Massachusetts

GeoMat™ Leaching Systems

Design Manual for
Pressure and Gravity Applications

August 2016

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Introduction

The GeoMat™ Leaching System (GeoMat), manufactured by Geomatrix Systems, LLC (Geomatrix) is low profile and designed for maximum treatment and infiltration of wastewater into soil; in certain instances, it is used for subsurface irrigation and nutrient reuse. GeoMat may be utilized with wastewater from a septic tank or pretreatment system (treatment unit). The GeoMat comes in 6, 12, 24, or 39 inches wide and nominally 1 inch thick.

Water flows into the GeoMat through gravity and pressure piping systems. The water is discharged into a highly transmissive core that is covered by a hygroscopic membrane. This combination of the core and membrane draw the water between the application points and uniformly apply the water to the surrounding soil. The soil then draws the water away from the surrounding membrane through capillary action. This results in a much more uniform application of water to the soil and minimizes the point loading associated with other low profile systems. GeoMat can be installed in trench and bed layouts and function with gravity, pump to gravity, and pressure distribution (PD) system configurations. GeoMat with 6 inches of ASTM C-33 sand beneath it can be configured to meet NSF Standard 40. When NSF Standard 40 certification is required, please contact Geomatrix for appropriate design information.

The combination of a high surface area to void space ratio and shallow placement in the soil profile result in enhanced aeration. Shallow placement in the more biologically active soil horizons additionally enhances treatment of nitrogen, phosphorus, pharmaceutical compounds and other emerging contaminants of concern, Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), viruses and other pathogens

Geomatrix products are the result of intensive research and development, including in-house and third-party testing. Test reports are available by contacting Geomatrix.

While some codes do not require the use of PD, treatment units, flow equalization or SoilAir, Geomatrix, highly recommends the use of these features to enhance treatment and system lifespan, especially where high flows and challenging waste streams are present.

Designing a GeoMat System

GeoMat Leaching Systems shall be designed in accordance with all 310 CMR 15.000 (Title 5) regulations and this manual. GeoMat can be installed directly into some native soils or in a sand bed configuration with a minimum of 6 inches of approved sand beneath the GeoMat. Use Tables 1 thru 3 for system sizing.

GeoMat in a Sand Bed

GeoMat installed in a sand bed can be loaded at a maximum loading rate of 1.5 gallons per day per square foot of GeoMat; please refer to Tables 1 – 3. A minimum of 6 inches of sand meeting the requirements of 310 CMR 15.255(3) must be placed beneath the GeoMat and 2 inches of this specification of sand should be placed over the GeoMat fabric membrane.

GeoMat installed horizontally (GeoMat Flat) must be designed and installed utilizing the following parameters:

- GeoMat when laid flat (GeoMat Flat) shall be placed a minimum of 4 inches apart edge of core to edge of core.
- Gravity or PD may be utilized. PD can utilize a conventional pump or HyAir™ pump for distribution.
- A minimum of 12 inches of sand should surround the perimeter of the GeoMat in a bed configuration.

GeoMat installed vertically (GeoMat Edge) must be designed and installed utilizing the following parameters:

- Maintain a minimum spacing of 6 inches center to center.
- PD is required and can utilize a conventional pump or a HyAir pump.

GeoMat in Native Soil

GeoMat may be installed directly atop Class I native soils. GeoMat in Class II, III, and IV soils require a minimum of 2 inches of sand meeting the requirements of 310 CMR 15.255(3) beneath, to the sides and above the GeoMat. GeoMat installed, as described, may be loaded at a maximum rate of 0.74 gallons per day per square foot of GeoMat; please refer to Tables 1 – 3.

GeoMat Flat when installed in native soils should be designed and installed utilizing the following parameters:

- GeoMat shall be separated, sidewall to sidewall, from adjacent rows of GeoMat by 2 times the width of the GeoMat utilized. See Table 5.
- Gravity or PD may be utilized. PD can utilize a conventional pump or HyAir pump.
- When specifically configured for gravity flow, and generally, on all configurations, the use of SoilAir™ should be considered. If SoilAir is not going to be installed, it is advisable to install a conduit from the outlet baffle of the septic tank to the future SoilAir enclosure location. The SoilAir enclosure should be located where a power supply can be readily configured. It is also

recommended, that an airline be run from the SoilAir enclosure location and connected to the wastewater supply pipe serving the GeoMat. This air line should be a minimum of 2 inch ID Sch. 40 PVC for a 5 bedroom or less single family home. Please contact Geomatrix for air line sizing on other projects. The air line should be pitched downwardly from the SoilAir enclosure location to the wastewater supply pipe and capped. These components are inexpensive and will facilitate remediating the system, if necessary in the future.

- When the wastewater is nonresidential in strength, the Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS) should be reduced utilizing pretreatment or utilize a SoilAir system to ensure that there is sufficient oxygen to reduce BOD; alternatively the size of the GeoMat system should be increased proportionately to account for the higher BOD.
- Contact Geomatrix for SoilAir™ information and design assistance with SoilAir Systems.

GeoMat Edge when installed in native soils is to be designed and installed utilizing the following parameters:

- Maintain a minimum spacing of 2 times the width of the product between adjacent rows. See Table 5.
- PD can utilize a conventional pump or HyAir pump.

System Design Steps

1. Determine Soil Loading Rate using Table 1
2. Determine the square footage of GeoMat required by utilizing the appropriate Loading Rate and Number of Bedrooms.
3. Determine the Length of GeoMat required using Table 2 and the square footage of GeoMat required, as calculated in step 2.
4. If installing in a sand bed, determine the Minimum Sand Bed Size using Table 3, Percolation Rate, Soil Class, and Number of Bedrooms. (Massachusetts requires a minimum sand bed of 400 sq. ft.). Verify that the actual sand bed required is equal to or larger than the minimum sand bed size of 400 sq. ft.

Table 1

Percolation vs. Loading Rate with a Minimum of 6 inches of Sand Beneath GeoMat or in Native Soils

	Loading Rate							
	GeoMat installed with a minimum of 6" of Sand Beneath GeoMat				GeoMat installed directly in Native Soils			
Perc. Rate min/inch	SOIL CLASS I GPD/sqft	SOIL CLASS II GPD/sqft	SOIL CLASS III GPD/sqft	SOIL* CLASS IV GPD/sqft	SOIL† CLASS I GPD/sqft	SOIL‡ CLASS II GPD/sqft	SOIL‡ CLASS III GPD/sqft	SOIL*‡ CLASS IV GPD/sqft
≤5	1.50	1.22	-	-	0.74	0.60	-	-
6	1.42	1.22	-	-	0.70	0.60	-	-
7	1.38	1.22	-	-	0.68	0.60	-	-
8	1.34	1.22	-	-	0.66	0.60	-	-
10	-	1.22	-	-	-	0.60	-	-
15	-	1.14	0.75	-	-	0.56	0.37	-
20	-	1.07	0.69	-	-	0.53	0.34	-
25	-	0.81	0.67	-	-	0.40	0.33	-
30	-	0.67	0.59	-	-	0.33	0.29	-
40	-	-	0.51	-	-	-	0.25	-
50	-	-	0.41	0.41	-	-	0.20	0.20
60	-	-	0.30	0.30	-	-	0.15	0.15

* - Must be reviewed by Geomatrix

† - GeoMat can be installed directly in native soils

‡ - Requires a minimum of 2” approved sand beneath GeoMat

Table 2

GeoMat Surface Area / Linear Foot for Flat and Edge Orientations

	Dimension			Surface Area - square foot per linear foot		
	L	W	H	GeoMat Orientation		
Product	inches	Inches	inches	Flat		Edge
GeoMat 600	12	6	1	0.67		1.08
GeoMat 1200	12	12	1	1.17		2.08
GeoMat 2400	12	24	1	2.17		4.08
GeoMat 3900	12	39	1	3.42		N/A

Table 3

Minimum Sand Bed Sizing

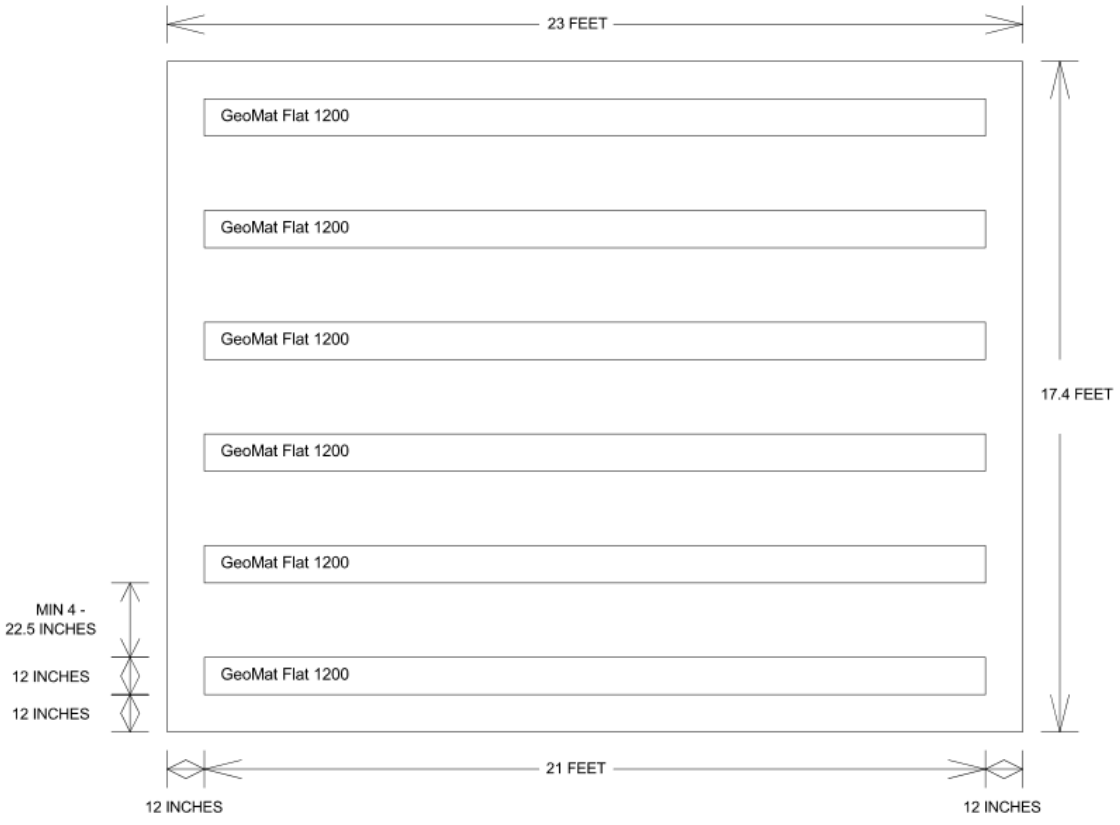
Perc Rate min/inch	2 Bedroom @220GPD				3 Bedroom @330GPD				4 Bedroom @440GPD			
	SOIL CLASS				SOIL CLASS				SOIL CLASS			
	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS I	CLASS II	CLASS III	CLASS IV
≤5	400	400	-	-	400	400	-	-	400	440	-	-
6	400	400	-	-	400	400	-	-	400	440	-	-
7	400	400	-	-	400	400	-	-	400	440	-	-
8	400	400	-	-	400	400	-	-	400	440	-	-
10	-	400	-	-	-	400	-	-	-	440	-	-
15	-	400	400	-	-	400	535	-	-	471	714	-
20	-	400	400	-	-	400	582	-	-	498	776	-
25	-	400	400	-	-	495	600	-	-	660	800	-
30	-	400	455	-	-	600	683	-	-	800	910	-
40	-	-	528	-	-	-	792	-	-	-	1056	-
50	-	-	660	660	-	-	990	990	-	-	1320	1320
60	-	-	880	880	-	-	1320	1320	-	-	1760	1760

Perc Rate min/inch	5 Bedroom @550GPD				6 Bedroom @660GPD				Add'l Bedroom @110GPD			
	SOIL CLASS				SOIL CLASS				SOIL CLASS			
	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS I	CLASS II	CLASS III	CLASS IV
≤5	446	550	-	-	535	660	-	-	89	110	-	-
6	471	550	-	-	566	660	-	-	94	110	-	-
7	485	550	-	-	582	660	-	-	97	110	-	-
8	500	550	-	-	600	660	-	-	100	110	-	-
10	-	550	-	-	-	660	-	-	-	110	-	-
15	-	589	892	-	-	707	1070	-	-	118	178	-
20	-	623	971	-	-	747	1165	-	-	125	194	-
25	-	825	1000	-	-	990	1200	-	-	165	200	-
30	-	1000	1138	-	-	1200	1366	-	-	200	228	-
40	-	-	1320	-	-	-	1584	-	-	-	264	-
50	-	-	1650	1650	-	-	1980	1980	-	-	330	330
60	-	-	2200	2200	-	-	2640	2640	-	-	440	440

Sample System Sizing

Sample#1
2 Bedroom
Soils – 4min/inch Class I
GeoMat Products – GeoMat Flat 1200
In Sand Bed

Step 1: Loading Rate – **1.5GPD / sqft**
Step 2: Sqft of GeoMat required – 2 BR @ 110 GPD = [220GPD] / [1.5GPD/sqft] = **147 sqft**
Step 3: Length of GeoMat Flat 1200 – [147 sqft] / [1.17 sqft/linft] = **126 linft**
Step 4: Minimum Sand Bed Size from Table 3 – **400 sqft**
Sample GeoMat layout – Qty 6 21ft Rows.
Minimum Bed Width 400 sqft / (21ft + 1ft + 1ft) = 17.4ft
17.4ft – [6 rows GeoMat 1200 1' wide] – 1ft – 1ft = 9.4ft /5 spaces = **22.5" between rows.**



Sample System Sizing (continued)

Sample#2
4 Bedroom
Soils – 30min/1inch Class III
GeoMat Products – GeoMat Flat 3900
In Sand Bed

Step 1: Loading Rate – **0.59GPD / sqft**
Step 2: Sqft of GeoMat required – 4 BR @ 110 GPD = [440GPD] / [0.59GPD/sqft] = **746 sqft**
Step 3: Length of GeoMat Flat 3900 – [746 sqft] / [3.42 sqft/linft] = **218.1 linft**
Step 4: Minimum Sand Bed Size from Table 3 – **910 sqft**
Sample GeoMat layout – Qty 5 44' Rows.
Minimum Bed Width 910 sqft / (44ft +1ft + 1ft) = 19.8ft
19.8ft – [5 rows GeoMat 3900 3.25' wide] – 1ft – 1ft = 1.55ft /4 spaces = **4.7" between rows.**

Sample System Sizing (continued)

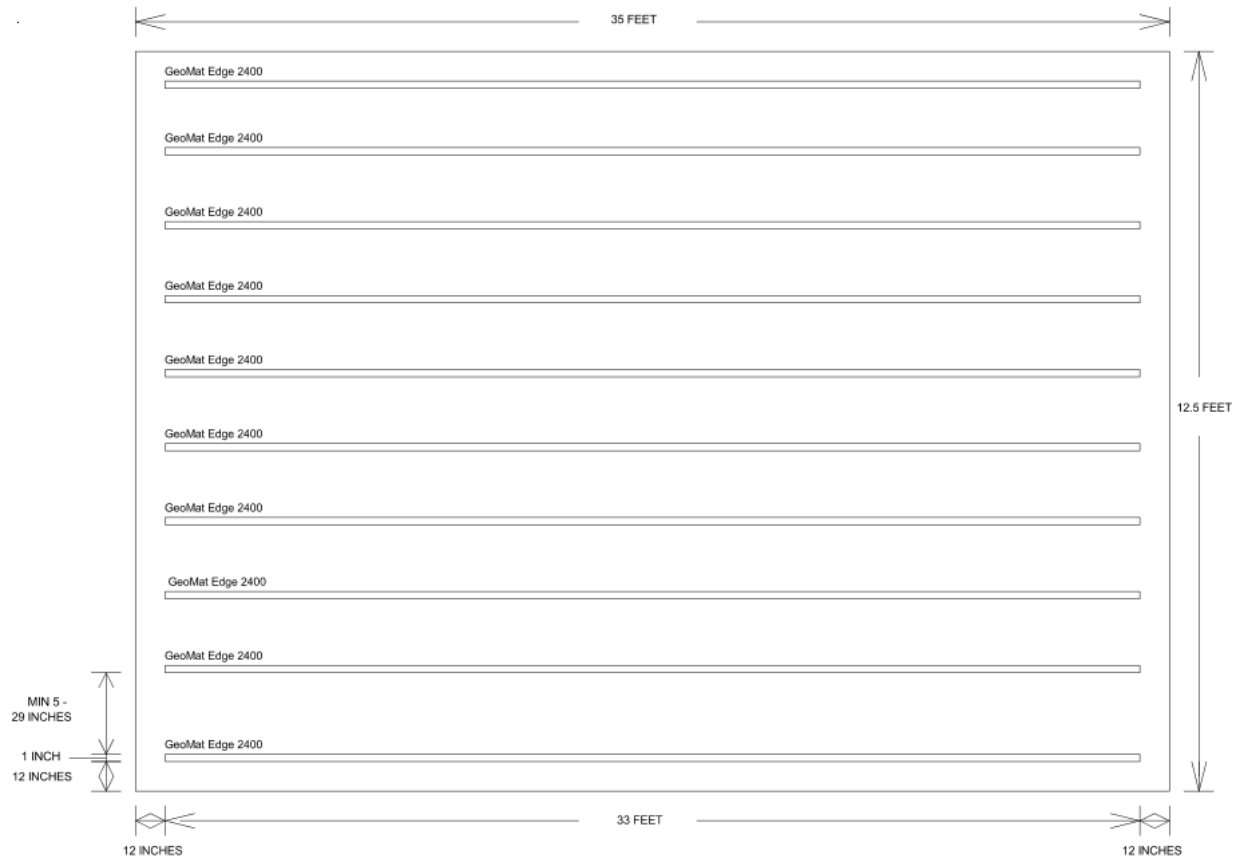
Sample#3
2 Bedroom
Soils – 4min/inch Class I
GeoMat Products – GeoMat Edge 600
In Sand Bed

Step 1: Loading Rate – **1.5GPD / sqft**
Step 2: Sqft of GeoMat required – 2 BR @ 110 GPD = [220GPD] / [1.5GPD/sqft] = **147 sqft**
Step 3: Length of GeoMat Edge 600 – [147 sqft] / [1.08 sqft/linft] = **136 linft**
Step 4: Minimum Sand Bed Size from Table 3 – **400 sqft**
Sample GeoMat layout – Qty 4 30ft Rows.
Minimum Bed Width 400 sqft / (30ft + 1ft 1ft) = 12.5ft
12.5ft – [4 Rows GeoMat 600 1" wide] – 1ft – 1ft = 10.2ft / 3 spaces = **40.8" between rows.**

Sample System Sizing (continued)

Sample#4
4 Bedroom
Soils – 30min/1inch Class III
GeoMat Products – GeoMat Edge 2400
In Sand Bed

Step 1: Loading Rate – **0.59GPD / sqft**
Step 2: Sqft of GeoMat required – 4 BR @ 110 GPD = [440GPD] / [0.59GPD/sqft] = **746 sqft**
Step 3: Length of GeoMat Edge 2400 – [746 sqft] / [2.17 sqft/linft] = **344 linft**
Step 4: Minimum Sand Bed Size from Table 3 – **910 sqft**
Sample GeoMat layout – Qty 10 35ft Rows.
Minimum Bed Width 910 sqft / (35ft + 1ft + 1ft) = 24.6ft
24.6ft – [10 Rows GeoMat 2400 1" wide] – 1ft – 1ft = 21.8ft / 9 spaces = **29.0" between rows.**



Basic Design Considerations

If the system is configured for gravity distribution, dosing volume does not inherently apply. SoilAir may be used to better distribute a dose to the GeoMat.

In gravity systems, internal GeoMat pipe will be Geomatrix 2 inch perforated pipe.

Cover depth shall maintain a minimum of 6 inches above the GeoMat distribution pipe. Use clean sandy fill and topsoil suitable for growing grass.

Minimum perimeter sand fill beyond the GeoMat on a sand bed shall be 12 inches. If the cover material over the GeoMat is above the original grade, it shall slope at a 2% pitch away from the GeoMat system and from a point two feet past the GeoMat, provide a 3:1 slope to original grade.

Preservation of the native soil between trenches and minimizing its disruption and compaction during construction is essential to maintaining soil structure and therefore water and gas movement in the soil around the system.

Keep the top of the GeoMat shallow, ideally 6-12 inches below finish grades. Maximum depth of cover is 24 inches. If SoilAir is utilized, the cover depth can be increased to 48 inches. Try to keep cover depth as consistent as possible over the laterals to balance air flux rates through the soil.

Keep the bottoms of the GeoMat laterals level;

Provide for lateral pipe drainage and maintenance access

Avoid working soils that are moist or wet because they can easily smear and compact.

Properly scarify the drain field base before installing components.

When reviewing a site and developing a design, it is best to position the GeoMat laterals parallel to ground surface contours. This will help make it easier to keep drain field base elevations level. Designing perpendicular to a surface contour will result in the downhill end of the drain field trench being shallower and the uphill end will be deeper; this results in non-uniform aeration and water movement.

When PD is used, the requirements of 310 CMR 255 (2) shall not apply Section 255(2) of the code requires the grading to be made level for 15 feet in all directions around a soil absorption system. This requirement is intended to prevent any breakout of wastewater during saturated flow conditions as can be found with gravity flow dispersal mechanisms (both conventional and gravel-less). This concern is not warranted with the very uniform application rate provided by the GeoMat. The distance to a downhill slope can be reduced to 2 feet; however contact Geomatrix on design assistance on slopes greater than 20%.

Pressure dosing must be designed in accordance with the Massachusetts Guidance Document Policy # BRP/DWM/WpeP/G02-2 dated May 24, 2002. Small frequent doses are recommended. See Table 4.

Table 4

Maximum Dosing Volumes

Product	Dosing Volume Gal/lin ft
GeoMat 600	0.156
GeoMat 1200	0.312
GeoMat 2400	0.623
GeoMat 3900	1.012

Except when installed with six inches of sand meeting the requirements of 310 CMR 15.255(3) beneath the GeoMat™, the requirements of 310 CMR 15.240(13)(Inspection Port) shall not apply.

Pump systems shall comply with the requirements of 310 CMR 231(6) with regard to the requirement of duplex pumps

Pump chamber shall provide at least one day storage or will require backup power system.

Systems are not to be installed beneath paved surfaces.

Soil excavation and / or plantings within five feet of the system are not permitted unless a root barrier is utilized. Contact Geomatrix for design assistance.

System can be installed as close as five feet from a building cellar wall.

System designs for use in Class IV soils must be reviewed by Geomatrix.

Five foot over dig as indicated in 310 CMR 15.255(5) is not required

GeoMat systems may be designed with an irregular shape to fit site specific conditions. An appropriately sized reserve area for a conventional system is required.

Residential systems with design flows of less than 2,000 gpd may reduce the required effective leaching area by 50% when utilizing gravity loading rates of 310 CMR 15.242(1)(a) provided that a secondary treatment device with a General Use Certification that allows for a 50% reduction in effective leaching area or SoilAir is utilized to ensure there is sufficient oxygen to meet the BOD. Additional reductions other than that allowed by the General Use Certificate for the secondary treatment device are not allowed.

The pressure distributed effluent loading rates in 310 CMR 15.242(1)(b) can be used but no reduction in effective leaching area can be applied.

An appropriately sized conventional system and reserve area for a conventional system are required for future upgrades.

GeoMat when installed in individual trenches is required to maintain at a minimum of two times the height or width, whichever is larger, between the trenches. 310 CMR 15.251(1) See Table 5.

Table 5
Minimum Separation Distances

Product	Trench Minimum Separation Distance **Without** Reserve Area	Trench Minimum Separation Distance **With** Reserve Area
	Inches	Inches
GeoMat 600	12	18
GeoMat 1200	24	36
GeoMat 2400	48	72
GeoMat 3900	78	117

Trenches constructed at different elevations shall be designed to prevent effluent from the higher trench(es) flowing into the lower trench(es). 310 CMR 15.251(3)

GeoMat can be installed by:

- Excavating and scarifying the system area and installing a level sand base.
- Excavating and scarifying the system area and installing the mat directly on leveled Class 1 native soils.
- Excavating and scarifying individual trenches for vertical installation
- Vibratory plow and trencher installation

GeoMat Excavation Requirements

The soil between the dispersal trenches shall remain undisturbed. If the presence of boulders or other obstacles make trench construction impractical, the entire leach field area may be excavated as necessary, backfilled with approved sand to the design elevation of the bottom of trench and the GeoMat constructed and backfilled with native soil material.

Transport Lines

Generally the effluent transport pipe from the treatment unit to the GeoMat is 1½ - 4 inch PVC pipe (Class 200 minimum) Pipe. The actual pipe size will depend upon such factors as distance, pump head, scour velocity, frictional losses and desired pressure at the distal orifices. The transport pipe should be sloped either back to the pump tank or HyAir vessel or toward the

GeoMat to drain the line after each dose. In some cases, it may be better to slope the transport line in both directions. In all cases, this is done to prevent freezing in cold weather. Care should be exercised to make certain that all fittings will facilitate drainage; in certain instances eccentric fittings may be required to keep flow lines at the same elevation. An anti-siphon device should be used where any chance of siphoning of the pump tank may occur.

Gravity Distribution Design Parameters

Gravity GeoMat laterals shall not exceed 50 feet.

Only parallel distribution shall be utilized.

Laterals for gravity systems can either be 2 inch SCH40 pipe with min. ½ inch perforations or 4 inch SDR35 perforated pipe.

It is recommended that a state approved effluent filter be utilized.

Pressure Distribution Design Parameters

GeoMat distribution manifolds are typically 1 ½ - 4 inch SCH.40 PVC. Distribution laterals are typically 1 - 2 inch SCH.40 PVC. Size will vary depending on design and site conditions. Distribution laterals that are at different elevations should have flow equalization valves installed to provide equal head/flow of effluent to all rows. Flow equalization valves are often installed in the pump chamber for easy operation, protection from damage and prevention of freezing. Flow equalization valves can be utilized on level systems to adjust flows to certain regions, promote resting, etc.

PD systems should be designed with less than 10% flow differential from the first to last orifice; soft ware is available from Geomatrix.

Orifice holes should be oriented in a downward (six o'clock) direction and be spaced according to the dosing requirements of the system. During fabrication of the distribution lateral, a new/sharp drill bit should be used to assure as smooth an orifice as possible. Any loose and connected drill shavings should be removed from the pipe with a bottle brush on an extension. Geomatrix GeoGuard™ orifice shields must be installed over the orifice holes and glued in place with PVC primer and glue.

Typical designs should account for a minimum of two feet of head pressure at the distal end of each GeoMat distribution lateral.

Design software for pump, lateral line, transport pipe, manifold, orifice size and additional head loss is available by emailing request to info@geomatrixsystems.com.

Two SCH40 PVC 45° fittings or equivalent 90 sweep elbows (also called turn ups) shall be attached to the distal end of each GeoMat distribution lateral to facilitate maintenance and

inspection. Standard 90°elbows should not be utilized because it will prevent and interfere with maintenance activities. The open end (upward end) of the sweep needs to be sealed off with either a ball valve, threaded plug or cap. The distal head ports are utilized for measuring and setting distal head on the GeoMat laterals. Distal head ports can also be used for cleaning the laterals with a bottle brush or jetter, should this be necessary at some point in the future.

The installation of a pressure filter, approved by Geomatrix, is recommended between the pump and laterals on pd systems. The Sim/Tech STF-100 is preapproved.

Zoned Drain Fields and Trenches at Different Elevations

Smaller sized pumps can be used on larger drain fields and still maintain adequate distal head by utilizing automatic sequencing valves, such as those manufactured by K Rain. These valves automatically direct flow to two or more zones or distribution laterals, one or more at a time and in a prescribed order sequentially redirect flow to separate zones within the drain field.

Site conditions may not facilitate installing all the drain field trenches at the same elevation. In this instance, or to fine tune design parameters, valves on the proximal end can be used to provide uniform wastewater distribution; valves also help facilitate cleaning of laterals. Access ports must be installed over these gate valves. Valves can also be located in the pump tank. Alternatively, orifice plates may be used to help equalize flow to trenches that are not at the same elevation.

Drain Field Cover

Drain field cover shall be a minimum of 6 inches over the top of the GeoMat distribution pipe. Uniform cover depth over the drain field results in consistent oxygen transfer to the entire system. The final grade over and around the drain field should direct storm water sheet flow away from drain field.

The area directly above and adjacent to any septic drain field should be protected from heavy vehicle traffic and excess weight loads before, during and post construction. On all construction projects, it is recommended that the proposed drain field location be staked and flagged/fenced to prevent encroachment. If vehicle encroachment is expected to be a problem before, during or after construction, some structure, such as garden timbers, railroad ties, fences or walls should be used to protect the drain field area. The drain field area should be free of debris and planted with grass. Impermeable materials and structures should not be installed or stored over the drain field unless SoilAir is utilized to enhance aeration. When possible, trees and shrubs should be kept a minimum distance of ten feet from the drain field. If trees and shrubs must be closer than ten feet from the drain field, root barriers can be utilized to prevent roots from entering the drain field; contact Geomatrix for design assistance. Roots from nearby moisture loving trees such as willow, black locust and red maple may cause problems with roots clogging or otherwise damaging the drain field lateral orifices. If a root barrier is not utilized, greater setback distances are recommended for these tree species.

Septic Do's and Don'ts

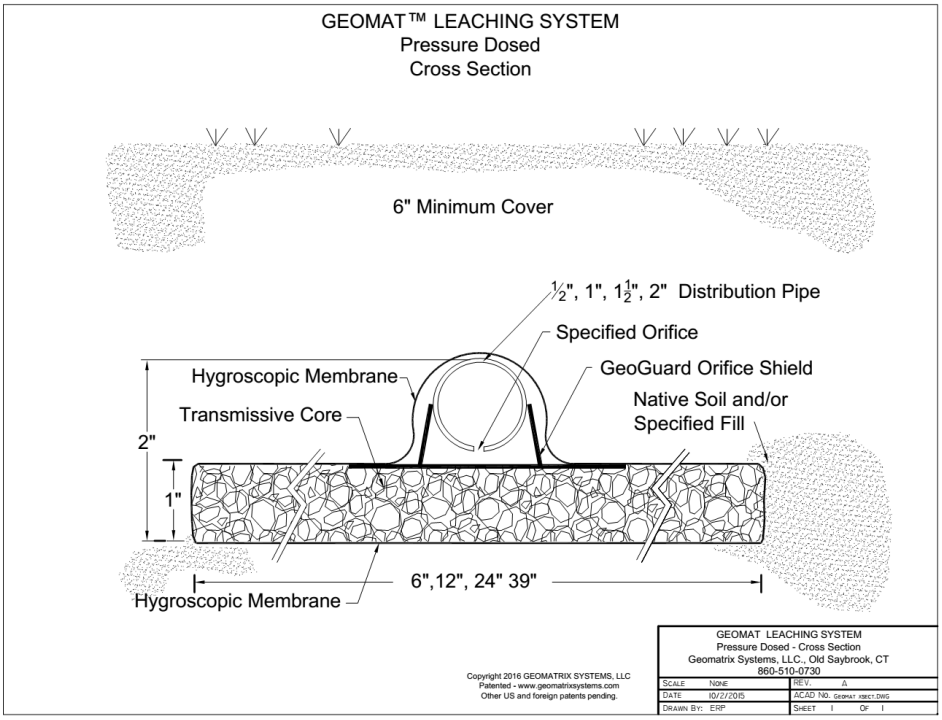
Do:

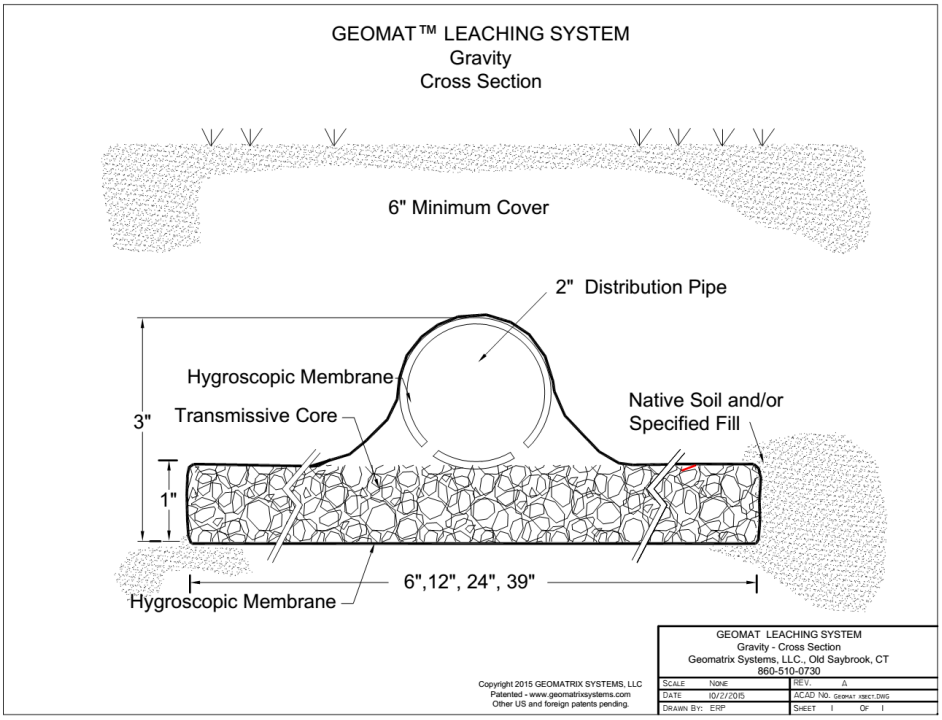
- Conserve water to reduce the amount of wastewater that must be treated and disposed.
- Repair any leaking faucets and toilets.
- Only discharge biodegradable wastes into system.
- Restrict garbage disposal use.
- Divert downspouts and other surface water away from your drain field & tanks.
- Keep your septic tank cover accessible for tank inspections and pumping.
- Have your septic tank pumped regularly and checked for leaks and cracks.
- Call a professional when you have problems.
- Compost your garbage or put it in the trash.

Don't:

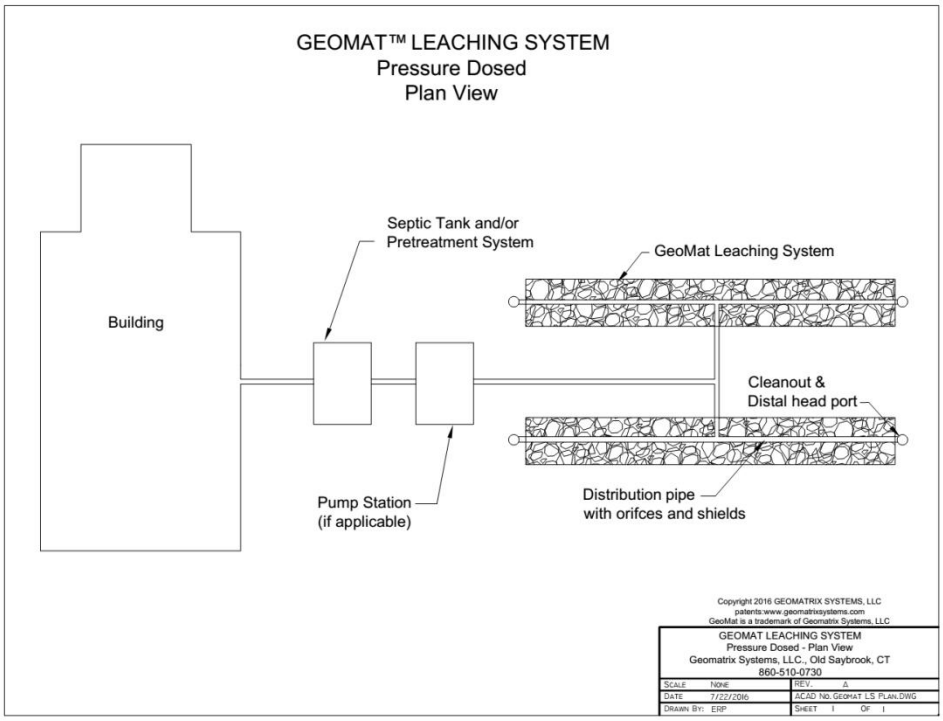
- Flush sanitary napkins, tampons, condoms, cigarette butts, diapers, wipes and such products into your system.
- Dump solvents, oils, paints, paint thinner, disinfectants, pesticides or poisons down the drain.
- Dig in your drain field or build anything over it.
- Plant anything other than grass over your drain field.
- Drive over your drain field or compact it in any way.

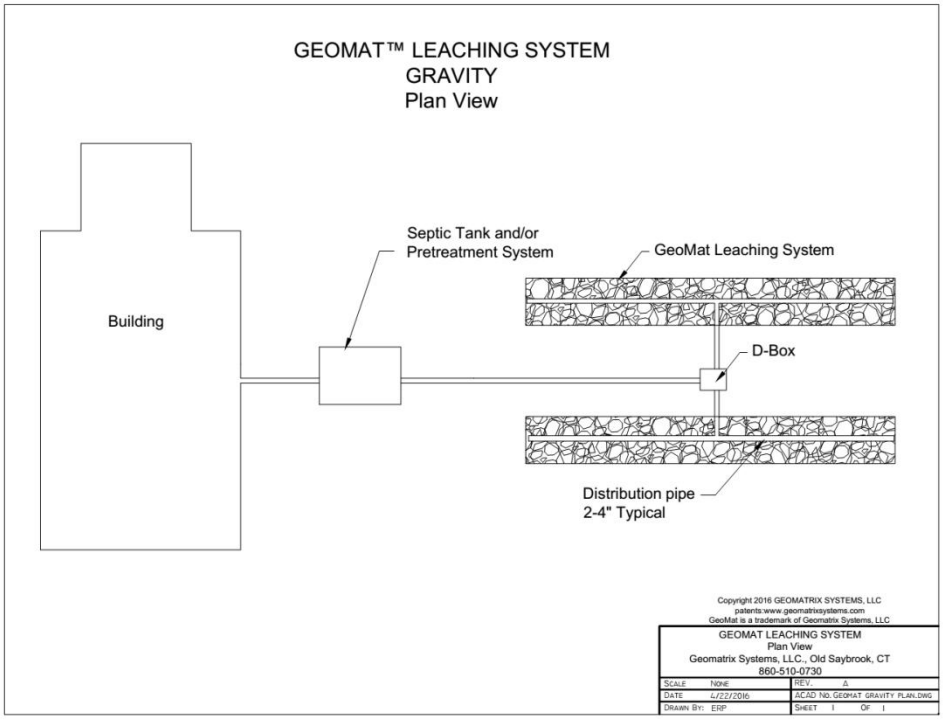
GeoMat Schematics



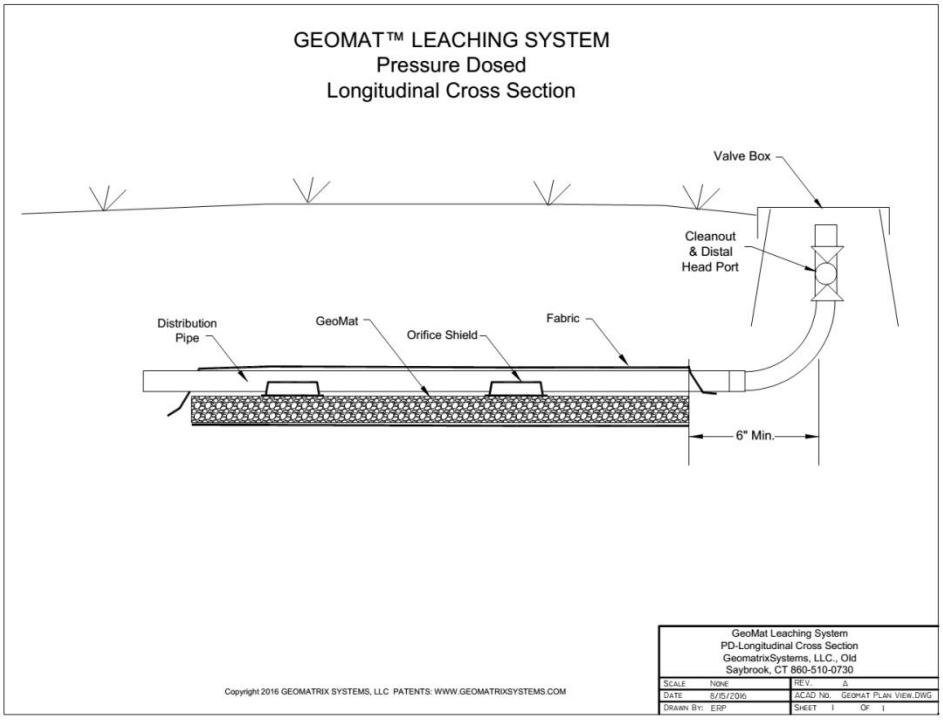


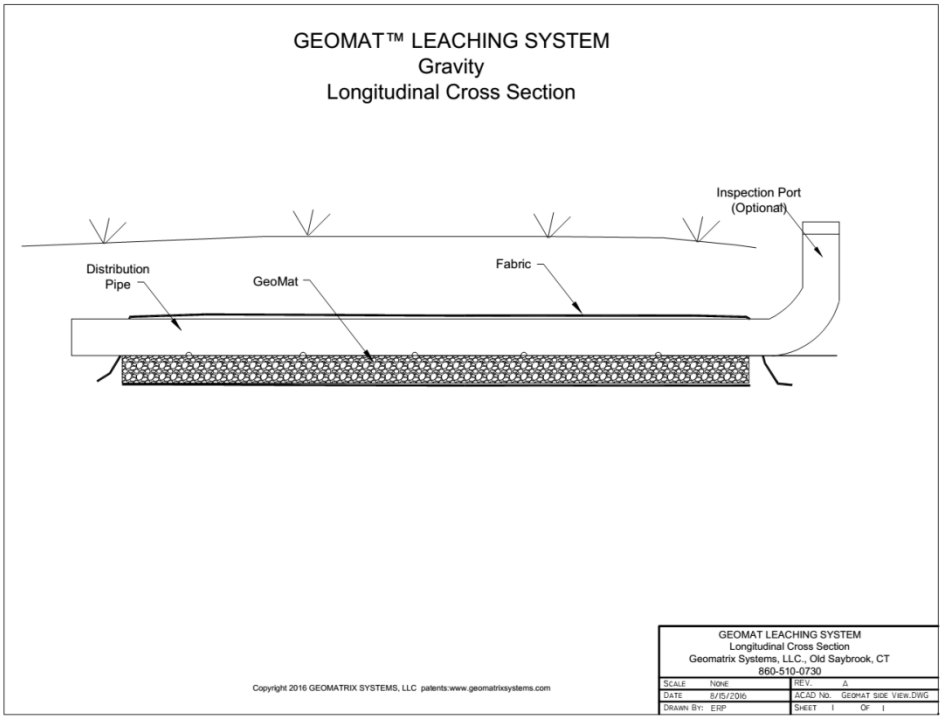
GeoMat Schematics (continued)



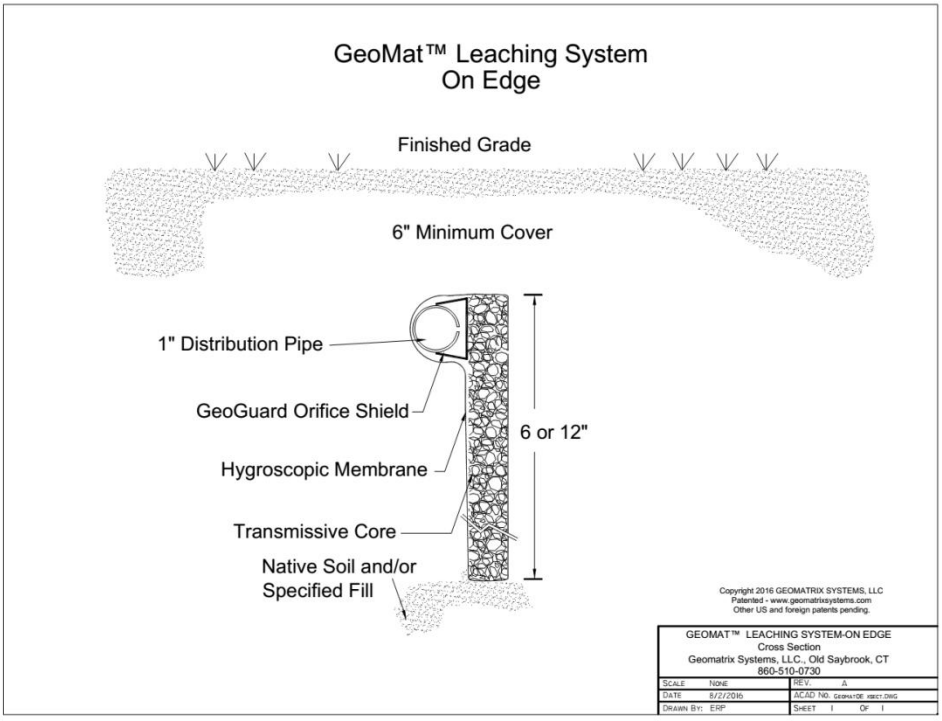


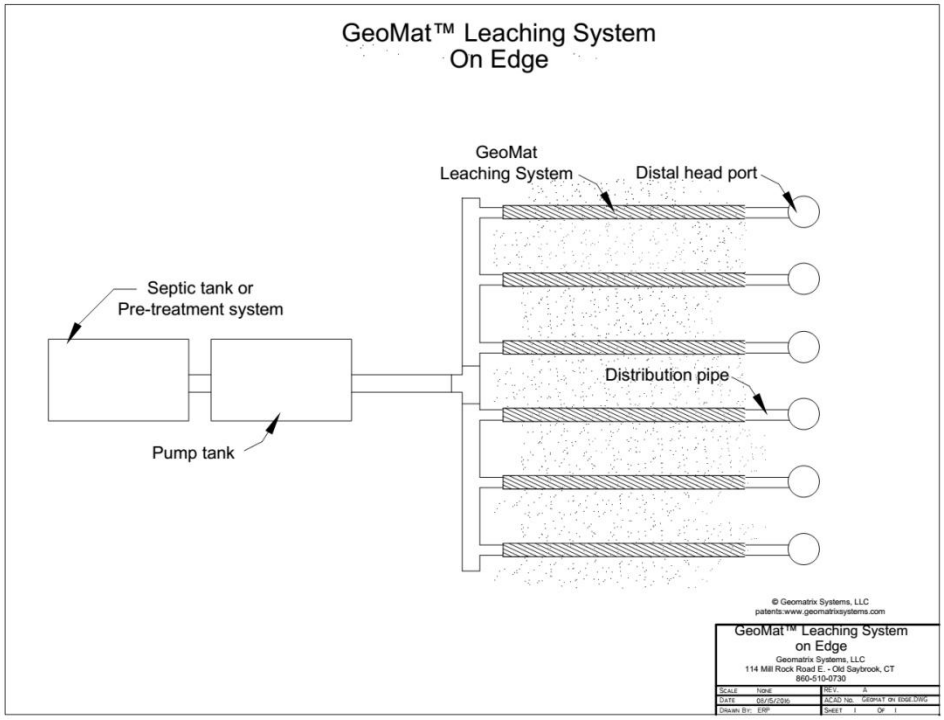
GeoMat Schematics (continued)



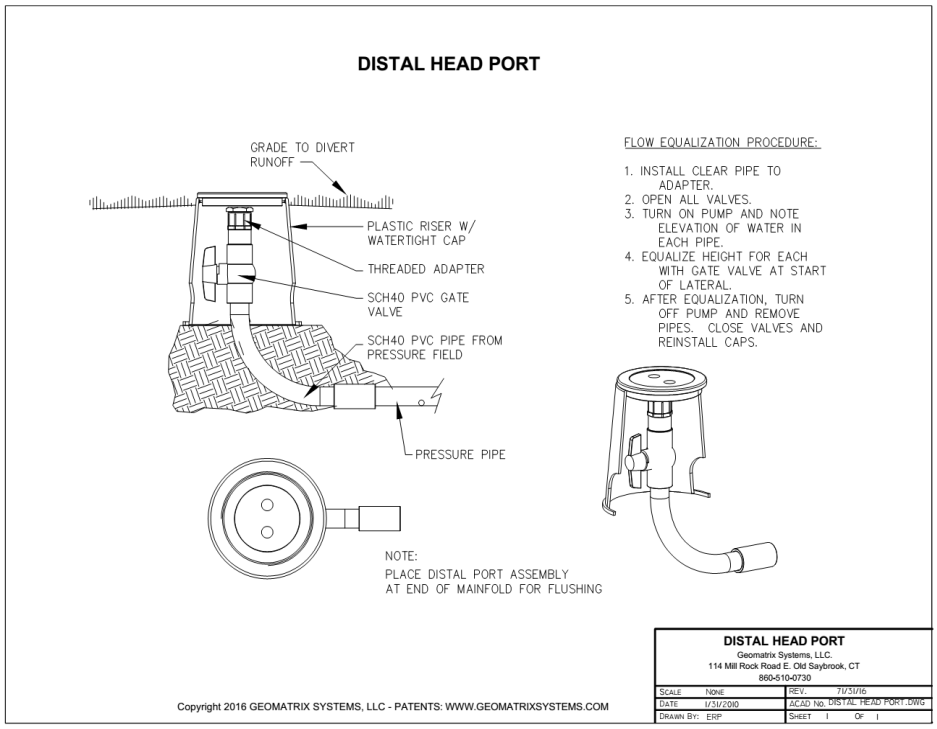


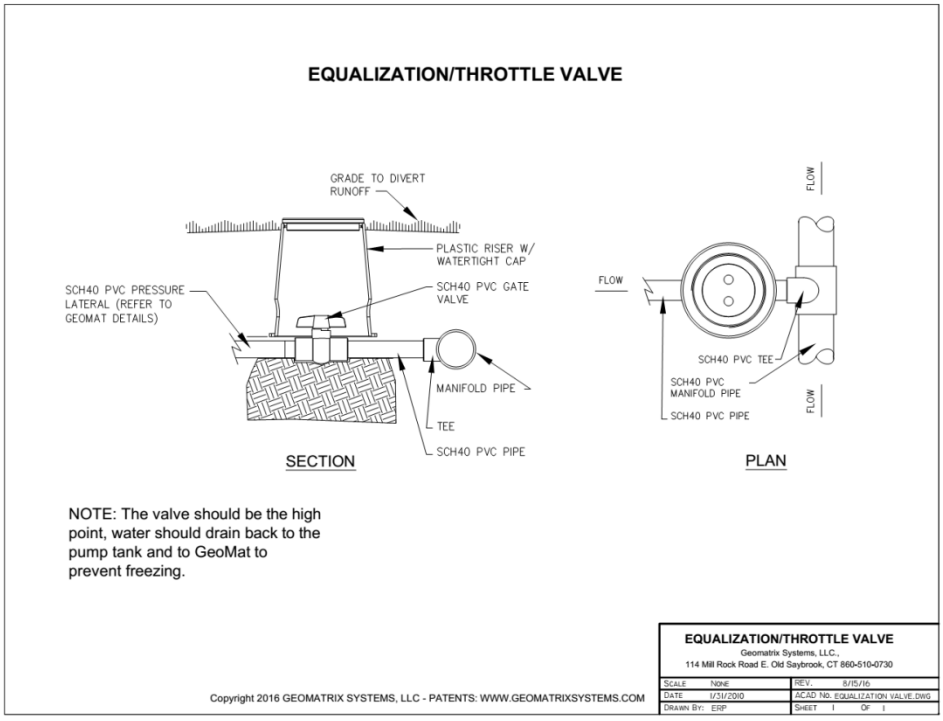
GeoMat Schematics (continued)



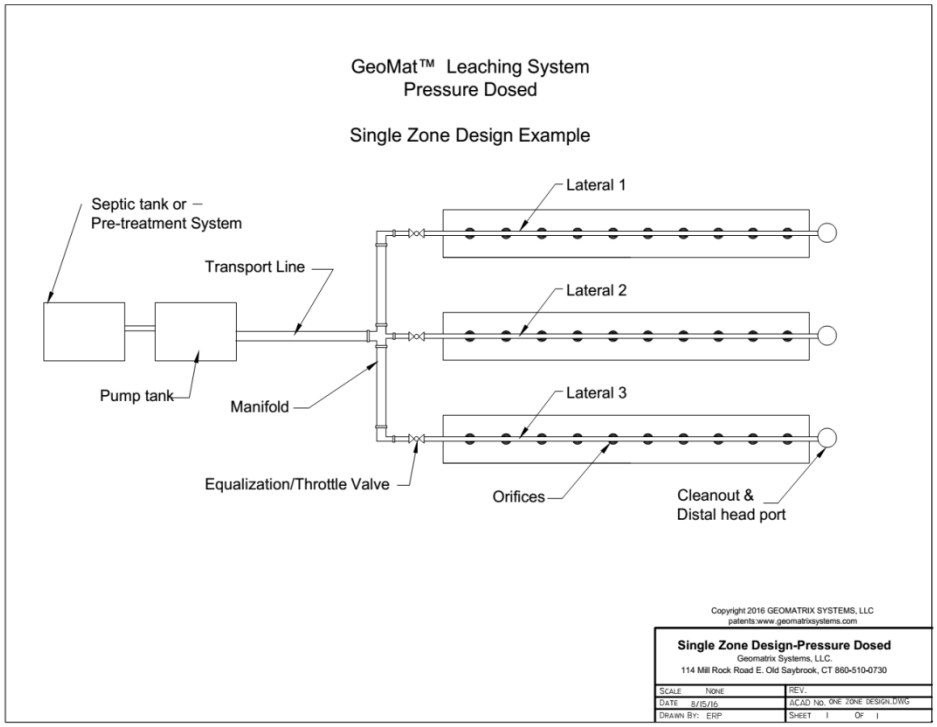


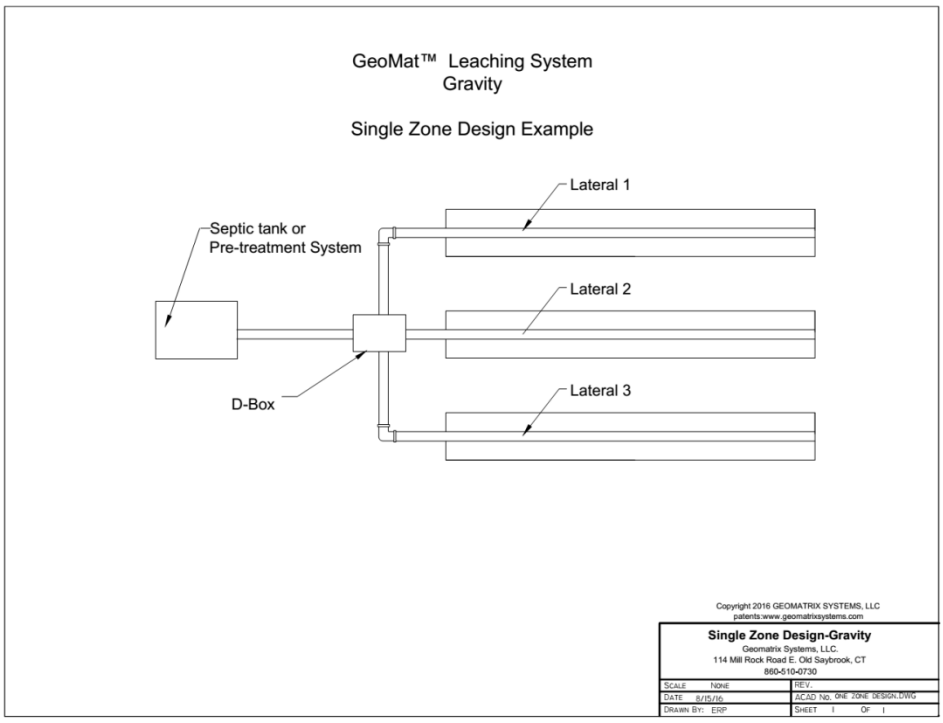
Distal Port & Flow Equalization Valve Schematics



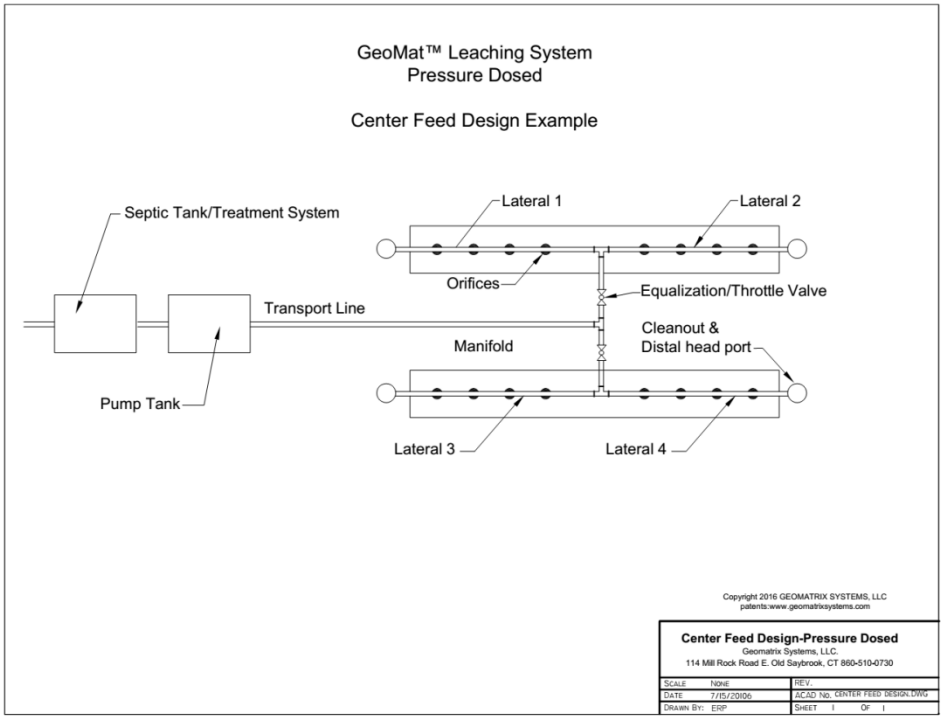


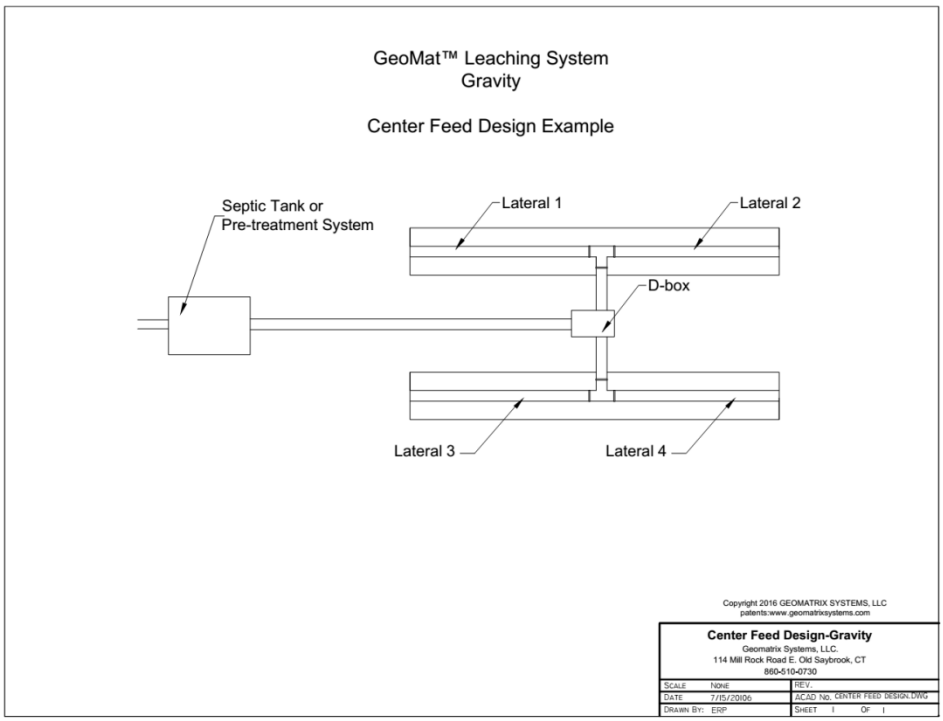
Typical GeoMat System Design Examples



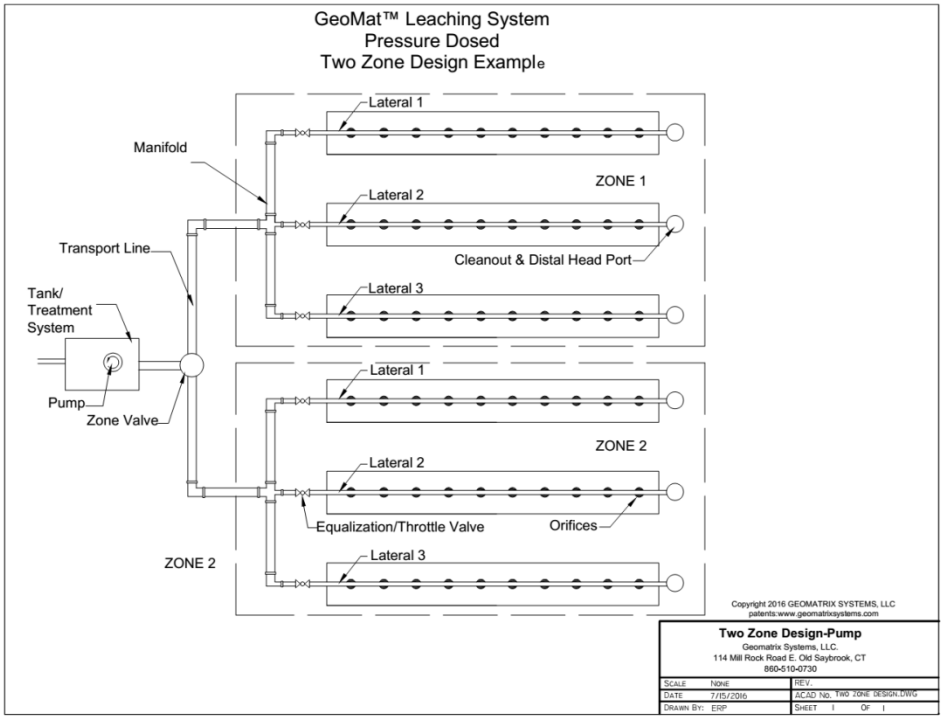


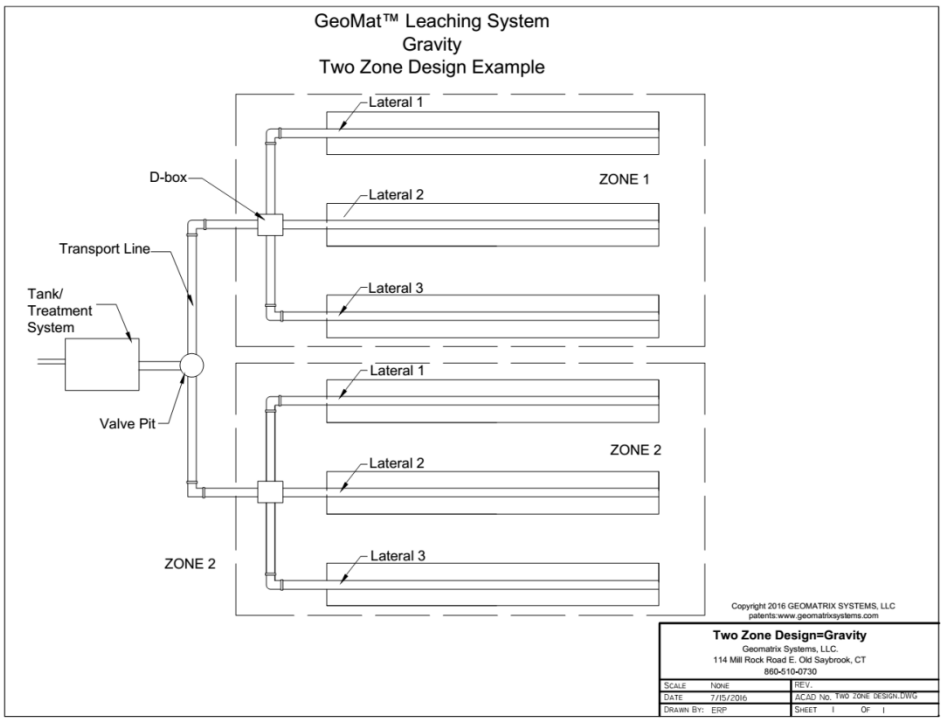
Typical GeoMat System Design Examples (continued)





Typical GeoMat System Design Examples (continued)





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