



Geotextile Sand Filter

Maine
Design & Installation Manual



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Innovative Onsite Products & Solutions Since 1970

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Glossary of Terms

B43 Module	48" x 36" x 7" (L x W x H)
HB Module	24" x 36" x 7" (L x W x H)
Transverse Module	36" x 48" 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 peak flow that is used to size a GSF system is 90 gallons per day per bedroom. Specific situations may require system designers to establish higher design flows than stated above.
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	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 9 inches along the sides of the modules.
GSF Module	The individual module of a GSF system. The module is comprised of a cusped plastic core and corrugated geotextile fabric.
MLF	Most Limiting Factor to Seasonal Ground Water Table (high water table), and/or bedrock, and /or restrictive horizon, Maine rules require 12", 18" or 24" from disposal bed bottom to MLF depending on Design Class and depth to ledge. Eljen's conservative leach field design specifies a receiving sand bed layer (level to within ½ inch) directly beneath the GSF modules as shown in Figure 4. The bottom of the disposal area is the bottom of the GSF module. <i>The Vertical separation from bottom of the GSF module to the MLF shall not be less than 12".</i>
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)
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 μ m	25 - 60
No. 50	297 μ m	10 - 30
No. 100	149 μ m	< 10
No. 200	75 μ m	< 5

GSF System Description

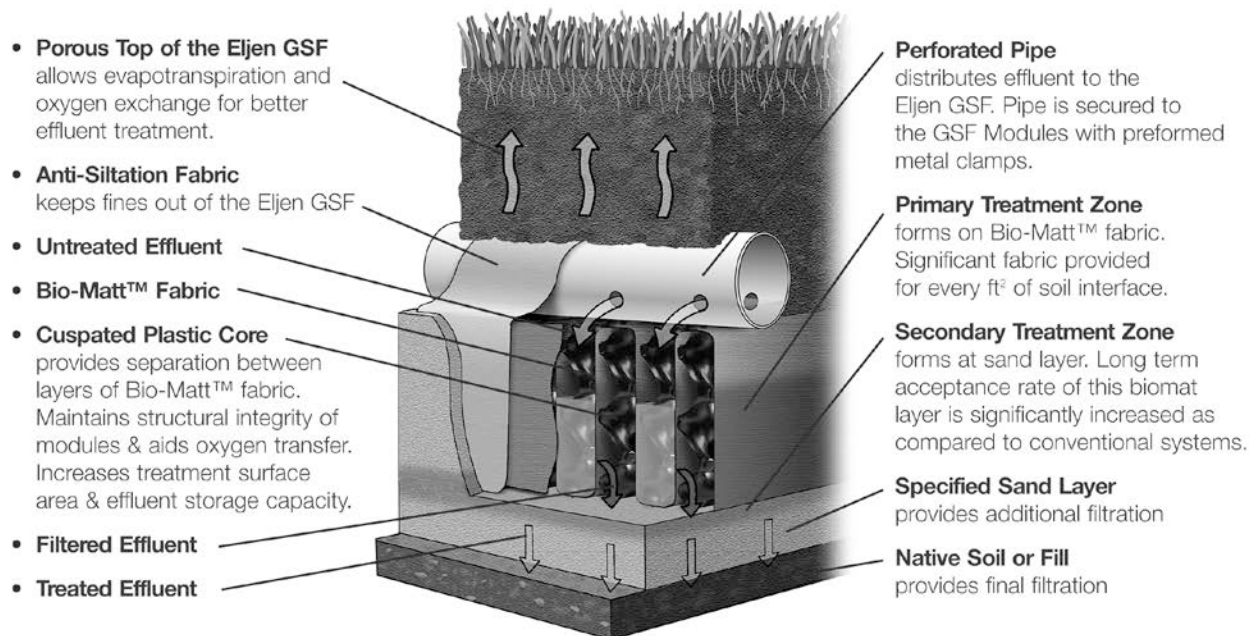
Primary Treatment Zone

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

Secondary Treatment Zone

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

FIGURE 1: GSF SYSTEM OPERATION



1.0 System Preconditions

1.1 REQUIREMENTS: GSF systems must meet the local rules and regulations except as outlined in this manual. The Maine Regulations 10-144, Chapter 241 and the local regulations will be referred to as the *guidelines*.

The sizing charts for residential waste strength systems only and are found in section 2.21. Please contact Eljen's Technical Resource Department at 1-800-444-1359 for design information on commercial systems. Guidance is located in sections 10 - 12.

1.2 WATER CONDITIONERS: Water conditioners can adversely affect septic tank treatment and add to the hydraulic load of the effluent disposal area. **Discharge residential conditioner backwash from these devices shall be into a separate alternative disposal 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 the Maine Rules Section 6(F)(4) and your local code for garbage disposal requirements. Eljen recommends a dual compartment tank or tanks in series.

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

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.

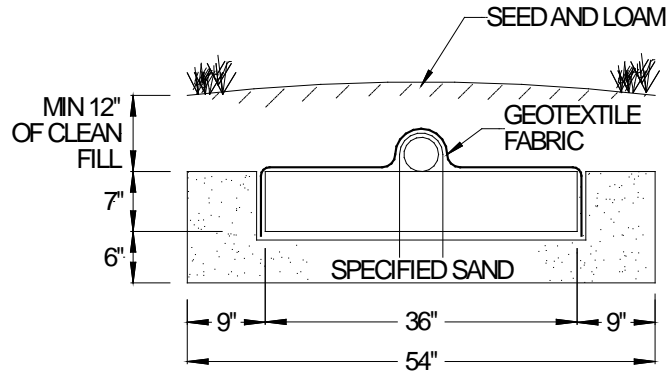
1.4 ADDITIONAL FACTORS EFFECTING RESIDENTIAL SYSTEM SIZE: Homes with expected higher than normal water usage may consider increasing the septic tank volume as well as incorporating a multiple compartment septic tank. Consideration for disposal area may be up-sized for expected higher than normal water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

For example:

- Luxury homes, homes with a Jacuzzi style tubs, and other high use fixtures.
- Homes with known higher than normal occupancy.

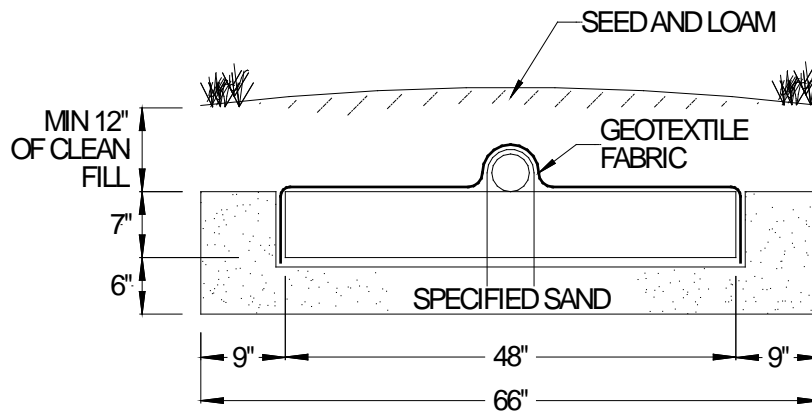
1.5 SYSTEM PROHIBITED AREAS: All vehicular traffic is prohibited over the GSF system. GSF systems shall not be installed under paved or concreted areas. If the system is to be installed in livestock areas, the system must be fenced off around the perimeter to prevent compaction of the cover material and damage to the system. If systems must be installed in trafficked areas, please contact Eljen's Maine distributor for installation guidelines.

FIGURE 2: TYPICAL B43 CROSS SECTION



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

FIGURE 3: TYPICAL TRANSVERSE CROSS SECTION



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

All systems are required to have a minimum of:

- 9 inches of Specified Sand is at the edges of the GSF module.
- 9 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.

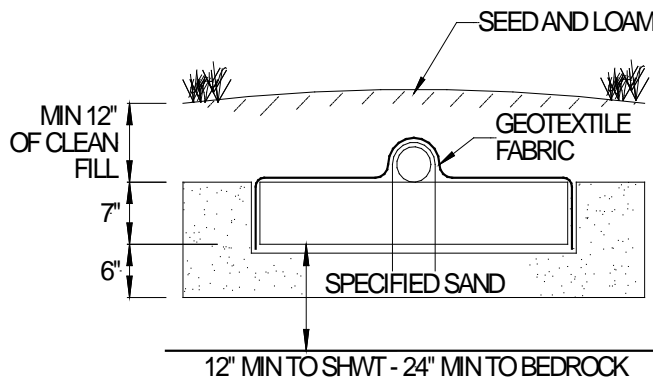
2.0 Design and Installation

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.

2.2 SEPTIC TANK FILTERS: Septic tank effluent filters are **REQUIRED** on the outlet end of septic tank. Filter manufacturers 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: Maine rules require 12", 18" or 24" from disposal bed bottom to Most Limiting Factor (MLF) depending on Design Class and depth to ledge. Eljen's conservative design specifies a receiving sand bed layer (level to within ½ inch) directly beneath the GSF assembly as shown in Figure 4. **The bottom of the disposal area is the bottom of the GSF unit. The Vertical Separation from bottom of the GSF units to the MLF shall not be less than 12".** The GSF's low profile results in a system's finished grade comparable to or lower than conventional disposal fields.

FIGURE 4: 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 with 24" of separation required on sites with 15% to 20% 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 of Section 6(M) of the Maine Rules, however, Eljen strongly recommends the use of SDR 35 pipe and fittings as to assure against crushing during backfill. Systems with excessive wheel loading require Schedule 40.

All systems require a perforated 4" diameter pipe is centered on top of the GSF modules and 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. Section 7 of this manual goes into details of how to construct the distribution network. All piping must meet state and local regulations.

In a bed system, non-perforated pipe may be connected at the end of each perforated distribution lateral thereby creating a looped distribution system as shown in Figure 9.

2.0 Design and Installation

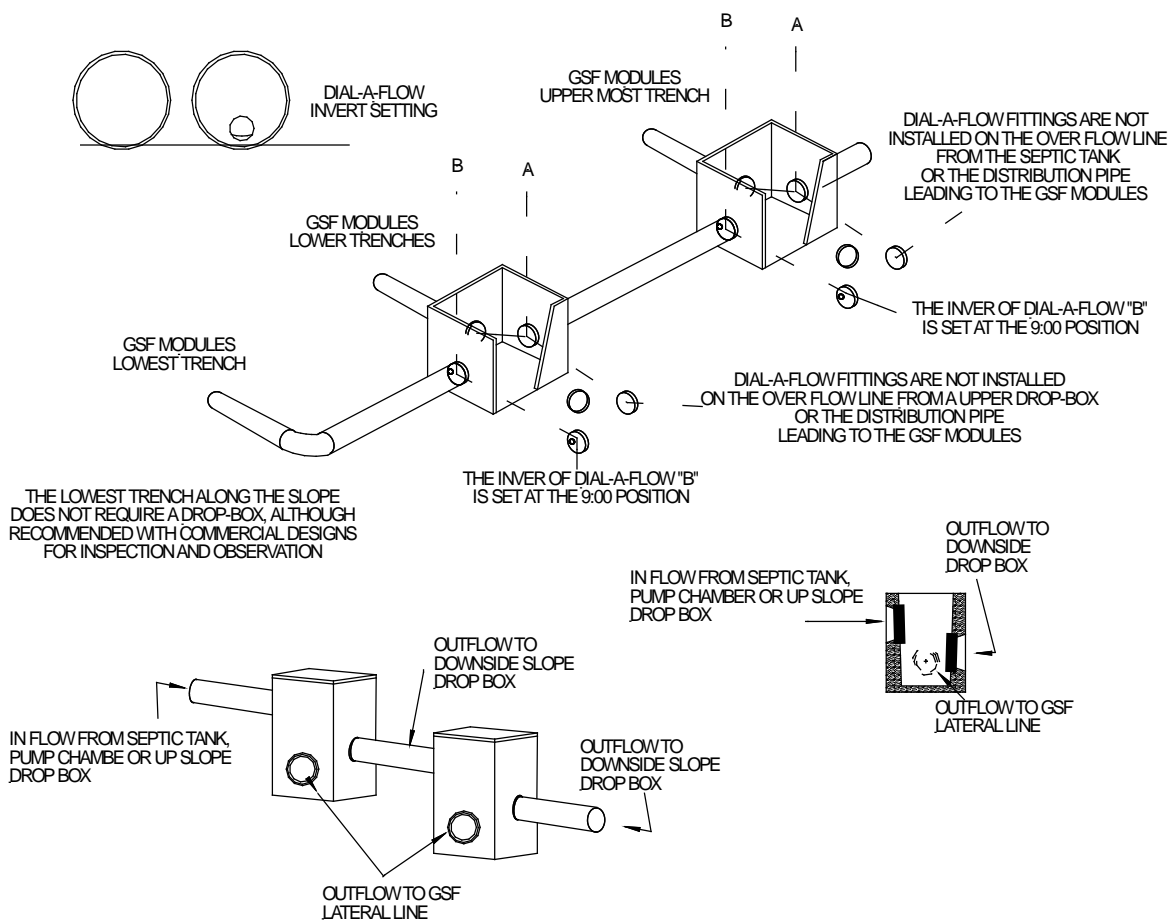
2.7 CONNECTIONS AND FITTINGS: Connections of lines to tanks and distribution boxes must be made using watertight mechanical seals. Use of any grouting material is not permitted.

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. Dial-a-Flow fittings on outlet pipes are required for demand dosed systems.

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 trench systems.

2.10 SEQUENTIAL DISTRIBUTION: Sequential Distribution using a distribution box will 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 5: SERIAL 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.

2.0 Design and Installation

2.12 SYSTEM VENTING: It is required to vent all systems that are over 18" below finished grade and systems beneath any surface condition that would not allow for surface air exchange with the system such as patios. See Section 8 for a more detailed explanation of venting GSF products.

2.13 BACKFILL & FINISH GRADING: Place a minimum of 12" of fill material meeting Maine Rules Section 11(E) Table 11A over the GSF system. The 12" height is measured from the top of the GSF modules to finished grade. Fill material must be free of large rocks that would damage distribution pipes, cover fabric or GSF modules. All other required fill shall meet the requirements of Section 11(E) of the Maine Rules. Topsoil placed on top of the fill shall meet Section 11(G) and must be seeded and protected from erosion as described in Section 11(G) of the Maine Rules. Grading of the system area during construction and upon completion must divert surface run off from buildings, parking areas and nearby sloped terrain away from the GSF. Grade or slightly mound the finished system to compensate for soil settling. A minimum of a 3% grade over the system will prevent water from ponding on top of the system. Systems with over 18" of cover material as measured from the top of the GSF modules require venting.

2.14 BACKFILL MATERIAL FOR RAISED SYSTEMS: Backfill material (placed underneath the disposal area) for raised systems shall meet the requirement of Section 11(E) Table 11A of the Maine Rules. Fill must be consolidated (stabilized) in lifts to prevent differential settling. A hand tamper is an appropriate choice.

2.15 EXPERIMENTAL SYSTEMS: Use of GSF modules at a higher loading rate than approved and or less than 12" of spacing between the rows of GSF modules are considered experimental systems under Chapter 18 of the Maine Rules. Installations on some sites may result in reduced capacity due to ground water mounding and/or the hydraulic capacity of the site. Special care must be given on sites with AI, All, D or E design class conditions.

2.16 LINED DISPOSAL FIELDS: Disposal fields for very permeable shoreline sites must comply with Chapter 16 of the Maine Rules. Place backfill below the GSF meeting Section 11(E) Table 11A of the Maine Rules at the required depth followed by a 6" layer of Specified Sand.

2.17 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.

2.18 SYSTEM SIZING: GSF systems must be sized on the basis of Table 600.1 of the Maine Rules (a simplified version can be found in Table 3 of this manual). Effective Area of a B43 module is approved at 48 sqft/module. Use the GSF sizing chart on Table 2 of this manual to determine the number of B43 modules for a given design flow and disposal field size group or divide the required infiltrative area by 48 and round up to the nearest 1/2 module. The 400% module rating for the GSF modules applies to residential systems for both Trench and Bed configurations. For example, two rows of 10 modules in a bed 40 feet in length is rated as providing 960 square feet. Refer to Sections 10 through 12 for additional information on commercial systems.

2.19 NUMBER OF GSF MODULES REQUIRED: Table 3 indicates the minimum number of B43 GSF modules required for various Soil Sizing Groups for Residential and Commercial Systems taking into account BOD₅ and TSS levels. Tables 4 and 5 should be used to determine the number of modules required on systems that have wastewater strengths that are different than typical residential wastewater.

2.0 Design and Installation

2.20 MODULE SPECIFICATION AND RATING TABLE:

TABLE 2: MODULE SPECIFICATION AND RATING TABLE

Eljen Geotextile Sand Filter Module Specification and Rating Table			
	L x W x H	Configurations	
		Bed ^(A)	Trench ^(B)
B43 Module	48" x 36" x 7"	48 ft ² /module	48 ft ² /module
HB Module	24" x 36" x 7"	24 ft ² /module	24 ft ² /module
Transverse Module*	36" x 48" x 7"	48 ft ² /module	48 ft ² /module

(A) A minimum of 12" of spacing between rows of modules for system that have all the rows at the same elevation.

Bed installations that have rows that step-down slopes of 15% or less shall have a minimum spacing of 12" of Specified Sand between module rows.

Step down bed installations from 16% to 20% shall have a minimum spacing of 24" of Specified Sand between module rows.

(B) 7.5' center to center spacing for B43 Modules

* Transverse modules are only used on sites with extreme constraints and are available by special order only.

2.21 RESIDENTIAL WASTE STRENGTH:

TABLE 3: RESIDENTIAL WASTE STRENGTH SIZING TABLE

Eljen Geotextile Sand Filter Sizing Table					
Field Sizing Group	2 Bedrooms Modules per System	3 Bedrooms Modules per System	4 Bedrooms Modules per System	Additional Bedroom Modules per System	Commercial BOD ₅ + TSS Less than 240 mg/L Modules Per 100 Gallons Design Flow
Medium	10	15	20	5	5.5
Medium-Large	13	19	25	6.5	6.9
Large	16	24	32	8	8.6
Extra Large	19	29	38	9.5	10.5

- Round up fractional modules to the next whole number or utilize HB modules.
- Level bed designs should use equal number of modules per row unless site constraints require unequal rows.

3.0 Trench Installation Sizing and Guidelines

Trench Example:

House size: 3 Bedrooms
 Disposal Area Sizing: Medium-Large Field Size Group
 Absorption Field Type: Trench

Calculate Minimum Number of Units Required

Lookup the units required from Table 3:

Eljen Geotextile Sand Filter Sizing Table				
Field Sizing Group	2 Bedrooms Modules Per System	3 Bedrooms Modules Per System	4 Bedrooms Modules Per System	Modules per Bedroom for each additional bedroom over 4
Medium-Large	13	19	25	6.5

Minimum Units required 19 B43 Modules

Calculate Minimum Trench Length

19 Units x 4 + 1.5 ft 77.5 linear feet

Trench Width

Trench width = unit width + sand extension
 36" + 18" (9" sand both sides of unit) 4 ft 6 in

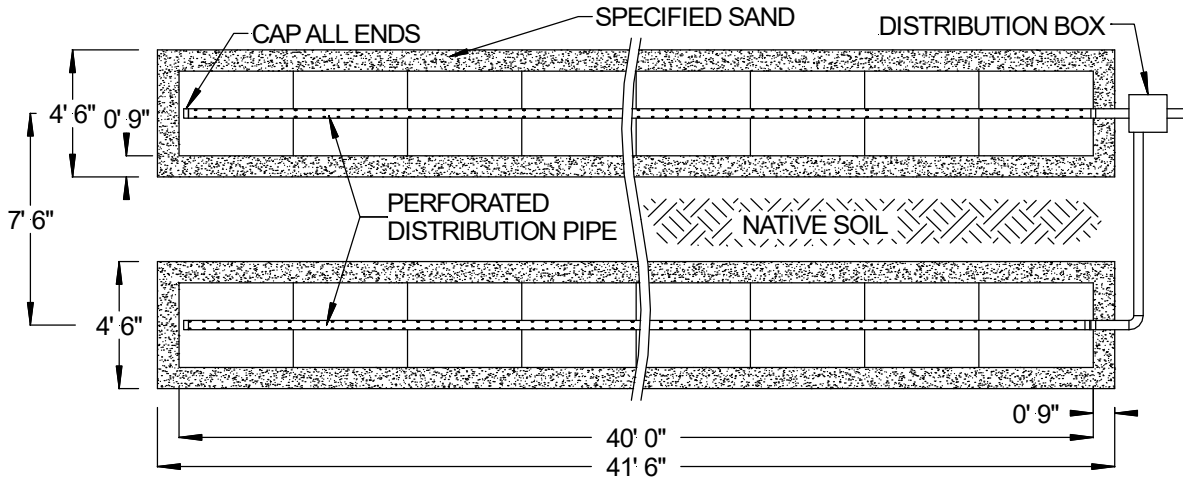
Final Dimension Layout

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

Min. Product Length	76 ft.
(note: 9 inches of sand required at each end of trench which makes the minimum trench length 77.5 ft.)	
Trench Width	4.5 ft.
Minimum Number of Units	19 B43 Modules
2 Trench Rows, Option 1	10 Modules each row, 41.5 ft. per row.
2 Trench Rows, Option 2	9 B43 and 1 B23 Modules per row, 39.5 ft. per row.
Min. System Area	348.75 ft ²

3.0 Trench Installation Sizing and Guidelines

FIGURE 6: PLAN VIEW – TRENCH SYSTEM EXAMPLE



(*2 Rows of 10 B43's shown in Figure 6)

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

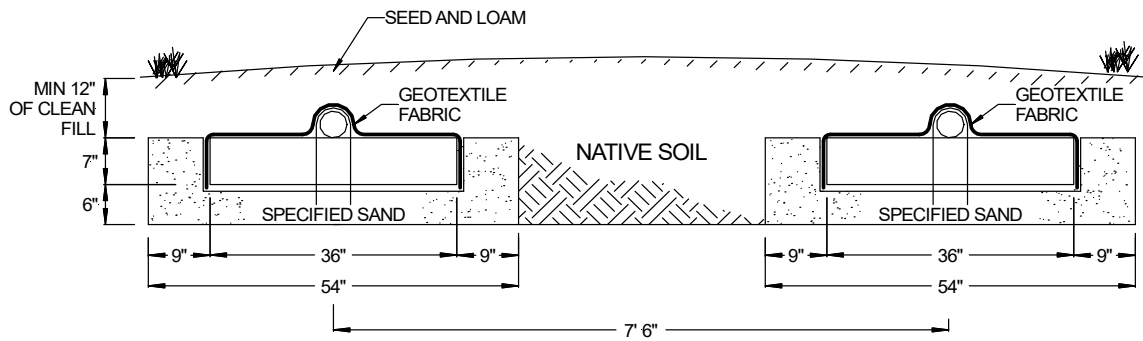
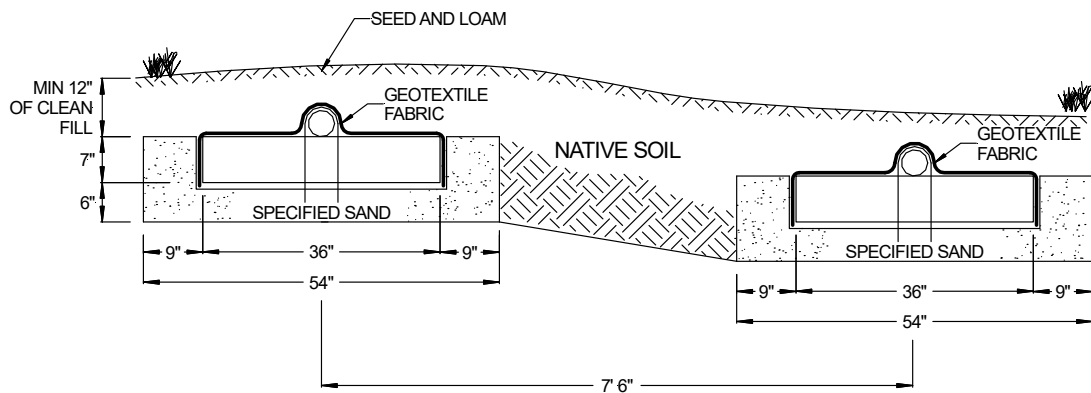


FIGURE 8: SECTION VIEW – TRENCH SYSTEM – SLOPING SITE



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 hand held 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 15. 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 9 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 pipe. 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

Bed Example:

House size:

5 Bedrooms

Disposal Area Sizing:

Large Field Size Group

Absorption Field Type:

Bed

Calculate Minimum Number of Units Required

Lookup the units required from Table 3:

Field Sizing Group	2 Bedrooms Modules Per System	3 Bedrooms Modules Per System	4 Bedrooms Modules Per System	Modules per Bedroom for each additional bedroom over 4
Large	16	24	32	8

Minimum Units required

$$32 + 8 = 40 \text{ B43 Modules}$$

Calculate Minimum Bed Length

Maintain a minimum of 2 rows in a bed system. (4 Rows for this example)

$$40 \text{ Units} \div 4 \text{ Rows} = 10 \text{ Mods/Row}$$

Calculate Minimum Row Length

$$10 \text{ Units} \times 4 \text{ ft./unit} + 1.5 \text{ ft} = 41.5 \text{ ft. per Row}$$

Bed Width (Level Installation)

$$\text{Bed Width} = \text{Number of Rows} \times 4 \text{ ft} + 0.5 \text{ ft}$$

$$4 \text{ rows} \times 4 \text{ ft} + 0.5 \text{ ft} = 16.5 \text{ ft}$$

Final Dimension Layout

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

Bed Length	41.5 ft.
Bed Width	16.5 ft.
Minimum Number of Units	40 Units
Units per Row	10 units per row
Lateral to Lateral Spacing	4 ft.
Lateral to Edge Spacing	2.25 ft.
System Area	684.75 ft ²

4.0 Bed Installation Sizing and Guidelines

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

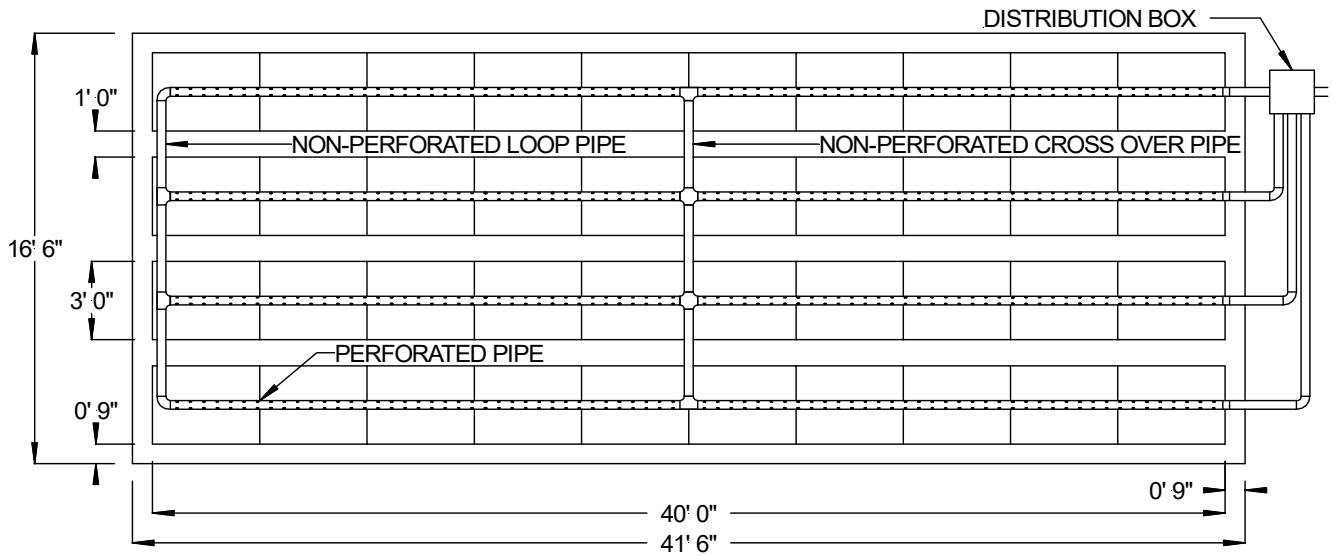


FIGURE 10: SECTION VIEW – BED SYSTEM EXAMPLE

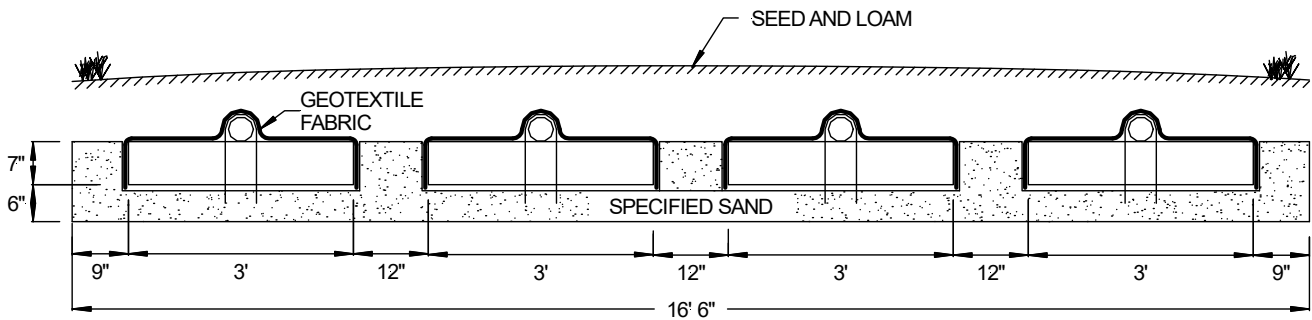
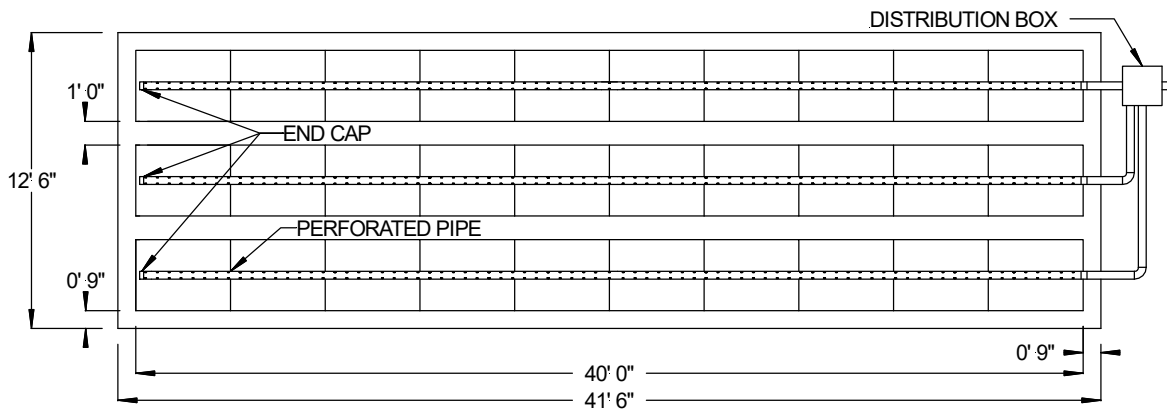


FIGURE 11: PLAN VIEW – STEP DOWN BED – PARALLEL DISTRIBUTION



4.0 Bed Installation Sizing and Guidelines

FIGURE 12: SECTION VIEW – BED SYSTEM

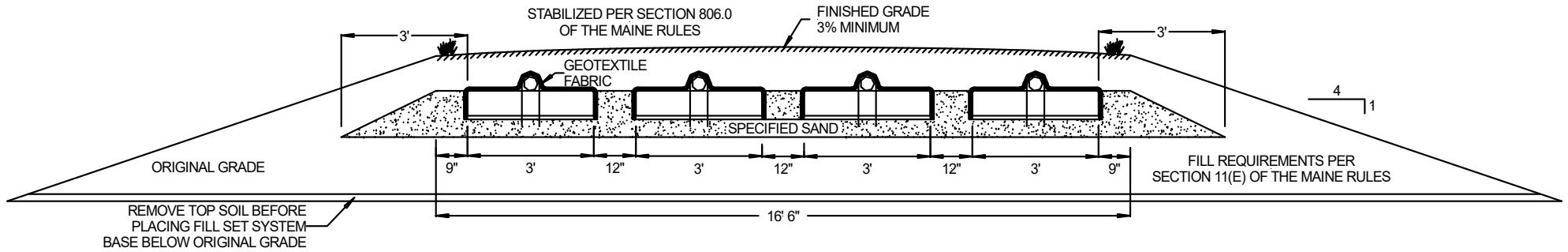
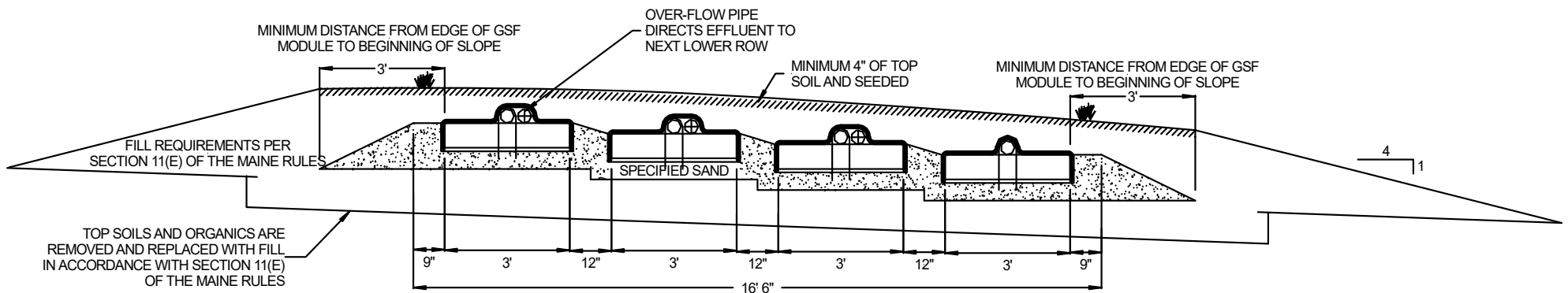
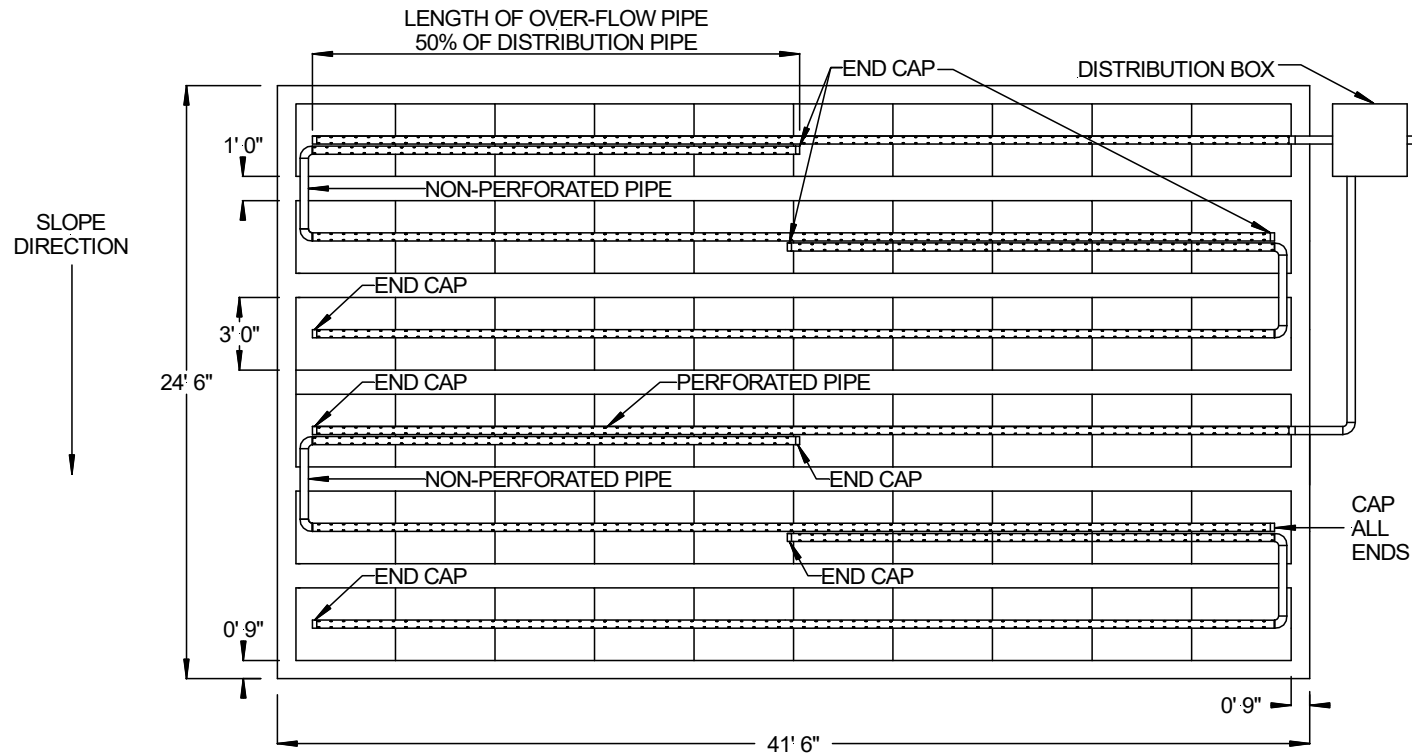


FIGURE 13: SECTION VIEW – BED SYSTEM



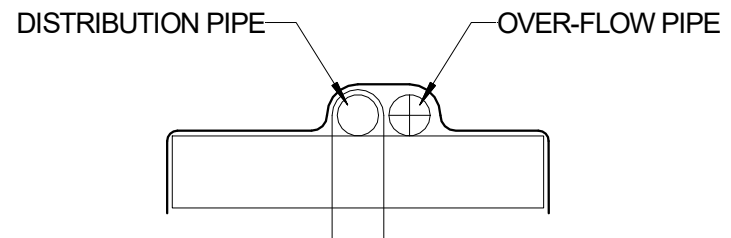
4.0 Bed Installation Sizing and Guidelines

FIGURE 14: PLAN VIEW – BED SYSTEM – SERIAL DISTRIBUTION



Sloped Bed Spacing:

- Slopes 0% to 15% will have a minimum spacing of 12" between GSF modules.
- Slopes 15% to 20% will have a minimum spacing of 24" between GSF modules.
- After 3 rows, add an additional serial distribution line. (FIG 14)
- Orifices locations for the over-flow pipes and distribution pipes are position at 4 and 8 o'clock. Perforated sections of the over-flow pipes and distribution pipes are covered with geotextile cover fabric.



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 hand held 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 15. 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 9 inches of Specified Sand along both sides of the modules edge. A minimum of 9 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 module rows with 24" of separation required on sites with 15% to 20% slope. 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 pipe. 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 Raised or Fill System Installation 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 hand held tamping tool or a portable vibrating compactor. The stabilized height below the GSF module must shall 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 15. 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 9 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. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.
14. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

6.0 Dosing Distribution Guidance

6.1 PUMP TO DISTRIBUTION BOX: Please 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 is sufficient. 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. While not required by Maine Rules, 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 insures 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.

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

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. Pipe volume per foot is provided in Table 6J of the Maine Rules. 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 sum total of 97.63 gallons per dosing cycle.

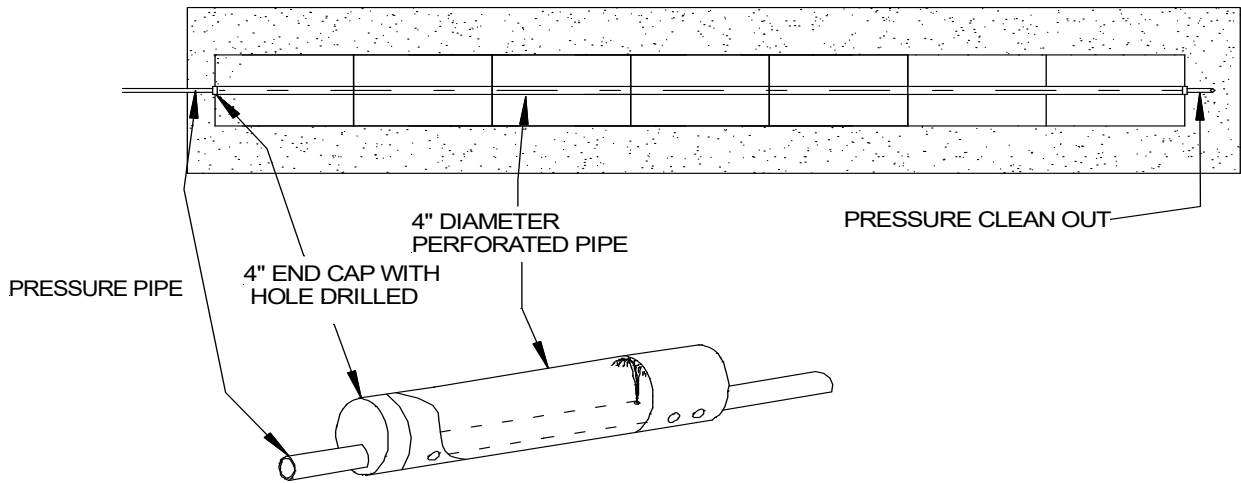
To set the flow rate into the distribution box, close the valve on the force main, turn on the pump and slowly open the valve until the effluent level in the distribution box is at the crown of the discharge pipes. The flow rate will need to be adjusted whenever the number of outlets is changed. If changes in effluent distribution are anticipated, easy access to distribution box is essential.

7.0 Pressure Distribution Guidance

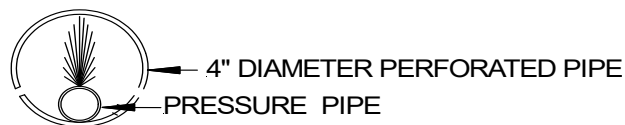
7.1 PRESSURE DISTRIBUTION: Dosing with small diameter pressurized laterals is acceptable for GSF systems. The pipe networks must be engineered and follow principles established for pressure distribution. Using pipe-in-pipe networks as shown in Figure 15, the orifice size and spacing of 3/16 inch and 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 15: PRESSURE PIPE PLACEMENT



PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS



7.0 Pressure Distribution Guidance

FIGURE 16: PRESSURE CLEAN OUT

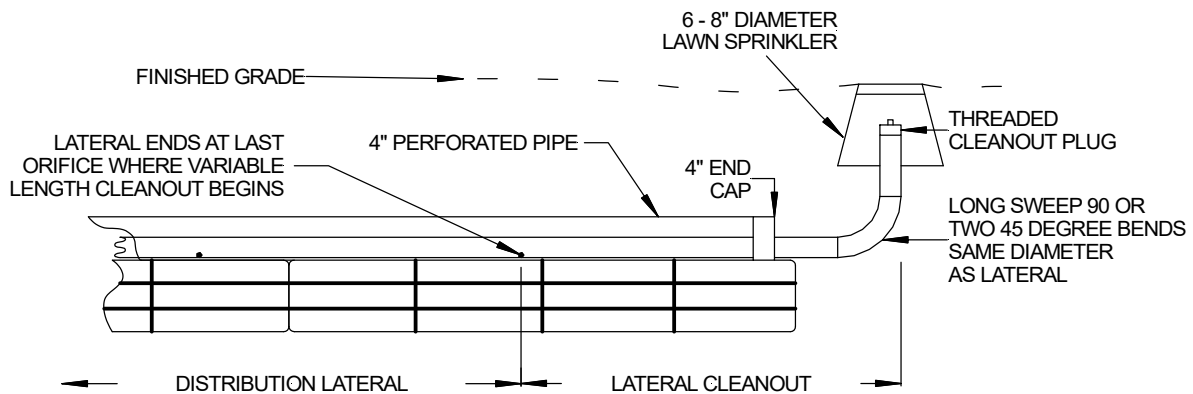
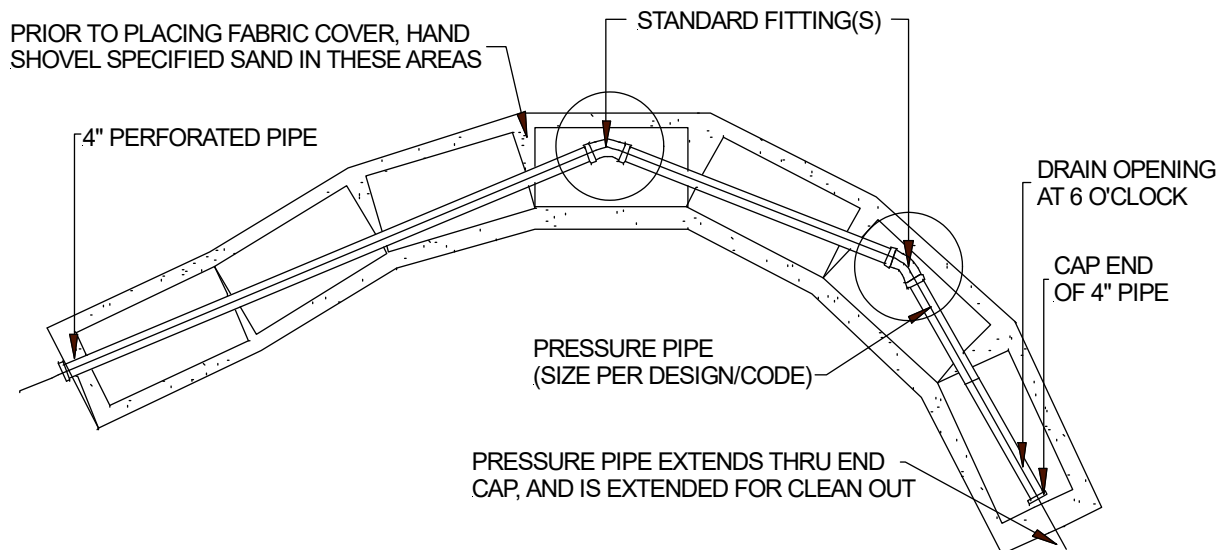


FIGURE 17: CONTOURED TRENCH PRESSURE DISTRIBUTION



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.

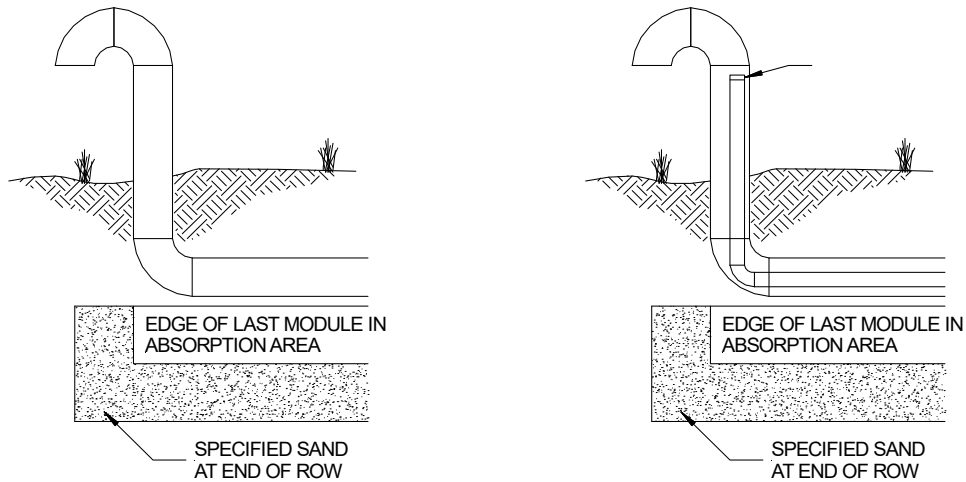
8.0 System Ventilation

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 cuspatations 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.

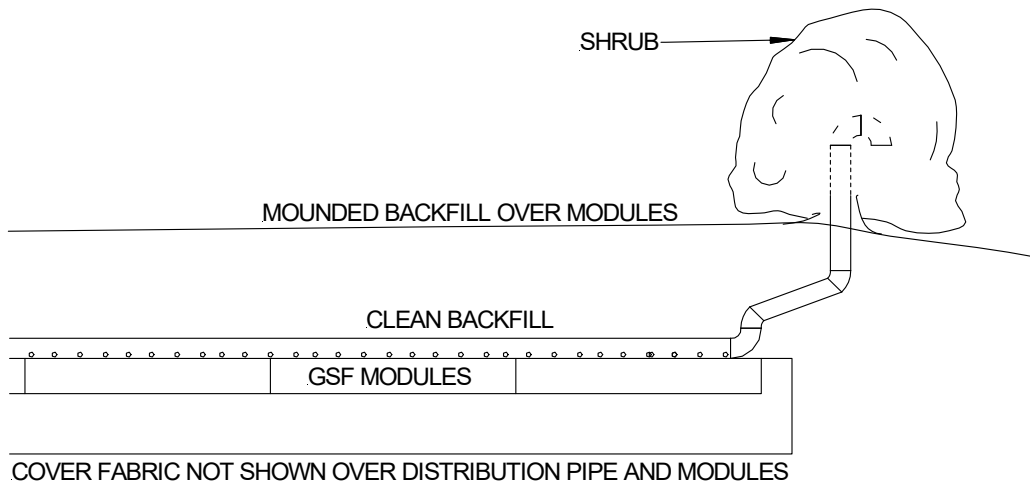
8.0 System Ventilation

FIGURE 18: 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 19: GSF WITH 4" VENT EXTENDED TO CONVENIENT LOCATION



9.0 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. On raised systems, the organic loam layer must be removed from trench or bed and slope extension areas prior to fill placement. A bucket with teeth is best used for this construction step as buckets without teeth can compact and smear the underlying soil.
4. Scarify subsoil prior to fill placement.
5. Backfill material shall meet Section 11(E) Table 11A of the Maine Rules. All backfill material shall be clean bank run sand, free of topsoil or humus and dredging directly beneath the EDA.
6. The 6" underneath and 9" surrounding the GSF modules shall be installed using a medium to coarse washed sand with an effective size of 0.25 to 2.0 mm, no greater than 10% passing a #100 sieve and no greater than 5% passing a #200 sieve, and no particles larger than .375", or materials meeting the ASTM C33 specification with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. Washed concrete sand easily meets the above specification and is a reliable choice. Suitability of bank run sand must be verified.
7. Fill (cover material) and Backfill material (fill added below and around the GSF Specified Sand envelope) shall be bank run sand with less than 4 to 8% passing a #200 sieve and clay less than 2% and no stones larger than 3" in any dimension to a minimum depth of 12" over the GSF modules with the last 4" to 6" of cover being clean loam.
8. Any system which is more than 18" below finish grade as measured from the top of the modules shall be vented.
9. This design complies with and must be installed in accordance with the Eljen Design and Installation Manual.

10.0 Commercial Recommendations and Guidance

Commercial systems differ from residential systems relative to wastewater characteristics, effluent distribution strategies, peak flows, system size and geometry. As these systems are normally larger, the designer must also consider the collection systems and their integrity, groundwater hydrology, drainage above and below the GSF system and design accordingly.

Designers should carefully review and document with their client effluent BOD₅ and TSS concentrations and water use numbers. The designer should document that the system installation meets the technology supplier's specifications to ensure long term performance. In addition, designers must be attentive to special details of the system, conduct follow-through startup and document technical capabilities for personnel required for Operation and Maintenance of the system.

To determine design flow for commercial systems, with the exception that the highest measured single day flow in a 12 month period shall not result in a design flow less than the measured average flow with a peaking factor of 2 to 3 depending on the type of usage.

Dispersion of effluent across a bed system or down a row of modules in a serially loaded system must be specifically addressed in the design plans. A variety of wastewater delivery options exists and includes pressure distribution, pressure dosing, and gravity dispersed type systems. Wastewater volume and strength, systems size, and site conditions often dictate which type of system is designed. Designers should confer with the local permitting authority as many jurisdictions mandate pressure distribution or pressure dosing when daily wastewater flow exceeds certain levels.

Designers must also consider how the distribution of the effluent onto the GSF modules may affect the linear loading rates and allow for the means to adjust the linear loading should the soils fail to move the effluent as predicted. Longer systems are naturally preferred as this geometry reduces the linear loading and the risk of hydraulic overload with surfacing of treated effluent down slope in serial type systems.

Extremely large systems should be designed as several smaller systems allowing for independent management of the wastewater treatment system. Designs typically include valves to rotate zones into service with access to flow diversion boxes. Management plans are frequently implemented for monitoring the fluid levels and adjusting the effluent application onto the geotextile filter modules.

Larger flow groundwater recharge systems can be impacted by site drainage from above the GSF. The additional effluent can also increase the groundwater mound down slope. Recharge systems such as the GSF must be designed and located so that they can accept precipitation and the specified wastewater volume. Control and diversion of up-slope stormwater is normally included in the design. Understanding the stormwater flows onto and out of the system is essential to successful management of these systems.

Landscape position and slope impact the drainage because the gradient frequently changes with the slope of the land, especially if placed above a restrictive layer. The depth and permeability of each soil layer above the restrictive horizon impacts the groundwater mound. For example, upper horizons may be fairly permeable and accept precipitation easily. If these layers are above a more restrictive horizon, a perched water table will develop whenever it rains. Movement of this perched groundwater can influence the disposal system and if not recognized will result in surfacing effluent. Interception and diversion of the groundwater is therefore necessary with larger systems especially over restrictive soils to insure acceptance of the treated effluent under wet conditions.

Down slope hydraulic capacity is also an important consideration with larger systems. For example, a system may be located on a free draining slope but down slope conditions show a perched water table due to a reduced hydraulic gradient. Design limits and linear loading must be considered and these limits should be based on the limitations of these down slope soils and gradient. Ideally systems are located with diverging topography that reduces the linear loading and results in the effluent moving down slope.

10.0 Commercial Recommendations and Guidance

It is recommended that all commercial systems, systems with high waste strength, and systems with more than 18" of cover material as measured from the top of the GSF modules to finished grade are vented. Designers that include vents in their designs often specify the use of Granular Activated Carbon or Charcoal (GAC) filters to ensure that septic odors do not become a nuisance. Designers should verify with the GAC filter manufacturer or supplier to ensure that the filter will allow air flow from both directions of the filter. Otherwise the filter will block airflow and the vent will not be effective in supplying enough oxygen that the system demands for long term performance.

System owners should educate occupants in the operation and maintenance of the system to help ensure long term system performance. The state or local permitting authority should provide for site specific items and require inspection and evaluation of an overall operating plan as commercial systems can produce flows in the thousands of gallons per day range. Designers should also provide oversight of system installation and associated system equipment.

Contact Eljen's Technical Resource Department at 1-800-444-1359 for questions regarding Commercial Systems. Overall responsibility for system design remains with the licensed designer and/or professional engineer.

11.0 Adjustment Factor for Wastewater Strengths Different from Typical Domestic Wastewater

TABLE 4: DISPOSAL FIELD SIZING FACTOR

Disposal Field Sizing Factor (From Maine Rules Table 600.1)		
Multiply the hydraulic loading rate (square feet per gallon per day) times the design flow (gallons per day) this gives the minimum square feet of bottom and side wall area below the invert needed.		
Parent Material	Soil Profiles	Loading Rates
Basal Glacial Till	1	4.1 ft ² /gpd Large
Ablation Till	2	3.3 ft ² /gpd Medium-Large
Basal Glacial Till	3	3.3 ft ² /gpd Medium-Large
Ablation Till	4	2.6 ft ² /gpd Medium
Stratified Glacial Drift	5	2.6 ft ² /gpd Medium
Stratified Glacial Drift	6	2.6 ft ² /gpd Medium
Mixed Geological Origins	7	3.3 ft ² /gpd Medium-Large
Lacustrine Deposits	8	4.1 ft ² /gpd Large
Marine Deposits	9	5.0 ft ² /gpd Extra Large

11.0 Adjustment Factor for Wastewater Strengths Different from Typical Domestic Wastewater

TABLE 5: SUBSURFACE WASTEWATER DISPOSAL SYSTEM

Subsurface Wastewater Disposal System Commercial High-Strength Wastewater (From Maine Rules Table 603.1)	
Strength of Wastewater Entering the Disposal Field (BOD ₅ plus TSS)	Adjustment Factor (AF) The Adjustment Factor for Wastewater Strength Entering the Disposal Field
30 or less milligrams/liter	0.5**
52	0.6**
82	0.7**
122	0.8**
175	0.9**
240	1
320	1.1
420	1.2
530	1.3
660	1.4
810	1.5
985	1.6
1180	1.7
1400	1.8
1645	1.9
2000*	2

* Subsurface wastewater disposal areas designed to handle wastes with a combined BOD₅ and TSS greater than 2,000 mg/l are beyond the scope of the Maine Rules and may require licensing by the Department of Environmental Protection as specified in Section 203.2 of the Maine Rules.

** Not applicable for GSF systems.

11.0 Adjustment Factor for Wastewater Strengths Different from Typical Domestic Wastewater

Refer to Tables 4 and 5 for information to determine systems sizing based on Disposal Field Sizing and High-Strength Wastewater Adjustment Factors.

TABLE 6: COMMERCIAL SYSTEM EQUATION TABLE

Commercial System Equation Table	
AF	Is the adjustment factor for wastewater strength entering the disposal field, taken from Maine Rules Table 603.1, if applicable.
HLR	Is the hydraulic loading rate, in square feet per gallon per day, for the applicable soil profile from Maine Rules Table 600.1.
AHLR = AF x HLR	Is the adjusted hydraulic loading rate.

Procedure

- Identify the Hydraulic Loading Rate (HLR) from the Disposal Field Sizing Factor from Table 3.
- Identify the High-Strength Wastewater Adjustment Factor (AF) based on the sum of BOD₅ and TSS from Table 4.
- Multiply the Hydraulic Loading Rate (HLR) x High-Strength Wastewater Adjustment Factor (AF) to determine the value for the Adjusted Hydraulic Loading Rate (AHLR).
- The GSF B43 module is rated at 48 square feet per module.
- Obtain the value for the system Design Flow.
- Determine the amount of square feet of absorption area required for the system by multiplying the Design Flow (DF) x Adjusted Hydraulic Loading Rate (AHLR).
- Determine the number of GSF modules required for the system by dividing the absorption area required by the GSF module rating of 48 SF/Module. See the sizing examples listed below.

12.0 Commercial System Sizing

Commercial Example:

B43 Module Rating: 48 ft²/module
 Design Flow: 2,500 GPD
 Soil Profile: 5
 BOD₅: 1,000 mg/L
 TSS: 300 mg/L

Determine the Disposal Field Sizing Factor

Lookup the units required from Table 4:

Parent Material	Soil Profiles	Loading Rates
Stratified Glacial Drift	5	2.6 ft ² /gpd Medium

Loading Rate 2.6 ft²/gpd

Determine the Wastewater Adjustment Factor

BOD₅ + TSS = Strength of Wastewater
 1,000 mg/L + 300 mg/L = 1,300 mg/L

Lookup the units required from Table 5:

Strength of Wastewater Entering the Disposal Field (BOD ₅ plus TSS)	Adjustment Factor (AF) The Adjustment Factor for Wastewater Strength Entering the Disposal Field
1180	1.7
1400	1.8

Wastewater Adjustment Factor 1.8

Determine the Adjusted Hydraulic Loading Rate

Disposal Field Sizing Factor x Wastewater Adjustment Factor = Adjusted Hydraulic Loading Rate
 2.6 ft²/gpd x 1.8 = 4.68 ft²/gpd

Determine the System Size

Design Flow x Adjusted Hydraulic Loading Rate = System Size
 2,500 gpd x 4.68 ft²/gpd = 11,700 ft²

Determine the Minimum Number of GSF Modules Required

System Size ÷ 48 ft²/ module = Minimum Number of Modules Required
 11,700 ft² ÷ 48 ft²/ module = 243.75 B43 Modules
 Round up to 244 B43 Modules

Final System Requirements

(Note: System layout will vary based on site constraints)

Minimum System Area	11,000 ft ²
Minimum Number of GSF Modules	244 B43 Modules

COMPANY HISTORY

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

COMPANY PHILOSOPHY

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



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