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Summer 2023

The Connecticut Institute of Water Resources

Photo: Michael Dietz, CT IWR Director

@CTIWR

WHO WE ARE AND WHAT WE DO

In a state like Connecticut where water seems plentiful, it is easy to take water for granted. As long as clean water comes out of the tap, water issues may not rise to the top of our list of concerns. Although we do have plentiful water for the most part, there are still many reasons to keep water in mind. Who wants to take their kids to the beach in the summer and find that the beach was closed due to high bacteria levels in the water? Or who wants to have their water heater fail due to high salt in their well? And how do we know that we will have enough water to supply the state if we have another severe drought?

The CT IWR is part of a national network of 54 state and territory water institutes created by the Federal Water Resources Research Act of 1964. Our mission is focused on all aspects of Connecticut's water resources including use, preservation, and proper management. Why is this important? It means that CT IWR is addressing the most pressing water issues in our state. Every institute receives funds annually from the United States Geological Survey (around $132,000). A small amount is used for staff support, but the majority of funds are given out to support research on critical water issues every year through a competitive process. In addition to helping address these critical water issues, the grants help support training of undergraduate and graduate students to work in water-related fields, and provide support for early career water resources scientists.

CTIWR
Institute of Water Resources

ABOUT US

The CT IWR is headed by Director Michael Dietz. Dr. Dietz is an Extension educator at UConn and also a joint faculty member in the Department of Natural Resources and the Environment. He has a background in water resources with a focus on green stormwater infrastructure techniques, and took over as director in January 2018. The Department of Natural Resources and the Environment provides critical administrative support to CT IWR. An advisory board composed of members who represent the main water resources constituency groups in the state help to guide our activities and select research projects for funding.

Questions and comments can be directed to the director at

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MESSAGE FROM THE DIRECTOR

This newsletter is a great time for me to reflect on issues related to water in our state, from a big picture perspective. This year I can't help but comment on the extremes. Almost daily we are hearing about reports of record-breaking ocean temperatures in Florida (over 100 degrees?!), severe water shortages out west, or flooding in Vermont. In our own state, we seem to be going back and forth between summer droughts and excess rains. July 2023 was the fourth wettest month on record in the Hartford area, with around 14 inches of rain (our normal July precipitation is 4 inches). Of note is that the first three wettest months were all months when we had hurricanes or tropical storms hit the area. This July was just "normal" rainfall. As we have noted previously, our warmer climate is impacting the hydrologic cy-

Above: The CT IWR director with his record-setting rainbow trout caught in the spring of 2023 from the Natchaug River. (OK, so he was just holding it really close to the camera and it wasn't a record setter ... but it was still a big fish!)

cle, and southern New England is expected to see more extreme events, along with more periods of drought. Recent experience certainly seems to bear that prediction out. Several of the researchers whom the CT IWR has funded are studying various aspects of these changes, and we hope to fund more projects on this critical issue in upcoming years.

I would like to introduce Dr. Bo Tao, our new associate director, who holds a Ph.D. in physical geography and an M.S. in land use planning. Bo was previously a research scientist at the University of Kentucky. His research focuses on land use reconstruction, land use, and climate impacts on biogeochemical and hydrological cycles. Dr. Tao has been doing an outstanding job working on some of our administrative tasks, including our proposal review and reporting cycles. He has also been overseeing our social media presence, which is a huge help to me. Besides his work for CT IWR, Bo is doing independent research work in the Department of Natural Resources and the Environment here at UConn. He lives in Mansfield with his wife (Dr. Wei Ren, also a new faculty member here in NRE!) and two children.

Bo Tao, CT IWR Associate Director

CALLING ALL WEATHER FANS

If you are a self-described "weather nut," perhaps you have heard about the new app from NOAA (the National Oceanic and Atmospheric Administration) called mPING (Meteorological Phenomena Identification Near the Ground). This app allows users to enter local weather observations directly into the app. The data are then compiled into a large database and displayed on a map accessible to anyone. NOAA created this app because weather radars can't "see" everything happening on the ground, so mPING reports are used by the NOAA National Weather Service to fine-tune their forecasts. This is a great way for you to participate in the weather forecasting process! More information is available at mping.nssl.noaa.gov.

VOLUNTEER OPPORTUNITIES

If you love water (who doesn't?) and are interested in volunteering, CT IWR is creating a new resource for you! Connecticut has numerous watershed organizations that host a variety of events and volunteer opportunities. These events can be social gatherings with a water theme, or they can be more involved activities such as stream cleanups, invasive species removal, or water sampling. CT IWR will be posting a frequently updated list of these opportunities, and to make it easy to see what is happening near you, we will host a map with links to the opportunities. We are trying to help connect the organizations who need assistance with the people who want to help! This information will be added on the "Resources for Residents" page: ctiwr.uconn.edu/resident-resources.

Challenges and Opportunities in the Context of Changing Climate

Bo Tao

The importance of sustainable and resilient water management strategies has never been as critical as it is today. As a state renowned for its picturesque coastline, rivers, and lakes, Connecticut faces significant challenges in water resource management as it grapples with the impacts of a changing climate. Shifting climate patterns, such as increasing temperatures, altered precipitation patterns, and rising sea levels, pose formidable challenges to the availability and quality of water resources. This summer saw the warmest temperatures ever recorded on Earth, with an average global temperature reaching 17.0 degrees Celsius (62.6 Fahrenheit) on July 3. Although this summer has not been excessively hot here in Connecticut, in the past few years we have seen it all, from record-breaking temperatures to more frequent and severe extreme events such as drought and heavy rain. In Connecticut, we see extreme weather events, such as heavy rainfall and flooding, resulting in runoff carrying pollutants from urban areas and agriculture, further deteriorating water quality in private and public systems and creating health risks for residents and wildlife; heavy rains and river flooding destroying roads and other infrastructure and flooding farms and towns (see news reports of the destruction in Vermont and Connecticut this summer), as well as adversely affecting local food security and farming businesses; water conservation problems due to prolonged droughts; increased infrastructure damage from a rising sea level and coastal storm surges; challenged water quality and aquaculture in Long Island Sound; compromised recreation due to high levels of bacteria found in swimming waters; and many other impacts.

These unprecedented challenges require considerable financial investment and sustainable and resilient water management strategies promoting water conservation, efficiency, infiltration, and reuse. We are pleased to see a series of recent and ongoing efforts to enhance and optimize water resources management in Connecticut. This year, the EPA announced $73.5 million for drinking water infrastructure upgrades in Connecticut, with $19 million in Bipartisan Infrastructure Law funding to address emerging contaminants like PFAS (see 2020 CT IWR newsletter for more on PFAS) in drinking water; USDA provided funds to help farmers improve water quality; Connecticut Water Co. invested $60 million in infrastructure improvements; and Clean Water Action 2023 is beginning more efforts to protect water and health, from watershed to water tap.

With more opportunities to adopt innovative and resilient strategies, CT IWR will continue collaborating with and serving all colleges and universities in the state to resolve state and regional water-related problems, promote sustainable practices, provide a strong connection between water resource managers and the academic community, and increase public awareness about the importance of water conservation and sustainable practices. We call for more efforts to integrate climate projections into infrastructure planning, identify vulnerable areas and prioritize adaptive measures, coordinate management efforts among various stakeholders, and foster collaborative decision-making to improve overall water quality and availability in Connecticut. CT IWR will take an active role in addressing the challenges posed by water resource management in Connecticut and the surrounding region for the benefit of communities, industries, and ecosystems.

Update on Private Residential Well Testing

Alec Janis

It's been a scorching, humid summer afternoon. The walk from the car to the front door has left you parched. After you enter the kitchen, you turn on the tap, fill up the closest glass available, and gulp down the same refreshing glass of water you've been drinking from the tap for the past 10 years. It's as refreshing as it's always been, but it's also got a splash of coliform bacteria, an arsenic floater, and a pinch of nitrates… You likely don't know those additional tasteless ingredients are there. The quality of the water in your well can change over time; you can't assume is will be safe to drink today just because it was safe many years ago.

In the past year, UConn Extension has sampled the water quality of 102 wells across the northern half of Connecticut as a part of a project funded by the USDA's Rural Health and Safety Education program. We found that half of the homes tested exceeded the standards set by the Connecticut Department of Public Health. The 2010 census reported that 820,000 residents relied on well water in the state. Factoring in the population growth in the past 13 years, it's possible that about 400,000 Connecticut residents are drinking water with at least one exceedance of drinking water standards.

So, what are we finding? One out of five wells tested positive for total coliform bacteria (TCB). Some samples had concentrations that were barely detectable; others were higher than our methods could effectively measure. Coliform bacteria will not necessarily make you sick; TCB is a family of bacteria that exist in the gut of all warm-blooded mammals. Within this family there are also harmful bacteria, such as E. coli, that can cause stomach cramps, vomiting, and diarrhea. The presence of these bacteria could signal that your well is being contaminated by an outside source. If E. coli is detected at any level, it can be cause for concern. As part of the project, we also provide follow-up educational workshops to help residents understand what the results mean and help them figure out how to address exceedances if they have any.

Arsenic exists in groundwater due to our natural geology and the historic farming practices of Connecticut. A study sampling over 2,000 private wells conducted by the USGS found that 1 in 10 wells contained arsenic above the minimum reporting level, and almost 1 in 20 exceeded Connecticut's Department of Public Health maximum contaminant level. Long-term exposure to high levels of arsenic can cause cancer, diabetes, loss of bone marrow, neuropathy, cirrhosis of the liver, and more. In children, arsenic can cause all of the above and can also hinder lung and immune system function. The worst part of arsenic is, like a silent killer, you'd never know it was there. So far, we have only found two exceedances for arsenic in the wells we have tested.

The presence of metals such as iron or manganese can give water a cloudy appearance, while arsenic, TCB, and many other groundwater contaminants, such as uranium, nitrites/nitrates, fluoride, and PFAS, have no effect on taste, odor, or clarity. This gives way to the common misconception that if your water smells

good and tastes good that it is good. The only way to be sure about what's in your water is to get it tested.

Nearly three quarters of our participants had tested their drinking water at some point since moving into their home. However, only 1 out of 10 routinely tested their drinking water (we recommend testing every one-to-two years). What this tells us is that people care about testing their drinking water, but habitual testing is not happening. You also can't always assume that your water is fine if you have treatment system. Despite the fact that two-thirds of our participants had some kind of treatment system in their homes, half of the participants still had at least one exceedance of CT DPH standards. Groundwater quality can change over time due to normal seasonal variation, changes in land use nearby, or due to excessive rain or drought. This suggests that even if your water is safe to drink now, it doesn't mean it always will be. Those tasteless, odorless contaminants could have entered your water system since you last tested without you ever knowing. To further emphasize the point, based on our data, we estimate 720,000 people in the state of Connecticut do not routinely test their wells. For more information about groundwater and how your well works, check out the presentation from one of our workshops here: s.uconn.edu/well-presentation.

● - Fully Treated ○ - Partially Treated	Filtration									Ion Exchange		Disinfection				Distillation	RO
	Adsorptive Media Filter [1]	Activated Carbon Filter [1]	Aeration Filtration	Acid Neutralization	Oxidizing Media Filter	Microfiltration	Nanofiltration	Ultrafiltration [3]	Sediment Filtration	Anion Exchange [1]	Water Softener	Boiling Water	Continuous Chlorination	Ozonation	UV		
Arsenic [2]	●		○		●		○			●			●	●		●	●
Bacteria						●	●	●				●	●	●	●	●	
Chloride							●									●	●
Copper											●			●		●	●
Fluoride	●	●					○			●						●	●
Hardness							●				●					●	●
Hydrogen-Sulfide		●	●		●								●	●			
Iron		●	●		●		●		●		●		●	●		●	●
Lead		●					●									●	●
Manganese		●	●		●		●		●		●		●	●		●	●
Nitrite/Nitrate			○				●			●			●	●		●	●
Pesticide		●					●						●				●
PFAS		●					●										●
pH				●													
Sodium							●									●	●
Sulfate	●					●	●	●		●						●	●
Taste/color/odor		●	●		●	●	●	●	●				●	●		●	●
Turbidity	○	○			○	●	●	●	●							●	●
Uranium	●						●			●						●	●

[1] Be sure to check the specific filter to see what it removes. Depending on the media used in the filter, some particles may not be removed.

[2] Connecticut groundwater contains two types of arsenic III, also known as, arsenite; and, arsenic V, also known as, arsenate. To ensure all forms of arsenic are removed, pretreatment may be needed through chlorination, aeration, or ozonation. Water with sulfate levels above 100 µg may also affect arsenic removal. Be sure to consult with a water treatment expert before investing in treatment technologies.

[3] Unlinke microfiltration, ultrafiltration remove particles based on size, weight, and charge in addition to removing viruses

Let's say you heed our advice and begin to regularly test your drinking water. Based off our numbers, it's a coin flip that it may have an exceedance of one of the parameters. The next step is to treat it. Sometimes the treatment can be as simple as bleaching your well. In other cases, the solution may not be as simple. When looking at treatment options, it's important to look at what the treatment removes, how much it costs initially, and what the recurring maintenance and associated costs. Groundwater will always have some minerals in it. Calcium, fluoride, manganese, iron and other minerals are essential to the body in low doses, so we recommend you treat your water only for exceedances and monitor your water quality by regularly testing your well every one to two years. Some technologies can take nearly anything out of your water while some can only remove a handful of minerals. To learn more about the different types of treatment systems and what they can remove from your water, reference the table above.

To learn more about available treatment options, look for the UConn treatment guide coming out on our website at the end of the summer.

The UConn Extension drinking water testing program is available to host workshops. We are currently looking to connect with young homeowners under the age of 50. If you, your business, your child's school, or your community's organization would like to organize a well-testing event with us, we will provide low-cost tests ($50 for a test that normally costs over $300) and an educational workshop to help well owners learn more about their water systems and how to deal with exceedances. Reach out to alec.janis@uconn.edu for more information.

RESEARCH HIGHLIGHT

Tracking Road Salt Movement in the Environment

Bo Tao

This year, CT IWR is highlighting a recent study supported by USGS that examines how road salt moves through our infrastructure and soils/groundwater.

Dr. Steven Brady from Southern Connecticut State University and Dr. Gabe Benoit from Yale University have been researching how road salt moves through small surface water systems, including interactions with groundwater. Their findings explain previously unaccounted-for fractions of "missing" salt and help resolve puzzling dynamics of export, particularly for small watersheds with residential development. The full technical report can be found here: ctiwr.uconn.edu/reports.

Many of Connecticut's urban, suburban, and even rural watersheds are increasingly polluted by salt. Common sources of salt pollution include agriculture, wastewater, industry, dust suppression, and, most substantially, the deicing of roads, parking lots, and walkways. In the last decade, annual sodium chloride (NaCl) used for deicing salt ranged from about 15 million to 32 million metric tons, twice the amount applied four decades ago.

As has often been assumed, salt-polluted surface and ground waters do not behave identically to unpolluted waters. Rather, salt lingers in watersheds. About 40 to 70% of deicing salt applied yearly does not leave the watershed within that year. In other words, about half of each year's deicing salt is held somewhere in the watershed. The duration of storage is uncertain, but if all deicing stopped, chloride concentrations in groundwater would continue to influence downstream salt levels for 20 to 30 years. In some systems, including those that Brady and Benoit have measured, summer salt levels in tributaries are higher than in winter, implying a delay of at least six months. Groundwater (and the salt it contains) moves very slowly, so that is why we can still see high levels of salt entering the small tributary streams into the summer.

Brady and Benoit have installed instruments in various locations in the watershed to help them to better understand where salt is being stored and for how long. But how does the salt get "trapped" in the watershed? Answering this question requires some basic knowledge about stormwater infrastructure. When rain falls on impervious surfaces like roads and parking lots, the stormwater that runs off is most likely directed to a nearby catch basin. These basins often have a sump or hollow area in the bottom to collect sediment, but water will often sit in the bottom of the sump between storms. These basins are notoriously leaky, so salty runoff in the winter can leak out into the shallow groundwater, or it can remain until the next storm. Some salty runoff also leaves roads and goes into the ground directly, where it enters the shallow groundwater. The research team is finding that during winter melting events, very salty water is being stored temporarily in some catch basins. Generally, once winter salting is done for the year, stormwater runoff with no salt will dilute the salty pools left over, and eventually push the salt out of the system. However Brady and Benoit found that some of these pools aren't even flushed out by large tropical-storm type rain events. This important work is helping us to better understand how salt moves in our landscape, and the potential impacts it might have. Brady and Benoit are expanding their research in the upcoming year to study the effects of road salt on amphibians (see upcoming research).

UPCOMING RESEARCH

FOR FY24, CT IWR HAS SELECTED THE FOLLOWING PROJECTS FOR FUNDING:

Title: Fostering Purpose-Based Education, Collaboration, and Community Connections with a Campus Bioswale
Investigator: Suzanne Huminski, Southern Connecticut State University
Amount: $24,992

Title: Improving Water Quality in Hartford (CT) Through Community-Led Lot Revitalization
Investigators: Mayra Rodríguez González and Zbigniew Grabowski, University of Connecticut
Amount: $25,024

Title: Development of a Continuous Aquatic Plant Tracking and Imaging Network (CAPTAIN) to Monitor Surface Water Bodies in Connecticut
Investigator: Chandi Witharana, University of Connecticut; Gregory Bugbee, The Connecticut Agricultural Experiment Station
Amount: $23,994

Title: Road Salt in Soils and its Effects on Overwintering Amphibians
Investigators: Steven Brady, Southern CT State University; Gaboury Benoit, Mill River Watershed Association
Amount: $24,971

Photo: Bo Tao, CT IWR Associate Director

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