Mission: to conduct research and develop scientific products that improve the capability of the Agency to carry out its homeland security responsibilities
EPA Homeland Security Responsibilities

Drivers

Bioterrorism Act
Presidential Directives
Executive Orders
National Response Framework
Elements of:
  – Comprehensive Environmental Response, Compensation and Liability Act
  – Emergency Planning and Community Right-to-Know Act
  – Clean Water Act
  – Safe Drinking Water Act
  – Oil Pollution Act
  – Clean Air Act
  – Resource Conservation and Recovery Act

Responsibilities

• **Support water systems to prepare for and recover from attacks and other disasters**
  by leading efforts to provide States and water utilities guidance, tools and strategies. *EPA is the federal government Sector Specific Agency (SSA) lead for water infrastructure.*

• **Clean up buildings and outdoor areas**
  impacted by a terrorist attack or other disaster by leading efforts to establish clearance goals and clean up.

• **Develop a nationwide laboratory network**
  with the capability and capacity to analyze for chemical, biological and radiological (CBR) agents for routine monitoring and in response to a terrorist attacks.
EPA’s “All Hazards” Universe

Refining EPA’s Approach to Homeland Security,
Contributing to Sustainability by Supporting Resilience

- Disasters, natural or man-made, are inevitable
- Sustainability of our communities requires resiliency to disasters
- Resiliency is improved with EPA guidance, tools and support
- Scientific gaps exist in our ability to prepare for and recover from environmental disasters
- Homeland Security Research Program’s (HSRP) mission is to fill science gaps to improve EPA’s response capabilities
## EPA Fiscal Year 2014-2018 Strategic Plan
### HSRP Alignment with Goals and Strategies

<table>
<thead>
<tr>
<th>Strategic Goal</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goals 2</strong></td>
<td><strong>Objective 2.1</strong> - Protect Human Health: “...protect and sustainability manage drinking water resources”</td>
</tr>
<tr>
<td>Protecting America’s Waters</td>
<td></td>
</tr>
<tr>
<td><strong>Goal 3</strong></td>
<td><strong>Objective 3.1</strong> – Promote Sustainable and Livable Communities Land, “Support sustainable, resilient, and livable communities by working with local, state, tribal, and federal partners to promote...emergency preparedness and recovery planning”</td>
</tr>
<tr>
<td>Cleaning Up Communities and Advancing Sustainable Development”</td>
<td></td>
</tr>
<tr>
<td><strong>Goal 4</strong></td>
<td>Administrative location in the Strategic Plan</td>
</tr>
<tr>
<td>Ensuring the Safety of Chemicals and Preventing Pollution</td>
<td></td>
</tr>
<tr>
<td><strong>Cross-Agency Strategies</strong></td>
<td><strong>Objective 3.2</strong> - Restore Land: “prepare for and respond to accidental or intentional releases of contaminants and clean up”</td>
</tr>
<tr>
<td>Working Toward a Sustainable Future “advance sustainability science, indicators, and tools”</td>
<td></td>
</tr>
</tbody>
</table>
HS Research Partner Engagement

**PARTNER**
Indoor / Outdoor Decon

*EPA Program Offices (OSWER, OW, OAR, OCSPP, OHS) & Regions*

**Water Resilience and Security**
Water System Security and Resilience

*EPA Program Offices (OW, OHS) & Regions, Critical Infrastructure Partnership Advisory Council (CIPAC) for Water*

All partners engaged in:
Needs prioritization
Research implementation
Product formulation/delivery
HSRP’s Foundation

- Applied research and technical support - *oriented to solutions*
- Customer & stakeholder engagement - *focused on needs/gaps*
- Systems-based approaches - *increased relevance and utility*
- Realistic schedules - *timely delivery*
- High quality tools and technical data - *more informed decision making*
ORD’s Homeland Security Research Program

ORD – Homeland Security Research Program Resources
FY12 – FY15 Dollars and FTE

DOLLARS (K)

FISCAL YEAR

FTE

2012 ENA
2013 ENA
2014 ENA
2015 PB

$26,360
$24,739
$24,060
$23,218

64.1
61.0
54.6
53.1

HS Research Program Dollars
HS Research Program FTE
Research Summary Outline

• Water System Security and Resilience
• Indoor/Outdoor Cleanup
  • Systems model
  • Evolution
  • Research conducted/underway
  • Impacts

• Cross Cutting Research Areas:
  • Fate and transport
  • Exposure
  • Sampling and analysis
Water System Security and Resilience Systems Approach

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

ORD’s Homeland Security Research Program
## Water Security and Resilience
### Evolution of Program

<table>
<thead>
<tr>
<th>Detection</th>
<th>Mitigation</th>
<th>Cleanup</th>
<th>Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contamination warning system data and tools</td>
<td>Flushing strategies</td>
<td>Infrastructure decon, water</td>
<td>System designs, vulnerability tools, indicators</td>
</tr>
<tr>
<td></td>
<td></td>
<td>treatment</td>
<td></td>
</tr>
</tbody>
</table>

Schematic of drinking water distribution system.
Experimental Research

- Sensor testing for contamination warning:
  - Water quality parameters (chemical and biological contamination)
  - Radiation
- Infrastructure decon
- Water treatment
  - Distribution system
  - Wash water
- Bench – pilot- full scale
Suite of Water Security and Resilience Tools

Preparing
Assessing vulnerabilities and consequences
- Blast vulnerabilities
  - BVAT
- Fate and transport of contaminants
  - EPANET-MSX
- Contamination vulnerabilities, consequences
  - C/VA

Detecting
Locating sensors and analyzing water quality data
- Sensor number and placement
  - TEVA-SPOT
- Anomalous water quality
  - CANARY

Responding
Evaluating response and remediation actions
- Forecast, simulate real-time operational conditions
  - EPANET-RTX
- Identify source, optimize flushing, guide sampling
  - WST
Assessing Tools and Approaches at Full Scale Water Security Test Bed

- Above ground drinking water pipe system with a 40,000 gallon lagoon, high rate groundwater pump, and storage tanks
- Supports research on distribution system decontamination, sensors, cyber security, and wash/flush water treatment
- Located near adjacent office building with plumbing
- CBR agents or simulants
- Located at Idaho National Lab
**Impacts**

**Office of Water’s Contamination Warning System**

- HSRP evaluated water quality sensors, developed a water sample concentrator, software tools for sensor placement and real-time sensor data monitoring
- Suite of water security computing tools piloted in 5 cities
- Components now used in many other cities

Sensor placement and event detection tools are part of the suite of water security computing tools
Impacts (cont.)

Research results included in the widely used Water Contamination Information Tool (WCIT):

- contaminant characteristics (e.g., persistence on infrastructure)
- decontamination methodologies
- monitors
- sampling and analysis methods

WCIT is a secure on-line database with comprehensive information about CBR agents of concern to the water sector.
Indoor/Outdoor Cleanup
Systems Approach

- Reduce Vulnerabilities
- Mitigation
- Lessons Learned and Preplanning
- Remediation
- Characterization & Risk Assessment
- Reoccupancy
Indoor / Outdoor Cleanup

Evolution of Program

<table>
<thead>
<tr>
<th>Buildings</th>
<th>Wide areas</th>
<th>Emerging issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy, engineering, traditional CBR agents</td>
<td>Efficacy, systems approaches, decision support tools</td>
<td>Ag security, emerging chemicals, all hazards</td>
</tr>
</tbody>
</table>

Transportable gasifier for carcass management.
Decontamination Efficacy Research

• What clean up technologies are most effective for contaminants on surfaces?

• How is efficacy changed by real world variations in environmental, process and agent characteristics?

Research
Study efficacy against chemical, biological, radiological, and nuclear fallout contamination on surfaces encountered during a wide area contamination incident
Decontamination Research from Bench to Full-Scale
Decontamination Engineering

How can decontamination processes be successful at full scale?

• Optimization – delivery and recovery of fumigant
• Monitoring – fumigant, decon progress
• Materials compatibility
• Waste generated
Systems Approach to Response and Remediation

What are the decision interdependencies?

How can decision makers become aware of these interdependencies during response and preparedness activities?

Developing decision-support tools:
- For choosing decon options - shows that interconnection between decision points during facility remediation
- For waste management - assesses the impact of wide area decontamination strategies on waste

Example output of facility remediation tool.
Impacts

- Natural anthrax contamination cleaned up based on our decon research
- Waste tools used in national disaster exercises
- OCSPP anthrax exclusion policy heavily cites our work
- OSWER guidance and other response guides heavily cite our work

Estimated Debris Mass - Initial Blast

- Waste Estimation Support Tool predicts waste volumes generated from an Radiological Dispersion Device blast

House contaminated with anthrax is tented in preparation for fumigation
In 2013, mail containing the biotoxin, ricin, was discovered at White House and Congressional postage handling facilities.

Provided real-time research product synthesis and technical support for ricin:
- sampling and analysis methods
- decontamination technologies
- exposure advisory values

Aided decisions made by Capital Police, OSWER, and Regions 3 and 4 on clean up of the:
- mail handling facilities including the expensive sorting equipment
- alleged perpetrator’s home in Mississippi

Afterwards, HSRP contributed to training given by Region 3 and OEM to responders on ricin sampling and analysis.
Cross Cutting Research Areas

- Fate and transport
- Exposure
- Sampling and analysis methods for characterization

Schematic showing how fate and transport impacts sampling strategies and exposure assessment methodologies
Agent Fate and Transport

For chemical, biological, and radiological (C,B,R) contamination, what is the agent’s fate?

- C/B – persistence over wide area and on water infrastructure?
- C/B/R – contaminant spread?
- C/R – reactivity over wide area and in water systems?

Impacts detection, characterization, mitigation, exposure assessment, and remediation

Research:

- Examining fate and transport of contaminants in drinking water
- Examining spore transport in urban outdoor environment
Exposure Assessment

How can characterization of exposure pathways and health risks from contamination be improved to better inform risk assessment and risk management decisions?

*Developed Provisional Advisory Levels for Chemical and Toxins (159 total)*

**Characteristics of PAL Severity Levels**

- **PAL 3**: Severe effects, lethality
- **PAL 2**: Impaired ability to escape increased severity of irreversible serious long-lasting effects
- **PAL 1**: Mild, transient, reversible effects, including changes from baseline biomarkers of exposure

Research:
- Incorporating exposure into water security and resilience tools
- Determining exposure assessment methodologies for biological contaminants (e.g., virus causing foot and mouth disease, *anthracis* spores)
- Developing provisional advisory exposure levels
Innovative Method Development
Improving capability and capacity

- Developing efficient sampling methods and rapid sample processing techniques
- Developing rapid, sensitive, and selective analysis protocols
- For CBR contaminants in environmental matrices and on surfaces

Plating Method: 30-40 samples
RV-PCR Method: 150 samples

Example of innovative analytical protocol developed for *Bacillus anthracis* spores in environmental samples.
Impacts

*Selected Analytical Methods* compendium used during tabletop exercises and responses by

- EPA’s Environmental Response Lab Network (ERLN)
- EPA’s Water Laboratory Alliance (WLA)

**Chemical Methods**
- 142 analytes
- 5 matrices

**Pathogen Methods**
- 31 analytes
- 4 matrices

**Radiochemical Methods**
- 25 analytes
- 6 matrices

**Biotoxin Methods**
- 18 analytes
- 5 matrices
How HSRP’s Research Fits into the System

- Design and operation of water systems and technologies
- Community environmental resilience
- Lessons Learned and Preplanning
- Reduce Vulnerabilities
- Detection
- Mitigation
- Characterization & Risk Assessment
- Remediation
- Decision making tools for response and remediation, Systems analysis of remediation
- Reuse
- Contaminated waste and water management
- Engineering considerations for decontamination
- Assessment of decontamination methodologies
- Develop sampling methods and strategies, and analysis protocols
- Evaluating exposure
- Detection and mitigation methods and strategies
- Community environmental resilience
- Lessons Learned and Preplanning
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- Detection and mitigation methods and strategies
ORD’s Homeland Security Research Program

- Sustainability indicators
- Sustainable materials management
- Contaminated sites

- Cumulative risk
- ExpoBox

- Safe and Sustainable Water (SSWR)
  - Sustainable water infrastructure modeling
  - Analytical methods
  - Net Zero

- Air, Climate and Energy (ACE)
  - Climate change impacts/response
  - Climate resilience indicators

- Sustainable and Healthy Communities (SHC)

- Human Health Risk Assessment (HHRA)
  - Predictive toxicology

- Chemical Safety for Sustainability (CSS)
  - Threat and risk assessment
  - Operational cleanup demos
  - Cleanup after outbreaks of FAD

- Federal Partners
Future Program Directions

- Wide area clean up – technologies and strategies
- Full scale demonstration of water tools and decontamination
- Exposure assessment
- Addressing “all hazards” science gaps
- Developing resilience metrics
- Cybersecurity
- Food Safety Modernization Act
- Emerging issues