



THE
Water
Research
FOUNDATION®



Water for All Summit

Peter Grevatt, PhD – Chief Executive Officer









Source: www.nytimes.com



Cuyahoga River Fire

Nov. 3, 1952

Cleveland Press Collection at
Cleveland State University Library



Source: <https://pixels.com/featured/cleveland-skyline-reflecting-on-the-cuyahoga-river-denis-tangney-jr.html>

Typhoid Mortality Rates: New York City

“Typhoid Mary” (foreground) in a hospital bed during her first quarantine



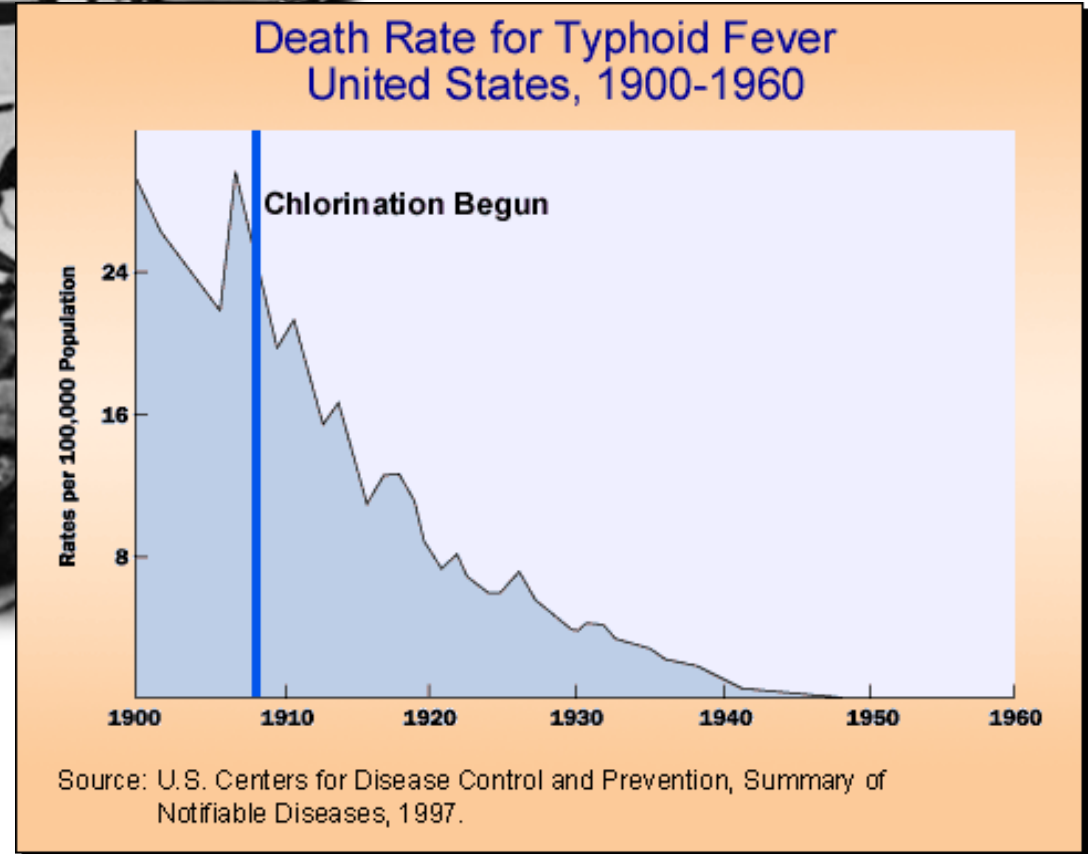
1870 Typhoid

39.3/100,000

1910 Chlorination begins in NYC

1930 Typhoid

1/100,000

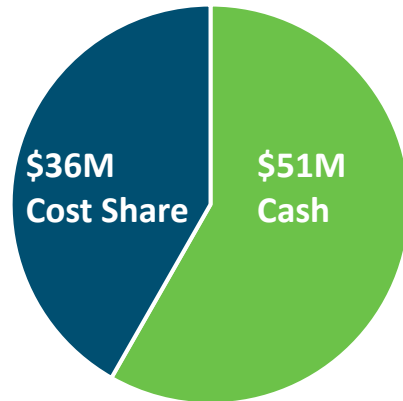


Funded Research

\$87M

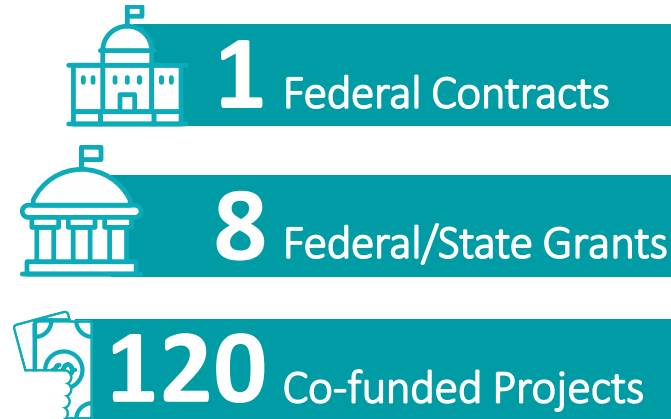
Contractually Funded Research

Managed by 53 Staff



333
Co-funders

Research Portfolio




Subscribers

1044 UTILITIES

90 CONSULTANTS

39 MANUFACTURERS

Research Programs

Research Priority

Tailored Collaboration

Emerging Opportunities

Unsolicited Research

Grants/Awards

Facilitated Research

Paul L. Busch Award

230

Average Contracts/Year

19

Ave. Contracts in Process/Month

100

Payments/Month

15*

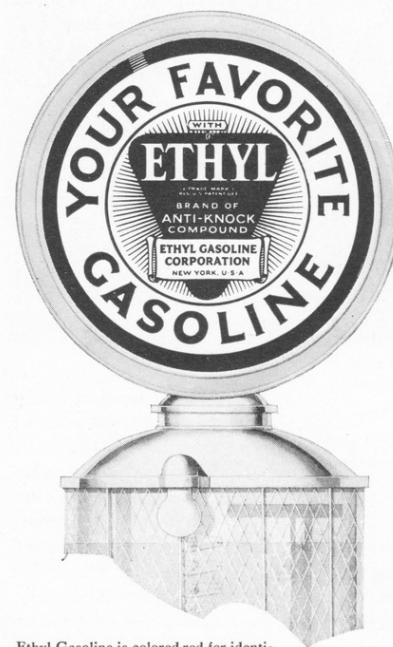
Reimbursements Per Month

*not typical



Less than a
teaspoonful
to the gallon

but what a difference ETHYL makes!



Ethyl Gasoline is colored red for identification but not all red gasolines contain ETHYL, whose active ingredient is tetraethyl lead. It takes more than dye to make an "anti-knock" (high compression) fuel.

ETHYL is the name of the "anti-knock" compound developed by General Motors Research Laboratories to make motor gasoline more efficient.

Leading oil companies mix it with their gasoline at their refineries to form *Ethyl Gasoline*—the standard high compression fuel.

There is less than a teaspoonful of ETHYL fluid in a gallon of Ethyl Gasoline—but what a difference it makes!

In cars of ordinary compression, ETHYL eliminates that "knock" and power loss as carbon forms—and turns the higher compression created by the carbon deposits into extra power. As for the new high compression cars, ETHYL made them possible!

Ethyl Gasoline is now available throughout the United States and Canada at pumps bearing the ETHYL emblem. Ride with ETHYL today.

ETHYL GASOLINE CORPORATION
25 Broadway, New York City
56 Church St., Toronto, Ont., Can.

**ETHYL
GASOLINE**

Knocks out that "knock"

THE DUTCH BOY'S LEAD PARTY

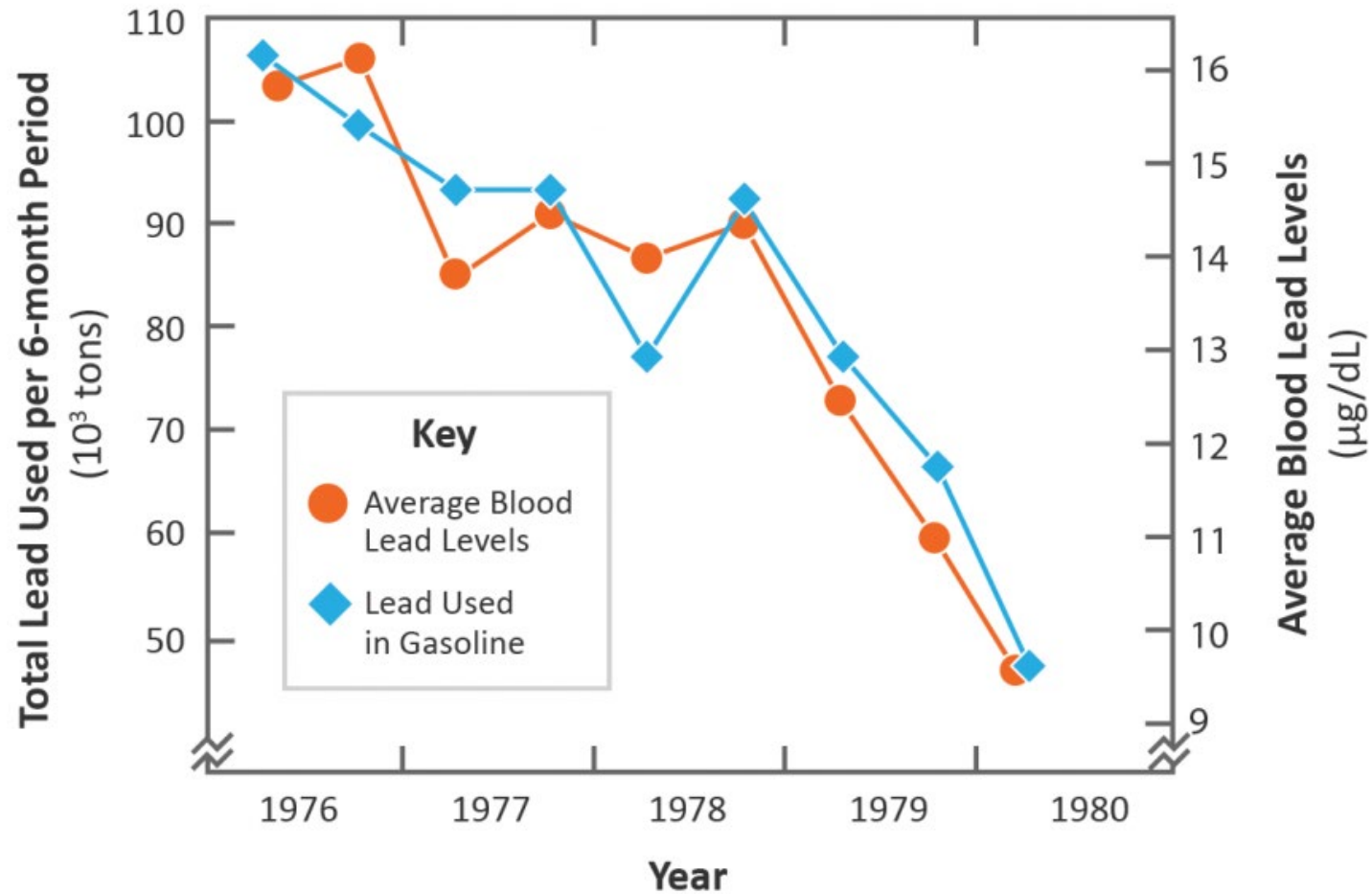


*A Paint Book
for
Girls and Boys*

With which is bound
COLOR HARMONY IN THE HOME
A Booklet for the Grown-ups



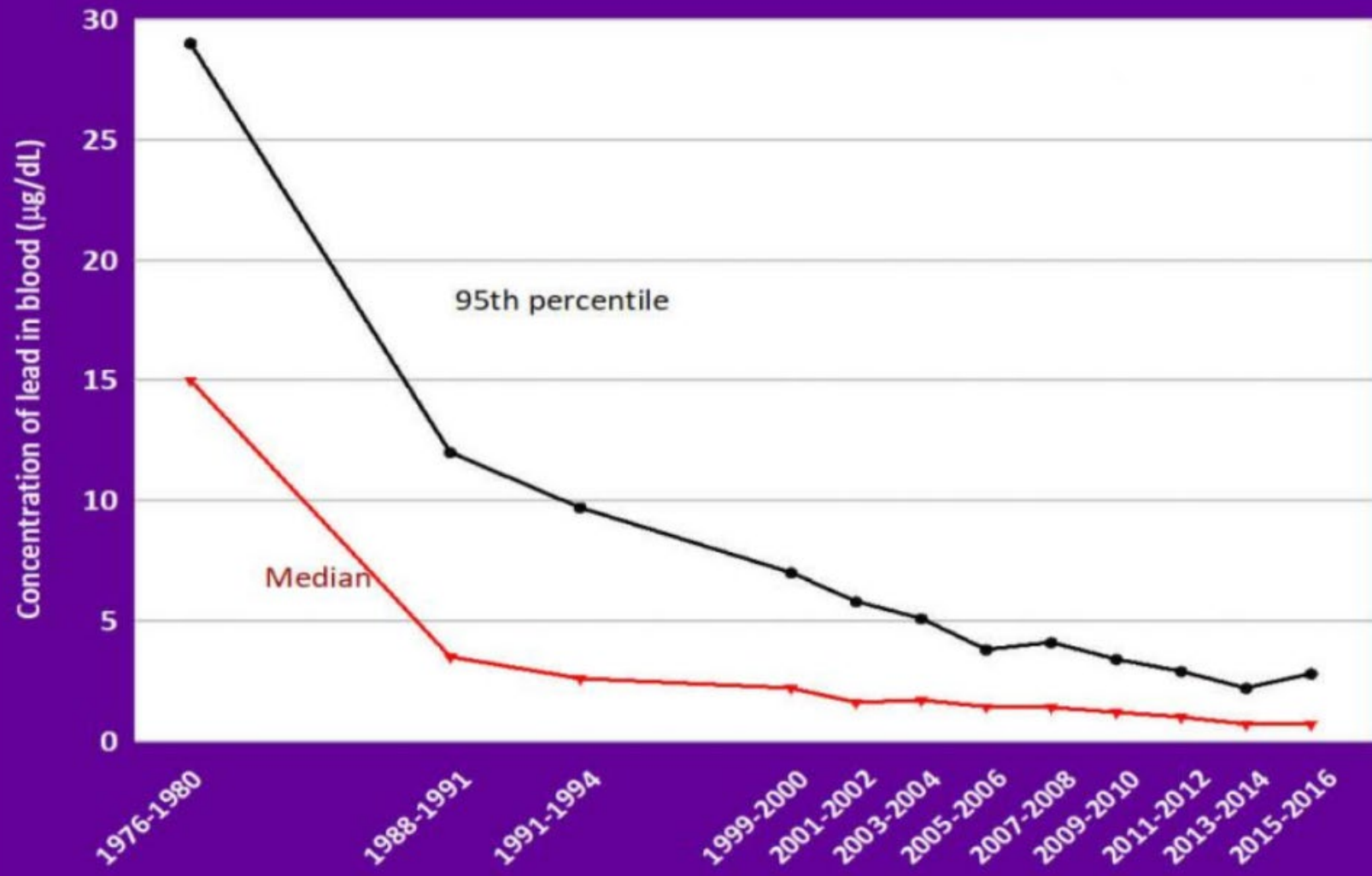
Lead Content in Gasoline and Average Blood Lead Levels



EPA standards led to parallel decreases in lead content of gasoline and blood lead level of the average American.

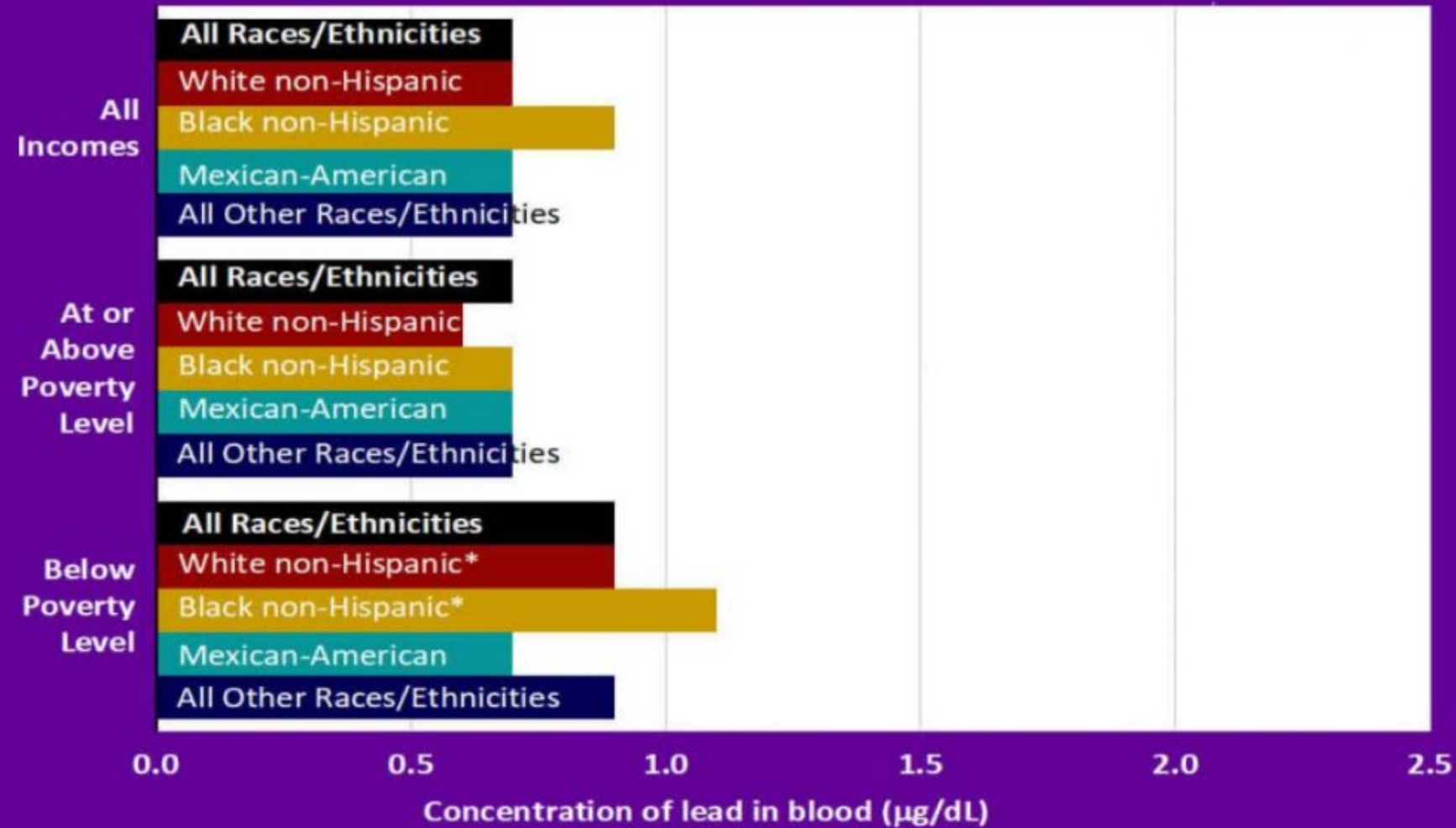
Source: www.epa.gov

Lead in children ages 1 to 5 years: Median and 95th percentile concentrations in blood, 1976-2016

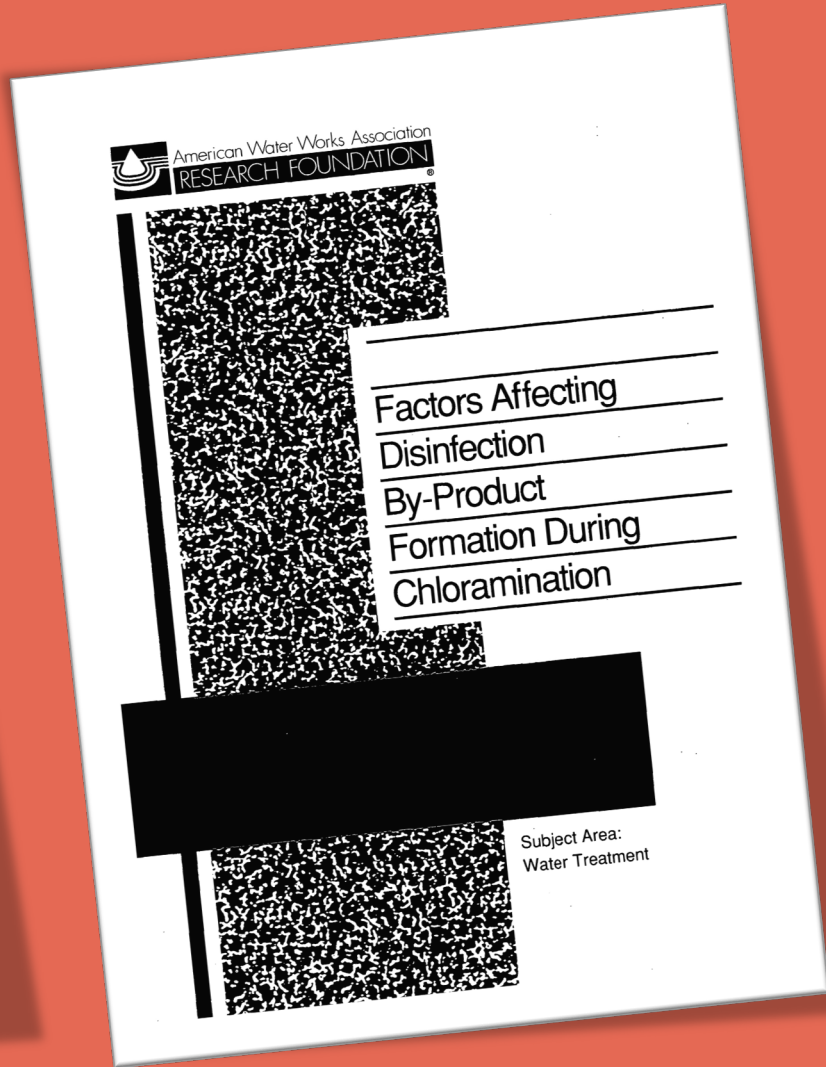
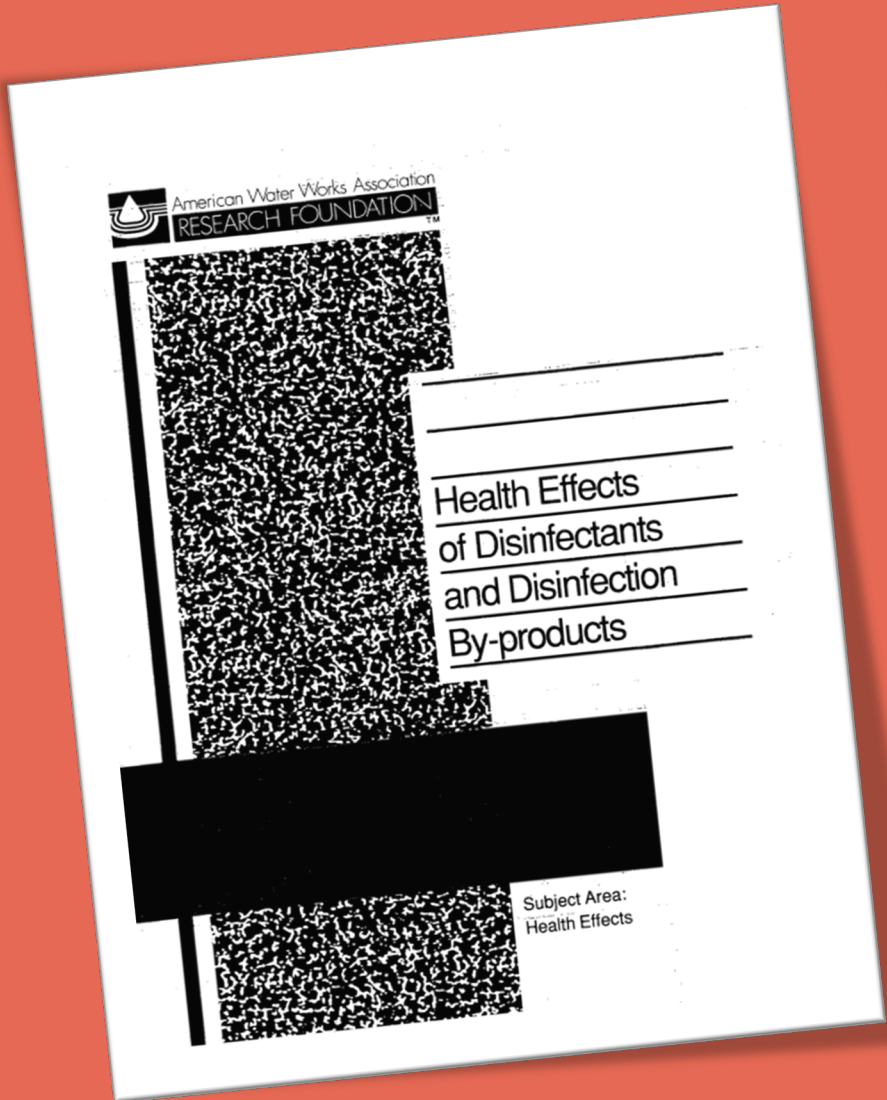


Source: www.blog.epa.gov

Lead in children ages 1 to 5 years: Median concentrations in blood, by race/ethnicity and family income, 2013-2016



1980s



Disinfection
Byproducts
(DBPs)

Radionuclides

1990s

American Water Works Association
RESEARCH FOUNDATION

American Water Works Association
RESEARCH FOUNDATION

Taste and Odor
in Drinking Water
Supplies—Phase III

Subject Area:
Monitoring
and Analysis

Design of
Biological
Processes for
Organics Control

Subject Area:
Water Treatment

AWWA
Research
Foundation
Advancing the Science of Water

Occurrence of MTBE and
VOCs in Drinking Water
Sources of the United States

Tailored Collaboration

Evaluation of
Membrane
Technologies for
Removal of
Atrazine and
Other SOC

AWWA
Research
Foundation

Subject Area:
Water Treatment

VOCs (MTBE)

Taste and Odor
Compounds

Manganese

Herbicides/
Pesticides

Atrazine, Nitrate

2000s



Factors Affecting the Formation of NDMA in Water and Occurrence



Technical Brief: Trace Organic Compounds and Implications for Wastewater Treatment



Water Environment Research Foundation

Collaboration. Innovation. Results.

Wastewater Treatment and Reuse

FINAL REPORT

Fate of Pharmaceuticals and Personal Care Products Through Municipal Wastewater Treatment Processes



NWRI



Water Environment Research Foundation

Collaboration. Innovation. Results.



Wastewater Treatment and Reuse



FINAL REPORT

Removal of Endocrine Disrupting Compounds In Water Reclamation Processes

Co-published by




Arsenic

Perchlorate

Hexavalent Chromium

NDMA,
Pharmaceuticals
EDCs, PCPs

2010s





Water Research Foundation
advancing the science of water

Treatment Mitigation Strategies for Poly- and Perfluoroalkyl Substances

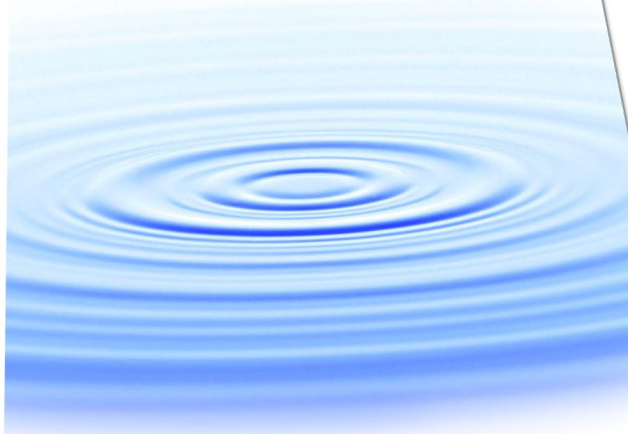
Web Report #4322

Subject Area: Water Quality



WATER REUSE

Formation of Nitrosamines and Perfluoroalkyl Acids During Ozonation in Water Reuse Applications



Water Reuse Research Foundation




Water Research Foundation
advancing the science of water


Impact of Climate Change on the Ecology of Algal Blooms

Web Report #4382

Subject Area: Water Quality



Awwa Research Foundation
Advancing the Science of Water®



Arsenic Water Technology Partnership

Arsenic Removal with Agglomerated Nanoparticle Media

Algal Toxins

PFAS

1,4-Dioxane

2010s

Project #4912

Developing Guidance for Evaluation and Implementation for Control of HABs in Source Water

Research Investment \$537,975 Year Completed 2022



Challenges and Opportunities of Nanomaterials in Drinking Water

Web Report #4311

Subject Area: Water Quality



Water Environment & Reuse Foundation

White Paper – Microplastics in Aquatic Systems

An Assessment of Risk

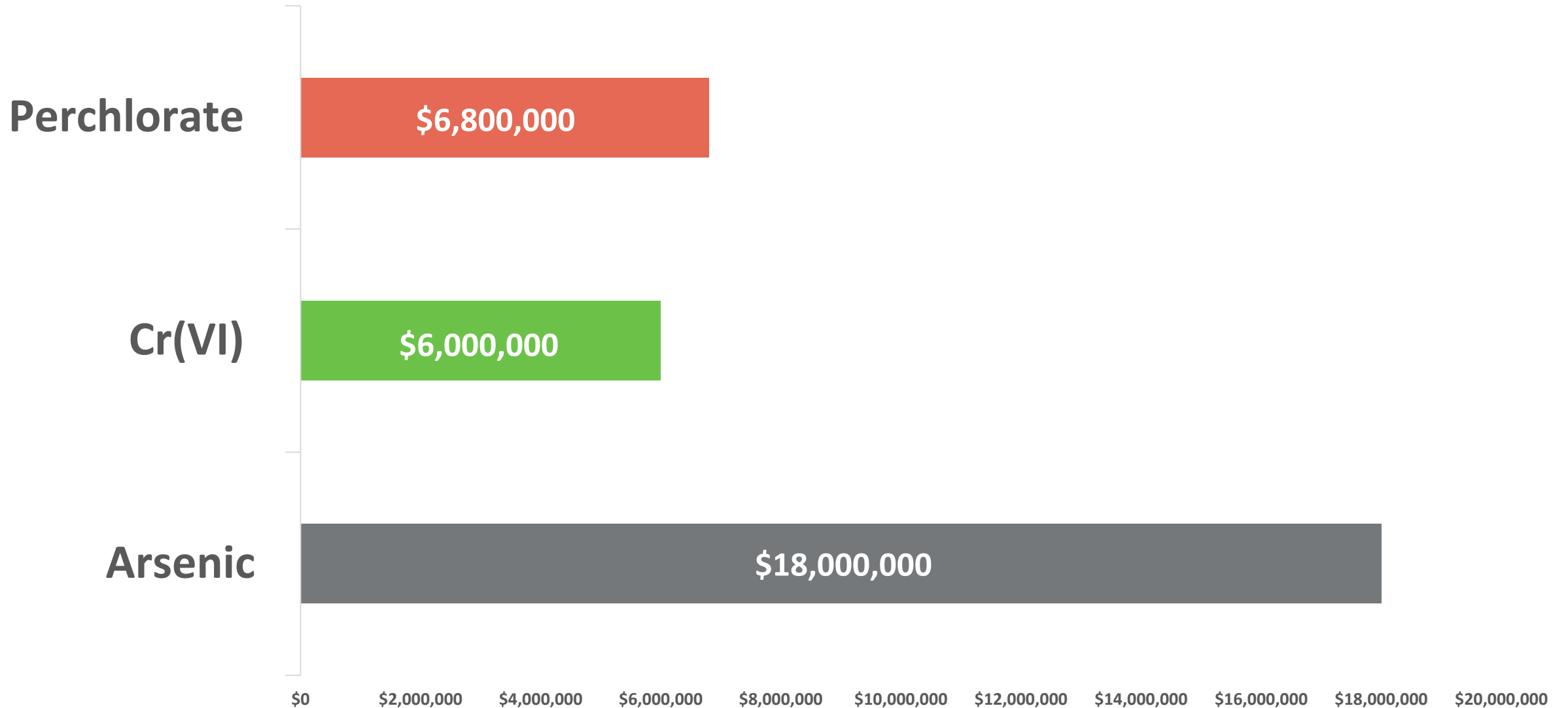


Microplastics

Nanomaterials

Additional Algal Toxins (HABs)

WRF Research Investments







Water intake facility for the City of Toledo, three miles off-shore in Lake Erie

[Algae crisis is 'game changer' for region's water supply - Toledo Free Press, August 10, 2014](#)

Photo: Sarah Ottney, Toledo Free Press



A sample glass of Lake Erie water near the City of Toledo water intake crib, August 2014

Photo: Haraz N. Ghanbari, AP



Touching harmful algae is not advised!



Source: The Independent



NEW AT 5:00

**CITY OF FLINT OFFICIALLY BECOMES
RELIANT ON FLINT RIVER WATER**

Lead & Copper Testing



CHARLOTTE WATER Lead in Drinking Water

Watch later Share

MORE VIDEOS

CHARLOTTE WATER **Barry Gullet**
Charlotte Water Director

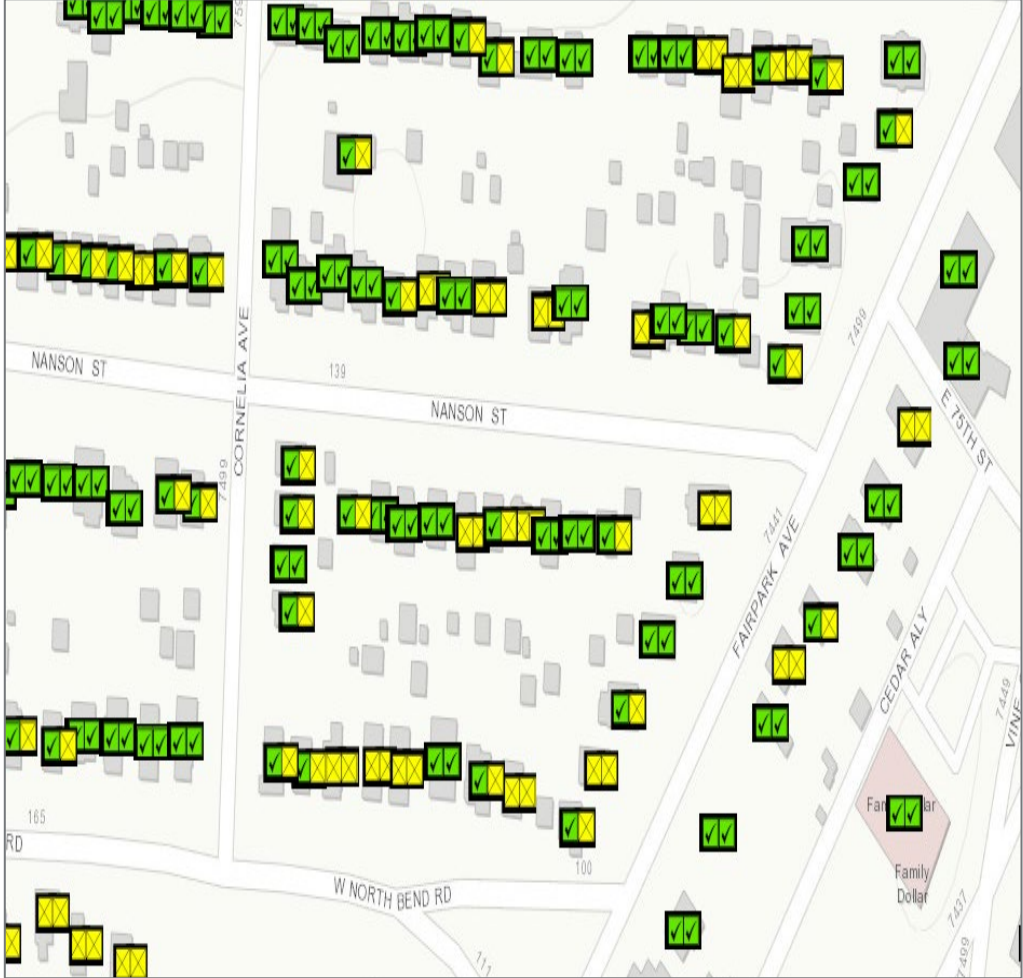
0:13 / 2:37

CC Settings YouTube

For another year, monitoring results of the drinking water system indicate no lead or copper issues for Charlotte Water customers.

- [Water Quality Data](#)
- [Environmental Protection Agency's \(EPA\) Lead & Copper Rule](#)
- [Getting the Lead Out - Charlotte's low risk for lead in drinking water](#)
- [Drinking Water Quality Report](#)
- [Your Water Quality - Customers can feel confident](#)

Greater Cincinnati Water Works - Lead Service Line Replacements



Source: Greater Cincinnati Water Works

PFAS Management, Analysis, Removal, Fate and Transport of Per- and Polyfluoroalkyl Substances (PFAS)



[Credit: WRD](#)

Of course you can park your motorcycle
in the house, my sweetie.



Go ahead. It's O.K. when your carpet is treated with
Scotchgard Protector Advanced Repel Technology.
www.scotchgard.com



USS Rupertus stands by to assist the burning USS Forrestal - July 29, 1967



POLITICS

‘Our voices are not being heard’: Colorado town a test case for California PFAS victims





[News]

Sports

Entertainment

Life

Money

Tech

Travel

Opinion

ELECTION 2020

Updated Iowa results 📦

THE BEST MORNING READS



ARE YOU REGISTERED TO VOTE
You can check her

HEALTH

Toxic 'forever chemicals' found in drinking water throughout US

Joshua Bote USA TODAY

Published 1:34 p.m. ET Jan. 23, 2020 | Updated 8:51 p.m. ET Jan. 23, 2020





The Philadelphia Suburbs Where Many Don't Drink the Water

About 80,000 people in three townships live in an area where groundwater has been contaminated by chemicals known as PFAS





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Hot Topics [Possible coronavirus host?](#) | [Sensitive Hunter Biden records](#) | [Texas man's last words](#)

HEALTH · Published January 22

Americans exposed to toxic chemicals in drinking water 'dramatically underestimated': report

TRENDING

Iowa Caucus Results

Coronavirus

SCIENCE

People In 43 US Cities Are Drinking Toxic "Forever Chemicals" In Their Tap Water, Tests Show

Drinking water was contaminated in 43 US cities, a new study found.

Legacy and Emerging Perfluoroalkyl Substances Are Important Drinking Water Contaminants in the Cape Fear River Watershed of North Carolina

Mei Sun^{*†‡}, Elisa Arevalo[‡], Mark Strynar[§], Andrew Lindstrom[§], Michael Richardson^{||}, Ben Kearns^{||}, Adam Pickett[‡], Chris Smith[#], and Detlef R. U. Knappe[‡]

View Author Information ▾

Cite this: *Environ. Sci. Technol. Lett.* 2016, 3, 12, 415–419

Publication Date: November 10, 2016 ▾

<https://doi.org/10.1021/acs.estlett.6b00398>

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Environmental Science
& Technology Letters

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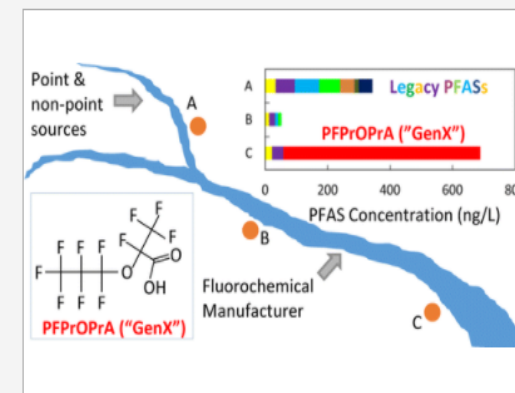
PDF (898 KB)

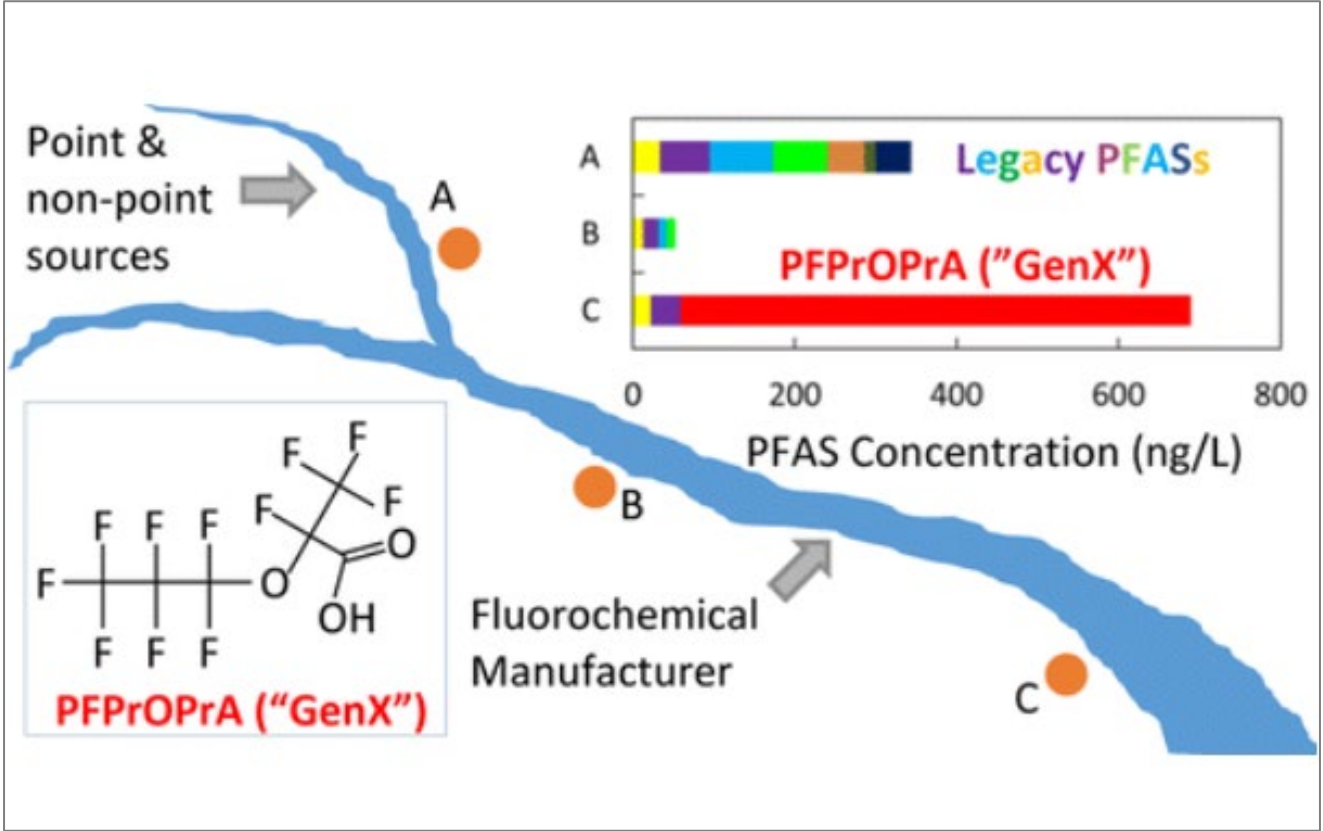
Supporting Info (1) »

SUBJECTS: Adsorption, Carbon, Ethers, Drinking water, Water treatment

Abstract

Long-chain per- and polyfluoroalkyl substances (PFASs) are being replaced by short-chain PFASs and fluorinated alternatives. For ten legacy PFASs and seven recently discovered perfluoroalkyl ether carboxylic acids (PFECAs), we report (1) their occurrence in the Cape Fear River (CFR) watershed, (2) their fate in water treatment processes, and (3) their adsorbability on powdered activated carbon (PAC). In the headwater region of the CFR basin, PFECAs were not detected in raw water of a drinking water treatment plant (DWTP), but concentrations of legacy PFASs were high. The U.S. Environmental Protection Agency's lifetime health advisory level (70 ng/L) for perfluorooctanesulfonic acid and perfluorooctanoic acid (PFOA) was exceeded on 57 of 127 sampling days. In raw water of a DWTP downstream of a PFAS manufacturer, the mean concentration of perfluoro-2-propoxypropanoic acid (PFPrOPrA), a replacement for PFOA, was 631 ng/L ($n = 37$). Six other PFECAs were detected, with three exhibiting chromatographic peak areas up to 15 times that of PFPrOPrA. At this DWTP, PFECA removal by coagulation, ozonation, biofiltration, and disinfection was negligible. The adsorbability of PFASs on PAC increased with increasing chain length. Replacing one CF_2 group with an ether oxygen decreased the affinity of PFASs for PAC, while replacing additional CF_2 groups did not lead to further affinity changes.





Toxin taints CFPUA drinking water

By Vaughn Hagerty StarNews Correspondent

Posted Jun 7, 2017 at 10:31 AM

Utility can't filter out chemical produced upriver at Fayetteville plant

WILMINGTON -- A chemical replacement for a key ingredient in Teflon linked to cancer and a host of other ailments has been found in the drinking water system of the Cape Fear Public Utility Authority (CFPUA), which cannot filter it.

Known commercially as GenX, the contaminating compound is made by the Chemours Co. at Fayetteville Works, a 2,150-acre industrial site straddling the Cumberland-Bladen county line along the Cape Fear River, about 100 miles upstream from Wilmington.

News & Politics

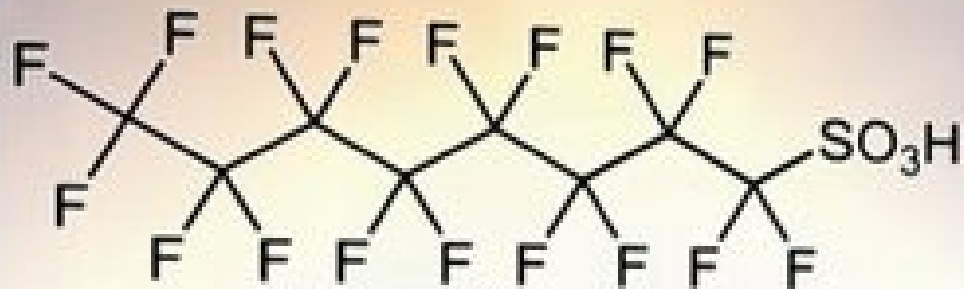
CFPUA approves \$107.3 million bond package including \$43 million for Sweeney upgrades, rates to increase next summer

By Port City Daily staff - September 11, 2019



Source: www.michigan.gov/pfasresponse





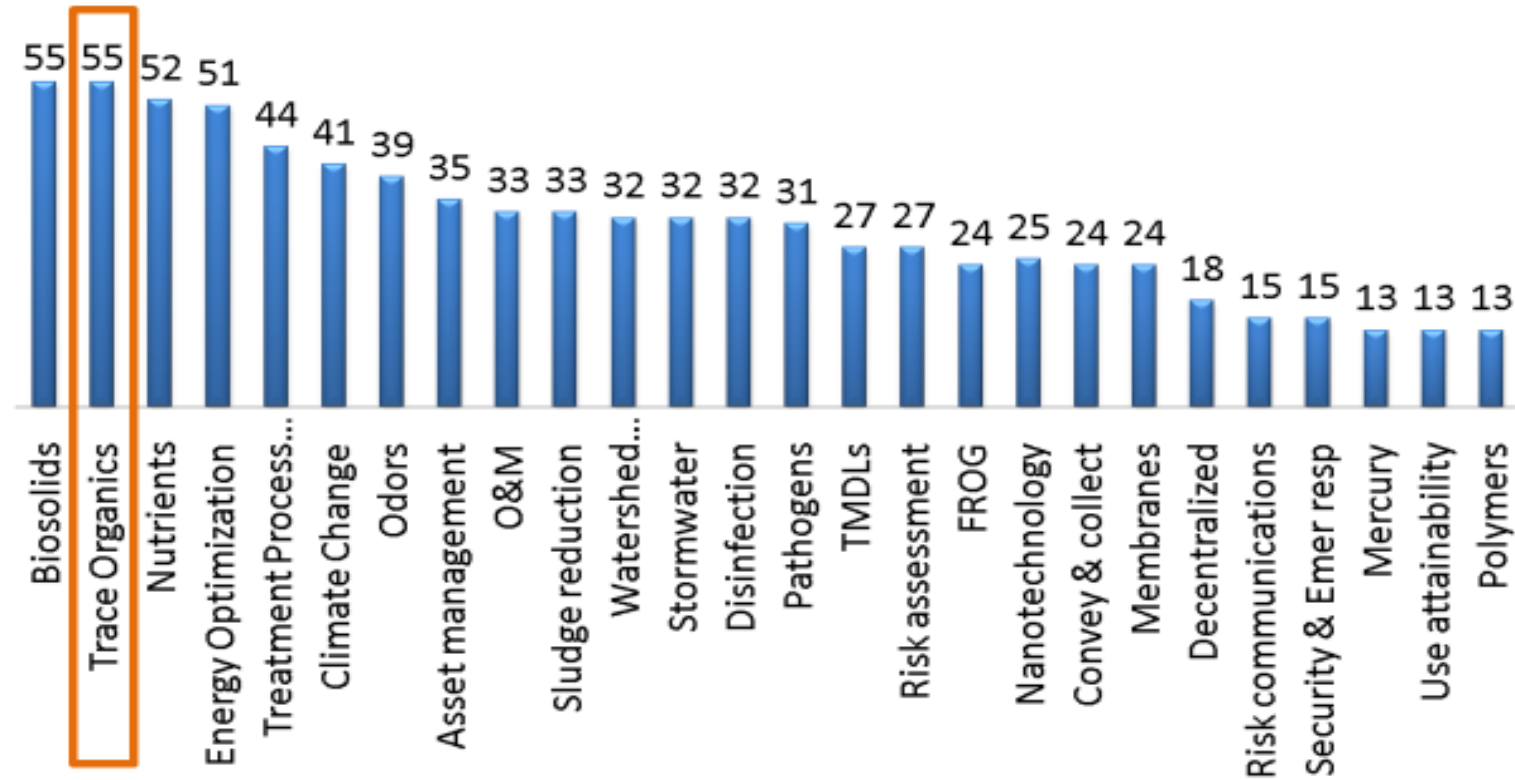
Per- and Polyfluoroalkyl Substances!

**FOREVER
CHEMICALS**



Survey: Which research topics are the most important for your organization? (WERF 2010)

The percentage of total respondents selecting that topic



What do consumers want to know?

Consumers want technical details

- Technical detail does not necessarily require technical language
- Water professionals often equate the two

Consumers need to know what we know

- They need information in context that explains “safe”
- What are you doing about it?
- What can I do?
- Where can I get more information?



*Is my drinking
water safe for my
family?*



Improving Analytical Methods

Impact of New Analytical Techniques

What does this mean for our water resources?

- If we can detect something, is it a problem?
- If it is a problem what can be done?
- What is the role of water utilities in managing these substances?

Common Utility Concerns with CECs

- What's in my influent? What are the sources and what are possible source control options?
- Are there reliable analytical methods?
- Can they be removed from drinking water? What is their fate in effluent and in biosolids?
- Are there potential adverse health or ecological effects?
- What are the regulatory implications?
- What can I tell my customers with certainty?

NDMA Research Area Objectives



Investigate the contributions of

- **source water quality**
- **treatment processes**
- **distribution system operations**



Develop control strategies to prevent or minimize the formation of nitrosamines



Identify unintended consequences and cost of implementation



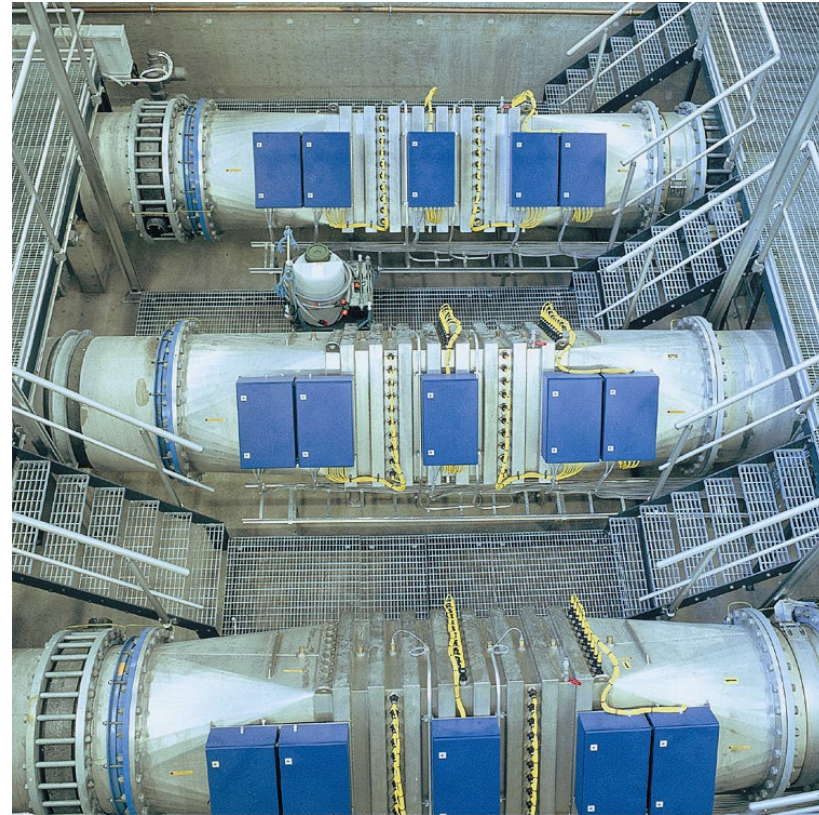
A microscopic view of water containing numerous small, translucent, and brownish particles, likely microplastics, scattered throughout the blue liquid. The particles vary in size and shape, some appearing as small dots, others as thin fibers or irregular fragments. The background is a deep, clear blue.

Microplastics in Water

Occurrence, Removal, Fate, and Transport in Water Treatment

Advanced Treatment

- Oxidation
 - Ozone
 - UV
- Adsorption
 - Carbon
 - Ion exchange
- Filtration
 - Membranes
- Biological Filtration



Advanced Treatment Costs

- Up to 9 times more energy than conventional treatment
- Higher capital and operating costs
- Skilled operations staff



Exhibit 6-4—National Annualized Sampling Costs—All PWS at 7% Discount Rate
[2016\$]

	Low cost estimate			High cost estimate		
	Previous LCR	Final LCRR	Incremental	Previous LCR	Final LCRR	Incremental
Lead Tap Sampling Monitoring	\$33,746,000	\$47,597,000	\$13,851,000	\$36,573,000	\$58,566,000	\$21,993,000
Lead Water Quality Parameters Monitoring	6,986,000	7,980,000	995,000	8,397,000	10,683,000	2,286,000
Copper Water Quality Parameters Monitoring	133,000	145,000	12,000	128,000	143,000	15,000
Source Water Monitoring	25,000	13,000	-12,000	66,000	45,000	-20,000
School Sampling	0	14,461,000	14,461,000	0	14,969,000	14,969,000
<i>Total Annual Sampling Costs</i>	40,890,000	70,197,000	29,307,000	45,164,000	84,407,000	39,243,000







Source: www.khou.com

Houston, TX – February 14, 2021

[KPRC/click2Houston.com](https://www.kprc.com/click2Houston.com)



Collecting snow to thaw for water

Ilana Panich-Linsman for The New York Times



Water for flushing toilet

Christopher Lee for The New York Times



Clean-up after burst pipe

Tamir Kalifa for The New York Times



New Melones Lake Reservoir, May 24, 2015

Photo: Mark Ralston, AFP/Getty Images



Voelvlei Dam near Cape Town, South Africa, January 2018

Photo: Mike Hutchings, Reuters



California households owe \$1bn in water bills as affordability crisis worsens

One in every eight households owes water debt, survey shows, with Black and Latino neighborhoods more likely to be in arrears



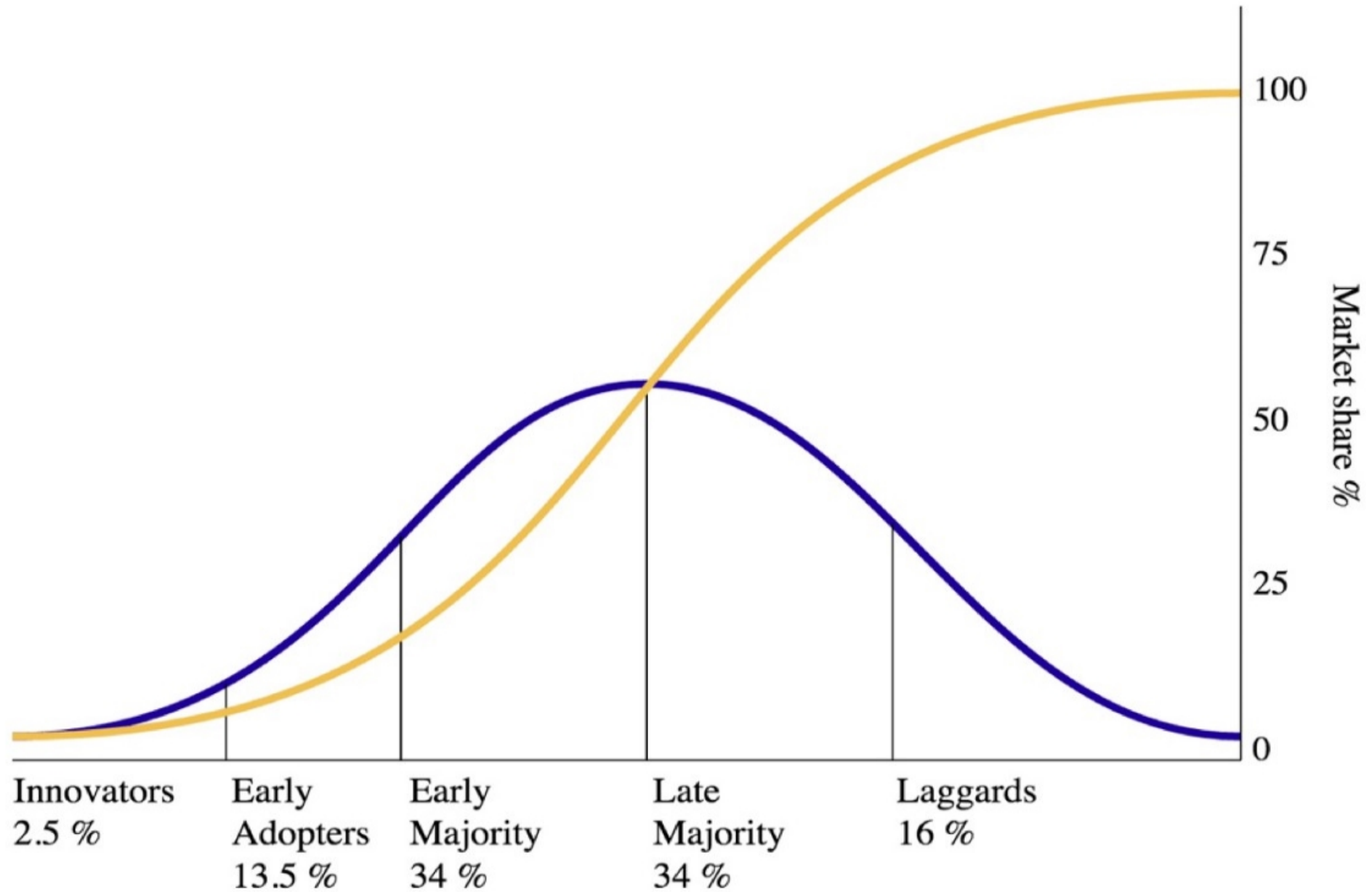
▲ Low-income households hit hard by the pandemic are likely prioritizing food, medication and other basic necessities over paying their water bill. Photograph: Mackenzie Lad/AP

[The Guardian, January 19, 2021](#)



Fostering Innovation





[How does the lifecycle of a software product work?](#)

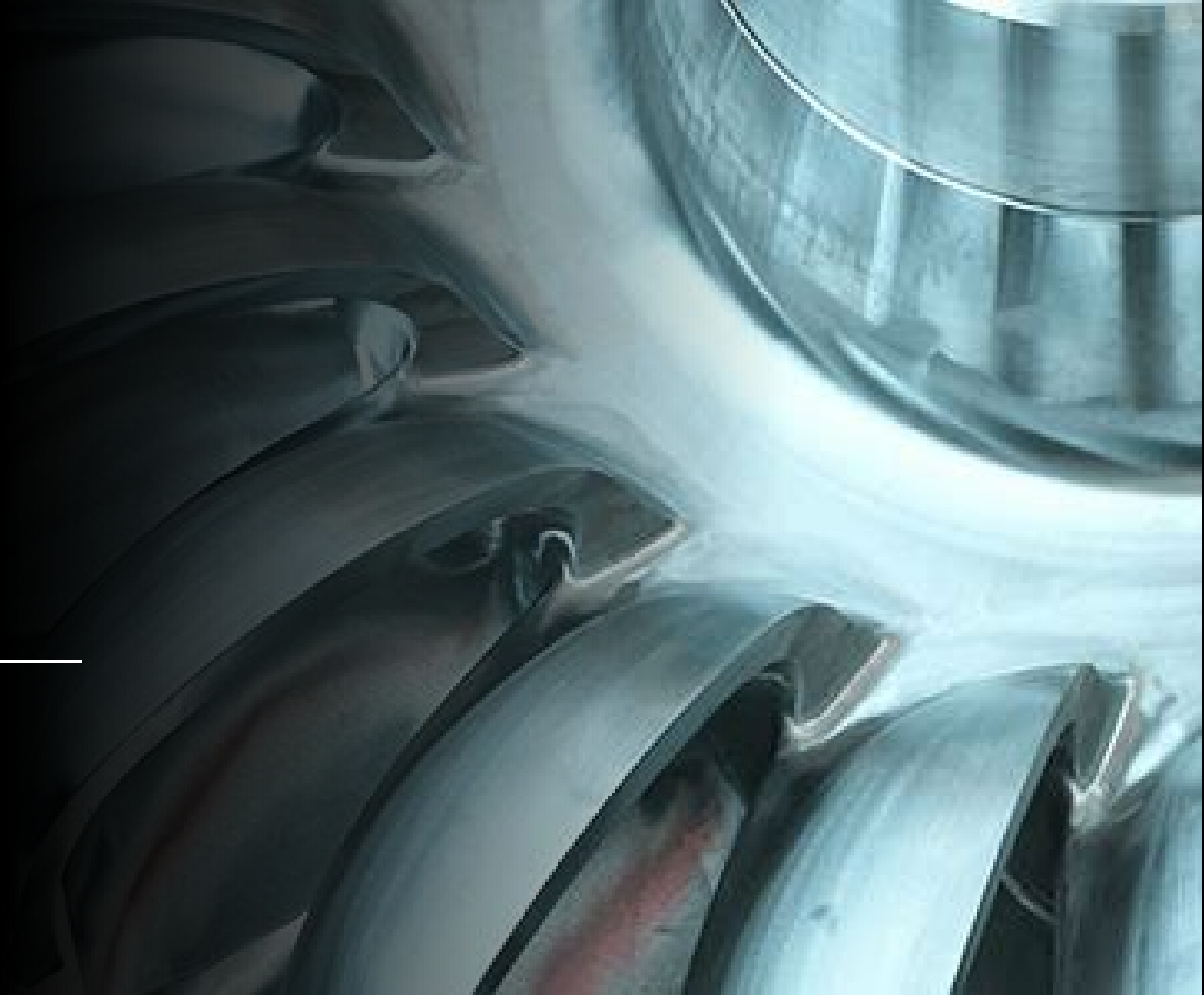
By Joca Tores, Medium.com, April 4, 2017

The Waterwheel at Onden
Hokusai circa 1830-1832





Halifax Water-Energy Recovery



Collaborative Technology Evaluation (CTE) Portfolios



ENERGY EFFICIENCY – 2 grants funded by the U.S. Department of Energy



NITROGEN REDUCTION – Funded through philanthropic partnership



PFAS DESTRUCTION – Grant application submitted to Department of Defense



WATER REUSE – Identifying topics, partners and funding opportunities



Best Practices in Customer Payment Assistance Programs

Subject Area: Management and Customer Relations



Customer Assistance Programs for Multi-Family Residential and Other Hard-to-Reach Customers

Project #4557





THE
**Water
Research**
FOUNDATION

**1199 N. Fairfax Street
Suite 900
Alexandria, VA 22314**

**6666 West Quincy Avenue
Denver, CO 80235**



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[WaterResearch](https://www.linkedin.com/company/WaterResearch)



[The Water Research Foundation](https://www.youtube.com/watch?v=TheWaterResearchFoundation)



www.waterrf.org



PGrevatt@WaterRF.org
Peter Grevatt, PhD - Chief Executive Officer

