APPENDIX B – GEOTECHNICAL AND CLIMATE

Geotechnical Engineering Exploration and Analysis

Proposed Stormwater Basins
Eagle Pass Court
Hartland, Wisconsin

Prepared for:

Ken Servi
Hartland, Wisconsin

July 7, 2025
Giles Project No. 1G-2506033

GILES
ENGINEERING ASSOCIATES, INC.

GILES
ENGINEERING ASSOCIATES, INC.
GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS

- Dallas, TX
- Los Angeles, CA
- Milwaukee, WI

July 7, 2025

Ken Servi
Kservi43@gmail.com
(414) 791-6367

Attention: Mr. Ken Servi

Subject: Geotechnical Engineering Exploration and Analysis
Proposed Stormwater Basins
Eagle Pass Court
Hartland, Wisconsin
Project No. 1G-2506033

Dear Mr. Servi:

As requested, Giles Engineering Associates, Inc. ("Giles") conducted a *Geotechnical Engineering Exploration and Analysis* for the proposed project. The accompanying report describes the services that were performed, and it provides the findings, conclusions, and recommendations that were derived from those services.

We sincerely appreciate the opportunity to provide consulting services for the proposed project. Please contact the undersigned if there are questions about the report or if we may be of further service.

Very truly yours,

GILES ENGINEERING ASSOCIATES, INC.

Andrew J. Globig
Project Professional

Benjamin M. Stark, P.E.
Project Engineer

WISCONSIN
BENJAMIN M. STARK
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VIRGINIA
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TABLE OF CONTENTS

GEOTECHNICAL ENGINEERING EXPLORATION AND ANALYSIS

PROPOSED STORMWATER BASIN
EAGLE PASS COURT
HARTLAND, WISCONSIN
PROJECT NO. 1G-2506033

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GEOTECHNICAL ENGINEERING EXPLORATION AND ANALYSIS

PROPOSED STORMWATER BASINS
EAGLE PASS COURT
HARTLAND, WISCONSIN
PROJECT NO. 1G-2506033

1.0 SCOPE OF SERVICES

This report provides the results of the *Geotechnical Engineering Subsurface Exploration and Analysis* that Giles Engineering Associates, Inc. ("Giles") conducted regarding the proposed stormwater management areas at the site. The *Geotechnical Engineering Subsurface Exploration and Analysis* included a Geotechnical Subsurface Exploration Program, Geotechnical Laboratory Services, and Geotechnical Engineering Services. The scope of each service area was narrow and limited, as directed by our client, and based on our understanding and assumptions about the proposed project. Service areas are briefly described later. Environmental-related consulting services are also beyond Giles' authorized scope.

2.0 SITE AND PROJECT DESCRIPTION

Two stormwater basins are planned to be constructed at the site, west of Eagle Pass Court, in Hartland, Wisconsin. At the time of our field services, the site was densely wooded. Foundations from a former structure were present within the south portion of the site. Topographically, the site generally sloped downward to the south. Ground surface elevations at the site were between El. 943 to El. 950. Those elevations are referenced to topographic contours on the plan provided by the client. A depiction of the project site is shown on the *Test Pit Location Plan* enclosed in Appendix A.

It is understood that the stormwater basins are preliminarily planned to be used for infiltration and will be about 4 to 5 feet deep, based on contours shown on the *Site Plan*. It is understood that both basin bottoms are preliminarily planned to be at El. 944.

3.0 GEOTECHNICAL SUBSURFACE EXPLORATION PROGRAM

To evaluate subsurface conditions, three test pits were conducted within the proposed basin areas with an excavator equipped with a toothed bucket. The test pits were excavated to depths ranging between ±10 to ±11 feet below-ground. The test pit locations were positioned on-site relative to apparent property lines and existing site features, and by estimating right angles. Approximate locations of the test pits are shown on the *Test Pit Location Plan*. A Giles representative observed the excavation procedures and logged the subsurface conditions within the test pits. The test pits were backfilled after the subsurface conditions were logged. However, backfill material was loosely placed and is, therefore, unsuitable for structural or pavement support.

Soil that was observed within the test pits was visually classified using the USDA textural classification system, in general accordance with the guidelines provided in the *Field Book for Describing and Sampling Soils* (USDA, Sept. 2012). The USDA classifications of the encountered soils are shown on the Wisconsin DSPS *Soil and Site Evaluation – Stormwater Infiltration* logs, enclosed in Appendix A. Supplemental information regarding soil classifications, including the USDA and USCS soil classification systems, is included in the *Soil Classification Notes* enclosure within Appendix D. For laboratory testing, select soil samples were collected and retained during excavation of the test pits.

Ground elevations at the test pit locations were estimated using the topographic contour lines on the plan provided by the client. The ground elevations are noted on the Wisconsin DSPS *Soil and Site Evaluation – Stormwater Infiltration* logs and are considered accurate within about one foot.

4.0 GEOTECHNICAL LABORATORY SERVICES

Laboratory testing to determine the percentage of material passing the No. 10 (P10) and No. 270 (P270) sieves was performed on select samples obtained from the test pits to assist with soil classification. Results of the sieve tests are noted on Wisconsin DSPS *Soil and Site Evaluation – Stormwater Infiltration* logs. Results of the laboratory tests are also reported in Table 1 below. Laboratory procedures are briefly described in Appendix C.

TABLE 1
RESULTS OF SIEVE TESTING

Test Pit No.	Sample Depth[a]	Sample Elevation[b]	Percent of Sample Finer than Sieve No.	
			P10	P270
TP-1	±5 feet	±El. 943.5	43%	34%
TP-2	±3 feet	±El. 942.0	37%	23%
TP-3	±3 feet	±El. 943.0	--	87%
TP-3	±8 feet	±El. 938.0	44%	18%

(a) Referenced to the site grades when the test pits were conducted.
(b) Elevations are referenced to the ground surface elevations at the test pits reported on the *Soil and Site Evaluation-Stormwater Infiltration* logs.

5.0 MATERIAL CONDITIONS

5.1. Surface Materials

Topsoil was at the surface of each test pit and was ±12 to ±14 inches thick. The topsoil consisted of sandy loam with estimated little amounts of organic matter.

5.2. Native Soils

Native silty clay loam and sandy clay loam soils were below the topsoil at Test Pits 2 and 3 and were encountered to ±2- to ±7-feet below ground surface at the test pits. Sandy loam and gravelly loamy fine sand were present below the surface material at Test Pit 1 and the cohesive materials at Test Pit 2 and 3. Native granular material was present to the termination depths at each test pit.

6.0 GROUNDWATER CONDITIONS

Groundwater was not encountered within the test pits, when the geotechnical subsurface exploration program was conducted. Groundwater conditions will likely fluctuate depending on precipitation, surface run-off, and other factors. The estimated water conditions are only an approximation based on the relative moisture conditions and colors of the observed soils in the test pits, and the lack of water encountered in the test pits at the time of the test pit excavations. The water table could be higher than estimated. If needed, groundwater observation wells could be installed and observed for relatively long periods of time at the site to further evaluate the long-term water table depth. Giles can install and monitor groundwater observation wells, if needed.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1. Stormwater Management Device Recommendations

It is understood that stormwater management basins are planned to be constructed in the areas of the Test Pits, as shown on Figure 1. The stormwater basins are preliminarily planned to be infiltration devices. It is understood that the basin bottom is preliminarily planned to be at El. 944.

Design Infiltration Rate Recommendations

Provided that the gravelly loamy sand (based on the USDA classification system) is continuous below the infiltration basins, and any unsuitable soils for infiltration (sandy clay loam and silty clay loam) are properly removed and replaced with engineered infiltration media, a design infiltration rate of 1.63 inches per hour is considered appropriate for design of the proposed infiltration devices. The recommended design infiltration rates are based on the textural classification of the soil within the test pits using guidelines provided in the WDNR Conservation Practice Standard 1002. USDA classifications are provided on the *Site and Soil Evaluation – Stormwater Infiltration* logs (in Appendix A), along with the correlated design infiltration rates. However, depending on details of the proposed stormwater infiltration devices, alternative infiltration rates might be appropriate.

Based on the conditions encountered within the test pits and considering the proposed basin bottom grade relative to existing ground grades, the site soils in the areas of the basins are suitable for infiltration of stormwater; however, based on the basin bottom elevation (El. 944), some over-excavation of cohesive silty clay loam and sandy clay loam to suitable granular material is expected to be required to achieve the recommended design infiltration rate, as previously discussed. The over-excavation depths at each basin will be dependent on the final design bottom elevation of the basins. The depths and elevations of suitable granular material for stormwater infiltration encountered at each test pit are shown on the following table.

TABLE 2
DEPTH/ELEVATION OF GRANULAR SOIL AT TEST PIT LOCATIONS

Test Pit No.	Depth to Gravelly Loamy Sand(1)	Elevation of Gravelly Loamy Sand(2)
1	±6 feet	±El. 942.5
2	±2 feet	±El. 943.0
3	±7 feet	±El. 939.0

(a) Depth to Gravelly Loamy Sand from ground surface adjacent to the test pit excavations when the test pits were performed.
(b) Elevations are referenced to the ground surface elevations at the test pits reported on the *Soil and Site Evaluation-Stormwater Infiltration* logs.

General Stormwater Infiltration Considerations

The following items are recommended for appropriate use of the design infiltration rate provided in this report.

- Soil that is at and below the bottom of each basin is recommended to be evaluated during basin construction to confirm that the design infiltration rate is appropriate. Unsuitable material is recommended to be completely removed and replaced with loosely placed infiltration media. The infiltration rate of infiltration media must be at least equal to the design infiltration rate.

- For proper infiltration, soil at the bottom of each infiltration device must not be compacted. Therefore, construction equipment should not travel within infiltration devices. Also, soil to about 12 inches below the bottom of each infiltration device is recommended to be loosened by raking or ripping. Raking or ripping is also recommended to be performed before placing infiltration media.

- Sediment must not be allowed to accumulate within an infiltration device during or after construction, since sedimentation will likely reduce the infiltration capacity of the device. Silt fences or other erosion-control devices should be installed in accordance with local, state, and federal requirements at the perimeter of the infiltration device areas to control sediment from erosion during construction.

It is recommended that Giles review the basin plans, when available. Additionally, it recommended that Giles provide observation and testing during infiltration device construction.

Groundwater Protection Considerations

Section NR 151(5)(c)5,i of the *State of Wisconsin Administrative Code* states that areas that do not have at least a 5-foot-thick soil layer with at least 10% fines, or a 3-foot-thick layer with at least 20% fines, between the bottom of the infiltration device and water table or bedrock surface shall be prohibited from infiltration of non-rooftop stormwater. “Fines” are defined in the code as material that passes the No. 200 sieve.

7.2. Generalized Construction Considerations

Demolition and Removal

All components of the existing foundations from the former structure are recommended to be completely removed from the proposed stormwater management area. Disposal of rubble and debris is recommended to be in accordance with local, state, and federal regulations for the material type. Outside the proposed stormwater management area, it might be feasible for existing foundations to remain provided the foundation remnants are stable, are cut-off at least three feet below the planned subgrade, and hollow cores are grouted solid. Former floor slabs (if present) that are outside the proposed stormwater management area possibly could also stay in-place provided the slabs are at least three feet below the planned finished grade, are perforated (broken) on a maximum two-foot grid, are “seated” into the subgrade for stability, and are covered with a minimum 12-inch-thick layer of well-graded free-draining granular material for drainage; the granular material is recommended to be properly placed and compacted. It is important to note that construction remnants that remain in-place might cause excavation difficulties for future construction. Furthermore, building components that remain in-place will likely be susceptible to frost heave. Excavations created during removal of construction components must be backfilled with engineered fill, which might need to be benched into the surrounding soil, as noted in Item No. 3 of the *Guide Specifications* enclosed in Appendix D.

Surface vegetation, trees and bushes (including root-balls), topsoil, and other unsuitable materials are recommended to be removed from the proposed development. Stripping should extend at least several feet beyond the proposed development area, where feasible. I.

Excavation Stability

Excavations are recommended to be made in accordance with current OSHA excavation and trench safety standards and other applicable requirements. Sides of excavations will need to be sloped, benched, or braced to develop and maintain a safe work environment. Temporary shoring must be designed according to applicable regulatory requirements. Contractors are responsible for excavation safety. Excavations will be susceptible to caving.

8.0 BASIS OF REPORT

This report is strictly based on the project description given in this report. Giles must be notified if any part of the project description or our assumptions are not accurate so that this report can be amended, if needed. This report is based on the assumption that the facility will be designed and constructed according to the codes that govern construction at the site.

The conclusions and recommendations in this report are based on estimated subsurface conditions as shown on the Wisconsin DSPS *Soil and Site Evaluation – Stormwater Infiltration* logs. Giles must be notified if the subsurface conditions that are encountered during construction of the proposed development differ from those shown on the Wisconsin DSPS *Soil and Site*

Evaluation – Stormwater Infiltration logs because this report will likely need to be revised. General comments and limitations of this report are given in the appendix.

The conclusions and recommendations presented in this report have been promulgated in accordance with generally accepted professional engineering practices in the field of geotechnical engineering. No other warranty is either expressed or implied.

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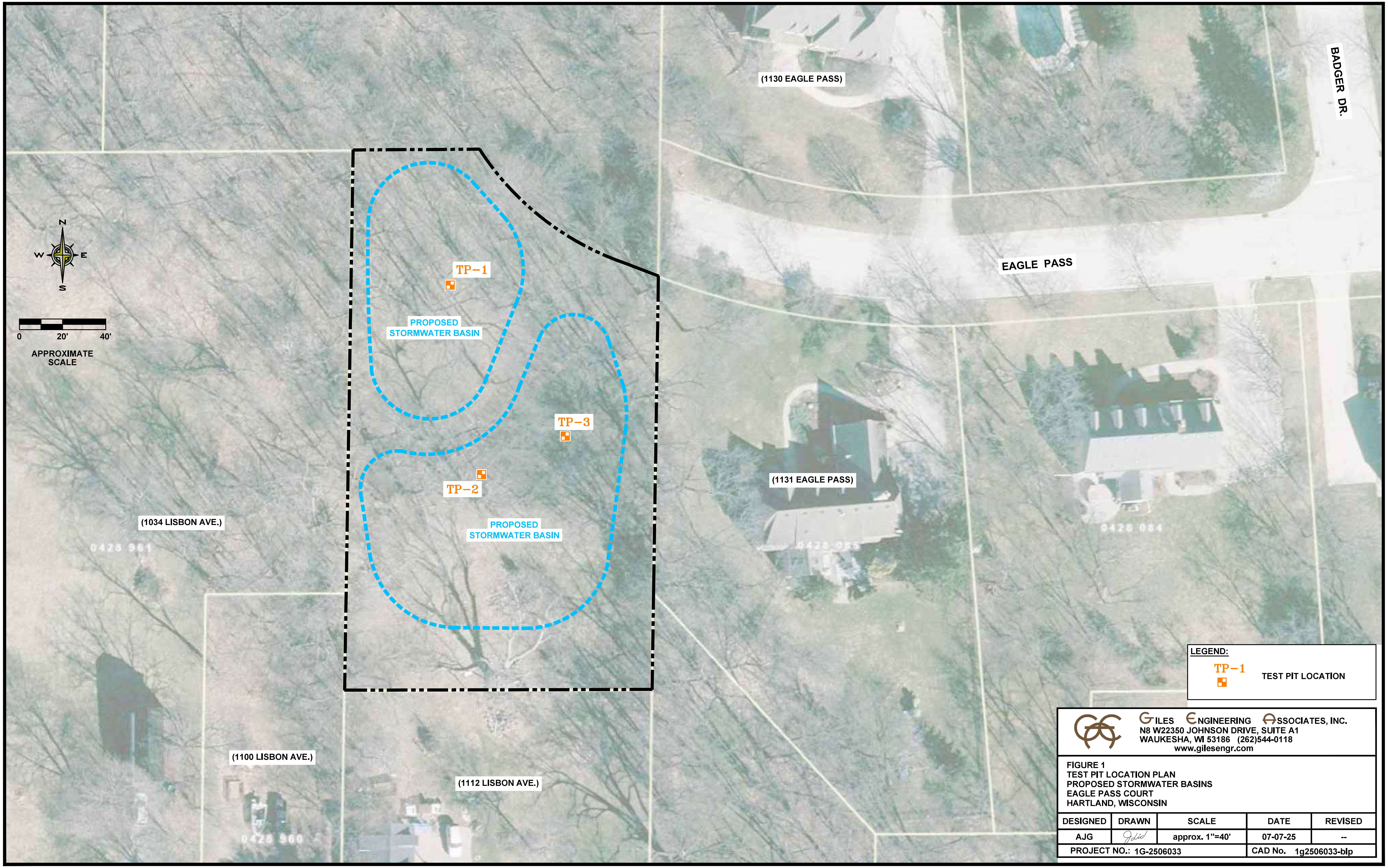
APPENDIX A

FIGURES AND TEST BORING LOGS

The Test Boring Location Plan contained herein was prepared based upon information supplied by *Giles'* client, or others, along with *Giles'* field measurements and observations. The diagram is presented for conceptual purposes only and is intended to assist the reader in report interpretation.

The Test Boring Logs and related information enclosed herein depict the subsurface (soil and water) conditions encountered at the specific boring locations on the date that the exploration was performed. Subsurface conditions may differ between boring locations and within areas of the site that were not explored with test borings. The subsurface conditions may also change at the boring locations over the passage of time.



LEGEND:

TP-1 ▣	TEST PIT LOCATION

GILES ENGINEERING ASSOCIATES, INC.
N8 W22350 JOHNSON DRIVE, SUITE A1
WAUKESHA, WI 53186 (262)544-0118
www.gilesengr.com

FIGURE 1
TEST PIT LOCATION PLAN
PROPOSED STORMWATER BASINS
EAGLE PASS COURT
HARTLAND, WISCONSIN

DESIGNED	DRAWN	SCALE	DATE	REVISED
AJG		approx. 1"=40'	07-07-25	--

PROJECT NO.: 1G-2506033
CAD No. 1g2506033-blp

Wisconsin Department of Safety and Professional Services
Division of Industry Services
4822 Madison Yards Way
PO Box 7302
Madison, WI 53707

Phone: 608-266-2112
Web: http://dsps.wi.gov
Email: dsps@wisconsin.gov

Program: Plumbing
Web: https://dsps.wi.gov/Pages/Programs/Plumbing

Soil and Site Evaluation – Stormwater Infiltration

In accordance with SPS 382.365, 385, Wis. Adm. Code, and WDNR Standard 1002
Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04(1)(m)]

Page 1 of 2

Attach a complete site plan on paper not less than 8 ½ x 11 inches in size. Plan must include but is not limited to: vertical and horizontal reference point (BM); direction and percent of slope; scale or dimensions; north arrow; and BM referenced to nearest road.

PLEASE PRINT ALL INFORMATION

COUNTY
Waukesha

PARCEL ID

PROPERTY OWNER
Servi Investments LLC

PROPERTY OWNER'S MAILING ADDRESS
1007 N. Pinegrove Court

CITY, STATE, ZIP CODE
Hartland WI 53029

PHONE

PROPERTY LOCATION
Govt. Lot: SW ¼ SE ¼ S35 T8N R18E
Lot #, Block #, Subd. Name or CSM #: ____
Municipality: Hartland
☐ City ☒ Village ☐ Town
Nearest Road: Eagle Pass Court

Drainage area____ ☐sq. ft. ☐acres

Test site suitable for (check all that apply):

☐ Site not suitable ☐Bioretention
☐ Reuse ☐Subsurface Dispersal System
☐ Irrigation ☐Other ____

HYDRAULIC APPLICATION TEST METHOD
☒ Morphological Evaluation
☐ Double Ring Infiltrometer
☐ Other: (specify) ____

SOIL MOISTURE
Date of test pits: 6/23/2025

USDA-NRCS WETS VALUE:
☐ Dry = 1
☐ Normal = 2
☐ Wet = 3

1 #OBS. ☒Pit ☐Boring Ground Surface Elevation 948.5 ft. Elevation of Limiting Factor____ ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App. Rate Inches/Hr.
A	0-14	10YR 3/3	--	SL	1, VF, GR	M, FR	A, S	<5	35	0.50
B	14-72	10YR 5/4	--	SL	1, F, SBK	M, FI	C, W	43**	34*	0.50
C	72-132	10YR 5/4	--	GR LS	1,M,GR	M, FI	--	45	20	1.63

Comments: *Percent fines based on sieve analysis of material passing No. 270 sieve
**Percent rock frags. based on sieve analysis of material passing No. 10 sieve.

2 #OBS. ☒Pit ☐Boring Ground Surface Elevation 945.0 ft. Elevation of Limiting Factor ____ ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App. Rate Inches/Hr.
A	0-14	10YR 3/3	--	SL	1, VF, GR	M, FR	A, S	<5	35	0.50
B	14-24	10YR 5/4	--	SCL	1, F, SBK	M, FI	C, W	10	55	0.11
C	24-132	10YR 5/4	--	GR LS	1,M,GR	M, FI	--	37**	23*	1.63

Comments: *Percent fines based on sieve analysis of material passing No. 270 sieve
**Percent rock frags. based on sieve analysis of material passing No. 10 sieve.

_3___ #OBS. ☒Pit ☐Boring Ground Surface Elevation __946.0____ ft. Elevation of Limiting Factor_________ ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App. Rate Inches/Hr.
A	0-12	10YR 3/3	--	SL	1, VF, GR	M, FR	A, S	<5	35	0.50
B	12-84	10YR 5/4	--	SICL	1, F, SBK	M, FI	C, W	<5	87*	0.04
C	84-120	10YR 5/4	--	GR LS	1,M,GR	M, FI	--	44**	18*	1.63

Comments: *Percent fines based on sieve analysis of material passing No. 270 sieve
**Percent rock frags. based on sieve analysis of material passing No. 10 sieve.

Name (Please Print): Michelle L. Peed, P.G.
Signature:
Credential Number: P.G. No.: 1370-13

Address: N8 W22350 Johnson Drive, Waukesha, WI
Date Evaluation Conducted: July 2, 2025
Phone Number: (262) 544-0118

APPENDIX B

FIELD PROCEDURES

The field operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) designation D 420 entitled “Standard Guide for Sampling Rock and Rock” and/or other relevant specifications. Soil samples were preserved and transported to *Giles’* laboratory in general accordance with the procedures recommended by ASTM designation D 4220 entitled “Standard Practice for Preserving and Transporting Soil Samples.” Brief descriptions of the sampling, testing and field procedures commonly performed by *Giles* are provided herein.

GENERAL FIELD PROCEDURES

Test Boring Elevations

The ground surface elevations reported on the Test Boring Logs are referenced to the assumed benchmark shown on the Boring Location Plan (Figure 1). Unless otherwise noted, the elevations were determined with a conventional hand-level and are accurate to within about 1 foot.

Test Boring Locations

The test borings were located on-site based on the existing site features and/or apparent property lines. Dimensions illustrating the approximate boring locations are reported on the Boring Location Plan (Figure 1).

Water Level Measurement

The water levels reported on the Test Boring Logs represent the depth of “free” water encountered during drilling and/or after the drilling tools were removed from the borehole. Water levels measured within a granular (sand and gravel) soil profile are typically indicative of the water table elevation. It is usually not possible to accurately identify the water table elevation with cohesive (clayey) soils, since the rate of seepage is slow. The water table elevation within cohesive soils must therefore be determined over a period of time with groundwater observation wells.

It must be recognized that the water table may fluctuate seasonally and during periods of heavy precipitation. Depending on the subsurface conditions, water may also become perched above the water table, especially during wet periods.

Borehole Backfilling Procedures

Each borehole was backfilled upon completion of the field operations. If potential contamination was encountered, and/or if required by state or local regulations, boreholes were backfilled with an “impervious” material (such as bentonite slurry). Borings that penetrated pavements, sidewalks, etc. were “capped” with Portland Cement concrete, asphaltic concrete, or a similar surface material. It must, however, be recognized that the backfill material may settle, and the surface cap may subside, over a period of time. Further backfilling and/or re-surfacing by *Giles’* client or the property owner may be required.

FIELD SAMPLING AND TESTING PROCEDURES

Auger Sampling (AU)

Soil samples are removed from the auger flights as an auger is withdrawn above the ground surface. Such samples are used to determine general soil types and identify approximate soil stratifications. Auger samples are highly disturbed and are therefore not typically used for geotechnical strength testing.

Split-Barrel Sampling (SS) – (ASTM D-1586)

A split-barrel sampler with a 2-inch outside diameter is driven into the subsoil with a 140-pound hammer free-falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the “Standard Penetration Resistance” or N-value is an index of the relative density of granular soils and the comparative consistency of cohesive soils. A soil sample is collected from each SPT interval.

Shelby Tube Sampling (ST) – (ASTM D-1587)

A relatively undisturbed soil sample is collected by hydraulically advancing a thin-walled Shelby Tube sampler into a soil mass. Shelby Tubes have a sharp cutting edge and are commonly 2 to 5 inches in diameter.

Bulk Sample (BS)

A relatively large volume of soils is collected with a shovel or other manually-operated tool. The sample is typically transported to *Giles’* materials laboratory in a sealed bag or bucket.

Dynamic Cone Penetration Test (DC) – (ASTM STP 399)

This test is conducted by driving a 1.5-inch-diameter cone into the subsoil using a 15-pound steel ring (hammer), free-falling a vertical distance of 20 inches. The number of hammer-blows required to drive the cone 1¾ inches is an indication of the soil strength and density, and is defined as “N”. The Dynamic Cone Penetration test is commonly conducted in hand auger borings, test pits and within excavated trenches.

- Continued -

Ring-Lined Barrel Sampling – (ASTM D 3550)

In this procedure, a ring-lined barrel sampler is used to collect soil samples for classification and laboratory testing. This method provides samples that fit directly into laboratory test instruments without additional handling/disturbance.

Sampling and Testing Procedures

The field testing and sampling operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Results of the field testing (i.e. N-values) are reported on the Test Boring Logs. Explanations of the terms and symbols shown on the logs are provided on the appendix enclosure entitled “General Notes”.

APPENDIX C

LABORATORY TESTING AND CLASSIFICATION

The laboratory testing was conducted under the supervision of a geotechnical engineer in accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Brief descriptions of laboratory tests commonly performed by *Giles* are provided herein.

LABORATORY TESTING AND CLASSIFICATION

Photoionization Detector (PID)

In this procedure, soil samples are "scanned" in *Giles'* analytical laboratory using a Photoionization Detector (PID). The instrument is equipped with an 11.7 eV lamp calibrated to a Benzene Standard and is capable of detecting a minute concentration of **certain** Volatile Organic Compound (VOC) vapors, such as those commonly associated with petroleum products and some solvents. Results of the PID analysis are expressed in HNu (manufacturer's) units rather than actual concentration.

Moisture Content (w) (ASTM D 2216)

Moisture content is defined as the ratio of the weight of water contained within a soil sample to the weight of the dry solids within the sample. Moisture content is expressed as a percentage.

Unconfined Compressive Strength (qu) (ASTM D 2166)

An axial load is applied at a uniform rate to a cylindrical soil sample. The unconfined compressive strength is the maximum stress obtained or the stress when 15% axial strain is reached, whichever occurs first.

Calibrated Penetrometer Resistance (qp)

The small, cylindrical tip of a hand-held penetrometer is pressed into a soil sample to a prescribed depth to measure the soils capacity to resist penetration. This test is used to evaluate unconfined compressive strength.

Vane-Shear Strength (qs)

The blades of a vane are inserted into the flat surface of a soil sample and the vane is rotated until failure occurs. The maximum shear resistance measured immediately prior to failure is taken as the vane-shear strength.

Loss-on-Ignition (ASTM D 2974; Method C)

The Loss-on-Ignition (L.O.I.) test is used to determine the organic content of a soil sample. The procedure is conducted by heating a dry soil sample to 440°C in order to burn-off or "ash" organic matter present within the sample. The L.O.I. value is the ratio of the weight loss due to ignition compared to the initial weight of the dry sample. L.O.I. is expressed as a percentage.

Particle Size Distribution (ASTB D 421, D 422, and D 1140)

This test is performed to determine the distribution of specific particle sizes (diameters) within a soil sample. The distribution of coarse-grained soil particles (sand and gravel) is determined from a “sieve analysis,” which is conducted by passing the sample through a series of nested sieves. The distribution of fine-grained soil particles (silt and clay) is determined from a “hydrometer analysis” which is based on the sedimentation of particles suspended in water.

Consolidation Test (ASTM D 2435)

In this procedure, a series of cumulative vertical loads are applied to a small, laterally confined soil sample. During each load increment, vertical compression (consolidation) of the sample is measured over a period of time. Results of this test are used to estimate settlement and time rate of settlement.

Classification of Samples

Each soil sample was visually-manually classified, based on texture and plasticity, in general accordance with the Unified Soil Classification System (ASTM D-2488-75). The classifications are reported on the Test Boring Logs.

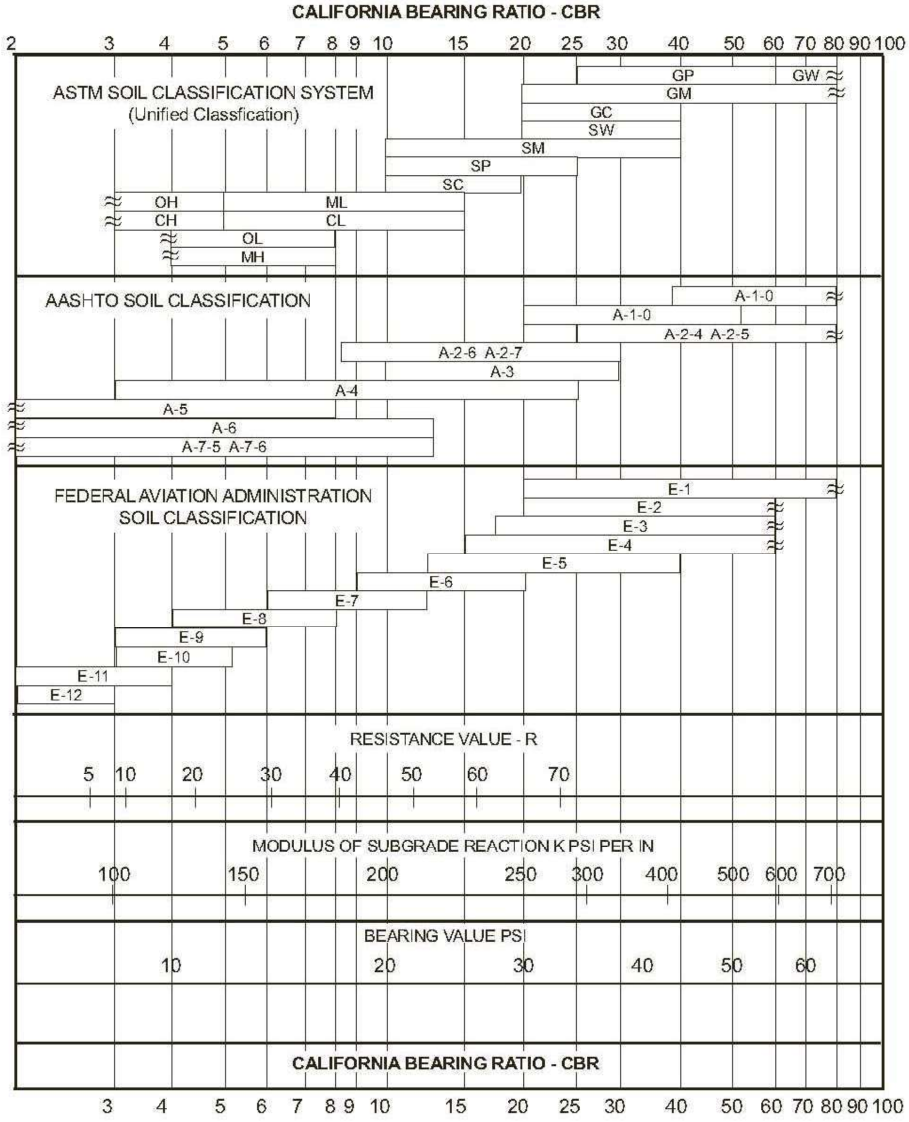
Laboratory Testing

The laboratory testing operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Results of the laboratory tests are provided on the Test Boring Logs or other appendix enclosures. Explanation of the terms and symbols used on the logs is provided on the appendix enclosure entitled “General Notes.”

California Bearing Ratio (CBR) Test ASTM D-1833

The CBR test is used for evaluation of a soil subgrade for pavement design. The test consists of measuring the force required for a 3-square-inch cylindrical piston to penetrate 0.1 or 0.2 inch into a compacted soil sample. The result is expressed as a percent of force required to penetrate a standard compacted crushed stone.

Unless a CBR test has been specifically requested by the client, the CBR is estimated from published charts, based on soil classification and strength characteristics. A typical correlation chart is below.



APPENDIX D

GENERAL INFORMATION

AND
IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL REPORT

GENERAL COMMENTS

The soil samples obtained during the subsurface exploration will be retained for a period of thirty days. If no instructions are received, they will be disposed of at that time.

This report has been prepared exclusively for the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. Copies of this report may be provided to contractor(s), with contract documents, to disclose information relative to this project. The report, however, has not been prepared to serve as the plans and specifications for actual construction without the appropriate interpretation by the project architect, structural engineer, and/or civil engineer. Reproduction and distribution of this report must be authorized by the client and *Giles***.**

This report has been based on assumed conditions/characteristics of the proposed development where specific information was not available. It is recommended that the architect, civil engineer and structural engineer along with any other design professionals involved in this project carefully review these assumptions to ensure they are consistent with the actual planned development. When discrepancies exist, they should be brought to our attention to ensure they do not affect the conclusions and recommendations provided herein. The project plans and specifications may also be submitted to *Giles* for review to ensure that the geotechnical related conclusions and recommendations provided herein have been correctly interpreted.

The analysis of this site was based on a subsoil profile interpolated from a limited subsurface exploration. If the actual conditions encountered during construction vary from those indicated by the borings, *Giles* must be contacted immediately to determine if the conditions alter the recommendations contained herein.

The conclusions and recommendations presented in this report have been promulgated in accordance with generally accepted professional engineering practices in the field of geotechnical engineering. No other warranty is either expressed or implied.

GUIDE SPECIFICATIONS FOR SUBGRADE AND GRADE PREPARATION FOR FILL, FOUNDATION, FLOOR SLAB AND PAVEMENT SUPPORT; AND SELECTION, PLACEMENT AND COMPACTION OF FILL SOILS USING STANDARD PROCTOR PROCEDURES

1. Construction monitoring and testing of subgrades and grades for fill, foundation, floor slab and pavement; and fill selection, placement and compaction shall be performed by an experienced soils engineer and/or his representatives.

2. All compaction fill, subgrades and grades shall be (a) underlain by suitable bearing material; (b) free of all organic, frozen, or other deleterious material, and (c) observed, tested and approved by qualified engineering personnel representing an experienced soils engineer. Preparation of subgrades after stripping vegetation, organic or other unsuitable materials shall consist of (a) proof-rolling to detect soil, wet yielding soils or other unstable materials that must be undercut, (b) scarifying top 6 to 8 inches, (c) moisture conditioning the soils as required, and (d) recompaction to same minimum in-situ density required for similar materials indicated under Item 5. Note: compaction requirements for pavement subgrade are higher than other areas. Weather and construction equipment may damage compacted fill surface and reworking and retesting may be necessary to assure proper performance.

3. In overexcavation and fill areas, the compacted fill must extend (a) a minimum 1 foot lateral distance beyond the exterior edge of the foundation at bearing grade or pavement subgrade and down to compacted fill subgrade on a maximum 0.5(H):1(V) slope, (b) 1 foot above footing grade outside the building, and (c) to floor subgrade inside the building. Fill shall be placed and compacted on a 5(H):1(V) slope or must be stepped or benched as required to flatten if not specifically approved by qualified personnel under the direction of an experienced soil engineer.

4. The compacted fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as “contaminated”, and shall be low-expansive with a maximum Liquid Limit (ASTM D-423) and Plasticity Index (ASTM D-424) of 30 and 15, respectively, unless specifically tested and found to have low expansive properties and approved by an experienced soils engineer. The top 12 inches of compacted fill should have a maximum 3-inch-particle diameter and all underlying compacted fill a maximum 6-inch-diameter unless specifically approved by an experienced soils engineer. All fill materials must be tested and approved under the direction of an experienced soils engineer prior to placement. If the fill is to provide non-frost susceptible characteristics, it must be classified as a clean GW, GP, SW or SP per the Unified Soil Classification System (ASTM D-2487).

5. For structural fill depths less than 20 feet, the density of the structural compacted fill and scarified subgrade and grades shall not be less than 95 percent of the maximum dry density as determined by Standard Proctor (ASTM-698) with the exception of the top 12 inches of pavement subgrade which shall have a minimum in-situ density of 100 percent of maximum dry density, or 5 percent higher than underlying fill materials. Where the structural fill depth is greater than 20 feet, the portions below 20 feet should have a minimum in-place density of 100 percent of its maximum dry density of 5 percent greater than the top 20 feet. The moisture content of cohesive soil shall not vary by more than -1 to +3 percent and granular soil ±3 percent of the optimum when placed and compacted or recompacted, unless specifically recommended/approved by the soils engineer monitoring the placement and compaction. Cohesive soils with moderate to high expansion potentials (PI>15) should, however, be placed, compacted and maintained prior to construction at a moisture content 3±1 percent above optimum moisture content to limit further heave. The fill shall be placed in layers with a maximum loose thickness of 8 inches for foundations and 10 inches for floor slabs and pavement, unless specifically approved by the soils engineer taking into consideration the type of materials and compaction equipment being used. The compaction equipment should consist of suitable mechanical equipment specifically designed for soil compaction. Bulldozers or similar tracked vehicles are typically not suitable for compaction.

6. Excavation, filling, subgrade and grade preparation shall be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs and seepage water encountered shall be pumped or drained to provide a suitable working platform. Springs or water seepage encountered during grading/foundation construction must be called to the soil engineer’s attention immediately for possible construction procedure revision or inclusion of an underdrain system.

7. Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below-grade walls (i.e. basement walls and retaining walls) must be properly tested and approved by an experienced soils engineer with consideration for the lateral pressure used in the wall design.

8. Whenever, in the opinion of the soils engineer or the Owner’s Representatives, an unstable condition is being created either by cutting or filling, the work shall not proceed into that area until an appropriate geotechnical exploration and analysis has been performed and the grading plan revised, if found necessary.

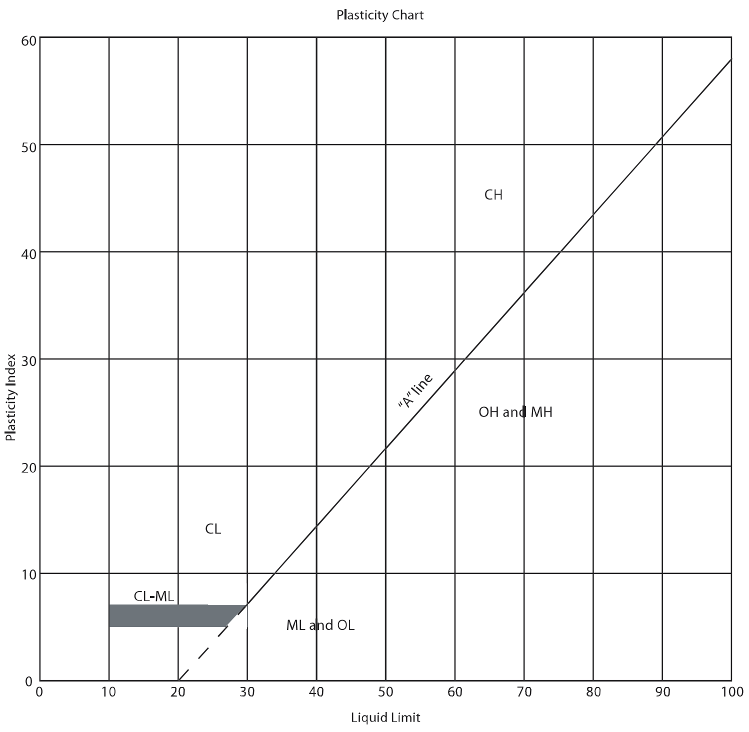
CHARACTERISTICS AND RATINGS OF UNIFIED SOIL SYSTEM CLASSES FOR SOIL CONSTRUCTION *

Class	Compaction Characteristics	Max. Dry Density Standard Proctor (pcf)	Compressibility and Expansion	Drainage and Permeability	Value as an Embankment Material	Value as Subgrade When Not Subject to Frost	Value as Base Course	Value as Temporary Pavement	
								With Dust Palliative	With Bituminous Treatment
GW	Good: tractor, rubber-tired, steel wheel or vibratory roller	125-135	Almost none	Good drainage, pervious	Very stable	Excellent	Good	Fair to poor	Excellent
GP	Good: tractor, rubber-tired, steel wheel or vibratory roller	115-125	Almost none	Good drainage, pervious	Reasonably stable	Excellent to good	Poor to fair	Poor	
GM	Good: rubber-tired or light sheepsfoot roller	120-135	Slight	Poor drainage, semipervious	Reasonably stable	Excellent to good	Fair to poor	Poor	Poor to fair
GC	Good to fair: rubber-tired or sheepsfoot roller	115-130	Slight	Poor drainage, impervious	Reasonably stable	Good	Good to fair **	Excellent	Excellent
SW	Good: tractor, rubber-tired or vibratory roller	110-130	Almost none	Good drainage, pervious	Very stable	Good	Fair to poor	Fair to poor	Good
SP	Good: tractor, rubber-tired or vibratory roller	100-120	Almost none	Good drainage, pervious	Reasonably stable when dense	Good to fair	Poor	Poor	Poor to fair
SM	Good: rubber-tired or sheepsfoot roller	110-125	Slight	Poor drainage, impervious	Reasonably stable when dense	Good to fair	Poor	Poor	Poor to fair
SC	Good to fair: rubber-tired or sheepsfoot roller	105-125	Slight to medium	Poor drainage, impervious	Reasonably stable	Good to fair	Fair to poor	Excellent	Excellent
ML	Good to poor: rubber-tired or sheepsfoot roller	95-120	Slight to medium	Poor drainage, impervious	Poor stability, high density required	Fair to poor	Not suitable	Poor	Poor
CL	Good to fair: sheepsfoot or rubber-tired roller	95-120	Medium	No drainage, impervious	Good stability	Fair to poor	Not suitable	Poor	Poor
OL	Fair to poor: sheepsfoot or rubber-tired roller	80-100	Medium to high	Poor drainage, impervious	Unstable, should not be used	Poor	Not suitable	Not suitable	Not suitable
MH	Fair to poor: sheepsfoot or rubber-tired roller	70-95	High	Poor drainage, impervious	Poor stability, should not be used	Poor	Not suitable	Very poor	Not suitable
CH	Fair to poor: sheepsfoot roller	80-105	Very high	No drainage, impervious	Fair stability, may soften on expansion	Poor to very poor	Not suitable	Very poor	Not suitable
OH	Fair to poor: sheepsfoot roller	65-100	High	No drainage, impervious	Unstable, should not be used	Very poor	Not suitable	Not suitable	Not suitable
Pt	Not suitable		Very high	Fair to poor drainage	Should not be used	Not suitable	Not suitable	Not suitable	Not suitable

* "The Unified Classification: Appendix A - Characteristics of Soil, Groups Pertaining to Roads and Airfields, and Appendix B - Characteristics of Soil Groups Pertaining to Embankments and Foundations," Technical Memorandum 357, U.S. Waterways Ixperiment Station, Vicksburg, 1953.

** Not suitable if subject to frost.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

Major Divisions			*Group Symbols*		*Typical Names*	*Laboratory Classification Criteria*		
Coarse-grained soils (more than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent: GW, GP, SW, SP More than 12 percent: GM, GC, SM, SC 5 to 12 percent: *Borderline* cases requiring dual symbols[b]	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP		Poorly graded gravels, gravel-sand mixtrues, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting within shaded area, above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u				
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting within shaded area, above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u				
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays			
			OL		Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		Pt		Peat and other highly organic soils			

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[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits, suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u is used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group sympols. For example GW-GC, well-graded gravel-sand mixture with clay binder.

GENERAL NOTES

SAMPLE IDENTIFICATION

All samples are visually classified in general accordance with the Unified Soil Classification System (ASTM D-2487-75 or D-2488-75)

DESCRIPTIVE TERM (% BY DRY WEIGHT)

Trace:	1-10%
Little:	11-20%
Some:	21-35%
And/Adjective	36-50%

PARTICLE SIZE (DIAMETER)

Boulders:	8 inch and larger
Cobbles:	3 inch to 8 inch
Gravel:	coarse - ¾ to 3 inch
	fine – No. 4 (4.76 mm) to ¾ inch
Sand:	coarse – No. 4 (4.76 mm) to No. 10 (2.0 mm)
	medium – No. 10 (2.0 mm) to No. 40 (0.42 mm)
	fine – No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt:	No. 200 (0.074 mm) and smaller (non-plastic)
Clay:	No 200 (0.074 mm) and smaller (plastic)

SOIL PROPERTY SYMBOLS

Dd:	Dry Density (pcf)
LL:	Liquid Limit, percent
PL:	Plastic Limit, percent
PI:	Plasticity Index (LL-PL)
LOI:	Loss on Ignition, percent
Gs:	Specific Gravity
K:	Coefficient of Permeability
w:	Moisture content, percent
qp:	Calibrated Penetrometer Resistance, tsf
qs:	Vane-Shear Strength, tsf
qu:	Unconfined Compressive Strength, tsf
qc:	Static Cone Penetrometer Resistance (correlated to Unconfined Compressive Strength, tsf)
PID:	Results of vapor analysis conducted on representative samples utilizing a Photoionization Detector calibrated to a benzene standard. Results expressed in HNU-Units. (BDL=Below Detection Limit)
N:	Penetration Resistance per 12 inch interval, or fraction thereof, for a standard 2 inch O.D. (1⅜ inch I.D.) split spoon sampler driven with a 140 pound weight free-falling 30 inches. Performed in general accordance with Standard Penetration Test Specifications (ASTM D-1586). N in blows per foot equals sum of N-Values where plus sign (+) is shown.
Nc:	Penetration Resistance per 1¾ inches of Dynamic Cone Penetrometer. Approximately equivalent to Standard Penetration Test N-Value in blows per foot.
Nr:	Penetration Resistance per 12 inch interval, or fraction thereof, for California Ring Sampler driven with a 140 pound weight free-falling 30 inches per ASTM D-3550. Not equivalent to Standard Penetration Test N-Value.

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon
ST:	Shelby Tube – 3 inch O.D. (except where noted)
CS:	3 inch O.D. California Ring Sampler
DC:	Dynamic Cone Penetrometer per ASTM Special Technical Publication No. 399
AU:	Auger Sample
DB:	Diamond Bit
CB:	Carbide Bit
WS:	Wash Sample
RB:	Rock-Roller Bit
BS:	Bulk Sample
Note:	Depth intervals for sampling shown on Record of Subsurface Exploration are not indicative of sample recovery, but position where sampling initiated

SOIL STRENGTH CHARACTERISTICS

COHESIVE (CLAYEY) SOILS

COMPARATIVE CONSISTENCY	**BLOWS PER FOOT (N)**	**UNCONFINED COMPRESSIVE STRENGTH (TSF)**
Very Soft	0 - 2	0 - 0.25
Soft	3 - 4	0.25 - 0.50
Medium Stiff	5 – 8	0.50 - 1.00
Stiff	9 – 15	1.00 - 2.00
Very Stiff	16 – 30	2.00 - 4.00
Hard	31+	4.00+

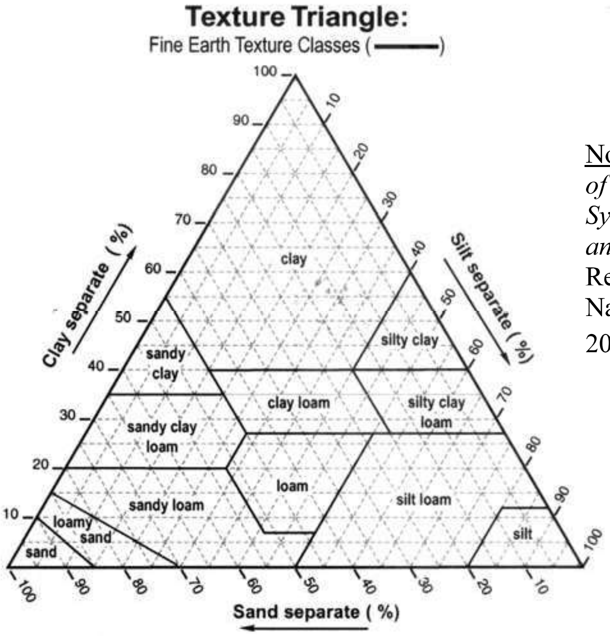
NON-COHESIVE (GRANULAR) SOILS

RELATIVE DENSITY	**BLOWS PER FOOT (N)**
Very Loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	51+

DEGREE OF PLASTICITY	**PI**
None to Slight	0 - 4
Slight	5 - 10
Medium	11 - 30
High to Very High	31+

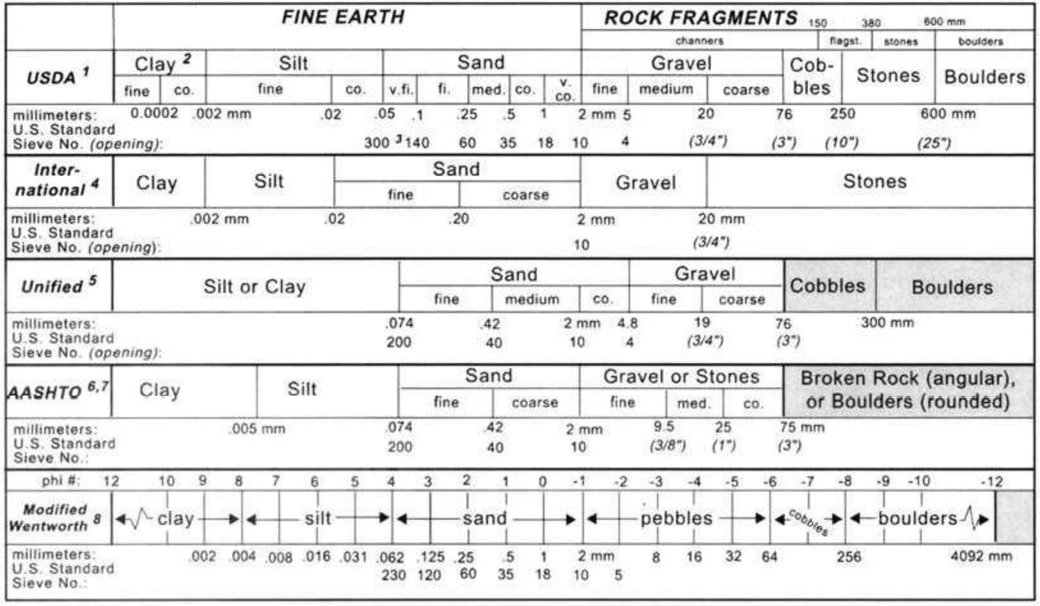
DEGREE OF EXPANSIVE POTENTIAL	**PI**
Low	0 - 15
Medium	15 - 25
High	25+

SOIL CLASSIFICATION NOTES



Note: *Texture Triangle* and *Comparison of Particle Size Classes in Different Systems* from *Field Book for Describing and Sampling Soil*, USDA Natural Resources Conservation Service National Soil Survey Center (September 2002).

Comparison of Particle Size Classes in Different Systems



	FINE EARTH									ROCK FRAGMENTS 150 380 600 mm					
										channers			flagst.	stones	boulders
USDA [1]	Clay [2]		Silt		Sand					Gravel			Cob-bles	Stones	Boulders
	fine	co.	fine	co.	v.fi.	fi.	med.	co.	v. co.	fine	medium	coarse			

millimeters: 0.0002 .002 mm .02 .05 .1 .25 .5 1 2 mm 5 20 76 250 600 mm
U.S. Standard Sieve No. (opening): 300 [3] 140 60 35 18 10 4 (3/4") (3") (10") (25")

International [4]	Clay	Silt	Sand		Gravel	Stones
			fine	coarse		

millimeters: .002 mm .02 .20 2 mm 20 mm
U.S. Standard Sieve No. (opening): 10 (3/4")

Unified [5]	Silt or Clay	Sand			Gravel		Cobbles	Boulders
		fine	medium	co.	fine	coarse		

millimeters: .074 .42 2 mm 4.8 19 76 300 mm
U.S. Standard Sieve No. (opening): 200 40 10 4 (3/4") (3")

AASHTO [6,7]	Clay	Silt	Sand		Gravel or Stones			Broken Rock (angular), or Boulders (rounded)
			fine	coarse	fine	med.	co.	

millimeters: .005 mm .074 .42 2 mm 9.5 25 75 mm
U.S. Standard Sieve No.: 200 40 10 (3/8") (1") (3")

phi #: 12 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -12

Modified Wentworth [8]	clay	silt	sand	pebbles	cobbles	boulders

millimeters: .002 .004 .008 .016 .031 .062 .125 .25 .5 1 2 mm 8 16 32 64 256 4092 mm
U.S. Standard Sieve No.: 230 120 60 35 18 10 5

1. Soil Survey Staff. 1995. Soil survey Laboratory information manual. USDA, Natural Resources Conservation Service, Soil Survey Investigations Report No. 45, Version 1.0, National Soil Survey Center, Lincoln, NE. 305 p.
2. Soil Survey Staff. 1995. Soil Survey Lab information manual. USDA-NRCS, Soil Survey Investigation Report #45, version 1.0, National Soil Survey Center, Lincoln, NE. Note: Mineralogy studies may subdivide clay into three size ranges; fine (<0.08μm), medium (0.08-0.2μm), and coarse (0.2-2μm); Jackson, 1969.
3. The Soil Survey Lab (Lincoln, NE) uses a no. 300 sieve (0.047 mm opening) for the USDA-sand/silt measurement. A no. 270 sieve (0.053 mm opening) is more readily available and widely used.
4. International Soil Science Society. 1951. *In*: Soil Survey Manual. Soil Survey Staff, USDA-Soil Conservation Service, Agricultural Handbook No. 18, U.S. Gov. Print. Office, Washington, D.C. 214 p.
5. ASTM. 1993. Standard classification of soils for engineering purposes (Unified Soil Classification System). ASTM designation D2487-92. *In*: Soil and rock; dimension stone; geosynthetics. Annual book of ASTM standards-Vol. 04.08.
6. AASHTO. 1986a. Recommended practice for the classification of soils and soil-aggregate mixtures for highway construction purposes. AASHTO designation M145-82. *In*: Standard specifications for transportation materials and methods of sampling and testing; Part 1: Specifications (14th ed.). American Association of State Highway and Transportation Officials, Washington, D.C.
7. AASHTO. 1986b. Standard definitions of terms relating to subgrade, soil-aggregate, and fill materials. AASHTO designation M146-70 (1980). *In*: sampling and testing; Part 1: Specifications (14th ed.). American Association of State Highway and Transportation Officials, Washington, D.C.
8. Ingram, R.L. 1982. Modified Wentworth scale. *In*: Grain-size scales. AGI Date Sheet 29.1. *In*: Dutro, J.T., Dietrich, R.V., and Foose, R.M. 1989. AGI data sheets for geology in the field, laboratory, and office, 3rd edition. American Geological Institute, Washington, D.C.

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

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Geotechnical, Environmental & Construction Materials Consultants

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United States
Department of
Agriculture

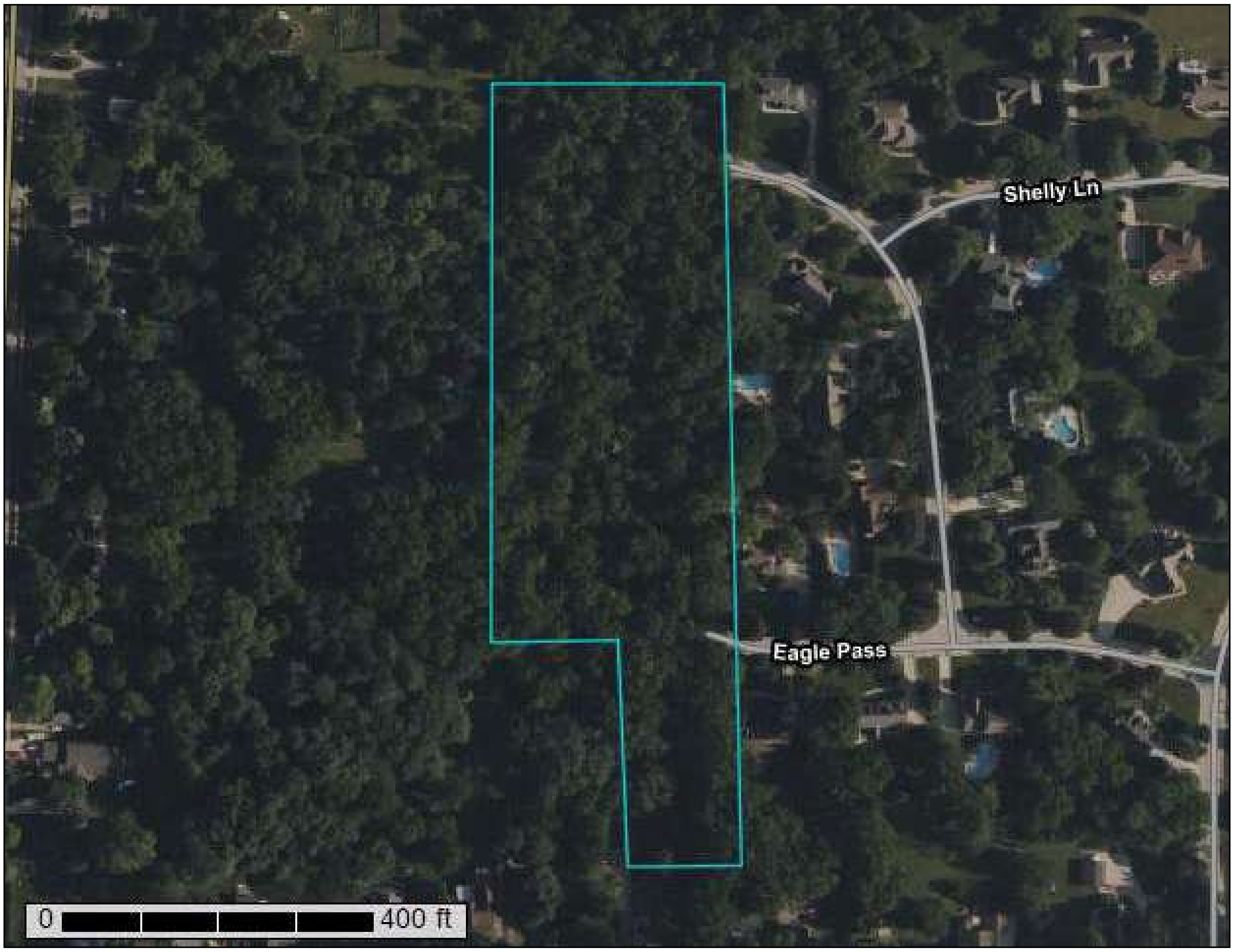
NRCS

Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Waukesha County, Wisconsin



June 28, 2025

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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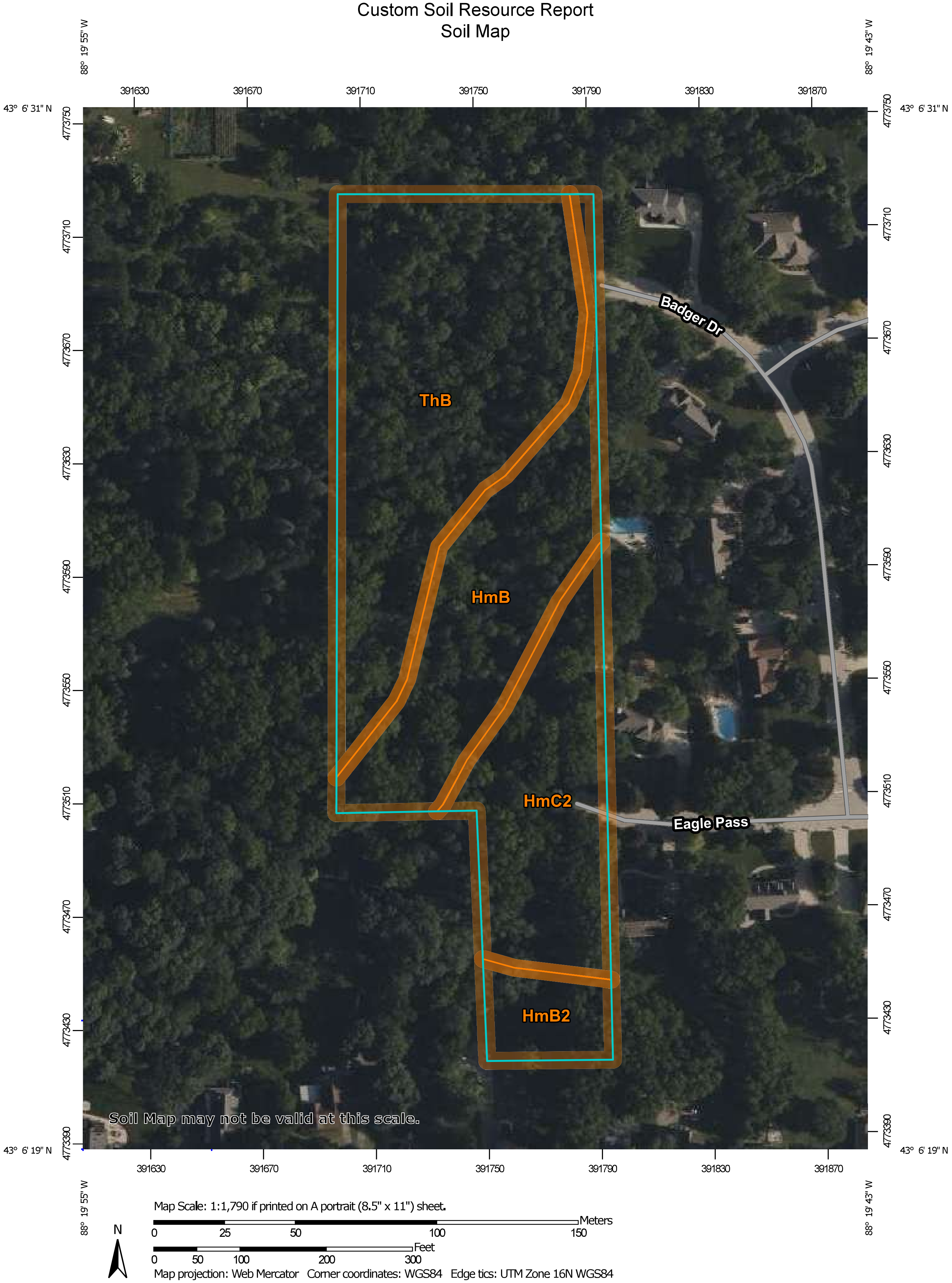
Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Soil Map may not be valid at this scale.

Map Scale: 1:1,790 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Waukesha County, Wisconsin
Survey Area Data: Version 3, Dec 10, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 4, 2022—Sep 13, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
HmB	Hochheim loam, 2 to 6 percent slopes	1.5	25.6%
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	0.4	5.8%
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	1.4	22.5%
ThB	Theresa silt loam, 2 to 6 percent slopes	2.8	46.1%
Totals for Area of Interest		**6.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Waukesha County, Wisconsin

HmB—Hochheim loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2t03x
Elevation: 820 to 1,330 feet
Mean annual precipitation: 29 to 31 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 135 to 155 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Hochheim and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hochheim

Setting

Landform: Drumlins
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy till and/or calcareous, dense loamy till

Typical profile

Ap - 0 to 9 inches: loam
Bt - 9 to 17 inches: clay loam
C - 17 to 33 inches: gravelly loam
Cd - 33 to 79 inches: gravelly loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Ecological site: F095XB007WI - Loamy Upland with Carbonates
Forage suitability group: Mod AWC, adequately drained (G095BY005WI)
Other vegetative classification: Mod AWC, adequately drained (G095BY005WI)
Hydric soil rating: No

Minor Components

Theresa

Percent of map unit: 7 percent
Landform: Drumlins
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: F095XB007WI - Loamy Upland with Carbonates
Hydric soil rating: No

Lamartine

Percent of map unit: 3 percent
Landform: Drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: F095XB005WI - Moist Loamy or Clayey Lowland
Hydric soil rating: No

HmB2—Hochheim loam, 2 to 6 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2t03w
Elevation: 820 to 1,330 feet
Mean annual precipitation: 29 to 36 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 135 to 175 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Hochheim, eroded, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hochheim, Eroded

Setting

Landform: Drumlins
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy till and/or calcareous, dense loamy till

Typical profile

Ap - 0 to 7 inches: loam
Bt - 7 to 16 inches: loam

C - 16 to 33 inches: gravelly sandy loam
Cd - 33 to 79 inches: gravelly sandy loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Ecological site: F095XB007WI - Loamy Upland with Carbonates
Forage suitability group: Mod AWC, adequately drained (G095BY005WI)
Other vegetative classification: Mod AWC, adequately drained (G095BY005WI)
Hydric soil rating: No

Minor Components

Theresa, eroded

Percent of map unit: 10 percent
Landform: Till plains
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F095XB007WI - Loamy Upland with Carbonates
Hydric soil rating: No

Lamartine

Percent of map unit: 5 percent
Landform: Drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: F095XB005WI - Moist Loamy or Clayey Lowland
Hydric soil rating: No

HmC2—Hochheim loam, 6 to 12 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2t03r
Elevation: 900 to 1,340 feet
Mean annual precipitation: 31 to 33 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 135 to 175 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hochheim, eroded, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hochheim, Eroded

Setting

Landform: Drumlins
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy till and/or calcareous, dense loamy till

Typical profile

Ap - 0 to 7 inches: loam
Bt - 7 to 16 inches: clay loam
C - 16 to 33 inches: gravelly sandy loam
Cd - 33 to 79 inches: gravelly sandy loam

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: F095XB007WI - Loamy Upland with Carbonates
Forage suitability group: Mod AWC, adequately drained (G095BY005WI)

Other vegetative classification: Mod AWC, adequately drained (G095BY005WI)
Hydric soil rating: No

Minor Components

Theresa

Percent of map unit: 5 percent
Landform: Drumlins
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F095XB007WI - Loamy Upland with Carbonates
Hydric soil rating: No

Hochheim

Percent of map unit: 5 percent
Landform: Drumlins
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F095XB006WI - Shallow Upland
Hydric soil rating: No

ThB—Theresa silt loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2szd9
Elevation: 700 to 1,240 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Theresa and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Theresa

Setting

Landform: Drumlins
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loess over loamy till and/or calcareous, dense loamy till

Typical profile

Ap - 0 to 8 inches: silt loam
BE - 8 to 14 inches: silt loam
Bt1 - 14 to 18 inches: silty clay loam
2Bt2 - 18 to 34 inches: clay loam
2Cd - 34 to 79 inches: loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 32 to 35 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: F095XB007WI - Loamy Upland with Carbonates
Forage suitability group: Mod AWC, adequately drained with limitations (G095BY006WI)
Other vegetative classification: Mod AWC, adequately drained with limitations (G095BY006WI)
Hydric soil rating: No

Minor Components

Hochheim

Percent of map unit: 10 percent
Landform: Drumlins
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F095XB006WI - Shallow Upland
Hydric soil rating: No

Lamartine

Percent of map unit: 5 percent
Landform: Drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: F095XB005WI - Moist Loamy or Clayey Lowland
Hydric soil rating: No

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NOAA Atlas 14, Volume 8, Version 2 WAUKESHA
Station ID: 47-8937
Location name: Waukesha, Wisconsin, USA*
Latitude: 43.0064°, Longitude: -88.2492°
Elevation:
Elevation (station metadata): 830 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.337** (0.273-0.417)	**0.403** (0.326-0.499)	**0.509** (0.411-0.630)	**0.595** (0.479-0.739)	**0.712** (0.556-0.896)	**0.801** (0.614-1.01)	**0.888** (0.663-1.14)	**0.975** (0.704-1.27)	**1.09** (0.762-1.43)	**1.17** (0.806-1.56)
10-min	**0.494** (0.400-0.611)	**0.590** (0.478-0.730)	**0.745** (0.602-0.923)	**0.872** (0.701-1.08)	**1.04** (0.814-1.31)	**1.17** (0.899-1.48)	**1.30** (0.971-1.67)	**1.43** (1.03-1.85)	**1.59** (1.12-2.10)	**1.72** (1.18-2.28)
15-min	**0.602** (0.488-0.745)	**0.719** (0.583-0.890)	**0.909** (0.734-1.13)	**1.06** (0.855-1.32)	**1.27** (0.992-1.60)	**1.43** (1.10-1.81)	**1.59** (1.18-2.03)	**1.74** (1.26-2.26)	**1.94** (1.36-2.56)	**2.09** (1.44-2.78)
30-min	**0.829** (0.672-1.02)	**0.994** (0.805-1.23)	**1.26** (1.02-1.56)	**1.48** (1.19-1.84)	**1.77** (1.38-2.23)	**2.00** (1.53-2.53)	**2.22** (1.65-2.84)	**2.44** (1.76-3.16)	**2.72** (1.90-3.58)	**2.93** (2.01-3.90)
60-min	**1.06** (0.862-1.32)	**1.28** (1.03-1.58)	**1.63** (1.32-2.02)	**1.93** (1.55-2.39)	**2.34** (1.84-2.96)	**2.67** (2.06-3.40)	**3.01** (2.25-3.87)	**3.35** (2.43-4.37)	**3.82** (2.68-5.04)	**4.18** (2.87-5.55)
2-hr	**1.30** (1.07-1.59)	**1.56** (1.28-1.90)	**1.99** (1.63-2.44)	**2.37** (1.93-2.91)	**2.91** (2.32-3.66)	**3.35** (2.61-4.22)	**3.80** (2.88-4.85)	**4.27** (3.13-5.52)	**4.92** (3.50-6.45)	**5.42** (3.77-7.15)
3-hr	**1.45** (1.20-1.76)	**1.73** (1.43-2.10)	**2.21** (1.82-2.69)	**2.64** (2.16-3.22)	**3.27** (2.63-4.10)	**3.79** (2.98-4.77)	**4.34** (3.32-5.52)	**4.92** (3.64-6.35)	**5.74** (4.12-7.51)	**6.40** (4.47-8.39)
6-hr	**1.75** (1.47-2.10)	**2.03** (1.70-2.44)	**2.55** (2.13-3.07)	**3.04** (2.52-3.65)	**3.77** (3.09-4.70)	**4.40** (3.52-5.50)	**5.08** (3.95-6.43)	**5.82** (4.38-7.47)	**6.89** (5.01-8.96)	**7.76** (5.48-10.1)
12-hr	**2.08** (1.77-2.46)	**2.35** (2.00-2.79)	**2.87** (2.42-3.40)	**3.36** (2.83-3.99)	**4.13** (3.44-5.11)	**4.81** (3.90-5.96)	**5.55** (4.38-6.97)	**6.37** (4.85-8.11)	**7.56** (5.57-9.76)	**8.54** (6.11-11.0)
24-hr	**2.38** (2.05-2.78)	**2.69** (2.31-3.15)	**3.26** (2.80-3.82)	**3.80** (3.24-4.47)	**4.65** (3.91-5.66)	**5.37** (4.41-6.57)	**6.16** (4.92-7.64)	**7.04** (5.42-8.86)	**8.30** (6.18-10.6)	**9.33** (6.75-11.9)
2-day	**2.66** (2.32-3.06)	**3.07** (2.68-3.55)	**3.80** (3.31-4.40)	**4.47** (3.86-5.18)	**5.46** (4.63-6.54)	**6.28** (5.21-7.56)	**7.16** (5.76-8.75)	**8.11** (6.30-10.1)	**9.44** (7.09-11.9)	**10.5** (7.69-13.3)
3-day	**2.92** (2.56-3.34)	**3.35** (2.94-3.84)	**4.12** (3.61-4.73)	**4.81** (4.20-5.54)	**5.84** (4.99-6.95)	**6.70** (5.60-8.01)	**7.61** (6.17-9.24)	**8.59** (6.72-10.6)	**9.97** (7.54-12.5)	**11.1** (8.16-14.0)
4-day	**3.15** (2.78-3.59)	**3.59** (3.18-4.10)	**4.38** (3.86-5.00)	**5.08** (4.46-5.82)	**6.14** (5.27-7.25)	**7.01** (5.89-8.33)	**7.94** (6.47-9.59)	**8.94** (7.03-11.0)	**10.3** (7.87-12.9)	**11.5** (8.50-14.4)
7-day	**3.72** (3.32-4.19)	**4.22** (3.77-4.76)	**5.08** (4.52-5.74)	**5.84** (5.18-6.62)	**6.97** (6.04-8.13)	**7.89** (6.69-9.27)	**8.86** (7.29-10.6)	**9.90** (7.86-12.0)	**11.3** (8.70-14.0)	**12.5** (9.34-15.6)
10-day	**4.23** (3.81-4.74)	**4.78** (4.30-5.36)	**5.72** (5.13-6.42)	**6.54** (5.84-7.36)	**7.72** (6.73-8.93)	**8.68** (7.40-10.1)	**9.68** (8.01-11.5)	**10.7** (8.56-12.9)	**12.2** (9.39-15.0)	**13.3** (10.0-16.5)
20-day	**5.79** (5.29-6.40)	**6.48** (5.91-7.16)	**7.62** (6.93-8.44)	**8.56** (7.75-9.52)	**9.88** (8.69-11.2)	**10.9** (9.39-12.5)	**11.9** (9.98-13.9)	**13.0** (10.5-15.4)	**14.4** (11.2-17.4)	**15.4** (11.8-19.0)
30-day	**7.17** (6.60-7.86)	**7.98** (7.35-8.76)	**9.30** (8.53-10.2)	**10.4** (9.46-11.4)	**11.8** (10.4-13.2)	**12.9** (11.2-14.6)	**13.9** (11.7-16.1)	**15.0** (12.1-17.6)	**16.3** (12.8-19.6)	**17.3** (13.2-21.1)
45-day	**8.98** (8.34-9.77)	**9.98** (9.26-10.9)	**11.5** (10.7-12.6)	**12.8** (11.8-14.0)	**14.4** (12.8-15.9)	**15.5** (13.5-17.4)	**16.6** (14.1-19.0)	**17.6** (14.4-20.6)	**18.9** (14.9-22.5)	**19.7** (15.2-24.0)
60-day	**10.6** (9.87-11.4)	**11.7** (11.0-12.7)	**13.6** (12.6-14.7)	**14.9** (13.8-16.3)	**16.7** (14.9-18.4)	**17.9** (15.7-20.0)	**19.0** (16.2-21.6)	**20.0** (16.4-23.2)	**21.2** (16.8-25.1)	**22.0** (17.0-26.6)

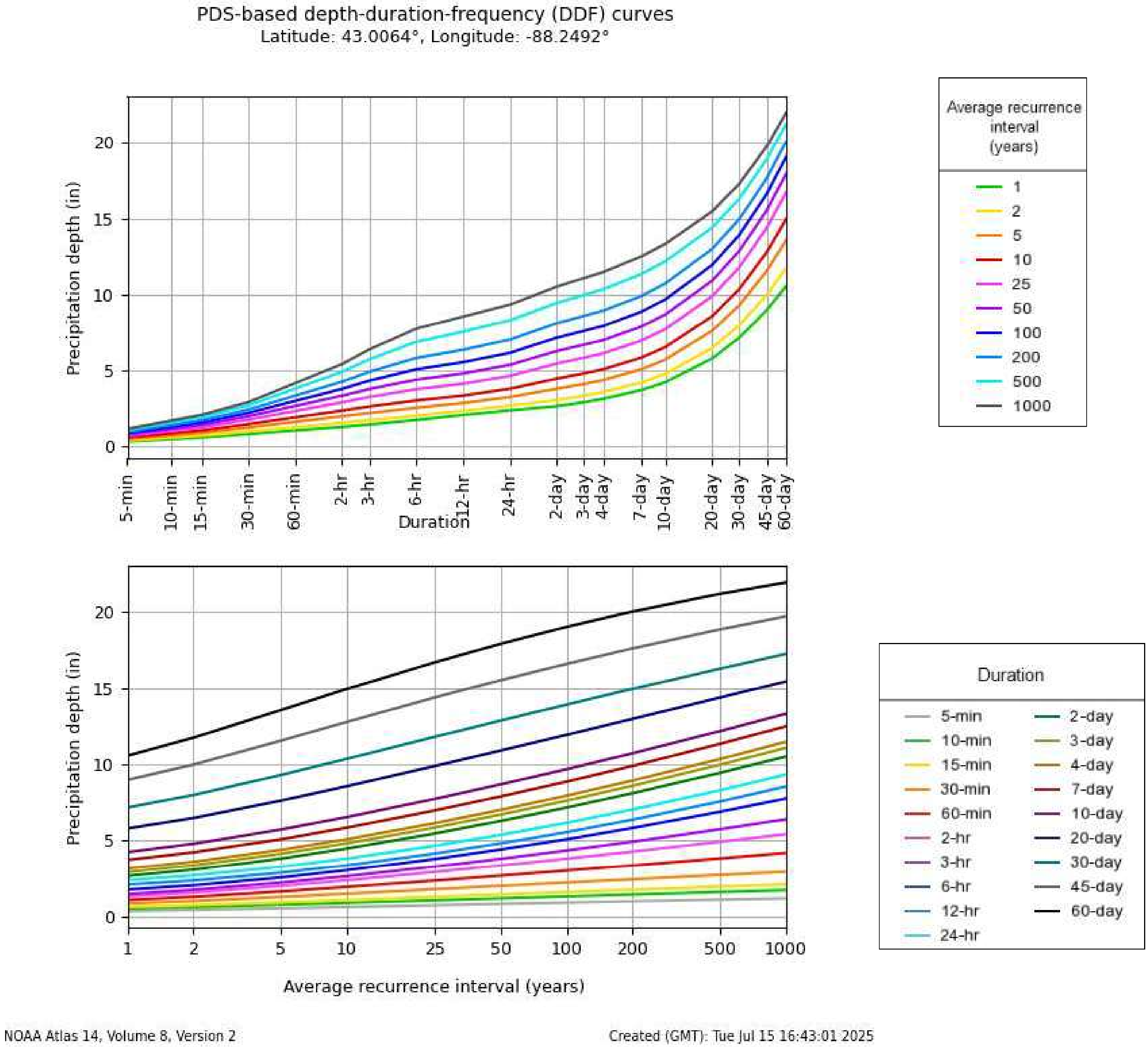
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

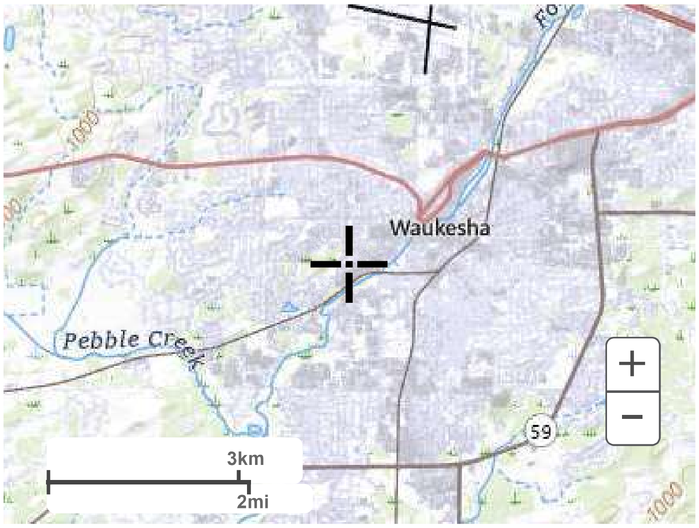
PF graphical



Back to Top

Maps & aerials

Small scale terrain



Large scale terrain

Large scale map

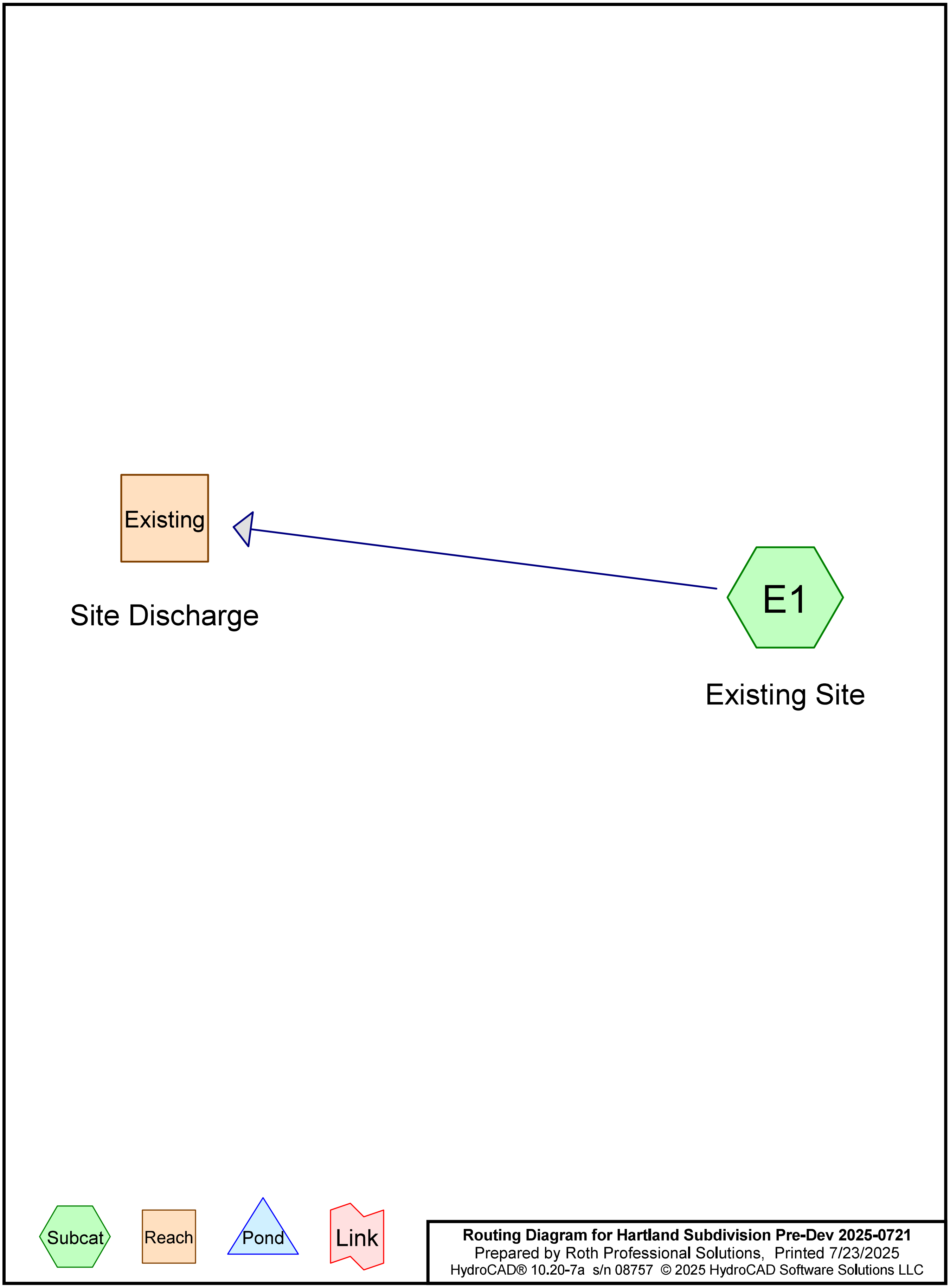
Large scale aerial

Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX C – HYDROLOGY CALCULATIONS AND REPORT



Routing Diagram for Hartland Subdivision Pre-Dev 2025-0721
Prepared by Roth Professional Solutions, Printed 7/23/2025
HydroCAD® 10.20-7a s/n 08757 © 2025 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	MSE 24-hr	4	Default	24.00	1	2.50	2
2	2-Year	MSE 24-hr	4	Default	24.00	1	2.90	2
3	10-Year	MSE 24-hr	4	Default	24.00	1	4.20	2
4	100-Year	MSE 24-hr	4	Default	24.00	1	6.00	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
5.083	55	Woods, Good, HSG B (E1)
5.083	**55**	**TOTAL AREA**

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Existing Site Runoff Area=5.083 ac 0.00% Impervious Runoff Depth=0.08"
Flow Length=400' Slope=0.0300 '/' Tc=7.7 min CN=55 Runoff=0.09 cfs 0.035 af

Reach Existing: Site Discharge Inflow=0.09 cfs 0.035 af
Outflow=0.09 cfs 0.035 af

Total Runoff Area = 5.083 ac Runoff Volume = 0.035 af Average Runoff Depth = 0.08"
100.00% Pervious = 5.083 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment E1: Existing Site

Runoff = 0.09 cfs @ 13.06 hrs, Volume= 0.035 af, Depth= 0.08"
Routed to Reach Existing : Site Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 1-Year Rainfall=2.50"

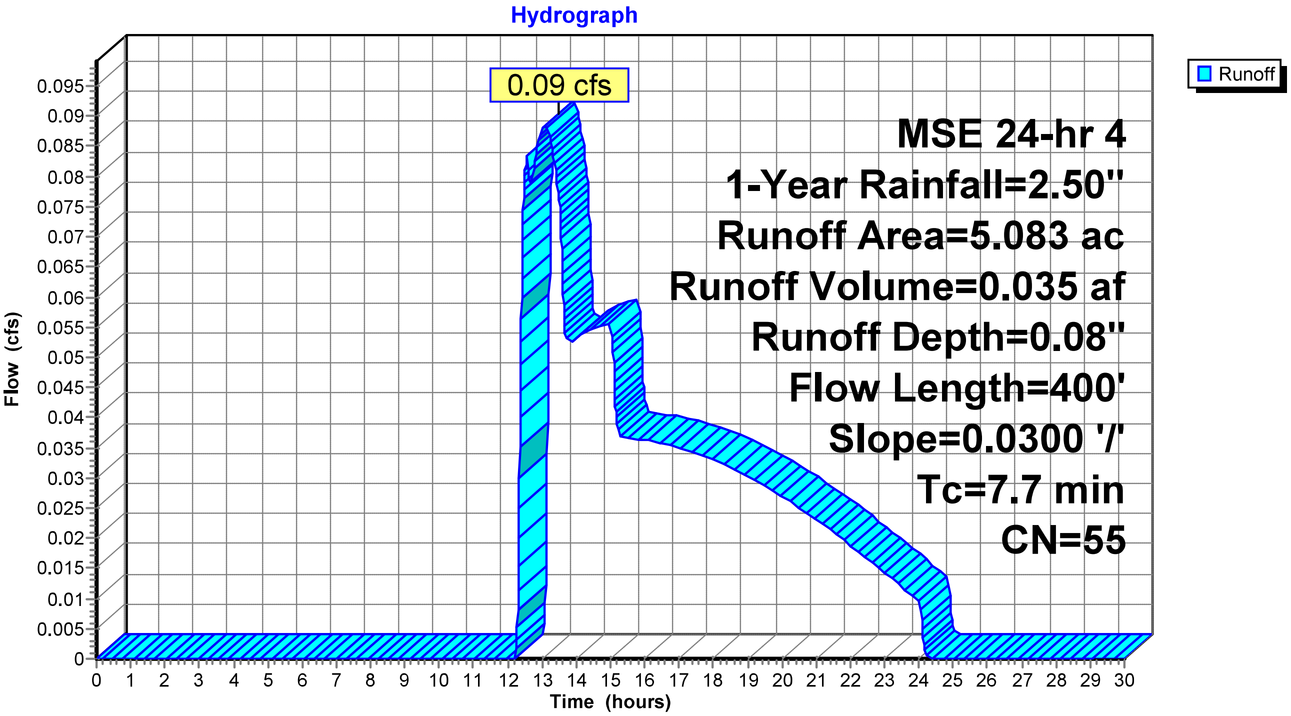
Area (ac)	CN	Description	Land Use
5.083	55	Woods, Good, HSG B	Woods
5.083		100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	400	0.0300	0.87		**Shallow Concentrated Flow, Natural Drainage** Woodland Kv= 5.0 fps

Pollutant Loading for 35.00" Rainfall, Pj=1.000
Project 0.00% Impervious, Rv= 0.050, Runoff= 1.75"

Area (acres)	Land Use	tss (pounds)	p (pounds)
5.083	Woods	40.32	0.50
5.083	Total	40.32	0.50

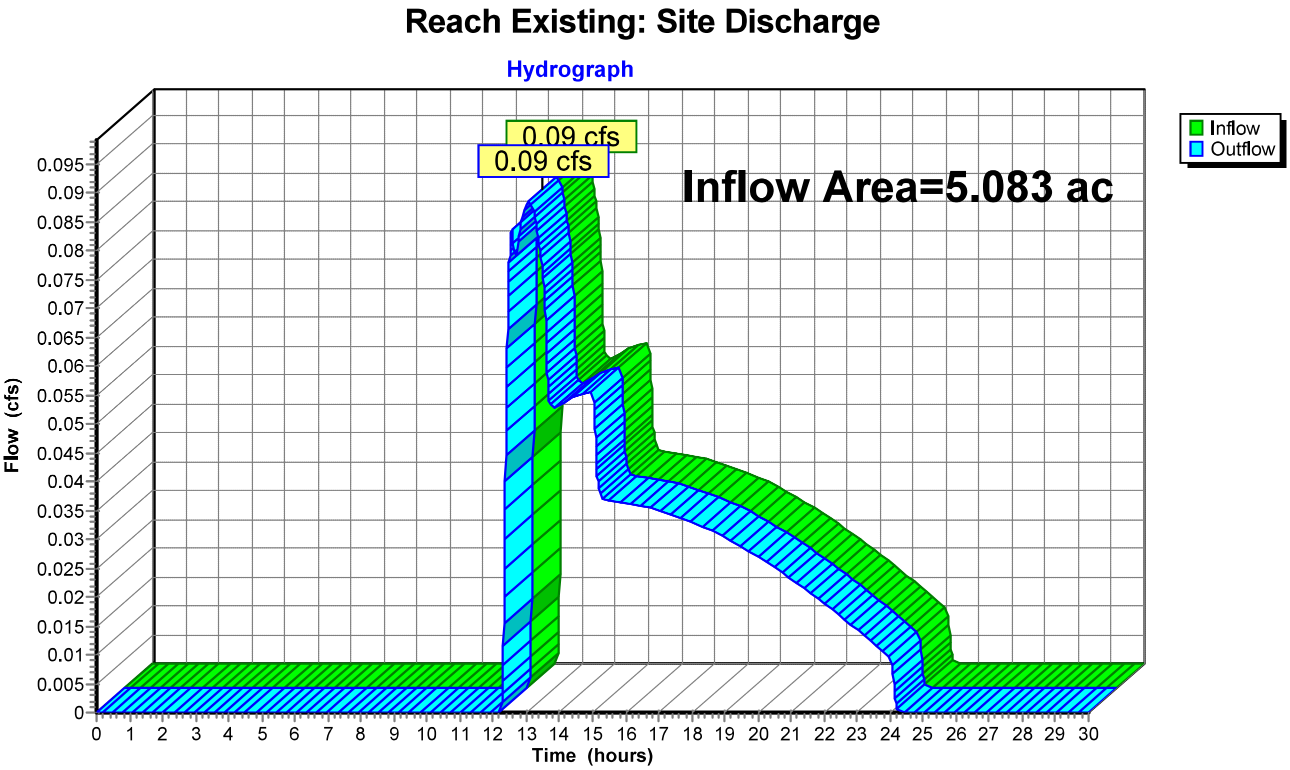
Subcatchment E1: Existing Site



Summary for Reach Existing: Site Discharge

Inflow Area =	5.083 ac,	0.00% Impervious,	Inflow Depth = 0.08"	for 1-Year event	
Inflow =	0.09 cfs @	13.06 hrs,	Volume=	0.035 af	
Outflow =	0.09 cfs @	13.06 hrs,	Volume=	0.035 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Existing Site Runoff Area=5.083 ac 0.00% Impervious Runoff Depth=0.17"
Flow Length=400' Slope=0.0300 '/' Tc=7.7 min CN=55 Runoff=0.33 cfs 0.072 af

Reach Existing: Site Discharge Inflow=0.33 cfs 0.072 af
Outflow=0.33 cfs 0.072 af

Total Runoff Area = 5.083 ac Runoff Volume = 0.072 af Average Runoff Depth = 0.17"
100.00% Pervious = 5.083 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment E1: Existing Site

Runoff = 0.33 cfs @ 12.36 hrs, Volume= 0.072 af, Depth= 0.17"
Routed to Reach Existing : Site Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
MSE 24-hr 4 2-Year Rainfall=2.90"

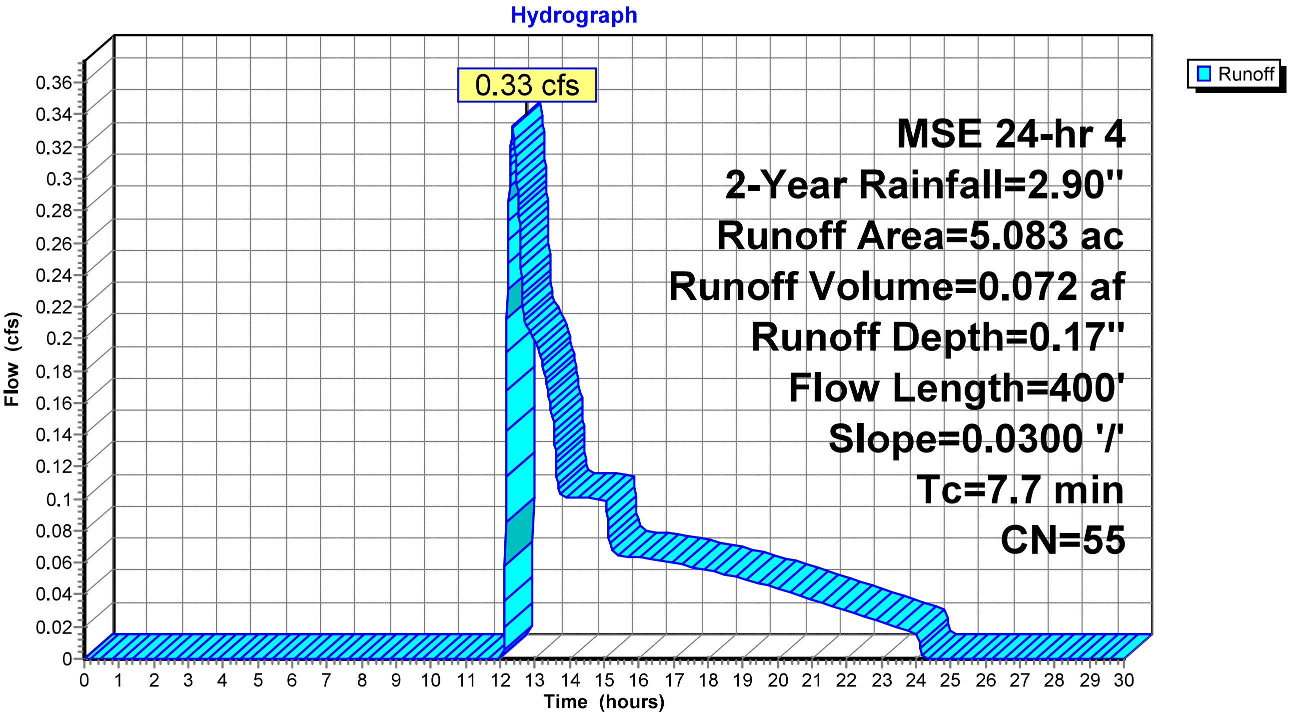
Area (ac)	CN	Description	Land Use
5.083	55	Woods, Good, HSG B	Woods
5.083		100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	400	0.0300	0.87		**Shallow Concentrated Flow, Natural Drainage** Woodland Kv= 5.0 fps

Pollutant Loading for 35.00" Rainfall, Pj=1.000
Project 0.00% Impervious, Rv= 0.050, Runoff= 1.75"

Area (acres)	Land Use	tss (pounds)	p (pounds)
5.083	Woods	40.32	0.50
5.083	Total	40.32	0.50

Subcatchment E1: Existing Site

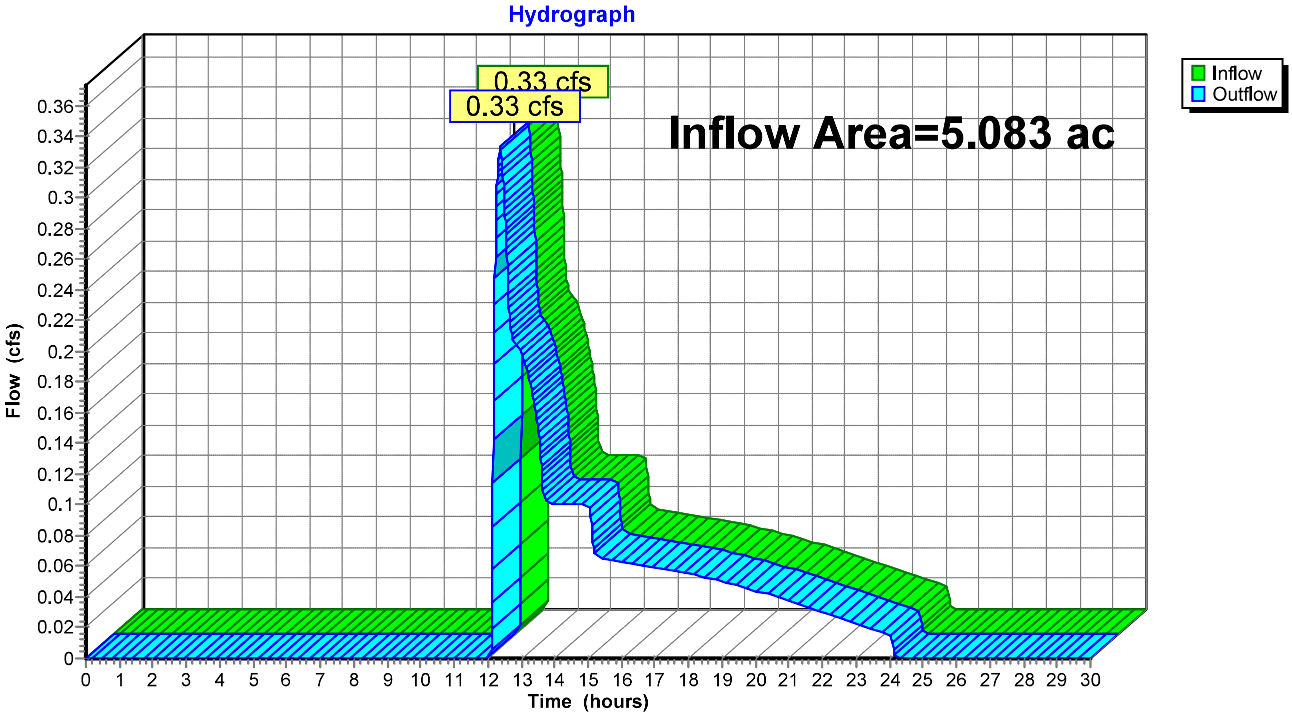


Summary for Reach Existing: Site Discharge

Inflow Area =	5.083 ac,	0.00% Impervious,	Inflow Depth = 0.17"	for 2-Year event	
Inflow =	0.33 cfs @	12.36 hrs,	Volume=	0.072 af	
Outflow =	0.33 cfs @	12.36 hrs,	Volume=	0.072 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Reach Existing: Site Discharge



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Existing Site Runoff Area=5.083 ac 0.00% Impervious Runoff Depth=0.61"
Flow Length=400' Slope=0.0300 '/' Tc=7.7 min CN=55 Runoff=3.48 cfs 0.259 af

Reach Existing: Site Discharge Inflow=3.48 cfs 0.259 af
Outflow=3.48 cfs 0.259 af

Total Runoff Area = 5.083 ac Runoff Volume = 0.259 af Average Runoff Depth = 0.61"
100.00% Pervious = 5.083 ac 0.00% Impervious = 0.000 ac