Office of Research and Development

ORD Water Research Planning with ECOS

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Briefing Outline

Slides 3-4: SSWR research topics and connecting to states' research needs

Slides 5-8: Watershed Sustainability research

Slides 9-12: Nutrients and Harmful Algal Blooms (HABs) research

Slides 13-18: Water Treatment and Infrastructure research

Slides 19-20: National Priorities and STAR Grants

Slide 21: Communication and Outreach Highlights

Slides 22-28: Cross-Program Research Coordination: HS and HHRA

![EPA]

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM

Clean Water Act

Safe Drinking Water Act

Watershed Sustainability

Nutrients and HABs

Water Treatment and Infrastructure

Connecting SSWR Research Topics to 2016 ERIS State Research Needs

Research Topic	State Identified Priority Areas and Related Research/Science Issues Identified						
	Water/Surface Water/Groundwater Quality	Nutrients and Nonpoint Source Pollution/Agriculture vs Groundwater/HABs	MS4* Compliance and Stormwater	Water Quantity and Reuse	Small System Drinking Water and Wastewater Treatment	Ensuring Safe Drinking Water/ Disinfection Byproducts	Issues with Altered Hydrology
Watershed Sustainability	✓	✓		✓			✓
Nutrients and HABs	✓	✓					
Water Treatment and Infrastructure	✓	✓	✓	✓	✓	✓	✓

*Municipal Separate Stormwater Sewer Systems

Main Topic Activities

Advancement of integrated water resource and watershed management approaches, models, and decision-making tools that ensure sufficient supplies of clean water to support economic, environmental, and public health requirements.

Research Priorities

- Recreational Water Quality Criteria

- Ambient Water Quality Criteria

- National Aquatic Resource Surveys (NARS)

- National Water Quality Benefits Estimation Platform

Watershed Sustainability

Science support for Drinking Water Health Advisories for Cyanobacterial Toxins

- Addressing data gaps for recreational use

Science support for 2017 Recreational Water Quality Criteria review and beyond

- Rapid molecular methods for same-day notification fecal contamination and microbial water quality models

- Improved coliphage/other bacteriophage enumeration methods – sensitive, low-cost methods

- Human health and exposure research – Fecal indicator bacteria, coliphage, salivary antibody assays to assess risk

- Microbial source tracking tools for various animal species and human source tracking markers

Watershed Sustainability

Addressing the challenges of expanding numbers, combinations, and novel features of chemical contaminants

- Toxicity testing, data analysis and method development – pesticides, metals, nitrates, major ions/ion ratios

- Supporting EPA's Office of Water (OW) efforts to update/revise the 1985 aquatic life guidelines

- Stream conductivity/major ions and ion ratios – physiology, ecotox (lab, experimental streams, field)

Critical research to protect aquatic life and human health

Watershed Sustainability

National Aquatic Resource Surveys

- Collaborative program with states and tribes
- Assesses the trends in quality of coastal waters, lakes and reservoirs, rivers and streams, and wetlands
- Provides critical, groundbreaking, and nationally-consistent data using a statistical survey design

National Water Quality Benefits Estimation Platform

- Cross-Agency effort to improve our ability to value the full ranges of benefits of water quality improvements
- Collaborative team: economists, ecologists, and water quality modelers
- Five waterbody types: Great Lakes, estuaries, coastal waters, rivers and lakes, and small streams

Main Topic Activities

Improve the science needed to develop nutrient thresholds for the protection of ecological endpoints by developing and implementing technologies and management practices.

Provide information and tools that improve the ability of local, state, and national stakeholders to manage risks posed by HABs.

Research Priorities

- New indicators for streams, lakes, and estuaries
- Relating nutrient loading to impacts
- Water quality standard/aquatic life criteria validation
- Interactions between nitrogen and phosphorous with biota
- Nutrient enhanced coastal acidification and hypoxia
- Inland HAB management and reservoir algal dynamics
- Cyanotoxins: adverse health outcomes, analytical methods, real-time online monitors

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Nutrients and HABs

Cyanobacteria Assessment Network

Multi-agency project to develop an early warning indicator system to detect algal blooms in U.S. freshwater systems.

EPA Niche:
- Satellite applications methods for freshwater HAB and water quality management

External Engagement:
- EPA Regional Technical Assistance Groups and HAB workshops with states
- Continental U.S. cyanoHAB satellite data delivered to OW, regions and states, with webinar trainings

Example Applications:
- Developed methods to quantify cyanoHAB frequency and extent
- Each year EPA could report on status of cyanoHABs in U.S. resolvable lakes

www.epa.gov/water-research/cyanobacteria-assessment-network-cyan

Analytical Methods

- **Method 544:** Determination of microcystins and nodularins in drinking water by LC/MS/MS

- **Method 545:** Determination of cylindrospermopsin and anatoxin-a in drinking water by LC/ESI-MS/MS

- **Method 546:** Determination of microcystins and nodularins in drinking water and ambient water by ELISA

- **Single Laboratory Validated Methods:** Determination of cylindrospermopsin and anatoxin-a and for microcystins and nodularins in ambient freshwaters by LC/MS/MS

www.epa.gov/water-research/methods-models-tools-and-databases-water-research#cyanotoxins

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Challenging Nutrients Coalition

Nutrients and HABs

EPA-led interagency collaboration on prize challenges to address nutrients www.challenge.gov

CHALLENGE	GOAL	RESULT/STATUS
Nutrient Sensor Challenge	Affordable nitrogen and phosphorous sensors to market	3x price reduction sensors on the market
Visualize Nutrients	Effective communication/visualization of nutrient data	Award winning video
Smart Septic Sensor Challenge	Nitrogen sensors to monitor septic system integrity	Breakthrough technology for low-cost nitrogen sensors (U. Connecticut)
Nutrient Reduction Challenge	Recover nitrogen/phosphorous from pork and dairy manure	Prototypes in development
Nutrient Sensor Action Challenge	Demonstrated use of nitrogen/phosphorous sensor data for use in decision making	Stage 1 - 11 teams participated Stage 2- launch 2/18

Actions: Science & Technology Support

- Florida Nutrient Criteria (2009-2013)

- Research Supporting Deepwater Horizon, Natural Resource Damage Assessment (NRDA) (2015-present)

- Removal of nitrogen and phosphorus using a pilot reactor for wastewater treatment plants in Madison, WI (ongoing)

- Chesapeake Bay Total Maximum Daily Load (TMDL) for nitrogen, phosphorus and sediment

- Rhode Island TMDL for phosphorus and chlorophyll-*a*

- Water Quality Trading

- Integrated Science Assessment (ISA) for NOx, SOx and PM

- Assisting the State of Washington request for EPA support on determining if criteria are needed for nutrient enhanced coastal acidification and hypoxia in Puget Sound (ongoing)

Main Topic Activities

Develop and evaluate data, approaches, and technologies that will support the promulgation and implementation of federal water regulations and guidance, while also addressing regional, state, and community issues of concern.

Develop and demonstrate best practices and tools for managing stormwater volume and improving water quality, and assess their feasibility.

Research Priorities

Emerging Contaminants
- Per- and Poly-fluoroalkyl Substances (PFAS)
- Cyanotoxins
- Disinfection byproducts (DBPs)

Lead
- Develop risk assessment/exposure model in support of Lead and Copper Rule (LCR) revisions
- Characterization in distribution/premise plumbing systems and improved sampling methods

Infrastructure Management
- EPANET-Advanced extensions for water security, contaminant reactions, and real-time control
- SWMM-Application/technical support for stormwater management in communities

Small Systems
- Drinking water treatment – development of biological treatment systems for ammonia removal
- Distribution systems – minimizing DBPs in small drinking water systems

Pathogens
- *Legionella*, *Mycobacterium:* Occurrence and detection
- Copper/silver ionization treatment, UV treatment
- Antibiotic resistant bacteria in wastewater/water reuse systems

Technical Support
- Technical support for states in addressing drinking water, wastewater, and stormwater challenges

Treatment & Infrastructure

Key Accomplishments

Cyanotoxins: Guidance for drinking water treatment, Toledo support

"*Your efforts were instrumental in restoring safe drinking water to over ½ million Ohioans and exemplifies a great example of how local, state and federal agencies are able to work together, mobilize essential resources and address critical issues.*"

—*Governor John R. Kasich (in a letter to US EPA staff)*

Lead:

- Risk assessment/exposure model development for lead in support of Lead and Copper Rule Revisions
- Lead characterization in distribution/premise plumbing systems and improved sampling methods

EPANET: Advanced extensions for water security, contaminant reactions, and real-time control

Small Systems: Development of biological treatment systems for ammonia removal

Treatability Database: Collaborate with OW to develop cost models for inclusion in database

Opportunistic Pathogens:

- *Legionella*, mycobacteria
- Occurrence and detection
- Copper/silver ionization treatment, UV treatment

Water Reuse

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Per- and Polyfluoroalkyl Substances (PFAS)

Treatment & Infrastructure

Hazard Information

Studying the potential hazards of PFAS in the environment using cutting-edge technologies pioneered by our computational toxicology research.

Validating Methodologies for Measuring PFAS in Environmental Media

Developing robust analytical methods for ground, surface, and wastewater and for solids including soils, sediments, and biosolids.

Reducing Exposure

Assisting states and federal partners in the remediation of environmental media, including drinking water.

Risk Communication

Working with ECOS and the Association of State and Territorial Health Officials (ASTHO), compile state case studies to better understand how state agencies manage their risk communication to the public.

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Stormwater Management

Treatment & Infrastructure

- National Stormwater Calculator (SWC) -Development of cost/benefit component and mobile web application for portability

- Storm Water Management Model (SWMM) Application at watershed-scales and addition of geographic information system (GIS)

- Performance assessments of Green Infrastructure (GI)/low impact development systems (permeable pavement, rain gardens, swales)

- Urban soil characterization for improving GI implementation

Lead and Copper Rule

Treatment & Infrastructure

ORD's Participation:

- Providing feedback on the state of the science as it pertains to lead and copper

- Input and review of LCR options under consideration to be taken forward to the Administrator

- Presentations and summaries of research during various stages of the process

- Provide technical recommendations under LCR revision

- Providing input from direct technical support experience, relating to state and utility capabilities to implement different regulatory options safely and effectively

Involvement in all three Lead and Copper Rule (LCR) Workgroups:

1. LCR Revision
2. LCR Implementation
3. Schools and Sampling (3Ts)

Workgroups include EPA staff from OW, ORD, and Regions.

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Treatment & Infrastructure

ORD's immediate monitoring assistance:

- Disinfectant residual monitoring plan to ensure residual is maintained throughout the distribution system

- Built pipe loop rigs that incorporated lead pipes removed from Flint homes for real-time monitoring of lead and corrosion control assessment

- Pipe scale analysis of lead pipes that were replaced

- Hydraulic and water quality distribution system modeling

National Priorities and STAR Grants – Infrastructure

EPA

National Priorities: Transdisciplinary Research into Detecting and Controlling Lead in Drinking Water
RFA

2016 - 2019

National Priorities: Impacts of Water Conservation on Water Quality in Premise Plumbing and Water Distribution Systems
Two grants awarded (**PA**, **IN**, CO, MI, CA, LA)

2016 - 2020

National Priorities: Life Cycle Costs of Water Infrastructure Alternatives
Two grants awarded (**VA**, **CO**, MD, UT, KS, CA)

2016 - 2021

National Center for Sustainable Water Infrastructure Modeling Research
One grant awarded (**TX**, NC, UT, CO)

2014 - 2017

National Centers for Innovation in Small Drinking Water Systems
Two grants awarded (**MA, CO**, TX, FL, IL, NE, FL, AL, NH, TX)

National Priorities and STAR Grants

2014 - 2017

National Priorities: Systems-Based Strategies to Improve The Nation's Ability to Plan And Respond to Water Scarcity and Drought Four grants awarded (**SC**, **UT**, **CA**, **CO**)

2013 - 2018

Centers for Water Research on National Priorities Related to Systems View of Nutrient Management
Four grants awarded (**NY**, **VA**, CA, MI, WA, MD, FL, TX, CO)

2018 - 2020

Freshwater Harmful Algal Blooms
Two grants awarded (**OH**, **IA**)

2016 - 2019

Water Quality Benefits
Six grants awarded (**NC**, **IA**, **MA**, **MI**, **NH**, **NC**, **CT**, MD, MN, TN, WI, VA)

2015 - 2020

Human and Ecological Health Impacts Associated with Water Reuse and Conservation Practices
Five grants awarded (**NV**, **CA**, **UT**, **IL**, **VA**, NY, MD, D.C.)
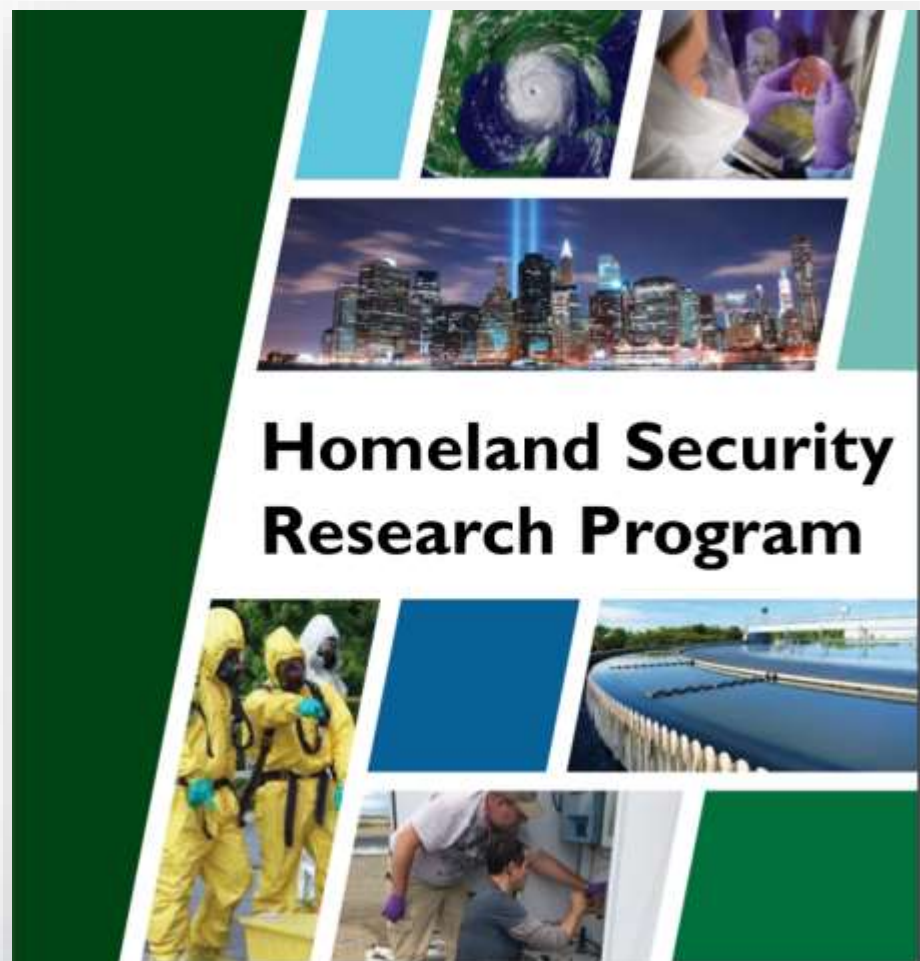
Communication and Outreach Highlights

- ❖ [SSWR Water Research Program Webinar Series](#)
- ❖ [SSWR/OW Small Systems Monthly Webinar Series](#)
- ❖ [SSWR & HSRP/OW Small Systems Annual Workshop](#)
- ❖ [EPA Tools and Resources Webinar Series](#)
- ❖ [Science Matters Biweekly Newsletter](#)
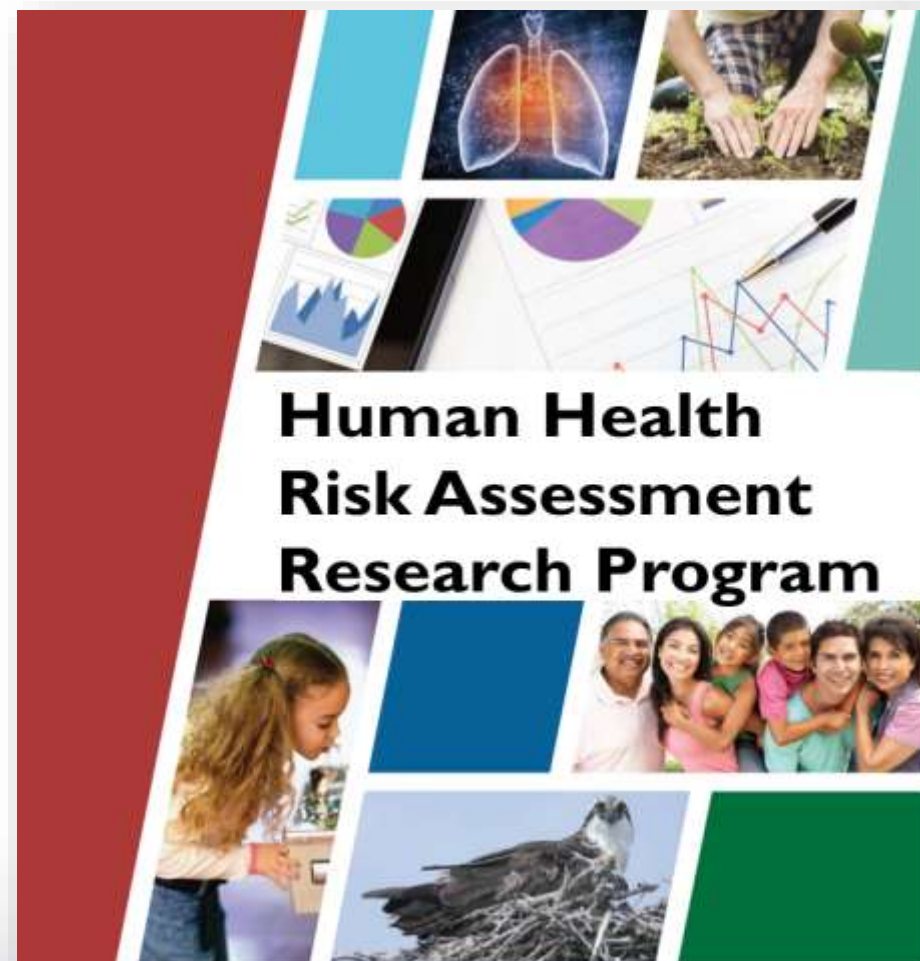- ❖ [Fact Sheets](#)

January 2015 – February 2018
- 29,570 Attendees
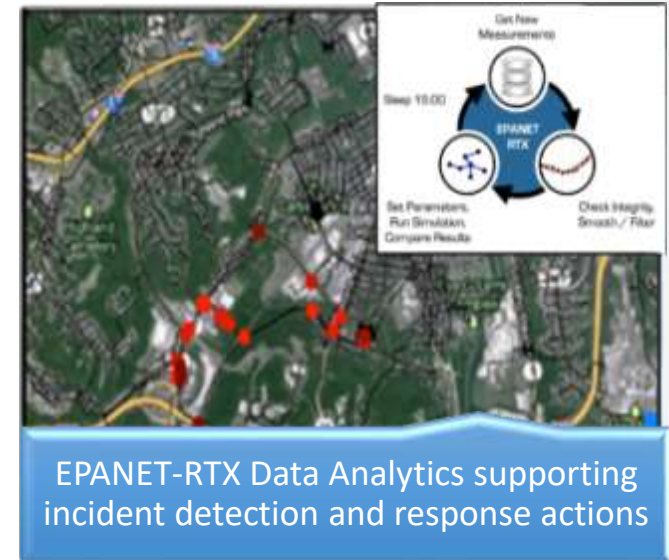- 18,091 Continuing Education Credits
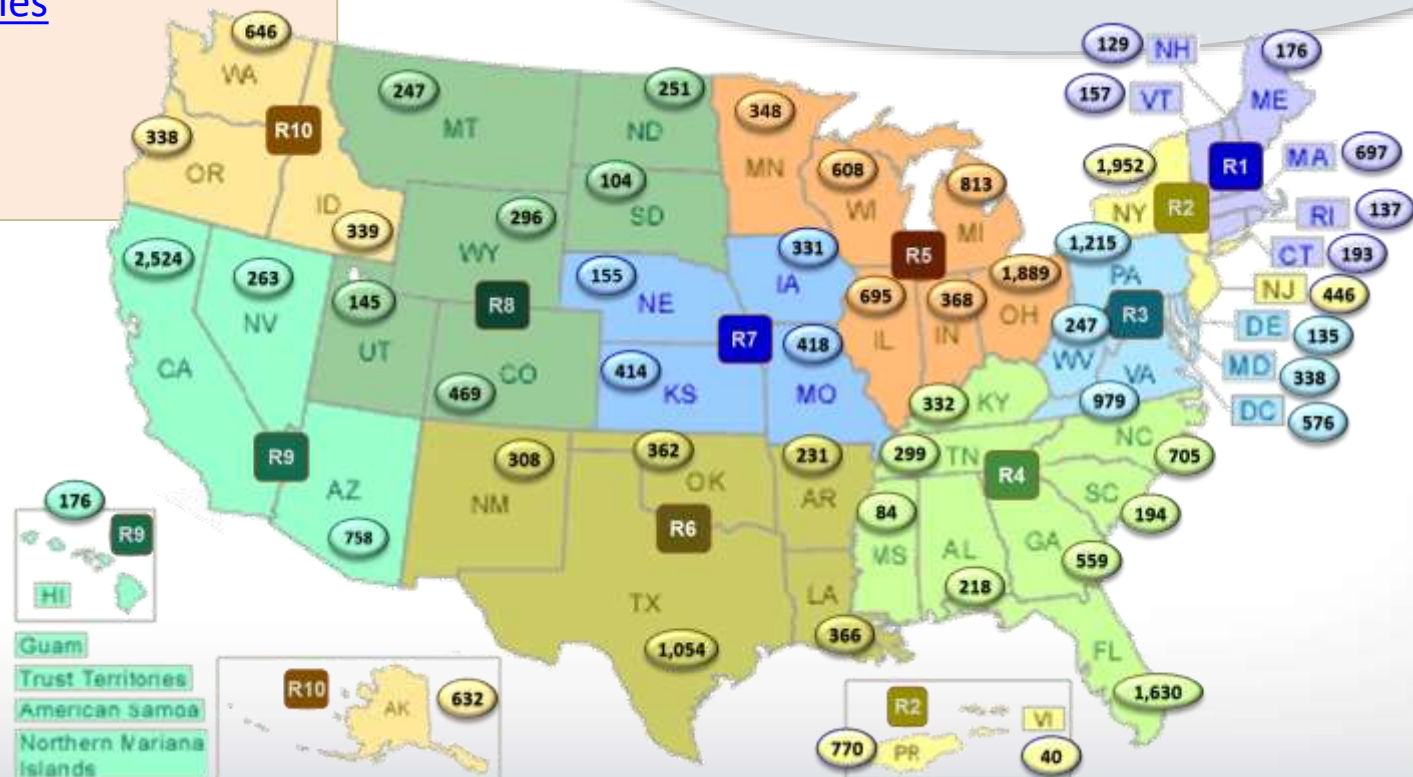
(HS)

(HHRA)

Research Capabilities

- Development of sample collection and analysis methods for drinking water contaminants of interest

- Development of methods and tools to identify sampling locations and strategies within water infrastructure

- Understanding and applying fate and transport of chemical, biological and radiological contaminants resulting from water infrastructure contamination to improve risk management decisions

- Develop and evaluate tools and methodologies to inform decontamination of water infrastructure (drinking water, premise plumbing, wastewater, stormwater, source water, and reuse), management of the contaminated water, and return to service

EPANET-RTX Data Analytics supporting incident detection and response actions

Impacts of contaminants on wastewater treatment plants

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Research Capabilities (cont.)

- Development of sample collection and analysis methods for large volumes of contaminated water

- Characterizing potential exposure pathways and consequences of priority contaminants in drinking water systems

- Development of Provisional Advisory Levels for priority chemical contaminants in water systems

- Development of methods and tools for incident detection (including evaluation of on-line monitoring sensors, sensor placement and event detection) for water infrastructure

- Demonstrating and documenting the impact of cybersecurity vulnerabilities on internet-facing process control systems used to operate water and wastewater systems
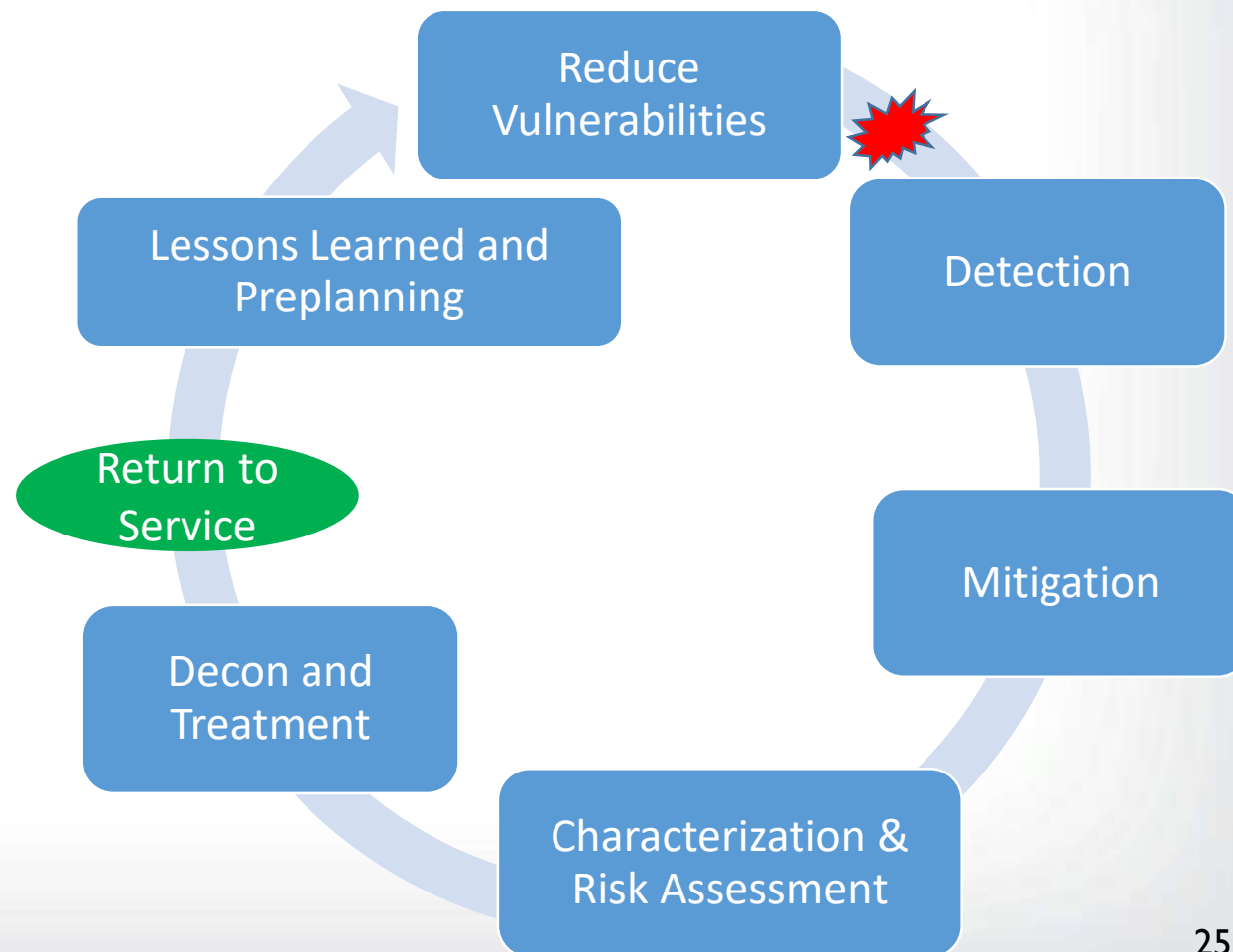

Flushing tests for contaminants in water distribution systems

Assessment of on-line monitors and pilot decontamination approaches

Elk River MCHM Spill (2014)

Corpus Christi Water Contamination (2016)

Water Security Problem Definition

- Reduce Vulnerabilities
- Detection
- Mitigation
- Characterization & Risk Assessment
- Decon and Treatment
- Return to Service
- Lessons Learned and Preplanning

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Lab- to Field-Scale: Water Security Test Bed

Water Security Test Bed Video:https://youtu.be/olCs_kbegBA

Testing of water distribution system and premise plumbing decontamination methods

On-site assessment of mobile water treatment systems: Ozone UV AOP and WaterStep

- Water Security Test Bed

- Assessment of water system infrastructure decontamination and contaminated water treatment methods at full-scale

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(1) Science Assessments & Translation

Science Assessment Development

Science Assessment Translation

(2) Advancing the Practice of Risk Assessment

Emerging and Innovative Assessment Opportunities

Essential Assessment Infrastructure and Support Tools

Vision: To advance the science and practice of risk assessment.

Key Outputs: A portfolio of fit for purpose assessment products that meet the needs and priorities of customers, including the states, tribes, and EPA regions and program offices.

- Focus on priority pollutants (PFAS, lead), criteria pollutants (to support NAAQS), drinking water contaminants, clean up of contaminated and hazardous waste sites
- Integration of new approach methods and emerging data into assessments of data poor chemicals

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HHRA Research Program

Portfolio Approach

- Moving away from a 'one-size-fits-all' approach to risk assessment towards a spectrum of assessment products to meet specific decision contexts

- Facilitating the incorporation of new data and science into risk assessment and decision-making

- Enabling assessments to be better tailored to meet needs of decision makers

- Increasing the number of chemicals that can be evaluated for their effects on human health by utilizing constrained resources in the most efficient manner

- Anchoring in systematic review

- Integrating key components of existing portfolio – Integrated Risk Information Systems (IRIS), Integrated Science Assessments (ISAs), and Provisional Peer-Reviewed Toxicity Values (PPRTVs) – to inform future assessments

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Discussion