EPA United States Environmental Protection Agency

SSWR Webinar
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Small Drinking Water Systems Research and Outreach

SAFE AND SUSTAINABLE WATER RESOURCES

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Safe and Sustainable Water Resources

Problems Facing Small Drinking Water Systems

Small water systems (defined here as including both community and non-community systems) are at the focal point of the regulatory goal of assuring safe drinking water

- They often are not aware of problems that may arise from their source water or infrastructure
- They often do not have the infrastructure to handle additional technologies or chemical additives
- They often lack financial resources to afford the latest technological developments much less the needed infrastructure improvements
- They often lack the technical expertise to choose, operate, and maintain even mildly complex systems
- They often have limited options for disposing residuals
- They often do not have the managerial support to comply with regulatory requirements and paperwork
- The state primacy agencies have limited resources to provide support for the large number of small systems that they must regulate

Effects of Ammonia & Nitrification in Source Water

There is currently no regulatory standard for ammonia in water. Ammonia may be especially concerning when significant nitrification occurs in the drinking water distribution system (due to the conversion of source-water ammonia to nitrite and nitrate by bacteria).

Effects of Elevated Ammonia Levels in Source Water and Drinking Water

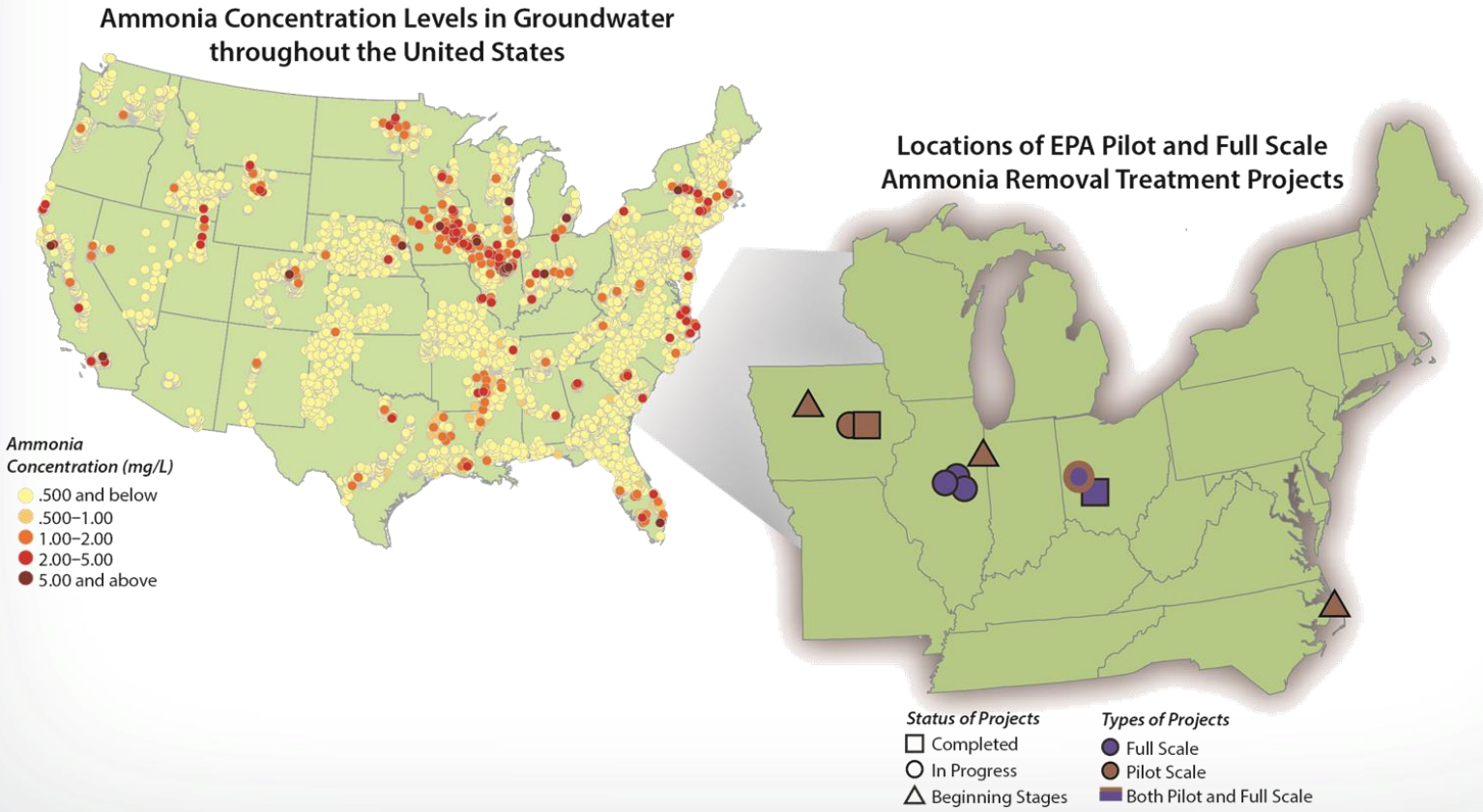
- Biological fouling of filters
- Wastewater discharge limits
- Oxidant/chlorine demand
- Difficulty complying with C·t requirements
- Interferes with As(III) oxidation

Effects of Nitrification in the Distribution System

- Taste and odor complaints
- Increased corrosion (pH drop)
- Iron release
- Nitrite/nitrate formation

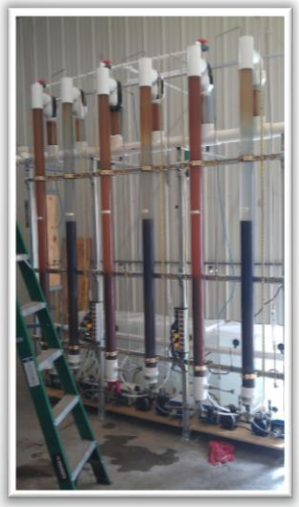
Ammonia and Drinking Water in the U.S.

EPA has completed or is currently conducting pilot studies and full-scale water plant evaluations at small drinking water ammonia treatment systems



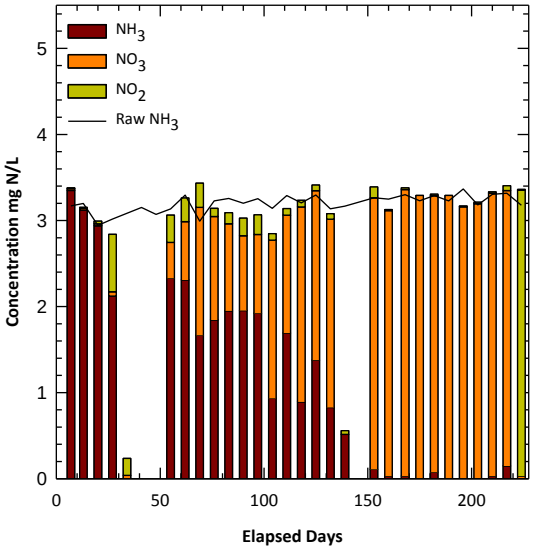
Ammonia Treatment in Small IA City: Pilot- to Full-Scale

- Small system in IA (pop. ≈ 1000) with over 3 mg N/L ammonia in source water
- One year long pilot study of an innovative biological treatment process was conducted on-site
- Pilot report and communication resulted in State acceptance
- Full-scale plant was designed and built based on the pilot
- Full-scale plant is in operation (since Jan. 2014) and effectively meeting treatment goals



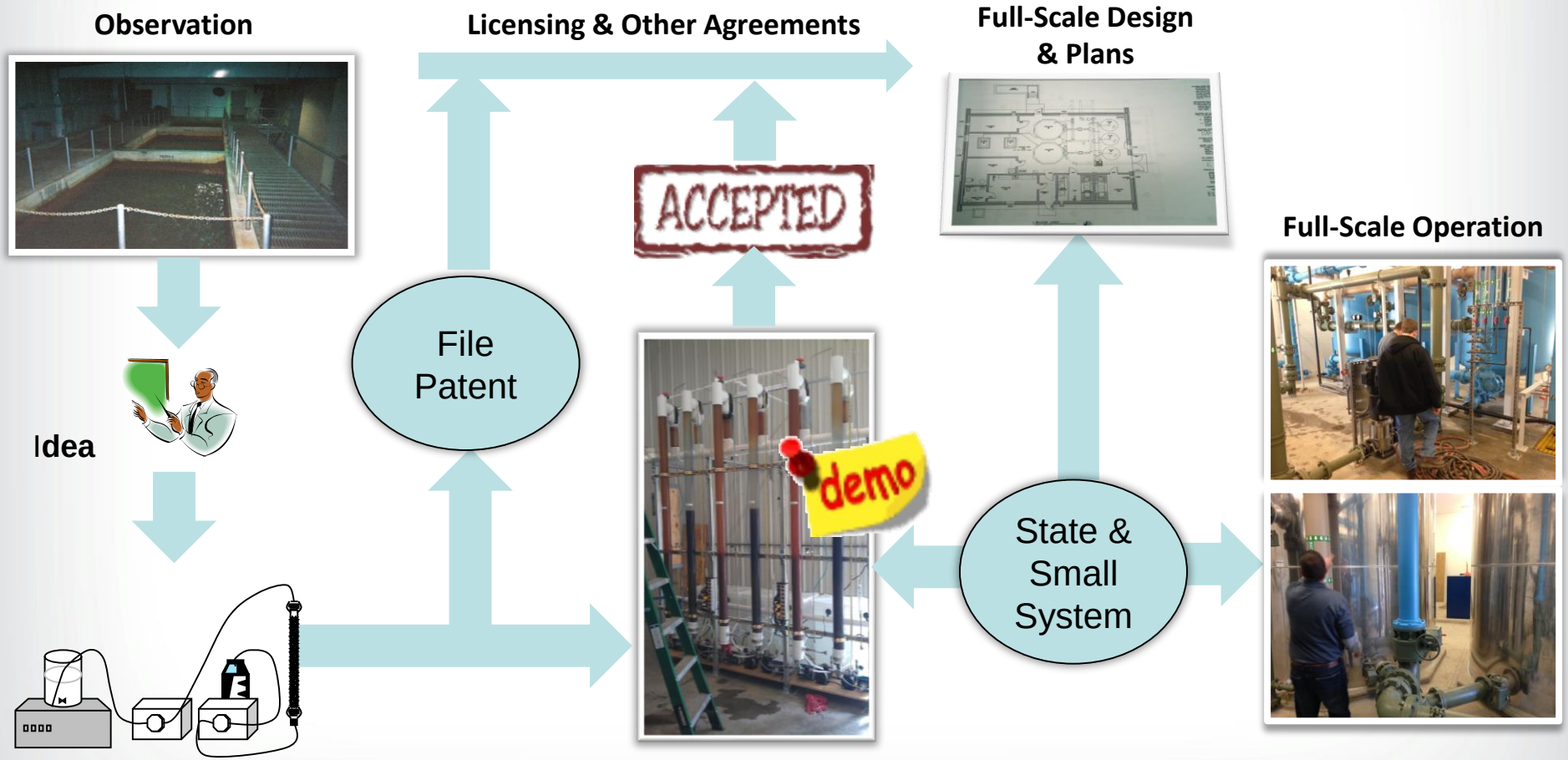
Pilot

Full-Scale



Success

A Model to Bring Technology to the Small Communities



Biological Treatment for Other Contaminants

Aerobic and Anaerobic Column Studies

This research will provide guidance on the design and operation of biological treatment systems for the removal of pesticides and chemicals of emerging concern

Anaerobic treatment column studies at EPA pilot plant.

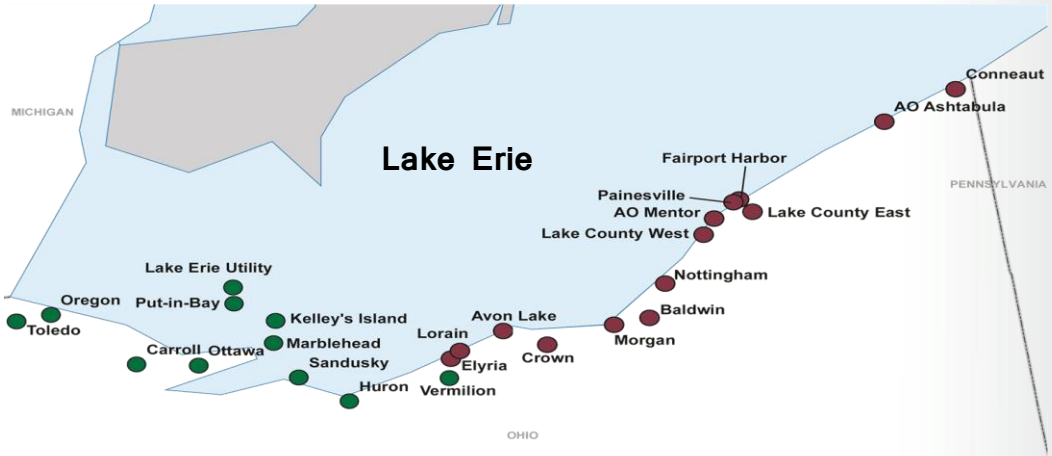
- Current anaerobic treatment research is being discussed for future studies as a next-step treatment process following biological ammonia treatment
- Oxygen levels are lowered by biological ammonia treatment prior to the initiation of the anaerobic step
- Concurrent removal of contaminants amenable to anaerobic biological removal, such as pesticides, EDCs, PCPs, and chemicals of emerging concern
- Removal of any nitrate generated during ammonia removal

HAB Treatment Research

Current work will allow Toledo and other smaller communities to better control HABs and analyze and treat for algal toxins.

EPA Study: Lake Erie Algal Toxins

- EPA is monitoring water quality and algal toxins through drinking water plants on Lake Erie



Impact

- The State of Ohio is using our data in their discussions with utilities that are at risk of algal toxins in their source waters to better inform them of how to treat algal toxins and what changes to their facilities would offer additional protection.

Understanding End Water Quality in Large Buildings

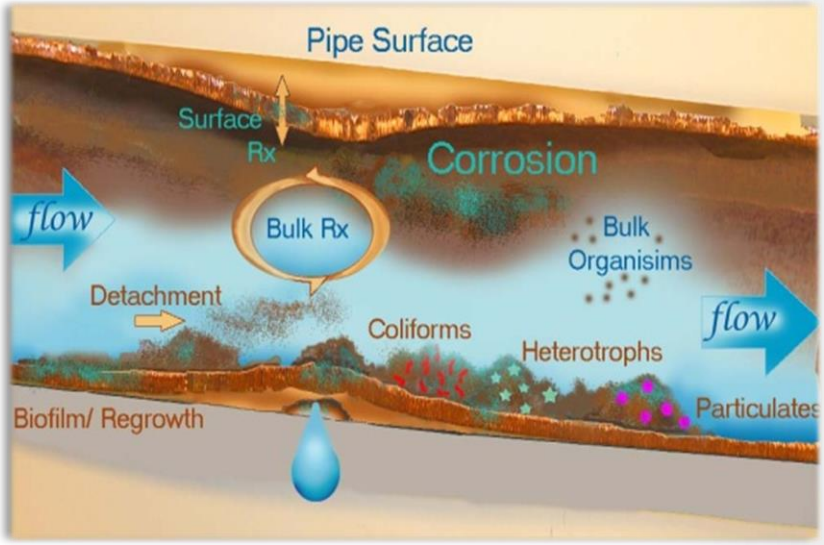
Collaborative effort between hospitals, EPA, Ohio EPA, Greater Cincinnati Water Works, VA, Army, Regions, OW. The research will help determine the effectiveness of secondary disinfection on a range of waterborne pathogens, and provide guidance on how best to monitor its effectiveness.

Issues

- Poor water quality as a result of long plumbing runs, complicated plumbing configuration and usage patterns, and tanks has potentially serious health implications.

Challenges

- Biofilm control
- Corrosion
- Legionella & other pathogens
- Maintain disinfectant residual
- Aesthetic complaints
- Accumulated contaminants
- Treatment potentially make building a public water supply



Internal premise plumbing surfaces are complex reactors

Demonstration Program
Arsenic Removal Technology

Performance and cost information is the most comprehensive research that has been collected on drinking water treatment technologies design for a specific problem. Funded 50 small, full-scale arsenic removal systems in 26 different states, impacting over 60,000 consumers.

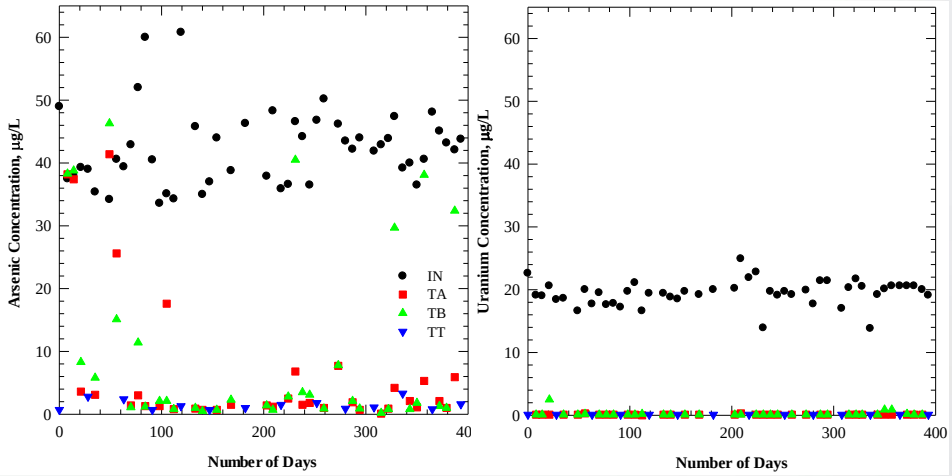
http://epa.gov/nrmrl/wswrd/dw/arsenic/where.html

- Data from extensive set of final reports is being extracted and repackaged to target small systems.
  - Residuals characterization
  - Technology costs
  - Simultaneous removal of co-occurring contaminants
  - Impact of arsenic on distribution system quality
  - Media regeneration
- Plans to revisit some demo sites to see where they are now

Treating Contaminant Groups: Inorganics

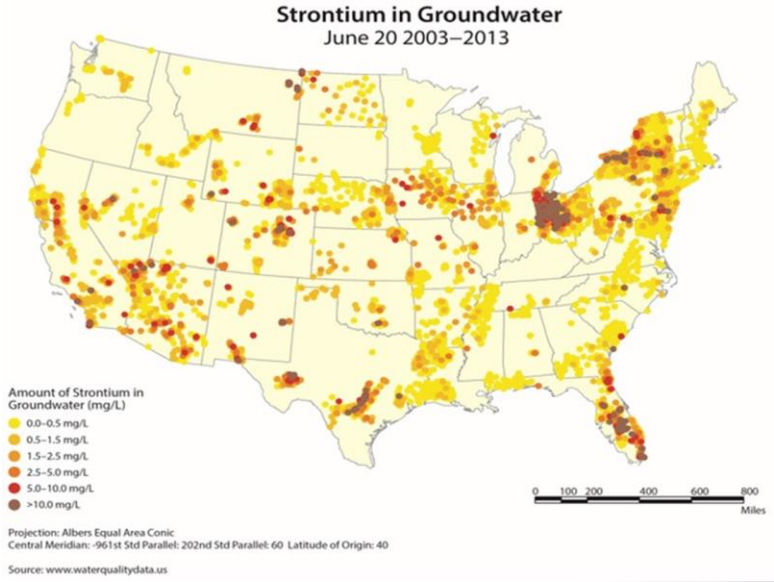
- EPA is interested in treating groups of contaminants
  - Cost effective
  - Simplified approach
- Examples: DBPs and VOCs
- Co-occurring inorganics
- Potentially impacts many small communities

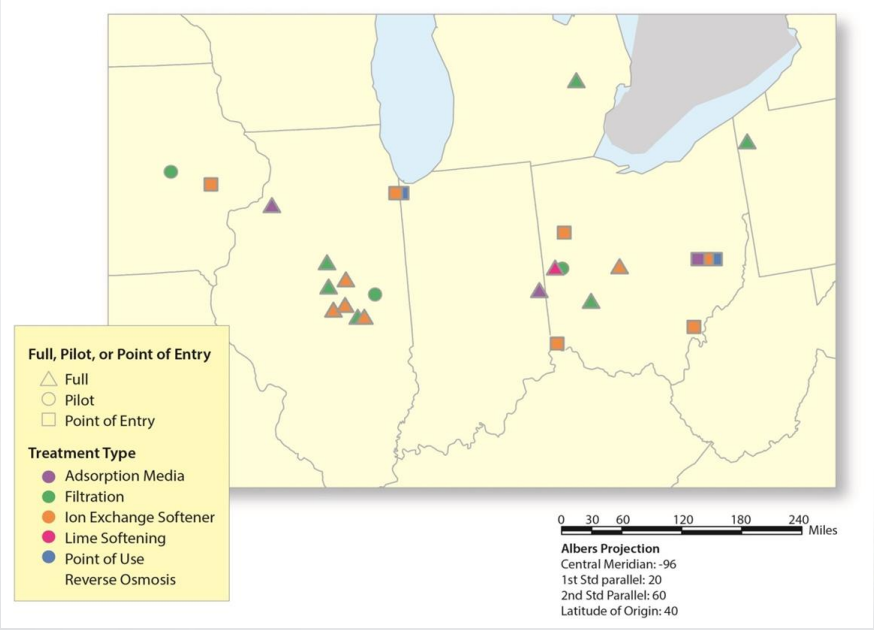
- Re-evaluate Arsenic Demo Project data
  - Arsenic, nitrate, molybdenum, uranium, vanadium
- Full-scale studies to evaluate effectiveness of treatment to reduce multiple inorganic contaminants simultaneously
  - POU RO, adsorption media, and anion exchange



Strontium Removal Studies

- Strontium is on EPA's CCL 3
  - Preliminary regulatory determination
- Health Reference Level = 4.0 mg/L
- Distributed across U.S. ground waters
- Potentially impacts many small communities





- Assessment of effectiveness of full-scale treatment to remove strontium
  - Ion exchange, lime softening, iron removal, POU RO, adsorption media
- Bench-scale studies to evaluate coagulation and lime softening for strontium removal
- Fundamental strontium solubility studies

Flouride Treatment Technologies

This research is evaluating technologies and approaches so that communities and state primacy agencies can gain confidence in technologies and their sustainability

- With state assistance, existing water treatment systems were identified for evaluation
- Fills a needs gap for a comprehensive document of available fluoride removal technologies – replaces decades old design manual
- Results will be used to support OGWDW
- Results can be used by the Regions for communicating novel and relevant treatment technologies to the states

Updated design and performance manual for fluoride treatment technologies for small systems in 2014.

Demonstration Project

UV Disinfection of Ground Water Systems

This research will provide reliable performance data for several innovative UV technologies for use as a sustainable disinfection strategy for small systems.

Evaluation and Assessment Activities

- Controlled test-bed challenge studies of innovative UV technologies
- Assess dose-response & reactor performance with 4-log inactivation goal for highly resistant AD2 and bacterial & viral surrogates
- Determine operating range capabilities of UV systems to meet WQ objectives
- UV demonstration studies. Involvement from IN, KY, & OH

Rural Communities in Puerto Rico

UV Disinfection for Surface & Ground Water Systems

The project will improve the health of people living small communities by providing clean and safe drinking water using a low cost multi-barrier solution to chlorine resistant waterborne pathogens.

- Evaluating the log term effectiveness of UV disinfection time for inactivation of MS2.
- The remote (non-PRASA) communities lack financial, technical, and managerial capacities to properly operate and maintain the systems.
- Other collaborators include citizens, UV system manufacturers, and AWWA Puerto Rico Chapter.

Citizen collaboration – training communities on the capabilities, operation, and maintenance of the systems.

Aeration Technologies for Reducing Volatile Disinfection Byproducts

Working with Region 6, the State of Oklahoma, and water utilities to develop a tool to help communities meet the Stage 2 Disinfectants and Disinfection Byproducts Rule

Data and analysis will provide…

- a comprehensive picture of the formation and removal of TTHMs via aeration in a water treatment plant's clearwell and tanks.

The tool will provide…

- states and utilities a way of determining the most sustainable and cost effective approach to control DBPs.

Brominated DBP Study in the Ohio River Watershed

Project studying the effect of bromide on trihalomethane formation at public water treatment plants.

Research Objectives

- Multiple site study – one ecoregion with (theoretically) similar DOM type
- Eight public water systems; Eight quarters
- Bromide, THM4, and other typical water quality parameters
- Source → Plant → DS

EPA science in ACTION

INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

Brominated Disinfection Byproducts (DBPs) Study

Risk management research project addressing challenges in the Ohio Watershed

Background

To protect public health, public water system (PWS) operators must meet federal limits for disinfection byproducts (DBPs) formed during the water treatment process. A better understanding of the relationship between bromide in source water and DBP formation will help operators in the Ohio River watershed improve treatment processes, ensure compliance with federal limits, and provide important information to state, local, and federal regulators responsible for protecting the rivers and streams in the watershed.

Collaborative Study

This project is a collaborative drinking water research study. EPA is evaluating water samples collected by PWS operators in order to investigate relationships between bromide in source water and the formation of brominated DBPs in finished drinking water. EPA is partnering with eight PWS operators for the research project. The participating operators obtain their water from the following sources:

- Ohio River
- Monongahela River
- Allegheny River
- Red Bank Creek, tributary to the Allegheny River

Local partners also include the Pennsylvania Department of Environmental Protection and the West Virginia Department of Health and Human Resources.

Research Approach

This study will include a two year long water sampling period, which began in January 2013. Samples are collected at four locations in the drinking water treatment and distribution process:

(1) Source water prior to treatment
(2) After filtration
(3) Finished water prior to distribution
(4) Finished water at the consumer tap at a compliance monitoring location

The samples are analyzed at EPA's Environmental Science Center at Ft. Meade, Maryland, and EPA's National Risk Management Laboratory in Cincinnati, Ohio. The measurement results will be used for data and modeling analyses through 2015.

Future Research Results and Outcomes

Once the results from the collected samples have been finalized, EPA will analyze the data to determine whether correlations exist between bromide in source water and brominated disinfection byproduct formation. Based on the analysis, EPA will then determine if models can be used to estimate DBP formation, optimize treatment, and inform source control strategies.

Contacts

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Participating Systems

Water System Source	Population
Allegheny River	250,000
Allegheny River	3,400
Ohio River	23,500
Allegheny River	5,000
Ohio River	22,700
Ohio River	86,800
Monongahela River	10,100
Red Bank Creek	1,300

Outreach to States and Systems

- In-depth training and information on various solutions and strategies for handling small systems problems and compliance challenges
- Designed for state personnel responsible for drinking water regulations compliance and treatment technologies permitting
- Held with our partners OGWDW and ASDWA
- Great networking opportunity
- Next workshop August/September, 2015 in Cincinnati, OH
- Free registration

2014 workshop had 225 attendees from across the U.S., as well as U.S. Island Territories and other countries.

Total State Employee Attendance for 2004-2013 Workshops

Fall 2013 workshop proceedings:
http://www.asdwa.org/index.cfm?fuseaction=page.viewpage&pageid=801

Workshop has Led to Improved Communication

By maintaining dialogue, EPA can focus efforts on the best ways to get information to the states that is the most helpful to them, and also inform ORD research.

Communications Workgroup

Small systems technical communications workgroup was formed to facilitate dialogue between ORD and the states.

- In 2014, a document was developed to assist communities with the new Reduction of Lead in Drinking Water Act: *How to Identify Lead-Free Certification Marks for Drinking Water Supply and Plumbing Materials* (EPA/600/F-13/153).
- Over 8,000 downloads in the first six months of 2014.
- Document used by numerous entities (regulators, utilities, stores, etc) (i.e., Lead in Drinking Water Act FAQs)
- Document currently being revised
- Additional products will be discussed in upcoming workgroup conference call (Speth.Thomas@epa.gov or Latham.Michelle@epa.gov)

"How to Identify Lead Free Certification Marks for Drinking Water Supply & Plumbing Materials" nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100GRDZ.txt

Publically Available Resource

- Interactive database that contains over 60 regulated and unregulated contaminants and covers 34 treatment process commonly employed or known to be effective
- Referenced information gathered from thousands of literature sources assembled on one site
- Working on nitrate
- Uses
  - Identifying effective treatment processes
  - Emergency / First response: Security and spill events
  - Regulatory review and designating best available technology
  - Identifying research needs

As resources allow, the number of regulated and unregulated drinking water contaminants will increase each year

Drinking Water Treatment Cost Model

Uses

The cost model can be used to determine the cost of installing and operating a particular drinking-water treatment process at a given utility, or it can be used to determine the nation-wide cost of implementing a new contaminant regulation or a lowering of a current regulatory limit.

A treatment technology is broken down into discrete components that can be measured for the purpose of estimating costs

- Specific equipment (e.g., tanks, vessels, pipes, and instruments)
- Other identifiable cost elements (construction costs, and annual expenditures on labor, chemicals, and energy)

WBS Engineering Models

- Adsorptive media
- Powdered activated carbon
- GAC-pressure
- GAC-gravity
- Greensand filtration
- Anion exchange
- Cation exchange
- Lime softening
- Conventional filtration
- Direct filtration

- Low-pressure membrane
- High-pressure membrane
- Packed tower aeration
- Multi-stage bubble aeration
- Chlorine pre-oxidation/disinfection
- Pre-oxidation/ disinfection
- Ultraviolet disinfection

TDB + Cost Model

Concept

To have a system where the treatment performance information can seamlessly input into the cost model

Benefits

- A transparent system for costing of future regulations
- Lowers the expertise to do preliminary cost evaluations for current systems
- Can concentrate on contaminants of interest to small systems
- Can integrate into outreach to universities

Water Systems

New Topic 4

Current Water Systems and Regulatory Support

Support federal regulations and guidance; and regional, state, and community programs and implementation

Next Steps: Technology Advances

Develop, test, and promote adoption of innovative drinking water, storm water, and wastewater technologies that will protect human health and the environment while maximizing resource recovery

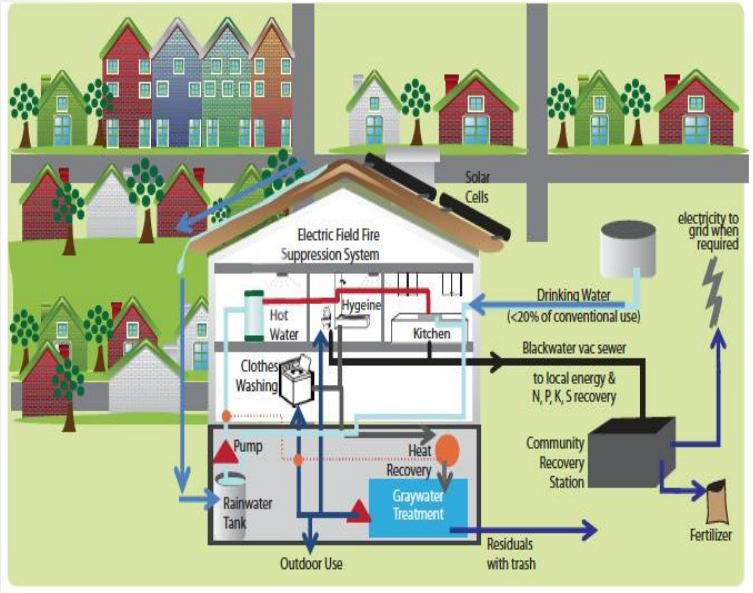
Long Term: Transformative Systems

To conduct integrated sustainability assessments, develop novel approaches, prioritize risks, and provide a framework for decision making

Bringing together into one framework research conducted and funded by EPA, including the STAR, RARE, Water Cluster, CRADAs, and Net Zero efforts.

Transformative Systems

Develop and assessment integrated approaches to water services based on fit for purpose use (i.e., water reuse) and resource recovery (nutrients, energy, materials)



Potential Areas *(not inclusive)*

- Integrated sustainability assessments
  - Life cycle assessments, Life cycle costs, advanced water foot printing approaches
- Assessment/prioritization of risks within alternative systems
  - Rapid, inexpensive monitoring
- Scenario-based planning
  - Integrated framework for stakeholder decision making, including climate change

Future Webinars

New for 2015

Small Systems

To disseminate detailed information about these and other EPA projects relevant to small water systems

Starting in January, 2015

- Monthly webinars
- Geared toward
  - State personnel
  - Small communities
  - Non-community systems
  - The research community
  - Others
- Goals
  - To reduce the number of systems that are in noncompliance with drinking water regulations
  - To provide more sustainable solutions for small systems

Questions?

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