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Minimum Requirements for Alternative On-Site Sewage Treatment Systems

Technical guidance manual per Article III, Section 3-14.1(B) of the
LMAS District Health Department Upper Peninsula Environmental Health Code

Updates and UPEHC revisions: 3/11/2022
Approved by Board of Health: 5/2/2022

Preface

The minimum requirements set forth in this document were developed by the LMAS District Health Department, Environmental Health Division. The minimum requirements contained in this document have been developed for district wide application of alternative methods of residential sewage treatment including commercial systems discharging less than 1000 gallons per day. This is a working document and modifications may be made as deemed necessary by the LMAS District Health Department.

MINIMUM REQUIREMENTS FOR **ALTERNATIVE ON-SITE SEWAGE TREATMENT SYSTEMS**

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Section 1: Alternative On-Site Sewage Treatment Systems – General Parameters

General

The minimum requirements set forth in this document apply to residential building sites and commercial sites discharging less than 1000 gallons per day requiring on-site sewage treatment and disposal for compliance under the LMAS District Health Department Upper Peninsula Environmental Health Code. The provisions of Section 3-14.1(B) Alternative OSTDS shall apply in the event that a site does not meet the minimum requirements set forth in Section 3-14.1 of the LMAS District Health Department Upper Peninsula Environmental Health Code. This manual shall also be used for sites that are approved for conventional but owner chooses to install an alternative system.

Alternative treatment systems are NOT viable options for every site. Some sites are unfortunately unsuitable for the construction of an on-site sewage treatment and disposal system.

This manual does not apply to commercial sites regulated by the Michigan Criteria for Subsurface Sewage Disposal. Subdivisions, site condominiums, and land divisions under one acre in size shall comply with the Michigan Department of Environmental, Great Lakes, and Energy (EGLE) Administrative Rules for On-Site Water Supply and Sewage Disposal for Land Divisions and Subdivisions.

Definitions

Advanced Treatment System	An OSTDS that treats effluent to a higher degree than a traditional OSTDS. These systems must meet NSF/ANSI Standard 40 or equivalent.
Absorption System	The part of an OSTDS in which septic tank effluent is distributed by arrangement of trenches or bed(s) that allows the effluent to be absorbed and treated by the surrounding soil.
Basal Area	The effective undisturbed natural soil surface area available to transmit the treated effluent from the sand fill media into the original receiving soils.
Design Consultant	The person responsible for designing the construction plans for alternative on-site sewage treatment systems. This can include (depending on type of system): Michigan Registered Sanitarian, Professional Engineer specializing in environmental or sanitary wastewater treatment, LMAS approved advanced treatment distributor/installer, or LMAS licensed septic installer.

Elevated Mound (<i>pump to gravity</i>)	An alternative method of on-site sewage treatment and disposal in which sand fill media is laid on top of properly prepared original soil surface. The sand fill media uses vertical separation to provide the necessary treatment. A Pump is utilized in this type of system. The effluent from the septic tank flows by gravity to the dosing chamber where it is pumped up to the absorption system installed on top of the sand fill. The effluent then flows by gravity throughout the laterals of the absorption system.
Geo-textile Fabric (filter fabric)	A non-woven fabric that is installed between the aggregate and soil cover used to impede or prevent the movement of sand, silt, and clay into aggregate/filter media.
Gravity Mound	An alternative method of on-site sewage treatment and disposal in which sand fill media is laid on top of properly prepared original soil surface. The sand fill media uses vertical separation to provide the necessary treatment. Pumps are <u>not</u> utilized for this type of system. The effluent out of the septic tank flows by gravity to the absorption system installed on top of the sand fill.
Greenbelt Area	The area measured horizontally downslope from the edge of the final treatment system, which is maintained undisturbed prior to, during, and after construction so as not to impede lateral movement of effluent.
Mottled soil	(Also known as redoximorphic features); Spots or blotches of contrasting colors, such as, but not limited to, gray or brown or gray and brown colors in close proximity, that are formed in the soil matrix by the processes of reduction, translocation, and oxidation of iron and manganese compounds in soils that have been periodically saturated.
Pressure Distribution	A system of small diameter pipes uniformly distributing effluent throughout a trench, bed, or chamber.
Pressure Mound System	An alternative method of on-site sewage treatment and disposal in which a specified sand fill media is laid on top of a properly prepared original soil surface. The pressure distribution and wastewater distribution cells are then placed entirely with the filter media at such a level that the desired vertical separation to provide necessary treatment exists. The fill material provides a measureable degree of wastewater treatment and allows effluent dispersal into the natural soil environment for final treatment.

Site Criteria

1. Purpose – This technical guidance manual is established for sites that were evaluated by LMAS staff to be unsuitable for conventional sewage disposal and treatment as established in the LMAS District Health Department Upper Peninsula Environmental Health Code. If additional site work is needed, the design consultant shall ensure that site work is completed per all applicable requirements.
2. Parcel Size
 - a. The parcel size shall accommodate the proposed design in a way as to not create a nuisance for neighboring parcels and/or waterways and shall include a separate designated future replacement absorption system location.
 - b. Lots that are less than one acre in size split after July 28, 1997 must be reviewed under EGLE Administrative Rules for On-Site Water Supply and Sewage Disposal for Land Divisions and Subdivisions.
3. Isolation Distances
 - a. Standard *minimum* isolation distance requirements set forth in the LMAS District Health Department Upper Peninsula Environmental Health Code shall be observed.
 - b. Reductions to these isolation distances may be allowed under a variance for existing homes where a “change in use” that will result in an increase of water use is not proposed.
 - c. The site shall not be located in an area subject to seasonal flooding or ponding of surface waters.
 - i. The site of the proposed system shall not be located in a floodplain of 100 years or less, or in an area subject to seasonal flooding, runoff, or ponding of surface waters. It shall be the property owner’s responsibility to document the 100 year flood plain as recognized by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), or appropriate agency, at the request of the Department.
 - d. Construction shall not be allowed within 10 feet of easements and right-of-ways.
 - e. The applicant is responsible for contacting other permitting agencies prior to obtaining any permits from the LMAS District Health Department.
 - f. Isolation from the absorption system shall be measured from the perimeter of stone.
4. Topography
 - a. Areas with 12% or greater slope are to be avoided.
 - b. Systems should not be installed where extensive cut and fill is required when other viable options exist. These earth moving practices destroy the natural soil structure which is relied upon for proper system operation.
 - c. Systems are not to be installed at the base of slopes unless surface water draining toward the system is diverted.
 - d. On sloping sites (i.e., those with slopes $\geq 5\%$) it can be expected that flow will move laterally down gradient. So as to not adversely impede this lateral movement, a suitable downslope greenbelt area shall be provided. The greenbelt area is to be measured from the toe of the side slope of the distribution mound and located within

property boundaries. The minimum required greenbelt area varies based on soil structure.

Soil Structure	Required Downslope Greenbelt (feet)
Medium sand	Not Required
Fine sand/Loamy Sand	10
Very Fine Sand/Sandy Loam	20
Loam/Sandy Clay Loam	30
Clay Loam/Silty Clay Loam	40
Silty Clay/Sandy Clay/Clay	Unsuitable

5. Minimum Soil Conditions

There is no minimal native soil restriction. Vertical separation shall be achieved with clean medium fill sand with no excessive fines (unless stated otherwise). Additional fill may be required in high water table situations where “wicking” may occur. LMAS reserves the right to require additional fill based on the particular site conditions or to require certain absorption system designs that have proven more effective in particular situations.

6. Installation Timeframe

- a. Installation of the alternative treatment system is limited to certain dry times of the year, typically from June 1 – October 15th. Any installation outside of this timeframe shall proceed only with express written approval from the design consultant on sites where soil conditions could result in soil smearing if worked on when wet which includes all sites with a permeability rate of >20 min/in. Certification that site conditions were favorable for installation will always be required as part of final approval for installations outside of the typical dry timeframe or if wet conditions are noted.
- b. Contact your local Sanitarian or the EH Director for approval if installing after Oct 15th.
- c. The issuance of an OSTDS permit does not guarantee the septic system can be installed to correlate with occupying the dwelling.

7. Site Preparation - Ultimate success or failure of a system also relies on clear communication along with the understanding of basic site preparation and construction principles. Critical issues include:

- a. Proper procedures must be followed to protect the location area including the required greenbelt area during and after construction. After establishing a suitable location for the initial and replacement area (including greenbelt), it should be suitably fenced or otherwise unmistakably identified to prevent further disturbance until actual construction can occur. Site planning resulting in a location for the

- system that is isolated from other anticipated home construction activities is encouraged.
- b. Soil smearing and compaction, which can reduce infiltration capacity, will occur if soils are worked on when wet. Construction activities should be scheduled only when soils are sufficiently dry. Acceptable soil moisture content of the soils to a depth of one foot should be evaluated by rolling a sample of soil between the hands. If the soil can be rolled into a ¼ inch or smaller “wire” it is considered too wet and should be allowed to dry before preparing. If site is questionable then certification from Design Consultant shall be required.
 - c. Excessive vegetation should be removed from the basal area. Remove all tree stumps and the central root system below grade by using a backhoe or excavator with a mechanical “thumb” or similar extrication equipment, lifting or leveraging stump in a manner that minimizes soil disturbance. It is not necessary for the soil of the system site to be smooth when the site is prepared. Avoid soil disturbance, relocation, or compaction. Avoid mechanical leveling or tampering of dislodged soil. Fill all voids created by stump removal with system sand.
 - d. The entire basal area of the mound should be suitably prepared by roughening in a ridge and furrow fashion with ridges following the contours. Methods that can be considered for roughening include chisel teeth fastened to the backhoe bucket, plowing with a multiple bottom agricultural chisel plow, or moldboard plow. Rototilling is not acceptable. Sand fill material should be applied immediately after roughening and prior to any subsequent precipitation.
 - e. Cleanliness of the sand fill should be checked prior to construction. Placement of fill material is to be accomplished from the end and upslope sides utilizing a tracked vehicle or equipment with adequate reach to minimize soil compaction. A minimum of six inches of fill material should be maintained below the tracks to minimize compaction. Wheeled vehicles should be prevented from travel over the mound basal area and downslope of the greenbelt area. Total depth of fill shall be established on a benchmark provided by the design consultant on the design plan.

Variance

1. Variance submittal shall occur prior to issuance of permit on LMAS Variance Request Form.
2. Variances will be reviewed under Article XV of the LMAS District Health Department Upper Peninsula Environmental Health Code.
3. Variances thus granted apply only to the specific project under consideration and do not serve as precedent in other cases.

Permitting

1. Upon completion of the permit application/design review, LMAS shall accept the design, reject the design, or require additional information for clarification and/or verification.
2. If the permit application/design is not acceptable, LMAS shall notify the applicant in writing and shall state the deficiencies or actions, or both, necessary to bring the design into compliance with the requirements set forth in this document.

3. When a completed permit application/design is deemed acceptable, LMAS shall issue a construction permit.

Limitation of Responsibility

1. Plan approval by LMAS may not be construed as an assumption of any responsibility for the design of the Alternative Treatment System and associated dispersal component(s).
2. LMAS does not hold itself liable for any defects in design and/or construction, or for any damages that may result from a specific installation.

Final Inspections and Approval to Use System

1. A final inspection shall be conducted by LMAS in accordance with Section 3-11.3 of the LMAS District Health Department Upper Peninsula Environmental Health Code. During this inspection, LMAS will approve or deny covering of the system. Approval to use the system will not be granted until all required information has been received.
2. The Design Consultant shall provide the LMAS District Health Department with written certification that the installed system meets their design and the intent of the minimum requirements contained within this document.
3. After all required information has been submitted, LMAS shall issue a final drawing/operating approval to the applicant.

Revocation of the Permit

1. The department may revoke any plan approval under this Section when one or more of the following conditions exists:
 - a. The location of the system(s) specified in the design is altered.
 - b. There is an increase in the scope of the project prior to, during, or following construction.
 - c. LMAS acquires new information indicating that any agency rules or regulations are violated before, during, or after construction.
 - d. LMAS has reasonable cause to believe that an intentional misrepresentation has occurred.

Disclaimer

1. The LMAS District Health Department reserves the right to require special restrictions, for rare circumstances, in addition to those listed herein to ensure that an adequate sewage disposal system is installed. These restrictions may be determined on a site specific basis.

Product Distribution and Use

1. Any new technology proposed within the District must go through an approval process.

2. Any manufactured and/or mechanical treatment devices that provide additional biological treatment shall be NSF approved with the classification of Class I (Standard 40, July 2000 or subsequent versions) to achieve a 90% reduction or better in biological oxygen demand and suspended solids and shall comply with the requirements set forth by NSF.
3. The manufacturer must provide assurance that continued consultation and service will be provided in the event that the distributor should fail to meet with required oversight or in the event that the distributor should go out of business.
4. The manufacturer/distributor must demonstrate the capabilities of providing adequate training and certification of installers and maintenance providers. They must also be conveniently available for consultation both on and off site.
5. The manufacturer must demonstrate that they are a viable company with proven technical expertise in the wastewater industry and capable of providing assurance of product reliability and backing in the event of product poor performance.
6. The manufacturer must have an established hands-on training program for prospective designers, installers, and service providers in the proper design, installation, and maintenance of their system. Video training, alone, is unacceptable.
7. The manufacturer/distributor must demonstrate that replacement parts are readily available for all mechanical components of the product(s).
8. If approved, failure to meet and maintain these minimum requirements for alternative on-site sewage treatment systems may result in product acceptance being revoked by the Department.

Becoming an Approved Distributor/Installer

1. All individuals/companies interested in distributing and/or installing an advanced treatment system within the LMAS District shall submit the product to LMAS for product review as noted above. If product use is approved by LMAS, these individuals must:
 - a. Submit letter of interest to LMAS along with proof of training (but not limited to): location of training, number of hours of training, experience with wastewater treatment systems, equipment experience, etc.
 - b. Be a septic installer properly licensed by LMAS; a plumber or septage hauler properly licensed by the State of Michigan; a person who by possession of a recognized degree or certificate of professional standing or who by extensive knowledge, training, and experience has successfully demonstrated the ability to solve and resolve problems associated with that particular product
 - b. Include manufacturer certification(s), if applicable.

- c. Any other information reasonably required by LMAS to determine whether applicant has the requisite knowledge, training, and experience to be the distributor/installer.
2. Once approved, future training to update siting, installation, start-up, and documentation procedures is required at a frequency recommended by the manufacturer.

Becoming an Approved Maintenance Service Provider

1. "Qualified maintenance provider" means a person approved by LMAS and who is:
 - a. A septic installer properly licensed by LMAS; or a plumber or septage hauler properly licensed by the State of Michigan; or
 - b. A person who, by possession of a recognized degree or certificate of professional standing, or who by extensive knowledge, training, and experience has successfully demonstrated the ability to solve and resolve problems with the approved advanced treatment system(s); or
 - c. The owner of the land where a permitted and approved advanced treatment system is installed; provided that the land owner consents to random inspections by LMAS and pays any established fees for that inspection.
2. A person seeking to become a qualified maintenance provider within the District shall submit a letter of interest along with sufficient proof that they are a qualified maintenance provider as defined in the manual.
3. The LMAS Health Officer may, by written notice, revoke qualified maintenance provider approval of any person who fails to adhere to any requirements of this manual or the LMAS Upper Peninsula Environmental Health Code. A person whose qualified maintenance provider approval is revoked may petition the LMAS Board for a formal administrative hearing pursuant to Article XVI of the LMASDHD Upper Peninsula Environmental Health Code.

Licensed Septic Installer Registration Process

1. Individuals interested in designing and/or installing alternative systems under this Technical Guidance Manual shall submit a letter of interest along with proof of experience in design and installation of these systems. Individuals shall also indicate knowledge in design of dosing systems, if applicable. Individuals shall specify type of system they will be able to design and/or install. Certain types of systems do require training from the unit manufacturer. Individual(s) must understand that all system design plans and installations shall comply with the requirements contained within this Technical Guidance Manual.

Section 2: Minimum Design Parameters - Dosing Devices

Description: An OSTDS consisting of a pump tank equipped with an electrical pump or siphon. The system is designed so that sewage gravity flows from the structure to a septic tank then to a pump tank. Effluent is pumped to the absorption system.

Dosing devices include:

- a. Pumps
- b. Siphons (requires no electricity)

Conditions for Application Submittal

1. A Michigan Registered Sanitarian, Professional Engineer specializing in environmental or sanitary wastewater treatment, or licensed sewage system installer registered with LMAS to design the particular alternative treatment system proposed shall provide a detailed design plan for each specific application.
2. Provide a scaled site plan detailing all aspects of the proposed work along with the LMAS District Health Department application form.
 - a. Plans shall be at least 8 ½" X 11" in size and shall be legible, clear, and permanent copies.
 - b. Plans shall include the name of the person who prepared the plan and shall be stamped if prepared by a Michigan Registered Sanitarian or Professional Engineer.
3. A *Submittal Checklist for Alternative Treatment* is available per request for guidance.

Design

1. All materials shall be durable, corrosion resistant, and designed for their intended use.
2. Electrical wiring shall be installed under direct supervision of a licensed electrical contractor and according to State and Local Electrical Codes as applicable. Please note that LMAS is not an electrical inspecting agency.
3. Designed to empty the pump tank in no less than 20 minutes.

Components

1. Design
 - a. Filtering of the effluent before it reaches the pump is required.
 - b. Timers/control panels appropriate to the design of the system shall be installed. Timers/control panels are used to assure proper functioning of the mechanics of the system, prevent overloading of the filter media, and reduce odor productions. A low level off control must be installed in conjunction with the timer. A minimum

of a visual alarm shall be installed, but both an audio and visual alarm are preferred.

- c. A 500 gallon (min) capacity pump tank required. This is usually adequate for a typical 3-4 bedroom domestic application. Tank used shall be manufactured as a sewage septic and/or dosing tank.
- d. A quick union disconnect shall be installed for easy removal of the pump. A riser to grade with a secondary form of security is required. Secondary devices can prevent an accidental fall into the tank if the primary lid is removed or damaged.
- e. Design consultant is responsible to propose correct pump type and hp based on system need. Provide pump make, model number, hp, effluent line size, and connection information into header pipe. A pump curve shall be submitted for pressure distribution proposals along with other additional details noted in application.

2. Installation

- a. Pump tanks shall be tested and certified to be watertight. Testing and certification must be performed on-site and in place, by the tank manufacturer or design consultant. Hydrostatic test or vacuum test may be utilized to determine if tank is watertight. Certification shall be submitted prior to or during the final inspection performed by the LMAS District Health Department.
- b. Pump tanks shall be placed on a stable, level surface. Buoyancy should be taken into account in high water table situations and measures taken to ensure tank stays in place.
- c. A water-tight riser shall be installed over the pump/float assembly for access/maintenance. Secondary security is required to preclude accidental tank entry.
- d. Backfill and grade around pump tank to prevent infiltration of surface water. Backfill should be free of any large stones (greater than 3 inches) or other debris.
- e. Electrical wiring shall be installed under direct supervision of a licensed electrical contractor and according to State and Local Electrical Codes as applicable.
- f. All joints shall be primed and chemically fused.

Permitting

- 1. Upon completion of the permit application/design review, LMAS shall accept the design, reject the design, require additional information for clarification, or require verification.
- 2. If the permit application/design is not acceptable, LMAS shall notify the applicant in writing and shall state the deficiencies or actions, or both, necessary to bring the design into compliance with the requirements set forth in this document.

3. When a completed permit application/design is deemed acceptable, LMAS shall issue a construction permit.

Limitation of Responsibility

1. Plan approval by LMAS may not be construed as an assumption of any responsibility for the design of the Alternative Treatment System and associated components.
2. LMAS does not hold itself liable for any defects in design and/or construction, or for any damages that may result from a specific installation.

Final Inspections and Approval to Use System

1. A final inspection shall be conducted by LMAS in accordance with Section 3-11.3 of the LMAS District Health Department Upper Peninsula Environmental Health Code. During this inspection, LMAS will approve or deny covering the system. Approval to use the system will not be granted until all required information has been received:
 - a. Request for a final inspection of the alternative system by the contractor, installer, or property owner shall serve as notice to the Department that the system is installed according to the permit and associated design plans. Final inspection conducted by the Department shall identify any items of noncompliance.
 - b. No portion of the system shall be covered and the system shall not be placed into service prior to final inspection and approval. Property owner is responsible for maintenance and monitoring of the system following approval from the Department, unless a contract agreement is in place between the property owner and a qualified maintenance provider.
 - c. The Design Consultant shall provide the LMAS District Health Department with written certification that the installed system meets their design and the intent of the minimum requirements contained within this document.
 - d. Any other information requested by LMAS such as watertight tank test results and pump installation certification.
2. After all required information has been submitted, LMAS shall issue a final drawing/operating approval to the applicant.

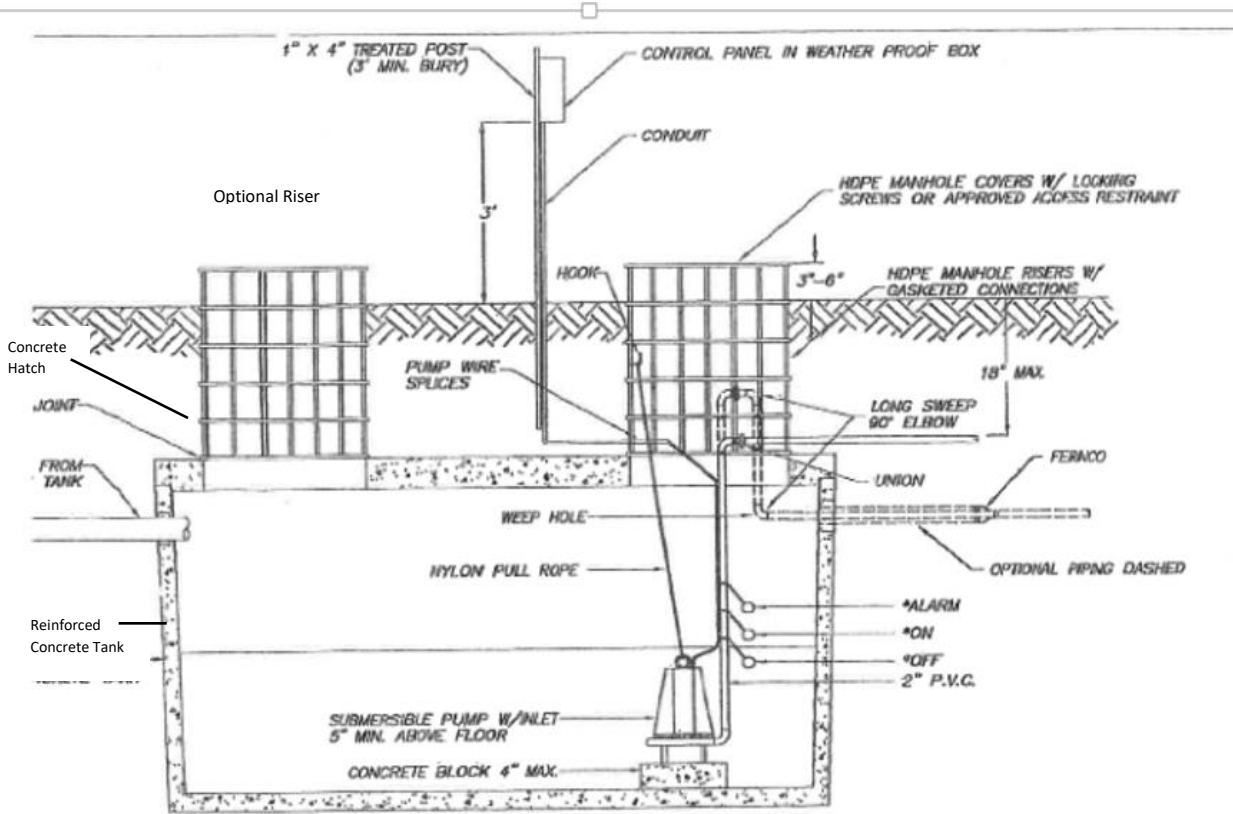
Revocation of Permit

1. The Department may revoke any plan approval under this Section when one or more of the following conditions exists:
 - a. The location of the system(s) specified in the design is altered.
 - b. There is an increase in the scope of the project prior to, during, or following construction.
 - c. LMAS acquires new information indicating that any agency rules or regulations are violated before, during, or after construction.
 - d. LMAS has reasonable cause to believe that an intentional misrepresentation has occurred.

Disclaimer

1. The LMAS District Health Department reserves the right to require special restrictions, in rare circumstances, in addition to those listed herein to ensure that an adequate sewage disposal system is installed. These restrictions may be determined on a site-specific basis.

Pump Tank Set-Up EXAMPLE



Examples of secondary restraints

Section 3: Minimum Design Parameters - Gravity and Elevated Mound

Description

A soil absorption system consisting of a septic tank, dosing/pump tank (if applicable), and an elevated absorption system (mound).

Conditions for Application Submittal

1. A Michigan Registered Sanitarian, Professional Engineer specializing in environmental or sanitary wastewater treatment, or licensed sewage system installer registered with LMAS to design the particular alternative treatment system proposed shall provide a detailed design plan for each specific application.
2. Provide a scaled site plan detailing all aspects of the proposed work along with the LMAS District Health Department application form.
 - a. Plans shall be at least 8 1/2" X 11" in size and shall be legible, clear, and permanent copies.
 - b. Plans shall include the name of the person who prepared the plan and shall be stamped if prepared by a Michigan Registered Sanitarian or Professional Engineer.
3. A *Submittal Checklist for Alternative Treatment* is available per request for guidance.

Sewage Treatment Components

1. Site Preparation - Ultimate success or failure of a system also relies on clear communication along with the understanding of basic site preparation and construction principles. Critical issues include:
 - f. Proper procedures must be followed to protect the location area including required greenbelt area during and after construction. After establishing a suitable location for the initial and replacement area including greenbelt area, it should be suitably fenced or otherwise unmistakably identified to prevent further disturbance until actual construction can occur. Site planning resulting in a location for the system that is isolated from other anticipated home construction activities is encouraged.
 - g. Soil smearing and compaction, which can reduce infiltration capacity, will occur if soils are worked on when wet. Construction activities should be scheduled only when soils are sufficiently dry. Acceptable soil moisture content of the soils to a depth of one foot should be evaluated by rolling a sample of soil between the hands. If the soil can be rolled into a 1/4 inch or smaller "wire" it is considered too wet and should be allowed to dry before preparing. If site is questionable then certification from Design Consultant shall be required.
 - h. Excessive vegetation should be removed from the basal area. Remove all tree stumps and the central root system below grade by using a backhoe or excavator with a mechanical "thumb" or similar extrication equipment, lifting or leveraging stump in a manner that minimizes soil disturbance. It is not necessary for the soil of the system site to be smooth when the site is prepared. Avoid soil disturbance, relocation, or compaction. Avoid mechanical leveling or tampering of dislodged soil. Fill all voids created by stump removal with system sand.

- i. The entire basal area of the mound should be suitably prepared by roughening in a ridge and furrow fashion with ridges following the contours. Methods that can be considered for roughening include chisel teeth fastened to the backhoe bucket, plowing with a multiple bottom agricultural chisel plow, or moldboard plow. Rototilling is not acceptable. Sand fill material should be applied immediately after roughening and prior to any subsequent precipitation.
- j. Cleanliness of the sand fill should be checked prior to construction. Placement of fill material is to be accomplished from the end and upslope sides utilizing a tracked vehicle or equipment with adequate reach to minimize soil compaction. A minimum of six inches of fill material should be maintained below the tracks to minimize compaction. Wheeled vehicles should be prevented from travel over the mound basal area and downslope of the greenbelt area. Total depth of fill shall be established on a benchmark provided by the design consultant on the design plan.

2. Septic Tank

- a. Tank requirements are established in Section 3-14.5 of the LMAS District Health Department Upper Peninsula Environmental Health Code.
- b. The minimum capacity for septic tanks for a one, two, or three-bedroom dwelling shall be 1,000 gallons, except where in the opinion of the Department, increased capacities may be required. Each additional bedroom shall require an additional 250 gallons. Each garbage grinder shall require an additional 250 gallons.
- c. Septic tanks shall be equipped with an approved effluent filter installed in the outlet baffle, or other approved location.
- d. Septic tanks shall be equipped with a watertight access riser installed to grade to facilitate maintenance. Risers shall be installed with dual lids, leaving the concrete lid in place, or shall be equipped with other Department approved safety device to preclude accidental tank entry.
- e. All septic tanks shall be installed to be level and to flow in accordance with the manufacturer's design intent.
- f. All systems receiving sewage from a grinder pump shall be equipped with a minimum of two 1,000 gallon septic tanks. The first septic tank shall be installed in series to allow the settling of sewage discharged by the pump and shall be equipped with an outlet baffle.
- g. Septic tanks and pump tanks shall be tested and certified to be watertight. Testing and certification must be performed on-site and in-place, by the tank manufacturer, design consultant, or licensed septic installer. Hydrostatic or vacuum test may be utilized to determine if the septic tank and/or pump tank are water tight. Certification shall be submitted prior to or during the final inspection performed by the Department.

3. Pump - See Section 2 of this manual for pump tank and pump design parameters.

4. Mound Components

a. Fill Requirements

- i. The texture of the fill material shall be clean sand with no excessive fines with a permeability rate of 3-10 min./in. A qualitative field check to

assess the cleanliness of the sand delivered to the construction site should be conducted.

- ii. Fill shall be free of debris, stones, frozen clods, or ice.
- iii. The material shall be compacted to avoid settling (or allowed to settle through one fall-winter-spring time period). Settling through the fall-winter-spring is the recommended method of compaction. Compaction of fill can be accomplished by utilizing only tracked equipment.
- iv. The depth of fill must be such that the bottom of the absorption area is isolated ≥ 4 feet above the established high groundwater elevation or limiting layer. Total depth of fill shall be established based on a benchmark provided by the design consultant on the design plan.

b. Sizing

Mound sizing will be based on the permeability rate of the native soil, unless design plan indicates that 4 ft of fill will be installed. If 4 ft of fill is installed then sizing will be based on the permeability rate of 3-10 min./in.

Native Soil Texture/ Structure	Permeability		Application Rate gpd/ft. ²		Minimum Absorption Area (Ft. ² /Bedroom)	
	in/hr	min/in	Bed	Trench	Bed	Trench
Coarse sand, Gravel, Gravelly Sand, Bedrock at Surface	>20	<3	.8	NA	**	NA
Stratified sand and gravel, Med. sand	20-6.0	3-10	.75	NA	200	NA
Fine sand Loamy sand	6.0-3.0	11-20	.5	NA	300	NA
Sandy loam, Loam	3.0-2.0	21-30	.375	NA	400	NA
Silty loam, Sandy clay loam	2.0-1.35	31-45	.3	NA	500	NA
Clay loam, Silty clay loam	<1.35	>45	.3	NA	500	NA
Silty clay, Clay	<1.35	>45	.2	NA	750	NA

** Pressure distribution is highly recommended. Refer to Section 4 of this manual.

c. Berm

A berm shall be constructed around the perimeter of the absorption

system. The berm shall be constructed of adequate size and texture to ensure optimum absorption system function. Soil texture shall consist of clean medium sand with no excessive fines. The size of the berm will be dependent on the native soil.

- i. Extend a minimum of 4 ft beyond all sides of the absorption system on sites where the native soil has a permeability greater than or equal to 3 inches per hour.
- ii. Extend a minimum of 10 ft beyond all sides of the absorption system where the native soil has a permeability less than 3 inches per hour.

d. Taper

The taper is the slope surrounding the berm. The taper shall be constructed of clean sand with no excessive fines and shall be evenly graded from the top of the berm to the natural soil surface with a slope of 3:1 (three horizontal to one vertical). For mounds constructed within a maintained lawn area, it is highly recommended that a slope of 4:1 or 5:1 be installed. Final grading of the mound area should divert surface water drainage away from the mound.

e. Observation port

At least one observation port to gauge ponding depth in the absorption area is necessary. This shall be placed within the aggregate and shall not be connected to a lateral.

f. Cover

- i. Geotextile fabric shall be used between the top of the aggregate and soil cover.
- ii. The entire mound shall be covered with sufficient suitable soil with a permeability ≥ 3.0 inches/hour to maintain vegetative growth and seeded/mulched upon completion. If the system is constructed after September 15th, a vegetative cover must be provided. Cover may consist of sod, mulch, straw, or other suitable material to prevent freezing.

Operation and Maintenance

1. The owner at his/her sole expense shall comply with a specific maintenance, monitoring, and inspection program specified by the LMAS District Health Department to ensure the optimum operation of the treatment system.
2. Septic Tank and Effluent Filter
 - a. Inspect the septic tank at least once every two years under normal usage. The tank shall be emptied of sludge and floating material by a licensed septage hauler at a recommended frequency of 3-5 years
 - b. After pumping, inspect the integrity of the septic tank to ensure that no groundwater is entering it. Also check the inlet and outlet and repair if needed.
 - c. Effluent filters require on-going maintenance due to their tendency to clog and cut off oxygen to the system. The effluent filter shall be cleaned at every septic tank pump out and inspected every 6-12 months. Follow filter manufacturer's maintenance instructions.
3. Pump Tank and Pump

- a. Inspect at least once a year to assure adequate operation of pump, floats, control panel, alarm, etc.
4. Infiltration Area
 - a. It is important that the system site remain free of shrubs, trees, and other woody vegetation. Roots can infiltrate and cause damage or clogging of system components.
 - b. Make sure the infiltration area is free of motorized vehicle traffic, is seeded, and that all water is diverted to avoid overloading.
 - c. If the system has a vent, make sure it is not obstructed.
 - d. Check and immediately report any odor or sign of water breakouts around the system.

Variance

1. Variance requests shall be submitted on the LMAS Variance Request Form. Submittal is necessary prior to issuance of permit.
2. Variances will be reviewed under Article XV of the LMAS District Health Department Upper Peninsula Environmental Health Code.
3. Variances thus granted apply only to the specific project under consideration and do not serve as precedents in other cases.

Permitting

1. Upon completion of the permit application/design review, LMAS shall accept the design, reject the design, require additional information for clarification, or require verification.
2. If the permit application/design is not acceptable, LMAS shall notify the applicant in writing and shall state the deficiencies or actions, or both, necessary to bring the design into compliance with the requirements set forth in this document.
3. When a completed permit application/design is deemed acceptable, LMAS shall issue a construction permit.

Limitation of Responsibility

1. Plan approval by LMAS may not be construed as an assumption of any responsibility for the design of the Alternative Treatment System and associated components.
2. LMAS does not hold itself liable for any defects in design and/or construction, or for any damages that may result from a specific installation.

Final Inspections and Approval to Use System

1. A final inspection shall be conducted by LMAS in accordance with Section 3-11.3 of the LMAS District Health Department Upper Peninsula Environmental Health Code. During this inspection, LMAS will approve or deny covering the system. Approval to use the system will not be granted until all required information has been received:
 - a. Request for a final inspection of the alternative system by the contractor, installer, or property owner shall serve as notice to the Department that the system is installed according to the permit and associated design plans. Final inspection conducted by the Department shall identify any items of noncompliance.
 - b. No portion of the system shall be covered and the system shall not be placed into service prior to final inspection and approval. Property owner is responsible for maintenance and monitoring of the system following approval from the

- Department, unless a contract agreement is in place between the property owner and a qualified maintenance provider.
- c. The Design Consultant shall provide the LMAS District Health Department with written certification that the installed system meets their design and the intent of the minimum requirements contained within this document.
 - d. Any other information requested by LMAS such as watertight tank test results and pump installation certification.
2. After all required information has been submitted, LMAS shall issue a final drawing/operating approval to the applicant.

Revocation of Permit

1. The Department may revoke any plan approval under this Section when one or more of the following conditions exists:
 - a. The location of the system(s) specified in the design is altered.
 - b. There is an increase in the scope of the project prior to, during, or following construction.
 - c. LMAS acquires new information indicating that any agency rules or regulations are violated before, during, or after construction.
 - d. LMAS has reasonable cause to believe that an intentional misrepresentation has occurred.

Disclaimer

2. The LMAS District Health Department reserves the right to require special restrictions, in rare circumstances, in addition to those listed herein to ensure that an adequate sewage disposal system is installed. These restrictions may be determined on a site-specific basis.

Section 4: Minimum Design Parameters – Pressure Distribution System

Description

An alternative method of treatment and disposal in which a specified sand fill media is laid on top of a properly prepared original soil surface. The pressure distribution system and wastewater cells are then placed entirely within the filter media at such a level that the desired vertical separation to provide the necessary treatment exists. The fill material provides a measurable degree of wastewater treatment and allows effluent dispersal into the natural soil environment for final treatment. Pressure distribution system is a system of small diameter pipes uniformly distributing effluent throughout a trench, bed, or chamber.

Conditions for Application Submittal

1. A Michigan Registered Sanitarian, Professional Engineer specializing in environmental or sanitary wastewater treatment, or licensed sewage system installer registered with LMAS to design the particular alternative treatment system proposed shall provide a detailed design plan for each specific application.
2. Provide a scaled site plan detailing all aspects of the proposed work along with the LMAS District Health Department application form.
 - a. Plans shall be at least 8 1/2" X 11" in size and shall be legible, clear, and permanent copies.
 - b. Plans shall include the name of the person who prepared the plan and shall be stamped if prepared by a Michigan Registered Sanitarian or Professional Engineer.
3. A *Submittal Checklist for Alternative Treatment* is available per request for guidance.

Septic Tank Requirements

1. Tank requirements are established in Section 3-14.5 of the LMAS District Health Department Upper Peninsula Environmental Health Code.
2. The minimum capacity for septic tanks for a one, two, or three-bedroom dwelling shall be 1,000 gallons, except where in the opinion of the Department, increased capacities may be required. Each additional bedroom shall require an additional 250 gallons. Each garbage grinder shall require an additional 250 gallons.
3. Septic tanks shall be equipped with an approved effluent filter installed in the outlet baffle, or other approved location.
4. Septic tanks shall be equipped with a watertight access riser installed to grade to facilitate maintenance. Risers shall be installed with dual lids, leaving the concrete lid in place, or shall be equipped with other Department approved safety device to preclude accidental tank entry.
5. All septic tanks shall be installed to be level and to flow in accordance with the manufacturer's design intent.
6. All systems receiving sewage from a grinder pump shall be equipped with a minimum of two 1,000 gallon septic tanks. The first septic tank shall be installed in series to allow the settling of sewage discharged by the pump and shall be equipped with an outlet baffle.
7. Septic tanks and pump tanks shall be tested and certified to be watertight. Testing and certification must be performed on-site and in-place, by the tank manufacturer, design

consultant, or licensed septic installer. Hydrostatic or vacuum test may be utilized to determine if the septic tank and/or pump tank are water tight. Certification shall be submitted prior to or during the final inspection performed by the Department.

Dosing/Pump Tank and Pump Requirements

Pump tank and pump shall be installed per minimum requirements noted in Section 2 of this manual.

Minimum Soil Conditions

There is no minimal native soil restriction. Vertical separation per DEQ Guidance shall be achieved with clean sand fill as noted below. Additional fill may be required in high water table situations where "wicking" may occur. LMAS reserves the right to require additional fill based on particular site conditions or to require certain absorption system designs that have proven more effective in particular situations.

Sand Fill Requirements - It is important that the specification of the sand fill material be closely controlled from both a performance and longevity standpoint. Sand fill should be clean and meet the Michigan Department of Transportation 2NS gradation without excessive fines. A qualitative field check to assess the cleanliness of sand delivered to the construction site should be conducted. (See Appendix A, within this section.)

Design Parameters

Refer to DEQ Pressure Mound System Technical Guidance within this Section.

Operation and Maintenance

1. The owner at his/her sole expense shall comply with a specific maintenance, monitoring, and inspection program specified by the LMAS District Health Department to ensure the optimum operation of the treatment system.
2. Septic Tank and Effluent Filter
 - a. Inspect the septic tank at least once every two years under normal usage. The tank shall be emptied of sludge and floating material by a licensed septage hauler at a recommended frequency of 3-5 years
 - b. After pumping, inspect the integrity of the septic tank to ensure that no groundwater is entering it. Also check the inlet and outlet and repair if needed.
 - c. Effluent filters require on-going maintenance due to their tendency to clog and cut off oxygen to the system. The effluent filter shall be cleaned at every septic tank pump out and inspected every 6-12 months. Follow filter manufacturer's maintenance instructions.
3. Pump Tank and Pump
 - a. Inspect at least once a year to assure adequate operation of pump, floats, control panel, alarm, etc.
 - b. The dose of wastewater shall be verified once a year to ensure it meets the permitted design plan.
 - c. The distribution laterals shall be inspected at least once a year to ensure even distribution.
4. Infiltration Area
 - a. It is important that the system site remain free of shrubs, trees, and other

woody vegetation. Roots can infiltrate and cause damage or clogging of system components.

- b. Make sure the infiltration area is free of motorized vehicle traffic, is seeded, and that all water is diverted to avoid overloading.
- c. If the system has a vent, make sure it is not obstructed.
- d. Check and immediately report any odor or sign of water breakouts around the system.

Variance

1. Variance requests shall be submitted on the LMAS Variance Request Form. Submittal is necessary prior to issuance of permit.
2. Variances will be reviewed under Article XV of the LMAS District Health Department Upper Peninsula Environmental Health Code.
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Permitting

1. Upon completion of the permit application/design review, LMAS shall accept the design, reject the design, require additional information for clarification, or require verification.
2. If the permit application/design is not acceptable, LMAS shall notify the applicant in writing and shall state the deficiencies or actions, or both, necessary to bring the design into compliance with the requirements set forth in this document.
3. When a completed permit application/design is deemed acceptable, LMAS shall issue a construction permit.

Limitation of Responsibility

1. Plan approval by LMAS may not be construed as an assumption of any responsibility for the design of the Alternative Treatment System and associated components.
2. LMAS does not hold itself liable for any defects in design and/or construction, or for any damages that may result from a specific installation.

Final Inspections and Approval to Use System

1. A final inspection shall be conducted by LMAS in accordance with Section 3-11.3 of the LMAS District Health Department Upper Peninsula Environmental Health Code. During this inspection, LMAS will approve or deny covering the system. Approval to use the system will not be granted until all required information has been received:
 - a. Request for a final inspection of the alternative system by the contractor, installer, or property owner shall serve as notice to the Department that the system is installed according to the permit and associated design plans. Final inspection conducted by the Department shall identify any items of noncompliance.
 - b. No portion of the system shall be covered and the system shall not be placed into service prior to final inspection and approval. Property owner is responsible for maintenance and monitoring of the system following approval from the Department, unless a contract agreement is in place between the property owner and a qualified maintenance provider.

- c. The Design Consultant shall provide the LMAS District Health Department with written certification that the installed system meets their design and the intent of the minimum requirements contained within this document.
 - d. Any other information requested by LMAS such as watertight tank test results and pump installation certification.
2. After all required information has been submitted, LMAS shall issue a final drawing/operating approval to the applicant.

Revocation of Permit

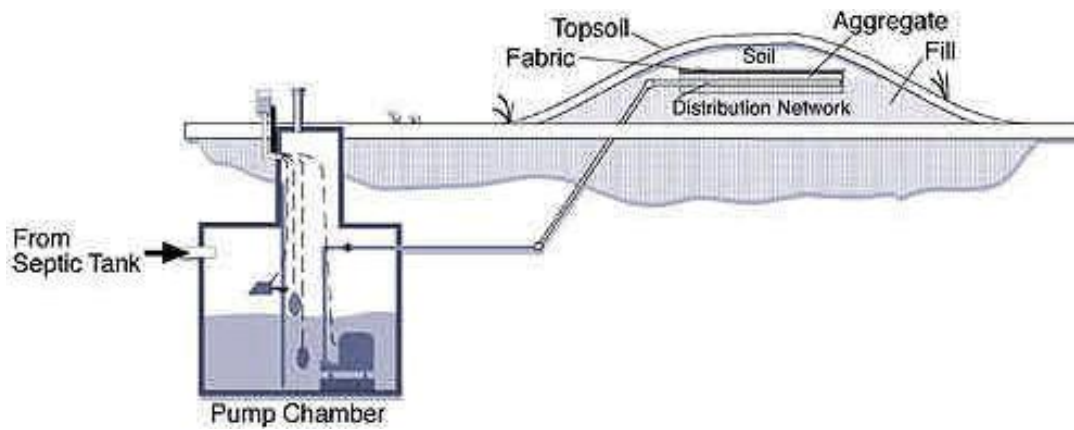
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 - c. LMAS acquires new information indicating that any agency rules or regulations are violated before, during, or after construction.
 - d. LMAS has reasonable cause to believe that an intentional misrepresentation has occurred.

Disclaimer

3. The LMAS District Health Department reserves the right to require special restrictions, in rare circumstances, in addition to those listed herein to ensure that an adequate sewage disposal system is installed. These restrictions may be determined on a site-specific basis.

Pressure Mound Systems

Technical Guidance for Site Suitability, Design, Construction and Operation and Maintenance



Michigan Department of Environmental Quality
Water Division Land Division and Local Health Department
Support Program June 2003

PREFACE

The technical guidance contained in this document has been developed for statewide application pursuant to R 560.424(2) of the Michigan Department of Environmental Quality Administrative Rules, "On-site Water Supply and Sewage Disposal for Land Divisions and Subdivisions." This technical guidance represents minimum standards for application of the described alternative method of sewage treatment and disposal for a development site less than one acre, subdivision lots, and site condominium units. The Michigan Department of Environmental Quality supports application of this technical guidance at the full discretion of the local health department having jurisdiction.

The standards may be used as minimums at the local level as written or modified to reflect more stringent requirements deemed necessary based on local conditions. Please note that pursuant to R 560.424(3), the specific alternative must be provided for under the regulations of the city, county, or district health department having jurisdiction and formal authorization must be granted by the Michigan Department of Environmental Quality.

R 560.424. Alternative methods of sewage treatment and disposal.

Rule 424. (1) The department may approve an alternative treatment and subsurface disposal system for a development site less than 1 acre in size or a lot deemed suitable or not suitable for a conventional subsurface sewage system.

(2) The department of environmental quality shall provide technical guidance in defining minimum site suitability and design and long-term operation and maintenance requirements considered essential for the proper functioning of specific alternative systems.

(3) The owner may utilize an alternative system if the specific alternative is provided for under the regulations of the city, county, or district health department having jurisdiction and if the department of environmental quality has authorized the alternative system's use.

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DEFINITIONS

Alternative System: A treatment and disposal system that is not a conventional system and provides for an equivalent or better degree of protection for public health and the environment than a conventional system.

Approved: A written statement of acceptability issued by the local health officer or the Department of Environmental Quality.

Basal Area: The effective in situ soil surface area available to transmit the treated effluent from the sand fill media into the original receiving soils.

Conventional System: An on-site sewage treatment system consisting of a watertight septic tank and a subsurface soil absorption system with non-uniform distribution of the effluent to subsurface soil trenches or an absorption bed.

Cover Material: The material used to cover a mound system, usually selected on its availability, cost, and ability to support vegetation, transfer oxygen, and shed water.

Distribution Cell Area: The area within the mound where the effluent is distributed into the fill material.

Effluent: Liquid discharged from a septic tank or other on-site sewage system component.

Excessively Permeable Soils: Soil that contains a high percentage of coarse to very coarse sands (2.0 mm and larger) and often including fine gravels and/or cobbles. Water passes through the soil very rapidly (i.e., soil permeability < 3 minutes/inch) and internal free water is very rare.

Greenbelt Area: The area measured horizontally downslope from the edge of the mound fill, which is maintained undisturbed prior to during and after construction so as not to impede lateral movement of effluent.

High Groundwater Elevation: The uppermost part of the soil or underlying material wholly saturated with water. The term includes perched and apparent conditions that are seasonally saturated for a time period in excess of two weeks, or permanently saturated.

Hydraulic Linear Loading Rate: The volume of effluent applied per day per linear foot of system along the natural ground contour.

Influent: Wastewater flowing into an on-site sewage system component.

In Situ Soil: Soil present in the natural or original position.

Limiting Layer: High groundwater elevation, soils with an expected permeability above

60 minutes/inch, or bedrock.

Original Grade: The natural land elevation which exists immediately prior to the construction of the mound system.

Permeable Soil: Soils with a textural classification, according to the U.S. Department of Agriculture Soil Conservation Service classification system, of silt loams, and some silty clay loams that are well structured with expected permeability less than or equal to 60 minutes/inch.

Permeability: The ability of soil to transmit liquids through pore spaces in a specified direction, e.g., horizontally or vertically.

Pressure Distribution: A system of small diameter pipes uniformly distributing effluent throughout a trench, bed, or chamber.

Pressure Mound System: An alternative method of on-site sewage treatment and disposal in which a specified sand fill media is laid on top of a properly prepared original soil surface. The pressure distribution system and wastewater distribution cells are then placed entirely within the filter media at such a level that the desired vertical separation to provide the necessary treatment exists. The fill material provides a measurable degree of wastewater treatment and allows effluent dispersal into the natural soil environment for final treatment.

Pump Chamber: A watertight tank or compartment following the septic tank or other pretreatment process that contains a pump, floats, and volume for storage of effluent.

Reserve Area: An area of land with site conditions deemed suitable for the installation of a replacement system upon failure of the initial system.

Sand Fill: Sand meeting specific criteria regarding particle size and installation technique to ensure adequate wastewater treatment.

Sanitary Sewage: Water and contaminants discharged from sanitary conveniences, including bathroom, kitchen, and household laundry fixtures of dwellings, office buildings, industrial plants, commercial buildings, and institutions. Commercial laundry wastes and industrial and commercial processes are not considered sanitary sewage.

Septic Tank: A watertight pretreatment receptacle receiving the discharge of sanitary sewage from a building sewer or sewers designed and constructed to permit separation of settleable and floating solids from the liquid, detention and anaerobic/facultative digestion of the organic matter prior to discharge of the liquid.

Slowly Permeable Soil: Soils with a textural classification according to the U.S. Department of Agriculture Soil Conservation Service classification system of silt loams and some silty clay loams that are well structured with expected permeability above 60 minutes/inch.

Soil Compaction: An increase in the soil bulk density and decrease in soil porosity by the application of mechanical forces to the soil that results in a soil that retains less water and resists root penetration. Soils with high clay content are more easily compacted than sandy soils.

Soil Loading Rate: The allowable application rate to the basal area required for absorption of effluent based upon soil texture for a given soil structure.

Soil Mottling (also known as redoximorphic features): Spots or blotches of contrasting colors, such as, but not limited to, gray or brown or gray and brown colors in close proximity, that are formed in the soil matrix by the processes of reduction, translocation, and oxidation of iron and manganese compounds in soils that have been periodically saturated.

Timer-Controlled System: A pressure distribution system where a pump's "on" and "off" times are preset, discrete time periods.

Uniform Distribution: A method of distribution that results in equal distribution of the effluent throughout the distribution network. This will help assure a vertical unsaturated flow regime.

Vertical Separation: The total depth of unsaturated soil that exists between the infiltrative surface of a distribution cell and a limiting layer.

INTRODUCTION

When properly sited, designed, constructed, operated and maintained pressure mounds provide a proven effective alternative method of on-site treatment. A pressure mound system relying on subsurface distribution to in situ soils can be an effective solution where site conditions are not suitable for conventional treatment and disposal systems. Typical situations where mound systems might be applied include:

✦ **Permeable or slowly permeable soils with a high groundwater elevation.**
Where permeable or slowly permeable soils with a high groundwater elevation prevent the installation of a conventional treatment system, a mound may be an acceptable alternative to provide for final treatment and disposal. Utilizing a mound with pressure distribution of effluent to promote unsaturated flow along with elevating the infiltrative surface to provide vertical separation maximizes final treatment efficiency.

✦ **Slowly permeable soils without high groundwater.**

Slowly permeable soils are most effective for final treatment and disposal where the natural soil profile is maintained in an undisturbed condition. Utilizing a mound system with pressure distribution for these sites offers a number of advantages as opposed to attempts to construct a conventional below grade final treatment and disposal system including:

- Damage to the natural soils during construction including compaction and smearing is minimized.
- Treated effluent is discharged and dispersed into the uppermost soil horizons, which are typically more permeable.
- The mound sand fill media provides additional treatment, which minimizes clogging of the slowly permeable soils while maintaining their hydraulic conductivity.
- Utilizing pressure distribution promotes unsaturated flow resulting in more efficient treatment, extended life of the system and improves overall hydraulic performance by minimizing groundwater mounding.

✦ **Excessively permeable soils or creviced bedrock.**

Excessively permeable natural soils or shallow soils over creviced bedrock present distinct concerns related to contamination of groundwater supplies or surface waters. In conjunction with a comprehensive evaluation of site specific environmental and/or public health concerns, mounds may be evaluated as a potential treatment alternative to minimize adverse impacts.

SITE SUITABILITY

Those sites meeting the following criteria for the initial, replacement, and greenbelt areas may be considered for pressure mounds:

- Soils - undisturbed natural soils only. Historical agricultural activities are not generally considered as disturbance.
- Soil texture and structure - the most limiting horizon encountered in the upper 18 inches must be a suitable soil texture and structure as shown in Table 1.
- Permeability of uppermost soil horizon - soils with an estimated permeability of 60 minutes/inch or less based on soil texture and structure.
- Depth to high groundwater elevation - 18 inches minimum from the undisturbed natural ground surface. The depth to high groundwater elevation shall be confirmed by a soil profile with 6 inches or more of soil without mottling (a.k.a. redoximorphic features) below the "A" horizon (topsoil) or groundwater monitoring in accordance with R 560.423 of the Michigan Department of Environmental Quality Administrative Rules, "On-site Water Supply and Sewage Disposal for Land Divisions and Subdivisions."
- Depth to creviced bedrock - 24 inches.
- Slope - natural ground slope should be ≤ 25 percent in mound area to promote safety of workers during construction.

SITE EVALUATION AND PLANNING

A critical step in the successful application of mound technology is the site evaluation and planning process. This step provides the site specific information necessary to evaluate overall site suitability and is used as the foundation for actual design.

Prior to completing the site evaluation, available site specific information related to soils, slopes, etc., should be reviewed in detail. For the majority of counties, USDA soil surveys are a valuable resource in this regard. This information will provide general guidance as to the potential for application of mound technology. After a thorough review of this information, preliminary site plans can be developed and a site evaluation conducted.

For each lot where a mound is intended, a minimum of three soil profile evaluations are considered sufficient to delineate the area under investigation for initial, replacement systems, and greenbelt areas and to establish consistency. Soil evaluations should be completed during those time periods where soils are sufficiently dry to avoid damage to the absorption area. In areas of complex soils, additional evaluations may be necessary. Soil evaluations should be completed by observation of shallow soil pits of adequate size, depth, and construction to safely enter and exit the pit and complete a soil profile description. All of the following shall be accurately reported by a competent soil consultant for each soil horizon or layer:

- Thickness
- USDA soil textural class
- Presence of soil mottles or redoximorphic features
- Soil structure - grade and shape
- Occurrence of saturated soil, groundwater, bedrock, or disturbed soils

Site planning for development sites less than one acre, subdivision lots, or site condominium units must also consider the following features:

- Property lines and lot lines
- Slope
- Required setback distances
- Existing or proposed structures
- Existing or proposed wells
- Surface waters

For projects involving multiple lots or units, overall planning should also consider and mitigate any negative impacts from other off-lot development activities, including grading, road construction, and surface water drainage.

DESIGN

Sufficient design detail must be provided for a development site less than one acre, subdivision lot, or site condominium unit to assure that adequate, suitable area is available for construction of initial and reserve mound systems and required greenbelt areas. These areas must be at locations that are readily accessible for construction and for future maintenance and repair. A proper design must allow for the home and any proposed improvements while maintaining required setbacks. The following design criteria are recommended:

Design Flows - For design purposes an allowance of 150 gallons per day per bedroom is suggested. This figure provides an adequate factor of safety necessary to promote satisfactory long term function of the distribution cell and mound.

Distribution Cell Sizing - The absorptive bottom area in the distribution cell should be designed to provide the minimum required by the city, county, or district health department having jurisdiction. The maximum loading rate should never exceed 1.0 gallon per day per square foot. More conservative loading rates will provide a higher factor of safety. Horizontal separation between distribution cells shall be based on allowable soil loading rate with a minimum of three feet.

Reserve Area - Reserve area with suitable site conditions must be set aside and protected for future use. The reserve area shall include a basal area, sized in accordance with Table 1, which is totally separate from the basal area of the initial mound.

Mound Orientation - The absorptive area should be long and narrow with the long dimension running parallel to the contour for a sloping site.

Soil Loading Rate - The minimum mound basal area required for absorption of effluent is based upon soil texture for a given soil structure. Table 1 suggests recommended maximum soil loading rates based upon the most limiting soil texture and structure encountered in the upper 18 inches of the soil profile. The basal area for sloping sites (i.e., those with slopes ≥ 2 percent) includes the area under the distribution cell and area downslope only. On flat sites (i.e., those with slopes ≤ 2 percent) the minimum required basal area includes that under the distribution cell and either side of it. Generally, the minimum required basal area will be found to be less than the actual area filled after accounting for required depth of fill and side slopes.

Hydraulic Linear Loading Rate - The hydraulic linear loading rate is the volume of effluent applied per day per linear foot of system along the natural ground contour. From a hydraulic standpoint, a long and narrow mound design is most efficient and better promotes aerobic conditions under the distribution cell. Table 1 suggests recommended maximum hydraulic linear loading rates based upon the most limiting soil texture and structure encountered in the upper 18 inches of the soil profile.

Setbacks - Table 2 summarizes minimum horizontal isolation distances which should be maintained from the toe of the mound fill.

Depth of Fill - The depth of fill must be such that the bottom of the distribution cell is isolated ≥ 3 feet above established high ground water elevation or limiting layer. Limiting layer includes soils with an expected permeability above 60 minutes/inch based on soil texture and structure. The minimum depth of fill at the outer edge of the distribution cell area shall be 12 inches. The approved plan shall indicate the location of a suitable benchmark to be used by the contractor during construction to judge that the required depth of fill has been provided.

Final Cover - The settled depth of final cover at the outer edge of the distribution cell should be a minimum of 12 inches and the top of the mound graded to promote positive drainage. Final cover over the mound should support the growth of a suitable vegetative cover while shedding rainfall and promoting aeration of the mound. Final cover should have a texture no heavier than sandy loam.

Side Slopes - The final side slope of the mound surface should be 4:1 or flatter.

Greenbelt Area - On sloping sites (i.e., those with slopes ≥ 2 percent) it can be expected that flow will move laterally down gradient. So as to not to adversely impede this lateral movement, a suitable downslope greenbelt area shall be provided. The greenbelt area is to be measured from the toe of the mound and located within property boundaries. The minimum required greenbelt area varies based on soil texture as indicated in Table 1.

Pressure Distribution System - Pressure distribution of effluent is required in the distribution cell to promote maximum achievable treatment, and is critical from a hydraulic standpoint, especially where slowly permeable soils are encountered. Pressure distribution system design should generally comply with currently accepted design practice including the following features:

- Septic tank effluent filters or screen pump vaults are necessary.
- Small frequent doses to the mound by means of time dosing to promote unsaturated flow and enhanced treatment and hydraulics are required. Design shall provide uniform doses with no more than 0.5 gallons per orifice per dose.
- Distribution cell area per orifice shall not exceed 12 ft².
- To reduce orifice plugging, high head pumps are recommended.
- Orifice shields should be provided.

- Provisions for flushing must be incorporated at the ends of all laterals.
- Geotextile fabric which prevents the downward migration of fine materials but allows for free passage of air and water should be placed over the stone in the distribution cell prior to placement of final cover.

Sand Fill Requirements - It is important that the specification of the sand fill material be closely controlled from both a performance and longevity standpoint. From a treatment standpoint, the mound functions in a similar fashion to a sand filter sand fill should be clean and meet the Michigan Department of Transportation 2NS gradation without excessive fines. A qualitative field check to assess the cleanliness of sand delivered to the construction site should be conducted. (See Appendix A.)

Observation Ports - At least one observation port to gauge ponding depth in the distribution cell is necessary. Where the distribution cell is divided into multiple zones, at least one per zone is required.

SITE PREPARATION AND CONSTRUCTION

Ultimate success or failure of a mound also relies on a clear communication and understanding of basic site preparation and construction principles. Critical issues include:

- Proper procedures must be followed to protect the mound area including required greenbelt area during and after construction. After establishing a suitable location for the mound and replacement area including greenbelt area, it should be suitably fenced or otherwise unmistakably identified to prevent further disturbance until actual construction can occur. Site planning resulting in a location for the mound that is isolated from other anticipated home construction activities is encouraged.
- Soil smearing and compaction, which can reduce infiltration capacity will occur if soils are worked on when wet. Construction activities should be scheduled only when soils are sufficiently dry. Acceptable soil moisture content of the soils to a depth of one foot should be evaluated by rolling a sample of soil between the hands. If the soil can be rolled into a 1/4 inch or smaller “wire” it is considered too wet and should be allowed to dry before preparing.
- Excess vegetation should be removed from the mound basal area. Trees should be cut flush to the ground and other vegetation over six inches in length should be mowed and cut vegetation removed. Where an excessive number of stumps and large boulders are encountered, the absorption area should be enlarged or an alternate site should be selected.
- The entire basal area of the mound should be suitably prepared by roughening in a ridge and furrow fashion with ridges following the contours. Methods that can be considered for roughening include chisel teeth fastened to the backhoe bucket, plowing with a multiple bottom agricultural chisel plow, or moldboard plow. Rototilling is not acceptable. Sand fill material should be applied immediately after roughening and prior to any subsequent precipitation.
- Cleanliness of sand fill should be field checked prior to installation. Placement of fill material then is to be accomplished from the end and upslope sides utilizing a tracked vehicle or equipment with adequate reach to minimize soil compaction. A minimum of six inches of fill material should be maintained below the tracks to minimize compaction. Wheeled vehicles should be prevented from travel over the mound basal area and downslope greenbelt area. Total depth of fill shall be established based on a benchmark provided by the design consultant on the approved plan.
- Final grading of the mound area should divert surface water drainage away from the mound. Sod the entire mound area or seed and mulch.

OPERATION AND MAINTENANCE

The system owner is responsible for assuring the continuous operation and maintenance of the system. Deed advisories need to be recorded to communicate to the system owner and subsequent future owners the importance of routine and regular maintenance activities. It is suggested that a maintenance inspection be conducted on an annual basis by a trained maintenance provider. The local health department or other management entity may require oversight of the on-site system by a properly certified operator. In such cases, the operator must be responsible for the continuous operation and maintenance of the system and must submit appropriate records routinely to the local health or other appropriate jurisdiction.

Routine and preventative maintenance aspects are:

- Scum and sludge levels in the septic tank as well as the pump chamber need to be inspected routinely on an annual basis and tanks pumped as necessary. Depending on tank size and usage, pumping will typically be required at intervals exceeding every 3 to 5 years.
- Periodic inspections of system performance are required. Liquid levels in the observation ports should be checked and examinations made for any seepage around the toe of the mound. The pressure distribution system should be assessed and laterals flushed as necessary. It is recommended that mounds be visited at least once per year. A suggested maintenance visit checklist is attached (Appendix C).
- A good water conservation plan within the house or establishment will help assure that the mound system will not be hydraulically overloaded.
- Avoid traffic in the initial and replacement mound areas and downslope greenbelt area. No vehicular traffic or livestock should be permitted. With lawn care equipment, such as a riding lawn mowers or tractor, it is important not to travel on the mound or the downslope area when the soil is saturated. Winter traffic on the mound should be avoided to minimize frost penetration in colder climate areas and to minimize compaction in other areas.

Owner's Manual - A user's manual needs to supplement the construction plan and must be submitted to the local health department for final approval. A copy of this manual must be provided to the property owner after completion of the mound system. The manual needs to contain the following as a minimum:

1. As-built drawings of all system components and their location are to be provided. The location of the reserve area also needs to be clearly defined and its importance communicated to the owner.
2. Specifications for all electrical and mechanical components.

3. Names and phone numbers of local health authority, component manufacturer, or management entity to be contacted in the event of an alarm, or other problems, or failure.
4. Information on the periodic maintenance of the mound system, including electrical/mechanical components.
5. Information on what activities can or cannot occur on and around the mound, reserve area, and greenbelt area.
6. A standard homeowner “Do’s and Don’ts” list for proper system operation.
7. Information regarding suitable landscaping and vegetation for the mound and surrounding areas.

APPENDIX A

Figure 1- Mound System Components

Figure 2 - Typical Site Plan

Figure 3 - Mound Plan View and Cross Section

Figure 4 - MDOT 2NS Sand Fill Gradation

Procedure for Qualitative Field Test of Sand Cleanliness

Figure 5 - Observation Port Example Details

Table 1 - Allowable Soil Loading Rates

Table 2 - Minimum Horizontal Isolation Distances

Figure 1
Typical Mound System Components

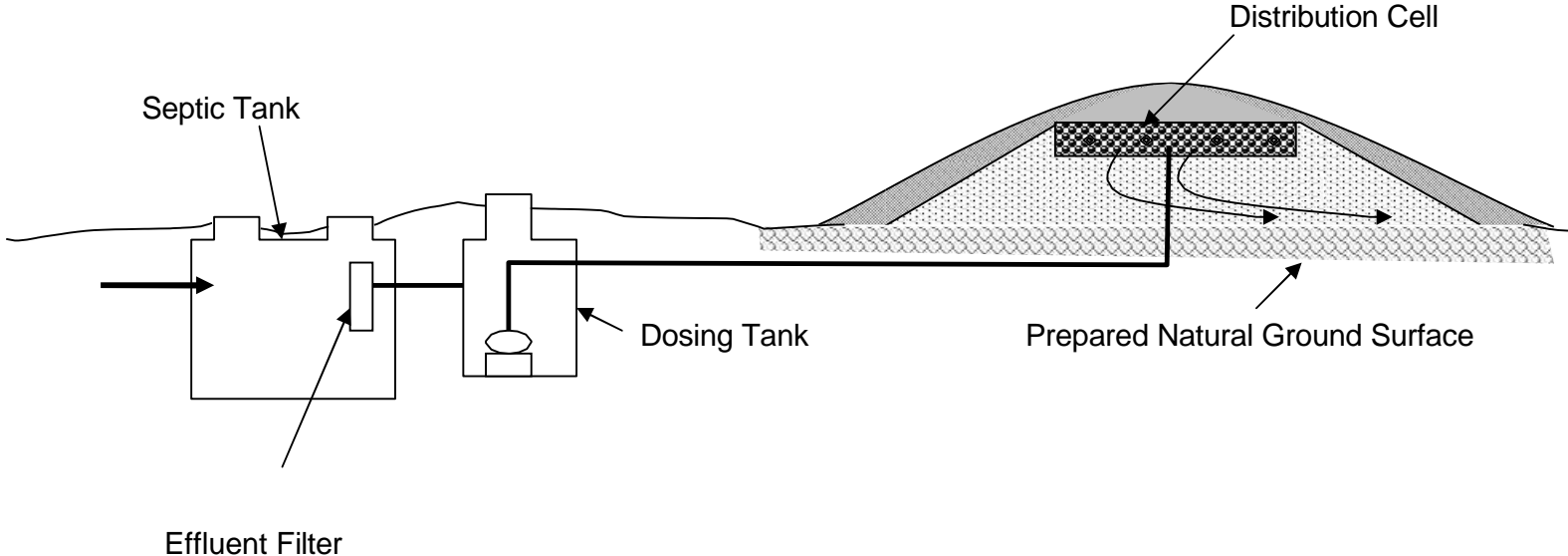


Figure 2
Typical Site Plan

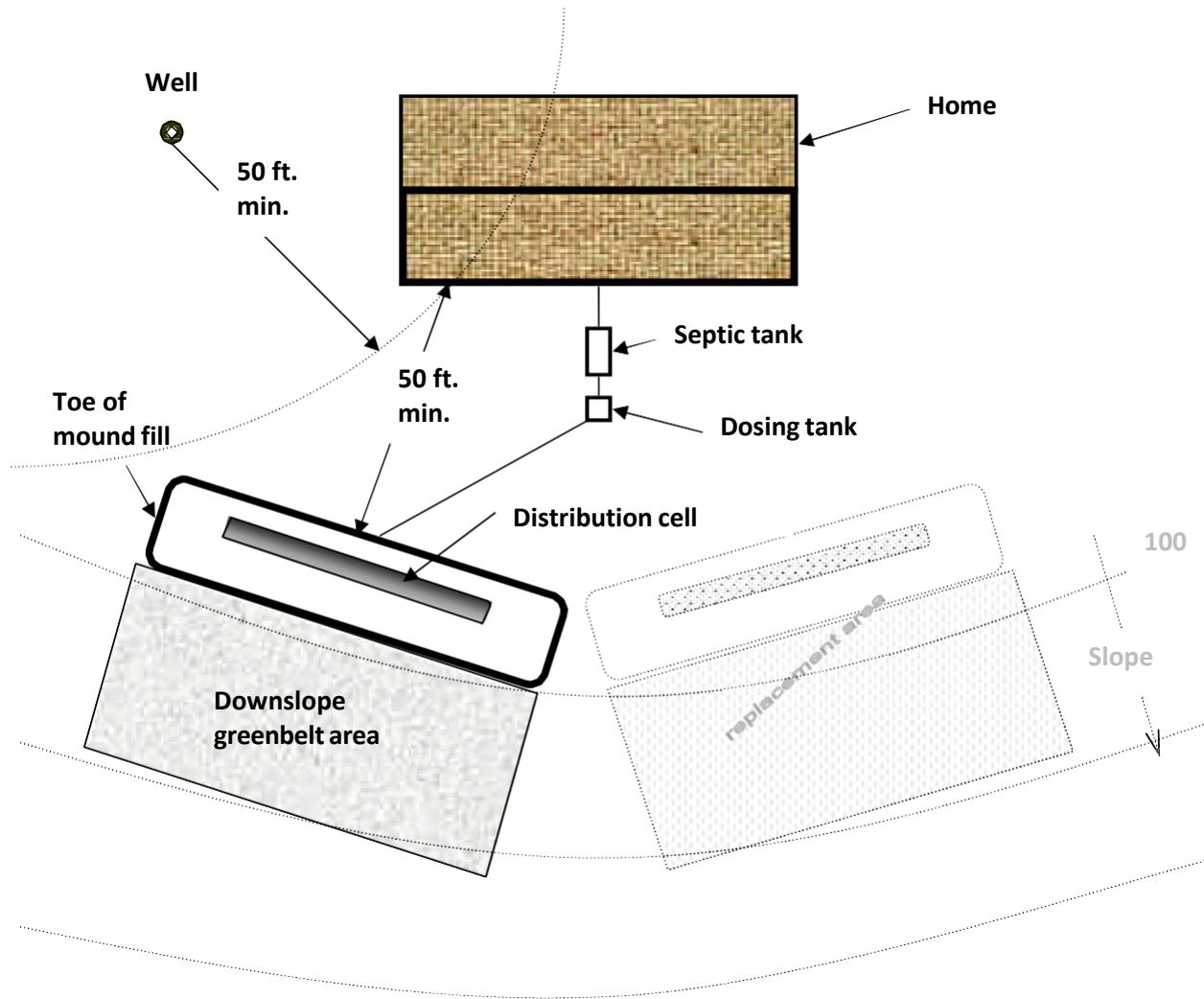
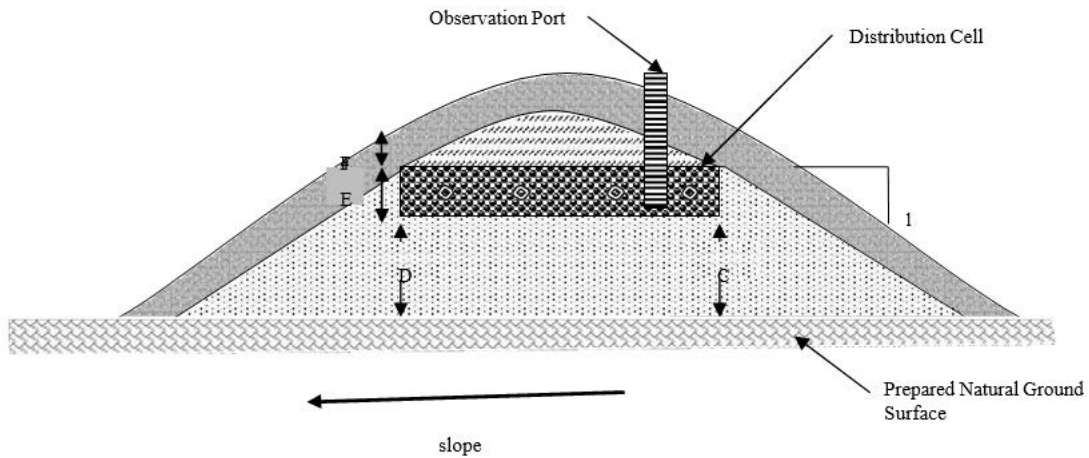
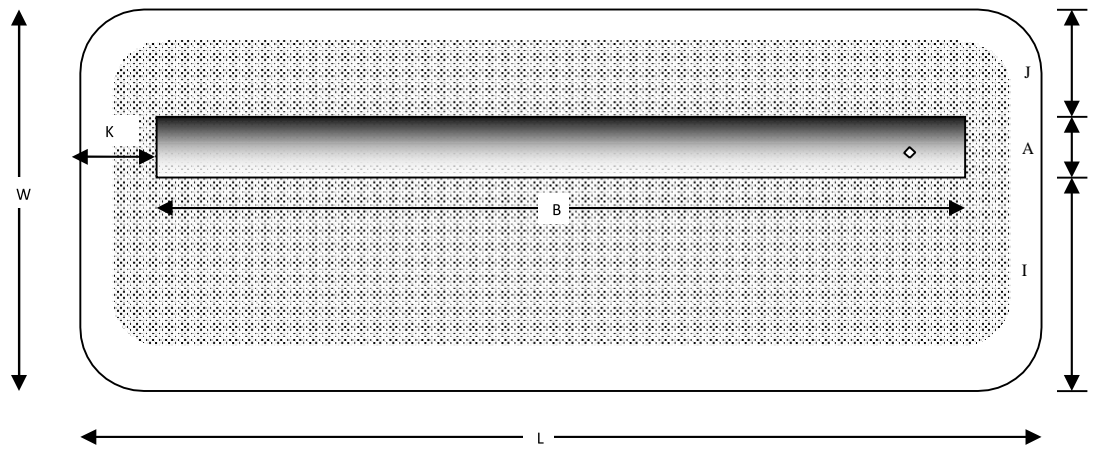


Figure 3
Mound Plan View and Cross Section

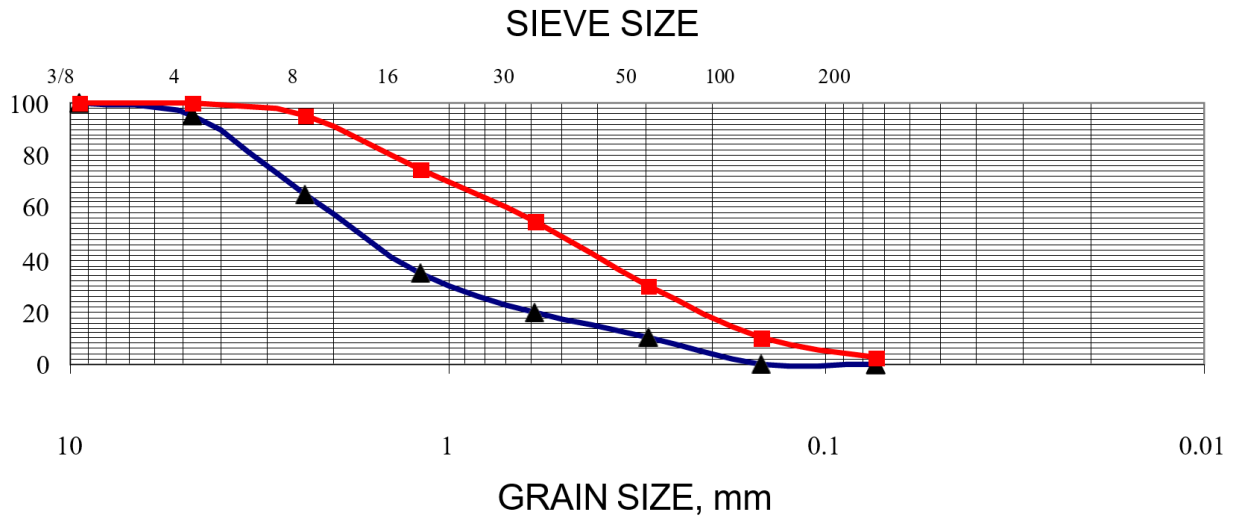


Legend

- A - Distribution cell width
- B - Distribution cell length
- C - Up slope fill depth under distribution cell
- D - Downslope fill depth under distribution cell
- E - Distribution cell depth
- F - Depth of final cover
- I - Distance from edge of distribution cell to downslope edge of fill
- J - Distance from edge of distribution cell to up slope edge of fill
- K - Distance from end of distribution cell to edge of fill
- L - Overall mound fill length
- W - Overall mound fill width

Figure 4
MDOT 2NS Sand Specification

Sieve Size	Grain Size (mm)	Percent Passing %	Percent Passing %
3/8	9.52	100	100
4	4.76	95	100
8	2.38	65	95
16	1.19	35	75
30	0.59	20	55
50	0.297	10	30
100	0.149	0	10
200	0.074	0	3

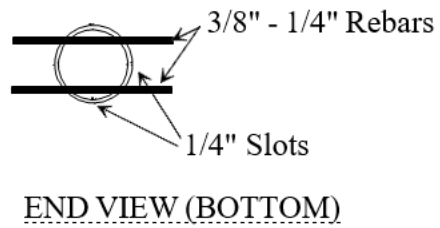
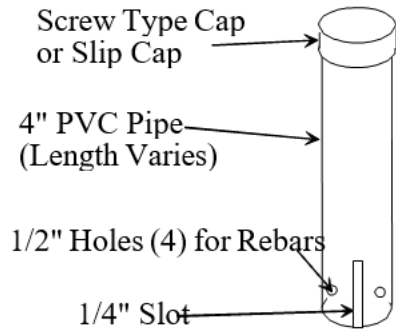
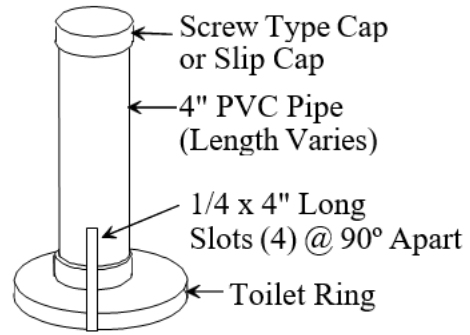
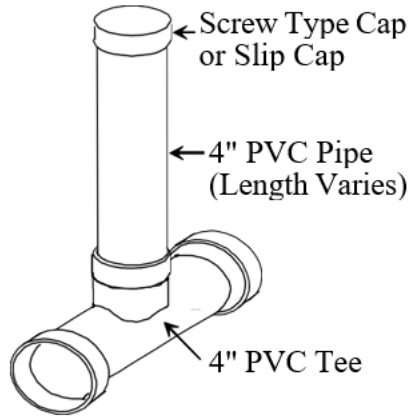


Procedure for Qualitative Field Test of Sand Cleanliness

Sand fill materials for mound construction should be obtained from a supplier that has documented through sieve analysis that the 2NS specification is met. As results of sieve analyses will typically vary over time, it is recommended that a qualitative field assessment of the cleanliness of the sand delivered to the construction site also be conducted. The following procedure is suggested:

1. Fill a quart jar one half full of the sand fill material to be tested.
2. Add water to fill the jar.
3. Shake the jar contents vigorously after which it should be allowed to settle for 30 minutes.
4. If after settling a perceptible layer of fines greater than 1/8 inch in thickness has accumulated on the surface, the fill material should not be considered clean enough and an alternate source should be explored.

Figure 5 – Observation Port Example Details



**Table 1
Allowable Soil
Loading Rates**

SOIL STRUCTURE* →	MAXIMUM SOIL LOADING RATE GPD/FT ²					MAX. HYDRAULIC LINEAR LOADING RATE, GPD/LF					REQUIRED DOWNSLOPE GREENBELT** (SLOPE > 2%, FEET)
	BK/GR			PL	M	BK/GR			PL	M	
	1	2	3			1	2	3			
SOIL TEXTURE*	1	2	3	PL	M	1	2	3	PL	M	
COARSE SAND / MEDIUM SAND	1.0	1.0	1.0	0.5	0.5	5.0	5.0	5.0	2.5	2.5	NR
FINE SAND / LOAMY SAND	0.4	0.5	0.6	0.4	0.4	3.5	4.0	4.5	2.0	2.0	10
VERY FINE SAND / SANDY LOAM	0.3	0.4	0.5	U	0.2	3.0	3.5	4.0	U	1.0	20
LOAM / SANDY CLAY LOAM	0.2	0.25	0.3	U	0.2	2.5	3.0	3.5	U	U	30
CLAY LOAM / SILTY CLAY LOAM	0.15	0.2	0.25	U	U	1.8	2.5	3.0	U	U	40
SILTY CLAY / SANDY CLAY / CLAY	UNSUITABLE										

* MOST LIMITING LAYER IN UPPER 18 INCHES

** MEASURED FROM TOE OF MOUND FILL

TABLE LEGEND

BK = BLOCKY
GR = GRANULAR
PL = PLATY
M = MASSIVE

1 = WEAK
2 = MODERATE
3 = STRONG
U = UNSUITABLE

Table 2
Minimum Horizontal Isolation Distances

From Toe of Mound Fill To:	Minimum Horizontal Isolation Distance (feet)
Private individual well	50
Surface waters	100
Basement foundation walls	50*
Top of drop-off	20
Property lines	10
Footing drains installed in water table without direct connection to surface water	25
Footing drains installed in water table with direct connection to surface water	50
Drains designed to lower the water table	100

*The downslope edge of the greenbelt area may be located within 25 feet of the foundation walls.

APPENDIX B

Design Example

Site Criteria

1. Soil Profile:
 - A. 0-8 in. - Dark grayish brown medium sand, weak granular structure.
 - B. 8-29 in. - Yellowish brown medium sand, single grain with common fine distinct light brownish gray iron oxide depletions evident below 18 inches.
 - C. 29-32 in. - Reddish brown clay loam, massive with many fine distinct greenish gray iron oxide depletions.
2. Slope: 4%
3. This is a site for a proposed 3 bedroom home.

Step 1. Evaluate the quantity and quality of wastewater generated.

For this example, it is intended to serve a three bedroom home and the designer has proposed to discharge domestic septic tank effluent to the mound. Design flows are established based on an estimate of 150 gallons per day (gpd) per bedroom, which equates to a design flow rate of 450 gpd. Using a design flow of 150 gpd/bedroom provides for a factor of safety resulting necessary to promote greater system performance and longevity.

Step 2. Evaluate the soil profile and site description for maximum soil loading rate and hydraulic linear loading rate.

From the soil profile description there are indications of a seasonal high groundwater elevation at 18 inches. The most limiting soil horizon in the upper 18 inches from a texture and structure standpoint is brown medium sand with weak granular structure. Using Table 1, the soil loading rate and linear loading rate are selected.

Soil Loading Rate (SLR) = 1.0 gpd/ft²

Linear Loading Rate (LLR) = 5.0 gpd/lineal foot

Step 3. Select the sand fill loading rate and calculate the distribution cell width (A).

The maximum sand fill loading rate for septic tank effluent is 1.0 gpd/ft². For this example the maximum rate will be used. Use of this rate is based on the assumption that the sand fill under the distribution cell will meet the requirements of Figure 4 and that a factor of safety has been provided in design flows as discussed in Step 1. The width of the distribution cell (A) can then be calculated as follows:

$$\begin{aligned} A &= \text{Linear Loading Rate} \div \text{Sand Fill Loading Rate} \\ &= 5.0 \text{ gpd/ft.} \div 1.0 \text{ gpd/ft}^2 \\ &= 5.0 \text{ ft.} \end{aligned}$$

Step 4. Determine the distribution cell length (B).

$$\begin{aligned} B &= \text{Design Flow} \div \text{Linear Loading Rate} \\ &= 450 \text{ gpd} \div 5.0 \text{ gpd/ft.} \\ &= 90 \text{ ft.} \end{aligned}$$

Step 5. Determine the soil infiltration area width (IW).

The soil infiltration width represents the width required to absorb the effluent into the natural soil. To provide a factor of safety, it is based on the most limiting horizon in the upper 18 inches. For this example, the most limiting horizon is medium sand which has a maximum soil loading rate of 1.0 gpd/ft².

$$\begin{aligned} IW &= \text{Design flow} \div (\text{soil loading rate} \times B) \\ &= 450 \div (1.0 \times 90) \\ &= 5 \text{ ft.} \end{aligned}$$

For this example, the infiltration width and distribution cell width (A) are equal. For other situations where the most limiting horizon is less permeable, it will be found that the infiltration width will exceed width of the distribution cell. The infiltration width defines the minimum overall dimensions of the basal area and is important when evaluating the adequacy of the mound fill area and horizontal spacing when using multiple distribution cells.

Step 6. Determine mound fill depth (C) at the upslope edge of the distribution cell.

In this case, the depth of fill (C) at the upslope edge of the distribution cell will be the fill required to elevate the stone three feet above high groundwater elevation, which is 1.5 ft.

Step 7. Determine the mound fill depth (D) at the downslope edge of the distribution cell.

For a 4% slope, the following can be

$$\begin{aligned} \text{used: } D &= C + 0.04(A) \\ &= 1.5 + 0.04(5) \\ &= 1.7 \text{ ft.} \end{aligned}$$

Step 8. Determine mound depths (E) and (F).

$$E = 1.0 \text{ ft. (total depth of stone)}$$

$$F = 1.0 \text{ ft. (minimum amount of final cover)}$$

Step 9. Determine the downslope width (I).

Using a recommended side slope of 4:1 the calculations is as follows:

$$\begin{aligned} \text{Downslope correction factor} &= 100 \div [100 - (\text{side slope} \times \% \text{ ground} \\ &\text{slope})] \\ &= 100 \div [100 - (4 \times \% \text{ slope})] \\ &= 100 \div [100 - (4 \times 4)] \\ &= 1.19 \end{aligned}$$

$$\begin{aligned} I &= 4(D + E + F) \times \text{downslope correction factor} \\ &= 4(1.7 + 1.0 + 1.0)(1.19) \\ &= 17.6 \text{ ft.} \end{aligned}$$

Step 10. Determine the upslope width (J).

Using a recommended side slope of 4:1 the calculations is as

$$\begin{aligned} \text{follows: Upslope correction factor} &= 100 \div [100 + (\text{side slope} \\ &\text{x \% slope})] \\ &= 100 \div [100 + (4 \times \% \text{ slope})] \\ &= 100 \div [100 + (4 \times 4)] \\ &= 0.86 \end{aligned}$$

$$\begin{aligned} J &= 4(C + E + F) \times \text{upslope correction factor} \\ &= 4(1.5 + 1.0 + 1.0)(0.86) \\ &= 12.0 \text{ ft.} \end{aligned}$$

Step 11. Determine the end slope length (K).

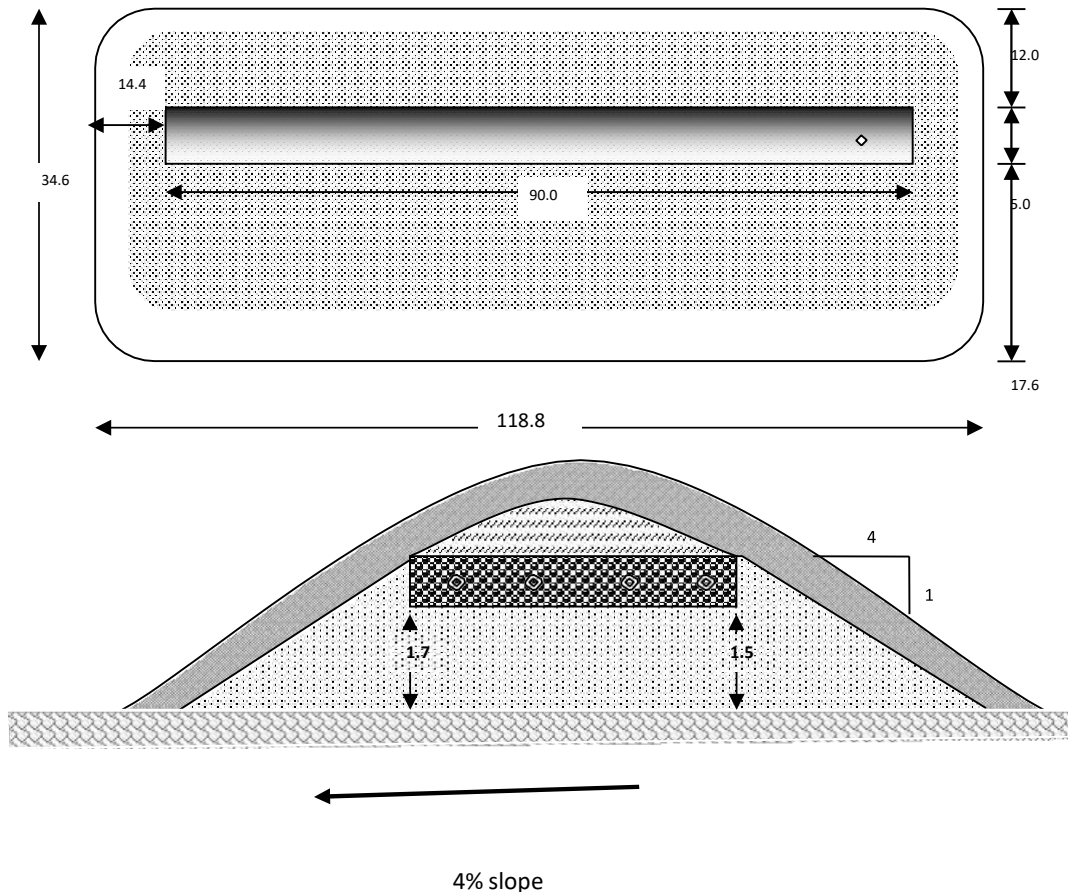
Using a recommended side slope of 4:1 the calculations is as

$$\begin{aligned} \text{follows: } K &= 4[(C+D)/2 + E + F] \\ &= 4[(1.5 + 1.7)/2 + 1.0 + 1.0] \\ &= 14.4 \text{ ft.} \end{aligned}$$

Step 12. Determine the overall width (W) and length (L) of the mound fill.

$$\begin{aligned} W &= A + I + J \\ &= 5 + 17.6 + 12.0 \\ &= \\ &= 34.6 \text{ ft.} \\ L &= B \\ &+ 2K \\ &= 90 + 2(14.4) \\ &= 118.8 \text{ ft.} \end{aligned}$$

The calculated dimensions are summarized on the following plan view and crossection:



APPENDIX C

Mound Maintenance Visit Checklist

 **General Observations**

Mound Appearance (check items that may apply)

- Erosion has occurred
Explain _____
- Greener vegetation visible in spots
Explain _____

Toe of Slope Wetness

- Soil at downslope toe is
- soggy Water at surface of
- downslope toe Sewage odor
around wet spots

General Condition

- Attractive, well groomed, completely
- sodded Mostly vegetated, evidence of
- mowing Overgrown with weeds
- Overgrown with brush

 **Observation Tube in Stone Bed**

- Observation tube is present
- Depth of ponding in tube _____

 **Other Observation Tubes**

Describe and note distance to water below soil surface:

 **Pump Chamber**

Appearance: (Note any apparent problems or concerns)

- Water level normal

Pump operation is:

- Demand (float) controlled
- Timer controlled

Number of floats: _____

- Check float operation and desirable function of each (first visit only)

If timer is present, note settings

_____ On time

_____ Off time

Flush Laterals

- Access is provided to ends of lines
- Have to dig up ends of lines (recommend addition of sumps for access)

Perform flush of each line by opening the end of one lateral at a time. Have helper turn pump on while you observe end of line. Note what flushes out of each line. Provide sketch to identify laterals.

Lateral #1 _____

Lateral #2 _____

Lateral #3 _____

Lateral #4 _____

Lateral #5 _____

Lateral #6 _____

After flushing all lines, make head measurement at the end of the line farthest from the pump. Note head and compare with previous records (if available) of how residual head in the system is supposed to be set. If head is more than 20 percent above previous value, bottle brush the lines – or otherwise clean – and measure head again.

Note final head: _____ ft.

APPENDIX D

Mound Design Worksheet

Site Criteria

1. Soil Profile

2. Slope: _____%

3. This is a site for a proposed _____ bedroom home.

Step 1. Evaluate the quantity and quality of wastewater generated.

Daily Flow = # of bedrooms x 150 gpd/bedroom
= (_____ x 150) gpd
= _____ gpd

Step 2. Evaluate the soil profile and site description for maximum soil loading rate and hydraulic linear loading rate.

Seasonal High Groundwater Elevation = _____ inches

Depth to Limiting Layer = _____ inches

Limiting Layer texture, structure, grade _____, _____, _____

Using Table 1 the soil loading rate (SLR) and linear loading rate (LLR) are selected.

Soil Loading Rate (SLR) = _____ gpd/ft²

Linear Loading Rate (LLR) = _____ gpd/lineal foot

Step 3. Select the sand fill loading rate and calculate the distribution cellwidth (A).

The maximum sand fill loading rate for septic tank effluent is 1.0 gpd/ft². For this design the following rate will be used _____ gpd/ft². The width of the distribution cell (A) can then be calculated as follows:

A = Linear Loading Rate ÷ Sand Fill Loading Rate

$$= \frac{\text{_____ gpd/ft.}}{\text{_____ gpd/ft}^2}$$
$$= \text{_____ ft.}$$

Step 4. Determine the distribution cell length (B).

B = Design Flow ÷ Linear Loading Rate

$$= \frac{\text{_____ gpd}}{\text{_____ gpd/ft.}}$$
$$= \text{_____ ft.}$$

Step 5. Determine the soil infiltration area width (IW).

The soil infiltration width represents the width required to absorb the effluent into the natural soil. To provide a factor of safety it is based on the most limiting horizon in the upper 18 inches. For this design the most limiting horizon is _____ with a _____, which has a maximum soil loading rate of _____ gpd/ft².

IW = Design flow ÷ (soil loading rate x B)

$$= \frac{\text{_____}}{\text{_____}}$$
$$= \text{_____ ft.}$$

For situations where the most limiting horizon is slowly permeable it will be found that the infiltration width will exceed width of the distribution cell. The infiltration width is important when evaluating the adequacy of the overall mound fill area and horizontal spacing when using multiple distribution cells.

Step 6. Determine mound fill depth (C) at the upslope edge of the distribution cell.

In this case, the depth of fill (C) at the upslope edge of the distribution cell will be the fill required to elevate the stone three feet above high groundwater elevation or limiting layer, which is _____ feet.

Step 7. Determine the mound fill depth (D) at the downslope edge of the distribution cell.

For a given slope, the following can be used:

D = C + (slope x A) Note: express slope as decimal, i.e., 4% = 0.04

$$= \text{_____} + (\text{_____} \times \text{_____})$$
$$= \text{_____ ft.}$$

Step 8. Determine mound depths (E) and (F).

E = _____ ft. (total depth of stone)
F = _____ ft. (amount of final cover)

Step 9. Determine the downslope width (I).

Using a recommended side slope of 4:1 the calculations is as follows: Downslope

correction factor = $100 \div [100 - (\text{side slope} \times \% \text{ ground slope})]$
= $100 \div [100 - (4 \times \underline{\hspace{2cm}} \% \text{ slope})]$
= $100 \div [100 - (4 \times \underline{\hspace{2cm}})]$
= _____

I = $4(D + E + F) \times \text{downslope correction factor}$
= $4(\underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}})(\underline{\hspace{1cm}})$
= _____ ft.

Step 10. Determine the upslope width (J).

Using a recommended side slope of 4:1 the calculations is as follows: Upslope

correction factor = $100 \div [100 + (\text{side slope} \times \% \text{ slope})]$
= $100 \div [100 + (4 \times \underline{\hspace{2cm}} \% \text{ slope})]$
= $100 \div [100 + (4 \times \underline{\hspace{2cm}})]$
= _____

J = $4(C + E + F) \times \text{upslope correction factor}$
= $4(\underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}})(\underline{\hspace{1cm}})$
= _____ ft.

Step 11. Determine the end slope length (K).

Using a recommended side slope of 4:1 the calculations is as follows:K

= $4[(C+D)/2 + E + F]$
= $4[(\underline{\hspace{1cm}} + \underline{\hspace{1cm}})/2 + \underline{\hspace{1cm}} + \underline{\hspace{1cm}}]$
= _____ ft.

Step 12. Determine the overall width (W) and length (L) of the mound fill.

$$W = A + I + J$$

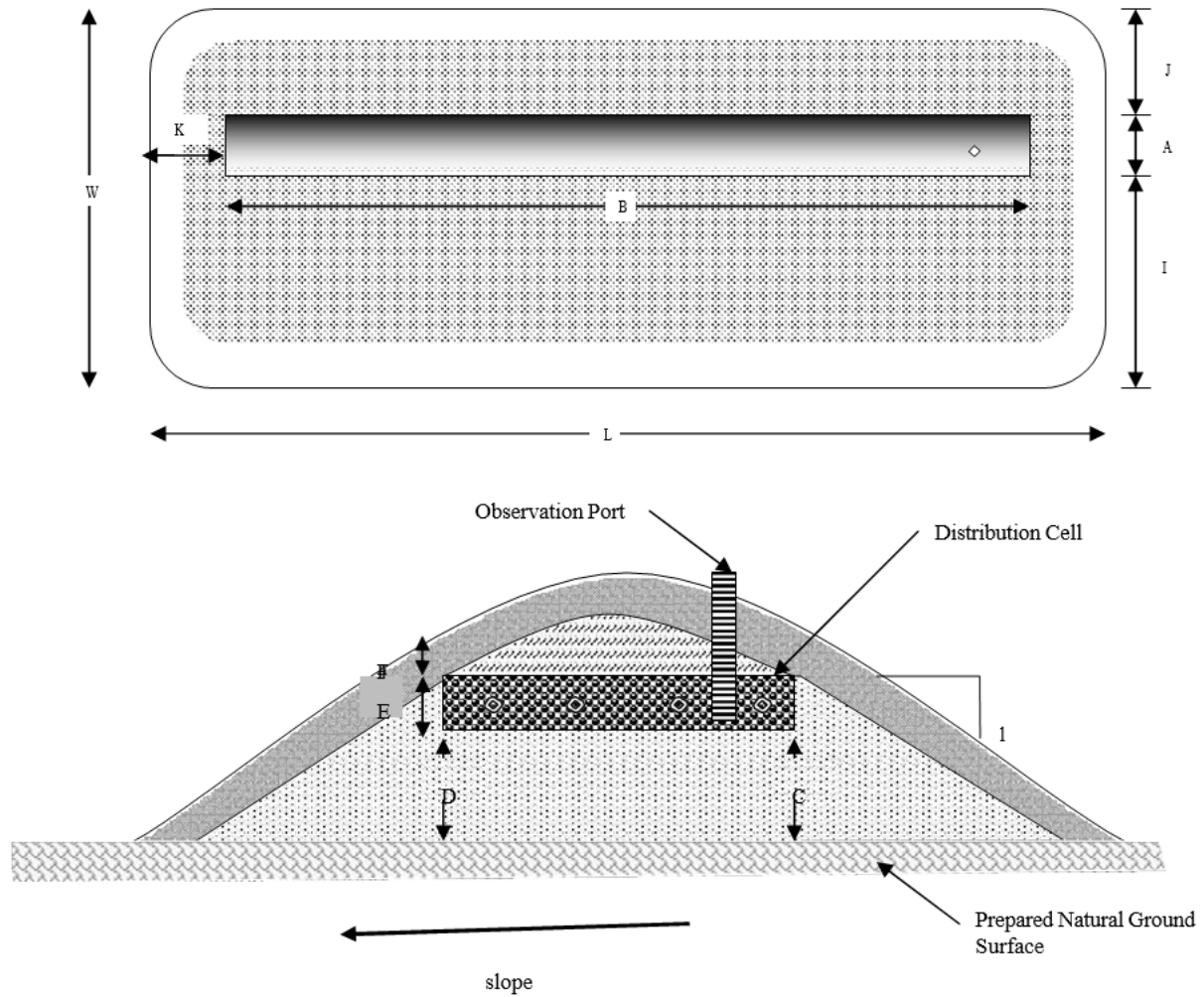
$$= \underline{\hspace{2cm}} + \underline{\hspace{2cm}} + \underline{\hspace{2cm}}$$

$$= \underline{\hspace{2cm}} \text{ ft.}$$

$$L = B + 2K$$

$$= \underline{\hspace{2cm}} + 2(\underline{\hspace{2cm}})$$

$$= \underline{\hspace{2cm}} \text{ ft.}$$



Mound Component Dimensions

A	Distribution cell width	
B	Distribution cell length	
C	Up slope fill depth under distribution cell	
D	Downslope fill depth under distribution cell	
E	Distribution cell depth	
F	Depth of final cover	
I	Distance from edge of distribution cell to downslope edge of fill	
J	Distance from edge of distribution cell to up slope edge of fill	
K	Distance from end of distribution cell to edge of fill	
L	Overall mound fill length	
W	Overall mound fill width	

Section 5: Minimum Design Parameters – Aerobic Treatment

Description

Manufactured and packaged advanced treatment that uses mechanical means to bring sewage effluent into contact with oxygen by maintaining aerobic conditions within the treatment component tank. These units can be categorized as either: 1) suspended growth, 2) attached growth (submerged fixed media), or 3) combination of both.

Conditions for Application Submittal

1. A Michigan Registered Sanitarian, Professional Engineer specializing in environmental or sanitary wastewater treatment, or licensed sewage system installer registered with LMAS to design the particular alternative treatment system proposed shall provide a detailed design plan for each specific application.
2. Provide a scaled site plan detailing all aspects of the proposed work along with the LMAS District Health Department application form.
 - a. Plans shall be at least 8 1/2" X 11" in size and shall be legible, clear, and permanent copies.
 - b. Plans shall include the name of the person who prepared the plan and shall be stamped if prepared by a Michigan Registered Sanitarian or Professional Engineer.
3. A *Submittal Checklist for Alternative Treatment* is available per request for guidance.
4. A contract/attachment to the deed shall be filed with the County Clerk indicating the property contains a secondary treatment system and the property limitation imposed by such a system. The property owner shall provide evidence that such contract/attachment has been filed before the Department issues the construction permit.
5. An initial two (2) year maintenance agreement signed by both the land owner and the product distributor/installer is required. Annual maintenance thereafter shall be performed by a qualified maintenance provider.
6. Plans will not be reviewed until all required components described herein are submitted with the applicable fee.

Sewage Treatment Components

1. Site Preparation - Ultimate success or failure of a system also relies on clear communication along with the understanding of basic site preparation and construction principles. Critical issues include:
 - a. Proper procedures must be followed to protect the location area including required greenbelt area during and after construction. After establishing a suitable location for the initial and replacement area including greenbelt area, it should be suitably fenced or otherwise unmistakably identified to prevent further disturbance until actual construction can occur. Site planning resulting in a location for the system that is isolated from other anticipated home construction activities is encouraged.
 - b. Soil smearing and compaction, which can reduce infiltration capacity, will occur if soils are worked on when wet. Construction activities should be

scheduled only when soils are sufficiently dry. Acceptable soil moisture content of the soils to a depth of one foot should be evaluated by rolling a sample of soil between the hands. If the soil can be rolled into a ¼ inch or smaller "wire" it is considered too wet and should be allowed to dry before preparing. If the site is questionable then certification from Design Consultant shall be required.

- c. Excessive vegetation should be removed from the basal area. Remove all tree stumps and the central root system below grade by using a backhoe or excavator with a mechanical "thumb" or similar extrication equipment, lifting or leveraging stump in a manner that minimizes soil disturbance. It is not necessary for the soil of the system site to be smooth when the site is prepared. Avoid soil disturbance, relocation, or compaction. Avoid mechanical leveling or tampering of dislodged soil. Fill all voids created by stump removal with system sand.
- d. The entire basal area of the mound should be suitably prepared by roughening in a ridge and furrow fashion with ridges following the contours. Methods that can be considered for roughening include chisel teeth fastened to the backhoe bucket, plowing with a multiple bottom agricultural chisel plow, or moldboard plow. Rototilling is not acceptable. Sand fill material should be applied immediately after roughening and prior to any subsequent precipitation.
- e. Cleanliness of the sand fill should be checked prior to construction. Placement of fill material is to be accomplished from the end and upslope sides utilizing a tracked vehicle or equipment with adequate reach to minimize soil compaction. A minimum of six inches of fill material should be maintained below the tracks to minimize compaction. Wheeled vehicles should be prevented from traveling over the mound basal area and downslope of the greenbelt area. Total depth of fill shall be established on a benchmark provided by the design consultant on the design plan.

2. Septic Tank

- a. Tank requirements are established in Section 3-14.5 of the LMAS District Health Department Upper Peninsula Environmental Health Code.
- b. The minimum capacity for septic tanks for a one, two, or three-bedroom dwelling shall be 1,000 gallons, except where in the opinion of the Department, increased capacities may be required. Each additional bedroom shall require an additional 250 gallons. Each garbage grinder shall require an additional 250 gallons.
- c. Septic tanks shall be equipped with an approved effluent filter installed in the outlet baffle, or other approved location.
- d. Septic tanks shall be equipped with a watertight access riser installed to grade to facilitate maintenance. Risers shall be installed with dual lids, leaving the concrete lid in place, or shall be equipped with other Department approved safety device to preclude accidental tank entry.
- e. All septic tanks shall be installed to be level and to flow in accordance with the manufacturer's design intent.

- f. All systems receiving sewage from a grinder pump shall be equipped with a minimum of two 1,000 gallon septic tanks. The first septic tank shall be installed in series to allow the settling of sewage discharged by the pump and shall be equipped with an outlet baffle.
 - g. Septic tanks and pump tanks shall be tested and certified to be watertight. Testing and certification must be performed on-site and in-place, by the tank manufacturer, design consultant, or licensed septic installer. Hydrostatic or vacuum test may be utilized to determine if the septic tank and/or pump tank are water tight. Certification shall be submitted prior to or during the final inspection performed by the Department.
3. Pump - See Section 2 of this manual for pump tank and pump design parameters.
4. Aerobic Unit
- a. Any aerobic treatment unit that is not on the most current LMAS District Health Department approved list will not be considered under this manual. Approval for use in the District is required prior to the application process. Products must meet the minimum requirements established in Section 1 of this manual.
 - b. The aerobic treatment unit shall be placed on a stable, level surface. A minimum of 4" thickness of sand or granular bed overlaying a firm and uniform base is required per manufacturer specifications for installation. Backfill should be free of any large stones (greater than 3") or other debris. Sites with silty soils, high water table or other poor bearing characteristics must have specifically designed bedding and bearing surfaces to prevent settling. Units that will be located within a saturated soil condition must be designed in a manner that considers all other structural issues including, but not limited to, buoyancy and structural effects on the treatment unit.
 - c. A sample port shall be installed such that a sample of the treated effluent can be easily taken without contamination to the sample bottle. The sample port shall be located on the outlet side of the unit between the unit and the dispersal mound.
 - d. Only an Approved Alternative System Distributor/Installer shall install the aerobic unit and must be present at all times during the installation. No work on the aerobic unit may be conducted unless under the direct supervision of an Approved Alternative System Distributor/Installer.
5. Dispersal Area
- a. Infiltrative surface – The infiltrative surface of unsaturated soil to which treated effluent is discharged shall be \geq 24 inches above the estimated highest limiting layer such as groundwater elevation, bedrock, or clay.
 - b. Effluent Distribution
 - i. Pressure distribution is preferred as it distributes the effluent evenly and allows for final treatment (polishing) as the effluent moves through the soil. Gravity flow is not recommended as it may permit excessive loading in one area, which may preclude final treatment (polishing) before effluent reaches the groundwater. (Converse 1997, revised 1999)
 - ii. Absorption System Requirements (refer to Table 1)

Table 1: Absorption System Requirements

Soil Texture	Soil Loading Rate	Sizing Requirements for Pressure Distribution Throughout Field *	Sizing Requirements for Gravity Flow Throughout Field *	Minimum Depth of Unsaturated Soil for Treatment Purposes
	gal/ft ² /day	ft ² /bedroom	ft ² /bedroom	Inches
Medium Sand	1.3	115	160	24
Fine Sand, Loamy Sand	0.9	170	235	24
Sandy Loam	0.6	250	325	24
Loam, Silt Loam	0.5	300	400	24
Sandy or Silty Clay Loam	0.3	500	625	24
Clay Loam	0.2	750	875	24

Notes:

1. The absorption system shall not be sized for less than two bedrooms.
2. As a recommendation, for sites with extremely high water table, shallow restrictive layers or slowly permeable soils, long narrow units instead of short wide units, are necessary so the effluent can be conveyed away from the unit. (Converse, 1997, revised 1999)

* Dispersal bed sizing does not include 4:1 side slope or basal area.

6. At least one observation port to gauge ponding depth in the absorption field is necessary
7. Geotextile fabric shall be used between the top of the stone and soil cover.
8. Taper - The slope surrounding the dispersal area. A taper shall be installed when the dispersal area is installed "on" or "above" the natural grade. The taper shall be constructed of clean sand with no excessive fines and shall be evenly graded from top of the dispersal area to the natural soil surface with a slope of 4:1 or flatter if within a maintained lawn. Final grading of the area should divert water drainage away from the system.
9. The entire mound shall be covered with sufficient suitable soil with a permeability ≥ 3.0 inches/hour to maintain vegetative growth and seeded/mulched upon completion. If the system is constructed after September 15th, a vegetative cover must be provided. Cover may consist of sod, mulch, straw, or other suitable material to prevent freezing.

Maintenance and Monitoring

1. The land owner at his/her sole expense shall comply with a specific maintenance, monitoring, and inspection program specified by this manual to ensure the optimum operation of the treatment system.
2. As a condition of approval, LMAS staff may randomly spot check any aerobic treatment unit.
3. Each owner of land where an aerobic treatment system is located shall have a written operation and maintenance agreement with a qualified maintenance provider for the life

of the system. Approval of the initial maintenance agreement shall be made by LMAS prior to the issuance of the construction permit to ensure required maintenance and inspection frequency. A list of qualified maintenance providers is available upon request. In the event the qualified maintenance provider fails to perform maintenance, the land owner shall make arrangements with another qualified maintenance provider to maintain the aerobic treatment unit.

4. Failure to submit annual maintenance reports to the Department is a violation of the permit and, unless corrected in a timely manner will result in enforcement action (pursuant to Article XIV of the LMAS District Health Department Upper Peninsula Environmental Health Code) against the land owner and possible revocation of operating approval.
5. All aerobic treatment units shall be maintained in accordance with the manufacturer's specifications.
6. The distributor/installer shall provide the manufacturer's operation and maintenance manual to the homeowner.
7. The aerobic treatment unit along with the complete septic system shall be inspected by a Qualified Maintenance Service Provider on the following schedule, at a minimum:
 - a. Within 6-8 weeks after sewage first enters the unit.
 - b. Twice per year for the first 2 years of operation (at least one every six months); once per year thereafter.
 - c. Maintenance, after the first two years of operation, may be reduced if the unit is equipped with a telemetry control panel which is attached to an internet based interface that provides continuous remote monitoring, information management and control of the aerobic unit. Sites that do not have internet access can use an active phone line equipped with an auto dialer to notify the authorized service provider of alarm conditions, including if power to any of the system equipment is disconnected. The system should also include a control panel that tracks, at a minimum, pump elapsed time, cycle counts and high level alarm counts or other means to determine flow through the system and other system information for troubleshooting purposes, as recommended by the manufacturer.
 - d. A meeting with a new owner is recommended at the time of transfer of the property. The LMAS District Health Department should be notified of this meeting and invited to participate. The new owner of the property shall be provided with all information regarding the advanced treatment system which includes (but not limited to) permit and final inspection, manufacturer installation, operation, and maintenance manual, deed notices, maintenance contract, annual maintenance reports, etc. The new owner shall be informed about annual maintenance requirements. The new owner then becomes responsible for submitting annual maintenance reports to the Department.
 - e. Due to difference in wastewater strength, increased user abuse, and hydraulic surges, additional treatment units and/or increased maintenance may be required.
8. Operation and maintenance procedures for seasonal or intermittent use facilities.
 - a. Frequently, aerobic treatment systems are installed at facilities that are used intermittently or seasonally. Because of the reduced or sporadic loading that these installations receive, the routine service and maintenance requirements are different from that normally expected of a year-round residence. The qualified maintenance service provider shall refer to the manufacturer's recommendations

for this type of use and include any additional maintenance and monitoring requirements in the service contract.

9. Owner Request for Service
 - a. Any qualified maintenance provider (under contract) that does not provide service within three (3) days of an owner request may be assessed civil penalties in accordance with Article XIV of the LMAS District Health Department Upper Peninsula Health Code and could result in revocation of qualified maintenance provider approval.
10. The maintenance agreement must be signed by the land owner and the qualified maintenance provider. If the qualified maintenance provider is the land owner then the land owner shall submit a statement in writing acknowledging that he/she is responsible for any and all maintenance. This statement shall also provide consent to random inspections that may be performed by the Department.
 - a. A copy of the initial contract shall be submitted to LMAS as part of the permitting process. The initial two-year contract shall indicate all required inspections as noted above.
 - b. It is the responsibility of the land owner to submit a current maintenance agreement to the Department. Failure to submit is a violation of the permit conditions and unless corrected in a timely manner could result in enforcement action pursuant to Article XIV of the LMAS District Health Department Upper Peninsula Health Code and possible revocation of operating approval.
 - c. Notice of expired maintenance agreements will be mailed to all landowners once LMAS is aware of the expired agreement.
11. Minimum reporting requirements for maintenance inspections performed by a qualified maintenance provider – report shall include information for each with N/A written if not applicable.
 - a. All aerobic treatment units need servicing consistent with the manufacturer’s recommendations to assure long-term system performance.
 - b. At a minimum the inspection report shall include:
 - i. A walk-over of the drainfield and noted conditions;
 - ii. Reporting of conditions observed in the observation port location in the drainfield. (Port shall be installed if there is not one);
 - iii. At least once per year (after the initial 2-year period), it is recommended to measure sludge and scum levels in the septic tank and notify the homeowner if the tank is in need of pumping. Check effluent filter for clogging and clean as needed;
 - iv. Condition of the aerobic unit;
 1. Effluent quality inspection consisting of a visual check for color, turbidity, appearance of scum layer, and examination of odors.
 2. Condition of filters, if applicable.
 - v. Alarm check;
 - vi. Filter cleaning (if applicable);
 - vii. Check of all electrical and/or mechanical components include pump cycle and run time meters;
 - viii. Homeowner education in:
 1. Product use
 2. Proper maintenance of system;
 - ix. Number of persons occupying the dwelling;

- x. List of corrections or alterations that were made during the visit;
 - xi. Septage pumping records shall be submitted each time any of the tanks are pumped, including the septic tank
 - 1. Provider shall obtain from homeowner and shall provide a copy to LMAS.
12. Maintenance Service Report Submittal to LMAS
- a. A copy of the maintenance report shall be submitted to LMAS annually and by no later than December 31st. Telemetry reports shall be submitted for systems on a reduced inspection frequency. Failure to submit an annual report as required is a violation of the operating approval and could result in enforcement action.
 - b. Reports must include information necessary to identify it to the correct property. This shall include, at a minimum: date of inspection, owner's name, and property information including Town (T), Range (R), and Section along with property ID number. Report shall also indicate if the facility is used year-round, seasonally, or intermittently.
 - c. It is recommended that providers submit their report forms to LMAS for review to ensure that all necessary information is included. This should be done prior to using the form.

Noncompliance Monitoring

- 1. The owner is responsible for the proper operation and performance of the system. If additional monitoring is required, the owner shall be responsible for all costs associated with the monitoring and/or system repair.
- 2. In the event that the aerobic treatment unit or associated dispersal component(s) are found to be in noncompliance with the requirements in which it was permitted, the following actions must be taken at the owner's expense:
 - a. The qualified maintenance service provider shall inspect the system in the presence of LMAS staff and correct any deficiencies noted.
 - b. If LMAS deems necessary, samples shall be taken to determine compliance at a frequency determined by LMAS. These samples include, but not limited to: BOD, TSS, and FC.
 - c. If LMAS deems necessary, the installation of a telemetry panel may be required to constantly monitor system function.
 - d. The qualified maintenance service provider shall submit a written report to land owner at the completion of the inspection and/or servicing.
 - e. Use of the system may need to be discontinued if the system malfunctions and is found to be non-repairable, or is non-compliant with the permit and results in an imminent health hazard.
- 3. LMAS Shall have access to the property during regular business hours in order to conduct surveillance monitoring.
 - a. Surveillance monitoring resulting from noncompliance may be charged a monitoring fee in accordance with the Department fee schedule.
 - b. LMAS shall be allowed to initiate required maintenance at the owner's expense if non-compliance with the permit or Upper Peninsula Environmental Health Code results in an imminent health hazard.

4. If compliance with the conditions in which the aerobic treatment unit and/or associated dispersal component(s) was permitted cannot be achieved, or if LMAS determines that the Upper Peninsula Environmental Health Code has been violated, a notice of violation will be issued to the owner.

Variance

1. Variance requests shall be submitted on the LMAS Variance Request Form. Submittal is necessary prior to issuance of permit.
2. Variances will be reviewed under Article XV of the LMAS District Health Department Upper Peninsula Environmental Health Code.
3. Variances thus granted apply only to the specific project under consideration and do not serve as precedents in other cases.

Permitting

1. Upon completion of the permit application/design review, LMAS shall accept the design, reject the design, require additional information for clarification, or require verification.
2. If the permit application/design is not acceptable, LMAS shall notify the applicant in writing and shall state the deficiencies or actions, or both, necessary to bring the design into compliance with the requirements set forth in this document.
3. When a completed permit application/design is deemed acceptable, LMAS shall issue a construction permit.

Limitation of Responsibility

1. Plan approval by LMAS may not be construed as an assumption of any responsibility for the design of the Alternative Treatment System and associated components.
2. LMAS does not hold itself liable for any defects in design and/or construction, or for any damages that may result from a specific installation.

Final Inspections and Approval to Use System

1. A final inspection shall be conducted by LMAS in accordance with Section 3-11.3 of the LMAS District Health Department Upper Peninsula Environmental Health Code. During this inspection, LMAS will approve or deny covering the system. Approval to use the system will not be granted until all required information has been received:
 - a. Request for a final inspection of the alternative system by the contractor, installer, or property owner shall serve as notice to the Department that the system is installed according to the permit and associated design plans. Final inspection conducted by the Department shall identify any items of noncompliance.
 - b. No portion of the system shall be covered and the system shall not be placed into service prior to final inspection and approval. Property owner is responsible for maintenance and monitoring of the system following approval from the Department, unless a contract agreement is in place between the property owner and a qualified maintenance provider.
 - c. The Design Consultant shall provide the LMAS District Health Department with written certification that the installed system meets their design and the intent of the minimum requirements contained within this document.

- d. Any other information requested by LMAS such as watertight tank test results and pump installation certification.
2. After all required information has been submitted, LMAS shall issue a final drawing/operating approval to the applicant.

Revocation of Permit

1. The Department may revoke any plan approval under this Section when one or more of the following conditions exists:
 - a. The location of the system(s) specified in the design is altered.
 - b. There is an increase in the scope of the project prior to, during, or following construction.
 - c. LMAS acquires new information indicating that any agency rules or regulations are violated before, during, or after construction.
 - d. LMAS has reasonable cause to believe that an intentional misrepresentation has occurred.

Disclaimer

1. The LMAS District Health Department reserves the right to require special restrictions, in rare circumstances, in addition to those listed herein to ensure that an adequate sewage disposal system is installed. These restrictions may be determined on a site-specific basis.

Section 6: Minimum Design Parameters – Geotextile Sand Filter (GSF)

Description

The Geotextile Sand Filter (GSF) is a passive advanced treatment assembly consisting of a proprietary GSF module(s), which contain a biomat fabric and a cusped plastic core for treatment of septic tank effluent. This is placed on a specified sand base to provide supplemental wastewater treatment before discharge to the native soil.

Conditions for Application Submittal

1. A Michigan Registered Sanitarian, Professional Engineer specializing in environmental or sanitary wastewater treatment, or licensed sewage system installer registered with LMAS to design the particular alternative treatment system proposed shall provide a detailed design plan for each specific application.
2. Provide a scaled site plan detailing all aspects of the proposed work along with the LMAS District Health Department application form.
 - a. Plans shall be at least 8 1/2" X 11" in size and shall be legible, clear, and permanent copies.
 - b. Plans shall include the name of the person who prepared the plan and shall be stamped if prepared by a Michigan Registered Sanitarian or Professional Engineer.
3. A *Submittal Checklist for Alternative Treatment* is available per request for guidance.
4. A contract/attachment to the deed shall be filed with the County Clerk indicating the property contains a secondary treatment system and the property limitation imposed by such a system. The property owner shall provide evidence that such contract/attachment has been filed before the Department issues the construction permit.
5. Plans will not be reviewed until all required components described herein are submitted with the applicable fee.

Sewage Treatment Components

1. Site Preparation - Ultimate success or failure of a system also relies on clear communication along with the understanding of basic site preparation and construction principles. Critical issues include:
 - f. Proper procedures must be followed to protect the location area including required greenbelt area during and after construction. After establishing a suitable location for the initial and replacement area including greenbelt area, it should be suitably fenced or otherwise unmistakably identified to prevent further disturbance until actual construction can occur. Site planning resulting in a location for the system that is isolated from other anticipated home construction activities is encouraged.
 - g. Soil smearing and compaction, which can reduce infiltration capacity, will occur if soils are worked on when wet. Construction activities should be scheduled only when soils are sufficiently dry. Acceptable soil moisture content of the soils to a depth of one foot should be evaluated by rolling a sample of soil between the hands. If the soil can be rolled into a 1/4 inch or

smaller "wire" it is considered too wet and should be allowed to dry before preparing. If site is questionable then certification from Design Consultant shall be required.

- h. Excessive vegetation should be removed from the basal area. Remove all tree stumps and the central root system below grade by using a backhoe or excavator with a mechanical "thumb" or similar extrication equipment, lifting or leveraging stump in a manner that minimizes soil disturbance. It is not necessary for the soil of the system site to be smooth when the site is prepared. Avoid soil disturbance, relocation, or compaction. Avoid mechanical leveling or tampering of dislodged soil. Fill all voids created by stump removal with system sand.
- i. The entire basal area of the mound should be suitably prepared by roughening in a ridge and furrow fashion with ridges following the contours. Methods that can be considered for roughening include chisel teeth fastened to the backhoe bucket, plowing with a multiple bottom agricultural chisel plow, or moldboard plow. Rototilling is not acceptable. Sand fill material should be applied immediately after roughening and prior to any subsequent precipitation.
- j. Cleanliness of the sand fill should be checked prior to construction. Placement of fill material is to be accomplished from the end and upslope sides utilizing a tracked vehicle or equipment with adequate reach to minimize soil compaction. A minimum of six inches of fill material should be maintained below the tracks to minimize compaction. Wheeled vehicles should be prevented from travel over the mound basal area and downslope of the greenbelt area. Total depth of fill shall be established on a benchmark provided by the design consultant on the design plan.

2. Septic Tank

- h. Tank requirements are established in Section 3-14.5 of the LMAS District Health Department Upper Peninsula Environmental Health Code.
- i. The minimum capacity for septic tanks for a one, two, or three-bedroom dwelling shall be 1,000 gallons, except where in the opinion of the Department, increased capacities may be required. Each additional bedroom shall require an additional 250 gallons. Each garbage grinder shall require an additional 250 gallons.
- j. Septic tanks shall be equipped with an approved effluent filter installed in the outlet baffle, or other approved location.
- k. Septic tanks shall be equipped with a watertight access riser installed to grade to facilitate maintenance. Risers shall be installed with dual lids, leaving the concrete lid in place, or shall be equipped with other Department approved safety device to preclude accidental tank entry.
- l. All septic tanks shall be installed to be level and to flow in accordance with the manufacturer's design intent.
- m. All systems receiving sewage from a grinder pump shall be equipped with a minimum of two 1,000 gallon septic tanks. The first septic tank shall be installed in series to allow the settling of sewage discharged by the pump and shall be equipped with an outlet baffle.

- n. Septic tanks and pump tanks shall be tested and certified to be watertight. Testing and certification must be performed on-site and in-place, by the tank manufacturer, design consultant, or licensed septic installer. Hydrostatic or vacuum test may be utilized to determine if the septic tank and/or pump tank are water tight. Certification shall be submitted prior to or during the final inspection performed by the Department.
- 6. Pump - See Section 2 of this manual for pump tank and pump design parameters.
- 7. Dispersal Area
 - a. Infiltrative surface – the infiltrative surface of unsaturated soil to which treated effluent is discharged to shall be ≥ 24 inches above the limiting layer noted in the site evaluation report. Allowance granted for the 12 inches of specified sand (2NS) required below the GSF modules.
 - b. The system shall be constructed per the GSF design manual within this section.
 - c. Effluent Distribution – pressure distribution throughout the dispersal system is preferred. Gravity flow distribution may be allowed only when gravity flow can be achieved throughout the entire system. Pump to gravity flow at the modules will not be allowed.
 - d. Taper – the slope surrounding the dispersal area. A taper shall be installed when the dispersal area is installed “on” or “above” the natural grade. The taper shall be constructed of clean sand with no excessive fines and shall be evenly graded from the top of the dispersal area to the natural soil surface with a slope of 4:1 or flatter if within a maintained lawn. Final grading of the area should divert water drainage away from the system.

Operation and Maintenance

Passive treatment systems do not require a maintenance and monitoring agreement, however they do require minimal maintenance as is standard for conventional onsite systems, provided the system is not subjected to abuse. An awareness of proper use and routine maintenance will ensure system longevity. The premise shall be used for the purpose intended when permitted. Any modification in usage of the premise shall be reported to the Department for evaluation. As a condition of operating approval, LMAS staff may conduct random site inspections.

- 1. Septic Tank and Effluent Filter
 - a. Inspect the septic tank at least once every two years under normal usage. The tank shall be emptied of sludge and floating material by a licensed septage hauler at a recommended frequency of 3-5 years
 - b. After pumping, inspect the integrity of the septic tank to ensure that no groundwater is entering it. Also check the inlet and outlet and repair if needed.
 - c. Effluent filters require on-going maintenance due to their tendency to clog and cut off oxygen to the system. The effluent filter shall be cleaned at every septic tank pump out and inspected every 6-12 months. Follow filter manufacturer’s maintenance instructions.
 - d. Owner must keep copies of the pump-out invoice and shall provide maintenance as required by the GSF manufacturer.
 - e. The use of enzymes or any septic system additives is prohibited.

2. Pumped Systems
 - a. Inspect at least once a year to assure adequate operation of pump, floats, control panel, alarm, etc.
 - b. The dose of wastewater shall be verified once a year to ensure it meets GSF requirements per the permitted design plan.
 - c. The distribution laterals shall be inspected at least once a year to ensure even distribution between the GSF modules.
3. Infiltration Area
 - a. It is important that the system site remain free of shrubs, trees, and other woody vegetation. Roots can infiltrate and cause damage or clogging of system components.
 - b. Make sure the infiltration area is free of motorized vehicle traffic, is seeded, and that all water is diverted to avoid overloading.
 - c. If the system has a vent, make sure it is not obstructed.
 - d. Check and immediately report any odor or sign of water breakouts around the system.

Noncompliance

1. The owner is responsible for the proper operation and performance of the system. If additional monitoring is required, the owner shall be responsible for all costs associated with the monitoring and/or system repair.
2. In the event that any part of the system is found to be in noncompliance with the requirements in which it was permitted, the following actions must be taken at the owner's expense:
 - a. The distributor shall inspect the system (with LMAS staff person present) to determine any deficiencies.
 - b. If LMAS deems necessary, effluent samples shall be taken to determine system compliance.
 - c. Use of the system may need to be discontinued if the system is found to be non-repairable, is non-compliant with the permit, or results in an imminent health hazard. If compliance with the conditions in which the GSF and/or associated components was permitted under cannot be achieved, or if the Department determines that the Upper Peninsula Environmental Health Code has been violated, a notice of violation will be issued to the owner.

Variance

1. Variance requests shall be submitted on the LMAS Variance Request Form. Submittal is necessary prior to issuance of permit.
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1. A final inspection shall be conducted by LMAS in accordance with Section 3-11.3 of the LMAS District Health Department Upper Peninsula Environmental Health Code. During this inspection, LMAS will approve or deny covering the system. Approval to use the system will not be granted until all required information has been received:
 - a. Request for a final inspection of the alternative system by the contractor, installer, or property owner shall serve as notice to the Department that the system is installed according to the permit and associated design plans. Final inspection conducted by the Department shall identify any items of noncompliance.
 - b. No portion of the system shall be covered and the system shall not be placed into service prior to final inspection and approval. Property owner is responsible for maintenance and monitoring of the system following approval from the Department, unless a contract agreement is in place between the property owner and a qualified maintenance provider.
 - c. The Design Consultant shall provide the LMAS District Health Department with written certification that the installed system meets their design and the intent of the minimum requirements contained within this document.
 - d. Any other information requested by LMAS such as watertight tank test results and pump installation certification.
2. After all required information has been submitted, LMAS shall issue a final drawing/operating approval to the applicant.

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1. The Department may revoke any plan approval under this Section when one or more of the following conditions exists:
 - a. The location of the system(s) specified in the design is altered.
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Geotextile Sand Filter

Michigan Design & Installation Manual



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Glossary of Terms

A42 Module	48" x 24" x 7" (L x W x H)
A22 Module	24" x 24" x 7" (L x W x H) <i>Note: A22 Half Modules are half the length of the standard A42 Module and are utilized to round up trench rows to equal length.</i>
B43 Module	48" x 36" x 7" (L x W x H)
B23 Module	24" x 36" x 7" (L x W x H) <i>Note: B23 Half Modules are half the length of the standard B43 Module and are utilized to round up trench rows to equal length.</i>
Bio-Matt™ fabric	Proprietary filter fabric within the Geotextile Sand Filter Modules upon which the primary biomat layer forms.
Cover Fabric	The geotextile cover fabric (provided by manufacturer) that is placed over the GSF modules.
Cusped Core	The rigid plastic core of the GSF module. It separates the geotextile fabric and creates downward infiltration channels and upward aeration channels to provide primary filtration and biological treatment of the septic effluent. The curvilinear shape of the cuspatations offers increased treatment surface area and greater effluent storage.
Design Flow	The estimated peak flow that is used to size a GSF system is 150 gallons per day per Bedroom.
Distribution Box	A plastic or concrete box that receives effluent from a septic tank and splits the flow to pipes placed above the GSF modules. For equal distribution, the outlet pipe orifices are typically set at the same elevation to equalize the flow to each line.
EHGWT	The Estimated High Ground Water Table (EHGWT) is the elevation of saturated condition as measured or as estimated from evaluation of soil color.
Flow Dial/Equalizer	Special insert placed in the end of distribution pipes within the distribution box to compensate for possible unlevel installation and promote favorable flow to the distribution pipes.
GSF	The Eljen Geotextile Sand Filter Modules and the 12-inch sand layer at the base and 6 inches along the sides of the modules.
GSF Module	The individual module of a GSF system. The module is comprised of a cusped plastic core and corrugated geotextile fabric.
LTAR	Long Term Acceptance Rate (LTAR) is the average equilibrium absorption rate for effluent in a system, usually expressed in gallons per day per square foot. It should not be confused with the soil loading rate that is used by regulatory officials in their regulations.
SHGWT	Seasonal High Ground Water Table (SHGWT) is the elevation to which the ground or surface water can be expected to rise due to a normal wet season.

Glossary of Terms

Specified Sand

To ensure proper system operation, the system **MUST** be installed using either MDOT 2NS sand or ASTM C33 Sand.

MDOT 2NS sand will have less than 10% passing the #100 Sieve and less than 3% passing the # 200 sieve. Ask your material supplier for a sieve analysis to verify that your material meets the required specifications.

TABLE 1: SPECIFIED SAND SIEVE REQUIREMENTS

MDOT 2NS SAND SPECIFICATION		
Sieve Size	Sieve Square Opening Size	Specification Percent Passing (Wet Sieve)
3/8 inch	9.52 mm	100
No. 4	4.76 mm	95 - 100
No. 8	2.38 mm	80 - 100
No. 16	1.19 mm	50 - 85
No. 30	590 µm	25 - 60
No. 50	297 µm	5 - 30
No. 100	149 µm	0 - 10
No. 200	75 µm	0 - 3

GSF System Description

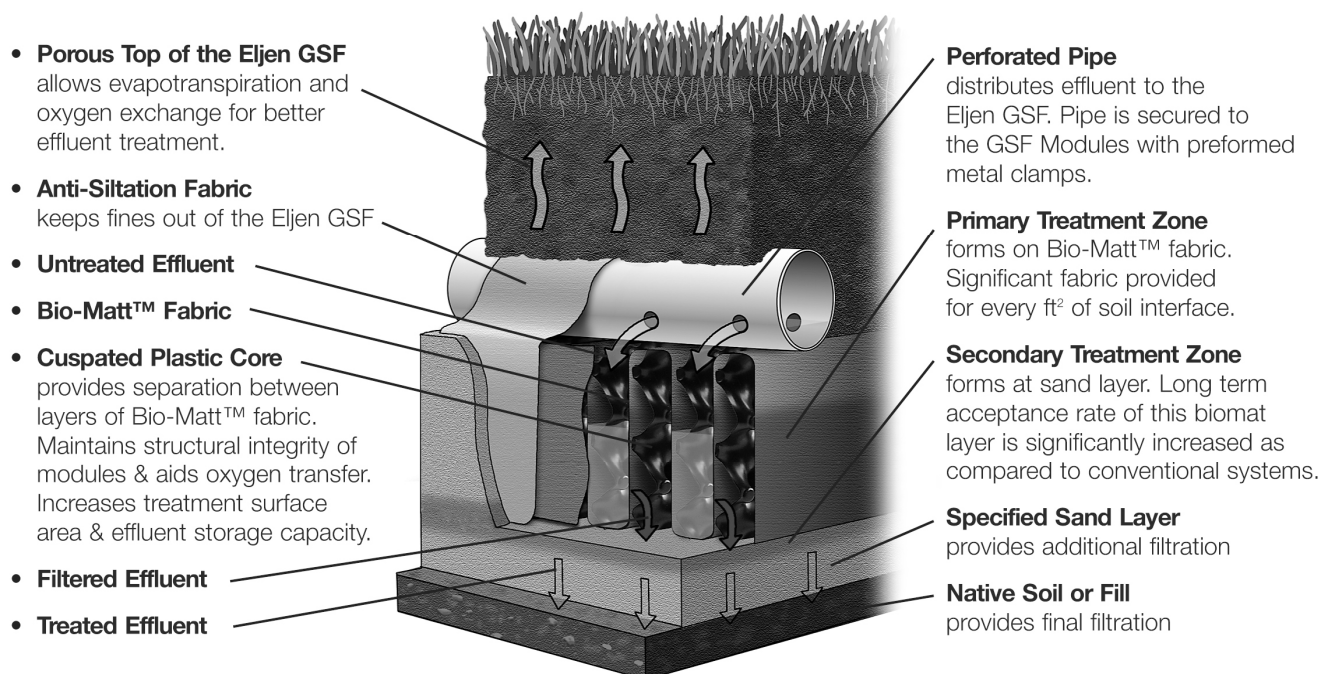
Primary Treatment Zone

- Perforated pipe is centered above the GSF module to distribute septic effluent over and into corrugations created by the cusped core of the geotextile module.
- Septic effluent is filtered through the Bio-Matt fabric. The module's unique design provides increased surface area for biological treatment that greatly exceeds the module's footprint.
- Open air channels within the module support aerobic bacterial growth on the modules geotextile fabric interface, surpassing the surface area required for traditional absorption systems.
- An anti-siltation geotextile fabric covers the top and sides of the GSF module and protects the Specified Sand and soil from clogging, while maintaining effluent storage within the module.

Secondary Treatment Zone

- Effluent drips into the Specified Sand layer and supports unsaturated flow into the native soil. This Specified Sand/soil interface maintains soil structure, thereby maximizing the available absorption interface in the native soil. The Specified Sand supports nitrification of the effluent, which reduces oxygen demand in the soil, thus minimizing soil clogging from anaerobic bacteria.
- The Specified Sand layer also protects the soil from compaction and helps maintain cracks and crevices in the soil. This preserves the soil's natural infiltration capacity, which is especially important in finer textured soils, where these large channels are critical for long-term performance.
- Native soil provides final filtration and allows for groundwater recharge.

FIGURE 1: GSF System Operation



Testing and Performance

GSF Modules were subjected to independent third-party testing in accordance with NSF/ANSI Standard 40 Protocol. Three different methods of distribution were tested:

- Pressure Distribution
- Lift Pump/Gravity Demand Dosed Distribution
- Gravity Distribution

The data and detailed reports for each system tested were reviewed by NSF in accordance with NSF/ANSI Standard 40 Protocol and the Pennsylvania Department of Environmental Protection Technical Verification Program. This independent review validates the performance data listed below for Demand Dosed, Pressure Dosed, and Gravity systems.

Testing Arrangement & Common Factors:

Common Factors for all tested systems listed in Table 2:

- A42 modules: (L x W x H) 48" x 24" x 7" plus Specified Sand.
- Six modules per bedroom at 150 gal/day, 18 modules total for three bedrooms per house equals 450 gal/day.
- Standard distribution pipe with orifices at the 5 & 7 o'clock position,
- 12 inches of Specified Sand base extending 6 inches at either edge of the modules.

Lift Pump/Gravity Demand Dosed System:

- 1000 gal septic tank – 500 gallon pump chamber to distribution box.
- Dial-a-flow fittings set level to deliver effluent into each of the three rows of laterals via a 4-inch perforated distribution pipe with orifices at the 5 & 7 o'clock position.
- A non-perforated pipe connects the distal end to the end of other rows.

Time Pressure Dosed System:

- 1000 gal septic tank – 500 gal pump chamber – 1.25" low-pressure pipe (LPP) or other diameter as required.
- LPP placed inside a 4-inch perforated distribution pipe with orifices at 12 o'clock, at least one drain hole per line at 6 o'clock.
- The 4-inch perforated pipe orifices are placed at the 5 & 7 o'clock positions with the end of pipe capped

Gravity System Trench Design:

- 1000 gal septic tank–gravity to distribution box.
- Dial-a-flow fittings set level to deliver influent into three individual trenches.
- Perforated distribution pipe with orifices at the 5 & 7 o'clock positions with the end of pipe capped.

TABLE 2: TESTING RESULTS

GSF Modules Treatment Performance NSF Standard 40 Protocol Wastewater Influent Median Characteristics: CBOD 180 mg/L & TSS 180 mg/L		
Demand Dosed		
	CBOD (mg/L)	TSS (mg/L)
Mean	2.0	2.7
Median	1.0	2.5
Min Value	1.0	2.5
Max Value	7.2	7.0

GSF Modules Treatment Performance NSF Standard 40 Protocol Wastewater Influent Median Characteristics: CBOD 180 mg/L & TSS 190 mg/L		
Timed Pressure Dosed		
	CBOD (mg/L)	TSS (mg/L)
Mean	2.6	2.7
Median	2.2	2.5
Min Value	1.0	2.5
Max Value	14.0	9.0

GSF Modules Treatment Performance NSF Standard 40 Protocol Wastewater Influent Median Characteristics: CBOD 180 mg/L & TSS 180 mg/L		
Gravity		
	CBOD (mg/L)	TSS (mg/L)
Mean	8.0	7.4
Median	7.6	5.0
Min Value	1.0	2.5
Max Value	18	55
TSS 2.5mg/L = sample was below detection limits CBOD 1.0mg/L = sample was below detection limits		

1.0 Design and Installation

FIGURE 2: Typical B43 GSF Cross Section

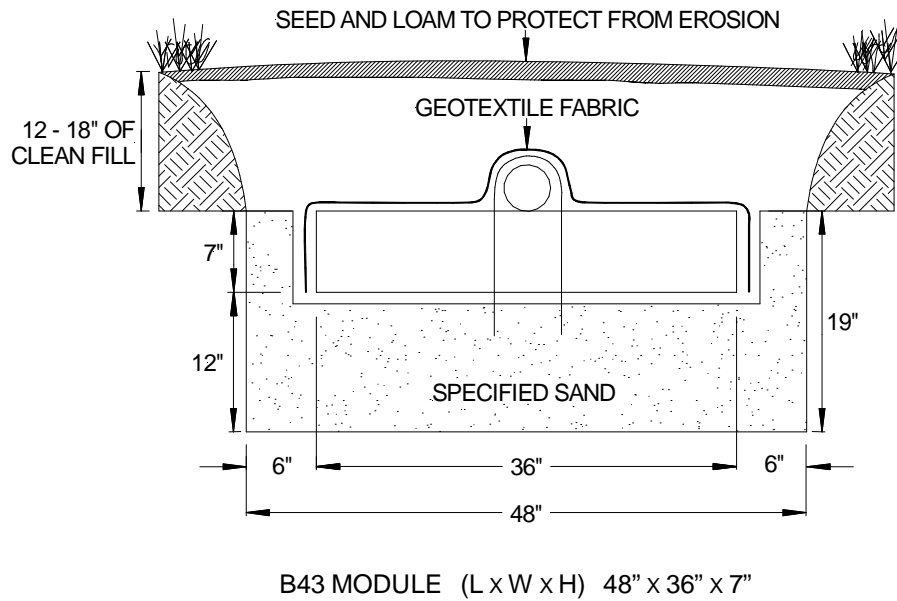
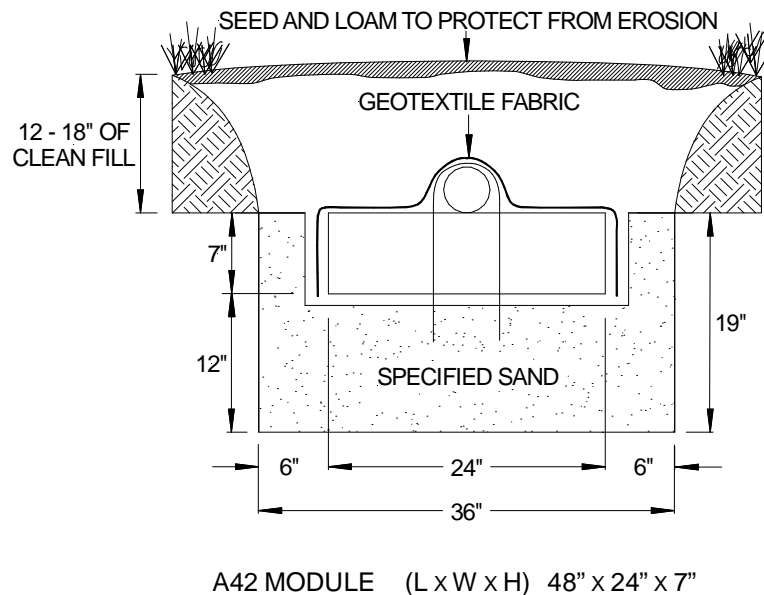


FIGURE 3: Typical A42 GSF Cross Section



All Systems are Required to Have a Minimum of:

- 6 inches of Specified Sand is at the edges of the GSF module.
- 6 inches of Specified Sand is at the beginning and end of each GSF Trench.
- 12 inches of Specified Sand is directly below the GSF module.
- Minimum 12 inches of native soil fill above the module.

1.0 Design and Installation

1.1 REQUIREMENTS: GSF systems must meet the local rules and regulations except as outlined in this manual. The Michigan Criteria for Subsurface Sewage Disposal and the local regulations will be referred to as the *guidelines* in this manual.

The sizing charts apply to residential systems only. Sizing charts are found in section 1.15. Please contact Eljen's Technical Resource Department at 1-800-444-1359 for design information on commercial systems.

1.2 SPECIFIED SAND SPECIFICATION FOR TRENCH SYSTEMS: The first 12 inches of sand immediately under, between rows and around the perimeter of the GSF system must be ***MICHIGAN DEPARTMENT OF TRANSPORTATION (MDOT) 2NS SAND, WITH LESS THAN 10% PASSING A #100 SIEVE AND LESS THAN 3% PASSING A #200 SIEVE.*** Please place a prominent note to this effect on each design drawing. See Table 1 for more information on the sand and sieve specifications.

1.3 CONNECTIONS AND FITTINGS: Connections of lines to tanks and distribution boxes must be made using watertight mechanical seals. Use of any grouting material is not permitted.

1.4 PLACING GSF MODULES: The "White Stripe" on the GSF modules indicates the top of the module and is not intended to indicate the location of the distribution pipe. With the white stripe facing up, all rows of GSF modules are set level, end to end on the Specified Sand layer. No mechanical connection is required between modules.

1.5 DISTRIBUTION PIPE: SDR-35 or equivalent is required. Place perforated pipe on top of GSF modules with holes at 5 and 7 o'clock. Secure pipe to GSF modules with provided wire clamps, one clamp per Eljen module. All distribution piping must meet a minimum 2,500 pound crush test specification or meet the requirements of the most recent revision of ASTM D 2665 for polyvinyl chloride (PVC) drain and waste pipe. Furthermore, all piping must meet state and local regulations.

1.6 DISTRIBUTION BOX: Set the gravity system D-box outlet invert a minimum of 1/8 inch drop in elevation per linear foot to the top first module in the trench. Set a 2-inch minimum drop for dosed systems from the D-box to the modules. Ensure that the distribution box and pipes feeding the system are placed on settled soil. Flow Dials may be used in either Gravity or Dosed installations.

1.7 COVER FABRIC: Geotextile cover fabric is provided by Eljen Corporation for all GSF systems. It is placed over the top and sides of the module rows to prevent long term siltation and failure. **Cover fabric substitution is not allowed.** Fabric should drape vertically over the pipe and must not block holes in the distribution pipe or be stretched from the top of the pipe to the outside edge of the modules. "Tenting" will cause undue stress on fabric and pipe.

1.8 BACKFILL & FINISH GRADING: Complete backfill with 12-18 inches of clean porous fill measured from the top of modules. Backfill exceeding 18 inches requires venting at the far end of the trench or bed. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff from the Effluent Disposal Area, (EDA). Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

1.9 ADDITIONAL FACTORS EFFECTING RESIDENTIAL SYSTEM SIZE: Homes with expected higher than normal water usage may consider increasing the septic tank volume as well as incorporating a multiple compartment septic tank. Consideration for disposal area may be up-sized for expected higher than normal water use.

For example:

- Luxury homes, homes with a Jacuzzi style tubs, and other high use fixtures.
- Homes with known higher than normal occupancy.
- Homes on high-pressure city water: recommend that the homeowner install a water pressure regulator to reduce pressure.

1.0 Design and Installation

1.10 GARBAGE DISPOSALS: Eljen discourages the use of garbage disposals with septic systems. If a GSF system is to be designed and installed with garbage disposals the following measures must be taken to prevent solids from leaving the tank and entering the GSF system:

- Increase the septic tank capacity by a minimum of 30% or
- Installation of a second septic tank installed in series or
- Installation of an appropriate sized septic tank outlet effluent filter.

Eljen strongly recommends the use of septic tank outlet effluent filters on all systems especially on those systems that have single compartment tanks, even if up-sized, and when the dwelling has a garbage disposal installed.

1.11 WATER SOFTENER BACKWASH: At no time should water softener backwash be disposed of in the septic system. Water softener backwash should be discharged to a separate soil absorption field.

1.12 SEPTIC TANKS: Many designers are now specifying dual compartment tanks for all their systems. Eljen supports this practice as it helps to promote long system life by reducing TSS and BOD to the effluent disposal area. Gas baffles and/or effluent filters are also recommended.

1.13 SEPTIC TANK FILTERS: Wastewater filters are strongly recommended as a means of preventing solids from leaving the tank and entering your system. Filter manufactures require that filters be cleaned from time to time. Ask your installer or designer for specific cleaning requirements based on the type or make of the filter installed. Eljen requires the septic tank to be pumped every three years or as needed which would be a good time to check and conduct filter maintenance.

1.14 SYSTEM VENTING: It is strongly recommended to vent all systems that are over 18" below finished grade and systems beneath any surface condition that would not allow for surface air exchange with the system such as patios. See Section 8.0 for a more detailed explanation of venting GSF products.

1.15 NUMBER OF GSF MODULES REQUIRED: Residential systems use a minimum of six (6) A42 modules per bedroom or five (5) B43 modules per bedroom. See Section 1.16 for more information on systems sizing.

1.16 SIZING GSF SYSTEM FOR TRENCHES, BEDS & SAND MOUNDS: To remain consistent with advanced treatment sizing practices within Michigan, Eljen recommends a 50% reduction to current state, county and/or local wastewater soil application rates for trenches, beds and mounds.

Based on third-party performance testing data, NSF verification letters and over 20 years of success using similar sizing across the country, Eljen Corporation feels this is a reasonable and rational approach to system sizing based on the improved effluent quality achieved by septic tank effluent going through the Eljen Module and 12 inches of Specified Sand.

Table 3 below shows adjusted soil application rate numbers for Michigan Pressure Sand Mounds based on sizing requirements found in the Michigan Department of Environmental Quality *Pressure Mound Systems: Technical Guidance for Site Suitability, Design, Construction, and Operation and Maintenance, June 2003*.

TABLE 3: GSF B43 & A42 PRESSURE SAND MOUND SOIL APPLICATION RATES

Soil Structure	Maximum Soil Loading Rate GPD/FT ²					Maximum Hydraulic Linear Loading Rate GPD/LF					Required Downslope Greenbelt** (Slope > 2 %, Feet)
	BK/GR			PL	M	BK/GR			PL	M	
	1	2	3			1	2	3			
Soil Texture*											
Coarse Sand / Medium Sand	2.0	2.0	2.0	1.0	1.0	5.0	5.0	5.0	2.5	2.5	NR
Fine Sand / Sandy Loam	0.8	1.0	1.2	0.8	0.8	3.5	4.0	4.5	2.0	2.0	10
Very Fine Sand / Sandy Loam	0.6	0.8	1.0	U	0.4	3	3.5	4	U	1.0	20
Loam / Sandy Clay Loam	0.4	0.5	0.6	U	0.4	2.5	3.0	3.5	U	U	30
Clay Loam / Silty Clay Loam	0.3	0.4	0.5	U	U	1.8	2.5	3.0	U	U	40
Silty Clay / Sandy Clay / Clay	UNSUITABLE										NA

* Most Limiting Layer in Upper 18 inches

** Measured From Toe of Mound Fill

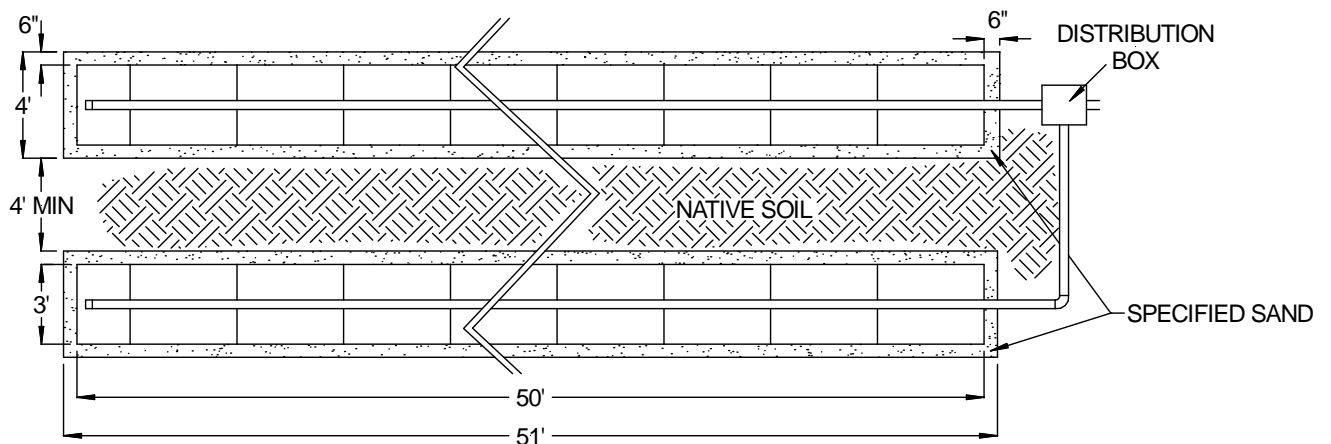
2.0 Trench Installation Sizing and Guidelines

Trench Example:

House size –	4 Bedrooms
Soil Permeability min/in –	15 min/in
Design Flow – 150 gpd x 4 bedrooms =	600 gpd
Existing Soil Application Rate (for this example) –	0.75 gpd/ft ²
<i>(Note: Please refer to your State, County, and/or Local regulations for specific application rate information)</i>	
How to calculate reduced application rate:	
0.75 gpd/ft ² ÷ 0.5 (50% reduction) =	1.5 gpd/ft ²
How to calculate the modules necessary:	
Field Size with Reduction = 600gpd ÷ 1.5 gpd/ft ² =	400 ft ²
Number of units required = 400 ft ² ÷ 16 ft ² / module =	25 modules
For this example, assume the number of trenches equals two:	
Trench Width – Module width (3ft) + Sand Sidewalls (6" + 6") =	4 ft
Trench Length – 25 modules ÷ 2 trenches = 12.5, use	12 B43 & 1 B23 modules per row
Modules (12.5) x 4 lf/module + 1 ft (6" sand at each end of trench) =	51 ft
Trench area (width x length x trenches) – 4 ft x 51 ft x 2 trenches =	408 ft ²

Trench Dimensions:	
Length =	51 ft/trench
Width =	4 ft
Trenches =	2
Modules =	24 B43 & 2 B23
Total Area =	408 ft ²

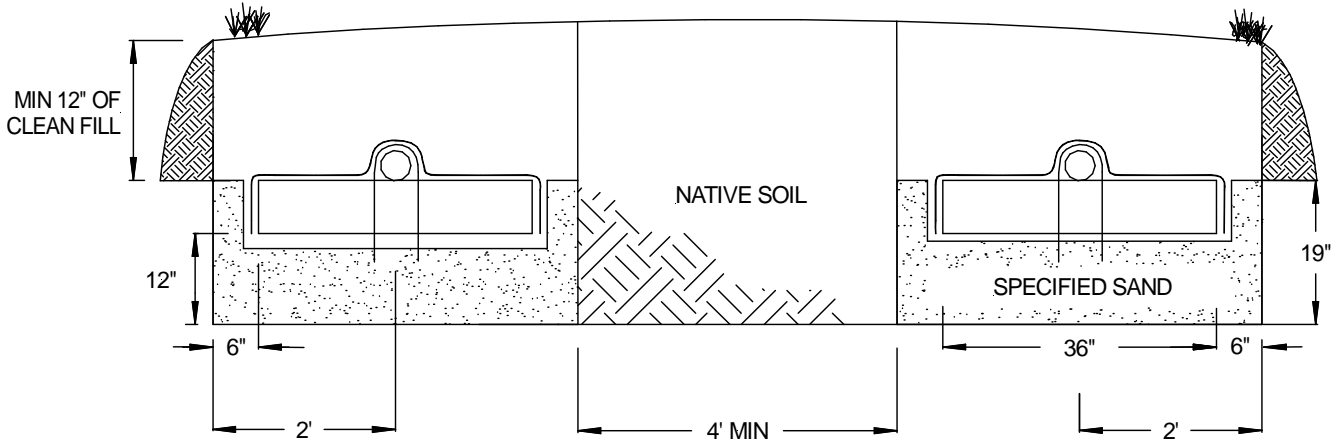
FIGURE 4A: PLAN VIEW – 600 GPD – TRENCH SYSTEM – LEVEL SITE



Design Flow 150 gpd x 4 Bedrooms = 600 gallons per day.
(12 B43 & 1 B23 Modules per Trench)

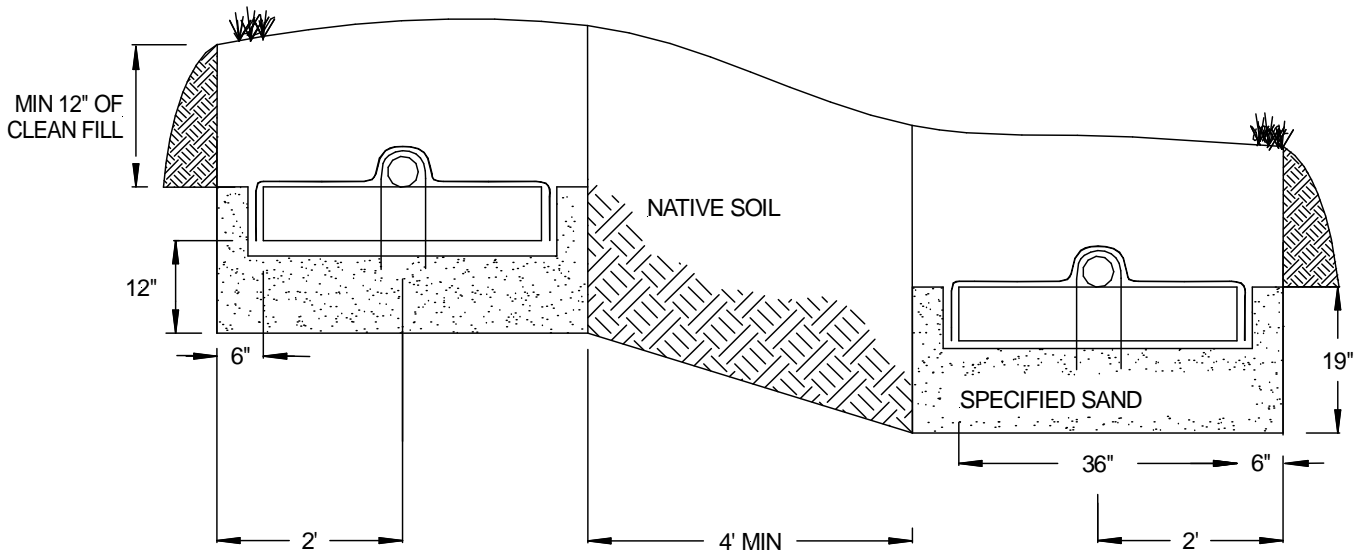
2.0 Trench Installation Sizing and Guidelines

FIGURE 4B: SECTION VIEW – 600 GPD – TRENCH SYSTEM – LEVEL SITE



Design Flow 150 gpd x 4 Bedrooms = 600 gallons per day.
 (12 B43 & 1 B23 Modules per Trench)

FIGURE 4C: SECTION VIEW – 600 GPD – TRENCH SYSTEM – SLOPING SITE



Design Flow 150 gpd x 4 Bedrooms = 600 gallons per day.
 (12 B43 & 1 B23 Modules per Trench)

2.1 Trench Installation Sizing and Guidelines

Trench Installation Guidelines Additional guidance in State and Local regulations	
Determine the Number Modules	Determine the number of GSF Modules required using the trench sizing example.
Plan all Drainage Requirements	Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.
Excavating the Trench Area	Scarify the receiving layer to maximize interface between the native soil and Specified Sand. Minimize walking in the trench prior to placement of the Specified Sand to avoid soil compaction.
Placing Specified Sand Base	Place Specified Sand in two 6 inch lifts, compact each lift at a time. The compacted height below the GSF module must be level at 12 inches. A hand tamping tool or vibrating compactor is both acceptable.
Place GSF Modules	Place the GSF Modules, PAINTED STRIPE FACING UP , end to end on top of the Specified Sand along their 4-foot length.
Distribution Pipes Gravity & Lift Pump/Gravity Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Distribution Pipes: Pressure Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. Insert a pressure pipe (<i>size per design and code</i>) into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 7. Each pressure lateral will have a drain hole at the 6 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Place Geotextile Cover Fabric	<p>Cover fabric substitution is not allowed. The installer should lay the Eljen provided geotextile cover fabric lengthwise down the trench, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by:</p> <ul style="list-style-type: none"> • Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe. • Place shovel full's of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.
Placing Specified Sand after Cover Fabric is in place	Place 6 inches of Specified Sand along both sides of the modules edge. A minimum of 6 inches of Specified Sand is placed at the beginning and end of each trench.
Backfilling the System	Complete backfill with native soil to 12 - 18 inches over the GSF modules. Backfill exceeding 18 inches requires venting at the distal end of the trench. Fill must be clean, porous and devoid of rocks. Do not use wheeled equipment over the system during backfill operation. A light track machine may be used with extreme caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff. Finish grade to prevent surface ponding. Topsoil and seed to protect from erosion.

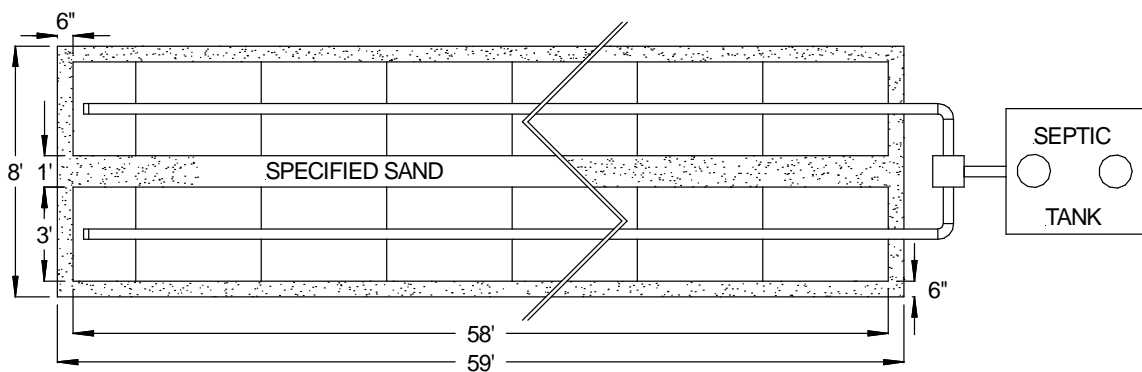
3.0 Bed Installation Sizing and Guidelines

Bed Example:

House size –	3 bedrooms
Soil Permeability min/in –	18 min/in
Design Flow – 150 gpd x 3 bedrooms =	450 gpd
Existing Soil Application Rate (for this example)	0.5 gpd/ft ²
<i>(Note: Please refer to your State, County, and/or Local regulations for specific application rate information)</i>	
How to calculate reduced application rate:	
0.5 gpd/ft ² ÷ 0.5 (50% reduction) =	1.0 gpd/ft ²
How to calculate the modules necessary:	
Field Size with Reduction = 450gpd ÷ 1.0 gpd/ft ² =	450 ft ²
Number of units required = 450 ft ² ÷ 16 ft ² / module =	28.125 modules, round up to 29 modules
For this example, assume the number of rows equals two:	
Bed Width – Module width (3ft) + Sand Sidewalls (6" + 6") x Rows (2) =	8 ft
Bed Length – 29 modules ÷ 2 rows = 14.5, use	14 B43 & 1 B23 modules per row
Modules (14.5) x 4 lf/module + 1 ft (6" sand at each end of bed) =	59 ft
Bed area (width x length x rows) – 4 ft x 59 ft x 2 rows =	472 ft ²

Bed Dimensions:	
Length =	59 ft
Width =	8 ft
Rows =	2
Modules =	28 B43 & 2 B23
Total Area =	472 ft ²

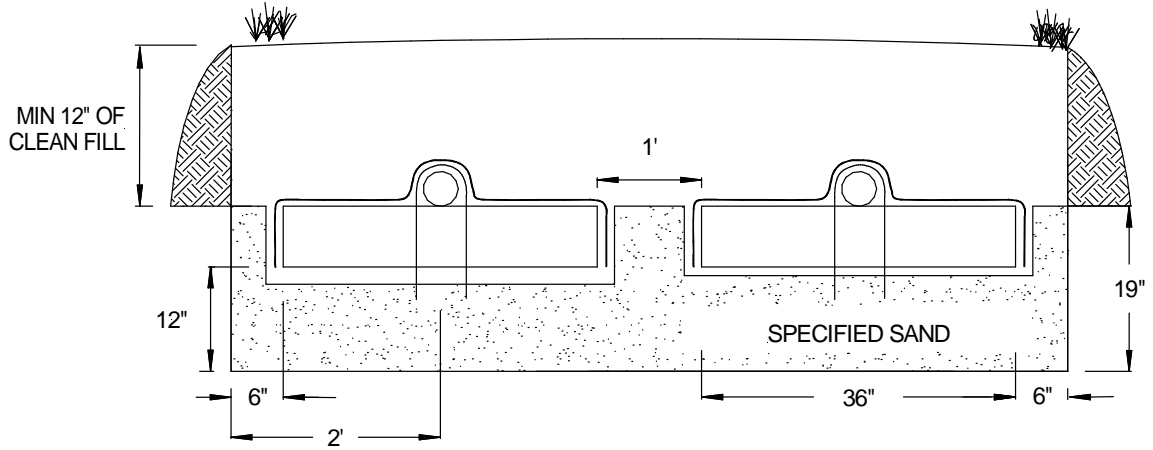
FIGURE 5A: PLAN VIEW – 450 GPD – BED SYSTEM – SLOPING SITE



Design Flow 150 gpd x 3 Bedrooms = 450 gallons per day.
 (14 B43 & 1 B23 Modules per Row)

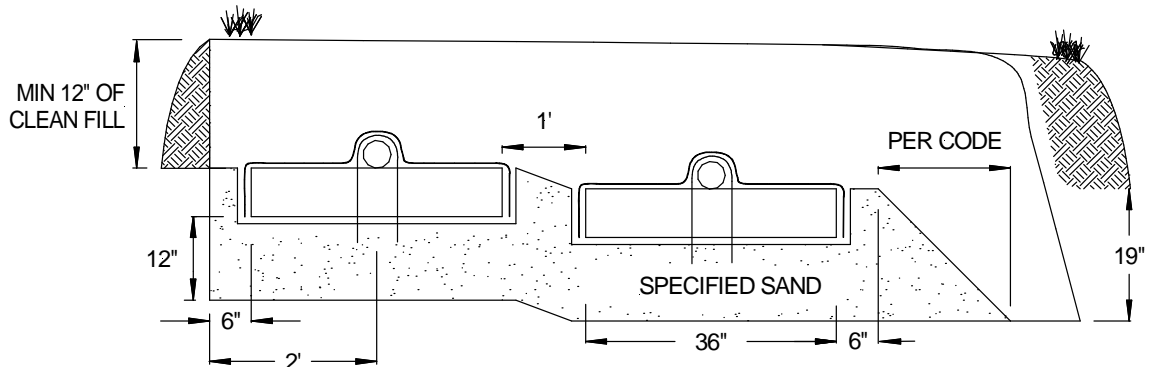
3.0 Bed Installation Sizing and Guidelines

FIGURE 5B: SECTION VIEW – 450 GPD – BED SYSTEM – LEVEL SITE



Design Flow 150 gpd x 3 Bedrooms = 450 gallons per day.
 (14 B43 & 1 B23 Modules per Row)

FIGURE 5C: SECTION VIEW – 450 GPD – BED SYSTEM – SLOPING SITE



Design Flow 150 gpd x 3 Bedrooms = 450 gallons per day.
 (14 B43 & 1 B23 Modules per Trench)

3.1 Bed Installation Sizing and Guidelines

Bed Installation Guidelines Additional guidance in State and Local regulations	
Determine the Number Modules	Determine the number of GSF Modules required using the bed sizing example.
Plan all Drainage Requirements	Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.
Excavating the Bed Area	Scarify the receiving layer to maximize the interface between the native soil and Specified Sand. Minimize walking in the bed prior to placement of the Specified Sand to avoid soil compaction.
Placing Specified Sand Base	Place Specified Sand in two 6 inch lifts, compact each lift at a time. The compacted height below the GSF module must be level at 12 inches. A hand tamping tool or vibrating compactor is both acceptable.
Place GSF Modules	Place the GSF Modules, PAINTED STRIPE FACING UP , end to end on top of the Specified Sand along their 4-foot length.
Distribution Pipes Gravity & Lift Pump/Gravity Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Distribution Pipes Pressure Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. Insert a pressure pipe (<i>size per design and code</i>) into a standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 7. Each pressure lateral will have a drain hole at the 6 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Place Geotextile Cover Fabric	<p>Cover fabric substitution is not allowed. The installer should lay the Eljen provided geotextile cover fabric lengthwise down the row, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by:</p> <ul style="list-style-type: none"> • Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe. • Place shovel full's of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.
Placing Specified Sand after Cover Fabric is in place	Place 6 inches minimum of Specified Sand along both sides of the modules and a minimum of 6 inches of Specified Sand is placed at the beginning and end of each row.
Backfilling the System	Complete backfill with native soil to 12 - 18 inches over the GSF modules. Backfill exceeding 18 inches requires venting at the distal end of the bed. Fill must be clean, porous and devoid of rocks. Do not use wheeled equipment over the system during backfill operation. A light track machine may be used with extreme caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff. Finish grade to prevent surface ponding. Topsoil and seed to protect from erosion.

4.0 Pressure Mound Installation Sizing and Guidelines

4.1 PRESSURE MOUND REFERENCE: The following sizing and guidelines provide the dimensions of the distribution cell for your pressure mound. Consult the *Pressure Mound Systems, Technical Guidance for Site Suitability, Design, Construction and Operation and Maintenance, Michigan Department of Environmental Quality, June 2003* for more information on the construction of the pressure mound.

4.2 PRESSURE MOUND EXAMPLE:

House size –	4 bedrooms
Slope of site	4%
Soil Structure –	Loam/Sandy Clay Loam Moderately Blocky and Granular (2)
Design Flow – 150 gpd x 4 bedrooms =	600 gpd
Refer to Table 3, and find the soil loading rate.	0.5 gpd/ft ²
Refer to Table 3, and find the maximum hydraulic linear loading rate.	3.0 gpd/lf

FIGURE 6A: CROSS SECTION – PRESSURE MOUND SYSTEM

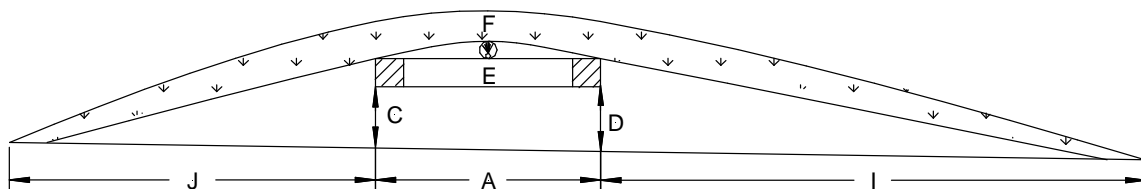
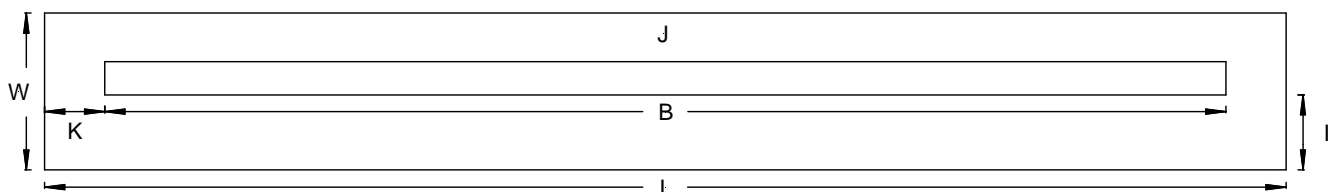


FIGURE 6B: PLAN VIEW – PRESSURE MOUND SYSTEM



- A – Distribution cell width (accounts for sand) – **Minimum 4 ft for B43, Minimum 3 ft for A42**
- B – Distribution cell length
- C – Up slope fill depth under distribution cell – **Minimum 1 ft**
- D – Downslope fill depth under distribution cell – **Minimum 1 ft**
- E – Distribution cell depth – **Constant 7 in**
- F – Depth of final cover – **Minimum 1 ft**
- I – Distance from edge of distribution cell to downslope edge of fill
- J – Distance from edge of distribution cell to up slope edge of fill
- K – Distance from end of distribution cell to edge of fill
- L – Overall mound fill length
- W – Overall mound fill width

4.0 Pressure Mound Installation Sizing and Guidelines

4.3 CALCULATE VARIABLES: The following equations are from the guidelines.

A – Distribution cell width = Linear Loading Rate ÷ Sand Fill Loading Rate
(State Rule w/ 50% Reduction = 2.0 gpd/ft²)

Linear Loading Rate from Table 3 = 3.0 gpd/lf ÷ 2.0 gpd/ft² = **1.5 ft**

(**NOTE:** For this example, the minimum width of distribution cell is **3 ft** when using A42 Modules.)

B – Distribution cell length = Design Flow ÷ Linear Loading Rate

600 ÷ 3.0 gpd/lf = **200 ft**

C – Up slope fill depth under distribution cell = **Minimum 1 ft**

(**NOTE:** For this example, assume the depth of fill at the up slope edge of the distribution cell is **1.5 ft.**)

D – Downslope fill depth under distribution cell = **Minimum 1 ft**

C + Slope of site (Distribution cell width)

1.5 ft + (0.04 x 3 ft) = **1.62 ft**

E – Distribution cell depth – Constant 7 in., convert to feet – **0.583 ft**

F – Depth of final cover = **Minimum 1 ft**

(**NOTE:** For the slope of the mound, we are using a **recommended 4:1 slope**)

I – Distance from edge of distribution cell to downslope edge of fill:

Downslope correction factor = 100 ÷ [100 – (side slope x % ground slope)]

100 ÷ [100 – (4 x 4)] = **1.19**

4 x (D + E + F) x Downslope correction factor

4 x (1.62 + 0.583 + 1) x 1.19 = **15.25 ft**

J – Distance from edge of distribution cell to up slope edge of fill

Up slope correction factor – 100 ÷ [100 + (side slope x % ground slope)]

100 ÷ [100 + (4 x 4)] = **0.86**

4 x (C + E + F) x Up slope correction factor

4 x (1.62 + 0.583 + 1) x 0.86 = **11.02 ft**

K – Distance from end of distribution cell to edge of fill

4 x [(C + D)/2 + E + F]

4 x [(1.5 + 1.62)/2 + 0.583 + 1] = **12.57 ft**

L – Overall mound fill length

B + 2(K)

200 + 2(12.57) = **225.14 ft**

W – Overall mound fill width

A + I + J

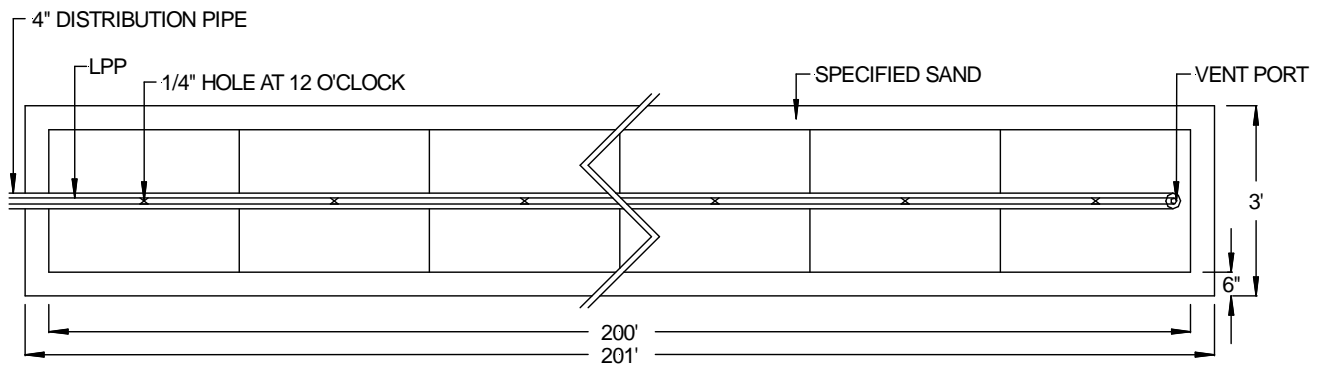
3 + 15.25 + 11.02 = **29.27 ft**

4.0 Pressure Mound Installation Sizing and Guidelines

Distribution Cell Construction –

Width – 3 ft
 Length – 200 ft
 Modules in cell – $200 \text{ ft} \div 4 \text{ lf per Modules} = 50 \text{ A42 Modules}$

FIGURE 6C: PLAN VIEW – 450 GPD – DISTRIBUTION CELL MOUND SYSTEM



Mound Construction –

Width – 29.27 ft
 Length – 225.14 ft

FIGURE 6D: SECTION VIEW – 450 GPD – MOUND SYSTEM

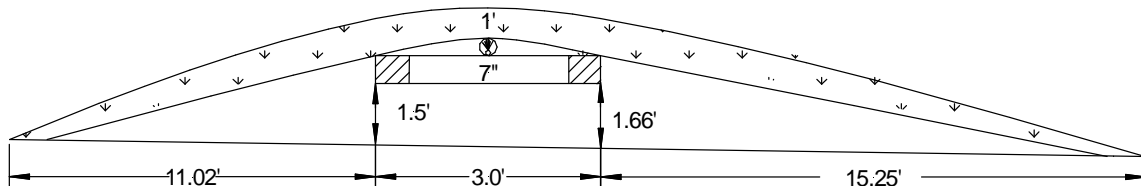
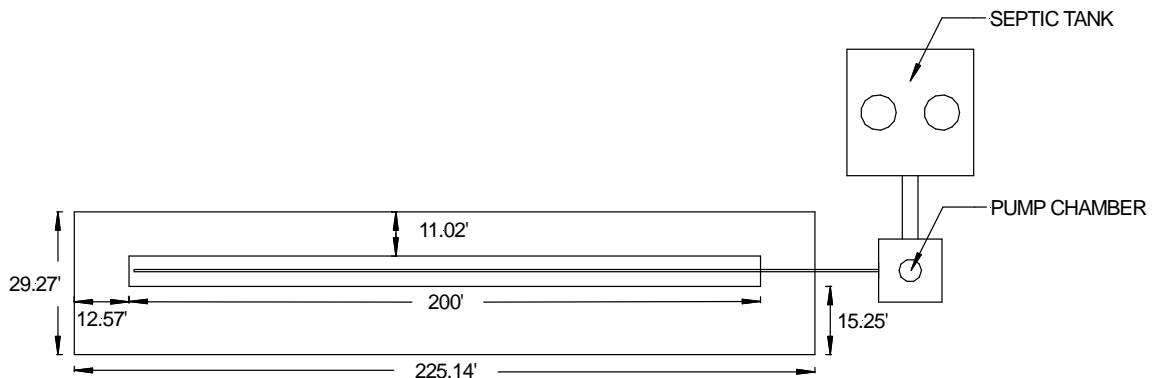


FIGURE 6E: SECTION VIEW – 450 GPD – MOUND SYSTEM



4.4 Pressure Mound Installation Sizing and Guidelines

Pressure Mound Installation Guidelines Additional guidance in State and Local regulations	
Determine the Number Modules	Determine the number of GSF Modules required using the mound sizing example.
Excavating the Bed Area	Scarify the receiving layer to maximize the interface between the native soil and Specified Sand. Minimize walking in the absorption area prior to placement of the Specified Sand to avoid soil compaction.
Placing Specified Sand Base	Place Specified Sand in two 6 inch lifts, compact each lift at a time. The compacted height below the GSF module must be level at 12 inches. A hand tamping tool or vibrating compactor is both acceptable.
Place GSF Modules	Place the GSF Modules, PAINTED STRIPE FACING UP , end to end on top of the Specified Sand along their 4-foot length.
Distribution Pipes: • Lift Pump/Gravity • Siphons • Pressure	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. Insert a pressure pipe (<i>size per design and code</i>) into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 7. Each pressure lateral will have a drain hole at the 6 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Pump Chamber to the GSF System	Refer to local regulations for guidance <ul style="list-style-type: none"> · Lift Pump/Gravity Guidance · Pressure Distribution Guidance · Pump Controls
Place Geotextile Cover Fabric	Cover fabric substitution is not allowed. The installer should lay the Eljen provided geotextile cover fabric lengthwise down the trench, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by: <ul style="list-style-type: none"> • Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe. • Place shovel full's of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.
Backfilling the System	Complete backfill with native soil to 12 - 18 inches over the GSF modules. Backfill exceeding 18 inches requires venting at the distal end of the bed. Fill must be clean, porous and devoid of rocks. Do not use wheeled equipment over the system during backfill operation. A light track machine may be used with extreme caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff. Finish grade to prevent surface ponding. Topsoil and seed to protect from erosion.

5.0 Dosing Distribution Guidance

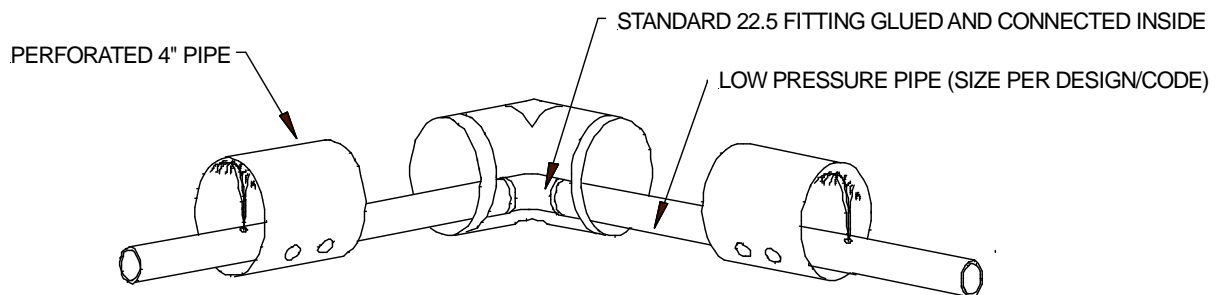
5.1 PUMP DISTRIBUTION BOX: Specify an oversized distribution box for pumped systems. Provide velocity reduction in the D-box with a tee or baffle. Set D-box invert 2 inches higher than invert of perforated pipe over GSF modules. If the absorption area is installed deeper than 18 inches, the system must be vented. See section 8.0 of this manual for detailed information on venting of systems.

5.2 DOSING DESIGN CRITERIA: Dosing volume must be set to deliver a maximum of 4 gallons per B43 Module and 3 gallons per A42 Module per dosing cycle with low head high volume pumps preferred. Higher flow rates and short dose cycle push the effluent down the line and thus disperse the effluent over a larger area. A valve on the force main is recommended to set the flow rate so that the orifices on the outlet pipes are submerged and the d-box does not overflow. Adjustment of the flow rate is likely needed if a row of modules are rested thus changing the number or outlets. Fewer outlets in the d-box force more effluent down each line and improve linear loading. Head loss and drain back volume must be considered in choosing the pump size and force main diameter.

6.0 Pressure Distribution Guidance

Standard procedures for design of pressure distribution networks apply to the GSF filter. Orifices shall be a minimum of 4-foot on center spacing so the orifices fall in the center of each module. A minimum orifice size of $\frac{1}{4}$ inch shall be maintained. A $\frac{1}{4}$ inch diameter drain hole is required at the 6 o'clock position of each pressure lateral for drainage purposes. The lateral pipe network (*size per design and code*) is placed within a standard 4-inch perforated pipe. The perforation in the 4-inch outer pipe are set at the 4 and 8 o'clock position, the drilled orifices on the pressure pipe are set to spray at the 12 o'clock position directly to the top of the 4-inch perforated pipe as shown below.

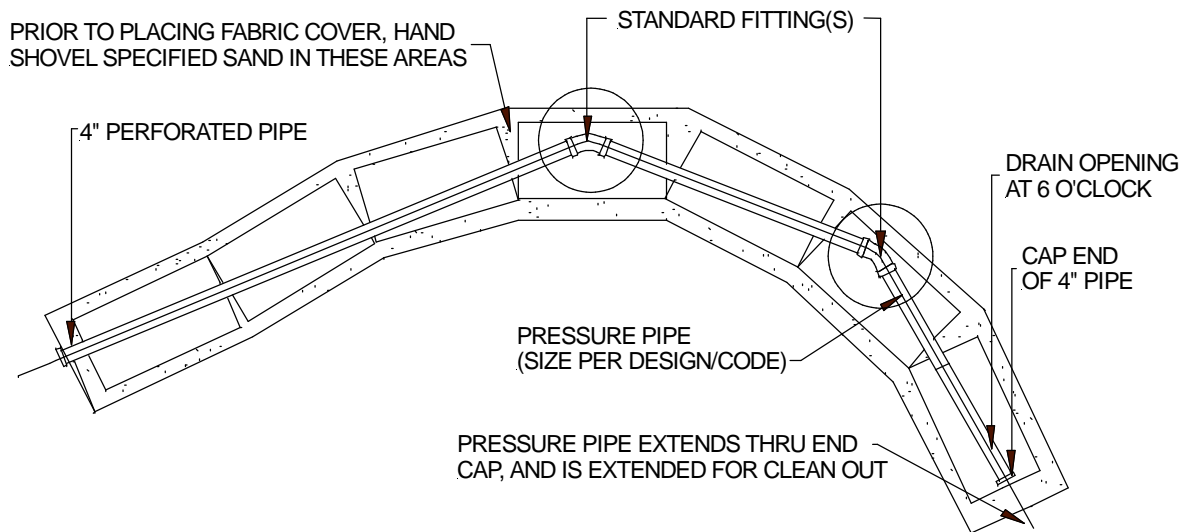
FIGURE 7: PRESSURE PIPE PLACEMENT



Pressure pipe placement when following contours or changes in trench direction.

6.0 Pressure Distribution Guidance

FIGURE 8: CONTOURED TRENCH PRESSURE DISTRIBUTION



GSF Pressure Distribution trench placed on a contour or winding trenches to maintain horizontal separation distances may also be used in Dosed or Gravity system by removing the pressure pipe and using the 4-inch diameter perforated distribution pipe.

7.0 Pump Controls

Demand and Pressure Dosed controlled systems will include an electrical control system that has the alarm circuit independent of the pump circuit, controls and components that are listed by UL or equivalent, is located outside, within line of sight of the pump chamber and is secure from tampering and resistant to weather (minimum of NEMA 4). The control panel shall be equipped with cycle counters and elapsed time meters. Where a water supply water meter is available it may be possible to eliminate the counters or timers.

The control panel shall be equipped with both audible and visual high liquid level alarms installed in a conspicuous location. Float switches shall be mounted independent of the pump and force main so that they can be easily replaced and/or adjusted without removing the pump.

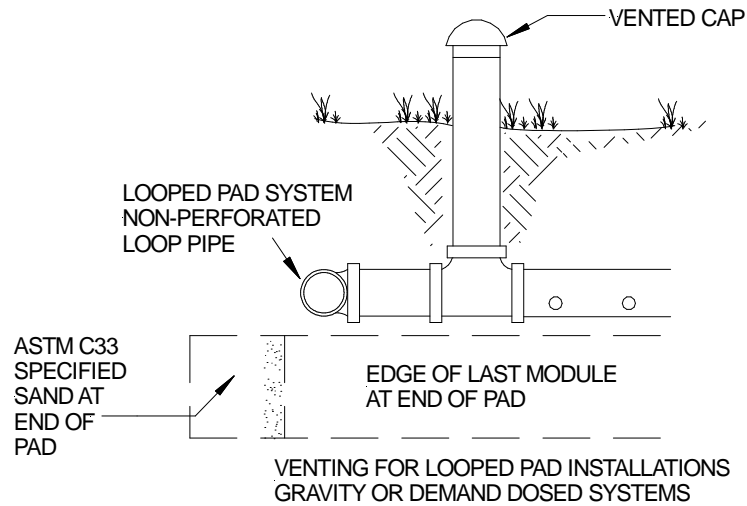
8.0 System Ventilation

8.1 SYSTEM VENTILATION: Air vents are required on all absorption systems located under impervious surfaces or systems **with more than 18 inches of cover material** as measured from the top of the GSF module to finished grade. This will ensure proper aeration of the modules and sand filter. The GSF PAD has aeration channels between the rows of GSF modules connecting to cuspations within the GSF modules. Under normal operating conditions, only a fraction of the filter is in use. The unused channels remain open for intermittent peak flows and the transfer of air. The extension of the distribution pipe to the vent provides adequate delivery of air into the GSF system, as shown in Figure 13.

Home plumbing operates under negative pressure due to hot water heating the pipes and reducing the density of air in the house vent. As hot air rises and exits the home, it must be replaced by air from the GSF. To maintain this airflow and fully aerate the GSF system, it is important that air vents are located only on the distal end of the GSF pipe network.

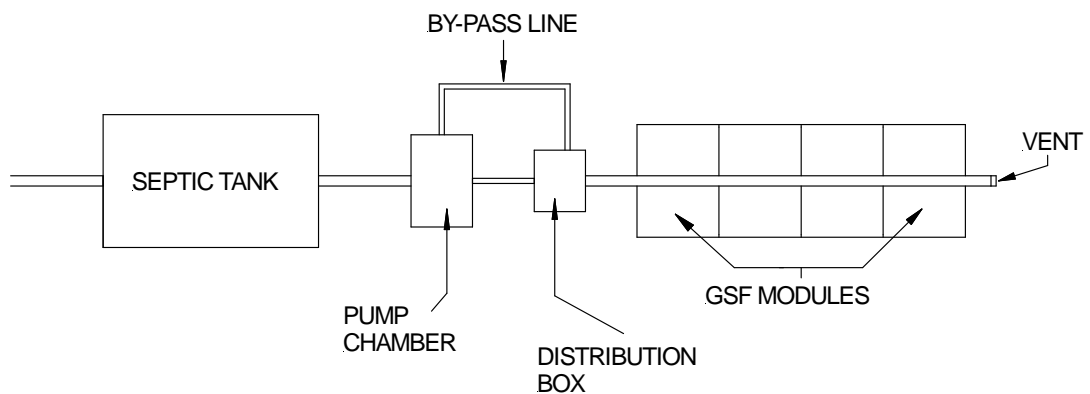
System Ventilation Example Drawings

FIGURE 9: VENT FOR GRAVITY AND PRESSURE DOSED BED SYSTEMS



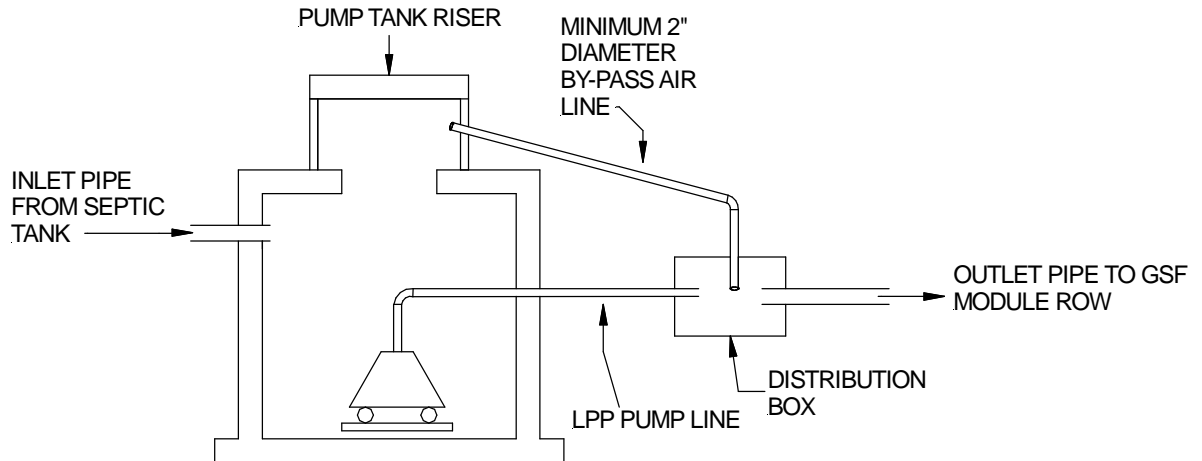
8.2 VENTILATION FOR PRESSURE AND DEMAND DOSED SYSTEMS: If a pressure or demand dosed system is specified with greater than 18 inches of cover, an additional 2-inch minimum air line must be extended from the GSF D-box back to a knockout or riser on the septic tank or pump chamber. This maintains the continuity of airflow from the field into the house plumbing.

FIGURE 10: AIR BY-PASS LINE PLAN VIEW FOR VENTING OF PUMPED SYSTEMS



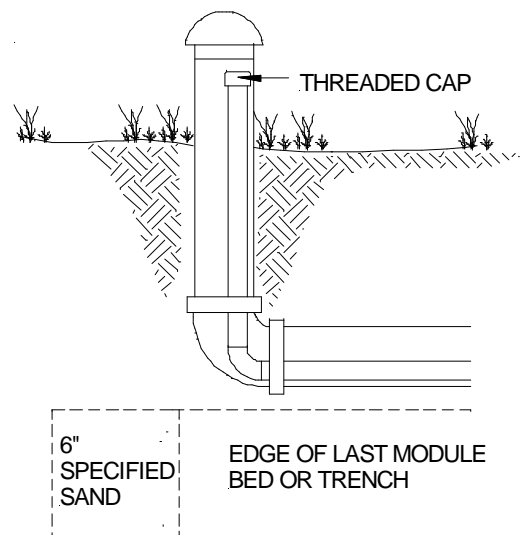
System Ventilation Example Drawings

FIGURE 11: AIR BY-PASS LINE CROSS SECTION FOR VENTING OF PUMPED SYSTEM



8.3 VENT PIPE FOR LOW PRESSURE DISTRIBUTION SYSTEMS: If the system is a low pressure distribution system with greater than 18 inches of cover, ensure that the LPP clean outs are located in the vent for easy access.

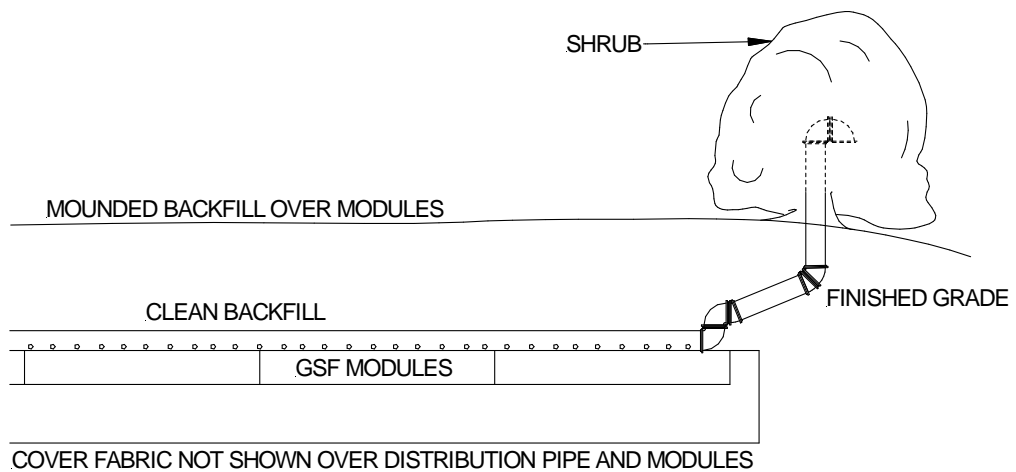
FIGURE 12: PRESSURE CLEAN OUT PRESSURE DOSED SYSTEMS



System Ventilation Example Drawings

8.4 VENTILATION PLACEMENT: In a GSF system, the vent is usually a 4-inch diameter pipe extended to a convenient location behind shrubs, as shown in Figure 13. Corrugated pipe may be used. If using corrugated pipe, ensure that the pipe does not have any bends that will allow condensation to pond in the pipe. This may close off the vent line. The pipe must have an invert higher than the system so that it does not drain effluent.

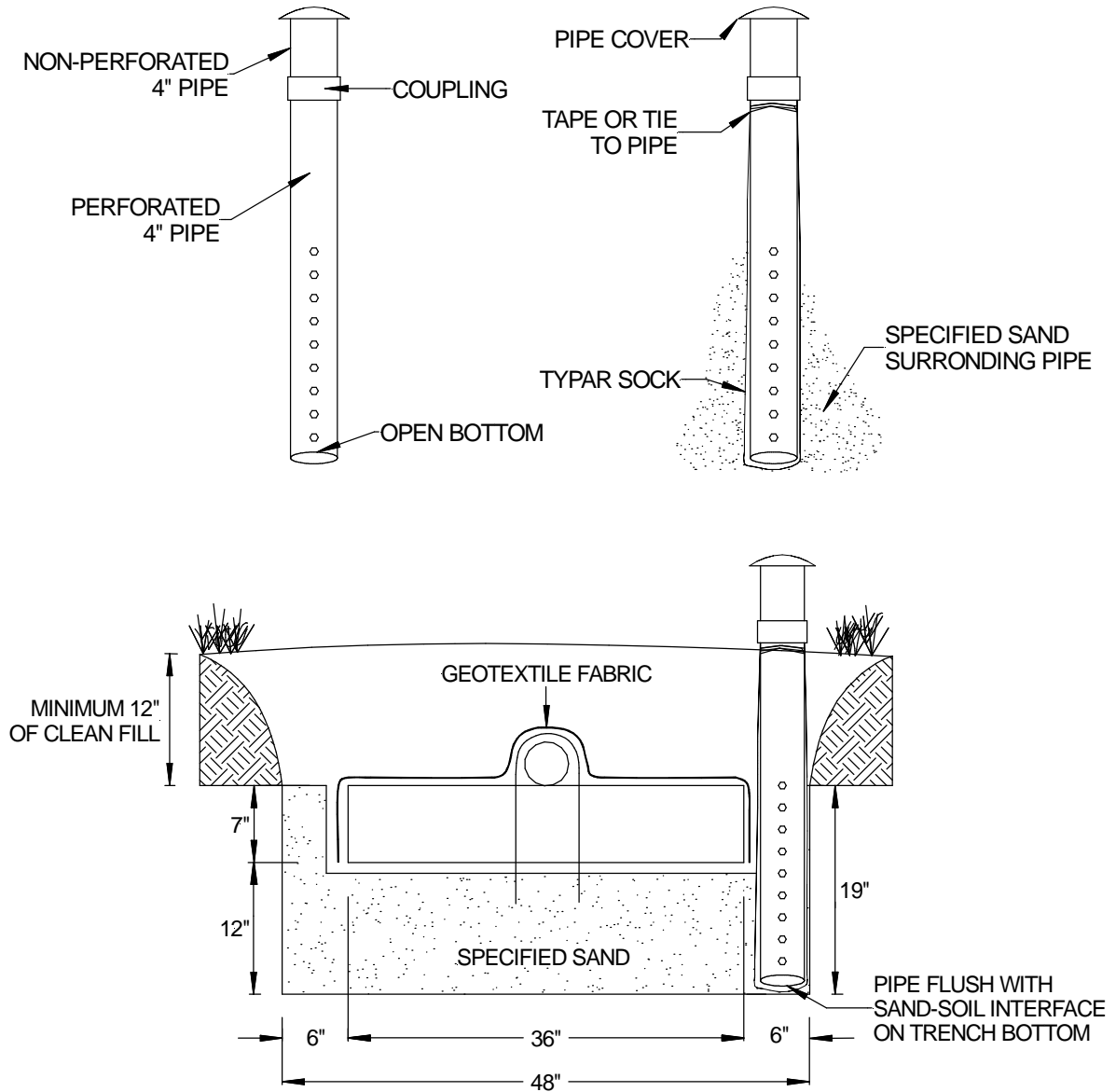
FIGURE 13: GSF WITH 4" VENT EXTENDED TO CONVENIENT LOCATION



9.0 Inspection/Monitoring Port

The system shall include an Inspection/Monitoring Port designed and installed with access from the ground surface. It shall be open and slotted at the bottom, and be void of sand or gravel to the infiltrative surface to allow visual monitoring of standing liquid in the trench. The figures below depict construction and placement of the Inspection/Monitoring Port. Positioning of the port in reference to the length of the trench is in accordance to your local regulations and specifications.

FIGURE 14: MONITORING WELL FOR SAND-SOIL INTERFACE



10.0 GSF Inspection Check List

Geotextile Sand Filter, (GSF) Checklist					
Facility Owner:					
Facility Address:					
Installation Date: (MDY)					
Previous Inspection Date: (MDY)					
Date of Inspection : (MDY)					
Residential Number of Bedrooms:					
Is this a Commercial Design? If yes what type:	Yes	No			
What is the estimated BOD5 and TSS strength?	BOD5	TSS	Comments		
Observation Port Location(s):	1	2	3		
Inspection Data, (complete all fields)					
Is daily flow within the system design flow? If no, explain:	Yes	No			
Does the owner verify the system use as described above? If no, explain:	Yes	No			
Septic tank last inspection date:	Date				
Inspected by:					
Septic tank last pumped date:					
Is pumping recommended?	Yes	No			
Condition of the soil absorption system: Wet, Dry, Firm, Soft, Vegetative, or Other. If Other, explain:	W	D	S	F	V
Is there evidence of storm water flows or erosion over the septic system? If yes, explain:	Yes	No			

10.0 GSF Inspection Check List

Is there evidence of soil slump or compaction by traffic or other means in the vicinity of the soil absorption system? If yes, describe:	Yes	No	Comments
Is effluent visible through the observation port? If yes, describe the condition and the fluid level:	Yes	No	Comments
Is there a garbage disposal in the home?	Yes	No	Comments
Is a water softer connected to the system?	Yes	No	Comments
Are solids visible through the observation port? If yes, describe the condition and depth of solids:	Yes	No	Comments
Is there evidence of surcharging or effluent ponding in the D-Box? If yes, describe and measure:	Yes	No	Comments
Are the system vents in place?	Yes	No	Comments
Are they operational? If no, describe conditions and location:	Yes	No	
Describe any other pertinent issues:			

Inspected by:	
License Number:	
Date:	
Time:	
Print Name & Signature of Inspector:	
<p><i>I certify I have inspected the system at the above address, completed this report, and the information reported is true, accurate, and complete.</i></p>	

COMPANY HISTORY

Established in 1970, Eljen Corporation created the world's first prefabricated drainage system for foundation drainage and erosion control applications. In the mid-1980s, we introduced our Geotextile Sand Filter products for the passive advanced treatment of onsite wastewater in both residential and commercial applications. Today, Eljen is a global leader in providing innovative products and solutions for protecting our environment and public health.

COMPANY PHILOSOPHY

Eljen Corporation is committed to advancing the onsite industry through continuous development of innovative new products, delivering high quality products and services to our customers at the best price, and building lasting partnerships with our employees, suppliers, and customers.



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www.eljen.com



Section 7: Minimum Design Parameters – Advanced Enviro-Septic® (AES)

Description

The Advanced Enviro-Septic® (AES) Wastewater Treatment System utilizes a unique combination of components that work together to treat effluent and prevent suspended solids from sealing the underlying soil. Comprised of a patented corrugated, perforated plastic pipe with interior skimmer tables and cooling ridges, the large-diameter pipe retains solids while the Bio-Accelerator® fabric, coarse fibers, and geotextile fabric provide multiple bacterial surfaces to treat effluent prior to its contact with the receiving soils. The continual cycling of effluent (the rising and falling of liquid inside the pipe) enhances bacterial growth. The AES system is completely passive.

Conditions for Application Submittal

1. A Michigan Registered Sanitarian, Professional Engineer specializing in environmental or sanitary wastewater treatment, or licensed sewage system installer registered with LMAS to design the particular alternative treatment system proposed shall provide a detailed design plan for each specific application. Presby Environmental, Inc certifies all AES designers and installers. Proof of certification is required.
2. Provide a scaled site plan detailing all aspects of the proposed work along with the LMAS District Health Department application form.
 - a. Plans shall be at least 8 1/2" X 11" in size and shall be legible, clear, and permanent copies.
 - b. Plans shall include the name of the person who prepared the plan and shall be stamped if prepared by a Michigan Registered Sanitarian or Professional Engineer.
3. A *Submittal Checklist for Alternative Treatment* is available per request for guidance.
4. A contract/attachment to the deed shall be filed with the County Clerk indicating the property contains a secondary treatment system and the property limitation imposed by such a system. The property owner shall provide evidence that such contract/attachment has been filed before the Department issues the construction permit.
5. Plans will not be reviewed until all required components described herein are submitted with the applicable fee.

Sewage Treatment Components

1. Site Preparation - Ultimate success or failure of a system also relies on clear communication along with the understanding of basic site preparation and construction principles. Critical issues include:
 - k. Proper procedures must be followed to protect the location area including required greenbelt area during and after construction. After establishing a suitable location for the initial and replacement area including greenbelt area, it should be suitably fenced or otherwise unmistakably identified to prevent further disturbance until actual construction can occur. Site planning resulting in a location for the system that is isolated from other anticipated home construction activities is encouraged.

- l. Soil smearing and compaction, which can reduce infiltration capacity, will occur if soils are worked on when wet. Construction activities should be scheduled only when soils are sufficiently dry. Acceptable soil moisture content of the soils to a depth of one foot should be evaluated by rolling a sample of soil between the hands. If the soil can be rolled into a ¼ inch or smaller "wire" it is considered too wet and should be allowed to dry before preparing. If site is questionable then certification from Design Consultant shall be required.
- m. Excessive vegetation should be removed from the area. Remove all tree stumps and the central root system below grade by using a backhoe or excavator with a mechanical "thumb" or similar extrication equipment, lifting or leveraging stump in a manner that minimizes soil disturbance. It is not necessary for the soil of the system site to be smooth when the site is prepared. Avoid soil disturbance, relocation, or compaction. Avoid mechanical leveling or tampering of dislodged soil. Fill all voids created by stump removal with system sand.
- n. The entire basal area of the mound should be suitably prepared by roughening in a ridge and furrow fashion with ridges following the contours. Methods that can be considered for roughening include chisel teeth fastened to the backhoe bucket, plowing with a multiple bottom agricultural chisel plow, or moldboard plow. Rototilling is not acceptable. Sand fill material should be applied immediately after roughening and prior to any subsequent precipitation.
- o. Cleanliness of the sand fill should be checked prior to construction. Placement of fill material is to be accomplished from the end and upslope sides utilizing a tracked vehicle or equipment with adequate reach to minimize soil compaction. A minimum of six inches of fill material should be maintained below the tracks to minimize compaction. Wheeled vehicles should be prevented from travel over the mound basal area and downslope of the greenbelt area. Total depth of fill shall be established on a benchmark provided by the design consultant on the design plan.

2. Septic Tank

- o. Tank requirements are established in Section 3-14.5 of the LMAS District Health Department Upper Peninsula Environmental Health Code.
- p. The minimum capacity for septic tanks for a one, two, or three-bedroom dwelling shall be 1,000 gallons, except where in the opinion of the Department, increased capacities may be required. Each additional bedroom shall require an additional 250 gallons. Each garbage grinder shall require an additional 250 gallons.
- q. Septic tanks shall be equipped with an approved effluent filter installed in the outlet baffle, or other approved location.
- r. Septic tanks shall be equipped with a watertight access riser installed to grade to facilitate maintenance. Risers shall be installed with dual lids, leaving the concrete lid in place, or shall be equipped with other Department approved safety device to preclude accidental tank entry.

- s. All septic tanks shall be installed to be level and to flow in accordance with the manufacturer's design intent.
 - t. All systems receiving sewage from a grinder pump shall be equipped with a minimum of two 1,000 gallon septic tanks. The first septic tank shall be installed in series to allow the settling of sewage discharged by the pump and shall be equipped with an outlet baffle.
 - u. Septic tanks and pump tanks shall be tested and certified to be watertight. Testing and certification must be performed on-site and in-place, by the tank manufacturer, design consultant, or licensed septic installer. Hydrostatic or vacuum test may be utilized to determine if the septic tank and/or pump tank are water tight. Certification shall be submitted prior to or during the final inspection performed by the Department.
8. Pump - See Section 2 of this manual for pump tank and pump design parameters.
9. Dispersal Area
- a. Infiltrative surface – the infiltrative surface of unsaturated soil to which treated effluent is discharged to shall be ≥ 24 inches above the limiting layer noted in the site evaluation report. Allowance granted for the 6 inches of specified sand (2NS) required below the AES pipe.
 - b. The system shall be constructed per the AES Design Manual within this section.
 - c. Effluent Distribution – pressure distribution throughout the dispersal system is not allowed per manufacturer specification. Pumped systems supply effluent to the system using a pump and D-box when site conditions do not allow for a gravity system.
 - d. Taper – the slope surrounding the dispersal area. A taper shall be installed when the dispersal area is installed "on" or "above" the natural grade. The taper shall be constructed of clean sand with no excessive fines and shall be evenly graded from the top of the dispersal area to the natural soil surface with a slope of 4:1 or flatter if within a maintained lawn. Final grading of the area should divert water drainage away from the system.

Operation and Maintenance

Passive treatment systems do not require a maintenance and monitoring agreement, however they do require minimal maintenance as is standard for conventional onsite systems, provided the system is not subjected to abuse. An awareness of proper use and routine maintenance will ensure system longevity. The premise shall be used for the purpose intended when permitted. Any modification in usage of the premise shall be reported to the Department for evaluation. As a condition of operating approval, LMAS staff may conduct random site inspections.

1. Septic Tank and Effluent Filter
 - a. Inspect the septic tank at least once every two years under normal usage. The tank shall be emptied of sludge and floating material by a licensed septage hauler at a recommended frequency of 3-5 years
 - b. After pumping, inspect the integrity of the septic tank to ensure that no groundwater is entering it. Check the inlet and outlet and repair if needed.
 - c. Effluent filters require on-going maintenance due to their tendency to clog and cut off oxygen to the system. The effluent filter shall be cleaned at

- every septic tank pump out and inspected every 6-12 months. Follow filter manufacturer's maintenance instructions.
 - e. Owner must keep copies of the pump-out invoice and they shall provide maintenance as required by the AES manufacturer.
 - f. The use of enzymes or any septic system additives is prohibited.
- 2. Pumped Systems
 - a. Inspect at least once a year to assure adequate operation of pump, floats, control panel, alarm, etc.
- 3. Infiltration Area
 - a. It is important that the system site remain free of shrubs, trees, and other woody vegetation. Roots can infiltrate and cause damage or clogging of system components.
 - b. Make sure the infiltration area is free of motorized vehicle traffic, is seeded, and that all water is diverted to avoid overloading.
 - c. If the system has a vent, make sure it is not obstructed.
 - d. Check and immediately report any odor or sign of water breakouts around the system.

Noncompliance

1. The owner is responsible for the proper operation and performance of the system. If additional monitoring is required, the owner shall be responsible for all costs associated with the monitoring and/or system repair.
2. In the event that any part of the system is found to be in noncompliance with the requirements in which it was permitted, the following actions must be taken at the owner's expense:
 - a. The distributor shall inspect the system (with LMAS staff person present) to determine any deficiencies.
 - b. If LMAS deems necessary, effluent samples shall be taken to determine system compliance.
 - c. Use of the system may need to be discontinued if the system is found to be non-repairable, is non-compliant with the permit, or results in an imminent health hazard. If compliance with the conditions in which the AES and/or associated components was permitted under cannot be achieved, or if the Department determines that the Upper Peninsula Environmental Health Code has been violated, a notice of violation will be issued to the owner.

Variance

1. Variance requests shall be submitted on the LMAS Variance Request Form. Submittal is necessary prior to issuance of permit.
2. Variances will be reviewed under Article XV of the LMAS District Health Department Upper Peninsula Environmental Health Code.
3. Variances thus granted apply only to the specific project under consideration and do not serve as precedents in other cases.

Permitting

1. Upon completion of the permit application/design review, LMAS shall accept the design, reject the design, require additional information for clarification, or require verification.

2. If the permit application/design is not acceptable, LMAS shall notify the applicant in writing and shall state the deficiencies or actions, or both, necessary to bring the design into compliance with the requirements set forth in this document.
3. When a completed permit application/design is deemed acceptable, LMAS shall issue a construction permit.

Limitation of Responsibility

1. Plan approval by LMAS may not be construed as an assumption of any responsibility for the design of the Alternative Treatment System and associated components.
2. LMAS does not hold itself liable for any defects in design and/or construction, or for any damages that may result from a specific installation.

Final Inspections and Approval to Use System

1. A final inspection shall be conducted by LMAS in accordance with Section 3-11.3 of the LMAS District Health Department Upper Peninsula Environmental Health Code. During this inspection, LMAS will approve or deny covering the system. Approval to use the system will not be granted until all required information has been received:
 - a. Request for a final inspection of the alternative system by the contractor, installer, or property owner shall serve as notice to the Department that the system is installed according to the permit and associated design plans. Final inspection conducted by the Department shall identify any items of noncompliance.
 - b. No portion of the system shall be covered and the system shall not be placed into service prior to final inspection and approval. Property owner is responsible for maintenance and monitoring of the system following approval from the Department, unless a contract agreement is in place between the property owner and a qualified maintenance provider.
 - c. The Design Consultant shall provide the LMAS District Health Department with written certification that the installed system meets their design and the intent of the minimum requirements contained within this document.
 - d. Any other information requested by LMAS such as watertight tank test results and pump installation certification.
2. After all required information has been submitted, LMAS shall issue a final drawing/operating approval to the applicant.

Revocation of Permit

1. The Department may revoke any plan approval under this Section when one or more of the following conditions exists:
 - a. The location of the system(s) specified in the design is altered.
 - b. There is an increase in the scope of the project prior to, during, or following construction.
 - c. LMAS acquires new information indicating that any agency rules or regulations are violated before, during, or after construction.
 - d. LMAS has reasonable cause to believe that an intentional misrepresentation has occurred.

Disclaimer

1. The LMAS District Health Department reserves the right to require special restrictions, in rare circumstances, in addition to those listed herein to ensure that an adequate sewage disposal system is installed. These restrictions may be determined on a site-specific basis.

ADVANCED ENVIRO))SEPTIC^{MD}

Design and Installation Manual for Advanced Enviro-Septic[®] (AES) Wastewater Systems



For more detailed design and installation information on AES, please contact Infiltrator Water Technologies at (800) 221-4436 or Presby Environmental, Inc. at (800) 473-5298.

www.infiltratorwater.com • www.presbyeco.com

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LMAS District Michigan



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April 2022

The purpose of this manual is to provide the minimum specifications for design and installation of the Advanced Enviro-Septic System (AES) System in LMAS District Michigan. All local ordinances, requirements, and procedures must be followed. Each revised version of this manual supersedes the previous version.

The systems presented in this document are common configurations and are provided for illustrative purposes. They are not intended to restrict the use of other configurations.

The information in this Manual is subject to change without notice. We recommend that you check your state's page on our website on a regular basis for updated information. Your suggestions and comments are welcome. Please contact us at:

Presby Environmental, Inc.
143 Airport Road
Whitefield, NH 03598
Phone: 1-800-473-5298 Fax: (603) 837-9864
Website: www.presbyenvironmental.com

The products and methods depicted in this Manual are protected by one or more patents.

Advanced Enviro-Septic® is a registered trademark of Presby Environmental Inc.

IMPORTANT NOTICE: This Manual is intended ONLY for use in designing and installing Presby Environmental's Advanced Enviro-Septic® Wastewater Treatment Systems. The processes and design criteria contained herein are based solely on our experience with and testing of Advanced Enviro-Septic®. Substitution of any product is prohibited.

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1.0 INTRODUCTION

1.1 Background

The Advanced Enviro-Septic® (AES) Wastewater Treatment System utilizes a unique combination of components that work together to treat effluent and prevent suspended solids from sealing the underlying soil. Comprised of a patented corrugated, perforated plastic pipe with interior skimmer tabs and cooling ridges, the large-diameter pipe retains solids while the Bio-Accelerator® fabric, coarse fibers, and geo-textile fabric provide multiple bacterial surfaces to treat effluent prior to its contact with the receiving soils. The continual cycling of effluent (the rising and falling of liquid inside the pipe) enhances bacterial growth. The AES system is completely passive, and yet provides increased aeration and a greater bacterial treatment area than traditional systems. The result is a system that is more efficient, lasts longer, and has a virtually no negative environmental impact.

Additional system benefits include:

- installs easily and quickly
- adapts easily to residential, commercial, and difficult sites
- prevents formation of organic material at the receiving soil interface
- safely recharges groundwater

Environmental Standards and Technical Support

All AES systems shall be designed and installed in compliance with the procedures and specifications detailed in this Manual and in the product's local approval. In the event of contradictions between this Manual and local rules, PEI should be contacted for technical assistance at (800) 473-5298.

Certification Requirements

Designers and installers who have not previously attended a PEI certification course are required to obtain certification. Certification is obtained by attending a certification course presented by PEI or its sanctioned representative or by viewing tutorial videos on our website and then successfully passing a short assessment test. PEI recommends professionals involved in the inspection or review of AES systems also become PEI certified.

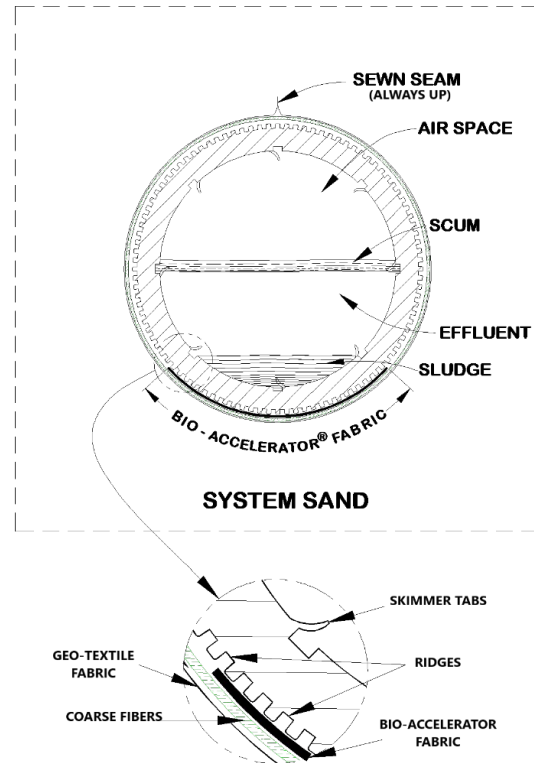
1.2 Michigan-Specific Information

The AES system is certified by NSF International as complying with NSF/ANSI 40 for the production of Class I effluent. The AES system may be designed and installed in Michigan in trench or bed configurations as detailed in this manual.

This manual is intended to provide system design, installation, and use information to the users in Michigan, including system designers, local health officials, system installers, and system owners. Illustrations presented in this manual are common configurations and are not intended to restrict the use of other configurations. If design, installation, operation, or maintenance specifications are not specifically addressed in this manual, the manufacturer should be contacted for guidance.

System Sizing

AES system design specification and instructions are detailed on pages 5-17 of this manual. Recommended sizing criteria for the basal area footprint in the AES system is provided in Table A on page 5. Note that local regulations may dictate other sizing criteria.



1.0 INTRODUCTION

1.3 System Components

AES Pipe

- nominal exterior diameter of 12 in
- holding capacity of 5.8 gallons per foot
- 10 ft length of AES pipe is flexible enough to bend up to 90° and can be cut to any length
- made with a significant amount recycled material

Offset Adapter - A 12 in plastic fitting with a single inlet hole oriented in the 12 o'clock position and designed to accept a 4 in sewer line, raised connection or vent pipe.

Double Offset Adapter - A 12 in plastic fitting with two 4 in holes designed to accept a 4 in inlet pipe, raised connection, vent or vent manifold, and/or bottom drain, depending upon the requirements of the design configuration.

Coupling - A plastic fitting used to create a connection between two pieces of AES pipe.

System Sand - The system sand that surrounds the AES pipes is an essential component of the system. It is critical that the correct type and amount of system sand is used during construction. System sand shall be coarse to very coarse, clean, granular sand, free of organic matter meeting MDOT 2NS sand specifications. System sand is placed a minimum of 3 in above and 6 in below, between, and around the outer perimeter of the AES pipes.

System Sand Bed Height Dimension

The height of an AES sand bed measures 21 in minimum (not including cover material):

- minimum of 6 in of system sand below the AES pipe;
- 12 in diameter of the pipe;
- minimum of 3 in of system sand above the AES pipe; and
- when a system sand extension is required it shall be a minimum of 6 in thick.

System Sand Acceptable Alternative - ASTM C-33 (concrete sand), natural or manufactured sand, with not more than 3% passing the #200 sieve (verified by washing the sample per the requirements of ASTM C-117 as noted in the ASTM C-33 specification) may be used as an acceptable alternate material for use as system sand.

Sand Fill – Sand fill may be used to raise the elevation of the system in order to meet the required separation distance from the SHWT or restrictive feature. Sand fill must have a permeability the same as the soil below or faster. No organic material or stones larger than 3 in are allowed in the sand fill. System sand may be used in place of sand fill.

Clean Fill – Clean fill is soil or sand used in side-slope tapers. Onsite material (soils excavated from the site) may be used as clean fill as long as it does not contain organic material or stones larger than 3 in. System sand or sand fill may also be used as clean fill.



2.0 SYSTEM DESIGN

2.1 Sizing

Table A: System Sand Bed Area and Bed Configuration Requirements for Subsurface Bed Systems

Texture Class of Native Soil	Estimated Permeability Rate		Sewage Application Rate (gpd/ft ²)
	Inches/Hour	Minutes/Inch	
Coarse Sand, Gravel, Gravelly Sand	>20	<3	Not Suitable
Stratified Sand and Gravel, Medium Sand	20-6.0	3-10	1.5
Fine Sand, Loamy Sand	6.0-3.0	11-20	1.0
Sandy Loam, Loam	3.0-2.0	21-30	0.8
Silty Loam, Sandy Clay Loam	2.0-1.35	31-45	0.6
Clay Loam, Silty Clay Loam	Not Suitable		
Silty Clay			

Table B: System Sand Bed Area and Bed Configuration Requirements for Above-Grade Bed Systems

Texture Class of Native Soil	Estimated Permeability Rate		Sewage Application Rate (gpd/ft ²)
	Inches/Hour	Minutes/Inch	
Coarse Sand, Gravel, Gravelly Sand	>20	<3	Not Suitable
Stratified Sand and Gravel, Medium Sand	20-6.0	3-10	1.5
Fine Sand, Loamy Sand	6.0-3.0	11-20	1.0
Sandy Loam, Loam	3.0-2.0	21-30	0.8
Silty Loam, Sandy Clay Loam	2.0-1.35	31-45	0.6
Clay Loam, Silty Clay Loam	Not Suitable		
Silty Clay			

Table C: AES Pipe Requirements

System Type	AES Pipe Loading Rate
Residential System	70 ft/br
Commercial (Non-Residential) System	2.14 gpd/ft

Assumes residential strength effluent. Contact Presby Environmental for technical assistance with high strength wastewater.

2.0 SYSTEM DESIGN

2.2 Design Procedure and Examples

Step #1: Determine System Sand Bed Area Required

From Table A or B: find the soil's application rate using the assigned soil texture and structure and calculate the minimum system sand bed area (SSBA): divide the daily design flow (gpd) by the application rate.

Step #2: Calculate the Minimum Amount of AES Pipe Needed

From Table C: Calculate the minimum amount of AES pipe needed: use 70 ft/br for residential systems or 2.14 gpd/ft for commercial/non-residential systems treating residential strength effluent – contact Technical Support for high strength wastewater.

Step #3: Calculate the Number of Serial Sections Needed

Calculate the minimum number of serial sections required (does not apply to parallel configuration): divide the daily design flow by 750 gpd (round up to nearest whole number).

Step #4: Determine Row Length and Quantity Needed

Select a row length suitable for the site and calculate the number of rows (round up to a whole number). The number of rows must be evenly divisible by the number of serial sections required (add rows as necessary – does not apply to parallel layouts).

Step #5: Determine Pipe Layout Width (PLW)

Calculate the PLW (the distance of the width of the pipes from outside edge to outside edge) using a 1.5 ft minimum center-to-center row spacing (larger spacing allowed). $PLW = [(# \text{ of rows} - 1) \times \text{spacing (1.5 ft)}] + 1 \text{ ft}$.

Step #6: Determine Minimum System Sand Bed Width (SSBW)

Calculate the minimum SSBW by dividing the SSBA from Step #1 by the selected row length from Step #4 + 1 ft (allows 6 inches of sand beyond the ends of the rows).

Step #7: Verify Final Bed Width Requirements

Verify the minimum SSBW from Step #6 will cover all the rows in the bed:

- Level beds and beds sloping less than 5%: If the minimum SSBW is less than the (PLW + 1 ft), use (PLW + 1 ft) as the new minimum SSBW.
- Beds sloping > 5%: If the minimum SSBW is less than the (PLW + 3.5 ft), use (PLW + 3.5 ft) as the new minimum SSBW. Adding 3.5 ft to the pipe layout width accounts for a 2.5 ft system sand extension on the down slope side of the field.

Step #8: Calculate System Sand Extensions (SSEs):

- Level beds: SSE are placed on each side of AES pipes = $[SSBW - (PLW + 1)] \div 2$. There will be no SSE's if the $SSBW = (PLW + 1 \text{ ft})$.
- Sloping Beds: SSE placed entirely on the down slope side of the bed = $SSBW - (PLW + 1)$ and must be at least 2.5 ft (3 ft from the edge of the AES pipe) for beds sloping greater than 5%.

Design Example #1

Single family residence, 3- bedrooms (450 gpd), soil type of medium sand, level site, in-ground bed using serial distribution layout.

Step #1: Determine System Sand Bed Area Required

Soil's application rate from Table A for medium sand = 1.5 gpd/ft²; $SSBA \rightarrow 450 \text{ gpd} \div 1.5 \text{ gpd/ft}^2 = 300.0 \text{ ft}^2$ minimum.

Step #2: Calculate the Minimum Amount of AES Pipe Needed

AES pipe required using 70 ft/br from Table C $\rightarrow 70 \text{ ft/br} \times 3 \text{ br} = 210 \text{ ft}$ minimum

2.0 SYSTEM DESIGN

Step #3: Calculate the Number of Serial Sections Needed

Serial sections required → $450 \text{ gpd} \div 750 \text{ gpd/section} = 0.6$ (round up to 1)

Step #4: Determine Row Length and Quantity Needed

Using a row length of 70 ft requires three rows → $(210 \text{ ft} \div 70 \text{ ft} = 3 \text{ rows})$

Step #5: Determine Pipe Layout Width (PLW)

Calculate the PLW (the distance of the width of the pipes from outside edge to outside edge) using a 1.5 ft minimum center-to-center row spacing (larger spacing allowed). $PLW = [(\# \text{ of rows} - 1) \times \text{spacing} (1.5 \text{ ft})] + 1 \text{ ft}$. $PLW = [(3 \text{ rows} - 1) \times \text{spacing} (1.5 \text{ ft})] + 1 \text{ ft} = 4 \text{ ft}$.

Step #6: Determine Minimum System Sand Bed Width (SSBW)

Minimum SSBW → $300.0 \text{ ft}^2 \div (70 \text{ ft} + 1 \text{ ft}) = 4.23 \text{ ft}$. (Round up to 5 ft.)

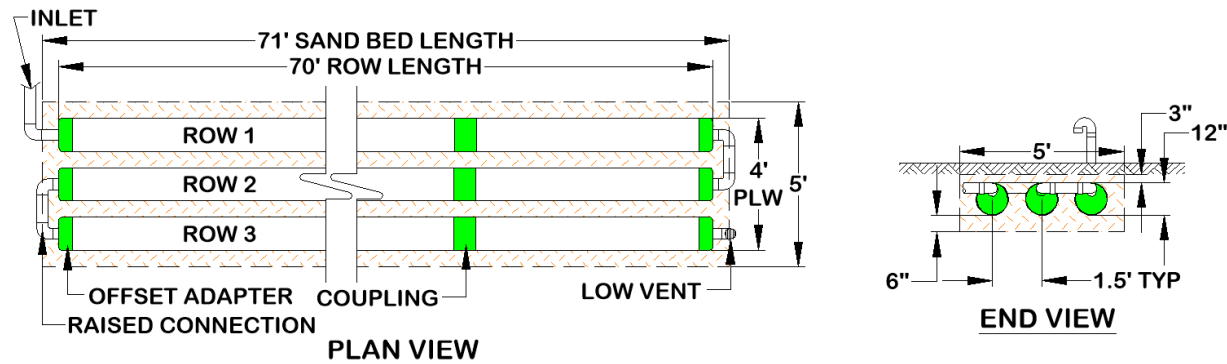
Step #7: Verify Final Bed Width Requirements

- Level beds and beds sloping less than 5%: 5 ft minimum SSBW from Step 6 is equal to the PLW from Step 5 + 1 ft for perimeter sand; use 5 ft as the minimum SSBW.
- Beds sloping > 5%: Not applicable as bed slopes less than 5 %.

Step #8: Calculate System Sand Extensions (SSEs):

- Level beds: There will be no SSE's as the SSBW = (PLW + 1 ft).
- Sloping Beds: Not applicable as bed is level.

Illustration of Example #1, Basic Serial Distribution



Design Example #2

Commercial system treating residential strength effluent (800 gpd). Soil type of medium sand, 7% sloping site, designed as an elevated system to meet required vertical separation using combination serial distribution layout.

Step #1: Determine System Sand Bed Area Required

Soil's application rate from Table B for medium sand = 1.5 gpd/ft^2 ; $SSBA \rightarrow 800 \text{ gpd} \div 1.5 \text{ gpd/ft}^2 = 533.3 \text{ ft}^2$ minimum.

Step #2: Calculate the Minimum Amount of AES Pipe Needed

AES pipe required using $2.14 \text{ gpd per lf} = 800 \div 2.14 = 373.83$. Round up to 380 lf for ease of construction.

Step #3: Calculate the Number of Serial Sections Needed

Serial sections required → $800 \text{ gpd} \div 750 \text{ gpd/section} = 1$. (round up to 2). System will use combination serial distribution containing equal serial sections. Note: System must be designed using an even number of pipe rows per section.

Step #4: Determine Row Length and Quantity Needed

Using a row length of 95 ft requires 4 rows → $(380 \text{ ft} \div 95 \text{ ft} = 4 \text{ rows}$ which will provide 2 rows per section).

2.0 SYSTEM DESIGN

Step #5: Determine Pipe Layout Width (PLW)

Calculate the PLW (the distance of the width of the pipes from outside edge to outside edge) using a 1.5 ft minimum center-to-center row spacing (larger spacing allowed). $PLW = [(\# \text{ of rows} - 1) \times \text{spacing} (1.5 \text{ ft})] + 1 \text{ ft}$. $PLW = [(4 \text{ rows} - 1) \times \text{spacing} (1.5 \text{ ft})] + 1 \text{ ft} = 5.5 \text{ ft}$.

Step #6: Determine Minimum System Sand Bed Width (SSBW)

Minimum SSBW $\rightarrow 533.3 \text{ ft}^2 \div (95 \text{ ft} + 1 \text{ ft}) = 5.56 \text{ ft}$.

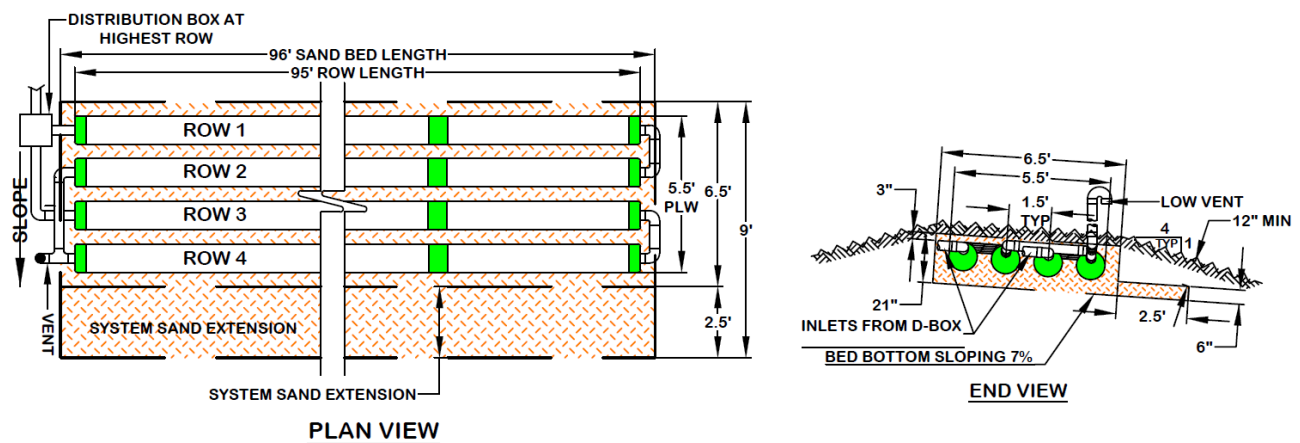
Step #7: Verify Final Bed Width Requirements

- Level beds: Not applicable as bed slopes with site at 7%.
- Beds sloping > 5%: The minimum SSBW from Step #6 is 5.56 ft which is less than the PLW of 5.5 ft + 3.5 ft. Use 9 ft as the new minimum SSBW. Adding 3.5 ft to the pipe layout width accounts for a 2.5 ft system sand extension on the down slope side of the field.

Step #8: Calculate System Sand Extensions (SSEs):

- Level beds: Not applicable as bed slopes with site at 7%.
- Sloping Beds: SSE placed entirely on the down slope side of the bed = $9 - (5.5 \text{ PLW} + 1) = 2.5$ (3 ft from the edge of the AES pipe).

Illustration of Example #2, Combination Serial Distribution:



2.3 Design Specifications

The AES system shall be designed in accordance with this Manual and local rules. Systems can be installed using either bed or trench design utilizing any of the design configurations outlined in this Manual.

Daily Design Flow

Residential daily design flow for AES systems is calculated in accordance with local rules. Systems servicing more than two residences shall use the commercial specifications detailed in the sizing tables. The minimum daily design flow shall be one bedroom for any single-family residential system and 300 gpd for any commercial system.

Septic Tank

The AES system is designed to treat effluent that has received “primary treatment” in a standard septic tank. Septic tanks shall be sized according to local rules.

2.0 SYSTEM DESIGN

Water Purification Systems

- Water purification systems and water softeners should not discharge into any AES system.
- If there is no alternative means of disposing of this backwash other than in the system, the system will need to be “oversized.” Calculate the total amount of backwash in gpd, multiply by 2, and add this amount to the daily design flow when determining the field and septic tank sizing.
- Water purification systems and water softeners require regular routine maintenance; consult and follow the manufacturer’s maintenance recommendations.

Pressure Distribution

The use of pressure distribution lines in AES systems is prohibited. Pumps may be utilized when necessary only to gain elevation and to feed a distribution box which then distributes effluent by gravity to the AES field. Siphon dosing is permitted; adequate venting is required in a siphon-dosed system or pumped system, which may require an additional high vent (referred to as “differential venting”).

Observation Ports

The AES system can accommodate observation ports if required.

Effluent (Wastewater) Strength

The AES pipe requirement for bed or trench systems is based on residential strength effluent, which has received primary treatment in a septic tank. Designing a system that will treat higher strength wastes requires additional AES pipe. In these situations, our Technical Advisors shall be consulted for recommendations at (800) 473-5298.

Effluent Filters

- If used, effluent filters shall be maintained on at least an annual basis. Follow manufacturer’s instructions regarding required inspections, cleaning and maintenance of the effluent filter.
- Effluent filters must allow the free passage of air to ensure the proper functioning of the system.
- Charcoal filters in vent stacks (for odor control) are not recommended by PEI. They can block air flow and potentially shorten system life.

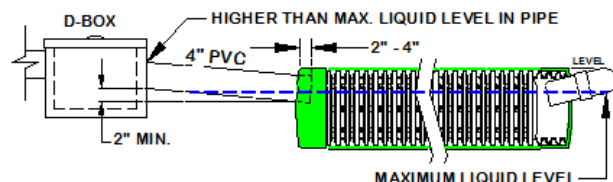
Flow Equalizers Required

All distribution boxes (D-box) used to divide effluent flow require flow equalizers in their outlets. A flow equalizer is an adjustable plastic insert installed in the outlet holes of a D-box to equalize effluent distribution to each outlet whenever flow is divided. Each bed or section of combination serial distribution is limited to a maximum of 15 gallons per minute (gpm), due to the flow constraints of the equalizers. Example: pumping to a combination system with 3 sections (using 3 D-box outlets). The maximum delivery rate is $(3 \times 15) = 45$ gpm. Always provide a means of velocity reduction when needed. All systems with combination serial distribution or multiple bed distribution shall use flow equalizers in each D-box outlet.



Two Inch Rule

The outlet of a septic tank or D-box shall be set at least 2 in above the highest inlet of the AES row, with the connecting pipe slope not less than 1% (approximately $\frac{1}{8}$ in per foot). Illustration of 2 in rule:



AES Pipe Requirement

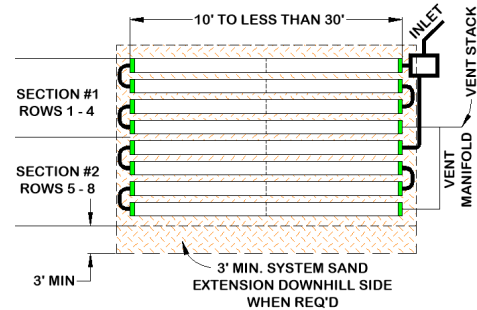
AES systems use the bed sizing tables, pipe and installation requirements noted in this Manual.

- Residential systems: 70 ft per br.
- Non-Residential/Commercial systems comprised of residential strength effluent: 2.14 gpd per ft.

2.0 SYSTEM DESIGN

Row Requirements

- All beds shall have at least 2 rows.
- Maximum row length for any system is 100 ft of pipe.
- Recommended minimum row length is 30 ft of pipe.
 - A combination (or D-box) distribution system shall be used if any row length is less than 30 ft.
 - A minimum of two D-box outlets must be used and the field must be vented.
- Minimum center-to-center spacing is 1.5 ft for all systems. Spacing may be increased at the discretion of the system designer or as needed to meet the required SSBA.
- Sewn seam must be oriented in the 12 o'clock position. This correctly orients the Bio-Accelerator[®] fabric in the 6 o'clock position.
- For level beds the AES rows shall be centered in the middle of the system sand bed area and any system sand extensions divided evenly on both sides.
- For sloping beds: the elevations for each AES row must be provided on the drawing. All rows shall be grouped 6 in from the up-slope edge of the system sand bed area (SSBA) with any system sand extensions placed entirely on the downslope side. Systems sloping greater than 5% require a 2.5 ft system sand extension on the downslope side of the bed (3 ft when measured from the pipe).
- Each row must be laid level to within $\pm \frac{1}{2}$ in (total of 1 in) of the specified elevation and preferably should be parallel to the contour of the site.
- It is most convenient if row lengths are designed in exact 10 ft increments to accommodate the length of the AES pipe as manufactured. However, AES pipe lengths can be cut to any length.



System Sand Extensions

System sand extensions are placed on the down slope side of sloping systems and equally divided on each side of level systems. The system sand extension is measured from the tall portion of the system sand bed. In systems sloping more than 5%, a 2.5 ft minimum system sand extension is required. The system sand extension area is a minimum of 6 in deep.

Sloping Sites and Sloping Mound Systems

- The percentage of slope in all system drawings refers to the slope of the system, not the existing terrain ("site slope") and refers to the slope of the bed itself ("system slope").
- The system slope and the site slope do not have to be the same.
- Maximum site slope is 12% and maximum system slope is 12%.

Separation Distances (Horizontal)

All horizontal separation distances are dictated by local regulations. Horizontal separation distances (setbacks) shall be measured from the outside aspect of the system sand adjacent to the outermost pipe row or system sand extension if applicable.

Separation Distances (Vertical)

Vertical separation distances shall be 24 inches from the bottom of the AES conduit to the limiting layer.

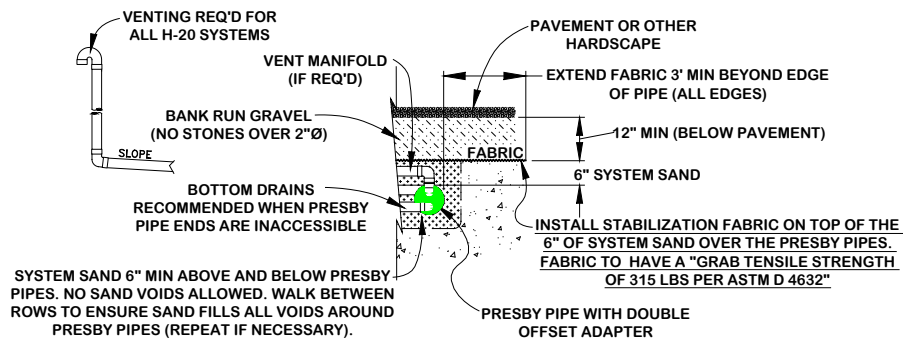
Barrier Materials over System Sand

No barrier materials (hay, straw, tarps, etc.) are to be placed between the system sand and cover material. The only exception is the placement of the specified fabric to achieve H-20 loading requirements.

2.0 SYSTEM DESIGN

H-20 Loading

If a system is to be installed below an area that will be subjected to vehicular traffic, it must be designed and constructed as depicted in order to protect the system from compaction and/or damage. Note that a layer of stabilization fabric is added between the 6 in system sand and the cover material. All H-20 systems require venting.



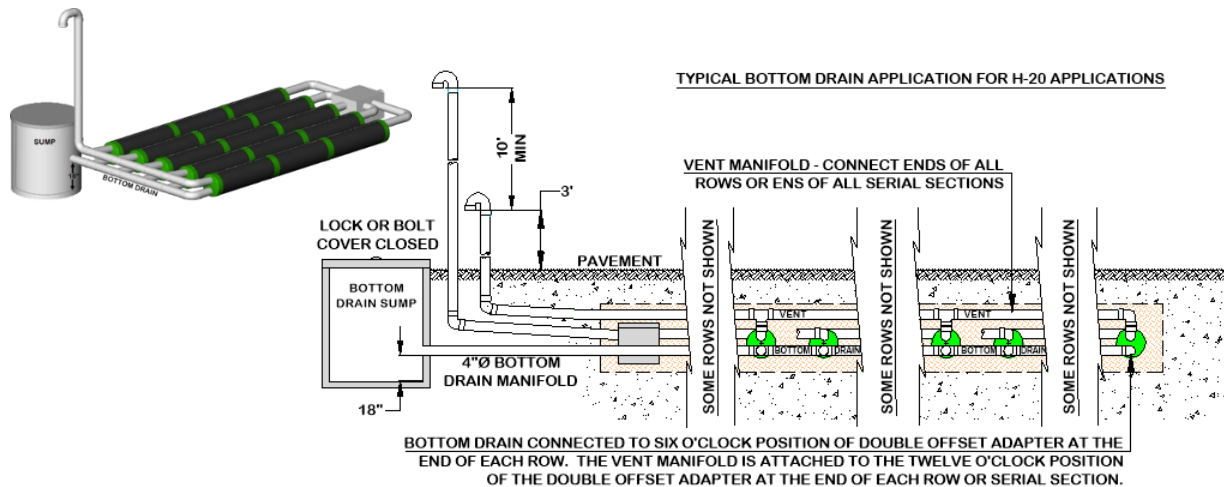
NOTE:

THE ONLY SOIL COMPACTION THAT SHOULD TAKE PLACE IS AT THE POINT OF PREPARATION FOR PAVEMENT.

Bottom Drain

A bottom drain is a line connected to the hole in the 6 o'clock position of a double offset adapter at the end of each row which drains to a sump and is utilized to lower the water level in a saturated system or to facilitate system rejuvenation. There must be 18 in from the bottom of the sump to the bottom of the drain. The sump should be brought above the final grade and have a locking or mechanically fastened cover. The bottom drain may be located on either end of the AES rows.

Illustrations of a bottom drain:



2.4 System Configurations

Elevated Bed Systems (Mounds)

Elevated beds are designed for sites with soil, depth to groundwater or restrictive feature constraints that do not allow for in-ground bed systems. An elevated bed system is a soil absorption field with any part of the system above original grade. Side-slope tapering is used to blend the raised portion of the system with the existing grade. Elevated bed systems require 6 in fill extensions on each side (measured from the pipe), after which side-slope tapering is to be a maximum of 4 horizontal feet for each 1 ft of vertical drop until it meets existing grade. In systems sloping greater than 5%, there must be a minimum of 2.5 ft of system sand extension (3 ft measured from

2.0 SYSTEM DESIGN

the pipe) beyond the last down-slope row of pipe. There must be a minimum of 12 in of cover material over the ends of all system sand extensions (if present).

Illustration of an elevated level bed:

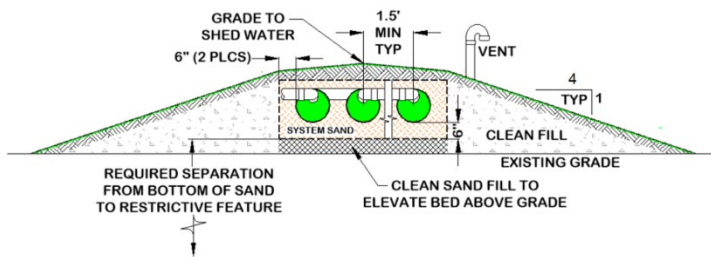
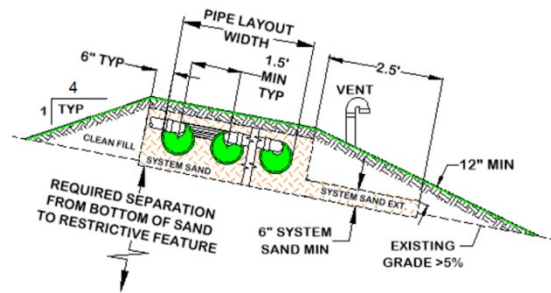
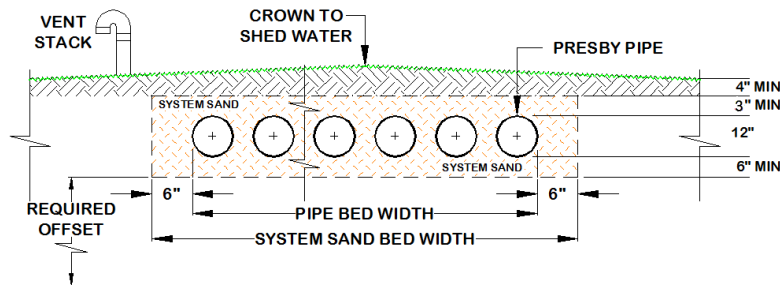


Illustration of an elevated sloping bed:



In-Ground Bed Systems

Systems are installed below existing grade for sites with no soil restrictive features to limit placement. In-ground systems that slope over 5% require a 2.5 ft system sand extension on the downhill side of the field. In-ground on level site:



Trench Systems

AES pipe may be installed in trench configurations on level or sloping terrain and may utilize serial, combination, butterfly, or parallel distribution. A minimum of 3 in of system sand is required above and 6 in below, between, and around the perimeter of the AES pipe. Consult state rules for acceptable trench width and/or required trench separation.

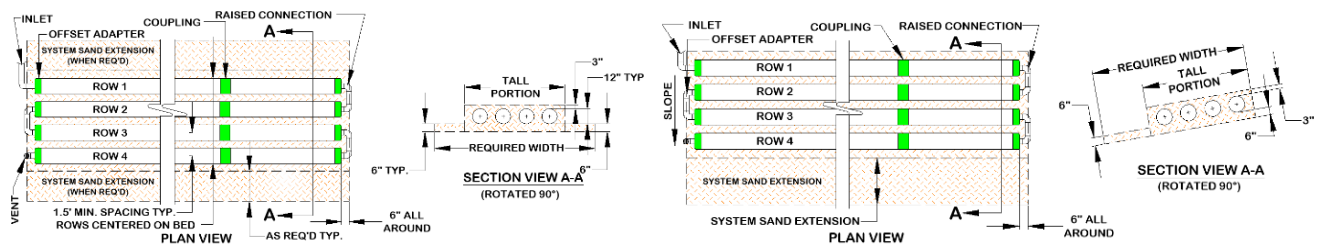
Basic Serial Distribution (Single Level)

AES rows are connected in series at the ends with raised connections, using offset adapters.

- Used for single beds of 750 gpd or less and multiple beds where each bed receives 750 gpd or less.
- Incorporates rows in serial distribution in a single bed.
- Rows shall meet requirements outlined in the design criteria above.
- Gravity fed basic serial systems may be fed directly from the septic tank.
- Bed may be constructed with unusual shapes to avoid site obstacles or meet setback requirements.



Illustration of basic serial systems bed designs:

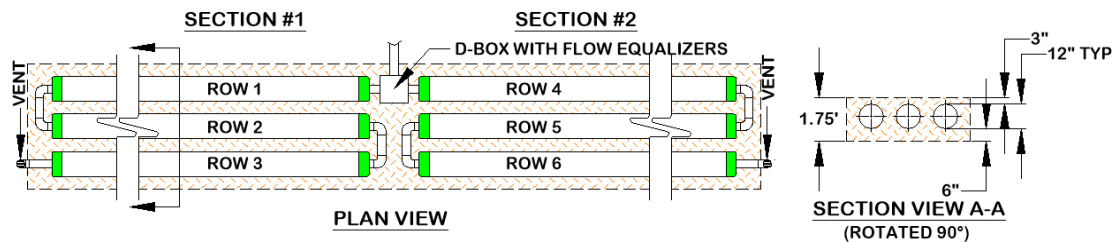


2.0 SYSTEM DESIGN

Butterfly Configuration

- A “butterfly configuration,” is considered a single bed system with two or more sections extending in opposite directions from the D-box along the contour.
- Butterfly configurations are generally used to accommodate bed lengths longer than the maximum row length of 100 ft.
- Beds can contain any number of serial sections.
- Rows shall meet requirements outlined in the design criteria above.

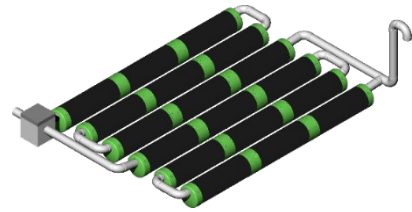
Illustration of a butterfly configuration bed design:



Combination Serial Distribution

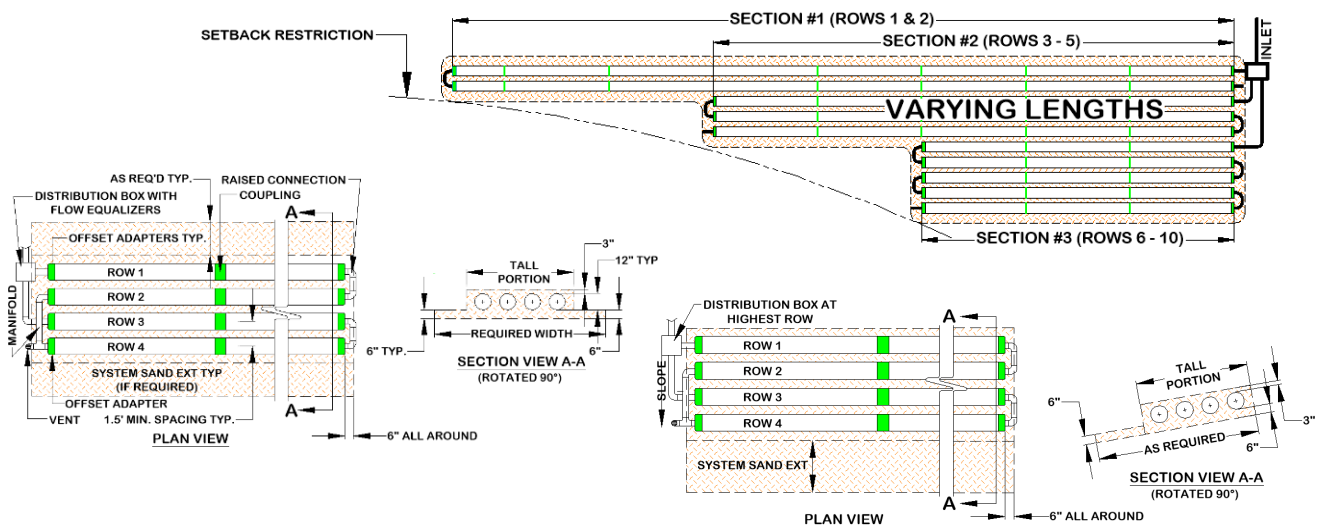
Combination serial distribution within one bed, or multiple beds, is required for systems with daily design flows greater than 750 gpd. Effluent flow is divided evenly to each section using a D-box with flow equalizers.

- Consists of two or more serial sections (with a maximum loading of 750 gpd/section) installed in a single bed each section receiving an equal amount of effluent from a D-box with flow equalizers.
- Each section consists of a series of AES rows connected at the ends with raised connections, using offset adapters and PVC sewer and drainpipe.
- There is no limit on the number of sections within a bed.
- Each section shall have the same linear feet of pipe determined by dividing the total minimum linear feet required in the system by the number of sections required.
- A section may exceed the minimum linear feet required.
- When the vent manifold is on the same side as the serial section inlets, the manifold runs over the top of these inlets.



Rows must meet requirements outlined in the design criteria above except rows within a section may vary in length to accommodate site constraints as shown below.

Illustrations of combination serial systems:

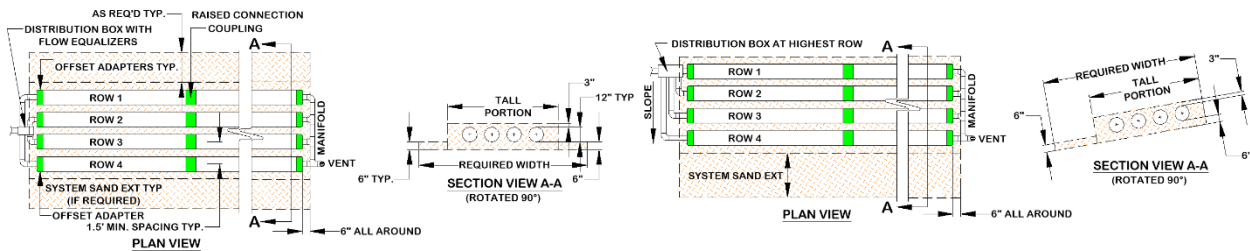


2.0 SYSTEM DESIGN

D-box (Parallel) Distribution

- All rows in this configuration must be the same length.
- Flow equalizers must be used in the D-box.
- Use a manifold to connect the ends of all rows. Manifold shall be sloped toward AES pipes.
- D-box placement shall be installed on level, firmly compacted soil.
- All rows shall be laid level end-to-end.
- A 2 in min. drop is required between the D-box outlets and the AES pipe inlets.
- Rows shall meet requirements outlined in the design criteria above.

Illustrations for D-box (parallel) distribution bed design:



Multiple Bed Distribution

Incorporates two or more beds, each bed receiving an equal amount of effluent from a D-box. Multiple beds may be oriented along the contour of the site or along the slope of the site.

- Each bed shall have the same minimum linear feet of pipe. The minimum linear feet of pipe per bed is determined by dividing the total linear feet required in the system by the number of beds.
- Rows within a bed may vary in length to accommodate site constraints, except with D-box configuration which requires all rows to be the same length.
- End-to-end configurations are preferred to side-to-side configurations.
- Bed separation distance is measured from the edge of the SSBA and is dependent on state requirements.

Illustration of End-to-End multiple beds:

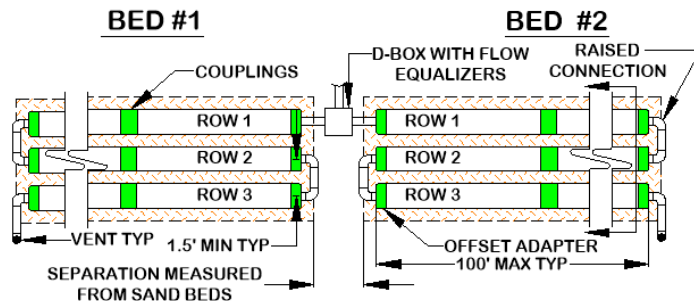
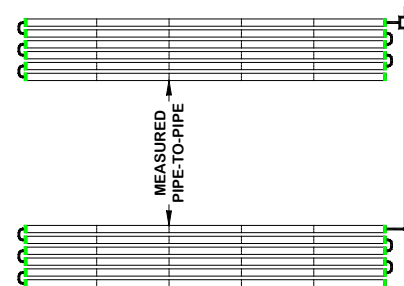


Illustration of Side-to-Side multiple beds:



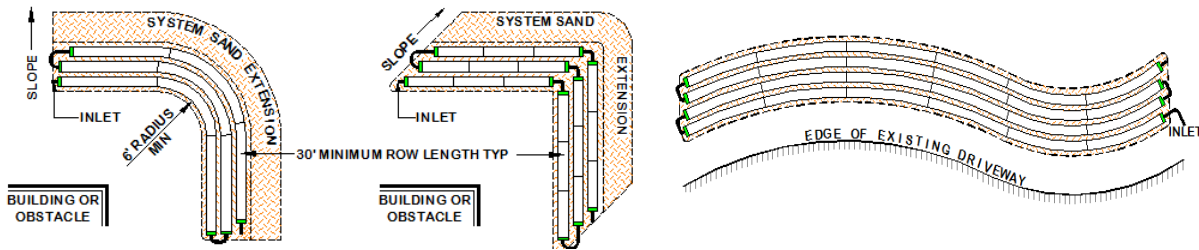
Angled and Curving Beds

Angled and curving beds are used to avoid obstacles and work well around structures, setbacks, and slopes. Multiple curves can be used within a system to accommodate various contours of the site.

- Rows are angled by bending pipes up to 90 degrees or through the use of offset adapters
- Rows shall meet requirements outlined in the design criteria above.

2.0 SYSTEM DESIGN

Illustrations of angled and curving beds:

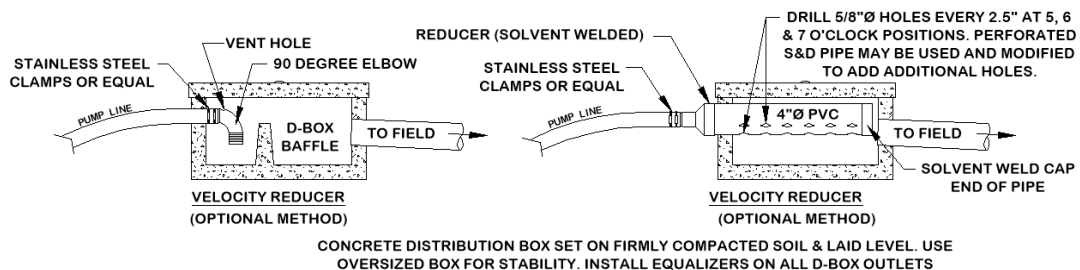


2.5 Pump Systems

Pumped systems supply effluent to the system using a pump and D-box when site conditions do not allow for a gravity system. Dosing siphons are also an acceptable means of delivering effluent to the system.

- Pump dosing should be designed for a minimum of 6 cycles per day; 6-8 cycles per day are recommended.
- If possible, the dosing cycle should provide one hour of drying time between doses.
- Pump systems must have a high-water alarm float or sensor installed inside the pump chamber. Follow state, local and national code requirements.
- Pumped systems with basic serial distribution are limited to a maximum dose rate of 40 gpm and do not require the use of a flow equalizer on the D-box outlet.
- All pump systems require differential venting.
- All pumped systems require a D-box with baffles, a velocity reducing tee or other means to be used for velocity reduction.
- All systems with combination serial distribution or multiple bed distribution shall use flow equalizers in each D-box outlet with each flow equalizer limited to 15 gpm, due to the flow constraints of the equalizers.
 - *Example: pumping to a combination system with 3 sections (using 3 D-box outlets). The maximum delivery rate is $(3 \times 15) = 45$ gpm. Higher flow rates can be accommodated by connecting multiple D-box outlets to each line.*
- The rate at which effluent enters the AES pipe shall be controlled. Excessive effluent velocity can disrupt solids that settle in the pipes.
 - Effluent shall never be pumped directly into AES pipes.
 - A D-box or tank shall be installed between the pumping chamber and the AES pipe to reduce effluent velocity.
 - Force mains shall discharge into a D-box (or equivalent) with velocity reducer such as a baffle, 90° bend, tee or equivalent.
- Velocity reducers are also needed for gravity systems when there is excessive slope between the septic tank and the AES system.

Two methods of velocity reduction:



2.0 SYSTEM DESIGN

2.6 Venting

An adequate air supply is essential to the proper functioning of AES systems. Venting is always required. All systems shall utilize differential venting.

General Rules

- Differential venting is the use of high and low vents in a system.
- In a gravity system, the roof stack acts as the high vent.
- High and low vent openings shall be separated by a minimum of 10 vertical ft.
- If possible, the high and low vents should be of the same capacity.
- Roof vent diameter must be a minimum of 3 in, 4 in diameter is recommended. If the roof vent is less than 3 in, an additional high vent is recommended.
- Vent openings shall be located to ensure the unobstructed flow of air through the entire system.
- The low vent inlet shall be a minimum of 1 ft above final grade or anticipated snow level. Vents extending more than 3 ft above grade must be anchored.
- Sch. 40 or SDR 35 PVC (or equivalent) should be used for all vent stacks.
- One 4 in vent is required for every 1,000 ft of AES pipe.
- A single 6 in vent may be installed in place of up to three 4 in vents.
- If a vent manifold is used, it shall be at least the same diameter as the vent(s).
- Vent piping should slope downward toward the system to prevent moisture from collecting in the pipe and blocking the passage of air.
- Remote venting may be utilized to minimize the visibility of vent stacks.
- When venting multiple beds, it is preferred that each bed be vented separately rather than connecting bed vents together. Multiple vents can be remotely located to the same location if desired.

Vent Manifolds

A vent manifold may be incorporated to connect the ends of a number of sections or rows of AES pipe to a single vent opening. Slope the lines connecting the manifold to the AES pipes to drain condensation.

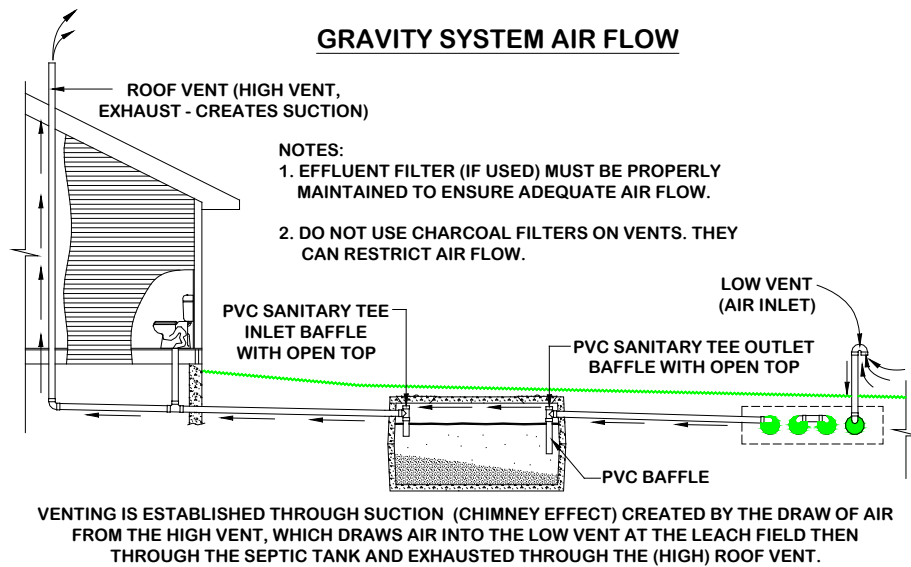


Gravity Systems Vent Location

- A low vent is installed at the end of the last row of each section or the end of the last row in a basic serial bed, or at the end of each row in a D-box distribution configuration system. A vent manifold may be used to connect the ends of multiple sections or rows.
- The house (roof) vent functions as the high vent as long as there are no restrictions or other vents between the low vent and the house (roof) vent.
- When the house (roof) vent functions as the high vent, there shall be a minimum of a 10 ft vertical differential between the low and high (roof) vent openings.

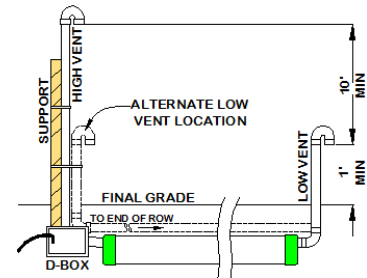
2.0 SYSTEM DESIGN

Illustration of gravity system air flow:



Pump System Vent Locations

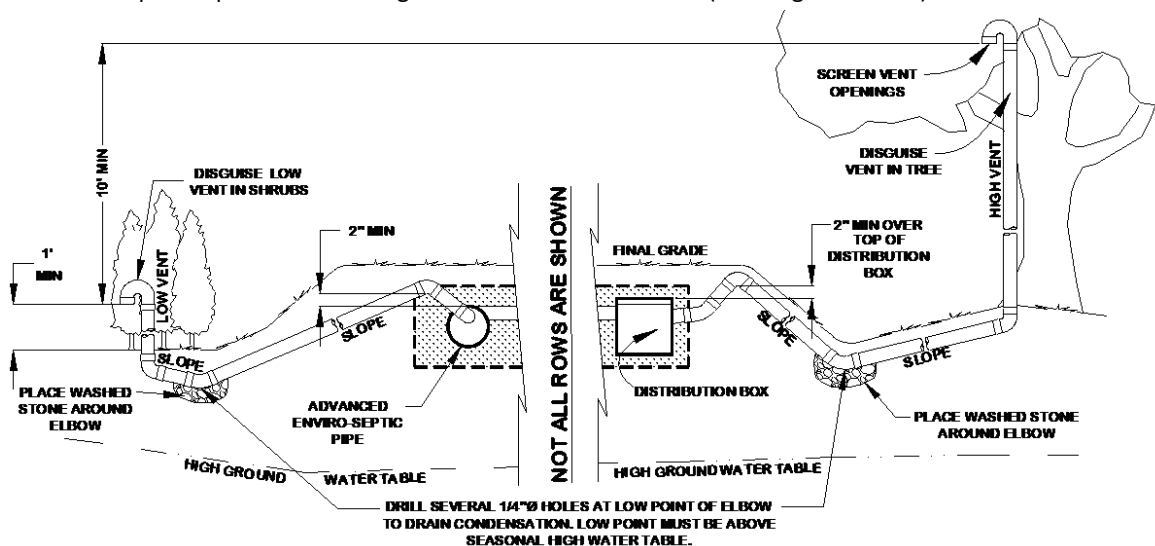
- A low vent is installed through an offset adapter at the end of each section, basic serial bed or attached to a vent manifold.
- A high vent is attached to an unused D-box outlet.
- The low and high vents may be swapped, provided the D-box is insulated against freezing in cold climates.
- For options to relocate the high vent, see Remote Venting.
- For options to eliminate the high vent, see Bypass Venting.



Remote Venting

If site conditions do not allow the vent pipe to slope toward the system, or the owner chooses to utilize remote venting for aesthetic reasons (causing the vent pipe not to slope toward the system), the low point of the vent line must be drilled creating several $\frac{1}{4}$ in holes to allow drainage of condensation. This procedure may only be used if the vent pipe connecting to the system has:

- A high point that is above the highest point of all AES pipes or the D-box (2 in minimum for each); and,
- A low point opened for drainage which is above the SHWT (see diagram below).

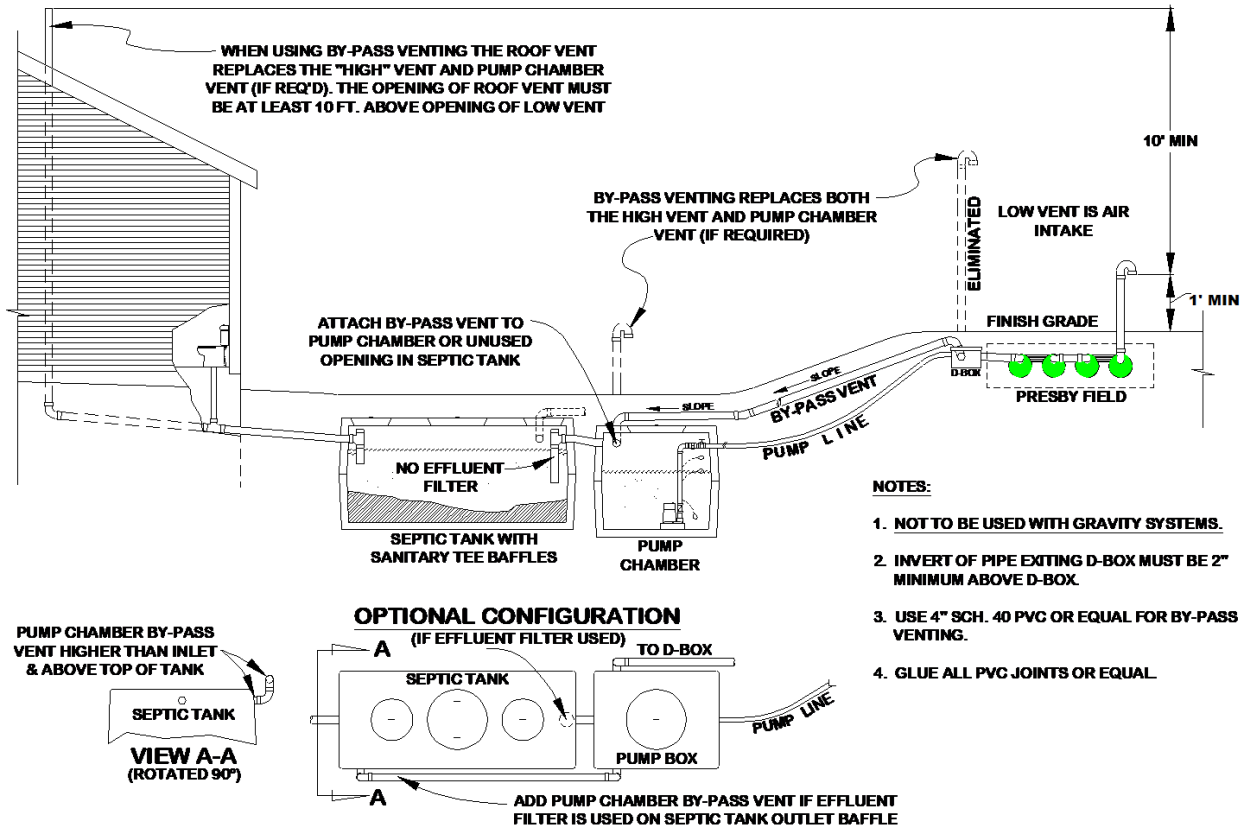


2.0 SYSTEM DESIGN

By-Pass Venting

When a field is fed using pumping or dosing, it is necessary to provide air flow through the system by using either an independent high vent at the field or “by-pass venting”. For by-pass venting, the system is plumbed by attaching Sch. 40 or SDR 35 PVC from the D-box back to the septic tank or pump chamber if no effluent filter is present. This process “by-passes” the pump line and allows air to flow from the low vent to the roof vent which functions as the high vent. The bypass vent line invert must rise 2 in above the D-box before dropping to pump chamber or septic tank.

Illustration of by-pass venting:



2.7 Site Selection

Determining Site Suitability

Refer to state or local rules regarding site suitability requirements.

Topographic Position Requirement

AES systems shall not be located where surface or ground waters will converge, causing surface water flow to become concentrated or restricted within the soil absorption field. The system shall be located in an area that does not concentrate water, both surface and subsurface. If allowed by state and local authorities, altering the terrain upslope of a system may alleviate this requirement if the waters are sufficiently altered to redirect flows away from the field.

- Locate systems on convex, hill, slope or level locations. Avoid swales, low areas, or toe-of-slope areas that may not provide sufficient drainage away from the system.
- No onsite system may be located on concave slopes that concentrate surface or ground water flows unless up-slope terrain is sufficiently altered or interceptor drains are used to redirect water away from the system.

2.0 SYSTEM DESIGN

- Systems should not be located where lawn irrigation, roof drains, or natural flows increase water loading to the soils around the system.
- Divert surface water away from the system. Interceptor drains, if used, must be upslope of the AES system and a minimum of 10 ft away from all AES pipe.
- Systems should not be located where structures such as curbs, walls or foundations might adversely restrict the soil's ability to transport water away from the system.
- Systems should be located to allow access for septic tank maintenance and to at least one end of all AES rows.
- Avoid locating systems in rocky or wooded areas that require additional site work, since this may alter the soil's ability to accept water.
- No trees or shrubs should be located within 10 ft of the system to prevent root infiltration.

AES as a Replacement System

If an AES system is being installed in the same location where another onsite system has previously been installed:

- Remove the existing components and contaminated sand and soil.
- If the soils under and around the system have not been compromised, it is permissible to install the AES system in the same excavated location using new system sand.

Note: Permits may be required for system replacement.

3.0 INSTALLATION

3.1 Installation Requirements

Component Handling

- Keep mud, grease, oil, etc. away from all components. Avoid dragging pipe through wet or muddy areas. Store pipe on high and dry areas to prevent surface water and soil from entering the pipes or contaminating the fabric prior to installation.
- The outer fabric of the AES pipe is ultra-violet stabilized; however, this protection breaks down after a period of time in direct sunlight. To prevent damage to the fabric, cover the pipe with an opaque tarp if stored outdoors.

Site Preparation Prior to Excavation

1. Locate and stake out the system sand bed, extension areas and soil material cover extensions on the site according to the approved plan.
2. Install sediment/erosion control barriers prior to beginning excavation to protect the system from surface water flows during construction.
3. Do not stockpile materials or equipment within the portion of the site receiving system sand.

Critical Reminder to Prevent Soil Compaction

It is critical to keep excavators, backhoes, and other equipment off the excavated or tilled surface of a bed. Before installing the system sand, excavation equipment should be operated around the bed perimeter; not on the bed itself. It is especially important to avoid using construction equipment down slope of the system to prevent soil compaction.

When to Excavate

- Do not work wet or frozen soils. If a fragment of soil from about 9 in below the surface can easily be rolled into a wire, the soil moisture content is too high for construction.
- Do not excavate the system area immediately after, during or before precipitation.

Tree Stumps

Before tilling, remove all grass, leaves, sticks, brush and other organic matter or debris from the excavated system site. Remove all tree stumps and the central root system below grade by using a backhoe or excavator with a mechanical “thumb” or similar extrication equipment, lifting or leveraging stump in a manner that minimizes soil disturbance. It is not necessary for the soil of the system site to be smooth when the site is prepared.

- Avoid soil disturbance, relocation, or compaction.
- Avoid mechanical leveling or tamping of dislodged soil.
- Fill all voids created by stump or root removal with system sand.

Raking and Tilling Procedures

All areas receiving system sand, sand fill, side-slope tapering and fill extensions shall be raked or tilled to remove the organic layer (grass, leaves, forest litter, etc.). When needed to meet vertical separation distances, the topsoil may be left in-place and tilled. If a backhoe/excavator is used to till the site, fit it with chisel teeth and till the site. The backhoe/excavator shall remain outside of the proposed system sand area and all areas that will be impacted by side-slope tapering. While tilling, remove all stones larger than 3 in, stumps roots, grass, brush and other organic matter or debris from the excavated system site.

- For in-ground bed systems, excavate the system bed as necessary below original grade. Using an excavator or backhoe, tilt the bucket teeth perpendicular to the bed and use the teeth to rake furrows 2 in – 6 in deep into the bottom of the entire area receiving system sand or sand fill.
- For elevated bed systems, remove all organics in the footprint of the dispersal area prior to installing system sand. Next, use an excavator or backhoe to rake furrows 2 in – 6 in deep into the receiving area.

Note: It is not necessary for the soil of the system site to be smooth when the site is prepared.

3.0 INSTALLATION

Install System Sand and/or Sand Fill Immediately After Excavation

- To protect the tilled area from damage by precipitation, system sand should be installed immediately after tilling.
- Work off either end or the uphill side of the system to avoid compacting soil.
- Keep at least 6 in of sand between the vehicle tracks and the tilled soil of the site if equipment must work on receiving soil.
- Track construction equipment should not travel over the installed system area until at least 12 in of cover material is placed over the AES pipes.
- Heavy equipment with tires shall never enter the receiving area due to likely wheel compaction of underlying soil structures.

Distribution Box Installation

It is essential that the D-box remain level after installation in order to ensure even distribution to all rows within the system. To prevent movement, D-box shall be set on a layer of level compacted soil, sand, pea gravel base or a concrete footing. Take care when backfilling that the D-box remains level.

Row Installation Sequence

1. Install a minimum of 6 in of system sand to the elevation where the bottom of AES pipes will be and install the sand for side-slope tapering to allow machinery movement around the perimeter of the system. Rake the system sand where the AES pipes will be installed so it is as level as possible before placing pipes on the system sand. This will make it easier to level the pipe rows.
2. Locate AES rows horizontally.
3. Locate AES rows vertically using a laser level or transit. Lift or lower the pipes at couplings using a hand shovel and adding or removing system sand as necessary.
4. Drop system sand along each row of couplings being careful to avoid moving the rows.
5. Add or remove system sand along rows to level. The rows may be raised by pushing additional system sand below the pipes. A hand shovel may be scraped along the system sand below the pipes to remove a small amount if needed.
6. Re-check horizontal and vertical locations. Re-check that pipes are level to within 1 in end-to-end.
7. Add system sand between and around the AES pipes, leaving the uppermost surface of the pipe exposed to allow for system inspection (if required by local approving authority).

Level Row Tolerances

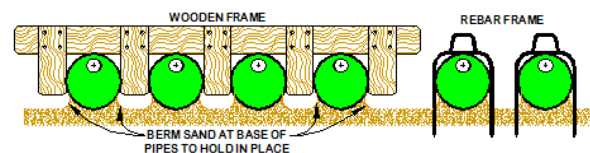
Use a laser level or transit to install rows level. Variations beyond 1 in ($\pm\frac{1}{2}$ in) may affect system performance and are not acceptable.

Correct Alignment of AES Bio-Accelerator® Fabric

The Bio-Accelerator (white geo-textile fabric) is to be positioned centered along the bottom of the pipe rows (sewn seam up).

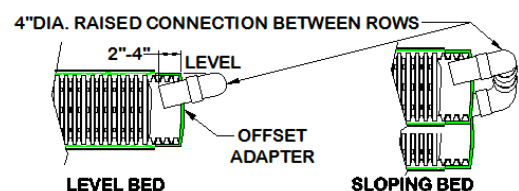
Row Spacers

System sand may be used to keep pipe in place while covering, but simple tools may also be constructed for this purpose. Two examples are shown. One is made from rebar, the other from wood. **Caution:** Remove all tools used as row spacers before final covering.



Connect Rows Using Raised Connections

Raised connections consist of offset adapters, 4 in PVC sewer and drainpipe, and 90° elbows. They enable greater liquid storage capacity and increase the bacterial surfaces being developed. Use raised connections to connect the rows of basic serial and combination serial configurations. Raised connections extend 2 in to 4 in into pipe and are installed on an angle (as

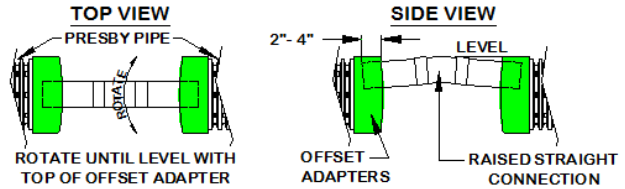


3.0 INSTALLATION

shown in the drawing to the right). If the ends are not at least 2 in into the pipe, they may become dislodged during backfilling. If the ends extend more than 4 in into the pipe, this may cut off the flow of oxygen to the system. The top of the raised connections should be level with the top of the AES pipe as shown. All PVC joints should be glued or mechanically fastened.

Raised Straight Connection

A raised straight connection is a PVC sewer & drain pipe configuration which is used to connect AES rows that are placed end to end along the same contour. Raised straight connections extend 2 in to 4 in into pipe and are installed on an angle (as shown in the drawings to the right). All PVC joints should be glued or mechanically fastened.



Backfilling Rows

1. Spread system sand between the rows.
2. Confirm pipe rows are positioned with Bio-Accelerator along the bottom (sewn seam up).
3. Straddle each row of pipe and walk heel-to-toe its entire length, ensuring that system sand fills all void spaces beneath the AES pipe.
4. Finish spreading system sand to the top of the rows and leave them exposed for inspection purposes.
5. Confirm that all rows of pipe are level to within 1 in end-to-end.
6. After inspection (if required) proceed to backfilling and final grading.

Backfilling and Final Grading

1. Spread system sand to a minimum of 3 in over the pipe and a minimum of 6 in on all four sides of the bed beyond the AES pipes.
2. Spread a minimum of 4 in of suitable earth cover (topsoil or loam) free of organics, stones over 4 in and building debris, having a texture similar to the soil at the site, without causing compaction.
3. To prevent erosion, soil cover above the system shall be planted with native, shallow-rooted vegetation such as grass, wildflowers and certain perennials or ground covers. No trees or shrubs should be located within 10 ft of the system perimeter to prevent roots from growing into and damaging the system.

Fill Extensions Requirements

All systems with any portion of the system sand bed above original grade require 6 in fill extensions on each side beyond the outside edge of all AES pipes and then tapering to meet existing grade at a maximum slope of 4:1. There must be a minimum of 12 in of cover material over the ends of all system sand extensions (if present).

4.0 REJUVENATION AND EXPANSION

4.1 *Bacteria Rejuvenation and Expansion*

Why Would System Bacteria Rejuvenation Be Needed?

Bacteria rejuvenation is the return of bacteria to an aerobic state. Flooding, improper venting, alteration or improper depth of soil material cover, use of incorrect sand, sudden use changes, introduction of chemicals or medicines, and a variety of other conditions can contribute to converting bacteria in any system from an aerobic to an anaerobic state. This conversion severely limits the bacteria's ability to effectively treat effluent, as well as limits liquids from passing through. A unique feature of the AES system is its ability to be rejuvenated in place.

How to Rejuvenate System Bacteria

System bacteria are "rejuvenated" when they return to an aerobic state. By using the following procedure, this can be accomplished in most AES systems without costly removal and replacement.

1. Contact PEI before attempting rejuvenation for technical assistance.
2. Determine and rectify the problem(s) causing the bacteria conversion.
3. Have system and septic tank pumped by a registered septic pumper.
4. Drain the system by excavating at least one end of all the rows and removing the offset adapters.
5. If foreign matter has entered the system, flush the pipes.
6. Safeguard the open excavation.
7. Guarantee a passage of air through the system.
8. Allow all rows to dry for 72 hours minimum. The system sand should return to its natural color.
9. Re-assemble the system to its original design configuration. As long as there is no physical damage to the AES components, the original components may be reused.

System Expansion

AES systems are easily expanded by adding equal lengths of pipe to each row of the original design or by adding additional equal sections. All system expansions shall comply with state and local regulations. Permits may be required prior to system expansion.

Reusable Components

AES pipe and components are not biodegradable and may be reused. In cases of improper installation, it may be possible to excavate, clean, and reinstall all system components.

System Replacement

If an AES system requires replacement...

- Remove the existing components and contaminated sand
- If the soils under and around the system have not been compromised, replace in the same excavated location with new system sand.
- If components are not damaged, they may be cleaned and reused.

Note: Permits may be required for system replacement.

5.0 OPERATION AND MAINTENANCE

5.1 Operation and Maintenance

Proper Use

AES systems do not require a maintenance and monitoring agreement, however they do require minimal maintenance as is standard for conventional onsite systems, provided the system is not subjected to abuse. An awareness of proper use and routine maintenance will guarantee system longevity. We encourage all system owners and service providers to obtain and review a copy of our Owner's Manual, available from our website www.presbyeco.com or via mail upon request to (800) 473-5298 or info@presbyeco.com.

System Abuse Conditions

The following conditions constitute system abuse:

- Liquid in high volume (excessive number of occupants and use of water in a short period of time, leaking fixtures, whirlpool tubs, hot tubs, water softening equipment or additional water discharging fixtures if not specified in system design).
- Solids in high volume (excessive number of occupants, paper products, personal hygiene products, garbage disposals or water softening equipment if not specified in system design).
- Antibiotics and medicines in high concentrations.
- Cleaning products in high concentrations.
- Fertilizers or other caustic chemicals in any amount.
- Petroleum products in any amount.
- Latex and oil paints.
- System suffocation (compacted soils, barrier materials, etc.) without proper venting.

Note: PEI does not recommend the use of septic system additives.

System Maintenance/Pumping of the Septic Tank

- Inspect the septic tank at least once every two years under normal usage.
- Pump the tank when surface scum and bottom sludge occupy one-fourth or more of the liquid depth of the tank.
- If a garbage disposal is used, the septic tank will likely require more frequent pumping.
- After pumping, inspect the septic tank for integrity to ensure that no groundwater is entering it. Also check the integrity of the tank inlet and outlet baffles and repair if needed.
- Inspect the system to ensure that vents are in place and free of obstructions.
- Effluent filters require ongoing maintenance due to their tendency to clog and cut off oxygen to the system. Follow filter manufacturer's maintenance instructions and inspect filters frequently.

Site Maintenance

It is important that the system site remain free of shrubs, trees, and other woody vegetation, including the entire SSBA, and areas impacted by side slope tapering and perimeter drains (if used). Roots can infiltrate and cause damage or clogging of system components. If a perimeter drain is used, it is important to make sure that the outfall pipes are screened to prevent animal activity. Also check outfall pipes regularly to ensure that they are not obstructed in any way.

6.0 WARRANTY

6.1 PRESBY ENVIRONMENTAL, INC. STANDARD LIMITED WARRANTY

(a) The structural integrity of each unit, endcap and other accessory manufactured by Presby Environmental, Inc. (collectively referred to as “Units”), when installed and operated in an onsite wastewater system in accordance with Presby Environmental’s installation instructions, is warranted to the original purchaser (“Holder”) against defective materials and workmanship for one year from the date upon which a septic permit is issued for the septic system containing the Units; provided, however, that if a septic permit is not required for the septic system by applicable law, the one (1) year warranty period will begin upon the date that installation of the septic system commences. In order to exercise its warranty rights, Holder must notify Presby Environmental in writing at its corporate headquarters in Whitefield, New Hampshire within fifteen (15) days of the alleged defect. Presby Environmental will supply replacement Units for those Units determined by Presby Environmental to be defective and covered by this Limited Warranty. Presby Environmental’s liability specifically excludes the cost of removal and/or installation of the Units.

(b) THE LIMITED WARRANTY AND REMEDIES IN SUBPARAGRAPH (a) ARE EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE UNITS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

(c) This Limited Warranty shall be void if any part of the Presby Environmental system (unit, endcap or other accessory) is manufactured by anyone other than Presby Environmental. The Limited Warranty does not extend to incidental, consequential, special or indirect damages. Presby Environmental shall not be liable for penalties or liquidated damages, including loss of production and profits, labor and materials, overhead costs, or other losses or expenses incurred by the Holder or any third party. Specifically excluded from Limited Warranty coverage are damage to the Units due to ordinary wear and tear, alteration, accident, misuse, abuse or neglect of the Units; the Units being subjected to vehicle traffic or other conditions which are not permitted by the installation instructions; failure to maintain the minimum ground covers set forth in the installation instructions; the placement of improper materials into the system containing the Units; failure of the Units or the septic system due to improper siting or improper sizing, excessive water usage, improper grease disposal, or improper operation; or any other event not caused by Presby Environmental. This Limited Warranty shall be void if the Holder fails to comply with all of the terms set forth in this Limited Warranty.

Further, in no event shall Presby Environmental be responsible for any loss or damage to the Holder, the Units, or any third party resulting from installation or shipment, or from any product liability claims of Holder or any third party. For this Limited Warranty to apply, the Units must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Presby Environmental’s installation instructions.

(d) No representative of Presby Environmental has the authority to change this Limited Warranty in any manner whatsoever, or to extend this Limited Warranty. No warranty applies to any party other than the original Holder.

The above represents the standard Limited Warranty offered by Presby Environmental. A limited number of states and counties have different warranty requirements. Any purchaser of Units should contact Presby Environmental’s corporate headquarters in Whitefield, New Hampshire, prior to such purchase, to obtain a copy of the applicable warranty, and should carefully read that warranty prior to the purchase of Units.