	Panda
Kane	83	Graymont
Millard	83	Graymont
Morgan	72	Estimate
Piute	72	Nevco
Rich	28	Estimate
Salt Lake	123	NSL
San Juan	67	Moab
Sanpete	59	Panda
Sevier	72	Nevco
Summit	86	Estimate
Tooele	86	Estimate
Uintah	63	Vernal
Utah	141	N. Provo
Wasatch	72	Estimate
Washington	86	St. George
Wayne	67	Moab
Weber	134	Ogden

Background PM_{10} 24-hour concentration data for Cass County, Nebraska provide an indication of the levels present in a midwestern area dominated by agricultural sources. The state-specified background levels for that area were 60 micrograms per cubic meter—a value very close to the NAAQS range being considered by EPA.

The background data compiled by the Coalition strongly suggest that the revised NAAQS being considered by EPA is at or below the background levels that exist in many parts of the country and well below the background levels that exist in the West and Midwest.

Table 2. Background PM_{10} 24-Hour Concentrations, Southern U.S.		
State	Location	PM_{10}, 24-hour Concentration, $\mu g/m^3$
North Carolina	Bakers	39.0
	Richmond	77.0
South Carolina	Cayce	56.0
	North Columbia	56.0
	Orangeburg	32.0
	Chesterfield	46.0
	Rock Hill	45.0
Georgia	Augusta	38.0
	Warrenton	38.0
	Camak	38.0
	Ruby	38.0
	Jefferson	38.0

A revised NAAQS in the range of 65 to 85 micrograms per cubic meter (98^{th} percentile) will be unattainable in regions of the U.S. dominated by resuspended crustal particulate matter from natural sources, agricultural sources, and unpaved roads. It is clear from modeling studies conducted by Coalition members and many others that the background levels in many parts of the U.S. are above the proposed range. However, the Policy Assessment Document (June 2010 draft) is essentially silent on this major issue. In fact, the ISA section 3.6 presents very little information concerning the policy relevant background across the U.S.

Lack of consideration of localized nonattainment conditions

The dispersion modeling data provided by Coalition member companies provides some insight into the consequences of revising the NAAQS to a value between 65 and 85 micrograms per cubic meter (98^{th} percentile format). AERMOD dispersion models of a number of sources with a relatively wide range of emissions indicate that the maximum receptor point PM_{10} 24-hour concentration values are in the range of 10 to 30 micrograms per cubic meter over the background levels. While there is considerably less information available for agricultural sources and unpaved roads, it is highly probable that the maximum receptor point PM_{10} 24 hour concentrations for these sources are considerably higher than the 10 to 30 microgram range for sources similar to those of Coalition members. With the revised NAAQS in the range of 65 to 85 micrograms per cubic meter, many localized areas of nonattainment will be unnecessarily created, especially for sources of resuspended crustal dust.

Industrial, agricultural, and municipal (unpaved roads) creating localized nonattainment conditions due to resuspended crustal dust emissions will be subject to EPA and state enforcement and vigilante litigation. In fact, it will be unnecessarily burdensome on all farmers, towns owning and maintaining unpaved roads, and even operators of industrial facilities of Coalition members. Any person or organization with access to dispersion modeling and/or air quality monitoring services will quickly be able to demonstrate that small farms, unpaved roads, and industrial sources contribute to a non-attainment condition. The fact that the non-attainment condition is almost entirely due to natural or nontraditional sources will not be a mitigating factor in many cases. Farmers, towns, and industrial sources will share significant liability for localized nonattainment even when their contribution is quite small.

EPA has not addressed the issue of localized nonattainment in any of the discussions or analyses included in the Policy Assessment Document (June 2010 draft). The nonattainment evaluation in the Policy Assessment Document (June 2010 draft) is limited to nonattainment on a county-wide basis.

The Coalition recommends that EPA delay any reconsideration of the level of the 24-hour NAAQS relevant to coarse-mode particulate matter until (1) coarse PM monitoring data become available, (2) the equivalency of the 98th percentile format and one-exceedance per year format can be more fully evaluated for various regions of the U.S., (3) background levels can be more fully evaluated, and (4) the issues of localized nonattainment caused primarily by background concentrations can be more fully evaluated. The data and analyses included in the ISA and the Policy Assessment Document (June 2010) do not justify a change in the 24-hour coarse mode particulate matter NAAQS.

2. Effective control strategies to achieve a very low 24-hour coarse PM NAAQS are not clear.

All previous NAAQS were directed at pollutants for which anthropogenic sources were clearly dominant. SIP control strategies were directed at sources amenable to control. This is not necessarily the case with coarse PM. As indicated in Section 3 of the ISA and specifically in Table 3-2 (reproduced below as Figure 3), the major sources of coarse PM, especially in the West and Midwest, include, but are not limited to the following difficult-to-control source categories.

(1) Exceptional meteorological events
(2) Wind-blown fugitive dust from unvegetated surfaces,
(3) Controlled burns and wild fires
(4) Paved and unpaved roads,
(5) Agricultural harvesting and tilling,
(6) Sea salt spray in ocean coastal areas
(7) Globally transported dust from Asian and African deserts, and
(7) Pollen and other biological materials

Table 3-2. Constituents of atmospheric particles and their major sources.

	Primary (PM <2.5 µm)		Primary (PM >2.5 µm)		Secondary PM Precursors (PM <2.5 µm)	
Aerosol species	Natural	Anthropogenic	Natural	Anthropogenic	Natural	Anthropogenic
Sulfate (SO_4^{2-})	Sea spray	Fossil fuel combustion	Sea spray	—	Oxidation of reduced sulfur gases emitted by the oceans and wetlands and SO_2 and H_2S emitted by volcanism and forest fires	Oxidation of SO_2 emitted from fossil fuel combustion
Nitrate (NO_3^-)	—	—	—	—	Oxidation of NO_x produced by soils, forest fires, and lighting	Oxidation of NO_x emitted from fossil fuel combustion and in motor vehicle exhaust
Minerals	Erosion and re-entrainment	Fugitive dust from paved and unpaved roads, agriculture, forestry, construction, and demolition	Erosion and re-entrainment	Fugitive dust, paved and unpaved road dust, agriculture, forestry, construction, and demolition	—	—
Ammonium (NH_4^+)	—	—	—	—	Emissions of NH_3 from wild animals, and undisturbed soil	Emissions of NH_3 from animal husbandry, sewage, and fertilized land
Organic carbon (OC)	Wildfires	Prescribed burning, wood burning, motor vehicle exhaust, cooking and industrial processes	Soil humic matter	Tire and asphalt wear, paved and unpaved road dust	Oxidation of hydrocarbons emitted by vegetation (terpenes, waxes) and wild fires	Oxidation of hydrocarbons emitted by motor vehicles, prescribed burning, wood burning, solvent use and industrial processes
EC	Wildfires	Motor vehicle exhaust (mainly diesel), wood biomass burning, and cooking	—	Tire and asphalt wear, paved and unpaved road dust	—	—
Metals	Volcanic activity	Fossil fuel combustion, smelting and other metallurgical processes, and brake wear	Erosion, re-entrainment, and organic debris	—	—	—
Bioaerosols	Viruses and bacteria	—	Plant and insect fragments, pollen, fungal spores, and bacterial agglomerates	—	—	—

Dash (—) indicates either very minor source or no known source of component.
Source: U.S. EPA (2004).

Figure 3. Reproduced Table 3-2, Integrated Science Assessment (highlight box added)

The importance of difficult-to-control PM_{10} source categories such as unpaved roads, wild fires, prescribed burns, open burning of agricultural wastes, agricultural tilling and harvesting are also indicated by emission inventories compiled by the U.S. EPA and the State of California. For example, the latest available PM_{10} emission inventory published by EPA as part of the AIRs database suggested that unpaved and paved roads are responsible for approximately 50% of PM_{10} emissions in the U.S. Another dominant source included agricultural burning, a source that EPA classifies as "Miscellaneous." As indicated in Table 3, the State of California PM_{10}

emission inventory indicates that major PM_{10} sources include farming, paved roads, unpaved roads, managed burns, and wild fires—all difficult-to-control sources.

Table 3. California PM_{10} Emission	
Source Category	PM_{10} Emissions, % of Total CA PM_{10} Emissions
All Stationary Sources Combined	6.82
Farming Operations	6.91
Paved Roads	16.24
Unpaved Roads	20.74
Fugitive Windblown Dust	12.12
Managed Burning and Disposal	4.63
Wildfires	10.71
All Other Source Categories	21.83
Total	100.00

The California emission inventory does not include the significant PM_{10} emissions from the Owens and Mono Lake areas, which have difficult-to-control windblown dust emissions that are responsible for more than 6% of the total U.S. PM_{10} emissions.

Industrial process and fugitive emissions are responsible for a relatively small part of the total inventory of coarse PM primary emissions in some parts of the country. Secondary formation of coarse PM is at or near negligible levels. Accordingly, the control strategies that EPA expects states to implement to achieve a revised coarse PM NAAQS in the Southwest, Midwest, and West are not clear.

The Policy Assessment Document should explicitly address (1) the feasibility of coarse PM control within SIPs and (2) the possible impact of proposed NAAQS changes on a broad range of health issues. As part of the Policy Assessment Document, EPA should provide a thorough analysis of the extent to which at a new NAAQS standard can be achieved, especially in difficult-to-control regions of the U.S. such as the Southwest, Midwest, and West..

3. Arbitrary standard setting based on insufficient data will aggravate already severe unemployment, which is itself a major health problem that should be considered.

The Coalition is aware of the provisions in the Clean Air Act Amendments that preclude EPA from considering economic factors in setting health-based ambient air quality standards. The Coalition also recognizes the cost-benefit analysis limits summarized below in the excerpt from page 1-3 of the Policy Assessment Document (June 2010 Draft).

> *In setting standards that are "requisite" to protect public health and welfare, as provided in section 109(b), EPA's task is to establish standards that are neither more nor less stringent than necessary for these purposes. In so doing, EPA may not consider the costs*

> *of implementing the standards. See generally Whitman v. American Trucking Associations, 531 U.S. 457, 471, 14 475-76 (2001).* Policy Assessment Document (June 2010 Draft), page 1-3

However, the Coalition does not see anything in Whitman v American Trucking that precludes EPA from considering the very significant health issues related to unemployment, especially unemployment that is a direct result of a misguided NAAQS. This is not an issue of cost or even the economic viability of Coalition member companies, farmers, and other stakeholders. Instead, it is an issue concerning the health and well-being of those who are unemployed.

In an attempt to err on the side of caution to protect public health, EPA could be taking the very steps that lead to significant adverse health outcomes—those caused by lack of employment directly related to an inappropriately selected NAAQS limit.

The relationship between unemployment (especially recession-related unemployment) is addressed in papers by Charles and DeCicca (2008), Kuhn et al (2009), George Washington School of Public Health (2009), McLean et al (2005), Mathers and Schofield (1998), Perry et al (2009), Stuckler et al (2009), Torres (1991), and the World Health Organization (2003). Numerous additional studies address the complex relationship between life expectancy and economic well-being.

While the unemployment/health issue is especially complex, it must be considered in the standard-setting process due to the impact of the NAAQS on the ability of industrial sources to obtain permits to modify or expand operations. The ability of industrial sources to hire new employees is partially dependent on the availability of construction and operating permits. Setting standards potentially at or even below background levels also threatens the viability of existing sources and the employment of persons at these existing sources.

If EPA lowers the 24-hour coarse PM standard to a level of 65 to 85 $\mu g/m^3$ as suggested in the Policy Assessment Document (June 2010 Draft), it takes the risk of increasing already severe unemployment or slowing employment growth, especially in arid and agriculturally-oriented regions of the Midwest, Southwest, and West. Throughout the Policy Assessment Document (June 2010 Draft), EPA stretches far beyond the available coarse particulate matter concentration and health effects data out of an excess of caution to provide a “margin-of-safety.” In so doing, EPA is turning a blind eye toward the health impact on a very important part of the U.S. population—the unemployed.

4. Spatial nonuniformity of coarse-mode particulate matter in intraurban areas introduces substantial uncertainty into the results of epidemiological studies used to evaluate necessary NAAQS level.

As indicated in the following excerpts from the Policy Assessment Document (June 2010 Draft), EPA has correctly identified the spatial nonuniformity of thoracic coarse-mode particulate matter as a major source of uncertainty.

> *The ISA (sections 2.3.3, 2.3.4) concludes that an important uncertainty in the $PM_{10-2.5}$ epidemiologic literature is that associated with the air quality estimates used in these studies. Specifically, the ISA concludes that there is greater error in estimating ambient exposures to $PM_{10-2.5}$ than to $PM_{2.5}$ and that such uncertainty is a particularly relevant consideration when interpreting $PM_{10-2.5}$ epidemiologic studies. Contributing to this uncertainty is the relatively limited spatial coverage provided by existing $PM_{10-2.5}$ monitors (US EPA, 2009a, sections 2.2.3, 2.3.3, 2.3.4, 3.5.1.1 and see above).*
> Page 3-15, Policy Assessment Document, June 2010 Draft

> *Epidemiologic studies currently use a variety of approaches to measure/estimate $PM_{10-2.5}$ concentrations. It is important that we better understand the relationship between results from studies that estimate $PM_{10-2.5}$ concentrations using either (1) difference method of colocated monitors, (2) difference method of county-wide averages of PM_{10} and $PM_{2.5}$, or (3) direct measurement of $PM_{10-2.5}$ using a dichotomous sampler.*
> Page 3-46, Policy Assessment Document, June 2010 Draft

Significant spatial variations in thoracic coarse particulate matter are to be expected given the high terminal settling velocities and deposition rates of these particles. These particles have relatively short atmospheric residence times and quickly deposit in localized areas around roadways, construction sites, industrial sources, agricultural operations, and natural areas vulnerable to wind erosion. The short residence times and limited atmospheric dispersion of thoracic coarse particles have been discussed extensively by a number of researchers, including but not limited to Blanchard et al (1999), Chen et al (2007), Chow et al (1999), Chow et al (2000), Chow and Watson (2001), Freiman et al (2006), Koutrakis et al (2005), Thornburg et al (2009), Wilson and Suh (1997), and Wilson et al (2005).

Furthermore, the significant spatial variability of thoracic coarse particulate matter has also been observed repeatedly by Coarse Particulate Matter Coalition members using ambient air monitors on and near plant property. Monitor movement over distances as short as 100 meters can result in substantial changes in the observed coarse particulate matter concentrations.

While EPA recognizes the issue of coarse-mode particulate matter spatial nonuniformity even in localized areas, the Coarse Particulate Matter Coalition was surprised that the ISA published in December 2009 included very limited information concerning spatial variability analyses for coarse-mode particulate matter. It is apparent that ISA Chapter 3, Section 3.5.1 and the relevant portions of Annex A of the ISA primarily address only $PM_{2.5}$ and PM_{10}—there is little information specifically relevant to $PM_{2.5-10}$. The coefficients of divergence provided in the ISA in Section 3.5.1 and Annex A for PM_{10} do not represent the coefficient of divergent values for $PM_{2.5-10}$. Despite the fact that six months have passed since the ISA was finalized, EPA staff personnel have not progressed in their analysis of coarse PM spatial nonuniformity. In fact, data are available to support an evaluation of coarse particulate matter spatial nonuniformity in EPA's AQS database.

The Coarse Particulate Matter Coalition has downloaded 24-hour PM_{10} and $PM_{2.5}$ data from monitoring sites providing data to the AQS. The Coalition has restricted this evaluation to the following three urban areas highlighted in the ISA and Policy Assessment.

Pittsburgh, 2009 data
Phoenix, 2007 data
Los Angeles, 2007 data

The Coalition has further restricted the evaluation to only those monitoring sites that have collocated PM_{10} and $PM_{2.5}$ monitors providing 24-hour average data. Using this approach, the Coalition calculated the $PM_{2.5\text{-}10}$ concentration based on the difference between the two collocated monitors operating simultaneously. While the Coalition does not enthusiastically support coarse PM measurement by "difference," this is presently the only publicly available coarse particulate matter data. The Coalition compared the coarse particulate matter data for each monitoring site with values measured simultaneously at similar monitoring sites in the same urban area.

The Coalition chose Pittsburgh because it was one of the 15 urban areas discussed in the ISA and because it represents an eastern city with moderate-to-high $PM_{2.5}$ concentrations. Pittsburgh is also of interest because many of the industrial sources and air quality monitors are located in river valleys that affect pollutant dispersion and transport. For 2009, the Coalition was able to locate data for four monitoring sites in the Greater Pittsburgh area that had collocated PM_{10} and $PM_{2.5}$ monitors.

Phoenix was also one of the 15 specific urban area addressed by EPA in the ISA and Policy Assessment. Coarse particulate matter dominates Phoenix's particulate matter air quality. There are three monitoring sites in the city with collocated PM_{10} and $PM_{2.5}$ monitors, and these sites are relatively closely spaced.

Los Angeles represents a relatively unique urban area due to its geographical scale, complex topography, semi-arid climate, and moderate-to-high $PM_{2.5}$ levels. In 2006, a total of six monitoring locations had collocated PM_{10} and $PM_{2.5}$ monitors. In subsequent years, several of the sites with collocated 24-hour FRMs were converted to continuous monitoring stations. The Coalition chose to use the 2007 data set, which had the maximum number of 24-hour FRM samplers representative of most of the monitoring sites in the U.S.

The Coalition has calculated the coefficients of divergence ("COD") for the monitors in these three cities using Equation 1 shown in the ISA (page 3-60) and in Wilson (2005). With this coefficient, a value of zero indicates no divergence, and a value of one indicates extreme divergence.

$$COD = \sqrt{\left(\frac{1}{p} \sum_{i=1}^{i=n} \left(\frac{X_{ij} - X_{ik}}{X_{ij} + X_{ik}} \right)^2 \right)} \qquad \text{Equation 1}$$

The results of these calculations are provided in Tables 4, 5, and 6. The CODs ranged from 0.30 to 0.47 for Pittsburgh (Table 4), 0.19 to 0.42 for Los Angeles (Table 5), and 0.22 to 0.36 for Phoenix (Table 6). All of these ranges are substantially above the $PM_{2.5}$ and PM_{10} COD values reported by EPA in the ISA and the Policy Assessment Document. For example, the COD for $PM_{2.5}$ data among $PM_{2.5}$ monitors in Pittsburgh averaged 0.15 and ranged from 0.09 to 0.22.

These calculations demonstrate that the spatial nonuniformity of the coarse particulate matter data is substantially greater than those for $PM_{2.5}$ and PM_{10}. These calculations support the conclusion that considerable uncertainty exists in the results of epidemiology studies relying on county-wide average concentrations.

Table 4. Coefficient of Divergence Values, Pittsburgh, PA Coarse Particulate Matter (Four monitoring sites in Allegheny County)

Monitoring Site	64	67	1301	3007
64	0	0.41	0.41	0.35
67		0	0.48	0.30
1301			0	0.47
3007				0

Table 5. Coefficient of Divergence Values, Los Angeles, CA Coarse Particulate Matter (Six monitoring sites in Los Angeles County)

Monitoring Site	2	1002	1103	4002	2002	9033
2	0	0.19	0.23	0.28	0.36	0.26
1002		0	0.32	0.23	0.29	0.34
1103			0	0.20	0.42	0.27
4002				0	0.40	0.29
2002					0	0.41
9033						0

Table 6. Coefficient of Divergence Values, Phoenix, AZ, Coarse Particulate Matter (Three monitoring sites in Maricopa County)

Monitoring Site	1003	4003	7020
1003	0	0.36	0.35
4003		0	0.22
7020			0

It is important to note that the four monitoring sites for Pittsburgh almost certainly do not fully characterize the extent of nonuniformity in metropolitan Pittsburgh and the surrounding suburbs in Allegheny County. Some of the highest coarse PM levels might be in industrial river valley locations that do not presently have collocated PM_{10} and $PM_{2.5}$ monitors or direct reading coarse PM monitors. There are simply an insufficient number of monitors to adequately apply difference calculations to estimate coarse-mode particulate matter spatial nonuniformity. Los Angeles County and Maricopa County (Phoenix) have similar monitoring site limitations.

The day-by-day monitoring data available in the AQS can be used to go beyond the COD to further suggest the extent of coarse particulate matter spatial nonuniformity. In Figures 4 through 6, trend lines from sixth-day point to sixth-day point have been added to demonstrate the shifts in the highest concentration values. These trend lines are meant for illustrative purposes and do not imply any data applicable to the five-day periods between each monitoring period. In the case of Pittsburgh, the highest coarse PM concentrations are not always at the same monitor. Unlike the conditions associated with $PM_{2.5}$, these variations suggest that regional air masses are not a dominant factor affecting coarse PM emissions. The variations are due to factors that, at most, affect only a small subset of the monitoring sites. This leads to a question that cannot presently be addressed due to the severe lack of coarse particulate matter data—are there opposing trends in coarse PM air quality in intraurban areas where on specific days the concentrations in some parts of a county decrease while concentrations increase in other parts of the county? If so, a spatial average concentration value used in an epidemiological study is of limited usefulness.

One of the characteristics of coarse PM concentration profiles evident from Figures 4, 5, and 6 is the day-to-day spiking characteristics. The coarse PM is not well characterized by a single average concentration value even for a single monitoring site directly and accurately measuring coarse PM. The spiking characteristics appear more pronounced for coarse-mode as compared to fine-mode particulate matter. This introduces additional uncertainty into the epidemiological results because of the significant differences that might exist in individual exposures.

The spiking characteristics apparent in the urban-oriented data shown in Figures 4, 5 and 6 are also readily apparent near farms and natural areas subject to wind erosion and dust entrainment. Gusts of wind create short-term spikes of coarse-mode particulate matter. The 24-hour concentrations created by ambient winds acting on arid or agriculturally disturbed soils can generate high coarse-mode concentrations. While the coarse-mode NAAQS ultimately promulgated by EPA will apply nationally, the epidemiological studies in the ISA and Policy Assessment have a heavy urban emphasis. There is extreme uncertainty in the coarse PM exposure conditions downwind of farms during tilling and harvesting. Extreme uncertainty also exists concerning coarse-mode concentrations downwind of controlled burns, wild fires, and natural wind erosion in arid portions of the West and Midwest. Ambient coarse-mode concentration data in rural and arid portions of the West are even less well-characterized than in the major urban areas. Any changes in the coarse PM NAAQS are premature until coarse-mode concentration data are available for a large part of the U.S—urban and rural.

In concluding our comments concerning coarse PM spatial nonuniformity, the Coalition disagrees with the statement reproduced below from page 3-15 of the Policy Assessment.

> *The net effect of these uncertainties on epidemiologic studies of $PM_{10-2.5}$ is to bias the results of such studies toward the null hypothesis.*
> Policy Assessment Document (June 2010 Draft), page 3-15

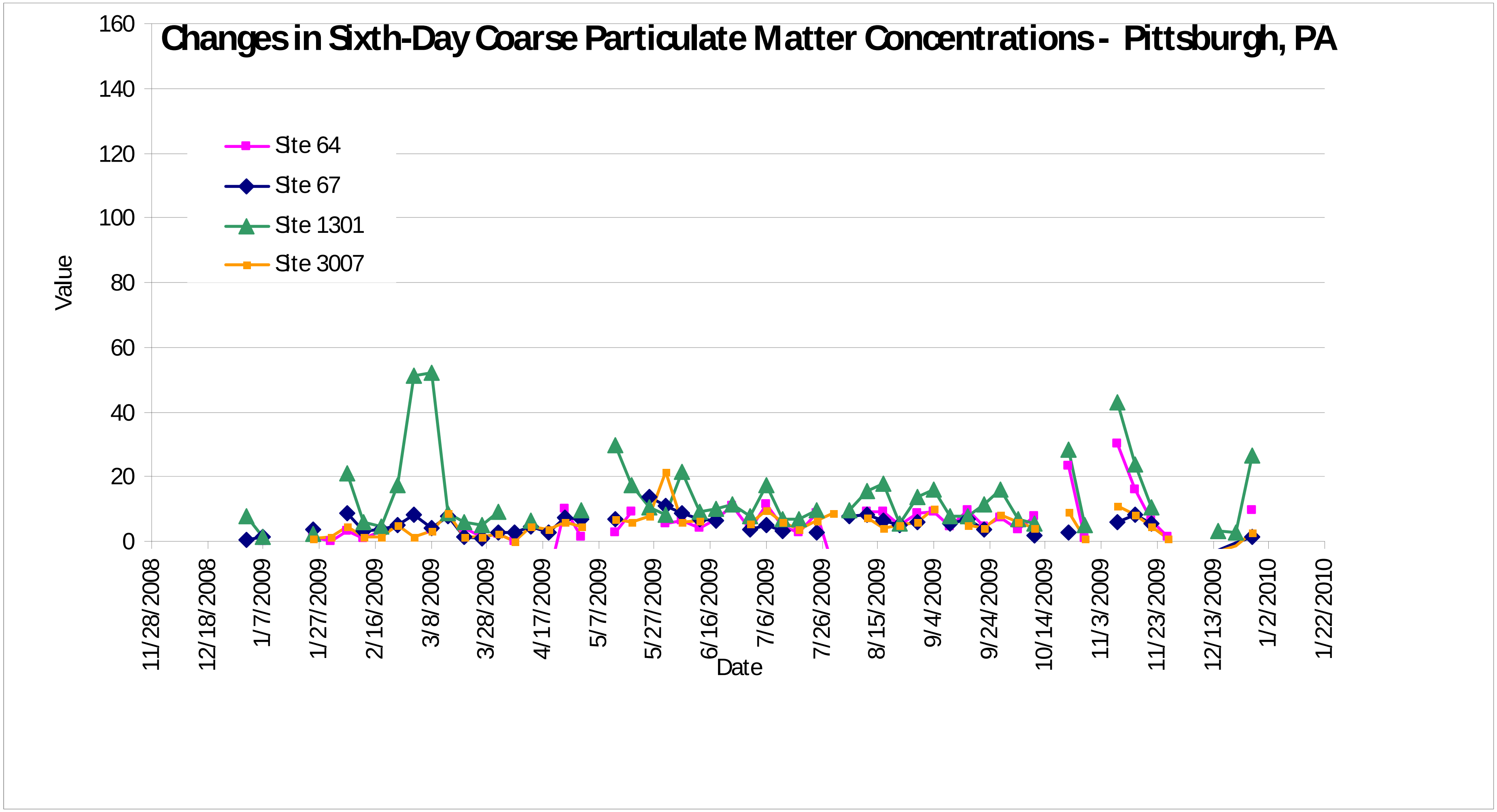

Figure 4. Pittsburgh Coarse Particulate Matter Concentrations Calculated by Difference from Collocated PM_{10} and $PM_{2.5}$ Monitors

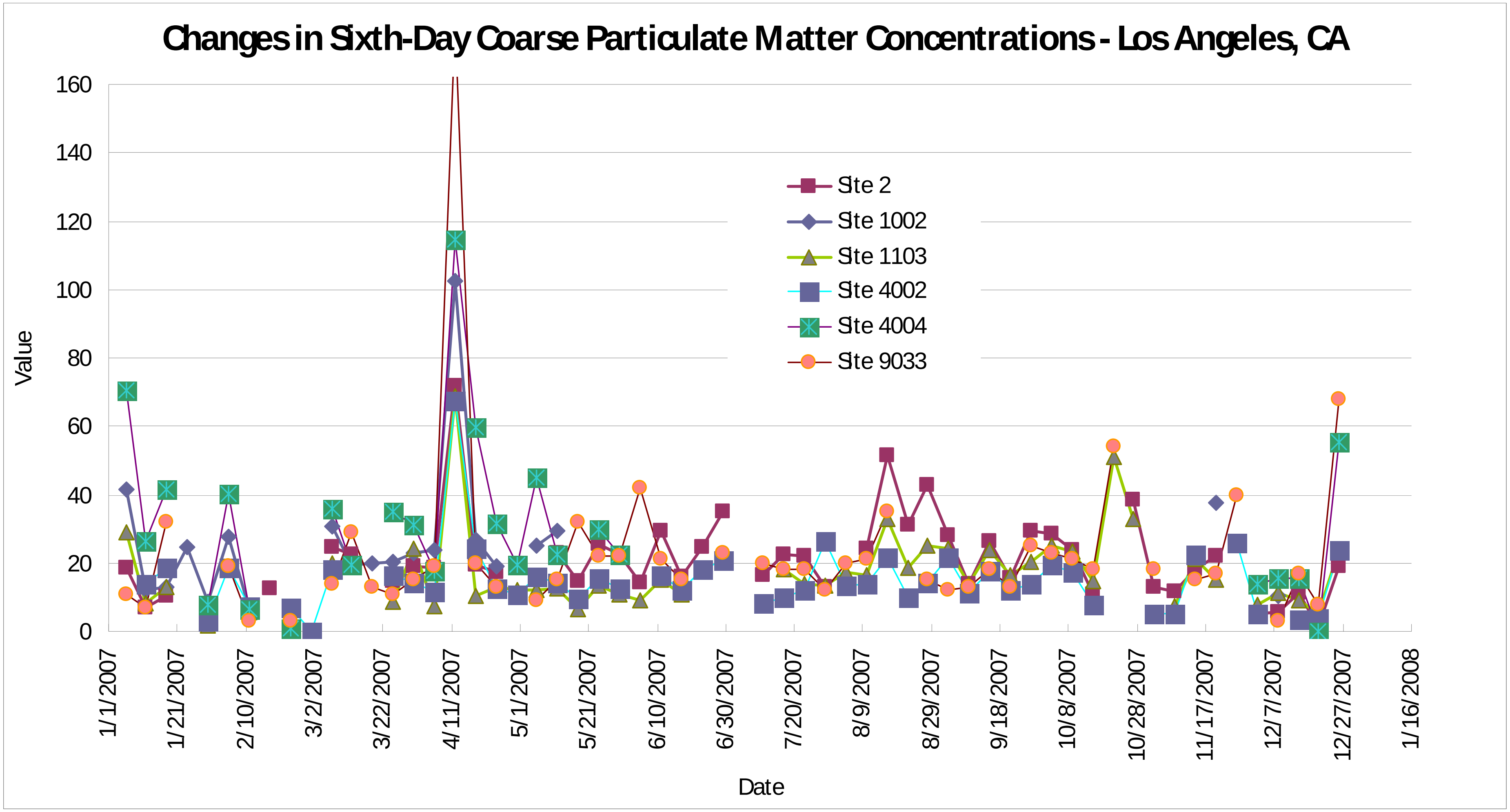

Figure 5. Los Angeles Coarse Particulate Matter Concentrations Calculated by Difference from Collocated PM_{10} and $PM_{2.5}$ Monitors

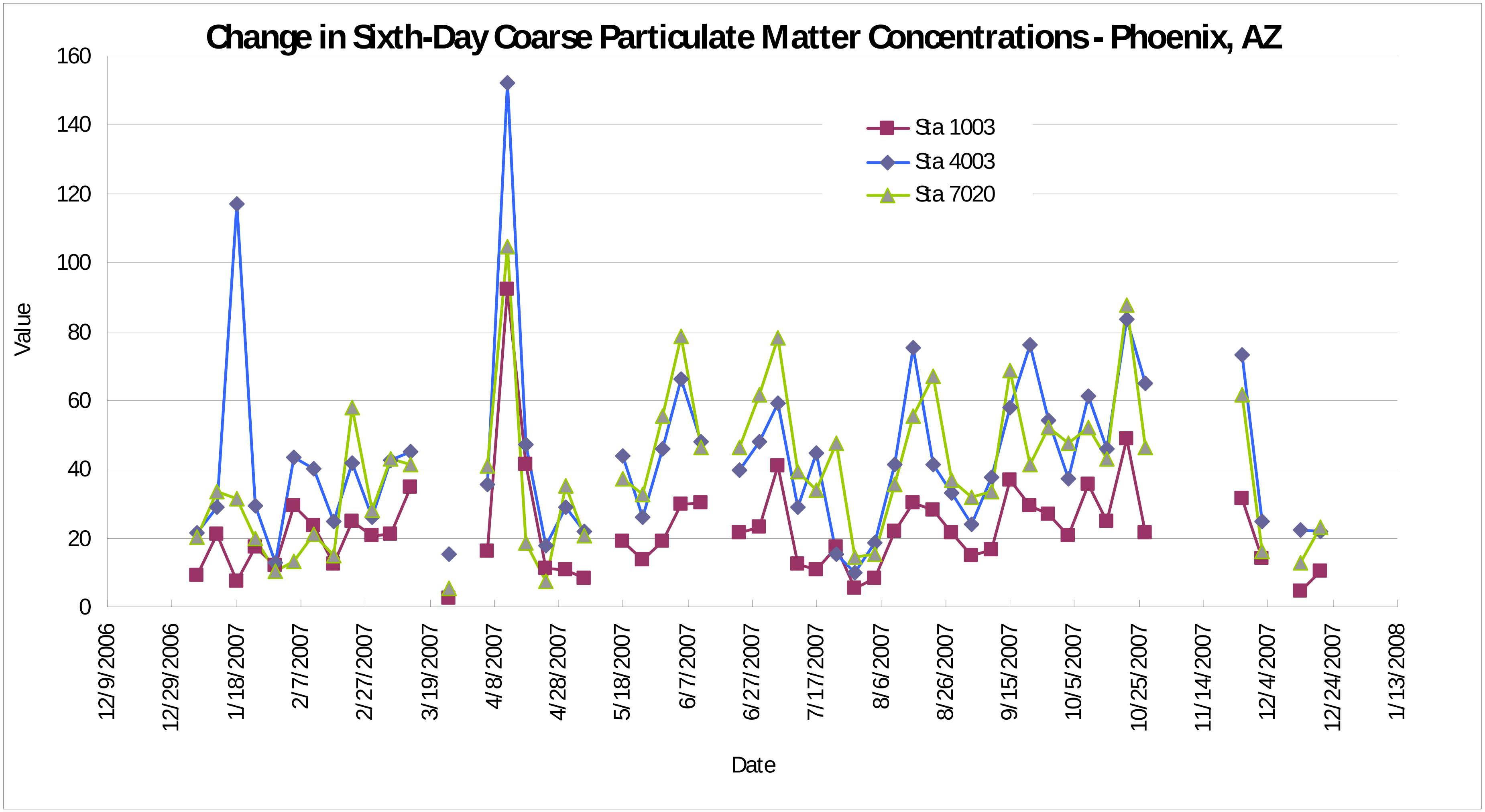

Figure 6. Phoenix Coarse Particulate Matter Concentrations Calculated by Difference from Collocated PM_{10} and $PM_{2.5}$ Monitors

The lack of data characterizing coarse PM spatial nonuniformity does not in any way change the number of hospital admissions or any other health indicators observed in the epidemiological studies cited in the ISA. The lack of data simply means that the researcher did not have adequate knowledge regarding the range of concentrations that might have contributed to the adverse health effects. Indeed, the health effects reported in the epidemiological studies might well have been caused by high concentrations in one or more very localized areas. The air quality analyses in these studies based on county-wide averages or other single monitor values were not sufficient to identify the presence or absence of these localized conditions.

Without adequate data on the spatial nonuniformity of the concentrations, the health outcome cannot be adequately matched to the dose. It is possible that the results of some of the epidemiological studies are significantly impaired by this lack of information.

It is also important to note that the extent of spatial nonuniformity in coarse PM concentrations between urban areas or between urban and rural areas cannot be assessed at this time due to the severe lack of coarse PM data. Accordingly, it would be premature, and almost certainly incorrect, to assume that the average-to-peak concentrations in study areas are consistent from city-to-city and state-to-state. The only practical means to adequately assess coarse PM health effects is to do the work necessary to measure coarse PM directly in a reasonable number of locations in the study area. There is no substitute for adequate data.

5. Supporting evidence is lacking to independently confirm the results of epidemiological studies used to evaluate the NAAQS level.

Section 3 of the Policy Assessment Document indicates that EPA would consider reducing the 24-hour standard applicable to coarse particulate matter to a value between 65 and 85 micrograms per cubic meter evaluated based on the three-year average 98^{th} percentile concentration. This is a major change in the stringency of the coarse standard that is not supported by the coarse PM air quality data and health effects studies described in the ISA. Considerable independent data are needed to confirm the suggestive relationships claimed by EPA in Section 3. The Coalition does not find sufficient confirming evidence in the ISA or the Policy Assessment.

In this section, the Coalition focuses on two possible types of confirming evidence: (1) a clear dose-response relationship based on data from urban and rural areas across the U.S. experiencing a wide range of coarse PM concentrations and (2) toxicological studies that clearly point to a plausible mechanism for coarse PM-induced health effects.

Dose-Response Relationships

The NAAQS are dose-based standards that apply across the entire U.S. Based on the regulatory history described in Section 1 of the Policy Assessment Document, EPA has concluded that rural crustal emissions cannot be addressed differently than urban coarse PM. As indicated in the ISA, the coarse concentrations are higher in the arid and rural portions of western U.S. than in the eastern U.S. These differences are apparent in the coarse PM data shown in Figures 4, 5 and 6, whichhave the lowest concentrations in Pittsburgh, moderate concentrations in Los Angeles, and relatively high concentrations in Phoenix. Other coarse data that can be recovered from PM_{10} and $PM_{2.5}$ data in the AQS illustrate similar regional differences.

If the health effects of coarse PM are truly a function of the total coarse PM without regard to composition, then there logically should be greater coarse PM-related health effects in the arid areas in the West than in the East. That is not indicated by the various health effects studies summarized in Chapter 3 of the Policy Assessment Document or in the ISA.

In considering the necessary coarse PM standard, EPA must now look beyond the urban areas that are the focus of the Policy Assessment Document, Chapter 3, and consider the coarse PM levels in rural background and rural agricultural areas.

To confirm the epidemiological study results summarized in the Policy Assessment Document, there should be a reasonable dose-response relationship. If no dose-response relationship is apparent, then EPA must look for specific components of coarse particulate matter or look for co-pollutants such as $PM_{2.5}$ to explain any observe health effects. Until a dose-response relationship becomes clear, changing the coarse PM NAAQS is premature.

There has been some discussion that the epidemiological studies inherently underestimate adverse health outcomes because they are inherently limited to time-series analyses focusing on one or more lag days from the step changes in particulate matter concentration. The analyses of health issues over a broad geographical area with a wide range of coarse PM concentrations should provide a means to identify any of these undetected health concerns. However, the data included in the ISA do not appear consistent with the conclusion that higher levels of coarse PM are necessarily associated with a corresponding increase in adverse health effects.

Toxicological Studies

The Policy Assessment Document (June 2010 Draft) correctly states the need for considerable additional toxicological data to identify and clarify mechanisms of injury caused by coarse particulate matter. Considering the severe lack of such information, it is premature to conclude that any observed relationship between coarse particulate matter exposure and adverse health effects is anything but a secondary relationship.

6. The Policy Assessment Document (June 2010 Draft) incorrectly implies that globally-transported dust from Asian and African deserts is primarily in the coarse mode.

Section 3 of the Policy Assessment Document presents a lengthy discussion of the possible health implications of dust storms originating in Asian and African deserts. On page 3-14 of Section 3, EPA stated the following:

> *As discussed above, most $PM_{10-2.5}$ epidemiologic studies have been conducted in urban locations in the U.S., Canada, and Europe while a small number of studies have examined the health impacts of dust storm events (US EPA, 2009a, sections 6.2.10.1, 6.5.2.3). Although these dust storm studies do not link specific particle constituents to health effects, it is useful to consider them within the context of the toxicity of particles of*

> *non-urban crustal origin. Several studies have reported positive and statistically significant associations between dust storm events and morbidity or mortality, including the following:*
>
> - *Middleton et al. (2008) reported that dust storms in Cyprus were associated with a statistically significant increase in risk of hospitalization for all causes and a non-significant increase in hospitalizations for cardiovascular disease.*
>
> - *Chan et al. (2008) studied the effects of Asian dust storms on cardiovascular hospital admissions in Taipei, Taiwan and reported a statistically significant increase associated with 39 Asian dust events. Evaluating the same data, Bell et al. (2008) also reported positive and statistically significant associations between hospitalization for ischemic heart disease and $PM_{10\text{-}2.5}$.*
>
> - *Perez et al. (2008) tested the hypothesis that outbreaks of Saharan dust exacerbate the effects of $PM_{10\text{-}2.5}$ on daily mortality in Spain. During Saharan dust days, the $PM_{10\text{-}2.5}$ effect estimate was larger than on non-dust days and it became statistically significant, whereas it was not statistically significant on non-dust days.*
>
> *In contrast to the studies noted above, some dust storm studies have reported associations that were not statistically significant. Specifically, Bennett et al. (2006) reported on a dust storm in the Gobi desert that transported PM across the Pacific Ocean, reaching western North America in the spring of 1998. The authors reported no excess risk of cardiac or respiratory hospital admissions associated with the dust storm in the population of British Columbia's Lower Fraser Valley (Bennett et al., 2006). In addition, Yang et al. (2009) reported that hospitalizations for congestive heart failure were elevated during or immediately following 54 Asian dust storm events, though effect estimates were not statistically significant. The implications of these studies for the current review, for consideration of potential standard indicators, are discussed below.*
> EPA Policy Assessment Document (June 2010 Draft), Page 3-14.

EPA continued with their discussion of dust storm issues with the following statement provided on pages 3-15 and 3-16:

> *Another uncertainty results from the relative lack of information on the chemical and biological composition of $PM_{10\text{-}2.5}$, and the effects associated with the various components (ISA, section 2.3.4). As discussed above, a few recent studies have evaluated associations between health effects and particles of non-urban, crustal origin by evaluating the health impacts of sand storm events. Though these studies provide some information on the health effects of particles that likely differ in composition from the particles of urban origin that are typically studied, without more information on the chemical speciation of $PM_{10\text{-}2.5}$, the apparent variability in associations with health effects across locations is difficult to characterize (US EPA, 2009a, 3 section 6.5.2.3).*

EPA Policy Assessment (June 2010 Draft), Pages 3-15 to 3-16

Implicit in Section 3 of the Policy Assessment Document is EPA's apparent assumption that the dust arriving in the U.S. due to Asian and African desert dust storms is primarily in the coarse mode. The assumption is inconsistent with particle size data obtained in numerous studies. Data provided in papers such as Gomes and Gillette (1993), Syzkman et al (2003), VanCurren et al (2002), Prospero (1996 and 1999), Bennett (2005), McKendry (2001), and Schultz and Serbert (1987) indicate that the mass median diameter of dust transported globally is in a size range close to or below 2.5 micrometers. It is apparent that dust storm particles are present in both the coarse mode and fine mode; however, it is not appropriate to assign observed health effects to coarse-mode particulate matter simply because the measured PM_{10} levels have increased.

All of the Asian and African dust storm discussions in the Policy Assessment Document should be substantially revised. This information should be discussed in both sections 2 and 3 of the document or deleted entirely. No conclusions regarding coarse-mode health effects should be based on the data cited in the Policy Assessment Document (June 2010 Draft) regarding globally transported dust.

7. The lack of coarse PM compositional data introduces substantial uncertainty into the epidemiological study results used to evaluate the necessary NAAQS level.

The Coalition continues to recommend that EPA compile and evaluate the variations in composition of coarse PM in both urban and rural areas of the U.S. The Coalition also believes that a thorough understanding of the variations in the composition of coarse and fine-mode particulate matter should be included in epidemiological studies to the maximum extent possible. Perhaps future toxicological studies will provide data and information that inform interpretation of epidemiological results in both rural and urban areas.

The Coalition continues to be encouraged that both EPA and CASAC recognize the importance of data concerning coarse and fine-mode particulate matter composition. The following statement in the Policy Assessments summarizes EPA's concerns:

> *Another uncertainty results from the relative lack of information on the chemical and biological composition of $PM_{10-2.5}$, and the effects associated with the various components (ISA, section 2.3.4). As discussed above, a few recent studies have evaluated associations between health effects and particles of non-urban, crustal origin by evaluating the health impacts of **sand storm events**.(emphasis added) Though these studies provide some information on the health effects of particles that likely differ in composition from the particles of urban origin that are typically studied, without more information on the chemical speciation of $PM_{10-2.5}$, the apparent variability in associations with health effects across locations is difficult to characterize (US EPA, 2009a, 3 section 6.5.2.3).*
> Policy Assessment, pages 3-16 to 3-17

While the Coalition agrees with the general concept expressed in the excerpt above, it is worth noting again that the reference to "sand storm events" is inappropriate considering that dust storms can have 50% or more of the particulate matter mass in the fine mode. Furthermore, very little compositional data are available as a function of the particle size distribution of globally transported dusts.

There is very little information available concerning the speculated presence of toxic materials on aging coarse-mode particles in urban environments. Considering that EPA evidently funded a number of coarse PM oriented studies as a result of solicitation EPA-G2006-STAR-Q1, "Sources, Composition, and Health Effects of Coarse Particulate Matter" (closing November 30, 2006.), it is unclear why no new data and information are included in the ISA and the Policy Assessment. Accordingly, the Coalition can only repeat the comments submitted on October 5, 2009 to CASAC, which, in turn, simply reiterated earlier Coalition comments.

- Future NAAQS standards should take into account the relative importance of the "carrier" mechanism in each size range if research eventually demonstrates that particles in portions of the fine and coarse particulate matter distributions serve as carriers of toxic contaminants present on the particle surfaces.

- The presently available data suggest that the "carrier" mechanism might be important with respect to fine particulate matter and unimportant with respect to coarse particulate matter."
  Coalition Presentation to CASAC, October 5, 2009

In conclusion, the Coalition strongly recommends that EPA maintain the present 24-hour NAAQS for coarse mode particulate matter for the reasons summarized in this submittal.

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