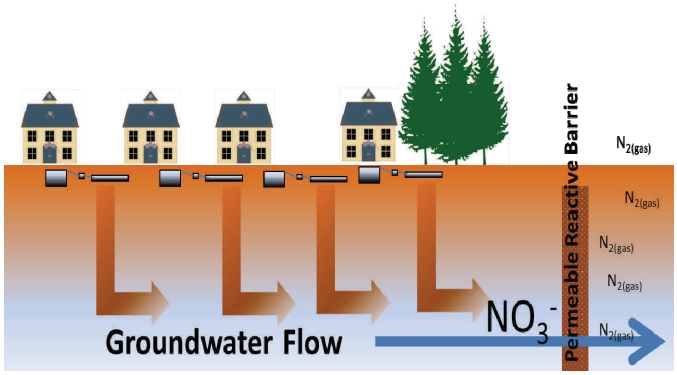
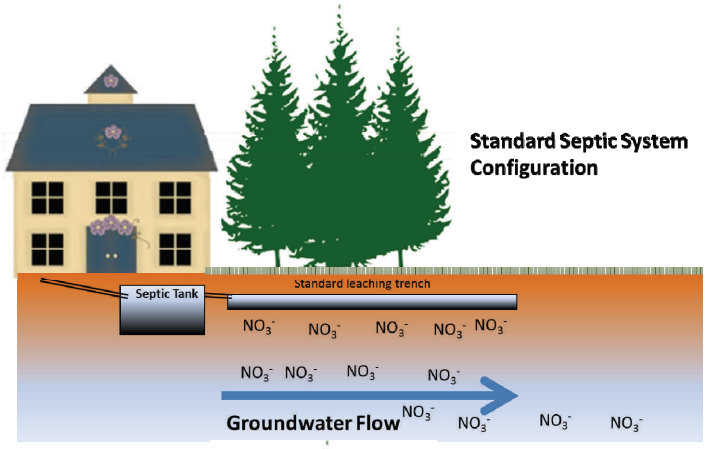
Sawdust may play an important role in saving our bays

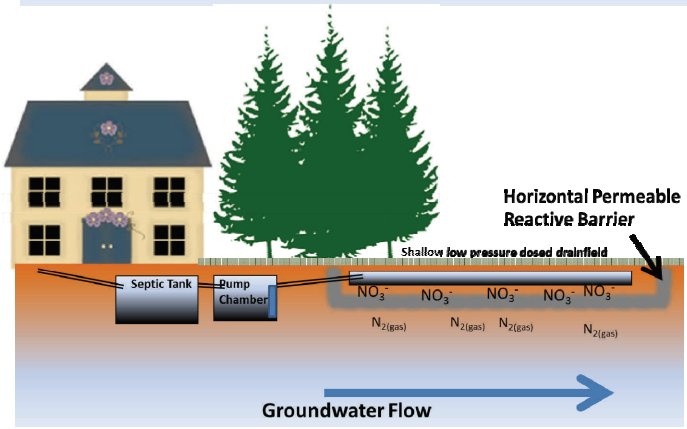
With funding from various sources, staff of the Massachusetts Alternative Septic System Test Center (MASSTC) operated by Barnstable County Department of Health and Environment have been experimenting with a simple technique of layering soil mixed with sawdust in certain ways beneath a standard soil treatment area (STA - alternately known as soil absorption systems or leaching fields) in order to reduce nitrogen loading. The principle is fairly simple. Components of a standard STA generally convert the ammonia-nitrogen in septic tank effluent into nitrate. If the percolating nitrate-laden effluent can be directed through a layer of sawdust matrix and certain conditions can be maintained, then the nitrate can be reduced to nitrogen gas. Thus, the nitrate-nitrogen wastewater that would have passed through a standard STA and produced offensive algae in our bays is converted to a harmless gas vented to the atmosphere. *The focus of our study has been to research simple inexpensive ways to produce these sequential conditions necessary to complete the above-described process.*

The present efforts mimic well-known principles to determine whether various placement and configurations of sawdust in a STA can be used as a carbon source to support denitrification. Many readers may be aware that the Nitrex™ system, a proprietary in-tank system that also uses woodchips held in an anoxic condition following advanced treatment, removes a high percentage of nitrogen from wastewater. In addition vertical reactive barriers using woodchips (alternately called permeable reactive barriers or PRB) have been used to mitigate groundwater plumes containing nitrate as illustrated here. Basically carbon in the form of woodchips is placed down gradient of a groundwater plume of nitrate and beneath the water table in the form of a permeable "barrier", causing a reduction of the nitrate to nitrogen gas as the plume passes through the permeable barrier. The reactive zone containing wood chips provides the carbon and anoxic conditions necessary for denitrification.



The Florida State Department of Health recently invested millions of dollars to see if this same principle of using wood as a carbon source to facilitate denitrification could be incorporated into individual onsite wastewater treatment system (OWTS). They found >85% removal could happen in the STA if it was modified with layers of lignocellulose (technical name for wood). These Florida configurations however still had some complexities that translate to higher costs. Following a review of the Florida data and other publically funded projects along with discussions with those principle investigators from Florida and others, MASSTC staff sought to adapt those same techniques to our area on Cape Cod. There were some fundamental changes that had to occur based on a number of soil column experiments (small simulated leachfields), but most indicated changes seemed feasible. The next step of placing large full-scaled systems at MASSTC is currently underway using two modifications of the Florida designs as well as one design that copies experiments conducted in the early 90's by University of Waterloo Professor Will Robertson. This latter effort illustrated below and compared with a standard septic system configuration introduces the same basic principle as the *vertical* barrier previously discussed but turns *it horizontally* and places it di-





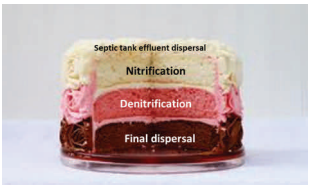
An added benefit of the shallow drainfields used in all the designs used is the ability to support lush lawn growth obviating the need for fertilizer or additional water

The demise of many oak trees on Cape Cod may result in the increased availability of sawdust that can be used in all of the denitrification designs used.

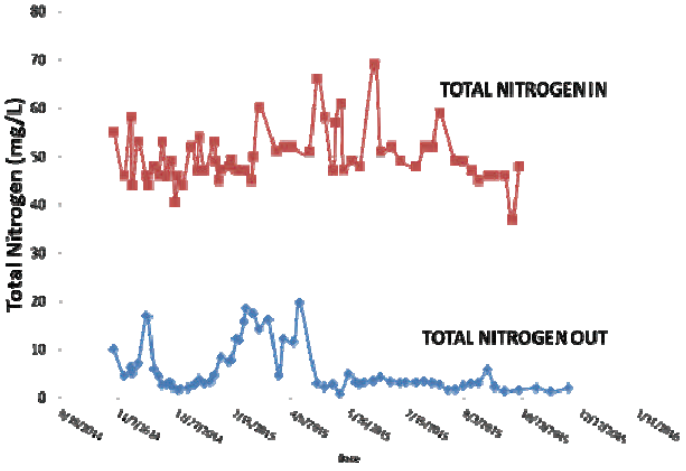
rectly below the leaching component to intercept nitrate-laden percolate. The preliminary first year results from this particular design are promising, suggesting that at least 50% and up to 90% was removed in the first year of the test. Working with the Florida researchers and others in Rhode Island and Suffolk County Long Island, we are hoping to develop an open-source design that optimizes nitrogen removal in a STA. The goal is to have total excavations (leachfield and sawdust-soil layer) not exceed four feet. The one complexity our designs is the requirement of a low-pressure dosed (LPD) septic tank effluent distribution system. In short, LPD distributes the septic tank effluent evenly across the STA using a pump and small diameter (one-inch) pipe. Alternately, a drip-dispersal unit could be used at some increased expense. As we continue to test our full scale systems at the Test Center, we will be watching closely as winter ensues and many biological systems have a slowdown in their performance. Although at MASSTC the full scale systems are tested using real wastewater from residential housing and at full design capacity, the proof will be the performance in actual homeowner situations. Recently, BCDHE partnered with the Buzzards Bay Coalition, the University of Rhode Island and Florida investigators in a proposal to EPA that puts the whole package together: home testing, validation, design manual compilation and investigating permitting issues and regulatory agency concerns.

Cautiously optimistic.

While initial small scale and large scale experiments look promising, there are still a number of aspects of the design that need to be validated. Foremost, in the unsaturated-flow systems, which is simply a layering of a sawdust-sand mixture under a somewhat standard STA, we must confirm that the lignocellulose will not compost (aerobically break down) at a rate such that the carbon for denitrification will be exhausted too quickly. In addition, in the saturated flow systems the more complicated aspects of maintaining saturation need to be worked out. Still the results thus far appear to suggest that one of these techniques may be a viable option. The team assembled and individuals conferred with are among the top practitioners in the field of onsite septic systems and include Damann Anderson and others from Hazen-Sawyer. This investigator is a lead researcher from the Florida Onsite Sewage Nitrogen Removal Study (FOSNRS) and is presently working with the Suffolk County efforts to validate the layering strategy. We also actively collaborate with The Laboratory of Soil Ecology and Microbiology (LSEM) and The New England Onsite Wastewater Training Center (NEOWTC) Program at the University of Rhode Island. The LSEM, under the guidance of lead scientist Jose Amador, has conducted landmark research in OWTS performance and the impacts of climate change on OWTS. George Loomis, the Director of the NEOWTC Center has been instrumental in completing design guidance documents for non-proprietary OWTS septic system technologies that have been accepted by Massachusetts, Vermont, and Rhode Island. This skill will be invaluable for moving this strategy into the regulatory codes and guidelines. Although it is too early to say, it may be that the tragedy of dying oak trees on Cape Cod may have one "silver lining" by providing the very byproduct used in cleaning our marine coastal waters.



*The concepts described here could be thought of like a **layer cake** where septic tank eluent passes sequentially through a layer for nitrification, denitrification and then final dispersal*



Results from one of the three designs being tested at the Massachusetts Alternative Septic System Test Center

For more information on this project and the various research efforts, contact

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