NEDERVELD

Tractor Supply Company - VanBuren

DRAINAGE SUMMARY AND CALCULATIONS FOR

STORM WATER MANAGEMENT

February 19, 2025

CONTENTS:

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Drainage Summary: Tractor Supply Company

I. Introduction.

- Location: The project is located at the southeast corner of Hull Road and Sumpter Road. The property is currently vacant/farm field.
- Terrain: In general, the site is quite flat, with a very gradual slope from the north down to the south.
- Area: The overall area of the site is approximately 4.15 acres. The drainage area for the proposed detention basin is approximately 4.29 acres.
- Current Drainage: Currently, the storm water from the site flows to the south and/or infiltrates in to the site soil. Note that per soil borings completed at the site, the site soil is primarily granular, with a reasonably high infiltration rate. However, the ground water is relatively high in this area.
- Detention/Retention Provisions: A storm water holding area is proposed along the east property line. The outlet location to the proposed holding area is to the Bradshaw County Drain, which is located to the east of the site. A drainage swale in a private easement is proposed to convey the storm water from the Tractor Supply detention basin to the Bradshaw County Drain.
- Storm Sewer Provisions: Storm sewer and catchbasins are proposed internal to the project that will collect storm water runoff from the developed portions of the site and direct the storm water runoff to the proposed detention basin.

II. Offsite Runoff

- Based on the surrounding development and topography, the site does not appear to receive a meaningful amount of off-site runoff.

III. Detention Design.

- A storm water holding area is proposed along the east end of the property. The basin is sized per township and county standards.

IV. Storm Sewer Design.

- *Design Standard:* The storm sewer system for the project is designed to collect the 10-year storm runoff from the site. Design flows are calculated with the rational method. Manning's equation is used to determine a hydraulic grade elevation in the system. The Manning's roughness value of 0.013 is used for concrete pipe. Note that concrete pipe is required per the township standards.
- *Runoff Coefficient:* Runoff Coefficients for each individual drainage areas are calculated.
- *Time of Concentration:* An initial Time of Concentration of 6.3 minutes is used for the upstream catchment areas and subsequent downstream time of concentrations are calculated using a flow speed of 2.5 ft/sec in the pipe network per Wayne County standards

Land Use Summary

Area, A (ac)	4.29
Proposed Impervious Area (ac)	2.51
Proposed Pervious Area (ac)	1.78
Runoff Coefficient, C	0.84
100-yr peak intensity, in/hr	7.4

Pervious Area Land Use Data

Characteristic	Existing Conditions	Proposed Conditions
Total Development Area (ac)	4.29	4.29
Impervious Area (ac)	-	2.51
Total Pervious Area (ac)	4.29	1.78
Pervious Area Breakdown by Cover Type		
Meadow/fallow/natural areas (non-cultivated)	0	0 acres
Predominant NRCS Soil Type (A, B, C, or D)	Type C	N/A
Improved areas (turf grass, landscape, row crops)	4.29 acres	4.29 acres
Predominant NRCS Soil Type (A, B, C, or D)	N/A	Type A / D
Wooded Areas	0 acres	0 acres
Predominant NRCS Soil Type (A, B, C, or D)	N/A	N/A
Calculated CPVC Volume (cubic feet)		13,017
CPVC Volume Provided (cubic feet)		14,356
CPRC Volume Provided (cubic feet)		24,732

The Professional Engineer who signs and seals this site plan certifies that the values in this table reflect the Wayne County stormwater calculations required for this development and that geotechnical investigations were performed that provide conclusive documentation that demonstrates whether infiltration (i.e., CPVC Volume Control) is practicable.

Nederveld Inc.

Project:	Tractor Supply
Project #:	23500325
Date:	6/14/2024
Revised:	2/18/2025

Information For Determining Storm Water Holding Requirements

C-DEVELOPED

A. Impervious Area (C=0.95)	Length (ft)	Width (ft)	Area (s.f.)	Quantity	Total Area (s.f.)	Area (Ac)
Building	1	1	22,407	1	22,407	0.51
Concrete/Asphalt	1	1	86,830	1	86,830	1.99
Total					109,237	2.51

B. BMP Area	**C=**	**1.00**			
Detention Pond			37054	sf	0.85
Bioretention Cell			4644	sf	0.11
Total BMP Area					0.96

C. 'Green' Area	**C=**	**0.30**			
Drainage Area			186690	sf	4.29
Total impervious area					2.51
Total BMP area					0.96
Total 'Green' area					0.82

D. Calculate C-dev = (.95(area.95)+0.3(area0.3)+1.0(area1.0))/total area **C-dev = 0.84**

Nederveld Inc.

Project:	Tractor Supply
Project #:	23500325
Date:	6/14/2024
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Township Requirement

Information For Determining Storm Water Holding Requirements

10 YEAR STORM EVENT:
For sites with under 5 acres of drainage area, the storage shall be designed for a 10 year storm.

A = Area = 4.29 acres
C = 0.84

Qa = allowable release rate from flood control = 0.10A =	0.429	cfs	
Qo = maximum outflow per acre impervious = Qa/AC =	0.120	cfs	
T10 = storage time from beginnnig to peak storage = -19.9 + (4,530/Qo)^.5 =	175	minutes	
Vs,10 = Max volume of water stored per acre impervious = (9108T10/(T10+19.9)-40QoT10) =	7,341	cf	
Vt,10 = Max volume of water stored = Vs,10(AC) =	**26,325**	**cfs**	

IF NO OUTLET:
Required to retain back to back 100 year storm events.

100 Year Design:
A = Area = 4.29 acres
C = 0.84

Qa = allowable release rate from flood control = 0.10A =	0.429	cfs	
Qo = maximum outflow per acre impervious = Qa/AC =	0.120	cfs	
T100 = storage time from beginnnig to peak storage = -45 + (19845/Qo)^.5 =	362	minutes	
Vs,100 = Max volume of water stored per acre impervious = (17649T100/(T100+45)-40QoT100) =	13,967	cf	
Vt,100 = Max volume of water stored = Vs,100(AC) =	50,084	cf	

Retention Volume Required is back to back 100 year storm events = **100,167 cf**

Per Wayne County standards, back to back 100 year storm events = 2 x 18900 x A x C = **135,545 cfs**

WAYNE COUNTY - STORM WATER MANAGEMENT CALCULATIONS

Design Basis: Wayne County Stormwater Control Standards, September 2021

I. Total Volume of Detention Area

1) Developed area contributing runoff (A) = 4.29 acres

Surface	Area (sf)	C factor	A x C
Building	22,407	0.95	21,287
Pavement	86,830	0.95	82,489
Water Surface	41,698	1.00	41,698
Semi-Impervious	35,755	0.30	10,727
	186,690		156,200

Weighted Runoff Coefficient (C) = (∑A x C) / ∑A = 0.84

2) Time of Concentration (T)
Surface to Storm Sewer = V = K*S^.5 where K = 0.48 for sheet flow and V is in ft/sec.
The pavement slope is 1.2% in general on the upper reaches. Therefore the velocity is = 0.48*1.2^.5 = 0.53
The pavement length is arppoximately 200 ft, so the time to enter storm sewer system is 200 / .53 = 377 seconds
The time for the storm water to flow from the upper storm sewer reaches to the holding is calculated in the storm sewer sizing spreadsheet to be approximately 10.3 minutes.

Total Time of Concentration (T) = **10.3** **min**

3) 100-year Peak Intensity, $I_{100} = 101 / (12.33 + T)^{0.84}$ = 7.35 in/hr

4) Channel Protection Volume Control (CPVC) Required Volume = 13,017 ft^3
$V_{CPVC} = A \times C \times 3,630$

5) Channel Protection Rate Control (CPRC) Required Volume = 24,732 ft^3
$V_{CPRC} = A \times C \times 6,897$

6) 100-year Allowable Release Rate (Q_{allow}) = 0.12 ft^3 /sec/acre
Q_{allow} = The rate was adjusted to be 0.12 cfs by Spicer Group (Drain Consultant for Wayne County)

7) 100-year Peak Allowable Discharge (Q_0) = 0.51 ft^3 /sec
$Q_0 = Q_{allow} \times (A)$

8) 100-year Peak Pond Inflow (Q_i) = 26.4 ft^3 /sec
$Q_i = C \times I_{100} \times A$

9) 100-year Runoff Volume (V_r) = 67,773 ft^3
$V_r = 18,900 \times A \times C$

10) Storage Ratio (V_r / V_s) = 0.797
$(V_r / V_s) = 0.206 - 0.15 \times \ln (Q_0 / Q_i)$

11) 100-year Required Storage Volume (V_s) = 53,983 ft^3
$V_s = V_r \times$ Storage Ratio

12) First Flush Required Storage Volume (V_{ff}) = 1,954 ft^3
$V_{ff} = 545 \times A \times C$ Automatically met with Perm Pool or with CPVC volume

The Site Plan must be designed to accomidate the following volumes:

Channel Protection Volume Control:	13,017	ft^3
Channel Protection Rate Control Volume:	24,732	ft^3
Flood Control Volume:	53,983	ft^3

Bioretention Cell ID	Bottom Contour Area	Top Contour Area	Surface Storage Volume*	Subsurface Storage Volume**	Active Infiltration Volume***
1	3706 s.f.	5369 s.f.	4538 c.f.	1479 c.f.	8339 c.f.
Total Volume Provided		**14356 c.f.**	**4538 c.f.**	**1479 c.f.**	**8339 c.f.**

CPVC Volume Req c.f.
Infiltration Rate 4.5 in/hr (Infiltration rate is 9.0 in/hr, a factor of safety of 2 was applied)
* Surface Storage = ((Bottom Contour Area + Top Contour Area)/2) * Ponding Depth
** Subsurface Storage = Bottom Contour Area * Porosity (0.3) * Subsurface Depth
*** Subsurface Storage = Bottom Contour Area * (Infiltration Rate / 12) * 6
Infiltration Rate per Soils and Structures Geotech Report, Project No. 2023.2100 dated February 8, 2024

Bioretention Cell 1	
Top of Storage	675.50
Surface Storage	1.00
Mulch	0.33
Soil	1.00
Choke	0.00
Stone	0.00
Outlet Invert	673.17

Subsurface Depth 1.33

Channel Protection Volume Control Provided:	14,356	ft^3
Adjusted Flood Control Volume with CPVC Credit:	39,627	ft^3

WAYNE COUNTY - STORM WATER MANAGEMENT CALCULATIONS

Design Basis: Wayne County Stormwater Control Standards, September 2021

II. Basin volume provided

Detention Basin Storage (only above water level. Anticipated to be elevation 671.0)

	Elev.	Area	Avg. Area	Height	Volume	
Sediment Storage	667.00	637			0	
			1,348	1.00		
	668.00	2,059			1,348	
			3,241	1.00		
	669.00	4,422			4,589	
			6,046	1.00		
	670.00	7,669			10,634	
			9,737	1.00		
	671.00	11,805			20,371	Permanent Pool Elevation
Retention Storage			14,370	1.00		
	672.00	16,935			14,370	
			19,073	0.50		
	672.50	21,210			23,906	
			22,325	0.50		
	673.00	23,440			35,069	
			24,423	0.45		
	673.45	25,405			46,059	Outlet Elevation
Detention Storage			26,773	0.55		
	674.00	28,140			14,725	
			29,360	0.50		
	674.50	30,580			29,405	
			31,865	0.50		
	675.00	33,150			45,337	
			35,100	0.90		
	675.90	37,050			76,927	Freeboard Elevation

Storage Elevations **Z_0 = 671.00**

V_{CPRC} = 24,732 cf **Z_{CPRC} = 674.30**

V_{FC} = 42,502 cf **Z_{FC} = 674.90**

III. Detention Pond Outlet Design

Flood Control Release:

Maximum Allowable Flow Rate = 0.12 cfs

***Release rate provided by Spicer Group on 11/26/24**

Flow Rate through Flood Control Orifice:

h from Orifice to 100 yr elev = h_{CPRC} = 1.50 ft

d_0 = 1-7/8 inch d_0 = 0.01917 ft^2

1 - 1-7/8 inch holes at elevation 673.40

Actual Release Rate Through Channel Protection Orifice:

$Q_{FC} = 0.62 \times \#\text{ of Holes} \times \text{Area} \times (2 \times g \times h)^{1/2}$ Q_{FC} = 0.12 cfs

Only one orifice is provided as the Drain Office has restricted the allowable outflow from this site to 0.12 cfs

IV. Emergency Overflow Design:

I_{100} = 7.35

Developed Runoff Coefficient (C) = 0.84

Area (A) = 4.29 acres

$Q_{100} = (C) \times I_{100} \times (A)$ = 26.36 CFS

$Q = 0.75CmH^{2.5} + CLH^{1.5}$ Trapezoidal Broadcrested Weir

C (weir coef.) = 2.6 Min Spillway Dim

H (height over wier) = 0.5 Ft Weir Base= 26.4 Ft

m (weir side slope) = 6 1V:mH Top width= 32.4 Ft

Spillway Design Dim

Weir Base= 26.5 Ft

Spillway Design Flow = 26.43 CFS Top width= 32.5 Ft

$Q = C * I * A$

C = 0.84 cfs

I = 7.35 in/hr

A = 4.29 acres

Q = 26.36 CFS

Primary Overflow: $Q = CLH^{1.5}$ **Rectangular Weir**

C (weir coef.) = 3.30

H (height over weir) = 0.74 Ft.

Weir wall in 4 ft diameter structure = 4.00 ft

Half Diameter of Outlet Structure (Bar Grate) = 6.28 ft

Total Length that Water Can Overflow Past Restriction = 10.28 ft (base length)

Spillway Design Dimension

Spillway Design Flow = 21.60 cfs Base= 10.28 Ft.

Elevation of Top of Weir Wall = 674.60

Height of water over weir wall = 0.74

Maximum Design High Water Elevation = 675.34

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Project:	Tractor Supply - VanBuren
Project #:	23500325
Date:	3/26/2024

FOR TOWNSHP ONLY , NOT RELEVANT TO COUNTY Revised: 1/22/2025

Sediment Forebay Sizing

Sediment Forebay; Not Required With Permanent Pool for County.

Vtff = 1806AC

North Outlet/Drainage Area =

Drainage Area =	75165	sf
Impervious Area =	52300	sf (C = 0.95)
Pervious Area =	22865	sf (C = 0.30)
C =	0.75	

North Drainage Area Forebay Sizing (For Township Only) = 1,806AC = **2,344 cf**

South Outlet/Drainage Area =

Drainage Area =	92300	sf
Impervious Area =	62125	sf (C = 0.95)
Pervious Area =	30175	sf (C = 0.30)
C =	0.74	

South Drainage Area Forebay Sizing (For Township Only) = 1,806AC = **2,822 cf**

NORTH SEDIMENT FOREBAY

Required Forebay Volume = 2,344 cf

Basin Contour Areas and Volumes (only above water level)

	Elev.	Area (s.f.)	Vol. (c.f.)	Vol. (ac-ft)	Cum. Vol.
Min. Elev.	671.00	2,290	0	0.00	0
	671.50	2,885	1,291	0.03	1,291
	672.00	3,610	1,620	0.04	2,911
	672.50	4,355	1,988	0.05	4,900

Storm Elevation Interpolation

	Elev.	Vol. (cf)	Area
	671.50	1,291	2,885
Forebay Volume Req'd>	**671.83**	**2,344**	**3,356**
	672.00	2,911	3,610

SOUTH SEDIMENT FOREBAY

Required Forebay Volume = 2,822 cf

Basin Contour Areas and Volumes (only above water level)

	Elev.	Area (s.f.)	Vol. (c.f.)	Vol. (ac-ft)	Cum. Vol.
Min. Elev.	671.00	3,210	0	0.00	0
	671.50	3,925	1,781	0.04	1,781
	672.00	4,865	2,193	0.05	3,974
	672.50	5,780	2,658	0.06	6,632

Storm Elevation Interpolation

	Elev.	Vol. (cf)	Area
	671.50	1,781	3,925
Forebay Volume Req'd>	**671.74**	**2,822**	**4,371**
	672.00	3,974	4,865

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Project:	Tractor Supply
Project #:	22400875
Date:	6/14/2024
Revised:	2/18/2025

Information For Determining Individual Runoff Coefficients (For Storm Pipe Sizing)

Drainage Area 1

Total Area =	6570	sf
Green Area =	1210	sf (C = 0.30)
Approximate Hard Surface =	5360	sf (C = 0.95)
Calculated C =	0.83	

Drainage Area 2

Total Area =	5730	sf
Green Area =	1685	sf (C = 0.30)
Hard Surface =	4045	sf (C = 0.95)
Calculated C =	0.76	

Drainage Area 3

Total Area =	6980	sf
Green Area =	835	sf (C = 0.30)
Hard Surface =	6145	sf (C = 0.95)
Calculated C =	0.87	

Drainage Area 4

Total Area =	5150	sf
Green Area =	1160	sf (C = 0.30)
Hard Surface =	3990	sf (C = 0.95)
Calculated C =	0.80	

Drainage Area 5

Total Area =	7610	sf
Green Area =	0	sf (C = 0.30)
Hard Surface =	7610	sf (C = 0.95)
Calculated C =	0.95	

Drainage Area 6

Total Area =	13795	sf
Green Area =	1745	sf (C = 0.30)
Hard Surface =	12050	sf (C = 0.95)
Calculated C =	0.87	

Drainage Area 7

Total Area =	4828	sf
Green Area =	0	sf (C = 0.30)
Hard Surface =	4828	sf (C = 0.95)
Calculated C =	0.95	

Drainage Area 8

Total Area =	4828	sf
Green Area =	0	sf (C = 0.30)
Hard Surface =	4828	sf (C = 0.95)
Calculated C =	0.95	

Drainage Area 9

Total Area =	5203	sf
Green Area =	0	sf (C = 0.30)
Hard Surface =	5203	sf (C = 0.95)
Calculated C =	0.95	

Drainage Area 10

Total Area =	5203	sf
Green Area =	0	sf (C = 0.30)
Hard Surface =	5203	sf (C = 0.95)
Calculated C =	0.95	

Drainage Area 11

Total Area =	10760	sf
Green Area =	965	sf (C = 0.30)
Hard Surface =	9795	sf (C = 0.95)
Calculated C =	0.89	

Drainage Area 12 (Bioretention Cell)

Total Area =	28228	sf
Green Area =	7263	sf (C = 0.30)
Hard Surface =	20965	sf (C = 0.95)
Calculated C =	0.78	

Drainage Area 13

Total Area =	3444	sf
Green Area =	864	sf (C = 0.30)
Hard Surface =	2580	sf (C = 0.95)
Calculated C =	0.79	

Drainage Area 14

Total Area =	18607	sf
Green Area =	10477	sf (C = 0.30)
Hard Surface =	8130	sf (C = 0.95)
Calculated C =	0.58	

Drainage Area 15

Total Area =	15587	sf
Green Area =	7926	sf (C = 0.30)
Hard Surface =	7661	sf (C = 0.95)
Calculated C =	0.62	

Nederveld Inc.

PER WAYNE COUNTY STANDARDS/CALCULATION

Storm Sewer Design - 10 year storm

Project:	Tractor Supply
Project #:	23500325
Date:	12/19/2024
Revised:	2/18/2025

MODEL OF DEVELOPED AREAS

From	To	C*	Factored C, overall area	Time (min)**	Time + Time Increment	Time Inc. (min)	Area Increment	Total Area (acres)	C * A	I (in/hr)	Q (cfs)	L (ft)	Pipe Size (in)	Type of Pipe	Full Flow Capacity (cfs)	Full Flow HGL (%)	Actual Pipe Grade (%)	Full Flow Velocity (ft/s)	Actual Flow Velocity (ft/s)	HGL Elev at Upstream CB	CB Rim Elev	Rim Elev. Over HGL (ft)	Invert Elev.	Cover (ft)
1	2	0.83	0.83	6.3	6.7	0.44	0.151	0.151	0.125	5.40	0.68	66	12	C	2.25	0.04	0.40	0.86	2.50	674.83	676.46	1.63	672.96	2.50
2	3	0.76	0.80	6.7	7.7	0.92	0.132	0.282	0.225	5.29	1.19	144	12	C	1.98	0.11	0.31	1.52	2.61	674.80	676.50	1.70	672.70	2.80
3	4	0.87	0.82	7.7	8.2	0.57	0.160	0.443	0.365	5.09	1.86	101	12	C	2.02	0.27	0.32	2.36	2.93	673.46	676.44	2.98	672.24	3.20
4	5	0.80	0.82	8.2	8.5	0.23	0.118	0.561	0.460	4.97	2.29	60	12	C	3.19	0.41	0.80	2.91	4.34	673.19	675.62	2.43	671.92	2.70
Building	5	0.95	0.95	6.3	6.6	0.32	0.514	0.514	0.489	5.40	2.64	64	12	C	2.25	0.55	0.40	3.36	3.36	673.29	678.00	4.71	671.66	5.34
5	Basin	0.95	0.89	8.5	8.7	0.23	0.175	1.250	1.114	4.92	5.49	61	18	C	8.91	0.27	0.72	3.10	4.43	672.94	675.95	3.01	671.44	3.01
																Crown	of Pipe at	Outlet =		672.50				
6	7	0.87	0.87	6.3	6.9	0.59	0.317	0.317	0.275	5.40	1.48	90	12	C	1.98	0.17	0.31	1.89	2.53	673.32	675.87	2.55	672.37	2.50
7	8	0.95	0.89	6.9	7.1	0.22	0.111	0.428	0.380	5.26	2.00	43	12	C	2.05	0.31	0.33	2.55	3.20	673.52	676.65	3.13	672.09	3.56
8	9	0.95	0.90	7.1	7.4	0.26	0.111	0.538	0.485	5.21	2.53	43	12	C	2.52	0.50	0.50	3.22	2.74	673.38	676.65	3.27	671.95	3.70
9	10	0.95	0.91	7.4	7.6	0.22	0.119	0.658	0.599	5.15	3.08	43	18	C	4.33	0.09	0.17	1.75	3.20	673.17	676.65	3.48	671.73	3.42
10	11	0.95	0.92	7.6	8.2	0.61	0.119	0.777	0.712	5.10	3.63	100	18	C	4.33	0.12	0.17	2.06	2.74	673.13	676.65	3.52	671.66	3.49
11	Basin	0.89	0.91	8.2	8.4	0.15	0.247	1.024	0.933	4.97	4.64	55	18	C	9.91	0.20	0.89	2.63	6.26	673.01	675.60	2.59	671.49	2.61
																Crown	of Pipe at	Outlet =		672.52				
12	Basin	0.78	0.78	6.3	6.5	0.17	0.648	0.648	0.507	5.40	2.74	64	12	C	1.98	0.59	0.31	3.49	6.26	672.25	675.00	2.75	672.20	1.80
Basin	OCS	0.00	0.70	6.3	6.3	0.03	0.167	2.922	2.554	5.40	0.12	10	12	C	2.25	0.00	0.40	0.15	6.26	672.05	675.60	3.55	671.00	3.60
OCS	Swale	0.00	0.00	6.3	6.4	0.07	0.481	2.922	2.554	5.40	0.12	27	18	C	5.15	0.00	0.24	0.22	6.26	674.96	675.60	0.64	673.40	0.70
																Crown	of Pipe at	Outlet =		674.90				
FES 14	13	0.79	0.79	6.3	6.6	0.33	0.427	0.427	0.336	5.40	1.82	43	12	C	2.52	0.26	0.50	2.31	2.20	675.22	674.00	(1.22)	674.00	(1.00)
																Crown	of Pipe at	Outlet =		675.00				
FES 15	13	0.95	0.95	6.3	6.5	0.22	0.358	0.358	0.340	5.40	1.84	43	12	C	2.71	0.27	0.58	2.34	3.20	675.62	674.00	(1.62)	674.00	(1.00)
13	MH #1358	0.95	0.87	6.5	6.8	0.26	0.079	0.864	0.751	5.35	4.02	43	12	C	4.36	1.27	1.50	5.11	2.74	675.51	677.00	1.50	673.86	2.14
																Crown	of Pipe at	Outlet =		674.86				

Formulas and Constants

Rational Equation
Q = CiA, where

Q = Flow (cfs)
C = Rational Coefficient
i = Rainfall Intensity (in/hr)
A = Tributary Area (ac)

Mannings Equation
Q =(1.486/n) x (R^(2/3) x S^(1/2) x A), where

Q = Flow (cfs)
n = Mannings Roughness Coef.
R = Hydraulic Radius
S = Slope of Pipe (ft/ft)
A = Area of Flow (sq. ft)

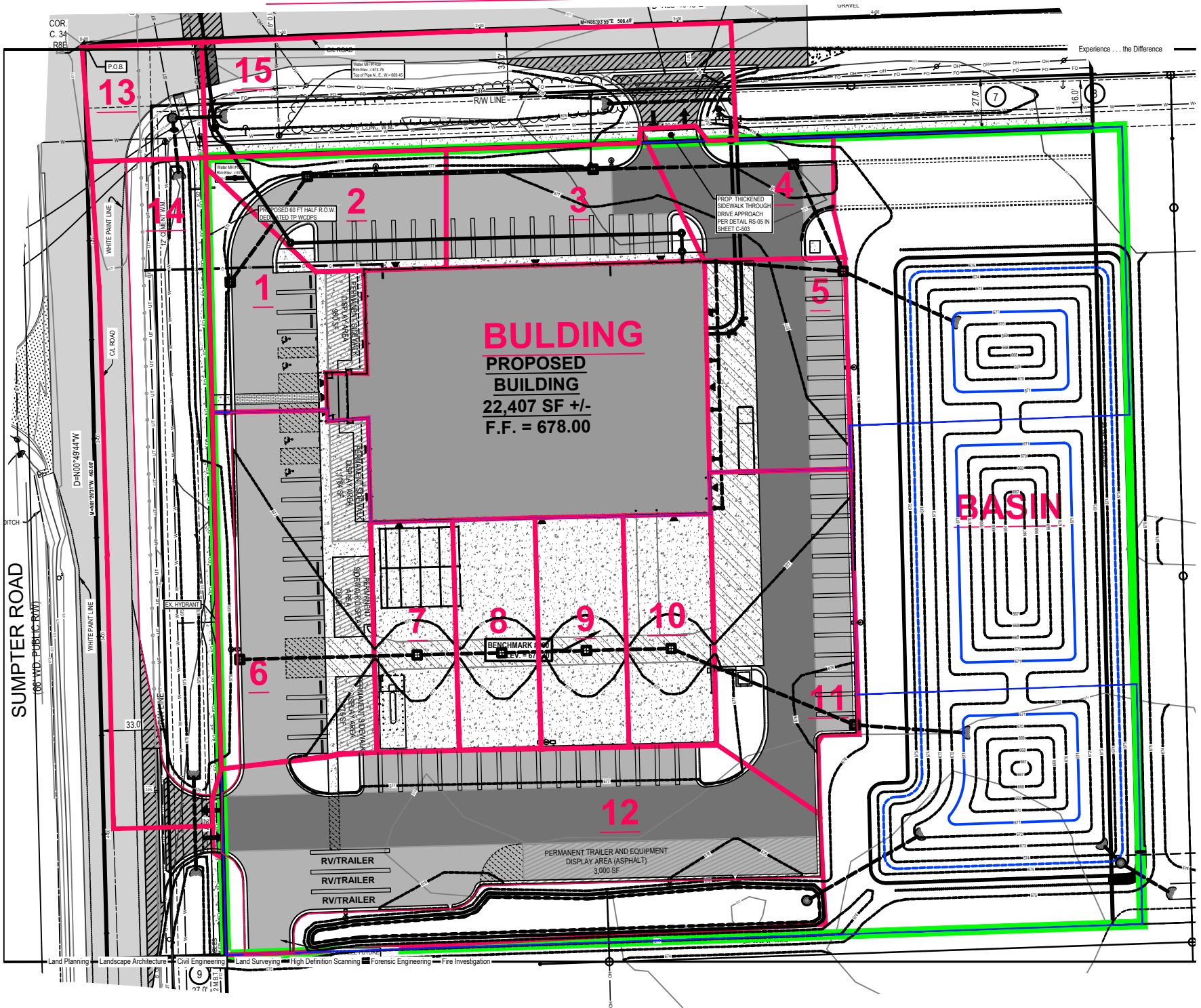
Manning Roughness Coefficients

Concrete	C		0.013
Cor. Metal	CM		0.024
Plastic	P		0.012

* A Runoff Coeffient is calculated for each individual drainage area.
** A Time of Concentration of 6.3 minutes iis used for upstream catchment areas based on Wayne County surface flow velocity estimates.
*** Intensity I = 63/(12.33+T)^.84

BASIN SIZING AREA

STORM PIPE SIZING AREAS



Map Scale: 1:3,520 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

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 1:12,000.

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: Wayne County, Michigan
Survey Area Data: Version 9, Aug 25, 2023

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

Date(s) aerial images were photographed: Sep 8, 2022—Oct 4, 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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Gf	Gilford sandy loam	A/D	26.6	55.5%
WdA	Wasepi sandy loam, 0 to 4 percent slopes	A/D	21.3	44.5%
Totals for Area of Interest			**48.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

The upper portion of the sand layer consists of brown, fine to coarse sand and extends to depths of 4.0 to 9.5 feet. The "N" values of the upper portion of the sand layer range from 6 to 28, indicating the sand is in a slightly compact to very compact state. The majority of the upper portion of the sand layer is in a compact state. The "N" values correspond to an internal friction angle ranging from 28 to 33 degrees.

The middle portion of the sand layer predominantly consists of brown, fine sand and extends to depths of 8.5 to 18.0 feet. This portion of the sand layer contains silty sand in the areas of Test Boring Five and Test Boring Six. The "N" values of the middle portion of the sand layer range from 19 to 46, indicating the sand is in a compact to very compact state. The "N" values correspond to an internal friction angle ranging from 33 to 38 degrees.

The lower portion of the sand layer consists of brown, fine to medium sand with trace amounts of silt and extends to depths of 18.0 to over 20.0 feet. The "N" values of the lower portion of the sand layer range from 21 to over 50, indicating the sand is in a compact to extremely compact state. The "N" values correspond to an internal friction angle ranging from 33 to 38 degrees.

A layer of gray and brown clayey and sandy silt underlies the sand layer in the areas of Test Boring Two and Test Boring Seven. The "N" values of the silt layer range from 9 to 19, indicating the silt is in a stiff state. The internal friction angle of the silt is 15 degrees.

A layer of gray silty clay underlies the sand layer in the area of Test Boring Eight. The "N" value of the clay layer is 11, indicating the clay is in a stiff state. The internal friction angle of the clay is between 0 and 5 degrees.

Bedrock is present below a depth of approximately 113.0 feet. The bedrock consists of gray limestone formed during the Middle Devonian Period. The bedrock is part of the Traverse Group Formation.

Description of Groundwater Conditions

Groundwater was encountered at depths ranging from 2.0 to 3.5 feet. These depths correspond to elevations ranging from 670.9 to 672.5 feet. Long-term groundwater monitoring was not performed as part of this investigation.

Description of Site

The site is located on the southeast corner of the Hull Road and Sumpter Road intersection in Van Buren Charter Township, Wayne County, Michigan. The site is a vacant agricultural parcel. The proposed building will be situated on the northwest portion of the parcel. The site is bordered to the north by Hull Road. The site is bordered to the south and east by agricultural land. The west side of the site is bordered by Sumpter Road. The surface elevation of the site ranges from 673.9 to 674.9 feet. Photographs #1 and #2 show the site at the time of the investigation.

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Infiltration testing was conducted at depths ranging from 2.9 to 3.5 feet in the proposed location of the stormwater detention pond. The soil profile in this area consists of a layer of sand which extends to a depth of at least 15.0 feet. The infiltration rate of the in-situ sand in this area ranges from 3.0 to 18.0 inches per hour, which should be sufficient for internal drainage of the site. However, due to the shallow water table, stormwater will only infiltrate to the elevation of the water table.

While the in-situ sand meets the exception for drains in Section 1805.4 of the Michigan Building Code, drains around the exterior foundations are recommended due to the proximity of the water table. Additional drains below the floor may be required. The drains should consist of a 4.0-inch diameter slotted plastic pipe wrapped in filter fabric. Pea gravel should be used for backfill within a 6.0-inch circumference of the drain. The drains should be connected to a storm sewer or have an outlet a minimum of 30.0 inches below the lowest floor elevation.

Drains below the pavement are not required but may extend the pavement lifespan. The recommended spacing under the pavement is 50.0 feet. The drain invert should be a minimum depth of 30.0 inches below the pavement surface. Pavement areas should be properly drained to minimize the effects of frost heaving and the loss of subgrade due to water infiltration. The parking areas should be sloped towards low points with catch basins or curb inlets.

Hot Mix Asphalt (HMA) Pavement

The recommended preliminary HMA pavement sections listed in Table 2 were developed based on the discussions and assumptions included in this report and the design procedures outlined in the "AASHTO Guide for Design of Pavement Structures." The subgrade should be prepared as described in the "Site & Subgrade Preparation" and "Fill" sections of this report. The recommended pavement section materials listed in Table 2 refer to and should comply with the standard material designations included in applicable MDOT specifications and guidelines including the 2020 MDOT "Standard Specifications for Construction." The final pavement design should be based on site specific traffic loading.

The following recommendations assume that maintenance repairs such as joint sealing, patching, and overlays are regularly performed throughout the lifespan of the pavement and that proper drainage has been established throughout the site. Proper drainage includes the installation of stormwater controls, underdrains, and establishing positive drainage in the subgrade and pavement layers.

Table 2: Recommended Pavement Sections

Pavement Cross Section Materials	Standard Duty		Heavy Duty	
	Material	Thickness (in)	Material	Thickness (in)
HMA Wearing Course	4EML	2.0	4EML	2.5
HMA Base Course	4EML	2.0	4EML	2.5
Aggregate Base	21AA Crushed Limestone	8.0	21AA Crushed Limestone	10.0
Sand Subbase	Class II	12.0	Class II	12.0

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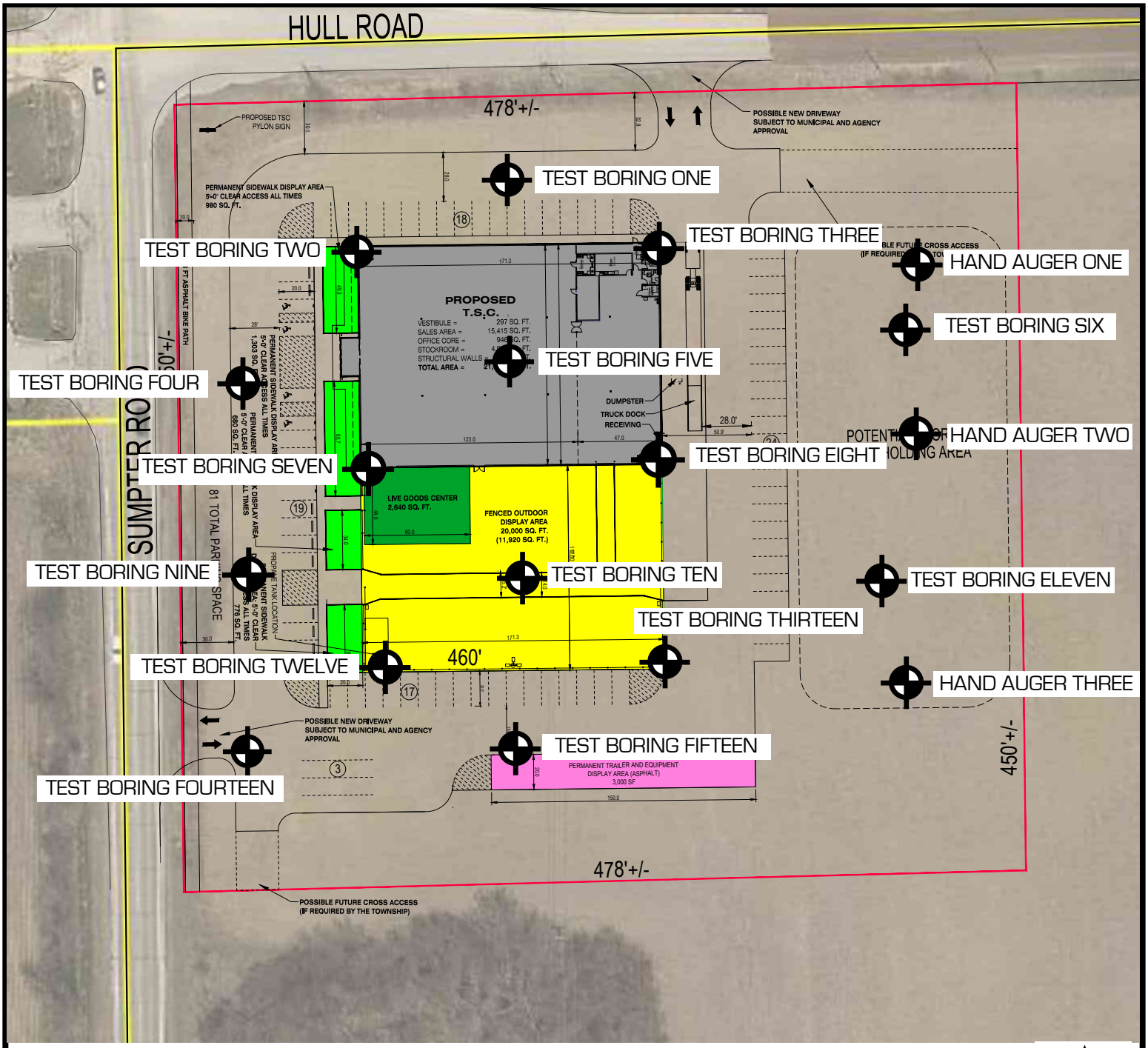
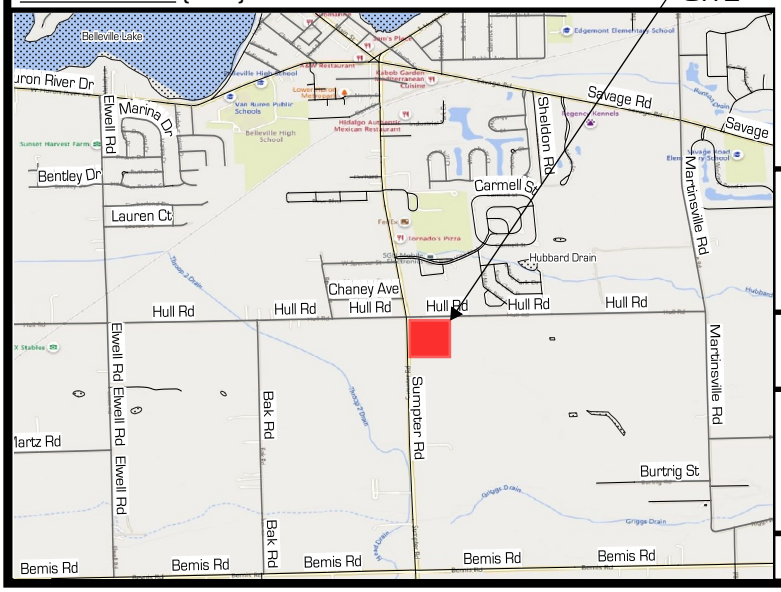


VICINITY MAP (NTS)



TEST BORING LOCATION PLAN

NTS

Note: The background of the test boring plan is a portion of an aerial photograph from Google Earth.

Tractor Supply - Belleville

Van Buren Township, Wayne County, Michigan

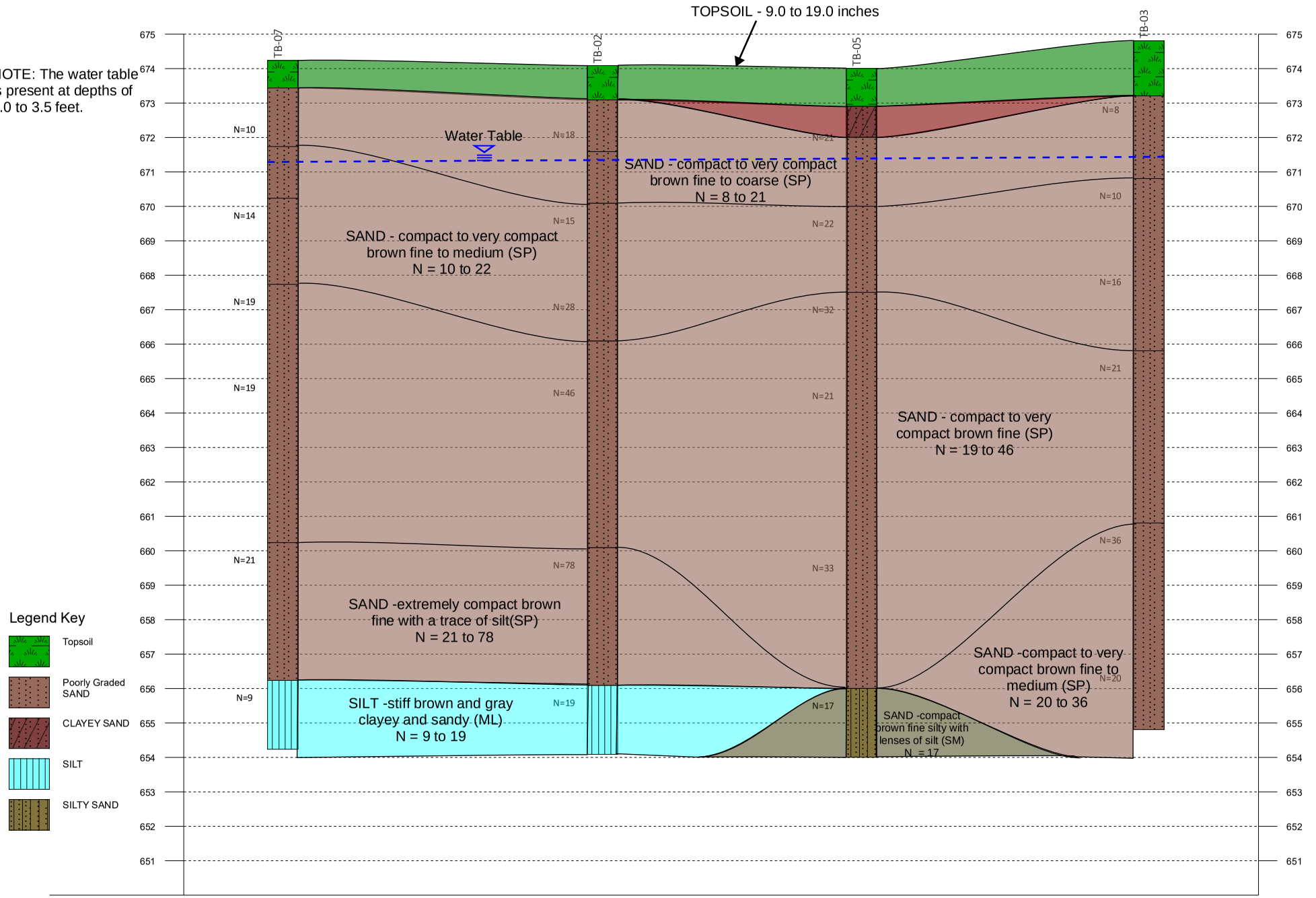
Soils & Structures, Inc.
6480 Grand Haven Road
Muskegon, Michigan 49441

JOB NO.: 2023.2100 DATE: 02-05-2024

Project Id:	2023.2100	Title:	Section line 1
Project Title:	Tractor Supply - Belleville	Vertical Scale:	1:45
Location:	Belleville, Michigan	Horizontal Scale:	1:587
Client:	CBE, LLC	Engineer:	Vincent Oderah, P.E.

GENERAL SOIL PROFILE

NOTE: The water table is present at depths of 2.0 to 3.5 feet.



SOILS & STRUCTURES

Hand Auger ID: HA - 01

Sheet 1 of 1

Project Name:	Tractor Supply - Belleville	**Project Number:**	2023.2100
Project Location:	Belleville, Michigan	**Logged By:**	E.Burt
Reviewed By:	J.Veeneman		
Client:	CBE, LLC	**Survey Datum:**	NAD 1983 StatePlane Michigan South
Hole Depth:	4.50		
Date Started:	Nov 21 2023	**Completed:**	Nov 21 2023
Northing:		**Easting:**	
Elevation:			
Drilling Method:	Hand Auger	**Frost Depth**	
Notes:	TB 1 - N end of proposed retention pond.	**Ground Water Levels**	
	End of Drilling	3.40 ' on Nov 21 2023	

Depth	Graphic	Material Description	Moisture Content	Hand Penetrometer	Blow Counts	DCP 5 10 15 20 25 30 35 40 45	USCS
0		TOPSOIL - dark brown sandy (12.0")					
1		SAND - brown fine to coarse					
2							
3		SAND - gray fine with coarse ***Infiltration test run at 3.5 feet below grade - 18 inches per hour.***					
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

SOILS & STRUCTURES

Hand Auger ID: HA - 02

Sheet 1 of 1

Project Name:	Tractor Supply - Belleville	**Project Number:**	2023.2100
Project Location:	Belleville, Michigan	**Logged By:**	E.Burt
Reviewed By:	J.Veeneman		
Client:	CBE, LLC	**Survey Datum:**	NAD 1983 StatePlane Michigan South
Hole Depth:	5.00		
Date Started:	Nov 21 2023	**Completed:**	Nov 21 2023
Northing:		**Easting:**	
Elevation:			
Drilling Method:	Hand Auger	**Frost Depth**	
Notes:	TB 2 - Middle of proposed retention pond.	**Ground Water Levels**	
		End of Drilling	3.40 ' on Nov 21 2023

Depth	Graphic	Material Description	Moisture Content	Hand Penetrometer	Blow Counts	DCP 5 10 15 20 25 30 35 40 45	USCS
0		TOPSOIL - dark brown sandy (12.0")					
1		SAND - brown fine to coarse ***Infiltration test run at 2.8 feet below grade - 3 inches per hour***					
3		SAND - light brown fine to coarse					
4		SAND - brown fine to coarse					
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

SOILS & STRUCTURES

Hand Auger ID: HA - 03

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: E.Burt
Reviewed By: J.Veeneman
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 6.00
Date Started: Nov 21 2023
Completed: Nov 21 2023
Northing:
Easting:
Elevation:
Drilling Method: Hand Auger
Frost Depth
Notes: TB 3 - S end of proposed retention pond.

Ground Water Levels

End of Drilling 3.40 ' on Nov 21 2023

Depth	Graphic	Material Description	Moisture Content	Hand Penetrometer	Blow Counts	DCP 5 10 15 20 25 30 35 40 45	USCS
0		TOPSOIL - dark brown sandy (18.0")					
1.5		SAND - brown fine to medium					
2.5		SAND - light brown fine to medium ***Infiltration test run at 2.9 feet below grade - 9 inches per hour.***					
3		SAND - gray fine to medium					
6							

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

SOILS & STRUCTURES

Borehole ID: TB-01

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Jan 17 2024
Completed: Jan 17 2024
Northing: 252661.4
Easting: 13362928.7
Elevation: 674.67
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 17 2024

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
1	TOPSOIL - dark brown sandy (18.0")												
2	SAND - slightly compact brown fine to medium with a trace of clay												
3			SPT-A	80	2-3-4	7			19.6				SP
4	SAND - slightly compact to compact brown fine to medium												
5			SPT-B	87	4-6-6	12			17.2				SP
6													
7													
8			SPT-C	87	3-4-7	11							SP
9	SAND - very compact brown fine to medium		SPT-D	100	6-11-20	31			19.8				SP
10	SAND - very compact brown fine												
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													

SOILS & STRUCTURES

Borehole ID: TB-02

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 20.00
Date Started: Jan 18 2024
Completed: Jan 18 2024
Northing: 252617.9
Easting: 13362849.9
Elevation: 674.09
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 18 2024

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0		TOPSOIL - dark brown sandy (12.0")												
1		SAND - compact brown fine to medium with a trace of clay and gravel												
2														
3		SAND - compact brown fine to coarse		SPT-A	100	5-9-9	18			14.7				SP
4														
5		SAND - compact to very compact brown fine to medium		SPT-B	80	4-7-8	15							SP
6														
7				SPT-C	100	4-10-18	28			20.4				SP
8		SAND - very compact brown fine												
9														
10				SPT-D	100	8-18-28	46			18.3				SP
11														
12														
13														
14		SAND - extremely compact brown fine with a trace of silt												
15				SPT-E	67	19-28-50	78							SP
16														
17														
18		SILT - stiff brown sandy												
19				SPT-F	80	9-11-8	19			20.1				ML
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

SOILS & STRUCTURES

Borehole ID: TB-03

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 20.00
Date Started: Jan 17 2024
Completed: Jan 17 2024
Northing: 252624.9
Easting: 13363011.6
Elevation: 674.81
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 17 2024

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
1		TOPSOIL - dark brown sandy (19.0")												
2		SAND - compact brown fine to coarse												
3				SPT-A	73	2-4-4	8			17.0				SP
4		SAND - compact brown fine to medium												
5				SPT-B	80	3-4-6	10			24.2				SP
6														
7				SPT-C	100	6-8-8	16							SP
8														
9		SAND - very compact brown fine												
10				SPT-D	87	5-9-12	21							SP
11														
12														
13														
14		SAND - compact to very compact brown fine to medium												
15				SPT-E	100	11-16-20	36			20.2				SP
16														
17														
18														
19				SPT-F	100	9-10-10	20							SP
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

SOILS & STRUCTURES

Borehole ID: TB-04

Sheet 1 of 1

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Jan 18 2024
Completed: Jan 18 2024
Northing: 252556.9
Easting: 13362789.4
Elevation: 674.48
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 2.00' on Jan 18 2024

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
1		TOPSOIL - dark brown sandy (13.0")												
2		SAND - slightly compact brown fine to coarse												
3		SAND - slightly compact to compact brown fine to medium		SPT-A	80	3-3-4	7			19.6				SP
4														
5				SPT-B	87	5-7-8	15							SP
6														
7		SAND - very compact brown fine with a trace of silt												
8				SPT-C	87	9-14-17	31							SP
9				SPT-D	87	5-9-13	22			20.4				SP
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

SOILS & STRUCTURES

Borehole ID: TB-05

Sheet 1 of 1

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 20.00
Date Started: Jan 18 2024
Completed: Jan 18 2024
Northing: 252558.8
Easting: 13362929.4
Elevation: 674.00
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 18 2024

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0	TOPSOIL - dark brown sandy (13.0")												
2	SAND - brown fine to medium clayey with a trace of gravel												
3	SAND - very compact brown fine to coarse		SPT-A	80	8-10-11	21			13.4				SP
5	SAND - very compact brown fine to medium		SPT-B	100	7-9-13	22							SP
7	SAND - very compact brown fine		SPT-C	100	9-14-18	32			23.9				SP
10			SPT-D	100	4-8-13	21							SP
15			SPT-E	100	11-15-18	33			28.9				SP
18	SAND - compact brown fine silty with lenses of silt		SPT-F	80	8-8-9	17			20.4				SM

SOILS & STRUCTURES

Borehole ID: TB-06

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 15.00
Date Started: Jan 17 2024
Completed: Jan 17 2024
Northing: 252574.8
Easting: 13363125.6
Elevation: 674.90
Drilling Method: 2-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 17 2024

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0		TOPSOIL - dark brown sandy (13.0")												
2		SAND - very compact brown fine to coarse with clay silt and gravel		SPT-A	47	8-11-14	25			11.7				SW-SC
4		SAND - compact brown fine to medium with a trace of clay and silt		SPT-B	67	2-5-10	15							SP
6		***Infiltration at 5.0 feet = 0.1 in/hr***												
7		SAND - very compact brown fine		SPT-C	100	6-12-16	28							SP
9		SAND - compact brown fine silty		SPT-D	67	5-8-11	19			23.5				SM
14		SAND - very compact brown fine with a trace of silt		SPT-E	47	8-11-14	25							SM

SOILS & STRUCTURES

Borehole ID: TB-07

Sheet 1 of 1

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 20.00
Date Started: Jan 18 2024
Completed: Jan 18 2024
Northing: 252495.0
Easting: 13362854.8
Elevation: 674.24
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 18 2024

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0	TOPSOIL - dark brown sandy (10.0")												
1	SAND - compact brown fine to medium with a trace of clay and gravel												
2													
3	SAND - compact brown fine to coarse		SPT-A	73	1-3-7	10							SP
4	SAND - compact brown fine to medium												
5			SPT-B	80	5-6-8	14			22.8				SP
6													
7	SAND - compact brown fine												
8			SPT-C	67	6-8-11	19			23.9				SP
9													
10			SPT-D	87	4-8-11	19							SP
11													
12													
13													
14	SAND - very compact brown fine with a trace of silt												
15			SPT-E	80	5-9-12	21			26.7				SP
16													
17													
18	SILT - stiff gray clayey with a trace of sand												
19			SPT-F	80	3-4-5	9			26.7				ML
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													

SOILS & STRUCTURES

Borehole ID: TB-08

Sheet 1 of 1

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 20.00
Date Started: Jan 17 2024
Completed: Jan 17 2024
Northing: 252501.1
Easting: 13363012.4
Elevation: 674.43
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 17 2024

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
1	TOPSOIL - dark brown sandy (19.0")												
2	SAND - slightly compact brown fine to medium with a trace of silt												
3			SPT-A	80	3-2-4	6			19.2				SP
4	SAND - compact brown fine												
5			SPT-B	80	4-5-5	10							SP
6													
7			SPT-C	87	7-8-10	18							SP
8													
9													
10			SPT-D	80	3-7-8	15			26.9				SP
11													
12													
13													
14	SAND - very compact brown fine with a trace of silt												
15			SPT-E	80	8-14-14	28			25.8				SP
16													
17													
18	CLAY - stiff gray silty												
19			SPT-F	47	4-4-7	11			17.8				CL
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													

SOILS & STRUCTURES

Borehole ID: TB-09

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Jan 18 2024
Completed: Jan 18 2024
Northing: 252440.1
Easting: 13362792.3
Elevation: 674.19
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 2.00' on Jan 18 2024

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0		TOPSOIL - dark brown sandy (9.0")												
1		SAND - brown fine to medium with a trace of clay												
2														
3		SAND - compact brown fine to coarse		SPT-A	53	2-2-6	8			18.8				SP
4														
5				SPT-B	80	5-8-9	17							SP
6														
7		SAND - compact brown fine with a trace of silt		SPT-C	80	7-8-9	17							SP
8														
9		SAND - very compact brown fine		SPT-D	87	8-11-15	26			24.6				SP
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

SOILS & STRUCTURES

Borehole ID: TB-10

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Jan 18 2024
Completed: Jan 18 2024
Northing: 252438.2
Easting: 13362930.3
Elevation: 674.60
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 18 2024

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0		TOPSOIL - dark brown sandy (11.0")												
1		SAND - compact brown fine to medium with a trace of clay and gravel												
2														
3		SAND - compact brown fine to medium		SPT-A	80	2-3-5	8							SP
4		SAND - compact brown fine												
5				SPT-B	87	2-5-7	12			25.3				SP
6														
7														
8				SPT-C	73	4-8-9	17			26.7				SP
9		SAND - very compact brown fine with a trace of silt		SPT-D	87	7-9-14	23							SP
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

SOILS & STRUCTURES

Borehole ID: TB-11

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher **Reviewed By:** K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 15.00
Date Started: Jan 17 2024 **Completed:** Jan 17 2024
Northing: 252416.4 **Easting:** 13363129.5 **Elevation:** 674.37
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.50' on Jan 17 2024

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
1		TOPSOIL - dark brown sandy (19.0")												
2		SAND - compact brown fine to medium												
3				SPT-A	67	3-5-8	13			15.4				SP
4		SAND - compact brown fine with a trace of clay and silt												
5				SPT-B	80	2-4-7	11			23.6				SP
6		***Infiltration at 5.0 feet = 3.3 in/hr***												
7		SAND - compact brown fine												
8				SPT-C	100	6-8-10	18							SP
9														
10				SPT-D	100	2-3-7	10			24.0				SP
11														
12														
13														
14				SPT-E	100	2-6-11	17							SP
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

SOILS & STRUCTURES

Borehole ID: TB-12

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Jan 18 2024
Completed: Jan 18 2024
Northing: 252384.0
Easting: 13362859.5
Elevation: 673.94
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 18 2024

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0	TOPSOIL - dark brown sandy (11.0")												
1	SAND - brown fine to medium with a trace of clay and gravel												
2													
3	SAND - slightly compact to compact brown fine to medium		SPT-A	73	1-2-5	7							SP
4													
5			SPT-B	87	6-7-8	15			17.6				SP
6													
7	SAND - very compact brown fine												
8			SPT-C	80	8-10-14	24							SP
9			SPT-D	87	5-9-13	22			20.8				SP
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													

SOILS & STRUCTURES

Borehole ID: TB-13

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Jan 17 2024
Completed: Jan 17 2024
Northing: 252384.3
Easting: 13363014.7
Elevation: 674.01
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 17 2024

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
1		TOPSOIL - dark brown sandy (18.0")												
2		SAND - slightly compact to compact brown fine to medium												
3				SPT-A	87	2-3-3	6			23.5				SP
4														
5				SPT-B	100	3-6-9	15			16.0				SP
6														
7		SAND - compact brown fine												
8				SPT-C	87	5-8-9	17							SP
9				SPT-D	73	1-5-7	12			27.7				SP
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

SOILS & STRUCTURES

Borehole ID: TB-14

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Jan 18 2024
Completed: Jan 18 2024
Northing: 252346.0
Easting: 13362793.6
Elevation: 674.28
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 2.50' on Jan 18 2024

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0	TOPSOIL - dark brown sandy (10.0")												
1	SAND - compact brown fine to medium with a trace of clay and gravel												
2													
3			SPT-A	87	1-3-6	9			21.0				SP
4	SAND - compact brown fine												
5	SAND - compact brown fine to coarse		SPT-B	87	7-7-8	15							SP
6													
7	SAND - compact to very compact brown fine to medium												
8			SPT-C	80	6-8-10	18			19.3				SP
9			SPT-D	100	5-8-15	23							SP
10	SAND - very compact brown fine												
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													

SOILS & STRUCTURES

Borehole ID: TB-15

Project Name: Tractor Supply - Belleville
Project Number: 2023.2100
Project Location: Belleville, Michigan
Logged By: J Christopher
Reviewed By: K Martella
Client: CBE, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 10.00
Date Started: Jan 18 2024
Completed: Jan 18 2024
Northing: 252344.3
Easting: 13362931.4
Elevation: 673.94
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 3.00' on Jan 18 2024

Depth	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
0	TOPSOIL - dark brown sandy gravelly (10.0")												
1	SAND - compact brown fine to medium with a trace of clay												
2													
3	SAND - compact brown fine to medium		SPT-A	67	1-5-7	12			19.4				SP
4													
5	SAND - compact brown fine		SPT-B	80	6-8-11	19							SP
6													
7													
8			SPT-C	80	7-8-10	18			24.8				SP
9			SPT-D	67	3-5-8	13							SP
10													