



NC Air, NC Water, NC Health

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The National Institute of Environmental Health Sciences

- One of the 27 National Institutes of Health, located in RTP, NC
- Wide variety of programs supporting our mission of environmental health:
 - Intramural laboratories
 - Extramural funding programs
 - National Toxicology Program
 - Public health focus
 - Disease prevention
 - Clinical research program



Environmental Burden of Disease

In 2015, pollution-related disease was responsible for **16% of deaths** worldwide

92% of pollution-related deaths occur in low-and middle-income countries

Welfare losses due to pollution are **\$4.6 trillion per year** – that's 6.2% of global economic output

The good news: Environmental health research can inform strategies to reduce pollution and save lives

NIEHS 2018-2023 Mission and Vision

Mission

To discover how the environment affects people in order to promote healthier lives

Strategic Themes for Environmental Health Science

Vision

To provide global leadership for innovative research that improves public health by preventing disease and disability



What is Our Environment?



Health and the Environment in NC

- Recent issue in the North Carolina Medical Journal collated several articles to frame the topic of human health and the environment
- Emphasized six topics of interest to NC physicians, as well as the communities and families they serve

Outdoor air quality

Toxic substances
and hazardous
waste

Infrastructure and
surveillance

Surface and ground
water quality

Homes and
communities

Global
environmental
health

Air Pollution

Outdoor Air Exposures

- Pesticides
- Vehicle emissions
- Industrial emissions
- Ozone
- Particulate matter (PM_{10/2.5/UF})
- PAHs
- Dioxins



Indoor Air Exposures

- Combustion by-products
- Biologic (mold)
- Dust
- Vapors (cleaning products)
- Flame retardants
- Volatile organic compounds (VOCs)



Examples of Rural and Urban Air Pollution



Traffic-related air pollution (TRAP) and other sources near major roadways



Smoke from wildfires in urban areas of California



Emissions from **concentrated animal feeding operations (CAFOs)** in rural areas of North Carolina



Emissions from **industrial plants and operations**

Air Pollution and Health Effects

OBESITY
Asthma
Diabetes
COPD
Developmental Disabilities
Cancer
DECREASED IQ
Cardiovascular Disease

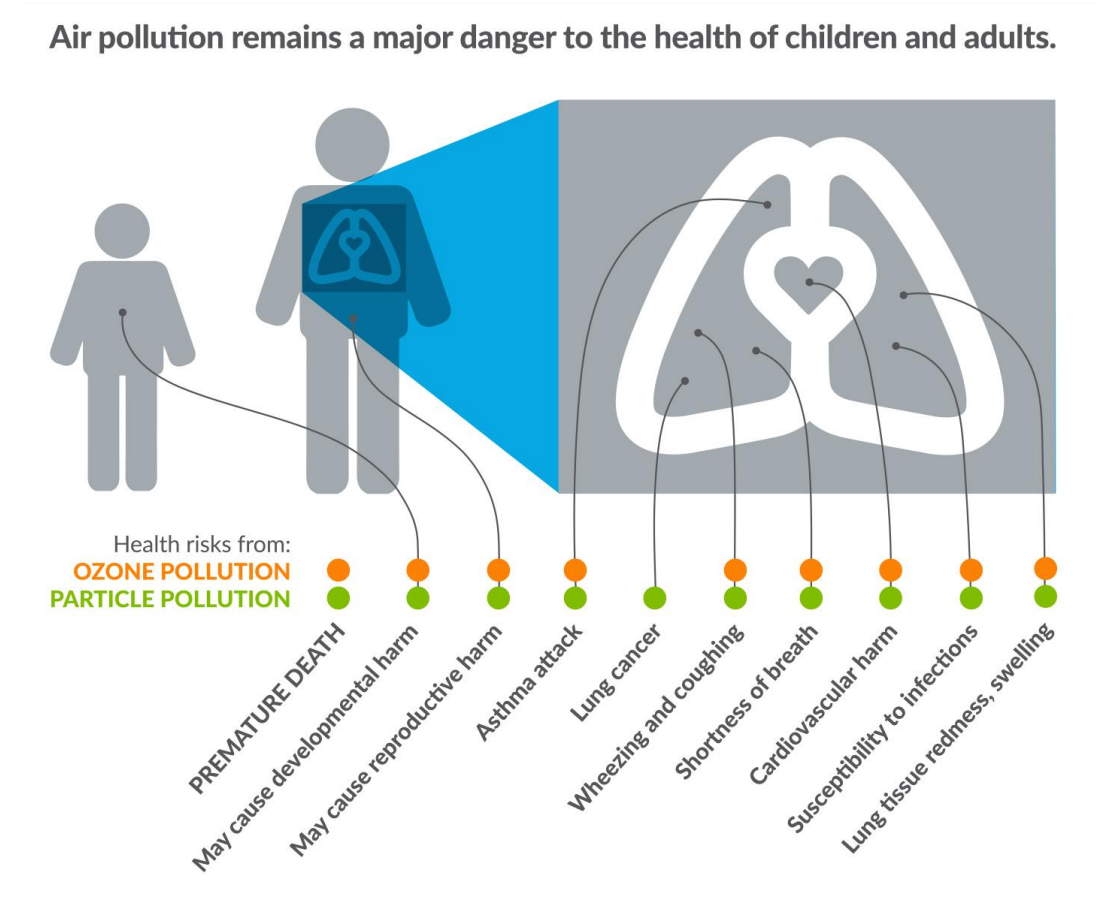
Autoimmunity
 Behavioral Effects
Autism
Alzheimer's
Pneumonia
Lower Respiratory Infections
Pulmonary Disease

Stroke



State of the Air 2018 Report: National

- Compared to the 2017 report, **ozone pollution worsened**, but improvements continued for levels of particle pollution
- **More than 133.9 million people** in the U.S. live in **counties with unhealthy levels** of one or both pollutants



State of the Air 2018 Report: North Carolina

NC earned mixed grades for ozone and particle pollution.
Compared to the 2017 report:

- NC metro areas have seen an increase in ozone pollution
 - Charlotte ranks 41st as the most polluted U.S. city for ozone
 - Asheville, Greensboro, Raleigh, and Durham also had more unhealthy days of ozone
- NC particle pollution levels are lower



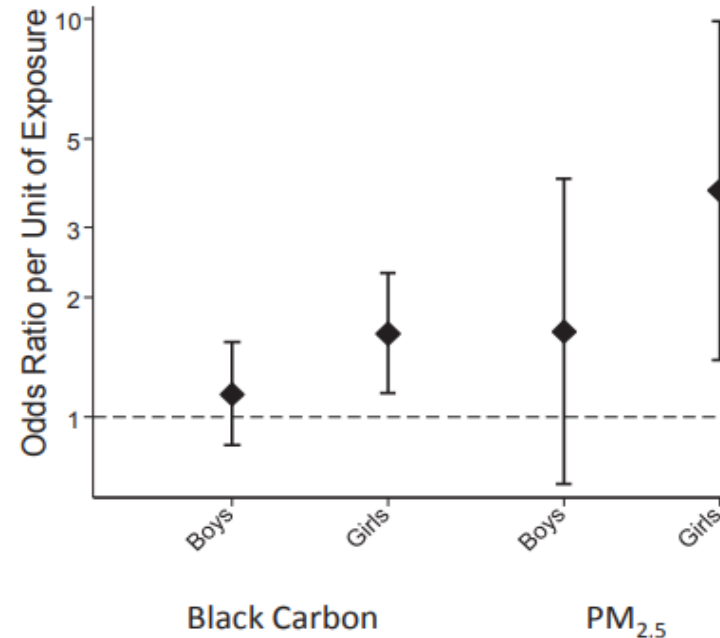
Air Pollutants and Associated Health Impacts

PM _{2.5}	↑ Total, cardiovascular/pulmonary, and lung cancer mortality; ↓ FEV1, ↓FVC, ↓PEF; atherosclerosis; cardiovascular disease; ↑BP; lung cancer; ↓birthweight; insulin resistance
PM ₁₀	Lung cancer; ↑ hospital admissions; ↑cardiovascular, respiratory, and total mortality
NO ₂	Asthma, ↓ FEV1, ↓FVC, ↓PEF, ↑ carotid intima media thickness, daily mortality, birthweight
NO _x	Atherosclerosis, cardiovascular disease, ↓ FEV1, ↓FVC, ↑ hospital admissions
SO ₂	↑Cardiovascular, respiratory, and total mortality; birthweight
BC	↑BP, worsening insulin resistance
O ₃	↓ FEV1, ↓FVC, ↑ hospital admissions
CO	↓Birthweight
NO	Daily mortality

Ambient Air Pollution and Asthma

- Living closer to major roads (<200m) associated with increased incidence and persistence of asthma
(Bowatte et al., 2018, Environ Int)
- Higher lifetime exposure to traffic-related pollution during childhood, not just early life exposure, increases risk of asthma
(Brunst et al., 2015, Am J Respir Crit Care Med)
- Among girls, but not boys, lifetime exposures to black carbon and PM_{2.5} were each associated with greater odds of asthma
(Rice et al., 2018, J Allergy Clin Immunol)

Early asthma/Reactive Airways (Age 3-5)



Air Pollution Associated with Impacts on Children's Health

Brain, Cognition and Behavior

- Pre- and post-natal polycyclic aromatic hydrocarbons (PAH) exposure associated with decreased global intelligence quotient
(*Suades-González et al., Endocrinology, 2015*)
- PAH associated with increased symptoms of anxiety/depression and attention problems and ADHD (*Perera et al., 2014*)

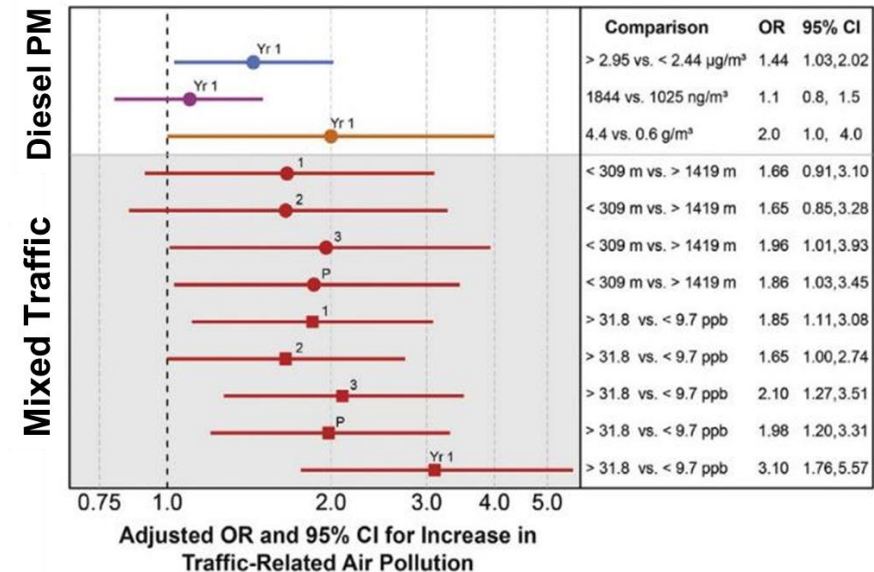


Birth Weight

- Clear association between PM2.5 exposure during pregnancy and decreased birth weight
(*Sun et al., Environ Pollution, 2016*)

Autism

- Consistent associations between autism and exposure to both mixed air pollutants and diesel particulate matter
(*Kalkbrenner et al., Curr Probl Pediatr Adolesc Health Care, 2014*)

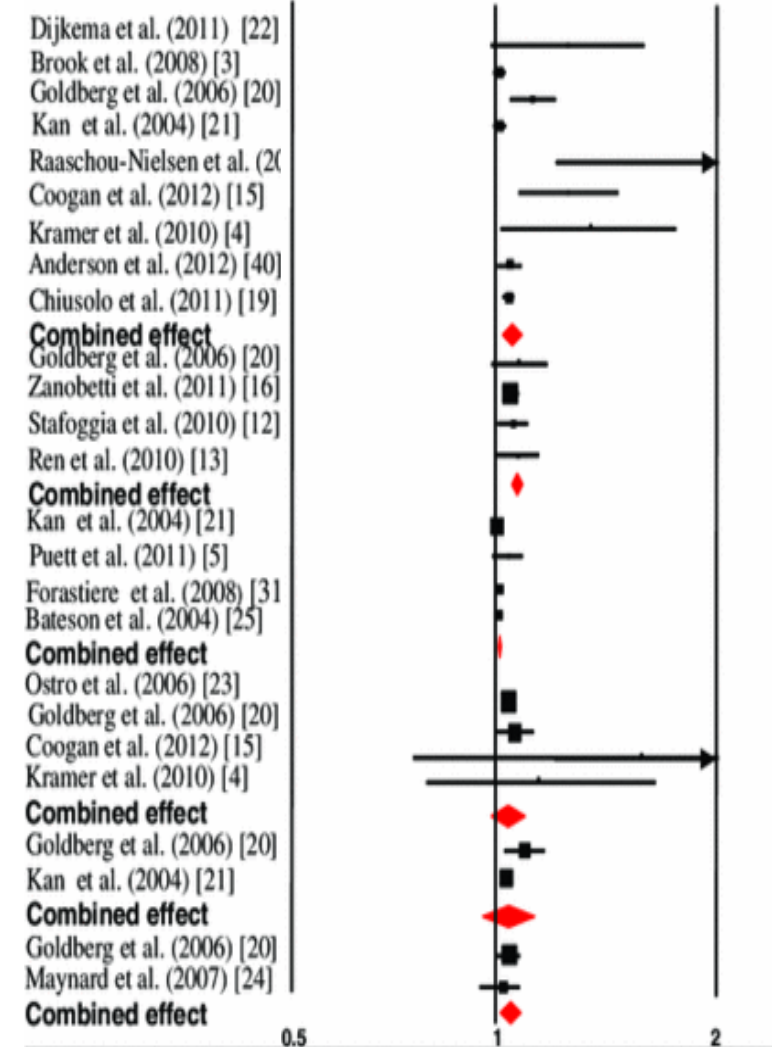


● Windham et al. 2006 - NATA[®] ■ Volk et al. 2013 - Emissions-based (CALINE4)
● Kalkbrenner et al. 2010 - NATA ■ Roberts et al. 2013 - NATA
● Volk et al. 2011 - roadway proximity

Air Pollution Associated with Type 2 Diabetes

- Gaseous pollutants and PM are weakly associated with a higher risk of diabetes-related mortality and morbidity
- Evidence of associations between air pollution exposures and diabetes mortality is somewhat inconsistent
- Some studies suggest women may be at greater risk than men

Source



Improved Air Quality Improves Health

A 10 mg/m³ reduction in PM_{2.5} resulted in:

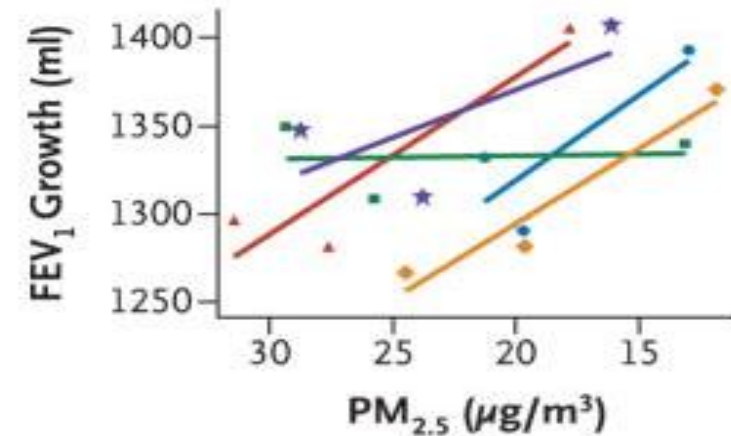
- 27% reduction in Total Mortality
- 31% reduction in Cardiovascular Deaths
- 57% reduction in Respiratory Deaths
- 6% increase in Lung Cancer Deaths
- 15% reduction in Other Deaths



Courtesy of Francine Laden

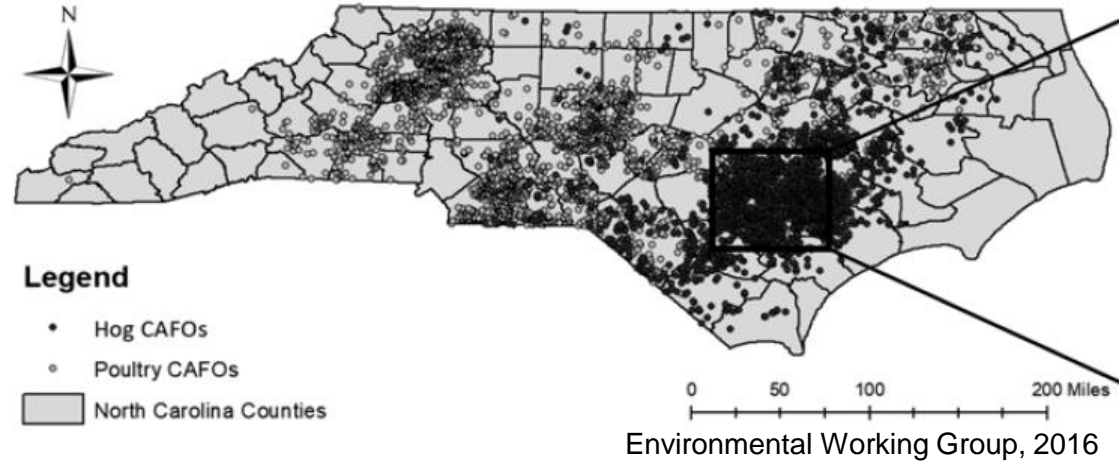
Long-term improvements in air quality are associated with positive effects on lung-function growth in children

(Gauderman et al. 2015)



CAFOs and Air Quality

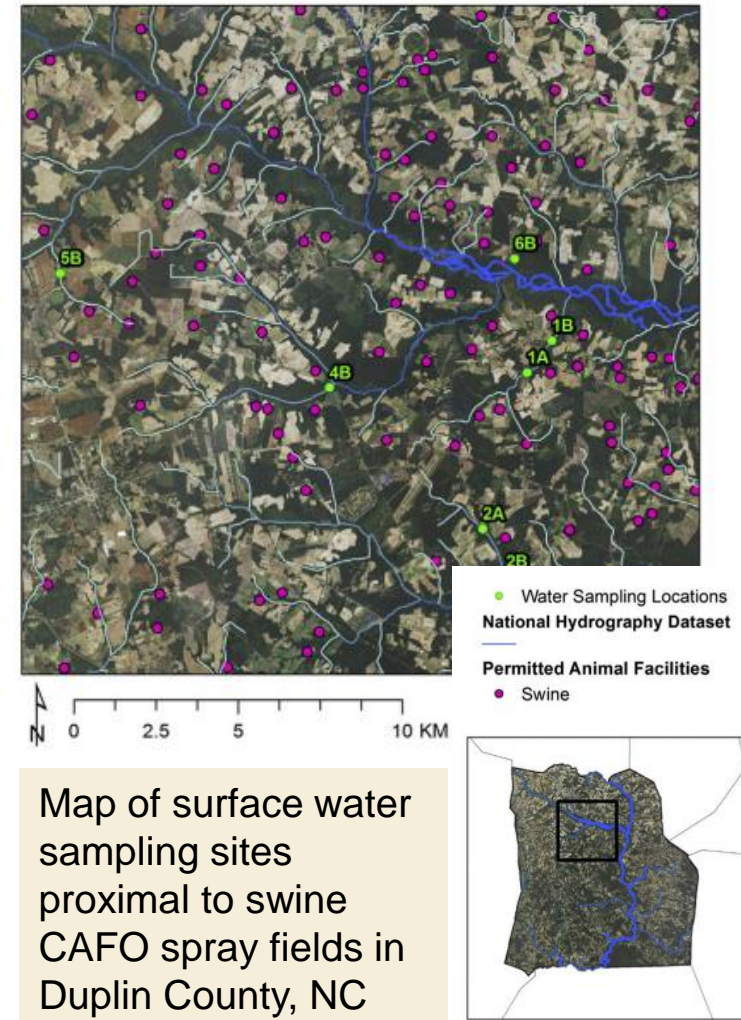
- Communities near CAFOs often have reduced air quality
- Impacts respiratory health and quality of life
- Proximity to large-scale food animal production was associated with increased oral corticosteroid orders and asthma hospitalizations in Pennsylvania



Air Emissions from CAFOs	Sources
Ammonia	Decomposition of organic nitrogen compounds in manure
Hydrogen sulfide	Decomposition of protein and sulfur-containing organic matter
Particulate matter	Feed, bedding materials, dry manure, animal dander

CAFOs and Water Quality in NC

- Investigated microbial water quality in surface waters near hog CAFOs in NC
- Collected water samples from up- and downstream sites near CAFO spray fields (land application of waste)
- Results suggested ↑ CAFO density, ↓ sanitary quality of surface waters
- Out of 187 samples tested, the following exceeded state and federal recreational guidelines:
 - 40% for fecal coliforms
 - 23% for *E. coli*
 - 61% for *Enterococcus*



What's in your Water?

PETROLEUM PRODUCTS

Microbes

Perchlorate

PESTICIDES

PCBs

Algal Blooms

PFAPs

Mercury

Arsenic

Micro-Plastics

Bacteria

Disinfection Byproducts

PFAS (PFOS/PFOA)

LEAD

TRICHLOROETHYLENE



Water Pollution



Fertilizers and pesticides from agricultural runoff



Sewage and food processing waste

Increased discharge of minerals and nutrients (eutrophication)



Arsenic, lead, mercury, and other heavy metals

Chemicals from industrial processes or hazardous waste sites



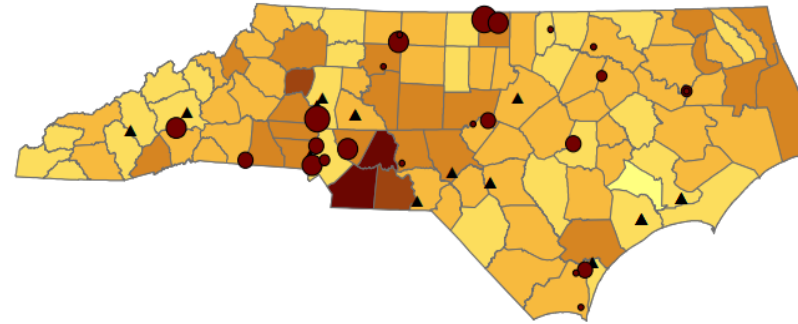
Impacts surface, ground and drinking water sources



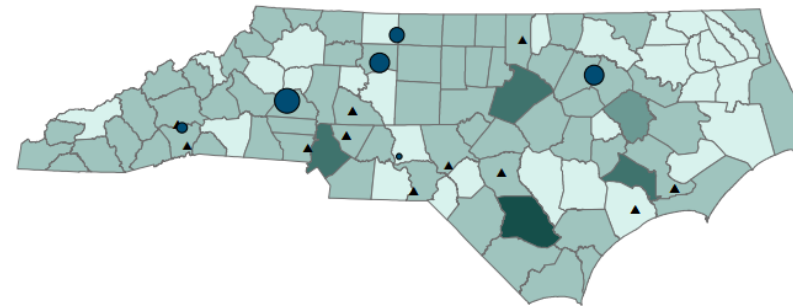
Well Water and Health in NC

- Millions of people in NC obtain drinking water from private wells, many of which contain contaminants such as arsenic
- Arsenic exposure has been linked to cancer, heart disease, and neurological disorders
- Over an 11-year period, 44% of wells tested statewide exceeded the EPA drinking water standard for arsenic
- Found elevated levels of arsenic in well systems for several counties, particularly those along the Carolina slate belt

Concentration of **arsenic** detected in NC private well water ($\mu\text{g/L}$), average 1998-2010



Concentration of **cadmium** detected in NC private well water ($\mu\text{g/L}$), average 1998-2010



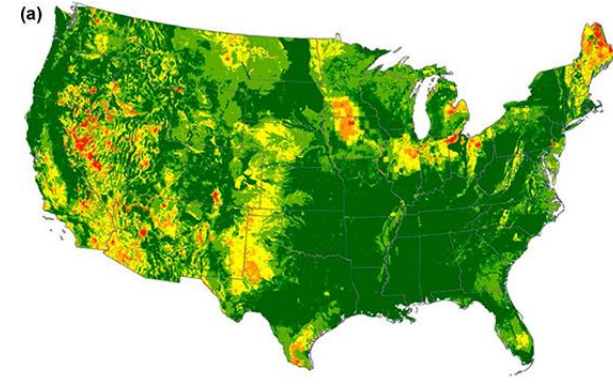
[NCDHHS, Well Water & Health, Maps by Contaminant Name](#)

Well Water Contaminants and Birth Defects in NC

- Fry and colleagues (UNC) examined the association between metals in private wells and specific birth defects
- Examined levels of arsenic, cadmium, manganese, and lead in private wells across NC
- Elevated manganese levels were significantly associated with higher prevalence of conotruncal heart defects



Arsenic



- Developmental low-level arsenic exposure in mice identified *sex-specific* epigenetic changes in the brain that persist in adulthood (HATs-male mice; **HDACs-female mice**) (Tyler et al. 2015)
- Low-level maternal arsenic exposure in drinking water and diet linked to **decreased head circumference** at birth and *sex-specific* effects suggest **females** born to exposed mothers are more likely to have **decreased birth weight** (Gilbert-Diamond et al. 2016)
- Arsenic-exposed Bangladeshi adults were found to have gene expression profiles that indicate arsenic may be an **endocrine disruptor** (Muñoz et al. 2015)
- U.S. Federal **drinking water regulations** helped decrease toxic exposure (17% decline in urinary arsenic levels) and protect human health (Nigra et al. 2017, Landrigan 2017, Ayotte et al. 2017)

Well-Water Arsenic Linked to Decreased IQ in Maine Children

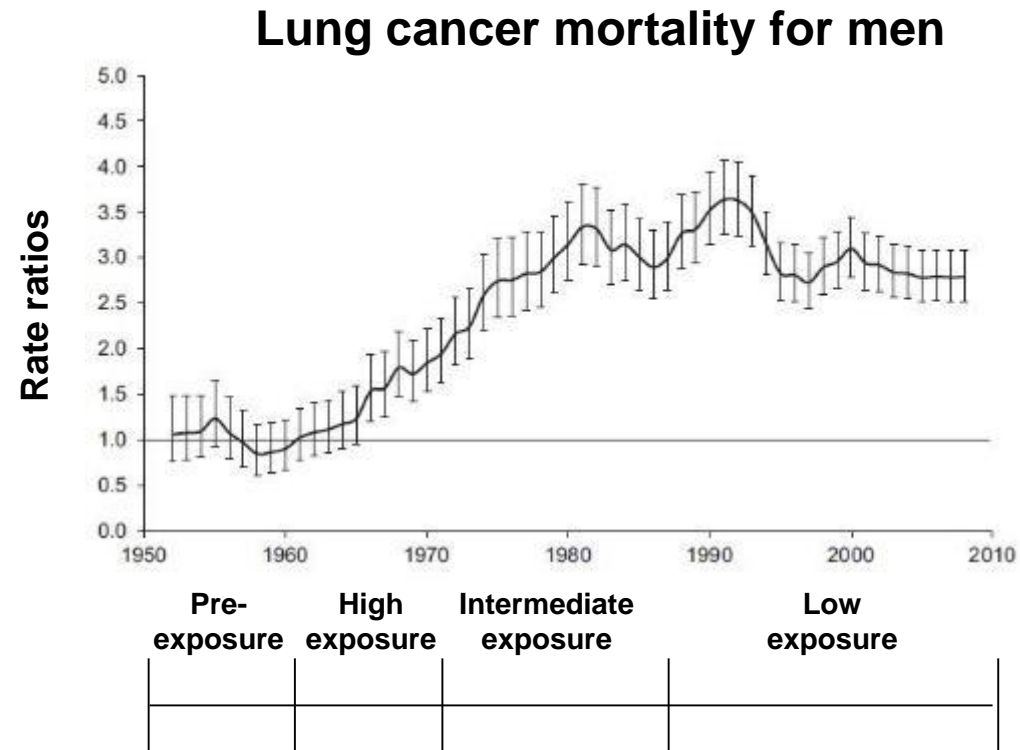
- Children with higher arsenic exposure showed reductions of 5-6 IQ points
- Arsenic in drinking water ≥ 5 ppb could pose a threat to child development



N= 272 children in grades 3-5

Cancer Mortality After Arsenic Exposure Reduction

- High drinking water arsenic exposures (600 µg/L)
- Lung, bladder, and kidney cancer mortality were elevated 40 years after exposure reduction
- Arsenic may have one of the longest human cancer latencies



Fish Consumption Advisories in NC

- Issued to protect young children, pregnant or nursing women, and other at risk-populations from eating fish that could harm their health
- Statewide and site-specific advisories for different pollutants, including mercury, polychlorinated biphenyls, and others
- Research shows that prenatal and early childhood exposure to these chemicals may impair child neurodevelopment and behavior



Eat Fish, Choose Wisely
A Family Guide to Eating Locally-Caught Fish in the Triangle

Brier Creek, Little Brier Creek, and Brier Creek Reservoir
Do not eat ANY fish from here.

Lake Crabtree and Crabtree Creek Below Dam

Catfish and Carp: Never eat from here.	Largemouth Bass: Children and women ages 15 to 44 should never eat this from any location in North Carolina. Everyone else can eat 1 serving per month from this location.	Most* other fish: Eat up to 1 serving per month.

NOTE: Lake Crabtree County Park enforces a catch-and-release only policy from these waters

Crabtree Creek

Other Locations on the Map

***Statewide and Regional: Mercury**

Project of the NIEHS-funded UNC Chapel Hill Superfund Research Program (SRP) Center

“Eat Fish, Choose Wisely,” a family-friendly guide to eating locally-caught fish in the Triangle area

<http://eatfishwisely.org/guide/>

PFAS Concerns and Health Effects

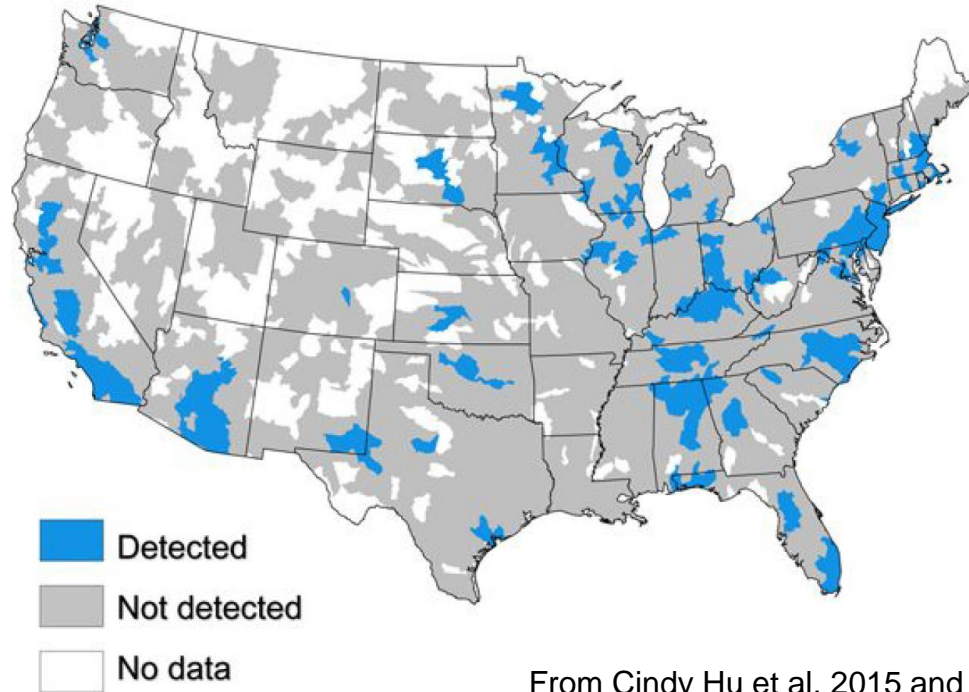
- Per- and polyfluorinated chemicals, collectively known as PFAS, are used in a variety of industrial and consumer products
- Highly persistent in the environment – recent discoveries in drinking water supplies in north and southeast states
- Exposure has been linked with adverse effects on the immune and endocrine system, neurodevelopment, and cancer



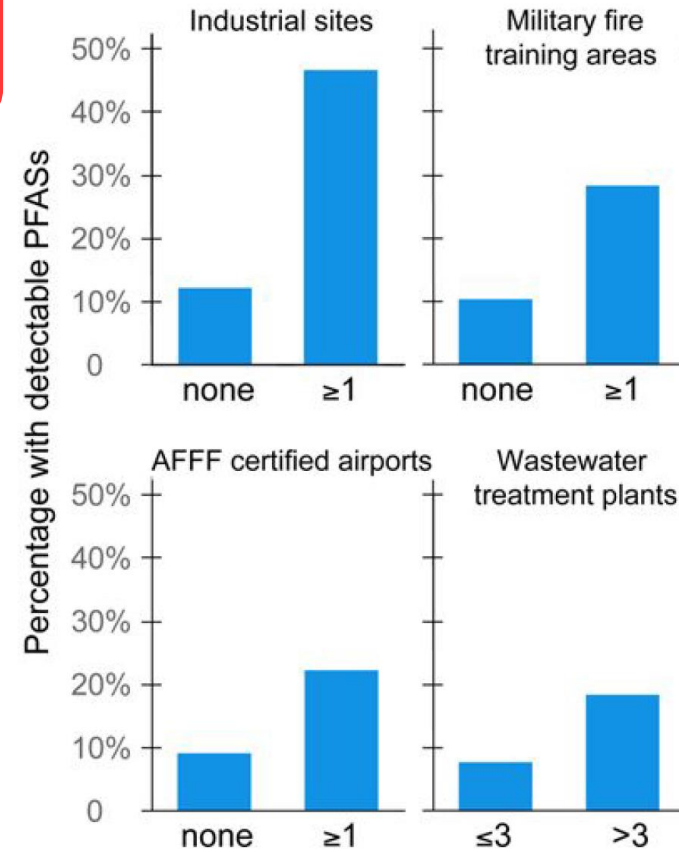
PFAS are widely used to make products more resistant to stains, grease, and water. NIEHS funds several grants focused on PFAS exposure and health outcomes.

Watersheds with point sources have higher detection frequencies for PFASs

More than 1,500 drinking water systems serving up to 110 million Americans may be contaminated



From Cindy Hu et al, 2015 and EWG and SSEHRI at Northeastern Univ. 2018



Cindy Hu et al, ES&T Letters, 2016

PFAS Concerns and Next Steps in NC

- In early 2017, GenX was detected in NC Cape Fear River – raised statewide concerns
- NIEHS Time Sensitive Awards - Hoppin
- NC researchers gathered at Duke for a symposium focused on PFAS monitoring in September 2018
- NC Policy Collaboratory received \$5 million to fund multi-university collaboration called the Per- and Polyfluoroalkyl Substance Testing (PFAST) Network
- Researchers will study PFAS contamination and its effects in North Carolina



NIEHS grantee Jason Surratt, Ph.D., is director of the PFAST Network

Community Engagement and Research Translation

NC State GenX Exposure Study

- Results of tap water analysis were mailed to study participants
- The research team hosted a community meeting to present the initial water results of the GenX Exposure Study
 - GenX not found in blood even though it was present in tap water
 - Found four new PFAS chemicals
 - Levels of historically-used PFAS were higher in Wilmington than the U.S. average



NTP REACT PFAS Project

- **Responsive Evaluation and Assessment of Chemical Toxicity (REACT) PFAS Project**
 - REACT is a general approach that the NTP is developing to address environmental and public health challenges.
 - Collaboration with EPA
 - Involves literature mining, computational, *in vitro* (cell) and *in vivo* (animal) toxicological methods
 - Enables “class” of chemicals to be screened for wide range of biological effects
 - Being applied to PFAS given there are too many chemicals in the class to research using traditional approaches
 - Screening >100 representative PFAS
 - Helps to focus future research

Coal Ash and Water Quality in NC

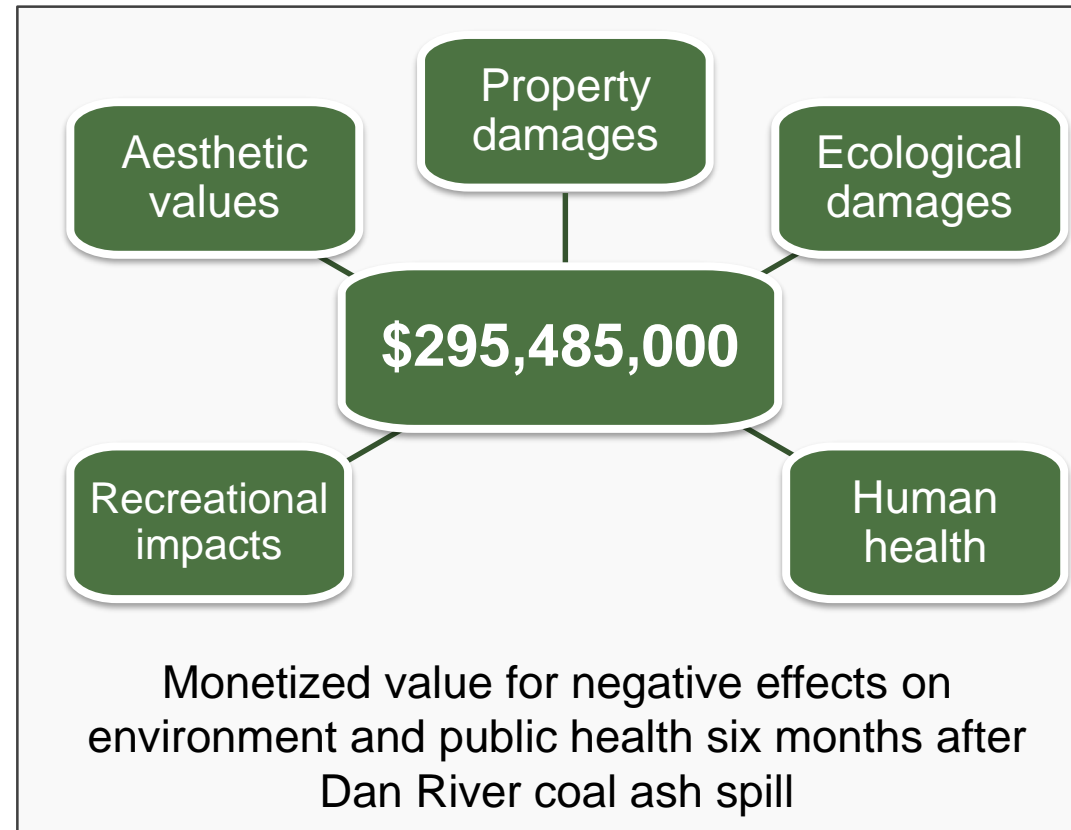
- Power plants burn coal for energy and resulting waste is coal ash, which is often stored in open landfills or ponds
- Fly ash, a primary component of coal ash, contains Metals, PAHs, and other toxic chemicals
- 2014 Dan River coal ash spill – 3rd largest coal ash spill ever recorded in the nation
- Poses long-term, harmful impacts for environment and public health



In February 2014, **more than 50,000 tons of coal ash** spilled into the **Dan River at Eden, NC** following the collapse of two stormwater drain pipes

Coal Ash and Economic Costs in NC

- Economic cost analysis of damages associated with Dan River coal ash spill
- Assessment performed six months after spill – included environmental and public health impacts
- Concluded pressing need to discontinue surface impoundment disposal of coal ash



Coal Ash and Health Impacts

- Assessed parents' perceptions on health of children living near coal ash storage facility in Kentucky (*Zierold and Sears, J Community Health, 2015*)
- Determined that parents felt strongly about coal ash and its effects on health and well-being of children
- Follow-up study showed that prevalence of ADHD, GI issues, and sleep problems were significantly greater in children living near coal ash (*Sears and Zierold, Glob Pediatr Health, 2017*)



NIEHS grantee Kristina Zierold, Ph.D., studies effects of coal ash on neurobehavior in children ages 6-14 years

UAB SCHOOL OF
PUBLIC HEALTH
The University of Alabama at Birmingham



Concerns with Coal Ash After Hurricane Florence

- Coal ash issues re-emerge in NC following Hurricane Florence
- Record-breaking flooding leads to breach of dam
- Release of coal ash from unlined coal ash ponds into Cape Fear River
- Further demonstrates hazards of coal ash disposal close to waterways

Forbes

Hurricane Florence Brings The Issue Of Coal Ash Back To The Surface

The New York Times

Florence's Floodwaters Breach Defenses at Duke Energy Plant, Sending Toxic Coal Ash Into River

NIEHS Community Has Been Involved in Many Disasters



Disasters: Potential Exposures and Health Impacts



Infectious Agents

Stray pets, wild animals, insects



Toxic or Foreign Substances

Asbestos, dust, lead, mold, silica



Heat

Dehydration, heat stress



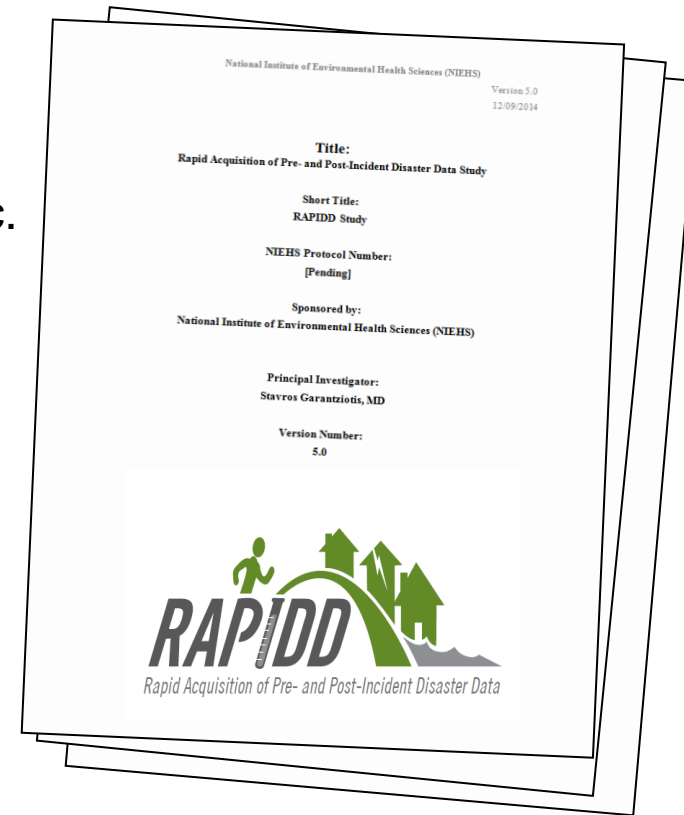
Mental Health

Stress, post-traumatic effects

Building Capacity for Researchers to Respond

The Rapid Acquisition of Pre-and Post Incident Disaster Data (RAPIDD)

- Generic Disaster Research Protocol
 - Survey tools, medical testing, consent forms, etc.
- Can be modified to fit the situation as needed
- Focus of 1st RAPIDD on workers, efforts underway for a community protocol
- NIEHS IRB pre-reviewed (May 2015)
 - Similar protocols developed by Universities
 - University of Iowa
 - University of Texas, Medical Branch



DR2 Success Stories: Research Post-Disaster

Collaborations

- Texas A&M University
- Oregon State University
- Rice University
- University of Texas
 - Houston
 - Austin
 - Medical Branch, Galveston
- Baylor University
- UNC Chapel Hill
- New York University
- Mount Sinai
- Local County Health Departments

Environmental Testing

- Testing of floodwater
 - Microbial contamination
 - Chemicals and heavy metals
- Testing of sediments and soils



Cohort Studies (communities and workers)

- Health and mental health surveys
- Wrist band samples
- Home evaluations



NIEHS Worker Training Program (WTP)

- Workers, volunteers, and homeowners deal with aftermath of disasters during recovery and clean-up
- WTP offers **HazMat Disaster Preparedness Training** to protect workers and communities on how to avoid exposure to toxins and hazardous materials following disasters
- WTP has offered awareness training following many recent disasters

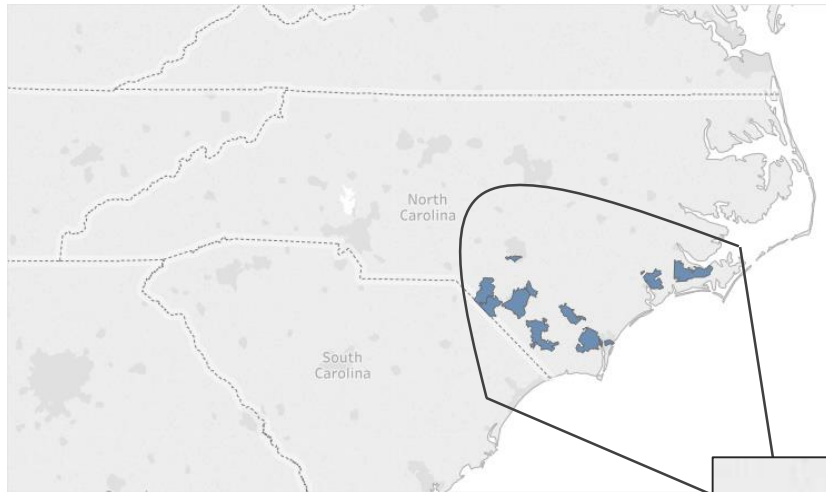
– Wildfires (2017, 2018)

– Hurricanes Harvey, Irma, and Maria (2017)

– Hurricane Florence (2018)

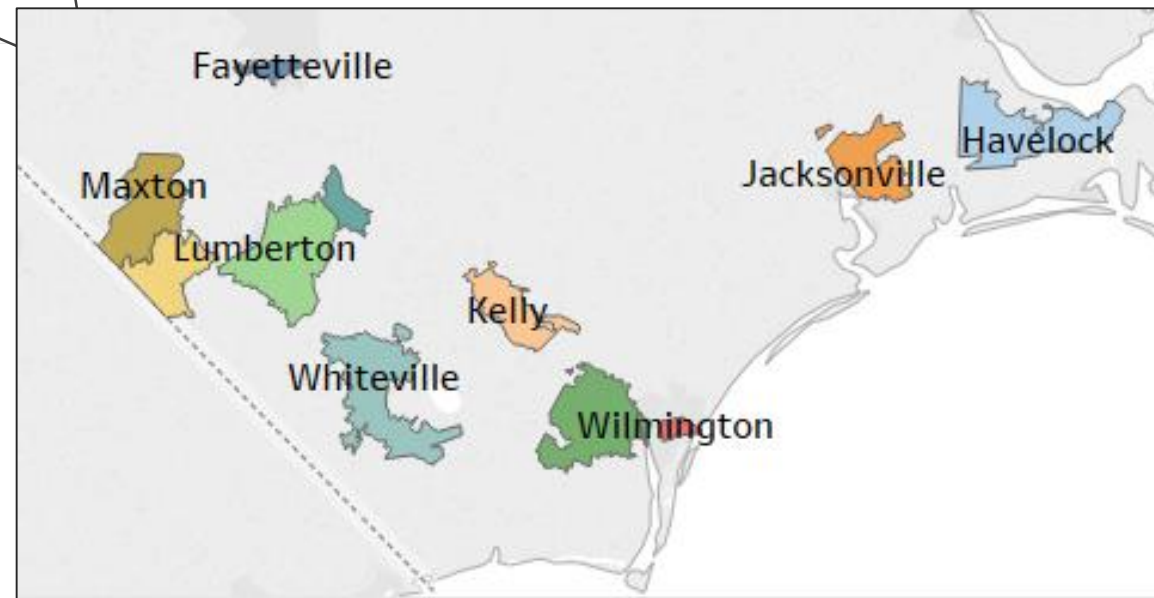
– Hurricane Matthew (2016)

WTP Success Story: Safety Training Post-Florence



- | | |
|--------------|------------|
| Fayetteville | Lumberton |
| Havelock | Maxton |
| Jacksonville | Rowland |
| Kelly | Tarheel |
| Leland | Whiteville |
| | Wilmington |

- NC cities where WTP **training was conducted** and **materials shared** following Hurricane Florence
- **Mold awareness and clean-up** were topics of priority



*Preliminary summary of training data shared Sept.-Oct. 2018

NIEHS Has a Wide Range of Experts Here in NC



NIEHS Clinical Research Unit

- 37 Current Active Studies Including:
 - E-Cigarettes
 - Myositis
 - Adolescent Obesity
 - Healthy Homes
 - Inflammation
 - Asthma
 - Fibroids, PCOS



NIEHS Engages Communities in Research

- Builds mutual trust between researchers and communities
- Improves research designs
- Promotes research to public health action
- Builds capacity to sustain project outcomes



Land, soil, and sediment...

ARSENIC
Mercury
DUST
Bacteria
Copper
PESTICIDES
Chromium
 Bioaccumulation
Metals
Fertilizer
Polycyclic Aromatic Hydrocarbons
Dioxin
 Polychlorinated biphenyls (PCB)



NIEHS is a Great Resource for Healthy NC!

- NC faces a range of environmental health issues
- NIEHS brings ~ \$250M annually in economic benefit to the Triangle
- NIEHS funds researchers across the state who have a broad range of environmental health expertise
- Community engagement cores at NIEHS-funded centers function as the outreach arm to translate findings and educate communities
- NIEHS Partnerships for Environmental Public Health (PEPH) program is a great way to stay connected





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THANK YOU!

<http://www.niehs.nih.gov>

Please come visit!





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Additional Slides

NIEHS Partnerships for Environmental Public Health (PEPH)

- Network of scientists, public health professionals, community members, educators, and other stakeholders
- Increase impact of environmental public health research at the local, regional, and national level
- Offers many ways to stay connected:
 - Events
 - Newsletter
 - Podcasts
 - Webinars

PEPH Key Principles

- Engage diverse communities
- Respond to current issues
- Focus on prevention
- Foster unified, integrated, and synergistic activities
- Support research to improve theories, methods, and practice
- Share the value of scientific advances and translational efforts
- Promote research into action



NC Policy Collaboratory

- Responding to uncertainty of PFAS in drinking water, the NC Policy Collaboratory received \$5 million
- Funding for multi-university collaboration called the Per- and Polyfluoroalkyl Substance Testing (PFAST) Network
- Researchers will study PFAS contamination and its effects in North Carolina
- Aim to help policymakers and the public better understand PFAS exposure



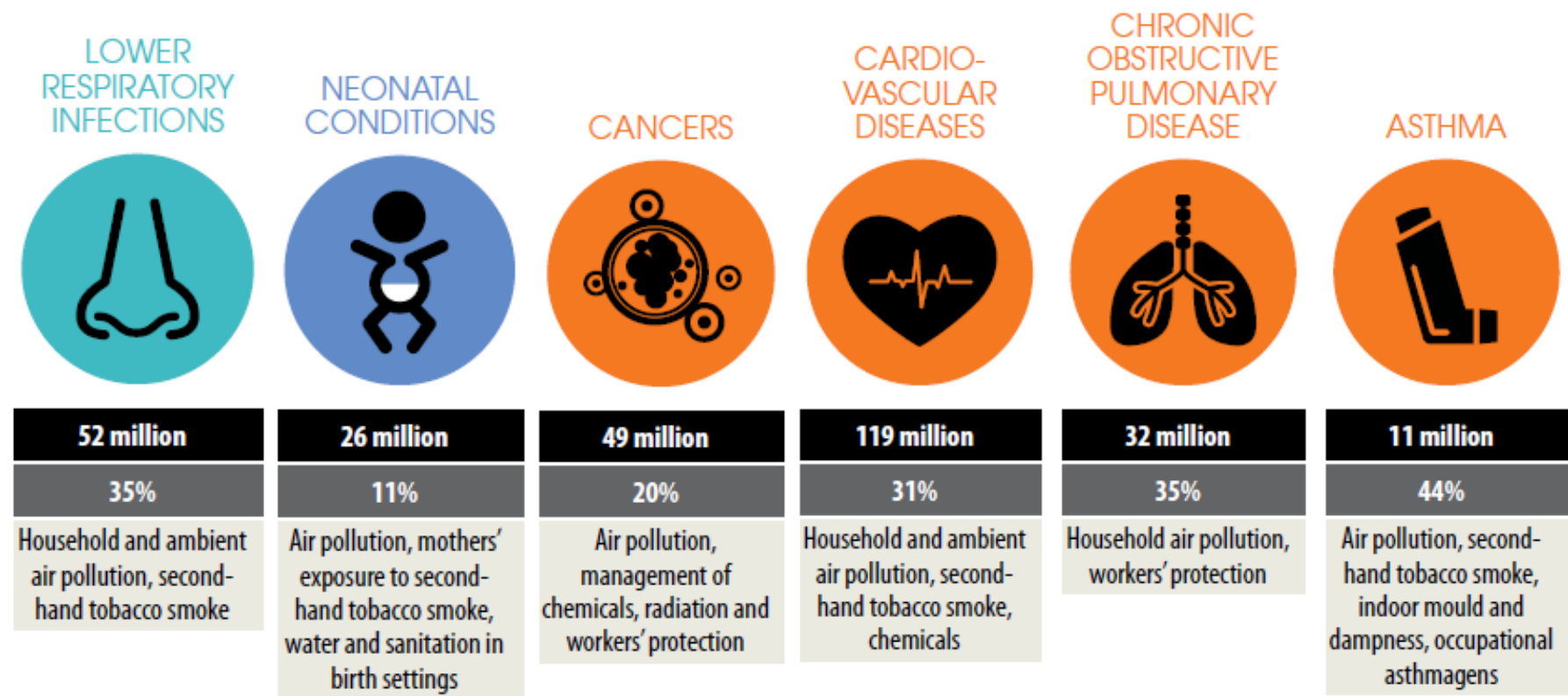
NIEHS grantee Jason Surratt, Ph.D., is director of the PFAST Network

Mountain Top Removal Mining and Air Quality

- Primary method for coal extraction in surface mines in the Central Appalachia region
- Blasting off top layer of mountain to expose underlying coal seam
- Nearby communities potentially exposed to airborne chemicals and dust



Diseases with Highest Preventable Burden from Environmental Risks — A Focus on Air Pollution



- DALYs due to preventable environmental risks
- Proportion of disease attributable to the environment
- Main areas of environmental action to prevent disease

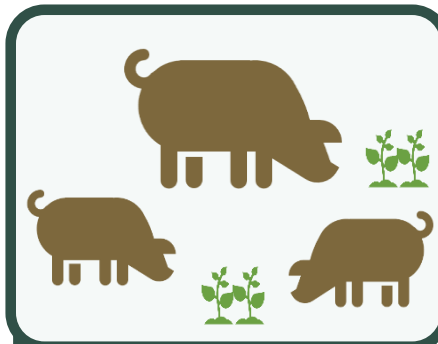
Examples of Rural and Urban Air Pollution



**Traffic-related
 air pollution
 (TRAP)** and
 other sources
 near major
 roadways



**Smoke from
 wildfires** in
 urban areas of
 California



Emissions from
**concentrated
 animal feeding
 operations
 (CAFOs)** in rural
 areas of North
 Carolina



Emissions from
**industrial
 plants and
 operations**

“The knowledge that is generated through well-designed, effectively executed research in anticipation of, in the midst of, and after an emergency is critical to our future capacity to better achieve the overarching goals of preparedness and response: preventing injury, illness, disability, and death and supporting recovery.”

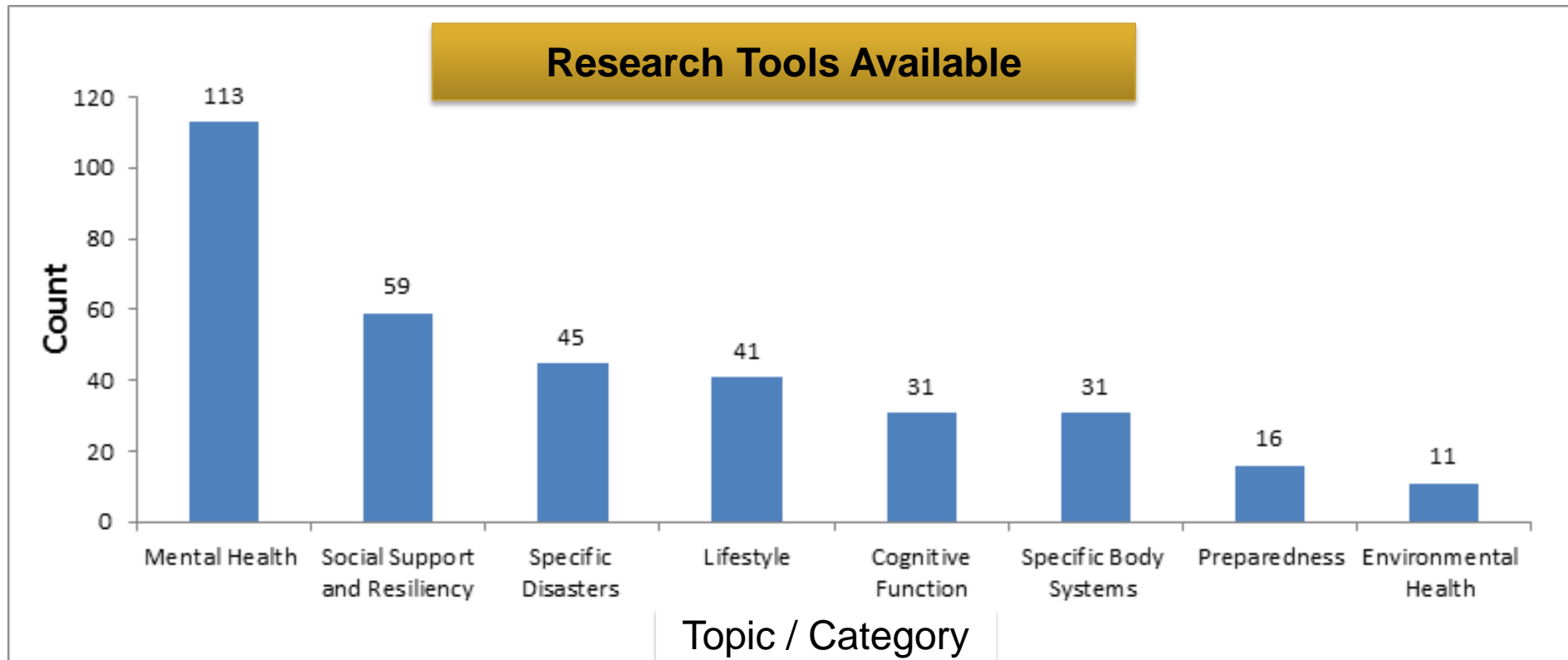


Lurie, Manolio, Patterson, Collins, & Frieden. *New England Journal of Medicine*. 368; Mar 2013

Building Capacity for Researchers to Respond

Repository of Surveys, Questionnaires, Protocols, Guidance, Consent Forms, etc.

- 300+ new tools to help start early baselines and identified research





NIH Disaster Research Response Website

Tools & Resources

Protocols

Networks

Collaborations & Projects

News & Events

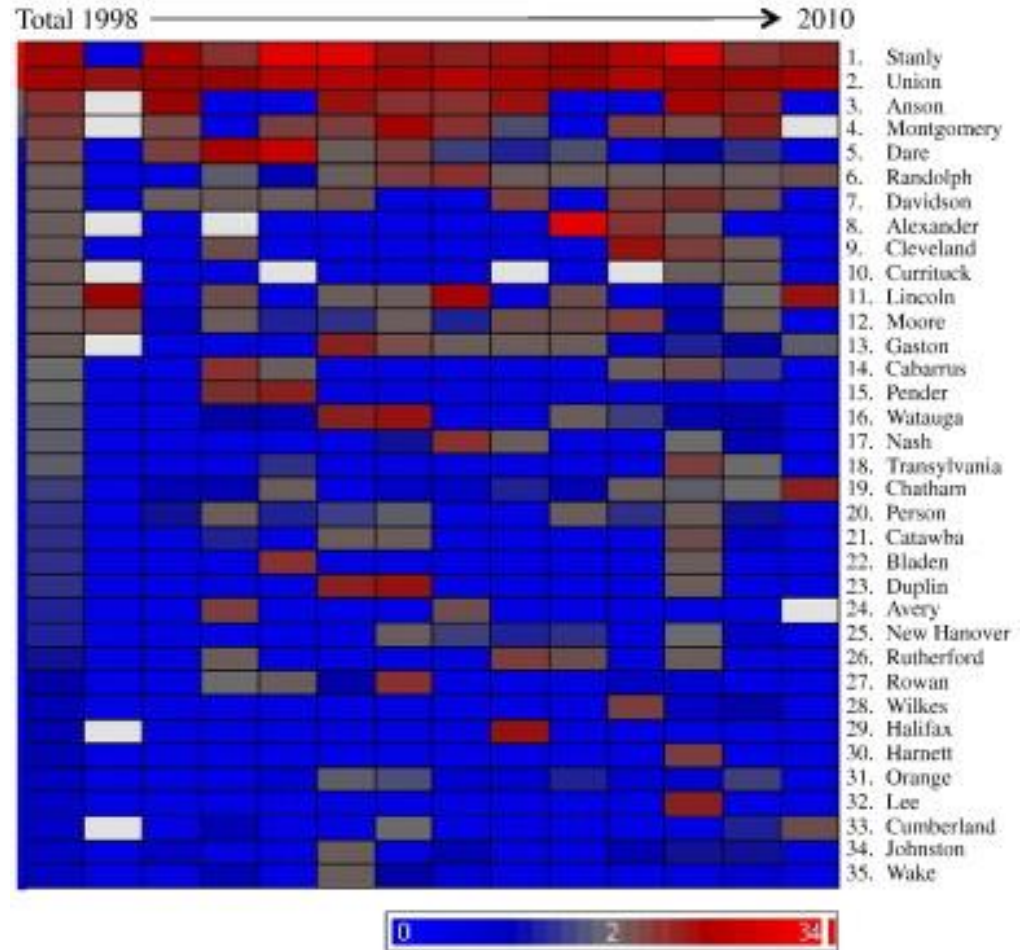
Funding Opportunities

Training & Exercises

<http://dr2.nlm.nih.gov>

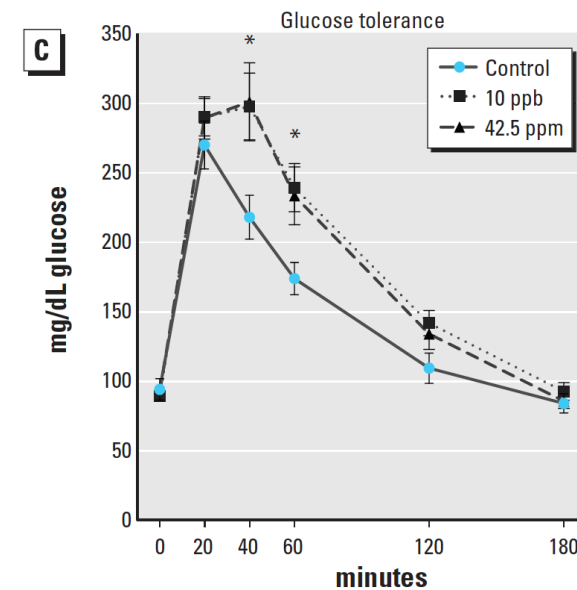
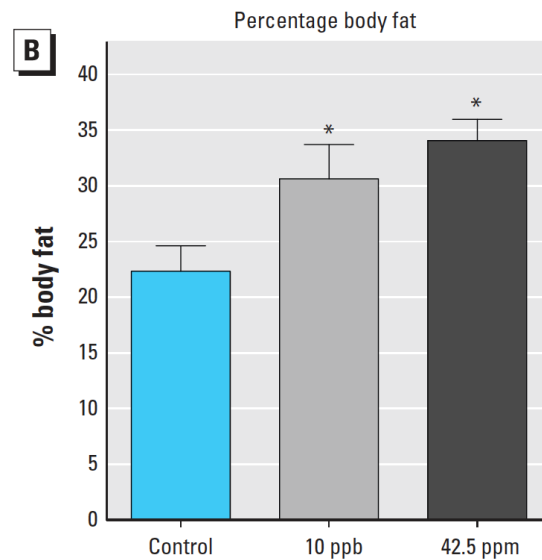
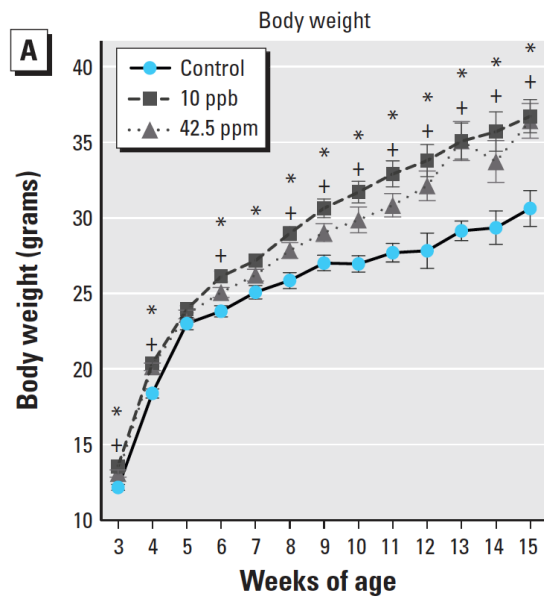
Arsenic in Well Water

- Arsenic exposure has been linked to cancer, heart disease, and neurological disorders
- Researchers evaluated arsenic levels in NC domestic well systems over an 11-year period
- 44 percent of wells tested statewide exceeded the EPA drinking water standard for arsenic
- Found elevated levels of arsenic in well systems for several counties, particularly those along the Carolina slate belt



The top thirty-five counties that exceed the EPA standard (10 µg/L)

In Utero Arsenic and Weight Gain in CD-1 Female Offspring



4.5 mo

10ppb=drinking water standard
42.5ppm cancer causing dose

Fish Consumption Advisories in NC

- Researchers developed “Eat Fish, Choose Wisely,” a family-friendly guide to eating locally-caught fish in the Triangle area
- Color-coded map with tabs to view recommended fish consumption for locations

Eat Fish, Choose Wisely
A Family Guide to Eating Locally-Caught Fish in the Triangle

Brier Creek, Little Brier Creek, and Brier Creek Reservoir
Do not eat ANY fish from here.

Lake Crabtree and Crabtree Creek Below Dam

Catfish and Carp: Never eat from here.

Largemouth Bass: Children and women ages 15 to 44 should never eat this from any location in North Carolina. Everyone else can eat 1 serving per month from this location.

Most* other fish: Eat up to 1 serving per month.

NOTE: Lake Crabtree County Park enforces a catch-and-release only policy from these waters

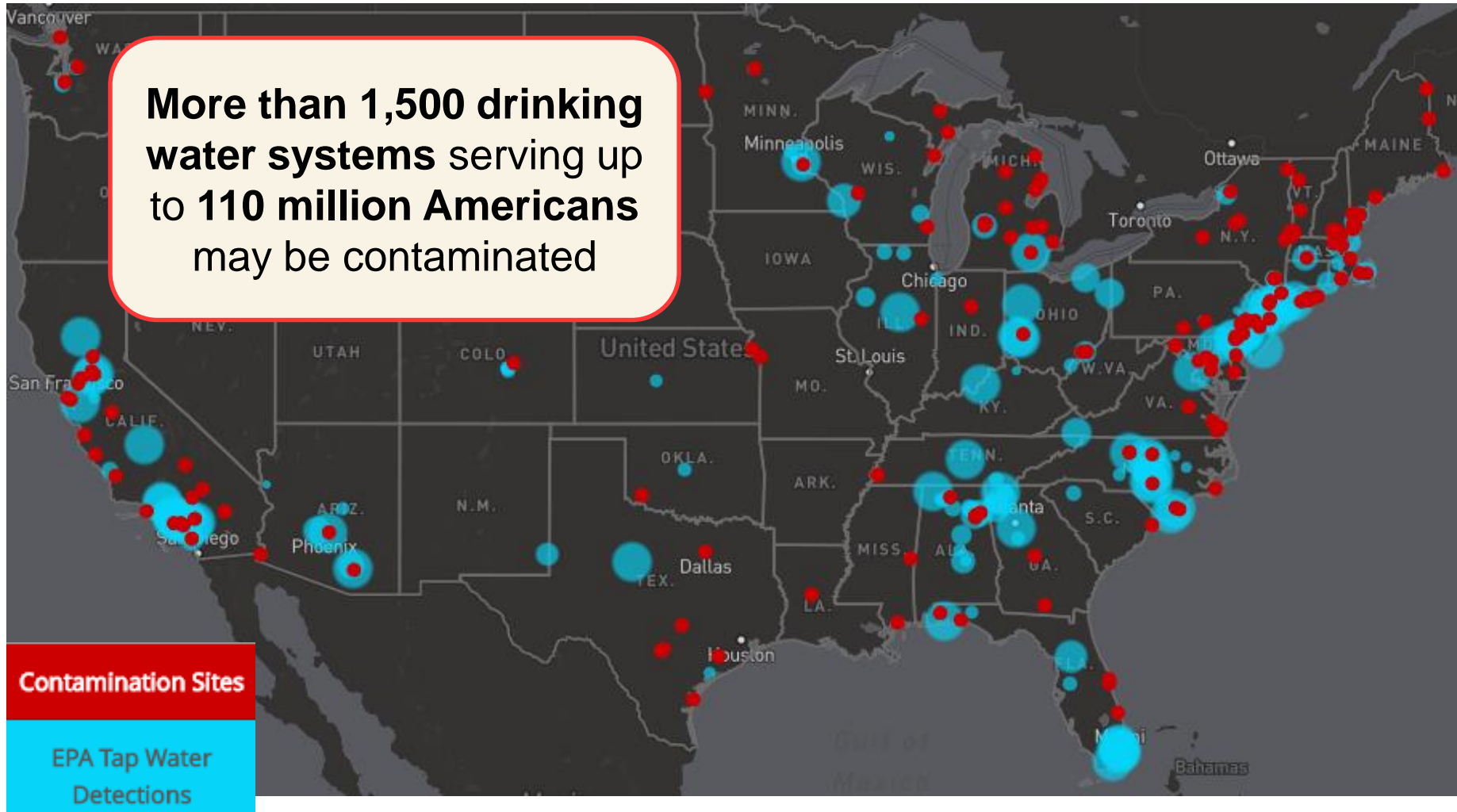
Crabtree Creek

Other Locations on the Map

***Statewide and Regional: Mercury**

Project of the NIEHS-funded UNC Chapel Hill Superfund Research Program (SRP) Center

PFAS is a National Issue



NIH Disaster Research and Response (DR2) Program

Improve disaster responses, reduce health impacts, and prevent future harm through:

- Timely and integrated collection of health and environmental **data**
- Creating a **national network** of transdisciplinary researchers
- **Broad inclusion** of public health, academia, and community stakeholders
- **Training researchers** on data collection, questionnaires, protocols, guidance, and safety issues

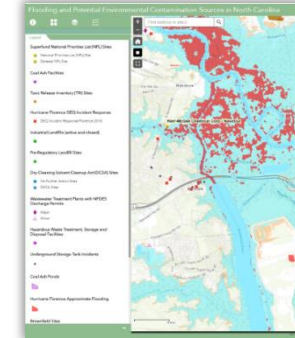
DR2 Framework



Community Engagement and Research Translation

Duke University SRP Center

- Community Gardens Project
 - Soil testing
 - Sharing information
- Website to address community concerns after hurricane
 - Health risks and post-hurricane action steps
 - Map database tool
- Fish Consumption
 - Survey
 - Community training
 - Sharing information



Community Engagement and Research Translation

Duke University SRP Center

Other Community Outreach and Engagement Efforts:

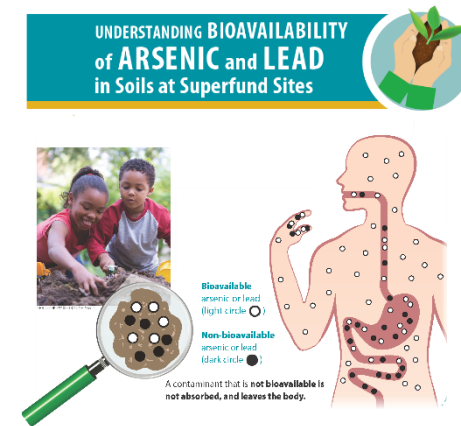
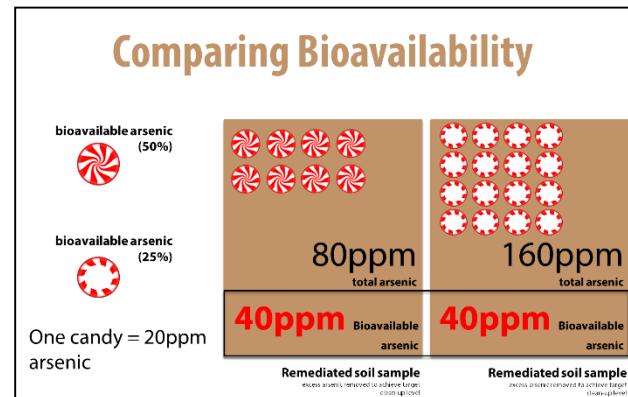
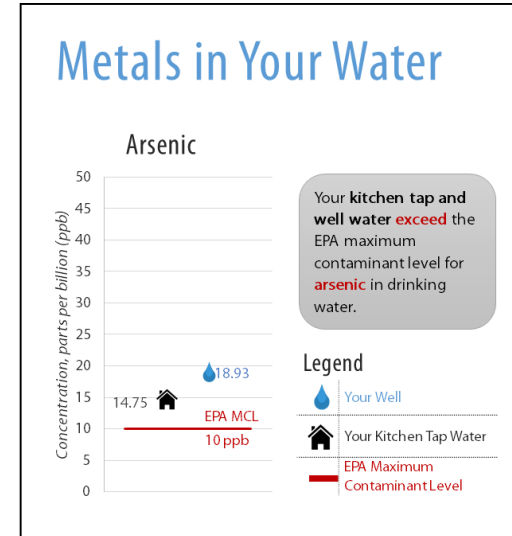
- Think Blue: Healthy Water Healthy You
- PFAS symposium
- Science + Policy Institute



Community Engagement and Research Translation

UNC Chapel Hill SRP Center

- Well Empowered
 - Well water and soil sampling
 - Community report-back
- Bioavailability of metals in soil (Collaboration with University of Arizona and EPA)
 - Hands-on educational kits
 - Factsheet



Community Engagement and Research Translation

UNC Chapel Hill SRP Center

Other Community Outreach and Engagement Activities:

- Science Expo
- Sharing fish consumption advisory information
- Tarheel Tox Talk Science Cafes

