Corrected Preliminary Review Comments from Dr. Judith C. Chow:
Ozone Monitoring Issues related to the Revised NAAQS

Urban Network Design Requirements

1. *Considering the ozone minimum monitoring requirements that are already promulgated through 40 CFR Part 58, is the considered change to these requirements sufficient to ensure a minimally adequate network in urban areas?*

Figure 1 of the Ozone monitoring document shows that there are many populated but unmonitored areas. Many of these areas have experienced substantial population and traffic growth, especially in the western and southeastern U.S. There is ample evidence that O_3 is transported over long-distances, as well as being locally generated, and that elevated concentrations can be found nearly everywhere (Bertschi and Jaffe, 2005; Choi et al., 2008; Dabdub et al., 1999; Goldstein et al., 2004; Guttorp et al., 1994; Hudman et al., 2004; Rao et al., 2003; Rosenthal et al., 2003; Spicer et al., 1979; Wolff et al., 1977). Elevated O_3 can also be generated by non-urban sources such as plantlife (Marr et al., 2002; Pun et al., 2002; Tao et al., 2003), fires (Bertschi and Jaffe, 2005; Preisler et al., 2005), and livestock (Howard et al., 2008). It is entirely appropriate to lower the population threshold for monitoring to protect urban public health.

2. *We are considering a timeline that would require newly required ozone monitors to be operational no later than January 1, 2011, based on the expectation that final rulemaking will be completed in 2009. Is this schedule appropriate or should EPA consider providing an additional year for new monitors to be deployed (or relocated)? What would be the advantages or disadvantages of a staggered deployment schedule?*

Maximum flexibility should be allowed for the addition of monitoring locations. It is better to: 1) thoroughly evaluate the potential measurement locations, 2) procure and install the best equipment, 3) train operators in its use, and 4) have an adequate shakedown period than to rush the process. It often takes a year or more to obtain the funding, permits, and infrastructure when a new air quality site is installed.

Non-Urban Network Design Requirements

1. *We are considering a new requirement that each State operate a minimum of three non-urban ozone monitors to meet certain objectives (described above). Considering the stated objectives of the non-urban ozone monitoring requirements, is three required monitors per state sufficient?*

It is not clear whether or not this would require three monitors in addition to those identified in Figure 2 of the Ozone monitoring document or would include those monitors. Perhaps columns could be added to Table 2 of the Ozone monitoring document that would include the number of current monitors in each state that are: 1) federal lands with sensitive ecosystems; 2) small towns (micropolises?); and 3) non-urban locations with expected high concentrations. Would this also include existing monitors from non-compliance networks (e.g., the National Park Service's 2B O_3 monitors http://www.nature.nps.gov/air/Studies/portO3.cfm)? Looking at the large differences in areas of different states, the complex terrain in some states as opposed to others, and the existing densities of monitors in Figures 1 and 2 of the Ozone monitoring document, it would seem that a more refined allocation of monitoring locations based on a conceptual model of O_3 precursor locations, formation potential, and transport corridors might be more useful than an allocation of three monitors per state.

2. *What factors should be considered in the siting of ozone monitors to assess impacts on ozone sensitive vegetation in national parks, wilderness areas, and other ecosystems?*

Factors for measurement location should include: 1) presence of species susceptible to damage (Legge et al., 1995; Miller and McBride, 1999; Musselman et al., 2006; Paoletti, 2006; Prinz, 1985); 2) potential for high O_3 levels (transport, upslope/downslope flows, local generation) (Lee et al., 2007; Wager and Baker, 2006); and 3) logistics and cost-effectiveness. It might be more logical and cost-effective to extend the NPS network to additional IMPROVE (http://vista.cira.colostate.edu/views) sites where some infrastructure already exists. It would also be useful to think "beyond compliance" (Chow and Watson, 2008) and not require a full-scale compliance monitoring site at some of the remote locations.

3. *In addition to the objectives that have been described for non-urban ozone monitors, what other objectives should be considered in the final network design? How would the consideration of additional objectives, if any, effect the minimum number of non-urban required monitors?*

Additional objectives should include: 1) tracking trends in O_3 and precursors to evaluate accountability and relationships to other pollutants for O_3 SIPs (Cohan et al., 2007; Foley et al., 2003); 2) increasing understanding of O_3 chemistry and transport (Blanchard et al., 1999; Blanchard and Fairley, 2001; Blanchard and Stoeckenius, 2001; Milford et al., 1989; Milford et al., 1994; Sillman et al., 1997; Sillman, 1999; Sillman, 2001); 3) defining non-attainment areas according to established criteria (Clark County Department of Air Quality and Environmental Management, 2004; Seitz, 2000); and 4) forecasting effects of climate change on O_3 concentrations (Grewe, 2007; Jacob and Winner, 2009; Zeng et al., 2008).

Additional monitors might be needed at some locations for NO_2 and certain VOCs to better attain these objectives. For some remote forest exposure locations it might be more effective to use passive O_3 monitors (Bernard et al., 1999; Grosjean and Williams, II, 1992; Manning et al., 1996; Paoletti, 2006; Skelly et al., 2001).

4. *Current ozone monitoring regulations (described in Appendix E of 40 CFR part 58) include requirements for station and probe siting (e.g., vertical distance of inlets, set-back distances from roadways). Are these requirements (that have been developed for urban monitors) appropriate for non-urban ozone monitors? What changes, if any, should be considered?*

No. O_3 monitors within the forest measure lower values than those outside or above the forest canopy because of the plant uptake (which also causes the damage). Both measurement types are important, as the difference indicates the exposure, so two nearby sites with different middle-scale to neighborhood-scale characteristics might be considered. Monitors within the shallow nighttime surface inversion often experience NO titration, even when they are somewhat distant from a roadway, due to the overnight trapping of pollutants. Monitors on a hilltop, tall building, or tower usually better indicate O_3 exposure and carryover than surface-based monitors. It is difficult to locate sites very distant from some type of roadway as the sites need to be accessed regularly.

5. *We believe that States should have the option of designating that existing non-urban ozone monitors that are potentially operated by another agency (e.g., CASTNET monitors operated by the National Park Service) be utilized for meeting certain non-urban minimum monitoring requirements. What factors should States use to determine if such monitors are appropriate to include in their networks?*

All available data should be compiled and used for the defined objectives. As noted above, the information needed and acquired should dictate the number of monitors rather than an arbitrary assignment of a certain number of monitors to each state. Where a number of different networks or monitor types are used, there should be a comparison and evaluation of the operating conditions,

including evidence of regular calibration, auditing, maintenance, precision, accuracy, and comparability.

Ozone Monitoring Season

1. *We are considering changes to the required ozone monitoring seasons based on analyses of the patterns of ozone exceedances and occurrences of the Moderate level of the Air Quality Index, during periods outside of the currently required seasons. What other factors should be considered, if any, in the determination of the length of the required monitoring season for each State?*

Some of the remote sites may not be easily accessible during winter owing to snow, and this should be considered. Elevated O_3 can occur in winter, however, owing to reflection of sunlight from snowcover and concentration of precursors during the day within a shallow layer over the snow. O_3 is also correlated with HNO_3 (Aneja et al., 1994; Bottenheim and Sirois, 1996) that is a precursor to wintertime $PM_{2.5}$ nitrate levels and can be useful as part of a multi-pollutant control strategy development where $PM_{2.5}$ concentrations are also excessive.

2. *We believe that ozone monitors that are located at NCore stations should be operated on a year-round monitoring schedule. Under what circumstances might it be appropriate to require year-round monitoring at other stations beside NCore?*

O_3 monitors should be operated year round wherever practical to evaluate multi-pollutant approaches and to determine the extent of elevated levels during winter. This is the case already at most multi-pollutant monitoring sites. There may be instances at remote locations where access is denied due to weather, and it is probably not cost-effective to take extreme measures for such locations. At a minimum they should be operated year-round in areas that experience excessive $PM_{2.5}$ and O_3 concentrations.

3. *We are considering that changes to the required ozone monitoring season be applicable to existing monitors beginning in 2010, one year ahead of the deployment schedule for newly required ozone monitors. Is this schedule reasonable for existing monitors?*

The same argument applies as above. It is better to phase in the changes in a logical manner than to set a mandate that will compromise quality and the utility of the data. It is probably less of a burden to extend the monitoring period than it is to locate new sites, but additional staff, training, and possibly instrumentation may be needed that will require some lead time.

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