GSF®

Geotextile Sand Filter

New York
Design & Installation Manual

eljen
CORPORATION

Innovative Onsite Products & Solutions Since 1970

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SUBJECT PAGE

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Glossary of Terms

Absorption Field Area	The footprint of the overall system for the effluent from the GSF modules to infiltrate into the soil.
Appendix 75-A	This appendix represents the minimum design standards for onsite wastewater treatment systems serving residential properties and receiving sewage without the addition of industrial wastes or other wastes as defined in Environmental Conservation Law, Section 17-0701, in quantities of less than 1,000 gallon per day (gpd) in the State of New York.
B43 Module	48” x 36” x 7” (L x W x H)
Cover Fabric	The geotextile cover fabric (provided by manufacturer) that is placed over the GSF modules.
Design Flow	The estimated daily flow that is used to size a GSF system is defined in Appendix 75-A.3, Table 1, ranging from 110 gallons per bedroom to 150 gallons per bedroom depending on use of water conserving fixtures. Individual Counties may have their own flow requirements.
Distribution Box	(Or 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.
Drop Box (D-Box)	A plastic or concrete box that is used on sloped systems where the elevation of the incoming distribution line is higher than that of the outgoing distribution line. This allows the loading of upper most trenches/rows in the system prior to loading lower trenches/rows.
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.
Serial Distribution	For designs commonly used on sloping sites where GSF module rows are laid on contour at varying elevations and where each successive module row receives septic tank effluent only after the preceding module row have become full to the bottom of the invert. This design supports unequal length of module rows.
Sequential Distribution	A method of effluent distribution for sloping sites using drop boxes where the effluent discharges first to the lowest outlet in the upper most box and then backs up to a slightly higher overflow outlet to the next down slope row of modules. Sequential loading maximizes utilization of a row of modules and allows downstream rows to rest for use only during peak flows or stress conditions. It can also be applied to a distribution box for a level bed system by fitting the outlet pipes with dial-a-flows. This method of distribution also supports inspection and management of the system to define the percent of the system in use, maximum use, and to monitor and adjust system stress.

Specified Sand

To ensure proper system operation, the system MUST be installed using ASTM C33 Sand.

ASTM C33 sand will have less than 10% passing the #100 Sieve and less than 5% passing the # 200 sieve. Ask your material supplier for a sieve analysis to verify that your material meets the required specifications.

TABLE 1: SPECIFIED SAND SIEVE REQUIREMENTS

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

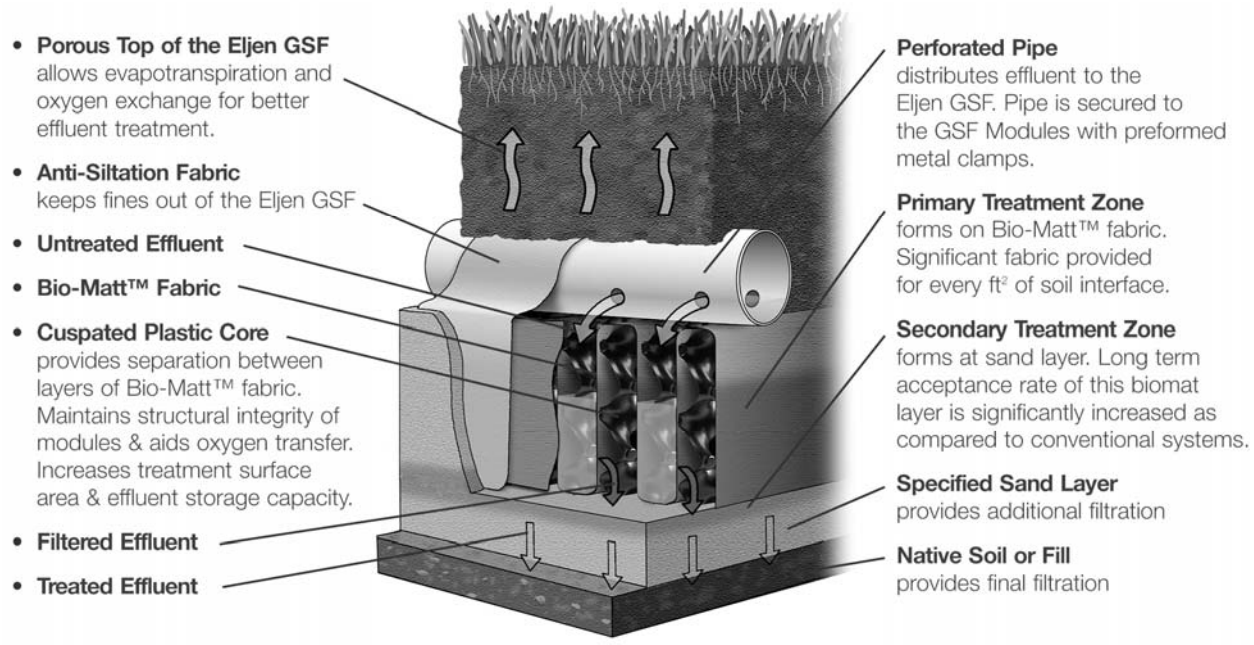
Primary Treatment Zone

- 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



1.0 System Preconditions

1.1 REQUIREMENTS: GSF systems must meet the local rules and regulations except as outlined in this manual. The New York Regulations Appendix 75-A and the local regulations will be referred to as the *guidelines*. Please contact the local health department, watershed agencies, or Code Enforcement Officer for site specific information to determine if there are any additional local design requirements beyond the requirements of Appendix 75-A.

The sizing charts for residential waste strength systems are found in this manual. Please contact Eljen's Technical Resource Department at 1-800-444-1359 for design information on commercial systems.

1.2 WATER CONDITIONERS: Water conditioners can adversely affect septic tank treatment and add to the hydraulic load of the absorption field area. See 75-A.3 for DOH recommendations. **Discharge from residential water conditioners shall be into a separate alternative disposal system integrated with a storm water groundwater recharge system. The location shall be as far as possible from surface aquifer wells and the GSF system.**

1.3 GARBAGE DISPOSALS: The use of a garbage disposal is not recommended as they can cause septic system problems by generating an increase of suspended solids, grease and nutrients.

However, if such units are proposed to be used, other measures should be taken to mitigate the increased nutrients to the field. Consult your local code for garbage disposal requirements. Eljen recommends:

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

NOTE: Eljen requires the use of septic tank outlet effluent filters on all systems. Filters with higher filtration are recommended for systems with garbage disposals.

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

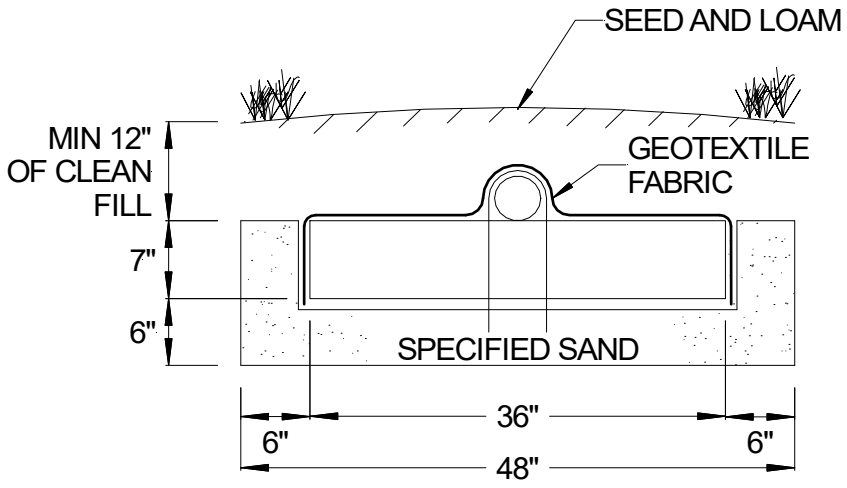
For example:

- Luxury homes, homes with a Jacuzzi style tubs, and other high use fixtures.
- Homes with known higher than normal occupancy.
- Homes with in-sink garbage disposals or Jacuzzi style tubs must have an additional 250-gallon sized tank based on Appendix 75-A requirements.

Designers should use discretion when there are multiple additional factors involved. Increase tank/system size in proportion to excess flow. Multi-compartment and or Dual tanks in series provide the best performance with better retention and separation of solids due to attenuation of flow.

1.5 SYSTEM PROHIBITED AREAS: All vehicular traffic is prohibited over the GSF system. GSF systems shall not be installed under paved or concreted areas. If the system is to be installed in livestock areas, the system must be fenced off around the perimeter to prevent compaction of the cover material and damage to the system.

FIGURE 2: TYPICAL B43 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 Row.
- 6 inches of Specified Sand is directly below the GSF module.
- Minimum 12 inches of cover above the module.

2.1 SEPTIC TANKS: Dual compartment tanks are recommended for all systems. Eljen supports this practice as it helps to promote long system life by reducing TSS and BOD to the effluent disposal area. Effluent filters are also required. Listed in the chart below are the septic tank capacity guidelines from Appendix 75-A.6, Table 3.

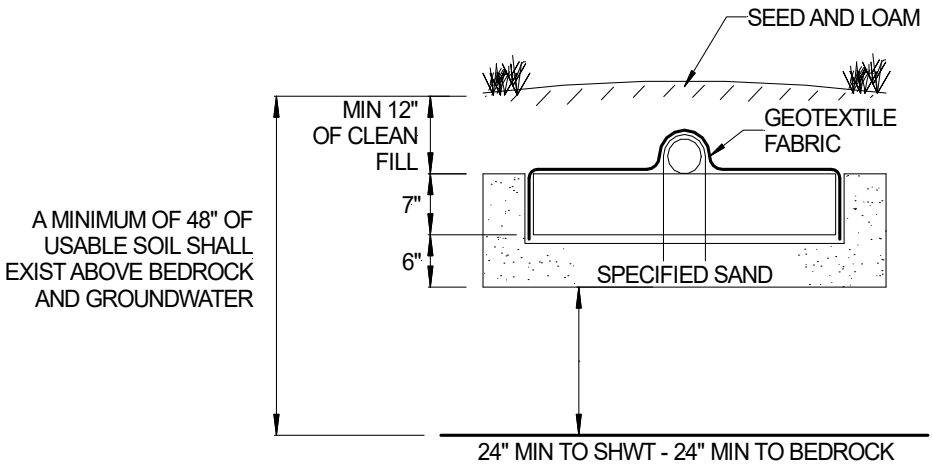
TABLE 2: MINIMUM SEPTIC TANK CAPACITIES

Minimum Septic Tank Capacities		
Number of Bedrooms	Minimum Tank Capacity (Gallons)	Minimum Liquid Surface Area (Square Feet)
1 - 3	1,000	27
4	1,250	34
5	1,500	40
6	1,750	47
NOTE: Tank size requirements for more than six bedrooms shall be calculated by adding 250 gallons and seven (7) square feet of surface area for each additional bedroom. A garbage grinder or spa tub shall be considered equivalent to an additional bedroom for determining tank size.		

2.2 SEPTIC TANK FILTERS: Septic tank effluent filters are ***REQUIRED*** on the outlet end of septic tank. Filter manufactures require that filters be cleaned from time to time. Ask your installer or designer for specific cleaning requirements based on the type or make of the filter installed. Eljen requires the septic tank to be pumped every three years or as needed which would be a good time to check and conduct filter maintenance.

2.3 VERTICAL SEPARATION TO LIMITING LAYER: As required by New York rules, in-ground designs require a minimum of 4 feet of useable soil above bedrock, unsuitable soil, and seasonal high groundwater. The highest limiting condition on the upslope side of the trench shall be at least 2-feet below the 6-inch Specified Sand layer.

FIGURE 3: VERTICAL SEPARATION DISTANCE



2.4 SPECIFIED SAND SPECIFICATION FOR GSF SYSTEMS: The sand immediately under, between rows and around the perimeter of the GSF system must meet ***ASTM C33 SPECIFICATIONS, 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 sand and sieve specifications. Washed concrete sand easily meets the above specification and is a reliable choice. Suitability of bank run sand must be verified.

2.5 PLACING GSF MODULES: The “painted stripe” on the GSF modules indicates the top of the module and is not intended to indicate the location of the distribution pipe. With the painted stripe facing up, all rows of GSF modules are set level, end to end on the Specified Sand layer. Beds on level sites require a minimum spacing of 12” of Specified Sand between parallel module rows. Although not required, Eljen recommends using 24” of separation required on sites with greater than 15% slope. No mechanical connection is required between modules.

2.6 DISTRIBUTION: Gravity, pump to gravity or pressure distribution are acceptable when using the GSF System. Piping shall meet the requirements guidelines; however, Eljen strongly recommends the use of ASTM 2729 or SDR 35 pipe and fittings as to prevent crushing during backfill.

All systems require a perforated 4” diameter pipe centered on top of the GSF modules unless the system is curving. The distribution pipe continues along the entire length of all modules in a trench or row. Holes are set at the 4 and 8 o’clock position and secured by the Eljen provided wire clamps.

When using pressure distribution, a pressure manifold is placed inside the 4-inch distribution pipe or inside an orifice shield. Section 7.0 of this manual goes into details of how to construct the distribution network. All piping must meet state and local regulations.

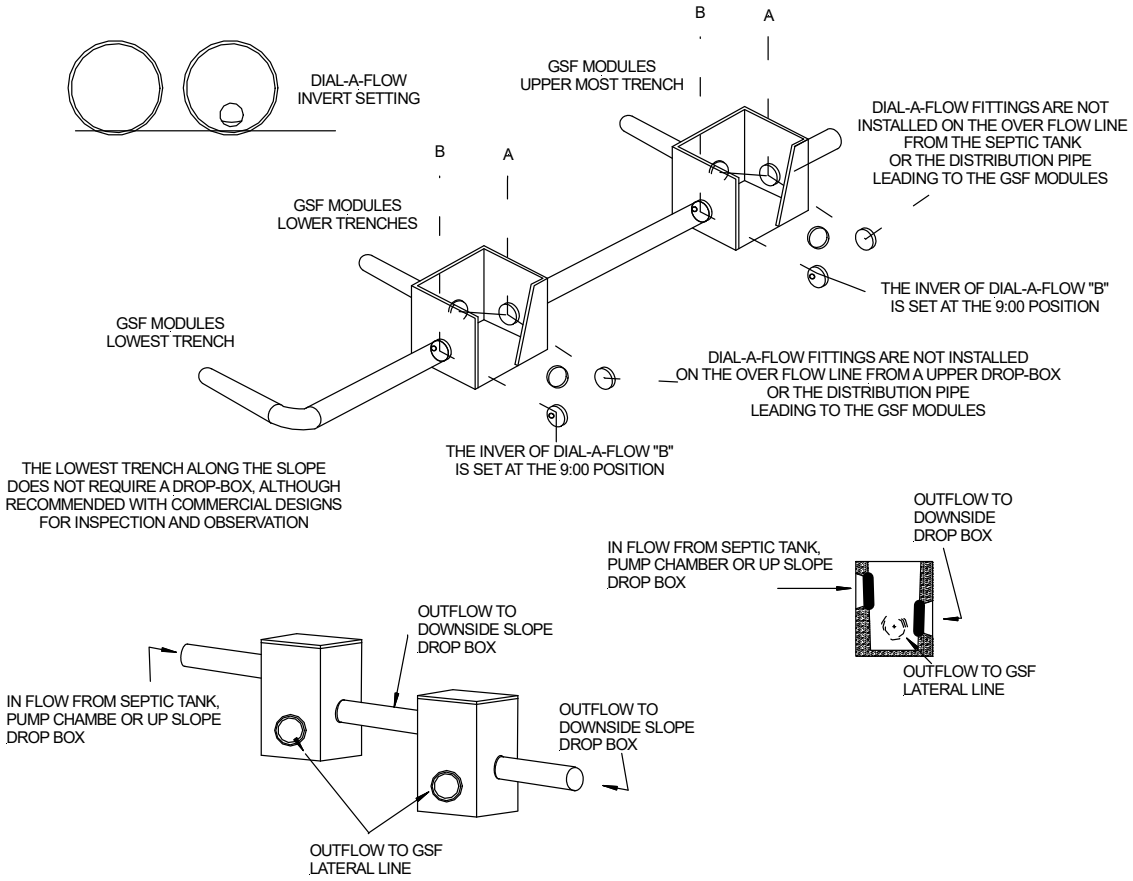
2.7 CONNECTIONS AND FITTINGS: Connections of lines to tanks and distribution boxes must be made using watertight mechanical seals. Use of any grouting material is not permitted.

2.8 DISTRIBUTION BOX CONNECTION: Plastic or concrete distribution boxes are acceptable. Distribution boxes must be installed level and on a compacted layer of sand or a base of gravel to prevent movement over time. Set gravity system distribution box outlet pipes 1/2” to 1/8” drop to per foot above the perforated pipe above the modules. A 2” minimum drop to the perforated pipe is required for pumped systems. Non-perforated pipes from the distribution box to the GSF modules must be placed on a compacted surface and secured with fill material that will prevent movement and settling.

2.9 PARALLEL DISTRIBUTION: Parallel distribution is the preferred method of dosing to a gravity or pump to gravity system. It encourages equal flows to each of the lines in the system. It is recommended for most systems.

2.10 SEQUENTIAL DISTRIBUTION: Sequential Distribution uses a distribution box to fully utilize the uppermost section of the system prior to spilling effluent into a lower row of modules. This is for use on any site with greater than 0.5% slope when not using parallel distribution.

FIGURE 4: SEQUENTIAL DISTRIBUTION DROP–BOX DETAIL



2.11 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.

2.12 SYSTEM VENTING: All systems require sufficient oxygen supply to the GSF system to maintain proper long-term effluent treatment. If a p-trap is installed between the septic tank and the home, it should be removed to allow air to flow from the GSF up through the home vent.

The following situations require venting at the distal (far) end of the GSF system:

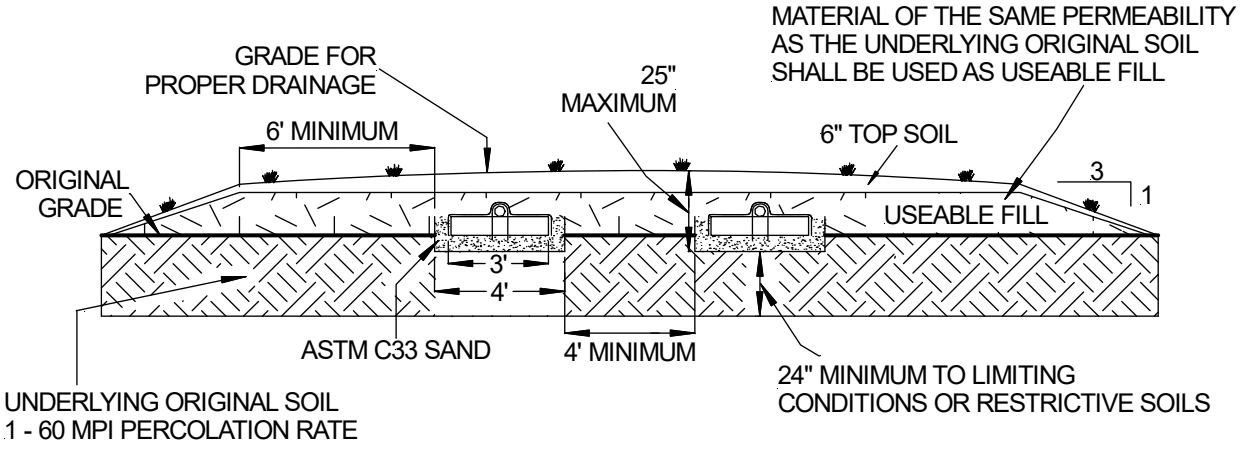
- Any system approved with more than 18 inches of total cover as measured from the top of the modules to finished grade.
- Any pump systems approved with a depth greater than 18 inches require by-pass lines from the distribution box back to the pump station riser or septic tank riser. This will ensure continuity of air flow around the pump station or septic tank and back up the home vent stack.

2.13 BACKFILL & FINISH GRADING: Carefully place backfill over the modules, followed by loam to complete a total minimum depth of 12 inches as measured from the top of the modules. Systems with total cover that exceeds 18 inches as measured from the top of the module shall be vented at the distal (far) end of the system. Backfill with suitable native soil that is clean and devoid of rocks larger than 2 inches. Finish grade to divert surface runoff from the absorption field area. Finish grade to prevent surface ponding above and upslope of the absorption system. Seed loam to protect from erosion. Designers must divert storm water from impervious surfaces around the absorption system. Where storm water infiltration may create a seasonal perched water table, curtain drains may also be required upslope of the absorption system.

2.14 FILL FOR SHALLOW TRENCH SYSTEMS: As specified in 75-A.8.e, Eljen GSF systems may be installed on a plowed ground surface with 2-feet of suitable soil between the bottom of the 6-inch Specified Sand layer and the identified limiting conditions or restrictive soils.

Designers are recommended to specify greater trench spacing in slower soils where they seek to insure hydraulic independence of each row of modules.

FIGURE 5: SHALLOW TRENCH CROSS SECTION



2.15 SYSTEM GEOMETRY: Design systems as long and narrow as practical along site contours to minimize ground water mounding especially in poorly drained low permeability soils. If possible, design level systems with equal number of modules per row.

2.16 SYSTEM SIZING: Eljen requires residential systems use a minimum of 5 B43 modules per bedroom in either a trench or bed configuration. The system size is based on dividing the design flow by the application rates given in Table 4B of Appendix 75-A, then applying Eljen's 6 square foot per linear foot (6 sf/ft) rating from Appendix 75-A.8 (c)(3)(iii), and minimums set in this manual. This will determine the minimum trench length needed for each system.

A minimum of 5 B43 modules per bedroom is required in beds designs. The footprint is based on the infiltrative area calculated by dividing the design flow by the application rates given in Table 5 of Appendix 75-A. In bed systems, the spacing between module rows will vary depending on system geometry. A minimum of 12 inches of Specified Sand is required around the perimeter of the module rows and a minimum of 12 inches of Specified Sand separating module rows. Equal numbers of modules are required in each row for bed applications.

Proposed Repair and Replacement system sizing designs are also covered in this manual. Proposed sizing for Repair and Replacement bed systems must be approved by the local health official if required. Eljen recommends that Repair and Replacement bed systems are installed as "long and thin" as possible when site conditions allow.

2.17 NUMBER OF GSF MODULES REQUIRED: The tables found in this manual indicate the minimum number of B43 modules allowed. Systems can always be designed beyond the minimum required number of modules. The minimum design requirements are 5 B43 modules per bedroom.

3.0 Trench Installation Sizing and Guidelines

To determine the minimum linear feet of trench required per Appendix 75-A, use Table 3 and identify the soil classification rating and then the number of bedrooms and the associated design flow of the dwelling. The intersection of these rows and columns will define the minimum linear feet of trench required for the system.

TABLE 3: TRENCH LINEAR SIZING TABLE (LF)

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom Flow Rate (gpd)			3 Bedroom Flow Rate (gpd)			4 Bedroom Flow Rate (gpd)			Each Additional Bedroom Flow Rate (gpd)		
		220	260	300	330	390	450	440	520	600	110	130	150
1 - 5	1.2	40	40	44	60	60	64	80	80	84	20	20	24
6 - 7	1.0	40	44	52	60	68	76	80	88	100	20	24	28
8 - 10	0.9	44	52	56	64	76	84	84	100	112	24	28	28
11 - 15	0.8	48	56	64	72	84	96	92	112	128	24	28	32
16 - 20	0.7	56	64	72	80	96	108	108	124	144	28	32	36
21 - 30	0.6	64	76	84	92	112	128	124	148	168	32	40	44
31 - 45	0.5	76	88	100	112	132	152	148	176	200	40	44	52
46 - 60	0.5	84	100	112	124	148	168	164	196	224	44	52	56

** The table above represents the minimum length of a trench based on Gallons/Day, respective application rates, and minimum modules required per bedroom. It does not take into account module length and required Specified Sand at the end of the trench row. All final system lengths must add 1-foot of length to compensate for the 6-inches of Specified Sand required at the end of each system row.*

To determine the number of modules required for the system, use Table 4 and identify the soil classification rating and then the number of bedrooms and the associated design flow of the dwelling. The intersection of these rows and columns will define the number of modules required for the system.

Table 4 has been adjusted to provide an Eljen required minimum of 5 modules per bedroom and has been rounded up to the next full module in systems that had partial modules as calculated to meet NYDOH sizing requirements.

TABLE 4: MINIMUM MODULES REQUIRED

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom Flow Rate (gpd)			3 Bedroom Flow Rate (gpd)			4 Bedroom Flow Rate (gpd)			Each Additional Bedroom Flow Rate (gpd)		
		220	260	300	330	390	450	440	520	600	110	130	150
1 - 5	1.2	10	10	11	15	15	16	20	20	21	5	5	6
6 - 7	1.0	10	11	13	15	17	19	20	22	25	5	6	7
8 - 10	0.9	11	13	14	16	19	21	21	25	28	6	7	7
11 - 15	0.8	12	14	16	18	21	24	23	28	32	6	7	8
16 - 20	0.7	14	16	18	20	24	27	27	31	36	7	8	9
21 - 30	0.6	16	19	21	23	28	32	31	37	42	8	10	11
31 - 45	0.5	19	22	25	28	33	38	37	44	50	10	11	13
46 - 60	0.5	21	25	28	31	37	42	41	49	56	11	13	14

Trench Example:

House size:	3 Bedrooms
Design Flow per Bedroom	110 gpd
Percolation Rate:	13 mpi
Absorption Field Type:	Trench

Determine Daily Design Flow:

Bedrooms x Design Flow per Bedroom = Daily Design Flow

3 Bedrooms x 110 gpd/bedroom = 330 gpd

Determine the Minimum Linear Feet of GSF Trench Required
Lookup the linear feet required from Table 3:

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom Flow Rate (gpd)			3 Bedroom Flow Rate (gpd)			4 Bedroom Flow Rate (gpd)			Each Additional Bedroom Flow Rate (gpd)		
		220	260	300	330	390	450	440	520	600	110	130	150
11 - 15	0.8	48	56	64	72	84	96	92	112	128	24	28	32

Linear Feet required **72 Linear Feet**

Determine Minimum Modules Required
Lookup the minimum modules required from Table 4:

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom Flow Rate (gpd)			3 Bedroom Flow Rate (gpd)			4 Bedroom Flow Rate (gpd)			Each Additional Bedroom Flow Rate (gpd)		
		220	260	300	330	390	450	440	520	600	110	130	150
11 - 15	0.8	12	14	16	18	21	24	23	28	32	6	7	8

Minimum Units required **18 B43 Modules**

Trench Width **4 ft**

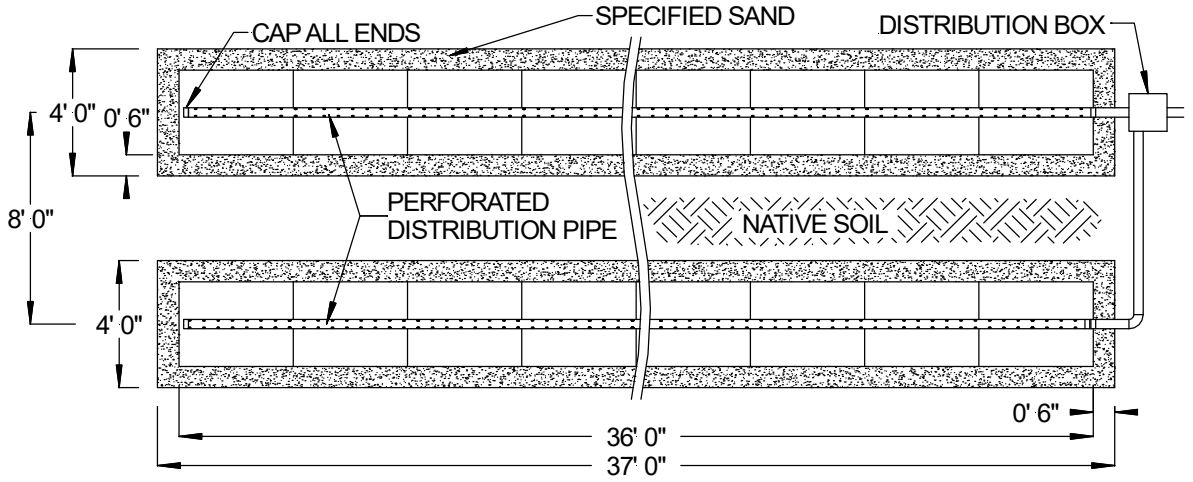
Final Dimension Layout
(Note: System layout and number of rows will vary based on site constraints)

Min. Product Length	72 ft.
(note: 6 inches of sand required at each end of trench which makes the minimum trench length 73 ft.	
Trench Width	43 ft.
Minimum Number of Units	18 B43 Modules

The system designer can decide how to configure the system based on site characteristics. In the example listed above, possible designs could include:

- A single row of modules with optional distribution box at the beginning of the trench used for inspection.
- A “butterfly” configuration, one row of modules in a single trench line with a distribution box located at the center of the system.
- Multiple trench configurations with equal number of modules in each trench following a distribution box.
- Multiple trenches on a hillside using drop boxes ahead of unequal length trenches.

FIGURE 6: PLAN VIEW –TRENCH SYSTEM EXAMPLE



(*2 Rows of 9 B43's shown)

FIGURE 7: SECTION VIEW – TRENCH SYSTEM EXAMPLE – LEVEL SITE

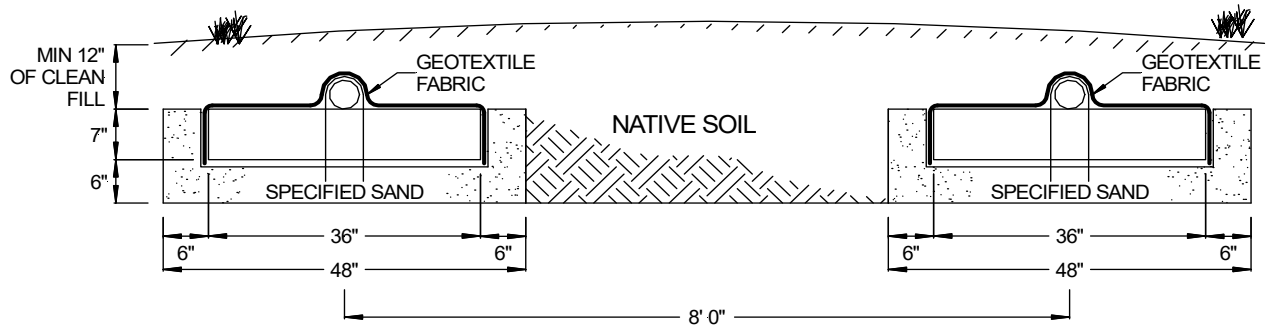
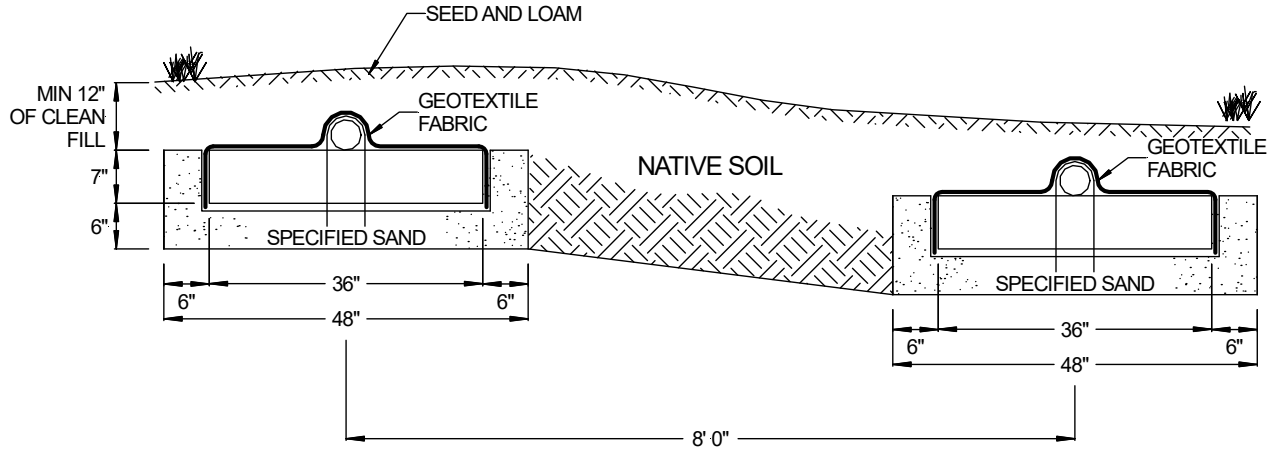


FIGURE 8: SECTION VIEW – TRENCH SYSTEM – SLOPING SITE



3.0 Trench Installation Sizing and Guidelines

1. Ensure all components leading to the GSF system are installed properly. Septic tank effluent filters are required with the GSF system.

2. Determine the number of GSF Modules required using the trench sizing example.

3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas.

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 trench; prepare the receiving layer to maximize the interface between the native soil and specified sand.

6. Minimize walking in the trench prior to placement of the specified sand to avoid soil compaction.

7. Place specified sand in a 6" lift and stabilize by foot, a handheld tamping tool or a portable vibrating compactor. The minimum stabilized height below the GSF module must be level at 6".

8. Place GSF modules with **PAINTED STRIPE FACING UP**, end to end on top of the specified sand along their 4-foot length.

9. 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.

10. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.

11. (Pressure Distribution Systems) 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 14. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall include sweeping cleanouts at the terminal ends and be accessible from grade.

12. ***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:
    a. 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.
    b. Place shovelfuls 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.

13. Place the sand extensions 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.

14. Complete backfill with a minimum of 12 inches of clean porous fill measured from the top of the module. Backfill exceeding 18 inches requires venting at the far end of the trench. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly.

15. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

4.0 Bed Installation Sizing and Guidelines

To determine the square feet of absorption bottom area required for the bed system, use Table 5 and identify the soil classification rating and then the number of bedrooms and associated design flow of the dwelling. The intersection of these rows and columns will define the square feet of absorption area required for the bed system.

TABLE 5: MINIMUM BED ABSORPTION AREA REQUIRED

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom Flow Rate (gpd)			3 Bedroom Flow Rate (gpd)			4 Bedroom Flow Rate (gpd)			Each Additional Bedroom Flow Rate (gpd)		
		220	260	300	330	390	450	440	520	600	110	130	150
1 - 5	0.95	232	274	316	348	411	474	464	548	632	116	137	158
6 - 7	0.80	275	325	375	413	488	563	550	650	750	138	163	188
8 - 10	0.70	315	372	429	472	558	643	629	743	858	158	186	215
11 - 15	0.60	367	434	500	550	650	750	734	867	1000	184	217	250
16 - 20	0.55	400	473	546	600	710	819	800	946	1091	200	237	273
21 - 30	0.45	489	578	667	734	867	1000	978	1156	1334	245	289	334
> 30	*Note: Design with Trench Configurations - Not Acceptable for Bed Configurations Under Appendix 75-A*												

To determine the number of modules required for the bed system, use Table 6 and identify the soil classification rating and then the number of bedrooms and associated design flow of the dwelling. The intersection of these rows and columns will define the number of modules required for the bed system.

These sizing tables have been adjusted to provide an Eljen required minimum of 5 modules per bedroom and have been rounded up to the next full module in systems that had partial modules as calculated to meet DOH sizing requirements.

Lower absorption rates assigned by DOH for beds in heavier clay loam soils allow greater spacing of module rows. This lower density of modules disperses the effluent from each row over a larger area and thereby reduces the application of effluent onto the soil. For very large beds call Eljen for more information on how the effluent can be managed to improve dispersion using gravity or dosed d-box designs.

TABLE 6: MINIMUM MODULES REQUIRED

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom Flow Rate (gpd)			3 Bedroom Flow Rate (gpd)			4 Bedroom Flow Rate (gpd)			Each Additional Bedroom Flow Rate (gpd)		
		220	260	300	330	390	450	440	520	600	110	130	150
1 - 5	0.95	10	10	11	15	15	16	20	20	21	5	5	6
6 - 7	0.80	10	11	13	15	17	19	20	22	25	5	6	7
8 - 10	0.70	10	13	14	16	19	21	21	25	28	6	7	7
11 - 15	0.60	12	14	16	18	21	24	23	28	32	6	7	8
16 - 20	0.55	14	16	18	20	24	27	27	31	36	7	8	9
21 - 30	0.45	16	19	21	23	28	32	31	37	42	8	10	11
> 30	*Note: Design with Trench Configurations - Not Acceptable for Bed Configurations Under Appendix 75-A*												

4.0 Bed Installation Sizing and Guidelines

Bed Example:

House size:	4 Bedrooms
Design Flow per Bedroom	110 gpd
Percolation Rate:	15 mpi
Absorption Field Type:	Bed

Determine Daily Design Flow:

Bedrooms x Design Flow per Bedroom = Daily Design Flow

4 Bedrooms x 110 gpd/bedroom = 440 gpd

Determine the Minimum Absorption Area Required

Lookup the absorption area required from Table 5:

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom Flow Rate (gpd)			3 Bedroom Flow Rate (gpd)			4 Bedroom Flow Rate (gpd)			Each Additional Bedroom Flow Rate (gpd)		
		220	260	300	330	390	450	440	520	600	110	130	150
11 - 15	0.60	367	434	500	550	650	750	734	867	1000	184	217	250

Absorption Area required **734 ft**

Determine Minimum Modules Required

Lookup the minimum modules required from Table 6:

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom Flow Rate (gpd)			3 Bedroom Flow Rate (gpd)			4 Bedroom Flow Rate (gpd)			Each Additional Bedroom Flow Rate (gpd)		
		220	260	300	330	390	450	440	520	600	110	130	150
11 - 15	0.60	12	14	16	18	21	24	23	28	32	6	7	8

Minimum Units Required **23 B43 Modules**

Calculate Minimum Bed Length

Maintain a minimum of 2 rows in a bed system. (2 Rows for this example)

23 Units ÷ 2 Rows = 11.5 modules per row, round up to **12 Mods/Row**

Calculate Minimum Row Length

12 Modules x 4 ft./Module + 2 ft = **50 ft per Row**

Bed Width

Bed Width = Absorption Area Required ÷ Row Length

734 ft^2 ÷ 50 ft = 14.7 ft, round to **15 ft**, for easy construction.

Determine Lateral Spacing

Lateral to Lateral Spacing = Bed Width ÷ Number of Rows

15 ft ÷ 2 rows = **7.5 ft**

Lateral to Edge Spacing = Lateral to Lateral Spacing ÷ 2

7.5 ft ÷ 2 = **3.25 ft**

Final Dimension Layout

(Note: System layout and number of rows will vary based on site constraints)

Bed Length	50 ft.
Bed Width	15 ft.
Minimum Number of Units	24 Modules
Units per Row	12 units per row
Lateral to Lateral Spacing	7.5 ft.
Lateral to Edge Spacing	3.25 ft.

FIGURE 9: PLAN VIEW – BED SYSTEM EXAMPLE – LEVEL SITE

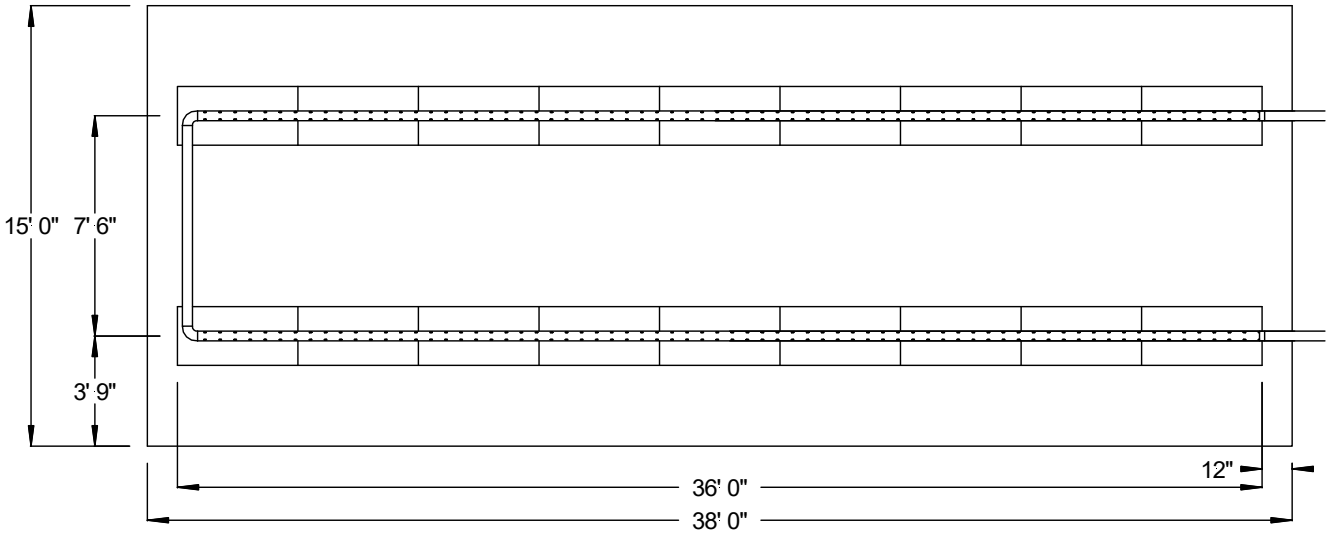
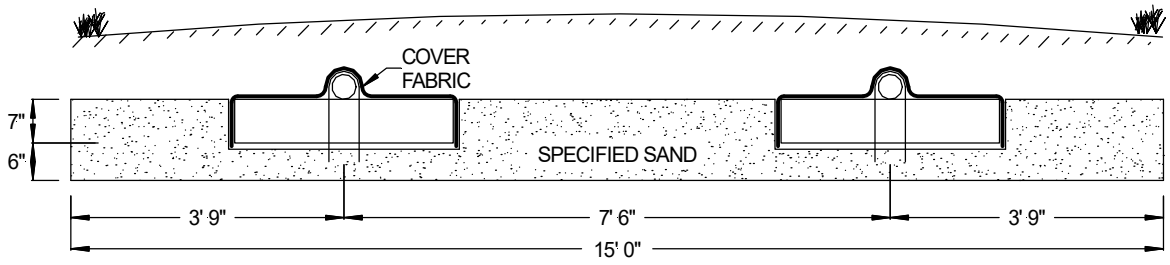


FIGURE 10: SECTION VIEW – BED SYSTEM EXAMPLE



4.0 Bed Installation Sizing and Guidelines

1. Ensure all components leading to the GSF system are installed properly. Septic tank effluent filters are required with the GSF system.

2. Determine the number of GSF Modules required using the bed sizing example.

3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas.

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 bed absorption area; prepare the receiving layer to maximize the interface between the native soil and specified sand.

6. Minimize walking in the absorption area prior to placement of the specified sand to avoid soil compaction.

7. Place specified sand in 6" lifts, stabilize by foot, a handheld tamping tool or a portable vibrating compactor. The minimum stabilized height below the GSF module must be level at 6".

8. Place GSF modules with **PAINTED STRIPE FACING UP**, end to end on top of the specified sand along their 4-foot length.

9. 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.

10. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.

11. (Pressure Distribution Systems) 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 14. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall include sweeping cleanouts at the terminal ends and be accessible from grade.

12. ***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:
    a. 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.
    b. Place shovelfuls 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.

13. Place 12 inches of Specified Sand along both sides of the modules edge. A minimum of 12 inches of Specified Sand is placed at the beginning and end of each module row. Beds on level sites require a minimum spacing of 12" of Specified Sand between parallel modules. No mechanical connection is required between modules.

14. Complete backfill with a minimum of 12 inches of clean porous fill measured from the top of the module. Backfill exceeding 18 inches requires venting at the far end of the bed. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly.

15. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

5.0 Repair and Replacement Bed Installation Sizing and Guidelines

General Guidelines for Repair and Replacement System Sizing

- Proposed Repair and Replacement system sizing shown in Tables 7 & 8 represent the minimum number of units and system area. Number of modules and system area can always be increased to meet local requirements and the needs of the design and site.
- Proposed sizing for Repair and Replacement bed systems must be approved by the local health official if required.
- Minimum edge to edge module spacing for Repair and Replacement bed systems is 12 inches.
- Maximum length per system row is 60 feet for gravity, 75 feet for pump dosing, and 100 for pressure distribution.
- Tables 7 & 8 are based on a minimum design flow of 150 gpd/bedroom. For lower flows, please contact Eljen Corporation for technical support.
- Eljen recommends that Repair and Replacement bed systems are installed as “long and thin” as possible when site conditions allow.
- System rows must use an equal number of modules per row. System area may need to be increased to accommodate additional units.

To determine the square feet of absorption bottom area required for the bed system, use Table 7 and identify the soil classification rating and then the number of bedrooms and associated design flow of the dwelling. The intersection of these rows and columns will define the square feet of absorption area required for the bed system.

TABLE 7: REPAIR AND REPLACEMENT MINIMUM ABSORPTION AREA

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom 300 gpd	3 Bedroom 450 gpd	4 Bedroom 600 gpd	Each Additional Bedroom 150 gpd
1 - 5	1.57	192	287	383	96
6 - 7	1.33	226	339	452	113
8 - 10	1.17	257	385	513	129
11 - 15	1.00	300	450	600	150
16 - 20	0.92	327	490	653	164
21 - 30	0.75	400	600	800	200
31 - 45	0.67	448	672	896	224
46 - 60	0.58	518	776	1035	259
61 - 80	0.50	600	900	1200	300
81 - 100	0.42	715	1072	1429	358
101 - 120	0.33	910	1364	1819	455

To determine the number of modules required for the bed system, use Table 6 and identify the soil classification rating and then the number of bedrooms and associated design flow of the dwelling. The intersection of these rows and columns will define the number of modules required for the bed system.

These sizing tables have been adjusted to provide an Eljen required minimum of 5 modules per bedroom and have been rounded up to the next full module in systems that had partial modules as calculated to meet DOH sizing requirements.

Lower absorption rates assigned by DOH for beds in heavier clay loam soils allow greater spacing of module rows. This lower density of modules disperses the effluent from each row over a larger area and thereby reduces the application of effluent onto the soil. For very large beds call Eljen for more information on how the effluent can be managed to improve dispersion using gravity or dosed d-box designs.

TABLE 8: REPAIR MINIMUM MODULES REQUIRED

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom 300 gpd	3 Bedroom 450 gpd	4 Bedroom 600 gpd	Each Additional Bedroom 150 gpd
1 - 5	1.57	10	12	16	5
6 - 7	1.33	10	15	19	5
8 - 10	1.17	11	17	22	6
11 - 15	1.00	13	19	25	7
16 - 20	0.92	14	21	28	7
21 - 30	0.75	17	25	34	9
31 - 45	0.67	19	28	38	10
46 - 60	0.58	22	33	44	11
61 - 80	0.50	25	38	50	13
81 - 100	0.42	30	45	60	15
101 - 120	0.33	38	57	76	19

5.0 Repair and Replacement Bed Installation Sizing and Guidelines

Repair Bed Example:

House size:	4 Bedrooms
Design Flow per Bedroom	150 gpd
Percolation Rate:	20 mpi
Absorption Field Type:	Repair Bed

Determine Daily Design Flow:

Bedrooms x Design Flow per Bedroom = Daily Design Flow

4 Bedrooms x 150 gpd/bedroom = 600 gpd

Determine the Minimum Absorption Area Required

Lookup the absorption area required from Table 7:

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom 300 gpd	3 Bedroom 450 gpd	4 Bedroom 600 gpd	Each Additional Bedroom 150 gpd
16 - 20	0.92	327	490	653	164

Absorption Area required **653 ft**

Determine Minimum Modules Required

Lookup the minimum modules required from Table 6:

Percolation Rate (min/in)	Application Rate (gpd/ft^2)	2 Bedroom 300 gpd	3 Bedroom 450 gpd	4 Bedroom 600 gpd	Each Additional Bedroom 150 gpd
16 - 20	0.92	14	21	28	7

Minimum Units Required **28 B43 Modules**

Calculate Minimum Bed Length

Maintain a minimum of 2 rows in a bed system. (2 Rows for this example)

28 Units ÷ 2 Rows = **14 Mods/Row**

Calculate Minimum Row Length

14 Modules x 4 ft./Module + 2 ft = **58 ft per Row**

Bed Width

Bed Width = Absorption Area Required ÷ Row Length

$653\ ft^2 \div 58\ ft = 11.26\ ft$, round to **11.5 ft**, for easy construction.

Determine Lateral Spacing

Lateral to Lateral Spacing = Bed Width ÷ Number of Rows

11.5 ft ÷ 2 rows = **5.75 ft**

Lateral to Edge Spacing = Lateral to Lateral Spacing ÷ 2

5.75 ft ÷ 2 = **2.875 ft**

Final Dimension Layout

(Note: System layout and number of rows will vary based on site constraints)

Bed Length	58 ft.
Bed Width	11.5 ft.
Minimum Number of Units	28 Modules
Units per Row	14 units per row
Lateral to Lateral Spacing	5.75 ft.
Lateral to Edge Spacing	2.875 ft.

FIGURE 11: PLAN VIEW – BED SYSTEM EXAMPLE – LEVEL SITE

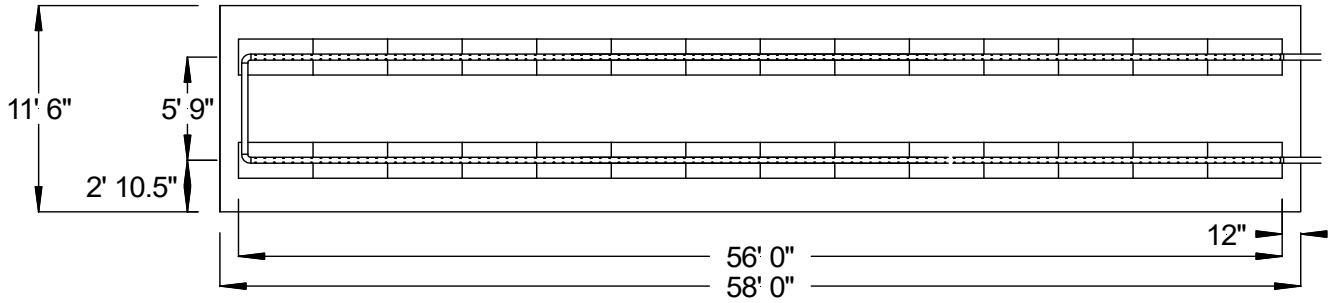
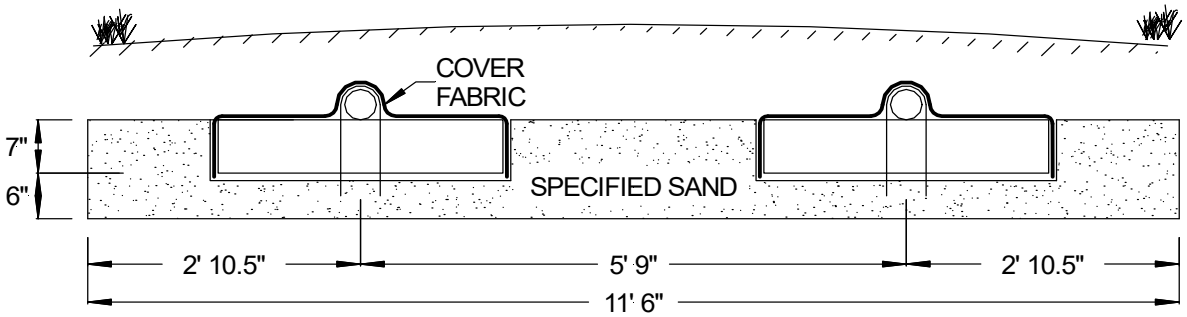


FIGURE 12: SECTION VIEW – BED SYSTEM EXAMPLE



5.0 Repair and Replacement Bed Installation Sizing and Guidelines

1. Ensure all components leading to the GSF system are installed properly. Septic tank effluent filters are required with the GSF system.

2. Determine the number of GSF Modules required using the sizing formula.

3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during preparation. Keep machinery off infiltrative areas.

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. Remove the organic soil layer. Prepare 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.

6. Place fill material meeting local requirements (or Specified Sand requirements) onto the soil interface as you move down the excavated area. Place specified sand in a 6" lift, stabilize by foot, a handheld tamping tool or a portable vibrating compactor. The stabilized height below the GSF module must meet the mound design requirements.

7. Place GSF modules with **PAINTED STRIPE FACING UP**, end to end on top of the specified sand along their 4-foot length.

8. A standard perforated 4-inch distribution pipe is centered along the modules 4-inch length. Orifices are set at the 4 & 8 o'clock position.

9. All distribution pipes are secured with manufacturers supplied wire clamps, one per module.

10. (Pressure Distribution Systems) Insert a PVC Sch. 40 pressure pipe (size per design and code) into the standard perforated distribution pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 14. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall include sweeping cleanouts at the terminal ends and be accessible from grade.

11. ***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:
    a. 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.
    b. Place shovelfuls 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.

12. Ensure there is 12 inches of specified sand surrounding the GSF modules in the mound. Slope the sand away from the mound as described on the plan.

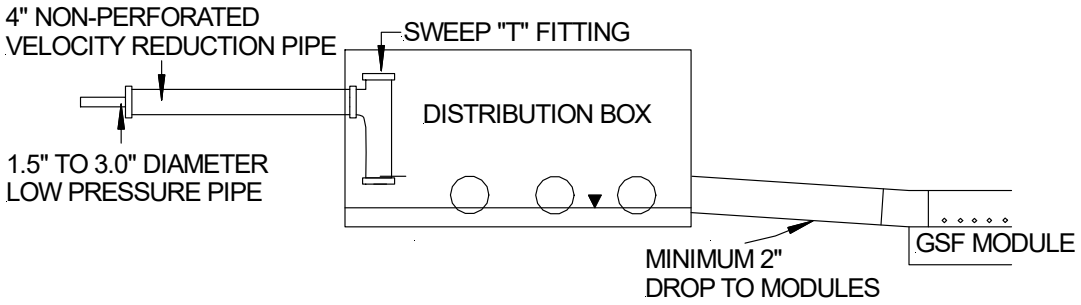
13. Complete backfill with a minimum of 12 inches of cover material measured from the top of the module. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly.

14. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

6.1 PUMP TO DISTRIBUTION BOX: Specify an oversized distribution box for pumped systems. Provide velocity reduction in the distribution box with an elbow on the inlet pipe that directs effluent to the base of the box or a distribution box with a baffle will suffice. A valve on the force main, normally located in the dosing tank is recommended to adjust the flow rate into the distribution box. Set distribution box invert 2" higher than invert of perforated pipe over GSF modules. Dial-a-Flow fittings may be used with a pumped system should the Designer decided to direct effluent to one or more trenches first. For example, in a Sloped pump system, the effluent must load the upper trench first and will require Dial-a-Flow fittings. A three-row level gravity system would not require Dial-a-Flow fittings unless directed in the Designers plans.

Eljen requires venting on all pumped systems with greater than 18 inches of cover as measured from the top of the module to aid in oxygen transfer within the system. A separate 2" minimum pipe is required from the distribution box back to the riser in the septic or pump tank. This ensures that fresh air can flow from the back end of the GSF into the home vent stack, overcoming the barrier created by the dosing pump. If any of the distribution lines are taken out of service to rest a portion of the system, they should be fitted with an elbow directed to the top of the distribution box to allow air exchange without receiving effluent.

FIGURE 13: SECTION VIEW – BED SYSTEM EXAMPLE



6.2 DOSING DESIGN AND FLOW RATE: Set the floats or pump time controls to deliver a maximum of 4 gallons per B43 module for each dosing cycle. Additional volume for the effluent draining back to the dose tank may be added to this volume.

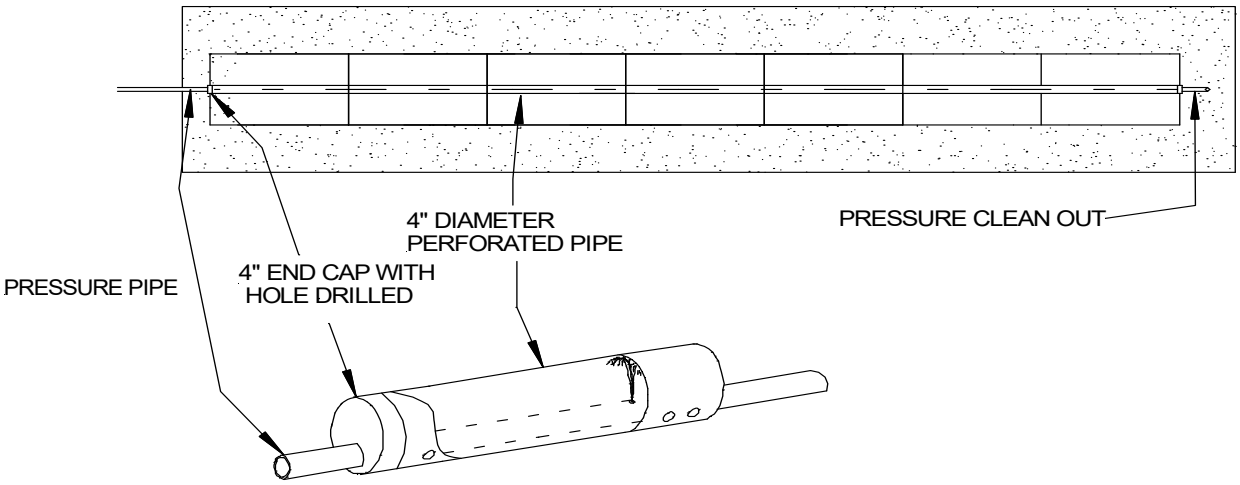
Maximum Dose Volume = number of modules x 4 gallons per module + force main volume

For example, if the system uses 24 modules, set the dose volume at 96 gallons plus the volume of effluent in the force main. A 2" pipe stores 0.163 gallons per foot. Using 10 feet of 2" pipe, the pipe storage volume is 1.63 gallons. This is added to the 96 gallons module dose volume for a maximum dose volume of 97.63 gallons per dosing cycle.

7.1 PRESSURE DISTRIBUTION: Dosing with small diameter pressurized laterals is acceptable for GSF systems. The pipe networks must be engineered and follow principles established for pressure distribution. Using pipe-in-pipe networks as shown in Figure 14, the orifice size and spacing of 3/16 inch and 4 feet is respectively recommended. On sloping sites, the orifices should be offset by 2 feet on each line. For example, the orifice on line one may be at 1 ft, 5 ft, 9 ft etc. with the next line at 3 ft, 7 ft, 11 ft etc. Flushing ports are required to maintain the free flow of effluent from orifices at the distal ends of each lateral. Contact Eljen's Technical Resource Department at 1-800-444-1359 for more information on pressure distribution systems

Standard procedures for design of pressure distribution networks apply to the GSF filter. A minimum orifice size according to the regulations shall be maintained. A drain hole is required at the 6 o'clock position of each pressure lateral for drainage purposes. The lateral pipe network, constructed of PVC Sch. 40 pipe *(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. Pressure clean outs are required at the end of each lateral.

FIGURE 14: PRESSURE PIPE PLACEMENT



PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS

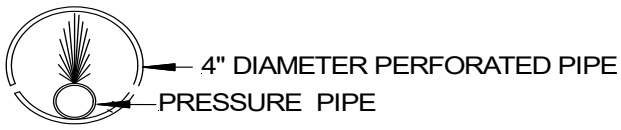


FIGURE 15: PRESSURE CLEAN OUT

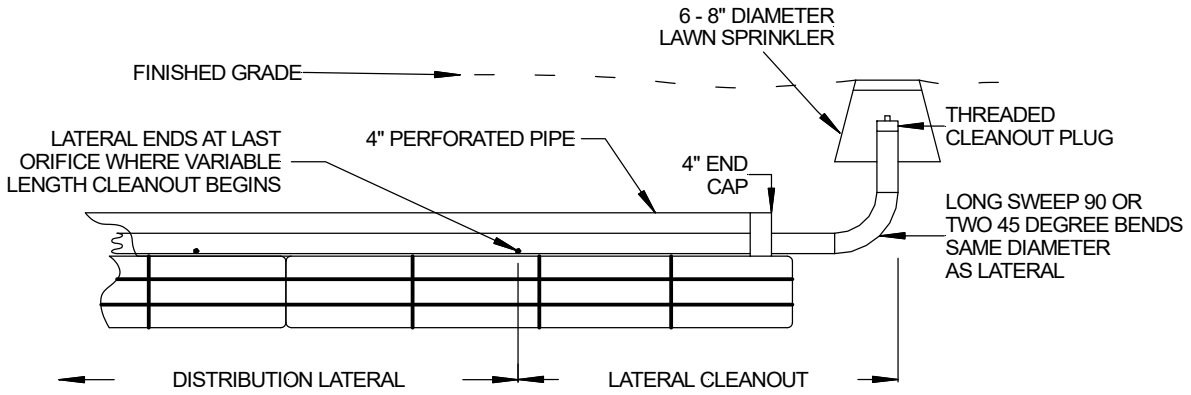
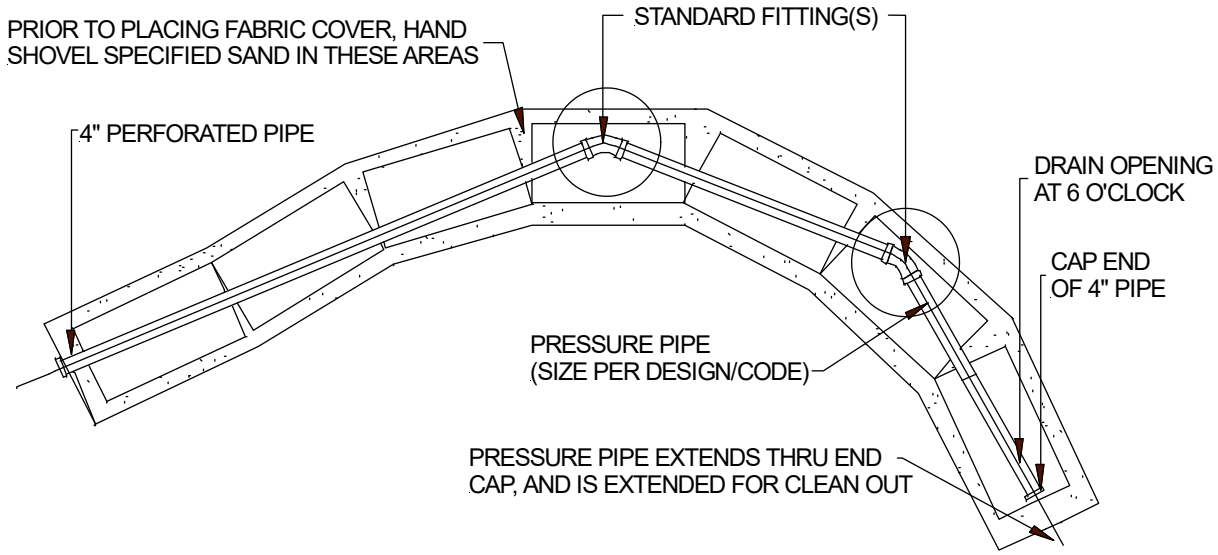


FIGURE 16: CONTOURED TRENCH PRESSURE DISTRIBUTION



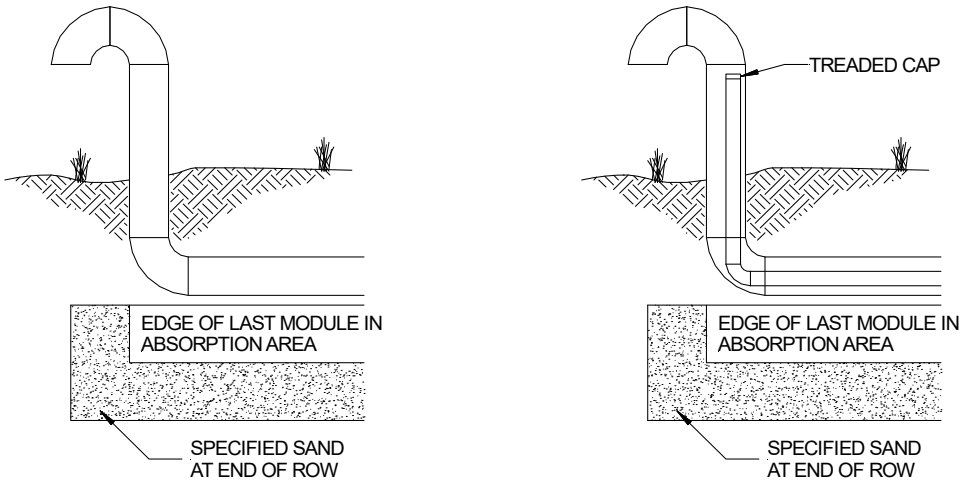
GSF Pressure Distribution trench placed on a contour or winding trenches to maintain horizontal separation distances may also be used in Dosed or Gravity system by removing the pressure pipe and using the 4-inch diameter perforated distribution pipe.

8.0 System Ventilation

8.1 SYSTEM VENTILATION: Air vents are required on all absorption systems located under impervious surfaces or systems **with *more than 18 inches of cover material*** as measured from the top of the GSF module to finished grade. This will ensure proper aeration of the modules and sand filter. The GSF 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.

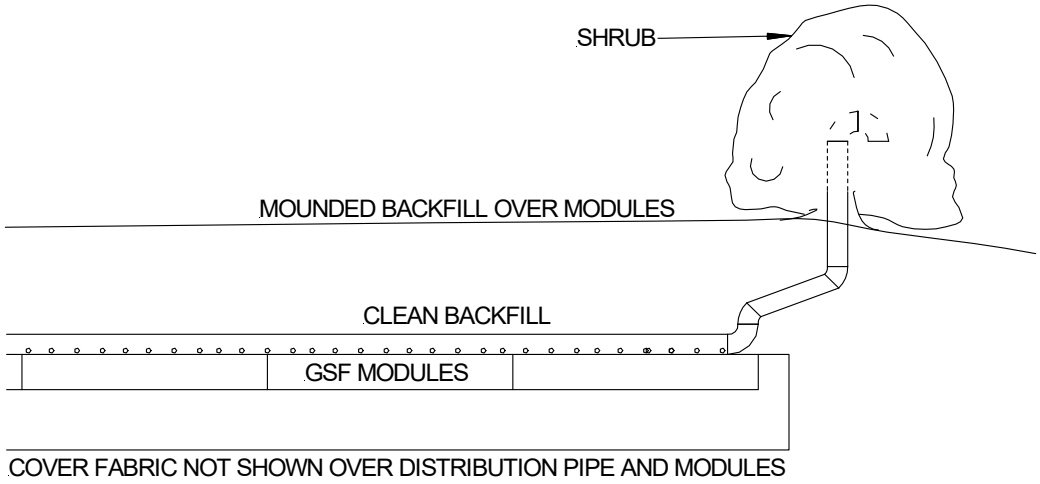
8.2 VENT PIPE FOR GRAVITY AND LOW-PRESSURE SYSTEMS: Systems with over 18” of cover over the top of the modules require a vent. If the system is a low-pressure distribution system, ensure that the LPP clean outs are located in the vent for easy access.

FIGURE 17: VENT LAYOUTS FOR GRAVITY AND LOW-PRESSURE SYSTEMS



8.3 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 the figure below. 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 18: GSF WITH 4" VENT EXTENDED TO CONVENIENT LOCATION



9.0 Required Notes on Design Plans

1. This design and construction requirement complies with Appendix 75-A and local health department regulations.

2. This design complies with and must be installed in accordance with the most current Eljen New York Design and Installation Manual.

3. This system is not designed for use with a garbage disposal.

4. This system is not designed for backwash from a water softener.

5. Organic material that can restrict flow must be removed for raised beds. The soil must be scarified to provide deep channels for the sand. A plowed interface on contour is recommended to prepare the soil for fill placement.

6. Scarify any smeared subsoil prior to fill placement.

7. Fill material shall meet or exceed State of New York Code requirements. All fill material shall be clean bank run sand, free of topsoil, humus, and “dredging” directly beneath the GSF system.

8. ASTM C33 Specified Sand with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve shall be place below and around the GSF modules, with 6 inches minimum underneath and 6 inches minimum surrounding the GSF modules in trench configurations. In bed systems, use 6 inches minimum underneath the modules with 12 inches minimum between module rows and 12 inches minimum around the perimeter of the modules.

9. Eljen provided geotextile cover fabric shall provide proper tension and orientation of the fabric around the sides of 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 fulls 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.

10. Backfill material shall be clean with no roots or stones larger than 2 inches in any dimension to a minimum depth of 8 inches over the GSF modules and final cover for vegetation of 4 inches to 6 inches of clean loam.

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

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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