ANNUAL REPORT
TO THE NEW JERSEY PINELANDS COMMISSION

ALTERNATE DESIGN TREATMENT SYSTEMS
PILOT PROGRAM

August 5, 2018

Executive Summary

In March of 2002 the Pineland Commission convened an ad hoc committee to evaluate the feasibility of using high performance septic system as a way for residential development to meet Pinelands water quality standards where the proposed development parcel is not large enough for the water quality standard to be met through dilution.

The ad hoc committee determined that high performance septic systems were commercially available and that several of these technologies were purported to remove nitrogen to the extent necessary, in combination with dilution, to meet the Pinelands water quality standard.

Acting on the ad hoc committee's recommendation, in August 2002 the Pinelands Commission authorized an amendment to the Pinelands Comprehensive Management Plan (CMP) to establish a pilot program to determine whether specifically authorized technologies could be installed, operated and maintained by homeowners in a manner that meets the water quality objectives.

During the intervening 16 year period since the establishment of the pilot program, the Commission has identified three technologies that are capable of meeting the Pinelands ground water quality standard of 2 mg/l total nitrogen when used on appropriately sized parcels. Specifically, the Amphidrome and Bioclere treatment technologies can meet the standard when used on minimum 1 acre parcels and the FAST treatment technology can meet the standard when used on minimum 1.4 acre parcels.

Two technologies were removed from the pilot program; the Ashco RSF III system because its manufacturer could not supply units to the Pinelands Area and the Cromaglass technology for its inability to remove nitrogen to the degree necessary to meet the water quality standard. The BioBarrier and SeptiTech technologies continue to be tested to determine if they can meet the standard and if they can, the minimum parcel size required for them to do so. Two other technologies, the Hoot ANR and Busse GT are authorized for use in the pilot program but as of the date of this report, none has been installed. Through June 2018, there are 320 residential alternate design treatment systems installed in the Pinelands Area.

Pursuant to the pilot program rules, all of these advanced wastewater treatment technologies are subject to warranty, deed notice, and system operation and maintenance requirements.
In addition to the advanced treatment systems serving residential development in the Pinelands Area, the Commission has also successfully authorized commercial development to use similar systems to meet Pinelands water quality standards.

The Commission will continue to monitor the performance of the technologies that are in the piloting stage and will release a pilot program implementation report in November 2019 that will include future program recommendations.

Background

The Federal National Parks and Recreation Act (1978) and New Jersey Pinelands Protection Act (1979) call for the preservation, protection and enhancement of the unique Pinelands ecosystem and its land and water resources. The exceptional quality of Pinelands water resources is protected and maintained through the control of development and other land uses and through close cooperation and coordination between local, state and federal agencies. To safeguard Pinelands water resources, the water quality provisions 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. In recent years, there has been much attention focused on the role that excessive nitrogen has played in the decline of the Barnegat Bay ecosystem. The Pinelands Area accounts for 33% of Barnegat Bay's Watershed and efforts to control nitrogen releases in the Pinelands Area can have a significant impact on both the Pinelands and Barnegat Bay. The Pinelands CMP has long recognized the importance of controlling nitrogen on both local and regional scales and provides for the establishment of land use policies and engineering solutions to protect the region's sensitive ecology.

The Commission's land use program discourages development in important ecological and agricultural areas while directing growth towards more suitable areas. While some of the designated growth areas are served by central sewer systems, others are not. In these unsewered growth areas, municipalities may zone for residential development on lots as small as one acre. One acre lots are also permitted in non-growth areas if certain cultural housing and grandfathered ownership conditions are met. In very limited instances, waivers of strict compliance allow for development of unsewered dwellings on lots as small as 20,000 square feet.

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 calculates that a minimum 3.2 acre parcel is required to dilute nitrogen to the required two ppm concentration when conventional septic system technology is used. Conventional septic system technology, typically consisting of a septic tank and effluent dispersal field (and sometimes a pump and dosing tank), effectively removes pathogens from wastewater when properly designed, sited and maintained. However, this technology does not remove or attenuate nitrogen in wastewater. Thus, unsewered residential development using conventional septic system technology is 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 requires the use of high performance or advanced denitrifying wastewater treatment technology. If the mass of nitrogen contained in wastewater discharged from an on-site septic system is sufficiently reduced through the use of an advanced treatment system, the Pinelands Septic Dilution Model calculates that the minimum parcel size required to meet the 2 ppm nitrogen concentration may be reduced from 3.2 acres down to a minimum 1.0 acre.

The basic principles of biological nitrogen reduction (BNR) in wastewater treatment are well documented in the scientific and engineering literature. In fact, biological nitrification and denitrification is now routinely employed at many large scale regional sewage treatment plants, especially those that discharge treated effluent to environmentally sensitive receiving waters. These treatment facilities employ professionally trained and licensed operators and have the ability to enhance nitrogen removal through the use of chemical feed equipment and to make real time process modifications in response to changing influent wastewater characteristics.

The use of biological denitrification technologies at the much smaller scale of individual onsite systems is a relatively recent development. The US EPA as well as a number of individual states and regions have developed and are currently administering programs to study the effectiveness of onsite wastewater denitrification treatment technologies. The Ad Hoc Committee On Alternative Septic Systems, convened by the Pinelands Commission in March 2000, conducted a thorough review of this ongoing work to evaluate alternate treatment technologies nationwide, consulted with officials from other state and university programs involved with advanced on-site septic system technologies and management strategies, retained an engineering consultant to assess the performance of selected technologies, met with treatment system manufacturers and county health officials, and coordinated research efforts with the New Jersey Department of Environmental Protection (NJDEP). After completing this work, the Pinelands Commission's Committee on Alternative Septic Systems recommended the establishment of a pilot program to test five specific onsite wastewater treatment technologies. (The pilot program has subsequently been expanded to test an additional four advanced treatment technologies). The Alternative Design Wastewater Treatment Systems Pilot Program detailed in the CMP at N.J.A.C. 7:50-10.21 is authorized as a means to test whether these advanced treatment technologies can be operated and maintained in a manner that meets Pinelands water quality standards, with maintenance requirements that a homeowner can reasonably be expected to follow.

Abridged timeline for the Pinelands Alternate Design Wastewater Treatment Systems Pilot Program:

Aug. 5, 2002	Effective date of the pilot program; residential development applications received after this date for parcels smaller than 3.2 acres that are not served by public sewer are required to use a Pinelands alternate design wastewater treatment system. Completed applications received prior to this date were permitted to use a pressure dosing septic system, provided the installation was completed by August 5, 2004.
Nov. 3, 2006	Executive Director's Implementation Report issued to the Commission (available at: http://www.state.nj.us/pinelands/images/pdf%20files/Final_110306_Pilot_Septic_Implem_Rpt_.pdf.) The report recommended the removal of the Ashco RFS III system from the pilot program due to its commercial unavailability, imposition of a temporary suspension of new Cromaglass installations based upon non-attainment of effluent total nitrogen targets and the establishment of various pilot program deadlines to allow continued installation of the pilot program systems.
June 15, 2009	Publication of proposed CMP amendments (N.J.A.C. 7:50-2.11, 3.39 and 6.85) addressing septic system management.
Nov. 5, 2009	Executive Director's second Implementation Report issued to the Commission (available at http://www.state.nj.us/pinelands/landuse/waste/Final_Nov%202009_ImplementationReport.pdf). The report discussed the nitrogen removal efficiencies of the treatment technologies, system maintenance requirements, treatment technology costs and system operational issues. The Report also contained an evaluation of the number of systems installed and a determination as to the adequacy of that number to render a final determination on the effectiveness of the treatment technologies in meeting the purposes and objectives of the State and Federal Pinelands Protection Acts.
June 7, 2010	Effective date of CMP amendments that established requirements for the long-term management of Pinelands alternate design wastewater treatment systems.
Oct. 18, 2010	Effective date of CMP amendment authorizing permanent approval of the Amphidrome and Bioclere technologies to serve residential development on minimum 1 acre parcels. The amendment also authorized the addition of up to four new NSF 245 USEPA ETV certified treatment technologies to the pilot program for installation through August 5, 2016.
Dec. 5, 2011	Notice published in the New Jersey Register announcing acceptance of the four "new" technologies (BioBarrier, Busse Green, Hoot ANR and SeptiTech) for participation in the pilot program.

Nov. 5, 2012	Executive Director's third Implementation Report issued to the Commission (available at: https://www.nj.gov/pinelands/landuse/current/altseptic/Final%20Nov%202012_ImplementationReport.pdf). The report recommended an extension of the deadline to install FAST and Cromaglass treatment systems to determine if retrofits to these technologies would result in improved nitrogen attenuation.
Sept. 2, 2014	Effective date of CMP amendments to eliminate the Cromaglass technology from the pilot program and to extend until August 5, 2018, the last day to install a FAST, BioBarrier, Busse GT, Hoot ANR and SeptiTech treatment technology.
March 5, 2018	Effective date of CMP amendment authorizing permanent approval of the FAST technology to serve residential development on minimum 1.4 acre parcels.
April 27, 2018	Executive Director's issuance of the Nov. 5, 2017 fourth Implementation Report (updated through April 27, 2018) which is available at: https://www.nj.gov/pinelands/landuse/current/altseptic/Final%20April%2027%202018%20%202018_ImplementationReport.pdf. This report recommended elimination of the August 5, 2018 installation deadline, with the discontinuation of any non-compliant technology effectuated by action of the Executive Director; the continued piloting of the SeptiTech and BioBarrier technologies (on minimum 1.7 acre parcels) to evaluate if nitrogen attenuation has improved due to actions undertaken by the technology vendors; that a follow-up implementation report be issued in November 2019; that consideration be given to suspending the Busse GT technology if no Busse GT systems are installed by Nov. 5, 2019 ; that consideration be given to introducing additional NSF 245 / USEPA ETV certified technologies to the pilot program; and that the Commission continue to assist the Pinelands Area Health Departments in their compliance with NJDEP's requirement for tracking the operation and maintenance of advanced wastewater treatment systems.
July 16, 2018	Rule proposal published in the New Jersey Register to allow for continued installation of BioBarrier, Busse GT, Hoot ANR and SeptiTech wastewater treatment technologies in the Pinelands Area beyond the current deadline of August 5, 2018.
August 5, 2018	Last day to install the BioBarrier, Busse GT, Hoot ANR and SeptiTech treatment technologies unless the Commission adopts an amendment to the CMP that expressly authorizes such installations beyond this date.
December 2018	Anticipated effective date of the rule proposed on July 16, 2018 to permit the continued installation of BioBarrier, Busse GT, Hoot ANR and SeptiTech wastewater treatment beyond the current deadline of August 5, 2018.

Introduction

Amendments to the CMP establishing the Pinelands Alternate Design Wastewater Treatment System Pilot Program became effective on August 5, 2002. The rule requires that the Executive Director submit an annual report to the Commission describing activity to date on the installation, maintenance and performance of each of the alternate design wastewater treatment technologies. This sixteenth annual report is submitted to fulfill the annual reporting requirement.

Before any of the approved technologies could be used within the Pinelands Area, the manufacturer of each treatment technology had to first submit and the Executive Director had to first approve detailed engineering plans and system specifications, details on the automatic remote malfunction alarm system, a wastewater sampling protocol, an operation and maintenance manual, a sample five year warranty, a sample five year operation and maintenance contract, and a sample deed notice. In addition, the New Jersey Department of Environmental Protection (NJDEP) had to first issue a Treatment Works Approval (TWA) authorizing local/county health departments to approve such systems pursuant to N.J.A.C 7:9A Standards for Individual Subsurface Sewage Disposal Systems (7:9A-3.9(a)4).

Use of the high performance alternative onsite wastewater treatment systems is now authorized in each of the Pinelands Area municipalities as a result of amendments to the CMP that became effective on December 3, 2007. Prior to that amendment, the pilot program technologies were only authorized for use in municipalities that had adopted an ordinance to implement the pilot program. Although most municipalities had adopted the requisite ordinance (34 of 40), the Commission found that applicants in the non-adopting municipalities were unable to proceed with their applications and as a result, were subjected to considerable hardship. The December 3, 2007 amendments provided applicants in those municipalities with needed relief as they are now permitted to use a pilot program treatment system on an otherwise developable parcel. Details of this amendment are discussed below.

The CMP also requires that each technology manufacturer or its agent submit a semi-annual report to the Executive Director. Such reports must include information on the number of systems installed, a discussion on the installation of systems, an analysis and evaluation of wastewater monitoring results to date, and a discussion of any operational or maintenance issues experienced.

Summary of Program Activity

The Pinelands Alternate Design Wastewater Treatment Systems Pilot Program was made possible as a result of two consecutive funding grants provided by the NJDEP (Grant Identifiers RP02-012 and RP05-056). In May 2009, Commission staff satisfied the final grant deliverable by providing the NJDEP, Division of Watershed Management with the Final Report on the "Atlantic Coastal Watershed Region Program Grant: Decentralized Wastewater Management in the Mullica River Basin and Other Pinelands Watersheds". The pilot program is now financed solely by the Pinelands Commission. The Commission posts the findings of the pilot program on it's website to further the technology transfer goals of the program and to share relevant information with other entities engaged in protecting ecologically sensitive regions. The Commission also distributes copies of its annual report to the NJDEP and to the seven Pinelands Area county health departments having jurisdiction in the Pinelands Area.

Septic System Management Initiatives

Pinelands Commission [N.J.A.C 7:50] Pinelands Comprehensive Management Plan

Since its inception, the Pinelands Commission has recognized the environmental benefits of periodic septic system maintenance. The CMP has long required that septic systems in the Pinelands be inspected and pumped at least once every three years and that written proof of maintenance be submitted to the local boards of health. In June 2009, the Commission proposed several amendments to the CMP at N.J.A.C. 7:50-2.11, 3.35, and 6.85 to further address septic system management. Those proposed amendments were related to the management of both conventional septic systems as well as advanced pilot program treatment systems. The rule proposal aimed to establish a framework for institutional or governmental programs to ensure the proper long-term operation and maintenance of all onsite wastewater systems in the Pinelands.

The Commission received extensive public comment on the septic system management rule proposal. A great number of the comments were opposed to requirements for the management of conventional septic systems. Responding to public opposition, the Commission withdrew the section of the proposal related to conventional septic systems and adopted only those portions of the proposal that required long term management of the advanced pilot program technologies. This action resulted in the continuation of the existing CMP rule related to the triennial inspection and pumping of conventional septic systems. In April of 2012, NJDEP adopted comprehensive amendments to the Standards for Individual Subsurface Disposal Systems (see N.J.A.C 7:9A-8.3 and 12.3, discussed in more depth below). These amendments addressed the long-term management of advanced pretreatment systems, including the Pinelands alternate design treatment systems. In light of the adoption of duplicative NJDEP regulations, in July 2017, the Commission approved proposed amendments to the CMP to eliminate the Commission's now redundant septic system management requirements, aiming to unify and simplify the statewide management of advanced wastewater treatment systems under NJDEP's equally protective rules.

In April 2013, Commission staff organized, hosted and led an interagency meeting between Commission staff, NJDEP and representatives of the seven Pinelands Area Health Departments to review the NJDEP's septic system management requirements. This meeting was instrumental in clarifying the applicable rules and in raising awareness of the management obligations of the participating regulatory entities.

The Commission has continued its efforts to inform the county health departments of their responsibilities under N.J.A.C 7:9A-7:9A-8.3(e) and N.J.A.C 7:9A-12.3, aimed at ensuring that advanced treatment systems are properly operated and maintained. The Commission's staff has further worked to inform the advanced treatment system service providers of their own obligations specified at N.J.A.C 7:12.3(d). This NJDEP regulation requires the service providers to notify the county health officials when a service contract has lapsed, so that the health officials can follow-up with the system owners. Pilot program systems that are not covered by a service contract with an authorized service provider are deemed by NJDEP's rules to be non-compliant systems. In the Pinelands Area, county health officials are charged with enforcing these NJDEP's regulations.

NJDEP [N.J.A.C. 7:15] Water Quality Management Plan

In addition to the septic system management requirements contained in N.J.A.C 7:9A, additional septic system management requirements are specified in NJDEP's Water Quality Management Planning (WQMP) rules (N.J.A.C 7:15-4.5(c)1.vi), last amended on November 7, 2016. These state-wide rules require that municipalities demonstrate that areas served by septic systems are subject to a mandatory maintenance program, such as an ordinance, to ensure that all septic systems are functioning properly. The applicability of this NJDEP rule was discussed during the April 2013 interagency management meeting.

NJDEP [N.JAC. 7:9A] Standards for Individual Subsurface Sewage Disposal Systems

In April 2012, the NJDEP readopted state-wide Standards for Individual Subsurface Sewage Disposal Systems (Standards) (N.J.A.C 7:9A). These rules require that local/county health departments provide operation and maintenance information triennially to septic system owners whose systems were approved after January 1, 1990. The comprehensive notices must include:

1. A general outline of how septic systems work and the potential impact of improper operation on ground and surface water quality and public health;
2. The recommended frequency of septic tank and grease trap pumping and instructions on how to determine when pumping is necessary;
3. A list of materials containing toxic substances that are prohibited from being disposed of into a septic system;
4. A list of inert or non-biodegradable substances that should not be disposed of into a septic system;
5. Proper practices for maintaining the area of the septic leach field;
6. Negative impacts to a septic system resulting from excessive water use; and
7. Warning signs for poor system performance or malfunctions and recommended or required corrective actions.

The NJDEP Standards, as amended on April 2, 2012, for the first time, authorize the state-wide use of advanced onsite wastewater treatment systems for new construction without first requiring a Department-issued TWA permit, provided the technology is not being used to meet a state or federal water quality standard. Where the treatment technology is being proposed to meet a state or federal water quality standard, a TWA permit is required. The NJDEP Standards require that local or county health departments maintain records on each advanced treatment system in their jurisdiction and provide annual reports to the NJDEP with respect to the following:

i. The type of advanced wastewater treatment device installed;
ii. The location of each installed device;
iii. The type of use (e.g., residential or commercial);
iv. The type of disposal area (e.g., bed, trench, drip dispersal);
v. The date of installation and startup; and
vi. The date of each inspection and maintenance call.

The NJDEP's system management Standards are, in many ways, similar to those of the Commission's pilot program. For example, the owner of each advanced treatment system must have a service contract in place throughout the life of the system with an authorized service provider. The NJDEP Standards require system owners to provide the local or county health department with a copy of the service contract prior to the health department's initial approval of the system. In the event that a property owner enters into a contract with a different service provider upon expiration of an existing contract, the homeowner must provide the health department with the new contract within 14 days of making the change. Importantly, if a property owner fails to renew a service contract, the previously authorized service provider is required to provide written notice to the health department within 30 days of the contract expiration. Authorized service providers must provide copies of system inspection forms to the health department within 30 days of the inspection. Pursuant to the NJDEP Standards, the failure of a property owner to maintain a service contract on an advanced treatment system constitutes a violation of the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., and constitutes a noncompliance violation of N.J.A.C 7:9A.

The NJDEP Standards that are related to the installation and use of advanced treatment systems apply state-wide to all advanced treatment systems, including the Pinelands alternate design pilot program wastewater treatment systems.

The county health departments have reported that since April 2012, they have approved a significant number of advanced treatment systems for use outside of the Pinelands pilot program. These advanced systems are often proposed to reduce the size and perhaps most commonly the height of disposal field installations by taking advantage of a 2.5 foot reduction in the minimum vertical separation distance required to the seasonal high water table. As a result, the county health departments must ensure proper operation and maintenance is conducted on all advanced treatment systems, not only those authorized for use through the Pinelands pilot program.

Commission staff and NJDEP staff from the Bureau of Nonpoint Pollution Control continue to work to ensure that the Pinelands Area health departments, Pinelands alternate design treatment system manufacturers and service providers are aware of the NJDEP's April 2, 2012 rule adoption, particularly with respect to the NJDEP's operation and maintenance contract requirements and health department enforcement provisions.

Educational Resources

The Commission staff continues to provide assistance to Pinelands Area municipalities and health departments to help them comply with the NJDEP's (N.J.A.C. 7:15 and N.J.A.C. 7:9A) septic system management requirements. The Commission has produced a number of useful educational documents for use by residents and public health officials.

Municipalities and health departments are encouraged to consult the *Onsite Wastewater Systems Management Manual for the New Jersey Pinelands*, (prepared by Stone Environmental, Inc. under contract to the Commission) http://www.state.nj.us/pinelands/landuse/current/septic/WW%20Mgt%20Manual_2008.09.05.pdf for guidance on the establishment of septic system management programs. This manual explores several management models for municipalities and others to consider and provides flexibility in the selection of any single model or any combination of model elements that are locally appropriate. In addition, municipalities and health departments are also encouraged to consult the report entitled *Legal Basis and Regulatory Framework of Onsite Wastewater Management in the New Jersey Pinelands* (also prepared by Stone Environmental, Inc. under contract to the Commission). http://www.state.nj.us/pinelands/landuse/current/septic/Pinelands_OWTS_Legal_Framework_Final.pdf These reports, as well as other related materials, including an informative septic system maintenance guidance document directed at homeowners, are posted on the Commission's website at www.nj.gov/pinelands. In addition, Commission staff produces and distributes training materials at the Rutgers Onsite Wastewater Treatment Systems seminars offered each year through Rutgers University's Office of Continuing Professional Education.

Pilot Program Amendments

Since the original adoption of the pilot program in August 2002, several pilot program-related amendments to the CMP have been adopted. These include:

1. A remedy for land owners in municipalities that had not yet adopted ordinances to implement the pilot program;

2. Removal of one technology (Ashco RFS^{III}) from the pilot program due to the manufacturer's inability to provide the technology to Pinelands residents;

3. Providing for management of pilot program treatment systems beyond the original five year mandatory maintenance contract period;

4. Extending the period of the pilot program to better evaluate both existing and new treatment technologies;

5. Granting permanent approval status to three of the pilot program technologies (Amphidrome, Bioclere and FAST);

6. Eliminating Cromaglass from the pilot program due to its inability to meet Pinelands water quality standards;

7. Authorizing the Commission to approve up to four new pre-screened NSF International / American National Standards Institute (ANSI) Standard 245 and/or United States Environmental Protection Agency - Environmental Technology Verification (USEPA ETV) certified technologies to participate in the pilot program. The Commission has approved the BioBarrier, SeptiTech, Hoot ANR and Busse Green GT systems to participate in the pilot program;

8. Requiring that local /county boards of health withhold certificates of compliance or similar authorizations which would permit the occupancy of a building served by an alternative design wastewater treatment system until such time as the Pinelands Commission provides written authorization to the local board of health that such a system may be authorized for use;

9. Extending the duration of the pilot program until August 5, 2018; and

10. Simplifying the requirements for the management of advanced treatment systems by removing the duplicative requirements in the CMP and relying instead on the NJDEP's comprehensive advanced system management requirements contained in N.J.A.C 7:9A.

In addition, the Commission is currently proposing a CMP amendment to permit the installation of pilot program technologies indefinitely in recognition of the Executive Director's ability to increase the minimum required parcel size or to suspend any technology's participation in the pilot program for failure to comply with the program requirements.

NJDEP Treatment Works Approvals

The NJDEP has provided welcome assistance to the Commission throughout the development and implementation of the pilot program. As noted above, the NJDEP reissued a Generic TWA to expedite local health department approvals of all of the Pinelands pilot program systems. The TWA permit allows the use of the Pinelands pilot program systems without individual applicants being subject to the standard $850 NJDEP permit fee or the standard 90 day review period. The expedited NJDEP Generic TWA Permit has been well received by both the regulatory and development community. It has proven to be an effective instrument by allowing individual applications to be approved directly by the Pinelands county health departments, resulting in significant time and expense savings to applicants.

Importantly, the generic TWA applies only to residential development that proposes to use a pilot program treatment system. Commercial development that proposes to use an advanced wastewater treatment system in order to meet Pinelands water quality standards must attain an individual TWA from NJDEP, pursuant to the requirements at N.J.A.C 7:9A-3.9(a)4.

Local and Regional Training and Technology Transfer

Throughout the duration of the pilot program, Commission staff has participated in a number of local, regional, and national educational conferences to share the Commission's experiences. Staff has developed targeted training sessions for each of the Pinelands Area Health Departments to review Pinelands and NJDEP septic system regulations, fundamentals of biological nutrient removal, and design, operation and maintenance requirements for advanced onsite treatment technologies. Representative regional training sessions include a USEPA conference in Mt. Kisco, NY, multiple New Jersey Environmental Health Association conferences in Atlantic City, NJ, a National Environmental Health Association conference in Atlantic City, NJ, a Massachusetts Health Officers Association conference in Springfield, MA, a New England Interstate Water Pollution Control Commission conference in Groton, CT, a National Environmental Health Association conference in Tucson, AZ, a Central Pine Barrens (Long Island) Joint Planning Commission conference in Brookhaven, NY, a Peconic Bay (Long Island) Advanced Wastewater Treatment Systems Water Quality Symposium in Hauppauge, NY, and a keynote address at the Onsite Water Protection Conference at North Carolina State University in Raleigh, N.C.

Commission staff has met with each of the Pinelands Area health departments to facilitate implementation of the pilot program and to assist the health departments in their review of plans and applications and to train inspectors on the alternative treatment technologies. In addition, Commission staff presents annually at the Rutgers/NJDEP Onsite Wastewater Treatment Systems Seminars held in New Brunswick and Bordentown, NJ. The Rutgers/ NJDEP program provides classroom training to professionals engaged in the onsite wastewater industry including state, local, regional and state-agency public health professionals, advanced treatment system manufacturers, septic system design engineers, system installers, and onsite system service providers. In addition, staff assists Pinelands Area residents by responding to questions related to the care and use of onsite wastewater systems. Moreover, Commission staff has conducted evening workshops throughout the Pinelands Area to enhance awareness of the connection between septic system maintenance and clean water, property values and public health. Lastly, commission staff regularly provides telephone assistance to homeowners, builders, developers and consulting engineers in complying with the requirements of the pilot program.

Treatment Technologies Installation Summary

The Alternate Design Treatment Systems Pilot Program was adopted through an August 5, 2002 amendment to the CMP. The pilot program originally included the first five technologies listed below. It has since been expanded to include four additional NSF Standard 245 and USEPA ETV certified treatment technologies. The complete list of pilot program technologies includes:

1. ~~Ashco RFS~~ III [a]
2. Amphidrome[b]
3. Bioclere[b]
4. ~~Cromaglass~~[c]
5. FAST[d]
6. BioBarrier
7. Hoot ANR
8. Busse GT
9. SeptiTech

Notes:

[a]Amendments to the CMP, effective December 3, 2007, removed the Ashco RFS III from the pilot program due to the manufacturer's failure to make the system commercially available in the Pinelands during the initial five year period of the pilot program and to otherwise demonstrate the ability or intention for future participation in the program.

[b]Amendments to the CMP, effective October 18, 2010, permanently approved the Amphidrome and Bioclere technologies for use on minimum 1.0 acre parcels.

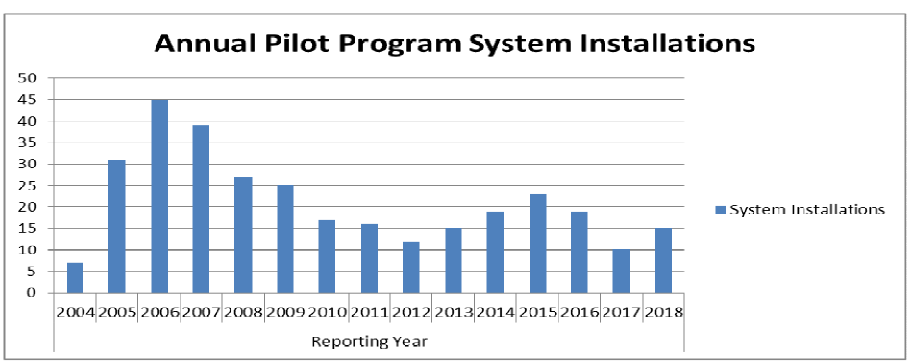
[c]Amendments to the CMP, effective September 2, 2014, removed the Cromaglass technology from the pilot program due to the technology's inability to meet Pinelands water quality standards and to otherwise demonstrate the ability or intention for future participation in the program. Installation of the Cromaglass technology ceased before that date as the result of a temporary suspension instituted by the Commission in 2006. Sixteen applicants with prior construction approvals were permitted to install the Cromaglass system after the imposition of the temporary suspension.

[d]Amendments to the CMP, effective March 5, 2018, permanently approved the FAST technology for use on minimum 1.4 acre parcels.

Three hundred and twenty (320) Pinelands alternate design treatment systems have been installed and activated through June 5, 2018. The first pilot program system came online in April 2004. Fifteen systems were installed during the current reporting period (July 2017 through June 2018). The following tables and figures summarize annual installations of each technology and their location.

Installed Pilot Program Technologies by Year of Installation

Technology	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total Installed
Amphidrome	7	10	10	27	12	7	5	8	4	5	1	1	4	2	5	108
Bioclere	0	2	11	9	7	9	6	5	5	5	8	4	4	1	1	77
Cromaglass	0	19	24	3	6	4	3	0	0	0	0	0	0	0	0	59
FAST	0	0	0	0	2	5	3	3	3	5	2	2	0	0	3	28
SeptiTech	Admitted into pilot program in 2013										3	9	11	7	5	35
BioBarrier	Admitted into pilot program in 2013										5	7	0	0	1	13
Total	7	31	45	39	27	25	17	16	12	15	19	23	19	10	15	320

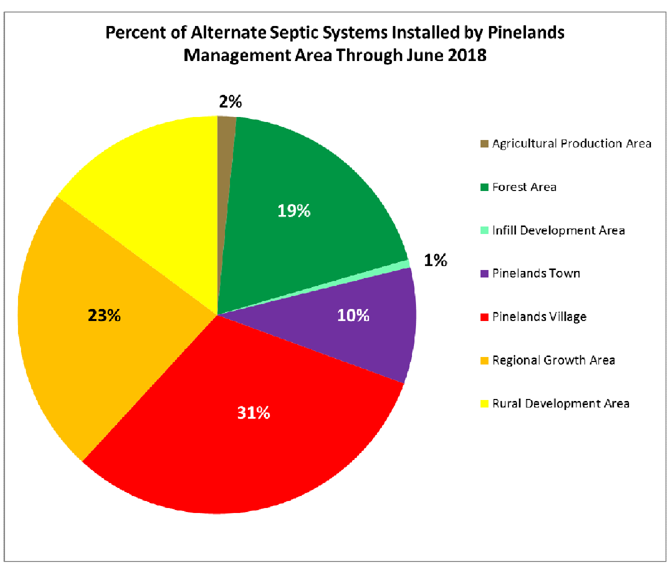


Installed Pilot Program Technologies by County and Municipality

		Technology						
County	Municipality	Amphidrome	Bioclere	Cromaglass	FAST	SeptiTech	BioBarrier	Total
Atlantic	Egg Harbor Twp	2	5		2			9
	Estell Manor		4					4
	Folsom	5	3	1	1			10
	Galloway	1	1		1			3
	Hamilton	15	21	4	1			41
	Hammonton	4	2					6
	Mullica	3	5			1		9
	Port Republic				1			1
Burlington	Evesham	1	1					2
	Medford	3			2	5		10
	Pemberton	12	12	23				47
	Shamong	2						2
	Tabernacle	3	5	1	1	2	1	13
	Washington	1	1					2
	Woodland	1	3		3	1		8
	Bass River							0
Camden	Chesilhurst		1					1
	Waterford	3						3
	Winslow	8	5	4	6	15		38
Cape May	Dennis	1						1
	Upper	2	2					4
	Woodbine		1					1
Gloucester	Franklin	1		1	3			5
	Monroe				2			2
Ocean	Jackson	15	2	16	5	10	12	60
	Lacey	1						1
	Manchester	19	2	9		1		31
	Stafford	5	1					6
		108	77	59	28	35	13	320

Note: The majority of systems installed in Pemberton Township are located in the Presidential Lakes subdivision, which was the subject of a prior Commission approval that required the use of pressure dosing septic systems. Pinelands alternate design treatment systems were not required but were used voluntarily by the developer in response to local water quality concerns.

Alternate Design Systems Installations by Pinelands Management Area



Administrative Approval of Technologies

In accordance with N.J.A.C 7:50-10.22, prior to being certified for use, the manufacturer of each alternate design treatment system had to submit specific documents to the Executive Director for review and approval. These documents included detailed engineering plans and specification, a Homeowners Manual on the proper use and operation of the system, a service provider's Operation and Maintenance Manual, a sample five year warranty, a sample five year operation and maintenance service contract, wastewater sampling and analysis protocols, and a sample deed notice to be filed with the County Clerk prior to the operation of each system to alert future property owners of the need to maintain the pilot program system. Upon approval by the Executive Director, these record documents were distributed to each of the seven Pinelands Area health departments and are on file at the Commission's headquarters.

Technology Approvals – First Round

Ashco-A-Corporation provided the required documentation and based upon a detailed review by Commission staff, the Executive Director approved the **Ashco RFS ^{III} system** effective May 15, 2003. However, as noted above, the Ashco RFS ^{III} was subsequently eliminated from the pilot program due to the firm's inability to supply treatment units to the region.

F.R Mahony & Associates, the manufacturer of the **Amphidrome system**, provided the required documentation and, based upon a detailed review by Commission staff, the Executive Director approved the single family Amphidrome system effective July 24, 2003. Based upon the Pinelands Septic Dilution Model, each Amphidrome system must be located on a parcel containing at least one acre for each dwelling unit to be served by the system. As noted above, the Amphidrome treatment technology has been released from the pilot program and granted permanent approval status in the CMP for residential use on minimum **1.0 acre** parcels. As a result, F.R. Mahony & Associates is no longer required to submit monitoring and operational data to the Commission. The Amphidrome technology must still be designed to accommodate effluent sampling, certified prior to and after construction by the manufacturer or agent and by a NJ licensed professional engineer to be properly designed and operational, equipped with local and remote alarm functionality, sold with a five-year warranty and covered under a renewable operation and maintenance contract for as long as the system is in active use.

Aquapoint, Inc., the manufacturer of the **Bioclere system,** provided the required documentation and, based upon a detailed review by Commission staff, the Executive Director approved the single family Bioclere system effective November 18, 2003. Based upon the Pinelands Septic Dilution Model, each Bioclere system must be located on a parcel containing at least one acre for each dwelling unit to be served by the system. As noted above, the Bioclere treatment technology has been released from the pilot program and granted permanent approval status in the CMP for residential use on minimum **1.0 acre** parcels. As a result, Aquapoint is no longer required to submit monitoring and operational data to the Commission. The Bioclere technology must still be designed to accommodate effluent sampling, certified prior to and after construction by the manufacturer or agent and by a NJ licensed professional engineer to be properly designed and operational, equipped with local and remote alarm functionality, sold with a five-year warranty and covered under a renewable operation and maintenance contract for as long as the system is in active use.

Cromaglass, Inc., the manufacturer of the **Cromaglass system**, provided the required documentation and, based upon a detailed review by Commission staff, the Executive Director approved the Cromaglass system effective December 29, 2004. Based upon the Pinelands Septic Dilution Model, the pilot program originally required that each Cromaglass system be located on a parcel containing at least one acre for each dwelling unit to be served by the system. As discussed herein, the Cromaglass technology was placed under a temporary suspension in November 2006 as a result of the technology's inability to meet expected total nitrogen concentrations in treated effluent. That suspension prohibited future installations of the Cromaglass technology. Effective September 2, 2014, the Cromaglass technology was removed from the pilot program due to the technology's inability to meet Pinelands water quality standards and the manufacture's failure to comply with the requirements of the pilot program. Homeowners in the Pinelands Area that currently use a Cromaglass system are not required to replace it. They have the option to continue to use the system in a manner consistent with the operation and maintenance requirements of N.J.A.C 7:9A-12.3 or, if they choose, they may replace the Cromaglass treatment tank with a conventional septic tank meeting the current requirements of NJDEP's Standards for Individual Subsurface Sewage Disposal Systems.

Bio-Microbics, Inc., the manufacturer of the **FAST system**, provided the required documentation and, based upon a detailed review by Commission staff, the Executive Director approved the FAST system effective June 9, 2005. Based upon the Pinelands Septic Dilution Model, the pilot program originally provided that each FAST system could be located on a parcel containing at least one acre for each dwelling unit to be served by the system. Based upon a comprehensive analysis of all effluent monitoring data collected to date, the FAST system has produced a grand median total nitrogen concentration of **18.2 mg/l**. Application of the Pinelands Septic Dilution Model indicates that the FAST system can be expected to meet the Commission's 2 mg/l total nitrogen standard when it is used to serve residential development on a minimum **1.4 acre** parcel. Accordingly, effective March 5, 2018 the CMP was amended to permanently approve the FAST technology for use on minimum 1.4 acre parcels. The FAST technology must still be designed to accommodate effluent sampling, certified prior to and after construction by the manufacturer or agent and by a NJ licensed professional engineer to be properly designed and operational, equipped with local and remote alarm functionality, sold with a five-year warranty and covered under a renewable operation and maintenance contract for as long as the system is in active use.

Technology Approvals – Second Round

Hoot Systems, LLC, the manufacturer of the **Hoot ANR system**, provided the required documentation (including the NSF Standard 245 certification report) and, based upon a detailed review by Commission staff, the Executive Director approved the single family Hoot ANR system effective September 14, 2011. Based upon the Pinelands Septic Dilution Model, each Hoot ANR system must be located on a parcel containing at least **1.0 acre** for each dwelling unit to be served by the system. There have been no installations of the Hoot technology in the Pinelands Area to date.

SeptiTech, LLC, the manufacturer of the **SeptiTech system,** provided the required documentation (including the NSF Standard 245 certification report) and, based upon a detailed review by Commission staff, the Executive Director approved the single family SeptiTech system effective September 14, 2011. As originally approved, based upon the Pinelands Septic Dilution Model and NSF testing data, each SeptiTech system needed to be located on a parcel containing at least one acre for each dwelling unit to be served by the system. As discussed in more detail below, based upon effluent monitoring data, new applications proposing to use the SeptiTech technology are now required to provide a minimum 1.7 acre parcel. This parcel size increase is in effect on an interim basis and is subject to increase or decrease based on the results of additional monitoring. The latest evaluation of the SeptiTech data demonstrates improved performance since release of the August 5, 2017 annual report, evidently resulting from microprocessor programming modifications. The Commission will continue to monitor the technology's performance, reevaluate the data, and adjust the minimum required parcel size accordingly.

Bio-Microbics, Inc., the manufacturer of the **BioBarrier system**, provided the required documentation (including the NSF Standard 245 certification report) and, based upon a detailed review by Commission staff, the Executive Director approved the single family BioBarrier system effective September 14, 2011. As originally approved, based upon the Pinelands Septic Dilution Model and NSF testing data, each BioBarrier system needed be located on a parcel containing at least one acre for each dwelling unit to be served by the system. As discussed in more detail below, based upon effluent monitoring data, new applications proposing to use the BioBarrier technology are now required to provide a minimum 1.7 acre parcel. This parcel size increase is in effect on an interim basis and is subject to increase or decrease based on the results of additional monitoring. The latest evaluation of the BioBarrier data has not demonstrated improved nitrogen attenuation performance. The Commission will continue to monitor the technology's performance, reevaluate the data, and adjust the minimum required parcel size accordingly.

Busse Green Technologies, Inc., the manufacturer of the **Busse GT system**, provided the required documentation (including the NSF Standard 245 certification report) and, based upon a detailed review by Commission staff, the Executive Director approved the single family Busse Green MBR system effective September 14, 2011. Based upon the Pinelands Septic Dilution Model, each Busse Green MBR system must be located on a parcel containing at least **1.0 acre** for each dwelling unit to be served by the system. There have been no installations of the Busse GT technology to date in the Pinelands Area.

System Permitting and Local Approvals

The pilot program relies upon the cooperation of local construction code officials, county health officials, treatment system manufacturers, system installers, certifying engineers and Pinelands staff to coordinate the approval of wastewater system engineering plans, the issuance of building permits, the approval of wastewater system installations and the issuance of certificates to occupy residences served by the alternative treatment technologies. Prior to any Pinelands alternative treatment system receiving a final operational approval, the Pinelands Area health departments and the Pinelands Commission are to receive an executed five year maintenance contract, five year warranty, three year wastewater sample and analysis protocol (for systems being piloted), deed notice, as-built plan and construction certification from the technology manufacturer and a NJ licensed engineer. While these documents have been received in the majority of cases, there have been instances where certificates of occupancy were issued before all required documentation was received by the health department and the Pinelands Commission. In these cases, Pinelands staff has to work with the technology vendors, homeowners and agency officials to obtain the needed documentation after the fact, often a difficult and time consuming task. Pinelands staff continue to work with the local agencies to educate them on the importance of assuring that all necessary documents are on file before issuing local approvals for home occupancy. To further help address this issue, amendments to the CMP were adopted in October 2010 to specifically require that local boards of health withhold certificates of compliance or similar authorizations which would permit the occupancy of a building served by an alternative design wastewater treatment system until such time as the Pinelands Commission provides written authorization to the local board of health that such a system is authorized for use.

Operation and Maintenance Summary

The manufacturer of the Amphidrome system, F.R. Mahony Associates, has instituted an effective program to assist contractors and engineers on the proper installation of the technology. The firm offers installer training with each system delivered and provides ongoing technical support to address contractor inquiries through its authorized service provider, Site Specific Design, Inc.

Aquapoint, the manufacturer of the Bioclere system, has also instituted an effective program to assist contractors and engineers on the proper installation of the technology and has utilized the services of Advanced Nitrate Solutions in the local sale, installation, operation and maintenance of the Bioclere technology.

During the period of 2005-2009, Cromaglass systems were installed and serviced exclusively by Mid State Electric, Cromaglass' authorized treatment system installation and servicing contractor. Cromaglass Corporation discontinued using Mid-State as its serving agent and until going out of business, was servicing the units directly. Cromaglass is reportedly no longer servicing its treatment units. Pursuant to the CMP, owners of existing Cromaglass units may contract with service providers that hold a NJDEP public wastewater treatment system operator's license at the S2 level or higher. Alternately, these homeowners may elect to replace the Cromaglass treatment tank with a conventional septic tank that meets the requirements of N.J.A.C 7:9A-8.2.

Bio-Microbics, the manufacturer of the FAST and BioBarrier systems, has designated Site Specific Design, Inc. as its authorized service agent for the servicing of the FAST and Bio Barrier technologies. Site Specific Design reports no alarm related events during the current reporting period. The firm has previously repaired or replaced airlifts on eleven previously installed FAST systems and extended recycling troughs on five systems to enhance the return of nitrified wastewater to the unit's anoxic chambers. Subsequent to these system repairs, the firm has addressed airlift issues during eight subsequent system installations. After system modifications, the Bio-Microbics FAST system has achieved an overall median total nitrogen concentration of 18.2 mg/l in treated effluent leading to its permanent authorization on 1.4 acre parcels. Bio-Microbics is required, under the terms of the pilot program, to trouble shoot the inadequate nitrogen attenuation performance of existing BioBarrier systems and must do so until the existing systems achieve total nitrogen concentrations of less than or equal to 14.0 mg/l.

SeptiTech, the manufacturer of the SeptiTech technology has designated both Site Specific Design, Inc. and South Jersey Engineers as authorized service agents providing operation and maintenance service on SeptiTech systems. In order to be authorized for use on minimum one acre parcels,(down from the current authorization for use on minimum 1.7 acre lots) SeptiTech is required, under the terms of the pilot program, to trouble shoot the performance of existing SeptiTech systems such that the existing systems achieve total nitrogen concentrations of less than or equal to 14.0 mg/l in treated effluent. To that end, SeptiTech has adjusted software controls on its systems and has made considerable progress in improving the treatment systems performance.

In addition to the servicing agents that are authorized by the technology manufacturers, both the Commission's and NJDEP's rules authorize individuals that possess a S2 or higher NJ Wastewater Treatment Plant Operator's License to provide operation and maintenance services on the Pinelands pilot program systems. In an effort to facilitate consumer choice and competition, Commission staff continues to encourage the New Jersey Water Environment Association (the professional association representing NJ's licensed wastewater operators) to alert its member to business opportunities that would expand the number of licensed individuals that offer operation and maintenance services on the pilot program systems.

Cost Summary

The pilot program requires the collection and reporting of cost data for each treatment technology. To facilitate monitoring of treatment system costs, the CMP requires the technology vendors to report the cost of each individual treatment system installation to the Commission.

The total cost of an onsite wastewater treatment system consists of at least three components. These include the cost of the treatment unit, its installation and its 5 year service package, the cost of the soil absorption system and its installation (e.g., excavation, replacement soil, stone and pipe), and the cost of engineering, surveying, and other permit and inspection services. The treatment unit manufacturers can readily provide the Commission with information on the cost of their equipment and related support services, which in the case of the Pinelands pilot program includes a five year maintenance contract, five year warranty, and three years of quarterly effluent analysis (for systems being piloted). The vendors, however, do not have direct knowledge of the cost of the soil absorption field installation, other installation and labor costs, or the cost for engineering (soil testing, system design, as-built plans, etc.) of the system. This site specific information is typically supplied by the homeowner or builder to the treatment system vendor who in turn supplies it to the Commission.

Table 1 on the following page summarizes average treatment system costs based upon information provided to the Commission by the system vendors, as supplemented by the homeowner or builder. Actual treatment unit costs, including equipment, five year operation and maintenance service contracts, five year warranties and the three year sampling program have remained relatively stable or have declined since the inception of the pilot program. Both FR Mahony and AquaPoint report that they have lowered the cost for their equipment since having attained permanent approval status and the discontinuation of required wastewater effluent sampling and reporting to the Commission. Figure 1 provides system cost comparisons during 2006, 2009, 2012 and 2017, the years in which pilot program implementation reports were issued.

Annual fluctuations in the average total system installation cost (including construction related expenses) have occurred since the inception of the pilot program. This variability is generally attributable to differences in the cost of non-treatment unit components, including material quantities and labor that vary on a system by system basis. Rarely are two individual system designs and material quantities identical. Variability in the cost and quantity of replacement soil, (select fill) stone aggregate, pipe, geo-textiles, labor, excavation, trucking, engineering, etc.) is common on a system by system basis. As a rule, larger and deeper systems typically cost more to construct than smaller, shallower systems. Average overall costs will be higher in a year in which a greater number of larger systems were installed than in a year when a greater number of smaller systems were built.

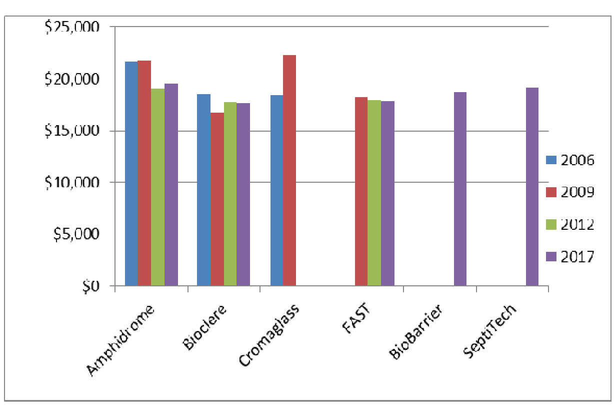
In time, the overall construction cost of advanced treatment systems may decline as system designers take advantage of disposal field size reductions that are now incorporated in the NJDEP's April 2012 revisions to N.J.A.C. 7:9A. The allowable size reductions are permitted due to the relatively high quality effluent quality (e.g. reduced BOD and TSS levels) produced by advanced onsite treatment technologies in comparison to standard septic tank systems. It is possible that additional long-term cost savings will result from the use of these advanced treatment technologies due to the significantly "cleaner" effluent that these systems produce, extending disposal field longevity.

Table 1. Average Total Cost of Pinelands Alternate Design Wastewater Treatment Systems
Note: Cost information is derived from a variety of sources and should be viewed as approximate.

Name of Treatment System Technology	**No. of Systems included in this cost analysis**	**Average Reported Cost per Treatment Unit with 5 year warranty and 5 year operation and maintenance service.**	**Average Reported Cost for Engineering, Soil Absorption Field Installation, Electrical Connections, etc.** (8)	**Average Reported Total Cost of the Advanced Onsite Treatment Systems**
Amphidrome	72	$19,512	$12,050	$31,562(1)
Bioclere	61	$17,474	$10,012	$27,486(2)
Cromaglass	42	$23,553	$11,712	$ 35,265(3)
FAST	28	$17,179	$11,325	$28,504(4)
BioBarrier	13	$18,744	$10,031	$28,775(5)
SeptiTech	31	$19,140	$9,274	$28,414(6)
Busse GT (7)	N/A	$24,000	N/A	N/A
Hoot ANR(7)	N/A	$14,500	N/A	N/A

1) Based on the reported cost of the Amphidrome system during the period of 2004 through June 2018.
2) Based on the reported cost of the Bioclere system during the period of 2005 through June 2018.
3) Based on the reported cost of the Cromaglass system during the period of 2005 through 2010, the last year of installation.
4) Based on the reported cost of the FAST system during the period of 2008 through June 2018.
5) Based on the reported cost of the BioBarrier system during the period of 2015 through June 2018.
6) Based on the reported cost of the SeptiTech system during the period of 2014 through June 2018
7) Information as provided by the system vendor. There have been no Busse GT or Hoot ANR systems installed in the Pinelands Area to date
8) Includes reported cost of the treatment system, treatment tanks if not supplied by system vendor, engineering, excavation, electrical, and effluent dispersal field components and system installation.

Figure 1. Average Total Comparative Cost of Pinelands Alternate Design Wastewater Treatment System during 2006, 2009, 2012 and 2017, the years in which pilot program implementation reports were issued.
Note: Cost information is derived from a variety of sources and should be viewed as approximate.

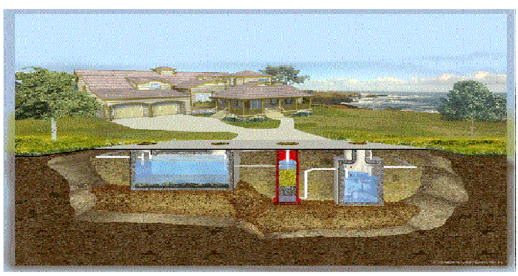


Treatment System Nitrogen Attenuation Summary

The pilot program requires that the technology suppliers arrange for samples of treated effluent to be collected from each system on at least a quarterly basis [approximately every ninety (90) days] for at least three years, yielding a total of at least 12 samples per system. Pursuant to the pilot program sampling and testing protocols, samples of treated effluent are collected from a sample collection port located between the treatment unit and the soil dispersal field. Sample procurement must comply with the latest version (currently Aug. 2005 with updates through April 2011) of the NJDEP Field Sampling Procedures Manual. The laboratory analysis of effluent samples must be performed by laboratories certified by the NJDEP employing analytical methodologies accepted by NJDEP. To permit the establishment of microbial cultures necessary for the treatment process to develop and stabilize, no samples are required during the first ninety days from system start-up. In most instances, technology vendors have adjusted sampling schedules to provide for more efficient, synchronized sample collection from multiple systems.

As discussed previously, a total of 320 Pinelands alternate design wastewater treatment systems have been installed and activated in the Pinelands Area to date.

Amphidrome®



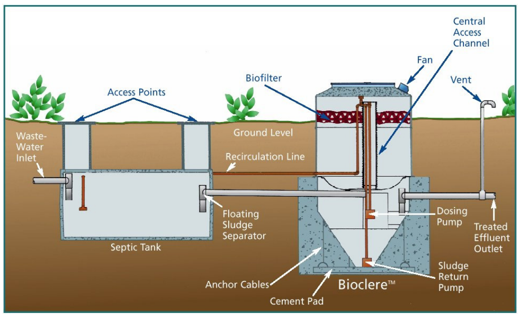
Amphidrome Technology

The Amphidrome process is an advanced biological treatment that utilizes an attached growth treatment concept and is an example of a biologically aerated filter system. This is a patented treatment system. The system is pre-engineered and designed for the removal of soluble organic nitrogen, and for the nitrification and denitrification processes to occur simultaneously in a single reactor. The process begins operating in an aerobic mode and gradually progresses to an anoxic mode. The cyclical action is created by allowing a batch of wastewater to pass from the anoxic/equalization tank through the granular biological filter into the clear well. The batch of wastewater is then pumped back from the clear well up through the filter, where it overflows into a trough that carries it back to the anoxic/equalization tank. These cycles are repeated multiple times, while the treatment is allowed to progress from aerobic to anoxic conditions within the filter. Once sufficient cycles have been repeated to insure the degree of treatment required, a batch of effluent is discharged. A control system operates the system based on predetermined settings. The Amphidrome reactor consists of: an underdrain, support gravel, filter media, and backwash trough. The underdrain is located at the bottom of the reactor and provides support for the media and distribution of liquid into the reactor during a reverse flow or backwash. It is also designed as a manifold to distribute air evenly over the entire filter bottom during the aerobic portion of the cycle. On top of the underdrain is approximately 18" of gravel. Several layers of different size gravel are used. Above the gravel is a deep bed of coarse, round silica sand. The deep bed filter design employed in this manner significantly reduces suspended solids and allows for adequate growth of microorganisms for treating wastewater. In order to achieve the necessary degree of nitrogen reduction under a wide range of conditions, this system is equipped with chemical addition pumps that allow the addition of alkalinity for nitrification and/or methanol for denitrification, when necessary.

The Amphidrome technology is no longer subject to effluent TN concentration analysis and reporting as a

result of its successful release from the pilot program. It is now authorized for permanent use one minimum one acre parcels subject to the provisions of N.J.A.C 7:50-6.84(a)5iv(3). Table 2 provides the running median and grand median values for total nitrogen concentrations (mg/l) from 68 monitored Amphidrome units. The Amphidrome technology produced a grand median total nitrogen concentration of **11.9 mg/l,** satisfying the Commission’s 14.0 total nitrogen standards for use on minimum one-acre parcels.

Bioclere

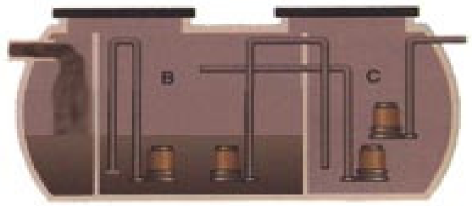


Bioclere Technology

The Bioclere system utilizes an attached growth trickling filter concept for wastewater treatment for residential or commercial facilities. A trickling filter typically consists of a bed of highly permeable media to which microorganisms are attached and through which wastewater is percolated. The Bioclere unit utilizes a patented plastic media in a randomly packed configuration. The incoming wastewater is passed from the primary settling tank to a baffled area in the sump of the Bioclere in which a dosing pump is located. The dosing pump doses the trickling filter at a predetermined frequency. A forced draught ventilation system provides adequate airflow for maintaining aerobic conditions in the trickling filter. In the tricking filter unit, the organic material present in the wastewater is degraded by microorganisms attached to the filter media. Organic material from the wastewater is converted into bio-mass or a slime layer. As the organisms grow, the thickness of slime layer increases and diffused oxygen is consumed before it can penetrate the full depth of the slime layer. Thus, an anaerobic condition is developed near the surface of the media and the microorganisms near the surface of the media enter into an endogenous phase of their growth and lose their ability to cling to the media. Eventually, the wastewater washes the slime off the media while a new slime layer starts establishing and the process continues. The excess bio-mass or the slime would settle in the bottom and the sludge return pump would pump it back to the primary settling tank. Sludge return also acts to combine nitrates to with a carbon source in the primary tank, facilitating denitrification and achieving a reduction in total nitrogen concentration.

The Bioclere technology is no longer subject to effluent TN concentration analysis and reporting as a result of its successful release from the pilot program. It is now authorized for permanent use on minimum one acre parcels subject to the provisions of N.J.A.C 7:50-6.84(a)5iv(3). Table 3 provides the running median and grand median values for total nitrogen concentrations (mg/l) from 38 monitored Bioclere units. The Bioclere technology produced a grand median total nitrogen concentration of **11.2 mg/l**, satisfying the Commission’s 14.0 total nitrogen standards for use on minimum one-acre parcels.

Cromaglass



Cromaglass Technology

In August 2013, the Executive Director recommended that the Cromaglass technology be removed from the Pilot Program entirely, with no further installations permitted. Prior to its permanent removal from the program, a temporary suspension barring new installations of the Cromaglass technology had been imposed in November 2006. This suspension came about as a result of the Commission's prior finding that the Cromaglass technology had not met CMP groundwater quality standards. The Cromaglass technology produced a grand median total nitrogen concentration of 31.5 mg/l, failing to meet the CMP's 14.0 mg/l total nitrogen standard for unsewered residential development on a minimum one acre parcel.

The Alternate Design Treatment Systems Pilot Program requires technology manufacturers to troubleshoot and remediate substandard treatment system performance. At the Commission's direction, Cromaglass undertook studies to determine the cause of inadequate nitrogen attenuation and recommended a number of remedial measures to improve nitrogen attenuation in its existing Pinelands treatment units. After reviewing Cromaglass' findings and recommendations, the Commission issued correspondence in 2011 requiring that Cromaglass implement a two-phase remediation program. Phase I was to include the retrofitting of 28 systems by March 1, 2012. Effluent sampling of the Phase I retrofit systems was to commence within two months of the completion of the Phase I retrofits and was to continue every two months for a total of six samples per system.

Cromaglass completed the Phase I retrofits by the March 1, 2012 deadline but did not fully comply with the system sampling requirements. The first round samples were collected on May 2, 2012 and produced a grand median total nitrogen value of 18.0 mg/l. The second round samples were collected five months later, included only 20 systems and resulted in a grand median total nitrogen value of 19.2 mg/l. In summary, Cromaglass was delinquent in sampling the retrofitted systems and failed to demonstrate the Cromaglass technology's capability to meet CMP water quality standards.

The Commission afforded the Cromaglass Corporation multiple opportunities to improve the technology's nitrogen attenuation. However, Cromaglass Corporation's inconsistent compliance with the pilot program's sampling and reporting requirements remained problematic. Further, the company failed to fully comply with the Commission's sampling and reporting requirements applicable to retrofitted Cromaglass units. The Commission therefore had no choice but to find that the Cromaglass Corporation's participation in the pilot program was not in substantial compliance with the sampling and reporting requirements of the CMP. Further the Cromaglass technology had not made satisfactory progress in attaining compliance with CMP water quality standards. **As a result, the Executive Director recommended and the Pinelands Commission approved the discontinuation of the Cromaglass technology's participation in the pilot program.**

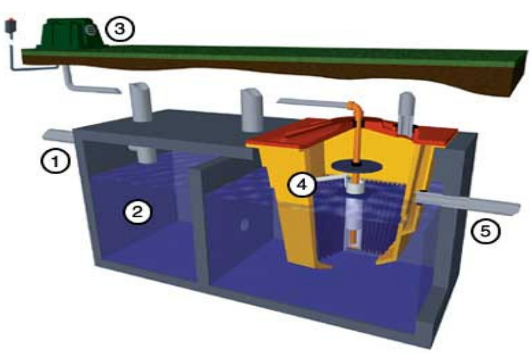
The Executive Director's recommendations were discussed at three public meetings of the CMP Policy & Implementation Committee in November 2012, February 2013 and August 2013. All of the input that the Committee received at these public meetings was in support of the Pilot Program, its further extension and the removal of the Cromaglass technology. The Commission then proceeded to adopt amendments to the CMP in June of 2014 to implement the Executive Director's recommendations. Specifically, N.J.A.C. 7:50-2.11 was amended to remove the Cromaglass technology from the definition of "alternate design pilot program treatment system". Similarly, N.J.A.C. 7:50-10.21(c) and 10.22(a)3 were amended to reflect the removal of the Cromaglass technology from the pilot program. N.J.A.C. 7:50-10.22(a)4 and 10.23(i) were also amended to remove the Cromaglass technology.

The Cromaglass system is a Sequencing Batch Reactor (SBR) that is designed as a continuously fed activated sludge process with clarifiers that are operated on a batch basis. Treatment is achieved by turbulent aeration of incoming wastewater, and batch treatment of bio-mass (sludge) in a separate aeration and quiescent settling chamber within a single vessel. Cromaglass systems are capable of achieving denitrification with the addition of an anoxic cycle following aeration. Air and mixing are provided by submersible pumps with venturi aspirators that receive air through a pipe intake from the atmosphere. Anoxic conditions are created by closing the air intakes of aeration pumps with electric valves, thus stopping aeration but the system continues mixing. Per-batch cycling time is 120 to 240 minutes and there are five cycles to and discharge. The system is operated using a programmable logical control (PLC) that can store a record of all operational functions, thus providing information on each function of each cycle to the operator.

Table 4 presents sample results for 59 Cromaglass systems through July 5, 2010. Total reported nitrogen values for each of these Cromaglass systems represents the sum of reported laboratory values for total Kjeldahl nitrogen plus nitrite nitrogen plus nitrate nitrogen. The Cromaglass technology produced a grand median total nitrogen concentration of **31.5 mg/l**, failing to meet the Commission's 14.0 total nitrogen standard for unsewered residential development on a minimum one acre parcel.

The Executive Director recommended and the Pinelands Commission approved a policy that provides for homeowners who are presently using the Cromaglass technology to be given the option to continue to use it in a manner that is consistent with NJDEP's operation and maintenance requirements or if they so choose, to convert the system to function as a septic tank or to otherwise replace it the Cromaglass tank with a conventional septic tank meeting the requirements of the NJDEP's Standards for Individual Subsurface Sewage Disposal Systems.

FAST

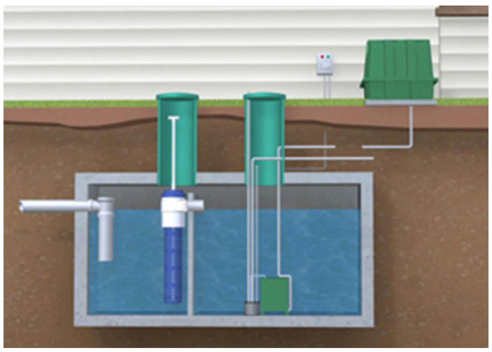


FAST Technology

The FAST (Fixed Activated Sludge Treatment) system is a pre-engineered modular system designed to treat wastewater from a single home, a group of homes, or commercial facilities. FAST is a fixed film, aerated system utilizing a combination of attached and suspended growth treatment principles capable of achieving nitrification and denitrification in a single tank. This combination offers the stability of fixed film media and the effectiveness of activated sludge treatment principles. A typical FAST system provides adequate volume for microorganisms in the aerated media chamber to treat wastewater. The attached growth system functioning on and around the plastic media assures that microorganisms remain inside the system instead of being flushed out, even during the peak hydraulic flow conditions. During the times of low flow, the large volume of thriving microorganisms prevent a dying-off of the system, making the system well suited to intermittent use applications.

The FAST technology is no longer subject to effluent TN concentration analysis and reporting as a result of its successful release from the pilot program. It is now authorized for permanent use on minimum 1.4 acre parcels subject to the provisions of N.J.A.C 7:50-6.84(a)5iv(3). Table 5 provides the running median and grand median values for total nitrogen concentrations (mg/l) from 25 monitored FAST units. The FAST technology produced a grand median total nitrogen concentration of **18.2 mg/l,** demonstrating that it can meet the Commission's 2 mg/l total nitrogen standard when used on minimum 1.4 acre parcels.

BioBarrier



BioBarrier Technology

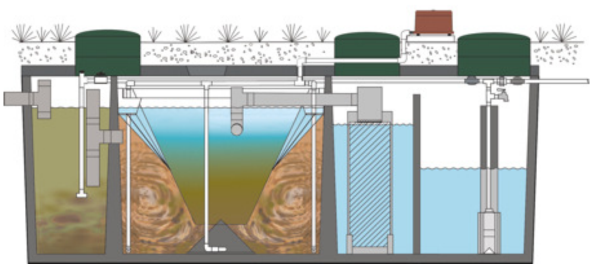
The BioBarrier® MBR is a membrane bioreactor that combines activated sludge treatment processes with solids separation via membrane filter technology. The system employs flat sheet membranes with pore sizes ranging between of 0.02 to 1.4 µm. The membranes are housed in an aerated membrane cartridge which 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 6, sample results have been evaluated from 12 BioBarrier systems to date. A total of 156 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 **24.9 mg/l** based upon all samples to date. This grand median total nitrogen value is higher than the 24.4 mg/l TN concentration presented in the Commission's 2017 annual report. 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 BioBarrier technology has not yet been demonstrated to meet the 14.0 mg/l TN concentration as required for use on one acre parcels, on October 3, 2016, the Commission imposed a restriction on the future use of the BioBarrier system, requiring that it be limited to parcels containing at least 1.7 acres, (subject to increase or decrease based upon additional sampling data), as determined by the Pinelands Septic Dilution Model. Further, Bio-Microbics instituted a voluntary moratorium on the sale and installation of all new BioBarrrier systems in the Pinelands Area effective February 2015. In addition to troubleshooting the mechanical operation of the system, BioMicrobics has instituted a homeowner education program aiming to eliminate the use of cleaning products containing quaternary ammonia, a nitrogen-based sanitizer known to disrupt biological nutrient reducing wastewater treatment processes. The Commission continues to monitor the technology's performance and may move to impose additional restrictions if improvement is not realized.

HOOT

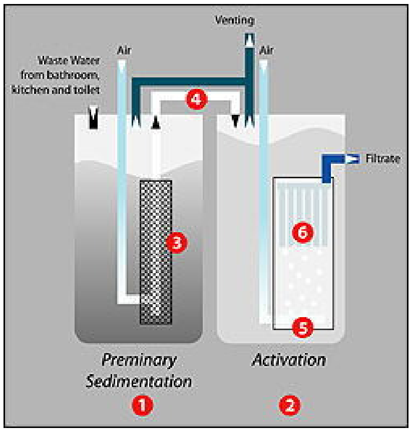


Hoot ANR Technology

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

Busse GT

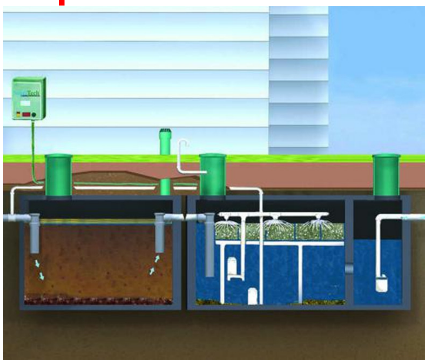


Busse GT MBR Technology

The Busse Innovative 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 there are currently no Busse GT systems operating in the Pinelands Area, the Commission has no performance data to report at this time.

SeptiTech



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 7(a), sample results have been evaluated from 34 SeptiTech systems to date. A total of 262 samples have been collected from these 34 SeptiTech systems producing a grand median total nitrogen concentration of **16.1 mg/l**. This analysis includes samples that were collected from systems that were erroneously installed without the denitrification cycle activated in the systems software. When the software error was discovered by the technology manufacturer, the systems were reprogrammed. Table 7(b) presents the results from these same 34 SeptiTech systems using only the sample results obtained from systems that were either installed without the programming error or from systems that were reprogrammed to eliminate the error. The edited data presented in Table 7(b) indicates that 213 sampling events from these 34 systems produced a grand median total nitrogen concentration of **11.9 mg/l**. In both analyses, the 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 post-reprogramming data value of 11.9 mg/l is significantly lower than the 15.7 mg/l TN concentration presented in the Commission's 2016 annual report which included the pre-reprogramming data. Commission staff will continue to closely monitor the technology's performance to ensure that the improved system performance is maintained as a result of the software correction. 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.

While the SeptiTech technology appears to be capable of meeting the 14.0 mg/l TN standard as a result of software corrections, additional monitoring is required to demonstrate it is capable of consistently maintaining that level of treatment. Accordingly, the Commission will retain the temporary restriction on new installations, requiring new systems to be limited to parcels containing at least 1.7 acres, (subject to increase or decrease based upon additional sampling data), as determined by the Pinelands Septic Dilution

Model. This restriction will be lifted if the SeptiTech technology is confirmed to be capable of sustainably meeting Pinelands water quality standards on lots that are smaller than 1.7 acres.

Household Variability and Concentration vs. Mass Loading

When evaluating data from single family wastewater treatment systems, it is important to recognize that the number of home occupants, water use, pharmaceutical use and cleaning and laundry product usage may vary greatly from one residence to another. These and other variables can markedly impact the concentration of nitrogen in wastewater and can adversely affect the ability of a treatment system to meet established discharge limits. The number of individuals occupying a dwelling can result in abnormally high or low levels of nitrogen in wastewater given that each person contributes approximately 9 lbs. of nitrogen to the system annually. Water conservation, while encouraged and desirable, has the potential to cause higher concentrations of pollutants in the wastewater (but not greater mass loading) because less water is available to dilute the pollutants. As a result of significant advances in water conservation, including the use of water conserving fixtures and appliances as well as behavior modifications, assumed values for total nitrogen concentration in domestic effluent, established during the 1960's and 1970's at approximately 40 mg/l, may under-estimate the actual average TN concentration in domestic wastewater streams. It is important to note however, that estimates of the total mass of nitrogen expelled by humans' remains constant at approximately 9 lbs. per person per year. It is evident from wastewater analyses conducted for the pilot program that there is a wide range in the concentration of total nitrogen in septic tank effluent. However, even if the concentration of nitrogen in domestic wastewater frequently exceeds 40 mg/l, the total mass of nitrogen is likely consistent with estimated values used in the Pinelands septic dilution model. As a result, even where effluent values exceed assumed post treatment concentrations, system discharges may still be meeting total nitrogen mass loading targets, even if the observed concentrations do not.

At the outset of the pilot program, four of the five original treatment technologies (Amphidrome, Bioclere, Cromaglass and FAST) were assigned an estimated total nitrogen removal efficiency of 65%. The fifth technology (Ashco RSF ^{III}) was assigned an estimated total nitrogen removal efficiency of 50%. The four new technologies added to the pilot program in 2013 (BioBarrier, Busse GT, Hoot ANR and SeptiTech) each have an assumed nitrogen removal efficiency of 65% based upon third party certifications. Using these estimates, if the total nitrogen contained in the raw influent is 40 mg/l, a 65% reduction would result in a concentration of 14 mg/l in the treated effluent (and a 50% reduction would result in a concentration of 20 mg/l). These effluent concentrations would be reduced to 2 mg/l at the parcel line of a one acre lot based upon the Pinelands septic dilution model. Similarly, if influent nitrogen levels range up to 80 mg/l, the same 65% removal efficiency would result in effluent concentrations of 28 mg/l. By monitoring only the effluent concentration and determining that it meets the required 14 ppm, the pilot program is able to conservatively ensure compliance with the Commission's 2 mg/l standard at the parcel boundary without regard to influent concentrations.

Use of certain cleaning (sanitizing) and laundry products as well as the use of certain medications can stress the bacteria that provide biological nitrification and denitrification. Because of this, education of system users is an important component of any wastewater management program.

In recognition of these factors, all of the alternative treatment system vendors have developed homeowner user manuals that provide critical information to the owners of the alternative treatment systems. In addition, several vendors have developed and provided system owners with questionnaires that are aimed at identifying laundry and cleaning product usage and any other condition that might lead to non-compliant sample results. Staff encourages all of the technology vendors to collect and analyze this type of information to better understand user characteristics and to enhance compliance with effluent discharge limits.

Effluent Monitoring Data

Effluent sampling data submitted to date have been analyzed and presented in this report. Tables 2, 3, 4, 5, 6, 7(a) and 7(b) provide the running median and grand median values for total nitrogen concentrations (mg/l)[1] and the

[1] One (1) mg/l = one (1) ppm

number of samples taken for the Amphidrome, Bioclere, Cromaglass, FAST, BioBarrier and SeptiTech wastewater treatment systems respectively. The Commission does not yet have effluent monitoring data for the Busse GT and Hoot wastewater systems. The analysis indicates a grand median of 11.9 mg/l for the Amphidrome system and 11.2 mg/l for the Bioclere system. Both of these grand median concentrations are below the 14 mg/l target, which is based upon the Pinelands septic dilution model and an influent concentration of approximately 40 mg/l. These technologies have been granted permanent approval status for residential use on minimum 1 acre parcels and are no longer subject to required effluent TN analysis and reporting. The TN grand median concentration for the Cromaglass system is 31.5 mg/l, and as a result of this value and Cromaglass Corporation's failure to comply with the requirements of the pilot program, new installations of the Cromaglass technology are no longer permitted in the Pinelands Area. The TN grand median concentration for the FAST system is 18.2 mg/l. While not meeting the Commission's required TN concentration for residential use on one-acre parcels, the FAST system has been demonstrated to meet the Commission's water quality standard if used on minimum 1.4 acre parcels. As noted, the FAST system has been advanced from the pilot program and is now permanently approved for residential use on minimum 1.4 acre parcels. The BioBarrier and SeptiTech technologies are relatively new to the pilot program. BioBarrier has produced a TN grand median concentration of 24.9 mg/l. Commission staff continues to recommend that future use of this technology be limited to minimum 1.7 acre parcel size until such time as the manufacture demonstrates improved and sustained performance. If that demonstration is not made, the Commission staff may recommend the imposition of further restrictions. SeptiTech has produced a TN grand median concentration of 16.1 mg/l when all samples are included in the analysis and 11.9 mg/l when samples affected by a system programming error are excluded. Commission staff will closely monitor the reprogrammed SeptiTech systems to determine if the improved performance is sustained before making a recommendation to lift the current minimum 1.7 acre parcel size.

Table 2. **Amphidrome** running median of total nitrogen (mg L-1) by number of sampling events for each wastewater treatmentsystem. The grand median, 25th percentile, 75th percentile, and number of systems sampled (N) per event are provided. (See Appendix 1 for discussion of data editing.)

Total Nitrogen Running Median

		Number of Sampling Events													
Technology	System	1	2	3	4	5	6	7	8	9	10	11	12	13	Grand Median
Amphidrome	1	18.5	25.3	32.1	25.3	20.7	19.6	18.5	17.7	16.9	16.0	16.9			18.5
Amphidrome	2	9.5	9.1	9.4	9.5	9.5	9.7	9.5	9.5	9.4	9.4	9.4	9.5	9.5	9.5
Amphidrome	3	18.4	12.1	18.4	50.4	18.4	14.9	12.6	12.0	11.5		12.0	12.6	12.9	12.7
Amphidrome	4	35.2	29.2	23.2	16.4	9.7	8.4	7.8	7.5	7.2	7.5	7.8	7.6		8.1
Amphidrome	5	10.0	42.3	51.3	31.8	12.3	31.8	17.8	16.0	15.8	16.8	15.8	16.2	15.8	16.2
Amphidrome	6	6.0	33.8	6.9	9.8	12.7	14.8	12.7	11.1	9.5	11.1	12.1	10.8		11.1
Amphidrome	7	12.7	11.8	11.0	9.2	8.5	9.6	9.5	10.1	10.7	10.8	10.7	10.1		10.4
Amphidrome	8	15.2	19.3	15.2	12.1	9.1	9.5	9.1	9.0	8.9	9.0	8.9	8.7		9.1
Amphidrome	9	143.9	79.5	15.1	12.5	9.8	10.1	10.3	10.1	9.8	10.1	10.3	10.1	10.3	10.3
Amphidrome	10	5.8	4.9	5.8	6.6	7.0	6.7	7.0	7.1	7.0	7.2	7.3			7.0
Amphidrome	11	14.9	10.1	6.0	8.4	10.8	12.2	10.8	9.8	10.0	9.5	8.9	8.4		9.9
Amphidrome	12	18.8	27.6	36.4	33.6	36.4	38.3	36.4	33.6	30.8	24.8	30.8			33.6
Amphidrome	13	4.7	5.4	4.7	5.2	5.7	5.2	5.3	5.5	5.7	5.8	5.7	5.8		5.4
Amphidrome	14	24.5	17.2	9.8	9.7	9.5	9.4	9.4	9.4	9.5	9.4				9.5
Amphidrome	15	4.0	6.3	5.3	5.4	5.3	5.4	5.5	5.4	5.5	5.7	5.9			5.4
Amphidrome	16	11.7	16.7	11.7	11.4	11.2	11.4	11.7	12.5	13.3	12.5	11.7	11.8		11.7
Amphidrome	17	27.0	47.2	58.2	56.5	54.8	54.5	54.2	54.0	53.8	53.1	52.3			54.0
Amphidrome	18	11.1	12.9	11.1	10.3	9.4	10.3	11.1	11.8	12.3	12.4	12.3	12.1	11.9	11.8
Amphidrome	20	16.0	13.4	16.0	14.9	16.0	14.9	16.0	14.9	13.9	14.9	16.0			14.9
Amphidrome	21	7.5	8.1	8.8	10.3	11.9	13.0	11.9	10.6	11.9	13.0	14.0			11.9
Amphidrome	22	36.8	49.3	55.0	45.9	36.8	28.1	19.5	19.4	19.5	23.0	26.6			28.1
Amphidrome	23	25.4	16.2	11.0	10.3	11.0	11.3	11.6	11.9	12.3	11.9	11.6	11.5	11.5	11.6
Amphidrome	24	7.3	5.7	6.5	6.9	6.5	6.2	6.5	6.9	7.3	6.9				6.7
Amphidrome	25	11.6	13.5	15.3	15.7	15.9	16.0	16.1	16.4	16.1	16.4	16.8	16.4	16.8	16.1
Amphidrome	26	14.2	19.1	23.9											19.1
Amphidrome	28	23.9	32.6	41.4	32.6	23.9	23.3	23.9	23.3						23.9
Amphidrome	29	7.6	17.6	7.6	9.1	7.6	7.5	7.6	7.5	7.4	6.8	6.3			7.6
Amphidrome	30	97.1	53.2	9.3	9.0	9.3	9.9	9.3	9.0	9.3	9.9	9.3	9.0	9.3	9.3
Amphidrome	31	11.8	13.5	12.3	12.9	13.5	12.9	12.3	12.6	12.3	12.3	12.3	12.1		12.3
Amphidrome	32	7.4	7.7	8.0	11.3	8.0	9.8	8.0	7.7	7.4	7.7				7.8
Amphidrome	33	6.4	5.0	6.4	6.0	6.4	6.3	6.1	6.3	6.4	6.5	6.6			6.4
Amphidrome	34	13.9	20.0	13.9	18.3	18.3	16.1	18.3	20.5	22.7	20.5	18.3			18.3
Amphidrome	35	9.0	11.5	13.9	16.0	13.9	12.8	13.9	16.0	13.9	16.0	18.1			13.9
Amphidrome	36	11.7	12.9	13.6	12.9	13.6	13.8	14.1	14.1	14.1	14.1	14.1	13.8		13.8
Amphidrome	37	9.9	9.5	9.9	10.8	11.7	11.2	10.6	11.2	11.7	11.3	11.7	11.8	11.7	11.2
Amphidrome	38	17.3	13.9	10.5	13.2	10.5	9.1	7.7	7.0	7.7					10.5
Amphidrome	41	27.4	26.7	25.9	26.7	25.9	22.0	19.1	18.6	19.1	19.1				24.0
Amphidrome	43	17.2	17.5	17.2	17.5	17.8	19.0	20.1	19.0	17.9	18.1	18.3	18.5	18.7	18.1
Amphidrome	44	11.9	13.6	15.3	15.9	16.5	15.9	15.3	15.1	15.0	13.4	13.7	14.3		15.1
Amphidrome	45	26.6	16.7	20.4	22.9	20.4	14.9	15.4	12.4	9.5	9.5	9.6	10.2	10.9	14.9
Amphidrome	46	9.0	9.7	10.4	10.9	10.4	10.4	10.4	10.4	10.4	10.8	10.4			10.4
Amphidrome	47	15.2	16.2	15.2	13.5	11.8	13.5	11.8	11.8	11.8	11.8	11.8			11.8
Amphidrome	48	37.6	28.3	24.2	23.8	24.2	23.8	23.4	23.8	24.2	23.8				24.0
Amphidrome	49	12.0	21.5	14.7	15.0	15.2	16.8	15.2							15.2
Amphidrome	50	22.9	19.0	22.9	25.1	27.3	25.6	23.9	25.6	23.9	23.4				23.9
Amphidrome	51	82.0	75.1	68.2	39.1	22.5	17.0	12.6							39.1
Amphidrome	53	12.0	13.9	12.6	12.3	12.0	10.0	12.0	10.1						12.0
Amphidrome	54	9.8	9.5	9.3	9.5	9.3	9.5	9.8							9.5
Amphidrome	55	23.2	18.6	16.6	15.3	14.0	14.0								15.9
Amphidrome	56	18.3	28.7	20.9	27.8	20.9	27.8								24.4
Amphidrome	57	56.0	50.7	56.0	52.5	49.0									52.5
Amphidrome	58	31.8	38.3	31.8	22.0	15.1									31.8
Amphidrome	59	28.1	30.6	33.0	32.6	32.3									32.3
Amphidrome	60	18.1	15.6	14.2	16.1	18.1	16.1								16.1
Amphidrome	61	6.7	7.9	7.2	8.2	8.2	8.1								8.0
Amphidrome	62	3.7	9.7	12.6	9.5										9.6
Amphidrome	63	5.9	6.0	6.0	8.6										6.0
Amphidrome	64	8.3	8.7	9.1	8.7										8.7
Amphidrome	65	48.0	27.3	47.5	29.2	34.4									34.4
Amphidrome	66	13.1	41.4	51.4	37.3										39.4
Amphidrome	67	18.8	15.8	16.1											16.1
Amphidrome	68	10.0	9.4	10.0											10.0
Amphidrome	69	52.1	30.5												41.3
Amphidrome	70	25.5													25.5
Amphidrome	71	5.8	7.7	6.3											6.3
Amphidrome	72	36.0	38.8												37.4
Amphidrome	73	24.2	22.4	20.5											22.4
Amphidrome	74	7.2													7.2
Sample # Median		14.6	16.5	14.0	13.2	12.7	12.9	11.9	11.8	11.7	11.8	11.8	11.5	11.7	**11.9**
25th Percentile		9.4	9.8	9.4	9.6	9.5	9.6	9.5	9.3	9.3	9.4	9.3	9.5	10.6	9.5
75th Percentile		24.7	28.1	23.0	24.4	19.4	16.4	16.0	16.1	15.6	16.1	15.9	12.6	14.3	16.1
n		68	66	64	59	55	51	47	44	42	40	35	21	11	

Table 3. Bioclere 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. (See Appendix 1 for discussion of data editing.)

Total Nitrogen Running Median

		Number of Sampling Events												
Technology	System	1	2	3	4	5	6	7	8	9	10	11	12	Grand Median
Bioclere	1	22.3	13.4	8.8	8.9	8.8	7.8	8.8	7.8	7.8				8.8
Bioclere	2	10.7	9.8	8.9	9.8	8.9	9.8	10.7	10.8	10.7				9.8
Bioclere	6	17.0	11.4	17.0	12.7	14.4	13.3	12.2	10.3					13.0
Bioclere	7	10.4	14.9	10.4	10.2	10.4	10.8	10.4	10.2	10.1	10.2	10.4	10.8	10.4
Bioclere	8	11.2	9.6	10.5	9.3	8.6	9.6	10.5	9.6	10.4				9.6
Bioclere	9	8.6	8.4	8.6	9.5	10.4	10.7	10.4	9.5	10.4				9.5
Bioclere	10	8.4	8.4	8.4	9.9	9.2	9.7	10.1	9.8	9.6	9.5	9.4	9.5	9.5
Bioclere	11	25.0	17.8	15.4	13.2	15.4	13.2	13.8	14.6	13.8	12.4	10.9		13.8
Bioclere	12	52.8	55.5	52.8	33.0	13.1	12.3	13.1	12.3	13.1	12.3	13.1	13.5	13.1
Bioclere	13	14.2	14.2	14.2	11.4	11.9	11.1	11.9	11.5	11.1	11.2			11.7
Bioclere	14	16.2	24.7	16.2	17.1	16.2	14.5	12.9	12.2	11.4	11.0	10.7	11.0	13.7
Bioclere	15	5.2	13.2	10.6	13.0	10.6	13.0	15.3	13.8	15.3	13.8			13.1
Bioclere	16	28.1	25.0	22.0	18.5	15.1	18.5	15.1	14.3	13.4	14.3	13.4	14.3	15.1
Bioclere	17	79.8	48.0	16.2	16.2	16.2	16.1	16.0	14.4	12.8	12.9	12.785		16.1
Bioclere	18	13.2	10.5	10.3	9.3	10.3	9.7	9.2	9.3	9.4	9.8	9.5	9.9	9.8
Bioclere	19	29.4	30.2	29.4	19.6	9.8	12.5	11.9	13.6	11.9				13.6
Bioclere	20	52.8	42.2	31.6	26.4	21.2	26.4	21.2	17.8	14.5				26.4
Bioclere	21	10.2	10.2	10.3	11.7	10.3	10.2	10.2	9.6					10.2
Bioclere	22	9.7	9.8	10.0	10.1	10.0	9.8	9.7	9.8	10.0	10.1	10.1		10.0
Bioclere	23	27.3	18.2	9.1	11.1	9.1	8.8	9.1						9.1
Bioclere	24	2.4	2.5	2.5										2.5
Bioclere	25	25.9	16.7	9.7	11.3	9.7	11.3	12.8						11.3
Bioclere	26	1.9	18.9	4.9	8.5	12.1	8.5	10.3						8.5
Bioclere	27	34.6	23.9	13.2	13.1	13.1	12.7	12.3						13.1
Bioclere	28	24.8	17.3	11.6	10.7	9.7	10.7							11.2
Bioclere	29	10.3	13.1	11.0	12.2	12.0								12.0
Bioclere	30	24.9	21.5	18.0	14.1	13.3								18.0
Bioclere	31	4.5	23.1	5.8	9.2									7.5
Bioclere	32	47.0	42.1	37.3	26.5									39.7
Bioclere	33	48.1	31.2	14.3	13.2	13.1								14.3
Bioclere	34	20.8	17.7	14.6	13.8									16.1
Bioclere	35	7.3	19.0	18.2										18.2
Bioclere	36	5.1												5.1
Bioclere	37	12.0												12.0
Bioclere	38	13.8												13.8
Bioclere	39	8.5												8.5
Bioclere	40	11.9												11.9
Bioclere	41	12.3												12.3
Sample # Median		13.5	17.5	11.3	12.0	10.6	11.0	11.9	10.8	11.1	11.2	10.7	10.9	**11.2**
25th Percentile		9.8	11.2	9.6	9.9	9.8	9.8	10.2	9.7	10.1	10.1	10.1	10.1	10.0
75th Percentile		25.7	24.1	16.4	14.0	13.2	13.0	13.0	13.7	13.1	12.6	12.8	12.9	13.1
n		38	32	32	30	27	24	23	19	17	11	9	6	

Table 4. **Cromaglass** 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. (See Appendix 1 for discussion of data editing.)

Total Nitrogen Running Median

		Number of Sampling Events												
Technology	System	1	2	3	4	5	6	7	8	9	10	11	12	Grand Median
Cromaglass	1	140.1	78.6	17.1	32.2	26.3	36.9	43.6	41.0	38.5	35.5	32.5		36.9
Cromaglass	2	49.0	45.0	49.0	45.0	49.0	45.0	41.0	43.8	44.9	43.0	44.9	43.0	45.0
Cromaglass	3	76.5	58.2	50.4	45.2	50.4	47.6	50.4	55.9	50.4	47.6	44.9		50.4
Cromaglass	4	77.2	55.7	77.2	64.4	77.2	83.6	78.8	78.0	77.2	69.1	61.0		77.2
Cromaglass	5	110.6	99.0	87.4	71.8	56.2	45.7	35.1	30.3	25.5	26.5	25.5		45.7
Cromaglass	6	61.6	44.7	47.3	39.0	47.3	50.0	52.7	50.0	47.3	47.3	47.3	47.7	47.3
Cromaglass	7	67.5	52.3	37.1	50.1	42.6	47.8	46.8	49.9	53.0	49.9	51.3		49.9
Cromaglass	8	85.5	61.9	38.3	37.0	38.3	39.9	40.7	41.1	40.7	41.1			40.7
Cromaglass	9	19.7	39.7	19.7	19.6	19.7	19.6	19.5	18.5	19.5	18.5	17.6		19.6
Cromaglass	10	58.5	61.3	58.5	42.2	25.9	23.0	20.1	18.1	20.1	18.1	20.1	18.634	21.5
Cromaglass	11	35.1	47.2	35.1	34.3	35.1	34.3	35.1	37.4	39.8	40.1	40.5		35.1
Cromaglass	12	30.6	26.5	22.5	19.5	22.5	26.5	22.5	19.5	16.5	15.0	13.6		22.5
Cromaglass	13	17.4	10.8	12.4	14.9	17.4	16.0	14.6	14.0	13.5	14.0	13.5	14.0	14.0
Cromaglass	14	31.7	28.7	31.7	30.9	30.0	29.9	29.7	27.7	25.8	26.6			29.8
Cromaglass	15	18.0	64.0	32.1	38.3	32.1	30.1	28.2	30.1	32.1	30.1	28.2		30.1
Cromaglass	16	25.5	17.1	14.4	17.2	14.4	14.3	14.2	14.3	14.2	13.3			14.4
Cromaglass	17	43.5	56.7	43.5	32.4	43.5	41.6	43.5	52.9	62.3	66.2			43.5
Cromaglass	18	104.4	85.3	66.1	57.6	66.1	60.6	56.3	55.7	55.2	52.1	49.0	40.9	56.9
Cromaglass	19	67.5	71.7	67.5	42.8	67.5	62.8	58.1	39.6	21.1	39.6	31.1	26.1	50.4
Cromaglass	20	46.3	32.5	18.6	15.2	18.6	28.8	39.0	31.2	23.4	27.3			28.1
Cromaglass	21	45.9	64.2	45.9	38.4	30.9	21.8	14.7	22.8	14.7	15.6	14.7	14.0	22.3
Cromaglass	22	57.6	49.7	41.7	31.0	41.7	40.2	41.7	40.2	38.7	38.2	37.8		40.2
Cromaglass	23	37.4	73.3	37.4	32.7	28.1	32.7	37.4	32.7	37.4	43.7	37.4	32.7	37.4
Cromaglass	24	31.8	32.6	33.5	32.6	31.8	31.2	30.6	28.0	25.5	19.5	24.8	19.2	30.9
Cromaglass	25	52.8	42.8	32.8	35.0	37.3	42.6	47.9	50.3	52.8	53.1			45.3
Cromaglass	26	74.3	68.7	63.2	43.5	23.7	20.2	16.8	16.5	16.8				23.7
Cromaglass	27	90.3	73.2	56.1	70.7	56.1	54.9	56.1	57.7	59.3	60.4			58.5
Cromaglass	28	86.7	56.8	29.6	29.1	28.6	27.8	28.6	29.1	29.6	38.0			29.3
Cromaglass	29	23.5	20.7	23.5	21.1	18.7	18.4	18.7	18.4	18.0	18.4	18.7		18.7
Cromaglass	30	103.3	64.6	25.9	29.6	25.9	29.6	33.4	32.2	31.0	32.2	33.4	32.2	32.2
Cromaglass	31	7.4	34.6	61.9	37.3	32.4	38.5	44.7	44.8	44.7	41.8			40.2
Cromaglass	32	78.3	63.0	50.6	49.1	47.7	34.5	25.3	23.3	21.3	23.3			41.1
Cromaglass	33	76.1	48.0	31.6	25.8	31.6	31.7	31.7	31.7	31.6				31.7
Cromaglass	34	49.5	114.9	49.5	47.8	49.5	51.6	53.8	61.0	68.3	74.1			52.7
Cromaglass	35	43.0	42.9	43.0	47.4	43.0	43.8	44.6	43.8	44.6	43.8			43.8
Cromaglass	36	100.1	90.1	80.1	78.9	77.8	78.9	77.8	63.7	77.8	76.3	74.8		77.8
Cromaglass	37	24.1	21.7	19.3	18.7	18.0	18.7	18.0	18.0	18.0	17.3	16.7		18.0
Cromaglass	38	61.3	49.0	36.8	35.1	33.4	24.5	15.7	16.0	16.3				33.4
Cromaglass	39	11.3	26.3	24.9	26.3	27.7	28.0	28.4	34.8	31.6	30.0	31.6		28.0
Cromaglass	40	17.2	13.5	17.2	18.9	17.2	18.9	17.2	15.5	17.2	17.9			17.2
Cromaglass	41	35.8	23.3	35.8	23.3	15.1	13.1	11.2	12.9	11.2	12.9			14.1
Cromaglass	42	48.2	29.2	10.2	11.6	10.2	11.6	13.1	11.6	10.2	11.6			11.6
Cromaglass	43	79.2	46.9	79.2	47.2	31.4	23.3	15.2	14.9	15.2				31.4
Cromaglass	44	8.3	11.5	14.6	14.6	14.6	14.6	14.5	12.6	10.6	9.8	9.1	9.9	12.0
Cromaglass	45	69.1	46.2	30.6	27.0	23.3	16.8	23.3	27.0	23.3	16.8	23.3		23.3
Cromaglass	46	29.1	24.0	29.1	29.7	29.1	29.7	30.3	31.8	33.4	38.4			29.7
Cromaglass	47	75.1	56.7	38.3	33.7	32.6	35.4	38.3	45.5	52.7	53.7			41.9
Cromaglass	48	30.1	48.0	65.9	48.0	52.7	59.3	52.7	54.6	56.5	60.6			53.7
Cromaglass	49	46.6	26.7	6.8	21.0	28.3	22.7	17.2	22.7					22.7
Cromaglass	50	18.0	22.0	18.0	21.1									19.5
Cromaglass	51	51.6	36.3	21.0	23.0	25.1	23.0	21.0						23.0
Cromaglass	52	18.1	16.6	18.1	29.0									18.1
Cromaglass	53	8.9	8.3	8.9	15.2									8.9
Cromaglass	54	21.2												21.2
Cromaglass	55	22.0	22.3											22.1
Cromaglass	56	21.5												21.5
Cromaglass	57	11.7	17.3	11.9	17.3									14.6
Cromaglass	58	7.1	16.6	26.1										16.6
Cromaglass	59	18.4	18.1	18.4	18.3	18.4								18.4
Sample # Median		45.9	45.0	33.1	32.4	31.4	30.7	31.1	31.7	31.3	36.7	31.3	26.1	31.5
25th Percentile		21.7	24.0	19.6	21.1	23.5	22.8	18.9	18.5	18.0	18.3	19.0	16.3	19.3
75th Percentile		71.7	61.3	49.1	43.1	43.2	43.5	44.3	44.8	45.5	47.4	43.8	36.8	44.6
n		59	57	56	55	51	50	50	49	48	44	26	11	

Table 5. **FAST** running median of nitrogen (mg total 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. (See Appendix 1 for discussion of data editing.)

Total Nitrogen Running Median — Number of Sampling Events

Technology	System	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Grand Median
FAST	1	31.3	45.4	37.9	34.6	37.9	37.4	37.0	34.1	31.3	30.7	30.0	28.4	26.8	28.4	26.8	25.7	24.6	23.9	23.1	21.8	23.1	21.8	20.5	20.5	20.6		28.4
FAST	2	27.1	25.8	27.1	34.6	27.1	27.7	27.1	27.7	28.2	27.7	27.1	26.1	25.0	24.8	24.5	24.1	24.1	23.4	23.1	22.1	20.7	19.3	18.1	17.8	18.2	18.1	24.9
FAST	3	39.3	34.5	29.6	29.6	29.6	27.2	29.6	29.6	29.6	29.6	29.6	28.5	29.6	28.5	27.4	26.1	24.8	24.5	24.2	24.1	24.0	23.2	22.4	21.3			28.5
FAST	4	32.4	23.0	23.9	25.1	23.9	18.9	15.9	15.5	15.9	15.5	15.0	15.5	15.9	17.5	15.9	15.5	15.0	14.4	13.8	13.7	13.8	13.7	13.6	13.5			15.5
FAST	5	30.1	24.4	30.1	24.9	19.6	20.6	20.7	20.2	19.6	19.2	18.7	19.2	18.7	18.5	18.2	18.0	17.7	17.6	17.5	17.3	17.1	17.3	17.1				18.7
FAST	6	12.4	16.6	20.7	21.4	20.8	21.4	22.0	22.3	22.0	22.2	22.4	22.5	22.4	22.2	22.0	21.4	20.8	20.8	20.8	20.8	20.7	20.3	19.8	18.0			21.1
FAST	7	33.3	30.6	27.8	24.6	21.3	17.1	12.9	11.9	12.2	12.6	12.9	13.4	12.9	13.4	13.9	13.4	13.9	15.0	16.1	16.0	15.9	14.9					14.4
FAST	8	48.6	40.7	32.7	29.5	29.8	31.0	29.8	29.4	29.8	31.0	32.2	31.0	29.8	29.4	28.9	27.6	26.2	26.2	26.1	20.9	15.6	15.5	15.4				29.5
FAST	9	28.1	29.6	28.1	25.7	23.2	25.5	23.2	21.4	19.6	19.0	18.3	16.9	17.0	17.7	17.0	16.3	15.5	16.3	15.5	15.1	14.7						18.3
FAST	10	16.5	17.1	17.6	24.7	17.6	17.1	17.6	17.1	16.5	16.5	16.5	16.5	16.5	16.5	16.5	17.1	16.5	16.5									16.5
FAST	11	21.9	22.0	21.9	20.4	21.9	20.4	18.8	18.7	18.6	17.5	16.3	15.4	14.5	13.4	12.3	11.9	11.4										18.6
FAST	12	44.5	27.4	13.1	19.9	25.2	19.2	15.4	20.3	22.1	18.8	22.1	18.8	15.4	18.8	20.7												19.9
FAST	13	23.2	19.3	23.0	23.1	23.2	23.1	23.0	19.2	15.4	15.0	15.4	19.2	15.4	15.0	15.4												19.2
FAST	14	13.5	11.0	13.5	18.0	15.9	14.7	13.5	14.7	13.5	11.0	13.5	14.0	14.5	14.0	14.5												14.0
FAST	15	14.2	14.2	14.2	13.1	14.2	13.7	14.2	14.3	14.4	14.6	14.7	16.0	16.8	17.0	16.8												14.3
FAST	16	28.6	17.5	28.6	31.3	30.9	29.8	28.6	29.8	28.6	21.8	15.0	14.5															28.6
FAST	17	29.2	32.6	29.2	22.7	17.8	17.8	17.8	17.9	17.8	17.9	17.8	17.8	17.7														17.8
FAST	18	25.2	16.4	13.7	19.5	13.7	12.2	11.1	12.4	11.1	12.4	13.7	12.4															13.1
FAST	19	29.6	20.3	10.9	10.9	10.9	11.0	10.9	11.0	10.9	10.9	10.8	10.8	10.8														10.9
FAST	20	20.8	21.0	21.1	22.8	21.1	21.0	20.8	18.8	16.8	13.9	11.0	13.9															20.8
FAST	21	23.9	20.3	22.6	23.3	22.6	21.5	20.3	18.5	17.4	17.2	16.9	16.6															20.3
FAST	22	26.3	35.0	26.3	19.2	18.5	15.3	18.5	15.3	12.2	12.1	12.2	12.2															16.9
FAST	23	18.7	13.5	8.2	8.1	8.0	8.1	8.2	9.7	11.1	10.4	11.1	11.1															10.0
FAST	24	6.5	7.5	8.4	14.5	8.4	8.6	8.7	14.4	9.4	9.5	9.4	9.5															9.1
FAST	25	17.1	13.6	17.1	19.2	17.1	13.6	14.4	15.8	14.4	14.3	14.2	14.3															14.4
Sample# Median		26.3	21.0	22.6	22.8	21.1	19.2	18.5	18.5	16.8	16.5	15.4	16.0	16.8	17.7	17.0	18.0	17.7	19.2	20.8	20.8	17.1	18.3	18.1	18.0	19.4	18.1	**18.2**
25th Percentile		18.7	16.6	14.2	19.2	17.1	14.7	14.2	14.7	13.5	12.6	13.5	13.9	15.4	15.7	15.7	15.9	15.3	16.3	16.1	16.0	15.6	15.4	16.3	17.8	18.8	18.1	15.7
75th Percentile		30.1	29.6	28.1	25.1	23.9	23.1	23.0	21.4	22.0	19.2	18.7	19.2	22.4	23.5	23.3	24.9	24.4	23.8	23.1	21.8	20.7	20.6	20.1	20.5	20.0	18.1	22.7
n	25	25	25	25	25	25	25	25	25	25	25	25	25	17	15	15	11	11	10	9	9	9	8	7	5	2	1	

Table 6. **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. (See Appendix 1 for discussion of data editing.)

Total Nitrogen Running Median — Number of Sampling Events

Technology	System	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	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	31.1	31.3	33.0	34.7		30.8
BioBarrier	2	13.8	12.1	12.6	13.2	12.6	11.5	12.6	13.2	13.8	13.2	13.8	15.7	17.5	19.1	20.6		13.2
BioBarrier	3	19.9	15.9	19.9	31.3	19.9	30.3	26.8	23.4	22.3	24.6	26.8	30.7	34.6	37.6			25.7
BioBarrier	4	20.4	21.9	23.4	25.8	23.4	25.8	28.2	25.8	27.5	25.6	27.5	27.9	28.2	28.8			25.8
BioBarrier	5	20.8	21.8	22.8	22.9	22.9	22.9	22.8	22.9	22.9	24.3	25.7	27.9	30.1	31.6			22.9
BioBarrier	6	18.9	28.4	32.0	27.5	32.0	32.8	33.6	32.8	32.0	32.8	33.6	35.7	37.8	40.4			32.8
BioBarrier	7	28.4	36.4	40.8	34.6	28.4	34.6	28.4	24.8	21.2	24.8							28.4
BioBarrier	8	13.3	25.8	38.3	25.8	13.3	22.4	31.1	31.3	31.1	31.3							28.5
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	31.6	31.6	31.6	32.2	23.3
BioBarrier	10	11.8	10.0	8.1	8.9	9.6	9.7	9.8	10.8	11.8	12.7	13.6	16.5					10.4
BioBarrier	11	28.4	16.7	10.8	19.6	10.8	19.6	28.4	31.3	34.2	38.4	42.6						28.4
BioBarrier	12	33.1	19.6	33.1	33.3	33.4	33.3	33.1	30.7	33.1	33.3	33.1						33.1
Sample# Median		19.4	20.1	21.4	24.3	21.4	24.6	28.3	25.3	29.3	25.2	29.2	28.6	31.3	31.6	31.6	32.2	**24.9**
25th Percentile		13.8	15.5	14.3	18.3	13.1	21.7	20.9	23.2	22.0	24.1	26.0	25.0	29.2	30.2	26.1	32.2	22.6
75th Percentile		22.7	22.9	32.3	28.4	27.4	30.9	30.9	31.1	31.7	31.6	32.7	30.8	33.1	35.3	33.2	32.2	31.4
n		12	12	12	12	12	12	12	12	12	12	10	8	7	7	3	1	

Table 7a. **SeptiTech** running median of total nitrogen (mg L-1) **for all samples** 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. (See Appendix 1 for discussion of data editing.)

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	13.8			25.6
SeptiTech	3	24.6	19.0	15.2	15.2	15.2	15.2	15.1	14.2	13.3	13.3	13.3	10.7			15.1
SeptiTech	4	19.9	17.9	19.9	20.7	19.9	20.7	19.9	17.9	15.9	12.9	9.8	9.7			18.9
SeptiTech	5	18.5	20.1	18.5	13.9	10.2	9.7	10.2	10.1	10.0	9.6	10.0				10.2
SeptiTech	6	17.2	22.4	27.6	22.4	23.6	20.4	23.6	20.4	17.2	14.8	12.4				20.4
SeptiTech	7	33.5	34.8	33.5	30.7	27.9	24.7	21.5	19.1	16.6	14.6	12.5				24.7
SeptiTech	8	32.8	24.9	17.0	12.0	14.5	12.3	10.0	10.4	10.8	10.4	10.4				12.0
SeptiTech	9	4.1	5.4	6.1	6.4	6.1	6.0	6.1	6.0	5.8						6.0
SeptiTech	10	30.9	26.8	29.0	26.7	24.3	23.5	22.7	21.5	22.3						24.3
SeptiTech	11	25.2	31.4	37.6	38.5	37.6	31.4	25.8	31.7	37.6						31.7
SeptiTech	12	10.7	16.0	21.3	16.0	10.7	12.0	13.0	11.9	12.9	13.0	13.0	13.1	13.2	13.1	13.0
SeptiTech	13	13.1	15.0	13.1	11.4	9.6	9.5	9.4	9.5	9.6	11.4	13.1	13.8	14.4	13.8	12.2
SeptiTech	14	33.3	23.8	19.2	26.3	19.2	26.3	19.2	26.3	19.2	19.0					21.5
SeptiTech	15	26.0	19.0	12.8	12.4	11.9	11.5	11.3								12.4
SeptiTech	16	19.9	16.5	19.9	34.8	19.9	19.8	19.6	18.8							19.8
SeptiTech	17	9.4	11.9	14.4	15.5	16.5	16.7	16.8	16.7							16.0
SeptiTech	18	38.8	44.1	38.8	38.4	38.8	38.4	38.0	35.9							38.6
SeptiTech	19	9.3	12.6	15.9	21.3	15.9	16.7	17.4	19.4							16.3
SeptiTech	20	21.9	22.4	21.9	18.1	16.2	16.1									20.0
SeptiTech	21	14.2	36.5	31.7	25.9	20.0	18.5	20.0								20.0
SeptiTech	22	39.4	45.1	39.4	39.2	39.0	38.0	36.9								39.2
SeptiTech	23	29.7	36.2	31.2	36.9	31.2	36.9	31.2								31.2
SeptiTech	24	7.5	6.6	5.7	5.9	6.1										6.1
SeptiTech	25	28.9	20.2	11.4	11.3	11.4										11.4
SeptiTech	26	9.2	8.7	8.1	8.7	9.2										8.7
SeptiTech	27	17.9	10.7	8.4	7.6											9.6
SeptiTech	28	5.5	6.7	7.3	7.6	7.6										7.3
SeptiTech	29	4.3	4.5	4.6	5.1											4.5
SeptiTech	30	7.4	8.6	9.7												8.6
SeptiTech	31	11.5	10.6	11.5												11.5
SeptiTech	32	16.4	12.2	12.2												12.2
SeptiTech	33	57.4														57.4
SeptiTech	34	28.5														28.5
Sample# Median		19.2	18.4	16.5	16.0	16.2	18.5	19.4	18.4	14.6	13.0	12.5	11.9	13.8	13.4	**16.1**
25th Percentile		9.7	10.7	11.0	11.3	10.5	12.1	11.7	10.8	10.2	10.9	10.1	10.0	13.5	13.3	10.8
75th Percentile		29.5	25.4	27.9	26.7	24.0	25.5	23.4	20.4	17.1	14.7	13.1	13.6	14.1	13.6	21.9
n		34	32	32	29	27	23	22	18	14	11	10	6	2	2	

Table 7(b). **SeptiTech** running median of total nitrogen (mg L-1) **for only software-activated denitrification cycle samples** 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. (See Appendix 1 for discussion of data editing.)

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	13.8	15.0	13.8	11.9	13.2	11.6	11.3								13.2
SeptiTech	3	5.3	5.1	5.3	6.7	5.3	5.3	5.3								5.3
SeptiTech	4	8.3	19.1	9.0	9.4	9.0	8.8	9.0	8.8							9.0
SeptiTech	5	7.7	8.5	9.2	8.9	9.2	9.6	9.2	8.9	9.2						9.2
SeptiTech	6	7.5	15.6	11.9	17.8	12.4	12.2	11.9	10.8							12.0
SeptiTech	7	16.6	14.6	16.6	14.6	12.5	11.9	11.3	10.2							13.5
SeptiTech	8	17.0	11.1	7.0	10.8	10.0	8.5	10.0	10.4	10.0						10.0
SeptiTech	9	4.1	5.4	6.1	6.4	6.1	6.0	6.1	6.0	5.8						6.0
SeptiTech	10	29.0	26.7	24.3	22.3	20.3	17.0	20.3								22.3
SeptiTech	11	25.2	31.4	37.6	38.5	37.6	31.4	25.8	31.7	37.6						31.7
SeptiTech	12	10.7	16.0	21.3	16.0	10.7	12.0	13.0	11.9	12.9	13.0	13.0	13.1	13.2	13.1	13.0
SeptiTech	13	13.1	15.0	13.1	11.4	9.6	9.5	9.4	9.5	9.6	11.4	13.1	13.8	14.4	13.8	12.2
SeptiTech	14	344.1	181.4	18.7												181.4
SeptiTech	15	26.0	19.0	12.8	12.4	11.9	11.5	11.3								12.4
SeptiTech	16	19.6	18.8	18.0												18.8
SeptiTech	17	9.4	11.9	14.4	15.5	16.5	16.7	16.8	16.7							16.0
SeptiTech	18	24.3	27.9													26.1
SeptiTech	19	9.3	12.6	15.9	21.3	15.9	16.7	17.4	19.4							16.3
SeptiTech	20	21.9	22.4	21.9	18.1	16.2	16.1									20.0
SeptiTech	21	14.2	36.5	31.7	25.9	20.0	18.5	20.0	20.0							20.0
SeptiTech	22	15.2	14.1													14.7
SeptiTech	23	29.7	36.2	31.2	36.9	31.2	36.9	31.2								31.2
SeptiTech	24	7.5	6.6	5.7	5.9	6.1										6.1
SeptiTech	25	28.9	20.2	11.4	11.3	11.4										11.4
SeptiTech	26	9.2	8.7	8.1	8.7	9.2										8.7
SeptiTech	27	17.9	10.7	8.4	7.6											9.6
SeptiTech	28	5.5	6.7	7.3	7.6											7.0
SeptiTech	29	4.3	4.5	4.6	5.1											4.5
SeptiTech	30	7.4	8.6	9.7	9.8											9.2
SeptiTech	31	11.5	10.6	11.5												11.5
SeptiTech	32	16.4	12.2													14.3
SeptiTech	33	57.4														57.4
SeptiTech	34	28.5														28.5
Sample# Median		14.0	14.3	11.9	11.3	11.7	11.9	11.3	10.4	9.6	11.4	13.0	13.1	13.8	13.4	11.9
25th Percentile		8.4	8.7	8.4	8.7	9.2	9.2	9.3	8.9	9.0	10.0	10.9	10.9	13.5	13.3	9.2
75th Percentile		23.7	19.3	18.0	17.3	16.1	16.7	17.3	16.7	11.5	12.2	13.1	13.4	14.1	13.6	16.4
n		34	32	29	26	22	19	18	13	7	3	3	3	2	2	

Other Issues in 2018

Residential Pilot Program

Ensuring that homeowners maintain their advanced wastewater treatment systems remains a priority in 2018. Periodic maintenance is not only critical to the effective removal of nitrogen, it is also important in extending the longevity of the treatment system and maintaining adequate hydraulic conductivity in receiving soils. It is for these reasons that both the Pinelands program and the latest NJDEP regulations require that operation and maintenance contracts remain in place throughout the life of each advanced treatment system.

On April 2, 2012, the NJDEP adopted amendments to N.J.A.C 7:9A, the statewide Standards for Individual Subsurface Sewage Disposal Systems. The amendments require perpetual professional management of advanced wastewater pretreatment components, including the Pinelands Alternate Design Wastewater Treatment Systems. Details of the DEP's rule adoption may be viewed on the DEP's web site at http://www.nj.gov/dep/dwq/pdf/njac79a.pdf.

In addition to the mandatory septic system management requirements that are contained in the Standards for Individual Subsurface Sewage Disposal Systems, additional septic system management requirements are contained in the New Jersey Water Quality Management Planning (WQMP) rules adopted by the NJDEP at N.J.A.C 7:15-4.5(c)1.vi.

The DEP's latest rules elevate the importance of maintaining operation and maintenance contracts in perpetuity by now declaring the absence of such a contract to be a violation of the New Jersey Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.). Further, NJDEP's rules now define unmanaged advanced treatment systems to be in violation of N.J.A.C 7:9A-3.4. Each of the seven Pinelands Area county health departments are charged with enforcing both the Act and the Regulation.

Collectively, the NJDEP's rules provide the county health departments with a variety of administrative tools to ensure compliance with these requirements. N.J.A.C 7:9A-8.3(e) requires that administrative authorities (health departments) track and manage all advanced wastewater treatment systems with respect to the type and location of system, the date of system startup and the inspection and maintenance calls conducted on each system. The rule requires that this information be reported to the NJDEP annually. Further, while enforcement action is always taken as a last resort, provisions of the Water Pollution Control Act provide health departments with the ability to seek compliance with the requirement for operation and maintenance contract through the courts.

Commission staff was successful in working with the NJDEP to secure generic treatment works approvals (TWA) for the four new NSF Standard 245 advanced treatment systems that have been authorized to participate in the Commission's pilot program. The revised TWA authorizes local administrative authorities (generally County Health Departments) to approve the use of those advanced treatment technologies that are authorized for participation in the Commission's pilot program and requires that the systems be periodically serviced by qualified personnel. The Commission appreciates the cooperation it continues to receive from NJDEP in all aspects of administering the pilot program.

The Commission remains committed to working with each of the Pinelands Area municipalities and the Pinelands Area County Health Departments to assist them in complying with these requirements.

Non-Residential Activities

The Alternate Design Wastewater Treatment Systems Pilot Program is limited to determining the capability of advanced treatment technologies to attenuate nitrogen in domestic (residential) wastewater. This is due to the Pinelands Ad Hoc Septic System Committee's determination that insufficient data were available to establish specific nitrogen removal efficiencies in treating commercially generated wastewater, due to the highly variable nature of non-residential (commercial and institutional) wastewater (i.e. variable flow and constituent concentrations). The CMP allows applicants for non-residential development in unsewered Pinelands growth areas to propose the use of an advanced treatment system (in lieu of dilution based upon parcel size alone) on a case by case basis. Both existing and new commercial development in Pinelands growth areas, that are without public sewer service could benefit from the use of pre-approved alternative treatment technologies because land parcels in these management areas are frequently too small to allow commercial establishments to meet Pinelands water quality standards through dilution alone.

Currently four advanced onsite wastewater treatment systems (Amphidrome Plus) are in use by commercial operations in the Pinelands Area to meet ground water quality standards in unsewered Regional Growth Areas and Pinelands Towns. Two systems are serving retail pharmacies, (Tabernacle and Jackson Townships), one system is serving a retail store (Woodbine Borough) and one system is serving a combined retail store and drive through restaurant (Folsom Borough). Each of these systems is under the operation of NJDEP licensed wastewater treatment plant operators. Monitoring of the two Amphidrome systems serving retail pharmacies demonstrates that these systems are meeting Pinelands water quality standards. Monitoring of the remaining two systems has not yet commenced as these systems have not yet been operating for six months; effluent monitoring commences after six months of operation to allow for the establishment of microbial treatment populations.

In addition to permitting the individual use of advanced treatment systems for residential use through the pilot program and on a case by case basis for commercial development, the Commission continues to encourage the use of community treatment systems to serve clusters of residences and/or commercial establishments. Community systems (also known as decentralized systems) can treat wastewater from groups of businesses and/or residences, often more economically than can be done by using multiple individual treatment systems. The Folsom Borough Amphidrome Plus system discussed above is an example of a community treatment system that will serve a retail store and a separate drive through restaurant.

On March 5, 2018 the Pinelands Commission adopted set CMP amendments, including an amendment that provides an opportunity for certain existing nonresidential uses in specific Pinelands Management Areas to use advanced wastewater treatment systems as a means to meet Pinelands water quality standards. Under previous CMP provisions, advanced wastewater treatment systems could be used to meet water quality standards by nonresidential development only in the growth-oriented areas of the Pinelands. Under the adopted rule amendment, certain existing commercial facilities located in an infill area within the Preservation Area District or Rural Development, Forest, and Agricultural Production Areas are permitted to expand by up to 50% of the existing floor area or up to 50% of the existing capacity provided an advanced treatment system is used such that the proposed use would meet Pinelands water quality standards. In addition, these pre-existing uses can change to another permitted use, provided an advanced wastewater treatment system is used so that the new facility meets Pinelands water quality standards, where such a change would otherwise not meet water quality standards by dilution alone. On the basis of the successful performance of commercially used advanced treatment systems, the Commission staff believes that this CMP amendment will result in improved water quality and a greater likelihood that existing uses will remain viable.

Cooperation with Local Government and Health Departments

The Commission continues to affirm its desire to assist the Pinelands Area municipalities in complying with the new NJDEP WQMP rules and the NJDEP Standards for Individual Subsurface Sewage Disposal Systems. These rules require all New Jersey municipalities to implement septic system management programs, for both traditional/conventional septic systems as well as advanced treatment technologies. Locally administered management programs help to ensure proper operation and maintenance of alternative treatment technologies as well as conventional or traditional septic systems. In the absence of septic system management programs, homeowners and businesses may neglect to perform the maintenance necessary to attain maximum longevity of their wastewater systems.

To advance the transfer of information acquired through the Pinelands alternate design treatment systems pilot program, Commission staff continues to share data with NJDEP and posts data from the annual reports on the Commission's web site.

Commission staff will continue to work with the local government officials, especially the Pinelands Area health officials and construction code officials, to achieve the objectives of the pilot program and assure required documentation is received prior to the issuance of construction approvals and certificates of occupancy. In addition, Commission staff will continue to work with the alternate design treatment systems technology vendors and their agents to assure adherence to the requisite sampling, analysis and reporting requirements of the pilot program.

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

Appendix 1

Data Editing

Total nitrogen (TN) is defined in the Pinelands CMP and in this report as the sum of total Kjeldahl nitrogen (TKN) plus nitrate nitrogen plus nitrite nitrogen. It should be noted that the retained data set includes instances where analyses for multiple parameters (from a single sampling event) were performed by different (DEP certified) laboratories under subcontract, i.e. nitrate and nitrite by one lab and total Kjeldahl nitrogen by another lab, and where different (DEP approved) methodologies were used on various sampling dates from a single system location. In all of these instances, both the laboratories and analytical methods used were DEP approved and/or certified. In some instances, these state certified laboratories reported total Kjeldahl nitrogen values (sum on ammonia nitrogen plus organic nitrogen) at higher levels than ammonia nitrogen values. Laboratory managers consistently reported that such variation is consistent with standard laboratory reporting protocols and does not constitute lab error. In instances where TKN concentration values were reported as less than ammonia nitrogen concentration values, the data used to calculate TN values consisted of the highest reported TKN or ammonia nitrogen concentration, plus nitrate nitrogen plus nitrite nitrogen. Where laboratories reported analyte values as "Not Detected" the Commission's analysis assigned a concentration of one-half the laboratory reporting limit to that parameter when computing the total nitrogen concentration in the sample.

Prior to conducting the data analysis, data were edited, sorted and evaluated by Commission staff. Where obvious errors in the data were evident, i.e. exceeding a maximum sample holding time or a lab reporting error, such data were discarded. When values for the various nitrogen parameters, (e.g. nitrate, nitrate, total Kjeldahl nitrogen) were not collected during a single sampling event, the results of the individual parameters were not used in computing total nitrogen concentrations. After discarding such data and consulting with NJDEP's Office of Quality Assurance and Division of Water Quality, Bureau of Nonpoint Pollution Control, more than 85 % of the submitted laboratory results were retained for analysis. The Commission continues to see improved conformance by analytical laboratories with regard to data reporting.

Data Accuracy

It is typical for a regulatory pilot program of this nature to generate data that would not meet the rigorous standards required of a peer reviewed research project. Because of the uncontrolled variables associated with such a pilot program, the reader should understand that a pilot program is not research. Uncontrolled variables are significant and numerous where treatment technologies are operating under real world conditions. Apart from these real world pilot programs, a number of technology test centers (National Sanitation Foundation (NSF), US Environmental Protection Agency Environmental Technology Verification (ETV)) routinely conduct benchmark tests to determine what a treatment system is capable of doing. Such trials are conducted under rigidly controlled conditions. While these benchmark studies measure what a technology is capable of achieving, they do not assess what a technology actually achieves in widely ranging real world applications. Moreover, while standard assessment protocols are well developed for test center benchmark trials, there are currently no known similar standard assessment protocols for evaluating actual field performance of treatment technologies. In December 1999, New Jersey, Massachusetts and Pennsylvania, acting under a Memorandum of Understanding (MOU) originally entered into in June 1996, agreed to work on the development of a standard protocol for approving innovative and alternate onsite wastewater treatment technologies. In its September 2005 report, released as a result of that MOU, this multi-state consortium acknowledged the dearth of third-party peer-reviewed, replicable data related to field trials of onsite wastewater systems. The group advises however, that even in the absence of "pure" data, regulators should exercise caution before throwing out "imperfect" data while assessing onsite system performance. The consortium instead recommends that regulators rank data on the basis of a hierarchy of strength, and to not to allow the perfect to be the enemy of the good. The consortium produced a report for the New England Interstate Water Pollution Control Commission, entitled *Variability and Reliability of Test Center and Field Data: Definition of Proven Technology From a Regulatory Program Viewpoint.* In its report, the consortium concludes that all non-fraudulent field performance data on alternate design wastewater treatment systems is valuable in regulatory decision making, even if that data is not gathered in a completely controlled study.[2]

On April 16, 2007, the NJDEP, Division of Watershed Management, Bureau of Environmental Analysis and Restoration issued a technical report entitled Nitrate as a Surrogate of Assessing Impact of Development Using Individual Subsurface Sewage Disposal Systems on Ground Water Quality. In that report, NJDEP relied upon datasets from the USGS National Water Information System (NWIS) and the New Jersey Ambient Ground Water Quality Monitoring Network (AGWQMN) to establish an ambient nitrate concentration of 2 mg/L in NJ groundwater. In that analysis, DEP acknowledges retaining data with questionable precision, rather than abandoning data, to conduct its analysis**.**

In assessing onsite wastewater treatment technologies, the Pinelands pilot program's methodology necessarily includes multiple uncontrolled variables. These include unique residential occupancies and personal practices, multiple private (NJDEP certified) laboratories conducting effluent analyses, various operation/maintenance firms, and multiple wastewater technology vendors. These variables represent real world conditions and reflect standard industry and marketplace practices. Some of these practices are regulated, such as laboratory certifications and analytical methods, while others are not. As a result of these real world circumstances, it should be emphasized that the monitoring provisions of this pilot program do not rise to the level of peer-reviewed, journal-published research, but instead are intended to provide a statistically sound measure of the field performance of the pilot program systems. Specific examples of variables that were not controlled in the pilot program assessment include variability in the make up of households serviced by the systems, variability of wastewater flow and strength characteristics, variability in raw water supplied to the residence (e.g. pH, alkalinity, etc.) variability in individuals involved in sample collection, variability in laboratories performing the analyses (including subcontracting between laboratories), and variability in laboratory personnel, equipment and analytical methods. Additionally, all samples were collected as grab samples (as opposed to composite samples) and are thus greatly affected by wastewater usage conditions that prevailed just prior to the sampling event and do not necessarily characterize long term effluent characteristics.

[2] Groves. T.W., F. Bowers, E. Corriveau, J. Higgens, J. Heltshe, and M. Hoover. 2005. Variability and Reliability of Test Center and Field Data: Definition of Proven Technology From a Regulatory Program Viewpoint. Project No. WU-HT-03-35. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by the New England Interstate Water Pollution Control Commission