EPA Region 1 New England Science Integration for Decision Making Fact-Finding Interviews
October 28, 2009
1 Congress St, Boston, MA

Three members of the SAB Committee on Science Integration for Decision Making conducted three interviews in EPA Region 1: Drs. Deborah Cory-Slechta and James Johnson conducted the interviews in person and Dr. Wayne Landis participated by phone. For each interview, Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 1's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews and thanked Michael Kenyon for serving as liaison with the SAB Staff Office in planning the interviews.

Interview with Mr. Ira Leighton, Acting Regional Administrator
October 28, 2009, 9:30 a.m. - 10:30 a.m.
In attendance:
Michael Kenyon, Director, EPA New England Regional Laboratory
Robert Hillger, Senior Science Advisor – ORD Liaison

Acting Regional Administrator Leighton welcomed the SAB members to Region 1 and commended the SAB for visiting all 10 regions. He predicted that the SAB members will hear one common message across the regions: there is a strong connection between solving environmental problems and the regions. No matter what the national priorities may be, environmental problems are ultimately about people, ecosystems, rivers, streams and what is impacting them. Problem solving requires a focus on science and technology and so Region 1 New England organized an information package for the SAB that has a problem solving focus. Discussions that may start as a national policy dialogue typically lead to the development of specific tools to give decision makers at the regional, state and local levels choices for problem solving. Successful environmental decisions have "real science embedded in them which demonstrates our commitment to the technical integrity of our decision making." Whenever EPA Region 1-New England's Science Council debates a cutting-edge issue, "someone will ask 'what is the specific tool that will translate this policy into decision making.'" He complimented Mike Kenyon, Director of the Office of Environmental Measurement and Evaluation, Mr. Robert Hillger, Regional Science Advisor and ORD Liaison, and the regional Office Directors for helping the Science Council be so effective.

He stated the hope that the SAB report will note that when EPA only focuses on engaging science at a high level of policy issues, the Agency only captures half its science needs. He

expressed the view that the report should address the need for applied science and how that could be better reflected in the Agency's science agenda.

Mr. Leighton provided some context for his concern for applied science. He observed that EPA plays a significant on-the-ground role in managing Superfund clean ups in New England. EPA also runs the water programs in Massachusetts and New Hampshire and administers the Clean Air Act's Prevention of Significant Deterioration (PSD) permit program in Massachusetts. A good example of the region's need for applied science arose with the implementation of the Clean Water Act 316(b) regulations related to cooling water intake and the discharge of heated water. This issue required Region 1 to take a leadership role in interpreting and applying regulations. As part of its permitting of the Dominion Electric Brayton Point power plant, the region needed to justify its decision requiring the plant to implement closed cycling in response to expert litigants' challenges to EPA's science. To support its decision, the region developed tools and worked with ORD's Narragansett laboratory on juvenile flounder studies. The region had invested in a staff person to return to graduate school and get a Ph.D.; this individual was able to work with ORD's Narragansett laboratory and conduct a research study with ORD on the impact of thermal discharge on flounder fecundity studies. The decision upholding Region 1-New England's science was significant for EPA and the environment. In Mr. Leighton's view, "If we don't have the right tools from EPA's research program…if we can't develop capabilities to have our biologists operating at highest levels, we'll be outgunned."

Committee members asked how the region consistently maintains and obtains the high level of science needed to support decision making. Mr. Leighton responded by asking Mr. Hillger to provide the Designated Federal Officer with the region's responses to the scientific integrity survey conducted by the EPA Office of the Science Advisor. Mr. Leighton noted that the key to maintaining a high level of scientific capability is investment in infrastructure. A region needs grassroot commitment to maintaining and honing science skills. He voiced his pride in Region 1 New England's Regional Science Council, which identifies science and scientific skills most relevant to the Region's work. The Council also identifies high quality speakers on topics related to the region's priorities and organizes a seminar series with distinguished speakers from institutions such as Harvard and MIT. Seminars are very well attended. Investment in science is not driven from the top alone; commitment to high quality science is diffused through the organization.

The region also tries to strengthen connections with ORD. When Region 1 New England was lead region for ORD, Mr. Leighton and the regional scientists tried very hard to strengthen connections between what ORD offers and decisions faced by regions. Region 1 organized a formal "Science Summit" and "Progress Review" with ORD senior management and identified priority science needs. More importantly, the Region helped conceive a better way of doing business collectively to ensure that Agency science was helping solve real pragmatic environmental problems the regions faced daily in meeting their obligations to the regulatory mission of the Agency. Unfortunately, the region did not "push those priorities across the finish line." Mr. Leighton asked Mr. Hillger to provide the Designated Federal Officer with a summary of the recommendations from the problem-solving summit.

Mr. Leighton also mentioned that "simple ideas make big differences" in ensuring that regional decision makers have the science needed to back up their decisions. He noted that ORD has a well-established mechanism to reward peer reviewed papers, but "there isn't a comparable award for a scientist whose efforts help make a $300 million decision come out right" Such a new award could help re-orient some ORD research. He also noted that the Regional Science Advisor and ORD Liaison , Mr. Hillger, has taken the initiative to strengthen Region 1 New England connections with STAR grant recipients in the region. Mr. Hillger has organized workshops to bring STAR-grant recipients together to talk with regional science practitioners to discuss the relationship between their STAR grant research and EPA problems. Principal investigators welcomed these well-attended workshops and discovered opportunities to reorient their research in some minor ways that would produce products of much greater relevance to decision makers. Ira felt such workshops should be institutionalized more formally.

Mr. Leighton also spoke about Region 1 New England's use of the new ORD Science Connector, which strengthens regional scientists' awareness of research and science activities in ORD and across the agency.

Maintaining and enhancing regional science happens, in Mr. Leighton's view, because it reflects a particular attitude towards EPA's relationship with science. He said that "You do it because you think you're joining an elite organization." The reason why he initially joined EPA is the same reason why top-notch scientists are still attracted. If EPA managers really build the infrastructure needed for science and "EPA maintains its ability to attract the next generation of scientists and engineers, we will continue to be a strong scientific agency." He noted that recruitment is especially important now, because EPA will be losing institutional knowledge as large numbers of scientists retire. "There has never been a more important time to have science applied to local problems and problem solving."

Mr. Leighton told a "real-world story that gave him passion" for this topic. In his former role as senior official with responsibility for remedy decisions, sometimes costing more than $400 million, he "wanted to get the decisions right." To support such decisions, a team would meet with him and provide the available information supporting the record of decision. There would typically be a lawyer, hydrogeologist, risk assessor, and engineer. Sometimes, the team would be "sort of together and sort of fractured." One time, he was going through a briefing at the end of the fiscal year and had almost reached a decision, when someone off in a corner said "your choice is to do sham science and sign the Record of Decision (ROD) or not make the decision." Such a choice is unacceptable. As a result, now whenever he meets with people teeing science up, he tells them, "Your job is to drive science with 'high beams'. I'm not putting up with a last-minute option to use 'sham science' for regional decisions." He asks staff to plan two years ahead for the science needed for site clean-up decisions. Regional scientists and managers and the Regional Science Council have the job of knowing the decisions in the pipeline and telling the Regional Administrator and the region what's needed. Mr. Leighton said that he is committed to listening to staff and supporting science needs. He says that managers must demand such planning for high quality science. They should not expect that good science will "happen organically"--that things will come together by themselves.

An SAB committee member asked about how the region maintained "science neutrality" and whether it had guidelines for neutrality. Mr. Leighton responded that an important regional mechanism supporting high quality, neutral science is use of a "community of practice." At key stages in the decision, especially in the clean-up programs, project teams are required to make a presentation to the responsible managers. The region invites other project teams to hear their approach to the science supporting record of decision. These open discussions "gradually ratchet up the quality of dialogue over time" and the quality of science improves. Scientists exchange ideas and interpretations and advance the community of practice.

A committee member asked about involving stakeholders in formulating problems for science support. Mr. Leighton responded that the Superfund program has a mechanism for providing community with independent technical expertise. This mechanism gives citizens access to technical information and allows them to present an informed, independent perspective. Superfund has used this program to great advantage.

Mr. Leighton noted that regional science has stood up well to scrutiny and challenge in controversial cases. The General Electric Housatonic case, for example, involved public health and ecological risk. EPA and the responsible party agreed to a consent decree involving an independent review of science supporting EPA's decision. EPA and the litigant jointly agreed on peer reviewers who vetted EPA's view of the science supporting the environmental decision and supported EPA's interpretation, thereby sustaining the decision.

Interview with EPA Region 1-New England Managers
October 28, 2009, 10:30-12:00 a.m.

EPA Region 1-New England Participants

Mr. Stephen Perkins, Acting Deputy Assistant Regional Administrator
Mr. Michael Kenyon, Director, Office of Environmental Measurement and Evaluation (OEME)
Mr. Gerry Sotolongo, Chief, Quality Assurance, OEME
Mr. David Webster, Chief, Industrial Permits Branch, Office of Ecosystem Protection (OEP)
Ms. Cynthia Greene, Chief, Energy and Transportation Unit, OEP
Ms. Ida McDonnell, Chief, Air Permits, Toxics and Indoor Programs Unit, OEP
Mr. Mel Cote, Chief, Ocean and Coastal Protection Unit, OEP
Mr. Steven Rapp, Chief, Acting Manager, Technical Enforcement Office, Office of Environmental Stewardship (OES)
Mr. Michael Jasinski, Chief, NH/RI Superfund Section, Office of Site Remediation and Restoration (OSRR)
Ms. Meghan Cassidy, Chief, Technical and Enforcement Section, OSRR
Mr. Robert Hillger, Regional Science Adviser – ORD Liaison

SAB committee members invited participants to address questions in the committee's *Preliminary Study Plan* and to identify the types of science-based decisions made in their organizations, their roles, the kinds of science they use and need, impediments to using science, and how they deal with uncertainty. Participants took turns providing responses to committee members' questions.

The first participant noted that regions generally make site-specific decision, rather than sweeping decisions at a larger geographic scale. The largest scale for Region 1-New England might be made at the estuary level. In his view, the region's "last big water pollution frontier" is stormwater impacts. Fifty per cent of streams are impaired by stormwater discharges. The University of New Hampshire Stormwater Center provides a test bed of technologies that can be applied and Region 1-New England is currently building a network of technologies and an information clearinghouse to access expertise outside EPA. EPA just sponsored a workshop for information sharing about available tools for permit writers from across three regions. In a later comment, another participant noted that although the region generally makes site-specific decisions, each decision can have broader implications and set a precedent in Region 1-New England and nationally.

Another participant spoke of the science integration needs in the region's ocean and coastal programs, which have direct responsibility for half a dozen major program areas, including:

- Technical support for National Pollutant Discharge Elimination System (NPDES) permits for power plant intake and discharge
- National Environmental Protection Act reviews for off-shore waters, large-scale commercial wind farms, and electric transmission

- Water quality impacts of off shore development project involve dredging and disposal
- Beach monitoring

The region has needed science for many of these cases. In his view, often "we have more information than we have political will and people to address."

He noted that science needs include:

- Beach monitoring, where there is a need to get faster results from sampling to inform the public in a timely manner with regards to beach closures and warning decisions
- Nutrients management (nitrogen and phosphorus)
    - Science needed to determine right concentration for effluent limits.
    - Need to understand the extent to which nutrient occurrence may be related to red tide occurrences which have been increasing over 15 years. Information related to Pfisteria in the Chesapeake Bay may not be relevant to red tide issues in New England

A committee member asked whether the region lacked site-specific information needed for decision making. One manager noted that literature reviews undertaken to assess impacts of thermal discharge from power plants often do not identify the specifics about size of affected fish, species, and temperatures that are specific to the issue at hand. Sometimes the literature is conceptual or outdated.

Other participants identified other types of science needs:

- Program areas differ in terms of data availability. The air programs are data rich, with a national emissions inventory and scientifically peer reviewed models, but other programs, such as the pesticide program have little data, models, or mapping tools
- Science to make GPRA goals and objectives more meaningful - for example, it may be more helpful to evaluate clean-ups by amounts of contaminants, instead of by total pounds of waste. Current enforcement metrics based on reducing pounds of pollutants are not based in science. It would be helpful to have a quick "off the shelf, "science-based approach for evaluating these outcomes
- Information needs for the regional laboratory include
    - Tools to identify and track the sources of bacteria and waste identified in storm water and urban rivers
    - Tools and ability to respond to biological and chemical warfare agents. EPA and the Department of Homeland Security identified warfare agents as a big research gap after 9/11 and Region 1 invested in this area
    - Polymerase chain reaction (PCR) analysis for addressing beach contamination issue. Region 1 - New England is preparing to use standards and methods being developed by EPA's Office of Water
    - Endocrine disruptors and pharmaceuticals
- Ecological effects information related to exposures from aluminum in different pH conditions and the effects on different fish species
- Information about synergistic effects

- Use of statistics to help identify numbers of samples needed for TMDLs and enforcement monitoring and for analysis of uncertainties in storm water, TMDL, and other analyses.
- Lack of useful Agency hazard information on dioxin, trichloroethylene, hazards of asbestos exposure at contaminated sites

When asked how the Region decides when to undertake a new method or a new scientific capability, the regional managers responded that several processes were involved. Regional managers have ongoing conversations to highlight science needs. In some instances, issues may be vetted through the regional science council, which tries to identify gaps in the regional science. Sometimes new initiatives arise because a regional scientist has an interest in gaining new technical skills or working with ORD. Sometimes the region successfully competes for regional grants from ORD for short-term research needs (as in the case of PCR and now where Region 1-New England now analyzes thousands of samples for the Office of Water nationally). In any case, the region keeps conversation about science needs active and going. The region also checks the Agency's Science Connector to identify activities already ongoing in the Agency.

One manager discussed the nature of public involvement in the NPDES permit process. There is no formal outreach to communities, because the review process involves public comment. EPA must respond to public comments and the response-to-comment documents can be "hundreds of pages long." Policy tends to get made in the permits program by the environmental appeals board, which looks at all the science generated by EPA and the permittee. EPA Region 1-New England has been upheld in three key appeals (the General Electric, Pittsfield, and Attleboro cases), which validated regional science and set precedent for national implementation of NPDES permits for cooling water intake.

In response to a question about nutrient criteria, a regional manager acknowledged that Region 1 New England currently takes a site-specific approach. His program translates current narrative criteria by modeling the water system, measuring inputs, considering biological endpoints (i.e., deposition into sediments, biota, and local conditions) and then back calculates, based on the particular river system, to identify a permit level for the discharger. The Region takes the narrative standard and uses best professional judgment to develop something enforceable and numeric. He noted that the proposed national numeric criteria were a "double-edged sword." It would be difficult to develop national numeric criteria sensitive to ecoregions and other factors, but the current approach does rely on using best professional judgment to interpret non-numeric, narrative standards. Some regions may not have the scientific infrastructure and protection of scientific integrity to ensure enforceable science-based standards. There are currently a "huge range" of nutrient limits set across the ten EPA regions.

Another manager discussed the region's use of quality assurance to support efforts across the Region. His division not only conducts audits, but also works with offices to identify sampling and quality assurance issues at the start of projects. His office has used guidance from EPA's Council for Regulatory Environmental Modeling and international modeling guidance. His office focuses on initial development of a quality assurance plan, uncertainty analysis, criteria identification, and then determination of whether data quality objectives have been met and if regional analyses need iteration. The goal is defensibility and his office asks "did you

document and did you have rationale for science conclusions." His organization tries to bring more transparency and up-front thinking to EPA's analyses.

A manager discussed the importance of Integrated Risk Information System (IRIS) numbers. The region follows the OSWER guidance on the hierarchy of human health toxicity values when performing human health risk assessments. According to this guidance IRIS values are used if available. Where IRIS values are not available, PPTV values if available are used. If neither IRIS nor PPTV values are used, other available peer reviewed toxicity values are used. The manager indicated that up to date IRIS values would be preferable. An SAB member asked if IRIS values are used "even if out of date". The response was that the above-mentioned guidance document is relied on when determining appropriate toxicity values.

The group noted that the region has developed a level of comfort with decisions based on uncertain scientific information. Regional scientists and managers realize that no two environmental data sets tell you the same thing. Through multiple discussions, regional scientists and managers communicate with each other about what is known with certainty, where the uncertainties exist, and have developed ways to communicate decisions and their rationales contingencies, and uncertainties to the public. It is often a difficult and dynamic situation for those who explain decisions and uncertainties to the public. Some stakeholders are comfortable with uncertainties; others less so.

In response to a question about cumulative risk assessment, a manager noted that EPA generally does not conduct any sort of cumulative risk assessment other than a hazard index approach to address chemical risk from a site. Many communities ask about cumulative risk, however, beyond that information, for example, the contributions of air exposures or childhood asthma in combination with site risk.

SAB committee members asked about the region's use of social science in understanding demographics and for targeting communications. Managers responded that the region had community involvement coordinators who conduct workshops, are good facilitators, and carefully plan community-based work, but that the region had very limited social science capability. They also voiced concern about administrative barriers to conducting social survey research as a result of Information Collection Request requirement and the requirements of the Federal Advisory Committee Act. A measure of success of community engagement is when members of the public stand up to congressionals" and when community thinking on an environmental issue "moves to a better place."

In response to a final question from committee members, a participant noted that the region does address science needs for tribes. One example is a study underway to assess the risks from pollutants in in a river system used by the Penobscot tribe members for both sustainability and cultural practices. .

Interview with EPA Region 1 New England Scientific and Technical Staff
October 28, 2009, 1:30-3:00 p.m.

EPA Region 1 New England Participants:

Mr. Marcel Belaval, Hydrogeologist, Drinking Water Branch, Office of Ecosystem Protection (OEP)
Dr. Alison Simcox, Environmental Scientist, Air Programs Branch, OEP
Ms. Ellen Weitzler, Environmental Engineer, Water Standards Branch, OEP
Dr. Rhona Julien, Environmental Scientist, Air Programs Branch, OEP
Dr. Raymond Putnam, Ph.D., Toxics and Pesticides Unit, Office of Environmental Stewardship (OES)
Mr. William Lovely, Environmental Engineer, Office of Site Remediation and Restoration (OSRR)
Ms. Sarah Levinson, Assistant Regional Manager, Office of Regional Administrator
Mr. Robert Hillger, Regional Science Advisor – ORD Liaison
Mr. Todd Borci, OES (water quality enforcement)
Dr. Dwight Peavey, OES (EPCRA enforcement)

SAB committee members asked participants to identify the types of science-based decisions made in their organization and their roles and invited them to address questions in the committee's *Preliminary Study Plan*.

The first participant worked on water quality standards and noted that the "most useful science for us is science that translates into regulatory action." A good example was state-specific copper criteria, where EPA has developed models pretty easy to use. In contrast, mercury criteria still need work. There is some on-going controversy with regards to risk if you use fish tissue criteria as opposed to water quality criteria. EPA made the change because fish tissue involved the "strongest science," but fish tissue data are expensive and time-consuming to collect. There was the potential of leaving the states with no operable criteria at all, but a national policy was issued to "use what you have until you have fish tissue data." For Massachusetts and New Hampshire Water Quality Standards, where Region 1-New England writes permits, the region "looks high and low for research outside and inside EPA." The region puts ORD "RARE" money "to good use."

The next participant described science in the regional Superfund program, which has well-defined processes and types of decisions. The Superfund has "very efficient process following national criteria." In the program, regional staff engages the public, develops site conceptual models, and data quality objective. Superfund processes are well implemented.

Science needs for the Superfund program include:

- Numeric criteria, action levels and action levels for ecotoxicity
- Action levels for subchronic exposures: the public asks "Is it safe for us to be out there when I see you in Tyvek suits." In response, "We do back of the envelope estimates," but it would be better to have science-based estimates

- Asbestos criteria for percentage of fiber in materials.

He spoke both of the need for more specific action-oriented levels for regulation and more easy access to information that may be available.

The next participant spoke about his work providing states with assistance reviewing their assessments for clean-up. His scientific contribution involves a strong knowledge of scientific tools and field methods. Although he is not doing research, he can assess whether methods and techniques are chosen appropriately and used correctly. He also, as a hydrogeologist, is involved in "bigger picture issues." He is often involved in regional water planning, i.e., water availability in aquifers that may be potentially impacted by climate change, looking at what data are available or under way, how can that data can be used by town planners. He looks to identify regional studies that may be needed.

From his perspective the biggest science gap is "applied knowledge of different investigation types and whether they are used well or not." In his work, he collaborates with state hydrogeologists, town water system operators, watershed groups, and the U.S. Geological Survey. EPA itself has few experts who focus on hydrology related to drinking water issues.

Next, a regional scientist spoke about his work on water enforcement related to surface water quality. He focuses on municipalities that discharge above certain level and supports decisions on enforcement levels. His work involves complex interpretation of data from many studies. From his perspective, there is little practical consistent guidance. Most research seems unrelated to practical environmental protection needs. Federal agencies such as ORD and USGS seems to be doing a lot of "sophisticated pharmaceutical work," but not helping regional scientists test for the most cost-effective set of pollutants from multiple output pipes. He called for science to "get back to basics" and use scarce resources for the most urgent and practical environmental protection research needs.

Another scientist added that regional scientists need more than just additional tools. They need help with evaluation of external science. Published literature is "out there but it is passive." The question is "how do you apply it to a practical problem?" Such questions shouldn't be left to the end user. EPA is different from industry, where "industry identifies a problem and then develops research to inform that problem. It doesn't work that way at EPA."

Yet another scientist spoke about the need for EPA to address some strategic science issues. He noted that EPA's legal framework requires the Agency to focus on selected chemicals, where there are other chemicals of greater concern, supported by "irrefutable data." He spoke of "missed opportunities" to focus on chemicals that bioaccumulate. The limitations of the Toxic Substances Control Act mean that "chemicals get out there and may have huge environmental problems" that need attention. He spoke of the need to address pharmaceutical chemicals and motivate industry and communities to reduce use of toxics, as EPA effectively did with chlorofluorocarbons.

A public health scientist spoke of EPA's difficulty in communicating integrated science with the public. Although Region 1-New England finds it relatively easy to integrate science for

decision making internally, the region "gets stymied" in the public arena, where politics and policy, and public participation get more complicated. It is much more difficult to confront science issues in a public arena. When asked whether the Region talks to communities or public to understand their perspective and values before it talks to them about science, she responded that often the Region finds that science may not be aligned with public perceptions.

The next scientist provided the Designated Federal Officer with written responses to the questions in the committee's *Preliminary Study Plan.* She spoke of her experience in the RCRA, TMDL, and air programs. She noted that the air program had a relatively "controlled process" for using science. The Clean Air Act prescribes development of National Ambient Air Quality Standards (NAAQS) for the six criteria air pollutants and requires them to be reviewed every five years. The law requires identification of attainment/non-attainment areas, and requires states to develop State Implementation Plans in non-attainment areas. As a regional scientist, her priority is to work with states to meet deadlines within those processes and she is "constantly aware of legal risks." As a result, there is a "tendency to go with what works -- what has passed muster legally and to ensure consistency across regions." EPA must make the process defensible in case EPA goes to court. She participates in national workgroups that set NAAQS for fine particles and also works with ozone.

She also is working on the SPARROW model to predict mercury levels in fish tissue at fine scale. This MERGANSER model involves a research team and represents a major Region 1-New England achievement. She commented that in the region, "a lot of what happens depends on a person's interest."

The regional scientists then briefly discussed frustrations finding the best science, given legal requirements. When asked whether the region ever finds that the "best science is yet unproven and unaffordable," several participants responded that the best science is "science which our resources allow us to use and retains legal defensibility."

The final scientist drew on her background in public health and Superfund. In her view, the Superfund program does an excellent job of integrating science in every decision. It brings together diverse groups of specialists (e.g., hydrogeologists, health and ecological risk assessors, community liaisons). It sustains an open dialogue on major questions--it gives everyone an opportunity to speak and raise questions about the decisions on the table. The challenge for managers is managing uncertainty at all levels. Managers must understand "how confident are we about what the contamination is, how hazardous it is, where it's going." No matter how much analysis is conducted, EPA struggles with managing uncertainty because decisions must be made in a certain timeframe and EPA does not have the luxury of long-term research.

She noted, however, that regional science is not perfect. Some decisions can be made by one individual (e.g., how many samples to obtain) and maybe not represent the best science all the time.

A committee member asked about the region's processes for managing uncertainty. The scientist responded that techniques employed by the region generally rely on a group dialogue, bringing people with diverse backgrounds and different perspectives together. She noted that

managers rarely ask technical staff to present quantitative estimates of uncertainty. Although regional scientists have access to Monte Carlo tools and other statistical analyses of uncertainty, often staff have only 15 minutes for a presentation and "we don't put error bars on our estimates." Monte Carlo techniques are rarely used or asked of specialists. She noted that in many site-specific analyses, the stakes may not justify such sophisticated techniques, unless the Region is "up against" a sophisticated Potentially Responsible Party that is challenging each exposure assumption. Another regional scientist observed that technical uncertainty analyses would be difficult for the public to understand.

Both scientists noted that the region focuses on each decision as making incremental improvement. "We don't need 100% certainty or perfection – but we do need to get over a threshold to get to the next level of environmental protection." There is a management process that may include a discussion of uncertainties. The region does not conduct the type of sensitivity analysis recommended by the 2009 National Research Council Report *Science and Decisions*, which calls for an examination of the implications of different assumptions. Often EPA does not have the luxury of time or the liberty to do such analyses.

The regional scientists talked briefly about public involvement. They recognized the importance of involving the public "up front." The Superfund program has mechanisms for soliciting and incorporating input. One scientist observed that the region could do a better job of involving the public up front more generally and for developing mechanisms that are efficient and effective.

The scientists concluded the discussion by identifying gaps in the region's science capabilities, barriers to science integration, and needs. Points discussed include:

- Hiring statisticians to help identify areas of contamination and summarize environmental sampling results
- Hydrogeologists
- Focus on bean-counting can frustrate science integration(e.g., the need to generate TMDLs vs. focus on strategic needs that may be presented by pharmaceuticals and personal needs products, a focus on bean counting rather than holistic public health protection)
- Scientist burn-out. Regional scientists sometimes find that needed science can only be generated on their personal time or with extraordinary effort.
- Losing staff to retirement, institutional knowledge, cut backs in training. Generalists need access to specialists to make informed decisions.
- Limited resources
- More agency wide commitment to applied science
- More research focused on hazard assessment
- Need for examination of, if and how EPA receives feedback on past decisions using science. Such analysis could provide an opportunity for managers to revisit past decisions to see how science was used and may provide insight for how science could be used more effectively in decision making in the future.