GSF®

Geotextile Sand Filter

West Virginia
Design & Installation Manual

eljen
CORPORATION

Innovative Onsite Products & Solutions Since 1970

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Table of Contents

SUBJECT

GSF DRAWINGS AND TABLES

DRAWINGS

TABLES

Glossary of Terms

B43 Module	48” x 36” x 7” (L x W x H)
Bio-Matt™ fabric	Proprietary filter fabric within the Geotextile Sand Filter Modules upon which the primary biomat layer forms.
Combination System	Multiple serial distribution layouts generally fed with equally divided effluent flow from a special Drop Box or other accurate dosing device.
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.
Drop 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.
EDA	Effluent Disposal Area
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 Drop Box to compensate for possible unlevel installation and promote favorable flow to the distribution pipes.
GSF	The Eljen Geotextile Sand Filter Modules and the 6-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 cuspated 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.
Serial or Sequential Distribution	Designs common to sloping sites where GSF lines are laid on the contour, receiving effluent from a series of Drop-Boxes starting at upper trench/line and overflows effluent when required to down-slope trenches/lines.
SHWT	Seasonal High Water Table (SHWT) is the elevation to which the ground or surface water can be expected to rise due to a normal wet season.

Specified Sand

To ensure proper system operation, the system must be installed using an ASTM C33 sand with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. Listed below is chart outlining the sieve requirements for the Specified Sand. Silica based sands are recommended and limestone based sands should be avoided.

TABLE 1: SPECIFIED SAND SIEVE REQUIREMENTS

ASTM C33 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 - 5

Request a sieve analysis from your material supplier to ensure that the system sand meets the specification requirements listed above.

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 Clamps

Wire clamps used to secure perforated pipe above the GSF modules.

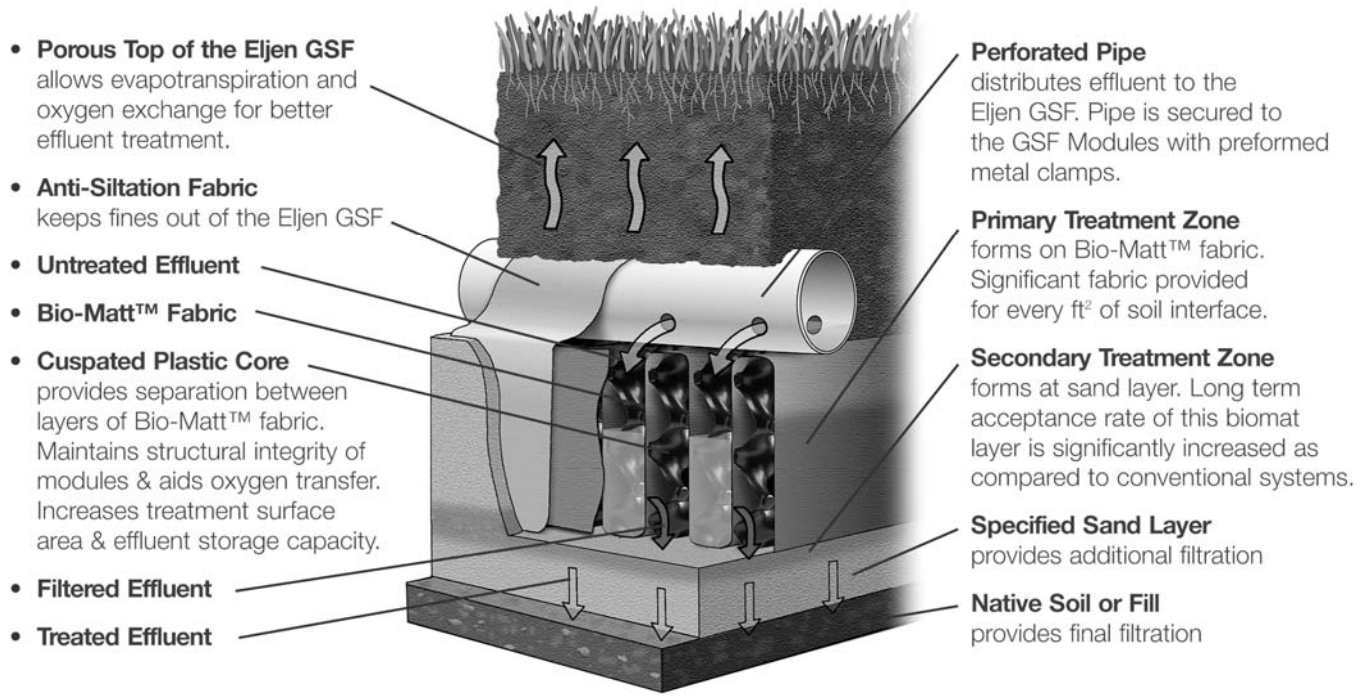
Primary Treatment Zone

- Perforated pipe is centered above the GSF module to distribute septic effluent over and into corrugations created by the cuspated 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 4 & 8 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 Drop 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 4 & 8 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 4 & 8 o'clock positions with the end of pipe capped

Gravity System Trench Design:

- 1000 gal septic tank–gravity to Drop Box.
- Dial-a-flow fittings set level to deliver influent into three individual trenches.
- Perforated distribution pipe with orifices at the 4 & 8 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

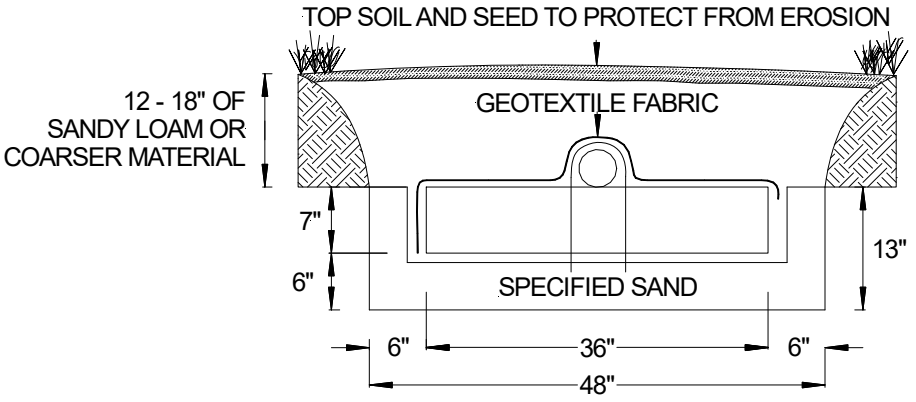
GSF Modules Treatment Performance
NSF Standard 40 Protocol
Wastewater Influent Median Characteristics:
CBOD 180 mg/L & TSS 180 mg/L

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

FIGURE 2: TYPICAL B43 GSF CROSS SECTION



B43 MODULE (L x W x H) 48" x 36" x 7"

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.
- 6 inches of Specified Sand is directly below the GSF module.

1.1 TREATMENT FIELD SIZE: The sizing table (Table 3) applies to residential systems only. The number of GSF modules required is the same for trench or bed systems. A minimum 12" separation is required between parallel rows of a GSF bed system. This allows for the utilization the 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 West Virginia regulations; the bottom of the GSF system may be designed with a 3-foot separation distance from the impermeable layer, or seasonal water table.

1.3 SPECIFIED SAND SPECIFICATION FOR TRENCH AND BED SYSTEMS: The first 6" of 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 page 4 of this manual for more information on the ASTM C33 sand and sieve specifications.

1.4 FILL FOR RAISED SYSTEMS: Fill material below the 6" Specified Sand in Section 1.3 for raised bed systems must be clean fill material in accordance with State of West Virginia or county requirements. Fill must be placed in 6" lifts to prevent differential settling within the system.

1.5 PLACING GSF MODULES: Each row of modules are laid level, end to end on the above Specified Sand bed with a minimum spacing of one foot between parallel rows. 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 at 4 & 8 o'clock. Refer to Section 2.0 and 3.0, for level and serial piping details respectively. Secure pipe to GSF modules with provided wire clamps. One clamp per Eljen module.

1.7 DROP BOX: Set gravity system Drop Box outlet invert a minimum of 1/8" drop in elevation per linear foot to the top first module in the trench or bed. Set a 2.0" minimum drop for dosed systems from the Drop Box to the modules. The fill below the Drop 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 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: Carefully place backfill over the modules, followed by loam to complete a total minimum depth of 12" as measured from the top of the module. Systems with total cover that exceeds 18" as measured from the top of the module shall be vented at the far end of the system. Backfill material shall be a well graded sandy fill; clean, porous, and devoid of rocks larger than 2", with a maximum of 10% passing a #200 sieve. Divert surface runoff from the Effluent Disposal Area, (EDA). Finish grade to prevent surface ponding. Seed loam to protect from erosion.

1.10 NUMBER OF GSF MODULES REQUIRED: Table 3, page 9, indicates the minimum number of B43 GSF modules required for various soil percolation rates for all systems. Residential systems use a minimum of 8 Type B units per bedroom. Example trench and bed configuration drawings are located on pages 10 – 17 of this manual.

1.11 ADDITIONAL FACTORS EFFECTING RESIDENTIAL SYSTEM SIZE: Homes with expected higher than normal water usage may consider increasing the septic tank volume and whether to use 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 with water conditioner backwash (Diversion from septic tank required).
- Homes on high-pressure city water: recommend that the homeowner install a water pressure regulator to reduce pressure to 45-50 psi.

1.12 GARBAGE DISPOSALS: Design drawings shall include a note "GARBAGE DISPOSALS SHALL NOT BE USED WITH THIS SYSTEM." If the property owner insists on installing a disposal, use a 2-compartment septic tank, increase tank volume by 25% which will provide a longer settling period for the increase of suspended solids that the garbage disposal will introduce into the system. Use an appropriate sized septic tank effluent filter.

1.13 WATER SOFTENERS/CONDITIONERS: Water conditioners can adversely affect septic tank treatment and add to the hydraulic load of the system. Discharge of residential conditioner backwash shall be into a separate alternative disposal system of in accordance with State/County regulations.

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

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

1.16 VEHICULAR TRAFFIC: All vehicular traffic is prohibited over the GSF system.

1.17 SEPTIC TANKS: Many designers are now specifying 2-compartment septic tanks and Eljen supports this practice. Effluent filters are required as a means of preventing solids from leaving the tank.

1.18 RISERS: It is strongly recommended that a riser(s) is installed which will extend the septic tank lids to within 6" of the finished grade. This will provide easy access to the septic tank for periodic maintenance, such as pumping, inspection and filter maintenance.

2.0 Systems for Level Sites

2.1 SYSTEM CONFIGURATIONS: Level in-ground or raised systems should be designed with 12" minimum spacing between module rows. The sand bed, 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. Ends are connected with non-perforated pipe at the far end of the system. A non-perforated "cross-over" connection, (Figure: 6) for Bed Configurations is required if the length of the rows are over 30 feet in length.

3.0 Systems for Sloped Sites

3.1 SERIAL DOSED DESIGN: Serially dosed GSF systems may be used on sloped sites.

3.2 ROW SPACING: Systems with up to 6" elevation drop between adjacent rows use 12" minimum spacing. If over 6" drop, use 2 times the elevation drop as minimum spacing between module rows.

3.3 DROP BOX: Provide a Drop Box at the beginning of the first row of modules for effluent velocity reduction and a system inspection port. Lower rows will also require Drop Boxes with Flow Dials to insure effluent is loaded to the upslope trench before continuing to lower trenches within the system.

4.0 Commercial Systems

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

5.0 Installation Sizing and Guidelines

Eljen GSF receives a 60% reduction to conventional field sizing. Once the conventional field sizing is found, reduce it by 60% and use the recommended number of GSF Modules per bedroom listed in Table 3.

Conventional System Size x (1 – 0.6) = Eljen System Size

TABLE 3: STANDARD GSF SIZING TABLE FOR B43 MODULES

Percolation Rate Minutes / Per Inch	Number of Eljen GSF Modules Per Bedroom
Less Than 5 Minutes	-
5 – 30	8
31 – 60	11
Over 60 Minutes	-
61 - 90	Dual Field of 13 Modules Each *

***Use a dual absorption field. In accordance with Title 64, West Virginia Department of Health and Human Resources Bureau for Public Health, Interpretive Rules Series 47, Sewage Treatment and Collection System Design Standards, Individual and On-Site Sewage Systems, Section 6.7.c states: "Construction of the dual soil absorption fields shall be in accordance with the dosing requirements of the standard soil absorption system, with a junction box or valving arrangement to provide for alternation of the fields. The size of each of the fields shall be in accordance with the percolation test results. Both fields shall be of the maximum sizing required for a sixty (60) minutes per inch rate."

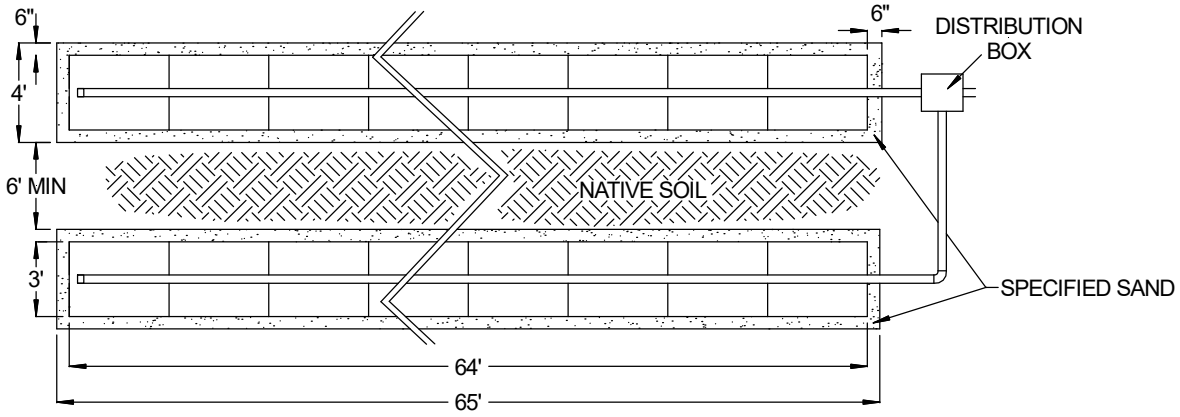
- Minimum number of B43 GSF modules per bedroom = 8.
- Design is based upon 150 gallons per day per bedroom.
- For commercial systems, contact Eljen's Technical Resource Department at 1-800-444-1359 for sizing and design requirements.

Trench Example:

House size –	4 Bedrooms
Soil Permeability min/in –	15 min/in
Conventional System Sizing – 300 ft^2 x 4 bedrooms =	1200 ft^2
How to calculate reduced field size:	
1200 ft^2 x (1 - (60% reduction)) = 1200 ft^2 x 0.4 =	480 ft^2
How to calculate the modules necessary:	
Units required per bedroom for 15 min/in percolation rate:	8 B43 Modules
House size x Units Required = 4 Bedrooms x 8 Modules =	32 modules
For this example, assume the number of trenches equals two:	
Trench Width – Module width (3ft) + Sand Sidewalls (6" + 6") =	4 ft
Trench Length – 32 modules ÷ 2 trenches = 16, use	16 B43 per row
Modules (16) x 4 lf/module + 1 ft (6" sand at each end of trench) =	65 ft
Trench area (width x length x trenches) – 4 ft x 65 ft x 2 trenches =	520 ft^2

Trench Dimensions:	
Length =	65 ft/trench
Width =	4 ft
Trenches =	2
Modules =	32 B43
Total Area =	520 ft^2

FIGURE 3: PLAN VIEW – 600 GPD – TRENCH SYSTEM – LEVEL SITE



Conventional Sizing = 1200 ft^2
Eljen Reduced Sizing = 520 ft^2.

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

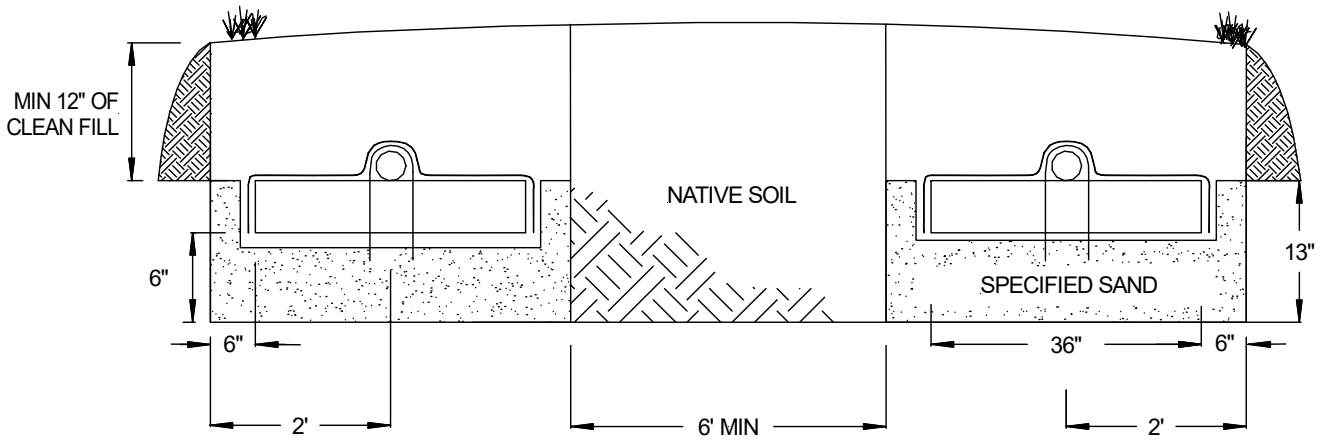
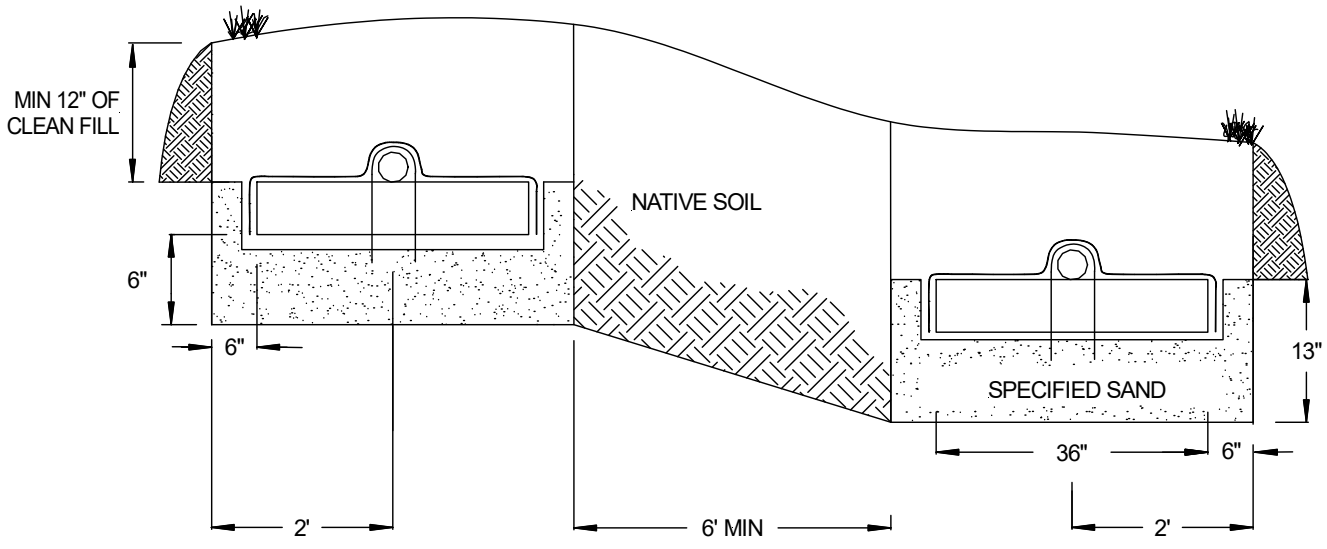


FIGURE 5: SECTION VIEW – 600 GPD – TRENCH SYSTEM – SLOPING SITE



5.1 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 6 inches of Specified Sand in the trench and compact. The compacted height below the GSF module must be level at 6 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 4 & 8 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 4 & 8 o'clock position. Insert a pressure pipe (size per design and code) into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 11. 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	***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: 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.

5.2 Bed Installation Sizing and Guidelines

Bed Example:

House size –	3 bedrooms
Soil Permeability min/in –	35 min/in
Conventional System Sizing – 400 ft^2 x 3 bedrooms =	1200 ft^2

How to calculate reduced field size:

1200 ft^2 x (1 - (60% reduction)) = 1200 ft^2 x 0.4 =	480 ft^2

How to calculate the modules necessary:

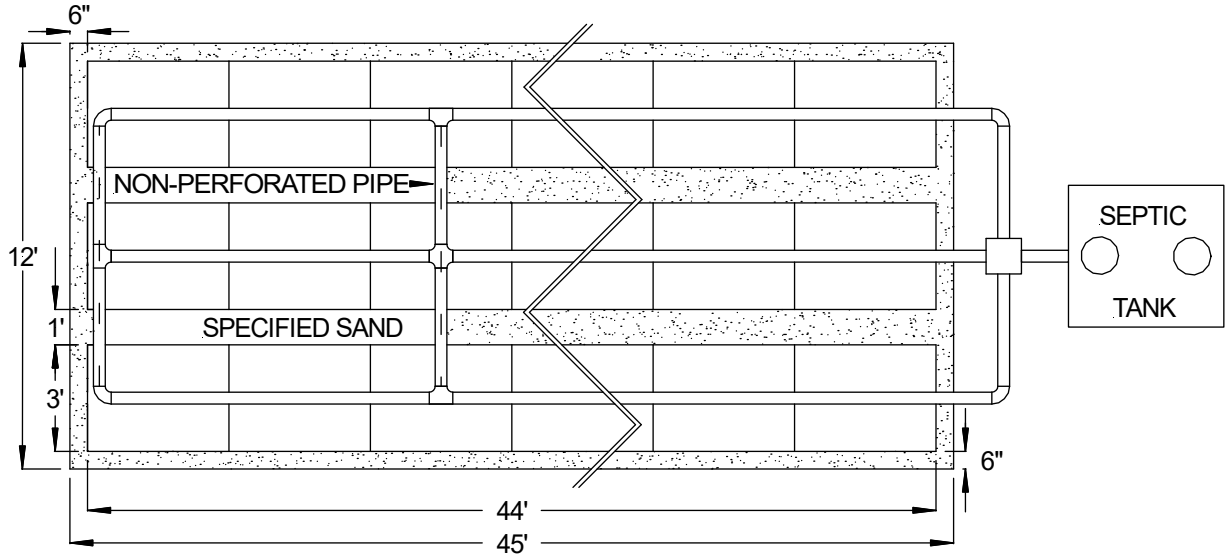
Units required per bedroom for 35 min/in percolation rate:	11 B43 Modules
House size x Units Required = 3 Bedrooms x 11 Modules =	33 modules

For this example, assume the number of rows equals three:

Bed Width – (Module width (3ft) + Sand Sidewalls (6” + 6”)) x Rows (3) =	12 ft
Bed Length – 33 modules ÷ 3 rows = 11, use	11 B43 modules per row
Modules (11) x 4 lf/module + 1 ft (6” sand at each end of bed) =	45 ft
Bed area (width x length) – 12 ft x 45 ft =	540 ft^2

Bed Dimensions:	
Length =	45 ft
Width =	12 ft
Rows =	3
Modules =	33 B43
Total Area =	540 ft^2

FIGURE 6: PLAN VIEW – 450 GPD – BED SYSTEM



Conventional Sizing = 1200 ft^2
Eljen Reduced Sizing = 540 ft^2.

FIGURE 7: SECTION VIEW – 450 GPD – BED SYSTEM – LEVEL SITE

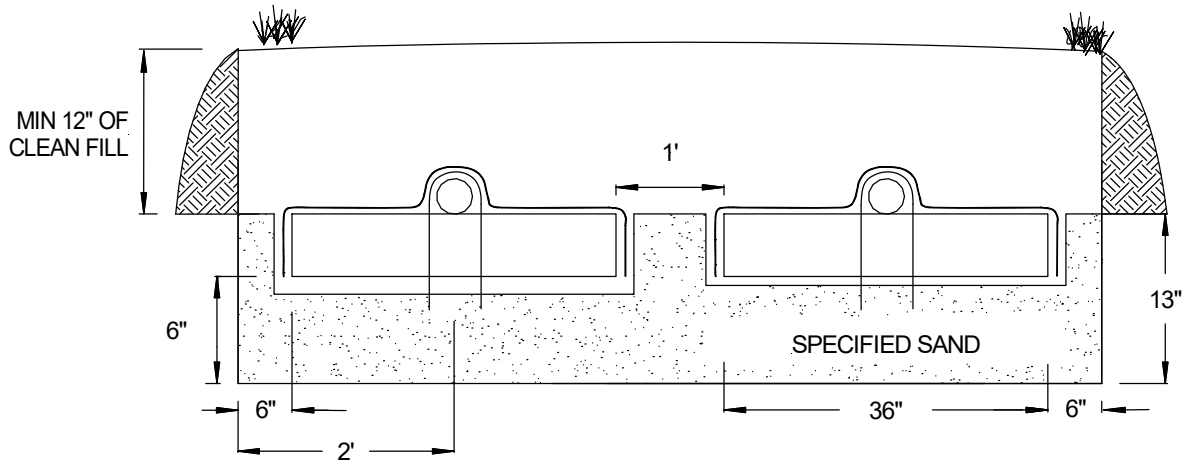
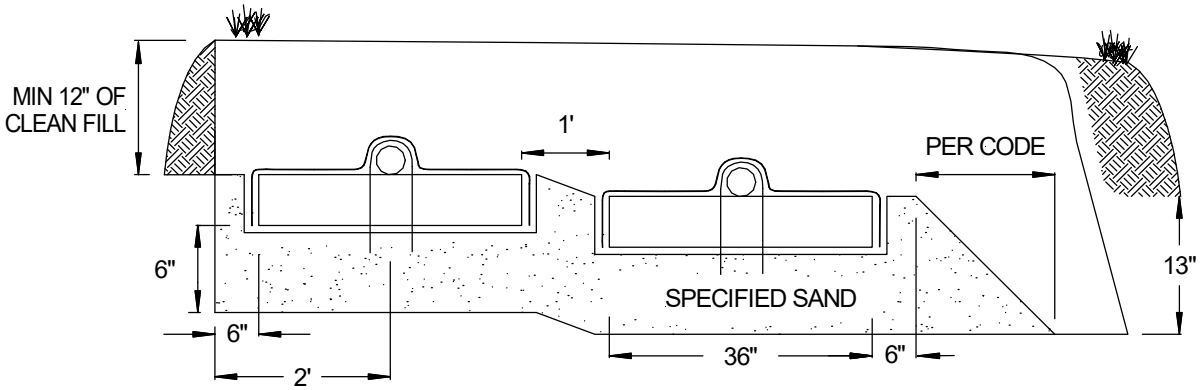


FIGURE 8: SECTION VIEW – 450 GPD – BED SYSTEM – SLOPING SITE



5.2 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 6 inches of Specified Sand in the bed and compact. The compacted height below the GSF module must be level at 6 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 4 & 8 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 4 & 8 o'clock position. Insert a pressure pipe *(size per design and code)* into a standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 11. 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	***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: 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.

Mound Example:

House size –	3 bedrooms
Soil Permeability min/in –	24 min/in
Conventional System Sizing – 300 ft^2 x 3 bedrooms =	900 ft^2

How to calculate reduced field size:

900 ft^2 x (1 - (60% reduction)) = 900 ft^2 x 0.4 =	360 ft^2

How to calculate the modules necessary:

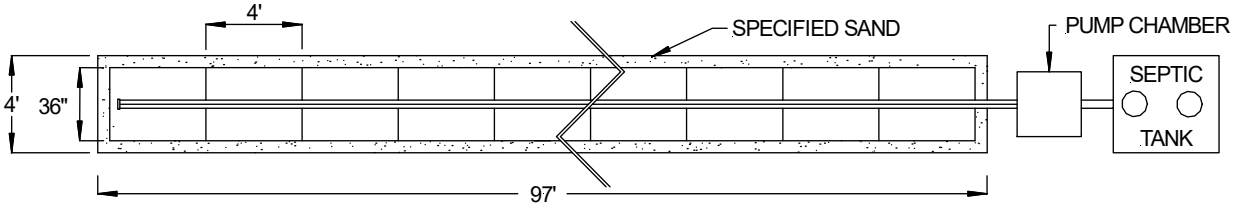
Units required per bedroom for 24 min/in percolation rate:	8 B43 Modules
House size x Units Required = 3 Bedrooms x 8 Modules =	24 modules

For this example, assume we are going to use 1 row:

Bed Width – (Module width (3ft) + Sand Sidewalls (6” + 6”)) x Rows (1) = 4 ft	
Bed Length – 24 modules ÷ 1 rows = 24, use	24 B43 modules per row
Modules (24) x 4 lf/module + 1 ft (6” sand at each end of bed) =	97 ft
Bed area (width x length) – 4 ft x 97 ft =	388 ft^2

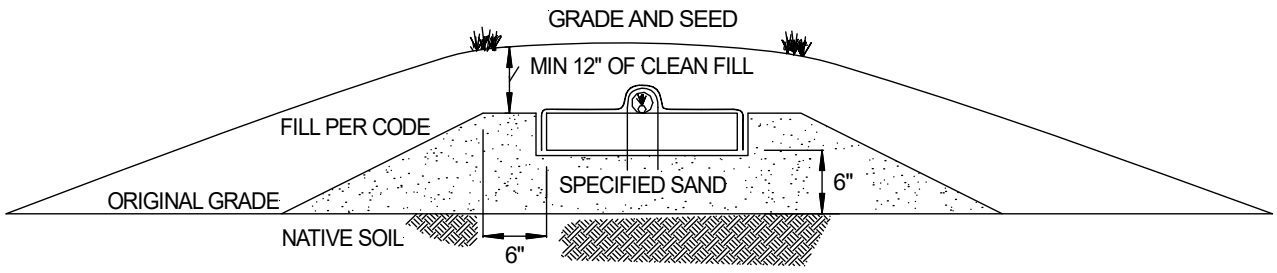
Bed Dimensions:	
Length =	97 ft
Width =	4 ft
Rows =	1
Modules =	24 B43
Total Area =	388 ft^2

FIGURE 9: PLAN VIEW – PRESSURE MOUND SYSTEM



Conventional Sizing = 900 ft^2
Eljen Reduced Sizing = 388 ft^2.

FIGURE 10: CROSS SECTION – PRESSURE MOUND SYSTEM



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 6 inches of Specified Sand in the bed and compact. The compacted height below the GSF module must be level at 6 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 4 & 8 o'clock position. Insert a pressure pipe *(size per design and code)* into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 11. 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 · 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: 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.

6.0 Dosing Distribution Guidance

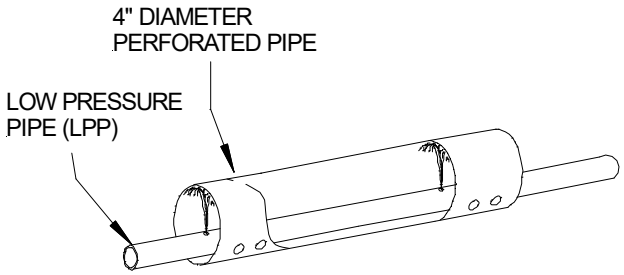
6.1 PUMP DROP BOX: Specify an oversized Drop Box for pumped systems. Provide velocity reduction in the Drop Box with a tee or baffle. Set Drop Box invert 2 inches higher than invert of perforated pipe over GSF modules. If the absorption area is installed deeper than 18 inches, the system must be vented. See section 10.0 of this manual for detailed information on venting of systems.

6.2 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 Drop 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 Drop 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.

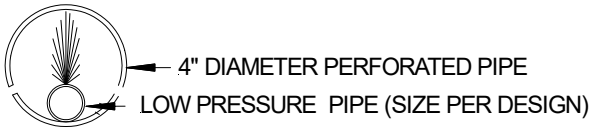
7.0 Pressure Distribution Guidance

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 one orifice falls in the center of each module. A minimum orifice size of ¼ inch shall be maintained. A ¼ 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 11: PRESSURE PIPE PLACEMENT

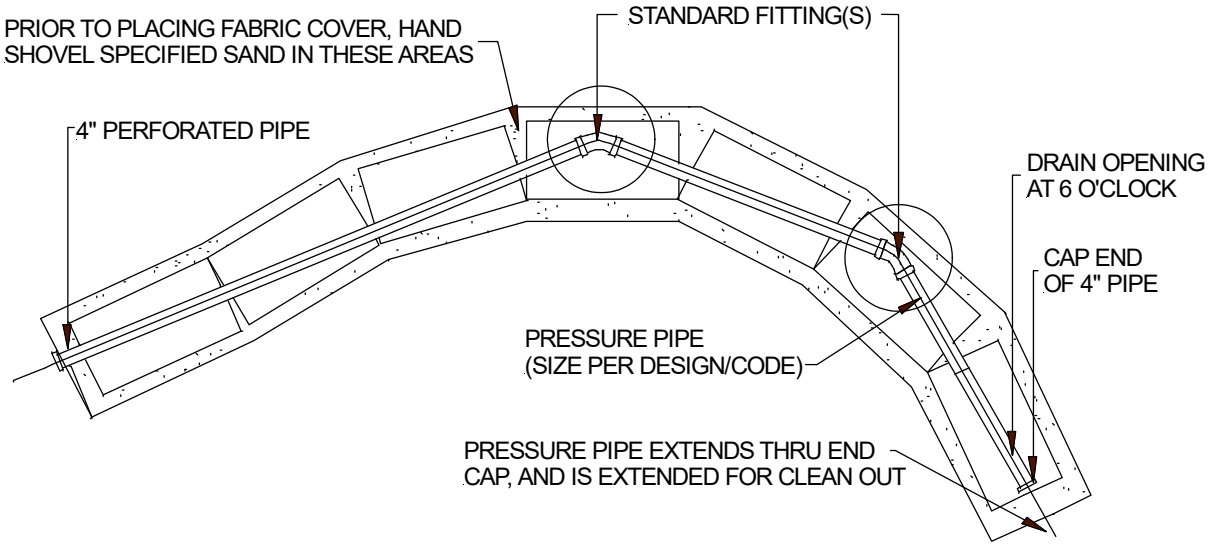


PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS



7.0 Pressure Distribution Guidance

FIGURE 12: 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.

8.0 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.

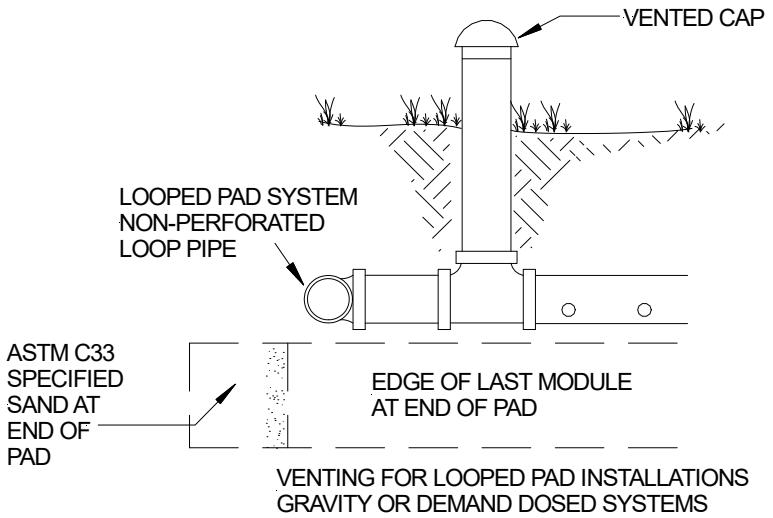
The control panel shall be equipped with both audible and visual high liquid level alarms installed in a conspicuous location. Float switches shall be mounted independent of the pump and force main so that they can be easily replaced and/or adjusted without removing the pump.

9.0 System Ventilation

9.1 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. 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 15.

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.

FIGURE 13: VENT FOR GRAVITY AND PRESSURE DOSED BED SYSTEMS



9.2 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 Drop 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 14: AIR BY-PASS LINE PLAN VIEW FOR VENTING OF PUMPED SYSTEMS

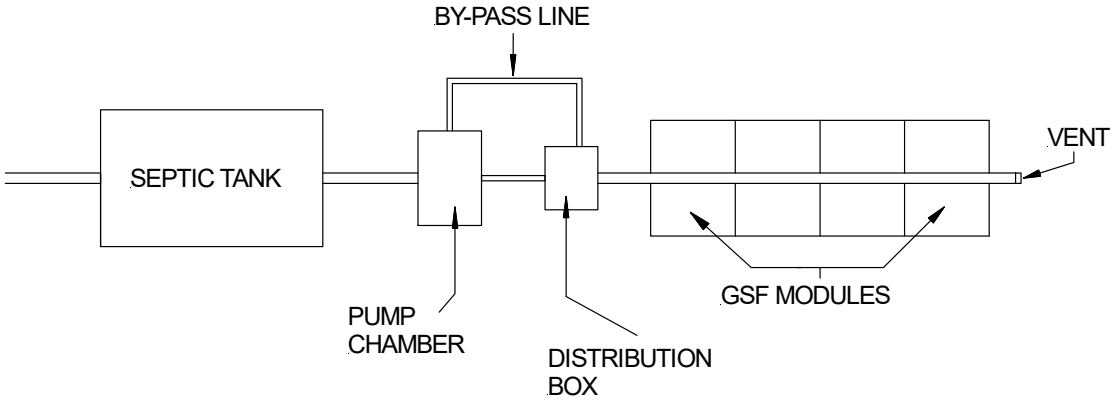
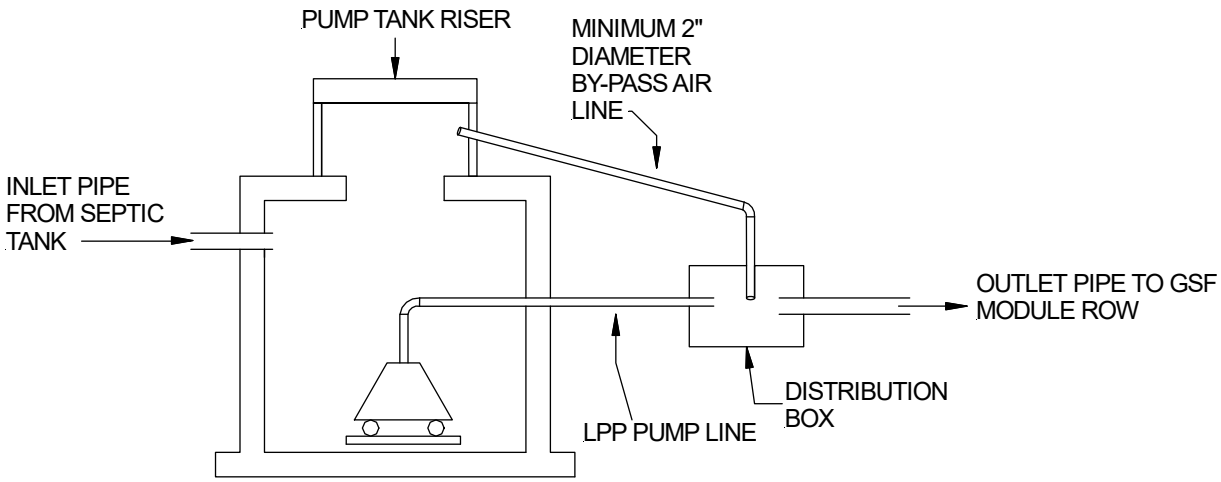
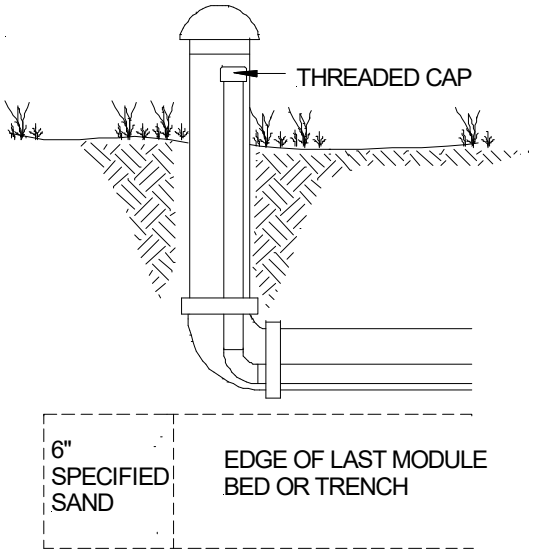


FIGURE 15: AIR BY-PASS LINE CROSS SECTION FOR VENTING OF PUMPED SYSTEMS



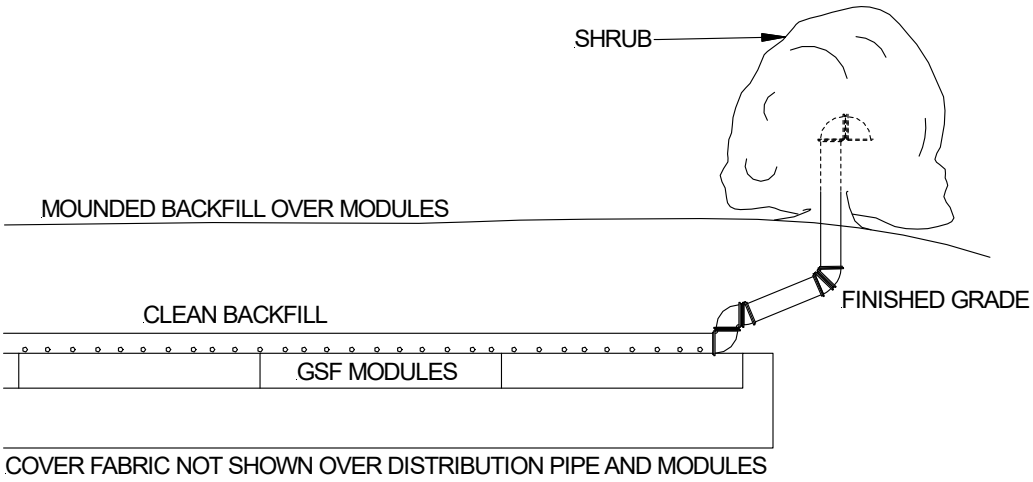
9.3 VENT PIPE FOR LOW PRESSURE DISTRIBUTION SYSTEMS: If the system is a low pressure distribution system with greater than 18 inches of cover, ensure that the LPP clean outs are located in the vent for easy access.

FIGURE 16: PRESSURE CLEAN OUT PRESSURE DOSED SYSTEMS



9.4 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 12. 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 17: GSF WITH 4" VENT EXTENDED TO CONVENIENT LOCATION



10.0 Inspection of GSF Systems

If the GSF system is not operating properly, a system inspection should be performed by a qualified 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

- Clogged filter
- No outlet baffle or tee
- Infiltration of ground water or surface water
- Tank needs to be pumped
- Line to Drop Box needs repair
- Cracked or leaking Septic Tank
- Line to septic tank is clogged

PUMP SYSTEMS

- Incorrect float settings or pump selection
- Wiring or electrical problems
- Infiltration of ground water or surface water into pump chamber
- No vent installed on disposal area
- Line to Drop Box needs repair
- Pump chamber not vented when installed with greater than 18 inches of cover

EFFLUENT DISPOSAL AREA

- Excessive backfill over system – (More than 18” requires venting)
- Crushed Distribution Pipe(s)
- Distribution Pipes are not Level
- Poor quality backfill over system – (No oxygen flow to system)
- Poor quality sand or fill used below the system
- Loam was not removed prior to construction
- System size is too small for actual use – (Excessive use or bedrooms)
- Surface drainage not pitched away from field

11.0 Designs for Replacing Failed Systems with Eljen GSF

Before designing a Geotextile Sand Filter system to replace a 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. Listed below are the most common reasons for septic system failures.

IDENTIFY THE CAUSE(s) OF FAILURE PRIOR TO REPLACEMENT
Leaky plumbing fixtures
Inaccurate percolation test
Pump settings incorrect or not working properly.
More occupants or bedrooms than system were designed for
Unusually high water usage
Garbage disposal
Water softener backwash
Excessive grease in system
Detrimental chemicals being used
Failed or missing septic tank outlet baffle
Infiltration of ground water into septic tank or pump chamber
System is faulty in design or installation
Specified Sand that does not meet the requirements as outlined in this manual
Improper materials
System too close to water table
Mounding due to poor drainage or soil permeability
Part or system not used because of blockage or excessive settling
System is undersized

12.0 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 bed and slope extension areas prior to fill placement. Scarify subsoil prior to fill placement.

4. Fill material shall meet or exceed Design & Installation Manual requirements. All fill material shall be clean sand, free of topsoil directly beneath the EDA. The 6” surrounding and the 6” 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.

5. BACKFILL & FINISH GRADING: Carefully place backfill over the modules, followed by loam to complete a total minimum depth of 12” as measured from the top of the module. Systems with total cover that exceeds 18” as measured from the top of the module shall be vented at the far end of the system. Backfill material shall be a well graded sandy fill; clean, porous, and devoid of sand rocks larger than 2”, with a maximum of 10% passing a #200 sieve. Divert surface runoff from the Effluent Disposal Area, (EDA). Finish grade to prevent surface ponding. Seed loam to protect from erosion.

6. Any system which is more than 18” below finish grade, as measured from the top of the module, shall be vented.

7. This design complies with and must be installed in accordance with the most current Eljen Design and Installation Manual”.

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		

13.0 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 Drop 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 certify I have inspected the system at the above address, completed this report, and the information reported is true, accurate, and complete.	

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.

eljen CORPORATION

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