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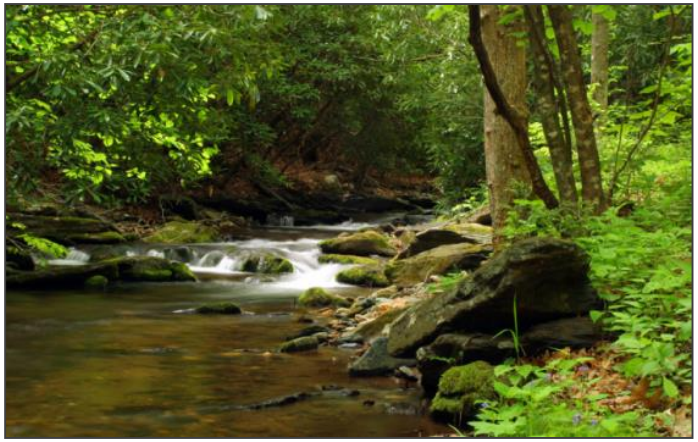
The Role of Public Health Laboratories in National Environmental Monitoring



The Role of Public Health Laboratories in National Environmental Monitoring

Niche

Origins

Expansion

Oversight

Drivers

Examples

Conclusion

The Public Health Laboratory Niche

National Environmental Monitoring Network:

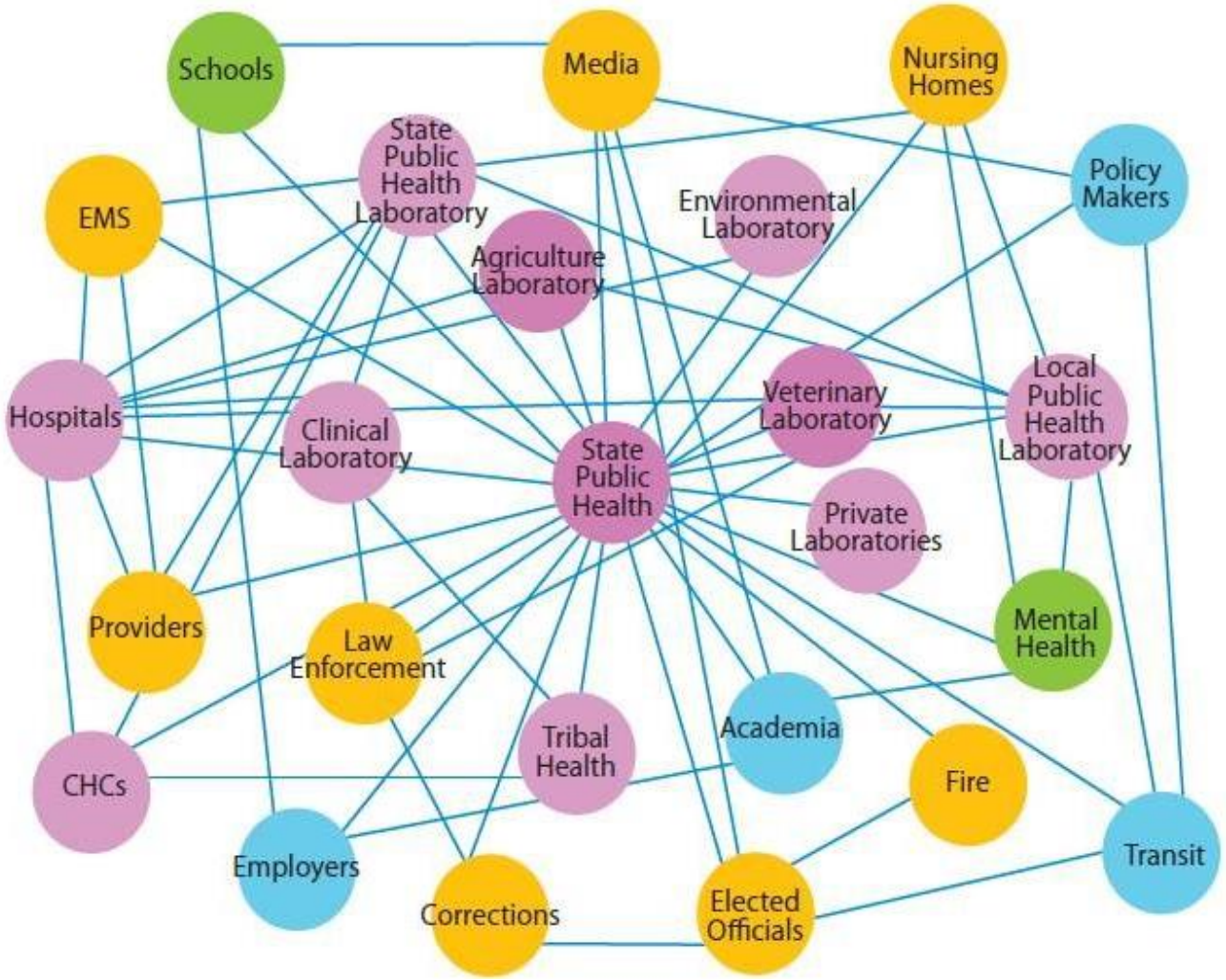
- Commercial
- Governmental
- Academic
- University
- Industrial environmental testing laboratories
- Engineers

… and Public Health Laboratories

Size and focus vary… all support public health and environment decision making

- Municipal, county, state, federal laboratories
- Regulatory, surveillance, monitoring
- Agriculture, Drinking Water, Wastewater, Ambient Water, Recreational Water, Food, Air, Dairy, Seafood
- SDWA, CWA, RCRA, CAA, FSMA
- EPA, CDC, FDA, USDA, DOD

State Public Health Laboratory System



Public Health Laboratory Origins

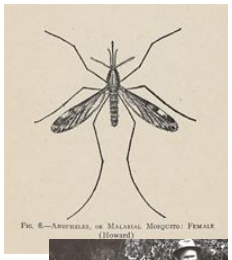
Municipal laboratories evolved in the mid-1800's after physicians linked illness to drinking water and food sanitation.

Sanitary microbiology integrated with teaching hospitals and medical universities and

…continues to be the most significant public health issue in many parts of the world.

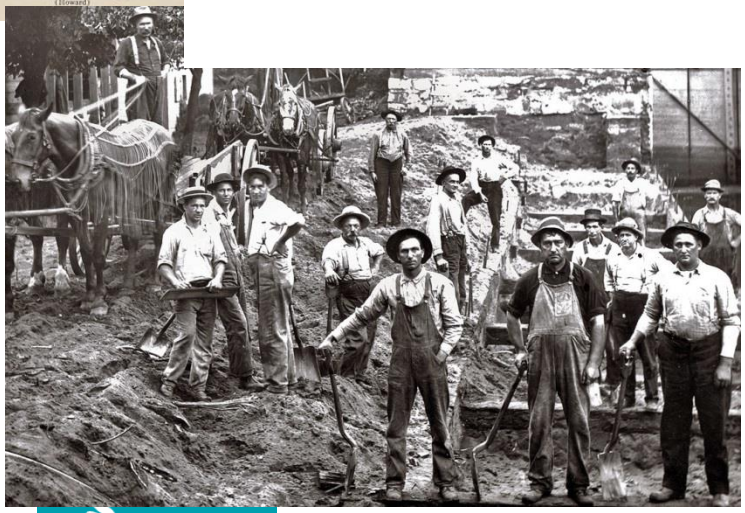
Expanding Role of Public Health Laboratories

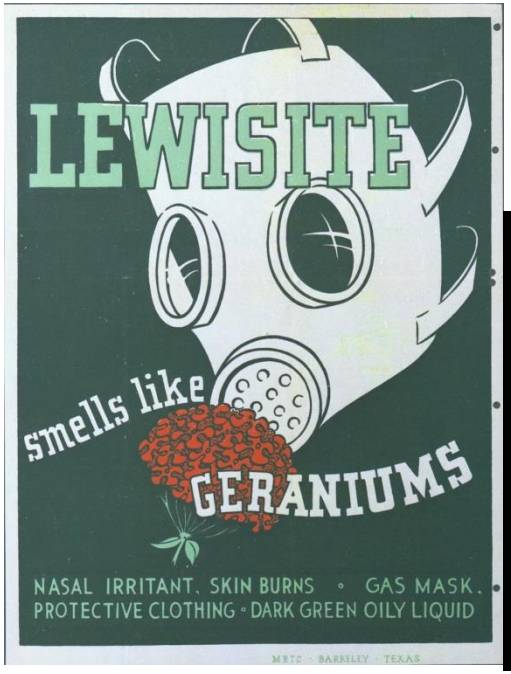
In response to national health crises

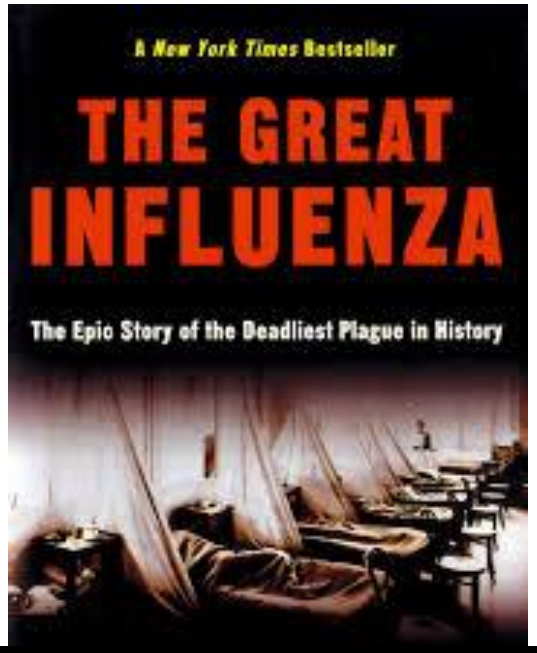


The Germ Theory of Disease
Alexander Fleming

"One sometimes finds what one is not looking for."







Meningococcal Disease, US Army, World Wars

	Number of cases	Number of deaths	Mortality
World War I	5,839	1,836	31.4%
World War II	13,922	559	4.0%

US Army, Office of the Surgeon General, 1958.

Chemical Exposure and Environmental Health

Chemical exposure from contaminants in water, air, food and other environmental matrices …

became the focus of government regulatory agencies to protect public health and the environment.

Public Health Laboratory Oversight

EPA – Regional, Office of Water, Pesticides Program, Office of Air
FDA – Food, Dairy, Shellfish Program
CDC, CMS - CLIA, CAP
USDA – Agriculture Produce
NELAP – SDWA, CWA, RCRA, CAA
Third Party Accreditation Bodies – ANAB-, A2LA, PJLA, etc.

Food Safety Modernization Act (FSMA) - public health laboratories are required to become accredited to ISO 17025:2005 to provide food testing support to FDA

Public Health Laboratory Testing has Expanded

Clients of RIDOH Laboratories Center for Environmental Sciences	
Public Water Systems	Beach Facilities
Drinking Water Quality Program	Epidemiology / Rabies Program
Private Well / Homeowners	Recreational Water Programs
Food Protection / Inspection	Childhood Lead Programs
Air Resources / Monitoring	Emergency Responders
Shellfish Harvesters / Distributors	FDA, CDC, EPA, USDA
Dairies / Dairy Product Producers	Environmental Enforcement
Food and Beverage Producers	Agriculture / Pesticides

Public Health Laboratory Testing – Beyond Drinking Water

Harmful plankton monitoring and biotoxin in shellfish during blooms

- domoic acid – amnesic shellfish poisoning
- saxitoxin paralytic shellfish poisoning
- okadaic acid diarrhetic shellfish poisoning

Ambient air quality

- particulates, criteria gases, VOCs, carbonyls other pollutants leading to respiratory ailments

Public Health Laboratories Testing – Beyond Drinking Water

- Surface water supplies for cyanotoxins
  - public water systems and recreational use
- Beach water for bacteria
  - microbiological and molecular biological testing techniques
- Groundwater for emerging contaminants
  - e.g., perfluorinated organic compounds, pharmaceuticals, personal care products, industrial chemicals
- Milk products for antibiotics, bacteria, somatic cells

Preparedness is Not Profitable

Public Health Laboratories depend on routine testing to maintain preparedness to pivot to emergency laboratory testing in response to outbreaks and large scale incidents of contamination.

Participate in Laboratory Response Networks

Support chemical, biological and radiological laboratory response networks during environmental and nationally significant incidents:

Environmental Response Laboratory Network

***ERLN* – EPA**

Food Emergency Response Network

***FERN* - FDA/USDA**

Laboratory Response Network

***LRN* - CDC**

Recent Events Continue to Expand Roles of Public Health and Environmental Laboratories

Health Advisories and Incidents Drive Role Expansion

Tennessee Valley Authority Coal Ash spill

Elk River, WV chemical spill (methylcyclohexane methanol)

Shale oil and gas extraction (fracking)

- triggers groundwater, air quality and naturally occurring radiation monitoring

Toledo public water supply - harmful algal bloom

EPA-issued health advisories:

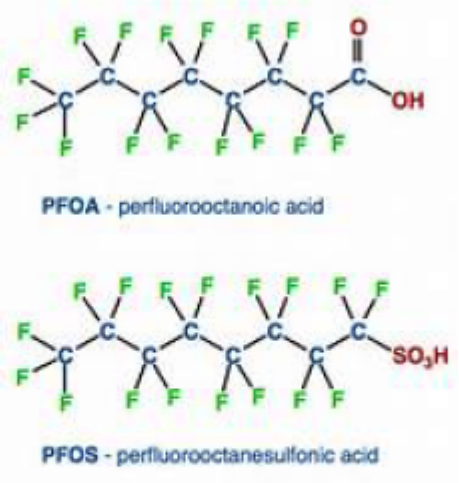
- cyanotoxins in public and recreational water
- per- and polyfluoroalkyl substances (flame retardants) in drinking and groundwater

Flint public water lead contamination (school testing in states)

NY State Public Health Lab

Response to Communities with Emerging Contaminants in Drinking Water.

PFOA, PFOS



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Driving Forces – Drinking Water

- Known levels of PFAS in Public Drinking Water Supplies for some NYS communities
- May 19th, 2016 – EPA issues lifetime health advisory of 70 ppt for long-term exposure
- Monitoring PFOA and PFOS – NY State Assembly Budget Proposal (FY 2017-2018)
  - Requires NYS Health Commissioner to identify and monitor emerging contaminants in PWS specifically including PFAS and 1,4-Dioxane.

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Driving Forces – Public Health Monitoring

- Intense public interest in body burden assessment
- PFAS included in NHANES biomonitoring (comparative purposes)
- Provide public health service, with accurate and defensible data (CLIA compliant), to NYS residents
- Biomonitoring database for evaluation of remedial actions.
- Improve outreach/partnerships with pubic hospitals and Public Service Centers within NYS
- Assist neighboring states through testing (NH and VT) or disseminating knowledge (MA)

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PFAS Testing in Drinking Water

- ISO Method 25101:2009(E) was validated for the testing of Drinking Water using automated solid phase extraction and LC/MS/MS. Over 500 water samples have been analyzed from Hoosick Falls during the initial part of this public health project.
- NY Environmental Laboratory Accreditation Program (ELAP) is providing interim approval for commercial labs to test drinking water using this ISO method.

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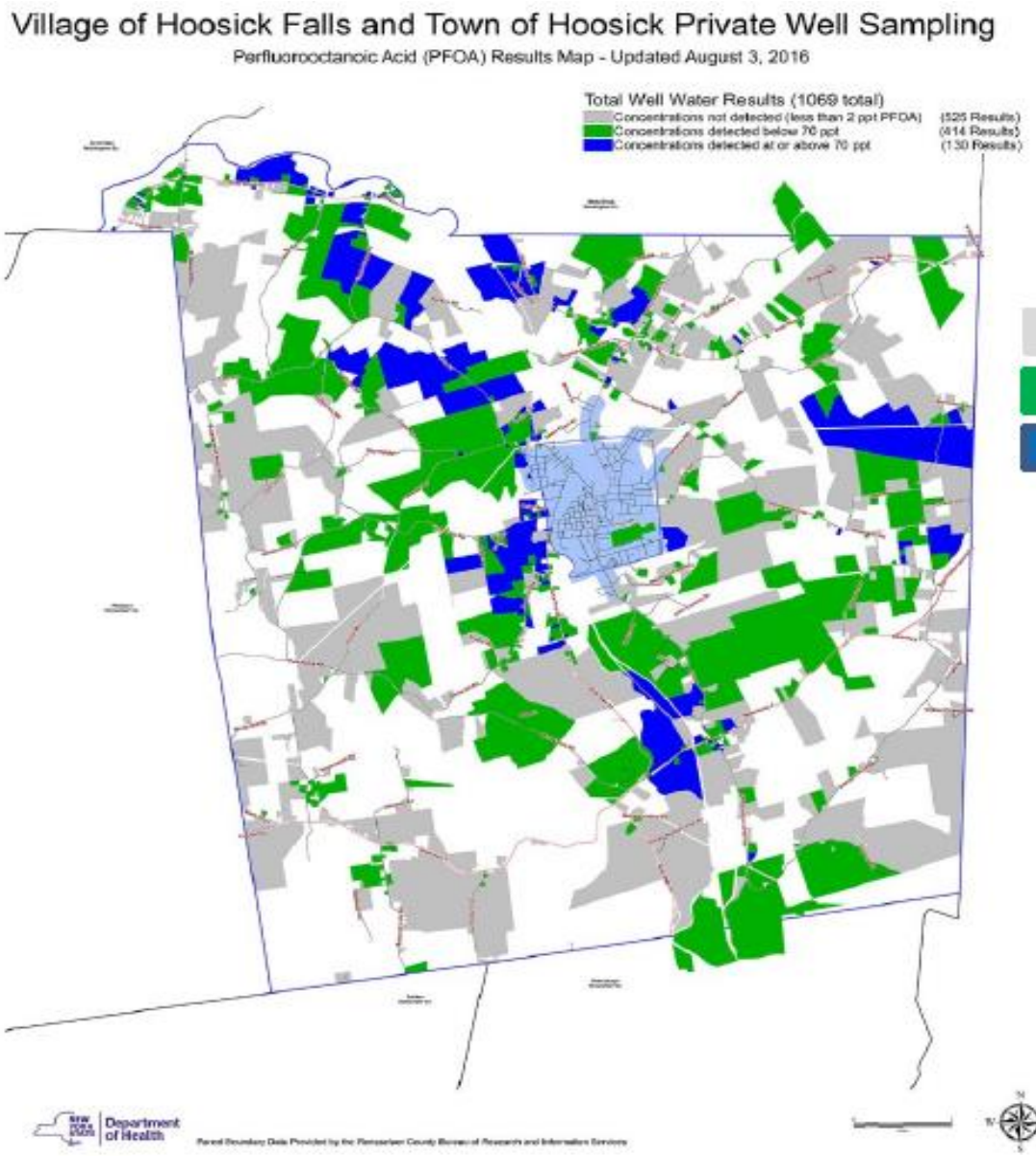
Public Water Supply –PFOA contamination

- 2016 - Hoosick Falls, NY

- The Village of Hoosick Falls is located in the Town of Hoosick, a rural community located in northeastern Rensselaer County, about 30 miles from Albany. The Town has a population of 6,700 with 3600 living in the Village.

- The raw water in the 3 Municipal Wells have tested at ranges between 150ng/L to 662ng/L of PFOA. Contamination was from a Plastics Fabrication Company located in the village.



PFOA <2 ppt

PFOA 2-70 ppt

PFOA >70 ppt

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PFAS Contamination

- **Newburg's** public water supply is taken from Lake Washington and served 28,000 residents.
- This lake is impacted by run off from the Air National Guard AFB where Aqueous Film-forming Firefighting Foam has been used (AFFF).

- **Petersburgh's** Wells were contaminated by a Plastics manufacturing plant.

- NH and VT samples were collected and shipped directly to Wadsworth by each state public health lab.

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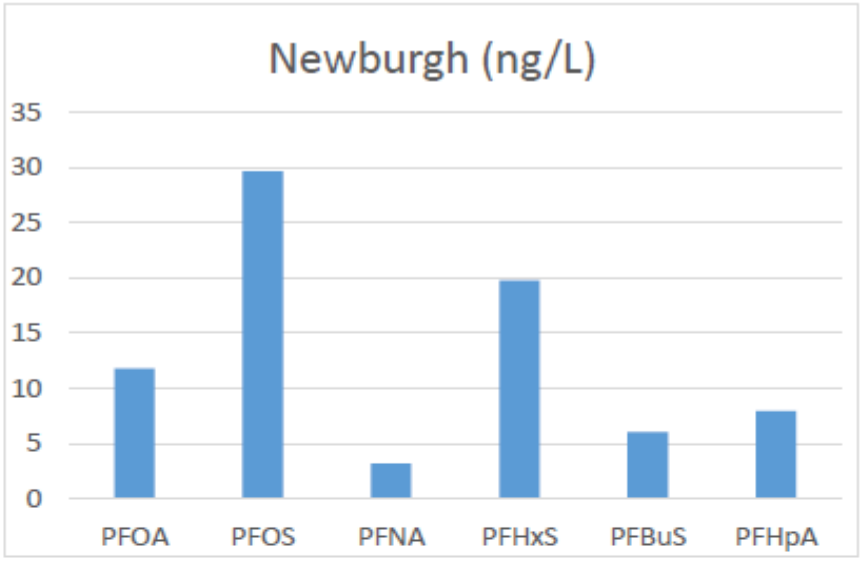

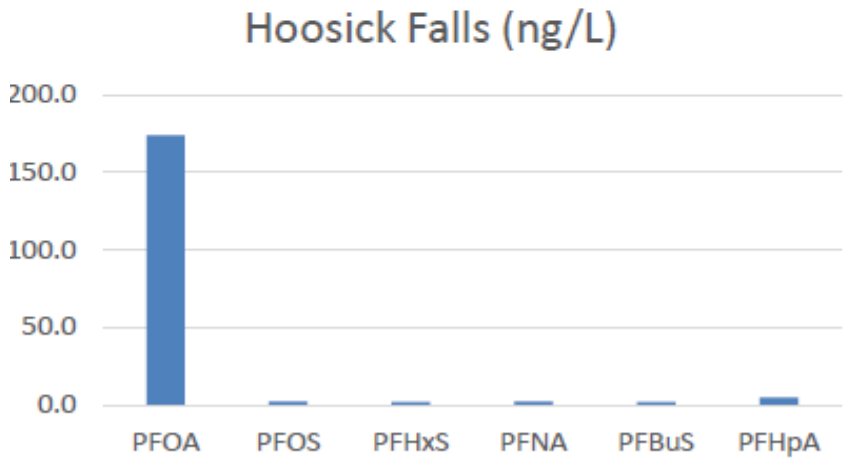

Drinking Water PFAS Profiles

Newburgh impacted mainly by AFFF contamination

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Public Health Lab Role

Exposure Assessment
Biomonitoring

Blood Collection

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LRN-C and High Throughput Capability

- Serum Testing offered to all Hoosick Falls Residents (3,500 village + 3,100 town - using private wells).
- Requested to leverage LRN-C expertise and surge capacity to develop rapid, CLIA compliant biomonitoring capability for PFOA.
- 2,081 serum samples were analyzed in a ~8 weeks.
- Method for 11 PFAS targets was developed in parallel and also validated to CLIA standards for emerging issues at other NY and States water supplies.
- Projected workload would increase and data processing and sample collection required alternative solutions.

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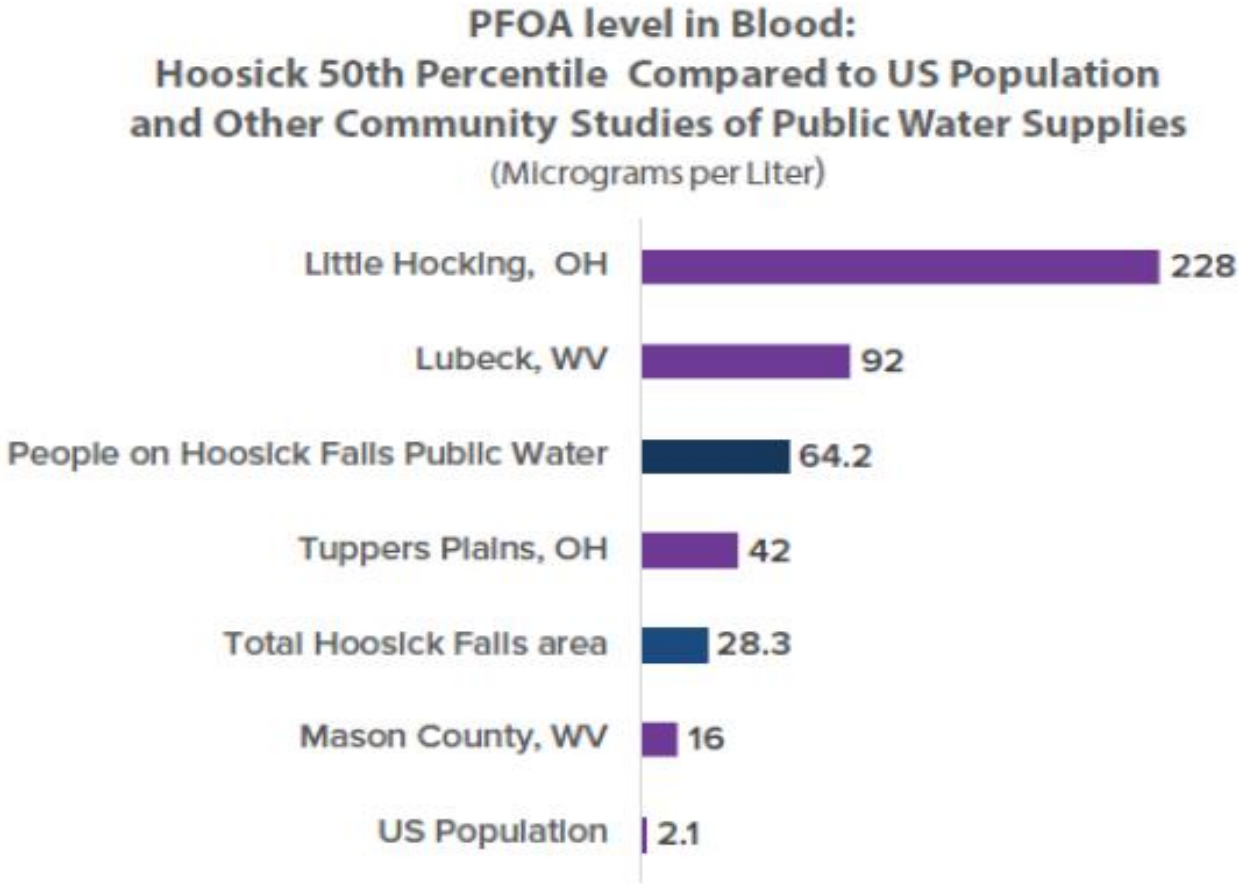
PFOA Blood Levels of Hoosick Residents Compared to Residents from Other Communities



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Recently Reported Serum Test Results for PFAS

	Analyzed - 9/22/2016-06/1/2017	
State/Town	**Samples tested**	**Target Analytes**
New Hampshire PHL	594	N-MeFOSAA,PFBuS, PFDeA, PFDoA, PFHpA, PFHxS, PFNA, PFOA, PFOS, PFOSA, PFUA (11 analytes)
Newburgh	1,566	PFBuS, PFHpA, PFHxS, PFNA, PFOA, PFOS (6 analytes)
Hoosick Falls	1,018 2,081*	PFOA
Vermont PHL	82	PFOA
Petersburgh	156	PFOA
TOTAL	5,497	
*Analyzed Feb-April 2016		

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Serum Testing for PFAS (ug/L)

			Serum Analysis - Locations in NY, NH and VT						
LOCATION	# Samples			PFOA	PFOS	PFHxS	PFNA	PFBuS	PFHpA
New Hampshire	566		Average	5.17	9.34	4.09	0.85	0.502	0.550
			50th Percentile	3.17	6.72	1.69	0.65	0.500	0.500
			95th Percentile	13.8	23.2	13.7	1.69	0.500	0.500
Newburgh	1566		Average	3.14	19.8	12.6	0.934	0.503	0.507
			50th Percentile	2.37	11.8	6.40	0.712	0.500	0.500
			95th Percentile	8.05	61.8	44.3	1.94	0.500	0.500
Vermont	82		Average	12.0					
			50th Percentile	3.22					
			95th Percentile	34.8					
Hoosick Falls/Petersburgh	3255		Average	49.5					
			50th Percentile	21.2					
			95th Percentile	177					
Total	5469								

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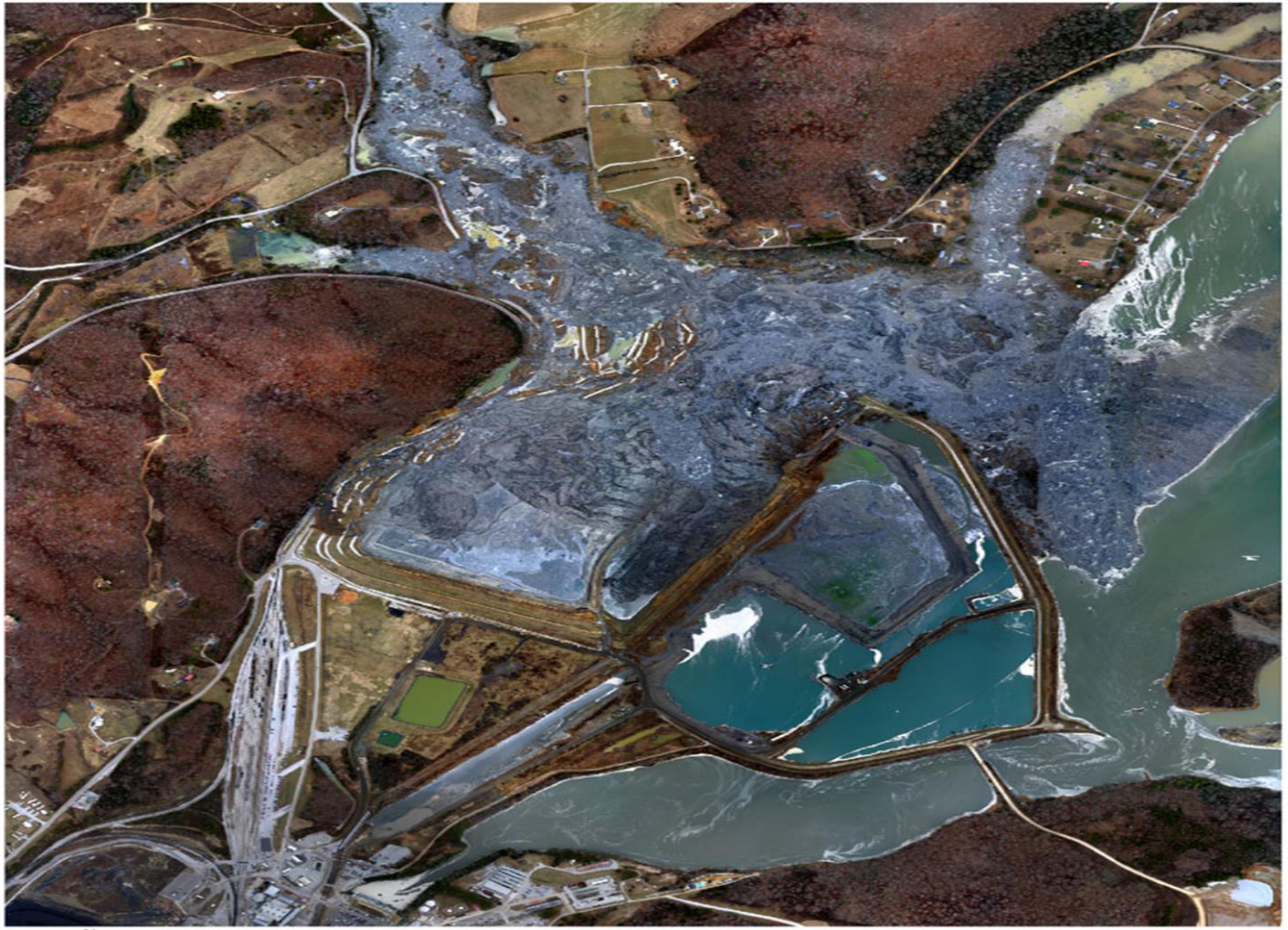
Tennessee Valley Authority Kingston Coal Ash Spill December 2008

Tennessee Department of Health
Laboratory Services

Aerial Image Of Kingston Ash Slide 12/23/08



TVA Kingston drinking water testing for inorganics and metals testing:

- 7 days/week for 1 month with a required 24-hour turnaround time.
- Followed by 5 days a week for 3 months with a required 24-hour turnaround time.
- Organic and radiochemistry labs performed testing on air, soil and coal ash samples.

TN Department of Health

TVA Analytical Parameters:

- Radiochemistry (***Soil, Ash, Air Filters***)
  - Gross Alpha-Gross Beta, Gamma
- Inorganic Metals (***Water, Soil, Ash, Air Filters***)
  - Fe, Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, Ag, Tl, V, Zn and Mercury
- Inorganic Routines (***Water***)
  - Total Alkalinity, Calcium Hardness, Settleable Residue, Total Suspended Solids
- Organics (***Soil, Ash***)
- PAHs

TN Department of Health

TVA Kingston Coal Ash Recovery Project Metrics:

- Clean up: ***6 years ~$1.2B***
- Total man hours: ***6.7M hours***
- ***3.5M cubic yards ~41,000 railcars*** of ash removed from river system transported to Alabama
- ***2.3 cubic yards*** of ash mechanically excavated from embayments,
- ***1.9 cubic yards*** of ash removed from other areas
- ***255 acres*** of river system cleaned up
- ***4.0M cubic yards*** of ash stacked and compacted in on-site landfill

Pennsylvania DEP laboratory reports **methane gases** and **VOC pollutant concentrations** emitted at or near Marcellus Shale natural gas exploration activities.

Goals:

- Screen ambient air pollutants near Marcellus Shale gas drilling operations;
- Assess potential air quality impacts;
- Assess potential health risks from exposure to ambient concentrations, and
- Determine whether the scope of the short-term Marcellus sampling initiative should be expanded.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Ohio Monitoring Requirements

- Total Microcystins

  May – October

  - Weekly raw and finished water
    - Eligible for monitoring reductions starting May 2017
  - Raw water detections >5 ug/L and any finished water detections trigger additional sampling

  November – April

  - Raw water only every other week
  - Detections trigger additional monitoring

- Cyanobacteria Screening (qPCR)

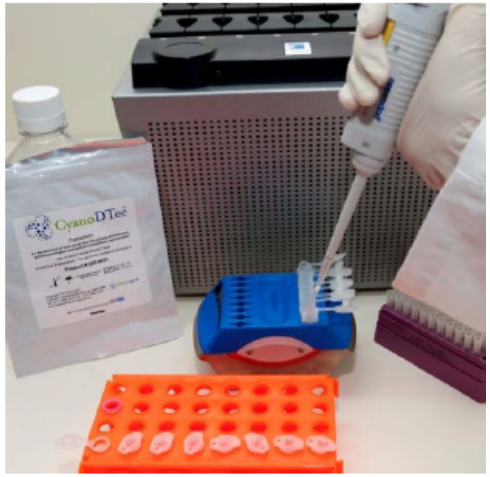
  All year

  - Biweekly raw water
  - Triggers follow up sampling by Ohio EPA for other cyanotoxins

Ohio Environmental Protection Agency

Cyanobacteria Screening: Molecular Methods (Multiplex qPCR)

- Quantitative polymerase chain reaction (qPCR) – identifies and quantifies the presence of genes unique to:
  - Cyanobacteria (16S rDNA)
  - Microcystin and Nodularin production (mcyE gene)
  - Cylindrospermopsin production (cyrA gene)
  - Saxitoxin production (sxtA gene)
  - Test completed within 2-3 hours
  - Scalable
  - Cost-effective
  - Utilizes certified reference material
  - Specific
- Ohio EPA method and certification in 2017
- Ohio EPA uses the data to trigger saxitoxins and cylindrospermopsin sampling and in 2017 will be used as trigger for microcystins monitoring.
- ***www.phytoxigene.com/products/***



Ohio Environmental Protection Agency

Analytical Methods Utilized by Ohio EPA

	Microcystins (µg/L)	Cylindro-spermopsin (µg/L)	Saxitoxins (µg/L)	Anatoxin-a (µg/L)
Surveillance sampling	ELISA (MC-ADDA)	ELISA	ELISA	LC-MS/MS
Repeat sampling in response to a finished water detection	ELISA (MC-ADDA)	LC-MS/MS	LC-MS/MS	LC-MS/MS

ELISA: Enzyme-Linked Immunosorbent Assay

LC-MS/MS: Liquid Chromatography followed by tandem Mass Spectrometry

Ohio Environmental Protection Agency

Microcystins Methods - Key Findings

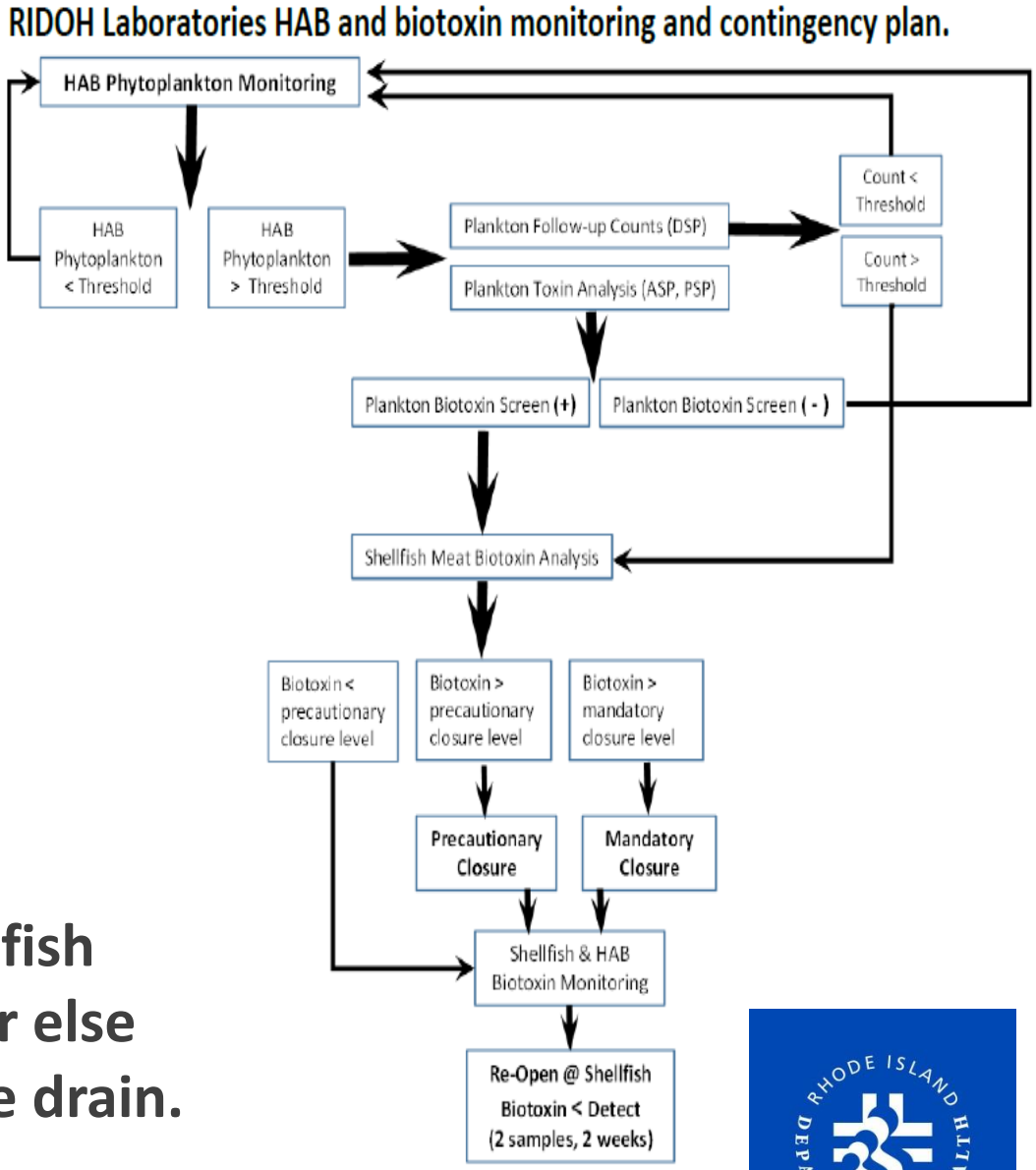
- 16 different MC-variants detected
- MC-LR was only detected at 5 of 11 sites (45%)
- Most commonly detected variants were: MC-YR, [Dha7] MC-LR and [DAsp3] MC-RR
- LC-PDA methods prone to interference, potential for false positives and false negatives
- LC-MS/MS MMPB method confirmed ELISA results (raw water)
- 91%-100% of samples had MC-variants not detectable by U.S. EPA Method 544 (including dominant MC-variant in some samples)
- LC-MS/MS individual variant analysis under-reported total microcystins, based on MMPB, LC-UV/MS scans, and ELISA data
- No perfect method for TOTAL Microcystins

Ohio Environmental Protection Agency

Rhode Island laboratory responds to toxic algae bloom, safeguarding health and the local economy

Posted on April 26, 2017 in All Posts, Environmental Health with 1 Comment

Protect public health, shellfish reputation and economy or else industry could go down the drain.



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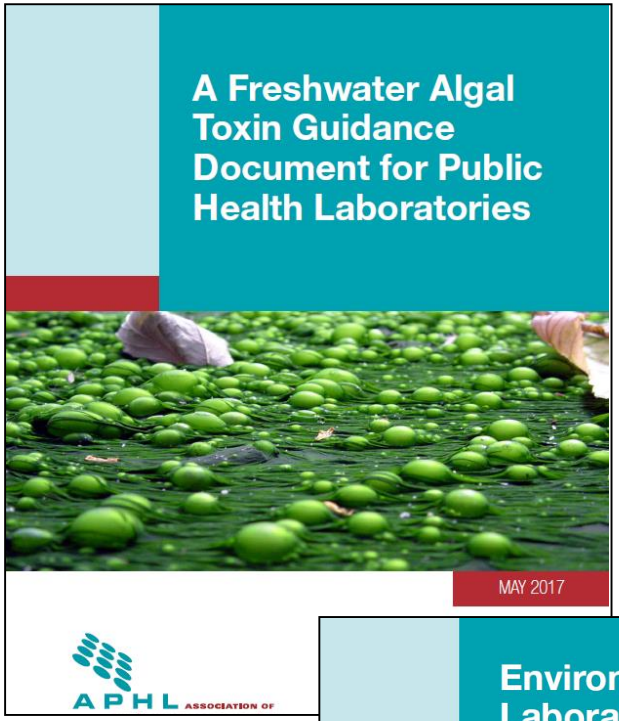

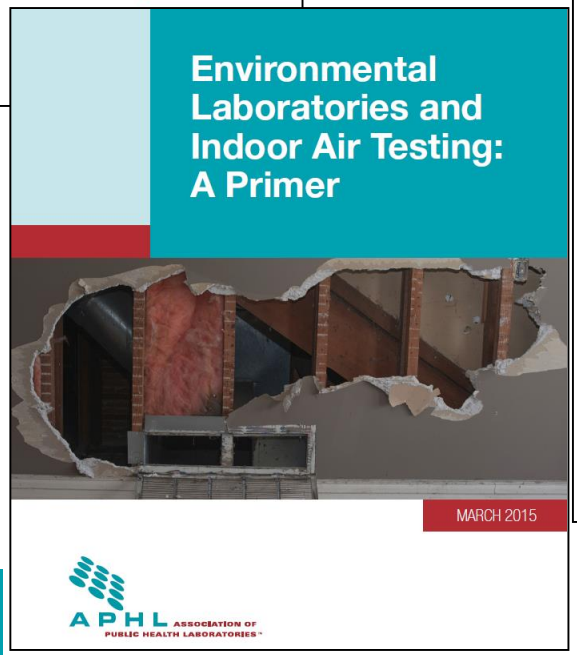

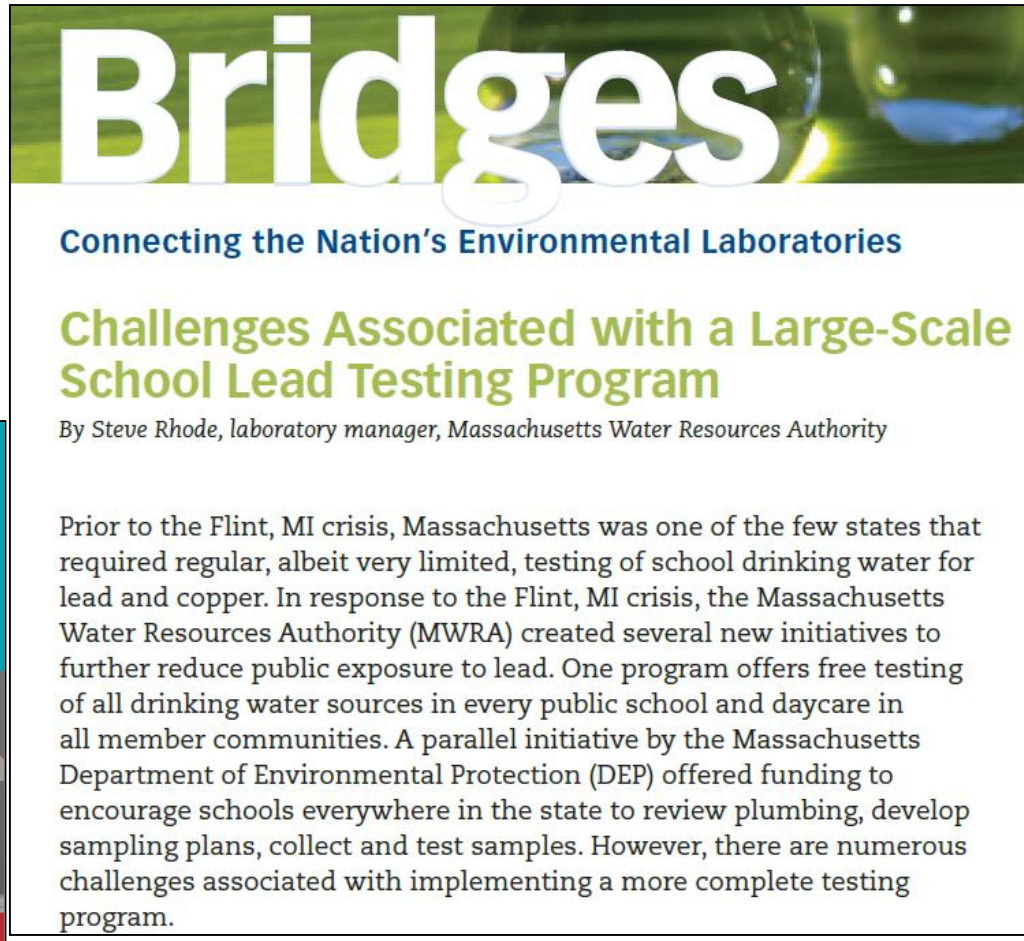

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CONCLUSION

Public health laboratories fit into national environmental measurement.

How to work with public health laboratories?

The Role of Public Health Laboratories in National Environmental Monitoring

The Association of Public Health Laboratories facilitates the interaction of state and local laboratories with programs seeking laboratory support and input to respond to new advisories and threats to the public health and the environment.

The Role of Public Health Laboratories in National Environmental Monitoring

As partners with public health and environmental protection programs, public health laboratories help:

- investigate community concerns
- assess human exposures
- ensure compliance with existing regulations
- identify the need for an intervention/policy

The Role of Public Health Laboratories in National Environmental Monitoring

- Future technology will continue to be adopted to bring increased sensitivity into environmental analysis and biomonitoring.
- Public health laboratories will continue be relied upon to ensure public and environmental health are protected.

Acknowledgments

Kenneth Aldous, PhD, Div. of Environmental Health Sciences, Wadsworth Center, NYS Department of Health

Heather Raymond, MS, HAB Coordinator, Ohio EPA

Martina McGarvey, DM, Director, Bureau of Laboratories, PA DEP

Bob Read, PhD, Director, Environmental Chemistry Lab Tennessee Department of Health, Div. of Lab Services

Association of Public Health Laboratories (APHL)

Thank you

Henry Leibovitz, PhD
Chief Environmental Laboratory Scientist
Rhode Island Department of Health
Division of Laboratories

Henry.Leibovitz@health.ri.gov