Alternate
Systems Guidance

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DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Water Supply and Wastewater Management

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AUTHORITY: Pennsylvania Sewage Facilities Act; Title 25 Pa. Code Section 73.72

POLICY: The Department of Environmental Protection (DEP) will develop, release for public comment and publish technical guidance for the siting, design and construction of alternate onlot sewage treatment systems.

PURPOSE: The purpose of this document is to provide current technical standards for alternate onlot systems and to update these standards periodically through amendments to this document.

APPLICABILITY: This guidance document applies to the siting, design and construction of alternate onlot sewage treatment systems proposed under the requirements of Chapter 73, Section 73.72.

DISCLAIMER: The policies and procedures outlined in this guidance are intended to supplement existing requirements. Nothing in the policies or procedures shall affect regulatory requirements.

The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of DEP to give the rules in these policies that weight or deference. This document establishes the framework within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant.

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ALTERNATE SYSTEMS - Chapter 73, Section 73.72

The following alternate systems and technologies have been determined to meet the criteria listed under Chapter 73, Section 73.72. They must meet the criteria in Section 73.72 in addition to the design and construction conditions in the following listings. It should be noted that Section 73.3(b), Policy, allows for the use of these systems when correcting a malfunction or making a repair of an existing system. It should also be noted that site suitability for these systems need not be considered as part of the suitability determinations performed under Chapter 71, Section 71.64(c)(1) (relating to site suitability for small flow treatment facilities). Where ranges are specified in the guidance, such as for slopes or percolation rates, these ranges are inclusive.

Alternate systems may be used to serve residential development or other facilities producing sewage having chemical characteristics typical of untreated domestic wastewater. Typical untreated domestic wastewater is defined as raw sewage effluent with composition within the following ranges: 12 - 50 mg/L ammonia as nitrogen, 8 - 35 mg/L organic nitrogen (20 - 85 mg/L total Kjeldahl nitrogen), 350 - 1200 mg/L total solids, 100 - 350 mg/L suspended solids and 110 - 400 mg/L BOD_5. (Source: Metcalf and Eddy. 1991. Typical Composition of Untreated Domestic Wastewater. *Wastewater Engineering - Treatment, Disposal, Reuse*, Third Edition, Page 109, Table 3-16.)

Alternate onlot systems require proper operation and maintenance to assure adequate sewage treatment over the life of the system. Municipalities are required to assure proper operation and maintenance of the systems proposed for use within their borders in accordance with the provisions of Chapter 71, Subchapter E, titled "Sewage Management Programs." All proposals submitted as alternate under Chapter 73, Section 73.72 of the regulations must document compliance with the appropriate regulatory requirements relating to sewage management. The operation and maintenance requirements for each technology are specified in the individual listings.

Under Chapter 72, Section 72.43(l), DEP may delegate the review of certain alternate sewage systems intended for single family residential use to Sewage Enforcement Officers (SEO) determined to be qualified by DEP to review the systems. Each alternate system listing describes the qualifications that must be met by an SEO to independently review that alternate system and issue a permit. If DEP review is necessary for a given technology, this is indicated in the individual description. DEP may also require review of proposals for systems not intended to serve single-family residential homes. The final determination on the issuance of an individual alternate permit is the sole responsibility of the local agency.

1. Alternate Individually Designed Composting Toilet

Classification as an alternate individually designed composting toilet is limited to those composting devices not approved by the National Sanitation Foundation (NSF) as a pre-manufactured container with a designated model number identification; which are designed or installed by an individual as a custom, integral part of a building or structure; which are designed and installed by an individual or corporation with existing installations in Pennsylvania preceding November 22, 1997; which have had Pennsylvania installations monitored and determined to be functional; which are warranted for a minimum of 2 years and which are in compliance with the standards listed below.

Permit applications for all other individually designed composting toilets must be submitted to the DEP regional and central offices with supporting documentation for consideration as an experimental individually designed composting toilet under Chapter 73, Section 73.71.

A. Design Review Certification

A statement signed by a representative of the company certifying that the following requirements have been met for the specific proposal (signed statement must contain each item below):

1. Materials: All materials proposed for use in the construction of the composting device (containment used to compost organic matter) must be durable and watertight, preclude infiltration of groundwater and prevent the escape of any liquids.

2. Structural soundness: Construction must be designed to withstand hydrostatic pressures when the composting device is full and withstand earth pressures when the composting chamber is either full or empty.

3. The composting device is constructed to prevent the entry of insects into any component in which biological activity is intended to occur except for entry points where wastes are intended to be deposited under normal usage.

4. The design distance between the upper surface of the seat and the untreated waste is not less than 12 inches unless a leveling device or a cleanable barrier is included in the design.

5. Water inlets must be protected against back siphoning or backflow by an air gap or vacuum breaker.

6. Component parts subject to malfunction, wear, or requiring maintenance must be accessible.

7. Electrical work, equipment and materials must comply with the National Electrical Manufacturers Association standards and the National Electric Code.

8. Complete, detailed design plans and specifications and instructions for the installation, initiation of service, operation, and maintenance must be provided to the permittee including:

   a. Design, including projected volumes and ratios of input urine liquids and input fecal solids (including paper and carbon bulking material); the chemical and biological characteristics of those materials; the oxygen requirements for complete conversion and stabilization of those materials; the ratio of waste mass volume to waste mass exposed surface and retention time; the air to waste interface efficiency of any aeration equipment; the average monthly and annual ambient air temperature and relative humidity and the design calculations based on these factors used to design the individual composting unit.

   b. Arrangement of plumbing and electrical components.

   c. Parts lists for replacement parts.

9. An operation and maintenance manual must be provided to the permittee.

   The above signed statement must be attached to the permit application and permit for the individually designed composting toilet. A copy of each approved permit application must be sent to the DEP regional and central offices by the SEO. This mailing is in addition to normal transmittal of permit applications.

B. Performance Monitoring

Individually designed systems must be monitored to determine if the composting unit is functioning within the performance specifications of the National Sanitation Foundation. At a minimum the monitoring shall include:

Five core samples of solid product shall be collected from the composting chamber at the cleanout port prior to the first clean-out cycle or within 1 year of the start-up of operation, whichever occurs first. Each core sample must weigh at least 10 grams and must be collected by a commercial laboratory that certifies the validity of the sample location.

The 7-day objectionable odor test described in NSF Standard 41 Section 7.1.4 must be conducted by the laboratory which collected the samples.

Tests must also be conducted for fecal coliform and moisture content. The sample must not contain fecal coliforms exceeding 200 MPN per gram as an arithmetic mean of the five samples collected. Moisture content of the solid end product must not exceed 65 percent by weight.

The results of all sample analyses must be received by the DEP regional and central offices within one year of the start-up of the system.

Individually Designed Composting Device(s) which have met the screening criteria to be considered for permitting under this listing:

Bio-Sun Systems, RR 2, Box 134A, Millerton, PA 16936.

2. Flow Equalization

Facilities with regular, predictable, fluctuating flows (alternating high and low flows) may benefit from this design. Tanks, controls and dosing equipment are used to equalize the peak flows. The following conditions apply:

A. The system designer has flexibility regarding where in the treatment process the flow equalization will occur (preceding or following the treatment tank). If flow equalization occurs before the treatment tank, the treatment tank capacity may be reduced appropriately. If equalization is to occur following the treatment tank, all flows must be treated in a septic or aerobic tank system that is designed for peak flow (no size reduction) and must be discharged to an equalization tank specifically designed to meet the needs of the proposed facility. Septic tank installations must consist of either a two-compartment rectangular tank or two rectangular tanks in series and must be in conformance with Chapter 73, Section 73.31. Aerobic tanks must be in compliance with Chapter 73, Section 73.32.

B. The effluent is discharged from the tank in a timed, controlled volume that is lower than the peak flow for the facility but sufficient to balance inflow and outflow over an extended period.

C. The equalization tank and discharge rate must be designed and established based upon the flow pattern of the facility; discharging a stabilized daily rate to the absorption area allows for reduction of the absorption area.

D. Since the effects of sustained maximum usage of an absorption area are unknown, the absorption area must be sized for the controlled daily volume plus 15-20 percent.

E. If flow equalization is proposed for an existing facility, proposals must include peak daily water consumption volumes collected over a 1-year period with the highest consecutive 7-day period highlighted. If the proposal is for a new facility, flow data from an equivalent facility is also acceptable. If flow data from an equivalent facility are not available for a new facility, flows are calculated using Chapter 73, Section 73.17(b). Where Section 73.17(b) does not list flow figures for the specific facility type, flows may be calculated using normally accepted engineering practices.

F. DEP's regional office must review the proposal prior to permitting by the SEO. If requested by the regional office, central office will also provide comments. Applicants may request informal comments from DEP prior to submittal of a formal application.

3. Alternate Peat Based System Options

Alternate peat based system configurations consist of an aerobic or septic tank, followed by a peat filter and an absorption area as described in this listing. Septic tank installations must consist of either a two-compartment rectangular tank or two rectangular tanks in series and must be in conformance with Chapter 73, Section 73.31. Aerobic tanks must be in compliance with Chapter 73, Section 73.32. All peat systems must also include a Zabel A-300 solids retainer or equivalent NSF approved filter on the preceding septic or aerobic tank.

A. General Requirements For All Peat Based Systems

1. System Requirements

a. All Ecoflo installations are required to have a minimum of 195 cubic feet of peat evenly distributed in the filter unit (nominally 31 inches deep). The SEO shall confirm the volume of peat prior to final approval of the system. ***Note: New compressed packaging for peat requires multiplication of the volume printed on the packaging by 1.75 (the compression ratio).***

b. The Puraflo system is sized at one preassembled peat filter module per bedroom (each module contains approximately 60 cubic feet of peat media). The depth of peat in the Puraflo system is 30 inches. No compression ratio is specified because these are pre-engineered, preassembled filter units.

2. Distribution of effluent from the septic tank or aerobic tank to the peat filter may be by gravity flow or pressure distribution. If a pump is required to lift effluent to the peat filter, a timed dose is required.

3. The peat filter must be watertight and all outlets properly sealed against liquid and solid infiltration and exfiltration. Where a liner is used, the liner must be 20 mil thick hyplon, polyvinyl chloride or polyethylene sheeting placed on 2 inches of sand or a layer of 10 ounce porous textile material to prevent punctures and tears. The liner must be extended to the surface and any inlets or outlets at or below the water table or at or below the water level in the unit must have an anti-seep collar, bentonite clay plug or leak-proof boot sealed to the liner material.

4. Operation and Maintenance

Peat filters require maintenance, including the periodic replacement of peat. The company's warranty must be attached to the permit application, permit and purchase agreement. This warranty must clearly notify the property owner of the need to replace the peat within the life expectancy period established by the company and provide access for the annual inspection. In addition, septic tanks, dosing tanks, and lift pump tanks shall be inspected every 6 months for structural integrity of the tank, inlet and outlet baffles, solids retainer, pumps, siphons and electrical connections. Aerobic tanks shall be inspected every 6 months for

structural integrity of the tank, inlets and outlet baffles, buoyed solids retainer, pumps, siphons and electrical connections. The inspection and concurrent pumping of excess solids shall be conducted in accordance with the manufacturer's and NSF requirements. In system configurations utilizing at-grade bed systems on sites exhibiting limiting zones between 10 and 20 inches to seasonal high water table or 16 to 20 inches to rock, operation and maintenance shall comply with both the manufacturer's specifications and the following requirements:

a. Disinfection units shall be inspected monthly by the property owner and every 6 months by the maintenance entity established under Chapter 72, Section 72.25(h). The disinfection unit must be clean and be functioning within the specifications of the manufacturer. A qualified technician must determine if the unit meets or exceeds the published minimum standards in Part 7 of this guidance. Additionally, the UV tube must be replaced if it is found to be necessary during the inspection or at least annually.

b. A laboratory shall test the discharge to the system for fecal coliforms, carbonaceous biological oxygen demand (CBOD), and suspended solids to determine compliance with Chapter 72 (relating to the administration of the sewage facilities permitting program). The sample must be taken following the disinfection unit. At least annually, a copy of these test results, along with documentation of the most recent inspection of the system by the maintenance entity established under Chapter 72, Section 72.25(h), shall be sent to the local agency.

Systems Approved Under This Listing

Ecoflo Pennsylvania system - distributed in Pennsylvania by Falling Spring Technologies, P.O. Box 410, Newburg, PA 17240.

Puraflo peat biofilter - manufactured by Bord na Mona, P.O. Box 77457, Greensboro, NC 27417, distributed in Pennsylvania by Site Development Services, P.O. Box 5873, Reading, PA 19610.

B. Alternate Peat System Option 1

1. Performance Standard

This system has demonstrated to the satisfaction of DEP, that it can produce an effluent equal to or better than 10 mg/L BOD_5/$CBOD_5$ and 10 mg/L TSS as monthly averages. With UV disinfection, it can also reduce fecal coliform concentrations to less than 200/100 ml. This system is approved for use on limiting zones of less than 20 inches.

2. Use of this System

This system may be approved either to serve new construction or as a repair system. This system option involves treatment of septic or aerobic tank effluent using a self-contained peat filter, with final treatment and disposal using one of the following options:

a. An onlot system as described in Chapter 73, other than IRSIS (see Alternate Peat System Option 2). Where the percolation rate is in the range of 3 to 60 minutes per inch (min/in), inclusive, up to a 40 percent reduction in the size of the absorption area is allowed. However, where the percolation rate is in the range of 61 to 180 min/in, inclusive, no reduction in absorption area sizing is permitted.

b. An at-grade absorption area. The minimum vertical isolation distances for this final treatment option are greater than or equal to 10 inches to the seasonal high water table, or greater than or equal to 16 inches to rock formation.

(1) On sites exhibiting limiting zones **greater than or equal to 20 inches** from the mineral soil surface, an at-grade absorption area designed in accordance with the alternate at-grade system standards in Part 9 of this guidance may be used, except that the soil profile must show that there is a minimum of 20 inches of suitable soil between the bottom of the proposed absorption area and the limiting zone rather than the 48 to 60 inches of suitable soil or sand/soil required by Part 9. Where the percolation rate is in the range of 3 to 60 minutes per inch, inclusive, up to a 40 percent reduction in the size of the absorption area is allowed. However, where the percolation rate is in the range of 61 to 180 min/in, inclusive, no reduction in absorption area sizing is permitted.

(2) On sites exhibiting limiting zones **less than 20 inches** from the mineral soil surface, soil morphological analysis by a soil scientist who is a professional member of the Pennsylvania Association of Professional Soil Scientists (PAPSS) or who is a "Qualified Soil Scientist" as defined in Chapter 73 of the regulations is required. On these sites, the treatment and disposal distribution configuration is based on the horizontal linear loading rate derived from the soil morphological analysis and the Hydraulic Linear Loading Rate (HLLR) chart in Appendix 5; or

c. An alternate drip irrigation system designated in accordance with Part 12 of this guidance.

3. Siting Requirements

a. For final treatment and disposal options using onlot systems as described in Chapter 73, see the appropriate regulations for siting requirements.

b. For final treatment and disposal using an alternate drip irrigation system, please see Part 12 of this guidance for requirements.

c. For final treatment and disposal using an at-grade system:

(1) On a site exhibiting a limiting zone at **greater than or equal to 20 inches** from the mineral soil surface, refer to Part 9 of this guidance.

(2) On a site with a limiting zone **less than 20 inches** from the mineral soil surface, the siting and distribution system design shall be based upon the HLLR table in Appendix 5 of this document. A soil scientist who is a professional member of the PAPSS or is a "Qualified Soil Scientist" as defined in Chapter 73 of DEP's regulations must conduct the necessary morphological evaluation. A report regarding the soil drainage classification determination, and confirmation that the appropriate loading rate and horizontal linear load from the HLLR table are met, must be signed by the soil scientist. The following procedure must be used:

(a) A minimum of four soil profile test pits shall be evaluated to verify the morphology of the proposed absorption site. These soil profiles shall include two soil profile evaluations on contour, bracketing the proposed absorption area, and two soil profile evaluations on contour, 50 feet downgradient from the absorption area.

(b) The on-contour spacing of the soil profile evaluations shall not exceed 100 feet in length.

(c) In cases where the calculated aggregate area length exceeds 100 feet, additional test pit evaluations are required to verify the soil morphology of both the absorption area and the downgradient area.

(d) Overall site suitability will be limited by the most restrictive depth to the seasonal high water table, depth to rock formation and soil morphology from all of the soil test pits evaluated.

(e) At a minimum, the vertical isolation distance must be greater than or equal to 10 inches to the seasonal high water table or greater than or equal to 16 inches to rock

formation. In addition, the soil must have a consistency of "very firm" or less to be suitable.

(f) Distribution of the effluent in the absorption area will be determined by the soil profile evaluations and the vertical depth between the bottom of the aggregate and the top of the seasonal high water table or rock formation.

(g) The loading rate (required to calculate aggregate area square footage) and hydraulic loading rate (required to calculate aggregate area length) shall be determined with the HLLR table by using the most restrictive results from the soil profile evaluations conducted. The shape and grade of structure, as well as textural classification of the mineral soil from the profile horizon above the seasonal high water table or restrictive horizon, is used to determine these rates.

(h) Disinfection: Disinfection of the effluent prior to discharge to the absorption area is required. This disinfection must be achieved by means of ultraviolet (UV) light emitting equipment designed as described below. No other means of disinfection, such as chlorination, may be used, as it is essential to prevent negative effects on soil bacteria in the absorption area that may be caused by residual effects of disinfection.

1) Ultraviolet radiation at a level of 254 nanometers must be applied at a minimum dosage of 25,000 microwatt-seconds per square centimeter at all points throughout the water disinfection chamber. However, a higher dosage may be required based on the specific transmittance of the wastewater. In lieu of determining the specific transmittance level of the wastewater, a dosage of 30,000 to 35,000 microwatt-seconds per square centimeter should be provided.

2) The maximum water depth in the chamber, measured from the tube surface to the chamber wall, shall not exceed 3 inches.

3) The ultraviolet tubes shall be jacketed so that a proper operating tube temperature of about 104°F is maintained. The jacket shall be made of quartz or high-silica glass with similar optical characteristics.

4) The units shall be designed to permit frequent mechanical cleaning of the water contact surface of the jacket without disassembly of the unit.

5) An automatic flow control device, accurate within the expected pressure range, shall be installed to restrict flow to the maximum design flow of the treatment unit.

6) Ultraviolet tubes must be replaced at least annually. To ensure that appropriate UV dose levels are maintained, a warning alarm must be installed to ensure prompt replacement of a burned-out tube. To ensure continued optical performance of the unit, an accurately calibrated ultraviolet intensity meter, properly filtered to restrict its sensitivity to the point of the disinfection spectrum, may also be installed in the wall of the disinfection chamber at the point of greatest water depth from the tube.

7) A spare UV tube and other necessary equipment must be available to allow prompt repair of the UV unit by qualified personnel instructed in the operation and maintenance of the equipment.

4. The following conditions apply to Alternate Peat Filter System Option 1:

a. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received review delegation in writing from DEP may independently review the design and issue the permit for alternate system designs approved under this listing. All other system proposals under this listing must be submitted to the DEP regional office for review and comment.

b. Where a conventional system other than IRSIS is proposed, sufficient soil profiles must be conducted to ensure that a minimum of 20 inches of suitable soil is present under the entire area proposed for the absorption area.

c. Where sizing reductions are proposed, they are not cumulative. No additional sizing reduction is allowed for use of either an aerobic tank or infiltration chambers.

d. If sizing reductions are proposed, where the system is used to serve a new dwelling, the soil profile evaluations and percolation testing must document that sufficient area is available for installation of a full-sized absorption area (prior to the calculation of the 40 percent reduction).

e. For repairs, system sizing must be maximized up to the square footage of a full-sized system.

f. Where an at-grade system is proposed, sufficient soil profiles must be conducted to ensure that the soil profile under the area of the proposed system has greater than or equal to 10 inches of suitable soil to seasonal high water table and greater than or equal to 16 inches to rock (instead of the 48 to 60 inches required by Part 9 of this guidance).

g. The system must be designed to take full advantage of the slope to move effluent out from under the absorption area and downgradient with the laterals placed parallel to the contour.

h. On sites with limiting zones at < 20" from the mineral soil surface, a laboratory shall test the discharge to the system for fecal coliforms, CBOD and suspended solids to determine compliance with Chapter 72. The sample must be taken following the disinfection unit. At least annually, a copy of these test results, along with documentation of the most recent inspection of the system by the maintenance entity established under Chapter 72, Section 72.25(h), shall be sent to the local agency.

C. Alternate Peat System Option 2

A self-contained peat filter may be used in place of an intermittent sand filter (Chapter 73, Section 73.162) for individual residential spray irrigation systems permitted by the local agency. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received review delegation in writing from DEP may independently review the design and issue a permit for this alternate spray irrigation system. All other system proposals under this listing must be submitted to the DEP regional office for review and comment.

D. Alternate Peat System Option 3

This option involves initial treatment in a septic or aerobic treatment tank followed by a self-contained, sealed bottom peat filter, with final treatment and disposal using a separate subsurface sand filter designed in accordance with Section 73.54 and the regulations referenced in that Section, except that 12 inches of sand in the filter may be eliminated. No reduction in absorption area sizing is allowed. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received review delegation in writing from DEP may independently review the design and issue a permit for this alternate peat system. All other system proposals under this listing must be submitted to the DEP regional office for review and comment.

4. Free Access Gravity Sand Filter System Option

A. This system option involves treatment of septic tank or aerobic tank effluent using a gravity sand filter, with final treatment and disposal using one of the following options:

1. an onlot system as described in Chapter 73 (this filter may be used as a 1:1 replacement for the intermittent sand filter described in Chapter 73, Section 73.162 for individual residential spray irrigation systems permitted by the local agency);

2. an at-grade absorption area designed in accordance with the at-grade alternate system standards in Part 9 of this guidance (except that the soil profile must show that there is a minimum of 20 inches of suitable soil between the bottom of the proposed absorption area and the limiting zone (48 to 60 inches of suitable soil or sand/soil is not required)); or

3. an alternate drip irrigation system designed in accordance with Part 12 of this alternate system guidance.

B. Specifications

1. Treatment tank: Either septic or aerobic tanks may be used in this option. If a septic tank is used, it must meet the requirements of Chapter 73, Section 73.31 and be either a two-compartment rectangular tank or two rectangular septic tanks in series. Aerobic tanks must meet the requirements of Chapter 73, Section 73.32.

2. Filter: The filter shall be constructed in a tank meeting the following specifications:

a. Systems designed to serve a single-family dwelling of three bedrooms or less (or equivalent flow) shall have a filter surface area of at least 40 square feet. The filter area shall be increased by 10 square feet for each additional bedroom over three (or additional equivalent flow).

b. Tanks shall be watertight and made of a sound, durable material not subject to excessive corrosion or decay.

c. Concrete tanks shall have a minimum wall thickness of 2 1/2 inches and be adequately reinforced.

d. If precast slabs are used as tank tops to support the access covers, the slabs shall have a thickness of at least 3 inches and be adequately reinforced.

e. Tanks shall be designed and constructed so that the depth from the cover to the top of the sand layer provides sufficient freeboard to allow for maintenance of the sand surface.

f. Access shall be provided by a minimum of two round or square access openings. These access openings shall be a minimum of 36 x 36 inches in size and provide access to the entire surface of the filter. If the access openings are less than 1,600 square inches in size, the tank wall must be extended a minimum of 6 inches above final grade. If the tank access openings are at least 1,600 square inches, the tank may be set a maximum of 12 inches below final grade.

As an alternative to having two access openings, a single rectangular opening may be used if the following requirements are met:

(1) The minimum dimension of any access opening shall be greater than or equal to 36 inches.

(2) For access openings with a dimension less than 60 inches, the inside of the tank wall shall be no greater than 18 inches from the edge of the opening in the direction of that dimension.

(3) For access openings with a dimension greater than or equal to 60 inches, the inside of the tank wall shall be no greater than 36 inches from the edge of the opening in the direction of that dimension.

(4) If more than one access opening is used, the distance between the openings shall be no greater than 36 inches.

g. All access openings shall be extended a minimum of 6 inches above final grade.

h. Access covers shall be constructed of sturdy, lightweight materials that facilitate easy removal or manual repositioning to allow for routine maintenance of the filter, and shall be secured against unauthorized access. They shall be designed to prevent entrance of groundwater, surface runoff and debris.

3. Media: Fine aggregate (sand) suppliers shall provide written certification to the SEO and permittee, with the first delivery to the job site, that the sand to be supplied meets the following specifications:

a. The fine aggregate shall have an effective size of between 0.3 to 0.6 mm, a uniformity coefficient of 3.5 or less and less than 4 percent of the coarse aggregate passing the #100 sieve. The sieve analysis shall be conducted in accordance with Department of Transportation PTM #616 and the uniformity coefficient shall be determined by using Department of Transportation PTM #149.

b. The sand may not contain more than 15 percent by weight deleterious material as determined by Department of Transportation PTM #510.

4. Contents of certification: The written certification shall include the name of the supplier, the testing results, the testing date, the amount of material purchased under this certification and the delivery date.

5. Construction: The sand filter shall be constructed according to the following standards:

   a. A 4-inch diameter perforated underdrain pipe with a minimum 2,500 pound crush test specification shall be placed on the bottom of the tank.

   b. Two rows of perforations with diameters between 1/2 and 3/4 inch shall be drilled in the underdrain pipe at 6-inch intervals. Stock perforated pipe meeting these standards may be used. The pipe shall be placed so that the perforations face downward and the rows are at approximately 45° angles from each other.

   c. Aggregate shall be placed around the underdrain to a total depth of 5 inches from the bottom of the tank. Coarse aggregate used in the underdrains and distribution system shall meet the Type B requirements posted in the Department of Transportation specifications Publication #408, Section 703, Table B. The uniform size and grading of the aggregate shall meet AASHTO No. 57 requirements, as described in Form 408, Section 703.2, Table C from a Department of Transportation certified stockpile.

   d. A minimum depth of 4 inches of aggregate shall be placed over the aggregate underdrain material. Coarse aggregate used in the transition layer shall meet the Type B requirements posted in the Department of Transportation specifications Publication #408, section 703, Table B. The size and grading shall meet AASHTO No. 8 requirements, as described in Form 408, Section 703.2, Table C from a Department of Transportation certified stockpile.

   e. Sand shall be placed over the aggregate to a depth of at least 24 inches.

   f. The sand in the filter may not be greater than 36 inches deep.

   g. A high water alarm shall be installed in the filter tank that will produce an audible and visual alarm when effluent backs up on the filter surface to 12 inches above the surface of the sand.

   h. The central distribution piping shall be a minimum of 3 inches in diameter and installed level.

i. The height of the central distribution system's effluent outlet above the sand surface shall allow for the installation of a splash plate.

j. A concrete splash plate or other suitable material shall be located under each effluent outlet to prevent scouring of the sand surface.

C. The following conditions apply to the Free Access Gravity Sand Filter System Option:

1. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received review delegation in writing from DEP may independently review the design and issue the permit for alternate system designs approved under this listing. All other system proposals under this listing must be submitted to the DEP regional office for review and comment.

2. Where an at-grade system is proposed, sufficient soil profiles must be conducted to assure that a minimum of 20 inches of suitable soil is present under the entire area proposed for the at-grade absorption area.

3. No reduction in size of the absorption area is allowed for use of either an aerobic tank or leaching chambers.

4. For repairs, the system sizing must be maximized up to the square footage of a full-sized system.

5. Where an at-grade system is proposed, the design of the at-grade system must meet the alternate system standards described in Part 9 of this guidance, except that the soil profile must show that there is greater than or equal to 20 inches of suitable soil (instead of the 48 to 60 inches specified in Part 9).

6. The absorption area must be designed to take full advantage of the slope to move effluent out from under the absorption area and downgradient with the long side of the bed parallel to contours.

D. Operation and Maintenance

The homeowner should be advised that sand filter systems require periodic maintenance to operate properly. Septic tanks, dosing tanks, and lift pump tanks must be inspected every 6 months for structural integrity of the tank, inlet and outlet baffles, solids retainer, pumps, siphons and electrical connections. Aerobic tanks must be inspected every 6 months for structural integrity of the tank, inlets and outlet baffles, buoyed solids retainer, pumps, siphons and electrical connections. The inspection and concurrent pumping of excess solids must be conducted in accordance with the manufacturer's and NSF requirements. In system configurations where spray irrigation is proposed as the final treatment and disposal option, operation and maintenance shall comply with the applicable provisions of Chapter 73, Section 73.167 (Operation and Maintenance) and specifically Chapter 72, Section 72.25(h). In addition, the free access sand filter must be inspected monthly by the property owner and every 6 months by the maintenance entity

established under Chapter 72, Section 72.25(h). Each component shall be inspected for compliance with the following standards:

1. Solids may not be accumulated on the surface of the sand in the free access sand filter nor may 12 inches of effluent be ponded over the sand. The high water alarm must be functional.

2. The surface of the free access sand filter shall be raked and porous, and any sand removed must be replaced with sufficient clean sand to maintain the depth at a minimum of 24 inches.

3. The plumbing in the free access sand filter tank shall be functional and free of leaks, and the splash plates must be in place.

4. The sand filter tank and cover shall be structurally sound and secured to inhibit unauthorized access. Any insulation must be in place and in good condition.

5. The area around the sand filter shall be free of ponded effluent and downgradient seepage.

5. CO-OP RFS III System Option

A. Description

This system option involves treatment of septic tank effluent using a free access recirculating filter and a manufacturer-required disinfection unit, with final treatment and disposal using one of the following options:

1. an onlot system as described in Chapter 73 (this filter may be used as a 1:1 replacement for the free access intermittent sand filter described in Chapter 73, Section 73.162 for individual residential spray irrigation systems permitted by the local agency);

2. an at-grade absorption area. On sites exhibiting limiting zones greater than or equal to 20 inches from the mineral soil surface, the at-grade absorption area shall be designed in accordance with the at-grade alternate system standards in Part 9 of this guidance. On sites exhibiting limiting zones less than 20 inches from the mineral soil surface, the documented level of consistent and reliable treatment achieved by the CO-OP RFS III System is sufficient to allow the use of an at-grade bed on soils that are more shallow than the normal 20 inches to limiting zone required for many at-grade bed installations. The minimum vertical isolation distance is 10 inches or more between the aggregate and the seasonal high water table, or 16 inches or more between the aggregate and a rock formation. On these sites, soil morphological analysis by a soil scientist who is a professional member of the Pennsylvania Association of Professional Soil Scientists (PAPSS) or who is a "Qualified Soil Scientist" as defined in Chapter 73 of the regulations is required. The treatment and disposal distribution configuration must be based on the horizontal linear loading rate derived from the soil morphological analysis and the HLLR chart in Appendix 5; or

3. an alternate drip irrigation system designated in accordance with Part 12 of this guidance.

B. Performance Standard

This system has demonstrated to the satisfaction of DEP, that it can produce an effluent equal to or better than 10 mg/L BOD_5/$CBOD_5$ and 10 mg/L TSS as monthly averages. With UV disinfection, it can also reduce fecal coliform concentrations to less than 200/100 ml. This system is approved for use on limiting zones of less than 20 inches.

C. Siting Requirements

1. For final treatment and disposal options using onlot systems as described in Chapter 73, see the appropriate regulations for siting requirements.

2. For final treatment and disposal using an alternate drip irrigation system, please see Part 12 of this guidance for requirements.

3. For final treatment and disposal using an at-grade system:

   a. On a site exhibiting a limiting zone at **greater than or equal to 20 inches** from the mineral soil surface, refer to Part 9 of this guidance.

   b. On a site with a limiting zone **less than 20 inches** from the mineral soil surface, the siting and distribution system design shall be based upon the HLLR table in Appendix 5 of this document. A soil scientist who is a professional member of the PAPSS or is a "Qualified Soil Scientist" as defined in Chapter 73 of DEP's regulations must conduct the necessary morphological evaluation. A report regarding the soil drainage classification determination, and confirmation that the appropriate loading rate and horizontal linear load from the HLLR table are met, must be signed by the soil scientist. The following procedure must be used:

      (1) A minimum of four soil profile test pits shall be evaluated to verify the morphology of the proposed absorption site. These soil profiles shall include two soil profile evaluations on contour, bracketing the proposed absorption area, and two soil profile evaluations on contour, 50 feet downgradient from the absorption area.

      (2) The on-contour spacing of the soil profile evaluations shall not exceed 100 feet in length.

      (3) In cases where the calculated aggregate area length exceeds 100 feet, additional test pit evaluations are required to verify the soil morphology of both the absorption area and the downgradient area.

      (4) Overall site suitability will be limited by the most restrictive depth to the seasonal high water table, depth to rock formation and soil morphology from all of the soil test pits evaluated.

      (5) At a minimum, the vertical isolation distance must be greater than or equal to 10 inches to the seasonal high water table or greater than or equal to 16 inches to rock formation. In addition, the soil must have a consistency of "very firm" or less to be suitable. In some of the HLLR table textural classifications, there is no suitable loading rate for massive or platy structures, so these soils would be unsuitable.

      (6) Distribution of the effluent in the absorption area will be determined by the soil profile evaluations and the vertical depth between the bottom of the aggregate and the top of the seasonal high water table or rock formation.

(7) The loading rate (required to calculate aggregate area square footage) and hydraulic loading rate (required to calculate aggregate area length) shall be determined with the HLLR table by using the more restrictive results from the soil profile evaluations conducted. The shape and grade of structure, as well as textural classification of the mineral soil from the profile horizon above the seasonal high water table or restrictive horizon, is used to determine these rates.

D. Specifications

1. Treatment tank: The septic tank used may be either a two-compartment rectangular tank or two rectangular septic tanks in series and must meet the requirements of Chapter 73, Section 73.31. Each tank must be equipped with a 4-inch Biotube effluent filter or equivalent.

2. Access: Access shall be provided by a minimum of two access openings. These access openings shall be a minimum of 24 inches by 36 inches and provide access to the entire surface of the filter.

3. Size: The effective surface area of the free access recirculating filter shall be sized to maintain a hydraulic loading rate no greater than 5 gpd/sq ft (design influent flow). In no instance shall the effective surface area be less than 120 sq ft with minimum sewage flow of greater than or equal to 200 gpd.

4. Media: Filter media shall conform to wastewater treatment media requirements to be hard, durable, and free of organic matter. Filter media shall be crushed boiler slag (Black Beauty product grade #1040) or manufacturer approved equal with the following physical properties:

Effective size	1.00 mm to 1.7 mm
Uniformity coefficient	less than 1.9
Particle shape	Angular
Hardness	6 to 7 on Moh's scale
Bulk density	75 to 100 lbs. per cubic foot
Specific gravity	2.73
Moisture content	less than 0.5%
Free silica	less than 1.0%

A minimum of 24 inches of media is required.

The bottom layer must consist of at least 16 inches of AASHTO #57 washed and crushed aggregate, followed by 8 inches of AASHTO #8 washed and crushed aggregate.

5. Underdrain Piping: The underdrain system shall consist of Infiltrator Systems, Inc.'s, Equalizer 36 chambers or equivalent. The underdrain shall be positioned on either side of the spray grid.

6. Distribution and Recirculation (400 to 600 gpd/unit in parallel):

Grids per system, with flexibility to shut off flow to any grid	2
Orifices/spray grid	4
Total orifices	8
Laterals per spray grid	2
Length of laterals	10 ft.
Orifice spacing	52 inch centers
Orifice size	0.25 inch diameter
Design flow per orifice	4.1 gpm
Recirculation ratio	12:1
Cycles per day	72
Recirculation tank	1,120 gal.
Flushing orifice to underdrain with valve	1 per grid
Return to head of septic tank with recirculation valve	1 per system
Freeboard (top of tank to sand)	1 ft.
Submersible pump	33 gpm at required total design head

The pump wet well shall contain a high water level alarm.

The recirculation tank must be constructed to comply with the minimum requirements in Chapter 73, Section 73.31(b).

7. Disinfection: Disinfection of the recirculating filter effluent prior to discharge to the absorption area is required. This disinfection must be achieved by means of ultraviolet (UV) light emitting equipment designed as described below. No other means of disinfection, such as chlorination, may be used as it is essential to prevent negative effects on soil bacteria in the absorption area that may be caused by residual effects of disinfection.

   a. Ultraviolet Radiation Equipment:

      (1) Ultraviolet radiation at a level of 254 nanometers must be applied at a minimum dosage of 25,000 microwatt-seconds per square centimeter at all points throughout the water disinfection chamber. However, a higher dosage may be required based on the specific transmittance of the wastewater. In lieu of determining the specific transmittance level of the wastewater, a dosage of 30,000 to 35,000 microwatt-seconds per square centimeter should be provided.

      (2) The maximum water depth in the chamber, measured from the tube surface to the chamber wall, shall not exceed 3 inches.

      (3) The ultraviolet tubes shall be jacketed so that a proper operating tube temperature of about 104°F is maintained. The jacket shall be

made of quartz or high-silica glass with similar optical characteristics.

(4) The units shall be designed to permit frequent mechanical cleaning of the water contact surface of the jacket without disassembly of the unit.

(5) An automatic flow control device, accurate within the expected pressure range, shall be installed to restrict flow to the maximum design flow of the treatment unit.

(6) Ultraviolet tubes must be replaced at least annually. To ensure that appropriate UV dose levels are maintained, a warning alarm must be installed to ensure prompt replacement of a burned-out tube. To ensure continued optical performance of the unit, an accurately calibrated ultraviolet intensity meter, properly filtered to restrict its sensitivity to the point of the disinfection spectrum, may also be installed in the wall of the disinfection chamber at the point of greatest water depth from the tube.

(7) A spare UV tube and other necessary equipment must be available to allow prompt repair of the UV unit by qualified personnel instructed in the operation and maintenance of the equipment.

E. The following conditions apply:

1. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received review delegation in writing from DEP may independently review the design and issue the permit for alternate system designs approved under this listing. All other system proposals under this listing must be submitted to the DEP regional office for review and comment.

2. Where an at-grade system is proposed, sufficient soil profiles must be conducted to assure that the minimum vertical isolation distance from the limiting zone (greater than or equal to 10 inches to seasonal high water table, or greater than or equal to 16 inches to rock) is present under the entire area proposed for the at-grade absorption area. The design of the at-grade system must meet the alternate system standards described in Part 9 of this guidance, except that the soil profile must show that there is greater than or equal to 10 inches to seasonal high water table or greater than or equal to 16 inches to rock (instead of the 48 to 60 inches specified in the listing).

3. For repairs, the system sizing must be maximized up to the square footage of a full-sized system.

4. The absorption area must be designed to take full advantage of the slope to move effluent out from under the absorption area and downgradient with the long side of the bed parallel to contours.

F. Operation and Maintenance

The homeowner should be advised that recirculating filter systems require periodic maintenance to operate properly. Septic tanks, dosing tanks, and lift pump tanks must be inspected every 6 months for structural integrity of the tank, inlet and outlet baffles, solids retainer, pumps, siphons and electrical connections. In system configurations where spray irrigation is proposed as the final treatment and disposal option, operation and maintenance shall comply with both the manufacturer's specifications and the applicable provisions of Chapter 73, Section 73.167 (Operation and Maintenance) and specifically Chapter 72, Section 72.25(h). In system configurations utilizing at-grade bed systems on sites exhibiting limiting zones between 10 and 20 inches to seasonal high water table or 16 to 20 inches to rock, operation and maintenance shall comply with both the manufacturer's specifications and the following requirements:

1. Disinfection units shall be inspected monthly by the property owner and every 6 months by the maintenance entity established under Chapter 72, Section 72.25(h). The disinfection unit must be clean and be functioning within the specifications of the manufacturer. A qualified technician must determine if the unit meets or exceeds the published minimum standards in Part 7 of this guidance. Additionally, the UV tube must be replaced if it is found to be necessary during the inspection or at least annually.

2. A laboratory shall test the discharge to the system for fecal coliforms, carbonaceous biological oxygen demand (CBOD), and suspended solids to determine compliance with Chapter 72 (relating to the administration of the sewage facilities permitting program). The sample must be taken following the disinfection unit. At least annually, a copy of these test results, along with documentation of the most recent inspection of the system by the maintenance entity established under Chapter 72, Section 72.25(h), shall be sent to the local agency.

SYSTEMS APPROVED UNDER THIS LISTING

Manufacturer: ASHCO - A Corp., and Distributor: Pennsylvania Rural Electric Association (PREA), 212 Locust Street, P.O. Box 1266, Harrisburg, PA 17108-1266.

6. Leaching Chambers

Leaching chambers are constructed of plastic and are installed in trenches or beds as a substitute for aggregate. Infiltrator Systems, Inc., manufacturer of the Infiltrator leaching chamber, and Advanced Drainage Systems, Inc. (ADS), manufacturer of the BioDiffuser leaching chamber, have submitted performance data which documents that their leaching chamber units function with an up to 40 percent reduction in absorption area sizing. No additional size reduction is allowed for leaching chamber designs when these chambers are used in conjunction with aerobic treatment tanks, composting toilets or other system components that would otherwise allow for sizing reductions.

If a site is otherwise suitable for installation of an onlot system using an absorption area for treatment and disposal of sewage (including elevated sand mounds), Infiltrator or BioDiffuser leaching chambers may be installed with an up to 40 percent reduction in the size of the absorption areas when all of the following standards are met:

A. Soil profile evaluation and percolation tests must document that there is sufficient area for installation of a full-sized absorption area (prior to the calculation of the up to 40 percent reduction).

B. Septic tank installations must consist of either a two-compartment rectangular tank or two rectangular tanks in series and must be in conformance with Chapter 73, Section 73.31. Aerobic tanks must be in compliance with Chapter 73, Section 73.32.

C. The property owner is provided with a 5-year warranty from the manufacturer of the unit for Pennsylvania installations.

D. The Infiltrator system is installed in accordance with all applicable specifications and appropriate general installation requirements listed in the manufacturer's chamber design guidelines (see Appendix 2). These installation guidelines are also applicable to the corresponding BioDiffuser product, as each of the BioDiffuser chambers have been designed to be dimensionally similar and functionally equivalent to the corresponding Infiltrator product, with the exception of the length of the units. For BioDiffuser installations, the chart in Appendix 2 should be replaced with the following:

PRODUCT	CHAMBER DIMENSIONS	CHAMBER RATING
Standard BioDiffuser	6.25' x 2.833' = 17.71 SF	29.50 SF
Bio 3	7.4' x 1.833' = 13.56 SF	22.57 SF
Bio 2	7.4' x 1.25' = 9.25 SF	15.39 SF

E. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received review delegation in writing from DEP may independently review the design and issue the permit for leaching chamber system designs approved under this listing.

7. Alternate Aggregates

A. Round Natural Aggregate and Tire Chip Aggregate

Based upon DEP's analysis of laboratory reports and other research, it has been determined that round, "Type C" coarse aggregate or tire chip aggregate may be used as an alternate material in the construction of onlot sewage disposal systems when all of the following criteria are met:

1. Third party certification is provided by an AASHTO/ASTM certified commercial soil testing laboratory demonstrating that the supplied material conforms to the specified aggregate requirements. The aggregate must meet AASHTO No. 3, 467, 5 or 57 size and grading requirements, or fall within the outer boundaries of sieve testing for each sieve size category as summarized in the table below.

2. The supplier provides written certification with the bill of lading for each first load delivered to the site, and for each aggregate type, that the aggregate meets the minimum requirements. A copy of each certification must be attached to the permit.

3. The permit application must be checked "alternate" and the words "coarse aggregate" must be placed on the line following the word "alternate."

4. No DEP review is required.

AASHTO NUMBER	TOTAL PERCENT PASSING SIEVE													
	4"	3½"	2½"	2"	1½"	1"	¾"	½"	3/8"	#4	#8	#16	#100	#200
3			100	90-100	35-70	0-15		0-5						<5
467				100	95		35-70		10-30	0-5				<5
5					100	90-100	20-55	0-10	0-5					<5
57					100	95-100		25-60		0-10	0-5			<5

B. Glass Cullet Aggregate

DEP has determined that coarse aggregate composed of cullet glass may be used as an alternate material in the construction of free-access intermittent sand filters (Chapter 73, Section 73.162(b)) as a replacement for the aggregate specified in Section 73.162(b)(4)(iv), as a replacement for the coarse aggregate specified in Part 4, "Free Access Gravity Sand Filter Options," B.5.d. of this guidance, or as a replacement for the pea gravel specified in Part 14, "A/B Soil System," B. Recirculating Subsurface Sand Filter, 3.a.4 of this guidance when all of the following criteria are met:

1. Third party certification is provided by an AASHTO/ASTM certified commercial soil testing laboratory demonstrating that the supplied material conforms to the specified aggregate requirements. The aggregate must meet AASHTO No. 8 size and grading requirements as summarized in the table below.

2. The supplier provides written certification with the bill of lading for each first load delivered to the site that the aggregate meets the minimum requirements. A copy of the certification must be attached to the permit.

3. The permit application must be checked "alternate" and the words "coarse aggregate" must be placed on the line following the word "alternate."

4. No DEP review is required.

AASHTO #8							
	Total Percent Passing						
Sieve	**1/2"**	**3/8"**	**#4**	**#8**	**#16**	**#100**	**#200**
	100	85-100	10-30	0-10	0-5		<5

C. Alternate Fine Aggregate (Sand)

Recycled glass fine aggregate prepared to meet the regulatory size and grading specifications for fine aggregate has been found to be an acceptable alternate material for use in place of conventional fine aggregate in onlot sewage treatment facilities.

In system designs that do not have a regulatory requirement for the material to be obtained from a Pennsylvania Department of Transportation (PADOT) certified stockpile (intermittent sand filter - §73.162(b)(2)(i) and (ii); free access sand filter (Part 4 of this guidance); recirculating sand filter (Part 14 of this guidance)), ground recycled glass that meets the referenced size and grading specifications may be used as a direct replacement for fine aggregate.

In system designs that have a regulatory requirement for the material to be obtained from a PADOT certified stockpile (elevated sand mounds and buried sand filters - §73.55(c)), recycled glass fine aggregate may be used without being obtained from a PADOT certified stockpile when:

1. Third party certification is provided by an AASHTO/ASTM certified commercial soil testing laboratory demonstrating that the supplied material conforms to the specified aggregate requirements. The aggregate must meet the size and grading requirements of one of the following fine aggregate categories, as summarized in the table below: Cement Concrete Sand Type A, Bituminous Concrete Sand Type B #1, Bituminous Concrete Sand Type B #3, or ASTM C-33.

2. The supplier provides written certification with the bill of lading for each first load delivered to the site, and for each different aggregate type for which crushed recycled glass is used. A copy of each certification must be attached to the permit.

3. The permit application must be checked "alternate" and the words "Fine aggregate" must be placed on the line following the word "alternate."

4. Suppliers of crushed glass must maintain third party certification records indicating that their stockpile(s) conforms to each aggregate/type requirements for which their crushed recycled glass is being supplied. In some cases, this may require that the suppliers take measures to prevent loss of fines, or the segregation

of aggregates by natural forces, or to protect against other deleterious changes to the stockpile. At a minimum, random triplicate samples must be collected and tested from each stockpile on a quarterly basis. The records must be maintained for a minimum of five years.

5. No DEP review is required.

FINE AGGREGATE Grading and Quality Requirements				
(Mass Material Percent, Passing) Sieve	**Cement Concrete Sand Type A**	**Bituminous Concrete Sand Type B**		**ASTM C-33**
		#1	**#3**	
3/8”	100	100	100	100
No. 4	95-100	95-100	80-100	95-100
No. 8	70-100	70-100	65-100	80-100
No. 16	45-80	40-80	40-80	50-85
No. 30	30-65	20-65	20-65	25-60
No. 50	10-30	7-40	7-40	5-30
No. 100	2-10	2-20	2-20	0-10
No. 200	-	0-10	0-10	-
Material Finer Than No. 200 Sieve Max. Percent Passing	3	-	-	3

8. Greywater Systems

The treatment of greywater requires the same methods of sewage disposal used in soil-based onlot disposal systems. Occasionally, the applicant may wish to separate "blackwater" (domestic human waste) from "greywater" (washwater, etc.) in order to reduce the amount of absorption area needed. The use of "blackwater" treatment systems such as composting, chemical, recycling and incinerating toilets or privies (proposed in conjunction with water under pressure), must meet the following conditions for the treatment of greywater:

A. An onlot system meeting Chapter 73 standards or other approved method of sewage disposal must be installed to treat greywater flow from the structure. Septic tank installations must consist of either a two-compartment rectangular tank or two rectangular tanks in series and must be in conformance with Chapter 73, Section 73.31. Aerobic tanks used must be in compliance with Chapter 73, Section 73.32.

B. Only the absorption area may be reduced by up to 40 percent as a compensation for the use of a non-flush toilet alternative. No reduction of septic tank sizing is allowed.

C. If planning is required, general soil and site suitability must be conducted in accordance with Chapter 71, Section 71.62.

D. When a blackwater treatment system is proposed for use in conjunction with a greywater system in a subdivision, the provisions of Chapter 71, Section 71.63(f)(1) apply, i.e., the site and soil suitability testing must be sufficient to document the availability of an area for a full-sized system.

E. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received review delegation in writing from DEP may independently review the design and issue the permit for systems approved under this listing.

9. At-Grade Bed Systems

A. The following standards are required for the siting of these systems:

1. Evaluation of the soil profile must show that there is greater than or equal to 48 inches of suitable soil as described in Chapter 73, except as may be otherwise specified in other listings in this *Alternate Systems Guidance*.

2. The percolation rate must be between 3 and 180 min/in.

3. The slope of the installation site must be less than or equal to 12 percent.

4. Construction of this system must comply with Chapter 73, Section 73.51.

5. The percolation tests must be conducted in accordance with Chapter 73, Section 73.15 and the absorption area must be sized in accordance with the requirements of Section 73.16(c) (Table A), using the column under "Subsurface Sand Filters and Elevated Sand Mounds." No size reduction is permitted for use of an aerobic tank.

B. The following standards are required:

1. An at-grade system may be used for single-family residential proposals or other facilities with typical domestic wastewater flow characteristics. Placing absorption areas hydraulically upgradient or downgradient from each other (known as "stacking") is prohibited.

2. Septic tank installations must consist of either a two-compartment rectangular tank or two rectangular tanks in series and must be in conformance with Chapter 73, Section 73.31. Aerobic tanks must be in compliance with Chapter 73, Section 73.32.

3. A minimum of a total of 10 inches of coarse aggregate meeting the requirements of Chapter 73, Section 73.51(a) or Part 7 of this *Alternate Systems Guidance* must be used. The absorption area shall be constructed in accordance with one of the two following options, at the discretion of the designer. Diagrams of both options may be found in Appendix 3.

a. Aggregate shall be placed over the laterals to a uniform depth of 2 inches. Aggregate shall be placed beneath the laterals on contour to a uniform depth throughout the absorption area. The laterals shall be designed in accordance with Chapter 73, Section 73.44(d). The upslope laterals shall be placed 1 foot from the upper edge of the aggregate. The downslope laterals shall be placed 6 feet from the downslope edge of the aggregate. There is no minimum distance between the upslope and downslope laterals. All laterals must terminate 2 to 5 feet from the ends of the aggregate. The design shall include a 3-foot subsoil berm around the ends

and downslope side of the aggregate area in addition to the berm described in #5, below. A 2:1 slope shall be maintained on the subsoil berm.

- OR -

b. The laterals shall be installed level and spaced evenly over the absorption area. Aggregate shall be placed over the laterals to a uniform depth of 2 inches. Sufficient aggregate shall be placed beneath the laterals so that they are level.

4. A 2:1 aggregate slope shall be maintained on all sides of the aggregate.

5. Berms shall meet the requirements of Chapter 73, Sections 73.55(b)(7) and 73.55(d)(3). The cover over the aggregate shall be 8 to 12 inches of soil suitable for the growth of vegetation and shall be seeded to assure the stability of the berm.

6. A minimum 4:1 length to width ratio shall be used for all bed configurations.

7. The system must use a pressure-dosed distribution system.

8. Lateral end cleanouts are required.

9. The surface shall be chisel plowed across the slope, including the area under the berm, as described in Chapter 73, Section 73.55(b)(2).

10. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received review delegation in writing from DEP may independently review the design and issue the permit for alternate at-grade system designs approved under this listing.

10. Modified Subsurface Sand Filter for Fast Percolation, Shallow Bedrock Sites with No Water Table Present

The following standards are required:

A. The site must have a percolation rate of less than 3.0 min/in. as determined by a percolation test conducted between 12 and 36 inches from the soil surface. Limiting zones other than excessively permeable rock or gravel layers may not occur within 72 inches of the soil surface.

B. The soil analysis must indicate a lower horizon at least 20 inches thick with sufficient fines present to support an acceptable percolation rate. The top of this horizon must occur at a depth greater than or equal to 36 and less than or equal to 60 inches from the soil surface.

C. A percolation test conducted at a depth between 36 and 60 inches from the soil surface must result in an average percolation rate between 3.0 and 180 min/in. The material in the horizon with a percolation rate less than 3.0 min/in. must be excavated and replaced with sand meeting the specifications outlined in Chapter 73, Section 73.55(c).

D. The maximum depth of excavation shall be 5 feet.

E. The total depth of sand and the suitable soil horizon must be equal to or greater than 48 inches.

F. A minimum of 12 inches of sand shall be used in every instance.

G. Sufficient sand must be provided so the bottom of the aggregate is within 36 inches of the soil surface.

H. The entire absorption area must be surrounded by a 4-foot perimeter of sand material not containing any part of the aggregate bed. The lateral system shall not extend into the 4-foot perimeter.

I. The design of the bed shall meet the specifications of Chapter 73, Sections 73.52 and 73.53, except for the addition of the width requirement in “H” above (where applicable).

J. An application rate of 1.50 square feet per gallon shall be used to determine total absorption area required for an in-ground system where the average percolation rate falls between 3.0 and 6.0 min/in. Sites with a percolation rate of over 6.0 min/in. for the percolation test conducted between 36 and 60 inches from the soil surface shall use elevated sand mound application rates.

K. Construction using trench configuration is not acceptable.

L. Septic tank installations must consist of either a two-compartment rectangular tank or two rectangular tanks in series and must be in conformance with Chapter 73, Section 73.31. Aerobic tanks must be in compliance with Chapter 73, Section 73.32.

M. The DEP regional office must review the proposal prior to permitting by the SEO.

11. Shallow Placement Pressure Dosed System

This modification of the in-ground pressure dosed system is used on sites where a limiting zone is identified at depths greater than or equal to 58 inches. Conditions for using this system are:

A. The design and construction of these systems must comply with all of the requirements of Chapter 73 except for Section 73.52(b)(5), which relates to the depth to the bottom of the absorption area (12 to 36 inches).

B. Septic tank installations must consist of either a two-compartment rectangular tank or two rectangular tanks in series and must be in conformance with Chapter 73, Section 73.31. Aerobic tanks must be in compliance with Chapter 73, Section 73.32.

C. Pressure distribution is required.

D. The minimum aggregate depth associated with a pressure distribution system of 10 inches allows a minimum installation depth of 10 inches. Percolation testing is performed at the depth of the installation in accordance with Chapter 73, Section 73.15. For systems designed at the minimum installation depth of 10 inches, the holes should be filled to the top with water and allowed to drain until a drop of 2 inches is measured during the initial presoak. The hole is then filled with water again to achieve the 12-inch minimum initial presoak required by Section 73.15(5)(i).

E. The system must be designed and installed parallel to the contours.

F. Due to the physical relationships between limiting zones, slopes, and system widths, depths and configurations for the design of the system are critical to proper system performance and installation. Design standards are identical to those found in Appendix 4 for slopes of 20-25 percent.

G. To ensure that the minimum 48-inch vertical isolation distance between the limiting zone and the bottom of the absorption area is maintained, the following formula may be used to verify depth and maximum width of the system based on field conditions:

$$W = \frac{[LZ - (ID + 48)]\,x\,8.3}{slope\ (percent)}$$

Where:

LZ = shallowest depth to limiting zone (inches)

ID = depth to installation (inches)

W = maximum width of the system (feet) when the long axis is parallel to the contours

slope = maximum percent of slope in the area of the proposed system installation ***Note: Do not use slope as a unit. The slope is expressed as an integer in this formula (e.g., 8 percent is expressed as 8).***

H. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received review delegation in writing from DEP may independently review the design and issue the permit for alternate at-grade system designs approved under this listing.

12. Drip Irrigation System

A. Siting Requirements

1. The soils must be classified morphologically as either well drained or moderately well drained as determined by a soil scientist. Any soil scientist who is a professional member of the Pennsylvania Association of Professional Soil Scientists (PAPSS) or is a "Qualified Soil Scientist" as defined in Chapter 73, Section 73.1 is qualified to conduct the morphological evaluation necessary to site a drip irrigation system. This soil drainage classification determination and confirmation that the loading rate and horizontal linear load in Section B are met must be signed by the soil scientist and be attached to the permit application. The soil scientist who signs the soils report shall determine the number and placement of soil profile descriptions required to conduct the morphological evaluation of soils in the proposed drip zones. The profiles may be supplemented with the use of a hand auger to confirm soil conditions between profiles. Excessive disturbance of soils within the proposed drip zone must be avoided. Requirements for a minimum number of soil profiles as specified in DEP's regulations, guidance or policy regarding other onlot systems is not applicable to drip irrigation systems.

2. The slope in each drip irrigation zone must be between 0 percent and 25 percent.

3. The depth to seasonal high water table from the surface of the ground must be greater than or equal to 20 inches. Standard tubing installation depth (see C. 2) may be used on sites with seasonal high water table limiting zones. A minimum vertical isolation distance of 20 inches must be maintained between the depth of installation of drip irrigation tubing and the shallowest indication of rock that is defined as a limiting zone.

4. The site location requirements of Chapter 73, Section 73.12 and the minimum isolation distances specified in Chapter 73, Section 73.13 apply. Isolation distances must be measured from a perimeter extending two feet beyond the outermost drip tubing in a drip irrigation zone.

B. Design Requirements

Treatment/Filtration

1. Treatment tanks: Sewage must be treated using either a two-compartment rectangular septic tank or two rectangular septic tanks in series that meet the standards of Chapter 73, Section 73.31 (Standards for Septic Tanks) or with an aerobic tank that meets the standards of 73.32 (Standards for Aerobic Treatment Tanks).

2. Intermittent Sand Filtration, Peat Filter, or Aerobic Treatment Unit: Sewage must be further treated using one of the following methods:

a. a septic tank followed by an intermittent sand filter designed in accordance with Chapter 73, Section 73.162; or

b. a septic tank followed by a peat filter designed in accordance with Part 3 of this *Alternate Systems Guidance* listing; or

c. an aerobic treatment unit used in place of a septic tank without a following sand or peat filter. If this option is chosen, the specific aerobic tank proposed for use must be identified, and the application must include a letter from the drip system manufacturer stating that they have evaluated this specific tank for compatibility with their system and have accepted it for this use.

3. Final filtration must be provided by a hydraulic unit fitted with in-line disk filters meeting or exceeding the filtration efficiency achieved by the American Perc Rite system disc filters manufactured by the American Manufacturing Company, Incorporated. The filters must have an automatic backwash system. The disc filters must automatically backwash before each dose and each zone must be automatically forward flushed a minimum of each 50 cycles to clean drip tubing, maintaining a scouring velocity of 2 feet per second at the distal end of each lateral connection. Backwash from the disc filters must be returned to the first compartment of the septic tank or to the inlet of an aerobic treatment tank. The system must be equipped with a dosing tank alarm to alert the property owner of problems with the system, and a flow meter. The hydraulic unit must be protected from temperatures below freezing in accordance with the manufacturer's specifications.

Drip Irrigation Zone

1. A minimum of two zones are required for each system, with adequate flow equalization provided to accommodate time dosing of the zones.

2. The drip tubing must follow the contour of the land.

3. The loading rate must be no more than 0.34 gallons per day per lineal foot of tubing (example: sewage flow is 400 gallons per day, 400 gpd/0.34 gallons per lineal ft. = 1,176 lineal ft. of tubing/2 zones = 588 lineal ft. of tubing per zone). Sewage flows must be calculated using Chapter 73, Section 73.17.

4. The tubing must have pressure-compensating emitters every 2 feet with spacing between tubing ranging between 1 and 3 feet unless justification for different spacing is provided (such as trees, irregular topography, etc.). All emitters within the zone shall provide equal distribution between plus or minus 10 percent. This standard has been met by the American Perc Rite System only. No substitution of other drip tubing is permitted.

5. The horizontal linear load (the gallons per foot along the topographic contour) must not exceed 4.6 gallons per day as calculated on the average daily flow of the

onlot system. The average daily flow is 50 percent of the peak design flow as listed in Chapter 73, Section 73.17(a) & (b).

The horizontal linear load equals the average daily gallons per day divided by the length of the system (example: 400 gallons per day peak flow x .5 = 200 gallons per day average daily flow; horizontal linear load equals 200 gpd /43.5 ft = 4.6).

The minimum horizontal length required is the average daily flow divided by 4.6 (example: 400 gallons per day peak flow x .5 = 200 gallons per day average daily flow, topographical length required is 200 gpd /4.6 = 43.5).

Where the soils exceed the minimum criteria in 12A. above, the horizontal linear load may be increased based on the evaluation of a combination of factors including, but not limited to, increased depth over limiting zone, permeability and slope.

6. The SEO, at his discretion, may require the site plan for the drip irrigation zones to be developed by or in consultation with the manufacturer or a representative of the manufacturer of the drip irrigation system being installed.

7. On slopes greater than 5 percent, top-feed supply and return manifolds are recommended.

C. Construction

1. Soil moisture conditions must be at or below field capacity during construction. These conditions must be determined in the same way that soil moisture conditions are determined prior to beginning the construction of an elevated sand mound.

2. Drip lines must be installed below the soil surface using a vibratory plow, a standard trencher or by manual or hand installation to a maximum depth of 12 inches from the soil surface, with 6 inches being the optimum installation depth. Cable pullers must not be used. Where installation depths less than 6 inches from the soil surface are necessary due to stoniness, additional cover shall be required to provide 6 to 12 inches of cover. The addition of native on-site or imported mulch is permissible in wooded areas of passive activity with established forest litter.

3. The manufacturer's representative must be present to oversee the installation of the system. The current list of representatives is available from the manufacturer. As an alternative, contractors may attend a training course provided by the manufacturer before installing drip tubing independent of oversight by the manufacturer.

4. Installation of the drip irrigation system shall meet the specifications provided by the manufacturer.

5. Drip tubing is susceptible to freezing when sufficient turf cover is not established in non-wooded areas prior to winter operation. When turf cover will not be established prior to winter operation, other measures, such as a temporary cover of mulch or straw, should be used to insulate the tubing.

D. Operation and Maintenance

The following operation and maintenance conditions must be attached to the permit issued by the local agency:

1. The manufacturer's representative must meet with the property owner within 1 month of system start-up and/or occupancy of the dwelling and with the local agency's SEO upon request, to explain the operation and maintenance of the system and provide written instructions to the property owner that includes:

    a. Instructions on the operation and maintenance of the system.

    b. The locations of all parts of the system.

    c. A caution notice regarding disturbance of the drip zones that may cause system damage (i.e., excavation for trees, fencing, etc.).

    d. An explanation of the automatic alarm system.

    e. A statement requiring that the manufacturer's representative be contacted if the alarm system is activated.

2. The manufacturer of the drip irrigation system must provide a minimum 2-year warranty on all defects due to materials or workmanship.

The only drip irrigation system that has met the requirements for this alternate system listing to date is the American Perc Rite System, manufactured by the American Manufacturing Company, Incorporated (5517 Wellington Road, Gainesville, Virginia 20155).

All proposals for the application of drip irrigation systems that fall outside the standards established by this alternate system listing must be proposed and reviewed as experimental systems under the provisions of Chapter 73, Section 73.71.

Until the local agency's SEO has received training on drip irrigation siting, design and construction or has received review delegation in writing from DEP, all proposals for drip irrigation must be forwarded to the appropriate regional office of DEP for review and comment prior to permit issuance.

13. Steep Slope Elevated Sand Mound Beds on Slopes Between 12 and 15 percent and Percolation Rates of 3-30 Minutes per Inch

A. The following characteristics are required for the siting of this type of system:

1. Evaluation of the soil profile must show that there is greater than or equal to 20 inches of suitable soil as described in Chapter 73, Section 73.14.

2. Slopes must be greater than or equal to 12 percent and less than or equal to 15 percent at the site of the proposed installation.

3. The installation of the system must not violate the 48-inch vertical separation requirement.

4. The percolation tests must be conducted in accordance with Chapter 73, Section 73.15(3)(ii) or (iii). The absorption area must be sized in accordance with the requirements of Chapter 73, Section 73.16(c), Table A, "Subsurface Sand Filters and Elevated Sand Mounds." No size reductions are permitted for use of aerobic tanks or other system components.

B. The following standards are required:

1. Systems shall be designed and permitted to serve single-family residential proposals that do not exceed 600 gallons per day or commercial facilities with residential flow characteristics that do not exceed 600 gallons per day.

2. Septic tank installations must consist of either a two-compartment rectangular tank or two rectangular tanks in series and must be in conformance with Chapter 73, Section 73.31. Aerobic tanks must be in compliance with Chapter 73, Section 73.32.

3. Sand shall meet the requirements of Chapter 73, Section 73.55(c). The downslope sand shall be extended to a 2:1 ratio.

4. Width must not exceed 10 feet. Overall bed dimensions, length to width, must be 6:1 or greater.

5. The downslope berm shall be extended to a 4:1 ratio to improve stability.

6. A pressure distribution system is required on all designs.

7. Lateral end cleanouts are required.

8. The surface shall be chisel plowed across the slope (including the area under the berm) as described in Chapter 73, Section 73.55(b)(2).

9. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received

review delegation in writing from DEP may independently review the design and issue the permit for alternate system designs approved under this listing. All other system proposals under this listing must be submitted to the DEP regional office for review and comment.

14. A/B Soil System (ABS System)

This system consists of a septic tank(s), dosing tank, recirculating subsurface sand filter, and UV disinfection, with final treatment and disposal using an at-grade absorption area designed in accordance with Part 9 or Appendix 5. The minimum vertical isolation distance is 10 inches between the aggregate and the seasonal high water table or 16 inches between the aggregate and a rock formation.

A. Performance Standards

This system has demonstrated to the satisfaction of DEP, that it can produce an effluent equal to or better than 10 mg/L BOD_5/$CBOD_5$ and 10 mg/L TSS as monthly averages. With UV disinfection, it can also reduce fecal coliform concentrations to less than 200/100 ml. This system is approved for use on limiting zones of less than 20 inches.

B. Design Requirements

Treatment/Dose Tanks

1. Treatment tanks: Sewage must be treated using either a two-compartment rectangular tank or two rectangular tanks in series that meet the standards of Chapter 73, Section 73.31(b). An effluent filter is recommended.

2. The dose tank preceding the sand filter shall be constructed of materials meeting the specifications outlined in 73.31(b), and 73.45(4)-(6) and shall have a capacity of 500 gallons. It must be designed so that the estimated daily flow is discharged to the sand filter in two or more doses with a minimum volume of 125 gallons.

Recirculating Subsurface Sand Filter (RSSF)

The recirculating subsurface sand filter included as part of this design shall be designed as set forth below.

1. Location:

   a. An RSSF must not be installed in areas where bedrock is found at a depth less than the proposed depth of the sand filter. However, an RSSF can be installed when the seasonal high groundwater table rises above the bottom of the sand filter if a suitable synthetic liner which will prevent sewage exfiltration or groundwater infiltration is included in the design.

   b. An RSSF shall not be constructed in unsuitable fill.

2. Size:

   a. The RSSF shall be sized using the appropriate application rate of 5.2 gallons/day/square foot and the estimated peak daily sewage flow, but in no case may the sand filter be less than 150 square feet for use with a

dual-chambered septic tank with a solids retainer unit and a minimum flow of 200 gpd.

b. For a single-family residence, the minimum area for an RSSF shall be in accordance with the following table:

Number of Bedrooms	Filter Area (square feet)
3 or less	310
4	385
5	465

3. Media:

a. Gravel: At least 2 inches of clean gravel or crushed stone shall surround underdrains and distribution pipes. The gravel or crushed stone shall have the following characteristics:

(1) Type A or C characteristics as described in Pennsylvania Department of Transportation specifications, Pub. 408, Section 703.2(a) and (b).

(2) Testing under PTM No. 100 to determine the loss of materials finer than the No. 200 sieve. The loss must be less than 5 percent.

(3) Consistency with AASHTO No. 3, 467, 5 or 57 size and grading requirements. The gravel may meet the characteristics of an individual category (3, 467, 5 or 57) or fall within the outer boundaries of sieve testing for each sieve category as shown in Part 7 of this guidance.

(4) A 3-inch layer of pea gravel having AASHTO No. 8 characteristics must be placed on the top of the underdrain aggregate to help prevent migration of the sand into the aggregate.

b. Sand: At least 24 inches of clean fine aggregate must be used. The aggregate shall be consistent with Type A concrete sand as described in Pennsylvania Department of Transportation specifications, or ASTM C-33 specifications.

The sand shall not contain more than 15 percent by weight deleterious material as determined by Pennsylvania Test Method No. 510, AASHTO-104 and/or ASTM-3-88.

c. Cover Soil: A layer of geotextile material must be placed over the coarse aggregate followed by a minimum of 12 inches of cover soil material in all installations. Ponding observation ports shall be installed to the top of the coarse aggregate through the cover soil material. The cover soil over the

sand filter must consist of soil suitable for growth of vegetation, be seeded to control erosion, and be graded so that surface water will run off.

4. Underdrain Piping:

   a. Underdrain piping shall be laid on a grade of 3 to 6 inches per 100 feet, sloped to the outfall pipe. Piping shall be placed between the distribution laterals to optimize effluent travel through the filter sand.

   b. Underdrain piping holes shall be equal to or greater in number and size to the distribution piping holes. The underdrain piping shall have two rows of holes placed at approximately 45-degree angles from each other along the bottom half of the pipe.

   c. The underdrain shall be divided for a 3:1 effluent recirculation to outfall drain by an 8-inch high baffle placed under the liner and perpendicular to the long sidewall of the filter. Seventy-five percent of the effluent collected by the underdrain shall be recirculated back to the RSSF dose tank through a T-configured underdrain pipe and gravity discharge pipe. The remaining 25 percent of the RSSF effluent shall be collected by an underdrain pipe set parallel to the baffle with gravity discharge to the at-grade absorption area dose tank.

   d. Underdrain piping shall have a cleanout extended to grade at a minimum of 1 foot from the sidewall and baffle. The outfall pipes from the underdrain header shall have an anti-seep collar and a leak-proof boot sealed to the subsurface sand filter liner.

5. Filter Base and Liner:

   The base of the filter shall be sloped at a 1 percent minimum slope to the underdrain pipe. An impervious liner of hyplon, polyvinyl chloride (PVC) or polyethylene sheeting of 20 mil thickness or equal must be installed on a tamped-earth base to prevent seepage to the groundwater. A 2-inch layer of sand or a layer of 10-ounce porous geotextile material must be placed on each side of the liner to prevent punctures and tears. Seams must be made according to the liner manufacturer's specifications.

Disinfection

1. Requirements: Disinfection of the RSSF effluent prior to discharge to the absorption area is required. This disinfection must be achieved by means of ultraviolet (UV) light emitting equipment designed as described below. No other means of disinfection (such as chlorination) may be used, as it is essential to prevent negative effects on soil bacteria in the absorption area that may be caused by residual effects of disinfection.

2. Ultraviolet Radiation Equipment:

   a. Ultraviolet radiation at a level of 254 nanometers must be applied at a minimum dosage of 25,000 microwatt-seconds per square centimeter at all points throughout the water disinfection chamber. However, a higher dosage may be required based on the specific transmittance of the wastewater. In lieu of determining the specific transmittance level of the wastewater, a dosage of 30,000 to 35,000 microwatt-seconds per square centimeter should be provided.

   b. The maximum water depth in the chamber, measured from the tube surface to the chamber wall, shall not exceed 3 inches.

   c. The ultraviolet tubes shall be jacketed so that a proper operating tube temperature of about 104°F is maintained. The jacket shall be made of quartz or high-silica glass with similar optical characteristics.

   d. The units shall be designed to permit frequent mechanical cleaning of the water contact surface of the jacket without disassembly of the unit.

   e. An automatic flow control valve, accurate within the expected pressure range, shall be installed to restrict flow to the maximum design flow of the treatment unit.

   f. Ultraviolet tubes must be replaced at least annually. To ensure that appropriate UV dose levels are maintained, a warning alarm must be installed to ensure prompt replacement of a burned-out tube. To ensure continued optical performance of the unit, an accurately calibrated ultraviolet intensity meter, properly filtered to restrict its sensitivity to the point of the disinfection spectrum, may also be installed in the wall of the disinfection chamber at the point of greatest water depth from the tube.

   g. A spare UV tube and other necessary equipment must be available to allow prompt repair of the UV unit by qualified personnel instructed in the operation and maintenance of the equipment.

Distribution

1. The design and construction shall comply with the requirements of Chapter 73, Sections 73.51, relating to construction of absorption areas, and Sections 73.44 and 73.45, relating to pressure distribution and dose tanks.

2. The slope of the installation site must be less than or equal to 12 percent.

3. The specifications of At-Grade Bed Systems - Section B of Part 9 of this guidance apply.

4. Lateral cleanouts and at least one ponding observation port are required.

C. Siting Requirements

1. For at-grade systems on sites with limiting zones of **20 inches or more**, refer to Part 9 of this guidance.

2. Where the system is proposed for installation on sites with soils having limiting zones **within 20 inches** of the mineral soil surface, the siting and distribution system design shall be based upon the Hydraulic Linear Loading Rate (HLLR) table in Appendix 5 of this document. A soil scientist who is a professional member of the Pennsylvania Association of Professional Soil Scientists (PAPSS) or is a "Qualified Soil Scientist" as defined in Chapter 73 of DEP's regulations must conduct the necessary morphological evaluation. A report regarding the soil drainage classification determination, and confirmation that the appropriate loading rate and horizontal linear load from the HLLR table are met, must be signed by the soil scientist. The following procedure must be used:

   a. A minimum of four soil profile test pits shall be evaluated to verify the morphology of the proposed absorption site. These soil profiles shall include:

      (1) Two soil profile evaluations on contour, bracketing the proposed absorption area.

      (2) Two soil profile evaluations on contour, 50 feet downgradient from the absorption area.

   b. The on-contour spacing of the soil profile evaluations in B.2.a) shall not exceed 100 feet in length.

   c. In cases where the calculated aggregate area length exceeds 100 feet, additional test pit evaluations are required to verify the soil morphology of both the absorption area and the downgradient area.

   d. Overall site suitability will be limited by the most restrictive depth to the seasonal high water table, depth to rock formation and soil morphology from all of the soil test pits evaluated.

   e. At a minimum, the vertical distance must be greater than or equal to 10 inches to the seasonal high water table and must be greater than or equal to 16 inches to rock formation. In addition, the soil must have a consistency of very firm or less to be suitable.

   f. Distribution of the effluent in the absorption area will be determined by the soil profile evaluations and the vertical depth between the bottom of the aggregate and the top of the seasonal high water table or rock formation.

g. The loading rate (required to calculate aggregate area square footage) and hydraulic loading rate (required to calculate aggregate area length) shall be determined with the HLLR table by using the more restrictive results from the soil profile evaluations conducted for B.2.a). The shape and grade of structure, as well as textural classification of the mineral soil from the profile horizon above the seasonal high water table or restrictive horizon is used to determine these rates.

D. Operation, Maintenance and Monitoring

1. ABS systems require periodic operation, maintenance and monitoring, as described in Chapter 72, Section 72.25(h) (relating to operation, maintenance and monitoring for Individual Residential Spray Irrigation Systems (IRSIS)). The maintenance entity established under Section 72.25(h) shall submit to the local agency laboratory test results of monitoring of the effluent quality for CBOD, TSS, and fecal coliform/100 ml. The sample should be taken following the disinfection unit. At least annually, a copy of the test results, along with the most recent inspection of the system by the maintenance entity established under Chapter 72, Section 72.25(h), shall be sent to the local agency.

2. Minimum required operation, maintenance and monitoring standards:

a. Septic tanks, dose tanks and recirculating sand filters shall be inspected every 6 months for structural integrity, inlet and outlet baffles, electrical connections, operation of pumps and inspection of the RSSF for ponding.

b. UV equipment must be inspected for operational effectiveness by checking UV tubes and alarms every 6 months. A qualified technician must determine if the unit meets or exceeds the published minimum standards in this listing. Additionally, the UV tube must be replaced if it is found to be necessary during the inspection or at least annually. The quartz sleeve needs to be mechanically cleaned by the property owner monthly.

c. The absorption area must be inspected every 6 months for ponding of effluent at the observation ports and any downgradient seepage.

3. An SEO who has successfully completed the appropriate DEP-sponsored continuing education course that included this specific technology or has received review delegation in writing from DEP may independently review the design and issue the permit for designs approved under this listing. All other system proposals under this listing must be submitted to DEP's regional office for review and comment.

15. Non-Infiltration, Evapotranspiration Bed Contained Within a Greenhouse

This technology consists of low flow plumbing fixtures inside the home, an aerobic treatment tank, and specially modified passive solar greenhouse beds where the wastewater is eliminated through the process of evapotranspiration. These systems are often used where site limitations, such as shallow depth to seasonal high water table or excessive slope, make use of other soil-based absorption systems difficult. The minimum requirements are as follows:

A. Design and installation must follow the manufacturer's specifications.

B. The bed must be contained in an enclosed, walled structure (usually cinder blocks) and insulated on the exterior to avoid contact with frozen ground. The bed must be lined to retain all effluent and avoid infiltration with the underlying soil.

C The bed must be sectionalized with a series of valves that control effluent flow to each section proportional to the evapotranspiration potential of the season.

D. Temperature controls and humidity exchangers must be used to maintain the proper internal environment necessary to reach optimal evapotranspiration potential.

E. The system must comply with Sections 73.72(d)(3) and 73.72(e) as part of the application process.

F. These systems require regularly scheduled maintenance and monitoring to insure the long-term reliability of their performance. The SEO should include all operation and maintenance requirements on the permit application.

G. It is the responsibility of the SEO to ensure that all components of the systems have been installed in compliance with the above conditions.

H. DEP's regional office must review the proposal prior to permitting by the SEO. If requested by the regional office, central office will also provide comments.

Systems Approved Under This Listing:

The only non-infiltration, evapotranspiration bed system currently meeting the alternate system standards is the Sundrive Biovaporator Solar Greenhouse Evapotranspiration Wastewater Disposal System marketed by Sundrive, Inc., 60 Sherman Road, Ottsville, PA 18942.

APPENDIX 1

System Summary
Alternate Systems*

SYSTEM	SITING CRITERIA	
Peat Based Systems		
Peat Based System Limiting Zone ≥ 20 Inches Option 1	**Depth to Rock**	≥ 20 inches
	Depth to Water Table	≥ 20 inches
	Slope	0 - 12 percent
	Percolation Rates	3 - 180 min/in.
	Other	May reduce size of absorption area by up to 40 percent with perc rate up to 60 min/in.
Peat Based System Limiting Zone < 20 Inches Option 1	**Depth to Rock**	≥ 16 inches
	Depth to Water Table	≥ 10 inches
	Slope	0 - 12 percent
	Percolation Rates	None - Soil morphological testing.
	Other	Need soil scientist to evaluate soils and provide design criteria.
	Disinfection	UV Disinfection Required.
Peat Based System Option 2 (IRSIS)	**Depth to Rock**	≥ 16 inches
	Depth to Water Table	≥ 10 inches
	Slope	0 - 25 percent
	Percolation Rates	None
	Other	Use in place of sand filter in IRSIS.
Peat Based System Limiting Zone ≥ 72 Inches Option 3	**Depth to Rock**	≥ 72 inches
	Depth to Water Table	≥ 72 inches
	Slope	0 - 12 percent
	Percolation Rates	> 90 min/in. @ 12 - 36 inches 3 - 90 min/in. @ 36 - 60 inches
	Other	For use in place of 12 inches of sand in a subsurface sand filter.
Free Access Gravity Sand Filter (with options other than IRSIS)	**Depth to Rock**	≥ 20 inches
	Depth to Water Table	≥ 20 inches
	Slope	0 - 25 percent
	Percolation Rates	3 - 180 min/in.
Free Access Gravity Sand filter (with IRSIS)	**Depth to Rock**	≥ 16 inches
	Depth to Water Table	≥ 10 inches
	Slope	0 - 25 percent
	Percolation Rates	none
CO-OP RFS III Limiting Zone ≥ 20 Inches	**Depth to Rock**	≥ 20 inches
	Depth to Water Table	≥ 20 inches
	Slope	0 - 25 percent
	Percolation Rates	3 - 180 min/in.
	Disinfection	UV Disinfection required.

*Refer to complete listing for specific conditions related to each system.

System Summary
Alternate Systems*

(Continued)

SYSTEM	SITING CRITERIA	
CO-OP RFS III Limiting Zone < 20 Inches	**Depth to Rock**	≥ 16 inches
	Depth to Water Table	≥ 10 inches
	Slope	0 - 12 percent
	Percolation Rates	None - Soil morphological testing.
	Other	Need soil scientist to evaluate soils and provide design criteria.
	Disinfection	UV Disinfection required.
CO-OP RFS III System (with IRSIS)	**Depth to Rock**	≥ 16 inches
	Depth to Water Table	≥ 10 inches
	Slope	0 - 25 percent
	Percolation Rates	none
At-grade Bed System	**Depth to Rock**	≥ 48 inches
	Depth to Water Table	≥ 48 inches
	Slope	0 - 12 percent
	Percolation Rates	3 - 180 min/in.
	Other	Design may be modified based on application (see specific listings).
Modified Subsurface Sand Filter for Fast Percolation Shallow Bedrock Sites with No Water Table Present	**Soil Depth**	≥ 72 inches and additional criteria
	Slope	≤ 8 percent
	Percolation Rates	< 3 min/in. at 12 - 36 inches 3 - 180 min/in. at 36 - 60 inches
Shallow Placement Pressure Dosed Systems	**Depth to Rock**	≥ 58 inches
	Depth to Water Table	≥ 58 inches
	Slope	0 - 25 percent
	Percolation Rates	3 - 180 min/in.
Drip Irrigation System	**Depth to Rock**	≥ 20 inches
	Depth to Water Table	≥ 20 inches
	Slope	0 - 25 percent
	Percolation Rates	None unless soil scientist requests
	Other	Need soil scientist to evaluate soils and provide design criteria.
Steep Slope ESM (Slope 12 - 15%, Perc Rate 3 - 30 min/in.)	**Depth to Rock**	≥ 20 inches
	Depth to Water Table	≥ 20 inches
	Slope	≥ 12 percent and ≤ 15 percent
	Percolation Rates	3 - 30 min/in.
	Other	≤ 600 gpd

*Refer to complete listing for specific conditions related to each system.

System Summary
Alternate Systems*

(Continued)

SYSTEM	SITING CRITERIA	
A/B Soil System Limiting Zone ≥ 20 Inches	**Depth to Rock**	≥ 20 inches
	Depth to Water Table	≥ 20 inches
	Slope	≤ 12 percent
	Percolation Rates	3 - 180 min/in.
	Other	Conditions dependent on final treatment option chosen.
A/B Soil System Limiting Zone < 20 Inches	**Depth to Rock**	≥ 16 inches
	Depth to Water Table	≥ 10 inches
	Slope	0 - 12 percent
	Percolation Rates	None - Soil morphological testing.
	Other	Need soil scientist to evaluate soils and provide design criteria.
	Disinfection	UV Disinfection required.
Non-Infiltration, Evapotranspiration Bed Contained Within a Greenhouse	**Depth to Rock**	Any - Non-soil-based System
	Depth to Water Table	Any - Non-soil-based System
	Slope	Any - Non-soil-based System
	Percolation Rate	Any - Non-soil-based System

*Refer to complete listing for specific conditions related to each system.

APPENDIX 2

Infiltrator Systems Inc.
Pennsylvania Chamber Design Guidelines

DEP has asked Infiltrator Systems, Inc. (ISI) to provide recommended guidelines for use for Infiltrator leaching chambers. ISI spent the last year training designers and installers in the particulars of chamber design and installation. In return, the wastewater community provided much insight into ways ISI could make chamber use simpler for the industry and provide the citizens of Pennsylvania with superior on-site systems. The following guidelines incorporate a year's worth of statewide learning for ISI. We thank all of those individuals who participated in our training.

The trained regulator, designer, or installer will notice obvious deviations to Chapter 73 code when reviewing the following requirements for Infiltrator chamber use. Please note that Chapter 73 was not written with consideration for use of chamber systems. Therefore some deviations (defined in this guideline) from Chapter 73 are allowed.

The primary reason for many of the differences between Chapter 73 and the Infiltrator chamber use guidelines is the dimension of each chamber product. Designs with Infiltrator chamber products are limited to the dimensional area that the selected chamber occupies. For example: designs incorporating the Standard Sidewinder chamber must be designed in length increments of 6.25'. This creates a deviation from Chapter 73 in respect to lateral lengths in pressurized systems.

The dimension of each product is fixed. Disturbing the integrity of any of the Infiltrator chamber products will void the product warranty. This means no cutting, drilling or otherwise damaging a chamber is allowed. Endplates may be drilled according to ISI installation guidelines to accept pressurized distribution pipe.

The following set of guidelines describes efficient methods for chamber use and outlines techniques that allow for the proper design, review, installation, and inspection of Infiltrator chamber systems.

Design Guidelines

System sizing

Chamber sizing for the purpose of calculating the number of chambers for a given onlot sewage disposal system is based on the dimensions of the selected Infiltrator Systems product chosen. The allowable chamber absorption area ratings (chamber ratings) are calculated by taking the chamber's bottom area and dividing it by 0.60 to account for the allowable 40 percent reduction in bottom area.

The following list displays the different chamber dimensions and calculated chamber ratings.

PRODUCT	CHAMBER DIMENSIONS	CHAMBER RATING
Standard Infiltrator	6.25' x 2.833' = 17.71 SF	29.50 SF
Quick 4 Standard	4.0' x 2.833' = 11.33 SF	18.88 SF
Standard Sidewinder	6.25' x 2.833' = 17.71 SF	29.50 SF
Equalizer 36	8.333' x 1.833' = 15.27 SF	25.45 SF
Equalizer 24	8.333' x 1.25' = 10.41 SF	17.35 SF

The following method should be used when sizing onlot sewage disposal designs in Pennsylvania incorporating Infiltrator chambers:

- Calculate the square footage of absorption area per Chapter 73 requirements.
  Example: 600 SF

- Divide the required absorption area by the appropriate chamber rating. Example using Standard Chambers: 600 SF divided by 29.50 = 20.34 chambers.

- Round up calculated quantity of chambers to next whole number.
  Example: Use 21 chambers for design.

- Calculate absorption area provided by multiplying chamber rating by number of chambers.
  Example: 21 x 29.50 = **619.50 sf**

System Layout and Design Specifics

Standard Trenches

Trenches utilizing chambers should be laid out in the same manner as a gravel trench. Separation distances for trenches and isolation distances from property lines, wells, tanks, and distribution boxes remain the same as required for gravel in Chapter 73.

Side-by-side combinations of chambers may be used. Two standard chambers may be placed side-by-side in a 6-foot wide trench. Two Equalizer 24 chambers may be placed side-by-side to provide the same allowable absorption area as a 4-foot wide trench. Each row of chambers shall be connected directly to the distribution box. When using a side-by-side combination of different width chambers, place the narrower chamber on the uphill side of the trench. Multiple trenches must all be the same length.

A single row of the Equalizer 36 chamber will provide for a narrower system when compared to stone. The Equalizer 24 chamber will allow for even narrower trenches. This may be of benefit on steep sites.

Shallow placement trench depth shall be a minimum of 12 inches on the downslope side of the trench for all Infiltrator chamber styles.

Effluent may be distributed to Infiltrator chambers by either gravity flow or pressurized flow in accordance with the requirements of Chapter 73.

Designs with Infiltrator chambers must address two points not considered in Chapter 73. First, distribution laterals must be supported from the top of the chamber with 120 lb. tensile strength all weather nylon straps. Second, laterals must enter from a manifold through an endplate, continue all through the length of the chamber run and exit the chamber void through the terminal endplate.

Example:

Ten standard chambers equal a length of 62.5'. The lateral length for these ten chambers would need to be at least 63'. The lateral would be supported at both ends by an endplate. A cap or cleanout at the end of the lateral will be supported by earth.

When using Infiltrator chambers it is not necessary to conform to orifice spacing standards established by 73.44(c)(8). Orifice hole sizing and equivalent flow standards shall be as required in Chapter 73.

The requirement of the last spray orifice being placed at the end of the lateral is not possible for Infiltrator chambers. Therefore, continue the lateral beyond the last orifice to the end of the chamber run. This extra pipe length does not add to the piping systems friction loss and therefore need not be calculated into the system's lateral length.

All spray orifices should spray up at 12 o'clock position except in systems using a siphon. This configuration allows for the effluent to spray into the top of the chamber creating droplets that will rain down onto the absorption interface. If the spray orifices faced downward the stream of effluent could scour and disturb the interface. For systems using a siphon the first spray orifice from the manifold in each lateral must face down at a 6 o'clock position. A minimum 1' x 1' paving brick must be placed and centered directly beneath all orifices facing 6 o'clock.

Laterals should be suspended from the top of the chamber with a 120-pound tensile strength all weather nylon cable tie (Denison # 10606 meeting Military Standard 3367-3-9 or equal). Laterals should extend the entire length of the chamber run and out both endplates. Both ends of the laterals should be secured in earth.

Orifice flow may be inspected by observing flow on the sand surface as it exits the chamber and by looking through chamber louvers.

Bed Systems

There are two primary considerations when using chambers in bed systems: chamber spacing and effluent distribution.

The recommended chamber edge-to-edge separation in seepage beds is 0 to 6 inches.

Gravity or pressurized flow can be used for bed systems. Designs must follow the guidelines described above for standard trenches.

Elevated Sand Mound (ESM)

The reduction in area allowed when using Infiltrator chambers pertains only to the absorption area directly beneath the chamber. Although the sidewall area in a sand mound designed with Infiltrator chambers is utilized, no absorption area credit is given for it. Use the above chamber ratings to properly size systems. Only the Standard Infiltrator chamber is appropriate for use in an ESM.

Laying out chambers for an ESM can be accomplished by considering primary dimensions. The first is the chamber's length (6.25'). The second dimension was created to separate the chambers on top of an

ESM to create a trench-like environment. Laterals should be spaced a minimum of 3.33' from center to center. This provides a chamber edge-to-edge separation of 6" and allows for absorption and treatment activity at the side wall interface. The area between the chambers is not included in calculating absorption area. This means a sand mound cannot be reduced in overall area by 40 percent. Rather, a typical sand mound using the allowable chamber ratings provides closer to a 25 percent reduction in the overall property usage.

The minimum bed width for an ESM is 10'. This is accomplished by designing a system three Infiltrator chambers wide. Use a 3.33' lateral separation dimension. Refer to the typical sand mound cross section for Infiltrator chambers. Place a 3-inch "lip" of sand at the outside edge of the outermost chambers in order to insure that chambers rest completely on a stable sand surface.

Sand placement for Infiltrator chambers is different than sand placement for gravel systems. The sand specification is the same. Placing the sand for chambers requires compaction of the sand to provide a stable base for the chambers. The two methods outlined in the installation instructions provide for this requirement. Both methods require that sand be placed in 12-inch lifts and compacted by running equipment (tracks or tires) over the sand surface. Water may be added to aid in compaction. Proper compaction of the sand is the responsibility of the installer.

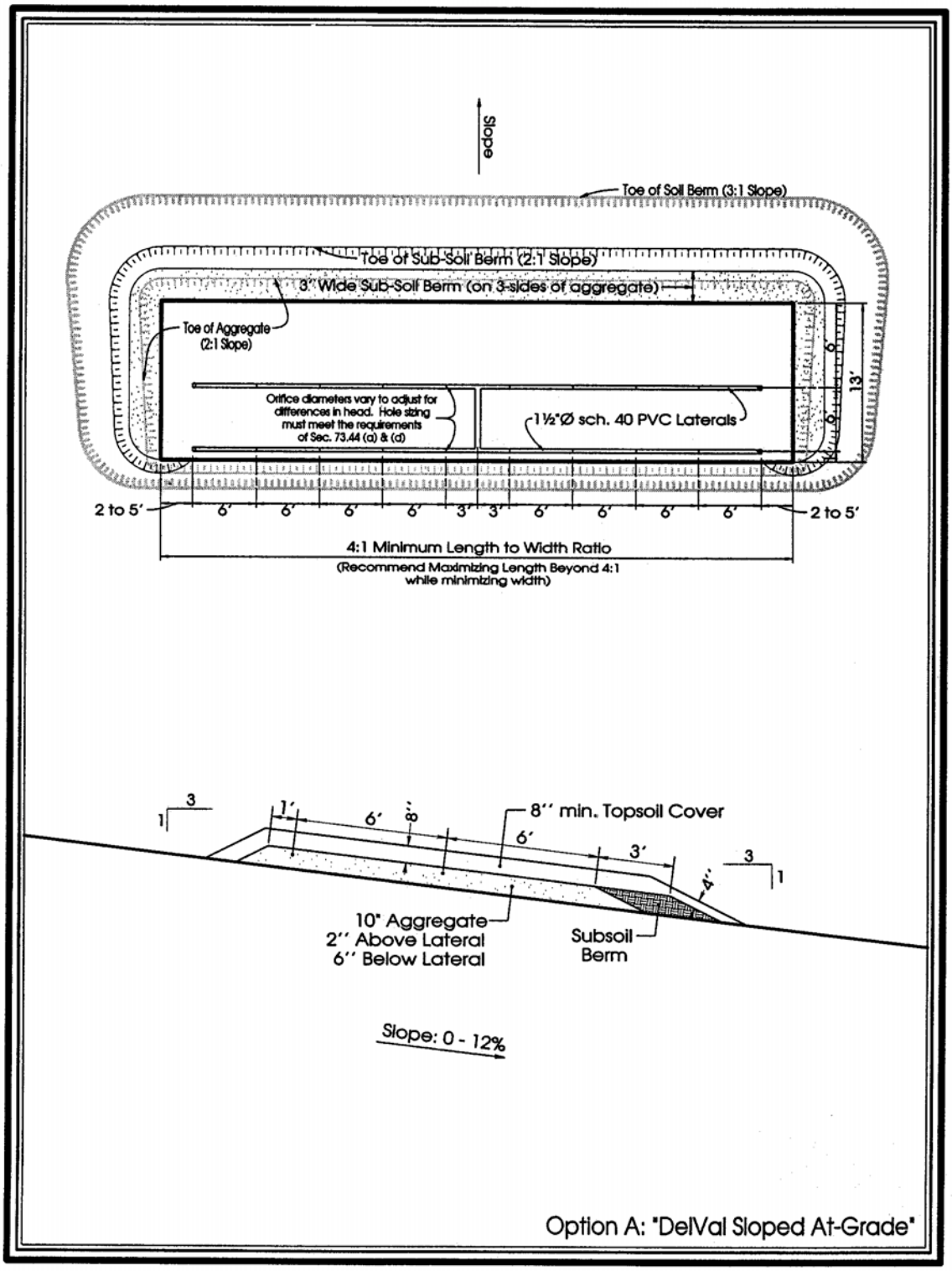
Pressurization requirements for Infiltrator chambers in sand mounds are the same as described in the previous section on standard trenches.

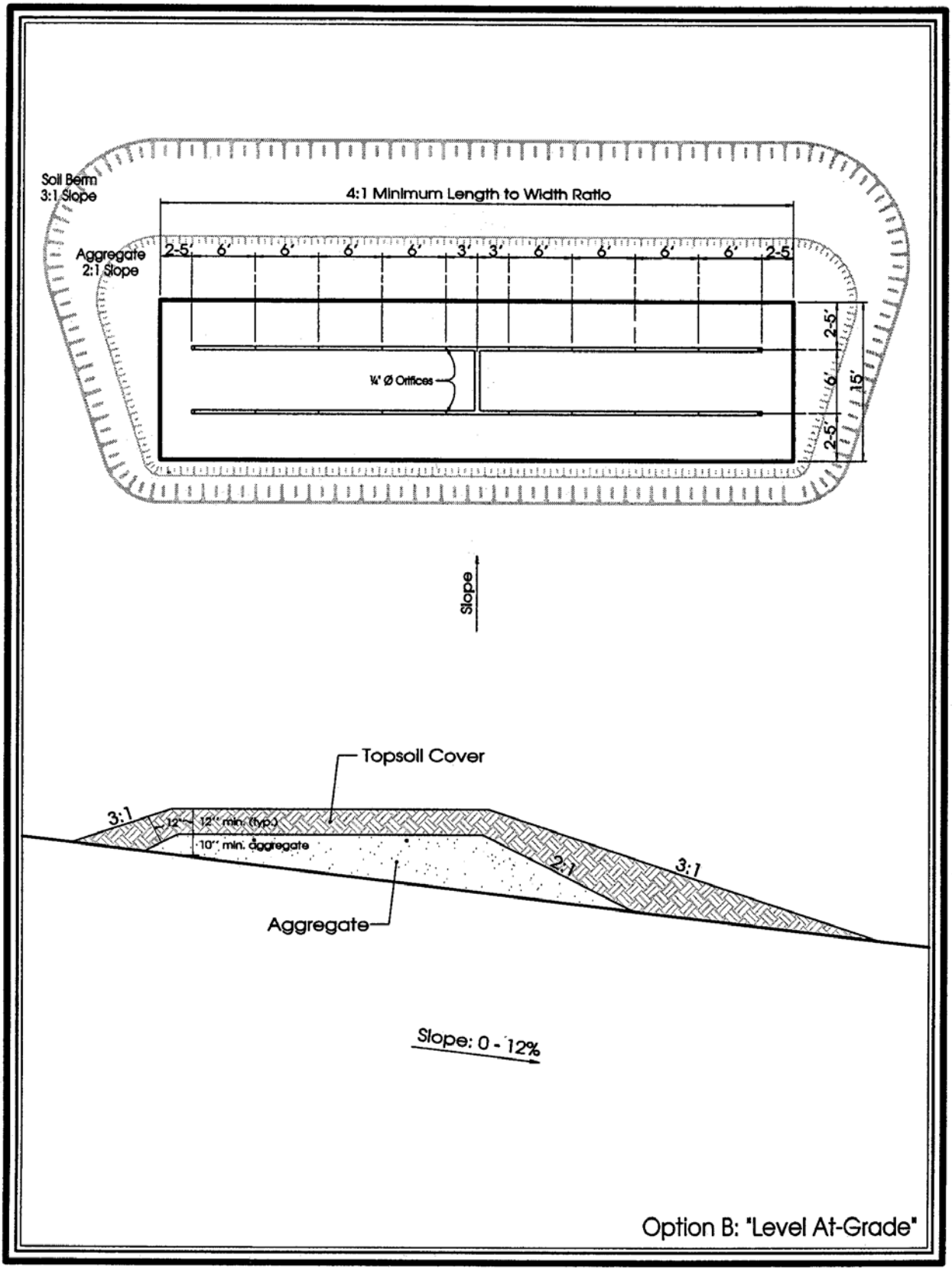
Installation of Chambers

Chambers shall be installed per manufacturer's guidelines. Fill sidewall area to top of slots with suitable native soil. Walk fill into place to give proper support of chamber sides. No hay or filter fabric should be used.

APPENDIX 3

At-Grade Bed System Diagrams




Soil Berm
3:1 Slope
4:1 Minimum Length to Width Ratio
Aggregate
2:1 Slope
2-5'
6'
6'
6'
6'
3'
3'
6'
6'
6'
6'
2-5'
¼" Ø Orifices
2-5'
6'
2-5'
15'
Slope
Topsoil Cover
3:1
12" min. (typ.)
10" min. aggregate
2:1
3:1
Aggregate
Slope: 0 - 12%
Option B: "Level At-Grade"

APPENDIX 4

Trenches on Slopes of 20 to 25 Percent

Precise placement of trenches, length of trenches and, in particular, the upslope and downslope depth of trenches must be evaluated to ensure that each trench has equal absorption area and that each trench's width and depth is in accordance with the following restrictions:

1. Minimum downslope excavation - 12 inches.

2. Maximum upslope excavation - 36 inches. The depth may not be within 48 inches of any limiting zone identified by the SEO. The effect of the slope on the limiting zone must be calculated.

3. Trench width may be no less than 1 foot, no more than 6 feet and must be determined based on depth to limiting zone.

PLOT PLAN AND DESIGN PREPARATION

1. Include all features typically required on the sewage permit application form.

2. Show the location of all soil tests conducted (both suitable and unsuitable).

3. Identify the location of all design elements (septic tank, manifold, delivery line, friction loss calculation, pump requirements, etc.) from a fixed reference point.

4. Provide site contour lines at 1 foot intervals in the area of the disposal system.

5. Show the location of each trench including its dimensions. The diagram should show the trench configuration required by the site contours. The elevation from an established benchmark must be shown for the downslope and upslope excavation of each trench.

6. Include a typical trench cross-section diagram.

7. Provide information on proper installation practices as found in Chapter 73. Detailed construction guidelines regarding type of construction equipment to be used, placement of backfill, sequence of trench construction and any other installation features specific to the needs of the site are to be included.

ON-SITE MARKINGS

Mark the location of all design elements with stakes or flags. Two rows of stakes should outline each trench and should be close enough to show any changes of direction needed to follow the contours. At the beginning and end of each trench, the ground surface elevation in relation to the established benchmark should be marked, as well as precise trench downslope and upslope depths.

APPENDIX 5

Hydraulic Linear Loading Rate Table

Soil Characteristics			Infiltration Loading Rate, gal/ft²/d	Hydraulic Liner Loading Rate, gal/ft/d					
				Slope					
				0-4%		5-9%		>10%	
Texture	Structure			Infiltration Distance, Inch		Infiltration Distance, Inch		Infiltration Distance, Inch	
	Shape	Grade		10-12	12-20	10-12	12-20	10-12	12-20
COS, S, LCOS, LS	--	0SG	1.6	4.0	5.0	5.0	6.0	6.0	7.0
FS, VFS, LFS, LVFS	--	0SG	1.0	3.5	4.5	4.0	5.0	5.0	6.0
CSL, SL	--	0M	0.6	3.0	3.5	3.6	4.1	5.0	6.0
	PL	1	0.5	3.0	3.5	3.6	4.1	4.0	5.0
		2, 3							
	PR/BK /GR	1	0.7	3.5	4.5	4.0	5.0	5.0	6.0
		2, 3	1.0	3.5	4.5	4.0	5.0	5.0	6.0
FSL, VFSL	--	0M	0.5	2.0	2.3	2.4	2.7	2.7	3.2
	PL	1, 2, 3							
	PR/BK /GR	1	0.6	3.0	3.5	3.3	3.8	3.6	4.1
		2, 3	0.8	3.3	3.8	3.6	4.1	3.9	4.4
L	--	0M	0.5	2.0	2.3	2.4	2.7	2.7	3.2
	PL	1, 2, 3							
	PR/BK /GR	1	0.6	3.0	3.5	3.3	3.8	3.6	4.1
		2, 3	0.8	3.3	3.8	3.6	4.1	3.9	4.4
SIL	--	0M	0.2	2.0	2.5	2.2	2.7	2.4	2.9
	PL	1, 2, 3							
	PR/BK /GR	1	0.6	2.4	2.7	2.7	3.0	3.0	3.5
		2, 3	0.8	2.7	3.0	3.0	3.5	3.3	3.8
SCL, CL, SICL	--	0M							
	PL	1, 2, 3							
	PR/BK /GR	1	0.3	2.0	2.5	2.2	2.7	2.4	2.9
		2, 3	0.6	2.4	2.9	2.7	3.0	3.0	3.5
SC, C, SIC	--	0M							
	PL	1, 2, 3							
	PR/BK /GR	1							
		2, 3	0.3	2.0	2.5	2.2	2.7	2.4	2.9

Adapted from Tyler, 2000.
Width of Infiltration Field = Hydraulic Linear Loading Rate divided by Infiltration Hydraulic Loading Rate
Length of Infiltration Field = Wastewater Volume divided by Hydraulic Linear Loading Rate