REPORT
TO THE NEW JERSEY PINELANDS COMMISSION

IMPLEMENTATION OF THE ALTERNATE DESIGN TREATMENT SYSTEMS PILOT PROGRAM

November 5, 2017

Updated April 27, 2018

Pilot Program Implementation

The Pinelands Comprehensive Management Plan (CMP) (N.J.A.C. 7:50 et seq.) requires the periodic assessment and reporting on the status of the Pinelands Alternate Design Wastewater Treatment System Pilot Program (pilot program). This report, dated November 5, 2017, and updated on March 23, 2018 is the fourth in a series of implementation reports. Previous reports were dated November 5, 2006, November 5, 2009 and November 5, 2012.

Two of the original five pilot program technologies (Amphidrome and Bioclere) met the nitrogen removal targets established in the pilot program and were permanently approved for residential use on minimum one acre parcels in October 2010. Two other original pilot program technologies (Ashco RSF^{III} and Cromaglass) were eliminated from the pilot program, the reasons for which are detailed later in this report. The fifth original pilot program technology (FAST) was the subject of a March 5, 2018 CMP amendment that permanently approved its residential use in the Pinelands Area on minimum 1.4 acre parcels.

As a result of their successful participation in the pilot program, the Amphidrome, Bioclere and FAST systems can now all be used to serve residential development in the Pinelands Area. In addition to these permanently approved systems, the CMP authorizes the installation of four pilot program technologies through August 5, 2018. Included are the BioBarrier, Busse GT, Hoot ANR and SeptiTech wastewater treatment systems. New installations of these systems are not permitted after this date unless the Commission takes action to authorize their continued use.

N.J.A.C 7:50-10.23(c) directs that this implementation report focus specifically on the BioBarrier, FAST, Busse GT, Hoot and SeptiTech treatment technologies (the currently piloted technologies). While the report briefly discusses various aspects of each of the technologies that have participated in the pilot program, more detailed information on the program and a more thorough discussion of the permanently approved and eliminated technologies is available in the Commission's August 5, 2017 Annual Report available at:
http://www.nj.gov/pinelands/landuse/current/altseptic/FINAL%202017%20SEPTIC%20PILOT%20PROGRAM%20ANNUAL%20REPORT%208.9.pdf

Per N.J.A.C. 7:50-10.23(c)1-6, this report evaluates the four technologies that are currently being piloted with respect to the following:

1. The level of nitrogen in the effluent from each treatment technology (Note: 14 mg/l TN in treated effluent is required to meet Pinelands water quality standards for residential use on minimum one acre parcels);

2. The maintenance required for each technology to meet effluent requirements;

3. The cost of installing and maintaining each treatment technology;

4. The problems associated with the installation, operation and maintenance of each treatment technology;

5. The number of systems of each technology that have been authorized under the pilot

program; and

6. Whether the pilot program, when viewed in its entirety, has served to further the purposes and objectives of the Pinelands Protection Act, the Federal Act and the CMP.

Pilot Program Technologies Past and Present

Table 1. Listing of technologies that have participated in the Pinelands Alternate Design Wastewater Treatment Systems Pilot Program, the type of Microbiological Treatment Process Employed, the average cost for the wastewater treatment equipment, the median concentration of total nitrogen (TN) in treated effluent and the technology's status in the Pinelands pilot program.

Technology Name	Microbiological Treatment Type	Equipment Cost	Median [TN] mg/L to date (≤ 14.0 mg/L TN is required for use on a 1 acre parcel)	Status
Amphidrome	Sequencing Batch Aerated Aggregate Filter (Attached Growth)	$19,563	< 14.0	Authorized for permanent use on 1.0 acre lots. "Graduated" from the pilot program.
Ashco RSF III	Recirculating Sand Filter (Attached Growth)	N/A	N/A	Eliminated due to lack of sales in the Pinelands Area. No units installed in the Pinelands.
Bioclere	Trickling Plastic Media Filter (Attached Growth)	$17,612	< 14.0	Authorized for permanent use on 1.0 acre lots. "Graduated" from the pilot program.
BioBarrier	Membrane Bioreactor (Suspended Growth)	$18,708	24.4	Min. lot size increased to 1.7 acres. Moratorium on new installations by vendor.
Busse GT	Membrane Bioreactor (Suspended Growth)	N/A	N/A	No units installed in the Pinelands.
Cromaglass	Sequencing Batch Reactor (Suspended Growth)	$22,553	31.5	Eliminated from the pilot program due to unsatisfactory TN attenuation.
FAST	Fixed Film (Attached and Suspended Growth)	$17,892	18.2	Authorized for permanent use on 1.4 acre lots. "Graduated" from pilot program.
Hoot ANR	Suspended Growth Activated Sludge	N/A	N/A	No units installed in the Pinelands.
SeptiTech	Fixed Film Plastic and Polystyrene Trickling Filter	$19,132	15.7	Minimum lot size increased to 1.7 acres. Performance has improved with system re-programming.

Pilot Program Technologies Currently Under Evaluation

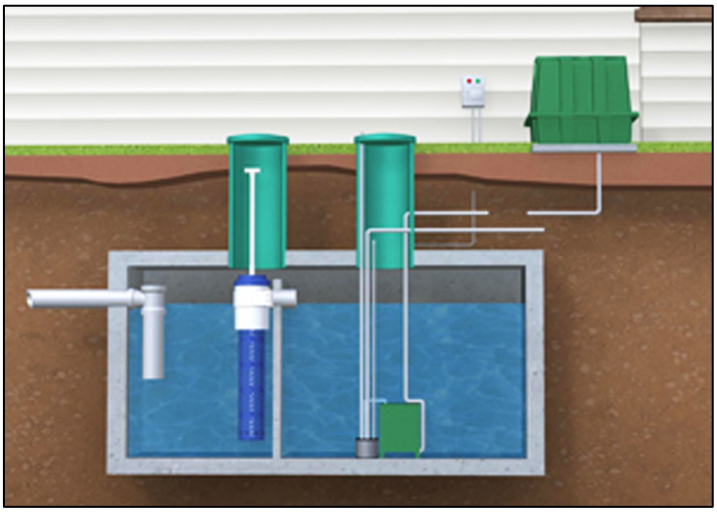
In October 2010, the CMP was amended to authorize additional, pre-screened technologies to participate in the pilot program. The amendment authorized the participation of select NSF Standard 245 and/or USEPA Environmental Technology Verification (ETV) certified nitrogen reducing wastewater treatment systems.

Vendors of NSF Standard 245 and/or USEPA ETV certified technologies were invited to apply for participation in the pilot program. The Commission received applications from the vendors of four NSF Standard 245 certified wastewater treatment technologies. These included the Septi-Tech, Bio-Barrier, Busse GT and Hoot ANR treatment systems, all of which were expected to produce final effluent TN concentrations on the order of 14 ppm based upon evaluation by NSF for Standard 245 certification. Upon review of NSF's reported performance and cost data, the Commission's Executive Director approved these four technologies for participation in the Commission's pilot program in May 2012. Subsequently, NJDEP issued a generic Treatment Works Approval (TWA) to authorize Pinelands Area Health Departments to approve the four newly authorized treatment systems as well as those that were previously admitted into the pilot program.

As of the date of this Implementation Report, and based upon pilot program system monitoring results to date, the SeptiTech and BioBarrier technologies are approved for use on minimum 1.7 acre parcels, subject to a future increase or decrease in the minimum parcel size based upon on-going monitoring of their performance.

The Hoot and Busse GT technologies, neither of which has yet been installed in the Pinelands Area, are eligible for use on minimum one acre parcels.

BioBarrier Technology



The BioBarrier® MBR is a membrane bioreactor that combines activated sludge treatment processes with solids separation via membrane filter technology. The system employs flat sheet membranes with pore sizes ranging between of 0.02 to 1.4 µm. The membranes are housed in an aerated membrane cartridge which is submerged in the wastewater. The membranes provide a barrier that retains wastewater microorganisms within the treatment unit. The large mass of retained microbes provides an effective buffer against shock loadings to the system. The long microbial residence time in the treatment system allows the microorganisms to undergo endogenous respiration, reducing the total amount of solids produced by the treatment process.

The system consists of a tank with three compartments. The first compartment provides primary treatment – sedimentation and separation of floatables and solids, and is equipped with a proprietary outlet screening device. A solid wall separates the first compartment from the second, in which the system's nitrogen reduction capabilities may be enhanced under anoxic conditions. The third compartment, the "aeration/membrane zone", is separated from the anoxic zone by a baffle wall with openings between the two zones. The BioBarrier® Membrane module is located in the third compartment. Aeration is provided to the third compartment by a blower which serves two functions. First, the blower provides mixing of the wastewater and biomass to allow complete contact between the bacteria and organic material in the wastewater, while supplying oxygen that is critical to the process. Second, the positioning of the aeration under the membrane sheets helps to remove solids that collect on the surface of the sheets. The membranes sheets, having microscopic pore size openings, separate the water from the solids in the aeration zone. An effluent pump provides a slight negative pressure on the "clean" side of the membrane, pulling filtered water through the membrane. The solids that are sloughed by aeration and membrane cleaning are retained in the aeration compartment.

As illustrated in Table 2, sample results have been evaluated from 12 BioBarrier systems through June 2017. A total of 114 samples have been used to evaluate these 12 BioBarrier systems. Total nitrogen (TN) values for each of the BioBarrier systems represents the sum of reported laboratory values for total Kjeldahl nitrogen plus nitrite nitrogen and nitrate nitrogen. The BioBarrier technology has produced a grand median total nitrogen concentration of **24.4 mg/l** based upon all samples through June 5, 2017. This grand median total nitrogen value is higher than the 21.9 mg/l TN concentration presented in the Commission's 2016 annual report and upon which the 1.7 acre minimum parcel size is based. (It is noteworthy that the manufacturer of the BioBarrrier technology has instituted a voluntary moratorium on the sale of new BioBarrier units in the Pinelands Area until such time as system total nitrogen removal is improved). As previously noted, the technology must attain a grand median total nitrogen concentration no greater than **14.0 mg/l** in order to meet Pinelands water quality standards when used to serve residential development on a minimum one acre parcel.

In response to the BioBarrier technology's performance, the Executive Director increased the minimum parcel size required for new BioBarrier installations from one acre to 1.7 acres in October 2016. The temporary restriction on the future use of the BioBarrier system, (subject to increase or decrease based upon additional sampling data), was determined by applying the Pinelands Septic Dilution Model to effluent monitoring data acquired to date. The temporary lot size restriction will apply to future uses of the BioBarrier technology until retrofits or other improvements to the BioBarrier technology demonstrate that the system is capable of meeting Pinelands water quality standards on lots that are smaller than 1.7 acres. An exception to the minimum 1.7 acre parcel size is being granted only in those instances where an applicant demonstrates that a financial commitment was made toward the purchase of the technology (e.g., engineering design or equipment acquisition) prior to August 5, 2016.

As noted above, upon learning of the system's substandard performance, the technology's manufacturer instituted a voluntary moratorium on the sale and installation of all new BioBarrrier systems in the Pinelands Area effective February 2015, regardless of the proposed lot size. The system manufacturer reports that they, and their local servicing agent, are evaluating a number of potential causes for the system's inability, thus far, to adequately reduce

total nitrogen. These potential causes include the performance of the weir connection between the aeration and anoxic zones, whether anoxic conditions are being attained in the anoxic zone and if bio-membranes are properly limiting the duration of active blower operations. In addition, the manufacture is working with homeowners by recommending alternatives to some household cleaner agents (especially those containing quaternary ammonia) that may be adversely impacting the BioBarrier system.

Table 2. BioBarrier running median of total nitrogen (mg L-1) by number of sampling events for each wastewater treatment system. The grand median, 25th percentile, 75th percentile, and number of systems sampled (N) per event are provided.

Total Nitrogen Running Median		Number of Sampling Events												
Technology	System	1	2	3	4	5	6	7	8	9	10	11	12	Grand Median
BioBarrier	1	14.1	20.6	14.9	21.0	27.1	29.0	30.8	31.1	31.3	31.1	30.8		29.0
BioBarrier	2	13.8	12.1	12.6	13.2	12.6	11.5	12.6	13.2	13.8	13.2	13.8		13.2
BioBarrier	3	19.9	15.9	19.9	31.3	19.9	30.3	26.8	23.4	22.3	24.6			22.8
BioBarrier	4	20.4	21.9	23.4	25.8	23.4	25.8	28.2	25.8	27.5	25.6			25.7
BioBarrier	5	20.8	21.8	22.8	22.9	22.9	22.9	22.8	22.9	22.9	24.3			22.9
BioBarrier	6	18.9	28.4	32.0	27.5	32.0	32.8	33.6	32.8	32.0	32.8			32.0
BioBarrier	7	28.4	36.4	40.8	34.6	28.4	34.6	28.4	24.8	21.2				28.4
BioBarrier	8	13.3	25.8	38.3	25.8	13.3	22.4	31.1	31.3	31.1				25.8
BioBarrier	9	13.6	14.3	15.0	14.4	15.0	23.3	15.0	23.3	31.6	23.3	31.6	29.3	19.2
BioBarrier	10	11.8	10.0	8.1	8.9	9.6	9.7	9.8	10.8					9.8
BioBarrier	11	28.4	16.7	10.8	19.6	10.8	19.6	28.4						19.6
BioBarrier	12	33.1	19.6	33.1	33.3	33.4	33.3	33.1						33.1
Sample# Median		19.4	20.1	21.4	24.3	21.4	24.6	28.3	24.1	27.5	24.6	30.8	29.3	**24.4**
25th Percentile		13.8	15.5	14.3	18.3	13.1	21.7	20.9	23.0	22.3	23.8	22.3	29.3	21.3
75th Percentile		22.7	22.9	32.3	28.4	27.4	30.9	30.9	29.7	31.3	28.3	31.2	29.3	29.5
n		12	12	12	12	12	12	12	10	9	7	3	1	

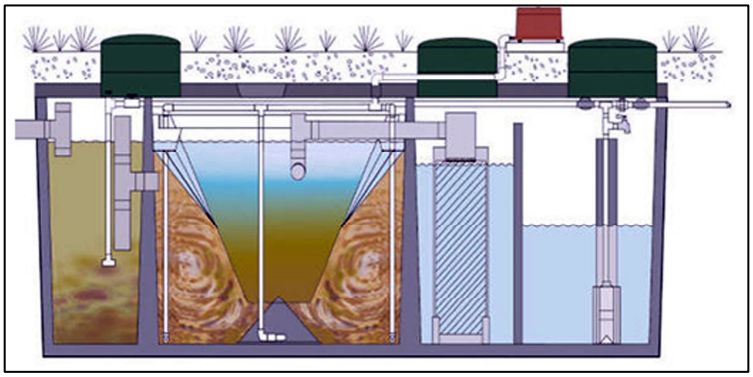
Busse Green MBR Technology

The Busse Wastewater Treatment System is a small scale membrane bioreactor. The Busse system provides treatment in a 3-stage, 4 tank process. Wastewater enters an intermittently aerated first tank and is then transferred by an airlift through a mesh filter to an identical second tank. Wastewater in the second tank is divided evenly between two membrane tanks, again with a screened airlift transfer. The membrane bioreactor tanks house 24 Kubota flat sheet membranes. The Kubota membranes units are comprised of two sections: the lower section contains the air piping and the upper section contains the membrane panels. The membrane units are submerged in activated sludge within the reactor tanks. The tanks are aerated by coarse and fine bubbles that provide a cross flow of liquid over the surface of the membrane panels. Cross flow circulation reduces membrane fouling and provides oxygen for microbial degradation of wastewater organics. The liquid head above the membrane drives permeate from the wastewater mixture through the membrane, where it flows via a manifold through the tank wall and is discharged. A return sludge airlift is activated by a programmable logic controller and is controlled by level sensors located in tanks two through four. A third air pump provides aeration to the airlifts in the first two tanks.

The bioreactor provides an aerobic environment where microorganisms present in the wastewater remove soluble contaminants, using them as a source of energy for growth and production of new microorganisms. The organisms flocculate and form aggregations that further physically entrap particulate organic matter. The organic matter is attacked by extracellular enzymes that solubilize the solids to make them available to the microorganisms as a food source. The conversion of the organic matter from soluble to biological solids allows for removal of the organic matter by settling and filtration of the solids in the treatment process.

As of this date, there are no Busse GT systems operating in the Pinelands Area. Therefore, the Commission has no performance data to report at this time.

Hoot ANR Technology



The Hoot ANR treatment system is an extended aeration/activated sludge treatment process coupled with anaerobic denitrification. The unit is comprised of five principal components, a Pretreatment Tank, Aeration Chamber, Clarifier, Media Tank and Final Clarifier/Pump Tank.

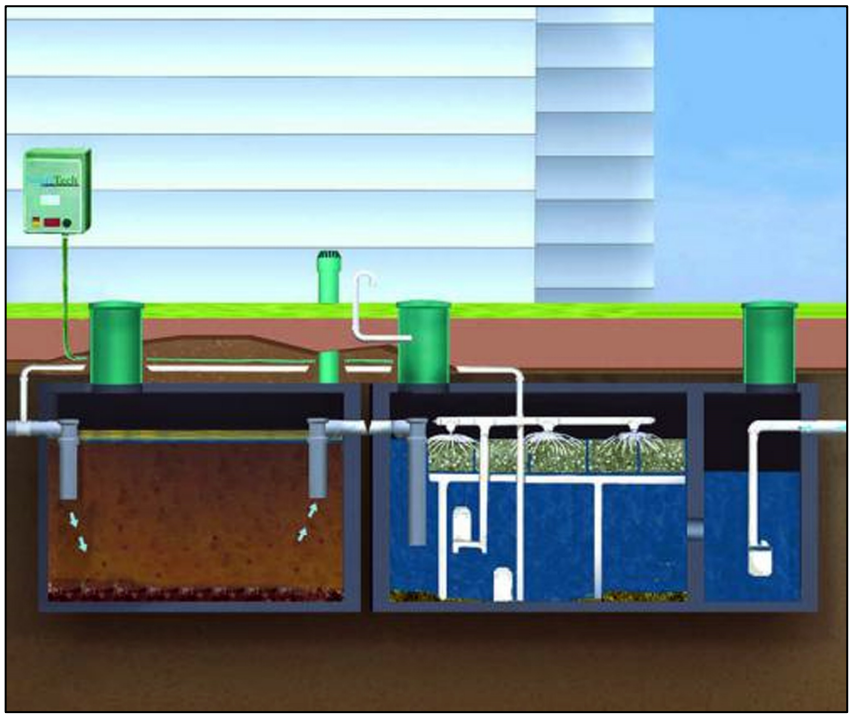
The Pre-Treatment tank provides separation and anaerobic digestion of influent solids and functions much like a septic tank by reducing up to 50% Total Settable Solids (TSS) and approximately 25% of Biochemical Oxygen Demand (BOD5). Liquid waste flows out of the pretreatment tank through a baffled outlet and into the aeration chamber. The activated sludge treatment process occurs in the aeration chamber through the introduction of oxygen into the mixed liquor to enable the conversion of soluble material into biomass. In addition, oxygen enables nitrifying bacteria to convert ammonia-nitrogen to nitrate-nitrogen. Wastewater then flow to a clarifier for additional solids settling. From the clarifier, wastewater is transferred to a media tank where an attached growth treatment process occurs. Here, a proprietary carbon source is added. In the presence of the supplemental carbon source, denitrifying bacteria release free nitrogen to the atmosphere. A final clarifier/pump tank constitutes the last treatment component before discharge to the soil absorption field. A portion of the daily flow of the system is recirculated from this chamber to the pre-treatment tank where it is reprocessed through the system.

As of this date, there are no Hoot ANR systems operating in the Pinelands Area. Therefore, the Commission has no performance data to report at this time.

SeptiTech Technology

The SeptiTech® wastewater treatment system is a two-stage treatment technology, based on a fixed film trickling filter, using a patented highly permeable hydrophobic media. The first stage of treatment occurs in the primary tank in which the solids are settled and partially digested. The second stage of the system is a processor that provides secondary wastewater treatment. Microorganisms present in the wastewater grow within the media, using nutrients and organic materials provided by the constant supply of fresh wastewater to form new cell mass. Air is drawn into the system via an air intake pipe at the top of the SeptiTech® System. Venturis located in the sprinkler head distribution piping aerate the wastewater sprayed onto the media. The system operates without a fan or compressor.

The SeptiTech® System is designed to remove total nitrogen from wastewater by nitrification and denitrification. Nitrification occurs in the second stage of the system, where ammonia – nitrogen is converted to nitrite and nitrate (predominately nitrate), while denitrification occurs in the anaerobic/anoxic primary tank. Denitrification also occurs in a stacked media module that floats in the reservoir below the aerobic media.



Wastewater from the primary tank flows by gravity to the processor reservoir section, located below the filter media. The second and third pumps are used to return wastewater and solids from the reservoir back to the primary tank. The forth pump is used to discharge treated wastewater to the disposal location.

As illustrated in Table 3, sample results have been evaluated from 29 SeptiTech systems through June 5, 2017. A total of 159 samples have been used to evaluate these 29 SeptiTech systems. Total nitrogen (TN) values for each of the SeptiTech systems represents the sum of reported laboratory values for total Kjeldahl nitrogen plus nitrite nitrogen and nitrate nitrogen. The SeptiTech technology has produced a grand median total nitrogen concentration of **15.7 mg/l** based upon all samples to date. This value is significantly lower than the 21.2 mg/l TN concentration presented in the Commission's 2016 annual report apparently reflecting improved performance as a result of system reprogramming changes made in response to the Commission's ongoing assessment of the technology's performance. As previously noted, the technology must attain a grand median total nitrogen concentration no greater than **14.0 mg/l** in order to meet Pinelands water quality standards when used to serve residential development on a minimum one acre parcel.

Because the SeptiTech technology has not yet been shown to consistently meet the 14.0 mg/l TN concentration as required for use on one acre parcels, the Commission has imposed a temporary restriction on future installations of the SeptiTech system, requiring that it be limited to parcels containing at least 1.7 acres, (based upon the 21.2 mg/l TN concentration presented in the Commission's 2016 annual report) subject to increase or decrease based upon additional sampling data. The temporary restriction was determined by applying the Pinelands Septic Dilution Model to effluent monitoring data acquired to date. Staff anticipates that programming changes made to the SeptiTech technology will improve its nitrogen removal efficiency and further anticipates that the minimum required parcel size will be adjusted downward from its current 1.7 acre minimum. The Commission would lift the temporary lot size restriction if and when retrofits or other improvements to the SeptiTech technology demonstrate that the system is capable of meeting Pinelands water quality standards on lots that are smaller than 1.7 acres. An exception to the minimum 1.7 acre parcel size requirement may be granted only in those instances where an applicant demonstrates that a financial commitment was made toward the purchase of the technology (e.g., engineering design or equipment acquisition) prior to August 5, 2016.

Table 3. **SeptiTech** running median of total nitrogen (mg L-1) by number of sampling events for each wastewater treatment system. The grand median, 25th percentile, 75th percentile, and number of systems sampled (N) per event are provided.

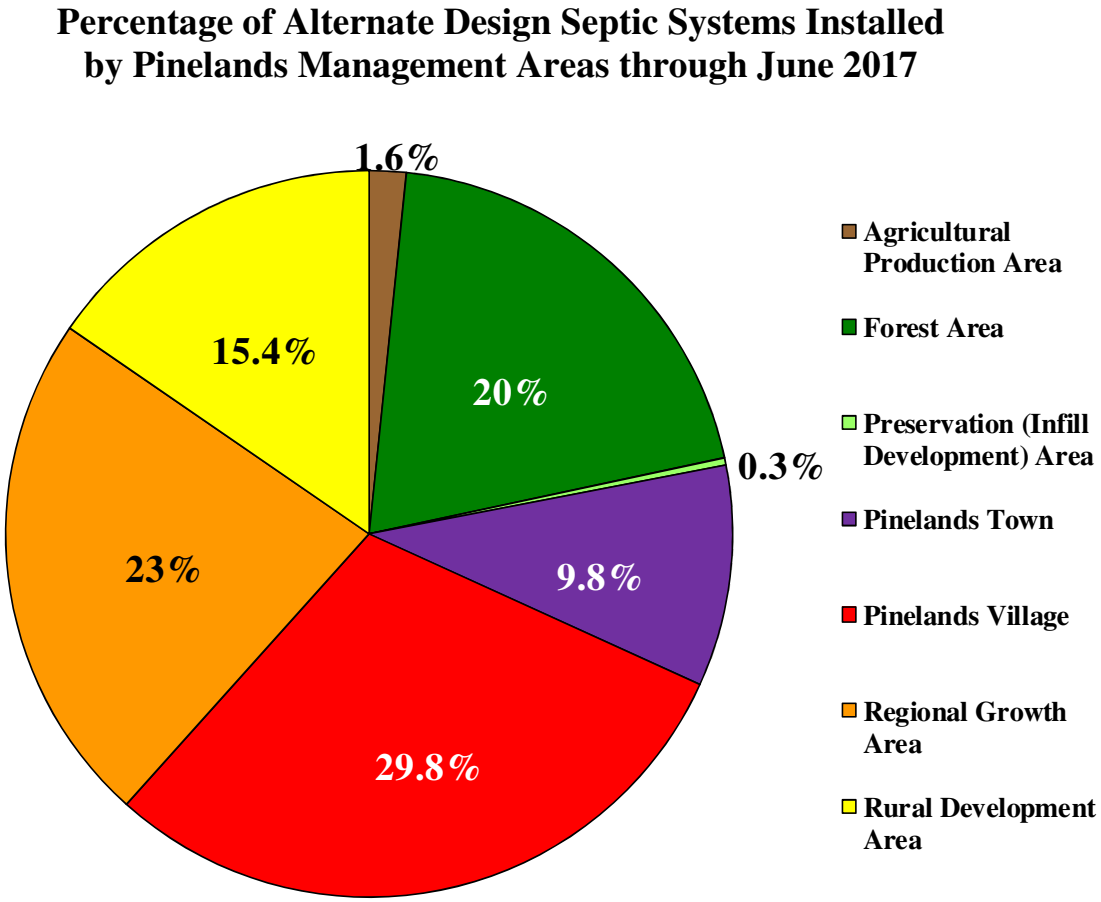
Total Nitrogen Running Median		Number of Sampling Events												
Technology	System	1	2	3	4	5	6	7	8	9	10	11	12	Grand Median
SeptiTech	1	8.7	8.8	8.7	8.7	8.7	8.8	8.7	8.7	8.7	8.7	8.7	8.7	8.7
SeptiTech	2	33.4	31.1	28.8	26.7	28.8	26.7	24.5	20.3	16.1	15.0	13.8		26.7
SeptiTech	3	24.6	19.0	15.2	15.2	15.2	15.2	15.1	14.2	13.3	13.3	13.3		15.2
SeptiTech	4	19.9	17.9	19.9	20.7	19.9	20.7	19.9	17.9	15.9				19.9
SeptiTech	5	18.5	20.1	18.5	13.9	10.2	9.7	10.2	10.1					12.0
SeptiTech	6	17.2	22.4	27.6	22.4	23.6	20.4	23.6	20.4					22.4
SeptiTech	7	33.5	34.8	33.5	30.7	27.9	24.7	21.5	19.1					29.3
SeptiTech	8	32.8	24.9	17.0	12.0	14.5	12.3	10.0						14.5
SeptiTech	9	4.1	5.4	6.1	6.4	6.1	6.0							6.0
SeptiTech	10	30.9	26.8	29.0	26.7	24.3	23.5							26.7
SeptiTech	11	25.2	31.4	37.6	38.5	37.6	31.4							34.5
SeptiTech	12	10.7	16.0	21.3	16.0	10.7	12.0	13.0	11.9	12.9	13.0			12.9
SeptiTech	13	13.1	15.0	13.1	11.4	9.6	9.5	9.4	9.5	9.6	11.4			10.5
SeptiTech	14	33.3	23.8	19.2	26.3	19.2	26.3							25.0
SeptiTech	15	26.0	19.0	12.8	12.4									15.9
SeptiTech	16	19.9	16.5	19.9	34.8									19.9
SeptiTech	17	9.4	11.9	14.4	15.5									13.2
SeptiTech	18	38.8	44.1	38.8	38.4									38.8
SeptiTech	19	9.3	12.6	15.9	21.3									14.3
SeptiTech	20	21.9	22.4	21.9										21.9
SeptiTech	21	14.2	36.5	31.7										31.7
SeptiTech	22	39.4	45.1	39.4										39.4
SeptiTech	23	29.7	36.2	31.2										31.2
SeptiTech	24	7.5	6.6											7.1
SeptiTech	25	28.9	20.2											24.5
SeptiTech	26	9.2	8.7											8.9
SeptiTech	27	17.9												17.9
SeptiTech	28	5.5												5.5
SeptiTech	29	4.3												4.3
Sample# Median		19.9	20.1	19.9	20.7	17.2	17.8	14.1	14.2	13.1	13.0	13.3	8.7	**15.7**
25th Percentile		9.4	15.2	15.6	13.1	10.3	10.3	10.1	10.1	10.4	11.4	11.0	8.7	10.4
75th Percentile		29.7	30.0	30.1	26.7	24.1	24.4	21.1	19.1	15.3	13.3	13.6	8.7	22.6
n		29	26	23	19	14	14	10	9	6	5	3	1	

Alternate Design Treatment System Installations by Pinelands Management Area

The Pinelands alternate design treatment systems have been installed in 7 of the 9 Pinelands Management Areas, with more than 60 percent having been installed in the designated growth areas (Pinelands Towns, Pinelands Villages and Regional Growth Area). Table 4 and Figure 1 show the distribution of systems by Pinelands Management Area.

Table 4 and Figure 1. Percentage of Pinelands Alternate Design Treatment Systems installed in various Pinelands Management Areas thru June 2017.

Pinelands Management Area	No. of Systems	Percentage of Systems
Agricultural Production Area	5	1.6
Forest Area	61	20
Preservation (Infill Development) Area	1	0.3
Pinelands Town	30	9.8
Pinelands Village	91	29.8
Regional Growth Area	70	23
Rural Development Area	47	15.4



Program Evaluation

1) What is the effluent total nitrogen concentration [TN] in each treatment technology based on an evaluation of all monitoring results under this pilot program?

The CMP requires that each technology manufacturer arrange for the collection and analysis of treated effluent on a quarterly basis for the first three years that each system is in use (for a total of twelve samples per system). All samples must be analyzed by certified NJDEP laboratories employing analytical procedures approved by NJDEP's Office of Quality Assurance. Further, sample collection, transport and analysis must conform to the latest NJDEP Field Sampling Procedures Manual to ensure quality assurance and quality control in the collection and transport of samples, (i.e. chain of custody, sample preservation, etc.) All effluent samples are collected between the treatment unit and the soil dispersal field. To permit the establishment of microbiological cultures necessary for the treatment process to develop and stabilize, no sampling is required during the initial ninety days from system start-up.

Table 5 illustrates the effluent grand median total nitrogen concentration for each of the piloted technologies and the minimum lot size required to meet Pinelands water quality standards as determined by application of the Pinelands Septic Dilution Model.

Table 5. Treatment technology, [TN] grand median, number of systems and effluent samples analyzed, and the minimum lot size required to meet 2ppm nitrogen standard (via treatment and dilution) and the status of the technology in the pilot program. Shaded rows identify technologies that are no longer participating in the pilot program as a result of having been permanently approved (Amphidrome , Bioclere and FAST) or that have been eliminated from the pilot program (Ashco RSF III and Cromaglass). **Note**: Shaded rows identify the five original pilot program technologies.

Technology	2017 Effluent [TN] mg/l	No. of Systems	No. of Samples	Min. lot size (acres) required to meet 2 mg/l [TN]	Pilot Program Status
BioBarrier	24.4	12	114	1.7*[1]	Evaluation is ongoing.
Busse GT	Not yet tested	0	0	TBD	Evaluation pending installations.
Hoot ANR	Not yet tested	0	0	TBD	Evaluation pending installations.
SeptiTech	15.7	29	159	1.7*	Evaluation is ongoing.

[1] ***Note**: The 1.7 acre lot size requirement was established based on 2016 monitoring results and will be retained until long-term improved performance is verified.

Technology	2017 Effluent [TN] mg/l	No. of Systems	No. of Samples	Min. lot size (acres) required to meet 2 mg/l [TN]	Pilot Program Status
Amphidrome	11.9	68	603	1.0	Permanent approval granted for use on minimum 1.0 acre parcels.
Ashco RSF III	Not tested	0	0	3.2	Eliminated from pilot program. No new Ashco RSF III systems permitted on lots smaller than 3.2 acres.
Bioclere	11.2	38	268	1.0	Permanent approval granted for use on minimum 1.0 acre parcels.
Cromaglass	31.5	59	556	3.2	Eliminated from pilot program. Existing units may remain in use on 1.0 acre lots. No new Cromaglass systems permitted on lots smaller than 3.2 acres.
FAST	18.2	25	429	1.4	Permanent approval granted for use on minimum 1.4 acre parcels.

2) What level of maintenance is required for each alternate design treatment technology to meet the required nitrogen targets?

The pilot program requires that a representative of the *system manufacturer* with expertise in the system design, construction and operation be onsite to inspect all system components and to correct any construction, installation or operational problems that might be experienced during system startup. A representative of the *design engineer* must also be onsite to inspect the system at startup. After conducting onsite inspections, both the manufacturer and the design engineer must provide the Pinelands Commission with written certifications attesting that the installation of the system was properly completed.

Once each system is operating, both an onsite audible and visual alarm and a remote telemetric alarm monitor the treatment system's electrical and mechanical components to notify both the residents and the contracted service provider of system operational problems in real time.

Each system is sold with a pre-paid five year maintenance contract which provides for the manufacturer's servicing agent to inspect the system at least once per year and to undertake any maintenance or repairs determined to be necessary.

Homeowners are provided with an operation and maintenance (do's and don'ts) manual that outlines procedures for the proper use and care of the treatment system. Typical homeowner

required maintenance involves pumping of septic tank solids at a recommended average frequency of once every three years, similar to the recommended pump out frequency for a conventional septic tank - leach field system.

The required startup inspections and the annual operation and monitoring inspection by the serving agent, coupled with the effluent sampling and analysis requirements identified in No. 1 above have been largely successful in minimizing anything other than routine maintenance (periodic pumping of solids). The five year warranty on each treatment system provides homeowners with protection from costs associated with unanticipated service calls and repairs during the warranty period. All of these features of the pilot program have kept the need for system maintenance to reasonable levels. Pursuant to NJDEP's regulations, homeowners are required to maintain operation and maintenance contracts on the treatment systems in perpetuity. However, a lack of universal enforcement of these NJDEP requirements by the County Health Departments remains a problem both in the Pinelands Area and statewide.

3) What is the cost of installing and maintaining each alternate design pilot program treatment system?

Equipment and system installation costs are reported to the Commission at the time of system start-up. The total cost of an onsite wastewater treatment system includes at least three separate components. These include the cost of the alternative treatment equipment (with 5 year service package), the cost of the soil absorption (disposal field) system, and the cost of engineering, excavating, construction, electrical connections, permitting and other installation services. The manufacturer provides equipment and support service cost information to the Commission. Other costs, such as engineering, permitting, inspection and construction are typically supplied by the homeowner or builder to the system manufacturer who in turn provides that information to the Commission.

Figure 2 shows the change in equipment costs for the Amphidrome and Bioclere units as reported to the Commission in 2006, 2009, 2012 and 2017. Figure 2 also provides equipment costs for the Cromaglass units during the years 2006 and 2009, the last year that the Cromaglass system was installed in the Pinelands Area. Equipment costs are also provided for the FAST units purchased in 2009, 2012 and 2017. Equipment costs for the BioBarrier and SeptiTech units are provided only for 2017 as none of these systems were installed in 2006, 2009 or 2012.

The actual dollar cost (unadjusted for inflation) to consumers for the Amphidrome, Bioclere systems declined by 10.7% and 5.4% during the 11 year period of 2006 through 2017, respectively. The actual dollar cost (unadjusted for inflation) to consumers for the FAST system declined by 2% during the eight year period of 2009 through 2017. The equipment cost of Cromaglass units increased by 21.6 % during the period 2006 through 2009. New installations of the Cromaglass system were suspended in November 2006 and the technology was eliminated from the pilot program in September 2014.

Figure 2. Average equipment costs to consumers purchasing Amphidrome and Bioclere units during 2006, 2009, 2012 and 2017, average equipment costs to consumers purchasing Cromaglass units during 2006 and 2009 (the last year of Cromaglass installation) and average equipment costs to consumers purchasing FAST units during 2006, 2012 and 2017. There were no sales of the BioBarrier and SeptiTech units in 2006, 2009 and 2012, thus only equipment costs for 2017 are provided.

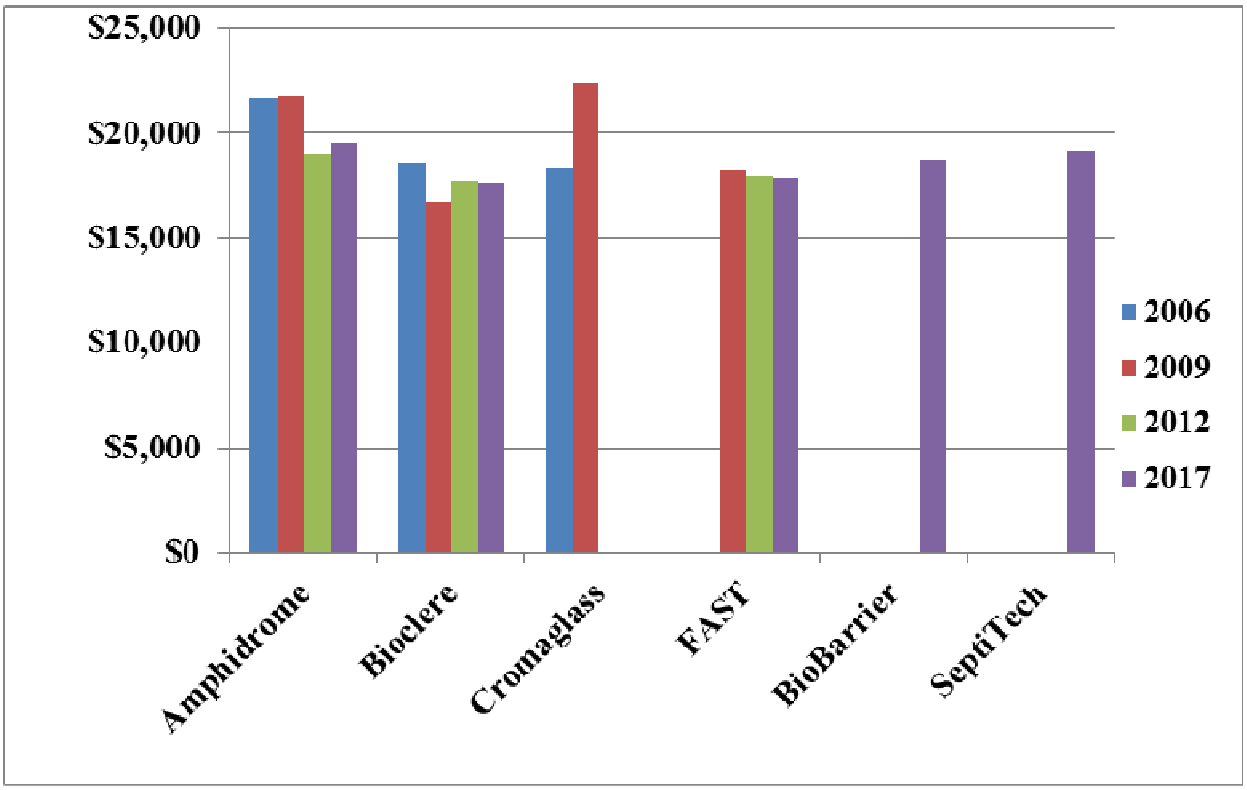


Table 6 provides the average total cost to consumers purchasing and installing an advanced treatment system and effluent disposal field. These costs were compiled using information provided to the Commission by the treatment system supplier and supplemented by the homeowner or builder. The average reported overall costs (equipment, engineering, construction and permitting) of the Alternate Design systems have declined or increased only slightly since the inception of the pilot program.

From 2006 to 2017 the overall cost of the Amphidrome system increased (in actual non-inflation adjusted dollars) by $500. During the same time period, the total overall cost of the Bioclere system decreased by $4489. From 2006 to 2009, the total overall cost for the Cromaglass system increased by $221. And the total overall cost for the FAST system declined by $2314 during the period of 2009 through 2017.

Amendments to the NJDEP's septic system design standards (N.J.A.C 7:9A) that took effect in April, 2012 allow for a reduction in the required size of effluent fields where higher quality effluent is produced by alternative treatment units, including those that participate in the Commission's pilot program. These regulatory changes can reduce overall construction costs if design engineers incorporate smaller absorption fields into their design plans. In addition,

because advanced treatment systems typically remove up to 98 % of total suspended solids (TSS) and biochemical oxygen demand (BOD), when properly maintained, the frequency of effluent disposal field repair or replacement is expected to be greatly reduced.

Table 6. Average total reported cost of Pinelands Alternate Design Treatment Systems including equipment costs, disposal field materials, permitting engineering and construction costs, current through June 2017. Note: Cost information was derived from a variety of sources and should be considered to be approximate and for comparison purposes only. The **shaded** rows identify technologies that are no longer participating in the pilot program as a result of either having been permanently approved (Amphidrome, Bioclere and FAST) or having been eliminated from the pilot program (Ashco RSF III and Cromaglass).

Name of Treatment System Technology	No. of Systems included in this cost analysis	Average Reported Cost per Treatment Unit and 5 year service package	Average Reported Cost for Engineering, Soil Absorption Field Installation, Electrical Connections, etc. (1)	Average Reported Overall Cost of the Alternate Design Treatment Systems
BioBarrier	12	$18,708	$10,033	*$28,741*
Busse GT	N/A	N/A	N/A	*N/A*
Hoot ANR	N/A	N/A	N/A	*N/A*
SeptiTech	27	$19,132	$9,360	*$28,492*
Amphidrome	69	$19,563	$12,202	*$31,765*
Ashco RSF III	0	N/A	N/A	*N/A*
Bioclere	59	$17,612	$10,023	*$27,635*
Cromaglass	41	$22,553	$12,712	*$35,265*
FAST	25	$17,892	$11,616	*$29,508*

(1) Reported engineering and construction costs including soil and site suitability investigations (soil logs and "perc"/permeability tests), preparation of engineering plans, completion of NJDEP standard application forms, excavation for soil absorption system and tank placement, soil absorption system materials (suitable "K4" replacement soil, stone filter materials and lateral piping, or gravel free chambers, geotextile fabric), installation of all components, electrical connections, surveyor services, as-built plans, engineering inspections and as-built certifications.

The total cost of each of the alternate design treatment technologies is approximately twice that of the average cost of a pressure dosing septic system. The purchase of a pressure dosing system would not, however, include a five year operation and maintenance contract, 5 year warranty, and quarterly effluent sampling, nor would the pressure dosing system provide enhanced treatment of wastewater. The total cost of the alternate design treatment technologies may be as

much as two to three times the cost of a conventional septic tank-leach field system. However, such systems (both pressure dosing and conventional) may only be used to serve development on minimum 3.2 acre parcels, whereas each of the alternate design technologies may be used on parcels that are smaller than 3.2 acres.

The cost of the mandatory five year warranty and operation and maintenance (O&M) contract is included in the total reported cost of the advanced treatment units. Upon expiration of the original five year O&M contract, contract renewal is required pursuant to NJDEP's regulations (see N.J.A.C 7:9A-12.3 (a)). Those regulations state that the owner of an advanced wastewater treatment system must maintain a service contract with an authorized service provider throughout the life of the system. The cost to renew an O&M contract ranges between $350 and $400 per year with some firms offering a discount for multi-year contract renewals. These fees do not include septic tank pumping, the average cost of which is approximately $200 per 1000 gallons. Septic tank pumping is generally recommended at a frequency of once every three years. Therefore, the total annualized cost for O&M services and pumping ranges from $420 to $470 per year or approximately $35 to $40 per month.

The advantages of improved water quality, professional system maintenance and the ability to meet water quality standards in areas currently zoned for one-acre residential development supports the continuation of the Pinelands Alternate Design Wastewater Treatment Systems Pilot Program.

4) Are there problems associated with the installation, operation and maintenance of each alternate design treatment system and what is the frequency of such problems? What measures are typically taken to eliminate system problems and what is has been the success of those measures?

The CMP requires each technology manufacturer to report to the Commission on the frequency and nature of system startup and operational problems. As noted in No. 1, above, a manufacturer's representative with expertise in system design, construction and operation and an inspector from the design engineer's office must be present during each system startup to identify and correct any construction, installation or operational problems. The practice has eliminated construction installation errors from going undetected and has resulted in limiting post installation problems.

Operational problems are rare and when they have occurred they are generally attributable to nearby lightning strikes. This type of problem is not unique to advanced wastewater systems; with lightning strikes sometimes affecting home electronics, well pumps and conventional septic system effluent pumps. In these events, service providers have successfully replaced pumps and blowers at no cost to system owners during the initial five year warranty period.

In the case of the SeptiTech technology, the Commission's requirement for quarterly effluent sampling and analysis was critical in identifying a software programming error that affected early installations of the SeptiTech system. This programming error resulted in systems being installed without the denitrification (anaerobic) cycle being activated. These systems were

erroneously programmed to operate only in an aerobic mode, reducing TSS and BOD but not total nitrogen. Once the programming error was detected through the Commission's effluent monitoring program, the manufacturer reprogrammed all previously installed systems and has taken steps to ensure that all future systems are properly programmed.

In general, the pilot program alternate design systems have not exhibited breakdowns at a frequency that is any greater than is typical of onsite systems that incorporate effluent pumps (such as pressure dosing or gravity dosing) which are often used to overcome shallow water table conditions or grade limitations.

5) What is the total number of systems of each technology that have been authorized under the pilot program?

Table 7. Total number of pilot program wastewater treatment system installations by year of installation (through June 2017).

Technology	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total Installed
Amphidrome	7	10	10	27	12	7	5	8	4	5	1	1	4	2	103
Bioclere	0	2	11	9	7	9	6	5	5	5	8	4	4	1	76
Cromaglass	0	19	24	3	6	4	3	0	0	0	0	0	0	0	59
FAST	0	0	0	0	2	5	3	3	3	5	2	2	0	0	25
SeptiTech	Admitted into pilot program in 2013										3	9	11	7	30
BioBarrier	Admitted into pilot program in 2013										5	7	0	0	12
Hoot ANR	Admitted into pilot program in 2013										0	0	0	0	0
Busse GT	Admitted into pilot program in 2013										0	0	0	0	0
Total	7	31	45	39	27	25	17	16	12	15	19	23	19	10	305

The Amphidrome and Bioclere technologies were permanently approved for use on minimum 1 acre parcels in the Pinelands in 2010, based upon effluent monitoring from 73 and 38 systems respectively. The FAST technology was permanently approved for use on minimum 1.4 acre parcels in 2018 based upon effluent monitoring from 25 FAST systems.

As shown in Table 7, the first SeptiTech and BioBarrier systems were installed in the Pinelands Area in 2014. Thirty SeptiTech and twelve BioBarrier systems were in use as of June 2017.

Table 7 shows that there are currently no Busse GT or Hoot ANR systems operating in the Pinelands Area.

N.J.A.C 7:50-10.22(a)6.xiii stipulates that no more than six alternate design treatment technologies may be approved for use in the pilot program at any one time. With the March 2018 permanent approval of the FAST technology, three of the once pilot program technologies (Amphidrome, Bioclere and FAST) have now advanced out of the pilot program, leaving four technologies (BioBarrier, SeptiTech, Busse GT and Hoot ANR) in piloting status. As a result, the Commission could now add two new technologies to the pilot program.

6) Has the pilot program, when viewed in its entirety, served to further the purposes and objectives of the Pinelands Protection Act, the Federal Act and this Plan?

The pilot program has demonstrated that advanced treatment technologies are currently available for residential use which, with proper installation, operation and maintenance, can achieve substantial compliance with the purposes and objectives of the Pinelands Protection Act, the Federal Act and the CMP.

The pilot program has enabled the installation of more than 300 alternate design treatment systems, representing six advanced onsite treatment technologies, during the period of August 2002 through August 2017. The effluent testing requirements of the pilot program have demonstrated that several of these technologies are capable of meeting the rigorous groundwater quality standards of the CMP. The pilot program has also revealed that certain treatment technologies did not meet original treatment expectations and as a result, were either removed from the pilot program or could only meet the Commission's groundwater quality standards if used on larger lots.

By identifying wholly compliant (Amphidrome and Bioclere), partially compliant, (FAST, SeptiTech and BioBarrier), and non-compliant technologies (Cromaglass), the pilot program has fulfilled one of its original objectives, that being to independently evaluate nitrogen removal capabilities under real world conditions. The pilot program has provided the Commission with the ability to identify technologies that are capable of meeting Pinelands nitrogen standards and to calculate and specify the minimum parcel size required for various treatment technologies to meet the Commission's 2 ppm nitrogen standard. While some jurisdictions nationwide have opted to approve nitrogen attenuating onsite wastewater treatment technologies based only on third party certifications (e.g. NSF Standard 245), the Commission's decision to evaluate technologies on the basis of their performance in the pilot program has proven to be a more prudent approach, with some technologies meeting or exceeding expectations and others not living up to the results reported by third party certifying organizations.

Conclusions and Recommendations

1) The continued use of advanced onsite treatment technologies is essential to the efficient use and orderly development of designated growth areas of the Pinelands.

The pilot program provides a means to test whether select onsite wastewater technologies can be maintained and operated to meet the water quality standards of the CMP in a manner that a homeowner can reasonably be expected to follow. The program has been successful in identifying advanced treatment technologies (Amphidrome, Bioclere and FAST) that can be expected to achieve compliance with Pinelands water quality standards when used at appropriate densities as established through the Pinelands septic dilution model and land use zoning requirements. Two additional technologies (SeptiTech and BioBarrier) are currently being evaluated. Based upon effluent data evaluated to date, both of these technologies appear to be capable of meeting Pinelands water quality standards provided they are used on minimum 1.7 acre parcels. Commission staff will continue to monitor these technologies and will work with the technology manufacturers to improve nitrogen removal efficiency.

A) Staff recommends that the SeptiTech and BioBarrier technologies remain in the pilot program and that the duration of the pilot program be extende to allow continued evaluation of these (and perhaps other newly introduced) technologies.

B) Staff further recommends that the Commission amend the CMP to authorize the installation of alternative design pilot program systems beyond August 5, 2018 and to do so without establishing a new installation deadline. The inclusion of an installation deadline has proven to be unwieldy because CMP amendments take a year or more to complete. Establishing an installation deadline in the CMP isn't necessary because the Executive Detector has the ability to suspend a system for poor performance or to temporarily adjust (increase) the minimum required lot size based on monitoring results. Notice of either action is published in the NJ Register and on the Commission's website. The Pinelands Commission can act to permanently remove a technology or authorize graduations (from the pilot program) through CMP amendment.

C) Staff also recommends that the next implementation report be provided to the Commission by November 5, 2019.

2) The residents of the Pinelands Area benefit when the Commission introduces new technologies for testing and approval, thereby expanding the number of systems from which residents may choose. Further, competition amongst the technology vendors has contributed to price stability and in some cases has resulted in equipment cost reductions. Currently, residents who desire to build where existing zoning allows residential development on parcels ranging from 1 acre to less than 3.2 acres, may currently choose from between 3 permanently approved and 4 pilot program systems.

A) Staff recommends that two new NSF Standard 245 and/or USEPA ETV certified nitrogen reducing treatment technologies be added to the pilot program in 2018 to expand the number of technology choices available to Pinelands Area residents as authorized by the CMP.

3) Only 2 of the 4 technologies now authorized by the pilot program (BioBarrier and SeptiTech) have been installed in the 6 years since first being admitted. The manufacturer of the Hoot technology reports that engineering plans have been prepared and that installation of several systems are scheduled. The manufacturer of the Busse GT technology reports that there a no installations of that system currently proposed.

The CMP enables the Executive Director to repeal the pilot program as it pertains to one or more technologies if it's determined that the program has not been implemented or has not been successful for one or more of the treatment system technologies. Such actions were previously taken with respect to the Ashco RSF III and Cromaglass technologies. The Ashco RSF III

technology was removed from the pilot program due to the manufacturer's failure to install any Ashco RSF III systems in the Pinelands Area. The Cromaglass system was removed from the pilot program after the manufacturer failed to rectify nitrogen attenuation deficiencies and because the manufacturer's failed to comply with effluent sampling requirements.

A) Because only six pilot program technologies may participate in the pilot program at one time and because there have been no Busse GT systems proposed for use since first being admitted to the pilot program more than 6 years ago, staff recommends that the manufacturer of the Busse GT system be put on notice that they will be suspended from the program and that staff will recommend their permanent removal via adoption of a CMP amendment if they don't install a system by November 5, 2019, the date of the next recommended program implementation report. Should there be no installations of the Busse GT technology by the November 5, 2019 deadline, an amendment to the CMP to remove the technology from the pilot program should be pursued. Such an amendment would allow for the introduction of a third new NSF Standard 245 and/or USEPA ETV certified technology to the pilot program in 2020.

4) The NJDEP has significantly enhanced its rules by requiring that all septic systems throughout the State be properly operated and maintained. Moreover, the DEP's latest rule revision requires that all advanced treatment systems, including Pinelands alternate design treatment systems, be professionally maintained in perpetuity. Notwithstanding the adoption of these much needed rules; lack of enforcement of the rules by the Pinelands Area County Health Departments remains a serious problem.

Presently, Commission staff work closely with each of the County Health Departments in their processing of all septic system permit applications, with additional measures taken for alternate design systems. These include Commission staff ensuring that design engineers and the system manufactures certify that each system was properly designed and constructed, that the appropriate Deed Notices were filed (to alert current and future owners of the special Operation and Maintenance (O&M) obligations applicable to these systems), and that requisite O&M contracts are in place before the County Health Departments allow occupancy of residences served by these systems.

Once an alternate design system is in use, Commission staff issue semi-annual notices to the O&M service providers reminding them of their obligation to notify the County Health Departments when an O&M contract expires if it not renewed.

To further aid the County Health Departments, Commission staff sponsored a one day seminar to review the NJDEP's septic system management rules and reviewed the requirements of the Commission's alternate design septic system pilot program. Subsequently, Commission staff met individually with each of the Health Departments to review the DEP's O&M requirements and to provide updated lists of the location and contract status of each alternate design systems within their jurisdiction.

Further, the Commission is committed to developing an enhanced O&M management tracking system to keep the County Health Department's apprised of the status of O&M contracts.

A) Staff recommends that Commission continue to insist on the professional operation and maintenance (O&M) of advanced treatment systems and continue to support the NJDEP's requirement for professional O&M on advanced wastewater treatment systems. The Commission should also continue to assist the Pinelands Area Health Departments identify the location and management contract status of systems and provide contact information of qualified system personnel to the health departments and system owners including the development of an enhanced O&M tracking system.

Questions related to the Pinelands Alternate Design Treatment Systems Pilot Program should be directed to Ed Wengrowski, Environmental Technologies Coordinator, at ed.wengrowski@pinelands.nj.gov or (609) 894-7300.

Appendix 1

Background

To safeguard Pinelands water resources, the water quality standards of the Pinelands Comprehensive Management Plan (CMP), (available for download at http://www.state.nj.us/pinelands/cmp/) focus on controlling the amount of nitrogen that enters the environment. Nitrogen is a significant point and nonpoint source pollutant due to its role in the eutrophication of surface water bodies. It is a useful indicator of overall Pinelands water quality and ecosystem health because it is naturally present in very low concentrations in the Pinelands environment.

The CMP's water quality standards permit the use of on-site septic systems (individual subsurface sewage disposal systems) provided that the design of the system and the size of the parcel on which the system is located will ensure that the concentration of nitrogen in the ground water exiting the parcel or entering a surface water body will meet the Commission's water quality standard of two parts per million (ppm). The CMP uses the Pinelands Septic Dilution Model to calculate nitrogen loading to groundwater from septic systems and to confirm that proposed loadings do not exceed the assimilative capacity of the environment. When standard values for home occupancy, wastewater volume, wastewater strength, and rainfall infiltration are used in solving the model, the model provides that a minimum 3.2 acre parcel is required to dilute nitrogen to the required two ppm concentration when a conventional septic system is used.

Conventional septic systems, typically consisting of a septic tank and effluent dispersal field (and sometimes a pump and dosing tank), effectively remove pathogens from wastewater when properly designed, sited and maintained. However, these systems do little to remove or attenuate nitrogen in wastewater. Thus, unsewered residential development using conventional septic systems are permitted only on minimum 3.2 acre parcels where sufficient land area is available to meet nitrogen-based water quality standards through dilution.

In order to comply with the Pinelands water quality standard, unsewered residential development on parcels smaller than 3.2 acres, where specifically permitted by the CMP, must use an advanced denitrifying wastewater treatment system. These systems employ technology that has the capability of reducing the mass of nitrogen in wastewater, and depending in the resultant nitrogen concentration, the minimum parcel size required to meet the 2 ppm nitrogen standard may be reduced from 3.2 acres down to a minimum 1.0 acre.

In an effort to identify advanced onsite wastewater treatment technologies that could be relied upon to reduce the mass of nitrogen in residential wastewater, the Pinelands Commission convened a special Pinelands Ad Hoc Committee on Alternative Septic Systems (Committee) in 2000. The Committee researched advanced septic system technologies that had the potential to meet the water quality requirements of the Pinelands Comprehensive Management Plan (CMP)

(N.J.A.C. 7:50-6, Part VII). The Committee's primary focus was directed toward identifying suitable onsite wastewater treatment technologies to serve residential development on lots smaller than 3.2 acres, where such development is authorized pursuant to N.J.A.C. 7:50-5. The Committee's ten member makeup included seven members of the Pinelands Commission, and one representative each from the Pinelands Municipal Council, the Pinelands Preservation Alliance, and the New Jersey Builders Association. Committee members and their affiliation are identified in Appendix 1. In its research efforts, the Committee consulted wastewater engineering professionals, state and regional on-site technology demonstration projects, alternate treatment system technology manufacturers, Pinelands Area county health departments, and other state and local agencies. Throughout the process, the Committee coordinated its research and program development with the New Jersey Department of Environmental Protection (NJDEP).

Residential development using either a conventional or advanced onsite wastewater treatment and disposal system must conform to the lot size and density requirements contained in the municipal land use ordinances that have been certified by the Commission pursuant to N.J.A.C. 7:50-3. Many municipalities have enacted zoning which permits unsewered residential development on lots of less than 3.2 acres. Based upon its research and a professional engineering consultant's findings, the Committee identified five technologies that it determined could be expected to meet Pinelands water quality requirements when used to serve residential development on lots that are smaller than 3.2 acres. In order to meet the Commission's 2 ppm nitrogen standard on a one acre parcel, these technologies would need to reduce the nitrogen concentration in untreated wastewater by approximately 65%, reducing the initial (assumed) concentration of 39.45 ppm down to 14.0 ppm. Similarly, nitrogen reductions on the order of 50%, could allow a particular technology to be used on a minimum 1.5 acre parcel. At the conclusion of its work, the Committee recommended, and the Pinelands Commission approved the establishment of a pilot program to evaluate the nitrogen removal capability of the Amphidrome, Bioclere, Cromaglass, and FAST treatment system technologies for use on minimum one acre parcels and the Ashco RSFIII for use on minimum 1.5 acre parcels.

The Commission's decision to implement a pilot program to test the nitrogen removal capabilities of each of the advanced treatment technologies, as opposed to simply accepting the findings of others, has proven to be well-advised. While several of the piloted technologies have met (or exceeded) original expectations, others have not. A technology's inability to meet original expectations is likely explained by the real-world circumstances under which the Commission's pilot program evaluates wastewater treatment technologies as opposed to the controlled and homogenous wastewater conditions under which technologies are often assessed in third party trials.

Appendix 2

Pinelands Ad Hoc Committee on Alternative Septic Systems
Members and Affiliation

S. Joseph Kowalski, Pinelands Commissioner
Candace McKee Ashmun, Pinelands Commissioner
Sally Dudley, Pinelands Commissioner
Linda M. Eckenhoff, Pinelands Commissioner
Theodore Gordon, Pinelands Commissioner
Jay Edward Mounier, Pinelands Commissioner
Norman F. Tomasello, Pinelands Commissioner
Edward McGlinchey, Pinelands Municipal Council
Lee Rosenson, Pinelands Preservation Alliance
John Sheridan, New Jersey Builders Association