Chapter 1

1. Introduction

To accomplish its mission, the U.S. Environmental Protection Agency (EPA) must pay close attention to trends in the condition of the nation's air, water, and land, and to associated trends in human exposure and health and the condition of ecological systems. Data on environmental trends serve two key purposes: they provide valuable input to EPA in developing its strategic outlook and priorities, and they allow EPA and the public to assess whether the Agency is succeeding in its overall mission to protect human health and the environment. EPA prepared this *Report on the Environment* (ROE) to accomplish these purposes.

In 2001, EPA embarked on a bold initiative to assemble, for the first time, an extensive set of environmental indicators that are important to its mission. EPA presented these indicators in its *Draft Report on the Environment Technical Document*, released in 2003. Since then, EPA has revised, updated, and refined the ROE in response to scientific developments and to feedback from public stakeholders and EPA's Science Advisory Board (SAB). *EPA's 2008 Report on the Environment* presents the results of this work.

The 2008 ROE compiles, in one place, the most reliable indicators currently available to answer 23 questions that EPA believes are of critical importance to its mission and the nation's environment. The indicators are supported by data gathered from federal and state agencies and non-governmental organizations. All of the indicators were peer-reviewed to meet exacting standards for accuracy, representativeness, and reliability. This 2008 ROE presents trends wherever adequate data are currently available, and it establishes reliable national baselines where they are not. Equally important, the report identifies key limitations of these indicators and gaps where reliable indicators do not yet exist. This report does not propose actions to reduce data limitations or fill gaps, nor does it analyze the costs and benefits of doing so.

Written for a broad range of environmental professionals, the ROE provides the technical foundation for two other components of EPA's ROE project:

- *EPA's 2008 Report on the Environment: Highlights of National Trends*, which presents highlights of the ROE that EPA believes would be of significance to the interested public.
- An electronic version of the ROE (the *e*-ROE, available at http://www.epa.gov/roe), which provides online access to printable versions of both reports, as well as to the data, methodology, references, and sources of additional information behind the indicators presented in the ROE.

EPA is committed to periodically updating the ROE and its component indicators so that the latest information on environmental status and trends is available to EPA, external scientists, and interested members of the public on a long-term basis.

Organization of This Report

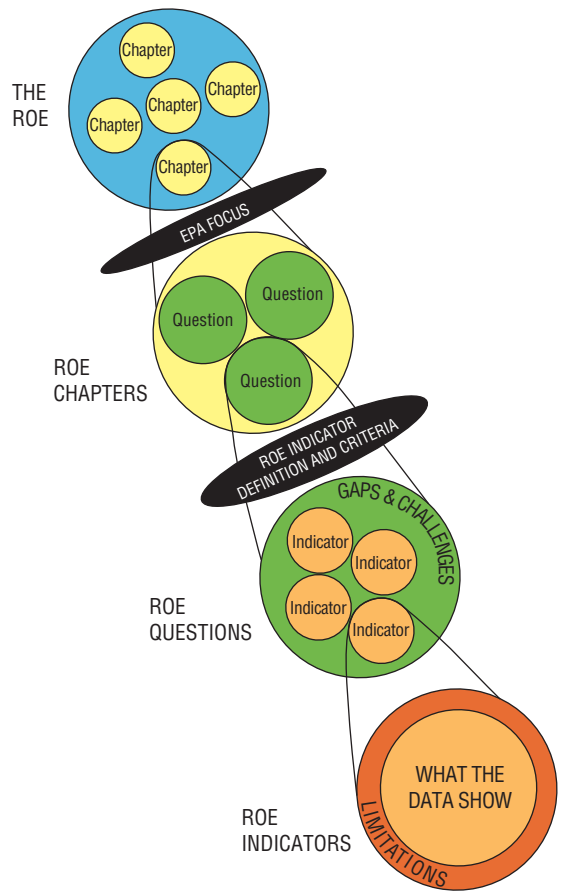
Exhibit 1-1 provides a schematic framework for *EPA's 2008 Report on the Environment*:

- **The ROE:** The report is organized around five main chapters: "Air," "Water," "Land," "Human Exposure and Health," and "Ecological Condition." These five chapters relate to EPA's five strategic goals (Clean Air, Clean and Safe Waters, Healthy Land, Healthy Communities and Ecosystems, Stewardship and Compliance) and serve to focus the ROE on issues important to EPA's mission to protect human health and the environment.
- **ROE chapters:** Each chapter is organized around a set of questions that EPA considers to be important and relevant to its mission.
- **ROE questions:** For each question, the ROE:
  - Describes the issues covered by the question. These issues include EPA's regulatory responsibilities, as well as areas where the Agency conducts or sponsors research, exerts policy leadership, provides information to the public, or shares an interest in human health and the environment with its federal, state, and tribal partners.
  - Presents indicators that are available to help answer the question; discusses critical indicator gaps that prevent the question from being fully answered; and reviews the challenges to filling these gaps.
- **ROE indicators:** All indicators presented in the ROE were peer-reviewed against an indicator definition and criteria (see Box 1-1) to ensure that they are useful, objective, transparent, and scientifically reliable. Each indicator describes what the data show and any limitations that generate uncertainty in the trend characterized by the indicator.

Further detail on the ROE chapters, questions, and indicators is provided below. Several sections follow the five main ROE chapters:

- **Chapter 7,** "Afterword," discusses the next steps for improving indicators and summarizes the challenges to answering the questions and synthesizing and integrating information across indicators.

Exhibit 1-1. The ROE framework



- **Appendix A** lists acronyms and provides a glossary of terms that have particular definitions within this document or whose definitions are not commonly available.
- **Appendix B** describes the process used to develop the 2008 ROE.
- **Appendix C** compares indicators used in the 2003 *Draft ROE Technical Document* with those in this 2008 version.

ROE Chapters

EPA has important mandates to protect air, water, and land (e.g., in the case of land, to ensure the safety of pesticides and chemicals used in commerce, to ensure the reduction and proper disposal of wastes, and to prevent and clean up contaminated lands). The Agency is therefore interested in trends in these media. In reality, however, most human health and ecosystem effects are influenced by many factors, including stressors acting through multiple media and non-environmental factors that are outside EPA's mission. EPA believes it is vitally important to conduct surveillance of trends in indicators of human health and ecological condition, even if they cannot be linked with confidence to national or regional trends in pollutant emissions or concentrations, in order to determine whether they warrant the Agency's closer attention.

Box 1-1. Indicator Definition and Criteria

Indicator definition: For *EPA's 2008 Report on the Environment*, an indicator is a numerical value derived from actual measurements of a stressor, state or ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.

Indicator criteria:

- The indicator is useful. It answers (or makes an important contribution to answering) a question in the ROE.
- The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.
- The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.
- The underlying data are characterized by sound collection methodologies, data management systems to protect their integrity, and quality assurance procedures.
- Data are available to describe changes or trends and the latest available data are timely.
- The data are comparable across time and space, and representative of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

To accommodate EPA's interest in both media-specific and broader, more complex environmental trends, the Agency has used the following conceptual model to organize the ROE indicators among the chapters:

- **Air, water, and land chapters (Chapters 2, 3, and 4):** The air, water, and land chapters focus on trends in these individual media, and on resulting trends in their effects on human health and ecological systems. An effect indicator is included in a media chapter *only* if the condition or effect can be demonstrably linked at the national level to trends in stressors *associated with that particular environmental medium*. For example, indicators of lake and stream acidity and ozone damage to trees are placed in the air chapter (rather than the ecological condition chapter) because trends in these effects indicators are clearly linked to trends in the emissions and concentration of particular air pollutants. Specifically, downward trends in the acidity of lakes and streams in certain geologically sensitive regions of the country are clearly linked to declining acid deposition; the type of damage to leaves in forest plants described by the indicator can be clearly attributed to ozone exposure. However, these indicators are exceptional: the ROE's three media chapters include very few indicators of effects, because most effects indicators cannot be linked with confidence to stressors associated with a single environmental medium.
- **Human exposure and health and ecological condition chapters (Chapters 5 and 6):** These two chapters address questions about trends in human exposure and health and ecological condition that are influenced by contaminants in more than one medium and by factors that are broader than EPA's mission. For example, the human exposure and health chapter includes a question about trends in human disease and conditions for which environmental contaminants may be a risk factor; these trends also are influenced by other factors, such as lifestyle, genetics, and the quality of medical care. The ecological condition chapter includes a question about trends in diversity and biological balance of the nation's ecological systems; these trends are influenced not only by trends in contaminants in multiple media but also by factors such as land use, invasive species, and natural resource management. Trends in the health or ecological indicators covered in Chapters 5 and 6 cannot be attributed with any confidence to *particular* contaminants or other causes covered in the ROE's media chapters. This is true even though epidemiological and laboratory studies may have demonstrated a clear relationship between a contaminant and a health or ecological effect.

ROE Questions

The 23 questions presented in the ROE were developed by EPA. These are questions the Agency believes *should* be answered with confidence if it is to be adequately informed about important environmental trends; however, they are not necessarily questions that EPA *can* fully answer at present based on the indicators that meet the ROE definition and criteria.

Each question asks about environmental trends, indicating EPA's interest in monitoring how the status of the environment and human exposure and health changes over time. The latest data point in the trend represents the most current information on the status of the environment or health when the data were gathered; for some indicators, only the baseline status is available.

ROE Indicators

Environmental conditions can be represented in many ways. For reasons discussed below, the ROE relies on an indicator approach. To maintain a high level of scientific integrity and consistency among the indicators used in the ROE, EPA established an explicit definition and six criteria (see Box 1-1) that all ROE indicators must meet. The criteria are based in part on EPA's Information Quality Guidelines (http://www.epa.gov/quality/informationguidelines/), which cover important information that EPA provides to the public. Together, the six criteria are intended to ensure that all indicators in the ROE are useful to EPA and the public, and that they are objective, transparent, and based on high-quality, comparable, and representative data across space and time. The ROE emphasizes indicators that can be tracked over time; therefore, one-time studies are not included unless they serve as baselines for future trends.

The ROE indicator definition intentionally excludes some categories of indicators. For example, ROE indicators include measures of pollutant emissions, but not measures of more

Box 1-2. Changes from the 2003 Draft ROE

EPA released the first edition of the ROE as a draft report in 2003 (see http://www.epa.gov/roe). A number of changes have been incorporated into this 2008 edition in response to comments on the 2003 draft. The major changes are:

- **Questions:** The ROE questions were revised to present a more consistent format and comprehensive coverage of EPA's interests across chapters.
- **Indicators:** The indicator definitions and criteria were revised. As a result, several changes were made to the 2003 indicators, including combining some indicators and deleting others. Also, new indicators have been added that were not available for the 2003 version of the report. See Appendix C for details.
- **Indicator placement:** Indicators of health or environmental effects that are linked predominantly to a single medium (air, water, land) were moved from the human exposure and health or ecological condition chapter to the chapter for the relevant medium.
- **Spatial scale:** National-level indicators were the focus of the 2003 Draft ROE and continue to be the focus in this 2008 ROE. However, as discussed under "Regional Indicators," the 2008 ROE demonstrates how relevant indicators might be identified, developed, and presented at finer geographic scales.

general causal factors such as energy generation or agricultural production. Also excluded are economic indicators such as the value of land or natural resources and the cost of pollution control, or efficiency factors such as pollutant emissions per vehicle mile traveled. Because ROE indicators focus on actual physical measurements, administrative indicators such as permits issued, regulations promulgated, and enforcement actions undertaken also are excluded. Indicators based on results predicted by environmental fate and transport models or risks to people or ecological systems are excluded as well, because they are not based on actual measurements.

Indicators, whether they represent baseline conditions or trends, involve uncertainties. While statistical analyses could have been presented for some of the indicators in this report, such analyses require considerably more complex indicator development and peer review than was possible given the time and resource constraints for the 2008 ROE. Therefore, EPA determined that this report would not include presentations of statistical confidence in the status of and trends in the indicators. When the word "trend" is used in an indicator, it simply means the direction of change and does not imply statistical significance. EPA recognizes that uncertainty is an important issue and does plan to quantify uncertainty in future versions of the ROE and its indicators.

EPA also recognizes that many others types of environmental data and information are available, in addition to indicators, that could potentially be used to answer the ROE questions. Many environmental reports, particularly those that focus on particular issues or locations, conduct integrated assessments by gathering and weighing the strengths and weaknesses of all the relevant information available. This integrated approach is not feasible for the ROE because it covers so many different topics across the entire nation.

EPA selected the indicators for this 2008 ROE based on indicators suggested by EPA, other federal agencies, state agencies, and non-governmental organizations. EPA developed a list of proposed indicators that it believed could play a significant role in answering the questions in the ROE. These included indicators from the 2003 Draft ROE that EPA judged to be relevant and consistent with the 2008 ROE indicator definition and criteria, as well as many new indicators (see Appendix C). Indicators that did not make a significant contribution to answering the questions were excluded from further consideration. The time frame for developing the ROE did not allow for development of additional indicators.

In creating this list, EPA reviewed all the indicator reports it could find, whether developed by EPA or others, and consulted with experts within and outside the Agency. Generally, EPA used existing indicators and did not invest in developing entirely new indicators for the 2008 ROE.

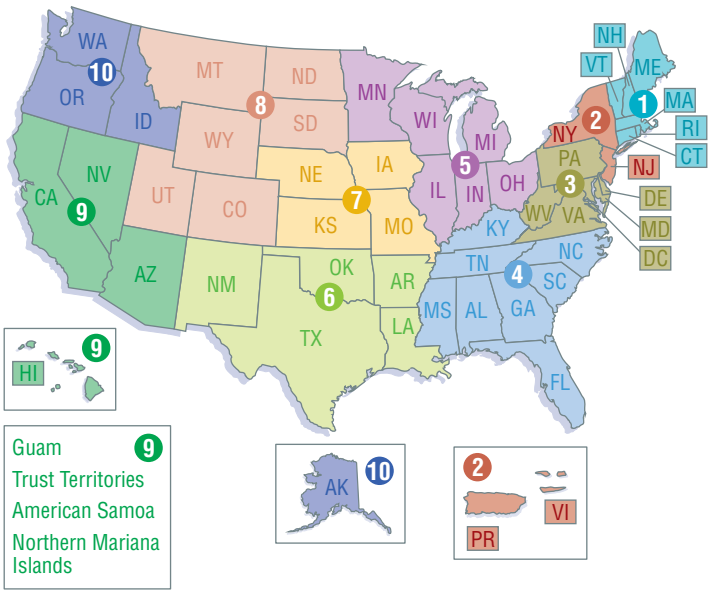
The proposed indicators were evaluated via an independent public peer review process (see http://www.epa.gov/roe for detailed information). Of the proposed indicators, 85 were ultimately selected for inclusion in the ROE. Appendix B provides more information on the indicator development process.

Each indicator consists of a graphic(s) or table(s) and explanatory text. All indicators present the most recent relevant, quality-assured data available when this report went to press. EPA intends to update these indicators in the e-ROE as new data become available. The baselines and reference levels for most indicators follow the underlying sources. Complete documentation of the indicator data sources can be found at http://www.epa.gov/roe. For ease of use in both the print and e-versions, each indicator was developed to stand alone, with sufficient information for the reader to understand its scope, origin, and data sources. As a result, some redundancies of text exist in the hardcopy version of the document.

Some indicators are used to answer more than one ROE question. In most cases, these indicators are presented with the question that they are first used to answer and referenced when they are used to answer another question later in the ROE. For example, the Blood Cotinine indicator is first used to answer a question in the air chapter and then another question in the human exposure and health chapter. The indicator is presented in the air chapter; the human exposure and health chapter refers the reader to the air chapter for details. Tables listing indicators and their page numbers are provided as navigation aids at the end of this introduction (Table 1-1), in the introduction to each chapter, and in the introduction to each question.

More than half of the indicators and supporting data derive from sources other than EPA, including other federal agencies, state agencies, and non-governmental organizations. These external sources also maintain many environmental data sets that are valuable for other purposes and offer potential for development of future ROE indicators. Many of these data sets, though important, were not included in this 2008 ROE because the data do not yet meet the ROE indicator criteria. For example, since 1971, the Centers for Disease Control and Prevention (CDC), EPA, and the Council of State and Territorial Epidemiologists have maintained a surveillance system for collecting and periodically reporting data on occurrences and causes of waterborne disease outbreaks (WBDOs). These surveillance activities are useful in characterizing the epidemiology of WBDOs, identifying changing trends in the etiologic agents that cause WBDOs, and determining why the outbreaks occurred. However, because of several limitations, including under-reporting and differences in how states investigate and report outbreaks, these data do not currently meet the ROE criteria for an indicator. EPA continues to work with CDC and other federal, state, and private organizations on important programs such as this one, so that they may meet the indicator criteria and be used in future editions of the ROE.

Exhibit 1-2. The EPA Regions



Regional Indicators

The ROE focuses on trends within the U.S., even though the indicators may be affected by sources outside U.S. borders. National-level indicators (indicators for which nationally consistent data are available) are the focus of this report. However, highly aggregated national data may mask important variations that take place at finer scales. Therefore, the ROE takes two preliminary steps to demonstrate how indicators might be identified, developed, and presented at finer geographic scales.

- National data are broken out by major geographic region for 32 indicators for which the data are sufficiently representative at that geographic scale. Rather than adopt regionalization schemes based on natural boundaries that would not be consistent among indicators, and because EPA Regions play an important role in the way EPA's environmental protection efforts are implemented, EPA chose to use EPA Regions for the 25 indicators where this was possible. EPA Regions follow state borders and do not reflect natural boundaries based on physiography, climate, or biota. To aid readers who are unfamiliar with EPA Regional boundaries, the ten EPA Regions are delineated in Exhibit 1-2, and also depicted in icons on each indicator graphic that displays regional data.
- Eight Regional Indicators (indicators that cover an EPA Region or substantial parts of one or more EPA Regions) were selected to demonstrate how such indicators can answer part of an ROE question that is unique to a particular Region, or could eventually be expanded to answer an ROE question at the national level. Like the National Indicators, all Regional Indicators were peer-reviewed against the ROE indicator definition and criteria. EPA hopes that the Regional Indicators will serve as useful models, and that lessons learned from them will help the Agency identify and present a more robust set of indicators that answer ROE questions at multiple scales in the future. However, it is important to note that the Regional Indicators are presented as *examples only:* trends in these indicators are not necessarily representative of similar trends in other regions or in the nation as a whole; they do not represent an exclusive set of indicators needed to answer the ROE questions at a regional scale; and they may or may not scale up to National Indicators. EPA may or may not include these indicators in future versions of the ROE.

Conclusion

The *Report on the Environment* represents a commitment by EPA to continually improve the quality and quantity of information available to understand the condition of human health and the environment and how it is changing over time. Within EPA, this commitment provides ongoing opportunities to use the ROE to inform strategic planning and related activities. The ROE also creates opportunities to establish and strengthen partnerships among federal, state, tribal, and non-governmental organizations for monitoring, data sharing, and data needs planning to support indicator development and improvement.

As mentioned earlier, the topics of air, water, land, human exposure and health, and ecological condition under which the indicators are presented are all interconnected. Changes in one medium affect other media; human health is affected by environmental condition; and environmental condition is affected by human factors. In reality, humans and ecological systems are exposed to multiple pollutants from multiple sources; large spatial and temporal variations in environmental exposures exist; and numerous non-environmental factors also have influence. EPA recognizes these complexities; to improve future versions of the ROE, EPA will continue to seek ways to better link and integrate indicators across questions and chapters.

Table 1-1. ROE Questions and Supporting Indicators[1]

Air Chapter	Section	Page
Outdoor Air Quality		
What are the trends in outdoor air quality and their effects on human health and the environment?	2.2	2-6
Carbon Monoxide Emissions	2.2.2	2-9
Ambient Concentrations of Carbon Monoxide	2.2.2	2-11
Lead Emissions	2.2.2	2-12
Ambient Concentrations of Lead	2.2.2	2-14
Nitrogen Oxides Emissions	2.2.2	2-16
Ambient Concentrations of Nitrogen Dioxide	2.2.2	2-18
Volatile Organic Compounds Emissions	2.2.2	2-20
Ambient Concentrations of Ozone	2.2.2	2-22
Ozone Injury to Forest Plants	2.2.2	2-24
Particulate Matter Emissions	2.2.2	2-26
Ambient Concentrations of Particulate Matter	2.2.2	2-29
Regional Haze	2.2.2	2-33
Sulfur Dioxide Emissions	2.2.2	2-34
Acid Deposition	2.2.2	2-37
Lake and Stream Acidity	2.2.2	2-42
Percent of Days with Air Quality Index Values Greater Than 100	2.2.2	2-44
Mercury Emissions	2.2.2	2-46
Air Toxics Emissions	2.2.2	2-48
Ambient Concentrations of Benzene	2.2.2	2-51
Concentrations of Ozone-Depleting Substances	2.2.2	2-52
Ozone Levels over North America	2.2.2	2-54
Ozone and Particulate Matter Concentrations for U.S. Counties in the U.S./Mexico Border Region	2.2.2	2-56
Ambient Concentrations of Manganese Compounds in EPA Region 5	2.2.2	2-58
Greenhouse Gases		
What are the trends in greenhouse gas emissions and concentrations?	2.3	2-62
U.S. Greenhouse Gas Emissions	2.3.2	2-64
Atmospheric Concentrations of Greenhouse Gases	2.3.2	2-66

[1] As mentioned earlier, some indicators are used to answer more than one question. In most cases, these indicators are presented where they are first used to answer a question and referenced under subsequent questions.

Table 1-1. ROE Questions and Supporting Indicators (continued)

Air Chapter (continued)	Section	Page
Indoor Air Quality		
What are the trends in indoor air quality and their effects on human health?	2.4	2-73
U.S. Homes Above EPA's Radon Action Level	2.4.2	2-74
Blood Cotinine Level	2.4.2	2-76
Water Chapter	**Section**	**Page**
Water and Watersheds		
What are the trends in the extent and condition of fresh surface waters and their effects on human health and the environment?	3.2	3-6
High and Low Stream Flows	3.2.2	3-8
Streambed Stability in Wadeable Streams	3.2.2	3-11
Lake and Stream Acidity	2.2.2	2-42
Nitrogen and Phosphorus in Wadeable Streams	3.2.2	3-13
Nitrogen and Phosphorus in Streams in Agricultural Watersheds	3.2.2	3-15
Nitrogen and Phosphorus Loads in Large Rivers	3.2.2	3-17
Pesticides in Streams in Agricultural Watersheds	3.2.2	3-19
Benthic Macroinvertebrates in Wadeable Streams	3.2.2	3-21
Ground Water		
What are the trends in the extent and condition of ground water and their effects on human health and the environment?	3.3	3-25
Nitrate and Pesticides in Shallow Ground Water in Agricultural Watersheds	3.3.2	3-27
Wetlands		
What are the trends in the extent and condition of wetlands and their effects on human health and the environment?	3.4	3-30
Wetland Extent, Change, and Sources of Change	3.4.2	3-32
Coastal Waters		
What are the trends in the extent and condition of coastal waters and their effects on human health and the environment?	3.5.2	3-35
Wetland Extent, Change, and Sources of Change	3.4.2	3-32
Trophic State of Coastal Waters	3.5.2	3-38
Coastal Sediment Quality	3.5.2	3-42
Coastal Benthic Communities	3.5.2	3-44
Coastal Fish Tissue Contaminants	3.8.2	3-61
Submerged Aquatic Vegetation in the Chesapeake Bay	3.5.2	3-46
Hypoxia in the Gulf of Mexico and Long Island Sound	3.5.2	3-48

Table 1-1. ROE Questions and Supporting Indicators (continued)

Water Chapter (continued)	Section	Page
Drinking Water		
What are the trends in the quality of drinking water and their effects on human health?	3.6	3-52
Population Served by Community Water Systems with No Reported Violations of Health-Based Standards	3.6.2	3-54
Recreational Water		
What are the trends in the condition of recreational waters and their effects on human health and the environment?	3.7	3-57
Consumable Fish and Shellfish		
What are the trends in the condition of consumable fish and shellfish and their effects on human health?	3.8	3-59
Coastal Fish Tissue Contaminants	3.8.2	3-61
Contaminants in Lake Fish Tissue	3.8.2	3-63
Land Chapter	**Section**	**Page**
Land Cover		
What are the trends in land cover and their effects on human health and the environment?	4.2	4-5
Land Cover	4.2.2	4-7
Forest Extent and Type	6.2.2	6-8
Land Cover in the Puget Sound/Georgia Basin	4.2.2	4-10
Land Use		
What are the trends in land use and their effects on human health and the environment?	4.3	4-13
Land Use	4.3.2	4-14
Urbanization and Population Change	4.3.2	4-19
Wastes		
What are the trends in wastes and their effects on human health and the environment?	4.4	4-23
Quantity of Municipal Solid Waste Generated and Managed	4.4.2	4-24
Quantity of RCRA Hazardous Waste Generated and Managed	4.4.2	4-26
Chemicals Used on the Land		
What are the trends in chemicals used on the land and their effects on human health and the environment?	4.5	4-29
Fertilizer Applied for Agricultural Purposes	4.5.2	4-30
Toxic Chemicals in Production-Related Wastes Combusted for Energy Recovery, Released, Treated, or Recycled	4.5.2	4-33
Pesticide Residues in Food	4.5.2	4-37
Reported Pesticide Incidents	4.5.2	4-39

Table 1-1. ROE Questions and Supporting Indicators (continued)

Land Chapter (continued)	Section	Page
Contaminated Land		
What are the trends in contaminated land and their effects on human health and the environment?	4.6	4-42
Current Human Exposures Under Control at High-Priority Cleanup Sites	4.6.2	4-44
Migration of Contaminated Ground Water Under Control at High-Priority Cleanup Sites	4.6.2	4-47
Human Exposure and Health Chapter	**Section**	**Page**
Exposure to Environmental Contaminants		
What are the trends in human exposure to environmental contaminants, including across population subgroups and geographic regions?	5.2	5-7
Blood Lead Level	5.2.2	5-10
Blood Mercury Level	5.2.2	5-12
Blood Cadmium Level	5.2.2	5-13
Blood Persistent Organic Pollutants Level	5.2.2	5-15
Blood Cotinine Level	2.4.2	2-76
Urinary Pesticide Level	5.2.2	5-22
Urinary Phthalate Level	5.2.2	5-26
Health Status		
What are the trends in health status in the United States?	5.3	5-31
General Mortality	5.3.2	5-33
Life Expectancy at Birth	5.3.2	5-35
Infant Mortality	5.3.2	5-36
Disease and Conditions		
What are the trends in human disease and conditions for which environmental contaminants may be a risk factor, including across population subgroups and geographic regions?	5.4	5-39
Cancer Incidence	5.4.2	5-43
Childhood Cancer Incidence	5.4.2	5-46
Cardiovascular Disease Prevalence and Mortality	5.4.2	5-48
Chronic Obstructive Pulmonary Disease Prevalence and Mortality	5.4.2	5-52
Asthma Prevalence	5.4.2	5-55
Infectious Diseases Associated with Environmental Exposures or Conditions	5.4.2	5-59
Birth Defects Prevalence and Mortality	5.4.2	5-62
Low Birthweight	5.4.2	5-65
Preterm Delivery	5.4.2	5-67

Table 1-1. ROE Questions and Supporting Indicators (continued)

Ecological Condition Chapter	Section	Page
Extent and Distribution		
What are the trends in the extent and distribution of the nation's ecological systems?	6.2	6-7
Land Cover	4.2.2	4-7
Forest Extent and Type	6.2.2	6-8
Forest Fragmentation	6.2.2	6-11
Wetland Extent, Change, and Sources of Change	3.4.2	3-32
Land Use	4.3.2	4-14
Urbanization and Population Change	4.3.2	4-19
Land Cover in the Puget Sound/Georgia Basin	4.2.2	4-10
Ecological Connectivity in EPA Region 4	6.2.2	6-13
Relative Ecological Condition of Undeveloped Land in EPA Region 5	6.2.2	6-14
Diversity and Biological Balance		
What are the trends in the diversity and biological balance of the nation's ecological systems?	6.3	6-18
Coastal Benthic Communities	3.5.2	3-44
Benthic Macroinvertebrates in Wadeable Streams	3.2.2	3-21
Bird Populations	6.2.2	6-20
Fish Faunal Intactness	6.2.2	6-21
Submerged Aquatic Vegetation in the Chesapeake Bay	3.5.2	3-46
Non-Indigenous Benthic Species in the Estuaries of the Pacific Northwest	6.2.2	6-23
Ecological Processes		
What are the trends in the ecological processes that sustain the nation's ecological systems?	6.4	6-27
Carbon Storage in Forests	6.4.2	6-28
Physical and Chemical Attributes		
What are the trends in the critical physical and chemical attributes of the nation's ecological systems?	6.5	6-31
U.S. and Global Mean Temperature and Precipitation	6.5.2	6-32
Sea Surface Temperature	6.5.2	6-37
Streambed Stability in Wadeable Streams	3.2.2	3-11
High and Low Stream Flows	3.2.2	3-8
Sea Level	6.5.2	6-39
Nitrogen and Phosphorus Loads in Large Rivers	3.2.2	3-17
Nitrogen and Phosphorus in Wadeable Streams	3.2.2	3-13

Table 1-1. ROE Questions and Supporting Indicators (continued)

Ecological Condition Chapter (continued)	Section	Page
Physical and Chemical Attributes (continued)		
What are the trends in the critical physical and chemical attributes of the nation's ecological systems? (continued)	6.5	6-31
Nitrogen and Phosphorus in Streams in Agricultural Watersheds	3.2.2	3-15
Lake and Stream Acidity	2.2.2	2-42
Hypoxia in the Gulf of Mexico and Long Island Sound	3.5.2	3-48
Ecological Exposure to Contaminants		
What are the trends in biomarkers of exposure to common environmental contaminants in plants and animals?	6.6	6-45
Coastal Fish Tissue Contaminants	3.8.2	3-61
Contaminants in Lake Fish Tissue	3.8.2	3-63
Ozone Injury to Forest Plants	2.2.2	2-24