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# Environmental Justice

Cross-cutting Research Roadmap

Preliminary Draft, July 2, 2014

## Table of Contents

<b>I.</b>	<b><u>EXECUTIVE SUMMARY</u></b>	<b>2</b>
<b>II.</b>	<b><u>INTRODUCTION</u></b>	<b>2</b>
	BACKGROUND	2
	PURPOSE	6
<b>III.</b>	<b><u>RESEARCH SCOPE</u></b>	<b>7</b>
	EXPANDED PROBLEM STATEMENT	7
	SCIENCE CHALLENGES	8
	RESEARCH ALIGNMENT AND COORDINATION	10
<b>IV.</b>	<b><u>CROSS-CUTTING ORD RESEARCH</u></b>	<b>11</b>
	CURRENT AND PLANNED ORD RESEARCH	11
	EXAMPLES OF ORD INTEGRATION	11
	OPPORTUNITIES FOR FURTHER INTEGRATION	11
<b>V.</b>	<b><u>RESEARCH GAPS &amp; PRIORITY RESEARCH NEEDS</u></b>	<b>11</b>
	SYNTHESIS OF EXISTING GAPS	11
	PRIORITIZED RESEARCH NEEDS FOR ORD	11
	INFORMING 2016 – 2019 ORD RESEARCH PLANNING	11
<b>VI.</b>	<b><u>SUMMARY</u></b>	<b>12</b>
	<b><u>APPENDIX A. ENVIRONMENTAL JUSTICE RESEARCH INVENTORY</u></b>	<b>13</b>
	<b><u>APPENDIX B. EPA CENTERS OF EXCELLENCE ON ENVIRONMENT AND HEALTH DISPARITIES RESEARCH</u></b>	<b>22</b>
	<b><u>APPENDIX C. AUTHORS AND CONTRIBUTORS</u></b>	<b>24</b>

## I. Executive Summary

TO BE COMPLETED IN FINAL CROSS-CUTTING ROADMAP

## II. Introduction

### Background

The EPA Office of Research and Development (ORD) is developing a Research Roadmap on Environmental Justice (EJ Roadmap). This is one of four ORD roadmaps (Nitrogen and Co-Pollutants, Children’s Environmental Health, Global Climate Change, and Environmental Justice) that examine the high priority research issues cutting across ORD’s six research programs.<sup>1</sup> While each roadmap addresses one cross cutting issue, it is important to note that EJ issues are multifactorial and relevant to topics addressed in the Children’s Environmental Health and Global Climate Change Research Roadmaps. The EJ Roadmap identifies key cross-cutting scientific issues, outlines current and planned research, and describes strategic direction for the next iteration of research priorities and planning activities.

This roadmap was developed by ORD in consultation with representatives from other EPA offices, including the Office of Environmental Justice. A number of highly impactful actions and documents, along with expert consultations and input from the public, have played an important role in shaping ORD’s EJ research portfolio. The most significant of these influences are described below:

### ***Executive Order 12898: Federal Actions to Ensure Environmental Justice in Minority Populations and Low income Populations***

In 1994, President Bill Clinton issued [Executive Order \(EO\) 12898](#), “Federal Actions to Ensure Environmental Justice in Minority Populations and Low-Income Populations.” EO 12898 mandates that “each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority and low-income populations.” The Presidential Memorandum accompanying EO 12898 underscored certain provisions of existing law that can help ensure that all communities and persons across the United States live in a safe and healthy environment. Current environmental and civil rights statutes provide many

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<sup>1</sup> Air, Climate and Energy (ACE); Safe and Sustainable Water Resources (SSWR); Chemical Safety for Sustainability (CSS); Sustainable and Healthy Communities (SHC); Human Health Risk Assessment (HHRA); and Homeland Security (HS).

opportunities to address environmental hazards in minority communities and low-income communities. The EO and its accompanying memorandum established the expectation that Federal agencies will utilize existing regulatory statutes to address EJ, including the Civil Rights Act of 1964 and the National Environmental Policy Act (NEPA) of 1969. The federal government’s commitment to implementing the EO 12898 was reaffirmed by the EPA Administrator along with the heads of other agencies in 2011 by signing a Memorandum of Understanding on Environmental Justice and Executive Order 12898.<sup>2</sup>

***Environmental Justice: A Cross Agency Research Priority***

As emphasized in Fiscal Year 2014-2018 EPA Strategic Plan,<sup>3</sup> the EPA Administrator actively supports the cross-agency strategy of working to make a visible difference in communities by: “Align[ing] community-based activities to provide seamless assistance to communities, both urban and rural, while maximizing efficiency and results” and “expand[ing] support of community efforts to build healthy, sustainable, green neighborhoods and reduce and prevent harmful exposures and health risks to children and underserved, overburdened communities.” The agency’s EJ-related research, along with the activities of the other EPA offices, support the Administrator’s commitment to ensuring that all communities have the same degree of protection from environmental and health hazards. Research conducted or supported by ORD is specifically designed to provide a sound scientific foundation for regulatory decision-making across the agency, and to deliver data, tools and technologies that support decision making at the community level.

***Plan EJ 2014***

In 2011, the EPA released Plan EJ 2014,<sup>4</sup> a landmark document that demonstrated the agency’s strong commitment to integrating EJ into its programs and policies. The goals of Plan EJ 2014 are to: “Protect the environment and health in overburdened communities; empower communities to take action to improve their health and environment; and establish partnerships with local, state, tribal and federal organizations to achieve healthy and sustainable communities.” Implementation plans were developed for five cross-Agency Focus Areas<sup>5</sup> and four Tools Development Areas.<sup>6</sup> In February, 2014, the EPA issued a progress report that confirmed the completion of most of the commitments made under Plan EJ 2014.<sup>7</sup>

Working with other EPA offices, ORD played a major role in the development and implementation of the Science Tools section of Plan EJ 2014. The goal of the activities

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<sup>2</sup> <http://www.epa.gov/environmentaljustice/resources/publications/interagency/ej-mou-2011-08.pdf>

<sup>3</sup> [http://www2.epa.gov/sites/production/files/2014-04/documents/epa\\_strategic\\_plan\\_fy14-18.pdf](http://www2.epa.gov/sites/production/files/2014-04/documents/epa_strategic_plan_fy14-18.pdf)

<sup>4</sup> <http://www.epa.gov/environmentaljustice/resources/policy/plan-ej-2014/plan-ej-2011-09.pdf>

<sup>5</sup> Incorporating EJ into Rulemaking, Considering EJ in Permitting, Advancing EJ through Compliance and Enforcement, Supporting Community-Based Programs, and Fostering Administration-Wide Action on EJ

<sup>6</sup> Science, Law, Information, and Resources

<sup>7</sup> [http://www.epa.gov/environmentaljustice/resources/policy/plan-ej-2014/plan-ej\\_progress-report-2013.pdf](http://www.epa.gov/environmentaljustice/resources/policy/plan-ej-2014/plan-ej_progress-report-2013.pdf)

associated with this section was to conduct research to understand and identify solutions to environmental and health inequalities in overburdened populations and communities in the United States. The strategies to be employed in accomplishing this goal included: (1) the application of integrated, transdisciplinary and community-based participatory research approaches, with a focus on cumulative impacts; (2) the incorporation of community perspectives into the EPA’s research agendas; (3) leveraging partnership with other agencies; (4) building and strengthening the technical capacity of agency scientists to conduct research in this area; and (5) building and strengthening the technical capacity of community-based organizations and community leaders. These strategies also provide a solid foundation for addressing the key science topics that frame this EJ Roadmap.

***Draft Technical Guidance for Assessing Environmental Justice in Regulatory Analysis, 2013***

One of most important documents produced under Plan EJ 2014 was “EPA’s Action Development Process: Interim Guidance on Considering Environmental Justice during the Development of an Action through the Action Development Process (ADP).”<sup>8</sup> To support the application of this guidance in the rulemaking process, ORD co-led the development of the “Draft Technical Guidance for Assessing Environmental Justice in Regulatory Analysis.”<sup>9</sup> The Technical Guidance is a resource for agency staff conducting analyses to evaluate potential EJ concerns associated with EPA regulatory actions. It is intended to be used along with other relevant agency guidance on human health risk assessment and economic analysis. The document also identifies data gaps and includes recommendations for addressing EJ research needs.

***Expert Consultation and Stakeholder Input***

*EPA Symposium on the Science of Disproportionate Environmental Health Impacts, 2010*  
In March, 2010, the EPA co-sponsored an important scientific gathering, “Strengthening Environmental Justice and Decision Making: A Symposium on the Science of Disproportionate Environmental Health Impacts.”<sup>10</sup> The event brought together experts from a wide range of disciplines, representatives from government and academia, EJ stakeholder groups and the public. A primary goal of the symposium was to identify science needs for EJ and stimulate ideas for innovative research to meet those needs. The Symposium also focused on why some populations experience greater environmental health risks from environmental pollution, and how this knowledge can be considered in the governmental decision making processes. As a follow up to the event, the EPA developed a report that highlighted ongoing actions by the agency in

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<sup>8</sup> <http://www.epa.gov/environmentaljustice/resources/policy/considering-ej-in-rulemaking-guide-07-2010.pdf>

<sup>9</sup> [http://yosemite.epa.gov/sab/sabproduct.nsf/0/0f7d1a0d7d15001b8525783000673ac3/\\$file/epa-hq-oa-2013-0320-0002%5B1%5D.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/0/0f7d1a0d7d15001b8525783000673ac3/$file/epa-hq-oa-2013-0320-0002%5B1%5D.pdf)

<sup>10</sup> [http://www.epa.gov/ncer/events/news/2010/03\\_17\\_10\\_calendar.html](http://www.epa.gov/ncer/events/news/2010/03_17_10_calendar.html)

response to those recommendations. The actions address the need to: (1) empower communities to take action to improve health and environment; (2) increase interagency collaboration on EJ; (3) advance scientific understanding of EJ issues; and (4) better integrate EJ into the EPA’s decision making processes.

*External Scientific Peer Review of the draft Technical Guidance for Assessing Environmental Justice in Rulemaking: Science Advisory Board Review, 2013*

As part of its extensive effort to obtain advice from external scientific experts and to engage the public and important stakeholders, the EPA requested the SAB to conduct a review of the draft EJ Technical Guidance document. The EPA also solicited input from Program Offices, Regions, and others to identify research gaps, and short- and long-term research needs related to EJ and rulemaking. The SAB recommendations, public comment and agency input have been collectively considered in the development of the current draft EJ Roadmap.

*National Advisory Council for Environmental Policy and Technology, 2012*

In 2011, the EPA requested guidance from the National Advisory Council for Environmental Policy and Technology (NACEPT) on technologies that can aid in addressing environmental problems associated with vulnerable populations and EJ communities. In February, 2012, NACEPT provided recommendations to address these needs.<sup>11</sup> Specifically, they advised the agency on the need to: (1) develop appropriate detection, communication and solution technologies; and (2) deploy these technologies in partnership with communities. The EPA’s current EJ research portfolio and one of the key science challenges in Section III of this roadmap reflect a careful consideration NACEPT’s recommendations.

*National Environmental Justice Advisory Council, 2014*

In 2012, the EPA requested advice from the National Environmental Justice Advisory Council (NEJAC) on research opportunities to address environmental health disparities through ORD’s six research programs. In response to the EPA’s request, the NEJAC established a Research Working Group. In 2014, the NEJAC will publicly release its final report, entitled “Recommendations for Integrating Environmental Justice into the EPA’s Research Enterprise.” The report provides a wide range of recommendations that will be considered by EPA in the further development of the EJ Roadmap.

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<sup>11</sup>[http://www.epa.gov/ofacmo/nacept/reports/pdf/2012/2012\\_0215\\_nacept\\_ej\\_vp\\_letter\\_with\\_case\\_studies\\_web.pdf](http://www.epa.gov/ofacmo/nacept/reports/pdf/2012/2012_0215_nacept_ej_vp_letter_with_case_studies_web.pdf)

Purpose

The purpose of the EJ Roadmap is to provide an overarching framework for EJ research across ORD’s six research programs, promote integration across these programs, and to communicate ORD’s current research and strategic directions internally and externally with partners and public stakeholders. The roadmap also draws upon relevant research described in ORD’s Children’s Environmental Health Roadmap (e.g., unique life stage sensitivities, community outreach) and the Global Climate Change Roadmap (e.g., effects of climate change on vulnerable populations). The results of the research are intended to inform EPA rulemaking and policy decisions related to disadvantaged groups, and to provide state/ local decision makers and communities with information, tools and technologies that contribute to the elimination of disproportionate environmental and health impacts.



***Environmental Justice  
Roadmap Goal:***

*To ensure that ORD research is highly relevant and responsive to the unique susceptibilities experienced by vulnerable groups throughout the US, supporting the development of national policies and providing information, tools and technologies to eliminate environmental and health inequities.*

The EJ Research Roadmap is neither a new, independent research program, nor does it replace priority research needs identified by the EPA Program Offices and Regions to inform regulatory decisions and implementation challenges. Rather, it identifies, integrates and highlights efforts across ORD’s current research programs to enhance the effectiveness of the science in meeting agency needs, particularly with regard to the unique susceptibilities and exposures experienced by vulnerable populations. The roadmap is also intended to promote sustainable, healthy communities by providing state-of-the-science tools and information that can be used to characterize and mitigate environmental and health inequities.

### III. Research Scope

#### Expanded Problem Statement

The EPA has long recognized that environmental risks are often greater for low income and minority communities.<sup>12</sup> The impacts on communities at higher risk are influenced not only by differential exposures and proximity to sources of harmful chemicals, but also by interactions with non-chemical stressors. Disproportionate impacts can also arise from enhanced susceptibilities, as well as from the lack of sufficient services or benefits. Communities may suffer from inadequate physical and economic infrastructures, such as poor housing, lack of transportation, limited access to medical care and inadequate water systems. Low income, minority and indigenous populations are often exposed to social stressors such as increased crime. These multiple chemical and non-chemical stressors may combine to induce adverse impacts on health, or result in greater cumulative impacts.

The World Health Organization defines health as an integrative index of multiple stressors that impact quality of life.<sup>13</sup> These environmental, social, and economic stressors, along with other factors, form a complex and challenging set of issues that must be addressed to ensure that all populations experience the same degree of health and environmental protection. To fully understand and address the unique research needs associated with disadvantaged and overburdened populations, ORD has built its current EJ research portfolio around the critical factors that may contribute to disproportionate environmental health impacts and health disparities. This research roadmap will consider the following factors associated with disproportionate environmental impacts and health disparities, and develop applications and approaches for their assessment and characterization:

- Interactions between chemical and non-chemical stressors, including economic and psycho-social stressors
- Quality of and access to the built and natural environment (e.g., housing, transportation, schools, walkability of neighborhoods, green space)
- Differential proximity and exposure to environmental hazards and benefits
- Unique exposure pathways and differences in exposure factors
- Multiple and cumulative impacts
- Susceptibility and vulnerability
- Community engagement and capacity (social capital)
- Resiliency

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<sup>12</sup><http://www.epa.gov/environmentaljustice/basics/ejbackground.html>

<sup>13</sup><http://www.who.int/about/definition/en/print.html>

## Science Challenges

The development of ORD's EJ research portfolio has been and will continue to be based on a careful consideration by agency scientists of the recommendations of outside scientific experts and stakeholders. A common theme in both internal deliberations and interactions with outside entities has been the importance of implementing a holistic systems approach for understanding the built and natural environment, economic and social factors, human biology and human health in an EJ context. Importantly, this approach must integrate perspectives of the scientific community, residential community and community leaders, community based non-governmental organizations and community health and environmental quality advocates. An integrated, transdisciplinary, stakeholder-inclusive research approach has emerged from these internal planning discussions and external consultations. It has become clear that to effectively address EJ concerns, there is a need to focus on how the complex interactions between social, economic, biological, spatial and environmental factors result in unequal environmental health conditions or disproportionate impacts among disadvantaged population groups, communities, neighborhoods and individuals.

Based on that holistic research objective, the EJ Research Roadmap is structured around three broad science challenges that provide a framework for describing the research activities that are ongoing and identifying remaining research needs that have been identified by EPA Program Offices, Regions, and outside entities. The science challenges are organized around the themes of biological, social, economic, spatial and environmental factors associated with vulnerable populations; decision support tools and information for regulatory and community decision making; and community engagement and capacity building.

The three science challenges discussed below describe what is needed to achieve ORD's goal of providing science results that will address EJ concerns through efforts at the national and local level.

### **1. *Understanding biological, social, spatial and environmental factors associated with vulnerable populations in communities***

Minority, low-income, and indigenous populations experience greater exposure and disease burdens that can increase their risk of adverse health effects from environmental stressors. Both higher exposures to environmental stressors and increased individual susceptibility can result in greater responses to environmental hazards. For example, the combination of higher exposures and pre-existing disease among minority, low income or indigenous population groups may lead to a predisposition to higher health risks. Under this science challenge, the use of community-based studies to evaluate specific exposures and/or health

and ecosystem impacts of concern (e.g., studies of asthma, lead exposure, near-roadway exposures, unique exposure pathways, differential mercury and fish consumption) would be informative for regulatory and local decision making. In addition, characterizing the influences of inherent biological factors (e.g., the role of the epigenome as a biosensor for cumulative exposure), in combination with a consideration of social and community conditions, would enable a better understanding of their collective impact on human health, vulnerability and resilience.

**2. *Developing decision support tools, information, mitigation and prevention strategies for EPA and community decision-making***

The complexity of the problems faced by EJ communities and the frequent need for multi-sectorial solutions highlights the importance of understanding the full scope and nature of these concerns. An important means of accomplishing this objective is to ensure that adequate information is available to decision makers and affected communities on exposures, risks and solution options. Appropriate detection, monitoring, assessment and information management tools, as well as solution technologies, are also essential for diagnosing and managing disproportionate impacts to affected communities. The complexity, sensitivity and cost of these tools and technologies will depend upon their intended use (e.g., by communities to understand local exposures or by the EPA to support the development of national standards). The development of data and methods to support cumulative risk (or impact) assessments has also been identified as a particularly important need by the EPA's science advisors and the public, in recognition of the multi-pathway, multi-stressor nature of EJ concerns.

**3. *Engaging communities to build scientific capacity by sharing and translating information, tools and technologies, and by conducting collaborative research.***

Meaningful community outreach to build capacity, through training, research collaborations and other interactions, are important elements of a strategy for understanding and addressing local EJ issues. The participatory nature of many of the EJ-related research activities that address the other two science topics imparts a capacity-building aspect to the collaborations between the scientists conducting the studies and the communities that are involved. The type and level of scientific engagement with communities can vary, from implementing a fully collaborative partnership on research, to facilitating the use of low cost, easy-to-use environmental monitoring tools, to jointly developing environmental science communication materials that are informative and understandable.

## Research Alignment and Coordination

To successfully address the three science challenges and the underlying questions that are being examined, it is critical for the research to be planned and conducted in a collaborative, cross-program approach. As described in Table 1, ORD's Sustainable and Healthy Communities (SHC) Research Program plays a leadership role for EJ research activities across the three science challenges. This research program has adopted a holistic view of environment and health as its conceptual framework, and involves research conducted in a manner consistent with principles of community-based participatory research. ORD's Air, Climate and Energy (ACE), Safe and Sustainable Water Resources (SSWR), Homeland Security (HS), Human Health Risk Assessment (HHRA) and Chemical Safety for Sustainability (CSS) Research Programs each include projects that help to address EJ science challenges.

Important mechanisms for coordination and collaboration with outside entities on EJ-related research are described below:

### **Collaboration on Health Disparities Research**

Solutions to the complex and multi-dimensional concerns associated with health and environmental inequities require intersectorial and intergovernmental actions. The EPA is not solely responsible for EJ research and programs, just as health disparities are not addressed only by the U.S. Department of Health and Human Services. To achieve health and environmental equities, a multi-stakeholder, multi-system approach is required. One mechanism for interagency collaboration on EJ research issues at the federal level is through the Interagency Federal Collaboration on Health Disparities Research (FCHDR). The FCHDR was created specifically to foster greater federal coordination, collaboration, and communication around the elimination of health disparities. A central goal of the group, which includes representation by the EPA, is to advance health disparities research through interagency communication, collaboration and partnership.

### **National Institute on Minority Health and Health Disparities Centers of Excellence Program**

In addition to participation on the FCHDR, the EPA has a research partnership with the National Institute on Minority Health and Health Disparities (NIMHD), a division of the National Institutes of Health. This partnership involves supporting health disparities research that takes into account the complex interaction of biological, social, spatial and environmental factors that influence the health of certain populations. The EPA and NIMHD recently funded grants to establish NIMHD Centers of Excellence on Environment and Health Disparities Research at ten different geographical locations throughout the United States. The types of research and community-based activities being conducted by the ten Centers of Excellence are described in Appendix B.

## IV. Cross-cutting ORD Research

### Current and Planned<sup>14</sup> ORD Research

ORD research described in this EJ Roadmap includes studies being conducted under each of ORD’s Research Programs (ACE, SHC, SSWR, HS, CSS and HHRA), as shown in Table 1. Appendices A and B represent a preliminary listing and categorization of ORD research. The appendices provide a snapshot of current representative ORD research activities for each science challenge. Some activities encompass more than one science challenge, but to limit redundancy, projects were placed under the primary challenge addressed. In addition, projects that address common issues under a science challenge were grouped together (e.g., cumulative risk assessment, chemical and nonchemical stressors).

### Examples of ORD Integration

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### Opportunities for Further Integration

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## V. Research Gaps & Priority Research Needs

### Synthesis of Existing Gaps

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### Prioritized Research Needs for ORD

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### Informing 2016 – 2019 ORD Research Planning

TO BE COMPLETED IN FINAL CROSS-CUTTING ROADMAP

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<sup>14</sup> Planned research and an expanded description of current research will be added at a later time.

## VI. Summary

**Table 1.** Lead and contributing programs for EJ science challenges. Research described in this EJ Roadmap includes studies being conducted under ORD’s six Research Programs (ACE, SHC, SSWR, HS, CSS, and HHRA). Lead programs are indicated in black, contributing programs in gray, and white indicates minor or no effort. Note: The level of contributions may change over time.

Science Challenges	ACE	SSWR	SHC	CSS	HS	HHRA
1. Understanding biological, social, spatial and environmental factors associated with vulnerable populations in communities	Gray	White	Black	Gray	White	Gray
2. Developing decision support tools, information, mitigation, and prevention strategies for EPA and community decision-making	Gray	Gray	Black	Gray	Gray	Gray
3. Engaging communities to build scientific capacity by sharing and translating information, tools and technologies, and by conducting collaborative research.	Gray	Gray	Black	White	Gray	Gray

## Appendix A. Environmental Justice Research Inventory

<b>Science Challenge 1. Understanding biological, social, spatial and environmental factors associated with vulnerable populations in communities</b>		
<b>Title</b>	<b>Research Program<sup>15</sup></b>	<b>Description</b>
<b>Chemical and Non-Chemical Stressors</b>		
Community Stressors and Susceptibility to Air Pollution in Urban Asthma (STAR <sup>16</sup> research grant)	SHC	Studies to understand the relationship between chemical and nonchemical stressors, including the impact of multiple chemical, social and psychosocial stressors on health effects in vulnerable populations. Evaluate the relative spatial distributions in key community level psychosocial stressors and air pollution exposures and examine their separate and synergistic effects on childhood asthma exacerbation, hypertension in adults and health effects on other susceptible populations. Determine the ability of stress to enhance effects of chemical exposures, and determine conditions where synergies would be expected. Outcomes may include support for better-integrated public health interventions that address both environmental chemical pollution and nonchemical stressors. Several of these projects support the development of cumulative risk assessment methodologies (see Science Challenge 2 for cumulative risk assessment tools).
Combined Effects of Metals and Stress on Central Nervous System Function (STAR research grant)	SHC	
Effects of Stress and Traffic Pollutants on Childhood Asthma in an Urban Community (STAR research grant)	SHC	
Analytical Strategies for Assessing Cumulative Effects of Chemical and Nonchemical Stressors (STAR research grant)	SHC	
Hypertension in Mexican-Americans: Assessing Disparities in Air Pollutant Risks (STAR research grant)	SHC	

<sup>15</sup> Air, Climate and Energy (ACE); Safe and Sustainable Water Resources (SSWR); Chemical Safety for Sustainability (CSS); Sustainable and Healthy Communities (SHC); Human Health Risk Assessment (HHRA); and Homeland Security (HS) Research Programs.

<sup>16</sup> STAR – Science to Achieve Results

<b>Science Challenge 1. Understanding biological, social, spatial and environmental factors associated with vulnerable populations in communities</b>		
<b>Title</b>	<b>Research Program<sup>15</sup></b>	<b>Description</b>
<b>Characterizing Near-Source Exposures</b>		
Understanding Near-Source Air Quality, Exposures, and Health Effects: What are the near-source impacts associated with individual or multiple sources and what mitigation options exists?	ACE	Advance the understanding of near-source exposure both in single-source dominated environments (e.g., highways) and environments where a clustering of sources may have a combined impact on local air pollution. Improve our understanding of the nature of health effects associated with near-source exposures and explore mitigation strategies that may include: reducing source emissions; optimizing local planning efforts to limit the proximity of sources and populations to each other; and modifying the near-source physical environment.
Assess the impact of emissions from rail yard and port activity on nearby areas, as well as to investigate mitigation strategies	ACE	
Characterization of specific components of near-roadway exposures associated with adverse health effects	ACE	
Near-Road Exposures and Effects from Urban Air Pollutants Study (STAR research grant)	ACE	
<b>Climate Change Research</b>		
Reducing vulnerabilities of populations that are susceptible to negative effects of climate change	ACE	Identify biological, social and environmental factors associated with health disparities and vulnerability to impacts of climate change. Develop information to support decisions to reduce those vulnerabilities, which include the following activities: 1) develop methods to assess urban resilience as a path toward sustainability under climate and land use changes; 2) develop and integrate climate and land use tools and datasets for impacts, vulnerability, and adaptation assessments; and 3) understanding the impact of climate change on disease risk – How do climate associated changes in air quality and weather events impact allergic, chronic, waterborne and infectious disease risk among specific populations?

<b>Science Challenge 2. Developing decision support tools, information, mitigation and prevention strategies for EPA and community decision-making</b>		
<b>Title</b>	<b>Research Program</b>	<b>Description</b>
<b>Air Quality Models and Technologies</b>		
Air quality model integration for community-based decision-making	ACE/SHC	Develop, evaluate, and apply emerging technologies such as, portable sensor technologies, ground-based remote sensing (e.g., for fence line monitoring or vertical profiles) technologies, satellite-based measurements, and fusion of measurement data and model output.  Evaluate and enhance air quality models, collect supporting scientific data, and document data and models to quantify the air quality impacts and potential mitigation benefits of roadway design configurations and roadside features on near-road pollution concentrations.
Valuation and development of tools to quantify the impacts of roadway design and roadside barriers on near-road air quality	ACE	
Next Generation Air Monitoring	ACE	
<b>Cumulative Risk Assessment Tools</b>		
Five CCAT- RESES Projects <sup>17</sup>	SHC	Develop tools and data to support cumulative risk assessments, incorporate community input, and incorporate information on the impacts of chemical and nonchemical stressors on human health. Apply novel statistical and analytical methods for assessments of low income communities near Superfund areas. Includes projects to advance the planning, scoping and problem formulations for cumulative risk assessments in communities dealing with environmental pollution sources, hazardous air emissions, brownfields, close proximity to rail yards, landfills, and commercial port operations. Develop methods and models for specific data-rich diseases and derive quantitative relationships between chemical dose-response and non-chemical stressor exposure.
Cumulative risk methods and impact assessments	HHRA	
New Methods for Analysis of Cumulative Risk in Urban Populations (STAR research grant)	SHC	
Predictive tools for identifying and prioritizing real-world mixtures of stressors (environmental, residential, SES, diet, etc.)	CSS	

<sup>17</sup> CCAT – Community Cumulative Assessment Tool  
RESES – Regional Sustainability and Environmental Sciences research

<b>Science Challenge 2. Developing decision support tools, information, mitigation and prevention strategies for EPA and community decision-making</b>		
<b>Title</b>	<b>Research Program</b>	<b>Description</b>
Effects-Based Cumulative Risk Assessment in a Low-Income Urban Community near a Superfund Site (STAR research grant)	SHC	Health impact assessment reports will provide health protection, health promotion recommendations on decisions around green infrastructure, stormwater management, ecosystem restoration and community revitalization.
Proctor Creek, Atlanta, GA - Health Impact Assessments (RESES)	SHC	
Gerena School, Springfield, MA - Health Impact Assessment	SHC	
<b>Ecosystem Services and Tools</b>		
Tampa Bay Ecosystem Services Demonstration Project	SHC	Develop ecosystem goods, service-related data and tools to enable effective, efficient, and socially just solutions to commonly-faced sustainability problems.
EnviroAtlas Pilot Studies	SHC	
Evaluate effectiveness of an ecosystems approach to watershed protection and restoration– Narragansett Bay and Watershed Demonstration Project	SSWR	EnviroAtlas pilot studies are evaluating the supply and distribution of ecosystem goods and services. Data could be used to identify disparities in, for example, public housing that is in close proximity to parklands for exercise, social interaction, and engagement with nature, and the use of roadside tree buffers which can shield nearby populations from vehicular air pollution.
Sustainable Decision Alternatives in Guánica Bay, Puerto Rico	SHC	Build working relationships with multiple levels of environmental governance institutions, to inform policy adjustments that will affect the trajectory of ecosystem change in ways that are cost effective, socially equitable, and environmentally sound. Explore the process and consequences of different decision scenarios faced by rural communities in the Guánica Bay watershed in southwestern Puerto Rico and identify common areas of understanding and support actions that are balanced across the needs of different communities.
<b>Drinking Water Treatment Technologies</b>		
Improving Drinking Water Quality for Small Rural Communities in Missouri	SSWR	Develop innovative treatment and monitoring technologies for small drinking water treatment systems to reduce health threats and provide clean drinking water sources for

<b>Science Challenge 2. Developing decision support tools, information, mitigation and prevention strategies for EPA and community decision-making</b>		
<b>Title</b>	<b>Research Program</b>	<b>Description</b>
Developing a Sustainable Water Supply in Puerto Rico	SHC	remote or small rural communities, while ensuring that they have technical assistance in complying with federal drinking water regulations. For example, provide a low cost, multi-barrier solution to chlorine resistant waterborne pathogens, permitting the development of an approach for sustainable drinking water that can be implemented in these and other rural communities in tropical environments. Includes research on approaches, tools, and models to determine which contaminants or groups of contaminants in complex mixtures are potentially associated with drinking water risks.  Studies in Puerto Rico involve the following activities: (1) perform community-based participatory research (CBPR) through Water and POU Perception and Use Inventory Surveys of residents in up to 12 colonias of the Paso del Norte Region; (2) design and test POU systems for specific water contaminants of these colonias; (3) implement select POU systems in over one hundred homes across at least three colonias; and (4) evaluate the sustainability of the use of the POU technologies with respect to environmental, social/user, and economic metrics.  In rural Alabama, assess public health impacts associated with rural water supply system performance and water quality across a range of small public and private utilities (900 households), conduct a qualitative microbial risk assessment using measured water quality exposure data and identify low cost, risk mitigation strategies to protect public health.
Evaluation of the Effectiveness of ultra violet (UV) Disinfection to Inactivate Waterborne Pathogens in Puerto Rico's Non-PRASA <sup>18</sup> Communities	SHC	
Integrated Assessment and Reduction of Contaminant Risks	SSWR	
Sustainable Sorbents and Monitoring Technologies for Small Groundwater Systems	SSWR	
Point of Use (POU) water treatment systems for improving sustainability and environmental justice in Colonias of the Paso del Norte Region	SSWR	
Water Infrastructure Sustainability and Health in Alabama's Black Belt	SSWR	
<b>Lead Contamination Exposure Models</b>		
West Oakland Residential Yards Study	SHC/ACE	Develop models to address lead exposure contamination in communities. Reducing community exposure to lead through immobilizing lead in the soil and adding clean topsoil to reduce the availability for uptake into vegetation and potential ingestion. Develop a screening-level model to predict community-level lead exposure for children aged 1 and 2 years old in U.S., support community-led efforts to understand and address community-level risk (e.g. as part of the C-FERST tool – see below under Risk Screening Tools)
Community-Level Child Blood Lead Modeling - Approach and Findings	SHC	
<b>Information Resources</b>		

<sup>18</sup> Puerto Rico Aqueducts and Sewers Authority

<b>Science Challenge 2. Developing decision support tools, information, mitigation and prevention strategies for EPA and community decision-making</b>		
<b>Title</b>	<b>Research Program</b>	<b>Description</b>
Integrated Science Assessments (ISAs) and Multipollutant Science Documents	HHRA	Integrated science assessments provide scientific support on criteria pollutants and considers factors such as gender, age, race, and nutrition to provide concise evaluation and synthesis of science necessary to inform decision-making. They also communicate science judgments that provide a critical part of the foundation for reviewing the National Ambient Air Quality Standards (NAAQS).
Integrated Risk Information System (IRIS)	HHRA	The IRIS program evaluates information on health effects, considering biological, social and environmental factors that may result from exposure to environmental contaminants. These science-based health assessments are used to inform decisions to protect public health (including vulnerable and susceptible populations) and the environment.
Rapid Risk Assessment	CSS	The use of high throughput assays for multiple biological pathways for hazard screening and high throughput exposure assessments to promote biologically-based rapid chemical risk assessments.
<b>Risk Screening Tools</b>		
Tribal-Focused Environmental Risk and Sustainability Tool (Tribal-FERST)	SHC	Projects to beta-test Tribal-FERST and C-FERST through community based case studies and a tribal case study in partnership with USET (United South and Eastern Tribes). Resulting from these beta testing approaches and external peer review are a number of enhancements to the existing tools, training materials and case-studies to better demonstrate experience and application. Collectively, these materials will be used to develop more effective training approaches.
Community-Focused Exposure and Risk Screening Tool (C-FERST)		
<b>Exposure Factors Handbook: Development of an Exposure Scenario Interactive Tool</b>	HHRA	An Exposure Factors Interactive Scenario Tool under development will enable assessors to interactively define a broader range of exposure scenarios for various receptor populations and life stages, based on data from the Exposure Factors Handbook: 2011 Edition. The tool will be made available to users through the Exposure Factors module of the EPA-Expo-Box website.
<b>Evaluation of Environmental Indicators for Community Resilience</b>	HSRP	Understand the vulnerabilities of communities to environmental risks that disasters may pose, and their capacity to restore critical environmental and ecological services to function after these disasters. Develop indicators that capture these vulnerabilities and modify existing decision support tools to allow communities to use these indicators.

<b>Science Challenge 2. Developing decision support tools, information, mitigation and prevention strategies for EPA and community decision-making</b>		
<b>Title</b>	<b>Research Program</b>	<b>Description</b>
<b>Sustainability Tool for Tribal Housing Decision Making</b>	SHC	Create a tool to help tribal decision makers understand and arrive at sustainable housing development and planning decisions, to advance the short and long-term housing interests of their tribe. The tool will weigh alternative housing decisions with regard to impacts on the health of occupants, Native American cultural values and social institutions, local and regional economic systems, and the environment.
<b>Risk Management Tools</b>		
Filed Data Evaluation (FDE) tool	SHC	<p>This research addresses the cleanup of contaminated ground water, and sediments and vapor intrusion into buildings and sustainable materials management. Contamination from abandoned hazardous waste sites, active industrial facilities, leaking gas stations, oil spills, or materials management operations such as landfills disproportionately occur in EJ communities. Water justice is an important consideration in addressing these sites, especially as contaminated groundwater is found at 80% of Superfund sites.</p> <p>As the need for drinking water increases due to population increase, cycles of drought and climate change can negatively impact communities reliant on private wells as drinking water sources; these negative impacts limit water supply in some locations or constrain community choices of water supply. This research addresses these temporal and spatial impacts to ground water.</p> <p>Additionally, this research addresses contaminated sediments in waterways, which impact communities dependent upon subsistence fishing. These sites can also impair indoor air quality when vapors enter homes from contaminants in soil gas or ground water; ORD research is examining ways to characterize and prevent these potential exposures.</p> <p>With increasing transport of oil via rail in the U.S., there is increasing likelihood of oil spills in EJ communities that are located near railways. This research is addressing the fate and</p>
Petroleum Vapor Intrusion (PVI) Screen	SHC	
Community guide to impacts to drinking water	SHC	
Improving bioaccumulation models for predicting residues at contaminated sediment sites	SHC	
Use of soil vapor extraction to reduce vapor intrusion potential into homes	SHC	
GIS-based tool for assessment of groundwater contamination	SHC	
Economic evaluation of water supply alternatives	SHC	
Tools for evaluating temporal and spatial impacts of contaminated sites and materials management operations on public health and the environment, for use in site remediation, restoration and revitalization decisions	SHC	

<b>Science Challenge 2. Developing decision support tools, information, mitigation and prevention strategies for EPA and community decision-making</b>		
<b>Title</b>	<b>Research Program</b>	<b>Description</b>
Enhance reuse of wastes for local energy production while minimizing disposal	SHC	transport of these spills and approaches to control/treat spills. Materials management tools are being developed to better characterize and control the transport of contaminants and ultimately assess better life cycle approaches to reduce the use of resources, further preventing these sources of exposure.
Protocol for private well-mapping for determining well densities, proximity-driven risks to water supply wells, and redevelopment corridor locations	SHC	
Integrate oil spill models with mapping environments to provide the spatial context needed for community decision making to control exposures	SHC	

**Science Challenge 3. Engaging communities to build scientific capacity by sharing and translating information, tools and technologies, and by conducting collaborative research**

Title	Research Program	Description
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Many of the projects that address Science Challenges 1 and 2 incorporate a community capacity-building component. Examples include community-based participatory research projects, community involvement in pilot studies involving the use of data management and analysis tools such as EnviroAtlas and C-FERST, and training on cumulative risk assessments and health impact assessments. In addition, the ten NIMHD Centers of Excellence described in Appendix A2 below are involved in a number of community outreach and capacity building activities.

## Appendix B. EPA Centers of Excellence on Environment and Health Disparities Research

EPA co-funds the ten Center of Excellence for environmental health disparities research, listed below, with the National Institute on Minority Health and Health Disparities (NIMHD). These centers are conducting research and community outreach activities on a wide range of EJ issues, particularly with respect to Science Challenges 1 and 3. Research includes studies of the interaction of biological, social and environmental determinants of population health, racial and socio-economic disparities in health outcomes and access to healthy community environments.

Title	Research Program	Description
Health Disparities Research Addressing Science Challenges 1 and 3		
Columbia University - Environmental Health Disparities in the Northern Manhattan Center of Excellence in Minority Health and Health Disparities - Multilevel social and environmental risk and protective factors	SHC	Obtain information about how Health Disparity Environmental Factors modify the association between cardiovascular and mental health outcomes, to design and implement community-based interventions.
Meharry Medical College - Environmental Context of Health Disparities - Built, social and policy environments	SHC	Expand the capacity of health services researchers and other biomedical scientists to use a trans-disciplinary systems approach to study the environmental context of health disparities.
Georgia State University - Environmental Health Disparities Core - Air and water pollutants in urban, natural, physical and built environments	SHC	Integrate environmental health disparities and environmental injustice into our understanding of the syndemic (aggregation and interaction of two or more diseases in a population) burden on populations experiencing health disparities in urban Atlanta and integrating environmental health disparities and environmental injustices into our understanding of the syndemic burden.
University of Illinois at Chicago - Improving Environmental Health Disparities: A Fundamental Cause Approach: Environmental hazards, physical and social environment	SHC	Explore mechanisms explaining racial differences in exposure to environmental hazards, access to care, and health outcomes in Cook County, link them to other social determinants data using effects of racial residential segregation on physical and social environment, incidence and late stage diagnosis of cancer in relation to environmental risk factors and changes in environmental conditions on health outcomes

Title	Research Program	Description
University of Kansas Medical Center - Central Plains Center for American Indian Community Health - Housing problems, environmental tobacco smoke	SHC	Addressing the critical issue of poor housing conditions in the American Indian community. This Center is using community-based participatory research (CBPR) methods to understand how to address health disparities faced by this population.
University of Michigan - Center for Integrative Approaches to Health Disparities, Environment Assessment Core - food access, built environment	SHC	Investigate the multilevel determinants of health disparities in cardiovascular risk by integrating social and biologic factors
University of New Mexico - New Mexico Center for Advancement of Research, Engagement, & Science on Health Disparities - Socioeconomic issues, the natural, chemical and built environment	SHC	Inform research, health care and policy decisions that reduce environmental health disparities in New Mexico and advance environmental health equity knowledge and interventions that are not only scientifically-based, but also culturally-centered and community-partnered.
University of South Carolina - Analysis and Action on the Environmental Determinants of Health and Health Disparities - Environmental health disparities and environmental stressors in South Carolina	SHC	(1) Build a program to assess environmental health disparities in South Carolina; (2) Assess community perception of environmental determinants of cancer risk and disparities in rural and urban communities in South Carolina; and (3) Engage and train members of EJ community-based organizations in the use of block assessment methodology.
University of Texas - Environmental Health Disparities Research - Air pollution, respiratory and cardiovascular health outcomes	SHC	(1) Conduct research to evaluate complex interactions between social, built and natural environmental systems while clarifying determinants of environmental health disparities; (2) Build research and training capacities to examine and address environmental health disparities; and (3) Facilitate translation of environmental health disparities research into policy, public health practice, and community-based engagement.
Weill Cornell Medical College - Environmental Health Disparities Core - Community-led culturally tailored environmental health outreach	SHC	Develop a set of community-led culturally tailored environmental health outreach initiatives; increase community awareness of priority environmental health issues; strengthen community capacity to address environmental health disparities; and increase community trust and participation in the research

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