GSF®

Geotextile Sand Filter

Nevada
Design & Installation Manual

eljen
CORPORATION

Innovative Onsite Products & Solutions Since 1970

March 2018

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DRAWINGS

TABLES

A42 Module 48” x 24” 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 Typically, homes are designed at 150 gallons per day per bedroom. Eljen tested its system using six (6) A42.

GSF The Eljen Geotextile Sand Filter Modules and the 12-inch sand layer at the base and 6 inches along the sides of the modules.

GSF Module The individual module of a GSF system. The module is comprised of a cuspated plastic core and geotextile fabric.

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)
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

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

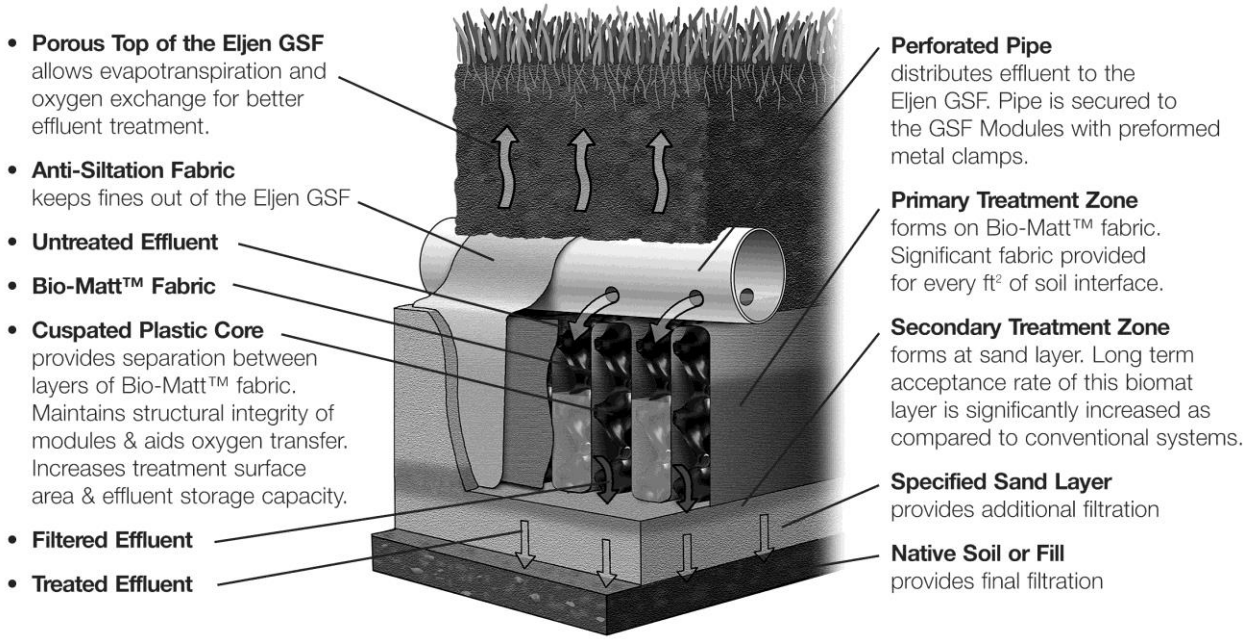
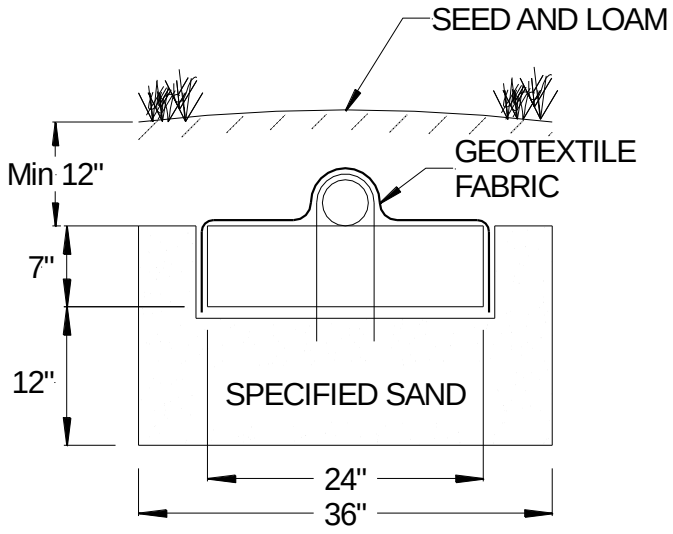


FIGURE 2: TYPICAL A42 GSF CROSS SECTION



A42 MODULE (L x W x H) 48" x 24" 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.
- 12 inches of Specified Sand is directly below the GSF module.
- Minimum 12 inches of native soil fill above the module.

1.0 Design and Installation

1.1 REQUIREMENTS: GSF systems must meet the local rules and regulations except as outlined in this manual. The local regulations (Onsite Wastewater Treatment Systems Technical Guidance Manual; County of Riverside) will be referred to as the *guidelines*.

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

1.2 SPECIFIED SAND SPECIFICATION FOR 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.

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

1.4 PLACING GSF MODULES: The "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. No mechanical connection is required between modules.

1.5 DISTRIBUTION: Gravity, pump to gravity or pressure distribution are acceptable when using the GSF System. A pressure manifold is placed inside the distribution pipe when using pressure distribution. Section 5.0 of this manual goes into details of how to construct the distribution network. All piping must meet state and local regulations. Connect mid points on bed systems with rows over 40' long (see Figure 5).

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

1.7 BACKFILL & FINISH GRADING: 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 absorption field. 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. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

1.8 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.

1.9 GARBAGE DISPOSALS: The use of a garbage disposal is not recommended as they can cause septic system problems by generating an increased number 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 and state code for garbage disposal requirements. Eljen recommends installing a dual compartment tank or tanks in series. Consider upsizing the field for the additional biological load.

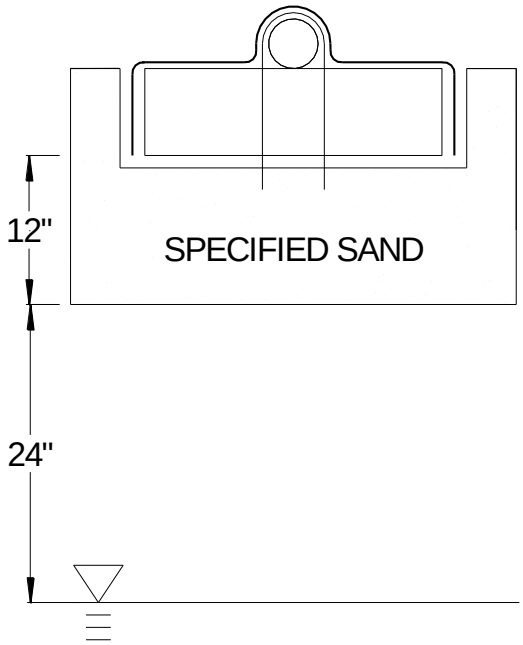
1.10 SEPTIC TANKS: Dual compartment tanks are recommended for all systems. Eljen supports this practice as it helps to promote long system life by reducing TSS and BOD to the effluent disposal area. Gas baffles and/or effluent filters are also required.

1.11 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.

1.12 SYSTEM VENTING: It is strongly recommended to vent all systems that are over 18” below finished grade and systems beneath any surface condition that would not allow for surface air exchange with the system such as patios. See Section 6.0 for a more detailed explanation of venting GSF products.

1.13 VERTICAL SEPARATION TO LIMITING LAYER: A minimum separation of 24” between the bottom of the soil absorption system and the maximum seasonal elevation of the groundwater table shall be maintained.

FIGURE 3: VERTICAL SEPARATION TO GROUNDWATER



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

1.15 GSF SYSTEM SIZING:

TABLE 2: TRENCH SIZING BASED ON PERCOLATION RATE

A42 GSF 10sf/per lf		3 Bedroom (1000 Ga. Tank)		4 Bedroom (1200 Ga. Tank)		5-6 Bedrooms (1500 Ga. Tank)	
Percolation Rate	Application Rate	Trench Length	# of Modules	Trench Length	# of Modules	Trench Length	# of Modules
0-11	1.6	72*	**18**	96*	**24**	120*	**30**
11-15	1.3	77	**19**	96*	**24**	120*	**30**
16-20	1.1	92	**23**	109	**27**	136	**34**
21-25	1	100	**25**	120	**30**	150	**38**
26-30	0.9	111	**28**	133	**33**	167	**42**
31-40	0.8	125	**31**	150	**38**	188	**47**
41-50	0.7	143	**36**	171	**43**	214	**54**
51-60	0.6	167	**42**	200	**50**	250	**63**

Notes: (*) Indicates minimum trench length required.

TABLE 3: BED SIZING BASED ON PERCOLATION RATE

Percolation Rate	Application Rate	3 Bed (SQFT Required)	Units Required	4 Bed (SQFT Required)	Units Required	5-6 Bed (SQFT Required)	Units Required
0-11	1.6	625	**18**	750	**24**	938	**30**
11-15	1.3	769	**19**	923	**24**	1154	**30**
16-20	1.1	909	**23**	1091	**27**	1364	**34**
21-25	1	1000	**25**	1200	**30**	1500	**38**
26-30	0.9	1111	**28**	1333	**33**	1667	**42**
31-40	0.8	1250	**31**	1500	**38**	1875	**47**
41-50	0.7	1429	**36**	1714	**43**	2143	**54**
51-60	0.6	1667	**42**	2000	**50**	2500	**63**

Example 1: Trench – A42 Modules

House size: 3 bedrooms
Percolation Rate/ Application Rate: 19 MPI = 1.1 gpd/ft^2
Design Flow: 150 gpd x 3 bedrooms = 450 gpd

Refer to Table 2 for the soil loading rate.

A42 GSF 10sf/per lf		3 Bedroom (1000 Ga. Tank)		4 Bedroom (1200 Ga. Tank)		5-6 Bedrooms (1500 Ga. Tank)	
Percolation Rate	Application Rate	Trench Length	# of Modules	Trench Length	# of Modules	Trench Length	# of Modules
0-11	1.6	72*	**18**	96*	**24**	120*	**30**
11-15	1.3	77	**19**	96*	**24**	120*	**30**
16-20	1.1	92	**23**	109	**27**	136	**34**

Modules Needed: 23 A42 Modules
Minimum Trench Length Required: 92 ft^2

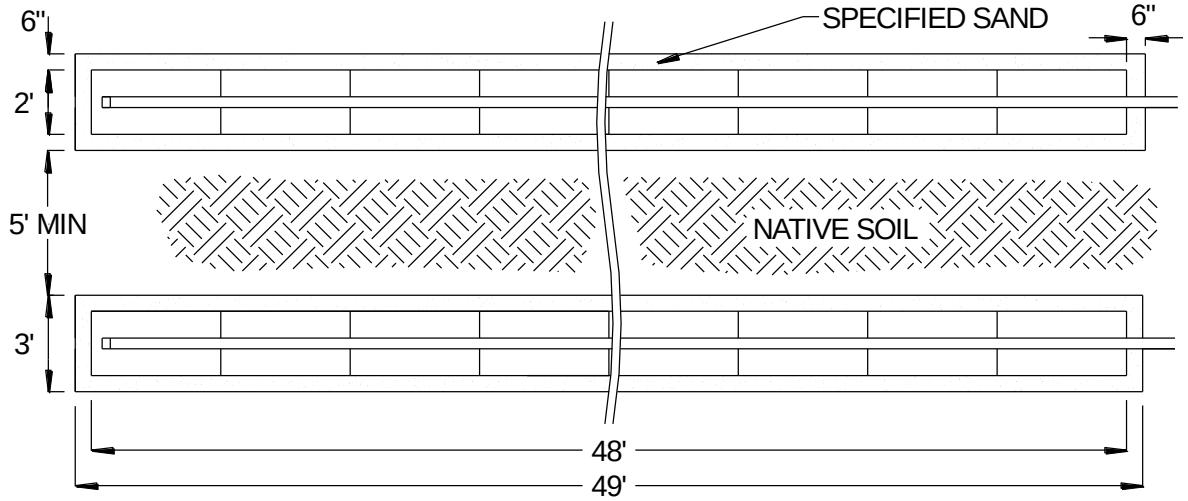
For This Example, Assume the Number of Rows Equals Two:

Row Width: Module width (2 ft) + Sand Sidewalls (6" + 6") = 3 ft
Row Length: 23 modules ÷ 2 rows = 11.5 modules per row
For even rows +1 Module = 12 modules per row
Modules (12) x 4 lf/module + 1 ft (6" sand at each end of row) = 49 ft per row

Trench Dimensions:

Length = 49 ft/row
Width = 3 ft
Rows = 2
Modules = 24 A42

FIGURE 4: PLAN VIEW – 450 GPD – A42 –TRENCH SYSTEM



***** THE MINIMUM DISTANCE BETWEEN SIDEWALLS FOR THE GSF IS = 5ft *****

Trench Installation Guidelines Additional guidance in State and Local regulations	
Determine the Number Modules	Determine the number of GSF Modules required using the trench sizing example.
Plan all Drainage Requirements	Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.
Excavating the Trench Area	Scarify the receiving layer to maximize interface between the native soil and Specified Sand. Minimize walking in the trench prior to placement of the Specified Sand to avoid soil compaction.
Placing Specified Sand Base	Place Specified Sand in two 6-inch lifts, stabilize each lift and then level. The stabilized height below the GSF module must be level at 12 inches. A hand tamping tool or vibrating compactor are 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	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. Recommended drop for gravity systems from D-Box to modules is 1/8" per linear foot. • 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 7. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall have a clean out at the end of the trench. 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 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.
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 a minimum of 12 inches of clean porous fill measured from the top of modules. Backfill exceeding 18 inches requires venting at the far end of the trench or bed. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

3.0 Bed Installation Sizing and Guidelines

Bed Example:

House size: 4 Bedrooms
Percolation Rate: 35 mpi
Absorption Field Type: Bed

Lookup Minimum Absorption Area

Lookup minimum absorption area from Table 3:

Determine Number of Modules Required

Lookup the minimum units required from Table 3:

Percolation Rate	Application Rate	3 Bed (SQFT Required)	Units Required	4 Bed (SQFT Required)	Units Required	5-6 Bed (SQFT Required)	Units Required
26-30	0.9	1111	**28**	1333	**33**	1667	**42**
31-40	0.8	1250	**31**	1500 →	**38**	1875	**47**
41-50	0.7	1429	**36**	1714	**43**	2143	**54**

Calculate Minimum Bed Length

Maintain a minimum of 2 rows in a bed system. (2 Rows for this example)
38 Units ÷ 2 Rows = 19 Mods/Row

Calculate Minimum Row Length

Modules (19) x 4 lf/module + 1 ft (6" sand at each end of row) = 77 ft

Bed Width

Bed Width = Absorption Area ÷ Bed Length
1500ft² ÷ 77 ft = 19.48 ft
(Round to 20 ft for easy construction) 20ft

Determine Lateral Spacing

Lateral to Lateral Spacing = Bed Width ÷ Number of Rows
2 Rows
20 ft ÷ 2 rows = 10 ft

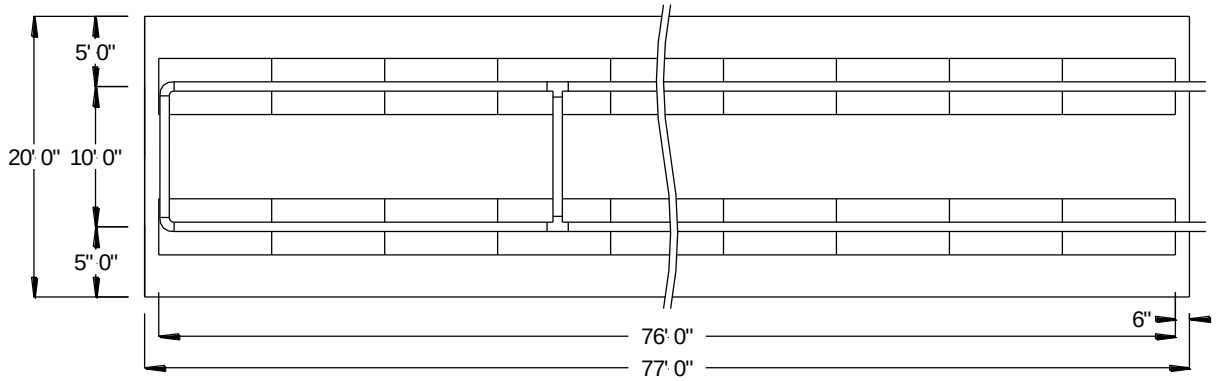
Lateral to Edge Spacing = Lateral to Lateral Spacing ÷ 2
10 ft ÷ 2 = 5 ft

Final Dimension Layout

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

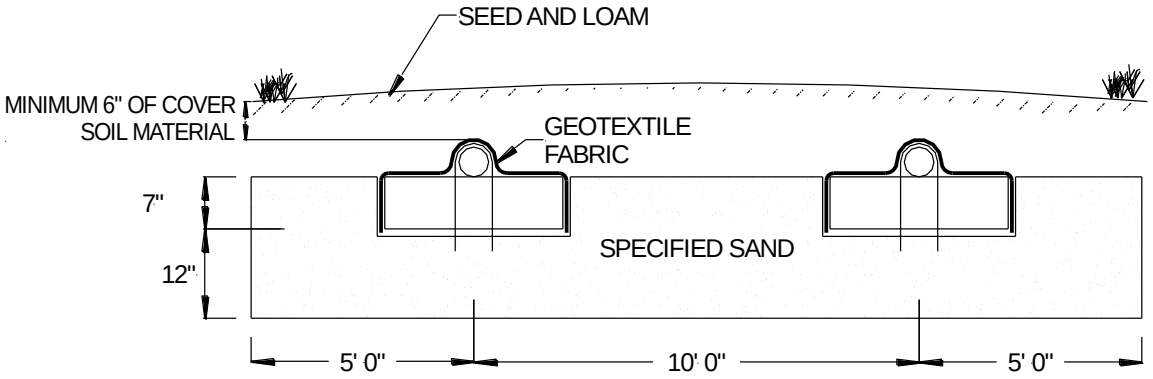
Bed Length	77 ft
Bed Width	20 ft
Minimum Number of Units	38 Units
Units per Row	19 units per row
Lateral to Lateral Spacing	10 ft
Lateral to Edge Spacing	5 ft
System Area	1540 ft²

FIGURE 5: PLAN VIEW – BED SYSTEM



(Note: Crossover connection is required for bed systems over 40' in length)

FIGURE 6: CROSS SECTION VIEW – BED SYSTEM



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 Table 3.
Excavating the Bed Area	Scarify the receiving layer to maximize the interface between the native soil and Specified Sand. Minimize walking in the absorption area prior to placement of the Specified Sand to avoid soil compaction.
Placing Specified Sand Base	Place Specified Sand in two 6-inch lifts, stabilize and level. The stabilized height below the GSF module must be level at 12 inches. A hand tamping tool or vibrating compactor are 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	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. Recommended drop for gravity systems from D-Box to modules is 1/8" per linear foot. • 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 7. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall have a clean out at the end of the trench. 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 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.
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 a minimum of 12 inches of clean porous fill measured from the top of modules. Backfill exceeding 18 inches requires venting at the far end of the trench or bed. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

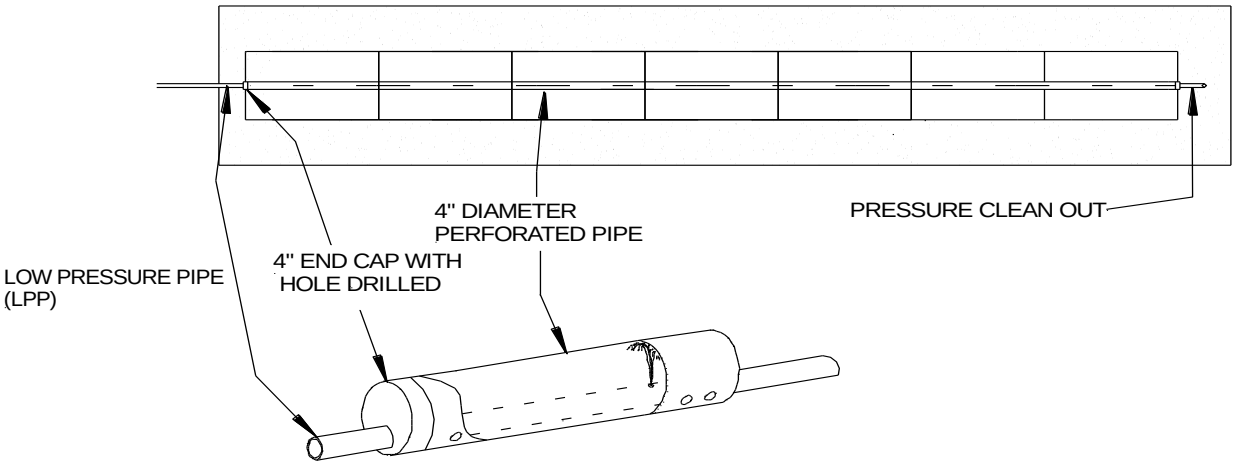
4.0 Dosing Distribution Guidance

DOSING DESIGN CRITERIA: Dosing volume must be set to deliver a maximum of **3 gallons per Module** per dosing cycle. Head loss and drain back volume must be considered in choosing the pump size and force main diameter.

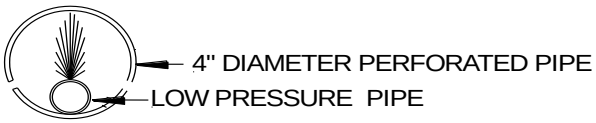
5.0 Pressure Distribution Guidance

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 *(size per design and code)* is placed within a standard 4-inch perforated pipe. The perforation in the 4-inch outer pipe are set at the 4 and 8 o'clock position, the drilled orifices on the pressure pipe are set to spray at the 12 o'clock position directly to the top of the 4-inch perforated pipe as shown below.

FIGURE 7: PRESSURE PIPE PLACEMENT



PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS

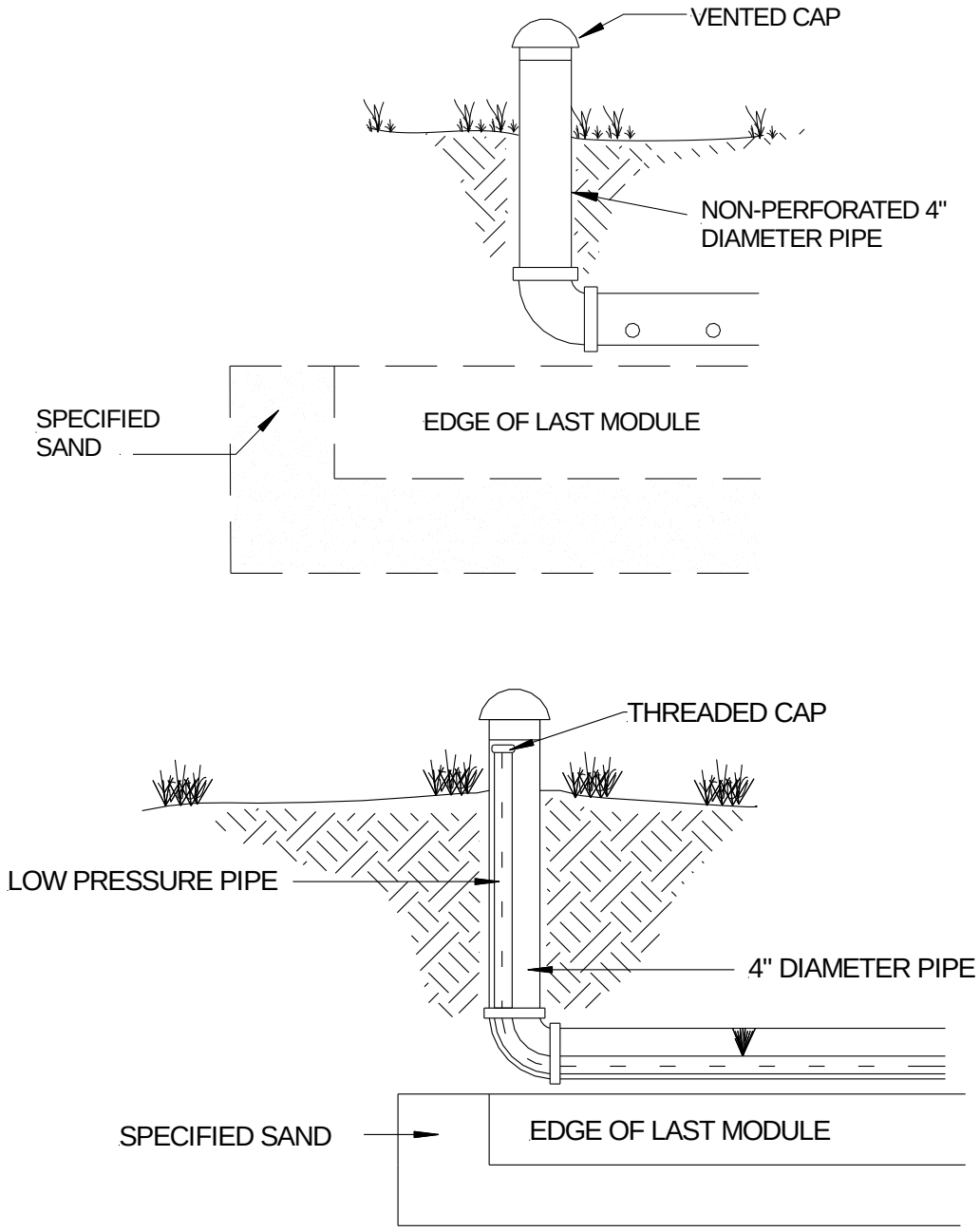


6.0 System Ventilation

6.1 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.

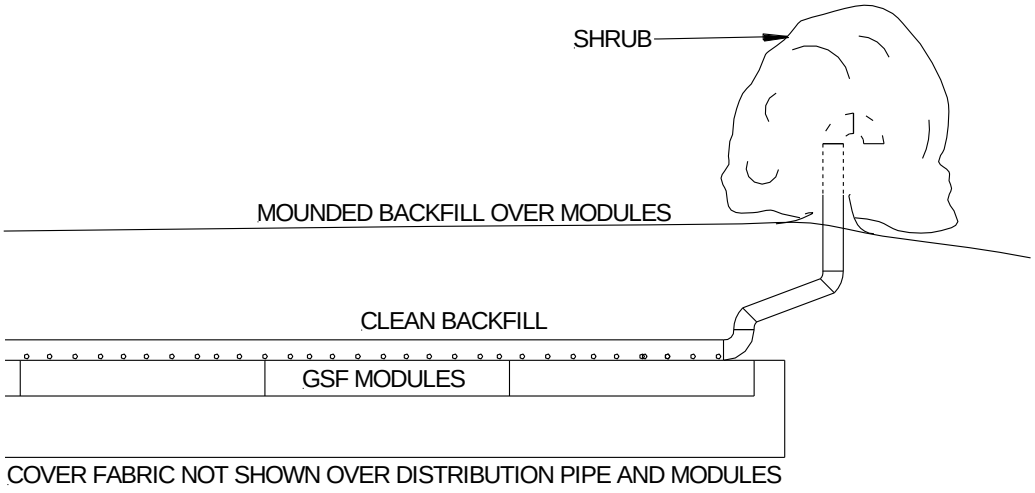
6.2 VENT PIPE FOR GRAVITY AND LOW-PRESSURE SYSTEMS: Systems with over 18" of cover over the top of the modules require a vent. If the system is a low-pressure distribution system, ensure that the LPP clean outs are located in the vent for easy access.

FIGURE 8: VENT LAYOUTS FOR GRAVITY AND LOW-PRESSURE SYSTEMS



6.3 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 9: GSF WITH 4" VENT EXTENDED TO CONVENIENT LOCATION



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			

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 softener connected to the system?	Yes	No	Comments
Are solids visible through the observation port? If yes, describe the condition and depth of solids:	Yes	No	Comments
Is there evidence of surcharging or effluent ponding in the D-Box? If yes, describe and measure:	Yes	No	Comments
Are the system vents in place?	Yes	No	Comments
Are they operational? If no, describe conditions and location:	Yes	No	
Describe any other pertinent issues:			

Inspected by:	
License Number:	
Date:	
Time:	
Print Name & Signature of Inspector:	
I 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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