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Advanced Septic System Feasibility Study

Town of Exeter, New Hampshire

Prepared for

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EXECUTIVE SUMMARY

Nutrient pollution from septic systems is a major concern in the Piscataqua Region Watershed. Traditional septic systems primarily focus on sanitizing by eliminating or deactivating harmful organisms, and the recognition of nutrients as contaminants is a more recent development. Consequently, it's necessary to modify the design and implementation of septic systems to diminish the discharge of nutrients from these systems. One of the modifications includes the use of advanced technologies (whole systems and/or system components) aimed at removing nitrogen from septic system effluent.

This study evaluates the location, suitability, and a framework for an advanced septic system technology program for the Town of Exeter. Many septic system upgrade or advanced septic system technology programs receive funding to support implementation and administration of the program. Without incentives, many property owners would fail to pay additional money to upgrade their septic system with an advanced treatment technology. Therefore, many existing septic system upgrade programs offer incentives to property owners for their participation in the upgrade or retrofit programs.

As the Town explores the means to address nitrogen loading from septic systems and whether a Town administered advanced septic system technology program is feasible, some recommendations and next steps are outlined below.

- Establish an area of priority septic systems that would be considered if an advanced septic system technology were to be established.
- Establish suitability criteria to assist with defining the priority septic systems.
- Develop a map of the priority septic system area.
- Establish a Priority Septic System Overlay District.
- Establish regulations to encourage the use of advanced septic system technologies in the Priority Septic System Overlay District.
- Implement a pilot program to plan and install an advanced septic system in the Town.
- Coordinate with NHDES to understand what steps the state is taking to approve advanced septic system technologies for use in New Hampshire.
- Provide education and outreach to users of septic systems on advanced septic system technologies.
- Provide education and outreach to users of septic systems on steps the state and Town are taking to mitigate water quality impacts from septic systems in priority areas.

1. INTRODUCTION

Nutrient pollution from septic systems is a major concern in the Piscataqua Region Watershed. Traditional septic systems primarily focus on sanitizing by eliminating or deactivating harmful organisms, and the recognition of nutrients as contaminants is a more recent development. Consequently, it's necessary to modify the design and implementation of septic systems to diminish the discharge of nutrients from these systems. One of the modifications includes the use of advanced technologies (whole systems and/or system components) aimed at removing nitrogen from septic system effluent.

The Town of Exeter ('Town') understands that septic systems may contribute to water quality impairments in downstream water bodies. Therefore, the Town applied for a Clean Water Act (CWA) Section 319 Watershed Assistance Grant through the New Hampshire Department of Environmental Services (NHDES) to conduct a feasibility study for development of the framework for an advanced septic system technology program.

This study explores how the Town might select the optimal retrofit locations, describes different types of advanced septic system technologies, potential amendments to the Town's current zoning and health regulations, potential funding sources, and incentive programs. The Town will use this study to determine if implementing an advance septic system technology program in the Town is feasible and what the next steps would be.

The following tasks were completed to prepare this report:

- Identification of septic system users within the Town
- Development of list of suitability criteria to prioritize participation in an advanced septic system program
- Development of a list of advanced septic system technologies
- Review of current regulations within the Town and suggested amendments to those regulations that would support an advanced septic system technology program
- Identification of potential funding mechanisms that could be used to fund the program
- Identification of incentive programs the Town may consider
- Recommendations and next steps

1.1 UNH Expert Panel Process for Advanced Septic System Technologies

In 2023, the University of New Hampshire convened an expert panel to provide policy recommendations to NHDES related to using advanced septic system technologies to remove or retain nitrogen and phosphorus from wastewater[1].

The noteworthy recommendations from the expert panel report, that are applicable to the Towns' efforts targeting nitrogen, include:

- New Hampshire should provide a rapid pathway to "general approval with conditions" for advanced septic system technologies that have been approved in Massachusetts, Rhode Island, and Suffolk or Nassau counties in Long Island, New York.
- Establish an inspection, maintenance, and monitoring program for advanced septic systems.
- Establish and maintain a database of septic system inspection and/or monitoring results.
- Map nutrient sensitive areas and require adequate wastewater nutrient treatment in these areas.
- Establish a training program for advanced wastewater professionals.
- Form an advanced septic system technology pilot program in New Hampshire.
- Establish a low-interest loan program capable of offering rapid support to homeowners facing an unexpected need to replace or upgrade their septic system.
- Make nutrient reduction a factor in site evaluation and system design.

[1] Expert Panel Process for Advanced Septic System Technologies

2. USERS, SUITABILITY, AND REGULATORY AUTHORITY

2.1 Identification of Septic System Users

A map of the parcels in Town currently served by septic systems was prepared (Attachment A). To develop this, geographic information system (GIS) data was reviewed to determine what parcels were served by sanitary sewer. All parcels not served by sanitary sewer, or with a sanitary sewer line near to it if not currently developed, were determined to be served by septic systems. Based on the analysis, approximately 36% of the parcels in Town (1,488) are or could be serviced by septic systems.

2.2 Suitable Criteria

To determine the optimal locations for retrofit of existing septic system with advanced septic system treatment technologies, suitability criteria should be evaluated. Potential suitability criteria are summarized in Table 1. The suitability criteria could be weighted, scored, and ranked if a program is implemented. Scoring could assist with ensuring the projects with the greatest overall value to water quality are implemented.

Table 1. Suitability Criteria

Criteria	Description
Location	Systems close to sensitive ecological areas, such as wetlands, rivers, lakes, and ponds, and proximity to drinking water supply wells should be prioritized for upgrades due to their potential for higher impact on water quality. Establishing a sensitive area setback and incorporating this into location regulations would be necessary.
Existing Nitrogen Contribution	Areas with high nitrogen contributions from septic systems or receiving water impaired due to nitrogen contributions from septic systems, especially those exceeding public health standards.
Estimated Nitrogen Reduction	Projects with the potential for high estimated nitrogen load reductions should be prioritized.
Underlying Soil Type or High Groundwater	Areas with sandy soils and high groundwater should be prioritized.
Population Served by System	Community septic systems or septic systems serving multi-family homes, which tend to have higher loading rates, should be prioritized.
Project Readiness	Ability and timeline of a project to be built should be prioritized.
Effectiveness of Current System	Systems which are poor working condition or in failure should be prioritized.
Regulatory Compliance	Compliance with local environmental regulations and requirements for new developments or redevelopment is necessary when upgrading to advanced systems.

2.3 Regulatory Authority

Septic systems in New Hampshire are regulated to ensure proper design, installation, operation, and maintenance to prevent pollution in public and private waters. Both NHDES and the Town are responsible for ensuring this. Here's a summary of the regulations:

- **Design and Installation**: Septic systems must be designed and installed by NHDES certified designers and installers. Proposed design plans and specifications are reviewed by NHDES to ensure proper siting, construction, and operation.
- **Approvals Required**: Before construction, an Approval for Septic System Construction must be obtained from NHDES. An Approval for Operation from NHDES is required before using a septic system.
- **Local Enforcement**: Health officers have enforcement responsibilities concerning septic systems according to state laws and Administrative Rules. Towns may order the replacement of failed systems and ensure that all occupied buildings have property sanitary conditions.

These regulations are in place to protect public health and the environment from the potential hazards of improperly managed septic systems.

2.3.1 Local Ordinance Review

While NHDES is responsible for establishing design guidelines and approves the installation of septic systems, the Town can impose regulations for septic systems to improve water quality. However, if NHDES does not support the use of alternative advanced septic system technologies, it may be difficult for the Town to require these be installed in environmental sensitive areas.

If the Town were to move forward with an advanced septic system technology program, the following regulatory amendments should be considered.

Potential areas in the current zoning ordinance for an amendment include:

- Update zoning ordinance to include a septic system priority overlay district. The overlay district could be based partly on the selected suitability criteria. Different zones could be added to the overlay district based the criteria selected.
- Section 9.2.3 General Regulations for the Aquifer Protection District requirements that apply to domestic wastewater disposal systems or septic systems could be expanded to a proposed "septic system priority overlay district". Other suggested amendments include:
    - Section 9.2.3.C.4. Septic System Design and Installation: This section could be expanded to include new design and installation guidelines that would encourage or require the selection of advanced septic system treatment technologies.
    - Section 9.2.3.E. Septic systems construction guidance reference documents could be expanded to include reference to the advanced septic system technologies.

- Section 9.3.4.C Building Setbacks: In the Exeter Shoreland Protection District Ordinance, regulates the distance a septic system or leachfield can be from the shoreline. These distances currently include within 300 feet from the shoreline of the Squamscott River, Dearborn Brook, Waterworks Pond, and Fresh River; within 150 feet from the shoreline of the Exeter River or the major tributaries of the Squamscott River and Exeter River as herein defined, or within 100 feet of the shoreline of perennial brooks and streams located within the Exeter Shoreland Protection District.
    - *Suggested Amendment:* The Town should consider whether these distances are protective enough of water quality. The Town may also consider encouraging or requiring the use of advanced septic system technologies within priority zone (said distance from the shoreline). If waivers are allowed within these buffer zones, the use of advanced septic system technologies should be encouraged to achieve nitrogen effluent concentrations below specific thresholds dependent on the specific buffer zone they are within.
- Section 9.4.5 New or Replacement Water and Sewer Systems: This section states there shall be no new or expansion of existing septic systems within the Special Flood Hazard Area, except to correct malfunctions of septic systems. Where replacement of existing water and sewer systems (including on-site systems) are proposed in a special flood hazard area the applicant shall provide the Building Inspector with assurance that these systems will be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters, and on-site waste disposal systems will be located to avoid impairment to them or contamination from them during periods of flooding.
    - *Suggested Amendment:* When malfunctions or replacement of existing on-site sewer systems are encountered within this area, advanced septic system technologies are encouraged/required.

3. ADVANCED SEPTIC SYSTEM TECHNOLOGIES

A literature review of advanced septic system technologies was conducted to determine the estimated cost, nitrogen reduction performance, constructability, and operation and maintenance (O&M) of each technology. In November 2023, the State of Rhode Island Department of Environmental Management released a list of alternative or experimental onsite wastewater treatment system technologies[2] (Attachment B). The technologies on the list are approved alternatives/experimental technologies for onsite wastewater treatment that have been approved by the state. The literature review of advanced septic system technologies is summarized in Table 2.

Table 2. Advanced Septic System Technology Summary

Advanced Septic System Technologies	Description	Cost[3,4]	Nitrogen Reduction Performance	O&M
AdvanTex AX20	A prepackaged packed bed filter that significantly reduces BOD and TSS inside a waterproof container installed after a two-compartment tank prior to discharge to a leachfield which may be reduced in size by 50%. When configured in Mode 3, this system is acknowledged as an approved nitrogen reducing system.	$18,750 - $21,150	TN ≤ 19 mg/L 71-76%	$260 per year, maintenance 1 time annually
Amphidrome Single Family System	The Amphidrome® system uses a submerged attached growth bioreactor process operating in a batch mode. The Amphidrome® system utilizes two tanks and one submerged attached growth bioreactor, called the Amphidrome® reactor. The first tank, the anoxic/equalization tank, is where the raw wastewater enters the system. The tank has an equalization section, a settling zone, and a sludge storage section. It serves as a primary clarifier before the Amphidrome® reactor.	$7,500- $15,000	TN <3 mg/L 59%	Up to $1,700 - $3,000 yearly
AquaKlear AK6S245	The system utilizes a clarifying trio and more compact all-in-one design it treats household wastewaters and releases it at a rate that is 98.8% cleaner than when it entered the system while leaving it odorless.	$13,750	54%	$300 per year, maintenance 1 time annually
BioBarrier	The System incorporates a Membrane Bioreactor (MBR) and uses three-compartment tankage either as a single three-compartment tank, or a single-compartment pre-treatment tank followed by a two-compartment tank. The	Varies based on design[5]	TN ≤10 mg/L	Requires minimal operator attention which results in

[2] Rhode Island Department of Environmental Management (ri.gov)

[3] Costs vary based on the site, type of system and design of system. For accurate costs, its best to contact the system manufacturer.

[4] Costs presented include estimated cost of technology or system and materials. Design, permitting, and construction costs are not included.

Table 2. Advanced Septic System Technology Summary

Advanced Septic System Technologies	Description	Cost[3,4]	Nitrogen Reduction Performance	O&M
	BioBarrier MBR is in the last of the three compartments in both configurations. The first compartment or tank provides primary treatment and is equipped with an outlet screening device (SaniTEE®). The second and third compartments must be in the same tank. Denitrification occurs in the second compartment of the System under anoxic conditions; a mixing pump installed in this compartment recycles some of the nitrified water through a baffle wall between the second and the third compartments (the aeration/membrane zone). The third compartment contains the Membrane Bioreactor, through which water passes for additional treatment prior to discharge to a leachfield by a float-activated discharge pump.			low maintenance costs
Bioclere Model 16, 24, 30 and 36 series	The Technology consists of a modified trickling filter positioned over a clarifier. Effluent from the septic tank enters the System and is pumped up to the top of the insulated unit where it is evenly distributed over the surface of the filter media. Biochemical oxidation takes place as the water trickles through the filter and over the biological film that grows on the surface of these randomly packed pieces of PVC plastic. Oxygen is supplied to the system through a small axial fan located in the top of the housing.	$7,500-$15,000 (for 16 series model)	TN≤19 mg/L 57%	Up to $1,700 - $3,000 yearly
Fuji Clean CEN 5, 7 or 10	The System is a single fiber-reinforced plastic tank divided into three chambers. Wastewater flows in a circuitous path through the sedimentation chamber to an anoxic chamber containing media followed by an aerobic chamber containing two types of media. Media in the System provide mechanical filtration and facilitate fixed-film and suspended-growth microorganisms' anaerobic and aerobic biodegradation of wastewater constituents, including conversions of nitrogen species to nitrogen gas. Wastewater and sludge are recirculated from the third chamber back to the sedimentation chamber. One small blower, a diaphragm compressor, provides aeration, airlift recirculation and airlift pump discharge of treated effluent to a leachfield. A 50% reduction in leachfield size is allowed for conventional leachfields.	$12,250 (for 5 series model)	TN ≤ 19 mg/L 77%	$300 per year + maintenance 2 time annually
Hoot BNR	The Hoot-NR (BNR) system, also known as the Hoot Nitrogen Reduction or Hoot Basic Nitrogen Reduction system, is a wastewater treatment solution designed to	$17,500	64%	$435 per year, maintenance

[5] Cost varies based on the size of the system based on hydraulic and organic loading and model based on population equivalent.

Table 2. Advanced Septic System Technology Summary

Advanced Septic System Technologies	Description	Cost[3,4]	Nitrogen Reduction Performance	O&M
	significantly reduce nitrogen levels. The Hoot BNR system is essentially a residential-sized municipal wastewater treatment plant that can fit in a backyard. It is a complete five-stage, activated-sludge aerobic unit that uses advanced aeration and time re-circulation to effectively process and treat wastewater. It's perfect for challenging sites like small lots, steep slopes, poor soils, and high groundwater areas.			1 time annually
Hydro-Action - AN Series	The Hydro-Action AN Series is a state-of-the-art wastewater treatment system that utilizes the extended aeration activated sludge process. This advanced system is designed to not only treat wastewater but also reduce nitrogen content, making it an efficient and environmentally friendly option for on-site wastewater treatment.	$15,250	66%	$410 per year, maintenance 2 time annually
MicroFAST	The FAST (Fixed Activated Sludge Treatment) system is an aerobic wastewater treatment system that utilizes an aerobic fixed film process that is a combination of the conventional trickling filter and activated sludge processes. The FAST system is designed to be installed within a two-compartment tank where the first compartment provides a primary settling zone for incoming sewage and the second houses the actual FAST system. The system contains submerged media that provide surfaces for microbial growth. Aeration and circulation are provided by a blower that pumps air into a draft tube that extends down the center of the tank. The system is capable of significantly reducing biological oxygen demand (BOD5), total suspended solids (TSS), and total nitrogen in the effluent.	$2,995 (for 0.5 system)	TN ≤ 19 mg/L	Requires minimal operator attention which results in low maintenance costs
Nitrex Nitrogen Removal System	The Nitrex system uses a proprietary patented nitrate-reactive media that converts nitrate to inert nitrogen gas through denitrification. Wastewater contaminated with nitrate is gravitationally fed through the treatment module. The Nitrex filter is known for its passive operation and is essentially maintenance-free. It provides almost 100% nitrate removal in a low-cost, easy-to-install process.	$16,000-$22,000	94%	$2,000 per year first 3 years then $870 per year
NitROE® Waste-Water Treatment System	The NitROE wastewater treatment system is an innovative technology developed to enhance nitrogen removal from septic systems before the effluent is discharged into the soil absorption system. The NitROETM tank is placed in the gravity-flow path between a septic tank and a soil absorption system for the purpose of enhanced total nitrogen removal. This supplementary NitROETM tank can be installed as part of a new or upgraded system, or it can be installed to supplement an existing system for enhanced total nitrogen reduction. For those site specific situations where pumping is required within a system due to site topography, the NitROETM	$23,500-$29,000	TN ≤ 10 mg/L 90%	$1300 first year, $600-$1000 years 2-3, $400-$600 annually after year 3 + $210 annually for electrical usage

Table 2. Advanced Septic System Technology Summary

Advanced Septic System Technologies	Description	Cost[3,4]	Nitrogen Reduction Performance	O&M
	tank can be arranged to fit within that particular scenario as well. However, the main goal is to use gravity flow whenever possible.			
Norweco	The Singulair wastewater treatment system is a self-contained three-chambered treatment system utilizing primary treatment (settling), mechanical aeration, clarification, and flow equalization to achieve treatment. Wastewater from the building enters the primary settling chamber through an inlet tee, then enters an aeration chamber. In the aeration chamber, an aspirator at the bottom of a shaft disperses air radially as fine bubbles provide oxygen for the biomass and vertically mix chamber contents. The wastewater in the aeration chamber passes through to the clarification chamber for final settling of solids. A portion of the clarified wastewater is recirculated back to either the inlet pipe (building sewer) or into the primary chamber for denitrification. Treated wastewater passes through an effluent filter as it exits the system and is then gravity fed to the leachfield.	$13,500	TN ≤ 19 mg/L 55%	$465 per year, maintenance 2 time annually
Recirculating Sand Filter	Wastewater, having received primary treatment in a septic tank or equivalent unit, flows by gravity to a recirculation (mixing) tank. In doses controlled by both a programmable timer and float switch, the mixed fresh wastewater and partially treated filter effluent is applied to a bed of coarse sand (fine gravel) media. This mixed wastewater is dispersed over the filter surface in a PVC distribution network surrounded in pea stone. Wastewater trickles down through the sand media, where biological treatment occurs. The treated effluent is collected in an underdrain at the bottom of the filter and discharged back to the recirculation tank. There most of it mixes with incoming wastewater, a small amount gets discharged to the drainfield, and the cycle begins again. Typically, a buoyant-ball check valve is used to control discharge and recirculation. Treated wastewater is discharged to a drainfield for additional treatment. The system is capable of significantly reducing biological oxygen demand (BOD5), total suspended solids (TSS), and total nitrogen in the effluent. The technology is targeted for use in critical resource areas and is intended to be used with shallow pressurized drainfields.	Varies based on design[6]	TN ≤ 19 mg/L	Requires minimal operator attention which results in low maintenance costs
Recip RTS~500 System	The ReCip® uses a filter medium contained in two adjacent, equally dimensioned cells. The medium provides a surface for microbes to attach, live, and grow. Timers	$8,000-$15,000	58%	Up to $1,700 - $3,000 yearly

[6] Cost varies based on the size of the system based on hydraulic and organic loading and model based on population equivalent.

Table 2. Advanced Septic System Technology Summary

Advanced Septic System Technologies	Description	Cost[3,4]	Nitrogen Reduction Performance	O&M
	on each of two reciprocating pumps control the process. BioConcepts Inc. describes the basic treatment processes as follows: at the start of the cycle, the first cell of the ReCip® unit is filled nearly to the top with wastewater. The pump located in the cell then pumps the liquid into the second cell, until the first cell is nearly empty. As the liquid leaves the first cell, the void space formerly occupied by the liquid fills with air from the vent system, exposing the medium to atmospheric oxygen contained in the air. At this point, the second cell is nearly full and the first cell is nearly empty. The two cells remain in this state for a time before the second cell's pump sends the liquid back to the first cell, drawing air into the second cell. Wastewater that clings to the medium contains nutrients and organics, which are oxidized by bacteria (biofilm) that are exposed to the air. The bacteria live and grow on the medium. In the presence of oxygen, organic matter is converted to carbon dioxide and water, and ammonia nitrogen (NH3-N) is converted to nitrate nitrogen (NO3 -). Anaerobic decomposition of the contaminants continues in the wastewater that is not exposed to air (at the very bottom of the cells), converting the NO3 - to nitrogen gas. The two cells continue to fill and drain, with rest periods between the cycles, until additional wastewater flows into the first cell. When the capacity of the first cell is met, its contents are pumped into the second cell. The excess volume exits the overflow of the second cell as treated effluent. As an example, if the rated capacity of the tanks is 500 gallons and one extra gallon enters the system, a gallon of treated effluent will exit cell number two.			
Retrofast 0.375 System	The system is a submerged attached-growth treatment system designed to enhance the performance of existing septic tanks. It is inserted as a retrofit device into the outlet side of new or existing septic tanks. It provides an anerobic zone for nitrification and an anoxic zone for denitrification, improving overall treatment process. The system includes a white liner, blue media blocks, an airlift device, and a remote blower (connected to the airlift via pipe).	$4,000-$5,500	51%	Up to $1,700 - $3,000 yearly
STAAR Media Filter	The System is an aerobic biological trickling filter that is a two-tank design with a primary anoxic tank (a septic tank) followed by the aerobic trickling filter tank (the processor tank). Raw wastewater enters and passes through the primary anoxic tank to a reservoir beneath treatment media in the aerobic processor tank. The wastewater is aerated and sprayed onto the media; a programmable logic controller (PLC) controls the timing and sequence of the recirculation of wastewater in the	$11,000-$20,000	TN ≤ 19 mg/L 64%	Up to $1,700 - $3,000 yearly

Table 2. Advanced Septic System Technology Summary

Advanced Septic System Technologies	Description	Cost[3,4]	Nitrogen Reduction Performance	O&M
	lower collection reservoir. A portion of the wastewater is pumped back to the septic tank; this process is self-adjusting based on demand and is controlled by the PLC. Treated wastewater is time dosed to a leachfield. A 50% reduction of leachfield area is allowed when utilized with conventional leachfields			
Waterloo Biofilter	The Waterloo Biofilter uses a patented, highly engineered foam filtration medium that is optimized to treat wastewater passively. The foam creates an environment where naturally occurring bacteria can thrive and remove contaminants found in wastewater. The system provides both physical filtration and biological treatment of wastewater in one step – ensuring polluting elements are removed before water is returned to the natural environment.	$7,000-$17,000	62%	Up to $1,700 - $3,000 yearly

As part of the literature review, best management practice technologies were also considered. In a Final Expert Panel Report to the Wastewater Treatment Workgroup of the Chesapeake Bay Partnership[7], the technologies summarized in Table 3.

Table 3. BMP Technologies for Nitrogen Reduction

BMP Technology	Description	Nitrogen Reduction Performance (%)	O&M
Integrated Fixed-Film Activated Sludge (IFAS)	A hybrid system of an aerobic treatment unit which uses high specific surface area plastic media submerged in an aerobic unit to promote attached or fixed bacterial growth. These processes are very effective at oxidizing organics and oxidizing ammonium to nitrates. Nitrates can be converted into nitrogen gas by incorporating an anoxic denitrification step in the treatment train.	50%	Semi-annual Inspections
Subsurface Constructed Wetland	Constructed wetlands are wastewater treatment systems consisting of shallow ponds or channels that are usually less than a meter deep; have been planted with aquatic plants; and rely upon natural microbial, biological, physical, and chemical processes to treat wastewater. They typically have impervious clay or synthetic liners, as well as engineered structures to control the flow direction, liquid detention time, and water level. Depending on the type of system, they sometimes contain an	20%	Monthly Visual Inspections

[7] Recommendations of the On-Site Wastewater Treatment Systems Nitrogen Reduction Technology Expert Review Panel

Table 3. BMP Technologies for Nitrogen Reduction

BMP Technology	Description	Nitrogen Reduction Performance (%)	O&M
	inert porous media such as rock, gravel, or sand. This BMP is installed prior to the drainfield.		
Elevated Sand Mounds	Elevated sand mounds have been in use as a combination wastewater treatment and dispersal system since the 1970s. The technology was developed to address sites with shallow depth to restrictions such as seasonal water tables and bedrock. The traditional elevated sand mound is comprised of a raised sand bed, 1 to 2 feet in depth, which is overlain by a gravel layer that has pressure distribution piping imbedded in the gravel. The gravel is covered with a minimum of 1 foot of soil to protect the system from freezing. Grass or other vegetation is established on the soil to stabilize the surface of the mound. The wastewater is applied to the sand and nitrified as it passes through the sand. The sand layer essentially acts as a single-pass sand filter. When the nitrified effluent reaches the soil layer, the effluent tends to pond due to the discontinuity between the sand and the soil layer creating an anoxic zone. If the soil layer has sufficient organic matter available, denitrification occurs in the upper horizon.	50%	Annual Inspection
Intermittent Media Filter (IMF)	An intermittent or single-pass media filter is a filter packed with sand or other granular media. They support aerobic biological mechanisms and physical processes such as sedimentation, filtration, and chemical adsorption. The basic components of an IMF system include a septic tank, a dosing tank, a pump with controller (or a siphon), a distribution network, the filter bed, and an underdrain. The wastewater is periodically dosed to the filter via the distribution system, where it percolates through the media to the underdrain that carries the treated effluent from the unit process. The IMF is installed prior to the drainfield.	20%	Annual Inspection
Recirculating Media Filter (RMF)	Media with a larger ES allows for higher HLRs and smaller filter sizes (surface area). This footprint advantage is somewhat offset by the need for a recirculation tank that mixes STE with filter effluent to allow significant denitrification. These engineered systems generally use gravel or coarse natural media (e.g., sand) specifically designed for recirculating filters and readily available to the construction site. Commercially marketed RMFs generally use lightweight media that minimize shipping costs and facilitate installation. For effective nitrogen removal, the influent must first be nitrified by periodically dosing it from a recirculation tank under pressure to the surface of the filter where percolation of wastewater through the filter draws in air that promotes aerobic treatment. Denitrification is facilitated by recirculating a majority of the nitrified effluent back to a septic tank (where it mixes with influent) or separate recirculation tank (where it mixes with STE). Septic tanks or recirculation tanks generally feature conditions that promote denitrification, including a lack of DO (anoxic conditions) and enough labile carbon.	50%	Semi-annual Inspections
Shallow-Placed,	Pressure-dosed dispersal is an in situ, or soil treatment, process that allows for uniform distribution	50%	Annual

Table 3. BMP Technologies for Nitrogen Reduction

BMP Technology	Description	Nitrogen Reduction Performance (%)	O&M
Pressure-Dosed Dispersal	of effluent across the entire dispersal field. Dosing allows for the creation of fluctuating aerobic/anoxic environments, which sets up the conditions for nitrification and denitrification to occur. Numerous research studies indicate that denitrification occurs in pressure-dosed systems and that the highest rates are achieved when the dispersal is into surficial soil horizons. Dosing also promotes wetting/drying cycles, which improves soil structure, improves soil permeability, and enhances long-term wastewater disposal at the site.		inspection
Permeable Reactive Barriers (PRBs)	PRBs or denitrification walls are a remedial process for treating shallow groundwater impacted with nitrogen-rich effluent from on-site wastewater systems and other sources where the extent of the groundwater plume and its flow direction are well-defined. PRBs have historically been used for remediating groundwater impacted from mostly industrial uses. The basic process involves digging a trench of suitable depth and width to intercept the flow of impacted groundwater. PRBs for remediating groundwater impacted from septic systems are denitrification systems. Denitrification can be accomplished at each individual site or with a PRB that intercepts existing nitrate plumes from multiple sites prior to their transition to local surface waters. Individual on-site denitrification systems can be constructed as separate modules by adding carbon or sulfur reaction driver sources in the base of the dispersal field with the appropriate reactive material. If nitrate is present in the absence of DO, this reactive material intercepts and denitrifies the effluent.	Up to 100%[8]	Annual inspection, annual operations to clear clogs, visual inspection and sampling

[8] At removing nitrate in groundwater plumes provided that they are designed, installed, and maintained. One of the most important factors for success is ensuring that the entire groundwater plume is intersected and that sufficient contact time is provided in the PRB to affect complete denitrification.

4. FINANCING AND INCENTIVES

A literature review was conducted to evaluate how septic system upgrade programs in other communities or states are funded and what incentive programs exist that may be worth considering if the Town were to implement an advanced septic system technology program.

4.1 Funding Mechanisms Approaches

Many septic system upgrade or advanced septic system technology programs receive funding to support implementation and administration of the program. A literature review of existing programs in other communities or states was conducted to determine the typical sources of funding. Most of the programs identified are administered by state, county, or municipal entities. The following are the funding sources used to support those programs.

- **Federal Funding**: The EPA's Clean Water State Revolving Fund (CWSRF) offers grants to all states for water infrastructure projects, including septic system upgrades[9].
- **USDA Single Family Housing repair Loans & Grants:** Also known as the Section 04 Home Repair program, this provides loans to low income homeowners to repair, improve, or modernize their homes or grants to elderly very-low income homeowners to remove health and safety hazards[10].
- **State-Specific Funding**: Many states have programs provide low-interest loans and grants for septic system repairs or replacements.
- **Local Community Funding**: Some local municipalities offer grant and loan programs to assist homeowners with septic system upgrades, especially in areas with high nitrogen pollution.
- **User Fees:** Municipalities charge a septic system use fee to support program implementation and administration. The fees collected are used to reimburse property owners for upgrading septic systems or installation water quality mitigation measures.

Charlestown, Rhode Island Septic System Upgrade Program: Case Study

Charlestown, Rhode Island offers a program which includes regular inspections, maintenance, and a database tracking all septic systems in town.

Charlestown offers septic system repair and replacement funds in the form of a low interest (1%) $25,000 loan to the homeowner. Repair and replacement funding ensures that failing systems are attended to and replaced by reducing financial barriers. Failures can cause public health and sanitation issues and nutrient loading to nearby waterbodies.

Source: Wastewater Management - Charlestown, RI (charlestownri.gov)

[9] Funding for Septic Systems | US EPA
[10] External Septic Grants and Loans | NH Department of Environmental Services

- **Alternative Financing**: Homeowners can explore home equity loans, personal loans, or septic company financing as options to fund their septic system needs.

Local funding was also explored to determine if there are funding options outside of the mechanism above that the Town could consider.

- **New Hampshire Section 319 Grants:** The Town could apply for Clean Water Act Section 319 funds to help protect water quality and can be used for a septic system cost-share reimbursement program.
- **Piscataqua Region Environmental Planning Assessment (PREPA) Grant:** The program provided a grant opportunity in the 42 New Hampshire and 10 Maine communities within the Piscataqua Region watershed. Grant projects were associated with recommendations from the 2015 PREPA.
- **Great Bay 2030:** Funding is available to support projects aimed at protecting and improving water quality in Great Bay[11]. Applications need to be submitted to the agency that describes the type of work the Town would like to do. One-time and multi-year project funding is available.

4.2 INCENTIVE PROGRAMS

Without incentives, many property owners would fail to pay additional money to upgrade their septic system with an advanced treatment technology. Therefore, many existing septic system upgrade programs offer incentives to property owners for their participation in the upgrade or retrofit programs. The incentives provided by these programs are summarized in Table 4.

Table 4. Description of Incentive Programs

Program	Description of Incentive
Multiple counties in Florida – Septic Upgrade Incentive Program[12]	Provides a reimbursement, of up to $7,000.00 per existing home. Addresses wastewater, such as septic to sewer connections, that are not attaining standards for nutrient levels or are in a defined area of interest. Subject to funding availability with a State grant from the Florida Department of Environmental Protection (FDEP). Program is available until the $2,541,000 of FDEP grant funding is thoroughly exhausted or September 30, 2025. Per the FDEP funding agreement all sitework and inspections must be completed by August 29, 2025.

[11] Great Bay 2030 | Piscataqua Regional Estuaries Partnership (prepestuaries.org)
[12] Welcome to Citrus County (citrusbocc.com)

Table 4. Description of Incentive Programs

Program	Description of Incentive
Maryland's Nitrogen-Reducing Septic Upgrade Program[13] – Bay Restoration Fund	Grant assistance program based on income criteria. The allowable grant costs can be for capital cost of the system and up to 2-years of operation and maintenance of the system. Homeowners can receive up to 100% of funds if the household income is less than $300,000 or 50% for household income above $300,000. For new construction, the grant program only covers the cost differential between a conventional system and an advanced treatment system.
New York State Septic System Replacement Fund[14]	Septic system users can be reimbursed up to fifty percent of costs for septic system projects up to a contribution of $10,000. The grant will help cover costs towards installations, replacement, or upgrades of enhanced treatment technologies. To receive reimbursement, users must complete a reimbursement request form, design approval, all work completed, an invoice for eligible costs, and an authorization from the contractor, if applicable. To use the fund, property owners need to cover the costs upfront for any new construction or repairs to all septic system projects. Some counties have secured additional funds that can be combined with the Septic System Replacement Fund. The program relies on a reimbursement policy. • **Rensselaer County** offers an additional $25,000 under a Community Block Development Grant per household or business to repair or replace failing septic systems. • **Suffolk County Septic Improvement Program**[15] provides up to $10,000 base grant. There is also up to an additional $10,000 that can be awarded to a grantee that installs a pressurized shallow drain field leaching system ($5,000) and/or toward the unit installation for low to moderate incomes eligible applicants ($5,000). Suffolk County also has low interest loans of up to $10,000 through the Community Development Corporation of Long Island. Additionally, Southampton, East Hampton and Shelter Island provide Community Preservation Funds. • **Nassau County Septic Environmental Program to Improve Cleanliness**[16] provides grant funding of up to $20,000 to repair and replace failing septic systems with nitrogen-reducing system. Nassau County uses $10,000 of federal funds from the American Recovery Plan Act (ARPA) in conjunction

[13] Onsite Disposal Systems (maryland.gov)
[14] Septic System Replacement Fund | Environmental Facilities Corporation (ny.gov)
[15] Reclaim Our Water > Septic Improvement Program
[16] Septic Environmental Program to Improve Cleanliness (SEPTIC) | Nassau County, NY - Official Website (nassaucountyny.gov)

Table 4. Description of Incentive Programs

Program	Description of Incentive
	with $10,000 from State Septic System Replacement Grant funds.
Barnstable County, Massachusetts[17]	Barnstable County located in Massachusetts provides homeowners with low-interest loans for repairing or replacing septic systems, upgrading to alternative septic system technologies, and connecting current systems to the municipal sewers. The funding offers homeowners 0%, 2%, 4%, and 5% interest rates to homeowners for their septic system projects. To be eligible for the 0% and 2% loans homeowners must own a single-family property is not used as a business and the project must include an advanced nitrogen and phosphorus removing technology. If those two requirements are met, the homeowner must also have a household income of less than 180% of the County's medium household income. The loans are only available to residential properties with a maximum of a 20-year repayment plan.
Delaware Septic Rehabilitation Loan Program[18]	The Septic Rehabilitation Loan Program provides low-interest financing to replace failing septic systems and cesspools with on-site wastewater disposal systems that will function in an environmentally sound and cost-effective manner. The program also provides funding for new septic construction and costs associated with connecting to central sewer systems. The program is based on income guidelines based on number of people. Eligible costs for on-site systems include site evaluation, septic system design, permits, construction costs, and closing and recording charges. Eligible costs for central sewer projects include impact fees, connection fees, permit costs, electrical, and abandonment of septic systems. Property owners with on-site wastewater disposal systems that need replacement; new construction of system; and central sewer connection, are required to meet program income guidelines, and can demonstrate the ability to repay the loan.

Case Study: Bay Restoration Fund, Septic System Upgrade Program for On-site Sewage Disposal System Upgrades Using Best Available Technology for Nitrogen Removal

Maryland's program is funded by the Bay Restoration Fund1 which is an Onsite Sewer Disposal System (OSDS) grant program that considers regulatory requirements. The funding is generated by collection of a $60 annual fee from each user served by an onsite system. After all funding has been collected, sixty percent of the funding goes to septic system upgrades and the other forty percent goes to use for cover crops. The sixty percent of funding that goes to septic system upgrades are allotted to upgrades to best available technology for nitrogen removal instead of conventional technology. The Fund prioritizes upgrades to: failing systems in and outside of critical areas, non-conforming systems in and outside of critical areas, new construction of systems in and outside critical areas. The program has a series of technologies in different classes based on their proven ability reduce nitrogen concentrations in effluent. *Source:* Onsite Disposal Systems (maryland.gov)

[17] Cape Cod AquiFund - Barnstable County
[18] Septic Rehabilitation Loan Program - DNREC (delaware.gov)

5. RECOMMENDATIONS AND NEXT STEPS

As the Town explores the means to address nitrogen loading from septic systems and whether a Town administered advanced septic system technology program is feasible, some recommendations and next steps are outlined below.

- Establish an area of priority septic systems that would be considered if an advanced septic system technology were to be established.
- Establish suitability criteria to assist with defining the priority septic systems.
- Develop a map of the priority septic system area.
- Establish a Priority Septic System Overlay District.
- Establish regulations to encourage the use of advanced septic system technologies in the Priority Septic System Overlay District.
- Implement a pilot program to plan and install an advanced septic system in the Town.
- Coordinate with NHDES to understand what steps the state is taking to approve advanced septic system technologies for use in New Hampshire.
- Provide education and outreach to users of septic systems on advanced septic system technologies.
- Provide education and outreach to users of septic systems on steps the state and Town are taking to mitigate water quality impacts from septic systems in priority areas.

ATTACHMENT A

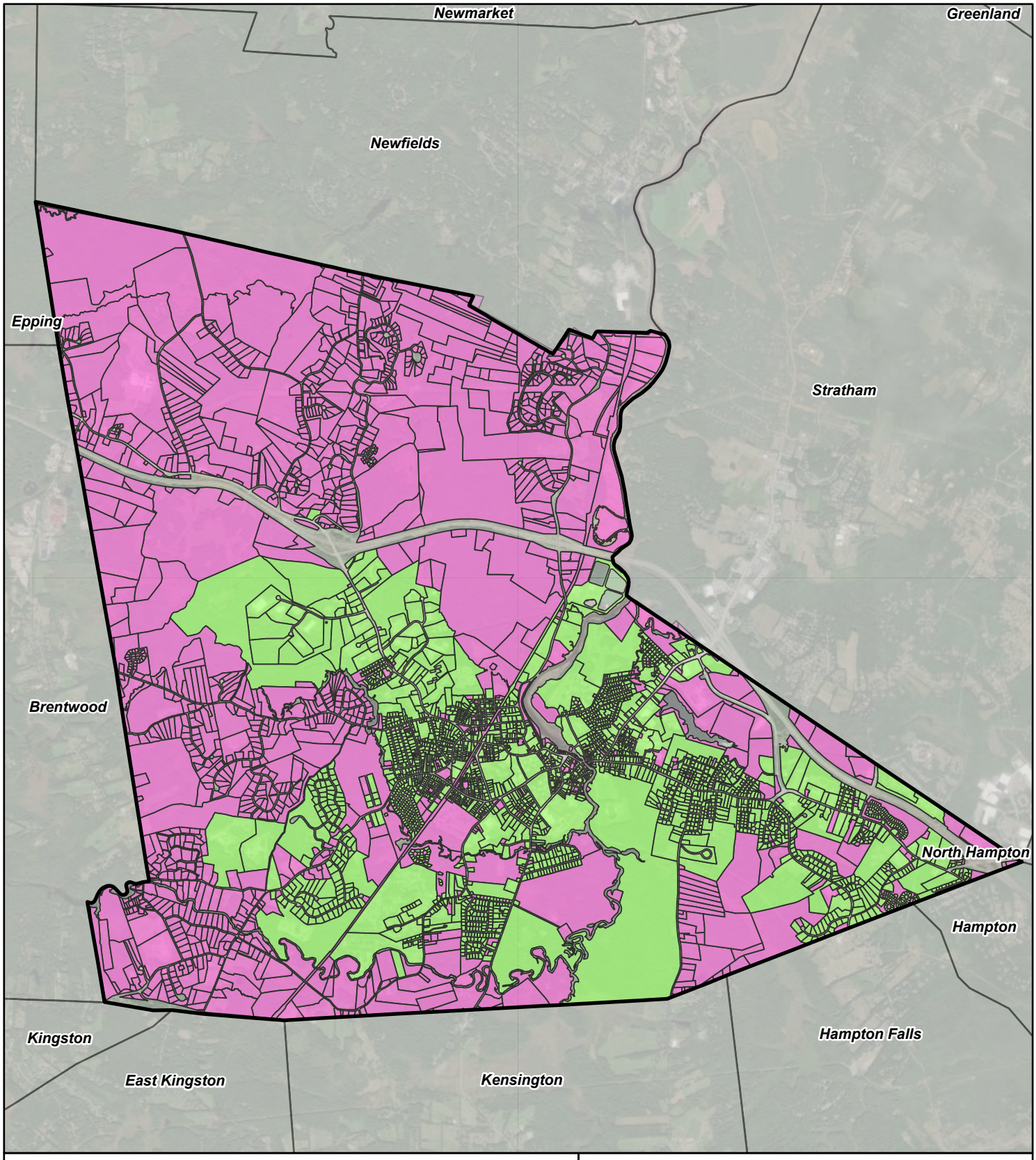
Location of Exeter Septic Systems

ATTACHMENT B

Rhode Island List of Alternative or Experimental Onsite Wastewater Treatment System Technologies

ATTACHMENT A

Location of Exeter Septic Systems



Legend

- Town Boundary
- Septic Service
- Sewer Service

N

0 4,000 Feet

Exeter Septic Systems

Exeter, New Hampshire

Geosyntec consultants

Acton, Massachusetts | December 2023

Figure 1

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ATTACHMENT B

Rhode Island List of Alternative or Experimental Onsite Wastewater Treatment System Technologies

B. NITROGEN REMOVAL SYSTEMS

Technology Name: **AdvanTex AX-20 Residential Certification**
AdvanTex Residential Design Manual – October 2019
AdvanTex Residential Installation Manual – March 2017
AdvanTex Residential O&M Manual Part 1 – March 2014
AdvanTex Residential O&M Manual Part 2 – May 2008
(Approved for TSS, BOD, and FOG removal in Mode 1, also approved for nitrogen removal in Mode 3.)

Vendor Information:
Orenco Systems Inc.
814 Airway Avenue
Sutherlin, OR 97479-9012
www.orenco.com

Vendor Contact:
Joseph Soulia
1-800-230-9580
jsoulia@orenco.com

Regional Contacts:
Atlantic Solutions, Ltd (Dealer)
436 Fish Road
Tiverton, RI 02878
Contact: Bob Johnson
(401) 293-0176
bjohnson@atlanticsolutionsltd.com

Effluential Technologies (O&M Provider)
436 Fish Road
Tiverton, RI 02878
Contact: Bob Johnson
(401) 293-0176
bjohnson@atlanticsolutionsltd.com

Green Wastewater Solutions (Dealer and O&M Provider)
80 Kilvert Street
Warwick, RI 02886
Contact: Rick Pezza
(401) 737-7600
rickp@gwsne.com

Model Numbers: AX-20

Certification: Alternative System or Technology - Class One

Technology Type: TN ≤ 19 mg/L, TSS ≤ 20 mg/L, BOD ≤ 20 mg/L, Oil & Grease ≤ 5 mg/L

Pretreatment Category: Category 1 – Timed-Dosed

Authority to Design: Cl-II & III Licensed Designers

Description: A prepackaged packed bed filter that significantly reduces BOD and TSS inside a waterproof container installed after a two-compartment tank prior to discharge to a leachfield which may be reduced in size by 50%. When configured in Mode 3, this system is acknowledged as an approved nitrogen reducing system.

Technology Name: **AdvanTex AX-20 or AX-100 Commercial Certification**
AdvanTex AX20 or AX100 Commercial Design Manual – September 2017
AdvanTex AX20 or AX100 Commercial Installation Manual – April 2019
AdvanTex AX20 or AX100 Commercial O&M Manual – May 2015
(Approved for TSS, BOD, and FOG removal in Mode 1, also approved for nitrogen removal in Mode 3.)

Vendor Information:
Orenco Systems Inc.
814 Airway Avenue
Sutherlin, OR 97479-9012
www.orenco.com

Vendor Contact:
Joseph Soulia
1-800-230-9580
jsoulia@orenco.com

Regional Contacts:
Atlantic Solutions, Ltd (Dealer)
436 Fish Road
Tiverton, RI 02878
Contact: Bob Johnson
(401) 293-0176
bjohnson@atlanticsolutionsltd.com

Effluential Technologies (O&M Provider)
436 Fish Road
Tiverton, RI 02878
Contact: Bob Johnson
(401) 293-0176
bjohnson@atlanticsolutionsltd.com

Green Wastewater Solutions (Dealer and O&M Provider)
80 Kilvert Street
Warwick, RI 02886
Contact: Rick Pezza
(401) 737-7600
rickp@gwsne.com

Model Numbers: AX-20 or AX-100
Certification: Alternative System or Technology - Class Two
Technology Type: TN ≤ 19 mg/L, TSS ≤ 20 mg/L, BOD ≤ 20 mg/L, Oil & Grease ≤ 5 mg/L
Pretreatment Category: Category 1 – Timed-Dosed
Authority to Design: Cl-II & III Licensed Designers

Description: A prepackaged packed bed filter that significantly reduces BOD and TSS inside a waterproof container installed after a two-compartment tank prior to discharge to a leachfield which may be reduced in size by 50%. When configured in Mode 3, this system is acknowledged as an approved nitrogen reducing system.

Technology Name: **Amphidrome®**
Amphidrome Design Guidance June 2020
Amphidrome Operation and Maintenance Manual June 2020
(Also approved for TSS & BOD removal)

Vendor Information:
F. R. Mahony & Associates, Inc.
273 Weymouth Street
Rockland, MA 02370

Contact:
Mike Sparks
Tel: (781) 982-9300
Fax: (781) 982-1056

Model Numbers: Amphidrome, Residential and Commercial, All Design Flows
Certification: Alternative System or Technology - Class Two
Technology Type: TN ≤19 mg/L, TSS ≤ 20 mg/L, BOD ≤ 20 mg/L, Oil & Grease ≤ 5 mg/L
Pretreatment Category: Category 1 – Timed-Dosed
Authority to Design: Cl-II & III Licensed Designers

Description: The Amphidrome® system uses a submerged attached growth bioreactor process operating in a batch mode.

The Amphidrome® system utilizes two tanks and one submerged attached growth bioreactor, called the Amphidrome® reactor. The first tank, the anoxic/equalization tank, is where the raw wastewater enters the system. The tank has an equalization section, a settling zone, and a sludge storage section. It serves as a primary clarifier before the Amphidrome® reactor.

This Amphidrome® reactor consists of the following four items: underdrain, support gravel, filter media, and backwash trough. The underdrain, constructed of stainless steel, is located at the bottom of the reactor. It provides support for the media and even distribution of air and water into the reactor. The underdrain has a manifold and laterals to distribute the air evenly over the entire filter bottom. The design allows for both the air and water to be delivered simultaneously--or separately--via individual pathways to the bottom of the reactor. As the air flows up through the media, the bubbles are sheared by the sand, producing finer bubbles as they rise through the filter. On top of the underdrain is 18" (five layers) of four different sizes of gravel. Above the gravel is a deep bed of coarse, round silica sand media. The media functions as filter, significantly reducing suspended solids and provides the surface area for which an attached growth biomass can be maintained. The Department allows a 50% reduction in conventional and approved AE "component technology" leachfield size with this System.

Technology Name: **BioBarrier Certification**

BioBarrier Installation Manual - February 2016
BioBarrier Owner's Manual – February 2016
BioBarrier Service Manual – April 2016
Monitoring Protocol, *Revised* November 27, 2019
Monitoring Protocol Notification

Vendor Information:
Bio-Microbics, Inc.
16002 West 110th Street
Lenexa, KS 66219

Tel: 913-422-0707
Fax: 913-422-0808
Web: www.biomicrobics.com/

Anna Cline, Sales & Regulatory Affairs Coordinator
Email: acline@biomicrobics.com

Regional Contact:
Lauren Usilton, President
J&R Sales and Service, Inc.
44 Commercial Street
Raynham, MA 02767

Tel: 508-823-9566

Web: www.JRSALESINC.COM

Email: laurenu@jrsalesinc.com

Model Numbers: BioBarrier 0.5N, BioBarrier 1.0N, and BioBarrier 1.5N

Certification: Alternative System or Technology - Class Two

Technology Type: TN ≤10 mg/L, TSS ≤ 30 mg/L, BOD ≤ 30 mg/L, Oil & Grease ≤ 5 mg/L

Pretreatment Category: Category 2 – Not Timed-Dosed

Authority to Design: Cl-II & III Licensed Designers

Description: The System incorporates a Membrane Bioreactor (MBR) and uses three-compartment tankage either as a single three-compartment tank, or a single-compartment pre-treatment tank followed by a two-compartment tank. The BioBarrier MBR is in the last of the three compartments in both configurations. The first compartment or tank provides primary treatment and is equipped with an outlet screening device (SaniTEE®). The second and third compartments must be in the same tank. Denitrification occurs in the second compartment of the System under anoxic conditions; a mixing pump installed in this compartment recycles some of the nitrified water through a baffle wall between the second and the third compartments (the aeration/membrane zone). The third compartment contains the Membrane Bioreactor, through which water passes for additional treatment prior to discharge to a leachfield by a float-activated discharge pump. The system is capable of significantly reducing biological oxygen demand (BOD_5), total suspended solids (TSS), and

total nitrogen in the effluent. Based on these reductions, the Department has allowed for a 45% reduction in leachfield size.

Technology Name: **Bioclere Certification Manual – September 1, 2019**

Vendor Information:
Aquapoint.3, LLC
Joe Pinto
39 Tarkiln Place
New Bedford, MA 02745
508-985-9050, extension 105
jpinto@aquapoint.com

Model Numbers: Bioclere 16-Series, 24-Series, 30-Series, and 36-Series

Certification: Alternative System or Technology - Class Two

Pretreatment Category: Category 2 – Not Timed-Dosed

Technology Type: TN ≤ 19 mg/L, TSS ≤ 30 mg/L, BOD ≤ 30 mg/L, Oil & Grease ≤ 5 mg/L

Authority to Design: Cl-II & III Licensed Designers

Description: The Technology consists of a modified trickling filter positioned over a clarifier. Effluent from the septic tank enters the System and is pumped up to the top of the insulated unit where it is evenly distributed over the surface of the filter media. Biochemical oxidation takes place as the water trickles through the filter and over the biological film that grows on the surface of these randomly packed pieces of PVC plastic. Oxygen is supplied to the system through a small axial fan located in the top of the housing. RIDEM has allowed for a 45% reduction in leachfield size as specified in the Certification.

Technology Name: FAST® Certification **FAST Manual – September 10, 2019**

Vendor Information:
Bio-Microbics, Inc.
16002 West 110th Street
Lenexa, KS 66219
Tel: 913-422-0707
Tel (toll-free): 800-753-3278
Fax: 913-422-0808
Web: www.biomicrobics.com/
Jim Bell, Executive Vice President
Email: jbell@biomicrobics.com

Regional Contact:
J&R Sales and Services
5344 Commercial Street
Raynham, MA 02767
Tel: 508-823-9566
Fax: 508-880-7232
Web: www.JRSALESINC.COM
Lauren D. Usilton, President
Email: laurenu@jrsalesinc.com

Model Numbers: MicroFAST 0.5, MicroFAST 0.625, MicroFAST 0.75 and MicroFAST 0.9

Certification: Alternative System or Technology - Class One

Pretreatment Category: Category 2 – Not Timed-Dosed

Technology Type: TN ≤ 19 mg/L; TSS ≤ 30 mg/L; BOD≤30 mg/L; O&G ≤5 mg/L

Authority to Design: Cl-II & III Licensed Designers

Description: The FAST (Fixed Activated Sludge Treatment) system is an aerobic wastewater treatment system that utilizes an aerobic fixed film process that is a combination of the conventional trickling filter and activated sludge processes. The FAST system is designed to be installed within a two-compartment tank where the first compartment provides a primary settling zone for incoming sewage and the second houses the actual FAST system. The system contains submerged media that provide surfaces for microbial growth. Aeration and circulation are provided by a blower that pumps air into a draft tube that extends down the center of the tank. The system is capable of significantly reducing biological oxygen demand (BOD_5), total suspended solids (TSS), and total nitrogen in the effluent. Based on these reductions, the Department has allowed for a 45% reduction in leachfield size.

Technology Name: **FujiClean Certification**
Category 1 Approval March 11, 2021
Monitoring Protocol, *Revised* November 27, 2019
Monitoring Protocol Approval May 14, 2020
Fuji Clean Design Manual - November 20, 2019
Fuji Clean Installation Manual – November 20, 2019
Fuji Clean O&M Manual – November 20, 2019

Vendor Information:
Fuji Clean USA, LLC
41-2 Greenwood Road, Ste 2
Brunswick, ME 04011 USA

Tel: 207-406-2927
Fax: 207-406-2929
Web: www.fujicleanusa.com

Contact:
Scott Samuelson
cell: 207-415-7885
Email: scott@fujicleanusa.com

Model Numbers: CEN5, CEN7 and CEN10

Certification: Alternative System or Technology - Class Two

Pretreatment Category: Category 1

Technology Type: TN ≤ 19 mg/L; TSS ≤ 20 mg/L; BOD≤20 mg/L; O&G ≤5 mg/L

Authority to Design: Cl-II & III Licensed Designers

Description: The System is a single fiber-reinforced plastic tank divided into three chambers. Wastewater flows in a circuitous path through the sedimentation chamber to an anoxic chamber containing media followed by an aerobic chamber containing two types of media. Media in the System provide mechanical filtration and facilitate fixed-film and suspended-growth microorganisms' anaerobic and aerobic biodegradation of wastewater constituents, including conversions of nitrogen species to nitrogen gas. Wastewater and sludge are recirculated from the third chamber back to the sedimentation chamber. One small blower, a diaphragm compressor, provides aeration, airlift recirculation and airlift pump discharge of treated effluent to a leachfield. A 50% reduction in leachfield size is allowed for conventional leachfields.

Technology Name: ****Attention OWTS Designers: Effective October 15, 2021 the DEM will not be accepting OWTS Construction Permit Applications that include this technology due to Vendor non-compliance with the RIDEM Monitoring Protocol for Nitrogen Removal Systems. ****

Hydro-Kinetic Model 600 FEU
Monitoring Protocol, *Revised* November 27, 2019
Monitoring Protocol Deadline July 30, 2021

Vendor Information:
Norweco, Inc.
220 Republic Street
Norwalk, OH 44857

Tel: 419-668-4471
Web: www.norweco.com

Scott Hetrick, Vice President of Sales
Email: shetrick@norweco.com
Tel: 419-669-4471
Fax: 419-663-5440

Technology Name & Model Numbers:
Hydro-Kinetic Model 600 FEU
(Maximum design flow 600 GPD)

Certification
Class Two

Pretreatment Category
Category 2 – Not Timed-Dosed

Technology Type:
TN ≤ 10 mg/L, TSS≤ 20 mg/L, BOD≤ 20 mg/L, O&G≤ 5 mg/L

Design Authority
Class II & III Licensed Designers

Local Contacts (Distributors/Dealers)

Siegmund Environmental Services
102 West Main Street
Norton, MA 02766

Matthew Dalton
Tel: 401-785-0130
Fax: 508-222-2499
Email: matt@seswastewater.com

Sterling Environmental Technologies
319A West Beach Road
Charlestown, RI 02813

Tel: 401-322-7669

Robert Frost
Tel: 401-523-4812
Fax: 401-315-0750
Email: bob@sterling-et.com

Description: The System uses extended aeration, attached growth, nitrification and denitrification processes to treat wastewater. It consists of four treatment chambers (pretreatment, anoxic, aeration and clarification) followed by a Hydro-Kinetic FEU filter containing filter media facilitating additional reduction of BOD and TSS by attached growth, prior to discharge to a leachfield. The clarification chamber incorporates a flow equalization unit. Aeration is controlled by a factory-programmed timer and wastewater is recirculated from the clarifier back to the anoxic chamber at factory set intervals. The system is available with both concrete and HDPE tankage and with the pre-treatment tank either integral to the other three chambers in a four-chambered tank, or as a distinct tank. Designs incorporating this System and a conventional leachfield shall be allowed a 40% reduction in the required leachfield size.

Technology Name: **Nitrex™**

Effective April 9, 2019 Nitrex is no longer an approved technology in Rhode Island; the RIDEM OWTS Program will not accept construction applications specifying Nitrex.

System owners may contact Lombardo Associates, Inc. at:

Pio Lombardo, PE
Lombardo Associates, Inc.
188 Church Street
Newton, MA 02458

Tel: (617) 964-2924

Fax: (617) 332-5477

E-mail: pio@LombardoAssociates.com

Technology Name:

Norweco Singulair DN Certification
Norweco Singulair DN Design Manual
Norweco Singulair DN Installation Manual
Norweco Singulair DN O&M Manual

Vendor Information:
Norweco, Inc.
220 Republic Street
Norwalk, OH 44857

Tel: 419-668-4471
Web: www.norweco.com

Robin Cassidy, Vice President of Customer Service
Email: rcassidy@norweco.com
Tel: 419-668-4471
Fax: 419-663-5440

Technology Name & Model Numbers:
Concrete:
Norweco Singulair Model DN 500 (600 GPD), 750 (800 GPD), 1000 (1000 GPD), 1250 (1250 GPD) & 1500 (1500 GPD)

HDPE:
Norweco Singulair Green® DN 500 (600 GPD)

Certification
Class Two

Pretreatment Category
Category 2 – Not Timed-Dosed

Technology Type:
TN ≤ 19 mg/L, TSS≤ 20 mg/L, BOD≤ 20 mg/L, O&G≤ 5 mg/L

Design Authority
Class II & III Licensed Designers

Local Contacts (Distributors/Dealers)

Siegmund Environmental Services
102 West Main Street
Norton, MA 02766

Matthew Dalton
Bob Silva
Tel: 401-785-0130
Fax: 508-222-2499
Email: matt@seswastewater.com

Sterling Environmental Technologies
319A West Beach Road
Charlestown, RI 02813

Tel: 401-322-7669

Robert Frost
Bob Frost
Tel: 401-523-4812
Fax: 401-315-0750
Email: bob@sterling-et.com

Description: The Singulair wastewater treatment system is a self-contained three-chambered treatment system utilizing primary treatment (settling), mechanical aeration, clarification, and flow equalization to achieve treatment. Wastewater from the building enters the primary settling chamber through an inlet tee, then enters an aeration chamber. In the aeration chamber, an aspirator at the bottom of a shaft disperses air radially as fine bubbles provide oxygen for the biomass and vertically mix chamber contents. The wastewater in the aeration chamber passes through to the clarification chamber for final settling of solids. A portion of the clarified wastewater is recirculated back to either the inlet pipe (building sewer) or into the primary chamber for denitrification. Treated wastewater passes through an effluent filter as it exits the system and is then gravity fed to the leachfield. The RIDEM recognizes the System as capable of achieving effluent concentrations of 30 mg/L for both TSS and BOD and less than or equal to 19 mg/L TN. Based on these reductions, the RIDEM has allowed for a 40% reduction in leachfield size.

*Where site conditions and design flow accommodate, Norweco Singulair Green® 600 may be used in place of the concrete Singulair tank.

Technology Name: ****Attention OWTS Designers: Effective October 15, 2021 the DEM will not be accepting OWTS Construction Permit Applications that include this technology due to Vendor non-compliance with the RIDEM Monitoring Protocol for Nitrogen Removal Systems. ****

Singulair TNT [concrete] 600, 750, 1000, 1250 and 1500
Singulair Green TNT [HDPE] 500
Monitoring Protocol, *Revised* November 27, 2019
Monitoring Protocol Deadline July 30, 2021

Vendor Information:
Norweco, Inc.
220 Republic Street
Norwalk, OH 44857

Tel: 419-668-4471
Web: www.norweco.com

Scott Hetrick, Vice President of Sales
Email: shetrick@norweco.com
Tel: 419-669-4471
Fax: 419-663-5440

Technology Name & Model Numbers:
Concrete: Singulair TNT 600, 750, 1000, 1250, 1500

HDPE: Singulair Green TNT 500
(Maximum design flow 600 GPD)

Certification
Class Two

Pretreatment Category
Category 2 – Not Timed-Dosed

Technology Type:
TN ≤ 19 mg/L, TSS≤ 20 mg/L, BOD≤ 20 mg/L, O&G≤ 5 mg/L

Design Authority
Class II & III Licensed Designers

Local Contacts (Distributors/Dealers)

Siegmund Environmental Services
102 West Main Street
Norton, MA 02766

Matthew Dalton
Tel: 401-785-0130
Fax: 508-222-2499
Email: matt@seswastewater.com

Sterling Environmental Technologies
319A West Beach Road
Charlestown, RI 02813

Tel: 401-322-7669

Robert Frost
Tel: 401-523-4812
Fax: 401-315-0750
Email: bob@sterling-et.com

Description: The Singulair TNT and Singulair Green TNT Wastewater Treatment System
The System consists of a three-chambered tank. The first chamber provides pretreatment, the second is an aeration chamber with an infused air system: air is introduced to the aeration chamber by an aeration system, which spins a hollow aspirator shaft, drawing air into the hollow shaft through four intake ports located beneath the aerator handle; the aerator vent through which the air is drawn is integral to the access cover above the aerator. The aeration system is controlled by a factory programmed, non-adjustable timer to run a 60 minute aeration cycle followed by a 60 minute anoxic cycle, during which the aerator is not running. Settling takes place in the clarification chamber (the third chamber) following aeration and currents generated by the spinning aerator draw sludge from the clarification chamber back to the aeration chamber. The Bio-Kinetic filter within the clarification chamber filters wastewater prior to discharge to a leachfield. The system is capable of significantly reducing biological oxygen demand (BOD_5) and total suspended solids (TSS) in the effluent. Based on these reductions, the Department has allowed for a 40% reduction in leachfield size.

Technology Name:	**Recirculating Sand Filter**
Vendor Information:	Generic
Certification:	Guidelines for the Design, Use, and Maintenance of Pressurized Drainfields - November 2013
Technology Type:	TN ≤ 19 mg/L, TSS ≤ 10 mg/L, BOD ≤ 10 mg/L, Fecal Coliform ≤ 10,000 cfu/100mL
Authority to Design:	Cl-II & III Licensed Designers

Description: Wastewater, having received primary treatment in a septic tank or equivalent unit, flows by gravity to a recirculation (mixing) tank. In doses controlled by both a programmable timer and float switch, the mixed fresh wastewater and partially treated filter effluent is applied to a bed of coarse sand (fine gravel) media. This mixed wastewater is dispersed over the filter surface in a PVC distribution network surrounded in pea stone. Wastewater trickles down through the sand media, where biological treatment occurs. The treated effluent is collected in an underdrain at the bottom of the filter and discharged back to the recirculation tank. There most of it mixes with incoming wastewater, a small amount gets discharged to the drainfield, and the cycle begins again. Typically, a buoyant-ball check valve is used to control discharge and recirculation. Treated wastewater is discharged to a drainfield for additional treatment. The system is capable of significantly reducing biological oxygen demand (BOD_5), total suspended solids (TSS), and total nitrogen in the effluent. The technology is targeted for use in critical resource areas and is intended to be used with shallow pressurized drainfields.

Technology Name:	**Smart Trickling Anaerobic/Aerobic Recirculating (STAAR™) Media Filter (formerly known as SeptiTech)** **STAAR Design Manual – October 21, 2021**
Vendor Information:	SeptiTech/Bio-Microbics of Maine, Inc. 69 Holland Street Lewiston, Maine 04240
Contacts:	Tracey H. Rioux, President 69 Holland Street Lewiston, Maine 04240

Tel: (207) 333-6940 x301
Cell: (207) 240-2855
trioux@septitech.com

Models:	STAAR 0.5/0.5D, STAAR 0.75/0.75D, STAAR 1.0/1.0D, STAAR 1.2/1.2D, STAAR 1.5/1.5D, STAAR 3.0/3.0D, STAAR 4.5/4.5D, STAAR 6.0/6.0D, STAAR 9.0/9.0D, STAAR 13.5/13.5D, STAAR 18/18D, and STAAR 24/24D
Certification:	Alternative System or Technology - Class Two
Technology Type:	Waste Strength Reduction Only – Non "D" Models: TSS ≤ 20 mg/L, BOD ≤ 20 mg/L, Oil & Grease ≤ 5 mg/L Waste Strength Reduction and Nitrogen Reduction – "D" Models: Total Nitrogen ≤ 19 mg/L, TSS ≤ 20 mg/L, BOD ≤ 20 mg/L, Oil & Grease ≤ 5 mg/L
Pretreatment Category:	Category 1 – Timed-Dosed
Authority to Design:	Cl-II & III Licensed Designers

Description: The System is an aerobic biological trickling filter that is a two-tank design with a primary anoxic tank (a septic tank) followed by the aerobic trickling filter tank (the processor tank). Raw wastewater enters and passes through the primary anoxic tank to a reservoir beneath treatment media in the aerobic processor tank. The wastewater is aerated and sprayed onto the media; a programmable logic controller (PLC) controls the timing and sequence of the recirculation of wastewater in the lower collection reservoir. A portion of the wastewater is pumped back to the septic tank; this process is self-adjusting based on demand and is controlled by the PLC. Treated wastewater is time dosed to a leachfield. A 50% reduction of leachfield area is allowed when utilized with conventional leachfields.