U.S. Environmental Protection Agency
Clean Air Scientific Advisory Committee (CASAC)
CASAC Ozone Review Panel

Summary Meeting Minutes of the CASAC's Public Advisory Teleconference

Monday, October 3, 2005 – 1:00 to 4:00 p.m. Eastern Time

SAB Staff Office, Washington DC

CASAC Ozone Review Panel Consultation on EPA's Draft *Ozone Environmental Assessment Plan: Scope and Methods for Exposure, Risk and Benefits Assessment* (August 2005)

Panel Members: See CASAC Ozone Review Panel Roster – Appendix A

Agenda: See Meeting Agenda – Appendix B

Purpose: The purpose of this public teleconference meeting was for the CASAC Ozone Review Panel to conduct a consultation with staff from EPA's Office of Air Quality Planning and Standards (OAQPS), within the Office of Air and Radiation (OAR), on the Agency's draft *Ozone Environmental Assessment Plan: Scope and Methods for Exposure, Risk and Benefits Assessment* (August 2005).

Attendees:

Chair:	Dr. Rogene Henderson
CASAC Members:	Dr. James Crapo Dr. Frederick Miller Mr. Richard Poirot Dr. Frank Speizer Dr. Barbara Zielinska
Panel Members:	Dr. John Balmes Dr. William (Jim) Gauderman Dr. Henry Gong Dr. Paul Hanson Dr. Philip Hopke Dr. Michael Kleinman Dr. Allan Legge Dr. Morton Lippmann Dr. Maria Morandi Dr. James Ultman Dr. Sverre Vedal
EPA SAB Staff:	Mr. Fred Butterfield, CASAC Designated Federal Officer (DFO) Dr. Vanessa Vu, SAB Staff Office Director

Other EPA Staff: Dr. Karen Martin, OAR, OAQPS
Ms. Vicki Sandiford, OAR, OAQPS

Meeting Summary

The discussion followed the issues and general timing as presented in the meeting agenda (Appendix B).

Convene Meeting, Call Attendance, Introduction and Administration

Mr. Fred Butterfield, Designated Federal Officer (DFO) for the Clean Air Scientific Advisory Committee, opened the teleconference meeting, called attendance, and welcomed all attendees. He noted the CASAC is a Federal Advisory Committee chartered under the Federal Advisory Committee Act (FACA) to provide advice and recommendations to the EPA Administrator. Consistent with FACA regulations, the deliberations of CASAC are held as public meetings and teleconferences for which advance notice is given in the *Federal Register*. The DFO is present at all such meetings to assure compliance with FACA requirements. He mentioned that there was only one individual offering public comments today. Mr. Butterfield said a transcript of this teleconference is not being taken. However, summary minutes were taken (by the DFO) for this teleconference meeting. These minutes will be certified by the CASAC (and Ozone Review Panel) Chair and posted on the SAB Web Site (http://www.epa.gov/sab/). Mr. Butterfield noted that all panelists had earlier submitted documentation with respect to possible financial conflicts-of-interest or appearances of a lack of impartiality, which was reviewed by the SAB staff prior to the teleconference meeting and found to be satisfactory.

Purpose of Meeting and Welcome

Dr. Rogene Henderson, CASAC and Ozone Review Panel Chair, welcomed Panel members and briefly stated the purpose of the meeting (see above). She then introduced Dr. Karen Martin of EPA's Office of Air Quality Planning and Standards (OAQPS).

Summary Presentation from OAQPS on EPA's Draft *Ozone Environmental Assessment Plan*

Dr. Karen Martin, OAQPS, thanked the members of the Ozone Panel, and then introduced Ms. Vicki Sandiford, also of OAQPS. Karen and Vicki then gave a brief overview of the EPA's Draft *Ozone Environmental Assessment Plan*, with Karen noting that this plan builds strongly upon the last review of the Ozone AAQS conducted during the mid-1990s. This draft plan can be accessed via the Agency's Technology Transfer Network (TTN) Web site at the following URL: http://www.epa.gov/ttn/naaqs/standards/ozone/data/o3eap_aug05.pdf, and a hard-copy is found in the FACA file for this meeting.

Public Comment Period

There was one public commenter during this teleconference, Mr. Jon M. Heuss of Air Improvement Resource, Inc., offering comments on behalf of the Alliance of Automobile Manufacturers (AAM). (Mr. Huess' written statement is attached as Appendix C.)

Summary of the Ozone Panel's Consultative Discussion on EPA's Draft *Ozone Environmental Assessment Plan*

The members of the CASAC Ozone Review Panel were generally complimentary toward EPA staff on the Draft *Ozone Environmental Assessment Plan*. Key points raised by Ozone Panel members during their consultative discussions on this Agency document for each of the four major charge areas (see the Agency's charge questions found in Appendix D) include the following:

Overview of Planned Assessment

- One Ozone Panel member noted that the extrapolation of these open-top chamber (OTC) ozone exposure data and the resulting concentration-response (C-R) functions to plant response in the ambient environment is still highly uncertain, adding that the fundamental problem with this approach is that essentially the same scientific uncertainties which were evident in the biological data during the last review are still evident today.

- This Panel member then went on to note that relatively little research money has been available for ozone-related research in the past decade — *i.e.*, since these dollars have been directed to particulate matter (PM) research — so it is not surprising that not many changes are evident since the last O_3 NAAQS review. Another Panel member also confirmed that there have not been sufficient additional and significant research findings to provide appreciable reductions in uncertainties since the previous assessment in 1996.

- While noting that EPA's proposal to develop a national ozone exposure surface map should provide a useful mechanism to look at existing air quality conditions, another Panel member noted that the assumptions inherent in models involving crop loss, vegetation loss, and economic benefits analysis will need to be clearly identified and addressed. This will also be the case for the limitations of these models — which include inadequate peer review and insufficient model validation.

- Another Ozone Panel commented that a number of the models that will be used by OAQPS in the vegetation and tree biomass analyses do not appear to have been published in the peer-reviewed literature, noting that results from peer-reviewed models carry a far greater weight than those that arise from non-peer-reviewed models found in a book chapter.

National Air Quality Analysis

- One Ozone Panel members noted that OAQPS' plans to characterize air quality in terms of the 12-hour SUM06 and current 8-hour average indices seemed appropriate. However, he added it will be necessary to validate the 12-hour SUM06 model and defend why this model is better than other possibilities such as AOT06 and W126. In addition, a clear discussion of the validation of each of the models to be selected for the analysis needs to be done. Agency staff notes that all three models (SUM06, AOT06 and W126) are equally able to predict National Crop Loss Assessment Network (NCLAN) response.

- Another Panel member remarked that many of the proposed analyses will utilize results from fixed site monitors that measure ozone concentrations at a height different than the height at which a particular crop plant is exposed. Independent of the indicator variable for the three models mentioned above, a defensible method must be established by which the monitored values can be adjusted or extrapolated to estimates of the ozone concentration the plants are

most likely to have seen — adding that, without such a correction, there will almost certainly always be an overestimation of the economic benefits from further reductions in ozone levels.

- Another Ozone Panel member commented that data appear to be insufficient, noting that the overwhelming majority of available ozone concentration data centers in urban environments, with sparse monitoring data in rural areas. Also, it is not apparent that uncertainties in the Community Multi-scale Air Quality (CMAQ) modeling system estimates of ozone concentrations in remote rural areas are known or can be evaluated (since there are few monitors in such areas). Furthermore, the concentration indices proposed for evaluation of plant effects have been driven by human health concerns and these metrics may or may not be appropriate for vegetation effects; research for relating concentration at various heights to exposure at the point of contact with vegetation appears to be scarce and too limited for the breath of potentially affected cultivars. Additionally, the relationship between exposure and biologically-relevant uptake for the variety of vegetation likely to be affected under a full range of environmental conditions that can alter the uptake and/or the effect is not sufficiently known. This member added that information on the effects themselves at various concentrations is also inadequate, and noted that these limitations will be hard to overcome without additional information. Overall, her sense is that the research situation is not much improved since the last Ozone NAAQS review in 1996.

- Another Panel member reiterated his earlier concern with the NLCAN C-R functions — expressing doubts that crop sensitivities will vary by variety — adding since a fundamental problem is there has been little funding available for ozone research, and therefore relatively little conducted compared with PM. Another Ozone Panelist commented that there needs to be a commitment on the part of EPA for adequate funding for each of the six criteria air pollutants.

Crop Exposure, Risk and Economic Benefits Analyses

- One Ozone Panel member noted that SUM06 was complimentary to use of the 8-hour averaging time for the secondary Ozone standard, and remarked that this might be a good opportunity for the Agency to conduct sensitivity analysis to more fully compare the two.

- Another Panelist asked whether the crop varieties used in the NCLAN exposure-response studies of the 1970s still represent those widely planted in the U.S. today, adding that, as the only viable alternative data source, the current assessment will need to use NCLAN results for their risk analysis activities. He also remarked that continued development of crop varieties over the past 20 to 30 years since the completion of the NCLAN work may have produced less sensitive crop varieties.

- Another member of the Ozone Panel questioned the soundness of the economic benefits assessment, noting that there are other factors that affect crop production than those identified in the Draft *Ozone Environmental Assessment Plan.* He recommended that Agency staff discuss factors that impact on the validity of the economic analyses.

- Another Panelist commented that there is merit in comparing the output from the OTC exposure methodology with the "free air" exposure methodology such as Aspen FACE (Free-Air Carbon Dioxide Enrichment) Experiment — noting that it is problematic to attempt to compare these two and recommended that staff be careful to understand the assumptions with re-

spect to hourly ozone data. Another Panel member noted that the Agency staff still need to address research questions from the previous review of the Ozone NAAQS in 1996,

Tree Exposure, Risk and Economic Benefits Analysis

- One Ozone Panel member commented that EPA staff's continued use of NHEERL-WED OTC C-R functions was acceptable — but still insufficient to capture the range of responses of important species of the U.S. He noted that other ozone response data are available, and especially recommended Tables 9-18 and 9-19 of the 1st External Review Draft Air quality Criteria document (AQCD) for Ozone, adding that these new research results should not be ignored. Another Panelist remarked that the use and continued reliance by OAQPS Staff on the OTC C-R functions derived from NHEERL-WED research is not recommended. He commented that this work was done with tree seedlings in pots, and that there is still much debate in the scientific community about the responses a seedlings and mature tree being different.

- The first Panelist cited above in this section also remarked that a single focus on ponderosa pine was too limiting, adding that the tree growth (TREGRO) model system has been successfully applied to many other species and that EPA staff's analyses should reflect the anticipated responses for both sensitive and insensitive species for various regions of the U.S. Another Panel member remarked that the stand growth (ZELIG) model system should be an important piece of this assessment.

- Another Ozone Panel member noted that assessing ozone effects on vegetation in natural settings using the USDA Forest Service Forest Inventory and Analysis (FIA) database might be compared to an epidemiological study, and that this approach could be subject to various confounding effects from various factors (*e.g.*, meteorology) and co-factors (for example, plant diseases and insect infestations). He added that, if such an analysis were to be conducted, a comprehensive, *a priori* approach to identifying potential confounders and controlling for them would be very helpful. However, another Panelist commented that there were not as many "confounders" with adverse effects of ozone on vegetation as with a (human) epidemiological study. Another Panel member seconded this by noting that ozone is "*the* pollutant" for plants, and that it is not confounded by other air pollutants — by drought and disease, perhaps, but not by other pollutants.

- The second Panelist cited above in this section also comments that consideration should be give to the use of the available passive ozone monitoring data and the "foliar injury" surveys which have been carried out by the park service. He added that assessing foliar injury involves measuring observed outcomes.

<u>Summary and Next Steps</u>

Dr. Henderson requested that Ozone Panel members send her and Mr. Butterfield any initial or revised individual written comments on the Draft *Ozone Environmental Assessment Plan* by close of business the following Tuesday, October 11. The Chair thanked everyone on the conference call for their participation. The CASAC DFO adjourned the meeting at approximately 4:00 p.m.

Respectfully Submitted:

/s/

Fred A. Butterfield, III

Fred A. Butterfield, III
CASAC DFO

Certified as True:

/s/

Rogene F. Henderson, Ph.D.

Rogene F, Henderson, Ph.D.
CASAC Chair

Appendices

Appendix A – Roster of the CASAC Ozone Review Panel

U.S. Environmental Protection Agency
Clean Air Scientific Advisory Committee (CASAC)
CASAC Ozone Review Panel

CHAIR

Dr. Rogene Henderson*, Scientist Emeritus, Lovelace Respiratory Research Institute, Albuquerque, NM

MEMBERS

Dr. John Balmes, Professor, Department of Medicine, University of California San Francisco, University of California – San Francisco, San Francisco, California

Dr. Ellis Cowling*, University Distinguished Professor-at-Large, North Carolina State University, Colleges of Natural Resources and Agriculture and Life Sciences, North Carolina State University, Raleigh, NC

Dr. James D. Crapo*, Professor, Department of Medicine, Biomedical Research and Patient Care, National Jewish Medical and Research Center, Denver, CO

Dr. William (Jim) Gauderman, Associate Professor, Preventive Medicine, Medicine, University of Southern California, Los Angeles, CA

Dr. Henry Gong, Professor of Medicine and Preventive Medicine, Medicine and Preventive Medicine, Keck School of Medicine, University of Southern California, Downey, CA

Dr. Paul J. Hanson, Senior Research and Development Scientist, Environmental Sciences Division, Oak Ridge National Laboratory (ORNL), Oak Ridge, TN

Dr. Jack Harkema, Professor, Department of Pathobiology, College of Veterinary Medicine, Michigan State University, East Lansing, MI

Dr. Philip Hopke, Bayard D. Clarkson Distinguished Professor, Department of Chemical Engineering, Clarkson University, Potsdam, NY

Dr. Michael T. Kleinman, Professor, Department of Community & Environmental Medicine, University of California – Irvine, Irvine, CA

Dr. Allan Legge, President, Biosphere Solutions, Calgary, Alberta, Canada

Dr. Morton Lippmann, Professor, Nelson Institute of Environmental Medicine, New York University School of Medicine, Tuxedo, NY

Dr. Frederick J. Miller*, Consultant, Cary, NC

Dr. Maria Morandi, Assistant Professor of Environmental Science & Occupational Health, Department of Environmental Sciences, School of Public Health, University of Texas – Houston Health Science Center, Houston, TX

Dr. Charles Plopper, Professor, Department of Anatomy, Physiology and Cell Biology, School of Veterinary Medicine, University of California – Davis, Davis, California

Mr. Richard L. Poirot*, Environmental Analyst, Air Pollution Control Division, Department of Environmental Conservation, Vermont Agency of Natural Resources, Waterbury, VT

Dr. Armistead (Ted) Russell, Georgia Power Distinguished Professor of Environmental Engineering, Environmental Engineering Group, School of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta, GA

Dr. Elizabeth A. (Lianne) Sheppard, Research Associate Professor, Biostatistics and Environmental & Occupational Health Sciences, Public Health and Community Medicine, University of Washington, Seattle, WA

Dr. Frank Speizer*, Edward Kass Professor of Medicine, Channing Laboratory, Harvard Medical School, Boston, MA

Dr. James Ultman, Professor, Chemical Engineering, Bioengineering Program, Pennsylvania State University, University Park, PA

Dr. Sverre Vedal, Professor of Medicine, Department of Environmental and Occupational Health Sciences, School of Public Health and Community Medicine, University of Washington, Seattle, WA

Dr. James (Jim) Zidek, Professor, Statistics, Science, University of British Columbia, Vancouver, BC, Canada

Dr. Barbara Zielinska*, Research Professor, Division of Atmospheric Science, Desert Research Institute, Reno, NV

SCIENCE ADVISORY BOARD STAFF

Mr. Fred Butterfield, CASAC Designated Federal Officer, 1200 Pennsylvania Avenue, N.W., Washington, DC, 20460, Phone: 202-343-9994, Fax: 202-233-0643 (butterfield.fred@epa.gov) (Physical/Courier/FedEx Address: Fred A. Butterfield, III, EPA Science Advisory Board Staff Office (Mail Code 1400F), Woodies Building, 1025 F Street, N.W., Room 3604, Washington, DC 20004, Telephone: 202-343-9994)

* Members of the statutory Clean Air Scientific Advisory Committee (CASAC) appointed by the EPA Administrator

Appendix B – Meeting Agenda

U.S. Environmental Protection Agency
Clean Air Scientific Advisory Committee (CASAC)
CASAC Ozone Review Panel

Public Teleconference
Monday, October 3, 2005 – 1:00 to 4:00 p.m. Eastern Time

EPA Science Advisory Board (SAB) Staff Office
1025 F. Street, N.W., Washington, DC 20004

Consultation on EPA's Draft *Ozone Environmental Assessment Plan: Scope and Methods for Exposure, Risk and Benefits Assessment* (August 2005)

Meeting Agenda

Monday, October 3, 2005

1:00 p.m.	**Convene Teleconference; Call Attendance; Introductions and Administration**	Mr. Fred Butterfield, CASAC DFO
1:10 p.m.	**Purpose of Meeting**	Dr. Rogene Henderson, Chair
1:15 p.m.	**Summary Presentation on EPA's Draft *Ozone Environmental Assessment Plan***	Dr. Karen Martin and Ms. Vicki Sandiford, EPA's Office of Air Quality Planning and Standards (OAQPS)
1:35 p.m.	**Public Comment Period**	Mr. Butterfield (Moderator)
2:05 p.m.	**Members' Discussion and Deliberation in Response to Charge Questions**	CASAC PM Review Panel Members
3:50 p.m.	**Summary and Next Steps**	Dr. Henderson
4:00 p.m.	**Adjourn Meeting**	Mr. Butterfield

Appendix C – Public Comments

Comments on the
U. S. Environmental Protection Agency's August 2005 Draft "Ozone Environmental Assessment Plan: Scope and Methods for
Exposure, Risk, and Benefits Assessment"

Prepared for the
Alliance of Automobile Manufacturers

By
Jon M. Heuss
Air Improvement Resource, Inc.
September 29, 2005

Executive Summary

In the 1996/1997 review, the lack of monitoring in rural and remote areas together with the significant uncertainties in the analyses conducted led the Administrator to acknowledge that the benefits estimates from various secondary standard alternatives "should be regarded as rough approximations." In the current review, there is still a lack of rural data and the Agency plans on using the same concentration–response functions that were used in the previous review. The proposed analyses are hoped to reduce the uncertainties. Because the issue of uncertainty loomed so large in the previous review, the Agency should use sensitivity analyses wherever possible to bound the estimates. While it may not be possible to do a formal probabilistic risk assessment that incorporates all of the uncertainties in the risk assessment during this review, the Agency should incorporate sensitivity analyses to the extent feasible and should lay the groundwork for such an analysis during the next review.

To reduce the uncertainty in estimating current ozone exposures across the U. S., the Plan proposes to use both observations and output from the CMAQ model. However, CMAQ is still in active development and any application by the Agency will, of necessity, use a version one or two generations behind the latest version. The Agency needs to assure CASAC and the public that the version it is using includes all the processes known to contribute to tropospheric ozone and provide full documentation of the model, the way it is applied, and the performance evaluation supporting the application. The specification of the mix of grid sizes in a continental application is critical because coarsely resolved models are unable to accurately represent the blending of air masses of different origin thus resulting in incorrect ozone production efficiencies.

Inspection of previous estimates of national exposure using seasonal indices (SUM06 and W126) suggests contributions from both anthropogenic and background ozone. Because of the continuing uncertainty as to what portion of the ozone in rural and remote areas is controllable through control of man-made U. S. emissions, there will be uncertainty related to any of the possible choices for defining or treating policy relevant background (PRB) in the Plan. The Criteria

Document and the Staff Paper (SP) should provide a realistic range of estimates for a properly defined PRB for each of the vegetation exposure metrics considered in the Plan and SP.

The 1996 Staff Paper and 2005 CD document a number of ways in which the NCLAN experiments were designed and conducted that result in overestimation of ozone impacts on crop yields. These include an artificially low baseline and the inclusion of more peaks than found in typical ozone distributions. Any cumulative value air quality standard, such as SUM06, that does not take into account the variables that affect ozone uptake via stomata can lead to overestimation of ozone injury on plants in the field. Since SUM06 is based on two assumptions --- that plant exposure to ozone equals plant response, and that there is an identifiable uniform threshold value for plant injury caused by ozone – CASAC should provide the Administrator and EPA staff with its view on the appropriateness and the scientific support for these assumptions.

Since the output of the AGSIM or any other model used to provide estimates of the benefits of ozone control will be important factors in the ultimate decision regarding secondary standards, the uncertainty in the estimate should be carefully evaluated and reported. Both uncertainties due to the model formulation and uncertainties due to the model inputs should be evaluated and discussed in the Staff Paper. In particular, the sensitivity of the results to different background assumptions should be explicitly evaluated.

As noted in the Plan, there are many uncertainties and limitations in the modeling framework being considered for tree growth and economics. As such, the exercise is more appropriate for a research project than for application to standard setting.

If staff and/or CASAC is going to recommend a seasonal secondary ozone standard, the question of whether tools are available to implement such a standard becomes important. Therefore, a careful review of the capability of CMAQ or other possible models to simulate the seasonal ozone metrics under consideration should be carried out.

Introduction

The Clean Air Scientific Advisory Committee (CASAC) Ozone Review Panel is holding a public teleconference on October 3, 2005 to conduct a consultation with the U. S. Environmental Protection Agency on the Agency's August 2005 draft Ozone Environmental Assessment Plan. The Agency indicates that the plan is intended to facilitate public review as well as consultation with CASAC, and to obtain advice in advance of the completion of the analyses identified in the plan. Air Improvement Resource, Inc. (AIR) has reviewed the draft Plan with a focus on the scope, approaches, and key issues associated with the Plan. Since the Plan will provide the analyses that will be used by the EPA staff to make recommendations concerning the national secondary ozone standard in the Ozone Staff Paper, it is important that all the key issues regarding ozone effects on vegetation be considered in the design and implementation of the Plan.

Section 1 Discussion of Previous Analyses and Decisions

In the previous review, EPA staff carried out many analyses that are similar to the analyses proposed in the Plan. In the 1996 Federal Register notice proposing revised primary and secondary

standards, the Administrator recognized many limitations and uncertainties in the available data and analyses. The proposal acknowledged that "the selection of a single averaging time for a national standard will of necessity be a compromise…" and that "specifying the form of a seasonal exposure index to correspond to the relationship between vegetation response and ozone exposure is complicated by the many biological variables that influence the uptake of ozone by the plant and plant responses to such uptake." (61 Federal Register, 65738, December 13, 1996)

The proposal also acknowledged that "because of a lack of monitoring data, national air quality typical of agricultural crop growing areas has not been characterized." (61 FR at page 65740) Some of the most important caveats and uncertainties concerning the exposure and risk assessments for crop yield that were listed in the proposal included "extrapolating from exposure-response functions generated in open-top chambers to ambient conditions," "the lack of a performance evaluation of the national air quality extrapolation," "the methodology to adjust modeled air quality to reflect attainment of various alternative standard options," and "inherent uncertainties in models to estimate economic values associated with attainment of alternative standards." (61 FR at page 65740)

Discussing the quantitative analyses carried out at that time, the proposal indicated that "the Administrator acknowledges the significant uncertainties in these analyses and recognizes that these benefits should be regarded as rough approximations." (61 FR at page 65743)

When the final standards were promulgated, the Administrator decided that based on the present limits of the scientific evidence of ozone effects and of rural air quality data, it was not appropriate to move forward with a seasonal secondary standard at that time. The decision was based in large part on the substantial uncertainties in the exposure, risk and valuation analyses and on the lack of air quality data in rural and remote areas. At that time, the Administrator reiterated her intention, that was expressed in the December 1996 proposal, to expand the rural ozone monitoring network (62 FR 38877-78 July 18, 1997)

The material in Section 1 of the Plan summarizes the previous analyses and decisions but it omits the Administrator's intention to expand rural ozone monitoring. The continuing lack of sufficient ozone monitoring in rural, remote, and agricultural areas remains a major impediment to the development of secondary ozone standard(s). The decision to expand rural monitoring was not, in 1997, and is not, today, dependent on the form of the secondary standard. We encourage the Agency to expand ozone monitoring in rural and remote areas, irrespective of what decision is made concerning the level and form of the secondary standard in the current review. The rural and remote ozone monitoring should be accompanied, in selected locations, with a larger suite of chemical measurements designed to aid in the determination of the policy relevant background.

Section 2 Overview of Planned Assessment

The Plan acknowledges that ozone studies published since the 1996/1997 review haven't fundamentally altered the conclusions from the 1996 Criteria Document. The text raises the possibility, however, that new tools and refinements may allow for reduction in the uncertainties in the analyses. However, one element of the analysis that has not changed since the last review is the source of the crop loss C-R functions, the NCLAN (National Crop Loss Assessment Network)

data that was obtained in the 1980's, and the tree-seedling C-R functions that were used in the 1996 review.

As discussed below, there are major issues and uncertainties related to the use of these C-R functions. Many of these were identified in the 1996 review and reiterated in the January 2005 draft CD. A key issue or threshold question that should be addressed by CASAC and by the Agency is whether, without any substantial new C-R functions, the proposed plan can reduce the uncertainties in the risk estimates by any substantial amount. Obviously, to help answer this question, the Plan should include quantitative estimates of the uncertainty wherever possible.

In addition, since no new ozone metrics are proposed in the Plan, and there are well know issues with the existing metrics, another threshold question is whether the Agency should focus its efforts on evaluating the critical loads approach rather than various seasonal metrics. An important but non-scientific question is whether the critical loads approach would be permitted under the current U. S. Clean Air Act framework and definitions.

Section 3 Air Quality Analyses

The overview for this section correctly points out that it is a great challenge to characterize ozone air quality for the vast rural areas of the country that do not have ozone monitors. The Plan proposes that existing ozone data and ozone outputs from the CMAQ model be used to generate national ozone exposure surfaces for base year 2001 "as is" air quality. There are several key issues with the proposed approach which are not discussed in the Plan.

Issues with Generating "As Is" Ozone Air Quality. First, there is no discussion in the Plan of the status of development and performance of the version of the CMAQ model that will be used in the Plan (version 4.4), either in terms of ozone or ozone precursors. Although the overall CMAQ project has a very active performance evaluation program, few relevant results have been published to date. The CMAQ effort is a very large on-going model development and application effort. A paper describing the application of MAQSIP, the predecessor of CMAQ, to the eastern U. S. was just recently published.[1] Various performance evaluations of CMAQ version 4.4 were presented at a Conference in October 2004 and have been submitted for publication. Since the papers are under review, only short summaries are available. One of the papers is an evaluation of the model performance for ozone during an annual application over the continental U. S. The one-page summary available on the website suggests that model performance may be less than adequate for the use planned by the Agency. For example, it is stated that "for the variables for which hourly measurements were available, correlations were insignificant on the intraday time scale, suggesting that these models in their current setup were not skillful in simulating the shorter-term variations in pollutant levels."[2] It is also noted that there is more spatial variation in the observations than in the predictions. Until satisfactory model performance for both ozone and ozone precursors is demonstrated, use of the CMAQ model to aid in the generation of ozone exposure surfaces is problematic.

[1] Mathur et al., J. Geophys. Res., **110**, DI3308, July 2005.
[2] C. Hogrefe et al., Evaluating temporal and spatial ozone and PM2.5 patterns simulated during an annual CMAQ application over the continental U. S., submitted for publication.

There are several additional pieces of information regarding CMAQ that are relevant. The July 2005 Monthly Highlights on the CMAQ website indicates that CMAQ version 4.5 will be released in the Fall of 2005 and it will include a new biogenic emissions model BEIS3.13. Separately the Highlights notes that "simulations of July 2001 performed for the continental United States resulted in ~40 % decrease in isoprene emissions and as much as a 10% decrease in monoterprene emissions over portions of the Pacific Northwest." Moreover, staff is now working on BEIS3.2 that will include an updated vegetation database and a more refined treatment of the temporal variability of isoprene. Since the role of biogenic emissions is an important issue in the determination of the background of ozone, uncertainties of the order of 40 % in isoprene, the most important biogenic for ozone formation, will translate into uncertainties in the overall ozone and background ozone that is modeled with CMAQ, particularly in rural and remote areas.

The July 2005 Monthly Highlights also notes that relatively high surface ozone was simulated over the complex terrain regions in the western United States in development runs of a continental version of CMAQ being developed for air quality forecasting. Diagnostic evaluations linked part of the explanation of the high levels to the upper boundary conditions that, in this application, were driven by satellite observations that were input into a Global Forecast Model that included transport and chemistry. The output of that model was then used to derive the boundary conditions. It is not clear, for the application in the Plan, what the source of the boundary conditions is, whether lightning emissions are included, or whether the stratospheric ozone source is included.

Clearly, CMAQ is still in active development and any application by the Agency will, of necessity, use a version one or two generations behind the latest version. The Agency needs to assure CASAC and the public that the version it is using includes all the processes known to contribute to tropospheric ozone and provide full documentation of the model, the way it is applied, and the performance evaluation supporting the application.

Second, the specification of grid size in CMAQ may be critical to adequate model performance. It has been shown in numerous studies that grid resolution affects the magnitude of ozone formation and loss processes as well as transport. Since ozone production is non-linear and highly sensitive to precursor ratios, large horizontal grids that mix emissions in the model in ways that do not occur in the real world can provide misleading results. In an evaluation of CMAQ results for the simulation of a high ozone episode in Houston, it was found that high horizontal resolution (1-km) was needed to adequately simulate peak ozone levels. Since the transport of high man-made ozone into downwind rural areas is one of the key issues involved in ozone vegetation effects, the coarse grid resolution in the continental simulations in the Plan may lead to substantial uncertainty and/or bias (see Mathur et al., 2005 for a discussion of how coarsely resolved models are unable to accurately represent the blending of air masses of different origin thus resulting in incorrect ozone production efficiencies). In regional and local applications of the model, various nested grid schemes are being evaluated. The issue of the appropriate mix of grids needs to be fully evaluated before the model is used as planned by the Agency.

Third, the interpolation module in the BenMAP (Environmental Benefits Mapping and Analysis Program) doesn't take chemical behavior into account. This is one of the reasons why the staff is interested in including CMAQ outputs as well as monitor data. However, there are large areas of the country with little or no monitoring data or verified emissions inventories. Thus, the Plan

indicates that staff is considering several options. Until the CMAQ results are verified or there is a major increase in rural ozone monitoring, there will be considerable uncertainty in the exposure surfaces generated with any of the approaches discussed. This uncertainty will translate directly into uncertainty in the yield loss estimates. This component of uncertainty was identified in the 1996 review as "the lack of a performance evaluation of the national air quality extrapolation." Since the Plan indicates that the CMAQ results, when used, will be used in a relative sense to aid in the interpolation/extrapolation, this adds additional uncertainty to the Plan.

Fourth, an inspection of the previous estimates of exposure surfaces reveals several major concerns. For example, the "as is" estimate of SUM06 for the year 1990 is shown in Figure VII-10 of the 1996 SP (the comparable map for W126 is on page E-1 of Appendix E). While there are high SUM06 values estimated in and around many major cities, the overall pattern does not fully mimic the areas of high anthropogenic emissions. The substantial SUM06 and W126 values throughout the Southwest and the Southeast suggest that SUM06 is influenced by both background ozone and natural emissions as well as by anthropogenic emissions. For comparison, spatial estimates from "as is" ozone in 2001 are given in the maps in Figures AX3-5 to AX3-19 of the January 2005 draft CD. In this case, maps of both the mean estimates and the 95% confidence intervals are presented. When the maps of the mean estimates for 1990 and 2001 are compared, there are many similarities, but there is one substantial difference. The methodology used for the 2001 case appears to spread the influence of major source areas much more than the methodology used for the 1990 case. Moreover, the 95% confidence intervals for the 2001 estimates are extremely wide in the central and western U. S. Thus, the uncertainty in the estimates is quite large and both seasonal indices appear to include contributions to some extent from background ozone.

Issues with Generating Ozone Air Quality Associated with Meeting Alternative Standards

In addition to generating "as is" ozone air quality, EPA plans on generating ozone surfaces meeting the current standard and meeting (as yet unspecified) alternative standards. There is another set of key issues associated with this portion of the Plan. First, and most importantly, there is no indication that the chemistry of ozone formation will be used in this portion of the Plan. The various forms of rollback in BenMAP are all arbitrary. In contrast to an arbitrary rollback of ozone concentrations, efforts to attain any alternative standard in the real world will involve combinations of national, regional, and local controls that will change the distribution of ozone concentrations at different locations in ways that can only be determined with photochemical models. Until such modeling is carried out, there will be continued uncertainty associated with using any form of arbitrary rollback. This component of uncertainty was identified in the 1996 review as uncertainty due to "the methodology to adjust modeled air quality to reflect attainment of various alternative standard options."

Second, there is no indication of how the background of uncontrollable ozone will be treated in the analysis. Previous AIR comments[3] raised several issues regarding the CD's discussion of policy relevant background. These included:

[3] J. M. Heuss, Comments on the First External Review Draft of "Air Quality Criteria for Ozone and Related Photochemical Oxidants," EPA 600/R-05//004bA, January 2005, Prepared for General Motors Corporation, Air Improvement Resource, Inc., April 26, 2005

- The definition of policy relevant background (PRB) in the draft CD is wrong; it omits consideration of the emissions from agricultural activities and omits consideration of the contribution to ozone from anthropogenic emissions in Mexico and Canada.

- In order to evaluate the range and variability in PRB, the CD needs to consider both observations and models.

- There are several issues with the one modeling study that the CD relied on to estimate PRB making its use problematic.

- The widespread nature of yearly maxima 8-hour ozone concentrations of 0.06, 0.07 and higher at Western national parks and monuments and in rural areas that are distant from large urban areas indicates the presence of a substantial regional policy relevant background of ozone.

Because of the continuing uncertainty as to what portion of the ozone in rural and remote areas is controllable through control of man-made U. S. emissions, there will be uncertainty related to any of the possible choices for defining or treating policy relevant background in the Plan. The CD and SP should provide a realistic range of estimates for a properly defined PRB for each of the vegetation exposure metrics considered in the Plan and SP.

Third, it is not clear which metrics will be evaluated. The Plan indicates that, at a minimum, a 12-hour, 3-month SUM06 index and an 8-hour average index will be evaluated. However, it is also indicated that additional indices may be selected. During the last review, the sigmoid-weighted W126 index was considered in detail. Since this index was selected by the Federal land managers for protecting vegetation in Class 1 areas (see January 2005 draft CD at page 9-194) and since it avoids the unrealistic assumption of an arbitrary cut-off value, it should be included in the analysis.

The Plan needs to specify how the 8-hour average index will be defined. Since the current 8-hour primary and secondary standards are defined as the average over three years of the yearly 4th highest 8-hour average, defining an equivalent 8-hour metric for an annual growing season will involve some thought and analysis.

Section 4 Crop Exposure, Risk, and Economic Benefits Analyses

The overview points out that staff will be updating the previous review's analyses but still using the NCLAN crop loss C-R functions. This means that the issues and uncertainties related to the NCLAN experiments that were identified during the previous review are still relevant for the current review. The most important of these issues are described below.

Sections 4.2 and 4.3 Use of NCLAN C-R Functions. The NCLAN experiments were carried out in the 1980s and the study design was a major improvement over earlier studies. The study was designed to provide input for an estimate of the economic effects of ozone on U. S. agriculture for the review of the ozone standard. Nevertheless, there were important issues concerning the NCLAN studies raised by the scientific community and acknowledged by the Agency during the previous review. For example, the 1996 Staff Paper indicated that some plant scientists con-

tinue to express concern that NCLAN was "designed and conducted in a way that results in overestimation of ozone impacts." (1996 Staff Paper at page 194) Three issues that were acknowledged by the Agency at the time are still relevant. First, the 1996 SP indicated:

> "…the modified ambient treatments contained numerous high peaks (ozone concentrations equal to or above 0.10 ppm), occurring more frequently than in typical ambient air quality distributions. Such exposure patterns have raised questions among some researchers as to how much of the plant's response was a result of having an excessive number of high peaks versus a cumulation of more moderate exposures." (1996 Staff Paper at page 194)

The question of the relative role of peaks and mid-level exposures in ozone vegetation effects is still a major issue and concern in the current review. Studies since 1996/1997 have not resolved the debate which relates to the appropriate form for the secondary standard.

Second, the 1996 SP indicated:

> "…the charcoal filtered chambers used to establish baseline crop yield loss were exposed to approximately 0.025 ppm ozone, which is lower than the range of 0.03 to 0.05 ppm identified in Chapter 4 of the staff paper as the value for seasonal background ozone levels. The result of using this lower level of 0.025 ppm is an overestimation of yield loss relative to that expected using 0.03 to 0.05 ppm." (1996 Staff Paper at page 194)

The question of the appropriate control or background for the yield loss estimates is still a major issue and concern in the current review. For example, the January 2005 draft CD notes that the issue of the background ozone level is important to all estimates of vegetative damages due to ozone, noting that recent research by Lefohn et al. 2001 has suggested that background levels may be considerably higher than assumed in some of the previous economic assessments. The CD goes on to acknowledge that, if that is true, "then the economic damages estimated in studies with lower background levels will be overstated." (January 2005 draft CD at page 9-327)

Third, the 1996 SP indicated:

> "Review of the NCLAN data indicates that differences in ozone sensitivity within species may be as great as differences between species with substantial variation in sensitivity from year to year." (1996 Staff Paper at page 195)

This finding raises two issues for the current review. The first is the variation in sensitivity from year to year. It is reflective of the well known fact that environmental variables affect gas exchange and ozone uptake. The Plan notes the growing body of information on ozone flux and vegetation damage, but indicates that it is not sufficient at this time to use in a quantitative way. (Plan at page 9) Manning has argued that any cumulative value air quality standard, such as SUM06, that does not take into account the variables that affect ozone uptake via stomata has no biological basis or relevance, and can lead to overestimation of ozone injury on plants in the field.[4] Since, as Manning notes, SUM06 is based on two assumptions --- that plant exposure to ozone equals plant response, and that there is an identifiable uniform threshold value for plant injury caused by ozone – CASAC should provide the Administrator and EPA staff with its view on the appropriateness and the scientific support for these assumptions.

[4] W. J. Manning, Environmental Pollution, 126, pages 375-379 (2003)

The finding of as great a difference within species as between species raises the issue of the relevance of the cultivars that were used in the NCLAN study to the cultivars that are being planted today. Since the Plan indicates that 2001 county level crop planting data will be obtained to create maps of the planting data for each species/cultivar of commodity crop, the Agency will be in a position to evaluate the relevance of the NCLAN cultivars.

Another significant issue that was raised during the review of the January 2005 draft CD is not mentioned in the Plan. One of the CASAC panelists raised the concern that the ozone concentrations at the "standard measurement height" may not be the same as the ozone concentration at plant height. As a result, the ozone exposure of the crop plants and the predicted crop loss will be overestimated. (See CASAC June 22, 2005 letter to the Administrator at page C-57 and Grunhage et al. 1999 reference in Chapter 9 of the CD) The Plan should acknowledge and correct for this effect.

Section 4.4 Economic Benefits Analysis. Since the output of the AGSIM or any other model used to provide estimates of the benefits of ozone control will be important factors in the ultimate decision regarding secondary standards, the uncertainty in the estimate should be carefully evaluated and reported. Both uncertainties due to the model formulation and uncertainties due to the model inputs should be evaluated and discussed in the Staff Paper. In particular, the sensitivity of the results to different background assumptions should be explicitly evaluated.

The draft CD notes the need for improving our understanding of the temporal and spatial characteristics of ozone as it relates to the implications for crop yields, production, and producer profits. (Draft CD at page 9-327) For example, the CD points out that most economic studies are static (comparing economic activity at one ozone level versus that at an alternative level) whereas the changes in air quality will be gradual which means that producer responses will be gradual, rather than abrupt. The implications of the simplifications and assumptions in the economic model for the overall assessment need to be discussed in the Staff Paper. In the previous review, the Administrator acknowledged that the overall benefits estimates are rough approximations. Given the lack of new or biologically-relevant C-R data, it is not clear whether new benefits estimates will be substantially more accurate or precise than the previous estimates.

Section 4.5 Comparison of NCLAN and FACE Since the SoyFACE experiment referred to uses the Pioneer soybean cultivar and the NCLAN experiments used a variety of other cultivars (see Table VII-2 of the 1996 SP), the interpretation of any comparison will be complicated by the fact that there are both cultivar and exposure method differences.

Section 5 Tree Exposure, Risk and Economic Benefits

As is the case with crops, there is little new data upon which to draw. The proposed analysis of ozone effects in the San Bernardino Mountains is not particularly relevant to the rest of the U. S. or the setting of a national standard. The area, being downwind of Los Angeles, has been subject to ozone levels far in excess of either federal or California ozone standards for many decades. As noted in the Plan, there are many uncertainties and limitations in the modeling framework being considered for tree growth and economics. As such, the exercise is more appropriate for a research project than for application to standard setting.

The analysis and comparison of the data from the Forest Service bio-monitoring sites with ozone exposure estimates is a useful project. However, it should not be limited to comparisons with the exposure surfaces. It would also be useful to compare the data separately with the CMAQ ozone output and with ozone surfaces generated with just interpolated observations.

Section 6 Next Steps

The Plan indicates that the first draft Staff Paper and a separate draft environmental assessment report will be released for CASAC and public review and that second drafts of both these documents are planned for release in April 2006. This is a very ambitious schedule. Because the issue of uncertainty loomed so large in the previous review, the Agency should use sensitivity analyses wherever possible to bound the estimates. While it may not be possible to do a formal probabilistic risk assessment that incorporates all of the uncertainties in the risk assessment during this review, the Agency should incorporate sensitivity analyses to the extent feasible and should lay the groundwork for such an analysis during the next review.

If staff and/or CASAC is going to recommend a seasonal secondary ozone standard, the question of whether tools are available to implement such a standard becomes important. Therefore, a careful review of the capability of CMAQ or other possible models to simulate the seasonal ozone metrics under consideration should be carried out.

Appendix D – Charge to the CASAC Ozone Review Panel

Within the main sections of the draft Environmental Assessment Plan, questions that we ask the Panel members to focus on in their review include the following:

Overview of Planned Assessment

1. Do Panel members have any comments on the major components of the planned environmental assessment as depicted in Figure 1?

National Air Quality Analysis

1. The importance of characterizing O_3 exposure of vegetation in non-monitored areas is described in section 3 of the draft plan. What are the Panel members' views on staff's primary approach to create a National Ozone Exposure Surface (NOES) using interpolated monitored data with spatial scaling from Community Multiscale Air Quality (CMAQ) model outputs?

2. Staff plans to characterize air quality in terms of the 12-hr SUM06 and current 8-hr average indices. Do Panel members have suggestions of other indices that the staff should consider?

Crop Exposure, Risk and Economic Benefits Analyses

1. Staff plans to use concentration-response (C-R) functions from the National Crop Loss Assessment Network (NCLAN) to estimate crop yield losses related to O_3 exposures in the U.S. What are the Panel members' views on staff's continued reliance on these C-R functions?

2. Do Panel members have any comments on the overall approach for updating the benefits analysis for crops, including using the Agricultural Simulation Model (AGSIM©)?

3. Staff believes it is important to compare study results obtained using the open top chamber (OTC) exposure methodology with those obtained using the alternative "free air" exposure methodology. Do Panel members have any comments on staff's planned approach for comparing these two exposure methods using soybean yield loss data, as available (as described in section 4.5)?

Tree Exposure, Risk and Economic Benefits Analysis

1. What are the Panel members' views on staff's continued use of National Health and Environmental Effects Research Laboratory-Western Ecology Division (NHEERL-WED) OTC C-R functions to characterize the risk of tree seedling biomass loss from O_3-related exposures in the U.S.?

2. Staff is interested in assessing O_3 exposure-related effects on trees beyond the seedling stage. To accomplish this, staff is considering using the linked tree growth (TREGRO) and stand growth (ZELIG) model system to evaluate how tree or forest growth will respond to O_3 air

quality under "as is" and just meeting alternative standard scenarios (Section 5.4). Staff plans to apply this method to ponderosa pine in the San Bernardino Mountains.

a. What are the Panel members' views on the appropriateness of using the linked TREGRO and ZELIG modeling system to assess the impacts of O_3 air quality on forest growth under current and alternative standards?

b. What are the Panel members' views on using the USDA Forest Service's Timber Assessment Market Model (TAMM) to quantify the economic impact of growth rate changes, modeled by TREGRO/ZELIG, for the different air quality scenarios?

c. What are the Panel members' views on the utility of applying this model system, given staff's plans to focus on a single species?

d. Can the Panel members suggest other approaches for quantifying the long-term impact of O_3 exposure on mature tree and/or forest growth?

3. What are the Panel members' views on the staff's approach using NHEERL-WED C-R functions to predict aspen seedling biomass loss in the Aspen FACE study (described in section 5.5)?

4. Staff is also interested in assessing O_3 effects on vegetation in natural settings. One approach is to make use of the visible foliar injury data within the large bio-monitoring database maintained by the USDA Forest Service Forest Inventory and Analysis (FIA).

a. What are the Panel members' views on using this database to evaluate the degree of co-occurrence of visible foliar injury and areas of high estimated O_3 exposure as indicated by the NOES (outlined in section 5.6)?

b. Do Panel members have other suggestions on how to analyze this bio-monitoring database or more broadly, to assess O_3 impacts to vegetation in natural settings?