



# Overview of US EPA's Office of Research and Development (ORD)

**Jennifer Orme-Zavaleta**

*Principal Deputy Assistant Administrator for Science*

**Region 5 and Neighboring States' Visit to US EPA Cincinnati  
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# ORD At A Glance

## Our Mission

Provide the science, technical support, technology and tools to inform US EPA's mission to protect public health and the environment.

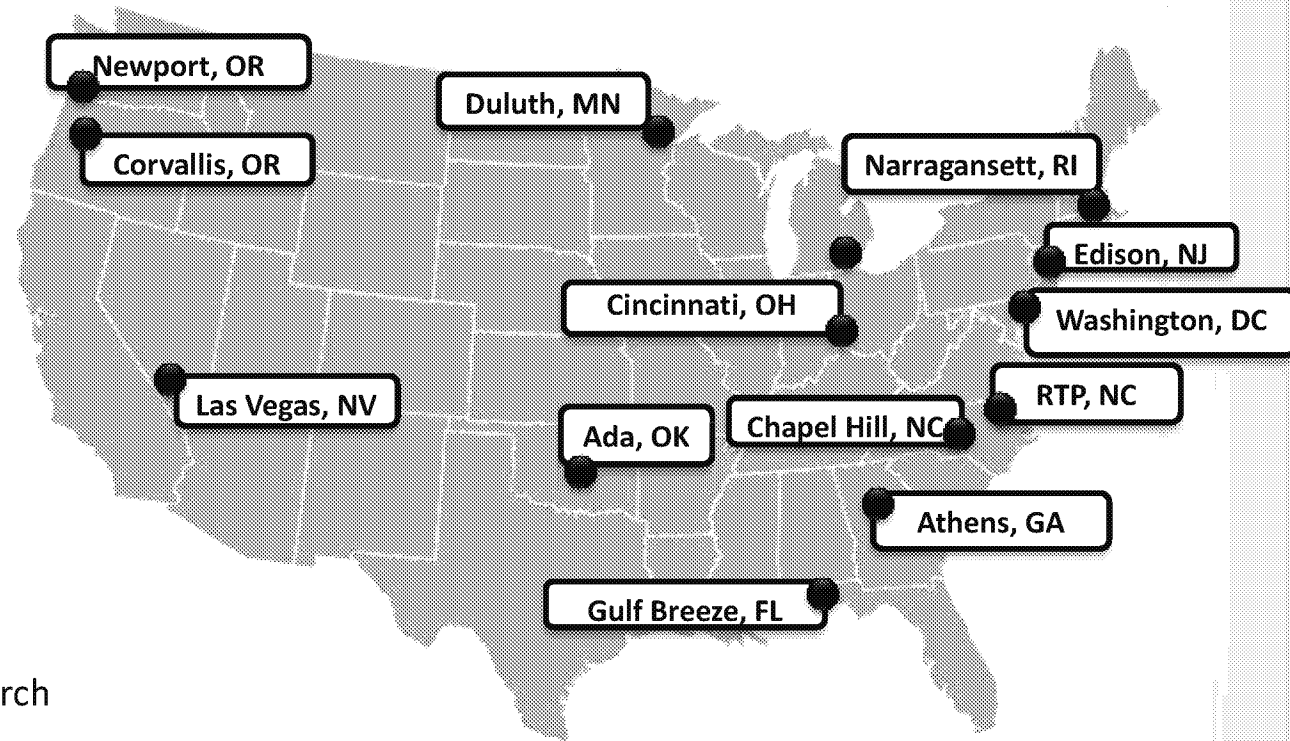
**1,704 full time equivalents**

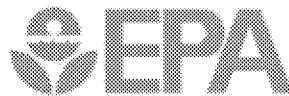
**\$498 million budget**

\$28 million extramural research grant program (STAR)

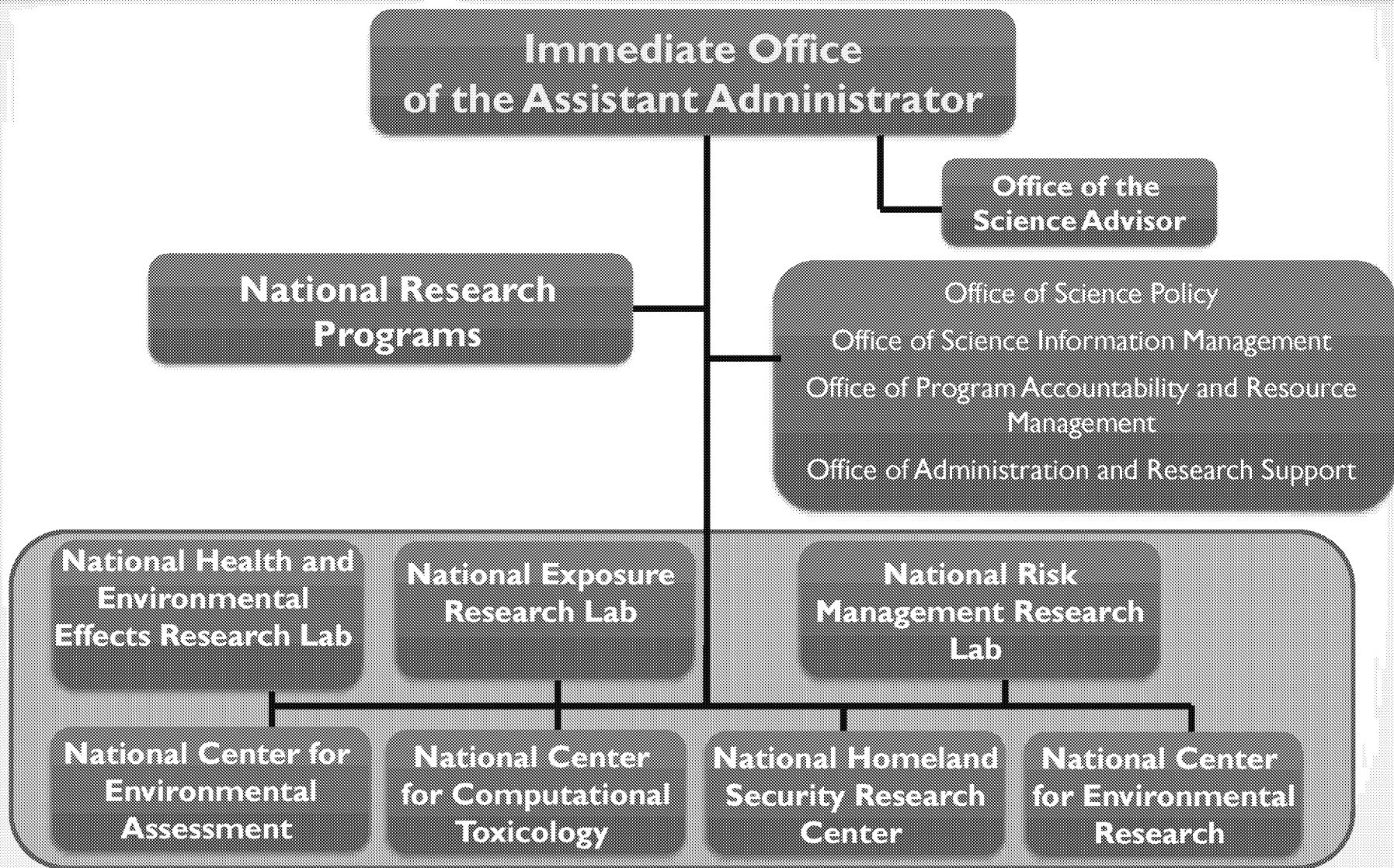
**13 research facilities**

(FY 2017 Enacted Budget)





# ORD Organizational Chart





## Research Authorization

US EPA's research provides science that is authorized by nearly 50 environmental laws including:

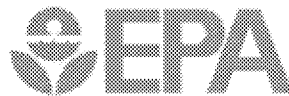
- **Toxic Substances Control Act:** “conduct such research, development, and monitoring as is necessary to carry out the purposes of this Act. The Administrator may enter into contracts and may make grants for research, development, and monitoring under this subsection.”
- **Safe Drinking Water Act:** “conduct research, studies, and demonstrations relating to the causes, diagnosis, treatment, control, and prevention of physical and mental diseases and other impairments of man resulting directly or indirectly from contaminants in water, or to the provision of a dependably safe supply of drinking water.”
- **Comprehensive Environmental Response, Compensation, and Liability Act:** “shall assure the initiation of a program of research designed to determine the health effects (and techniques for development of methods to determine such health effects) of such substance...and in combination with other substances with which it is commonly found.”
- **Clean Air Act:** “shall establish a national research and development program for the prevention and control of air pollution.”



## ORD Research

ORD provides the scientific foundation for US EPA to execute its mandate to protect human health and the environment.

1. **Longer Term Research:** Conducts *innovative and anticipatory* research applied to a range of US EPA program and regional needs to solve longer term environmental challenges and provide the basis of future environmental protection.
2. **Research on Specific Environmental Challenges:** Experts provide research support to US EPA program and regional offices, as well as states, tribes and communities, to help them respond to contemporary environmental challenges.
3. **Technical and Emergency Support:** Because of our expertise, local, state and national officials come to us for technical support to respond to environmental crises and needs, large and small.



# Research Programs

## Air and Energy

- *Air pollution*
- *Air quality modeling*
- *Decision support tools*

## Sustainable & Healthy Communities

- *Ecosystem services*
- *Human health*
- *Sustainable materials management*

## Homeland Security

- *Water system security*
- *Resilience and remediating wide areas*

## Chemical Safety for Sustainability

- *Computational toxicology and exposure*
- *Evaluation of risk across life cycle of manufactured chemicals, materials and product*

## Human Health Risk Assessment

- *Risk assessments for specific chemicals*
- *Risk assessment methods*

## Safe & Sustainable Water Resources

- *Water treatment and infrastructure*
- *Watersheds and aquatic ecosystems*
- *Source/recreational water protection*

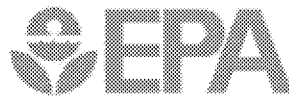


# US EPA Cincinnati



## Research at US EPA's Cincinnati Laboratory

- **ORD research conducted at US EPA Cincinnati has broad impacts at local, regional and national levels.**
- **US EPA Cincinnati facilities:**
  - More than 630,000 square feet of labs, offices and field facilities
  - US EPA Cincinnati facilities are home to 910 employees: 508 feds and 402 non-feds
- **Wide range of research activities, including the following signature research capabilities to address science challenges:**
  - Safe and reliable drinking water: treatment, disinfection and protection
  - Homeland security research to help detect, respond to and become more resilient to natural and man-made disasters
  - Watershed management and water quality protection
  - Development of analytical methods and decision support tools
  - Technical support and human health risk assessments for Superfund sites
  - Contaminated site monitoring and remediation

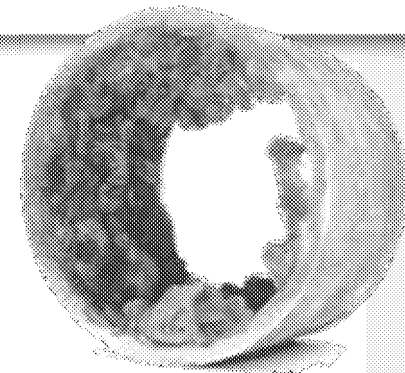


# Water Research

## Water Treatment and Infrastructure

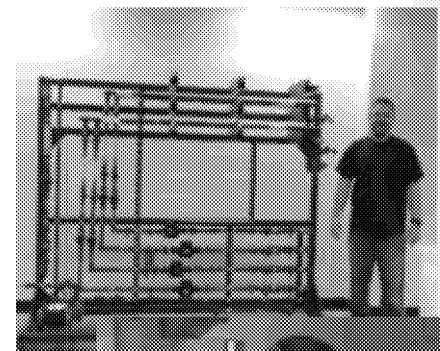
### Drinking Water

- Premise plumbing and distribution systems, including biofilm, lead service line corrosion, and pipe scale studies
- Contaminant removal (e.g., PFAS, pathogens, nitrate, algal toxins, etc.)
- Disinfection residual and disinfection byproducts
- Development and evaluation of novel and cost-effective treatment technologies and approaches, including pilot- and full-scale testing
- Tools and methods to support cleanup of water systems following chemical, biological and radiological contamination incidents



### Stormwater–Wastewater–Water Reuse

- Evaluate green/gray infrastructure practices for stormwater management
- Provide support to communities to characterize and cost-effectively resolve stormwater runoff and combined sewer overflow issues
- Decentralized wastewater treatment
- Non-potable water reuse for small systems
- Safety of reuse water of the potential issues associated with water reuse





# Water Research

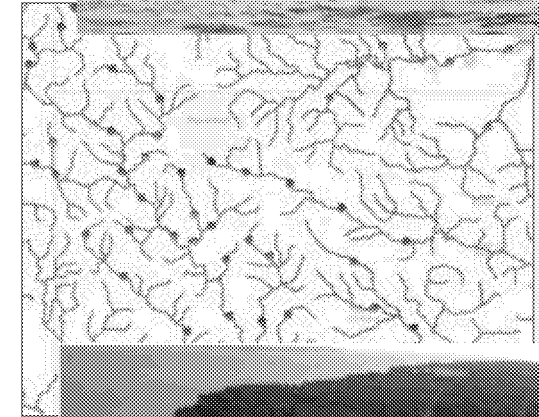
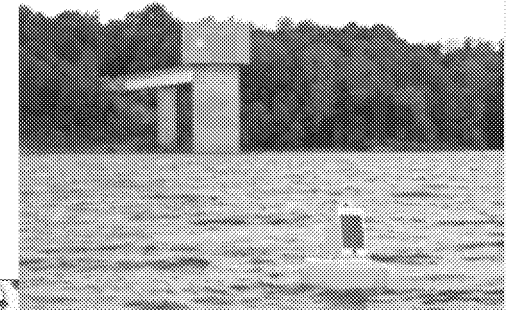
## Source and Recreational Waters

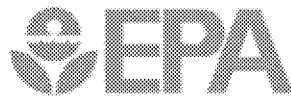
### Watersheds

- Watershed integrity and resiliency to protect water quality
- Support for effective recreational water quality criteria
  - Microbial source tracking to determine source
  - Methods to assess microbial risk in recreational water
  - Develop water quality benchmarks and criteria
  - Predict stream nutrient concentrations and conductivity
- Ecosystems

### Nutrients and Harmful Algal Blooms (HABs)

- Best management practices for nutrient runoff reductions
- Research and tools to characterize and measure algal toxins
- Monitoring of HAB event and analytical methods development
- Management and mitigation of HABs
- Methods development for measuring cyanotoxins





# Water Research

## Development of Models and Tools

Supports environmental decision making

### Drinking Water

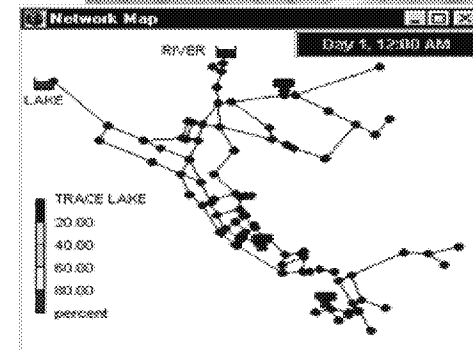
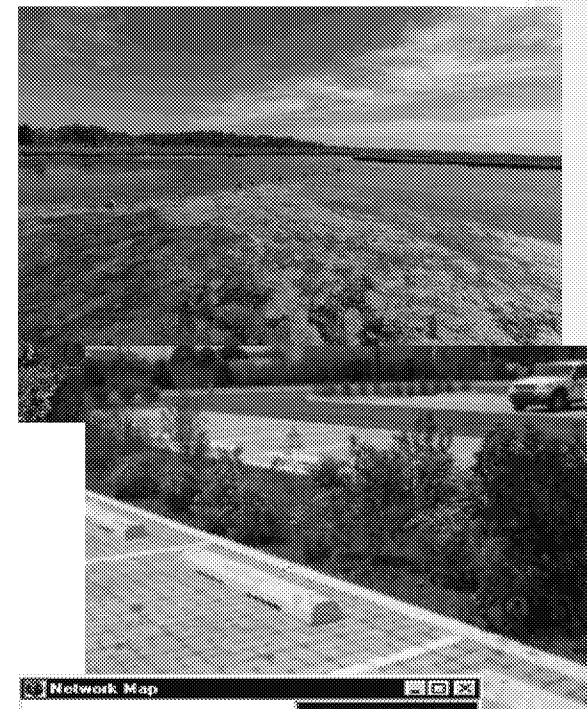
- EPANET (distribution system)
- Treatability Database
- SmartWater System
- Breakpoint Chlorination Simulator
- Chloramine Formation and Decay Simulator
- CANARY (water security)

### Stormwater

- Storm Water Management Model (SWMM)
- National Stormwater Calculator
- Green Infrastructure Modeling Toolkit

### Watersheds/Ecosystems

- CADDIS stream diagnostics tool





# Homeland Security Research

## Improve water utilities' abilities to prepare for and respond to incidents

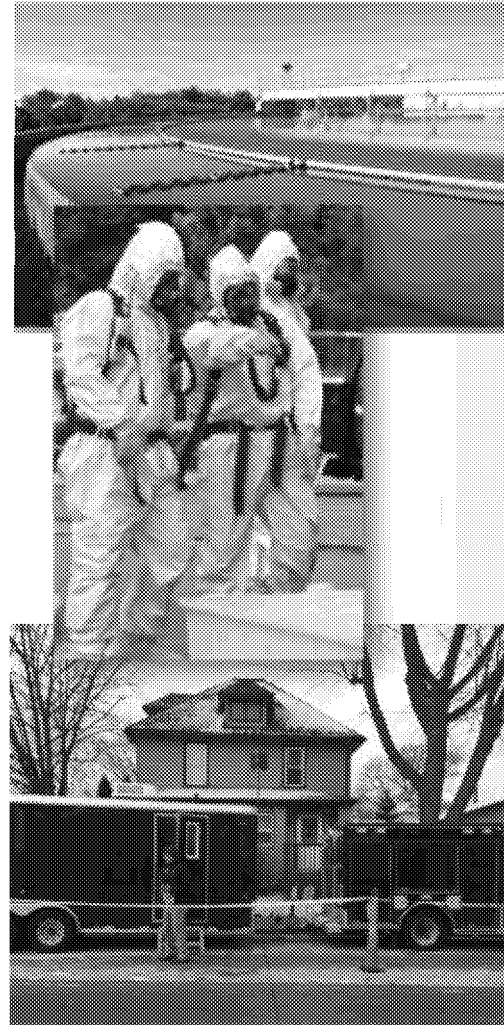
- Contaminant fate and transport in drinking and wastewater systems
- Approaches for on-line monitoring of contaminants in drinking water systems
- Decontamination methods for water infrastructure including premise plumbing

## Advance capabilities to clean-up wide-area incidents

- Sampling and analysis methods
- Decontamination approaches for wide areas, transit systems
- Strategies for staging, storing and treating waste

## Example Projects

- Built improved water distribution model to understand operations within drinking water system (Flint, MI)
- Deployed developed decontamination methods to cleanup MCHM in the water systems (Charleston, WV)
- Provided guidance on how to deal with Ebola contaminated PPE, solid, and liquid wastes (New York, NY)
- Supported Ricin sample analysis, decontamination methods, and waste handling (PA, WI, CO, MS, OK, TN, VT and Washington, DC)





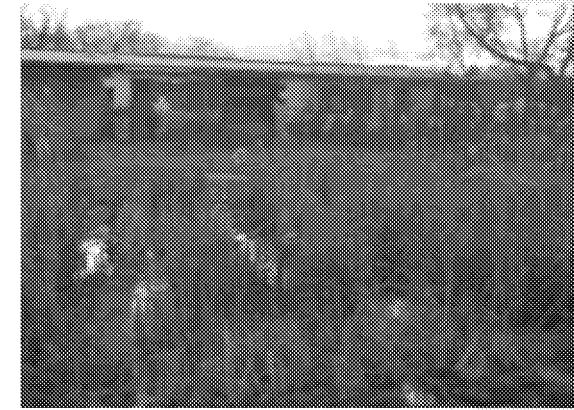
# Human Health Risk Assessment

## Provisional Peer-Reviewed Toxicity Values (PPRTV) support US EPA's Superfund program; target of 12 assessments per year

- Use the same Agency guidance as Integrated Risk Information System (IRIS) assessments, external peer review
- Including assessments of data-poor chemicals using new approach methods
- Publicly available at <http://hhpprtv.ornl.gov>

## Superfund Health Risk Technical Support Center provides scientific and technical support to US EPA, regional and state partners

- Superfund hotline responds to ~50 requests/year
- Requests include rapid response and emergency actions (e.g., Elk River MCHM spill, Lower Passaic River, etc.)
- Support with use of published PPRTVs, evaluation of published health values from US EPA and other agencies (e.g., ATSDR MRLs) for use by partners

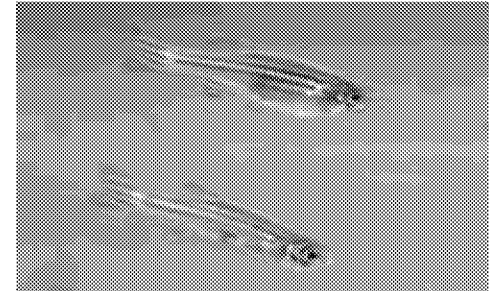




# Chemical Safety and Exposure Science

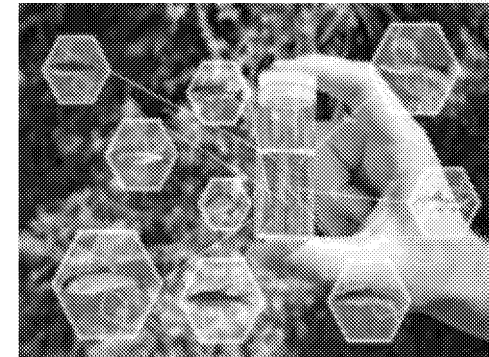
## Ecological modeling and adverse outcome pathways

- Characterize mixture risk
- Develop gene expression fingerprints for chemical mode of action in fathead minnow to identify exposures to pesticides, industrial and methodologically challenging chemicals



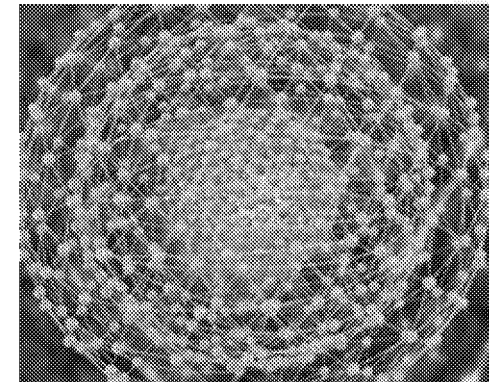
## Methods to assess co-occurrence of imperiled species and environmental contaminants for ecological risk assessment

- Environmental DNA (eDNA) methodology to determine occupancy and distribution of imperiled aquatic species
- Bayesian modeling framework for evaluating and mapping chemical stressors and ecological receptors



## TSCA Support

- Physical property models that have been incorporated into US EPA's Chemistry Dashboard, which directly supports implementation of the new TSCA



## Life Cycle Assessment (LCA)

- Develop method to automate the LCA process, near field human exposure models, and Consumer Product Life Cycle Analyzer to conduct automated life cycle risk assessments



# Contaminated Site Research

## Technical Support to Superfund and Communities

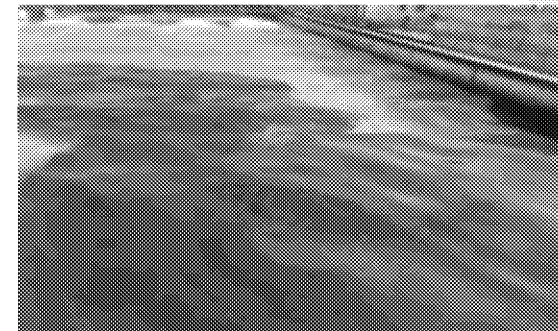
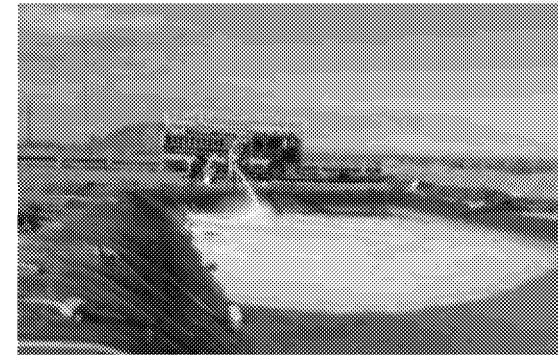
- ORD's Technical Support Centers (TCSs)
- Specialized scientific and engineering support to US EPA and state decision makers for Superfund (CERCLA and SARA) and Brownfields (RCRA)
- Three TCSs headquartered in Cincinnati (Engineering, Superfund Human Health Risk, and Ecological Risk Assessment) respond to approximately 400 requests annually for support from all 10 US EPA regions

## Per- and poly-fluoroalkyl substances (PFAS)

- Developing and validating methods in non-drinking water media (wastewater, biosolids, soils)
- Studies to understand occurrence, fate and treatment technologies

## Oil Spill Remediation

- Mitigate effects of past and future oil spills by developing lab protocols and study the behavior, fate and effects of oil and spill agents (e.g., dispersants)





# Community-Focused Research

## Materials and Waste Management

- Landfill performance data and landfill fire management
- Technical support to hazardous waste sites nearing the end of the RCRA 30-year post closure care requirements

## Indoor Air Research

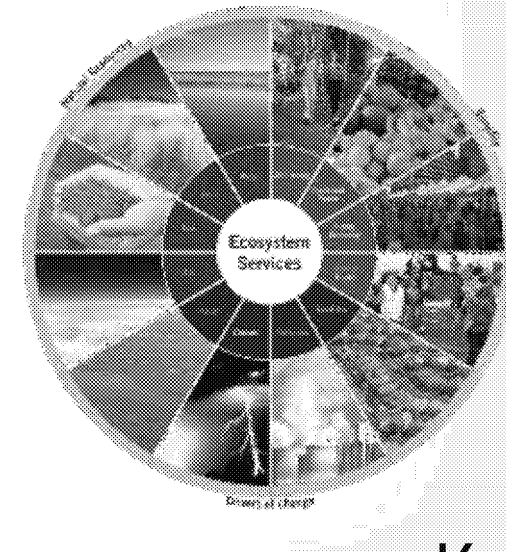
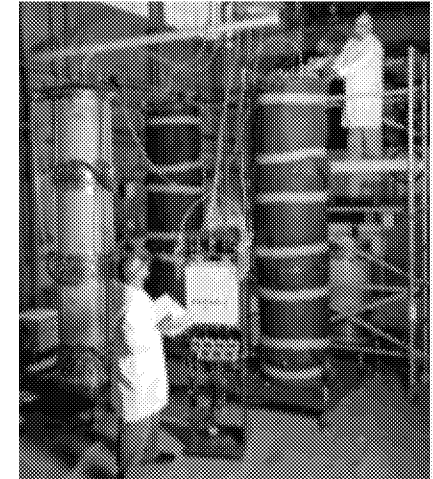
- Quantifying environmental exposures (e.g., mold contamination) related to asthma; testing interventions to reduce impact, especially on children and disadvantaged groups

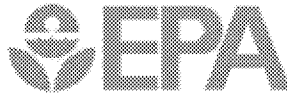
## Community Public Health Research

- Support to stakeholders in conducting Health Impact Assessments (HIAs); recommendations on monitoring and managing the effects
- Use of human biomarkers to investigate community health and well-being as it relates to built infrastructure

## Ecosystems Research

- Conducting research to understand how ecosystem services are impacted by changes that humans make to the built and natural environment
- EcoService Models Library (ESML) to make ecological model descriptions more available and informative





# US EPA Research Supports States

## Some Recent Examples

10

**AK** – PFAS  
**ID** – Modeling for agriculture, energy, water and air systems interactions  
**OR** – Water nitrate contamination; Tools to help communities identify environmental issues; Ocean acidification research; Reducing methyl mercury levels; Advanced monitoring technologies  
**WA** – Managing nutrients in riparian ecosystems; Habitat suitability models

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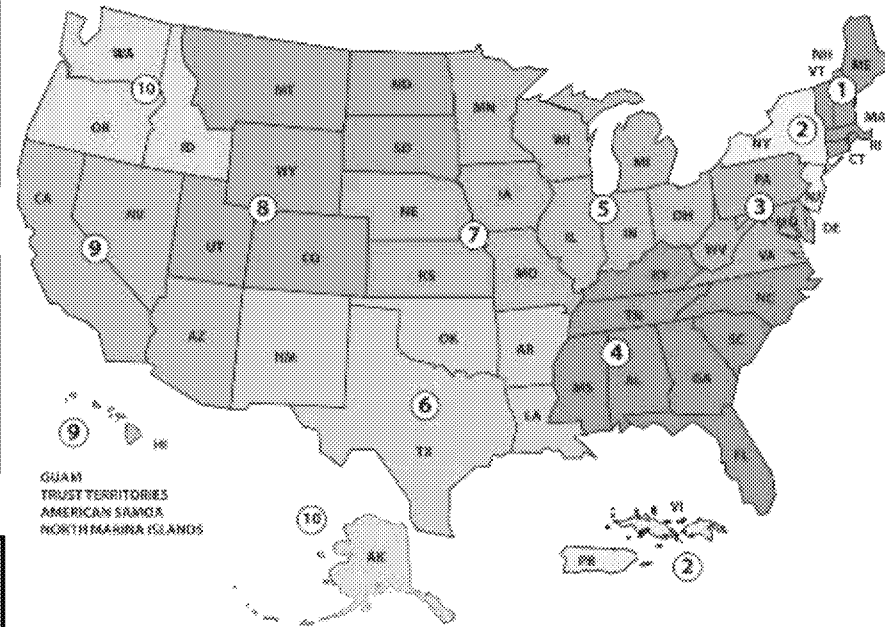
**CA** – Evaluating chemicals; Population and land use projections; Synthetic turf field safety; Decontaminating subway railcars; Decision support tools to advance communities' priority projects; Risk assessment training; Advanced monitoring technologies  
**NV** – Groundwater characterization and remediation

8

**CO** – Simulating conditions in drinking water utilities; Advanced monitoring technologies  
**MT** – IRIS assessment for Libby Amphibole Asbestos; Asbestos exposure following forest fires  
**UT** – Fine particle air pollution; Emissions measurement methods

7

**IA** – High ammonia levels in drinking water  
**KS** – Prairie rangeland burning; Community air quality monitoring  
**MO** – Models and tools to reduce sewer overflows



6

**LA** – Cancer risk assessments  
**OK and TX** – Community air quality monitoring  
**OK** – Chemical composition analysis; Evaluating water interactions at Superfund site  
**TX** – Chemical contamination risks

5

**MI** – Lead contamination technical support; Simulating conditions in drinking water utilities  
**MN** – Sulfate standard development support; Modeling bioaccumulation of PCBs and mercury in fish  
**OH** – Harmful algal blooms limiting drinking water; Managing algal toxins; Small drinking water systems; Simulating conditions in drinking water utilities  
**WI** – Predicting water quality at beaches

1

**CT** – Community air quality monitoring;  
**CT, MA, ME, NH, RI and VT** – Stream monitoring network; Planning for energy and air emissions  
**CT and NH** – Advanced monitoring technologies  
**ME** – Tribal risk assessment (sediment and water quality)  
**VT** – Impervious cover data for watersheds

2

**NJ and NY** – Stream monitoring network; Planning for energy and air emissions  
**NJ** – PFAS  
**NY** – Management of bio-hazardous wastes; Planning for biological incident; Simulating conditions in drinking water utilities

3

**DE, MD, PA, VA and WV** – Stream monitoring network  
**MD** – Managing stormwater treatment systems; Advanced monitoring technologies; Reducing harmful air pollutants; Management of bio-hazardous wastes  
**MD, PA and VA** – Stormwater management planning support  
**PA** – CADDIS causal assessment; Community air quality monitoring

4

**AL, GA, KY, NC, SC, TN** – Stream monitoring network  
**FL, GA, KY, NC, SC, TN** – Characterizing urban background levels for contaminated site cleanup levels  
**FL, KY** – Simulating conditions in drinking water utilities  
**GA** – Green infrastructure in Atlanta's Proctor Creek  
**KY** – Advanced monitoring technologies  
**MS** – Fecal bacterial and viral indicators  
**NC** – Community air quality monitoring; STEM education; Wright Chemical Superfund Site  
**SC** – Food waste reduction



## For More Information

- **US EPA research web page**  
[www.epa.gov/research](http://www.epa.gov/research)
  - **US EPA Science Matters newsletter**  
<https://www.epa.gov/sciencematters>
  - **States and ORD: Partners to Meet State Research Needs**  
<https://www.epa.gov/research/states-and-ord-partners-meet-state-research-needs>
  - **US EPA Tools and Resources webinar series**  
<https://www.epa.gov/research/epa-tools-and-resources-webinar-series>
  - **US EPA Strategic Research Action Plans**  
<http://www.epa.gov/research/strategic-research-action-plans>
  - **ORD list of models, methods, tools and databases**  
<https://www.epa.gov/research/methods-models-tools-and-databases>
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