

Exploring Solutions to Excess Nutrients: Restoring Cape Cod's Waters



Bulletin 2: Winter 2021

Welcome to our second bulletin on the Environmental Protection Agency's research to address excess nutrient loading in Cape Cod's waters. This is a biannual update for interested community members. This team includes EPA scientists based in the Office of Research and Development and Region 1, Boston, MA, and many external research partners and stakeholders.

We have been working with our partners for the past two years to pilot and evaluate nitrogen reducing approaches that could ultimately be used to develop a watershed-level plan to reduce nutrient loading in the Three Bays Watershed of Cape Cod, Massachusetts, where nitrogen is the main nutrient of concern.

While the past year has gone differently than we had planned, we adapted to pandemic-era science and adjusted our research so that we could still make progress on our experiments. We have had innumerable video conference calls to check in with our EPA and external team members, found ways to conduct some research virtually, and have made our way into the field for other experiments.

This issue of the bulletin provides updates since July 2020 on our efforts to tackle the nutrient loading challenges with our stakeholders in the Three Bays Watershed. If you'd like to read our first issue you can access it [here](#). As a refresher, septic systems are the source of 80% of the nutrient loading on the Cape. While these systems are designed to treat bacteria in wastewater, traditional septic systems do not remove much nitrogen, which then flows through groundwater to ponds, streams, and estuaries. Our team of biophysical and social scientists is working on several projects to identify scalable solutions to this challenge that are summarized in our Project Updates. Our Deeper Dive section is about the progress of our enhanced innovative/alternative septic system research and our Scientist Spotlight is with Dr. Giancarlo Cicchetti.



Map of the Three Bays Watershed in Barnstable County, Massachusetts

Letter from the Lab

Here, we share a few words from Dr. Timothy Gleason, the science lead of this project at EPA.

Thank you for your continued interest in our research. We remain committed to using a solutions-driven research approach to evaluate and pilot watershed-based solutions using non-traditional interventions to address the area's important nitrogen issues. We are extremely fortunate to have the opportunity to work in partnership with a group of talented and dedicated people from across many

organizations to design and conduct research on key questions associated with how to reduce nutrient loads and restore water quality in the Three Bays watershed and across Cape Cod.

Partnerships truly are the key ingredient for addressing challenging problems such as this, as no single individual or organization can solve this problem alone. Our key partners include the Barnstable Clean Water Coalition, the U.S. Geological Survey, The Nature Conservancy, the Massachusetts Alternative Septic System Test Center, and Mount Holyoke College. We look forward to expanding our list of research partners as we move forward with the project.

We have had to make some adjustments to our research due to the COVID-19 pandemic, cancelling face-to-face stakeholder meetings and delaying other activities. Despite those challenges, we were still able to make progress in several areas due to the dedication and resilience of our partners and our staff.

We are looking forward to the opportunity to once again be able to connect directly with all interested stakeholders later this year. Until then, please take care and stay safe.

-Dr. Timothy Gleason

Project Updates

Here's a snapshot of what the research team has been working on since the [last bulletin in](#) summer 2020:

Aquaculture

Shellfish are filter feeders, and as such, have the capacity to improve coastal water conditions and reduce nutrient impacts in coastal waterbodies. EPA researchers are looking at both the water quality benefits and socioeconomic benefits and barriers to shellfish aquaculture on Cape Cod. During 2020, the aquaculture team conducted a shellfish feeding experiment in the laboratory to measure rates of filtration. They are currently processing the results. The aquaculture team welcomed a new student to the team who is helping with experiments and preparing communication materials about how shellfish treat nutrients for communities along the Atlantic coast. In early 2021, the shellfish team plans to get back in touch with aquaculturists in the Cape Cod area to plan for water clarity experiments when we move past freezing temperatures.



Benthic conditions research

Benthic, or seafloor, conditions are an important indicator of ecosystem health. Benthic habitats in many Cape Cod estuaries have been negatively impacted by excess nitrogen loading over decades. Currently, EPA researchers are analyzing data from a benthic survey of the Three Bays estuary conducted in 2019 and aiming to release a summary report of results later this year. The survey included water column observations, analyses of the estuary's seafloor sediment and animal populations, and photos of the seafloor. With these data, scientists can assess the health of different areas of the bay and how it has changed over time. One of the researchers involved with the bioassessment of the benthic environment, Dr. Giancarlo Cicchetti, is featured in this edition's Scientist Spotlight.

Reuse of dredged sediments

EPA scientists are also exploring the reuse of clean dredged sediments from the watershed. The dredged sediments may be used to build elevation of nearby marshes to mitigate sea level rise, or to create new wetlands

that could reduce nutrient loading in the water. Researchers are processing samples from both sand- and mud-added wetland experiments to identify bacteria that carry out nitrification and denitrification in different types of dredged sediments to better understand the best application of these materials in restoration efforts.

Recreational benefits of improved water quality

Since 2016, social scientists at EPA have been studying how water quality on Cape Cod affects visitation to coastal areas and the value of recreation in coastal waters. The overall goals of this work are to quantify how many people are recreating on estuary waters and the value of improving water quality in the Three Bays Estuary and other estuaries and coastal waters on the Cape. Data collection for this work was completed in 2019, and the socioeconomic analyses are in various phases of completion. Results using cell data to understand water recreation in New England were published in a 2020 article. An external report on how to apply the innovative counting method researchers used to estimate water recreation is forthcoming, and additional scientific papers based on visitation estimates and uses as related to water quality in New England are also in development.

You can find publications related to this work on the EPA [Human Dimensions of Water Quality Research webpage](#).

Cranberry bogs



From left to right, Casey Dannhauser of BCWC, Laura Erban of EPA, and Casey Kennedy of USDA walking along the Marstons Mills bog research site in early March 2020, strategizing on the controlled flooding experiment.

Our team has been exploring how the iconic cranberry bogs of Cape Cod can be a nature-based solution to nitrogen reduction. Learning lessons from installing the initial bioreactor in July 2020, researchers in collaboration with BCWC, EPA Region 1, The Nature Conservancy, and Mount Holyoke College have installed a “mini reactor.” The mini reactor is a quarter of the length of the original reactor and is being used to experiment and monitor nitrogen levels to achieve the desired nitrogen reduction and residence time for water in the reactor.

There is also a team conducting research on controlled flooding in the bogs. That research was put on hold in 2020, but researchers are ready to move forward in this experiment when circumstances improve.

Innovative/Alternative (I/A) septic systems research

Research and experimentation around installing enhanced I/A septic systems has continued with our partners for the past six months. This work has involved social science, biophysical science, and significant engagement with our partners. Read more about this in the Deeper Dive section of this bulletin.



Featured Photo

This bulletin's featured photo comes from the benthic conditions team. The team, including EPA researcher Don Cobb on the far right with two contractors, are on a boat in Cape Cod using the Sediment Profile Imaging (SPI) camera to take vertical profile photos of the top several inches of the seafloor in September 2020.

Deeper Dive

Research to inform adoption of innovative/alternative septic systems for nutrient management

Since summer 2020, the I/A septic systems team has moved forward with plans to install enhanced [nitrogen-treating systems](#) at about 12 houses in the Sand Shores neighborhood, located next to Shubael Pond in Barnstable, Ma. This project has involved consistent coordination among EPA, USGS, and Barnstable Clean Water Coalition team members to understand the hydrology around the pond and build community understanding of what the installations will entail.

During fall 2020, the team assessed new information from monitoring wells and concluded a series of focus groups. Focus groups with homeowners throughout Cape Cod and the islands have provided insights into which factors motivate or deter the installation of I/A septic systems. Research outputs from the focus groups will provide recommendations on how to better communicate about these systems and the process of installation with the public. The focus groups and community meetings led by BCWC have informed outreach to homeowners willing to participate in the septic upgrade at Sand Shores. With the USGS, additional [wells were installed](#) to map groundwater flow paths through the neighborhood. Monitoring wells will help scientists understand how installing numerous enhanced systems in a small area affects water quality and the nutrient loading of local waterbodies.

EPA also organized a two-part session, with TNC, for the Restoring America's Estuaries Annual conference in October 2020. The sessions focused on innovations in onsite waste treatment technology (septic systems) and accelerating adoption of advanced onsite wastewater treatment technologies for achieving nitrogen reduction and estuary recovery. Several partners and colleagues contributed to the sessions including speakers from The Nature

Conservancy, Cape Cod Commission, Massachusetts Alternative Septic System Test Center, Suffolk County, NY Health Department and USEPA. EPA researchers spoke about the nitrogen septic sensor challenge, and the social science and groundwater monitoring components of the project. The social science research presented early results of focus groups in southern New England, examining the underlying factors influencing the social acceptance and homeowner adoption of nitrogen-reducing systems. These insights provide useful guidance to environmental managers on reducing social barriers to system acceptance and informing targeted homeowner outreach, to improve how I/A septic systems are communicated to the public for wider-scale adoption. The other presentation focused on early findings on groundwater flow and nutrients.

The team is also planning an interactive virtual workshop to promote knowledge-sharing of enhanced I/A pilots that have occurred in New England and discuss paths to broader use. This will cover transferrable lessons learned from various past pilot projects and will explore the most appropriate places to utilize this technology.

End goals of this project include quantifying nitrogen reduction and cost effectiveness of the enhanced I/A systems; evaluating how clustering these systems influences groundwater quality; and communicating lessons learned to local, state, regional and federal partners in watersheds similarly compromised by legacy septic systems.

Scientist Spotlight

Dr. Giancarlo Cicchetti

Dr. Giancarlo Cicchetti is a researcher studying the benthic conditions of the Three Bays watershed. This is what he had to say in response to our questions about his time at EPA and experiences with the project.



How long have you been at the EPA?
22 years!

What kind of scientist are you?
I am a marine ecologist.

What led to your interest in this field of study?
I have loved aquatic creatures since I was very young and would go look in the water at every opportunity. I still do that.

Which aspect of the nutrients research on Cape Cod are you involved in?

The benthic assessment. We take pictures of the seafloor and look at who is living there. We have developed guidance and rules for evaluating benthic

condition based on the numbers, sizes, types, and activities of creatures living in and on top of the sediment.

What do you like most about working on this project?

I am fascinated by the many interesting things living on the bottom of estuaries and oceans, I like photography, I like being on a boat with my good friend Captain Don, and bioassessment has been the main focus of my EPA career. It is a good project for me.

Who have you been working with outside of EPA as a stakeholder/collaborator on this project?

I have not been working directly with stakeholders, but the product of our work – a collection of seafloor images linked to a map of the Three Bays estuary – will show stakeholders the condition of their estuary through pictures of the seabed in a view they are familiar with and that intuitively shows good or bad condition.

How does your research strive to address excess nutrients on Cape Cod?

Our benthic assessment will complement the two other benthic assessments of this estuary (sediment profile imaging and benthic faunal analysis) to better document and communicate how excess nutrients have degraded this estuary.

In a sentence or two, what is your favorite outdoor memory?

Catching fish with my son on our boat when he was young. We would motor out the Charlestown Breachway in Rhode Island and anchor on the pile of extra boulders that were barged a mile out and dumped after construction of the rock jetties. The water was clean and clear, and we caught many different species of fish. It was always interesting, and we always had a great time.

What's your favorite way to spend time outdoors?

I have two favorites - fishing for black seabass in my pedal kayak and birding with my son. I like being alone with nature in the kayak, and I like learning about birds and forests from my son.

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