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Board of Scientific Counselors

REPORT OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY BOARD OF SCIENTIFIC COUNSELORS SUSTAINABLE AND HEALTHY COMMUNITIES (SHC) SUBCOMMITTEE RESPONSES TO CHARGE QUESTIONS

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I. LIST OF ACRONYMS

AALM All Ages Lead Model
A-E Air and Energy Research Program
AFFF Aqueous Film Forming Foam
ANPRM Advanced Notification of Proposed Rulemaking
AOC Area of Concern
ASTHO Association of State and Territorial Health Officials
ASTSWMO Association of State and Territorial Solid Waste Management Officials
BLL Blood Lead Level
BUILD Brownfields Utilization, Investment and Local Development Act
C&D Construction and Demolition
CAA Clean Air Act
CCR Coal Combustion Residuals
CDC Centers for Disease Control and Prevention
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
COPCs Inorganic Constituents of Potential Concern
CRSI Climate Resilience Screening Index
CSS Chemical Safety for Sustainability
DASEES Decision Analysis for a Sustainable Environment, Economy and Society
DoD United States Department of Defense
DoE United States Department of Energy
DW Drinking water
ECOS Environmental Council of the States
EHHI CoP Environmental and Human Health Indicators Community of Practice
EPA United States Environmental Protection Agency
EQI Environmental Quality Index
ERIS Environmental Research Institute of the States
ETSC Engineering Technical Support Center
F&T Fate and Transport
FEMA Federal Emergency Management Agency
FY Fiscal Year
GIS Geographic Information System
GLLA Great Lakes Legacy Act
GLNPO Great Lakes National Program Office
GLRI Great Lakes Restoration Initiative
GWTSC Groundwater Technical Support Center
HELP Hydrologic Evaluation of Leachate Performance
HENUC Human Exposure Not Under Control
HHRA Human Health Risk Assessment Program
HHS United States Department of Health and Human Services
HIA Health Impact Assessment
HS Homeland Security
HSRP Homeland Security Research Program
HWBI Human Health and Well-being Index
IEUBK Integrated Exposure Uptake Biokinetic model

LCA Life Cycle Assessment
LEAF Leaching Environmental COPCs Assessment Framework
LUST Leaking Underground Storage Tanks
MIW Mining-influenced Water
MSW Municipal Solid Waste
MWiz Materials Management Wizard
N Nitrogen
NAAQS National Ambient Air Quality Standard
NAICS North American Industry Classification System
NIEHS National Institute of Environmental Health Sciences
NIFA National Institute of Food and Agriculture
NPL Superfund National Priority List
NPM National Program Manager
OAR EPA's Office of Air and Radiation
OBLR Office of Brownfields and Land Revitalization
OCHP EPA's Office of Children's Health Protection
OCR EPA's Office of Community Revitalization
OCSPP EPA's Office of Chemical Safety and Pollution Prevention
OEJ EPA's Office of Environmental Justice
OEM Office of Emergency Management
OLEM EPA's Office Land and Emergency Management
OP EPA's Office of Policy
ORCR EPA's Office of Resource Conservation and Recovery
ORD EPA's Office of Research and Development
OSC On-Scene Coordinator
OSRTI Office of Superfund Remediation and Technology Innovation
OUST Office of Underground Storage Tanks
OW EPA's Office of Water
P3 People, Prosperity and the Planet
Pb The elemental heavy metal – lead
PBT Persistent, Bioaccumulative Toxicants
PCBs Polychlorinated biphenyls
PFAS Per- and poly-fluoroalkyl substances
PVI Petroleum vapor intrusion
R2R2R Remediation to Restoration to Revitalization
RAO Remedial Action Objectives
RAU Ready for Anticipated Use
RCRA Resource Conservation and Recovery Act
REE Rare Earth Element
RESES Regional Sustainability and Environmental Sciences Research Program
RFA Request for Applications
RIMM Risk-Informed Materials Management
ROE EPA's Report on the Environment
RPM Remedial Project Manager
SARA Superfund Amendments and Reauthorization Act
SBIR Small Business Innovation Research
SDWA The Safe Drinking Water Act
SHC EPA ORD Sustainable & Healthy Communities Research Program

SMM Sustainable Materials Management
SRP Superfund Research Program
SSWR Safe and Sustainable Water Resources Research Program
STAR EPA's Science to Achieve Results Program
STEM Science, Technology, Engineering and Mathematics Programs
STEAM Science, Technology, Engineering, Arts, and Mathematics Programs
StRAP Strategic Research Action Plan
SWDA Solid Waste Disposal Act
TSCA Toxic Substances Control Act
TSP Superfund Technical Support Project
USACE United States Army Corp of Engineers
USDA United States Department of Agriculture
USEEIO US Environmentally-Extended Input- Output Model
VI Vapor Intrusion
VOC Volatile Organic Compound

II. INTRODUCTION

The mission of the EPA Office of Research and Development (ORD) is to provide the best available science and technology to inform and support public health environmental decision-making at the Federal, state, tribal, and local levels, addressing critical environmental challenges and anticipating future needs through leading-edge research. ORD prepares Strategic Research Action Plans (StRAPs) to guide its research planning over the ensuing four years, and beyond, and inform its Agency Partners (program and regional offices) and external stakeholders of the program's strategic direction over the next four years. The draft 2019-2022 StRAPs are the third such strategic planning exercise in this format (previous StRAPs covered 2012-2016 and 2016-2019).

The draft 2019-2022 StRAPs orient ORD's research to respond to Administration priorities, as expressed in EPA's Strategic Plan. Additional detail on specific research needs has been identified through formal discussions with EPA programs and regions over calendar year 2018. Development of this third iteration of the StRAPs also emphasizes consultation with the states to identify their needs, particularly through the Environmental Council of the States (ECOS), along with engagement with the tribes. The six StRAPs are:

- Air and Energy (A-E)
- Safe and Sustainable Water Resources (SSWR)
- Sustainable and Healthy Communities (SHC)
- Chemical Safety for Sustainability (CSS)
- Homeland Security Research Program (HSRP)
- Human Health Risk Assessment (HHRA; delayed awaiting Agency input on priorities)

The consolidated EPA program and region, state, and tribal research needs are structured in the StRAPs under Topics, which are organized into Research Areas, and then detailed into draft research Outputs (Appendix 1 of each StRAP). The Outputs, in turn, will serve as the focus for future engagement with EPA ORD Laboratories, Centers, and Offices (LCOs) to identify research products that address the identified needs. ORD will also maintain engagement with partners throughout the research process to optimize the utility of the research products to meet their needs.

III. BACKGROUND

The BOSC Sustainable and Healthy Communities (SHC) Subcommittee was established to provide program-specific advice to EPA's SHC Research Program (SHCRP). The mission of the SHCRP is to conduct research and deliver products that improve the capability of EPA to carry out its responsibilities, including cleaning up communities, making a visible difference in communities, and working toward a sustainable future. SHCRP conducts applied, relevant research and aims to provide the knowledge, data, and tools needed to meet today's needs without compromising the ability of future generations to meet their needs in ways that are economically viable, beneficial to human health and wellbeing, and socially just, while supporting local communities seeking to become more sustainable. SHCRP plans to engage the Subcommittee over the next several years to provide advice on the Program's portfolio and to assess progress in addressing EPA's needs.

IV. STRAP RESEARCH OBJECTIVES

ORD is seeking input from the BOSC on the draft StRAP documents and proposed research strategies therein. The emphasis is on advancing ORD research that can successfully address the needs identified by EPA programs and regions, and states and tribes. This BOSC review at the strategic planning phase will be followed by regular BOSC reviews of research activities over the course of StRAP3 implementation.

The Subcommittee convened for a face-to-face, public meeting on April 2-3, 2019 at EPA's Research Center in Research Triangle Park, NC. The focus of the meeting was on the EPA ORD Public Review Draft StRAP (Feb. 2019), and review of three key topic areas within SHCRP's portfolio: (1) Contaminated Sites; (2) Waste and Sustainable Materials Management; and (3) Healthy and Resilient Communities. It supports EPA's mission by working with the states and tribes, in conjunction with EPA's program and regional offices.

This plan emphasizes the following actions:

- Technical support for remediating CERCLA-designated contaminated sites and returning them to productive use.
- Science to reduce costs and set science-based cleanup levels in areas designated under CERCLA.
- Research to help manage waste in landfills and support sustainable materials management.
- Research to characterize vulnerability to risks of structural damage causing leaks, and to prevent or remediate contamination from leaking underground storage tanks.
- Research to evaluate the potential associations between human health and ecosystem goods and services, and to document these relationships using SHC's EnviroAtlas.
- Research to assess the impacts of pollution on susceptible and vulnerable sub-groups such as children, environmental justice communities, and other susceptible populations to identified chemical and biological exposure agents in the pollution.

The agenda is attached as an appendix to this report. The meeting included discussions of research priorities with staff from the Office of Land and Emergency Management (OLEM), formerly the Office of Solid Waste and Emergency Response (OSWER), regional representatives' perspectives with partner panel discussions, and an ORD research laboratory tour. The Subcommittee worked in full group and

breakout groups to discuss and address the charge questions and associated recommendations. Interaction between OLEM and SHC staff and the Subcommittee throughout the meeting allowed for clarifications and are captured in the minutes from the meeting. Following adjournment, members continued collaborating via email within assigned breakout groups to finalize the responses to the charge questions. These responses were synthesized into this report, distributed to members for final consensus review, and finalized by the SHC Subcommittee chairs in May 2019.

Contaminated Sites: Accelerating Cleanups
The objective is to provide cost-efficient, rapid, and effective technical support and innovative methods for site characterization and cleanup, especially for complex site-specific issues; contribute to EPA program guidance and other technical support to manage contaminated groundwater (present at 85% of NPL sites), leaking underground storage tanks, and mine waste; and to provide science-based approaches so that OLEM, EPA regions, and states can better engage in effective restoration of contaminated sites. The results can inform the public as they participate in the selection of remediation options.

Technical support and research-and-development under this objective will provide support for OLEM, EPA's Regions, and delegated programs that:

- clean up contaminated soils and sediments;
- remediate contaminated groundwater;
- remediate mining and mineral processing sites;
- remediate and characterize solvent vapor intrusion;
- remediate contamination from leaking underground storage tanks; and
- remediate sites impacted by PFAS and lead (Pb).

Waste and Sustainable Materials Management: Reducing the Burden of Contamination
The objective is to develop an integrated approach to materials management, including the need to evaluate landfill performance and its long-term impact on human health and the environment. Many existing materials considered to be either hazardous or non-hazardous waste intended for some form of disposal could potentially be reused, recycled, or reprocessed into other resources. Sustainable Materials Management (SMM) considers the full life cycle of materials thereby reducing toxics and greenhouse gases, reducing unnecessary consumption of natural resources, reducing emissions, beneficially using waste materials, and protecting human health and the environment.

Research and development under this objective will provide data and tools to support OLEM and state and local delegated programs that:

- manage wastes, transfer stations, material recycling facilities (MRFs), waste to energy plants and municipal and hazardous waste landfills;
- use economic input-output models and process life cycle assessment models of waste materials; and
- reuse wastes in a beneficial manner.

Healthy and Resilient Communities: Revitalizing Communities from Contamination and Natural Disasters and Extreme Weather Events
The objective is to increase community resilience by reducing potential risks, promoting health, and revitalizing communities. Research under this objective will identify links between these desirable outcomes and effective site restoration and the provision of ecosystem services and health-promoting

features of the built and natural environments. This research includes support for the Agency's Goal 6 and others stipulating that all, including susceptible and vulnerable sub-groups (e.g., children, elderly, minority communities), should benefit from remediation, restoration, and revitalization efforts (R2R2R). It also includes understanding the challenges associated with preparing for and recovering from the impacts of hazards, disasters and extreme weather events, especially when these might result in contaminants migrating from containment sites.

Research and development under this objective will provide data and tools to support Agency and delegated programs to:

- develop weight of evidence approaches to evaluate remedy effectiveness and restoration effectiveness, and how the provision of ecosystem services contributes to community revitalization;
- address the risks and impacts to susceptible and vulnerable sub-groups from contaminated sites;
- improve the resiliency of communities against contamination and natural disasters and extreme weather events; and
- measure and report on the outcomes of EPA's environmental protection activities, e.g., EPA's Report on the Environment.

V. CHARGE QUESTIONS AND CONTEXT

The Charge Questions were designed to assist the subcommittee in structuring its discussion and its feedback to SHCRP. By way of context, the subcommittee was informed that ORD has taken on a new strategic metric that is intended to measure and improve ORD's direct responsiveness to Agency needs. The Agency has asked ORD to "Refocus the EPA's robust research and scientific analysis to inform policy making," and to meet and improve on the following Strategic Measure: By September 2022, increase the number of research products meeting customer needs. The Charge Questions, therefore, ask the subcommittee to assess how responsive SHC's StRAP is to broad Agency directions, specific Program and Regional Office needs, and the needs of Agency stakeholders in the states and tribes. They ask if SHCRP's explanations are clear, if there are important topics within the scope of SHC that the StRAP does not address, and to assist subcommittee members as it considers mechanisms to promote innovative solutions.

Accordingly, the SHC Subcommittee was charged with five questions StRAP-related questions, and two research program-specific questions as follows:

- **Q.1a:** Does the research outlined for the 2019–2022 timeframe support the relevant Agency priorities as described in the EPA and ORD Strategic Plans?
- **Q.1b:** Each ORD research program undertook a rigorous engagement process to provide additional detail on specific EPA program and region, state, and tribal needs, the results of which are summarized in the StRAP objectives and explanations of research topics and areas. How well does the proposed research program respond to these partner-identified needs?
- **Q.1c**: Does the StRAP, including the topics, research areas, and proposed outputs, clearly describe the strategic vision of the program? Given the environmental problems and research objectives

articulated, please comment on the extent to which the StRAP provides a coherent structure toward making progress on these objectives in the 2019-2022 time frame.

- **Q.1d**: Recognizing ORD's focus on addressing identified partner research needs, in the presence of reduced scientific staff and resources, are there any other critical emerging environmental needs or fields of expertise and/or new research methods where this program should consider investing resources?
- **Q.1e:** What are some specific ideas for innovation (including prizes/challenges) and market-based approaches that the program could use to advance solutions to existing and emerging environmental problems?

Sustainable and Healthy Communities Research Program (SHC)

- **Q.2**: SHC's StRAP is set-up as a series of problem statements with solutions (labeled as Outputs). This is the approach we have used to address partner-identified needs (see Q.1b above). Is this approach helpful in identifying research that is likely to meet the needs of EPA's program and regional offices? What about the needs of the states and tribes?
- **Q.3**: At the request of EPA's Regions, we have included the impact of natural disasters (e.g., severe weather, wildfires) in research areas 9 and 10. The focus is on how these types of disasters impact contaminated site remediation and restoration and community resilience. What suggestions does the subcommittee have for making this research more efficacious?

VI. SUBCOMMITTEE RESPONSES TO CHARGE QUESTIONS

The BOSC SHC Subcommittee commends the work of SHC Program Scientists, Administrators, and Supporting Staff. The body of work presented throughout the BOSC deliberations is an impressive display of EPA's capabilities and the size of the challenges they are faced with in pursuit of protecting human health and the environment. ORD staff are clearly thinking holistically about the research needs and approaches. SHC scientists are seeking not only to advance scientific knowledge and develop the needed technologies, but also to involve stakeholders and address broader economic and social questions relating to community revitalization, resilience, and development. The depth of knowledge displayed by the SHC Program Director and Deputy Director is impressive. Their ability to speak extemporaneously on areas of related research and to respond to BOSC member questions displayed a high degree of engagement with their staff and broad understanding of the complex issues under investigation.

We appreciate how the SHC research program provides scientific solutions and technical support to EPA partners and state and tribal decision makers to remediate and restore our nation's most challenging and complex contaminated sites. This work will develop permanent remedies and innovative treatment technologies (as specified by SARA) that are needed to accelerate both the pace and cost reduction of cleanups, while also returning contaminated sites to safe and productive use by communities.

We recognize that there may be recommendations made within this document that are currently already underway but were not shared with us in the limited time the subcommittee was together. We look forward to learning more in upcoming meetings and the response to these recommendations by SHC staff.

In the responses to charge questions below, we acknowledge outstanding strengths in the SHC StRAP and Program and offer a variety of suggestions and recommendations for consideration. Across the SHC topics, a few overarching themes have emerged. We highlight the need for additional metrics to help monitor progress as SHC moves from needs and problems through the research process on the way to helpful outputs and outcomes. We encourage more long-term focus in addition to time-sensitive acute and near-term issues. We suggest attention to making research from CERCLA sites available for managing additional contaminated sites. We encourage more attention to prevention and vulnerability reduction including cross-cutting emphasis on disasters, extreme weather events, and climate change[1] throughout SHC's Topic Areas. These areas and more are discussed below.

CHARGE QUESTION 1A

Q.1a. Does the research outlined for the 2019-2022 timeframe support the relevant Agency priorities as described in the EPA and ORD Strategic Plans?

Narrative

The report is well organized with a clear focus on Contaminated Sites, Waste and Sustainable Materials Management, and Healthy and Resilient Communities and is tied to EPA/ORD strategic priorities. The EPA Strategic Plan calls for the revitalization of land and the prevention of contamination. Throughout the EPA Strategic Plan, there is a call for attention to vulnerable populations. ORD's Strategic Goals include supporting decision-making at all scales by making research results, tools and technical expertise more widely known and available to federal, state, tribal, and local partners. The research outlined in Topic 2 of the SHC StRAP provides needed support to states in helping them to make informed decisions on the safe and appropriate beneficial use and reuse of different material types, and supports the Agency's core mission by looking at materials management from a systematic point of view through the lens of life cycle assessment. The SHC StRAP's focus in Topic 3 on identifying susceptible and vulnerable sub-groups and providing forecasting tools for evaluation and measuring effects is a positive start on addressing vulnerability in connection with EPA and ORD priorities. SHC is guided by a robust definition of resiliency that not only focuses on coping with disturbance and maintaining essential function, identity, and structure of socio-ecological systems, but also the capacity for adaptation, learning, and transformation. In this way, the StRAP is forward looking and has the potential to pull communities forward through the revitalization process.

We offer suggestions on ways to improve the response to Agency priorities, including adding more explicit attention to climate change[1] as it relates to contamination, waste management, and community resilience, incorporating more research on prevention and reducing community vulnerabilities related to contamination, and workforce development.

Strengths

It is clear that SHC is working collaboratively with other National Programs and agencies on site characterization and remediation as well as chemicals of immediate concern. This is a good example of cooperative federalism outlined in EPA and ORD strategic plans.

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[1] **USGCRP**, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018

SHC staff working in this area have a high degree of technical expertise, particularly in regard to the highly complex mix of disciplines required to guide the safe management of hazardous and municipal solid waste disposal facilities.

The StRAP acknowledges the importance of engaging with local stakeholders throughout the process of remediation, restoration, and revitalization (R2R2R) in order to build resilience in contaminated socio-ecological systems. In this way, the StRAP responds to EPA's goal of cooperative federalism by increasing transparency and public participation by creating tools for community-based environmental work and facilitating multi-directional communication between the public and environmental agencies.
By reporting indicators through the Report on Environment (ROE) and EnviroAtlas and interpreting and forecasting indicator trends, SHC's StRAP supports the EPA's and ORD's priorities associated with creating consistency and certainty as well as prioritizing robust science.

Suggestions

- **Environmental and Climate Change**: Climate change crosscuts most of the SHC research program in one way or another. The SHC StRAP should be explicit in calling out the burden that environmental changes, including climate change, will place on communities and especially susceptible and vulnerable sub-groups, particularly related to contamination and waste management. Such research provides an important set of data to support decision-making at all scales. This research and expertise should be made more widely known and available to federal, state, tribal, and local partners.
- **Topic 2 Connections to Agency Priorities**: While the SHC StRAP is in general strongly focused on goals defined in the ORD and EPA Strategic Plans, there is not a clear connection to the ambitious clean-up goals articulated in the EPA Strategic Plan with respect to contaminated sites, brownfield and LUST clean-up and turnover. Greater detail is needed on how SHC research will be implemented to support specific Agency priorities and goals.
- **Prevention:** While SHC does a strong job of identifying opportunities to remediate contamination, more attention should be focused on preventing contamination. EPA's Objective 1.3 is "Revitalize Land and Prevent Contamination". SHC's program on remediation, restoration, and revitalization might be expanded to include Prevention (P-R2R2R). While SHC's emphasis on revitalization goes appropriately beyond disaster management's consideration of recovery, the notion of prevention is likewise important to attempt to avoid contamination in the first place[2]. Deeper research consideration of community context and other site-specific and environmental processes with a specific focus on prevention would help to meet new statutory requirements to improve the safety of chemicals in commerce (from the EPA Strategic Plan). See additional ideas in response to Charge Question 3.
- **Research on Reducing Vulnerabilities:** EPA's Goal 2 of cooperative federalism involves establishing active platforms for public participation and building capacity of vulnerable community stakeholders. While the identification of susceptible and vulnerable sub-groups is central to SHC's Topic 3 research, we recommend additional research attention on reducing such community vulnerabilities, particularly those that have greater risk of exposure to toxins due to their location or traditional subsistence lifeways. Research on what drives vulnerability and how communities can build adaptive capacity and reduce vulnerability would support these EPA goals.

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[2] As stated in the StRAP on p. 15, "Controlling the source [of contaminants] will reduce or eliminate the need for perpetual MIW treatment and decrease overall costs, treatment waste volumes, and energy use."

- **Research on Public Participation:** We acknowledge that SHC's community-based work is designed to run through regional partners, however, more research that identifies mechanisms to enhance local participation to reduce vulnerability would fit well within Topic 3 of the SHC program. Engaging a broad array of partners also involves making sure SHC research on vulnerable communities, the relationship between ecosystem services and human wellbeing, and the R2R2R process is more accessible to communities and decision-makers (beyond peer-reviewed journals and technical reports). This will help support EPA and ORD goals of supporting community-driven problem solving through integrating decision support tools and processes.
- **Workforce Development:** ORD's Goal 3 focuses on enhancing the ORD workforce. While the SHC StRAP is more focused on research design, building a skilled workforce to address community vulnerability and resilience is integral to achieving successful outcomes and supporting EPA and ORD priorities. Engaging professionals experienced in environmental impact assessment (National Environmental Policy Act of 1969), social impact assessment, and health impact assessment frameworks would ensure a more comprehensive process to expand the current focus on case studies.

Recommendations

The Subcommittee offers these five recommendations to capitalize on efforts to respond to Agency priorities.

Recommendation 1a.1: Add *prevention* to SHC research programs that support R2R2R phases of building community resilience in the context of contaminated sites.

Recommendation 1a.2: Create systems or platforms for program and regional offices, states, and other partners to acknowledge where and how research outputs have made a material difference in publicly visible projects (including work on sites beyond EPA jurisdiction) to respond to the EPA priority of shared governance and collaboration.

Recommendation 1a.3: Dedicate research attention to not only identifying, but also to document pathways for *reducing* vulnerability in communities, giving consideration to site-specific and intersectional characteristics of vulnerability and measurable benchmarks.

Recommendation 1a.4: Review each problem statement under each research topic and consider how climate change could worsen the problem.

Recommendation 1a.5: Enhance workforce development by engaging professionals with experience in environmental impact assessment, social impact assessment, and health impact assessment.

CHARGE QUESTION 1B

Q.1b. Each ORD research program undertook a rigorous engagement process to provide additional detail on specific EPA program and region, state, and tribal needs, the results of which are summarized in the StRAP objectives and explanations of research topics and areas. How well does the proposed research program respond to these partner-identified needs?

Narrative

The BOSC SHC Subcommittee agrees that SHC developed the StRAP objectives in direct response to needs identified by partners through an extensive engagement process that included multiple interactions and a process of coordinated engagement with SHC and its national and regional partners. The outputs are articulated to show how SHC's research activities will advance the development of solutions to address those issues directly.

Based on the materials provided to the subcommittee and the presentations at the face-to-face meeting, it appears that a robust process of engagement took place to incorporate partner needs. In the StRAP, the needs of several partners and regions appear to be well represented. Representatives from Region 3 noted their appreciation for the listening and engagement by SHC that will increase the likelihood of buy-in from other partners and they stated that the StRAP represents states needs as well. Representatives from other agency partners complemented SHC's tool development and overall collaborative relationships to help address EPA-wide goals by linking efforts. The StRAP acknowledges the need for partnership with FEMA (p.3) and the related agreement to work together should be an asset to addressing both disasters and extreme weather events and their implications for contaminated sites, etc.

The BOSC SHC Subcommittee recognizes that ORD must balance its available resources against what is likely an extensive list of additional issues that partners may have identified. However, the BOSC is not presented with information about how prioritization of issues occurs and what the universe of partner priorities contains. We are not questioning the selections of research needs, but instead identifying that the BOSC SHC Subcommittee has no information to review for the priority setting process for research needs included in the StRAP and does not have full information on the needs of all regions, states, and tribes.

SHC may find ways to address more issues by exploring the potential for collaboration with partners in academia or other agencies in order to address important problem statements not able to be addressed due to limited resources or the need for specialization in a topical field external to EPA. More of this is included in the discussion on innovation.

Strengths

SHC did a great job through multiple channels reaching out to partners including regional offices, program offices, ECOS, ASTHO, and other local/state partners. Based on the presentations by Region 3 at the meeting, it is clear that SHC is working closely with some cities and hearing community needs.

The BOSC SHC Subcommittee appreciates the intentional inclusion of "vulnerable groups" (e.g., children, elderly, minority communities, etc.) in research considerations and feels that this is a very important addition. Susceptible and vulnerable sub-groups are more likely to be affected by contaminated sites because of physical proximity, immature physiological systems (e.g., children), and existing medical conditions. In addition, social, economic or emotional stress may amplify the effects of toxins. Furthermore, there are several factors which predispose individuals to greater vulnerability after exposure to toxins (biological agents) and toxicants (chemicals) from the site. Vulnerable populations are also marginalized with limited social and political capital, and many have language barriers that make these individuals and communities less able to advocate for themselves.

Efforts related to establishing a science-based landfill post-closure time horizon are clearly in response to partner needs for guidance and efforts related to understanding the phenomena of 'hot landfills' and management of bioreactor landfills.

The US-EEIO and updates to the Solid Waste Facts and Figures report to include classification by generator NAICS code will provide states and other partners information to more proactively pursue source reduction and reuse strategies. Such analyses are critical for providing a holistic approach to materials management across the full supply chain and provide information that is a hedge against unintended consequences. The US-EEIO model has been applied to a range of research questions, including sustainable purchasing and supply chain management decisions, by users that include private and public sector organizations and universities.

Suggestions

- **Clarity on Partner Research Needs**: The BOSC SHC Subcommittee recommends more detail in the StRAP on state recommendations to know how well this outreach is represented in the StRAP (e.g., how many state-suggested research topics have been accepted, where did state recommendations fit in the research priorities). Similarly, tribes are mentioned but it is not explicit what the tribe needs are and how well their needs are represented. It would be helpful to get a better understanding of the specific needs of the different tribes as each has a unique geography and culture as well as site and nature of contamination. It would also be helpful for the StRAP to include increased clarity on the process by which the research activities were prioritized from among all of the partner-identified needs. While it does appear that a number of agency partners, regions, and states were engaged in the StRAP development process, it isn't clear about the involvement of other states and regions. Engagement with local governments and local partner needs identification is not always clearly and explicitly captured in the StRAP.
- **Definition of Community Partner**?: The definition of communities is not clear, and a clearer definition would be helpful in the StRAP. In many cases there are multiple communities within a geographical area of focus. Much of the exposure potential is very local and likely to be in cities given the increasing number of citizens moving to cities. It is clear that SHC reached out to many non-federal partners such as ECOS, APHA, APA, ASTHO, and ASTSWMO. In the future it may be helpful to reach out to more municipal-level partners such as ICLEI, ICMA, NLC, and the Urban Sustainability Directors Network.
- **Environmental Justice**: There is an opportunity to engage with local EJ organizations. SHC should explore mechanisms to identify EJ partners in affected communities. Determining community needs goes beyond engagement with national organizations such as APHA and ASTHO. While these organizations can provide important insights, direct engagement with community members who live in close proximity to contaminated sites and use resources that may be directly affected would provide valuable perspective. An approach based on SHC's Partner Alliance and Coordination Teams (PACTs) that engages communities directly and gathers feedback in a systematic fashion could inform ORD's objectives. This is especially needed with EPA's greater focus on environmental justice.
- **Partner Engagement:** Following principles of community engagement (e.g., building relationships from the ground up versus top down) to maintain the trust initiated or built to date, and of community-based participatory research will help continue to ensure research priorities are based on local issues and needs identified by states and regions. Through partnerships with the regional offices, it may be possible to engage more explicitly and more frequently with local communities given that the regions perform or monitor work conducted at the local level and can therefore best

identify needs and concerns, collect data, etc. The Cultural Broker approach referenced by FEMA may be a useful partnership model to explore:

> *"Culture Brokers for Disaster Preparedness are people with local knowledge and the trust of community members. They are capable of bridging gaps, are willing to help, and would be trained to use the four Guiding Principles to enhance local levels of preparedness. Recruiting these individuals can help outside organizations and local communities connect, build trust, and share knowledge. Such a methodology has been proven effective in educational, medical, and public health environments…"*[3]

- **Communications and Social Media:** We encourage SHC to engage experts in communications (print and electronic media, social media) and the social sciences to provide culturally appropriate follow-up opportunities to the regions, states and tribes to provide input on the StRAP, even if some of their specific requests (localized needs) are not among the highest priorities for implementation of the StRAP in 2019-2022, to inform ideas shared with collaborating agencies for future work. Research Area 11 of the StRAP highlights the management plan for the Report on Environment indicators and website. Public access to this information and readily understandable "abstracts" written in plain language could facilitate interaction to better respond to local needs.
- **Engagement Metrics:** Communities (e.g., cities, tribes, neighborhoods) are most affected by contamination, but are rarely leading the remediation. SHC should explore working with regional partners to define a metric to determine how well they are working with their local communities to measure success of these research program areas. The approach to remediation may be improved with a robust community engagement process, particularly if the community is empowered to actively participate in the process and assumes a high level of ownership in the process.
- **Flexibility for States**: Invitations to states to participate in Research Area Coordination Teams (RACTs) require a significant time commitment (e.g., 10% of a staff person's time over 3 months). States could use more flexibility (such as a 1-day meeting) or other arrangements that would be more palatable. In general, SHC should consider increasing the flexibility of participation from states.
- **Uniform Reporting**: SHC could explore a national uniform reporting system for contaminated sites so that site contamination information can be available to partners at all levels of government and with better data, communities can better leverage their resources to support remediation of sites, especially non-CERCLA sites. This is an issue of transparency and engagement.
- **Partner Focused Tools**: It is not clear that communities are always well engaged in the decisions to develop tools and toolkits. SHC should be clear about which communities asked for each tool, which communities committed to working on the tool development, which communities committed to staff learning the tool and testing its utility in the community, and which communities committed to evaluating tool efficacy over time? In many cases, community staff are under resourced and unable to effectively learn a new tool. SHC may want to consider 1) sharing the existing toolkit to a broader community audience to ensure that more users are engaged, 2) obtaining user feedback on which tools to continue to support and/or update, and 3) explore technical assistance to communities in using the most effective tools (e.g., regional contacts or contractor support). If not already doing so, SHC should consider incorporating an evaluation plan for all toolkits, workshops, etc. to ensure products are meeting the needs of end-users.
- **Modeling**: The US-EEIO can provide powerful analysis for those skilled in LCA. SHC should use it to develop accessible analysis products to empower a wider set of practitioners to understand and communicate the full environmental burden of different consumption choices. We agree that the model should be further extended, e.g., by developing models for each state and linking to global

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3 The U.S. Federal Emergency Management Agency (FEMA). 2019. "Building Cultures of Preparedness: A report for the emergency management higher education community." Washington, DC: FEMA.

models as well. There is also potential to integrate data on physical flows of materials and to integrate tracking of waste, recycling and reuse. SHC should be transparent in regard to certain limitations of I/O LCA and the utility of process LCA in certain circumstances.

- **Regional Representation in RESES:** We suggest increasing the balance of annual regional representation in the intramural Regional Sustainability and Environmental Sciences Research Program (RESES). Recognizing and engaging with heterogeneous groups within geographic boundaries of a project, including multiple communities with their own perceptions and goals, is critical for long-term project success.
- **Technical Support:** There may be a way to expand the capacity building from Topic 1 (Contaminated Sites) and provide technical support on other topics as well. Topic 3 on Healthy and Resilient Communities seems like a good place to include considerations about how some communities have a greater toxicity burden than others and how to reduce this burden. The StRAP (p. 32 and 44) briefly mentions the disparities between communities, but there is little discussion about how to reduce them other than vulnerability assessments. There should be more consideration about what communities can actually do on their own and how they can better partner with outside groups. A place for this might be on the output Pathways to Revitalization and Resilience that Build Community Capacity.[4] SHC should support continuing education for participating local community staff so they can develop partner networks and reduce their toxic burdens over time. It would be helpful to explore how to link SHC expertise with communities that have ownership of the site and ensure sustainability so that when EPA experts leave, there is a stronger capacity (resiliency) in the more empowered community.
- **Potential Partners:** As part of the review process, specific SHC partnership opportunities were identified by members of the BOSC SHC Subcommittee:
    - Partner with the American Academy of Pediatrics and local and state health departments to obtain consistent and ongoing and comprehensive data (e.g., on children's blood levels);
    - Partner with the CDC Childhood Lead Poisoning Prevention Program for state-level data;
    - Partner with the Pediatric Environmental Health Specialty Units (PEHSU's) to help identify emerging concerns as well as to provide education and outreach;
    - Increase formal involvement with the National Institutes of Health (NIH)/National Institute of Environmental Health Sciences (NIEHS) Superfund Basic Research Program staff as well as the Community Outreach and Education Cores of the funded 5-year academic centers (who by nature include contacts with Region I-X agency offices, states, tribes and various non-profits); and
    - The US Geological Survey has established considerable strength in monitoring for ground/ surface water contaminants, including PFASs, pharmaceuticals and other chemicals of emerging concern. SHC could discuss with USGS on how to combine efforts for identifying chemicals of concern, so that there are methods and experts present in the US. This identification should be combined with identifying their effect on human health and well-being.

Recommendations

The Subcommittee offers these five recommendations to capitalize on engagement with SHC partners.

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[4] A great example of a program that does this is EPA's Indian General Assistance Program in Alaska, which helps Alaska tribes (who do not have jurisdiction over their land) build the capacity to manage solid waste and air quality.

Recommendation 1b.1: Clarify the definition of community and how SHC research plans and activities were prioritized from among all of the partner-identified needs.

Recommendation 1b.2: Through partnerships with regions, follow principles of community engagement and community-based participatory research to ensure research priorities are based on local issues and needs identified by states and regions. Engage communications and social science experts to provide culturally appropriate research follow-up to regions, states, and tribes. To the extent practicable, ensure that research products can be understood and used by community members. Develop mechanisms to share problem statements not actively pursued by SHC with partners to solicit assistance in addressing low-priority issues.

Recommendation 1b.3: Increase the balance of annual regional representation in the intramural Regional Sustainability and Environmental Sciences Research Program (RESES) and through this program, engage with diverse groups and communities within boundaries of projects to better address and incorporate their varied perceptions, needs, and goals.

Recommendation 1b.4: SHC should include evaluation plans for all outputs, including research products, mapping tools, and educational products. Systematic evaluation of research activities using a standard framework will ensure that engagement and resulting outputs are meeting the needs of stakeholders and the Agency.

Recommendation 1b.5: Future publications of the Solid Waste Facts and Figures report should provide separate data tables in accessible, machine readable formats such as .csv to complement the pdf narrative document.

CHARGE QUESTION 1C

Q.1c. Does the StRAP, including the topics, research areas, and proposed outputs, clearly describe the strategic vision of the program? Given the environmental problems and research objectives articulated, please comment on the extent to which the StRAP provides a coherent structure toward making progress on these objectives in the 2019-2022 time frame.

Narrative

The topics, research areas, and proposed outputs contained in the StRAP are important and express clear near-term goals that are very responsive to the strategic vision of the program. The research area activities are well-articulated. However, we believe the strategic vision should incorporate more longer-term horizons for research, including how climate change[5] may influence problems over time. Some research areas would benefit from greater clarity and overall, there is need for a clearer overarching framework to connect research areas and situate them within wider, longer-term, dynamic contexts. Such structure would also help guide measurements of progress during the current StRAP timeframe. We offer additional suggestions to encourage more comparisons across sites and to broaden activities related to the beneficial use of non-hazardous waste streams. Developing measures of social and

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[5] **USGCRP**, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018

institutional learning will help promote resilience at multiple scales related to recovering contaminated sites and enhancing the flow of ecosystem services for human wellbeing.

Strengths

Activities under each research area are well articulated for how they respond to partner identified needs.

Research Area 3 on Solvent Vapor Intrusion is a good example of a clearly defined research area that is written with a high degree of specificity and has well-defined research questions and outputs. Individually, the activities provide strong applied focus to support the practical challenges with Sustainable Materials Management.

The SHC StRAP recognizes that environmental conditions are not static, but are shifting. In addition to the topic related to disasters and extreme weather events, two examples of where this is done well are the Advanced Streamline-Based Ground Water Transport Model (GW Transport) and the landfill temperature management.

Suggestions

- **Integrated Framework**: An integrated, overarching framework is needed to illustrate how specific problem statements or outputs address and contribute to an overall set of research goals and priorities. The current conceptual diagram in the StRAP (Figure 3) does a good job of laying out a broad framework that articulates the basic connections among broad research topics and how they relate to broader questions of economic prosperity, ecological and public health, and community resilience and equity. This framework provides a logical structure that could be expanded upon to more clearly articulate connections among the specific problem statements in the StRAP and to illustrate connections to other research areas, disciplines, and partners at local, regional, and national levels. Other EPA frameworks might be useful as well to help with overall structure, such as The Total Environment Framework and the Non-Hazardous Materials Management Hierarchy to respond to priority research areas that broadly serve RCRA goals. Overarching frameworks such as these can also help to identify opportunities to engage additional expertise in economic and social scientists to create comprehensive solutions.
- **More Long-term Vision**: SHC should place a stronger emphasis on strategic long-term vision. Sustainable environmental protection will be lost without strong science to engage, inform, and empower communities with the data and tools they need. Using a logic model approach or road map to describe the relationships between resources, activities, outputs, outcomes, and impacts of a research program. This may help to articulate the processes involved in research over the longer term rather than just short-term outputs, outcomes, and products. Logic models are learning and management tools that provide a picture of how an organization does its work and plans for short, medium, and long-range impacts. It helps everyone see what works and why. This tool links the expected outcome of a program or project to its individual activities and processes.[6]
- **Cross-cutting Comparisons:** SHC is in a unique position to be able to look across site-specific cases in order to compare and contrast factors influencing community vulnerability, resiliency, and progress along the R2R2R pathway. Prioritizing cross-cutting research through cross-partner and inter-agency collaboration will help to highlight what is context specific and what is generalizable across contaminated sites, community experience, and other issues and processes of interest.

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[6] https://www.epa.gov/risk/mira-logic-model

- **Broaden Waste and Materials Management Focus:** SHC should continue efforts to characterize our nation's waste stream not only in terms of the qualities of the materials themselves, but in terms of the processes and where possible the type of products or value chains that create them. Life Cycle Analysis informs consumers, institutional buyers, and manufacturers of the impacts of their decisions related to material flows. We suggest broadening activities related to beneficial use to include non-hazardous but voluminous waste streams that lack domestic markets and other non-disposal options for end-of-life.
- **Social Learning and Resilience:** The definition of resilience used in the StRAP is robust and forward looking. One of the key terms in that definition is "learning". Social learning is an essential component of building healthy and resilient systems (including communities).[7] Incorporating ideas about multi-level, social, and institutional learning into research on resilience may well help develop process-based metrics that are critical to community revitalization and enhancing the flow of ecosystem services for human wellbeing. Measures related to how many people access the EnviroAtlas could be a simple measure of social learning at the individual scale. At the institutional scale, social learning may lead to changes in policy and management approaches based on lessons learned and the expansion of existing knowledge about complex systems.

Recommendations

The Subcommittee offers these four recommendations to capitalize on the SHC's StRAP structure and strategic vision.

Recommendation 1c.1: Clearly articulate a long-term vision, set of integrative research questions, and overarching framework that guides the development of specific problem statements, research needs and outputs and illustrates how these specific research questions contribute to overall SHC research goals and questions.

Recommendation 1c.2: Incorporate a logic model approach and terminology with emphasis on the adaptive process of research and engagement on dynamic environmental problems, rather than just shorter-term solutions (outputs, outcomes, products).

Recommendation 1c.3: Develop research capacity for more cross-cutting research to address what is context specific and what is generalizable across contaminated site R2R2R processes and community experiences.

Recommendation 1c.4: Incorporate metrics for multi-level, social, and institutional learning that are critical to community resilience.

CHARGE QUESTION 1D

Q.1d: Recognizing ORD's focus on addressing identified partner research needs, in the presence of reduced scientific staff and resources, are there any other critical emerging environmental needs or fields of expertise and/or new research methods where this program should consider investing resources?

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[7] The works of Claudia Pahl-Wostl and Reinette Biggs may be of particular use here.

Narrative

EPA ORD has a long history of balancing near-term partner needs and long-term research to be ahead of critical emerging problems. We believe long-term vision is not as strong in the current StRAP and look forward to seeing how SHC is balancing funding for these two important areas. The BOSC SHC Subcommittee provides the following discussion on emerging issues for SHC to consider. There will be new chemicals of concern and SHC is uniquely qualified to look for these new chemical exposure concerns. A key metric of success is how well SHC is able to identify these new chemicals and explore their effects. States are wrestling with unregulated contaminants in drinking water and have little capacity to measure and understand the potential effects or communicate risk to the public. How can SHC work with states more effectively to engage with community partners and provide them with the necessary information and tools to effectively deal with the contamination?

The suggestions below highlight a number of emerging issues for consideration by SHC, including expanding the range of extreme weather events to be considered, engaging in scenario planning, and exploring new pathways for material flows. The StRAP's focus on disasters and extreme weather events should be expanded to consider not only the current focus on flooding, hurricanes, heavier and more frequent precipitation events, wildfires, lightning strikes, dry and windy conditions, but also increasing heat index (air temperature and relative humidity), earlier frost, and overall unpredictability and variability associated with projected changes in climate[8].

Due to its position in serving many types of stakeholder, SHC has a unique nation-wide view of issues. This perspective along with the deep expertise of it**s** staff should equip SHC to imagine possible scenarios and anticipate future problems and the kind of solutions they will require. Some of the critical challenges faced by communities today such as the fallout of recycling markets and the acute risk of natural hazards and contaminated sites could have been anticipated. Scenario planning efforts could provide a creative opportunity to engage SHC staff with other agencies and community partners to break out of silos, generate novel ideas, and maintain a dynamic research organization.

Strengths

The StRAP recognizes the potential for more disasters and extreme weather events. Topic 2 on Waste and Sustainable Materials Management research does a good job of prioritizing areas of greatest concern, especially around dealing with responses to acute issues related to the management of landfills. Meanwhile, efforts focused on LCA are a good indicator that SHC is taking a systematic view of material flows through the economy in a way that enables answering questions around options for minimizing environmental damage and threats to human health through material substitution and other potential solutions over longer time frames.

The development of LCA-based resources provides foundational materials for comprehensive view of material management questions spanning the goals of the program to protect human health and the environment from the hazards of waste disposal, conserve energy and natural resources by recycling and recovery, reducing and eliminating waste.

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[8] **USGCRP**, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018

Suggestions

- **Class-based Approach**: SHC should assess whether ORD can use a chemical class-based approach for PFAS compounds. A simple organofluorine measurement may need to be explored as an output. Simple test methods at sites must be an output due to the broad extent of contaminated sites both known and unknown.
- **Water Treatment and PFAS**: SHC should be explicit about research on the role of other water treatment processes (e.g., ozone, UV) in changing parent PFAS and degradation compounds. Similarly, PFAS in community drinking water sources ultimately ends up in the sanitary system and this sewage sludge may be land applied. This application is typically on land growing non-human food crops. It is not clear that SHC is researching the potential for this PFAS pathway.
- **Lead**: Greater emphasis is needed on relative source contribution of water to blood lead levels. EPA has done previous research on this topic using current models (e.g., SHEDS-IEUBK), but questions about water contamination continue to arise in communities; increased community emphasis on mitigating lead exposure from drinking water may be diverting attention and resources away from better characterized sources of exposure such as paint and dust as well as consumer and cultural products. States need better tools and data to drive public health interventions and allocate limited resources.
- **Measurement of Unregulated Contaminants**: There is a growing need for need measurement approaches and tools for unregulated mobile contaminants, those that are water soluble and pass through traditional drinking water treatment systems.
- **Infiltration vs. Vapor Intrusion (VI)**: Some cities are infiltrating stormwater through green infrastructure projects as an adaptation tool due to increased precipitation. Brownfield redevelopment at VI sites often leave some contaminated soil or groundwater. There should be a role for SHC to support research and information dissemination to the city planning level about contaminated sites with volatiles and balancing stormwater infiltration with concerns about migrating contamination. Very few local governments have the expertise to evaluate this or the funding to perform the sampling and study to understand the site hydrogeology. SHC should support uniform data and access including an inventory of state sites so these data are available to communities and local planners.
- **Exposome Research:** The exposome represents all exposures experienced by an individual during their lifetime. Registered chemicals currently number in the tens-of-thousands, and therefore comprise a significant portion of the human exposome. To date, quantitative monitoring methods have been developed for only a small fraction of registered chemicals. Novel approaches are therefore needed to efficiently characterize thousands of additional analytes in both environmental and biological samples[9]. SHC may want to include exposome research more explicitly in its StRAP. This may be included in the total environment approach.
- **Contaminant Migration into Storm and Sanitary Systems**: SHC should also recognize the role of LUST sites in urban areas and the migration of contamination into the right of way where water mains and sanitary and stormwater pipes are located. Water main joints may be compromised when placed in contact with petroleum compounds and sanitary and stormwater pipes are not leak proof so contamination may migrate into these pipes and carry contamination untreated to surface water. It is not clear that many communities are recognizing this risk and the opportunity for

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[9] Sobus, J., J. Rager, AND M. Strynar. Developing Non-Targeted Measurement Methods to Characterize the Human Exposome. 2015 Assn of Public Health Laboratories, Indianapolis, IN, May 18 - 21, 2015. https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=311892&Lab=NERL

contamination to enter ground and surface waters. There may be a role for SHC to raise awareness and provide tools and technical assistance in dealing with these challenges.

- **Life Cycle Cost Analysis**: SHC should explore using LCA for materials technology and innovation to answer questions around how to get desirable properties of materials to enable more cost-effective reuse and recycling. LCA can be used to better identify sources of contaminants and support research on how to efficiently reduce these contaminants in the environment through market incentives. LCA can also be used to determine how the systems have to change in order to support innovations in materials that are generated. For example, how does the current solid waste management system need to change to take advantages of the full potential benefits of movement to bio-based plastics and development of circular materials flows?
- **Circular Economy for Materials Management:** Recent dramatic changes to international markets for recyclable material highlight a need for research to support the development of domestic markets and a more "circular economy". SHC provided examples of where its research has supported safe and novel re-use options for special waste types from power plants and other industries. A similar approach is now needed to create new pathways for material flows that have been recently disrupted. These and other critical research relating to the technologies and materials innovations for cost-effective reuse and recycling, underscore the need for research that can address circular economy issues at a systems level and a holistic approach that integrates physical, natural and social sciences, business, economics, and engineering. For example, how does the current solid waste management system need to change to take advantages of the full potential benefits of movement to bio-based plastics and development of circular materials flows? What research is needed to avoid unintended outcomes related to introducing new materials into a waste management system not designed to handle it?
- **Adaptive Technology**: There is a role for SHC to support research on resource and material recovery technology that can operate on different scales and is more flexible to respond to market fluctuations.
- **Disasters and Extreme Weather Events:** In addition to disasters and severe storms, industrial processes involving the injection of wastewater into wells or the use of wells that lack adequate casing can result in groundwater contamination. Local small earthquakes related to oil and natural gas exploration and extraction (hydraulic fracturing or fracking) pose risks that compound contaminated site management and may thwart community resilience-building efforts. We encourage SHC to consider not only the pulse or acute types of disasters and extreme weather events, but also the longer-term issues that can emerge more slowly. Process-based indicators may resolve some of the tension between measuring short and long-term outcomes and can reflect engagement strategies related to ecosystem services cascades and social learning. Baseline data are not as useful because the climate change is shifting the baselines and current data are not predictive of future ecosystem status. Orienting around future goals rather than past expectations may be useful.
- **Ecosystem Services and Community Wellbeing:** Ecosystem benefits can be complicated to calculate as they depend on the community or people they are serving. There is an inherent assumption that increasing ecosystem goods and services leads to increased human well-being. However, more investigation in line with broader scientific inquiry should focus on the relationships between services and well-being, recognizing that the flow and ability to capture benefits across populations and contexts may be inequitable. We suggest incorporating recent advances in conceptual understanding and applied uses of ecosystem services that recognize that benefits and values emerge from a cascading process, which is mitigated at each step by social and cultural factors resulting in inequitable access to ecosystem service benefits within communities.

- **Engagement:** Engagement strategies are important components of SHC's research agenda but are not themselves a focus of research. There is an opportunity here to focus research inquiry on questions of engagement and associated methods. Engaging cultural anthropologists, medical anthropologists, applied ecologists, behavioral scientists, and sociologists early on in the research process on community resiliency in the face of contamination may help to maximize consideration of human and ecological health and the engagement processes that catalyze resiliency.
- **Comparative Community Experiences with Contamination and R2R2R:** SHC is uniquely positioned to go back to communities who have been through the process of R2R2R - or are further along the process - to identify what stakeholders wish they would have known or done along the way. In other words, looking back systematically can illuminate areas worthy of new investigation or incorporation into new processes and technical support. Relatedly, better understanding long-term impacts of contaminated sites and R2R2R efforts comes from long-term studies such as that on permeable reactive barriers.

Recommendations

The Subcommittee offers these five recommendations to capitalize on emerging issues.

Recommendation 1d.1: Expand research on measurement approaches and tools for unregulated mobile contaminants, those that are water soluble and pass through traditional drinking water treatment systems.

Recommendation 1d.2: Establish a research area for open scenario planning for emerging issues apart from specific responses to partner needs in order to identify possible challenges before they manifest. Include a broad set of agency partners and community partners.

Recommendation 1d.3: Engaging public and private sector researchers and practitioners in health education and risk communication to share results from research and work products via various and emerging forms of electronic (Internet and social) media.

Recommendation 1d.4: Broaden the types of hazards, disasters and extreme weather events that threaten community resilience and contaminated site projects to include both acute and chronic stressors and associated increased levels of variability and uncertainty.

Recommendation 1d.5: Incorporate metrics to measure the utility of ecosystem services for specific communities that rely on them.

CHARGE QUESTION 1E

Q.1e. What are some specific ideas for innovation (including prizes/challenges) and market-based approaches that the program could use to advance solutions to existing and emerging environmental problems?

Narrative

Innovation is an important and growing tool for private and public organizations to develop new solutions and scale known solutions. SHC has a long history of developing innovative solutions to

complex environmental problems. Through the STAR and People, Prosperity, and Planet Programs, EPA ORD invests in innovation at academic institutions and supports undergraduate research. EnviroAtlas is a valuable platform for facilitating access to innovative approaches. SHC's extensive LCA data could be put to highly creative use if made more fully available using innovative open access mechanisms. In previous sections, we recognize SHC engagement with many community partners to identify stakeholder needs.

Based on the information provided in the StRAP, there is an opportunity to expand the SHC innovation investments more deeply into communities. SHC should explore models using innovation funds and market-based approaches to advance community-based solutions to these identified environmental needs. This innovation funding could support expanded research on open source technology, data accessibility, citizen science, youth programs, network building, and evaluation of community engagement strategies to support EPA Prevention – Remediation – Restoration – Revitalization programs (P-R2R2R-P).

Strengths

SHC curates an extensive set of data that is available to the public through EnviroAtlas and other tools for research and education. This platform may provide a vehicle for drawing attention to innovative approaches and ways of visualizing data.

Data from LCA-based research efforts and the Solid Waste Facts and Figures Report contain high levels of detail that could be put to creative use if presented in open and accessible formats.

The Partner Alliance and Coordination Teams are a great venue for innovative thinking, particularly if they include external partners with direct experience with issues such as community contamination-to-revitalization processes.

Suggestions

- **Incentives for Community Engagement**: There is an opportunity for SHC to explore research on the role of Federal (and state and local) tax incentives to promote community engagement. Many communities are using local incentives for Brownfield site remediation. These incentives focus on remediation, but not community engagement. There is a role for SHC in supporting research on the effectiveness of these engagement programs and potential federal, state, and local incentives to support research, community engagement, and remediation at orphan sites.
- **Small Grant Programs for Community Engaged Research**: Small grant programs could be used to fund research projects where multiple stakeholders are connected and then aligned around a common problem and all agree to work together to produce a solution. This approach may be useful for areas that are priorities but lower on the funding list and could support non-traditional collaboration among universities, local governments, businesses, and neighborhoods. Market based solutions should be explored to ensure that underserved communities and environmental justice communities are actively engaged in remediation and community revitalization strategies. SHC should explore research on the co-benefits of projects that engage with communities early to identify research and data needs to help with designing a remedy. There is an opportunity to take successful models like R2R2R in the Great Lakes and scale this across other EPA contaminated sites and explore ways that states and locals could use this approach or adapt this strategy for their non-CERCLA sites. SHC should explore strategies to improve the quality of community engagement and transfer of control to local communities as EPA's role diminishes post-remediation.

- **Market-based Solutions**: SHC research programs have the potential to help scale examples of market-based solutions and incentives to adopt new technology and financing. For market-based solutions to work, there has to be a clear understanding of the market. For example, research by SHC on Waste and Sustainable Materials Management to date has focused largely on technical and scientific questions. Comprehensive solutions may require input from additional disciplines. For example, characterizing different types of materials is useful for supporting reuse strategies, but those strategies need to be demonstrated as economically viable. Alternatively, what economic conditions would support resource recovery and reuse cycles? Engaging experts in environmental economics and behavioral sciences would help to plan and incorporate local and state incentives as part of work conducted with regional and other partners. Additionally, we suggest expanding research on existing federal and/or state tax rebate incentives to engage more small businesses and larger private sector companies and laboratories, similar to achievements with electric vehicles, the Energy STAR Program, the Water Sense Program, and the NIH Small Business Innovation Research Program.
- **University and Youth Partnerships**: There is an opportunity for SHC to explore opportunities to further advance the EPA P3 Program by promoting programs with universities and the private sector that focus on community sustainable materials management innovation opportunities. Extending partnerships with the Student Conservation Association, which has youth and young adult programs, and AmeriCorps may be helpful for developing student research design and development programs, internships, and externships. Community-campus or community-business partnerships may be good models to explore.
- **Communications Research**: SHC should consider innovative strategies to engage with both public and private sector researchers and practitioners in health and risk communication to share results from research and work products via various forms of media, including television, online short films, webpages/internet, social media (words/phrases), and visuals (photos, pictograms, drawings) and evaluate their comparative efficacy.
- **Staff Incentives**: There is an opportunity for SHC to create incentives for their scientists to work directly with end users to inform their research. It is important that the tools developed by SHC yield successful projects that provide direct assistance to contamination stressed communities. Land grant universities provide good examples and partners on this effort as their primary mission is to provide research-based outreach and technical assistance to communities on a variety of topics ranging from food and agricultural production to community and economic development, environmental and natural resource management and family and youth issues.
- **Open Source Technology**: There is an opportunity to broaden the investment in research programs to develop open source sampling technology so communities can engage in citizen science and assist in gathering local data such as air particulates and stormwater quantity and quality. SHC should explore the concept of “Government-as-a-Platform” for developing innovative strategies for empowering direct and indirect partners with data. Small challenge grants and larger prizes could help to drive such programs. Evaluation outcomes include not only the technology but community education and linkages with STEM or STEAM programs in K-12 education.
- **Innovation Metrics**: In future BOSC SHC Subcommittee meetings, it would be helpful to have more information on current innovation investments and the metrics used to judge their success.

Recommendations

The Subcommittee offers these four recommendations to capitalize on innovations and market-based approaches.

Recommendation 1e.1: Engage experts in environmental economics and behavioral sciences to explore local and state incentive programs as well as existing federal and/or state tax rebate incentives to engage more small businesses and larger private sector companies and laboratories as well as community groups in the design of remediation technologies and community revitalization strategies.

Recommendation 1e.2: Engage students and researchers from a diversity of schools and disciplines, including design, planning, law, business, natural and social sciences, humanities, and the arts using ORD data to create business models and or innovative product designs that maximize material reuse and minimize environmental risk and burden. Similarly, engage with the Student Conservation Association and AmeriCorps to develop student research design and development programs, internships, and externships to expand on the P3 model.

Recommendation 1e.3: Connect with experts in health and risk communication to investigate multi-media mechanisms for sharing research and work products and their comparative efficacy.

Recommendation 1e.4: Develop open source sampling technology for citizen science to help gather local environmental data and other innovative strategies to empower direct and indirect partners with data.

Charge Question 2

Q.2: SHC's StRAP is set-up as a series of problem statements with solutions (labeled as Outputs). This is the approach we have used to address partner-identified needs (see Q.1b above). Is this approach helpful in identifying research that is likely to meet the needs of EPA's program and regional offices? What about the needs of the states and tribes?

Narrative

The approach of paired problem statements and outputs is good for ensuring that SHC Program research is responsive to the specific needs of ORD clients and partners. There are good examples throughout the StRAP where problem statements and outputs articulate helpful questions and actionable solutions. The lingering question is how to look at what is known and what needs to be known about a specific problem (such as a specific contaminated site or contaminant) and how to communicate that knowledge to key partners and affected communities to address the challenge. We offer suggestions on how to more effectively bridge from problems to helpful outputs by giving more attention to implementation plans and research processes, seeking more coherence across problem-output sets, and adding greater specificity in output details. In general, we feel there could be more documentation of the needs of tribes and communities specifically, though we recognize the key role of EPA Regions in making these connections.

Strengths

The problem statements often effectively identify the needs of partners and lay out the key issues in need of research and the outputs highlight proposed solutions.

The mixed methods evaluation elements of RESES is a great example of the capabilities of SHC to evaluate its own outputs.

The research focus areas on Volatilization to Indoor Air (VI) and PFAS are examples where problem statements articulate clear challenges in many communities where there is often no expertise in the local government or NGO community. The VI research theme is well-defined, more specific, and actionable. PFAS research is much needed and important and SHC is asking the right questions. Problem statements on lead are important and related outputs conducted in partnership with other researchers and organizations are likely to be helpful in reducing lead exposures in populations.

Suggestions

- **Implementation Plan**: It would be helpful to have an implementation plan to identify how the problems identified in the StRAP will be addressed. More details on planned steps and processes that will help to achieve associated outputs would be helpful as some of the current problems and outputs are somewhat vague. Such information will help to articulate how SHC research links to specific EPA goals for the retirement of sites and community engagement.
- **More on Process**: We found the terminology inherent in the structure of the StRAP to be a bit problematic, specifically the term "Output" as the research response to the problem statements. In many cases, the outputs are reports, rather than benchmarks to indicate progress on a problem, such as reduced vulnerability. Thus, while the outputs are readily achievable, this doesn't mean that the overarching goals of reducing vulnerability will be achieved. Furthermore, the focus on outputs seems to skip over the process of research. Having an inclusive, robust process is as important as having a good outcome. Our suggestion is to consider including sections or at least information on participation, process, and research methods with progress along those paths reportable as outcomes. Better words for these sections of the StRAP might be "objective" or "strategy" or "method". Following a logic model framework, such as the health education framework or other approaches, will help pay attention to process and impact data as much as solutions (outputs, outcomes).
- **Increase Coherence Across Problems and Outputs**: Currently, problem areas stand alone and are addressed iteratively with specific solutions to individual problems. This lack of cohesion among and across research areas may lead to a lack of focus on emerging needs (see charge question 1d). An overarching framework or effort to synthesize and connect research areas would be useful and could help to leverage outputs for other related problems to build knowledge across SHC efforts (and ORD more broadly).
- **Organizing Outputs**: Problem evaluation approaches may help to identify patterns in conditions and approaches that lead to the most effective solutions across varied problems. The field of Information Architecture may offer useful approaches for organizing outputs. Flexible tag-based systems can be used to find intersections and common threads across seemingly disparate activities. For example, tags could be used to identify all outputs related to a particular statute, contaminant, population, or existing research that is being built upon. This approach may help to summarize efforts across common themes and communicate how the whole of SHC's efforts is greater than the sum of its parts.

- **Problem and Output Specificity**: One of the key limitations in many of the problems statements is the lack of a clearly articulated problem that the output is seeking to address. For example, "technical support at contaminated sites", does not describe what gap or deficiencies in technical assistance currently exist. Specific metrics for measuring delivery of technical assistance to states, regions, tribes and communities would be useful. More specific taxonomy of end products (e.g., tool, data, database, recommendations, etc.) may be more helpful in describing all components necessary to comprehensively solve partner identified needs.
- **Tribes and Communities within each of EPA Regions I-X**: It would be useful to see greater documentation of the needs of tribes and communities. We acknowledge that very specific needs and concerns may not be ranked among the highest priorities for research conducted in a given period and that EPA Regions have a key role to play in working with states, tribes, and communities.

Recommendations

The Subcommittee offers these four recommendations to capitalize on the problem-output approach used in the StRAP.

Recommendation 2.1: Articulate an implementation plan with more detailed steps and processes for achieving outputs.

Recommendation 2.2: Improve cohesion across problems and outputs by using program evaluation and information architecture systems to identify patterns in conditions and approaches that lead to successful outputs and solutions.

Recommendation 2.3: Add specificity of metrics related to outputs and consider a taxonomy of end products to describe components necessary to address partner identified needs.

Recommendation 2.4: Document the needs of tribes and communities more thoroughly.

CHARGE QUESTION 3

Q.3: At the request of EPA's Regions, we have included the impact of natural disasters (e.g., severe weather, wildfires) in research areas 9 and 10. The focus is on how these types of disasters impact contaminated site remediation and restoration and community resilience. What suggestions does the subcommittee have for making this research more efficacious?

Narrative

Awareness of the implications of natural hazards and disasters on contaminated sites, landfills, and other sources of environment contaminants is the first step in helping communities prepare for and respond to a unique set of challenges posed by climate change[10]. Awareness of the presence of sites that may be at risk from disasters and extreme weather events may also further motivate general preparedness and resilience-building efforts when those threat multipliers are evident. We suggest

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[10] **USGCRP**, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018

expanding this focus throughout the SHC research agenda, connecting to longstanding work on the Disaster Management Cycle to incorporate more research and data access on prevention and preparedness, and working across agencies to share information and map cross-boundary risks. We draw attention to the importance of terminology, as while hazards may be natural, disasters are not purely natural as they involve social, built, economic, political, and natural processes. We highlight the importance of ensuring that research on disasters and extreme weather events related to CERCLA sites flows onward to those responsible for other types of contaminated sites. Finally, we urge recognition of cultural dimensions of resilience and the importance of cultural differences in community-oriented research.

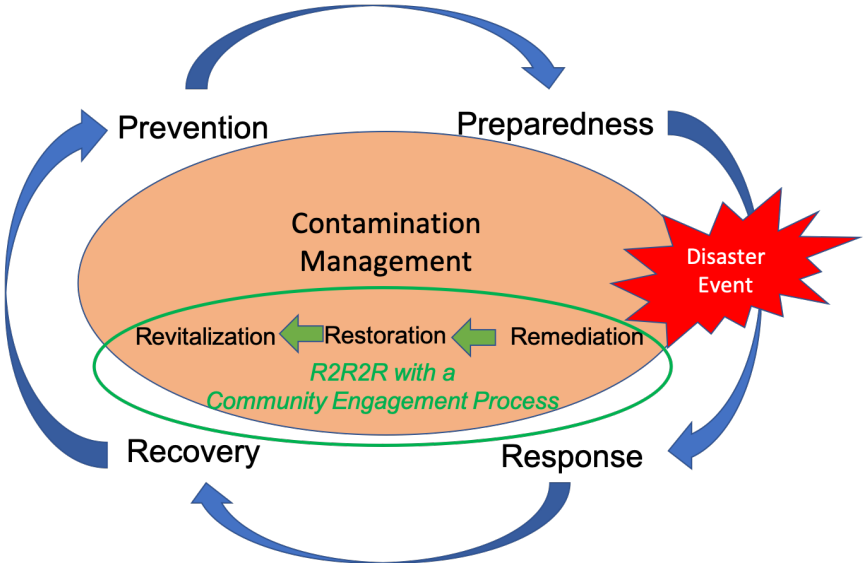
Strengths

We applaud SHC for recognizing the role of natural hazards, disasters, and extreme weather events and their impacts on vulnerable populations and community resilience, particularly related to contaminated sites. SHC's definition of resilience is robust and in line with broader contemporary scientific thinking. EnviroAtlas is a powerful asset for revealing potential risks to a diverse array of partners and communities.

Suggestions

- **Mainstream Disasters and Extreme Weather Events**: Given the widespread implications of disasters and extreme weather events across the SHC research agenda, we suggest using this as a cross-cutting theme, along with resilience, throughout the StRAP (not just in Topic 3). For example, research into the characterization of built-environment materials banks can explore what-if scenarios for the generation of disaster debris from extreme weather events. The emerging set of risks presented by the changing environmental conditions are having and will continue to have both acute and chronic impacts on contaminated sites and contaminant flows, waste and materials management, and community resilience. Vulnerability assessments should emphasize risks presented by changing environmental conditions and should include climate projections. In terms of overall strategic vision, there should be more attention to adaptive management throughout the document, particularly given the dynamic nature of contamination and materials management in the face of a rapidly changing climate. This would include considering how rising temperatures, increasing unpredictability of weather, long term changes as well as acute shifts, and more disasters and extreme weather events will affect all aspects of the program. Recent EPA involvement in research and reporting on disaster debris is a good example of supporting important cross-cutting strategies.
- **Disaster Management Cycle**: We encourage SHC to draw more connections between the R2R2R process and the Disaster Management Cycle, including attention to prevention and preparedness. We offer the figure below as a possible way to begin to visualize these relationships.

Integrating Contamination Management with Disaster Management and Remediation to Restoration to Community Revitalization (R2R2R) as an Iterative Cycle



- **Working Across Agencies**: We encourage SHC to be more explicit about how SHC is working across agencies (e.g., FEMA, NOAA, HHS, ATSDR, Homeland Security) to support community resilience and to avoid duplicative efforts. It is important that relevant outputs from research areas 9 and 10 be made known to administrators of the cross-agency US Climate Resilience Toolkit. Working in collaboration with FEMA and other agencies to ensure maps are an accurate representation of flood risk promotes transfer of the best available science.
- **Preparedness Networks and Mapping**: Dedicating time to making sure all partners (upstream and downstream of potential disaster-affected contaminated sites and communities) know each other and build trusting relationships among the partners is an essential issue associated with preparedness that helps to prevent an extreme weather event from becoming a disaster. Goal 5 of the Superfund Recommendations is about key stakeholders and community visioning. This can and should include mapping critical sites and flow-ways and tapping into local professional knowledge of how things work and connect. SHC could highlight these steps and provide them through technical support and engagement networks to reduce vulnerabilities and prevent disasters related to contaminated sites. This includes the importance of cross-boundary or risk management and preparedness arrangements across multiple jurisdictional settings.[11] Mapping cross-boundary risks using EnviroAtlas would help a wide variety of users. Establishing collections within EnviroAtlas may help to reveal the intersection of identified sites that may have unique challenges and potential risks from flooding, wildfire, and other hazards and extreme weather events. Asset mapping is another key to community recovery and revitalization, as outlined in Research Area 10. If additional resources on asset mapping are needed for SHC and partners, consider Purdue University's Center

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[11] The US Forest Service's current work on cross-boundary/trans-boundary wildfire risk governance could be useful for ideas in this arena (https://www.fs.fed.us/rmrs/groups/co-managment-fire-risk-transmission-comfrt-collaborative-approach-wildfire-risk-reduction).

for Regional Development's asset mapping resources[12] as an example of numerous similar databases and programs managed by U.S. Universities.

- **Inform Beyond-CERCLA Contaminated Site Management**: We encourage SHC to evaluate mechanisms that ensure work on natural hazards, disasters, and extreme weather events on CERCLA sites flows onward to inform management of other contaminated sites, such as waste lagoons of concentrated animal feeding operations, coal ash ponds at existing power plants, nuclear power plant spent waste fuel rod sites, and other state and locally regulated sites.
- **Cultural Resilience**: Disasters do more than affect health and property, they can have impacts such as stigmatization and long-term community identity impacts. Research suggests that cultural differences can influence disaster response and recovery.[13] By incorporating research attention on cultural resilience, place attachment, and intergenerational transfer of knowledge within communities, SHC may gain critical insights into factors enabling or constraining success along the community R2R2R pathway.

Recommendations

The Subcommittee offers these five recommendations to capitalize on SHC's focus on how disasters impact contaminated site remediation, restoration, and community resilience.

Recommendation 3.1: Establish disasters and extreme weather events as a cross-cutting theme throughout the StRAP, with attention to both acute and chronic stresses.

Recommendation 3.2: Expand the community remediation-restoration-resilience (R2R2R) framework to include preparedness (P-R2R2R-P) by making connections with the Disaster Management Cycle.

Recommendation 3.3: Work with other agencies to support cross-boundary community resilience, using EnviroAtlas as a mechanism to map critical sites and flow-ways related to contaminated sites and potential impacts from disasters and extreme weather events.

Recommendation 3.4: Ensure research on disasters and extreme weather events related to CERCLA sites flows onward to inform management of other contaminated sites.

Recommendation 3.5: Incorporate more appreciation of cultural differences in research on disaster response, recovery, and resilience along the community R2R2R pathway.

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[12] Lionel J. "Bo" Beaulieu is a national expert in asset mapping and community development and is the director of Purdue University's Center for Regional Development. There are two presentations on their website https://www.pcrd.purdue.edu/index.php under media and presentations.

[13]Clarke, H.E. and B. Mayer 2017. Community Recovery Following the Deepwater Horizon Oil Spill: Toward a Theory of Cultural Resilience. Society & Natural Resources, 30(2):129-144; Picou, J.S. 2000. The 'Talking Circle' as Sociological Practice: Cultural Transformation of Chronic Disaster Impacts. Sociological Practice, 2(2):77–97; Dyer, C.L. 1993. Tradition Loss as Secondary Disaster: Long-term Cultural Impacts of the Exxon Valdez Oil Spill. Sociological Spectrum, 13(1):65–88. https://doi.org/10.1080/02732173.1993.9982017; and The U.S. Federal Emergency Management Agency (FEMA). 2019. "Building Cultures of Preparedness: A report for the emergency management higher education community." Washington, DC: FEMA.)

VII. SUMMARY LIST OF RECOMMENDATIONS

Recommendation 1a.1: Add *prevention* to SHC research programs that support R2R2R phases of building community resilience in the context of contaminated sites.

Recommendation 1a.2: Create systems or platforms for program and regional offices, states, and other partners to acknowledge where and how research outputs have made a material difference in publicly visible projects (including work on sites beyond EPA jurisdiction) to respond to the EPA priority of shared governance and collaboration.

Recommendation 1a.3: Dedicate research attention to not only identifying, but also to document pathways for *reducing* vulnerability in communities, giving consideration to site-specific and intersectional characteristics of vulnerability and measurable benchmarks.

Recommendation 1a.4: Review each problem statement under each research topic and consider how climate change could worsen the problem.

Recommendation 1a.5: Enhance workforce development by engaging professionals with experience in environmental impact assessment, social impact assessment, and health impact assessment.

Recommendation 1b.1: Clarify the definition of community and how SHC research plans and activities were prioritized from among all of the partner-identified needs.

Recommendation 1b.2: Through partnerships with regions, follow principles of community engagement and community-based participatory research to ensure research priorities are based on local issues and needs identified by states and regions. Engage communications and social science experts to provide culturally appropriate research follow-up to regions, states, and tribes. To the extent practicable, ensure that research products can be understood and used by community members. Develop mechanisms to share problem statements not actively pursued by SHC with partners to solicit assistance in addressing low-priority issues.

Recommendation 1b.3: Increase the balance of annual regional representation in the intramural Regional Sustainability and Environmental Sciences Research Program (RESES) and through this program, engage with diverse groups and communities within boundaries of projects to better address and incorporate their varied perceptions, needs, and goals.

Recommendation 1b.4: SHC should include evaluation plans for all outputs, including research products, mapping tools, and educational products. Systematic evaluation of research activities using a standard framework will ensure that engagement and resulting outputs are meeting the needs of stakeholders and the Agency.

Recommendation 1b.5: Future publications of the Solid Waste Facts and Figures report should provide separate data tables in accessible, machine readable formats such as .csv to complement the pdf narrative document.

Recommendation 1c.1: Clearly articulate a long-term vision, set of integrative research questions, and overarching framework that guides the development of specific problem statements, research needs

and outputs and illustrates how these specific research questions contribute to overall SHC research goals and questions.

Recommendation 1c.2: Incorporate a logic model approach and terminology with emphasis on the adaptive process of research and engagement on dynamic environmental problems, rather than just shorter-term solutions (outputs, outcomes, products).

Recommendation 1c.3: Develop research capacity for more cross-cutting research to address what is context specific and what is generalizable across contaminated site R2R2R processes and community experiences.

Recommendation 1c.4: Incorporate metrics for multi-level, social, and institutional learning that are critical to community resilience.

Recommendation 1d.1: Expand research on measurement approaches and tools for unregulated mobile contaminants, those that are water soluble and pass through traditional drinking water treatment systems.

Recommendation 1d.2: Establish a research area for open scenario planning for emerging issues apart from specific responses to partner needs in order to identify possible challenges before they manifest. Include a broad set of agency partners and community partners.

Recommendation 1d.3: Engaging public and private sector researchers and practitioners in health education and risk communication to share results from research and work products via various and emerging forms of electronic (Internet and social) media.

Recommendation 1d.4: Broaden the types of hazards, disasters and extreme weather events that threaten community resilience and contaminated site projects to include both acute and chronic stressors and associated increased levels of variability and uncertainty.

Recommendation 1d.5: Incorporate metrics to measure the utility of ecosystem services for specific communities that rely on them.

Recommendation 1e.1: Engage experts in environmental economics and behavioral sciences to explore local and state incentive programs as well as existing federal and/or state tax rebate incentives to engage more small businesses and larger private sector companies and laboratories as well as community groups in the design of remediation technologies and community revitalization strategies.

Recommendation 1e.2: Engage students and researchers from a diversity of schools and disciplines, including design, planning, law, business, natural and social sciences, humanities, and the arts using ORD data to create business models and or innovative product designs that maximize material reuse and minimize environmental risk and burden. Similarly, engage with the Student Conservation Association and AmeriCorps to develop student research design and development programs, internships, and externships to expand on the P3 model.

Recommendation 1e.3: Connect with experts in health and risk communication to investigate multi-media mechanisms for sharing research and work products and their comparative efficacy.

Recommendation 1e.4: Develop open source sampling technology for citizen science to help gather local environmental data and other innovative strategies to empower direct and indirect partners with data.

Recommendation 2.1: Articulate an implementation plan with more detailed steps and processes for achieving outputs.

Recommendation 2.2: Improve cohesion across problems and outputs by using program evaluation and information architecture systems to identify patterns in conditions and approaches that lead to successful outputs and solutions.

Recommendation 2.3: Add specificity of metrics related to outputs and consider a taxonomy of end products to describe components necessary to address partner identified needs.

Recommendation 2.4: Document the needs of tribes and communities more thoroughly.

Recommendation 3.1: Establish disasters and extreme weather events as a cross-cutting theme throughout the StRAP, with attention to both acute and chronic stresses.

Recommendation 3.2: Expand the community remediation-restoration-resilience (R2R2R) framework to include preparedness (P-R2R2R-P) by making connections with the Disaster Management Cycle.

Recommendation 3.3: Work with other agencies to support cross-boundary community resilience, using EnviroAtlas as a mechanism to map critical sites and flow-ways related to contaminated sites and potential impacts from disasters and extreme weather events.

Recommendation 3.4: Ensure research on disasters and extreme weather events related to CERCLA sites flows onward to inform management of other contaminated sites.

Recommendation 3.5: Incorporate more appreciation of cultural differences in research on disaster response, recovery, and resilience along the community R2R2R pathway.

CONCLUSIONS

This StRAP of the USEPA-ORD-SHC for the years 2019-2022 could make a real difference in both the shorter term and in the longer term for communities of the United States. Nevertheless, this subcommittee also identified specific improvements represented by the recommendations above to further improve both the finalization of the StRAP and the implementation then monitoring and evaluation of the data on process, impact, and actions (outputs, outcomes, solutions, technologies and tools). In summary, recommendations focus on better defining and/or documenting details of vulnerability reduction, prevention of contamination, the value of community and ecosystem services; broader community engagement with improved balance in regional (and thus state, tribal and county-to-local) representation; increased inter-agency communications and collaboration; and, acknowledging both acute and chronic extreme weather events, beyond impacts of floods and wildfires (natural or man-made).

Overall, we find the activities described in the SHC StRAP under the three topic areas to be well aligned with the goals of the ORD strategic plan. In addition, these activities are clearly of high importance for protecting human health and the environment from significant risks that exist related to contaminated sites, hazardous waste streams and disposal facilities, and disasters and extreme weather events.

Key themes from our review include the need to better define community partners, focus on longer-term research vision, expand research focus on understanding material streams and prevention of contamination, and build additional social science research capacity on the intersection of disasters, contamination, and vulnerable communities. The foundational science for better understanding of sustainable and healthy communities is poised to empower states and other actors to take action and avoid further increasing environmental burdens.

We thank the SHC for the opportunity to review and comment on this important national program effort. We reviewed materials provided in advance, as well as the applications presented in panel discussions, and other interactions at the Subcommittee meeting. Overall the BOSC SHC Subcommittee was very impressed by the quality of research that was presented in this regard.

VIII. APPENDIX A: MEETING AGENDA

United States Environmental Protection Agency
Board of Scientific Counselors (BOSC)
Sustainable and Healthy Communities (SHC) Subcommittee

April 2-3, 2019
US EPA Research Triangle Park Campus,
Room C-112
109 T.W. Alexander Drive, Research Triangle Park, NC 27711
Adobe Connect for Viewing and Listening Remotely: https://epawebconferencing.acms.com/shcpartners
Conference Call for Presenters and Public Commenters: 1-866-299-3188 Code: 202-564-3324#

TIME	TOPIC	PRESENTER
Tuesday, April 2, 2019*		
8:00 – 8:30	Registration	
8:30 – 9:00	Call to Order and Introductions	Courtney Flint, Chair Jace Cujé, Designated Federal Officer (DFO) Bruce Rodan, ORD-Associate Director for Science

9:00 – 10:15	**Overview of SHC's Strategic Research Action Plan (StRAP)**
	• Topics, Research Areas, Outputs
	• Partner Engagement
	  ○ Office of Land and Emergency Management (OLEM)
	  ○ Regions
	  ○ Regional Sustainability and Environmental Sciences Research Program (RESES)
	• BOSC Questions or Clarification and Further Questions
		Mike Slimak (NPD-SHC)
		
		Stiven Foster (OLEM)
		
		Regina Poeske (EPA Region 3)
		Sarah Mazur (SHC)
		
		Subcommittee

10:15 – 10:30	Break	

10:30 – 12:00	**Topic 1: Contaminated Sites**
	• Overview
	• OLEM Perspective
	• Selected Illustrations
	  ○ Site Characterization and Remediation (RA2)
	  ○ Chemicals of Immediate Concern (RA5)
	  ▪ Lead (Pb)
	  ▪ Per- and polyfluoroalkyl substances (PFAS)
		Andrew Geller (Deputy-SHC)
		Dan Powell (OLEM)
		
		Tom Holdsworth (SHC Matrix Interface (MI))
		
		Andrew Geller (SHC)
		Elaine Cohen-Hubal (NERL)

TIME	TOPIC	PRESENTER
	• BOSC Questions of Clarification and Discussion	Subcommittee
12:00 – 1:00	Lunch	

1:00 – 2:30	**Topic 2: Waste and Sustainable Materials Management**
	• Overview
	• OLEM Perspective
	• Selected Illustrations
	  ○ Landfill Management (RA6)
	  ○ Life Cycle Inventories and Methodologies (RA7)
	• BOSC Questions of Clarification and Discussion
		Andrew Geller (Deputy-SHC)
		Barnes Johnson (Director, ORCR/OLEM)
		Thabet Tolaymat (NRMRL)
		Wes Ingwersen (NRMRL)
		
		Subcommittee

2:30 – 2:45	Break	
2:45 – 3:00	Public Comments	
3:00 – 4:30	**Lab Tour** • EnviroAtlas • Bioaccessibility • Solvent Vapor Intrusion	Anne Neale (NERL), Megan Mehaffey (NERL), Laura Jackson (NHEERL) Karen Bradham (NERL) John Zimmerman, Alan Williams (NERL)
4:30 – 5:30	BOSC Deliberations	Subcommittee
5:30	Wrap-Up and Adjourn**	Courtney Flint, Chair

Wednesday, April 3, 2019*		
8:30 – 9:00	Registration	
9:00 – 9:15	Call to Order	Courtney Flint, Chair

9:15 – 10:45	**Topic 3: Healthy and Resilient Communities**
	• Overview
	• Program Office/Region Office Perspective
	• Selected Illustrations
	  ○ Benefits from R2R2R (RA9)
	  ○ Community-Driven Solutions (RA10)
	• BOSC Questions of Clarification and Discussion
		Sarah Mazur (SHC)
		John Thomas (Office of Community Revitalization) /Jonathan Essoka (EPA Region 3)
		
		Joel Hoffman (NHEERL)
		Nicolle Tulve (NERL) and Susan Julius (NCEA)
		Subcommittee

10:45 – 11:00	Break	

11:00 – 11:30	BOSC Open Discussion with SHC Team	Subcommittee SHC Team
11:30 – 12:30	Lunch	
12:30 – 3:20	BOSC Deliberations***	Subcommittee
3:20 – 3:30	Break	
3:30 – 4:30	BOSC's Initial Response to StRAP	Subcommittee
4:30	Wrap-Up and Adjourn	Courtney Flint, Chair Jace Cujé, DFO

***** All times noted are Eastern Time and are approximate.

****** Wrap-up and adjournment may occur any time following the site visits, at the discretion of the DFO and Chairs.

******* Breaks at the discretion of the chair.

IX. APPENDIX B: MATERIALS

Material Provided in Advance of the Meeting

- Board of Scientific Counselors (BOSC) Sustainable and Healthy Communities (SHC) Subcommittee Meeting—April 2019; Notice of public meeting (84 *FR* 9337; March 14, 2019)
- **Tier 1 –** *most important to review*
    1. SHC Strategic Research Action Plan (StRAP)
    2. FY2018-FY2022 EPA Strategic Plan
    3. ORD Strategic Plan 2018-2022
    4. Superfund Task Force Recommendations
    5. Memorandum on EPA's Environmental Justice and Community Revitalization Priorities
    6. SHC Stakeholder Engagement Fact Sheet
- **Tier 2** – *additional information on research drivers*
    1. 2016 State Research Needs Survey
    2. SHC StRAP Topic 3 Drivers
    3. EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan
    4. Federal Action Plan to Reduce Childhood Lead Exposure
- **Tier 3** – *additional reading for BOSC members*
    1. *Sample SHC Research*
        - EPA's Sustainability and Healthy Communities National Research Program 2018 Accomplishments
        - SHC Research Bibliography, 2016-present
        - SHC Overview Fact Sheet
    2. *Innovative Programs*
        - Innovation at EPA Webpage
        - ORD's People, Prosperity and the Planet
    3. *Programmatic Context*
        - U.S. EPA Sustainable Materials Management Program Strategic Plan, FY 2017-2022
        - Sustainable Materials Management: The Road Ahead
        - Great Lakes National Program Office and it's authorities
            - Great Lakes Water Quality Agreement & Areas of Concern
            - Great Lakes Restoration Initiative
        - Brownfields Program

Informational Materials

- **Actionable Recommendation Examples**
    1. 2015 BOSC EC report posted at https://www.epa.gov/sites/production/files/2016-01/documents/bosc_ec_report_draft.pdf)
    2. 2012 joint SAB/BOSC EC Report posted at https://www.epa.gov/sites/production/files/2015-02/documents/120928rpt.pdf.
    3. Previous Agendas, Meeting Documents and Approved Meeting Minutes from SHC Subcommittee "Past Meetings" accessible at https://www.epa.gov/bosc/sustainable-and-healthy-communities-bosc-subcommittee (right-hand column).

Additional Material Provided During the Meeting

1. National Program Director (NPD) & Deputy NPD Welcome Letter

- Presentation: Sustainable & Healthy Communities Research Program: Overview of the Strategic Research Action Plan for FY 19-22 (StRAP)
- Presentation: Office of Land and Emergency Management (OLEM) Research Priorities for the Sustainable and Health Communities Research Program
- Presentation: Regional Engagement: SHC's Strategic Research Action Plan (StRAP)
- Presentation: Regional Sustainability and Environmental Sciences Research Program (RESES)
- Presentation: Overview - Topic 1: Contaminated Sites
- Presentation: OLEM/OSRTI Perspective
- Presentation: Site Characterization and Remediation (RA2)
- Presentation: US EPA's Science-Based Approach to Lead: Sustainable and Healthy Communities Research Program
- Presentation: US EPA's Science-Based Approach to PFAS: Sustainable and Healthy Communities Research Program
- Presentation: Overview - Topic 2: Waste and Sustainable Materials Management
- Presentation: OLEM Perspective
- Presentation: Landfill Management (RA6)
- Presentation: Research Area 7: Life Cycle Inventories and Methodologies
- Lab Tour
    - Presentation: EnviroAtlas
    - Bioaccessibility
    - Solvent Vapor Intrusion
- Presentation: Overview - Topic 3: Healthy and Resilient Communities
- Presentation: Office of Community Revitalization Local Assistance Programs: *Supporting locally led, community-driven solutions that protect human health and the environment, strengthen local economies, and improve people's everyday lives*
- Presentation: Benefits of Remediation to Restoration to Revitalization (R2R2R)
- Presentation: Research Area 10: Community-driven Solutions (Health Outcomes)
- Presentation: Research Area 10: Community-driven Solutions (resilience)

Additional Material Provided After the Meeting

- SHC's Tools Table
- ORD-Regions Coordinated Engagement Process Diagram