COUNTY OF SUFFOLK

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DEPARTMENT OF HEALTH SERVICES
DIVISION OF ENVIRONMENTAL QUALITY

2018 REPORT ON THE PERFORMANCE OF INNOVATIVE AND ALTERNATIVE ONSITE WASTEWATER TREATMENT SYSTEMS

Prepared: **October 2019**

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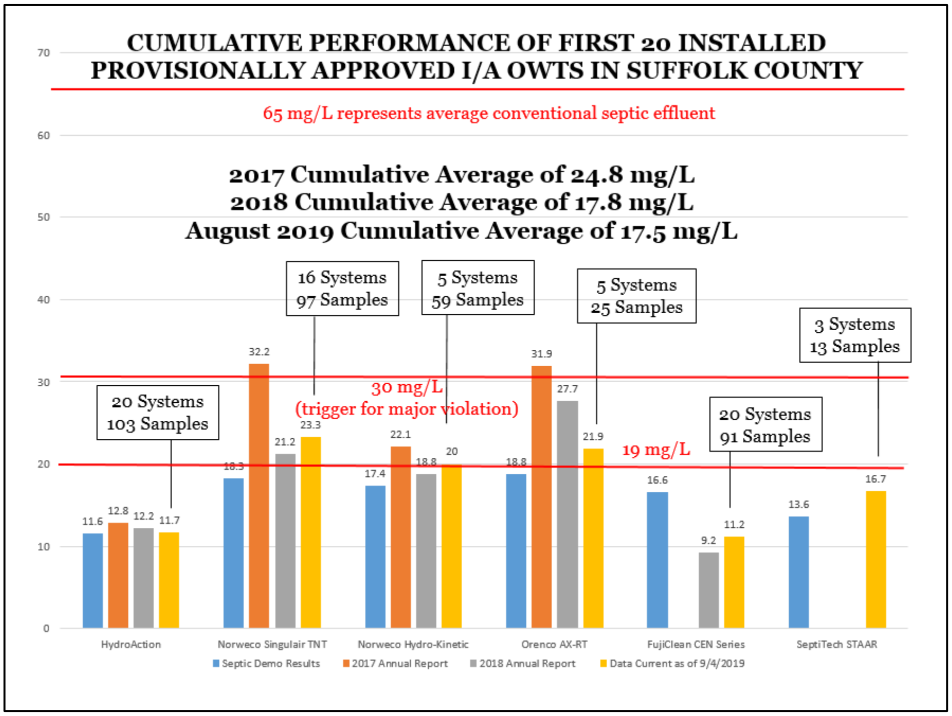
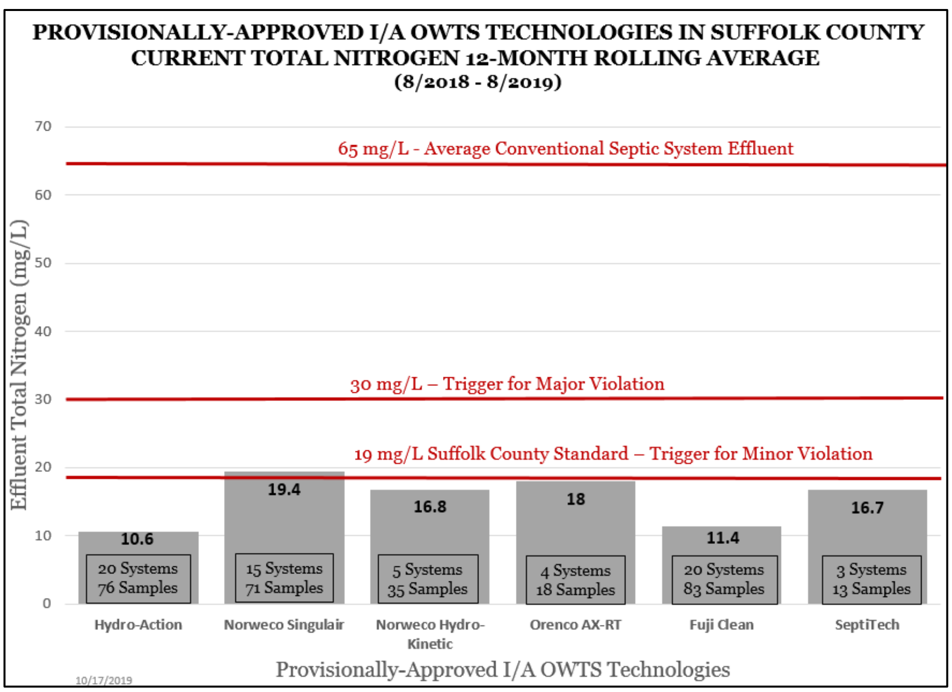
Preface

This annual technology review for Innovative and Alternative Onsite Wastewater Treatment Systems was completed in 2019 based on data collected in 2018. Preparation of the next annual report will occur in 2020 and will include data acquired during 2019. However, it should be noted that as of September 4, 2019, sixty nine (69) provisionally approved I/A OWTS have been sampled with a cumulative average of <u>17.5 mg/L</u> Total Nitrogen (388 total samples). Thus, at the time of report issuance, the pool of provisionally approved technologies is meeting the current Suffolk County Sanitary Code goal of 19 mg/L total nitrogen for these systems.





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 2019 using the complete dataset from 2018. The 2019 annual report will be prepared in the spring of 2020.

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.

There have been 169 I/A OWTS installations in Suffolk County as of 12/31/2018. A total of 545 SCDHS Office of Wastewater Management permit approvals were issued as on 12/31/2018, showing a potentially large increase in I/A OWTS installations in 2019. **Table 1** shows the amount of I/A OWTS permit approvals and I/A OWTS installations by technology type.

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.

Table 1: I/A OWTS Wastewater Permit Approvals and Installations as of 12/31/2018

Technology	I/A OWTS Permit Approvals as of 12/31/2018	I/A OWTS Installations as of 12/31/2018
Hydro-Action AN-Series	145	47
Norweco Singulair TNT	141	46
Norweco Hydro-Kinetic	6	6
Orenco Advantex AX20-RT	18	8
Orenco Advantex AX-20	3	3
Orenco AX Max-225	1	1
BUSSE GT	2	2
PUGO Systems	4	4
EcoFlo CocoFilter	2	2
WaterLoo BioFilter	2	2
Amphidrome	2	2
FujiClean USA	201	37
BioMicrobics BioBarrier	2	2
Gravelless Recirculation Filters (aka Constructed Wetlands Various Layouts)	3	2
SeptiTech STAAR	4	2
NRB (lined)	3	1
NRB (Unlined)	3	1
NRB (Box)	3	1
TOTAL	**545**	**169**

I/A OWTS Performance in Suffolk County

Suffolk County initiated two I/A OWTS Demonstration Projects, the first in 2014 and the second in 2016. A total of thirteen (13) technologies were installed and evaluated as part of the Demonstration Program. 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. 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 are granted provisional approval. Six technologies have been granted provisional approval. The results of the demonstration systems are summarized in **Table 2** and the results of the Provisional Use Sampling is summarized in **Table 3.** The results of all bi-monthly manufacturer samples taken throughout the provisional use phase are utilized to determine approval or disapproval for the technology to enter the general use phase. The results of the 12-month rolling average during provisional use phase are utilized to determine if the technology is consistently meeting the Department's performance requirements. If there is non-performance shown in the dataset of a technology's sample results that is causing an exceedance of performance requirements, the Department reserves the right to revoke or suspend the approval status of such technology. Article 19 I/A OWTS Standards illustrates the minor and major violation thresholds for provisional and general use phases. In addition, the Department takes samples of systems within the provisional use phase for quality assurance and quality control. Table 3 indicates the results of the technologies under these three sampling scenarios.

Table 2: Septic Demo System Performance in Suffolk County as of 12/31/2018
Data Represents a 6-Month Rolling Average

Technology	AVG TN (mg/L)*	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 Advantex – RT	18.8 mg/L	Approved in March 2017
Norweco – Hydro-Kinetic	17.4 mg/L	Approved in April 2017
Fuji Clean System	16.6 mg/L	Approved in January 2018
SeptiTech STAAR	13.6 mg/L	Approved in July 2018
Amphidrome	15.1 mg/L	Projected Approval in November 2019
Orenco AX Series	19.7 mg/L	Projected Approval in September 2019
Ecoflo Coco Filter + Denite	18.8 mg/L	Projected Approval in September 2019
Ecoflo Coco Filter	32.6 mg/L	Cannot Project Approval at this Time
BUSSE MBR	84.9 mg/L	Cannot Project Approval at this Time
Waterloo Biofilter	70.6 mg/L	Cannot Project Approval at this Time
Waterloo Biofilter + Denite	61.1 mg/L	Cannot Project Approval at this Time
Pugo	21.9 mg/L	Cannot Project Approval at this Time
BioMicrobics Bio Barrier	50.5 mg/L	Cannot Project Approval at this Time

*19 mg/L is the Standard for average effluent TN for I/A OWTS in Suffolk County

Table 3: Sample Results of Provisional Use Technologies as of 12/31/2018

Technology	**Avg.TN (mg/L)** 12-Month Rolling Avg. (MFR-only)	**# of Samples**	**Avg.TN (mg/L)** Provisional Phase to date (MFR-only)	**# of Samples**	**Avg.TN (mg/L)** Provisional Phase to date (MFR and County)	**# of Samples**
Fuji Clean System	**9.2**	28	**9.2**	28	**11.0**	37
Hydro-Action AN Series	**12.2**	51	**12.2**	56	**13.1**	90
SeptiTech STAAR	**17.6**	4	**17.6**	4	**17.6**	4
Norweco – Hydro-Kinetic	**19.0**	29	**20.4**	39	**21.2**	68
Norweco – Singulair TNT	**22.5**	42	**24.5**	50	**25.2**	89
Orenco Advantex – RT	**26.7**	8	**27.7**	10	**30.3**	18

- 19 mg/L is the standard for average effluent TN for I/A OWTS in Suffolk County
- The 12 month rolling average of all provisional technologies as of 12/31/2018 is 17.8 mg/L. The cumulative average of all provisional technologies as of 12/31/2018 is 18.6 mg/L.
- As per the Standards, only manufacturer samples are used to determine if a technology is meeting the Department's performance requirements. County samples are utilized for quality assurance/quality control. See appendices for all sample results.
- The cumulative average of a technology's TN results is utilized to determine approval of use in Suffolk County. The 12-month rolling average is utilized to determine when major and minor violations are issued.

<u>I/A OWTS Performance in Proximate Jurisdictions</u>

Prior to developing an I/A OWTS implementation 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 4** and **Table 5** depict the I/A OWTS technologies approved for use in these jurisdictions along with performance data for 2018 compared to the tested nitrogen effluent during their NSF 245 or EPA ETV certification process.

Table 4: I/A OWTS Approved in Proximate Jurisdictions

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

• (black)	General Use
• (red)	Provisional Use/Undergoing Field Verification
• (blue)	Piloting Use

Table 5: 2018 Comparison of I/A OWTS Results

The cumulative average of an I/A OWTS technology's TN results is utilized for approval of use in Suffolk County. 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 average TN data to evaluate I/A OWTS performance.

Technology	NSF 245 or ETV Certification	**Suffolk County (Mean)**	Maryland (Mean)	Barnstable County (Mean)	New Jersey Pinelands (Grand Median)	Rhode Island (Median)
Advantex AX	NSF 24 mg/l	**18.1 mg/L ***	17.2 mg/l	20.19 mg/l	No Data	14.9 mg/L
Advantex RT		**27.7 mg/L****	14.5 mg/l		No Data	No Data
HydroAction	NSF 15 mg/L	**12.2 mg/L ****	20.3 mg/l	No Data	No Data	No Data
Norweco Singulair	NSF 12 mg/L	**24.5 mg/L ****	27.0 mg/l	28.98 mg/l	No Data	No Data
Norweco Hydro-Kinetic	NSF 7.9 mg/L	**20.4 mg/L ****	No Data		No Data	No Data
BUSSE MF	NSF 16 mg/l	**80.9 mg/L ***	No Data	No Data	No Data	No Data
Amphidrome	ETV 10.81 mg/L	**15.1 mg/L ***	No Data	25.14 mg/l	11.9 mg/l	No Data
BioMicrobics BioBarrier	NSF 9 mg/L	**31.7 mg/L ***	No Data	No Data	24.9 mg/l	No Data
BioMicrobics FAST	NSF 17 mg/L	**No Data**	25.4 mg/l	25.2 mg/l	18.2 mg/l	17.1 mg/L
BioMicrobics SeptiTech	NSF 17 mg/L	**17.6 mg/L ****	20.0 mg/l	13.47 mg/l	14 mg/l	11.3 mg/L
Ecoflo Coco Filter	NSF 18.6 mg/L	**47 mg/L ***	No Data	No Data	No Data	No Data
Ecoflo Coco Filter + Denite	No Data	**18.8 mg/L ***	No Data	No Data	No Data	No Data
Fuji Clean CEN Series	NSF 10 mg/L	**9.2 mg/L ****	14.1 mg/L	No Data	No Data	No Data
Waterloo Biofilter	ETV 14 mg/L	**63 mg/L ***	No Data	24.11 mg/l	No Data	No Data
Bioclere	No Data	**No Data**	No Data	21.42 mg/l	11.2 mg/l	No Data
Pugo	NSF 17 mg/L	**24.4 mg/L ***	No Data	No Data	No Data	No Data
AquaKlear	No Data	**No Data**	27.5 mg/l	No Data	No Data	No Data
Hoot BNR	No Data	**No Data**	21.4 mg/l	No Data	No Data	No Data
Hoot ANR	NSF 5.6 mg/L	**No Data**	No Data	19.41 mg/L	No Data	No Data

* represents data collected in the Suffolk County Septic Demonstration Program

** represents data collected during Suffolk County Provisional Use Approval

Maryland Data obtained from https://mde.maryland.gov/programs/Water/BayRestorationFund/OnsiteDisposalSystems/Documents/BAT_CLASS_I.pdf

Barnstable County Data obtained from https://septic.barnstablecountyhealth.org/category/data-and-statistics

New Jersey Data obtained from the 8/5/2018 Annual Report to the New Jersey Pinelands Commission on Alternate Design Treatment Systems Pilot Program

Rhode Island Data obtained from "Evaluation of Nitrogen Concentration in Final Effluent of Advanced Nitrogen-Removal OnsiteWastewater Treatment Systems (OWTS)' Brittany V. Lancellotti & George W. Loomis & Kevin P. Hoyt & Edward Avizinis & Jose A. Amador

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 Reducing Biofilters (NRBs) as a system potentially capable of meeting this goal. Currently, CCWT is developing NRBs; a relatively passive technology that uses layers of sand and sawdust to treat wastewater. CCWT is evaluating these NRBs to determine if they can treat wastewater to 10 mg/l of total nitrogen or less. In 2016, CCWT installed three (3) different configurations of the NRB at the Massachusetts Alternative Septic System Test Center (MASSTC), and in 2017, CCWT worked with Suffolk County to install 3 NRB's on residential sites located at County Park properties as experimental I/A OWTS units. The SCDHS 2018 sample results for the NRB's are outlined in **Table 6**. See appendix iii for all NRB sample results from 2018. In addition, CCWT is performing their own research on the NRB's which is outlined in the 2017 Annual Technology Review of Innovative / Alternative OWTS which was prepared by SCDHS and CCWT for the New York State Department of Environmental Conservation.

Table 6: SCDHS 2018 NRB Sample Results

NRB Technology	# of Systems as of 12/31/2018	# of Grab Samples as of 12/31/2018	AVG TN mg/L
Unlined NRB	1	4	5.5 mg/L
Lined NRB	1	4	7.7 mg/L
Box NRB	1	No sites sampled in 2018	

Conclusions, 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.

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. 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. Constructed wetland installations are planned for 2019.

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 2019 using the complete dataset from 2018. This report will serve as a template for the 2019 annual report which will be prepared in the spring of 2020.

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 Innovative and Alternative Onsite Wastewater Treatment Systems (I/A OWTS), adopted 2015's Comprehensive Water Resources Management Plan, initiated the Subwatersheds Wastewater Plan, piloted twelve (12) I/A OWTS technologies on forty (40) residential properties, adopted Article 19 of the sanitary code, and also amended the Residential Construction Standards for the first time since 1973. These efforts would not have been possible without the assistance of many stakeholders, most notably, New York State Department of Environmental Conservation (NYSDEC) and the Long Island Nitrogen Action Plan (LINAP). The Septic / Cesspool Upgrade Program Enterprise (SCUPE) is a DEC grant that enables Suffolk County to embark on these aggressive measures to battle nitrogen pollution.

Thousands of parcels are currently served by polluting cesspools and septic systems, but will never connect to a sewer system. Reversing degradation of water quality will depend on replacement of existing systems with new, individual Innovative and Alternative Onsite Wastewater Treatment Systems (I/A OWTS).

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

Liquid Waste Licensing

Suffolk County began septic industry licensing with 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 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. Six (6) training classes were offered in 2017 with two hundred and five (205) total participants.

Long Island Nitrogen Action Plan (“LINAP”)

The New York State Department of Environmental Conservation (“NYSDEC”) partnered with Suffolk County, Nassau County, and numerous other stakeholders to complete the LINAP and help improve wastewater treatment within Suffolk County to protect water resources. The NYSDEC has provided grant funding for the Suffolk County Septic/Cesspool Upgrade Program Enterprise (“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 Responsible Management Entity 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. In 2017, the residential standards were revised to allow for the following: best-fit retrofits, procedures for conducting percolation tests, updated to gravelless absorption trenches and the addition of Pressurized Shallow Drainfields (PSD’s) following I/A OWTS. Future revisions to the Construction Standards will include specifications for polishing units to further reduce nitrogen from I/A OWTS effluent. SCDHS meets with stakeholders in the “Article 6 Work Group” several times a year to discuss the status of the Reclaim Our Water program and any potential standard changes.

Suffolk County Septic Demonstration Programs

Demonstration programs 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. 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 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 establish a framework for holistic performance management of wastewater to mitigate impacts to ground and surface waters. The SWP will set priority areas, nitrogen reduction goals, and describes where, when, and what methods should be implemented to meet nitrogen reduction goals. The SWP is slated for completion in 2019, after which the County will begin utilizing the findings of the SWP, for example for priority areas in the Septic Improvement Program and potential sewer projects, as well as shaping future Sanitary Code changes.

Septic Improvement Program (“SIP”) and New York State Septic System Replacement Program (SSRP)

The Suffolk County Septic Improvement Program (SIP) launched on July 3, 2017 at www.ReclaimOurWater.info. The Program provides homeowners looking to install new nitrogen reducing septic systems (known as I/A OWTS) with county grants up to $20,000 to offset the increased costs of these new technologies. In addition, homeowners can also qualify for a New York State Septic System Replacement Program (SSRP) grants of up to $10,000 for a total of up to $30,000 in grants. Between the County and State there is enough funding to issue approximately 80 grants per month. Applications are accepted on a rolling basis and priority is given to high and medium density residential parcels located within the 0-25 year groundwater travel time or within 1,000 feet of enclosed waterbodies. Post-installation landscaping and irrigation restoration is the responsibility of the property owner.

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 Tables 6 and 7, 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." **Tables 7 and 8** below summarize the approval process for both residential and commercial systems.

Table 7: 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 1	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
Provisional 2	All Other installations during Provisional Use Approval	Every 12 months, unless seasonal then every month of operation.	The annual dataset must maintain a combined average of 19 mg/L or less TN in order to remain in the Provisional phase ***
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.*

Table 8: Approval Chart for Commercial 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
Provisional 1	First 20 Systems Installed and	Monthly Sampling for	The dataset of all the 20 systems must have a

	systems installed in commercial subcategories**	12 months; bi-monthly sampling for an additional 12 months	combined average of 19 mg/L or less TN
Provisional 2	All Other installations during Provisional Use Approval	Every 12 months, unless seasonal then every month of operation.	The annual dataset must maintain a combined average of 19 mg/L or less TN in order to remain in the Provisional phase ***
General Use	All Systems	Every 12 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. The minimum of 20 systems for Provisional Use includes the number of systems installed as part of Experimental and Piloting processes.

** Piloting and Experimental phases are identical for residential and commercial systems. A technology can advance to Provisional Approval after successfully completing piloting phase with residential systems, commercial systems, or any combination thereof.*

*** In order for a commercial technology to receive General Use Approval specific to any of the following subcategories: (1) office, retail, industrial, gym and dry goods; (2) restaurants, coffee shops, and other kitchen / fats, oils, and grease (FOG) waste; (3) multi-tenant residential; (4) institutional use; (5) medical use, a minimum of four (4) systems must be installed and successfully implemented in that specific subcategory.*

****The combined average of the dataset in Experimental, Piloting and Provisional 1 is the requirement to achieve successful completion of that phase. The combined average of the dataset in Provisional 2 and General Use shall be evaluated to affirm compliance to maintain approval or disclose non-performance to be considered for revocation*

<u>Suffolk County's Septic Demonstration Programs:</u>

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 were 58 I/A OWTS were installed, evaluated over a 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 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. The dual purpose framework of the program included:

Phase 1 Septic Demo Systems

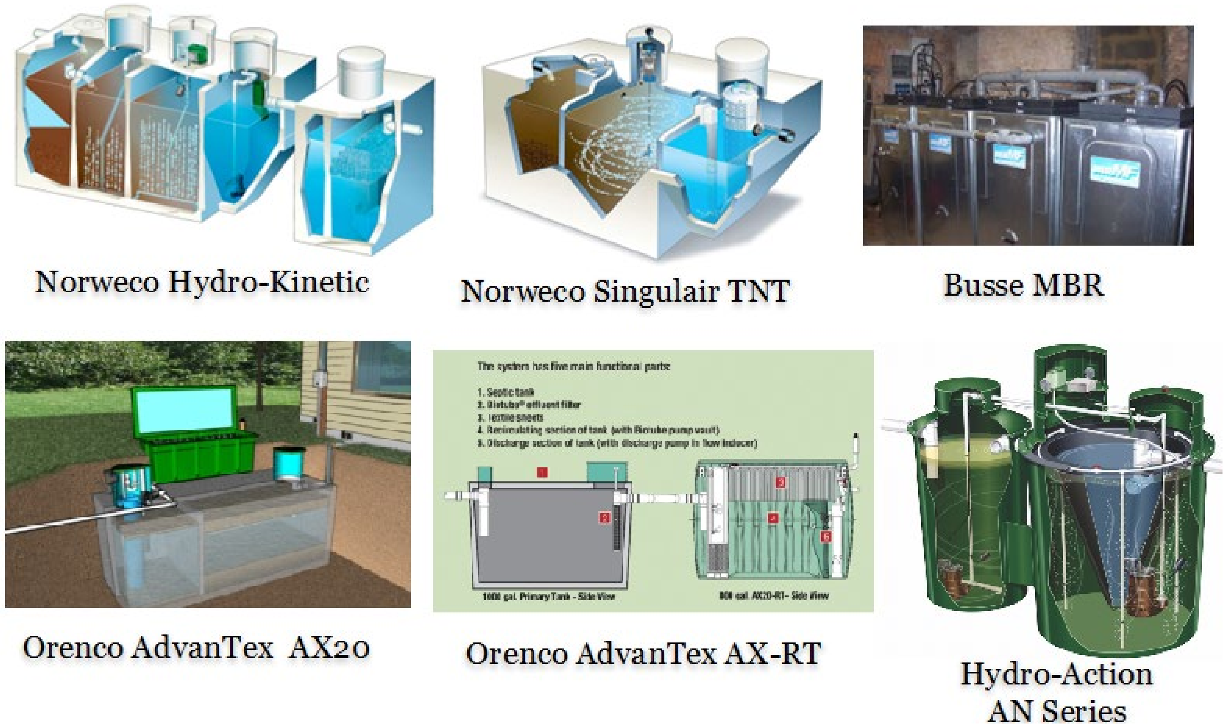
In April of 2014, Suffolk County issued the first Request for Expression of Interest (RFEI) for a Demonstration Program of Innovative and Alternative Onsite Wastewater Systems (I/A OWTS). A total of 19 systems were donated from 4 manufacturers representing 6 different technologies. Following the County-wide lottery for the interested homeowners, the systems were installed between June 24, 2015 and February 29, 2016 and 2 technologies received Provisional Approval in 2016 and another 2 technologies received approval in 2017. See Appendices i and ii for sampling results of the Phase 1 septic demo systems, most of which were under provisional use approval in 2018.

The systems were given 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 6 consecutive months.

Table 9: 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 1: 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 systems 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. Hydroaction was granted Provisional Use Approval on September 28, 2016.

20 year-round Provisional Use systems are required to be sampled by the manufacturer every 2-months for a 24 month period. **HydroAction sampled 13 systems bi-monthly as of 12/31/2018. The cumulative average of all systems as of 12/31/2018 was 12.2 mg/L TN. The 12-month rolling average for 2018 was 12.2 mg/L.**

Norweco Singulair TNT

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. 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.

20 year-round Provisional Use systems are required to be sampled by the manufacturer every 2-months for a 24 month period. **Norweco sampled 11 systems bi-monthly as of 12/31/2018. The cumulative average of all systems was 24.5 mg/L TN. The 12-month rolling average for 2018 was 22.5 mg/L. Norweco has submitted a corrective action plan to implement work designed to reduce effluent TN from the Singulair systems and meet the 19 mg/L standard.**

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.

Note: The 18.5 mg/l average above excluded two months of data for the Orenco RT system as the homeowner reported that a significant amount of bleach was discharged to the systems after cleaning coral from a fish tank. The Department made a decision to exclude the April and May 2016 samples and Provisional Use Approval was issued in April 2017.

20 year-round Provisional Use systems are required to be sampled by the manufacturer every 2-months for a 24 month period. **Orenco sampled 4 systems bi-monthly as of 12/31/2018. The cumulative average of all systems was 27.7 mg/L TN. The 12-month rolling average for 2018 was 26.7 mg/L. Orenco has submitted a corrective action plan to implement work designed to reduce effluent TN from the AX-RT systems and meet the 19 mg/L standard.**

Norweco HydroKinetic

The HydroKinetic 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 HydroKinetic systems were installed as part of the Septic Demonstration Program. The Department began sampling the systems in August 2016. The Hydrokinetic system averaged 24.6 mg/l in 2017 and the dataset of 75% of the systems maintained an average of 17.4 mg/L and was issued Provisional Use Approval in April of 2017.

20 year-round Provisional Use systems are required to be sampled by the manufacturer every 2-months for a 24 month period. **Norweco sampled 5 systems bi-monthly as of 12/31/2018. The cumulative average of all systems was 20.4 mg/L TN. The 12-month rolling average for 2018 was 19.0 mg/L.**

Orenco AX-20 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.

Three (3) Orenco AX-20 systems have been installed as part of the Septic Demonstration Program. **The Orenco AX system averaged 22.8 mg/l as of 12/31/2018 and the dataset of 75% of the systems maintained a 6-month rolling average of 19.7 mg/L. If the current performance trends continue the Orenco AX-20 could receive Provisional Use Approval in 2019.**

BUSSE GT

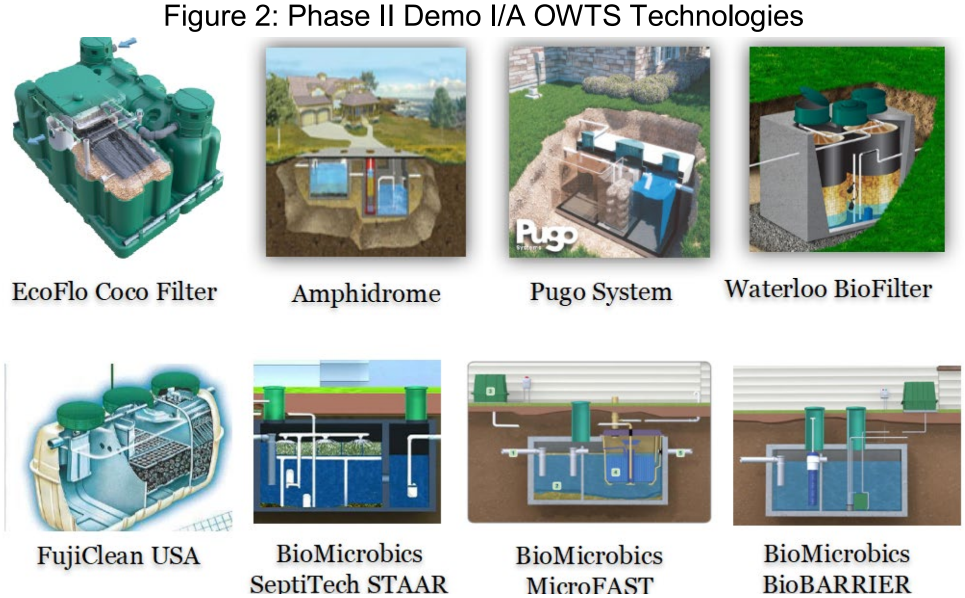
The Busse System is installed above grade, in non-living areas of the house such a garage or basement. The fiberglass tanks have four compartments, the first for settling, second for aeration, third for settling and final compartment for membrane filtration.

There are two (2) Busse 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. Site SDS#7 was briefly turned back on from June 19, 2017 to July 25th 2017 and the performance did not improve. The manufacturer is currently working with local engineers to reconfigure the system and treatment process. The monitoring of these systems may resume in 2019. **The average performance of the system was 83.1 mg/L as of December 31, 2017.** No sampling was done in 2018.

<u>Phase 2 Septic Demo Systems:</u>

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 20 systems were donated from 6 manufacturers representing 8 different technologies. On July 26, 2016, 20 homeowners were selected from a lottery. Installations for these systems began in November 2016 and were completed by the end of 2017. See Appendices i and ii for sampling results of the Phase 2 septic demo systems, some of which were granted provisional use approval in 2018.

Figure 2: Phase II Demo I/A OWTS Technologies



Amphidrome

Amphidrome is a multi-tank system utilizing a biologically active filter operating as a sequencing batch reactor. Sewage first enters a septic tank to allow for settling and separation. Liquid wastewater flows by gravity from the septic tank into the reactor where it moves through layers of gravel and sand and receives aeration via an external blower. Wastewater continues through the reactor into the clearwell tank containing two submersible pumps. When the first submersible pump cycles on it pushes wastewater backward through the system; back flowing up though the reactor and also recirculating back to the septic tank. When the submersible pump cycles off, the wastewater moves again by gravity forward through the system and into the clearwell tank. The second submersible pump in the clearwell tank moves final effluent to discharge.

There were two (2) Amphidrome Systems installed between February and June of 2017 as part of Phase 2 of the Septic Demonstration Program. **The average of all of the samples at equilibrium was 26.1 mg/L and the dataset of 75% of the systems maintained a 6-month rolling average of 15.1 mg/L.** Amphidrome is slated for Provisional Use Approval in 2019.

Ecoflo Coco Filter

Ecoflo Coco Filter is a trickling media filter comprised of multiple tanks. The first tank is a baffled septic tank for settling and separation of incoming sewage. The liquid wastewater moves through an effluent filter and then to the Ecoflo Coco Filter. In the filter unit a tipping weir evenly disperses incoming wastewater over a thick bed of coconut husks. The wastewater is treated by the bacteria living on the coconut husks as it moves downward through the media and is then collected at the bottom of the unit. A submersible pump in the filter unit moves the collected wastewater through a splitter valve which allows some water to be recirculated back to the septic tank and some to be moved to a sulfur polishing unit. The wastewater that is pumped to the sulfur polishing unit moves by gravity through the sulfur media and finally out to discharge.

There were two (2) Ecoflo Coco Filter Systems installed between November 2016 and February 2017 as part of Phase 2 of the Septic Demonstration Program. Ecoflo also installed a denitrification polishing filter following the treatment unit to remove excess nitrate from the effluent. Suffolk County took composite samples before and after the secondary denitrification unit. **The average of Ecoflo Coco Filters at equilibrium was 54.8 mg/L as of 12/31/2018, the 6-month rolling average was 32.6 mg/L and the 6-month rolling average *after* the denitrification unit was 18.8 mg/L**. Ecoflo Cocofilter with Denite Unit is slated for Provisional Use Approval in 2019.

Note: Site SDS#9 was installed on November 10, 2016 but had a failure of the dosing weir and the system was restarted on July 25, 2017.

Pugo System

Pugo is a self-contained, extended aeration and contact filtration unit consisting of three chambers. In the primary chamber sewage separates and settles allowing liquid wastewater to flow through and solids to sink to the bottom where they are subject to anaerobic digestion. Liquid wastewater then enters the aeration chamber where it is circulated via aeration from an external blower through plastic media harboring microbes which will metabolize and remove nutrients from the wastewater. An air lift pump powered by the same external blower recirculates aerated wastewater back to the primary chamber to complete denitrification. Wastewater flows by gravity into the third and final clarifying chamber where settling of any residual solids occurs and final effluent is discharged.

There were four (4) Pugo Systems installed between January and March of 2017 as part of Phase 2 of the Septic Demonstration Program. **The dataset of 75% of the systems maintained a 6-month rolling average of 21.9 mg/L TN.**

Note: Site SDS#29 was restarted on 9/27/2017 due to the system failure suspected to the due to the homeowner's use of essential oils.

FujiClean CEN Series

FujiClean is a self-contained, extended aeration and contact filtration treatment unit consisting of three chambers. The first sedimentation chamber allows for pretreatment of influent via settling and separation. Liquids then move by gravity to the anaerobic chamber where it comes in contact with a submerged media that allows for colonization of bacteria to aid in nitrate denitrification. In the final chamber aerobic contact filtration occurs via an external air blower and a submerged media. The same air blower also powers air lift pumps which recirculate sludge and water from the last chamber back to the first chamber and pumps final effluent out to discharge.

There were four (4) FujiClean CEN Systems installed between March and June of 2017 as part of Phase 2 of the Septic Demonstration Program. The systems were sampled from June 2017 through November 2017 after reaching equilibrium and averaged 18.5 mg/L TN. **The dataset of 75% of the systems maintained an average of 16.6 mg/L TN. FujiClean CEN received Provisional Use Approval in January 2018.**

20 year-round Provisional Use systems are required to be sampled by the manufacturer every 2-months for a 24 month period. **Fuji sampled 8 systems bi-monthly as of 12/31/2018. The cumulative average of all systems was 9.2 mg/L TN. The 12-month rolling average for 2018 was 9.2 mg/L.**

Waterloo Biofilter

Waterloo Biofilter is a packed bed media filter comprised of multiple tanks. Raw sewage flows from the building into a septic tank with digester where solids are separated from liquids. After gravity flowing into the pump tank, wastewater is time dosed over the biofilter in the treatment tank by a submersible pump. Wastewater is absorbed by and trickles downward through foam media which provides both physical filtration and biological treatment via inhabitant microbes. Treated wastewater is collected at the bottom of the treatment tank where a submersible pump moves it through the piping manifold which splits the flow between the alkalinity tank and sulfur polishing tank. The wastewater that is pushed to the alkalinity tank is conditioned prior to recirculation into the primary septic tank. The remainder of the wastewater is pumped to the polishing unit where sulfur contact further reduces nitrogen levels prior to final effluent discharge.

There were two (2) Waterloo Biofilter Systems installed May 2017 as part of Phase 2 of the Septic Demonstration Program. Waterloo also installed a denitrification polishing filter following the treatment unit to remove excess nitrate from the effluent, **this secondary denitrification had a 6-month rolling average of 61.1 mg/L TN as of 12/31/2018**. **The 6-month rolling average of Waterloo Biofilter was 70.6 mg/L as of 12/31/2018.** SCDHS worked with the manufacturer in 2018 to try to improve overall performance of the two systems and hope the 2019 results will reflect improvement.

BioMicrobics BioBarrier

BioBarrier is a membrane bioreactor consisting of two tanks. The first tank allows for settling and separation of incoming sewage with liquid wastewater moving through an effluent filter to prevent large solids from entering the treatment tank. Next liquid wastewater moves into the first chamber of the treatment tank, known as the anoxic zone, where a low oxygen mixed liquor is maintained by an external mixing blower. Wastewater then flows to the second chamber, known as the aerobic zone, where the reactor unit is submerged. A second external blower piped to the reactor unit creates an upward flow between membrane plates providing vigorous scouring action. Wastewater is passed through the membranes for microfiltration and ultrafiltration processes to produce the final effluent which is pumped to discharge.

There were two (2) BioBarrier MBR Systems installed between May and June of 2017 as part of Phase 2 of the Septic Demonstration Program and as of **12/31/2018 the systems have a 6-month rolling average of 50.5 mg/L.** SCDHS worked with the Manufacturer in 2018 to try and improve the performance of these systems. Hopefully this improvement will be reflected in the 2019 Annual Report.

BioMicrobics SeptiTech STAAR

SeptiTech STAAR is a trickling filter comprised of two tanks. The first tank is a baffled septic tank for settling and separation of incoming sewage. Wastewater from the primary septic tank flows into the bottom of the second tank, mixing with already treated wastewater. A pump at the bottom of the second tank moves wastewater upward and through sprayers which both aerate and disperse the wastewater onto the filter media. As wastewater moves through the filter media it is treated by inhabitant microbes and then moves by gravity back to the tank below mixing with newly incoming wastewater from the primary septic tank and previously treated water. A portion of the treated wastewater along with sludge that accumulates at the bottom the filter tank is recirculated back to the primary septic tank for denitrification. A submersible pump located in the second chamber of the filter tank moves the final effluent to discharge.

There were two (2) SeptiTech STAAR Systems installed in 2017 as part of Phase 2 of the Septic Demonstration Program. **The 6-month rolling average for SeptiTech STAAR was 13.6 mg/L and the technology received Provisional Use Approval in July of 2018.**

20 year-round Provisional Use systems are required to be sampled by the manufacturer every 2-months for a 24 month period. **Septitech sampled 2 systems bi-monthly as of 12/31/2018. The cumulative average of all systems was 17.5 mg/L TN. The 12-month rolling average for 2018 was 17.5 mg/L.**

BioMicrobics MicroFAST

MicroFAST is a two tank fixed activated sludge treatment system. The first tank is a baffled septic tank for settling and separation of incoming sewage. Wastewater from the septic tank flows into a secondary treatment tank consisting of a fixed film aeration unit that receives oxygen from an external blower 24/7. Following the aeration unit is a clearwell with a recirculation pump that sends effluent back to the headworks of the septic tank for denitrification. Final effluent can be dispersed to leaching by pump or gravity.

Two (2) MicroFAST Systems are anticipated to be installed in 2019 as part of Phase 2 of the Septic Demonstration Program.

V. Septic Demonstration Program – Lessons Learned

1. Aesthetics and yard disruption are the most important factors to homeowners when selecting a system. Technologies with more than 3 lids and a footprint larger than a conventional septic tank will not be as widely used as I/A systems that take up a smaller footprint.

2. Homeowners who take an active role in their septic system project, especially those that make a financial investment are more likely to be satisfied with the project and operate the I/A OWTS in accordance with manufacturer recommendations.

3. Although all technologies in the Septic Demonstration Program had NSF 245, or ETV Certification, not all technologies are capable of meeting performance standards under actual residential conditions in Suffolk County.

4. Not all preexisting sites are able to meet Department Standards and setbacks. The Department should develop best-fit standards for upgrades and retrofits of existing systems with I/A OWTS.

VI. Other Approved Technologies in Suffolk County

Since the initial Septic Demonstration Program, there have been additional I/A OWTS technologies that have received approval for use in Suffolk County. Below is a summary of the non-demonstration systems approved for experimental and pilot use at of 12/31/2018.

Experimental Use

Nitrogen Reducing Biofilter (NRBs) - NRBs are field-built systems that take advantage of naturally occurring soil microbes to achieve nitrogen removal by nitrification of influent nitrogen in a sand layer and subsequent denitrification of nitrate in a lower layer consisting of sand lignocellulose (wood chips). NRBs are passive systems in which wastewater flows by gravity. The Center for Clean Water Technology (CCWT) at Stony Brook University is researching and testing NRBs at the Massachusetts Alternative Septic System Test Center (MASSTC) and has also installed 2 NRBs in Suffolk County under Experimental Use approval as of 12/31/2018. 2 NRB designs will be tested, lined, unlined and box nitrogen reducing biofilters.

Nitrex Filter – The Nitrex Filter by Lombardo and Associates consists of an up-flow carbon media filter comprised of a proprietary blend of lignocellulose that is used in combination with a NSF-Certified nitrification system. This technology has been tested at the MASSTC as well as other test centers. There is one Nitrex Filter installed in Suffolk County at the Scully Estate.

Detailed description of some of these technologies are included in section XI, Emerging Technologies, of this report.

Pilot Use

ECOPOD-N Series by Delta Environmental received piloting approval on July 20, 2017. The system utilizes a fixed film process in a modular unit located in the septic tank. Both nitrification and denitrification occur in a single tank. There have been no ECOPOD-N installations in Suffolk County as of 12/31/2018.

Hoot-ANR by Hoot Systems, LLC received piloting approval on November 30, 2018. The Hoot-ANR I/A OWTS uses extended aeration, activated sludge and fixed film filtration processes to achieve wastewater treatment. The system consists of a pretreatment tank, an aeration chamber, a clarifier and an attached growth media chamber. There have been no Hoot installations in Suffolk County as of 12/31/2018.

VII. O&M Requirements for Provisionally Approved Systems

Article 19 of the Suffolk County Sanitary Code requires all I/A OWTS be maintained in accordance with manufacturer recommendations, at a minimum of every 12 months. All of the Provisionally Approved systems currently include 3-year operation and maintenance (O&M) agreements as part of their purchase and are maintained every six (6) months. Maintenance can include the following activities depending on the technology:

- Measure scum and sludge and recommend pumping as needed
- Check floats, controls, and alarms
- Check recirculation rates
- Clean all submerged pumps
- Change filter in aerators and blowers
- Measure air flow through system

- Check pump system and flush out Pressurized Shallow Drainfields (PSD's)

Table 10 provides the cost of an O&M provided by the vendors for the six provisionally-approved technologies. Table 11 provides the cost of replacement parts provided by the vendors for the six provisionally-approved technologies. Table 12 provides the wattage and estimated costs of electricity to run the six provisionally-approved technologies.

Table 10: O&M Costs for Provisionally Approved Systems

Technology	One Year Contract Cost
Hydro-Action AN	$250.00
Orenco Advantex AX20-RT	$271.66
Fuji Clean Systems	$300.00
Norweco Hydro-Kinetic	$300.00
Norweco Singulair TNT	$315.00
SeptiTech STAAR	$250.00

Table 11: Repair and Replacement Costs for Provisionally Approved Systems

Technology	Item	Cost	Life Expectancy
Norweco Singulair TNT	Aerator Replacement	$500.00	10 years
	Control Panel Replacement**	$1,200.00	20 years
Fuji Clean CEN System	Blower Replacement (MAC 80R)	$320.00	10 years
	Blower Replacement (MAC 100R)	$420.00	
	Blower Rebuild	$150.00	
	Float Replacement	$100.00	5-10 years
	Control Panel Replacement**	$400.00	20 years
Hydro-Action AN Series	Blower Replacement	$400.00	10 years
	Blower Rebuild	$100.00	
	Recirculation Pump Replacement	$400.00	10 years
	Float Replacement	$80.00	5-10 years
	Control Panel Replacement **	$1,200.00	20 years
Orenco Advantex AX20-RT	Recirculation Pump Replacement	$800.00	10 years
	Float Replacement	$80.00	5-10 years
	Control Panel Replacement **	$1,500.00	20 years
Norweco Hydro-Kinetic	Blower Replacement	$300.00	10 years
	Blower Rebuild	$100.00	

	Recirculation Pump Replacement	$500.00	10 years
	Control Panel Replacement **	$1,200.00	20 years
SeptiTech STAAR	Recirculation Pump Replacement	$520.00	10 years
	Float Replacement	$75.00	5 -10 years
	Control Panel Replacement **	$1,200.00	20 years

Table 12: Estimated Electrical Costs for Provisionally Approved Technologies

Technology	1 year electrical consumption (kWh/year)	Increased electrical costs per year ($0.17/ kWh)
Orenco Advantex AX20-RT	335.8 kWh	$57.09
Fuji Clean System	463.55 kWh	$78.80
Hydro-Action AN	699.22 kWh	$118.87
SeptiTech STAAR	912 kWh	$155.04
Norweco Singulair TNT	979.66 kWh	$166.54
Norweco Hydro-Kinetic	1051.2 kWh	$178.70

Note: the Hydro-Action unit utilizes a mixer pump during start-up. The pump use is discontinued after startup, and usage data will vary after the start-up period.

VIII. Performance of Commercial I/A OWTS in Suffolk County

Four commercial systems were sampled in 2018. An Orenco AX-MAX-225 unit was installed at Meschutt Beach County Park in Hampton Bays in 2016. With the exception of documented blower malfunction, the system is performing below the nitrogen standard of 19 mg/L total nitrogen. Two (2) vegetated recirculating gravel filters have been installed in Suffolk County. One was installed at Sylvester Manor Educational Farm on Shelter Island in 2017, which is meeting the 19 mg/L total nitrogen standard and the other at Fishers Island Yacht Club which is averaging 33.5 mg/L as of December, 31, 2018. The Fishers Island system was installed to monitor and demonstrate nitrogen reduction in a low-flow seasonal environment with high influent concentration. The Fisher's Island system has shown an average nitrogen reduction of 56%. Finally, a Norweco HydroKinetic I/A OWTS was installed with an Eljen geotextile gravelless sand filter leaching field in 2018 at Lake Ronkonkoma County Park, this system is averaging 68.1 mg/L TN. SCDHS is working with Norweco on a corrective action plan for the Hydro-Kinetic system installed at Lake Ronkonkoma County Park. System performance of these commercial systems is illustrated in **Table 13**; see Appendix iv for all sampling results of the commercial systems.

Table 13: Commercial System Performance in Suffolk County

Commercial System	Location	2017-only Performance (mg/L)	2018-only Performance (mg/L)	2019-only Performance (mg/L)

Orenco AX-Max	Meschutt Beach County Park	17.0	15.4 (51.9 mg/L including blower malfunction)	11.4
Vegetated Recirculating Gravel Filter	Sylvester Manor Education Farm	14.5	7.4	9.4
	Fishers Island Yacht Club	124.3 (59% nitrogen reduction)	33.5 (55% nitrogen reduction)	N/A
Norweco HydroKinetic	Lake Ronkonkoma County Park	N/A	68.1 (pre-leach field effluent)	93.8 (pre-leach field effluent)
Fuji Clean CEN	Peconic Baykeeper	N/A	N/A	9.6
	Surf Lodge	N/A	N/A	11.9

IX. <u>Performance of I/A OWTS in Other Jurisdictions</u>

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. See Table 14 for an hypothetical example.

<u>Table 14: The Case for Utilizing Total Nitrogen Average versus Median</u>

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

<u>Massachusetts</u>

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 15** lists the most common technologies and treatment performance as of December 31, 2016.

Table 15: 2017-2019 Treatment Performance of I/A OWTS in Barnstable County, MA

	Technology	Mean TN (mg/L)
Barnstable County	Advantex	20.2
	FAST	25.2
	SeptiTech	13.5
	Bioclere	21.4
	Norweco	27.0
	OMNI Recirculating Sand Filter	19.5
	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 16** 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
- Fuji Clean CEN-Series

Table 16: Technology Performance Summary Table of Maryland BAT systems

	Technology	Mean TN (mg/L)
Maryland	Fuji Clean CEN-Series	14.1
	Orenco Advantex AX-20	17
	Orenco Advantex AX-RT	14.5
	Hoot BNR	21
	Hydro-Action AN Series	20.3
	RetroFAST	25.4
	SeptiTech	20
	Singulair Green/TNT	27
	AquaKlear	27.5

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 17** lists the performance data of the NJ Pinelands Commission systems, based on the most recent annual report which is for 2018 through August 5, 2019.

Table 17: Technology Performance Summary Table for the New Jersey Pinelands

	Technology	TN (mg/L)
New Jersey Pinelands	MicroFAST	18.2
	SeptiTech	11.6
	Bioclere	11.2
	Amphidrome	11.9
	BioMicrobics BioBarrier	29.3

X. 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 Horsley 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.

XI. 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 Reducing 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 installed NRB's at 3 private residences on County Park Sites in 2017 and 2018 with additional installations planned for 2019. Three pilot NRBs installed in Suffolk County, NY (Unlined, Lined and Box) were monitored once the system reached steady state. The SCDHS 2018 sample results for the NRB's are outlined in **Table 18**. See appendix iii for all NRB sample results for 2018. In addition, CCWT is performing their own research on the NRB's which is outlined in the 2017 Annual Technology Review of Innovative / Alternative OWTS which was prepared by SCDHS and CCWT for the New York State Department of Environmental Conservation.

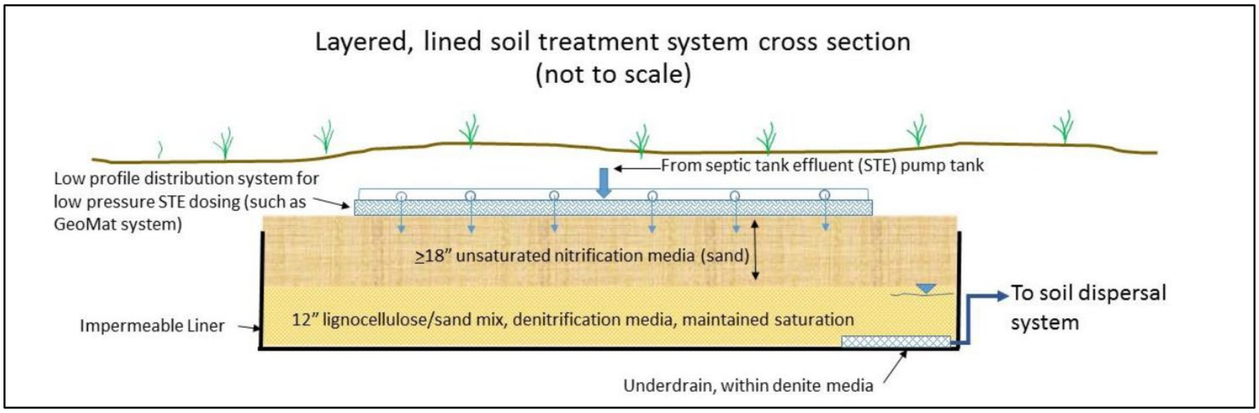
Field installed pilot NRB systems have been capable of reducing nitrogen to below 6 mg/L. Additional pilot testing is needed on year-round residences in Suffolk County. Further refinement of NRB's is required in order to bring the installation costs to affordable levels. CCWT has been working with the SCDHS to develop a cost efficient and passive I/A OWTS. CCWT has constructed the CCWT Wastewater Research and Innovation Facility (WRIF) in Stony Brook, NY. The WRIF allows the Center to design and implement experiments that will yield technical design standards. CCWT has started the development of the next generation of nitrogen removing biofilters, (a.k.a. NRB 2.0). The basis for significant cost reduction rests on three essential design objectives, namely:

1. Reducing the footprint dimensions of the nitrification sand filter unit process;
2. Reducing the detention time of the denitrification wood chip bioreactor unit process and/or improve overall efficiency of denitrification process;
3. Reducing the extent of controls, valves, and associated hardware.

Table 18: SCDHS 2018 NRB Sample Results

NRB Technology	# of Systems as of 12/31/2018	# of Grab Samples as of 12/31/2018	AVG TN mg/L
Unlined NRB	1	4	5.5 mg/L
Lined NRB	1	4	7.7 mg/L
Box NRB	1	No sites sampled in 2018	

Figure 3: Schematic of a Lined Nitrogen Reducing Biofilter



CCWT and SCDHS have also had conversations with Dr. Daniel Smith of AET Tech LLC regarding three (3) emerging technologies summarized in Table 19. Dr. Smith has been working on the development of 3 technology platforms summarized in Table 19. The first technology, Anaerobic Ion Exchange (AN-IX), utilizes a chemical process with anaerobic solids blanket chamber providing ammonification and three (3) ion exchange chambers filled with zeolite that captures NH4+. It differs from other I/A OWTS in that it does not utilize oxygen or the nitrification/denitrification bioreactions. The nitrogen removal is due to ammonium being retained in the zeolite. AN-IX has been tested at test center setting in Maryland and Florida and has shown a 95% total nitrogen removal. The zeolite media needs to be replaced or regenerated approximately every 3 years. The footprint of the technology is small and contains no electrical components. Suffolk County plans to work with Dr. Smith and CCWT to pilot the AN-IX system locally.

The second technology being developed by AET Tech LLC is the Submerged Oxygenation Biofilter/Auto-Denitrification (SOB-AD), which utilizes a submerged oxygenation biofilter made of porous granular media (90% zeolite, 10% limestone alkalinity admixture) in which wastewater passes through once followed by a denitrification sub-chamber. SOB-AD operates by passive gravity flow and has no inherent need for a wastewater pump.

The third technology being developed by AET Tech LLC is the Air Circulation Biofilter / Denitrification (ACB-DEN) process that employs an air circulation ion-exchange biolfilter and anaerobic denitrification. It utilizes an unsaturated downflow granular media biofilter with low-level air circulation to assist in media oxygenation and ammonium oxidation followed by a denitrification sub-chamber. The media consists of 90% zeolite and 10% alkalinity admixture. Utilizes a wastewater pump and requires replacement or regeneration of zeolite. Air circulation and downward airflow pattern minimize clogging and allow increase in loading rate to keep footprint small

Table 19: Summary of Emerging Technologies by Dr. Daniel P. Smith of AET Tech LLC

Technology	Process	Footprint	Nitrogen Recovery
Anaerobic Ion Exchange (AN-IX)	Upflow pretreatment and NH_4^+ ion exchange	89 ft^2	Yes
Submerged Oxygenation Biofilter / Auto-Denitrification (SOB-AD)	NH_4^+ oxidation to NO_2^- / anammox & denitrification	82 ft^2	No
Air Circulation Biofilter / Denitrification (ACB-DEN)	Biofiltration: nitrification & denitrification	77 ft^2	No

XII. Education and Outreach

Industry education and public outreach has been part of the foundation of the Reclaim Our Water initiative and has proven to be key to the installation and performance of I/A OWTS throughout Suffolk County. Below find a summary of the education and outreach that was completed in 2018:

- 21 Septic Improvement Program presentations and meetings
- 23 Liquid Waste Industry Education Training Classes and Tours with 573 Total Participants
- Three Article 6 Workgroup Stakeholders Meetings
- Three Subwatersheds Wastewater Plan Stakeholders Meetings

See section VII in the “Report to NYS Environmental Facilities Corporation on Suffolk County’s Septic Improvement Program and State Septic System Replacement Program” (appendix iv) for further details on public outreach.

XIII. Summary and Recommendations

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 allowed the assessment of system design, operation & maintenance, installation issues, and the overall ability of each technology to meet nitrogen reduction objectives in Suffolk County. Though all technologies participating in the demonstration program have certification for nitrogen reductions (through NSF 245 or EPA’s ETV testing), not all technologies proved capable of reducing total nitrogen to at or below 19 mg/L in Suffolk County.

The performance standard of 19 mg/L represents the most stringent requirement for TN that does not allow for increase in density. The County should not consider changing the performance standard of 19 mg/L until there is sufficient data justifying a 90% confidence in the results as concluded by Horsely Witten Group in the analysis of Barnstable County’s septic system database. (i.e. there should be a minimum of 12 samples of 20 systems of a technology before the County considers changing the performance standard)

Although Provisionally Approved systems were able to perform to the standard of 19 mg/L during demonstration testing, 2 out of 6 technologies are not currently meeting 19 mg/L during Provisional bi-monthly sampling. SCDHS will continue to meet with manufacturers in 2019 and address performance issues. SCDHS will request and require implementation of corrective action plans from underperforming manufacturers, and SCDHS should continue monitoring the performance of all provisionally approved systems to ensure compliance with standards are maintained.

New emerging technologies such as the Nitrogen Reducing Biofilters being evaluated and piloted by SBU's CCWT are promising alternatives to current propriety technologies being evaluated. SCDHS and CCWT should work cooperatively to aggressively pursue, evaluate, and install these technologies in Suffolk County.

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Appendix i: Septic Demo Composite Samples for Technologies within Pilot Use Phase in 2018

Busse GT

Site #	Sample Date	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	58.6	33.9	1.1	24.7	< 0.5	NR	NR	5.49	NR	NR
	4/18/16 -4/19/16	102.4	34.3	29	68.1	< 0.5	< 8	< 10	4.08	64	NR
	5/16/16-5/17/16	76.3	27.3	22.3	48.9	< 0.5	< 10	< 10	NR	59.8	NR
	6/20/16 - 6/21/16	108.2	46.7	28.9	61.5	< 0.5	NR	< 10	3.84	NR	NR
	8/15/16 - 8/16/16	13.4	13.4	15.3	< 0.5	< 0.5	< 7	< 10	3.57	80	NR
	9/19/16 - 9/20/16	80.8	30.2	26.9	50.6	< 0.5	7	< 10	3.7	72	NR
	10/3/16-10/4/16	70.1	22.7	17.3	47.4	< 0.5	8	10	3.62	74	NR
	6/19/17-6/20/17	113.1	6.1	4	107	< 0.5	< 5	< 10	3.5	71.96	NR
	7/24/17-7/25/17	140	NR	7.3	140	< 0.5	NR	NR	NR	73.4	NR
SDS#3	9/26/16 - 9/27/16	68.5	16.8	20.9	51.7	< 0.5	7	< 10	3.68	74	NR

Orenco AX20

Site #	Sample Date	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	23.9	8	4.2	15.2	0.7	10	< 10	6.64	54	37
	12/12/16-12/13/16	51.3	37.1	5.2	14.2	0.7	182	380	6.84	55	65.6
	2/6/17-2/7/17	33.2	23.4	9.8	9.8	< 0.5	93	< 10	6.81	53	124
	3/20/17-3/21/17	19.9	11.9	8.1	8	< 0.5	18	12	6.86	51	90
	4/24/17-4/25/17	14.1	11	10.7	2.2	0.9	42	16	7.14	NR	113
	6/26/17-6/27/17	14.9	7	6	7	0.9	22	< 10	7.07	71.96	105
	8/14/17-8/15/17	15.8	3.8	4.9	12	< 0.5	14	11	7.44	72.14	105.4
	8/28/17-8/29/17	16.9	5.2	5.7	11.7	< 0.5	11	5	7.16	69.8	113
	10/2/17-10/3/17	14.7	3.5	2.6	11.2	< 0.5	9	< 20	7.46	69.8	130
	11/13/17-11/14/17	11.4	1.2	3.6	10.2	< 0.5	9	< 10	7.29	62.1	106
	12/11/17-12/12/17	15.1	7.5	4.2	7.6	< 0.5	19	7	6.96	56.5	66
SDS#33	12/18/17-12/19/17	16.2	3.4	0.8	3.3	9.5	17	18	6.96	58.3	NR
	2/5/18-2/6/18	14.1	2.8	0.6	7.2	4.1	9	6	7.25	51.3	69
	3/19/18-3/20/18	14.4	3.6	1.1	10.8	< 0.5	9	< 10	7.22	50.2	63
	4/16/18-4/17/18	13	3.2	1	9.8	< 0.5	11	< 10	7.09	52.9	69
	5/14/18-5/15/18	17.2	3.9	1.3	13.3	< 0.5	6	< 10	6.88	63.5	50
	6/18/18-6/19/18	20.7	20.7	14.7	< 0.5	< 0.5	41	20	7	72.5	296
	7/16/18-7/17/18	48.7	38.1	1.9	10.6	< 0.5	< 5	< 10	6.71	77.9	66
	8/13/18-8/14/18	23.6	15.5	7.5	8.1	< 0.5	40	116	6.68	24.9	96
	9/17/18-9/18/18	11.9	5.3	4.9	6.6	< 0.5	6	< 10	NR	24.1	78
	10/22/18-10/23/18	14	1.7	1.4	11.8	0.5	NR	NR	6.95	18.1	NR
	11/26/18-11/27/18	15	4	2.7	11	< 0.5	< 6	2	6.85	13.7	NR
	12/17/18-12/18/18	14.9	7.4	5	7.5	< 0.5	< 5	< 13	6.59	13	NR
SDS #34	8/28/17-8/29/17	24.2	8.7	5.7	10	5.5	< 5	< 5	6.4	74.7	38
	10/2/17-10/3/17	20.9	2.4	2.3	18.5	< 0.5	< 5	< 10	6.2	73.4	17
	11/13/17-11/14/17	44.9	40.5	42.2	4.4	< 0.5	7	< 10	7.13	65.7	203
	12/11/17-12/12/17	63.4	54.4	44.7	8.1	0.9	94	190	6.9	63	211
	1/22/18-1/23/18	22.7	5.6	3.2	17.1	< 0.5	7	< 10	5.63	57.6	162
	3/5/18-3/6/18	28.5	4.9	3.1	23.6	< 0.5	7	< 5	5.52	60.3	10
	4/2/18-4/3/18	22.1	4.5	4.3	17.6	< 0.5	< 5	< 5	5.31	61.9	NR
	4/30/18-5/1/18	18.4	8.2	5	10.2	< 0.5	< 5	< 5	6.05	64.4	25
	6/11/18-6/12/18	28.9	11.9	7	17	< 0.5	20	21	6.3	73.22	39
	7/2/18-7/3/18	24	7.5	4.4	16.5	< 0.5	< 7	< 10	6.08	76.28	NR
	7/30/18-7/31/18	28.9	6.7	5.6	22.2	< 0.5	< 11	< 13	5.95	78.08	19
	8/27/18-8/28/18	24.7	10.8	9.6	13.9	< 0.5	< 5	< 10	6.41	27.3	NR
	10/15/18-10/16/18	26	6.7	9.6	19.3	< 0.5	< 6	< 10	NR	21.2	NR
	11/19/18-11/20/18	19.2	4.2	4.7	15	< 0.5	< 6	< 10	5.76	19.4	16.6
	12/10/18-12/11/18	15.2	0.9	2.4	14.3	< 0.5	< 6	< 10	4.17	14.9	NR

Amphidrome

Site #	Sample Date	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS#28	3/20/17-3/21/17	44.6	44.6	43.5	< 0.5	< 0.5	20	12	7.45	45	267.6
	4/10/17-4/11/17	30.7	29.3	33.2	1.4	< 0.5	NR	10	7.53	53	NR
	5/8/17-5/9/17	47.7	46.8	47.1	< 0.5	0.9	11	20	7.66	59.36	236
	6/19-17-6/20/17	9.5	6.1	1.2	< 0.5	3.4	12	12	7.61	68.37	183
	7/24/17-7/25/17	9.9	1.8	< 0.5	8.1	< 0.5	< 5	7	7.53	73.4	NR
	8/21/17-8/22/17	5.7	3.6	< 0.5	2.1	< 0.5	12	31	7.65	78.08	NR
	10/4/17-10/5/17	15.5	2.2	< 0.5	13.3	< 0.5	NA	NA	NA	73	NA
	10/30/17-10/31/17	11.9	< 1	< 1	11.9	< 0.5	6	12	7.16	63.9	46
	12/4/17-12/5/17	24.4	< 0.5	0.8	24.4	< 0.5	< 5	< 10	NR	54.9	NR
	1/22/18-1/23/18	42.9	8.5	6.2	34.4	< 0.5	15	18	5.31	46	50
SDS#35	10/2/17-10/3/17	18.8	1.5	< 0.5	17.3	< 0.5	7	< 10	7.27	74.5	48
	11/13/17-11/14/17	18.1	1.8	< 0.5	16.3	< 0.5	7	< 10	7.49	66.4	64
	12/11/17-12/12/17	46.1	46.1	34.2	< 0.5	< 0.5	> 168	26	7.24	63.9	212
	1/22/18-1/23/18	73.2	48.2	12	25	< 0.5	244	476	6.81	57.6	72
	3/5/18-3/6/18	36.6	13.8	5	8.9	13.9	48	48	6.81	55.9	48
	4/2/18-4/3/18	44.3	44.3	34.3	< 0.5	< 0.5	53	66	7.17	60.1	211
	4/30/18-5/1/18	54.5	45.1	21.1	< 0.5	9.4	13	17	7.17	64.4	123
	6/4/18-6/5/18	22.1	2.6	< 0.5	19.5	< 0.5	6	< 10	6.9	66.74	35
	7/2/18-7/3/18	13.8	2.7	< 0.5	11.1	< 0.5	6	< 10	7.03	72.32	NR
	7/30/18-7/31/18	16.9	3.1	0.7	13.8	< 0.5	13	14	7.25	74.3	198
	8/27/18-8/28/18	10.8	1.3	< 0.5	9.5	< 0.5	< 5	< 10	NR	24.8	NR
	10/15/18-10/16/18	7.6	1.7	< 1	5.9	< 0.5	6	< 10	7.62	21.1	195
	11/19/18-11/20/18	11	0.8	< 1	10.2	< 0.5	< 6	< 10	7.54	17.4	188
	12/10/18-12/11/18	10.7	0.5	< 0.5	10.2	< 0.5	< 6	< 10	7.92	15.2	216

Eco-Flow

Site #	Sample Date	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS#9	12/12/16-12/13/16	93	93	82.2	< 0.5	< 0.5	< 5	13	7.78	NR	503.2
	1/23/17-1/24/17	84.4	82.7	70.6	0.6	1.1	< 6	< 10	7.78	NR	512.5
	2/27/2017-2/28/17	97.1	91.1	75.5	6	< 0.5	11	< 10	7.47	47.5	NR
	3/27/17-3/28/17	62.9	57.2	55.1	4.3	1.4	18	< 10	7.24	47	312
	4/17/17-4/18/17	52.3	38.2	35	9.6	4.5	11	5	6.99	NR	253.6
	5/15/17-5/17/17	N/A	NR	46.3	3.3	0.9	24	< 10	7.04	63.86	NR
	7/24/17-7/25/17	86.6	86.6	99.1	< 0.5	< 0.5	55	33	7.61	75.2	NR
	8/21/17-8/22/17	88.3	83	69.9	0.8	4.5	14	10	7.26	78.8	NR
	9/25/17-9/26/17	44.8	37.2	34.2	7.6	< 0.5	32	25	7	71.8	244
	10/30/17-10/31/17	37.3	20.2	23	17.1	< 0.5	33	13	7.26	67.1	236
	12/4/17-12/5/17	NR	NR	2.2	9.6	< 0.5	22	< 3	7.11	57.6	296
	1/22/18-1/23/18	46.4	31.5	25.8	12.3	2.6	26	14	6.92	53.1	220
	3/5/18-3/6/18	48.3	28.4	29.7	17.3	2.6	26	12	7.15	53.1	251
	4/2/18-4/3/18	61.8	40.5	30.3	19.1	2.2	25	19	7.03	48.7	252
	4/30/18-5/1/18	64.4	59.6	44.2	2	2.8	42	16	6.98	57.9	345
	6/4/18-6/5/18	80	76.5	67	2.3	1.2	49	25	7.08	66.38	411
	7/2/18-7/3/18	82.2	65.5	63.2	16.7	< 0.5	20	< 10	7.12	72.5	NR
	7/30/18-7/31/18	110.3	97.8	94.3	12.5	< 0.5	< 13	< 13	7.27	75.02	382
	8/27/18-8/28/18	77	57	54.4	20	< 0.5	12	< 10	7.1	24.6	NR
SDS#8	3/6/17-3/7/17	47.5	47.5	35	< 0.5	< 0.5	12	10	NR	48.6	NR
	4/3/17-4/4/17	54.4	54.4	50.8	< 0.5	< 0.5	< 6	< 10	7.71	47.6	NR
	5/1/17-5/2/17	61.7	44.8	45.7	13.3	3.5	9	< 10	7.2	58.82	324
	6/5/17-6/6/17	10.8	1	< 0.5	9.8	< 0.5	< 5	12	6.92	60.98	241
	7/10/17-7/11/17	13	3.6	1.1	9.4	< 0.5	< 5	< 10	7.05	75.92	202
	8/7/17-8/8/17	2.4	2.4	1.4	< 0.5	< 0.5	< 5	8	6.95	73.22	196
	9/11/17-9/12/17	19.3	1.3	< 0.5	18	< 0.5	< 5	< 5	7.04	70.2	127
	10/16/17-10/17/17	16	< 0.5	< 0.5	16	< 0.5	< 5	< 5	6.92	67.3	122
	11/20/17-11/21/17	15.1	1.4	0.5	13.7	< 0.5	< 5	< 10	7.42	62.4	106
	1/29/18-1/30/18	22.5	< 1	< 1	22.5	< 0.5	< 5	< 10	6.99	41.5	75

* system restarted 7/25/17- system failure due to broken balancing foot on influent dispersal weir

Eco-Flow with Denite

Site #	Sample Date	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS#9	12/12/16-12/13/16	87.5	87.5	82.7	< 0.5	< 0.5	< 5	< 10	7.64	NR	478.4
	1/23/17-1/24/17	77.9	77.9	76.7	< 0.5	< 0.5	< 6	< 10	7.52	NR	496
	2/27/17 - 2/28/17	91.9	91.9	75.6	< 0.5	< 0.5	< 7	< 10	7.47	47.5	NR
	3/27/17-3/28/17	66.2	64.3	58.4	1.4	0.5	15	< 10	7.36	47	339.6
	4/17/17-4/18/17	41.1	34	33.9	7.1	< 0.5	10	< 5	7.19	NR	298
	5/15/17-5/16/17	43.3	43.3	46.2	< 0.5	< 0.5	21	< 10	7.15	63.86	NR
	6/19/17-6/20/17	87.4	87.4	75	< 0.5	< 0.5	131	< 10	7.27	73.4	510
	7/24/17-7/25/17	87.7	87.7	106	< 0.5	< 0.5	153	14	7.1	75.2	NR
	8/21/17-8/22/17	82.6	81.8	74.6	< 0.5	0.8	12	11	7.38	78.8	NR
	10/30/17-10/31/17	20	20	24.4	< 0.5	< 0.5	15	11	7.31	67.1	267
	12/4/17-12/5/17	27.2	27.2	21.7	< 0.5	< 0.5	< 7	8	7.19	57.6	333
	1/22/18-1/23/18	29.5	29.5	28.5	< 0.5	< 0.5	8	< 10	7.26	53.1	302
	3/5/18-3/6/18	34.2	28.6	30.7	3.4	2.2	10	4	7.3	53.1	NR
	4/2/18-4/3/18	36.4	36.4	34.1	< 0.5	< 0.5	< 5	< 10	7.03	48.7	387
	4/30/18-5/1/18	64.7	64.7	47.9	< 0.5	< 0.5	29	40	7.19	57.9	392
	6/4/18-6/5/18	75.1	75.1	69.3	< 0.5	< 0.5	43	15	7.1	66.38	428
	7/2/18-7/3/18	68.2	68.2	63.4	< 0.5	< 0.5	13	< 10	7.2	72.5	NR
	7/30/18-7/31/18	106	106	95.7	< 0.5	< 0.5	< 13	< 13	7.57	75.02	372
	8/27/18-8/28/18	72	51.2	55.6	20.8	< 0.5	44	26	7.42	24.6	NR
SDS#8	3/6/17-3/7/17	40.6	40.6	35.5	< 0.5	< 0.5	12	< 10	7.58	48.6	328.4
	4/3/17-4/4/17	51.8	51.8	51.1	< 0.5	< 0.5	< 6	< 10	7.53	47.6	NR
	5/1/17-5/2/17	44.7	44.7	46.7	< 0.5	< 0.5	10	< 10	7.11	58.82	352
	6/5/17-6/6/17	1.1	1.1	< 0.5	< 0.5	< 0.5	< 5	12	7.18	60.98	343
	7/10/17-7/11/17	1.3	1.3	1	< 0.5	< 0.5	< 5	< 10	7.28	75.92	294
	8/7/17-8/8/17	1.5	1.5	1.4	< 0.5	< 0.5	< 5	< 5	7.27	73.22	271
	9/11/17-9/12/17	1.1	1.1	0.6	< 0.5	< 0.5	< 5	< 5	7.48	70.2	235
	10/16/17-10/17/17	0.8	0.8	< 0.5	< 0.5	< 0.5	< 5	< 5	7.54	67.3	244
	11/20/17-11/21/17	4	2.3	1.3	1.7	< 0.5	< 5	< 10	7.57	62.4	157
	1/29/18-1/30/18	5.2	4.4	3.3	0.8	< 0.5	< 5	< 10	7.41	41.5	167

* system restarted 7/25/17- system failure due to broken balancing foot on influent dispersal weir

Waterloo

Site #	Sample Date	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS #37	6/12/17-6/13/17	42.3	40.4	37.4	0.6	1.3	26	< 10	7.31	70.7	267
	8/14/17-8/15/17	23.9	17.5	22.8	5.7	0.7	14	< 10	7.04	79.88	223
	9/18/17-9/19/17	31.6	22.1	23	8.7	0.8	15	10	7.09	74.1	NR
	10/23/17-10/24/17	31.7	16.3	17.7	15.4	< 0.5	14	7	7.07	70.9	188
	11/27/17-11/28/17	38.6	29.5	22.8	8.6	0.5	18	9	6.96	59.5	203
	1/29/18-1/30/18	48.8	43.1	36.8	4.6	1.1	27	15	7.07	50.7	233
	3/12/18-3/13/18	43.2	39.4	28.1	3.2	0.6	35	20	7.01	46.6	264
	4/9/18-4/10/18	62.1	60.8	51.8	0.7	0.6	61	25	7.15	53.8	318
	5/7/2018-5/8/2018	59.7	58.7	52.5	1	< 0.5	33	11	7.15	65.7	305
	6/11/18-6/12/18	72.2	69.7	39.3	2.5	< 0.5	38	18	7.35	68.9	270
	7/9/18-7/10/18	54.1	53	49.7	1.1	< 0.5	70	13	7.07	74.66	303
SDS #38	6/12/17-6/13/17	118.7	118	93.8	< 0.5	0.7	28	17	9.7	72.14	450
	7/17/17-7/18/17	82.5	79	83	3.5	< 0.5	19	14	7.33	80.42	450
	8/14/17-8/15/17	84.5	81	90.1	3.5	< 0.5	12	< 10	7.42	77.54	455
	9/18/17-9/19/17	74.9	62.4	12.5	11.4	1.1	7	6	7.43	75.2	376
	10/23/17-10/24/17	53.5	39.6	39.4	13.9	< 0.5	NR	NR	NR	70.2	NR
	11/27/17-11/28/17	68.3	48.9	36.5	19.4	< 0.5	5	< 5	7.22	58.6	258
	1/8/18-1/9/18	61.2	44.5	33.4	13.8	2.9	< 5	6	7.19	47.6	263
	2/26/18-2/27/18	47.7	40.4	36.5	6.5	0.8	17	7	7.25	51.8	33
	3/26/18-3/27/18	69.7	60.7	73.3	7.4	1.6	10	8	7.72	48.2	334
	4/23/18-4/24/18	113.9	101	92.2	12	0.9	10	5	7.53	54.1	349
	5/21/18-5/22/18	85.7	75.6	67.1	9.3	0.8	25	< 5	7.54	63.5	204
	6/25/18-6/26/18	96.1	78.6	65.8	15.9	1.6	20	10	7.5	72.68	348
	7/23/18-7/24/18	94.3	71.2	63	22.1	1	< 9	< 10	7.42	76.82	297

Waterloo with Denite Filter

Site #	Sample Date	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS #37	6/12/17-6/13/17	42.5	42.5	40.7	< 0.5	< 0.5	16	< 10	7.38	70.7	321
	7/17/17-7/18/17	23.9	23.9	23.4	< 0.5	< 0.5	28	< 10	7.28	78.44	340
	3/12/18-3/13/18	42.4	41.3	24.5	< 1	1.1	26	< 5	7.13	46.6	308
	4/9/18-4/10/18	60.9	59.8	55	1.1	< 0.5	43	< 13	7.2	53.8	359
	5/7/2018-5/8/2018	64	64	56.3	< 0.5	< 0.5	38	14	7.17	65.7	396
	6/11/18-6/12/18	61.1	61.1	43.1	< 0.5	< 0.5	27	< 10	7.47	68.9	356
	7/9/18-7/10/18	47.6	47.6	47.1	< 0.5	< 0.5	26	< 10	7.14	74.66	336
SDS #38	6/12/17-6/13/17	96.8	96.8	87.4	< 0.5	< 0.5	20	< 10	7.56	72.14	448
	7/17/17-7/18/17	73	73	73.3	< 0.5	< 0.5	20	18	7.34	80.42	459
	2/26/18-2/27/18	33.5	33.5	31.5	< 0.5	< 0.5	15	6	7.19	51.8	362
	3/26/18-3/27/18	56.1	56.1	61.3	< 0.5	< 0.5	6	< 5	7.67	48.2	334
	4/23/18-4/24/18	106	106	87.9	< 0.5	< 0.5	9	< 5	7.45	54.1	387
	5/21/18-5/22/18	75.4	75.4	64.9	< 0.5	< 0.5	11	28	7.31	63.5	400
	6/25/18-6/26/18	84.1	84.1	70.8	< 0.5	0.5	13	< 10	7.55	72.68	433
	7/23/18-7/24/18	78.7	78.7	72.9	< 0.5	< 0.5	10	< 10	NR	76.82	NR

BioMicrobics BioBarrier

Site #	Sample Date	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
SDS #39	7/24/17-7/25/17	63.9	5.8	19.2	58.1	< 0.5	33	8	6.83	75.2	NR
	8/21/17-8/22/17	61	14.5	14.5	44.9	1.6	33	< 5	6.08	79.16	NR
	10/4/17-10/5/17	69.8	18	18.8	51.8	< 0.5	NA	NA	NA	70.2	NA
	10/30/17-10/31/17	N/A	NR	20.9	47.9	< 0.5	< 6	< 10	6.42	65.1	NR
	12/4/17-12/5/17	60.6	29.3	29.5	31.3	< 0.5	< 5	< 3	7.43	48.6	112
	1/8/18-1/9/18	64.9	14.4	17.5	50.5	< 0.5	< 5	< 5	6.07	44.8	NR
	2/26/18-2/27/18	73.4	26.7	22.3	46.7	< 0.5	< 5	< 10	5.3	45.7	NR
	3/26/18-3/27/18	77.1	17.1	26.9	60	< 0.5	< 4	< 5	4.43	47.7	NR
	4/23/18-4/24/18	56.2	12.7	11.1	43.5	< 0.5	< 5	< 5	5.02	51.8	NR
	5/21/18-5/22/18	100.2	44.8	18.3	55.4	< 0.5	< 6	< 5	6.01	63.86	NR
	6/25/18-6/26/18	25	< 0.5	< 0.5	25	< 0.5	< 5	< 10	7.03	69.26	19.4
	7/23/18-7/24/18	42.4	4.4	4.2	38	< 0.5	< 5	< 10	5.44	76.82	NR
	8/20/18-8/21/18	42.4	1.2	1.3	41.2	< 0.5	< 6	< 10	5.62	23.3	NR
SDS #40	7/17/17-7/18/17	22.74	3.74	4.1	1	18	< 5	< 10	6.92	78.8	32
	8/14/17-8/15/17	36.2	9.1	10.2	20.9	6.2	< 5	< 10	6.88	76.64	18
	9/18/17-9/19/17	33.7	9.1	8.9	24.6	< 0.5	< 5	< 10	5.32	73.8	NR
	10/23/17-10/24/17	N/A	NR	3.5	20.9	< 0.5	< 5	< 10	6.28	69.1	6.28
	1/29/18-1/30/18	51.8	27.4	17.6	18.5	5.9	56	< 20	7.07	50.5	50
	3/12/18-3/13/18	31.4	6.6	10.4	23.8	1	8	< 5	4.75	42.1	NR
	4/9/18-4/10/18	24.6	1.6	< 0.5	23	< 0.5	< 5	< 10	6.24	43.3	NR
	5/7/18-5/8/18	25.5	2.6	< 0.5	22.9	< 0.5	< 5	< 10	6.04	59	NR
	6/11/18-6/12/18	33.8	4.6	3.6	29.2	< 0.5	< 5	< 10	4.05	64.58	NR
	7/9/18-7/10/18	21	1	< 0.5	20	< 0.5	< 5	< 10	6.08	75.02	NR
	8/6/18-8/7/18	88.7	27.9	25.7	60.8	< 0.5	< 5	< 10	4.61	27.2	NR
	9/10/18-9/11/18	69.5	18.8	11.4	50.7	< 0.5	< 6	< 10	4.51	22.6	NR

BioMicrobics SeptiTech STAAR

Site #	Sample Date	TN	TKN	Ammonia (as	NO3	NO2	BOD	TSS	PH	Temp	Alk
SDS #41	12/4/17-12/5/17	9.4	< 0.5	< 0.5	9.4	< 0.5	8	5	7.02	57.6	NR
	1/22/18-1/23/18	15.7	8.6	1	7.1	< 0.5	31	25	6.21	52.3	50
	3/5/18-3/6/18	9.1	3.1	4.2	6	< 0.5	76	45	6.76	51.1	52
	4/2/18-4/3/18	17.2	11.5	2.2	5.7	< 0.5	62	77	6.44	47.8	42
	4/30/18-5/1/18	8.9	6.4	2.8	2.5	< 0.5	35	21	6.97	57.2	52
	6/4/18-6/5/18	6	2.2	1.3	3.8	< 0.5	8	< 10	7.04	65.66	40
	7/2/18-7/3/18	12.2	2.1	< 0.5	10.1	< 0.5	< 5	< 10	6.61	75.74	NR
SDS #42	12/18/17-12/19/17	53.1	47	46.4	< 0.5	6.1	NR	11	1.86	58.3	NR
	1/29/18-1/30/18	10.1	7.2	3	< 0.5	2.9	23	< 10	7.21	52.5	75
	3/12/18-3/13/18	13.3	0.6	0.5	9	3.7	14	< 5	6.95	54.3	32
	4/9/18-4/10/18	22.1	6.6	2.4	15.5	< 0.5	12	< 10	6.77	57.7	31
	5/7/18-5/8/18	12.5	7.6	3.3	4.9	< 0.5	42	20	7.07	67.5	47
	6/11/18-6/12/18	14.4	6.5	2.6	7.1	0.8	9	< 10	7.1	75.2	46
	7/9/18-7/10/18	21.4	9.4	6.5	12	< 0.5	8	< 10	7.1		53

Appendix ii: Bi-Monthly Grab Samples for Technologies within Provisional Use Phase in 2018

Hydro-Action

SITE	Sample Date	TN (mg/l) (ALL)	TN (mg/l) (MFR)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
	8/2/2017	9.3		2.2	< 0.5	7.1	< 0.5	N/A	N/A	7.1	N/A	N/A
PS#1	11/8/2017	8.7		0.9	N/A	7.8	< 0.5	N/A	N/A	N/A	N/A	N/A
SD#18	12/13/2017	15.7	15.70	< 0.1	< 0.1	15.7	< 0.05	< 4	10	6.8	15	7.4
	2/15/2018	20.4	20.40	< 0.1	2.2	20.4	< 0.05	< 4	16	7.2	15.8	2.8
	3/15/2018	20.3		3	< 0.5	< 0.5	17.3	N/A	N/A	N/A	N/A	N/A
	4/20/2018	2	2.00	< 0.1	0.12	2	< 0.05	< 4	< 10	6.7	15.8	30
	7/3/2018	8.1	8.10	0.9	0.13	7.2	< 0.05	< 2	< 10	7.3	18.9	34
	8/21/2018	5.9	5.90	1.1	0.14	4.8	< 0.05	< 2	< 10	6.9	23.8	46.2
	9/20/2018	14.7		1.7	N/A	13	, 1.25	N/A	N/A	N/A	N/A	N/A
	10/22/2018	21.25	21.25	0.95	< 0.1	20.3	< 0.05	< 4	10	6.1	15.2	5.1
	12/26/2018	8.79	8.79	0.69	< 0.1	8.1	< 0.05	3.4	24	7	9.1	68.4
	8/2/2017	11.5		1.4	< 0.5	10.1	< 0.5	N/A	N/A	6.7	N/A	N/A
PS#2	11/16/2017	31.7		8	N/A	23.7	< 0.5	N/A	N/A	N/A	N/A	N/A
SD#10	12/14/2017	11.4	11.40	1.4	0.12	10	< 0.05	< 4	13	6.9	15	26.8
	2/15/2018	9.3	9.30	1.1	0.23	8.2	< 0.05	< 6.7	41	7.3	16.5	23
	4/5/2018	13.2		3.8	< 0.5	9.4	< 0.5	N/A	N/A	N/A	N/A	N/A
	4/20/2018	13.25	13.25	0.85	0.27	12.4	< 0.05	< 67	46	6.65	14	20.8
	10/4/2018	10.2		1.5	N/A	6.2	< 2.5	N/A	N/A	N/A	N/A	N/A
	7/3/2018	7.58	7.58	0.58	< 0.1	7	< 0.05	< 2	< 10	7.1	18.4	38
	8/21/2018	9.1	9.10	1.2	0.15	7.9	< 0.05	< 2	< 10	6.8	24.5	38.3
	10/4/2018	10.2		1.5	N/A	6.2	< 2.5	N/A	N/A	N/A	N/A	N/A
	10/22/2018	10.6	10.60	1.2	< 0.1	9.4	< 0.05	< 4	10	7	17	49.3
	12/26/2018	10.97	10.97	0.67	< 0.1	10.3	< 0.05	< 4	8	7.3	8.9	42.4
	8/2/2017	13.1		6.2	0.65	6.9	< 0.5	N/A	N/A	7.4	N/A	N/A
PS#3	11/2/2017	17.7		4.2	N/A	13.5	< 0.5	N/A	N/A	N/A	N/A	N/A
SD#12	12/14/2017	12.4	12.40	2.8	0.16	9.3	0.34	< 4	48	7.2	16	36.2
	2/15/2018	8.7	8.70	1.6	0.37	7.1	< 0.05	< 4	20	7.1	16	56
	3/8/2018	14.4		7.6	< 0.5	6.8	< 0.5	N/A	N/A	N/A	N/A	N/A
	4/20/2018	14	14.00	< 0.1	< 0.1	14	< 0.05	< 13	< 10	6.8	14	46.8
	7/3/2018	8.41	8.41	1.4	0.14	6.8	0.21	< 4	< 10	6.9	18.2	102
	8/21/2018	11.6	11.60	< 0.1	< 0.1	11.6	< 0.05	< 2	< 10	6.9	24.5	92.7
	9/20/2018	11.2		1.7	N/A	9.5	< 1.25	N/A	N/A	N/A	N/A	N/A
	10/22/2018	11.4	11.40	1	< 0.1	10.4	< 0.05	< 4	< 10	7.2	15.4	95.1
	12/26/2018	9.25	9.25	0.95	< 0.1	8.3	< 0.05	6.8	35	7.2	8.9	66.5
	8/2/2017	14.1		3.7	0.51	10.4	< 0.5	N/A	N/A	6.3	N/A	N/A
PS#4	11/16/2017	13.2		2.6	N/A	10.6	< 0.5	N/A	N/A	N/A	N/A	N/A
SD#11	12/14/2017	12.9	12.90	4.5	1.7	8.4	< 0.05	< 4	< 10	6.9	16	13.4
	2/15/2018	11	11.00	2	1	9	< 0.05	< 4	35	6.8	15.9	9
	4/5/2018	20.1		13.4	1.98	6.7	< 0.5	N/A	N/A	N/A	N/A	N/A
	4/20/2018	12.9	12.90	3.1	1.3	9.8	< 0.05	< 67	60	6.65	14	9.2
	7/3/2018	8.2	8.20	4.1	0.2	4.1	< 0.05	< 4	11	6.7	18.6	4
	8/21/2018	10.85	10.85	0.95	0.34	9.9	< 0.05	< 2	10	5.8	27	3.1
	10/22/2018	11.13	11.13	0.93	< 0.1	10.2	< 0.05	< 4	< 10	7.2	16.8	45.6
	12/26/2018	19.59	19.59	4.5	4.2	15	0.089	19	35	7.2	9.6	3

Hydro-Action…continued

	8/2/2017	4.1		0.9	< 0.5	3.2	< 0.5	N/A	N/A	7.5	N/A	N/A
PS#5	11/8/2017	4.7		1.5	N/A	3.2	< 0.5	N/A	N/A	N/A	N/A	N/A
SD#6	12/13/2017	7.8	7.80	< 0.1	< 0.1	7.8	< 0.05	5.4	11	7.1	15	40.8
	2/15/2018	22.2	22.20	0.7	4	21.5	< 0.05	< 4	28	6.9	16.2	2.4
	3/15/2018	28.9		2.9	2.36	26	< 0.5	N/A	N/A	N/A	N/A	N/A
	4/20/2018	43.1	43.10	< 0.1	0.19	39.4	3.7	< 67	68	5.6	9.6	2.2
	7/2/2018	6.5	6.50	1.6	< 0.1	4.9	< 0.05	< 2	< 10	6.7	18.4	8
	8/21/2018	3.5	3.50	1.3	< 0.1	2.2	< 0.05	< 2	< 10	7.4	23.4	66.4
	9/6/2018	5.8		1.1	N/A	4.2	< 0.5	N/A	N/A	N/A	N/A	N/A
	10/22/2018	3	3.00	1.4	< 0.1	1.6	< 0.05	< 4	< 10	7.3	14.8	54.5
PS#6	2/15/2018	25.9	25.90	4.6	0.85	19.2	2.1	14	25	7.4	16	40.2
	4/19/2018	10.39		5.4	N/A	3.3	1.69	N/A	N/A	N/A	N/A	N/A
	4/19/2018	27.1	27.10	4.4	0.52	21	1.7	< 13	10	7.01	11.8	44.2
	7/3/2018	14.2	14.20	< 0.5	0.25	14.2	< 0.05	< 2	< 10	7.2	19.1	8
	8/21/2018	14.3	14.30	< 0.1	0.13	14.3	0.084	< 2	< 10	7	22.5	35.6
	9/13/2018	10.2		1.3	N/A	8.9	< 0.5	N/A	N/A	N/A	N/A	N/A
	10/22/2018	12.8	12.80	1	< 0.1	11.8	< 0.05	< 4	< 10	7.5	15	64.7
	12/26/2018	13.7	13.70	1.4	< 0.1	12.3	< 0.05	< 2	< 5	7.1	9.1	20
PS#7	4/19/2018	16.12	16.12	7.9	25	7.5	0.72	< 13	14	7.46	11	235
	4/26/2018	47.7		47.7	N/A	< 1	< 0.5	N/A	N/A	N/A	N/A	N/A
	7/2/2018	11.2	11.20	5.9	1.2	3.8	1.5	5.4	< 20	6.9	17.7	100
	10/10/2018	8.45		3.3	N/A	< 1.25	3.9	N/A	N/A	N/A	N/A	N/A
PS#8	4/26/2018	11.4		10.2	N/A	1.2	< 0.5	N/A	N/A	N/A	N/A	N/A
	10/10/2018	13.55		3.3	N/A	8	2.25	N/A	N/A	N/A	N/A	N/A
PS#9	4/12/2018	12.5		9	3.78	< 2.5	3.5	N/A	N/A	N/A	N/A	N/A
	9/20/2018	9.5		4.1	N/A	5.4	< 1.25	N/A	N/A	N/A	N/A	N/A
	12/26/2018	4.05	4.05	3	0.21	0.89	0.16	16	13	7.1	8	64
PS#10	7/2/2018	14.3	14.30	5	1.4	7.9	1.4	< 4	< 10	6.2	16.9	24
	8/21/2018	14.41	14.41	2.9	0.18	11.3	0.21	< 4	< 10	7.2	23.5	69.3
	9/6/2018	15.73		3.7	N/A	10.2	1.83	N/A	N/A	N/A	N/A	N/A
	10/22/2018	7.4	7.40	2.9	0.1	4.5	< 0.05	< 4	< 10	7	13.5	109
	12/26/2018	5	5.00	1.5	< 0.1	3.5	< 0.05	2	8	7.3	9.6	74.6
PS#11	7/2/2018	32.4	32.40	29.3	25.2	1.9	1.2	5.1	< 10	6.7	17.9	136
	9/6/2018	4.9		1.8	N/A	2.6	< 0.5	N/A	N/A	N/A	N/A	N/A
PS#12	11/8/2018	11.78		6.1	N/A	2.8	2.88	N/A	N/A	N/A	N/A	N/A
PS#14	10/4/2018	39.6		32.1	N/A	< 5	< 2.5	N/A	N/A	N/A	N/A	N/A
PS#16	8/21/2018	4.08	4.08	3.2	0.33	0.8	0.08	12	14	7.6	23.1	100
	10/22/2018	14.32	14.32	10.1	5.4	0.92	3.3	28	15	7.1	15	101
	10/25/2018	10.3		2.8	N/A	< 5	< 2.5	N/A	N/A	N/A	N/A	N/A
	12/26/2018	18.75	18.75	0.75	< 0.1	18	< 0.05	< 4	23	7.1	8.7	30.9
PS#17	8/21/2018	4.27	4.27	3.4	0.32	0.79	0.079	14	11	7.5	23.4	104
	10/22/2018	7.2	7.20	1.9	< 0.1	5.3	< 0.05	8.1	20	7.4	15.5	70.4
PS#18	8/21/2018	3.6	3.60	2	0.15	1.6	< 0.05	7.5	12	7.5	22.5	51
	10/22/2018	6.8	6.80	4.8	0.92	2	< 0.05	17	18	7.1	14.9	63.8
	12/26/2018	7.49	7.49	1.9	0.22	5.5	0.087	12	13	7.2	11.4	53.3
PS#19	11/8/2018	16.25		2.3	N/A	12.7	< 1.25	N/A	N/A	N/A	N/A	N/A

Orenco Advantex AX-RT

SITE	Sample Date	TN (mg/l) (ALL)	TN (mg/l) (MFR)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
PS# 1	8/2/2017	23.3		1.3	1.84	22	< 0.5	N/A	N/A	6.6	N/A	N/A
SD# 2	11/2/2017	31		1.2	1.21	29.8	< 0.5	N/A	N/A	N/A	N/A	N/A
	11/29/2017	32.1	32.1	3.9	2.5	28.2	< 0.5	< 4	< 5	6.81	24.3	30
	3/8/2018	21.6		4.5	3.37	17.1	< 0.5	N/A	N/A	N/A	N/A	N/A
	3/14/2018	21.5	21.5	3.3	2.1	18.2	< 0.5	5.8	< 5	7.36	23.3	106
	4/29/2018	29.4	29.4	3.5	2.6	25.9	< 0.5	5.1	< 5	7.88	25	59.5
	7/5/2018	20.7	20.7	5.4	4.6	15.3	< 0.5	5.8	5.3	6.76	25.6	100
	9/20/2018	29.1		4.7	N/A	24.4	<1 1.25	N/A	N/A	N/A	N/A	N/A
	11/2/2018	17.1	17.1	< 0.1	0.31	17.1	< 0.05	< 2	< 10	6.5	23.7	34.9
PS# 2	8/2/2017	43.39		11.9	9.92	30.4	1.09	N/A	N/A	6	N/A	N/A
SD# 43	11/8/2017	29.8		6.2	N/A	23.6	< 0.5	N/A	N/A	N/A	N/A	N/A
	11/22/2017	32	32	6.3	7.1	25.8	0.5	7.4	< 5	6.28	23.2	7.5
	3/14/2018	47.5	47.5	15.7	14.9	26.3	5.48	5.4	8.3	6.63	23.2	20
	3/15/2018	49.32		18.1	15.47	24.4	6.82	N/A	N/A	N/A	N/A	N/A
	4/29/2018	39.5	39.5	11.1	9.8	25.8	2.64	5	7.7	7.08	25.7	14.5
PS# 3	11/1/2018	31.1	31.1	4.2	5.4	26.8	0.06	4.1	< 10	5.6	23.6	2.5
	11/8/2018	41.3		8.9	N/A	29.9	< 2.5	N/A	N/A	N/A	N/A	N/A
PS# 4	11/1/2018	6.4	6.4	< 0.1	< 0.1	6.3	< 0.05	2	10	6.8	23..5	60

Norweco Singulair TNT

SITE	Sample Date	TN (mg/l) (ALL)	TN (mg/l) (MFR)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
PS#1	8/2/2017	38.89		28.1	22.52	3.1	7.69	N/A	N/A	6.6	N/A	N/A
SD#21	10/30/2017	59.6	59.6	59.6	45.9	< 0.05	< 0.05	44	63	6.82	20.5	250
	11/16/2017	70		70	N/A	< 1	< 0.5	N/A	N/A	N/A	N/A	N/A
	12/19/2017	66.97	66.97	65.9	41.9	0.488	0.582	47	68	6.76	15	250
	2/14//18	109	109	109	75.5	< 0.05	< 0.05	520	280	7.16	12.1	380
	4/5/2018	40.9		38.7	38.74	1.7	0.5	N/A	N/A	N/A	N/A	N/A
	5/3/2018	30.3	30.3	15.5	12	14.8	< 0.5	< 4	35	6.45	16.2	96.5
	6/12/2018	6.71	6.71	4.1	1.4	2.61	< 0.5	13	41	N/A	N/A	205
	7/12/2018	7.8		7.8	4.4	< 0.5	< 0.5	4.5	37	6.9	23.5	95
	8/2/2018	24.4	24.4	5.3	2.6	19.1	< 0.5	< 4	41	6.7	24.6	115
	9/10/2018	5.58		4.5	3.8	< 0.5	1.08	13	22	5.75	20.8	30
	10/1/2018	1.7	1.7	1.7	1	< 0.5	< 0.5	< 4	< 6.3	5.51	26.1	100
	10/4/2018	33.4		5	N/A	25.9	< 2.5	N/A	N/A	N/A	N/A	N/A
PS#2	8/2/2017	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SD#27	8/10/2017	53.9		9.4	N/A	44.5	< 0.5	N/A	N/A	N/A	N/A	N/A
	10/30/2017	39.8	39.8	10.1	0.648	29.5	0.213	17	124	5.99	20.2	29
	11/2/2017	48.4		12.4	N/A	36	< 0.5	N/A	N/A	N/A	N/A	N/A
	12/19/2017	53.2	53.2	34.1	6.9	17.5	1.6	60	82	6.53	12.6	96
	2/14/2018	63.6	63.6	54.7	26.1	7.72	1.22	72	69	7	12.6	190
	3/8/2018	35.1		7.7	0.65	27.4	< 0.5	N/A	N/A	N/A	N/A	N/A
	4/30/2018	30.4	30.4	4.3	1.2	26.1	< 0.5	26	25	7.2	14.2	61
	6/12/2018	9.39	9.39	4.1	2.4	5.29	< 0.5	16	29	N/A	N/A	275
	7/12/2018	9.28		2.2	< 2	7.08	< 0.5	< 4	< 5	7	23.5	19.5
	8/2/2018	10.34	10.34	3.1	3	7.24	< 0.5	< 4	11	6.67	24.7	175
	9/12/2018	18.2		3.3	1.4	8.1	< 0.5	10	33	6.71	23.7	120
	9/20/2018	18.2		3.4	N/A	14.8	< 1.25	N/A	N/A	N/A	N/A	N/A
	10/2/2018	20.1	20.1	3.1	1.2	17	< 0.5	< 4	50	6.3	22.6	85
	12/11/2018	22.3	22.3	2.9	1	19.4	< 0.5	< 4	34	NR	NR	70
PS#3	8/2/2017	12.2		12.2	5.68	< 1	< 0.5	N/A	N/A	6.5	N/A	N/A
SD#15	10/30/2017	11.9	11.9	5.46	0.645	6.19	0.215	5	33	6.37	21.3	56
	11/22/2017	21		13.1	N/A	5	2.9	N/A	N/A	N/A	N/A	N/A
	12/19/2017	23.04	23.04	15.5	1.49	7.54	< 0.05	20	47	6.26	17.4	44
	2/14/2018	5.93	5.93	5.53	1.76	< 0.05	0.399	11	28	6.6	11.8	30
	3/29/2018	8.5		8.5	N/A	< 1	< 0.5	N/A	N/A	N/A	N/A	N/A
	5/1/2018	8.41	8.41	7.9	7.8	0.51	< 0.5	5.4	5.5	6.42	18.9	85
	6/13/2018	8.2	8.2	4.9	4	3.3.	< 0.5	< 4	18	N/A	N/A	69
	7/11/2018	8.99		5.8	2.8	3.19	< 0.5	< 4	12	6.62	28.2	75
	8/1/2018	13.25	13.25	10.9	8.6	2.35	< 0.5	< 4	8.3	6.79	28.2	88
	9/12/2018	10.65		14.1	6.4	1.38	< 0.5	7	23	6.54	26.6	85
	9/13/2018	8.2		8.2	N/A	< 2.5	< 1.25	N/A	N/A	N/A	N/A	N/A
	10/3/2018	10.65	10.65	3.5	2.6	7.15	< 0.5	4.2	55	6.45	22.4	85
	12/5/2018	12.2	12.2	4.1	2.2	8.14	< 0.5	< 4	30	6.52	12.4	75

Norweco Singulair TNT…continued												
PS#4	8/2/2017	23.3		20.7	2	2.6	< 0.5	N/A	N/A	6.4	N/A	N/A
SD#26	10/30/2017	3.25	3.25	2.54	0.982	0.438	0.268	< 3	< 4	6.94	18	46
	11/22/2017	5.19		2.3	N/A	2.3	0.59	N/A	N/A	N/A	N/A	N/A
	12/19/2017	20.5	20.5	20.5	14.9	< 0.05	< 0.05	22	21	7.06	14.6	130
	2/14/2018	17.4	17.4	16.6	5.41	0.08	0.729	38	52	7.27	12.3	92
	4/5/2018	9.4		9.4	4.46	< 1	< 0.5	N/A	N/A	N/A	N/A	N/A
	5/3/2018	7.7	7.7	7.7	6.2	< 0.5	< 0.5	< 4	36	6.54	20.4	82.5
	6/12/2018	4.9	4.9	4.9	5.8	< 0.5	< 0.5	13	22	N/A	N/A	105
	7/12/2018	6.11		< 2	< 2	6.11	< 0.5	< 4	< 3.7	6.56	28.3	105
	8/2/2018	3.7	3.7	3.7	2.8	< 0.5	< 0.5	< 4	18	6.93	26.7	165
	9/10/2018	1.7		1.1	< 1	< 0.5	0.6	11	25	6.18	29	90
	10/1/2018	6.3	6.3	6.3	4.8	< 0.5	< 0.5	< 4	26	6.61	26.5	35
	10/4/2018	12.2		4.7	N/A	< 5	< 2.5	N/A	N/A	N/A	N/A	N/A
	12/3/2018	8.16	8.16	3.5	1.8	4.66	< 0.5	< 4	14	6.58	17.6	80
PS#5	2/14/2018	171	171	171	109	< 0.05	< 0.05	90	70	7.17	8.5	530
	4/19/2018	96.9		96.9	N/A	< 2.5	< 1.25	N/A	N/A	N/A	N/A	N/A
	5/2/2018	6.5	6.5	6.5	6	< 0.5	< 0.5	< 4	124	6.8	13.5	480
	8/23/2018	10.9	10.9	10.9	6.8	< 0.5	< 0.5	6.8	33	6.59	22.9	275
	9/11/2018	11.3		11.3	5.6	< 0.5	< 0.5	88	19	6.38	24.4	280
	10/2/2018	37.08	37.08	33.9	28.8	3.18	< 0.5	5	13	6.76	22.5	290
	10/25/2018	102.6		95.1	N/A	< 5	< 2.5	N/A	N/A	N/A	N/A	N/A
PS#6	2/20/2018	34.7	34.7	30	15.6	3.97	0.685	27	24	7.68	10.8	130
	4/19/2018	31.4		31.4	N/A	< 2.5	< 1.25	N/A	N/A	N/A	N/A	N/A
	5/2/2018	2.82	2.82	2.1	1.4	0.72	< 0.5	< 4	14	7.13	15.5	165
	6/13/2018	9.21	9.21	3.9	1.8	5.31	< 1	14	22	N/A	N/A	131
	7/10/2018	17.5		17.5	15.8	< 0.05	< 0.05	11	13	7.05	25.3	170
	8/1/2018	7.26	7.26	3.5	2.6	3.76	< 0.5	< 4	< 11	6.63	27.5	135
	9/11/2018	7.3		6.3	5	1	< 0.5	5.8	16	6.55	25	275
	10/2/2018	15.7	15.7	3.1	1.2	12.6	< 0.5	< 4	14	6.65	23.3	140
	10/23/2018	21.6		14.1	N/A	< 2.5	< 5	N/A	N/A	N/A	N/A	N/A
	12/20/2018	19.7	19.7	6.9	4.8	12.8	< 0.5	< 4	36	7.2	NR	110
PS#7	2/14/2018	77.9	77.9	76.7	67	0.1	1.13	25	26	7.56	10.2	320
	4/26/2018	86.6		86.6	N/A	< 1	< 0.5	N/A	N/A	N/A	N/A	N/A
	10/10/2018	50.35		46.6	N/A	< 2.5	< 1.25	N/A	N/A	N/A	N/A	N/A
	10/23/2018	11.84	11.84	11.3	9.8	< 0.5	0.54	8.9	51	6.2	20	180
PS#9	8/23/2018	13.26	13.26	10.9	6.2	1.06	1.3	4.2	24	6.43	25.6	115
	9/13/2018	10.3		10.3	N/A	< 2.5	< 1.25	N/A	N/A	N/A	N/A	N/A
	9/11/2018	14.6		12.1	6	4.12	1.38	15	51	6.08	24.9	105
	10/3/2018	23.3	23.3	23.3	23.2	< 0.5	< 0.5	5.5	65	6.74	26.2	220
PS#10	9/13/2018	18.5		18.5	N/A	< 2.5	< 1.25	N/A	N/A	N/A	N/A	N/A
	10/23/2018	15.5	15.5	2.5	2.4	13	< 0.5	< 4	11	6.24	22.1	75
	12/20/2018	12.9	12.9	6.1	5	6.8	< 0.5	< 4	11	7.13	NR	120
PS#11	9/11/2018	16.3		1.3	< 1	15	< 0.5	< 4	18	6.36	24.8	105
	10/3/2018	14.2	14.2	2.9	1	11.3	< 0.5	< 4	29	6.69	23.5	120
	12/4/2018	18	18	4.1	2.4	13.9	< 0.5	< 4	20	6.75	12.1	100
PS#12	9/11/2018	8.3	8.3	8.3	5.8	< 0.5	< 0.5	< 4	15	6.26	22.3	100
	10/3/2018	2.5		2.5	2.2	< 0.5	< 0.5	< 4	19	6.5	21.1	75

Norweco Hydro-Kinetic

SITE	Sample Date	TN (mg/l) (ALL)	TN (mg/l) (MFR)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
PS# 1	8/2/2017	7.4		7.4	6.71	< 1	< 0.5	N/A	N/A	6.9	N/A	N/A
SD# 4	10/30/2017	31	31	31	28.9	< 0.05	< 0.05	< 3	27	6.84	18.3	250
	11/22/2017	25.6		22.7	N/A	2.9	< 0.5	N/A	N/A	N/A	N/A	N/A
	12/19/2017	11.78	11.78	5.39	0.165	6.39	< 0.05	5	41	6.81	13	120
	2/14/2018	8.39	8.39	1.92	0.319	6.47	< 0.05	< 3	< 6.7	7.15	12.4	110
	3/29/2018	7.1		3.4	1.71	3.7	< 0.5	N/A	N/A	N/A	N/A	N/A
	4/24/2018	12.4	12.4	4.13	0.157	8.24	< 0.05	< 2.9	< 6.7	6.54	12.4	100
	6/12/2018	24.9	24.9	24.9	23	< 0.5	< 0.5	4.2	13	N/A	N/A	250
	7/18/2018	6.92		3.9	2.4	3.02	< 0.5	< 4	9.3	6.81	25.9	160
	8/2/2018	4.99	4.99	4.3	3	0.69	< 0.5	< 4	< 6.3	6.63	24.6	170
	9/12/2018	3.9	3.9	3.9	2	< 0.5	< 0.5	< 4	< 10	6.71	24.7	355
	10/4/2018	10.35		1.8	N/A	7.3	< 1.25	N/A	N/A	N/A	N/A	N/A
	10/23/2018	11.24	11.24	4.1	1.4	7.14	< 0.5	< 4	< 5	NR	NR	135
	12/3/2018	10.7	10.7	1.5	< 1	9.5	< 0.5	< 4	6.5	6.33	12	100
PS# 2	8/2/2017	13.3		1.7	<0.5	11.6	< 0.5	N/A	N/A	6.8	N/A	N/A
SD# 24/25	10/30/2017	10.9	10.9	2.23	< 0.05	8.66	< 0.05	< 3	< 10	7.27	17.3	130
	11/22/2017	26.1		2.4	N/A	23.7	< 0.5	N/A	N/A	N/A	N/A	N/A
	12/19/2017	47.88	47.88	1.98	< 0.05	45.9	< 0.05	< 3.2	< 4	6.62	11.2	30
	2/14/2018	68.7	68.7	9.16	5.43	59.5	< 0.05	< 3	< 5	5.78	12.4	8.4
	3/29/2018	19.7		2.4	N/A	17.3	< 0.5	N/A	N/A	N/A	N/A	N/A
	5/1/2018	12.4	12.4	3.47	0.468	8.88	< 0.05	< 3.3	< 3.3	6.96	11	84
	6/12/2018	9.68	9.68	1.5	< 1	8.18	< 0.5	4.3	< 5	N/A	N/A	105
	7/18/2018	8.92		1.7	< 1	7.22	< 0.5	< 4	< 3.6	6.2	22.4	115
	8/2/2018	18.6	18.6	8.1	7.8	10.5	< 0.5	< 4	< 8.3	7.07	25.2	210
	9/12/2018	7.45		4.7	4	13.4	< 0.5	< 4	< 6.3	6.76	23	140
	10/1/2018	8.83	8.83	6.9	5.8	0.55	1.38	5	15	6.71	21.7	99
	10/4/2018	22.1		2	N/A	17.6	< 2.5	N/A	N/A	N/A	N/A	N/A
	12/12/2018	35.8	35.8	24.1	23.4	11.7	< 0.5	< 4	21	NR	NR	200
PS# 3	8/2/2017	14.6		< 0.5	0.63	14.6	< 0.5	N/A	N/A	6.9	N/A	N/A
SD# 19	10/30/2017	35.4	35.4	1.08	< 0.05	34.3	< 0.05	< 3	< 10	7.1	18.4	80
	11/2/2017	33.6		0.6	N/A	33	< 0.5	N/A	N/A	N/A	N/A	N/A
	12/19/2017	36.73	36.73	0.83	< 0.05	35.9	< 0.05	< 3.2	< 4	6.61	13	40
	2/14/2018	33.5	33.5	3.29	< 0.05	30	0.171	8	75	6.67	12.2	56
	3/8/2018	37.9		2.7	< 0.5	35.2	< 0.5	N/A	N/A	N/A	N/A	N/A
	5/1/2018	17.1	17.1	2.78	1.59	14.3	< 0.05	< 3.3	< 5	6.81	12.1	100
	6/12/2018	9.73	9.73	1.9	1.2	7.83	< 0.5	19	< 5	N/A	N/A	175
	7/18/2018	11		1.3	< 1	9.73	< 0.5	< 4	< 5	7.25	21.7	150
	8/1/2018	17	17	1.5	< 1	15.5	< 0.5	< 4	< 5	6.56	24.3	175
	9/11/2018	15.6		1.5	< 1	14.1	< 0.5	< 4	< 5	6.75	24.4	165
	9/20/2018	17.1		1.7	N/A	15.4	< 1.25	N/A	N/A	N/A	N/A	N/A
	10/2/2018	14.9	14.9	1.5	< 1	13.4	< 0.5	< 4	< 6.3	6.87	21.7	145
	12/5/2018	29.4	29.4	26.5	27.2	2.92	< 0.5	< 4	< 5	7.01	10.5	200

Norweco Hydro-Kinetic…continued												
PS#4	8/2/2017	10.6		3	1.13	7.6	< 0.5	N/A	N/A	6.9	N/A	N/A
SD#17	10/30/2017	11.3	11.3	2.59	< 0.05	8.75	< 0.05	< 4	< 10	7.25	19.2	220
	11/22/2017	11.8		1.8	N/A	10	< 0.5	N/A	N/A	N/A	N/A	N/A
	12/19/2017	15.23	15.23	2.03	< 0.05	13.2	< 0.05	< 4.8	< 4	7.24	11.4	200
	2/14/2018	23.8	23.8	12.9	1.28	10.8	0.12	< 3.4	< 5	7.43	7.3	160
	3/29/2018	65.2		64.1	N/A	1.1	< 0.5	N/A	N/A	N/A	N/A	N/A
	5/1/2018	56.8	56.8	56	48.4	0.63	0.139	9	< 6.7	7.32	10.3	390
	6/13/2018	4.94	4.94	2.9	1.8	2.04	< 1	< 4	< 5	N/A	N/A	192
	7/17/2018	3.24		1.3	< 1	1.94	< 0.5	< 4	< 8.3	7.21	21.3	200
	8/1/2018	3.5	3.5	1	< 1	1.8	< 0.5	< 4	< 5	6.78	25.5	210
	9/11/2018	20.4		< 1	1	20.4	< 0.5	< 4	< 13	6.47	23	145
	9/13/2018	25.8		2.4	N/A	23.4	< 1.25	N/A	N/A	N/A	N/A	N/A
	10/3/2018	1.7	1.7	1.7	< 1	< 0.5	< 0.5	< 4	< 8.3	6.61	22.4	130
PS#5	8/3/2017	56.9		54.9	59.83	2	< 0.5	N/A	N/A	6.8	N/A	N/A
SD#14	10/30/2017	17	17	3.66	1.35	13.2	0.133	< 3	< 4	6.57	16.5	64
	11/8/2017	18.1		2.2	N/A	15.9	< 0.5	N/A	N/A	N/A	N/A	N/A
	12/19/2017	27.23	27.23	1.93	0.8	25.3	< 0.05	< 4.8	< 5	6.34	12	24
	2/14/2018	47.6	47.6	30.6	17.8	17	< 0.05	< 3.2	< 10	6.69	8.2	110
	3/15/2018	86.6		86.6	74.8	< 1	< 0.5	N/A	N/A	N/A	N/A	N/A
	6/13/2018	17.4	17.4	8.7	7.6	8.66	< 1	< 4	< 5	N/A	N/A	134
	7/17/2018	19.4		18.9	16.6	0.52	< 0.5	25	< 5	6.87	22.1	185
	8/1/2018	11.37	11.37	2.5	1.2	8.87	< 0.5	< 4	< 5	6.16	25.1	100
	9/11/2018	6.38		3.1	2	3.28	< 0.5	< 4	< 13	6.13	22.8	130
	10/2/2018	14.7	14.7	9.9	7.4	4.8	< 0.5	< 4	< 6.3	6.42	22.9	110
	10/25/2018	24.5		13.3	N/A	8.7	< 2.5	N/A	N/A	N/A	N/A	N/A
	12/4/2018	15.9	15.9	4.5	3.8	11.4	< 0.5	< 4	< 5	6.47	12.8	80

Fuji Clean

SITE	Sample Date	TN (mg/l) (ALL)	TN (mg/l) (MFR)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
PS#1	4/12/2018	21.45		16.7	17.57	2.3	2.45	N/A	N/A	N/A	N/A	N/A
	4/12/2018	3.62	3.62	< 1	< 1	1.89	1.73	17	< 5	7.39	24.6	52
	6/6/2018	15.5	15.5	15.5	13.8	< 0.5	< 0.5	9.3	20	7.53	24.7	140
	8/9/2018	8.54	8.54	1.5	< 1	7.04	< 0.5	< 4	< 4.5	7.28	22.2	105
	10/8/2018	6.82	6.82	3.7	< 1	2.56	0.56	16	8.3	7.34	20.9	88
	10/25/2018	12.6		3.9	N/A	6.2	< 2.5	N/A	N/A	N/A	N/A	N/A
	12/7/2018	9.03	9.03	1.5	< 1	7.53	< 0.5	< 4	< 2.5	7.38	24.3	35.5
PS#2	4/12/2018	3.1		1.6	< 0.5	1.5	< 0.5	N/A	N/A	N/A	N/A	N/A
	4/12/2018	4.1	4.1	2.7	1	1.4	< 0.05	< 4	< 5	7.86	24.7	58
	6/6/2018	6.58	6.58	4.3	2.2	1.58	0.7	< 4	< 5	7.83	24.4	125
	8/9/2018	3.62	3.62	< 1	< 1	3.62	< 0.5	4	< 6.3	7.36	22.6	45
	10/8/2018	6	6	2.5	< 1	3.5	< 0.5	12	< 10	7.32	26.2	76
	10/25/2018	8.25		1.6	N/A	5.4	< 1.25	N/A	N/A	N/A	N/A	N/A
PS#3	4/12/2018	22.3	22.3	4.1	1.6	18.2	< 0.05	< 4	< 5	7.41	24.6	45.5
	6/6/2018	5.65	2.65	2.9	1.6	2.75	< 0.5	< 4	5	7.74	24.5	150
	8/9/2018	10.12	10.12	2.7	< 1	7.42	0.73	20	< 16	7.58	22.7	110
	9/13/2018	6.1		2.9	N/A	3.2	< 1.25	N/A	N/A	N/A	N/A	N/A
	10/8/2018	9.16	9.16	2.5	< 1	6.66	< 0.5	< 4	< 6.3	7.69	26.6	100
	12/7/2018	7.58	7.58	2.5	< 1	5.08	< 0.5	< 4	< 5	7.6	24.4	105
PS#4	4/12/2018	55.62		53.7	54.95	< 2.5	1.92	N/A	N/A	N/A	N/A	N/A
	4/12/2018	7	7	6.5	2.4	0.5	< 0.5	15	24	7.76	24.6	69.5
	7/17/2018	6.08	6.08	4.9	1.6	1.18	< 0.5	< 4	8.7	7.57	24.3	135
	8/9/2018	8.42	8.42	3.7	1	4.72	< 0.5	4.5	< 14	7.36	22.4	115
	9/6/2018	10.75		3.6	N/A	5.9	< 1.25	N/A	N/A	N/A	N/A	N/A
	10/8/2018	5.7	5.7	2.5	< 1	3.2	< 0.5	4.8	< 6.3	7.34	26.1	110
	12/7/2018	24.6	24.6	2.3	< 1	21.2	1.19	< 4	< 6.3	6.95	24.3	32.5
PS#5	8/9/2018	6.67	6.67	3.5	< 1	3.17	< 0.5	7.1	< 8.3	7.64	22.7	125
	9/6/2018	16.6		8.4	N/A	5.7	< 2.5	N/A	N/A	N/A	N/A	N/A
	10/8/2018	10.3	10.3	5.7	1	4.62	< 0.5	10	19	7.31	26.2	83
	12/7/2018	10.5	10.5	4.1	< 1	6.42	< 0.5	11	43	7.22	24.4	95
PS#6	10/8/2018	7.19	7.19	2.5	< 1	4.69	< 0.5	7.3	< 17	6.99	26	75
	10/10/2018	11.55		5.2	N/A	5.1	< 1.25	N/A	N/A	N/A	N/A	N/A
	12/7/2018	15.2	15.2	2.1	< 1	13.1	< 0.5	< 4	13	6.72	24.4	14
PS#9	10/8/2018	8.05	8.05	2.9	< 1	5.15	< 0.5	7.8	< 17	7.47	20.9	68
	12/7/2018	10.2	10.2	4.7	< 1	5.49	< 0.5	4.4	32	7.24	24.2	100
PS#11	10/9/2018	7.8	7.8	2.3	< 1	5.5	< 0.5	5.8	< 13	7.32	26.3	59.5
	12/7/2018	15.4	15.4	2.7	< 1	12.7	< 0.5	< 4	< 13	7.11	24.6	23

BioMicrobics SeptiTech

SITE	Sample Date	TN (mg/l) (ALL)	TN (mg/l) (MFR)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alk
1	9/25/2018	16.6	16.6	1.9	1.6	14.7	< 0.5	< 4	< 13	NR	NR	30
	11/29/2018	20.3	20.3	6.3	NR	14	< 0.5	< 4	< 13	NR	NR	NR
2	9/25/2018	14.8	14.8	3.3	< 1	11.5	< 0.5	6.6	< 13	NR	NR	40
	11/29/2018	18.5	18.5	4.1	NR	7.86	6.54	8.1	18	NR	NR	NR

Appendix iii: Septic Demo Composite Samples for Technologies within Experimental Use Phase in 2018

Unlined NRB

SITE	Sample Date	Type	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
Southaven County Park	9/11/2018	Grab	2.8	2.1	<0.5	0.7	<0.5	<22	78	6.48	21.9	310
	10/23/2018	Grab	6.2	3.3	1.8	2.9	<0.5	NR	NR	NR	15.4	NR
	11/27/2018	Grab	11.9	2.4	1	9	0.5	<6	NR	NR	8.7	NR
	12/18/2018	Grab	1.2	1.2	<1	<0.5	<0.5	<5	<12.5	7.78	5.4	170

Lined NRB

SITE	Sample Date	Type	TN (mg/l)	TKN (mg/l)	Ammonia (as N)	NO3 (Nitrate as N)	NO2 (Nitrite as N)	BOD	TSS	PH	Temp	Alkalinity
Robinson Duck Farm County Park	9/11/2018	Grab	11.4	11.4	11	<0.5	<0.5	<22	127	6.67	24.4	321
	10/23/2018	Grab	3.3	3.3	<0.5	<0.5	<0.5	NR	NR	NR	15.7	NR
	11/27/2018	Grab	13.8	13.8	10.9	<0.5	<0.5	32	28	6.27	8.7	NR
	12/18/2018	Grab	2.4	2.4	1.1	<0.5	<0.5	26	74	6.82	5.6	254

Appendix iv: Commercial System Composite Samples

Orenco Advantex AX-MAX Unit

SITE	Sample Date	TN	TKN	Ammonia (as	NO3	NO2	BOD	TSS	PH	Temp	Alk
Meschutt	7/25/16 - 7/26/16	18.1	17.2	9.5	0.9	< 0.5	35	37	7.37		133.2
Beach	8/22/16 - 8/23/16	20.1	20.1	18.6	< 0.5	< 0.5	125	88	7.33	78	183.4
	9/26/16 - 9/27/16	14.1	< 0.5	< 0.5	14.1	< 0.5	8	10	7.29	74	51.8
	6/5/17-6/6/17	8	1	< 0.5	7	< 0.5	< 5	< 10	8.03	63.68	213
	7/10/17-7/11/17	24.5	7.9	4	3.7	12.9	< 10	9	6.74	79.16	37.4
	8/7/17-8/8/17	16	6	9.9	10	< 0.5	7	< 5	7.09	80.06	83
	9/11/17-9/12/17	20.8	13.6	4.3	6.1	< 0.5	18	48	7.07	73.4	84
	10/16/17-10/17/17	15.5	15.5	19.9	< 0.5	< 0.5	< 5	< 5	7.76	62.2	200
	6/18/18-6/19/18	68.8	67.3	49.8	< 0.5	1.5	17	11	7.82	76.28	169
	7/16/18-7/17/18	144.6	140	8.3	4.6	< 0.5	20	< 10	7.37	81.32	120
	8/6/18-8/7/18	21.2	8.4	6.6	11.4	1.4	< 5	< 10	7.32	27.6	86
	8/20/18-8/21/18	21.3	4.1	3.1	16.7	0.5	< 6	< 10	7.31	21.9	123
	9/10/18-9/11/18	3.8	2.1	1.5	1.7	< 0.5	< 5	< 10	6.92	26.8	35

Norweco Hydro-Kinetic

SITE	Sample Date	TN	TKN	Ammonia (as	NO3	NO2	BOD	TSS	PH	Temp	Alk
Lake	6/4/18-6/5/18	110	110	103	< 0.5	< 0.5	34	27	7.89	68	504
Ronkonkoma	7/2/18-7/3/18	107	107	114	< 0.5	< 0.5	88	34	7.73	79.16	7.2
County	7/30/18-7/31/18	93.8	92.6	90.9	0.7	0.5	19	22	7.44	80.24	437
Park	8/27/18-8/28/18	2.1	< 0.5	< 0.5	1.2	0.9	16	44	7.29	26.2	NR
	10/15/18-10/16/18	28.3	0.1	1.3	27.7	0.5	12	17	7.06	19.5	151
	11/19/18-11/20/18	67.5	0.1	< 1	67.4	< 0.5	< 6	13	7.25	10.4	98.6

Vegetated Recirculating Gravel Filter

SITE	Sample Date	TN (mg/l)	TKN (mg/l)	Ammoni	NO3	NO2	BOD	TSS	PH	Temp	Alk
Sylvester	8/7/17-8/8/17	18	< 0.5	< 0.5	18	< 0.5	< 5	< 5	7.41	75.38	154
Manor	9/11/17-9/12/17	16.4	1.4	< 0.5	15	< 0.5	< 5	< 5	7.56	71.1	175
	10/16/17-10/17/17	9.1	1	< 0.5	8.1	< 0.5	< 5	< 5	7.6	66.4	177
	5/15/18-5/15/18	3.3	3.3	< 1	< 0.5	< 0.5	< 7	< 10	7.68	58.5	206
	6/18/18-6/19/18	8.1	1.7	< 0.5	6.4	< 0.5	< 5	< 10	7.46	68.36	22
	7/16/18-7/17/18	10.8	1.8	< 0.5	9	< 0.5	< 5	< 10	7.53	72.68	20
Fishers	8/1/2017	84.6	84.6	77.9	< 0.02	0.01	43	21	7.94	NR	472
Island	8/1/2017	275	275	246	< 0.02	0.044	340	150	8.73	NR	959
Yacht	10/12/2017	164	164	158	< 0.02	0.018	14	12	8.2	NR	764
Club	10/12/2017	315	315	298	< 0.02	0.058	660	82	7.8	NR	1550
	7/12/18-7/13/18	114	114	104	< 0.02	0.01	64	36	8.64	NR	370
	7/12/18-7/13/18	45.5	45.5	41.7	< 0.02	< 0.01	13	27	7.77	NR	275

*Note TN sample results in red are influent, pre-treatment results.

COUNTY OF SUFFOLK

STEVEN BELLONE
SUFFOLK COUNTY EXECUTIVE

PETER A. SCULLY
DEPUTY COUNTY EXECUTIVE

SUFFOLK COUNTY
DEPARTMENT OF HEALTH SERVICES
DIVISION OF ENVIRONMENTAL QUALITY

REPORT TO NYS ENVIRONMENTAL FACILITIES CORPORTATION (EFC) ON SUFFOLK COUNTY'S SEPTIC IMPROVEMENT (SIP) PROGRAM AND STATE SEPTIC SYSTEM REPLACEMENT PROGRAM (SSRP)

Report on Activity from March 1, 2018 to March 31, 2019

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Commissioner

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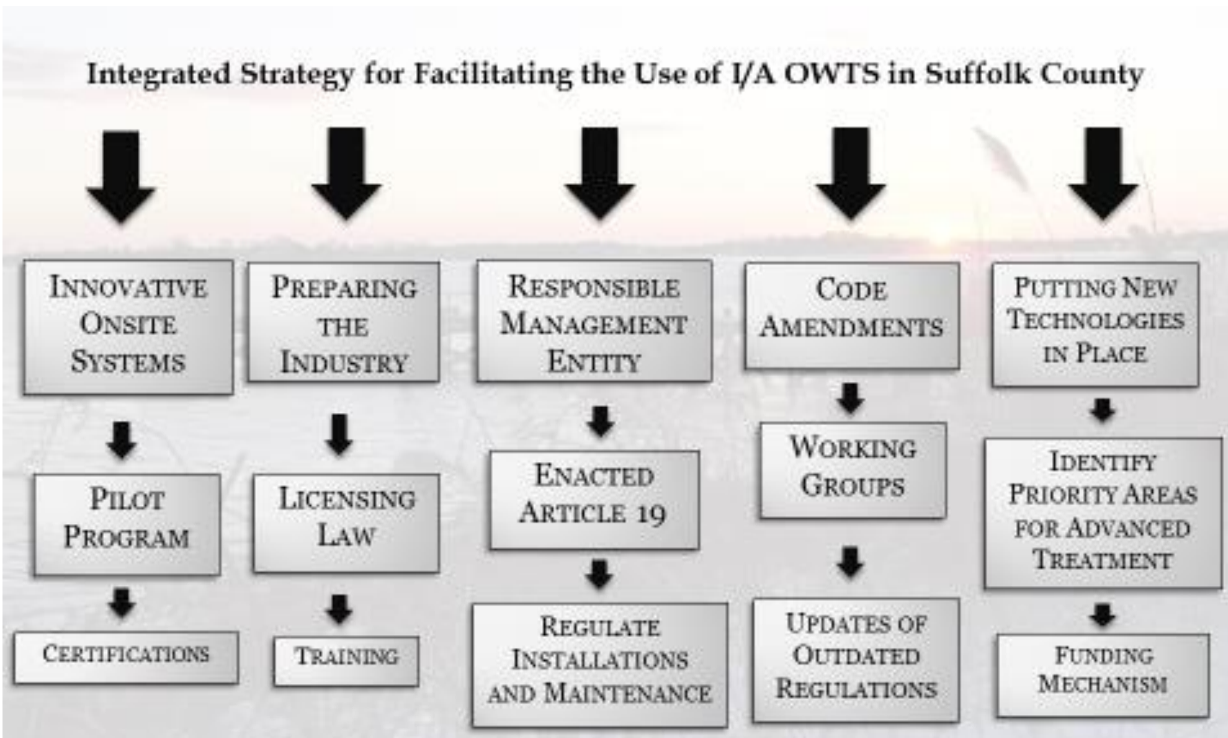
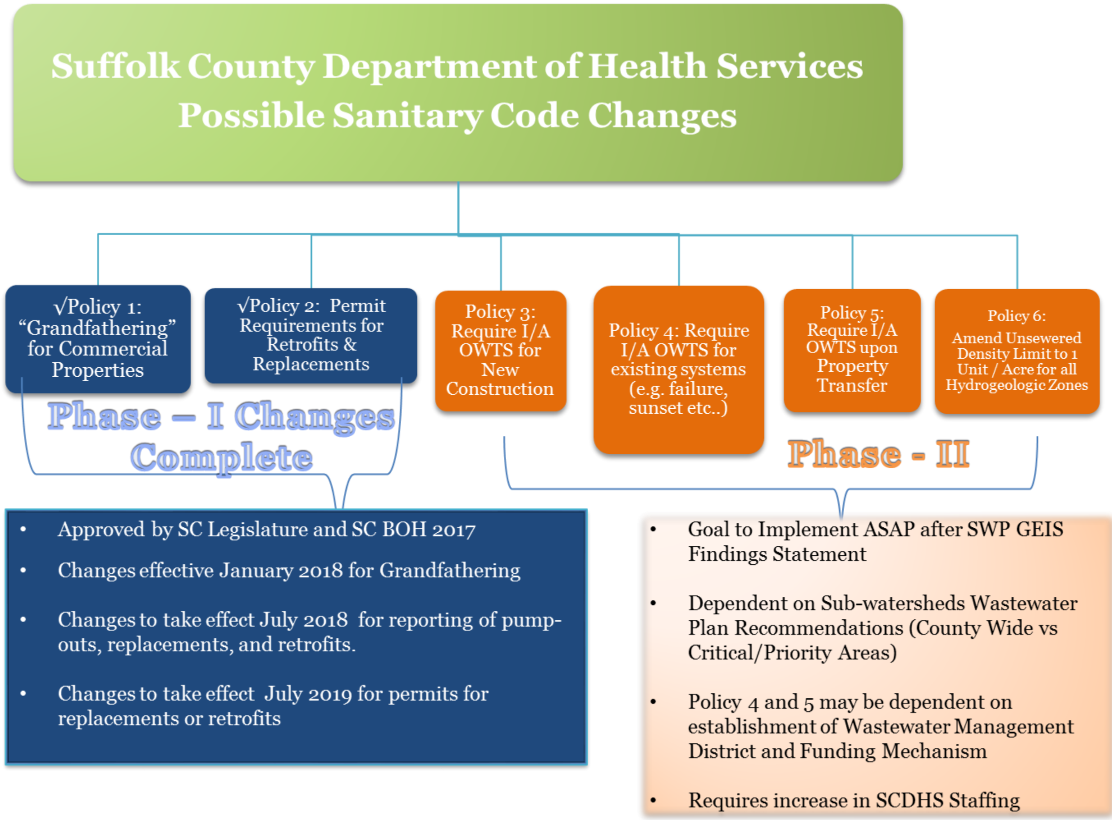
I. Overview of Suffolk County's Reclaim Our Water (ROW) Initiative

In 2014, the IBM Smarter Cities Report recommended that new standards be implemented to permit the use of new individual onsite nitrogen reducing wastewater treatment technologies in Suffolk County for the protection of the county's water resources. The recommendation resulted in the development of an aggressive, multi-pronged program to facilitate and promote the use of Innovative/Alternative Onsite Wastewater Treatment Systems (I/A OWTS), which are designed to significantly reduce nitrogen discharges into the environment. The effort began with the I/A OWTS Septic Demonstration Tour, during which key County staff were joined by representatives of other government agencies in visiting four northeastern states to review their approaches to permitting, funding, and overall regulation of I/A OWTS. Building on the information gathered during the Septic Tour, a five-track strategy was developed to facilitate the use of I/A OWTS in Suffolk County.



Initial steps to implement the integrated strategy included two demonstration programs designed to both evaluate the performance of I/A OWTS in Suffolk County and to begin fostering the establishment and growth of a local I/A OWTS business market. To ensure that the I/A OWTS technologies are installed and maintained properly, the County established regulatory and training requirements for both industry professionals and government oversight staff. First, the County established a comprehensive training program that provides endorsements of liquid waste industry licenses for the installation and maintenance of I/A OWTS. Industry professionals who wish to install and maintain I/A OWTS in the county must receive the appropriate endorsements as codified in Article 19 of the Suffolk County Sanitary Code. Although not mandatory, training classes are also provided to design professionals.



In 2016, Suffolk County established the Article 6 Work Group to review, comment, and guide proposed revisions to the Suffolk County Sanitary Code focused on the reduction of nitrogen from onsite wastewater sources in Suffolk County. Under the guidance of the Article 6 Workgroup, recommended sanitary code changes were grouped into two phases. Phase I changes included "no regret" policy options that could be implemented immediately. Phase I policy options generally included policy changes that could move forward without the need for a stable and recurring revenue source and without waiting for the identification of wastewater upgrade priority areas. Phase II policy options generally include sanitary code changes that would require I/A OWTS installation mandates under certain conditions. Potential code amendments for increasing the minimum lot size in Suffolk County were also considered. Because the Phase II policy options include mandates with the potential to add significant expense to existing property owners, it was concluded that recommendations for Phase II policy options should be tied to the findings of the County's pending Subwatersheds Wastewater Plan (SWP). The conclusion acknowledged that the SWP would provide recommendations to consider installations within the highest priority areas first, industry and RME readiness, and the potential range of stable and recurring revenue needs to offset wastewater upgrade costs to existing property owners.

Additional program milestones achieved in 2016 included the adoption of Article 19 of the Suffolk County Sanitary Code and the commencement of the SWP development process. A historic first in Suffolk County, Article 19 enabled the use of I/A OWTS in Suffolk County on a voluntary basis, and set forth a framework for ensuring that the new technologies were properly tested, installed, and maintained.

Building on the momentum created the year before, Suffolk County in 2017 announced the first ever Septic Improvement Program (SIP) which provided grants and low-cost loans to qualified homeowners for the installation of I/A OWTS. Finally, in acknowledgement of Suffolk County's proactive and aggressive measures to combat nitrogen from OSDS, New York State awarded Suffolk County over $10 million of $15 million in grant funding available state-wide from the New York State Septic Replacement Program.

Suffolk County's Subwatersheds Wastewater Plan

As part of Suffolk County's Reclaim Our Water initiative, and in cooperation with the Long Island Nitrogen Action Plan* (LINAP), and other stakeholders, Suffolk County is pursuing proactive measures to reduce nitrogen pollution to its water resources. The Suffolk County Comprehensive Water Resources Management Plan (2015; "Comp Water Plan") documented and characterized negative trends in the quality of the sole source groundwater aquifer. The Comp Water Plan also linked impacted groundwater to both drinking water and surface waters, including significant adverse impacts of nitrogen as a contributing cause of low dissolved oxygen, harmful algal blooms ("HABs"),loss of eelgrass and other submerged aquatic vegetation, and, ultimately, coastal resiliency. For the first time, the Comp Plan established an integrated framework to address the legacy problem of onsite wastewater disposal systems in a meaningful manner; with acknowledgement that patchwork sewering will not be sufficient to solve the problem.

Two principal recommendations of the Comp Water Plan were to establish priority areas for wastewater upgrades and to define preliminary nitrogen load reduction goals for the protection of all of Suffolk County's water resources. Preparation of the Suffolk County Subwatersheds Wastewater Plan ("**SWP**") was initiated in May 2016 to fulfill these recommendations.

Subwatersheds Wastewater Plan Summary

The SWP will be used to establish first order nitrogen load reduction goals generated based upon the need to obtain water quality improvements for all of the County's surface water, drinking water, and groundwater resources. Although several similar studies have been completed to evaluate the sources and impact of nitrogen pollution to the major estuaries of the County; an integrated, holistic, evaluation that delineates all of the County's subwatersheds and provides a common platform of assumptions and boundary conditions has not been completed.

Execution of the SWP began with the establishment of a uniform and consistent set of subwatershed boundaries, development of receiving water residence times, and the generation of nitrogen loading rates through groundwater and surface water (hydrodynamic) analytical modeling. The modeling results were than keyed to baseline water quality for 191 individual surface waterbodies to establish tiered priority areas for wastewater management upgrades. Following the establishment of tiered priority areas, preliminary load reduction goals were developed using empirical data relationships, existing regulatory target guidelines, and other readily available data sources from related studies.

Finally, recommendations for wastewater management upgrades were than generated based upon the established priority ranks, ability to meet nitrogen load reduction goals, cost-benefit evaluation, and contemplated sanitary code modifications.

II. Overview of 2017 County Septic Improvement Program (SIP)

The Suffolk County Septic Improvement Program (SIP) launched on July 3, 2017 at www.ReclaimOurWater.info. The initial program provided homeowners who install new nitrogen reducing septic systems (known as I/A OWTS) with grants up to $11,000 to offset the increased costs of these new technologies. In addition, homeowners could apply to participate in a loan program administered by a third party lender to finance the remaining cost of the system. The County had enough funding to issue approximately 185 – 200 grants per year. Applications are accepted on a rolling basis and priority was given to high and medium density residential parcels located within the 0-25 year groundwater travel time or within 1,000 feet of enclosed waterbodies. Post-installation landscaping and irrigation restoration is the responsibility of the property owner.

The details of the initial grant program were as follows:

- Administered by Suffolk County Department of Health Services.
- Individual homeowners may be eligible for a grant up to $11,000.
- $10,000 will be provided toward the purchase and installation of an approved I/A OWTS and leaching structure, as well as for attendant engineering and design services.
- An additional $1,000 may be available for installation of Pressurized Shallow Drainfield for a maximum grant of up to $11,000.
- All other costs, including, but not limited to, irrigation repairs, electrical improvements unrelated to system installation or other improvements necessary for the installation are to be paid by the property owner/applicant.
- Post-installation landscaping restoration is the responsibility of the property owner.

The eligibility criteria for the initial program are listed below:

- The residence must be single family, owner-occupied year round and the owner's primary residence.
- The residence must be served by a septic system or cesspool and is not connected to a public sewer or located in any sewer district or any proposed sewer district.
- Property is not a rental property.
- New construction is not eligible; however construction projects on existing residences may be eligible.
- No in-home business (other than a personal home office that does not require additional kitchen use or customer access).
- No resident is a current employee of Suffolk County, elected official or office holder of any political party (including official political party committee members).

- Availability of valid Certificates of Occupancy (CO) or Certificate of Zoning Compliance for the residence.
- Income verification (Provide a copy of owner (s) most recently filed federal income tax return).

The loan program details are listed below:

- Administered by CDCLI Funding Corporation
- Individual homeowners may be eligible for low cost financing up to $10,000
- Competitive 3% interest rate
- Repayment term of up to 15 years
- The loan program is administered by CDCLI Funding Corp, with financial support from Bridgehampton National Bank

III. <u>Integrating County SIP and NYS SSRP</u>

In February of 2018, Suffolk County was notified of an award of $10,025,000 in the first funding round of the New York State Septic System Replacement Program which represented 67% of the $15 million statewide allocation for the first year of the program. Several obstacles had to be addressed before the County could begin issuing grants utilizing state funding to homeowners:

1. Staffing: The initial Septic Improvement Program required the hiring of six (6) dedicated employees to launch a grant program intended to issue no more than 200 grants per year. Under the SSRP, the County now had enough funding to issue one thousand (1,000) grants per year and it was anticipated that an additional nine (9) employees would be needed to administer such a large program. The State Program did not allow for the use of awarded funds to pay for program administration so the County pursued the use of water quality improvement funds to hire these nine (9) positions. The Suffolk County Legislature approved these positions in the 2019 budget and the hiring of these positions began in January of 2019.

2. How to incorporate SSRP funds to existing SIP applicants: The County expressed interest to allow applicants who applied for County SIP Grants to also apply for State SSRP Funds. County Staff had several productive calls with EFC to discuss a limited scope program that would allow SCDHS to notify SIP applicants that they were now potentially eligible for up to $10,000 in SSRP funds in addition to up to $11,000 in County SIP funds for a combined total of up to $21,000. EFC also advised the County that applicants who already had systems installed could request reimbursement through the SSRP provided the system was installed after March 1, 2018. This limited scope program began implementation in October of 2018.

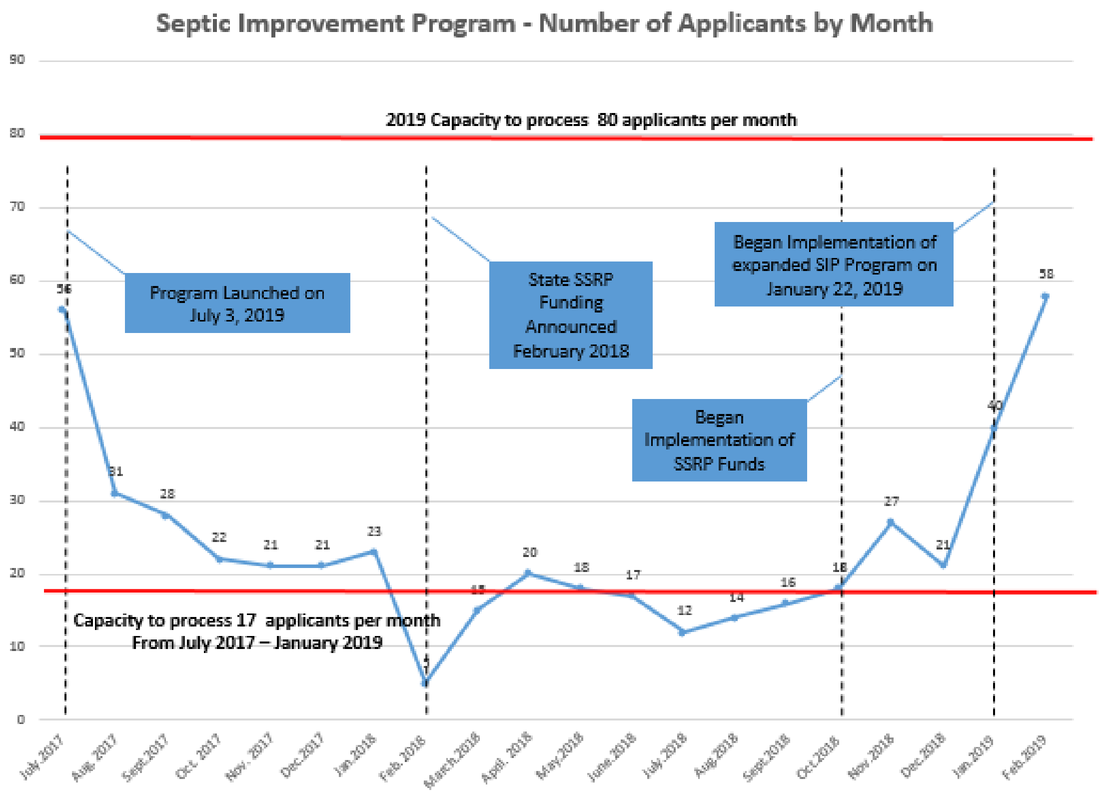
3. Addressing Eligibility Differences Between the Programs: The long term use of SSRP funds required a change to the County Law authorizing the Septic Improvement Program. The

goal was to change County eligibility requirements to match that of the State Program so that it would open up the pool of applicants and be easier to implement. The Suffolk County legislature adopted the revised Septic Improvement Program on December 18, 2018 and it became effective on January 22, 2019.

The Revised Law is Summarized Below and is more consistent with the State SSRP:

- Provide additional $5,000 for Low to Moderate Income (LMI) households (Encourage greater participation).
- Increase maximum grant to $20,000 ($15,000 plus $5,000 for LMI) (Encourage greater participation).
- Eliminate income restriction and replace with income scale as indicated (Consistent with State program).
- Allow grants for multifamily homes and residential properties with in-home businesses (Consistent with State Program).
- Grant recipient to be responsible for design costs (limited upfront required investment, eliminate administrative burden to County of managing payments to design consultants).
- Authorize ability to enter into agreements with municipalities if necessary for exchange of information and coordination.
- Remove restrictions to make all County employees eligible for grants (Consistent with State law, expand universe of eligible properties).
- Allow grants for leased/rental/seasonal properties (Consistent with State program, expand universe of eligible properties).
- Remove restriction of only natural persons being eligible for grant. This expands eligible properties to include those owned by a person, firm, partnership, corporation, trust, trustee, association, company or other legal entity capable of owning an interest in real property.(Consistent with State program)
- The definition of “Accessory Apartment” has been added to section 839-1 within Section 2 to specify the meaning of such term as used in the proposed amendment. (Respond to local conditions)
- A new section 839-11 within Section 2 has been added to require the Department to provide an annual report to the County Legislature’s Environment, Planning and Agriculture Committee, or any successor committee, no later than March 15th each year, such report to include certain grant program statistics. (Transparency)

IV. **Program Demand**



The above graphic shows the breakdown of SIP applications received by month. The bottom red line represents the initial program capacity to process 17 applications per month (July 2017 through January 2019) whereas the top red line represents the expanded program capacity to process 80 applications per month. Prior to the program launch in July 2017, County staff participated in various town hall outreach presentations where potential applicants were urged to preregister for the septic improvement program. These outreach sessions proved successful, as there were 56 applicants in July of 2017, which was the second busiest month of the program to date. Interest for the program dropped off in February of 2018 which coincides with the announcement of New York State Septic System Replacement Program (SSRP). Many homeowners read about the infusion of State grant funds for septic system replacement and were hesitant to move forward with the County grant program until they knew how the two programs would complement each other.

In October of 2018, the County issued a press release stating that homeowners would be able to combine both County and State grants for a combined amount of up to $21,000.00 towards the purchase of an I/A OWTS. Interest for the program increased with this announcement while simultaneously County staff began working to amend the Septic Improvement Law to expand eligibility and amount of funding available. This revised law was adopted by the Suffolk County Legislature in December of 2018 and became effective on January 22, 2019. In addition, the County's budget included increased Staffing for SCDHS to be able to process the expected increase in applications. The expanded program is aimed to increase the amount of grant recipients from 200 per year to 1,000 per year. There were 98 applicants in the first six weeks of this expanded program, interest continues to grow, and it is expected the program will reach its monthly capacity in April of 2019.

Anticipated Financial Demand for 2019 & 2020

It is anticipated that by April 2019 demand in the Septic Improvement Program and State Septic System Replacement Program will surge in Suffolk County. Since January 22, 2019 when SCDHS launched the expanded SIP Program, there have been an average of 17 applicants per week. If the program continues to grow at this rate, we expect demand for a minimum of 884 grants per year which would amount to a **minimum of $8,840,000** in yearly funding from the State of New York.

In addition, recent changes to the Suffolk County Sanitary Code take effect in July 2019. As of July 1, 2019, the replacement of a cesspool with a new cesspool will be prohibited. For the first time replacement systems at a must meet the minimum requirements that have existed for new construction in the County since 1973 - a conventional septic system consisting of a septic tank and leaching structure. These systems can cost approximately $6,000 - $10,000. Due to this new requirement, some property owners may choose to utilize County and State grant funding to install a better performing nitrogen reducing septic system. SCDHS staff conducted a survey of the liquid waste industry and determined that approximately 2.2% of cesspool systems fail per year. There are an estimated 252,000 cesspools in Suffolk County, which represents an annual failure rate of approximately 5,544 cesspool per year. If 10% of these property owners elected to go with an I/A OWTS over a conventional septic system it would increase the demand on the State Septic System Replacement Program from 884 grants per year to 1,438 grants per year which bring the estimated funding demand for 2020 to **$14,380,000.**

V. County Grant Program Statistics

Program Statistics as of March 14, 2019:

- SCDHS started accepting applications July 3, 2017
  - √ 1557 Total Applicants
  - √ 813 Registered but not submitted an application
  - √ 305 Active Grant Certificates
  - √ 7 Pending Grant Certificate Issuance
  - √ 186 Pending Review (Waiting for Documents)
  - √ 225 In Progress (Incomplete Applications)
  - √ 5 Not Eligible
- 74 Installations to date
- 81 Pending Installations
- 9 Pending Review

List of Grants by Town:

Town	# of Grant Certificates Issued
Southampton	86
Brookhaven	80
East Hampton	53
Huntington	22
Islip	21
Southold	15
Shelter Island	13
Smithtown	8
Riverhead	4
Babylon	3

List of Applications by Technology:

Technology	# of Septic Demo Installs	# of SIP Jobs	Approval Status	Other Installations or Pending Applications
Hydroaction AN Series	5	56	Provisional	250
Norweco Singulair TNT	5	38	Provisional	194
Orenco Advantex AX20-RT	2	9	Provisional	20
Norweco Hydro-Kinetic	6	0	Provisional	2
Fuji Clean CEN Series	4	74	Provisional	308
Orenco Advantex AX-20	3	0	Demonstration	0
Orenco AX-MAX-225	1	0	Demonstration	1
BUSSE	2	0	Demonstration	0
Pugo	4	0	Demonstration	0
Ecoflo Cocofilter	2	0	Demonstration	0
Waterloo BioFilter	2	0	Demonstration	0
Amphidrome	2	0	Demonstration	0
BioMicrobics BioBarrier	2	0	Demonstration	0
BioMicrobics SepticTech STAAR	2	1	Provisional	2
BioMircrobics microFAST	0	0	Demonstration	0
Constructed Wetlands	2	0	Demonstration	1
Nitrogen Reducing BioFilters (NRB's)	9	0	Experimental	0
Totals	53	178		778

Total Combined Applications (Installed, Under Review, or Permitted) is 1009
Total Installs = 186 (53 Septic Demo, 73 SIP, 60 Other)

System Costs Overall (based on 50 systems)

- Average Engineering Costs = $2,503.00
- Average Base System Costs = $16,331.00
- Average Misc. + Leaching Costs = $5,836.00
- Average Total Cost = $22,216.00

VI. SSRP Statistics – Started Utilizing EFC Funds in January of 2019

Program Statistics as of March 18, 2019:

- ✓ Number of SSRP Applications Received: 265
- ✓ Number of SSRP Approved Grants: 233
- ✓ Number of SSRP Grants Declined: 3
- ✓ Number of SSRP Grant Agreements Executed: 154

Payment Process and Reimbursement History from EFC

In January of 2019 SCDHS contacted EFC and Suffolk County's Department of Audit and Control to discuss and clarify the process for request and disbursement of NYS grant funds. SCDHS cannot request a drawdown from the state until the invoices and payment vouchers are pre-audited by the County's Department of Audit and Control. Under the agreed-upon process, SCDHS staff will enter vouchers into Suffolk County's Integrated Financial Management System (IFMS) for a pre-audit and notify Department of Audit and Control that the vouchers have been entered. SCDHS staff will then forward the vouchers to Expenditures. Once Audit gives SCDHS the green light on the pre-approval, SCDHS staff can request the state funds from EFC.

Payment Process Timeline: Audit and Control has requested notification that the vouchers have been uploaded for pre-audit by each Wednesday at 12 pm. Audit will let staff know that the pre-audit has been done by that Friday (they have 1.5 days). Staff will then make the drawdown request from EFC (which is done every two weeks) so it will be received the following Thursday and payment will be made on that Friday.

Summary of Reimbursement Requests to Date:

Date	Number of Grants	Amount Requested
1/30/2019	4	$29,075.27
2/14/2019	3	$30,000.00
3/1/2019	8	$74,540.77
3/22/2019	5	$48,755.53
TOTALS	**20**	**$182,371.57**

Anticipated Reimbursements Over the next 6-Months:

Month	Number of Grants	Max Amount of Request
April 2019	14	$140,000.00
May 2019	18	$180,000.00
June 2019	18	$180,000.00
July 2019	18	$180,000.00
August 2019	18	$180,000.00
September 2019	18	$180,000.00
TOTALS	**104**	**$1,040,000.00**

- Number of Grants paid based on number of installations predicted per month. Note the grants issued per month exceed number of installations per month at this time due to lag time between grant issuance and installation. It is predicted that the number of installation per month will eventually equalize so that the number of installs per month equal the number of grants issued per month (approximately 74 to 120).

VII. **Public Outreach**

2017 Septic Improvement Program Public Outreach

- Completed Suffolk County Septic Improvement Program (SIP) Town Hall Meetings on 4-24-17 in Flanders, 4-27-17 in Port Jefferson, 5-8-17 in Huntington, and 5-12-17 in Centereach.

- Presented Suffolk County Septic Improvement Program (SIP) at Miramar Beach Civic Associations on 5-23-17, East Moriches Property Owners Moriches Bay Civic Association 5-31-17, Patchogue Rotary Club 6-7-2017, Mastic Beach Civic Meeting 8-2-17, Bellport Village Civic Meeting 7-26-2017, and Commack Civic Group 9-20-2017.

- Participated in Suffolk County Septic Improvement Program (SIP) briefing calls with various civic groups on 3-28-17 and Town Supervisors on 6-12-17.

- Held Suffolk County Septic Improvement Program (SIP) public stakeholders meetings on 7-12-17 in Selden and 7-13-17 in Riverhead.

2018 Septic Improvement Program Public Outreach

- Completed County Septic Grant presentations on 2-8-2018 to Lake Ronkonkoma Civic Organization, 3-8-2018 to Ronkonkoma Civic Association, 5-16-2018 to Lake Ronkonkoma Advisory Board, 6-6-2018 at Huntington Library, 6-28-2018 at Montauk Library, 7-30-18 at Riverhead Library, 9-24-2018 at Smithtown Library, 10-2-2018 at Middle Country Library, 10-3-2018 in Cold Spring Harbor, 10-16-2018 to Strongs Neck Civic Association, 11-29-2018 at Northport Public Library,

- Participated in 2-14-2018 East Hampton Grant / Loan / Rebate Coordination Meeting

- Hosted a Septic Grant Informational Session on 3-2-2018, and 10-11-2018 for Designers and Installers

- Hosted a Septic Grant informational Session on 4-30-2018 for Community Development Agencies

- Hosted a Septic Grant Informational Session on 7-25-2018 to Westhampton Beach Conservation Advisory Council

- Hosted a Septic Grant informational booth at Seatuck Environmental Center for National Estuary Day on 9-15-2018.

- Hosted a Suffolk County I/A OWTS Program Overview and Septic Tour to CT State Officials and non-profit groups.

- Presented Grant and loan program to Long Island Liquid Waste Association on 10-9-2018

- Hosted a Grant marketing and outreach work session on 10-24-2018

- Meeting with Brookhaven Town Supervisor on 12-10-2018 on SIP and SCDHS I/A OWTS Program

2019 Septic Improvement Program Public Outreach

- Completed Septic Grant presentations on 1-7-2019 for Pattersquash Civic Association, on 1-14-2019 at Sachem Public Library, on 2-4-2019 at Comseqogue Public Library, 2-26-2019 and 3-29-2019 at Connetquot Public Library, on 3-7-2019 at BBP Public Library.

- Hosted a Septic Grant Informational Session on 1-9-2019, and 3-6-2019 for Designers and Installers

- Participated in Septic Grant training session with Sag Harbor Village Harbor Protection Committee on 3-8-2019.