ALTERNATE ON-SITE WASTEWATER TREATMENT SYSTEMS

TASK 2 – REVIEW OF STANDARDS, CODES & REGULATIONS FOR ON-SITE SYSTEM TECHNOLOGIES

Suffolk County Department of Health Services
Suffolk County, New York

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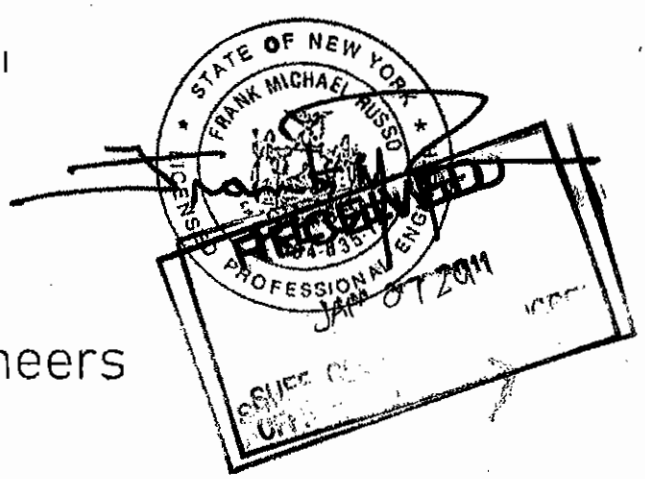

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ALTERNATE ON-SITE WASTEWATER TREATMENT SYSTEMS

TASK 2 – REVIEW OF STANDARDS, CODES AND REGULATIONS FOR ON-SITE SYSTEM TECHNOLOGIES

TABLE OF CONTENTS

ALTERNATE ON-SITE WASTEWATER TREATMENT SYSTEMS

TASK 2 – REVIEW OF STANDARDS, CODES AND REGULATIONS FOR ON-SITE SYSTEM TECHNOLOGIES

APPENDICES

Appendix A – New York State Department of Health

Appendix B – National Sanitation Foundation (NSF International)

Appendix C – State of New Jersey Pinelands Commission

Appendix D – Washington State Department of Health

Appendix E – Nitrogen Removal of Three Alternate Septic Systems Technologies and a Conventional System – Massachusetts Alternative Septic System Test Center, September 2002

Appendix F – Performance of Innovative Alternative On-site Septic Systems for the Removal of Nitrogen in Barnstable County, Massachusetts 1999-2007

Appendix G - University of Rhode Island/State of Rhode Island

Appendix H – USEPA Onsite Wastewater Treatment Systems Manual

Note: Appendices are contained on CD following this report.

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ALTERNATE ON-SITE WASTEWATER TREATMENT SYSTEMS

TASK 2 – REVIEW OF STANDARDS, CODES AND REGULATIONS FOR ON-SITE SYSTEM TECHNOLOGIES

EXECUTIVE SUMMARY:

This study prepared for the Suffolk County Department of Health Services investigates alternate sewage treatment systems that could possibly replace current systems, or be required for new construction of on-site septic tank and cesspool systems. Over 60 websites were studied yielding over 150 downloads of information. Products developed for advanced on-site treatment were technically screened for further evaluation.

Standards from national agencies such as the National Sanitation Foundation (NSF), the United States Environmental Protection Agency (EPA), and the states of New York, New Jersey, Massachusetts, Rhode Island and Washington are available and have assisted in determining that on-site wastewater alternatives can be considered by Suffolk County.

The United States Environmental Protection Agency (EPA) published the *Onsite Wastewater Treatment Systems Manual* in June 2005. The manual reflects the recent advances in technology that have made on-site wastewater treatment more environmentally protective. Upon completion of the research, over 40 treatment systems were evaluated. Below is a listing of newer technologies that will be considered for further research based on their stated ability within the literature to consistently remove total nitrogen from domestic wastewater:

- Continuous Flow, Suspended Growth Aerobic Systems (CFSGAS)
- Fixed-Film Processes
- Sequencing Batch Reactor Systems
- Membrane Biological Reactors

ALTERNATE ON-SITE WASTEWATER TREATMENT SYSTEMS

TASK 2 – REVIEW OF STANDARDS, CODES AND REGULATIONS FOR ON-SITE SYSTEM TECHNOLOGIES

INTRODUCTION:

This report section presents the results of a research investigation into available alternative sewage treatment systems that could replace current on-site septic tank and cesspool systems. The investigation is being conducted for the Suffolk County Department of Health Services (SCDHS), Division of Environmental Quality, Office of Wastewater Management. The purpose of this task is to research and locate alternate on-site treatment systems that could possibly be further evaluated for incorporation into Suffolk County standards for the potential to produce consistent effluent total nitrogen concentrations of 10 mg/L or less. The flow ranges considered are for single-family residential dwellings (300 gallons per day) up to a limit of 30,000 gallons per day (gpd) for commercial, industrial or high-density residential applications.

PROCEDURE:

A search of the internet was conducted over a period of several months that revealed over 60 sites that deserved a detailed review. From these sites, many documents and research projects were reviewed yielding over 150 downloads that were technically screened for consideration. The information obtained was in the form of standards, regulations, codes, product brochures, owner's manuals, case study reports, research papers, demonstration projects, educational and resource training centers, testing data tables and technical drawings and specifications.

Of the detailed literature review, eight (8) sources provided the most relevant and valuable information pertaining to nitrogen reduction on-site systems. They are:

- New York State Department of Health – (see Appendix A)
- National Sanitation Foundation (NSF International) – (see Appendix B)
- State of New Jersey Pinelands Commission – (see Appendix C)
- Washington State Department of Health – (see Appendix D)
- Nitrogen removal of three alternate septic systems technologies and a conventional system – Massachusetts Alternative Septic System Test Center, September 2002 – (see Appendix E)
- Performance of innovative alternative on-site septic systems for the removal of Nitrogen in Barnstable County, Massachusetts 1999-2007 – (see Appendix F)
- University of Rhode Island/State of Rhode Island – (see Appendix G)
- USEPA Onsite Wastewater Treatment Systems Manual – (see Appendix H)

ALTERNATE ON-SITE WASTEWATER TREATMENT SYSTEMS

TASK 2 – REVIEW OF STANDARDS, CODES AND REGULATIONS FOR ON-SITE SYSTEM TECHNOLOGIES

PART 1: LITERATURE SEARCH (300 – 1,000 GALLONS PER DAY):

1) NATIONAL STANDARDS

A) National Sanitation Foundation (NSF International)

NSF International is an American National Standards Institute (ANSI) accredited certification agency. For on-site wastewater treatment systems, NSF/ANSI has established a series of standards for granting product certification. Currently there are four (4) standards, they are:

- **NSF/ANSI Standard 40** for residential wastewater treatment systems having capacities between 400 gallons and 1500 gallons per day;
- **NSF/ANSI Standard 41** for treatment systems that do not utilize a liquid saturated media as a primary means of storing or treating human excreta or human excreta mixed with other organic household materials;
- **NSF/ANSI Standard 46** for components of wastewater treatment systems, and;
- **NSF/ANSI Standard 245** for residential wastewater treatment systems designed to provide nitrogen reduction.

NSF/ANSI Standard 40 is not restrictive in type of treatment technology and includes a wide range of product evaluation methods. The most notable criteria is the ability of a system to produce an acceptable quality of effluent based on the U.S. EPA secondary effluent treatment requirements for municipal treatment facilities for a Class I system.

NSF/ANSI Standard 41 is used to evaluate treatment systems that do not utilize a liquid saturated media as a primary means of storing or treating human excreta or human excreta mixed with other organic household materials.

NSF/ANSI Standard 46 applies to a wide range of products relating to components of wastewater treatment systems. The standard includes performance evaluations for grinder pumps, septic tank effluent filters, chlorination devices, and UV disinfection devices.

NSF/ANSI Standard 245 requires six (6) months of pilot condition performance testing incorporating stress tests to simulate wash day, working parents, power outage and vacation conditions. The standard is set up for systems having capacities rated between 400 and 1,500 gallons per day (gpd). For Standard 245 compliance, the systems must also test and meet Standard 40 requirements.

ALTERNATE ON-SITE WASTEWATER TREATMENT SYSTEMS

TASK 2 – REVIEW OF STANDARDS, CODES AND REGULATIONS FOR ON-SITE SYSTEM TECHNOLOGIES

It should be noted that NSF/ANSI Standard 245 compliance does not ensure that a technology will provide the same performance under installed field conditions.

B) United States Environmental Protection Agency (USEPA) Standards

The U.S. Environmental Protection Agency has published a group of documents outlining its mission, priorities and regulatory authorities in regards to on-site wastewater treatment systems. These documents provide guidance and technical information to help communities establish comprehensive septic system management programs. USEPA resources include:

- **Guidance:** Voluntary national guidelines and implementation tools to improve the overall management of septic (onsite) wastewater systems
- **Manuals:** Technical information reflective of sound, professional practice
- **Policy and Regulations:** Congressional reports, program strategy, Memorandum of Understanding, and regulatory requirements

The USEPA acknowledges the failure of many conventional septic systems to minimize nitrate contamination of ground water, remove phosphorus compounds, and attenuate pathogenic organisms (e.g., bacteria, viruses). Methemoglobinemia or blue baby syndrome, affecting pregnant women, is one of the many public health issues that stems from an excess of nitrates in drinking water. In addition, failures of on-site sewage treatment processes have direct environmental impacts. Nitrates and phosphorus discharged into surface waters, directly or through subsurface flows, can spur algal growth and contribute to eutrophication and low dissolved oxygen in lakes, rivers, and coastal areas harming wild life.

1. Onsite Wastewater Treatment Systems Manual

This USEPA publication provides information on onsite wastewater treatment system (OWTS) sitting, design, installation, maintenance, and replacement. Advances from the expert community are utilized to make onsite systems more cost-effective and environmentally protective in small urban and rural areas. A performance-based approach to selecting and designing OWTS is promoted to enable States and local communities to design onsite wastewater programs that fit local environmental conditions and community capabilities. This approach is based on:

- Defining system performance requirements;
- Characterizing wastewater flow and pollutant loads;
- Evaluating site conditions;
- Defining performance and design boundaries, and;

- Selecting a system design that addresses these factors.

Performance requirements for OWTS should be based on environmental risk assessments that account for the hazards of individual potential pollutants. For example, nitrate-nitrogen requirements have been set in Wisconsin and Massachusetts that regulate system effluent to be no more than 10 mg/L.

2. Environmental Technology Verification Program (ETV)
The EPA Environmental Technology Verification Program was created in 1995 to accelerate the entrance of new environmental technologies into the global market. 12 technology testing centers have since been established to verify the performance of environmental technologies. Part of the program is dedicated to the verification of market-ready onsite wastewater technologies using protocols developed by manufacturers. The goal of this program is to obtain credible product operating data that can be widely distributed and accepted by regulators and others. Product certifications are not provided at this time.

3. Standards

- **NSF/ANSI Standard 245** for residential wastewater treatment systems designed to provide nitrogen reduction.

2) NEW YORK STATE STANDARDS

A) New York State Department of Health, Appendix 75-A of Title 10 of the Official Compilation of Rules and Regulations (NYCRR)

The New York State Department of Health (NYSDOH) has adopted the following revisions to its current standards for residential on-site wastewater treatment.

- Add, as an alternative to a conventional septic tank, a new category of on-site wastewater treatment systems called Enhanced Treatment Units (ETUs)
- Allow National Sanitation Foundation Class I Standard 40 or EPA Environmental Technology Verification (ETV) testing Environmental Test Units (ETUs) to be designed with a 33% absorption trench length reduction
- Only consider ETUs for design approval in jurisdictions served by a Responsible Management Entity (RME) or where maintenance of the

systems is monitored and required by a local sanitary code or watershed rule or regulation due to the increased maintenance required for these systems

The updated NYSDOH regulations require an owner of an Enhanced Treatment Unit (ETU) be within a jurisdiction served by either a Responsible Management Entity or the local sanitary code. ETUs will be monitored as if they were a full scale treatment plant with effluent limits and there are consequences and penalties associated with non-compliance. RME could be a local government agency or a private entity with an additional service contract.

3) SUFFOLK COUNTY STANDARDS

A) Suffolk County Department of Health Services Standards, Approval of Plans and Construction – Sewage Disposal Systems for Single-Family Residences

Single-family residential construction in Suffolk County must conform to construction standards for water supplies and sewage disposal systems. Properly designed, maintained, and operated sewage disposal systems ensure public safety in accordance with the standards of the SCDHS Office of Wastewater Management. Such systems may only be used on sites with adequate soil percolation and vertical/horizontal separation distances. Proper system sitting is given first priority throughout construction planning stages and the standards list a variety of prohibited site locations for consideration of conventional technologies. The geography of many areas of Long Island is often unable to support the requirements for conventional on-site sewage disposal technologies. Rather than restrict the use of land, the SCDHS has considered the use of alternative technologies to assure proper treatment of sewage in otherwise unsuitable areas. Requirements for alternative systems as stated in the standards include:

- The system shall be designed by a licensed professional engineer.
- It is clearly demonstrated that the proposed system is physically equivalent or better than the conventional systems, in respect to storage capacity, leaching area, land area utilization, grading, accessibility, maintainability, reparability, life expectancy, energy usage, effluent quality and reliability.
- An engineering report determines that the proposed design is most suitable for the building site and that the proposed sanitary system will function properly without causing any health hazard and will minimize the impact on the surrounding environment.
- The design professional supervises the installation of the system and certifies that the system was built in accordance with the approved plan and submits as-built plans of the system.

ALTERNATE ON-SITE WASTEWATER TREATMENT SYSTEMS

TASK 2 – REVIEW OF STANDARDS, CODES AND REGULATIONS FOR ON-SITE SYSTEM TECHNOLOGIES

It is made clear that alternative systems, on an experimental basis, are inappropriate for realty developments or subdivisions.

PART 2: LITERATURE SEARCH (1,000 – 30,000 GALLONS PER DAY):

1) NATIONAL STANDARDS

A) National Sanitation Foundation (NSF International)

The NSF standards as referenced above, apply equally to this flow category of alternate wastewater treatment systems. The treatment systems as covered by the NSF Standards can be packaged as modules to achieve a total required capacity.

B) United States Environmental Protection Agency (USEPA) Standards

The USEPA standards as referenced above, apply equally to this flow category of alternate wastewater treatment systems. The treatment systems as covered by the USEPA Standards can be packaged as modules to achieve a total required capacity.

C) Recommended Standards for Wastewater Facilities (Generally referred to as: Ten States Standards)

The "Committee on Development of Uniform Standards for Sewage Works" was formed in 1947 with the responsibility of reviewing and unifying existing standards for sewage works. Joint sewage works design standards were adopted by ten representative states, including New York, and the Province of Ontario as a result of this committee and have subsequently been revised to aid in the design of modern wastewater facilities. These standards are intended for municipal conventional wastewater collection and treatment systems rather than small municipal or more innovative approaches to on-site sewage disposal. The standards do however include requirements for new process and application evaluations which may be relevant for the SCDHS to adapt in reviewing future on-site sewage disposal system technologies:

- **Chapter 10-Section 10.2** for preliminary project submittals
- **Chapter 50-Section 53.2** for required engineering data for new process and application evaluation
- **Chapter 50-Section 2** outlines requirements that aid in determining the possibility for success of new processes and equipment. Detailed testing, including appropriately-composited samples under various ranges of

strength and flow rates, in-depth description of test methods, and monitoring observations may be required by the SCDHS throughout the reviewing process

2) NEW YORK STATE STANDARDS

The NYS standards as referenced above, apply equally to this flow category of alternate wastewater treatment systems. The treatment systems as covered by the NYS Standards can be packaged as modules to achieve a total required capacity.

3) SUFFOLK COUNTY STANDARDS

A) Suffolk County Sanitary Code – Article 6, Realty Subdivisions, Developments and Other Construction Projects

Article 6 of the Suffolk County Sanitary Code outlines sewage facilities requirements for conventional single-family residential realty subdivisions and developments. Community systems for sewage disposal are required when:

- the realty subdivision or development, or any portion thereof, is located within an existing sewer district;
- the realty subdivision or development is located in an area where the subsoil or groundwater conditions are not conducive to the proper functioning of individual sewerage systems;
- the realty subdivision or development is located outside of Groundwater Management Zones III, V and VI, and any parcel in the realty subdivision or development is less than 20,000 square feet in area, unless the realty subdivision or development meets the population density equivalent requirements of paragraph B.1 of section 760-605; or
- the realty subdivision or development is located within Groundwater Management Zones III, V or VI, and any parcel in the realty subdivision or development is less than 40,000 square feet in area, unless the realty subdivision or development meets the population density equivalent requirements of paragraph B.2 of section 760-605.

Individual sewerage systems are approved by the SCDHS when the following conditions are met:

- the realty subdivision or development is located outside of Groundwater Management Zones III, V and VI, and all parcels of the realty subdivision or development consist of an area of at least 20,000 square feet; or the realty subdivision or development has a population density equivalent

equal to or less than that of a realty subdivision or development of single-family residences in which all parcels consist of an area of at least 20,000 square feet;

- the realty subdivision or development is located within Groundwater Management Zones III, V or VI, and all parcels in the realty subdivision or development consist of an area of at least 40,000 square feet; or the realty subdivision or development has a population density equivalent equal to or less than that of a realty subdivision or development of single-family residences in which all parcels consist of an area of at least 40,000 square feet;
- the realty subdivision or development, or any portion thereof, is not located within an existing sewer district and is located in an area where subsoil and groundwater conditions are conducive to the proper functioning of individual sewerage systems; and
- the individual sewerage systems comply with the Department's current Standards and the minimum State requirements as set forth in 10 NYCRR, Part 75, to the extent applicable to Suffolk County; and
- the requirements of section 760-606 hereof are complied with.

B) Suffolk County Department of Health Services – Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other than Single-Family Residences

In Section XXV of these standards, the Suffolk County Department of Health acknowledges that not all sites are suitable for typical sewage disposal systems. Areas of Long Island with inadequate soil percolation and vertical/horizontal separation distances necessitate the use of alternative systems. Clustered leaching systems, chamber leaching systems, and diffusion well systems are cited as viable alternatives for use in such areas. In addition to the typical plan requirements, applications for sites with alternative sewerage disposal systems must include the following:

- The system shall be designed by a licensed professional engineer.
- It is clearly demonstrated that the proposed system is physically equivalent or better than the conventional systems, in respect to storage capacity, leaching area, land area utilization, grading, accessibility, maintainability, reparability, life expectancy, effluent quality and reliability.
- An engineering report shall be submitted that defines the disposal system and determines that the proposed design is most suitable for the building site and that the proposed sanitary system will function properly without causing any health hazard and will minimize the impact on the surrounding environment.

- The design engineer shall supervise the installation of the system and certify that the system was constructed in accordance with the approved plans. An inspection log shall be maintained and a copy submitted to the Department if requested.

PART 3: STUDIES, STANDARDS, REGULATIONS AND CODES IN OTHER STATES

1) NEW JERSEY:

The New Jersey Department of Environmental Protection (NJDEP) has established the Standards for Individual Subsurface Sewage Disposal Systems (N.J.A.C. 7:9A) to ensure proper design, construction, and operation of residential and commercial onsite wastewater treatment systems. N.J.A.C. 7:9A does not consider performance based standards for effluent; however such standards are the goal of the NJDEP. Regulations are based on conventional systems and do not identify specific alternative treatment technologies. Individual design approvals for alternative technologies that do not strictly conform to N.J.A.C. 7:9A exist on a residential basis and are obtained through the NJDEP. The Alternative Treatment Systems Pilot Program was formed in 2009 to modernize N.J.A.C. 7:9A.

State of New Jersey Pinelands Commission- Annual Report To The New Jersey Pinelands Commission - Alternate Design Treatment Systems Pilot Program, August 5, 2009

Both Federal and State of New Jersey statutes call for the preservation, protection and enhancement of the Pinelands ecosystem and its land and water resources. The Pinelands water resources are 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 Pinelands Comprehensive Management Plan (CMP) focuses on controlling the amount of nitrogen that enters the environment. The Commission's land use program discourages development in important ecological and agricultural areas while directing growth towards areas that are more suitable. In unsewered growth areas, the water quality standards of the CMP permit the use of on-site individual subsurface sewage disposal systems with the condition that the design of the system and the size of the parcel will ensure that the concentration of nitrogen in the groundwater 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 utilizes 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. The model calculates that a minimum 3.2 acre parcel is required to dilute nitrogen to the required 2 part per million (ppm) concentration when conventional septic system technology is used. Thus, unsewered residential development using conventional septic system technology is permitted only on minimum 3.2 acre parcels. In order to comply with the Pinelands water quality standard, unsewered residential development on parcels smaller than 3.2 acres requires the use of advanced on-site denitrifying wastewater treatment technology. If the mass of nitrogen contained in the wastewater discharged from an on-site septic system is sufficiently reduced through the use of an advanced treatment system, the CMP allows the minimum lot size required to meet the 2 ppm property line concentration to be reduced from 3.2 acres down to a minimum of 1.0 acre.

The Ad Hoc Committee On Alternative Septic Systems, convened by the Pinelands Commission in March 2000, conducted a thorough review of 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 a consultant to assess the technical 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 extensive research, the Committee recommended the establishment of a pilot program to test five (5) specific on-site wastewater treatment systems. The Alternative Design Wastewater Treatment Systems Pilot Program contained in the CMP (N.J.A.C. 7:50-10.21) is authorized as a means to test whether these systems can be operated and maintained so as to meet the water quality standards contained in the CMP with maintenance requirements that a homeowner can be reasonably be expected to follow.

2) WASHINGTON:

Washington State Department Of Health, Office Of Environmental Health And Safety: Report To The Puget Sound Action Team - Nitrogen Reducing Technologies For On-site Wastewater Treatment Systems, June 2005

The report was funded by a contract administered by the Puget Sound Action Team. The research and report on Nitrogen Reducing Technologies is part of a larger effort to identify and remedy water quality issues in Lower Hood Canal. The Preliminary Assessment and Corrective Action (PACA) Plan was developed through an arrangement between the Puget Sound Action Team, the state's partnership for Puget Sound, and the Hood Canal Coordinating Council (HCCC). The purpose of the report was to:

Help on-site sewage industry members, regulators and concerned citizens understand the role of nitrogen in on-site wastewater systems and the nitrogen chemistry during wastewater treatment.

The report summarized nitrogen treatment options for on-site sewage systems and the abilities of on-site sewage technologies to reduce nitrogen in the wastewater effluent. The report is intended for homeowners, on-site sewage industry professionals and public policy makers. It is an introduction to nitrogen and nitrogen removal processes as it relates to on-site wastewater system technologies that are available to remove nitrogen from on-site wastewater treatment systems.

They have researched the efforts of the EPA and the National Sanitation Foundation (NSF) to develop the Environmental Technology Verification (ETV) protocol to provide a national testing protocol that can be used to verify nitrogen removal performance. This protocol is the only national protocol in existence for nitrogen removing technologies. Numerous Environmental Protection Agency (EPA) sponsored National Demonstration Sites around the country have tested on-site nitrogen removal systems. They have determined that the results of performance testing have been promising, but quite variable.

At the time of their report, six products had completed ETV testing with demonstrated total nitrogen removal.

The DOH was proposing, in draft rules (Chapter 246-272A WAC On-Site Sewage Systems Draft) to the Washington State Board of Health (WSBOH), that standards be established for any proprietary products that are sold as nitrogen reducing technologies. In order to be registered in the State of Washington, product manufacturers would have to verify that their product is capable of producing effluent TN equal to or less than 20 mg/L using the NSF/EPA Environmental Technology Verification program protocol [Protocol for the Verification of Residential Wastewater Treatment Technologies for Nutrient Reduction / EPA Environmental Technology Verification Program (November, 2000)]. The approved WSBOH rules for on-site sewage require that any systems to be used for nitrogen reduction demonstrate that their product's performance is verified through the EPA/NSF ETV Protocol.

3) MASSACHUSETTS:

Title 5 of the Massachusetts Environmental Code establishes a nitrogen loading limitation of no more than 440 gallons of design flow per day per acre for residential

onsite wastewater treatment systems. This limitation does not apply to effluent meeting the federal Safe Drinking Water Act nitrate standard of 10 ppm through the use of an alternative treatment system. Allowable nutrient loading per acre can be increased with the use of enhanced nutrient removal technologies. For example, a loading of 550 gpd/acre is acceptable for recirculating sand filter technologies.

Facilities with a design flow of 2,000 gpd or more and in Nitrogen sensitive areas are required to use a recirculating sand filter or equivalent technology as part of treatment. The Nitrogen concentration in the system effluent shall not exceed 25 mg/L.

A) Nitrogen Removal Efficiencies of Three Alternate Septic System Technologies and a Conventional Septic System – Massachusetts Alternate Septic System Test Center, September 2002

In 1999, the Buzzards Bay Project National Estuary Program, a unit of the Massachusetts Office of Coastal Zone Management, with the Barnstable County Department of Health and the Environment, UMass Dartmouth School of Marine Science and Technology, Massachusetts Environmental Trust, and the Massachusetts Department of Environmental Protection constructed a facility to promote and test innovative alternative on-site sewage disposal systems. This facility is called the Massachusetts Alternative Septic System Test Center (MASSTC). It is located in the Massachusetts Military Reservation in Cape Cod. At this location, a side-stream from the sewer interceptor that primarily serves U.S. Coast Guard personnel housing fed three replicates of each technology and compared the performances of those to their conventional standard Title 5 (septic tank and leaching field) system for removal efficiencies of TSS, BOD, fecal coliforms and nitrogen. The MASSTC is primarily used for research, its results are based purely on local conditions, and the specific designs for each system with no modifications made.

Three replicates of each of four (4) technologies were initially tested at the startup of the MASSTC. The results of these initial tests were reported in the year 2000. For that report, adjustments were made to the nitrogen removal results to account for dilution of the effluent by precipitation into the Soil Absorption System (SAS) fields. Since that time, the assumed quantity of precipitation dilution has been reconsidered and modified. For this report, the results from the prior testing of nitrogen concentrations sampled below the SAS fields were re-adjusted and included with the newer data for those technologies. This provides for two (2) years of data for each of these technologies. In addition, for this 2002 report, two (2) newer technologies were tested and reported. One (1) year of data was analyzed for these newer technologies.

Effluent from each technology was sampled bi-weekly using composite samplers. This project was an extensive field testing program. Performance results were measured over a two year period.

B) Performance of Innovative Alternative On-Site Septic Systems for the Removal of Nitrogen in Barnstable County, Massachusetts, 1999-2007

This report was prepared by the Barnstable County Department of Health and Environment (BCDHE), Barnstable, Massachusetts. The BCDHE is the oversight agency to innovative alternative (I/A) system performance and maintenance for the 14 towns located in Barnstable County. They ensure compliance by supplementing the regulatory activities of the local boards of health. In 1995, Massachusetts regulations for on-site septic systems were revised to allow for the approval on I/A systems. Under these revisions, between 1995 and 2007 over 1,100 I/A systems have been installed in Barnstable County. This report represents the efforts of the BCDHE, together with the 15 Boards of Health within the County, to compile reliable nitrogen removal performance data of the installed I/A systems.

> *Innovative/alternative septic system technologies in Massachusetts that purport to reduce nitrogen are approved in a progressive manner from Piloting Approval to General Use Approval in accordance with the amount of data and information that support the manufacturers' claims.*

Piloting Approval allows for the installation of up to 15 systems based on limited manufacturer claims and data presented from installations in other states. These systems must be monitored and reported based on an approval letter issued by the Department of Environmental Protection (DEP). Provisional Approval is obtained with data submittals and 50 installations that have been monitored for at least three (3) years. For General Use Approval, at least 90% of the provisional systems must meet criteria specified in the provisional approval letter.

The BCDHE's regulatory limit of performance for I/A technology wastewater treatment effluent TN is generally accepted to be$\leq$ 19 mg/l. The basis for this standard is derived from the majority of Provisional Approval letters for nitrogen removal, which commonly state:

> *For Systems installed at residential facilities with design flows less than 2,000 gpd, TN concentration in the System effluent shall not exceed 19 mg/l...Achieving this concentration at the point where the system*

discharges to the soil absorption system assumes that approximately 50% of the TN is removed from the influent wastewater.

This report stated that they considered 557 individual systems of which 487 are single-family installations and the remaining 70 are multi-family systems. They decided that systems with less than 4 samples analyzed would not be included, and therefore, the data base represents 297 single family and 50 multi-family systems. The highest system test sample count was 33, with most systems having between 6 – 8 test results. Because of the high variability of small sample sizes, they chose to use both the mean and median values to draw their conclusions. The following is a summary of how the report was interpreted; however, it should be noted that the report contained inconsistencies between what was stated in their written sections and their data tables.

Based on the presentation of their data for the 1,169 units incorporating the 15 technologies that were installed between 1999 and January 2007:

- 486 systems had nitrogen sampling data from 12 technologies
- 2,666 nitrogen effluent samples were analyzed from 12 technologies
- Of the 298 systems considered for analysis, 61% of the systems have a median TN of 19 mg/L or less.

4) RHODE ISLAND:

In July 2010 (Amended August 2010), the State of Rhode Island and Providence Plantations, Department of Environmental Management, Department of Water Resources (RIDEM) issued their ***Rules Establishing Minimum Standards Relating to Location, Design, Construction, and Maintenance of Onsite Wastewater Treatment Systems (OSWTSs)***. These rules establish the minimum standards for the proper location, design, construction and maintenance of OSWTSs used for the treatment and dispersal of wastewater. OSWTSs must be located, designed, constructed, operated and maintained in a manner to produce an effluent that will not cause adverse public health or environmental impacts when discharged into the environment. Cesspools are no longer approved. Existing installations are considered substandard and will be phased out. Funds exist in communities that have established wastewater management districts to assist homeowners with the costs of replacing cesspool systems with alternative technologies. OSWTSs designers and installers must be licensed by the State. New systems cannot be installed, altered facilities cannot be constructed (with some exceptions) and repairs to existing systems cannot be made without the written authorization of the Director. Site soil evaluations and site condition reviews are required for new or altered construction projects.

ALTERNATE ON-SITE WASTEWATER TREATMENT SYSTEMS

TASK 2 – REVIEW OF STANDARDS, CODES AND REGULATIONS FOR ON-SITE SYSTEM TECHNOLOGIES

Nitrogen reducing technology is required for all new systems, altered facilities (with some exceptions) and systems requiring maintenance (with some exceptions) that are located in "salt pond and narrow river critical resource areas".

In areas that are designated as "*drinking water supply watershed critical*", where wells are onsite or on adjacent lots, the design flow shall not exceed 345 gallons per day (gpd) per 20,000 square feet (SF) of lot size. Flows per 20,000 SF can be exceeded depending on the percent removal and effluent nitrogen removal technology approved by the Director. Also, nitrogen credit land can be set aside to allow for increased flows. With effluent concentration technologies of 10 mg/l or less, there are no flow restrictions.

On June 24, 2010, the RIDEM issued an official listing of 30 approved alternative or experimental onsite wastewater treatment system technologies. Seven (7) of these technologies are approved for nitrogen removal and two (2) others are approved for nitrogen removal if configured and combined with one of the nitrogen removal systems.

A) Block Island and Green Hill Pond Watershed, Rhode Island EPA National Community Decentralized Wastewater Treatment Demonstration Project – July 1, 1999 to December 31, 2003 and April 1, 2000 to March 31, 2004

The Block Island and Green Hill Pond Watershed, Rhode Island EPA National Community Decentralized Wastewater Treatment Demonstration Project was initiated in July 1999 and continued through December 2007. It was funded with a $3,000,000 EPA grant with a $1,000,000 local match. The project integrated training, research, demonstration and outreach with community management of onsite systems using a watershed approach towards reducing pollution to local water resources. It was led by community partners with the involvement of the University of Rhode Island Cooperative Extension (URI). The purpose of the demonstration project was to establish sustainable wastewater management programs in Block Island and the Green Hill Pond area using performance standards and a range of alternative technologies to reduce pollution risk to local water resources while accommodating environmentally sound development.

In each town, wastewater management ordinances were adapted, each town transitioned to 100% municipal funding, and cesspools are being phased out.

Seventeen (17) systems were installed in Green Hill Pond, five (5) systems were installed in Chepachet Village and twelve systems were installed Block Island. System process sampling was conducted every month for a year for the older projects then up to 3 or 4 times per year for the newer installations. The

demonstration sites were selected from responses to an advertisement regarding replacement of failed residential systems. URI constructed, monitored and maintained the systems for the duration of the project and the residents provided access and received a $7,500 rebate for participating.

B) New England Onsite Wastewater Training Program @ URI CELS

The University of Rhode Island College of the Environment and Life Sciences maintains an Onsite Wastewater Resource Center for training and educational programs serving the greater New England region. The center is located at URI Peckham Farm and consists of numerous innovative, alternate and conventional onsite wastewater treatment systems setup for all aspects of siting, design, installation, operation and maintenance.

PART 4: LITERATURE SEARCH FOR TECHNOLOGIES

1) USEPA ONSITE WASTEWATER TREATMENT SYSTEMS MANUAL

The United States Environmental Protection Agency (EPA) published the *Onsite Wastewater Treatment Systems Manual* in June 2005. The manual reflects the recent advances in technology that have made onsite wastewater treatment more cost-effective and environmentally protective. Chapter 4 of the publication contains information on individual onsite/decentralized treatment technologies or unit processes. Such treatment technologies are often integrated into conventional treatment systems and are nearly always preceded by a septic tank. The EPA discusses the system design, performance, operation, and maintenance of treatment processes and systems in a series of fact sheets. Manufacturer specific treatment technologies explored in this study are organized based on these EPA fact sheets by process.

A) Major Types of Processes

1. Continuous-Flow, Suspended Growth Aerobic Systems (CFSGAS)

This technology utilizes an activated sludge process that maintains a relatively high biomass population by recycling settled microorganisms back into treatment. Recycled biomass transforms soluble and colloidal biodegradable organic matter and some inorganic compounds into cell mass and metabolic end products through an aerobic process in an aeration tank. A clarifier is then used to separate the biomass from the wastewater. Preliminary treatment occurs within a septic tank.

As part of our research, thirteen (13) systems of this technology were located in our database. The majority of the products in this category have indicated effectiveness in removing nitrogen to levels of 10 mg/L or less on a consistent basis. We recommend that continuous flow, suspended growth aerobic systems (CFSGAS) be considered as a technology for further research and testing.

2. *Fixed-Film Processes*

This technology utilizes a natural or synthetic porous medium that is able to support biomass growth. A trickling filter system is characterized by the medium remaining stationary relative to fluid flow. Rotating biological disks provide an alternative treatment method in which the medium is in motion relative to the wastewater. Influent enters a septic tank, moves through a fixed-film reactor for biological purification, and into a clarifier to separate the remaining biomass before effluent release.

As part of our research, seventeen (17) systems of this technology were located in our database. The majority of the products in this category have indicated effectiveness in removing nitrogen to levels of 10 mg/L or less on a consistent basis. We recommend that Fixed-Film Processes be considered as a technology for further research and testing.

3. *Sequencing Batch Reactor Systems*

This technology utilizes an activated sludge process in which all treatment steps occur in sequential order within the same tank. The two major classifications of SBRs are intermittent flow (IF) and the continuous flow (CF) and have both been successful in practice. SBR design is flexible and the process can be adapted to enhance nitrogen, phosphorus, or ammonia removal.

As part of our research, two (2) systems of this technology were located in our database. The majority of the products in this category have indicated effectiveness in removing nitrogen to levels of 10 mg/L or less on a consistent basis. We recommend that Sequencing Batch Reactors be considered as a technology for further research and testing.

ALTERNATE ON-SITE WASTEWATER TREATMENT SYSTEMS

TASK 2 – REVIEW OF STANDARDS, CODES AND REGULATIONS FOR ON-SITE SYSTEM TECHNOLOGIES

4. *Effluent Disinfection Processes*

This technology utilizes either chlorination or ultraviolet irradiation to destroy pathogenic and other microorganisms in wastewater. Waterborne pathogens such as harmful bacteria, protozoan cysts, and viruses are found in the United States and cannot be effectively removed through conventional wastewater treatment. This disinfection process combines conventional pretreatment with disinfection mixing to remove such pathogens.

The products in this category have shown effectiveness in removing bacteria and other harmful components in wastewater; however without a treatment process prior to entering the disinfection area, nitrogen will not be removed to levels of 10 mg/L or less on a consistent basis. We do not recommend that Effluent Disinfection Processes be considered as a technology for further research and testing.

5. *Vegetated Submerged Beds and Other High-Specific-Surface Anaerobic Reactors*

This technology utilizes any tank or cavity filled with solid permeable media through which wastewater flows. The two major classifications are vegetated submerged beds (VSBs) and anaerobic upflow filters (AUFs). VSBs are characterized by macrophyte growth on the treatment media surface and horizontal flow. AUFs include sludge blanket systems, fixed media anaerobic filters, and partially fluidized beds of fine media. Minimally pretreated or high-strength wastewater flows with a high hydraulic retention time through these technologies and post treatment is generally required.

Aquatic and land treatment systems are deemed inappropriate for further research as the land requirements for these technologies are too large for the densely developed areas of Suffolk County. We do not recommend that Vegetated Submerged Beds and Other High-Specific-Surface Anaerobic Reactors be considered as a technology for further research and testing.

6. *Evapotranspiration and Evapotranspiration/Infiltration*

This technology uses evapotranspiration which is defined as the removal of water from a medium by direct evaporation and plant transpiration. Evapotranspiration is used to disperse pretreated wastewater effluent. Evapotranspiration/infiltration combines both evapotranspiration and soil infiltration to dispose of effluent. Wastewater enters from a primary pretreatment unit through a series of distribution pipes to a porous bed. A

liner prevents infiltration in solely evapotranspiration processes and is left out of infiltration designs to allow bed water to permeate the ground. Water-tolerant plants on the bed surface draw up effluent through capillary wicking and into the atmosphere.

Evapotranspiration systems are deemed inappropriate for further research as they are climate specific and would not be able to evaporate wastewater efficiently throughout the year in the northeast climate of Long Island. We do not recommend that Evapotranspiration and Evapotranspiration/Infiltration be considered as a technology for further research and testing.

7. *Stabilization Ponds, FWS Constructed Wetlands, and Other Aquatic Systems*

This technology utilizes large basins to collect wastewater undergoing a combination of physical, chemical, and/or biological treatment. Aquatic systems are a less common method of onsite wastewater treatment due to their large land requirement and human health risk. Supplemental treatment is often required before effluent discharge or reuse and this technology is only approved in a few states.

Aquatic and land treatment systems are deemed inappropriate for further research as the land requirements for these technologies are too large for the densely developed areas of Suffolk County. We do not recommend that Stabilization Ponds, FWS Constructed Wetlands, and Other Aquatic Systems be considered as a technology for further research and testing.

8. *Intermittent Sand/Media Filters*

This technology utilizes a variety of bed filters packed with sand or granular material to provide advanced secondary treatment of septic tank effluent or settled wastewater. The packed-bed filters are lined with an impervious PVC liner or other similar material and a distribution network doses wastewater onto the filter surface. The wastewater is allowed to percolate through the sand and is released through an underdrain system. This effluent is either discharged or further treated.

The majority of the products in this category have not indicated effectiveness in removing nitrogen to levels of 10 mg/L or less on a consistent basis. We do not recommend that Intermittent Sand/Media Filters be considered as a technology for further research and testing.

9. Recirculating Sand/Media Filters

This technology utilizes sand, gravel, or other media to provide advanced secondary treatment of septic tank effluent or settled wastewater. Wastewater is dosed onto the media surface and percolates through the filter and out of an underdrain system. The effluent is then recirculated by a pump back into the media filter. This process continues until a ball float valve located within the recirculation tank discharges the flow.

The majority of the products in this category have not indicated effectiveness in removing nitrogen to levels of 10 mg/L or less on a consistent basis. We do not recommend that Recirculating Sand/Media Filters be considered as a technology for further research and testing.

10. Land Treatment Systems

The most common variation of land treatment systems is the spray irrigation system. Spray irrigation systems utilize a septic tank, aerobic unit, sand filter, and a disinfection unit as a means of wastewater pretreatment. The pretreated wastewater is then discharged evenly on a vegetated plot for final purification. This type of technology requires large land areas and setbacks and is therefore not widely used.

Aquatic and land treatment systems are deemed inappropriate for further research as the land requirements for these technologies are too large for the densely developed areas of Suffolk County. We do not recommend that Land Treatment Systems be considered as a technology for further research and testing.

11. Membrane Biological Reactors

Membrane biological reactors (MBRs) have been used for the treatment of both municipal and industrial wastewater and have a variety of advanced wastewater applications. One such recent application is in the area of onsite wastewater treatment. Technologies in this area are on the cutting edge of American technology and practical systems are currently available only from the global market. MBRs as a means of onsite wastewater treatment were not included in the *Onsite Wastewater Treatment Systems Manual* due to their recent emergence, but research and success on the municipal and industrial scales has identified this technology as a topic for further consideration on the onsite level. MBR systems utilize a bioreactor and microfiltration to separate suspended biomass and solids from treated wastewater. Effluent quality is

similar to the combination of secondary clarification and effluent microfiltration (Metcalf and Eddy).

As part of our research, three (3) systems of this technology were located in our database. The majority of the products in this category have indicated effectiveness in removing nitrogen to levels of 10 mg/L or less on a consistent basis. We recommend that Membrane Biological Reactors be considered as a technology for further research and testing.

TASK 4 – SELECTION, SAMPLING AND EVALUATION OF ALTERNATIVE OSSDS

Upon review of the information gathered during Task 2 - Review of Standards, Codes and Regulations for On-site System Technologies, we will determine which specific treatment systems will be selected for future in-depth sampling and evaluation from each recommended technology and for each flow category. This concludes Task 2.