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FY-1994
EPA Research Program Guide

October 1, 1993— September 30, 1994

Office of Research and Development
U.S. Environmental Protection Agency
Washington, DC 20460

Notice

The program descriptions and resource estimates included in this document reflect the latest detailed information available at time of publication. Time will change some of this information. In addition, the resource figures have been rounded off and some smaller programs omitted. For the latest information, contact the individual listed.

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Introduction

Research to provide the scientific foundation for environmental decisionmaking is a vital part of the U.S. Environmental Protection Agency's (EPA's) mission. To be effective, environmental research must continually evolve in response to changes in scientific understanding of the nature and complexity of environmental problems. In recent years, EPA has been reexamining the structure and focus of its research as part of an ongoing effort to improve the quality of its science and to expand the range, efficiency, and effectiveness of the approaches and tools available to mitigate and solve our nation's environmental problems.

To assist in this reexamination, EPA called upon two independent advisory groups: the Science Advisory Board and the Expert Panel on the Role of Science at EPA. In response to their recommendations and to new policy directions within the Agency, EPA's Office of Research and Development (see box below) has redesigned both the content and structure of its research programs to produce a comprehensive, integrated, and targeted research agenda that can more effectively respond to the environmental decisionmaking needs of the coming years.

EPA'S OFFICE OF RESEARCH AND DEVELOPMENT

EPA's Office of Research and Development (ORD) includes 12 research laboratories and approximately 1,300 scientists and engineers across the nation. This office is responsible for the scientific foundation of EPA policies and the scientific credibility of EPA decisions. ORD conducts basic and applied research to:

- Advance scientific understanding of environmental problems
- Develop new ideas, methods, and approaches for solving those problems
- Support EPA's programs, regulations, and policies

ORD's research laboratories and its scientists and engineers are active on many frontiers of environmental research. They collaborate with other federal agencies, universities, and industry laboratories in designing and conducting research, and they disseminate the knowledge generated by EPA science to national and international communities that can apply this knowledge to promote environmental quality. Upon request, ORD scientists and engineers also provide technical reviews, expert consultation, technical assistance, and advice to environmental researchers and decisionmakers in federal, state, local, and foreign governments.

ORD's research is divided into 12 broad Research Themes with some themes having specific research issues. The following information describes the research themes and the related issues with the funds available for FY-94.

RESEARCH THEMES AND ISSUES

1. Protecting Ecological Systems
- Issues:
  - Wetlands
  - Large Lakes and Rivers
  - Coastal and Marine
  - Contaminated Sediments
  - Aquatic Ecocriteria
  - Non-Point Sources
  - Ecological Risk Assessment
  - Habitat and Biodiversity
  - Environmental Releases of Biotechnology Products

2. Environmental Monitoring and Assessment*

3. Global Change
- Issues:
  - Global Climate Change
  - Stratospheric Ozone Depletion

4. Air Pollution
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  - Air Toxics
  - Criteria Air Pollutants
  - Pollutants from Motor Vehicles
  - Indoor Air Pollution

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  - Bioremediation

8. Health Risk Assessment
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  - Human Exposure
  - Health Effects
  - Health Risk Assessment Methods

9. Innovative Technology and Outreach
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  - Innovative Technologies
  - Environmental Education
  - International and National Technology Transfer

10. Exploratory Research and Special Environmental Problems
- Issues:
  - Environmental Review of Toxic Chemicals
  - Lead
  - Anticipatory Research on Emerging Environmental Problems
  - Exploratory Grants and Centers

11. Laboratory Infrastructure*

12. Cross Program*

*Note: Theme areas not broken down into separate issues count as both a theme and a research issue.

How to Use the Program Guide

The following descriptions of ORD's research program are organized by themes and issues. Each description is a very broad summary of the research being done, where that research is being done, who to contact for more information about the program, and the approximate total funding for that area. Funding is spent through extramural contracts, grants and coperative agreements.

For each program description, one or more contacts are listed along with the major research areas to be pursued. For further information, you may call the contacts. Their telephone numbers are listed in a separate section near the end of this report. Where two or more research laboratories are listed, please turn to the "ORD Organization" section of this report for descriptions of the major mission and functions of each.

Some of the research funded for this fiscal year will be done in-house by EPA's laboratories. The rest will be accomplished extramurally. Proposals for funds for research in areas of interest to the agency are welcomed and are considered on a competitive basis. To receive information regarding application procedures for extramural funds, please contact the person indicated in the area of specific interest to you. In addition, approximately fifteen percent of EPA's research budget is used to support long-term exploratory research. Information regarding funds for exploratory research grants can be obtained from the:

Research Grants Program
Office of Exploratory Research (3903F)
USEPA
Washington, DC 20460
(202)260-9266

Finally, for further information regarding Office of Research and Development research publications (600/625 series) or for additional copies of this report, please contact:

Center for Environmental Research Information
USEPA
26 W. Martin Luther King Drive
Cincinnati, OH 45268
(513)569-7562

Protecting Ecological Systems

"Natural ecosystems like forests, wetlands, and oceans are extraordinarily valuable," the SAB wrote in its *Reducing Risk* report. They contain natural resources that feed, clothe, and house the human race, and they act as sinks that absorb and neutralize the pollutants we generate. However, the SAB cautioned, ecological systems "have a limited capacity for absorbing the environmental degradation caused by human activities." After that capacity is exceeded, it is only a matter of time before those ecosystems deteriorate, and human health and welfare begin to suffer.

Largely because of the laws that EPA administers, the Agency's research and policicies in the 1970s and 1980s focused on reducing risks to human health. The SAB has now recommended that EPA attach as much importance to reducing ecological risk as it does to reducing human health risk because of the inherent value of ecological systems and their strong links to human health.

In response to these recommendations, EPA's Office of Research and Development has begun substantial forward-looking research to provide the scientific basis needed to anticipate, prevent, and control ecosystem damage. This research answers questions such as: What causes risk to ecosystems? How can we measure and predict risk? What can we do to prevent, reduce, and control risk? How can we restore damaged ecosystems? How can we evaluate the success of our protection efforts?

Pollution, loss of habitat, and other stresses caused by human activity threaten ecosystems at the local, regional, and global levels. The nine research issues that compose the *Protecting Ecological Systems Research Theme* focus on protecting ecosystems at the regional and local levels, and cover three broad areas:

- "Ecosystem" issues examine impacts on and protective measures for different types of ecosystems
- "Assessment" issues focus on developing tools and methods for reducing pollution and improving the overall health of ecosystems
- "Emerging ecological issues" reflect specific issues of particular concern in the coming years.

Wetlands Issue - Wetlands function as buffers between land and water, improving the environmental quality of both by purifying water, storing flood waters, recharging ground water, and providing habitat for diverse animal and plant life, including over one-third of our nation's endangered species. During the last 200 years, we have lost more than half the U.S. wetlands to human activities—primarily the conversion of wetlands for agricultural use. Despite growing recognition of their ecological value, wetlands continue to decline and disappear at a significant rate nationwide. Some states have lost 90 percent of their wetlands. Concern over the loss of wetlands and the valuable functions they provide has led to substantial federal mandates to manage and protect these resources. Many scientific issues concerning the value, use, and protection of wetlands must be addressed to respond to these mandates and develop an effective risk reduction program. EPA's research program is designed to advance our understanding of wetlands at both the individual and landscape levels in many fundamental areas, including:

- Determining how wetlands contribute to environmental quality
- Developing methods for assessing and enhancing the function of wetlands
- Investigating how pollution and other pressures affect wetlands
- Assessing the risks posed by the loss of wetlands and wetland functions.
- Developing guidelines and criteria for restoring or creating wetlands to reduce these risks
- Improving the performance of wetlands constructed for wastewater treatment, and identifying the ecological risks and benefits of their use

Contact	**Office/Lab**	**Total Extramural Funds ($K)**
Thomas Murphy, Issue Planner		
Mary Kentula	ERL/Corvallis	1,902.5
William Sanville	ERL/Duluth	750.0
Subhas Sikdar	RREL/CINN	320.0
Steve Cordle	OEPER/HQ	30.0

Large Lakes and Rivers Issue - The five Great Lakes and connecting rivers are the largest surface freshwater system on earth. They provide just over 20 percent of the world's water supply and serve as a source of water for municipal and industrial use, shipping, boating, and recreational and commercial fishing. Because of their large size, the Great Lakes are affected by many different anthropogenic stresses: chemicals from agricultural runoff, hazardous waste sites, contaminated sediments, industrial outfalls, and atmospheric deposition; lake level controls, commercial development, and dredging operations that destroy wetlands and alter shoreline structure; and fish management practices and proliferation of non-native species that alter the balance of ecosystems.

Preventing and controlling pollution in the Great Lakes and connecting rivers poses a significant challenge because of their complexity, because they retain pollutants for long periods of time, and because of numerous, sometimes overlapping, legislative and programmatic authorities. Research is needed to develop realistic ecological goals, a management program that strategically directs resources, and ecological indicators that document progress toward restoring and protecting ecosystem integrity. Results from research on the Great Lakes and connecting rivers will ultimately be extrapolated to managing other lakes and rivers.

ORD researchers are developing models—known as "mass balance" models—that simulate the flow of pollutants into, and their impacts on, large lakes and rivers. These models will enable local, state, regional, and international organizations to compare the risk reductions that can be achieved by various pollution prevention and control strategies. Also, ORD will continue efforts to develop a strategy for predicting and coping with the dramatic, long-term consequences of ecological explosions that are often caused when non-native species are introduced into large freshwater ecosystems.

Contact	**Office/Lab**	**Total Extramural Funds ($K)**
Gilman Veith, Issue Planner		
Robert Ambrose	ERL/Athens	63.6
William Richardson	ERL/Duluth	3,673.0
Steve Cordle	OEPER/HQ	88.0

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Coastal and Marine Issue - Coastal ecosystems of the United States comprise 19,200 linear miles of estuaries. About half of the nation's population of over 270 million people live in coastal areas. This large and growing population places coastal and estuarine ecosystems at risk from the cumulative effects of multiple pollutants and habitat degradation. We do not know the capacity of coastal ecosystems to assimilate these stresses without significant loss of ecological integrity.

EPA's problem-oriented research will develop models and methods to identify, assess, and predict the cumulative effects of human activities on these ecosystems. These models and methods will be used to establish priorities for protecting ecosystems and to determine the effectiveness of pollution control strategies. ORD's marine and estuarine scientists are developing mathematical and physical ("microcosm") models to better understand risks to coastal waters from toxic chemicals, nutrient overenrichment, and habitat changes.

Contact	Office/Lab	Total Extramural Funds ($K)
Norb Jaworski, Issue Planner		
Jonathan Garber	ERL, Narr	422.4

Contaminated Sediments Issue - Sediments—the mud and sand that settle on the bottom of lakes, rivers, estuaries, and other water bodies—are the ultimate sink for many pollutants in aquatic systems. Once contaminated, sediments can serve as a persistent source of toxic chemicals long after other pollution sources have been eliminated. Contaminants released from sediments are taken up by aquatic life, thereby threatening aquatic species, communities, and populations, causing habitat loss, and reducing species diversity. By infiltrating critical food webs, organic chemicals and metals associated with sediments can pose a risk to humans and wildlife.

The SAB's *Reducing Risk* report identified contaminated sediments as posing a "high risk" to local ecosystems. Research is needed to better understand what effect contaminated sediments have on the ecosystems—especially the benthic, or "bottom-dwelling," ecosystems—and to develop effective pollution prevention and control strategies.

EPA's research will focus on developing:

- Criteria for sediment quality that will help us better know when sediments do and do not pose a risk to aquatic life, wildlife, and human health
- Models to better understand and predict the flow of contaminants into and out of sediment
- Tests to evaluate and monitor contamination in sediments
- A national inventory of sites with contaminated sediments
- Strategies to prevent and control sediment pollution, and to clean up contaminated sediments safely and cost-effectively

Contact	Office/Lab	Total Extramural Funds ($K)
Norb Jaworski, Issue Planner		
William Budde	EMSL/CINN	22.4
Subhas Sikdar	RREL/CINN	100.0
Lawrence Burns	ERL/Athens	159.1
Gary Ankley	ERL/Duluth	450.0
Norman Rubinstein	ERL/Narr	515.3

Aquatic Ecocriteria Issue - Aquatic ecosystems are highly sensitive to pollution and disturbance. As such, they serve as sentinels in assessing the health of our ecological resources. They provide early warning in pollution prevention programs and benchmarks in restoring polluted watersheds. The protection of aquatic systems is one of EPA's paramount missions and is specifically mandated in several laws. Though EPA has successfully controlled specific pollutants and discharges into water bodies, ecosystem integrity continues to decline in many systems. More comprehensive approaches are needed to protect aquatic ecosystems from the cumulative impact of many diffuse sources of pollution and the many other stresses and disturbances that result from human activity.

Historically, EPA has protected aquatic life by controlling pollution based on the risk to individual species. In this issue area, ORD research will focus on developing methods to also assess the risk at the population and community levels. Risks to wildlife that feed on the aquatic food chain will receive high priority. This research will include creating a diagnostic framework to determine which of many possible stresses are damaging particular ecosystems.

Also, ORD scientists will develop biological indicators (such as the presence or abundance of a particular aquatic or bird species) that can be used to evaluate the structure and function of aquatic communities. Once scientists better understand how to measure ecological integrity, they can set baseline levels ("ecocriteria") for aquatic parameters that must be met to ensure aquatic integrity. Also, this understanding will provide a scientific foundation for efforts to restore adversely affected systems.

Contact	**Office/Lab**	**Total Extramural Funds ($K)**
Gilman Veith, Issue Planner		
Terence Harvey	ECAO/CINN	38.3
Rosemarie Russo	ERL/Athens	75.7
Nelson Thomas	ERL/Duluth	616.4
Wayne Davis	ERL/Narr	25.0
Foster Mayer	ERL/GB	1,137.6
Ken Hood	OEPER/HQ	79.2
Charles Ris	HHAG/HQ	17.8

Non-Point Sources Issue - Many reports by the EPA, SAB, states, and others have identified pollution from non-point sources—such as agriculture, urban runoff, atmospheric deposition, land disposal, construction, and mining—as the largest category of contamination threatening our nation's water quality. In 1990, EPA reported to Congress that non-point source pollution has severely damaged aquatic communities nationwide and destroyed the aesthetic values of many treasured recreational waters. Non-point source pollution affects primarily aquatic ecosystems. Current estimates are that 45 percent of damaged estuaries, 76 percent of damaged lakes, and 65 percent of damaged river miles are caused by non-point sources. Research is needed to answer four key questions:

- What causes the problems observed in watersheds?
- How can prevention, restoration, and management reduce pollution from major non-point sources?
- How do we evaluate the efficacy of prevention, restoration, and management efforts?
- Which management practices and technologies are most effective in solving problems at various geographic scales?

Working collaboratively with the U.S. Department of Agriculture, the U.S. Geological Survey, and other federal agencies, ORD will:

- Develop new methods for assessing the causes and consequences of pollution in watersheds
- Measure the effectiveness of current controls of pollution in watersheds
- Develop data on the cost-effectiveness of various ways to manage non-point sources in watershed restoration projects
- Document and promote new and innovative ways to prevent and control pollution
- Emphasize research on integrated farm management, integrated pest management, chemical and waste reduction, innovative forestry practices, new mining methods, and sustainable development in urban, suburban, and rural environments

Contact	**Office/Lab**	**Total Extramural Funds ($K)**
Rosemarie Russo, Issue Planner		
Mason Hewitt	EMSL/LV	234.0
Robert Carsel	ERL/Athens	891.6
Michael Jawson	ERL/Ada	316.5
Christine Ribic	ERL/Corvallis	260.0
Anthony Carlson	ERL/Duluth	260.0

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Ecological Risk Assessment Issue - Until the late 1980s, EPA considered the protection of human health to be its primary mission and was less concerned about risks posed to ecosystems. One consequence of this historical policy has been that the development of methods to assess the risks pollution poses to ecosystems lags far behind our achievements in assessing risks to human health. For example, we lack methods to assess the risks to large-scale ecosystems and to evaluate the risks posed by non-chemical stressors such as land use changes, global climate change, or hydrologic modification. EPA needs to strengthen its ability to reliably assess ecological risk and to reduce the most *significant* risks.

Research in this area will focus on ecosystems that are defined within watersheds. ORD will develop risk methods for assessing and comparing risks for ecosystems from the many different kinds of stressors within a watershed. This research will be performed in conjunction with the Environmental Monitoring and Assessment Program (EMAP) to characterize environmental conditions and pollution sources. The long-term goal is to provide the scientific basis for developing an ecosystem-level planning and decisionmaking or management framework based on predicting, assessing, and monitoring ecological risk.

Contact	Office/Lab	Total Extramural Funds ($K)
Mike Slimak, Issue Planner		
Tom Waddell	EMAP/RTP	363.1
Lawrence Burns	ERL/Athens	810.6
Joan Baker	ERL/Corvallis	5364.5
Jonathan Garber	ERL/Narr	402.4
Foster Mayer	ERL/GB	504.1
Steven Hedtke	ERL/Dul	763.8
Dorothy Patton	RAF/HQ	94.0
Mike Slimak	OEPER/HQ	1,334.4

Habitat and Biodiversity Issue - In its *Reducing Risk* report, the SAB ranked loss of habitat and loss of biodiversity among the highest ecological risks facing the nation because of their scale, intensity, and irreversibility. The two issues are intimately linked: the number and variety of species decline as their land and water habitats are modified, damaged, or destroyed. The greatest current threat to biodiversity is habitat loss—often as a result of independent and poorly coordinated land use decisions that fragment habitats and isolate species. Cohesive policies and coordinated management decisions are needed to prevent further unintentional habitat loss on private and public land.

Dealing effectively with issues of habitat and biodiversity will require participation by a multitude of public land management agencies and private parties. EPA is in a unique position to provide leadership for scientific integration of this public/private effort. As a first step, EPA has organized a consortium of public agencies and non-governmental organizations to conduct a pilot regional assessment of the comparative risks to biodiversity. This will be done by comparing wildlife diversity, environmental diversity, and environmental stressors within a sampling grid developed by the Environmental Monitoring and Assessment Program.

Subsequent research will analyze biodiversity nationwide, search for correlations between species diversity and environmental diversity, evaluate the comparative risks to biodiversity, and develop approaches for managing environmental diversity to preserve and enhance species diversity.

Contact	**Office/Lab**	**Total Extramural Funds ($K)**
Tom Murphy, Issue Planner		
Eric Preston	ERL/Corvallis	360.0
Bruce Jones	EMSL/LV	86.7
Peter Jutro	OEPER/HQ	4.0

Environmental Releases of Biotechnology Products Issue - The safe use of biotechnological products to remediate, restore, and improve our environment is a recent concept that has growing public acceptance and scientific credibility. Many of these products are created by modifying the genetic material in organisms ranging from microorganisms to plants and animals. Others are natural organisms specifically cultivated for large-scale introduction into an environment they might not normally inhabit—for example, when certain microorganisms are introduced to control pests. We know little about whether, and to what extent, the use of these biotechnology products in the environment may pose a risk to ecosystems and human health.

EPA's research in this area covers a broad range of issues to improve our ability to predict, measure, prevent, and control the ecological and human health risks these products may pose. Specifically, research is examining:

- How well organisms introduced into the environment move through, survive, and multiply in the environment
- To what extent these organisms exchange genes with natural organisms in the environment
- Whether genetically engineered organisms can change the structure function, and stability of communities of natural organisms and thereby pose risks to ecosystems and human health
- Methods for monitoring the fate of introduced organisms in the environment
- Strategies for preventing, reducing, and controlling human health and ecological risk

Contact	**Office/Lab**	**Total Extramural Funds ($K)**
Robert E. Menzer, Issue Planner		
Steve Hern	EMSL/LV	192.3
Roger Wilmoth	RREL/CINN	100.0
Larry Claxton	HERL/RTP	750.0
Lidia Watrud	ERL/Corvallis	2,324.0
Richardson Anderson	ERL/Duluth	310.0
Robert E. Menzer	ERL/GB	3,187.3
Marshall Dick	OEETD/HQ	14:8
Jack Durham	OEPER/HQ	127.7

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Environmental Monitoring and Assessment

Environmental Monitoring and Assessment Issue - Environmental monitoring in the 1970s and 1980s was usually short-term and local--we did not develop systems to evaluate overall ecological conditions at the regional or national level. Consequently, we have lacked the ability to monitor trends in ecosystem health. Such monitoring is essential to anticipate, and potentially avert, future environmental problems, and to assess how effective our environmental protection efforts have been.

The Science Advisory Board, in its 1988 *Future Risk* report, recommended that EPA "explicitly develop and use monitoring systems that help the Agency anticipate future environmental conditions." In direct response to this recommendation, EPA initiated the Environmental Monitoring and Assessment Program (EMAP)—an ambitious long-term, nationwide program to regularly assess and document the condition of our nation's ecological resources.

EMAP began in 1990. Working collaboratively, scientists from EPA, other federal agencies, and universities have been developing innovative tools and methods needed to monitor ecological resources on a national and regional scale. EPA, other federal agencies, and the states have begun using these tools to monitor key environmental indicators and resources. Once several years of monitoring information is available, scientists will be able to:

- Analyze the current condition of resources and trends affecting them
- Evaluate overall ecosystem conditions
- Relate effects to possible causes

EMAP is currently in the pilot demonstration phase. When fully implemented nationwide in the late 1990s, EMAP will monitor eight types of ecological resources: estuaries, the Great Lakes, wetlands, surface waters, agricultural ecosystems, arid ecosystems, forests, and landscapes. Each year, the program will provide resource managers and the public with a national report card on ecological status and trends at regional and national levels. EMAP staff will work to make sure that potential users of the monitoring information know what is available and how to access it.

EMAP research has value beyond the U.S. national and regional scope it is designed for. Local studies are also being conducted to demonstrate how the new tools developed under EMAP can be applied to monitoring at the local, state, and regional levels. EMAP scientists are also working with the international community to apply EMAP indicators to monitoring programs in other countries.

• *Working Together to Produce Results*

The Environmental Monitoring and Assessment Program is highly collaborative. EMAP has been integrating data from many other ongoing monitoring efforts by the U.S. Forest Service, the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, the U.S. Geological Survey, the National Science Foundation, the Nature Conservancy, the government of Canada, and others. Also, other federal agencies contribute in-kind services to EMAP and, in some cases, take the lead in directing EMAP monitoring activities in their areas of expertise.

• *Early Program Benefits*

EMAP has already provided significant benefits to scientists and decisionmakers. State environmental offices, EPA regional offices, and other federal agencies are already interpreting monitoring data for estuaries, forests, and other ecosystems. EMAP results have increased our understanding of the ecological health of the Chesapeake Bay and lakes in the northeast. Also, EMAP research has significantly advanced the state-of-the-art in ecological monitoring and assessment technologies.

Contact	Office/Lab	Total Extramural Funds ($K)
Ed Martinko, Issue Planner		
Bob Schonbrod	EMSL/LV	6,368.4
Bernie Daniel	EMSL/CINN	631.6
Roger Blair	ERL/Corvallis	5,819.7
Johnnie Pearson	AREAL/RTP	1,263.1
Stephen Lozano	ERL/Duluth	789.5
Norman Rubinstein	ERL/Narr	1,052.6
Kevin Summers	ERL/GB	4,289.5
Sidney Draggan	EMAP/HQ	2,421.9
Ken Hood	OEPER/HQ	275.0
Rick Linthurst	EMAP/RTP	13,533.7

Global Change

In its *Reducing Risk* report, the SAB ranked global climate change and stratospheric ozone depletion as relatively high-risk problems affecting both the natural ecology and human welfare. These problems are of concern, the SAB noted, because they may impact large regions or even the entire planet, because a very long time period would likely be required to mitigate any impacts, and because some effects may be irreversible.

Already, changes in the earth's atmosphere demonstrate that we are altering our global system, and recent evidence indicates that some of these changes may be occurring more rapidly than we previously thought. In 1990, EPA began working with other research organizations to increase our understanding of these problems and develop approaches to mitigation. This work includes two areas of research: global climate change and stratospheric ozone depletion.

Global Climate Change Issue - Human activities are dramatically changing the earth's atmosphere. In recent years, atmospheric levels of carbon dioxide and other "greenhouse gases" that may contribute to global warming have increased. Current best scientific judgement is that the average annual temperature at the earth's surface could increase by 1.5°C to 3.5°C before the year 2050. Although this increase may seem small, it could have serious consequences for life on this planet.

There are many uncertainties in our ability to predict the rate and extent of global climate change. For example, we still don't know how clouds, oceans, and land affect the global warming process. EPA began its global change research in 1990 under the United States Global Change Research Program to improve knowledge of the causes and effects of global change—particularly climate change. Several federal agencies have collaborated to plan and implement this multi-year research program. EPA is responsible for investigating several areas:

- The rate of tropical deforestation and its contribution to greenhouse gases
- How changes in land use and associated human activities affect processes that drive the production, consumption, and emission of greenhouse gases in soil and plant systems
- Assessing the global warming potential of gases other than carbon dioxide
- Investigating the potential impacts of climate change on terrestrial systems (including soils, plants, and freshwaters)
- Predicting and modeling the emissions—resulting from mankind's activities—of greenhouse gases and other chemically active gases that influence greenhouse gas concentrations
- Developing technologies to cost-effectively reduce the sources of or increase the sinks for greenhouse gases and their chemical precursors
- Greenhouse gas emissions feedbacks due to climate change (and land use changes) at the sub-grid scale for terrestrial biosphere -- Earth Systems Models

Contact	Office/Lab	Total Extramural Funds ($K)
Courtney Riordan, Issue Planner		
Michael Maxwell	AEERL/RTP	4,289.4
Joe Sickles	AREAL/RTP	1,744.4
Bill Forte	EMSL/LV	2,146.0
Lee Mulkey	ERL/Athens	3,015.5
David Tingey	ERL/Corvallis	5,150.0
John Eaton	ERL/Duluth	500.0
Hal Walker	ERL/Narr	859.3
William Davis	ERL/GB	400.0
Michael Dellarco	OMMSQA/HQ	
Jack Durham	OEPER/HQ	4861.6

Stratospheric Ozone Depletion Issue - The stratospheric ozone layer in the earth's upper atmosphere protects humans and other forms of life from harmful levels of ultraviolet radiation. Man-made chemicals emitted into the atmosphere— such as chlorofluorocarbons (CFCs)—are depleting this protective layer. Scientific evidence suggests that increased exposure to ultraviolet light may damage our immune system and eyes, increase the incidence of skin cancer, and threaten ecosystems on land and in the ocean. Satellite data show that ozone is being depleted in several areas, including over the poles and the continental United States. Recent satellite data suggest that this depletion may be happening more rapidly than scientists originally anticipated.

Congress recognized the urgency of the problem in 1990 by adding a stratospheric ozone protection title (Title VI) to the Clean Air Act. This new provision requires EPA to phase out all known ozone depleting chemicals, to develop procedures for evaluating the safety of proposed alternatives, and to establish recycling and disposal standards for ozone-depleting chemicals. A primary focus of EPA's stratospheric ozone research is to provide, in cooperation with industry, the scientific and engineering information needed to:

- Replace ozone-depleting compounds with more environmentally acceptable alternatives
- Recycle or safely dispose of ozone-depleting chemicals

However, even if ozone-depleting compounds are phased out according to the most optimistic forecasts, stratospheric ozone depletion will continue over the next 40 to 60 years. Therefore, another important focus of the research program is to better define the potential human health and ecological effects of increased ultraviolet radiation. This knowledge will enhance the scientific basis for ongoing policy development and help determine whether and what kind of strategies are needed to prevent or minimize any effects.

Contact	Office/Lab	Total Extramural Funds ($K)
F. T. Princiotta, Issue Planner		
Larry Cupitt	AREAL/RTP	1,448.8
William Rhodes	AEERL/RTP	2,250.1
Hillel Koren	HERL/RTP	396.0
Lee Mulkey	ERL/Athens	200.0
Henry Lee	ERL/Narr	390.0

Air Pollution

Air pollution is a concern for several reasons. Once released into the atmosphere, air pollutants cannot be contained or controlled. Atmospheric dispersion can lead to widespread human exposure. With a total surface area the size of a tennis court, the human lung is a vulnerable interface through which air pollutants can enter and, in sufficient concentrations, harm the human system. Air pollutants also can damage ecosystems, reduce visibility, and corrode materials. In light of these concerns, the SAB, in its *Reducing Risk* report, ranked both ambient and indoor air pollution as relatively high risks to human health, and identified acid deposition and airborne toxics as medium-risk problems affecting both natural ecosystems and human welfare.

A number of recent laws, such as the Clean Air Act Amendments of 1990, have given EPA new mandates to reduce the risks from air pollution. In response, ORD has significantly expanded its air pollution research so that the Agency can provide federal and state decisionmakers with the information they will need to implement these mandates. EPA's air pollution research is divided into five research issues described below: acid deposition, air toxics, criteria air pollutants, pollutants from motor vehicles, and indoor air pollution.

Acid Deposition Issue - Certain pollutants—particularly sulfur dioxide and nitrogen oxide emissions from fuel combustion—are transformed in the atmosphere and deposited back to earth in dry or wet (acid rain) forms. Acid deposition has many impacts. It damages lakes and streams, harms forests, corrodes materials, reduces visibility, and may damage human health. The 1990 Clean Air Act Amendments require reduction of sulfur dioxide and nitrogen oxide emissions to prevent further environmental damage. The Amendments also require monitoring to assess the environmental improvements resulting from reduced emissions.

EPA's acid deposition research program is designed to provide the scientific basis for fulfilling EPA's mandate under the Clean Air Act, and to implement international obligations under agreements with the United Nations and Canada. In the near term, EPA research will:

- Evaluate devices that will be placed within stacks for continuous monitoring of emissions - these devices are central to enforcing the Clean Air Act provisions that set limits for the quantity of pollutants, such as sulfur dioxide, that a source will be allowed to emit
- Evaluate an atmospheric chemistry model that links sources of air pollutants to sites of deposition by simulating atmospheric movement and chemical changes

Emphasis will then shift to assessing the benefits that result from control of acid-generating air pollutants. Monitoring programs will track changes in acid deposition levels, lake and stream chemistry, forest conditions, and visibility. Monitoring under this program will fill in critical holes in existing monitoring networks, with a particular focus on highly stressed and susceptible geographic regions.

Contact	Office/Lab	Total Extramural Funds ($K)
Gary Foley, Issue Planner		
Charles Sedman	AEERL/RTP	275.0
James S. Vickery	AREAL/RTP	5,599.2
Joan Baker	ERL/Corvallis	685.0
Jack Puzak	OMMSQA/HQ	

Air Toxics Issue - The 1990 Clean Air Act Amendments require regulations to control emissions of toxic air pollutants and research to examine deposition of these pollutants to large lakes and coastal waters. Overall, to meet the air toxics mandate in the Amendments, research is needed to better understand the health and ecological risk from air toxics and to develop better ways to measure, prevent, and control emissions.

For the next five years, EPA's research program will continue to identify the most effective means to prevent and control air emissions. The program will also develop analytical chemistry methods and tools to measure emissions of toxic pollutants. EPA is studying air toxic problems in urban areas and deposition of air toxics to large lakes and coastal waters. EPA also will collect and evaluate data to assess the health and ecological effects of toxic air pollutants.

Contact	**Office/Lab**	**Total Extramural Funds ($K)**
Jeanette Wiltse, Issue Planner		
Doug McKinney	AEERL/RTP	2,319.4
Larry Cupitt	AREAL/RTP	3,972.2
Al Dufour	EMSL/CINN	196.6
Ila Cote	HERL/RTP	1,472.1
Judy Graham	ECAO/RTP	1,257.4
Jeanette Wiltse	OHEA/HQ	393.3
Marshall Dick	OEETD/HQ	87.7
Charles Ris	HHAG/HQ	374.3

Criteria Air Pollutants Issue - Under the Clean Air Act, EPA has established air quality standards for several widespread air pollutants—nitrogen oxides, carbon monoxide, ozone, particulate matter, sulfur oxides, and lead (referred to collectively as criteria air pollutants). Over the last two decades, we have significantly reduced levels of these pollutants. However, there is still concern that these substances may continue to pose a human health and ecological risk—either because pollutant levels remain higher than the air quality standards in some areas, or because new scientific evidence suggests some of the standards may not be sufficiently protective. Of particular concern is the failure to meet the ozone standard in many areas.

EPA research—designed primarily to support both federal and state efforts to implement the Clean Air Act—will provide:

- Improved understanding of the human health and ecological effects of criteria pollutants—particularly ozone, particulate matter, and acid aerosols—to help determine whether any air quality standards should be revised
- An assessment of the natural and human sources of criteria pollutants that contribute to the formation of ozone
- Improved characterization and modeling of the atmospheric processes that determine exposures to ozone, particles, and other criteria pollutants
- A better understanding of how pollution and natural factors contribute to reductions in visibility, so that we can better predict and assess the visibility impacts of pollution in the future
- Methods for monitoring ambient concentrations of criteria pollutants
- Low-cost approaches to preventing and controlling certain types of emissions, particularly VOC and nitrogen

Contact	**Office/Lab**	**Total Extramural Funds ($K)**
Les Grant, Issue Planner		
Larry Purdue	AREAL/RTP	13,202.6
Charles Sedman	AEERL/RTP	4,150.9
William Hogsett	ERL/Corvallis	2,143.1
Michael Dellarco	OMMSQA/HQ	
Marshall Dick	OEETD/HQ	125.0
Paul Ringold	OEPER/HQ	111.2
Les Grant	ECAO/RTP	1,088.6
Ila Cote	HERL/RTP	8,247.0

Pollutants from Motor Vehicles Issue - Pollutants from motor vehicles are a primary reason why certain areas in the United States still fail to meet EPA standards for ambient air quality. To address these problems, several new laws mandate or provide incentives for switching from conventional gasoline and diesel fuel to reformulated gasoline and alternative fuels, such as methanol. This new direction raises several important questions:

- Will the new fuels pose any human health or ecological risks?
- If so, how do these risks compare to the risks of using conventional fuels?
- Which fuels will achieve maximum air quality benefits with minimum risks to human health or welfare?

EPA research is designed to answer these questions and to support the Agency in fulfilling its new mandates. The Office of Research and Development is actively encouraging other agencies and institutions to participate in this research, which will be coordinated with the "Criteria Air Pollutants" and "Air Toxics" research described above. Over the next five years, EPA's research in this area will:

- Characterize the emissions for reformulated gasoline and alternative fuels
- Provide data to identify how a switch to new fuels could affect air quality
- Improve models for assessing human exposure to motor vehicle pollutants
- Identify the possible human health hazards associated with evaporative emissions from alternative fuels or major fuel additives
- Assess the major toxic chemicals—such as benzene—associated with fuel use

Contact	Office/Lab	Total Extramural Funds ($K)
Les Grant, Issue Planner		
Ken Knapp	AREAL/RTP	1,754.2
Ila Cote	HERL/RTP	3,566.0
Judy Graham	ECAO/RTP	35.0
Michael Dellarco	OMMSQA/HQ	
Hugh McKinnon	HHAG/HQ	79.7

Indoor Air Pollution Issue - Indoor air pollution—in residences, offices, schools, and other buildings—is widely recognized as one of the most serious potential environmental risks to human health. Concern about indoor air pollution is high because most people spend more than 90 percent of their time indoors where concentrations of many pollutants—including chemicals, microorganisms, allergens, particles, and fibers—are substantially higher than outdoors. Also, population subgroups (such as children, the elderly, and the infirm) who are potentially more vulnerable to any ill effects are more likely to spend most of their time indoors.

Research has shown that there are many documented, suspected, and potential health risks associated with indoor air pollution. Though scientists have considerable information about many indoor pollutants, their sources, and their associated health effects, they know little about how much risk indoor air pollutants pose to human health. Research is needed to identify, characterize, and compare the health risks associated with indoor air pollutants so that risk managers can make informed decisions to protect public health. Also, more cost-effective ways are needed to prevent and reduce exposures in residences, businesses, and institutions. Key questions that must be addressed include:

- What are the most important health effects associated with indoor air pollution, and what pollutants and pollutant mixtures cause these effects?
- What pollution sources, exposure scenarios, and building practices influence indoor exposures?
- How does the perception of indoor air quality affect worker productivity, absenteeism, and health care costs?
- What are typical and high-end indoor exposures, and how do these exposures relate to indoor pollutant levels?
- What are the most cost-effective ways to design, construct, operate, and maintain buildings to optimize indoor air quality and energy efficiency?

The primary focus of EPA's indoor air research will be to determine whether the signs and symptoms typically regarded as indicators of indoor air pollution (e.g., headaches, eye irritation, and skin rashes) are indeed associated with particular indoor air pollutants or pollutant mixtures. If so, further research will be conducted to ascertain whether repeated or prolonged exposures to these pollutants may cause damage or disease, and to develop risk management strategies to reduce these exposures.

Contact	Office/Lab	Total Extramural Funds ($K)
Ken Sexton, Issue Planner		
Mike Berry	ECAO/RTP	350.0
Al Dufour	EMSL/CINN	315.0
Roger Wilmoth	RREL/CINN	237.5
Dale A. Pahl	AREAL/RTP	1,470.2
Mike Osborne	AEERL/RTP	3,342.8
Robert Dyer	HERL/RTP	1,250.0
Michael Dellarco	OMMSQA/HQ	
Ken Sexton	OHR/HQ	158.2

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Drinking Water Contamination

Drinking water—essential to human life—comes from surface waters, marine and ground water. Many of these sources are contaminated to some degree with pollutants and with disease-causing microorganisms. Most drinking water is disinfected and treated prior to distribution to kill microorganisms and remove chemical contaminants. However, even treated drinking water may pose public health concerns:

- Drinking water may be recontaminated as it travels through the distribution system to the tap
- While disinfection eliminates the risk of contagious disease from drinking water, disinfectants—and the by-products formed when disinfectants react with natural and man-made organic matter in water—may themselves pose a risk to human health
- Occasionally, some pollutants and microorganisms may remain after treatment if treatment systems are ineffective or if a drinking water source is polluted before consumption

Since everyone drinks water, a risk associated with drinking water could affect large numbers of people. For this reason, the Science Advisory Board ranked pollutants in drinking water as a high risk to human health.

The 1986 Safe Drinking Water Act requires EPA to identify and regulate drinking water contaminants that may affect human health. To do this, new technologies are needed to identify additional contaminants and to monitor pollutants at increasingly lower levels. EPA is conducting research in two issue areas—drinking water pollutants and disinfection, and ground water—to ensure the safety of our public water supplies and to provide the scientific basis needed to implement the Clean Water Act and Safe Drinking Water Act and its amendments.

Drinking Water Pollutants and Disinfection Issue - To ensure that drinking water is safe, answers are needed in two fundamental areas:

- *Pollutants* - Does drinking water contain pollutants at levels that may pose a significant risk to human health? If so, how can these pollutants be reduced or eliminated?
- *Disinfection* - Do disinfectants and their by-products pose a significant risk to human health? If so, are alternative technologies available that can reduce the risk of microbial disease, yet not pose a significant human health risk?

In the first area, ORD is conducting long-term research to identify, assess, and control contaminants in public water supplies. Also, ORD is developing new cost-effective screening techniques to evaluate the safety of drinking water supplies.

In the second area, ORD researchers are examining how effective various disinfection technologies are, what kind of by-products they form, the human health risk of the disinfectants and their by-products, and whether by-product formation can be controlled. Research is also being conducted to better understand exactly how much risk microorganisms in drinking water pose and how much disinfection is needed to prevent disease. After several more years of research, ORD scientists hope to have sufficient information to compare the risks of microorganisms with the risks of disinfectants and their by-products.

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Robert Clark	RREL/CINN	1,360.4
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Fred Hauchman	HERL/RTP	2,101.2
Wayne Marchant	EMSL/LV	105.5
Don Tang	OEETD/HQ	43.4
Richard Hardesty	OHEA/HQ	71.3
James Cogliano	HHAG/HQ	20.7

Ground Water Issue - Ground water is an extremely valuable natural resource. Ground water feeds our streams, lakes, and wetlands, provides water for irrigation, and supplies us with a quarter of the freshwater we use for all purposes in the United States today. Almost half the United States' population relies on ground water for drinking water; in rural areas, ground water is the main source of drinking water.

Until recently, we assumed that the subsurface environment could somehow assimilate residential, urban, farming, and industrial waste without deterioration. However, we now know the subsurface is at risk from many sources. Chemical use and improper waste disposal have contaminated many of our ground water supplies, resulting in closure of municipal water supplies and, in some cases, major disease outbreaks. Once contaminated, ground water is expensive, difficult, and often impossible to clean up.

Significant scientific advances are needed to measure, prevent, contain, and remediate ground water contamination. Our knowledge of the extent of subsurface contamination is limited by a shortage of measurement and monitoring methods. We still know relatively little about how subsurface transport and transformation processes contribute to or mediate the impacts of pollution on ground water resources. Also, we lack tools for cost-effective remediation of ground water per acre. Ground water remediation is currently very expensive in the best of circumstances and impossible with existing technology in the worst of circumstances.

EPA research is addressing these scientific challenges. Specifically, researchers are working to:

- Improve our ability to identify and quantify threats to ground water and develop effective, scientifically defensible approaches to pollution prevention
- Develop technologies and decision tools to contain, remove, and destroy contaminants in subsurface environments
- Improve our understanding of how the subsurface transports and transforms pollutants, and of how pollutants move between ground water and surface water
- Develop practical, cost-effective, and reliable monitoring methods
- Examine the impacts of pollution on subsurface microbial ecology

Contact	*Office/Lab*	*Total Extramural Funds ($K)*
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Steve Gardner	EMSL/LV	2,484.1
Lee Mulkey	ERL/Athens	1,350.4
James McNabb	ERL/Ada	6,432.4
Subhas Sikdar	RREL/CINN	842.3
Ken Sala	OMMSQA/HQ	
Will LaVeille	OEPER/HQ	293.0

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Waste Management

Just about all human activities generate some form of waste. Beginning in 1965, the federal government began to require safeguards and encourage environmentally sound methods for disposal of household, municipal, commercial, and industrial refuse. Today, solid and hazardous waste disposal are regulated under the Resource Conservation and Recovery Act. Discharges of industrial and municipal wastewater, as well as the sludge produced by wastewater treatment, are regulated under the Clean Water Act.

Waste management poses many challenges. Though we have turned some of our wastes into resources through recycling and recovery programs, we still generate a substantial volume of waste we must dispose of. At the same time, the public has become increasingly concerned about the potential ecological and health risks, and the costs, of waste management practices. Effective waste management will continue to require a combination of technological and socioeconomic solutions, such as changes in institutional and personal behavior. Both the public and government decisionmakers need better information on the performance, costs, and comparative risks and benefits of the various waste management alternatives. EPA's waste research is divided into three areas described below: municipal solid waste, hazardous waste, and wastewater and sludge.

Municipal Solid Waste Issue - Municipal solid waste management touches the life of every U.S. citizen daily and is among the most important issues directly affecting local governments. The issue receives strong public interest and scrutiny on the local and national levels and demands ever larger local government appropriations. We generate over four pounds of municipal solid waste per person per day in the United States—only about 15 percent of which is recycled. Yet public concern about the potential risks of two of the primary waste disposal options—incineration and landfilling—is often very high, making it difficult for local public officials to find an acceptable solution for waste disposal. Waste reduction and recycling are generally preferred as management options, but these approaches currently can divert only a limited volume of waste from disposal.

Improved information on environmental and health risks of waste management and safer management practices—such as reducing waste volume and toxicity, and improved recycling and disposal options—are needed to restore public confidence. These changes will require a partnership between government and industry to produce innovative technologies and management strategies and cooperation among all levels of government to ensure that research results are translated into tools and information that can be used by local decisionmakers and the public.

The primary goals of ORD's municipal solid waste research are to optimize waste reduction and recycling; stimulate cost-effective, innovative waste management technologies; accurately assess the health and environmental risks of waste management; and minimize these risks. Areas of greatest priority under this research issue are:

- Systematically evaluating innovative waste management systems, technologies, and techniques—particularly those related to recycling
- Assessing and developing strategies for managing recycling and improving the market for recyclables
- Improving the combustion process to minimize release of pollutants
- Evaluating approaches to operating landfills as bioreactors that produce energy from solid waste in the form of methane
- Evaluating the health and ecological risks of waste management options, and identifying opportunities to reduce those forms of waste that result in toxic emissions

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Robert Landreth	RREL/CINN	1,138.7
Robert Hall	AEERL/RTP	395.0
Richard Hardesty	OHEA/HQ	40.0

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Hazardous Waste Issue - Under the 1976 Resource Conservation and Recovery Act (RCRA) and subsequent amendments, EPA administers a complex regulatory program governing the treatment and disposal of hazardous waste. The challenge of this program is to efficiently and effectively manage hazardous wastes at minimal overall cost to the economy. The RCRA regulations and the permitting decisions that stem from them must be based on sound science and engineering, and costs must be reliably estimated.

In its *Reducing Risk* report, the Science Advisory Board noted that mismanagement of hazardous wastes—while not as critical as some other environmental problems—can have significant health effects on a local level. Also, hazardous wastes may threaten sensitive areas, such as wetlands, and critical habitats. Regardless of expert opinion, the public perceives hazardous wastes as a significant health threat and one of the top environmental issues of our time. Because of public perception, hazardous waste concerns may significantly reduce property values and affect community activity and development.

ORD has been conducting research for several years to provide the scientific basis, tools, and information that EPA, states, industry, and the public need to implement the RCRA program. In the coming years, EPA research will:

- Identify source reduction or recycling solutions for difficult-to-manage RCRA wastes—particularly wastes from smaller companies that lack the technological and financial basis to invest in research
- Assess the risks of incineration and other waste management alternatives
- Improve techniques for monitoring and sampling at incinerators, landfills, and waste sites
- Improve the combustion process to minimize releases of toxic chemicals from hazardous waste incinerators
- Determine the effectiveness of modern landfills and the long-term integrity of stabilized or solidified wastes

Also, depending on the new mandate EPA receives when RCRA is reauthorized, research will likely expand into new areas, including non-hazardous industrial wastes and large-volume industrial wastes such as mining wastes and oil and gas drilling muds and brines.

Contact	*Office/Lab*	*Total Extramural Funds ($K)*
Alfred Lindsey, Issue Planner		
Clyde Dempsey/Subhas Sikdar	RREL/CINN	1,419.7
Bruce Peirano	ECAO/CINN	117.8
M. Rodney Midgett	AREAL/RTP	222.5
Robert Hall	AEERL/RTP	185.0
William Budde	EMSL/CINN	96.8
Christian Daughton	EMSL/LV	648.3
Ken Sala	OMMSQA/HQ	
Bala Krishnan	OEETD/HQ	36.0
Richard Hardesty	OHEA/HQ	44.8
James Cogliano	HHAG/HQ	20.0
John Schaum	EAG/HQ	53.0

Wastewater and Sludge Issue - Most municipalities and many industries produce wastewater that is discharged into surface water after treatment. Contaminants in wastewater may impact local ecology and may affect human health if people are exposed to pollutants by swimming in polluted surface water, drinking untreated surface water, or eating fish or shellfish that have concentrated pollutants in their tissues.

Under the Clean Water Act, EPA regulates industrial and municipal wastewaters and requires their treatment prior to discharge. As a result, the quality of our nation's surface waters has dramatically improved over the past 20 years. Nevertheless, significant water quality problems still occur frequently throughout the United States, including fish kills, beach closures, fishing advisories and bans, and contaminated sediments. Also, wastewater treatment generates large volumes of sludge that contain higher levels of contaminants and microorganisms than the wastewater. Safe use or disposal of sludge is often a major challenge.

ORD will continue to conduct research to reduce the health and ecological risks from wastewater discharge and sludge use and disposal:

- *Municipal Wastewater and Sludge.* In the near term, research will focus on municipal wastewater and sludge. EPA recently issued new regulations for managing the use and disposal of sewage sludge. ORD is supporting this new effort through research to better define and reduce the risk from chemicals and disease causing microorganisms when sewage sludge and wastewater are used or disposed.
- *Urban Wet Weather Discharges.* In the mid-term, research will focus on wet weather flows—the voluminous discharges into surface water of raw sewage and stormwater that occur during periods of high precipitation in cities with combined sewage and stormwater systems. ORD scientists will monitor these flows to determine the fate and risk of the pollutants and microorganisms they contain, and will develop cost-effective strategies for preventing and controlling these flows.
- *Industrial/Municipal.* Over the long term, ORD will develop better methods to:
  - •Prevent and treat releases from industrial and municipal sources
  - •Provide cost-effective wastewater treatment in small communities
  - •Improve the sewage system infrastructure, much of which is in poor condition
- *Standardized Methods.* ORD will develop standardized methods that can be used for monitoring chemical and biological contaminants in all forms of wastewater and urban discharges. New monitoring and quality assurance methods are needed to detect these substances at the increasingly lower concentration levels required in water quality criteria and discharge permits.

Contact	Office/Lab	Total Extramural Funds ($K)
E. Timothy Oppelt, Issue Planner		
Subhas Sikdar	RREL/CINN	813.2
Norman Kowal	ECAO/CINN	104.0
William Budde	EMSL/CINN	420.4
Carol Finch	OMMSQA/HQ	
Don Tang	OEETD/HQ	53.6
Richard Hardesty	OHEA/HQ	59.1

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Environmental Cleanup

For much of this and previous centuries, most industrial and municipal wastes were disposed of with little regard for the public health or environmental consequences. This "out of sight, out of mind" attitude has left us with a legacy of thousands of uncontrolled and abandoned hazardous waste sites that continue to pollute the environment—especially ground water—and endanger human health.

To address this problem, Congress enacted the Comprehensive Environmental Response, Compensation and Liability Act—more commonly known as Superfund—in 1980, and the Superfund Amendments and Reauthorization Act (SARA) in 1986. SARA established a multibillion dollar program to continue cleanup of hazardous waste sites and leaking underground storage tanks, and provided EPA with new directions and mandates—including a greater emphasis on cleanup, development of more efficient and effective cleanup technologies, and improved assessment of the human health and ecological risks posed by Superfund sites. EPA's research in this area, described below, responds to this mandate. Research is divided into two issue areas: surface cleanup and bioremediation. Also, research conducted in several other issue areas—ecological risk assessment, ground water, health effects, health risk assessment methods, and cross program—will aid Superfund efforts.

Surface Cleanup Issue - As many as 30,000 hazardous waste sites in the United States may need remediation. Over 1,200 of these are currently on EPA's National Priority List. With an average remediation cost approaching $25 million per site, about $30 billion will be needed to clean up these priority sites alone. Hundreds more sites will be added to the priority list as EPA continues its assessment process. To make significant progress, more cost-effective techniques are clearly needed to evaluate and clean up sites.

The primary goal of EPA's surface cleanup research is to improve the efficiency, cost, and effectiveness of site assessment, decisionmaking, and cleanup activities. While many promising remedial technologies exist, they are not being used because they have not been adequately developed or demonstrated. Over the next few years, ORD research in this area will:

- Develop monitoring and analytical technologies that can be used to rapidly and cost-effectively determine the presence and concentration of toxic and cancer-causing substances at contaminated sites, and to track the progress of cleanup actions
- Develop mobile treatment equipment that can be transported to sites to provide onsite treatment, which avoids the costs and risks associated with transporting wastes off site
- Conduct pilot-scale and field demonstrations to encourage the commercialization and use of innovative and alternative technologies to reduce the toxicity, mobility, and volume of hazardous substances
- Evaluate new technologies developed by the private sector for their efficacy in treating wastes at Superfund sites
- Investigate the use of geographic information systems as an organizing and planning tool to help site managers improve the efficiency of cleanup operations
- Develop new information management and quality assurance tools and procedures to improve the speed with which data are tracked, interpreted, and reviewed at sites
- Provide technical assistance and training to encourage the application of new technologies in the field

Contact	Office/Lab	Total Extramural Funds ($K)
Alfred Lindsey, Issue Planner		
Robert Olexsey	RREL/CINN	18,956.9
Steve Billets	EMSL/LV	3,634.7
William Budde	EMSL/CINN	713.8
William A. McClenny	AREAL/RTP	611.8
Richard Nalesnik	OEETD/HQ	385.5
Ken Sala	OMMSQA/HQ	

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Bioremediation Issue - Bioremediation—the use of biodegradation processes to convert contaminants to natural by-products—offers cost-competitive, less intrusive, environmentally sound cleanup options that can be tailored to specific chemical contaminants and environmental media (i.e., air, land, water, and ground water). Many complex issues must be addressed as this technology is considered and implemented for commercial application:

- What biodegradation pathways and processes can be used for bioremediation of various types of chemicals and waste mixtures?
- How do various chemical and environmental factors affect the rate and effectiveness of bioremediation processes, and how can this information be integrated into various bioremediation strategies?
- What engineering processes are needed to maximize biodegradation processes and opportunities for application?
- What are the human health and ecological implications of contaminants before, during, and after bioremediation?

EPA is conducting an extensive bioremediation research program in cooperation with other federal agencies and industry. Several biological systems have already been developed that can successfully degrade particular pollutants under laboratory conditions. Over the next several years, ORD will:

- Test these systems in the field at actual contaminated sites (e.g., sites that have been contaminated by an oil spill or hazardous wastes)
- Identify, characterize, and develop microorganisms (plus whole plants, fungi, etc. and possibly, genetically engineered microorganisms) that can be used for bioremediation of oil spills, wood preservative wastes, pesticides, and munition wastes in soils and sediments
- Monitor the toxicity of the target chemicals before, during, and after bioremediation
- Develop computer models that can assist in tailoring bioremediation strategies to various chemical contaminants and environmental situations, and provide a sound basis for optimizing chemical and biological degradation process steps and the design of practical field technologies
- Transfer research results to outside communities, such as industry, the states, and other agencies (e.g. DOD and DOE) to enhance the use of bioremediation

Contact	**Office/Lab**	**Total Extramural Funds ($K)**
Robert Menzer, Issue Planner		
Fred Bishop	RREL/CINN	3044.5
John Rogers	ERL/Athens	1336.5
Hap Pritchard	ERL/GB	1751.5
John T. Wilson	ERL/Ada	1130.0
Sue McMaster	HERL/RTP	539.2
Fran Kremer	CERI/CINN	470.0
Kurt Jakobson	OEETD/HQ	977.1

Health Risk Assessment

Human health risk assessment is a systematic process scientists use to evaluate whether a pollutant poses a risk to human health, what kind of risk it poses, and how great that risk is. Health risk assessment is a fundamental tool for environmental management. EPA scientists have used it extensively to determine which environmental pollutants pose human health risks and where to focus environmental protection efforts.

The health risk assessment process is only as good as the data on which it is based. Many data gaps and uncertainties remain that compromise the utility of health risk assessments and force scientists and risk managers to substitute knowledge with conservative assumptions. For example, we still don't know the extent of human exposure to pollution, and we lack fundamental information on the extent to which the pollutants we are exposed to actually penetrate and harm the human body.

Risk information is in ever greater demand as more and more environmental decisions are based on opportunities for greatest risk reduction. Recent congressional hearings and new environmental legislation have stressed the need to improve health risk assessment methods. In its *Reducing Risk* report, the SAB recommended that EPA "improve the data and analytical methodologies that support the assessment, comparison, and reduction of different environmental risks." In response, ORD is conducting research in three areas—human exposure, health effects, and health risk assessment methods—to improve the ability of scientists within EPA and outside the Agency to assess, predict, and compare the human health risk of environmental pollutants.

Human Exposure Issue - We are exposed to pollutants in several ways—by drinking water, breathing air, eating food, and through skin contact. Without exposure there is no risk. Therefore, assessing exposure is a fundamental step in the risk assessment process. This step examines such questions as:

- What are the sources of contaminants?
- By what environmental pathways (e.g., air, water, food) are we exposed?
- How much of a contaminant are we exposed to, how often, and for how long?
- How many and what kinds of people (e.g., the elderly, children) are exposed?
- What activities and lifestyles determine exposure?
- How much of what we are exposed to actually enters our bodies and reaches vulnerable tissues and organs?

Despite its importance, human exposure has been relatively neglected. Scientists rarely studied people's actual exposure (e.g., by using personal monitors or checking their body tissues and fluids). Instead, they made crude estimates of exposure based on concentrations of pollutants in the environment (e.g., monitoring air quality or spot-checking food). Also, exposure studies usually focused on estimating or measuring exposure to individual pollutants by single routes of exposure (i.e., air, skin, water, food). In reality, we are often exposed to many pollutants simultaneously via several exposure routes.

As a result, we still know little about the extent and degree of human exposure to pollution. Congress, the National Research Council, and other groups have stressed the need for improved exposure assessments. In its *Future Risk* report, the SAB recommended that EPA "expand its efforts to understand how and to what extent humans are exposed to pollutants in the real world."

During the next five years, ORD will embark on a major human exposure research effort—the National Human Exposure Assessment Survey (NHEXAS). This ambitious program will be the first to develop an integrated system that will allow risk assessors and managers to estimate *total* human exposure to environmental pollutants from *all* pathways of exposure.

Under NHEXAS, EPA—in cooperation with other agencies and research programs—will design and implement a national monitoring program to assess the status of and trends in exposures to important environmental chemicals. NHEXAS will monitor exposure of both the general population and highly exposed subgroups. The project will produce a comprehensive human exposure database that can be used to measure the success of risk management decisions, compare the relative risks of various environmental agents, identify existing or emerging problems, and refine tools used for exposure assessment. Research under NHEXAS will include:

- Use of personal monitors and human tissue and fluid samples ("biomarkers") to collect exposure data by environmental media and route, activity pattern, and socioeconomic status

- A survey of human activity patterns
- Identification and characterization of important emission sources and the pathways by which pollutants are transported
- Evaluating alternative strategies for reducing exposure
- Epidemiological studies to examine the association between measured exposures and environmentally induced disease
- Development of improved methods for monitoring and modeling human exposure, including the identification and measurement of "non-listed," unknown chemicals in environmental and body burden samples

Contact	Office/Lab	Total Extramural Funds ($K)
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Jim Quackenboss	EMSL/LV	2,452.6
Dale A. Pahl	AREAL/RTP	2,281.7
Maurice Berry	EMSL/CINN	449.7
Chris Saint	OMMSQA/HQ	
Elizabeth Bryan	OHR/HQ	3,791.3

Health Effects Issue - Three key questions that must be addressed during the human health risk assessment process are:

- What health effects does this substance cause?
- How do effects change with increasing dose?
- How can we estimate human health effects from animal studies?

Our ability to answer these questions is hampered by large gaps in biological data and by uncertainties in the tools we use to assess risks. Past research efforts to fill data gaps have focused largely on understanding which chemicals cause cancer and how. Relatively little attention has been paid to environmental causes of other important health problems such as pulmonary disease and effects on behavior, development, and reproduction. Also, much of the health effects research so far has been conducted on animals or isolated human cells. Consequently, we lack direct information on health effects in human populations.

ORD's health effects research is designed to improve the biological basis for risk assessment by filling some of these data gaps and refining risk assessment tools. Scientists will explore how chemicals act on a cellular and subcellular level to harm human tissue, why effects vary with the level, duration, and frequency of exposure, and how our bodies process various types of environmental chemicals. Researchers will develop:

- Physiologically based models that allow scientists to predict to what extent the environmental pollutants we are exposed to will end up in human tissues
- Biologically based models to estimate the type, extent, and severity of cancer and non-cancer effects that may result when pollutants do penetrate the human system
- New epidemiological methods to improve our ability to identify emerging environmental health problems in human populations
- Health effects data to support EPA regulatory programs, including the air, water, toxics, pesticides, Superfund, and hazardous waste programs

Contact	**Office/Lab**	Total Extramural **Funds ($K)**
Lawrence W. Reiter, Issue Planner		
John Vandenberg	HERL/RTP	4,558.1
David E. Kleffman	OHR/HQ	802.9

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Health Risk Assessment Methods Issue - In performing a health risk assessment, scientists must often extrapolate from one set of circumstances to another to compensate for data gaps. For example, risk scientists may use animal data to predict effects in humans or effects seen at very high levels of exposure to predict effects at low levels of exposure. Extrapolation introduces uncertainty because we simply don't understand enough about fundamental biological, chemical, and physical processes to know whether these extrapolations are valid or not.

ORD is working to refine the methods used for health risk assessment and to better quantify and express uncertainty when performing an assessment. This research focuses on improving the health risk assessment *process* itself and is complementary to the data and tools orientation of the health effects research described above. Under this issue area, ORD also performs health risk assessments and provides guidance and risk information to scientists and decisionmakers within and outside EPA. ORD's methods research includes:

- Using data from exposure studies to check the assumptions made in risk assessments when exposure information is lacking
- Developing and refining models that can help us extrapolate from one species to another and from high to low doses
- Developing methods to more explicitly incorporate and express uncertainty in risk assessments
- Developing methods for comparing different risks
- Developing risk assessment guidelines—for use within and outside EPA—that incorporate advances in science and health risk assessment methods
- Assessing the risk of high-profile chemicals, such as dioxin, and conducting risk assessments to support EPA's regulations and cleanup actions
- Maintaining and developing systems to disseminate health risk information to EPA offices, other federal agencies, the states, and the overall scientific community

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John Winter	EMSL/CINN	226.6
Philip Cook	ERL/Duluth	200.0
Michael Dourson	ECAO/CINN	698.1
Jay Benforado	OSPRE/HQ	200.0
Herman Gibb	OHEA/HQ	1,352.9
Chris Saint	OMMSQA/HQ	
Charles Ris	HHAG/HQ	454.4
Dorothy Patton	RAF/HQ	157.6
John Schaum	EAG/HQ	860.3
Michael Berry	ECAO/RTP	67.0

Innovative Technology and Outreach

A major theme of the Science Advisory Board's *Future Risk* and *Reducing Risk* reports is that controlling pollution after it has been generated—the primary environmental protection approach used by EPA in the 1970s and 1980s—is no longer sufficient. This approach tends to shift pollutants from one environmental medium to another—for example, when air pollutants captured in stacks are disposed of on land. It is also purely reactive, and does nothing to anticipate or prevent pollution. And some kinds of environmental contamination—such as radon in homes and agricultural run-off—simply cannot be solved by the federal command-and-control approaches we have used in the past. Also, despite our past successes, persistent and cumulative pollution continues to damage ecosystems and natural resources around the world.

To make meaningful progress in solving environmental problems, we will need new strategies and innovative technologies. In its *Reducing Risk* and *Future Risk* reports, the Science Advisory Board recommended that EPA—and the nation as a whole—make greater use of all the tools available to anticipate and reduce risk, and that EPA use education and technology transfer to encourage other sectors of society to use those tools. This research theme focuses on new and innovative approaches to reducing environmental risk. It includes four issue areas: pollution prevention, innovative technologies, environmental education, and technology transfer.

Pollution Prevention Issue - Pollution may occur when a product is manufactured, used, and disposed of, so there are many points in the life cycle of a product where change may reduce or eliminate pollution. For example, a manufacturing process can be modified and different raw materials used so that certain pollutants are no longer generated. Products can be redesigned for maximum life and ease of recycling. Waste materials from one industry may be used as resources by another. Consumers can choose products based on their low environmental impact. All these options prevent, rather than control, pollution. In its *Reducing Risk* report, the Science Advisory Board recommended that EPA "emphasize pollution prevention as the preferred option for reducing risk." This research issue responds directly to that recommendation.

Activities in this issue area will support EPA's pollution prevention strategy as it is developed and applied in various economic sectors. Tools will be developed to enable planning, implementation, and evaluation of pollution prevention. In partnership with other EPA offices, Federal, State and local government agencies, and industry, ORD will apply multi-disciplinary research to:

- Develop and validate tools—such as methods for assessing the life cycle of products, computerized tools for simulating and designing production processes, and measurement methods—to enable industry to incorporate pollution prevention into products and manufacturing operations
- Develop and evaluate the efficacy of policy, financial, managerial, and other techniques for encouraging the development and adoption of pollution prevention technologies and practices
- Develop and evaluate source reduction options that can be included in EPA regulations and in enforcement and compliance agreements
- Provide new technologies and technical assistance to help small businesses comply with EPA regulations and reduce risk to public health and the environment and be more economically competitive
- Disseminate information on pollution prevention approaches, techniques, and technologies to other federal agencies, states, industry, and other actively involved parties
- Develop and evaluate new technologies to prevent pollution from agricultural chemicals and animal waste management, with a special focus on protecting sensitive ecosystems from agricultural impact
- Help other federal agencies adopt pollution prevention practices and technologies
- Provide oversight of pollution prevention in several other issue areas: air toxics, indoor air, global climate change, hazardous waste, municipal solid waste, non-point sources, stratospheric ozone depletion, and technology transfer

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Harry Freeman	RREL/CINN	2,447.0
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Werner Beckert	EMSL/LV	80.0
Robert Carsel	ERL/Athens	600.0
Paul Shapiro	OEETD/HQ	976.9

Innovative Technologies Issue - The more efficient and cost-effective technologies we can develop to measure, reduce, control, and clean up pollution, the more successful we will be at protecting human health and the environment with the available resources. In 1986, a gold mine of opportunity for development and commercialization of new technologies opened with the passage of the Federal Technology Transfer Act (FTTA), which allows joint ventures between the federal and private sectors. The combination of EPA's often unique R&D resources with extensive industry experience and capabilities in full-scale development and marketing is a powerful force for innovation and change. Also for this year, Congress appropriated funds to expand the development and use of innovative technologies under the Environmental Technology Initiative (ETI). This program, which is focused primarily on the commercialization stage of technology development, will fund numerous projects in ORD.

Under this research issue, ORD is creating synergistic partnerships with the private sector to advance the development and application of state-of-the-art environmental technology. During the next five years, ORD will establish a comprehensive research program covering these areas:

- *Fundamental R&D.* ORD will develop pollution prevention, control, and/or monitoring technologies that show promise for efficient and effective application across different environmental media. Products will be commercialized by industry through FTTA agreements.
- *Small Business Innovation Research.* ORD will support small businesses in developing concepts by funding feasibility and pilot studies of innovative ideas. ORD will then encourage (but not fund) large-scale development and commercialization of promising technologies.
- *Public-Private Partnerships.* ORD will establish partnerships with the private sector to accelerate commercialization of innovative technologies. ORD will sponsor early, pilot-scale development, with co-funding and technical assistance from industry. Industry will then assume responsibility for full-scale demonstration and subsequent commercialization. ORD will retain a share of rights to any invention; income will be used to fund the program.
- *Advanced Manufacturing.* EPA will emphasize innovative, advanced manufacturing technologies which substantially reduce or prevent pollution emissions to all media, working closely with other federal agencies to ensure that environmental concerns receive high priority in all research and development activities.
- *Environmental Technology Initiative (ETI).* ETI's goals are to advance environmental protection through the use of innovative technologies and to enhance the marketplace for U.S. environmental technologies both at home and abroad. ORD will manage 42 out of 73 selected projects comprising ETI's FY 1994 Program Plan. ORD will perform work and establish partnerships with federal agencies, and other public and private institutions to achieve ETI's goals.

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Environmental Education Issue - Long-range progress in environmental protection depends on the availability of a well-educated scientific and technical work force. "Without the steady infusion of young talent into university, state, federal, and private sector laboratories," the Science Advisory Board wrote in *Future Risk*, "the country could face a personnel shortage that would cripple our environmental protection efforts." The SAB recommended that EPA increase the amount and improve the quality of the scientific and engineering talent dedicated to environmental research.

As the primary federal center for environmental science, ORD has the opportunity to be an important catalyst, encouraging talented youths to enter the environmental field and apply their skills at EPA and other institutions in solving our nation's environmental problems. Under this issue area, ORD will:

- Encourage students attending minority institutions to pursue environmental careers by supporting undergraduate education and training through academic fellowships and summer internships and supporting graduate education through academic traineeships
- Promote its research laboratories as resource centers for local communities to learn about environmental science and engineering
- Encourage students to pursue environmental science careers by working with colleges and universities to develop enrichment programs that provide students with mentors and research experience
- Continue working with colleges and universities to establish undergraduate and graduate programs in environmental science, environmental engineering, and risk communication
- Work with minority institutions to make EPA an attractive employer to qualified applicants

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International and National Technology Transfer Issue - Research provides the scientific and technological basis for action. The faster we can get new information, ideas, and technologies out to user communities—in a clear, usable form—the more progress we can make in solving environmental problems. Under this issue area, ORD will advance, integrate, and coordinate its technology transfer efforts. Activities will include:

- Development of cross-media and cross-issue publications and technical meetings for small communities, small industries, the international community, and federal, state, and local regulators - groups that have not traditionally been extensive users of ORD products. Small communities and industries face particular environmental challenges because of their limited resources. International technology transfer will focus on helping developing countries achieve their national objectives in an environmentally sound manner.
- Working with issue planners to develop the technology transfer plans for their issue areas
- Soliciting feedback on the effectiveness and utility of technology transfer tools and products
- Promoting cooperative R&D agreements between EPA and industry by educating the private sector about the new possibilities for joint ventures now allowed under the Federal Technology Transfer Act
- Evaluating state-of-the-art information storage and dissemination technologies—such as optical imaging, CD-ROM, intelligent databases, and interactive information capabilities—that can enhance technology transfer efforts

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Exploratory Research and Special Environmental Problems

In its *Safeguarding the Future* report, the Expert Panel observed that "If scientists can identify emerging environmental trends and their consequences, EPA and the nation can take steps now to reduce the risks posed by these trends, rather than pay the much larger costs to address problems that have evolved to maturity."

Investing in exploratory research generates fresh ideas, better research tools, and more powerful insights into environmental problems. The Expert Panel recommended that EPA place a high priority on establishing an effective grants and centers program aimed at enlisting the nation's scientific expertise to address issues of central importance. In addition to such investigator-initiated research, ORD will also conduct research on special, cross-cutting environmental problems that do not fit into the issues discussed above. This theme area covers four issues: environmental review of toxic chemicals, lead, anticipatory research, and exploratory grants and centers.

Environmental Review of Toxic Chemicals Issue - Under the Toxic Substances Control Act, EPA is responsible for ensuring that new and existing chemicals do not pose an unreasonable risk to the environment or human health. If they do, the Agency may restrict their production and use. The volume of chemicals to be assessed is staggering—many thousands of chemicals already exist and thousands more are created each year. Once an industry notifies EPA of its intent to manufacture or import a new chemical, the Agency has a very limited time frame to decide whether to restrict production or use. Conventional laboratory techniques are too expensive and time-consuming for use in screening chemicals for risk. Faster, more cost-effective methods—such as the ability to predict chemical fate/exposure and effects based on chemical structure—are needed to predict and measure risk.

This research issue will support EPA's need for more efficient screening and assessment techniques by developing methods to:

- Rapidly screen and assess the health and ecological risks of chemicals
- Predict the transport, fate, and persistence of chemicals in the environment
- Predict the occupational and environmental exposures associated with chemicals and chemical processes or uses

Also, ORD will evaluate pollution prevention techniques that can be used to minimize environmental releases and occupational exposure.

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Lead Issue - Lead is an environmental chemical of great concern. We have long known that it causes serious, irreversible health effects—including lowered IQ and learning disabilities in children—at relatively low levels. Despite dramatic success in reducing environmental lead exposure over the past two decades, it still remains one of our most serious public health problems.

We are exposed to lead from many sources—including water, soil, paint, and air. Because exposure is so broad and complex, EPA has created an Agency-wide "Lead Strategy" to reduce overall lead exposure in the general population and to markedly reduce lead exposure in children and women of childbearing age. R&D in this area will provide immediate support for EPA's Lead Strategy and will investigate additional lead issues of emerging scientific interest and likely future policy concern. ORD's lead research will include the following areas of focus:

- Improving methods for rapidly and reliably detecting and measuring lead in paint, soil, and dust
- Developing methods to clean up lead in urban soils and at hazardous waste sites
- Developing treatment methods to reduce the rate of leaching of lead into drinking water from plumbing and distribution systems
- Evaluating alternatives to land disposal of debris from abatement of lead in paint and soil
- Measuring the relative human exposure to lead from various sources, and mapping "hot spots" where exposure to multiple sources may create high-risk areas warranting early abatement attention
- Developing models to predict how exposure to lead affects the level of lead in the blood and how lead is distributed among target organs in the human body
- Further investigating the health effects of lead and defining the factors that make children more vulnerable to lead
- Supporting outreach efforts—including lead information clearing houses and symposia, workshops, and training courses on lead-related issues

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Harold Vincent	EMSL/LV	674.3
Robert Elias	ECAO/RTP	275.0
Maurice Berry	EMSL/CINN	132.0
Lee Mulkey	ERL/Athens	200.0
Don Tang	OEETD/HQ	107.0
Chris Saint	OMMSQA/HQ	
Charles Ris	HHAG/HQ	150.0

Anticipatory Research on Emerging Environmental Problems Issue - In the past, EPA's research—driven largely by the Agency's legislative mandates—focused on existing environmental problems. ORD did little to anticipate or predict emerging environmental problems. Both the Science Advisory Board and the Expert Panel pointed out that great benefit can be derived from identifying and responding to trends in environmental quality before they begin to cause serious ecological or human health problems. Early identification and response reduce the overall cost of protection and avert damaging health and ecological effects. The SAB specifically recommended that EPA improve its capability to anticipate environmental problems.

EPA does not now have a research program in this area. The proposed program will identify and "jump start" research on new issues that may become important for future Agency pollution prevention and risk reduction efforts. Working with other EPA offices, the academic community, and other scientific organizations, ORD will identify emerging issues and research needs that may result from national policy decisions and economic, environmental, and social trends, such as changing economic and energy policies, agricultural practices, population densities, and manufacturing practices.

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Exploratory Grants and Centers Issue - By funding environmental R&D outside EPA, grants and centers strengthen links between EPA and the outside scientific community. Under the grant mechanism, EPA funds projects proposed by researchers at research institutions, such as universities and institutes.

Centers are selected through a competitive process to provide R&D in a broad research area, such as mechanisms of ecosystem toxicity. Supporting the efforts of external scientists through grants and centers produces high-quality research, stimulates cross-fertilization of ideas between EPA and external scientists, and provides training opportunities for young scientists and engineers.

ORD will continue and, if resources allow, increase its use of grants and centers to fund environmental R&D by the academic community. Grants will be used to fund research in ecology and environmental biology, chemistry and physics, environmental health, socio-economics, and environmental engineering. ORD will fund at least four exploratory environmental research centers and five hazardous substance research centers. In the near term, this issue will also support the experimental program to stimulate competitive research and several additional centers to conduct research on such topics as air toxics and environmental equity. Targeted support will also be provided to Clark-Atlanta University and the University of Texas at El Paso.

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Laboratory Infrastructure

Underlying the success of ORD's scientific research program is its infrastructure—trained scientists and engineers, laboratories and equipment, supplies to conduct research, and the sound management of these resources. The current condition of ORD's infrastructure is inadequate and could seriously impair the quality and type of research being conducted within ORD.

Providing an adequate infrastructure to conduct research is ORD's highest priority. A significant step in this direction has been the recognition of infrastructure as an important cross-cutting issue. ORD is addressing deficiencies, including replacement of obsolete equipment, provision of sufficient operating expenses for laboratories, and repair and maintenance of facilities. This issue area will build on established planning and oversight processes and will address new questions such as:

- How can ORD address the serious problem of limited federal workyears to manage a large extramural research program?
- How can ORD implement the human resource management recommendations made by the SAB and the Expert Panel?
- What impact will various levels of capital investment for new facilities and repairs have on the implementation of ORD's research strategy?
- How might new strategic initiatives impact ORD's infrastructure?

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Cross Program

Several ORD functions apply to many EPA research and program areas. For efficiency, ORD has grouped these cross-program functions into a single theme area, described here. This coordinated approach allows ORD to take a broad, multimedia view when performing these functions, and ensures that the tools developed will have maximum flexiblity and value for many different applications.

Integrated Analytical Methods. Many of EPA's research and program efforts require technologies to monitor and measure pollutants in the environment. To meet these needs, ORD will focus on developing multimedia monitoring methods needed by the Regions and states to implement environmental laws and regulations.

Quality Assurance (QA). Ensuring quality is an essential part of any program—results must be reliable and usable. QA activities include defining data needs, determining how to collect meaningful and accurate data, and assessing the overall quality of a program and its results. ORD will coordinate quality assurance activities across all Agency regulatory and research programs, developing new and improved QA approaches and systems based on innovative ideas and experiences within and outside EPA. ORD will continue to review QA programs across EPA to measure their effectiveness in providing environmental data of appropriate type and quality for decisionmakers.

High Performance Computing. This initiative is part of a federal program sanctioned under the High Performance Computing Act of 1991. High performance computing and communications technology will expand environmental assessment capabilities to enable multi-pollutant and multimedia analysis. This "holistic" approach expands our ability to model and monitor the environment—for example, it will provide a foundation for future assessment of impacts on entire ecosystems. The primary goal of ORD's high performance computing program is to provide reliable and useful assessment tools for use by government, industry, and others.

Planning, Budgeting, Regulatory Science Review, and Regional Liaison. The science, planning, and budget efforts that ORD conducts must be linked with the environmental policy and regulatory activities of EPA's program and regional offices. To do this, ORD provides advice on and analysis of the scientific and technological basis for both regulatory and non-regulatory programs; manages the issue-based process for planning; works to improve EPA's science knowledge base; promotes the interests of EPA regional offices in activities; and manages and tracks budget activities.

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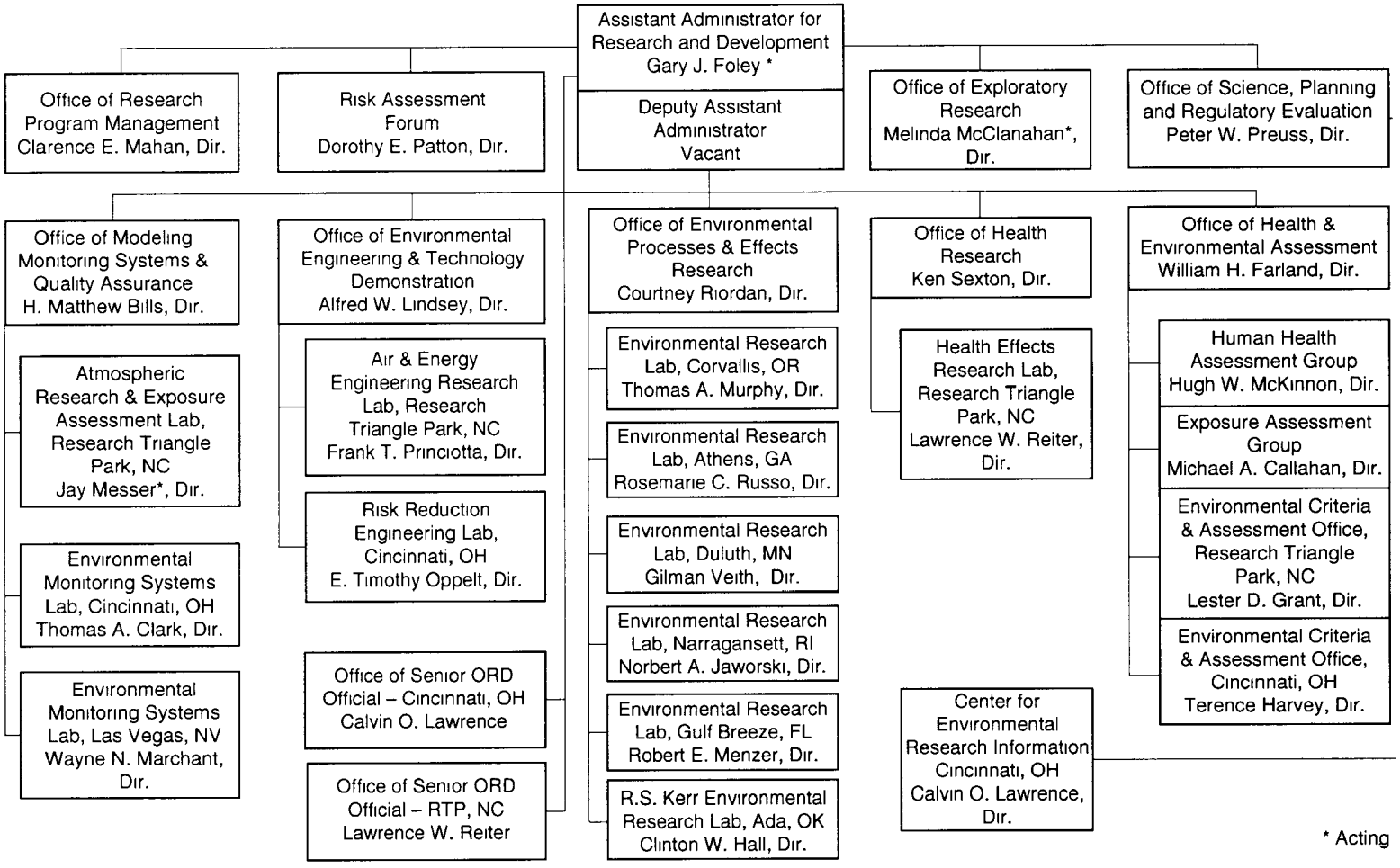
Virginia Kahn	ORPM/HQ	501.0
Joe DeSantis	OSPRE/HQ	530.0
Ron Landy	REG. SCI./HQ	913.2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ORD Organizational Descriptions

Office of Science, Planning and Regulatory Evaluation

The Office of Science, Planning and Regulatory Evaluation (OSPRE) performs several major functions that link ORD's science program and the environmental policy and regulatory activities of EPA's program and regional offices. The first major function, regulatory support, is to ensure that all relevant scientific and technology information is considered and improves the science that underlies Agency regulations, decisions, and policies. The OSPRE staff, working with laboratory experts, evaluates legislation; represents ORD in Agency initiatives that require creative scientific approaches; and works with other federal agencies, like the Department of Agriculture, to design joint research programs. The second major function, research planning and science review, is to implement ORD's new issue-based research planning process and the recommendations of the Expert Panel on the Role of Science at EPA. OSPRE planning staff facilitates the many steps of the process among the ORD Headquarters offices and laboratories and communicates ORD's research agenda to the external scientific community. The science review staff is implementing several key recommendations of the Expert Panel for improving the science base for Agency decision making. The third major function, technology transfer, is to promote ORD science and information to the broadest possible audience outside the Agency. OSPRE staff has the lead for the Agency's participation in the National Technology Initiative, a federal government effort to forge partnerships between Federal laboratories and the private sector and implements the Agency's Federal Technology Transfer Act program. The Center for Environmental Research Information develops technology transfer products including databases, publications, seminars, and workshops for state and local governments, academia, and international organizations. The fourth major function, regional operations, is to link ORD with EPA's regional offices and the environmental decision makers in state and local government. OSPRE advocates regional needs in ORD's research program and promotes the flow of information and technology to state and local government clients through three programs: 1) the Regional Scientist Program, 2) the Superfund Technical Liaison Program, and 3) the State and Local Program.

ORD Organizational Descriptions

Office of Research Program Management

The Office of Research Program Management (ORPM) is a principal staff office to the Assistant Administrator. In this role, ORPM provides executive leadership and guidance on matters of budgeting, accountability, program planning, analysis, review, integration and coordination, resource management, organizational and manpower management, environmental compliance, policy development and analysis, and administrative development and management services. ORPM is responsible for the overall budget execution and financial management of all ORD resources. ORPM is also responsible for assuring that the budget requests to the Agency, OMB, and Congress respond to the regulatory and programmatic needs of EPA, while at the same time anticipating future environmental research necessary to address emerging issues. ORPM also has national responsibility for human resource management (HRM) programs within ORD, with the ORD Comprehensive Human Resource Management Plan providing the basis for these programs.

Office of Environmental Engineering and Technology Demonstration

The Office of Environmental Engineering and Technology Demonstration (OEETD) is responsible for the assessment and development of methods for control of the environmental and socio-economic impacts of municipal and industrial operations and of energy and mineral resource extraction, processing, conversion, and utilization systems.

The Risk Reduction Engineering Laboratory in Cincinnati, Ohio, investigates ways to prevent, control, and treat hazardous wastes and Superfund related activities. This includes defining and characterizing sources of pollution, catalyzing advances in the state-of-the-art of pollution control, providing engineering concepts for cost-effective engineering solutions to difficult pollution problems and early-warning of emerging sources of pollution.

It also investigates, develops and demonstrates cost-effective methods for the treatment and management of municipal wastewater and sludges and urban runoff; and of industrial processing and manufacturing and toxic discharges; and the development of technology and management systems for the treatment, distribution, and presentation of public drinking water supplies.

- *Drinking Water:* This research program integrates chemistry, engineering, microbiology, and cost information to provide effective, reliable, and cost-effective techniques for assuring the delivery of safe drinking water to reduce the risk of chemically and microbiologically induced health effects to the public. Included are laboratory, pilot plant, and field studies on control of lead, radon, synthetic organics, disinfection by-products, viruses, and cysts.

- *Hazardous Wastes:* This program focuses on investigating incineration, land disposal, and alternative technologies for treating, detoxifying, and disposing of hazardous wastes.

- *LUST Trust Fund Technical Support:* This program works in close support to the Office of Underground Storage Tanks (OUST) to develop procedures for detecting and preventing leaks from storage tanks and associated piping. Under the LUST Trust Fund, technical assistance is provided on site assessment, technology selection, and corrective action to decision officials.

- *Pesticides:* This research program evaluates processes for treating wastes from production, application, and disposal of pesticides. The program also evaluates treatment alternatives for disposing cancelled and suspended pesticides, and provides data and guidance on the effectiveness of protective equipment for reducing worker exposure to pesticides.

- *Superfund:* Research is directed at identifying, developing and evaluating technologies to support remediation, removal, and enforcement actions. The Superfund Innovative Technology Evaluation (SITE) program facilitates development and conducts demonstrations of innovative technologies as alternatives to containment. The Superfund Technical Assistance Response Team (START) provides engineering and scientific assistance to Regional Offices, Program Offices, and others on

the cleanup of hazardous wastes, particularly those associated with Superfund sites.

- *Toxic Chemical Testing and Assessment:* The goals of this research program are to provide test protocols, treatment and control procedures for regulating the manufacture and use of existing toxic chemicals (including asbestos); assess release and exposure in review of Premanufacturing Notices (PMNs) for new chemicals; and evaluate techniques and devices to contain and destroy genetically engineered organisms.

- *Wastewater Treatment (Municipal and Industrial):* Research efforts are focused on developing cost-effective methods for treating municipal wastewater and sludges, urban runoff, and industrial wastewater discharges from processing and manufacturing operations. The main goal is to provide design and operating guidelines for efficient wastewater management based on the principles of pollution prevention and process integration. The research also includes the development of toxicity-based permitting via use of bioassay procedures.

- *Municipal Waste:* This program promotes the integration of municipal solid waste management technologies through research on safe and effective recycling practices, reducing multimedia pollutant releases from municipal land disposal facilities, and research on the utilization and safe disposal of municipal waste combustion residues.

- *Pollution Prevention:* Research is conducted (1) to assess opportunities for multimedia pollution prevention through source reduction and recycling within operating industrial facilities, (2) to develop and demonstrate innovative pollution prevention technologies for industrial, agricultural, and transportation sector processes, (3) to develop and standardize methodologies for performing consumer product life cycle analyses and for measuring waste reduction.

- *Oil Spills:* As a result of EPA's involvement in efforts to clean up the Alaskan oil spill, research is underway to develop and evaluate remediation technologies. The program emphasizes exploiting the natural ability of indigenous microorganisms to degrade oil, with or without nutrient addition.

The major purpose of the *Air and Energy Engineering Research Laboratory* in Research Triangle Park, NC, is to develop and assess methods and technologies for preventing or reducing the effects of air pollutants on human health and welfare and on the global environment.

- *Acid Rain:* This program focuses on developing innovative controls for acid rain precursors, SO_2 and NO_x, including the Limestone Injection Multistage Burner; developing models that will identify the best possible control alternatives for various scenarios; and developing inventories of acid rain precursor emissions.

- *Air Toxics:* Emphasis is placed on developing technologies and pollution prevention approaches to reduce emissions of volatile organic compounds (VOCs); identifying sources of VOCs; developing improved designs that will achieve better control of woodstove emissions; and providing direct technical assistance to state and local agencies through the Control Technology Center (CTC), which has extensive information on existing technologies applicable to a variety of air pollution sources.

- *Hazardous Wastes:* The primary goal of this program is to study the fundamental combustion mechanisms that influence thermal destruction of hazardous wastes. Included are studies of metal aerosols from waste incineration, failure modes in a small pilot-scale rotary kiln, and small pilot-scale studies of fluidized-bed incineration.

- *Indoor Air Quality/Radon:* Research is currently concentrating on (1) developing and demonstrating technologies for reducing the entry of naturally occurring radon into houses, schools, and other

public buildings, (2) studying emissions from building materials and consumer products as sources of indoor air pollution, (3) evaluating the effects of "sinks" that adsorb/desorb pollutants in the indoor environment, and (4) evaluating indoor air control options for gases and particles.

- *Municipal Waste Combustion:* Work focuses on evaluating techniques to minimize pollutant formation during combustion, and determining the effectiveness of various devices in controlling air pollution from municipal waste incinerators.

- *Ozone Non-Attainment:* This program supports ORD's overall ozone non-attainment strategy by developing innovative technologies, mitigation strategies, process modifications and improving existing technologies that will prevent or reduce, the emission of hydrocarbons, nitrogen oxides, and VOCs.

- *Stratospheric Ozone:* In cooperation with industry, AEERL evaluates, identifies, and recommends substitute products and new industrial processes that will replace ozone depleting substances that are now in use. The current emphasis is on alternatives for home and commercial refrigeration systems.

- *Global Climate Change:* This program is evaluating mitigation options for greenhouse gases (carbon dioxide, methane, nitrous oxide) including innovative technological solutions to the problem. Also planned are inventories of emissions that are contributing to global climate change.

Office of Environmental Processes and Effects Research

The Office of Environmental Processes and Effects Research (OEPER) is responsible for the administration of a broad range of ecological research programs. These programs are structured to provide the scientific data and technological methods necessary to understand the entry and movement of pollutants into the environment and to determine the effects of such substances on organisms and ecosystems. The information and research products resulting from these

programs are directly applicable to fulfilling the Agency's regulatory responsibilities.

Research is conducted within the full realm of environmental media—atmosphere, soil, ground water, surface water, and coastal and marine waters. Major areas of study include toxic substances, hazardous waste, pesticides, acid deposition, biotechnology, global climate change, stratospheric ozone, wetlands, water quality, ecological risk assessment, and status of critical ecological resources. The Office actively provides technical support in environmental science and technology to regions and states to assist in problem solving and to transfer information and technology to local users.

The Robert S. Kerr Environmental Research Laboratory (*RSKERL*) in Ada, OK, serves as U.S. EPA's center for ground water research, focusing its efforts on studies of the transport and fate of contaminants in the subsurface, development of methodologies for protection and restoration of ground water quality, and evaluation of the applicability and limitations of using natural soil and subsurface processes for the treatment of hazardous wastes. Subsurface transport and fate information is incorporated into mathematical models for use in predicting the transport and fate of contaminants in the subsurface. Efforts to support the immediate needs and activities of EPA's operating programs are focused on the Underground Injection Control Program, the Wellhead Protection Program, and the Hazardous Waste and Superfund Programs. RSKERL's Technology Support Program provides decision-makers with a source of information on subsurface fate and transport of contaminants and *in situ* remediation technologies, as well as the associated expert assistance required to effectively use this information.

The Environmental Research Laboratory in Athens, GA, conducts and manages fundamental and applied research, and provides technical assistance/ technology transfer required by the Agency to predict the transformation, speciation, and transport of pollutants across and within the air-water-soil-media. This research is the foundation for the development of model-based methodologies: (1) to assess the potential

ecological and human exposures and risks associated with conventional and toxic pollutants released or deposited into the water and sediment of aquatic/marine ecosystems and in soil ecosystems; (2) to quantify the interactions of soil ecosystems with and responses to global climate change and land use/management at the sub-grid scale in order to account for greenhouse gas emissions feedbacks for Earth Systems Models, plus design sequestration strategies; and (3) to design and evaluate strategies for soil-related remediation/risk reduction techniques, such as non-point source control and contaminated soil cleanup.

This research identifies and characterizes the natural biological and chemical processes that determine the environmental fate and effects of specific substances, such as pesticides, toxic chemicals, or metals. The results are applied in state-of-the-art computer models for assessing and managing environmental pollution problems in a multimedia context. Emphasized research areas are radiatively important trace (greenhouse) gas emissions from temperate and tropical terrestrial/soil systems in response to global climate change and land use/management, ecological exposure and risk assessment methods, artificial intelligence-expert systems for predicting chemical reactivity from structure, remediation processes and hazardous waste site and non-point source pollution evaluation.

EPA's Center for Exposure Assessment Modeling (CEAM), an internationally known center of modeling expertise located at the Athens Lab, provides documentation and codes for selected multimedia models related to hazardous waste management, non-point source assessment, ecological exposure/risk analysis and general water quality evaluation.

The Environmental Research Laboratory in Corvallis, OR, conducts research on terrestrial and watershed ecology and assesses the comprehensive ecological impact of inland pollution and other environmental changes caused by man. This includes the ecological effects of airborne pollutants, such as acid deposition; the ecological effects of global climate and UV-B changes; the effects of toxic chemicals on terrestrial plants, animals, and ecosystems; the assess-

ment and restoration of contaminated or degraded environments; the characterization and assessment of the vulnerability of ecological systems, such as wetlands, to human impacts; and the ecological risks from the terrestrial release of bioengineered organisms and other biological control agents.

The Environmental Research Laboratory in Duluth, MN, is primarily responsible for developing measures of ecological health for the nation's freshwaters. The mission of this laboratory is to develop methods for predicting and assessing the effects of pollutants and pollution activities on freshwater resources. Located on Lake Superior, the laboratory specializes in the toxicology and ecological effects of industrial chemicals, pesticides, and other hazardous substances.

In conjunction with its field station in Grosse Ile, MI, the primary research programs include developing ecosystem response models, diagnostic methods for watersheds, and mass balance ecosystem models for the Great Lakes. Studies of exotic species, integration of research data into EMAP, and non-point pollution also will be of high priority.

ERL-Duluth continues to conduct its research in surface freshwater systems, both flowing and lakes, including the Great Lakes and freshwater wetlands. Research programs center on stresses from water criteria pollutants, xenobiotics, and biological stressors including climate changes and sediments. Investigations focus on the impact of these stresses through a risk assessment framework including stressor source assessment, classification/characterization, hazard identification, and stressor dose-response analysis.

The Environmental Research Laboratory at Narragansett, RI, along with its Pacific Coast laboratory in Newport, OR, is a National Marine Water Quality Research Laboratory that has been given expanded roles in sediment quality and monitoring. The Laboratory's research and monitoring efforts support primarily the EPA Office of Water, Office of Emergency and Remedial Response, and the Office of Air and Radiation. The Laboratory efforts respond mainly to legislative requirements of the Clean Water Act, the Marine Protection Act, Research Sanctuaries

Act, Clean Air Act, and the Superfund Reauthorization Act. Major emphasis is placed on providing the scientific base for environmental criteria, waste disposal practices, environmental analysis, and impact assessments of marine and estuarine risk of regulatory activities by responsible offices.

The principal research and monitoring themes of the Laboratory reflect its major strengths and are critical to accomplishing the Laboratory's mission and the Ecological Risk Assessment Program of the Agency. The Laboratory's major themes are: (1) Predictive Biological Test Method Development, (2) Ecological Processes and Significance, (3) Environmental Exposure and Chemistry, and (4) Ecological Indicators and Monitoring.

The Laboratory is responsible for the following research and program areas: (1) marine and estuarine disposal, (2) water use designation and derivation of criteria for marine and estuarine water and sediment, (3) environmental assessment of ocean disposal and discharges of waste and wastewaters, (4) technical and research support for evaluating remediation options at proposed and designated marine/estuarine Superfund sites, (5) research on the effects of global warming and the depletion of stratospheric ozone on marine systems, and (6) ecological monitoring for Near Coastal Ecosystems. Technical assistance, technology transfer, and investigations of an emergency nature; e.g., spills of toxic materials; are also provided to aid EPA offices in evaluating environmental threats posed by toxicants, other pollutants, and physical modifications along our nation's coasts. Technical assistance is also provided to other federal agencies, states, municipalities, and industry.

The Environmental Research Laboratory in Gulf Breeze, FL, has broad research objectives related to the near-coastal marine environment that include the development of scientific information for (1) formulation of guidelines, standards, and strategies for management of pesticides and toxic chemicals in the near-coastal marine environment, (2) definition of current ecological "health" status and measurement and prediction of changes in ecological structure and function over time, (3) description of cause(s) of aberrant conditions or observed changes in ecological

status, and (4) application of biological systems to bioremediate toxic and hazardous chemicals in the environment. Research is primarily devoted to chemical compounds and biological products regulated by EPA's Office of Prevention, Pesticides and Toxic Substances, the Office of Water Programs, and the Office of Solid Waste and Emergency Response.

Research programs specifically addressed by the Laboratory include (1) definition and evaluation of factors and mechanisms that affect biodegradation rates and bioaccumulation potential in food-webs, (2) development of procedures and evaluation protocols for the biological treatment of toxic chemicals and hazardous wastes in the environment, (3) determination of effects of carcinogens, mutagens, and teratogens in aquatic species, (4) development of principles and applications of ecotoxicology, including measurements and predictions of the fate and effects of chemicals and biotechnological products on estuarine organisms, populations, communities, and associated ecological structure and function, (5) development and verification of methods and data that allow extrapolation of effects from laboratory observations to field situations, within and among species, populations, communities, and ecosystems, (6) development of methods to evaluate the environmental risk of toxic chemicals and products of biotechnology to the marine environment, (7) environmental monitoring and assessment of bays and estuaries of the Gulf of Mexico to define ecological "health" status and to define changes over time and cause(s), and (8) development and evaluation of procedures and chemical and biological products for remediating spilled oil at sea or in coastal environments.

Office of Exploratory Research

The Office of Exploratory Research (OER) is responsible for planning, administering, managing and evaluating EPA's exploratory research program in general and, in particular, its extramural grant research in response to Agency priorities as established by Agency planning mechanisms. Its basic objective is to support research aimed at developing a better basic scientific understanding of the environment and its inherent problems. OER accomplishes this objective through several core programs: a Competitive Research

Grants Program, an Environmental Research Centers Program, a Hazardous Substance Research Centers Program, a Visiting Scientists Program, a Small Business Innovation Research Program, and an Experimental Program to Stimulate Competitive Research (EPSCoR). In addition to the core programs, OER administers other programs that are important to the accomplishment of the OER objective. They include:

- A Minority Institute Undergraduate Fellowship Program that awards fellowships to college seniors and graduate students enrolled on a full-time basis at Historically Black Colleges and Universities (HBCU) and the Hispanic Association of Colleges and Universities (HACU) and majoring in curricula that could lead to environmental careers.

- A Minority Institute Summer Intern Program that extends to recipients of fellowships under the Minority Fellowship Program the opportunity for hands-on experience in the area of their academic training by way of a summer internship at an EPA facility.

- The Agency's Senior Environmental Employment Program (SEEP) that utilizes the skills and talents of older Americans to meet employment needs of environmental programs.

- The Federal Workforce Training Program that coordinates ORD's participation in workforce training programs used by state and local governments.

- The Resident Research Associate Program which provides a mechanism for non-federal post-doctoral and senior scientists to conduct research projects in ORD Laboratories.

Office of Health and Environmental Assessment

The Office of Health and Environmental Assessment (OHEA) is responsible for assessing the effects of environmental pollutants in varying exposure situations on human health and ecological systems and

determining the degree of risks from these exposures. The risk assessments performed by OHEA are used by the Agency as the scientific basis for regulatory and enforcement decisions. OHEA's responsibilities also include the development of risk assessment guidelines and methodologies, and recommendations for new research efforts that will better support future EPA risk assessment activities and reduce the uncertainties in EPA risk assessment activities.

Comprehensive methodologies are prepared for health assessments of both single chemicals and complex mixtures. Technical assistance to various Agency programs and regional offices concerning acceptable pollutant levels and dose-response relations is also provided.

The Office includes four organizational groups:

The Human Health Assessment Group provides state-of-the-art methodology, guidance, and procedures on the health risks associated with suspected cancer-causing agents and the risks associated with chemicals that are suspected of causing detrimental reproductive effects, including mutagenic, teratogenic, and other adverse reproductive outcomes and reduced fertility. The group also assures quality and consistency in the Agency's scientific risk assessments; provides advice on proposed testing requirements for adequate risk assessments; and prepares independent risk assessments.

The Exposure Assessment Group provides advice on the exposure characteristics and factors of agents that are suspected of causing detrimental health effects; provides state-of-the-art methodology, guidance, and procedures for exposure determinations; assures quality and consistency in the Agency's exposure assessments, and prepares independent assessments of exposure and recommendations concerning the exposure potential of specific agents.

The Environmental Criteria and Assessment Office in Research Triangle Park, NC, is responsible for preparing air quality criteria documents and air pollutant health assessment documents for use in Agency regulatory activities, as well as legislatively required health-related reports.

ORD Organizational Descriptions

The Environmental Criteria and Assessment Office in Cincinnati, OH, prepares health and hazard assessment documents on water pollution and solid and hazardous wastes and hazardous air pollutants.

Office of Health Research

The Office of Health Research (OHR) is responsible for developing and evaluating toxicity test methods and for providing toxicity data to enable the Agency to accurately identify hazards and determine human risk from environmental exposure. To fulfill this mission, research is conducted in three major areas:

- Toxicity test method development
- Generation of dose-response data
- Development of methods to use data from toxicity testing and dose-response studies to estimate human morbidity and mortality; including extrapolation from animal data to human effects, from high to low doses, from acute toxicity to long-term effects, and from exposure to dose.

The *Health Effects Research Laboratory (HERL)* in Research Triangle Park, NC, conducts research, both intramurally and extramurally, which is responsive to these goals. Physical, biological, and chemical agents are studied, and research is conducted in the scientific disciplines of pulmonary toxicology, genetic toxicology, neurotoxicology, developmental and reproductive toxicology, and epidemiology and biometry. Research to improve the quality of health risk assessment is being conducted through the development of pharmacokinetic and biologically based models. These models are being developed to more accurately predict the relationship between environmental concentration, target tissue dose, and ultimate health effect.

Office of Modeling, Monitoring Systems and Quality Assurance

The Office of Modeling, Monitoring Systems and Quality Assurance (OMMSQA), under the supervision of an Office Director, is responsible to the Assistant Administrator for Research and Development for planning, managing, and evaluating a comprehensive program for: research, monitoring, and assessment of the condition of our Nation's ecological resources;

research with respect to the characterization, transport, and fate of pollutants which are released into the atmosphere; development and demonstration of techniques and methods to monitor and model human and ecological exposure and to relate ambient concentrations to exposure by critical receptors; research, development, and demonstration of new monitoring methods, systems, techniques, and equipment for detection, identification, and characterization of pollutants at the source and in the ambient environment and for use as reference or standard monitoring methods; establishment, coordination, and review of Agency-wide Quality Assurance Program; development and provision of quality assurance methods, techniques, and materials including validation and standardization of analytical methods, sampling techniques, quality control methods, standard reference materials, and techniques for data collection, evaluation, and interpretation.

Environmental Monitoring and Assessment Program (EMAP) Office. The Environmental Monitoring Assessment Program (EMAP) Office, under the direction of a Director, is responsible for: (1) designing and implementing a comprehensive, long-term nationwide environmental research, monitoring, and assessment program to assess and to document periodically the condition of the Nation's ecological resources; (2) designing data management systems, analytical procedures, and assessment guidelines which ensure that the results of the freshwater, terrestrial, and near coastal ecosystem monitoring activities can be combined into a consistent framework for reporting and assessing overall status and trends; (3) providing service to a wide spectrum of users including: (a) decision-makers, both internal and external to the Agency; (b) Agency and other program managers; (c) EPA, other federal and academic scientists; and (d) operational managers and analysts; (4) collecting, archiving, and reporting on the status and trends in indicators of ecological condition on a regional and national basis; (5) providing a scientifically valid process for combining the ecosystem-specific data into comprehensive ecological risk assessments of major environmental conditions on a regional and national basis; (6) providing a scientifically, technically, and managerially innovative program with extensive

involvement of EPA laboratories, several other federal agencies, EPA's Office of Policy, Planning and Evaluation, EPA Regulatory Program and Regional Offices, states, and interested international communities; (7) providing a Quality Assurance function for ecological monitoring and assessment.

The Environmental Monitoring Systems Laboratory in Las Vegas, NV, conducts research and develops programs related to (a) monitoring of pollutants in the environment, (b) developing sampling strategies and techniques for monitoring hazardous waste leachates in soil and groundwater, (c) developing remote sensing techniques, (d) conducting human exposure monitoring and modeling studies covering several environmental media, (e) evaluating analytical methods for the characterization and quantification of hazardous wastes, and (f) providing quality assurance in support of the EPA's hazardous waste, Superfund, pesticides, ionizing radiation, and acid deposition programs.

The Environmental Monitoring Systems Laboratory in Cincinnati, OH, has as its primary mission: (a) conducting research in the development, evaluation, and standardization of chemical and biological methods for environmental assessments, (b) conducting research for detecting, identifying, and quantifying microbial pathogens found in environmental media, (c) providing technical assistance to the Program Offices and regions for conducting bioassessments of aquatic systems, (d) providing quality assurance in support of the wastewater, and related solid wastes, Superfund, and toxics programs.

The Atmospheric Research and Exposure Assessment Laboratory in Research Triangle Park, NC, conducts intramural and extramural research programs through laboratory and field research in chemical, physical, and biological sciences to (a) characterize and quantify present and future ambient air pollutant levels and resultant exposures to humans and ecosystems on local, regional, and global scales, (b) develop and validate models to predict changes in air pollution levels and air pollutant exposures and determine the relationships among the factors affected by predicted and observed changes, (c) determine source-to-receptor relationships relating to ambient air quality and air pollutant exposures, developing predictive models to

be used for assessments of regulatory alternatives derived from these relationships, directly or indirectly, and (d) conduct long-term research in the areas of atmospheric methods, quality assurance, field monitoring, biomarkers, spatial statistics, exposure assessment, human activity patterns, and modeling research.

ORD Office/Laboratory Abbreviations

CERI/CINN	Center for Environmental Research Information Cincinnati, OH 45268 (513) 569-7391
ECAO/CINN	Environmental Criteria and Assessment Office Cincinnati, OH 45268 (513) 569-7531
ECAO/RTP	Environmental Criteria and Assessment Office Research Triangle Park, NC 27711 (919) 541-4173
EMSL/CINN	Environmental Monitoring Systems Laboratory Cincinnati, OH 45268 (513) 569-7301
EMSL/LV	Environmental Monitoring Systems Laboratory P.O. Box 93478 Las Vegas, NV 89193-3478 (702) 798-2525
AREAL/RTP	Atmospheric Research and Exposure Assessment Laboratory Research Triangle Park, NC 27711 (919) 541-2106
RSKERL/ADA	Robert S. Kerr Environmental Research Laboratory P.O. Box 1198 Ada, OK 74820 (405) 436-8511
ERL/ATH	Environmental Research Laboratory 960 College Station Road Athens, GA 30605-2720 (706) 546-3500

ORD Office/Laboratory Abbreviations

ERL/COR	Environmental Research Laboratory 200 SW 35th Street Corvallis, OR 97333 (503) 754-4601
ERL/DUL	Environmental Research Laboratory 6201 Congdon Boulevard Duluth, MN 55804 (218) 720-5550
ERL/GB	Environmental Research Laboratory Sabine Island Gulf Breeze, FL 32561 (904) 934-9208
ERL/NARR	Environmental Research Laboratory South Ferry Road Narragansett, RI 02882 (401) 782-3001
HERL/RTP	Health Effects Research Laboratory Research Triangle Park, NC 27711 (919) 541-2281
RREL/CIN	Risk Reduction Engineering Laboratory Cincinnati, OH 45268 (513) 569-7418
AEERL/RTP	Air and Energy Engineering Research Laboratory Research Triangle Park, NC 27711 (919) 541-2822
OEETD/HQ	Office of Environmental Engineering and Technology Demonstration (8301) Washington, DC 20460 (202) 260-2600

ORD Office/Laboratory Abbreviations

OEPER/HQ	Office of Environmental Processes and Effects Research (8401) Washington, DC 20460 (202) 260-5950
OER/HQ	Office of Exploratory Research (8701) Washington, DC 20460 (202) 260-5750
OHEA/HQ	Office of Health and Environmental Assessment (8601) Washington, DC 20460 (202) 260-7317
OHR/HQ	Office of Health Research (8501) Washington, DC 20460 (202) 260-5900
OMMSQA/HQ	Office of Modeling, Monitoring Systems and Quality Assurance (8201) Washington, DC 20460 (202) 260-5767
ORPM/HQ	Office of Research Program Management (8102) Washington, DC (202) 260-7500
OSPRE/HQ	Office of Science, Planning and Regulatory Evaluation (8105) Washington, DC 20460 (202) 260-7669
HHAG/HQ	Human Health Assessment Group (8602) Washington, DC 20460 (202) 260-5898
EAG/HQ	Exposure Assessment Group (8603) Washington, DC 20460 (202) 260-8909
RAF/HQ	Risk Assessment Forum (8602) Washington, DC 20460 (202) 260-6743

ORD Office/Laboratory Abbreviations

REG SCI/HQ	Regional Scientist Program (8105) Washington, DC 20460 (202) 260-7667
EMAP/RTP	Environmental Monitoring and Assessment Program (MD-75) Research Triangle Park, NC 27711 (919) 541-4909

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