RHODE ISLAND

GST™ Leaching Systems

Design Manual for
Pressure and Gravity Applications

May 20, 2022

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Introduction

Geomatrix Systems, LLC (Geomatrix) Gravel Sand Treatment system (GST™) is an adaptation of the time proven stone leaching trench. This traditional leaching system has been improved with the use of a reusable, removable form to accurately shape and construct leaching fingers along the sides of a central distribution channel. The forms are property of Geomatrix, available through authorized representatives and rented on a per system basis. The fingers are constructed with clean washed ½ inch to ¾ inch stone and are surrounded with ASTM C-33 sand. These fingers serve to increase the sidewall surface area by more than six times that of a traditional stone leaching trench. Additionally, the narrow profile of the leaching fingers and central distribution channel (stone structure), combined with the uniform profile of the sand treatment media, serve to enhance oxygen transfer efficiencies. Enhanced oxygen transfer results in better treatment of the wastewater pollutants and a leach field with a longer lifespan. GST has direct stone to soil and/or sand contact for enhanced long-term performance. This is the same basis that time proven sand filters and stone leaching trenches utilize. GST can be configured with standard gravity, pressure and/or time dosed distribution. GST can be utilized with pretreated wastewater or septic tank effluent when sized accordingly. GST is also compatible with a SoilAir® system (SoilAir).

GST has a high surface area to void space ratio. This ratio results in more complete filling and draining of the GST stone structure with wastewater doses which in turn results in greater gas flux and aeration, enhancing treatment.

The GST is available in Rhode Island in 6 inches, 12 inches, and 18 inches tall, 37 inches or 62 inches wide.

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 pressure distribution, 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 GST System

GST Leaching Systems shall be designed in accordance with all State and local regulations including Rhode Island Rules Establishing Minimum Standards Relating to Location, Design, Construction and Maintenance of Onsite Wastewater Treatment Systems ("RI DEM OWTS Rules"). Contact Geomatrix with any questions you may have and for design assistance on non-single family residential and commercial systems.

In Rhode Island GST can be installed in trench configuration only.

GST is constructed with clean washed ½ inch to ¾ inch stone and are surrounded with ASTM C-33 sand.

GST may be specified for H-20 loading in traffic areas. Areas subject to vehicular traffic, including parking areas, shall be limited to twenty-five percent (25%) of the leachfield area. In cases where SoilAir is utilized up to one hundred percent (100%) of the leachfield area can be covered with an impermeable material such as bituminous concrete pavement, asphalt, stone parking areas, geosynthetic membranes etc. When specified for H-20 loading, the GST system must be covered by a minimum of 12 inches of load bearing materials. See H-20 Cross sections on page 14.

Use Tables 1 thru 3 for system sizing and sand and stone volume requirements.

GST in Trench Configuration

GST can be installed in a trench configuration in native soil or in ASTM C-33 sand fill (Figures 4 and 7). GST can be loaded at the loading rates in Table 1 based on the Effective Leaching Credit (ELC) set forth in Table 2.

Gravity or Pressure distribution may be utilized. Pressure distribution 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 GST required by utilizing the appropriate Soil Loading Rate and maximum daily flow using section 6.22B of RI DEM OWTS Rules.
3. Determine the Length of GST required using Table 2, the GST model, and the square footage of GST required, as calculated in step 2.
4. Determine the sand and stone required using Table 3.

Table 1
Soil Loading Rates for Sites with Soil Evaluation

Soil Category	Soil Texture [1,2]	Soil Structure	Soil Consistence In-hand Using Soil Clods	Typical Soil Class	Septic Tank Effluent for Applications with Soil Evaluation (gal/ft²/day)	Category 1 Systems[3] GST Loading Rates[5] (gal/ft²/day)	Category 2 Systems[4] GST Loading Rates[5] (gal/ft²/day)
1	cos, s, lcos, ls, cosl, fs	structureless-single grain subangular blocky	Loose friable	Outwash (class C), ice contact (class D) and course ablation till (class B) deposits	.70	2.3[4]	1.5[4]
1m*					.61*		
2	vfs, lvfs	structureless-single grain	loose	Outwash (class C), ice contact (class D) deposits	.61	2.7	1.9
3	ls, sl, l	granular, subangular blocky	very friable to friable	Lodgement Till (Class A), Ablation Till (Class B), Outwash (Class C), or Ice Contact (Class D)	.70	3.5	2.3
4	lfs, lvfs, fsl,vfs	granular, subangular blocky	very friable to friable	Lodgement Till (Class A), Ablation Till (Class B), Outwash (Class C), or Ice Contact (Class D)	.61	3.1	2.0
4m*					.70*		
5	sil, si, vfsl	subangular blocky	very friable to friable	Typically Eolian deposits (Class G)	.52	2.7	1.9
6	lcos, cosl, lfs, ls, sl, l	structureless-massive	very friable to friable	Ablation till (Class B)	.61	2.3	1.5
6m*					.70*		
7	fsl, vfsl, sil, si, vfs	structureless-massive	very friable to friable	Ablation till (Class B)	.52	2.1	1.5
7m*					.61*		
8	All textures	structureless-massive	firm to very firm	Lodgement till (Class A)	.46	1.9	1.3
8m*					.48*		
9	All textures	platy, structureless-massive	firm to very firm	Lodgement till (Class A)	.40	1.5	1.0
9m*					.43*		
10	All textures	platy, structureless-massive	extremely firm	Lodgement till (Class A)	Not Allowed	Not Allowed	Not Allowed

* Starred items (*) are for soils with gravelly or channery coarse fragment modifiers

[1]Soil textures defined on Page 5 of this manual.

[2]GST placed in cos, vcos, gravelly or very gravelly soils shall have a leveled-off 6-inch ASTM C-33 sand layer-Instead of 2 inch with all other soils.

[3]Category 1 Systems = Any advanced treatment system that is time dosed according to the specifications of the RI DEM Guidelines for the Design and Use of Sand Filters and Pressurized Shallow-Narrow Drain fields and has been classified as meeting treatment standards of less than or equal to 20 mg/L for both BOD and TSS and FOG of less than or equal to 5 mg/L.

[4]Category 2 Systems = Any advanced treatment system that is not time dosed according to the specifications of this guide and has been designated by the RI DEM as meeting treatment standards of 30 mg/L or less for both BOD and TSS and FOG of less than or equal to 5 mg/L. Time dosing and an in-line screen filter or a screen pump vault must be used on the pump dosing the GST.

[5]The design loading rate for systems receiving RI DEM approved advanced treatment system effluent (Cat. 1 or Cat. 2 as applicable) shall be based upon the texture, structure and consistence (described in Table) of the most restrictive soil horizon within 3.0 feet below the proposed base of the GST. The base of the GST is depicted in Figure 6 of this manual. The design loading rate for GST systems accepting septic tank effluent shall be based on RI DEM OWTS Rule 6.33 – Leachfields.

Table 2
Effective Leaching Credit (ELC)

Product Name	Dimensions (W x H)	Effective Leaching Credit (SF/LF)	Edge to Edge Spacing (inches)
GST 3706	37" x 6"	6.2	18
GST 3712	37" x 12"	10.3	18
GST 3718	37" x 18"	14.4	18
GST 6206	62" x 6"	10.3	18
GST 6212	62" x 12"	17.5	18
GST 6218	62" x 18"	24.8	18

Table 3
Sand and Stone Volume Guide

62" series

Product Name	Amount of ¾" Stone Required	Amount of ASTM C-33 Sand Required
	Cubic Yards per Linear Foot	
GST 6206	0.20	0.25
GST 6212	0.27	0.35
GST 6218	0.35	0.46

37" series

Product Name	Amount of ¾" Stone Required	Amount of ASTM C-33 Sand Required
	Cubic Yards per Linear Foot	
GST 3706	0.16	0.18
GST 3712	0.19	0.25
GST 3718	0.22	0.32

Soil Texture:

The relative proportions of soil separates (sand, silt, and clay particles) in a particular soil. USDA soil texture abbreviations illustrated in Table 1 are defined as: cos = coarse sand; vcos = very coarse sand; fs = fine sand; lfs = loamy fine sand; ls = loamy sand; fsl = fine sandy loam; sl = sandy loam; l= loam; vfs = very fine sand; lvfs = loamy very fine sand; vfsl = very fine sandy loam; sil = silt loam; vfsl = very fine sandy loam; si = silt; sicl = silty clay loam. Refer to the most recent RI DEM Soil Evaluation Guidance Document for additional information.

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 GST.

In gravity systems, GST pipe shall be 4 inch perforated pipe.

A minimum cover depth of 6 inches shall be present above the GST distribution pipe. A maximum of 30 inches of cover material above the distribution pipe shall be utilized. Suitable cover material above the distribution pipe is clean sandy fill and topsoil that is suitable for growing grass.

Minimum perimeter sand fill beyond the GST on a sand bed shall be 12 inches. The cover material should be final graded at a 2% pitch over the GST system and for 24 inches beyond the outermost edge of the GST. If cover material over the GST is above the original grade, it shall maintain the 2% pitch for a minimum of 24 inches beyond the outermost edge of the GST and then run at a 3:1 slope to original grade. Per RI DEM OWTS Rule 6.33Q a minimum ten foot horizontal separation distance shall be provided between the outer edge of the stone in the outer dispersal trench and any ground surface elevation less than the elevation of the invert of the distribution line. The adjacent side slope shall not be steeper than 3:1 (horizontal:vertical) for a twenty-five (25) foot minimum distance from the edge of the stone in the dispersal trench or until the toe of the slope returns to the elevation of the original grade. The toe of the 3:1 slope shall be a minimum of five (5) feet from any property line.

Remember to follow these design parameters when designing and installing GST:

- 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 trenches. For this reason, construction is to be trench-by-trench when possible unless a layer of specified sand is utilized as a continuous base beneath, around and covering the GST;

- The RI DEM requires systems to have a minimum of 6 inches of cover and a maximum of 30 inches of cover over the GST distribution pipe. Keep cover depth as consistent as possible over the laterals to balance air flux rates through the soil;

- Keep the bottoms of the GST laterals level;

- Minimum separation to the seasonal high water table is 3 feet. In Critical Resource Areas separation to the seasonal high water table is 4 feet. For systems with pressure distribution and advanced pretreatment, separation from the seasonal high water table is reduced to 24 inches;

- Separation to impervious layer is 5 feet. For systems with pressure distribution and advanced pretreatment separation from impervious layer is reduced to 4 feet;

- Provide for lateral pipe drainage and maintenance access;

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

- Scarify the drain field base before installing components.

When reviewing a site and developing a design, it is best to position the GST laterals parallel to ground surface contours. This will help make it easier to keep drain field base elevations uniform. Designing perpendicular to a surface contour will mean that the down gradient end of the drain field trench being shallow-placed, whereas the upgradient end will be much deeper. Leaching systems that are parallel with surface contours also have a larger hydraulic window which minimizes soil saturation.

When pressurize distribution is used, the requirements of Rhode Island DEM *OWTS Rules*, as amended, must be followed. Small frequent doses of effluent to the GST are preferred over fewer larger doses; however, rest/reaeration intervals must also be provided for; 4 – 8 doses per day is typical. Pump chambers should preferably be designed with float switches controlling high water alarm, pump on/off and low water/redundant off. A dose counter is recommended. Time dosing can also enhance performance.

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

Minimum setback distances set forth in RI DEM OWTS Rule 6.23 must be observed unless otherwise approved.

GST systems may be designed with an irregular shape to fit site specific conditions.
When installed in individual trenches, GST is required to maintain at a minimum of 1.5 feet distance between trenches edge to edge.

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

If SoilAir is used, the entire GST system may be placed under traffic areas, otherwise maximum leaching area under traffic areas shall be limited to twenty-five percent (25%).

An inspection port shall be installed on every row of GST. The inspection port – PN: IPGST15 consists of a 4 inch PVC Tee with two slotted openings on the Tee ends. A threaded plug on top prevents debris from entering the inspection port. These inspection ports are designed to be stable and not move upwardly or downwardly over the life of the system. This will allow confirmation of the bottom elevation of the leaching system during inspection or at any time afterwards. It is also possible to monitor effluent ponding levels through this port. If it is ever necessary to pump the leaching system out, the inspection port will prevent a "posthole" from being formed as occurs when an open bottom pipe is utilized for pumping. The inspection ports can be finished in a valve box to be flush with grade.

GST Excavation Requirements

The soil between the dispersal trenches shall remain undisturbed when possible. If the presence of boulders or other obstacles make trench construction impractical, the entire leach field area may be excavated as necessary, backfilled with ASTM C-33 sand to the design elevation of the bottom of trench and the GST constructed and backfilled in ASTM C-33 sand.

Gravity Distribution Design Parameters

Gravity GST laterals shall not exceed 50 feet.

Parallel distribution shall be utilized whenever possible to avoid overloading any lateral above the long term acceptance rate.

Laterals for gravity systems shall be perforated with 3/8 inch to 5/8 inch perforations per RI DEM OWTS Rule 6.34C.2. Piping shall be 4 inch SCH40 or 4 inch SDR35.

All outlet tees or other approved outlet devices shall be equipped with an effluent screen approved by RI DEM.

Pressure Distribution Design Parameters

The pressure transport pipe from the septic tank or treatment unit to the GST shall be 1.25 - 2 inch PVC pipe (Class 200 minimum). 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 GST to drain the line after each dose. In some cases, it may be better to slope the transport line in both directions. This should be done to prevent freezing in cold weather. An anti-siphon device should be used where any chance of siphoning of the pump tank may occur.

GST distribution manifolds shall be 1.25 – 2 inch SCH.40 PVC. Distribution laterals shall be 1 – 1.25 inch SCH 40 PVC. Size will vary depending on design and site conditions. Distribution laterals should have flow equalization valves installed to provide equal flow of effluent to all rows when GST laterals are at different elevations. Flow equalization valves are often installed in the pump chamber for easy operation, protection from damage and prevention of freezing. A disconnect/throttle valve shall be installed downstream of the pump to throttle and shut off flow to the GST piping, if necessary.

Pressure distribution systems should be designed with less than 10% flow differential from the first to last orifice; software 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 QuickSnap™ or GeoGuard™ orifice shields must be installed over the orifice holes and glued in place with PVC primer and glue. Upward facing orifice shields shall be located 1/3 and 2/3 from manifold.

Typical designs should account for a minimum of two feet of head pressure at the distal end of each GST 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 degree elbows or equivalent 90 degree sweep elbows (also called turn ups) shall be attached to the distal end of each GST distribution lateral to facilitate setting and measuring distal head, maintenance and inspection. A standard 90 degree elbow should not be utilized because it will interfere with maintenance activities. The open end (upward end) of the sweep needs to be closed off with either a ball valve or threaded plug or cap. These turn ups also serve as distal head ports for measuring and setting distal head on the GST laterals at different elevations.

The installation of a pressure filter, approved by Geomatrix, is recommended between the pump and the laterals on pressure distribution 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 each respective zone or distribution lateral, in a prescribed order.

Site conditions may not facilitate installing all the drain field trenches at the same elevation. In these situations, distribution valves can be used to provide uniform wastewater distribution;

alternatively, throttle valves can be utilized for the same purpose. Access points must be installed for each valve. Valves can be located in the pump tank or in the valve boxes.

Drain Field Cover

Drain field cover shall be a minimum of 6 inches and a maximum of 30 inches over the top of the GST distribution pipe. Uniform cover depth and composition 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. 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.

Geomatrix Systems GST Inspection Port

PN: IPGST15

Figure 1

Figure 2

4” pipe provided by installer

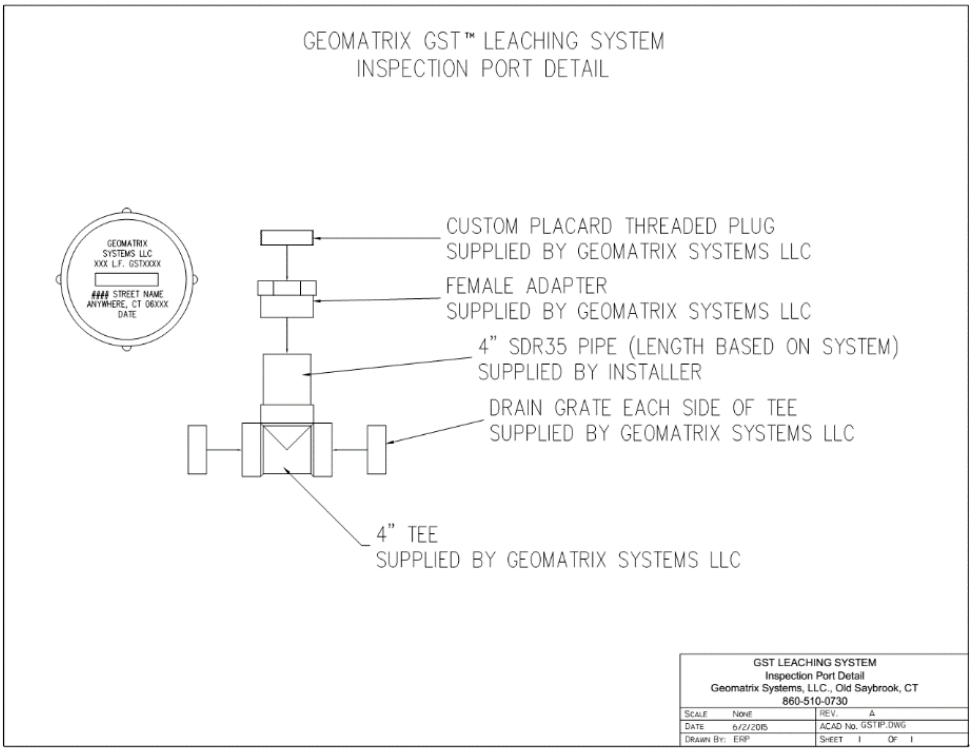


Figure 3

GST Schematics

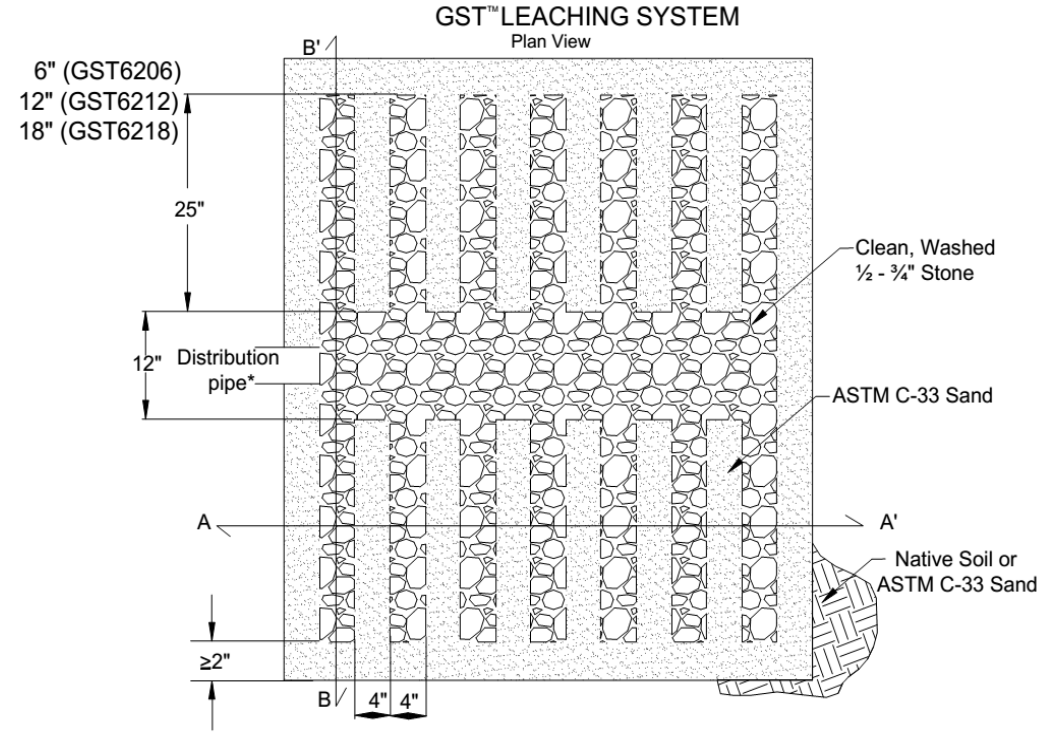
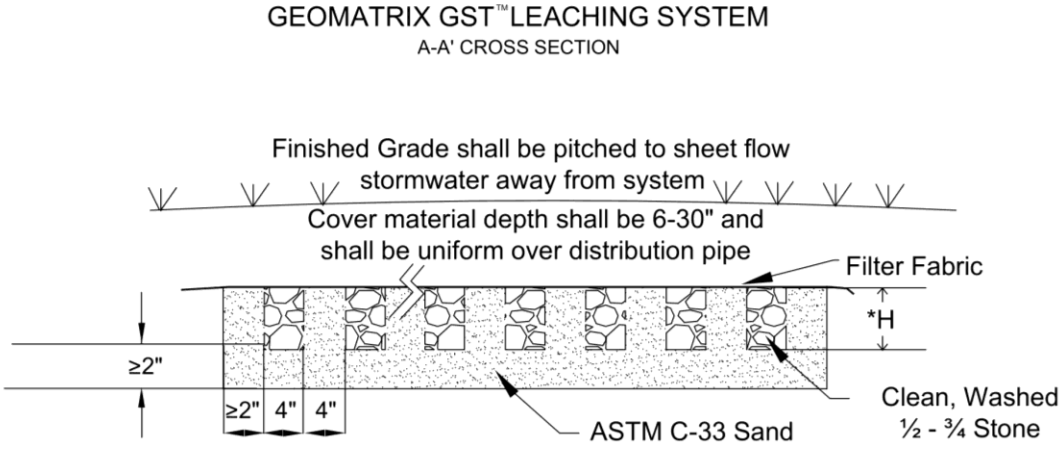


Figure 4



*H= 6" (GST6206)
12" (GST6212)
18" (GST6218)

Figure 5

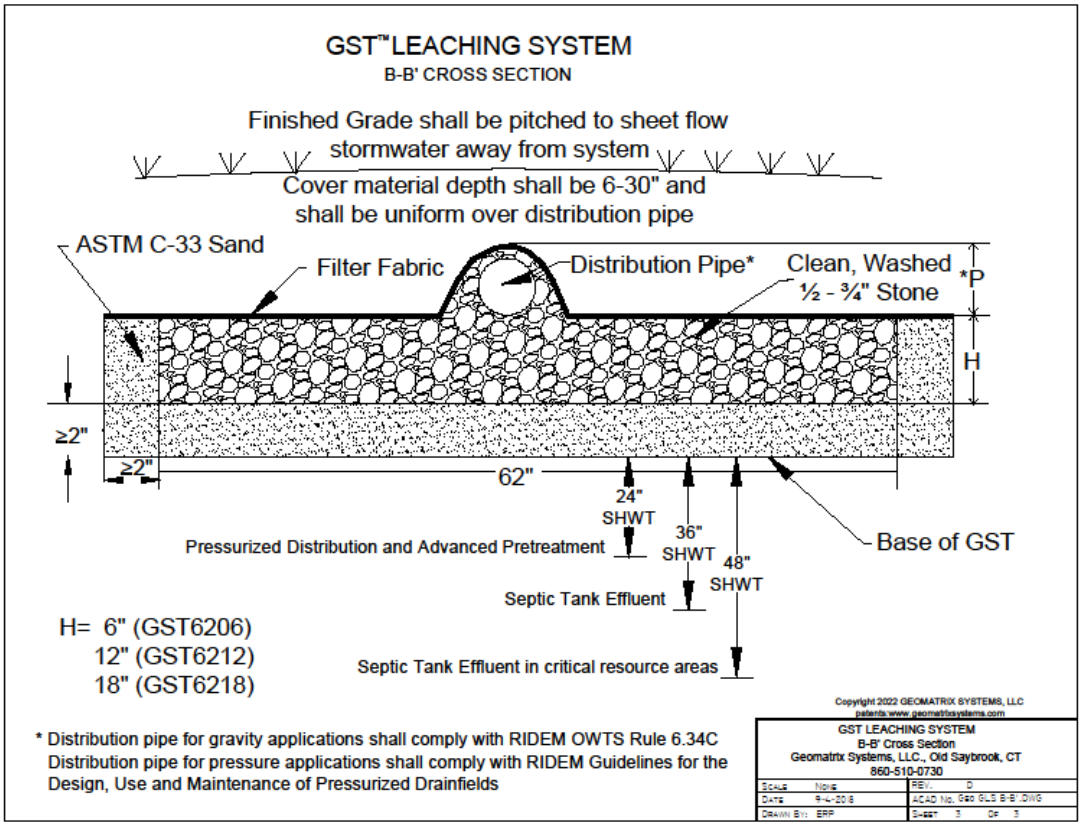


Figure 6

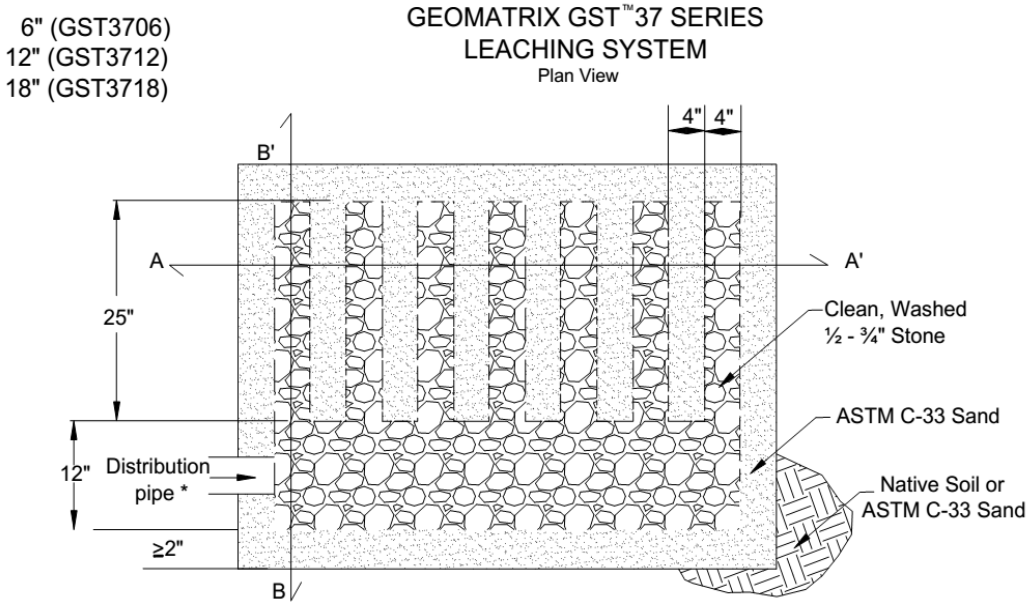
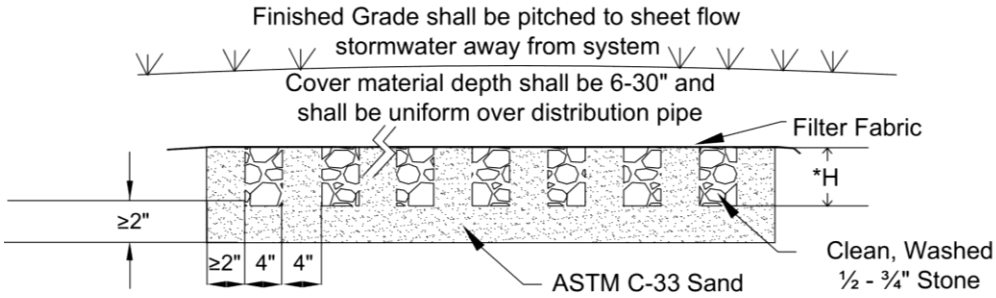


Figure 7

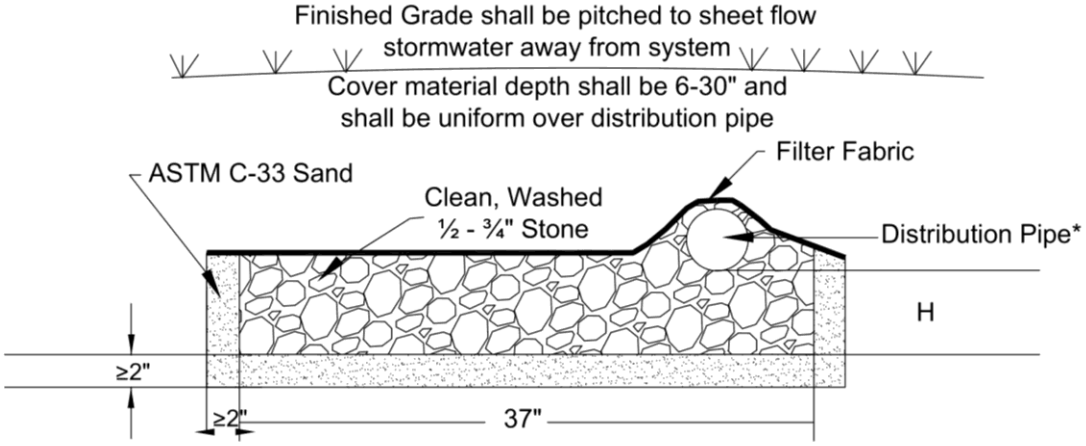
GEOMATRIX GST™37 SERIES
LEACHING SYSTEM
A-A' CROSS SECTION



*H= 6" (GST3706)
12" (GST3712)
18" (GST3718)

Figure 8

GEOMATRIX GST™37 SERIES
LEACHING SYSTEM
B-B' CROSS SECTION



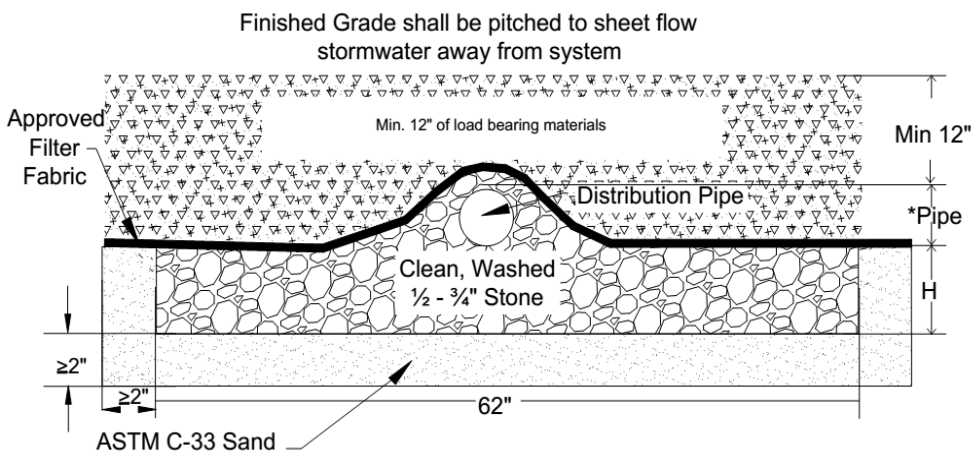
* Distribution pipe for gravity applications shall comply with RIDEM OWTS Rule 6.34C
Distribution pipe for pressure applications shall comply with RIDEM Guidelines for Design, Use and Maintenance of Pressurized Drainfields

H= 6" (GST3706)
12" (GST3712)
18" (GST3718)

Figure 9

H20 Schematics

GST™ 62" LEACHING SYSTEM
H-20

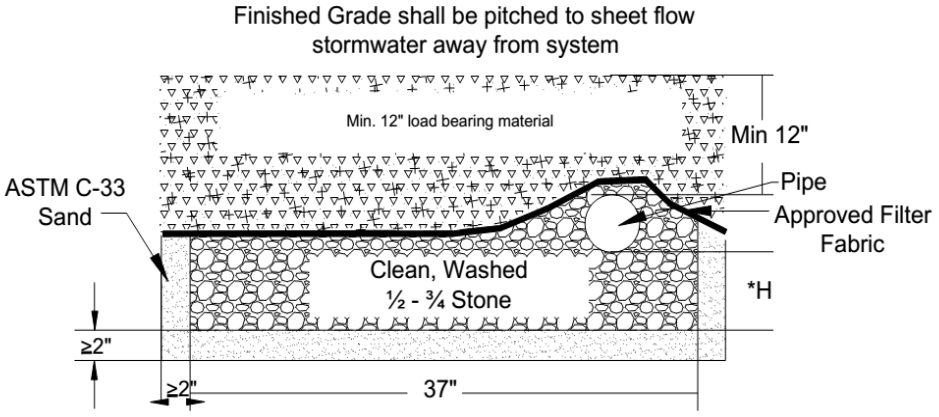


* Distribution pipe for gravity applications shall comply with RIDEM OWTS Rule 6.34C
Distribution pipe for pressure applications shall complywith RIDEM Guidelines for the Design, Use and Maintenance of Pressurized Drainfields

H= 6" (GST6206)
12" (GST6212)
18" (GST6218)

Figure 10

GEOMATRIX GST™37 SERIES
LEACHING SYSTEM
H-20



Distribution pipe for gravity applications shall comply with RIDEM OWTS Rule 6.34C
Distribution pipe for pressure appliations shall comply with RIDEM Guidelines for the Design, Use and Maintenance of Pressurized Drainfields

*H= 6" (GST3706)
12" (GST3712)
18" (GST3718)

Figure 11

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:

- Don't flush sanitary napkins, tampons, condoms, cigarette butts, diapers, wipes and such products into your system.
- Don't dump solvents, oils, paints, paint thinner, disinfectants, pesticides or poisons down the drain.
- Don't dig in your drain field or build anything over it.
- Don't plant anything other than grass over your drain field.
- Don't drive over your drain field or compact it in any way.

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