

**Summary Minutes of the
U.S. Environmental Protection Agency (EPA)
Science Advisory Board (SAB)
Panel for the Review of EPA's 2007 Report on the Environment (ROE)
Meeting July 10-12, 2007**

Panel Members: See Panel Roster – Appendix A

Date and Time: Tuesday, July 10, 9:00 a.m. – 5:15 p.m.; Wednesday, July 11, 8:30 a.m. – 5:15 p.m., Thursday July 12, 18:30 a.m. – 12:15 p.m. Eastern Daylight Time

Location: Marriott Metro Center Hotel, 775 12th Street, N.W., Washington, D.C.

Purpose: The purpose of this meeting was to review EPA's draft 2007 Report on the Environment: Science Report

Attendees: Panel Chair: Dr. Deborah Swackhamer

Panel Members: Dr. Henry Anderson
Dr. Fred Benfield
Dr. Mark Borchardt
Dr. Timothy Buckley
Dr. Aaron Cohen
Dr. David Dzombak
Dr. Dennis Grossman
Dr. Phillip Hopke
Dr. George Lambert
Dr. Allan Legge
Dr. Maria Morandi
Dr. Deborah Neher
Dr. Duncan Patten
Dr. Ramesh Reddy
Dr. Gary Sayler
Dr. Alan Steinman
Dr. C. John Suen
Dr. Robert Twiss
Dr. Judith Weis
Dr. Barry Wilson

EPA SAB Staff: Thomas Armitage, Designated Federal Officer
Jack Kooyoomgian

Anthony Maciorowski, Deputy Director SAB
Office
Vivian Turner
Vanessa Vu, Director, SAB Office

EPA Staff: Tom Barnwell, EPA/ORD
Veronica Blette, EPA
Sara Boubberhan, EPA/OPP
Jennifer Brady, EPA
Barry Burgan, EPA/OW
Arden Calvert, EPA
Andrea Cherepy, EPA/OAR
Virginia Engle, EPA
Michael Hadrick, EPA/OAR
David Hrdy, EPA
Lauren Knizner, EPA/OPP
Carrie Knowlton, EPA NCEA/ORD
Cpan Lee, EPA
Lobdell, EPA
Macara Lousberg, EPA/OW
Jennifer Martogolies, EPA
Ethan McMahan, EPA OEI
Jay Messer, EPA
Bill Nickerson, EPA
Hope Pillsbury, EPA
Peter Preuss, EPA NCEA/ORD
Velu Senthil, EPA
Henry Schuver, EPA/OSW
Denice Shaw, EPA NCEA/ORD
Nita Sylvester, EPA
Ellen Tarquinio, EPA
Guy Thomassoni, EPA
Linda Tuxen, EPA
Sherri White, EPA

Others Present: Linda Aller, Bennett and Williams
Janet Burris, Syracuse Research Corp.
Robert Griffin, Little Hocking Water
Association
Chris Lamie, ERG
Pat Rizzuto, Bureau of National Affairs
John Wilhelm, ERG

Meeting Summary

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

Convene Meeting

Dr. Thomas Armitage, Designated Federal Officer (DFO) for the SAB Panel for the Review of EPA's 2007 Report on the Environment, convened the meeting at 9:00 a.m. on July 10. He stated that the EPA Science Advisory Board (SAB) is a chartered federal advisory committee whose meetings are public by law. He reviewed the Federal Advisory Committee Act (FACA) requirements and the Panel's compliance with Federal ethics and conflict-of-interest requirements. Dr. Armitage stated that as DFO, he would be present during Panel business and deliberations. He stated that summary minutes of the meeting would be prepared and certified by the Chair.

Welcoming Remarks

Dr. Anthony Maciorowski, Deputy Director of the EPA SAB Office, thanked the Chair and members of the Panel for providing advice to EPA on the Report on the Environment (ROE) 2007 Science Report. He introduced EPA staff members who were present at the meeting to present information and respond to Panel questions.

Introduction of Members, Purpose of Meeting, and Review of the Agenda

Dr. Deborah Swackhamer, Panel Chair, also welcomed Panel members. She stated that during the next three days, the Panel would review EPA's ROE 2007 Science Report and deliberate on six charge questions that had been included in the information packages provided to each panelist. She stated that the Panel would have time to break into subgroups and begin developing the advisory report to EPA. She reviewed the charge questions to the Panel (Appendix C), the meeting agenda (Appendix B), and a proposed schedule of milestones for submitting an advisory report to EPA by the target date of January 2008. She thanked members for providing preliminary responses to the charge questions and noted that these responses were also included in the panel member information packages. Dr. Swackhamer then asked Panel members to introduce themselves.

Highlights of EPA's 2007 Report on the Environment Science Report

Dr. Swackhamer invited Drs. Peter Preuss and Denice Shaw of EPA's National Center for Environmental Assessment to discuss highlights of the ROE 2007 Science Report.

Dr. Preuss briefly discussed the development of EPA's ROE 2007 Science Report and commented on the scope of the document. He stated that the Report on the Environment was developed to provide environmental indicator information (both human health and ecological condition indicators) that could be used to track the progress of EPA's

programs. He noted that the ROE 2007 Science Report was developed by EPA's Office of Research and Development in collaboration with EPA's Office of Environmental Information. The report answered key questions that were relevant to the Agency's mission and its programs. In developing the report, it became evident that there were thousands of potential indicators that could have been used to answer the questions. Much effort went into developing criteria for indicator selection and selecting indicators. Much of the data to answer the questions came from sources outside of EPA.

Dr. Preuss noted that in developing questions and indicators for the 2007 ROE Science Report, EPA built upon the draft 2003 Report on the Environment. The 2003 draft was reviewed by the SAB, and EPA implemented many of the SAB's recommendations. For example, the 2007 report now contained indicators of climate change. He stated that there had been greater involvement of EPA Program offices in developing 2007 ROE, and the Agency had begun discussions with the Office of Management and Budget about how the ROE could fit into strategic planning. He stated that the Agency was interested in the SAB's comments on the questions in the 2007 ROE. The Agency spent a great deal of time developing the questions and selecting indicators, and wanted to know whether the right ones were included in the report.

Dr. Preuss asked the Panel to consider two important points as they deliberated on the charge questions: 1) What can EPA do to improve the current draft report? 2) What can be done in the long term to improve EPA's Report on the Environment? He asked that criticisms be accompanied by recommendations (short and long-term) that could be implemented to improve the report. Dr. Preuss stated that the ROE is supported by EPA's senior management, and that the White House is considering pulling together a suite of indicators that reach across the Government. He stated that he looked forward to receiving the Panel's report.

Questions from the Panel

Panel members posed a number of questions to Drs. Preuss and Shaw and offered comments on the report. A member noted that some of the Panel's recommendations were likely to be difficult to implement and he asked whether all recommendations would be considered by EPA. Dr. Preuss stated that EPA would consider all recommendations. He noted that if the Panel finds that the Agency took a wrong direction in one or more of the chapters, it would be important to receive feedback. He stated that broad recommendations would be welcome. A panelist commented that members had provided many detailed recommendations in their preliminary comments, as well as some "higher level" recommendations. The panelist noted that the meeting agenda called for discussion of the individual ROE 2007 report chapters and he asked how the larger overarching questions could be addressed. Dr. Swackhamer responded that she had flexibility to adjust the agenda to discuss overarching recommendations and would find time at the end of the meeting to do this. Another panelist stated that the recommendations in the Panel's report should be associated with time frames.

A panelist asked EPA staff whether institutionalization of the Report on the Environment might make it more difficult to improve the document in the future. Dr. Preuss responded that the Agency wanted the report to evolve, and he provided several examples of changes that had been incorporated into the report. He noted that regional indicators had been included in the report. The agency had also included scaling in the report. He stated that the Agency would try to keep improving the report. In addition, he stated that EPA had been trying to present more statistical information on the indicators. He noted that in the future, the Agency wanted to present a more quantitative discussion of the uncertainty associated with the indicators.

A panelist asked whether EPA would improve data collection efforts to make the information in the ROE more relevant. Dr. Shaw responded that some efforts were underway to improve data collection. She mentioned there had been an effort to improve the comparability of water quality data collected by states. Dr. Shaw noted that most of the available data used in the ROE were not collected for the purpose of providing indicator information. Many of the data were collected to provide information for enforcement. However, as a result of looking at indicator gaps EPA is now discussing how to improve data collection efforts.

A panelist stated that one of the recommendations in the SAB review of the 2003 Report on the Environment was that more statistical analysis be incorporated into the report. The SAB also recommended that EPA provide resources for this kind of analysis. He questioned why more statistical analysis had not been incorporated into the 2007 report. Dr. Preuss responded that limited resources had been available for developing the 2007 report. He stated that three people were working full time on the report along with several hundred volunteers. Because of limited resources and competing priorities, it had been difficult to implement all of the SAB's previous recommendations. Dr. Swackhamer stated that she wanted the Panel's report to contain a long-term recommendation on the need to incorporate statistical analysis in the ROE. Dr. Preuss stated that EPA would do as much of this as possible in the short term and noted that EPA had been working on quantitative uncertainty analysis. A panelist asked EPA staff to comment further on why the SAB's previous recommendation to provide additional resources for development of the ROE had not been addressed. Dr. Preuss pointed out that work had been constrained by the availability of resources. He noted that EPA's science budget had been reduced.

A panelist stated she was pleased to see that the 2007 ROE addressed issues and indicators that had not been typically associated with EPA, but was disappointed that many indicators did not have long term trend data and represented only a snapshot of information. The panelist expressed concern that a decision may have been made to eliminate older data sets that could be useful in evaluating trends. Dr. Shaw responded that EPA had devoted much time to the selection of indicators and had set a high threshold for indicator acceptability. The Agency had discussions with the Office of Management and Budget (OMB), National Oceanic and Atmospheric Administration (NOAA), and U.S. Geological Survey (USGS) about indicators and would welcome the Panel's suggestions concerning missing indicators.

A panelist noted that EPA had stated that the 2007 ROE would be used as a progress assessment. The panelist stated, however, that some of the indicators were not related to work that EPA was doing. He indicated that it would be helpful to know more about how the indicators were related to EPA programs. Another panelist reiterated concern about the lack of statistical information in the report. He stated that it appeared EPA had been trying to do the best analysis possible with available data instead of trying to obtain more statistically meaningful data. Dr. Preuss responded that EPA was taking data from systems that were developed 20-30 years ago. He noted that efforts were underway to improve these systems so that statistical information could be provided in a more meaningful way. He also stated that the 2007 ROE was not meant to be a progress report on how EPA programs are performing. He pointed out that there were many performance measures that were not included in the ROE.

A panelist noted that the health data used in the 2007 ROE did not relate human health to environmental indicators that were particularly relevant to EPA programs. He questioned whether it might be more useful to consider an interagency effort to report indicators of human health. EPA staff responded that it was important to look for trends in human health at a broad level and then consider how programs might address problems. Staff indicated that EPA was involved in discussions with other agencies but this was a long term process. A panelist asked how much interagency collaboration had occurred in developing the 2007 ROE. Dr. Shaw responded that questions in the report were “EPA’s questions”, but there had been collaboration on the identification of indicators and data sets. In developing the 2007 report EPA convened a group of people to work on a strategy. Groups across EPA reviewed the questions in the report.

A panelist asked EPA staff to provide context for the 2007 report by describing what it was expected to do for the Agency. Dr. Preuss responded. He stated that the effort to develop the report started with the intent of answering some questions about the condition of air, water land, human health, and ecological condition. The original intent was to develop a report that answered these questions. In the first draft of the report the questions were broad, but it became clear that it would be helpful to view these questions through an EPA lens. Therefore, the questions became more focused on issues relevant to EPA. He stated that the report was still meant to provide information showing whether conditions are getting better or not, but EPA also wanted to use this information in the Agency’s strategic planning process.

A panelist stated that descriptions of the limitations and data gaps in the 2007 report frequently focused on the problem of incomplete data. He stated that he had not expected that indicators would be comprehensive, but the description of the gaps and limitations raised his expectation that more information might be presented on what could be done to improve the indicators. EPA staff responded that in some areas no indicators were available and this was a key gap. Another panelist noted that many model freshwater systems had been well studied and data from such studies could be used to provide indicator information in the report. He also noted that EPA offices had developed guidance manuals for the development of criteria documents, and these could be mined

for data and indicators. Dr. Preuss responded that in developing the 2007 ROE, EPA decided not to use the available surface water monitoring database. This decision was made because it was not possible to aggregate the state data. Some of these data could have been used, but the Agency decided that this would introduce potential bias.

A panelist questioned why EPA did not include classic microbiological indicators in the 2007 ROE. Dr. Shaw responded that the Agency could not find national data. The panelist stated that these kinds of data have been available for many years from the states, and from the Centers for Disease Control. Dr. Preuss stated that EPA had looked into using these kinds of data. Flaws were found in the available data sets so they were not used. Some of the microbiological data had been gathered through voluntary reporting and could not be used. Another panelist stated that, to fill gaps where national data were not available, EPA should consider using more regional indicator data.

Public Comments

Dr. Swackhamer thanked EPA staff for responding to the Panel's questions and stated that the Panel would hear public comments and then discuss overarching comments on the draft ROE 2007 Science Report.

Comments were provided by Robert Griffin of the Little Hocking Water Association. Mr. Griffin's comments are available on the SAB website at:
http://www.epa.gov/sab/pdf/comments_from_robert_griffin_lhwa_roe_7-10-07.pdf

General Comments on EPA's 2007 Report on the Environment

Dr. Swackhamer asked panelists to provide general comments on the ROE 2007 Science Report and invited EPA staff to respond to comments and questions.

The Panel discussed the need for a conceptual framework in the 2007 report. A panelist noted that the SAB review of the 2003 report recommended that a conceptual framework be used to develop indicators. He noted that this philosophical approach did not appear to be used in the 2007 report. Several panelists stated that more information was needed "up front" in the report to describe a conceptual framework. They noted that more representation of the complexity of the system and interactions between indicators was needed. The panelists did not, however, recommend reorganization of the entire report. They stated that organizing it by media chapters was effective.

Several panelists stated that presenting information according to EPA region was not useful because this was not an "ecologically-based" approach. However, other panelists stated that it was useful to see some of the information presented by EPA region.

The panel discussed the need to provide more interpretation of information in the 2007 report. A panelist noted that a great deal of information was presented in the report, but facts were presented without telling readers whether improvement had occurred, or was needed, in environmental condition. Another panelist stated that the air chapter

documented some environmental improvements, and that EPA should expand upon that. It was noted that the discussion of lake and stream acidity in the air chapter was good. Another panelist noted that the SAB review of the 2003 ROE recommended that the report be kept free of conclusions about the successes of programs. He noted that the Agency should continue to bear this in mind. A panelist stated that the EPA could provide more linkages to indicators developed by the Heinz Center. Another panelist noted that, if descriptions were provided to indicate why indicators were important, it would be obvious how trends should be interpreted. However, including value terms like good or bad might lead some to criticize the report as a biased assessment.

A panelist agreed that the air indicator information showed trends. However, he noted that the same kind of trend information for water was not in the report. He stated that more trend information should be included in the report.

Panelists stated that they had difficulty viewing some of the figures and would generally like to see them enlarged. It was stated that some of the color figures should be outlined to make them more readable.

The chair thanked the Panel for their general comments on the document and stated that she wanted to begin discussing the individual chapters of the report. She stated that during the next two days the Panel would also be meeting in breakout subgroup sessions (corresponding to each chapter) to work on the advisory report.

Discussion of the Air Chapter

The panel discussed a range of air chapter issues.

A panelist began the discussion by stating that although SO₂ emissions had been reported in the air chapter, concentrations were not provided. He stated that it would be useful to report SO₂ concentrations. He noted that SO₂ concentration was mentioned in the discussion of acid deposition.

Another panelist noted that, when looking at the list of indicators in the air chapter it was apparent that EPA had considered stressors but not responses. He stated that the chapter focused on emissions, but it was necessary to include indicators that represented outcomes of the emissions (not the emissions themselves). He stated that emissions were a stressor, not an indicator. A panelist noted that the report should provide information on responses, not just doses. Another panelist expressed some disagreement with this point. He noted that emissions were an important indicator of air quality. He stated that he was more concerned about the questions in the air chapter than the indicators. The answers to the questions focused on outdoor air quality, not the effects on health and the environment. He commented that a statement should be included in the air chapter indicating that the chapter was limited to outdoor air quality, not health. He also noted that emissions were less relevant than concentrations, but they were useful. The Chair suggested that to address his concern, question 2 in the air chapter could be limited to outdoor air quality and not the effects on human health and the environment.

A panelist noted that the air chapter of the ROE would lose important information if emissions were not reported. She questioned why indoor effects were not included in the health chapter. She also noted that additional indoor air quality information should be included in the report because EPA had information on emissions in buildings.

Another panelist commented that EPA might consider using an indicator related to the behavioral aspects of health, such as the use of tobacco products or candle burning. It was suggested that behavioral indicators might be surrogates for other indoor air quality indicators. EPA staff responded that each of the indicators in the ROE 2007 Science Report had been through a rigorous peer review process. Fewer indicators were used in the 2007 ROE than in the 2003 draft report. A panelist noted that it was important to be cognizant of the long process that EPA had gone through to develop the indicators. However, he noted that some of the indicators in the report were not directly linked to health effects. He noted that it might be helpful to indicate with the symbol “H” those indicators that referred to health based standards.

A panelist noted that some important regional problems were not identified in the 2007 ROE. For example, San Joaquin County, California has the highest asthma rates in the U.S. The panelist noted, however, that if one looked at the indicators of particulate matter in the 2007 ROE, it appeared that EPA Region 9 was doing well. There was no indication of the air quality problems within the Region. EPA staff responded that the Agency had been considering how to scale the indicators, and that further work was underway to do this. They noted that for many of the indicators it was possible only to scale them to the regional level. They also noted that the San Joaquin example might be a useful case study.

Another panelist noted that the list of national air indicators in the 2007 ROE was quite specific and that the indicators demonstrated the success of ambient air quality standards. He stated that there were many problems associated with mixtures, and that indicators were not included in the 2007 ROE to reflect these problems. EPA staff responded that the Agency had been thinking about this issue. The air research program had been looking at mixtures. Another panelist noted that the report needed to discuss mixtures. He stated that this was the philosophy that the Europeans had adopted. He also stated that the idea of critical loads was important.

A panelist stated that EPA should consider how to further divide the EPA regions into more meaningful units. For example, in California air basins had been used. Another panelist noted that the 2007 ROE included five ozone indicators. She stated that EPA might want to consider reducing this number to a single indicator.

The Chair stated that it was good that the ROE had addressed climate change, and she asked EPA staff whether more recent data would be incorporated into the report. EPA staff responded that it was the Agency’s intention to update the report through the end of October 2007. Another panelist also stated that it was very good that indicators of greenhouse gasses had been added to the report. A panelist suggested that the report

more specifically link some of the indicators to climate change. Several panel members noted that the report provided “snapshots,” but additional trend information should be included. A panelist asked EPA staff how the Agency intended to link the air chapter to strategic planning. EPA staff responded that the details of this were not yet clear, but several pilot efforts had been initiated.

A panelist stated that in the health chapter of the 2007 ROE, the first three indicators were global. He asked whether similar broad air indicators (important to society) could be identified. He noted that some other broad measures related to air quality might be considered (such as distribution of population growth and industrial sectors). Another panelist noted that some of the trend information in the air chapter of the report was based on estimates. He questioned whether real data were available to develop trends for these indicators. EPA staff responded that in the case of power plants real data were available. Models were used for other information. The Chair stated that if panelists knew of other available data, the data should be identified for EPA. She stressed that the Panel should make specific recommendations.

A panelist stated that it would be appropriate to include a discussion of uncertainties in the air chapter. The Panel further discussed the use of approaches that could be used for regional analysis of indicator data. One member noted that an “ecorisk approach” might be considered as an alternative to using EPA regions (i.e., different regions could be used to evaluate various types of indicators). Another panelist expressed support for using different regions to evaluate different kinds of indicators. He also noted that the rules for including data sets in the report were so strict that they appeared to limit the value of the report.

Following the discussion of the air chapter the Chair announced that the Panel would recess for lunch and reconvene in one hour to begin discussing the water chapter.

Discussion of the Water Chapter

The Panel discussed a range of water chapter issues.

A panelist stated that his major concern about the water chapter was inadequate use of drinking water standards. He questioned why the Agency did not use a national drinking water standard to evaluate drinking water data. EPA responded that the Agency did not receive information on drinking water contaminant concentrations, but it did receive information on violations of drinking water standards.

Another member noted that he was concerned about the transparency of some water indicators. He stated that there was very little information in the water chapter to support some of the indicators. He also stated that within ecoregions, EPA should look at trends related to important taxa. He noted that if data were collected consistently, trends could be evaluated.

A panel member stated that it would be helpful to include in the 2007 ROE a more detailed description of the databases used. He noted that when trends were evaluated, a statement should be included indicating whether support would be available to continue data collection activities. He noted that people should be warned if data will not be gathered on a continuing basis. He added that for many data sets, there was little certainty that data collection would continue. This should be indicated when data gaps are characterized. He also noted that it was important to indicate how vulnerable the ROE was to data collection problems.

The Chair stated that she was surprised to see that the report did not include references to impaired waters. She expected to see indications of impaired river miles and successful total maximum load development, but this information was not included. EPA staff responded that Clean Water Act Section 305(b) data were not included in the report because it was determined that they were not comparable nationally. Impaired waters were determined to be an administrative indicator and therefore were not included.

The chair noted that the amount of phosphorus discharged to surface waters appeared to have declined, but the 2007 ROE did not provide an explanation of this. She also noted that in another part of the report contained references to improved water treatment and waters that did not meet standards, but specific locations of waters were not mentioned. The Chair questioned why places were not identified in these instances.

A panelist noted that the coastal fish tissue indicator lumped fish species. She noted that it would be preferable to separately analyze fish by species or habitat type (i.e., pelagic vs. bottom dweller). EPA staff responded that the fish ecologists had not yet agreed upon how to do this. Furthermore, the Agency did not have information needed to complete analyses of separate species.

A panelist indicated that although the report included positive statements regarding the health of coastal benthic communities, data indicated that a substantial number of coastal benthic communities were in “bad shape.” She stated that this was a discrepancy in the report.

Another member questioned why urban systems were not discussed in the water chapter. He noted that metro megaplexes were causing environmental problems in the U.S. He stated that the effects of urbanization on streams should be mentioned in the 2007 ROE. EPA staff responded that it was hard to define an urban area for this purpose. They stated that the Agency was working with USGS to include this kind of information in future reports.

A panelist noted that a major problem affecting water quality in the U.S. was sedimentation. He questioned why sedimentation was not addressed in much detail. Another panelist questioned why more information was not included in the ROE on water quantity and ground water availability. EPA staff responded that there had never been an emphasis in the ROE on water quantity. They stated that USGS had been looking at water quantity but it was not reflected in the ROE to a great extent. EPA staff stated that

this was something the Agency would like to include in the future, but presently there was no indicator that could be used nationally.

Another member questioned EPA about when the wadeable stream data were collected each year. EPA staff responded that these data were collected between April and November. Staff stated that the purpose of collecting the data was to obtain a spatial estimate of condition for the whole country. The panelist stated that data collected within such a long period of time would not be comparable. EPA staff responded that the Agency was not using these data to compare streams in different regions but to provide a national indicator.

A panelist asked why lake and reservoir data were not reported in the water chapter. EPA staff responded that national data sets were not available to represent these water bodies. The panelist noted that EPA had developed water quality criteria guidance documents that should be consulted for available data sets. The panelist also asked why EPA had used only wetland acreage, and not other wetland information, as an indicator. EPA staff responded that the Agency did not have other wetland data that would provide a good national picture.

A member questioned why EPA did not include information in the ROE on disinfection byproducts and disease indicators. He expressed the opinion that the current list of indicators in the ROE did not “tell the public everything it wants to know.” He questioned why indicators of fecal contamination and sediment contaminants were not included. EPA staff responded that it was a challenge to select indicators for the report. They stated that all indicators could not be included and that at the local level there were other mechanisms to inform the public about some of these issues. EPA staff stated that the Agency was striving to provide a picture of conditions at the “30,000 foot level.”

A panelist asked why some important Great Lakes data were not included in the 2007 ROE. EPA staff responded that these data were not included because it was not possible to compare Great Lakes data sets to data gathered in the rest of the country. A member asked why freshwater fish tissue data were not represented in the ROE. EPA staff responded that fish tissue data were collected by states, but they were not comparable from state to state.

A member noted that information in the water chapter could be reported according to USGS hydrologic cataloging units (HUCs). EPA responded that perhaps the wadeable streams data could be split this way, but for other indicators it may be problematic to find enough data to report information by USGS HUCs.

A panelist questioned why the data on pesticide levels in streams were compared to drinking water maximum contaminant levels, and why fish tissue contaminant levels in lakes were not compared to health-based numbers.

Another panelist stated that he understood the value of using nationally consistent indicator data. He noted, however, that it would be useful to provide case studies to

represent conditions in different regions of the country. EPA staff responded that this could be done. However, the Agency wanted to avoid the appearance of bias in selecting case studies. The panelist responded that EPA had indicated that there were no available data on phosphorus in lakes, and this represented a very large gap. He noted that such gaps could be filled by using regional case examples. For example, fish tissue data from the Great Lakes could be used in a regional case study. Lake Okeechobee was mentioned as a possible regional case example.

A panelist noted that aquifer discharge could be used as a consistent indicator of ground water quantity. He stated that many aquifers had been well monitored. Good data could be obtained to represent this indicator. Another panelist suggested that EPA use data from drinking water quality reports that were provided to consumers.

The Chair thanked the panelists for their comments and stated that the Panel would next discuss the land chapter of the report.

Discussion of Land Chapter

The Panel discussed a range of land chapter issues.

A panelist noted that soil erosion was an important problem and that it should be represented in the ROE. EPA staff responded that soil erosion was an important environmental concern but some had questioned whether soil erosion was particularly relevant to EPA's mission.

Another panelist stated that there was clearly an "EPA focus" in the land chapter. He noted, however, that many of the indicators in the land chapter were not directly related to human health. He suggested that the indicators directly related to human health (e.g., poison control center data) might be moved to the human health chapter. The Panel discussed the link between poison control center data and the environmental quality. A panelist suggested that pesticide sales data would be a more appropriate indicator to be used in the land chapter. EPA staff responded that this indicator did not reflect what was used on the land.

A panelist stated that the land chapter did not provide information about "what was happening" in urban and suburban areas (for example in urban parks). She did not, however, know of a source of available information to represent this. Another panelist noted that the land chapter used Toxics Release Inventory (TRI) data but it was problematic that these data could not be linked to the air chapter. He noted that there was a good comparison in the land chapter between Resource Conservation and Recovery Act (RCRA) and Superfund sites.

A panelist asked whether EPA had considered how to address biotechnology issues. EPA staff responded that some consideration had been given to this in looking at the Superfund National Priorities List sites. Another panelist asked whether EPA had considered looking at indicators of urbanization such as roads and streets. He noted that

there were links between such land indicators and air quality indicators (such as vehicle miles traveled) and it would be useful to include such information in the ROE.

Another panelist stated that he found most of the questions in the land chapter to be “off base” relative to the overall report. He stated that the report posed questions about trends in human health, but the relationship of most of the land indicators to human health was tenuous, and the available data did not reflect trends. The panelist suggested that the questions might not be appropriate because they could not be answered with the available information. He noted that the resolution of the land cover information used in the report was too coarse to address the questions asked. He stated that new data sets could provide a better view of land use, land cover, and the importance of biodiversity. The panelist questioned why EPA had not used finer resolution ecological classification information in the report. EPA staff stated that they viewed the level of classification in the report as a useful starting point, and that new information would be considered for use in future reports.

Another panelist noted that it would be useful to provide a conceptual framework to bring pieces in the land chapter together and link them to other chapters. A panelist noted that it was not clear why forest land cover data (and not non-forest data) were used in the report. EPA staff responded that this was partly because the U.S. Forest Service had available data. EPA staff asked the Panel to comment on other data that might be available. A panelist recommended that EPA provide a better explanation of why various pieces were included in the chapter.

A panelist noted that he had expected to see more information on watershed management and landscape ecology in the land chapter. He noted that Tiger files could be used to provide more useful information. He recommended that EPA consult land use planners to explore some additional indicators that could be included in the report. A member noted that snowpack was an important indicator that could also be used in the report. This indicator could be viewed as part of land cover. In addition, the panelist noted that radioactive waste was a missing indicator. Another panelist commented that it would be useful to know how many RCRA sites were declassified.

The panel discussed biosolids. A panelist asked EPA whether the Agency had considered including data on biosolids, animal wastes, and compost. He noted that this could be a potentially useful indicator related to the assimilative capacity of land. EPA responded that this was a good example of where progress could be made. A panelist suggested that EPA might want to consider including a soils map in the report. Other parameters such as capacity to hold or filter nutrients, vegetated vs. exposed areas, and losses of topsoil might also be considered.

The panel discussed the use of TRI data and urbanization /population change data. A member suggested that in the air chapter EPA should reference the TRI data. He noted that emission of persistent bioaccumulative toxic (PBT) chemicals was a key category of indicator, but he noted that a definition of PBT chemicals was not included in the report. A panelist suggested that EPA provide further analysis of sources of pesticide residues.

He suggested that this would be a good indicator. The panelist further noted that EPA's stated purposes of using the 2007 ROE for strategic planning and communication seemed to conflict. He noted that some data would be more or less appropriate for each of these two purposes. Another panelist questioned how EPA defined contaminated land.

The Chair then thanked panelists and EPA staff for their comments and the discussion. She stated that the Panel would take a 15 minute break and reconvene in three breakout subgroups (air, water, and land) to discuss how the groups would develop the responses to the charge questions. She reminded the panel that they would meet in the three breakout sessions the following morning and then reconvene as a whole at 11:00 a.m. to summarize the breakout group discussions. She requested that the leaders of each breakout group be prepared to provide a brief summary of the discussion in their sessions.

Concurrent Panel Subgroup Meetings

Panelists met briefly in breakout subgroups to review the charge questions and make assignments to prepare for the discussion the following morning. The meeting was then recessed for the day at 5:15 p.m.

Wednesday, July 11, 2007

Concurrent Panel Subgroup Meetings (continued)

Three panel subgroups (air, water, and land) convened at 8:30 a.m. to discuss their responses to the charge questions. The following DFOs were present in the subgroup sessions (Air - Thomas Armitage; Water – Anthony Maciorowski; and Land – Vivian Turner).

Discussion of Highlights of Subgroup Recommendations

At 11:00 a.m. the Panel convened as a whole to discuss the recommendations developed by each of the subgroups in response to the charge questions. The major recommendations discussed by each subgroup are summarized in the bullets presented in appendix C.

Following the discussion of highlights of subgroup recommendations, the Panel recessed for lunch. The Chair stated that following lunch, the panel would discuss the human health and ecological condition chapters.

Discussion of the Human Health Chapter

The Panel discussed a range of human health chapter issues.

The Panel discussed the need to put the information in the health chapter in an appropriate historical context. A panelist noted that in the discussion of the effects of

chemicals (e.g., lead and mercury) there was no historical information on “where the country has been.” Furthermore, there was no discussion of reference dose or what could be a potentially harmful level. The panelist stated that this appeared to be a large gap. EPA staff responded that such information was provided for lead but not for other chemicals.

The Panel discussed the appropriateness of the indicators. A panelist noted that one major concern about the chapter was the failure to establish relevance between the indicators and the questions. He noted that this concern applied to all of the indicators. He stated that the report did not clearly explain why an indicator was selected and what it was supposed to show. The panelist stated that the indicators should be clearly anchored to the questions. Another panelist stated that in the report, exposure was not tied to disease. Therefore, it was hard to tell how much human health had improved due to improvements in environmental quality. EPA staff responded that the Agency would like to provide this kind of information in the ROE but it was difficult to do that on a national scale.

Another panelist stated that there was a substantial amount of evidence presented in the report to justify the indicators. However, he also stated that the report needed to more clearly describe why each indicator was chosen. The panelist also stated that, to the extent possible, “linked indicators” should be provided in the report (i.e., indicators linked to disease). The panelist noted that at the state level, hospital data were available on cardiovascular disease. Such data could be linked to particulate matter data at the local level, and trends over time could be interpreted. The panelist noted that this information could be added to the report as a combination of text and graphics.

Another panelist reiterated that in the introduction of the health chapter a better description should be provided to indicate how indicators were chosen. He stated that in the report there should be more discussion of the toxicology that supported the indicators. For example, the report could discuss what was known about the risk of disease attributable to environmental exposure.

Another panelist agreed that the linkage of indicators to disease should be further discussed in the report. He noted that uncertainties could be discussed at the beginning of the gaps and limitations section. He also stated that the report should provide more discussion of neurotoxicity issues. For example, the link between pesticide application and Parkinson’s disease could be addressed.

A panelist stated that the Agency had missed a great deal of available information on indicators of infectious disease. He recommended use of the Centers for Disease Control outbreak data. Other members noted that the human health chapter contained limited regional information. They stated that much more information was available from states. A panelist stated that the report could be improved by further evaluating the spatial distribution of the available information. A panelist recommended looking at behavioral risk factor data. He noted, for example, that data were available on fish consumption,

and that these data could provide a better understanding of health risks associated with contaminants in fish tissue.

A panel member suggested that the report could be improved by including more impact estimates (i.e., more cause and effect discussion). He noted that, before including attributable risk in the report, some degree of cause-effect discussion should be provided (e.g., reproductive outcomes and air pollution). The panelist suggested that EPA consider evaluating relationships between air pollution indicators and mortality. The Chair noted that EPA had a national fish consumption advisory for mercury but this had not been discussed in the report. She stated that such a discussion would provide useful information. Another panelist suggested that the ROE should contain more information on sensitive populations. EPA staff responded that some of the data sets mentioned by the Panel had various limitations or vulnerabilities. EPA staff stated that the data must meet quality requirements to be used in the report.

The panel discussed the organization of the health chapters. A member suggested that an additional chapter might be included in the ROE to discuss body burden estimates. A panelist suggested that a new question could be posed, “What is the relation between body burden and contaminants?” The Panel discussed whether it might be useful to include a parallel discussion of contaminants in other species. A Panelist stated that, rather than including a separate chapter on body burden, EPA might want to include a section in the human health chapter linking dose and body burden to the three media chapters. In addition, panelists suggested that EPA include in the report a discussion of contaminant effects on populations vs. individuals.

The Chair thanked the Panel for their comments and indicated that after a short break the Panel would discuss the ecological condition chapter.

Discussion of the Ecological Condition Chapter

A panelist started the discussion of the ecological condition chapter by asking EPA staff whether the Agency planned to further address comments that were provided in the SAB review of the 2003 ROE. EPA responded that the Agency had tried to address these comments. However to address them completely, EPA would have had to prepare the ecological condition chapter in a different way. The Agency decided to keep the format of the ecological condition chapter consistent with the other chapters. A panelist stated that the organization of the ROE made sense (i.e., first providing the media chapters and then bringing the material together in synthesis chapters discussing health and ecological condition).

The panel discussed the indicators in the ecological condition chapter. A member suggested that EPA consider including more wildlife data (other than the bird data currently in the report). It was suggested that useful data about eagles were available. A member suggested that the issue of lead shot be addressed in the 2007 ROE. Another member noted that the land use data in the 2007 report were very old and he asked EPA staff how they intended to handle that problem. EPA staff responded that the Agency

would update the land cover and land use information but this would not be included in the current version of the ROE.

A member stated it was good that sea level and global temperature were included in the ecological condition chapter, but he added that this information should be linked to the greenhouse gas discussion in the air chapter. EPA staff responded that updates would be incorporated for these indicators. The Chair pointed out that the Natural Resources Defense Council had provided specific comments on these indicators and she hoped that EPA would address those comments.

Another panel member recommended that EPA staff give further consideration to the SAB comments on the ecological condition chapter of the draft ROE 2003 report. EPA staff responded that some of these comments could be further addressed if EPA could move toward developing regional or subregional indicators.

A member commented that the indicators for temperature and precipitation in the 2007 report were very useful. Another member stated that the questions in the ecological condition chapter adequately spanned the scope of issues. However the indicators did not completely address the questions. She noted that there was a heavy emphasis on vertebrates, and that information on plants and microbes was missing. Another panelist questioned why some indicators, such as submerged aquatic vegetation and non-indigenous species, were not in the ecological condition chapter (these indicators were in the water chapter). EPA staff responded that if the Agency found effects to be driven by a particular medium (e.g., water) the indicators were included in that chapter. A member commented that the 2007 ROE should provide information about the health of coral reefs. She stated that sedimentation and eutrophication, stressors affecting coral reefs, were important to EPA programs. She also stated that additional information on amphibians should be included in the ROE. EPA staff responded that the coral reef indicator was not included in the report because it did not meet indicator criteria.

A member stated that more fish population indicators should be included in the report. The Chair pointed out that additional data representing ecosystem health, such as disease, body burden, and endocrine disrupting activity should be included in the report. Another member questioned why so much of the report was focused on forest land, and why disturbance indicators were not included in the report.

The Chair then thanked the Panel for their comments and stated that she wanted to discuss some specific issues that had been raised by panelists.

Discussion of Specific Issues

The Panel discussed the need for more integration in the ROE (as opposed to observation). Several members suggested that the ROE should contain a synthesis chapter. Another member stated that there should be more discussion of the underlying science, and more discussion of the interplay among indicators. Another member stated that the report should provide information and let readers formulate their own analyses.

He stated that the report should enable readers to see what the issues are. A member stated that the report needed a good discussion “up front” to enable readers to think about multiple indicators and how they were integrated. He stated that the report should begin with a conceptual framework that would lead readers to their own conclusions.

A member reiterated the statement that the report should include more trend data. He stated that a synthesis piece in the report should look at trends. Several members supported the recommendation that the science in the report be strengthened by providing more synthesis and a conceptual framework. A member stated that the Agency should say “as much as possible” given the available data, and press for the collection of additional data. A member noted that much of data represented in the ROE were collected because of mandates. He stated that the Agency should move beyond reporting the data and make more conclusive statements about what the data show. Another member cautioned that the report was not developed to discuss the successes or failures of specific regulatory programs. A member stated that the ROE did not need to relate observed changes to regulatory programs, but it should identify the changes and discuss them in the context of current scientific understanding.

The Chair then thanked Panel members for their comments and stated that before recessing for the day, the Panel would meet in two breakout subgroups (human health and ecological condition) to discuss how they would develop the responses the charge questions. She reminded the panel that they would meet in the two breakout sessions the following morning and reconvene at 10:30 a.m. as a whole to summarize the breakout group discussions. She requested that the leaders of each breakout group be prepared to provide a brief summary of the discussion in their sessions.

Concurrent Panel Subgroup Meetings

Panelists met briefly in breakout subgroups to review the charge questions and make assignments to prepare for the discussion the following morning. The meeting was then adjourned for the day at 5:15 p.m.

Thursday, July 12, 2007

Concurrent Panel Subgroup Meetings (continued)

Two panel subgroups (human health and ecological condition) convened at 8:30 a.m. and discussed their responses to the charge questions. The following DFOs were present in the subgroup sessions (human health - Thomas Armitage; ecological condition – Anthony Maciorowski). Summaries of the discussion in each session were presented when the Panel reconvened as a whole.

Discussion of Highlights of Subgroup Recommendations

At 11:00 a.m. the Panel convened as a whole to discuss the recommendations developed by each of the subgroups in response to the charge questions. The major

recommendations discussed by each subgroup are summarized in the bullets presented in appendix D.

Following the discussion of the subgroup recommendations the Chair called for a discussion of overarching recommendations.

Discussion of Overarching Recommendations

The panel discussed overarching recommendations (included in Appendix E.) A panel member noted that the discussion of emerging issues should be strengthened in the ROE. A member stated that the Panel should consider the public comments received at the meeting from the representative of the Little Hocking Watershed. He noted that these public comments addressed an important emerging issue.

The panel discussed whether different approaches should be taken to develop the human health and ecological condition chapters. A member stated that it would be good to show different approaches, but the report should not be fragmented. It should be strengthened “up front.”

A member stated that there was some confusion about whether the ROE was a comprehensive report on the environment or a report directed toward EPA domains. He stated that an additional statement was needed at the beginning of the report to clarify this. Another member noted that EPA should strengthen the discussion of the purpose of the report.

The Panel discussed the need for more synthesis and pulling together linkages among indicators and questions in the report. Members stated that more interconnectedness was needed. A member noted that Exhibit 5-1 on page 5-7 of the report could be expanded with some additional text. The Panel discussed an example conceptual framework developed by one panelist (Appendix F). Panelists noted that it was particularly important to further describe the importance of the indicators. The Panel discussed whether a separate synthesis chapter was needed to pull together the report.

Following the discussion of overarching issues the Chair thanked the Panel members for their comments and also thanked EPA staff for responding to the Panel’s questions. She stated that the meeting had been very productive and then reviewed the schedule for developing the Panel report. She stated that she would like to receive draft sections from each of the five subgroup leaders by August 10. A first draft of the report would then be developed for review by Panel members. She stated that a teleconference would be scheduled to discuss the report. The Chair then adjourned the meeting.

Respectfully Submitted:

/Signed/

Dr. Thomas Armitage
Designated Federal Officer

Certified as True:

/Signed/

Dr. Deborah Swackhamer, Chair
SAB Panel for the Review of EPA's
2007 Report on the Environment

APPENDICES

Appendix A: Panel Roster

Appendix B: Meeting Agenda

Appendix C: Highlights of the Air, Water, and Land Subgroup Discussions

Appendix D: Highlights of Human Health and Ecological Condition Subgroup
Discussions

Appendix E: Overarching Comments

Appendix F: Example Conceptual Framework

Appendix A – Panel Roster

U.S. Environmental Protection Agency Science Advisory Board Panel for the Review of EPA's 2007 Report on the Environment

CHAIR

Dr. Deborah Swackhamer, Interim Director and Professor, Institute on the Environment, University of Minnesota, Minneapolis, MN

MEMBERS

Dr. Henry Anderson, Chief Medical Officer, Division of Public Health, Wisconsin Division of Public Health, Madison, WI

Dr. Fred Benfield, Professor of Ecology, Department of Biological Sciences, Virginia Tech, Blacksburg, VA

Dr. Mark Borchardt, Director, Public Health Microbiology Laboratory, Marshfield Clinic Research Foundation, Marshfield, WI

Dr. Timothy Buckley, Associate Professor and Chair, Division of Environmental Health Sciences, School of Public Health, The Ohio State University, Columbus, OH

Dr. Aaron Cohen, Principal Scientist, Health Effects Institute, Boston, MA

Dr. David A. Dzombak, Walter J. Blenko Sr. Professor of Environmental Engineering and Associate Dean for Graduate and Faculty Affairs, College of Engineering, Carnegie Mellon University, Pittsburgh, PA

Dr. Dennis Grossman, Principal Associate - Biodiversity Protection and Conservation Planning, Environmental and Natural Resources Department, Abt Associates Inc., Bethesda, MD

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

Dr. George Lambert, Associate Professor of Pediatrics, Director, Center for Childhood Neurotoxicology, Robert Wood Johnson Medical School-UMDNJ, Belle Mead, NJ

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

Dr. Maria Morandi, Assistant Professor, Division of Environmental and Occupational Health, School of Public Health, University of Texas, Houston, TX

Dr. Deborah Neher, Associate Professor and Chair, Plant and Soil Science, College of Agriculture and Life Sciences, University of Vermont, Burlington, VT

Dr. Duncan Patten, Research Professor, Land Resources and Environmental Sciences Department, Montana State University, Bozeman, MT, USA

Dr. Ramesh Reddy, Graduate Research Professor and Chair, Soil and Water Science Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, USA

Dr. Gary Saylor, Beaman Distinguished Professor, Joint Institute for Biological Sciences, Oak Ridge National Laboratory, University of Tennessee, Knoxville, TN

Dr. Alan Steinman, Director, Annis Water Resources Institute, Grand Valley State University, Muskegon, MI

Dr. C. John Suen, Professor, Earth and Environmental Sciences, College of Science and Mathematics, California State University, Fresno, Fresno, CA, USA

Dr. Robert Twiss, Professor of Environmental Planning Emeritus, University of California-Berkeley, Ross, CA

Dr. Judith S. Weis, Professor, Department of Biological Sciences, Rutgers University, Newark, NJ

Dr. Barry Wilson, Professor, Animal Science and Environmental Toxicology, College of Agriculture and Environmental Science, University of California, Davis, CA

SCIENCE ADVISORY BOARD STAFF

Dr. Thomas Armitage, U.S. Environmental Protection Agency, Washington, D.C.

Appendix B – Meeting Agenda

**U.S. ENVIRONMENTAL PROTECTION AGENCY
SCIENCE ADVISORY BOARD
Panel for the Review of EPA’s 2007 Report on the Environment
Public Meeting, July 10-12, 2007**

**Marriott Metro Center Hotel
775 12th Street, N.W., Washington, D.C. 20005**

AGENDA

Tuesday, July 10, 2007

- 9:00 - 9:10 a.m. **Meeting Convened by the Designated Federal Officer**
Dr. Thomas Armitage
- 9:10 - 9:15 a.m. **Welcoming Remarks**
Dr. Anthony Maciorowski, Deputy Director, EPA Science
Advisory Board Staff Office
- 9:15 - 9:30 a.m. **Introduction of Members, Purpose of the Meeting and**
Review of Agenda
Dr. Deborah Swackhamer, Chair
- 9:30 - 9:45 a.m. **Highlights of EPA’s 2007 Report on the Environment**
Dr. Peter Preuss, Director, EPA National Center for
Environmental Assessment

Dr. Denice Shaw, EPA National Center for
Environmental Assessment
- 9:45 - 10:45 a.m. **General Comments on EPA’s 2007 Report on the**
Environment
Dr. Deborah Swackhamer and Panel
- 10:45 - 11:00 a.m. **BREAK**
- 11:00 - 11:30 a.m. **Public Comments**
- 11:30 a.m. – 12:45 p.m. **Panel Discussion of Chapter 2 (Air)**
Dr. Deborah Swackhamer and Panel
- 12:45 – 1:45 p.m. **LUNCH**

- 1:45 – 3:15 p.m. **Panel Discussion of Chapter 3 (Water)**
Dr. Deborah Swackhamer and Panel
- 3:15 – 3:30 p.m. **BREAK**
- 3:30 – 4:45 p.m. **Panel Discussion of Chapter 4 (Land)**
Dr. Deborah Swackhamer and Panel
- 4:45 -5:15 p.m. **Panel Subgroup Meetings to Plan Writing Sessions**
-- Air
-- Water
-- Land
- 5:15 p.m. **RECESS FOR THE DAY**

Wednesday, July 11, 2007

- 8:30 – 10:45 a.m. **Concurrent Panel Subgroup Meetings**
(Panel subgroups will meet in breakout rooms to prepare written responses to the charge questions)
-- Air
-- Water
-- Land
- 10:45 – 11:00 a.m. **BREAK**
- 11:00 a.m. – 12:30 p.m. **Discussion of Highlights of Subgroup Recommendations**
Dr. Deborah Swackhamer, Chair and Panel
- 12:30 – 1:30 p.m. **LUNCH**
- 1:30 – 3:00 p.m. **Panel Discussion of Chapter 5 (Human Health)**
Dr. Deborah Swackhamer and Panel
- 3:00 - 3:15 p.m. **BREAK**
- 3:15 - 4:45 p.m. **Panel Discussion of Chapter 6 (Ecological Condition)**
Dr. Deborah Swackhamer and Panel
- 4:45 – 5:15 p.m. **Panel Subgroup Meetings to Plan Writing Sessions**
-- Human Health
-- Ecological Condition

5:15 p.m.

RECESS FOR DAY

Thursday, July 12, 2007

8:30 - 10:30 a.m.

Concurrent Panel Subgroup Meetings

(Panel subgroups will meet in breakout rooms to prepare written responses to the charge questions)

- Human Health
- Ecological Condition

10:30 – 10:45

BREAK

10:45 -11:45 a.m.

Discussion of Key Panel Recommendations

Dr. Deborah Swackhamer and Panel

11:45 a.m. - 12:15 p.m.

Meeting Summary and Action Items

12:15 p.m.

ADJOURN

Appendix C

Highlights of Air, Water, and Land Subgroup Discussion

Chapter 2. Air

Charge Question 1.

- General document:
 - General scope is appropriate
 - Stove piping is a problem:
 - Suggestion: Add a science framework showing interactions within and between among media, and within and between indicators
- Reformulation of question
 - Question 1 and 2 should be rephrased to say “What are the trends in (outdoor/indoor) air quality related to human health and the environment?”

Charge Question 2.

1. EPA needs to add SO₂ concentration as an indicator. This is a good news story but it is missing.
2. The Panel found it odd that acid deposition is in this chapter. It could be referred to, but it would be more appropriate in ecology and water chapter. However this may be contradictory because on one hand we are telling EPA to provide greater integration and on the other telling them to remove this (acid deposition is an integrating indicator). Several indicators could span different chapters. Could make a reference and cross-link it to other chapters.
3. With respect to the emissions inventory. There needs to be a broader explanation of what is in the National Emissions Inventory (NEI). Later in text there is reference to TRI and PBT. It is not clear what the difference is between air toxics (POPS and HAPS). This report is for the general public. A general definition is needed. EPA Could expand this section (Air toxics also known as HAPS). There is a reference in water chapter to compounds also found in the air. This is an integration issue. There needs to be some discussion of all of these aspects of toxic material.
4. There needs to be some discussion of the direction the air indicators are going (either increasing or not). There is a need to understand the direction that these indicators are going. The report needs to state: where have we been, where are we now, and where are we going. There is no history provided. EPA can talk about ongoing efforts (e.g., mercury that will likely lead to lower emissions- a qualitative description). There are ongoing things that can be described to make the point that this is not static, we have

active processes in place that will likely lead to better air quality. We would anticipate trends to continue. Air quality management is an ongoing process.

5. The subgroup did not get a sense of time concerning how long air monitoring networks have been in place. The report can have a discussion of questions that integrate across the pollutants. For example, the trend in climate is likely to lead to problems for secondary pollutants, due to increased radiation from stratospheric ozone depletion. EPA needs to look more at the chapter as a whole instead of separate pieces.

6. EPA needs an indicator to show that we are moving from primary pollutants to secondary pollutants. We can see the SO₂ and lead going down. This allows one to start to talk about interplay. This fits into discussion of the indicators, an assessment of what is going on. This pulls things together. EPA can bring in climate and ozone issues.

7. The report needs a piece on how climate is affecting aerosols. A paragraph would be appropriate. The subgroup is not talking about massive expansions, just taking opportunities to build the links in the discussion section.

8. When EPA talks about air toxics the discussion is limited to emissions. This should be expanded.

9. We find the elimination of things that are not data (i.e., modeled estimates) to be strange. Most of the emissions data are estimated, and the criteria do not specify that things not monitored cannot be used.

10. EPA can do more with the air toxics. There is a disconnect between 1990 and 1999. EPA should look at the possibility of having estimates to determine trends. The report needs to describe more about what is in the national emissions inventory.

11. EPA should add an additional indicator which is estimated air toxics data. (a problem is that networks have changed, benzene has most robust data). The subgroup anticipates that in the future we will have robust network. There are butadiene data. NAT network data should be useful. The ROE criteria do not exclude using modeled data.

12. If EPA has model results the Agency would still have a certain measure of reliance as long as modeling assumptions have not changed.

13. Issue: Because EPA selects sites going back to 1990 the Agency may see a trend declining. However, if EPA looked at same data for sites for last 5 years, it is questionable whether one would still have the same understanding of trends. This is an issue of base year and site selection bias. The process should be described transparently. When regional indicators are considered the picture may change. The subgroup questions whether EPA is getting all of the information that is relevant.

Charge Question 3.

- Most reviewers thought that gaps and limitations had been identified, but each offered suggestions for improvements with regard to the limitations that were identified:
 - The health relevance of the indicators should be better documented with more extensive reference to the epidemiologic evidence.
 - The implications of each limitation should be discussed, and the uncertainties associated with each limitation should be quantified to the extent feasible.
 - The report should offer solutions to filling gaps and limitations. Better integration of the Agency's regulatory and programmatic perspectives is needed.
 - The effects of trends in ambient concentrations on exposure and dose should be discussed.

- Two reviewers identified additional limitations
 - The report should acknowledge and discuss the limitations of a single-pollutant, local source approach to pollution control in the context of the marked reductions in individual pollutants documented by the indicators, as exemplified by continuing challenges with regard to ozone and PM_{2.5}. The importance of temporal trends in the importance of primary vs. secondary pollutants with regard to PM and ozone should be discussed
 - The report should discuss the bias that may result from choice of base year for trends.

Charge Questions 4 and 5.

The use of regional indicators and regionalization of national indicators is a valuable direction for the ROE. It is important to show trends within and between regions;

Regionalization of National Indicators

- This makes statistical analysis even more important;
- Regionalization should be based on air shed rather than administrative structure or means based on science e.g., urban vs. rural
- Limitations of extrapolation to sub-regional levels (e.g., states, cities) should be identified.
- There is a need for a caveat indicating that regional or national data may not represent local conditions

Regional Indicators

- Regional indicators are valuable for gaining buy-in from regions.
- Two regional indicators are presented (i.e., Region 5 Mn, and U.S.-Mexico border air pollution but it appears that there should be others. EPA should

describe the process for selection of regional indicators. Is it science based? What is the rationale?

- The use of regional indicators has conceptual value but is not realized in current report. There is inconsistency between case studies.
- There is a need for providing indicators at “hot-spot” locations. EPA should point to other sources.
- The future ROE should consider using the PM speciation network to inform PM composition.

Question 6

- More integration and clarity with synthesis of data is needed.
- The presentation is linear and is not integrated. EPA needs to think about it more holistically.
- The case has to be made that genuine improvements in air quality have been made over time.
- The science in the document needs to be strengthened by explaining the story of what has happened and why have things occurred. The document should make use of data to move to a better understanding. This report will be the base to make improvements. There is a need for better understanding of what is happening. The story of what we know will strengthen the report.
- Radon and climate change indicators should have synthesis discussion.
- It is important to relate climate change to other indicators. EPA should take advantage of the opportunity to integrate to answer important questions. Where are greenhouse gases coming from? What is the interplay between greenhouse gas emissions and other pollutants? Things like energy efficiency may make a big difference in terms of traditional pollutants.

- Chapter 2. Water.

QUESTION 1

1) Overall, broadness and consistency of questions are appropriate given EPA's mission and scope of ROE.

**2) However, we recommend the following elements be considered when developing future versions:
Discussion of interconnectedness of different systems
The inclusion of some questions that we believe are currently missing:**

What is the condition of coral reefs?

What are the trends, availability, and usage of water for human activities? By sector?

What are the trends, extent, and condition of riparian zones and lake shoreline, and their effects on human health and the environment?

QUESTION 2

1) In general, the narratives accurately captured the indicator data. There were occasional discrepancies—please see specific comments

2) The lack of acceptable national indicators to provide answers to a number of questions is problematic. A possible approach to overcome such difficulties may be to develop internally consistent local or regional indicators that only cover individual environmental units or ecological provinces in those cases where data for national indicators are not available or do not meet the criteria for inclusion in the ROE. Indicator data from different watersheds or hydrological basins may not be directly comparable with each other, but the local or regional sets of data may provide meaningful temporal trends.

3) There are missing indicators:

Snowpack: extent, condition, and volume

Pathogens: coliforms, enteric viruses, toxins, etc.

Storm water and wastewater: contaminant effects

Drinking water primary contaminants

QUESTION 3

- 1) In general, the gaps and limitations are adequate, objective, and transparent in identifying and communicating the gaps and limitations of the indicators in answering the REO questions.
 - 2) It is somewhat problematic that many of the indicators aggregate data over a prolonged period of time. While this may be the result of the sampling methodology, it needs to be mentioned and discussed.
 - 3) Lack of temporal changes in long-term data; too many snapshots.
 - 4) Need to clarify indicator limitation vs data gaps (needs to be better clarified)
 - 5) Where national data are not available, should look for regional data sets to fill that gap or to show the trend (see question 1)
-

QUESTION 4

- 1) Regionalization is an important component and we endorse its inclusion in the ROE.
 - 2) The use of EPA Regions to scale national data has little ecological justification, although we understand its pragmatic appeal. If possible, the data should be analyzed at more appropriate scales. The use of EPA regions to regionalize data, needs to be better explained.
-

QUESTION 5

1) There is considerable utility in using regional indicators in *ROE* in answering the questions.

2) We recommend that the ROE identify more regional data bases, such as at LTER sites, USGS groundwater basins, and state agencies. We recognize that not all data will meet the criteria developed by EPA; however, regional indicators may have national importance and will be of significance to the local populations.

3) We recommend that regional data sets be used to analyze trends.

QUESTION 6

1) The overall quality is good and level of communication is appropriate.

2) We recommend that the interconnectedness among chapters be more strongly emphasized. This can be accomplished through cross-referencing chapters or the use of conceptual frameworks.

3) Specific recommendations:

Include summary section after each media chapter; include emerging issues. For water, these issues include:

- Effect of climate change on water quantity and quality
 - Emerging pathogens associated with climate change
 - Pharmaceutically produced compounds
 - Nanoparticle wastes
 - Water availability and sustainability
 - Invasive species
 - Better characterization of algal toxins
-

QUESTION 6: con'd

4) We also recommend that a summary chapter be included that gives an overall assessment of the US Environment. This chapter could also success stories

Chapter 3. Land.

OVERARCHING ISSUES

- Conceptual framework
 - Indicator criteria
 - Regional indicator
 - Status and trends
 - Importance of ecosystem services
 - Transparent set of assessment metrics
 - Connection with assessment metrics
-

CHARGE QUESTION 1 FORM AND SCOPE OF QUESTIONS

- 5 fundamental questions: What are the trends in extent of _____ and their effects on human health and environment? (land cover, land use, wastes, chemicals, contaminated land)
 - Few indicators relate directly to human and environmental health
 - Trends: qual vs quant (need to define trend)
 - Add question: soil quality and conservation
-

CHARGE QUESTION 2 COMMENT ON INDICATORS

- Make clear reasons for choosing indicators
 - Indicators should be related to the big picture questions, not just chosen for availability and because they meet criteria
 - Perhaps indicator criteria too stringent
-

CHARGE QUESTION 2 COMMENT ON INDICATORS

- Land cover
 - data old and resolution coarse
 - develop time series and consider of classification resolution data
 - Consider other ecosystem types, not just forest
 - One regional case study on land use (Puget Sound); too specific, not replicable elsewhere
 - Land use: adopt standardized classification approach; work on trends; consider adding road density
-

CHARGE QUESTION 2 COMMENT ON INDICATORS

- Solid/Hazardous Wastes
 - Contaminated Land: consider additional RCRA and NPL sites
 - Chemicals
 - Include pesticides, PBTs, mining waste data
 - Include suburban/urban indicator
 - Move pesticide food/incident data to Hum. Health
-

CHARGE QUESTION 3 GAPS AND LIMITATIONS

- Well presented
 - Discuss indicators considered but not included because of data not meeting criteria
 - Make clear data gap discussion not comprehensive, and that gaps identified are of highest priority to agency
-

CHARGE QUESTION 4 REGIONAL DATA

- Breakdown by regions important
 - Eco-region breakdown makes more sense for some indicators, e.g., land use and land cover
 - Admin region breakdown also useful, e.g., in setting performance goals
 - Type of regional scaling determined on indicator-by-indicator basis
-

CHARGE QUESTION 5 REGIONAL EXAMPLES

- One regional example doesn't work; need more than one region
 - Include regional indicators and examples if they can be replicated across US
-

CHARGE QUESTION 6
OVERALL QUALITY OF REPORT

- Clearly written and technically accurate
 - Fundamental questions far from completely answered, but this is acceptable
 - Data gap discussions too brief or not properly explained in some cases
 - Land chapter not at same state of development as air and water chapters
 - Include statistical analysis of data where possible
-

Appendix D

Highlights of Human Health and Ecological Condition Subgroup Discussion

Chapter 5. Human Health.

Charge Question 1.

- Questions in the human health chapter are generally appropriate and well formulated.
- Recommend re-naming Chapter 5 to “Human Exposures and Health.”
- Recommend reordering questions to human exposures first, keep Q2 second, and put last “Trends in Health Status.”
- Debatable: Delete Q1 and move data to introduction as context. Others believe Q1 emphasizes EPA’s public health mission.

Charge Question 2.

The indicators used are appropriate. However,

- **Problem:** they are not sufficiently extensive to provide robust answers to the questions. The revised indicator definitions and criteria may be overly restrictive and prevent the use of valuable data systems.

Solutions:

- Other data sets could add substantially to the understanding of health status. For example, NHIS data provide a national perspective only. The Behavioral Risk Factor Surveys that are done in all states gather similar data which can be aggregated to the national level but have the advantage of offering state-specific data. Hospital and emergency room discharge data should also be employed. Infectious disease reporting data bases maintained by CDC might also be included.
 - In the future the Agency needs to adopt the suites of indicators that other agencies have developed, but present them in relation to environmental factors.
- **Problem:** All of the health indicators have complex, multiple causes, which may include the environmental factors that are the focus of this report to some extent. Therefore, levels and trends in these indicators cannot be readily interpreted as reflecting the role of environmental exposures even though, as the authors state, there is evidence, in some cases well-established, for causal effects.

Solutions:

- Indicators should be chosen based on the evidence for their relation to environmental exposures. Health outcomes that do not meet such criteria should be excluded or their inclusion carefully substantiated. The evidence for their inclusion should be described qualitatively.
- Evidence for the environmental relevance of the health indicators should be summarized in a brief but comprehensive fashion in the media chapters. If impact estimates have been conducted by the agency or others their results should be included in Chapter 5 (e.g., estimates of the mortality impacts of particulate air pollution in the U.S.). Efforts underway to develop so-called linked indicators (e.g., the Environmental Public Health Tracking Project) should be noted and described more fully.

Problem: The various bio-indicators describe events at different points along the exposure to effect continuum. Some, for example, blood Pb, might be viewed as markers of intermediate effects, while others, for example phthalates in urine, might best be viewed as markers of exposure.

Solutions:

- More thought should be given to which bio-indicators should be included as health indicators. Smoking trends as indicated by cotinine in blood or saliva, currently in Chapter 2, should be moved to Chapter 5 because it bears significantly on respiratory diseases as well as cancer.
- Move pesticide indicators (Page 4-8) to chapter on exposure.
- The Panel questions where to place pesticide poison incidence indicator.

Charge Question 3.

- The adequacy, objectivity, and transparency of the identification and communication of gaps and limitations of the indicators are adequate with some potential areas for improvement.
- The gaps and limitations sections can be improved by identifying the reasons for not including data sets by dividing the basis of the limitations into technical concerns, lack of statistical power, or other specific reasons.
- Gaps can be narrowed by including data sets that may not meet specific stringent criteria (e.g., older data sets than can be used to trend important indicators) or using regional data sets that are of national priority, case studies demonstrating a framework for discussion or national applicability. Examples could include birth defect data from states that have been collected birth defects data for 50 years, another example could be lead level data in children in the U.S. that are available for several decades.
- More information is needed in providing more quantitative description of the indicator's relevance by utilizing the epidemiologic literature in discussing the amount environmental factors could contribute to the severity or prevalence of specific disease states. One such example would be the extent to which environment influences cancer incidence (Doll et al., 2000).

- Add to the discussions of whether or how the limitations and gaps affect the interpretations of the ROE, indicators, or the larger framework of the disease state or indicator.
- The concept statements in the indicator limitation sections such as “the measurement of Hg or any other environmental chemical in a person’s blood or urine does not by itself mean that the chemical has caused or will cause harmful effects in that person” could be removed from each indication and this concept placed in the conceptual framework section in the Human Health chapter.

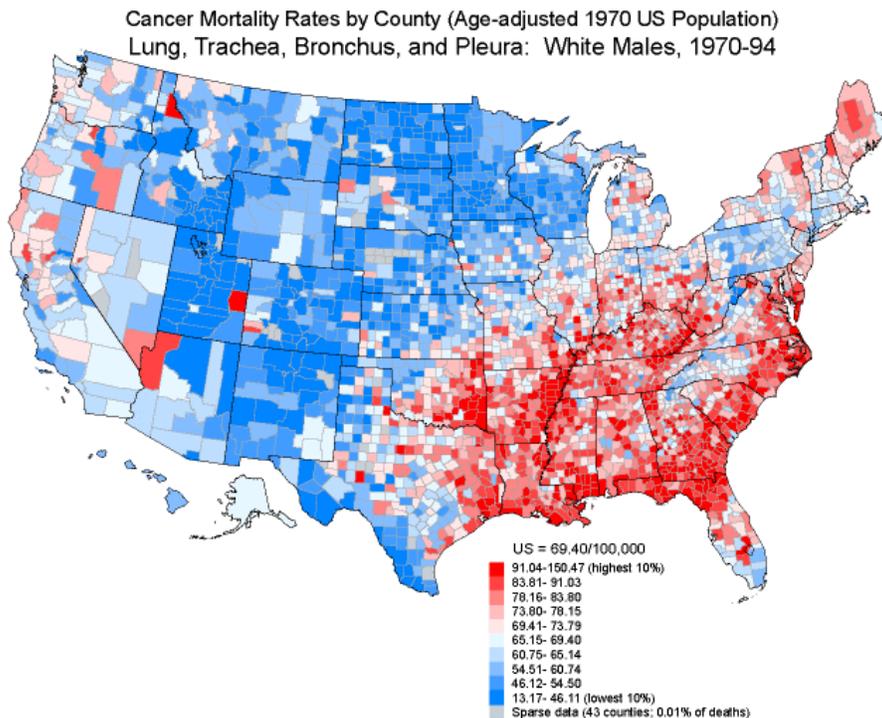
Charge Question 4.

- The breakdown by regions is appropriate and provides value.
- Type of region breakdown needs to be justified.
- In human health chapter there is a very limited breakdown by region.
- EPA should examine data regionalization for next report.
- EPA should consider using county data from states.

Charge Question 5.

- There is great utility and interest in increasing the resolution of the health indicators.
- National-level indicators are by themselves insufficient for gauging the state of the U.S. environment as it relates to health outcomes. Nationally aggregated data cannot reflect local and regional environmental or health trends that are important to the quality of life and health of the residents living in these areas. It would be helpful if EPA were to provide “regional” reports that were integrative and coherent. The current approach does not provide much benefit.
- Regional indicators as presented (EPA administrative regions) are not particularly informative geographic descriptors of health. Ecosystems, watersheds etc are far more useful as presented in some of the other chapters and would be a novel approach to presenting health data and set the ROE apart from the already existing health data presentations.
- For some of the indicator resolution can go down to the state and even the county level (indicators derived from birth and death certificates) making it possible to aggregate the data in many geographic patterns. See example map below.

- The NHIS survey data and the SEER cancer data only has national resolution. However, state-based surveys such as the Behavioral Risk Factor Surveillance System (BRFSS) can provide much of the same disease prevalence data as the NHIS and with resolution at the state level. State cancer reporting registries are in nearly all states and while not as rigorous as the SEER program, provide credible cancer incidence data widely used by states without SEER registries.
- It would be easy to build on the higher geographic resolution theme by presenting individual or multiple state data which could inform the gross national estimates presented and point toward the future.



Charge Question 6.

- The Chapter is, in general, technically accurate but has inconsistencies (regional trends existing vs. not).
- EPA needs to base qualifiers on trends or comparisons (temporal/regional) on statistical evaluation. (Suggestion: NHANES provides the information).
- EPA needs to clarify and support which health effects are associated with the media indicators at current environmental levels.
- EPA needs to expand bullet 2 on page 5-5 to include biological agents.

- Add the sentence: “Infectious diseases associated with environmental exposures or conditions are also addressed”
- EPA needs to expand discussion on sensitive populations.

Chapter 6. Ecological Condition

The ecological condition chapter is by far the most complex - deals with millions of different species, each of which may be subject to diseases such as neurodevelopmental problems and cancer, as well as effects at the population, community, and ecosystem level.

Charge Question 1.

- All kinds of ecosystems should be covered as no other agency has jurisdiction over the health of the nation’s ecosystems.
- Particularly needed are questions on “ecological health,” wildlife diseases, coral reefs, amphibians, estuarine/ marine fish populations, response to acidification (connect to Chapter 2).
- The chapter needs more focus on processes such as denitrification..
- The chapter should discuss disturbance processes that “sustain and influence” ecosystems.
- The chapter could be organized by ecosystem types like Heinz report.

Charge Question 2.

- The ecological condition should be a synthesis rather than a repeat of independent indicators
 - It should be organized by major ecosystem types
- The subgroup interpreted charge question 2 in two parts
 - a. are current indicators used appropriately?
 - b. Do the indicators chosen answer the question?
- The chapter needs a major reorganization as indicated below to reflect an integrated ecosystem health focus.

Organization by ecosystems

- Chapter should be organized by ecosystems (they are what we are trying to protect)
 - Examples: forests, grasslands, shrublands, arid lands, wetlands, agriculture, freshwater, coastal, marine
- Indicators should be organized by ecosystem type, ecosystem processes, and ecosystem components

Ecosystem type

- extent (e.g., land cover, land use, urbanization)
- quality defined by landscape integrity, i.e., connectedness, fragmentation

Ecosystem process examples and indicators

- Examples:
 - primary productivity, decomposition, disturbance, nutrient cycling, hydrological / chemical cycling, C sequestration
- Indicators:
 - fire frequency
 - floods, drought
 - algae blooms
 - invasive species

Ecosystem component examples and indicators

- physico-chemical
 - examples: riparian, alkali flats, wetlands, snowpack, physical habitats
 - Indicators (by ecosystem type):
 - Mean temperature and precipitation
 - Sea surface temperature & level
 - Stream flows
 - N and P discharge in rivers, streams, etc
- biological (genome to community)
 - examples: biodiversity, endangered species and communities,
 - Indicators (by ecosystem type):
 - extent (e.g., land cover)
 - community: (e.g., land cover, coastal benthic communities)
 - species: birds, fish, macroinvertebrates, submerged aquatic vegetation
 - status e.g., protection, management policy, zoning

Charge Question 3.

- In general, presentation of gaps and limitations was substantially improved from the 2003 Draft ROE—the limitations and gaps presented in a clear and objective way.
- In general, the gaps and limitations are adequate, objective, and transparent in identifying and communicating the gaps and limitations of the indicators in answering the ROE questions.
- Where national data sets are not available, EPA should look for regional data sets to fill that gap or to show the trend (“lower the bar”).
- EPA should examine Agency guidance manuals for alternative data sets.

- In those cases where sufficient data are available to assess trends, EPA should make sure that the limitations of the data sets are explicitly identified..

Charge Question 4.

- Ecologically relevant regions (watersheds etc.) should be used rather than EPA regions.
- With GIS one can see comparisons of ecologically relevant units with EPA Regions.
- The ROE will be greatly enriched by picking a well-studied unit (e.g. Lake Mendota) with good long-term data sets for each of the different regions.
- Not all indicators need to be regionalized.

Charge Question 5.

- If regional indicators (case studies) are expanded, one will be able to see more long-term trends, which cannot be done with the rigorous criteria that have been required for national indicators.
- Efforts should be made to expand many of the regional indicators to become national indicators.
- Case studies should be used with care – are they representative and applicable elsewhere?
- Or do they have models or tools that can be of value elsewhere?

Charge Question 6.

- Overall it is well done and written clearly.
- It needs more discussion and synthesis.
- It needs statistics.
- The ecological condition paradigm is an excellent conceptual framework but is essentially ignored within and between the discussions of the indicators used.
- The interconnections/interactions with the media chapter should be clearly stated and expanded. This approach would greatly improve the level of communication.
- The level is generally appropriate for the audience (but use degrees C for temperature and other metric units).

Future Versions of the Report

- Consider indicators focusing on genotypes (evolutionary responses).
- Consider putting these indicators back into the appropriate media chapters and have this chapter focus on higher-level integrated ecological health.

Appendix E
Overarching Comments

“Higher Level” Recommendations
(apply to all chapters)

We recognize and emphasize the tremendous value of this report to the nation, and strongly urge the Agency to fully support and permanently embed this report in its core mission-directed activities. This requires an investment in resources beyond the three FTE positions that currently are devoted to this effort. While the staff that have produced this report are applauded for their remarkable productivity and output, a sustained and increased investment in staff for the ROE is essential and is strongly recommended.

CHARGE QUESTION 1

1. It has been suggested that the EPA questions should be modified to correctly reflect where ROE will only present **status** information because there is no ability to present **trends** at this time. All of the questions should be modified to say status and trends, rather than just trends.

CHARGE QUESTION 2

2. The **choice of indicators** should be driven by the questions that need to be answered. It appears that indicator selection is currently driven by the presence of strong statistical datasets. It is suggested that the current filter results in the lack of presentation of important indicators for human and ecological health.
3. There needs to be a good **indicator description** that identifies why the indicator is important and what it tells. This will allow the reader to interpret the data based on their interests and needs. Should also indicate if trend is **quantitative or qualitative**. This should occur at the beginning of each indicator description.
4. Each indicator should include some discussion about the documented relationship between it and a **human health and ecological condition**. (give example).
5. There should be an additional indicator(s) that incorporate the importance/status/trends of **ecosystem services**.

CHARGE QUESTION 3

6. There needs to be a **transparent set of assessment metrics and benchmarks** that are used across indicators. The current use of metrics and benchmarks is not standardized and referenced.
7. Data Gaps sections should all be separated out into clear discussion of **data limitations, uncertainty, and data gaps**
8. For indicators with trends, time intervals of **trend period should be justified** – what is appropriate?
9. **Emerging Issues should be strengthened** – put at the end of each chapter, put at the end of Health and Eco chapters, and expand Chapter 7.

CHARGE QUESTION 4

10. National indicator datasets should be subdivided where appropriate to provide **finer-scale (regional) indicators** when the data are of sufficient consistency and resolution to support a finer level of analysis. These air, water, land and human and ecological health indicators should be analyzed in reference to appropriate airshed, watershed and ecoregionalizations.

CHARGE QUESTION 5

11. **Regional case studies** should be used where they provide a valuable example that should be replicated in different areas across the US.
12. We recommend that there should be clear and transparent **criteria** for the selection of **regional indicators**.
13. Long-term, well-supported **“platinum” datasets** (e.g. Lake Tahoe, Lake Mendota, Great Lakes air, water and fish, LTER sites) should be used to illustrate trends when national data sets are not available, with appropriate caveats.

CHARGE QUESTION 6

14. Overall, the ROE is a value collection of data, trends, and impact indicators. It is clearly written and presented, the graphics are of high value, and the organization is generally very good. We felt that the approach to ask key scientific questions about the environment was a highly effective framework for presenting the information. For the most part, the questions are appropriate in scope and presentation. However, we recommend a **greater degree of integrated discussion across the indicators** and chapters than currently exists. While there are discussion sections after a series of indicators that are provided to answer a given question, there is not a corresponding synthesis discussion across the questions that tie things together, and make the whole of the report greater than the sum of its parts. We specifically recommend that a conceptual framework be added to the introduction (see next recommendation), and that a greater degree of synthesis discussion be added to both the

Health and Eco chapters in this version of the report. We recommend that future editions of this report add a Synthesis Chapter that fully integrates the entire report, including the integration of health and ecosystem status, trends, and effects.

15. EPA should develop a **conceptual framework** of human and environmental health that illustrates the connectedness between the media chapters, and the Health and Eco chapters. By the term ‘conceptual framework’, we mean a short description and figure that explains the relationships between source, transport, and fate of human and environmental health hazards, as well as their exposure to receptors, dose, and impact. This should be in the introduction of the document. In addition, this figure could be at the beginning of each chapter to provide an overall context for that chapter (for example, the relevant part of the figure that shows the role and importance of a given chapter could be highlighted in the graphic). This would provide the clear basis for the use and prioritization of specific indicators, the choice of scale and boundaries in regional indicators, and selection of metrics (i.e., thresholds, benchmarks, etc.). This in turn provides the appropriate context for future monitoring and assessment of status and trends.
16. Indicators need to elaborate wherever possible on their **effect and outcomes** to human and ecological condition. The primary stressors (e.g., emissions data) have value and should be used, but we recommend that the report more fully explain how they contribute to answering the ROE questions.
17. The introduction to the ROE should be strengthened to **more fully describe the report structure**. It should describe that the first three chapters address the status and trends using specific indicators for individual ‘media’ of air, water and land, and the next two chapters are synthesis chapters that integrate the information as well as provide information on health and ecosystem health indicators. Although the report has these two sections, we do not recommend that it be split any further.
18. The introduction of the ROE should **clearly indicate the intent and purpose** of the report for both its intended audience and EPA use.
19. There needs to be a **consistent approach for statistical analysis** and reporting that is a part of the results presentation for each indicator. We understand that this is underway for some indicators in the final version of this report, and eventually for all indicators, and we applaud and encourage this effort.

Appendix F

Example Conceptual Framework

