Maine Department of Health and Human Services

Maine Center for Disease Control and Prevention
286 Water Street, 3rd Floor
11 State House Station
Augusta, ME 04333-0011

John Elias Baldacci
Governor

Brenda M. Harvey,
Acting Commissioner

Dora Anne Mills, MD, MPH
Public Health Director
Maine CDC Director

February 7, 2006

Presby Environmental, Inc.
Attn.: David W. Presby, President
143 Airport Road
Whitefield, New Hampshire 03598

Subject: Product Registration, Presby De-Nyte

Dear Mr. Presby:

The Division of Health Engineering has completed a review of a registration application for your company's product. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules), for code registration, for use in Maine.

Product Description

The Presby De-Nyte consists of a molded plastic cell, approximately 16 inches wide by 18 inches long by 12 inches deep. The cells have four corrugations along the bottom and each of the 18 inch long sides; one side being open at the top and the other side being closed. A plastic plate is located along the open topped corrugations to provide void space for effluent flow. Integral interlocking flaps would join adjacent cells.

The cells are filled with a mixture of sawdust and sand, layered above a mixture of stone, coal, and charcoal, and vented according to the manufacturer's directions. According to the report dated January 25, 2005 by Joselle Germano-Presby, Ph.D. et. al., birch sawdust produced the best results and pine sawdust produced the worst results.

The Presby De-Nyte is designed for use with Presby Enviro-Septic systems exclusively. The cells are placed beneath the Enviro-Septic lines and effluent drains down into them via gravity flow. The effluent passes through the media filling the cells and escapes into the surrounding soil through the open topped corrugations.

Claim

According to the information you provided, the Presby De-Nyte in conjunction with a Presby Enviro-Septic system reduced nitrate nitrogen to 1 mg/l and nitrite nitrogen to 0.05 mg/l. The information also demonstrated that this system reduced BOD5, TSS, TKN, e. coli, and several other commonly tested wastewater parameters by 95% or more.

Determination

On the basis of the information and sample product submitted, the Division has determined that the Presby De-Nyte is acceptable for use in the State of Maine, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions with the following conditions:

1. The separation from the limiting factor shall be measured to the top of the De-Nyte cells, since that is the point where effluent enters the soil.

2. Systems using the Presby Enviro-Septic system and Presby De-Nyte shall be sized according to the requirements of the Presby De-Nyte design manual.

3. First time system variance points may be claimed for use of the product in accordance with Table 1900.11 of the Subsurface Wastewater Disposal Rules.

In the event that the product fails to perform as claimed by the applicant, use of the new or experimental technology in Maine, including all installations approved pursuant to Section 1801.7 of the Rules, shall cease. Use of the new or experimental technology shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of Presby De-Nyte. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar products.

This letter supersedes the letter dated February 23, 2005. If you have any questions please feel free to contact me at (207) 287-5695.

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Sincerely,

James A. Jacobsen

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@maine.gov

/jaj

xc: File

STATE OF MAINE
DEPARTMENT OF HEALTH AND HUMAN SERVICES
161 CAPITOL STREET
11 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0011

JOHN ELIAS BALDACCI
GOVERNOR

JOHN R. NICHOLAS
COMMISSIONER

February 23, 2005

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143 Airport Road
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PHONE: (207) 287-5338
TTY: Deaf/Hard of Hearing (207) 287-5550

FAX: Admin./Plumbing/Eating & Lodging: (207) 287-3165
Drinking Water: (207) 287-4172
Radiation Control: (207) 287-3059

2. Systems using the Presby Enviro-Septic system and Presby De-Nyte shall be sized according to the requirements of Chapter 6 of the Subsurface Wastewater Disposal Rules. Page 9 of the Presby De-Nyte design manual must be revised accordingly.

3. First time system variance points may be claimed for use of the product in accordance with Table 1900.11 of the Subsurface Wastewater Disposal Rules.

In the event that the product fails to perform as claimed by the applicant, use of the new or experimental technology in Maine, including all installations approved pursuant to Section 1801.7 of the Rules, shall cease. Use of the new or experimental technology shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

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Sincerely,

James A. Jacobsen

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@state.me.us

/jaj

xc: Product File

We are requesting that the following point values in five variance tables (Chapter 20 Variances; 2000.1, 2, 4, 8, 9) be assigned to De-Nyte™ installations. Following the point assignment is an explanation for the request.

Table 2000.1 – Soils
Profiles 1-7 = 15 points
Profiles 1, 8, & 9 = 10 points

Explanation: Since a De-Nyte™ system receives treated leachate from the Enviro-Septic® system and treats it further, the only soil factor pertinent to its installation is permeability of clean water. Profiles 1-7 percolate more quickly than 1, 8 & 9, therefore the higher point assignment. Other soil profiles are unacceptable at this time.

Table 2000.2 – Seasonal Groundwater or Restrictive Layer
20 points for all installations

Explanation: A De-Nyte™ system receives treated leachate not requiring further soil filtration treatment. Additionally, separation distances for all De-Nyte™ systems require at least 23 inches between the system outflow and the seasonal groundwater or restrictive layer.

Table 2000.4 – Size of Property and Disposal Area Setback from Property Line
20 points for all installations
Request 25' setbacks for systems under 1,000 GPD.
Request 50' setbacks for systems over 1,000 GPD.

Explanation: This table is designed for systems treating contaminated effluent. The setbacks are based on lot sizes and the potential for effluent treatment. A De-Nyte™ system removes 99% of effluent contaminants and does not rely upon acreage for effluent treatment.

Table 2000.8 – Disposal Area Adjustment
10 points for all installations

Explanation: De-Nyte™ systems treat Enviro-Septic® system leachate and are sized for that purpose. Adding area size creates no treatment advantage.

Table 2000.9 – Vertical Separation Distance Adjustment
10 points for all installations

Explanation: The disposal field in all De-Nyte™ systems starts at least 30 inches above any limiting factor and an outflow of treated water at least 23 inches above any limiting factor.

Denitrification of Enviro-Septic® System Leachate using the De-Nyte™ System by Presby Environmental, Inc.

Research Report **DRAFT** January 25, 2005

Joselle Germano-Presby, Ph.D., M. Sean McGuigan, Ralph Ross and David W. Presby

Presby Environmental, Inc., Sugar Hill, NH 03586

Summary

The purpose of this experiment was to test the capability of the De-Nyte™ system (Presby Environmental, Inc.) to remove nitrite and nitrate from Enviro-Septic® leachate. Highly nitrified leachate from a one-year-old Enviro-Septic® system at a septic system test site in Stoke, Quebec, Canada was pumped to four De-Nyte™ model systems for one year. The only difference between model systems was the type of organic carbon source they contained. The following wastewater components were analyzed in the septic tank effluent (STE), leachate and De-Nyte™ liquid samples: ammonia, BOD_5, soluble BOD_5, COD, soluble COD, fecal coliforms (*E. coli*), nitrate nitrogen, nitrite nitrogen, total nitrogen from nitrate and nitrite, total phosphorus, TKN, and TSS. These components were compared between leachate and the De-Nyte™ liquid, and between the STE and the De-Nyte™ samples to provide an overall picture of total treatment. The three De-Nyte™ systems containing birch sawdust reduced the total nitrate and nitrite in the leachate by 91-97%. Maple sawdust demonstrated 70% reduction of total nitrate and nitrite from leachate, whereas white pine sawdust allowed 0-20% reduction. Nitrogen reduction levels remained strong throughout the year, indicating that the carbon source was plentiful. Mass balance estimations of projected De-Nyte™ system lifetime were determined to be 8 years. Percolating leachate through sawdust caused slight net gains in TSS and COD, however these were negligible when considering total treatment. Overall, the combination Enviro-Septic®/De-Nyte™ system demonstrated reduction of TSS and BOD_5 by 99%, COD by 97%, TKN and ammonia by 98%, total nitrogen by 96%, phosphorus by 95% and *E. coli* by 99.9%, and yield a final product containing up to 10-fold less nitrate (1 mg/L) and 20-fold less nitrite (0.05 mg/L) than drinking water standards. These levels of treatment are unsurpassed by any other alternative denitrifying wastewater system.

not strictly anoxic, facultative anaerobes will favor the use molecular oxygen in respiration because it is more efficient than using nitrate.

Systems have been devised that remove nitrate from polluted groundwater, such as ion exchange, reverse osmosis and electrodialysis (Kapoor & Virarghavan 1997). In most cases, it is more practical to treat nitrate at its source, for example within the wastewater treatment system itself. Biological denitrification is commonly used in such alternative wastewater treatment systems. In order for a system to achieve complete treatment of nitrogenous waste, it must contain separate aerobic and anaerobic environments where nitrification and denitrification can occur, respectively.

Examples of alternative onsite wastewater disposal systems include modified recirculating sand filters (RSFs), trickling filters, fixed activated sludge treatment, peat filter fields, multi-soil-layering, denitrification walls and in situ reactive porous media barriers. In trickling filters, wastewater is "trickled" over a media that serves as a surface for bacterial growth. Trickling filters usually receive STE, or a combination of STE and partially treated wastewater (Heufelder & Rask 2001). Waterloo Biofilter® (Waterloo Biofilter Systems Inc.) is one example of a trickling filter. Waterloo Biofilters® tested at the Massachusetts Alternative Septic System Test Center (MASSTC) reduced total nitrogen by an average of 60% (Heufelder & Rask 2001; Costa *et al.* 2002).

A recirculating sand filter is technically a type of trickling filter, in that the sand acts as the biological growth media (Heufelder & Rask 2001). By themselves, RSFs can be expected to remove 40-45% (Heufelder & Rask 2001), 60% (Ljunggren *et al.* 2005) or 70% (Piluk & Byers 2001) total nitrogen from residential STE. Denitrification in RSFs is limited because they are primarily aerobic systems. Some sand filters have been modified to promote increased denitrification. For example by pumping RSF effluent back to the septic tank, total nitrogen removal by an RSF serving two schools was significantly improved (Richardson *et al.* 2004). Coupling an RSF with a soil absorption field yielded 70-90% reduced total nitrogen in the discharging effluent (Schroeder 1996). When assembled using bottom ash (a power plant waste material) and coupled with a gravel storage filter, total nitrogen removal of an RSF reached 83-90% (Sandy *et al.* 1985).

A fixed activated sludge treatment system (FAST®) by Bio-Microbics, Inc. consists basically of a two-compartment septic tank. The first is a settling compartment, and the second is an aerated compartment containing suspended growth media. Treated wastewater in the second compartment is recirculated back to the original compartment, where denitrification takes place. A FAST® system, tested by MASSTC, reduced total nitrogen by 55% (Heufelder & Rask 2001; Costa *et al.* 2002).

Peat filter fields or peat bed systems appear to vary widely in nitrogen remediation, depending on their set-up. One study determined that a peat bed system with water table only removed 21% total nitrogen, whereas similar systems without water tables displayed no net nitrogen reduction (Veneman & Winkler 1992). Another study demonstrated 69-83% reduction of total nitrogen from peat filter fields (Brooks *et al.* 1984).

In multi-soil-layering, denitrification walls and in situ reactive porous media barriers, an organic carbon source is placed in the path of treated wastewater (e.g. from a leach field) or contaminated groundwater. The carbon source may be sawdust (Robertson & Cherry 1995; Schipper & Vojvodic-Vukovic 1998), methanol, ethanol, acetic acid, sucrose (Kapoor & Virarghavan 1997), juke pellets (Wakatsuki *et al.* 1993), peat (Brooks *et al.* 1984), etc., however it must be in an anoxic environment in order to promote denitrification. In one six-year field

The combined Enviro-Septic®/De-Nyte™ system takes advantage of bacterial action in three steps.

System Component	Conditions	Bacterial Actions	Treatment Results
1 Septic Tank	Anaerobic	Respiration. Ammonification.	Solid wastes settle. Limited digestion of organic carbonaceous and nitrogenous matter. Production of ammonia.
2 Enviro-Septic® System	Aerobic	Respiration. Ammonification. Nitrification.	Nearly complete digestion of organic carbonaceous and nitrogenous matter. Most ammonia is converted to nitrate.
3 De-Nyte™ Cells	Anaerobic	Heterotrophic denitrification.	Nitrate is converted to nitrogen gas using residual organic matter and a supplied carbonaceous energy source.

Table 1. A denitrifying onsite wastewater treatment system by Presby Environmental, Inc. would consist of a standard septic tank, an Enviro-Septic® system installed over a network of De-Nyte™ cells. Each of these system parts provides varying conditions that favor specific bacterial metabolic activities pertaining to the type of wastewater treatment desired.

The purpose of this experiment was to test the capability of the De-Nyte™ system to remove nitrite and nitrate from Enviro-Septic® leachate. The following wastewater components were analyzed in septic tank effluent (STE), leachate and De-Nyte™ liquid samples: ammonia, carbonaceous 5-day biochemical oxygen demand (BOD_5)[1], soluble BOD_5, total chemical oxygen demand (COD)[2], soluble COD, fecal coliforms (*E. coli*), nitrate nitrogen (NO_3-N), nitrite nitrogen (NO_2-N), total nitrogen from nitrate and nitrite, total phosphorus[3], total Kjeldahl nitrogen (TKN)[4], and total suspended solids (TSS). Not only were these components compared between leachate and the De-Nyte™ liquid, but also between the STE and the De-Nyte™ samples. This provided a measure of the overall wastewater treatment (combination of Enviro-Septic® and De-Nyte™), which was subsequently compared to performance data of other alternative wastewater treatment systems.

[1] BOD_5 is the amount of oxygen required to stabilize carbonaceous waste biologically through aerobic bacterial metabolism; it is an indirect measure of carbon-containing compounds.
[2] COD is the amount of oxygen required to completely stabilize the waste in a sample by chemical oxidization; it is also an indirect measure of carbon-containing compounds.
[3] Phosphorus is present in organic molecules such as sugar phosphates, phospholipids and nucleotides, and inorganic compounds such as polyphosphates.
[4] TKN is the amount of nitrogen contained within organic compounds such as nucleic acids, amino acids, and urea, plus ammonia.

Figure 2. The septic system test site in Stoke, Quebec, Canada. Note the location of the De-Nyte™ test building down slope of the Enviro-Septic® system.

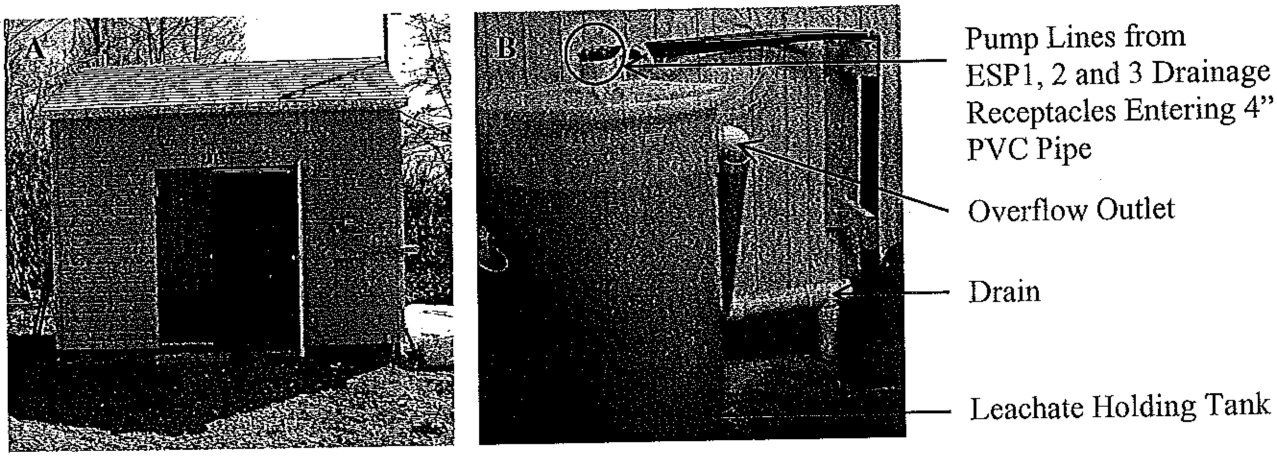

Figure 3. A) De-Nyte™ test building. B) Enviro-Septic® leachate holding tank. The 4" PVC pipe sticking out of the top of the tank extends down to a few inches above the bottom of the tank. The black pump lines from ESP1, 2 and 3 extend into the 4" PVC pipe down to the liquid level.

Four diaphragm pumps (SHURflo LLC; Cypress, CA; model 8000-533-236) pumped leachate from the holding tank to four De-Nyte™ model systems. Four suction lines (1/4" plastic tubing; 100" long) extended from 12" above the holding tank bottom to each of the pumps mounted on the wall. Four 25' pressure lines of the same tubing extended from the pumps to the De-Nyte™ systems. Each pump cycled (one gallon per minute for one minute) twelve times daily at 6:00 am, 6:40 am, 7:20 am, 8:00 am, 12:00 pm, 1:00 pm, 2:00 pm, 5:00 pm, 6:00 pm, 7:00 pm, 9:00 pm, and 10:00 pm. Therefore each De-Nyte™ system received a total of 12 gal Enviro-Septic® leachate daily.

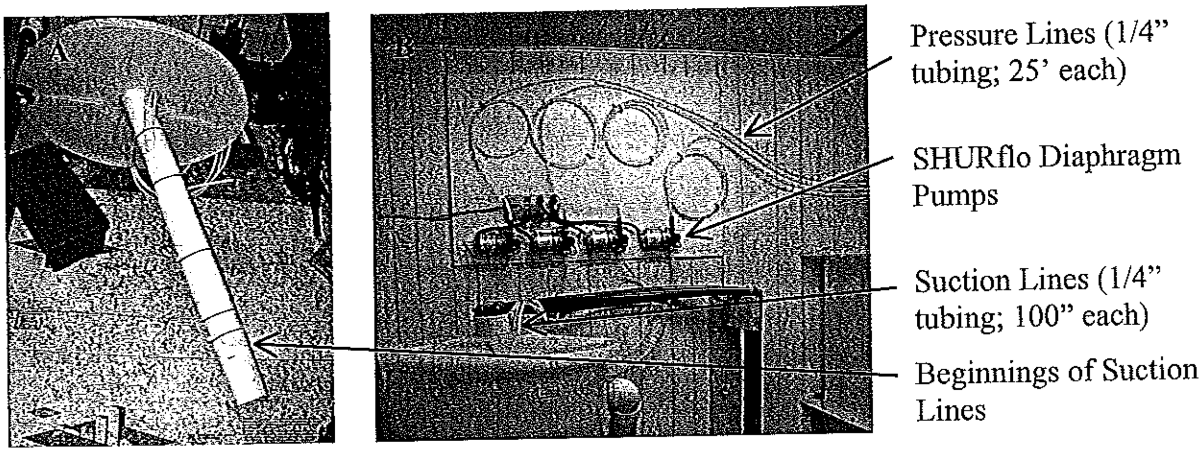

Figure 4. A) Cover of leachate holding tank with suction lines attached to 4" PVC pipe. B) Diaphragm pumps were mounted to the wall. All lines were the same length in order to keep equal backpressure on the pumps.

Four De-Nyte™ model systems were constructed and deemed DN1, DN2, DN3, and DN4. The only difference between them was the contents of their De-Nyte™ cells. Each system was housed in a large plastic chamber of 52"L × 24"W × 48"H inside dimensions (custom made by Cy-Bo Plastics Inc., St Laurent, Quebec). Each box had a 2" hole in the bottom center of the 24" upright side, to which a drain pipe/sample port was attached. A 3" layer of washed 3/4" stone was placed at the bottom of each chamber, followed by a 2" layer of washed 3/8" stone. To create a low vent, a ~50" piece of 4" perforated PVC pipe was placed diagonally on top of the 3/8" stone layer. One end was capped, while the other was connected by a 90° elbow to a vertical 4" solid PVC pipe rising a few inches above the top of the chamber. A 12" layer of clean medium-coarse sand (washed concrete sand) was then placed over the stone layers, encompassing the bottom of the low vent. Three De-Nyte™ cells were placed adjacently atop the sand.

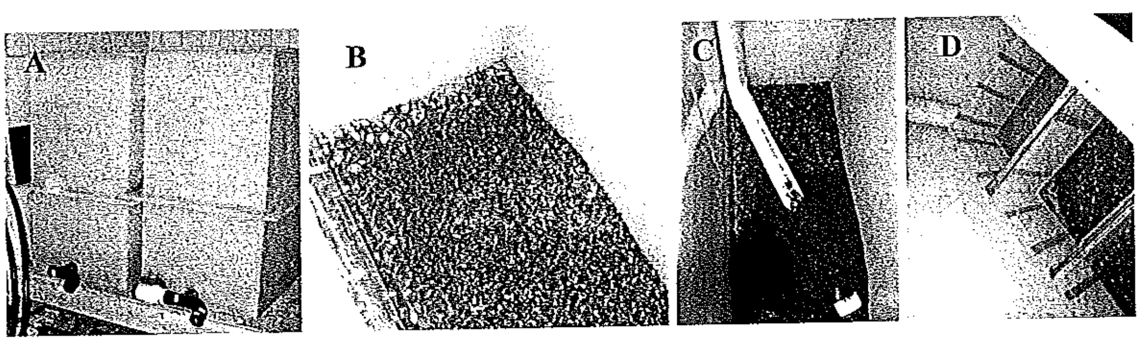

Figure 5. A) Large plastic chambers (52"L × 24"W × 48"H inside dimensions) housed each of the De-Nyte™ model systems. Note the position of the drain pipe/sample ports. B) A 3" layer of washed 3/4" stone and a 2" layer of washed 3/8" stone were placed at the bottom of each chamber to allow draining. C) The low vent was placed on top of the 3/8" stone layer and covered with a 12" layer washed concrete sand. D) Three "De-Nyte" cells were placed on top of the 12" sand layer.

At the time these experiments were set up, actual De-Nyte™ cells had yet to be manufactured. Therefore model "De-Nyte" cells of comparable dimensions, volume and function were constructed by stacking two Sterilite 54-quart storage boxes inside one another (Sterilite Corp., Townsend, MA; model 1958; 22 1/2"L × 16"W × 11 1/2"H at top of taper). The bottom panel of the inside box was cut out, therefore the depth of a "De-Nyte" cell was 13" from outside box bottom to inside box top. Thirty 1/2" holes (six along the widths and nine along the lengths) were evenly distributed below the rim of the outside Sterilite box (10" from box bottom to hole bottom). Strips of red/orange plastic (12"L × 1"W × 0.05" thick) were inserted between the boxes (two or three per side) in order to allow liquid to seep from the bottom up, between the sides and out the holes. These model "De-Nyte" cells were shown to hold 11.74 gal of liquid, compared to 11.66 gal of an actual De-Nyte™ cell.

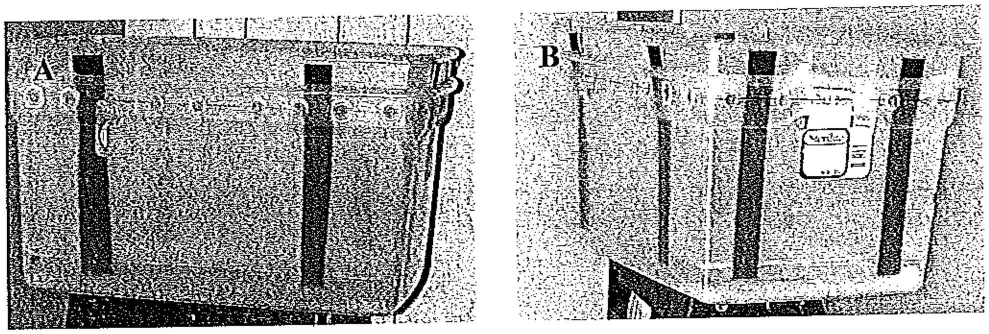

Figure 6. A) Model "De-Nyte" cells consisted of two Sterilite storage boxes stacked within each other. B) Strips of red/orange plastic wedged between the boxes allowed liquid to seep up and out of the holes at the top of the outside box. These are comparable in size and function to actual De-Nyte™ cells.

The "De-Nyte" cells were filled with varying materials; see details below. Organic materials and sand were mixed together in the indicated ratios and placed atop the stone/coal/charcoal layer filling the cells to the top. After two months of testing, preliminary results suggested that the materials in DN2, DN3 and DN4 were not functioning adequately. Therefore on March 16, 2004 their "De-Nyte" cells' materials were replaced with new different materials.

December 16, 2003 to March 16, 2004

DN1 (Maple)

- 43% (by volume) coarse maple sawdust (red maple and sugar maple, Cherry Pond Lumber Co., Whitefield, NH)
- 57% washed concrete sand
- 2 1/2" washed 3/8" stone

DN2 (Pine)

- 33% thin 1/2" softwood sawdust (eastern white pine, Cherry Pond Lumber Co., Whitefield, NH)
- 67% washed concrete sand
- 2 1/2" washed 3/8" stone

DN3 (Maple/Pine)

- 21% coarse maple sawdust
- 21% thin 1/2" softwood sawdust
- 57% washed concrete sand
- 2 1/2" washed 3/8" stone

DN4 (Maple/Pine/Newspaper)

- 11% coarse maple sawdust
- 11% softwood shavings (animal bedding; Newman Lumber Co., Woodsville, NH)
- 11% shredded newspaper
- 67% washed concrete sand
- 2 1/2" washed 3/8" stone

March 16, 2004 to December 16, 2004

DN1 (Maple) -- Remained the same

DN2 (Maple/Birch)

- 38% coarse maple sawdust
- 38% birch sawdust (white birch; Cherry Pond Lumber Co., Whitefield, NH)
- 25% washed concrete sand
- 2 1/2" washed 3/8" stone

DN3 (Birch/Coal)

- 67% birch sawdust
- 33% washed concrete sand
- 2 1/2" of anthracite coal (Agway Nut Coal; 0.4"-1.3")

DN4 (Birch/Charcoal)

- 67% birch sawdust
- 33% washed concrete sand
- 2 1/2" of 2" natural hardwood charcoal (Royal Oak Enterprises Inc., Atlanta, GA)

Once the "De-Nyte" cells were filled, a temperature probe was inserted into the organic material in the middle cell. A high vent was created by placing a ~15" piece of 4" perforated PVC pipe horizontally between the first "De-Nyte" cell and the 24" side of the chamber at the level of the top of the cell. A 90° elbow connected this to a vertical 4" solid PVC pipe rising to ~12" above the chamber. The high vents from all four chambers were connected to each other and vented outside the test building.

Duct tape and sheets of plastic were used to prevent leachate from seeping between the cells, or between the cells and the walls of the chamber. This ensured that all leachate passed through the "De-Nyte" cells. The filled cells were covered with 8" of washed concrete sand. A leachate distribution manifold was placed on top of this sand layer and then covered with a 4" layer of sand.

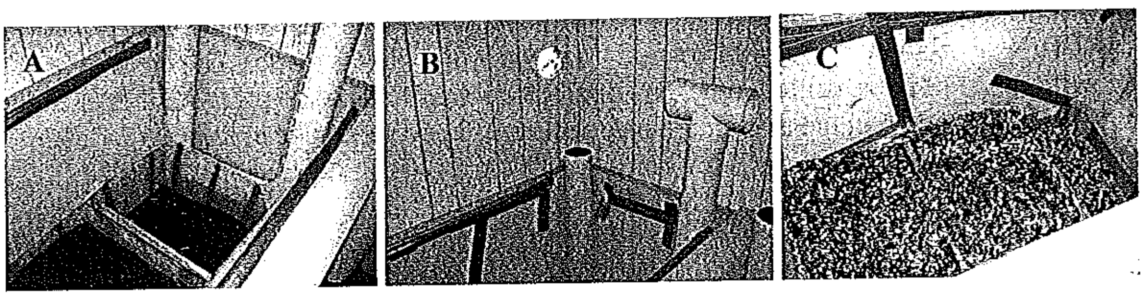

Figure 7. A) "De-Nyte" cells in DN1 being filled with a mixture of maple sawdust and sand. Note the position of the high vent behind the first cell. B) Each system had a low and high vent. High vents were connected and vented outside. C) "De-Nyte" cells in DN2 being filled with a mixture of softwood sawdust and sand. Note how sheets of plastic and duct tape were used to prevent liquid from evading the "De-Nyte" cells.

The leachate distribution manifolds were constructed using a 45" piece of 4" PVC pipe. The pipe was made into an arc by cutting it laterally, removing roughly one third of its circumference. Two 4" end caps were glued to the ends of the arc pipe. Holes were drilled in the center of these caps so that a 46" piece of 1/2" PVC pipe could be placed through them, centering it in the arc. The 1/2" pipe had six 1/8" holes drilled in it, measuring from the end at 4.5", 8.5", 20.5", 24.5", 36.5", and 40.5". These holes were in a straight line and located in the 12 o'clock position of the arc. Two 1/2" end caps were glued to the ends of the 1/2" pipe. A hole was drilled in one of these and fitted with a 1/4" barb for the pressure line. The distribution manifold was placed on top of the 8" sand layer with its open side down. Therefore when the pumps cycled, the fluid sprayed up onto the inside of the arc pipe and gently rained onto the sand below the manifold. In real life, De-Nyte™ cells would be installed directly under the leach field. The distribution manifold was designed to achieve the same effect on the sand above the De-Nyte™ system, as leachate would have on sands below the leach field.

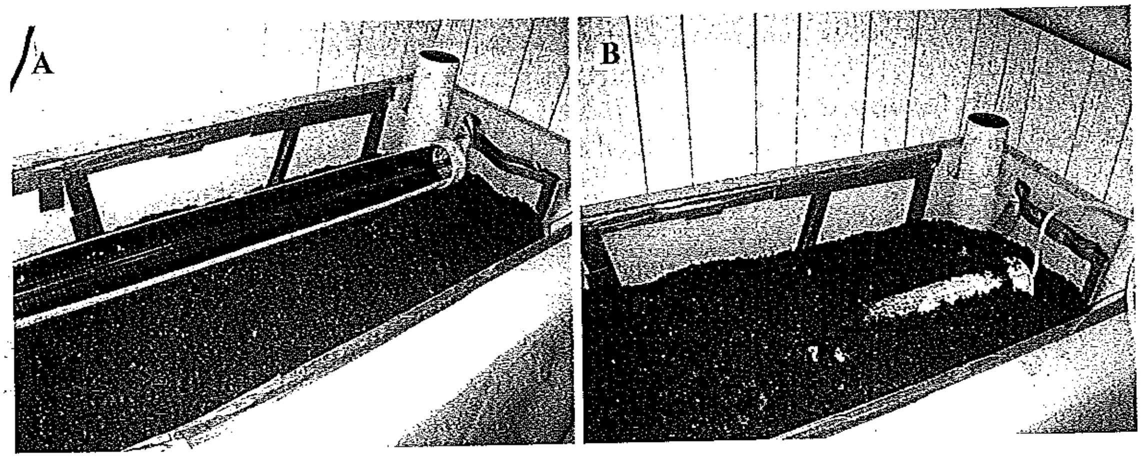

Figure 8. A) This distribution manifold is tipped up to view how it was made. The clear tube is a 1/2" pipe with a line of holes drilled in it. B) Distribution manifolds were placed arc open side down, so that the holes were in the twelve o'clock position. They were placed atop an 8" layer of sand and covered with an additional 4"of sand.

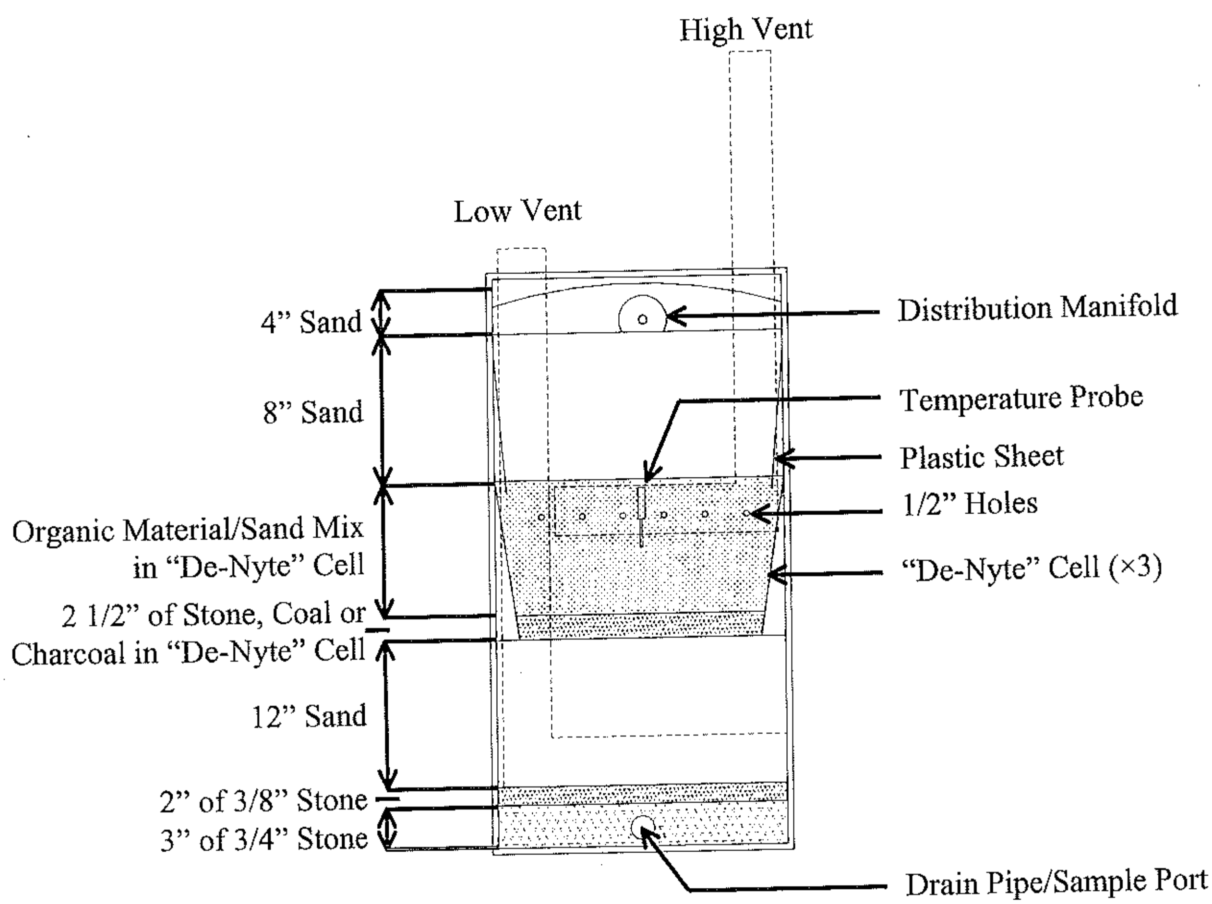

Figure 9. A schematic diagram showing the assembly of the De-Nyte™ model systems. Not to scale.

An air conditioning/heater unit was installed in the test building. The thermostat was located on a wooden stand between systems DN2 and DN3. It was originally set at 8°C, but then changed to 11°C on January 28, 2004. These temperatures were chosen to mimic median Dorchester, New Hampshire ground temperatures at 20" to 40" depths (pers. com., Joe Homer, USDA - Natural Resources Conservation Service). Additional temperature probes were located 1) in the air between system DN4 and the wall, 2) in the top sand layer of one of the systems, 3) in the leachate holding tank and 4) within the organic layer of the middle "De-Nyte" cell in each of the systems. The thermostat and probes were connected into a computer system, and temperature was recorded hourly at each location.

As mentioned above, the De-Nyte™ model systems received one gallon of Enviro-Septic® leachate twelve times daily. After passing through the systems, the liquid drained out the holes near the bottom of the chambers. These led to the same drain that accommodated the leachate holding tank overflow, thereby exiting to the outside of the building.

The original De-Nyte™ model systems were fed Enviro-Septic® leachate for three weeks before taking the first samples for analysis. Environnement E.S.A. Inc. carried out all of the sampling. Samples from the leachate holding tank and the four De-Nyte™ model systems were taken biweekly on the following days: January 7 and 20, February 3 and 17, March 2, 16 and 30, April 13 and 27, May 4 and 18, June 1, 15 and 29, July 14 and 27, August 10 and 24, September 7 and 21, October 5 and 19, November 1 and 23, and December 14, 2004. After changing their materials on March 16, DN2, DN3 and DN4 were fed leachate for two weeks before resuming sampling. Therefore, only the leachate and DN1 were sampled on March 2 and March 16, 2004. Samples from the De-Nyte™ model systems were taken by diverting the drains to the sample ports and allowing any remaining liquid to drain out. Clean five-gallon buckets were then placed below each sample port and left there for the time it took three or four pump cycles to occur. Since each pump cycle delivered one gallon of leachate to each of the systems, each bucket collected the displaced De-Nyte™ liquid totaling about three or four gallons.

Leachate and De-Nyte™ liquid samples were analyzed for ammonia, BOD_5, soluble BOD_5, COD, soluble COD, fecal coliforms (*E. coli*), nitrate nitrogen, nitrite nitrogen, total nitrogen from nitrate and nitrite, total phosphorus, TKN, and TSS by Biolab Division Thetford. Total nitrogen was estimated by taking the sum of TKN plus total nitrogen from nitrate and nitrite.

Results and Discussion

The De-Nyte™ system, developed by Presby Environmental, Inc., was tested for its capability to treat highly nitrified Enviro-Septic® leachate. Leachate from an adjacent Enviro-Septic® system was pumped to four model De-Nyte™ model systems. Amounts of TSS, BOD_5, soluble BOD_5, COD, soluble COD, TKN, ammonia, nitrite nitrogen, nitrate nitrogen, total nitrogen from nitrite and nitrate, total phosphorus, and *E. coli* in the liquid draining from the model systems were compared with the respective components of the leachate being pumped to the systems and of the STE being fed to the Enviro-Septic® system.

The strength of the STE fed to the Enviro-Septic® system was considered to be sufficiently strong for the purposes of these experiments (Table 2). For example, its average total nitrogen (52-57 mg/L) was higher than that of wastewater used to dose alternative septic systems tested by the MASSTC (35 mg/L) (Costa *et al.* 2002). Average STE strengths over the one-year time period of the De-Nyte™ tests were comparable to the two-year (26 months) average. This suggests that the sampling was adequate and that the averages are good representatives of the STE. The two-year STE average was used when comparing it to strengths of De-Nyte™ liquid samples.

Table 2	STE 10/10/02-12/14/04		STE 12/16/03-12/14/04	
Components	n	Average	n	Average
TSS (mg/L)	31	104	15	105
BOD_5 (mg/L)	31	166	15	162
Sol. BOD_5 (mg/L)	25	102	15	96
COD (mg/L)	31	424	15	438
Sol. COD (mg/L)	25	198	15	196
TKN (mg/L)	31	52	15	57
Ammonia (mg/L)	31	31	15	33
NO_2-N (mg/L)	21	0.08	15	0.06
NO_3-N (mg/L)	21	0.13	15	0.13
NO_2+NO_3-N (mg/L)	25	0.15	15	0.16
Phosphorus (mg/L)	31	5.6	15	6.1
E. coli (per 100 mL)	31	2,213,226	15	2,112,667

Table 2. Number of samples (n) and average component concentrations in the STE fed to the Enviro-Septic® model system. Note that averages over one year of samples are comparable to two-year averages.

The model Enviro-Septic® system leachate was highly nitrified, containing averages of 29 mg/L nitrate N and 6 mg/L nitrite N (Table 3). However, it exhibited very low average values of TSS (2 mg/L), BOD_5 (3 mg/L), COD (17 mg/L), TKN (1.5 mg/L), ammonia (1 mg/L), phosphorus (1 mg/L) and *E. coli* (800 per 100 mL). These results were expected and can be explained by the extensive aerobic bacterial growth and high rate of nitrification promoted by Enviro-Septic® (Germano-Presby *et al.* 2004).

Table 3		Leachate 1/7/04-12/14/04		Leachate 1/7/04-2/17/04		Leachate 3/30/04-12/14/04	
Components	Detection Limit	n	Average	n	Average	n	Average
TSS (mg/L)	1 mg/L	24	<1.9	4	4.3	18	<1.3
BOD_5 (mg/L)	2 mg/L	24	<2.9	4	<2.3	18	<3.1
Sol. BOD_5 (mg/L)	2 mg/L	22	<2.7	2	<2.0	18	<2.9
COD (mg/L)	3 mg/L	24	<16.8	3	18.0	19	<14.2
Sol. COD (mg/L)	3 mg/L	22	<8.6	2	15.0	18	<7.0
TKN (mg/L)	0.9 mg/L	25	<1.5	4	3.0	19	<1.1
Ammonia (mg/L)	0.5 mg/L	25	<0.8	4	<2.0	19	<0.5
NO_2-N (mg/L)	0.05 mg/L	23	<5.55	4	10.33	17	<3.09
NO_3-N (mg/L)	0.05 mg/L	23	29.09	4	18.25	17	32.18
NO_2+NO_3-N (mg/L)	0.05 mg/L	25	33.59	4	28.75	19	33.83
Phosphorus (mg/L)	0.3 mg/L	24	<1.2	4	1.8	19	<1.2
E. coli (per 100 mL)	10 per 100 mL	25	<794.5	4	2255.0	19	<255.4

Table 3. Number of samples (n) and average component concentrations in the Enviro-Septic® leachate fed to the De-Nyte™ model systems. Leachate strengths were averaged over three different time periods because some of the De-Nyte™ systems were altered part way through the testing. A less than sign (<) before an average indicates that one or more of the data was reported by Biolab Division Thetford to be below the component's minimum detection limit.

Preliminary results from the first six weeks of testing four De-Nyte™ model systems are presented in Table 4. The only difference between the model systems was the type of organic materials contained within the "De-Nyte" cells. The original DN3 (Maple/Pine) and DN4 (Maple/Pine/Newspaper) were exhibiting a net nitrate reduction from leachate of only ~20%. Moreover, DN2 (Pine) was showing a net gain in nitrate. Comparing these to DN1 (Maple), with a preliminary net nitrate reduction of 65%, suggested that something was inhibiting denitrification in the other systems. Since DN2, DN3 and DN4 all contained pine sawdust and/or shavings, it is probable that there was something in pine that was inhibiting the growth of anaerobic bacteria. This is further supported by the fact that DN2 contained the highest proportion of pine sawdust, and it was the only system to display no net denitrification. Based on these preliminary results, the materials in DN2, DN3 and DN4 were changed on March 16, 2004. The materials in DN1, however, remained the same throughout the testing.

Table 4	DN1 Maple/Sand/Stone 43%/57%/2 1/2”				DN2 Pine/Sand/Stone 33%/67%/2 1/2”			
Components	n	Ave	% Reduction from leachate	% Increase from leachate	n	Ave	% Reduction from leachate	% Increase from leachate
TSS (mg/L)	4	3.0	29.4%		4	3.0	29.4%	
BOD_5 (mg/L)	4	3.8		66.7%	4	2.5		11.1%
Sol. BOD_5 (mg/L)	2	2.0	0.0%		2	2.0	0.0%	
COD (mg/L)	3	26.0		44.4%	3	14.0	22.2%	
Sol. COD (mg/L)	2	9.0	40.0%		2	12.0	20.0%	
TKN (mg/L)	4	1.1	62.8%		4	1.0	66.1%	
Ammonia (mg/L)	4	0.5	75.3%		4	0.5	75.3%	
NO_2-N (mg/L)	4	3.12	69.8%		4	9.90	4.1%	
NO_3-N (mg/L)	4	6.40	64.9%		4	19.50		6.8%
NO_2+NO_3-N (mg/L)	4	9.40	67.3%		4	29.25		1.7%
Phosphorus (mg/L)	3	0.3	81.5%		3	0.3	83.3%	
E. coli (per 100 mL)	4	10.0	99.6%		4	10.0	99.6%	
	DN3 Maple/Pine/Sand/Stone 21%/21%/57%/2 1/2”				DN4 Maple/Pine/Newspaper/Sand/Stone 11%/11%/11%/67%/2 1/2”			
Components	n	Ave	% Reduction from leachate	% Increase from leachate	n	Ave	% Reduction from leachate	% Increase from leachate
TSS (mg/L)	3	1.3	68.6%		4	3.5	17.6%	
BOD_5 (mg/L)	3	2.7		18.5%	4	2.5		11.1%
Sol. BOD_5 (mg/L)	1	2.0	0.0%		2	2.0	0.0%	
COD (mg/L)	3	9.0	50.0%		3	12.3	31.5%	
Sol. COD (mg/L)	2	4.5	70.0%		2	6.5	56.7%	
TKN (mg/L)	4	1.0	67.8%		4	1.0	68.6%	
Ammonia (mg/L)	4	0.5	75.3%		4	0.5	75.3%	
NO_2-N (mg/L)	4	5.74	44.4%		4	7.70	25.4%	
NO_3-N (mg/L)	4	14.63	19.9%		4	14.38	21.2%	
NO_2+NO_3-N (mg/L)	4	20.50	28.7%		4	21.75	24.3%	
Phosphorus (mg/L)	3	0.3	83.3%		3	0.3	83.3%	
E. coli (per 100 mL)	4	10.0	99.6%		4	10.0	99.6%	

Table 4. Preliminary results from the first six weeks of testing (1/7/04-2/17/04). Number of samples (n) and average component concentrations (Ave) in the liquid exiting four De-Nyte™ model systems. Percent reduction values were estimated by comparing De-Nyte™ sample averages to leachate strength averages from 1/7/04-2/17/04 (Table 3). Nitrite and nitrate percent reductions by DN2, DN3 and DN4 were much lower than DN1; therefore the organic carbon sources within DN2, DN3 and DN4 were changed on 3/16/04.

The results from the modified DN2, DN3 and DN4 (sampled March 30-December 14, 2004) and DN1 (sampled January 7-December 14, 2004) and percent reductions estimated from leachate are summarized in Table 5. De-Nyte™ samples were also compared to the original STE strength (two-year average; Table 6). Of the four systems, DN2 (Maple/Birch) was the most effective at denitrifying leachate. With averages of 1 mg/L nitrate N and 0.1 mg/L nitrite N, reductions from leachate were 97% and 98%, respectively. Samples from DN2 contained an average of only 2 mg/L total nitrogen. Comparing this to 52 mg/L in the STE gives an overall total nitrogen reduction of 96% (Table 6). DN3 (Birch/Coal) and DN4 (Birch/Charcoal) also demonstrated excellent denitrification, reducing (from leachate) nitrite each by 98% and nitrate by 91% and 95%, respectively (Table 5). These results constitute overall total nitrogen reductions of 93% and 96%, respectively (Table 6).

Overall total nitrogen removal by the combined Enviro-Septic®/De-Nyte™ systems far exceeds that of a standard septic system (21-25% total nitrogen removal), which consisted of a septic tank and soil absorption system designed to Massachusetts "Title 5" standards, and was tested by MASSTC (Costa *et al.* 2002). In fact, Enviro-Septic®/De-Nyte™ outperforms the most effective modified RSFs (Sandy *et al.* 1985; Schroeder 1996), peat filter fields (Brooks *et al.* 1984), in situ porous media reactive barriers (Robertson *et al.* 2000), and the high tech Waterloo Biofilters® and FAST® systems currently being tested by MASSTC (Costa *et al.* 2002).

The total nitrite and nitrate nitrogen concentrations in the Enviro-Septic® leachate and the liquid from all four De-Nyte™ systems are displayed over time in Figure 10. De-Nyte™ system levels roughly follow leachate levels; i.e. when nitrate levels in the leachate spike, so do levels exiting the De-Nyte™ systems. There is no downward trend suggesting that the systems' organic carbon sources are far from depletion, and that their denitrification capacities would continue to operate at consistently high levels.

Mass balance estimations of projected De-Nyte™ system lifetime were carried out using the following equation (Robertson & Cherry 1995):

$$5\ CH_2O + 4\ NO_3^- \rightarrow 5\ CO_2 + 2\ N_2 + 3\ H_2O + 4\ OH^-$$

With 2 1/2" of stone or charcoal at the bottom, and a 67%: 33% sawdust to sand ratio (taking compaction into consideration), a single De-Nyte™ cell contains about 2.9 kg of cellulose (assuming that birch sawdust is white birch with a moisture content of 72% and cellulose content of 50%). Using the above equation, that translates to a total treatment capacity of 1.03 kg of nitrate nitrogen per cell.

An Enviro-Septic®/De-Nyte™ system designed for a four-bedroom house would contain 217 De-Nyte™ cells. Hence, this system would have enough cellulose to denitrify a total of 223 kg nitrate nitrogen in its lifetime. Assuming the design rate of 150 GPD per bedroom, and an average 33.6 mg/L nitrate plus nitrite nitrogen (Table 3) exiting an Enviro-Septic® system, this De-Nyte™ system would be receiving 0.076 kg of nitrate nitrogen per day or 27.2 kg of nitrate nitrogen per year. If the De-Nyte™ system can accommodate 223 kg nitrate nitrogen in its lifetime, then its lifetime would be 8.2 years. This is a conservative estimate because actual loading rates seldom reach maximum design flows, and the STE from Stoke sewage is stronger than typical residential STE. Furthermore, cellulose is not the sole carbon source available to the bacteria; other components of the wood and residual COD and BOD_5 in the leachate are also available for digestion.

Table 5	DN1 1/7/04-12/14/04 Maple/Sand/Stone 43%/57%/2 1/2”				DN2 3/30/04-12/14/04 Maple/Birch/Sand/Stone 38%/38%/25%/2 1/2”			
Components	n	Ave	% Reduction from leachate	% Increase from leachate	n	Ave	% Reduction from leachate	% Increase from leachate
TSS (mg/L)	25	<1.6	16.8%		19	<2.1		57.9%
BOD_5 (mg/L)	25	<2.3	20.7%		19	<2.3	25.9%	
Sol. BOD_5 (mg/L)	23	<2.0	26.7%		19	<2.0	30.8%	
COD (mg/L)	24	<17.3		2.7%	19	<15.3		7.4%
Sol. COD (mg/L)	23	<7.7	9.9%		19	<8.1		15.0%
TKN (mg/L)	25	<0.9	35.2%		19	<0.9	20.7%	
Ammonia (mg/L)	25	<0.5	34.9%		19	<0.5	0.0%	
NO_2-N (mg/L)	25	<1.82	67.2%		19	<0.06	98.0%	
NO_3-N (mg/L)	25	8.18	71.9%		19	<1.12	96.5%	
NO_2+NO_3-N (mg/L)	25	9.99	70.2%		19	<1.14	96.6%	
Phosphorus (mg/L)	24	<0.3	73.1%		19	<0.3	70.0%	
E. coli (per 100 mL)	25	<16.4	97.9%		19	<10.0	96.1%	
Total Nitrogen		10.9				2.0		
	DN3 3/30/04-12/14/04 Birch/Sand/Coal 67%/33%/2 1/2”				DN4 3/30/04-12/14/04 Birch/Sand/Charcoal 67%/33%/2 1/2”			
Components	n	Ave	% Reduction from leachate	% Increase from leachate	n	Ave	% Reduction from leachate	% Increase from leachate
TSS (mg/L)	19	<1.4		2.6%	19	<1.9		42.1%
BOD_5 (mg/L)	19	<2.7	12.2%		19	<4.4		44.7%
Sol. BOD_5 (mg/L)	19	<2.6	10.7%		19	<3.9		36.6%
COD (mg/L)	19	<22.3		56.7%	19	<23.3		63.7%
Sol. COD (mg/L)	19	<10.2		45.1%	19	<12.5		78.9%
TKN (mg/L)	19	<0.9	21.2%		19	<0.9	21.2%	
Ammonia (mg/L)	19	<0.5	0.0%		19	<0.5	0.0%	
NO_2-N (mg/L)	19	<0.06	98.2%		19	<0.05	98.3%	
NO_3-N (mg/L)	19	<2.96	90.8%		19	<1.47	95.4%	
NO_2+NO_3-N (mg/L)	19	<2.97	91.2%		19	<1.47	95.6%	
Phosphorus (mg/L)	19	<0.3	73.2%		19	<0.3	71.8%	
E. coli (per 100 mL)	19	<10.0	96.1%		19	<10.0	96.1%	
Total Nitrogen		3.9				2.4		

Table 5. Number of samples (n) and average component concentrations (Ave) in the liquid exiting four De-Nyte™ model systems. Results are from the original DN1 system (sampled 1/7/04-12/14/04) and the modified DN2, DN3 and DN4 systems (sampled 3/30/04-12/14/04). A less than sign (<) before an average indicates that one or more of the data was reported by Biolab Division Thetford to be below the component's minimum detection limit. Percent reduction values were estimated by comparing De-Nyte™ sample averages to leachate strength averages from corresponding sample dates (Table 3). Total nitrogen was estimated by adding TKN to total nitrogen from nitrite and nitrate.

Table 6	Overall % Reduction from STE			
	DN1 (Maple)	DN2 (Maple/Birch)	DN3 (Birch/Coal)	DN4 (Birch/Charcoal)
TSS	98.5%	98.0%	98.7%	98.2%
BOD_5	98.6%	98.6%	98.4%	97.3%
Sol. BOD_5	98.0%	98.0%	97.4%	96.2%
COD	95.9%	96.4%	94.7%	94.5%
Sol. COD	96.1%	95.9%	94.8%	93.7%
TKN	98.3%	98.3%	98.3%	98.3%
Ammonia	98.4%	98.4%	98.4%	98.4%
Phosphorus	94.6%	94.6%	94.6%	94.6%
E. coli	99.9%	99.9%	99.9%	99.9%
Total Nitrogen	79.1%	96.1%	92.6	95.5%

Table 6. Overall reduction of wastewater components by the combined Enviro-Septic®/De-Nyte™ systems. Percent reductions were estimated by comparing De-Nyte™ sample averages to STE strengths averaged over a two-year period (Table 2).

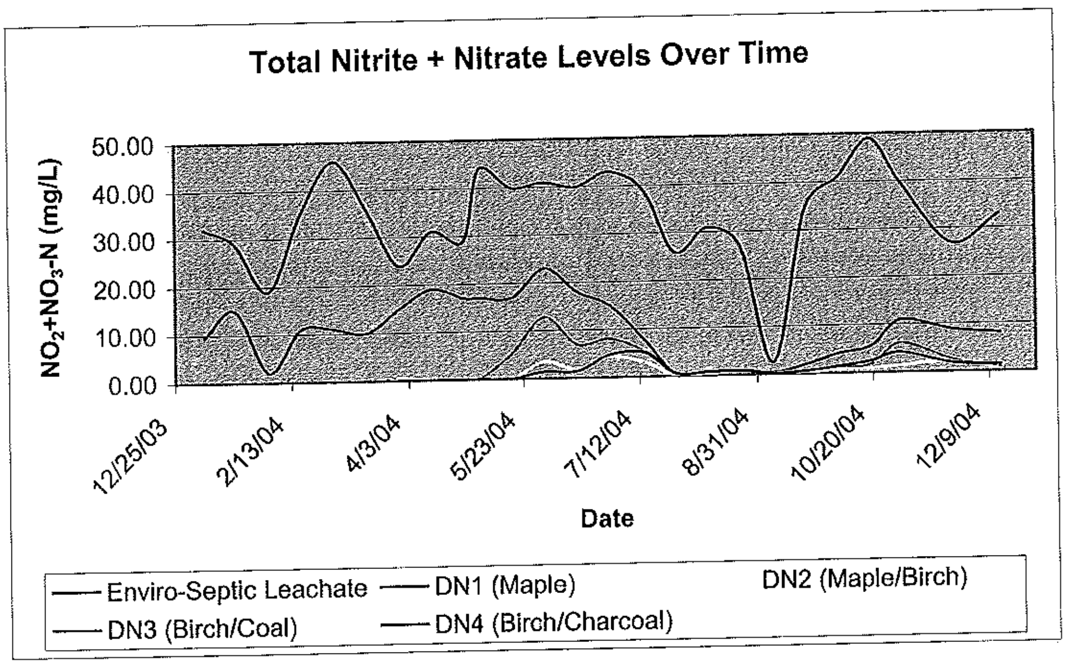

Figure 10. Line graph showing levels of total nitrite and nitrate nitrogen in the Enviro-Septic® leachate and De-Nyte™ liquid over time.

DN1 (Maple) displayed significant denitrification, but its nitrate N (8 mg/L) and nitrite N (2 mg/L) were 7-fold and 30 fold higher, respectively, than DN2. DN2 had a 75%:25% ratio of organic material to sand, whereas DN1 contained much more sand (43%:57%). Because DN2 contained about 75% more organic carbon source than DN1, one would expect it to demonstrate roughly 75% higher denitrification capacity. Since DN2 outperformed DN1 by much more than this, birch sawdust appears to support denitrifying heterotrophic bacteria better than maple sawdust in the De-Nyte™ system.

The only difference between DN3 (Birch/Coal) and DN4 (Birch/Charcoal) were that they contained coal or charcoal at the bottoms of the "De-Nyte" cells in lieu of stone. Denitrification was comparable between these two systems. Both demonstrated 98% reduction (from leachate) of nitrite N, however DN4 removed slightly more nitrate than DN3 (95% versus 91% from leachate, respectively). This suggests that charcoal may facilitate the growth of anaerobic bacteria. This is corroborated by the fact that DN4 (Birch/Charcoal) was the only system that had a net increase in BOD_5 and soluble BOD_5 (from leachate; Table 5). Charcoal must therefore be a source of soluble and insoluble metabolizable carbonaceous material, which would only lengthen the functional lifetime of a De-Nyte™ system.

All of the De-Nyte™ systems demonstrated net gains in COD; these ranged from 3% to 64% increase from leachate. DN2, DN3 and DN4 exhibited net gains in TSS and soluble COD as well. This was expected, with the sawdust as the obvious source. One cannot expect to percolate water through a layer of sawdust and 12" of sand and have none of it escape. DN1 probably displayed the least net gain in COD and no net gain of TSS because it had the lowest ratio of organic material to sand.

Even though percolating leachate through sawdust and/or charcoal causes a net gain in TSS, BOD_5 and COD, the gains are insignificant when looking at the complete treatment process. Percent reductions were estimated by comparing the final product (De-Nyte™ liquid) to the original STE. In summary, these experiments demonstrate that the combination of an Enviro-Septic® system and a De-Nyte™ system can reduce TSS by 99%, BOD_5 by 99%, COD by 97%, TKN and ammonia by 98%, phosphorus by 95% and *E. coli* by 99.9% (Table 6), and yield a final product containing up to 10-fold less nitrate (1 mg/L) and 20-fold less nitrite (0.05 mg/L) than drinking water standards (Linsley *et al.* 1992). Furthermore, the percent reductions in Tables 5 and 6 are conservative estimates because a significant portion of the data was below the minimum detection limits reported by Biolab Division Thetford. When estimating averages, the minimum limit value was input as the datum value if the actual datum value was reported to be below the limit. Therefore, many averages were estimated to be higher than actual, meaning the resulting percent reduction estimates are lower than actual. The combined Enviro-Septic®/De-Nyte™ system offers a low-cost, practical and highly effective means of preventing nitrate pollution of groundwater by residential and non-residential septic systems.

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DE-NYTE TEST RESULTS
BOLD #'S = LESS THAN

ADN	1/7/04	1/20/04	2/3/04	2/17/04	AVE 1/7-2/17	3/2/04	3/16/04	3/30/04	4/13/04	4/27/04	5/4/04	5/18/04	6/1/04	6/15/04	6/29/04	7/14/04	7/27/04	8/10/04	8/24/04	9/7/04	9/21/04	10/5/04	10/19/04	11/1/04	11/23/04	12/14/04	AVE 1/7-12/14	AVE 3/30-12/14	n	ADN
TSS	11	3	1	2	4.3	1	3	2	1	3	1	1	1		1	1	2	1	1	1	1	1	1	1	1	3	1.9	1.3	24	TSS
BOD	3	2	2	2	2.3	2	3	2	2	21	2	2	2		2	2	2	2	2	2	2	2	2	2	2	2	2.9	3.1	24	BOD
SOL BOD			2	2	2.0	2	2	2	2	18	2	2	2		2	2	2	2	2	2	2	2	2	2	2	2	2.7	2.9	22	SOL BOD
COD		12	36	6	18.0	46	33	25	44	36	12	17	39	3	3	35	6	14	3	3	6	3	3	3	3	12	16.8	14.2	24	COD
SOL COD			24	6	15.0	7	26	3	25	18	3	6	13	3	3	12	3	13	3	3	n/a	3	3	3	3	6	8.6	7.0	22	SOL COD
TKN	1.0	1.5	4.8	4.8	3.0	1.3	1.3	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	4.3	0.9	0.9	1.0	0.9	0.9	2.0	0.9	1.5	1.1	25	TKN
NH4	0.5	0.8	4.0	2.8	2.0	1.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8	0.5	25	NH4
N02	13.00	7.30	8.00	13.00	10.33	17.00	17.00	7.80	14.00	18.00	12.00	0.05	0.05		0.05	0.05	0.05	0.05	0.05	lab error	0.05	0.05	0.05	0.05	0.05	0.05	5.55	3.09	23	N02
N03	19.00	22.00	11.00	21.00	18.25	29.00	20.00	16.00	17.00	10.00	32.00	40.00	41.00		43.00	39.00	26.00	31.00	27.00	lab error	35.00	41.00	49.00	40.00	27.00	33.00	29.09	32.18	23	N03
N02-N03	32.00	29.00	19.00	35.00	28.75	46.00	36.00	24.00	31.00	29.00	44.00	40.00	41.00	40.00	43.00	39.00	26.00	31.00	27.00	2.70	35.00	41.00	49.00	40.00	27.00	33.00	33.59	33.83	25	N02-N03
P		1.7	1.8	1.9	1.8	1.4	0.9	0.3	0.3	0.9	1.1	1.3	1.3	1.3	1.2	1.1	1.2	1.5	1.4	1.5	1.5	0.8	1.6	1.4	1.4	0.9	1.2	1.2	24	P
E COLI	320	4500	3100	1100	2255.0	5800	190	10	110	10	55	10	20	10	10	10	10	10	10	10	10	4500	10	10	20	18	794.5	255.4	25	E COLI
FILT EC			240	10	125.0	2400	55	10	64	10	30	10															314.3	24.8	9	FILT EC

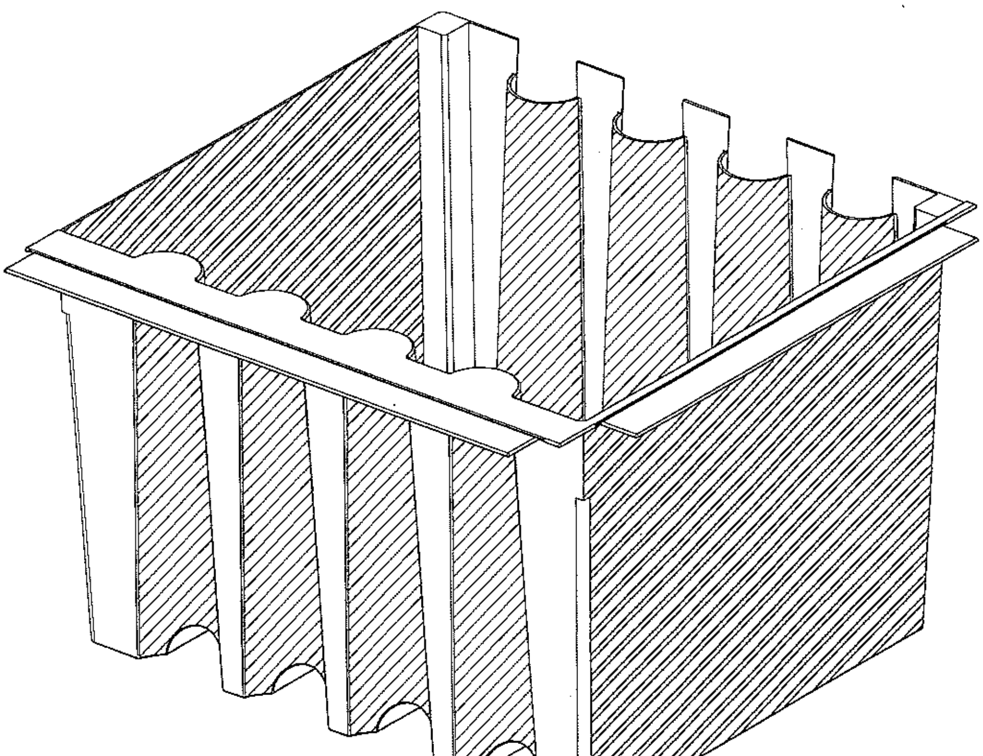
DN1	1/7/04	1/20/04	2/3/04	2/17/04	AVE 1/7-2/17	3/2/04	3/16/04	3/30/04	4/13/04	4/27/04	5/4/04	5/18/04	6/1/04	6/15/04	6/29/04	7/14/04	7/27/04	8/10/04	8/24/04	9/7/04	9/21/04	10/5/04	10/19/04	11/1/04	11/23/04	12/14/04	AVE 1/7-12/14	n	% removal	DN1
TSS	7	3	1	1	3.0	1	2	2	1	1	1	1	1	4	2	1	1	1	1	1	1	1	1	1	1	1	1.6	25	16.8	TSS
BOD	9	2	2	2	3.8	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.3	25	20.7	BOD
SOL BOD			2	2	2.0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.0	23	26.7	SOL BOD
COD		12	30	36	26.0	13	19	12	44	6	3	34	59	3	13	40	6	3	3	18	24	12	3	3	6	12	17.3	24	-2.7	COD
SOL COD			6	12	9.0	13	13	3	44	6	3	27	3	3	3	3	3	3	3	3	12	3	3	3	3	3	7.7	23	9.9	SOL COD
TKN	1.2	0.9	1.3	1.1	1.1	0.9	1.1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	25	35.2	TKN
NH4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	25	34.9	NH4
N02	4.00	2.50	0.77	5.20	3.12	3.50	3.40	5.80	9.00	8.30	2.20	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.13	0.09	0.08	1.82	25	67.2	N02
N03	5.60	13.00	1.20	5.80	6.40	7.50	6.70	8.90	10.00	8.60	15.00	17.00	23.00	18.00	15.00	7.60	0.51	0.87	1.00	0.47	2.00	4.20	5.60	10.00	8.80	8.10	8.18	25	71.9	N03
N02-N03	9.60	15.00	2.00	11.00	9.40	11.00	10.00	15.00	19.00	17.00	17.00	17.00	23.00	18.00	15.00	7.60	0.51	0.87	1.00	0.47	2.00	4.20	5.60	11.00	8.90	8.10	9.99	25	70.2	N02-N03
P		0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.6	0.7	0.3	0.3	0.3	0.3	0.3	0.3	24	73.1	P
E COLI	10	10	10	10	10.0	10	10	10	10	10	10	10	10	10	10	10	10	170	10	10	10	10	10	10	10	10	16.4	25	97.9	E COLI
FILT EC			10	10	10.0	10	10	10	10	10	10	10															10.0	9	96.8	FILT EC

DN2	1/7/04	1/20/04	2/3/04	2/17/04	AVE 1/7-2/17	n 1/7-2/17	% removal	3/30/04	4/13/04	4/27/04	5/4/04	5/18/04	6/1/04	6/15/04	6/29/04	7/14/04	7/27/04	8/10/04	8/24/04	9/7/04	9/21/04	10/5/04	10/19/04	11/1/04	11/23/04	12/14/04	AVE 3/30-12/14	n	% removal	DN2
TSS	4	3	1	4	3.0	4	29.4	3	2	2	1	1	1	14	1	1	2	1	3	1	1	1	2	1	1	1	2.1	19	-57.9	TSS
BOD	4	2	2	2	2.5	4	-11.1	7	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.3	19	25.9	BOD
SOL BOD			2	2	2.0	2	0.0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.0	19	30.8	SOL BOD
COD		6	18	18	14.0	3	22.2	31	25	30	18	17	13	20	6	35	3	3	3	7	36	3	3	3	22	12	15.3	19	-7.4	COD
SOL COD			18	6	12.0	2	20.0	19	19	24	6	11	7	19	3	12	3	3	3	3	6	3	3	3	3	3	8.1	19	-15.0	SOL COD
TKN	1.1	0.9	1.1	1.0	1.0	4	66.1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	19	20.7	TKN
NH4	0.5	0.5	0.5	0.5	0.5	4	75.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.5	19	0.0	NH4
N02	11.00	5.40	8.20	15.00	9.90	4	4.1	0.27	0.11	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	19	97.9	N02
N03	16.00	26.00	11.00	25.00	19.50	4	-6.8	0.38	0.06	0.05	0.12	0.13	3.60	1.80	4.30	3.10	0.30	0.24	0.79	0.14	0.16	0.90	0.95	1.40	2.20	0.68	1.12	19	96.5	N03
N02-N03	27.00	31.00	19.00	40.00	29.25	4	-1.7	0.65	0.17	0.05	0.12	0.14	3.60	1.80	4.30	3.10	0.30	0.24	0.79	0.14	0.16	0.90	0.95	1.40	2.20	0.68	1.14	19	96.6	N02-N03
P		0.3	0.3	0.3	0.3	3	83.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.6	0.3	0.4	0.3	0.3	0.5	0.6	0.3	0.3	0.3	0.3	0.3	0.35	19	70.0	P
E COLI	10	10	10	10	10.0	4	99.6	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10.0	19	96.1	E COLI
FILT EC			10	10	10.0	2	92.0	10	10	10	10	10															10.0	5	59.7	FILT EC

DN3	1/7/04	1/20/04	2/3/04	2/17/04	AVE 1/7-2/17	n 1/7-2/17	% removal	3/30/04	4/13/04	4/27/04	5/4/04	5/18/04	6/1/04	6/15/04	6/29/04	7/14/04	7/27/04	8/10/04	8/24/04	9/7/04	9/21/04	10/5/04	10/19/04	11/1/04	11/23/04	12/14/04	AVE 3/30-12/14	n	% removal	DN3
TSS	2	1	1		1.3	3	68.6	4	2	1	1	2	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1.4	19	-2.6	TSS
BOD	4	2	2		2.7	3	-18.5	15	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.7	19	12.2	BOD
SOL BOD			2		2.0	1	0.0	13	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.6	19	10.7	SOL BOD
COD		12	12	3	9.0	3	50.0	62	44	18	6	22	72	3	3	23	12	28	49	3	24	30	3	3	12	6	22.3	19	-56.7	COD
SOL COD			6	3	4.5	2	70.0	44	25	18	3	11	13	3	3	12	3	13	3	3	24	3	3	3	3	3	10.2	19	-45.1	SOL COD
TKN	0.9	0.9	1.2	0.9	1.0	4	67.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	19	21.2	TKN
NH4	0.5	0.5	0.5	0.5	0.5	4	75.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	19	0.0	NH4
N02	7.70	0.05	4.20	11.00	5.74	4	44.4	0.05	0.05	0.05	0.18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	19	98.2	N02
N03	12.00	26.00	7.50	13.00	14.63	4	19.9	0.05	0.05	0.05	0.19	5.50	13.00	7.10	8.20	5.60	0.59	0.79	0.80	0.33	0.68	1.40	1.90	6.20	2.70	1.10	2.96	19	90.8	N03
N02-N03	20.00	26.00	12.00	24.00	20.50	4	28.7	0.05	0.05	0.05	0.37	5.50	13.00	7.10	8.20	5.60	0.59	0.79	0.80	0.33	0.68	1.40	1.90	6.20	2.70	1.10	2.97	19	91.2	N02-N03
P		0.3	0.3	0.3	0.3	3	83.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	19	73.2	P
E COLI	10	10	10	10	10.0	4	99.6	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10.0	19	96.1	E COLI
FILT EC			10	10	10.0	2	92.0	10	10	10	10	10															10.0	5	59.7	FILT EC

DN4	1/7/04	1/20/04	2/3/04	2/17/04	AVE 1/7-2/17	n 1/7-2/17	% removal	3/30/04	4/13/04	4/27/04	5/4/04	5/18/04	6/1/04	6/15/04	6/29/04	7/14/04	7/27/04	8/10/04	8/24/04	9/7/04	9/21/04	10/5/04	10/19/04	11/1/04	11/23/04	12/14/04	AVE 3/30-12/14	n	% removal	DN4
TSS	3	7	1	3	3.5	4	17.6	6	6	3	2	1	1	1	1	1	1	1	1	2	1	2	3	1	1	1	1.9	19	-42.1	TSS
BOD	4	2	2	2	2.5	4	-11.1	25	14	2	13	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4.4	19	-44.7	BOD
SOL BOD			2	2	2.0	2	0.0	20	12	2	11	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3.9	19	-36.6	SOL BOD
COD		6	18	13	12.3	3	31.5	75	50	61	43	11	39	3	6	35	6	62	3	3	30	3	3	3	3	3	23.3	19	-63.7	COD
SOL COD			6	7	6.5	2	56.7	44	44	49	24	7	3	3	3	6	3	13	3	3	18	3	3	3	3	3	12.5	19	-78.9	SOL COD
TKN	0.9	0.9	1.1	0.9	1.0	4	68.6	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	19	21.2	TKN
NH4	0.5	0.5	0.5	0.5	0.5	4	75.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	19	0.0	NH4
N02	6.90	6.90	5.00	12.00	7.70	4	25.4	0.05	0.05	0.05	0.05	0.05	0.08	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	19	98.3	N02
N03	13.00	17.00	8.50	19.00	14.38	4	21.2	0.05	0.05	0.05	0.05	0.05	1.40	1.50	4.80	5.10	0.69	0.81	0.96	0.23	0.63	1.50	2.50	4.20	1.90	1.40	1.47	19	95.4	N03
N02-N03	20.00	24.00	13.00	30.00	21.75	4	24.3	0.05	0.05	0.05	0.05	0.05	1.50	1.50	4.80	5.10	0.69	0.81	0.96	0.23	0.63	1.50	2.50	4.20	1.90	1.40	1.47	19	95.6	N02-N03
P		0.3	0.3	0.3	0.3	3	83.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.6	0.3	0.3	0.3	0.3	0.3	0.3	19	71.8	P
E COLI	10	10	10	10	10.0	4	99.6	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10.0	19	96.1	E COLI
FILT EC			10	10	10.0	2	92.0	10	10	10	10	10															10.0	5	59.7	FILT EC

De-Nyte™ Wastewater Treatment Systems Design and Installation Manual For Maine



Draft

De-Nyte™ System
Design and Installation Manual

Preview

Purpose

The purpose of this manual is to provide guidance in the design and installation of De-Nyte™ denitrification systems.

Presby Environmental, Inc., standards

All De-Nyte™ denitrification systems using Presby Environmental, Inc., products must be designed and installed in compliance with the procedures and specifications described in this manual.

Certification required

Presby Environmental, Inc., requires all designers and installers to be certified. Certification is obtained by attending the "De-Nyte™ Designer Certification Course" and/or the "De-Nyte™ Installer Certification Course" presented by Presby Environmental, Inc. Until designers and installers are certified, designs and installations must be approved/inspected by Presby Environmental, Inc., or its sanctioned representatives.

Special Note: Presby Environmental, Inc., highly recommends that all individuals involved in the approval or permitting process also attend these sessions.

In this manual

This manual contains the following subjects.

Technical support

Presby Environmental, Inc., provides technical support to all individuals using our products. For questions about our products or the information contained in this manual, please contact us at 1-800-473-5298.

Section A
Introduction

Introduction

Liquid that enters the ground from conventional leaching systems is generally marginally treated allowing many harmful contaminants to enter the ground and groundwater. Nitrates are a part of these contaminants. The De-Nyte™ system is specifically designed to remove nitrates from leachate producing liquid superior to EPA drinking water standards.

What the De-Nyte™ system does

Using a number of Presby Environmental, Inc., products, the De-Nyte™ system functions as a combination wastewater treatment and leachate denitrification system.

Why the De-Nyte™ system excels

The De-Nyte™ system excels because its components perform the nitrification and denitrification processes more effectively and less intrusively than other systems. At minimal cost this passive system uses no motors, pumps, or mechanical devices and performs without a lagoon or constructed wetland.

De-Nyte™ system advantages

Here's a brief list of the advantages of the De-Nyte™ system.

- Enables greater points for variances
- Requires no electricity and no mechanical devices
- Installs simply
- Requires little additional area (Installs beneath an Enviro-Septic® system)
- Protects groundwater, lakes, oceans, and streams
- Helps with problem sites

How the De-Nyte™ system works

Here's how the De-Nyte™ system works.

1. Raw sewage enters a septic tank.
2. The septic tank separates and anaerobically (without oxygen) turns sewage into effluent containing high levels of NH_3 (ammonia) and NH_4 (ammonium), a process called ammonification.
3. Effluent enters the Enviro-Septic® system where aerobic bacteria break down the NH_3 (ammonia) and NH_4 (ammonium) and convert them into NO_2 (nitrites) and then into NO_3 (nitrates), a process called nitrification. The Enviro-Septic® system also further filters and treats phosphorus, e-coli, BOD, COD, and other harmful components.
4. An array of De-Nyte™ cells installed below the Enviro-Septic® system captures the nitrified leachate.
5. De-Nyte™ cells control the leachate flow through a carbon source.
6. The bacteria along with the carbon source converts the potentially harmful nitrates into harmless nitrogen gas.
7. The De-Nyte™ cells further filter and treat phosphorus, e-coli, BOD, COD, and other harmful components.
8. Vents inside the system expel the harmless nitrogen gas into the atmosphere.

Continued

Why it works so well

The De-Nyte™ system works so well because anaerobic bacteria (bacteria existing without oxygen) in septic tanks convert raw sewage into effluent containing high levels of ammonia (NH_3) and ammonium (NH_4).

The Enviro-Septic® leaching system enhances the production of aerobic bacteria (bacteria requiring oxygen to exist) that convert NH_3 and NH_4 into nitrite (NO_2) and nitrate (NO_3) in a process called nitrification. No other passive system nitrifies leachate more effectively and further filters and treats phosphorus, e-coli, BOD, COD, and other harmful components better than Enviro-Septic®.

The De-Nyte™ cells take this highly treated leachate, and through a process celled denitrification turn the nitrates into harmless Nitrogen gas. During this process the De-Nyte™ cells further filter and treat phosphorus, e-coli, BOD, COD, and other harmful components.

Section B
Definitions of Terms

Introduction

As you read through the information in this manual, you will encounter common terms, terms that are common to our industry, and terms that are unique to De-Nyte™ systems. While alternative definitions may exist, this section defines these terms as they are used in this manual.

List of terms

Here's a list of the terms defined in this section.

- Cell plate
- Center-to-center spacing
- De-Nyte™ cell
- De-Nyte™ cell array
- Differential venting
- High and low vents
- Injection ports
- J-plate
- Low vent manifold
- Lower bed
- Mix #1
- Mix #2
- Presby Maze®
- Sampling port
- Upper bed

Cell plate

A cell plate is a plastic insert placed inside a De-Nyte™ cell to maintain a separation between the cell mix and the cell wall to allow liquid flow.

Center-to-center spacing

Center-to-center spacing is the horizontal distance from the center of one line of Enviro-Septic® pipe to the center of the adjacent line. All Enviro-Septic® lines in a De-Nyte™ system are 1.5 feet center to center.

De-Nyte™ cell

A De-Nyte™ cell is a plastic container designed to capture, control, and denitrify leachate. Each cell measures 16 ¼" by 18" by 12" tall.

De-Nyte™ cell array

A De-Nyte™ cell array is a bed of interlocking De-Nyte™ cells installed beneath an Enviro-Septic® wastewater treatment system.

Differential venting

Differential venting is a method of venting a system by using high and low vents.

High and low vents

High and low vents are pipes used in differential venting.

Continued

Definitions of Terms, Continued

Injection ports	Injection ports are lengths of pre-drilled 4" PVC pipe inserted into each De-Nyte™ cell. An injection port extends from the bottom of the cell to no less than 6 inches below the system finish grade.
J-plate	A J-plate is a plastic cover used to prevent sand from entering and obstructing the liquid flow between the cell wall and the cell plate. Only the cells forming the left hand border of an array require J-plates.
Low vent manifold	A low vent manifold is a grid of perforated PVC pipe used to provide aeration beneath a De-Nyte™ cell array.
Lower bed	The lower bed is the first layer of system sand installed in a De-Nyte™ system.
Mix #1	Mix #1 is the first layer of material placed in a De-Nyte™ cell.
Mix #2	Mix #2 is the second layer of material placed in a De-Nyte™ cell.
Presby Maze®	A Presby Maze® is a plastic unit that traps suspended solids and pre-treats septic tank effluent inside a septic tank.
Sampling port	A sampling port is a port providing access to treated liquid in a treatment system.
Upper bed	The upper bed is the layer of system sand 6 inches thick installed between the bottom of the Enviro-Septic® pipe and the top of the De-Nyte™ cell array.

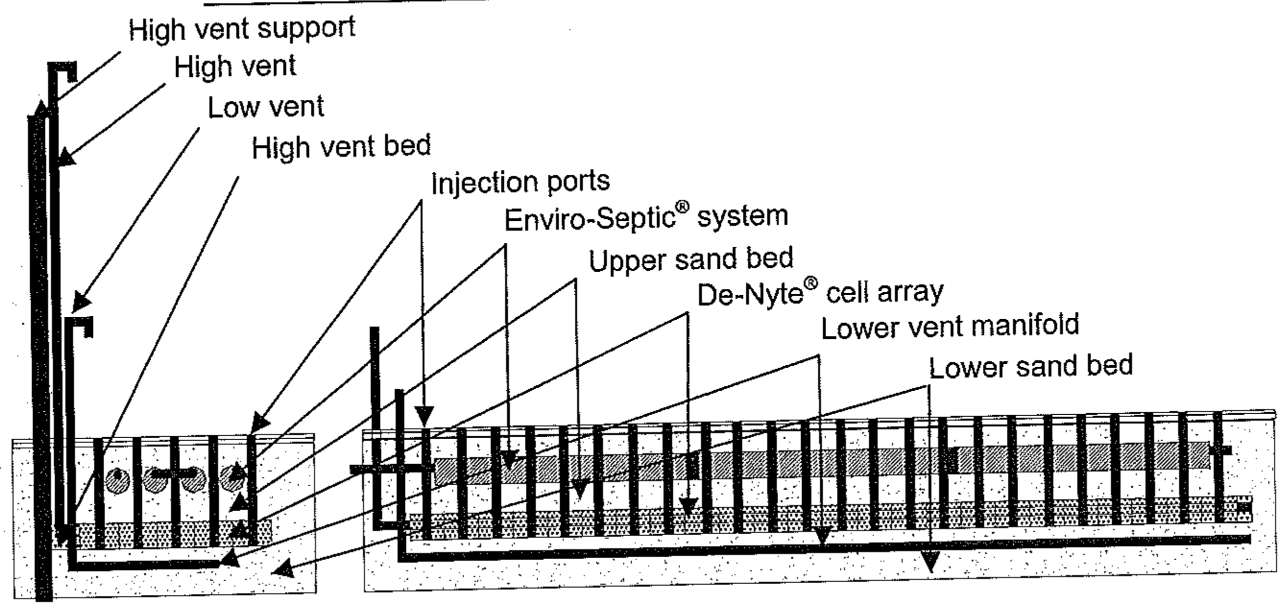
Section C
De-Nyte™ System Components

Purpose The purpose of this section is to describe the components used in the De-Nyte™ system.

List The De-Nyte™ system consists of various components installed in layers. These layers are identified as follows.

1. lower bed of system sand
2. lower vent manifold
3. De-Nyte™ cell array and high vent bed
4. injection port
5. upper bed of system sand
6. Enviro-Septic® system

System diagram Here are end and side view diagrams of the De-Nyte™ system.



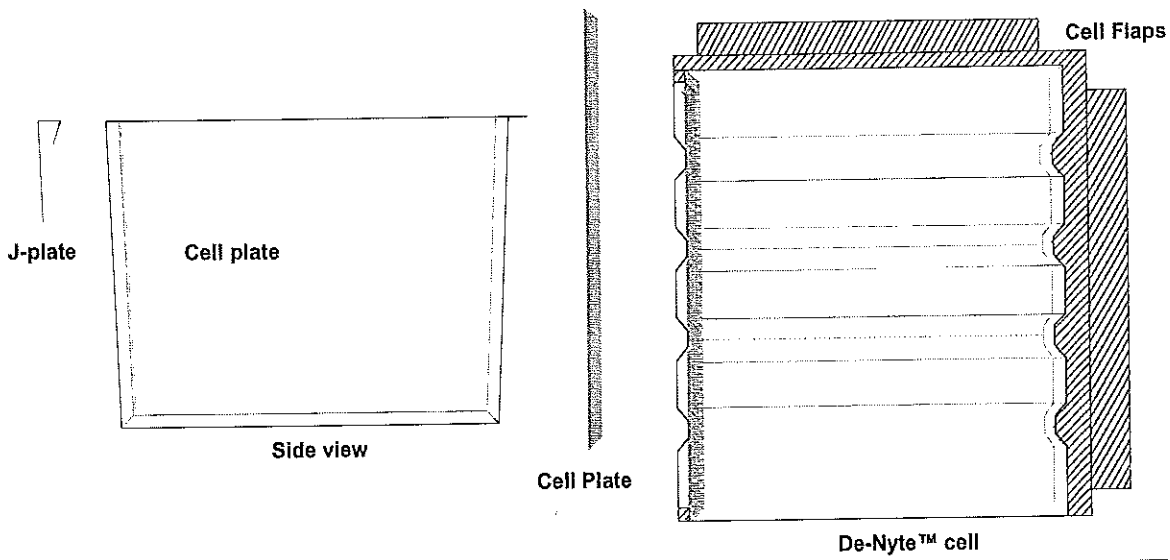
Section D
De-Nyte™ Diagrams

Introduction

This section presents diagrams of the De-Nyte™ cell and cell array.

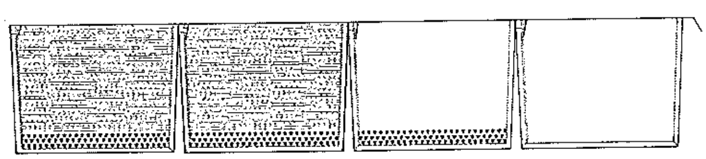
De-Nyte™ cell and cell plates

These are side and top views of a single De-Nyte™ cell showing the J-plate, cell plate, and the cell flaps.

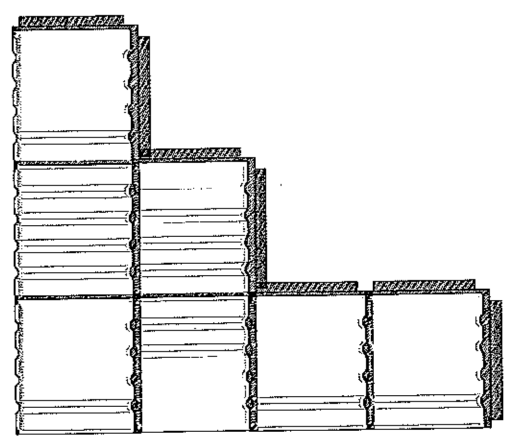


Fill sequence and array assembly

These diagrams illustrate the fill sequence and array assembly.



Cell Fill Sequence (right to left)



Cell Array Assembly Order

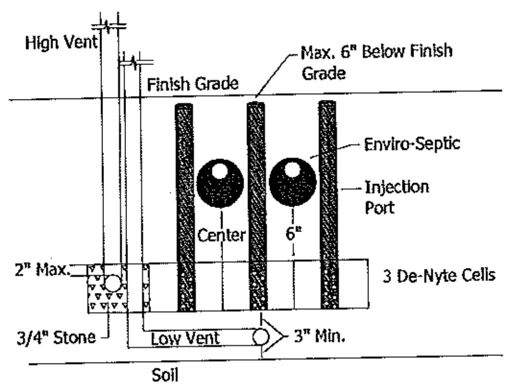
Section E
Design Criteria

Cell size De-Nyte™ cells measure 16 1/4" x 18" x 12" tall.

Depth and types of cover De-Nyte™ systems should not be installed beneath pavement, hard surfaces, or heavily traveled areas.

Distances The Distance to the seasonal groundwater or restrictive layer and all other setbacks will be measured from the edge of the Enviro-Septic® pipe. The distance above the seasonal groundwater or restrictive layer is 30 is inches.

Elevations The top of the De-Nyte™ cell will be 12 inches below the bottom of the Enviro-Septic® lines. The bottom of the high vent will be even with or no lower than 2 inches below the top of the De-Nyte™ cell. The top of the low vent will be 3 inches below the bottom of the De-Nyte™ cell. The top of the injection port will be no greater than 6 inches below the final grade.



High flow Systems over 2,500 GPD must be split into two or more beds with a minimum separation of 20' between each bed.

High vent The high vent is embedded in ¾" stone. This stone bed should be a minimum of 12 inches deep by 12 inches wide and topped with a liner to prevent sand from infiltrating into the stone bed. The high vent will be 12 inches longer than the long side of the De-Nyte™ cells and centered standard 4" perforated PVC pipe with perforations of 1/2" to 5/8" is used with the holes at the 5 and 7 o'clock positions. The top of the vent pipe shall be laid level or up to 2 inches below the upper edge of the De-Nyte™ cells. The outlet of this vent must be 10 feet higher than the outlet of the low vent manifold.

Note: If the bed width is greater than 25 feet, two high and low vents must be used.

Continued

Injection ports An injection port must be installed in each De-Nyte™ cell.

Line orientation Enviro-Septic® lines must be laid level and spaced 1.5 feet center to center over the De-Nyte™ cells. De-Nyte™ cells will be set perpendicular to the pipe with the shortest seam/side parallel and directly under the Enviro-Septic lines. The De-Nyte™ cells must be oriented in the same direction.

Linear footage of Enviro-Septic® needed The chart below has the linear footage of Enviro-Septic® required for all types of systems.

	Number of Bedrooms						Commercial Per 100 GPD
	2	3	4	5	6	Add'l Room	
Linear Footage Needed	120	180	240	300	360	60	60

Lines of cells The number of lines of De-Nyte™ cells that are required in a system is taken from the number of lines of Enviro-Septic® pipe and adding one.

Maximize variance points Due to the capabilities of the De-Nyte™ system to remove nitrates and other contaminants, this system allows installations to maximize variance points.

Maze use (Presby) A Presby Maze® may be used with residential or commercial systems. Commercial systems may receive a 25% size reduction, residential systems a 10% reduction.

Minimum/maximum line lengths To maintain efficient effluent cycling, the minimum length of an Enviro-Septic® line should be 30' and the maximum length 100'. In some instances site conditions may require shorter or longer lengths.

Reference: See Section H, "Non-Conventional System Configurations." In the *Enviro-Septic® and Simple-Septic Leaching Systems Design and Installation Manual.*

Continued

Design Criteria, Continued

Number of De-Nyte™ cells required

After determining the number of lines and the length of the Enviro-Septic®, use the chart below to determine the total number of cells needed.

Total Number of De-Nyte™ Cells Needed

# of lines	Linear feet of Enviro-Septic® pipe in one line																
	20'	**25'**	**30'**	**35'**	**40'**	**45'**	**50'**	**55'**	**60'**	**65'**	**70'**	**75'**	**80'**	**85'**	**90'**	**95'**	**100'**
1	34	40	48	56	62	70	78	86	92	100	108	114	122	130	136	144	152
2	51	60	72	84	93	105	117	129	138	150	162	171	183	195	204	216	228
3	68	80	96	112	124	140	156	172	184	200	216	228	244	260	272	288	304
4	85	100	120	140	155	175	195	215	230	250	270	285	305	325	340	360	380
5	102	120	144	168	186	210	234	258	276	300	324	342	366	390	408	432	456
6	119	140	168	196	217	245	273	301	322	350	378	399	427	455	476	504	532
7	136	160	192	224	248	280	312	344	368	400	432	456	488	520	544	576	608
8	153	180	216	252	279	315	351	387	414	450	486	513	549	585	612	648	684
9	170	200	240	280	310	350	390	430	460	500	540	570	610	650	680	720	760
10	187	220	264	308	341	385	429	473	506	550	594	627	671	715	748	792	836
11	204	240	288	336	372	420	468	516	552	600	648	684	732	780	816	864	912
12	221	260	312	364	403	455	507	559	598	650	702	741	793	845	884	936	988
13	238	280	336	392	434	490	546	602	644	700	756	798	854	910	952	1008	1064
14	255	300	360	420	465	525	585	645	690	750	810	855	915	975	1020	1080	1140
15	272	320	384	448	496	560	624	688	736	800	864	912	976	1040	1088	1152	1216
	For each additional line																
add	17	20	24	28	31	35	39	43	46	50	54	57	61	65	68	72	76

Overhang footprint

The De-Nyte™ cells will extend a minimum of 12" on each side of the Enviro-Septic pipe.

Perimeter sand per soil profile

All systems soil profiles of 2-7 will have a minimum of 12 inches of system sand around the perimeter of the De-Nyte™ cells except on the high vent side. Systems that have soil profiles of 1, 8 & 9 must increase the system sand perimeter to 24 inches on three sides and add a 12 inch sand perimeter on the outside of the high vent stone.

Provide notes for homeowners

Designers should add homeowner notes to their designs regarding system use and maintenance. Notes should include topics such as abusive substances, additives, constant discharge, etc. Suggested tank pumping and inspection schedules would also be beneficial.

Raised systems fill extensions

De-Nyte™ systems that are raised above the original grade must use raised systems fill extensions as specified in the "Enviro-Septic® & Simple Septic® Leaching Systems Design and Installation Manual Maine State Attachment."

Reasonable rectangles preferable

In general, fewer long lines are preferable to a greater number of short lines. Longer lines provide more efficient settling of solids. In addition, longer more narrow systems reduce the potential for ground water mounding.

Continued

Sampling ports	Sampling ports may be required.
Serial distribution	All De-Nyte™ systems will be set in serial distribution unless flow is greater than 900 GPD. High flow (above 900GPD) combination systems should use sections as large as possible. All non-conventional De-Nyte™ systems must be approved by Presby Environmental before seeking state approval. Reference: See Sections F– "Combination Systems" and H-"Non-Conventional Configurations in the *Enviro-Septic® and Simple-Septic Leaching Systems Design and Installation Manual.*
System size	De-Nyte™ system size is in direct correlation with Enviro-Septic® system size.
Ten foot increments work best	It is easier for the installer if systems are designed in 10' increments since Enviro-Septic® pipe is 10' in length.

Section F
Installation, Handling, and Storage Guidelines

Introduction

This page contains guidelines that must be observed while installing, handling, and storing Presby Environmental products.

Site preparation

Here are some site preparation guidelines.

- Remove topsoil, roots, and organic matter from the required sand area of a proposed system, including the slope extensions of raised systems.
- Maintain the existing characteristics of the underlying soil as much as possible.
- Add the sand fill on the same day that the leach area is excavated.
- Do not allow water to run into or over the system during construction.
- Do not work wet or frozen soils.
- Do not smear or compact soils while preparing site.

Note: It is not necessary for the leach area to be smooth when the site is prepared.

Avoid contamination

Keep mud, grease, oil, etc., from all system components. Avoid dragging pipe through wet or muddy areas.

Installation procedure

1. Spread and level a minimum of 3 inches of system sand over the soil.
2. Install and level the low vent manifold.
3. Spread the next layer of system sand taking care to level well.
4. Install the left outside and top row De-Nyte™ cells.
   Note: Make sure the cell plate is secure in each cell and the flaps are folded over the adjacent cell.
5. Insert the J-plate over the outside wall of each left row cell.
6. Place the injection port in the center of the cell.
7. Add the proper amount of mix #1 to each cell and fill to the top with mix #2.
8. Install the high vent in a bed of 3/4" stone.
9. Install the next left and top row cells repeating the flap and fill procedure.
   Note: J-plates are not used for these or remaining cells.
10. Spread 6 inches of system sand and install Enviro-Septic® pipe as per manual.

Soil compaction

Minimize machine movement to avoid soil compaction and destruction of the soil structure under and around the system. Be especially careful not to compact soil on the down slope side of the system.

Continued

Installation, Handling, and Storage Guidelines

Backfilling and final grading	Spread a minimum of 6 inches of system sand over the Enviro-Septic® pipe. Spread the remaining fill. Final grading should shed water away from the system.
Erosion control	Protect the site from erosion by proper grading, mulching, seeding, and control of runoff.
Storage	The outer fabric of the Enviro-Septic® pipe and the De-Nyte™ cells are ultra-violet stabilized. However, the protection breaks down after a period of time in direct sunlight. To prevent damage, cover with an opaque tarp. Care should be taken to keep all system components free of mud, grease, oil, etc. Store all system components on high and dry areas to prevent surface water and soil from entering or contaminating the components prior to installation.

Section G
Sand and Fill Requirements

Introduction

This page describes the sand and fill requirements for the De-Nyte™ leaching system.

System sand

All configurations of De-Nyte™ require a minimum of 12" of system sand surrounding the circumference of the cell bed except on the high vent side. This sand, typically gravelly coarse sand, must adhere to the following percentage and quality restrictions.

Percentage Restrictions
35% **or less** of the total sand may be gravel.
40%-90% of the total sand is to be coarse and very coarse sand.
Gravel Quality Restrictions
No gravel is to exceed 3/4" in diameter.
No gravel is smaller than 2mm/.0787" in diameter. (It must **not** pass through a #10 sieve.)
Coarse Sand Quality Restrictions
No coarse sand is smaller than 0.5mm/.0196" in diameter. (It must **not** pass through a #35 sieve.)
Fines Quality Restrictions
No more than 2% of the total sand may pass through a #200 sieve.

ASTM Standard: C-33 (concrete sand) meets the above requirements.

Sand fill and clean fill

Sand fill is the material used to surround the system sand.

Note: System sand may also be used as sand fill.

Clean fill is the material used to complete the system.

Reference: See "Sand Fill and Clean Fill Requirements" in your State attachment.

Raised system fill extensions

Raised systems require fill extensions.

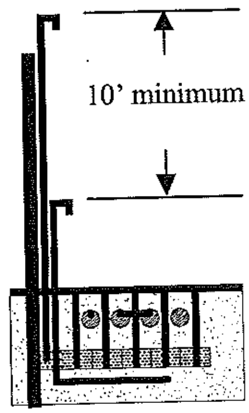
Reference: See "Raised systems fill extensions" in the "Enviro-Septic® & Simple Septic® Leaching Systems Design and Installation Manual Maine State Attachment."

Section H
Venting Requirements

General rule	Venting is good. It is always better to use more than the minimum.
Separate system venting	While they occupy approximately the same footprint, Enviro-Septic® and De-Nyte™ systems must be vented separately.
Enviro-Septic® systems	Enviro-Septic® systems require venting when pumped, under more than 18" of cover, or installed under parking areas, roads, or surface features that restrict air passage through the soil. Reference: See "Venting" in *The Enviro-Septic® & Simple-Septic® Leaching Systems Design and Installation Manual.*
De-Nyte™ systems	Two vents as a minimum are required for each De-Nyte™ system: a low vent manifold and a high vent.
Low vent manifold	The low vent manifold will be a total length no shorter than 60% of the total length of Enviro-Septic® used. Standard 4" perforated PVC pipe is used with the holes at the 5 and 7 o'clock positions. The manifold will be designed such that it is evenly spaced under the De-Nyte™ cells. The outlet of this vent is 10 feet lower than the high vent outlet.
High vent	The high vent will be 12 inches longer than the long side of the De-Nyte™ cells and centered. It will be laid in a bed of 3/4" stone. Standard 4" perforated PVC pipe with perforations of 1/2" to 5/8" is used with the holes at the 5 and 7 o'clock positions. The top of the vent pipe shall be laid level with or up to 2 inches below the upper edge of the De-Nyte™ cells. The outlet of this vent is 10 feet higher than the low vent manifold. Note: If the bed width is greater than 25 feet, two high and two low vents must be used.

Continued

This arrangement enhances the circulation of air throughout the entire system. The high vent outlet is a minimum of 10 feet higher than the low vent outlet.



Vent manifolds A vent manifold can be incorporated to connect the ends of a number of sections or lines of Enviro-Septic® pipe to a single vent opening.

Vent piping slope Vent piping in the high vent and the low vent manifold should be laid level.

Section I
System Rejuvenation and Expansion

Introduction

This section covers procedures for rejuvenating failing systems and explains how to expand existing systems.

Definition: failing system

System failures, almost without exception, are related to the conversion of bacteria from an aerobic to an anaerobic state. Flooding, improper venting, alteration or improper depth of soil, sudden use changes, introduction of chemicals or medicines, and a variety of other conditions can contribute to this phenomenon.

Rejuvenating failing systems

Failing systems need to be returned from an anaerobic to an aerobic state. Most systems can be put back on line and not require costly removal and replacement by using the following procedure.

1. Determine the problem causing the system failure and correct it.
2. Drain the system by pumping out the sump of a bottom drain or by excavating one end of all the lines and removing the end cap or offset adapter.
3. Drain the lines.
4. If foreign matter has entered the system, flush the pipes.
5. Safeguard the open excavation.
6. Guarantee a passage of air through the system.
7. Allow all lines to dry for a minimum of 72 hours.
8. Re-assemble the system to its original design configuration.

System expansion

De-Nyte™ systems can be expanded by adding equal lengths of pipe, cells and vents to each part of the original design or by adding additional equal sections.

Note: All system expansions need to meet State and/or local regulations.

Re-usable components

Most of the De-Nyte™ components are not biodegradable and may be reused. In cases of improper installation it may be possible to excavate, clean, and reinstall all system components.

System replacement

If system components require replacement, simply remove the existing components and contaminated sand and replace with new.

The information in this manual is subject to change without notice. Your suggestions and comments are welcome. Please contact us at

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