Recommended Standards and Guidance for Performance, Application, Design, and Operation & Maintenance

Proprietary Distribution Technologies

For Trenches, Seepage Beds, At-grades and Mounds

December 12, 2008
Technical Advisory Panel Meeting

Minnesota Pollution Control Agency

Dick Bachelder, ADS/Hancor
Ben Berteau, Ring Industrial Group
Peder Larson, Larkin Hoffman Daly & Lindgren Ltd.
Carl Thompson, P.E., Infiltrator Systems, Inc.

Who We Are

- Competitors and Manufacturers of Engineered Drainfield Products with more than 20 years of performance history.
  - Our products make up > 95% of the all proprietary non-gravel distribution systems installed in North America

- Experts on science of drainfield operation and regulation
  - State Technical Advisory Committees
  - NOWRA Board
  - NSF Standard Task Groups

Why Are These Products Preferred in Many Areas?

- Quality control concerns associated with drain rock are eliminated
  - No reduction in infiltration capacity due to fines, compaction or embedment
- Speed of installation allows for drainfield to be installed quickly - avoiding weather damage

Why Are These Products Preferred in Many Areas?

- Simplifies construction on tight lots – lightweight products do not need to be trucked to the sites
- Lightweight products protect underlying soils from wheel compaction
- Simplifies inspection– manufactured products are engineered to the same width, depth and length

Why Are These Products Preferred in Many Areas?

- Environmentally friendly – Use recycled materials instead of an energy intensive mined resource
- All manufacturers provide field technical service
- Smaller footprint – allows additional flexibility on tight lots (products are approved in 48 of 50 states with reductions in gross drainfield area)

[Drain Rock] Installation and Quality Control Considerations

These are eliminated when a non-gravel system is used

- When placing drain rock into an excavation, the installer shall ensure that drainfield rock is of suitable quality and placed into the excavation in a fashion that maintains the infiltrative surface of the soil.

- The installer shall verify the quality of drainfield rock at the pit and/or when delivered to the site to ensure it meets required specifications.

- If the quality of the gravel washing process is poor, the silt particles remaining on the surface of the drain rock will likely washed when the system is loaded with effluent. This could result in a layer of fines (clay and silt) that would accumulate at the infiltrative surface, thereby reducing infiltrative capacity.

[Drain Rock] Installation and Quality Control Considerations

These are eliminated when a non-gravel system is used

- If the drainfield rock is ‘mishandled’ on site, it can become contaminated with grass, soil and other materials and debris when drainfield rock is moved with heavy equipment.

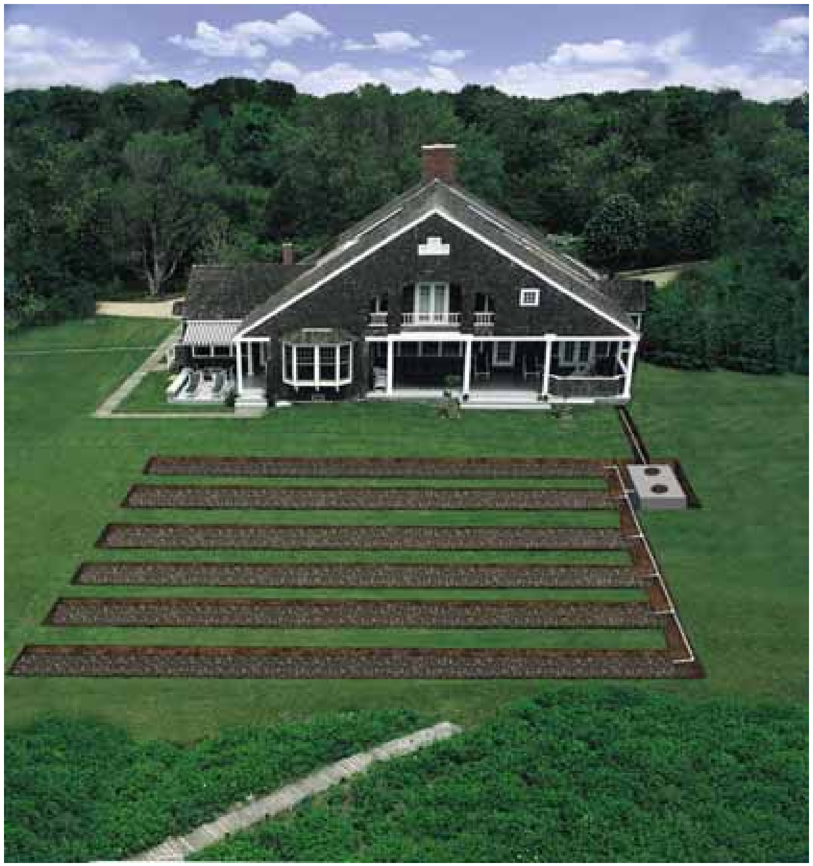
- The pit operator and installer can follow some simple Best Management Practices when loading and moving the drainfield rock so it remains clean and will not become contaminated with fines, silt and clay clods, and other undesirable materials.

[Drain Rock] Installation and Quality Control Considerations

These are eliminated when a non-gravel system is used

- The following techniques can be used to verify drainfield rock meets required specifications:
  - Sieve analyses provided by the gravel pit (statement the material meets drainfield rock requirements)
  - Collect independent samples and test at a materials testing laboratory
  - Perform field tests (jar or bucket test)
    - 1. Use a quart size mason jar. 1/4 fill with aggregate.
    - 2. Use a 5 gallon bucket.
- Other techniques may be helpful - with experience. Look for fines on the rock surface. Another simple technique is to pick up a handful of drainfield rock and observe ‘fines’ on your fingertips. Check for dustiness when drainfield rock is loaded or unloaded from the truck; dust would indicate the rock is too dirty and should be rejected.

How Our Products Are Used



Example: 3 Bedroom Home with Design Flow of 450 gpd and Soil Loading Rate of 0.45 gpd/sf

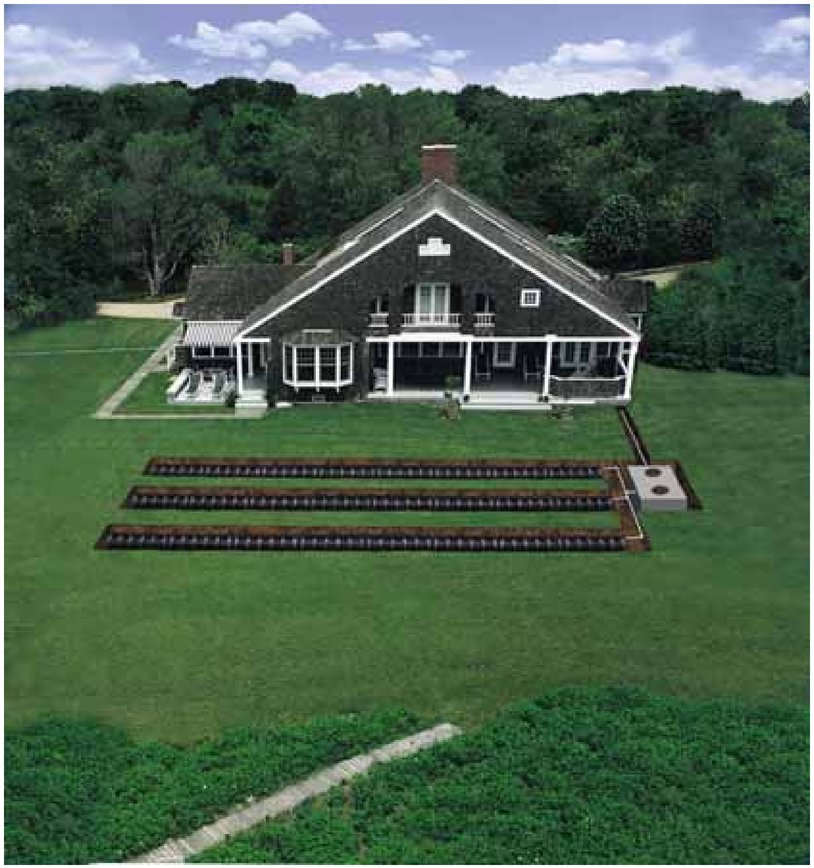
Total Gross Trench Bottom Infiltration Area = 450/0.45 = 1000 sf

Gravel Trench – 3’ wide (12” gravel depth) – Rating = 3 sf per linear foot

Total Trench Length = 1000/3 = 333.3’

- 6 trenches 56’ long

How Our Products Are Used



Example: 3 Bedroom Home with Design Flow of 450 gpd and Soil Loading Rate of 0.45 gpd/sf

Total Gross Trench Bottom Infiltration Area = 450/0.45 = 1000 sf

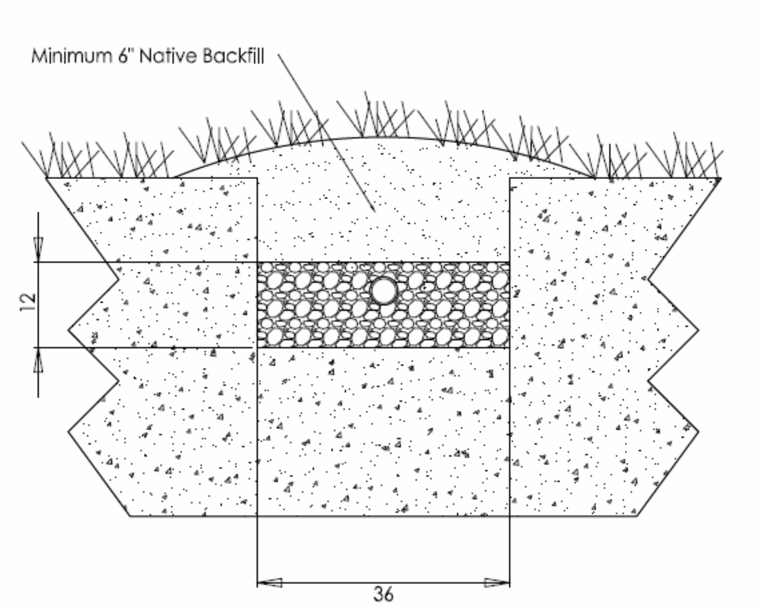
Non-Gravel Trench – 3' wide (12" gravel depth) – Rating = 6.0 sf per linear foot (<u>2.0 Equivalency Factor</u>)

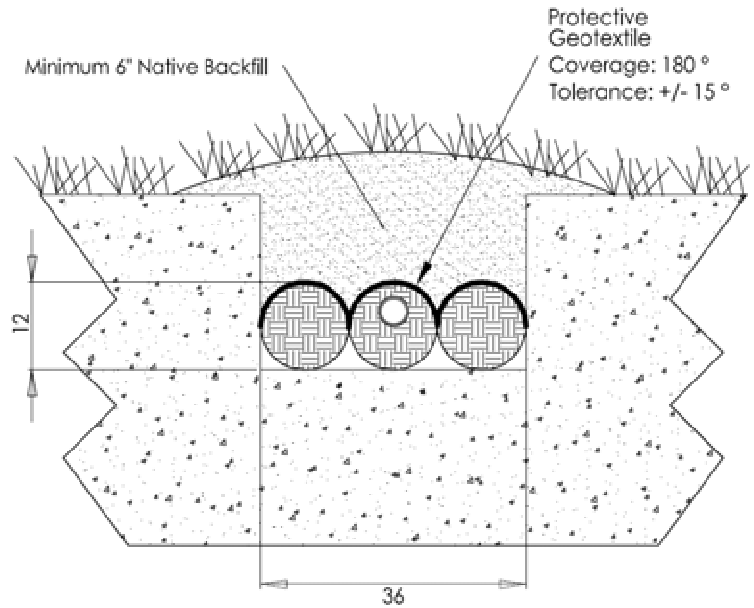
Total Trench Length = 1000/6= 167.7'

- 3 trenches 56' long

Note: We are not asking for this equivalency factor/sizing in Minnesota

How Our Products Are Used





Product Rating (sf/lf) = Trench Width x Equivalency Factor

Equivalency Factor = <u>LTAR Non-Gravel System</u>
LTAR of Gravel System

Examples:

- 3’ wide trench x <u>2.00</u> equivalency factor = 6 sf/lf (50% Gross area reduction)
- 3’ wide trench x <u>1.67</u> equivalency factor = 5 sf/lf (40% Gross area reduction)
- 3’ wide trench x <u>1.33</u> equivalency factor = 4 sf/lf (25% gross area reduction)

How Our Products Are Used

- Non-gravel products now make up the majority of residential drainfield installations in North America
- Non-gravel systems (concrete chambers) were included in the Maine code in 1974 with a 50% reduction compared to gravel drain rock
- Over 2.5 million non-gravel drainfields have been installed in North America over the past 20 years
- 48 of 50 States allow use of non-gravel products with equivalencies (gross area reductions)
- Chambers (certified per IAPMO PS 63) are included in the Unified Plumbing Code when sized at 70% of a gravel drainfield (1.53 equivalency factor)

MN History

- 1998 – Non-gravel drainfields allowed when installed with a 40% reduction (1.67 equivalency factor) when manufacturer warranties the system

- 12” deep products installed in 36” wide trenches rated at 5 sf/lf. Includes:
  - “Standard” Chambers
  - EZflow 1203H

(these products are also widely used at a rating of 3.0 sf/lf or with an equivalency factor or 1.0)

MN History

Minnesota Installations Of Warrantied Infiltrator Systems

An Estimated 6,378 Infiltrator "Warrantied Systems" have been installed:

Year	Number of Systems
1998	216
1999	462
2000	688
2001	899
2002	1,863
2003	2,250
Total	**6,378**

46 counties allow installations of Infiltrator Systems at Warrantied size as of March 2004:

• Aitkin	• Hubbard	• Nicollet
• Beltrami	• Isanti	• Pipestone
• Blue Earth	• Jackson	• Pope
• Becker	• Kandiyohi*	• Redwood
• Carlton	• Koochiching	• Rice
• Chippewa	• Le Sueur	• Rock
• Clear Water	• Lincoln	• Sherburne
• Cottonwood	• Lyon	• Stearns
• Dakota	• Mahnomen	• Swift
• Dodge	• Martin	• Todd
• Douglas	• McLeod	• Wabasha
• Faribault	• Meeker	• Watonwan
• Freeborn	• Mille Lacs	• Wadena
• Grant	• Mower	• Winona
• Goodhue	• Murray	• Yellow Medicine
	• Nobles	

*Reviews and approves individual Warrantied size installations.

Use in Wisconsin

- 1997 – Chambers are approved for general use with a 40% gross area reduction

- 1997 – 2001 - Multiple products approved – each with a slightly different rating

- 2001 – Department “invites” manufacturers to meet with staff to develop uniform sizing approach. Manufacturers and Department staff develop proposed policy.

- 2002 – Wisconsin TAC approves uniform sizing policy that results in all products that nominally fit in a 3’ wide trench being rated at 5.0 sf/lf (1.67 equivalency factor)

Use in Washington

- All gravelless products are sized in accordance with “Recommended Standards and Guidance Document”
- Drainfield size reductions of up to 40% (1.67 equivalency factor) allowed based on soil type.
- Manufacturers register their products yearly by submitting (or re-certifying previously submitted) product dimensional information

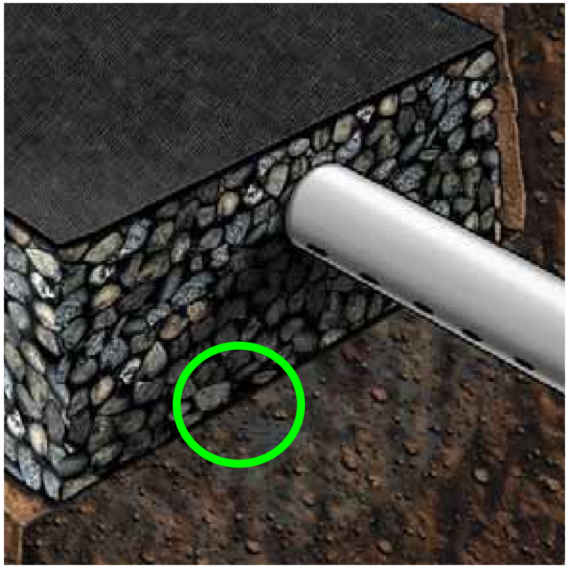
Use in Other States

States that permit the most onsite systems annually (more than 20,000 systems/year in 2008)

State	Equivalency Factor	Gross Area Reduction
NC	1.33 – 1.53	25% - 35%
FL	1.33 – 1.67	25% - 40%
GA	1.33 – 1.53	25% - 35%
VA	1.33 – 2.00	25% - 50%
TX	1.67	40%
CA	1.43	30%

Technical Discussion

Gravel Drain Rock



Non-Gravel

Establishing an Equivalency Factor

$$\text{Equivalency Factor} = \frac{\text{LTAR Non-Gravel System}}{\text{LTAR of Gravel System}}$$

Technical Discussion

Research Study	Description of Study	Equivalency Factor (Septic Tank Effluent)
Sweeny, Robert. 2008. Field Inspection and Evaluation of the Hydraulic Performance of EZflow 1201P Gravel Substitute Drainfield Systems in Clackamas, Marion, Multnomah and Deschutes Counties, Oregon. Presented at 2008 OR DEQ Technical Advisory Committee meeting	436 field evaluations of 103 EZflow systems over a five year period for determining product failure rate	2.0
Christopherson et al. 2008. Field Comparison of Rock-Filled and Chambered Trench Systems in Journal of Hydrologic Engineering, Vol. 13, No. 8,	Field evaluation of over 100 gravel and chamber systems 5 to 10 years old	No failures detected for either system type
Lowe et al. 2008. Controlled Field Experiment for Performance Evaluation of Septic Tank Effluent Treatment during Soil Evaluation, , Journal of Environmental Engineering,	Two-year field study of 30 pilot-scale test cells.	1.4 – 1.8
Walsh, R. 2006. Infiltrative Capacity of Receiving Media as Affected by Effluent Quality, Infiltrative Surface Architecture, and Hydraulic Loading Rate, Master Thesis at Colorado School of Mines	One dimensional column study	3.2
Uebler et al. 2006. Performance of Chamber and EZ1203H Systems Compared to Conventional Gravel Septic Tank Systems in North Carolina, , Proceedings of NOWRA	Field evaluation of failure rates of approximately 300 of each type system (gravel, chamber, EPS) 2-12 years old	1.4
Radcliffe et al. 2005. Gravel and Sidewall Flow Effects in On-Site System Trenches, , Soil Science Society of America Journal	Two dimensional computer model (HYDRUS-2D)	1.5 – 1.93

Radcliffe et al

Gravel and Sidewall Flow Effects in On-Site System Trenches

Dr. David Radcliffe, Larry West, and Shelby Finch
University of Georgia

Introduction

Gravel in conventional on-site system trenches is thought to impede infiltration in several ways (Siegrist, 1987). Gravel particles may mask part of the soil surface at the bottom of a trench, preventing infiltration in these areas. Gravel particles may compact or become embedded in the soil or in the biomat that forms at the trench-soil interface and reduce the hydraulic conductivity of this layer. Fine particles that wash off coarse gravel particles may form a low-conductivity layer at the trench-soil interface. Chamber systems have been developed for on-site systems that, unlike standard systems, do not use gravel in the trench bottom. In Georgia, chamber systems have been approved by the State Department of Human Resources for installation using half the drain line length of gravel systems. The assumption is that infiltration rates are twice that of gravel systems since gravel particles block about half of the trench bottom. This assumption is based on an analysis using Darcy's Law for steady 1D flow:

$$Q = K\, i\, A \qquad (1)$$

where Q is the infiltration rate, i is the hydraulic gradient, and A is the cross-sectional area for infiltration. The argument is that if A is reduced by half in gravel systems, then the infiltration rate should be reduced by half.

Radcliffe et al

Objective

Our objective was to use HYDRUS-2D to determine the effect of gravel masking and embedded gravel in on-site system trenches. This work led us to investigations of the role that sidewall flow plays in infiltration from trenches.

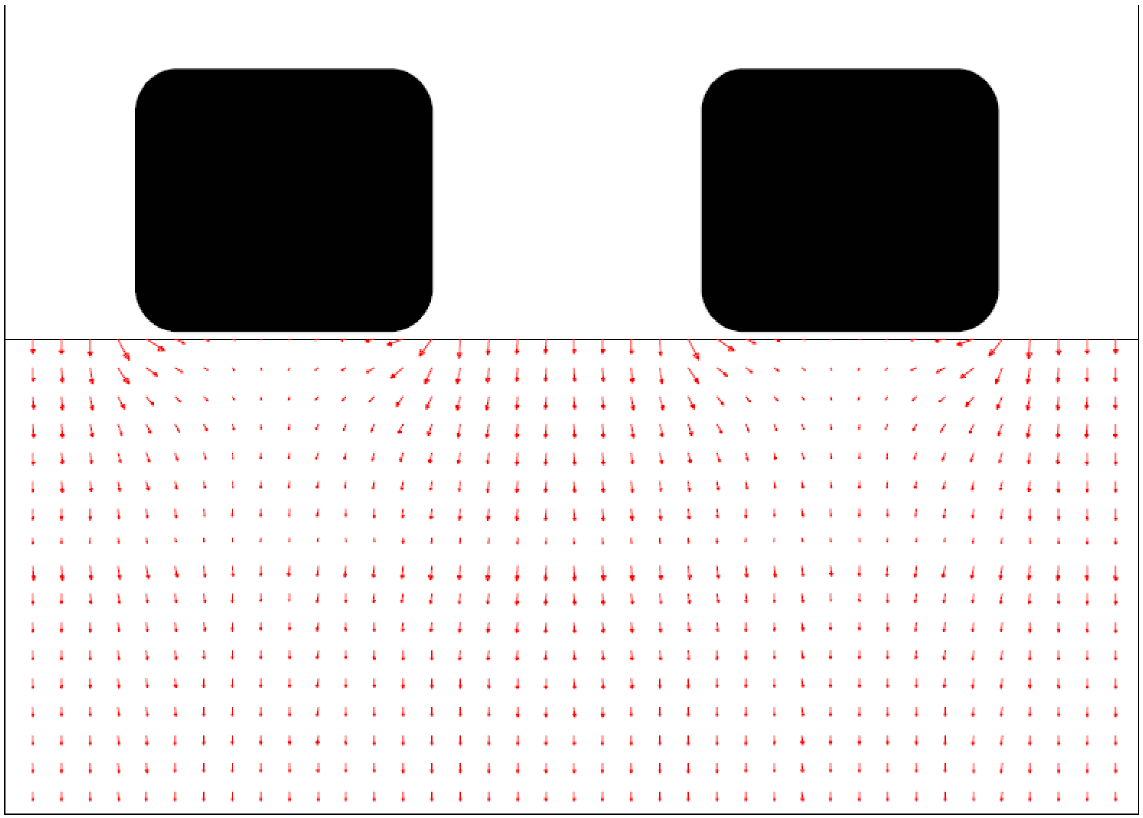


Figure 1. Velocity vectors of flow in the biomat in simulations showing the effect of gravel masking for infiltration into the Cecil BC horizon. The arrows show the direction and rate of flow (longer arrows indicate faster flow).

Radcliffe et al

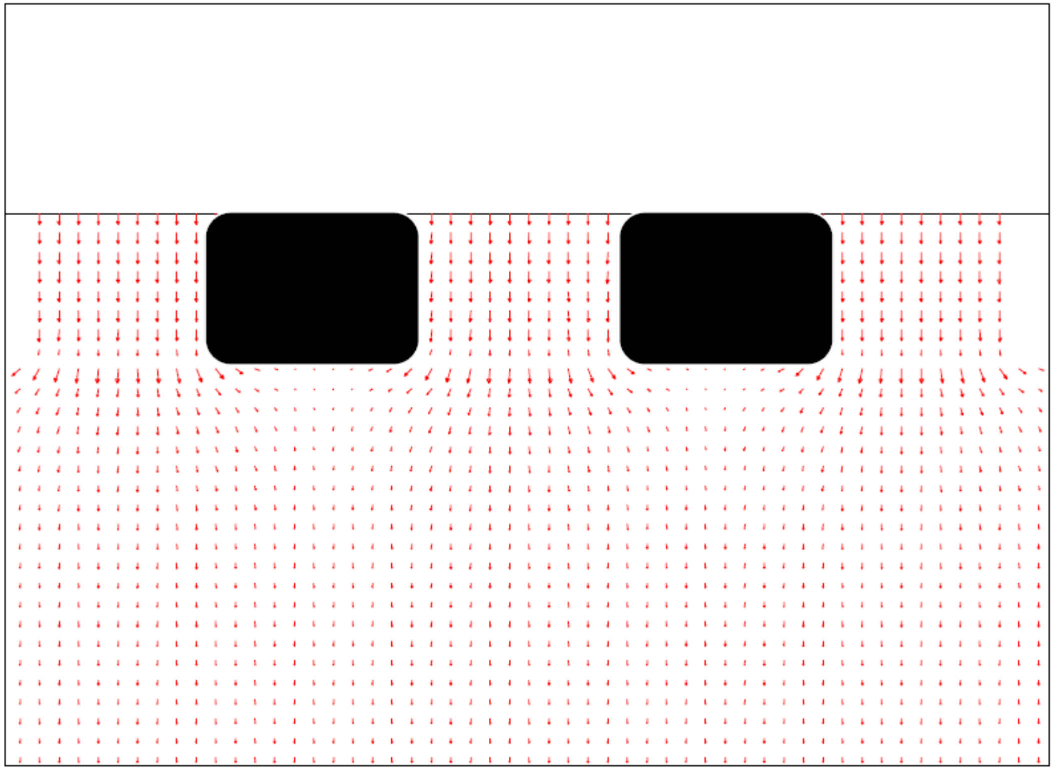


Figure 3. Velocity vectors of flow in the biomat in simulations showing the effect of embedded gravel for infiltration into the Cecil BC horizon. The arrows show the direction and rate of flow (longer arrows indicate faster flow).

Equivalency Factor Determined = 1.5 - 1.93

In-Ground Dispersal of Wastewater Effluent: The Science of Getting Water into the Ground

CONTRIBUTING WRITERS

Kevin D. White, Ph.D., P.E. and Larry T. West, Ph.D.

ABSTRACT: This paper describes the scientific principles of Darcy's law and hydraulic resistance as they relate to the in-ground dispersal of onsite wastewater effluent. A clear understanding of how water moves into the ground via dispersal trenches is needed to facilitate proper system design and effect some standardization of dispersal trench sizing and design. Hydraulic conductivity of the media, hydraulic head, media layer thickness, and area of infiltration are key in determining water movement into the soil. Restrictive media layers, such as fines or biomat, are shown to control infiltration rates and long-term soil acceptance rates of septic tank effluent because of low hydraulic conductivity characteristics.

Darcy's law is stated as follows;

$$Q = -KA\,(dH/dL)$$

Where;

Q = the flow rate of effluent (gpd)
K = the hydraulic conductivity of the media (gpd/ft^2)
A = area for effluent transmission (ft^2)
dH/dL = hydraulic gradient (unit less)

COLUMN STUDIES SIMULATE TRENCH INFILTRATION

Column studies are an effective tool that can be used to test the various hydraulic parameters of soils or dispersal trenches (as described by Darcy's Law), while reducing selected parameters to constants. For example, in column studies, the area through which flow occurs is constant (the column bottom). Similarly, the hydraulic head can be held constant in a column study. Thus, each of the key factors controlling flow through porous media can be evaluated independently.

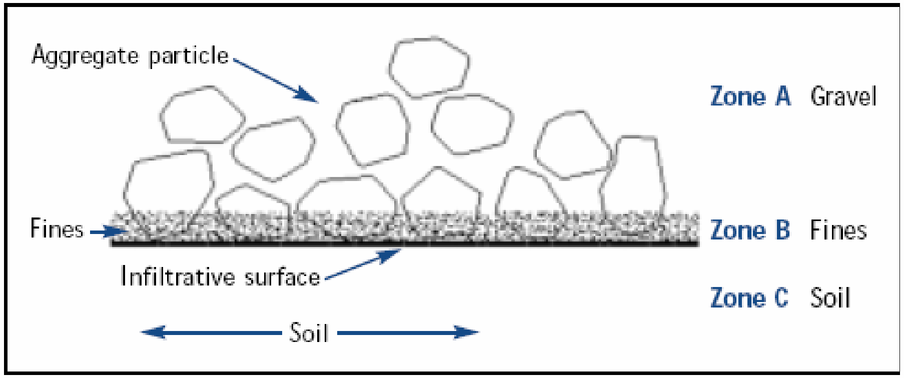


Figure 1 Layering of Porous Medias, Each with Its Own Characteristic Hydraulic Conductivity

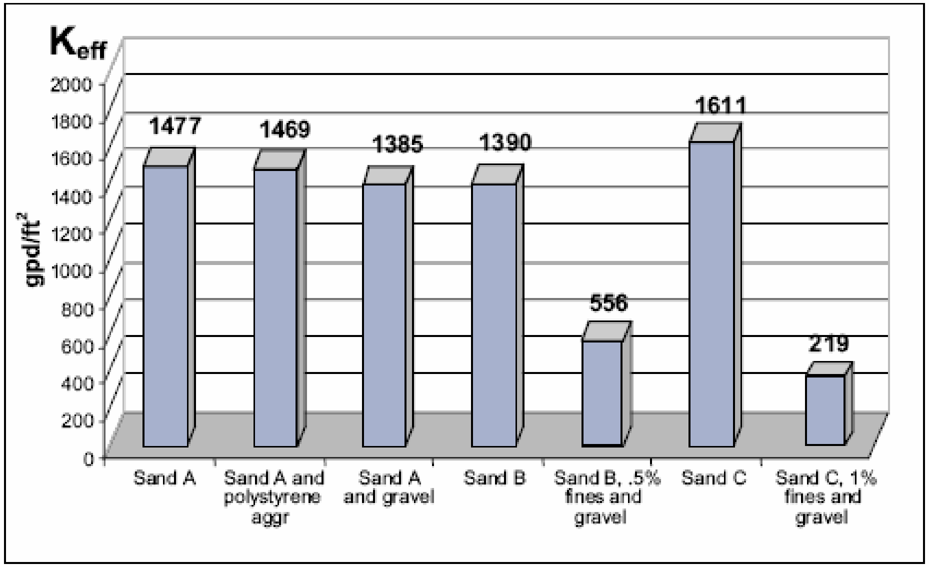


Figure 4 Hydraulic Conductivity of Several Soil or Soil/Aggregate Media, as Determined by Column Experiments Utilizing Constant Head and Constant Area

Equivalency Factor = 2.5 – 7.4

Flow Model Using Published K Values for Biomat

Table 4 Trench Flow Model Using High Hydraulic Conductivity Estimates for Fines/Biomat Layers

Zone	Description	K (gpd/ft^2)	L (ft)	R	Q (gpd)	J_w (gpd/ft^2)
1	Gravel with no fines	1000	0.3	.0003	—-	—-
2	Fines	0.5	0.03	.06	—-	—-
3	Soil/Biomat	0.5	0.04	.08	—-	—-
4	Effluent Saturated Soil	6	0.25	.0417	—-	—-
		K_{EFF} = 3.41			Q = 3.41	J_w = 3.41

Table 5 Trench Flow Model Using Low Hydraulic Conductivity Values for Fines/Biomat, and Unsaturated Soils

Zone	Description	K (gpd/ft^2)	L (ft)	R	Q (gpd)	J_w(gpd/ft^8)
1	Gravel with no fines	1000	0.3	.0003	—-	—-
2	Fines	0.01	0.03	3	—-	—-
3	Soil/Biomat	0.01	0.04	4	—-	—-
4	Effluent Unsaturated Soil	0.6	0.25	1.25	—-	—-
		K_{EFF} = 0.075			Q = 0.115	J_w = 0.115

Equivalency Factor = 1.42 – 1.5

Controlled Field Experiment for Performance Evaluation of Septic Tank Effluent Treatment during Soil Infiltration

Kathryn S. Lowe[1] and Robert L. Siegrist, Ph.D, P.E.[2]

Abstract: Decentralized systems are responsible for treating approximately 25% of the wastewater generated in the United States. The most common decentralized system involves onsite treatment using a septic tank unit followed by dispersal to a subsurface soil infiltration unit where percolation to groundwater occurs. To evaluate the hydraulic and purification processes occurring during soil treatment of septic tank effluent (STE), a field experiment was initiated in the Spring of 2003 with continued operation and monitoring for 2 years. A replicated factorial design (2^2) was employed to evaluate three infiltrative surface architectures (ISAs) (open, stone, and synthetic) and two daily hydraulic loading rates (HLRs) (4 and 8 cm/day). Pilot-scale test cells were established in native sandy loam soils at the Mines Park Test Site located on the Colorado School of Mines campus in Golden, Colo. STE was obtained from a nearby multifamily apartment building and applied to the test cells daily. Field monitoring included baseline characterization of soil and site properties, routine characterization of the STE applied, observations of STE ponding on the infiltrative surface, periodic measurement of constant-head infiltration rates, and periodic sampling and analyses of the soil pore water at 60- or 120-cm depths below the infiltrative surface. Monitoring revealed that the ISA and HLR influenced the rate and extent of hydraulic capacity loss during soil treatment. For example, an open horizontal infiltrative surface maintained an infiltration capacity that was 40–80% higher than one covered with either washed stones or synthetic aggregate. Purification of STE during infiltration and percolation through the sandy loam soil was very high. The cumulative mass removed during 2 years of operation for dissolved organic carbon, total nitrogen, and total phosphorus averaged 94, 42, and 99%, respectively. While there was no significant difference in the purification performance based on ISA or HLR, an increase in the vadose zone depth slightly increased purification.

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CE Database subject headings: Wastewater management; Water reclamation; Infiltration.

Lowe et al

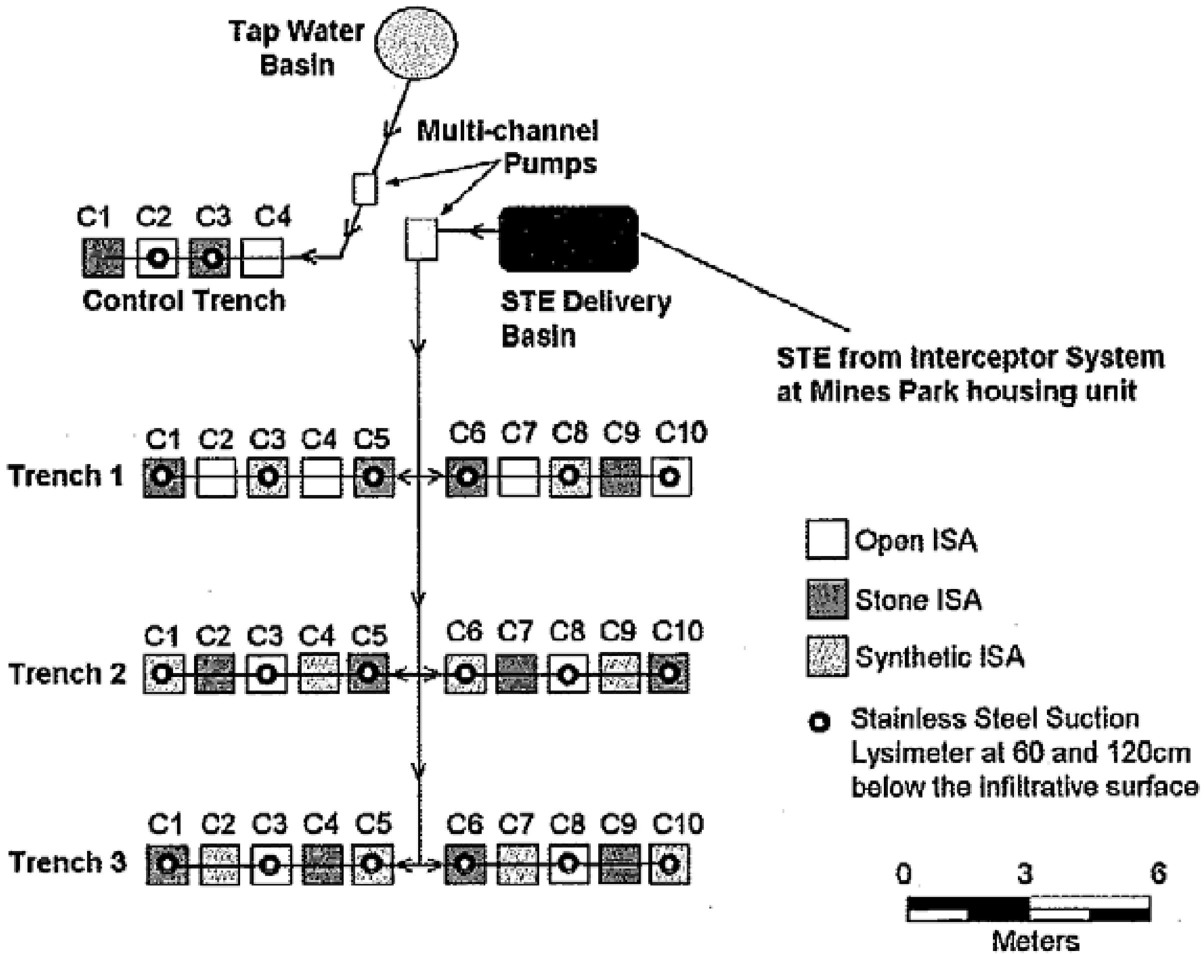
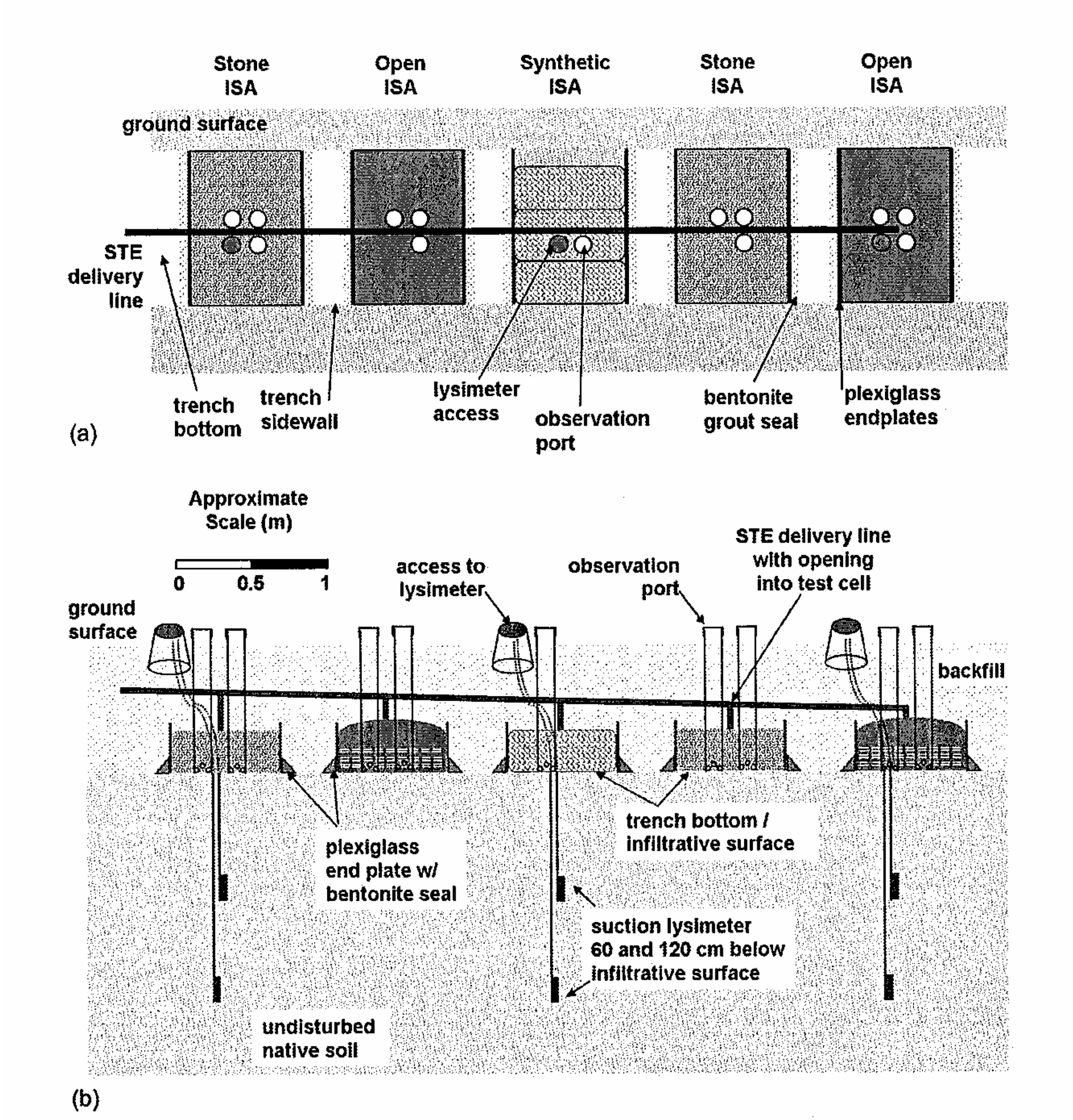


Fig. 1. Schematic detail of experimental layout

Lowe et al

- Controlled field study with soil test cells
  - Factorial design (2 x 3)
    - 3 infiltrative surface architectures
      - Open, Gravel, Synthetic
    - 2 daily hydraulic loading rates
      - 4 and 8 cm/d (2x and 4x normal design rates)
      - Continuous loading for 16hr daily, 7 days a week,...
    - 5 replicates of each condition
  - STE loading started in May 2003 (~24 month study)

Lowe et al



Equivalency Factor Measured = 1.4 - 1.8

INFILTRATIVE CAPACITY OF RECEIVING MEDIA AS AFFECTED BY EFFLUENT QUALITY, INFILTRATIVE SURFACE ARCHITECTURE, AND HYDRAULIC LOADING RATE

D. Ryan Walsh, Kathryn Lowe, Dr. John McCray, Dr. Robert Siegrist*

Abstract

The operational lifetimes of onsite wastewater treatment systems are often directly related to the clogging of the infiltrative surface within the soil treatment unit. Strategies such as pretreatment prior to discharge or installation of gravelless trenches could mitigate clogging. There are economic benefits to increasing the operational lifetime of the soil treatment unit and also minimizing the area required for treatment; however, care must be taken to protect the receiving environment. A one-dimensional column study was conducted at the Colorado School of Mines to evaluate the hydraulic performance as affected by effluent quality, infiltrative surface architecture, and hydraulic loading rate. A replicated factorial design (2^3) was used to compare two effluent qualities (biofilter effluent and septic tank effluent), two infiltrative surface architectures (open and gravel-laden), and two hydraulic loading rates (20 cm/d and 50 cm/d). The columns were packed with a medium to coarse sand and effluent was delivered daily following a micro-dosing loading regime. Hydraulic parameters were routinely monitored over a period of 144 days including acceptance rate and ponding height. Effluent quality was monitored for parameters such as pH, organic matter, and nutrients. The columns loaded with higher quality biofilter effluent had longer times to continuous ponding (80-113 days) than the columns loaded with septic tank effluent (14-31 days). The higher quality biofilter effluent also resulted in higher final acceptance rates than septic tank effluent within columns with gravel-laden infiltrative surface architecture. Open infiltrative surface architecture had higher final acceptance rates than gravel-laden within the columns loaded with septic tank effluent. Infiltrative surface architecture had less of an effect on the final acceptance rates within the columns receiving the biofilter effluent. The 20 cm/d hydraulic loading rate had higher final acceptance rates than 50 cm/d within the columns loaded with biofilter effluent.

Walsh et al

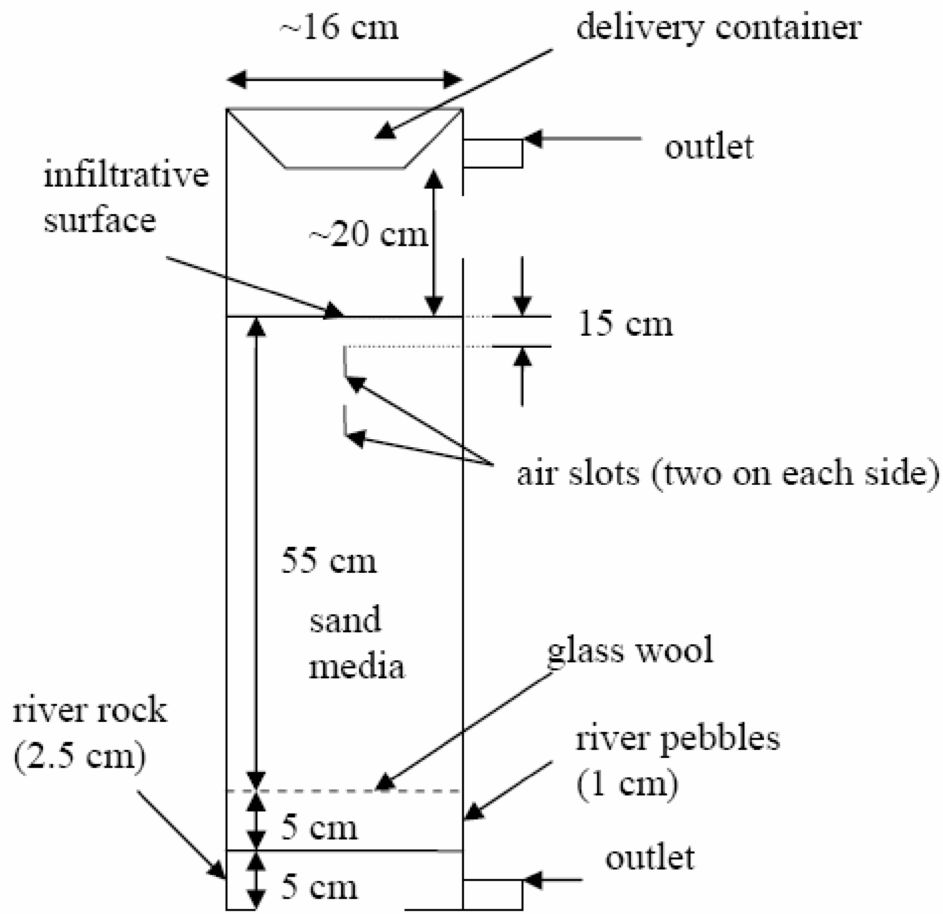


Figure 1-Column design (not to scale)

Walsh et al

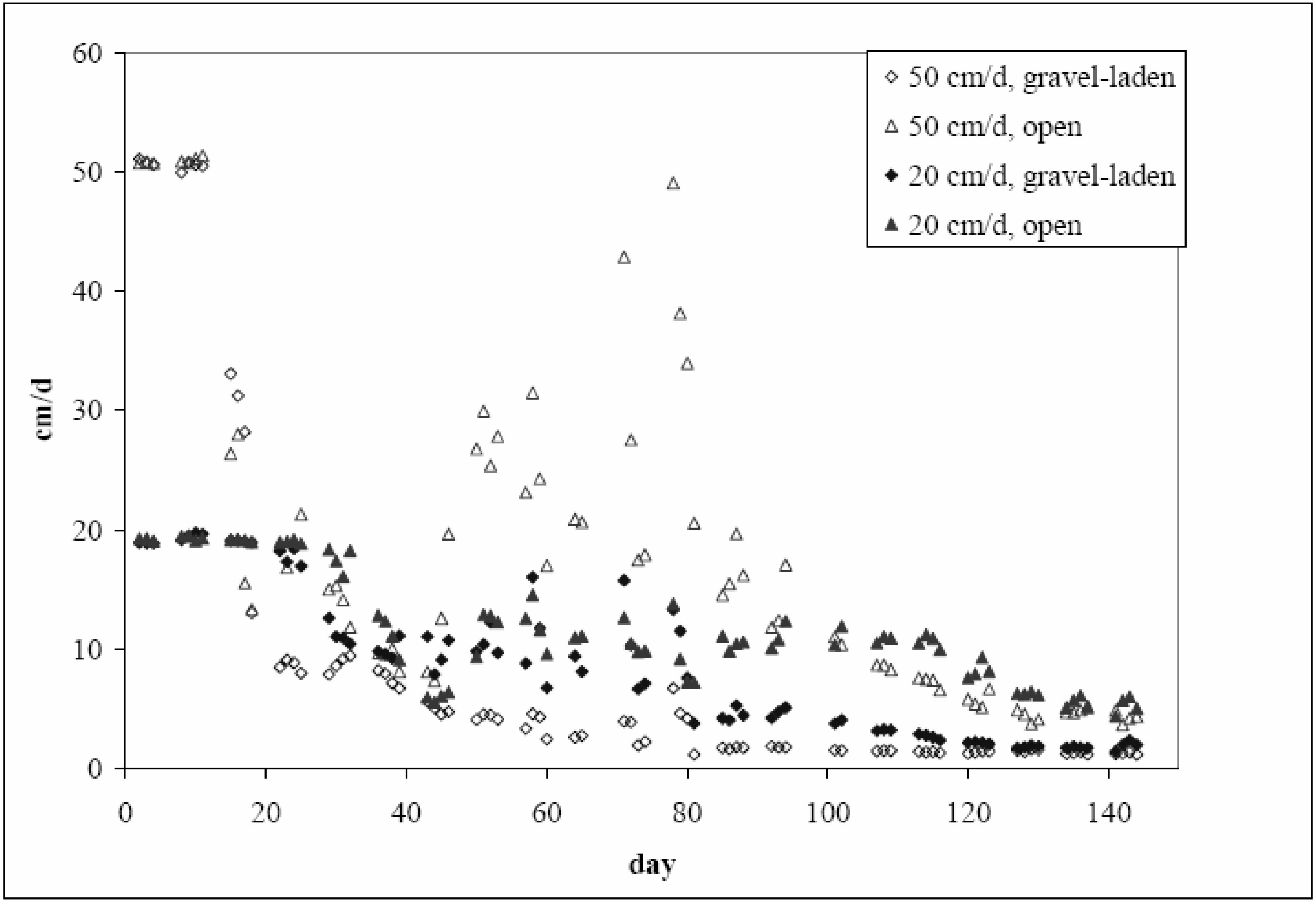


Figure 2-Acceptance rates for STE loaded columns (day 1 is 9-20-05)

Walsh et al

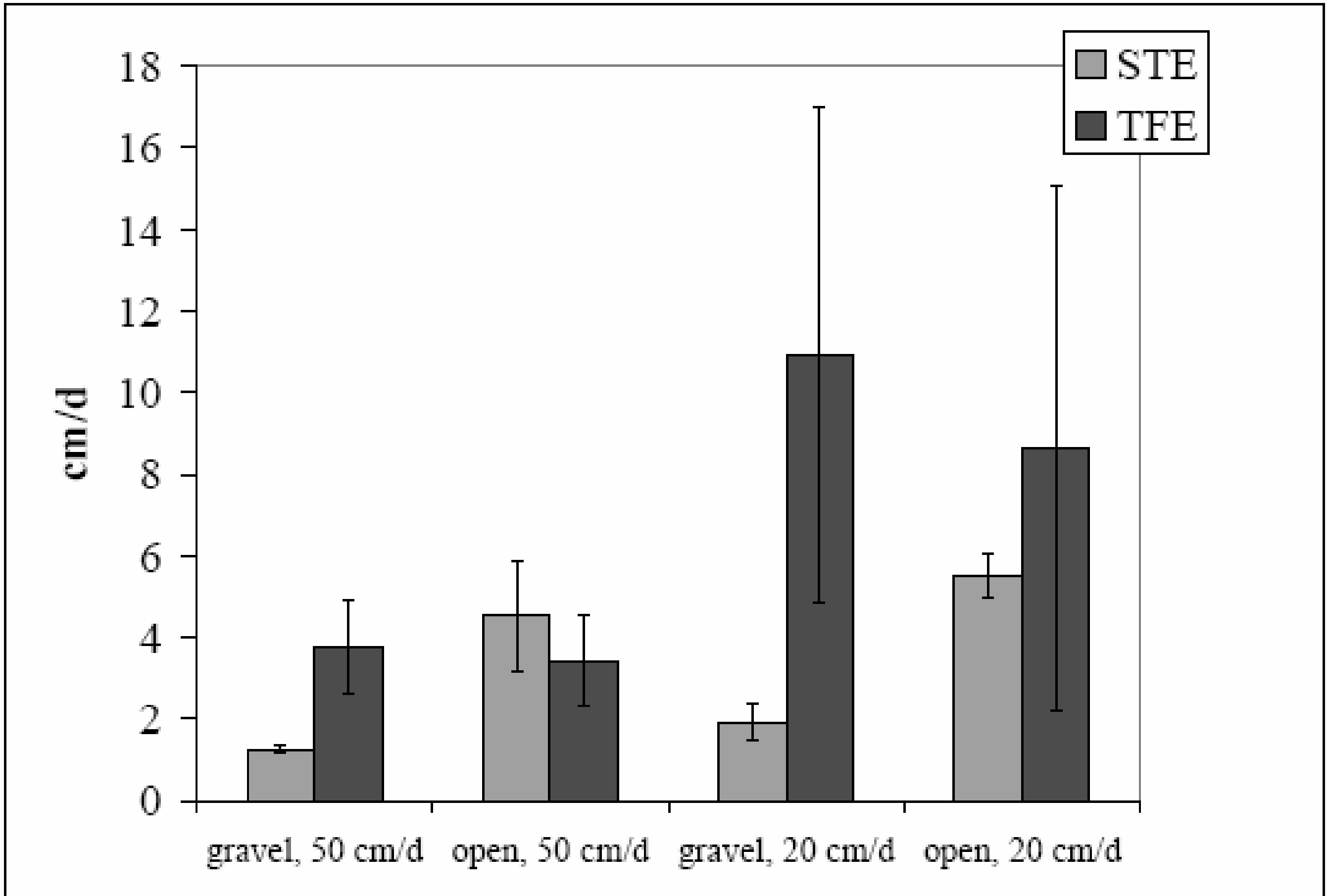


Figure 4-Average final acceptance rates for each condition
(error bars represent ± one standard deviation)
(n = 14 for both data sets)

Walsh et al

The acceptance rate data shows that within the columns receiving STE, the open ISA resulted in a higher final acceptance rate. One way to explain the open ISA having a higher final acceptance rate is that by introducing gravel to the infiltrative surface, the effective infiltrative zone through which effluent can flow through is reduced. The effective zone in which suspended solids and metabolic byproducts can accumulate onto is also reduced. This results in a higher effective cumulative organic loading when normalized by the effective infiltration area. Previous research supports this theory (Diaz, 2003; Siegrist *et al.*, 2004).

The columns receiving TFE show no difference between the two ISA, suggesting that ISA plays less of a role when applying a higher quality effluent. This is consistent with the hypothesis stating that as water quality approaches that of pure water, the hydraulic conductivity of the media is what limits the infiltrative capacity and not the ISA.

Walsh et al

The open [no gravel on soil interface] ISA had a higher infiltrative capacity than the gravel-laden ISA at the end of the project for columns receiving STE [septic tank effluent]. The ratio of open ISA to gravel-laden ISA mean final acceptance rates was 3.2. This has implications suggesting that open ISA would have more favorable long term hydraulic behavior when applying STE.

Equivalency Factor
Measured = 3.2

Uebler et al

Performance of Chamber and EZ1203H Systems Compared to Conventional Gravel Septic Tank Systems in North Carolina

R.L. Uebler, S. Berkowitz, P. Beusher, M. Avery, B. Ogle, K. Arrington and B. Grimes

Abstract

The North Carolina On-Site Wastewater Section conducted a statewide survey, which compared the performance of chamber and EZ1203H systems with 25% trench length reduction to conventional gravel systems. A total of 912 systems were randomly chosen in 6 counties across the state. To control evaluation bias, a group of students from Western Carolina University were hired to inspect each system. A system was considered to have failed if there was evidence of sewage at the ground surface or if an owner reported problems with the system. The statewide failure rate of both standard chamber and EZ1203H systems compared to conventional gravel systems was not statistically different at a 95% confidence level.

Uebler et al

Soil Group	Texture Family (USDA)	Texture Class (USDA)	LTAR (gpd/ft^2)
I	Sands	Sand, Loamy Sand	1.2 to 0.8
II	Coarse Loams	Sandy Loam, Loam	0.8 to 0.6
III	Fine Loams	Sandy Clay Loam, Silt Loam, Clay Loam, Silty Clay Loam, Silt	0.6 to 0.3
IV	Clays	Sandy Clay, Silty Clay, Clay	0.4 to 0.1

The trench bottom area is then calculated by dividing the design flow, 120 gpd per bedroom, by the LTAR. Trench length is then determined by dividing the required trench bottom area by the trench width of 3 feet.

The chamber systems surveyed in this study were the standard design, which had an average open bottom width of about 29 inches and height of about 12 inches. The polystyrene aggregate systems surveyed were the EZ1203H, which is 12 inches high and 36 inches wide. The North Carolina approval for the both the standard chamber and the EZ1203H, allows for a 25% reduction in trench length compared to a conventional gravel trench system. Other trench requirements for chambers and EZ1203H systems are the same as for conventional systems. Trenches are dug with a 3-foot width, and placed on 9-foot centers, if multiple trenches are required.

Uebler et al

The following questions were answered with a yes or no by the survey team for each system inspected:

1.) Is sewage ponded on the surface?
2.) Does pressure to the soil surface with a shoe result in sewage coming to the surface?
3.) Is there a straight pipe?
4.) Is there evidence of past failure?
5.) Is there evidence of a repair?

In addition, an attempt was made to interview the occupants at each survey site in person or by phone. Answers to the following questions were obtained during the interview:

1.) Has your tank been pumped for other than routine maintenance?
2.) Are you having any of the following problems with your system today: surfacing on the ground; wet over system; odors; back up into the house; other?
3.) Have you had problems with the system in the past: surfacing on the ground; wet over system; odors; back up into the house; other?
4.) How was the problem solved?
5.) Has system been repaired or replaced?

A yes for one or more of the above questions answered by the survey team or the occupant was considered to be a system failure. More information was collected, but was not used to determine system failure.

Uebler et al

Table 1. System failure rate for conventional gravel, chamber, and EZ1203H systems.

System Type	Systems OK	Systems Failed	Total	Percent Failure
Gravel	281	22	303	7.3
Chamber	277	26	303	8.5
EZ1203H	277	29	306	9.5
Total	835	77	912	8.4

Table 2. System failure rate by physiographic region disregarding differences in system type.

Physiographic Region	Systems OK	Systems Failed	Total	Percent Failure
Coast	256	34	290	11.7
Piedmont	286	31	317	9.8
Mountain	293	12	305	3.9
All Regions	835	77	912	8.4

Uebler et al

Table 3. System failure rate by age group disregarding differences in system type.

System Age	Systems OK	Systems Failed	Total	Percent Failure
2 to 4 years	283	24	307	7.8
5 to 7 years	351	26	377	6.9
8 to 12 years	201	27	228	11.8
All Ages	835	77	912	8.4

Summary

The purpose of this survey was to determine if there was a difference in the failure rate of chamber and EZ1203H systems compared to gravel. Based on the data collected, the statewide failure rate of both standard chamber and EZ1203H systems compared to conventional gravel systems was not statistically different at a 95% confidence level. In laymen's terms, we would say that the chamber and EZ1203H systems performed the same as gravel systems.

Equivalency Factor Demonstrated = 1.33

Technical Summary

Demonstrated Equivalency Factor Range:

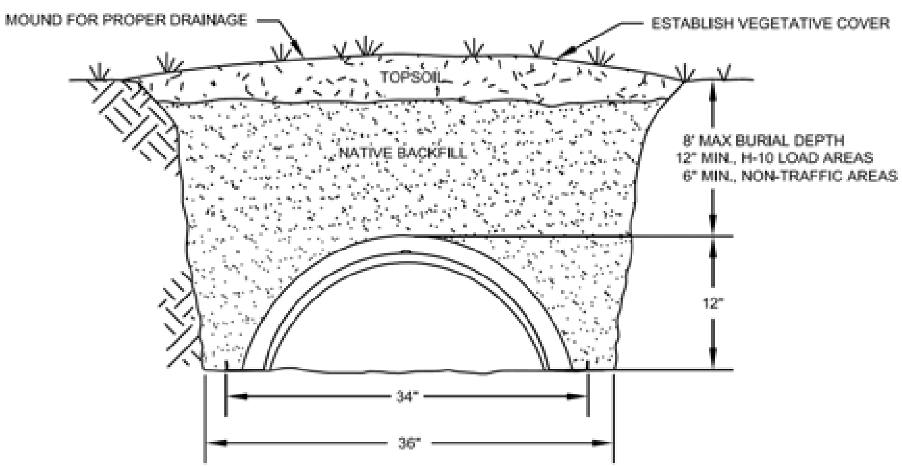
1.33 – 3.2

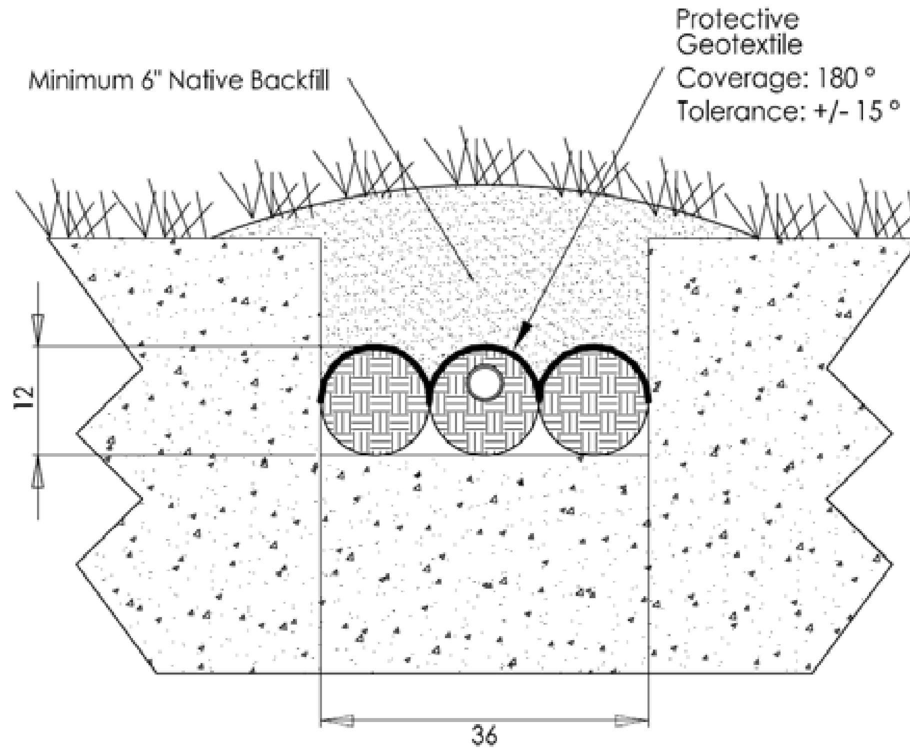
Conclusion: Draft Document

Standards Section	Explanation
Introduction	Purpose of the document, general background information
Performance	How this technology is expected to perform
Application	How this technology is to be applied. This section includes conditions that must be met prior to proceeding with design. Topics in this section describe the “registered” status of the technology, listing requirements, permitting, installation, testing, inspection requirements, etc.
Design and Construction Operation and Maintenance	How this technology is to be designed and constructed (includes minimum standards that must be met). How this technology is to be operated and maintained (includes responsibilities of various parties, recommended maintenance tasks and frequency, assurance measures, etc)
References	List of references cited in the document

Conclusion: Draft Document

Covers Chambers and Expanded Polystyrene Aggregate Bundles For Trenches, Seepage Beds, At-grades and Mounds





Conclusion: Draft Document

Design and Installation Considerations using Proprietary Distribution Technologies

- Proprietary distribution technologies shall have, at least equal to that provided by drainfield rock distribution media, the following attributes:
  - Be constructed or manufactured from materials that are nondecaying and nondeteriorating and do not leach chemicals when exposed to sewage and the subsurface soil environment;
  - Provide liquid storage volume at least equal to the storage volume provided within the thirty percent void space in a twelve-inch layer of drain rock in a drain rock-filled distribution system. This storage volume must be established by the proprietary distribution technology, system design and installation, and must be maintained for the life of the system. This requirement may be met on a lineal-foot, or on an overall system design basis;
  - Provide suitable effluent distribution to the infiltrative surface at the soil interface; and
  - Maintain the integrity of the trench or bed. The material used, by its nature and its manufacturer-prescribed installation procedure, must withstand the physical forces of the soil sidewalls, soil backfill and the weight of equipment used in the backfilling.

Conclusion: Draft Document

Design and Installation Considerations using Proprietary Distribution Technologies (trenches or beds)

- The infiltrative surface area of proprietary distribution technologies shall be determined by dividing the design flow (Gallons Per Day) by the appropriate soil loading rate (Gallons per Day per Square Foot) and multiplying that area by an efficiency factor of 0.75.

0.75 multiplier represents a 1.33 equivalency factor

Conclusion: Draft Document

Example: 3 Bedroom Home with Design Flow of 450 gpd and Soil Loading Rate of 0.45 gpd/sf

Total gross infiltration area = 450/0.45 = 1000 sf

Total infiltration area required for proprietary distribution device:

1000 sf x 0.75 = 750 sf

Using proprietary device (chamber or EPS) installed in a **3' wide trench**:

Total Trench Length = 750 sf/3 sf/lf = 250'
Perhaps 5 trenches 50' long

Another calculation that yields the same result is to divide the total required gross infiltration area by a product rating (4 sf/lf in this case):

1000 sf/4 sf/lf rating = 250' of trench

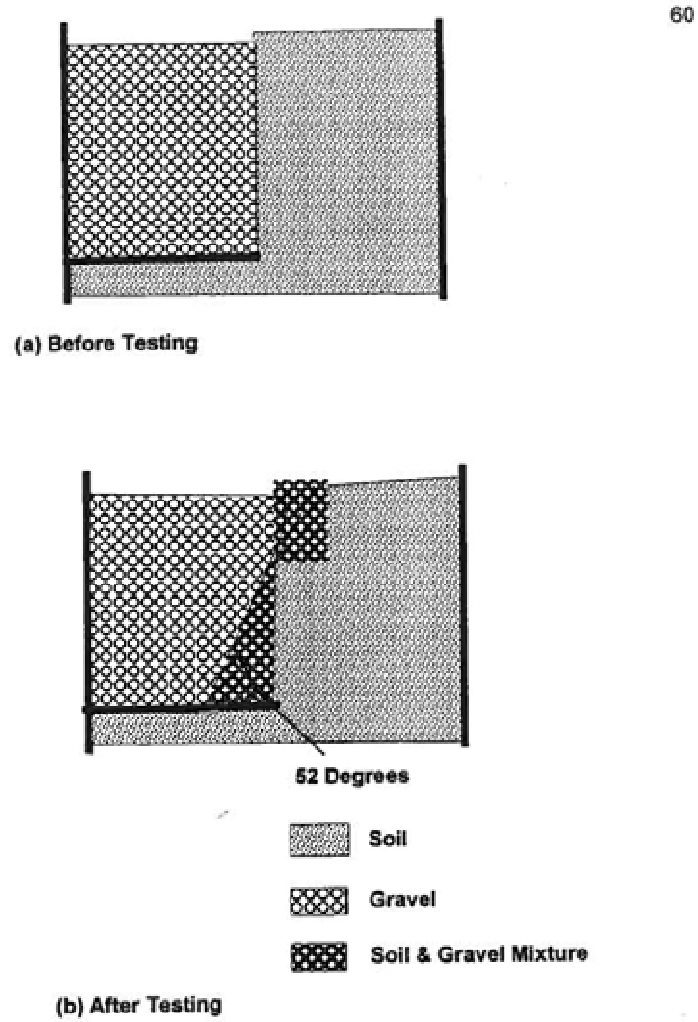
System Size Analysis NC (120 GPD/BR) Vs MN (150 GPD/BR)	Sizing for 3BR System in Various Soil Types 1203H & Standard Chambers Trench Length (Ft)	Soil Interface Area Rating (SF/FT)	Long Term Acceptance Rate (GPD/SF)	State Described Soil Condition	BOD_5 Loading Assume: Uniform Distribution Daily Flow 315 GPD BOD_5 150 mg/l (Lbs/Day/SF)
Sand					
North Carolina	75	4.0	1.2	Soil Group I (sands) 1.2 - 0.8 GPD/SF	0.00175
Minnesota	94	4.0	1.2	Medium Sand, Single Grain, loose	0.00140
Medium Sand					
North Carolina	113	4.0	0.8	Soil Group I (sands) 1.2 - 0.8 GPD/SF	0.00117
Minnesota	188	4.0	0.6	Medium Sand, Single Grain, weakly cemented-friable	0.00070
Sand and Loam					
North Carolina	113	4.0	0.8	Soil Group II (coarse loams) 0.8 - 0.6 GPD/SF	0.00117
Minnesota	144	4.0	0.78	Crse and Med Sndy Lm, prs blk gr, mod strg, friable	0.00091
Loam					
North Carolina	150	4.0	0.6	Soil Group II (coarse loams) 0.8 - 0.6 GPD/SF	0.00088
Minnesota	469	4.0	0.24	Coarse and Medium Sandy Loam, platy, weak, firm	0.00028
Silt Loam					
North Carolina	150	4.0	0.6	Soil Group III (fine loams) 0.6 - 0.3GPD/SF	0.00088
Minnesota	225	4.0	0.5	Silt Loam, prs blk gr, mod or strong, friable	0.00058
Silt					
North Carolina	300	4.0	0.3	Soil Group III (fine loams) 0.6 - 0.3 GPD/SF	0.00044
Minnesota	469	4.0	0.24	Silt Loam, prs blk gr, mod or strong, firm	0.00028
Clay Loam					
North Carolina	300	4.0	0.3	Soil Group III (fine loams) 0.6 - 0.3 GPD/SF	0.00044
Minnesota	469	4.0	0.24	Cly-Lm Slty-Cly-Lm Sndy-Cly-Lm,prs blk gr, mod or strg, firm	0.00028
Clay					
North Carolina	450	4.0	0.2	Soil Group IV (clays) 0.4 - 0.1 GPD/SF	0.00029
Minnesota	469	4.0	0.24	Cly Slty-Clay Sndy Cly, prs blk gr, mod or strg, friable	0.00028

Table 1.

For sizing based on a trench width of (inches)	*Infiltrative Area*	*The measured width of the product must be at least (inches)*
36	3.0 sf/lf	32.4
30	2.5 sf/lf	27.0
24	2.0 sf/lf	21.6
18	1.5 sf/lf	16.2
12	1.0 sf/lf	10.8

- Rigid products must be installed in a trench a few inches wider than the products width
- Chart above requires to product to be 90% of the trench width and is used in several states including Idaho, Virginia, Washington

Trench Width Measurement



Keys, 1996

Figure 3.2.4 Cross-Section of Gravel Sidewall with Angle of Intrusion

Trench Width Measurement

Conclusion: Draft Document

Mound design standards for proprietary distribution technologies

- The mound distribution media bed area consists of bottom area only and must be calculated by dividing the design flow by 1.2 gallons per day per square foot and multiplying that area by the 0.75 efficiency factor.

- The original soil mound absorption area shall not be reduced. The original soil mound absorption area is determined by multiplying the original soil mound absorption length by the original soil mound absorption width. The original soil mound absorption width is calculated by multiplying the predetermined mound distribution media bed width by the mound absorption ratio found in Table IX or IXa in part 7080.2150, subpart 2, item E.

- All other mound system requirements found in 7080.2200 shall be adhered to.

0.75 multiplier represents a 1.33 equivalency factor

Conclusion: Draft Document

At-grade design standards for proprietary distribution technologies

- The at-grade absorption system utilizing proprietary distribution technologies must be calculated by dividing the design flow by the appropriate soil loading rate found in Table IX or IXa in part 7080.2150, subpart 2, item E, and multiplying that area by the efficiency factor of 0.75.

- All other at-grade system requirements found in 7080.2230 shall be adhered to.

0.75 multiplier represents a 1.33 equivalency factor

Going Forward

- Develop guidance document to cover these proprietary distribution devices
  - once adopted we see no need for the for the "warranty" system sizing – 1.67 multiplier (40% reduction)
- With a general guidance document in place, individual submittals are relatively simple
  - Dimensions of products
  - Installation instructions

Our Commitment

We're in this for the long term.

Thank you.

Dick Bachelder, ADS/Hancor
Ben Berteau, Ring Industrial Group
Peder Larson, Larkin Hoffman Daly & Lindgren Ltd.
Carl Thompson, P.E., Infiltrator Systems, Inc.