System Malfunctions – The View from Below

Agenda

- Failure rates
- Malfunction Analysis
- Questions Anytime Please

Dennis Healy
Infiltrator Water Technologies
Area Sales Representative

Failure Rates

1. What is the failure rate of onsite systems?
2. What is the national failure rate?
3. What is an acceptable failure rate?
4. What data do we have on failure rates?

Let’s review two peer reviewed studies.

Field Performance Research on Infiltration Area Effectiveness

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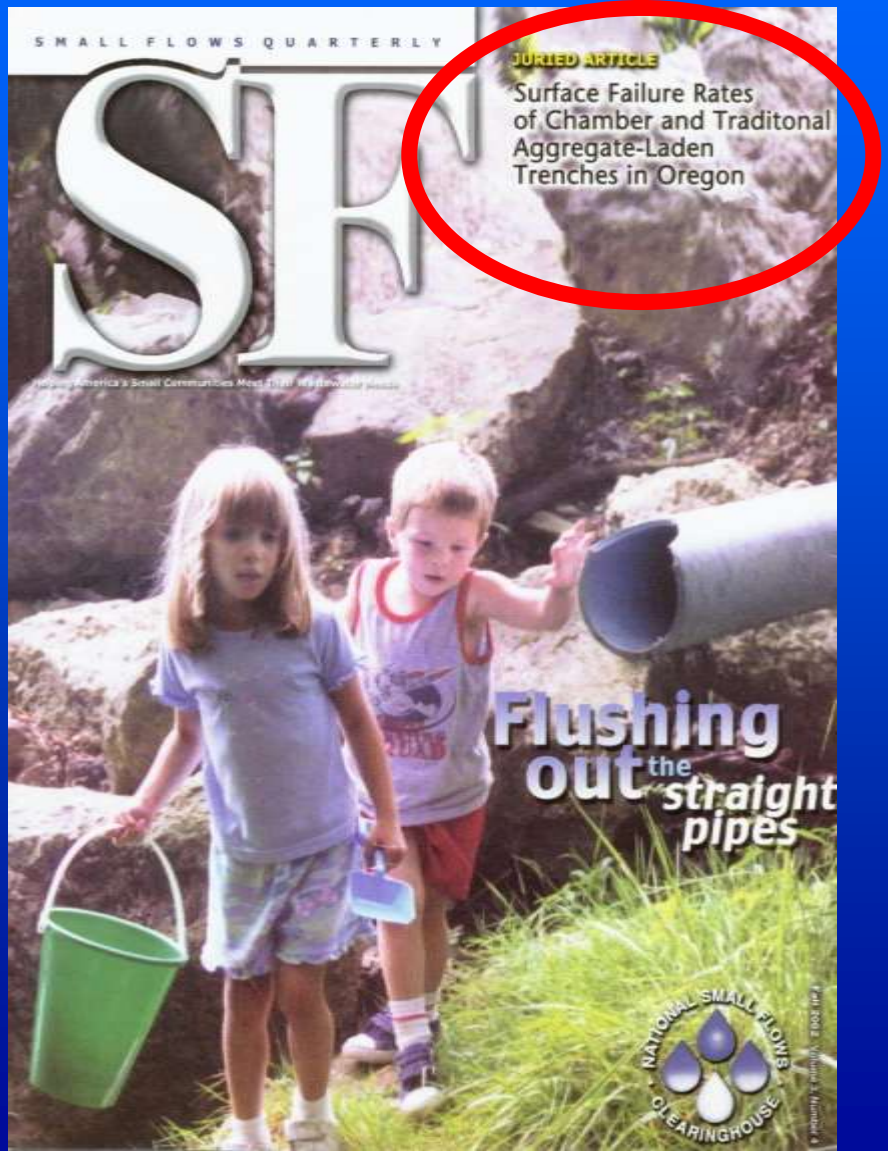

Independent, third-party research assessment of the hydraulic performance of Conventional Systems in Oregon.

Published in Small Flows

Study Regions:
Cascade West and Cascade East

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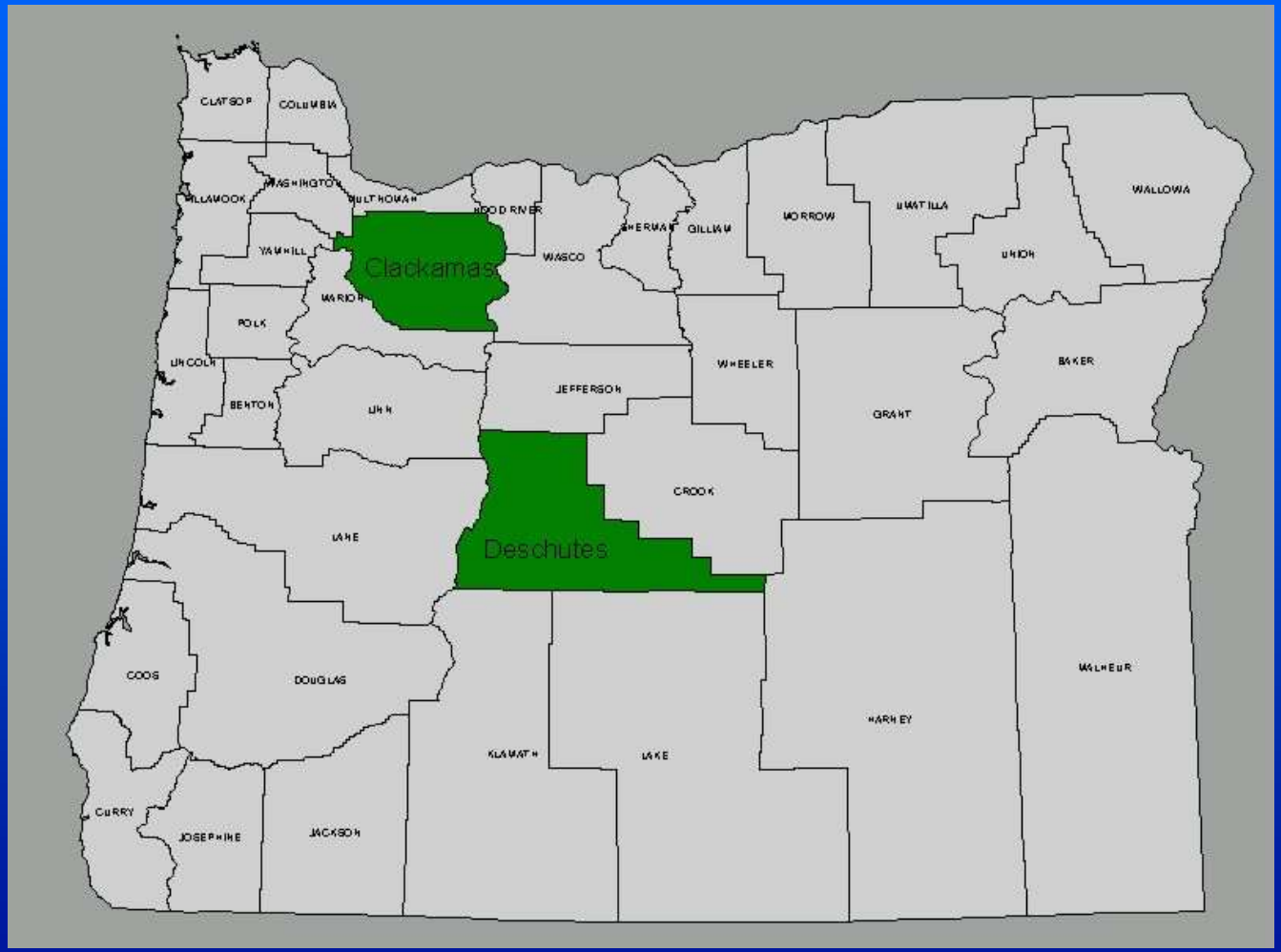

Statistical Analysis of Hydraulic Function of Random, Stratified Sample

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	Treatment (ISI Chambers)			Control (Aggregate)			Total Sample		
	H	$\hat{p}_1$	n	HF	$\hat{p}_2$	n	HF	Failure Rate	n
By soil grouping									
-high permeability	1	0.97a[3]	39	0	1.00a	44	1	1.2%	83
-moderate permeability	0	1.00a	71	2	0.97a	74	2	1.4%	145
-low permeability	1	0.99a	88	1	0.99a	73	2	1.2%	161
By climatic zone									
-humid temperate (CWR)	1	0.99a	99	2	0.98a	91	3	1.6%	190
-semi-arid (CER)	1	0.99a	99	1	0.99a	100	2	1.0%	199
All systems	2	0.99a	198	3	0.98a	191	5	1.3%	389

Field Performance Research on Infiltration Area Effectiveness

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Dr. Hoover Research Conclusions:

- No significant difference in the surface failure rate of Chamber systems compared to conventional gravel systems
- Failure rates were < 2% for both systems

Field Performance Study
North Carolina

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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.

North Carolina - Summary of Study

- Largest field performance study in the world
- Study performed by the North Carolina DENR
- Field survey of 900 systems in North Carolina ranging in age from 2 to 12 years
  - 300 - 3’ wide x 1’ high gravel and pipe
  - 300 - EZflow 1203H at 25% length reduction
  - 300 - Infiltrator Standard chamber at 25% length reduction
- Goal: Examine performance in differing soil and climactic conditions

NC - Results

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

- Results show no statistical difference at the 95% confidence level in malfunction rates between 3 system types surveyed
- Approval granted to products that are shown to perform the same or better than a conventional gravel and pipe system

Malfunction Investigation

Questions, Questions…

1. Who will get blamed?
2. Is everyone being honest?
3. What are the two biggest factors that determine the life of a system?
4. Who is responsible for those factors?
5. Do we have any data on those factors?

Overview

Malfunction investigation:

- **Septic tank investigation**
  - **Function**
  - **Malfunction issues and examples**
  - **O&M**
- **Drainfield investigation**
  - **Function**
  - **Malfunction issues and examples**
  - **Malfunction modes**
  - **O&M**

Evaluate the complete system (pump chamber, dbox… etc.)

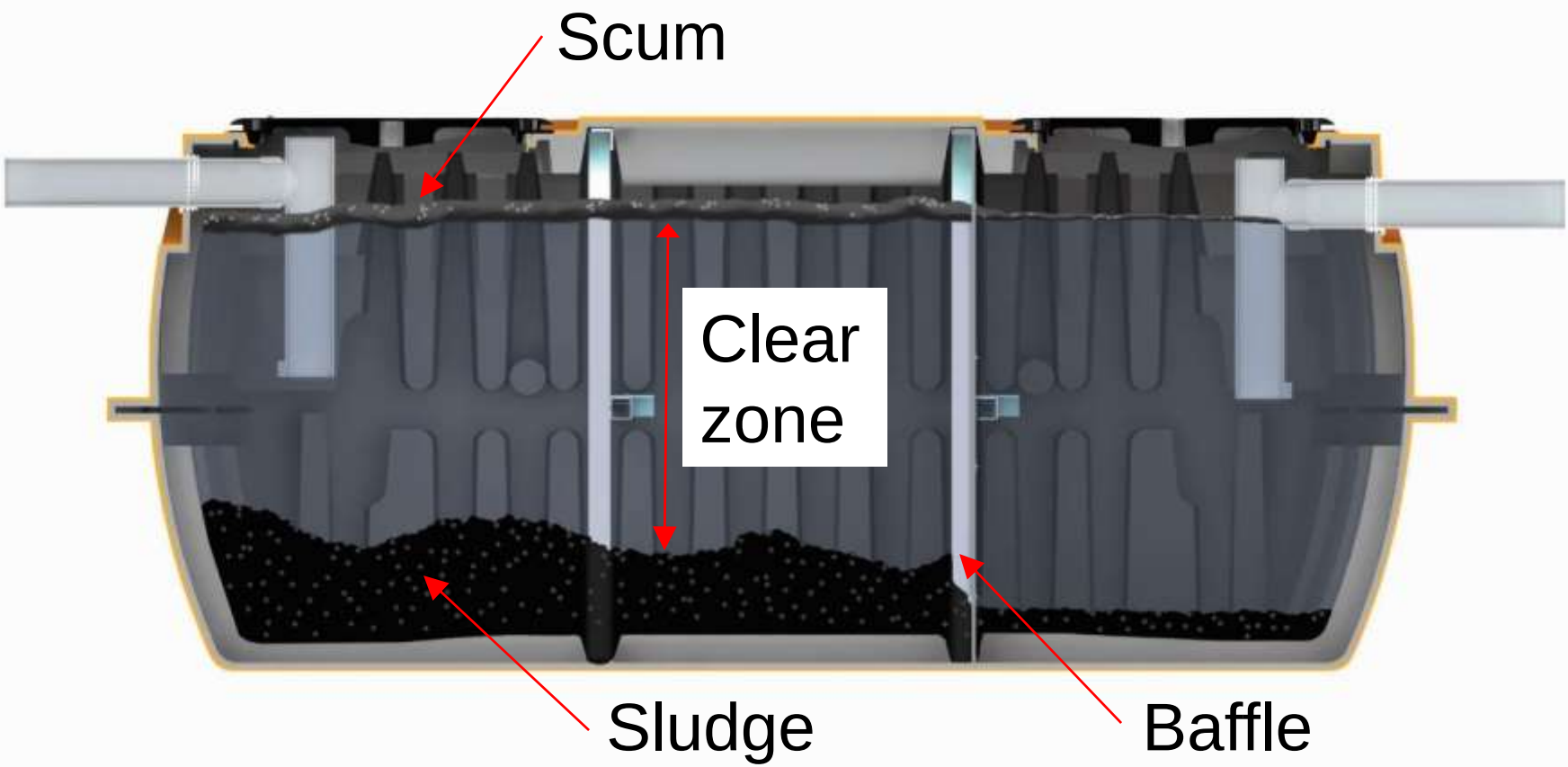
Malfunction investigation
Assemble the team

- Regulator
  - Observe mode of system malfunction
- Owner
  - Provide information on system usage
- Installer and Pumper
  - Measure scum and sludge levels
  - Pump tank
  - Excavate and Pump drainfield
- Engineer/System Designer
  - Compile and evaluate investigation data

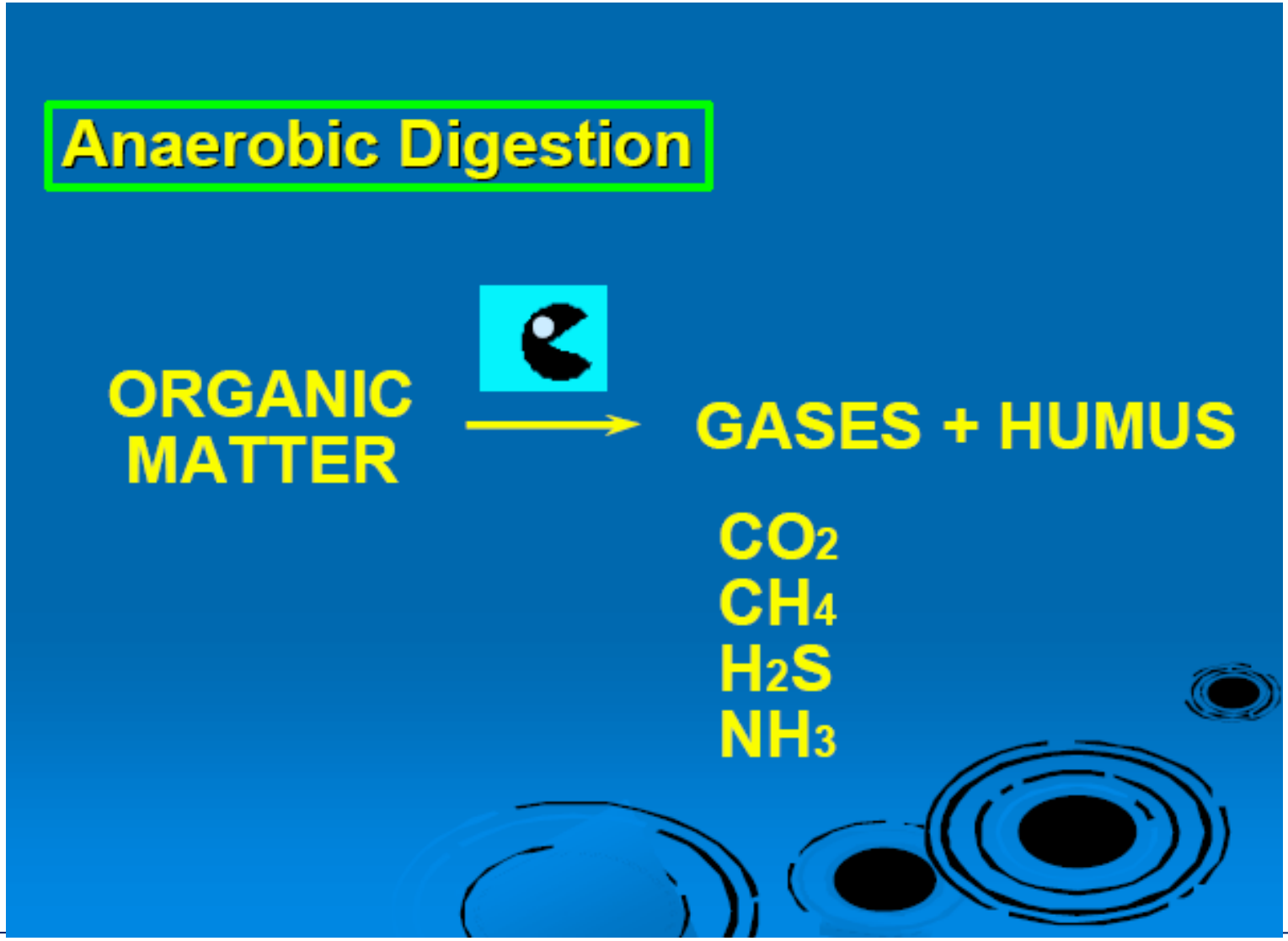
Tank Investigation: Tank functions

- **Low-velocity flow environment**
- **Solids removal by settling and floatation**
  - **75-95% solids removal**
  - **Reduce FOG by 85-95%**
- **Anaerobic digestion**
  - **65-80% BOD reduction**
- **Storage of solids**
  - **Non-biodegradable or resistant to biodegradation**

Typical tank design – Two compartments



Biological treatment in tank



Factors affecting anaerobic digestion

- **Wastewater strength**
- **pH (watch out for coffee shops)**
- **Chemicals, Pharmaceuticals (difficult to diagnose)**
- **Fats, oil, and grease (FOG)**
- **Flow pattern and flow rates – tank residence time**
- **Water softener backwash – is this bad?**

Factors affecting tank performance

- **Garbage grinders**
  - **Add to solids accumulation rate**
  - **Add to organic load**
  - **May add grease and oil**
  - **Increase hydraulic load**

- **Sewage (basement) lift pumps**
  - **Increase turbulence in the septic tank**
  - **Increase hydraulic load to tank**
  - **Should discharge into sewer line – not directly to tank**

Issue: Hydraulic overload

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Issue: Excessive scum height

Issue: Scum in screen

Issue: Solids in D-box

Solids and sludge in D-box show that tank has malfunctioned

Educate homeowners

- **Homeowners need basic information on operation:**
  - **How the system works**
  - **How to use the system**
- **What should not be put into septic systems**
- **Homeowner must be encouraged to:**
  - **Have the system inspected periodically**
  - **Pump the tank on a schedule or based on measurements**

Issue: Latex discharge

Drainfield Investigation

SYSTEM STATISTICS and CALCULATIONS
ROBINSON, LARRY

SITE CHARACTERISTICS:

Limiting zone: 20 inches Sand required. 28 In.
Perc. rate: 142.85 Min/inch
Number of bedrooms: 4 Slope: 12.0%

SEPTIC TANK:

Minimum size required: 1250 gal. 2 - compartment
To be installed: 1000 gallon, 1 – compartment septic tank connected to an existing 1000 gallon septic tank.

ABSORPTION AREA DESIGN:

500 gal./day flow x 3.856 = 1928 sq. ft.(800sq.ft.Min.Req. by Township)
To be installed: Infiltrator chambers, which yield up to a 40% reduction in disposal area will be used. Each infiltrator chamber is rated at 29.50 sq. ft. of absorption are equivalent. Infiltrator chambers to be arranged in a rectangular pattern consisting of an array of (7) rows of chambers X (10) col. total of (70) infiltrator chambers. Total disposal rating of the infiltrator chambers is (2065) sq. ft.

Side A				Side B		
Lateral length:	32.65	Ft.		Lateral length	32.65	Ft.
Number required	7	Laterals		Number required	7	Laterals
Hole size:	1/4	In.		Hole size:	1/4	In.
Hole spacing:	6	Ft. on ctr		Hole spacing:	6	Ft. on center
Lateral diameter:	11/2	In.		Lateral diameter	11/2	In.
		Manifold Diameter:	2	In.		
		Manifold length:	21.60	Ft.		

PUMP SIZING:

7 Laterals(Side A) x 5 holes + 7 laterals (Side B) x 5 holes = 70 Holes x 1.28 gal/min/hole = 89.60 Gal./min.

HEAD LOSS:

Terminal head:	3.00	ft.
Elevation change:	8.64	ft.
Friction loss:	13.05	ft.
Total ft. head:	24.69	ft.

EQUIV. PIPE LENGTH:

Delivery pipe:	69.70	ft.
Manifold pipe:	21.60	ft.
1 Tee Fitting:	11.10	ft.
1 Quick disconnect:	1.35	ft.
2 Elbows: (45^0)	7.74	ft.
1 Coupler:	2.70	ft.
Total:	114.19	ft.

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Get a copy of the permit, Review design/construction:

Verify through as-built drawings that system was installed per design

- **Verify that site soil characterization and groundwater depth are accurate**

- **Check design calculations for drainfield sizing vs. regulations**

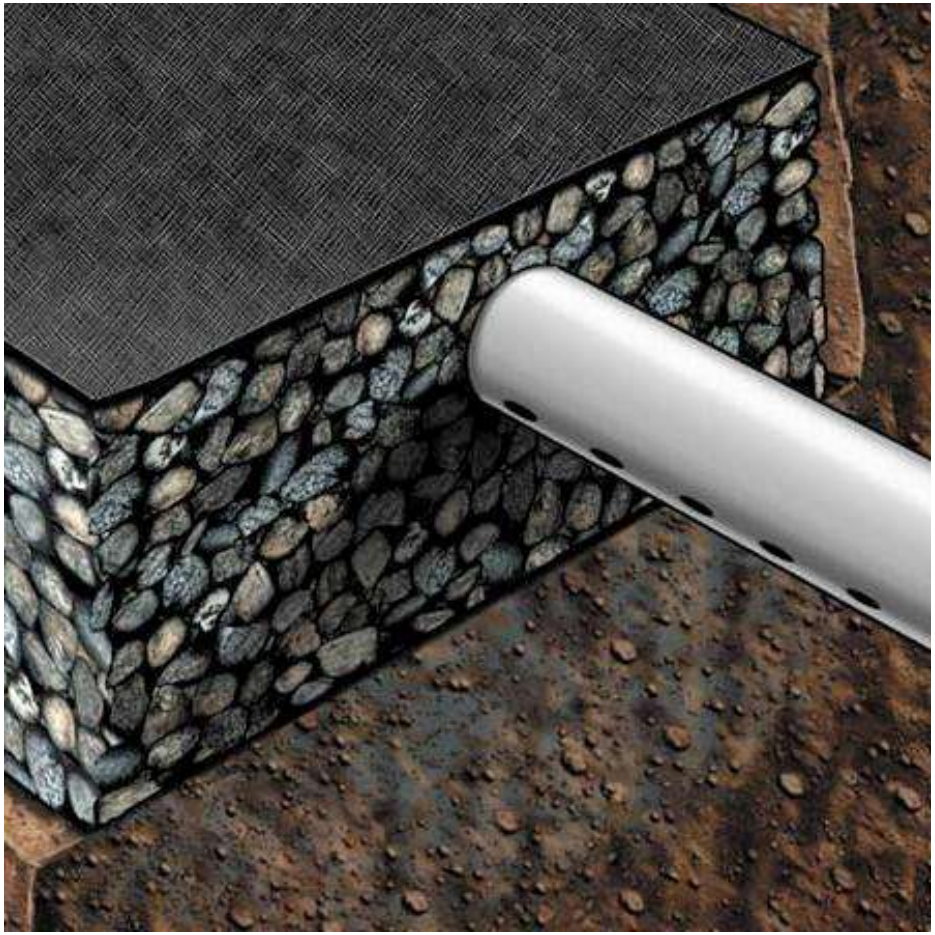
Drainfield Function

1. Maintains the structure of the excavation.

2. Exposes the applied wastewater to more infiltrative surface.

3. Provides storage space for the wastewater between the void fractions.

Source: USEPA Onsite Wastewater Treatment Systems Manual



Drainfield checks

Excavate drainfield and verify:

- Chambers are open
- Stone depth and width
- Each trench has effluent

Issue: Solids in drainfield

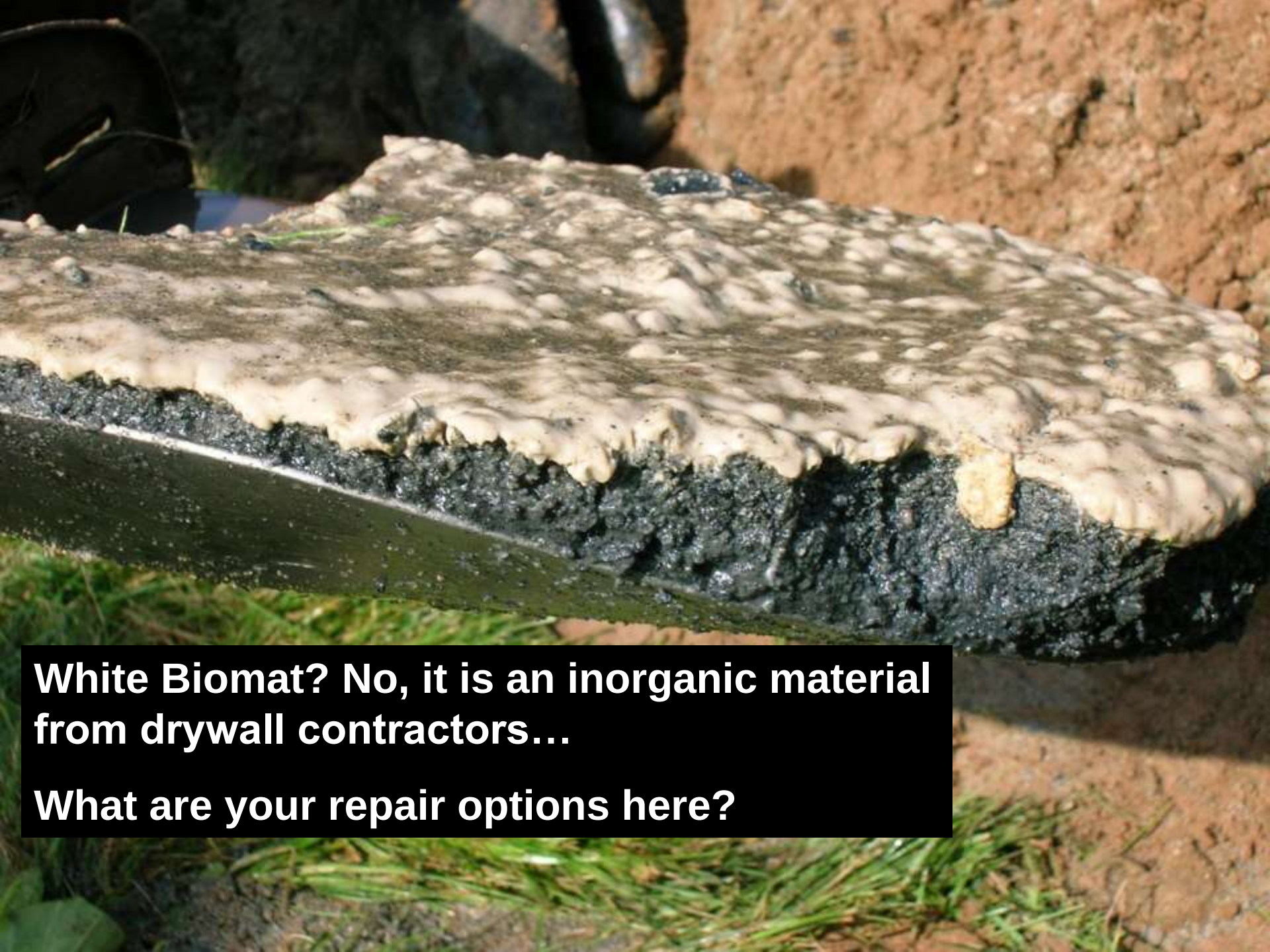
- Solids clogged trench bottom
- No vertical water infiltration, distinct color change, not a nice transition in color
- Sand at trench bottom shows no evidence of treatment taking place (absence of discoloration)

Issue: Solids in drainfield

Sand below biomat/solids layer is clean – no evidence of vertical infiltration

Issue: Solids in drainfield

Sand below biomat shows slight staining – evidence of some vertical wastewater infiltration


White Biomat? No, it is an inorganic material from drywall contractors…
What are your repair options here?

Biomat tells us things…

Issue: Solids in drainfield

Clod of powdered laundry detergent found in chamber; demonstrates that effluent flowed over top of both baffle and outlet tee in septic tank to carry material to drainfield

Excavate the system, you would be surprised what you will find. In this case inorganics (paint) have sealed up the system. Homeowner still claimed innocence.

Issue: Unknown substance clogging infiltrative surfaces

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What does an unhealthy trench bottom look like?

Issue: Fats, oil, and grease discharge

Oily slime was discharged to this drainfield, clogging the infiltrative surface and causing malfunction

Issue: Fats, oil, and grease discharge

Adirondack Environmental Services, Inc

Date: *24-Nov-08*

CLIENT: Infiltrator
Work Order: 081112006
Reference: /
PO#:

Client Sample ID: B10 Mat Sludge
Collection Date: 11/11/2008
Lab Sample ID: 081112006-001
Matrix: SLUDGE

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
GASOLINE AND DIESEL RANGE ORGANICS SW8015M (Prep: SW8015B - 11/12/2008)						Analyst: **MG**
TPH (Diesel)	735	100		µg/g	1	11/12/2008 8:31:18 PM
TPH (Gasoline)	< 100	100		µg/g	1	11/12/2008 8:31:18 PM
OIL AND GREASE E1664						Analyst: **VZ**
Oil & Grease	1070	10		µg/g	1	11/24/2008

Issue: Landscape and vegetation

Issue: Siting in wetland soils

Drainfield was constructed near wetlands

Issue: Siting in wetland soils

Drainfield was constructed proximal to area of surficial ponding

Issue: Siting in wetland soils

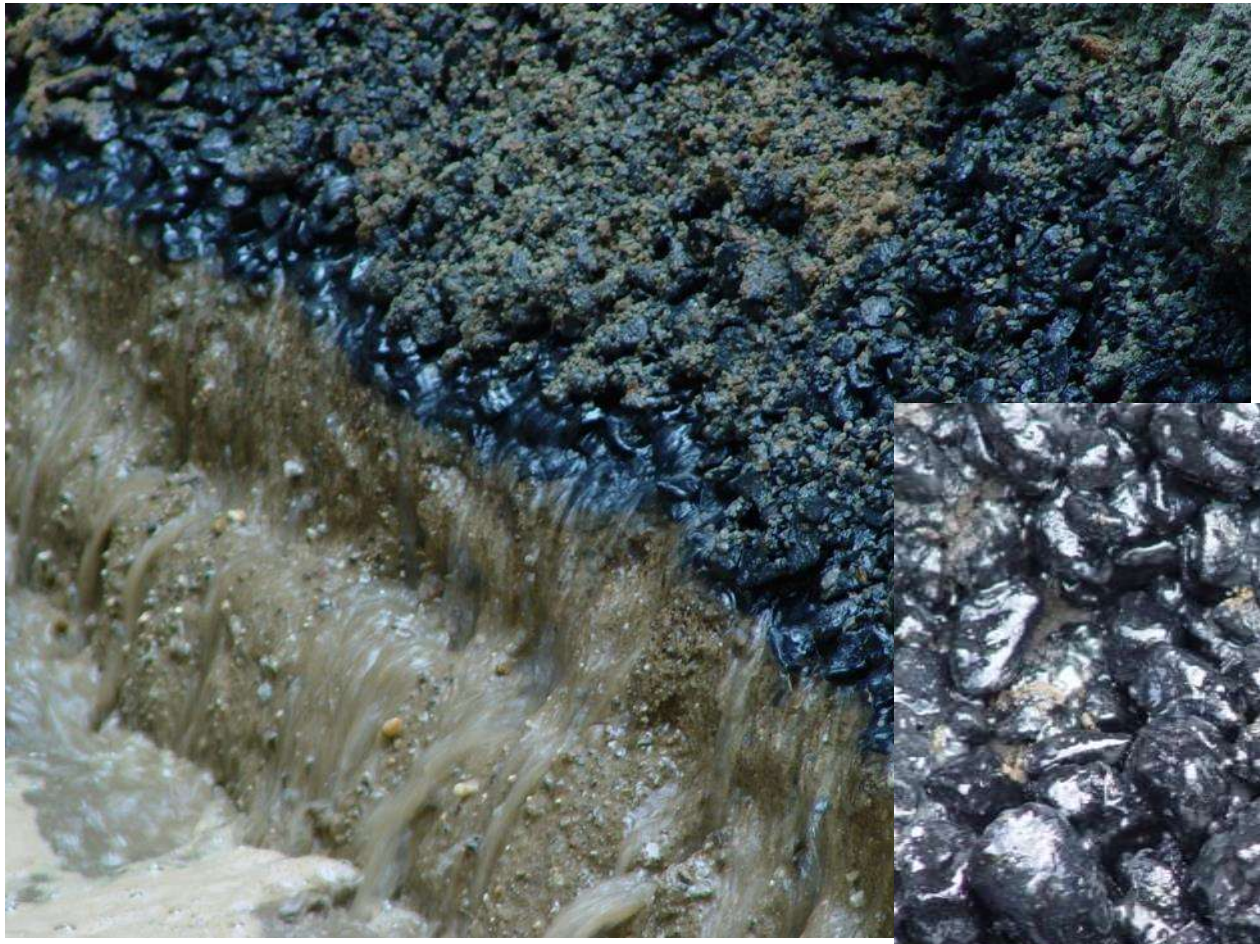
Drainfield was constructed below groundwater table

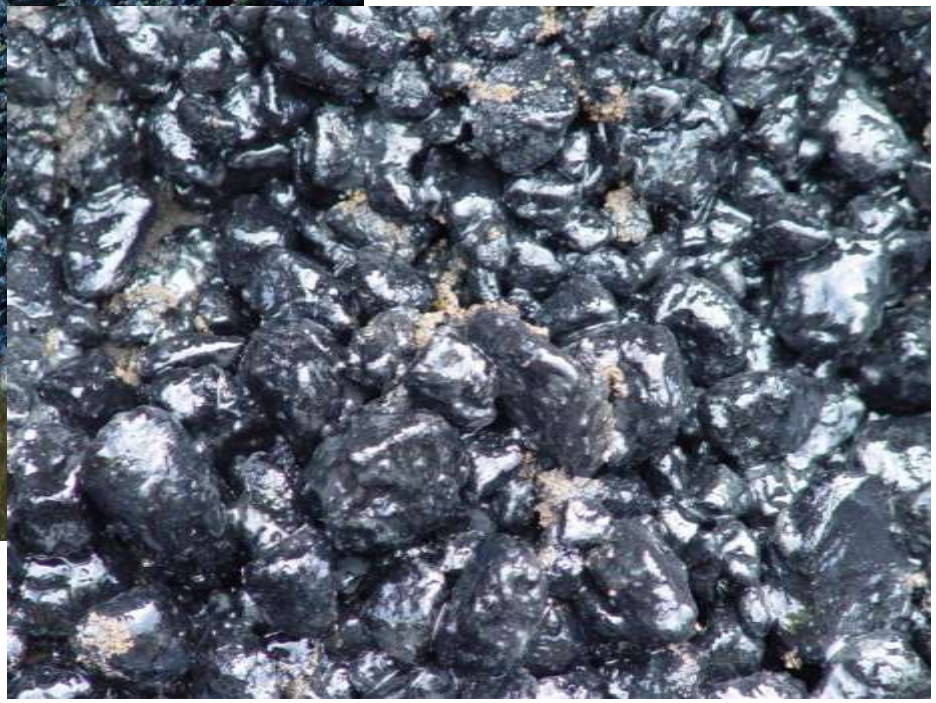
Issue: Siting within a topographic depression

Viewing pre-construction photos can help diagnose the problem

The septic system was installed here

Excavate the system





PROBLEM:
Siting

SOLUTION:
Relocate
Elevate


PROBLEM:
Clogged
Infiltrative
Surface


SOLUTION:
Replace
Expand


PROBLEM:
Incorrect
Soil Texture


SOLUTION:
Expand


PROBLEM:
Malfunctioning
Tank


SOLUTION:
Pump Regularly


PROBLEM:
Leaking
Tank


SOLUTION:
Repair or
Replace

PROBLEM:
Excessive Water Use

SOLUTION:
Repair Fixtures
Reduce Water Use

In Conclusion:

- **It is not up to you to determine what caused the failure – verify that the system met code**
- **Develop a policy for responding to repairs**
- **The designer nor the installer should not have to bear the expense if there is no fault from their services provided**
- **The repair solution: codes are a minimum design criteria – you can go bigger**

Questions ?

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