Minnesota Pollution Control Agency

OSTP Mound Design Worksheet

UNIVERSITY OF MINNESOTA

1. SYSTEM SIZING:

A. *Design Flow (Flow & Soil - 1.A)* : 450 GPD

B. *Soil Loading Rate (Flow & Soil-3.C)*: .79 GPD/ft²

C. *Depth to Limiting Condition:* <1 ft

D. *Percent Land Slope:* 1 %

E. *Design Media Loading Rate:* 1.20 GPD/ft²

F. *Mound Absorption Ratio* (1.E÷1.B): 1.5

G. *Design Contour Loading Rate:* 12 GPD/ft

(From Table I - same as Linear Loading Rate)

Table I
MOUND CONTOUR LOADING RATES:

Measured Perc Rate	← OR →	Texture - derived mound absorption ratio		Contour Loading Rate:
≤ 60mpi		1.0, 1.3, 2.0, 2.4, 2.6	→	≤12
61-120 mpi	← OR →	5.0	→	≤12
≥ 120 mpi*		>5.0*	→	≤6*

*Systems with these values are not Type I systems. Contour Loading Rate is a recommended value.

2. DISPERSAL MEDIA SIZING

A. Calculate *Required Dispersal Bed Area: Design Flow* (1.A) ÷ *Design Media Loading Rate* (1.E) = ft²

450 GPD ÷ 1.20 GPD/ft² = 375 ft²

If a larger dispersal media area is desired, enter size: — ft²

B. Calculate *Dispersal Bed Width*: *Contour Loading Rate* (1.G) ÷ *Design Media Loading Rate* (1.E) = *Bed Width*

12 ft ÷ 1.2 gpd/ft² = 10 ft

C. Calculate *Dispersal Bed Length*: *Dispersal Bed Area* (2.A) ÷ *Bed Width* (2.B) = *Bed Length*

375 ft² ÷ 10 ft = 37.5 ft

D. Select *Dispersal Media*:

■ Rock

☐ Other Approved Media (Describe):

3. ABSORPTION AREA SIZING

Note: Mound setbacks are measured from the Absorption Area.

A. Calculate *Absorption Width: Bed Width* (2.B) X *Mound Absorption Ratio* (1.F) = *Absorption Width*

10 ft X 1.5 = 15 ft

B. For slopes from 0 to 1%, the *Absorption Width* is measured from the bed equally in both directions.
Calculate *Absorption Width Beyond the Bed*: *Absorption Width* (3.A) - *Bed Width* (2.B) ÷ 2 = *Width beyond Bed*

(ft - ft) ÷ = ft

C. For slopes >1%, the *Absorption Width* is measured downhill from the upslope edge of the *Bed*.
Calculate *Downslope Absorption Width*: *Absorption Width* (3.A) - *Bed Width* (2.B) = ft

15 ft - 10 ft = 5 ft

Comments:

Slope, CLR Choice, Material issues

4. MOUND SIZING

A. Calculate *Clean Sand Lift:* 3 feet minus *Depth to Limiting Condition* (1.C) = *Clean Sand Lift* (1 ft minimum)

3.0 ft - [3] ft = [0] ft

B. Calculate *Upslope Height: Clean Sand Lift* (4.A) + *media depth* (1 ft.) + *cover* (1 ft.) = *Upslope Height*

[3] ft + [1] ft + [1] ft = [5] ft

D-34: Slope Multiplier Table

Land Slope %		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Upslope	3:1	3.00	2.91	2.83	2.75	2.68	2.61	2.54	2.48	2.42	2.36	2.31	2.26	2.21	2.17	2.13	2.09	2.06	2.03	2.00	1.97	1.95	1.93	1.91	1.89	1.87	1.85
Berm Ratio	4:1	4.00	3.85	3.70	3.57	3.45	3.33	3.23	3.12	3.03	2.94	2.86	2.78	2.70	2.62	2.55	2.48	2.41	2.35	2.29	2.23	2.18	2.13	2.08	2.03	1.98	1.93

Land Slope %		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Downslope	3:1	3.00	3.09	3.19	3.30	3.41	3.53	3.66	3.80	3.95	4.11	4.29	4.48	4.69	4.95	5.24	5.55	5.88	6.24	6.63	7.04	7.47	7.93	8.42	8.93	9.46	10.02
Berm Ratio	4:1	4.00	4.17	4.35	4.54	4.76	5.00	5.26	5.56	5.88	6.25	6.67	7.14	7.69	8.29	8.92	9.57	10.24	10.94	11.67	12.42	13.19	13.99	14.82	15.67	16.54	17.44

C. Select *Upslope Berm Multiplier* (based on land slope): [3.85] (figure D-34)

D. Calculate *Upslope Berm Width*: *Multiplier* (4.C) X *Upslope Mound Height* (4.B) = *Upslope Berm Width*

[3.85] ft X [5] ft = [19.25] ft

E. Calculate *Drop in Elevation Under Bed: Bed Width* (2.B) X *Land Slope* (1.D) ÷ 100 = *Drop* (ft)

[10] ft X [1] % ÷ 100 = [.1] ft

F. Calculate *Downslope Mound Height: Upslope Height* (4.B) + *Drop in Elevation* (4.E) = *Downslope Height*

[5] ft + [.1] ft = [5.1] ft

G. Select *Downslope Berm Multiplier* (based on land slope): [4.17] (figure D-34)

H. Calculate *Downslope Berm Width: Multiplier* (4.G) X *Downslope Height* (4.F) = *Downslope Berm Width*

[4.17] x [5.1] ft = [21.27] ft

I. *Calculate Minimum Berm to Cover Absorption Area: Downslope Absorption Width* (3.B or 3.C) + 4 ft. = ft

[15] ft + [4] ft = [19] ft

J. *Design Downslope Berm* = greater of 4H and 4I: [21.27] ft

K. Select *Endslope Berm Multiplier*: [4] (usually 3.0 or 4.0)

L. Calculate *Endslope Berm* (4.K) X *Downslope Mound Height* (4.F) = *Endslope Berm Width*

[5.1] ft X [4] ft = [20.4] ft

M. Calculate Mound Width: *Upslope Berm Width* (4.D) + *Bed Width* (2.B) + *Downslope Berm Width* (4.J) = ft

[19.25] ft + [10] ft + [21.27] ft = [50.52] ft

N. Calculate Mound Length: *Endslope Berm Width* (4.L) + *Bed Length* (2.C) + *Endslope Berm Width* (4.L) = ft

[20.4] ft + [38] ft + [20.4] ft = [78.8] ft

5. ORGANIC LOADING: (Optional)

A. *Organic Loading* = *Design Flow* X *Estimated BOD* in mg/L in the effluent X 8.35 ÷ 1,000,000

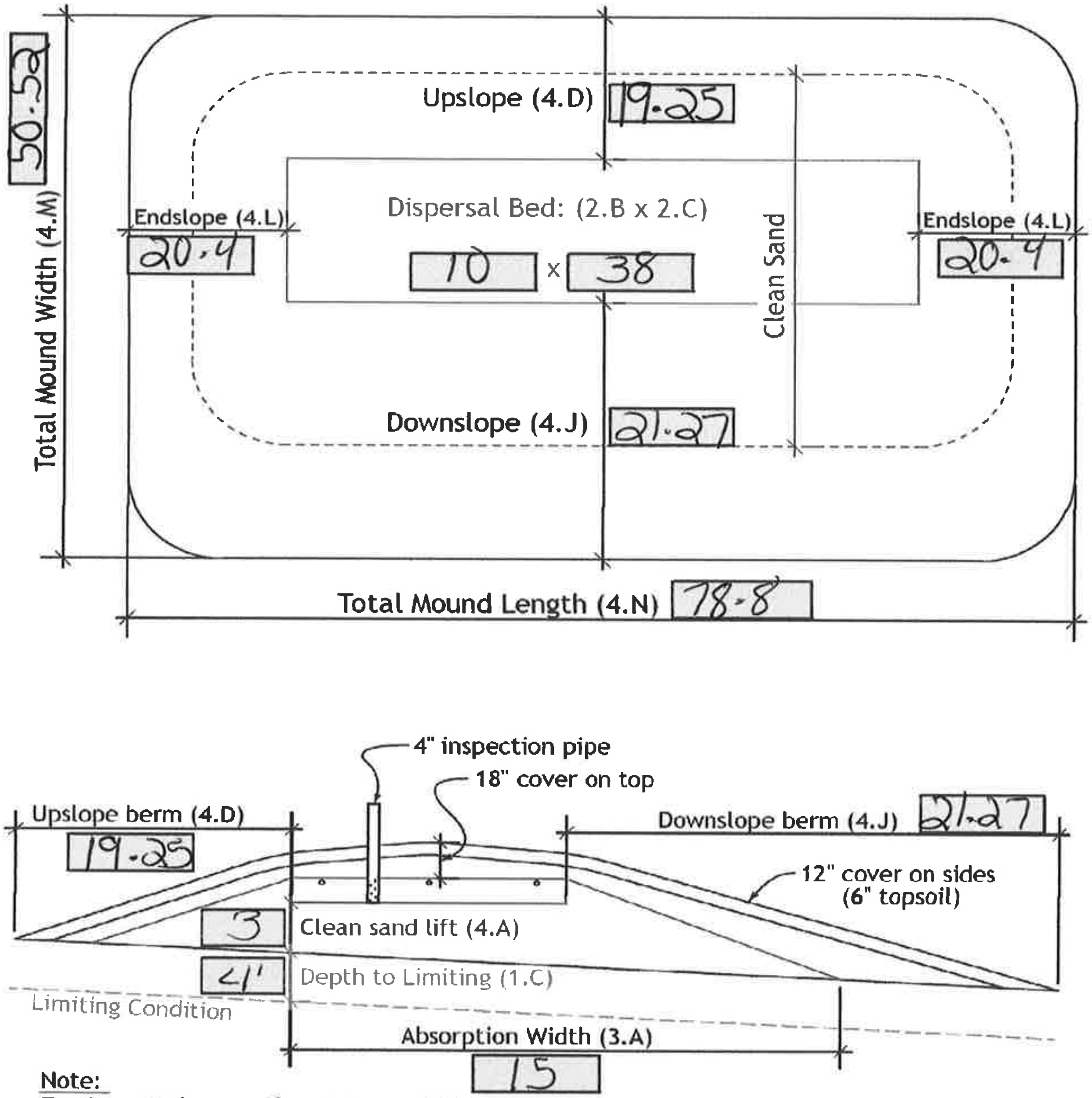
[ ] gpd X [ ] mg/L X 8.35 ÷ 1,000,000 = [ ] lbs BOD/day

B. Calculate *System Organic Loading: lbs. BOD* (5.A) ÷ *Bed Area* (2.A) = lbs/day/ft^2

[ ] lbs/day + [ ] ft^2 = [ ] lbs/day/ft^2

C. Recommended Organic Loading Rate: [ ] lbs/day/ft^2

6. MOUND DIMENSIONS



Note:
For 0 to 1% slopes, *Absorption Width* is measured from the *Bed* equally in both directions.
For slopes >1%, *Absorption Width* is measured downhill from the upslope edge of the *Bed.*

Comments:

Divert surface water away from mound.

APPROXIMATE MOUND MATERIAL CALCULATIONS:

... Bed (Rock) Volume : Bed Length (ft) x Bed Width (ft) x Depth = Volume (ft^3)

38 ft x 10 ft X 1.0 = 380 ft^3

380 ft^3 ÷ 27 = 14 yd^3

Add 20% for constructability: 14 yd^3 X 1.2 = 16.8 yd^3

B. Calculate *Clean Sand Volume:*

Upslope Volume: ((*Upslope Mound Height* - 1) x 3 x *Bed Length*) ÷ 2 = cubic feet

((5 ft - 1) X 3 ft X 38) ÷ 2 = 228 ft^3

Downslope Volume: ((*Downslope Height* - 1) x Downslope Absorption Width x *Media Length*) ÷ 2 = cubic feet

5.1 5 38 389.5 ft^3

... cubic feet

((5.1 ft - 1) X 3 ft X 10 ft = 123 ft^3

Volume Under Rockbed : Average Sand Depth x Media Width x Media Length = cubic feet

3 ft X 10 ft X 38 ft = 1,140 ft^3

Total Clean Sand Volume: *Upslope Volume* + *Downslope Volume* + *Endslope Volume* + *Volume Under Media*

228 ft^3 + 389.5 ft^3 + 123 ft^3 + 1,140 ft^3 = 1,880.5 ft^3

Divide ft^3 by 27 ft^3/yd^3 to calculate cubic yards: 1880.5 ft^3 ÷ 27 = 69.65 yd^3

Add 20% for constructability: 69.65 yd^3 X 1.2 = 83.58 yd^3

C. Calculate Sandy Berm Volume:

Total Berm Volume (approx.): ((Avg. mound height - .5 ft topsoil) x Mound Width x Mound Length) ÷ 2 = cu. ft.

((5 -0.5) 50.52 78.8) ÷ 2 = 8,957 ft^3

... Sand Volume - Rock Volume = cubic feet

8957 ft^3 - 1880.5 ft^3 - 380 ft^3 = 6,696.5 ft^3

Divide ft^3 by 27 ft^3/yd^3 to calculate cubic yards: 6696.5 ft^3 ÷ 27 = 248 yd^3

Add 20% for constructability: 248 yd^3 x 1.2 = 297.6 yd^3

D. Calculate *Topsoil Material Volume: Total Mound Width X Total Mound Length X .5 ft*

50.52 ft X 78.8 ft X 0.5 ft = 1990.5 ft^3

Divide ft^3 by 27 ft^3/yd^3 to calculate cubic yards: 1990.5 ft^3 ÷ 27 = 73.72 yd^3

Add ... 73.72 yd^3 x 1.2 = 88.5 yd^3

I hereby certify that I have completed this work in accordance with all applicable ordinances, rules and laws.

Greg Westerlund	Greg Westerlund	663	9/8/22
(Designer)	(Signature)	(License #)	(Date)

Minnesota Pollution Control Agency

OSTP Pump Selection Design Worksheet

University of Minnesota

1. PUMP CAPACITY

A. Pumping to Gravity or Pressure Distribution: ○ Gravity ● Pressure

1. If pumping to gravity enter the gallon per minute of the pump: ____ GPM

2. If pumping to pressure, is the pump for the treatment system or the collection system:

● Treatment System ○ Collection System

3. If pumping to a pressurized treatment system, what part or type of system:

■ Soil Treatment ☐ Media Filter ☐ Other

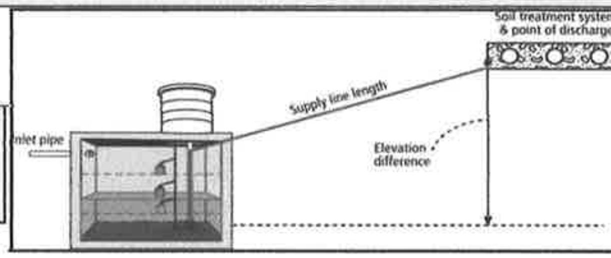
4. If pumping to a pressurized distribution system: 33 GPM

(Line 11 of Pressure Distribution or Line 10 of Non-Level or enter if Collection System)

2. HEAD REQUIREMENTS

3. Elevation Difference 8 ft between pump and point of discharge:

NOTE : IF system is an individual subsurface sewage treatment system, complete steps 4 - 9. If system is a Collection System, skip steps 4, 5, 7 and 8 and go to Step 10.



4. Distribution Head Loss: 5 ft

5. Additional Head Loss: ____ ft (due to special equipment, etc.)

Distribution Head Loss	
Gravity Distribution = 0ft	
Pressure Distribution based on Minimum Average Head Value on Pressure Distribution Worksheet:	
Minimum Average Head	**Distribution Head Loss**
1ft	5ft
2ft	6ft
5ft	10ft

6. A. Supply Pipe Diameter: 2 in

B. Supply Pipe Length: 50 ft

7. Based on **Friction Loss in Plastic Pipe per 100ft** from Table I:

Friction Loss = 2.4 ft per 100ft of pipe

8. Determine *Equivalent Pipe Length* from pump discharge to soil dispersal area discharge point. Estimate by adding 25% to supply pipe length for fitting loss. *Supply Pipe Length (5.B)* X 1.25 = *Equivalent Pipe Length*

50 ft X 1.25 = 62.5 ft

Friction Loss in Plastic Pipe per 100 ft (C=130)					
	Nominal Pipe Diameter				
Flow Rate (GPM)	1	1¼	1½	2	3
10	9.11	3.08	1.27	0.31	---
12	12.77	4.31	1.78	0.44	---
14	16.99	5.74	2.36	0.58	---
16	---	7.35	3.03	0.75	0.10
18	---	9.14	3.76	0.93	0.13
20	---	11.11	4.58	1.13	0.16
25	---	16.79	6.92	1.71	0.24
30	---	---	9.69	2.39	0.33
35	---	---	12.90	3.18	0.44
40	---	---	16.52	4.07	0.57
45	---	---	---	5.07	0.70
50	---	---	---	6.16	0.86
55	---	---	---	7.35	1.02
60	---	---	---	8.63	1.20
65	---	---	---	10.01	1.39
70	---	---	---	11.48	1.60

9. Calculate *Supply Friction Loss* by multiplying *Friction Loss Per 100ft* (Line 6) by the *Equivalent Pipe Length* (Line 7) and divide by 100.

Supply Friction Loss =

62.5 ft per 100ft X 2.4 ft ÷ 100 = 1.5 ft

Minnesota Pollution Control Agency

OSTP Pump Selection Design Worksheet

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10. Equivalent length of pipe fittings.

Section 10 is for Collection Systems ONLY and does NOT need to be completed for individual subsurface sewage treatment systems.

Quantity X Equivalent Length Factor = Equivalent Length

Fitting Type	Quantity		Equivalent Length Factor		Equivalent Length (ft)
Gate Valve		X		=	
90 Deg Elbow		X		=	
45 Deg Elbow		X		=	
Tee - Flow Thru		X		=	
Tee - Branch Flow		X		=	
Swing Check Valve		X		=	
Angle Valve		X		=	
Globe Valve		X		=	
Butterfly Valve		X		=	
Valve 10		X		=	
Valve 11		X		=	

Equivalent Length Factors (ft.) for PVC Pipe Fittings

Fitting Type	Pipe Diameter (in.)		
	1½	2	3
Gate Valve	1.07	1.38	2.04
90 Deg Elbow	4.03	5.17	7.67
45 Deg Elbow	2.15	2.76	4.09
Tee - Flow Thru	2.68	3.45	5.11
Tee - Branch Flow	8.05	10.30	15.30
Swing Check Valve	13.40	17.20	25.50
Angle Valve	20.10	25.80	38.40
Globe Valve	45.60	58.60	86.90
Butterfly Valve	-	7.75	11.50

NOTE: Equivalent length values for PVC pipe fittings are based on calculations using the Hazen-Williams Equation. See Advanced Designs for SSTS for equation. Other pipe material may require different equivalent length factors. Verify other equivalent length factors with pipe material manufacturer.

NOTE: System installer should contact system designer if the number of fittings varies from the design to the actual installation.

A. Sum of Equivalent Length due to pipe fittings: ______ ft

B. *Total Pipe Length* = Supply Pipe Length (5.B) + Equivalent Pipe Length (9.A.)

______ ft + ______ ft = ______ ft

Hazen-Williams Equation for h_f

$$h_f = \frac{10.5}{D^{4.87}} * (Q \div C)^{1.85} * L$$

Q in gpm L in feet D in inches C = 130

C. Hazen-Williams friction loss due to pipe fittings and supply pipe (h_f):

(10.5 ÷ Pipe Diameter$^{4.87}$) X (Flow Rate ÷ Constant)$^{1.85}$ X Total Pipe Length (10.B)

(10.5 ÷ ______ in$^{4.87}$) X (______ gpm ÷ 130)$^{1.85}$ X ______ ft = ______ ft

11. *Total Head* requirement is the sum of the *Elevation Difference* (Line 3), the Distribution Head Loss (Line 4), Additional Head Loss (Line 5), and either Supply Friction Loss (Line 9), or Friction Loss from the Supply Pipe and Pipe Fittings for collection systems (Line 10.C)

NOTE: Supply Friction Loss (Line 8) need ONLY be used if NOT a collection system.

NOTE: Friction Loss from the Supply Pipe and Pipe Fittings (Line 9.C) need ONLY be used if system is a collection system.

8 ft + 5 ft + 1.5 ft + ______ ft = 14.5 ft

3. PUMP SELECTION

A pump must be selected to deliver at least 33 GPM (Line 1 or Line 2) with at least 14.5 feet of total head.

I hereby certify that I have completed this work in accordance with all applicable ordinances, rules and laws.

Greg Westerlund (Designer) Greg Westerlund (Signature) 663 (License #) 9/8/22 (Date)

UNIVERSITY OF MINNESOTA

OSTP Soil Observation Log

Project ID: Test 1 v 03.19.15

Client/ Address:	Tom Otto ? 13506 309th Ave, Princeton MN	Legal Description/ GPS:	Lot 1, Blk 8, Wealthwood Estates Golf Course

Soil parent material(s): (Check all that apply) ☑ Outwash ☐ Lacustrine ☐ Loess ☐ Till ☐ Alluvium ☐ Bedrock ☐ Organic Matter

Landscape Position: (check one) ☑ Summit ☐ Shoulder ☐ Back/Side Slope ☐ Foot Slope ☐ Toe Slope Slope shape: Condave

Vegetation	Wooded	Soil survey map units	1115	Slope%	1.0	Elevation:	1255
Weather Conditions/Time of Day:	Sunny			Date	09/02/22		

Observation #/Location:	Soil Boring #2, South end of mound area	Observation Type:	Auger

Depth (in)	Texture	Rock Frag. %	Matrix Color(s)	Mottle Color(s)	Redox Kind(s)	Indicator(s)	Structure		
							Shape	Grade	Consistence
4	Organic	<35%	10R 2/1			T3	Single grain	Weak	Loose
8	Sandy Loam	<35%	10R 2/2				Single grain	Weak	Friable
9	Sandy Loam	<35%	10R 4/6	7.5YR 4/3		S4	Single grain	Weak	Friable

Comments

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Greg Westerlund (Designer/Inspector) — [signature] (Signature) — 663 (License #) — 9/8/22 (Date)

UNIVERSITY OF MINNESOTA

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Client/ Address:	Tom Otto ? 13506 309th Ave, Princeton MN	Legal Description/ GPS:	Lot 1, Blk 8, Wealthwood Estates Golf Course

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Landscape Position: (check one) ☑ Summit ☐ Shoulder ☐ Back/Side Slope ☐ Foot Slope ☐ Toe Slope Slope shape: Condave

Vegetation	Wooded	Soil survey map units	1115	Slope%	1.0	Elevation:	1255
Weather Conditions/Time of Day:	Sunny					Date	09/02/22
Observation #/Location:	Soil Boring #1, North end of Mound area					Observation Type:	Soil Pit

Depth (in)	Texture	Rock Frag. %	Matrix Color(s)	Mottle Color(s)	Redox Kind(s)	Indicator(s)	Structure: Shape	Structure: Grade	Structure: Consistence
4	Organic	<35%	10R 2/1			T3	Single grain	Weak	Loose
8	Sandy Loam	<35%	10R 2/2				Single grain	Weak	Friable
9	Sandy Loam	<35%	10R 4/6	7.5YR 4/3		S4	Single grain	Weak	Friable

Comments

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