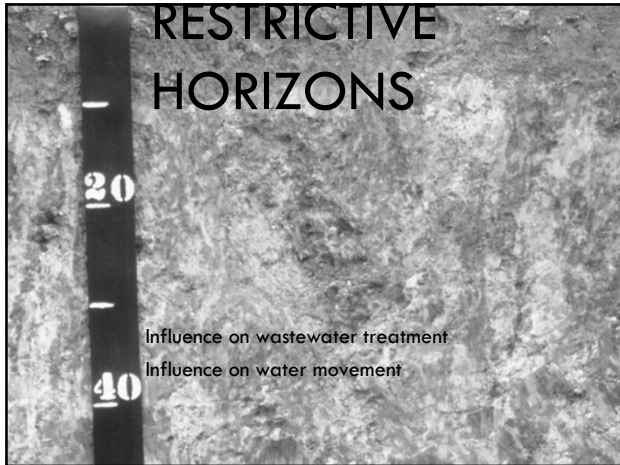
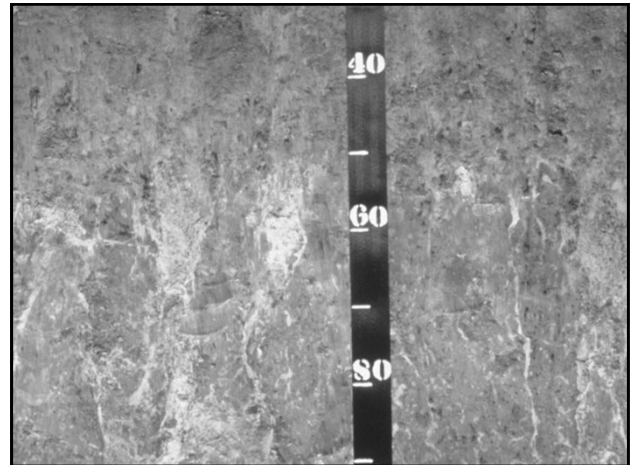




1



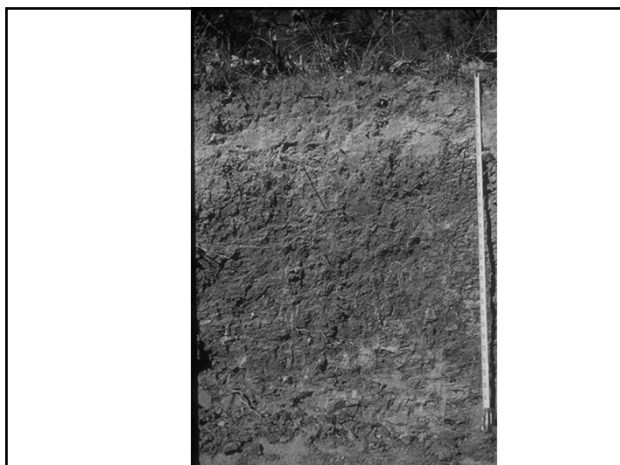
2



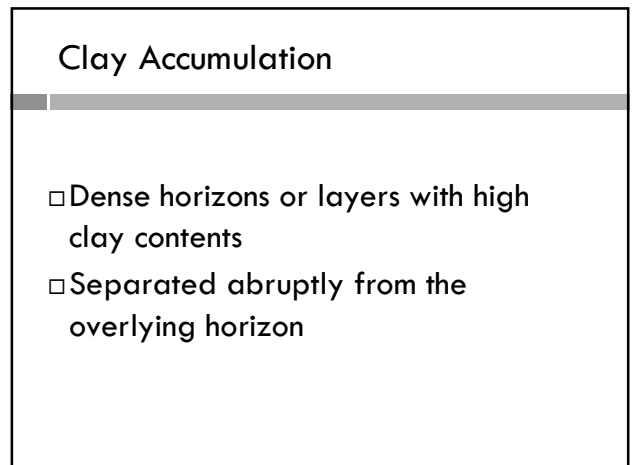
3



4



5



6

Claypan Formation

- High clay content results from:
 - ▣ Illuviation
 - ▣ Different parent materials

7

Clay Characteristics

- High clay content (>40%)
- Increases bulk density
- Decreases pore sizes
- Slowly permeable
- Roots follow structure faces
- Roots often flattened by pressure

8

Impact of High Clay Content on Onsite Wastewater Treatment

- Illuvial clay reduces porosity
 - ▣ Reduces permeability
 - ▣ Reduces aeration
- Difficult to maintain aerobic environment
- Effluent perches in or above

9

Do I have a shrink-swell clay?

----Yes.

A shrink swell clay is a 2:1 clay mineral which has an affinity for absorbing and holding water. The absorption of water between the layers of the clay mineral cause the mineral to swell. The degree of the shrinking and swelling of these minerals is dependent on soil moisture and the total quantity of the clay mineral present.

10

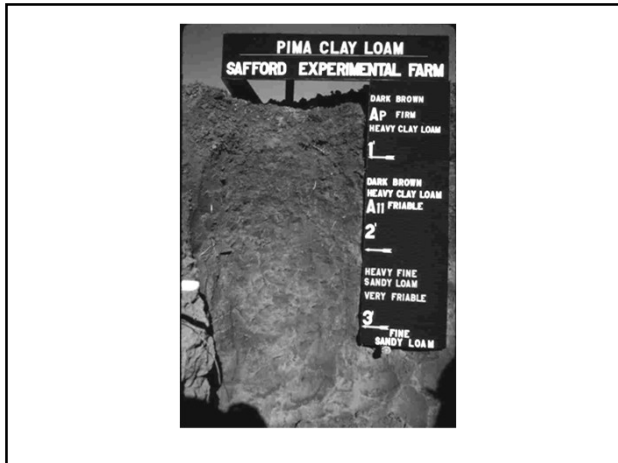


11

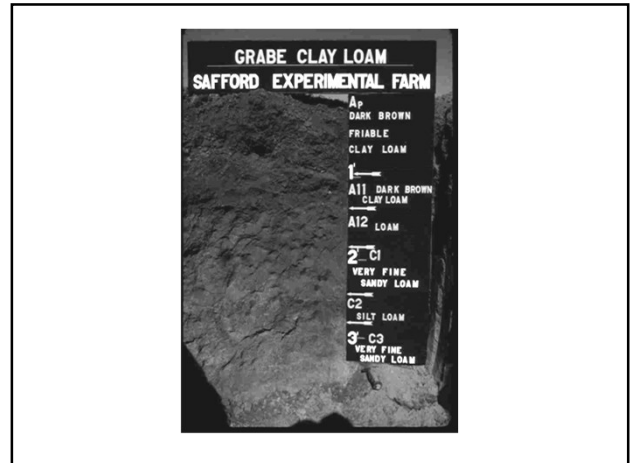
Classification of Expansive Soils

Soil Group	Clay %	Liquid limit %	Expansive Class	Plasticity Index %	Expansion Index	% Swell
A	<10	0-25	Non-exp	0-6	—	0
B	<10	25-30	Marginal	6-10	<50	2-4
C	15-25	30-50	Moderately exp.	10-25	50-90	4-7
D	25-35	50+	Highly	25-50	90-130	7-12
E	>35	70+	Highly	50+	130+	>12

12



13



14

Sequence of Soil Characteristics Questions	SAR, Trench, Chamber, and Pit gal/day/ft ²	SAR, Bed gal/day/ft ²
C. Is the texture of the horizon sandy clay loam, clay loam, silty clay loam, or finer and the soil structure weak platy?	A site-specific SAR is required	A site-specific SAR is required
D. Is the moist consistency stronger than firm or any cemented class?	A site-specific SAR is required	A site-specific SAR is required
E. Is the texture sandy clay, clay, or silty clay of high clay content and the structure massive or weak?	A site-specific SAR is required	A site-specific SAR is required
F. Is the texture sandy clay loam, clay loam, silty clay loam, or silty loam and the structure massive?	A site-specific SAR is required	A site-specific SAR is required
H. Is the texture sandy clay, clay, or silty clay of low clay content and the structure moderate or strong?	0.20	0.13
I. Is the texture sandy clay loam, clay loam, or silty clay loam and the structure weak?	0.20	0.13
J. Is the texture sandy clay loam, clay loam, or silty clay loam and the structure moderate or strong?	0.40	0.27

15

Impact of Effluent on Clays

- Discharge of Na-rich wastewater may cause dispersion of clay resulting in additional plugging of pores
- Clay content is twice of overlying horizon

**LIME SULFUR (SOIL CONDITIONER)
CALCIUM POLYSULFIDE TREATMENT**

16

CD HORIZON (DENSIC MATERIALS, DENSE TILL)

Influence on Onsite Wastewater Treatment

17

Cd Horizon



18

Cd Horizon Formation

- Unaltered materials
- Bulk density inherited from parent materials

19

Cd Horizon Location

- Mostly earthy materials
 - Glacial till
 - Volcanic mudflows
 - Colluvial materials (landslide)
 - Mechanically compacted materials
 - Mine spoils

20

Cd Horizon Characteristics

- Relatively unaltered materials
- High bulk density
- Roots cannot enter except in cracks
- Can have platy-like structures

21

Impact of Cd Horizon on Onsite Wastewater Treatment

- Dense nature
 - Low porosity
 - Slow permeability
 - Slow aeration
- Effluent may perch above Cd horizon
 - Cause lateral flow
 - Cause anaerobic conditions
 - Redox features

22

Sequence of Soil Characteristics Questions	SAR, Trench, Chamber, and Pit gal/day/ft ²	SAR, Bed gal/day/ft ²
B. Is the structure of the horizon moderate or strongly platy?	A site-specific SAR is required	A site-specific SAR is required
C. Is the texture of the horizon sandy clay loam, clay loam, silty clay loam, or finer and the soil structure weak platy?	A site-specific SAR is required	A site-specific SAR is required
D. Is the moist consistency stronger than firm or any cemented class?	A site-specific SAR is required	A site-specific SAR is required
E. Is the texture sandy clay, clay, or silty clay of high clay content and the structure massive or weak?	A site-specific SAR is required	A site-specific SAR is required
F. Is the texture sandy clay loam, clay loam, silty clay loam, or silty loam and the structure massive?	A site-specific SAR is required	A site-specific SAR is required

23

Field Identification of Cd Horizon

- Lack of evidence of pedogenic processes (NO Structure)
- High bulk density
- No cracks or cracks that roots can enter spaced ≥ 10 cm apart

24

ANTHROPOGENIC PANS ~ COMPACTION

Influence on Onsite Wastewater Treatment

25



26

Anthropogenic Pan Formation

- Not naturally occurring
- Formed as result of human activity
 - ▣ Usually when soil was wet
 - ▣ Pressure applied by tillage operations or other means
- Natural structures altered or destroyed – usually massive, large blocky or platy-like

27

Anthropogenic Pan Location

- Possible wherever traffic has been applied to soils
 - ▣ Wet is more severe
 - ▣ Dry can penetrate deeper
 - ▣ Can extend >36 inches below impact

28

Anthropogenic Pan Characteristics

- Surface and/or Subsurface layer
- Massive, structure altered
- Higher bulk density and lower porosity than layer above or below



29

Impact of Anthropogenic Pan on Onsite Wastewater Treatment

- Dense nature
 - ▣ Low permeability
 - ▣ Low aeration
- Effluent may perch above pan
 - ▣ Late winter
 - ▣ Early spring
 - ▣ After heavy rains
 - ▣ Heavy use

30

Disruption, Reformation and Management of Anthropogenic Pan

- Pneumatic fracturing
 - Create pores
 - Temporary (<1 year in 2 MN OWTs)
- Deep tillage
 - Break pan
 - Not restore natural structure

31

Sequence of Soil Characteristics Questions	SAR, Trench, Chamber, and Pit gal/day/ft ²	SAR, Bed gal/day/ft ²
B. Is the structure of the horizon moderate or strongly platy?	A site-specific SAR is required	A site-specific SAR is required
E. Is the texture sandy clay, clay, or silty clay of high clay content and the structure massive or weak?	A site-specific SAR is required	A site-specific SAR is required
F. Is the texture sandy clay loam, clay loam, silty clay loam, or silty loam and the structure massive?	A site-specific SAR is required	A site-specific SAR is required

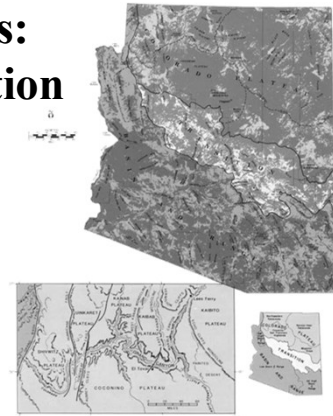
32

Field Identification of Anthropogenic Pan

- Occur near soil surface
- Lack results of pedogenic processes
- Massive – lack natural peds
- Higher bulk density and lower porosity than layer directly above or below the pan

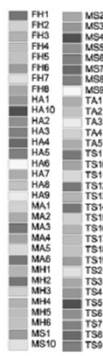
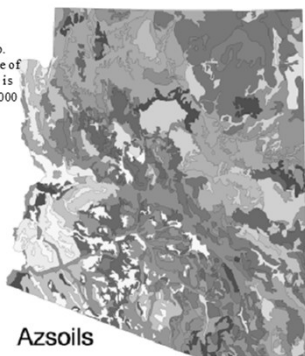
33

AZ Soils: Cementation Issues



34

Arizona
General
Soil Map.
The scale of
this map is
1:1,000,000



35

Petrocalcic Horizon

Influence on Onsite Wastewater Treatment

36

Petrocalcic



37

What is Caliche

Caliche refers to what soil scientists call calcic or petrocalcic subsurface horizon. It is the illuvial accumulation of calcium and magnesium carbonates within a subsurface soil horizon.

38

Petrocalcic Formation

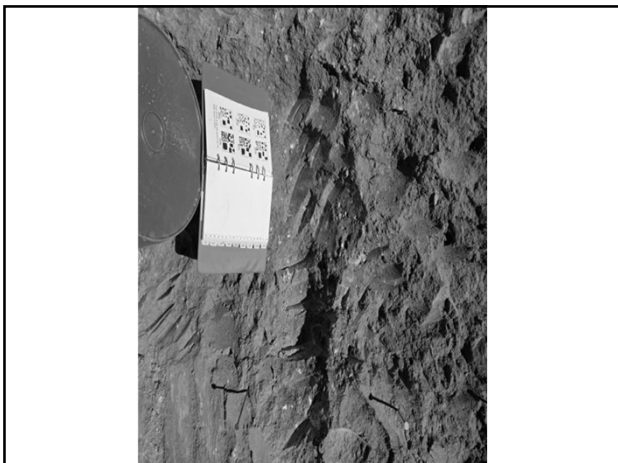
- ☐ Aeolian or parent material additions of carbonates
- ☐ Carbonates dissolved in water and translocated downward
- ☐ Limited precipitation – carbonates not leached from soil profile
- ☐ Accumulations are shallow
- ☐ Continued accumulations plug pores

39

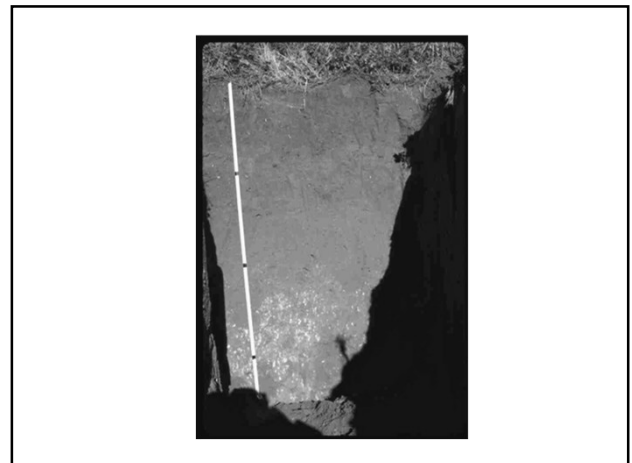
Stages of Carbonate Morphology

Stage	Description	% CaCO ₃	Note
I	Presence of CaCO ₃ filaments or coatings on sand grains	< 10%	filaments or coatings on sand grains
II	Presence of CaCO ₃	15-75% in nodules	15-75% in nodules
IIa		15% entire soil volume	50-90% of the soil volume is whitened
III	Many nodules and coatings	20% entire soil volume	>90% of the soil volume is whitened
III+		40% entire soil volume	>90% of the soil volume is whitened
IV	Upper portion of the horizon is nearly pure cemented CaCO ₃ . 75-90% of the upper boundary of horizon has a weak platy structure appearing as a laminar layer.		
V	Laminar layer & platy structure are strongly expressed. Commonly referred to as a: Petrocalcic- Mother of Caliche		

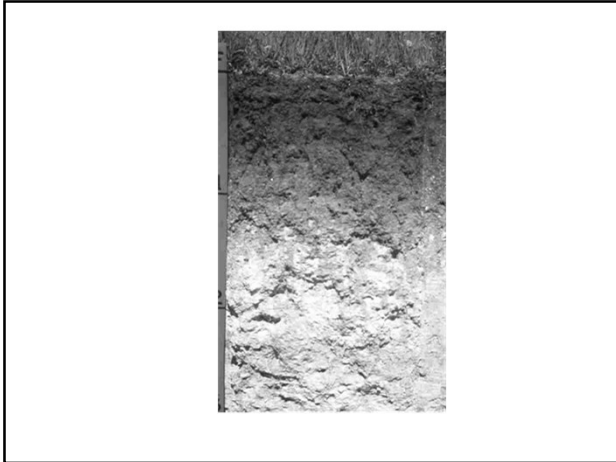
40



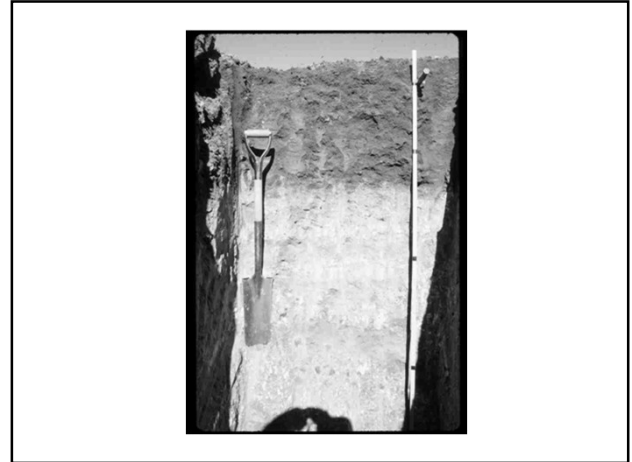
41



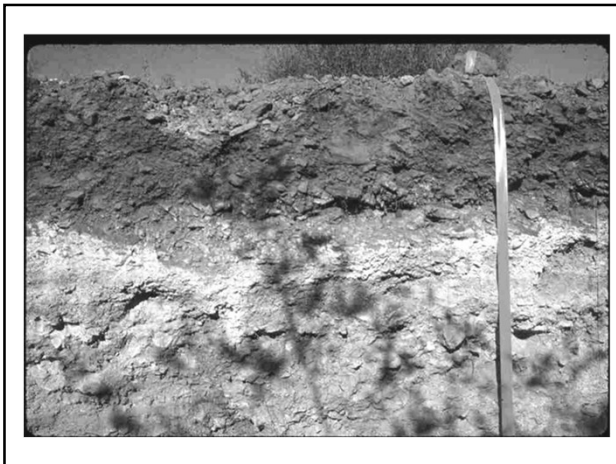
42



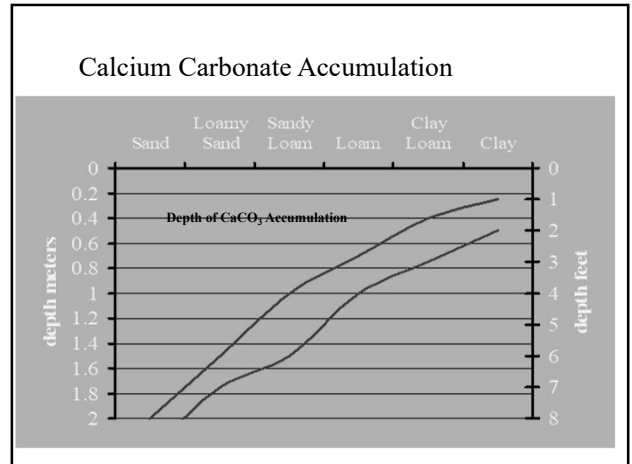
43



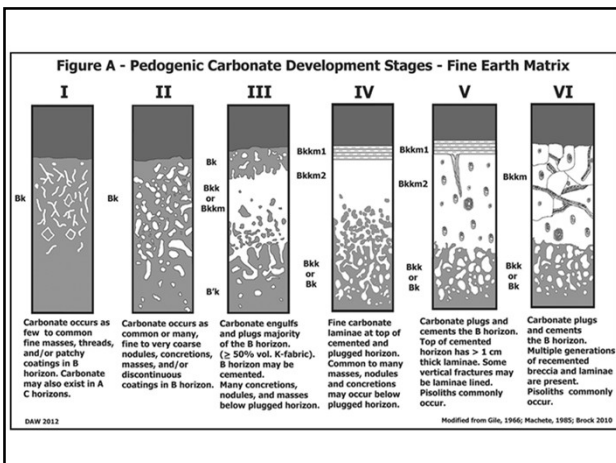
44



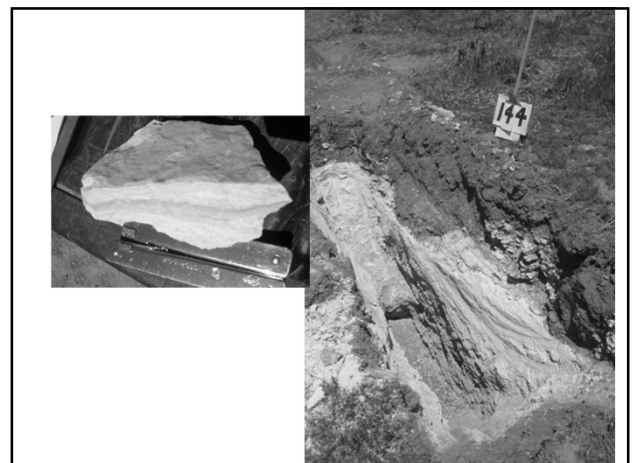
45



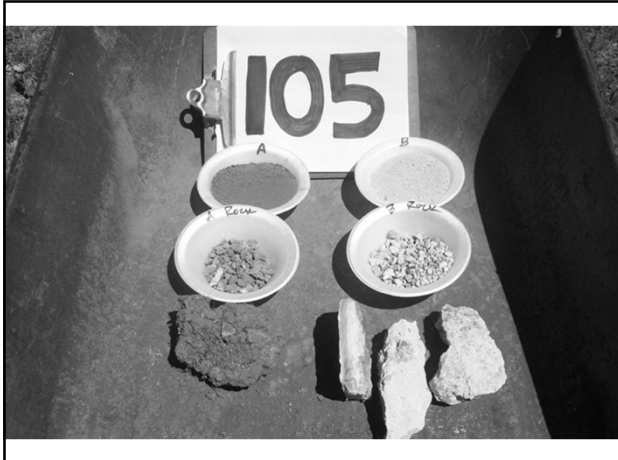
46



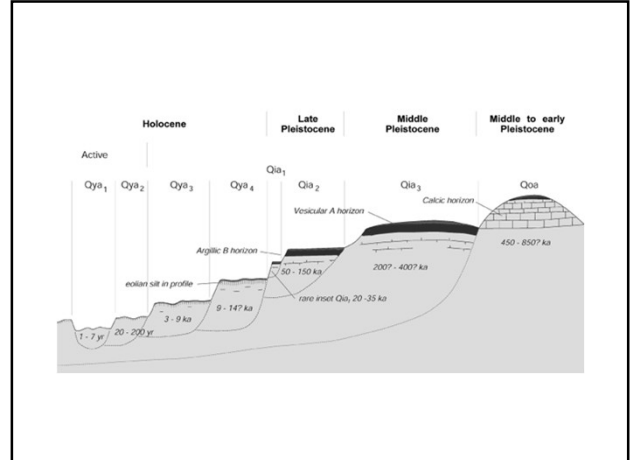
47



48



49



50



51

Petrocalcic Location

- Arid and semiarid regions

52

Petrocalcic Characteristics

- White color and effervescent
- Secondary carbonate accumulations fills pores and cements layers
- Water and roots cannot enter except through cracks
- Massive or platy-like
- Very hard or harder when dry
- Moderately low to very low permeability, unless layer is fractured
- Carbonates form filaments and pendants

53

Impact of Petrocalcic on Onsite Wastewater Treatment

- Plugged pores and cementation reduces porosity
 - Reduces permeability
 - Reduces aeration
- Effluent may perch above petrocalcic and flow laterally
- Ca removes P forming insoluble Ca phosphates - stable crystal structures

54

Field Identification of Petrocalcic

- Cemented or indurated by carbonates, and
- Roots penetrate only along vertical fractures, and
- ≥ 10 cm thick or ≥ 1 cm thick if consists of laminar cap directly underlain by bedrock

55

Petrogypsic Formation

- Secondary accumulation of gypsum
- Parent materials rich in gypsum
- Gypsum easily dissolved but limited precipitation and evaporation cause it to accumulate shallow
- Gypsum accumulations plug pores and cement layer

56

Petrogypsic Location

- Arid regions

57

Petrogypsic Characteristics

- Secondary accumulation of gypsum cements layer
- Fragments do not slake in water
- Roots and water do not enter except through cracks
- Massive
- Very hard or harder when dry
- Moderately low to very low permeability, unless fractured
- Gypsum accumulates as masses or clusters of crystals

58

Impact of Petrogypsic on Onsite Wastewater Treatment

- Plugged pores and cementation reduces porosity
 - Reduces permeability
 - Reduces aeration
- Effluent may perch above petrogypsic and flow laterally
- Ca removes P forming insoluble Ca phosphates

59

Field Identification of Petrogypsic

- Cemented or indurated by gypsum, and
- Roots penetrate only along fractures with horizontal spacing of ≥ 10 cm, and
- ≥ 10 cm thick, and
- $\geq 50\%$ gypsum, and
- Product of thickness (cm) and gypsum content (%) ≥ 150

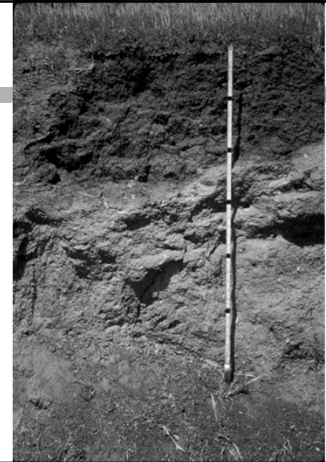
60

SAR Table

Sequence of Soil Characteristics Questions	SAR, Trench, Chamber, and Pit gal/day/ft ²	SAR, Bed gal/day/ft ²
B. Is the structure of the horizon moderate or strongly platy?	A site-specific SAR is required	A site-specific SAR is required
D. Is the moist consistency stronger than firm or any cemented class?	A site-specific SAR is required	A site-specific SAR is required
E. Is the texture sandy clay, clay, or silty clay of high clay content and the structure massive or weak?	A site-specific SAR is required	A site-specific SAR is required
F. Is the texture sandy clay loam, clay loam, silty clay loam, or silty loam and the structure massive?	A site-specific SAR is required	A site-specific SAR is required

61

Duripan



62

Duripan Formation

- 1 - Monosilicic acid adsorbed on soil particle, polymerizes, precipitates as soil dries
Particles cemented by this precipitation
- 2 – Silica adsorbed on surface of soil particles, forming bridges that cement particles

63

Duripan Location

- ☐ Arid regions
- ☐ Xeric moisture regimes
- ☐ Soils are usually dry or seasonally dry

64

Duripan Characteristics

- ☐ Cemented with silica
- ☐ < 50% of volume or air-dry fragments slake in water or during prolonged soaking in HCl
- ☐ Very firm or firmer
- ☐ Always brittle, even after prolonged wetting

65

Impact of Duripan on Onsite Wastewater Treatment

- ☐ Accumulation of silica and cementing reduces porosity
 - ☒ Reduces permeability
 - ☒ Reduces aeration
- ☐ Effluent may perch above duripan and flow laterally

66

Sequence of Soil Characteristics Questions	SAR, Trench, Chamber, and Pit gal/day/ft ²	SAR, Bed gal/day/ft ²
D. Is the moist consistency stronger than firm or any cemented class?	A site-specific SAR is required	A site-specific SAR is required

67

Field Identification of Duripan

- ☐ Cemented or indurated in 50% of volume, and
- ☐ Evidence of accumulation of opal or other forms of silica, such as laminar caps, coatings, lenses, partly filled interstices, bridges between sand grains, or coatings on rock fragments, and
- ☐ <50% of volume of air-dry fragments slake in HCl, even after prolonged soaking in acid, and
- ☐ Roots penetrate only along vertical fractures with a horizontal spacing ≥ 10 cm

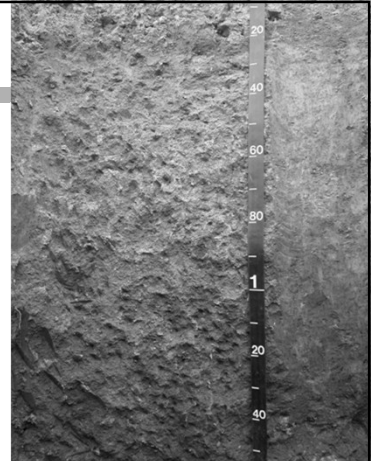
68

STONE LINES AND PALESOLS

Influence on Onsite Wastewater Treatment

69

Paleosols or Stone Lines



70

Paleosol Location

- ☐ Not limited to any specific part of the world

71

Paleosol Formation

- ☐ Soil forming processes operated before deposition took place
- ☐ Soil that formed in sediment may form from similar, or different, processes

72

Paleosol Characteristics

- Highly variable as a result of diverse soil forming processes
- Clay translocation is of greatest concern

73

Impact of Paleosols on Onsite Wastewater Treatment

- Illuvial accumulation of large amounts of clay reduces porosity
 - ▣ Reduced permeability
 - ▣ Reduced aeration
- Difficult to maintain aerobic conditions

74

Sequence of Soil Characteristics Questions	SAR, Trench, Chamber, and Pit gal/day/ft ²	SAR, Bed gal/day/ft ²
C. Is the texture of the horizon sandy clay loam, clay loam, silty clay loam, or finer and the soil structure weak platy?	A site-specific SAR is required	A site-specific SAR is required
E. Is the texture sandy clay, clay, or silty clay of high clay content and the structure massive or weak?	A site-specific SAR is required	A site-specific SAR is required
F. Is the texture sandy clay loam, clay loam, silty		

75

Stone Layers

- Impact on waste water treatment
- Impact on water movement

76



77



78

Questions

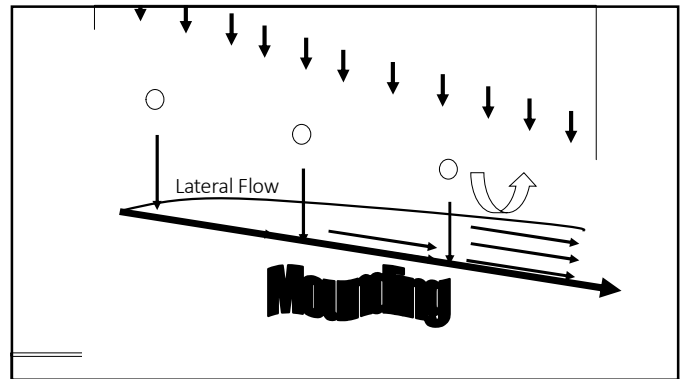


79

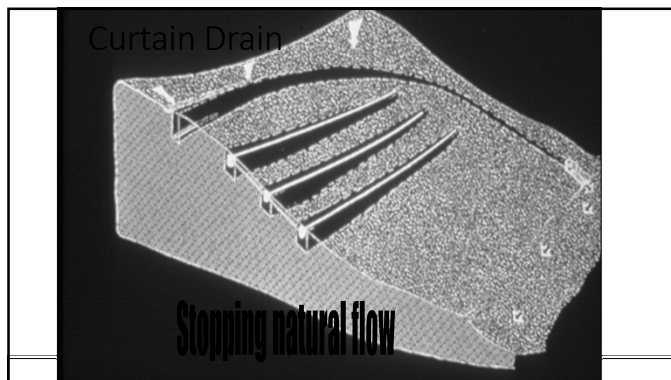
Mounding: Simple ISTS Method

THE BUILD-UP OF EFFLUENT UNDER A SYSTEM

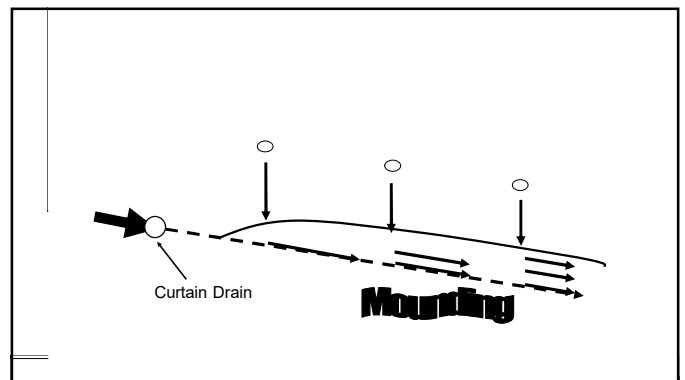
1



2



3



4

Where the two flows meet

- Trenches
 - Biomat: Flow control
- Unsaturated zone
 - Separation
 - Treatment
- Mounding
 - Raising of saturated levels
- Ground water
 - Saturated flow

5

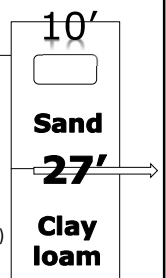
Absorption Area

Soils: sandy soil (treatment level C) over clay loam

Layout: bed with 12" of rock @ 10' wide

$$\begin{aligned} \text{Ratio:ab} &= (\text{shlrd} \div \text{reduction factor}) \div \text{shlrr} \\ &= (1.2 \text{ gpd/sqft} \div 1) \div 0.45 \text{ gpd/sqft} \\ &= 2.7 \end{aligned}$$

$$\begin{aligned} \text{Absorption width} &= \text{ratio:ab} \times \text{system width (bottom area)} \\ &= 2.7 \times 10 \text{ ft} = 27 \text{ ft for the system} \end{aligned}$$



6

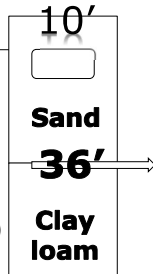
Absorption Area

Soils: Sandy soil (treatment level A) over Clay loam

Layout: bed with 12" of rock @ 10' wide

$$\begin{aligned} \text{Ratio:ab} &= (\text{shlrd} \div \text{reduction factor}) \div \text{shlrr} \\ &= (1.6 \text{ gpd/sqft} \div 1) \div 0.45 \text{ gpd/sqft} \\ &= 3.6 \end{aligned}$$

$$\begin{aligned} \text{Absorption width} &= \text{ratio:ab} \times \text{system width (bottom area)} \\ &= 3.6 \times 10 \text{ ft} = 36 \text{ ft for the system} \end{aligned}$$



7

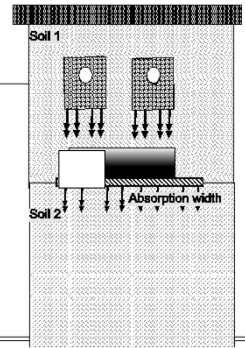
SHLR & Mounding

SHLR First layer

SHLR Slowest layer

Flow = SHLR x Area

Flow in – Flow out



8

Flow to Depth

Flow in – Flow out

Qin – Qout

Other factors:

- Length and width
- Porosity

9

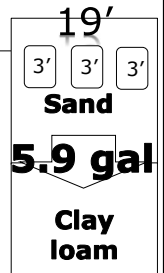
Mounding

Soils: Sandy soil (treatment level A) over Clay loam

Layout: 3 trenches with 6" of rock @ 3' wide [19']

Flow = [(Shlrd ÷ reduction factor) x width] - [Shlrr x width]

$$\begin{aligned} &= (1.6 \text{ gpd/sqft} \div 1) \times 9' - [0.45 \text{ gpd/sqft} \times 19'] \\ &14.4 \text{ gal} - 8.55 \text{ gal} \\ &= 5.9 \text{ gal} \end{aligned}$$



10

Mounding {inches}

GoM= Qin-Qout 14.4 gal – 8.55 gal= 5.9 gal

$$\begin{aligned} \text{Inches} &= \text{GoM} \div 7.5 \div \text{TW} \times [\text{Qin} \div 12] \div \% \times 12'' \\ &= 5.9 \div 7.5 \div 19' \times [14.4 \div 12] \div .33 \times 12'' \\ &= 1.7'' \\ &1.7'' \end{aligned}$$

11

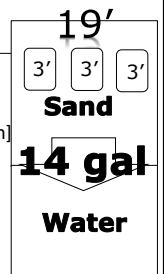
Mounding

Soils: Sandy soil (treatment level A) over Saturated soil

Layout: 3 trenches with 6" of rock @ 3' wide [19']

Flow = [(shlrd ÷ reduction factor) x width] - [shlrr x width]

$$\begin{aligned} &= (1.6 \text{ gpd/sqft} \div 1) \times 9' - [0 \text{ gpd/sqft} \times 19'] \\ &14.4 \text{ gal} - 0 \text{ gal} \\ &= 14.4 \text{ gal} \end{aligned}$$



12

Mounding {inches}

$$\text{GoM} = Q_{\text{in}} - Q_{\text{out}} \quad 14.4 \text{ gal} - 0 \text{ gal} = 14.4 \text{ gal}$$

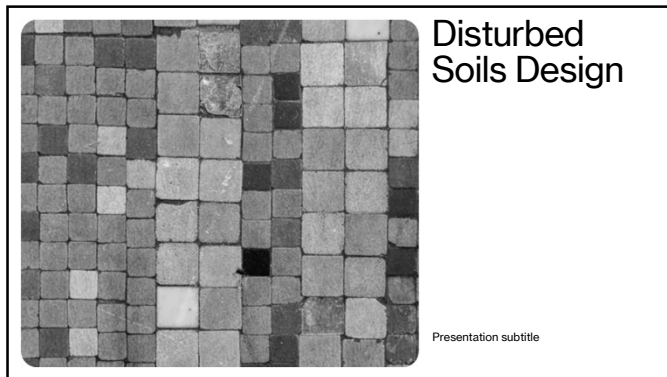
$$\begin{aligned} \text{Inches} &= \text{GoM} \div 7.5 \div \text{TW} \times [Q_{\text{in}} \div 12] \div \% \times 12'' \\ &= 14.4 \div 7.5 \div 19' \times [14.4 \div 12] \div .33 \times 12'' \\ &= 4.4'' \end{aligned}$$

13

Questions



14



1

Terms

- Natural Soils
- Disturbed Soils
- Damaged Soils
- Fill Soils
- Cut Soils

2

Choosing the SHLR

- Texture: Structure: Consistence
- System elevation
- Perc Test
- Most restrictive

3

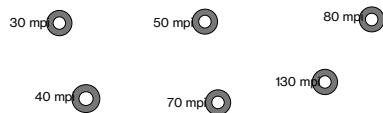
Problem Identification: Traffic

- Tracks
- Spoil piles
- Compaction
 - Structure
 - Massive/ Platey
- Acceptance

4

Site work

- Texture: Loam
- Structure: Blocky: Moderate
- Consistence: Friable



5

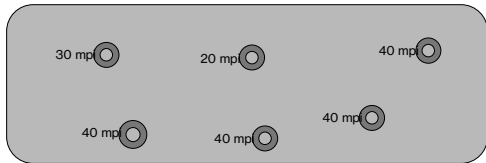
Problem Identification: Fill

- Color
 - Natural
 - Layers
 - Topsoil on top
- Un-Natural
- Un-Natural slopes

6

Site work

- Texture: Loam
- Structure: Blocky: Moderate
- Consistence: Friable



7

Problem Identification: Cut soils

- Un-Natural
- Structure
 - Massive at or around the surface
- Evenness of Horizon Depth

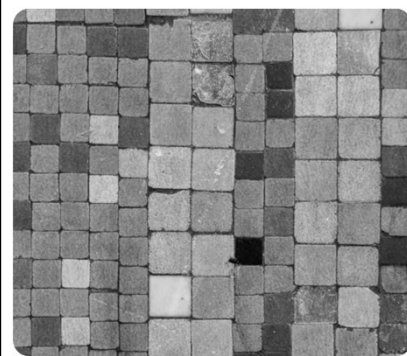
8

Acceptance

- Building above
- Large absorption area
- Managing Dosing
 - Time dosing
 - Drip

9

Questions



Presentation subtitle

10

Flow Equalization

Flow Equalization Time Dosing Using the WHOLE Day

Design Guidance pg 66

1

Flow Equalization

Flow Equalization Systems

- Makes the flow introduced to the treatment system more consistent.
- Flow equalization is important if
 - The average flow is $\geq 70\%$ of the design capacity
 - Water use habits or facility operations are variable-
Example church only open on Sun.
 - Frequent peaks exceed system capacity
 - Wash day: cleaning service

Uses 24 hours Limits Use

2

Flow Equalization

Effects of Flow Equalization

Flow variations

% Flow

Days

Average daily flow

Use based on timer setting

3

Flow Equalization

Other Benefits of a Flow Equalization System

- Regular feeding the hungry population of microbes that are used for treatment.
- Soil Treatment: Regular resting
- Monitoring of flows from the surge tank may help detect
 - major changes in flow patterns
 - leaking effluent
 - clogging orifices
- Provide storage and spread-out water delivery after a power outage.

4

Flow Equalization

Timer

Pump tank

Pump tank

Septic tank

Adv. Treatment Unit

Soil Treatment Area

EVERY COMPONENT
DOWNSTREAM IS TIME DOSED

5

Flow Equalization

What is needed to Time Dose??

- Flow controlled by timer
- Timers
 - ON: OFF
 - Clock
- Programmable Logic Controller
 - Computer

6

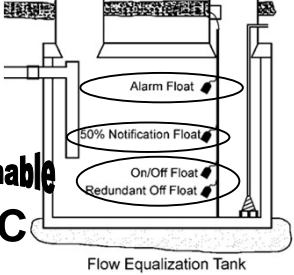
Flow Equalization

Flow Equalization System

Timer Override=Broken

- Timer
- Moderates flow from facility
- Controls in tank

Peak enable
PLC



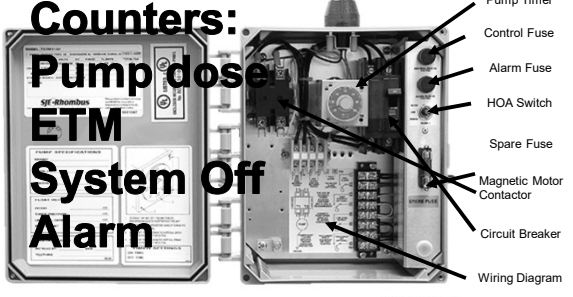
Flow Equalization Tank

7

Flow Equalization

Timed Dose Panel

Counters:
Pump dose
ETM
System Off
Alarm



- Pump Timer
- Control Fuse
- Alarm Fuse
- HOA Switch
- Spare Fuse
- Magnetic Motor Contactor
- Circuit Breaker
- Wiring Diagram

www.siefrombus.com

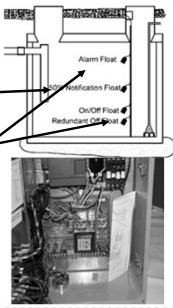
8

Flow Equalization

Control Panel Needs

- Track doses
- Track time of pump on – Flow measurement
- Track Peak enable- – Design flow
- Track Pump Off events – *Set flow too HIGH*
- Track Alarms – *Set flow too Low*

Timer



9

Flow Equalization

The Design “Math”

- The Flows
 - The Design
 - The Components
- The Tanks
- The Dosing

Backward

Forward

10

Flow Equalization

Forward Design

- Looking at flow [Real: Design] components are sized
- The anticipated flows are handled in the system
- Typical savings in component LIFE
 - System is Designed to “Last”
- LARGE Peaks are managed thru SIZE

11

Flow Equalization

Backward Design

- Reduced flow System [Type III]
- Limited Soil treatment area
- STA sets allowable flow
 - Timer Controlled
- System [Pump tank] now operates as a Holding tank
- Septic tank design [before timer] based on typical values

12

Flow Equalization

Time-Dosed Systems

It is a soft failure



Calibrate the Flow=PDR
PDR= Pump Delivery Rate

13

13

Flow Equalization

Calibrate Pump

- Run a Dose
- Measure start and end liquid depth
- Time the dose
- Do the math
(Change in depth x GPI) ÷ Time = Gallons per minute



14

14

Flow Equalization

Residential Systems

Pump Tank capacity
= # days x Design flow

3 Bedroom home –
450 gpd

2 x 450 = 900 gal. or
1,000 gal. tank

3 x 450 = 1350 gal. or
1,500 gal. tank



15

15

Flow Equalization

Setting the timer

- Start by setting the average daily flow at 50% design flow
- Monitor System
 - No alarms/ No Off timer-
 - Good
 - Alarms- Up the flow
 - Shorter off
 - Off timer- Reduce the flow
 - Longer off
- Peak enable set at Design flow

FULL SIZE



16

16

Flow Equalization

Cabin

- System Size available area : 70% of area Design flow = 200 gpd
- Peak Weekend **450 gal – 200 gal= 250 gal**
- 4 days **6 x 75 = 450 250**
- 6 people **8 x 75 = 600 400**
- 8 people **8 x 75 = 600 400**
- 8 people **8 x 75 = 600 400**
- 6 people **6 x 75 = 450 250**

BACKWARD **1,300 gal**

TIMER SET 200 GPD

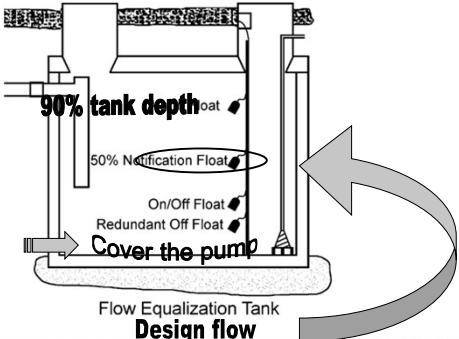
7080.2300 A/H page 58

17

17

Flow Equalization

Pump Tank Design



90% tank depth

50% Notification Float

On/Off Float

Redundant Off Float

Cover the pump

Flow Equalization Tank

Design flow

18

18

Flow Equalization

Data Required

Flow Characteristics:

- Average Daily
- Surge [%]
 - Regular Highs flows
 - Weekly
 - Monthly
- Special Occasions
- How often: Annually/ Bi- Annual

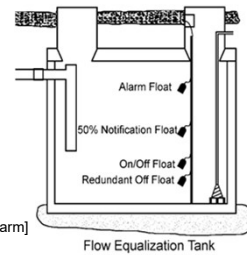
19

19

Flow Equalization

Calculating for Commercial

- Measure the flow
 - Read meter
 - Calculate flow
- Calculate volume in tank
 - Average flow - Timed dose
- Necessary storage
 - **PEAK Surge Volume**
 - Design storage [Surge volume + Ave]
- Tank volume
 - Sum three volumes [Min.+ Design + Alarm]
 - Design tank capacity
 - $\{[(\text{Surge} + \text{Ave}) \times \text{Peaking}]\}$



20

20

Flow Equalization

Small Restaurant

DF = 1,200 GPD
BOD @ 1,500 MG/L

- Grease trap= 1,200 gal
- Septic tank~ 3,600 gal
- Pump tank [Splitter]
- Gusagator~ 3 @Model 12
- STA~ 2,000 sqft

CANNOT AFFORD IT

21

21

Flow Equalization

Flow Controlled by Surge Tank

Day	Daily Flow (gal)	Timed Dose (gal)	Surge Vol. (gal)
Peaking 20%			
Sunday pm			700
Monday	250	350	600
Tuesday	200	350	450
Wednesday	150	350	250
Thursday	200	350	100
Friday	250	350	0
Saturday	700	350	350
Sunday	700	350	700

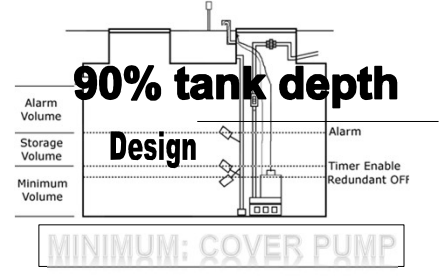
350 + 350

22

22

Flow Equalization

Required Volumes



23

23

Flow Equalization

Storage Volume

- Surge Vol. + Ave (Storage volume)
 - 700 + 350 gpd = 1,050 gallons
- Design vol. = Storage x Peaking [20% min]
- 1,050 gal x 1.2 = 1,260 gallons

24

24

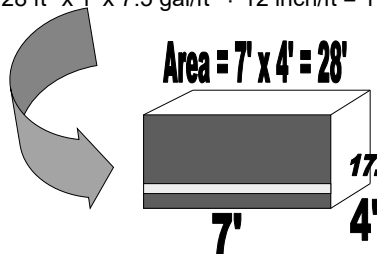
Flow Equalization

Gallons Per Inch

Area x 1' x 7.5 gal/ft³ ÷ 12 inch/ft = gal/inch
 28 ft² x 1' x 7.5 gal/ft³ ÷ 12 inch/ft = 17.5 gal/in

Area = 7' x 4' = 28'

17.5 gal per inch



25

25

Flow Equalization

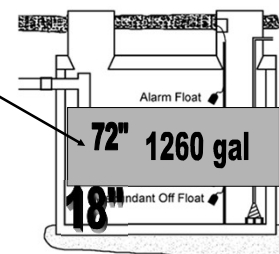
Floats: Setting Depths

- Off
 - Set at 18" [Pump+ 2" + Block(4")]
 - 18" x 17.5 g/in= 315 gal.
- Storage volume
 - 1,260gal ÷ 17.5 g/in= 72"
- Peak enable set at
 - 350 gal ÷ 17.5 g/in= 20"
 - 18" + 20" = 38" from bottom
- Alarm depth
 - Method 1
 - 18" + 72" = 90"
 - Method 2
 - 96" x 90% = 86.4"

72" 1260 gal

18"

96" Tank depth



26

26

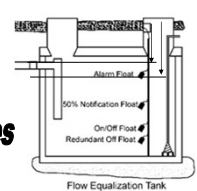
Flow Equalization

Setting the timer

- Pump delivery rate~ Calibration
- 5 inches in 3 minutes
- 5"x 17.5 gal/in ÷ 3 min = 29 gpm

SMALL RESTAURANT

3 minutes



27

27

Flow Equalization

Timer On

- Amount of time for a dose
- Dose = [Ave flow ÷ # of doses] + Drainback
- [350 gpd ÷ 7 doses] + 12 gallons = 62 gallons
- Check minimum system dose ~50 gallons
- Dose volume ÷ Pump rate = Minutes
- 62 gal ÷ 29 gpm = 2.1 minutes On

28

28

Flow Equalization

Timer off

- Day ÷ Number of doses – On time
- [1,440 minutes ÷ 7 doses] – 2.1 min=

203.6 minutes

203.6 min ÷ 60 m/h = 3.4 hr

29

29

Flow Equalization

Time off = 3.4 hr

Time on = 2.1 min



30

30

Flow Equalization

Small Restaurant

- Design flow = 1,200 gpd
- Treatment flow 350 gpd
- Measured flow
- Grease trap= 1,200 gal
- Septic tank~ 3,600 gal
- Pump tank W/ Storage 1750 gal
- Gusagator~ 1- Model 12
- STA~ 600 sqft

Same

CAN AFFORD IT

31

31

Flow Equalization

Another example

Gussy Burger

- Flows for the week
- Because of the time of year the receipts are about 15% lower than the typical income
- The Gussy burger has a monthly Grease Lighting event that typically ups revenue about 30% for that week
- Annually they have a Burger cook-off that the revenue doubles for that week
- What do we recommend?

Table Design Flow 2450 gpd

32

32

Flow Equalization

Grease Trap & Septic tanks

Grease Trap

- 100% Flow @ Peak (Design flow)
- 2450 gpd x 70% = 1715 gal

Septic tank

- Gravity to the Tank
- Peak flow x 3
- 2450 gpd x 3 = 7350 gal

33

33

Flow Equalization

Calculate flows

Table Value 3.5 gal/meal

- Measured flows based on Meals
- Sunday 240 = 840 $3.5 \times 240 = 840$
- Monday 0
- Tuesday 130 = 455 $840 - 650 = 190$
- Wednesday 150 = 525 $980 - 650 = 330$
- Thursday 180 = 630 $1120 - 650 = 470$
- Friday 280 = 980
- Saturday 320 = 1120 **990 Surge**
- Average flow 650 gpd
- Peak flow 1,120 gpd
- Comparing to 'Normal'

4550 gal ÷ 7 days = 650 gal/day

38

38

Flow Equalization

Monthly Event

- Storage = Ave Flow + Surge
- 650 gal + 990 gal = 1640 gal
- Slow time {off by 15%} = Add 15%
- 1640 gal x 1.15 = 1886 gal
- Increasing storage (Event)
- Add 30% increase
- 1886 gal x 1.3 = **2452 gal**

Business level

GROWTH

RIGHT

Guidance Min

1,640 gal x 1.2 = 1,968 gal

39

39

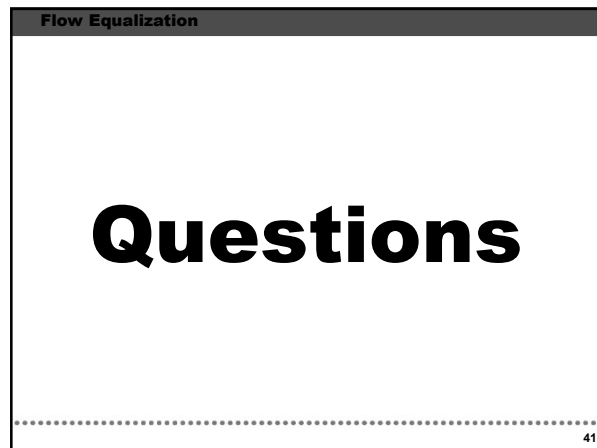
Flow Equalization

Annual Event

- Special use
- Empty the Tanks
- Portables
- Washing schedule
- Pre cooking
- Clean up

40

40



41

PRESSURE DISTRIBUTION

DESIGN OF ONSITE SYSTEMS



1

WHY USE PRESSURE

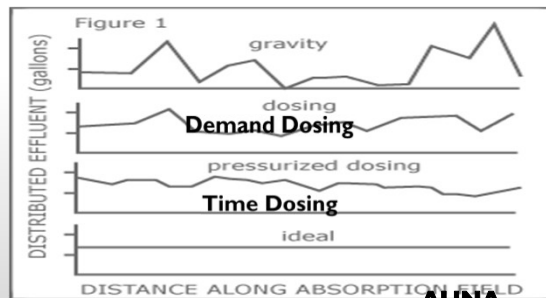
I need to spread the effluent out over the contour

- Above ground systems
- Low BOD "Pretreated" Distribution
- Larger Systems

An option when:

- I have a pump anyway
- Sandy soils

2



3

THE GOAL FOR PRESSURE DISTRIBUTION:

- Evenly distribute wastewater under low-pressure (1- 10 feet of head) over the entire surface of the soil treatment area by using a pressurized pipe (1-2 inch).
- **At the SAR**
- Less than **10% difference** in pressure along the lateral
- Distal pressure (design) is a minimum

4

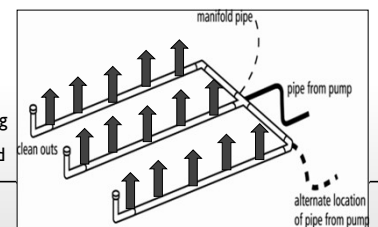
BASIC COMPONENTS

- Supply line
- Manifold
- Lateral
- Orifices in lateral from which sprays wastewater
- Cleanout on each lateral
- Distribution media & Inspection pipe in distribution media
- **Fully developed biomat is BROKEN**



5

Even over space
Even over time
Even resting
Never overloaded



IDEAL DOSING

6

Pressure Distribution Design Worksheet

Minnesota Pollution Control Agency

1. Select Number of Perforated Laterals (2-3 foot spacing):

2. Select Perforation Spacing (e.g. 9 ft² per orifice): ft²

Note: Must use 2 lines for media filters

3. Select Perforation Diameter: inch

4. Length of Laterals = Media Bed Length - 2 Feet. Perforation can not be closer than 1 foot from edge.

- 2ft = ft

5. Determine the Number of Perforation Spaces. Divide the Length of Laterals (Line 4) by the Perforation Spacing (Line 2) and round down to the nearest whole number.

Number of Perforation Spaces = ft ÷ ft = Spaces

6. Number of Perforations per Lateral. Is equal to 1.0 plus the Number of Perforation Spaces (Line 5).

Perforations Per Lateral = Spaces + 1 =

Check Table 1 to ensure that the number of perforations per lateral guarantees less than a 10% discharge variation.

1/4 Inch Holes					3/8 Inch Holes						
Perforation Spacing (feet)	1	1 1/4	1 1/2	2	3	Perforation Spacing (feet)	1	1 1/4	1 1/2	2	3
1	10	13	18	30	60	1	11	16	21	34	68
2	8	12	16	28	54	2	10	14	20	32	64
3	8	12	16	25	52	3	9	14	19	30	60

1/2 Inch Holes					3/4 Inch Holes						
Perforation Spacing (feet)	1	1 1/4	1 1/2	2	3	Perforation Spacing (feet)	1	1 1/4	1 1/2	2	3
1	12	18	26	46	87	1	21	33	44	74	149
2	12	17	24	40	80	2	20	30	41	69	135
3	12	16	22	37	75	3	20	29	38	64	128

7

EVEN OVER THE AREA

7080.2050 Suppb 4

- Laterals can not be closer than 1 foot from edges of bed
- > 1' from edge
- Number of Holes
 - 4-9 sqft/orifice
- 3' max hole spacing
- Minimum hole spacing
 - Reasonable [2]
- Hole size: 1/8 inch – 1/4 inch

8

EVEN OVER THE LATERAL

- Pressure loss
- Size of the Pipe
 - Flow rate impacts
 - Flushing
- Maximum # Hole

9

PRESSURE DESIGN

Check number of perforations to ensure less than 20% variation from average

- Table is from point of entry to end of lateral
- If center feeding the total number per lateral is double

Select maximum pipe diameter which allows for the number of perforations needed

- This diameter will impact dose amount so smaller diameter pipe may be needed if you have a large distribution network

10

MAXIMUM NUMBER OF PERFORATIONS

Table 1 Maximum Number of Perforations Per Lateral to Guarantee <10% Discharge Variation

1/4 Inch Holes						3/8 Inch Holes					
Perforation Spacing (feet)	1	1 1/4	1 1/2	2	3	Perforation Spacing (feet)	1	1 1/4	1 1/2	2	3
1	10	13	18	30	60	2	11	16	21	34	68
2	8	12	16	28	54	2 1/2	10	14	20	32	64
3	8	12	16	25	52	3	9	14	19	30	60

1/2 Inch Holes						3/4 Inch Holes					
Perforation Spacing (feet)	1	1 1/4	1 1/2	2	3	Perforation Spacing (feet)	1	1 1/4	1 1/2	2	3
1	12	18	26	46	87	1	21	33	44	74	149
2	12	17	24	40	80	2	20	30	41	69	135
3	12	16	22	37	75	3	20	29	38	64	128

11

LPP TRENCH CROSS SECTION [NC]

- Sleeve helps protect orifices
- Helps diffuse energy of wastewater spray
- Some options may use orifice shields

12



13



14

O&M

- Clean & Flush Lines
- Clean devices
- Verify operation
- **FREQUENCY**
 - Orifice size
 - 1/4 inch ~ 3 years
 - 1/8 inch ~ 1 year



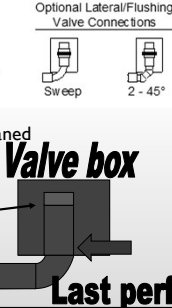
15

LATERAL TURN-UP SHOWING GRAVELLESS OPTION – SLEEVED LINE SHOWN AT REAR

16

CLEAN OUTS

- For all pressure lines
- Allows lines to be check and cleaned
- Need
 - Sweep 90 or 2 @ 45
 - Valve box
 - Treaded cap/valve



Optional Lateral/Flushing Valve Connections

Sweep 2 - 45°

Valve box

Last perf

17

PRESSURE DESIGN

- Choose perforation diameter
 - 1/4\"
 - Smaller with treatment level A or B
- Use number of perforations to determine required GPM
- Pump discharge capacity based on the perforation discharges for a minimum average heads shown in Table III

Head (ft)	Perforation Discharge (GPM)			
	1/8	3/16	7/32	1/4
1.0 ^a	0.18	0.41	0.56	0.74
2.0 ^b	0.26	0.59	0.80	1.04
5.0 ^c	0.41	0.93	1.26	1.65

a: Use 1.0 for dwellings using 1/4 inch or 3/16 inch or holes.

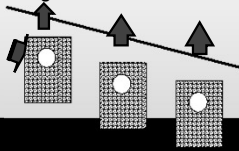
b: Use 2.0 for dwellings using 1/8 inch holes; or, for other establishments using 1/4 inch or 3/16 inch holes.

c: Use 5.0 for other establishments using 1/8 inch perforations and media filters.

18

WHEN THE SYSTEM IS NOT LEVEL

- The flow will not be equal
- Higher distal pressure- More flow
- Lower trenches will loaded higher
- Be careful of upslope drainage
 - Manifold flow
 - Block lateral drainage



19

BALANCING PRESSURE DISTRIBUTION

UN-LEVEL DISTRIBUTION

20

THE PROBLEM

- Bigger arrow more flow
- More flow~ Not even



21

DESIGN OPTIONS

- Goal:
- Splitting the flow equally
- Choices
 - Separate pieces
 - Balancing valves
 - Design

22

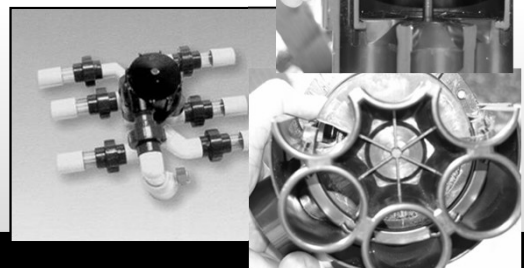
SEPARATE PIECES

- Typically equal
- Separate pumps
 - Alternating
- Splitter valves
- Equal by Dose
- **NO Timers**



23

HYDRO SPLITTING



24

HYDRAULIC SWITCHING VALVES

- Have clear PVC pipes where flow can be verified
- Have hard rubber cam device
- **MUST** be accessed, disassembled, and cleaned



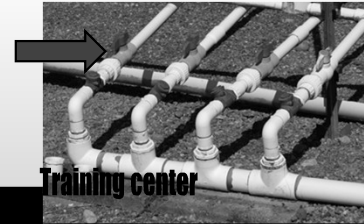
Highest Point

25

USING VALVES

USE GLOBE OR GATE VALVES

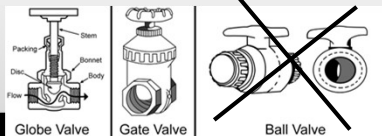
- Balancing the pressure



26

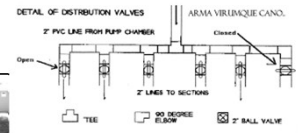
FLOW REGULATING VALVES “BALANCING”

- Adding one increases friction
- **Should NOT** be a ball valve
- Gate valve is better
- Globe valve is best but most expensive



27

VALVE BOXES

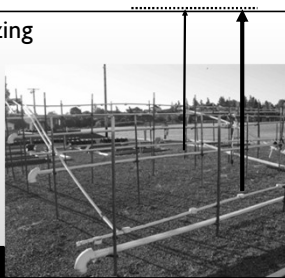


Adjust to SAME heights
Room to work

28

DESIGN

- Orifice spacing and sizing
- Sprays to the same elevation
- Lower laterals
 - Higher pressure
 - Smaller holes
 - Larger spacing



29

QUESTIONS

30

Drip System Work Sheet

Drip Distribution Design

1

1

Drip System Work Sheet

Why Drip Distribution?

Functional in most site conditions
 Uniform application of the effluent
 Control application rate
 Shallow soil – 12" to 6"
 Steep slopes
 High groundwater
 Full use of landscape area
 Reuse wastewater in the landscape
 –Wooded area

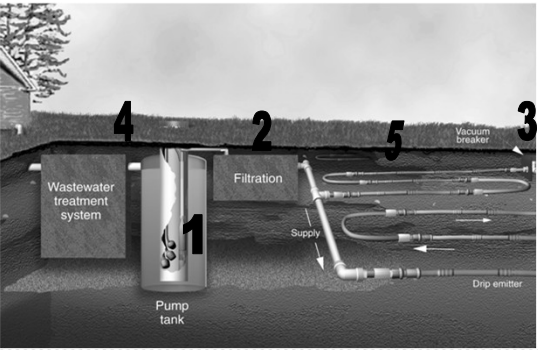


2

2

Drip System Work Sheet

Drip Distribution System

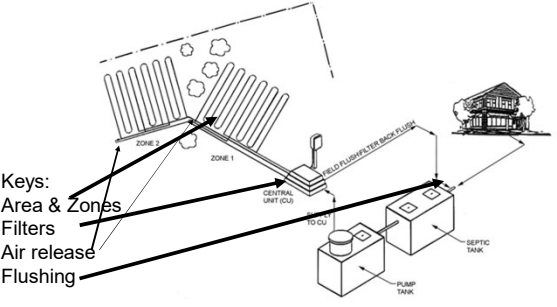


3

3

Drip System Work Sheet

Drip Field Layout



Keys:
 Area & Zones
 Filters
 Air release
 Flushing

4

4

Drip System Work Sheet

Drip Emitters

Emitter Types
 Pressure Compensating or
 Non-Pressure Compensating
 emitters.

Controlled flow rate for emitters -
 Friction used to control flow

The operating pressure is typically
 15-25 psi for non-pressure
 compensating and 15-45 psi for
 pressure compensating emitter
 systems, with water exiting the
 emitter at 0 psi.



5

5

Drip System Work Sheet

Drip Filters

Types

- Screen
- Disc
- Sand Media Filter

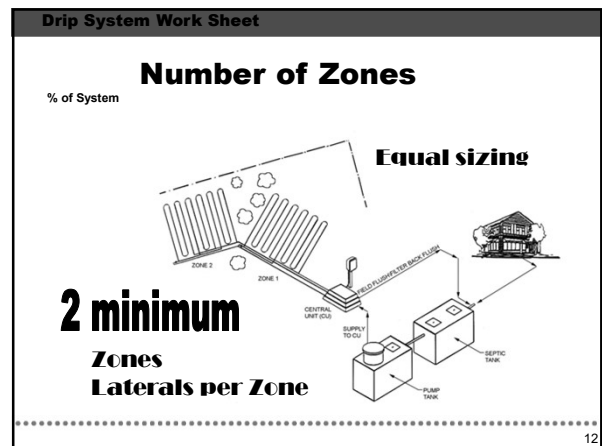
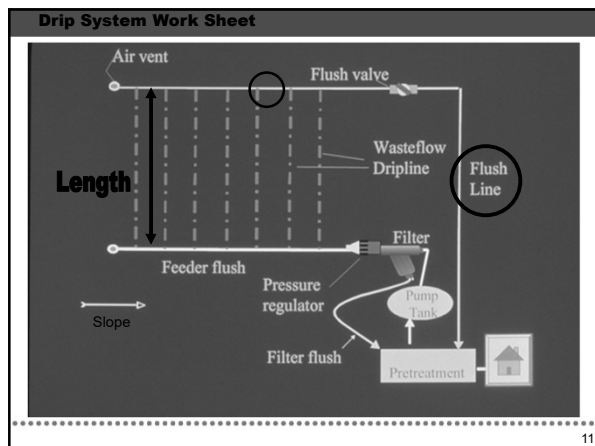
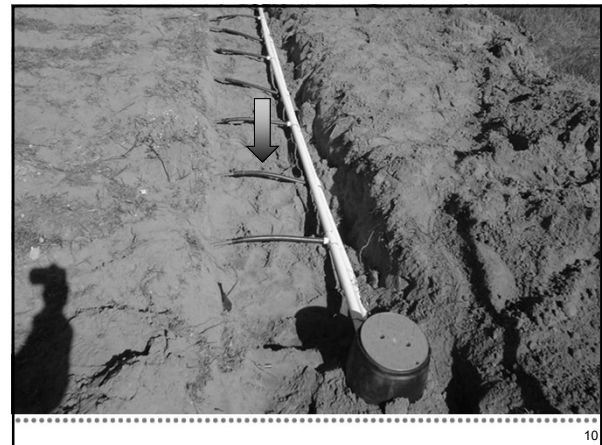
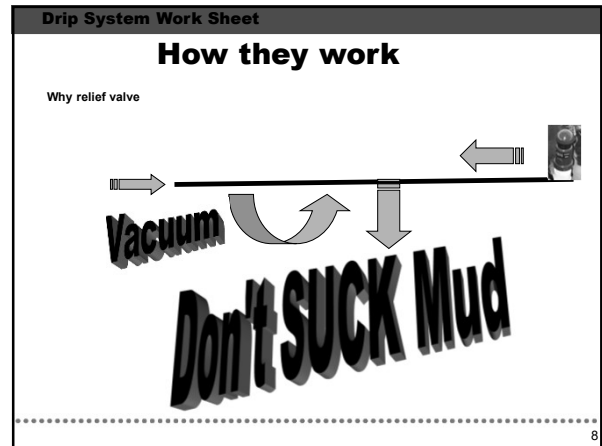
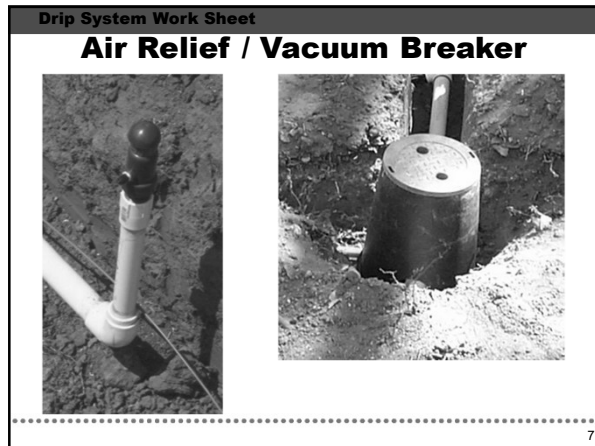
Remove particles greater
 than 100 microns

Protects emitters from
 plugging by particles in
 the effluent



6

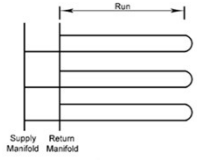
6



Drip System Work Sheet

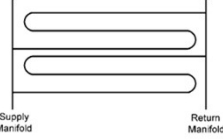
Drip Field / Zone Configurations

Drip field runs - two foot spacing between runs
 Ladder approach –manifold attached to single runs
 Looped runs to form lateral



Supply Manifold Return Manifold

**Leaking at bottom ~
Check drainback**



Supply Manifold Return Manifold

13

Drip System Work Sheet

Drip Design

Level of Treatment
 Septic Tank or Advanced Technology

Soil Contact = SHLR

CLR < 12 gpft
 Site Layout
 Equal pieces

Table IX: Loading rates for determining bottom... using detailed soil descriptions

USDA soil texture	Soil structure and grade	Equipment Level C		Equipment Level A, A-1, B, B-2	
		Absorption area loading rate (gpd/ft²)	Mound absorption ratio	Absorption area loading rate (gpd/ft²)	Mound absorption ratio***
Sand, coarse sand, loamy sand, loamy coarse sand, fine sand, loamy fine sand, loamy very fine sand, silty loess, 10% rock fragments	Single grain, granular, blocky, or prismatic structure, weak grade	**	1.0	**	1.0
Sand, coarse sand, loamy sand, loamy coarse sand, <10% rock fragments	Single grain, granular, blocky, or prismatic structure, weak grade	1.3	1.0	1.6	1.0
Fine sand, very fine sand, loamy fine sand, loamy very fine sand, <10% rock fragments	Single grain, granular, blocky, or prismatic structure, weak grade	0.6	2.0	1.0	1.6

14

Drip System Work Sheet

Drip Sizing

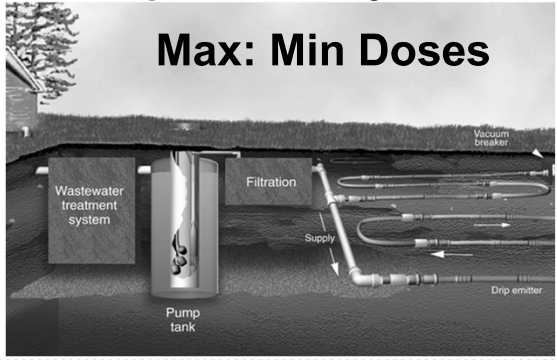
Area = Flow ÷ SHLR
 600 gpd ÷ 0.6 = 1,000 sqft
 Geometry ~ CLR < 12 gpft
 600 gpd ÷ 100' = 6 gpf
 Length of Drip tubing < 300'
 # of Laterals **Use 6 ~ 3 per zone**
 1,000 sqft ÷ 100' ÷ 2' spacing = 5 laterals
 # of Emitters
 3 x 100' ÷ 2' = 150 emitters [one zone]

15

Drip System Work Sheet

Drip Distribution System

Max: Min Doses



Wastewater treatment system Pump tank Filtration Supply Drip emitter Vacuum breaker

16

Drip System Work Sheet

Drainback Zone 1

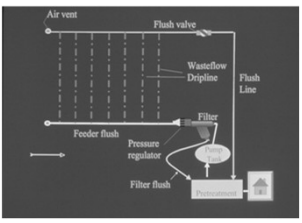


**Table II
Volume of Liquid in Pipe**

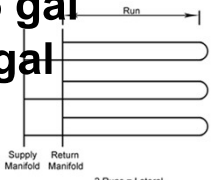
Pipe Diameter (inches)	Liquid Per Foot (Gallons)
1	0.045
1.25	0.078
1.5	0.110
2	0.170
3	0.380
4	0.661

17

Drip System Work Sheet

Minimum Dose

Fill the tubing at least 4 times
 Volume of the tubing x 4
 Remember to add in Solid Pipe
 Supply and Flushing **6 gal**
 Our System **12 gal**
 6 gal + 6gal = 12 gal
 Fill + Flush



Supply Manifold Return Manifold

2 Runs = Lateral

18

Drip System Work Sheet

Volume of Drip Tubing

Area (sqft) x length (ft) x 7.5 gal/cuft
 $\pi \times r^2 \times \text{length}$
 $3.14 \times [0.275'' \div 12'']^2 \times \text{length} \times 7.5 \text{ gal/cuft} =$
 $.012 \text{ gal/ft} \times \text{Length [ft]} = \text{gallons}$

0.55 "

19

19

Drip System Work Sheet

Minimum Dose

Volume of tubing x 4 + Drainback
 $\{.012 \text{ gal/ft} \times \text{Length [ft]} \times 4\} + \text{DB GAL}$
 $\{.012 \text{ gal/ft} \times 300 \text{ ft} \times 4\} + 12 \text{ gal}$
 $17.3 \text{ gal} + 12 \text{ gal} = 26.4 \text{ gal}$

20

20

Drip System Work Sheet

Max Dose Volume

= Depth (in) ÷ 12 in/ft x 1" ÷ 12 in/ft x length(ft) x Porosity x 7.5 gal/cuft
 $= \frac{12''}{12} \times \frac{1''}{12} \times 300 \text{ ft} \times 0.46 \times 7.5 = 86.25 \text{ gal}$

Porosity Values

Soil Texture	Porosity	Soil Texture	Porosity
Sand	0.33	Clay Loam	0.46
Loamy Sand	0.37	Silty Clay Loam	0.47
Sandy Loam	0.45	Sandy Clay Loam	0.43
Loam	0.46	Silty Clay	0.47
Silt Loam	0.5	Clay	0.47
Sandy Clay Loam	0.39		

Fill the Soil 1" 300 ft

21

21

Drip System Work Sheet

Checking Pressure

Time to Pressure

22

22

Drip System Work Sheet

Flushing Flow

23

23

Drip System Work Sheet

Dose volume [MIN:MAX]

26 gal: 86 gal

= Length ÷ Spacing = # orifices
 $= 300 \text{ ft} \div 2 \text{ ft} = 150 \text{ # orifices}$
 $= \text{# orifices} \times \text{flow per emitter}$
 $= 150 \text{ emitters} \times 0.61 \text{ gph} \div 60 \text{ min/hr}$
 $= 1.5 \text{ gpm [Rate]}$
20 min
 $\text{Time On} = \text{Dose} \div \text{Rate} = 30 \text{ gal} \div 1.5 \text{ gpm}$
 $\text{\# of doses} = \text{Design flow} \div \text{volume of dose}$
 $600 \text{ gpd} \div 2 \text{ zones} \div 30 \text{ gal} = 10 \text{ doses}$
 $\text{Off Time} = [1440 \div 10 \text{ doses}] - \text{on time}$
 $1440 \text{ min} - 20 \text{ minutes} = 124 \text{ minutes}$

24

24

Drip System Work Sheet

Think About It

2 zones each at 300'
 Design Flow rate 1.5 gpm
 Measure 1.4 gpm
 Measure 0.8 gpm
 Measure 20 gpm
 Measure 3 gpm

Plugging
 Broken
 Both ZONES

25

25

Drip System Work Sheet

Smiley Campground

5 Sites that are hooked up
 7 Sites that are not hooked up
 Laundry [1 Washer/ Dryer]
 6 Employees
 165' of 4" sewer line for the 5 sites and the Laundry
 Site:
 - Ramsey County
 - Wellhead Protection Area
 - Only room for one Site
 - Bedrock

1,700 GPD

26

26

Drip System Work Sheet

Soil Observation Log

Client: Smiley Campground Location / Address: 13 County Rd 21
 Project ID: v-03.01.2021

Soil parent material(s) (Check all that apply): ☐ outwash ☐ Lacustrine ☐ Loess ☐ Till ☐ Alluvium ☐ Bedrock ☐ Organic Matter
 Landscape Position: (select one) Back/Side Slope Slope No. 4.0 Slope shape Linear, Concave Elevation relative to benchmark:
 Vegetation: Grass Soil survey map units: Mostly 221 Limiting Layer Elevation:
 Weather Conditions/Time of Day: Sunny / Noon Date: 05/15/20

Depth (in)	Texture	Rock Frag. %	Matrix Color(s)	Mottle Color(s)	Redox Kind(s)	Indicator(s)	Shape	Structure	Grade	Consistence
0-12	Loam	3	7.5YR 2/1	None	None	None	Granular	Moderate		Friable
12-30	Silt Loam	8	7.5YR 4/4	None	None	None	Blocky	Moderate		Friable
30-40	Clay Loam	16	7.5YR 4/2	7.5YR 6/6	Concentric	54	Blocky	Moderate		Friable
40	Bedrock									

→ **TLC: 30" - 36" = -6"**
 ★ **TLB: 30" - 18" = 12"**

Comments: B. Springstem 5/15/2020

27

27

Drip System Work Sheet

Smiley Campground

Design Flow ~ 1,700 gpd
 Silt loam soils ~ .78 gpd/sqft
 Area: 1,700 gpd ÷ 0.78 gpd/sqft **2179 sqft**
 Laterals = Area ÷ Length ÷ Spacing
 Layout: 2179 sqft ÷ 150' ÷ 2' **8 laterals**
 2 zone minimum
 2 Zones with 4 laterals
 # of emitters per zone: 1,200 ft of tubing Total
 4 laterals x 150' ÷ 2' **300 emitters**

28

28

Drip System Work Sheet

Flow rate

300 emitters x .61 gph ÷ 60 min/hr
3.1 gpm

29

29

Drip System Work Sheet

Drainback

Length x Gal/ft = Vol **1.5" Pipe**
 Fill: 70' x 0.11 **7.7 gal**
 Flush: 165' x 0.11 **18.2 gal**
 Total: Fill + Flush **25.9 gal**

30

30

Drip System Work Sheet

Minimum Dose

Volume of tubing x 4 + Drainback
 $\{.012 \text{ gal/ft} \times \text{Tubing Length [ft]} \times 4\} + \text{DB}$
 $\{.012 \text{ gal/ft} \times 600 \text{ ft} \times 4\} + 25.9 \text{ gal}$
 $28.8 \text{ gal} + 25.9 \text{ gal} = 54.7 \text{ gal}$

55 gal

31

31

Drip System Work Sheet

Max Dose Volume

$= \frac{\text{Depth (inches)}}{12 \text{ in/ft}} \times 1' \div 12 \text{ in/ft} \times \frac{\text{Tubing length(ft)}}{(\text{Soil Porosity})} \times 7.5 \text{ gal/cuft} + \text{DB gals}$

$= \frac{12''}{12} \div 12 \text{ in/ft} \times 0.083 \text{ ft} \times \frac{600}{1} \times 7.5 \text{ Gal/ft} + \text{DB}$

$(12'' \div 12'') \times 0.083 \times 600 \times 0.46 \times 7.5 = 171.8 \text{ gal} + 25.9$
 $= 197.7 \text{ gallons}$

Fill the Soil

12"
600 ft
1"

32

32

Drip System Work Sheet

Dose volume [MIN:MAX]
55 gal: 197.7 gal

Time On = Dose(choiced) ÷ Pump Rate(calibrated) =
 $70 \text{ gal} \div 3.8 \text{ gpm}$
18.4 min

of doses= Design flow ÷ volume of dose
 $1,700 \text{ gpd} \div 2 \text{ zones} \div 70 \text{ gal} = 12.1 \text{ doses}$

Off Time = [1440 ÷ # doses] – on time
 $[1440 \div 12.1] - 18.4 \text{ min} =$
 $119 \text{ min} - 18.4 \text{ minutes} =$
100.6 min

34

34

Drip System Work Sheet

Questions

35

35

Matching Technology to the Site

Technology Options



1

1

Matching Technology to the Site

What System?

- What is the best system for the site conditions?
- Lowest cost?
- Appearance/ Land use
 - Developer
 - Owners



2

2

Matching Technology to the Site

How Do I Select the Right System?

Must know the soil and site conditions

- Detailed description of soil characteristics
- Hydrology of the site - drainage
- Encumbrances
- Sensitivity of a site
- Area available for components



3

3

Matching Technology to the Site

How Do I Select the Right System?

Must know:

- Client needs and financial limitations
- Health, planning and building requirements
- Limitations on neighboring properties
- Availability of system management



4

4

Matching Technology to the Site

Registered Product Purpose

- "Pretreat" wastewater so downstream component(s) can function more reliably for longer terms
- Remove much of the treatment from the natural soil conditions – can not forget about dispersal
- Generally provide high quality effluent ~ secondary treatment

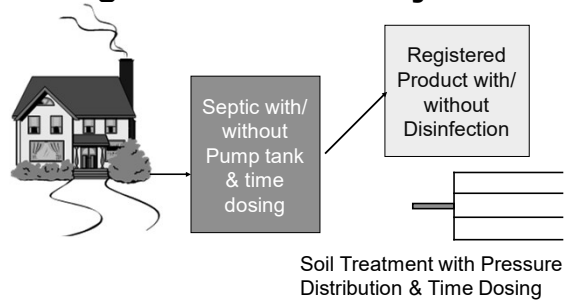


5

5

Matching Technology to the Site

Registered Product Systems



6

6

Matching Technology to the Site

Registered NOT Approved

- Actual performance but NOT guaranteed
- Technology key to Environmental protection
 - Type I the Design/Location is the Key
- No Homeowner Approval and are part of the System
- Monitoring/Reporting allows:
 - System performance verification
 - Environmental protection



7

7

Matching Technology to the Site



8

8

Matching Technology to the Site

Issues: Risks

- Flat lot: Elevation
- Sandy Soils
- Shoreland
- Small lot
- Separation

Rental Property

9

9

Matching Technology to the Site



SPMF

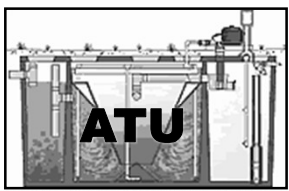


RMF

GENERAL CONSIDERATIONS FOR REGISTERED PRODUCT UNITS



CWS
Not registered



ATU

10

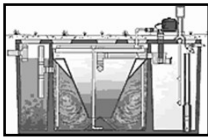
10

Matching Technology to the Site

Aerobic Treatment Unit

What is it and why is it used?

- A tank where Air/Oxygen is added
- Provides aerobic treatment in **saturated** conditions using artificial/mechanical aeration
- Provides better quality effluent – organics & solids, especially
- Reductions in soil depth [with disinfection] and sizing permitted
- Higher level of O&M required compared to Type I systems



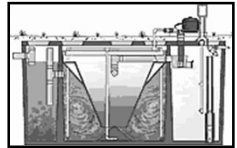
11

11

Matching Technology to the Site

ATU Considerations

- Small land use requirement
- Out-put depends on unit
- Sizing based on hydraulics and organics
- All proprietary systems some designed to handle high strength waste
- Some units have a better ability to handle flow and organic fluctuations
- Time dosing will improve consistency of treatment
- Septic tank capacity may be reduced to assure sufficient food for bacterial and limit production of hydrogen sulfide



12

12

Matching Technology to the Site

ATU Considerations

- NSF 40 testing
 - BOD
 - TSS
 - Fecal is now available
- Typical treatment levels
 - BOD <25 mg/l
 - TSS < 25 mg/l
 - Fecal ~90-98% without disinfection
 - Nutrients, minimal with conventional design
- Monitoring/Maintenance
- Minimum Frequency (6 months) and contracts for single family homes



13

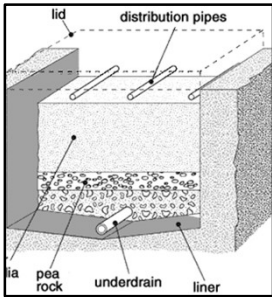
13

Matching Technology to the Site

Media Filter

What is it?

- A container or lined excavation containing a specific UNSATURATED media through which wastewater flows
- An aerobic, fixed-film bioreactor
- Treatment occurs in an unsaturated flow



14

14

Matching Technology to the Site

Single Pass Media Filter Considerations

- Larger land use requirement
- Pressure distribution and time dosing typical
- Typically loaded around 1 gpd/ft² with filter septic tank effluent
- Typical treatment levels
 - BOD, TSS <10
 - Fecal ~ 99 - 99.99% reduction
 - Limited nutrient removal dependent upon media
- Monitoring/Maintenance Essential
 - Frequency annual for single family home



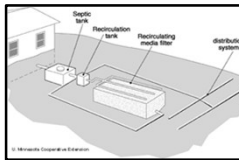
15

15

Matching Technology to the Site

Recirculating Media Filter Considerations

- Time dosing required
- Wide range of medias
- Typical loading rates:
 - Typically around 5 gal/ft²/day, but accelerated loading rates are used with some medias
 - Dosing frequency - 12-72+ times/day
 - Recirculation ratios of 5:1 – 20:1



16

16

Matching Technology to the Site

RMF Considerations

- Small land use requirement
- Designed for N removal
- Treatment levels
 - BOD₅ - <25mg/l
 - TSS - <25 mg/l
 - Fecal coliform - 95 – 99.9%
 - Nitrogen - 30 – 90%
 - Phosphorus - limited dependent on media



17

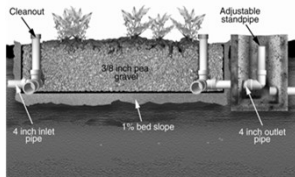
17

Matching Technology to the Site

Constructed Wetland

What is it?

- Largely anaerobic reactor unless air is artificially injected
- Contained in a lined cell
- Cell is filled with 20-24 inches of solid media, usually gravel
- Appropriate wetland vegetation is planted
- Liquid surface is 3 or more inches below the surface



18

18

Matching Technology to the Site

Constructed Wetland Considerations

- Large land use requirement
- In cold climates, the liquid depth may be lowered during the winter & mulch is commonly added
- Expected treatment efficiencies:
 - BOD₅ < 30 mg/l
 - TSS < 30mg/l
 - Fecal coliform 95 – 99.9 % reduction
 - Nutrients Media dependent but limited
- Bi-annual maintenance if wastewater levels are being adjusted on single family home

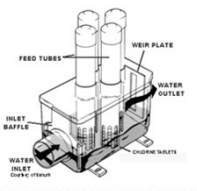
19

19

Matching Technology to the Site

Disinfection

- Soil
- Chlorination
 - De-Chlorination
- Ultraviolet radiation




20

20

Matching Technology to the Site

- Uniform distribution
- Required Separation
 - Mounding

Whoops?



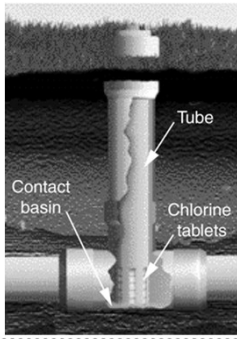
21

21

Matching Technology to the Site

Tablet Chlorinator

- Clean effluent
 - TLB2 minimum
- Needs Chlorine
- Short Frequency
 - 6 weeks
- O&M Issues



22

22

Matching Technology to the Site

UV

- Clean effluent
 - TLB2 minimum
- Light intensity is key
- Bulb life sets replacement



23

23

Matching Technology to the Site

Management: O&M plus Monitoring

- Set by Risk & Technology
 - Every 6 – 12 months on a single family home [MINIMUM: Low Risk]
- Performed by a properly trained Service provider
 - **WHOLE SYSTEM**
- Follow through by local government unit to track management
- Owner must understand that this service is required and that it has a cost because without the unit will not perform long term.

24

24

Matching Technology to the Site		
Operation and Maintenance Issues		
Technology	Number of tank pump outs in 5 years	Number scheduled maintenance visits (per year)
S P Sand Filter	None	1
Textile Filters	None	2
SP Modular Peat	1	1
FAS	2	2
UV Light	NA	2 – 4
BSF	NA	1



25

25

Matching Technology to the Site		
Operation and Maintenance Issues in 5 Years		
Technology	Homeowner Complaints	Operational Complications
S P Sand Filter	None	None
Textile Filters	Odor (low) Nuisance alarms (low)	None
SP Modular Peat	Odor (low - moderate)	Rodents in media bed Peat settling, exp. laterals Peat removal / repacking
FAS	Electrical cost (high) Odor (moderate) Blower noise (low)	Initial start-up foaming and odor.
UV Light	None	Minor elect. shortage Major elect. failure
BSF	None	None



26

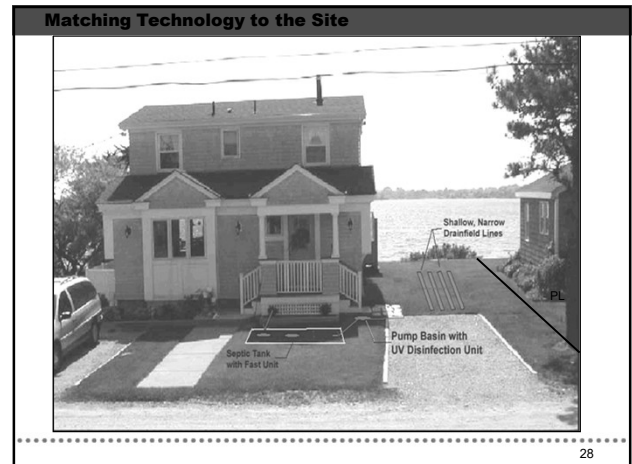
26

Matching Technology to the Site		
Estimated Annual Operation and Maintenance Costs		
Technology	Operating costs @\$0.15 per kwh	Inspection and maintenance costs
S P Sand Filter	\$24	\$200
Textile Filters	\$40	\$250
SP Modular Peat	\$24	\$215
FAS	\$420	\$425
UV Light	\$35	\$150 - \$200
BSF	\$15	\$75



27

27



28

28

Matching Technology to the Site

Issues

- **Flat lot: Elevation**
 - Pump
- **Sandy Soils**
 - Pressure distribution
- **Small lot**
 - Flow Eq.
 - TLA~ TLB
 - Organic loading reduction
 - Area reduction
- **Separation**
 - TLA reduced separation
 - TLB reduced separation

SHORELAND Frequency Rental Property

29

29

Matching Technology to the Site

Courtesy of Onanco, Inc.

Questions

30

30