U.S. EPA Water Technology Innovation Cluster Leaders Meeting

Fostering & Strengthening Cluster-to-Cluster Collaboration

Meeting Summary Report

Sunday, October 1, 2017

Hilton Chicago

Chicago, Illinois

Environmental Technology Innovation Cluster Development and Support Program
Immediate Office of the Assistant Administrator
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, Ohio

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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) hosted a meeting of Water Technology Innovation Cluster Leaders on October 1, 2017, ahead of the Water Environment Federation's Annual Technical Exhibition and Conference (WEFTEC) at the Hilton Chicago hotel. There were approximately 110 individuals who attended and represented water clusters, government agencies, national water associations, water utilities, and water technology companies. The meeting was organized to bring together various stakeholders who have a dedicated interest in water technology innovation and implementation. These groups shared an interest in a meeting on the topic of further strengthening collaboration among water technology innovation clusters. The focus of the meeting was to identify best practices and showcase examples, as well as to encourage the water cluster leaders to begin collaborating to strengthen the water industry.

The meeting had five goals: (1) showcase the Erie Hack as a major project of the cluster network and review lessons learned; (2) make further progress in engaging and supporting water utilities, building on the lessons learned from the Cluster Leaders Meeting in 2016; (3) learn the latest on U.S. initiatives for water infrastructure and discuss the role and opportunities for the water clusters; (4) discuss cluster strategy and opportunities for development of a global network of water clusters to advance technological solutions to water problems; and (5) showcase and learn about progress and programs of water clusters both here in the U.S. and abroad.

The audience heard presentations and panel discussions from water cluster organizations, water utility representatives, water technology companies, and various water research and support organizations. Each speaker and panelist shared experiences and insight into how their organizations operate. They encouraged the water cluster organizations in the room to collaborate with each other to solve water challenges. The presentations were distributed to the registered meeting participants after the meeting.

ABBREVIATIONS AND ACRONYMS

AWWA	American Water Works Association
CSO	Combined sewer overflow
CWA	Cleveland Water Alliance
DHS	Department of Homeland Security
EPA	U.S. Environmental Protection Agency
ETICP	U.S. EPA Environmental Technology Innovation Clusters Program
FEMA	Federal Emergency Management Agency
GLOS	Great Lakes Observing System
HAB	Harmful algal bloom
IOOS	Integrated Ocean Observing System
ISO	International Organization for Standardization
IT	Information technology
LIFT	Leaders Innovation Forum for Technology
MWRD	Metropolitan Water Reclamation District of Greater Chicago
MOU	Memorandum of understanding
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
ORD	U.S. EPA Office of Research and Development
OW	U.S. EPA Office of Water
R&D	Research and development
SRF	State Revolving Fund, EPA
SSO	Sanitary sewer overflow
TMA	The Maritime Alliance
WEF	Water Environment Federation
WEFTEC	Water Environment Federation's Annual Technical Exhibition and Conference
WIFIA	Water Infrastructure Finance and Innovation Act, EPA

INTRODUCTION AND OVERVIEW

The EPA Water Technology Innovation Cluster Leaders Meeting was held Sunday, October 1, 2017 in Chicago, Illinois. The meeting had five goals: (1) showcase the Erie Hack as a major project of the cluster network and review lessons learned; (2) make further progress in engaging and supporting water utilities, building on the lessons learned from the Cluster Leaders Meeting in 2016; (3) learn the latest on U.S. initiatives for water infrastructure and discuss the role and opportunities for the water clusters; (4) discuss cluster strategy and opportunities for development of a global network of water clusters to advance technological solutions to water problems; and (5) showcase and learn about progress and programs of water clusters both here in the U.S. and abroad. There were approximately 110 individuals in attendance from eight different countries.

WELCOME TO WEFTEC AND MEETING OBJECTIVES

Speakers

DR. BARRY LINER, Director, Water Science and Engineering Center, Water Environment Federation
STEVE FRENKEL, Executive Director, Current
SALLY GUTIERREZ, Director, Environmental Technology Innovation Clusters Program, Office of Research and Development, EPA

Sally Gutierrez welcomed everyone to the meeting. She invited Dr. Barry Liner to open the meeting and welcome everyone to WEFTEC. Dr. Liner began by noting that this is the sixth water cluster leaders meeting. He shared a brief anecdote about research he did for a presentation earlier in the week on commercialization in the municipal water space. He expressed that the many water clusters from around the globe and their partners played a major role in the advancements that he examined. Dr. Liner thanked everyone for their attendance at WEFTEC and their work in the water sector.

Next, Steve Frenkel welcomed everyone to Chicago. Current is one of the newest additions to the water cluster community and it is approaching its one-year anniversary. This is Current's first WEFTEC, and Mr. Frenkel expressed that this is a great opportunity for Current to connect with the community. Over the last year, Current has been trying to understand the ecosystem and find the opportunities to add value to the work that is being done by the water clusters. Current is trying to build an advanced water research and technology innovation platform. The goal is to independently develop, validate, and commercialize innovative water technologies. Since the fall of 2016, it has been focused on that value proposition and trying to build a technology-to-market platform around three core programs, which are designed to leverage Chicago's core capabilities to help new innovation more efficiently get to market. Mr. Frenkel explained the three programs:

1. Current Research – The focus of this program is to amplify advanced water research through a consortium of institutions of global reach: Argonne National Labs, Northwestern University, the University of Illinois, and the University of Chicago. They have created a consortium of over 100 research leaders who have opted-in to be partners with Current. Through this, they have identified collaborations and new research funding opportunities to project Chicago's academic capacity nationally and globally.
2. Current Demonstration – As part of the technology-to-market platform, technologies and innovations discovered through Current Research feed into Current Demonstration. This program's focus is validating new innovations to reduce the risk of technology development and time to market. Current is doing this through a four-step process, but the core of it is validating the underlying technical and economic assumptions of technology as well as physically testing and validating those technologies in the field at scale.
3. Current Connect – Technologies that emerge from Current Demonstration proceed to Current Connect. This program is designed to grow and scale those innovations and connect them to customers, users, and investors. A strong partnership with water utilities is at the core of Current. The Chicago Department of Water Management has the largest water filtration plant of its type in the world, and the Municipal Water Reclamation District of Greater Chicago (MWRD) has the largest wastewater treatment plant of its type in the world. There is an amazing ecosystem in Chicago to leverage a lot of capability and capacity to demonstrate, pilot, and scale technology in Chicago. Mr. Frenkel took a moment to recognize Debra Shore, the Commissioner

of MWRD, who is an advocate for Current, a champion for innovation, and part of the creation and original vision for Current.

Mr. Frenkel provided an overview of Current's recent activities, which included a 10-day trip to Israel, which was a 45-person delegation led by Mayor Rahm Emanuel. Three new memoranda of understanding (MOU) were signed during the trip. For research partnerships and collaborations, they signed one with the Technion Institute of Advanced Technology. A second MOU was signed with Mekorot (the national water utility) to foster best practices exchange with MWRD and the Chicago Department of Water Management. The third MOU was with Israel NewTech, which is the innovation arm of the Ministry of Economy. Current will use these MOUs as a platform to start building international relationships.

Two weeks prior to the meeting, Current officially launched the three programs that Mr. Frenkel described. They are looking forward to working with the participants to accelerate technology commercialization. As part of the launch, Current announced a partnership with the Water Environment & Reuse Foundation's Leaders Innovation Forum for Technology (LIFT) program that will enable technologies to be screened and scanned by the LIFT Tech Scan program, to refer those technologies to Current for validation, demonstration, and physical testing through its platform. Technologies that prove viable and have a strong end-user market will be referred back to LIFT for channel distribution and connection to its national network of utilities and other end-users. Current looks forward to growing and working with the other water clusters.

Ms. Gutierrez briefly covered the meeting objectives. She acknowledged and expressed gratitude to the team that helped to shape the agenda for the meeting.

CLEVELAND WATER ALLIANCE – ADVANCING WATER CLUSTER INTITATIVES: LESSONS FROM THE ERIE HACK

Speakers

BRYAN STUBBS, Executive Director, Cleveland Water Alliance
DOROTHY BAUNACH, Water Innovation Cluster Director, Cleveland Water Alliance
MAX HERZOG, Program Manager, Cleveland Water Alliance

Introduction

JEFF LAPE, Acting Director, Office of Science and Technology, Office of Water, U.S. EPA

Jeff Lape, EPA, began: "Water transformation is underway. It is happening everywhere, and it is exciting." We have seen some dramatic changes happening across the landscape. We think three wastewater treatment plants in the country have gone energy positive and two dozen are recovering nutrients (nitrogen and phosphorous) from their waste streams. Water reuse, once driven by the droughts and water shortages in the U.S., is a fundamental tool to protect groundwater sustainability. Mr. Lape expressed that one of the most exciting areas is water intelligence, the notion of sensors, information technology (IT), and analytics providing us with real-time information about water. It is an exciting time, and it is going to be driven by the water cluster leaders. Mr. Lape explained that he and Ms. Gutierrez are among the people within EPA who are trying to bring the message of technology innovation in the water sphere. One of the standing questions EPA has is, "What can we do?" So as the water cluster leaders innovate and bring new technology to the table, what can our federal and state partners do to help foster that activity? Mr. Lape then introduced the panelists.

Bryan Stubbs, Cleveland Water Alliance (CWA), opened the panel. He noted that water intelligence is something that resonates with CWA's partners. In addition, he mentioned a $1 million grant that had been awarded two days prior with their partners at the U.S. Economic Development Administration, National Aeronautics and Space Administration (NASA), and in Wisconsin and Ohio around aerospace and water. Mr. Stubbs turned it over to Max Herzog to present on the Erie Hack.

Mr. Herzog started with a brief overview of the project. The first aspect of the project was the Regional Innovation Challenge, a competition-style format for innovation that brought together teams of students and professionals to work on innovative ideas for water and compete for prizes. The other key aspect was the Water Innovation Summit, a conference that brought together keynote water innovation speakers and panelists and when the final prizes for the challenge were awarded. There was about seven months of preparation building up to the execution before the project ran from February 23 to May 3, 2017.

The program had four goals: (1) catalyze water innovation by helping the teams participating in the challenge to actually produce technologies with the potential to scale; (2) expand the water cluster to include new partners across a broader geography; (3) identify water opportunities by going around to water experts and stakeholders to find out the challenges they face around water resources and what are the opportunities to address them; and (4) elevate the value of water by looking at the discourse more broadly around water and how we see it as integral to our social fabric, ecology, and economic development.

The program framework consisted of collaboration, ideation, innovation, and acceleration. In terms of collaboration around the Erie Hack, they really sought to build a local support infrastructure. This led

them to expand their scope outside of northeast Ohio, where they conventionally function, to several other cities. They identified champions to help them execute the program in their respective city. Each city had a research institution that served as a research champion. They brought their researchers to help with issue identification, mentorship, and outreach. Innovation champions were the people working at local incubators or accelerators, and they served a similar role to the research champions. They provided mentorship and outreach using their entrepreneurship and technology expertise and networks – who may not have a background in water, but had an essential entrepreneurial spirit. Finally, with the help of research and innovation champions, funding champions were identified. These were local foundations or utilities interested in supporting this work in their city. Mr. Herzog discussed the City of Detroit as an example of how these champions functioned. Wayne State University, TechTown Detroit, and the Erb Family Foundation were Detroit's champions. They had similar partnerships in other cities around Lake Erie: Toledo, Ohio; Windsor, Ontario; Erie, Pennsylvania; and Buffalo, New York.

The next piece of the framework was ideation, in which they identified the issues they wanted the teams to address in their solutions. They held eight stakeholder meetings in four cities: Toledo, Detroit, Buffalo, and Cleveland. These meetings were co-created with the NASA Glenn Research Center. The meetings helped them to broadly engage the local ecosystems in those cities. Additionally, the knowledge gathered during these sessions helped them form the base of the six ideation challenge statements:

- Mitigate nutrient loading and its environmental impacts
- Reduce and remediate urban pollution
- Cultivate resilience in water infrastructure systems
- Manage aging water infrastructure systems
- Connect communities to the value of water
- Drive the creation of meaningful data

The challenge itself was the innovation piece of the framework, which was approached with a couple of steps. This included hosting information sessions and public events to inform potential participants of the opportunities and hacking days, where teams could work on their projects and get access to mentorship and networking. The selection process was next. There were four different quarter finals in the four cities as well as a semi-final in Detroit for the whole competition. This led to the final selection at the Water Innovation Summit. Throughout the process, support services were offered to the teams, including mentorship and data and analytics tools.

The final element of the framework was acceleration – how to move forward with the teams now and in the future. Oftentimes, hackathons have a lot of energy during the program, but fizzle once it ends. CWA avoided this by offering $100,000 in cash and prizes, including a first-place prize valued at $50,000. Being able to offer these sums was not only a motivator to get participants engaged, but it also gave teams the opportunity to invest their time, as teams participated on a volunteer basis. Consulting hours were awarded to winning teams. During these consulting hours, CWA met with teams on their needs and strategized moving forward. Hours were also awarded to non-winning teams, and CWA has maintained an open door policy since the competition. This provides the teams with access to CWA's ecosystem resources. Its ecosystem has expanded as a result of the Erie Hack, so now it can direct teams to the right people in their local cities for support for their technology.

Mr. Herzog stated that the Erie Hack was successful, and he described details on how they addressed the program goals.

- Goal: Catalyze water innovation
    - Result: Today, CWA is still collaborating with 11 of the participating teams.
- Goal: Expand water cluster
    - Result: They saw very broad participation – over 200 individual participants on over 40 teams. Also, through ideation sessions, mentorship, and partnership, they engaged over 100 partner organizations. The program significantly expanded CWA's scope across the Lake Erie basin, where it had not been active. Many of the innovators who participated did not have a previous interest in water, and 73% of surveyed teams reported that they were "more interested in water-based innovation" than they were before.
- Goal: Identify water opportunities
    - Result: This type of program served as a strong tool to identify water challenges. They had identified six key problem statements that were defined and vetted by cross-sector experts across the region, which will continue to shape CWA's mission and programs going forward. Currently, they are interested in the opportunity around harmful algal blooms (HAB) and nutrient data that was identified and emphasized in the program, and they were able to jumpstart this innovation because a number of the highest performing teams were focused on this topic.
- Goal: Elevate the value of water
    - Result: They executed 22 public events in six cities and two countries, so a large audience heard their message on the importance of water technology innovation. The Erie Hack received press coverage in 39 states, Ontario, Canada, and Washington, D.C. This included coverage on the local National Public Radio show, "All Things Considered." The program was impactful on the participating teams. Ninety percent of surveyed teams now "see water resources and work in our region as more significant," and 65% "feel more connected to water resources in our region."

Lastly, Mr. Herzog spoke about CWA's current programs. Its current innovation challenge is called the Internet of H2O. It is a $50,000 challenge on "the internet of things-meets-water." CWA is working with the Great Lakes Observing System (GLOS), U.S. Ignite, and DigitalC, and it has been discussing a future acceleration fund with the National Science Foundation for this work. This challenge is aimed at developing a resilient and scalable solution that leverages software-defined networking, internet of things detection technology, and data analytics to monitor and interpret nutrient data in real-time. The goal is to apply existing advanced technologies that do not function in the water space to resource management and innovation. High-capacity teams are targeted for this problem because it is a more specific and technical challenge than the one for the Erie Hack. The challenge started with eight teams, which has been condensed to five. These teams are being pushed to deploy their detection technologies and collect and analyze data through this program. In Lake Erie, this is a $1.3 billion problem in the next 30 years if left unmanaged. With this challenge, the goal is to help Ohio, Michigan, and Ontario meet their set reduction goals.

The other program CWA is currently involved in is the HAB Warning System. This is a partnership with the National Oceanic and Atmospheric Administration's (NOAA) Integrated Ocean Observing System

(IOOS), GLOS, and LimnoTech. NOAA has funded this partnership, which seeks to improve the monitoring and safety of drinking water in cities surrounding Lake Erie.

Mr. Herzog closed by showing a slide on all of the partner organizations involved with the Erie Hack before taking questions from the audience.

Questions

How many of these solutions can be quickly deployed to the lake organizations and utility clusters that are around the lake and have major problems with HABs and nutrient issues? Can you try to put that into specific, real-world applications for those utilities?

Mr. Stubbs said the short answer is that they are looking at more of these in the next few years. Most of these are early-stage technologies, but they are seeing a lot of promising solutions, especially for monitoring. This is something that CWA is scaling up efforts on and has been able to bring funding toward. There is push from elected officials to get this scaled up, as Ohio has been at the epicenter of HAB effects. He thinks that this will be a solution that will be able to expand beyond the Great Lakes.

Are you working at anything where you can get this out online where people can see the process or even participate virtually?

They are open to finding ways to communicate the story and successes, and it is something they are still navigating.

How are you working with the larger ocean industry? All of the technologies mentioned are being used in the ocean industry, so there is a lot of opportunity to work together and learn from each other.

The Great Lakes have always been considered "the red-headed stepchild: of the NOAA program, IOOS. CWA is now a part of the ocean technology transfer program and can start getting the collaboration going. Mr. Stubbs works with ocean industry groups, including The Maritime Alliance, and is excited to continue the collaboration.

Is intellectual property (IP) something you are considering as part of the assessment of the teams? And, beyond the funding that you are providing in prize awards, you are looking towards the local environments to assist them in being able to move forward beyond winning the competition. But, how are you enabling that furthering of the technology development?

Mr. Stubbs said yes – it is called the IP Challenge. They took an X-prize approach because they did not want to take any of the IP, especially on the data and open data platforms. As teams evolved, though, they had to begin using non-disclosure agreements. It remains a challenge to help push out these technologies without companies giving away their IP. They have also discussed ways to approach a shared IP platform for challenges to move things forward. Also, Ms. Baunach noted that there are many partners in the innovation ecosystem, such as universities, who are able to help with the IP aspect. CWA's job is to drive the innovation and have other partners to help with protecting IP.

Looking at the slide with all of the partners and sponsors and knowing the limited resource base of the employees you have, how much money did it cost to run this program?

Mr. Stubbs said they raised about $750,000 in hard cash, which does not include in-kind contributions. The two lead foundations, the Joyce Foundation and the George Gund Foundation, made it possible. Mr.

Stubbs went to the participating cities to find the organizations and foundations that would care about this. The infrastructure has been laid already, which was the hardest, but they can do things more cheaply now. For the Internet of H2O program in partnership with DigitalC, it costs about $200,000 with a $50,000 cash prize. This does not include in-kind contributions.

ROUNDTABLE DISCUSSION PART 1: *Engaging and Supporting Water Utilities and Other Water Technology End-Users*

Topic Introduction

DEBRA SHORE, Commissioner, Metropolitan Water Reclamation District of Greater Chicago

Introduction

GARY KELLER, Co-Founder & Board Member, H2OTECH, Atlanta, Georgia

Gary Keller took the stage to introduce Commissioner Debra Shore. Ms. Shore has spent decades working to restore the north branch of the Chicago River, she is the founding editor of Wilderness Magazine, and has spent two terms as Commissioner of the Metropolitan Water Reclamation District of Greater Chicago (MWRD).

MWRD was founded in 1889 as the Chicago Sanitary District with the mission of protecting the drinking water supply for Chicago by keeping sewage out of the lake. This is the agency that reversed the Chicago River. In 1989, it changed its name to the Metropolitan Water Reclamation District, and in late 2004, it got additional authority for stormwater management for Cook County. Now the Agency provides wastewater treatment for 95% of the county and stormwater management for 100% of the county.

Ms. Shore is in her second term and eleventh year on the Board of Commissioners. As board members, they are charged with setting policy, approving the budget, awarding contracts, hiring the Executive Director, and trying to be a part of crafting a vision for the Agency. MWRD is in the midst of a major transformation – a paradigm shift – from a waste treatment agency to a resource recovery agency, and Current is a part of that. In the last five years alone, the District has had the following major achievements: (1) installed the largest ultraviolet light system to disinfect wastewater at the O'Brien plant in Skokie, (2) built and began operating the largest nutrient recovery facility using the Ostara process to capture phosphorous from the waste stream at the Stickney treatment plant and turn it into a slow-release fertilizer that it can sell, (3) started producing a high-quality compost by mixing its class A biosolids with woodchips from Chicago's forestry operations, and (4) began exploring opportunities for reuse of treated water by a Ford assembly plant on Chicago's south side and by a major chemical plant next to its Stickney plant.

A number of obstacles come to Ms. Shore's mind when considering innovation at MWRD. Culture is one obstacle. As noted, at MWRD, the mission for 125 years has been to protect the drinking water supply in Lake Michigan by keeping sewage out of the lake. It was a waste treatment agency, and the mentality and culture was focused on waste. In addition, most public utilities are understandably risk-averse. As you may have heard George Hawkins of DC Water say, "we in the utility sector are in a fierce race to be second." This means that as stewards of tax payers dollars, they are also stewards of public health, and they do not want to take risk with people's health or money. Having Current as a technological innovation platform to develop and validate innovative solutions is valuable to MWRD because it is not eager to gamble with new or unproven technologies or radically different approaches. As a large bureaucracy, the culture is, "well, that's the way we've always done it."

In 2009, Ms. Shore had the potential opportunity for a federal appointment at EPA. Her advisor said, "Have you talked to the 'we be's?'" The advisor explained that the "we be's" are the "we be here before you, and we be here after you" people. Ms. Shore was still in her first term in office and asked to withdraw her name from consideration, but all organizations and agencies have "we be's." It is part of

the culture and worth paying attention to. It is hard to change culture, which is why we often reach for a technical fix rather than push for what is really needed – which is adaptive change.

Another obstacle is legal. You may want to be innovative, but you cannot. MWRD faced this when it was embarking on a significant shift in its culture and prospect, and it had to seek a statutory change from the state legislature in order to be able to sell things. For its entire history, MWRD had thought of and defined itself as a waste agency. Once it was recognized that many of the waste streams flowing into sewage plants have value, and that MWRD might be able to capture and monetize some of that value, its attorneys said that they did not believe MWRD had the authority to make money from waste. As a result, in 2014, MWRD introduced House Bill 4716 in the Illinois General Assembly. The full text is available online at http://www.ilga.gov/legislation/98/HB/PDF/09800HB4716lv.pdf. Ms. Shore shared a quote from the bill to give the audience a sense of the language they used:

> "(a) The General Assembly finds that (1) technological advancements in wastewater treatment have resulted in the ability to capture recovered resources and produce renewable energy resources from material previously discarded; (2) the capture and beneficial reuse of recovered resources and the production of renewable energy resources serves a wide variety of environmental benefits including, but not limited to, improved water quality, reduction of greenhouse gases, reduction of carbon footprint, reduction of landfill usage, reduced usage of hydrocarbon-based fuels, return of nutrients to the food cycle, and reduced water consumption; (3) the district is a leader in the field of wastewater treatment and possesses the expertise and experience necessary to capture and beneficially reuse or prepare for beneficial reuse recovered resources, including renewable energy resources; and (4) the district has the opportunity and ability to change the approach to wastewater treatment from that of a waste material to be disposed of to one of a collection of resources to be recovered, reused, and sold, with the opportunity to provide the district with additional sources of revenue and reduce operating costs. (b) As used in this Section: "Recovered resources" means any material produced by or extracted from the operation of district facilities, including but not limited to: (1) solids, including solids from the digestion process, semi-solids, or liquid materials; (2) gases, including biogas, carbon dioxide, and methane; (3) nutrients; (4) algae; (5) treated effluent; and (6) thermal energy or hydropower. "Renewable energy facility" shall have the same meaning as a facility defined under Section 5 of the Renewable Energy Production District Act… (c) The district may sell or otherwise dispose of revered resources or renewable energy resources resulting from the operation of district facilities, and may construct, maintain, finance, and operate such activities, facilities, and other works as are necessary for that purpose. (d) The district may take in materials which are used in the generation of usable products from revered resources, or which increase the production of renewable energy resources, inducing, but not limited to, food waste, organic fraction of solid waste, commercial or industrial organic wastes, fats, oils, and greases, and vegetable debris…"

The bill passed with a bipartisan majority and was signed into law. Now, the district is beginning to actually generate revenue from these processes and projects. It is important to note that there are these legal obstacles that need to be overcome.

Another obstacle is bandwidth or capacity. Money, time, and imagination can all limit the ability of a utility to collaborate or innovate. Everybody is strapped for funds, so where does the support come from

for research and development? Ms. Shore noted that she also serves on the Board of the Great Lakes Protection Fund. Local foundations are an important source of funding, but they can also be important connectors through the projects they support. The Protection Fund is supporting a number of projects that are involved in nutrient reduction and research. The teams that are working on those projects can be important connectors through water clusters. How we get that information communicated is going to be key. Regarding time as a limiting factor, when Ms. Shore first decided to run for office over a decade ago, an advisor told her: "The only thing every candidate has in equal measure is time. Some people may have more money or charisma or friends, but you all have the same amount of time. So, how you choose to spend that time turns out to be some of the most difficult decisions you make." Applied to the utility sector, we all have to make sure we are fulfilling our core mission: treating sewage, filtering and delivering drinking water, and managing stormwater. Given the demands on our time to fulfill that core mission, how do we decide which collaborative opportunities to take? What might benefit your organization the most? Which projects bear a higher risk? How might water clusters assist utilities by connecting them with additional resources of intellectual capital and potential financial support?

In Ms. Shore's view, there is enormous untapped potential in building collaborations between academic institutions, federal research labs, and local utilities. Why are graduate students from the region's business, engineering, environmental science, and policy programs not doing projects every semester on topics of interest and concern to utilities? Could a utility in one locale avail itself of the academic and research expertise in another locale, if it is not home to a university or college? Could utilities develop a sister city relationship with a university in the same state or elsewhere? And, how do water clusters become a robust forum for sharing information gleaned from research projects? How do we spread the word in a way that is useful to the utility manager who has time – and possibly, imagination – constraints. The great benefit of an organization like Current is that it becomes the booster, facilitator, connector, and enthusiast for the utility sector.

MWRD wants its treatment plants to become a test bed for new technologies, and Current helps make that happen. Current is the matchmaker between universities and utilities. If the utility manager does not have time to pitch itself as a source of worthy research projects, the water cluster can do so.

MWRD is working on four areas now: nutrient recovery, biogas generation, biosolids as a beneficial resource, and treated water. Ms. Shore thinks that the next frontier in resource recovery is big data. She does not necessarily mean sensors, but mining the waste stream that is coming into a sewage plant for information. There is an enormous amount of information about diseases, genetic information, pharmaceuticals, and even micro-constituents. This next frontier will not only be about how we protect individual information, but also how we collect worthwhile data.

Finally, each cluster must reflect its own character and culture of place. They serve different constituents and work under different circumstances and needs, but the goal everywhere is to break down silos and create portals for collaboration, innovation, and good work.

Participants discussed the following questions during the roundtable:

1. The best practices were developed from the thoughts and presentations from the Cluster Leaders Meeting last year. Are these the correct ones? Would you add or delete some? Could you see yourself using these as you develop your cluster? Highlight one successful example in a few words.

    a. Reverse pitch
    b. Workforce development
2. What are some ways you would like water organizations, like the clusters present here, to engage and support your efforts? What could water utilities do to take advantage of a network of water clusters, even if your utility is not in an area served by a water cluster? What would be a value proposition a utility would be looking for?
    a. Listen to utilities' needs
    b. Encourage utilities to take risks
3. What ideas would the group have to assist cluster organizations in better engaging water utilities, especially small- and medium-sized utilities with limited resources?
    a. Clusters act as a facilitator for utilities with regulators
    b. Clusters act as a facilitator for startups with utilities
    c. The procurement process is a barrier

WATER INFRASTRUCTURE POLICY

Speakers

INTRODUCTORY REMARKS ON WATER INFRASTRUCTURE POLICY
D. LEE FORSGREN, Deputy Assistant Administrator, Office of Water, U.S. EPA
PERSPECTIVES ON U.S. EPA WATER INFRASTRUCTURE FINANCE POLICY
DR. ANDREW SAWYERS, Director, Office of Wastewater Management, Office of Water, U.S. EPA
PERSPECTIVES ON PUBLIC-PRIVATE INSFRASTRUCTURE FINANCE POLICY
HANK HABICHT, Managing Director, U.S. Water Partnership

Introduction

BIJU GEORGE, Chief Operating Officer, DC Water

Biju George introduced D. Lee Forsgren to provide introductory remarks on EPA's water infrastructure policy.

Mr. Forsgren started his remarks by bringing the audience up-to-date on EPA personnel. David Ross was recently nominated to be the Assistant Administrator for the Office of Water (OW). He is currently Wisconsin's Assistant Attorney General and Director of Environmental Protection in the Wisconsin Department of Justice.

Mr. Forsgren described EPA's priorities as outlined by the Administration.

1. The Administration is going to adhere to the rule of law and enforce the laws as written.
2. It is ready to partner with states and tribes in a manner of cooperative federalism. He explained that this means that "if it is within the four corners of the law, if a state or tribe has assumed a program, and they are responsible, we at EPA are not going to put our policy preferences over their determinations of what should be done."
3. The last element is public engagement. Public participation is a major part of their discussion and they want to hear from everyone because they do not believe one size fits all and Washington does not have all the answers. This will be important as they try to solve many problems, which will require technology, cooperation, and collaboration. Everyone is trying to do the right thing, and when those things do not happen, it is usually because they faced some sort of impediment. They are trying to figure out if those impediments are good or bad. If the impediment was an intuitional barrier that does not serve the purpose it was designed for, why does it need to stay? They are taking a fresh look at that.

According to Mr. Forsgren, the overall philosophy is that we can have a clean environment, sensible regulations, and economic growth. The Administration believes they can improve people's lives through cooperative engagement and breaking down barriers. A key element to that is the expansion of water infrastructure. There will be a presidential initiative on infrastructure, and water infrastructure will be a major part of it. There will be more opportunity for public-private partnerships and more resources proposed in that than what has been seen in decades. This will be a great opportunity and a great challenge. There will be an emphasis on using innovation to solve problems.

Dr. Andrew Sawyers provided general thoughts on water infrastructure. EPA estimates infrastructure needs across the country to be over $665 billion. This number rises to over $1 trillion for the American Water Works Association (AWWA) and other needs surveys. There is a critical need to start thinking about how to address this infrastructure challenge. Dr. Sawyers believes that he and his colleagues need

to start thinking about infrastructure in a portfolio management way, which is an opportunity for EPA to invest in infrastructure going forward. Dr. Sawyers stressed the importance of embracing and thinking holistically about innovation as well as thinking bigger about infrastructure. What are the opportunities ahead? Implementing widget after widget is not sufficient. We also have to think about how a widget creates a foundation for us so that our future infrastructure is resourceful, resilient, and meeting the needs of those impacted; particularly, those that are disadvantaged: middle-sized utilities. The Agency has an obligation to make sure that these clients' needs are satisfied, so much of its efforts are targeted toward these critical clients.

Dr. Sawyers addressed the areas that are going to be useful for EPA as it thinks about infrastructure and shaping it for the future.

1. The role of critical stakeholders – The role of stakeholders needs to be expanded. Public sector financing is going to be critical. The State Revolving Funds (SRFs), which have been around collectively for about 50 years, have funded over $155 billion. That is significant when also considering the construction grant era, which is another $120 billion. Over the years, there has been additional federal investment, which makes the federal footprint substantial. Dr. Sawyers expressed that EPA is going to continue to play a role, but it needs to be expanded. The Water Infrastructure Finance and Innovation Act (WIFIA) is another tool for EPA to expand its funding footprint. In this case, EPA is essentially a bank that directly lends resources to municipalities across the country. WIFIA will be very important for the future. If the government is actually providing a subsidy of about $25 million, it is essentially leveraging that subsidy upwards of $3 billion. When considering private and public sector involvement, WIFIA could provide close to $6 billion based on a $25 million subsidy. WIFIA is an important part of EPA's framework going forward, complementing the SRFs. Similarly, the U.S. Department of Agriculture and U.S. Department of Housing and Urban Development are providing infrastructure investment. Other types of capital that are going to play a role to meet the needs of those who need it most are crucial. The role of stakeholders needs to be expanded and the most important aspect of that is the impact it will have on the customers.
2. Asset management – Many efforts over the last 15-20 years have been around "fix as fail," and Dr. Sawyers stressed to move away from this philosophy. EPA's OW spends a significant amount of time trying to figure out how to expand asset management and ensure that it becomes an integral part of approaching infrastructure expansion. Technology and innovation will really help as we broaden our footprint around asset management. Inadequate maintenance ultimately leads to higher cost. Small- and medium-sized utilities that do not have the capacity to address asset management need technologies that we are developing and technical assistance within the Agency to focus on helping communities better understand what is needed in terms of asset management. Dr. Sawyers thinks that this is one of the most important ideas going forward.
3. Reliable and resilient technology – Technology will help us move in to the next century and help us to frame the infrastructure of the future. There are a lot of benefits accruing to stakeholders across the board when you think about predictive analytics. Dr. Sawyers has spent time with tech companies over the past year and has seen examples of people who now have a very full understanding of what is happening in their systems. You can now remotely know what is happening in the system. You can actually direct flows, manage combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs). But not only that – you have more efficient pumps,

predictive analytics, and a better understanding of the system. Technology will play a very important role in helping us improve our response. As technology improves, our ability to respond to natural disasters will improve, so we have to continue technology investment. We need to prioritize our investment, predictive analytics, and how we are going to use technology to reduce some of the deficits we see in infrastructure investment.

4. Revenue models – Most of the revenue at municipalities are from customers, but there are some issues with this revenue model. Dr. Sawyers noted that two trends in communities across the country are population decline and leveraged systems where resources are exhausted, and alternate types of revenue are needed to address these. Complementing the technology idea is this idea of sustainable revenue, including resource recovery as a real part of the water and wastewater industry, which means finding out a way to use waste to generate additional revenues. EPA works on creating sustainable revenue systems, and stormwater utilities are going to be a significant part of this. In traditional cases, water and wastewater have enterprise funds, and many of those are funding those obligations, but there is a need for more investment in stormwater utilities. There are about 9,000 municipal separate storm sewer systems across the country, of which only about 1,400 have enterprise funds and actually funding those stormwater obligations.

Of these four areas, one of the most important areas for EPA – which has perhaps been a barrier to additional expansion in some cases – is affordability. Those who are most often impacted are capacity constrained. These groups are not just capacity constrained in terms of ability to finance projects, but also in their technical and resource ability. EPA has an obligation to figure out ways to better understand how to help communities address affordability issues, and OW spends a significant amount of time trying to get to this issue. This work includes looking at financial leadership documents, developing a water finance clearinghouse, and completing a household compendium that analyzed the household affordability program. There are a lot of efforts here and things that can be done, but Dr. Sawyers believes that this is one that definitely must be pursued further to help communities, not only through a full cost pricing approach, but to also develop models that can help utilities to address these critical issues.

Finally, Dr. Sawyers addressed the idea of helping to create sustainable markets, which ties into revenues. In many ways, a lot of the public funding that is provided today has remained in the public sector realm. But in order to continue and expand, a market-oriented approach should be employed, which Dr. Sawyers calls the "new infrastructure of the future." By market-oriented approach, he means the types of resources that are needed to make the utility effective. Communities are often concerned about the fact that they are not accruing resources or benefits, which is a barrier to them. But, in a market-centered approach, benefits accrue to all of the different stakeholders. Dr. Sawyers has thought about the co-op model as well. He thinks the model has the potential to make an impact, where the communities actually become investors in the utilities and have a stake in them. So, not only are they interested in making sure that they are accruing benefits, but they also want to make sure public health issues are addressed. In this context, they are actually willing to take more risk. The idea around a co-op or investor-owned utilities or SRF, and using the SRF, WIFIA, and others to expand how we think about community or utility ownership are going to be particularly critical.

Hank Habicht opened the next portion of the panel by sharing an anecdote from his time at EPA. While there, he and his colleague, Bill Reilly, worked on innovation, specifically one that pushed geographic-

oriented initiatives around large bodies of water including many current EPA programs as well as clusters. In those days, they promoted cluster regulations for various industries. Back in those days, the challenge was the balance of power between the federal, state, and local governments. In water, the center of gravity is the locality, the community where people live. There is obviously a role for the federal government, and Mr. Habicht has been working to promote innovation, support good ideas, and promote avenues for non-federal capital. There are a lot of things that can be done at the national level. Some of it involves removing roadblocks, and some of it includes positive things that can be done.

The water sector has seen great change over the last 25 years. There is more sophistication, knowledge, data, good ideas, and institutions engaged in water. Water has to be addressed locally with national support infrastructure. Mr. Habicht acknowledged the work that EPA is currently doing on this and recognized that EPA has to be not only a regulator; but also, a facilitator. He noted that today's convening is evidence of its role as a facilitator.

Organizations outside the government also have a role to play. Critiquing Washington and how stove-piped the sector is not enough – these organizations must take action themselves, and do it in conjunction with what everyone else is doing. Mr. Habicht spoke on the two areas that those outside the government are trying to do.

1. Policy – They are trying to come up with a few agreed upon areas of policy to help everyone in the room succeed in their work.
2. Finance – How do we take the good ideas and work going on that is largely unconnected nationally and try to synthesize actual funded projects in the water space? Recognizing that we are not trying to solve a problem that is already being addressed and stand on the shoulders of the people who are already working on it.

Right after the election, a group who has been in the water space for a while created the ad hoc group on water policy. The group involves major associations, investment leaders, and others, and has worked with the Administration and those on the Hill. You can see principles of that effort in a testimony that was delivered at the House this week at the House Transportation Infrastructure Committee by Jim Proctor of private company McWane. Mr. Habicht felt that this was the best public statement that reflects the work of this group. The testimony is available online: https://transportation.house.gov/uploadedfiles/2017-09-26_-_proctor_testimony.pdf. He feels that progress is only going to be made in water if all of the sophisticated organizations can say a few things exactly the same way. The problem is that the policy makers see something different among these organizations, and since they have heard so many different recommendations, they want to know what the most important thing is. Mr. Habicht highlighted a few of the points:

1. Consolidation – There is a lot of incentive for large utilities to help pull the smaller ones together. In other parts of the world, utilities have consolidated. Drinking water is very fragmented. How can we take these smaller, under-resourced communities and find ways to find communities of interest in economies of scale by combining them so that the investment community can see a larger source of investment opportunity? Or how can we just find better ways to partner and provide technical assistance?
2. Funding – SRF is one of the great public financing success stories. Mr. Habicht supports maximum funding of WIFIA, but also supports stronger Congressional support for technical assistance. In the venture capital community, there is the term, "valley of death." For small

utilities, it is the first several stages of understanding what a problem is, doing the analysis and feasibility studies, and putting out requests for proposals. But a lot of these projects never get done due to lack of resources.

3. Incentivize private capital – When talking to investors in the water space, the issue is not needing more privatization – it is the need to improve the procurement of governance process around water resources management. Water resource management is not just about building treatment plants and pipes, but about the whole water infrastructure. Eliminating penalties, lifting the cap on private activity bonds, expanding the ways the SRF can be deployed to include more blended financing projects.
4. Modernizing the SRFs and streamlining the procedure – This is how the issue of the pricing of water to its actual value was addressed. Mr. Habicht explained that this involved talking about utility management and planning and integrating the understanding of the full operating cost of a utility. Whether or not that leads to a mandate for increased rates, at the least, the true operating cost of a utility needs to be understood. That can lead to a better discussion on rates, but also addresses the affordability issue.
5. Innovative technology – There is a lot of energy in new technology, and we all know that is has to be proven enough for us to take a chance on it. However, there are so many technologies that have been sufficiently proven, but they are still stuck at the starting blocks because they are told they need give to ten years of operating experience before a utility will adopt it. There are a lot of good ideas, but we need to accelerate the timetable for technologies to be sufficiently verified to the point where people feel comfortable using them. There are risk management tools that can be used to deal with that. The efforts of the test bed networks around the country need to be consolidated and engage in better communication. Mr. Habicht believes that this is something that should be endorsed by Congress. Better mechanisms for collaboration around technology are needed.

There is a lot that can be done outside of Washington. Many of the same people and additional private sector people are pulling together an effort called the Water Finance Roundtable. It is based on discussions at the EPA finance clearinghouse, efforts in various states, and Global Water Intelligence. There is a lot of good information about different kinds of financing vehicles, but for somebody who is not a veteran water investor, it is still difficult to figure out entry points for investing and people still have a monolithic view of it being bond-funded. This is not true, given the proliferation of green and gray infrastructure ideas of green and impact bonds and blended finance. Water investors are on the sideline and they know it is important, but they are just not jumping in. Maybe that can be unleased with a little concerted effort. This roundtable is meant to build on existing efforts and pull together the fundamental information to educate about water investing and the water landscape. It also is meant to talk candidly about the challenges, have a feedback loop into the policy arena, and be project-focused. Pull together the different pipeline information and then convene potentially interested parties together nationally and locally around specific projects. Mr. Habicht thinks that the water clusters are a great focal point for having national dialogues, but at the end of the day, the projects are going to be generated at the local level.

Questions

When a cluster leader sees a technology doing great things locally within their cluster, and a federal initiative arises and that technology can be taken to scale, what is the first step, call, meeting that the

cluster leaders need to take so they can start working towards this when they think about what is going on in their locality? Where do they start?

Mr. Forsgren said that the short answer was to reach out to them and they can see what they can do. We want to try to make technologies known so that people who could benefit from them are aware of them. We want to help facilitate and ideas on how to do that are welcomed.

This group here, a network of 18 clusters, represents a national resource. They have connections to all of the players and there is a great opportunity to leverage the capability here. We should try to design a mechanism to create a sustainable relationship with EPA and other parts of the federal government involved with water technology. The cleanup from Hurricanes Harvey and Irma is going to cost billions of dollars, and innovation will be a large part of it.

The reality is that we have gone from grants to loans, so a lot of what we are talking about that needs to be put in place is hard to monetize in a sense of a traditional loan scenario. Can you give some observations on what the ideas are for addressing how we look at those things that used to be granted, but now are loans and require a return on the investment? When we start talking about technology, data, on the soft infrastructure, this is a scenario where the discussion on how to monetize comes up. This also leads to a discussion on changing procurement, especially around performance-based procurement. What are two or three things that are coming up about loans versus grants as well as soft infrastructure?

As for transitions from grants to loans, Dr. Sawyers said the idea was how we can have that transition of national investment that is cost-effective in some ways. Grants were free to a certain extent, but the states had to provide a match. In a loan scenario, states still have to provide a match, but it is low-cost. For the capital cost for most SRFs on the clean water side, last year's interest rate was 1.7%, and drinking water was perhaps in the same range. When you look at the federal programs for clean water and drinking water, the average interest rate was below 2%. He suspects that the SRFs are still going to play a significant role, so there is still going to be a loan portfolio that is providing the ability to invest in projects at a fairly cheap cost to capital. WIFIA also comes into the conversation. The cost to capital at the Treasury rate at this time is about 2.6%. Every item that we have talked about today is eligible to be funded by WIFIA and/or the SRF. As we expand that portfolio of federal investment, there is also an opportunity to provide the private capital that can jointly fund many of these projects. The idea of blended funding can also help to monetize this transition.

Going forward, grants, loans and low-interest loans will be interesting for us. As private capital gets involved, it will play a critical role, but there are some criteria that need to be put in place. Private investors will have to acknowledge that they need to be patient investors. Getting 10-20% immediately is not going to happen. Additionally, we have to understand that there are cultural issues tied to water, and sewer in particular. You really have to think about who your audience is, the customer. Water and sewer deals outside of the private realm is complicated in many cases. The expectations need to be very clear upfront. Also, foundations are playing a critical role, primarily on technical assistance and technology deployment.

Following up on that last point, utilities are afraid to go to private funding. But at the same time, private funding has a very skewed view of how the funding works. Since you are on the other side, can you give

us a feel for what the future would look like so the private sector has a better view of how they can leverage what is available?

Mr. Habicht offered his response. The most critical success factor here is humility. There is not anyone smart or financially sophisticated enough to have the answer. The important thing is for people to gather together around common approaches. The other obvious point is that the technologies, capital, and ideas are all there to solve virtually all of our water problems. We are not waiting for some great technological breakthrough or that people do not want to invest. The capital and ideas are there. The challenge is more so how to facilitate the money coming in, and part of it is setting expectations. The investment community makes its decisions based on return and risk. In the water space, the returns are not going to be "Google-type" returns, but the risks are going to be minimal compared to many other sectors. There needs to be a dialogue to balance those things out. One way of getting there is through blended financing. A second way is through consolidation. We have so many utilities in the water space, and it makes sense to find ways to consolidate. The economics are going to look a lot better when you have a diverse portfolio of smaller utilities rather than investing in one at a time. Thirdly, this new generation of investment, green and impact bonds, promise better returns for investors. And lastly, the fourth way is technology. We need to find a way to channel developments in technology into a unified space where people can compare notes and move more quickly to move a technology forward. These are all elements that help get the private sector more comfortable with this.

This question is in terms of the infrastructure bill as a whole. Last week, the President said that the private sector model might not work. Where do you see the timing of when the Administration is going to put forward a proposal? In the sense of that public-private model, is there still going to be that private component in that piece?

Mr. Forsgren replied that it will be soon, but he does not know when. He said that the private component will be included.

ROUNDTABLE DISCUSSION PART II: *Establishing Successful Cluster-to-Cluster Collaboration*

Topic Introduction

HEIN MOLENKAMP, Managing Director, Water Alliance, The Netherlands

Hein Molenkamp provided the audience with an overview of how the Water Alliance works. It focuses on research commercialization and governmental cooperation for water technologies and water quality issues. It is a lot about utilities and the water sector. A lot of commercially available technologies are, of course, used in the water sector, but many are also used in other sectors that face water issues.

The Netherlands is a small country, but it considers itself the European water technology hub. Mr. Molenkamp explained how Water Alliance is set up. It is based around speeding up the process from getting technologies from the idea phase to the commercial level. In the Netherlands water cluster, known as Water Campus, they have facilities to help companies accelerate this process.

Water Campus is a mixture of science, applied research, and business. Water Alliance is the business aspect of Water Campus. Scientific knowledge from a European network of universities and demonstration sites are two crucial elements of Water Campus. They emphasize the importance of demonstration sites for scaling up technologies. In the Netherlands, they often talk about small- and medium-sized water technology companies. Since many of the companies are small, they cannot set up their own laboratories, which is why demonstration sites are so important. Companies can visit the sites for a certain amount of time to do testing, which means they do not have to invest in their own labs.

In Europe, even though there are many countries, Water Alliance acts as a portal for companies who are interested in the market and helps companies get in touch with organizations. A current European project called Enterprise Europe Network is helping companies get in touch with other companies.

Mr. Molenkamp ended by saying Water Alliance is open to collaborating with the U.S. water clusters and briefly highlighted ongoing collaboration efforts. He then invited the participants to begin discussions on this topic.

Participants discussed the following questions during the roundtable. The main points from the report outs are outlined after each question.

1. Should clusters pursue collaboration? Highlight one reason why or provide a successful example in a few words.
    a. The overwhelming response to this question was yes.
2. What are some things that clusters can collaborate on? E.g., Regional technology challenges to understand what kind of water technologies are really required at a national or regional level.
    a. Knowledge exchanges, networking, open channels for business, students
3. What would be the value proposition of collaboration, and should it be formalized? Is the model in the brief an appropriate framework that could be considered?
    a. Collaboration allows clusters to learn from each other.
4. Should there be funding (government or private) provided to foster cluster collaboration, build capacity, and to strengthen programs to serve local utilities and other end-users?
    a. Most every table responded yes to this question during the report outs.

DEMONSTRATION HUB FOR MUNICIPAL OPTIMIZATION (INCLUDING EMERGENCY RESPONSE) & REGIONAL WATER INNOVATION PARTNERSHIP

Speakers

SHANNON DUNNE, City of Houston Public Works
YVONNE FORREST, City of Houston Public Works
RICHARD SELINE, Executive Director, AccelerateH2O

The final meeting agenda was adjusted to allow the City of Houston to present on the City's response to Hurricane Harvey.

Richard Seline began by saying that the real collaboration of "Cluster Nation" proved out, and he thanked everyone who responded to the alert for emergency treatment technologies during the response to Hurricane Harvey in Houston. This event proved that this community, nationally and internationally, stood up when it was most important. Mr. Seline showed the track that Hurricane Harvey was projected to take and explained that it was not able to be accurately predicted. It essentially hit Texas three times. This showed that you have to be prepared for the predictions, even if they are not accurate. AccelerateH2O has been working with groups in Texas on data and instrumentation, especially for storm and flood events. Texas had seven storms in 24 hours. In 36 hours, Houston received 21 trillion gallons of water from the hurricane – the amount of water that goes over Niagara Falls in a year and a half. This is the largest rainfall on record in the United States and possibly globally. When something like this happens, it starts registering what you as a community, region, or network of water technology interests could or should be doing.

Mr. Seline thanked SplashLink's Ebie Holst for her and her team's work before, during, and after the hurricane. They sent out a call for emergency treatment technologies. He was given the task to find small-footprint, portable, energy-independent, skid-mounted technology along the Gulf Coast. Many folks in this room sent him contacts and filled out information about technologies. These technologies are now in a repository for all of us to use. Mr. Seline presented the lessons learned from the emergency response efforts thus far:

- Few technologies, equipment, and portable units are sitting idle in warehouses of manufacturers, vendor-suppliers, or other similar reserves waiting for a disaster response. The reality is that if equipment and units are sitting idle, CFOs and COOs are not counting revenues.
- Other non-governmental organizations and water-related associations promised the ability to deliver units within a certain timeframe. Industry with large-scale plants and facilities, including exploration and production energy suppliers could not assemble nor deliver units in a timely fashion,
- There are no Emergency Response Centers for Water Restoration located along the entire Gulf (from Texas to Florida) that house a requisite number of units and equipment as well as corresponding personnel to address challenges within a 12- to 24-hour timeframe.
- Though the most important focus before and during the hurricane response was towards water quantity – the residual impact during and post the hurricane remains the challenges on water quality that continues to affect health, safety, residential, and commercial activities, and overall redesign of new infrastructure and operations.

- While formal processes are always in the handbooks for emergency response, we must include entrepreneurs, innovators, inventors, and off-the-grid teams that have worked tirelessly at the neighborhood level and know the criteria and effectiveness for designing and implementing an efficient, effective, and economic water resilient strategic plan.
- The lesson learned from post- Sandy and Katrina as well as other disasters from Israel, Singapore, Japan, and the Netherlands indicates the informal networks and capacities are vital to an overall strategy for resilience.
- All the academic, scientific, technical, engineering, and innovative insights cannot match the realities of the boots-on-the ground staff and workers that risked life and limb to restore the last of the three major treatment facilities for the City of Houston – they know their systems and facilities and what works and what does not.

Shannon Dunne started with some photos of Houston post-hurricane and presented a graphic that shows how large the city is relative to other large U.S. cities. The land area of Washington, DC, Pittsburgh, Boston, Baltimore, San Francisco, Denver, Miami, Cleveland, and St. Louis combined would fit within Houston's land area – almost 700,000 square miles.

Then, he provided an overview of Houston's wastewater infrastructure by the numbers: 40 plants, 383 lift stations, 6,200 miles of pipe, etc. Mr. Dunne showed a map of the city's wastewater facility locations. Houston typically receives 40 inches of rain per year, but Hurricane Harvey dumped 53 inches of rain on the city. In the past three years, it is the third flood Mr. Dunne has seen in Houston. He showed a few slides of photos of the impact on the wastewater system. He conveyed the diligent efforts of the wastewater treatment plant operators who got the 37 plants back up and running within a day and a half. They were the first responders to the first responders. Mr. Dunne's staff was there as soon as the storm hit, and some did not go home for days. To him, the problem with the industry is that it is outdated; he compared it to using a smartphone versus using a rolodex. And he knows that they cannot keep doing it this way.

Mr. Seline stated that one of the big lessons learned is where technology and innovation come together. "if we're trying to become a 21st century set of communities and innovators, the fact of the matter is we have to recognize who and what we are working with." He stressed that it is important for the private sector to have emergency response efforts when it comes to water, because right now, that is not the case. He cited the examples of the energy companies in Houston who could not respond because they were not prepared for this. Emergency response is something we all have to deal with.

Yvonne Forrest took the stage and expressed that wastewater was not where the troubles started in Houston. As the water rose, that is when they found out how little equipment the city had available, and they took extreme measures to keep the water plants from going under water and not have to put out a boil water notice. Water pumps came from Louisiana, and they had to go through north Texas to get back into Houston so that they could bring new pumps to keep water pumping out of the facility so that the water plants continued running. While they were looking for wastewater treatment technology, they were also looking for things to keep the water system from going under. Going forward, the City of Houston wants to make its system more resilient. A lot of the wastewater plants are in the bayous and technically in the flood ways, but they have water plants there as well.

With the technology hub that AccelerateH2O is helping facilitate, as the City of Houston is in recovery mode and repairing facilities, Ms. Forrest stressed to not build the same thing in the same place the same way. She asked, what else is out there? Are there ways to consolidate some lift stations or treatment plants using cutting-edge technology so that we do not have as many facilities in the future harm's way? She expressed how much support other cities offered during the hurricane. But, there are only so many tools in the tool box and you can only use what is in it and there are no more tools available. With this demonstration hub, Houston is looking forward to helping everyone know what tools are out there, how to use them, and how to connect them. They made the official announcement of the demonstration hub at WEFTEC. Ms. Forrest closed by saying that "whatever Houston learns, we are learning it for all of us."

ROUNDTABLE DISCUSSION PART III: *Practice and Experience in Building Successful Water Cluster – Building Water Cluster Strategy and Programs, Funding Models, Operational Successes*

Topic Introduction

EBIE HOLST, Chief Executive Officer, SplashLink

Due to the agenda adjustment for the City of Houston's presentation, there was not enough time for the third roundtable discussions. Ebie Holst spoke briefly on the topic, which was followed by an open discussion session rather than roundtable discussions for the remaining time.

Ms. Holst and her company, SplashLink, work with a number of water clusters, so she noted that her comments are from the lens that she has in working with many of the audience members. She has watched some of the water clusters mature and understands the stakeholders that they serve. Over time, she has become a proponent for cluster-to-cluster collaboration. In her view, the types of stakeholders the clusters serve have similar profiles, and there are some helpful themes about their perspectives in terms of how to work together with the clusters.

Ms. Holst asked participants to raise their hands if their cluster serves new, innovative companies and new technologies. Nearly everyone raised their hand. She asked the same question, but for utilities, research institutions, private sector companies, and industrial/heavy water users. And again, most participants raised their hand. That is a lot of stakeholders for clusters to engage. She provided thoughts on how clusters can operate as a network on behalf of those stakeholders and how that might actually change the value proposition they are able to offer.

Researchers and innovators bring their young initiatives and new technology to clusters to foster support. If those companies are successful – and there are so many of them that it makes it hard to be successful – not only from some of the issues that go along with being an innovator and having access to testing, but if you want to take your technology to market, it may be that the local cluster's market is not going to be a fit. Ms. Holst believes that when clusters isolate from each other, they end up trapping themselves because the technology coming out may not be the right technology for the needs of the region it comes from. What if, as a value proposition as a network of clusters, any technology coming out of your region could have an accelerated access to other regions and stakeholders anywhere in the world? For example, if there is a water reuse technology from Cleveland, and the demand for water reuse is in southern California, CWA can reach out to the Los Angeles Cleantech Incubator, who can tap the utilities there that might be looking for that technology. Does it not become a better value proposition for those utilities to know they can go to one place and have access to the entire nation (or world) of innovations? Likewise, a new technology company only has to go to one place, a cluster leader, who can help shepherd it through the system of markets and help accelerate it through the markets that may have a need for that technology.

That is a lot of value. There are versions of that same theme where, if you take the issue of an oil and gas company, and it is also looking for some type of solution to a particular problem it has at this time, and the company has the money and is willing to take a risk on piloting a new technology. If the problem it is trying to solve is based in Texas, and it taps Mr. Seline of Accelerate H2O, who can get that call out to anywhere else in the world that may have a range of solutions to provide. That starts to bring a lot of

money into the network of clusters working together. It also provides the opportunity for clusters to perhaps spend more time getting to know individual stakeholders within their region, really understanding the challenges that utilities, local companies, etc., have – those challenges that need the visibility to your peers in other parts of the world.

Regarding the call out for emergency technologies following Hurricane Harvey as mentioned by Mr. Seline earlier, the support that SplashLink offered was a microcosm of what can be done on a day-to-day basis together. Ms. Holst stressed that clusters should be specializing in the stakeholders in their region and championing them. She thinks many of the cluster leaders in the audience spend a lot of time trying to survive with near-term wins. The challenges around competing for dollars and brand names that can be participating in this can actually translate into some age-old business solutions; for example, a revenue share. If there is a large company in a cluster's region that engages through the cluster's door, but benefits from technologies in other parts of the network, there are ways to share financial rewards around that and enable all of you to dig deep in the areas of expertise in representing your regions, opportunities, and solutions, and be different and be stronger together.

Ms. Holst said that one of the potential outcomes of this meeting is to figure out a way to pilot the day-to-day version of some of this with the backdrop that Hurricane Harvey has presented. She asked, how can we actually start escalating the challenges and solutions of our clients into this central knowledge of all of us together? If we understand that as a value proposition for each of these different stakeholder profiles, then we can understand what tools we need to get it done. If we understand the goal, we will be able to identify the process and tools.

Discussion

Below is a summary of some of the points made during the discussion portion of this session.

Can you talk about your experience with the emergency response efforts to Hurricane Harvey on a national level? To some extent, that begins to form the basis of a pilot for what national sharing of resources might look like. What areas that lack provision of support have you seen from government agencies or national organizations that should be set in to that and one that has been dealt with and addressed by SplashLink?

Ms. Holst responded that Mr. Seline would be best to answer the question about some of the gaps they are seeing in Texas. One of the roles that SplashLink is able to play is that there is a speed it can provide. The benchmark in emergency response is often to call whoever's phone number is readily available and ask them if they know somebody. And if they do not know somebody, maybe they will know somebody who knows somebody. This ends up being a telephone train, which is not the most efficient way to approach this. Everybody wants to help in an emergency response situation. But, people in the crisis get swarmed by vendors and have no control over it. They are just trying to wrap their head around what the actual problem is and assess it. One of the things that SplashLink could provide is a buffer around that. It could offer identity protection, a mechanism to get requests out to the network of potential solution providers, a mechanism that forces those solutions providers to have a structured, tailored response that addresses what is meaningful for the particular person seeking the technology.

SplashLink was able to provide, despite not having that infrastructure in the past, is the buffer and identity protection and the ability to engage with players based on specific needs and criteria.

Mr. Seline addressed the fact that states have different approval processes for technologies. Even though a technology may be approved in one state, it has to go through the testing and piloting process again to be approved in another state. This is especially challenging during times of crises when approval processes take many days, which prevent technologies from getting on the ground in an emergency.

Egils Milbergs expressed that events like hurricanes are catalytic events that create opportunity for new water infrastructure. For the longer term and rebuilding, Mr. Milbergs suggested the creation of a special projects/innovation office focused on innovation and the next water infrastructure for a place like Houston. This needs to have four elements: (1) a data platform, (2) leadership to run it, (3) funding, and (4) a strategy. Once it is in place, cluster nation has a place to look to.

Gary Keller mentioned that having a program that allows validation of products that are able to provide specific solutions would be valuable. Unfortunately, the EPA programs that did this in the past no longer exist. But, being able to do something like this with an emergency response focus endorsed by EPA would make sense to make sure it is sustainable.

Ms. Holst said that one of the challenges is thinking of things in the way they have historically happened, and that tends to bottleneck things. She thinks of the clusters as parallel processors. This does not mean recreating work; it means more players to carry a heavier load. If we have standards around how we test and what needs to be tested and what information needs to be provided and shared, then we can accelerate all of these different things if all of us are doing it.

Adriana Felix-Salgado informed everyone that the International Organization for Standardization (ISO) recently came out with a standardization for environmental technology verification, ISO 14034. She said that the more organizations and clusters that deploy it to validate technologies will create momentum for it and hopefully get the EPA regions on board.

Ms. Holst said one of the things she sees in the clusters today is the focus on connecting new technology players with a utility. This is important; but, it is also important to nurture those relationships alongside the long-running solutions provider companies. They have been doing it a long time, and there are not silver bullets. If you have new technology companies, they are going to have to fit in with existing systems, and if you are engaging the network of players in your region who have been doing this for years with existing products and services, those are the ones that the new technology companies have to integrate with. They are going to be the players that are best-equipped to respond for your peers when they are in trouble. Ms. Holst encouraged the audience to think of themselves as their own network that is connected to a broader network where you can accelerate how you are serving every one of your stakeholder profiles. If you approach everything you do with that in mind, then the tools will come along. We need to get into the habit of talking about the challenges we are trying to solve, and then enabling the expertise to self-identify in the context of what needs to get done.

Grasshopper Mendoza reflected on how 12 years after Hurricane Katrina, we still have not built upon the lessons learned. She attributed this largely to competition.

Walt Kovalick suggested that the cluster leaders review the Stafford Act, which is the law that allows Congress to allocate money to Federal Emergency Management Agency (FEMA) and the Department of Homeland Security (DHS). The Stafford Act can be viewed online here: https://www.fema.gov/media-library-data/1490360363533-a531e65a3e1e63b8b2cfb7d3da7a785c/Stafford_ActselectHSA2016.pdf.

PRESENTATIONS FROM INTERNATIONAL CLUSTER LEADERS

Introduction

HECTOR RODRIGUEZ, Acting Director, U.S. Export Assistance Center–Las Vegas & Global Environmental Technologies Team Leader, U.S. Department of Commerce

Speakers

MR. JAKOB ANDERSEN, The Consul General of Denmark
MR. WOOWEON LEE, Director, Task Force for Water Cluster, Ministry of Environment, South Korea
KERRY FREEK, Vice President and Senior Manager of Communications, WaterTAP, Ontario, Canada
HEIN MOLENKAMP, Managing Director, Water Alliance, The Netherlands
YIU KEI CHAN, Commercial Specialist, U.S. Commercial Service, Singapore
JUSTINE ESCOURROU, Environment Trade Advisor, Business France
EMILIE FILLOL, International Project Manager, Aqua-Valley, France
BOOKY OREN, Booky Oren Global Water Technologies, Israel

Hector Rodriguez from the U.S. Department of Commerce opened the panel and introduced each presenter.

Mr. Jakob Andersen, Denmark

- The government wants to promote Denmark and what it stands for.
- It came out with three areas to focus on, and one is water and wastewater.
- This provides seed money to start various alliances around the world.
- They created an alliance between about 28 Danish drinking water and wastewater companies and the four largest Danish utilities. The goal is to exchange knowledge between utilities.
- Over the last 25 years, Denmark has looked at its wastewater plants as a resource rather than a burden.
- Denmark has partnerships with technical universities to exchange students and utility personnel. Starting in 2018, this will be fully financed by Danish and American companies.

Mr. WooWeon Lee, South Korea

- Mr. Lee presented a slide depicting the development scheme of the water sector in South Korea. It includes the life cycle of a water technology, a REWater Project, which provides funding to encourage new ideas and technologies in the field of reuse, the water cluster, and a backup system known was the Water Industry Promotion Act.
- In Korea, a water cluster is a visible and measurable complex facility in a specific area with test beds, a training center, research center, and global business center, etc.
- The purpose of the water cluster is to give researchers and businessmen a pathway from research and development (R&D) to commercialization.
- The water cluster will be located in Daegu, South Korea. The national and local government has invested over $300 million in the water cluster complex. There has not been a business investment yet.
- Mr. Lee showed the features of the complex: the global business center (industry promotion), the R&D center (testing), and the water campus (training, administration).

- The test bed will have demonstrations for drinking water, wastewater, and water reuse. They are also considering a flow test center.
- They tried to find other water clusters to model theirs after, but could not find any.
- The Water Industry Act is under deliberation in the National Assembly. It includes operating the water cluster, but it is mainly about water technology contributing to public health, sanitation, and sustainable development.
- The construction of the water cluster is to be completed by the end of 2018, and the testing facility will begin running mid-2019.

Kerry Freek, Ontario, Canada

- WaterTAP helps companies grow their businesses. It delivers a direct assistance program, which is modeled to provide very specific time-limited projects to companies based on their priorities and WaterTAP's priorities.
- Over the last five years, WaterTAP has learned a lot about the barriers and struggles that the companies face to get their technologies adopted in end-user markets. It is taking this information and gleaning into events and initiatives that can help move things forward.
- Last year, it developed a Better Best Practices initiative. WaterTAP has an objective from the legislation that created it, the Water Opportunities Act, that states that it should provide advice back to the government on how to grow the sector. This initiative is about convening and the mandate to provide this advice and addressing some of the barriers that the companies are facing. It is especially focused on procurement issues and understanding challenges with affordability and water infrastructure. It is looking at asset management, funding, and regulation, and trying to help the small municipalities pick long-term sustainable solutions.
- WaterTAP hosted the second annual Ontario Water Innovation Week in November in conjunction with the World Water Tech North America forum.

Hein Molenkamp, The Netherlands

- The Dutch water cluster is about working together on a scientific, government, and company level.
- Water Alliance tries to help its companies speed up their innovations by having all kinds of facilities. Mr. Molenkamp noted that many of the facilities are open for international work as well. It is an open innovation system.
- The water cluster focuses on education. It has spent years setting up a special water technology education program. It has programs for preliminary schools to teach students at a young age about water technology, among others. The Netherlands wants to make sure that there will be a lot of people working in the water technology field.
- Wetsus, an arm of Water Campus, is an international research institute with research carried out at the university level, but companies are also involved. At the moment, researchers from 20 universities throughout Europe are earning their PhD's at this laboratory. The research programs are supported by around 110 international companies. This ensures that there is always market-driven research there.
- The Centre of Expertise is also a part of Water Campus, but housed in the applied research arm of it. Here is where students at the university for applied science can do their studies at an application center, where companies do their research. Students and companies are brought

together here, so they can learn from each other and seek potential employment at the companies.

Yiu Kei Chan, Singapore

- Singapore is a regional hub for southeast Asia for water innovation and test bedding water technologies.
- Mr. Chan presented a slide on Singapore's current water consumption and its goals for 2060 consumption levels.
- Singapore is only 20 miles by 12 miles, but 5.6 million people live there. It has four national water taps supplying water to the country: a local water catchment area, imported water, recycled and reused water, and desalinated water. For the past 100 years, 50% of the daily water consumption is imported. It is trying to be self-sufficient by 2030-2035.
- One of Singapore's projects is NEWater, where it converts industrial and sewage water into ultra-pure water. The latest project is a deep tunnel sewage system. Their first system, started in 2001-2002, was modeled after a deep tunnel system in Chicago. Now, they are adding on to that to create a system across the country.
- Singapore is also looking at membrane filtration systems, ultraviolet advanced oxidation process, rapid microbial testing of water to validate quality, algae pre-treatment systems for desalination, and wastewater treatment system.
- Singapore International Water Week will be in July 2018.
- Singapore has its own water cluster. It is not only trying to develop innovation and technology, but also skilled manpower to operate and maintain water infrastructure in Singapore.
- It looks at water and energy in three areas: economic competitiveness, environmental sustainability, and security.

Justine Escourrou and Emilie Fillol, France

- Business France is the national agency for the international development of the French economy. It has two missions: fostering export of French businesses and promoting and facilitating foreign investments in France. It has 10 offices in North America.
- France has a large, dynamic domestic market ($14.8 billion in 2014), which is the largest in Europe. It is home to global market players like Suez and Veolia, and it has a substantial research and innovation capacity driven by startups and other innovation centers, like R&D centers.
- The French are internationally recognized for the construction, operation, and maintenance of drinking water infrastructure. It is a market open to foreign investment with market opportunities for new entrants. One-fourth of companies in the water treatment sector in France are foreign companies.
- France is attractive in the water treatment sector for its comprehensive ecosystem driven by multiple innovation clusters.
- The France Water Team Network is a consortium of six water clusters. Its mission is to improve its members' competitiveness through innovation, skills development, and internationalization. It has more than 650 members. This network builds collective actions, such as exhibitions and business prospections, in order to promote innovative water technologies and products.
- Ms. Fillol showed a map of the France Water Team's international network. This helps companies do business abroad and promotes cluster collaboration.

Booky Oren, Israel

- Mr. Oren decided to work in the water industry because it is an industry where he felt he could make a change. So in 2003, he joined the government and lead the national water company, Mekorot.
- In 2006, Israel made its first national decision to promote the water industry.
- In 2011, Mr. Oren realized a major problem in the water sector, called innovation to implementation, or i2i. There is so much innovation in the sector, but it is not good enough because we do not know how to implement it on a large scale.
- He said that there are many people in the room with the same great ideas, but the main issue is how to collaborate. It is not about just saying that it needs to happen. He thinks that we do not have any other choice. Each of us has too many challenges to overcome alone.
- Once, a colleague told Mr. Oren that there are three terms to initiate partnership: (1) you do not have any other choice, (2) there needs to be high-management level commitment, and (3) trust.
- The water sector is too big for a single player. The clusters by themselves are too small. He urged that by the next time this group convenes, that real partnerships are created, not just shared successes.

PRESENTATIONS FROM THE U.S. NETWORK

Sally Gutierrez invited any of the cluster leaders who wanted to share "micro Ted talks" about their clusters to come forward.

Bryan Stubbs, Cleveland Water Alliance

- CWA's phone is always open, and he is happy to talk further with anyone any time.

Michael Jones, The Maritime Alliance

- Based in San Diego, The Maritime Alliance (TMA) is a strategic partner with the U.S. Department of Commerce. They worked together to create the green technology team, which now has over 100 members from around the world.
- Worldwide, the water industry accounts for $500 billion; whereas, the ocean industry is $1.5 trillion. Mr. Jones encouraged looking at water and ocean technologies together.
- TMA believes in regional clusters and national and international outreach, and it started a BlueTech Cluster Alliance with nine clusters from seven countries.
- In November, it is holding its ninth annual BlueTech Week in San Diego. It expected 18 clusters and cluster-in-formation from nine states and at least nine countries to convene.

Dean Amhaus, The Water Council

- The Water Council (TWC) is looking forward to working with CWA and NASA on an upcoming partnership.
- It has an estimated $400,000 available (over a certain period of time) for piloting technologies with universities and utilities.
- One of the issues we all face is sustainable funding. TWC has found a state legislator who is interested in a funding mechanism for not only water, but clusters as a whole. They have been working together to create a $500 million evergreen fund to help cluster development, do more piloting, and R&D for industry.
- TWC is beginning to address the talent shortage in the water technology industry. There are very few African Americans working in the industry. TWC has teamed up with three historically black colleges and universities – Tuskegee University, Morgan State University, and Jackson State University – to get engineering students to intern at TWC companies with a goal for employment after graduation. If TWC gets a grant to come through, those interns will become mentors for local high school students.

Egils Milbergs, Pure Blue

- Pure Blue is a startup cluster in Seattle, Washington. Its goal is to solve global water problems.
- It has the view that if it solves a problem in the Puget Sound, Washington area, then it is scalable to the rest of the world.
- Pure Blue is an economic development initiative, not just a water quality initiative.
- It recently launched the first component of its accelerator program in Tacoma, Washington, and it already has six companies involved.

- Pure Blue believes in cluster-to-cluster collaboration. Innovation is not bolted to a single individual, organization, or region. Innovation needs to take place in the context of a global network of resources, talent, and creativity.
- Pure Blue's theme is the "new world of water." It is working on a multi-million-dollar initiative to create a super cluster. It has not selected a domain of focus yet, but it is time for the clusters to use the network of water cluster nation.

Aayushi Jain, Los Angeles Cleantech Incubator Water Cluster

- The Los Angeles Cleantech Incubator (LACI) was established as an economic development initiative out of the Los Angeles mayor's office. It is a non-profit that helps incubate cleantech companies. LACI works out of a 60,000 square foot campus donated by the Los Angeles Department of Water and Power.
- LACI's water cluster is now at 300 members. There are quarterly meetings that focus on local water – storm water, groundwater, and water resiliency, which is the largest topic.

Karen Meidlinger, on behalf of Water Technology Innovation Ecosystem

- Ms. Meidlinger spoke on behalf of Dr. Rominder Suri, who leads Philadelphia's water cluster. She said that the expertise there is on identifying emerging contaminants, identifying new risks around them, and removing them. This is a result of the large presence of pharmaceutical companies around Philadelphia.

Mike Dixon, WaterNEXT

- WaterNEXT is a brand new cluster based in Calgary, Alberta, Canada that launched three weeks prior to the meeting.
- It is interested in all water technologies, but it has a large interest in produced water, point-of-use water treatment, and big data.

Steve Picou, Louisiana Water Economy Network

- Mr. Picou indicated that he looks forward to hosting everyone at next year's WEFTEC in New Orleans. In 2018, the City of New Orleans will be celebrating its 300th anniversary.

Ms. Gutierrez thanked everyone for attending and adjourned the meeting.