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THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

FEB 13 2013

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Dear Dr. von Stackelberg:

I wish to offer my gratitude to the U.S. Environmental Protection Agency's Science Advisory Board and the Board of Scientific Counselors for their joint review of the Office of Research and Development's strategic research action plans. ORD is now well-positioned to provide a strong foundation for sound environmental-policy decisions.

The boards' clear and insightful recommendations will help to ensure our continued progress in scientific and technological innovation, sustainability and integration across the research enterprise. We recognize that a number of comments concerned the degree of detail provided in the action plans and the reviewers' ability to understand the full spectrum of the program. With the release of ORD's research management system to our agency's partners this past November, we have increased considerably the transparency of the research portfolio.

Further, we will revisit our strategic direction periodically with the SAB while we revitalize our use of the BOSC to perform more detailed reviews of the quality and impact of the research programs. Both the research management system and regular program evaluations will ensure that we remain on the right path toward delivering products and results that enhance the EPA's ability to protect public health and the environment.

I have attached a detailed response to each recommendation so that members of both boards can see how their advice has been considered.

Please accept my sincerest thanks for the boards' rigorous review of the initial implementation of the ORD research program. Your guidance is invaluable as the EPA pursues a sustainable path to protecting public health and the environment.

Sincerely,

Lisa P. Jackson

Attachment

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December 2012

Office of Research and Development's

Response to Specific Recommendations in:

Implementation of ORD Strategic Research Plans: A Joint Report of the Science Advisory Board and ORD Board of Scientific Counselors (Sept. 28, 2012)

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ORD Responses to SAB/BOSC Report:
General Findings and Overarching Recommendations

2.2.2* Recommendations on First Year Progress

- **ORD should consider including a more detailed timeline with deliverables for planned activities for each research program with specific milestones and/or intermediate deliverables.**

- **In future action plans, ORD should provide a comprehensive mapping of projects to goals, and not just provide examples.**

Response

ORD's Strategic Research Action Plans are intended to convey the overall research directions of the six programs so that EPA partners and outside stakeholders can easily see the big picture of each program's vision, priorities and connection to the Agency Strategic Plan. We agree that more specific, detailed timelines with deliverables are essential for implementing the programs and we have developed an internal Research Management System to track information at that level. Each research program has identified a cohesive set of projects and tasks that will lead to the achievement of the research objectives mapped out in the Strategic Research Action Plans. In addition, for each project, expected milestones and products are identified. This information will be used to inform ORD managers and scientists, and our EPA partners in the program and regional offices, about the planned activities in each research program.

2.3.2. Recommendations on Sustainability

- **Each ORD program should define more specifically what sustainability means within the program context, and identify how each plan incorporates ecological and human health into the definition of sustainability.**

- **ORD should collaborate with other partners in EPA, including the National Center for Environmental Economics, to develop a plan to develop the social, behavioral and decision science needed to support sustainability research and other goals identified in ORD's six major research programs. A useful first step would be for ORD to plan a workshop on this topic and seek SAB and BOSC advice in workshop planning**.

Response

Understanding and advancing sustainability science is a major ORD goal that supports broader EPA activities on sustainability. As the programs develop, the strategic research action plans will better articulate the contribution of each program to help decision makers take actions that lead to more sustainable outcomes. This is an ongoing focus integrated across all of the ORD programs. ORD is reviewing its decision support tools to ensure they are up-to-date and accessible to assist stakeholders in

* Numbering of recommendations corresponds to numbers in the SAB/BOSC report.

achieving sustainability goals. Ecological and human health are central features of several of these models, methods and databases.

The National Program Directors (NPDs) are working together on how best to integrate social, behavioral and decision science research into the programs. ORD and NCEE are planning an internal workshop focused on sharing expertise for economic benefits analyses. This internal workshop will aid us in planning a public meeting ORD will develop with NCEE in keeping with your suggestion. We appreciate the offer of advice which would clearly be helpful as we consider moving forward with this effort.

2.4.2. Recommendation on Balancing Immediate Program Needs and Emerging Issues

- **ORD should develop a structured approach (e.g., through a risk portfolio or decision science-based analysis) to assess the relative priorities of emerging issues *vis à vis* existing and legacy research activities.**

- **ORD should make training and development for ORD staff a priority and seek new ways to interact with scientists outside the EPA through partnerships with other agencies and academic institutions to keep staff on the frontier of science and alert to emerging issues.**

- **ORD should strive wherever possible to craft its research such that it fulfills the dual goals of meeting specific programmatic goals while also maintaining and expanding the agency's core capabilities in critical research areas.**

Response

Achieving a balanced program is an ongoing consideration as ORD addresses emerging issues and also meets the current and urgent needs of our EPA partners. We agree wholeheartedly that emerging issues will be better identified and anticipated if EPA scientists are at the "frontier of science." ORD is looking closely at its workforce to determine where the greatest gaps in expertise may be and how best to retrain those scientists eager for new opportunities. The emphasis on innovation has moved us toward a culture of continual learning and new experiences that we believe will help us in this endeavor. We could not agree more on the importance of partnerships with other agencies and academic institutions to keep our scientists at the forefront of emerging issues. We continually strive to meet program goals while also emphasizing our core science capabilities. We will consider these recommendations as we develop workforce plans and focus on using resources as effectively and efficiently as possible. In terms of exploring a risk portfolio analysis, we welcome additional dialogue with the SAB/BOSC on how we could best utilize this approach to inform our strategic directions.

2.5.2. Recommendations on Integration

- **ORD should develop individual "roadmaps" with goals and an outline of paths to those goals for each of the integrated research topics, similar to the roadmap being developed for ORD's nitrogen topic.**

- **ORD should develop a graphical framework for each integrated research topic that identifies and discusses the responsibilities and relationships of the various participating EPA programs and external agencies and groups.**

- **ORD should enhance its internal and external communication between research programs and provide more opportunities for formal exchange of research information.**

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Response

We are looking forward to the coming year as the National Program Directors and their teams focus on implementing the research programs. Integration across the programs continues to be an important goal and we look to the initial integration efforts to understand the approaches that work best. We agree that "roadmaps" laying out goals and projects are useful, particularly for the very large Agency and inter-Agency efforts. In addition to the Nitrogen topic, roadmaps are currently under development for Children's Health, Global Climate Change and Environmental Justice. These are labor-intensive coordination efforts that require the attention and engagement of many participants. For more focused efforts, we are coordinating very closely with all of our partners. The Non-monotonic Dose Response targeted effort is fully integrated, summoning and integrating resources to respond to a high priority Agency need in an expeditious manner. The CSS and HHRA research programs have established a cross-program team and are developing an integration plan, similar to the Nitrogen Roadmap.

Graphical frameworks are indeed helpful devices for organizing the information and clarifying the relationships for the various participants. We are in full agreement that ORD should take advantage of all opportunities to enhance communication between research programs and to exchange research information. At the same time, we have to bear in mind that we do not want to proliferate our research planning activities in such a way that we return to a large number of research programs and the associated increased transaction costs that we experienced previously.

2.6.2. Recommendations on Innovation

General Response

The SAB/BOSC insights and recommendations on how to strengthen ORD's new innovation efforts will be used to guide ORD innovation activities. ORD supports the overall set of recommendations on how to expand the impact and improve outcomes for innovation – including the necessity of visible and sustained commitment from ORD leadership. As the SAB/BOSC report points out, management of an innovative organization is more than launching innovation projects and programs – innovation must be built into the culture, which requires careful attention to managing organizational processes so they provide the proper incentives and support.

Consistent with the SAB/BOSC recommendations, ORD's Innovation Team plans to continue a sharp focus on central areas of EPA's mission and will continue to create opportunities for transformative research. As the SAB/BOSC report observes, managing the full cycle of innovation will be quite challenging (i.e., different approaches are needed for the different phases -- from ideation, to proof of concept and prototypes, to fuller scale applications, and finally to mainstreaming and commercialization). Over time, there is a clear need for a more unified "system of innovation" at EPA that can support projects through different stages of innovation.

The ultimate goal is to deliver transformative strategies and technology into "real world" practice by EPA programs and regions, and other organizations engaged in environmental protection and sustainability. This issue is not unique to ORD within the Agency. With the strong support of the Deputy Administrator, EPA has launched a Technology Innovation Roadmap to encourage the use of novel approaches to regulatory support and guidance, and ORD is working closely within the Technology Network to help accomplish this. One area of particular interest is the development of new environmental sensor/app technology that can provide low-cost, real-time monitoring information, and thus potentially transform environmental protection strategies.

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Two Recommendations on Metrics

- **When assessing potential innovation projects and impacts of innovation projects, ORD should consider multiple benefits of such projects, and identify and focus its metrics on the goals of the EPA's organizations and their specific need rather than on conventional business performance metrics.**
- **ORD should sponsor a focused workshop on metric development for innovation that would result in a set of metrics that represents a reasonable fit with the ORD mission and desire for innovation.**

Response

ORD agrees that conventional metrics have limited value for our innovation projects, and will work to find ways to measure the multiple benefits and impacts of innovation. The references provided in the SAB/BOSC are a helpful start. We can also learn from other government research organizations that have a proven record of innovation. For example, we envision an initial evaluation of the Pathfinder Innovation Projects after the third year of the program. The proposal to host a workshop to develop metrics that fit ORD's mission and the specific innovation priorities is a practical way to define a first-generation approach to measuring our progress. As the SAB/BOSC report points out there are many different perspectives on the value and utility of metrics, and ORD will continue to search for the approaches that work best at EPA. One option that we will consider is requesting that the BOSC or SAB conduct an evaluation and review of the innovation program.

- **ORD innovative activities and support of those activities should be prioritized to reflect the EPA's most pressing needs.**
- **ORD should provide more information on the guiding principles that govern how Pathfinder Innovation Projects grants are awarded and how questions for challenges are chosen.**

Response

ORD is already working to find ways to more clearly target innovation activities to areas with greatest potential to transform how EPA accomplishes its mission. This is needed both for external prizes and challenges, and for the internal Pathfinder Innovation Project competition that provides seed funding for high-risk, high reward ideas. We are currently having internal discussions about how to best target innovation, without stifling creative ideas that may offer large value but don't fit neatly into specific categories. It appears that EPA would benefit from a dual strategy: some innovation activities might be selected and funded based on investigator-initiated proposals that demonstrate relevance to EPA mission and transformation potential for EPA's work on environmental protection and sustainability; other innovation projects would be solicited to fill defined priority problems. ORD will continue to refine how best to balance identification of innovation priorities and being open to novel research that is of high value.

- **ORD should undertake additional efforts to identify and leverage the top innovators via mentoring of others and/or assembling the top innovators in small teams to promote further breakthroughs.**

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Response

There is some evidence from the innovation literature, experiences in other organizations, and ORD's Pathfinder Innovation Projects, that some researchers have more passion and capability for innovative research than others. This program has really emphasized innovation in terms of the potential to drive transformational solutions (rather than incremental improvement to current practice). ORD will explore ways to better use the existing innovators (e.g., skunkwork projects, and encouraging young investigators who have fresh ideas but not a substantial record of publication).

- **ORD should provide as much encouragement for social and sociotechnical innovations as for purely technological ones.**

Response

Innovation to advance environmental protection and sustainability should move beyond the current emphasis on technology to include social innovation. This will require additional internal discussion and scoping to better define ORD's role in this area and to figure out how to build needed capacity (both internal expertise and possible strategic partnerships with other organizations that conduct social science research). Additionally, EPA and ORD will benefit from better definition of the social dimensions of environmental protection. We also need a clearer understanding of social research priorities, which should be accomplished working closely with EPA program and regional offices. Clearly, future funding levels for ORD will play a significant role in determining how and to what extent we are able to move the organization in this direction.

- **ORD should use, solicit and support innovation research projects in communities and utilities across the country.**

Response

We agree. ORD's Sustainable and Healthy Communities program was established to include the opportunity to work on community-level innovation. A small number of innovative projects are already underway (e.g., the project in Durham, NC, to use cell phones to measure temperature for understanding heat island issues), and more will be planned over the next few years. The innovation work on citizen science (including the next generation of environmental sensors and apps) is focused on empowering communities with environmental information to make better decisions.

- **ORD should develop an award system that would align with the desired behavioral changes in moving the ORD culture to one of innovation.**

Response

ORD has taken some initial steps to better reward and recognize innovation (e.g., revised promotion criteria). ORD will also host a PeerOvation Workshop in 2013 that will use a collaborative voting process across the entire organization to identify the most notable recent innovations in ORD (including all aspects of science and administration). The workshop will involve innovation training, short presentations on the innovation stories selected by ORD staff, and some afternoon sessions to define new innovation opportunities.

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3.1.5. Recommendations for the Air, Climate and Energy (ACE) program

- **ORD should more explicitly map the long list of individual projects and project outputs in the Strategic Research Action Plans to strategic research themes and the overarching vision.**

Response

Each project in the ACE research portfolio is associated with a primary theme and each output is associated with a specific project. This more detailed information is not presented in the Strategic Research Action Plan (StRAP) but can be provided. As shown in the summary tables in the StRAP, many of the outputs are related to more than one theme and/or science question.

- **The Strategic Research Action Plan should include a plan for energy research and indicate how this research will integrate with the plans for climate and air quality research.**

Response

The energy research portfolio in ACE was developed as an integral component of the climate and air quality research. This is seen from the goals of the energy research, which are to evaluate potential impacts to climate-related emissions and air quality associated with energy production and use. Since the presentation to the SAB and BOSC, ACE has further consolidated the research under the energy topic area to more clearly demonstrate the integral connections between energy, climate, and air quality.

Plans for energy-related research will continue to focus on evaluations of potential future energy technology scenarios using the MARKAL model, a numerical model widely used to carry out economic analysis of energy-related systems. Agency-level priorities, including the energy-water nexus and environmental impacts of oil and gas production related to hydraulic fracturing, will continue to be high priorities for energy-related research in ACE. These priorities have been, and are being, developed in a coordinated manner with other ORD research programs (primarily SSWR) and with appropriate EPA partners in Headquarters and Regional Offices, as well as with key external partners, including DOE and USGS.

- **To support this additional systems-level focus on energy, ORD should identify senior leadership to provide necessary systems science expertise and ensure that the connections between energy research projects are drawn and made explicit.**

Response

The ACE NPD has the primary responsibility to provide leadership on energy research issues at EPA. To support the NPD, ORD has identified senior leadership to address connections between energy research activities across different programs. These positions are at the Associate Director level in ACE, SSWR, and SHC. Since the SAB/BOSC meeting in July, the connections are being more explicitly identified and documented.

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We agree with the recommendation that senior-level leadership on systems science will be needed for ORD to fully institute broad systems-oriented evaluations of energy options over the long term. In our current environment, we are working in the interim to build internal capacity to conduct such evaluations with the expertise we have in house, working with experts in DOE and in the broader research community. As we are able to expand these efforts to meet Agency priority research needs, we will examine how best to develop an appropriate scope and investment that would provide the most benefit in this area.

- **The Strategic Research Action plan should include a description of how ORD's ACE activities are positioned within the portfolio of other research activities at the EPA and the research of other federal agencies**.

Response

The StRAP contains a broad discussion of how the ACE activities connect to other research within the Agency, along with some specific examples. It is difficult in a strategic document to provide a comprehensive description of all the ways that the ACE activities connect with other programs. However, the presentations during the meeting with the SAB and BOSC related to nitrogen research and climate research describe two of the most important areas of research that cross programs.

For nitrogen, we are developing a roadmap that will create a path for unifying and integrating EPA nitrogen research efforts across multiple media and various temporal and spatial scales. The completed roadmap will be comprised of two documents: a foundational document, Vision for Integration, and an accompanying Implementation Plan that will identify the necessary research and information to support the design, analysis, and comparison of potential solutions to reactive nitrogen and co-pollutant problems.

In the area of climate, the ACE activities are closely coordinated with those of other federal agencies through the US Global Change Research Program. EPA is represented on the USGCRP by the ACE Associate Director for Climate, which provides a direct connection between ACE and other federal agencies. The Associate Director for Climate also interacts with EPA Headquarters and Regional Offices on climate-related activities. The interactions between ORD's efforts in ACE (and SSWR) are coordinated with the climate-related efforts in EPA's Office of Air and Radiation (OAR), Office of Water (OW), and other Offices and the Regions. From these collective interactions a Climate Research Roadmap is being developed to assure a coordinated and targeted effort within ORD and leveraged across the Agency as well as other federal agencies via interactions with CENRS.

Additionally, the StRAP already addresses how the ACE program will work with relevant agencies across the federal government to develop coordinated approaches to air, climate, and energy issues. The StRAP specifically mentions that the ACE research program will build on and leverage existing relationships with the National Oceanic and Atmospheric Administration, the Centers for Disease Control and Prevention, the National Institute of Environmental Health Sciences, the National Aeronautics and Space Administration, and the U.S. Department of Energy. The coordination with other federal agencies includes interactions with individual agencies, as well as multi-agency interactions through the Air Quality Research Subcommittee and the Global Change Research Subcommittee of the National Science and Technology Council's Committee on the Environment, Natural Resources, and Sustainability.

- **The Strategic Research Action Plan needs more comprehensive and greater depth in planned social science and behavioral research.**

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Response

The issue of social science and behavioral research is common across several ORD programs. Within ACE, we have been working toward developing a greater role for social, behavioral, and economic research. As an example, we have hired expertise in public policy and are seeking a post doc to help evaluate how to support community-level decision making. While these efforts do not substitute for comprehensive, in-depth social and behavioral research plans, they do help us set the stage for broader discussions across ORD about the most effective approaches to integrating social and behavioral expertise into our research. At this stage in the development of that capacity, it does not make sense to duplicate such expertise in each program. Thus, the necessary discussions are initially focused on how to develop this capacity within ORD as we conduct a broader evaluation of our the knowledge and skills of our current and future workforce.

3.2.6. Recommendations for the Chemical Safety for Sustainability (CSS) program

CSS Response

The CSS research program has been designed with a goal of leading development of innovative science to support safe, sustainable use of chemicals and materials required to promote ecological wellbeing including human and environmental health. We thank the committee for affirming the important progress made in the CSS research program during our first year of the path forward. We agree that the CSS strategic research plan is a noteworthy accomplishment and that the planned research is comprehensive and designed to have significant impact. As ORD ramps up implementation of the CSS research program, we strive to enable the Agency to address the impact of existing chemicals; to anticipate impacts of new chemicals and materials/products across the lifecycle; and to evaluate complex interactions of chemicals and biological systems to support Agency decisions.

General Recommendations for CSS

- **Clearly demonstrate how CSS research impacts upon end users (e.g., risk managers, policy makers) and how it brings value for informing decisions.**

Response

An important objective of reorganizing ORD research under the Path Forward is to efficiently focus resources to address problems of national significance as well as to build the scientific basis to improve Agency and stakeholder decisions. As we move to fully implement the strategic research action plan, key pillars of the CSS program will facilitate integration of the science to inform decisions and provide solutions. The CSS research pillars: (1) chemical safety evaluation, (2) systems understanding, (3) knowledge infrastructure, and (4) decision support. These advancements will be made in the context of immediate Agency needs for risk-based solutions and longer term Agency requirements to support safe and sustainable chemical use. As such, we continue to engage our Agency partners to improve the value of CSS products by iteratively considering end user needs, and we have recently increased emphasis on outreach to demonstrate CSS research impacts.

In addition, in May 2012, the SAB's Exposure and Human Health Committee undertook an initiative to develop advice to assist the EPA in advancing the application of ORD's computational research for human health risk assessment to meet the agency's programmatic needs. The report from this review is being finalized and is expected to provide additional guidance on translating CSS science for informing decisions by end users within the EPA and the broader community of risk assessors, risk managers, and policy makers.

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We are aware that the CSS brings forth an innovation and at times a revolution in hazard and exposure assessment that has the potential to equally transform risk assessment and the attending areas of risk management and policy/decision making. For the program to have demonstrable impact, it will require engagement, input, and buy-in from its end-users. This iterative approach, by design, will force a solutions-based approach that will take into account the needs of the end user and as such will be responsive and relevant to those needs. To ensure that we meet these goals, we hope to expand our engagement with external advisors such as the SAB and BOSC.

- **Increase focus on the refinement and verification of proximal and consumer exposure models, including both external and internal dosimetry.**

Response

We thank you for affirming the importance of incorporating exposure considerations throughout the CSS research program. Similarly, the recently published NAS report "Exposure Science in the 21st Century: A Vision and a Strategy," calls for research to characterize exposures quickly and cost-effectively at multiple levels of integration (time, space, biological scale), for multiple and cumulative stressors. Although a separate exposure theme could increase focus on exposure science to support chemical safety evaluation, we believe a truly integrated CSS research program will provide the context required to advance exposure science and to provide solutions fit for purpose.

We agree that application and verification of near-field models for efficient evaluation of potential exposures is a key research need to advance chemical safety evaluation. Since meeting with the SAB/BOSC in July, important progress has been made within ORD on developing efficient approaches for characterizing potential exposures to large sets of chemicals, and a manuscript has been submitted for publication. In addition, several manuscripts have gone to press describing approaches for incorporating consideration of proximal exposures associated with consumer product use to rapidly prioritize chemicals based on potential exposure. The CSS component of ORD's Science to Achieve Results (STAR) extramural grants program is about to release a Request for Applications (RfA), "New Methods in 21st Century Exposure Science" that seeks to support research that will develop innovative methods to (1) characterize co-occurrence of semivolatile chemicals from consumer products in real-world indoor environments; (2) strengthen the understanding of how people are exposed to chemical ingredients of consumer products; and (3) generate data required to predict and evaluate predictions of exposure for all relevant indoor sources and pathways. Advances in these areas will provide tools to assess the potential impacts of chemicals in consumer products, to minimize exposures to vulnerable groups and to safely manage risks to human health.

Recommendations for Endocrine Disrupting Chemicals

- **In the effort to transition toward EDSP21, place greater attention on the challenges involved in using reductionist approaches (e.g., ToxCast) in evaluating highly integrated physiological networks, such as the endocrine system.**

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Response

As noted by the SAB/BOSC, the knowledge gained as we apply the new high throughput methods and advanced computational modeling to prioritize chemicals for screening in the EPA Endocrine Disruption Screening Program will inform similar efforts with other toxicity pathways and support efforts to create an entirely new paradigm of safety assessment. As CSS research in this area progresses we will continue to address gaps in the assay platforms required to cover key aspects of biology for endpoints of concern to improve predictive capability of models developed using ToxCast data. The CSS program will also begin to build understanding of chemistry into the ToxCast models such that prior knowledge of chemical determinants of physical-chemical properties and reactivity is used to refine predictive models.

It is important to note that the objective of our CSS systems research in adverse outcome pathways (AOP) discovery and virtual tissue modeling is to understand molecular pathways and cellular processes underlying adverse outcomes and so that we enhance the ability to predict toxic responses resulting from chemicals exposures. We believe this integrated approach will allow the CSS program to provide the focus on addressing challenges in using and interpreting ToxCast data that the SAB/BOSC has identified.

- **Frame the research on EDSP21 as a precedent for addressing analogous challenges for evaluating other complex integrated biological systems (e.g., nervous system).**

Response

We agree that successful implementation of the EDSP21 workplan will provide a model for how to advance and potentially revolutionize chemical safety evaluation and as recommended we will begin to explicitly frame the aspects of this research that can be applied in addressing other important toxicity endpoints. The goal of the EDSP21 workplan is to use *in vitro* and *in silico* methods to evaluate a greater number of chemicals for potential activity in these same pathways than could reasonably be carried out using the current EDSP Tier 1 Screen (T1S). The near term goal is the use of high-throughput screening and *in silico* approaches along with other data to immediately prioritize thousands of chemicals for the current EDSP T1S. The intermediate term goal is the incorporation of high throughput and *in silico* mechanistic predictive models and signals to inform a targeted application of the current EDSP T1S. Finally, the longer term goal is the eventual replacement of T1S with a suite of assays based on non-whole animal methods. Because the Endocrine Screening program will be developing traditional toxicity screening data, the EDSP21 research provides one important opportunity to evaluate the new computational toxicology tools. We have similar work plans in place to address prioritization for chemicals under the Toxic Substances Control Act and the Safe Drinking Water Act. But, we agree that as the longer term goals of the EDSP21 research are implemented, there are opportunities to generalize insights and extend the approach being developed for endocrine outcomes to improve evaluation of other key biological systems and endpoints.

Recommendation for Nanomaterials

- **Define ORD's unique niche within the broader landscape of nanotechnology research.**

Response

ORD's nanomaterials research is housed within the Chemical Safety for Sustainability research program, with focus on innovative research in hazard and exposure assessment, green chemistry, and sustainability. This research is unique in that it employs a holistic and transdisciplinary approach to address environmental health and safety issues of nanomaterials, and is founded on a life cycle and comprehensive

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environmental assessment framework that evaluates nanomaterials from cradle to grave and identifies key research needs. ORD's research employs a basic understanding of the unique properties of nanoparticles to evaluate their fate in the environment and potential toxicity through the use of *in vivo* and *in vitro* testing as well as the utilization of high throughput screening assays to provide comprehensive hazard identification. This application of computational science, both in chemistry and toxicology, will provide a unique advantage to promote sustainable molecular design and benign design in the context to nano-based and emerging materials. ORD is also developing methods for the sampling and detection of nanomaterials across their life cycle.

The approach is strengthened by the interaction with the EPA program offices, which helps in the prioritization of nanomaterials for evaluation. For example, two years ago EPA's Office of Chemical Safety and Pollution Prevention identified silver nanoparticles as a priority since they are used mainly as antibacterial agents. Since that time, ORD's researchers carried an integrated approach to evaluate environmental, health and safety issues associated with silver nanoparticles which provided the program office with the data needed to make regulatory decisions based on science. As a result, the EPA is in a better position with regards to the potential regulation of silver nanoparticles as antibacterial agents.

The CSS research program evaluates a broad array of chemicals, including endocrine disrupting chemicals. Models and approaches developed as part of CSS in several cases can be adapted and applied to nanomaterials. For example, quantitative structure-activity relationship models can potentially be tailored to nanomaterials once enough data are available for such application. As we understand more about the unique properties of nanoparticles ORD is uniquely positioned to evaluate green synthesis methods as an alternative for the manufacture of 'benign' nanomaterials.

Recommendations for Computational Toxicology

- **Clearly and transparently describe the proposed approach for verification of new computational toxicology tools for their intended purpose and with respect to risk assessment, and present to BOSC for review.**

- **Define the typical range of intra- and inter-individual variation in biological control pathways in order to distinguish between adaptive vs. adverse changes. Address how the program will dovetail with higher tier targeted testing.**

- **Place greater emphasis on integration of toxicokinetics (ADME) and physiologically-based pharmacokinetic models.**

Response

We greatly appreciate the SAB/BOSC feedback on the need to clearly articulate verification/validation approaches of fitness for purpose of the computational toxicology tools, the need to evaluate intra- and inter-individual variation, relationship to higher-tier targeted testing, and the need to incorporate ADME where such data are available. The CSS is committed to addressing these concerns and continuing to engage the BOSC and the SAB as we move forward and iteratively develop our approaches. In the immediate term, the EDSP21 research provides one important opportunity to evaluate the new computational toxicology tools and address some of these issues versus traditional toxicity testing approaches. That plan also engages an important cadre of external advisors in the form of the Science Advisory Panel (SAP).

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3.3.8. Recommendations for the Human Health Risk Assessment (HHRA) program

- **The EPA should broadly examine the diverse venues where risk assessment activities reside within the agency and seek to establish connections and integration that will foster ongoing enhancement of methodologies that are common to risk practitioners throughout the Agency.**
- **ORD leadership should elaborate a strategic vision that enhances linkages among the thematic areas of the HHRA and with the other research programs, particularly the CSS program, and that emphasizes the way that the HHRA program contributes to sustainability research. This vision will be needed for revising the HHRA strategic plan.**
- **A wide- reaching plan is needed for incorporating data from emerging technologies, e.g., "omics" and high throughput testing, into EPA risk assessment approaches and for evaluating the utility of these data for decision-making. This activity needs emphasis in Theme 4.**
- **While progress by HHRA has been on pace during its first year, the agenda needs to be set for the longer-term with priorities given to the most critical topics for decision-making, particularly as resources may decline.**
- **Exposure sciences need greater emphasis within the activities of the HHRA and further expertise is needed in this cross-cutting area.**
- **The addition of further social, behavioral, and decision scientists to HHRA would benefit many of its activities and enhance integration with other programs. This recommendation echoes prior reports and speaks to the broad, multidisciplinary nature of decision-making and communication with regard to risk in the face of uncertainty. Long-standing gaps in expertise within the Agency should be addressed.**
- **Concerted and sustained efforts are needed to assure that scientists with HHRA and elsewhere in EPA and decision-makers are fully versed in the latest risk assessment approaches and the interpretation and application of their findings.**
- **EPA risk managers should also be educated about new data and approaches to risk assessment, leading to greater confidence in decisions based on these approaches. They need to be kept aware of advances made under Theme 4.**
- **Peer reviews of HHRA documents and assessments could be made more efficient. The plans for changes in the IRIS assessments should benefit the peer review process. Additionally, the intensity of peer review should reflect the complexity and importance of the product. For extensive peer reviews, it is important to evaluate and improve the process to triage comments so that effort is directed at the points of criticism that are most important and that have significant implications for overall risk estimates and decision-making. This may be facilitated by an independent "monitor" or "editor."**

Response

The HHRA research program appreciates the thoughtful review and helpful recommendations of the SAB/BOSC. We value the panel's recognition of HHRA's straightforward approach, significant contributions to sustainability, and efforts to provide training and education to risk assessors, both within and outside of the Agency. Since publication of its Strategic Research Action Plan (StRAP), HHRA's strategic vision has evolved to focus on better integrating activities within the program and across ORD. These strategic alignments are consistent with the panel's recommendations and will help HHRA to leverage resources, accelerate methodological advancements (e.g., support transparent evidence synthesis and systematic review), and advance incorporation of new toxicity testing data and methods. Additionally, such alignments will support the development of a portfolio of assessment and decision-support products that efficiently and effectively address client needs. The HHRA research program will

work to transform its risk assessment approaches consistent with recommendations of the panel and the NRC. Greater consideration of children's health and environmental justice issues will be an important part of HHRA's implementation of the panel's recommendations. In meeting these goals, HHRA also aims to enhance its engagement with stakeholders and its collaborations with outside parties, including other federal agencies.

The panel's recommendations for HHRA were largely focused on advancing and more clearly articulating the Program's strategic vision through: integration and coordination within HHRA, with ORD's other research programs, across EPA, and with other agencies; outlining HHRA's contributions to sustainability; transforming risk assessment approaches including the rapid incorporation of new data and methods; and advancing HHRA's exposure methodology work. HHRA will build on its existing efforts to fully respond to the panel's complete set of recommendations as outlined below.

- Increase integration and coordination within HHRA, with ORD's other research programs, across EPA, and with other agencies – Consistent with the Panel's recommendations, HHRA is identifying and leveraging opportunities for synergy across HHRA's themes and within ORD. Within its program, HHRA has begun identifying and addressing elements that cut across themes, such as systematic review. Within ORD, HHRA is coordinating with other research programs and developing an integrated research agenda, including with CSS and SHC. As part of this effort, HHRA plans to improve the identification and communication of key data gaps in order help EPA focus its research efforts.

  Over the last year, HHRA has expanded its interactions with EPA's program and regional offices and has established a regular schedule of frequent meetings. The Integrated Risk Information System (IRIS) Program has undertaken efforts to engage other federal agencies and stakeholders earlier on and during the assessment development process. HHRA scientists working on Provisional Peer Reviewed Toxicity Values (PPRTVs) have increased coordination with EPA's Office of Solid Waste and Emergency Response (OSWER) to ensure that their highest priority needs are met first. Enhanced outreach and engagement with stakeholders in non-governmental organizations, industry, state agencies and academia are a high priority to improve the identification, completion and communication of assessment activities. HHRA also plans to improve the efficiency of peer review by utilizing a standing SAB peer review panel and revising procedures for contract-led peer review panels. HHRA will continue to increase these efforts in the future and will work to more fully describe them in its StRAP.

- Outline HHRA's contributions to sustainability – The SAB/BOSC noted that the data and tools generated by HHRA contribute to sustainable decision-making, consistent with HHRA's mission. HHRA's strategic vision will include articulating the many ongoing contributions to sustainability. The research program also plans to contribute to sustainability tools developed in other ORD programs (particularly CSS and SHC) that address exposure and ecological health. Though constrained by current limits on new hiring, integration of social and behavioral scientists in risk assessment related activities is planned to advance these goals.

  HHRA is also pursuing new activities that will contribute to EPA's sustainability efforts to integrate social, economic, and environmental factors. For example, in concert with other national programs, HHRA is focusing on epigenetics as informing approaches to better address community and multigenerational risks posed by environmental factors impacting the human epigenome. Additionally, as mentioned earlier (p.2), HHRA is leading ORD's collaboration with the National Center for Environmental Economics (NCEE) to plan and execute a workshop on non-cancer economic benefits, as recommended by the SAB/BOSC.

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- Transform risk assessment approaches, including the rapid incorporation of new data and methods – HHRA is contributing to ORD's five cross-cutting areas, including children's health and environmental justice, with an initial emphasis on integration with the CSS research program. The focus of this effort is to address the SAB/BOSC recommendation to begin, as soon as possible, to incorporate new methods and types of data from emerging technologies into its assessment products. A cross-program team has been established, and an integration plan, similar to the nitrogen roadmap, is under development.

  The cross-program integration effort will also address the SAB/BOSC recommendation to advance intellectual exchange and education on new methodologies among risk scientists at EPA and in the risk assessment community. While the SAB/BOSC commended HHRA for its Risk Assessment Training Experience (RATE) program, the panel indicated that more coordination and education is needed across the Agency with regard to risk assessment methodologies and practices. HHRA will provide more training opportunities and tools to EPA risk assessors and decision-makers. HHRA will also develop additional outputs related to training and education in its revised program plan, as suggested by the SAB/BOSC.

- Advance HHRA's exposure and methodology work – HHRA acknowledges the importance of exposure science as relevant to all themes and will work to expand and more clearly articulate ongoing planned activities in this area in the StRAP. As an example, HHRA is developing the EPA-Expo-Box, a web-based toolbox for exposure assessors that will explain the components of exposure assessment and provide links to exposure assessment and risk characterization tools, including databases, models, guidance documents, reference materials, and EPA's Exposure Factors Handbook.

3.4.7 Recommendations for the Safe and Sustainable Water Resources (SSWR) program

SSWR Response

We greatly appreciate that the SAB/BOSC report indicated that the research activities planned for FY13 and future years are appropriate for answering the science questions in the SSWR Strategic Research Action Plan (StRAP), and that ORD's planned research activities for FY13 align appropriately with the overall research goals of the program. We also appreciate the SAB and BOSC's recognition of ORD's progress in implementing the SSWR research program, that the priorities in identifying planned activities within the plan are well balanced, and that SSWR research appropriately incorporates sustainability into its existing program and into its long-term research planning.

General Recommendations on SSWR Research Program

- **ORD should include specific tasks and milestones in the SSWR Strategic Research Action Plan.**

Response

The SSWR Strategic Research Action Plan was designed to be a high-level overview. As noted by the SAB/BOSC, the SSWR implementation plan includes specific milestones, tasks and products for each of the scientific questions in SSWR's two Themes, and these are contained within ORD's Research Management System.

- **The SSWR program should further clarify what is the agency's focus vs. the focus of other agencies regarding SSWR sustainability-related research.**

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Response

We agree. The SSWR National Program Director co-chairs the interagency Subcommittee on Water Availability and Quality (including: USGS, USDA, NOAA, USBR, NSF, DOE) to examine water research areas of common interest, including sustainability, and to foster better integration of research. Specifically to focus on water sustainability research, EPA signed an MOU with Dept of the Army to link research in SSWR with the Army's need to promote sustainable resource management on Army installations and to achieve the Army's goal of net zero water, waste, and energy through the development and demonstration of new applications and technologies for use on its installations (MOU signed Nov 28, 2011). SSWR is focusing primarily on Net Zero water. EPA has also signed an MOU with DoD to link research in SSWR to DoD needs to advance innovative solutions and demonstrate cutting-edge technology in support of sustainability and greater resource resiliency on military bases. (MOU signed Feb 7, 2012). SSWR seeks to transfer water system technological successes and water system solutions demonstrated on the installations to broadly benefit communities across the U.S. SSWR, working with STAR Grants and DoD's Strategic Environmental Research and Development Program, proposed issuing a joint solicitation that will focus on increased water reuse and sustainability.

- **The SSWR program should develop a structured way to assess emerging issues in establishing priorities**.

Response

We agree. We are exploring the development of workshops to bring together scientists from EPA, other federal agencies and academia to forecast the kinds of issues related to water that the Agency will face in the next 7-10 years. The findings of these workshops could be used to form the basis of new STAR RFA's to provide the science that will be needed in the future by ORD and others to address these new issues as they emerge.

- **The SSWR program should consider the magnitude and distribution of risks associated with not pursuing emerging SSWR research issues that could benefit certain communities such as environmental justice communities.**

Response

SSWR is committed to critical water research issues, especially as they may affect vulnerable populations and ecosystems or pose environmental justice (EJ) concerns. Much of the research in our current work has EJ and vulnerable population and ecosystem components, although it may not have been explicitly identified as such in the StRAP. Such research issues are high priority for SSWR and we are currently trying working with the Associate Director for CSS who has the lead to integrate environmental justice-related efforts that cross ORD National Programs.

- **ORD should transparently communicate its efforts to prioritize research and conduct outreach and actively engage with communities when developing SSWR research priorities.**

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Response

We agree. We endeavor to be transparent with all our partners inside and outside the Agency in our approach to prioritizing research. While developing the StRAPs, we held meetings with our external partners and meetings with Office of Water (OW) stakeholders (including Regions, programs, Office Director and AA-level briefings) to share our research priorities and to encourage them to articulate their research priorities. These meetings were well received, and in the face of declining budgets, it allowed SSWR to prevent duplication and to build complementary research efforts. We do have direct outreach and engagement with communities, where appropriate, for development of tools and demonstrations of approaches to management (e.g., Cape Cod, Narragansett Bay, Omaha NE, Net Zero). However, the focus of much of SSWR's research is on regional and national approaches to problem solutions and sustainability. For the application of SSWR's research to local communities, we work closely with SHC and have integrated and complementary research efforts.

Recommendations on Nitrogen Research in SSWR

- **EPA should invest more in assessing use of market mechanisms for nutrient control, and identify metrics for nutrient management.**

Response

We appreciate this suggestion and have used it to guide two of our current research projects that examine the potential use of market mechanisms for nutrient control. One project is examining the feasibility of nutrient trading with typical participants like agricultural producers and wastewater treatment plants in the East Fork Watershed in southwest Ohio. One of the major barriers to successful nutrient trading in the United States is thin markets (too few willing and able buyers and sellers), so this project also includes identifying actors who would not typically participate, but might help to address the limitations in the supply or demand for nutrient reduction (e.g., examining the incentives a drinking water treatment plant might have for entering the market). This project also continues our focus on avoiding unintended consequences and choosing best management practices that produce co-benefits.

In a second project, ORD is working with the OW and Chesapeake Bay Program to evaluate a range of market and non-market based scenarios with the goal of optimizing economic performance in implementing the Chesapeake Bay Total Maximum Daily Load (TMDL) for N, P and sediment. An important metric for these scenarios is the aggregate value of "bonus" ecosystem services (i.e. those additional to nutrient removal) generated by various management practices, with emphasis on reduction of non-point source nitrogen loads. One goal of this research and modeling effort is to establish optimization methods that will be transferable to other watersheds.

- **The SSWR program should be engaged with and knowledgeable about research on mechanisms and forms of nutrient delivery in agriculture.**

Response

As recommended by the SAB/BOSC, we *are not* currently conducting research on the mechanisms and forms of nutrient delivery in agriculture. However, as recommended, we *are* in a position to take the results of research performed by others and use them to develop "field-scale" nutrient management modeling scenarios that can be combined with various past, present, future or artificial weather situations (and/or alternative crop management scenarios) to explore edge-of-field nutrient delivery averages,

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variability and trends on regional to national scales. Researchers outside of ORD should conduct very high-resolution studies. We are exploring linking with others who are doing multi-field routing (Agricultural Policy/Environmental eXtender model, APEX) and watershed modeling (Soil and Water Assessment Tool, SWAT) but are not in a position to do this work ourselves.

Elements of this recommendation are incorporated into the Nitrogen Research Roadmap effort described below. We are also planning a working meeting with USDA to establish a collaborative interdisciplinary research and management partnership between EPA and USDA (also described below). In addition, in collaboration with OW and OAR, we are advertising for a postdoctoral candidate, who will focus on sustainable nutrient analysis. The candidate will have the opportunity to assess the economic tradeoffs and unintended consequences associated with various nutrient management strategies including those strategies that will impact farms and farming communities. ORD has also begun to engage with the EPA's Farm, Ranch, and Rural Communities Committee on nutrient management issues.

- **ORD should identify and seek opportunities for leveraging research related to nutrients with other federal agencies and utilize ORD's strengths in areas such as monitoring, data analysis, and modeling within such leveraged efforts.**

Response

The SAB Integrated Nitrogen Committee's report "*Reactive Nitrogen in the United States: An Analysis of Inputs, Flows, Consequences, and Management Options*" has been a valuable resource for the Agency. ORD is currently leading a cross-Agency effort, with OW and OAR, to develop a Nitrogen Research Roadmap that identifies research needed to lay the foundation for the Agency, federal partners and stakeholders to move forward on their path of integrated research that informs decisions and leads society toward sustainable nutrient management. The Roadmap will provide a resource to aid development of effective research to inform science-based policies needed for successful implementation of an integrated and sustainable nutrient management program. Identifying mitigation pathways and practices that will lead to a reduction of nutrient loading in the United States, as recommended by the SAB, will require cross-agency cooperation between EPA, USDA, USGS, DOI and other agencies, as well as cross-office coordination within EPA (i.e., across ORD, OW, OAR, and Regional Offices).

ORD recognizes that to manage nutrients effectively, water quality and quantity data collected routinely by the USGS and States have to be merged efficiently with information from the National Resource Conservation Service and other local USDA affiliates on conservation practices and permit compliance monitoring. Nutrient management at the scale relevant to TMDLs or Source Water Protection (i.e., the watershed scale) requires analytical tools that integrate this information, allowing for a bridge between small-scale implementation of nutrient reduction strategies and watershed-wide nutrient loadings. Existing nutrient fate and transport models provide a good framework for developing these new approaches. ORD is working with such models and testing newer integrative classification and statistical methods within these frameworks. The integrated models are necessary for watershed sustainability assessments but also for parallel research on development of market and non-market based mechanisms for reducing nutrient loads in watersheds. Such work is taking place within watershed test-beds (e.g., Narragansett Bay and East Fork Watershed Systems among others) where the appropriate stakeholders and water resource professionals are interacting collectively. ORD plans to develop guidelines for application in other systems from these studies.

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- **ORD should assess and encourage opportunities for innovation in nutrient research.**

Response

Currently, the STAR grants program is seeking applications to establish Centers to conduct water research and demonstration projects that are innovative and sustainable using a systems approach for nutrient management in the Nation's waters. The announcement asks for proposals that address nutrient management holistically and include societal and technological considerations such as local resources, prevailing land uses, watershed health, manure management, energy costs, municipal wastewater treatment, in-building water reuse, or nutrient resource recovery. A systems view would also consider valuation of monetized and non-monetized possible co-benefits and consequences (e.g., decreased sediment runoff, improved recreational value) which may be part of a nutrient management program.

SAB's support of innovative nutrient research has helped guide the expansion of our ongoing research. As mentioned above, ORD is leading the development of a Nitrogen Research Roadmap, with OW and OAR. Currently the *Vision for Integration* component of the Roadmap recognizes that there will be an insufficient systems level understanding without integration of research to inform decisions across EPA and other agencies. This lack of understanding will impede prevention or mitigation of environmental degradation by reactive nitrogen (Nr) and co-pollutants, which is exacerbated by population, pressures (Nutrient Innovations Task Group 2009, SAB 2011). Significant, sustainable reductions in nutrients must be economically efficient, socially acceptable, environmentally sound, adaptable to climate change, and permanent. These requirements can be met only through innovative and integrated research that informs the systematic collective, adaptive management of air, land, and water. The next component of the Roadmap is an *Implementation Plan* (to be developed) that will identify the necessary research and information to support the design, analysis, and comparison of potential solutions to Nr and co-pollutant problems. The *Implementation Plan* will describe the near-term and long-term research strategies that can be used to inform Nr and co-pollutant management decisions across the Agency and beyond.

Region 1 has teamed up with ORD to address nutrient pollution in the Narragansett Bay Watershed using a triple value model that collaborates with key stakeholders to identify and address broad sustainability goals for the Region. This work explores integrated strategies for nutrient mitigation, looks for innovation and best practices in water use, land use, industrial processes, energy, and infrastructure, while providing a replicable approach for other EPA Regions with similar challenges.

We currently have a collaboration between the OW's National Aquatic Resource Survey (NARS) (SSWR provides technical support) and USGS's National Water-Quality Assessment Program (NAWQA). Based on USGS monitoring at a subset of NARS streams and rivers, ORD will be able to calculate relative risk of contaminants and nutrients to the biotic indicators in NARS. In combination, the sites sampled will provide the data necessary to assess the water quality and ecological condition of streams in the region and to support empirical modeling of factors affecting those conditions.

Also, ORD in consultation with OW and OAR, is in the process of initiating discussions with USDA to foster a collaborative relationship between EPA and USDA that advances reactive nitrogen research to inform science based management, improve communications, and recommend alternative approaches to managing Nr in an integrated framework. Currently we are evaluating several possible research collaboration and demonstration areas.

ORD has funded a Pathfinder Innovation Project (PIP) team that is developing a mobile smart phone app to measure water quality. This PIP project combines an experimental remote sensing technology,

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currently being tested aboard the International Space Station, with water quality measurements. The technology used in this PIP will be extended to detect cyanobacteria blooms in estuaries.

Recommendations on Green Infrastructure Research

- **The SSWR program should take a leadership role in conducting green infrastructure research and incorporate natural infrastructure into its research.**

Response

We agree. SSWR's green infrastructure research activities include ongoing collaborations with communities that are integrating green infrastructure into their Long Term Control Plan for stormwater management and control of Combined Sewer Overflows (CSOs). Stormwater modeling tools have also been enhanced (e.g., Storm Water Management Model (SWMM), and the National Stormwater Calculator) to estimate the how much stormwater runoff can be reduced with new green infrastructure practices and/or the protection of existing natural green infrastructure in the community.

SSWR also supports leading researchers in green infrastructure research through the STAR grants program. A recent solicitation requested studies of the effectiveness of green infrastructure approaches in the Philadelphia area. Grants awarded for a 2011 solicitation on extreme environmental events include funding for research on assessing and mitigating the impacts of severe storm events.

- **The SSWR program should inventory best practices and innovation activities, and seek partnership opportunities to assess lessons learned related to green infrastructure.**

Response

We agree. ORD is working with community pilot efforts in cities including Omaha, NE; Louisville, KY; Clarksburg, MD; Cleveland, OH; Cincinnati; OH; Kansas City, MO. Using the knowledge and information that is being gathered from these studies, ORD is developing guidance on how to use assets within the community for managing stormwater via green infrastructure.

More broadly, EPA has developed a *Technology Innovation Roadmap* that guides EPA's efforts to promote innovation along the entire continuum of technology development and deployment. To implement the Roadmap, EPA is developing an inventory to identify relevant internal and external technology activities. Also, EPA will pursue technology innovation opportunities in four selected cross-program areas, one of which is "energy efficiency and wastewater treatment." EPA will showcase pilot projects that employ innovative ideas on practices, tools, and methods that can be beneficially replicated elsewhere. In evaluating these pilot projects, the Agency will identify barriers to progress, how those barriers were overcome, and lessons learned, including recommended policy options that could be applied in other situations. The Agency is also finding new ways to reach out to the technology development community and, as a first step, is identifying priority environmental technology needs where innovation could lead to major improvements, efficiencies, and private sector opportunities.

- **The SSWR program should develop tools to encourage/improve how states help communities address Combined Sewer Overflow consent order requirements.**

Response

We have enhanced our stormwater modeling tools (see above). The SWMM model can now also estimate how much green infrastructure, as well as enhancements to existing wastewater/stormwater

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systems, can reduce CSOs. The SWMM model was downloaded more than 20,000 times from its EPA hosted website over the past 12 months and continues to provide a critical tool for communities when developing stormwater management plans. As mentioned above, the SWMM-based stormwater calculator (to be released in 2013) will be a user-friendly tool that can be used for planning low impact development approaches to maintain or add new green infrastructure on existing or new development sites. More broadly green infrastructure-related research funded through the STAR grants program helps directly address these issues in communities across America.

- **ORD should support competitions that solicit innovation in storm water monitoring and modeling.**

Response

We agree. We are currently supporting a STAR Grants RFA that is examining green infrastructure management approaches in an urban context using Philadelphia as a case study site. We are also examining a possible RFA for a Modeling Support Center for Sustainable Water. The Center would provide outreach and a platform for community involvement. Additional advancements and extensions to the SWMM model would be enhanced through these community interactions.

3.5.5 Recommendations for the Homeland Security Research Program (HSRP)

- **ORD should develop metrics for measuring progress and success at project conception.**

Response

Project design and management is currently an important emphasis across ORD as we implement projects for all the research programs. Project management training is now ongoing and project leaders in all ORD locations will have the opportunity for this training. One of the concepts conveyed in the training is the importance of developing measures of success and milestones at project inception. Further consideration needs to be given to what metrics would be appropriate to use for all projects, and additionally, how metrics could be tailored for individual projects.

- **The HSRP should document its impact by identifying the multiple benefits of its products. It should concurrently expand its communication about the broad applicability and many benefits of HSRP products and expertise; outline the value proposition to stakeholders; and market HSRP expertise to additional partners to increase resource leveraging**."

Response

We agree with this recommendation and believe it is related to the recommendation just below calling for "current products to be assessed and mapped to the needs of potential new partners." The recommended mapping can be performed in a manner that accomplishes the recommendations in both comments.
As an example, to help estimate and predict public health vulnerabilities from intentional contamination of water systems, HSRP has developed the Threat Ensemble Vulnerability and Risk Assessment (TEVA) Tool for Water Distribution Systems. A second use of this tool would be to help water utilities better plan for normal maintenance based on potential risks that could result when using different approaches to maintenance. A third use of the tool would be to help utilities develop response plans based on contamination that could result from natural disasters. HSRP would partner with OW, water utilities, and

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water trade associations to promote the tool for these multiple uses. HSRP is in the process of performing this mapping for a set of both past and future products in its portfolio.

- **The HSRP, as a valuable national resource, should adopt an 'all-hazards' approach to enhance its value. Current products should be assessed and mapped to the needs of potential new partners. HSRP is strongly encouraged to conduct research portfolio analysis and road mapping to elucidate their current and future research needs.**

Response

The "mapping" part of the recommendation is described above. We agree that adopting an "all-hazards" approach is a useful step. We are currently looking into what part of the immense area called "all-hazards" HSRP can achieve success with and how an "all-hazards approach" might impinge on the other five national research programs. In conjunction with the product mapping in our response to the above recommendation #2, this amounts to conducting a portfolio analysis and road mapping. For instance, we are currently developing a white paper on this topic to explore this issue from the standpoint of a) the scholarly literature, b) the bigger picture of EPA's homeland security mission, and c) the specific advice the SAB/BOSC provided HSRP in the text of their report. We will map research needs into one of three "bins" defined as: 1) EPA's CBR/terrorist gaps being addressed now by HSRP, 2) EPA's "all-hazards" gaps being addressed now by HSRP through multiple uses of Bin #1 products or the work of other science organizations (ORD, other agencies, academia, etc), and 3) EPA's "all-hazards gaps not being addressed by any organization. The emerging, conceptual approach to planning our "All-Hazard" research program is to:

1. Examine EPA's mission, supporting legislation, presidential directives, and policy to understand the Agency's "All-Hazards" responsibilities.
2. Work with the Office of Homeland Security in EPA to identify the appropriate universe of "all-hazards" science and technology needs to support EPA's mission.
3. Assign each of the above needs to one of the three bins (defined above).
4. Determine what, if any, resources should be redirected from existing HSRP work (Bin #1) to address the highest priority gaps in Bin #3.
5. Engage with other national research programs to leverage interest and resources.
6. Build out the HSRP network in the Balanced Matrix to leverage capabilities in ORD laboratories and centers.
7. Update the HSRP Research Action Plan and conduct the relevant research on the highest priority gaps in Bin #3.

- **HRSP should continue to enhance its relationships with other federal agencies where there is synergy**

Response

We agree with this recommendation and have been very successful in building relationships related to chemical, biological and radiological weapons of mass destruction. This recommendation is tied to a part of the above recommendation to "market HSRP expertise to additional partners to increase resource leveraging." In response to both recommendations, HSRP will continue to seek collaborative relationships with partners to allow resource leveraging and avoid duplications. In the past, this has resulted in both funds being provided to HSRP to perform research, as well as influencing the projects of other partners by providing technical oversight and advice to project performers funded by other agencies.

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For example, in FY12, HSRP received several million in funding from a variety of sources, such as Department of Homeland Security, Department of Defense, and Environment Canada.

An example of HSRP's continued dedication to performing activities that address this recommendation is a future conference hosted by the Chemical and Biological Defense Division within the Department of Homeland Security (DHS) Science & Technology Directorate, the Defense Threat Reduction Agency Chemical and Biological Technology Directorate within the Department of Defense (DoD), and EPA's HSRP. The goal of the conference is to provide the Chemical and Biological Defense Science and Technology community at DHS, DoD, and EPA an opportunity to interact with each other in order to foster collaboration and ideas. This will be an excellent opportunity to establish new collaborations among the conference attendees. The conference is scheduled for early 2013.

3.6.7. Recommendations for the Sustainable and Healthy Communities (SHC) Research Program

- **Integrating ecological and human health. The SAB and the BOSC commend EPA for recognizing the importance of bringing together human health and ecosystem services. Although this integration requires considerable effort, it is an important area that is worthy of investment. Moreover, EPA is the one agency that is positioned to do this. Although the communication flow among the different experts (e.g., ecosystem scientists and, human health scientists) does not always occur at the level needed, ORD is attempting to foster these interactions. Sustained efforts to promote interaction and integration are needed. ORD should outline the barriers to this integration and think creatively about strategies to help overcome them.**

Response

SHC agrees that the integration of ecological and human health is an area that is worthy of investment. The overall goal of SHC is to develop decision tools that enable communities to integrate information on ecosystem services, human well-being, and economic factors to evaluate tradeoffs among the three pillars of sustainability. Our experience is that the community is the scale at which this interaction and integration of research is not only possible, but also necessary. In our initial case studies, ORD's Regional and community partners have defined their issues in terms of human health, e.g., childhood asthma and ambient air quality, and community services affecting public health, e.g., drinking water quality, supported by ecological services. To address this integrated problem formulation, ORD scientists are working to integrate data layers and health or ecological goods and services information through the development of increasingly interoperable tools. These tools, specifically ORD's Community or Tribal Focused Environmental Risk and Sustainability Tool (C / T-FERST; http://www.epa.gov/heasd/c-ferst/) and the EnviroAtlas (no public site yet available), consume and publish data through EPA's GeoPlatform. In addition, modules such as the Eco-Health Browser (http://www.epa.gov/research/healthscience/browser/introduction.html) are directly accessible by both tools. Additionally, as the program evolves, there will be increasing emphasis on bringing transdisciplinary teams together to work on high-priority community issues from four community-level decision sectors (transportation, land use, waste management, and buildings and infrastructure (including water and energy)). From the STAR Grants program, several grants about Confined Animal Feeding Operations (CAFO) have contributed to improving estimates of the occurrence and risks of steroid hormones associated with animal waste and in developing new or improved waste handling systems. Data from one of these grants was recently used to set the new 2012 Maryland nutrient management regulations that require incorporation of litter into the soil to reduce runoff.

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A major barrier to relating changes in ecological conditions to human health and well-being is the lack of access to health outcomes data for use in the development of health-based valuation of ecosystem goods and services (EGS) and ecological epidemiological association of EGS and human health impacts. This lack of access is also a barrier to developing community level exposure and health risk information for use by communities in problem formulation and issue identification. These health data are considered sensitive and are often case or site-specific, thus limiting our ability to extrapolate results from one community to another. To address this, EPA is exploring new partnerships with health organizations and researchers, encouraging the uploading and integration of community-collected data in tools SHC develops, and developing new crowd-sourcing applications that will allow collection of new data that relates human well-being to ambient environmental conditions. Further, significant progress will likely require access to geo-coded health data available through other organizations.

Another barrier to integration is a lack of in-house ORD expertise in software development and a dependence on contractors for carrying forward the data and software architecture standards to ensure interoperability. While the SHC has a research task specifically focused on interoperability, greater integration of teams of scientists working on interoperability directly with those scientists developing health and ecologically based tools will address some of these needs. In addition, an increased collaboration with information scientists in EPA's Office of Environmental Information is addressing issues with respect to data and metadata standards and accessibility. ORD is currently undertaking a workforce planning effort, which will address needs across the research programs for greater expertise in software development.

An additional barrier is integration of data across multiple scales. Many environmental stressors that affect community health and well-being are regional-scale processes. To anticipate changes in local conditions, it is crucial to understand these broad-scale processes and EPA will draw extensively on landscape ecology/hierarchy theory to develop tools (e.g., EnviroAtlas) that facilitate understanding of these linkages across scales. Related is the lack of access to fine-scale remotely sensed data that allow analysis of ecological processes at a scale that is relevant to community decision-making.

SHC's approach to overcoming these barriers can be illustrated through its initial case studies. One example of developing joint human health and ecological case studies at the community scale is the T-FERST case study with the Passamoquoddy Pleasant Point, Maine Tribe. The Tribe are collaborators in the development of T-FERST; their data needs have driven development of data on watershed, ecological succession of hardwood forest, a change in wild blueberry availability, and coastal vulnerability to climate change –linked sea level rise. EnviroAtlas and C-FERST scientists are also working together in Portland, Maine in a case study initiated by a grant to Portland. Another example is the initiation of a new Health Impact Assessment project that involves a Green infrastructure approach for dealing with pervasive flooding that creates issues with mold, mildew, sewage backup, water damage in an overburdened community in EPA's Region 4, highlighting the ecosystem services/public health link.

- **Inclusion of social, behavioral and decision sciences. Social, behavioral and decision sciences are an essential component of the SHC program because they contribute to understanding human actions driving environmental, social and economic change, the value of ecosystem services, development of decision-support tools, the design of policies, and behavioral responses to policy changes. SHC has taken a step in the right direction but much work remains to be done. The SAB and the BOSC would like to see future efforts expanded.**

Response

SHC agrees. SHC has funded training and accessibility to resources to incorporate multiple drivers and stressors including social and economic factors, in systems models using the VenSim platform

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(http://www.vensim.com). Collaborations with Program Office partners who have expertise in economics and valuation build some capacity for ORD. SHC will work with ORD's other National Research Programs, including the HHRA-led collaboration with NCEE, to develop decision-support tools that incorporate valuation approaches for health and ecological goods and services, particularly with respect to community health and well being. ORD's National Research Programs, Labs, and Centers are working to identify critical workforce needs for ORD's evolving research programs. Social, behavioral, economics, and decision sciences are noted as needed workforce capabilities.

- **Distinguishing research from implementation. Throughout the action plan, it was difficult to separate (a) research from implementation, and (b) client from partner from community. The SAB and the BOSC suggests that SHC articulate more clearly its plan for research and how this plan fits in terms of interacting with local communities, state environmental agencies, and regional offices, and distinguish research from implementation in the text.**

Response

The SHC research program ranges from hypothesis-driven research to the development of models and tools for different client needs. The results of the traditional research are not only published as EPA reports but also become input to these models and tools. We tried to describe this continuum in the StRAP but we know we can be clearer in differentiating between research and implementation. SHC's mantra is like the BASF commercial: we do not actually make integrated environmental decisions for a community; we help them make these decisions better. SHC's involvement with any specific community is dependent on the degree to which that involvement is negotiated with the EPA Regions and our program partners and the degree to which the involvement in one place will help further develop the tools that can then be used in additional places. We are developing mechanisms for Regional Offices to access training for SHC tools, and to be part of the transdisciplinary teams that develop these tools.

- **Focusing the science questions and research. There was some concern that there were too many science questions, with most too broad in scope. The SAB and the BOSC recommend that the Strategic Research Action [Plan] be edited to explain how each of these science questions will be answered given the research that will be undertaken. This task would help SHC bring its stated research objectives into sharper focus, especially in light of resource constraints. The SAB and the BOSC also recommend that, at the very least, the program should prioritize the science questions.**

Response

We agree that the there are too many science questions and that some are overly broad. The Strategic Action Research Plans are intended to be updated and revised as the program evolves. We will consolidate the science questions when the opportunity to revise the StRAPs occurs. SHC continues to engage its program partners to better understand their needs with the goal of focusing SHC products and outputs to meet those needs.

- **Engaging communities and building partnerships. The SAB and the BOSC commend the SHC program for engaging stakeholders in community listening sessions. However, more structured and guided methods will allow for a better understanding of community values, needs/wants, and constraints. There also remained some confusion about what SHC means by community engagement. The SHC program should clarify its view of what community engagement, participatory research, and community self-assessment mean for the program. The SHC program should draw upon the previous work in this area.**

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Response

SHC agrees with the SAB recommendation for systematic community engagement and are working on a set of guidelines to make it clear why certain communities are chosen for collaboration. SHC will conduct actionable research using appropriate participative and collaborative case studies to refine our understanding (research) of relevant problems formulated at stakeholder or the local community level. Decision-support tools will be developed in Transdisciplinary collaboration with community stakeholders to ensure the applicability of the tools and solutions both to specific settings and to future locations. SHC's desired outcome is the development of generalizable tools that are applicable to those problems, supporting decisions that support sustainability.

SHC is already committed to research translation, community engagement and participatory research. We are developing lessons learned from community and regional work related to ecosystem services. We are also working in partnerships with others, such as EPA's Superfund and others in academia and the NGO community who are experienced in working with groups to develop meaningful community engagement opportunities. Further, we have committed to a broad slate of outreach and communication efforts to elicit information on community priorities, barriers to sustainability-based decisions, and community needs that SHC can address.

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