BOSC
BOARD OF SCIENTIFIC COUNSELORS

REPORT OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY BOARD OF SCIENTIFIC COUNSELORS HOMELAND SECURITY SUBCOMMITTEE

RESPONSES TO CHARGE QUESTIONS

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CONTENTS

LIST OF ACRONYMS

ASPECT	Airborne Spectral Photometric Environmental Collection Technology
AWWA	American Water Works Association
BG	Bacillus *globigii*
BOSC	U.S. EPA Board of Scientific Counselors
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CESER	U.S. EPA Center for Environmental Solutions and Emergency Response
CISA	Cybersecurity and Infrastructure Security Agency
COVID-19	Coronavirus Disease 2019
DHS	U.S. Department of Homeland Security
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ESF	Emergency Support Function
HS	Homeland Security
HSRP	Homeland Security Research Program
ICCOPR	Interagency Coordinating Committee for Oil Pollution Research
INL	Idaho National Laboratory
NCP	National Contingency Plan
NCPPS	National Contingency Plan Product Schedule
NSF	National Science Foundation
OEM	U.S. EPA Office of Emergency Management
OLEM	U.S. EPA Office of Land and Emergency Management
ORD	U.S. EPA Office of Research and Development
OW	U.S. EPA Office of Water
PFAS	Per- and polyfluorinated alkyl substances
RACT	Research Area Coordination Team
RFP	Request for proposal
SME	Subject Matter Expert
StRAP	Strategic Research Action Plan
TPH	Total petroleum hydrocarbons
WAF	Water-Accommodated-Fraction
WRF	Water Research Foundation
WSTB	Water Security Test Bed

INTRODUCTION

The U.S. Environmental Protection Agency's (EPA's) Homeland Security Research Program (HSRP) addresses science gaps related to remediation of environmental contamination that threatens public health and welfare, as well as science gaps related to environmental quality before, during, and after a disaster. HSRP helps EPA carry out its homeland security (HS) and emergency response mission by working closely with its partners to understand the potential threats and consequences of hazardous substance release. HSRP works in coordination with partners and stakeholders to conduct the research necessary to provide decision makers the information they need for their communities and environments to rapidly recover after a disaster.

The HSRP is focused on addressing two primary research objectives:

- Advance EPA capabilities to respond to wide-area contamination incidents; and
- Improve the ability of water utilities to prevent, prepare for, and respond to water contamination that threatens public health.

The research to address HSRP partner needs is organized into seven research areas. The research areas are descriptive of the program and align with EPA's response decisions supporting recovery under the National Response Framework, specifically with respect to EPA's lead role under Emergency Support Function #10 - Oil and Hazardous Materials Response Annex (ESF-10). EPA also leads inland responses to hazardous materials and oil releases under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Oil Pollution Act authorities. These response decisions are highly interdependent, with one decision impacting other decisions. The research areas are designed to reflect and support this interdependent system of activities through coordination across the program in support of the HSRP's two primary objectives.

The HSRP research areas are: (1) Contaminant Fate, Transport, and Exposure, (2) Contaminant Detection/Environmental Sampling and Analysis, (3) Wide-Area Decontamination, (4) Water Treatment and Infrastructure Decontamination, (5) Oil Spill Response, (6) Waste Management, and (7) Tools to Support Systems-based Decision-making.

Under the current EPA HSRP Strategic Research Action Plan (StRAP) (2019–2022), HSRP is conducting research that contributes directly to deliver research results and solutions needed to support EPA's overall mission to protect human health and the environment, fulfill the EPA's legislative mandates, and advance cross-Agency priorities.

EPA's recent reorganization, presented as the simplified Homeland Security Enterprise, positions the HSRP well to continue to assess homeland security science needs of EPA partners and stakeholders. HSRP is currently working with three primary partners to identify needs and develop products and outputs associated with their homeland security responsibilities, including protecting and restoring drinking water supplies and infrastructure, and helping communities become more resilient to natural disasters and to acts of terrorism that involve chemical, biological, or radiological weapons. EPA supports three different offices: (1) The Office of Emergency Management (OEM) which reports to the Office of Land and Emergency Management (OLEM), and provides programmatic regulations and guidance for environmental preparedness and responses; (2) The Office of Water (OW); and (3) regional offices which direct the environmental responses in the field, led by the on-scene coordinators.

The EPA Board of Scientific Counselors (BOSC) HS Subcommittee reviewed the entire program in 2019 through a review of the program's StRAP. Over the course of the next two years (2020–2021), the program intends more in-depth reviews with the BOSC HS Subcommittee focused on research under the research areas.

The focus of this current BOSC HS Subcommittee is to review two research areas: Research Area #4 - Water Treatment Infrastructure Decontamination and Research Area #5 - Oil Spill Response.

The BOSC HS Subcommittee was given specific charge questions to guide its review. The Subcommittee reviewed the charge questions, received briefings from HSRP leadership on Research Area #4 and #5 topic areas, and met as sub-teams to address the charge questions and write this report. The BOSC HS Subcommittee meeting agenda and references to briefing materials can be found on EPA's website.

CHARGE QUESTIONS AND CONTEXT

The HS Subcommittee was charged with addressing a series of questions about two HSRP research areas: Research Area #4 - Water Treatment Infrastructure Decontamination and Research Area #5 - Oil Spill Responses. Charge questions were as follows:

Research Area #4 - Water Treatment Infrastructure Decontamination

Q.1a. How well does the water research portfolio of proposed Products and Outputs respond to the partner-identified needs?

Q.1b. The Water Security Test Bed (WSTB) is a critical capability for the water research portfolio to assess full-scale decontamination approaches for contaminated infrastructure, including premise plumbing, and emergency on-site treatment of contaminated water. Are there suggested improvements to the test bed, to the planned research, and/or partner/stakeholder involvement for StRAP implementation?

Q.1c. The HSRP wastewater research is informed by Water Research Foundation (WRF) and National Science Foundation (NSF) workgroups to examine the fate of priority pathogens in wastewater collection system infrastructure and in wastewater treatment plants. To what extent is the planned research and capabilities adequate to address the acceptance and safe/effective treatment of wastewater?

Research Area #5 - Oil Spill Response

Q.2a. The U.S. EPA has the regulatory responsibility for maintaining the National Oil and Hazardous Substances Pollution Contingency Plan Product Schedule (NCPPS), which lists commercially available spill-treating agents for oil spill response operations. Please provide recommendation on how protocol development can be improved or advanced to support the EPA OLEM Program Office which maintains the NCPPS. How can our research program improve partner and/or stakeholder engagement beyond the EPA Program Offices?

Q.2b. Spilled oil that cannot be mechanically removed from the environment undergoes physical, chemical, and biological changes that affect the behavior and ultimate fate of the oil. To better assess oil behavior and the impact of oil on ecosystems, HSRP conducts research on biodegradation,

toxicity, dispersion, and detection of oil in water. Please provide recommendations on how to expand or improve experiments conducted within this Research Area and to improve the delivery or dissemination of products to our partners and stakeholders.

The responses of the HS Subcommittee to the charge questions are contained in the following section.

SUBCOMMITTEE RESPONSES TO CHARGE QUESTIONS

Charge Question 1 Topic Area: Research Area #4 - Water Treatment Infrastructure Decontamination.

Charge Question 1a

Q.1a. How well does the water research portfolio of proposed Products and Outputs respond to the partner-identified needs?

Narrative

The water research portfolio of proposed Products and Outputs responds well to the partner-identified needs. HSRP has a strong network of partners through the Office of Land Management, the Office of Water, and EPA regional offices. The HSRP has a proven track record of delivering needed products. The new EPA Center for Environmental Solutions and Emergency Response (CESER) is an asset to the HSRP program. The emphasis is on customer driven research, including the identification, planning, product development, and data transfer leads to advances in early warning, response, and recovery capabilities.

Strengths

- HSRP works with a wide array of partners to identify and address needs.
- HSRP has developed a number of products that directly address partner's needs.
- HSRP remains agile in adjusting to newly emerging research needs based on current events such as the Coronavirus Disease 2019 (COVID-19) and the California wildfires.
- HSRP is working with health agencies to monitor for pathogens, whether natural or terrorism related. For example, the COVID-19 experience is better positioning the Agency to develop decontamination procedures.
- HSRP has demonstrated ability to pivot from all- hazards to specific pathogens.
- HSRP is evaluating on-premise plumbing to better assess potential interior exposure. This is much needed. Homeowners are looking for guidance. Newer home construction utilizes plastic plumbing materials.
- HSRP continues to publish on various issues including but not limited to management of pathogens, lead, and Legionella.

Suggestions

- Develop an annual process for checking in with partners to better identify needs beyond those provided by the various EPA offices.

- Evaluate current partners and determine if there are additional partners, e.g., utilities, professional associations, etc. that should also be approached for input.
- Partner with EPA experts developing non-targeted suspect screening methods to establish a capability to expand screening and detection to additional compounds some of which might be "unknowns."
- There were two areas that the committee identified that could be strengthened. Currently cybersecurity is a medium priority area, and this should be elevated to a high priority area. While the work in sensors is going well, the research plan could be improved by developing molecular sensors to detect current and future biothreats.

Recommendations

The Subcommittee offers these recommendations to support the relevant Agency priorities:

Recommendation 1a.1: Increase the focus on cybersecurity research and prioritize consequence research and research on vulnerabilities in drinking water system security and system elements common to drinking water and wastewater systems.

Recommendation 1a.2: Leverage investments by other federal organizations and the private sector to customize sensors for priority molecules for deployment in systems critical to the water resources portfolio.

Charge Question 1b

> Q.1b. The Water Security Test Bed (WSTB) is a critical capability for the water research portfolio to assess full-scale decontamination approaches for contaminated infrastructure, including premise plumbing, and emergency on-site treatment of contaminated water. Are there suggested improvements to the test bed, to the planned research, and/or partner/stakeholder involvement for StRAP implementation?

Narrative

Ongoing development of the WSTB aims to provide full-scale, research and development test beds for water and wastewater distribution systems, large building premise plumbing, wastewater collection systems, and cybersecurity. The overall goals are to prevent, minimize, and/or ameliorate contamination events and cyberattacks. The emphasis on full-scale testing arose in part from some studies showing non-translatable pilot-scale results. For example, decontamination results for pipes contaminated with an anthrax surrogate, Bacillus *globigii* (BG), were much better at pilot scale than full scale, such that full scale required a completely different decontamination approach. Near-full-scale research is important given pilot scale research misses real world variables and increases end user acceptance (e.g., end user may not be comfortable deploying pilot scale research during a real emergency).

EPA's OW and its partnering offices have each created a list of prioritized "needs" to be addressed by HSRP research. Of 11 OW needs, five have already been addressed in some way using the WTSB. A need for cybersecurity is now being pursued. Similarly, nine of 12 partner needs have been addressed in some way. HSRP personnel believe the remaining needs can be addressed with upgrades, such as increased

distribution network complexity, and installing a wastewater collection system and a small treatment system.

In addition to the above BG decontamination, other completed decontamination experiments include chlorine dioxide efficacy, physical pipe scouring and relining, Bakken crude oil flushing, washdown and per- and polyfluoroalkyl substances (PFAS) water treatment, and premise plumbing contamination and decontamination. Currently planned experiments will build on the pipe re-lining and premise decontamination, evaluate mobile emergency water treatment systems, and add radionuclide detection, decontamination, and treatment.

In August 2017, EPA's National Homeland Security Research Center convened a panel of Subject Matter Experts (SMEs) at the WSTB to elicit independent viewpoints of the overall concept, approach, implementation, and sustainability of the WSTB. Proceedings are described in EPA/600/R-18/165, "Subject Matter Expert Panel Review of the Full-Scale Water Security Test Bed (WSTB) - A Summary Report", May 2018. The SMEs represented drinking water, wastewater, and storm water trade associations; a large water and wastewater utility; state drinking water administrators; and the Idaho National Laboratory (INL). Topics discussed included distribution system, premise plumbing, and water treatment decontamination research.

A major advantage of being located at the INL is the ability to perform near full-scale radiation injections. A short half-life isotope of potassium bromide, available from academic institutions with small scale production reactors, would be an attractive surrogate tracer for simulating radiation fate and transport in the test bed. HSRP personnel are not aware of another facility that can accept and handle radioactive material and inject it into large or full-scale water piping and appurtenances. Performing experiments to detect and decontaminate radiation from water infrastructure is a big opportunity for EPA and the INL. A first test was very close to being conducted in July 2019 before it was cancelled due to a wildfire. The strategy developed by the radiation safety personnel is to store all contaminated water in frac tanks on site and let it decay naturally until radiation safety personnel verify the contamination has dropped to background levels (over approximately 30 days). The water will then be disposed of normally.

Another major opportunity is cybersecurity for the Water and Wastewater Systems Sector, which has been designated a critical infrastructure sector by the Cybersecurity and Infrastructure Security Agency (CISA). CISA is an operational component under the U.S. Department of Homeland Security (DHS). The INL has established cybersecurity test beds for wireless networks (Communications Sector) and electrical power systems (Energy Sector). Collaboration would require coordination with the DHS, which the INL is already pursuing. The impact of electromagnetic pulses on these sectors could be evaluated together as part of a full-scale exercise. Although the EPA has begun work in water and wastewater cybersecurity, they understand there is much they do not know, so they are actively looking to engage knowledgeable groups. The challenge for the EPA is engaging the DHS and private industry to build the needed physical and cybersecurity infrastructure for testing scenarios of interest.

Opportunities exist for more engagement directly with water utilities and trade associations (American Water Works Association, or AWWA, Water Environment Federation, WRF etc.). The challenge for a research organization is how to build and maintain relationships with a wide variety of stakeholders and summarize their needs with limited staff and resource. Other unaddressed needs include the following.

- Research necessary to provide input for OW training and webinar materials.

- Companies and universities are looking for partners to collaborate on industry requests for proposals (RFPs).
- Water utilities are requesting help on operator training and certification in detecting and responding to cyberattacks. The ability to host large groups of operators at the WSTB would require upgrades to office and meeting spaces, bathrooms, etc.

  Private companies are seeking full-scale technology challenges. For example, the premise plumbing test bed offers opportunities to use Cooperative Research and Development Agreements and Memorandums of Understanding to work with private industry to help design appliances such as hot water heaters, refrigerators, and dishwashers to facilitate decontamination. Previous findings indicate certain design changes would greatly facilitate decontamination. Like training and certification, the WSTB could need upgrades to accommodate private groups and potentially their large and expensive equipment.

Strengths

- Doing experiments at full scale can result in different results from pilot scale – example is the BG decontamination, where pilot showed no spores detected after treatment with 25-30 mg/L ClO_2, but data from full scale show spores persisted in presence of up to 100 mg/L ClO_2.
- WSTB could be easily expanded to increase the scope of research performed at the facility.
- The co-located distribution system, premise plumbing, wastewater collection, and cybersecurity test beds provide for wholistic, integrated research.
- The WSTB site has the space and some existing infrastructure needed to expand the scope of water systems research.
- Full-scale distribution system and premise plumbing experiments at the WSTB can verify pilot-scale results and provide feedback to improve pilot scale experimental processes. Different types of experiments using the distribution system and premise plumbing test beds have demonstrated efficacy.
- Premise plumbing test bed can support designing consumer appliances for decontamination.
- Unique radiation capabilities of distribution system and premise plumbing test beds.
- Location and relationships with the INL's CISA-supported cybersecurity test beds for wireless networks and electrical power systems will accelerate the EPA's cybersecurity program for water and wastewater systems and support full-scale exercises that integrate all three test beds.
- The WSTB operational technology cybersecurity program has established partners with agreements in place. It includes governmental and limited utility, industrial, university, and consulting partners.

  Increased partnering outside the EPA has broadened program opportunities, e.g., the INL cybersecurity. Partners to date have been mostly U.S. governmental, however, several prospective partners have shown interest, including utilities, industrials, universities, and consultants, which could yield new sources of funding.

Suggestions

The BOSC HS Subcommittee sees the panel proceedings described in the report EPA/600/R-18/165 as being comprehensive and relevant to Charge Question 1b, therefore, the Subcommittee fully supports

that panel's recommendations. The following suggestions and recommendations are meant to augment the panel's recommendations.

- **On-site Test Water Formulation** – augment the above panel recommendation *Evaluate variable finished water quality impacts…* by developing capability for changing the quality of the WSTB's ground source water to create waters having different qualities, e.g., the water qualities of specific utilities.
- **Marketing** - expand awareness the WSTB's capabilities and research among potential beneficiaries of the WSTB's capabilities, such as utilities, academic researchers, research foundations, trade associations, regulators, consultants, etc., through articles in water/wastewater industry trade and scientific print media, conference presentations, webinars, etc. Note that a brief web search for the WSTB primarily turned up only official EPA material.
- **Opportunities for Collaboration -** Consider expanding collaborations to address cybersecurity for the Water and Wastewater Systems Sector, which has been designated a critical infrastructure sector by the CISA. Other potential collaborations for consideration include partnering with institutions that can provide materials (tracers) short half-life radiation injections to understand fate in these water systems.

Recommendations

The Subcommittee offers these recommendations to support the relevant Agency priorities:

Recommendation 1b.1: Develop a Broad End-user Partner/Stakeholder Involvement Process - throughout the research cycle so that products have a better chance of being used for actual emergencies and other opportunities; to include transitioning from "passive" (e.g., ad hoc encounters at professional association meetings) to more "active" stakeholder engagement that involves advanced planning, regularly scheduled encounters, and tracking networking progress. Greater emphasis should be placed on recruiting SMEs from utilities, professional association/research entities (WRF, AWWA Water Utility Council, etc.), academia, and consultants (not just EPA regions). Earlier and ongoing input should be received from a broader range of stakeholders to drive improvements in the WSTB itself and the research it generates.

Recommendation 1b.2. Develop a Long-term WSTB Build Out Plan to Address the Full Water Cycle - by including wastewater collection and treatment and building water systems. The current general drinking water system decontamination strategy presumes that contaminated drinking water will be discharged into wastewater collection systems. A much better understanding of contaminant "fate and transport" through wastewater systems is needed to more readily restore drinking water systems, e.g., wastewater systems will need to approve contaminated water discharges into collection systems. Conducting drinking water and wastewater research concurrently should also lead to efficiencies.

Charge Question 1c

Q.1c. The HSRP wastewater research is informed by Water Research Foundation (WRF) and National Science Foundation (NSF) workgroups to examine the fate of priority pathogens in wastewater collection system infrastructure and in wastewater treatment plants. To what extent

is the planned research and capabilities adequate to address the acceptance and safe/effective treatment of wastewater?

Narrative

After the 2014 Ebola outbreak, there was a high level of national interest in the fate of pathogens in water resource recovery facilities (WRRFs). HSRP has actively worked to address many of the questions associated with the potential survivability of these priority pathogens within the wastewater collection system and wastewater treatment plants, including their potential to be released back into the environment.

Strengths

- HSRP is actively working with partners to examine the fate of priority pathogens within wastewater.

The Training and Education facility in Cincinnati, Ohio offers a valuable resource to model many different scenarios at pilot scale.

Suggestions

- Reach out to groups, such as MITRE Corporation and others, that are currently working on COVID-19-related wastewater surveillance programs to be actively involved in the evolving efforts.
- Develop a disaster/emergency response capability that would enable HSRP researchers to respond shortly after an disaster/emergency to conduct research on the impact of the disaster on the local wastewater treatment infrastructure, as well as conduct research on the impact of compromise/failures due to the disaster of the wastewater treatment infrastructure on both human health and the environment.

  HSRP should explore the potential impacts of priority pathogens on frontline workers in the wastewater industry.

Recommendations

The Subcommittee offers these recommendations to support the relevant Agency priorities:

Recommendation 1c.1: To improve the adequacy and translational value of the research portfolio, HSRP should improve the connection between pilot scale studies and field studies by partnering with municipalities researching priority pathogens in full scale operating wastewater systems.

Recommendation 1c.2: HSRP should increase research into the nature and extent of storm water related releases of priority pathogens in untreated sewage from treatment plants in natural disasters to address a limitation of the existing research portfolio.

Charge Question 2 Topic Area: Research Area #4 - Water Treatment Infrastructure Decontamination.

Charge Question 2a

Q.2a. The U.S. EPA has the regulatory responsibility for maintaining the National Oil and Hazardous Substances Pollution Contingency Plan Product Schedule (NCPPS), which lists

commercially available spill-treating agents for oil spill response operations. Please provide recommendation on how protocol development can be improved or advanced to support the EPA OLEM Program Office which maintains the NCPPS. How can our research program improve partner and/or stakeholder engagement beyond the EPA Program Offices?

Narrative

The EPA Office of Research and Development (ORD) recognizes the importance of providing strategic partners reliable resources that support effective and safe responses to petrochemical releases. Understanding the impact of approved chemicals on local and regional ecosystems, and developing standard testing and evaluation protocols are priorities for ORD. To accomplish this mission, as set forth in Subpart J, Section 311 of the *Clean Water Act*, ORD has worked with partners to prioritize needs and undertaken significant efforts to standardize these test and evaluation protocols for oil spill response. Recent initiatives have included protocol development in the product areas of dispersants, surface washing agents, and herding agents used for in-situ burning.

ORD recognizes that studying the behavior and environmental fate of oil spill response agents and their degradation products is necessary to assure guidance for safe use, based upon a full understanding of ecological impacts. In the past five years, significant efforts have been undertaken to characterize biodegradation and photo-weathering of oils. Studies have specifically examined photo-weathering influences in hypersaline waters, wave-based mechanical dispersion of oil plumes, and oil droplet, density, and dispersion modelling.

HSRP identified the need to update and standardize protocols, last updated in 1994. On January 22, 2015, EPA released proposed rule changes (*Federal Register* Volume 80, No. 14) to accomplish this update. Several changes to the National Contingency Plan (NCP) were made, including changing the Water-Accommodated-Fraction (WAF) methodology from use of a blender to a slow-stir process. In addition to the proposed changes to the WAF test protocol, ORD wanted to include new species and taxonomies to broaden its understanding of oil and agent toxicology; however, these changes were not incorporated into the 2015 final rule. Broadening the species and taxa of test subjects provides increased understanding of the chemical impact to the varied biological systems in which they are deployed.

Efforts by HSRP to increase the number of species for toxicology testing are well directed. Specifically, prioritization of species selection based on historical use of standard test species, strong existing protocols, and large databases provides a benchmarking capability which leverage past investments, existing expertise, and data. Inclusion of freshwater species, which supports data gathering to evaluate oil spill response agents in freshwater is an important goal. Expansion to include invertebrates is well justified by the need to broaden the depth of ecosystem element representation.

Recently, ORD identified a need to evaluate the effectiveness of surface washing agents. Cleaning shoreline and riparian zones using surface washing agents is time consuming and requires extensive resources. Research staff recently developed a protocol for evaluating agent effectiveness. The initial methodology was not consistently repeatable by end users, perhaps due to chemical variability between agents. To address these limitations staff have suggested methodological changes to increase protocol reliability.

Recent HSRP projects have aimed to characterize oil slick thickness and spread using emerging technological instruments, such as unmanned aerial vehicles, the EPA Airborne Spectral Photometric

Environmental Collection Technology (ASPECT) aircraft and orbital satellites. Oil slicks are dynamic, and it is crucial to fully characterize plumes to provide responders information for accurate and timely remedial strategy development. While initial results of this research are promising, future project milestones include consolidating layered of datasets, which should improve the understanding of slicks and to fully develop three-dimensional models. Data gathered from this project may also prove valuable for testing agent effectiveness.

An ongoing identified need includes building and maintaining a stockpile of reference oils with which to conduct product testing. While ORD has reached out to numerous sources, it has encountered obstacles to procure small samples (a few barrels) of the identified oils. The oil needed for this testing is limited to specific sourced locations and grades and cannot include general stockpile blends. Vendors who maintain supplies of these oils have been unwilling to sell small quantities to ORD. Recent disasters have further depleted limited supplies of oils, so the need to identify and maintain a reliable source is great. The reference oils requirement cannot be overstated, given the dramatic increase in domestically produced shale oils, which are comprised of shorter carbon chains, and contain little or no sulfur. Past research conducted on imported heavier crude oils do not yield the same results as new domestic crude oil as far as droplet size, density, and ability to float or sink during aquatic spills or leaks. Additionally, with imported crude oils, common environments for spills—oceans and ports—are far different than those for domestically produced oils. Domestic crude production expands spill potential locations to include inland lakes and rivers, which require distinctly different testing and species for toxicology research. Domestic crude oils that lend themselves to faster bioremediation and natural attenuation in the soils are much easier to refine with lower energy expended to yield final products and therefore have a smaller carbon footprint that heavier, more sulfur laded imported crude oils.

Sandia National Laboratory, in conjunction with the U.S. Department of Energy (DOE) has in recent years acquired quantities of domestically produced crude oil for testing related to transportation safety. These entities might well provide a new pathway for access to quantities of domestically produced crude oils for the continued ORD research into crude oil spill cleanup and remediation.

HSRP has demonstrated extensive use of leveraging partnerships to supplement existing funds and overcome resource limitations. Leveraging partners continues to be a critical force multiplier for HSRP. Collaborations with the National Academy of Sciences, Pegasus Technical Services, Interagency Coordinating Committee on Oil Pollution Research (ICCOPR), Gulf Coast Research Initiative, and the Woods Hole Oceanographic Institute, have produced critical information and understanding of the chemical fate and ecological impact of oil spill response agents. Emergency response support teams continue to foster strong relationships with the National Response Teams and ICCOPR to identify gaps in research and prioritize research needs. A recent study, initiated in response to a stated need of OLEM, examined oil density, droplet size distribution, and their impact on listed dispersion product effectiveness. These partnerships resolve gaps in knowledge and expertise, overcome limitations of test facilities, and add critical research personnel to the larger team.

Strengths

- Given resource limitations, ORD has demonstrated consistent ability to leverage partner and stakeholder collaboration to broaden its knowledgebase, testing capability, and output to meet their mission.

- ORD consistently test products on a few standard species, as defined in Appendix C of the *Clean Water Act,* using Species Sensitivity Distribution estimate toxicity in untested but potentially impacted species in an ecosystem concern.
- Prioritization of species selection based on historical use of standard test species, strong existing protocols, and large databases that can be leveraged for benchmarking is a valuable strategy because it leverages past investments, existing expertise, and data. The inclusion of freshwater species and algae to generate data to support evaluation oil spill response agents in freshwater and across broader taxa is an important goal. Expansion to invertebrates is well justified by the need to expand the depth of ecosystem element representation.
- The research into oil slick characterization and utilization of advanced technologies is impressive. Although the stakeholder need for this research was response-based, data will provide information for development of methodology and test protocols for oils and agents in the future.

Suggestions

- HSRP could broaden their strategic partnerships through engagement with the European spill response organizations and other international organizations to potentially include the Commonwealth Scientific and Industrial Research Organization, as well as the Canadian Government through the multi-partner research initiative.
- HSRP could consider the developing protocols for testing the toxicity and effectiveness of sorbents. Sorbents are used occasionally but have yet to be identified as a priority for testing by stakeholders.
- ORD should consider developing a clear justification for raising the priority of research that assesses the toxicity/phototoxicity of chemicals and their long-term degradation and metabolic products to ensure that the research is added to a future rule making docket. Examining the toxicological effects of chemicals can be challenging. A more effective justification may balance the view that such research, though building on considerable strengths of ORD, is not urgent.

Recommendations

The Subcommittee offers these recommendations to support the relevant Agency priorities:

Recommendation 2a.1: Establish a working group to identify and eliminate institutional barriers so procurement of reference oils used for product testing, including small samples of specific grades and source locations is simple and reliable over time. This might include legal, purchasing, scientists, in both EPA and source organizations, as well as connecting with other government agencies such as DOE and the National Laboratory System.

Charge Question 2b

Q.2b. Spilled oil that cannot be mechanically removed from the environment undergoes physical, chemical, and biological changes that affect the behavior and ultimate fate of the oil. To better assess oil behavior and the impact of oil on ecosystems, HSRP conducts research on

biodegradation, toxicity, dispersion, and detection of oil in water. Please provide recommendations on how to expand or improve experiments conducted within this Research Area and to improve the delivery or dissemination of products to our partners and stakeholders.

Narrative

ORD maintains a Research Area Coordination Team (RACT) with a focus on oil spills. They work with multiple collaborators and partners (including Canada, U.S. Coast Guard, National Oceanic and Atmospheric Administration, U.S. Department of Interior, etc.). The research is supported by an Oil Spill Liability Trust Fund. The RACT's primary activities include developing approaches for efficient and effective management of oil releases, establishing protocols for regulations and spill response efforts, and providing scientific support to program and regional offices, and federal partners. The current research and operations focus on methods to manage oil marine spills (e.g., in situ burning, dispersing agents, surface washing, solidifiers, and herders). Much of their work is dependent on reference oils to fully characterize oils for the NCPPS, to conduct research on a wide variety of oils in the laboratory, test tanks (OHMSETT), and field, and to conduct toxicity, biodegradability, and dispersive behavior tests on spilled oil. These three needs require sample sizes ranging from 500 ml to multiple barrels.[1]

Strengths

- Publication of results in high impact journals,
- Presentations at prominent conferences,
- Focus on expanding the global knowledge base, service as SMEs,
- International recognition of the oils research program,
- The move to improve autonomous and remotely operate samplers (air, water, sediments, and oils), monitoring platforms, and sensors,
- Innovation and creativity to solve difficult problems, such as the recent correlation between fluorescence and total petroleum hydrocarbons (TPH) which will enable more rapid and accurate estimates of plume size and amount spilled,
- Outstanding interagency collaborations (e.g., leveraging resources, expertise exchange, and sharing of data), and
- Actively incorporating lessons learned from Deepwater Horizon.

Suggestions

- Expand focus of biodegradation tests to include anaerobic conditions which might be expected at depth and in sediments.
- Since COVID-19, the U.S. Government purchased domestically produced shale oils from North Dakota (Bakken) and Texas (Permian) that are lighter oils with lower sulfur than the Middle Eastern crudes that traditionally populated the strategic petroleum reserve. EPA is still having difficulty purchasing domestic light sweet oil. We understand there are challenges in accessing the strategic reserve because the oils are blended and permission from the president is required to acquire samples,

……

[1] Work with Coast Guard on potentially receiving oil from ongoing responses.

therefore it is suggested that EPA consider ways to cost-effectively purchase smaller amounts through a third party vendor, for example on the barrel scale.

Recommendations

The Subcommittee offers these recommendations to support the relevant Agency priorities:

Recommendation 2b.1: Establish a task force with members from private entities, stakeholders, and government organizations to identify and eliminate barriers to the timely acquisition of small amounts of oils, fuels, and related materials at reasonable cost for research purposes.

Recommendation 2b.2 Strengthen connectivity between EPA researchers and product users in field applications to ensure the knowledge attainable from field use of products reaches EPA, informs research needs, and drives translational science elements of EPA's research program. Toward this end, develop and socialize (at meetings like the Hot Zone Conference) a protocol for direct engagement with partner product users at time of use.

Recommendation 2b.3: Identify and address priority gaps in research and products (e.g. surface burn, surface wash, dispersants, herders, sorbents) for effective handling of spills to inland freshwaters.

SUMMARY LIST OF RECOMMENDATIONS

Charge Question 1a: How well does the water research portfolio of proposed Products and Outputs respond to the partner-identified needs?

- **Recommendation 1a.1:** Increase the focus on cybersecurity research and prioritize consequence research and research on vulnerabilities in drinking water system security and system elements common to drinking water and wastewater systems.
- **Recommendation 1a.2:** Leverage investments by other federal organizations and the private sector to customize sensors for priority molecules for deployment in systems critical to the water resources portfolio.

Charge Question 1b: The Water Security Test Bed (WSTB) is a critical capability for the water research portfolio to assess full-scale decontamination approaches for contaminated infrastructure, including premise plumbing, and emergency on-site treatment of contaminated water. Are there suggested improvements to the test bed, to the planned research, and/or partner/stakeholder involvement for StRAP implementation?

- **Recommendation 1b.1: Develop a Broad End-user Partner/Stakeholder Involvement Process** - throughout the research cycle so that products have a better chance of being used for actual emergencies and other opportunities; to include transitioning from "passive" (e.g., ad hoc encounters at professional association meetings) to more "active" stakeholder engagement that involves advanced planning, regularly scheduled encounters, and tracking networking progress.

Greater emphasis should be placed on recruiting SMEs from utilities, professional association/research entities (WRF, AWWA Water Utility Council, etc.), academia, and consultants (not just EPA regions). Earlier and ongoing input should be received from a broader range of stakeholders to drive improvements in the WSTB itself and the research it generates.

- **Recommendation 1b.2. Develop a Long-term WSTB Build Out Plan to Address the Full Water Cycle -** by including wastewater collection and treatment and building water systems. The current general drinking water system decontamination strategy presumes that contaminated drinking water will be discharged into wastewater collection systems. A much better understanding of contaminant "fate and transport" through wastewater systems is needed to more readily restore drinking water systems, e.g., wastewater systems will need to approve contaminated water discharges into collection systems. Conducting drinking water and wastewater research concurrently should also lead to efficiencies.

Charge Question 1c: The HSRP wastewater research is informed by Water Research Foundation (WRF) and National Science Foundation (NSF) workgroups to examine the fate of priority pathogens in wastewater collection system infrastructure and in wastewater treatment plants. To what extent is the planned research and capabilities adequate to address the acceptance and safe/effective treatment of wastewater?

- **Recommendation 1c.1:** To improve the adequacy and translational value of the research portfolio, HSRP should improve the connection between pilot scale studies and field studies by partnering with municipalities researching priority pathogens in full scale operating wastewater systems.
- **Recommendation 1c.2:** HSRP should increase research into the nature and extent of storm water related releases of priority pathogens in untreated sewage from treatment plants in natural disasters to address a limitation of the existing research portfolio.

Charge Question 2a: The U.S. EPA has the regulatory responsibility for maintaining the National Oil and Hazardous Substances Pollution Contingency Plan Product Schedule (NCPPS), which lists commercially available spill-treating agents for oil spill response operations. Please provide recommendation on how protocol development can be improved or advanced to support the EPA OLEM Program Office which maintains the NCPPS. How can our research program improve partner and/or stakeholder engagement beyond the EPA Program Offices?

- **Recommendation 2a.1:** Establish a working group to identify and eliminate institutional barriers so procurement of reference oils used for product testing, including small samples of specific grades and source locations is simple and reliable over time. This might include legal, purchasing, scientists, in both EPA and source organizations, as well as connecting with other government agencies such as DOE and the National Laboratory System.

Charge Question 2b: Spilled oil that cannot be mechanically removed from the environment undergoes physical, chemical, and biological changes that affect the behavior and ultimate fate of the oil. To better assess oil behavior and the impact of oil on ecosystems, HSRP conducts research on biodegradation, toxicity, dispersion,

and detection of oil in water. Please provide recommendations on how to expand or improve experiments conducted within this Research Area and to improve the delivery or dissemination of products to our partners and stakeholders.

- **Recommendation 2b.1:** Establish a task force with members from private entities, stakeholders, and government organizations to identify and eliminate barriers to the timely acquisition of small amounts of oils, fuels, and related materials at reasonable cost for research purposes.
- **Recommendation 2b.2** Strengthen connectivity between EPA researchers and product users in field applications to ensure the knowledge attainable from field use of products reaches EPA, informs research needs, and drives translational science elements of EPA's research program. Toward this end, develop and socialize (at meetings like the Hot Zone Conference) a protocol for direct engagement with partner product users at time of use.
- **Recommendation 2b.3:** Identify and address priority gaps in research and products (e.g. surface burn, surface wash, dispersants, herders, sorbents) for effective handling of spills to inland freshwaters.

APPENDIX A: MEETING AGENDA

Day 1: Thursday August 20, 2020, Eastern Daylight Time

12:00 - 12:10	Introduction and FACA rules Welcome and Opening Remarks Introduction of BOSC HS Subcommittee Members	Tom Tracy, Designated Federal Officer (DFO) Paula Olsiewski, BOSC Homeland Security (HS) Subcommittee Chair
12:10 - 12:15	ORD Welcome	Bruce Rodan, PhD ORD Associate Director for Science
12:15 - 12:35	CESER Welcome Center-NPD structure ORD COVID-19 research	Greg Sayles, Director Center for Environmental Solutions and Emergency Response (CESER)
12:35 - 13:00	Homeland Security Research Program Overview	Shawn Ryan, HS National Program Director Sang Don Lee, HS Principal Assoc.
13:00 - 13:15	Break (15 min)	
13:15 - 14:00	Overview of Oil Spill Response Research	Robyn Conmy, CESER
14:00 - 15:45	NCPPS Protocol Development (30 min) • NCP Reference Oil Selection • Treating Agent Toxicity Test • Surface Washing Agent Efficacy Protocol	 Robyn Conmy, CESER Mace Barron, CESER Robyn Conmy, CESER
	Break (10 min)	
	Behavior, Fate, and Effects (40 min) • Oil Biodegradation • Toxicity of Oil and Agents • In situ Burning Air Emissions • Oil Dispersion at Lab and Tank Scales	 Kiara Lech, CESER Mace Barron, CESER Brian Gullett, Center for Environmental Measurement and Modeling (CEMM) Robyn Conmy, CESER
	Spilled Oil Detection Tools (25min) • Detection of Deepwater Plumes • Oil Slick Detection • AUV and ROV Platform Development	 Alex Hall, CESER Blake Schaeffer, CEMM Robyn Conmy, CESER
15:45 - 15:50	Public Comment	Tom Tracy, DFO
15:50 - 16:00	Break (10 min)	
16:00 - 17:00	Subcommittee Worktime	

Day Two – Friday, August 21, 2020, Eastern Daylight Time

12:00 - 12:30	Overview of Water Research	Jeff Szabo, CESER
12:30 - 14:30	Full scale research at the WSTB (25 min) • Decontamination methodologies (distribution system and premise plumbing) • Sensors and automatic flushing • Cybersecurity • WSTB Videos and Virtual Tours	Jeff Szabo, CESER John Hall, CESER Jim Goodrich, CESER
	Premise plumbing research (10 min)	Helen Buse, CESER Matthew Magnuson, CESER
	Break (10 min)	
	Wash-water treatment methodologies (15 min)	Matthew Magnuson, CESER Jim Goodrich, CESER
	Wastewater research (10 min)	Matthew Magnuson, CESER
	Sensor research (10 min)	John Hall and Jeff Szabo, CESER
	Source water and storm water research (20 min) • Rainfall simulator, field sampling and field installation videos	Anne Mikelonis, CESER Jim Goodrich, CESER Katherine Ratliff, CESER
	Water system modeling tools (15 min)	Terra Haxton, CESER Katherine Ratliff, CESER
	Water sampling strategies, collection, and analysis methods (5 min)	Sarah Taft, CESER
14:30 - 14:45	Break (15 min)	
14:45 - 16:00	Subcommittee Worktime	
16:00 - 17:00	Q&A	Shawn Ryan, Sang Don Lee, Jeff Szabo, Robyn Conmy

APPENDIX B: MATERIALS

Material Provided in Advance of the Meeting

Materials to Support the Charge Questions

- Agenda
- Charge questions
- HS Draft StRAP FY 2019–2022

Informational Materials

- Virtual Participation Guide
- Presentation: Introduction to the Homeland Security Research Program
- Presentation: EPA Office of Research and Development Homeland Security Research Overview
- Presentation: U.S. EPA's Office of Research and Development Overview