U.S. Environmental Protection Agency (EPA) Board of Scientific Counselors (BOSC)

Homeland Security (HS) Subcommittee

Face-to-Face Meeting Minutes

August 25–27, 2015

Dates and Times: August 25, 2015, 8:00 a.m. to 5:00 p.m.; August 26, 2015, 8:00 a.m. to 6:00 p.m.; August 27, 2015, 8:00 a.m. to 2:00 p.m. Eastern Time

Location: EPA Andrew W. Breidenbach Environmental Research Center Facility, 26 Martin Luther King Drive West, Cincinnati, Ohio

Meeting Minutes:

Provided below is a list of the presentations and discussions that took place during the meeting with hyperlinked page numbers. The minutes follow. The agenda is provided in Appendix A, and the Participants are listed in Appendix B. Definition of terms are provided in Appendix C.

Tuesday, August 25, 2015

The meeting generally followed the issues and timing as presented in the agenda attached as Appendix A to this meeting summary.

Designated Federal Officer (DFO) Welcome

Mr. Thomas Tracy, Designated Federal Official

Mr. Thomas Tracy, DFO for the Board of Scientific Counselors (BOSC) Homeland Security (HS) subcommittee, formally opened the meeting.

Introduction and Review of Charge Questions

Dr. Paula Olsiewski, Chair

Dr. Paula Olsiewski, chair of the BOSC HS subcommittee, welcomed the subcommittee members and stated that she was honored to be present. She requested that each subcommittee member introduce themselves. Dr. Olsiewski started by saying she is a Program Director at the Alfred P. Sloan Foundation where she directs the Foundation's programs in Microbiology of the Built Environment and Synthetic Biology. She also led the Foundation's Biosecurity program until its conclusion in 2011. Dr. Tammy Taylor, vice-chair of the BOSC HS subcommittee, is the Chief Operating Officer of the National Security Directorate at the Pacific Northwest National Laboratory (PNNL). Her roots are in environmental engineering, and her expertise is related to radiological consequence management, threat reductions, and environmental restoration. Mr. Edward (Ed) Hackney is the Director of Revenue Management for United Water. His areas of expertise include information science and uncertainty analysis. He has experience addressing issues related to cybersecurity of SCADA (Supervisory Control and Data Acquisition) systems. Dr. Monica Schoch-Spana is with the University of Pittsburgh Medical Center's Center for Health Security. She is a medical anthropologist whose expertise includes understanding community response to health events and increasing community resilience to disasters. Mr. Andrew DeGraca is the Water Quality Division Director for the San Francisco Public Utilities Commission. He is a chemical engineer with expertise in water security. Dr. Janis (Jan) Hulla is a senior toxicologist with the U.S. Army Corps of Engineers. She has expertise in ecological and human health risk assessment. Dr. Debra (Debbie) Reinhart is the Assistant Vice President for Research in the Office of Research and Commercialization at the University of Central Florida. Her expertise is related to solid and liquid waste management. Mr. Edwin (Ed) Roehl is the Chief Technical Officer for Advanced Data Mining International. He is a mechanical engineer with expertise in data mining and decision support systems, including water security tools. After the last member introduction, Dr. Olsiewski thanked the members and everyone else present in the room introduced themselves briefly.

Dr. Olsiewski introduced the five charge questions and explained that it is the subcommittee's responsibility to answer them over the next few days, and that some of them are cross-cutting to all the BOSC subcommittees.

General Board of Scientific Counselors Charge Questions

Charge Question 1. Given the research objectives articulated in the Strategic Research Action Plan (StRAP), are the topics and project areas planned and organized appropriately to make good progress on these objectives in the 2016-2019 time frame?

Dr. Olsiewski explained the first general charge question as, 'Is the program designed to achieve the objectives?' She stated that the subcommittee needs to try to answer this question as they listen to the presentations.

Charge Question 2. How effective are the approaches for involving the EPA partners in the problem formulation stage of research planning?

Dr. Olsiewski explained that the Homeland Security Research Program (HSRP) EPA program is an applied program. She pointed out that the work the subcommittee would be learning about is different from academic research and that their EPA partners have real world needs. The research must address these needs.

Charge Question 3. How well does the program respond to the needs of EPA partners?

Dr. Olsiewski stated that this question addresses the program formulation, which will be described in more detail to the subcommittee over the next few days.

Homeland Security Subcommittee Additional Charge Questions

Charge Question 4. How well has the Program transitioned research to the end-user? How can we improve our ability to transition research to the end-user in the future?

Dr. Olsiewski stated that the research materials provided to the subcommittee illustrated the body of interesting research being conducted, but that may not be ready yet for end users. Eventually this research has to be transitioned.

Charge Question 5. How can we infuse social science into the development of our research products to improve their usability?

Dr. Olsiewski noted that the utility of research products to the end users must be determined up front. Anthropologists and other social scientists are present at this meeting to help answer this question.

The subcommittee did not have any questions about the charge questions.

Program Overview

Dr. Gregory Sayles, National Program Director of EPA ORD HS Research Program

Dr. Sayles thanked Dr. Olsiewski and the subcommittee members for their participation. He explained that the following presentations would start at a high level and drill down to provide more details on the program. The next few presentations focus on the "big picture" rather than on the details of individual experiments taking place within the HSRP. At this time, National Homeland Security Research Center (NHSRC) staff are seeking high level advice on the charge questions from the subcommittee. Over the next few years, NHSRC staff will provide more project-specific details. This meeting was the first step in that process.

Dr. Sayles thanked NHSRC staff for preparing the meeting materials and provided an overview of the meeting agenda. The presentations begin with a high level overview, similar to the materials he provided the subcommittee with in April 2015. Three research overview presentations will be provided as a precursor to the poster sessions. The poster sessions will provide an opportunity for the subcommittee to engage with EPA researchers.

Dr. Sayles defined the term "EPA partners" as customers of HSRP's work; the people within the Agency (EPA) who ask NHSRC personnel to develop solutions. Dr. Emily Snyder's presentation will describe this process in more detail. Input received from EPA partners contributes to research prioritization. Other factors, including classified threats, also play a role. A classified briefing will be held to discuss threats relevant to EPA's mission.

Dr. Sayles noted that one of the charge questions addresses how the HSRP transitions the work to their partners. The Bio-Response Operational Testing and Evaluation (BOTE) study, which will be highlighted later in the meeting via a video, is one example of how that is accomplished. Customers need different types of scientific products, such as hands-on decision support tools. The Tools Café will provide

subcommittee members a chance to use tools developed by the HSRP. The partner panel discussion will provide the subcommittee members with an opportunity to directly interact with some of EPA's partners.

Dr. Sayles stated that the most useful output from the subcommittee would be a list of a few recommendations on ways NHSRC can improve the program. The most important recommendations should be highlighted if possible. He acknowledged that the draft report that the subcommittee prepares will be reviewed by the BOSC Executive Committee, which meets next in December 2015.

Dr. Sayles posed the question, "Why is homeland security even discussed at EPA?" He explained the reason is because of presidential directives and legislative acts requiring EPA to have responsibilities in this area. EPA's homeland security responsibilities include supporting water systems to prepare for and recover from attacks and other disasters by leading efforts to provide states and water utilities guidance, tools and strategies. EPA is the federal government Sector Specific Agency (SSA) lead for water infrastructure. Another homeland security responsibility that EPA has is cleaning up building and outdoor areas impacted by a terrorist attack or other disaster by leading efforts to establish clearance goals for cleanup. Finally, EPA is charged with developing a nationwide laboratory network with the capability and capacity to analyze for chemical, biological and radiological (CBR) agents for routine monitoring and in response to a terrorist attacks (ERLN: Environmental Response Laboratory Network). Dr. Sayles stated that the HSRP is geared around fulfilling these responsibilities.

EPA's mission is to protect human health and safeguard the environment. After September 11, 2011, that was no different. In the early 2000's, EPA's core strengths were reoriented to homeland security. Those core strengths include emergency response, water quality protection, pesticides registration/testing, hazardous materials cleanup, radiological monitoring/cleanup, and research and development. Dr. Sayles stated that the HSRP has now broadened its scope to take on "all hazards" or all disasters in addition to terrorism. Some examples of recent incidents that demonstrate that EPA does respond to all hazards and disasters were pointed out by Dr. Sayles including Deepwater Horizon spill in 2009, ricin letters in 2013, West Virginia 4-methylcyclohexanemethanol (MCHM) spill in 2014, Fukushima nuclear accident in 2011, Ebola outbreak in 2014, avian influenza poultry outbreak in 2015, Department of Defense (DoD) "live" *Bacillus anthracis* (anthrax) samples in 2015, Hurricane Sandy in 2012, and cyber-attacks on drinking water plants.

Dr. Sayles described how HS fits into the Agency as a whole. EPA has a lot of elements that are referred to as HS, but the main elements include the following:

- EPA Regions 1–10: on the ground teams who respond when something happens (for example, the Colorado River contamination from the mine blowout was handled by EPA Regions 6, 8, and 9).
- Office of Solid Waste and Emergency Response: main programmatic office for cleanup; responsible for guidance, training, and response support.
- Office of Air and Radiation: responsible for guidance and response support for radiological cleanup and methods.
  Office of Chemical Safety and Pollution Prevention: register antimicrobials that could be used for cleanup of biological agents.
- Office of Water (OW): responsible for drinking water and wastewater, helps utilities with their water emergencies.
- Office of HS – coordinates all of the groups, interagency outreach.
- Office of Research and Development (ORD): supports the science needs of these agency offices as they carry out the HS program for the Agency.

Dr. Sayles summarized the mission, objectives, and current projects of the HSRP. The HSRP's mission is to conduct research and develop useful scientific products that improve the capability of the Agency to carry out its HS responsibilities. The Agency as a whole has five goals outlined in EPA's Strategic Plan that include 1) Addressing Climate Change and Improving Air Quality, 2) Protecting America's Waters,

3) Cleaning up Communities and Advancing Sustainable Development, 4) Ensuring the Safety of Chemicals and Preventing Pollution, and 5) Protecting Human Health and the Environment by Enforcing Laws and Assuring Compliance. The third goal includes promoting emergency preparedness and recovery plans. The HSRP StRAP has two main objectives that align directly with the second and third goals. Those objectives are 1) Improve water utilities' abilities to prepare for and respond to incidents that threaten public health, and 2) Advance EPA's capabilities to respond to wide area contamination incidents. The StRAP is also organized into three main topics: 1) Water System Security and Resilience, 2) Characterizing Contamination and Assessing Exposure, and 3) Remediating Wide Areas. Within those three topic areas are 13 integrated, transdisciplinary projects which will be highlighted during the poster session.

Dr. Sayles pointed out that there is a lot of work to be done in the HS research and development program, and given their small number of people and limited resources, it is not possible to address all of the potential hazards in a realistic timeframe. Thus, it has become important for them to prioritize their work. The advice given by the Science Advisory Board (SAB)/BOSC in 2014 was that HSRP should keep the main focus on its core, the chemical, biological, radiological and nuclear hazards (CBRN) and terrorism, and to keep in mind that much of the work can have multiple uses. Therefore, NHSRC strives to design research and products to be as useful to as many hazards and disasters as possible. Dr. Sayles mentioned that their work has been useful to address recent disasters.

Dr. Sayles described the process used by NHSRC to prioritize their work. There are a lot of inputs and stakeholders involved. First, the HSRP must address EPA's mission and responsibilities in HS. Those responsibilities are carried out by NHSRC's EPA partners (in offices throughout EPA). Their needs play a role in setting HSRP priorities. Each HS incident provides lessons learned from the responses, including gaps that need to be addressed. EPA is well connected to other agencies (e.g., Federal Emergency Management Agency [FEMA]) which help to inform HSRP priorities. Current threats identified by threat assessments also inform HSRP priorities. NHSRC gathers needs from their partners on an annual or semi-annual basis, and that is the main way they inform their year-to-year priorities for funding. The Agency also sets high level strategic directions for the HSRP. All of these feed into the HSRP priorities. In addition, external review boards (e.g., the SAB) provide input to help set the HSRP priorities.

NHSRC is not isolated within EPA and has connections with individuals working in the Office of the President, Office of Science and Technology Policy (OSTP), and the National Security Council. Members of NHSRC help to inform workgroups in these organizations. It is important that NHSRC stay informed and connected to the science and technology groups in DoD and the Department of Homeland Security (DHS) that perform similar work. NHSRC stays well connected to these other organizations at a management level in order to stay informed about what they are working on and to look for opportunities to work together. They conduct joint research, including day-to-day hands on research collaborations, with DHS, DoD, Centers of Disease Control and Prevention (CDC), and others.

Dr. Sayles provided a brief history of the evolution of HSRP. Approximately 12 years ago, HSRP began working closely with EPA's OW on development of a contamination warning system for water distribution systems. Work was done on testing and placing sensors and developing software to interpret the data. HSRP then transitioned from preparing for contamination and disasters to responding to contamination once it has been detected. This includes flushing strategies and exposure minimization. HSRP is addressing cleanup issues following a disaster. They are also looking ahead at water system designs and vulnerability tools to determine if water systems can be designed and operated to better handle contamination.

In the indoor/outdoor cleanup areas, the program started after September 11, 2001 and the anthrax letter attacks. They began with working on how to clean up a room in a building, the heating, ventilating, and air conditioning (HVAC) system within the building, and other indoor cleanup work. This research has evolved to include wide areas, including downtown areas, transportation systems, parks, and other

outdoor areas. Decision support tools are being developed to help prioritize all of that work. In the future, the Agency plans to work on emerging issues such as agricultural security, epidemics, emerging chemicals/threats, and thinking big picture about all hazards.

Dr. Sayles summarized the HSRP StRAP for 2016-2019. As noted above, the two research objectives in the HSRP StRAP are to:

1. improve water utilities' abilities to prepare for and respond to incidents that threaten public health; and
2. advance EPA's capabilities to respond to wide area contamination incidents.

The research work is organized into three research topics:

1. Characterizing Contamination and Assessing Exposure.
2. Water System Security and Resilience.
3. Remediating Wide Areas.

Dr. Sayles discussed the two research objectives in more detail. The first objective is addressed through HSRP products that promote resilience before a disaster occurs (e.g., modeling tools to support design of resilient water systems) and rapid recovery from disasters (e.g., rapid detection, mitigation, risk assessment, water treatment, and infrastructure decontamination). The second objective is addressed through HSRP products that help determine the nature and extent of contamination, assess risks, mitigate damages, promote efficient cleanup, and manage waste. The three research topics will be described in more detail in later presentations.

One measure of success of the HSRP is that NHSRC personnel are called upon during urgent times to provide technical support to their partners. This support is in the form of guidance on the use of tools developed by the HSRP and also providing science translation and expert advice. NHSRC personnel provided critical technical support during recent incidents including the responses to the Ebola outbreak in 2014, ricin letter incidents in 2013, and *Burkholderia* biological incident at Tulane University in 2015. During the Ebola outbreak, NHSRC helped with preparedness planning for laboratory capacity and sample analysis, and advised on personal protective equipment (PPE) decontamination. In response to the ricin incidents, NHSRC provided technical support for the analytical methods, coordinated the availability of Ricin assay reagents, and evaluated the efficacy of hydrogen peroxide fumigant-based systems against ricin toxin on sensitive materials. During the response to the *Burkholderia* incident, NHSRC acted as a liaison between the EPA field responders and the CDC laboratory and assisted CDC with sample tracking, processing and turnaround times.

Dr. Sayles explained the group's ongoing ways of doing outreach as well. Different customers need different ways of getting resources. The HSRP website is one method of outreach (http://www2.epa.gov/homeland-security-research). Work is also disseminated via a HS webinar series, the International Decontamination Research Conference (occurring every 18 months), EPA's Homeland Security Collaborative Network (meets monthly), national and international technical conferences, stakeholder email updates (> 1,000 subscribers), EPA communication vehicles, and participation on over 40 interagency groups.

Dr. Sayles described how NHSRC conducts their research. EPA laboratories and modeling facilities (i.e., Cincinnati, Research Triangle Park) are utilized, as well as extramural organizations including safety labs, unique facilities, and labs with specialized capabilities. They get as much done as they can in EPA facilities, but there are some things that need to be done elsewhere (e.g., anthrax experiments). They often do tests at EPA facilities with surrogates, and then test with the live agents at safety laboratories. He emphasized that they are very careful about what laboratories they go to get the work done.

Dr. Sayles presented information on HSRP budget resources, the smallest research program within ORD. HSRP's budget dropped during Fiscal Years (FY) 2012 through FY 2016 in both dollars and full-time

equivalent (FTE). Dr. Sayles used a pie graph to illustrate the enacted budget by topic area for FY 2015. The largest amount of resources are allocated to the research topic "Remediating Wide Areas."

Dr. Sayles noted that the work of the HSRP is applied research and development (solutions to urgent capability gaps), relevant (customer-driven), and useful (tools, methods, models and data that end-users can put into action immediately). He pointed out that some of HSRP's customers were there in the room, and that they worry about tools they might need but don't yet have. NHSRC personnel have a sense of urgency to do relatively short-term, applied work on the areas that are most important to their customers, and they work closely with those partners to provide products that are hands-on and useful to them. He reiterated how grateful they were to have the subcommittee there to help them.

The subcommittee did not have any questions on the HS research overview.

Research Overviews

EPA Project Leads

Dr. Sayles explained that the next three presentations would describe the research at a more detailed level. Incident response is complex. Although there is an effort to organize the HSRP in a logical way, preparing for and responding to an emergency is not linear. Preparing for and responding to emergencies is a system of interconnected activities. A systems diagram was developed to help organize HSRP work and illustrate that activities are not done in isolation. The following activities were included in a circular diagram: detection, mitigation, characterization and risk assessment, remediation or decontamination, reoccupy/reuse, lessons learned and preplanning, and reduce vulnerabilities. Dr. Sayles explained that lines could be drawn between the activities in this diagram because they inform each other. For example, decisions about how to clean up a site are going to have a large effect on how much sampling needs to occur and how much waste will be generated. A lot the research has cross connections, and was intentionally built that way.

Dr. Sayles further explained that HSRP projects often address elements from different research topics. NHSRC tries to build transdisciplinary collaborations into projects because there is overlap and cross-talk between them. This approach allows NHSRC to leverage multidisciplinary staff, knowledge, and resources. Some projects do not fit neatly into only one of the three research topics. Other projects can be applied to multiple types of media. When designing research projects, NHSRC staff have tried to eliminate 'silos' in order to do the best science possible.

Dr. Sayles asked the subcommittee to consider the cross-cutting systems and complex way that HSRP work is done when addressing Charge Question 1. He reminded the subcommittee that the current HSRP projects will be highlighted during the upcoming poster sessions and some of the projects will have multiple posters. Additionally, the next three presentations will be organized by the three research topics.

Mr. DeGraca requested clarity on how water is defined within the HSRP. If possible, it would be helpful to define water as drinking water, wastewater, or storm water. Otherwise, "water" can refer to the entire water cycle. Dr. Sayles agreed that this can be a point of confusion. Dr. Ernst will discuss water research in her presentation and provide some clarity on the definitions used in the HSRP. Dr. Sayles noted that water is addressed in different ways in HSRP (e.g., through drinking water in the distribution system, water associated with the cleanup of a building). Dr. Sayles agreed that it is important to be careful with the terminology and a more conscious effort will be made to do so.

Characterizing Contamination and Assessing Exposure - Dr. Tonya Nichols

Dr. Nichols stated that their goal for this research area is to help provide the science to establish sampling strategies that maximizes the collection extent for a contamination. On the other side, she points out that they also need to minimize the sampling and analytical burden. There are three major questions in this area of research:

1. What are the standardized sample collection and analysis methods and strategies for characterization of contamination? (what's there, what's available, and what needs to be refined)
2. Can exposure pathways and models be improved to better inform risk assessment and risk management decisions for water-related exposures?
3. Can exposure pathways and models be improved to better inform risk assessment and risk management decisions after a wide area contamination incident?

HSRP exposure assessment research starts with taking samples in the contaminated building and determining the environmental concentration (e.g., in water, air, surfaces, soil, etc.). One important question to consider during sampling is "how do you know if you are really collecting the representative sample?" Next, one needs to determine what the potential exposure pathways are (e.g., showering, walking, and driving). The last step is to determine what concentration humans could be exposed to without adverse health effects.

Dr. Nichols discussed standardized sample collection, analysis methods, and strategies. An important sampling question to consider is "when do you need to take a sample?" Samples need to be taken before, during, and after an incident. In the best case scenario, background samples will be available, which are important for comparison to pre-incident samples and samples taken after remediation. However, pre-incident background samples are not available in most cases and in these instances, sampling starts with detection. Immediately after notification of an incident, personnel start taking samples to characterize the nature and extent of the contamination. A series of sampling events may be needed to see if the contamination is spreading and/or persisting. Whether natural attenuation or full-scale decontamination is applied, confirmatory samples are generally taken again to see if the remediation strategy if working.

Dr. Nichols described the actual response phase of incidents in more detail. In the first few hours of an incident, CDC and the Federal Bureau of Investigation (FBI) have the lead and take public health and forensic samples. In some water scenario cases, NHSRC personnel may have the lead in identifying the contaminating agent. The data is shared among the agencies, and they also determine the extent of the contamination. After the contaminant is identified, then some remediation is done. More samples are taken to see if remediation is working. The timeline for the response phase is days, weeks, and possibly months. Sampling and analysis needs change during the response timeline. The sampling method to determine what an agent is may not be the same screening method used once the contaminant is identified. There needs to be response-relevant methods.

Some people may view sample collection and sample analyses as two separate entities, however, NHSRC views them as a connected process. How a sample is taken in the field will directly affect the laboratory analysis. The On-Scene Coordinators (OSCs) in the regions along with the response teams (e.g., CMAT, ERT, RRT) actually coordinate the sampling in the field and they also request the sample analysis from various laboratories. It is important for those two processes to be coordinated. The OSCs coordinate with the Environmental Response Laboratory Network (ERLN), which is nationwide system run out of EPA headquarters that connects commercial, federal, state, and other laboratories that can do environmental analysis with a quality program. They also utilize the Water Laboratory Alliance (WLA) (nationwide) and the National Analytical Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama.

Dr. Nichols explained that the OSCs and laboratories are NHSRC's customers. The responsibility of NHSRC is to provide their customers with sample collection and analysis methods that are field- relevant and provide sound science and data so that decisions can be made. They also provide direction for the remediation strategy, if necessary, and risk-based cleanup goals.

Dr. Nichols noted that if possible, everything should be sampled following a natural disaster. Sample collection needs to be thorough and include as many matrices as possible (e.g., water, porous and non-porous surfaces, air, soil, waste, wastewater, and building materials). Sampling methods need to be user-friendly and translatable to the analysis methods in the laboratory. The sampled agents include biologicals, chemicals, biological toxins, and radiologicals. NHSRC staff look for anything and

everything during their method development work, but they try to prioritize what they are looking for based on potential needs identified by the OSCs and other partners, or agents identified by threat analyses. Staff are developing methods and leverage existing methods for many different matrices and hundreds of different agents. Since 2005, they have worked to compile the available methods from within EPA and different agencies (e.g., CDC, DHS) so they are ready and available for an incident and the OSCs and responders will know which methods to use. This collection of available methods is available in a large document titled, "Selected Analytical Methods for Environmental Remediation and Recovery (SAM) 2012." The same information is available through a searchable web-based tool also called SAM (http://www.epa.gov/sam/). This tool identifies analytical methods to be used by laboratories tasked with performing analyses of environmental samples following a HS event.

Dr. Hulla commented that she believes there is a priority list for threat agents produced by CDC. She asked if they have that in the tool. Dr. Nichols replied by saying yes, that the list of agents in SAM was developed from the CDC Select Agent List and the WLA Priority Contaminant List, and SME historical data. SAM includes about 300 agents. The methods in SAM are in different stages of development; some are standardized methods while others are just the best available methods that can be easily implemented. The next version of SAM is due out in 2017. The online tool is updated in real-time. Dr. Nichols mentioned that this tool will be demonstrated in the Tools Café portion of the meeting.

Dr. Reinhart asked about whether the group also gives some priority to on-site field analysis that doesn't require transfer to a laboratory. Dr. Nichols asked if she was referring to the field screening methods. Dr. Reinhart clarified that she was referring to analysis. Dr. Nichols replied that CDC does not have a lot of confidence in hand-held assays, however, there are a lot of first responders that use them. EPA does not use the hand-held assays in the on-site screening process. Mr. Nalipinksi (EPA OSC) stated that they do work very closely with the National Guard Civil Support Teams and use their capabilities as a screening tool to prioritize which samples should be sent to the laboratory. The OSCs use this screening method and process samples at State laboratories because EPA laboratories have a limited capacity and longer turnaround time. He confirmed that EPA OSCs do not use the hand-held assays for analysis in the field.

Dr. Nichols provided an example of how sample collection typically occurs. One of the biggest bottlenecks in sample analysis is laboratory capacity. Sponge stick is the preferred method of environmental surface sampling for biological agents, however, this results in many samples. One sponge stick results in 11 culture plates of presumptive B. anthracis colonies that requires 2–5 PCR (polymerase chain reaction) analyses per sample with confirmed results in about 48–72 hours. The time to result for 100 samples is 4–5 days for one laboratory with 2–3 technicians. That is why the use of the same analysis methods (as provided in the SAM) across multiple laboratories is an important idea.

Dr. Hulla asked if the cultures have to be grown up in order to use PCR. Dr. Nichols replied that they do not and that there is another area of research involving rapid viability that uses an enrichment assay followed by PCR, which is a faster process. This method is not recommended by CDC and needs to be verified and validated.

Dr. Nichols explained one example of HSRP research addressing sample collection issues. The question posed was "Can environmental sampling personnel use one sponge stick to sample larger or multiple areas (a procedure which is outside of what the standard CDC method recommends)?" The research suggested that composite surface sampling, by either the standard CDC method or the HSRP modified method can increase the amount of surface area sampled without an increase in laboratory processing time, labor, and consumables. The results were published (Tufts et al., 2014; doi:10.1371/journal.pone.0114082) and the research continues in this area.

Dr. Nichols moved from sample collection and analysis to the next step of the HSRP exposure assessment research, which is determining potential exposure pathways. In regards to human exposure, she posed the question: "When and where are we most vulnerable to contaminants in a drinking water distribution system?" In order to help answer that question, NHSRC is developing models to assess the consequences

of CBRN contaminant introduction into water systems to support vulnerability assessments. Their research is informing where physical security or other measures are best applied to reduce these vulnerabilities. Dr. Nichols mentioned that Dr. Ernst would talk more about the water models during her presentation. She provided an example of how the NHSRC is addressing potential water exposures. They did a survey of household water uses and found that showers and humidifiers are two areas of potential vulnerability for inhalation exposure to microbiological agents in water. Then they used the water models to determine potential exposures and consequences.

Dr. Nichols changed the focus from indoor contamination to outdoor wide area contamination incidents. She pointed out that pollutants do not respect borders and can be moved by many factors in the environment, including human behavior. Her group is trying to figure out how to translate the exposure of a person in a house based on the samples taken from the environment around their house (e.g., soil, water samples). The next step is trying to connect the dots from the samples that are taken to interpret their meaning in regards to human exposure. The public wants to know when it is safe to re-enter a building and resume normal activities after a contamination incident. In order to help with this determination, NHSRC is evaluating existing exposure assessment methodologies to connect microbial field sampling data to determining potential environmental exposures. They have done a lot of research on *B. anthracis*, including aerosolization and reaerosolization models. For example, those models are used to estimate *B. anthracis* exposure to humans from reaerosolized spores on outdoor urban surfaces. There are a lot of uncertainties associated with that. They are also assessing exposure modeling for predicting population distributions of exposures following an outdoor release due to variability in human activity patterns, building characteristics, and population demographics.

Dr. Nichols noted that during a contamination incident, they are trying to determine the environmental exposure concentration, potential human exposure pathways, and what concentration humans could be exposed to without adverse effects. Throughout this process, the HSRP exposure assessment research supports remediation decisions for the following issues:

- Where cleanup is needed.
- What should be remediated versus hauled away.
- Prioritization of cleanup areas.
- Cleanup goals.

Dr. Nichols provided the list of posters related to this topic of research that would be displayed during the first poster session, including:

- Evaluate Potential Exposure to Contaminants and By-Products.
- Biological Sampling and Analysis.
- Chemical and Biological Toxin Sampling and Analysis.
- Radiological Sampling and Analysis.

Water System Security and Resilience - Dr. Hiba Ernst

Dr. Ernst recapped what Dr. Sayles already presented about how the water program has moved from doing research on detection (e.g., contamination warning system data and tools) and mitigation (e.g., flushing strategies) towards doing research on cleanup and resilience (e.g., infrastructure decontamination, wash water treatment, system designs, vulnerability tools, treatment indicators). The program is now focusing on an all hazards such as hazardous spills, weather disasters, pipe breaks and cross contamination. They are developing tools to handle those issues. Dr. Ernst presented the StRAP research questions for the Water System Security and Resilience topic area:

- Can water systems models be designed to enable utilities to be more resilient to disruptions while enhancing daily operations?

- What technologies, methods, and strategies for detection and mitigation of contamination in water systems best minimize public health consequences?
- What methodologies and strategies are most effective for water infrastructure decontamination and water treatment?
- How can the Program place its research in a decision maker-friendly format for use by EPA water partners and water utilities?

Dr. Ernst emphasized that the tools they develop should be used by the water utilities on a daily basis so that they are available when needed in the event of an incident. They also want to improve the detection of agents and are using models with sensors to help the water utilities with this. When the program was started, the folks in the program at the time did a large literature review on water decontamination and found there was very little information available for chemical warfare agents and other threat agents (radiological and biological). This research program was developed to try and fill these gaps and to help OW with their decontamination efforts. Finally, the program needs to develop tools that are user friendly.

Dr. Ernst addressed the question that was brought up earlier by Mr. DeGraca regarding HSRP's definition of water. She stated that they originally focused on drinking water because they did not have the time or capability to consider the entire water cycle. In their first action plan, they also mentioned the needs of wastewater. They are now starting to work on wastewater and looking toward water reuse and source water as well. The program now views water as "every drop counts."

Dr. Ernst reported the results of a 2013 survey of water utilities which indicated 65% of the respondents have some sort of modeling system, basically a hydraulic model and possibly a water quality model as well. They have found that the use of modeling has become more pronounced with the water systems. NHSRC is developing tools to support them. Models are being used by water systems for their planning, critical infrastructure protection to identify which areas are more critical for support, and for response and mitigation.

NHSRC's vision for the future is that water utilities rely on advanced tools to automatically detect water quality problems and identify and evaluate potential response actions, thereby integrating security with daily operations. NHSRC has developed software tools that work with a water utility's hydraulic model and help support their contamination warning system, data analytics and real-time modeling, and evaluation of response actions. The 2013 survey indicated that utilities are realizing the critical importance of real-time analytics. Those tools can work with their SCADA system and help them see in real time what the data is doing.

Dr. Ernst stated that their group has taken EPANET, the premier modeling software used by drinking water utilities, and given it more capabilities. One example is the real-time analytics tool EPANET-RTX, which can fuse real-time field (SCADA) data with infrastructure models. They have also continued advancement of EPANET software in collaboration with another program in ORD to develop EPANET3. They are also working with systems modeling tools to measure resilience of water systems to natural disasters, terrorist attacks, and other emergencies. Right now they are looking at perturbations in a water system and trying to determine how a water system can respond quickly to an event. They are partnering with the DHS cyber group to work on effectiveness of cybersecurity standards and identifying cybersecurity gaps and needs in water systems.

Dr. Ernst stated their goals are to improve the resilience of water and wastewater systems and provide water systems with the tools and technologies to mitigate intentional and accidental contamination, respond to natural disasters, and improve operations.

Next, Dr. Ernst summarized the group's research in water infrastructure resilience. Infrastructure resilience is the reduction of the magnitude and/or duration of disruptive events. She explained that the water sector is tightly linked to the energy sector. Natural disasters may result in power outages affecting the operation of critical water infrastructure. Most of the large water utilities have generators on site, but

for those utilities that do not have generators, they have to deal with a disruption in service. The HSRP water group wants to use models to determine what will happen in a water system when there is a disruption in the operation of a pump, and also determine how the utility can quickly recover. Their goal is to shorten the time to recovery and minimize the ongoing effect. They are working to develop new and advanced simulation capabilities for drinking water and wastewater resilience and determining how to use system analysis to examine the consequences of disasters, improve resilience and mitigation strategies.

Dr. Ernst described the decision-making tools already developed and under development by the HSRP water group. The Water Security Toolkit (WST) is a hydraulic and water quality model for simulation and optimization of response options by identifying possible contaminant injection locations, hydrants for flushing, and locations for decontamination. This tool helps utilities determine what areas or valves to close in the event of a contamination event, what hydrants should be flushed to get the contaminant out of the system as quickly as possible, or how to contain the contamination in a certain area.

The West Virginia MCHM spill taught the HSRP water group that they should build their tools to also study treatment plant source waters, more specifically, the rivers. They've taken a modeling tool (the RSMS - Ohio Riverine Spill Modelling System) and updated it with the U.S. Army Corp of Engineer's Hydraulic Engineering Centers - River Analysis System (HEC-RAS) data for emergency spill response and planning. Their goal is to use the modeling tool to describe a river spill concentration plume as it moves down the river. A portion of the tool was used by a conglomerate of water utilities around the Ohio River in 2014 to predict when the MCHM spill would reach Ohio. The model helped Greater Cincinnati Water Works (GCWW) know the right time to shut down their intake.

Dr. Ernst described the capabilities of the WST in more detail and how it can help inform decision making during the response to a water incident. She showed an example of a diagram produced by the tool that includes the pipes and the nodes in a water system. With a given injection node, the tool produced a graph comparing the population exposed for one, two, or three different flushing locations. Dr. Ernst noted that it is important to identify which hydrants should be used during remediation to minimize spreading the contaminant.

Dr. Ernst discussed the water group's research in detection and mitigation methods and strategies. They are working on rapid detection of contamination in drinking water distribution systems, on-line water quality monitoring and development of sensors, and the use of software tools to optimally place sensors and detect deviations from baseline water quality readings. Water utilities would like some radiological sensors. In response to that need, the HSRP water group developed an on-line radiological sensor and is working with the Office of Air and Radiation to test that sensor on actual contaminants. Another example of their research is the development of software tools to optimize their use with sensors, such as sensor placement optimization tools. They worked with the American Water Works Association (AWWA) to have their tools tested, and the AWWA provided input on ways to improve the tools. They can 'train' the event detection tool CANARY to detect/discriminate water quality changes in the system. The tool can then recognize if there is a significant change in chlorine residual or total organic carbon (TOC) to show that there is a contaminant in the system. The impact of their research is that water systems are better prepared to detect intentional and unintentional contamination.

Dr. Ernst provided some real world applications of some of these water system tools. They have worked with the following utilities to provide these capabilities:

- GCWW, Cincinnati, Ohio
    - Optimal monitoring and placement of water sensors for the 2015 All-Star game using the sensor placement tool
- City of Milford, Ohio
    - Adapting the utility model to a SCADA-driven real time model using EPANET-RTX

    - Improve system operation, water quality and a better understanding of water losses in the system

- Montreal Water Utility, Montreal, Canada
    - Use models to support response to *Escherichia coli* detection in the system
    - TEVA-SPOT (Threat Ensemble Vulnerability Assessment - Sensor Placement Optimization Tool) backtracking algorithm to identify upstream critical facilities and inform vulnerable zones

Dr. Ernst emphasized that in order to better understand how to decontaminate a system, you have to understand the fate and transport of the contaminants that you are dealing with. In this area, they have worked on experimental investigation of CBR contaminant fate and transport, prediction and modeling of CBR fate and transport, and strategies to minimize contamination of distribution systems due to contaminated tank sediments. Contaminants are transported in bulk water but can also adsorb to pipe walls and attach to biofilms. Dr. Ernst explained that they do fate and transport experiments with surrogates in-house and then use the national laboratories for experiments with the actual contaminants. She also stated that because they cannot do experimental tests for all possible contaminants, they are using modeling to help understand contaminant fate and transport. It was noted that extrapolating data generated for one contaminate to another is a significant source of uncertainty in risk assessment. NHSRC built a pilot-scale facility to study contaminant fate through waste water treatment. Dr. Ernst said that they are studying water tanks and what kinds of contaminants adhere to the sediments in the tanks. They are studying how to prevent those contaminants from breaking out with hydraulic changes and releasing the contaminant back into the distribution system. She showed a picture of a tracer test done during the draining of a tank designed to study sediment removal and resuspension. Small changes in design of the tank can have a great impact on sediment removal.

Dr. Ernst described some of the experiments they have done in the area of water tanks and what kind of contaminants adhere to the sediments in the tanks. They collected sediment from tanks when water utilities were getting ready to clean them and found that sediments from different tanks can vary a lot. They did basic tests on the sediment (identification, size distribution, pH, absorption capacity, cation/anion exchange), but they also used cesium, lindane, and a biological contaminant to do contaminant adherence studies. They are now collaborating with another program in ORD to study *Legionella* because traces were found in some of the sediments they studied.

Dr. Ernst described some decontamination experiments they have done at their Test and Evaluation facility using a pilot scale drinking water system (~75 feet of PVC pipe, the most common pipe material). There is also a section with cement mortar and corroded iron coupons so they can also understand adherence of contaminants on those surfaces. They studied decontamination of B. anthracis surrogate spores by evaluating six disinfectants (varying concentration, holding time, and pH). They studied the effectiveness of flushing alone and flushing following each disinfectant application. Results from these experiments were used to generate data tables on the decontamination effectiveness of common drinking water disinfectants and flushing.

Dr. Ernst explained that the HSRP water program is not only focused on drinking water, but also the contaminated water that is generated from cleanup operations that may contain biological agents. Public utilities are reluctant to take water that may have biological agents such as anthrax in it. To help with this issue, the HSRP water group is starting to do research on wastewater. They built a wastewater system in their Test and Evaluation facility and also utilize mobile treatment units so water can be treated at a contamination site instead of being shipped.

Dr. Ernst explained that their decontamination research originally started on the bench scale, and later expanded to pilot scale, and then to the full scale. The U.S. water sector identified full-scale testing of water security tools, sensors, and methods with real contamination as a major gap in the research. The

HSRP water group is trying to address that gap using a full-scale decontamination facility (located in Idaho) that they built using some old pipes that were taken out of commission. Phase 1 of the project built an L-shaped distribution system with 450 feet of pipe between two hydrants. This allows them to evaluate contamination detection methods, water treatment technologies, and drinking-water-infrastructure decontamination methods at full-scale. They can simulate intentional and inadvertent distribution system contamination (chemicals, biologicals, and radiologicals) and disruptions (cyber-attacks). There is also a lagoon that they use to test water treatment units. They are working with ICS-CERT (DHS's Industrial Control Systems Cyber Emergency Response Team) to try to do some cybersecurity experiments at this facility. They hope to use this facility to provide training and simulation opportunities for utilities and responders to practice implementation of resilient technologies and prepare for and mitigate for potential service interruptions.

Dr. Ernst described a comparison between pilot and full-scale results using the decontamination experiments that she mentioned earlier as an example. Those experiments studied the efficacy of six different disinfectants with *B. anthracis* surrogate spores [*Bacillus globigii* (BG) spores]. In the pilot scale decontamination loop at EPA's Test and Evaluation facility, they found that chlorine dioxide was the best disinfectant for removing BG spores from the pipes (no spores detected on cement-mortar coupons after treatment with 25-30 mg/L chlorine dioxide [ClO_2]). They allowed the ClO_2 to remain in the system for a period of time before flushing. The water utilities prefer flushing because it is easy for them. Hence, the HSRP water group works to give the utilities better guidance on best flushing practices for removal of contaminants. After testing in the pilot scale, they did field-scale experiments at the Water Security Test Bed System (WSTB) at Idaho National Laboratory (INL). However, chlorine dioxide was not as effective during field-scale experiments (ClO_2 was lost very rapidly even before flushing; spores persisted on cement-mortar in the presence of up to 100 mg/L ClO_2). Dr. Ernst explained that temperature fluctuation (because those pipes are above ground), sticking of spores to the biofilm within the pipes, and dead-end spaces that are not present in the pilot scale system probably impacted the decontamination in the field scale. The preliminary results from these experiments taught the group that full-scale decontamination was less effective than pilot and bench-scale decontamination. Therefore, the group's ability to test their methods at INL is appropriate and applicable to the real world.

Remediating Wide Areas - Dr. Shawn Ryan

Dr. Ryan presented the goals for this topic area, which are to support water systems to prepare for and recover from attacks and other disasters and to clean up buildings and outdoor areas. The water treatment and water infrastructure decontamination research that Dr. Ernst discussed crosses into this area because water is a large part of remediating wide areas. Dr. Ryan provided some examples of incidents that have helped guide the program and have highlighted some capability gaps:

- Amerithrax incidents in 2001 highlighted capability gaps for response and remediation
    - Natural "anthrax" responses over the years have demonstrated improvements and highlighted remaining gaps
- Interagency studies further highlighted capability gaps for wide area remediation
    - Example: Wide-Area Response and Recovery Project, led by DHS with EPA involvement highlighted gaps in responses to chemical, radiological, and biological incidents
    - Example: Underground Transport Restoration Project, a collaboration between EPA and DHS, demonstrates capability gaps such as how to decontaminate a rail car without destroying it
- Additional "all hazard" incidents have highlighted the relevance of their research and capability gaps
    - Ebola outbreak - low-tech, readily available methods especially for porous materials (methods they developed for anthrax were relevant and available for the Ebola outbreak)

  - Ricin contamination and "anthrax" laboratory contamination – highlighted need for methods for sensitive equipment and materials
  - *Burkholderia* incident – highlighted need for methods for outdoor areas, particularly soil, which presents a major challenge

Dr. Ryan discussed the StRAP research questions related to Remediating Wide Areas.

- What are indicators of community environmental resilience and how can existing tools incorporate these indicators?
- What technologies, methods, and strategies are effective for mitigating the impacts of the contamination and for reducing the potential exposures?
- What technologies, methods, and strategies are most effective (minimize cost while protecting human health and the environment) for cleanup of indoor and outdoor areas (including management of waste)?
  - Dr. Ryan emphasized that waste management is a large piece of cleanup. Whatever is done during cleanup creates waste that must be dealt with in the end. That should be addressed throughout the response effort. It is important to have methods that reduce waste throughout the process.
- How can the program place its research in a decision maker-friendly format for use by EPA partners and state and local decision makers?

Dr. Ryan discussed specific projects that the wide area group is working on. He began with fate and transport of contaminants and by-products in indoor and outdoor environments. The HSRP wide area group researches questions that come from their partners. For example, they are working to understand the persistence of non-spore forming biological agents and whether natural attenuation (i.e., closing up an area) is a viable option for remediation. Also, they are developing an understanding of the transport mechanisms of *Bacillus anthracis* spores to inform mitigation, sampling, and remediation decision making. They are assessing the fate of persistent chemical agents, such as mustard lewisite, and VX (chemical warfare nerve agent), on environmental matrices. Chemicals pose significant challenges to the group, because they can be reactive and penetrate deep into materials and then be released under certain conditions, such as an elevation in temperature or rainfall. Those are situations that they research. They also try to understand how radioactive agents (e.g., cesium) behave in an urban environment, including binding and adhering to certain materials, and then determine decontamination options based on that behavior.

One important question to consider is "What specific actions do they need to do to address these fate and transport needs?" Dr. Ryan explained that the wide area group performs literature reviews to determine gaps and important transport mechanisms based upon historical data. They do laboratory tunnel-based studies to understand the transport of biological particulates as a function of environmental conditions, forces, and mitigation measures. In addition, they do laboratory chamber based studies to assess fate/persistence as a function of environmental conditions and matrices.

Dr. Ryan stressed that their focus with research is to inform mitigation and remediation decisions. He provided an example of a fate and transport project that the group worked on in collaboration with CDC and DHS (titled "SPORE") with the goal of understanding reaerosolization of *B. anthracis* spores. One of the first issues that came up during that project was the need for a surrogate. There had been some previous studies on the fate of *Btk* (*Bacillus thuringiensis serovar kurstaki*) in the environment. So the team wondered if it could be an appropriate surrogate for *B. anthracis*. They also studied *Bg* (*Bacillus globigii*) as a potential surrogate. They did experiments on the fate of dry versus wet spores because dry-deposited spores reaerosolize more and with less applied force than wet spores. The results of this particular experiment showed that *B. anthracis* spores and *Btk* spores behaved similarly in regards to wet and dry deposition and reaerosolization, while *Bg* spores behaved significantly differently. This study was also done in collaboration with U.S. Army Dugway Proving Ground.

Dr. Ryan then discussed the area of supporting detection and mitigation methods and strategies. The early phase of an incident is less than 72 hours and involves mostly local responders. The cleanup phase can last for days to years and involves local, state, tribal authorities, contractors, EPA, and others. The mitigation methods include reducing the risk of exposure to the public and responders at the release site, contain the contamination preventing spread beyond the release site, and having hazard mitigation methods readily available to support early phase response, remediation activities, and continuity of operations. Rapid detection is an important component of mitigation, particularly in drinking water distribution systems. The HSRP projects in this area address gaps such as on-line monitoring for rapid detection of contaminants and gross decontamination methods for biological and radiological agents.

Dr. Ryan provided examples of mitigation strategies that the HSRP wide area group are researching and developing. The use of existing and readily available materials allow for faster deployment. The group tackles the questions: Can they be used effectively to reduce exposure or spread of contamination? Can mitigation methods be derived from locally and readily available materials? and What is the field-scale applicability of specifically designed materials for mitigation?

Dr. Ryan explained that fire-fighting materials are commonly available during a response and are fast to deploy. However, their effectiveness for radiological mitigation has not been demonstrated. Therefore, the HSRP wide area group has done experiments to compare wet fire retardant thickness to cesium-137 dose reduction on a surface. They have done similar experiments in the biological and chemical areas to look for materials that are readily available to help with cleanup.

Dr. Ryan then discussed the area of decontamination as a critical aspect of remediation. This is an area that the HSRP wide area group focuses on a lot. They try to understand how the efficacy of methods are impacted by real-world, site-specific variables. In the Development, Identification and Efficacy of Decontamination Methods Project, they focus on finding decontamination methods for surfaces. They have examined materials contaminated with biological, radiological or persistent chemical agents, with a focus on porous or permeable materials. They mostly examine methods available in other areas, such as hospitals, to test if they can be applied to wide area decontamination. They have done experiments to find decontamination methods for water and wastewater infrastructure, as well as critical infrastructure and sensitive materials and equipment. They are also trying to understand self-help methods for homes, pets, vehicles, etc. These methods are easily implemented without specialized training or equipment and have the potential to reduce exposure over time.

Dr. Ryan provided examples of experiments that tested the application of methods and products intended for other purposes being used to decontaminate anthrax. Sodium persulfate is a soil decontaminant used for organic chemicals. The HSRP wide area group tested it in soil and it worked very well for *B. anthracis*. They expanded the testing to other indoor and outdoor materials, such as asphalt. It worked well for some materials (though not as well as it did in soil), providing a six-log viability reduction in *B. anthracis* spores, indicating it might be a good candidate for field use. However, when they tested the soil pesticide chloropicrin, it did not perform well at reducing *B. anthracis* viability. This experiment demonstrates the importance of testing disinfectants that are already available to see if they work for particular agents before mistakes are made in the field.

Dr. Ryan discussed another project area they are researching: "Engineering and Application Considerations for Decontamination Methods." The purpose of this project to inform decision making on the pros, cons, and practical application considerations of decontamination methods. From their previous experiments, they have an understanding of what methods and chemicals may work well in the field for decontamination. They have a need to understand how certain factors (e.g., temperature, humidity) may impact the efficacy of those methods. So this project builds on the project just discussed in that it assesses promising decontamination efforts in more applied settings and helps to determine operational-relevant information such as cost, time, waste generation, and impacts on materials. Dr. Ryan pointed out that they

are trying to minimize impacts on materials and waste generation without affecting the efficacy of decontamination.

Dr. Ryan said that some of the critical knowledge gaps being addressed in this project include:

- Effective decontamination methods for drinking water and wastewater infrastructure decontamination.
- Increase capability and capacity for remediating environments resulting from a wide area release.
- Effective decontaminants for outdoor areas, including soil, and are applicable to wide areas (under many different conditions).
- Decontamination methods that reduce waste generation.
- Decontamination methods for sensitive equipment and materials, including critical infrastructure.

Dr. Ryan pointed out that they strive to work together with their partners, the responders. For example, the HSRP wide area group found that methyl bromide was effective in the laboratory against *B. anthracis* and useful because it is not an oxidizer like some of the other options. They provided this information to their partners who tested methyl bromide against *B. anthracis* in a test house and then in a rail car. The HSRP wide area group was out there with their partners during the field test to learn how they can improve their laboratory testing to better correlate with field conditions.

Dr. Ryan explained that their research is done at numerous scales, including large chambers and pipe loops, and surrogates are generally used for chemical, biological or radiological agents. He pointed out that scale-up is not always easy. This was shown in the project "Efficacy of Sporicidal Wipes for Decontamination of Mid-Size Surfaces." The wipes were efficacious against *B. anthracis* (6-log kill) on a 1 foot (ft.) by 1 ft. surface. That small surface size is not practical for a responder. Therefore, they wanted to test larger surface sizes to understand how usable wipes are for the field. When they tried to scale-up (to 3 ft. x 3 ft. on glass), they found the efficacy dropped markedly. The average log reduction went down to 3.4 – 4.3 (depending on wipe type) on glass when applied over a larger area. In addition, they found that cross contamination occurred into areas that were not inoculated. They used this information to provide guidance to the responders in the field.

Dr. Ryan discussed the treatment, disposal, minimization and handling of contaminated water and waste. He pointed out that waste management is a critical aspect of all remediation efforts because all efforts, from initial site entry to final sampling, generate waste. The HSRP wide area group is looking for methods to reduce or minimize the amount of waste generated during remediation. They are exploring the handling of CBR agent-contaminated drinking water and wastewater, including the acceptance of wash water by wastewater treatment facilities. They are aware of the stigma associated with bio-contaminated wastewater and are looking at simplified ways to get assurance that the biological agent is inactivated and also what levels of assurance are needed for acceptance at wastewater treatment facilities. They are studying the impact of wash-down activities involving biological agents on wastewater treatment plants, including understanding the fate of biological agents in the treatment system. They are developing best approaches for managing waste and debris from biological incidents and treatment and disposal options for large volumes of contaminated drinking water and wastewater. In addition, they are informing options for staging/storing and selection of treatment or disposal pathways for waste and debris from radiological incidents.

Dr. Ryan explained that one of the challenges they have is getting all of the information they have out to the decision makers. He discussed the decision-making tools and information to support a systems approach to response and remediation. Responding to incidents involves a system approach because activities are intricately tied together. Decision support tools have been developed to aid in providing information for decision making. The decision support methodologies and tools for wide area decontamination include:

- Incident Waste Decision Support Tools (IWASTE)

    - All hazards incident waste estimation and information on disposal and treatment options
- Decontamination Selection Tool (DeconST)
    - Ties together scenario specific sampling, decontamination and waste management options
    - Allows decision makers to see the pros and cons of different options
    - Does not make a decision for them
- Waste Estimation Support Tool (WEST)
    - Developed for wide area radiological incidents
    - Has a lot of applicability to other areas

Dr. Ryan discussed the project on community environmental resilience. He reiterated that everything within a response is intricately tied together in a system. For example, the initial release impacts what can be done, sampling impacts the amount of waste generated, and the mitigation efforts impact the decontamination options. This project is trying to take an integrated look at environmental and social science theory, methods, and data to build a community environmental resilience index. They are going to design a decision support tool that provides scientific information to community stakeholders in a way that incorporates local values and priorities. Environmental resilience is about minimizing environmental risks associated with disasters, quickly returning critical environmental and ecological services to functionality after a disaster, while applying this learning process to reduce vulnerabilities and risks to future incidents.

Discussion with the Three EPA Project Leads

Dr. Tonya Nichols, Dr. Hiba Ernst, Dr. Shawn Ryan, Subcommittee Members, EPA Staff

Dr. Sayles invited the subcommittee to present the three EPA project leads with their questions about the HSRP.

Mr. Edwin Roehl asked the project leads how they see the respective roles of the community or utility versus EPA during incident response. He asked for more information on the implementation model for this technology. Dr. Ryan explained that NHSRC provides research to the decision makers through their EPA contacts, the regional coordinators, OSCs, OEM, and OW. They provide the information to them, and their partners may be involved with the decision makers and the local response. Dr. Ryan added that NHSRC are the behind-the-scenes people.

Dr. Sayles asked Mr. Roehl to clarify his question. Mr. Roehl explained that, as a technologist, he has worked on projects that were not applied. NHSRC has discussed needs that can arise at any time, at any place, and in an unforeseen ways. Given that most of the beneficiaries of this technology are not attuned to handling these types of situations, it seems that there is no alternative to having a sort of "SWAT team" approach with EPA and other agencies that have the training to deal with these situations and implement this technology (i.e., HSRP products). He asked if NHSRC sensitizes the community and first responders, or if EPA just come in and take over.

Mr. Mike Nalipinski, a former OSC who currently works with EPA's Consequence Management Advisory Division (CMAD), responded to Mr. Roehl's question. He reiterated that all responses start at the local level. However, first responders don't always do the best thing in the event of an incident (e.g., chemical plant explosion, biological incident). As these sorts of situations start to escalate, state resources and mutual aid come in. By that time, EPA is starting to monitor the incident and may send an OSC to offer technical assistance, which is usually accepted. OSCs might ask the first responders questions related to monitoring or sampling. If the local authorities say it is beyond their capabilities, EPA will come in and bring their contractors to implement cleanup activities. EPA is ready to reach out with whatever type of technical assistance is needed. OSCs and environmental response teams are involved immediately after a CBR incidence occurs because they have the technical expertise and act as liaisons with the NHSRC researchers. He noted the example provided by Dr. Ryan about using materials for

cleanup that are "off the shelf." He once told Dr. Ryan about the importance of cleanup materials being readily available (at a local hardware store, for example). He described the example of the use of disinfecting wipes and that there are a lot of wipes available that are effective for biologicals. He mentioned that this issue is linked to waste generation. For example, during the decontamination for Ebola, they had places available to take solid waste but not liquid waste. So in their personal decontamination program, they looked at places to take the wipes rather than generating water. Responders reached out to NHSRC researchers to determine the most effective commercially available product. Mr. Nalipinski concluded that the scale of the response starts out local and then goes federal. When the response requires highly technical expertise, EPA assists other federal agencies and local responders.

Mr. Roehl provided a point of clarification. Thus far, the examples discussed were about contaminated areas. With respect to a water or wastewater utility, he is not sure that the capability is there in most utilities to implement the technologies that are being developed by NHSRC. Dr. Sayles asked if Ms. Debbie Newberry, a member of the Water Security Division (WSD) in EPA's OW, to provide insight. Ms. Newberry's work is focused on bridging the gap between the researchers and the utilities.

Ms. Newberry stated that, as people have been saying, EPA does not come in and take over in the event of a HS type incident. It is a local response first (i.e., from local and state governments). In most instances local responders do not come to the federal government for help. In the water sector, for the first several days of an incident, the utilities use mutual response (i.e., utilities helping utilities). The WSD have helped set up this process. She stressed the importance of reaching out to that audience with the research done at EPA. They need to get the information out there. Utilities need to want this information and ask for it. Water utilities do not necessarily have highly technical staff. Therefore, the research needs to be provided in a way that can be more easily understood and applied. The WSD has been working with NHSRC on how to best do that. They listen very closely to the needs of the utilities and try to fit in work that ORD is doing for them. One of the big challenges over the coming years is getting these great products to the right people and make sure they are working. Mr. Roehl thanked Ms. Newberry for the clarification.

Dr. Sayles pointed out that there are two subcommittee members who are affiliated with utilities and may want to respond to Mr. Roehl's question. Mr. Hackney (United Water) commented that there are only a small number of players in the water space who have the capabilities, such as laboratories and skilled engineers, to adopt these kind of comprehensive and complicated tools and methodologies. There are a large number of smaller water companies that can barely handle day-to-day operations, and when something bad happens, they literally don't have the ability to adopt these tools and methodologies. In regards to mutual aid, he stated that there have been a number of incidents in his area when his large company has helped out neighboring companies and likewise. He emphasized that the small companies need someone to come in and help them adopt these technologies.

Ms. Newberry emphasized the importance of understanding mutual aid. Larger utilities are going to be there before EPA is. In most instances, it will be 48 hours until EPA gets their feet on the ground. Making sure that larger utility companies have the necessary capabilities is critical.

Dr. Monica Schoch-Spana switched the topic to risk communication. She commented that the types of assistance NHSRC can give to folks is impressive and in the interest of protecting public health and safety. She asked if each of the project leads could talk about the extent their programs handle risk/crisis communication. She emphasized that they need the population to engage in protecting themselves. During a wide area contamination, there are people who would like to reoccupy the area. She asked how will they get the public's confidence in the scientific tools that are being used on their behalf. For example, consumers of water will want to know if the sampling was good enough and if they can trust the science behind it. She asked for more information on how risk communication enters NHSRC's portfolios.

Dr. Ernst replied that risk communication was a significant portion of their portfolio a couple of years ago. She reiterated that NHSRC is not the response community and is not responsible for crafting the messages to the public. However, NHSRC has tried to help water utilities and the community craft messages that are useful to them. NHSRC's goal is to provide tools so that messages can be ready for dissemination as needed. The process is that, in the event of an emergency, the utilities or local responders will pull from those messages and work with their public affairs people to deliver them. NHSRC's water group did do a lot of research in this area and created a couple of documents and developed a tool on this topic (available online under the "Containment and Mitigation" tab at http://www2.epa.gov/homeland-security-research/water-system-security-and-resilience-homeland-security-research). They interviewed water utility professionals and the public and crafted messages to suit these two kind of needs. However, it is not NHSRC's responsibility to communicate directly with the public. NHSRC has had a couple of projects in the past where they worked with communities in regards to a hypothetical contamination of their water reservoirs (e.g., with *B. anthracis*), and helped determine what the community would do and what cleanup measures would be taken. She mentioned that due to the budget, they do not currently have any projects planned for this topic.

Dr. Sayles commented that the reason there is a charge question on how they can better infuse social science into their research products is because it has been hard to squeeze funds out for this. Therefore, they are asking the subcommittee for advice on where there might be strategic opportunities to integrate social science. Dr. Ryan added that part of this is how to disseminate information. He stressed that quality assurance is critical. NHSRC must have confidence in their results so they can assist with crafting messages to the public. It is important to have data that support those messages.

Dr. Hulla switched the topic to handling uncertainty. She stated that upstream from the process of communicating risk is the risk assessment (using the "Red Book"[1]). The risk assessment includes characterization, toxicity assessment, and exposure assessment. She pointed out that at each of those steps there is uncertainty. She asked the project leads how they deal the uncertainty. Dr. Nichols thanked Dr. Hulla for her thoughtful question. She said there is a huge amount of uncertainty with most of the agents they work on. It is not clear if NHSRC researchers have a good handle on how to calculate the uncertainty, but there is a responsibility to translate uncertainty to the public. It is important to be transparent about what is known and unknown and provide a best estimate. In some cases, this estimate is qualitative because an uncertainty analysis is not possible. In regards to data usability, there are many uncertainties. For example, while *B. anthracis* has been the topic of research for a long time, the detection limit is unclear. This represents a huge uncertainty. Dr. Nichols concluded that she does not have a good answer for how to calculate or estimate uncertainty, but she does think NHSRC has a responsibility to identify uncertainties and variabilities in samples and populations.

Dr. Hulla asked if part of the research strategy includes increasing precision of sampling and exposure. Dr. Nichols replied that it is for sampling numbers and strategies, but it can be difficult to determine where precision is in the sampling analysis and strategy. There are a lot of questions to be considered (i.e., Can you take less samples? What is the uncertainty of composite sampling? Can we just take one wipe sample in a room and know if it is contaminated or do we need to take more samples?, etc.).

Dr. Nichols revisited Dr. Hulla's question about PCR analysis. NHSRC is working on two sides. On one side, they are trying to minimize the burden on the sample processing of the sponge stick samples that the first responders seem to prefer. To reduce time, they may not have to use culture enrichment prior to PCR. They could use PCR in certain phases of the response. However, if the purpose of sampling is to determine if the biological agent is alive, then a culture or some variation of a culture, like an enrichment assay with rapid viability PCR, is needed. Dr. Nichols reiterated that is not the standard method for CDC, and they have to work within the confines of standard methodology. The use of PCR as a screening tool

[1] National Research Council. *Risk Assessment in the Federal Government: Managing the Process*. Washington, DC: The National Academies Press, 1983.

may be appropriate and would allow for more samples to be processed. More samples can help provide a more accurate picture of the extent of contamination.

Mr. Nalipinski commented that he wanted to provide additional examples of how the program deals with uncertainty and risk communication with the local authorities during a contamination event, specifically, how this works in the field and the program's process for reaching out to the research folks. Often, his group will arrange technical working groups and *ad hoc* working groups that facilitate the decisions made by the local authorities on whether something is clean or not. For public health decisions, it is typically CDC that provides advice. Mr. Nalipinksi shared that his group has pulled together a technical working group on the uncertainties of characterization and its impact on public health decisions. Another group is working on decontamination technology selection and its relation to the efficacy of decontamination and characterization of uncertainty. He explained that a lot of education is provided through technical working groups at the state and federal level that advise local health officials on where the uncertainties are, how effective the cleanup will be, and the level of residual risk. This is how public outreach has been implemented in the field during responses and how they loop in the technical experts. The experts have a lot credibility with local public health officials.

Dr. Olsiewski added that politicians (e.g., a mayor or governor) have a very important role in communicating with the public because they are the leaders, but they do not always listen to what the scientists are saying. That is why it is important to get the information out before there is a problem. Mr. Nalipinski commented that it is important to open the dialogue early during a response and have one public face so that trust is built up with the public from the beginning. The beginning of the dialogue is typically the responsibility of the OSC.

Dr. Sayles commented that he appreciated the subcommittee's challenging questions that span from the research to the operational side. He said that he appreciated having members of the response team there to help bridge the gap between the research and the operational side of things.

Dr. Reinhart asked who is doing the research in robotics for sampling. Dr. Nichols responded that NHSRC has conducted sampling with the robotic vacuum, a device that can reduce exposure during sampling. Robotic samplers, like the Roomba vacuum, can characterize an entire room with just one sample. Research is being done at EPA's laboratory in RTP. Dr. Ryan added that DoD is developing robotics for applications such as disassembling a bomb. NHSRC is focused on the use of readily available devices. For example, they are designing experiments to answer questions like how well do the robot vacuums that consumers can buy work and how do they compare to sponge sticks and the more advanced vacuum samplers that CDC recommended be used in 2001. Dr. Nichols added that an analytical method must be developed to match the sampling method. Dr. Ryan concurred. The point he made is that they are trying to stay away from the one-of-a-kind products, but not ignore them completely in case something becomes the universal solution.

Dr. Schoch-Spana commented that she was excited to see the emphasis that the HSRP placed on self-help methods for decontamination. She asked if Dr. Ryan could speak to what process they have for confirming social acceptability and practical feasibility of self-help methods. She asked if they are engaging consumers because that is an important aspect. Dr. Ryan replied that a process for this is not currently available. They are struggling with trying to find self-help methods that have value. Within their small working groups, they have been trying to figure out what to do or not do. For example, a household vacuum in a contamination scenario may not be very effective and it may make the situation worse. Tilex may not completely resolve the situation, but it may help reduce reaerosolization. Dr. Ryan said it is important to focus on those technical issues, but it is also important to help with research related to how to inform the public of this information.

Partner Engagement throughout the Research Lifecycle

Dr. Emily Snyder, Deputy National Program Director of EPA ORD HS Research Program

Dr. Snyder noted that sometimes external threat assessments influence EPA's strategic directions and sometimes external reviews influence both partner and strategic directions, but in different ways.

Dr. Snyder described HS research partner engagement. There are two primary formal processes for collecting needs and engaging partners. These processes line up perfectly with the two main research objectives: indoor/outdoor cleanup and water resilience and security. All partners are engaged in needs prioritization, research implementation, and product formulation/delivery.

Dr. Snyder presented a schematic of Agency indoor/outdoor cleanup partners. These include:

- Office of Air and Radiation
- EPA Regions
    - Regional risk assessors are critical and develop pieces of information that are needed right away for response and communication to the general public.
    - Regional laboratories are also critical and are able to work with some important agents although their facilities are not Biosafety Level 3 (BSL-3).
- Office of Solid Waste and Emergency Response
    - Office of Emergency Management
        - Consequence Management Advisory Division
        - HS interacts the most with this office.
    - Office of Resource Conservation and Recovery
    - Office of Superfund Remediation and Technology Innovation
        - This office provides information to state and local partners on how to manage waste. Waste drives the cost and the timeline.
- Office of Chemical Safety and Pollution Prevention Programs (Office of Pesticide Programs)
    - This office is critically important for response because they register pesticides and other products and thus have data available on registration and exemption.

Dr. Snyder presented a schematic of the Agency water partners. These include:

- Office of Air and Radiation
- EPA Regions
    - Engage frequently with the regions. With the water side of the program, the emergency response component is handled by OSCs. Offices within the regions address other issues like upholding the Clean Water Act (CWA), general resilience of water systems, and engagement with many sub-offices within OW.
- Office of Solid Waste and Emergency Response
    - Office of Emergency Management
        - Consequence Management Advisory Division
    - Office of Resource Conservation and Recovery
    - Office of Superfund Remediation and Technology Innovation
- Office of Chemical Safety and Pollution Prevention Programs (Office of Pesticide Programs)

Water utilities are the main end user and ORD must work through the critical infrastructure protection advisory committee. This committee facilitates interaction between water utilities and government agencies. Within the Office of Water HS works with three of the four sub-offices: the Office of Science and Technology (OST), the Office of Waste Management (OWM), and the Office of Groundwater and Drinking Water (OGWDW).

Dr. Hulla asked for clarification on the difference between WSD and the Drinking Water Protection Division. Dr. Ernst responded that there is some crossover between the two groups. The WSD has the

lead on climate change and was instituted after the Bioterrorism Act. This group looks at activities associated with terrorist incidents, has grown to also address natural disasters, and works closely with the Emergency Operations Center. Ms. Newberry added that the Drinking Water Protection Division is focused on working with traditional drinking water and source water contaminants and its activities are not related to terrorism or natural disasters.

Dr. Snyder described the multi-step need generation process used by HS. Needs are first identified and prioritized. A total of 90 needs were identified in this process and staff subject matter experts (SMEs) in EPA Program offices, ORD, and the Regions are included in discussions to lump these needs together and narrow them down. Dr. Hulla asked if evaluation of cost-benefit is part of this prioritization. Dr. Snyder replied that the impact of filling the needs gap and the effort required to fill that gap is evaluated. The group also considers the consequences of not addressing a specific gap.

The next step involves a strategic review and refinement of the priorities. Managers in ORD, the Program offices, and EPA Regions are involved. This work is then reviewed by Senior Management and a Priorities Memo is drafted for the year. The HSRP uses the priorities in planning and implements research based on these priorities.

Dr. Snyder outlined the partner priorities as a function of the response system. There are highest priorities for chemical, biological, and radiological agents. For biological agents, some of the high and medium high priority needs include:

- Contaminant fate and transport in wastewater systems.
- Washdown including common cleaning equipment.
- Self-help decontamination and risk reduction measures.
- Characterization and Risk Assessment.
    - PCR data during characterization.
    - Composite- based sampling.
    - Waste sampling and analysis.
    - Analysis of biotoxins.
    - Air sampling (including analyzing non-traditional filters).
- Decontamination of outdoor areas and critical infrastructure.
- Improve decontamination capability and capacity (to assist in wide area decontamination).
- Biotoxin decontamination (including sensitive equipment).
- Nonspore forming agents: many of these are from the CDC Select Agent list and are based on what HS's partners are seeing (e.g., smallpox, variola, *Burkholderia*).
    - Naturally occurring agents like blue green algae are currently outside of the scope.

For chemical agents, some of the high and medium high priority needs include:

- Sampling and analysis for air, water, soil, and surfaces – Analytes studied will be informed by the SAM Summit.
- Effective decontamination methods for porous or permeable materials, utility of natural attenuation as a decontamination technology, and lack of data on the fate of chemical agents in the urban environment.
- Treatment and disposal options for large volumes of contaminated drinking water and wastewater.

For radiological agents, some of the high and medium high priority needs include:

- Detection of radionuclides in drinking water.
- Rapid gross decontamination methods.
- Self-help decontamination and risk reduction measures.
- Tool to determine amount of data needed to release area for radiological controls.

- Scalable decontamination technologies (particularly for critical infrastructure).
    - This is a critical area.
- Rapid minimally destructive decontamination technologies for wide area resulting in waste volume reduction.
- Options for storage/staging and selection of treatment/disposal pathways.

Dr. Snyder described the need collection process for water security and resilience. OGWDW WSD discussed the 2014 Priorities in the context of the Critical Infrastructure Partnership Advisory Council (CIPAC) needs. Recently completed and planned research were highlighted. Office of Wastewater Management discussed current and planned research activities as well as general priorities. Staff SMEs and managers in OW and ORD developed the 2015 priorities.

Dr. Snyder outlined the partner priorities as a function of the response system. For water security, some of the high and medium high priority needs in 2015 include the following:

- Assist wastewater utilities in preparing for and responding to incidents.
    - Cybersecurity.
- On-line monitoring.
- Fate and transport of all hazards contaminants in water infrastructure.
- Aerosolization potential of contaminants from water systems at the point of household use.
- Sampling and analytical methods for large volumes of contaminated wastewater.
- Syncing WCIT (Water Contaminant Information Tool) and SAM methods.
- Specific priorities were informed by the SAM Summit.
- Decontamination of infrastructure including premise plumbing.
- Improve wastewater system resilience.

Dr. Snyder described the process for research implementation and what is done with the identified research needs. Partner needs are a capability gap determined and prioritized with partners. These needs feed into outputs, which are directly usable and championed by our partners. The products of these outputs include reports, journal articles, and conference proceedings. For high priority needs/gaps, teams are formed with ORD researchers and partners to scope outputs. These teams develop products that are needed to formulate the output (when applicable).

Dr. Snyder provided an example of a partner need/output/product – Research for Water Quality Surveillance and Response Systems (SRS). The partner need was robust, comprehensive, and fully coordinated surveillance and monitoring systems. The project focused on water quality sensor performance testing, innovative sensors and sensor stations, sensor placement, and data analysis software. The outputs were tools and data to support a systematic framework for enhanced distribution system monitoring activities to detect emerging water quality issues and respond before they become problems. As a part of the project, they identified self-help decontamination methods, key technical information, and recommendations via literature searches, laboratory/pilot scale testing, and SME input.

Dr. Snyder provided a second example of a partner need/output/product – Implementing Research for SRS with Partners. There were a lot of team members involved with this project from both EPA and water utilities. The format for the input was design and implementation meetings, water utility software testing groups, and feedback from the water industry. The products included software tools, reports, and technical briefs. An analysis of nine large U.S. cities showed that SRS's can cut public health impacts of large-scale contamination incidents in half and reduce costs by billions of dollars. Tools designed for water security have multiple benefits in improving operations and resilience, a key element for the water utilities.

Dr. Snyder noted that operational demonstrations of transitioning the research are dependent on funding allowances. Ideally methods and tools developed by the research program are assessed through

operational evaluations and/or demonstrations. These are done jointly with ORD's EPA partners and are frequently done with interagency partners (e.g., DHS). An example of this is the BOTE project.

There are many levels of organization and Dr. Snyder pointed out that one of the key lessons learned is that each part of the organization may require a different communication strategy. It is optimal to utilize existing communication channels to reach our partners. Partners may not have time available to sit through a separate presentation on ORD's research. Different communication strategies are also used for different partners (e.g., monthly as needed, multiple times per year, biannually to annually).

Dr. Snyder emphasized the importance of assessing partner engagement in order to identify methods that are not working so that they can be stopped or modified. Assessment can also identify the need for new engagement efforts and successful efforts that should continue. It is important to listen to partner input and provide transparency on how their input will be used. ORD has started to conduct anonymous surveys which have been a useful tool for obtaining partner feedback. Other approaches include formal meetings, hot washes for the need collection processes, and periodic informal check-ins and survey follow-up.

Dr. Olsiewski pointed out that one of the products is the report, but then these reports have to be distilled down. She asked who is responsible for this activity. Dr. Snyder replied that ORD is responsible for this process and received advice on how to distill down the report. ORD does tool creation but does not do implementation guidance. ORD is responsible for distilling down the science and the EPA Program Offices are responsible for the implementation. This effort seeks to be coordinated in terms of the tools that are developed.

Dr. Reinhart asked how decisions on project prioritization are made (i.e., vote, dollars, criteria). Dr. Snyder responded that ORD has a rigorous process for prioritization and justification must be provided on where we gather cost-benefit information and the benefits/risks of not filling the needs gap. Criteria are in place that are related to those areas and ORD has a webinar where the needs are discussed. The group then votes on the prioritization. An initial prioritization is developed at the strategic assessment meeting. Any changes to the determined prioritization require justification. Voting is conducted both during and after the meeting.

Dr. Schoch-Spana asked how ORD's research program remains flexible to address unplanned needs. Dr. Snyder replied that ORD is required to plan many years out and has plans for work that will start in 2016, but if there is an urgent need then resources can be reshuffled to address those needs. No work is locked down until the fiscal year starts. After the start of the fiscal year, ORD would determine what drops out based on urgency. ORD can be fairly nimble because the program is small and understands the consequences of what must be dropped to address urgent needs.

Dr. Hulla noted that field partners are separate from EPA partners. She asked if the separation is reflected in the selection of prioritized projects. Dr. Snyder replied that ORD received input from the water utilities up front and this input feeds the start of the process. Dr. Hulla asked if products are created by ORD for EPA or utility partners. Dr. Snyder answered that products are developed for both end users. Certain products may be very end-user specific, but it depends on who needs the product.

Dr. Olsiewski asked for clarification on who are the EPA partners. Dr. Snyder responded that clients/customers within EPA are partners. ORD collaborators outside of EPA are stakeholders. However, the water utilities outside of EPA are considered partners. Dr. Sayles added that ORD designs their products to be used by partners, which include EPA staff outside of ORD. The previously used terminology was "direct customer." The purpose of ORD's partnership with other EPA offices is to get end products into the field.

In response to this discussion Dr. Snyder and Dr. Sayles offered to develop a document with the definition of terms for the BOSC subcommittee (see Appendix C). This document was distributed to the group the morning of Wednesday, August 26th.

Classified Briefing on Homeland Security Threats (Closed)

Most of the BOSC HS subcommittee members attended a closed classified briefing on current HS threats.

Research Overview Posters and Engagement with Researchers (Session 1)

All

The BOSC HS subcommittee members viewed the following HSRP research posters:

1. Community Resilience to Environmental Disasters
2. Detection and Mitigation Methods and Strategies
3. Evaluate Potential Exposure to Contaminants and By-Products
4. Development of Sample Collection and Analytical Methods: Biologicals
5. Development of Sample Collection and Analytical Methods: Chemicals and Biotoxins
6. Development of Sample Collection and Analytical Methods: Radiological Contaminants
7. Research to Real World: Transferring Information to the End User

Group Question and Answer on Posters

All

Dr. Nichols noted that ORD works with the ELRN. The bottleneck in this process is that a lot of the laboratory methods are not validated and laboratories must be competent in the sample processing methods.

Mr. Nalipinski noted that all response decisions are local and the decision maker is the organization that makes the final call on characterization of contamination. It is difficult to prove the negative, so a more robust decontamination technology is often selected. For some agents, validated methods are not available and the use of guardian reagents is necessary. Samples can't be obtained from CDC and public health officials need to be educated on these issues. This is all folded together in a response.

Mr. Hackney asked if the selected methods are based on a lot of other parameters. Mr. Nalipinski responded that the response is based on the sample processing capacity and turn-around time. ORD is generating innovative sampling approaches that use less samples. Sometimes officials support the use of composite sampling and sometimes they don't. Clarity can be lost in efficiency.

Dr. Ernst noted that ORD has tried to incorporate more facilities into the water laboratory alliance in order to increase capacity. Dr. Nichols added that ORD is also streamlining method and sampling processing. The sample processing is the bottleneck and not a lot of research dollars are dedicated to improving sample processing.

Dr. Hulla noted that focus has been placed on cleanup, but a lot of this work might have application in establishing nature and extent science. For example, portable machines are available for gas chromatography methods. She asked if more portable sampling methods could be developed in order to decrease the waste stream and increase the resilience. Mr. Nalipinski responded that there are facilities that use gas chromatography–mass spectrometry (GC-MS) for chemical weapon analysis and traditional compound analysis. These facilities can deploy to the field, but portable units are not available and have a smaller throughput.

Dr. Hulla asked if existing methods can be used on portable GC-MS devices. Dr. Snyder replied that the performance requirements for clearance were not met with portable GC-MS units in the past. The Department of Defense was trying to improve the capability of these units in the past. Often during characterization, the purpose is to determine that decontamination is not needed in a specific area. Mr. Nalipinski added that screening strategies feed into clearance, decontamination, and the cleanup strategy. We are looking at the nature and extent of contamination.

Dr. Schoch-Spana noted that one of the charges is to integrate a social science perspective into the HSRP. It sounds like ORD works hard to engage with partners and learn about their priorities. She asked to what extent ORD's partners value social science. Dr. Sayles responded that it varies with each partner. In general the Agency consists of physical scientists doing environmental work. Thus, social science is not infused into ORD's every day work. This is why HSRP has sought input in this area. Mr. Nalipinski noted that the OSCs do try to think about social science in their response. Mr. Nalipinski shared that his first introduction to situational awareness was during the response to Hurricane Irene. Staff from the Vermont Department of Transportation were receiving Twitter and Instagram messages about road closures and alerts. He was essentially mining social media to help confirm his operational perspective so that the proper tactics were deployed. Social media could be used to confirm perspectives so OSCs can plan sampling locations. Social media has utility from an operational perspective, but its use has not gained a lot of traction.

Dr. Maxwell, an anthropologist at ORD, shared that she has looked across EPA and other Agencies to see how social science has been integrated into operations and culture. Something that stood out was differences in what is meant by "social science." There are distinct branches. EPA does not always have an understanding of what social science questions should be asked, but the Agency does understand the importance of incorporating community values. A different language is used than that of social scientists. EPA may not fully understand the value added by incorporating social science, but they do have some sense of it. This is linked to the organizational culture at EPA, which does not typically engage in social science.

Dr. Hulla asked if there is an equivalent of an SAB in the area of social science. Dr. Lemieux shared that a national level exercise was completed in Philadelphia. The objective of the exercise was to examine intermediate and final phases of response and as part of the exercise a community advisory board was established. Members of the community advisory board included physicians, clergy, and other local entities. Those local participants were very engaged in the exercise and offered additional options that EPA had not thought of. A community advisory board could be a way to engage locals in the response process and this was a successful element of this exercise. Dr. Nichols added that inside EPA there are community involvement coordinators. Community involvement coordinators help with issues unrelated to disasters and are more attuned to the social needs of their community.

Dr. Lee provided an overview of his work with the Japanese government related to cleanup following the Fukushima disaster. Dr. Lee was asked by the Japanese government how to communicate better with their customers, which include workers, farmers, and the local government. Dr. Lee collected information on the Superfund community advisory boards for the Japanese government. EPA gives grants to community advisories. The Japanese government also asked about psychological compensation. The United States does not offer psychological compensation. Dr. Lee stated that he learned that a collection of tools is needed so that when the responders communicate with the customers at the end state of the cleanup, different tools are available to fit the customers' different needs. There may be different solutions to address the customer's concern and we need to learn to have multiple tools available that are characterized to better meet the customer's needs.

Wrap Up and Adjourn

Mr. Tracy dismissed the group for the day.

Wednesday, August 26, 2015

Research Overview Posters and Engagement with Researchers (Session 2)

All

The BOSC HS subcommittee members viewed the following HSRP research posters:

1. Innovative Design and Operation of Water Systems for Resiliency

2. Fate and Transport of Contaminants and By-products in Drinking Water and Wastewater Systems
3. Fate and Transport of Contaminants and By-products in Indoor and Outdoor Environments
4. Development, Identification and Efficacy of Decontamination Methods
5. Engineering Application Considerations for Decontamination Methods
6. Treatment, Disposal, Minimization and Handling of Contaminated Water and Waste
7. Decision-Making Tools and Information to Support a Systems Approach to Response and Remediation
8. Systems Analysis and Demonstration of Remediation Approaches

Group Question and Answer on Posters

All

Dr. Tammy Taylor, vice-chair of the BOSC HS subcommittee, opened up the floor for questions following the poster session.

Dr. Hulla asked how uncertainty is considered in decision tools related to fate and transport modeling. She asked if uncertainty is being quantified and if uncertainty can be quantified to the point that you can distinguish between different options. Dr. Paul Lemieux, who works on tools for wide area contamination incidents for the HSRP, responded by saying that the tools being developed are based in Microsoft Excel so that add-ins like Crystal Ball can be used to look at a Monte Carlo analysis with uncertainty parameters. This is probably the most straightforward way that NHSRC can deal with uncertainties without having to incorporate complex analysis directly in the tools. This is a cost effective approach. He is unsure of the approaches used for addressing uncertainty within the water tools. In the waste tools, their target is to provide an order of magnitude estimate. Thus, uncertainty in the estimates is acknowledged upfront. Decision makers want to know a general order or magnitude for waste and not a specific number. This rough value can be used for planning purposes. Eventually, if they are using the tool for a real incident, you get to a point when the tool is not as useful because there is real data to inform decisions.

Dr. Hulla noted that it appears that the best approach is to be able to use the real data and plug it into the risk estimates as you get them to decrease the uncertainty. She asked Dr. Lemieux if he is using quantitative uncertainty to evaluate the value of these methods. He responded that they are not to that point yet. Dr. Hulla asked if they are to a point where they are able to use uncertainty in the decision making process to be able to distinguish one option for response versus another. Dr. Lemieux replied that, right now, the parameters that you can plug in will give you that ability to look in a gross manner at high level. He offered to show Dr. Hulla some of these approaches during his demonstration of the WEST tool during the Tools Café. The WEST tool allows for the application of different decontamination strategies to different types of buildings or surfaces in the building to evaluate the impact these different approaches will have on waste volume. Dr. Hulla asked if the WEST tool can quantify uncertainty. Dr. Lemieux replied that this can be achieved using the Monte Carlo plug-in, which is not coupled with the current version of the model.

Dr. Regan Murray, who works on water modeling tools for NHSRC, was introduced to the group. They are not using spreadsheet-based models, but rather physics-based models for water flow and water quality. There is a lot of uncertainty for the water systems. She stated that they are trying to understand all the sources of uncertainty. In regards to detection, because they are using indirect sensors, they do not even know what the contaminant might be or where it entered into the system. They are trying to understand the sources of uncertainty and quantify those uncertainties. When they pull all of the tools together into the decision making tools, their goal is to have some information about the uncertainty to provide to the users. Dr. Hulla responded that if you have measurements without the range of uncertainty, you cannot distinguish one option from another. Based on that, she questioned how to evaluate the value of their products.

Dr. Sang Don Lee, who works on remediation for the HSRP, commented that for wide area incidents, few measurements are available. They are currently trying to use Japan's data for radiological contamination and incorporate it into the PALs (Provisional Advisory Levels) model. This may be the best way to come close to the real values. They are not trying to neglect or ignore uncertainties, but are looking for more real-world data to rely on. Dr. Murray added a similar point for the water tools. She stated that as more data comes in from sensors and the SCADA system, this data can reduce the uncertainty. The Real Time Modeling Tool (EPANET-RTX) is directly focused on reducing uncertainty. Dr. Hulla clarified that she is just looking to be able to measure the uncertainty, not necessarily to reduce it. She stated that they are making decision tools, and in order to distinguish one option from another, you need to know the uncertainty in those options. She stated that she hasn't seen this yet within the tools. However, she noted that Dr. Lemieux has done a good job of addressing this issue and it appears that they are on the cusp of integrating uncertainty analysis into the tool itself.

Dr. Terra Haxton, who works on the Water Security Toolkit software for NHSRC, commented that this is one aspect they are trying to move toward with water distribution systems. They are doing lots of different runs to determine the uncertainty, different parameters, and Monte Carlo analysis. For example, they are trying to determine how uncertain is the actual plume extent in the water system and how uncertain are they in where they should actually take samples and where should they flush.

Dr. Ernst added that the reason why Dr. Hulla is not seeing the uncertainty analyses is that they are presenting a very high level of the research. In some of the consequence planning and management modeling that Mr. Rob Janke works on, there is some estimation of the uncertainty with the consequences. She offered to provide Dr. Hulla with additional information. Dr. Hulla thanked Dr. Ernst for her response and was satisfied with the current level of detail.

Dr. Lemieux commented that another big problem with uncertainty is that they have almost no data with which to ground truth any of these models, with the exception of the Fukushima incident. For example, with the WEST model, they are starting the model assuming that they will get plume shape files from the National Laboratory or somebody. Dr. Hulla pointed out that part of their research efforts can be establishing uncertainty. Dr. Lemieux pointed out that there are things that have much more uncertainty that any of their predictions have. For example, plume models may be useful, but are wrong from the start. Looking at uncertainty is a very challenging thing and they have to be sure they do not overpromise on what they deliver. Dr. Hulla stated that attaching uncertainty to their products would increase the level of confidence of end users in these products. Mr. Roehl stated that it might actually have the opposite effect when they see the uncertainty. He added that he would characterize these tools that they are developing as "open-ended" (not validated by actual field use) and "can be characterized as their best educated guess." The physics based models have difficulty with precision. Dr. Hulla agreed. Mr. Roehl continued by saying that his impression is that a lot of their research is just beginning. Therefore, the uncertainty levels are going to be high. They want to get a product out that is their best educated guess sooner rather than later. Dr. Hulla and Mr. Roehl agreed that this information needs to be communicated. Mr. Roehl stated that users might consider information as gospel, and we as researchers know the things that are wrong with it. The public has a need for these kinds of tools and we have to do the best we can. In time, as the body of knowledge in these research areas improves, the uncertainty piece will become much more realizable.

Dr. Sayles remarked that one reason they involve customers throughout the process is so that they understand the state of the science and how precise the models are. Their customers are actually part of the development. He added that they work with their customers during the transition and it seems that these customers have a firm understanding of the utility and uncertainty of the tools. Mr. Roehl commented that might be true for internal EPA customers, but that customers from outside of EPA might have a different understanding. Dr. Sayles agreed and responded by saying they have a role in translating their tools for them and helping them understand what they mean.

Dr. Reinhart changed the topic and noted that one of the points made by Dr. Sayles during the previous day's discussion is that NHSRC wants to be flexible and responsive. She asked for insight on how nimble NHSRC can truly be with new disasters. Dr. Sayles pointed out that one of the things Dr. Snyder presented is how learning from experiences factors in to NHSRC's priorities and their customer's priorities. Dr. Snyder explained that their partners will communicate when they have a very urgent need and let NHSRC know that they need them to do whatever they can to address that need. She explained that if they are in the current year, they have the ability to shift resources. If entering the new fiscal year, the plan can be adjusted accordingly. NHSRC communicates to their partners what they will have to drop to take on a new priority and that becomes part of the decision. Dr. Reinhart asked if, instead of dropping other work, a partner could contribute money to take on the new priority. For example, could they pay a contractor to work on the urgent priority, or could they pick up a student. Mr. Leroy Mickelsen, member of EPA's National Decontamination Team, provided an example of this scenario. They had a joint demonstration project looking at decontaminating a rail car with methyl bromide. During the project, new questions about off-gassing arose. The aeration process showed different results for how much methyl bromide was coming out during the aeration cycle. His response team asked researchers if they could do a project together looking at some of the materials and off-gassing after fumigation. They formed a team including a point person from the response side and a point person from the research side. They are in the process right now of setting objectives for the research and trying to figure out where the funds will come from, either from research funds or response funds. The research side were quick to respond putting someone on the team right away. Prioritizing how important this is will be a part of the process.

Dr. Ryan added to Mr. Mickelsen's example. He stated that most of their efforts have flexibility and there is flexibility within projects to address changing priorities. Hiring a contractor, as Dr. Reinhart mentioned, may also be an option.

Dr. Keely Maxwell, a general anthropologist with NHSRC, added that there are other pots of funding that can be used to respond to emerging issues (e.g., Innovation Funding within NHSRC, Rare Funding within ORD (to be used when ORD partners with the regions who have particular scientific questions they want answered), and Innovation Pathways Funding in ORD (high-risk, high-reward funding)).

Dr. Hulla asked Dr. Snyder if she stated that the timeframe for flexibility, because of funding, is a fiscal year. Dr. Snyder replied that doing what Dr. Ryan was describing can occur at any time. Dr. Hulla asked what is built into their approach to accommodate the flexibility. For example, she pointed out people have died from *Legionella* too. Thus, it would be appropriate to flex funding to *Legionella*. She asked what is built in to be able to do this kind of flexing and is there a reserve fund. What can be done within their tools and funding? Dr. Snyder responded that they had a reserve fund in the past set aside for emerging issues, but that is not currently available because their resources have declined. Therefore, existing efforts must be modified, or if entering a new fiscal year, they can set their priorities. Dr. Hulla asked if EPA as an entire Agency has the money available for them. Dr. Snyder replied no.

Dr. Hulla asked what flexibility is built into EPA's tools to address emerging issues. Dr. Ernst added insight on the *Legionella* scenario. NHSRC wouldn't just jump into doing research alongside of something else they are doing. She explained how they shift their research to align with the needs of their main customers. For example, if OW or the Office of Air along with OSWER needs something, then NHSRC will stop and juggle the work. Dr. Hulla asked if that can be done in a timeframe shorter than a fiscal year. Dr. Snyder responded that it can.

Dr. Sayles pointed out that they were discussing two different time scales. He explained that maybe a new emphasis on *Legionella* doesn't have to start tomorrow, but it is a new area they want to work on. Every single year they plan the next year's work. The StRAP is for the next three years, but that really outlines the general trajectory that they are on. Every single year they plan.

Dr. Hulla asked if the flexibility can be built into their tools. Dr. Lemieux responded that there is a certain amount of flexibility possible within the tools that they try to build as they go along. He explained that

when they designed the DeconST tool, it was originally built for one building with an anthrax contamination. The data in that tool came from existing decontamination technologies. However, they inherently built into the tool the ability to add additional decontamination technologies. That is one of the reasons why they used Excel so the user could add that in themselves. He summarized that there is a certain amount of flexibility within the tools for the user to add additional features within the existing framework. He continued that, as far as modifying the behavior of the tools on a grand scale, there is not a lot of flexibility in that because the tools are part of a software development package. Dr. Hulla asked if they could do it a modular design. Dr. Lemieux responded that they will try to design the tool from the beginning in that way. But he pointed out that the problem when you are developing software, is that "creeping featuritis" will kill your budget. He stated that you have to be very judicious about how you add features. So they try to build flexibility within the tool itself to add things they haven't anticipated. He stated that they are trying to use their budget effectively in developing the tool.

Ms. Kathy Nickel, a program analyst with NHSRC, commented that most of the tools are not contaminant-specific. She asked Dr. Hulla if that is what she was asking, are they able to handle more than one contaminant. Dr. Hulla replied yes. She asked if they are using PCR as a tool, do they have the primers that they need for these other contaminants. She asked if they can flex in that context.

Dr. Matthew Magnuson, a research chemist with NHSRC, responded by adding to the *Legionella* example. During their water tank sediment research, they were finding some *Legionella* in the sediments they were studying. He stated that nobody really knows exactly what that means. Their OW partners were also on that work group and immediately expressed interest in *Legionella* contaminants in the water system. He explained that Dr. Nichols has funded an effort this year to develop analytical tools to look at a broader range of sediments to understand how much of a problem this actually is. He explained that future work will be determined depending on those results.

Dr. Haxton added that their water distribution modeling tools are not contaminant-specific. These tools are not tied to a specific contaminant and can be used for any contaminant as long as specific data are available to back up the model. Dr. Ernst commented on the EPANET-RTX tool. There is a component that looks at contaminant backtracking as well as the consequence if you have a certain area affected. She explained that the information entered into the calculation includes: the identity of the contaminant, lethal dose (LD) 50, kind of spread, and physical chemical properties (e.g., solubility, volatility, etc.). These factors will affect the consequences in the model. The model is used to provide the number of people exposed for a given contaminant.

Ms. Nickel suggested discussing EPANET-MSX, which can model the interactions of multiple species. Dr. Murray shared that EPANET-MSX, developed in 2007, is a tool that looks at the interaction of multiple species. She explained that before this tool, EPANET could only look at one constituent in the water. Dr. Hulla asked if she was referring to chemical species or microbial species. Dr. Murray stated that both microbes and chemicals could be considered. It is a very general tool that can model any type of interaction between multiple species, but information about each species and the nature of their interaction must be entered. The tool solves differential equations on top of the hydraulics models. Dr. Hulla asked if they can update this model as they get more data. Dr. Murray confirmed that this was feasible. She stated that they use it as underlying tool for other water models. Dr. Hulla asked if the tool calculates an uncertainty factor. Dr. Murray stated that it could not. One of the biggest challenges with using the tool is gathering the necessary data because data on how the contaminants interact with all of the complexities of the water distribution system is not available. Dr. Hulla stated that the tool can guide you on how much data you need to make a good decision. Dr. Murray agreed. Mr. Roehl commented that the accuracy of the tool will vary according to the system complexity. He acknowledged that it is hard to come up with generalization of the uncertainty about a generic or semi-generic tool (for example EPANET).

Dr. Taylor changed the topic to validation testing. She asked Dr. Nichols if she could help the subcommittee understand the validation step for pathways, procedure or techniques. She also asked what advice or recommendations the subcommittee can provide that could help them smooth that path into the future. Dr. Nichols responded that ORD has traditionally developed the methods. They do the research and the program offices are the implementers of the methods they develop. She explained it is also the program offices responsibility to validate those methods. Dr. Nichols stated that it has been a straightforward process for regulatory methods. She explained that there are different approaches for validation. There are standards organizations (e.g., American Society for Testing and Materials [ASTM], National Environmental Laboratory Accreditation Conference [NELAC]) and in-house validation processes. She pointed out that, in regards to emergency methods, these are not traditional agents. Because of that, they have been very dependent on the Laboratory Response Network (LRN) because they have validated methods. She pointed out that there is not a validated method for vacuums, but there is for sponge sticks, wipes, and swabs. She explained that when they recognize that a method needs to be refined or be developed, they get to a stop gap because ORD is not the primary agency that validates methods. She posed the question is method development their responsibility or someone else's. Until a method is validated, it is hard for OSCs to implement it. When you are talking about rapid viability PCR, the analytical community may agree with it, but it is not a validated procedure. So the question is can it be implemented.

Dr. Ryan pointed out that another complexity around method validation is interagency acceptedness. Dr. Ernst added that, historically, OW did the validation because there was a need to set standards and have the appropriate quality assessment (QA). HSRP has extended into doing methods. The SAM includes methods beyond those considered "regulatory methods." Dr. Hulla asked if NHSRC has reached out to the National Institute of Standards and Technology (NIST). Dr. Nichols replied that they have, but not on a formal basis. She explained that NHSRC was very close to receiving help from CDC on validating the rapid viability PCR method, but then their contact at CDC retired. A standard process for engaging other partners on method validation is not in place. A more formal process for collaboration is needed. ORD benefits from their methods being developed and used, but usability is dependent on the confidence in the methods. Dr. Hulla asked if NIST is one of their partners. Dr. Nichols replied that they have worked with NIST on workgroups, but they are not formal partners. She noted that NIST validated the bulk white powder procedure.

Dr. Hulla asked if DHS has a procedure for method validation. Dr. Nichols said they have tried to go through DHS but have not had success. Dr. Taylor added that they contracted a lot of their certifications to ASTM. Dr. Hulla asked Dr. Nichols if they have an ongoing effort to get the validations, for ricin for example. Dr. Nichols explained that, for biologicals, it is a "dance" between CDC method validation and trying to get HSRP methods validated. She went on to say that the validation of ultra-dilute chemical warfare agent methods serves as a good example. At the time, they were able to use volunteer laboratories inside and outside the agency. They were able to get methods for chemical warfare agents validated, but there is now an issue with volunteer laboratories doing the validation (because that is considered giving services to the government). This approach actually provided a benefit to volunteer laboratories because they are trying to get contracts. However, there was a legal problem with it. Dr. Nichols concluded that the validation issue is challenging.

Dr. Taylor asked if a recommendation could be made to ORD at the management level to assist with this process. Mr. Brendan Doyle noted that validation could be an interagency process. He shared that there is a Subcommittee on Standards, which includes co-chairs from EPA, DHS, and NIST. The subcommittee has struggled on writing a national strategy for standards. He emphasized that there is an opportunity to leverage some of the interagency committees, and that NHSRC cannot do it alone. Phil Mattson is the co-chair from DHS on the Subcommittee on Standards. The co-chair from NIST is Lisa Karam.

Mr. Doyle changed the topic to community resiliency. This is an example of an area where they are without a formal validation process. Through convening a government-wide set of workshops that

included other players throughout EPA (not necessarily partners), FEMA, and outside the standards and testing community, they were able to take the draft indicators for community resiliency that they developed and work through a pathway for development into scientifically validated indicators. He stated that they have seen some collegial traction and validation for some of the work being done here. This is both an informal and formal. Dr. Taylor commented that this work is driven by grass roots passion.

Dr. Magnuson asked the subcommittee to what degree they view the consensus or community acceptance of various models and approaches as acceptable levels of validation of those models and approaches. Dr. Taylor responded that she personally finds them incredibly valuable, but at the end of the day it does not matter how valuable they are if they are not defensible. She pointed out that you have to define what it is you are trying to be defensible against. Dr. Hulla stated that the National Academy of Sciences published a reference manual on scientific evidence put together in coordination with the Federal Judicial Center, the research and education agency of the federal judicial system. One of the statements in that document is that it is not transitioned until it's accepted by the courts. Dr. Taylor encouraged Dr. Magnuson to build up the defensibility of their research to the highest level possible.

Mr. DeGraca voiced his concern that we live in the real world, and we need guidance to respond to the emergencies. We need to have something in place even if it's not perfect, and then work up to whatever the standard needs to be. Having benchmark levels of validity (e.g., levels A, B, and C) would be good for the subcommittee to understand as well as NHSRC's end users. Dr. Ernst stated that the challenge for NHSRC is always determining how perfect something is and when to let go of it. Another challenge has been balancing this determination versus using a different approach and determining when a tool is adequate for use. Mr. Roehl commented that the determination of adequacy will also be customer driven.

Dr. Maxwell stated that in social science validation or standards are not necessarily discussed. One rising issue in social sciences is the use of qualitative versus quantitative research. This has been a topic of her research. For example, what are the National Science Foundation (NSF's) ideas for quality assurance and how can qualitative and quantitative methodologies be best used for scientific validation. Dr. Taylor stated that they will look into incorporating the importance of qualitative methodologies. Dr. Hulla asked if the weight-of-evidence approach has been considered. Dr. Maxwell responded that it has not.

Dr. Taylor and Dr. Olsiewski thanked NHSRC staff for their time and supporting information.

Video Presentation of the Bio Operational Testing and Evaluation Project

Dr. Shawn Ryan

Dr. Ryan introduced the video. The BOTE project was an enormous inter-governmental effort started by EPA and DHS but also included FBI, DoD, Department of Energy (DOE), and CDC. There was an international presence (personnel from the United Kingdom were there) at the exercise. This project provided an opportunity to test methods in the field. Up to that point, they had general ideas of how things were going in field, but mostly had a lot of laboratory work. Dr. Ryan emphasized that one of real challenges for the group is to take all of the research and determine the pros and cons of each decontamination method in order to make recommendations. The project brought over 300 people together, including OSCs from around the country. There were people doing sampling, implementing decontamination, assessing waste being generated, and determining whether spores were staying inside the facility or getting out. There were a lot of different parts of the project. It involved bringing research from the laboratory into the field. Dr. Ryan concluded that an important piece of the project was to figure out how they take the information learned from this project and use it in the field. The video documents the whole process from inception in the laboratory to the field.

The BOSC HS subcommittee members viewed the video. After the video, Dr. Sayles commented that a lot of people worked on the BOTE project and they are very proud of it. They wanted to show it to the subcommittee because it demonstrates that the translation of science to the folks who need to use it should be done hand-in-hand. He emphasized that they did not do it on their own. The operational folks did the

project with them. He pointed out that is the goal, to hand over the work to the operational side by doing the work together. It was a joint effort to transition the work to the users.

Dr. Nickel asked what method for decontamination ended up working the best in the project. Dr. Ryan replied that the answer to this question is complex. He stated that chlorine dioxide did very well. He noted that there was a logistical challenge of getting into the bathroom area of the building for decontamination. The decontamination team had the option to do whatever they needed to do to the building. The vaporized hydrogen peroxide (VHP) group decided to keep everything in the rooms. Because of that, they had trouble reaching an effective concentration. He noted that if they had changed their procedure, the cost would have increased but the decontamination may have been more effective.

Mr. Nalipinski commented that these tests were done in the spring. In the fall, they used the data gathered in the spring, and the whole process was tested again. They are doing tests with underground transportation. They fumigated a rail car a few weeks ago with methyl bromide. Next year, they plan to do a subway tunnel.

Dr. Lemieux commented that when they were in the building, they were tracking the amount of materials and labor, and they tried to quantitatively assess the uncertainty between different decontamination teams. They were also helping responders estimate the cost of decontamination.

Dr. Olsiewski asked if the building's HVAC system was totally off. Dr. Ryan replied that the heat and humidity was turned off. The two floors of the building had different levels of contamination. Dr. Olsiewski asked if the building was considered offline. Dr. Ryan replied that it was somewhat offline. Heaters had to be brought in to get the right temperature when necessary. Dr. Olsiewski asked about the humidity and water activity in the walls. Mr. Mickelsen discussed the effect of humidity in the air on samples.

Dr. Schoch-Spana stated that the project was interesting because they were trying to recreate real-world conditions. Political pressure affects the decision on which decontamination method is used. She asked Dr. Ryan if there is value in another module of research, perhaps some type of rehearsal of risk communication messages tied to each of these approaches. This would include getting feedback on comprehensibility and responsiveness to community values. She pointed out that they are giving the decision makers the hard science about efficacy and cost, but also providing the communicability of some of these options would respond to some of the pressure that is present in real world conditions. She feels that everyone could benefit from those types of risk communication explorations as well. Dr. Ryan agreed.

Mr. Nalipinski mentioned that, as a subset of the fall operation, they had technical working groups who met with the locals and provided the time estimate for the operation and explained the confidence levels in the different options. That is where the risk communication and understanding the local needs and priorities as well as resiliency objectives were discussed. They found that the locals were concerned the most with waste disposal. The education process associated with an incident happens within the scientific working groups and scientific coordinator discussions.

Dr. Ryan explained that part of the risk communication piece also came out because it was planned out as a building on a university campus. So they also considered the students around campus and the pressures.

Dr. Nichols noted that there has been increased focus on improving science communication. They are trying to bring the science communication team within their center into the projects earlier so they can help them think about how to explain the science to the public. She pointed out that NHSRC does not do traditional quantitative risk assessment, but they are providing the science to start to look at what the risks are. She continued that they have done some risk communication messaging. For example, they have done message mapping to identify three main messages, research on what community members really want to know, and research on how different demographic groups hear messages differently. NHSRC has

also collaborated with other groups, such as the University of Kentucky, in this area. This work will be published in the next year. However, that work is not continuing due to funding constraints.

Dr. Maxwell commented that she thinks it would be feasible to do another project like BOTE and include testing the messaging in multiple communities. Dr. Nichols added that, in their risk communication research, it was interesting to see how different demographic groups heard the same message differently and compare what parameter each group really wanted to hear.

Dr. Hulla commented that perhaps there is a lesson to be learned from the Superfund restoration. Her experience was that there was doubt in the community no matter what the Agency said. EPA's response to that was to fund the community to hire their own experts and restoration advisory boards. She asked if this would be possible in HS remediation.

Mr. Nalipinski commented that in a HS/terrorist scenario, there will be incredible political pressure to resolve the issue as quickly as possible. There would likely not be time to develop something of that nature. Along that line, though, he described the Scientific Advisory Board that was formed to look at the end result of remediation. That group is formed early in the process so they can be informed throughout the process. Board members are from academia, research facilities, and other outside organizations. The hope is that they give a "thumbs up" that the approaches are acceptable. Mr. Nalipinski added that those would be the people he would put up in front of the public to reassure them.

Dr. Hulla asked what data gaps were identified while doing the BOTE project. Dr. Ryan responded that one of the gaps was determining what it would take to make VHP more effective. Another gap identified with respect to the exposure assessment is understanding what could be reaerosolized and under what conditions. Dr. Hulla asked if they took air samples in addition to swipe samples. Dr. Ryan replied that they did. He added that gaps were also identified for wastewater samples. These gaps include determining how to concentrate samples when there are a lot of surfactants in the water and dealing with multi-agent concentrations. Dr. Ernst explained that the concentrator will concentrate organisms in a large volume down to a much smaller volume. She clarified that in the BOTE project, they only had the one contaminant. Dr. Hulla asked if viruses were considered a data gap. Dr. Ernst replied that they were not. NHSRC compared their concentrator method with CDC's method and the methods were very comparable.

Dr. Ryan identified another gap associated with sampling what is coming in to the wastewater treatment plant. For example, how will the entry of Ebola be assessed. Waste decontamination is also a gap. Two of the regions were using a slightly different method for this – one was using a spritz treatment inside the bag and the other was doing a spray treatment. Dr. Ryan said that, in the end, when they analyzed the waste in sample bags, no matter what method they had used, there were still viable spores in the bags. So the data gap is how we can treat the waste in those bags so that it can be shipped off with some assurance that there is nothing left there.

Mr. Nalipinski stated that waste was a huge issue in the project – more specifically, how do you treat and classify that waste. The stigma of waste generation, volume of waste generation and the disposal options were all big issues. They started working operationally to decrease waste. Mr. Nalipinski said that one option for certain contaminants may be to just spray and leave and then come back when it is dry.

Dr. Ryan stated data management is another area where more work is needed. They collected over 3,000 samples that were sent to LRNs. Without the data collection tool they used, it would have been difficult to keep track of where those samples were taken. However, they found that in the absence of the experts who developed the tool, staff were not able to properly use the tool. This highlighted a big gap: tools must be available for use that don't require an expert.

Mr. Nalipinski shared that NHSRC is studying data collection in the subway system. The issues identified in the BOTE project were applied to transportation projects. Next, they plan to apply the learnings to outdoor projects.

Dr. Ernst shared that they learned that the water decontamination unit does not work as efficiently with dirty water. This issue is being examined further.

Dr. Nichols noted that while the technical solutions being developed are wonderful, the issue becomes how to communicate that to the public. She pointed out that the community is going to want to know when they can go back in and if it is safe. A preliminary exposure assessment was included in the project. At the very least, it should show the change in potential exposure from before and after the decontamination effort. That process showed them the gaps in how to really assess the exposure. Since the BOTE study, they have started working on data usability and determining how microbiological data can be used to assess exposure.

Tools Café

All

The following tools were demonstrated for the BOSC HS subcommittee:

1. Decontamination Selection Tool (DeconST)
2. Waste Estimation Support Tool (WEST)
3. Incident Waste Assessment and Tonnage Estimator (I-WASTE)
4. Water Infrastructure Resilience Tool (WNTR)
5. Threat Ensemble Vulnerability Assessment – Sensor Placement Optimization Tool (TEVA-SPOT)
6. Ohio River Spill Model Tool
7. Selected Analytical Methods (SAM) online database

Subcommittee Discussion

Subcommittee and Others

Charge Question 3. How well does the Program respond to the needs of EPA partners?

Dr. Hulla asked if tools have a modular design. This may speak to the architecture flexibility. She asked if it would be legitimate to have a modular up-front design so that a switch could be made between agents in the same tool. She supported the inclusion of flexibility here and making tools more modular. Dr. Taft responded that it wouldn't be an either/or for sampling and analytical plans, and this approach would fit better for the sample collection piece. Cost is not built into the tool. Dr. Ryan added that the decontamination decision tool could be more modular, but not all of the tools can be made modular. Some tools are a body of knowledge and there are complexities that prevent aspects of the tool from being totally modular. This approach can be considered at a high level but may not be possible for all tools.

Dr. Snyder noted that it might be more logical to design tools to be applicable to as many hazards as possible rather than try to make a tool work for biologicals, chemicals, biological toxins, and radiologicals.

Dr. Hulla asked NHSRC to consider partnering with NIST. NHSRC has contaminants for which there are no established analytical methods. NIST's mission is to validate methods and it would be valuable to loop them in. Dr. Taft noted that NHSRC has reached out to them for help with exposure work. Dr. Taylor added that this is not a reasonable recommendation to include in the report.

Dr. Reinhart asked if drinking water is the focus because it's the priority. Dr. Snyder replied that NHSRC works more with partners on wastewater. Dr. Ernst added that NHSRC did not ignore wastewater. An action plan was developed that considered both wastewater and drinking water, but the drinking water folks were vocal about how much research they needed. NHSRC can now spread more into the wastewater area because of the research that has already been completed on drinking water. NHSRC is moving into water reuse and actively leveraging resources to do more research in this area.

Charge Question 4. How well has the Program transitioned research to the end-user? How can we improve our ability to transition research to the end-user in the future?

Dr. Hulla noted that validation process levels have been discussed throughout the meeting. At the highest validation level, this would be something that is defensible in court. She asked for more insight on EPA's opinion of other possible validation levels. For example, the lowest validation level would be something not validated in the laboratory. Dr. Ernst shared that NHSRC was lucky to have conducted a field study and get the LRN pitch in with sample processing and analysis. Having a restriction that everything must be validated in the field is challenging. Dr. Hulla stated that this process would apply to characterization tools for end users. Dr. Taft responded that the SAM analytical methods have tiers. For example, Tier 2 methods have a published paper supporting the work and Tier 3 methods have been multi-laboratory validation tested for a specific analyte in a specific matrix. Dr. Nichols added that these are called applicability tiers and they help build confidence in the methods.

Dr. Hulla asked if a tiered approach to sampling biologics has been generated. Dr. Nichols replied that a validated sampling workgroup tried to go from the laboratory to the field, but this process was very difficult. A validation plan for sampling is not currently available.

Mr. DeGraca suggested the following approach: Tier 4: purified in a laboratory; Tier 3: single laboratory validation; Tier 2: multi-laboratory validation; Tier 1: defensible in court/regulation.

Dr. Snyder noted that the specific approach is not needed at this time, but the objective is to develop approaches for communicating to end users that a method is "ready for prime time." Dr. Hulla agreed that the goal is to develop a tiered system so that the end user knows where they are.

Dr. Reinhart asked how NHSRC monitors concerns that are not yet on their partner's lists. Dr. Snyder responded that it is important for NHSRC to keep a pulse on things and do this with our partners.

Dr. Olsiewski noted that HS uses an all hazards approach but focuses on threat agents.

Dr. Hulla shared that within the discussion on remediating wide areas box, there was an opportunity to conduct a cost-benefit analysis. She asked if it would be reasonable to recommend that a cost-benefit analysis be conducted in the process of transitioning tools to the end user. The uncertainty level with respect to sampling tradeoffs should also be considered in this transition.

Dr. Ryan noted that the process is moving in this direction. At a high level, these are good points to consider, but there may not be a high level of detail. Mr. Roehl pointed out that a few of the tools look at cost-benefit options. Dr. Ryan added that the robustness of being able to adjust the sampling plan is not there, but it is possible to determine the cost for running a certain number of samples.

Dr. Reinhart suggested that a general sense of cost may help with prioritization. Dr. Olsiewski added that it would ultimately help decision makers if they can get some sense of the cost of their decisions.

Dr. Hulla suggested the group also consider the uncertainty level with respect to sampling tradeoffs. Dr. Taft noted that the sampling strategy can be challenging. There must be a balance between sampling strategy and uncertainty and NHSRC is trying to work on integrating uncertainty into their tools. In the real world, the responders said that a targeted type approach was needed rather than a statistical approach. Dr. Ryan noted that NHSRC used PNNL's Visual Sampling Plan tool. This tool is used a lot, but the integration of information into the tool is unknown. Dr. Snyder added that in the real world a targeted approach is used to figure out where the contamination is within the characterization phase. It's unclear how this ties into the clearance phase.

Dr. Ernst noted that there is concern about the tradeoff between sampling robustness and cost. The group is treading into an area that is held by the responders.

Dr. Ryan shared that a cost spreadsheet is being developed that can address the whole cost analysis. This spreadsheet could be used to address tradeoffs.

Dr. Olsiewski asked how robotic composite sampling is integrated. Dr. Hulla responded that is cheaper with more uncertainty.

Dr. Taft emphasized that NHSRC is trying to focus on the DQO (Data Quality Objectives) process and not telling people how to do the sampling. Dr. Hulla stated that the end users of the tools are going to want to make a decision based on cost, benefit, and certainty. These considerations can help transition tools.

Dr. Schoch-Spana pointed out that there are complexities to the roles defined by Dr. Sayles and Dr. Snyder. There is interaction with the partners but there are other folks served by ORD in a secondary or tertiary way (e.g., water utilities and their customers). She asked how NHSRC interacts with the front line emergency officials involved with sampling. She wondered how NHSRC communicates in face to face and field settings. She noted the value in knowing more about primary or secondary relationships. Dr. Snyder shared that on the indoor/outdoor decontamination side, EPA's boots on the ground are the OSCs. State and local officials are in charge and the OSCs, with the support of the technical working group, help guide what happens during the response. NHSRC has targeted OSCs and people who support them in the program office. NHSRC communicated with regional, state, and local laboratories. The end users may be different in different situations.

Dr. Ernst noted that NHSRC has elected that OSWER and OEM are key partner. OW communicates with the region on a monthly basis. There is also a Water Sector within EPA and quarterly calls are held with NHSRC. NHSRC does talk to the water utilities with the support of OW and there is a significant connection between researchers and the water utilities. There is no defined communication process, but there are approaches available that can be adjusted as needed.

Dr. Nichols stated when NHSRC held the SAM summit, states sent representatives to the meeting because they believed in the goal of the meeting and the end product. Their buy in is important.

Dr. Snyder stated that ORD made a decision to have targeted partners and serve those partners. With the Water program, we can't avoid serving the utilities so those are one of our partners. Dr. Ryan added that if NHSRC receives a call from a local official, they don't know the whole story. When OSCs work with state and local officials, they work in multiple capacities. OSCs still have to work with the local officials because they make the public health decisions. Sometimes OSCs just provide support and do not carry out the decontamination.

Mr. DeGraca noted that utilities will use tools more frequently if they are focused for disasters that actually occur. The tools will have more value. He suggested that NHSRC consider other scenarios (e.g., hurricanes, earthquakes) during tool development. Dr. Snyder agreed that support of general response is important. NHSRC should leverage as much as possible with limited research to make tools applicable to all hazards. The resilience framework addresses all kinds of disasters.

Mr. DeGraca asked when NHSRC engages their partners. For example, the Water Research Foundation engages utilities during planning. It appears that NHSRC engages partners at different times. Dr. Ryan shared that NHSRC have collaborated with the Water Environment Research (WERF) on multiple projects and have leveraged their capabilities. Dr. Ernst supported increased involvement with water utilities. Dr. Ryan noted that the water utilities are already involved with NHSRC's partners.

Dr. Olsiewski asked if NHSRC has independent contacts with utilities beyond OW or operational partners. Dr. Ernst responded that NHSRC has direct contact with some groups including the American Water works Association (AWWA). AWWA provided data from 12 utilities who also beta tested a tool and provided feedback. Dr. Snyder was generally supportive of that recommendation and indicated support for engagement with utilities. Mr. Roehl stated that he also works with water utilities. Utilities are not very sophisticated when it comes to technology. If targeting utilities in the general sense, products have to look different from products developed for sophisticated users. Dr. Ernst added that tools are

needed to help the smaller systems as well. Mr. Roehl stated that if a product can be made readily usable by the smaller utilities, it could also be used by sophisticated users.

Mr. Hackney pointed out that all of NHSRC's tools were written in a different architecture, which can pose problems. Dr. Taylor responded that there is no cost benefit to creating a uniform platform. PNNL has the same problem. Cost-driven issues need to use in-house expertise and what's available.

The subcommittee thanked NHSRC staff for their participation and assistance in providing clarification for their questions.

Mr. Tracy noted that he must be involved in all requests for clarification from NHSRC. The subcommittee should not reach out to NHSRC directly.

Subcommittee Work Time

Subcommittee, Dr. Sayles, and Dr. Snyder

Charge Question 1. Given the research objectives articulated in the StRAP, are the topics and project areas planned and organized appropriately to make good progress on these objectives in the 2016-2019 time frame?

Context: The StRAPs are designed to clearly convey the vision and objectives of the research program, and to describe, at a high level, the research topics, and major outputs planned for 2016-2019. Upon receiving recommendations from the SAB and the BOSC EC, as well as from EPA partners and others, ORD has further developed the StRAPs, including refining the objectives and topics, and providing more clarity on the research efforts. We recognize there are likely several reasonable approaches for organizing the research to best accomplish the objectives and would appreciate the BOSC's input in this area.

NHSRC needs to accelerate projects related to cybersecurity and raise their priority. Cyber issues are not big enough on the radar screen and should be this should be a separate project area.

- Capabilities may need to be contracted if not in-house.
- EPA needs to explain its position on cyber issues.
- The timeline is incorrect and projects cannot wait to be started in 2017/2018.

Charge Question 2. How effective are the approaches for involving the EPA partners in the problem formulation stage of research planning?

Context: ORD works with EPA partners to develop scientific solutions that meet the Agency's priorities. The first step in this process is problem formulation which provides the foundation of the research: problems that are well-defined lead to the most effective research efforts and solutions. Problem formulation occurs at many different levels from articulating high-level research needs reflected in the StRAP design, to defining more specific needs reflected in StRAP outputs. Partner involvement in problem formulation occurs in regular staff-to-staff meetings with EPA partners; workshops and conferences where States, regions, policy and science staff describe the problems they face; and discussions among senior managers at EPA. In addition, each National Program Director reaches out to EPA partners in a variety of targeted ways to agree on problem definition.

General Observations: [None discussed]

Specific Strengths: [None discussed]

Opportunities for Improvement:

- Greater interface with scientific engineering communities to ensure they are up to date on the most current analytical techniques or technologies (e.g., increased attendance at conferences and professional meetings – more funding is needed for this activity).

- EPA's mission is mostly focused on cleanup but methodologies could be leveraged to address characterization (nature and extent of contamination).
- More information is needed on the criteria used for project prioritization.
- Across the Agency, partners need to know more about social science in order to request more integration of social science research done by Homeland Security. If the same conversations are continued with the same partners, there will be stasis.
- Question to be asked: Dr. Reinhart noted that the following question should be considered.
    - How does information get disseminated between interagency working groups? There is a lot of overlap that may not filter out.
- Lacking a sense of coordination for federal research programs. A process to share timelines and overall plans is needed in order to improve coordination between efforts.
- Increase outreach to utilities and "secondary partners" – A checks and balances on perspectives is needed.

Deficiencies: [None discussed]

Recommendations: [None discussed]

Charge Question 3. How well does the Program respond to the needs of EPA partners?

Context: In addition to the up-front work with EPA partners to understand their research needs for the upcoming year(s), ORD must translate the high-priority needs into research efforts that address these anticipated needs. In addition, ORD should be flexible to address critical, unanticipated, unplanned needs that can emerge at any given time.

General Observations:

- Tension between budget limitations and the application of an all hazards approach. There are funding limitations to implementing this approach in all scenarios.

Specific Strengths:

- Focusing on homeland security and an all hazards approach in response to partners (e.g., Ebola and *Burkholderia*).
- Many of their tools are modular in design and can be added on/built upon. The tools have the capabilities to have new types of threats, agents, methods loaded into the tools.
- Focusing on solid waste.

Opportunities:

- Have a cost consideration included in the approach/problem formulation.
- Breadth versus depth – ORD working on a lot of projects but not very deeply in any of these areas.

Deficiencies:

- The process used for determining priority needs; organizational structure/communication processes.

Recommendation:

- Reestablish the funding that allows ORD to respond to an emerging issue. ORD should have funding set aside to be flexible to respond to critical, unplanned, emerging issues. This may not be an effective recommendation.

Charge Question 4. How well has the Program transitioned research to the end-user? How can we improve our ability to transition research to the end-user in the future?

Context: Conducing high-quality research that is responsive to partner needs is not successful unless the resulting scientific products are transitioned successfully to the partners who will use them. However, this transition is not a trivial endeavor because it requires that products be formulated and delivered to maximize their usefulness to the partners. Transition is successful when end-users use our products.

General Observations: [None provided]

Specific Strengths:

- Validation tiers for chemical sampling and analytical process
- Review website tracking on visits to tools websites to assess popularity

Opportunities for Improvement:

- Add cost-benefit analysis and uncertainty analysis to make decision making tools more end-user applicable.
    - Two applicable research areas include addressing sampling and analysis and addressing remediating wide areas.
- Move applications to a smaller number of platforms so there is better operability between things.
    - The sustenance of these application tools is something that becomes very onerous and time consuming. Dr. Taylor shared that she had a great conversation with Tara about her approach to those tools and transition to software developers. Tools should be transitioned to someone who is an expert in migration and version control once intellectual capital is established. Dr. Taylor wondered if it was reasonable to include a recommendation to the researchers to work towards making tools publically available on these platforms.
        - She asked if a background check is required for the folks who are brought in to transition these tools. Transition can be beneficial to the security of the nation and advancement of the tools
    - Dr. Snyder responded that this is a fair suggestion for water tools, for waste and decontamination tools, the audience is limited (i.e., smaller than a handful). Simple platforms are needed so that end users do not need to make a large investment in a new platform.
- Thinking about the end users and determining if the output is the correct output. Outputs could be tweaked to make them more user friendly.
- Mr. DeGraca supported the development of one page fact sheets on contaminants with data on analytical methods, turnaround times, etc. Utilities and other organizations who need to respond quickly need one primary resource for this information. Information should be user friendly and digestible.
    - Dr. Snyder noted the challenges associated with keeping resources current. NHSRC is working on updating available materials with more recent data.

Deficiencies:

- Scaling from the laboratory to the field (i.e., BOTE study).
- Underestimation of application of more sophisticated approaches.
    - Local resources are limited but may be capable of more sophisticated approaches.
- Tools training to eliminate the need for experts.
- More technology evaluation (e.g., biosensors used in the field), which may impact the sampling approaches used.

Miscellaneous:

- Use of real-time sensors to monitor conditions so we can assess the decontamination process.
    - More rugged sensors are not yet in the marketplace.
    - Constant data stream – cyber risk associated with multiple points of entry.

Recommendation:

- Outreach to water utilities could be improved (i.e., more systematic and coordinated approaches to get input and feedback from water utilities).
- Validation tiers for biological and radiological sampling and analytical processes
    - Scalability with respect to decontamination – SAM equivalent for decontamination.

Charge Question 5: How can we infuse social science into the development of our research products to improve their usability?

Context: Over the last several years, the National Academies of Science (NAS), EPA Science Advisory Board, and BOSC have recommended that EPA research account for the social science aspects of decision making, including decisions made during disaster response. The NAS and the Office of Science and Technology Policy have highlighted key social factors in building community resilience to disasters. Given limited resources, HSRP seeks the advice from the Subcommittee on how best might targeted social science research help achieve the Program's objectives.

General Observations:

- Strong appetite for infusing more social science and also for understanding the potential in this area – What is social science and what can it do for us? There is a desire to understand how social science can help more.
- There is implicit social science going on. There is awareness about the real world context in which these products are rolled out.
- In many cases, ORD staff are already sensitized to the fact that their operational partners face many complex social and political challenges when conducting their everyday work and using ORD research products. At some level, ORD staff have an intuitive understanding of some of the issues faced by first responders that a social scientist could more systematically investigate.
- Self-help tools are important and we do not always think about this aspect,
    - Self-help refers to things a person can do on their own without relying on the government.
    - More encouragement to practice self-help.

Specific Strengths:

- There is both bottom up and top down support in innovative projects like the Siri projects, there has been stakeholder adoption of this work.
- Seems to be a history of attention to public communication challenges around decontamination and other matters, but that vein of research has stopped due to competing priorities amid scarce resources.
- Encouragement to do more self-help.

Opportunities for Improvement:

- A selection of current projects could be expanded to address public communication aspects such as BOTE 2. Attention could be paid to the communication dilemmas that rise for decision makers around explaining their choices for decontamination approaches. There is on-going work in this area, but there is a public communication element that is missing that could be valuable to the decision makers. Some guidance could be developed that involves pretesting select messages.

- There could be systematic inquiries into operational realities faced in the field (e.g., communities taking waste, decisions made on decontamination approaches) that would help provide greater context for decision making tools).
- Opportunity or Decision: Orientation workshop that includes social scientists who work in the HS space. The workshop would provide an opportunity for researchers with a variety of different trainings to see the work done in risk communication and organizational dynamics that can improve consequence management.
    - SMEs could be included.
    - Tap into other partners within EPA to raise the responsiveness to community value questions

Deficiencies: Need more funding

Recommendations: [None discussed]

Miscellaneous:

- Advisory board similar to a RAB.
- EPA receives pushback for being one sided. The opinion of an independent expert could be valuable.
    - G. Sayles responded that this is a programmatic concern rather than a research question.

Wrap Up and Adjourn

Mr. Tracy dismissed the group for the day.

Thursday, August 27, 2015

Partner Panel Discussion

Dr. Snyder, Moderator

Jeff Swertfeger – Greater Cincinnati Water Works

Debbie Newberry – EPA Office of Water's Water Security Division

Jim Mitchell - EPA Region 5, On-Scene Coordinator

Ross Elliott - EPA Office of Solid Waste and Emergency Response's Office of Resource Conservation and Recovery

Mike Nalipinski – EPA Office of Solid Waste and Emergency Response's Office of Emergency Management

Dr. Emily Snyder, Deputy National Program Director of EPA ORD HS Research Program

Dr. Snyder explained that the partner panel discussion will be an opportunity to understand how the HSRP does partner engagement. Their partners will provide insight into HSRP's partner engagement from problem formulation all the way to the transition of the research. She asked each of the partners in the panel to introduce themselves. She explained that each of the partners would share their prepared remarks, and then there would be a question and answer session during which she would give each subcommittee member a chance to ask questions.

Mike Nalipinski introduced himself as the Associate Director of the Consequence Management Advisory Division. He explained that his group works with the research folks to identify the up and coming issues they see on the horizon and to develop projects with them. They also work closely with them when incidents occur. He indicated that he would also be speaking for Terry Smith today (also from OEM). Mr.

Smith works with the ERLN trying to find laboratories when there are surge capacity issues and for the various types of contaminants, including unique contaminants without validated analytical techniques (e.g., ricin).

Ross Elliott introduced himself as the Associate Director of the Materials Recovery and Waste Management Division. He stated that they deal primarily with hazardous and solid waste issues.

Jeff Swertfeger introduced himself as the Superintendent for Water Quality at GCWW. He stated that his responsibility is to watch over the treatment and the water as it goes through the distribution system.

Debbie Newberry introduced herself as the Deputy Division Director for the WSD.

Jim Mitchell (via a video call) introduced himself as an OSC who works for the EPA Region 5 Emergency Response Program. He stated that he is a health physicist by training. He mentioned that he has done a lot of work in radiological emergency preparedness.

Jeff Swertfeger – Greater Cincinnati Water Works (GCWW)

Mr. Swertfeger began by stating that the GCWW serves 1.1 million people in southwest Ohio and northern Kentucky. Most of the water comes from the Ohio River. He stated that part of his group's responsibility is to implement protective measures for contamination throughout the treatment and distribution system. He explained that they first became involved with the HSRP group as the first pilot utility in the Water Security Initiative, a role that they applied for. They worked with this group to use TEVA-SPOT modeling to identify where to put sensors in their distribution system. He characterized it as a true partnership in which they had a lot of input. There was a lot of listening going on and learning on both sides. After they used TEVA-SPOT, Mr. Swertfeger said they did a lot of work on identification of water quality sensors, including determining what was available and the specific needs and criteria. There was a lot of interaction and back and forth to determine the criteria and best practices. He recounted that it was a great working experience to see how it developed from the research and development side to the real system implementation. Mr. Swertfeger explained that a lot of data was produced by the sensors and they used the CANARY product to analyze it. The data was more than one person could handle even with a SCADA system. He related that using the automated data analytics in CANARY was a great benefit to them.

Mr. Swertfeger described some of the current collaborations between his group and the HSRP. Those include several distribution networking projects, working with real-time modeling, and collaboration in preparation for the recent All-Star game in Cincinnati. They partnered with Rob Janke to determine where to put sensors to protect the game and all of the events going on around the city. They actually had water quality sensors inside the stadium and around the stadium and nearby venues. They used TEVA-SPOT to determine the best places to put the sensors.

Mr. Swertfeger added that they collaborated with the HSRP group to set up a bi-annual seminar-type meeting with people in the Cincinnati area who work on distribution issues. This meeting includes people from EPA, several water utilities, consultants, University of Cincinnati, Lexington, Kentucky, and University of Michigan. He expressed his appreciation toward EPA for taking the lead to bring these groups together to talk about distribution research.

Mr. Swertfeger concluded by stating that they are looking forward to using these products not just for contaminant and typical homeland security issues, but also to see how they can take the work that is being done and use it for a more all-hazards type approach. He stated that he does not think the systems will be sustainable by utilities if they are viewed only as security-centric. By looking at dual uses for these systems and products, he is better able to make the case to other utilities to keep the systems up and running.

Debbie Newberry – EPA Office of Water's Water Security Division

Ms. Newberry began by stating that the WSD was created after the events of September 11, 2001. She explained that there are various Presidential Directives that drive the direction they go and several Acts of Congress along with partnership activities that guide what they need to get done. She emphasized that it is important to remember that the WSD took some specific actions covered under the Act that required utilities to provide the WSD with their vulnerability reports. That is the only action that was required of the utilities. Everything else they do in conjunction with the WSD is voluntary. Therefore, the WSD needs to work closely with the utilities and provide a lot of education and outreach. They encourage the utilities to do right thing and help them to understand the importance of each action that the WSD is suggesting or requesting them to do. They hope to provide the utilities with information in a usable format that they can understand quickly and easily. She pointed out that many of the water utilities are overworked, they do not have much money, and their infrastructure is crumbling around them. She stated that is something they always have to keep in mind. Ms. Newberry underscored the importance of providing the water utilities with things that will help them in their everyday work. The utilities are doing things for the WSD not because is mandated, but because the WSD is encouraging it. So they keep in mind that whenever the WSD gives the utilities guidance or money, they are using it not just for water security but also just to provide safe water to their customers.

Ms. Newberry said that they started out dealing with just terrorism, but since Katrina, they also deal with natural disasters. That makes it a little bit more challenging. She pointed out three things to remember are that water security is fast moving, its changing constantly, and it's voluntary. She explained that, in the beginning, there was the Water Security Initiative, and a plan was formed between the WSD and the HSRP on how to move forward with research, which was a lot of work. As the two groups move forward, it becomes a little bit more dynamic. The WSD works with their partners to see what the sector needs, and it is not always R&D. They usually they need things quickly. She pointed out that R&D is usually a long-term process, so the challenge is meshing that together. She stated that she thinks HSR is doing a good job with that and the WSD is becoming more dynamic to handle that. Each year they examine the priorities together. The HSRP group suggests all sorts of projects and the WSD rates them as high, medium or low. She clarified that low does not mean that the WSD doesn't think the priority is unimportant. It just means that it is not on the list of things that the water utilities have said they need. Ms. Newberry said that the WSD and the HSRP have changed how they work together, which has been a good thing. They can now go back and forth on different types of projects.

Ms. Newberry described some of past and current HSRP projects the WSD and utilities have benefited from. The HSRP group has done a lot of valuable work with sensors and sensor placement. Also, the work in decontamination of utilities themselves has been important. She pointed out that some of the pipes are pretty nasty so they are working together on decontamination. They have been working on method development and prioritizing methods. In order to get the methods out to the utilities, the HSRP group are getting creative to make method validation happen. Ms. Newberry stated that the WSD uses the SAM and SAM methods quite a bit. They also find the WCIT (Water Contaminant Information Tool) to be useful and easy for the water utilities to use. They are working together to update the WCIT tool with the SAM information.

Jim Mitchell - EPA Region 5, On-Scene-Coordinator

Mr. Mitchell began by saying that the overall EPA response community came to a realization after September 11, 2001 and Hurricane Katrina that one region can't handle all of these potential types of wide area contaminations alone. They learned that the regions need to come together and harmonize their programs so that regions can support each other seamlessly. In 2002 or 2003, they started developing national approaches to responses that looked at a number of different categories including equipment and clothing. During that process, they looked at research on sampling and air monitoring, and NHSRC was a part of that process to move that along and get consistency in how they bring out their resources. They are

training a lot of their resources through the Incident Command Network on chemical, biological, radiological and nuclear cleanup issues in the field.

Mr. Mitchell stated that his expertise is in the radiological decontamination. He has worked extensively with some of the modelers at NHSRC to define some of the problems, such as the decontamination needs, the different scenarios that are possible, the different radiological materials, and to set the boundaries of what they are trying to prepare for. He explained that setting the problems helps them to determine what their needs are in the field from a detection perspective, a sampling perspective, and a decontamination perspective.

Mr. Mitchell stated that his department has worked a lot with NHSRC, particularly in determining what the needs are in the event of a wide area radiological contamination. They did a wide area tier 2 exercise that used a lot of the research and methodologies and brought all of these different organizations together. They learned about what needed to be done from a training perspective. ORD provided waste estimates during the exercise. In regards to the transition and use of products, he stated that the NHSRC is presenting information to the regions about what research they are doing. They provide this information through websites, information and actual training. Mr. Mitchell underscored that an important aspect of this is helping them understand where the expertise lies. He stated that the key things in his mind are to continue the collaboration process, to understand where the expertise is, and to slow down and think about the applications of the response a little more thoroughly. He added that they do all of that with NHSRC.

Ross Elliott - EPA Office of Solid Waste and Emergency Response's Office of Resource Conservation and Recovery

Mr. Elliott began by stating that the Materials Recovery and Waste Management Division falls under the Office of Resource Conservation and Recovery, which is largely a waste office. It has about 160 folks operating out of Washington D.C. He stated that the main focus of the office over the past 25 years has been putting in place a hazardous waste regulatory program. In their division, they do a lot of regulatory work and development including interpretation of how older regulations apply. Mr. Elliott pointed out that hazardous waste is a fairly narrow sliver of the entire U.S. waste 'pie'. There are a lot of other wastes out there that they do not directly implement programs for. Their knowledge about wastes generated during incidents has grown over the past 10 to 15 years. As demonstrated during Hurricane Katrina, a lot of questions flow to them during incidents. They are often put on the spot by senior decision makers at EPA about waste. Therefore, their office evolved a group of staff that focus on the homeland security area. This core of HS folks focus on waste and the critical relationships they need to have with the responders (e.g., USDA, FEMA, OSWER/OEM, and DOT). Those relationships help get them through critical events. Interactions with the NHSRC occur in the lulls between incidents.

Mr. Elliott talked about how his focus has always been hazardous waste, but the work the HS group does in his division has been eye opening for him because it is about everything else plus hazardous waste. When he first observed a planning meeting with the NHSRC folks, he was very impressed with this research group within ORD. He stated that he has seen varying interactions between program offices and ORD over the years working at EPA, and this group impressed him. He observed that the interactions with this group were positive, and it looked like everyone was engaged. There was a lot of planning, prioritization, discussions, and voting happening.

Mr. Elliott stated that he has received positive feedback about NHSRC from the HS group within his division. Then he provided an example of a positive interaction they have had with NHSRC. Mr. Elliott pointed out that during the Ebola incident, nobody knew how big the incident was going to get, and nobody knew what to do with the waste from one patient. They were working on an Occupational Safety and Health Administration (OSHA) document about protecting worker safety and Paul Lemieux and others provided some important input relating to the type of bleach and temperature that were important for disinfection. He stated that was a good example of how the research can help assist during the crisis

period. He emphasized the importance of pushing for relevant research during non-crisis periods. He mentioned that they interact with their partners during non-crisis periods through work groups and by reviewing documents, among other ways. He ended by saying that it is his personal preference to become more engaged in waste treatment research.

Mike Nalipinski – EPA Office of Solid Waste and Emergency Response's Office of Emergency Management

Mr. Nalipinski started by explaining where CMAD fits in to the picture. He explained how this group works on the characterization, decontamination and clearance phases of remediation and cleanup. They try to determine what happened initially in an incident in order to transition to informing the remediation and cleanup. They do not have folks out there doing the decontamination. Rather, they are the liaison between the responders and the research folks. He explained that when responders in the field have questions about odd things they don't normally work with, they come to them and they try to reach out to the experts for the answers (e.g., Paul Lemieux who has information on incineration and waste disposal). They also bridge over to Mr. Elliott's group when trying to determine how to move the materials. So they are the link that was formed after September 11, 2001, with expertise to bear in the remediation/cleanup side.

Mr. Nalipinski stated that they maintain an old Cesna (called ASPECT) for use in aerial evaluations for radiological and chemical contaminations. They also maintain chemical warfare mobile laboratories (called PHILIS). The mission of the Consequence Management Advisory Division is to provide scientific and technical expertise for all phases of CBRN consequence management and be available to support OSCs. He stated that basically means that they translate the current science to the response and get involved in partner processes in order to anticipate what the next unique response will be. They link to the Office of Homeland Security to get intel information, and they focus on the priorities of the law enforcement agencies. They are doing a lot of work on the transit systems because that has been identified as a target for many years. They work with a variety of organizations (e.g., DoD Civil Support Teams).

Mr. Nalipinski pointed out that they have had more field deployments in the past year than they've had in the last eight years. Ebola, ricin, and *Burkholderia* incidents have all happened within the past year. In regards to *Burkholderia*, he believes the reason that people called on them is because they have the relationship with the researchers. The researchers didn't have specific information on *Burkholderia* or Ebola, but they were able to take the information they did have from the bench scale and literature searches and advise on a solution they thought would work. Mr. Nalipinski stated that they took that information to the field and tried to build confidence in the responders using the science that the researchers provided.

Mr. Nalipinski mentioned that they also have international partnerships. For example, they work a lot with the United Kingdom and they are working with Japan on the radiation issues. They also work with other countries to be aware of how they are handling the same issues we are dealing with in order to not be duplicative.

Mr. Nalipinski talked about how they worked with NHSRC during the Ebola incident. During that incident, Mr. Nalipinski's group helped develop a decontamination strategy for Region 2 (New York City). The types of questions that were asked included: What to use to decontaminate? What bodily fluids carry the most Ebola? What do we have to focus on? How do we clean up the bowling alley, bus, or restaurant? Those are the types of questions for which they tried to provide technical input. They partnered with the EPA research community to ensure the decontamination guidance was efficacious for Ebola. They recommended appropriate disinfectants, contact times, use of sterilant versus a disinfectant, and pre-cleaning steps. These were all things NHSRC looked into from an anthrax perspective and then reached out to their medical contacts in order to apply them to Ebola.

Mr. Nalipinski discussed the ricin work they did in collaboration with NHSRC. They worked with DoD Civil Support Teams to try to come up with a methodology to screen for ricin. Dr. Taylor asked if all of these things were things that the NHSRC partnered with them on. Mr. Nalipinski replied that they were. He said NHSRC also helped with the communication messages to public health officials and decision makers about the methods being used. Mr. Nalipinski stated that analytical issues are huge for ricin. They are still working with LRNs to find a lab to work on ricin issues. Mr. Nalipinski stated that the ongoing ricin analysis work includes NHSRC and CMAD working with LRN labs, DoD Livermore to resolve the bleach interference issues with the methods.

Mr. Nalipinski summarized the work that NHSRC and CMAD did to address a recent *Burkholderia* incident. He pointed out that NHSRC was able to take information from the anthrax work and apply it to *Burkholderia*. When two primates were found infected with this bacteria at the Tulane National Primate Center in Nov. 2014, CMAD served as the scientific support coordinator (i.e., liaison) between NHSRC, the laboratories and other folks with expertise. They formed a technical working group with their partners at NHSRC to figure out the optimal area to sample. They worked on how to decontaminate the outside field cages. Fortunately, all of the samples tested negative and the decontamination strategy did not have to be implemented. But they had one ready to go that was developed by the folks at NHSRC.

Questions from the Subcommittee

Dr. Snyder started with Mr. DeGraca for questions and then worked around the table to each subcommittee member.

Mr. DeGraca commented that the discussion about ricin not having methods is particularly important. He asked if there are other contaminants out there with holes that need to be plugged. Mr. Nalipinski responded that there probably are, but that Mr. Smith would have a better handle on that. He said there are always holes out there, we just don't know what they are yet (e.g., in regards to analysis and decontamination). He commented that having a reserve fund in the budget to handle issues that pop up would help the researchers. Mr. DeGraca had a question in regards to seeing analytical problems after a disinfectant has been applied. He asked if verifying methods with real-world applications is a bigger hole. Mr. Nalipinski replied that is a challenge they can work with within their current structure. For example, if a method has a specific issue, they can choose a different decontamination method to clear an area. He added that in some scenarios, public health officials will want to use a tool even if the methods are not validated. Mr. DeGraca commented that personal preferences come into play.

Dr. Schoch-Spana asked if the partners would see value added in the field if the level of social scientific expertise was increased within the NHSRC group. For instance, greater understanding into the social factors influencing people's willingness to take in hazardous waste, or factors strengthening trust with officials/public, etc. She commented that there is already a lot of expertise in social science within this research community. She asked if it would be helpful to them as EPA partners if there was more development in social science expertise.

Mr. Swertfeger responded absolutely. He would see value in a couple of ways. For example, the Water Security Initiative looked as some of the epidemiology work and having the knowledge of social science would have helped make that stronger. He commented that he thinks she is right when it comes to the whole response. If they have to go out with a public notice and people to be careful or not use their water, having an understanding of social science might be helpful in order to get the messages out without causing public panic. He stated that they don't train on those types of things at the local level. He said that kind of knowledge and expertise could be helpful to them.

Mr. Nalipinski followed up on the topic by saying that one of the most difficult things in a response is determining how to better communicate with the public and instill confidence in your scientific decisions. This is true especially when there is not a wide body of knowledge on the contaminant.

Mr. Ed Hackney did not have any questions for the panel.

Dr. Taylor commented that there was some confusion on the prioritization process and the gathering of needs from the stakeholder community. She asked what that looks like from the partner perspective and if there is an annual call for needs.

Ms. Newberry explained that their program is a voluntary partnership and they don't make any decisions on what to do without their partner involvement. They have several meetings a year to discuss products and research. Every few years, they meet with their partners and establish a roadmap of the gaps and priorities that are needed. The roadmap is discussed with the work group and they vote on the priorities. EPA is part of that, along with other government agencies, utilities, and associations that support the utilities. The roadmap is a group document. Ms. Newberry explained that they are working with NHSRC to use that document to determine our work. She added that they discuss new work in the partners group to see if they are interested in it. Dr. Taylor asked if they send their high, medium, and low priorities to NHSRC. Dr. Newberry replied that they give them the roadmap as what they want them to start with. Then, the WSD will vote on the HSRP potential projects and rate them as high, med or low based on the roadmap. She reiterated that a "low" doesn't mean it is not important. Quickness is important to this group of utility partners.

Mr. Nalipinski commented that they coordinate calls with each of the ten regions. Each region has a member in a chemical weapons group, a biological group and a radiological group. CMAD chairs calls every quarter or so to determine the issues in those disciplines out in the field. They compile those challenges. Then one person from each of those disciplines comes into the partner process with the discussions and voting that Dr. Snyder talked about on Tuesday. If something comes up outside of that process, they reach out to NHSRC.

Mr. Swertfeger explained that their process for this is less formal. They don't have annual meetings to look over research plans. However, they do reach out to NHSRC with needs and they ask us what our needs are. They also ask for feedback on existing products and what types of new products would be useful. It's informal, based on relationships developed here and at conferences and workshops. The research group has been very open and seeking that type of input from them.

Mr. DeGraca commented that Ms. Newberry mentioned that utilities are a consultant. He asked how they were consultants. Ms. Newberry responded by describing the CIPAC (Critical Infrastructure Partnership Advisory Council) Group. She explained that when this group gets together, they can talk about security because it is a Federal Advisory Committee Act (FACA)-exempt group. They are supposed to work together and come to an agreement about what is needed for the sector. There are small, medium and large drinking and waste water utilities present along with all the major associations. Mr. DeGraca stated that he is involved on the AWWA council board and he is not aware of any of these discussions. Ms. Newberry said that is interesting because two members of AWWA are part of this council. They should be doing outreach on this with their sector. Mr. DeGraca responded that there seems to be a disconnect in getting that information out the broader group. Ms. Newberry said she was sorry to hear that because they thought AWWA getting everything out their council.

Dr. Paula Olsiewski asked if there is something that could be included in the research so the partners can better utilize social media for things like situational awareness, communication with the public, communication with their own staff, or engagement on self-help methods. Ms. Newberry and Mr. Nalipinski both said yes. Ms. Newberry added that they are trying to do that within WSD as much as possible. She stated that she thinks EPA as a whole needs to do a better job with that, but there has been a lot of concern/resistance in the Agency. Dr. Newberry stated that she thinks it is a great area for research and understanding. Dr. Olsiewski brought up something Mr. Nalipinski said about situational awareness with bridges in Vermont. Mr. Nalipinski replied that there is a lot of opportunity with social media to help with situational awareness. He emphasized that the opportunity to reach out to a community is in the first few hours after an incident. He pointed out that there is a challenge at EPA about getting the right

information out on social media if you don't have messages that have been vetted and approved by senior management.

Ms. Newberry stated that there should be general messages that can be used for all incidents that should go out in first hour, assuring the public that we are paying attention to this. She said that she thinks there could be a lot done in that area.

Mr. Mitchell added that what they will do in the event of a wide area incident is look to what has been successful in the past. He has found that if you lose people's trust right away it's hard to get it back. Trust is something we have to build based on sound scientific information. The research will support the message, but it's about how to communicate the methodology in the right way. He suggested that Information Technology (IT) could mine information to know what the public is thinking. Mr. Mitchell stated that he thinks it's important to utilize social media to get messages out the public. He thinks it is important to respond to what the community is feeling and to be transparent with them, which involves letting them know when we don't have any information.

Mr. Edwin Roehl asked what the partners see as the greatest challenges to the HSR people, other than funding restraints. Ms. Newberry indicated something she sees as a large challenge is trying not to overlap with the other organizations working on the same types of projects. This is true especially in the water sector, where some of the big areas that require research have various organizations all working on the same thing (e.g., CDC, DHS, other groups within EPA). Trying to do the coordination to not work on the same things is a challenge. This involves conflicting areas of responsibility and potentially conflicting documents.

Mr. Nalipinski commented that he thinks NHSRC has come a long way since the BOTE project in understanding the operational problems that can happen when you go into the field. They now understand how to overcome challenges that can't be planned for. As a follow-up to what Debbie said, he commented that there are a lot of things happening in other agencies that are similar to the work we are doing with NHSRC, and they only discover it through happenstance and personal relationships. He thinks having a touchstone to identify what all national government resources are working on would help. Mr. Roehl asked what would that touchstone look like and how would it be implemented. Mr. Nalipinski stated that right now they simply do a web search. Mr. Roehl asked if they are looking for more. Mr. Nalipinski stated that ideally they are. Mr. Roehl suggested that it might be a worthy use of time to figure that out. Ms. Newberry said yes, but that she sees that as an incredible amount of time. It is very difficult, especially when information is considered secret or top secret. She pointed out that creating something like this would not be easy or fast. It would take numerous sharp people working on it full time.

Mr. Nalipinski commented that the NHSRC folks really work hard to get the field folks involved in the planning of their research. However, other governmental organizations do not always do this well. He doesn't know how to get these other agencies to get the operators involved in the planning.

Mr. Swertfeger said that EPA in general has a problem communicating with people outside of federal agencies (but he mentioned that was not the case with this group). He suggested that maybe some work on communication could be done there (e.g., getting information to water utility operators). Social sciences could be useful to better communicate the work and information at all times, not just during an event. It is important to find out who your targets are. He thinks a lot of the work is not being used in the industry because they do not understand it. He said that a challenge the whole Agency has is making its products easier for the user to understand. Ms. Newberry seconded that. She emphasized that the products have to be written in such a way for the general public to understand.

Mr. Roehl commented that GCWW has a special relationship with the HS people because of their locations. It seems they get to try all of the latest technologies. He asked if the partners see a way for other utilities to be more involved. He commented that could be a way to do the technology transfer. Mr. Swertfeger responded that he thinks that is already being done somewhat, but there is an opportunity to do

that more. AWWA could be a way to reach interested utilities and also help tailor the messages and products to be more user friendly. Other organizations that could be leveraged include the Water Research Foundation, American Water Association and the rural water associations. Ms. Newberry mentioned leveraging the WaterISAC system as much as possible. She stated that it has come a long way in the past few years and it is a good mechanism to get information out. Mr. Roehl raised the concern that what they are discussing creates a big intermediary between the researchers and end users. Ms. Newberry commented that her organization is working on that especially with the Water Security Initiative. A lot of documentation and papers are being written for outreach. So they will be able to evaluate if this type of approach is effective and should be mimicked in other areas.

Dr. Debra Reinhart asked how the partners reach out and find experts when they need them. She wondered if this was just institutional knowledge. Mr. Mitchell responded that, in general, the OSCs get information through meetings, trainings, briefings. If an OSC is working on a response, they can get the information they need pretty quickly through trainings and SOPs, CMAD, or NHSRC. They know how to get information from those channels. Dr. Snyder asked if he could give an example of NHSRC providing technical support.

Mr. Mitchell described a ricin case in at a home in Wisconsin. The OSC was called out to the response. He contacted one of their biological experts and they brought in CMAD. CMAD helped with the sampling and waste management issues. Mr. Mitchell indicated that the information that was needed was probably generated by NHSRC and then provided on scene by CMAD.

Dr. Hulla commented about the discussion on seeking professionals. She pointed out that EPA advertises in the Federal Register. The Society of Toxicology will look in there and help find someone to meet the need. So she recommends going through the professional societies to find experts.

Dr. Hulla stated that the DoD developed a naphthalene dosimeter that the military fuel handlers decided they did not want. She would like the partners to consider using this wherever you need to monitor petroleum.

Dr. Hulla commented that the National Academy of Sciences report on Exposure Science in the 21st Century: A Vision and a Strategy may be another resource for the people in the room. As part of this report, the federal agencies put together Exposure Science 21 working groups including biomonitoring, sensors and dosimeters, monitoring, data collection and analysis, and social sciences. They are working on how to coordinate resources within the federal agencies to meet the requirements of the National Academy of Sciences in this. EPA has people on these committees.

Dr. Hulla asked about the process of choosing products to develop. She asked if there is a cost estimate attached to the concept proposals from the partners. Dr. Snyder responded that they do not develop proposals or provide cost estimates. They just come to them with a need. Dr. Hulla asked how cost comes into the decision making process and if technology readiness is part of the decision making process.

Mr. Nalipinski gave an example of how it works. His division might have a question like how to get rid of wastewater from an anthrax cleanup that used bleach. The NHSRC would look into the different issues associated with that concept. Dr. Hulla asked if there was a back and forth, and Mr. Nalipinski said they would go back and forth with a dialogue about the issue. Depending on their funding, they may be able to fund some component or particular issue in that concept. There would be a discussion on how CMAD prioritizes the issues. Then a decision is made on whether or not to do a project. Dr. Snyder indicated that they try to do the highest priorities. Dr. Hulla asked if they discuss the technology readiness. Mr. Nalipinski replied that he wants something that works and he can take to the field. They also consider if there are multiple uses for a particular product. If there are multiple uses, they advocate for that study to be moved farther along. Mr. Swertfeger also brought up that the operating costs are also a part of the decision. He said that when they are looking to buy a product from EPA or any vendor, the cost to maintain the system is one of the things they really push back on.

Dr. Hulla asked Ms. Newberry about blue-green algae as a hazard. She stated that climate change is expected to increase blue-green algae in drinking water sources. She asked if that has been proposed as a possible project. Ms. Newberry explained that particular concern is being worked on by the Office of Groundwater and Drinking Water with different parts of ORD, and it is a high priority for them. Dr. Sayles added that there is a big effort on algal blooms in a different part of ORD.

Dr. Olsiewski thanked the panel saying it had been a very informative presentation and discussion.

Public Comments

All

No public comments were made.

Open Discussion and Wrap Up

Subcommittee

Dr. Snyder noted that the StRAP does not simply represent an annual planning process – this is a living and responsive relationship. NHSRC needs to continue to have flexibility in this relationship to address real world issues. It became clear early on that NHSRC cannot be all things to all stakeholders all the time. It is important not to be spread too thin given the available resources.

Dr. Reinhart asked if NHSRC had to halt a project to provide resources to address Ebola. Dr. Snyder responded that no projects were stopped and other project work informed the work on Ebola. NHSRC kept existing research projects going, but jumped on calls to provide Ebola support or provided support on synthesis documents. NHSRC has a project within the program on technical support because we realize the importance of this and want to make folks understand that we value the time they put into emerging issues.

Dr. Hulla observed that the biggest challenge was communication between the agencies. A possible solution comes out of a tiered approach for establishing validation. There is a series of technology readiness levels used by other agencies that go from a first tier concept validation, validation in a suitable environment, validation in the field, etc. all the way up to ready to transition. She asked if this would improve communication between federal agencies. When tools are transitioned, users better understand accountability. Technology readiness is a common language.

Dr. Snyder responded that technology readiness levels are more challenging to implement because they are more designed for widgets. When ORD develops a method it's not something that's going to be commercial. ORD is not developing technologies per say, but this could possibly be applied to the tools.

Dr. Sayles added that in many cases when tools are released they are ready to be used. Some beta versions may be released with a more advanced version released at a later time. Dr. Snyder noted that in an emergency situation we use what we have.

Dr. Taylor stated that this speaks to the decontamination research side of SAM. Dr. Reinhart said that she needed a better understanding of the 1, 2, or 3 priority levels equivalent of SAM. Multi-laboratory validation of the technology or research solutions is needed. Using a tiered approach would provide an indication of whether or not something was tried and it worked, someone else tried it and it worked, the process is multi-laboratory validated, or it was tried for other agents and it worked. This represents a "lower level SAM." The validation process for advancing the research applications at the local level are not assumed to be ready for transfer or other applications.

Dr. Snyder agreed the formal technology readiness used by DoD could be restrictive of resources. Dr. Hulla emphasized that technology readiness levels overcome issues associated with communicating research and value to clients and would improve communication of the content in Appendix 1 of the

StRAP. Mr. DeGraca agreed that this approach helps promote the program and move research to application.

Dr. Snyder noted that this communication issue is not a big challenge because NHSRC works closely with customers and inter-agency groups. The problem is a lack of venues to share work with other agencies. Technology readiness levels wouldn't create better collaboration.

Dr. Olsiewski pointed out that there is a high level of transparency within ORD and everything is on the web. Dr. Snyder agreed. Other agencies do not have this transparency but this is not something we are going to solve. Dr. Taylor added that we aren't focused on stakeholder environment, we are focused on partner involvement and maximizing the efficiency of a program for partners.

Mr. DeGraca asked if there was a way to streamline the process given the large number of parties involved with the work. There could be a way to better focus prioritization meetings. Dr. Reinhart stated that the communication challenge is taking what you have learned and disseminating it. Dr. Olsiewski disagreed and did not observe any organizational problems.

Dr. Snyder suggested that the subcommittee chairs take this issue to the Executive Committee since that is more of an ORD effort. Dr. Sayles added that the HSRP is in the first few years of trying to develop a program that gets people to work together on problems. Setting up multi-disciplinary teams would result in more meetings but it would be for the benefit of the science. A fraction of those meetings is due to ORD's efforts to make this organization use their resources across the board to influence NHSRC's activities. Another repercussion of having multi-disciplinary teams would include limitation of staff time. Some staff volunteer to work on all of the committees that they are interested in, which results in those people being in meetings all the time. Some staff love that there is an inclusive process while others are not interested in participating in a large number of meetings.

Dr. Olsiewski asked if staff have a professional development plan. Dr. Snyder said that professional development plans are encouraged. Dr. Sayles agreed and added that NHSRC supports staff attendance at conferences and professional meetings.

Dr. Olsiewski noted that management is an important part of the organization, not just science.

Dr. Hulla asked how cost-benefit is considered and if competition is part of the planning process. This relates to Charge Question 1. Dr. Snyder stated that there are 13 research projects and within these projects there is a set budget. Staff propose products to meet those outputs and the products that best get to the outputs are selected. All of those outputs are based on partners' priorities and what gets funded/not funded is directly linked to partners. Plans are reviewed annually and funding is associated with deliverables. Dr. Sayles added that, in the past, funding has been pulled from a project if no progress is being made.

Dr. Snyder stated that if appropriations from Congress that are labeled HS are received, then it is split. There is a research budget that is specifically used for conducting research. There is a separate pot of money and multiple pots of money come from Congress (e.g., research pot, travel pot, salary pot, etc.). Dr. Sayles added that the EPA Administrator sets priorities and these are translated into research priorities. Program leadership decides what areas get what amount of funding. The big focus has been on how the program absorbs the cuts that we know are coming and to give feedback on the impact of those cuts.

Dr. Olsiewski advised the subcommittee to review the ORD 101 slides, which are online on the BOSC website.

Dr. Schoch-Spana shared that she was impressed by the vibrant relationships over the project lifecycle. Charge Question 5 addresses social science, a true chicken and egg problem. If partners don't know there are social science capabilities in house they may not know to ask for assistance in this area. Dr. Snyder agreed and added that NHSRC may need to help partners know what to incorporate with respect to social

science. Dr. Sayles added that some don't see how research can inform social science or help. A social science workshop would be valuable to raise awareness.

Dr. Reinhart shared that it appears that cybersecurity issues seem to be a low priority in the StRAP. Dr. Snyder replied that NHSRC is just now trying to understand what the research needs are with respect to cybersecurity. This area is not a low priority. NHSRC is putting together an expert's workshop because it's unclear what research should be done in this area. Cybersecurity is within the scope and we need to make sure this research is done to benefit the water utilities. Cybersecurity was included in the StRAP to acknowledge that work will be done in this area.

Subcommittee Work Time

Dr. Olsiewski

Following Wednesday's session, Dr. Taylor developed a draft of the subcommittee's progress in answering the five charge questions. The subcommittee continued work on this draft during this session. The following represents their continued progress in addressing these questions.

Charge Question 1. Given the research objectives articulated in the StRAP, are the topics and project areas planned and organized appropriately to make good progress on these objectives in the 2016-2019 time frame?

General Observations:

- Vibrant, energetic community engaged with stakeholders.
- High morale.
- Eagerness to help out in any way they are called upon.
- Self-conscious: Trying to hone in on a few select project areas and do research in these areas well.
- Include a timeline in the StRAP with the expected schedule for products/deliverables.
    - If unable to provide this information or if this information is constantly changing, this charge question should be modified.
- Documentation of a formal process for diverting/pivoting resources to respond to emergencies is not included in the StRAP.
- Cyber issues: need to accelerate these projects and raise the priority, not big enough on the radar screen and should be its own separate project area.
    - Capabilities may need to be subcontracted if not in-house.
    - EPA needs to explain its position on cyber issues.
    - Timeline is incorrect – cannot wait until 2017/2018 to begin these projects.

Particular Strengths:

- Interested in working with others and open to listening/collaboration.
- Partners are involved and engaged in the process from project conception to deliverable of product.

Opportunities for Improvement:

- Communication with partners.
- Definition of Technology maturity levels – placeholder for TRL, tiered approach.
- Resilience is an emerging concept.
- Multi-use of tools (i.e., use for multiple scenarios).

Challenges:

- Cybersecurity.

- Social science.
- Breadth versus depth.

Recommendations:

- Cybersecurity needs to move to the front of the line.
- Social science is a crosscutting issue and should be incorporated across the board.

Charge Question 2. How effective are the approaches for involving the EPA partners in the problem formulation stage of research planning?

General Observations:

- Involved from concept to conclusion.
- Working hard, researchers are fully engaged with reaching out to partners.

Particular Strengths:

- Focusing on homeland security and an all hazards approach in response to partners (e.g., Ebola and *Burkholderia*).
- Many of their tools are modular in design and can be added on/built upon. The tools have the capabilities to have new types of threats, agents, methods loaded into the tools.
- Focusing on solid waste.

Opportunities for Improvement:

- Greater interface with scientific engineering communities to ensure they are up to date on the most current analytical techniques or technologies (e.g., increased attendance at conferences and professional meetings – more funding is needed for this activity).
- EPA's mission is mostly focused on cleanup but methodology could be leveraged to address characterization (nature and extent of contamination).
- More information on criteria used for project prioritization.
- Across the Agency, partners need to know more about social science in order to request more integration of social science research done by Homeland Security. If the same conversations are continued with the same partners than there will be stasis.
- Question to be asked (Dr. Reinhart): How does information get disseminated between interagency working groups? There is a lot of overlap that may not filter out.
- Lacking a sense of coordination for federal research programs – process to share timelines and overall plans in order to improve coordination between efforts.
- Increase outreach to utilities and "secondary partners" – checks and balances on perspectives.

Challenges:

- Tension between budget limitations and the application of an all hazards approach. There are funding limitations to implementing this approach in all scenarios.

Recommendations:

- Initiate processes for consideration of social sciences with partners at the beginning of the planning process.

Charge Question 3. How well does the Program respond to the needs of EPA partners?

General Observations:

- Need to qualify response based on the understanding of the term "partners".

- Tension between all hazards research and science…multipurpose leverage in new areas…exploiting opportunities.

Particular Strengths:

- Focusing on homeland security and an all hazards approach in response to partners (e.g., Ebola and *Burkholderia*).
- Many of their tools are modular in design and can be added on/built upon. The tools have the capabilities to have new types of threats, agents, methods loaded into the tools; constantly revisit products to keep them relevant (e.g., SAM).
- Expanding focus beyond water to solid waste is commendable.

Opportunities for Improvement:

- Have a cost consideration included in the approach/problem formulation.
- Breadth versus depth – ORD working on a lot of projects but not very deeply in any of these areas.

Challenges:

- EPA is complex in general, as many managers as worker bees making it harder to make decisions… is this relevant for us? 90 needs down to 16 projects… it was hard to figure out how they made those prioritization decisions; OFI then in prioritization that builds in cost consideration of target approach? Estimate of cost (or estimate of ROI)?
- Breadth versus depth – connected observation (Edwin).
- It is not clear to the Subcommittee how the prioritization process actually works; the process used for determining priority needs; organizational structure/communication processes.

Recommendations:

- Ensure that NHSRC has flexibility in their budget/funding planning so that the organization is able to respond to an emerging issue. Funding should be set aside to be flexible to respond to critical, unplanned, emerging issues.
- Process for reprioritization of funding should be more transparent so that it can be better understood by partners.
- Red/orange/green methodology for linking partner needs with work that the HSRP is doing (suggested by Mr. DeGraca).

Charge Question 4. How well has the Program transitioned research to the end-user? How can we improve our ability to transition research to the end-user in the future?

General Observations:

- Sampling and analysis – and remediation of wide areas – application of cost/benefit/certainty analysis to make them more end user friendly / transitional – Dr. Hulla.
- Are focused on what is the product, outcome, and what the end users need.
- Every tool is architected differently and thus requires different support.
- Missing opportunity to integrate by being on different architectures.
- Providing outputs and estimates without a level of uncertainty.
- Analysis of large amounts of data produced by tools.

Particular Strengths:

- Validation tiers for chemical sampling and analytical process.
- Review website tracking on visits to tools websites to assess popularity.

- Impressed with the power of SAM.
- Waste and decontamination tools – generally a handfuls of users… WEST more widely available.

Opportunities for Improvement:

- Tool development – Move applications to a smaller number of platforms so there is better operability between things; smaller number of platforms; as future versions of software products are revised, move to a smaller number of platforms for interoperability – Mr. Hackney.
    - Water tools – transition to software stakeholders per best practices established by Dr. Haxton (technical tools and updates).
    - Outputs from some of tools are things that the EPA might care about, but are not useful for end user like a utility – stakeholder outreach with utilities for defining those end user community – e.g., small, med, large hospital – how about number of beds.
- Make more modular and applicable to as many hazards as possible (Dr. Hulla).
- Leverage economies of scale with partnerships with local capabilities in the evolution of technology (Dr. Reinhart).
- Add cost-benefit analysis and uncertainty analysis to make decision making tools more end-user applicable.
- Addressing sampling and analysis and addressing remediating wide areas – two applicable research areas.
- The sustenance of these application tools is something that becomes very onerous and time consuming, had a great conversation with Dr. Haxton about her approach to those tools and transition to software developers, transition to someone who is an expert in migration and version control once intellectual capital is established. Is it reasonable to include a recommendation to the researchers to work towards making tools publically available on these platforms?
- Is a background check required for the folks who are brought in to transition these tools?
- Transition can be beneficial to security of the nation and advancement of the tools.
- Dr. Snyder: this is a fair suggestion for water tools, for waste and decontamination ST tools the audience is limited; smaller than a handful. Want simple platforms so that end users do not need to make a large investment in a new platform.
- Thinking about the end users and determining if the output is the correct output. Tweaking outputs to make them more user friendly.
- One page fact sheet on contaminants with data on analytical methods, turnaround times, etc. Want to only look at one resource for this information. More user friendly and digestible.
- Working on updating this with more recent data.

Challenges:

- Scaling from the laboratory to the field (i.e., BOTE study; BOTE's are expensive, how can scaling be accomplished more economically?)
- Underestimation of application of more sophisticated approaches.
- Local resources are limited but may be capable of more sophisticated approaches
- Tools training to eliminate the need for experts.
- More technology evaluation (e.g., biosensors used in the field) – may impact the sampling approaches used.
- End users need to know if technology is ready for prime time and the confidence in these technologies.

Recommendations:

- Improve outreach and engagements with water utilities (i.e., more systematic and coordinated approaches to get input and feedback from water utilities).

    - Use plain language; consideration of knowledgebase of end users (element of social science).
- Validation tiers for biological and radiological sampling and analytical processes
- Scalability with respect to decontamination – SAM equivalent for decontamination (Dr. Taylor's notes: See second recommendation in notes – Dr. Hulla's comment regarding validation of numbers; Mr. DeGraca's comments piled on relative to this, but Dr. Sayles was struggling with applicability – thought that a recommendation was in there, but… field validated versus… applicability… Validation has more meaning to "utilities" i.e., Mr. DeGraca… (validation tiers for bio and rad sampling) SAM equivalent for decontamination).
- Track and analyze web visits/downloads/internet traffic.
- Distinguish your product as a research tool or a technology transfer tool.

Miscellaneous:

- Use of real time sensors to monitor conditions so we can assess the decontamination process.
- More rugged sensors are not yet in the marketplace.
- Constant data stream – cyber risk associated with multiple points of entry.

Charge Question 5. How can we infuse social science into the development of our research products to improve their usability?

General Observations:

- Improve usability is the key – organizational dynamics, political, and connection to the physical science technical that work is occurring in.
- Two different ways that we can infuse both of these…
- In many cases, ORD staff are already sensitized to the fact that their operational partners face many complex social and political challenges when conducting their everyday work and using ORD research products. At some level, ORD staff have an intuitive understanding of some of the issues faced by first responders that a social scientist could more systematically investigate.
- Strong appetite for infusing more social science and also for understanding the potential in this area – What is social science and what can it do for us? There is a desire to understand how social science can help more.
- There is implicit social science going on. There is awareness about the real world context in which these products are rolled out. Gets into organization dynamics and politics. Could be more systematic though.
- Right now in the partner relationships there is some social and political elements - There is in the partner relationships some awareness of what is going on that is social and political, but is presently holding up the potential applications.
- More involvement with first responders/better communication with stakeholders.
- Importance of self-help tools – do we always think about this aspect?
- Not relying on government to help, things a person can do on their own.
- Encouragement to do more.

Particular Strengths:

- Stakeholder adoption of work.
- There is both bottom up and top down support in innovative projects like the Siri projects, there has been stakeholder adoption of this work.
- Seems to be a history of attention to public communication challenges around decontamination and other matters but that vein of research has stopped due to competing priorities amid scarce resources.
- Encouragement to do more self-help.

Opportunities for Improvement:

- Low hanging fruit – BOTE II that pays attention to the communication dilemmas that arise surrounding decontamination choices.
- Social factors relative to citizens taking waste into their community; railcar decontamination had to happen at LLNL instead of in the community it occurred.
- There could be expanding select current projects to address public communication aspects such as BOTE 2, pays attention to the communication dilemmas that rise for decision makers around explaining their choices for decontamination approaches – already work going on but there is a public communication element that could be valuable to the decision makers, some guidance that could involve pretesting select messages.
- Could be systematic inquiries into operational realities faced into the field, ex: communities taking waste, decisions made on decontamination approaches – that would help provide greater context for decision making tools.
- Opportunity or Decision: Orientation workshop that brought in social scientists who work in homeland security space so that researchers with a variety of different trainings can see the work done in risk communication pipeline and organizational dynamics that improve consequence management.
- SME could be brought in.
- Tap into other partners within EPA to raise the responsiveness to community value questions.

Challenges:

- This topic is not funded explicitly so the leadership will need to creatively need to integrate this.

Recommendations:

- Develop activities such as workshops and expert lectures to provide an orientation to the potential applications of psychological, sociological, anthropological elements and how to make it integral to existing project activities; already assets in EPA – Community Involvement Coordinators in other partner organizations could help with this.
- Capitalize on the low-hanging fruit opportunities – infusion opportunities; follow on work to existing initiatives like the BOTE, in risk communication.
- Identify opportunities to integrate social media (e.g., situational awareness, communication, self-help, data mining and mapping).

Wrap Up and Adjourn

Dr. Sayles thanked the subcommittee for their participation and the work done this week. He appreciated the BOSC's interaction with ORD staff and is looking forward to future interactions.

Mr. Tracy dismissed the group and thanked them for their participation.

Appendix A: Agenda

United States Environmental Protection Agency Board of Scientific Counselors (BOSC)

Homeland Security (HS) Subcommittee

Meeting Agenda – August 25–27, 2015

Cincinnati, Ohio

TIME	TOPIC	PRESENTER
Tuesday, August 25, 2015		
7:30 - 8:00	Registration	
8:00 - 8:15	DFO Welcome	Thomas Tracy
8:15 - 9:00	Introductions and Review of Charge Questions	Paula Olsiewski
9:00 - 10:00	Program Overview	Gregory Sayles
10:00 - 10:15	Break	
10:15 - 11:15	Research Overviews	EPA Project Leads
11:15 - 12:00	Partner Engagement throughout the Research Lifecycle	Emily Snyder
12:00 - 1:30	Lunch	
1:30 - 2:30	Classified Briefing on Homeland Security Threats (Closed)	Gregory Sayles and others
2:30 - 4:00	Research Overview Posters and Engagement with Researcher (Session 1)	All
4:00 - 5:00	Group Q &A on Posters	All
5:00 – 5:15	Wrap Up and Adjourn	
Wednesday, August 26, 2015		
8:00 - 10:00	Research Overview Posters and Engagement with Researchers (Session 2)	All
10:00 - 11:00	Group Q &A on Posters	Subcommittee
11:00 - 11:30	Video Presentation of the Bio Operational Testing and Evaluation Project	All
11:30 - 1:00	Lunch	All
1:00 - 3:00	Tools Café	All
3:00 - 6:00	Subcommittee Work Time	Paula Olsiewski
6:00 - 6:15	Wrap Up and Adjourn	
Thursday, August 27, 2015		
8:00 - 8:30	Assemble and coffee	All
8:30 - 10:00	Partner Panel Discussion • Mike Nalipinski – EPA Office of Solid Waste and Emergency Response's Office of Emergency Management • Debbie Newberry – EPA Office of Water's Water Security Division • Ross Elliott - EPA Office of Solid Waste and Emergency Response's Office of Resource Conservation and Recovery • Ben Franco – Region 4 On-Scene Coordinator	Emily Snyder

	• Terry Smith - EPA Office of Solid Waste and Emergency Response's Office of Emergency Management • Jeff Swertfeger – Greater Cincinnati Water Works	
10:00 - 10:30	Public Comment (if any)	
10:30 - 11:30	Open Discussion and Wrap up	All
11:30 - 2:00	Subcommittee Work Time	Paula Olsiewski
2:00 - 2:15	Wrap Up and Adjourn	

Breaks at the discretion of the chair.

Appendix B: Participants

BOSC HS Subcommittee Members:

Paula Olsiewski, *Chair*
Tammy P. Taylor, *Vice Chair*
Andrew DeGraca
Edward Hackney
Janis E. Hulla
Debra R. Reinhart
Edwin A. Roehl, Jr.
Monica L. Schoch-Spana

EPA Designated Federal Officer (DFO): Tom Tracy, *Office of Research and Development*

EPA Presenters:

Greg Sayles, *Office of Research and Development, National Program Director for the HS Research Program*
Emily Snyder, *Office of Research and Development, Deputy National Program Director for the HS Research Program*
Tonya Nichols, *Office of Research and Development, National Homeland Security Research Center*
Hiba Ernst, *Office of Research and Development, National Homeland Security Research Center*
Shawn Ryan, *Office of Research and Development, National Homeland Security Research Center*
Mike Nalipinski, *Office of Solid Waste and Emergency Response's Office of Emergency Management*
Debbie Newberry, *Office of Water's Water Security Division*
Ross Elliott, *Office of Solid Waste and Emergency Response's Office of Resource Conservation and Recovery*
Jim Mitchell, *Region 5, On-Scene-Coordinator*

Other EPA Attendees:

Eletha Brady-Roberts	Terra Haxton	Regan Murray
Jonathan Burkhardt	Robert Janke	Kathy Nickel
Worth Calfee	Sang Don Lee	Jeff Szabo
Romy Campisano	Paul Lemieux	Sarah Taft
Steve Clark	Matthew Magnuson	Joseph Wood
Brendan Doyle	Keely Maxwell	
Vince Gallardo	Leroy Mickelsen	

Other Participants:

Jeff Swertfeger, *Greater Cincinnati Water Works*

Contractor Support:

Kaedra Jones and Amanda Ross, ICF International

Appendix C: EPA Office of Research Development Definition of Terms

Roles:

Partner – Our primary customers; the end-users of our work from whom we performed it; the groups from which we solicit needs, invite to work with us on the research, and work closely with on formulation and delivery of the outputs. Since HSRP's mission is to improve the capability of EPA to carry out its homeland security responsibilities, our Partners are the operational offices at EPA. Since EPA's Office of Water works very closely with utilities, we consider utilities as partners as well and the EPA offices.

Examples: Office of Emergency Management's Office of Emergency Response and Office of Resource Conservation and Recovery (and divisions and branches below), Office of Water's Office of Groundwater and Drinking Water (Water Security Division), Regions, and water utilities.

Stakeholder – External entities that benefit from our research. Although these entities may use EPA Homeland Security research products or outputs, they are not the primary end-users of the research.

Examples: Department of Homeland Security, Department of Health and Human Services (includes Centers for Disease Control), Department of Defense, state laboratories, etc.

Results of our research:

Product - A deliverable produced by the research program.

Examples: Journal articles, detailed reports, and conference proceedings.

Output – A deliverable produced by the research program developed to be directly usable by our Partners.

Example: Decision support tools, sampling and analysis methods, and data syntheses.

Partner need – A capability gap determined and prioritized with Homeland Security Research partners. Needs are used to plan Outputs.

Example: Self-help decontamination and risk reduction measures for anthrax.

Products →	**Outputs**
The scientific ingredients that often are synthesized into an Outputs	*Designed to be immediately usable by our Partners*
Journal articles Detailed reports Conference proceedings	Decision support tools Sampling and analysis methods Data syntheses