COUNTY OF SUFFOLK

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DEPARTMENT OF HEALTH SERVICES
DIVISION OF ENVIRONMENTAL QUALITY

2016 REPORT ON THE PERFORMANCE OF INNOVATIVE AND ALTERNATIVE ONSITE WASTEWATER TREATMENT SYSTEMS

Prepared: **December 2017**

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Tables of Contents Page

I. Executive Summary

The Suffolk County Department of Health Services (SCDHS) has prepared this annual report in accordance with the requirements of Article 19 of the Suffolk County Sanitary Code (Article 19). The report summarizes the performance of innovative and alternative onsite wastewater treatment systems (I/A OWTS) installed in Suffolk County as well as neighboring jurisdictions and examines emerging technologies that could potentially become available for use in Suffolk County. This report also provides recommendations for future research, development and modifications to Suffolk County's performance standard provided technology treatment capabilities warrant such adjustments.

This report was prepared in 2017 using the complete dataset from 2016. This report will serve as a template for the 2017 annual report, which will be prepared in the spring of 2018.

Performance Standard for Total Nitrogen

Suffolk County currently requires I/A OWTS to be capable of reducing effluent total nitrogen (TN) to 19 milligrams per liter (mg/l) or less as outlined in the SCDHS "Standards Promulgated Under Article 19 for the Approval and Management of Innovative and Alternative Onsite Wastewater Treatment Systems" (Article 19 Standards). The established treatment requirement mimics the performance requirements of Rhode Island and Massachusetts. The treatment level of 19 mg/l represents a reduction in TN through the I/A OWTS of approximately 50% to 70% depending on the incoming nitrogen concentration, which may vary from site to site depending on water usage and other factors. Other States permit higher effluent TN such as the State of Maryland, which requires I/A OWTS to meet 30 mg/l or less. The New Jersey Pinelands Commission regulates nitrogen reduction in terms of density. Systems that treat to 14 mg/l TN based on their standard may be used for development of lots of at least 1 acre in size.

It should be noted that the Suffolk County Sanitary Code Article 6 (Article 6) limits the amount of sewage that can be discharged on a parcel of land based on lot area when using an onsite sewage disposal system such as a conventional system (septic tank plus leaching structure) or an I/A OWTS. I/A OWTS are only permitted to be used when a site meets the density requirements of Article 6. Using an I/A OWTS coupled with the density requirements of Article 6, greater water resource protection can be achieved.

I/A OWTS Performance in Suffolk County

Suffolk County initiated an I/A OWTS Demonstration Project in 2014. A total of nineteen (19) I/A OWTS units were donated by four (4) manufacturers representing six (6) different I/A OWTS technologies. The purpose of the Demonstration program is to assess the design, operation, maintenance, installation, and overall ability of an I/A OWTS technology to meet nitrogen reduction objectives. Following a County-wide lottery for interested homeowners, the demonstration systems were installed between June 24, 2015 and February 29, 2016. The Hydro-Action AN unit and

Norweco Singulair TNT unit are currently the only two (2) technologies that received Provisional Approval in 2016 in accordance with Article 19 Standards based on their performance in the demonstration program. SCDHS performed monthly composite sampling of the demonstration systems to evaluate their nitrogen removal capabilities under real-world conditions. Technologies that maintained an average of 19 mg/l TN or better for 75% of all the systems tested for a minimum of six (6) months were granted provisional approval. The 2016 results of the demonstration systems are summarized in **Table 1**.

Table 1: 2016 Septic Demo System Performance in Suffolk County

Technology	AVG*	Provisional Approval
Hydro-Action AN Series	11.6 mg/L	Approved in September 2016
Norweco Singulair TNT	18.3 mg/L	Approved in October 2016
Orenco AX-RT Series	18.5 mg/L	Approved in March 2017
Norweco Hydro-Kinetic	17.5 mg/L	Approved in April 2017
Orenco AX Series	21.6 mg/L	Cannot project approval at this time
Busse MMF	72.3 mg/L	Cannot project approval at this time

***Standard is 19mg/L**

I/A OWTS Performance in Proximate Jurisdictions

Prior to developing an I/A OWTS management program, Suffolk County embarked on a four (4) state tour to evaluate I/A OWTS programs in neighboring jurisdictions . This tour included visits to the New Jersey Pinelands Commission, Maryland Department of Environment, Rhode Island's New England Onsite Wastewater Training Program, and Massachusetts Barnstable County Department of Health and Environment. Lessons learned from these jurisdictions were instrumental in guiding the County in the development of a robust I/A OWTS management program and as such, the County has continued to consult with these jurisdictions throughout the Demonstration Program and I/A OWTS program development. **Table 2** and **Table 3** depict the I/A OWTS technologies approved for use in these jurisdictions along with performance data for 2016 compared to the tested nitrogen effluent during their NSF 245 or EPA ETV certification process. **Figure 1** depicts a graph of the effluent TN of these systems in 2016.

Table 2: I/A OWTS Approved in Proximate Jurisdictions

Technology	Jurisdiction				
	Suffolk	MA	RI	MD	NJ
Advantex AX Series	•	•	•	•	
Advantex AX-RT Series	•	•	•	•	
Amphidrome		•	•		•
AquaKlear				•	
BioBarrier MBR		•	•		•
Bioclere		•	•		•
Busse	•				•
Ecoflo Coco				•	
FAST		•	•		•
Fuji Clean				•	
Hoot ANR					•
Hoot BNR				•	
Hydro-Action AN Series	•			•	
Hydro-Kinetic	•		•	•	
MicroFAST		•		•	
Mod FAST		•			
Nitrex		•	•	•	
Nitrex Plus		•			
OMNI Recirculating Sand Filter		•			
OMNI-Cycle System		•			
Recirculating Sand Filter		•	•		
RetroFAST				•	
RID Phosphorus Removal System		•			
RUCK		•			
RUCK CFT		•			
SeptiTech		•	•	•	•
Singulair DN		•	•		
Singulair TNT	•	•	•	•	
Waterloo Biofilter		•			
White Knight			•		

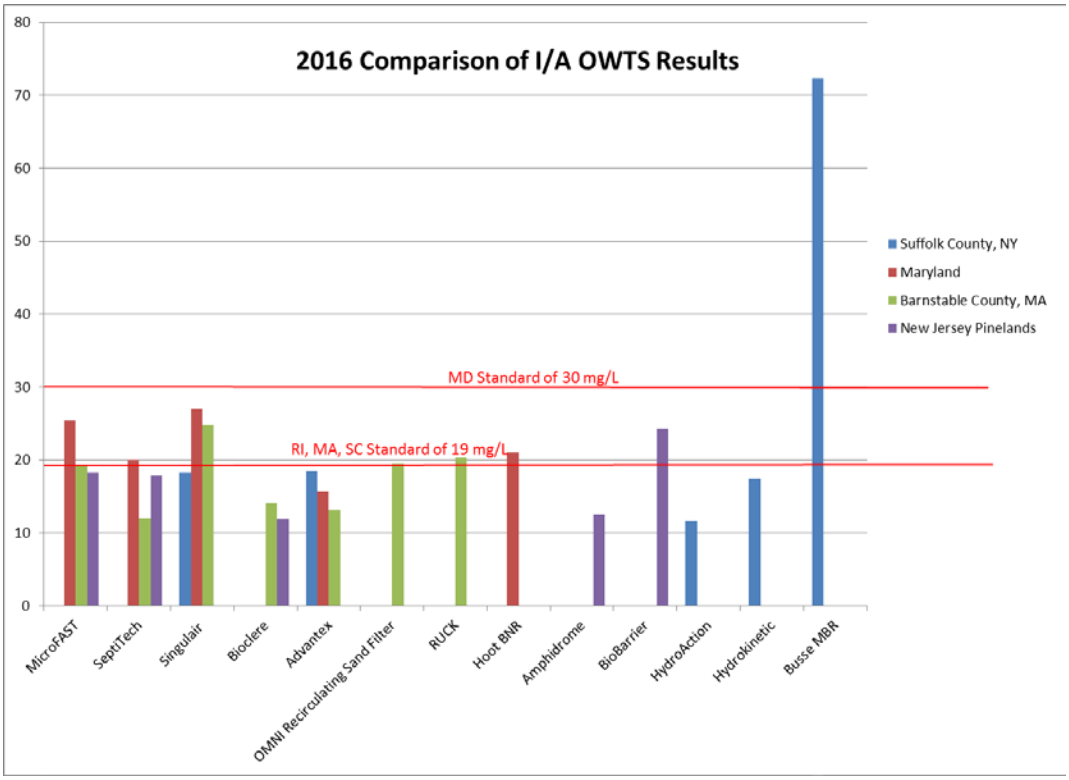
• General Use
• Provisional Use/Undergoing Field Verification
• Piloting Use

Table 3: 2016 Comparison of I/A OWTS Results*

Technology	NSF 245 or ETV Certification	**Suffolk County**	Maryland	Barnstable County	New Jersey Pinelands
Advantex AX	NSF 24 mg/L	**21.6 mg/L**	17.0 mg/L	13.17 mg/L	
Advantex RT		**18.5 mg/L**	14.52 mg/L		
HydroAction	NSF 15 mg/L	**11.6 mg/L**	20.33 mg/L		
Norweco Singulair	NSF 12 mg/L	**18.3 mg/L**	27.0 mg/L	24.85 mg/L	
Norweco Hydro-Kinetic	NSF 7.9 mg/L	**17.5 mg/L**			
BUSSE MF	NSF 16 mg/L	**72.3 mg/L**			
Amphidrome	ETV 10.81 mg/L				12.5 mg/L
BioMicrobics BioBarrier	NSF 9 mg/L				24.3 mg/L
BioMicrobics FAST	NSF 17 mg/L		25.44 mg/L	19.27 mg/L	18.3 mg/L
BioMicrobics SeptiTech	NSF 17 mg/L		20.0 mg/L	12.0 mg/L	17.9 mg/L

*Suffolk County utilizes the combined average of a technology's TN results. SCDHS believes that using an average is the best method of evaluating a technology because it is a true indication of how well a technology will protect the environment. Use of Median data tends to artificially lower TN results and is not a true indicator of mass loading. Suffolk County and the State of Maryland appear to be the only jurisdictions in close proximity that use TN average data to evaluate I/A OWTS performance.

Figure 1: 2016 Comparison of I/A OWTS Results in Proximate Jurisdictions



*Suffolk County utilizes the combined average of a technology's TN results. SCDHS believes that using an average is the best method of evaluating a technology because it is a true indication of how well a technology will protect the environment. Use of Median data tends to artificially lower TN results and is not a true indicator of mass loading. Suffolk County and the State of Maryland appear to be the only jurisdictions in close proximity that use TN average data to evaluate I/A OWTS performance.

Emerging Technologies

The New York State Center for Clean Water Technologies (CCWT) at Stony Brook University was established to develop and commercialize affordable and effective nitrogen removal systems for residential and commercial use. Currently, CCWT is developing Nitrogen Reducing Biofilters (NRB's); a relatively passive technology that uses layers of sand and sawdust to treat wastewater. CCWT is evaluating these NRB's to determine if they can treat wastewater to 10 mg/l of total nitrogen or less. In 2016, CCWT installed three (3) different iterations of the NRB at the Massachusetts Alternative Septic System Test Center (MASSTC), and in 2017, CCWT will work with Suffolk County to install NRB's on residential sites located at County Park properties as experimental I/A OWTS units. If these NRB's complete the experimental phase and piloting phase successfully then NRB's could receive provisional approval in late 2019 or early 2020.

Recommendations and Next Steps

Based on the information contained in this report, The Department makes the following recommendations and conclusions:

1. The I/A OWTS Demonstration Program was an effective method to spark the use of innovative and alternative technologies in Suffolk County. The demonstration program captured the leading manufacturers participating in Programs in Rhode Island, Massachusetts, Maryland, and New Jersey. The demonstration program also received international interest from Germany, Japan, and Canada. These are Companies who have not yet established themselves in proximate jurisdictions. The demonstration program allowed the assessment of system design, operation & maintenance, installation issues, and the overall ability of each technology to meet TN reduction objectives in Suffolk County. Though all technologies participating in the demonstration program have certification for nitrogen reductions (through NSF245 or EPA's ETV testing), not all technologies have yet proved capable of reducing TN to 19 mg/L or less in Suffolk County. It is important for the County to continue the next phase of the demonstration program, which will result in an additional eight (8) technologies to be installed at twenty (20) private residences for evaluation.

2. The performance standard of 19 mg/L represents the most stringent requirement enacted by a government agency in regards to TN that does not also allow for increase in density. SCDHS does not feel that a change to the performance standard is warranted at this time.

3. Data from other jurisdictions supports not changing the TN performance standard at this time as Suffolk County and Maryland are the only proximate jurisdictions that use a true average. Massachusetts, Rhode Island, and New Jersey use the median which SCDHS believes is not a true indicator of how well the systems perform. If these jurisdictions used the mean instead, resulting data would show the systems have difficulty achieving a TN of 19 mg/L.

4. The County should not consider changing the performance standard of 19 mg/L for TN until there is sufficient data justifying a 90% confidence level in the dataset of a technology as concluded by Horsely Witten Group in the analysis of Barnstable County's septic system database. (i.e. there should be a minimum of twelve (12) samples of twenty (20) systems of a technology before the County should consider changing the performance standard).

5. New emerging technologies such as the NRB's are being evaluated and piloted by SBU's CCWT and constructed wetlands, which are promising alternatives to current proprietary technologies, are being evaluated by other entities in Suffolk County. SCDHS should work cooperatively with CCWT to aggressively pursue, evaluate, and install these non-proprietary technologies in Suffolk County.

II. Purpose of Annual Evaluation

Pursuant to Article 19 of the Suffolk County Sanitary Code (Article 19), the Suffolk County Department of Health Services (SCDHS) serves as the Responsible Management Entity (RME) to facilitate development and use of Innovative and Alternative Onsite Wastewater Treatment Systems (I/A OWTS) as an environmental conservation and public health protection measure. In compliance with Section 760-1907 of Article 19, SCDHS has prepared this annual report, which outlines the progress of the I/A OWTS program within Suffolk County, and considers potential opportunities for improvement. The purpose of the annual report is to regularly review and recommend research on I/A OWTS to increase the effectiveness of the County's program. This report was prepared in 2017 using the complete dataset from 2016. This report will serve as a template for the 2017 annual report which will be prepared in the spring of 2018.

The report provides an evaluation of I/A OWTS currently installed in Suffolk County in addition to an evaluation of the use and performance of I/A OWTS in similar jurisdictions. The report utilizes data from the National Sanitation Foundation/American National Standards Institute ("NSF/ANSI"), the U.S. Environmental Protection Agency's Environmental Technology Verification ("ETV") Program, and other jurisdictions, including Massachusetts, Rhode Island, New Jersey and Maryland. One main goal of this report is to evaluate the performance capabilities of I/A OWTS and make recommendations to change Suffolk County's performance standard if warranted.

III. Reclaim Our Water Overview

Water is the single most significant resource for which Suffolk County bears responsibility. In 2014 Suffolk County Executive Steve Bellone kicked off his *Reclaim Our Water* initiative by identifying water quality as his administration's highest priority. Since then, the County has participated in a four (4) State tour of I/A OWTS; adopted 2015's Comprehensive Water Resources Management Plan; initiated the Subwatersheds Wastewater Plan; piloted six (6) I/A OWTS technologies on nineteen (19) residential properties; and amended the sanitary code for the first time since 1973 with the enactment of Article 19. These efforts would not be possible without the assistance of the many stakeholders, most notably, New York State Department of Environmental Conservation (NYSDEC) and the Long Island Action Plan (LINAP). The Septic / Cesspool Upgrade Program

Enterprise (SCUPE) is a NYSDEC grant that enables Suffolk County to embark on these aggressive measures to battle nitrogen pollution.

Approximately 360,000 residential parcels are currently served by polluting cesspools and septic systems with little to no nitrogen removing capabilities, and will probably never be connected to a sewer system. Reversing degradation of water quality due to nitrogen pollution will depend on replacement of existing systems with new, individual I/A OWTS that have nitrogen removing capabilities.

The following are key program components of the *Reclaim Our Water* initiative:

Liquid Waste Licensing

Suffolk County modified the septic industry licensing requirements by adding eleven specialized endorsements under the "liquid waste umbrella" and required training, certification and continuing education for I/A OWTS installers. The installer must hold a current Liquid Waste License pursuant to the Suffolk County Code Chapter 563, Article VII (Septic Industry Businesses) with an Endorsement as an Innovative and Alternative Treatment System Installer through the Suffolk County Department of Labor, Licensing and Consumer Affairs. The Department of Labor, Licensing, and Consumer Affairs maintains a list of liquid waste license holders.

Long Island Nitrogen Action Plan ("LINAP")

The NYSDEC is working closely with Suffolk County to complete the LINAP and to help improve wastewater treatment to protect water resources. The NYSDEC has provided grant funding for the Suffolk County SCUPE for the evaluation of I/A OWTS, development of an I/A OWTS program, and to initiate the Subwatersheds Wastewater Plan to prioritize areas in need of improved wastewater treatment. The SCUPE funding enabled the County to hire start-up staff for the I/A OWTS Program and a Responsible Management Entity. It also provided funding for the Septic Improvement Program. Overall, these programs are early actions in the NYSDEC LINAP, a multiyear initiative to reduce nitrogen in Long Island's surface and ground waters, in which Suffolk County participates as a partner.

Suffolk County Sanitary Code and Standards for Construction

Suffolk County Department of Health Services has prepared and implemented Article 19 Standards to regulate I/A OWTS and has since been updating the Standards and Sanitary Code in order to keep the County's regulations up to date with the progress of the I/A OWTS program and technology advances. The Standards also include how the Department serves as the RME to administer and conduct a comprehensive set of activities and have the legal authority and technical capacity to ensure the long-term operation, maintenance, and management of all I/A OWTS in Suffolk County.

Suffolk County Septic Demonstration Programs

Demonstration Projects give I/A OWTS Manufacturers the opportunity to showcase and demonstrate single family residential onsite wastewater treatment system technologies in Suffolk County—at no cost to the County and participating homeowners — in an effort to test

the viability of these systems in local conditions and potentially expedite provisional approval of said technologies. There have been two demonstration programs in Suffolk County, one beginning in 2014 and the other in 2016. As of 2016, there were nineteen (19) demonstration systems installed in Suffolk County. Technologies participating in the demonstration program were offered a streamlined path to Provisional Approval. If 75% of the systems of a technology in the demonstration program maintained a dataset of 19 mg/L or better for a minimum of six (6) months, they were granted Provisional Use Approval.

Subwatersheds Wastewater Plan ("SWP")

The SWP is the science based bridge that will serve to support policy decisions and provide a recommended blueprint for wastewater upgrades. The SWP is based on a series of models, data evaluations and cost-benefit analyses. The SWP will set priority areas, nitrogen reduction goals, and describes where, when, and what methods should be implemented to meet nitrogen reduction goals.

IV. Performance of I/A OWTS in Suffolk County

All I/A OWTS technologies must be approved by the Department for use in Suffolk County as either an "Experimental", "Piloting", "Provisional", or "General Use" system in order to be permitted for installation as an onsite wastewater treatment system in accordance with the Article 19 Standards. During each phase of approval, the I/A OWTS technology must undergo sampling as stated in the Article 19 Standards. The minimum sampling requirements and resulting combined TN average outlined in **Table 4**, and defined in the Article 19 Standard, shall be required prior to a system receiving approval to move from one phase of approval to the next and eventually to the final approval phase known as "General Use."

TABLE 4: Summary Approval Chart for Residential Systems

Approval Phase	# of Systems	Sampling Frequency	Performance Requirement
Experimental	3 – 5 Year-Round	Monthly Sampling 12 months rolling average	The total dataset of 75% of the systems must have a combined average of 19 mg/L or less TN
Piloting*	8 – 12 Year-Round	Monthly Sampling 12 months rolling average	The total dataset of 75% of the systems must have a combined average of 19 mg/L or less TN
Septic Demonstration Systems*	1 – 5 Year-round	Monthly Composite Samples 6 month rolling average for streamlined approval.	The dataset of 75% of the systems must maintain a combined average of 19 mg/L or less TN
Provisional	First 20 Year-Round	Bi-Monthly Sampling for 24 months rolling average	The dataset of all the 20 systems must have a combined average of 19 mg/L or less TN
General Use		Every 36 Months	The dataset must maintain an average of 19 mg/L or less in order to remain in General Use phase **

Note: The number of required systems is a cumulative number. For example, the minimum of 20 systems for Provisional Use includes the number of systems installed as part of Experimental and Piloting phases.

**Suffolk County Sponsored I/A OWTS Demonstration Program may permit a streamlined Pilot approval phase.*

***The combined average of the dataset in Experimental, Piloting and Provisional 1 is the requirement to achieve successful completion of that phase.*

Suffolk County's Septic Demonstration Programs:

In 2014, Suffolk County developed provisions for participation in an I/A OWTS Demonstration Program, whereby a Vendor installs, tests and maintains systems at no cost or at a reduced cost to Property Owner(s). This program is based on a similar program in Rhode Island where 58 I/A OWTS were installed, evaluated over a ten (10) year period to provide a means for industry training, performance evaluations, and provide data for the development of I/A OWTS regulations. Systems being tested as part of a Demonstration Program were subject to a streamlined approval process where the Department has approved a technology for Provisional Use if 75% of the units installed have a combined total average effluent TN of 19 mg/L or less for at least six (6) months of composite sampling.

The Demonstration Program proved to be an exceptional tool to assess the design, operation, maintenance, installation, and overall ability of an I/A OWTS technology to meet nitrogen reduction objectives in Suffolk County. The dual-purpose framework of the program also included a means for accelerated construction of programmatic infrastructure and validation of its and local institutional ability to review, approve, install and operate I/A OWTS systems. As part of this approach Suffolk County dedicated significant staff resources to work with manufacturers, who also committed to terms of an intensive cooperative program, including:

- industry training (designers, installers, O&M contractors)
- regulatory training (procedures/standards to review/approve, and inspect)
- cooperative process optimization; i.e., vendors working with Suffolk to optimize systems (recirculation rates, oxygen supply, etc.) given local influent strength, venting configurations, etc.
- demonstration of systems to design professionals, non-governmental organizations (NGOs), civics, local governments, etc.

A technology's successful completion of a demonstration program allows admittance into the Provisional phase, where rigorous testing and statistical protocols are utilized prior to granting general use approval.

Phase 1 Septic Demo Systems:

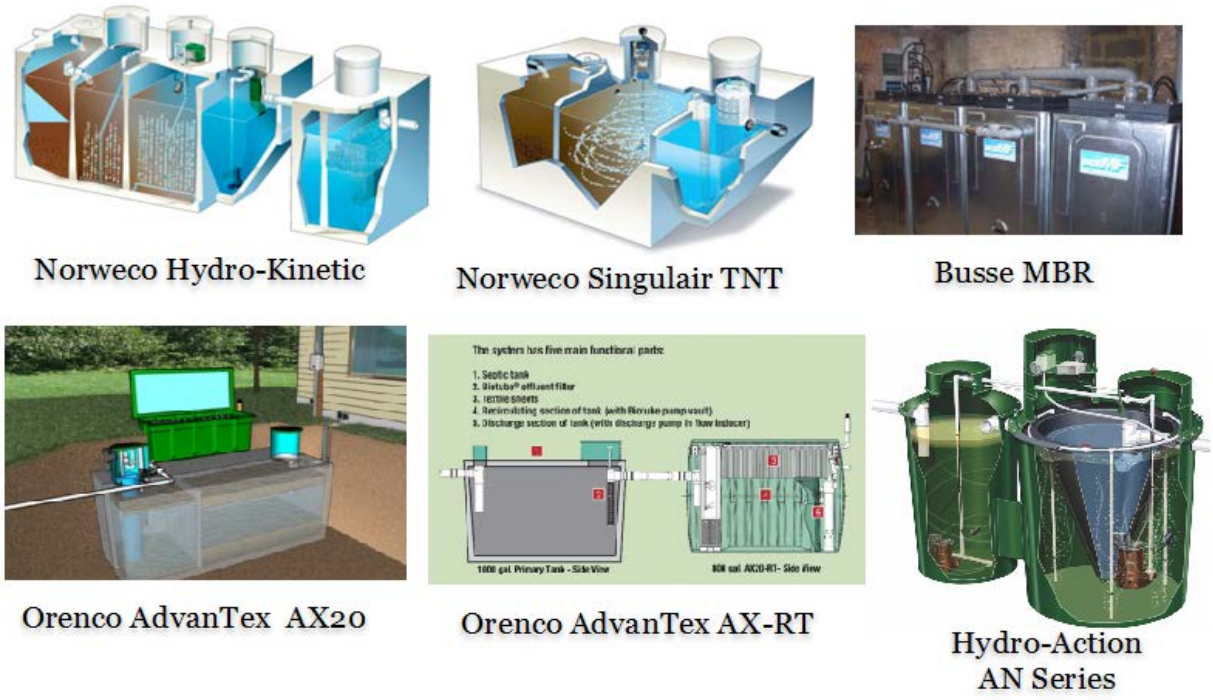
In April of 2014, Suffolk County issued the first Request for Expression of Interest (RFEI) for a Demonstration Program of Innovative and Alternative Onsite Wastewater Systems (I/A OWTS). A total of nineteen (19) systems were donated from four (4) manufacturers representing six (6) different technologies. Following the County-wide lottery for the interested homeowners, the systems were installed between June 24, 2015 and February 29, 2016 and two (2) technologies received Provisional Approval in 2016 (Hydro-Action AN and Norweco Singulair TNT).

The systems were given approximately three (3) months to reach equilibrium and were then sampled monthly. Systems were granted Provisional Use Approval if the dataset from 75% of the systems averaged 19 mg/l or less for a minimum of six (6) months.

Table 5: Sampling Requirements for Experimental and Piloting Use Approval

Parameter	Sample Type	Testing Location
BOD_5	24 h composite	Laboratory
Total suspended solids	24 h composite	Laboratory
pH	Grab	Test site
Temperature (wastewater)	Grab	Test site
Temperature (ambient air)	Grab	Test site
Effluent Alkalinity (as CaCO3)	24 h composite	Laboratory
TKN (as N)	24 h composite	Laboratory
Ammonia-N (as N)	24 h composite	Laboratory
Nitrite-N (as N)	24 h composite	Laboratory
Nitrate-N (as N)	24 h composite	Laboratory

Figure 2: Phase-I Suffolk County Demonstration Systems



Hydro-Action AN Series

The Hydro-Action systems utilize a suspended growth aeration system. The treatment occurs as wastewater enters the pretreatment tank and flows by gravity into the aeration compartment. Wastewater flows by gravity from the aeration chamber through a hole in the base of the cone shaped clarifier, where final settling takes place. The hydraulic roll created by the aeration system helps draw settled solids out of the base of the clarifier and back into the aeration chamber. The aerobically-charged wastewater is then recirculated back to the pretreatment tank, where it further

denitrifies. Treated wastewater exits by gravity through a tee structure located in the center of the clarifier, treated effluent is then discharged to a Department approved leaching structure.

Five (5) Hydro-Action AN units were installed as part of the Septic Demonstration Program. The systems were sampled from May 2016 through November 2016 and averaged 11.9 mg/L TN. **The dataset of 75% of the systems maintained an average of 11.6 mg/L TN. Hydro-Action was granted Provisional Use Approval on September 28, 2016. Table 6** outlines the 2016 24-hour composite sample results for the Hydro-Action AN demonstration units.

Table 6: 2016 Steady State 24-Hour Composite Sample Results for the Hydro-Action AN Demonstration Systems

Site #	Sample Date	Calculate	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS#18	5/16/16-5/17/16	No	18.7	2.4	<0.5	15.8	0.5	16	16	6.56	60.3	18
	6/20/16 - 6/21/16	No	24.8	8.5	0.8	16.3	<0.5	N/R	67	6.77	70.8	26.8
	7/18/16 - 7/19/16	No	10.6	5.3	<0.5	5.3	<0.5	18	53	7.07	80	65
	8/15/16 - 8/16/16	No	4.5	<0.5	<0.5	4.5	<0.5	>9	<10	7.17	80	68
	9/12/16 - 9/13/16	No	9	2.3	<1.0	6.7	<0.5	N/R	<10	7.13	73	54.4
	11/14/16-11/15/16	No	10.1	7.9	3.8	2.2	<0.5	18	33	6.57	56	23.3
SDS#10	5/9/16 - 5/10/16	Yes	5.7	<0.5	<0.5	3.6	2.1	19	16	6.6	59.3	22
	6/13/16-6/14/16	Yes	9.7	2	<0.5	7.7	<0.5	<17	<10	7.34	N/R	N/R
	7/11/16-7/12/16	Yes	14.1	2.2	<0.5	11.9	<0.5	9	10	6.94	77	318
	8/8/16 - 8/9/16	Yes	8.8	<1.0	1.4	8.8	<0.5	<17	14	7.08	78	45.6
	9/12/16 - 9/13/16	Yes	9.7	2.9	<1.0	6.8	<0.5	N/R	10	7.33	73	48
	10/17/16 - 10/18/16	Yes	9.3	2	<0.5	7.3	<0.5	11	10	7.32	N/R	58
SDS#12	5/9/16 - 5/10/16	Yes	14.1	5.1	<0.5	9	<0.5	27	<25	7.09	58.5	52
	6/13/2016-6/14/16	Yes	12.2	2	<0.5	10.2	<0.5	<16	<10	7.75	72.4	111
	7/11/16-7/12/16	Yes	14.5	4.9	<0.5	9.6	<0.5	22	53	7.63	69	138
	8/8/16 - 8/9/16	Yes	10.4	6.1	3.5	4.3	<0.5	55	90	6.88	74	176
	9/12/16 - 9/13/16	Yes	12.1	1.8	<1.0	10.3	<0.5	N/R	10	7.64	72	110.2
	10/17/16 -10/18/16	Yes	11.1	1.7	<0.5	9.4	<0.5	<7	<10	7.52	N/R	76
SDS#11	5/9/16 - 5/10/16	Yes	5.2	<0.5	<0.5	2.4	2.8	37	<25	7.08	59.2	72
	6/13/16 - 6/14/16	Yes	10.8	2.3	<0.5	8.5	<0.5	<17	<10	7.16	71.6	35
	7/11/16 to 7/12/16	Yes	10.5	2.6	<0.5	7.9	<0.5	11	11	6.83	72.4	27
	8/8/16 - 8/9/16	Yes	10.1	<1.0	<0.5	10.1	<0.5	10	<10	6.69	73	23
	9/12/16 - 9/13/16	Yes	13.4	3.2	<1.0	10.2	<0.5	N/R	22	6.02	80	10
	10/17/16-10/18/16	Yes	12.6	3.3	<0.5	9.3	<0.5	14	23	6.67	71	20
SDS#6	5/16/16-5/17/16	Yes	11.3	5.5	3.6	5.2	0.6	<16	13	7.49	58.6	54.5
	6/20/16 - 6/21/16	Yes	24.2	4.9	<0.5	19.3	<0.5	N/R	<10	7.22	70.4	23.5
	7/18/16 - 7/19/16	Yes	12.8	0.9	<0.5	11.9	<0.5	<9	<10	7.42	80	54
	8/15/16-8/16/16	Yes	13.9	9.3	1.2	2.2	2.4	10	<10	7.75	75	163
	9/12/16 - 9/13/16	Yes	4.3	1.8	<1.0	2.5	<0.5	N/R	<10	7.72	72	88.6
	11/14/16-11/15/16	Yes	19.6	3.8	<0.5	15.2	0.6	7	<10	7.19	50	53.2
		Average	11.94	3.788	2.383333	8.48	1.5	18.93	28.19	7.121	69.87	70.1414

Norweco Singulair TNT

The Norweco Singulair TNT 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. Treated wastewater passes through an effluent filter as it exits the system and is then gravity fed to the leaching structure.

Five (5) Singulair TNT systems were installed as part of the Septic Demonstration Program. The systems were sampled from May 2016 through November 2016 and averaged 20.8 mg/L TN. **The dataset of 75% of the systems maintained an average of 18.3 mg/L TN. Norweco Singulair TNT was granted Provisional Use Approval on October 7, 2016. Table 7** outlines the 2016 24-hour composite sample results for the Norweco Singulair TNT demonstration units.

Note: No samples were taken from the fifth Norweco Singulair TNT site due the fact the homeowner would not grant SCDHS employees access to the site. The average was based on the 4 sites that were sampled.

Table 7: 2016 Steady State 24-Hour Composite Sample Results for the Norweco Singulair TNT Demonstration Systems

Site #	Sample Date	Calculate (Yes or No)	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS#21	9/19/16 - 9/20/16	No	23	12.4	6.2	1.1	9.5	79	62	6.96	74	82
	10/3/16-10/4/16	No	42.6	36.6	35.7	5.4	0.6	197	108	N/R	74	N/R
	11/21/16-11/22/16	No	57.4	52.2	40.1	<0.5	5.2	197	88	7.43	64	262
SDS#27	5/9/16 - 5/10/16	Yes	15.3	15.3	<0.5	<0.5	<0.5	86	110	6.82	59	131
	6/13/16 - 6/14/16	Yes	26.1	23.5	1.1	2.6	<0.5	96	232	7.15	73.6	142.5
	7/11/16-7/12/16	Yes	31.1	22.5	3.9	8.6	<0.5	111	190	6.87	70	150
	8/8/16 - 8/9/16	Yes	10.7	<0.1	<0.5	10.7	<0.5	19	16	7.64	N/R	123
	9/19/16 - 9/20/16	Yes	46.2	30.2	8.1	16	<0.5	171	384	6.85	76	116
	10/3/16-10/4/16	Yes	44.6	20.2	2	24.4	<0.5	124	232	6.34	64	N/R
SDS#15	3/21/16 - 3/22/16	Yes	14	14	2.3	<0.5	<0.5	48	90	6.81	62	102
	4/18/16-4/19/16	Yes	14.8	14	14.2	0.8	<0.5	<16	27	7.12	57.6	146
	5/16/16-5/17/16	Yes	22.2	5.6	2.3	16.6	<0.5	21	32	6.57	66.8	38.75
	6/20/16 -6/21/16	Yes	15.8	5.2	1.5	10.6	<0.5	N/R	61	6.87	77.7	62
	7/18/16 - 7/19/16	Yes	17.3	12	<0.5	5.3	<0.5	78	82	6.88	81	110
	8/15/16 - 8/16/16	Yes	53.1	<0.5	<0.5	44.6	<0.5	55	160	6.49	84	51.2
	9/19/16 - 9/20/16	Yes	10.1	6.8	3.2	2.4	0.9	48	32	6.8	81	71
	10/3/16-10/4/16	Yes	6.3	3.3	<0.5	2.3	0.7	33	25	6.71	74	N/R
	11/21/2016-11/22/16	Yes	17.2	15.1	9.1	<0.5	2.1	64	34	6.84	65	93
SDS#26	3/14/16 - 3/15/16	Yes	15.4	15.4	5.4	<0.5	<0.5	73	87	6.77	47.6	N/R
	4/18/16-4/19/16	Yes	12.5	12.5	7.1	<0.5	<0.5	55	53	6.72	57.6	122
	5/9/16 - 5/10/16	Yes	12.8	12.8	5.3	<0.5	<0.5	53	81	6.66	58	77
	6/13/16 - 6/14/16	Yes	14.1	14.1	9.8	<0.5	<0.5	18	20	7.15	75.3	116
	7/11/16-7/12/16	Yes	13.7	13.7	10.6	<0.5	<0.5	25	37	6.94	77	112
	8/8/16 - 8/9/16	Yes	11.8	11.1	12.7	<0.5	0.7	13	19	7.04	74	122
	9/19/16 - 9/20/16	Yes	2.9	2.9	1.5	<0.5	<0.5	21	17	6.06	76	74
	10/3/16-10/4/16	Yes	3.7	2.3	2	1.4	<0.5	11	10	N/R	68	N/R
	11/28/16-11/29/16	Yes	9.1	5.2	0.6	3.9	<0.5	25	60	6.57	N/R	49.6
*SDS#16												
		Average	20.88	15.16	8.395455	9.79375	2.81429	68.84	87	6.8424	69.488	106.957

*site removed from demo program due to homeowner issue- SCDHS not allowed on site for sampling

Orenco AX-RT Series

The AdvanTex® AX-RT Series is a recirculating textile filter treatment system. It is contained within a single fiberglass tank installed with the access panel at grade. It is preceded by a two-compartment septic tank and discharges to a leachfield. Raw sewage enters the septic tank through its inlet tee. In the septic tank, the raw sewage separates into three distinct zones -- a scum layer, a sludge layer, and a clear layer. Effluent from the clear layer passes through a Biotube® effluent filter and is discharged by gravity to the recirculation treatment tank portion of the AX-RT unit, which contains a Biotube Pump Package.

The recirculation pump is timer controlled to ensure that small, intermittent doses (micro-doses) of effluent are applied to the textile sheets throughout the day. This ensures an aerobic, unsaturated environment for optimal treatment to occur. Effluent is sprayed over the textile sheets. The effluent then percolates down through the textile sheets and is distributed between the recirculation and discharge chambers by means of the AX-RT baffle. Periodically, a pump in the discharge chamber doses effluent to the dispersal system.

One (1) Orenco AX-RT system was installed as part of the Septic Demonstration Program. The system was sampled from February 2016 through September 2016.**The dataset of 75% of the systems maintained an average of 18.5 mg/L TN. Table 8** outlines the 2016 24-hour composite sample results for the Orenco AX-RT Series demonstration units.

Note: The 18.5 mg/l average above excluded two months of data for the Orenco RT system due to homeowner error of introducing a significant amount of bleach to the systems during as indicated by the homeowner.

Table 8: 2016 Steady State 24-Hour Composite Sample Results for the Orenco AX-RT Demonstration System

Site #	Sample Date	Calculate (Yes or No)	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS#2	3/21/16 - 3/22/16	Yes	21.2	3.6	1.8	17.6	<0.5	<13	<10	6.24	54.3	64
	*4/11/16-4/12/16	No	70.9	68.1	42.2	0.5	2.3	12	N/R	6.14	N/R	47
	*5/16/16-5/17/16	No	35	3.8	3.2	31.2	0.5	<10	<10	6.16	66.8	45.5
	6/20/16 - 6/21/16	Yes	24.5	7.9	7.1	16.6	<0.5	N/R	<10	N/R	69.9	N/R
	7/18/16 - 7/19/16	Yes	19.7	12	0.5	7.7	0.8	<9	<10	6.55	78	135
	8/22/16 - 8/23/16	Yes	13.6	3.2	2.8	9.9	0.5	<9	<10	6.21	77	118.6
	9/26/16 - 9/27/16	Yes	19.6	19.6	16.1	<0.5	<0.5	24	13	9.87	77	228
	10/3/16-10/4/16	Yes	14.5	14.5	19.7	<0.5	<0.5	25	13	N/R	64	N/R
		Average	18.85	16.59	11.675	13.9167	1.025	20.33	13	6.8617	69.571	106.35

*samples excluded based on homeowner report of significant bleach discharged to system for fish tank coral cleaning

Norweco Hydro-Kinetic

The Hydro-Kinetic 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 leaching structure. 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.

Five (5) Norweco Hydro-Kinetic systems were installed as part of the Septic Demonstration Program. **The Department began sampling the systems in August 2016. The Hydro-Kinetic system averaged 17.5 mg/l in 2016 but there was not enough data collected to issue Provisional Use Approval. Table 9** outlines the 2016 24-hour composite sample results for the Norweco Hydro-Kinetic demonstration units.

Table 9: 2016 Steady State 24-Hour Composite Sample Results for the Norweco Hydro-Kinetic Demonstration Systems

Site #	Sample Date	Calculate (Yes or No)	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS#4	8/22/16 - 8/23/16	Yes	4.2	<1.0	0.5	4.2	<0.5	<9	25	7.53	81	136
	9/26/16 - 9/27/16	Yes	8.7	1.4	<0.5	7.3	<0.5	9	12	7.43	77	185
	10/17/16-10/18/16	Yes	10.2	2.3	1.2	7.9	<0.5	<7	<10	7.13	N/R	134
	11/28/16-11/29/16	Yes	11.7	2.4	<0.1	9.3	<0.5	9	48.4	6.98	57	99
	12/12/16-12/13/16	Yes	13.6	1.4	<0.5	12.2	<0.5	<5	<10	6.93	N/R	93.2
SDS#24/25	9/26/16 - 9/27/16	No	7	3.5	0.9	3.5	<0.5	11	12	7.31	73	176.2
	10/17/16-10/18/16	No	13.8	6.9	4.9	6.9	<0.5	20	10	7.33	N/R	182
	11/28/16-11/29/16	No	33.8	<1	<0.5	33.8	<0.5	<5	<10	6.84	N/R	54.4
	12/12/16-12/13/16	No	52.3	<1	<0.5	52.3	<0.5	<5	<10	6.36	N/R	29.8
SDS#19	8/22/16 - 8/23/16	Yes	2.3	<1.0	<0.5	2.3	<0.5	<11	<10	7.43	78	222
	9/19/16-9/20/16	Yes	7.7	2	0.8	5.7	<0.5	10	10	7.28	76	200
	10/17/16-10/18/16	Yes	7.7	2.3	0.8	5.4	<0.5	8	<10	7.14	N/R	192
	11/28/16-11/29/16	Yes	10.6	3.2	0.7	7.4	<0.1	7	6.4	7.02	57	125
	12/5/16-12/6/16	Yes	11.1	1.5	<0.5	9.6	<0.5	8	<10	7.09	56	107.6
SDS#17	11/14/16-11/15/16	Yes	16.6	1.5	1.1	15.1	<0.5	7	<10	6.74	59	114
	12/5/16-12/6/16	Yes	40.4	3.1	1.1	37.3	<0.5	<5	11.6	6.55	54	40.8
SDS#14	11/14/16 - 11/15/16	Yes	35.4	9.9	8.3	25.5	<0.5	<5	<10	6.74	50	133
	12/5/16 - 12/6/16	Yes	28.9	18	17.4	10.9	<0.5	9	<10	6.92	53	147.2
		Average	17.56	4.243	3.427273	14.2556	<0.5	9.8	16.93	7.0417	64.25	131.733

Orenco AX Series

The Orenco AX series is a prepackaged packed bed media filter that is contained in a fiberglass container that is installed after a two-compartment septic tank. A pump basin in the second compartment of the septic tank distributes effluent to the treatment unit where it is nitrified. Effluent trickles through the media collects at the bottom of the treatment unit where it flows by gravity back to the inlet end of the septic tank for denitrification. When the level in the septic tank reaches peak level a valve seals off the recirculation and sends treated effluent to a separate chamber where it is then discharged to the leaching structure.

One (1) Orenco AX system was installed as part of the Septic Demonstration Program. The system began sampling in November 2016. There is currently not enough data to issue approval at this time. **Table 10** outlines the 2016 24-hour composite sample results for the Orenco AX Series demonstration units.

Table 10: 2016 Steady State 24-Hour Composite Sample Results for the Orenco AX Series Demo Units

Site #	Sample Date	Calculate (Yes or No)	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS#13	11/14/16-11/15/16	No	23.9	8	4.2	15.2	0.7	10	<10	6.64	54	37
	12/12/16-12/13/16	No	51.3	37.1	5.2	14.2	0.7	182	380	6.84	55	65.6
		Average	37.6	22.55	4.7	14.7	0.7	96	380	6.74	54.5	51.3

BUSSE GT

The BUSSE GT System is installed above grade, in non-living areas of the house such a garage or basement. The fiberglass tanks have four compartments, the first for settling, second for aeration, third for settling and final compartment for membrane filtration.

There are two (2) BUSSE GT systems that were installed as part of the demonstration program. Both systems were taken off line in the spring of 2016 due to non-performance, most notably, an effluent pH of less than 4 in both systems. The manufacturer is working with local engineers to reconfigure the system and treatment process. It is anticipated that the monitoring of these systems will resume in 2018. **Table 11** outlines the 2016 24-hour composite sample results for the BUSSE GT demonstration units.

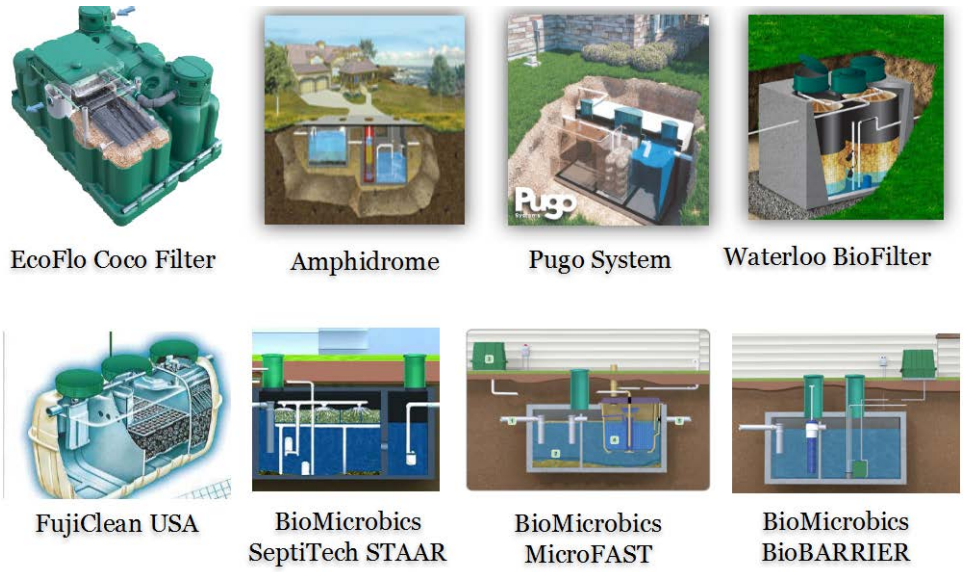
Table 11: 2016 Steady State 24-Hour Composite Sample Results for the BUSSE GT Demo Units

Site #	Sample Date	Calculate (Yes or No) (5)	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS#7	3/28/16 - 3/29/16	No	58.6	33.9	1.1	24.7	<0.5	N/R	N/R	5.49	N/R	N/R
	4/18/16 -4/19/16	No	102.4	34.3	29	68.1	<0.5	<8	<10	4.08	64	N/R
	5/16/16-5/17/16	No	76.3	27.3	22.3	48.9	<0.5	<10	<10	N/R	59.8	N/R
	6/20/16 - 6/21/16	No	108.2	46.7	28.9	61.5	<0.5	N/R	<10	3.84	N/R	N/R
	8/15/16 - 8/16/16	No	13.4	13.4	15.3	<0.5	<0.5	<7	<10	3.57	80	N/R
	9/19/16 - 9/20/16	No	80.8	30.2	26.9	50.6	<0.5	7	<10	3.7	72	N/R
	10/3/16-10/4/16	No	70.1	22.7	17.3	47.4	<0.5	8	10	3.62	74	N/R
SDS#3	9/26/16 - 9/27/16	No	68.5	16.8	20.9	51.7	<0.5	7	<10	3.68	74	N/R
		Average	72.29	28.16	20.2125	50.4143	<0.5	7.333	10	3.9971	70.633	N/R

Phase 2 Septic Demo Systems:

Based upon the success of Phase I of the Demonstration Program, Suffolk County issued an RFEI for a Phase II Demo Program in which a total of twenty (20) systems were donated from six (6) manufacturers representing eight (8) different technologies. On July 26, 2016, twenty (20) homeowners were selected from a lottery. Installations for these systems began in November 2016 and should be completed by the end of 2017. The performance of the Phase II systems will be documented in the 2017 annual report.

Figure 3: Phase II Demo I/A OWTS Technologies



V. Performance of I/A OWTS in Other Jurisdictions

When viewing I/A OWTS performance in other jurisdictions, it is important to note that Suffolk County utilizes the combined average of a technology's TN results in order to represent the overall ability of a technology. SCDHS believes that using an average is the best method of evaluating a

technology because it is a true indication of how well a technology will protect the environment. The median tends to give artificially lower TN results and is not a true indicator of mass loading. Other than Maryland, Suffolk County appears to be the only jurisdictions in close proximity that uses the true TN average to evaluate I/A OWTS performance. A combined average yields a true mass loading versus other methods of analysis. For example:

Table 12: The Case for Utilizing Total Nitrogen Average versus Median

Technology	System 1	System 2	System 3	System 4	Average	Median
A	18 mg/l	18 mg/l	20 mg/l	20 mg/l	19 mg/l	19 mg/l
B	16 mg/l	16 mg/l	16 mg/l	60 mg/l	27 mg/l	16 mg/l

Therefore, the Department believes that a combined average provides an improved method of analyzing a technology's performance

Massachusetts

The Massachusetts Department of Environmental Protection (MassDEP) has jurisdiction of I/A OWTS. The State Environmental Code Title 5 is the regulation used to evaluate and approve conventional and advanced onsite systems. Suffolk County based its approval process on Massachusetts three-phase (piloting, provisional, and general use) model. MassDEP requires I/A OWTS in the Nitrogen Sensitive Areas (Public Wellheads and properties with private wastewater and private well under one acre) under Title 5 guidelines and when density is greater than 440 gallons per day. MassDEP also requires the use of a secondary treatment unit for installations of septic systems with a design flow of 2,000 gpd or greater when the system is located within a Zone II/ Interim Wellhead Protection Area. In these instances, the regulations state 19 mg/L must be met for residential where the load is 660 gpd/acre and 25 mg/L for multi-family residential and commercial areas where the load is up to 550 gpd/acre.

MassDEP Title 5 regulations are in place in order to protect drinking water sources. Barnstable County and other Cape Cod towns have more stringent regulations and require I/A OWTS in areas beyond the State's Nitrogen Sensitive Areas and pertain to environmental protection measures.

I/A OWTS Approved in the State of Massachusetts

- General Use Approval
  - MicroFAST
  - Recirculating Sand Filters
  - RUCK
- Provisional Use Approval
  - Orenco Advantex AX20 and RT
  - Amphidrome
  - Bioclere
  - FAST
  - RetroFAST
  - Nitrex
  - BioMicrobics SeptiTech STAAR

- Norweco Singulair
- Waterloo Biofilter

Barnstable County Department of Health and Environment Septic Database

Barnstable County Septic Database tracks sampling, O&M, and pump-outs of the 2,355 I/A OWTS located on Cape Cod and Nantucket. These numbers include single family residential, multi-family residential and commercial sites. However, for the purpose of this report we only focused on residential I/A OWTS. **Table 13** lists the most common technologies and treatment performance as of December 31, 2016.

Table 13: 2016 Treatment Performance of I/A OWTS in Barnstable County, MA

	Technology	Mean TN (mg/L)
Barnstable	Advantex	13.17
	FAST	19.27
	SeptiTech	12
	Bioclere	14.04
	Singulair	24.85
	OMNI Recirculating Sand Filter	19.51
	RUCK	20.35

Rhode Island

The State of Rhode Island Department of Environmental Management (DEM) Office of Water Resources regulates wastewater treatment for the entire state. The DEM also license I/A OWTS manufacturers and review plans for new I/A OWTS technologies. Most of the systems approved meet 50% TN reduction and meet TN effluent of 19mg/L; RI DEM have also approved the Norweco Hydro-Kinetic for 75% TN reduction. There is no long-term monitoring required in Rhode Island. I/A OWTS are required in critical areas such as SAMPs – Special Area Management Plans (South Shore Salt Pond and Narrow River) and public well radius areas. I/A OWTS (advanced treatment) can be used when there in a non-conforming lot that does not meet setbacks or density and for new construction, as part of the variance criteria. Local municipalities may require I/A OWTS more often in certain situations beyond the requirements of the state. If an I/A OWTS is required by a local municipality for a specific project, a letter is sent to the state informing them of such.

Approved Technologies for Nitrogen Reduction in Rhode Island:

- Amphidrome
- BioBarrier
- BioClere
- FAST (single home and modular)
- Norweco Singulair DN, Green, TNT
- Norweco Hydro-Kinetic
- White Knight

- Orenco Advantex AX and RT
- Recirculating Sand Filter
- SeptiTech

Maryland

Maryland regulations require I/A OWTS, which they refer to as Best Available Technology (BAT), for removal of nitrogen in onsite sewage disposal system for new construction and replacement systems within the Chesapeake Bay and Atlantic Coastal Bays Critical Areas; the Critical Area is the area within 1,000 feet of the waterbody. Maryland has a treatment performance limit of 30 mg/L for TN and is the least stringent of the states looked at for this report. All wastewater systems greater than 5,000 GPD must utilize BAT. In addition, sites outside of the Critical Area may be required to install a BAT if they do not meet current standards (pre-existing lot size or deficient soil types). There are approximately 8,944 (BAT) (I/A OWTS) installed in the state of Maryland. Maryland's program goal is primarily to upgrade existing conventional septic systems in the Critical Areas to nitrogen reducing BAT systems by providing state grant funds. The Bay Restoration Fund provides grants to property owners to cover part or all of the cost for a Nitrogen-Reducing Pretreatment Unit. Based on the availability of funding, applications are processed on a first-come, first-served basis with priority given to the repair or replacement of failing septic systems within the Critical Areas. Low interest loans are also available. Only pre-qualified state-licensed disposal system contractors may install BAT systems in the State. Pre-paid two-year maintenance contracts and annual inspections in perpetuity are required for all BAT installations. The Maryland Code states "the property owner is required to operate and maintain the BAT for the life of the system through a certified service provider. The owner shall ensure the BAT system is inspected and has necessary operation and maintenance performed at a minimum of once per year." Inspection contracts are with the selected system distributor's trained inspector, which there are few of, so homeowners have little choice in regard to who completes the annual inspections. The **Table 14** lists the performance data of the BAT systems approved for use in Maryland.

Approved Technologies for Nitrogen Reduction in Maryland:

- Orenco Advantex AX20 and AX-RT
- AquaKlear
- Hoot BNR
- Hydro-Action AN Series
- RetroFAST
- BioMicrobics SeptiTech STAAR
- Norweco Singulair Green and Singulair TNT

Table 14: Technology Performance Summary Table of Maryland BAT systems

	Technology	Mean TN (mg/L)
M.D.	Orenco Advantex AX-20	17
	Orenco Advantex AX-RT	14.52
	Hoot BNR	21
	Hydro-Action AN Series	20.33
	RetroFAST	25.44
	SeptiTech	20
	Singulair Green/TNT	27
	AquaKlear	27.47

New Jersey

New Jersey Pinelands Commission regulates land use and development within the Pinelands region. I/A OWTS are required for new construction within the New Jersey Pinelands region. There are approximately 300 I/A OWTS installed compared to the 10,000 existing conventional on-site wastewater disposal systems. Legacy conventional septic systems are not required to be updated, as long as they are repaired/replaced in-kind/in-place they are grandfathered, however cesspools are outlawed. Within the Pinelands growth areas, the following systems are approved on the minimum corresponding lot size: Amphidrome (1 acre), Bioclere (1 acre), BioMicrobics MicroFAST (1.4 acres), BioMicrobics BioBarrier (1.7 acres), SeptiTech (1.7 acres). Hoot and BUSSE I/A OWTS technologies have also been approved for piloting use but there are none of these installed. Cromaglass I/A OWTS technology was being piloted but never received approval. After an I/A OWTS technology completes the pilot program, an approval for a specific lot size is determined. After a technology has completed the pilot phase, no additional laboratory testing or sampling is required. On residential properties that are at least 3.2 acres or more, no I/A OWTS technology is required, even for new construction. New Jersey Pinelands Commission requires NEHA certification for installers, and a five (5) year pre-paid operation & maintenance contract. The Commission encourages homeowners to renew their operation & maintenance contracts after the five years are up, but this is not a requirement, and usually does not happen. Therefore, there is no guarantee that the systems are continuing to meet the treatment standard they did during piloting after the initial five (5) year maintenance contract expires. The **Table 15** lists the performance data of the NJ Pinelands Commission systems.

Table 15: Technology Performance Summary Table for the New Jersey Pinelands

	Technology	TN (mg/L)
N.J.	MicroFAST	18.3
	SeptiTech	17.9
	Bioclere	11.95
	Amphidrome	12.5
	BioMicrobics BioBarrier	24.3

VI. Statistical Analysis of Barnstable County's I/A OWTS Database

The Horsley Witten Group, Inc. (HW) was hired by the United States Environmental Protection Agency (USEPA) in 2016 to conduct a statistical analysis of the sampling data that has been collected through the Barnstable County Septic Database. This database includes field sampling data for approximately 2,039 advanced treatment systems and provides an opportunity to evaluate how many samples are needed to understand the performance of a new nitrogen reducing technology for onsite septic systems. Two questions were evaluated with the data provided by Barnstable County:

1. How many samples are needed to understand the performance of an individual system serving one home?
2. How many systems need to be sampled to evaluate the overall performance of an advanced technology?

The Horsely Witten Group (HW) determined from the analysis that twelve (12) samples per system is a reasonable number of samples that contributes to an acceptable percent error range (e.g., 20% or below). A twelve (12) sample plan would make it easy to implement a monthly sampling plan across one year. All of the results presented in this section represent the calculation using a 90% confidence level. HW also analyzed the number of systems needed within different technologies, some of the technologies analyzed had a reached the 20% error range threshold with only a few systems tested (8 systems or less), whereas other technologies require more systems and data to analyze (20 systems) in order reach the same threshold. Since the field evaluation data collection protocol will be designed to test many technologies, this analysis can help inform regulators to choose an appropriate number of systems to test. The analysis shows that field testing a select number of systems between eight (8) and twenty (20) with twelve (12) samples collected on each system would provide a sufficient amount of data to evaluate the performance of the technology. Suffolk County was the first jurisdiction to develop an approval process based on this statistical analysis.

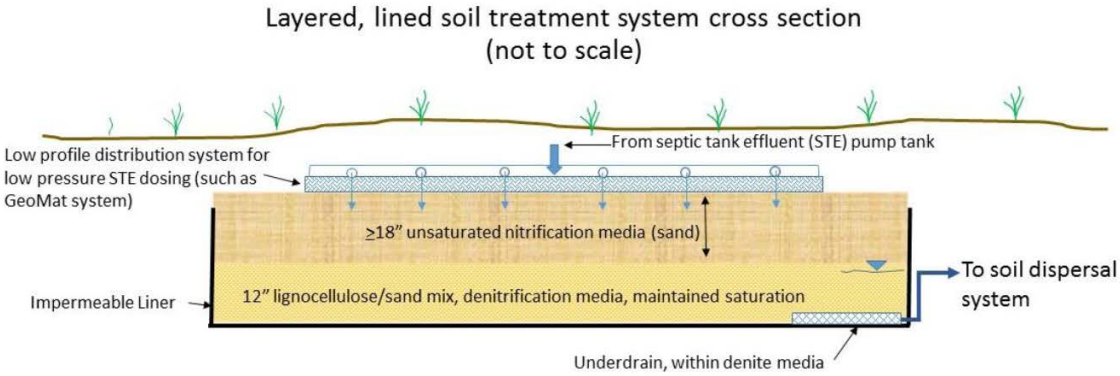
VII. Emerging Technologies

New York State recently established the NYS Center for Clean Water Technology (CCWT) at Stony Brook University, whose primary objective is to develop and commercialize wastewater treatment systems for individual onsite (household) use that are affordable and highly efficient at removing nitrogen and other contaminants. The CCWT has identified Nitrogen Removing Biofilters (NRBs) as a system potentially capable of meeting this goal.

NRBs utilize a two-stage biofiltration concept treating septic tank effluent (STE). In the two-stage process, nitrification occurs in the Stage 1 biofilter, followed by denitrification in the Stage 2 biofilter. The NRB designs investigated by the CCWT typically consist of a vertically stacked media arrangement, with the Stage 1 biofilter directly above the Stage 2 biofilter. The first stage provides ammonification and nitrification via a porous media (sand) biofilter. The underlying second stage provides denitrification via an anoxic biofilter with reactive media (such as lignocellulose). An alternative design being tested utilizes a lined stage 1 nitrification biofilter discharging to an upflow

stage 2 biofilter in a tank. The initial NRB design was developed as part of the Florida Onsite Sewage Nitrogen Reduction Strategies Study (FOSNRS) and further refined incorporating lessons learned in additional trials conducted at the Massachusetts Alternative Septic System Test Center (MASSTC). The full-scale pilot testing demonstrated that NRBs are able to achieve high percentages of total nitrogen removal (up to 90%). CCWT has installed three (3) variations of NRB's at the MASSTC in 2016 and will work with Suffolk County to install NRB's at private residences on County Park Sites in 2017 and 2018.

Figure 4: Schematic of a Lined Nitrogen Reducing Biofilter



VIII. Summary and Recommendations

Suffolk County's *Reclaim Our Water Initiative* has assertively set the stage for the use of nitrogen reducing septic systems in Suffolk County. Specifically, the I/A OWTS Demonstration Program proved to be an effective method to further the assessment of I/A OWTS technologies in Suffolk County and their ability to reach nitrogen reduction objectives, provide the Department with valuable information regarding construction of programmatic infrastructure necessary to allow for the review and approval of I/A OWTS and allowed for validation of local institutional ability to install and operate systems.

The Demonstration Program also allowed the Department to compare how I/A OWTS technologies functioned in Suffolk County as compared to their performance in proximate jurisdictions. The Hydro-Action AN series performed significantly better in Suffolk County than in Maryland, averaging 11.6 mg/L in Suffolk and 20.33 mg/L in Maryland. Norweco Singulair TNT also performed better in Suffolk County than in Massachusetts and Maryland, where the technology averaged 24.85 mg/l and 27 mg/l respectively. The Orenco AX-RT series performed consistently below 19 mg/l in all jurisdictions and the BUSSE system, which is only in use in Suffolk County, failed to reduce TN and both systems had to be taken offline due to a pH below 4.

The performance standard of 19 mg/L TN represents the most stringent enacted TN requirement that does not also allow for increase in density above Article 6 requirements, and changing the performance standard is not recommended at this time. Review of data from other jurisdictions supports this recommendation. Suffolk County and Maryland are the only proximate jurisdictions that use a true average to determine system performance. Massachusetts, Rhode Island, and New

Jersey use the median, which Suffolk County believes is not the best indicator of system performance. If these jurisdictions used the mean instead, the resultant data would show the systems have difficulty achieving 19 mg/L. In addition, as the statistical analysis of the Barnstable County, MA database by Horsely Witten Group indicated, jurisdictions should be cautious not to change performance standards unless and until there is adequate confidence that the data represents the true performance of a specific technology. The statistical analysis showed that in order to reach a 90 percent confidence level in the data a minimum of twelve (12) samples from twenty (20) systems of a technology are needed. Suffolk County is the first jurisdiction to adopt an approval process based on this statistical analysis.

In 2017, the Department hopes to install eight (8) different technologies on twenty (20) residential sites as part of the second phase of the I/A OWTS demonstration program. It is recommended that in the second phase the minimum number of systems required to be installed per technology be increased to two (2) systems to allow for a larger sample data set and improved evaluation of system functionality. In addition, the Department will continue to work with The Center for Clean Water Technology at Stony Brook University to pursue sites for the installation and evaluation of Nitrogen Reducing Biofilters which hold much promise and excitement. The Department anticipates that there could be several more technologies Provisionally Approved in 2017.

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