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**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
WASHINGTON, D.C. 20460



OFFICE OF THE ADMINISTRATOR  
SCIENCE ADVISORY BOARD

1

2 Honorable Stephen L. Johnson  
3 Administrator  
4 U.S. Environmental Protection Agency  
5 1200 Pennsylvania Avenue, N.W.  
6 Washington, D.C. 20460

7

8 Subject: SAB Advisory on EPA's Draft *Report on the Environment 2007: Science Report*

9

10

11 Dear Administrator Johnson:

12

13 EPA's Office of Research and Development requested that the Science Advisory  
14 Board (SAB) review the Agency's draft *Report on the Environment 2007: Science Report*  
15 (ROE). The ROE is an update of EPA's draft 2003 Report on the Environment which  
16 was reviewed by the SAB in 2004. The ROE compiles and updates scientific indicators  
17 of status and trends in human health and ecological condition in the United States. In  
18 response to the Agency's advisory request, an SAB panel conducted a peer review of the  
19 ROE. The enclosed advisory report provides the advice and recommendations of the  
20 Panel.

21

22 The SAB commends the Agency for incorporating many of the previous SAB  
23 recommendations into the improved ROE. However, as detailed in the enclosed report,  
24 the SAB has identified a number of shortcomings in the ROE that limit its usefulness.  
25 The SAB has provided recommendations to improve the document before final  
26 publication.

27

28 The SAB emphasizes the tremendous value of EPA's ROE. It is the only report of its  
29 kind providing an objective assessment of changes in environmental quality over time as  
30 related to human and ecological health. The SAB therefore strongly urges EPA to fully  
31 support and permanently embed the ROE into its core mission-directed activities. This  
32 will require an investment in resources beyond those currently devoted to the ROE. The

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1 SAB has provided additional recommendations aimed at strengthening future EPA  
2 Reports on the Environment.

3  
4 Thank you for the opportunity to provide advice on this important topic. The SAB  
5 looks forward to receiving your response to this advisory.

6  
7 Sincerely,  
8  
9

10  
11  
12 Dr. M. Granger Morgan, Chair  
13 Science Advisory Board

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

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**NOTICE**

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This report has been written as part of the activities of the EPA Science Advisory Board, a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The Board is structured to provide balanced, expert assessment of scientific matters related to the problems facing the Agency. This report has not been reviewed for approval by the Agency and, hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency, nor of other agencies in the Executive Branch of the Federal government, nor does mention of trade names or commercial products constitute a recommendation for use. Reports of the EPA Science Advisory Board are posted on the EPA website at <http://www.epa.gov/sab>.

1                                   **U.S. Environmental Protection Agency**  
2                                   **Science Advisory Board**  
3                                   **Panel for the Review of EPA's 2007 Report on the Environment**  
4  
5  
6

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2  
3 **1.0 EXECUTIVE SUMMARY**  
4

5 The Science Advisory Board (SAB) Panel for the Review of EPA's 2007 Report on  
6 the Environment has reviewed the Agency's draft *Report on the Environment 2007:*  
7 *Science Report* (ROE 2007 Science Report). The ROE 2007 Science Report compiles  
8 and updates scientific indicators of status and trends in human health and ecological  
9 condition in the United States. EPA initially presented this information in a draft *Report*  
10 *on the Environment Technical Document* released in 2003 and reviewed by the SAB.  
11 Since then, EPA has revised the Report in response to feedback from the SAB and  
12 stakeholders. The ROE 2007 Science Report will be used by EPA to inform strategic  
13 planning, priority setting, and decision making across the Agency, and to communicate  
14 with the general public.  
15

16 In developing the ROE 2007 Science Report, EPA compiled indicators to help answer  
17 twenty-six policy-relevant questions deemed to be critically important to the Agency's  
18 mission and national interest. EPA sought the SAB's review of: the adequacy of the  
19 formulation and scope of the questions posed in the Report; the appropriateness of the  
20 indicators in answering the questions; the accuracy of the characterization of indicator  
21 data gaps and limitations; the degree to which the data gaps and limitations of the  
22 indicators limit ability to answer the questions; the appropriateness of regionalization of  
23 national indicators; the utility of regional indicators in the Report; and the overall quality  
24 of the Report with respect to technical accuracy, clarity, and appropriateness of the level  
25 of communication. In this advisory report, the SAB provides specific comments and  
26 recommendations in response to the charge questions.  
27

28 The Panel emphasizes the tremendous value of the ROE 2007 Science Report and  
29 concurs with the statement in the previous SAB review of EPA's 2003 Report on the  
30 Environment (ROE 2003) that there is an urgent need for this kind of assessment. It has  
31 the potential to have an important impact on improving understanding of the state of the  
32 environment by synthesizing relevant information from many sources and identifying  
33 data gaps and needs for the development of effective environmental policy and protection  
34 programs. The Panel therefore strongly urges EPA to fully support and permanently  
35 embed the Report on the Environment into its core mission-directed activities. This will  
36 require an investment in resources beyond those currently devoted to the ROE 2007  
37 Science Report.  
38

39 The Panel finds that the ROE 2007 Science Report is a valuable collection of data,  
40 trends, and impact indicators. The Panel commends EPA for incorporating many of the  
41 SAB's recommendations from the 2003 review to improve the organization and scope of  
42 the Report. Generally, the formulation and scope of the questions in the ROE 2007  
43 Science Report are adequate; narratives in the text have captured information about the  
44 indicators presented in the document; EPA has effectively identified many of the key

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1 indicator data gaps and limitations; and regional analyses have made the Report more  
2 meaningful. However, as discussed below, the Panel has identified shortcomings in the  
3 document that limit its usefulness in fulfilling its stated purposes. **While the Report**  
4 **may help inform strategic planning and priority setting, it should not be used for**  
5 **decision making as it contains little data interpretation and no conclusions**  
6 **supported by statistical analysis.** Recommendations for improvements in the Report  
7 are provided to make it more useful to EPA and other intended audiences. The  
8 recommendations address EPA's specific charge questions as well as general  
9 improvements needed to make the Report a more effective assessment of status and  
10 trends in the condition of human health and the environment. The Panel has  
11 recommended revisions that should be incorporated into the final Report as well as  
12 improvements that will require a much longer time frame to implement, and thus should  
13 be incorporated in future Reports on the Environment. We strongly recommend that EPA  
14 make the suggested short-term changes prior to release of the Report.

15  
16 *Overarching "higher level" findings and recommendations that pertain to all chapters of*  
17 *the ROE 2007 Science Report*

- 18
- 19 • **Strengthened scientific underpinnings:** The Panel finds that the scientific  
20 underpinnings of the final Report need to be strengthened to make it a "science  
21 report," as indicated by its title, rather than simply a data report. As discussed below,  
22 this can be accomplished by including greater synthesis, interpretation, statistical  
23 analysis, and discussion related to the literature. An alternative would be to remove  
24 "science" from the title so that the report is characterized as a status and trends report.  
25
  - 26 • **Better integration and discussion of indicators:** The organization of the Report  
27 into individual media chapters (air, water, and land) and synthesis chapters on human  
28 health and ecosystem condition makes sense, and the approach of asking key  
29 scientific questions about the environment is a highly effective framework for  
30 presenting the information in the Report. However, the Panel recommends that the  
31 final Report contain a greater degree of integrated discussion across the indicators and  
32 chapters than currently exists. **A conceptual framework that illustrates the**  
33 **connectedness between the media chapters and the human health and ecological**  
34 **condition chapters should be added to the introduction of the final Report. In**  
35 **addition the final Report should contain a synthesis chapter that fully integrates**  
36 **the entire Report and discusses health and ecosystem status, trends and effects.**  
37 This synthesis chapter should include a discussion that interprets and discusses the  
38 observed trends, connects the trends seen in the various indicators with cause/effect,  
39 and also connects the indicators with each other. The Panel notes that the Report  
40 provides a large amount of valuable data and information that can be interpreted by  
41 readers, but it contains few clear conclusions and statements of significance of the  
42 findings. **Future Reports on the Environment should provide such conclusions**  
43 **and statements.**  
44

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- 1 • **Statistics and uncertainties:** The ROE 2007 Science Report states that, due to time  
2 and resource limitations, statistical analysis of uncertainty and trends in indicators  
3 was not included. The Panel finds that this has limited the usefulness of the Report,  
4 and that a statistical approach to analysis and presentation of the data is needed to add  
5 rigor to the Report. **The Panel therefore recommends that EPA incorporate into**  
6 **future Reports on the Environment a consistent approach to statistical analysis**  
7 **and reporting across all indicators.** This should be part of the results presentation  
8 for each indicator. In some cases, this may involve formal statistical analyses,  
9 whereas in other cases it may involve the inclusion of additional information such as  
10 error bars around mean values. When sufficient data are not available for quantitative  
11 analyses, this can also be reported. Without such information, the ROE cannot fully  
12 meet its intended purpose of reporting scientifically established trends in human  
13 health and environmental condition.  
14
- 15 • **All questions in the final Report should address status and trends:** The Panel  
16 was asked to comment on the adequacy of the formulation and scope of questions  
17 posed in the ROE 2007 Science Report. Although the scope of the questions posed in  
18 the Report is generally appropriate, questions are only asked about trends. **The Panel**  
19 **recommends that all questions in the final Report address both status and**  
20 **trends.** The discussions of “what the data show” should clearly reflect cases where  
21 trends cannot be presented because only status information is available. In addition,  
22 it is recommended that EPA explicitly state how each question in the Report is related  
23 to the conceptual framework of the Report.  
24
- 25 • **Indicator selection criteria:** The Panel was asked to comment on whether the  
26 indicators presented in the ROE 2007 Science Report were used appropriately to  
27 answer questions in the Report. EPA has established a set of criteria that were used  
28 to drive the process of selecting the indicators used in the Report. The Panel finds  
29 that, with some exceptions, the narratives in the text of the Report have accurately  
30 captured the indicator data. However, the high national data standards set by the  
31 indicator selection criteria have resulted in the lack of presentation of important  
32 indicators of status and trends in human and ecological health. **To strengthen future**  
33 **Reports on the Environment, the Panel has identified and recommends including**  
34 **a number of missing indicators and regional case studies supported by long-term**  
35 **data sets. Some additional indicators have also been recommended for inclusion**  
36 **in the final Report. In addition, the Panel recommends that for each indicator in**  
37 **the final Report, EPA provide a clear description of why the indicator is**  
38 **important, what it tells, and the documented relationship between the indicator**  
39 **and human health and ecological condition.**  
40
- 41 • **Indicator discussion:** Each question in the ROE 2007 Science Report is  
42 accompanied by a discussion of the most critical indicator gaps, limitations, and  
43 challenges that prevent the question from being fully answered. The Panel was asked  
44 to comment on the accuracy of characterization of the indicator gaps and limitations

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1 and the degree to which they limit the ability to answer questions in the Report. In  
2 general, the Panel finds that most of the indicator data gaps and limitations have been  
3 identified. However, to improve the final Report, **EPA should clarify whether**  
4 **specific bullets in the indicator limitations sections refer to indicator limitations**  
5 **or data gaps. The Panel recommends that in future Reports on the**  
6 **Environment, the discussion of indicator limitations and data gaps be separated**  
7 **into different types of limitations. For example, the limitations could be grouped**  
8 **based on geographic limitations; statistical limitations; and data coverage**  
9 **limitations.** The Panel also recommends that the discussion in the final Report be  
10 expanded to include some of the more prominent available data sets that were  
11 excluded, and the reasons for their exclusion.  
12

- 13 • **Regional indicators:** The ROE 2007 Science Report has broken out national-level  
14 data for some of the indicators by EPA region, and provided ten regional indicators.  
15 The Panel was asked to comment on the utility of these approaches. The Panel finds  
16 that regional analysis of data makes the Report more meaningful, and recognizes the  
17 pragmatic appeal of using EPA administrative regions for this purpose. However, the  
18 use of EPA administrative regions to scale national data has little ecological  
19 justification and does not provide particularly informative geographic descriptors of  
20 human health. **Therefore, the Panel recommends that in future Reports on the**  
21 **Environment, indicator data be presented by relevant geographic units such as**  
22 **ecoregions, airsheds, and watersheds.** This would be a useful approach for  
23 presenting both ecological and human health data. The Panel supports the use of  
24 regional indicators that can reflect important information for gauging the state of the  
25 U.S. environment. Key regional issues such as the ecological health of the Great  
26 Lakes or the Everglades should also be addressed in a national report on the  
27 environment, and the use of state and county data could increase the resolution for  
28 reporting the health indicators in future Reports on the Environment.  
29
- 30 • **Use of regional indicators and case studies to illustrate trends:** It is disappointing  
31 that the lack of available long-term data has been listed as a data gap that for many  
32 indicators in the Report. This has precluded trend analysis for these indicators and  
33 limited the usefulness of the Report. Regional data are not a substitute for national or  
34 even representative national data. However, the Panel notes that with appropriate  
35 caveats, in future Reports on the Environment more **regional indicators and case**  
36 **studies with long-term well supported data sets could be used to illustrate trends**  
37 **when national data sets are not available.** Some regional case studies are included  
38 in the Report, and it should be clearly stated that the specific case studies presented  
39 may not be representative of a general or national situation when they represent a  
40 picture of success or failure. However, this concern should not constrain the use of  
41 additional regional studies to demonstrate important examples.  
42

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1 In addition to overarching findings and recommendations pertaining to all chapters of  
2 the ROE 2007 Science Report, the Panel has provided specific recommendations  
3 pertinent to individual chapters of the Report.  
4

5 *Air Chapter findings and recommendations*  
6

7 Although the questions in the air chapter of the Report are generally appropriate, a  
8 science framework is needed in the air chapter to show interaction within, between and  
9 among media, as well as between and among indicators. The Panel also notes that a short  
10 historical section is needed in the air chapter of the final Report to provide background  
11 information on the criteria pollutants. This information is needed to provide an  
12 understanding of the importance of these pollutants as indicators, how they have been  
13 tracked, and their relationship to other indicators in the Report. As discussed in section  
14 5.2 below, the Panel has identified a number of missing air indicators that should be  
15 added to the final Report because they represent important trends in air quality, or present  
16 a more holistic picture of atmospheric chemistry. These include SO<sub>2</sub> concentration, air  
17 toxics, and indicators of trends in secondary air pollutants.  
18

19 Most of the gaps and limitations of air indicators have been identified in the ROE  
20 2007 Science Report. However, the Panel finds that the pollutant-by-pollutant recounting  
21 approach used in the air chapter does not show the interplay of the various criteria and  
22 toxic pollutants with one another or the role of stratospheric ozone depletion and climate  
23 change on air quality. An integrative description of these pollutants is needed to provide  
24 public or other policy makers a full picture of the state of the atmospheric environment.  
25

26 *Water Chapter findings and recommendations*  
27

28 The Panel finds that some of the questions in the water chapter inappropriately call for  
29 information on trends in both the extent and condition of certain indicators. Therefore, it  
30 is recommended that in the final Report, EPA refine the differentiation between extent  
31 and condition for indicators where inclusion of both extent and condition does not make  
32 sense. For example, it is not meaningful to refer to the extent of coastal waters because  
33 the issue of importance is condition not extent. In addition, questions should be  
34 incorporated in the water chapter of future Reports on the Environment to provide  
35 information on critical habitats and missing thematic elements such as trends,  
36 availability, and usage of water for human activities.  
37

38 The Panel finds that there is a lack of acceptable water indicators in the Report to  
39 answer to some of the questions posed. Additional indicators have been recommended to  
40 answer questions in future Reports on the Environment. For example: 1) The freshwater  
41 indicators in the Report have a strong lotic bias and equal attention should be devoted to  
42 indicators relevant to lentic systems. 2) EPA should identify and use indicators that have  
43 relevance human health as well as ecology. 3) EPA should identify indicators of  
44 important ecosystem processes like denitrification, decomposition, and primary

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1 production. In this regard, data on biogeochemical processes in wetlands such as organic  
2 matter decomposition and accretion, denitrification, and sulfate reduction can provide  
3 early indications of impending ecological changes. 4) EPA should identify indicators that  
4 will aid in evaluating the impact of emerging issues like biofuel feedstock production on  
5 the quality and quantity of water. 5) Some chemical indicators, such as pesticides in  
6 agricultural streams, should be based on measured concentrations in sediments and biota  
7 rather than the water column, where concentrations may be low but biota may be  
8 impacted by elevated levels in sediments. The Panel also notes that in the Report,  
9 concentrations of chemical indicators have been inappropriately compared with drinking  
10 water maximum contaminant levels.

### 11 12 *Land Chapter findings and recommendations*

13  
14 The questions in the land chapter address land resource management and land  
15 contamination. Although the questions are relevant to EPA's mission, it is recommended  
16 that in future Reports on the Environment EPA consider adding a question that addresses  
17 soil quality. Moreover, the Panel finds that the questions in the land chapter are not  
18 completely answered by the indicators presented, and that range of indicators in the land  
19 chapter is not at the same overall level of development as in the water and air chapters.  
20 For example, few land indicators provide direct measures of effects on human health.  
21 Some additional resources and an expanded set of disciplines are needed to bring this  
22 chapter to the same level of evaluation. To more completely answer the questions posed,  
23 the Panel recommends that EPA include the following additional indicators in the final  
24 Report: 1) a pesticide use indicator (this would be particularly important from the  
25 standpoint of human exposure); and 2) indicator data for persistent bioaccumulative toxics  
26 (PBTs) and mining wastes (e.g., Toxics Release Inventory derived information),  
27 radioactive wastes, and wastes applied on agricultural land (biosolids, compost, etc.). In  
28 future Reports on the Environment EPA should: 1) consider a range of available land  
29 cover classification schemes with different levels of resolution (this is necessary because  
30 the resolution of the data in the current draft of the Report is too coarse to completely  
31 answer the questions); 2) extend land cover characterization to all major ecosystem types,  
32 not just the forest land cover characterized the current draft of the Report; and 3) adopt  
33 standard approaches for land use and land cover analysis to evaluate information and  
34 document trends across a range of available data sets.

### 35 36 *Human health chapter findings and recommendations*

37  
38 The questions in the human health chapter are comprehensive, appropriate, and well-  
39 developed. However, the Panel notes that they encompass both human health and  
40 exposure. It is therefore recommended that in the final Report, the chapter be more  
41 descriptively renamed "Human Exposures and Health." The indicators used in the  
42 human health chapter are appropriate, but the Panel recommends that in future Reports on  
43 the Environment EPA consider using an expanded suite of human health indicators that  
44 would include National Health Interview Survey (NHIS) Behavioral Risk Factor Survey

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1 (BRFS) information, hospital and emergency room admission data, and reports of  
2 infectious disease maintained by the Centers for Disease Control. These indicators would  
3 more effectively capture such important health concerns as effects related to indoor air  
4 quality, use of pesticides, and exposure to pathogens.  
5

6 In addition, the Panel finds that there is a critical need to expand the indicator  
7 discussion in the human health chapter of the final Report to include relevance to the  
8 stated questions in the Report. Such discussion is needed because the relevance of the  
9 indicators to the questions can be wide ranging and it is important that the Report provide  
10 a characterization of the value or importance of the indicator to the question. Strong  
11 epidemiologic evidence is available in the literature to support many of the indicators  
12 EPA has chosen and it is recommended that such information be provided in the final  
13 Report. To further strengthen the scientific credibility of the Report, the Panel also  
14 recommends that the discussion of indicator gaps and limitations be expanded in the final  
15 Report to include a more quantitative description of indicator relevance by relying on the  
16 epidemiologic literature. The discussion might be further expanded to address how the  
17 limitations and gaps affect the interpretations of the Report on the Environment  
18 indicators.  
19

20 *Ecological condition chapter findings and recommendations*  
21

22 The questions posed in the ecological condition chapter of the Report are generally  
23 appropriate but the Panel recommends that in the final Report, the chapter be reorganized  
24 to reflect an integrated focus on ecosystem health. To meet this objective, it is  
25 recommended that the chapter be organized hierarchically according to: 1) major  
26 ecosystem type, 2) ecosystem processes and services, and 3) ecosystem components  
27 (physical, chemical, biological). In addition, the Panel finds that the scope of indicators  
28 in the ecological condition chapter needs considerable broadening to cover all ecosystem  
29 types and fill specific gaps (i.e., missing ecosystems, missing populations, and missing  
30 processes) in the indicator coverage. Specific indicators and indicator types have been  
31 suggested in section 5.6 and Appendix A below to broaden the coverage and fill gaps.  
32 Easily accessible data may be available for some of these indicators and they could be  
33 included in the final Report, while others should be included in future Reports on the  
34 Environment. It is recognized that EPA cannot develop an unlimited set of indicators but  
35 should select those that address key ecological issues.  
36

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1 **2.0 INTRODUCTION**  
2

3 This report transmits the advice of the U.S. Environmental Protection Agency Science  
4 Advisory Board (SAB) Panel for the Review of EPA's 2007 Report on the Environment.  
5 The Panel conducted a peer review of EPA's draft *Report on the Environment 2007:*  
6 *Science Report* (ROE 2007 Science Report). the draft ROE 2007 Science Report  
7 compiles and updates scientific indicators of status and trends in human health and  
8 ecological condition in the United States. The Agency released its first draft Report on  
9 the Environment in 2003. That report was reviewed by the SAB (U.S. EPA Science  
10 Advisory Board, 2004) and the SAB's advice was used to develop the improved and  
11 updated ROE 2007 Science Report. A second SAB Panel was formed to review the 2007  
12 Report. EPA intends to use the ROE 2007 Science Report to inform strategic planning,  
13 priority setting, and decision making across the Agency. The ROE 2007 Science Report  
14 is also intended to provide information that will enable the public to assess whether EPA  
15 is succeeding in its overall mission to protect human health and the environment.  
16

17 In developing the ROE 2007 Science Report, EPA identified twenty-six policy-  
18 relevant questions about environmental and human health deemed to be critically  
19 important to the Agency's mission and national interest. The Agency selected a suite of  
20 indicators to answer these questions. The ROE 2007 Science Report consists of chapters  
21 that answer status and trend questions concerning air, water, land, human health, and  
22 ecological condition. In each of these five chapters, EPA has described the scope of the  
23 priority questions to be answered; provided a set of indicators to answer the questions;  
24 and discussed indicator data gaps, limitations, and challenges that prevented questions  
25 from being fully answered. In the ROE 2007 Science Report, EPA has established an  
26 explicit indicator definition and six indicator criteria. Trends and national baseline  
27 information have been presented for some of the indicators in the Report. EPA has stated  
28 that the ROE 2007 Science Report was written for a target audience of environmental  
29 professionals. The Agency has developed a less detailed ROE 2007 "Highlights  
30 Document" for the more general audience of concerned citizens, and a web-based "e-  
31 ROE" to facilitate electronic access to materials in the Report and provide timely updates  
32 in the future. The SAB Panel was only asked to review the ROE 2007 Science Report.  
33

34 The Panel emphasizes the tremendous value of EPA's Report on the Environment.  
35 This is the only report of its kind providing an objective assessment of changes in  
36 environmental quality over time as related to human and ecological health. We concur  
37 with the statement in the SAB's review of EPA's draft 2003 Report that there is an urgent  
38 need for this kind of assessment. It can have an important impact on improving the state  
39 of the environment by synthesizing relevant information from many sources for the  
40 development of effective environmental monitoring, policy and protection programs.  
41 EPA's Report on the Environment can also provide the public with essential information  
42 about environmental status and trends and their relevance to public health and ecological  
43 condition. The Panel therefore strongly urges EPA to fully support and permanently  
44 embed the Report on the Environment in its core mission-directed activities. This will

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1 require an investment in resources beyond those currently devoted to the ROE 2007  
2 Science Report. While the EPA staff that produced the ROE 2007 Science Report are  
3 commended for their remarkable productivity and output, a sustained and increased  
4 investment in staff and expertise for the Report on the Environment is essential and  
5 strongly recommended. The Panel offers recommendations for improvements in the  
6 ROE 2007 Science Report to make it more useful to EPA and other intended audiences.

### 8 **3.0 CHARGE TO THE REVIEW PANEL**

9  
10 EPA gave the following six charge questions to the SAB Panel for its review of the  
11 ROE 2007 Science Report.

12  
13 **Charge Question 1.** Please comment on the adequacy of the formulation and scope of  
14 the questions in the Chapters of the *Report on the Environment 2007: Science Report*.  
15 Does the SAB have any specific recommendations on how to improve or clarify the  
16 formulation of the questions? Does the SAB have recommendations on changing the  
17 scope of the questions to better reflect EPA's mission?

18  
19 **Charge Question 2.** Please comment on whether all of the relevant indicators in the  
20 Report have been used appropriately to answer the questions. Please comment on  
21 whether the integrity of the material in the indicator write-up is preserved in the chapter  
22 narrative.

23  
24 **Charge Question 3.** Please comment on the adequacy, objectivity, and transparency of  
25 the identification and communication of gaps and limitations of the indicators in  
26 answering the Report on the Environment questions.

27  
28 **Charge Question 4.** Please comment on the utility, comparability, and objectivity of the  
29 regionalization of the national Report on the Environment indicators. Does the use of  
30 EPA Regions to scale national data accurately reflect, or does it inappropriately distort,  
31 the problem domain?

32  
33 **Charge Question 5.** Please comment on the utility of the regional indicators in *Report*  
34 *on the Environment 2007: Science Report* in answering the questions. Does the SAB  
35 have recommendations for whether and how to build on this base in future versions of the  
36 report?

37  
38 **Charge Question 6.** Please comment on the overall quality of the *Report on the*  
39 *Environment 2007: Science Report* with respect to technical accuracy, clarity, and  
40 appropriateness of the level of communication.

### 41 42 **4.0 REVIEW PROCESS**

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1 The Panel's review of EPA's ROE 2007 Science Report was structured to develop  
2 responses to all of the charge questions for each chapter of the Report. Panel subgroups  
3 were assigned lead responsibility for reviewing individual chapters of the Agency's draft  
4 Report. The Panel then discussed the subgroup responses and developed the following  
5 sections that provide specific findings and recommendations concerning the air, water,  
6 land, human health, and ecological condition chapters. The Panel has also provided  
7 "higher level" overarching recommendations that pertain to all chapters of the ROE 2007  
8 Science Report. The overarching findings and recommendations address EPA's specific  
9 charge questions as well as general improvements needed to make the Report a more  
10 effective assessment of status and trends in the condition of the human health and the  
11 environment. The Panel has recommended revisions that should be incorporated into the  
12 final Report as well as improvements that will require a much longer time frame to  
13 implement, and thus should be incorporated in future Reports on the Environment. The  
14 Panel strongly recommends that EPA make the suggested short-term changes prior to  
15 releasing the final Report. Italicized subheadings within the following sections  
16 correspond to the Panel's charge questions listed in section 3.0 above.

## 17 18 **5.0 OVERARCHING RECOMMENDATIONS**

19  
20 The Panel finds that the ROE 2007 Science Report is a valuable collection of data,  
21 trends, and impact indicators, and strongly endorses its continued development and  
22 dissemination. Some members of the Panel found that the Report was an improvement  
23 over EPA's draft 2003 Report on the Environment, and commend the Agency for  
24 addressing many of the SAB's comments and recommendations on the 2003 Report.  
25 Generally, the formulation and scope of the questions in the ROE 2007 Science Report  
26 are adequate, narratives in the text have captured information about the indicators  
27 presented in the document, EPA has effectively identified many of the key indicator data  
28 gaps and limitations, and regional analyses have made the Report more meaningful.  
29 However, as discussed below, the Panel has identified numerous shortcomings in the  
30 document that limit its usefulness in fulfilling its stated purposes. While the Report may  
31 help inform strategic planning and priority setting, it should not be used for decision  
32 making as it contains data with little interpretation and no conclusions supported by  
33 statistical analysis. Recommendations for improvements in the Report are provided to  
34 make it more useful to EPA and other intended audiences.

### 35 36 *Organization of the ROE 2007 Science Report*

37  
38 The organization of the Report into individual media chapters (air, water, and land)  
39 and synthesis chapters on human health and ecological condition makes sense, and the  
40 approach of asking key scientific questions is a highly effective framework for presenting  
41 the information in the Report. However, the Panel finds that the introduction to the ROE  
42 2007 Science Report should be revised to more fully describe the report structure. To  
43 accomplish this, the Panel recommends that:  
44

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- 1 • **In the final Report the introduction should be revised to clearly indicate that the**  
2 **first three chapters address status and trends using specific indicators for the**  
3 **individual “media” of air, water, and land, and that the next two chapters are**  
4 **syntheses that integrate the information and provide information on human**  
5 **health and ecosystem condition indicators. As discussed below, a conceptual**  
6 **framework and an additional synthesis chapter should be added to the final**  
7 **Report.**
- 8
- 9 • **In the final report the introduction should also clearly state its purpose for**  
10 **intended audiences and EPA.**

11  
12 *Strengthened scientific underpinnings*

13  
14 The Panel finds that the scientific underpinnings of the final Report need to be  
15 strengthened to make it a “science report,” as indicated by its title, rather than simply a  
16 data report. As discussed below, this can be accomplished by including greater synthesis,  
17 interpretation, statistical analysis, and discussion related to the literature. An alternative  
18 would be to remove “science” from the title so that the report is characterized as a status  
19 and trends report.

20  
21 *Incorporation of a conceptual framework and synthesis chapter*

22  
23 The Panel finds that the final Report needs a greater degree of integrated discussion  
24 across the indicators and chapters. Each chapter of the Report is currently designed to be  
25 a stand-alone document for readers interested in the particular subject areas of land,  
26 water, air, health, and ecology. Consequently, the interconnections among these areas are  
27 not well established or discussed. For example, the relationship between waste  
28 management and chemical uses (addressed in chapter 4) and water quality (addressed in  
29 chapter 3) was mentioned in the introduction of the water chapter, but this relationship  
30 was not obvious from the presentations of the individual data. The Report currently  
31 contains a discussion section after each question and related series of indicators, but there  
32 is not a corresponding synthesis discussion across the questions to tie the document  
33 together and make the whole greater than the sum of its parts. The Panel also notes that,  
34 although the Report provides a large amount of valuable data and information that can be  
35 interpreted by readers, it contains few clear conclusions and statements of significance of  
36 the findings. In future Reports on the Environment EPA should provide such conclusions  
37 and statements. The Panel specifically recommends that:

- 38
- 39 • **In the final Report, EPA should incorporate a conceptual framework into the**  
40 **introduction to illustrate the connectedness between the media, human health,**  
41 **and ecological condition chapters.** The conceptual framework could be a short but  
42 comprehensive description and figure that demonstrates scientific understanding of  
43 the relationships between the stressors (drivers), responses and outcomes to human  
44 health and ecosystem condition. The conceptual framework should address

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1 relationships between source, transport, and fate of human and environmental health  
2 hazards, as well as exposure to receptors, dose, and impact. The description of the  
3 conceptual framework might discuss efforts underway to develop so-called linked  
4 indicators of environmental hazards and human health (e.g., the Environmental Public  
5 Health Tracking Project) [*DFO NOTE- please provide a reference*]. The figure  
6 could be included in introduction and at the beginning of each chapter to provide  
7 overall context for the chapter. For example, in each chapter the relevant parts of the  
8 figure that show the role and importance of a given chapter could be highlighted in a  
9 graphic. This would provide the clear basis for the use and prioritization of specific  
10 indicators, the choice of scale and boundaries in regional indicators, and selection of  
11 metrics (i.e., thresholds, benchmarks, etc.). The choice in scale and metrics would  
12 provide the appropriate context for future monitoring and assessment of status and  
13 trends.

- 14  
15 • **The final Report should contain a synthesis chapter that fully integrates the**  
16 **entire Report and provides an overall assessment of health and ecosystem status,**  
17 **trends and effects.** The synthesis chapter could also analyze and discuss in more  
18 detail the connections among various related indicators. For example, the  
19 relationship between nitrogen and phosphorus in agricultural watersheds (in chapter  
20 3) and fertilizer use (in chapter 4) could be discussed. In this regard, a number of  
21 questions could be addressed, such as: Are there any indications that indicators are  
22 correlated? Is it possible to use the indicator data for such an analysis? The Panel  
23 recommends that the synthesis chapter be added to the final Report and further  
24 developed in future Reports on the Environment.  
25
- 26 • **In appropriate places of the final Report, interconnections between the**  
27 **indicators should be established by cross-referencing the discussion of indicators**  
28 **in different chapters.** EPA should elaborate wherever possible on the relationships  
29 between indicators and the outcomes with respect to human health and ecological  
30 condition.  
31
- 32 • **In future Reports on the Environment, a summary section should be included**  
33 **after each media chapter to summarize information presented in the chapter**  
34 **and identify relevant emerging issues.**  
35

### 36 *Statistical analysis*

37

38 The ROE 2007 Science Report states that, due to time and resource limitations,  
39 statistical analysis of uncertainty and trends in indicators was not included. The Panel  
40 finds that this has limited the usefulness of the Report, and that a statistical approach to  
41 analysis and presentation of the data is needed. Without such information, the Report on  
42 the Environment cannot fully meet its intended purpose of reporting scientifically  
43 established trends in human health and environmental condition. Panel understands that  
44 EPA has begun this work for some indicators and that the analysis for those indicators

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1 will be included in the final Report. It is our further understanding that this work will  
2 eventually be completed for all indicators. The Panel understands that some of the most  
3 important indicators are not well developed and few high quality data sets may be  
4 available for these indicators. The Panel suggests that these indicators could be used with  
5 the explanation that a higher level of statistical analysis and reporting will be developed  
6 in the future. We encourage the effort to develop statistically established trends and  
7 recommend that:

- 8
- 9 • **In future Reports on the Environment EPA should incorporate a consistent**  
10 **approach to statistical analysis and reporting.** This should be part of the results  
11 presentation for each indicator. In some cases, this may involve formal statistical  
12 analyses, whereas in other cases it may involve the inclusion of additional  
13 information such as error bars around mean values.

14  
15 *Charge Question 1. Adequacy of formulation and scope of questions in the ROE 2007*  
16 *Science Report*

17  
18 The Panel was asked to comment on the adequacy of the formulation and scope of  
19 questions posed in the ROE 2007 Science Report. Although the scope of the questions  
20 posed in the ROE 2007 science Report is generally appropriate, questions are only asked  
21 about trends. The scope of the questions should be broadened in the final Report to focus  
22 on status as well as trends. This will reflect the importance of capturing information to  
23 represent a baseline established as an initial step to evaluate trends when more data  
24 become available. To help readers understand the importance of the questions and  
25 associated indicators, it is also important to explain the relationship between questions  
26 and the conceptual framework in the final Report. The Panel therefore recommends that:

- 27
- 28 • **In the final Report all questions should be broadened to ask “What are the**  
29 **status and trends...” rather than focusing only on trends.** In some chapters of the  
30 report few long term data sets are presented, and thus the current information is more  
31 focused on status rather than trends. In cases where a trend cannot be presented  
32 because only status information is available, this should be clearly reflected in the  
33 discussion of what the data show.
  - 34  
35 • **In the final Report, EPA should explicitly state how each question in the Report**  
36 **is related to the conceptual framework of the Report.**

37  
38 *Charge Question 2. Use of indicators to answer questions in the ROE 2007 Science*  
39 *Report and presentation of indicator data in the chapter narratives*

40  
41 The Panel was asked to comment on whether the indicators presented in the ROE  
42 2007 Science Report were used appropriately to answer questions in the Report, and  
43 whether narratives in the text accurately captured indicator information. EPA has  
44 established a set of criteria that were used to drive the process of selecting the indicators

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1 in the Report. The criteria included rigorous data requirements for selection of  
2 indicators. The Panel finds that, with some exceptions, the narratives in the text of the  
3 Report have accurately captured the indicator data. However, the high national data  
4 standards set by the indicator selection criteria are restrictive and this has resulted in the  
5 exclusion of many important indicators of status and trends in human and ecological  
6 health. Future Reports on the Environment can be strengthened by including additional  
7 indicators and data sets that may not meet the current selection criteria. Some additional  
8 indicators have also been recommended for inclusion in the final Report. In addition, the  
9 Panel finds that the final Report should contain further discussion of the relationships  
10 between the indicators and human health and ecological condition. Indicators should be  
11 also included in the final Report to represent the status of and trends in ecosystem  
12 services. The Panel specifically recommends that:

- 13  
14 • **In the final Report, for each indicator EPA should provide a clear description of**  
15 **why the indicator is important, the rationale for selecting the indicator, what it**  
16 **tells, and the documented relationship between the indicator and human health**  
17 **and ecological condition.** The description could be provided in an introductory  
18 section for each indicator that refers to the conceptual model or framework. This is  
19 critical in order to enable the reader to interpret the indicator's meaning relative to the  
20 question. The primary stressors (e.g., air emissions data) are important indicators but  
21 the Report should more fully explain how these stressors contribute to answering  
22 questions in the Report.  
23
- 24 • **In the final Report additional indicators should be included to capture the status**  
25 **of and trends in ecosystem services.** For further information on this topic, EPA is  
26 referred to Meyerson et al., 2005. *[DFO NOTE – Dr. Buckley suggests that a*  
27 *relevant question and indicators be specified]*  
28
- 29 • **In future Reports on the Environment, EPA should consider relaxing the**  
30 **restrictive indicator selection criteria so that additional indicators can be**  
31 **included.** This will enable EPA better evaluate trends and answer questions in the  
32 Report. In this regard, regional indicators supported by long-term data sets may be  
33 particularly useful. Although this is recommended as a revision for future Reports  
34 on the Environment, some regional trend data may currently be available and easily  
35 obtained. In these cases, revision of the final Report is recommended to use the  
36 available data. Additional specific indicators that should be considered are identified  
37 in various sections of this advisory report. *[DFO NOTE – Dr. Buckley notes that a*  
38 *specific recommendation be provided to address how the indicator selection criteria*  
39 *should be changed, and the report should contain some examples of the resulting*  
40 *indicators]*  
41
- 42 • **In the final Report, additional trend data (classified as either qualitative or**  
43 **quantitative) should be included for as many indicators as possible.** This is

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1 recommended as a revision for the final Report if data are available and certainly as a  
2 revision for future Reports on the Environment.

- 3
- 4 • **In the final Report, EPA should identify the status of the monitoring programs**  
5 **(e.g., extant, “on hold,” or expired) that have provided indicator data used in the**  
6 **Report.** This will enable readers to determine whether additional trend information  
7 will be available.

8

9 *Charge Question 3. Discussion of indicator data gaps and limitations in the ROE 2007*  
10 *Science Report*

11

12 Each question in the ROE 2007 Science Report is accompanied by a discussion of the  
13 most critical indicator gaps, limitations, and challenges that prevent the question from  
14 being fully answered. The Panel was asked to comment on the accuracy of  
15 characterization of the indicator gaps and limitations, and the degree to which they limit  
16 the ability to answer questions in the Report. In general, the Panel finds that most of the  
17 indicator data gaps and limitations have been identified and clearly explained in the  
18 Report. However, the Panel is troubled by the frequency of statements indicating that  
19 long-term data were not available for many indicators, and that this precluded trend  
20 analysis. The Panel appreciates this transparency but finds that there are too many  
21 indicators in the ROE 2007 Science Report that use “snapshot” data. The Panel  
22 acknowledges that baseline data are essential, but as noted above, in future Reports on the  
23 Environment EPA should consider relaxing the indicator criteria, especially on a regional  
24 basis, to allow the use of data sets that are amenable to trend analysis.

25

26 It is somewhat problematic that many of the indicators in the Report aggregate data  
27 over a prolonged period of time. While this may be the result of the sampling  
28 methodology, it needs to be mentioned and discussed as a weakness. For example, in the  
29 presentation of the indicator “nitrogen and phosphorus in streams in agricultural  
30 watersheds,” the data are aggregated over nearly 10 years, but it is safe to assume that  
31 agriculture in each of the watersheds has changed over that time. The Panel notes that  
32 change in agriculture may be a confounding effect.

33

34 The Panel also notes that it is not always clear which bullets in the Report refer to  
35 “indicator limitations” or to “data gaps.” This should be clarified in the final report, and  
36 in future Reports on the Environment it may be useful to subdivide the data gaps and  
37 limitations section into different types of limitations, instead of providing a laundry list  
38 after each indicator. For example, the limitations could be grouped based on: 1)  
39 geographic limitations; 2) statistical limitations; 3) data coverage limitations; etc. The  
40 following specific recommendations are provided to amplify and clarify the discussion of  
41 indicator data gaps and limitations in the Report:

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- 1 • **In the final Report, EPA should clarify whether specific bullets in the indicator**  
2 **limitations sections refer to indicator limitations or data gaps.**  
3
- 4 • **In future Reports on the Environment, each of the sections that address data**  
5 **gaps and limitations should be separated into clear discussions of types of**  
6 **limitations (e.g., geographic, statistical, data coverage, etc.)**  
7
- 8 • **In the final Report, the discussion of gaps and limitations should be expanded to**  
9 **identify some of the more prominent available data sets that were excluded and**  
10 **the reasons for their exclusion (e.g., technical concerns, lack of statistical power,**  
11 **or other specific reasons).** This discussion might also identify indicators that could  
12 effectively narrow data gaps but may not meet specific stringent criteria (e.g., older  
13 data sets that can be used to show trends in important indicators, regional data sets  
14 that are of national priority, or case studies demonstrating a framework for discussion  
15 or national applicability). This would help address questions about some omissions,  
16 such as fish advisories issued by states and birth defect data.  
17
- 18 • **In the final Report the discussion of data gaps and limitations should be**  
19 **strengthened by adding or expanding existing information in several areas.**  
20 These include: 1) Discussion of the need for a transparent set of metrics that can be  
21 used for all indicators. The current use of metrics and benchmarks is not standardized  
22 and referenced. *[DFO NOTE – Dr. Buckley suggests that we suggest some specific*  
23 *metrics]* 2) The need to provide additional information on emerging issues such as  
24 exotic wildlife diseases or invasive species (the emerging issues should be discussed  
25 at the end of each individual chapter and summarized in an expanded chapter 7 -  
26 afterword). 3) Further justification and discussion of limitations associated with the  
27 intervals of time used to establish trends. *[DFO Note – Dr. Buckley suggests that an*  
28 *example be provided]* To understand and account for such potential confounding  
29 effects, the description of each indicator should include a discussion of the relevant  
30 time periods that can be aggregated without losing integrity.  
31
- 32 • **In the final Report, the implications of each indicator limitation should be**  
33 **discussed, and the uncertainties associated with each limitation should be**  
34 **quantified to the extent feasible.**  
35

36 *Charge Question 4. Regionalization of national indicators in the ROE 2007 Science*  
37 *Report*  
38

39 The ROE 2007 Science Report has broken out national-level data for some of the  
40 indicators by EPA region, and the Panel was asked to comment on the utility of this  
41 approach. The panel notes that national-level indicators are by themselves insufficient  
42 for gauging the state of the U.S. environment. Nationally aggregated data cannot reflect  
43 local and regional environmental trends that are important to the quality of life and health  
44 of the residents living in these areas. Exposures to environmental contaminants may be

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1 relevant at three scales: national (e.g., mercury emissions), regional (e.g., contaminants in  
2 lake fish), and local (e.g., contaminated land sites). Moreover, disasters such as  
3 Hurricane Katrina and “9/11” taught us that while the immediate direct effects of such  
4 events are regional or local in scale, the overall long-term effects reverberate through the  
5 nation. Similarly, a decline in the health of one region’s environment could affect the  
6 entire nation. Therefore, national indicator data should be presented at the finest spatial  
7 resolution that can be scientifically supported. For example, it would be valuable to  
8 examine national trends in air quality as well as regional, state, and/or county trends.  
9

10 The disaggregation of the national indicator data in the Report by EPA administrative  
11 regions is useful for some purposes. For example, indicator data for individual EPA  
12 regions could be used for goal setting and performance evaluation. However, this should  
13 be done independently from the primary environmental assessments because the use of  
14 EPA administrative regions to scale national data has little ecological justification and  
15 does not provide particularly informative geographic descriptors of human health. The  
16 Panel finds that a preferable approach would be to analyze the air, water, land, human  
17 health, and ecological condition indicators using appropriate airshed, watershed, and  
18 ecoregional units. A useful approach to regionalization of indicators may be to include  
19 two subcomponents for each indicator: 1) a national metric of some kind, with the  
20 obvious caveat that data aggregation can lead to masking of local trends; and 2) a  
21 consistent (whenever possible) approach to showing regional data, preferably based on  
22 ecologically justifiable regions, not EPA administrative regions. The following specific  
23 recommendations are provided regarding this approach.  
24

- 25 • **In future Reports on the Environment EPA should analyze the air, water, land,**  
26 **human health, and ecological condition indicators using appropriate airshed,**  
27 **watershed, and ecoregional units.** However, the appropriate scaling for indicator  
28 analysis and reporting must be considered on an indicator-by-indicator basis. This is  
29 also true for temporal scaling issues and the appropriateness of data aggregation over  
30 time and space.  
31
- 32 • **In the final Report, if EPA administrative regions continue to be used as the**  
33 **basis for regionalizing data the Panel recommends that this process be better**  
34 **explained.** For example, it is unclear why the data are not presented consistently for  
35 each Region. Presenting these data consistently for each EPA Region would at least  
36 provide more comparability, although it will not address the bigger issue of  
37 ecological validity.  
38

39 *Charge Question 5. Utility of regional indicators in the ROE 2007 Science Report*  
40

41 EPA has included ten regional indicators in the ROE 2007 Science Report. The Panel  
42 was asked to comment on the utility of regional indicators in answering the questions in  
43 the Report. The Panel finds that regional indicators and case studies should be used in  
44 future Reports on the Environment when they may be of particular value for use in trend

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1 analysis, or provide information that is vital to the nation's interest (e.g., topsoil  
2 preservation in the central Midwest). In addition, important regional issues, such as the  
3 ecological health of the Great Lakes or the Everglades, should be addressed in a national  
4 report on the environment. The Panel notes, however, that the justification for the  
5 inclusion of particular regional indicators is not clear in the current draft of the Report on  
6 the Environment and therefore appears somewhat arbitrary. It is difficult to understand  
7 why the current regional indicators have been chosen, as they do not appear to provide  
8 value for replication elsewhere. The following specific recommendations are provided  
9 concerning the use of regional data sets and indicators:

- 10  
11 • **In future Reports on the Environment, it is recommended that EPA identify  
12 and use, with appropriate caveats, more regional indicators and data bases to  
13 illustrate trends when national data sets are not available.** The Panel notes,  
14 however, that such regional data are not a substitute for national or even  
15 representative national data. Regional indicators should also be used in future  
16 Reports on the Environment when they have national importance or are of particular  
17 significance to local populations. Long-term, well-supported data sets are available  
18 for such regional indicators. Examples include data available from: the National  
19 Science Foundation's Long Term Ecological Research Program sites, USGS  
20 groundwater basins, state agencies, and data collected on Lake Tahoe, Lake  
21 Mendota, and the Great Lakes.
- 22  
23 • **In future Reports on the Environment, it is recommended that EPA develop and  
24 use clear and transparent criteria for the selection of regional indicators and  
25 case studies, with the recognition that not all data and indicators will meet the  
26 criteria for national indicators developed by EPA.** For example regional  
27 indicators should have long-term well supported data sets, be of particular national or  
28 local significance, or represent an assessment approach that that could be replicated.

## 30 **6.0 AIR CHAPTER COMMENTS**

### 31 32 *Charge Question 1. Adequacy of formulation and scope of questions in the air chapter*

33  
34 In general, the Panel finds that the scope of questions in the air chapter of the Report  
35 is appropriate. However, it is problematic that the indicator data in the chapter are  
36 presented in isolation. A science framework consisting of a process model and  
37 discussion is needed in the air chapter of the final Report to provide context for the  
38 components by showing the interaction within, between, and among media and indicators  
39 as well as the effects on human health and ecosystem condition. The lack of such a  
40 framework is a significant problem. It is critically important for EPA to understand that  
41 data presented in isolation are not science. It is only when the data are explained as well  
42 as appropriately interrelated across factors and chapters that one gains the scientific  
43 understanding of what the data mean. The following recommendations are provided to  
44 improve the formulation and scope of the questions in the air chapter.

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• **In the final Report, some questions should be reformulated. It is recommended that Questions 1 and 3 in the air chapter be rephrased as follows: “What are the trends in and status of (outdoor/indoor) air quality related to human health and the environment?”** This appropriately broadens the questions beyond the current phrasing, “What are the trends in (outdoor/indoor) air quality and their effects on human health and the environment?”

• **In future Reports, on the Environment the discussion provided in the response to the indoor air quality question should be expanded.** The Panel finds that the discussion of indoor air and related indicators is too limited considering the importance of the indoor environment and the amount of time spent by the population indoors. While indoor environments do not fall within the statutory mandate of EPA, exclusion of available and relevant data makes the Report incomplete. For example, the Agency has played a significant role in promoting the reduction of emissions from many consumer products (e.g., formaldehyde in particle board or benzene in varnishes and paints) which are important sources of emissions indoors.

*Charge Question 2. Use of indicators to answer questions in the air chapter of the ROE 2007 Science Report and presentation of indicator data in the chapter narrative*

Overall, the Panel finds that the integrity of the indicator information is maintained in the air chapter narrative, but as noted above, the indicators are not adequately linked to information across the various other Report chapters. A short historical section containing background information on the criteria pollutants is needed in the final Report to provide an understanding of the importance of these pollutants as indicators, how they have been tracked, and their relationship to other indicators in the Report. Because the Report contains no history of the air indicators, there is no indication of how long the air monitoring networks have been in place. This knowledge would give the reader a sense of the importance that EPA places on the air monitoring networks. Further, it would provide the opportunity for the reader to learn about the various types of air monitoring networks. The air chapter can then have a discussion of questions that integrate across the pollutants. In addition, it is important to discuss issues such as trends in climate that likely lead to secondary pollutant problems due to increased radiation from stratospheric ozone depletion. There is a clear need to look at the air chapter from the whole atmosphere perspective instead of simply isolated atmospheric components.

The most significant shortcoming in the air chapter is the fact that the pollutant-by-pollutant recounting approach does not show the interplay of the various criteria and toxic pollutants with one another or the role of stratospheric ozone depletion and climate change on air quality. Put another way, a holistic picture of the overall interacting chemistry of the atmosphere is missing. The Panel notes that substantial gains have been made in limiting the emissions of specific primary pollutants and it is now increasingly recognized that the interplay among multiple air pollutants (i.e., air pollutant mixtures) is

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1 largely responsible for the human health impacts of air pollution. Human activities have  
2 made the atmosphere more oxidizing through increases in NO<sub>x</sub> emissions. This leads to  
3 greater ozone, more rapid conversion of SO<sub>2</sub> to SO<sub>4</sub><sup>-2</sup>, NO<sub>x</sub> to NO<sub>3</sub><sup>-</sup>, and biogenic and  
4 anthropogenic volatile organic compounds (VOCs) to secondary organic aerosols. Thus,  
5 one cannot really look at the problem of ozone and fine particulate matter without  
6 considering SO<sub>2</sub> and NO<sub>x</sub> emissions all together. NO<sub>x</sub> has been controlled to the point  
7 where it does not have direct health impacts (the basis for the level in the NO<sub>2</sub> primary  
8 national ambient air quality standards [NAAQS]), but that approach fails to achieve  
9 control of O<sub>3</sub> and PM<sub>2.5</sub> (Particulate Matter less than 2.5 micrometers in diameter). The  
10 discussion of VOCs in the air chapter is almost entirely focused on anthropogenic VOCs,  
11 but it is now recognized that for many parts of the U.S., biogenic VOCs dominate and it  
12 is necessary to think very differently about how to bring about continuing improvements  
13 in air quality. Thus, the pollutant-by-pollutant evaluation or “stove piping” within the air  
14 chapter does not really provide a clear picture of the current status of air quality and what  
15 must be done in the future to continue the gains made over the past 35 years. Local  
16 sources no longer contribute to local concentrations that can be dealt with locally. Those  
17 sources have been or are being controlled through either air quality state implementation  
18 plan (SIPs) processes or maximum achievable control technology (MACT) and residual  
19 risk. New conceptualization of the problems is needed. Recitation of pollutant-by-  
20 pollutant gains without truly integrative description of their interplay fails to provide the  
21 public or other policy makers of the full picture of the state of the atmospheric  
22 environment.

23  
24 The Panel notes that the Report contains some discussion of trends in air indicators,  
25 but it is unfortunate that there is neither mention nor discussion of how to estimate trends  
26 in air indicators 10 to 20 years into the future. The Agency should discuss ongoing  
27 efforts, activities and/or programs that can be qualitatively described to make the point  
28 that future trends are not static, and that processes are in place that will lead to ever-  
29 improving air quality. This would provide the reader with the rationale for the suggestion  
30 that improving air indicator trends will continue into the future. It must be made clear to  
31 the reader that EPA views air quality management as an ongoing process. The Panel also  
32 notes that EPA used data from sites going back to 1990 to demonstrate declining trends,  
33 but it is not clear that the same data for these sites during the past 5 years would provide  
34 the same understanding of trends. The issue of base year and site selection bias must be  
35 considered and a transparent description of the analysis must be provided. In addition,  
36 the Panel notes that when regional indicators are considered the picture of air quality may  
37 change. It is important for EPA to consider whether all of the available relevant  
38 information is being used in the Report.

39  
40 A number of missing air indicators have been identified below and in Appendix A.  
41 These indicators should be added to the future Reports on the Environment because they  
42 represent important trends in air quality, or present a more holistic picture of atmospheric  
43 chemistry. The Panel also notes that the reference to acid deposition in the air chapter  
44 seems out of place as presented. It would appear to be more appropriate to refer to this in

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1 the water and land chapters. That being said, the Panel recognizes that this may be a  
2 contradictory suggestion because EPA is being advised to provide greater integration  
3 while removing the reference to acid deposition (an integrating indicator) from the air  
4 chapter. However, it is not unreasonable for given indicators to appear in different  
5 chapters as long as there is a clear cross reference across the chapters and the reason for  
6 the cross reference clearly explained. The following specific recommendations are  
7 provided to improve the air indicators in the Report.  
8

- 9 • **In the final Report, a science framework is should be incorporated into the air**  
10 **chapter to show the interaction within, between and among media as well as**  
11 **between and among indicators.** The data presented must be explained because data  
12 presented in isolation are not science. In addition, the health/environmental relevance  
13 of the air indicators should be better documented with more extensive reference to the  
14 epidemiologic evidence as well as the environmental evidence.  
15
- 16 • **In the final Report, a short historical section should be added to the air chapter**  
17 **to provide background information on the criteria pollutants.**  
18
- 19 • **In the final Report, SO<sub>2</sub> concentration should be added to the air chapter as an**  
20 **indicator.** The Panel notes that this is a “good news” story for both EPA and the  
21 environment. SO<sub>2</sub> emissions controls have resulted in significant reductions in  
22 ambient SO<sub>2</sub> concentrations. This has also resulted in a reduction in the amount of  
23 acidic deposition attributable to SO<sub>2</sub> emissions.  
24
- 25 • **In the final Report, an air toxics indicator should be added to the air chapter.**  
26 This is an important and rapidly emerging human and environmental health issue.  
27 Currently the air chapter discussion about air toxics is simply limited to emissions.  
28 This should be expanded keeping in mind the following recommendation concerning  
29 the National Emissions Inventory [*DFO Note: please briefly explain how this*  
30 *should be expanded*]. While it is true that in the current network the benzene data are  
31 the most robust, it should be anticipated by EPA that in the future the network will be  
32 more robust for additional chemicals of concern.  
33
- 34 • **In the final Report, a broader explanation of what is in the National Emissions**  
35 **Inventory (NEI) should be added to the air chapter.** This is important because  
36 there is reference in the text to the Toxic Release Inventory (TRI) and Persistent  
37 Bioaccumulative and Toxic (PBT) chemicals. Further, it is not clear in the text what  
38 the difference is between Persistent Organic Pollutants (POPS) and Hazardous  
39 Atmospheric Pollutants (HAPS). Sometimes the terms air toxics and HAPS are used  
40 as synonyms. Since the ROE 2007 Science Report is to be read by the general public,  
41 it is essential that all of the terms used in the text be clearly and unambiguously  
42 defined. This becomes an important integration issue when chemicals and the  
43 responses to those chemicals appear in different media chapters. Reference is made  
44 in the water chapter, for example, to compounds also found in the air but no cross-

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1       referencing is evident. Clearly, EPA needs to do more with the air toxics. There is a  
2       disconnect between 1990 and 1999 [*DFO NOTE: additional explanation of the*  
3       *disconnect is needed here*]. The Agency could look at the possibility of using  
4       estimates to determine trends.

- 5
- 6       • **In the final Report, further analysis of the trends in air indicators should be**  
7       **added to the air chapter.** While it is important to know whether air indicator trends  
8       are either increasing or not, it is very important for the reader to understand the reason  
9       for the direction of indicator trends. The Report needs to state where have we been,  
10      where we now, and where are we going. As it stands, there is no history provided  
11      on how the air indicators were developed or evolved.
- 12
- 13      • **In the final Report, an indicator should be added to the air chapter to focus on**  
14      **the growing importance of secondary air pollutants.** These pollutants are  
15      becoming increasingly important as regulatory efforts have resulted in reductions of  
16      major primary pollutants to secondary pollutants. Such an indicator would allow  
17      EPA to show the interaction of the atmospheric components and would help to pull  
18      the pieces together conceptually. This nicely fits into the discussion of the air  
19      indicators because it provides an assessment and explanation of what is going on.  
20      When this is done, it allows one to bring in the more complex issues such as climate  
21      and ozone.
- 22
- 23      • **In the final Report, a small piece should be added to the air chapter to discuss**  
24      **how climate is affecting aerosols.** A paragraph would be appropriate. There is not a  
25      need for a large addition. One simply needs to create the opportunities in the text to  
26      build the cross links in the discussion section.
- 27

28      *Charge Question 3. Identification of gaps and limitations of the air chapter indicators*  
29

30      Overall, the Panel finds that most of the gaps and limitations of air chapter indicators  
31      have been identified. That being said, a number of suggestions for informational  
32      improvements to the gaps and limitations are identified to provide a better understanding  
33      of the meaning and relevance of the indicators. The Panel finds that indicator limitations  
34      are presented in a generally pro forma and mechanical fashion. There is virtually no  
35      discussion of whether, and how, these limitations should affect the reader's interpretation  
36      of the estimates with regard to magnitude of point estimates or shape of trends. With the  
37      exception of the ambient concentration indicators for criteria pollutants, benzene, and  
38      manganese in Region 5, quantitative estimates of uncertainty are lacking, leaving  
39      unanswered questions concerning the robustness of the majority of the indicators.

40

41      The Panel also finds that in the discussion of gaps and limitations of the air indicators,  
42      more emphasis should be placed on how limitations fit into the "big picture," or how  
43      changes in outdoor concentrations may have increased or decreased the importance of  
44      other contributors to exposure and health risk. For example, given what is known,

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1 information should be provided to indicate how decreases or increases in ambient  
2 contaminant concentrations are reflected in total exposure and human and ecosystem  
3 health. It is important to know whether the trends in decreasing ambient concentrations  
4 for certain contaminants are reflected to the same extent in bio-measurements (human  
5 and other organisms) beyond Lead (Pb). These are questions that require thinking more  
6 globally than the media-by-media presentation  
7

8 The Panel notes that in the air chapter, as well as other chapters, the final Report  
9 should offer approaches and/or solutions to filling gaps and limitations. In this regard, it  
10 would be useful to provide EPA's regulatory and programmatic perspectives. The  
11 chapter should provide a sense of the philosophical position of the Agency so that its role  
12 in new science can be understood. The following specific recommendations are provided  
13 to improve the discussion of indicator limitations in the air chapter.  
14

- 15 • **In the final Report, EPA should acknowledge and discuss the limitations of a**  
16 **single pollutant, local source approach to pollution control in the context of the**  
17 **marked reductions in individual pollutants documented by the indicators, as**  
18 **exemplified by continuing challenges with regard to ozone and PM<sub>2.5</sub>.** The  
19 significance of temporal trends viewed in the light of the importance of primary vs.  
20 secondary pollutants (specifically with respect to PM and ozone) should be discussed.  
21
- 22 • **For the final Report, EPA should view the PM speciation network as the vehicle**  
23 **to provide the needed information on PM composition.**  
24
- 25 • **In the final Report, the bias that may result from the choice of base year for**  
26 **trends for a given air indicator should be discussed as this has implications in**  
27 **the interpretation of the air indicator data.**  
28
- 29 • **In the final Report, the effects of trends in ambient concentrations of air**  
30 **pollutant indicators on exposure and dose should be discussed Report.**  
31

32 *Charge Question 4. Regionalization of the national Report on the Environment*  
33 *indicators in the air chapter*  
34

35 The Panel finds that the concept of having "national" as well as "regional" air  
36 indicators would be very informative if an appropriate approach were used. The main  
37 problem with the approach currently used in the air chapter is that the EPA regions are  
38 artificial administrative units that do not reflect airsheds. In addition, the national air  
39 quality data are dominated by data from urban air quality monitoring stations. The  
40 extrapolation of air indicator data from national to regional to subregional levels (e.g.,  
41 states, cities) could be extremely misleading unless the inherent limitations of the data are  
42 clearly understood.  
43

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1 *Charge Question 5. Utility of the regional indicators in answering the questions in the*  
2 *air chapter*

3  
4 The Panel finds that regional air indicators would be very useful as long as their  
5 application has a sound scientific basis. Unfortunately, this is generally not the case in  
6 the air chapter. As noted above, the EPA regions do not correspond to airsheds but rather  
7 artificial administrative units. That being said, the Agency could get around this dilemma  
8 by carefully defining the “region” according to an air issue. While two examples of  
9 regional indicators are provided in the chapter (Manganese within Region 5 and PM  
10 along the U.S.-Mexico border), the basis for the selection of these indicators is not  
11 evident. This illustrates the need for EPA to consider developing and providing air  
12 indicators for ‘hot-spot’ locations/areas. For future Reports on the Environment, more  
13 conceptual development is required by EPA with respect to applying regional and sub-  
14 regional (i.e., hot spot) air indicators.

15  
16 *Charge Question 6. Overall quality of the air chapter with respect to technical accuracy,*  
17 *clarity, and level of communication*

18  
19 The Panel finds that the air chapter fails to provide the critical links between the  
20 observed changes in concentrations of pollutants and the understanding of the functioning  
21 of the atmospheric environment. The air chapter benefits from a long record of  
22 atmospheric monitoring that provides a wealth of data. Data are an essential part of  
23 science because they provide the basis for developing an understanding of the sources,  
24 processes and fate of the measured constituents. However, the final Report needs to do  
25 more than report data. The pollutant-by-pollutant presentation does not adequately  
26 reflect the understanding of the interrelationships among the measured species. As  
27 mentioned above, there are key trends in the understanding of the atmosphere that should  
28 be addressed in the final Report, such as the clear reduction of primary pollutants (CO,  
29 SO<sub>2</sub>, lead) but much flatter trends in secondary pollutants (O<sub>3</sub>, PM<sub>2.5</sub>). NO<sub>x</sub> has been  
30 controlled to the point where it does not have direct health impacts (the basis for the level  
31 in the NO<sub>2</sub> Primary NAAQS), but leaves concentrations that permit formation of O<sub>3</sub> and  
32 PM<sub>2.5</sub> that lead to air quality violations. As mentioned above, the discussion of VOCs in  
33 the air chapter is almost entirely focused on anthropogenic VOCs. However, it is now  
34 recognized that for many parts of the U.S., biogenic VOCs dominate. In addition, the  
35 relationships between climate change and stratospheric ozone depletion, and tropospheric  
36 chemistry that enhances key pollutants (O<sub>3</sub> and PM<sub>2.5</sub>), provide an important link between  
37 these currently isolated aspects of the chapter and other air pollutants which the EPA  
38 monitors. Thus, to improve understanding of atmospheric processes and achieve  
39 continuing improvements in air quality, indicator data such as those currently presented  
40 in the air chapter must be treated as a valuable resource but not an end in themselves.  
41 More attention needs to be paid to the “one atmosphere” concept that EPA has been  
42 trying to implement, and using the data presented to demonstrate how they have  
43 improved our understanding of the atmospheric system in the U.S.

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1 **7.0 WATER CHAPTER COMMENTS**  
2

3 *Charge Question 1. Adequacy of formulation and scope of questions in the water chapter*  
4

5 The Panel finds that the overall broadness and consistency of the questions in the  
6 water chapter of the ROE 2007 Science Report are appropriate given EPA's mission and  
7 the scope of the Report. However, the questions in the water chapter do not adequately  
8 address the interconnectedness of different water systems. The Panel also finds that  
9 additional questions are needed to incorporate missing information on critical habitats  
10 and thematic elements. The following specific recommendations are provided to improve  
11 the formulation and scope of the questions.  
12

- 13 • **In the final Report, the questions in the water chapter should be expanded to**  
14 **focus on the interconnectedness of different systems (both within the different**  
15 **water types and across media).**  
16
- 17 • **In the final Report, additional questions should be included in the water chapter**  
18 **to incorporate missing information on availability and usage of water for human**  
19 **activities, especially with respect to water withdrawals** (see data in Roy, S.B. et  
20 al., 2005 and Solley, W.B. et al., 1995).  
21
- 22 • **In future Reports on the Environment, additional questions should be included**  
23 **in the water chapter to incorporate missing information on critical habitats or**  
24 **thematic elements such as:**  
25
  - 26 - Extent and condition of coral reefs;
  - 27 - Wastewater management information (It is recommended that EPA review  
28 available National Pollution Discharge Elimination System data for possible  
29 useful indicators);
  - 30 - Extent and condition of, and trends in, riparian zones and lake shoreline (i.e.,  
31 land-water interface, where much of the biological activity occurs), and their  
32 effects on human health and the environment; and
  - 33 - More national indicators and analyses providing data and information on non-  
34 indigenous invasive species.  
35
- 36 • **In future Reports on the Environment, some key model aquatic systems should**  
37 **be identified in several ecoregions of the U.S. and data collected from these**  
38 **systems should be mined and analyzed in the context of questions presented in**  
39 **the Report.**  
40
- 41 • **For future Reports on the Environment, EPA should examine the 2004 National**  
42 **Research Council Report on national and global water resources and water**  
43 **infrastructure problems, and the importance of research in addressing them**  
44 **(National Research Council, 2004).** Relevant questions to be considered in future

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1 reports include: (1) Will drinking water be safe? (2) Will there be sufficient water to  
2 support both the environment and future economic growth? (3) Can effective water  
3 policy be made? (4) Can water quality be maintained and enhanced? (5) Will our  
4 water management systems adapt to climate change? While the Panel recognizes that  
5 some, if not most, of these questions are outside the narrowly defined scope of the  
6 ROE 2007 Science Report, EPA should consider addressing these questions because  
7 they help place the water media chapter into context and inform the process.  
8

- 9 • **In the final Report, EPA should examine the relevance of measures of “Extent  
10 and Condition” across all aquatic ecosystem types.** In this regard, the Panel finds  
11 that the question on the “extent” of coastal waters is not meaningful because for  
12 coastal waters, the issue of importance is their condition not their extent.  
13

14 *Charge Question 2. Use of indicators to answer questions in the water chapter of the*  
15 *ROE 2007 Science Report and presentation of indicator data in the chapter narrative*  
16

17 In general, the Panel finds that the narratives in the water chapter of the ROE 2007  
18 Science Report have accurately captured the indicator data. However, there is a lack of  
19 acceptable water indicators to provide answers to the questions in the chapter. In this  
20 regard, the following concerns are noted.  
21

- 22 - The indicators selected to address freshwater issues are all based on streams and  
23 rivers. It is problematic that there is no mention of any indicators for lakes, ponds,  
24 and reservoirs.
- 25 - The section in the water chapter on wetlands provides minimal analysis of available  
26 data. The Panel finds that addressing only loss or gain in wetland acreage as  
27 indicators is not adequate.
- 28 - Only total nitrogen and phosphorus were used as nutrient indicators in the water  
29 chapter. Other nutrient indicators mentioned below should be considered.
- 30 - The drinking water section of the water chapter needs some additional critical  
31 analysis to consider the implications of drinking water quality to human health. For  
32 example, the water chapter indicator dealing with "drinking water" covers only the  
33 number of systems that have not reported exceedances of maximum contaminant  
34 levels (MCLs). The Panel finds that it would be more informative to report this  
35 indicator in the final Report as the number of systems that have had exceedances, and  
36 include data on which contaminants were present and the degree to which they  
37 exceeded the MCL.
- 38 - The lack of microbial indicators in the water chapter makes it difficult if not  
39 impossible to ascertain human health implications and impairment of water resources  
40 due to fecal pathogen contamination, regulated contaminants, or EPA Contaminant  
41 Candidate List elements. In the case of pathogens, this is an unfortunate lack (as  
42 implied in the water chapter limitations and gap analysis) given that there is a non-  
43 ambiguous (etiological) link between pathogen exposure and disease, albeit an  
44 unclarified dose-dependent relationship. In earlier U.S. EPA Water Quality Inventory

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1 Reports to Congress (U.S. EPA, 2000), pathogen data were evaluated and used to  
2 classify contributions to pollution of water resources. It was noted that pathogens  
3 were either the first or second primary pollutant contributing non-attainment of water  
4 quality standards for estuaries, coastal shoreline, and rivers and stream. These data,  
5 once obtainable from the states, are apparently no longer accessible or have been  
6 judged statistically or probabilistically unreliable for accurate trend analysis.

- 7 - It appears that many of the indicators used in the water chapter are composite or  
8 multi-metric in nature. These indicators are useful, but the Panel recommends that  
9 they be complemented with single metric indicators that are easier to understand and  
10 require fewer caveats and assumptions.
- 11 - In the water chapter there is very limited use of data on specific toxic industrial  
12 chemicals and contaminants, of either a regulated or unregulated nature, for which  
13 EPA has statutory responsibility under the Clean Water Act. Analysis of specific  
14 toxic and bioaccumulating chemicals, other than pesticides, is largely confined to fish  
15 tissue contaminant concentration. The lack of such information for streams, rivers,  
16 and sediments makes it difficult to discriminate the nature of water contamination and  
17 impairment (e.g., urban/industrial vs. agricultural).
- 18 - The water chapter data on “pesticides in agricultural streams” is comprised of  
19 measurements of concentrations in the water only. However, the Panel notes that  
20 many of these chemicals are hydrophobic and are better analyzed in the sediments  
21 and biota rather than in the water column, where they may appear low even in  
22 situations where biota may be impacted by their elevated levels in the sediments. It is  
23 also unclear why these concentrations were compared with EPA’s MCLs for drinking  
24 water. People are not generally drinking water out of agricultural streams, so the  
25 importance of the concentrations of the pesticides is their toxicity to biota living in  
26 the streams, not to human consumers of drinking water.
- 27 - The section of the water chapter on “coastal fish tissue contaminants” includes  
28 analyses of many species of fish, and indicates that 22% of the sites showed high  
29 contamination. However, the contaminant data are pooled from many different  
30 species of fish and shellfish from different habitats, trophic levels, and age classes.  
31 The Panel notes that these factors strongly influence the degree to which a particular  
32 species bioaccumulates various contaminants.

33  
34 It is suggested that, in the water chapter of future Reports on the Environment it may  
35 be possible to develop internally consistent local or regional indicators (covering  
36 individual environmental units or ecological provinces) in those cases where data for  
37 national indicators are not available or do not meet the criteria for inclusion in the ROE  
38 2007 Science Report. Indicator data from different watersheds or hydrological basins  
39 may not be directly comparable with each other, but the local or regional sets of data may  
40 provide meaningful temporal trends.

41  
42 The Panel also finds that the final Report should contain better justification for some  
43 of the schemes used to grade indicators in the water chapter. In some instances (e.g.,  
44 trophic state of coastal waters) the grading of “high, medium and low” quality are quite

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1 understandable. On the other hand, the low, medium, and high grading of “nitrogen and  
2 phosphorus in wadeable streams” presented on pages 3-22 and 3-23 is confusing. It is  
3 hard to understand why the grading is “low” when below the 75<sup>th</sup> percentile for the  
4 reference. It appears this system was used because of statistical issues that are not  
5 discussed in the Report. Providing only qualitative indication (such as low nitrogen,  
6 medium nitrogen, and high nitrogen or low flow and high flow) is not adequate for those  
7 who would like to use this report as a guide to determine the state of these systems. The  
8 Panel suggests that it might be better to provide a range of values in the final Report for  
9 each of these parameters presented. The following specific recommendations are  
10 provided to address the concerns noted above.

- 11
- 12 • **In future Reports on the Environment, EPA should include indicators of**  
13 **condition of lakes, ponds, and reservoirs.**
- 14
- 15 • **In future Reports on the Environment, EPA should consider including the**  
16 **following important specific indicators:**
  - 17 - **Snow pack (extent, condition, and volume);**
  - 18 - **Pathogens (coliforms, enteric viruses, toxins, etc.);**
  - 19 - **Storm water and wastewater (contaminant effects)**
  - 20 - **Drinking water primary contaminants (e.g., microbial indicators and**  
21 **pathogens: bacterial, viral or protozoan)**
  - 22 - **Emerging contaminants such as endocrine disruptors and others.**
- 23
- 24 • **In future Reports on the Environment additional wetland data should be used.**  
25 In many areas, wetlands will more efficiently indicate the ecological integrity of the  
26 entire watershed than will any other portion of the landscape. New data on basic  
27 wetland soil, vegetation, and periphyton characteristics are now emerging in various  
28 ecoregions. These data can provide important information. In addition, some of the  
29 possible complementary or alternative wetland indicators may include  
30 biogeochemical processes, such as organic matter decomposition and accretion,  
31 denitrification, phosphorus saturation, and sulfate reduction, which can provide early  
32 indications of impending ecological changes.
- 33
- 34 • **For future Reports on the Environment, EPA should evaluate whether nutrient**  
35 **indicators based on bioavailable nitrogen and phosphorus or**  
36 **nitrogen:phosphorus ratios, may be more useful.**
- 37
- 38 • **For future Reports on the Environment, EPA should develop drinking water**  
39 **indicators based on the available data from the Agency’s own databases and the**  
40 **consumer confidence reports released to the public annually by community**  
41 **water systems.** Based on these data, EPA could formulate indicators that can  
42 delineate trends in drinking water quality. The water chapter should include source  
43 water monitoring data in addition to treated water quality data.
- 44

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- 1 • **For future Reports on the Environment, pathogen monitoring should be**  
2 **investigated as a primary indicator for water quality trends and human health**  
3 **effects across various water sources.** This recommendation would encourage more  
4 cooperation with states in providing data for analysis for longer term trends.  
5
- 6 • **In future Reports on the Environment, composite or multi-metric indicators**  
7 **should be complemented with single metric indicators that are easier to**  
8 **understand and require fewer caveats and assumptions.** For example, the coastal  
9 benthic communities indicator could be supplemented with data on the abundance of  
10 key reference organisms that are particularly important to ecosystem function in each  
11 region (i.e., keystone species), or species that have special value to the stakeholders  
12 of the region (e.g., manatees in Florida or coho salmon in Pacific Northwest).  
13
- 14 • **In the final Report, data for the indicator “pesticides in agricultural streams”**  
15 **should not be compared to human health benchmarks.** In future Reports on the  
16 Environment, data should reflect pesticide toxicity to stream biota (e.g., sediment  
17 concentrations of pesticides could be considered).  
18
- 19 • **In future Reports on the Environment, EPA should incorporate more**  
20 **information on specific toxic industrial chemicals for which the Agency has**  
21 **statutory responsibility under the Clean Water Act.**  
22
- 23 • **In future Reports on the Environment, EPA should analyze fish tissue**  
24 **contaminant data by different species, or at least conduct separate analyses of**  
25 **fish from different trophic levels or different habitats (as was done for the “lake**  
26 **fish tissue” indicator) to see which species (e.g., piscivores) are more likely to**  
27 **have higher levels of contaminants than others.**  
28

29 Additional technical comments and recommendations concerning the specific  
30 indicators in the water chapter are provided in Appendices A and B of this report.  
31

32 *Charge Question 3. Identification of gaps and limitations of the water chapter indicators*  
33

34 In general, the Panel finds that EPA has effectively identified and communicated the  
35 gaps and limitations of the indicators in answering questions posed in the water chapter  
36 of the ROE 2007 Science Report. However, it is disappointing that many of the  
37 indicators used in the chapter are recent and do not include many years of prior  
38 monitoring to show trends, so this gap/limitation is cited frequently. This is in striking  
39 contrast to the air chapter of the Report in which numerous graphs with downward trends  
40 are presented showing the overall improvement in release and ambient concentrations of  
41 various air pollutants (with the exception of greenhouse gases which are going up). The  
42 Panel finds it hard to understand why the data collected for the last three decades on  
43 various water systems are not adequate to determine status of and trends in the ecological  
44 condition of water systems. The gaps identified in the water chapter (e.g., on page 3-40)

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1 for freshwater systems highlight the need for more data. The Panel notes that more data  
2 will not necessarily answer the questions presented in Report, but it may be helpful to use  
3 additional data from well-planned and consistent monitoring of representative systems.  
4

5 In several instances the “indicator limitations” discussion in the water chapter  
6 addresses or provides recommendations on how to interpret indicators. In these instances  
7 the discussion is most often focused on interpretation of indicators to show human health  
8 effects. The Panel finds that the discussion of how to interpret indicators or, show what  
9 they mean, would fit better in the section of the water chapter titled, “what the data  
10 show.” Alternatively, it is suggested that EPA could add a separate section titled, “what  
11 does this mean for human health.” An example of such a limitation is on page 3-27 in the  
12 discussion of the nitrate in streams indicator. The text states that, “Drinking water  
13 treatment can significantly reduce concentrations of nitrate, so the level of contaminants  
14 reported in this indicator are not necessarily representative of exposures to people when  
15 these waters are used as public water supplies.” The Panel notes that this is a separate  
16 issue from the sample design and temporal limitations of the data set, concerns that most  
17 commonly appear in the indicator limitations list. The interpretation statement included  
18 on page 3-27 raises important human health questions that could well be addressed by  
19 providing additional information. These include questions such as: How many  
20 communities rely on these streams for their water supply? How many communities rely  
21 on the streams that had nitrates above the MCL? How many communities treat their  
22 water for nitrate? The Panel notes that while treatment can reduce nitrate levels, this is  
23 often cost prohibitive for community water systems and they must find an alternate water  
24 supply. A similar issue is apparent in the limitations discussion of the “pesticide in  
25 streams” indicator on page 3-32. Important human health questions that could be  
26 addressed include: How practical is it to treat a community water supply for pesticides?  
27 and How many communities do this?  
28

29 The Panel recognizes that the "Survey of the Nation's Lakes" will provide a valuable  
30 database in the future for assessing conditions of ponds and reservoirs that are  
31 representative of all lakes in the United States. However, in the interim, usable data that  
32 already exist should not be overlooked. For example, there is wealth of information (and  
33 associated data) available on nutrients, especially for rivers, lakes, and coastal waters.  
34 The Panel recommends that staff visit (or revisit) their own EPA guidance manuals for  
35 lakes, rivers, coastal waters, and wetlands for potential data sets, if they have not already  
36 done so. In addition, long-term monitoring programs of EPA (e.g., Environmental  
37 Monitoring and Assessment Program - EMAP) and other Federal Agencies (e.g., the U.S.  
38 Geological Survey's National Water Quality Assessment Program, and the National  
39 Oceanic and Atmospheric Administration's Status and Trends and Mussel Watch  
40 Programs), and of states or universities should be examined. Indicator criteria should be  
41 relaxed (within reason) to enable the use of important trend data. It is important to be  
42 able to see the trends with appropriate caveats about methodologies used. This was done  
43 for the “SAV in the Chesapeake” indicator discussed on pages 3-74 to 3-75. In this case,  
44 data were adjusted to account for methodological inconsistencies. A similar approach

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1 should be adopted for other parameters (e.g., sediment contamination, tissue  
2 contaminants, benthic communities, etc.), if feasible. The following specific  
3 recommendations are recommended to address indicator gaps and limitations in the water  
4 chapter.

- 5
- 6 • **For future Reports on the Environment, EPA should visit (or revisit) the**  
7 **Agency's guidance manuals for lakes, rivers, coastal waters, and wetlands for**  
8 **potential data sets to fill identified data gaps.**
- 9
- 10 • **For future Reports on the Environment, long-term monitoring programs of**  
11 **EPA (e.g., Environmental Monitoring and Assessment Program - EMAP) and**  
12 **other Federal Agencies (e.g., the U.S. Geological Survey's National Water**  
13 **Quality Assessment Program, and the National Oceanic and Atmospheric**  
14 **Administration's Status and Trends and Mussel Watch Programs), and of states**  
15 **or universities should be examined. Indicator criteria should be relaxed (within**  
16 **reason) to enable use of important trend data.**
- 17

18 *Charge Question 4. Regionalization of the national Report on the Environment*  
19 *indicators in the water chapter*

20

21 The Panel finds that regionalization of national indicators is an important component  
22 of the water chapter of the ROE 2007 Science Report. However, as noted previously, the  
23 Panel is concerned that the use of EPA administrative regions will distort true ecological  
24 patterns or gradients. If possible, in future Reports on the Environment the data should  
25 be analyzed at more appropriate scales. For surface water, a more appropriate approach  
26 may be to use watersheds or established hydrologic units that also account for altitudinal  
27 gradients. For groundwater, EPA should evaluate the validity of using U.S. Geological  
28 Survey (USGS) groundwater basins as regional units. Contributing watersheds may be  
29 used as a scaling unit for estuaries.

30

31 The Panel notes that a regional approach will also aid in evaluating indicators for  
32 various water systems during extreme events such as hurricanes, drought, and possibly  
33 bioterrorism. As noted previously, it is important for EPA to mine existing data and find  
34 ways to use these data to develop indicators for different ecoregions. For example, an  
35 enormous amount of data is collected by the five Water Management Districts in Florida  
36 on various water systems. Similar data sets exist for various ecoregions. For future  
37 Reports on the Environment, these data can be used to identify indicators.

38

39 *Charge Question 5. Utility of the regional indicators in answering the questions in the*  
40 *water chapter*

41

42 The Panel finds that there is considerable utility in using regional indicators to answer  
43 questions in the water chapter of the ROE 2007 Science Report. The regional indicators  
44 used in the water chapter answer parts of the questions to one degree or another but

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1 certainly do not address all aspects of the questions. The Panel suggests that additional  
2 regional indicators could be used to answer questions in the water chapter. One indicator  
3 used to respond to the question of the condition and extent of coastal waters and their  
4 effects on human health and the environment is the occurrence of dinoflagellate blooms  
5 on the west coast of Florida. The Panel notes that dinoflagellate blooms (*Pfiesteria*) have  
6 been strongly linked to nutrient input in the bays of North Carolina and Virginia and  
7 could be possible regional indicators. In addition, recurrent harmful algal blooms  
8 (HABs) of *Alexandrium* off the coast of New England, brown tide (*Aureococcus*) in the  
9 middle Atlantic, and *Pseudonitzschia* off the coast of the Pacific Northwest are being  
10 monitored, among others. The Panel questions why harmful algal blooms in fresh waters  
11 and invasive species have not been included as indicators in the discussion of extent and  
12 condition of fresh surface waters. The Panel notes that a regional indicator would seem  
13 to make sense here, either based on Great Lakes or Everglades long-term data.  
14 Occurrences of freshwater HABs like *Microcystis* could also be used as indicators. In  
15 future Reports on the Environment, EPA should consider incorporating these and other  
16 monitored blooms into the HAB indicator in the water chapter. In the water chapter,  
17 there are seven other indicators listed in response to the question of the condition and  
18 extent of coastal waters and their effects on human health and the environment. Even  
19 taken collectively, these indicators do not answer all aspects of the question, although  
20 each indicator illuminates some facet of the problem posed. If EPA continues to use  
21 regional indicators in answering this question in future Reports on the Environment, it  
22 would be helpful to explicitly identify the benefits and limitations associated with each  
23 regional indicator vis-à-vis national indicators.

24  
25 The Panel finds that for future Reports on the Environment, development of regional  
26 indicators focusing on individual water systems would be a useful way to identify  
27 common indicators across regions. For example, separate water systems could be divided  
28 into groups: lakes and reservoirs, streams and rivers, wetlands, estuaries, and coastal  
29 waters. Indicators used in each of these groups could be evaluated across ecoregions and  
30 climatic gradients. Regional EPA offices, in collaboration with USGS and state agencies  
31 in the region, could identify data sources and transform data into useable information for  
32 the Report on the Environment.

33  
34 The Panel notes that as indicators are developed, there are a multitude of processes  
35 that must be integrated, some of which can be described in deterministic/mechanistic  
36 equations (e.g., water flux, sediment and contaminant transport) or stochastic models  
37 (e.g., climate change). In contrast, other processes that affect water resources are more  
38 complex and “fuzzy,” and thus more difficult to incorporate into quantitative models  
39 (e.g., irrational behavior of population groups rooted in cultural and social belief  
40 systems). The process of indicator development will require interdisciplinary research  
41 and education to synergize expertise from various domains and develop holistic  
42 approaches or models that are modular, scalable and flexible linking land and water  
43 resources to internal and external forcing functions. The following specific

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1 recommendations are provided to strengthen the use of regional indicators in the water  
2 chapter of the Report:

3  
4 • **In future Reports on the Environment, EPA should utilize and build on existing**  
5 **databases that have been collected and existing local expertise that has been**  
6 **developed at benchmark sites in various ecoregions.** Some specific examples are  
7 provided in the discussion above and in the following recommendations. This effort  
8 should focus on addressing water quality and quantity issues that could potentially  
9 affect human, economic, and ecological health. The specific proposed goals of such  
10 an effort should be to:

- 11  
12 - Identify attributes of land and water resources that can serve as indices of  
13 sustainability, and develop field and laboratory methodologies to determine these  
14 attributes in space and time within different benchmark water systems;  
15 - Investigate the sensitivity and dependence of basin factors to internal and external  
16 forcing functions such as climate change, extreme events, water law, land use  
17 policies, and social customs;  
18 - Develop predictive tools that will aid in determining the interactions and linkages  
19 between hydrologic processes, biogeochemical processes and socio-economic  
20 factors; and  
21 - Expand institutional collaborations through partners and maximize the utilization  
22 of available resources to promote interdisciplinary research and educational  
23 activities in benchmark water systems.

24  
25 • **In future Reports on the Environment, EPA should give state data sets much**  
26 **closer scrutiny for possible inclusion.** Some states have a wealth of site-specific  
27 data. For example, private well testing data are available in states with a high  
28 proportion of private wells (cf. the “Wellogic: system in Michigan:  
29 [http://www.michigan.gov/deq/0,1607,7-135-6132\\_6828-16124--,00.html](http://www.michigan.gov/deq/0,1607,7-135-6132_6828-16124--,00.html)) and local  
30 sport fish testing in states with strong recreational fisheries may mesh well with the  
31 existing national indicators. Highlighting what some states have done might help  
32 advance interest in expanding the efforts to a national surveillance system.

33  
34 • **For future Reports on the Environment, the Panel recommends that EPA**  
35 **consider the following example potential local/regional indicator for use in the**  
36 **water chapter.** The State Water Resources Control Board of California is funding  
37 USGS to lead and conduct a Ground-Water Ambient Monitoring and Assessment  
38 (G.A.M.A.) program (<http://ca.water.usgs.gov/gama/>), under which groundwater  
39 samples from public and private water supply wells from California are analyzed for  
40 water quality. The data collected will be integrated with existing water-quality data  
41 (such as the public supply well water-quality data of the California Department of  
42 Health Services). The monitoring program is scheduled to repeat the collection and  
43 analyses once every ten years, and therefore, it will provide the badly needed  
44 information for temporal trends. Although this type of data set may not be useful in

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1 developing a national water quality indicator, it is nevertheless meaningful and very  
2 useful in answering many of the questions in the regional context.  
3

- 4 • **In future Reports on the Environment, the Panel recommends that, in addition**  
5 **to the Gulf of Mexico and Long Island Sound, other places where hypoxic**  
6 **conditions tend to occur and are well monitored (such as Chesapeake Bay, the**  
7 **coastal waters off Oregon, and parts of Lake Erie) should be added to the**  
8 **hypoxia indicator.**  
9
- 10 • **For future Reports on the Environment, EPA should develop indicators for arid**  
11 **regions.** In this regard the Agency should draw upon the numerous studies and data  
12 collection efforts conducted by various federal and state agencies in the western states  
13 where the climate is arid. Most areas in these states (EPA Region 9: California,  
14 Arizona, Nevada) can be classified as desert or semi-desert, and water resources  
15 issues, both in terms of quality and quantity, are highly contentious.  
16

17 *Charge Question 6. Overall quality of the water chapter with respect to technical*  
18 *accuracy, clarity, and level of communication*  
19

20 The Panel generally finds that the water chapter is technically accurate and that the  
21 level of communication is appropriate. As noted above, additional indicators are needed  
22 to answer the questions in the water chapter. The following recommendation is provided  
23 to strengthen the overall quality of the water chapter and other parts of the document.  
24

- 25 • **In future Reports on the Environment, a summary section should be included**  
26 **after each media chapter. In addition to summarizing information presented in**  
27 **the chapter, this section should also identify relevant emerging issues. In the**  
28 **water chapter such issues might include:**  
29
- 30 - **Effect of climate change on water quantity and quality;**
  - 31 - **Emerging pathogens associated with climate change;**
  - 32 - **Pharmaceutically produced compounds;**
  - 33 - **Nanoparticle waste products;**
  - 34 - **Water availability and sustainability;**
  - 35 - **Invasive species; and**
  - 36 - **Better characterization of algal toxins.**

## 37

### 38 **8.0 LAND CHAPTER COMMENTS**

39

40 *Charge Question 1. Adequacy of formulation and scope of questions in the land chapter*  
41

42 In the land chapter of the ROE 2007 Science Report, indicators are presented to  
43 address fundamental questions about the state of the nation's land and its effect on human  
44 health and the environment. The five questions in the chapter focus on trends in: the

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1 extent of land cover, land use, wastes, chemicals used on land, and contaminated land.  
2 The questions in the land chapter are appropriate to the mission of the EPA. The first two  
3 questions (addressing land cover and land use) relate to land resource management, while  
4 the last three questions relate to land contamination. However, the Panel finds that an  
5 additional question is needed to address the important issue of soil quality and  
6 conservation. In addition, the Panel finds that, while the inclusion of the phrase “and  
7 their effects on human health and the environment” in each question is understandable  
8 given the mission of EPA, there are few land indicators in the Report that directly  
9 measure effects on human health. The following specific recommendations are provided  
10 to improve the overall formulation and scope of the questions in the land chapter.  
11

- 12 • **In future Reports on the Environment, EPA should consider adding a**  
13 **fundamental question on soil quality and conservation to the land chapter.** The  
14 structure of the question could be parallel to the others in the chapter. While it could  
15 be argued that soil quality is covered conceptually under one of the existing  
16 questions, it is not obvious which one, and the Panel believes that soil quality and  
17 conservation is at the same level of importance as land cover, land use, etc. A variety  
18 of indicators could be established in relation to this fundamental question, including  
19 soil properties such as ability to hold nutrients (as measured by cation exchange  
20 capacity [CEC] or organic matter content), soil nutrient inventory (e.g., to assess  
21 loadings of nutrients and legacy phosphorous inventory), soil salt content (e.g., to  
22 assess effects of irrigation), and others.  
23
- 24 • **In the final Report, EPA should consider the following suggested revisions of the**  
25 **land chapter questions in order to improve their clarity.**
  - 26
  - 27 - To better reflect the information presented in the chapter, the first question could  
28 be revised to ask: What are the trends (and status) in the extent of different land  
29 cover types and their effects on human health and the environment? Similarly, the  
30 third question could be phrased as: What are the trends (and status) in waste  
31 deposition on the land and its effects on human health and the environment?  
32
  - 33 - The word “trend” (used in the questions) has a specific meaning in statistical  
34 science. It needs to be made clear whether qualitative or quantitative trends (or  
35 both) are used in the land chapter (and other chapters) of the Report (i.e., “trend”  
36 as used here needs to be defined). The definition of trend used in the Report can  
37 cover both statistical and qualitative assessment of change over time, as long as  
38 the intended meaning in a particular situation is indicated. The Panel suggests  
39 that trend information be developed wherever possible, and that EPA use both  
40 qualitative as well as quantitative data to generate trend information for all  
41 indicators.  
42
  - 43 - The waste deposition addressed in Question 3 (wastes) could be considered a  
44 “land use” issue and included as a subtopic of Question 2 (land use). The

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1 separation of waste management is understandable, however, as it is recognized  
2 that the hazardous and solid waste management programs run by EPA are large  
3 and important land media activities for the agency.  
4

5 - Waste deposition on land has impacts on groundwater that are likely of equal or  
6 greater significance than the direct impacts on land. Thus, the topic encompassed  
7 by Question 3 has overlap with the fundamental question regarding groundwater  
8 in Chapter 3, and there is a need for an explanation of integration among  
9 components of the Report in the introduction.

10

11 - The indicators presented in relation to Question 4 (addressing chemicals used on  
12 land) focus on agriculture. The agency may wish to list agriculture explicitly as  
13 the focus in Question 4. An alternative would be to include agricultural land  
14 indicators under Question 2 (addressing land use), considering agriculture as a  
15 specific land use.

16

17 - Question 5 (addressing contaminated land) has some overlap with Questions 3  
18 and 4. The "contaminated land" issue that is addressed by Question 5 (e.g., from  
19 pesticide use, industrial waste disposal, etc.) can be viewed as subsidiary to  
20 Questions 3 and 4. The factors distinguishing Question 5 (addressing  
21 contaminated land) from Questions 3 and 4 should be explained more fully.  
22

23

24 *Charge Question 2. Use of indicators to answer questions in the land chapter of the ROE*  
25 *2007 Science Report and presentation of indicator data in the chapter narrative*

26

27 The Panel finds that the five fundamental land chapter questions are not completely  
28 answered by the indicators presented, and in some cases are answered only in very small  
29 part. Further, most of the indicators do not represent by themselves a direct causal  
30 relationship to human and environmental health. However, the Panel recognizes that  
31 presently it may not be possible define land indicators that are directly linked to ultimate  
32 health effects.

33

34 In Appendix A of this report the Panel has provided specific technical comments and  
35 suggested improvements to individual indicators used in the land chapter. These  
36 improvements are recommended to answer the questions in the chapter more completely.  
37 The following more general recommendations and suggestions for additional indicators  
38 are provided to improve the indicators in the land chapter:

39

- 40 • **In future Reports on the Environment, with respect to the land chapter**  
41 **indicators the Panel recommends that EPA should: 1) consider a range of land**  
42 **cover classification schemes with different levels of resolution. This is necessary**  
43 **because the resolution of the data in the current Report is too coarse to**  
44 **completely answer the questions; 2) characterize land cover of all major**  
**ecosystem types, not just the forest land cover characterized the current draft of**

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1       **the Report; 3) adopt standard, established approaches for land use and land**  
2       **cover analysis to evaluate information and document trends across a range of**  
3       **available data sets.**

- 4
- 5       • **In the final Report EPA should include more direct indicators of effects in the**  
6       **land chapter.** For example, low stream flows associated with particular land uses  
7       could be used as an indicator because a lower flow could raise water temperatures and  
8       reduce dilution of pollutants. In addition, as in other chapters, a better explanation of  
9       the reasons for choosing the indicators used should be provided.
  - 10
  - 11       • **In future Reports on the Environment, the indicators selected should be clearly**  
12       **related to the “big picture” fundamental questions, and not chosen just because**  
13       **of availability or compliance with indicator criteria (i.e., they are the only**  
14       **indicators left after others have been eliminated).**
  - 15
  - 16       • **In the final Report, EPA should consider adding indicators for mining wastes,**  
17       **and wastes applied on agricultural land (biosolids, compost, etc.).** The Panel  
18       finds that the two waste indicators in the land chapter are appropriate, but adding  
19       these additional indicators would provide important information about waste on land.  
20
  - 21       • **In the final Report, EPA should add an indicator based on the generation and**  
22       **disposal of civilian radioactive waste.** This will fill an important data gap. The  
23       Panel recognizes that some data on defense radioactive waste may not be publicly  
24       available. However, it is recommended that EPA staff work with the U.S. Nuclear  
25       Regulatory Commission to obtain statistical information on status and trends  
26       concerning civilian radioactive waste generation, disposal, and management. (U.S.  
27       Nuclear Regulatory Commission, 2007).
  - 28
  - 29       • **In the final Report, a pesticide use indicator should be added to the land**  
30       **chapter.** This could be done by renaming the existing indicator, “fertilizer applied  
31       for agricultural purposes,” as “fertilizer and pesticide applied” and adjusting the type  
32       of data used to populate the indicator. In this regard, one possible indicator that could  
33       be used is pesticide sales, which could likely be parsed into agricultural and  
34       residential/commercial landscape applications. The latter would provide a  
35       suburban/urban indicator, which is important from the standpoint of human exposure.  
36
  - 37       • **In the final Report, the reported pesticide incident indicator should be moved to**  
38       **the human health chapter.** The Panel finds that the decline in reported pesticide  
39       incidents has a direct relationship with human health. However, the link between  
40       reported pesticide incidents and the human health impacts of land management  
41       practices is tenuous. Reported pesticide incidents cover all sorts of uses of pesticides,  
42       and are based on calls to poison control centers. Many of these incidents are related  
43       to misuse of household products and activities far removed from land management.  
44

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1 *Charge Question 3. Identification of gaps and limitations of the land chapter indicators*  
2

3 The Panel finds that the discussions of indicator information gaps and limitations in  
4 the land chapter are objective, honest and insightful. In many cases, these sections point  
5 out why particular indicators do not provide the comprehensive picture that is needed or  
6 are “not ready for prime time.” However, with respect to data gaps, there is much more  
7 that could be said for each question. The data gap topics chosen for discussion seem  
8 somewhat arbitrary, though the data gaps discussions do uniformly address the lack of  
9 measures needed to directly assess the relationship of the indicator values to human  
10 health. Therefore the Panel recommends that:

- 11
- 12 • **In the final Report, the discussions of the data gaps in the land chapter should be**  
13 **modified to make it clear that the gaps mentioned are the highest priority gaps**  
14 **determined by the agency, and that the list is not intended to be comprehensive.**  
15

16 *Charge Question 4. Regionalization of the national Report on the Environment*  
17 *indicators in the land chapter*  
18

19 Concerns about the use of EPA administrative regions to regionalize national data have  
20 been noted previously. The Panel also notes that for future Reports on the Environment,  
21 the Agency may wish to consider the utility of the land chapter for cross-media  
22 evaluations if EPA regions were keyed to important environmental factors. The Panel  
23 notes that no single regionalization approach fits all evaluation needs and that in the age  
24 of geographic information systems (GIS), there is no need to oversimplify. Therefore, in  
25 evaluating the condition of land, for example, EPA could select a particular level of  
26 USGS Hydrologic Units and overlay an ecoregionalization scheme. Bailey’s U.S. Forest  
27 Service (USFS) Ecoregions of the U.S. (Bailey, 1995) or Omernik’s Ecoregional schema  
28 (Omernik, 1987) would be fine, as these combine soil, elevation, moisture, vegetation,  
29 and other factors. The use of different types of regional groupings could be used to show  
30 the location and extent of many features in the other chapters in the Report.  
31

32 *Charge Question 5. Utility of the regional indicators in answering the questions in the*  
33 *land chapter*  
34

35 As further discussed in Appendix A, the Panel did not find the one regional example  
36 included in the land chapter (the Puget Sound/Georgia Basin example given in the Land  
37 Cover subsection) to be very useful. It is sufficiently unique that it was not seen as  
38 providing much value as a national model or case study. The Panel could not determine  
39 why this example was included, it was not clear how this example could be standardized  
40 for use in other regional analyses. It was the opinion of the Panel that inclusion of  
41 regional indicator examples will be most valuable if they can and should be replicated  
42 across the U.S. It would be useful to include examples from more than one region.  
43 Examples and case studies of significant national importance (e.g., from the Great Lakes  
44 region) should be given preference.

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1  
2 *Charge Question 6. Overall quality of the land chapter with respect to technical*  
3 *accuracy, clarity, and level of communication*  
4

5 The Panel finds that the land chapter is generally clearly written and technically  
6 accurate. The data presented are interesting and will be useful for multiple purposes.  
7 However, in most cases, the fundamental questions in the land chapter are far from  
8 completely answered by the indicators and indicator data available, and the big picture  
9 understanding that the public may expect is not achieved. The data gap discussions are  
10 brief and the Panel recommends that they be reviewed and expanded where appropriate.  
11 In addition, while the Report writers clearly made strong efforts to avoid interpretations  
12 regarding influence of programs, some such interpretation statements have made their  
13 way into the Report and should be removed.  
14

15 The Panel also finds that the range of indicators in the land chapter is not at the same  
16 level of development as indicators the water and air chapters. This is understandable  
17 given that EPA does not have a land program like it has water and air programs. The  
18 modest level of development of the land chapter must ultimately be addressed through  
19 direction of additional resources and an expanded set of disciplines in the Agency.  
20

21 **9.0 HUMAN HEALTH CHAPTER COMMENTS**  
22

23 *Charge Question 1. Adequacy of formulation and scope of questions in the human health*  
24 *chapter*  
25

26 The panel generally finds the questions within the human health chapter of the ROE  
27 2007 Science Report to be comprehensive, appropriate, and well developed. There is  
28 strength in the questions in their simplicity and clarity. However, the Panel recommends  
29 the following specific revisions to improve the scope and clarity of the questions.  
30

- 31 • **In the final Report the questions within the human health chapter should be**  
32 **reordered to be consistent with event sequence in the environmental health**  
33 **paradigm as depicted in Figure 5.1 of the Report (i.e., exposure precedes the**  
34 **health effect).**
- 35  
36 • **In the final Report the human health chapter should be more descriptively**  
37 **renamed as “Human Exposures and Health.” This change is needed because the**  
38 **questions contained within the chapter encompass both human health and**  
39 **exposure.** In addition to being more descriptive, the inclusion of “exposure”  
40 within the chapter title offers the following advantages:
  - 41
  - 42 - It appropriately elevates exposure assessment within the Report on the
  - 43 Environment as a central and critical domain within EPA;

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- 1 - It is a key tenet to the Report content in linking environmental change to human
- 2 and ecological change; and
- 3 - It provides a more appropriate place to include National Health and Nutrition
- 4 Examination Survey (NHANES) pesticide body burden measurements that are
- 5 currently out of place within the land use chapter.

6  
7 There were differing opinions among panelists regarding the adequacy and scope of  
8 the first question within the chapter “What are the trends in health status in the United  
9 States?” Some panelists thought that because the environmental factors considered in the  
10 Report play relatively small roles in the epidemiology of major U.S. health trends (i.e.,  
11 general mortality, life expectancy, and infant mortality), such broad health-related  
12 conditions would have limited utility as environmental health indicators per se. Others  
13 felt that this question was appropriate in highlighting EPA’s health mission. There was  
14 some consensus around a compromise suggestion for eliminating this question in the final  
15 Report but retaining the content as introductory text to the subsequent, more specific  
16 health question “What are the trends in human disease and conditions for which  
17 environmental contaminants may be a risk factor, including across population subgroups,  
18 and geographic regions?” In contrast to the previous more general question, there is  
19 strong justification for the inclusion of this question in the final Report.

20  
21 *Charge Question 2. Use of indicators to answer questions in the human health chapter of*  
22 *the ROE 2007 Science Report and presentation of indicator data in the chapter narrative*

23  
24 The Panel finds that the indicators used in the human health chapter of the ROE 2007  
25 Science Report are appropriate. However, as discussed below, additional indicators are  
26 recommended to more completely answer the questions. In addition, there is a critical  
27 need to expand the discussion of the health indicators’ relevance to the questions. This  
28 discussion can appropriately stem from the following indicator criterion on page 1-7 of  
29 the Report.

30  
31 “The indicator is useful. It answers (or makes an important contribution to  
32 answering) a question in the Report on the Environment.”

33  
34 Although there is strong epidemiologic evidence that supports the indicators chosen  
35 (cancer incidence, childhood cancer incidence, cardiovascular disease, chronic  
36 obstructive pulmonary disease, asthma, infectious disease, birth defects, low birth weight,  
37 preterm delivery) the Panel finds that the Report fails take advantage of this literature to  
38 provide either a qualitative or quantitative description of the environmental contribution.  
39 For example, what is the estimated fraction of cardiovascular disease that can be  
40 attributed to air pollution? Although the Report acknowledges that the health questions  
41 are complex and have multiple causes, it fails to provide a quantitative or even qualitative  
42 assessment of the relevance of the indicator to the question. This is an important  
43 consideration in providing the reader with the necessary context for understanding the  
44 meaningfulness of the indicator in the context of the health question. For example, there

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1 are scientifically credible estimates for the contribution of the environment to various  
2 cancers (see Doll and Peto and Lichtenstien et al.) **[DFO NOTE – please provide**  
3 **complete references]**. There are similar estimates of air pollutions contribution to asthma  
4 **[DFO NOTE – references needed]** and cardiovascular **[DFO NOTE – references**  
5 **needed]** morbidity and mortality. The Panel therefore recommends that:

- 6
- 7 • **For the final Report, if credible quantitative impact estimates are available (e.g.,**  
8 **estimates of the mortality impacts of particulate air pollution in selected**  
9 **locations in the U.S.) [DFO NOTE – References needed], they should be included.**  
10 Establishing the relevance of the indicator grounded in the literature will go a long  
11 way toward strengthening the science of the Report.  
12
- 13 • **In future Reports on the Environment, EPA should consider using an expanded**  
14 **suite of human health indicators** that would include the following:  
15
  - 16 - The National Health Interview Survey (NHIS) Behavioral Risk Factor Survey  
17 (BRFS). This is a population-base survey administered by states and includes the  
18 relevant domains of Secondhand Smoke Policy (Module 10), Indoor Air Quality  
19 (Module 11), and the Home Environment (Module 12). These modules include  
20 salient indicators for indoor air quality: 1) the use of gas appliances, 2) use of a  
21 coal stove, fireplace, or kerosene heater; 3) use of pesticides; 4) whether smoking  
22 is allowed indoors at home and at work. Because these data are collected at a  
23 state level, there is sufficient resolution to the data for use as a regional as well as  
24 a national indicator. (this recommendation is relevant to the Air Chapter)
  - 25 - Hospital and emergency room discharge data; **[DFO NOTE – Dr. Buckley notes**  
26 **that these database(s) should be specifically identified]**
  - 27 - Reports of infectious disease maintained by CDC. **[DFO NOTE – Dr. Buckley**  
28 **notes that these database(s) should be specifically identified]**  
29
- 30 • **In future Reports on the Environment, EPA needs to adopt the suites of**  
31 **indicators that other agencies have developed, but present them in relation to**  
32 **environmental factors. [DFO NOTE – Dr. Buckley notes that this statement from**  
33 **face-to-face meeting requires additional clarification or justification]**  
34

35 *Charge Question 3. Identification of gaps and limitations of the human health chapter*  
36 *indicators*  
37

38 The Panel finds that the identification and communication of gaps and limitations of  
39 the indicators in the health chapter are adequately addressed with some potential areas for  
40 improvement. The following recommendations are provided to improve the  
41 identification of gaps and limitations. The Panel recommends that:

- 42
- 43 • **In the final Report, the discussion of gaps and limitations should be expanded to**  
44 **include a more quantitative description of the indicator’s relevance by relying on**

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1 **the epidemiologic literature (also suggested above).** The discussion might be  
2 further expanded to address how the limitations and gaps affect the interpretations of  
3 the Report on the Environment indicators, or the larger framework of the disease state  
4 or indicator. *[DFO NOTE – Dr. Buckley notes that an example would be useful*  
5 *here]*  
6

- 7 • **In the final Report, the concept statements in the indicator limitations sections**  
8 **such as “the measurement of mercury or any other environmental chemical in a**  
9 **person’s blood or urine does not by itself mean that the chemical has caused or**  
10 **will cause harmful effects in that person” should be removed from each**  
11 **discussion of indicator gap and instead placed in the conceptual framework**  
12 **section of the chapter.**  
13

14 *Charge Questions 4 and 5. Regionalization of the national indicators and utility of the*  
15 *regional indicators in answering the questions in the human health chapter*  
16

17 As noted previously, the Panel finds that regional analysis will make the Report on the  
18 Environment richer and more meaningful. Nationally aggregated data cannot reflect  
19 local and regional environmental or health trends that are important to the quality of life  
20 and health of the residents living in these areas. Regional indicators as presented by EPA  
21 administrative regions are not particularly informative geographic descriptors of health.  
22 The Panel notes that ecosystems, watersheds etc. are far more useful, as presented in  
23 some of the other chapters, and would be a novel approach to presenting health data that  
24 would set the Report on the Environment apart from the already existing health data  
25 presentations. The finer the spatial scale of this analysis, the more valuable it becomes.  
26 The finest spatial resolution contained with the Report is at the regional level and trend  
27 analysis is shown simplistically as line graphs. The Panel notes that even for this  
28 relatively simple analysis, and certainly as the Report on the Environment is developed to  
29 include indicators with greater spatial resolution, more sophisticated and innovative  
30 means of analysis and presentation will be required.  
31

32 For some of the indicators resolution can go down to the state and even the county  
33 level (indicators derived from birth and death certificates) making it possible to aggregate  
34 the data in many geographic patterns. The NHIS survey data and the Survey  
35 Epidemiology and End Results (SEER) cancer data only has national resolution.  
36 However, state-based surveys such as the Behavioral Risk Factor Surveillance System  
37 (BRFSS) can provide much of the same disease prevalence data as the NHIS with  
38 resolution at the state level. State cancer reporting registries are in nearly all states and  
39 while not as rigorous as the SEER program provide credible cancer incidence data widely  
40 used by states without SEER registries. It would be helpful for EPA to provide  
41 “regional” reports that were integrative and coherent. The current approach does not  
42 provide much benefit. Therefore the Panel specifically recommends that:  
43

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- 1 • **In the final Report, EPA should build on the higher geographic resolution theme**  
2 **by presenting individual or multiple state data which could inform the gross**  
3 **national estimates presented and point toward the future. This should be done if**  
4 **it is possible within time constraints.**
- 5
- 6 • **For future Reports on the Environment (if time does not permit inclusion of the**  
7 **state data in the final ROE 2007 Science Report) EPA should consider making**  
8 **use of county-level data available from the states.** All of the vital statistic data  
9 presented and used for the EPA Regional indicators can and have been scaled to the  
10 county level and excellent maps have been generated and already published in books.  
11 Geographic differences in disease have been identified. Virtually every state provides  
12 tables and maps of their vital statistics by county and they are used to identify local  
13 priorities to allocate targeted interventions and funding, yet on page 5-68 of the ROE  
14 2007 Science Report it is stated that “underlying data for most ROE indicators ...do  
15 not enable extensive analysis of disease trends within or across geographic regions.”  
16 The Panel notes that this statement only pertains to the NHIS survey data. Certainly  
17 cardiovascular disease, stroke, and chronic obstructive pulmonary disease mortality  
18 can be presented at the county level or certainly the state level.

19  
20 *Charge Question 6. Overall quality of the human health chapter with respect to*  
21 *technical accuracy, clarity, and level of communication*  
22

23 The Panel finds that the human health chapter is generally technically accurate  
24 although limited in its assessment and synthesis. As with the Report in general, there is a  
25 need to further develop the chapter from its current form, which can be characterized as a  
26 data report, to a more sophisticated scientific document that includes assessment based on  
27 the primary literature and appropriate statistical analysis. The following specific  
28 additional recommendations are provided to improve the overall quality of the human  
29 health chapter.  
30

- 31 • **In the final Report, Bullet #2 on page 5-5 should be rewritten to include**  
32 **biological agents.** The following sentence should be added: “Infectious diseases  
33 associated with environmental exposures or conditions are also addressed.”  
34
- 35 • **In the final Report, the discussion of sensitive populations should be expanded**  
36 **because these populations are important in considerations of environmental**  
37 **health.**  
38

39 **10.0 ECOLOGICAL CONDITION CHAPTER COMMENTS**  
40

41 The ecological condition chapter of the ROE 2007 Science Report is extremely  
42 complex. The Panel recognizes that developing the chapter has been a difficult task, as it  
43 covers millions of different species of organisms as well as populations, biological  
44 communities, and ecosystems, all of which interact with each other and are differentially

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1 affected by environmental factors. EPA is to be commended for tackling this important  
2 task. Compiling this information and pointing out the gaps and limitations is a very  
3 useful project for the agency, the scientific community, and the general public. However,  
4 the Panel finds that reorganization of the chapter is needed to reflect an integrated focus  
5 on ecosystem health. To reflect an integrated focus on ecosystem health, the ecological  
6 condition chapter should be reorganized hierarchically according to: 1) major ecosystem  
7 type, 2) ecosystem processes and services, and 3) ecosystem components (physical,  
8 chemical, biological). This is discussed in more detail below.

9  
10 Structuring the chapter as recommended above will involve reorganization of material  
11 presently covered in the chapter and including additional indicators discussed below.  
12 The Panel recognizes that many of the comments and recommendations provided below  
13 in response to the specific charge questions probably cannot be addressed in the final  
14 Report, but should be considered for future Reports on the Environment. However, the  
15 Panel recommends that EPA complete as much of the reorganization as possible for the  
16 final Report. The Panel also suggests that in the final Report, the ecological condition  
17 chapter include a synthesis of the independent indicators, and that it emphasize the  
18 connections between ecosystems and stressors.

19  
20 *Charge Question 1. Adequacy of formulation and scope of questions in the ecological*  
21 *condition chapter*

22  
23 In general, the Panel finds that the questions in the ecological condition chapter are  
24 formulated appropriately. An exception is the biomarker question addressing the level of  
25 exposure of specific plant and animal species to different forms of pollution and toxic  
26 chemicals. The Panel suggests that in the final Report, rather than focusing on trends in  
27 biomarkers, the question should refer to trends in exposure and effects of contaminants in  
28 organisms. Biomarkers are the data collected to analyze the trends. In addition, the  
29 Panel notes that it is important to show the linkages between the effects seen in the  
30 ecological condition chapter and the indicators discussed in the media chapters; for  
31 example, EPA should strengthen the link between sea temperature and sea level rise  
32 discussed in this chapter and greenhouse gases in the air chapter. The Panel therefore  
33 recommends that:

- 34  
35 • **In the final Report, the climate indicator trends in the ecological condition**  
36 **chapter should be placed in a paleoclimatic context, and references to the**  
37 **Intergovernmental Panel on Climate Change (IPCC) Report should be included.**  
38

39 Although most of the questions in the ecological condition chapter appear to be  
40 germane, the associated indicators in the chapter seem to have been chosen because of  
41 the availability of data, not always their appropriateness to answer the questions. In some  
42 cases there are significant gaps between the questions and the corresponding indicators.  
43 As recommended previously for other chapters of the final Report, EPA should provide  
44 their rationale for the selection of these particular indicators. This rationale may be that,

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1 for many desired indicators of ecological condition, the needed data simply are not  
2 available. If a desired indicator has no data, the final Report should contain a statement  
3 of the need for data.

4  
5 As further discussed below, the Panel also notes that the scope of indicators used to  
6 answer questions in the chapter needs considerable broadening to cover more ecosystem  
7 types, with the recognition that EPA cannot develop an unlimited set of indicators but  
8 should select those that address key ecological issues. **Easily accessible data may be  
9 available for some of these indicators and could be included in the final Report,  
10 while others will have to wait for future Reports on the Environment.** A critical  
11 issue to be considered is whether data must meet some test that many ecological studies  
12 may not achieve. The final Report will be more useful if it includes more information,  
13 and then discusses caveats about the methodology. Specific gaps in coverage (missing  
14 ecosystems, missing populations, and missing processes) in the ecological condition  
15 chapter of the ROE 2007 Science Report are presented below in Appendix A.

16  
17 *Charge Question 2. Use of indicators to answer questions in the ecological condition*  
18 *chapter of the ROE 2007 Science Report and presentation of indicator data in the*  
19 *chapter narrative*

20  
21 In reviewing indicators used in the ecological condition chapter, the Panel considered  
22 the charge question in two parts: “Are the current indicators appropriately used to answer  
23 the questions?” and “Are these the correct indicators to answer the questions?” The  
24 Panel finds that the indicators in the ecological condition chapter provide relevant and  
25 useful information as an initial attempt to answer the general questions posed, but many  
26 of the indicators are not transparent. Ideally, they should be intuitive to readers and  
27 require little explanation. The limited number of acceptable indicators in the ecological  
28 condition chapter can offer only a narrow perspective or a snapshot, and many do not  
29 show temporal trends. They are hardly adequate. This argues for an introductory  
30 discussion of each indicator along with a conceptual process diagram so that the reader  
31 can better understand the role of each indicator and its importance relative to the  
32 questions asked. The Panel’s specific recommendations to address these concerns are as  
33 follows:

- 34  
35 • **In the final Report, EPA should reorganize the ecological condition chapter to**  
36 **focus on three major indicator categories: Ecosystems, Ecological Processes and**  
37 **Services, and Ecosystem Components.**  
38  
39 • **In the final Report, appropriate indicators should be included in the ecological**  
40 **condition chapter to provide information on the ecosystem extent (e.g., land**  
41 **cover, land use, urbanization) and quality /condition (e.g., landscape integrity,**  
42 **connectedness, fragmentation, and contamination) of major ecosystem types.**  
43 Examples of major ecosystem types include: forests, grasslands, shrublands, arid  
44 lands, wetlands, farmlands, freshwater, and coastal, marine, and urban ecosystems. .

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- 1  
2 • **In the final Report, indicators should be included in the ecological condition**  
3 **chapter to represent important ecosystem processes and services such as:**  
4 **provisioning (timber, fuel, minerals, etc.); regulating (disease, climate, flood);**  
5 **cultural (spiritual, aesthetic); and supporting (soil formation, primary**  
6 **productivity, pollination, clean air, clean water, decomposition, disturbance,**  
7 **nutrient cycling, hydrological/chemical cycling, carbon sequestration**  
8 **[productivity – decomposition]).** Potential indicators relevant to the ecosystem  
9 processes listed above include: fire frequency, floods, drought, algae blooms, invasive  
10 species, carbon storage, soil salinity, nutrients, and erosion.  
11  
12 • **In the final Report, indicators should be included in the ecological condition**  
13 **chapter to represent physico-chemical components of ecosystems (e.g., soils,**  
14 **water, chemicals, snow pack, and physical habitats).** Some physico-chemical  
15 indicators are already included in the Report (e.g., mean temperature and  
16 precipitation, seas surface temperature, sea level, stream flows, and nitrogen and  
17 phosphorus discharge in rivers and streams).  
18  
19 • **In the final Report, indicators should be included in the ecological condition**  
20 **chapter to represent biological components of ecosystems ranging from the**  
21 **genome to the community level of organization.** Such components include  
22 biodiversity, endangered species, invasive species, keystone species, and  
23 communities. Specific examples of biological component indicators include: the  
24 extent and range of communities (e.g., land cover, and coastal benthic communities,  
25 and coral reefs) and particular taxa (e.g., birds, fish, macroinvertebrates, and  
26 submerged aquatic vegetation); the protection status of biological components (e.g.,  
27 management policy and zoning information relevant to understanding status and  
28 future vulnerability); and threats. The Panel finds that the current indicators in the  
29 ecological condition chapter have too much reliance on vertebrates, not enough  
30 emphasis on the small organisms that run the world (e.g., microbes, flora).

31  
32 In Appendix A below the Panel has provided specific technical comments and  
33 suggested improvements concerning individual indicators currently used in the ecological  
34 condition chapter.

35  
36 *Charge Question 3. Identification of gaps and limitations of the ecological condition*  
37 *chapter indicators*

38  
39 The Panel finds that, in general, the limitations and gaps are assessed fairly and  
40 objectively, and are presented in a clear and transparent way in the ecological condition  
41 chapter. As in other chapters of the Report it may be useful to subdivide this section into  
42 different types of limitations, such as geographic limitations, statistical limitations, data  
43 coverage limitations, etc. Often when gaps or limitations are discussed it is based on an  
44 inadequate understanding of relationships between the indicator and the environment.

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1 Limitations are also often based on inadequate data, or inability to interpret data because  
2 they are “incomplete.” To address this concern, the chapter and each indicator in the  
3 final Report should include a “conceptual model” of how stressors (drivers), responses  
4 and outcomes are perceived by the scientific community. This will improve  
5 interpretation and discussion and help the reader understand the importance of the  
6 indicator. Recommendations to address this issue have been discussed previously.  
7

8 As in other chapters of the Report, it is disappointing that so many of the indicator  
9 data are recent and prior monitoring are not available data to see temporal trends. As  
10 noted previously, there are many monitoring programs of EPA, other Federal Agencies,  
11 and states that have long-term data sets. These data sets may not be based on  
12 probabilistic surveys and the statistical approaches that meet the indicator selection  
13 criteria, but if they provide good long-term data they should be incorporated into future  
14 Reports on the Environment and their sampling deficiencies discussed in the section on  
15 gaps and limitations. Ignoring decades of prior monitoring because methodologies were  
16 that is not “up to” current standards results in the inability to see trends in many  
17 important parameters. The Panel finds that it is important to show trends and include  
18 caveats about methodology. As methods, indices, and statistical design continue to  
19 improve, EPA should not discard the present measurements in favor of the new and  
20 improved indices. When methods are changed, there should be a time when both the old  
21 and new methods are used in order to establish their comparability.  
22

23 The Panel provides the following specific recommendations to improve the discussion of  
24 indicator limitations in the Report.  
25

- 26 • **In the final Report, the discussion of “trends in diversity and biological balance**  
27 **of the nation’s ecological systems,” (on page 6-29) should acknowledge that some**  
28 **systems inherently have different numbers and variety of species, making it**  
29 **inappropriate to make comparisons among systems.**  
30
- 31 • **In the final Report, the discussion of “fish faunal intactness,” should explain why**  
32 **1970 is chosen as the reference.**  
33
- 34 • **In the final Report, trend data should be adjusted to account for methodological**  
35 **inconsistencies.** For example, in the discussion of “SAV in the Chesapeake” which  
36 shows trends since 1978, the Report on the Environment states that “methods  
37 changed over the course of this study. However, data have been adjusted to account  
38 for any methodological inconsistencies.” The same should have been done with other  
39 parameters that are presented as a snapshot at one time that could have shown trends.  
40
- 41 • **In future Reports on the Environment EPA should use available information**  
42 **from the Agency’s water quality criteria guidance manuals.** The Panel notes that  
43 EPA has previously conducted a detailed review of current information and  
44 developed water quality criteria guidance manuals for lakes, rivers, coastal waters. It

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1 is not clear whether this information was used in addressing some of the questions  
2 raised in the Report.

3

4 *Charge Question 4. Regionalization of the national Report on the Environment*  
5 *indicators in the ecological condition chapter*

6

7 As discussed previously, regionalization is an important element in the Report on the  
8 Environment. However, the EPA regions, while important for administrative purposes,  
9 are not relevant for representation of regional indicators in the ecological condition  
10 chapter. The separation of data into the ten EPA regions may inadvertently convey  
11 inaccurate ecological information to readers. For example, Exhibit 6-2 shows the  
12 changes in acreage in the extent of forested land in the U.S. broken down by EPA  
13 regions. However, the Report fails to recognize the differences in climate, biomes, and  
14 the amount of total area among these ecologically distinct units. The Panel finds that the  
15 basis of the division is misleading. Ecologically relevant units, such as watersheds,  
16 climatic provinces, major coastal realms, forests, etc. will provide a scientifically sound  
17 basis for conceptual and statistical analyses. Results from ecoregional analysis could  
18 easily be reported in the final Report for EPA administrative units by using current GIS  
19 technology. It might be mentioned early in the final Report that some indicators will be  
20 regionalized based on the type of indicator (e.g., one that relates to large watersheds such  
21 as nutrient discharge to oceans), or to major climatic zones (e.g., forest indicators). In  
22 this way objectivity of regionalization is addressed. Since there is little comparison  
23 across indicators, between questions, even when indicators are listed from other chapters,  
24 comparability across regions is limited. This suggests the future need for some kind of  
25 cross-reference table or section in the final Report that addresses the issue of  
26 comparability of indicators, questions and regions.

27

28 *Charge Question 5. Utility of the regional indicators in answering the questions in the*  
29 *ecological condition chapter*

30

31 The Panel finds that regional indicators in the ecological condition chapter have  
32 considerable value and should be retained. Although regional examples have value for  
33 the national report, caution should be used in applying interpretation of regional  
34 examples on a national basis. As discussed above, the shortage of acceptable national  
35 large-scale indicators can be remedied by developing regional or local indicators.  
36 However, the justification of the inclusion of these particular indicators in the chapter is  
37 not clear. The use of a region to demonstrate some trend or change is useful if it  
38 represents scaling of similar national data. Some of the data sets are sufficiently  
39 complete to support useful regional subdivision, while others are not. This decision must  
40 be made on an indicator-by-indicator basis. If it is developed only because a particular  
41 EPA region did the exercise to develop an indicator, the methodology should be tested in  
42 another region that is not geographically or physiognomically equivalent (e.g., ecological  
43 connectivity in EPA Region 4). If the indicator represents an "interesting" region (e.g.,  
44 Puget Sound area) where analysis of changes has been completed, it needs to be pointed

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1 out that the complexity of the study is such that it would be difficult to duplicate it across  
2 the nation. The Panel finds that the use of regional examples in the ecological condition  
3 chapter is particularly useful in cases where:

- 4
- 5 - It presents the successful application of an approach, model or tool that may have  
6 wider application. For example, the conceptual approach used for Biscayne Bay  
7 may have application to a wide range of problems in quite different environments  
8 and the connectivity done for EPA Region 4 may have broader applications.  
9
  - 10 - It serves to explain the functioning of the ecosystem and helps build  
11 understanding of a conceptual framework of wider application. Diagrams of  
12 conceptual models or frameworks might be linked (especially in the web version  
13 of the “e-ROE”) to regional examples that demonstrate processes or cause and  
14 effect relationships.  
15
  - 16 - It has wider applicability to areas within the same ecologically relevant region or  
17 type. Case examples can be very effective if the Report is built around natural  
18 systems (for example, tidal wetlands, dunes, tundra).  
19
  - 20 - It has a long-term data set that permits explanation of trends. This would be  
21 especially useful where nationwide data sets have limited time series.  
22
  - 23 - It represents an issue of national importance and deserves illumination even if it  
24 fails to meet the other criteria. Significance may stem from its natural values  
25 (e.g.: Great Lakes), or from its importance as an emerging issue (nanotechnology,  
26 pharmaceuticals).  
27
  - 28 - It provides a higher resolution example of a nationwide indicator.  
29

30 The following recommendations are provided to improve the use of regional indicators in  
31 the ecological condition chapter.  
32

- 33 • **In the final Report, it should be clearly stated that specific case studies in the**  
34 **Report may not be representative of a general or national situation, both when**  
35 **they represent a picture of success or one of failure.** These concerns should not  
36 constrain the use of regional examples if developed in a fashion similar to other  
37 indicators with emphasis on the importance and applicability of the example.  
38
- 39 • **In future Reports on the Environment, specific case studies using regional**  
40 **indicators should be selected for their ability to demonstrate the long-term**  
41 **trends that cannot be accomplished at the national level. It would be useful to**  
42 **pick well-studied sites (e.g., Lake Mendota, Lake Tahoe) where there are long-**  
43 **term data sets available for each region.**  
44

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- 1 • **For future Reports on the Environment, some of the regional indicators should**  
2 **be expanded to become national indicators (e.g., SAV, invasive species, harmful**  
3 **algal blooms).**

4  
5 *Charge Question 6. Overall quality of the ecological condition chapter with respect to*  
6 *technical accuracy, clarity, and level of communication*  
7

8 As noted above, the ecological condition chapter provides relevant, accurate, and  
9 useful information, but it is far too limited in scope. The nation's ecosystems and key  
10 ecosystem processes are far more extensive than indicated. One problem is the immense  
11 difference between the objectives and base questions for the Report and the availability  
12 of applicable information to meet these objectives. The ecological condition chapter of  
13 the final Report would benefit from improved organization, as mentioned earlier.  
14 Somewhere in the general introduction of the final Report there needs to be a description  
15 of how all the themes are or can be integrated. To improve integration it would be  
16 possible to take a regional approach (e.g., large watershed) and show how each theme can  
17 be integrated within the region. This is something that should be considered for future  
18 Reports on the Environment. The Report also makes scaling difficult. Regional data  
19 need to be scaleable to a larger region or nationally, and national data need to be scaled to  
20 regional levels for application and understanding of the data. A more consistent and  
21 defensible approach is needed in future Reports on the Environment to deal with  
22 regionalization of indicators.  
23

24 There is no easy way to develop ecological condition indicators, populate them with  
25 data, and then interpret the results. One approach requires use of conceptual models that  
26 show how indicator selection was achieved and how the indicator actually "indicates" the  
27 consequences of changing stressors, processes and outcomes. The authors should be  
28 commended for their ecological condition paradigm diagram Exhibit 6-1, but this type of  
29 diagram showing interactions among many processes and attributes should be placed "up  
30 front" and a conceptual model of flows between stressors and outcomes will look quite  
31 different from this general interactive model. The ecological condition paradigm is an  
32 excellent conceptual framework, but not well utilized in discussions of the indicators.  
33 The interconnections of human health and ecological condition with each other and with  
34 the media chapters should be discussed and expanded. This approach would greatly  
35 improve the level of communication. For example, the schematic that the SAB provided  
36 in its prior advisory report to demonstrate interconnections should be referred to as it is  
37 still germane and would improve the Report on the Environment. The inclusion of a  
38 statistical approach to the data, and consistent use of metric measures would also add  
39 rigor and are needed in a scientific document.

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1  
2 **11.0 REFERENCES**  
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## 1 **Appendix A: Specific Technical Comments, Corrections, and Recommendations**

### 2 3 **General**

- 4 - In the final Report, EPA should identify, perhaps by using a letter (e.g., “H”),  
5 those indicators that explicitly relate to human health. Such identification will  
6 help differentiate those indicators from others that relate more to ecological  
7 health. For example, indicators presented on pages 3-32 (pesticides in  
8 agricultural watersheds), 3-44 (nitrate and pesticides in shallow ground water in  
9 agricultural watersheds), 3-90 (population served by community water systems  
10 with no reported violations of health-based standards), and 3-103 (coastal fish  
11 tissue contaminants) include a health component because of health based  
12 standards.
- 13 - In some cases, data are presented for each of the 9 ecoregions (e.g., Exhibit 3-3).  
14 The type of panel in Exhibit 3-3, showing a map of the 9 ecoregions, with stacked  
15 bars emanating from each region, should be more frequently used in the Report  
16 because it is much more informative than aggregated data. This is recommended  
17 as a revision for future Reports on the Environment.

### 18 19 **Air chapter**

#### 20 21 **Ambient Concentrations of Lead (Figure B on page 2-22)**

- 22 - The caveat regarding the lead trend sites above the NAAQS is not really useful  
23 since the last year with a concentration above the NAAQS was 1982. The  
24 description in the narrative is sufficient for describing this event and the Figure is  
25 not necessary. It is not clear if excluded sites could be useful for establishing  
26 trends in more recent years. In the final Report, perhaps the X axis in Figure B  
27 could be modified in a manner similar to the NO<sub>x</sub> or other NAAQS emission  
28 trends as presented in Figure A on page 2-24 or SO<sub>2</sub> on page 2-54.

#### 29 30 **Particulate Matter (PM)**

- 31 - With regard to PM, a significant fraction of the 2.5 size range results from  
32 secondary formation. The Report on the Environment does not mention the  
33 potential use of the PM characterization sites (which also provide data on  
34 elemental composition and elemental carbon/organic carbon [EC/OC]). These  
35 sites have been operational for several years and it would be worth considering in  
36 future Reports on the Environment. At a minimum, there is probably enough data  
37 to provide a snapshot of regional differences in broad ranges of composition  
38 (North American Consortium for Atmospheric research in Support of Air Quality  
39 Management – NARSTO data, for example).

#### 40 41 **Acid Deposition Data**

- 42 - The presentation of acid deposition data is visually attractive but the format is  
43 discordant with how data are presented for other pollutants (i.e., charts). The  
44 graphical format on pages 2-59 and 2-60 is difficult to follow in its detail as

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1 compared with the chart (bar graph, pie chart). Thus it would seem for added  
2 clarity in understanding national and regional trends, in the final Report it would  
3 be advisable to follow the format used for the other pollutants in the air chapter.  
4

## 5 ***Water Chapter***

### 6 **Presentation of Data**

- 7
- 8 - On rare occasions, the discussion text in the water chapter is not consistent with  
9 the data being presented. For example, in the discussion of “coastal benthic  
10 communities” on pages 3-71 to 3-73 it is shown that 17% of area of all the U.S.  
11 coastal waters have low index values, and that 27% of the area in U.S. EPA  
12 Region 3 has a low index value. The Panel notes that a substantial portion the  
13 area of U.S. coastal waters (20 to 25% of the area) has a low index, and in  
14 addition there are extensive areas with “moderate” rather than “high” condition.  
15 However, in the discussion on page 3-85 of the water chapter, the Report states  
16 that, “Benthic communities in the nation’s estuaries are largely intact in terms of  
17 species diversity... which is critical because these organisms are a fundamental  
18 link in the coastal food web.” While the second part of the sentence is true, the  
19 first part is the statement is not supported by the data. The Panel recommends  
20 that in the final Report this misrepresentation of the data be corrected.  
21  
22

### 23 **High and Low Stream Flows**

- 24 - “High and low stream flows” is not an accurate characterization of this indicator.  
25 The data also address timing, but this is not intuitive from this heading. A more  
26 accurate title is recommended for the final Report.
- 27 - Page 3-15 lines 5-11: The text is confusing in this section. First, the word  
28 “substantially” is vague, perhaps intentionally, and lacks rigor. Second, what  
29 does substantially “larger low flows” mean? Is this an increase in volume for low  
30 flows? A greater number of streams experiencing low flows? Or does it mean  
31 something else? This should be clarified in the final Report.
- 32 - 3-15/24-32: it might be instructive to know if the change in timing showed any  
33 type of pattern. Was there more often a delay or an acceleration, or was there no  
34 distinct pattern? Distinct patterns may be useful to identify, as they may be  
35 related to withdrawal patterns or climate change influences.
- 36 - Since this indicator comes directly from the Heinz Center Report, EPA should  
37 look into how Heinz has modified its data.  
38

### 39 **Nitrogen and Phosphorus in Wadeable Streams**

- 40 - 3-22/1: This indicator should be labeled Total N and P, not just N and P, to be  
41 accurate.
- 42 - Although there are geographic limits to the data, much of the land cover that  
43 sends waters to the oceans is covered. Limitations on what is not included are  
44 explained. It might be mentioned in the final Report that many if not most of the

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1 rivers in the Southwest do not discharge into the ocean, or if they do, much of the  
2 river has already been diverted for other purposes.

3

#### 4 **Nitrogen and Phosphorus in Agricultural Watersheds**

- 5 - 3-25/10: The important point is not that nitrite and ammonium are not *present*—  
6 rather, they are present but in low concentrations.
- 7 - 3-25/20: Clarify in the final Report that it is the decomposition of the excess algae  
8 that can deplete oxygen in water. Also, include internal P loading from sediments  
9 as a potential P source, especially in shallow lakes.
- 10 - 3-26/3: The low range for phosphorus is still quite high, and indicates eutrophic  
11 conditions for most systems. It is unclear why such a high threshold was chosen  
12 for the low end of this indicator. It is not surprising that such a high percentage  
13 fell into this low category, but its significance is debatable. Clarify this in the  
14 final Report.
- 15 - 3-26/10: Flow-weighting makes considerable sense, given the aggregation of data.  
16 However, it would be very instructive if the data were analyzed for base flow and  
17 storm event periods, assuming the data set allows this type of analysis.

18

#### 19 **Nitrogen and Phosphorus Discharge from Large Rivers**

- 20 - 3-28/1: In the final Report replace “Discharge” with “Load”
- 21 - Exhibit 3-9: As noted in the text, load is a function of both discharge and  
22 concentration—in the final Report it would be instructive to have discharge data  
23 also included in this figure, to see how much of the change in load is a function of  
24 discharge vs. concentration. While both drive load, changes driven by the former  
25 are more climate related, while changes driven by the latter are more a function of  
26 land use practices, and therefore more related to human activities. This is an  
27 important distinction.
- 28 - In future Reports on the Environment statistical analysis (trend analysis) is  
29 recommended for these data to determine if these trends are significant or not.

30

#### 31 **Pesticides in Streams in Ag Watersheds**

- 32 - Exhibit 3-11: There is considerable value in disaggregating the data into at least a  
33 few key pesticides. In the present format, there may be considerable  
34 improvement or declines in a key pesticide, but the trend would be masked.  
35 While there is presentation value in aggregated data, it also can lead to  
36 misinterpretations—if the aggregated data need to be retained, they should be  
37 enhanced in the final Report by adding trends on a few key pesticides.
- 38 - 3-33/25: Include a map of the watersheds in the final Report to show explicit  
39 geographic distribution of the data collection.

40

#### 41 **Benthic Macroinvertebrates in Wadeable Streams**

- 42 - 3-36: The explanation of the O/E model will be difficult for many readers to  
43 follow. This may be an acceptable limitation, especially if the intended audience

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- 1 of the Report on the Environment is scientists, but others will balk at the non-  
2 intuitive narrative. .  
3 - What is the justification for the inclusion of these 3 ecoregions? Why not more,  
4 less, others?  
5 - Exhibit 3-13: Why are the O/E data not shown in a geographic context, as well?  
6 - Data from the wadeable stream sampling are suspect, not because of the sampling  
7 technique but rather the timing. Samples are taken from April to November and  
8 then treated equally. Certainly streams change considerably over this time, both  
9 in physical and chemical characteristics.

### 10 11 **3.2.3 Discussion**

- 12 - 3-39/30: These indicators do not reveal the role of precipitation—the load  
13 indicators don't provide any precipitation information, and in fact, as currently  
14 presented, mask the role of precipitation.  
15 - 3-39/33: This should be rephrased in the final Report—the chemical and physical  
16 indicators are proxies, at best, for the biological condition of the fresh surface  
17 waters. The Report on the Environment provides a very limited picture, not a  
18 mixed picture, of biological conditions, simply because there are so few  
19 biological indicators to this point. The only trophic level discussed for surface  
20 fresh waters in the entire U.S. is benthic invertebrates—nothing about bacteria,  
21 algae, macrophytes, fish, or waterfowl. Hence, it is misleading to state the  
22 biological condition index is mixed—there simply are insufficient data to draw  
23 any conclusions about the overall state of the nation's surface fresh water biology.  
24 - The final Report should include something on waterborne pathogens in this  
25 section; even if it is not an indicator, perhaps there can be cross-references to  
26 other sections where this indicator is discussed.

### 27 28 **Nitrate and Pesticides in Shallow Ground Water in Ag Watersheds**

- 29 - The indicator “nitrate and pesticides in shallow groundwater in agricultural  
30 watersheds” does not match well with the question it addresses in the Report  
31 because as it fails to inform on “extent.” The Panel therefore suggests that it may  
32 be appropriate to restrict the question in the final Report to just “condition of  
33 groundwater”  
34 - See comments on the pesticides in streams indicator—they apply here, as well.

### 35 36 **3.3.3 Discussion**

- 37 - There is a dire need for a national monitoring program to address groundwater  
38 extent; this is within the domain of the USGS and hopefully funding can be  
39 obtained to start this work. In the interim, why not use groundwater contribution  
40 to stream base flow as a measure? Gauging stage data from appropriate streams  
41 across the nation might serve this purpose.

### 42 43 **Wetland Extent, Change, and Sources of Change**

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- 1 - 3-54/19: An important limitation of these data, which is not stated, is that extent  
2 does not equate to quality—the increase in freshwater ponds results in a very  
3 different quality of habitat than an increase in wetlands.
- 4 - If possible, the data should also be shown in the final Report by region within the  
5 U.S.
- 6 - Exhibit 3-19: More attention should be paid in the final Report to the “other”  
7 category; relative to the identified land use categories, this change in very large  
8 and cries out for better classification.

## 10 **Trophic State of Coastal Waters**

- 11 - The Panel recommends that in the final Report the water chapter indicator called  
12 “trophic state of coastal waters” be renamed “nutrients” or “eutrophication” in  
13 coastal waters. Trophic state is a larger concept that would encompass, for  
14 example, depleted stocks of large piscivores like cod in New England that have  
15 altered food webs and the trophic state of the waters through top-down cascading  
16 effects. As written, the focus of this section of the water chapter is only on  
17 bottom up, nutrient-related issues. In future Reports on the Environment it would  
18 be useful to include considerations of the state of all trophic levels but the name  
19 of the indicator could be changed immediately.
- 20 - 3-62/2: It appears from the exhibits that this indicator do not include the Great  
21 Lakes coastal regions; this should be denoted in the final Report.
- 22 - 3-62/7: Note that algal blooms can also include attached, macroscopic algae, such  
23 as *Cladophora* or *Enteromorpha* blooms.
- 24 - 3-62/12: If the definition of algal blooms stays strictly planktonic, this sentence is  
25 correct as is; however, if it is extended to include benthic algae, then this sentence  
26 will need amending to reflect that reduction of chlorophyll *a* by filtering activity  
27 is restricted to water column chlorophyll *a*.
- 28 - 3-62/27: It may be instructive to include a table in the final Report that lists the  
29 reference conditions for each region; this gives readers an idea of the thresholds,  
30 and how they vary with region.
- 31 - 3-62/34: It does not appear that the composite U.S. score is weighted in any  
32 fashion. Is that correct? Given the very different lengths of coastal areas in each  
33 Region, what is the rationale for giving them equal weights?
- 34 - Exhibits 3-20 to 3-25:
  - 35 A) In the final Report, a more effective graphic display would be to show the  
36 regional map of the U.S. in the center of the Exhibit (now in the bottom footnote),  
37 and have each region blown up as a pie chart, radiating out from the U.S. map.  
38 The pie chart would show the 4 water quality categories.
  - 39 B) As noted earlier, ecoregions are a much more scientifically defensible  
40 geographic approach for showing regional data than EPA regions.
  - 41 C) There may be value in applying statistical tests to determine if there are  
42 differences among regions; one would need to know more about the data  
43 computation and distribution, but at first blush, a Chi-square test may work.

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- 1 - 3-63/9: The indicator should be accurately defined in the final Report—this is  
2 dissolved inorganic nitrogen (DIN), *not* nitrogen, per se. Why not call it what it  
3 is?  
4 - 3-64/1: As above, in the final Report this should be called dissolved inorganic  
5 phosphorus (DIP), or ortho-P, not “phosphorus”, which could mean a lot of  
6 different things to readers.  
7

### 8 **Dissolved Oxygen**

- 9 - It is unclear when dissolved oxygen (DO) measurements were taken; because DO  
10 concentration is dependent on time of day, this point should be reflected in the  
11 discussion in the final Report.  
12

### 13 **Coastal Sediment Quality**

- 14 - 3-67/2: It is unclear why this indicator was not applied to fresh water systems, as  
15 well. This does not invalidate its merit for coastal systems, but readers may  
16 wonder why there is an apparent inconsistency among systems.  
17 - Exhibits 3-26 and 3-27: See comments above regarding 1) using a different  
18 graphic for these exhibits, using pie charts from each region emanating from a  
19 map of the U.S.; 2) revising composite U.S. score to weight based on coastline  
20 within each region; and 3) statistical analysis for differences among regions.  
21

### 22 **Coastal Benthic Communities**

- 23 - Exhibit 3-28: See comments above for Exhibits 3-26 and 3-27.  
24

### 25 **SAV in Chesapeake Bay**

- 26 - 3-74/2: In the final Report, EPA may want to generalize the importance of SAV  
27 beyond just Chesapeake Bay, similar to what is done for the introduction in the  
28 Hypoxia Indicator.  
29 - 3-74/28: In the final Report, it would be useful, either here or in indicator  
30 limitations, to identify what percent of total area was estimated based on prior  
31 years' surveys for those years with incomplete coverage. Is this a small amount  
32 (<10%) or something more significant where the uncertainties have more  
33 significance?  
34 - 3/75-25: Species composition is also an important variable, as not all SAV species  
35 provide the same ecosystem functions.  
36

### 37 **Hypoxia in Gulf of Mexico and Long Island Sound**

- 38 - This was a very well structured indicator.  
39

### 40 **HAB Outbreaks Along the Western Florida Coastline**

- 41 - Other potential limitations to this indicator include: 1) cell density not necessarily  
42 equate to toxicity; and 2) biovolume may be a better indicator than density,  
43 although this may be too labor-intensive to compute.

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- 1 - The selection of an indicator such as HAB should not be restricted to *coastal*
- 2 *waters*; rather, the question is more appropriately aimed at surface waters—for
- 3 future Reports on the Environment consideration should be given to reorganizing
- 4 the questions in the water chapter around surface water (including both fresh and
- 5 marine coastal), ground water, and drinking water.
- 6 - The HAB indicator is site specific. Perhaps the algal blooms are more common
- 7 along the Florida coastline, but they are not unique to that region.

### 8 9 **3.5.3 Discussion**

- 10 - 3-84/28: In the final report the “location of a large city” should not be
- 11 characterized as a human *activity*—the Report on the Environment is confusing
- 12 state variables and flows. This should be reworded to identify the relevant
- 13 activities (e.g., runoff from impervious surfaces, combined sewer overflows, etc.).

### 14 15 **Population Served by CWS with No Reported Violation...**

- 16 - It is unclear why the indicator is not the inverse of what is presented—i.e., the
- 17 number of CWS with reported violations. This seems the more direct
- 18 measurement.
- 19 - 3-90/39: The value of reporting the number regions above the national percentage
- 20 is unclear. Don’t the regional data what makes up the national percentage? What
- 21 is the point of including this information?

### 22 23 **3.7.3 Discussion**

- 24 - Why not have a regional indicator based on number of beach closings (number of
- 25 beaches or number of days)? This information is currently being collected in the
- 26 Great Lakes, as part of the EPA Beach Act.

### 27 28 **Coastal Fish Tissue Contaminants**

- 29 - Exhibit 3-38: See comments given above regarding 1) using a different graphic
- 30 for these exhibits, using pie charts from each region emanating from a map of the
- 31 U.S.; 2) revising composite U.S. score to weight based on coastline within each
- 32 region; and 3) statistical analysis for differences among regions.

### 33 34 **Contaminants in Lake Fish Tissue**

- 35 - Exhibits 3-40/41: In the final Report, it would be more instructive to represent
- 36 these data by Region to show geographic differences.
- 37 - 3-109/4: In the final Report, the absence of Great Lakes data should be noted
- 38 earlier in this section, not just as an indicator limitation bullet. This is important
- 39 given the historical legacy of contaminants in this region, so the exclusion of
- 40 these data may result in an underreporting of the degree of contamination.

### 41 42 **Land Chapter**

### 43 44 **Land Cover**

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- 1 - The Panel's issues of concern for the land cover indicator are that: a) the data are  
2 old, b) the classification categories for land cover are too coarse, and c) to date  
3 there is no time series (trend) information, though EPA reports that time series  
4 information is under development. There are a number of regional and national  
5 products; including the National Land Cover Data Set (NLDC), LandFire, and  
6 others. These would provide greater resolution and time series for these analyses.
- 7 - The Panel recommends that in future Reports on the Environment, EPA consider  
8 using a range of land cover classification schemes with different levels of  
9 resolution based on what is most appropriate to answer specific questions.
- 10 - In the land chapter there is no discussion regarding the relationship between the  
11 status/trends in land cover and the effects on human health and the environment.  
12 In the final Report, it would be helpful to elucidate what data collection and  
13 analysis will be required to answer these questions and steps that need to be taken  
14 to make this a practical and useful indicator.

#### 15 16 **Forest Extent and Type**

- 17 - The Panel believes that EPA needs to characterize land cover of all major  
18 ecosystem types. Therefore it is unclear why the Agency chose to only report on  
19 forest extent and type over other types of land cover. Other land cover types are  
20 distinguishable from existing imagery products data sets, the data presented for  
21 the land use indicator show trends in many different land cover (use) types. The  
22 rationale for only using forest extent and type needs to be clarified in the final  
23 Report.
- 24 - The forest extent and type indicator that is presented in Chapter 6 (ecosystem  
25 condition) only represents timberland. This presents only one category of forest  
26 land and others should be included in future Reports on the Environment.

#### 27 28 **Land Cover in the Puget Sound/Georgia Basin**

- 29 - The land chapter regional example on Puget Sound using the National Oceanic  
30 and Atmospheric Administration Coastal Change Analysis Program (CCAP) data  
31 has very coarse classification information that translates to a low sensitivity  
32 indicator instrument. The reference point of 10% impervious surface becomes an  
33 important metric to make a statement regarding what the indicator means, whether  
34 things are falling apart or improving, and when action needs to be taken. There  
35 are many changes brought up in this section that may be better suited to the land  
36 use indicator category.
- 37 - There is no good explanation why the Puget Sound example was chosen to be  
38 representative of "land cover." Such an explanation should be included in the  
39 final Report. The area encompasses many watersheds that have many different  
40 types of land cover, but the data only assess changes to forest and urban classes.  
41 The example does not provide much useful information or methodology that  
42 would describe an approach that should be used for assessment of land condition  
43 outside of the immediate area covered by the case study. The Panel suggests that  
44 regional indicators should provide this use through inclusion in this Report. The

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1 Panel supports the inclusion of regional examples, but believes that they should  
2 present data or methods that can be applied across the U.S. An example or case  
3 study should be chosen to demonstrate particular aspects of the conceptual model  
4 underlying the set of indicators and their linkage to the fundamental questions.  
5

## 6 **Land Use**

- 7 - The Panel suggests that in future Reports on the Environment, EPA evaluate and  
8 adopt widely-used standardized approaches to classify land uses that have been  
9 developed through the National Resource Inventory and the Forest Inventory and  
10 Analysis programs as well as the National Agricultural Statistics Service and  
11 Economic Research Service. The Panel finds that much of the introductory  
12 material in the land chapter discusses the differences between approaches rather  
13 than interpreting what they can tell us about the status of land resources. The  
14 Panel is pleased to see that this indicator provides a beginning of a time series that  
15 can be used to document trends. The usefulness of the discussion will be  
16 improved by elaboration of what specific land uses changed from one class to  
17 another.
- 18 - The Panel notes differences between national and EPA regional data for land use  
19 in the Report. The discussion regarding the land use indicator is inconsistent  
20 concerning the inability to obtain data for land cover and the data available for  
21 land use. The land use data sets imply that there are trend data available for land  
22 cover. If this is not the case because the land use and land cover data are different  
23 in nature, this will need further explanation. For future Reports on the  
24 Environment the agency should work to adopt standard approaches for land use  
25 and land cover analyses. Standardized land use and land cover analysis and  
26 reporting at national and regional scales ultimately will benefit from a higher level  
27 of classification and mapping consistency across all federal agencies.
- 28 - For future Reports on the Environment, the Panel recommends that EPA consider  
29 adding road density (which can be measured directly just like stream density) as  
30 an indicator for land use. Accurate road density data are readily available in  
31 electronic, Geographic Information System (GIS) format (e.g., as Topographically  
32 Integrated Geographically Encoded Referencing System [TIGER] files). Since  
33 TIGER is a U.S. Census Bureau product, its limits and accuracy are well  
34 documented (<http://tiger.census.gov/>). Nationwide data are available, and  
35 changes over time can be mapped and measured. Density can be determined for  
36 specified regions of interest. There are other sources of road network data, but a  
37 1990-2000 TIGER would be a good start.

## 38 **Urbanization and Population Change**

- 39 - The Panel finds that the urbanization and population change indicator in the land  
40 chapter presents much good information regarding the relationship between these  
41 factors. However, the chapter provides limited and indirect examination of the  
42 relationship between the available information and the resulting affect on human  
43 and environmental health.  
44

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- 1       - The Panel finds that the urbanization and population change indicator actually  
2       measures a stressor of land use in addition to one type of land use (developed  
3       land). The Panel questions whether population is a land use indicator or part of a  
4       group of indicators considered to be major drivers (stressors) of most indicators.
- 5       - In the final Report, the developed land data set that is used in the land chapter to  
6       represent urbanization and population change needs to be clearly described in the  
7       introductory text for this indicator. EPA should evaluate whether a more useful  
8       indicator might be “population density by land use type,” not by EPA region.  
9       Exhibit 4-11 on page 4-33 shows population density in the U.S. by EPA Region  
10      but the EPA Regional averages do not capture the aggregation of population  
11      density. Data aggregation is a major issue and EPA needs to be cautious that this  
12      does not misrepresent the extent and intensity of environmental impact.
- 13      - The discussion for the land use indicator addresses human residential and  
14      commercial uses. The Panel suggests that more could be said in the final Report  
15      about other land changes (e.g., changes in agricultural land and associated  
16      fertilizer and pesticide use), beyond just identifying them as gaps.

#### 17 18 **Quantity of Municipal Solid Waste Generated and Managed**

- 19      - The data used to represent this indicator are well defined and consistently  
20      collected. However, the connection to human health and the environment is  
21      missing and should be discussed in the final Report.
- 22      - In the discussion of indicator limitations it is stated that the available information  
23      is model driven. The Panel recommends that more information be provided in the  
24      final Report about sources of uncertainty associated with the modeled estimates.  
25      If the estimated waste generation is based on a model that uses materials utilized,  
26      these changes and thus the quality and quantity of the waste is not “consistent  
27      from year to year” as stated. The Panel also notes that this indicator does not  
28      appear to meet EPA’s indicator acceptance criteria. The Panel does not  
29      recommend omission of the indicator, but more discussion of the quality of the  
30      estimate is needed in the final Report.
- 31      - In the discussion of indicator limitations, a gap concerning landfill capacity is  
32      identified. The Panel notes that landfill capacity is not a nationally limited  
33      resource (only cheap landfill space near some very large cities is in short supply).  
34      Therefore, landfill capacity should probably not be listed as a gap in the final  
35      Report.
- 36      - Some interpretation in the discussion of this indicator is not well linked to the data  
37      and should be avoided in the final Report. For example, on page 4-46 it is stated  
38      that, “Recycling efforts related to municipal solid waste have increased over the  
39      four decades showing the steepest increases between 1980 and 2000, most likely  
40      due to the increased awareness about the benefits of recycling and the  
41      implementation of policies by state and local governments tying waste  
42      generation directly to the cost of waste services.”

#### 43 44 **Quantity of RCRA Hazardous Waste Generated and Managed**

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- 1 - The data used to represent this indicator are well defined and consistently  
2 collected. However, the connection to changing levels of exposure and the  
3 resulting impact to human health and the environment is missing and should be  
4 discussed the final Report. This is an indirect land use issue, especially when  
5 deep well injection is a major method of getting rid of the RCRA waste.  
6

#### 7 **Fertilizer Applied for Agricultural Purposes**

- 8 - There is good information presented in the land chapter discussion of this  
9 indicator, but it is again not related to human and environmental health. The  
10 'delta' between fertilizers applied, that taken up by the crops, and that which is  
11 released to the environment is the most relevant indicator.  
12 - The Panel notes that this indicator is limited to three crops and questions how well  
13 it represents fertilizer application in cropping across the U.S. The Panel also  
14 notes that separation of data for this indicator by EPA regions could be helpful  
15 since nitrogen and phosphorus drain into rivers, and large watershed regions  
16 might be more appropriate.  
17 - The Panel recommends that a pesticide use indicator be added to the land chapter.  
18 Of the final Report. This could be done by renaming the indicator as "Fertilizer  
19 and Pesticide Applied." In this regard, one possible indicator that could be used  
20 is pesticide sales, which could likely be parsed into agricultural and  
21 residential/commercial landscape applications. The latter would provide a  
22 suburban/urban indicator, which is important from the standpoint of human  
23 exposure.  
24

#### 25 **Toxic Chemicals in Production-Related Wastes Released, Treated, Recycled, or** 26 **Recovered for Energy Use**

- 27 - The Panel notes that the title for the indicator should perhaps be modified in the  
28 final Report so that it does not appear that only toxic chemicals related to energy  
29 use are being considered.  
30 - Toxic chemicals have a direct relationship to human and environmental health;  
31 therefore any reduction in the release of these chemicals has net positive health  
32 benefits. The indicator limitations section clearly points out the gaps in our  
33 knowledge and reporting base. In the final Report, this indicator might be more  
34 appropriately placed in a section dealing with toxic and harmful chemicals.  
35 - In the final Report it would be helpful to weight the amounts of toxic chemicals  
36 by toxicity (e.g., the un-normalized weights given in Exhibit 4-18 on page 4-55),  
37 but this is addressed under limitations.  
38 - The Panel recommends that in the final Report indicator data (e.g., Toxics  
39 Release Inventory [TRI] derived) be included for persistent bioaccumulative  
40 toxics (PBTs) and mining wastes, even if the available data are limited, such as is  
41 apparently the case for PBTs.  
42

#### 43 **Pesticide Residues in Food**

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- 1 - The Panel notes that pesticide residues in food have a direct relationship to human  
2 and environmental health and any reduction in pesticide residue has net positive  
3 health benefits. However, the linkage of this indicator to land use is weak and the  
4 Panel recommends that in the final Report the indicator be moved to Chapter 5  
5 (Human Health).
- 6 - The indicator limitations section clearly points out that we should be monitoring  
7 the detections that exceed established tolerance levels in addition to what our  
8 instruments are able to detect.

#### 9 10 **Reported Pesticide Incidents**

- 11 - The Panel finds that the decline in reported pesticide incidents has a direct  
12 relationship with human health. However, the link between reported pesticide  
13 incidents and the human health impacts of land management practices is tenuous.  
14 Reported pesticide incidents cover all sorts of uses of pesticides, and are based on  
15 calls to poison control centers. Many of these incidents are related to misuse of  
16 household products and activities far removed from land management. The Panel  
17 recommends that in the final Report the indicator be moved to Chapter 5 (Human  
18 Health).

#### 19 20 **High Priority Cleanup Sites with No Human Contact to Contamination in Excess of** 21 **Health-Based Standards**

- 22 - The Panel finds that this indicator has a direct connection to human health and  
23 addresses whether people are being kept away from hazardous sites. It may be  
24 useful to include some RCRA Corrective Action sites in the analyses in the final  
25 Report. In addition, it may be useful to provide an indicator that would address  
26 the number of sites that have been taken off the high priority site list.
- 27 - The Panel recommends that EPA consider including in the final Report an  
28 indicator for the number and associated land area of sites of this type that have  
29 been cleaned up.

#### 30 31 **High Priority Cleanup Sites where Contaminated Groundwater is Not Continuing** 32 **to Spread Above Levels of Concern**

- 33 - The Panel finds that this indicator also has a direct connection to human health as  
34 it addresses whether contaminated waters are being contained. It would appear  
35 that there are many additional CERCLIS listed sites and other RCRA Corrective  
36 Action sites that could also be included in these analyses. It may also be useful in  
37 this case to provide an indicator in the final Report that would address the number  
38 of sites that have been taken off the high priority list. EPA should also consider  
39 including an indicator of the number and associated land area of sites of this type  
40 that have been cleaned up.

#### 41 42 *Human Health Chapter*

#### 43 44 **Health Effects of Air Pollutants**

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- 1 - In describing health effects associated with air pollutants, authors should be  
2 careful to include in the final Report those effects associated with low-level  
3 exposure as occurs in the ambient environment. For example, ambient carbon  
4 monoxide is described as having effects including cardiovascular, neurological,  
5 visual impairment, reduced work capacity, reduced manual dexterity, poor  
6 learning ability, and difficulty performing complex tasks. The Panel questions  
7 whether these effects are associated with low level exposures.  
8

9 ***Ecological Condition Chapter***

10  
11 **Need for Additional Indicators**

- 12 - Indicators are provided in the ecological condition chapter to answer the question:  
13 “What are the trends in the diversity and biological balance of the nation’s  
14 ecological systems?” The Panel notes that the concept of biological balance  
15 includes complex interrelationships for which clear indicators are not easily  
16 selected. Those indicators selected are either population states or events which  
17 are difficult to translate into “balance.” Very few biological taxa indicators are  
18 included. At present, it is a good start but inadequate. Far more indicators of  
19 floral and faunal groups as well as biological communities should be included in  
20 future Reports on the Environment.  
21

22 **Ecosystems are Missing**

- 23 - Western Continental Issues. In the ROE 2007 Science Report there is little or no  
24 attention paid to the arid ecosystems in the Great Basin and the desert southwest.  
25 Grassland/prairie, shrublands, rangelands, and chaparral are important ecosystems  
26 in terms of biodiversity. It is important to include information on these  
27 ecosystems in future Reports on the Environment.  
28 - Coral Reefs. Coral reefs have been in serious decline due to eutrophication,  
29 overfishing, siltation, disease, and climate, among other factors. Many of the  
30 factors affecting coral reefs are germane to EPA regulatory programs. Much  
31 monitoring data are available on these ecosystems. The Panel notes that earlier  
32 reviews recommended that coral reef cover, which had been proposed as an  
33 indicator, not be included in the 2007 ROE Science Report because it lacked  
34 calibration between methods, does not explain how sites were selected, and lacks  
35 a consistent analytical framework to adjust for bias in geographic distribution and  
36 sampling method. We think that, because of their ecological, economic, and  
37 recreational value, the benefits of including corals in the Report outweigh these  
38 problems. Many coral reef monitoring programs use transects, and data from  
39 these monitoring programs could be used in the Report. A regional coral reef  
40 indicator could be developed, using only those that reefs that were sampled  
41 appropriately. Problems with the data could be described in the limitations and  
42 gaps section. The Panel recommends that coral reef information could be added  
43 to future Reports on the Environment.

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- 1       - Soil Ecosystems. Soils are one of the key drivers that cut across all terrestrial  
2 ecosystems. Soil is a fragile and finite resource that plays a unique role in  
3 maintaining air and water quality. Use and management of native, agricultural,  
4 forested, range, and urban lands play an integral part in influencing soil and water  
5 quality within a watershed. Protecting soil quality is important for ecosystem  
6 productivity and water quality. Soil morphological, physical, chemical, and  
7 biological properties can serve as indicators. Spatial data in various ecoregions  
8 are currently available on range of soil properties and should be included in future  
9 Reports on the Environment.

10  
11 **Populations are Missing**

- 12       - Marine/estuarine fish. The Panel recommends that in future Reports on the  
13 Environment, the ecological condition chapter include considerations of  
14 marine/estuarine fish populations. There are numerous long-term data on these  
15 populations available from NOAA Fisheries. Many species are in decline due to  
16 overfishing; this has received considerable attention. The depletion of predatory  
17 fish can have ramifications through the food web via trophic cascades that can  
18 result in reduced numbers of grazers, and subsequent algae blooms, that can  
19 exacerbate eutrophication. The depletion of filter feeders such as oysters can also  
20 lead to reduced water quality. While fisheries are not EPA's responsibility, the  
21 depletion of upper trophic level species can have major effects on the ecosystem  
22 and environmental quality.
- 23       - Amphibians. The Panel recommends that in future Reports on the Environment  
24 EPA include in the ecological condition chapter an indicator dealing with  
25 amphibians. There have been many studies documenting the precipitous decline  
26 and loss of populations of amphibians, and some of those could be used to  
27 construct an indicator. While the reasons for the disappearance of amphibians are  
28 not all understood, some factors involved appear to be climate change, ultraviolet  
29 radiation, and pesticides, all of which are relevant to EPA. If development of a  
30 national indicator is not possible, a regional one could be developed.
- 31       - Invasive species. The Panel recommends that in future Reports on the  
32 Environment EPA include data on non-indigenous invasive species in a variety of  
33 terrestrial and aquatic ecosystems. There are numerous data sets that could be  
34 used to develop indicators, at least for some regions. For example, SERC  
35 (Smithsonian Environmental Research Center) has data sets for marine/estuarine  
36 invasive species.
- 37       - Taxa containing massive diversity. The Panel recommends that in future Reports  
38 on the Environment indicators be developed for taxa such as microflora and  
39 microfauna, and non-vascular and vascular plants, which have very high  
40 biodiversity. Ecosystems host complex microbial communities, including  
41 bacteria, fungi, protozoa, and viruses. The size and diversity of microbial  
42 communities are directly related to quality and quantity of resources available.  
43 Microbial processes and populations have more rapid turnover than higher trophic  
44 levels and are often more responsive to environmental change. These

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1 characteristics make microbes good indicators of ecosystem condition because  
2 they are potentially very sensitive to perturbations such as nutrient loading,  
3 hydrologic alterations, and fire. New information is now emerging about these  
4 indicators and the Panel hopes this information will be added in future reports.  
5

#### 6 **Processes are Missing**

- 7 - Denitrification. The Panel recommends that in future Reports on the Environment  
8 the ecological condition chapter include an indicator of the natural denitrification  
9 process which is important for nutrient balance in ecosystems, for example, the  
10 denitrification of nitrate from atmospheric deposition. Ecological processes in low  
11 order streams are important in processing excess nutrients (e.g., denitrification of  
12 N from atmospheric deposition).
- 13 - Soil Processes. Another issue of importance is the trend in the extent and  
14 condition of the nation's soil resources. As noted above, soils are one of the key  
15 drivers that cut across all terrestrial ecosystems. Soil quality and associated  
16 processes can have major influences on ecosystem productivity and nutrient  
17 cycling. Loss of topsoil due to erosion and other processes can influence  
18 ecosystem productivity and long-term assimilative capacity as well as stream  
19 water quality. Assimilative capacity is important as ecosystems have finite  
20 capacity to provide services before they are drastically altered. For example,  
21 long-term application of nutrients via fertilizers or organic wastes may ultimately  
22 saturate a system. This is evident through accumulation of phosphorus in soils  
23 and increased levels of nitrate in ground waters. Salination of irrigated farmland  
24 soil is an urgent issue in the arid Southwest. Potential soil quality indicators  
25 include: carbon storage, organic matter, nutrient inventory, phosphorus index,  
26 extent and soil type, soil quality, salinity, soil erosion. The Panel recommends  
27 that future Reports on the Environment consider these indicators.
- 28 - Acidification. The Panel notes that there are long-term data sets available on  
29 responses to acidification and its reduction (National Acid Precipitation  
30 Assessment Program [NAPAP]) that should be included in future Reports on the  
31 Environment.
- 32 - Disturbance. Disturbance is a critical process in all ecosystems and should be  
33 included in future Reports on the Environment. The Report discusses its  
34 importance but has no indicator of disturbance or response to it (e.g., resilience).  
35

#### 36 **Trends in Diversity and Biological Balance of the Nation's Ecological Systems**

- 37 - On page 6-29, the final Report should acknowledge that some systems inherently  
38 have different numbers and variety of species, making it inappropriate to make  
39 comparisons among systems.  
40

#### 41 **Choice of Forests, Wetlands, and Land Use as Indicators in Chapter 6**

- 42 - While there is nothing wrong with these categories, it is unclear to readers why  
43 these were chosen and not other equally appropriate categories. A conceptual

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1 framework would be very helpful in the final Report to place these categories and  
2 indicators into some type of context.

3

#### 4 **Forest Extent and Type**

- 5 - This indicator is limited to “timberlands” which is misleading. This is nearly  
6 equivalent to using corn and wheat fields in order to describe the extent of  
7 grasslands. The Panel notes that this indicator is based on productive capacity,  
8 and therefore a statement in the Report concerning the limits of indicators that  
9 have excluded production does not apply. However, the discussion of indicator  
10 limitations does recognize some of the limits of using timberland data.
- 11 - 6-16/15: What percent of forest land is not being captured in this analysis? In the  
12 final Report this percent should be explicitly noted as part of the uncertainty.

13

#### 14 **Forest Fragmentation**

- 15 - The Panel understands the value of using forest fragmentation as an indicator but  
16 questions why a fragmentation indicator is not equally important for the other  
17 ecosystems. The Panel questions whether this is because of the availability of  
18 data. The Panel finds that in the final Report, a schematic diagram graphically  
19 showing the four degrees of forest cover to complement the narrative would be  
20 helpful, as would a presentation of the absolute area of forested lands identified  
21 for each region.

22

#### 23 **Wetland Extent, Change, and Source of Change**

- 24 - Development of artificial wetlands, ponds etc. may skew data for this indicator.

25

#### 26 **Ecological Connectivity (Region 4)**

- 27 - The Panel notes that development of this indicator is an exercise demonstrating  
28 how to show connectivity, but since it is regional it does not tell much about  
29 connectivity either nationally or in major ecoregions. The distinction between  
30 hub and corridor should be better defined and shown in the map in the final  
31 Report. If the methodology is relatively simple and uses just National Land  
32 Cover Data Set (NLCD) data, then a major effort should be made to see if it is  
33 applicable to non-forested regions.

34

#### 35 **Relative Ecological Condition of Undeveloped Land (Region 5)**

- 36 - The Panel finds that this is a case where a tool has been developed for one EPA  
37 region but it does not tell the story about the landscape in general or its  
38 usefulness. The indices used have the potential to display a lot of information, but  
39 it is not stated what exact data layers are included in each index. This tool used  
40 only NLCD data to generate three indices, two of which use species diversity or  
41 rarity. The Panel questions whether it is possible to go to species level with  
42 NLCD satellite data. If models were used for the diversity and rarity indices, they  
43 should be explained. In the discussion in the final Report it should be noted that  
44 increases in developed land affect habitat and impact physical and chemical

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- 1 processes such as runoff from impervious surfaces, reduced groundwater  
2 recharge, and increased stream temperatures.  
3 - Shades of green are extremely difficult to distinguish in Exhibit 6-8.  
4 - Undeveloped is a relative term and appears to be confounded with population  
5 density, making it inappropriate to draw conclusions or causative associations (as  
6 on page 6-27, “The potential for future land use changes with increasing  
7 urbanization is the major determinant for judging potential fragmentation of  
8 ecological systems in EPA Region 5...”)  
9 - In the final Report EPA should clarify the interpretation or importance of the  
10 cover types mentioned: maple-beech-birch, spruce and pine. Is this simply a  
11 descriptive statement or should the reader be able to infer something about a trend  
12 of ecological significance?  
13

### 14 **6.2.3 Discussion**

- 15 - It is unclear why forests, wetlands, and land development, of all available  
16 indicators, are the three worth highlighting for the nation’s ecological condition.  
17 This should be clarified in the final Report.  
18 - 6-27/1-3: It may also be worth noting that these increases in developed land affect  
19 not only habitat loss for biota, but also impact physical and chemical factors, such  
20 as more runoff from impervious surfaces, leading to greater loading of nutrients  
21 and contaminants, a more unstable hydrology, reduced groundwater inputs, and  
22 increased stream temperatures.  
23

### 24 **6.3 Discussion**

- 25 - 6-30/25-31: It is helpful to know about the absence of a systematic biodiversity  
26 initiative in the U.S., but there is still a need to explain in the final Report the  
27 rationale behind including those indicators that are found in the Report.  
28

### 29 **Bird Populations**

- 30 - The limitations on the data set should not detract from the usefulness of this  
31 indicator. It is one of the more consistent, long-term sets of ecological measures  
32 in the whole Report.  
33 - In the final Report, EPA may want to qualify in the text in the data bullets to note  
34 that the significant increases or decreases are of observations, not population size.  
35

### 36 **Fish Faunal Intactness**

- 37 - The discussion in the ecological condition chapter states a concern over the  
38 inability to show magnitude of loss. The Panel notes that this could be remedied  
39 by using a map of number of species lost. With such a small number of species to  
40 begin with, the percent decline figure can be misleading. The Panel questions  
41 whether using 1970 as a reference year potentially confounds comparisons from  
42 regions that were heavily polluted at that time. The Panel recommends that data  
43 from estuarine fish should be included in future Reports on the Environment.  
44

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## 1 **Non-indigenous Species in the Estuaries of the Pacific Northwest**

- 2 - The limitation one area implies that non-indigenous species are less important in  
3 other estuaries. The Panel notes that the restriction to species captured in a grab  
4 sample suggests that this is how most invasive species can be sampled. However,  
5 this is not true – more estuarine invasive species tend to be epibionts that attach to  
6 surfaces. Some invasive species cause greater disruption of ecosystems than  
7 others, so it may make sense to use indicators that address those species that are  
8 most ecologically or economically problematic. The Panel finds the preliminary  
9 classification of estuaries as “exposed” or “background” depending upon the  
10 assumed amount of ballast water or aquaculture releases is naïve, since estuarine  
11 biota disperse, and currents aid their spread, particularly in the planktonic stages.  
12 There is no need to pre-classify estuaries. Once the data on non-indigenous  
13 species are collected, then estuaries can be classified according to their percentage  
14 of non-indigenous species. The Panel recommends that in future Reports on the  
15 Environment this indicator be expanded to other estuaries as well as other aquatic  
16 and terrestrial ecosystems.

### 17 **6.3.3 Discussion**

- 18 - 6-40/18: Chesapeake Bay SAV may not be a representative example for wider-  
19 spread phenomena.
- 20 - 6-40/24: It may not be possible to statistically defend this claim with the available  
21 data sets.
- 22 - Good regional long-term data sets may be available to address above ground plant  
23 richness and diversity (e.g., Long Term Ecological Research Programs, Harvard  
24 Forest data)
- 25 - 6-42/25: Perhaps a useful template for the type of exhibit on this page would be a  
26 map of the U.S. subdivided into regions, with more detailed maps of each region  
27 showing data for different representative species. For invasive species, this may  
28 be an autotroph or a heterotroph, or aquatic vs. terrestrial, depending upon which  
29 species provides the best information for the region.

### 30 **6.4 Discussion**

- 31 - Perhaps the Midwest Environmental Advocates (MEA) model could be used for  
32 identifying ecological processes that sustain the nation’s ecological systems (i.e.,  
33 provisioning, regulating, cultural, and supporting).
- 34 - There is a fundamental problem in the indicator chosen for this question. The  
35 question deals with processes, but the indicator deals with a state variable, not a  
36 process. This can be resolved by changing the question or choosing an indicator  
37 that answers the question, such as primary productivity, decomposition rates, or  
38 nutrient uptake/cycling rates. Long Term Ecological Research Program sites  
39 should provide a rich source of data for these types of information.

## 40 **Carbon Storage in Forests**

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- 1       - The Panel notes that carbon storage in forests is not an ecological process per se,  
2       but a condition representing the net balance between the processes of  
3       photosynthesis and decomposition. This indicator can show trends. However,  
4       many more processes need to be covered in future Reports on the Environment.  
5       The use of several geographic regions is more logical here than the use of EPA  
6       regions elsewhere. Unfortunately, the data in the chapter represent only  
7       “timberlands” which include many highly managed forests and this should be  
8       pointed out in the limitations section. Use of this indicator should be expanded in  
9       future Reports on the Environment to carbon storage reservoirs, such as  
10      grasslands, especially below ground (soil) storage which holds a significant  
11      portion of the total carbon.  
12

### 13 **Phytosynthesis and Decomposition**

- 14      - Photosynthesis and decomposition are the two most important ecological  
15      processes. Carbon storage is described as an indicator representing the net  
16      balance between these two processes. Restricting the indicator to forests and  
17      excluding grasslands greatly weakens this indicator. In the final Report this needs  
18      to be discussed in the limitations section on page 6-46.  
19

### 20 **6.4.3 Discussion**

- 21      - 6-48/4: The indicator does not provide data on trends in primary production; this  
22      process is a rate. The indicator provides data on a stock, which is different.  
23      - 6-49/1: Another limitation, assuming carbon storage is used as the proxy  
24      indicator for this question, is that carbon storage from many other important  
25      terrestrial ecosystems is missed.  
26

### 27 **U.S. Temperature and Precipitation, Sea Surface Temperature, Sea Level**

- 28      - These are very good time series data. They are all physical attributes that have  
29      impacts on biota and on ecological processes. These indicators, and their links to  
30      greenhouse gas emissions discussed in the air chapter, should be included in the  
31      ecological condition chapter discussion in the final Report.  
32

### 33 **Sea Surface Temperature**

- 34      - 6-59/4: Why not include statistical information?  
35

### 36 **Sea Level**

- 37      - Although not technically “sea” level, one limitation is the lack of data reported for  
38      Great Lakes levels. These data are available from the U.S. Army Corps of  
39      Engineers (Detroit District), and should be considered for inclusion in future  
40      Reports on the Environment.

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## 1 **Appendix B: Editorial Comments**

### 3 ***General***

- 5 - Throughout the Report there is generous use of acronyms, which may be confusing,  
6 but perhaps unavoidable. Thus, including a list of acronyms and abbreviations (e.g.,  
7 units of measurements) would be an improvement.
- 8 - As this version of the Report is intended for scientists rather than the general public, it  
9 would be helpful to use metric system units throughout for measurements (e.g. °C  
10 rather than °F for temperature).

### 12 ***Introduction***

14 1-4: Identify explicitly the philosophy behind choosing indicators.

### 16 ***Water Chapter***

18 3-7/14: Replace “like” with “such as”.

19 3-7/42: Move “only” to after “meet”.

20 3-9: Should N and P discharge be load?

21 3-9: Delete “wetland extent...” from the coastal waters box.

22 3-11/37: Seems that NPS paragraph also should include affects of land cover, such as  
23 impervious surfaces.

24 3-12/1-3: Air deposition should include nutrients, as well (N and P)

25 3-12/12-18: It is not just extent of the fresh waters, but also their configuration in the  
26 landscape that matter. This should be noted.

27 3-15: Exhibit 3-1: Clarify caption: “Relative percentages of rivers and streams in terms of  
28 their changes of high and low flow ...”

29 3-17/3: Are any estimates available of the percentage increase of dammed rivers between  
30 1949 and 1970?

31 3-26/10: Suggestion--briefly explain the weighting scheme used.

32 3-28/24: Change to “have a broad geographic distribution”.

33 3-36: Needs enumeration of rows 1-45.

34 3-42/19: Add: Groundwater accretions in agricultural watersheds may also increase  
35 contaminant loads of rivers and streams.

36 3-48/15: Comment---changes in water table elevations are available in many  
37 groundwater basins. For example, California Department of Water Resources maintains  
38 the water table data. Over-drafting groundwater resources is a major concern and  
39 pressing environmental issues in the central and western states. Regional indicators  
40 should be developed to address the question of “extent”.

41 3-50/17: This is not a *location* classification—it is salinity of media

42 3-53/4: Insert “and other types of coastal” after ‘Estuarine’

43 3-53/7: Insert ‘, chemical’ after ‘biological’.

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- 1 3-53/14: Insert “These conversions reduce the area of the relatively unique systems such  
2 as forested swamps and bogs and increase the area of the ubiquitous ponds and marshes.”  
3 after “pond.”  
4 3-54/19: Insert “although still much less in absolute terms than the other wetland types”  
5 before “Panel D”.  
6 3-54/40; 3-55: Exhibit 3-19--Please clarify the meaning of describe the process of  
7 “deepwater conversion”.  
8 3-57: Insert “and continue to be lost” after “1990s”.  
9 3-57/29: Insert “and some wetland types such as forested swamp and bogs are difficult or  
10 even impossible to create or restore.” after “lost”.  
11 3-57/32: Insert “using a logistically plausible” after “estimate” and Remove “without an  
12 impractical”.  
13 3-58/3: Insert “function and” before “condition”.  
14 3-63/9; Exhibit 3-21: Include quantitative information for nitrogen concentrations.  
15 3-64: Exhibit 3-32— Include quantitative information for phosphorus and chlorophyll.  
16 3-67/3: May want to define what is meant by “adverse”.  
17 3-71: Exhibit 3-28 is missing letters and a dash in the label within the text box.  
18 3-79: Exhibit 3-32 is missing data in Panel A.  
19 3-71: Exhibit 3-38--Fix caption number.  
20 3-72/19: Address the possible effect of the weighting scheme and methodology on the  
21 results.  
22 3-74/32: Comment---The data show two distinct trends – increasing from 84 to 92 and  
23 leveling from 92 to 05. Discuss these trends.  
24 3-79: Exhibit 3-32--- Include missing data in graphic.  
25 3-82/6: Limitations---the temporal trend is limited by the short time span (only 5 years of  
26 data).  
27 3-84/30: Comment---How much different? Many times higher or less?  
28 3-87/5: Suggestions---Include brief definitions of surface water and ground water.  
29 3-103/17: Suggestion---Include brief description of health risk basis of guideline.  
30 3-104: Exhibit 3-38---Indicate that the values are percentages. Add: “Percent” to caption.  
31 3-108/10: Briefly explain toxic equivalents (TEQ). MDLs have no relations to health  
32 risk.  
33 3-109/2: Comment---Imported seafood account for 70% of consumption. Perhaps it is a  
34 FDA issue.  
35

### 36 ***Land Chapter***

- 37  
38 4-61: Consider an outline to the bars in Exhibit 4-6, 4-7 (pp. 4-26, 4-27) to make them  
39 more visible, such as in Exhibit 4-23.  
40 4-31: legend is incomplete in Exhibit 4-8  
41 4-50: NPK are identified as pounds per acre; are thesethe desired units? Are these values  
42 devoid of inert ingredients (i.e., just element)?  
43

### 44 ***Human Health Chapter***

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1 5-7: Figure 5-1 can be enhanced by depicting susceptibility factors including genetics,  
2 diet, etc. described in the paragraph starting on line 28 of page 5-6. Furthermore, this  
3 figure might more effectively appear within the introduction as a way to provide both a  
4 conceptual framework for the Report on the Environment as well as the organizing  
5 principle. The figure and text would need to be modified to include ecological effects  
6 and to show increased uncertainty as indicators move from left to right.  
7 5-7 and 5-8: In the introduction, terms such as “definitive proof” and “conclusive  
8 evidence” are used. It might be better to omit the adjectives.  
9

### 10 *Ecological Condition Chapter*

11  
12 6-14: In Exhibit 6-2 add black outline bars to make it easier to see light colors.  
13 6-14: In Exhibit 6-2, indicate the percentage changes rather than absolute changes  
14 because forest coverage and sizes differ from region to region.  
15 6-15: Clarify that emphasis in Exhibits 6-3 and 6-4 is on economically important species.  
16 6-15: In Exhibits 6-3 and 6-4, indicate percentage changes rather than absolute changes  
17 because covering and sizes differ from region to region.  
18 6-18: On line 13 explain “degree of connectivity.” Can a quantitative definition be used?  
19 6-21: In Exhibit 6-6, a different color scheme should be used. The map does not show  
20 clearly the difference in the greens.  
21 6-22: On lines 22-24, please specify the twelve layers and the four layers if possible. Are  
22 any weighting factors used?  
23 6-25: On line 15 clarify “decreases in Regions 6 and 9” and “increases in Regions 3 and  
24 5.” The data in the graphic show discrepancies from the statement in the text.  
25 6-30: Insert acknowledgement that nutrient enrichment can also be considered a  
26 “pollutant” and be responsible for community shifts toward invasive species.  
27 6-30: On line 1 the following suggested change in the wording is provided: “...by global  
28 events such as large meteor impacts...” or “...bolide collisions...”  
29 6-32: With regard to bird populations, delete the following debatable statement, “are  
30 among the most visible and important biological components of ecological systems and”  
31 6-32: Note whether abundances in Exhibit 6-9 are standardized by numbers of observers.  
32 6-32: On line 22 discuss the possible causes for the decrease in grassland species.  
33 6-34: With regard to fish faunal intactness, explain why 1970 is chosen as the reference.  
34 6-35: Expand the legend in Exhibit 6-10 to explain the pie chart (i.e., reduction areas  
35 expressed as % total land area).  
36 6-37: On line 12 replace “>=” with “≥”.  
37 6-38: In Exhibit 6-12, illustrate where the “exposed” and “minimally exposed” estuaries  
38 are located on the map and provide an idea of the sampling intensity.  
39 6-40: On line 24, the following statement needs supporting data and justification:  
40 “...fewer blooms in recent years as compared to 1996...”  
41 6-45: The key in Exhibit 6-13 is missing the color codes. Letters are missing in the title  
42 of the exhibit.  
43 6-45/32: The word “somewhat” understates the trend. Inspection of the data indicates a  
44 decline in the 1990’s of approximately 33%, which is more substantial than “somewhat.”

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- 1 6-46: In Exhibit 6-14, indicate in the captions and on the labels that the values are net
- 2 changes of storage, not total storage.
- 3 6-46: On line 31, can an estimate of carbon storage (e.g., % of total) in soils be provided?
- 4 How significant is this omission?
- 5 6-46: In Exhibit 6-14, add outlines to fill in order to increase the visibility and
- 6 acknowledge that the net carbon storage is affected by climate and soils.
- 7 6-48: On line 9, the dates in the discussion do not correspond to the dates presented in the
- 8 indicator.
- 9 6-49: On line 2 include estimates of carbon storage in soils.
- 10 6-53: On line 41, what is the confidence level or statistical significance of the regression?
- 11 6-54: In Exhibit 6-16, add negative signs on the temperature scale.
- 12 6-55: On line 14, include the names of the three climate regions.
- 13 6-56: In Exhibit 6-18, the graphs as presented do not clearly show support for the
- 14 discussion. Please modify the graphic data to show statistical significance.
- 15 6-56: In Exhibit 6-18, the Y axis scales should be changed to appropriate values to better
- 16 show trend data.
- 17 6-57: On line 2, a limitation should be added indicating that the empirical debiasing
- 18 models used to adjust the data may themselves introduce non-climatic biases.
- 19 6-61: On line 33 the following change in wording is suggested: "subsidence or uplift
- 20 caused by tectonic movements of landmasses." Delete "changes in natural land
- 21 accretion."
- 22 6-64: On line 6, the following change in wording is suggested: "...due to changes in sea
- 23 level or land elevation caused by tectonic movements."