Estimating Subgrade Infiltration Rates for Post-Construction Stormwater Management Site Planning

May 10, 2019

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THE OHIO STATE UNIVERSITY
Stormwater Management Program

Overview of Presentation

- Infiltration-based post-construction BMPs
- Planning level site suitability evaluation
- Estimating infiltration rates for preliminary site planning and conceptual design

Relationship between Infiltration Rate and Hydraulic Conductivity

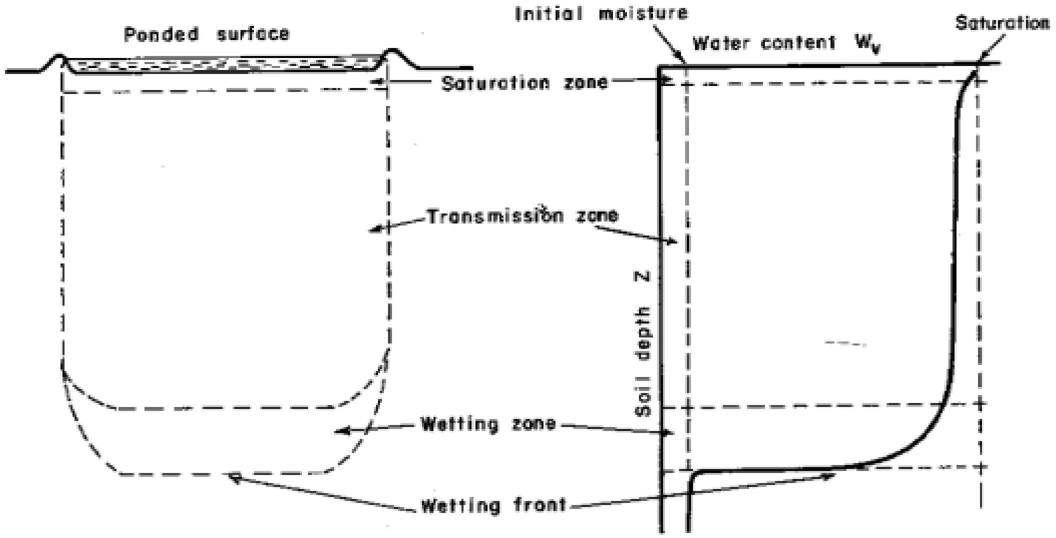


Fig. 12.3. The infiltration moisture profile. At left, a schematic section of the profile; at right, the water content versus depth curve. The common occurrence of a saturation zone as distinct from the transmission zone may result from the structural instability of the surface zone soil.

Source: Hillel (1982)

$$i(t) = K_{fs}\,\frac{\Delta H}{\Delta L} = K_{fs}\,\frac{H_{pond}(t)+L_f(t)-H_{suction}(t)}{L_f(t)}$$

Post-Construction Stormwater Infiltration BMP Options

Bioretention

Infiltration Basin

Infiltration Trench

Permeable Pavement

Source: Philadelphia Water Department

Underground Infiltration System

Table 4b Infiltration-based Post-Construction Practices

Infiltration Practice		
Bioretention Area/Cell		
Infiltration Basin		
Infiltration Trench		
Permeable Pavement – Infiltration		
Underground Storage – Infiltration		

Source: Ohio EPA. 2018. NPDES Construction Storm Water Permit.

Table 4b Infiltration-based Post-Construction Practices

Infiltration Practice	Maximum Drain Time (t_d) of WQv	
Bioretention Area/Cell	24 hours	
Infiltration Basin	24 hours	
Infiltration Trench		
Permeable Pavement – Infiltration		
Underground Storage – Infiltration		

Source: Ohio EPA. 2018. NPDES Construction Storm Water Permit.

Table 4b Infiltration-based Post-Construction Practices

Infiltration Practice	Maximum Drain Time (t_d) of WQv	
Bioretention Area/Cell	24 hours	
Infiltration Basin	24 hours	
Infiltration Trench	48 hours	
Permeable Pavement – Infiltration	48 hours	
Underground Storage – Infiltration	48 hours	

Source: Ohio EPA. 2018. NPDES Construction Storm Water Permit.

Post-Construction Infiltration BMPs – Minimum Infiltration Rates (Kfs)

Infiltration Practice	Maximum Drain Time (t_d) of WQv	Minimum Kfs
Bioretention Area/Cell	24 hours	
Infiltration Basin	24 hours	
Infiltration Trench	48 hours	
Permeable Pavement – Infiltration	48 hours	
Underground Storage – Infiltration	48 hours	

Source: Ohio EPA. Rainwater and Land Development.

Post-Construction Infiltration BMPs – Minimum Infiltration Rates (Kfs)

Infiltration Practice	Maximum Drain Time (t_d) of WQv	Minimum Kfs
Bioretention Area/Cell	24 hours	No minimum
Infiltration Basin	24 hours	
Infiltration Trench	48 hours	
Permeable Pavement – Infiltration	48 hours	
Underground Storage – Infiltration	48 hours	

Source: Ohio EPA. Rainwater and Land Development.

Post-Construction Infiltration BMPs – Minimum Infiltration Rates (Kfs)

Infiltration Practice	Maximum Drain Time (t_d) of WQv	Minimum Kfs
Bioretention Area/Cell	24 hours	No minimum
Infiltration Basin	24 hours	0.5 in/hr
Infiltration Trench	48 hours	0.5 in/hr
Permeable Pavement – Infiltration	48 hours	
Underground Storage – Infiltration	48 hours	

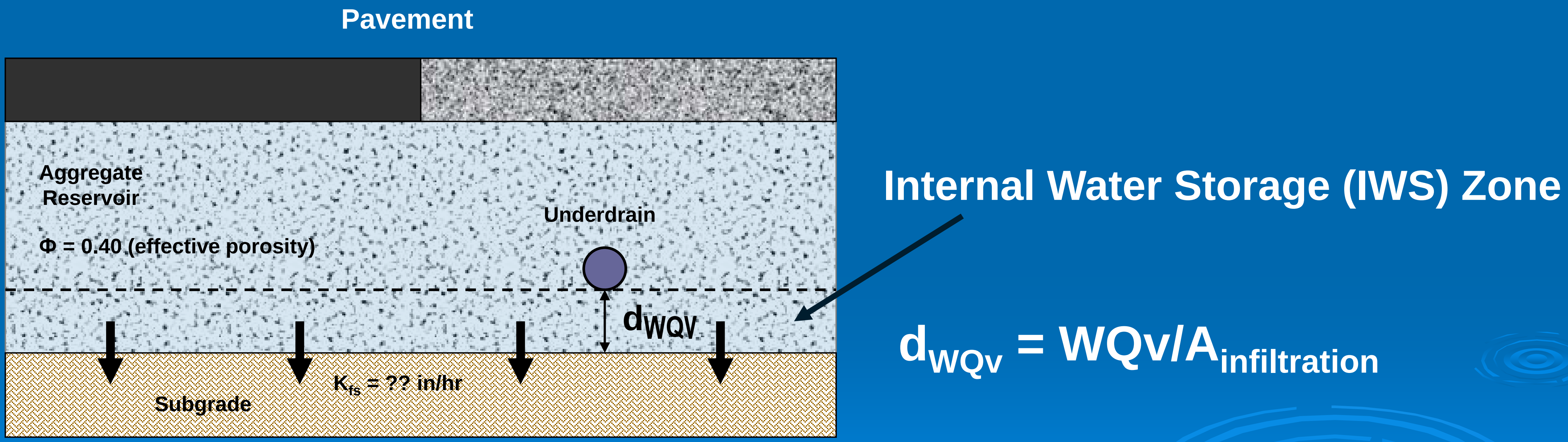
Source: Ohio EPA. Rainwater and Land Development.

Post-Construction Infiltration BMPs – Minimum Infiltration Rates (Kfs)

Infiltration Practice	Maximum Drain Time (t_d) of WQv	Minimum Kfs
Bioretention Area/Cell	24 hours	No minimum
Infiltration Basin	24 hours	0.5 in/hr
Infiltration Trench	48 hours	0.5 in/hr
Permeable Pavement – Infiltration	48 hours	$> d_{WQv}/t_d$
Underground Storage – Infiltration	48 hours	$> d_{WQv}/t_d$

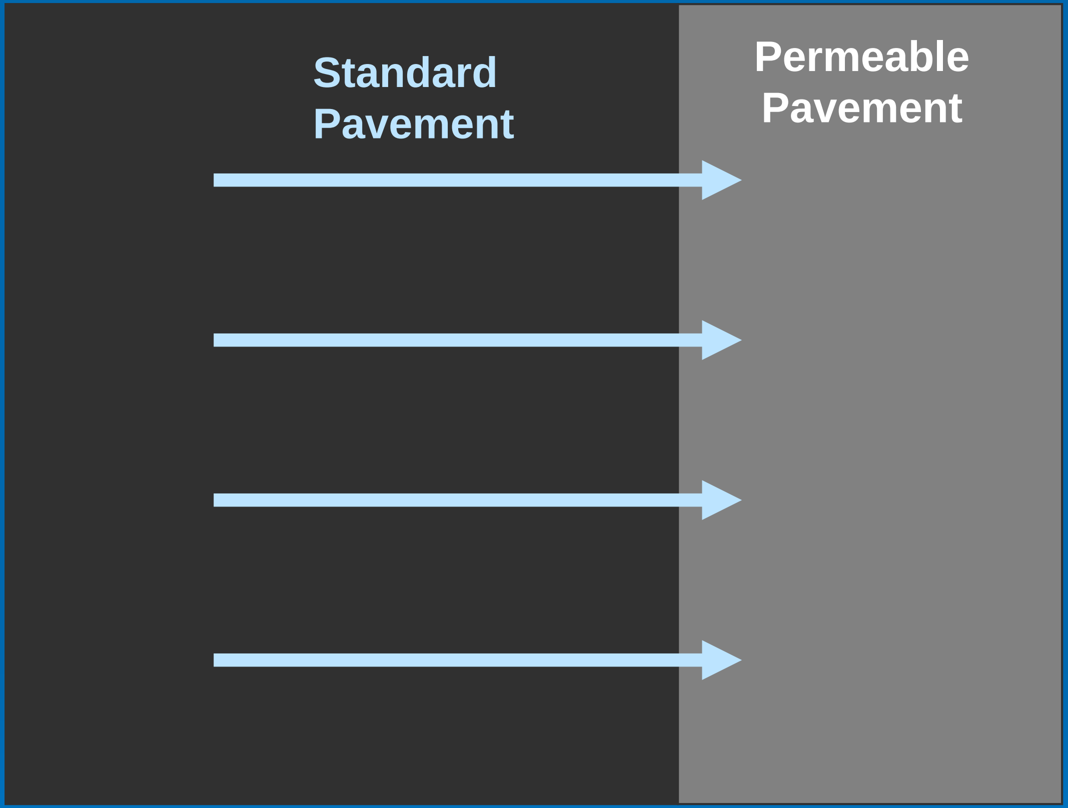
Source: Ohio EPA. Rainwater and Land Development.

WQv Depth for Permeable Pavement and Underground Infiltration Systems



$$d_{WQv} = WQv/A_{infiltration}$$

Hydrologic Loading Ratio and Minimum Kfs

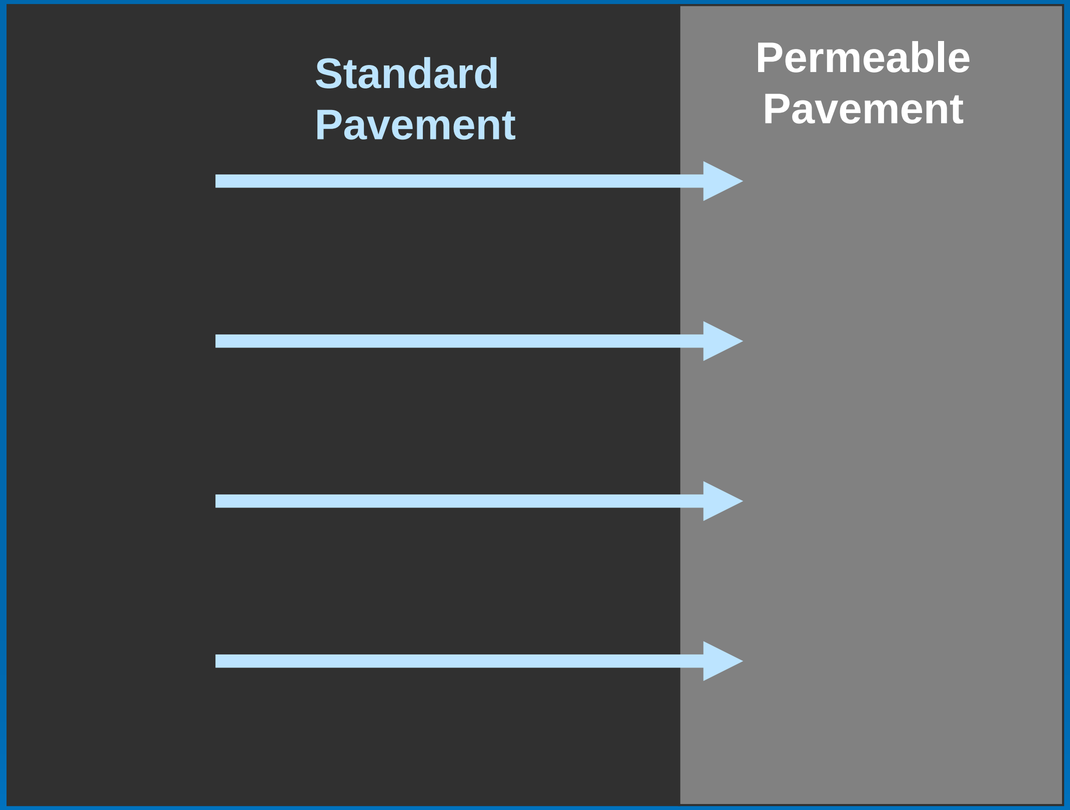


$$d_{WQv} = WQv/A_{infiltration} = 2.6 \text{ in}$$

$$A_{impervious} < 2*A_{permeable}$$

$$HLR = A_{impervious}/A_{infiltration} = 3.0$$

Hydrologic Loading Ratio and Minimum Kfs



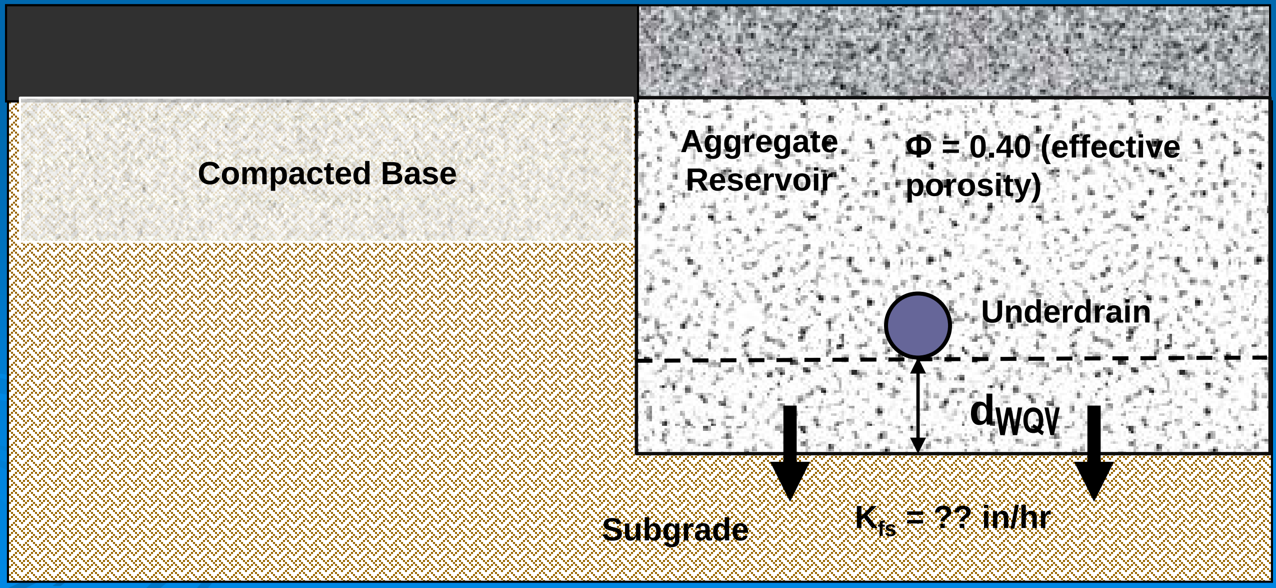
$A_{impervious} < 2*A_{permeable}$

$HLR = A_{impervious}/A_{infiltration} = 3.0$

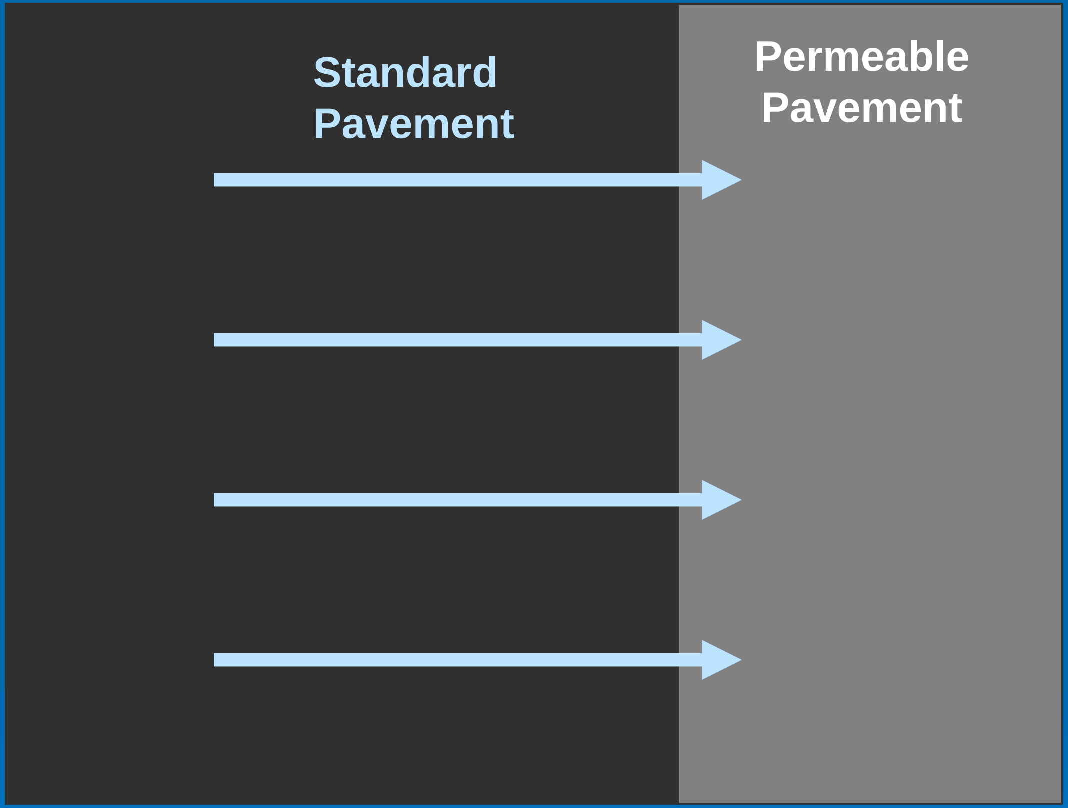
$d_{WQv} = WQv/A_{infiltration} = 2.6$ in

Adjusted for aggregate porosity of 0.40

$d_{WQv} = 2.6$ in/0.4 = 6.4 in



Hydrologic Loading Rate and Minimum Kfs



$A_{impervious} < 2{*}A_{permeable}$

$HLR = A_{impervious}/A_{infiltration} = 3.0$

$d_{WQv} = WQv/A_{infiltration} = 2.6 \text{ in}$

Minimum infiltration rate

$Kfs(min) = d_{WQv}/t_d = 2.6 \text{ in}/48 \text{ hr} = \underline{0.054 \text{ in/hr}}$

Hydrologic Loading Ratio and Minimum Kfs (subsurface infiltration reservoir, t_d = 48 hr)

$A_{infiltration}$	$A_{impervious}$	HLR	WQv	dWQv	Kfs(min)
(acre)	(acre)		(ft3)	(in)	(in/hr)
1.0	1.0	1	3104	0.9	0.02
1.0	2.0	2	6207	1.7	0.04
1.0	3.0	3	9311	2.6	0.05
1.0	5.0	5	15518	4.3	0.09
1.0	10.0	10	31037	8.6	0.18
1.0	20.0	20	62073	17.1	0.36

HSG-C

HSG-B

HSG-A

WQv Calculator

Water Quality Volume BMP Compliance Worksheets (v3.1 2018-10-23)

Worksheet	Contents
1	Introduction
2	Project Details and WQv Calculation
3	Wet Extended Detention Basin
4	Wetland Extended Detention Basin (Constructed Wetl
5	Dry Extended Detention Basin
6	Infiltration Basin
7	Bioretention
8	Infiltration Trench
9	Permeable Pavement - Infiltration
10	*Permeable Pavement - Extended Detention [Under Deve*
11	*Sand or Media Filter [Under Development]*

Step 2 - Trench Bottom Area/Dimensions

Area that can drain in 48 hr =		ft^2
5% of A_{imp} =	0	ft^2
Minimum Infiltration Trench (Bottom) Area =	0	ft^2
Infiltration Trench (Bottom) Area =		ft
Trench Width, W_{trench} =		ft
Trench Length, L_{trench} =		ft^2
Trench Area/Impervious Area, A_{trench}/A_{imp} =		
Length to Width Ratio (L:W) =		ft/ft

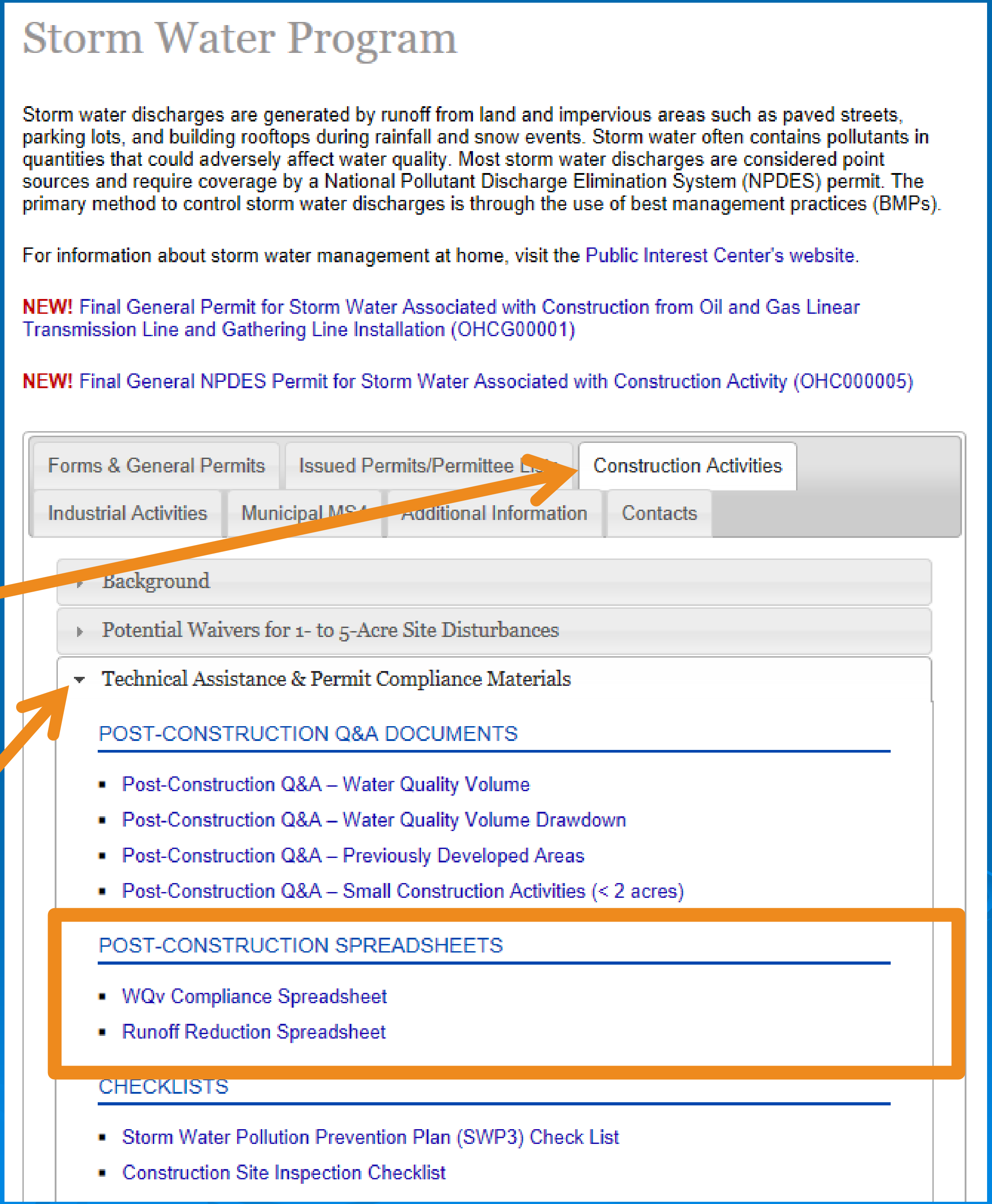
Step 3 - Trench Layer Depths

Depth of WQv, d_{WQv} =		ft
Aggregate Adjusted WQv Depth, $d_{aggr\text{-}WQv}$ =		ft
WQv Drawdown Time, t_{WQv} =		hr
Depth of Surface Gravel Filter Layer, $d_{gravel\ filter}$ =	0.50	ft
Depth of Aggregate Storage Layer, $d_{storage}$ =		ft
Depth of Bottom Sand Filter Layer, d_{sand} =	0.67	ft
Total Depth of Aggregate, $d_{aggregate}$ =	1.17	ft

WQv Compliance Spreadsheet

Available for download at Ohio EPA's Storm Water Program website:

- Search "Ohio EPA Storm Water"
- Click "Construction Activities" tab
- Click "Technical Assistance & Permit Compliance Materials"



Storm Water Program

Storm water discharges are generated by runoff from land and impervious areas such as paved streets, parking lots, and building rooftops during rainfall and snow events. Storm water often contains pollutants in quantities that could adversely affect water quality. Most storm water discharges are considered point sources and require coverage by a National Pollutant Discharge Elimination System (NPDES) permit. The primary method to control storm water discharges is through the use of best management practices (BMPs).

For information about storm water management at home, visit the Public Interest Center's website.

NEW! Final General Permit for Storm Water Associated with Construction from Oil and Gas Linear Transmission Line and Gathering Line Installation (OHCG00001)

NEW! Final General NPDES Permit for Storm Water Associated with Construction Activity (OHC000005)

Forms & General Permits | Issued Permits/Permittee Li | Construction Activities
Industrial Activities | Municipal MS4 | Additional Information | Contacts

Background

Potential Waivers for 1- to 5-Acre Site Disturbances

Technical Assistance & Permit Compliance Materials

POST-CONSTRUCTION Q&A DOCUMENTS

- Post-Construction Q&A – Water Quality Volume
- Post-Construction Q&A – Water Quality Volume Drawdown
- Post-Construction Q&A – Previously Developed Areas
- Post-Construction Q&A – Small Construction Activities (< 2 acres)

POST-CONSTRUCTION SPREADSHEETS

- WQv Compliance Spreadsheet
- Runoff Reduction Spreadsheet

CHECKLISTS

- Storm Water Pollution Prevention Plan (SWP3) Check List
- Construction Site Inspection Checklist

Appropriate Use for Estimates

Methods are available to provide rough estimates of infiltration (exfiltration) rates expected from BMPs such as bioretention or pervious pavement systems.

These methods are appropriate for **preliminary site planning**, i.e., to determine if an LID approach makes sense for a particular site or to develop a ballpark area allocated for infiltration BMPs.

Appropriate Use for Estimates

If moving forward with a design that incorporates infiltration BMPs (i.e., if credit is being taken toward meeting WQv, runoff volume reduction or peak discharge requirements) field measured infiltration tests are necessary to determine a more accurate infiltration rate for sizing and design of BMPs.

Estimating Infiltration Rates for BMPs for Site Planning

- Estimate the depth of excavation for the proposed infiltration BMP
- Identify the soil texture at the proposed depth of excavation
- Estimate infiltration rate by soil texture

Estimate Depth of Excavation for the Proposed Infiltration BMP

Infiltration Practice	Typical Excavation Depth Range
Bioretention Area/Cell	60” – 84” (72”)
Infiltration Basin	48” – 72” (60”)
Infiltration Trench	48” – 60” (48”)
Permeable Pavement – Infiltration	18” – 30” (30”)
Permeable Pavement – Infiltration w/Q_{peak}	36” – 96” (60”)
Underground Storage – Infiltration	48” – 96” (96”)

Identify the soil texture at the proposed depth of excavation

In order of preference:

1. Particle or grain size distribution test on soil samples collected at the proposed location and depth (need at least percent sand, silt, and clay).

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-2	4.3	19	5.186	0.741	0.063	41.9	47.1	10.5	0.5
⊠	B-3	1.8	4.75	0.041	0.012	0.002	0.0	15.2	75.3	9.5

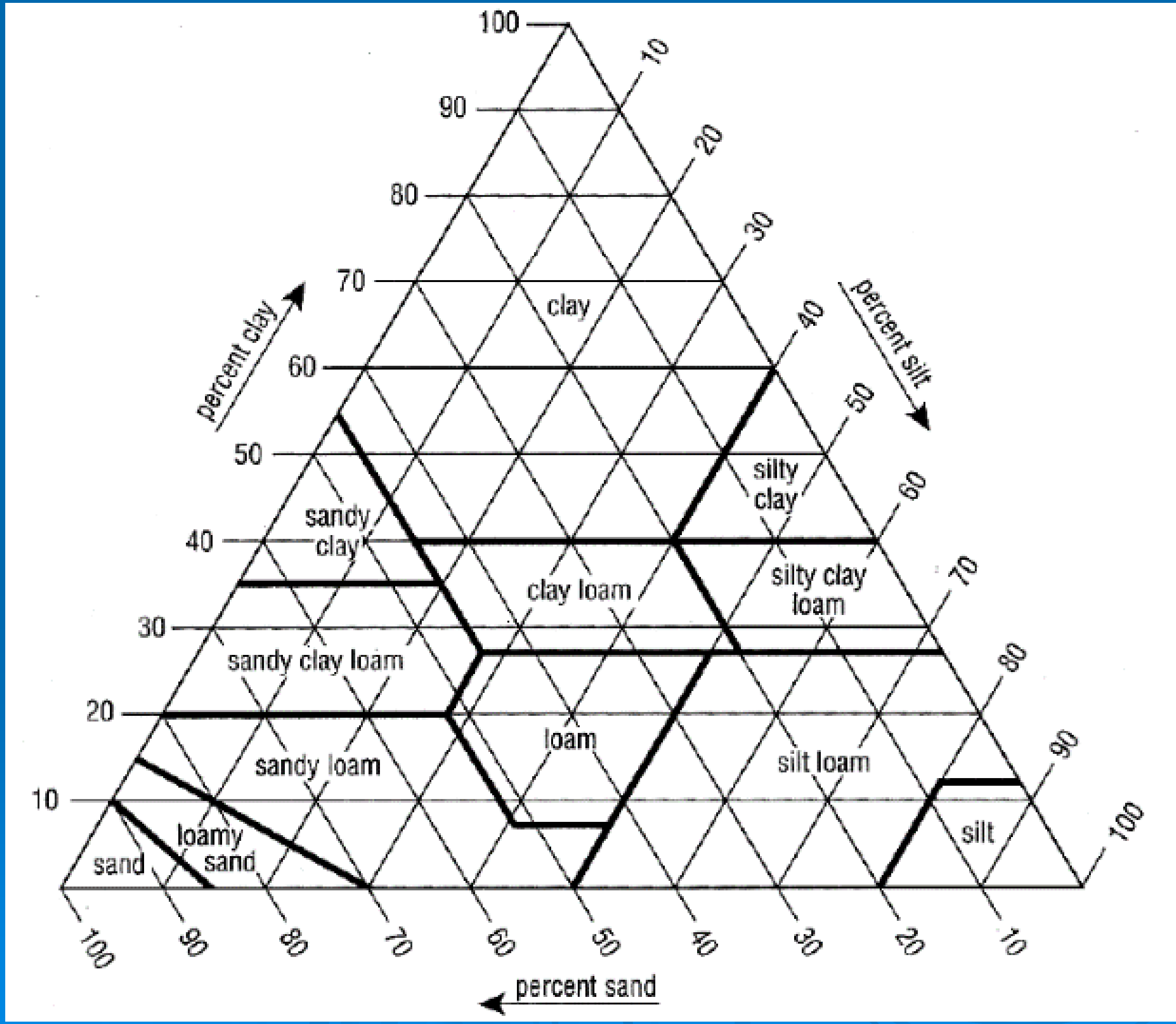
intertek psi

Professional Service Industries, Inc.
4960 Vulcan Ave, Suite C
Columbus, OH 43228
Telephone: (614) 876-8000
Fax: (614) 876-0548

GRAIN SIZE DISTRIBUTION

Project: MVNU Competition Field
PSI Job No.: 01021470
Location: Mt. Vernon
Ohio

USDA Soil Texture



Identify the soil texture at the proposed depth of excavation

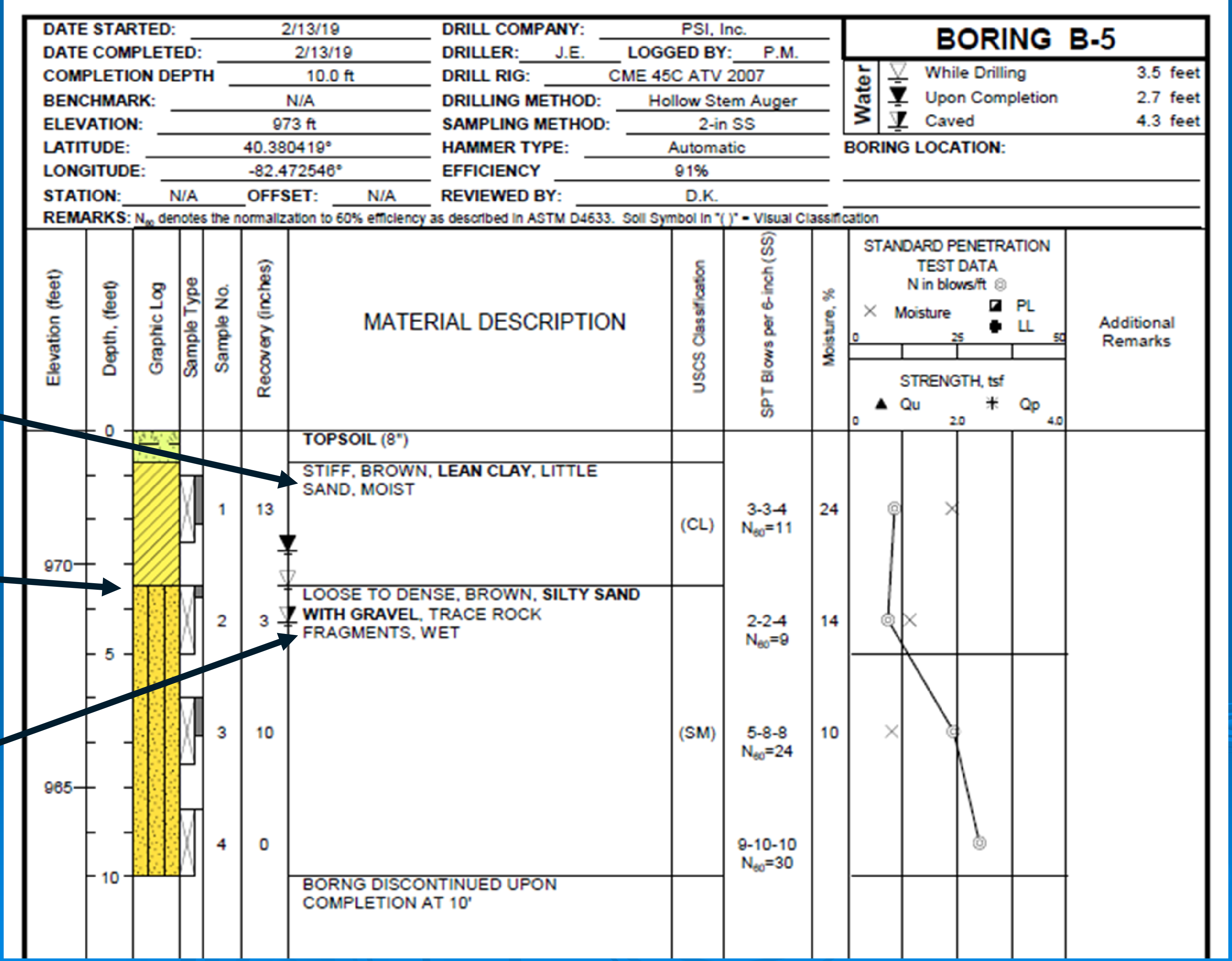
In order of preference:

1. Particle or grain size distribution test on soil samples collected at the proposed location and depth (need at least percent sand, silt, and clay).
2. Field-conducted soil classification by a certified professional (soil pedologist or geotech).

Lean clay (CL)

Texture change at 3.5’ depth

Silty sand with gravel (SM)



DATE STARTED:	2/13/19	DRILL COMPANY:	PSI, Inc.
DATE COMPLETED:	2/13/19	DRILLER: J.E.	LOGGED BY: P.M.
COMPLETION DEPTH	10.0 ft	DRILL RIG:	CME 45C ATV 2007
BENCHMARK:	N/A	DRILLING METHOD:	Hollow Stem Auger
ELEVATION:	973 ft	SAMPLING METHOD:	2-in SS
LATITUDE:	40.380419°	HAMMER TYPE:	Automatic
LONGITUDE:	-82.472546°	EFFICIENCY	91%
STATION: N/A	OFFSET: N/A	REVIEWED BY:	D.K.

BORING B-5

Water		
While Drilling	3.5	feet
Upon Completion	2.7	feet
Caved	4.3	feet

BORING LOCATION:

REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Soil Symbol in "( )" = Visual Classification

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %
	0			**TOPSOIL** (8")			
		1	13	STIFF, BROWN, **LEAN CLAY**, LITTLE SAND, MOIST	(CL)	3-3-4 N_{60}=11	24
970		2	3	LOOSE TO DENSE, BROWN, **SILTY SAND WITH GRAVEL**, TRACE ROCK FRAGMENTS, WET		2-2-4 N_{60}=9	14
	5	3	10		(SM)	5-8-8 N_{60}=24	10
965		4	0			9-10-10 N_{60}=30	
	10			BORNG DISCONTINUED UPON COMPLETION AT 10'			

Translating USCS Classification to USDA Soil Texture

Figure 5. USCS classifications (Ayers et al. 2011) mapped onto the USDA triangle.

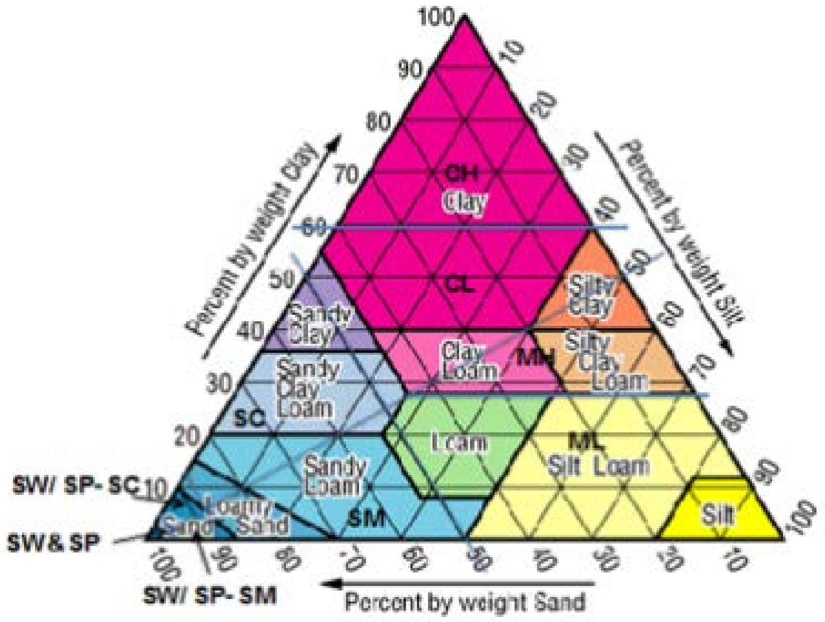
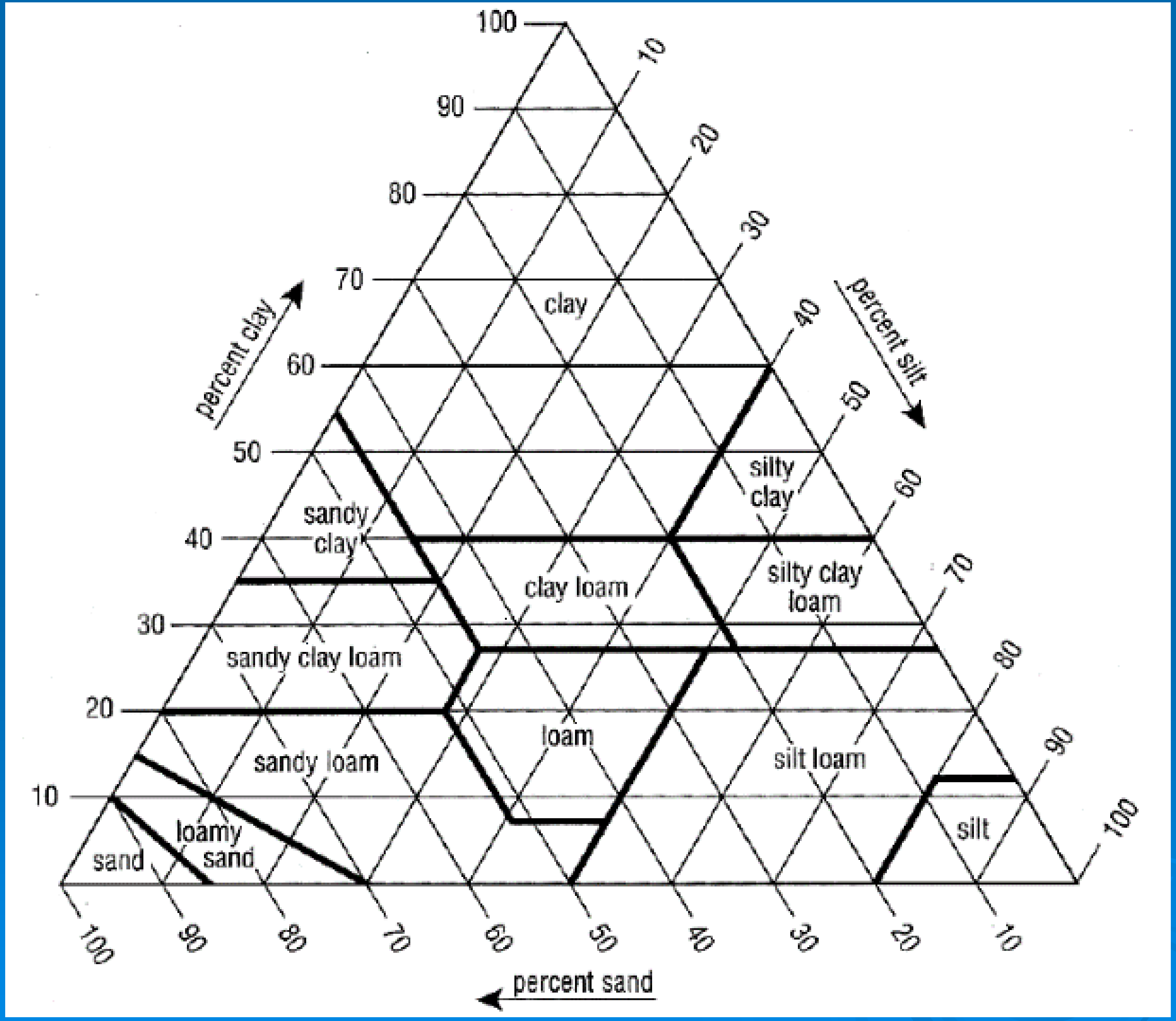


Table 13. USCS classification best fit for USDA classification based on Ayers et al. (2011).

USDA Classification	USCS Classification	
	Most Probable	Possible
Sand	SW, SP	—
Loamy Sand	SM	SC
Sandy Loam	SM	—
Sandy Clay Loam	SC	—
Sandy Clay	SC	CL
Loam	ML	—
Silt Loam	ML	—
Silt	ML	—
Clay Loam	CL, MH	—
Silty Clay Loam	MH	—
Clay	CH	CL
Silty Clay	CL, MH	—
Peat	—	—

USDA Soil Texture



Field Description 09-24-13

Soil description for the under-construction sediment control basin at Holden Arboretum, Lake County, Ohio. The basin is south/southeast of the visitor's center. The exposed basin wall at the south end of the structure (latitude N 41° 36′ 39.7″ and longitude W 81° 18′ 03.5″) was described on September 11, 2013.

The area is mapped to Platea silt loam, 2 to 6 percent slopes in Web Soil Survey.

Soil description

Ap1 horizon: 0 to 2 inches; dark grayish brown silt loam, 11% clay, 10% sand; many fine and very fine roots; weak fine and medium granular structure; <1% rock fragments

Ap2 horizon: 2 to 8 inches; dark grayish brown silt loam, 11% clay, 10% sand; very few very fine roots; massive structure do to compaction; <1% rock fragments

Bw horizon: 8 to 26 inches; yellowish brown silt loam, 12% clay, 10% sand, with redoximorphic concentrations (10YR 5/6) and depletions (10YR 6/1); no roots; massive structure do to compaction; <1% rock fragments

Bt horizon; 26 to 39 inches; dark yellowish brown silty clay loam, 32% clay, 8% sand with redoximorphic concentrations (10YR 5/6) and depletions (10YR 6/1); moderate medium and coarse subangular blocky structure; 1% to 2% rock fragments

Btx horizon: 39 to 50 inches (to the bottom of the excavation); dark yellowish brown silt loam, 18% clay, 15% sand with redoximorphic concentrations (10YR 2/1); weak very coarse prismatic structure parting to moderate thin platy structure; 3% to 5% rock fragments; note: this horizon is a fragipan

Steve Prebonick

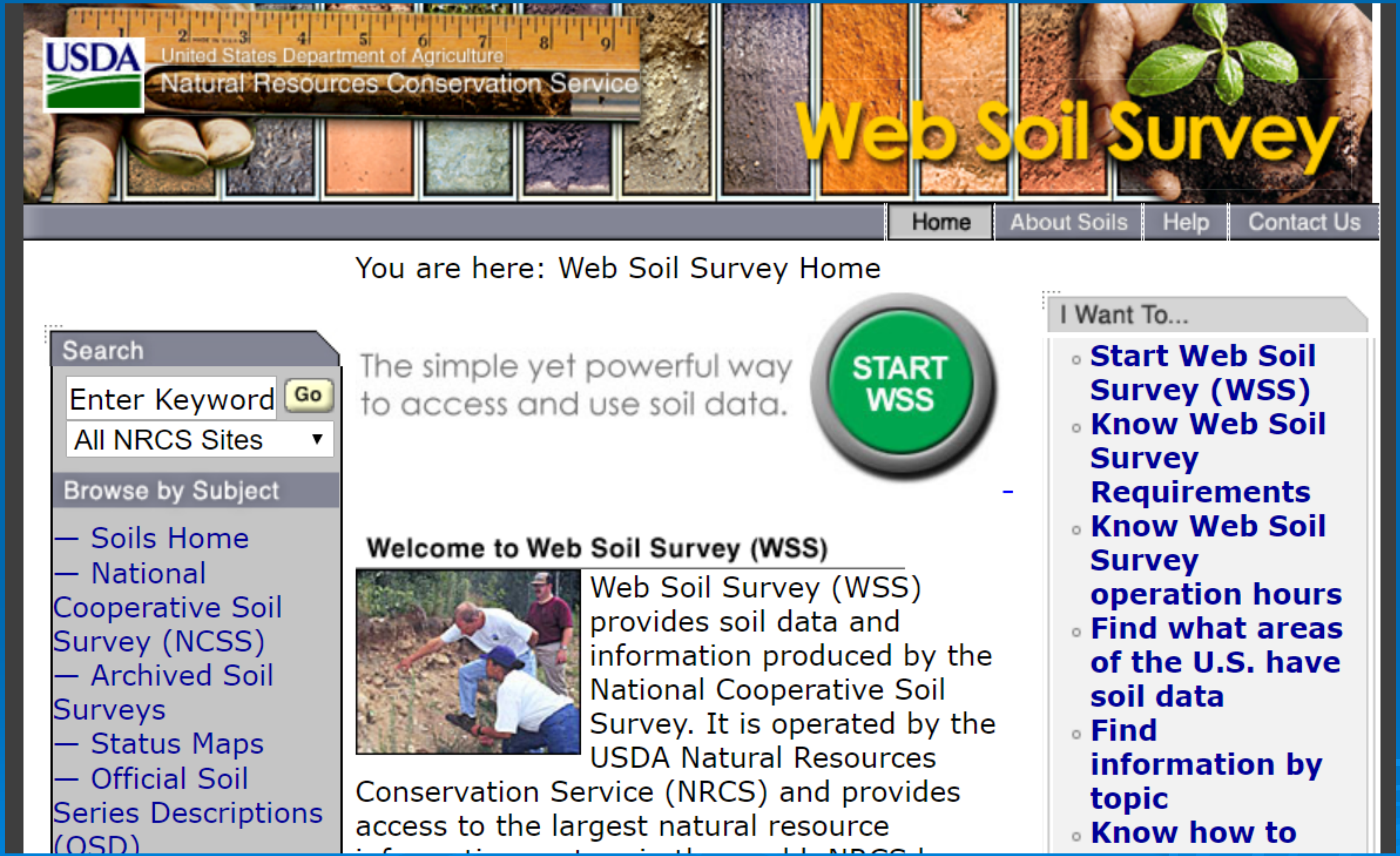
Soil Scientist, ODNR

Identify the soil texture at the proposed depth of excavation

In order of preference:

1. Particle or grain size distribution test on soil samples collected at the proposed location and depth (need at least percent sand, silt, and clay).
2. Field-conducted soil classification by a certified professional (soil pedologist or geotech).
3. Soil survey texture for appropriate depth based on soil type (soil map unit) at location of proposed practice.

NRCS Web Soil Survey



https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

NRCS Web Soil Survey – Soil Map

Search

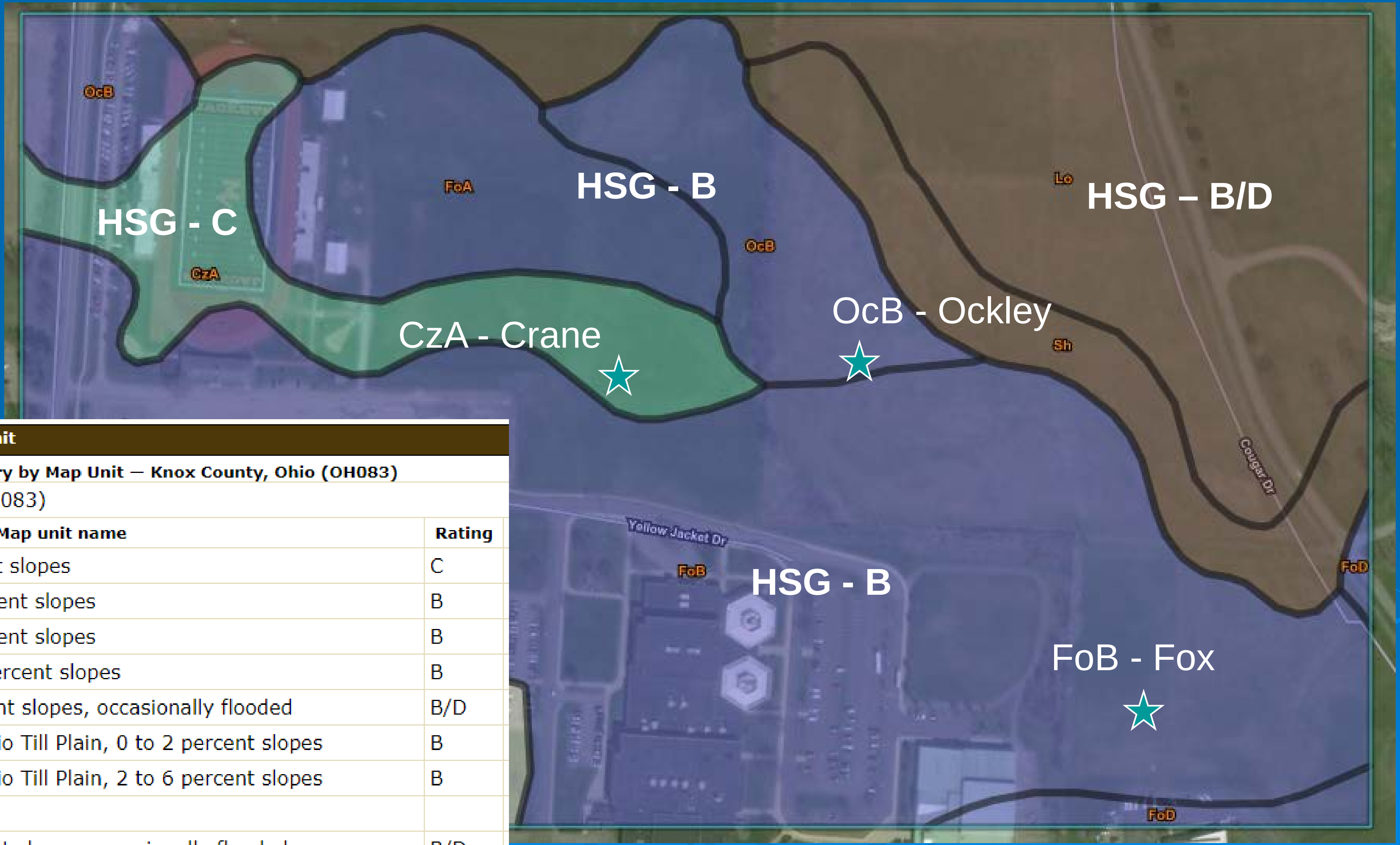
Map Unit Legend

Knox County, Ohio (OH083)

Knox County, Ohio (OH083)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CzA	Crane silt loam, 1 to 4 percent slopes	6.9	7.2%
FoA	Fox gravelly loam, 0 to 2 percent slopes	7.4	7.7%
FoB	Fox gravelly loam, 2 to 6 percent slopes	41.1	42.9%
FoD	Fox gravelly loam, 12 to 25 percent slopes	4.3	4.5%
Lo	Lobdell silt loam, 0 to 3 percent slopes, occasionally flooded	17.4	18.2%
OcA	Ockley silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	0.1	0.1%
OcB	Ockley silt loam	9.5	9.9%

NRCS Web Soil Survey – HSG Map



Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Knox County, Ohio (OH083)

Summary by Map Unit — Knox County, Ohio (OH083)

Map unit symbol	Map unit name	Rating
CzA	Crane silt loam, 1 to 4 percent slopes	C
FoA	Fox gravelly loam, 0 to 2 percent slopes	B
FoB	Fox gravelly loam, 2 to 6 percent slopes	B
FoD	Fox gravelly loam, 12 to 25 percent slopes	B
Lo	Lobdell silt loam, 0 to 3 percent slopes, occasionally flooded	B/D
OcA	Ockley silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	B
OcB	Ockley silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	B
Pg	Pits, gravel	
Sh	Shoals silt loam, 0 to 2 percent slopes, occasionally flooded	B/D

NRCS Web Soil Survey – Typical Profile

CzA—Crane silt loam, 1 to 4 percent slopes

Map Unit Setting

National map unit symbol: nlgt
Elevation: 600 to 1,000 feet
Mean annual precipitation: 30 to 40 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Crane and similar soils: 90 percent
Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of t

Description of Crane

Setting

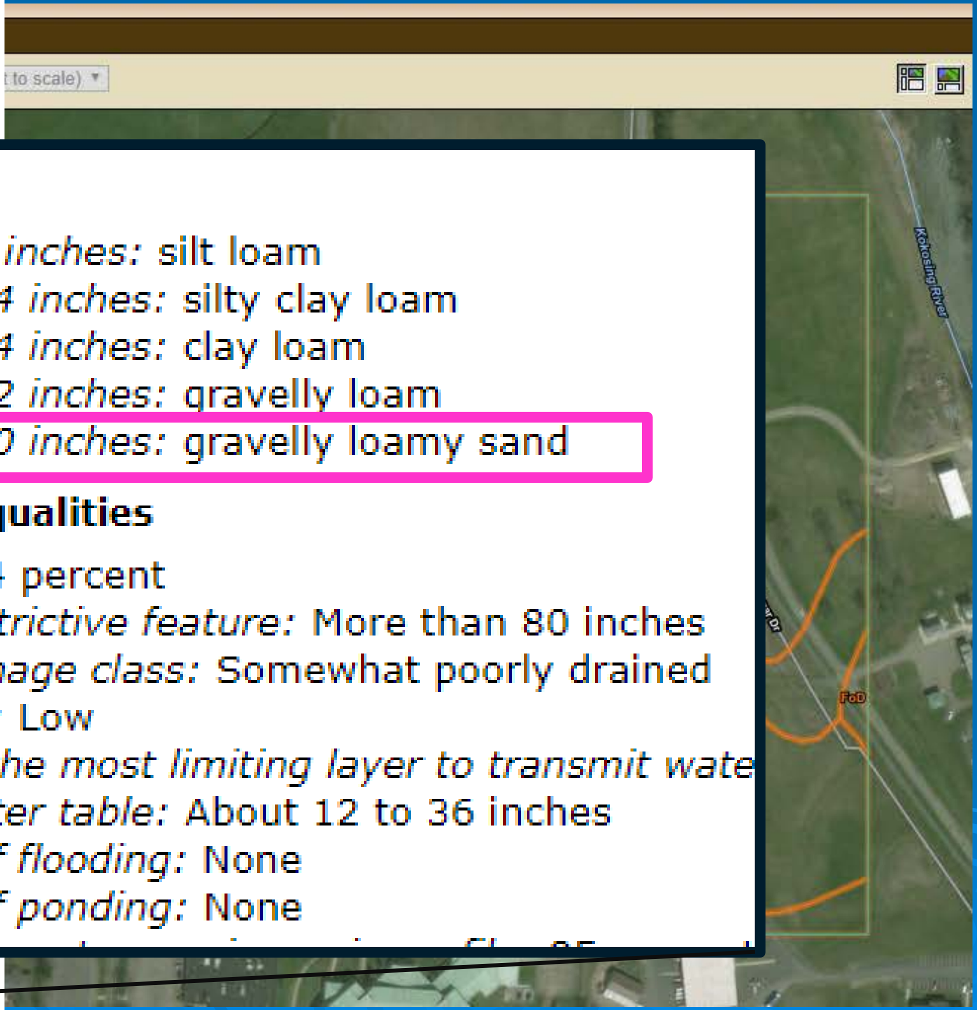
Landform: Outwash plains, terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Microfeatures of landform position: Mounds
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy glaciofluvial deposits derived from mixed o

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 24 inches: silty clay loam
H3 - 24 to 34 inches: clay loam
H4 - 34 to 52 inches: gravelly loam
H5 - 52 to 60 inches: gravelly loamy sand

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moder
Depth to water table: About 12 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Available water storage in profile: High (about 9.7 inches)



Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 24 inches: silty clay loam
H3 - 24 to 34 inches: clay loam
H4 - 34 to 52 inches: gravelly loam
H5 - 52 to 60 inches: gravelly loamy sand

Properties and qualities

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Capacity of the most limiting layer to transmit wate
Depth to water table: About 12 to 36 inches
Frequency of flooding: None
Frequency of ponding: None

Turning Soil Texture into Kfs

Soil Water Characteristic Estimates by Texture and Organic Matter for Hydrologic Solutions

K. E. Saxton and W. J. Rawls

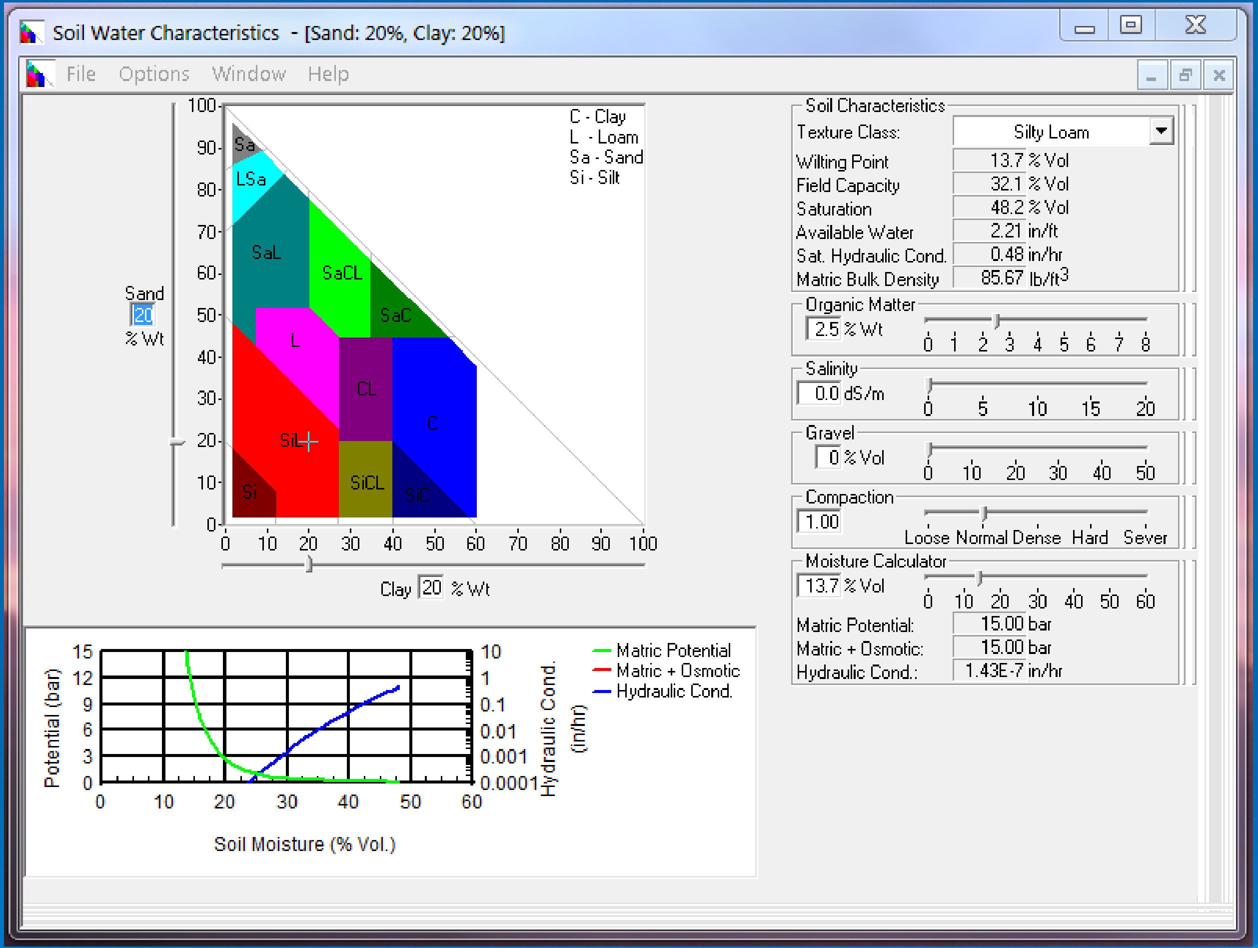
ABSTRACT

Hydrologic analyses often involve the evaluation of soil water infiltration, conductivity, storage, and plant-water relationships. To define the hydrologic soil water effects requires estimating soil water characteristics for water potential and hydraulic conductivity using soil variables such as texture, organic matter (OM), and structure. Field or laboratory measurements are difficult, costly, and often impractical for many hydrologic analyses. Statistical correlations between soil texture, soil water potential, and hydraulic conductivity can provide estimates sufficiently accurate for many analyses and decisions. This study developed new soil water characteristic equations from the currently available USDA soil database using only the readily available variables of soil texture and OM. These equations are similar to those previously reported by Saxton et al. but include more variables and application range. They were combined with previously reported relationships for tensions and conductivities and the effects of density, gravel, and salinity to form a comprehensive predictive system of soil water characteristics for agricultural water management and hydrologic analyses. Verification was performed using independent data sets for a wide range of soil textures. The predictive system was programmed for a graphical computerized model to provide easy application and rapid solutions and is available at http://hydrolab.arsusda.gov/soilwater/Index.htm.

characteristics (Van Genuchten and Leij, 1992). Application of this knowledge is imperative for hydrologic simulation within natural landscapes. However, hydrologists often do not have the capability or time to perform field or laboratory determinations. Estimated values can be determined from local soil maps and published water retention and saturated conductivity estimates, but these methods often do not provide sufficient range or accuracy for computerized hydrologic analyses.

The texture based method reported by Saxton et al. (1986), largely based on the data set and analyses of Rawls et al. (1982), has been successfully applied to a wide variety of analyses, particularly those of agricultural hydrology and water management, for example, SPAW model (Saxton and Willey, 1999, 2004, 2006). Other methods have provided similar results but with limited versatility (Williams et al., 1992; Rawls et al., 1992; Stolte et al., 1994). Recent results of pedotransfer functions (Pachepsky and Rawls, 2005) are an example of modern equations that cannot be readily applied because the input requirements are beyond that cus-

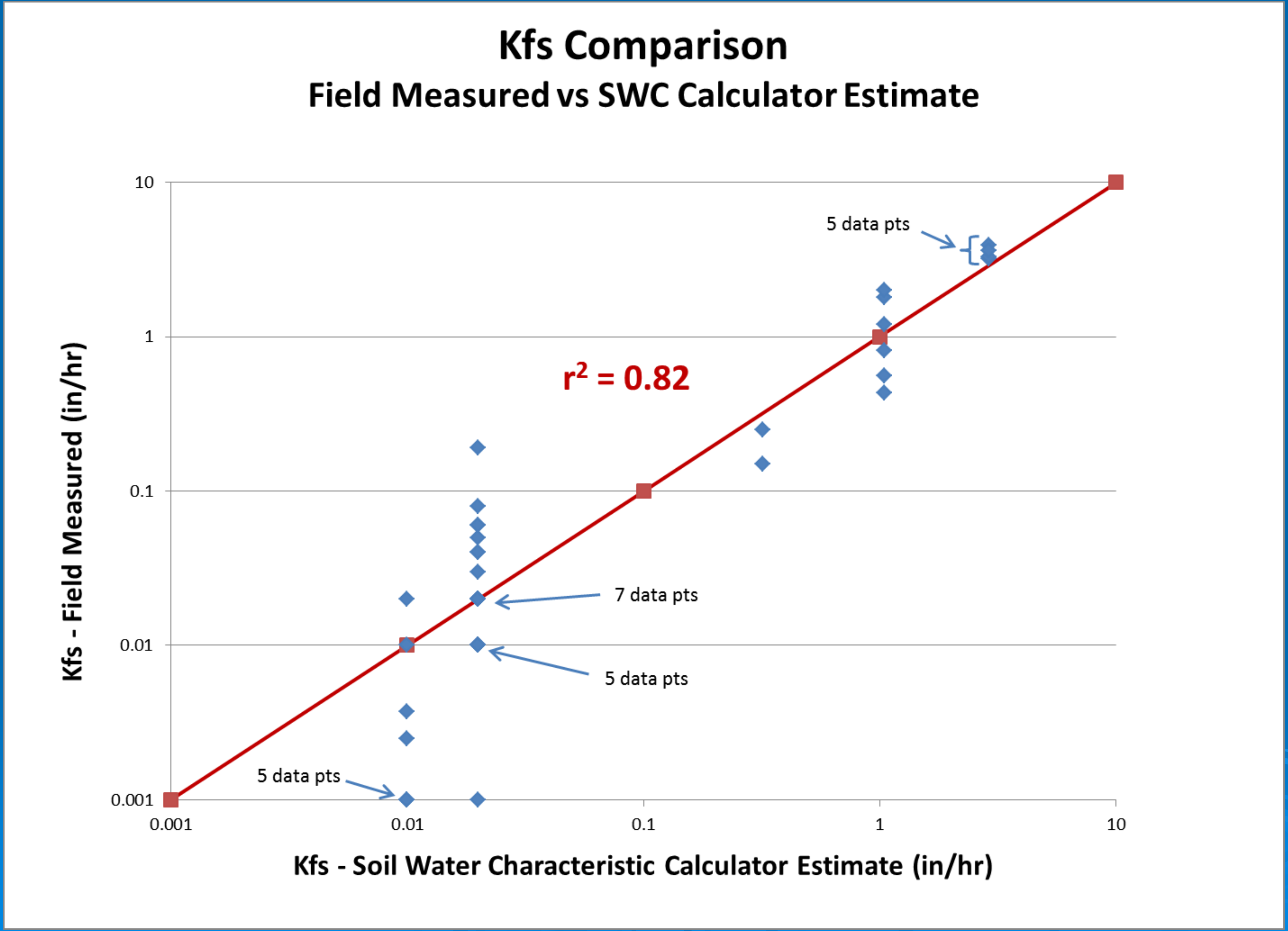
Soil Water Characteristics Calculator



http://hydrolab.arsusda.gov/soilwater/Index.htm

Estimated Infiltration Rates for BMPs for Site Planning

- Using USDA-ARS Soil Water Characteristic Calculator
  - Select soil texture based on tested particle size distribution or soil survey texture for subgrade layer
  - Reduce organic matter content to 0.05%
  - Increase soil density (“compaction”) to “dense” (1.10)



Kfs Comparison
Field Measured vs SWC Calculator Estimate
10
1
0.1
0.01
0.001
0.001
0.01
0.1
1
10
Kfs - Field Measured (in/hr)
Kfs - Soil Water Characteristic Calculator Estimate (in/hr)
r2 = 0.82
5 data pts
7 data pts
5 data pts
5 data pts

Subgrade K_{fs} Estimates

Subgrade USDA Soil Texture	Clay Content %	Ksat (in/hr)
Sand	< 8	2.8
Loamy Sand	< 15	2.0
Sandy Loam	< 20	0.80
Loam	< 20	0.25
Silt Loam	< 20	0.10
Loam	20 – 27	0.06
Silt Loam	20 - 27	0.03
Silt	< 12	0.05
Sandy Clay Loam	20 – 35	0.07
Clay Loam	27 – 40	0.02
Silty Clay Loam	27 – 40	0.02
Silty Clay	40 – 50	0.01
Sandy Clay	35 – 55	<0.005
Clay	> 40	<0.005

Subgrade K_{fs} Estimates

with Generalized Hydrologic Soil Group

Subgrade USDA Soil Texture		Clay Content %	Ksat (in/hr)
Sand	HSG-A	< 8	2.8
Loamy Sand	HSG-A	< 15	2.0
Sandy Loam	HSG-A	< 20	0.80
Loam	HSG-B	< 20	0.25
Silt Loam	HSG-B	< 20	0.10
Loam	HSG-C	20 – 27	0.06
Silt Loam	HSG-C	20 - 27	0.03
Silt	HSG-C	< 12	0.05
Sandy Clay Loam	HSG-C or D	20 – 35	0.07
Clay Loam	HSG-C or D	27 – 40	0.02
Silty Clay Loam	HSG-C or D	27 – 40	0.02
Silty Clay	HSG-D	40 – 50	0.01
Sandy Clay	HSG-D	35 – 55	<0.005
Clay	HSG-D	> 40	<0.005

Summary

- Infiltration BMPs
  - Bioretention – applicable on most sites
  - Infiltration basins and trenches – need Kfs $\geq$ 0.5 in/hr
  - Permeable pavement and underground infiltration systems – good potential for HSG-A, B, C soils

$Kfs(min) = d_{WQv}/t_d$

$A_{infiltration}$	$A_{impervious}$	HLR	WQv	dWQv	Kfs(min)
(acre)	(acre)		(ft3)	(in)	(in/hr)
1.0	1.0	1	3104	0.9	0.02
1.0	2.0	2	6207	1.7	0.04
1.0	3.0	3	9311	2.6	0.05
1.0	5.0	5	15518	4.3	0.09
1.0	10.0	10	31037	8.6	0.18
1.0	20.0	20	62073	17.1	0.36

Summary

- Planning level infiltration rate estimates help explore post-construction BMP options
  - Requires identification of soil texture at location and depth of proposed infiltration practice
- Infiltration rate estimates are not sufficient for post-construction BMP design – representative field measurements of infiltration rate necessary for design

RAINWATER AND LAND DEVELOPMENT PROVISIONAL APPENDIX A-#

INFILTRATION ESTIMATES FOR STORMWATER PRACTICE PLANNING

DATE: 12/20/18

https://epa.ohio.gov/Portals/35/storm/technical_assistance/ProPractices.pdf

Questions:

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