Coastal Watershed Septic System Nutrient Loading, Resource Risk Assessment and Funding Strategies for Mitigation

Matthew J. Dowling[1], Kristen Hemphill[1, 2]

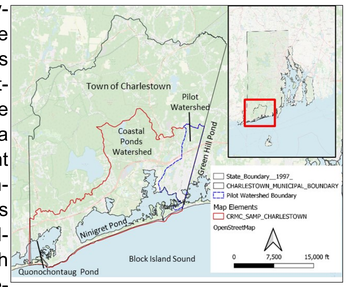
[1]Town of Charlestown, Rhode Island: Onsite Wastewater Management Program and the Laboratory of Applied Watershed Management
[2]University of Rhode Island, Natural Resources Science

Town of Charlestown, R.I. On-Site Wastewater Management Program
Water Resource and Environmental Protection

INTRODUCTION

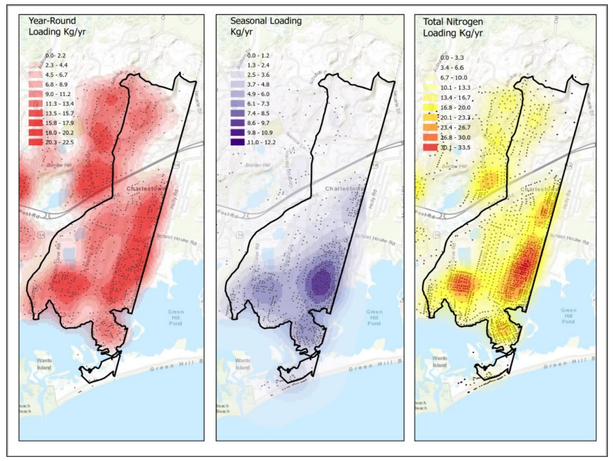
Like many communities in the northeastern USA, the Town of Charlestown (RI) relies heavily on onsite wastewater treatment systems (OWTS) to manage residential and commercial wastewater and on groundwater as a potable water source. Charlestown is also a coastal community situated on three coastal salt ponds along the south shore of RI. The town's highest densities of OWTS are located within proximity to these ponds, with some areas exceeding 10 OWTS per acre. Further, the town's economy is primarily based on the coastal zone where tourism, recreation, and coastal businesses thrive.

OWTS can be an effective method of managing wastewater in the absence of a sewer system by treating and recycling wastewater onsite. Yet, even in the best circumstances, not all pollutants are removed during wastewater treatment. Conventional septic systems are typically effective at removing bacteria and pathogens; however, the pollutant nitrogen (N) remains at elevated concentrations in septic effluent plumes from older conventional and substandard systems and is problematic for both human health and surface water resources.



METHODS

Calculating Watershed Nitrogen Loading

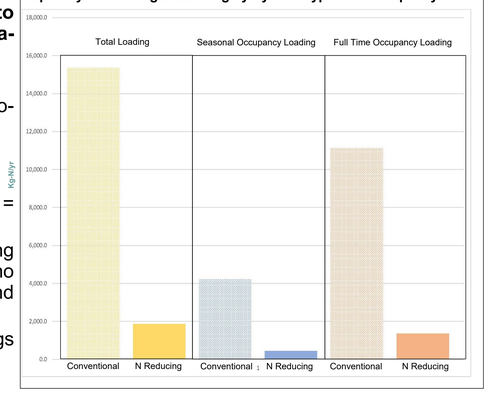


In kind replacement of an older conventional system to N reducing technology currently (in 2023) costs >$30,000. **Here we developed a risk assessment program to identify sites for grant funded OWTS upgrades to modern N reducing technologies to realize the highest returns for water resource protection.**

We first calculated annual nutrient loading to the Pilot Watershed in kilograms of nitrogen per year by using:

- System flow at 115 gallons per bedroom per day,
- Effluent Nitrogen Concentrations mg/L, by septic system type = Nitrogen Reducing Technology (19 mg/L) or Other (65 mg/L),
- Drainfield Type = An additional 3 mg/L reduction for any N reducing OWTS that uses a shallow pressurized dosed drainfield and no additional N reduction for gravity drainfields or for bottomless sand filters, drainfield type, and
- Occupancy (seasonal or full time) - Seasonal occupied dwellings received 1/3 of the flow of full time occupied dwellings

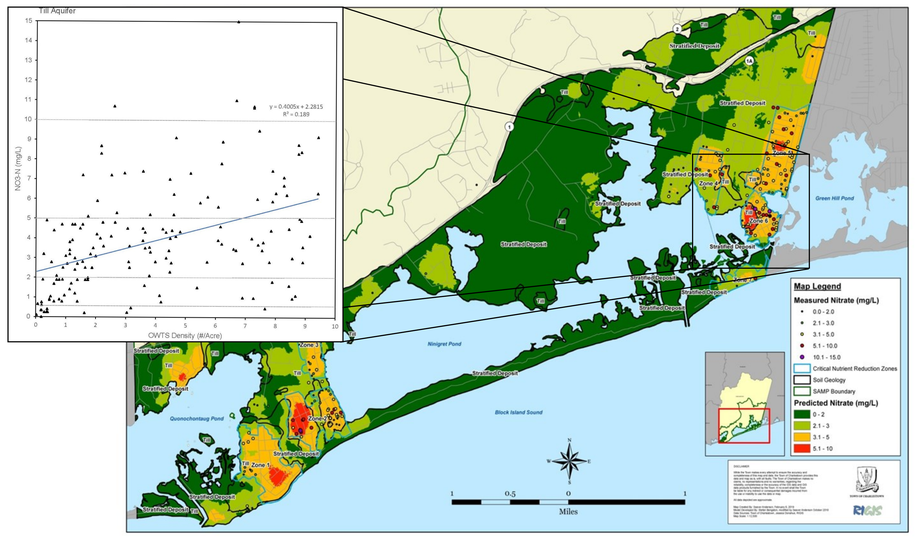
Greater Allen's Cove / Eastern Ninigret Pond Pilot Watershed Annual Septic System Nitrogen Loading by System Type and Occupancy



The results were quantified and modeled with GIS using kernel density estimation to determine the probability density of N loading separately for full time occupied and seasonally occupied and then for total. Mapped results are displayed on the panel to the **left** and loading is summarized graphically **above.**

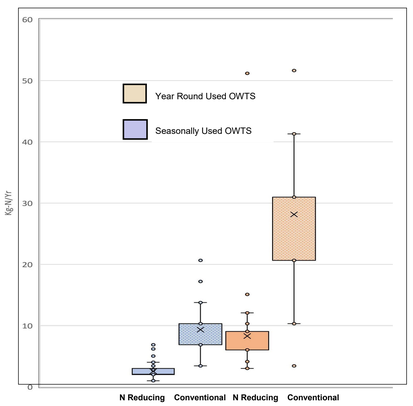
PROBLEM

Models indicate nearly 80% of groundwater N concentrations in these densely developed coastal areas originate from OWTS effluent, where over 70% of OWTS still utilize older conventional and substandard OWTS technologies. We have correlated a significant relationship of groundwater N concentrations to the density of OWTS and determined that the mean groundwater N concentration in our coastal zone is >3 mg/L, indicative of high risk for source water pollution. **Upgrading older OWTS to N reducing technologies is the primary mechanism to mitigate N loading to these watersheds.**



RESULTS

Per OWTS Annual Nitrogen Loading by System Type and Occupancy



38 responses were received (17%). Applicants were then ranked based on a 12 point risk ranking criteria protocol and the top sites were selected to enter into the upgrade program.

Seven sites will be upgraded by the July 2023 for a total annual N reduction of 81.1 Kg-N per year.

Eight additional sites will be upgraded for a total annual N load reduction of **>150 Kg/Yr.**

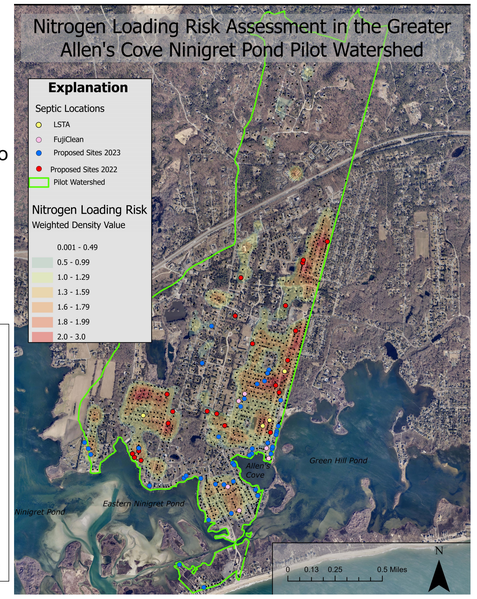
The current calculated total annual N loading to the pilot watershed is 17,219 Kg/yr. Using the loading analysis, we determined a Loading Risk Assessment by creating an overlay of N loading hotspots from the loading assessment and weighting systems within a 200 foot buffer to coastal features or wetlands. We then visually identified the neighborhoods within the pilot watershed where risk was observed highest.

SNEP grant funds are used to reimburse OWTS owners 75% total cost, up to $18,000 for in-kind replacement of a substandard OWTS in high risk zones to modern N reducing technology.

The Town offers 1% financing through the RI State Revolving Fund to finance remaining costs.

219 "Highest Risk Sites" for N loading were identified and correspondence for grant funded upgrade applications were sent in two mailings.

Upgrade Site Number	New OWTS Type	Pre Upgrade Annual N Loading	Post Upgarde Loading	Annual N Load Reduction
		kg-N/yr	kg-N/yr	kg-N/yr
Site 1	Experimental Layered Soil Treatment Area	30.98	9.6	**21.38**
Site 2	FujiClean CEN5 / GeoMat	10.33	2.07	**8.26**
Site 3	FujiClean CEN5 / Pressurized SNDF	6.88	1.28	**5.6**
Site 4	FujiClean CEN5 /BSF	10.33	3.02	**7.31**
Site 5	FujiClean CEN5 / Pressurized SNDF	30.98	6.2	**24.78**
Site 6	FujiClean CEN5 / Pressurized GST	6.88	1.38	**5.5**
Site 7	FujiClean CEN5 / Pressurized SNDF	10.33	2.07	**8.26**
	Total Annual kg-N/yr Reduction			**81.09**



This project is funded by an EPA SNEP Pilot Watershed Grant [00A00962] and the Town of Charlestown [AWD08519].
Project partners: New England Onsite Wastewater Resource Center, New England Onsite Wastewater Training Program, University of Rhode Island Laboratory of Soil Ecology and Microbiology, Salt Ponds Coalition and Save The Bay

EPA United States Environmental Protection Agency
SNEP Southeast New England Program
THE UNIVERSITY OF RHODE ISLAND Onsite Wastewater Resource Center