



EPA's Decentralized Program and Regional Perspectives on Nutrient Reduction for Onsite Wastewater Systems

Kristina Heinemann and Michael Flood

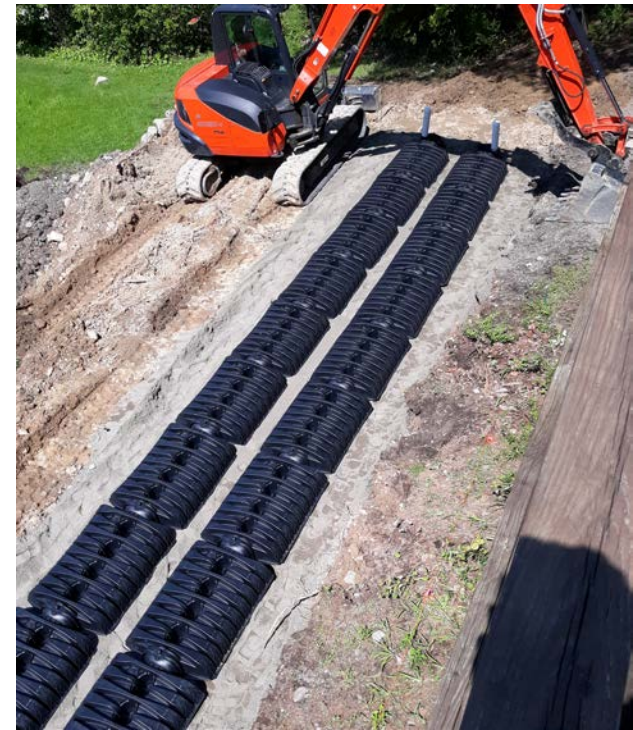
U.S. EPA, Region 2
Water Division
Watershed Management Branch

Today's Talk

- I. Introductions and personal reflections
- II. Federal authorities
- III. EPA National Initiatives
- IV. EPA Regional Initiatives
- V. Perspectives on moving onsite wastewater treatment into the 21st century

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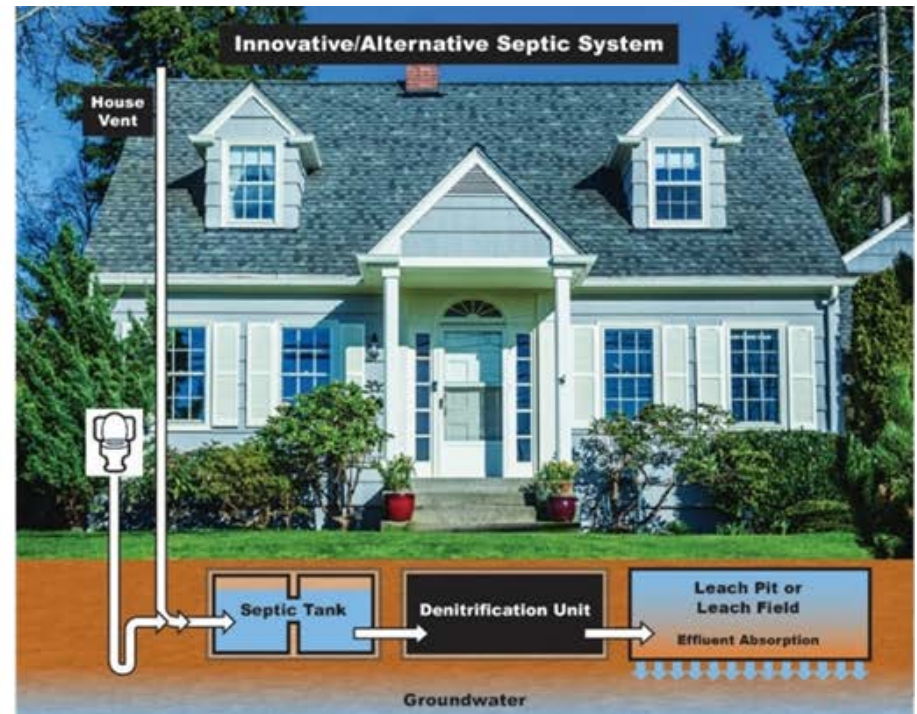
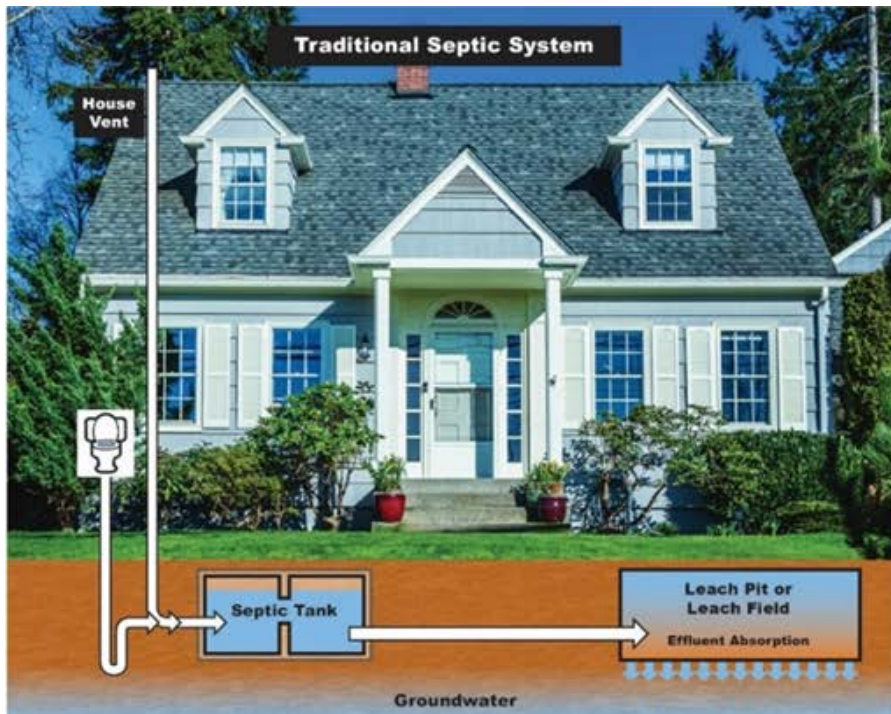
Personal Reflections



Personal Reflections



What is an I/A Onsite Wastewater Treatment System?



<https://www.epa.gov/water-research/innovativealternative-septic-systems>

Federal Authorities

Decentralized and Onsite Wastewater Treatment Federal Regulatory Context

- Clean Water Act does not regulate discharges to groundwater
- Large Capacity septic systems are considered Class V Underground Injection Wells under the Safe Drinking Water Act.
 - Receives any amount of industrial or commercial wastewater (i.e., car washes, print shops, etc.)
 - Receives solely sanitary waste from multiple family residences or a non-residential establishment and has the capacity to serve 20 or more persons per day.
- Bottomline – there no federal limits for discharges to groundwater (CWA or SDWA) – these are set by states and/or local governments.

Clean Water Act: Clean Watersheds Needs Survey (CWNS)

- Mandated by the CWA
- An assessment of capital improvement needs
- Been 10 years since the last CWNS in 2012
- March 1, 2022 - February 28, 2023:
2022 CWNS is open for data collection.
- Contact your CWNS State Coordinator for questions about your state.
- CWNS administered every 4 years

EPA National Initiatives

EPA's Decentralized Program – National Priorities

1. Increase outreach and public education

2. Identify and utilize current information and data

3. Promote the benefits of advanced decentralized treatment technologies

4) Share information on funding sources and pursue innovative public and private financing options

5. Expand mechanisms to address workforce, education, training, and research needs

Priority # 1: Homeowner Outreach

SAVE THE DATE!
SepticSmart
Week 2022
September 19-23, 2022

**Get ready for the
10th anniversary
of SepticSmart Week!**

This year SepticSmart Week celebrates 10 years of outreach and education activities that encourage homeowners and communities to care for and maintain their septic systems.

For more information, visit
www.epa.gov/septic



The Impacts of Failing Septic Systems



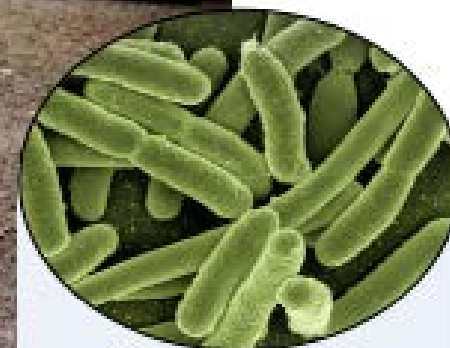
Economic Impacts

- Losses in home and property values
- Losses in business revenues
- Declining economic prosperity



Nutrient Pollution

- Nitrogen pollution and algal blooms in lakes, rivers and streams
- Fish kill events
- Ecosystem degradation



Contamination of Recreational & Drinking Water Resources

- Disease outbreaks from exposure to *E. coli* and other pathogens
- Contamination of vital drinking water resources

Priority #2 Understanding the Decentralized Universe

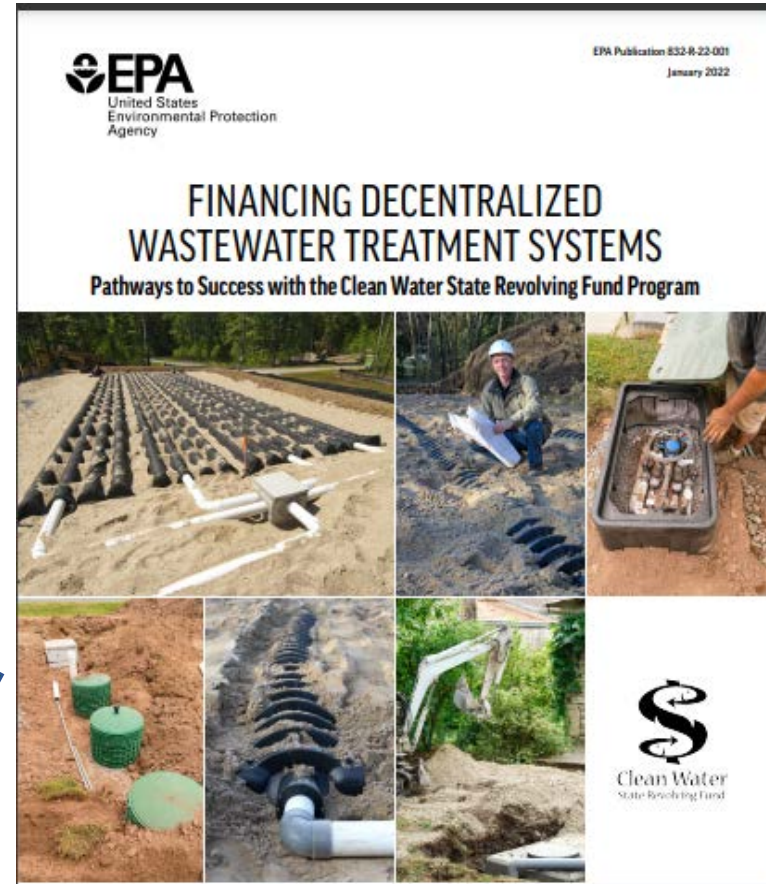
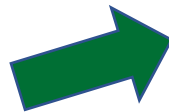
- The last credible national estimate from the 1990 Census.
- At that time, about 25% of the U.S. population relied on septic systems.
- In 2018 EPA initiated a discussion and process with the US Census Bureau
 - The proposed question on septic systems has been evaluated as having “merit”
 - Will be included in the Census process of cognitive and field testing

2022 ACS Content Test Timeline



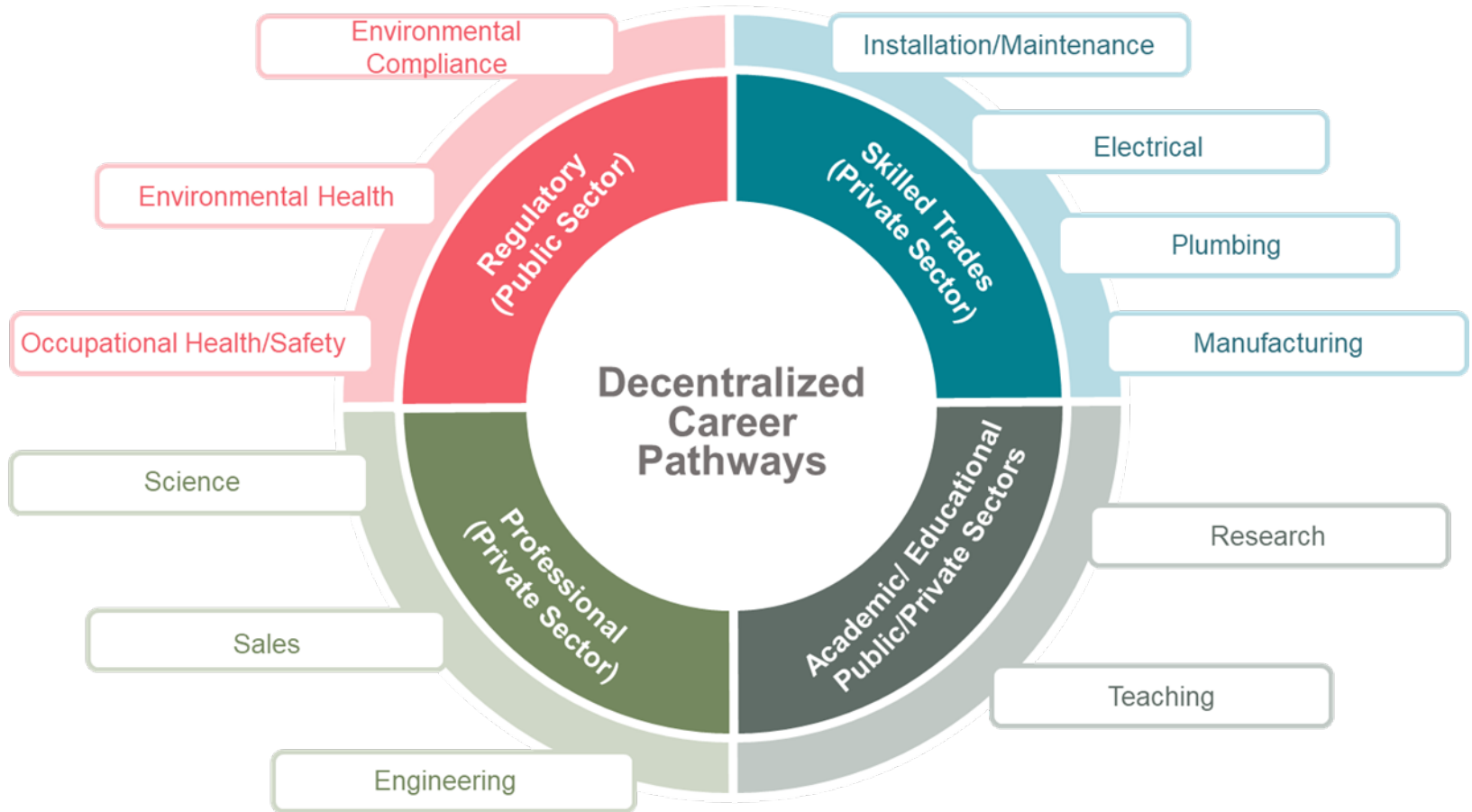
Priority # 4: Financing Decentralized Wastewater Treatment Systems

- Water Resource Reform and Development Act of 2014 (WRRDA) and the American Water Infrastructure Act of 2018 (AWIA) → more emphasis on financing projects.
- The Clean Water State Revolving Fund (CWSRF) offers below-market interest rates, loan forgiveness, extended-term financing, and flexible repayment options.
- This guide helps stakeholders facilitate a process to:
 - (1) identify the problem
 - (2) select the best financing solution
 - (3) identify critical partners
 - (4) effectively finance the project
 - (5) implement projects.



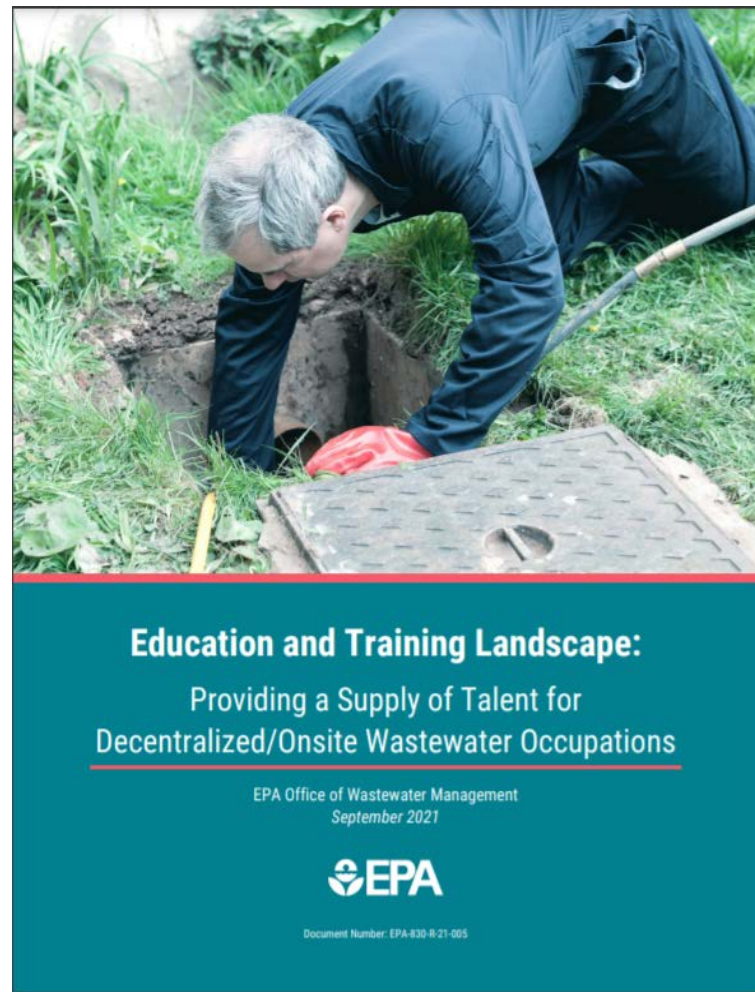
<https://www.epa.gov/system/files/documents/2022-02/financing-dwts.pdf>

Priority #5 : Support for Decentralized Career Pathways



Priority #5: Support for Decentralized Career Pathways

- *Pipeline to a Sustainable Workforce: A Report on Decentralized Wastewater Occupations* – Outlines jobs, growth predictions, wages, etc.
- *Education and Training landscape: Providing a supply of talent for decentralized / onsite wastewater occupations* - Outlines job functions, credentials, and provides examples of education and training approaches.
- *Building a Decentralized Wastewater Training program* - A step-by-step guide for partnering with local community colleges.
- Documents available at: <https://www.epa.gov/septic>



Local Examples of Workforce Development

- Suffolk County: Septic Improvement Program.
- New York State Center for Clean Water Technology and Stony Brook SoMAS graduate program.
- Important contribution to research as well as creating a highly trained workforce to advance decentralized wastewater treatment.



Septic Improvement Program

Suffolk County continues to effectively transition from the use of outdated cesspools and septic systems to Innovative and Alternative Onsite Wastewater Treatment Systems (I/A OWTS).

Under the County's [Septic Improvement Program](#), homeowners are eligible for a grant for the purchase and installation of an approved I/A OWTS and associated engineering and design services. Under the program, homeowners who decide to replace their cesspool or septic system with the new and advanced technologies are eligible up to \$30,000 in grants from Suffolk County and the [New York State Septic System Replacement Fund](#) to offset the cost of one of the new systems. In addition to the grant, homeowners can qualify for low interest loans from Community Development Corporation of Long Island for up to \$10,000 to cover any additional costs such as engineering and soils analysis.

As of April 16, 2020, 1494 people have applied for the grants, of which 370 systems have been installed, with an additional 205 installations pending and 187 in progress. Outside of the County SIP program, there have been 418 systems installed for a total of 788 throughout the county. Some of these additional installations were funded by other sources including town Community Preservation Funds and the State Septic System Replacement fund.



Innovative/Alternative Onsite Wastewater Treatment System Installation (Fuji Clean CEN Series) - Photo Credit: Suffolk County

**Excerpt from the April 2020 NYSDEC
newsletter**

EPA Regional Initiatives

**3. Promote the benefits of
advanced decentralized treatment
technologies**

The Challenge of Nutrient Removal

- Globally excess nutrients are a severe threat to coastal environments
- Nitrogen load from conventional septic systems is a threat to drinking water and coastal resources
- Nitrogen-reducing Innovative/Alternative (I/A) onsite technologies are available, but are costly and not yet in widespread use
- Widespread use presents governance and funding challenges.
- State and local I/A approval processes can be lengthy due to understandable caution about long-term performance and operation and maintenance
- Performance demonstration with in-person sampling is costly, episodic, and short term



EPA's Emphasis on Nutrient Reductions

- EPA recognizes that nutrient pollution is a continuing and growing challenge with profound implications for public health, water quality, and the economy.
- Does not come with new funding but seeks to leverage existing resources and promote collaboration.
- EPA seeks action to address decentralized systems, including promoting financing options, conducting an Advanced Septic System Nitrogen Sensor Challenge, and supporting research pilots and demonstration projects for innovative/alternative septic systems.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF WATER

April 5, 2022

MEMORANDUM

SUBJECT: Accelerating Nutrient Pollution Reductions in the Nation's Waters

FROM: Radhika Fox
Assistant Administrator

A handwritten signature in black ink, appearing to be "Radhika Fox".

TO: State Environmental Secretaries, Commissioners, and Directors
State Agriculture Secretaries, Commissioners, and Directors
Tribal Environmental and Natural Resource Directors

East Coast Geographies

At least 2.6 million conventional systems in vulnerable coastal areas:

- ~340,000 Cape Cod, RI, CT
- ~500,000 Long Island, NY
- ~300,000 Coastal FL

and more in coastal NH and other locations.

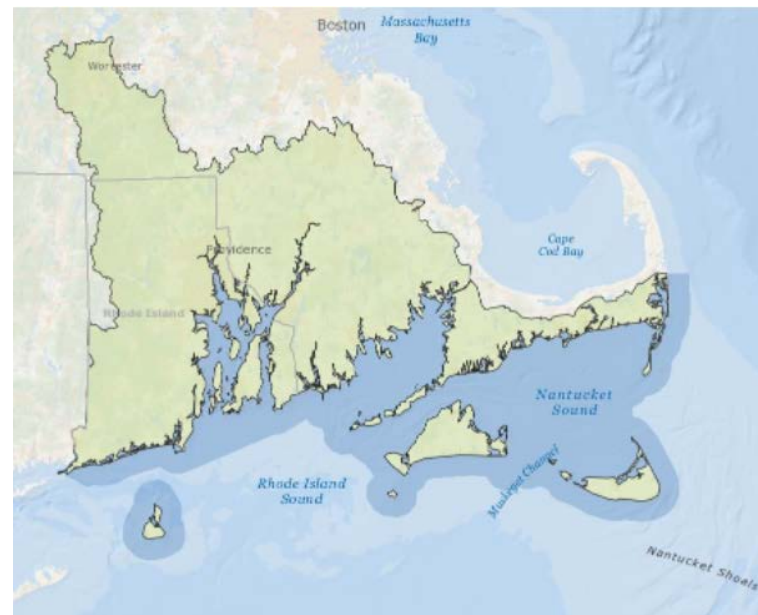


Long Standing EPA Region 2 Collaboration with Suffolk County

- 2012 Clean Watersheds Needs Survey
- Nitrogen is Public Enemy #1
- Suffolk County Septic Tour, March 2014
- IBM Smarter Cities Challenge, June 2014
- Annual *Septic Smart Week* Events
- New England data sharing agreement
- *Long Island Groundwater* Meetings April 2014 – June 2016
- Suffolk Co nutrient issues sustainability conceptual model
- Suffolk Co Subwatersheds Wastewater Plan

Our Neighbor to the North – EPA Region 1 Southeast New England Program

- Established in 2012, funded since 2014 and led by EPA Region 1
- Rhode Island and S.E Massachusetts
- Other geographic areas stand to learn from SNEP projects and initiatives in southern New England such as Watershed Implementation Grants that could focus on planning and assessment that looks at adoption of I/As, wastewater management districts, and alternative funding mechanisms.



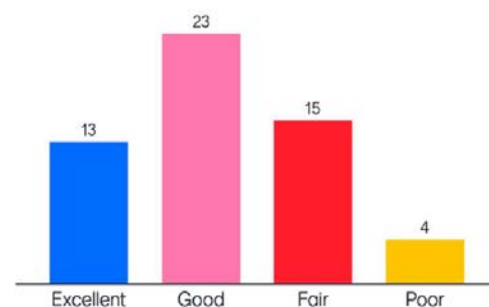
SNEP I/A OWTS Workshop - June 2021

Stakeholder Input

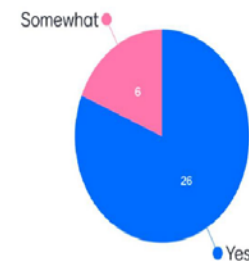
What are some of your concerns regarding the implementation of I/A systems?



I would describe my knowledge of I/A systems to be...



Do you believe that I/A systems are a promising technology that should be pursued for nutrient attenuation?



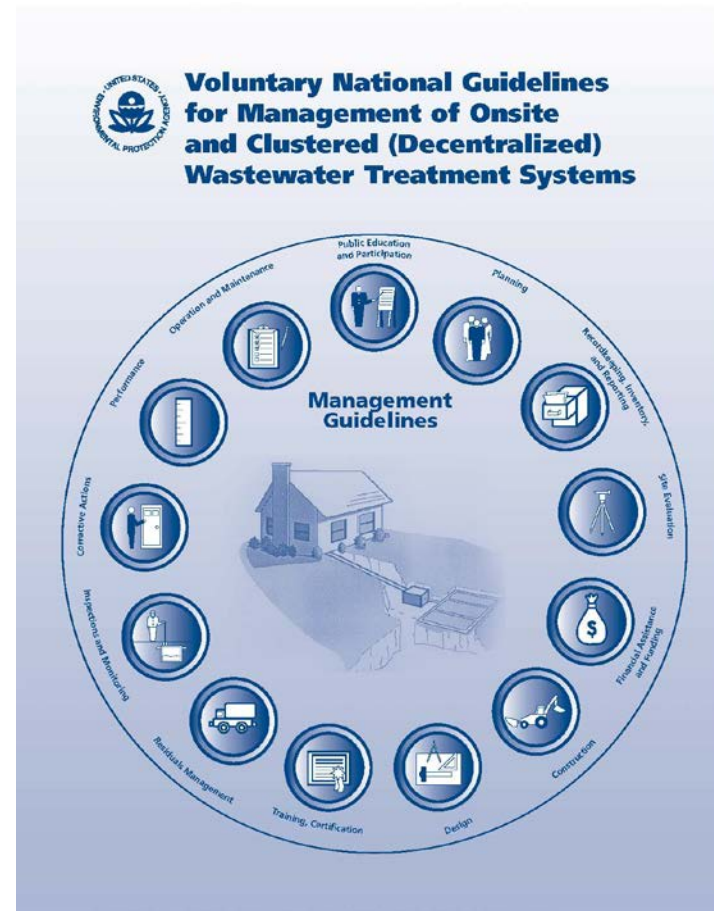
SNEP I/A Stakeholder Needs

- Support states and municipalities in the creation of Responsible Management Entities, provide guidance
- Assist with incentives and grants for adoption of systems
- Establish and maintain regional data-sharing agreements
- Facilitate stakeholder workshops to identify information gaps
- Elevate the importance of I/A in addressing water quality issues
- Define positive results and benefits of widespread I/A use
- Incentivize I/A technological advancements with technology grants
- Subsidize initial O&M costs until sufficient systems are installed to establish an RME

SNEP Competition for Responsible Management Entity (RME) Development

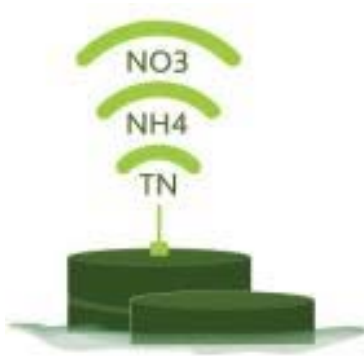


- RME is a term of art put forward in EPA's 2003 Voluntary National Management Guidelines
- RMEs can address many of the governance, finance, and management issues presented by reliance on large numbers of I/A OWTS's
- SNEP issued a competition to make \$2.3 million available for RME development
- Entire community stands to benefit



Another part of the solution – supporting better and smarter onsite wastewater treatment

- EPA's Advanced Septic System Nitrogen Sensor Challenge, 2017 – 2021
- Develop a nitrogen sensor that could be deployed in I/A OWTS's



Ultimate goal - integrate and expand use of I/A Onsite Technologies

The I/A Nitrogen Sensor would be:

- ▶ Less expensive, accurate, and autonomous
- ▶ Ideally measure Total Nitrogen; but minimum nitrate and ammonium
- ▶ Require no more than quarterly servicing

Co-benefit: Job Creation

- ▶ Technology innovators, *skilled* system installers and service providers, monitoring personnel

Test and Quality Assurance Plan (T/QAP)

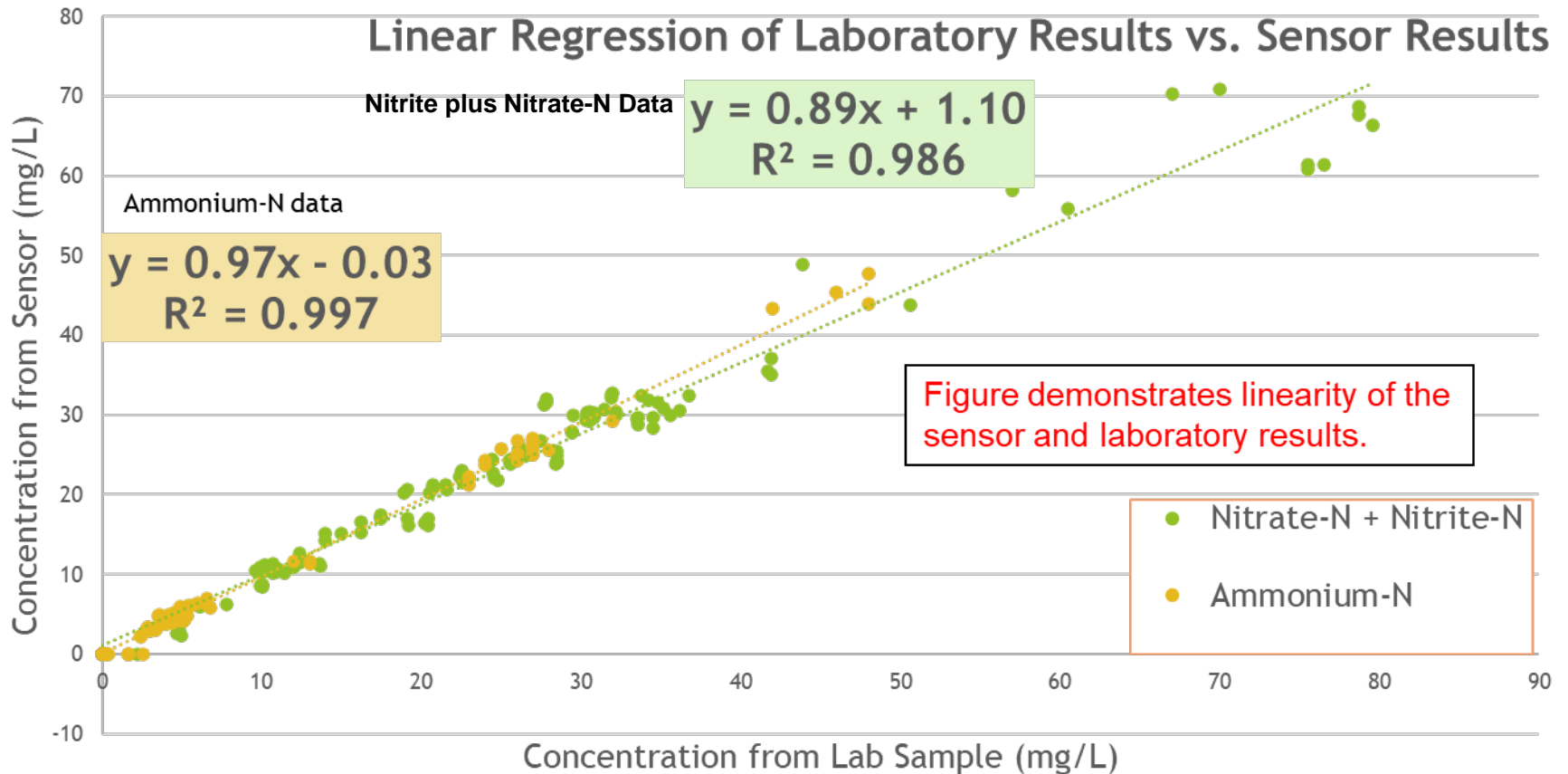
Performance Goals

- Cost: under \$1,500
- Parameters: Total Nitrogen (ideal), nitrate, nitrite, ammonium, organic carbon
- Autonomous hourly readings
- No more than quarterly servicing
- Accuracy: 20% of lab values
- Precision: 20-30% RSD
- Range: 2-60 mg/L as Nitrogen
- Size: Under 1 ft³

Achievements

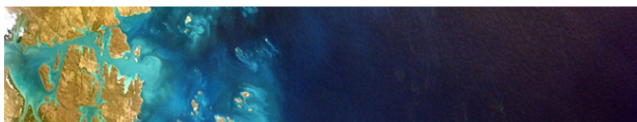
- T/QAP developed with Technical Panel of experts and stakeholder input
- Validated methodology through repeated prototype testing and statistical evaluation
- T/QAP available for future septic sensor developers as reference for testing outside of challenge

US EPA Advanced Septic System Nitrogen Sensor Challenge and ISO 14034 ETV Performance Verification Stony Brook University Sensor





Verification Statement



Stony Brook Nitrogen Sensor
Registration number: (V-2021-09-01)
Date of issue: 2021-September-23

Technology type	Nitrogen Sensor		
Application	Sensor for real-time nitrate plus nitrite and ammonium measurement in wastewater treatment system effluent		
Company	The Research Foundation for the State University of New York		
Address	Stony Brook University, Intellectual Property Partners N5002 Melville Library, Stony Brook, NY 11794-3369 USA	Phone	1-631-632-4163
Website	www.stonybrook.edu/commcms/ipp/	E-mail	donna.tumminello@stonybrook.edu

Verified Performance Claim

Operating at a temperature not lower than 4°C under low sample turbidity, a single Stony Brook Nitrogen Sensor unit provides simultaneous detection and measurement of nitrate plus nitrite and ammonium concentrations with no interferences from cations, anions, and dissolved organic matter in domestic wastewater matrices, with varying frequency of readings (hourly, daily, weekly, monthly).

Verified performance of the sensor, based on third-party testing over a six-month period, includes the following:

Measured Parameters: Nitrate (NO₃⁻) plus nitrite (NO₂⁻) and ammonium (NH₄⁺) in a single sample stream

Accuracy: Bias ≤ 20 % using wastewater (as defined in the Test/Quality Assurance Plan¹) with self-calibration, self-cleaning and self-sensor recovering after power outage

Precision: RSD ≤ 20 % using wastewater (as defined in the T/QAP)

Selectivity: No interferences from cations, anions, and dissolved organic matter in wastewater

Response range: 2 to 70 N-mg/L for NO₃⁻, NO₂⁻, NH₄⁺

Limit of detection: 2 N-mg/L

Measurement frequency: Variable frequency of readings (hourly, daily, weekly, monthly)

Data management: Record and automatically transmit data to designated server on the cloud, including remote capability of programming variable sampling frequencies.

¹ Test Quality Assurance Plan (T/QAP) Phase II of the Advanced Septic System Nitrogen Sensor Challenge, Revision 3.0, June 2019, Battelle and EPA, 2019

Septic Nitrogen Sensor Successfully Completes Environmental Performance Testing

October 13, 2021

Contact Information

David Deegan (deegan.dave@epa.gov)
(617) 918-1017

BOSTON – An innovative sensor technology to provide real-time information on the amount of nitrogen in wastewater has been developed as part of a U.S. Environmental Protection Agency (EPA) research challenge. The sensor has completed rigorous field testing on Cape Cod. The new technology shows strong potential for use in coastal areas where excess nutrients from septic systems adversely affect water quality in nearby surface and groundwater.

The nitrogen sensor designed for use in advanced treatment septic systems was developed by Dr. Qingzhi Zhu at the School of Marine and Atmospheric Sciences, New York State Center for Clean Water Technology at Stony Brook University in Stony Brook, N.Y. This project won EPA's "Advanced Septic System Nitrogen Sensor Challenge" in 2020 after an international competition to advance the development of low-cost sensors to measure nitrogen levels discharged from advanced septic systems.

The sensor has now completed extensive independent third-party testing performed at the Massachusetts Alternative Septic System Test Center in Sandwich, Mass. The prototype sensor was exposed to wastewater effluent from standard, as well as advanced, nitrogen-reducing septic systems for six months. The sensor was tested with effluent receiving various levels of treatment, a simulated septic system failure, and a septic system during a simulated power outage. The testing successfully verified the long-term performance of the new technology in the field and promises to aid efforts to address significant estuarine water quality and ecological problems caused by excess nitrogen.

"The ability to measure nitrogen concentrations in the effluent exiting advanced septic systems will provide real-time data on the performance of these systems and help safeguard water quality in coastal communities," said EPA New England Acting Regional Administrator Deb Szaro. "I applaud the determination and creativity shown by Dr. Zhu and his team, and by EPA scientists in pursuing the goal over many years to develop technology for these measurements. EPA is hopeful that this new technology will increase the viability and use of innovative/ alternative septic systems, which are an integral part of our region's future wastewater treatment infrastructure as we move to address the ecological issues caused by high levels of nitrogen."

The groundbreaking sensor is designed to be used in innovative/alternative nitrogen-reducing septic systems (I/A systems). The Stony Brook University team and the New York State Center for Clean Water Technology believe that the commercial adoption of the sensor can help increase consumer and regulator confidence in the performance of I/A systems, leading to more widespread use by homeowners, municipalities and other organizations seeking to reduce nitrogen pollution and restore coastal water quality.

Conventional septic systems are not designed to remove nitrogen from wastewater. Nitrogen from conventional residential septic systems, along with excess nitrogen from lawn fertilizer and other sources, enters groundwater and eventually surface water where it can cause harmful algal blooms, low dissolved oxygen, and fish and shellfish kills. In contrast, I/A systems are specifically engineered to turn the nitrogen in wastewater into harmless nitrogen gas. The nitrogen removal performance of these systems has traditionally been determined by sampling and lab analysis, which are costly and labor intensive. With the new sensor technology, nitrogen concentrations in the effluent leaving an I/A system are measured directly and transmitted electronically to remote locations in near-real time. Stony Brook University has already begun to deploy prototype sensor units in I/A systems that are being installed on Cape Cod and Long Island, with plans to deploy more in the future.

Moving Onsite Wastewater Treatment into the 21st Century

- **Increased expectations for advanced onsite technologies as an essential, environmentally-sound, and *permanent* part of U.S. wastewater treatment infrastructure**
 - *More complex* technology requires more sophisticated management, governance, and funding mechanisms
- **Sensored I/A systems that will optimize/maximize pollutant reductions**
 - Underserved or unsewered areas, coastal and otherwise will have access to better performing, more sophisticated, 21st century onsite wastewater treatment
- **Follow-on Technology Challenges**
 - Use machine learning and big data approaches to optimize I/A performance across multiple parameters; N reduction, energy use, etc.
 - Advance smart onsite systems that incorporate multiple sensor technologies

For more information

EPA Septic Home page: <https://www.epa.gov/septic>

EPA Septic outreach tool kit: <https://www.epa.gov/septic/septic-systems-outreach-toolkit>

Financing Decentralized projects with CWSRF: <https://www.epa.gov/system/files/documents/2022-02/financing-dwts.pdf>

Education and Training Landscape: Providing a Supply of Talent for Decentralized / Onsite Wastewater Occupations: https://www.epa.gov/system/files/documents/2021-09/education_training_landscape.pdf

Building a Decentralized Wastewater Training Program:
https://www.epa.gov/system/files/documents/2021-10/decentralized_partnershipsguide.pdf

Pipeline to a Sustainable Workforce: Decentralized/Onsite Wastewater Occupations:
<https://www.epa.gov/septic/pipeline-sustainable-workforce-decentralizedonsite-wastewater-occupations>

EPA Voluntary National Guidelines for Management of Onsite and Clustered ...
https://www.epa.gov/sites/default/files/2015-06/documents/septic_guidelines.pdf

VerifiGlobal ISO 14034 Performance Verification and T/QAP:
<https://www.verifiglobal.com/media/ximlsxwg/verifiglobal-verification-statement-for-stony-brook-nitrogen-sensor-2021-09-24-signed.pdf> and <https://www.verifiglobal.com/media/v4bdtsyn/revision-3-tqap-june-2019-final.pdf>

Southeast New England Program: <https://www.epa.gov/snep>

Thank you!

Heinemann.kristina@epa.gov

Flood.michael@epa.gov