UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

July 8, 2010

EPA-SAB-10- 010

The Honorable Lisa P. Jackson
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Subject: Office of Research and Development Strategic Research Directions and Integrated Transdisciplinary Research

Dear Administrator Jackson:

On March 26, 2010, the Science Advisory Board (SAB) provided you with comments on the President's Requested FY 2011 Research Budget (EPA-SAB-10-005). As mentioned in that letter, the SAB has undertaken an advisory activity that has paralleled the annual research budget review since 2007: it has advised the Office of Research and Development (ORD) on strategic research directions. These parallel advisory activities have enabled SAB members to address strategic issues beyond a one-year budget horizon, while still allowing them to counsel EPA on practical realities related to annual budgets. We transmitted our last SAB report on ORD strategic directions on November 26, 2008 (EPA-SAB-09-006). We appreciated your April 21, 2009 response to that report, where you confirmed "ORD's goals are to both solve problems of broad, national significance that cut across multiple EPA program and regional offices…and to provide the more targeted research required to meet the needs of EPA's regulatory programs."

Since receipt of your April 2009 response, members of the chartered SAB have met with ORD representatives twice (on November 9-10, 2009 and April 5-6, 2010) to continue discussion of ORD strategic research directions. At the November meeting, SAB members received briefings on ORD's sixteen research programs. They participated in breakout groups with ORD National Program Directors, who have lead responsibility for research planning, and interacted with ORD scientists in a poster session highlighting recent research projects. At the April 2010 meeting, ORD leadership provided a presentation linking examples of current ORD

research activities to your key priorities (improving air quality; assuring the safety of chemicals; cleaning up our communities; protecting America's waters; taking action on climate change; building strong state and tribal partnerships; and expanding the conversation on environmentalism and working for environmental justice). ORD also presented anticipated research accomplishments and their connection to these priority areas. ORD leadership emphasized that the overarching goal of sustainability is the "true north" and guiding principle for all ORD research activities. Effective ORD research must generate science that helps solve environmental problems and not just identify them. To meet this goal, ORD leaders informed us that ORD would increasingly undertake "integrated transdisciplinary research," defined "as the process to develop sustainable solutions to environmental problems by engaging partners who transcend traditional scientific disciplines throughout each stage of the research process."

At the April 2010 meeting, ORD leadership asked the SAB to address six charge topics related to ORD research directions and integrated transdisciplinary research:

1. The extent to which ORD's suggested strategic research directions address your priorities by providing the scientific information needed to inform environmental decision-making, especially decisions made by EPA's Program and Regional Offices.
2. Suggestions for key areas that ORD should leverage by working with other (non-ORD) science programs across EPA and with the science programs of other Federal agencies.
3. Areas for increased emphasis in ORD's research program over the next five years; areas for decreased emphasis over the next five years.
4. Are there strategic research directions that ORD should pursue differently or undertake as it draws upon its unique expertise to conduct integrated, transdisciplinary research (ITR)?
5. Where can research on socio-economics best contribute to ORD's ITR efforts?
6. Where can we apply lessons learned from environmental research to protect human health and from human health research to protect the environment?

The intent of these charge questions was to focus SAB attention on whether ORD is "doing the right science." ORD leadership noted that a separate EPA federal advisory committee, ORD's Board of Scientific Councilors, provides ORD with detailed advice as to whether it is "doing the science right." Based on discussions with ORD at the November and April meetings and the background materials provided to us, we have reached three general conclusions and are providing them to you in this interim letter on ORD strategic research directions. First, we conclude that the current research highlighted by ORD, as well as the strategic directions ORD suggested in April, clearly support your key priorities in general. Second, we strongly endorse ORD's efforts to plan future research in light of: a) its relevance to Agency decisions linked to one (or preferably several) of your key priorities, b) the potential of the research to deepen systems thinking about root causes of environmental problems; and c) and the likelihood that potential research will stimulate innovative environmental problem solving. Finally, we support a systems approach and transdisciplinary research for ORD, because they will strengthen the quality and relevance of research supporting EPA's mission now and well into the future.

However, we cannot fully address ORD's six charges because we lack the detailed information needed to respond to those charges. Although ORD identified many positive

linkages between its research programs and your key priorities, the materials provided do not characterize ORD's entire research portfolio. Therefore, we cannot address the *extent* to which current research activities support key priorities, or identify areas for *increased emphasis* or *decreased emphasis* in ORD's research program over the next five years, at this time. In addition, two of ORD's charges focused on integrated transdisciplinary research, but ORD did not provide the SAB with background information on its plans for implementation. We know that integrated transdisciplinary research is a work in progress. The SAB needs a clearer understanding of how ORD plans to develop and use the approach before we can provide appropriate advice on strategic directions related to it.

ORD convincingly demonstrated linkages between ORD research contributions and EPA accomplishments under the key priorities. Some research program areas, such as sustainability, human health risk assessment, ecosystem services, and human health, contributed to all seven priorities. Some contributed to fewer, but all research programs showed linkages to key priorities in some way.

We recommend that EPA make these linkages when planning future research programs. The ecosystem services program, for example, has no single program office champion, but it generates science that is useful for decisions affecting clean air and water, cleaning up communities, chemical safety, environmental justice, climate change adaptation and mitigation, and decisions by state and tribal partners.

One of your key priorities, building strong state and tribal partnerships, deserves special mention. While some EPA offices maintain regular contact with states, tribes, and regions (e.g., EPA's Office of Water meets twice a year with state toxicologists involved in drinking water standard setting), there is no systematic communication between ORD and states regarding research needs. A more systematic process is needed for states and tribes to identify, organize, prioritize and communicate their immediate and anticipated requirements for science support into the ORD research planning and implementation process. States have unique perspectives on environmental research needs and can help inform research strategies and agendas, but many do not have their own resources to conduct research. ORD could be more proactive in sponsoring regular meetings and webinars and in encouraging ORD scientists (and managers) to participate in Interpersonnel Agreements (IPAs) at the state level and similarly encouraging IPAs from states to ORD. We recommend that ORD work actively with states, regional scientists, and local academics to develop interagency research projects, such as community-based research.

<u>The importance of a systems approach and integrated transdisciplinary research</u>

We believe two changes are essential to support your key priorities. It will be essential for EPA as a whole, and not just ORD alone, to adopt a systems approach to research planning. It will also be essential to plan and conduct research in new, integrated and cross-discipline ways to support this systems approach. The heart of a systems approach is an emphasis on understanding an environmental problem or environmental management strategy in relation to the environment as a whole, and not in isolation. A systems approach also incorporates "feedback loops," where what is learned from the research is fed back to and modifies the

research questions being asked, as well as the management strategies taken. A systems approach will help EPA gain a fuller understanding of why an environmental problem occurs or how an environmental management strategy might work. There are few examples of using systems approaches in current ORD research programs, but one that stands out is the Sustainability Program's and Biofuels Interagency Work Group's approach to understanding the environmental impacts and benefits of biofuels. They are considering multi-media impacts and benefits to both humans and ecosystems related to feedstock production, transportation to processing plants, biofuels production and distribution, and the end-uses of the biofuels – the entire biofuels "system" as well as an all-encompassing range of impacts and benefits. This allows for a comprehensive assessment of biofuels and the development of more effective management and mitigation strategies.

A systems approach that incorporated human health concerns into global change analysis could be used to break down artificial barriers between human health and ecological assessment. Systems approaches, if applied to air research or to ORD's "one hydrosphere" vision, could help EPA better understand the root causes of environmental problems that may be related to energy usage, transportation, and local planning and zoning.

Integrated research across disciplines, environmental media, and organizational units is an essential tool in implementing the systems approach to research that will support your key priorities. Again, there are examples of transdisciplinary research within ORD, such as the Ecosystems Services program that has combined economics with ecology. We strongly recommend that transdisciplinary research be implemented throughout ORD as the rule rather than the exception. Development of such a systems-oriented, integrated transdisciplinary research program that is responsive, innovative, and credible will require: 1) careful planning and implementation; 2) strategic examination of ORD's workforce needs; 3) budget allocations to align with research priorities; 4) effective integration of social science expertise into ORD's work; and 5) commitment to conduct and evaluate transdisciplinary research pilots and apply lessons learned to ORD's overall research program.

Implementing integrated transdisciplinary research: opportunities and challenges

ORD framed its discussion of strategic research directions by providing examples of current ORD activity. ORD also provided a suggested research vision and strategic directions and examples of anticipated accomplishments for each of your seven key priorities. We support this approach, which links multiple ORD programs to environmental goals and tangible decision contexts. ORD representatives noted that the suggested research vision and strategic directions resulted from discussions between ORD National Program Directors, who provide leadership for ORD research programs, and program office counterparts. It will be valuable for ORD to confirm these suggested research visions with EPA managers in program and regional offices and regions and use the resulting visions for research to guide future planning and to communicate with the public about ORD's research activities.

We recommend that ORD consider and implement as soon as possible strategies to 1) encourage systems approaches to research and, 2) support and provide leadership for integrated

transdisciplinary research teams. Planning and conducting a systems-based and integrated transdisciplinary research program requires mechanisms to encourage scientists to think outside their traditional disciplines or research programs, to seek connections and questions that cross research programs and media, and to look for "systems effects" related to a research question. National Program Directors noted the utility of linkages across ORD research programs and linkages to your priorities in preparation for the SAB meeting. In the process, many discovered new areas for possible collaboration, coordination, and data sharing. ORD representatives also acknowledged that there is no clear process or mechanism to establish leadership in interdisciplinary work beyond the National Program Director community. Collaboration and coordination on research projects too often occurs serendipitously rather than deliberately.

ORD's presentations demonstrated the value of transdisciplinary research and collaboration across research program areas. However, ORD's management structure currently provides the ORD Executive Committee and Laboratory Directors with primary control of resources, while research planning is the responsibility of National Program Directors. Integrated transdisciplinary research requires alignment of research resources with Agency priority needs and is more likely to succeed with true matrix management that recognizes those priorities and addresses resource allocation decisions. EPA's management of resources will need to evolve to support transdisciplinary teams and their work. Priority areas such as environmental justice, ecosystem services, sustainability, and climate change, which have no single program office advocate and which are strong candidates for integrated transdisciplinary research, will especially need a change in management and support to sustain viable research programs.

The primary drivers for ORD's future research should be the overall goal of sustainability, the Agency's key priorities, and the potential for encouraging innovation. Where possible, ORD should play to its historical strengths, but ORD legacy programs should not determine ORD's future research. Two areas where ORD's historical expertise relates directly to your priorities and link to sustainability and innovation are the domains of assuring the safety of chemicals and environmental justice. We encourage ORD to continue investments in green chemistry and green engineering, and developing new ways to assess and model chemical toxicity, including determining cumulative risks, toxicity of chemical mixtures, and toxicity of vulnerable life stages. These new approaches will foster innovation to strengthen American international trade competitiveness and may even open new opportunities for green jobs and businesses in environmental justice communities. Similarly, environmental justice is a natural platform for bringing together a wide array of disciplines in a model where integrated research can play a role in eliminating problems that lead to environmental justice issues. ORD should look for opportunities to work with communities to address such issues, where ORD can link its historical expertise in chemical assessment and engineering to the social sciences. The SAB would be pleased to work with the Agency to identify additional implementation opportunities.

Role of social and behavioral sciences

ORD’s research direction largely misses strategic opportunities related to social and behavioral sciences. It also misses the opportunity to improve ORD research programs by incorporating social and behavioral sciences. It is important to note that your priorities call for

preventing and reducing adverse environmental impacts (e.g. *improving* air quality, *protecting* America's water, *taking action* on climate change), not just studying how and why our life-sustaining environmental resources are being degraded. If the intent is to have impact, then research on social and behavioral science topics offer the most promising avenues to advance your priorities. EPA needs to reorient its research agenda to recognize that many environmental threats stem from the actions, decisions, and behaviors of individual Americans. The automobile and its emissions is a classic example. ORD's list of current activities includes studying the effect of vegetation on pollution reduction and studying emissions of biofuel blends. Although these represent important areas of research, they reflect ORD's legacy programs, oriented toward regulatory support. They are likely to have little impact in terms of understanding and influencing the social and decision-making dimensions of automobile purchases, commuting, and vehicle miles traveled. Similar arguments can be made for strengthening research related to unique social and behavioral patterns in environmental justice communities, understanding how water is used and valued, and studying how energy is consumed and the impact of consumption patterns on climate change. Social and behavioral sciences can provide knowledge that also assists EPA in communicating science in ways that help people better understand their choices and give them options for changing behavior.

Although ORD has reached out to social and economic scientists in some areas (e.g., through the use of consultants in its ecosystem services research program and through a recent extramural solicitation for social science research related to improving homeland security risk communication), ORD lacks intramural expertise to involve social scientists where they are needed. Social, behavioral, and economic scientists have consistently been involved only in ORD's global change program. They should be involved in all integrated transdisciplinary research efforts, from initial problem formulation through final project evaluation. In addition, research on benefits, costs, public values and perceptions, and behavior should be viewed as appropriate subjects for environmental research and not as factors outside the paradigm for science and research that ORD presented to SAB members at the April 5-6, 2010 meeting.

Importance of research partnerships

The scientific and policy issues that underlie many of the critical and inter-related global challenges facing our planet are complex and cut across multiple program offices within EPA as well as many federal agencies. Due to the nature of the challenges and scientific capacity within EPA, there is strong justification for EPA to provide leadership in establishing multi-agency partnerships that leverage resources and provide comprehensive solutions. For example, effective solutions to climate change and air pollution can best be achieved through partnership with DOE. Similarly, effective solutions to the inter-related issues of water quality, land use, and urban and agricultural run-off require partnerships with U.S. Department of Agriculture and U.S. Geological Survey.

Conclusion

The comments provided in this letter are interim comments on ORD strategic research directions and integrated transdisciplinary research. We are seeking continued and more focused dialogue with ORD as part of the Board's efforts to advise on science and research supporting EPA's decisions. The SAB looks forward to any comments you have at this time on our initial reflections on these important topics.

Sincerely,

/Signed/

Deborah L. Swackhamer, Chair
Science Advisory Board

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SCIENCE ADVISORY BOARD STAFF

Dr. Angela Nugent, Designated Federal Officer, 1200 Pennsylvania Avenue, NW 1400F, Washington, DC, Phone: 202-343-9981, Fax: 202-233-0643, (nugent.angela@epa.gov)