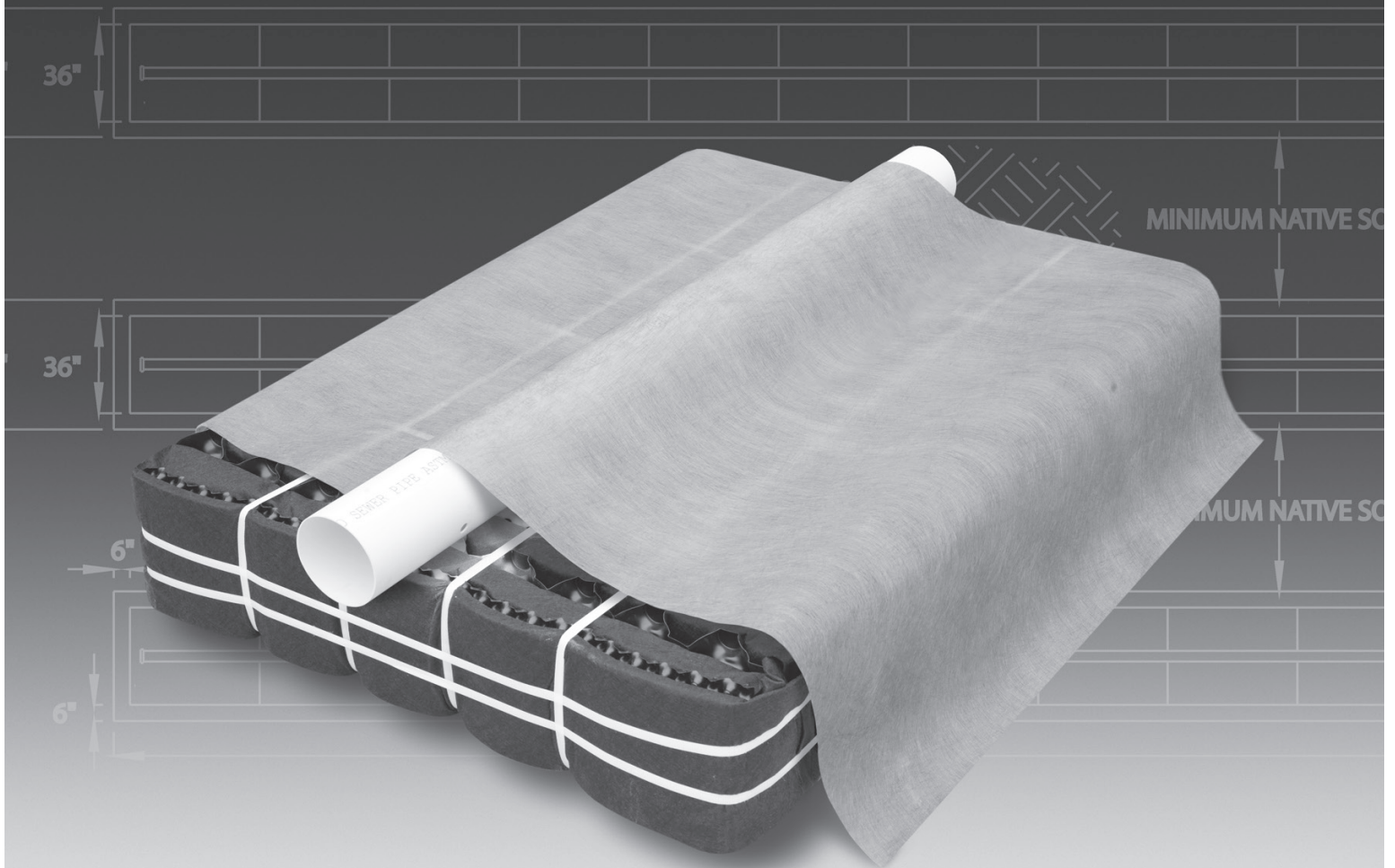




Geotextile Sand Filter

Virginia Design & Installation Manual



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Glossary of Terms

B43 Module	(L x W x H) 48" x 36" x 7"
Biofabric	Special 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.
Cuspated 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 cuspations 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	Also known as a D-Box – is 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. The distribution box method is only used when the receiving GSF modules are at the same elevation.
Flow Dial	Special insert placed in the end of distribution pipes within the distribution box to compensate for possible unlevelled installations and promote favorable flow to the distribution pipes.
GSF	The Eljen Geotextile Sand Filter modules and the Specified Sand layer along the base and sides of the modules.
GSF Module	The individual module of a GSF system. The module is comprised of a cuspated plastic core and corrugated geotextile fabric.

Glossary of Terms

Specified Sand To ensure proper system operation, the system must be installed using ASTM C33 sand with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. Listed below is a chart outlining the sieve requirements for the Specified Sand. Ask your material supplier for a sieve analysis to verify that your material meets the required specifications.

Table 1: SPECIFIED SAND SIEVE REQUIREMENTS

ASTM C33 Sand Specification		
Sieve Size	Sieve Square Opening Size	Specification Percent Passing (Wet Sieve)
0.375"	9.5 mm	100.0 - 100.0
#4	4.75 mm	95.0 - 100.0
#8	2.36 mm	80.0 - 100.0
#16	1.18 mm	50.0 - 85.0
#30	600 µm	25.0 - 60.0
#50	300 µm	5.0 - 30.0
#100	150 µm	< 10.0
#200	75 µm	< 5.0

STA Soil Treatment Area

STE Septic Tank Effluent (STE) is anaerobically digested effluent that is discharged to a Geotextile Sand Filter module for further treatment.

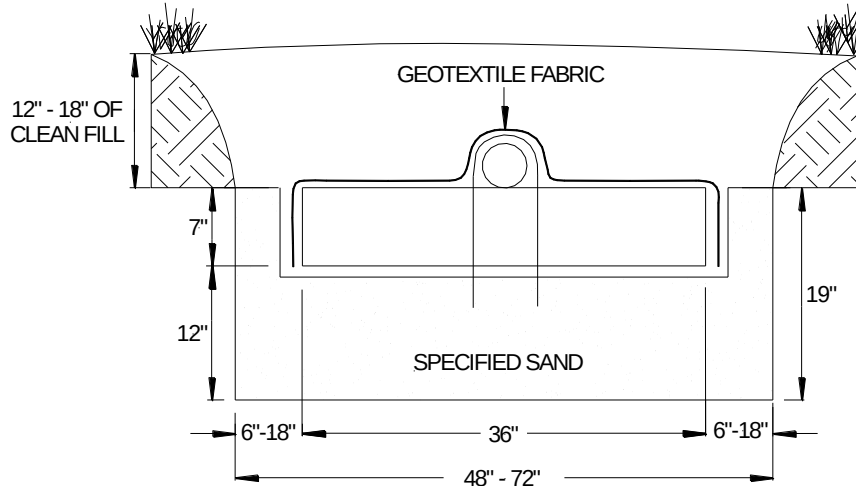
Width & Length The system width is the sand dimension perpendicular to the GSF module rows. The system length is measured parallel to the rows of GSF modules.

Wire Clamp Wire Clamps are used to secure perforated distribution pipe above the GSF modules.

GSF System Description

This manual provides design and installation information for the Eljen GSF Geotextile Sand Filter system utilizing the GSF B43 Module.

FIGURE 1: TYPICAL GSF B43 MODULE TRENCH CROSS SECTION



Minimum Vertical Separation Requirements to Limiting Features	
Vertical Separation from Bottom of Sand	Effluent Description
≥ 18" (Must Be Naturally Occurring Soil)	Septic, TL-2
< 18" - 12" (Minimum 6" of Naturally Occurring Soil)	TL-2, TL-3

**Note: The minimum vertical separation distance to a limiting feature must be maintained across the entire modified trench/pad area.*

The GSF B43 module contains 7 Square feet of geotextile filter fabric per square foot, which equates to 86 square feet per module.

Design layouts and installation instructions for sequential, equal or dosed distribution systems are included. Details on unique design and construction procedures are also provided. To receive design standards for specially engineered dosing systems or commercial systems, contact Eljen's Technical Resource Department at 1-800-444-1359. GSF systems must be designed and constructed according to this Design & Installation Manual and the State of *Virginia Sewage Handling and Disposal Regulations*, including *Chapter 613, Regulations for Alternative Onsite Sewage Systems* (hereinafter the *Regulations*).

The Eljen GSF system technology is based on research conducted by nationally recognized engineering scientists from the University of Connecticut. Eljen Corporation has over 30 years of success in the onsite wastewater industry, with tens of thousands of systems currently in use. The GSF is recognized by regulatory officials and experts in the industry as one of the most reliable wastewater treatment technologies in the marketplace today. The system specifications in this manual are founded on this research and history.

The GSF technology is based on scientific principles which state that improved effluent quality provides increased soil absorption rates. GSF's proprietary two-stage Bio-Matt™ pre-filtration process improves effluent quality while increasing reliability and ease of operation.

Third-party independent testing data based on NSF/ANSI Standard 40 Protocol has shown that the Eljen GSF provides advanced treatment of septic tank effluent to better than secondary levels.

GSF System Description

The Eljen GSF Geotextile Sand Filter system is a cost-effective upgrade from other septic technologies. Comprised of a proprietary two-stage Bio-Matt™ pre-treatment process, the geotextile modules apply a better-than-secondary septic tank effluent to the soil, increasing the soil's ability to accept the effluent. The result is superior treatment in a smaller soil absorption area.

How the GSF System Works

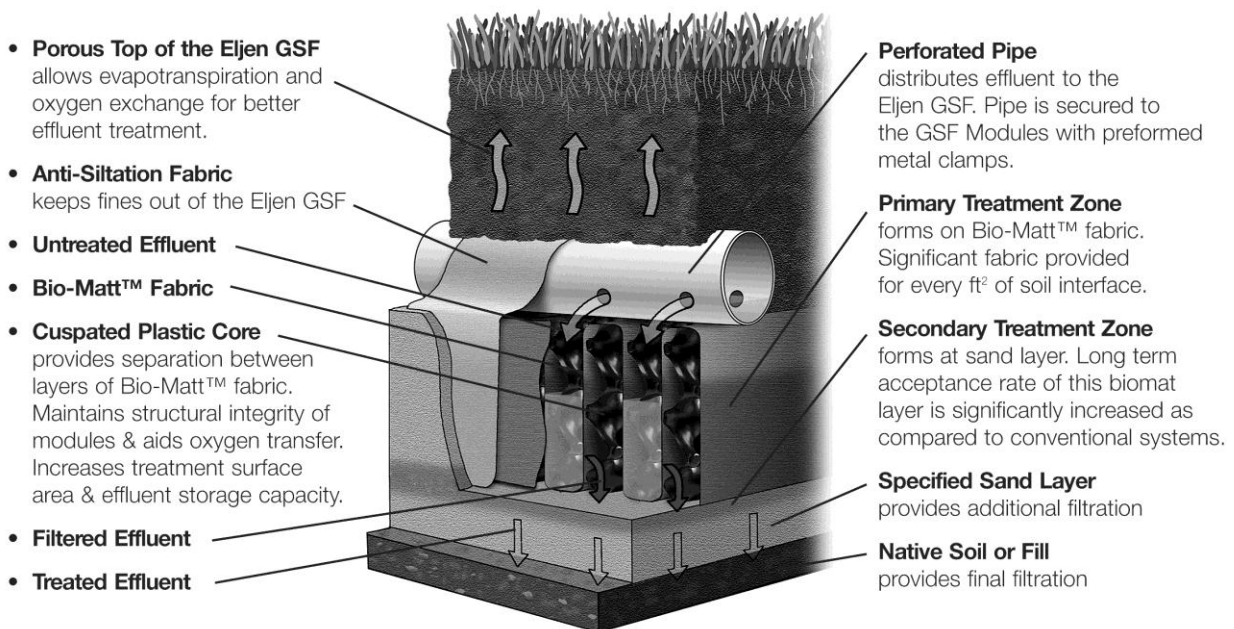
Primary Treatment Zone

- 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 slowly 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 2: GSF SYSTEM OPERATION



1.0 Basic System Design

1.1 TREATMENT FIELD SIZE: The sizing tables on pages 28 – 34 apply to residential systems only. A minimum of 12 inches of separation is required between parallel rows of a GSF PAD system to utilize sidewall infiltration area. Please contact Eljen's Technical Resource Department at 1-800-444-1359 for design information on commercial systems.

1.2 DEPTH TO GROUND WATER OR RESTRICTIVE LAYER: As required by state regulations; the bottom of the GSF system requires a 12-inch minimum separation distance from the maximum seasonal high groundwater table. Of the 12 inches required, 6 inches of soil must be naturally occurring. See Figure 1 of this manual for the separation distances required based on effluent type. **Note: The minimum vertical separation distance to a limiting feature must be maintained across the entire modified trench/pad area.*

1.3 SPECIFIED SAND SPECIFICATION FOR MODIFIED TRENCH AND PAD SYSTEMS: The first 12 inches of Specified Sand immediately under, between rows and around the perimeter of the GSF system must be an **ASTM C33 WASHED CONCRETE SAND WITH LESS THAN 10% PASSING A #100 SIEVE AND LESS THAN 5% PASSING A #200 SIEVE**. Please place a prominent note to this effect on each design drawing. See Table 1 for more information on the ASTM C33 sand and sieve specifications.

1.4 FILL FOR RAISED SYSTEMS: Fill material below the 12-inch sand specified in Section 1.3 for raised PAD systems must be clean fill material in accordance with State of Virginia requirements.

1.5 PLACING GSF MODULES: Each row of modules is laid level, end to end on the above Specified Sand. No mechanical connection is required between modules.

1.6 DISTRIBUTION PIPE: SDR-35 or equivalent is required. Place SDR-35 perforated pipe on top of GSF modules with holes a 5 and 7 o'clock. Secure pipe to GSF modules with provided wire clamps, one clamp per Eljen module.

1.7 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 Modified Trench or PAD configuration. Set a 2-inch minimum drop for dosed systems from the D-box to the modules. The fill below the distribution box and pipes feeding the system must be compacted to prevent settling. Flow Dials may be used in either Gravity or Dosed installations.

1.8 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.

1.9 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 Modified Trench or PAD. Use well graded sandy 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 Soil Treatment Area, (STA). Finish grade to prevent surface ponding. Seed and loam system area to protect from erosion.

1.10 NUMBER OF GSF MODULES REQUIRED: Tables 2 - 5 indicate the minimum number of B43 GSF modules required for various soil percolation rates and system configurations. Residential systems use a minimum of 5 B43 units per bedroom. Examples of the Modified Trench and PAD configuration are located in sections 15 and 16 of this manual.

Note: The use of linear loading rates may affect the number of modules required for a particular design. Eljen promotes the use of best engineering practices regarding linear loading rates when designing PAD systems on sloped terrain. Longer thinner systems are recommended.

1.0 Basic System Design

1.11 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 increased 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 with water conditioner backwash (Diversion from septic tank required).

1.12 GARBAGE DISPOSALS: Garbage disposals should not be used with the GSF system. Design drawings shall include a note “**Garbage disposals shall not be used with this system**”. However, if such units are proposed to be used, other measures must be taken to prevent solids from leaving the tank and entering the system such as:

- Increasing 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.

NOTE: Eljen requires the use of septic tank outlet effluent filters on all systems, especially on those systems that have single compartment tanks and garbage disposal systems installed, even if the tanks design capacity has been increased.

1.13 WATER SOFTENERS/CONDITIONERS: Water conditioners can adversely affect septic tank treatment and add to hydraulic load of the system. Discharge of residential conditioner backwash from these devices shall be into a separate alternative disposal system. This location should be far enough away from the STA as to not affect its performance.

1.14 SYSTEM VENTING: All systems require sufficient oxygen supply to the STA to maintain proper long term effluent treatment. Therefore, the following situations require venting at the distal end of the STA:

- Any system with more than 18 inches of total cover measured from the top of the module.
- Areas subject to compaction.

1.15 VEHICULAR TRAFFIC: All vehicular traffic is prohibited over the GSF system. This is due to the compaction of material required to support traffic loading which greatly diminishes absorption below the STA; and the void space that naturally exists in soils for oxygen transfer on top of the STA is reduced by compaction from vehicular traffic.

1.16 SEPTIC TANKS: Must conform to the minimum requirements of State and/or Local Regulations. Many designers are now specifying 2-compartment septic tanks. Eljen supports this practice.

1.17 EFFLUENT FILTERS: Effluent filters are required as a means of preventing solids from leaving the tank.

1.18 RISERS: It is strongly recommended that risers be installed which will extend the septic tank lids to finish grade. This will provide easy access to the septic tank for periodic maintenance such as pumping, inspection, and filter maintenance. Please follow all State and Local Codes in regards to installation requirements for risers.

1.19 PUMP SYSTEM DESIGNS:

- The *Regulations* do not specifically address pumps used for purposes other than conveying effluent to a dispersal system. 12 VAC 5-610-880 is waived in its entirety for pumps, pump chambers, and appurtenances integral to treatment systems.
- Conveyance Pumps. The pump requirements contained in 12 VAC 5-610-880 subsections A.1, B.6, and B.7 are waived. Pump systems designed in accordance with these sections of the *Regulations* are not appropriate for systems dispersing treated effluent to a reduced size absorption area.

1.0 Basic System Design

1.20 Separation Distances to Water Table: The separation distances between the infiltrative surface of a soil absorption system and a water table is shown Figure 1 of this manual. **Note: The minimum vertical separation distance to a limiting feature must be maintained across the entire modified trench/pad area.*

1.21 Separation Distance to Impervious Strata for Shallow Placed Systems: The separation distance to an impervious strata may be reduced from 18 inches to a distance not less than 12 inches below the Modified Trench or PAD bottom when a professional engineer certifies in writing that they have evaluated the hydraulic capacity of the site to disperse wastewater and that in their professional opinion, water mounding will not encroach on the separation distance required as outlined in Figure 1 of this manual. **Note: The minimum vertical separation distance to a limiting feature must be maintained across the entire modified trench/pad area.*

1.22 Plans and Specifications: When plans conform to requirements of GMP #125, the requirements for formal plans and specification required in 12 VAC 5-610-250.C is waived. Typical treatment system drawings and specifications are shown at the end of this manual. When used in conjunction with a permit sketch, site specific specifications, and manufacturer installation criteria, these documents will normally be sufficient to assure a system can be properly installed. In some instances where a complex system is encountered, formal plans and specifications may be required. This determination is left to the discretion of the District Health Department.

2.0 Systems for Level Sites

2.1 SYSTEM CONFIGURATIONS: Design level in-ground or raised PAD systems with 12-inch minimum spacing between module rows. For Modified Trenches, center-to-center spacing must be no less than three times the width of the trench for slopes up to 10%. For slopes over 10%, add one extra foot of separation for every 10% increase in slope. The Specified Sand, Modified Trench, PAD, GSF modules, and distribution pipes are installed level at their design elevations.

2.2 DISTRIBUTION PIPE LAYOUT: Perforated SDR-35 pipe or equivalent runs along the center of the modules for both Modified Trench and PAD configurations. Ends for PAD systems should be connected with non-perforated pipe at the distal end of the system as shown in Figure 5. For PAD systems over 40 feet in length, a non-perforated "cross-over" connection should be installed perpendicular to the length of the STA connecting all distribution pipes at the midway point of the system.

3.0 Systems for Sloped Sites

3.1 ROW SPACING: For PAD Systems, center-to-center and center-to-edge spacing will vary per design. For slopes up to 15% a minimum of 1 foot edge to edge module spacing is required. For slopes over 15% a minimum 2 foot edge to edge module spacing is required. The edge of module to toe of downhill slope spacing is based on the Regulations or a minimum 3:1 slope requirement.

For Modified Trenches, center-to-center spacing must be no less than three times the width of the trench for slopes up to 10%. For slopes over 10%, add one extra foot of separation for every 10% increase in slope.

Note: For proposed PAD sites with slopes greater than 25% - Professional Engineer consultation is recommended.

3.2 DISTRIBUTION BOX: Provide a D-box at the beginning of the first row of modules for effluent distribution and velocity reduction and as a system inspection port. All rows must be fed evenly.

4.0 Pumped & Pressure Systems

4.1 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 5.0 of this manual for detailed information on venting of systems.

4.0 Pumped & Pressure Systems

4.2 DOSING DESIGN CRITERIA: Dosing volume must be set to deliver a maximum of 4 gallons per B43 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.

4.3 LOW PRESSURE DISTRIBUTION: Per 12 VAC 5-610-940 (c) (1), Pressure percolation lines should have a minimum 1 1/4 inch inside diameter. Orifices should be designed at 3/16 inch to 1/4 inch in diameter and at pre-determined intervals per design and code. Design requirements will vary depending on length of system and dose volume. At least one drain hole per line at the 6 o'clock position must be added to each line. Eljen recommends that timed pressure distribution systems be designed by a professional engineer or other qualified person. See Figures 3 and 4 for example Low Pressure Distribution drawing details.

Flushing ports are required at the distal end of all pressure distribution networks. Flushing valves and vents can be consolidated in larger systems by using valves on the outlet manifold.

FIGURE 3: EXAMPLE PRESSURE DISTRIBUTION – UPWARD FACING ORIFICE LAYOUT

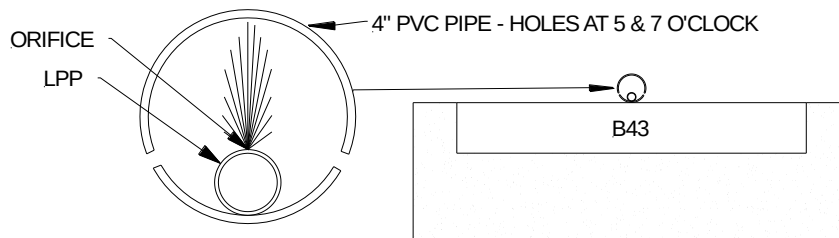
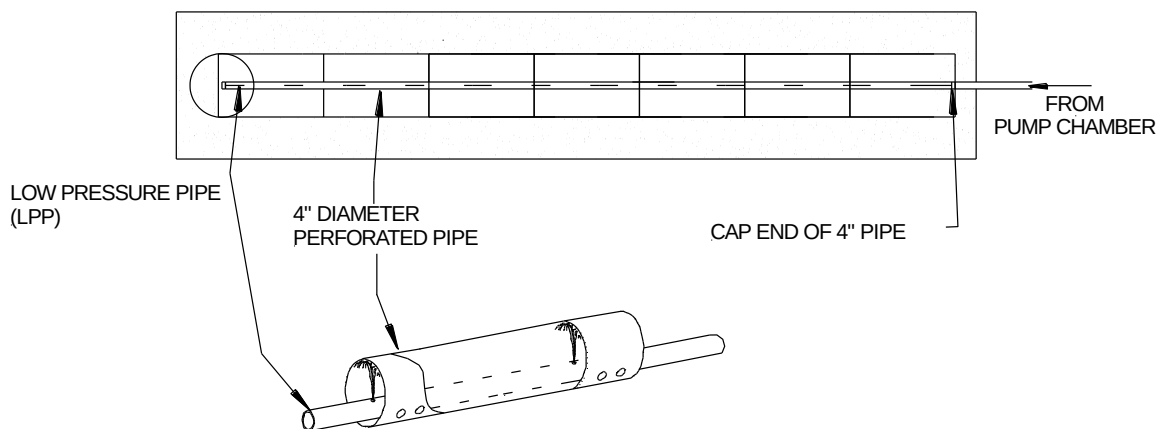
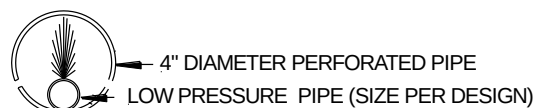


FIGURE 4: EXAMPLE PRESSURE PIPE DESIGN LAYOUT



PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS



5.0 General System Installation Guidelines

1. All GSF systems are installed onto a 12-inch layer of Specified ASTM C33 Sand. Specified Sand is compacted in two 6-inch lifts.
2. Place the 7-inch tall GSF modules on top of a 12-inch minimum level surface of ASTM C33 Specified Sand with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. ***You must use the Specified Sand as listed in Table 1 of this manual to ensure proper system operation.***
3. The GSF modules are placed with the ***WHITE PAINTED STRIPE FACING UP***, end to end on top of the Specified Sand.
4. Use the provided wire clamps to secure the approved perforated 4-inch diameter distribution pipe, SDR-35 or equivalent, to the top of each GSF module.
5. Installation of the manufacturer supplied cover fabric. Cover fabric placement requires setting the tension and orientation of the fabric around the sides of the perforated pipe on top of the GSF modules. If the fabric is too loose, it blocks the effluent from draining into the modules. If the fabric is too tight, it could tear if punctured by a sharp object and allow soil and sand to fall into the open corrugations of the modules. The correct tension of the cover fabric is set by:
 - 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.
 - With a shovel, place small piles 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.
 - Anchor the cover fabric by placing Specified Sand along the sides and up to the top of the module and walk it in to ensure the cover fabric is secure in place.
6. PAD system requires Specified Sand placed between module rows at various center-to-center distances. Percolation rate, application rate and number of bedrooms have a direct effect with regards to center-to-center spacing. Table 4 & 5 provides values to calculate width and length of the PAD. Sizing examples can be found on pages 32 & 34.
7. Modified Trench Systems require a set amount of Specified Sand at the sides of all modules and 6 inches at each end of the Modified Trench; see Table 2 or 3 for specific trench width requirements.
8. When backfilling the installation with native soil, it is required that the backfill material is a well graded sandy fill; clean, porous, and devoid of rocks.
9. Finish by grading the area to divert storm water runoff away from the system.
10. **Driving or paving over the Geotextile Sand Filter area is prohibited.** For shallow installations, light-weight track-mounted machines are best for setting the final grade. It is also permissible to back-blade the soil to set final minimum cover. Landscape stakes are helpful to outline the construction area while backfilling the system.
11. Seeding and stabilizing the soil cover is required to protect the system from soil erosion.
12. Where the elevation of the surface exceeds the natural grade, a block or landscape timber frame or sloping soil toe at a 3:1 grade can be used to help eliminate soil erosion and support maintenance of the stabilizing grass cover adjacent to the GSF System.
13. Provide a well-anchored D-box on a stable, level and compacted gravel or sand base. A d-box with a velocity reduction tee or baffle is required for pumped systems.
14. For pumped or pressurized systems, an additional 2-inch minimum airline must be extended from the 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. Systems must also be vented at the distal end of the Modified Trench or PAD when there is more than 18 inches of cover material as measured from the top of the module.

6.0 Required Notes on Design Plans

1. This system (is/is not) designed for the use of a garbage disposal.
2. This system is not designed for backwash from a water softener.
3. Organic Loam Layer must be removed from PAD and slope extension areas prior to fill placement. Scarify subsoil prior to fill placement.
4. Fill material shall meet or exceed the Eljen GSF Design & Installation Manual requirements. All fill material shall be clean sand, free of topsoil, directly beneath the STA.
5. The 6, 12, or 18 inches surrounding and the 12 inches below the GSF modules shall be washed concrete sand meeting the requirements of ASTM C33 with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve.
6. Backfill and Finish Grading: Carefully place backfill over the modules, followed by a total minimum depth of 12 - 18 inches of well graded sandy fill; clean, porous, and devoid of rocks, as measured from the top of the modules. Finish grade must divert surface runoff from the STA and prevent surface ponding. Protect the system area from erosion by loaming and seeding or by using other approved methods of erosion control.
7. Systems with total cover that exceeds 18 inches as measured from the top of the module shall be vented at the far end of the system.
8. This design complies with and must be installed in accordance with the most current Eljen Design and Installation Manual.

7.0 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 6.

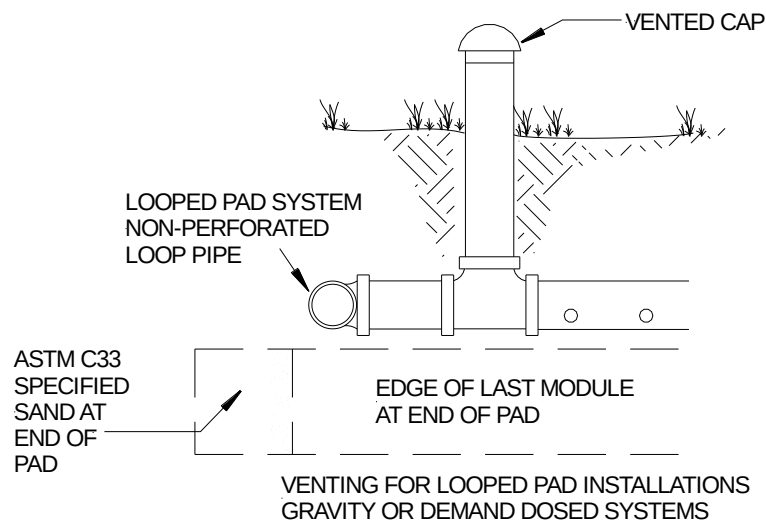
Home plumbing operates under negative pressure due to hot water heating the pipes and reducing the density of air in the house vent. As hot air rises and exits the home, it must be replaced by air from the GSF. To maintain this airflow and fully aerate the GSF system, it is important that air vents are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

If a pressure or pump dosed system is specified with greater than 18 inches of cover, an additional 2-inch minimum airline 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.

In a gravity fed GSF system, the vent is usually a 4-inch diameter pipe extended to a convenient location behind shrubs, as shown in Figure 6. Corrugated pipe can be used with the placement and grade such that any condensation that may accumulate in the pipe does not fill and thus close off this line. If the vent is extended, the pipe must not drain effluent and must have an invert higher than the system.

System Ventilation Example Drawings

FIGURE 5: VENT FOR GRAVITY AND PUMP DOSED PAD SYSTEMS



System Ventilation Example Drawings

FIGURE 6: GSF WITH 4" VENT EXTENDED TO CONVENIENT LOCATION BEHIND A TREE OR SHRUB

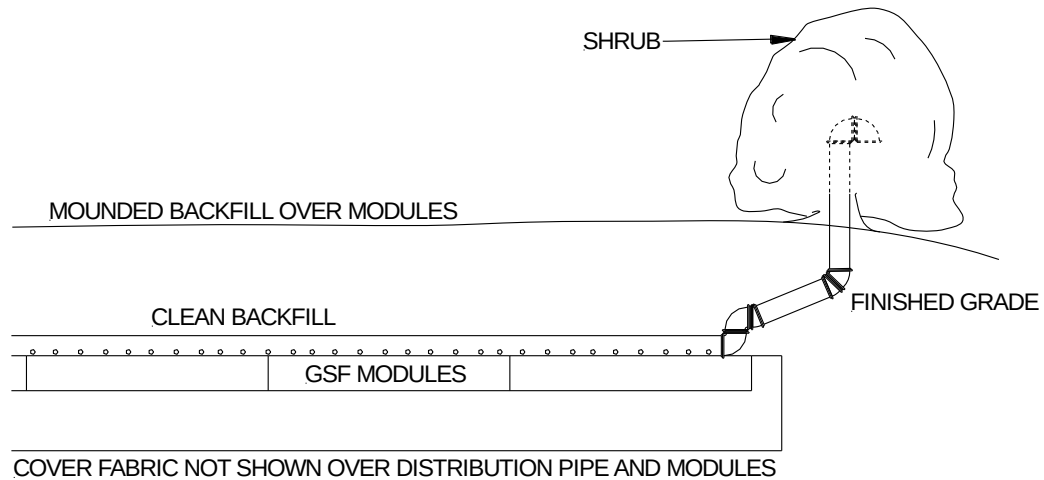
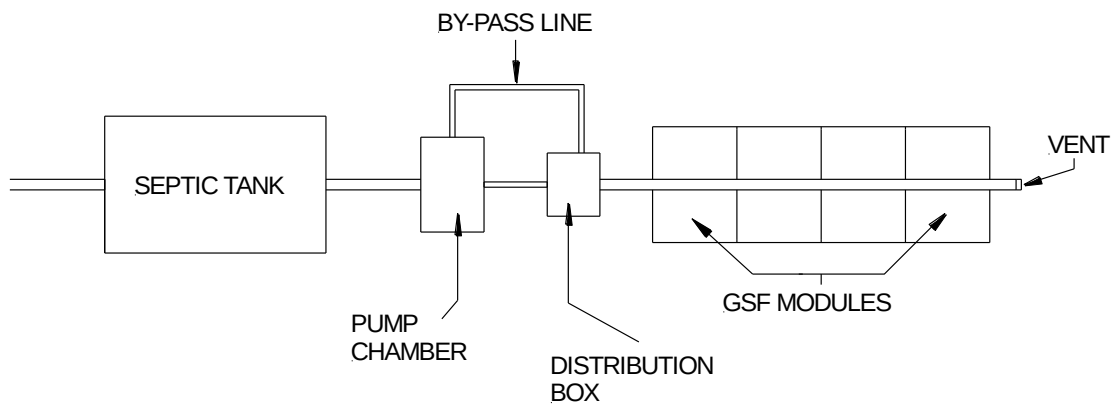
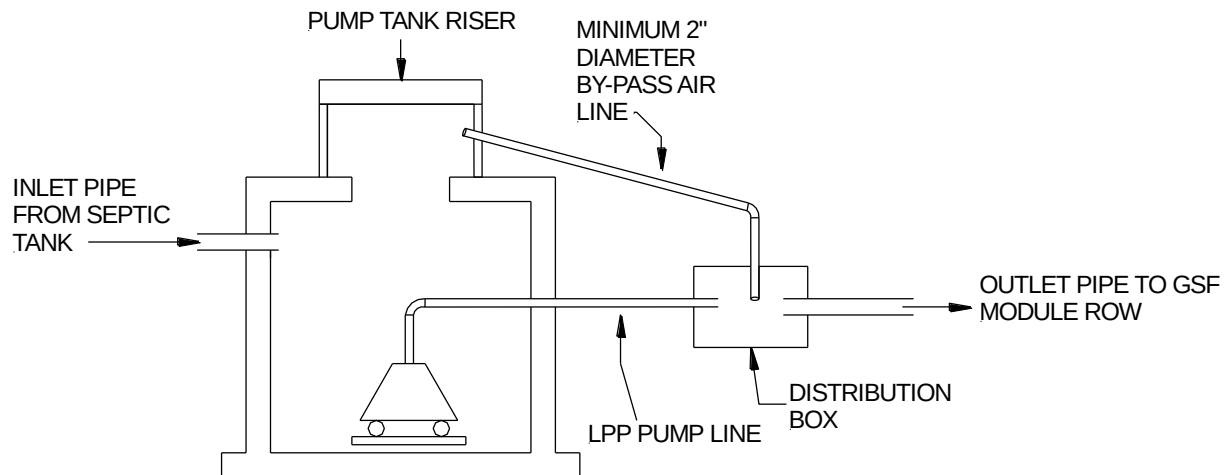


FIGURE 7: AIR BY-PASS LINE PLAN VIEW FOR VENTING OF PUMPED SYSTEMS DESIGNED WITH GREATER THAN 18 INCHES OF COVER



System Ventilation Example Drawings

**FIGURE 8: AIR BY-PASS LINE CROSS SECTION FOR VENTING OF PUMPED SYSTEM
DESIGNED WITH GREATER THAN 18 INCHES OF COVER**



8.0 Commercial Systems

Commercial systems require different sizing and design criteria as compared to residential systems. This manual is intended for residential design only. Please contact Eljen's Technical Resource Department at 1-800-444-1359 for more information on commercial systems.

9.0 Modified Trench Installations

1. Determine type and number of modules, length and width of the Modified Trench from Sizing Table 2 or 3.
2. Carefully lay out the system components and boundaries. Define the location and elevation of the Modified Trench and distribution box based on the septic tank outlet elevation and pipe grades required to maintain flow to each component.
3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clayey soils used for the GSF system as well as down-slope from the system where soil structure is critical for absorption and drainage of the treated effluent.
4. 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.
5. Excavate the Modified Trench. Scarify the receiving layer to maximize the interface between the native soil and Specified Sand.
6. Minimize walking in the Modified Trench prior to placement of the Specified Sand to avoid soil compaction.
7. Place Specified Sand (see Table 1 for Specified Sand requirements) in two 6-inch lifts, compact each lift at a time. The compacted Specified Sand height below the GSF module must be a minimum of 12 inches.
8. A hand tamper or vibratory compactor is sufficient to stabilize the Specified Sand below the GSF modules. Check the zero grade of the top of the Specified Sand using a flat piece of lumber and a carpenter's level and/or a laser before placing the modules.
9. Place GSF modules with **WHITE PAINTED STRIPE FACING UP**, end to end on top of the Specified Sand.
10. Provide D-box(s) installed in accordance with this manual and current *Virginia Sewage Handling and Disposal Regulations*.
11. Use 4-inch SDR-35 or equivalent non-perforated pipe from the distribution box to the GFS modules. Recommended drop for gravity systems from D-Box to modules is 1/8 inch per linear foot.
12. Center 4-inch SDR-35 or equivalent perforated distribution pipe lengthwise over modules with orifices at 5 and 7 o'clock on level trench systems.
13. Secure pipe to GSF modules using one Eljen wire clamp per module. Push wire clamp ends straight down into up-facing core, through the fabric and into the underlying Specified Sand.
14. Install the manufacturer supplied cover fabric. Cover fabric placement requires setting the tension and orientation of the fabric around the sides of the perforated pipe on top of the GSF modules. The correct tension of the cover fabric is set by; 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. With a shovel, place small piles 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. Anchor the cover fabric by placing Specified Sand along the sides and up to the top of the module and walk it in to ensure the cover fabric is secure in place.
15. Place 6 inches, 12 inches or 18 inches of Specified Sand along both sides of the modules and 6 inches at the beginning and end of each Modified Trench. See Table 2 or 3 for the amount of Specified Sand required at the sides of modules for your specific design and application rate.
16. Carefully place backfill over the modules, followed by loam to complete a total minimum depth of 12 - 18 inches as measured from the top of the module. Systems with total cover that exceeds 18 inches as measured from the top of the module shall be vented at the distal end of the system. Backfill material shall be a well graded sandy fill; clean, porous, and devoid of rocks.
17. Divert surface runoff. Finish grade to prevent surface ponding. Seed, loam, and protect from erosion.

Modified Trench Installation Example Drawings

FIGURE 9: MULTIPLE TRENCH CROSS SECTIONS

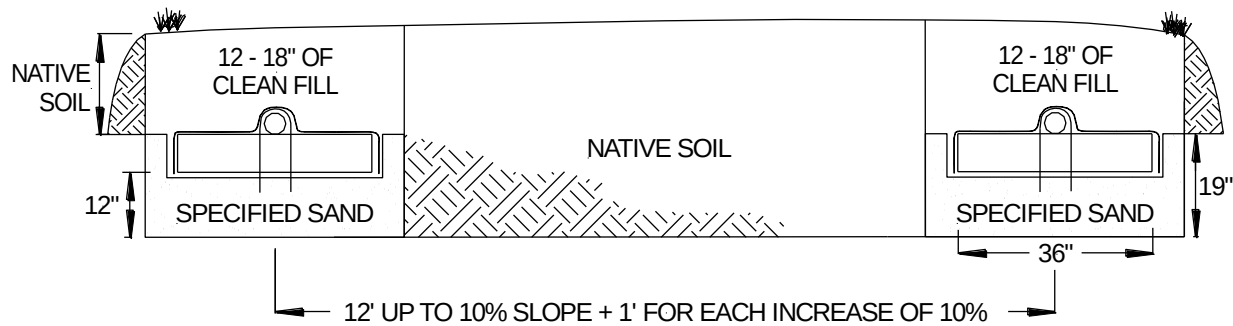


FIGURE 10: MULTIPLE TRENCH PLAN VIEW

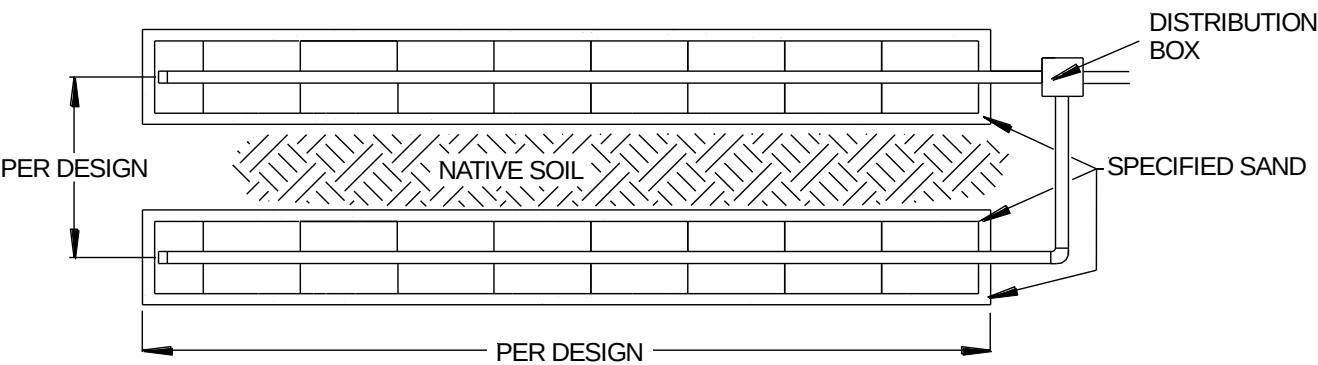
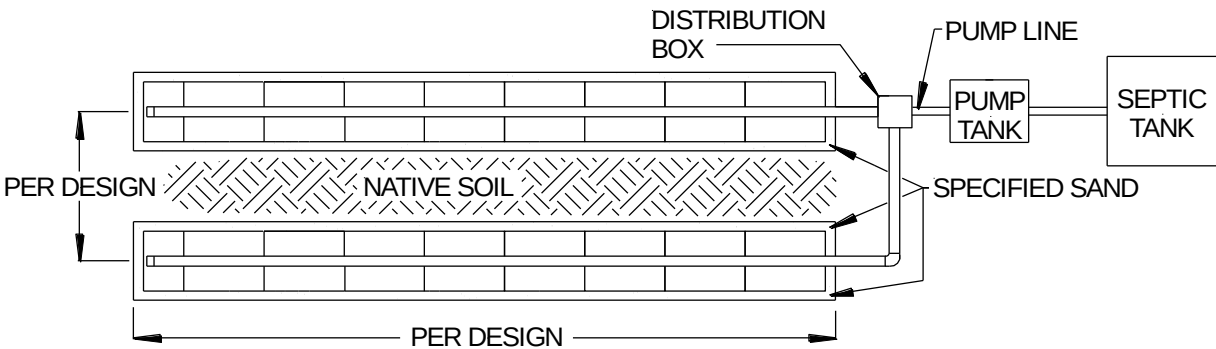


FIGURE 11: MULTIPLE TRENCH PUMP DOSED PLAN VIEW



10.0 Modified Trench Installations for Shallow Placement Systems

1. Determine the module type, length and width of the Modified Trench from Sizing Table 2 or 3. Modified Trenches use center to center spacing consistent with the Regulations. Please see Table 2 or Table 3 for the amount of Specified Sand required for the appropriate sf/module rate chosen.
2. Carefully lay out the system components and boundaries. Define the location and elevation of the Shallow Placement Modified Trench system and distribution box based on the septic tank outlet elevation and pipe grades required to maintain flow to each component.
3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clayey soils used for the GSF system as well as down-slope from the system where soil structure is critical for absorption and drainage of the treated effluent.
4. 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.
5. Excavate the Shallow Placement Modified Trench area. Key in and scarify the receiving layer to maximize the interface between the native soil and Specified Sand material.
6. Minimize walking in the excavated area prior to placement of the specified fill material to avoid soil compaction.
7. Place fill material meeting State/County requirements onto the native soil interface.
8. Compact Specified Sand (see Table 1 of the manual for Specified Sand requirements) below the GSF modules in two 6-inch lifts with a light tracked machine or compactor to a total height of 12 inches minimum.
9. A hand tamper or vibratory compactor is sufficient to stabilize the sand below the GSF modules. Check the zero grade of the top of the sand using a flat piece of lumber and a carpenter's level and/or a laser level before placing the modules.
10. Place GSF modules with **WHITE PAINTED STRIPE FACING UP**, end to end on top of the Specified Sand.
11. Provide d-box(s) installed in accordance with this manual and current *Virginia Sewage Handling and Disposal Regulations*.
12. Use 4-inch SDR-35 non-perforated pipe or equivalent non-perforated pipe from the distribution box to the GFS modules. Recommended drop for gravity systems from D-Box to modules is 1/8 inch per linear foot to the GFS modules.
13. Center 4-inch SDR-35 perforated distribution pipe or equivalent lengthwise over modules with orifices at 5 and 7 o'clock.
14. Secure pipe to GSF modules using one Eljen supplied wire clamp per module. Push wire clamp ends straight down into up-facing core, through the fabric and into the underlying sand.
15. Spread 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. With a shovel, place small piles 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. Anchor the cover fabric by placing Specified Sand along the sides and up to the top of the module and walk it in to ensure the cover fabric is secure in place.
16. Place the required amount of Specified Sand along the sides of the module rows and at the beginning and end of the Shallow Placement Modified Trench system. For sections of Specified Sand above existing grade, install at a 3:1 slope.
17. Carefully place backfill over the modules, followed by loam to complete a total minimum depth of 12 - 18 inches as measured from the top of the module. Sides/Slopes of capping material must be installed at a minimum of 3:1. Systems with total cover that exceeds 18 inches as measured from the top of the module shall be vented at the distal end of the system. Backfill material shall be a well graded sandy fill; clean, porous, and devoid of rocks.
18. Divert surface runoff. Finish grade to prevent surface ponding. Seed, loam and protect from erosion.

Modified Trench for Shallow Placement Systems Example Drawings

FIGURE 12: LEVEL SHALLOW PLACEMENT TRENCH SYSTEM

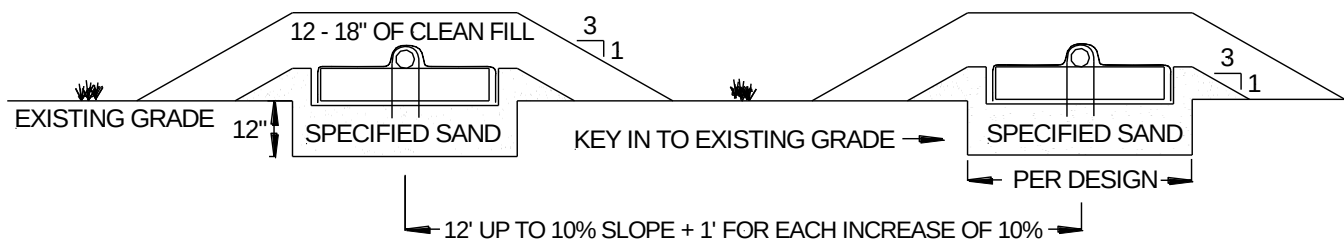
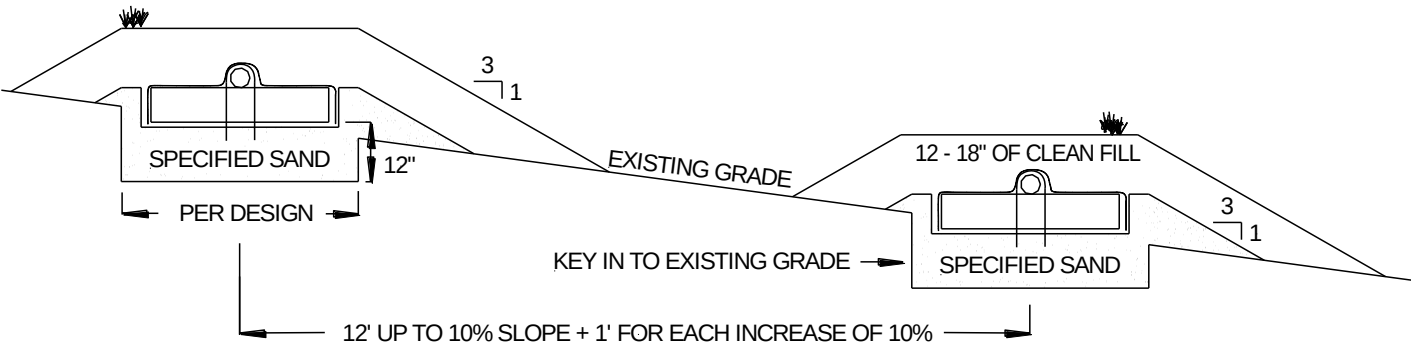


FIGURE 13: SLOPING SHALLOW PLACEMENT TRENCH SYSTEM



11.0 PAD Installations for Subsurface Installations

1. Determine the module type, length and width of the PAD from Sizing Table 4 or 5.
2. Carefully lay out the system components and boundaries. Define the location and elevation of the raised PAD or fill system and distribution box based on the septic tank outlet elevation and pipe grades required to maintain flow to each component.
3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clayey soils used for the GSF system as well as down-slope from the system where soil structure is critical for absorption and drainage of the treated effluent.
4. 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.
5. Excavate the PAD area. Scarify the receiving layer to maximize the interface between the native soil and specified fill material.
6. Minimize walking in the excavated area prior to placement of the specified fill material to avoid soil compaction.
7. Place Specified Sand (see Table 1 for Specified Sand requirements) in two 6-inch lifts, compacting each lift after placement. The compacted Specified Sand height below the GSF module must be a minimum of 12 inches.
8. A hand tamper or vibratory compactor is sufficient to stabilize the Specified Sand below the GSF modules. Check the zero grade of the top of the Specified Sand using a flat piece of lumber and a carpenter's level and/or a laser level before placing the modules.
9. Place GSF modules with **WHITE PAINTED STRIPE FACING UP**, end to end on top of the Specified Sand.
10. Provide d-box(s) installed in accordance with this manual and current *Virginia Sewage Handling and Disposal Regulations*.
11. Use 4-inch SDR-35 non-perforated pipe or equivalent non-perforated pipe from the distribution box to the GFS modules. Recommended drop for gravity systems from D-Box to modules is 1/8 inch per linear foot to the GFS modules.
12. Center 4-inch SDR-35 perforated distribution pipe or equivalent lengthwise over modules with orifices at 5 and 7 o'clock.
13. Secure pipe to GSF modules using one Eljen supplied wire clamp per module. Push wire clamp ends straight down into up-facing core, through the fabric and into the underlying Specified Sand.
14. Spread 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. With a shovel, place small piles 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. Anchor the cover fabric by placing Specified Sand along the sides and up to the top of the module and walk it in to ensure the cover fabric is secure in place.
15. Place the required amount of Specified Sand along the sides of the module rows and at the beginning and end of the PAD. Use Table 4 or 5 and the design examples on pages 32 & 34 for center-to-center spacing requirements.
16. Carefully place backfill over the modules, followed by loam to complete a total minimum depth of 12 - 18 inches as measured from the top of the module. Systems with total cover that exceeds 18 inches as measured from the top of the module shall be vented at the distal end of the system. Backfill material shall be a well graded sandy fill; clean, porous, and devoid of rocks.
17. Divert surface runoff. Finish grade to prevent surface ponding. Seed, loam, and protect system area from erosion.

12.0 PAD Installations for Raised or Fill Systems

Determine the module type, length and width of the PAD from Sizing Table 4 or 5.

1. Carefully lay out the system components and boundaries. Define the location and elevation of the raised PAD or fill system and distribution box based on the septic tank outlet elevation and pipe grades required to maintain flow to each component.
2. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clayey soils used for the GSF system as well as down-slope from the system where soil structure is critical for absorption and drainage of the treated effluent.
3. 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.
4. Excavate the PAD area. Scarify the receiving layer to maximize the interface between the native soil and specified fill material.
5. Minimize walking in the excavated area prior to placement of the specified fill material to avoid soil compaction.
6. Place fill material meeting State/County requirements onto the native soil interface.
7. Compact Specified Sand (see Table 1 of the manual for Specified Sand requirements) below the GSF modules in two 6-inch lifts with a light tracked machine or compactor to a total height of 12 inches minimum.
8. A hand tamper or vibratory compactor is sufficient to stabilize the sand below the GSF modules. Check the zero grade of the top of the sand using a flat piece of lumber and a carpenter's level and/or a laser level before placing the modules.
9. Place GSF modules with **WHITE PAINTED STRIPE FACING UP**, end to end on top of the Specified Sand.
10. Provide d-box(s) installed in accordance with this manual and current *Virginia Sewage Handling and Disposal Regulations*.
11. Use 4-inch SDR-35 non-perforated pipe or equivalent non-perforated pipe from the distribution box to the GFS modules. Recommended drop for gravity systems from D-Box to modules is 1/8 inch per linear foot to the GFS modules.
12. Center 4-inch SDR-35 perforated distribution pipe or equivalent lengthwise over modules with orifices at 5 and 7 o'clock.
13. Secure pipe to GSF modules using one Eljen supplied wire clamp per module. Push wire clamp ends straight down into up-facing core, through the fabric and into the underlying sand.
14. Spread 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. With a shovel, place small piles 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. Anchor the cover fabric by placing Specified Sand along the sides and up to the top of the module and walk it in to ensure the cover fabric is secure in place.
15. Place the required amount of Specified Sand along the sides of the module rows and at the beginning and end of the PAD. Use Table 4 or 5 and the design examples on pages 32 & 34 for center-to-center spacing requirements.
16. Carefully place backfill over the modules, followed by loam to complete a total minimum depth of 12 - 18 inches as measured from the top of the module. Systems with total cover that exceeds 18 inches as measured from the top of the module shall be vented at the distal end of the system. Backfill material shall be a well graded sandy fill; clean, porous, and devoid of rocks.
17. Divert surface runoff. Finish grade to prevent surface ponding. Seed, loam and protect from erosion.

PAD System Example Drawings

FIGURE 14: SUBSURFACE PAD SYSTEM CROSS SECTION

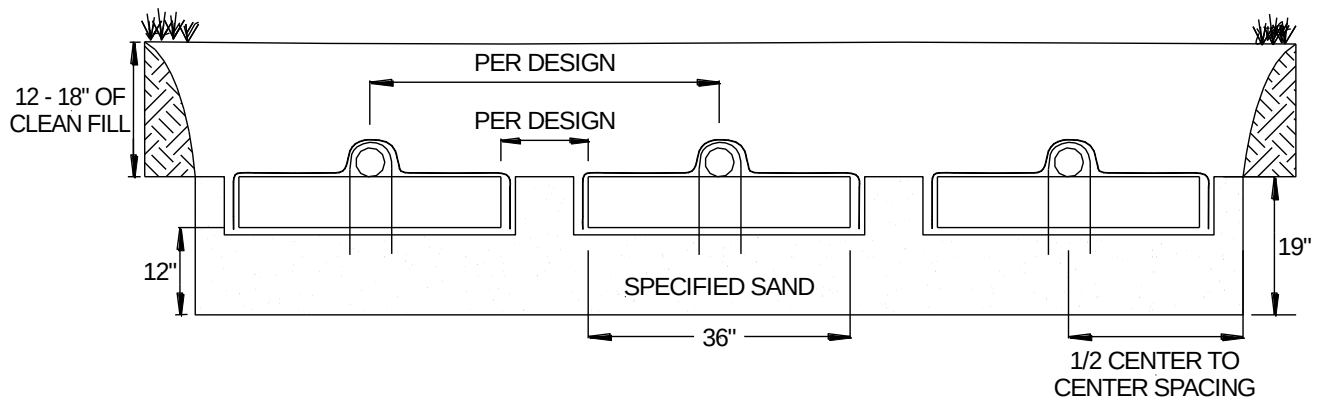


FIGURE 15: RAISED OR FILL PAD SYSTEM CROSS SECTION

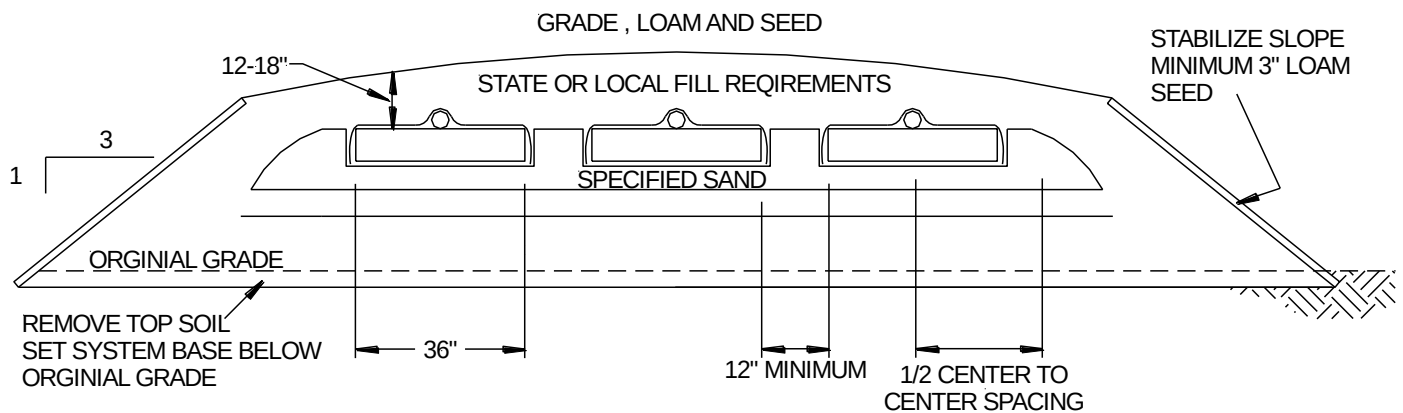


FIGURE 16: GRAVITY PAD SYSTEM PLAN VIEW

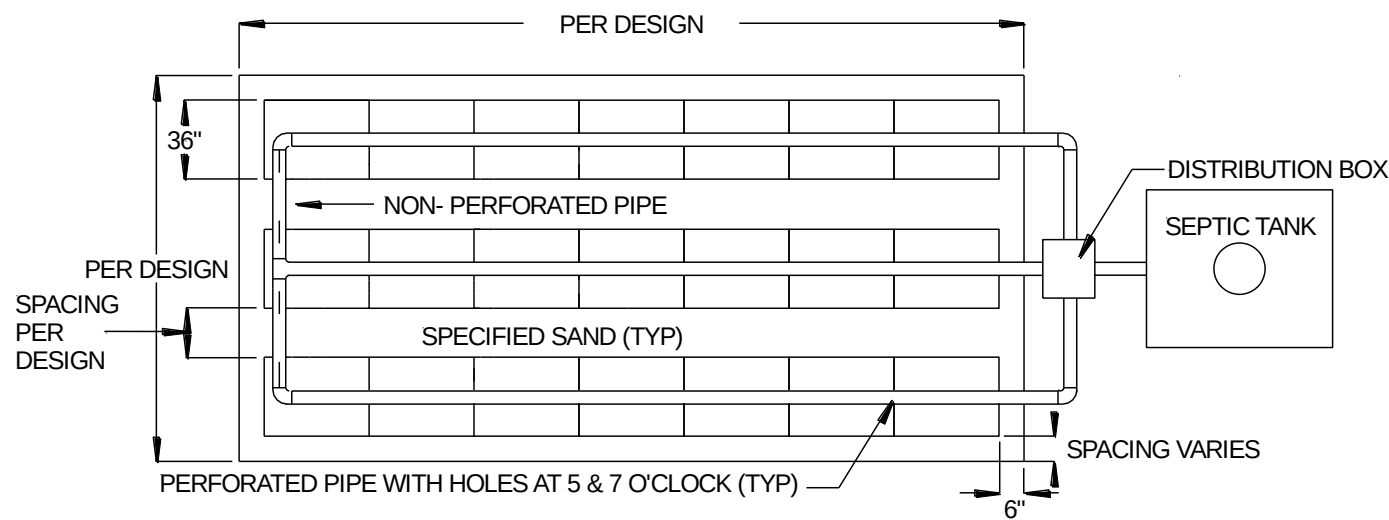
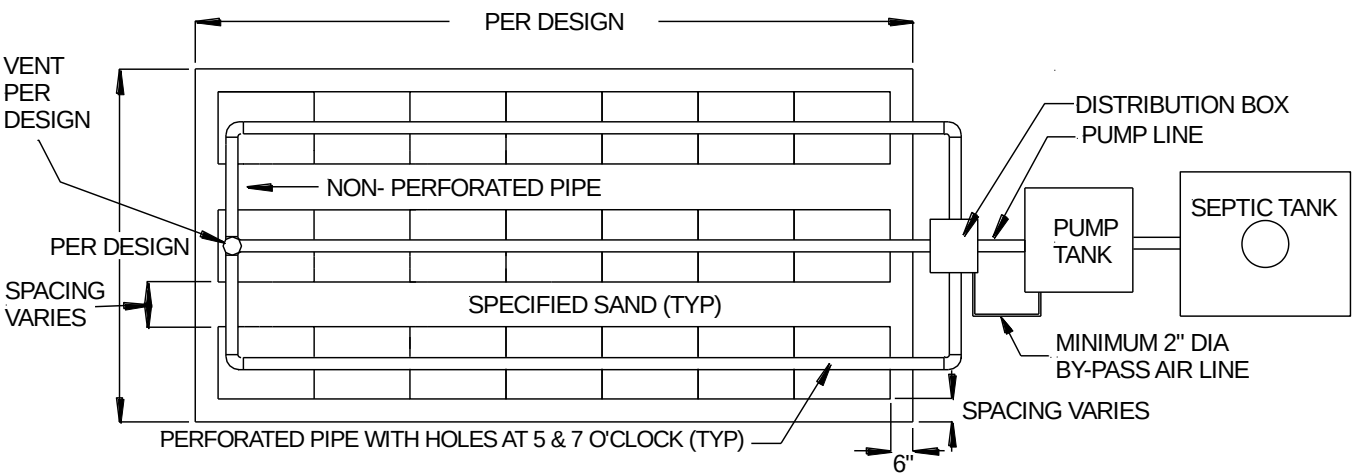


FIGURE 17: PUMP DOSED PAD SYSTEM PLAN VIEW
(WITH VENTING IF REQUIRED)



13.0 Slope System Installations for Modified Trenches & PADS

1. Carefully layout the system components to maintain the required setbacks from the property boundary, home, system components, water systems (onsite and neighboring property), and other topographic boundaries. Define the location and elevation of the trench based on limiting conditions such as bedrock or seasonal high water table elevation. Set the septic tank outlet elevation and pipe grades required to maintain flow to each component.
2. Prepare the site according to all State and Local Regulations. Do not install a system on saturated ground or wet soils that can smear during excavation. Keep heavy machinery off clayey soils used for the GSF system as well as down-slope from the system where soil structure is critical for absorption and drainage of the treated effluent.
3. 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.
4. Excavate the Modified Trench or PAD. Groove receiving layer by raking or contour plowing at a right angle to slope before placing the specified fill material or Specified Sand. Scarify the receiving layer to maximize the interface between the native soil and Specified Sand.
5. Minimize walking in the excavated area prior to placement of the Specified Sand to avoid soil compaction.
6. Place Specified Sand in Modified Trench or PAD area. Compact in two 6-inch lifts. Refer to Table 1 for more information on the Specified Sand specification. The compacted height below the GSF module must be 12" minimum.
7. A hand tamper or vibratory compactor is sufficient to stabilize the Specified Sand below the GSF modules. Check the zero grade of the top of the Specified Sand using a flat piece of lumber and a carpenter's level and/or a laser before placing the modules.
8. Place GSF modules with **WHITE PAINTED STRIPE FACING UP**, end to end on top of the Specified Sand.
9. Distribution to all module rows must equal. This can be accomplished by utilizing single or multiple D-boxes placed at the beginning of the system or at the beginning of each row of modules along the slope.
10. Use 4" SDR-35 or equivalent non-perforated pipe from the d-boxes to each row of the GSF modules.
11. Install a line of 4" SDR-35 perforated distribution pipe lengthwise on the upper first row over the GSF modules with orifices at 5 and 7 o'clock and cap at end.
12. Secure pipe to GSF modules using one Eljen wire clamp per module. Push clamp ends straight down into up-facing core, through the fabric and into the underlying Specified Sand.
13. Install the manufacturer supplied cover fabric. Cover fabric placement requires setting the tension and orientation of the fabric around the sides of the perforated pipe on top of the GSF modules. The correct tension of the cover fabric is set by; 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. With a shovel, place small piles 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. Anchor the cover fabric by placing Specified Sand along the sides and up to the top of the module and walk it in to ensure the cover fabric is secure in place.
14. For PAD systems, center-to-center and center-to-edge spacing will vary per design. For slopes up to 15% a minimum of 1 foot edge to edge module spacing is required. For slopes over 15% a minimum 2 foot edge to edge module spacing is required. The edge of module to toe of downhill slope spacing is based on the Regulations or a minimum 3:1 slope requirement. *Note: For proposed PAD sites with slopes greater than 25% - Professional Engineer consultation is recommended.*
15. Modified Trenches use center to center spacing consistent with the Regulations. Please see Table 2 or Table 3 for the amount of Specified Sand required for the appropriate sf/module rate chosen.
16. Carefully place backfill over the modules, followed by loam to complete a total minimum depth of 12 - 18 inches as measured from the top of the module. Systems with total cover that exceeds 18 inches as measured from the top of the module shall be vented at the distal end of the system. Backfill material shall be a well graded sandy fill; clean, porous, and devoid of rocks.
17. Divert surface runoff. Finish grade to prevent surface ponding. Seed loam, and protect from erosion.

Slope System Installation Drawings

FIGURE 18: SLOPED MODIFIED TRENCH SYSTEM CROSS-SECTION
(Note: Equal Distribution Required)

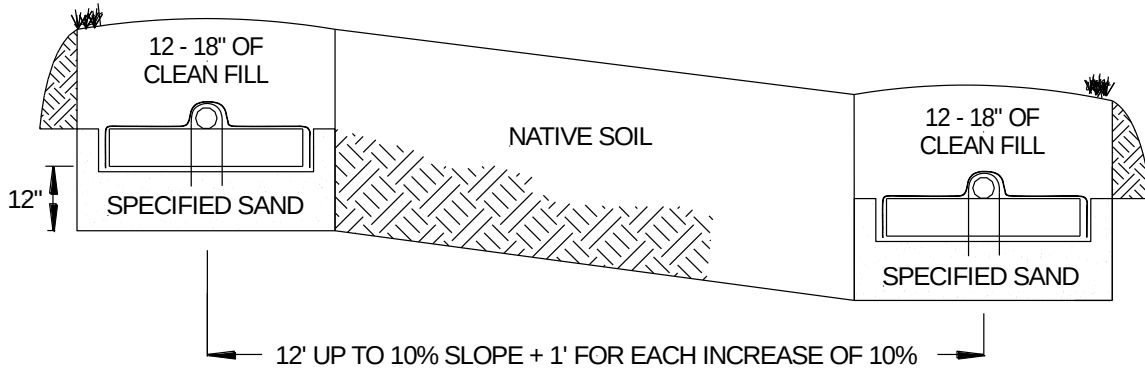
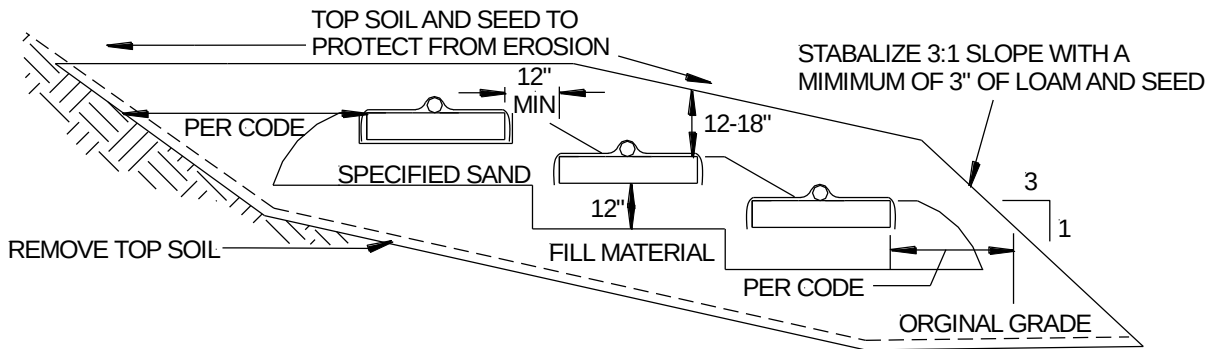


FIGURE 19: SLOPED PAD SYSTEM CROSS-SECTION
(Note: Equal Distribution Required)



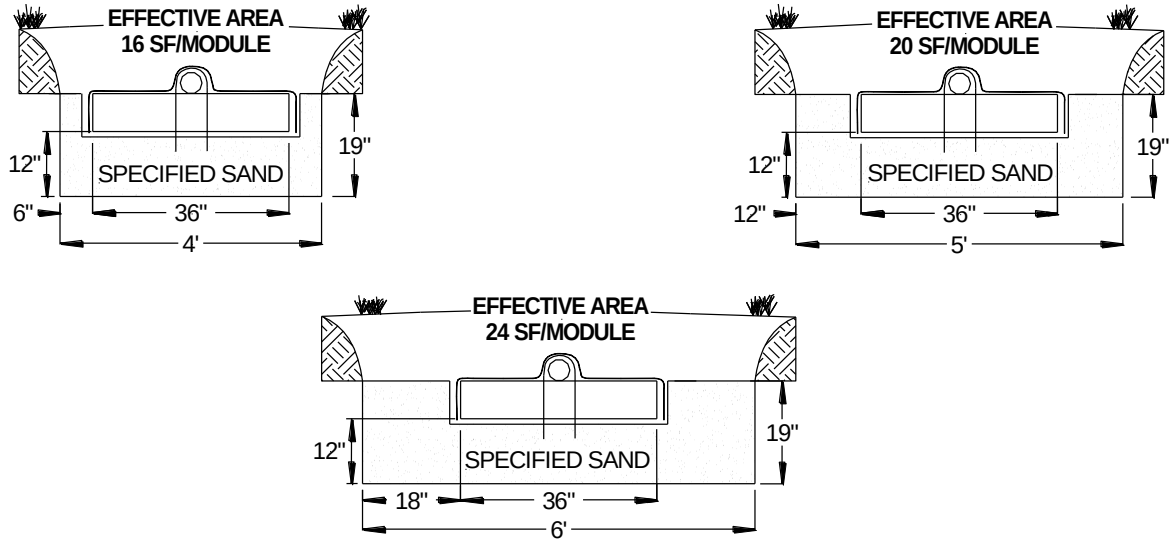
**Note: For Sloped PAD systems, center-to-center and center-to-edge spacing will vary per design. For slopes up to 15% a minimum of 1 foot edge to edge module spacing is required. For slopes over 15% a minimum 2 foot edge to edge module spacing is required.*

14.0 Modified Trench Design Guidance

Design Parameters for all examples and sizing charts to follow:

- Effective areas for trench applications are derived from trench width bottom area only.
- Minimum area of system required is based around GPD and TL-2 HLR *not* actual installed area.

FIGURE 20: MODIFIED TRENCH OPTION CROSS SECTION



14.0 Modified Trench Design Guidance

TABLE 2: B43 MODIFIED GRAVITY TRENCH

NOTE: Hydraulic loading rates shown have been reduced to accommodate requirements of Chapter 613, Regulations for Alternate Onsite Sewage Systems. Designers have the ability to reduce rates further if desired.

Percolation Rate	TL-2 Hydraulic Loading Rate ¹	Modified Trench Width	Module Rating	Minimum Required Area for Trench in ft ²			Specified Sand at Sides of Modules (Inches)	Minimum Number Modules ²			Modules Per Additional Bedroom ²
				Number of Bedrooms				Number of Bedrooms			
				3	4	5		3	4	5	
(Minutes/Inch)	GPD/ft ²	Inches	ft ² /module								
15 or less	1.75	48	16 ft ²	320	343	429	6	20	22	27	6
20	1.35	48		333	444	556	6	21	28	35	7
30	1.15	48		391	522	652	6	25	33	41	9
35	1.05	48		429	571	714	6	27	36	45	9
40	0.95	48		474	632	789	6	30	40	50	10
45	0.85	48		529	706	882	6	34	45	56	12
50	0.75	48		600	800	1000	6	38	50	63	13
55	0.70	48		643	857	1071	6	41	54	67	14
60	0.65	60	20 ft ²	692	923	1154	12	35	47	58	12
65	0.60	60		750	1000	1250	12	38	50	63	13
70	0.55	60		818	1091	1364	12	41	55	69	14
75	0.50	60		900	1200	1500	12	45	60	75	15
80	0.45	60		1000	1333	1667	12	50	67	84	17
85	0.40	60		1125	1500	1875	12	57	75	94	19
90 ³	0.35	72	24 ft ²	1286	1714	2143	18	54	72	90	18
95	0.33	72		1382	1842	2303	18	58	77	96	19
100	0.30	72		1493	1991	2488	18	63	83	104	21
105	0.28	72		1624	2165	2706	18	68	91	113	23
110	0.25	72		1780	2373	2966	18	75	99	124	25
115	0.23	72		1969	2625	3281	18	83	110	137	28
120	0.20	72		2203	2937	3671	18	92	123	153	31

TABLE NOTES:

1. Hydraulic Loading Rate numbers have been reduced to accommodate requirements of Chapter 613, Regulations for Alternative Onsite Sewage Systems.
2. Minimum number of modules allowed for system = 5 modules per bedroom.
3. For percolation rates greater than 90 min/inch design using a 6 foot trench layout.

14.0 Modified Trench Design Guidance

B43 Gravity Modified Trench Design Example

Example: Gravity System

Determine the Modified Trench Area in Square Feet: ft^2 based on the percolation rate, hydraulic loading rate and number of bedrooms in Table 2.

Given:

Bedrooms = 4
Gallons per Day = 600 gpd
Percolation Rate = 75 minutes/inch

Review Table 2: B43 in a Modified Gravity Trench

Loading rate = 0.5 gallons per day/ ft^2
Modified Trench Area = 1200 ft^2 required

Move across to the next column and locate desired trench width. For this example, the trench width is 5 feet.

"Total Modules" required for given percolation rate = 60 Modules.

Calculate Modified Trench Length:

Assume 3 rows of modules using 20 modules per row (This varies due to site constraints).

Multiply the number of modules per row times the length of module and add an additional one foot of length (6 inches at each end of trench) for Specified Sand: (20 modules x 4 lf/module) + 1 lf of Specified Sand = A Modified Trench row length of 81 lf per row or 243 lf of total.

Calculate Trench Area:

Trench Area = Effective area of module x number of modules: 20 ft^2 /module x 60 modules = 1200 ft^2 .

Final Trench Dimensions: Length = 81 lf/row, Width = 5 linear feet, Trenches = 3, Modules = 60, Area = 1200 ft^2

14.0 Modified Trench Design Guidance

TABLE 3: B43 MODIFIED PRESSURE SYSTEM TRENCH

NOTE: Hydraulic loading rates shown reflect the maximum reduction allowed for pressure systems. Trench bottom hydraulic loading rates for pressure systems shall not exceed the values in Table 1 of Chapter 613, Regulations for Alternative Onsite Sewage Systems.

Percolation Rate	TL-2 Hydraulic Loading Rate	Modified Trench Width	Module Rating	Minimum Required Area for Trench in ft²			Specified Sand at Sides of Modules (Inches)	Minimum Number Modules¹			Modules Per Additional Bedroom¹
				Number of Bedrooms				Number of Bedrooms			
			(Minutes/Inch)	GPD/ft²	Inches	ft²/module		3	4	5	
15 or less	1.80	48	16 ft²	320	333	417	6	20	21	27	6
20	1.40	48		321	429	536	6	21	27	34	7
30	1.20	48		375	500	625	6	24	32	40	8
35	1.10	48		409	545	682	6	26	35	43	9
40	1.00	48		450	600	750	6	29	38	47	10
45	0.90	48		500	667	833	6	32	42	53	11
50	0.80	48		563	750	938	6	36	47	59	12
55	0.75	48		600	800	1000	6	38	50	63	13
60	0.70	60	20 ft²	643	857	1071	12	33	43	54	11
65	0.65	60		692	923	1154	12	35	47	58	12
70	0.60	60		750	1000	1250	12	38	50	63	13
75	0.55	60		818	1091	1364	12	41	55	69	14
80	0.50	60		900	1200	1500	12	45	60	75	15
85	0.45	60		1000	1333	1667	12	50	67	84	17
90 ²	0.40	72	24 ft²	1125	1500	1875	18	47	63	79	16
95	0.38	72		1198	1597	1996	18	50	67	84	17
100	0.35	72		1280	1707	2134	18	54	72	89	18
105	0.33	72		1376	1834	2293	18	58	77	96	19
110	0.30	72		1486	1981	2476	18	62	83	104	21
115	0.28	72		1615	2154	2692	18	68	90	113	23
120	0.25	72		1770	2360	2949	18	74	99	123	25

TABLE NOTES:

1. Minimum number of modules allowed for system = 5 modules per bedroom
2. For percolation rates greater than 90 min/inch design using a 6 foot trench layout.

14.0 Modified Trench Design Guidance

B43 Modified Pressure System Trench Design Example

Example: Pressure System

Determine the Modified Trench Area in Square Feet: ft^2 based on the percolation rate, hydraulic loading rate and number of bedrooms in Table 3.

Given:

Bedrooms = 5
Gallons per Day = 750 gpd
Percolation Rate = 30 minutes/inch

Review Table 3: B43 in a Modified Pressure System Trench

Loading rate = 1.2 gallons per day/ ft^2
Modified Trench Area = 625 ft^2 required

Move across to the next column and locate desired trench width. For this example, the trench width is 4 feet.

"Total Modules" required for given percolation rate = 40 Modules.

Calculate Modified Trench Length:

Assume 2 rows of modules using 20 modules per row (This varies due to site constraints).
Multiply the number of modules per row times the length of module and add an additional one foot of length (6 inches at each end of trench) for Specified Sand: (20 modules x 4 lf/module) + 1 lf of Specified Sand = A Modified Trench row length of 81 lf per row or 162 lf total.

Calculate Trench Area:

Trench Area = Effective area of module x number of modules: 16 ft^2 /module x 40 modules = 640 ft^2 .

Final Trench Dimensions: Length = 81 lf/row, Width = 4 linear feet, Trenches = 2, Modules = 40, Area = 640 ft^2

15.0 Modified PAD Design Guidance

TABLE 4: B43 GRAVITY PAD

Note: The use of linear loading rates may affect the number of modules required for a particular design. Eljen promotes the use of best engineering practices regarding linear loading rates when designing PAD systems on sloped terrain. Longer thinner systems are recommended.

Percolation Rate	TL-2 Hydraulic Loading Rate ¹	Minimum Required PAD Area in ft ²			Each Additional Bedroom (ft ²)	Minimum Number Modules ^{2,3}			Modules Per Additional Bedroom ^{2,3}
		Number of Bedrooms				Bedrooms per house			
	(Minutes/Inch)	GPD/ft ²	3	4	5	3	4	5	
15 or less	1.75	320	343	429	86	15	20	25	5
20	1.35	333	444	556	111	18	24	30	6
30	1.15	391	522	652	130	18	24	30	6
35	1.05	429	571	714	143	21	28	35	7
40	0.95	474	632	789	158	21	28	35	7
45	0.85	529	706	882	176	21	28	35	7
50	0.75	600	800	1000	200	24	32	40	8
55	0.70	643	857	1071	214	24	32	40	8
60	0.65	692	923	1154	231	24	32	40	8
65	0.60	750	1000	1250	250	24	32	40	8
70	0.55	818	1091	1364	273	27	36	45	9
75	0.50	900	1200	1500	300	27	36	45	9
80	0.45	1000	1333	1667	333	27	36	45	9
85	0.40	1125	1500	1875	375	27	36	45	9
90	0.35	1286	1714	2143	429	27	36	45	9
95	0.33	1382	1842	2303	461	30	40	50	10
100	0.30	1493	1991	2488	498	33	44	55	11
105	0.28	1624	2165	2706	541	33	44	55	11
110	0.25	1780	2373	2966	593	33	44	55	11
115	0.23	1969	2625	3281	656	33	44	55	11
120	0.20	2203	2937	3671	734	33	44	55	11

TABLE NOTES:

1. Hydraulic Loading Rate numbers have been reduced to accommodate requirements of Chapter 613, Regulations for Alternative Onsite Sewage Systems
2. Minimum number of modules allowed for system = 5 modules per bedroom
3. Maximum number of modules recommended for system = 11 modules per bedroom

15.0 Modified PAD Design Guidance

B43 Gravity PAD Design Example

Example: Gravity Pad Design Example

Determine the area of PAD in square feet: ft^2 based on the percolation rate, hydraulic loading rate and number of bedrooms in Table 4.

Given:

Bedrooms = 4
Gallons per day = 600 gpd
Percolation Rate = 100 minutes/inch

Review Table 4: B43 in a Gravity PAD configuration and find:

Loading rate = 0.3 gallons per day/ ft^2
PAD area in square feet = 1991 ft^2

Move across to the next column and locate "Minimum Number Modules" for your given percolation rate = 44 Modules

Calculate PAD Length:

Assume 4 rows of modules using 11 modules per row will be used in the PAD.

Multiply the number of modules per row times the length of module and add an additional one foot of length (6 inches at each end of trench) for Specified Sand: (11 modules $\times$ 4 lf/module) + 1 lf of Specified Sand = A PAD length of 45 lf.

Calculate Approximate PAD Width:

Divide the PAD area in square feet by PAD length: $1991 \text{ ft}^2 \div 45 \text{ lf} = 44.24 \text{ lf}$ round up to 44.25 lf.

Calculate the Center-to-Center Spacing and Center-to-Edge Spacing for Four Rows of Modules:

Center-to-Center Module Spacing:

PAD width = 44.25 lf

$44.25 \text{ lf} \div 4 \text{ rows} = 11.06 \text{ lf}$ round up to 11.25 lf center-to-center module spacing.

Center-to-Edge Module Spacing:

Center-to-edge module spacing = $\frac{1}{2}$ center-to-center spacing or $11.25 \text{ lf} \div 2 = 5.625 \text{ lf}$, round to 5.75 lf.

Module center-to-center row spacing is 11.25 feet and each end row is centered 5.75 feet from the edge of the PAD

Total PAD width is $(3 \times 11.25 \text{ lf}) + (2 \times 5.75 \text{ lf}) = 45.25 \text{ lf}$.

Final Layout Dimensions:

The PAD is 45 feet in length by 45.25 feet in width or 2036 square feet with 4 rows of modules 45 feet in length with a center-to-center spacing of 11.25 feet and an edge to centerline row distance of 5.75 feet.

15.0 Modified PAD Design Guidance

TABLE 5: B43 PRESSURE SYSTEM PAD

Note: The use of linear loading rates may affect the number of modules required for a particular design. Eljen promotes the use of best engineering practices regarding linear loading rates when designing PAD systems on sloped terrain. Longer thinner systems are recommended.

Percolation Rate	TL-2 Hydraulic Loading Rate*	Minimum Required PAD Area in ft²			Each Additional Bedroom (ft²)	Minimum Number Modules ^{1,2}			Modules Per Additional Bedroom ^{1,2}
		Number of Bedrooms				Bedrooms per house			
		3	4	5		3	4	5	
(Minutes/Inch)	GPD/ft²								
15 or less	1.80	320	333	417	83	15	20	25	5
20	1.40	321	429	536	107	18	24	30	6
30	1.20	375	500	625	125	18	24	30	6
35	1.10	409	545	682	136	21	28	35	7
40	1.00	450	600	750	150	21	28	35	7
45	0.90	500	667	833	167	21	28	35	7
50	0.80	563	750	938	188	24	32	40	8
55	0.75	600	800	1000	200	24	32	40	8
60	0.70	643	857	1071	214	24	32	40	8
65	0.65	692	923	1154	231	24	32	40	8
70	0.60	750	1000	1250	250	27	36	45	9
75	0.55	818	1091	1364	273	27	36	45	9
80	0.50	900	1200	1500	300	27	36	45	9
85	0.45	1000	1333	1667	333	27	36	45	9
90	0.40	1125	1500	1875	375	27	36	45	9
95	0.38	1198	1597	1996	399	30	40	50	10
100	0.35	1280	1707	2134	427	33	44	55	11
105	0.33	1376	1834	2293	459	33	44	55	11
110	0.30	1486	1981	2476	495	33	44	55	11
115	0.28	1615	2154	2692	538	33	44	55	11
120	0.25	1770	2360	2949	590	33	44	55	11

TABLE NOTES:

1. Minimum number of modules allowed for system = 5 modules per bedroom
2. Maximum number of modules recommended for system = 11 modules per bedroom

15.0 Modified PAD Design Guidance

B43 Pressure System PAD Design Example

Example: Pressure System PAD

Determine the Area of PAD in Square Feet: ft^2 based on the percolation rate, hydraulic loading rate and number of bedrooms in Table 5.

Given:

Bedrooms = 5
Gallons per day = 750 gpd
Percolation Rate = 65 minutes / inch

Review Table 5: B43 in a Pressure System PAD configuration and find:

Loading rate = 0.65 gallons per day/ ft^2
PAD area in square feet = 1154 ft^2

Move across to the next column and locate "Total Modules" for your given percolation rate = 40 Modules

Calculate PAD Length:

Assume 4 rows of modules using 10 modules per row will be used in the PAD (This varies due to site constraints). Multiply the number of modules per row times the length of module and add an additional one foot of length (6 inches at each end of trench) for Specified Sand: (10 modules x 4 lf/module) + 1 lf of Specified Sand = A PAD length of 41 lf.

Calculate Approximate PAD Width:

Divide the PAD area in square feet by PAD length: $1154 \text{ ft}^2 \div 41 \text{ lf} = 28.14 \text{ lf}$ round up to 28.25 lf.

Calculate the Center-to-Center Spacing and Center-to-Edge Spacing for Two Rows of Modules:

Center-to-Center Module Spacing:

PAD width = 28.25 lf

$28.25 \text{ lf} \div 4 \text{ rows} = 7.06 \text{ lf}$ round up to 7.25 lf center-to-center module spacing.

Center-to-Edge Module Spacing:

Center-to-edge module spacing = $\frac{1}{2}$ center-to-center spacing or $7.25 \text{ lf} \div 2 = 3.625 \text{ lf}$, round to 3.75 lf.

Module center-to-center row spacing is 7.25 feet and each end row is centered 3.75 feet from the edge of the PAD.

Total PAD width is $(3 \times 7.25 \text{ lf}) + (2 \times 3.75 \text{ lf}) = 29.25 \text{ lf}$.

Final Layout Dimensions:

The PAD is 41 feet in length by 29.25 feet in width or 1199.25 square feet. 4 rows of modules, 41 feet in length, with a center-to-center spacing of 7.25 feet and an edge to centerline distance of 3.75 feet.

16.0 Troubleshooting GSF Systems

If the GSF system is not operating properly, a system inspection should be performed *by a Qualified Service Provider* to identify the cause of the problem so that the system can be restored to normal operation. Possible problem areas to check if a system is not operating properly are:

Septic Tank:

- Line to septic tank is clogged due to uneven settling or roots.
- Clogged septic tank outlet filter.
- No outlet baffle or tee.
- Septic tank needs to be pumped.
- Line to distribution box is cracked or settles and needs repair or replacement.
- Cracked or leaking septic tank results in low water levels with discharge of solids, or infiltration of storm water, ground water, or surface water.

Pump Systems:

- Incorrect float settings discharge a high a volume or pumping rate to d-box and GSF system.
- Too low float settings does not account for drain-back and results in repeat pumping of effluent.
- Wiring or electrical problems.
- Infiltration of ground water or surface water into pump chamber discharge a high volume or pumping rate to d-box and GSF system.
- No vent installed on disposal area with greater than 18 inches of cover.
- Line to d-box is cracked or blocked and needs repair.

Soil Treatment Area:

- Soil and sizing was not correct with too small of a system installed.
- Lower soils permeability due to smearing or compacted during construction.
- Excessive backfill over system. More than 18" of cover as measured from finished grade to the top of the module requires venting.
- Crushed distribution pipe(s).
- Distribution pipes and modules experienced differential settling with part of the system not in use.
- Poor quality backfill over system resulting in no oxygen flow to the system.
- Poor quality sand or fill used below the system.
- Organic layer was not removed prior to construction.
- Storm water from roofs and upslope not directed away from field.
- Excessive water use or change in occupancy than included in the design. For example, room over garage or in a basement that has been converted to apartment for extended family members.

17.0 Designs for Failed Systems

Before designing a Geotextile Sand Filter system to replace an existing failed system, identify all possible reasons why the system failed. Proper identification of the failure is critical to ensure the GSF system will operate properly.

<i>Listed below are some common causes/reasons for septic system failures.</i>	
a)	Leaky plumbing fixtures
b)	Inaccurate percolation test
c)	Pump settings incorrect or not working properly
d)	More occupants or bedrooms than system were designed for
e)	Unusually high water usage
f)	Garbage disposal
g)	Water softener backwash
h)	Excessive grease in system
i)	Detrimental chemicals being used
j)	Failed or missing septic tank outlet baffle
k)	Infiltration of ground water into septic tank or pump chamber
l)	System is faulty in design or installation
m)	Specified Sand that does not meet the requirements as outlined in this manual
n)	Improper materials
o)	Mounding due to poor drainage or soil permeability
p)	Part or system not used because of blockage or excessive settling
q)	System is undersized

18.0 System Maintenance and Sampling Requirements

The purpose of this section is to help provide an easy and effective way to monitor and sample Eljen Alternative Onsite Sewage Systems per Section 12VAC5-613-80 of *Chapter 613, Regulations for Alternative Onsite Sewage Systems*. Installing an Eljen Sampling and Collection Unit will allow you to sample your TL-2 Alternative Onsite Sewage Systems and meet the requirements listed below. If you have any questions pertaining to any part of this document or regarding Eljen products in general, please call our Technical Services Department at 1-800-444-1359.

OWNER RESPONSIBILITIES: The following requirements are in accordance with the *Virginia Chapter 613, Regulations for Alternative Onsite Sewage Systems*.

- Maintain an operator: At all times, a certified service provider should be retained for routine maintenance and inspections for all TL-2 systems.
- Keep a log: A log must be maintained on any services or inspections conducted on the TL-2 system by the owner and operator. Requirements for log entries are in the section below, *Operators Responsibilities*.
- Keep operators manual on the premises for transfer to next owner.
- Schedule routine Operator visits.
 - All TL-2 systems require a check 180 days after its initial operation. A grab sample is required to be tested by an EPA certified laboratory and results reported to the Local Health Department.
 - After approval, the system requires inspection once a year by an Operator.
 - Every five years, a grab sample is required to be tested by EPA certified laboratory and results reported to the Local Health Department.

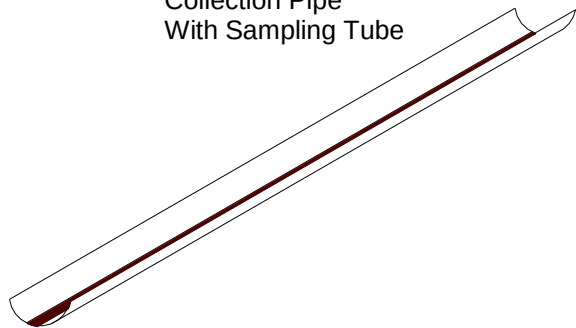
OPERATOR RESPONSIBILITIES: The following requirements are in accordance with *Virginia Chapter 613, Regulations for Alternative Onsite Sewage Systems*. If you have any questions, please contact your Service Operator.

- Keep a log for the TL-2 systems
 - Results of all testing and sampling
 - Reportable incidents
 - Maintenance, corrective actions, and repair of system components
 - Sludge or solids removal
 - Date and time reports were made and delivered to the system owner
- Collect a grab sample for the owner at the 180 day mark, and every 5 years after that date
- Notify the Local Health Department if the relationship with the owner ends

19.0 System Sampling Port Installation

SAMPLING PARTS INSTALLED WITHIN SYSTEM AREA

Collection Pipe
With Sampling Tube



Sampling Tube Storage Pipe
(Length and Size Per design)

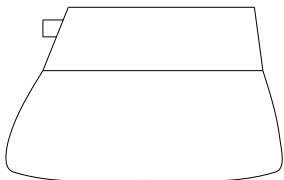


Cap or Irrigation
Box

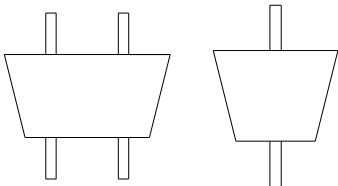


EQUIPMENT FOR TAKING SAMPLES

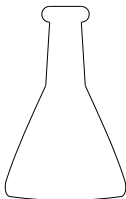
Wet-Dry Vac



Collection
Stoppers



Collection
Flask



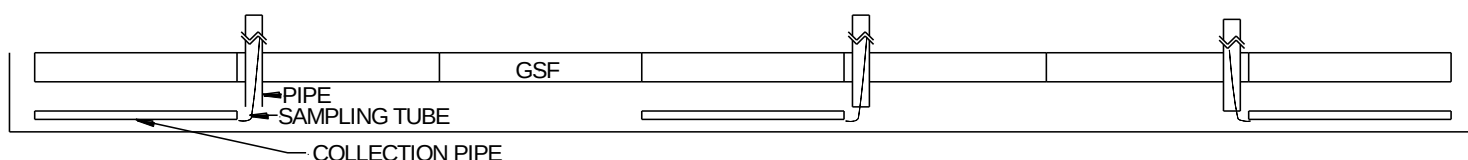
Sampling Tube
Connectors



System Sampling Port Installation Overview

1. Determine the location of the System Sampling Port within in the system. We recommend a minimum of three collection pipes are place within the same row. One Collection Pipe under the first module, one under the last, and one in the middle of the row.
2. The System Sampling Port consists of:
 - a. Collection Pipe
 - b. Sampling Tube
 - c. Sampling Tube Storage Pipe

FIGURE 21: SYSTEM SAMPLING PORT LOCATIONS

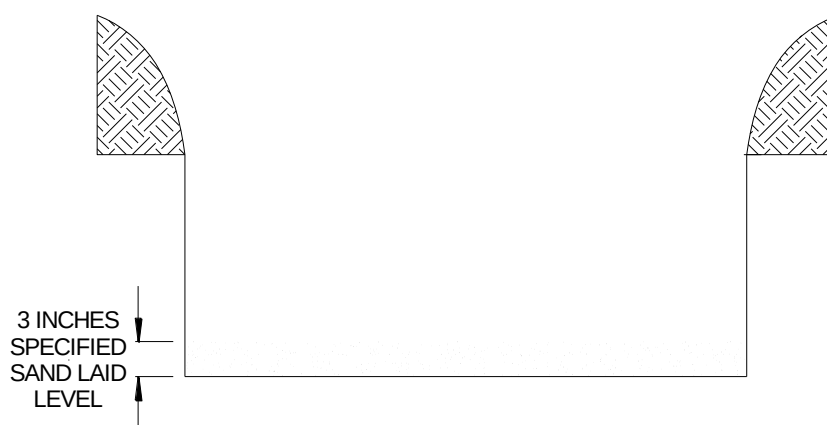


3. Carefully lay out the system area and boundaries.
4. Prepare the site. Excavate a trench to the design elevation for the system. *Note: this includes the 12 inches of Specified Sand.*

Collection Pipe & Sampling Tube Installation

1. In the excavated trench, place Specified Sand in a 3-inch lift and stabilize.

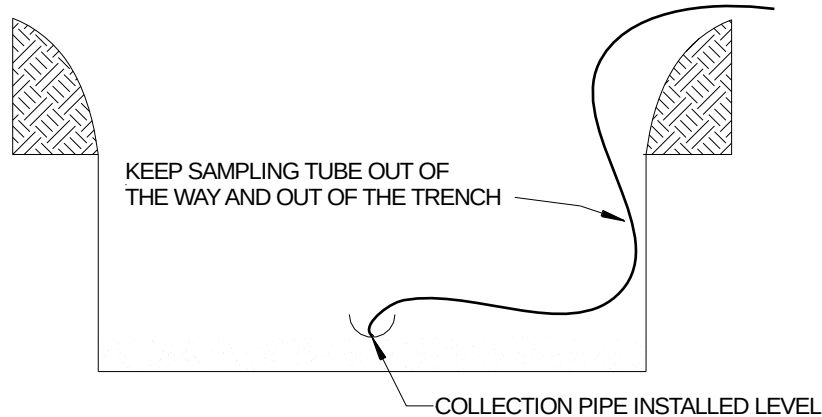
FIGURE 22: PLACE 3 INCHES OF SPECIFIED SAND



Collection Pipe & Sampling Tube Installation

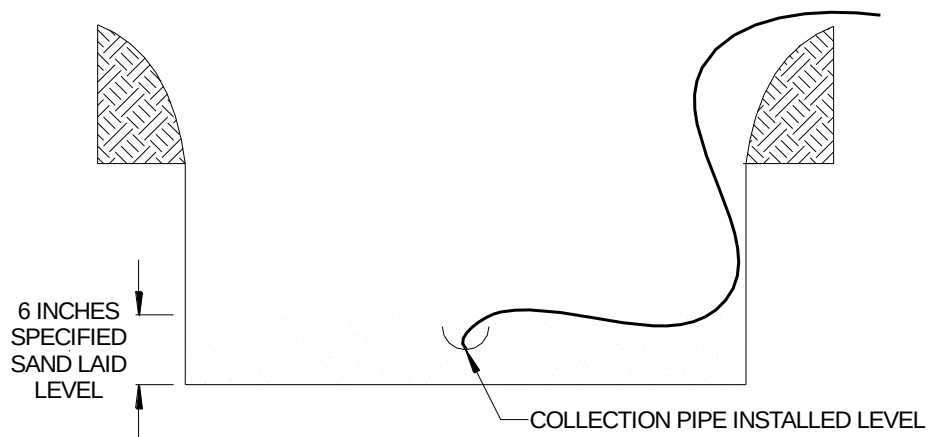
- Place the three Collection Pipes level in the Modified Trench or PAD under the location of the first, middle and last module of a row. The Collection Pipe should be centered underneath the GSF Module (See Figure 21). **Keep the sampling tube out of the way and out of the trench.**

FIGURE 23: PLACE SAMPLERS ON SAND



- Place another 3-inch lift of Specified Sand in the system area, filling the Collection Pipe with the Specified Sand. The height of Specified Sand should now be 6 inches high within the system area.

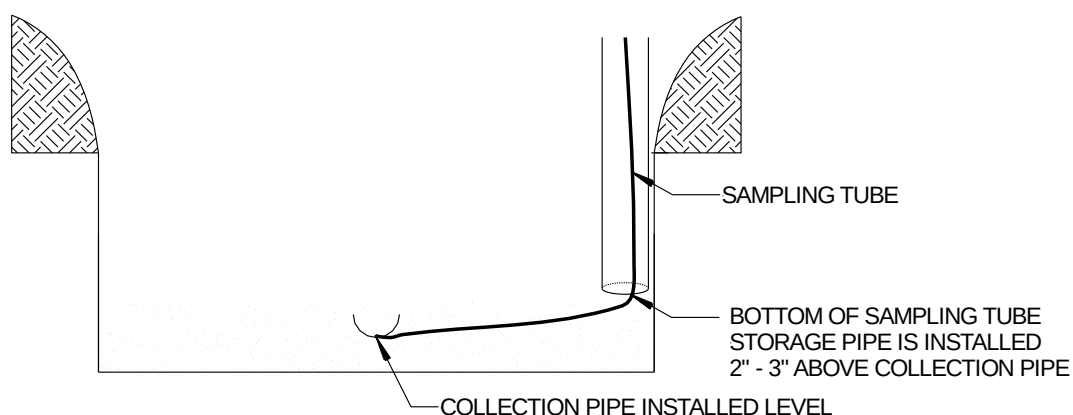
FIGURE 24: PLACE ANOTHER 3 INCH LIFT OF SPECIFIED SAND



Collection Pipe & Sampling Tube Installation

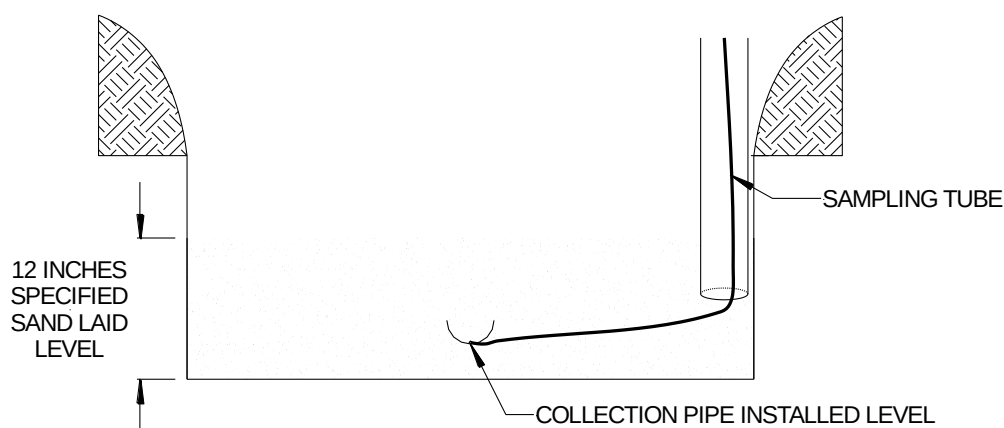
4. Pull the Sampling Tube through the Sampling Tube Storage Pipe and install on top of the Specified Sand Layer. It should be located at the outside edge of the proposed location of the GSF unit area to be sampled. The Sampling Tube Storage Pipe should be tall enough to make it to the surface.

FIGURE 25: INSTALLATION OF SAMPLING TUBE STORAGE PIPE



5. Install the remaining 6 inches of Specified Sand above the collection pipe and compact.

FIGURE 26: COMPLETE INSTALLATION OF REMAINING SPECIFIED SAND

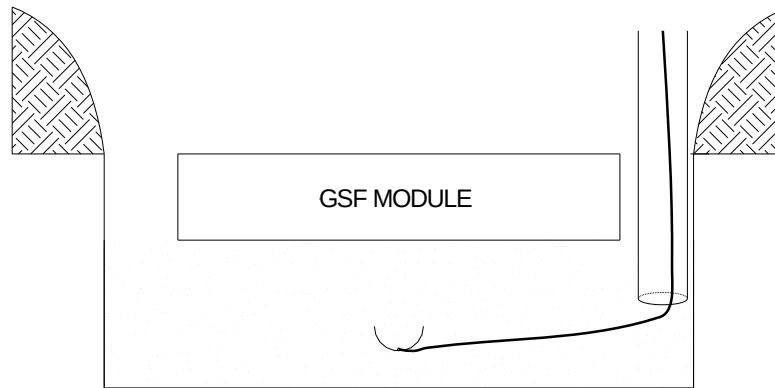


6. The compacted Specified Sand height below the GSF module must be a minimum of 12 inches. A hand tamper or vibratory compactor is sufficient to stabilize the Specified Sand below the GSF modules. Check the zero grade of the top of the Specified Sand using a flat piece of lumber and a carpenter's level and/or a laser before placing the modules.

GSF Module Installation

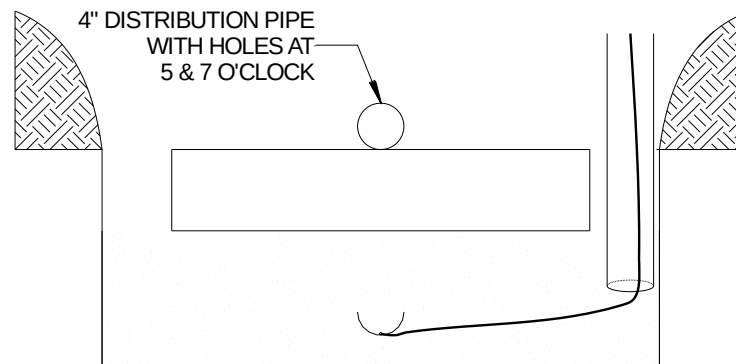
1. Place GSF Modules with **WHITE PAINTED STRIPE FACING UP**, end to end, on top of the Specified Sand.

FIGURE 27: INSTALLATION OF GSF UNITS



2. Use 4-inch SDR-35 or equivalent non-perforated pipe from the distribution box to the GFS modules. Recommended drop for gravity systems from D-Box to modules is 1/8 inch per linear foot.
3. Center 4-inch SDR-35 or equivalent perforated distribution pipe lengthwise over modules with orifices installed at 5 and 7 o'clock positions.

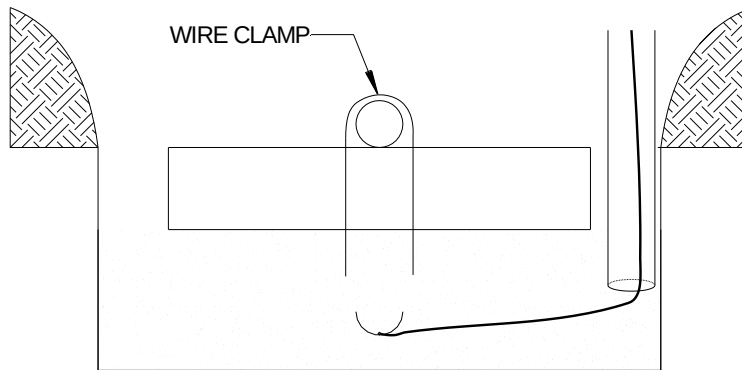
FIGURE 28: INSTALLATION OF DISTRIBUTION PIPE



GSF Module Installation

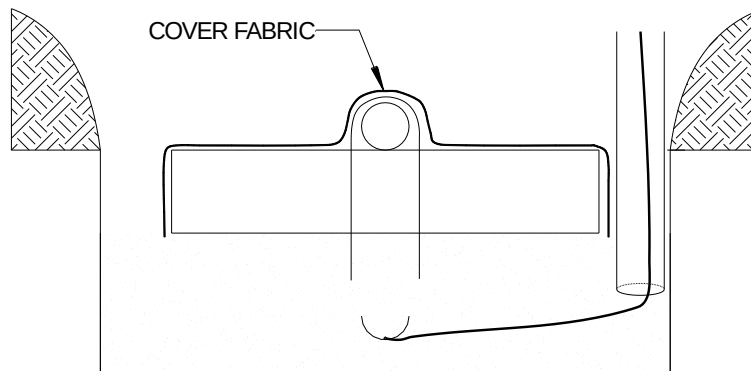
- Secure distribution pipe to GSF modules using one Eljen provided wire clamp per module. Push wire clamp ends straight down into up-facing core, through the module fabric and into the underlying Specified Sand.

FIGURE 29: INSTALL WIRE CLAMP



- Spread 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.

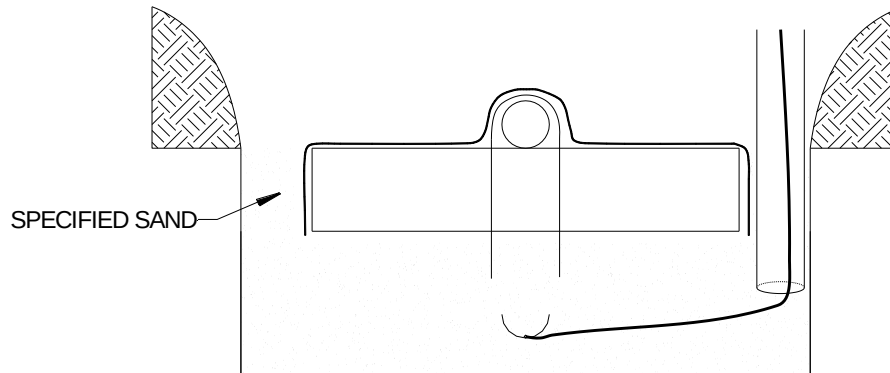
FIGURE 30: PLACE COVER FABRIC OVER PIPE AND GSF



GSF Module Installation

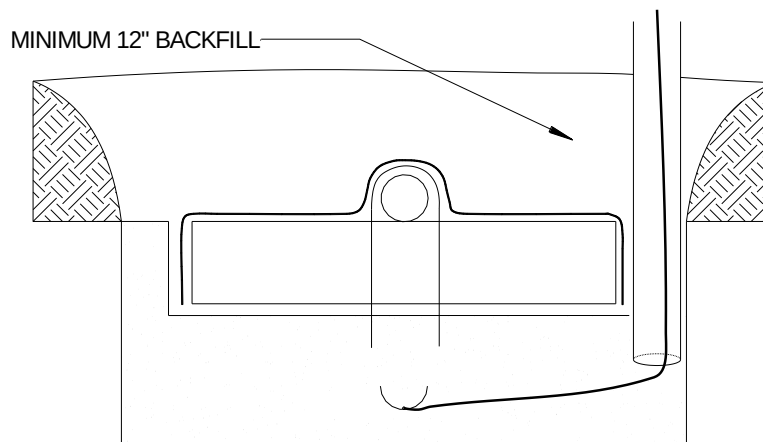
6. With a shovel, place small piles of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe. Anchor the cover fabric by placing Specified Sand along the sides and up to the top of the module and walk it in to ensure the cover fabric is secure in place.

FIGURE 31: INSTALL SPECIFIED SANDS TO TOP OF MODULE



7. Place the remaining required amount of Specified Sand along both sides and end of the module rows. Amount of Specified Sand will vary per design. See Tables 2 – 5 for the amount of Specified Sand required.
8. Carefully place clean backfill over the modules, followed by loam, to complete a minimum cover depth of 12 - 18 inches as measured from the top of the module. Backfill material shall be a well graded sandy fill; clean, porous, and devoid of rocks. *Note: Systems with total cover that exceeds 18 inches as measured from the top of the module shall be vented at the distal end of the system.*

FIGURE 32: COMPLETE BACKFILL

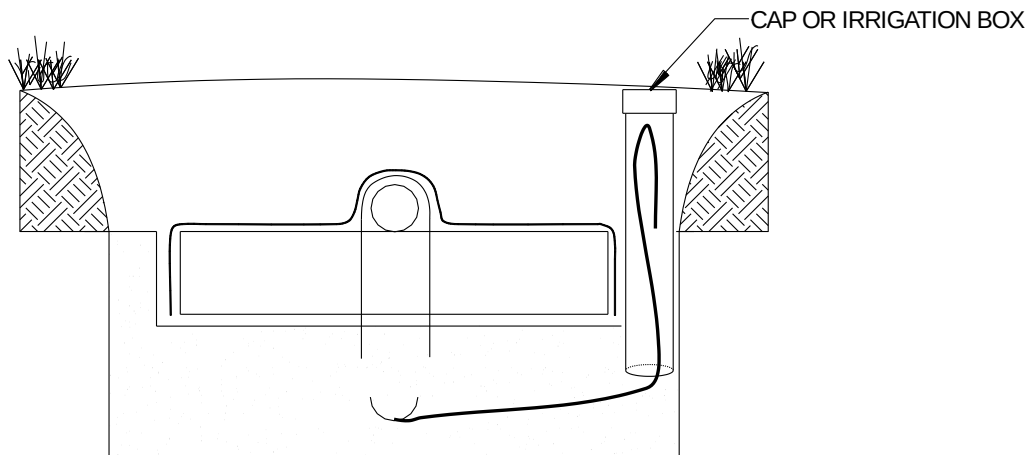


9. Divert surface runoff and finish grade to prevent surface ponding. Seed, loam, and protect from erosion.

Final System Sampling Port Installation Procedures

1. Cut excess Sampling Tube from the pipe. Leave 5 – 10 feet of excess for easy sampling by the provider.
2. Push entire Sampling Tube into the Sampling Tube Storage Pipe.
3. Cap or place irrigation box over top of pipe. Mark so that service provider can find for sampling.

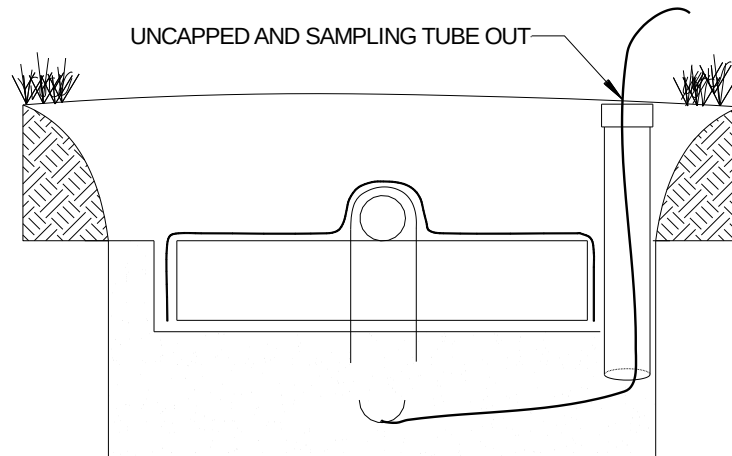
FIGURE 33: FINAL INSTLLATION CROSS SECTION



System Sampling Procedures

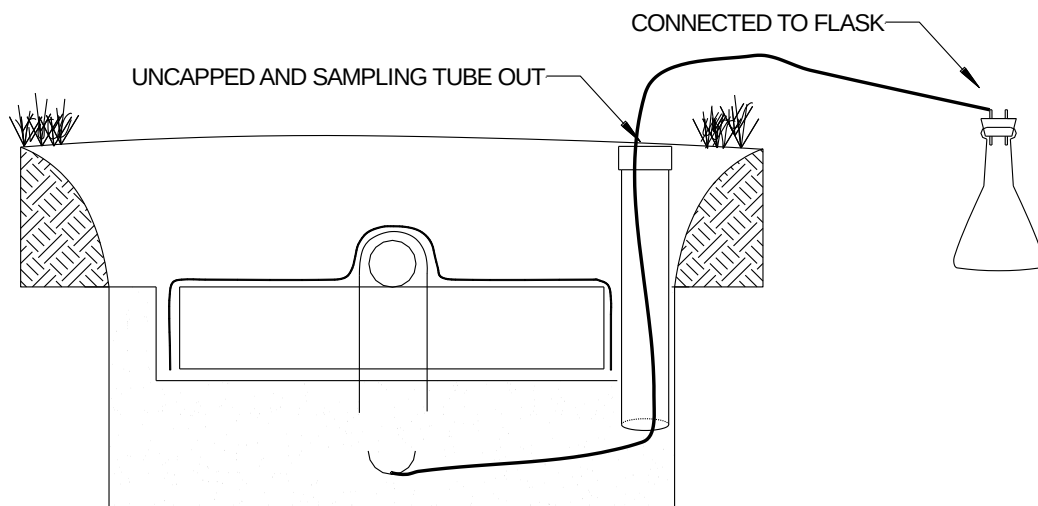
1. Sampling can be done quickly and in a single day. Ensure there is an electrical outlet onsite with appropriate amount of extension cord for your wet-dry vac. For best outcome, you want your wet-dry vac as close as possible to the Sampling Tube Storage Pipe.
2. Ensure your Collection Flask is clean and ready to receive a sample. One Collection Flask per System Sampling Port
3. Open the Sampling Tube Storage Pipe and remove the Sampling Tube. Each System Sampling Port will be sampled individually.

FIGURE 34: PREPARE FOR SAMPLING



4. Plug the Sampling Tube into the Collection Stopper; place the Collection Stopper into the Collection Flask.

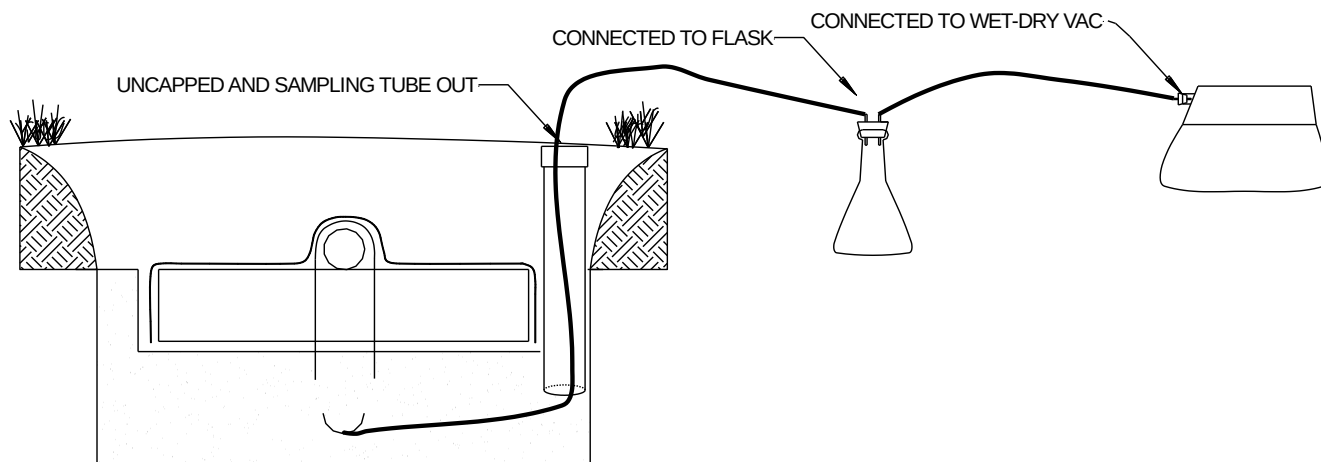
FIGURE 35: CONNECT SAMPLING TUBE TO COLLECTION FLASK



Sampling Procedures

5. Connect the Collection Flask to the wet-dry vac using provided tubing. The wet-dry vac stopper will ensure a good seal. If using your own wet-dry vac, a Connection Stopper must be installed to make a positive connection from the Collection Flask to the wet-dry vac. Please contact Eljen Corporation for guidance.

FIGURE 36: CONNECT SAMPLING FLASK TO WET-DRY VAC



6. Turn on wet-dry vac and collect the necessary sample volume for testing.
7. Disconnect Sampling Tubing from Collection Flask and wet-dry vac and return to Sampling Tube Storage Pipe.
8. Return sample to approved lab for testing.

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				
Check Pumps, Filters, Baffles Floats Wiring, Alarms and all other equipment for condition and proper operation. Provided additional comments on a separate sheet if necessary.	Comments:				
Inspected by:					
Septic tank last pumped date:					
Is pumping recommended?	Yes	No			
Condition of the soil absorption system: Wet, Dry, Firm, Soft, Vegetative, Other. If Other, explain.					
Is there evidence of storm water flows or erosion over the septic system? If yes, explain:	Yes	No			

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 there 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:	
<i>I certify that I have inspected the system at the above address and completed this report, the information reported is true, accurate, and complete as indicated.</i>	

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.



Innovative Environmental Products & Solutions Since 1970

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