



# Memo

**Date:** December 17, 2014

**To:** Dan Prather, Preliminary Bridge Engineer  
Office of Bridges & Structures

**From:** Rich Lamb, Foundations Design Build Engineer  
Geotechnical Engineering Section

Jason Richter, Chief Geologist  
Geotechnical Engineering Section

**Concur:** Gary Person, Foundations Engineer  
Geotechnical Engineering Section

**Subject:** SP 2515-21 Bridge 25033  
TH 63 over Mississippi River in Red Wing  
Subsurface Investigation

## 1.0 Project Description

This report provides a Subsurface Investigation for constructing Bridge 25033 in Red Wing. This new structure will replace Bridge 9040, an overhead steel truss constructed in 1960 and commonly known as the Eisenhower Bridge. The new bridge will continue to carry traffic over the Mississippi River and CP Rail between Redwing, Minnesota and Hager City, Wisconsin. Based on the preliminary bridge design, the new bridge will be approximately 1,630 ft. long and 52 ft. wide and will be constructed just upstream from the existing structure. The longer bridge spans, including the 432 ft. main river span, will be constructed with steel box girders while the remaining spans will utilize pre-stressed concrete girders.

Figure 1: Site Layout



## 2.0 Site Geology and General Subsurface Conditions

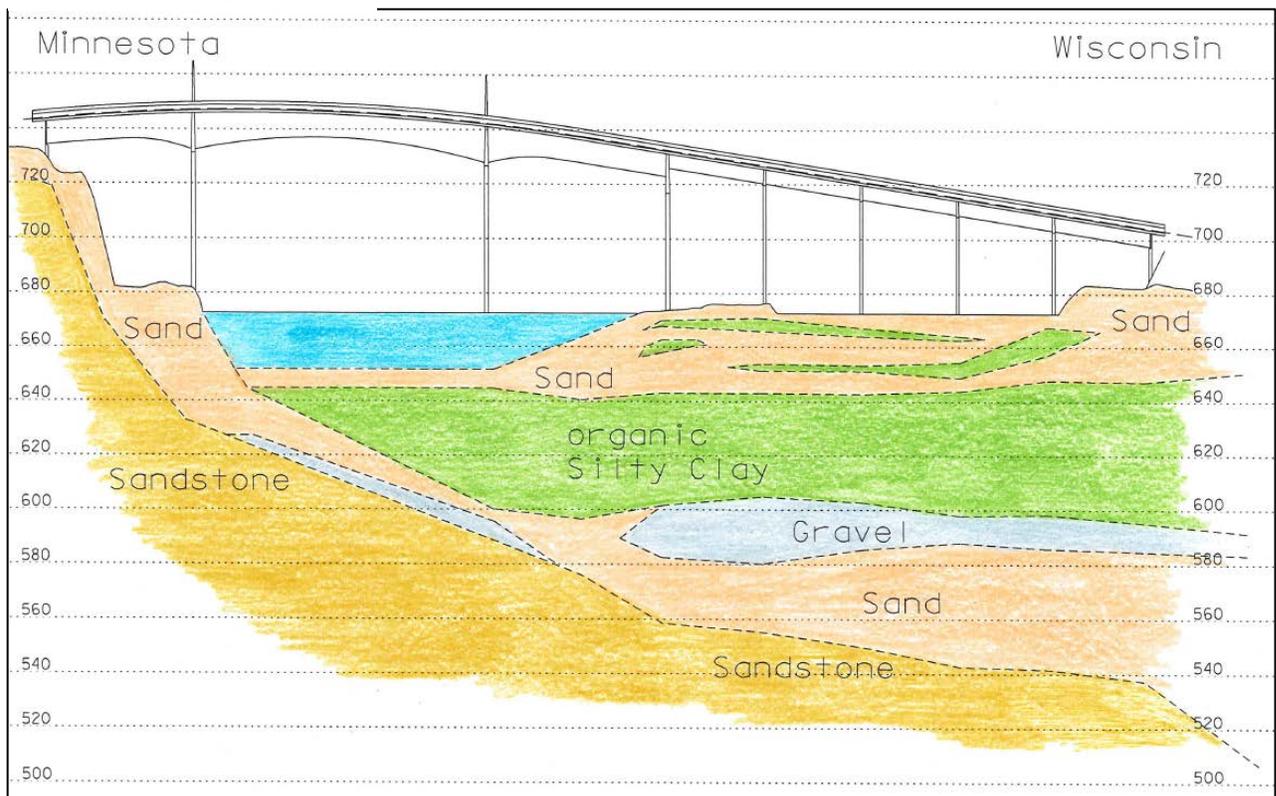
Surficial soils within the Redwing Bridge project area consist of coarse sand and gravel alluvial deposits from Glacial River Warren and modern river channel deposits of sand and gravel with areas of silt, clay, and organics.

The surficial soils on the south end of the project, within the city of Redwing are relatively shallow, 4 feet to 10 feet thick, and consist of loamy sand and gravel with some Sandstone colluvium. The soil is underlain by Paleozoic Bedrock of the St. Lawrence Formation, an intermixed Siltstone and Sandstone with some dolomitic zones. The Saint Lawrence ranges from 5 feet to almost 20 feet thick. Below the St. Lawrence is the Franconia Formation. The Franconia Formation is a variably glauconitic, fine to medium grained Sandstone with thin seams of Shale and has zones where the Sandstone has become cemented with dolomite.

Bedrock depths become deeper just north of Redwing within the scoured river valley of Glacial River Warren. Borings within the river for pier 2 are approximately 7 feet to 30 feet of sand overlaying a marly organic silty clay ranging 20 feet to 45 feet thick. Below the organic zone is a 10 to 20 foot zone of sand and gravel with bedrock of the Franconia Formation below.

Bedrock depths become progressively deeper as you head into Wisconsin ranging from 85 to over 145 feet below ground/water surface (approx. 588' to 537' in elevation).

Figure 2: Site Geology



## 2.1 Subsurface Investigation

Eleven foundation borings were taken at the site by MnDOT forces in the summer/fall of 2014. In addition, American Engineering Testing, Inc. (AET) was contracted to perform one boring for Pier 1 in November, 2014. The borings included Standard Penetration Tests, split spoon and thinwall sampling and triple barrel rock coring (NX size). Please refer to the attached boring plan for boring locations.

## 2.2 Subsurface Conditions

The borings encountered typical alluvial materials including soft silty clays, highly organic to organic silt loams, silty clay loams and granular soils underlain by sedimentary bedrock. Please refer to the proceeding descriptions and the attached boring logs for a more complete description of the results of the subsurface investigation.

### 2.21 South Abutment

Based on boring T119, the foundation soils at the south abutment were found to consist of an upper 16 feet of medium dense to very dense Sand with some Gravel overlying bedrock consisting of Sandstone and Siltstone of the St. Lawrence Formation. The top of bedrock was found near elevation 719.1.

### 2.22 Pier 1

Boring T100A was performed at Pier 1 by American Engineering Testing, Inc. in early November 2014. This boring encountered an upper 20 ft. layer of loose to medium dense gravelly sand with some concrete, bituminous and brick pieces (fill) followed by a 30 ft. layer of dense to very dense sand (Alluvium). Below these soils, sandstone bedrock was encountered to the terminus of the boring.

### 2.23 Pier 2

Borings T101, T102 and T103 were taken on the river through a barge deck in the fall of 2013. Boring T101, the boring closest to Pier 2, encountered approximately 18 feet of water followed by 8 feet of loose sand and then 45 feet of organic to highly organic, very soft Silty Clay Loam. This material was described as marly and contains shells and shell fragments and a few silt pockets. These soils were underlain by 12 feet of very dense Sand and Gravel resting on top of Sandstone bedrock. Boring T103 was taken in line with Pier 2 and 72 ft. south of the proposed bridge to get subsurface information near the existing pier (located downstream of proposed Pier 2). This boring produced results similar to T101 including 15 ft. of water followed by a three ft. layer of organic Silt Loam, a 29 ft. layer of loose sand, a 21 ft. layer of organic Silty Clay, a 14 ft. layer of very dense Sand and Gravel and finally layers of Sandstone bedrock. Boring T102 was taken halfway between Piers 2 and 3 and also encountered soils similar to T101.

### 2.24 North Approach Spans (Piers 3-7) and North Abutment

Borings T104 – T109 were taken for Piers 3-7 and the north abutment in the floodplain area. These borings encountered an upper 20-25 ft. layer of very loose silty sands followed by 40-50 ft. of very soft to soft, organic to highly organic silty clay material. Below these soils, medium dense to very dense sand and sand and gravel was found down to the top of Sandstone bedrock which was first encountered approximately 120-130 ft. below the surface.



### 2.3 Groundwater Conditions

Groundwater was encountered at varying elevations from south to north along the project. Please refer to the attached boring logs for more details. In general, the water table was found to be near the river level at the time of the investigation.

### 2.4 Lab Testing

Standard lab tests including moisture tests, organic content, unconfined compression and grain size tests were performed on soil samples recovered from the borings. In addition, several one dimensional consolidation tests were performed on the silty clay material near the north abutment. The results show that these cohesive soils are normally consolidated and may strain as much as 5-10% under the proposed embankment loads.

Table 1: Consolidation Test Results (average values from T110)

Moisture Content	56%
Over Consolidation Ratio	0.8
Initial Void Ratio, $e_0$	1.5
$C_c$	0.63
$C_r$	0.06
$C_v$ (ft <sup>2</sup> /day)	0.13

Rock core samples from Boring T100A (Pier 1) were tested for strength and found to have an unconfined compressive strengths ( $q_u$ ) ranging from 549-2,057 psi and elastic moduli (E) between 33-500 ksi.

Table 2: Consolidation Test Results (from rock core recovered from T110)

Boring	Depth (ft.)	Elev (ft.)	Depth below top of bedrock (ft.)	$q_u$ (psi)	E (psi)
T100A	51.3	630.7	1.8	1,224	180,000
T100A	52.5	629.5	3	1,150	150,000
T100A	57.5	624.5	8	1,356	170,000
T100A	58.5	623.5	9	549	33,000
T100A	59.6	622.4	10.1	1,265	133,000
T100A	63.7	618.6	13.9	1,373	280,000
T100A	70.3	611.7	20.8	1,708	312,000
T100A	74.5	607.5	25	1,429	250,000
T100A	84.6	597.4	35.1	2,057	500,000
T102	141.5	531	101.5	1197	210,500
T102	151.5	521	111.5	603	75,000

Figure 3: Unconfined Compression Test



Average values for unconfined compressive strength and elastic modulus were computed to be 1,350 psi and 290,000 psi respectively. These values are similar to those reported for the St. Croix River Crossing



project in the similar rock formations. Rock core was recovered from Boring T101 at Pier 2, however, the core pieces were too short to test.

### **3.0 Bridge 9040 Existing Foundation Information**

Bridge 9040 was constructed in 1960 as a two lane continuous steel truss to carry US Highway 63 traffic over the west channel of the Mississippi River. The bridge is 1,631 feet long and features a 420 ft. navigation channel span. The Wisconsin side of the bridge acts as a causeway spanning over a seasonal floodplain. Based on pile driving records, the existing bridge substructures were supported on timber piling with the exception of the South Abutment (spread footing on bedrock) and Pier 1 (Steel H Piles). The timber piles had butt diameters ranging from 13-15 in. and tip diameters of 7.5-10.5 in.

Bridge inspection reports over the years have noted “settlements and shifting” of the substructures on the north side of the bridge (mainly Pier 8 and North Abutment). This movement was severe enough that, in 1972, a project was let to raise the bridge seat elevations by 1.7 ft. at the north abutment and 1.1 ft. at Pier 8. In following years settlement continued and, in 1984, an inspection report noted vertical deflections ranged from 0.26-0.47 ft. for Pier 2 – Pier 7 and as much as 2.03 ft. for Pier 8 and 3.30 ft. for the north abutment. This amount of settlement could be the result of either pile group settlement and/or pile downdrag. More recent inspection reports have noted that the settlement rates have slowed.

### **4.0 Addition Subsurface Investigations**

Additional subsurface investigation information is planned at the following locations to complete the subsurface investigation for final design:

- Pier 2 – Additional core samples suitable for unconfined compression testing are needed to advance the foundation design
- North Abutment near the west side of the proposed footing. Needed to confirm top of bedrock elevation.

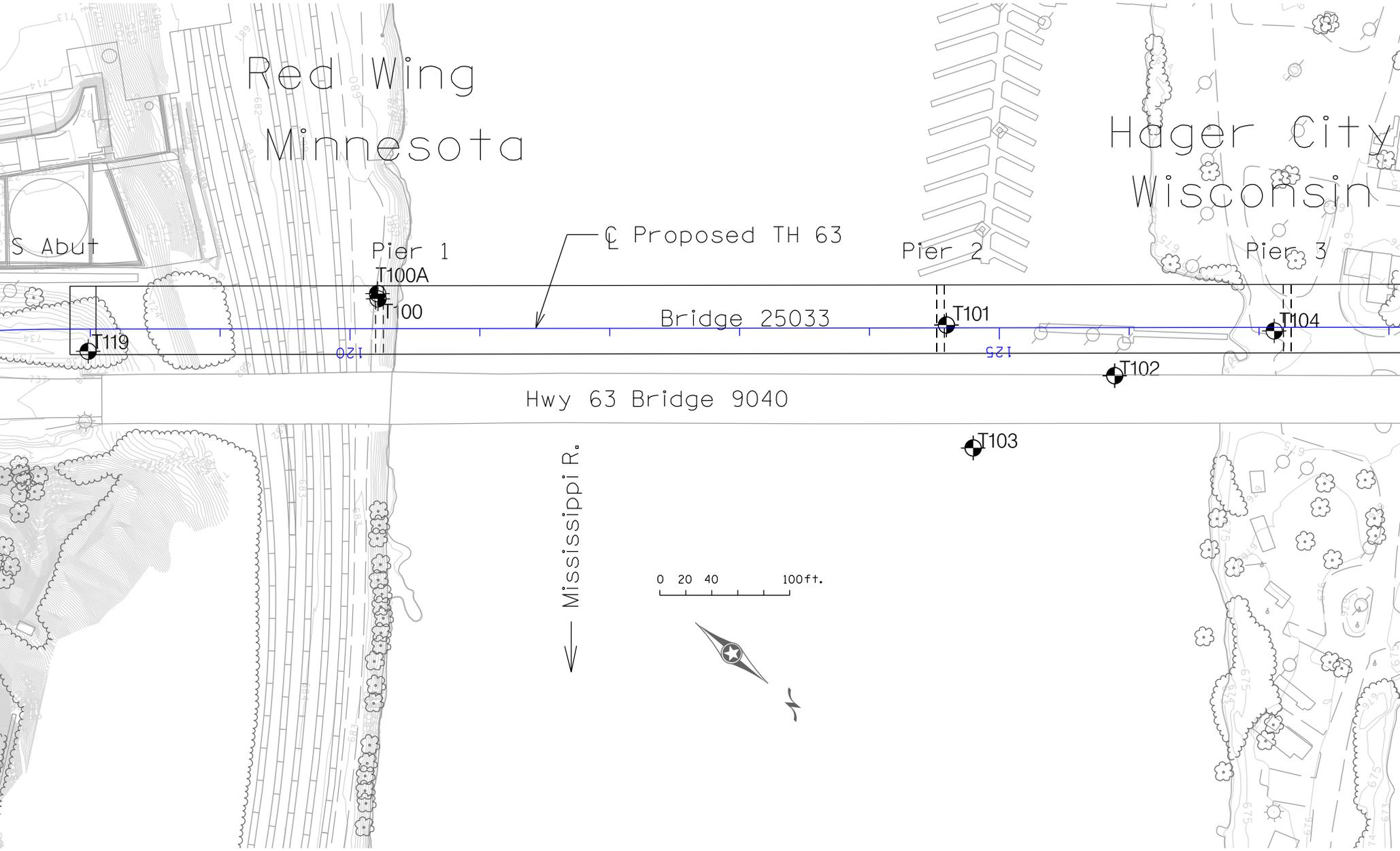
Attachments: Boring Plan, Subsurface Profile, Boring Logs

cc: J. Brunner  
C. Hanson  
K. Western  
B. Jilk  
D. Thomas  
T. Ward  
Robert Arndorfer (WISDOT)



Red Wing  
Minnesota

Hager City  
Wisconsin



# Hager City Wisconsin

Pier 2

Pier 3

Pier 4

Pier 5

Pier 6

Pier 7

N Abut

T101

T104

T105

T106

T107

T108

T109

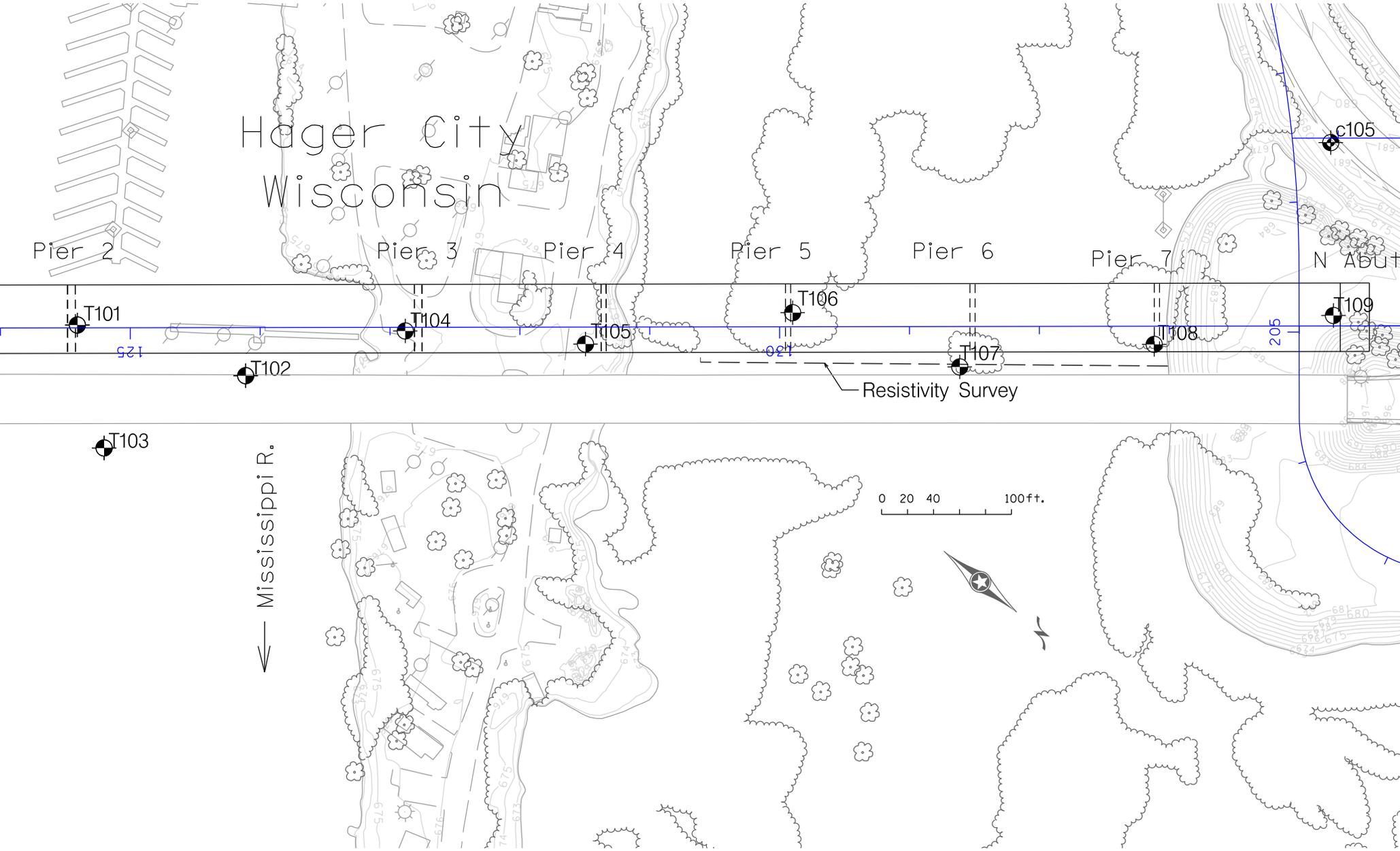
T102

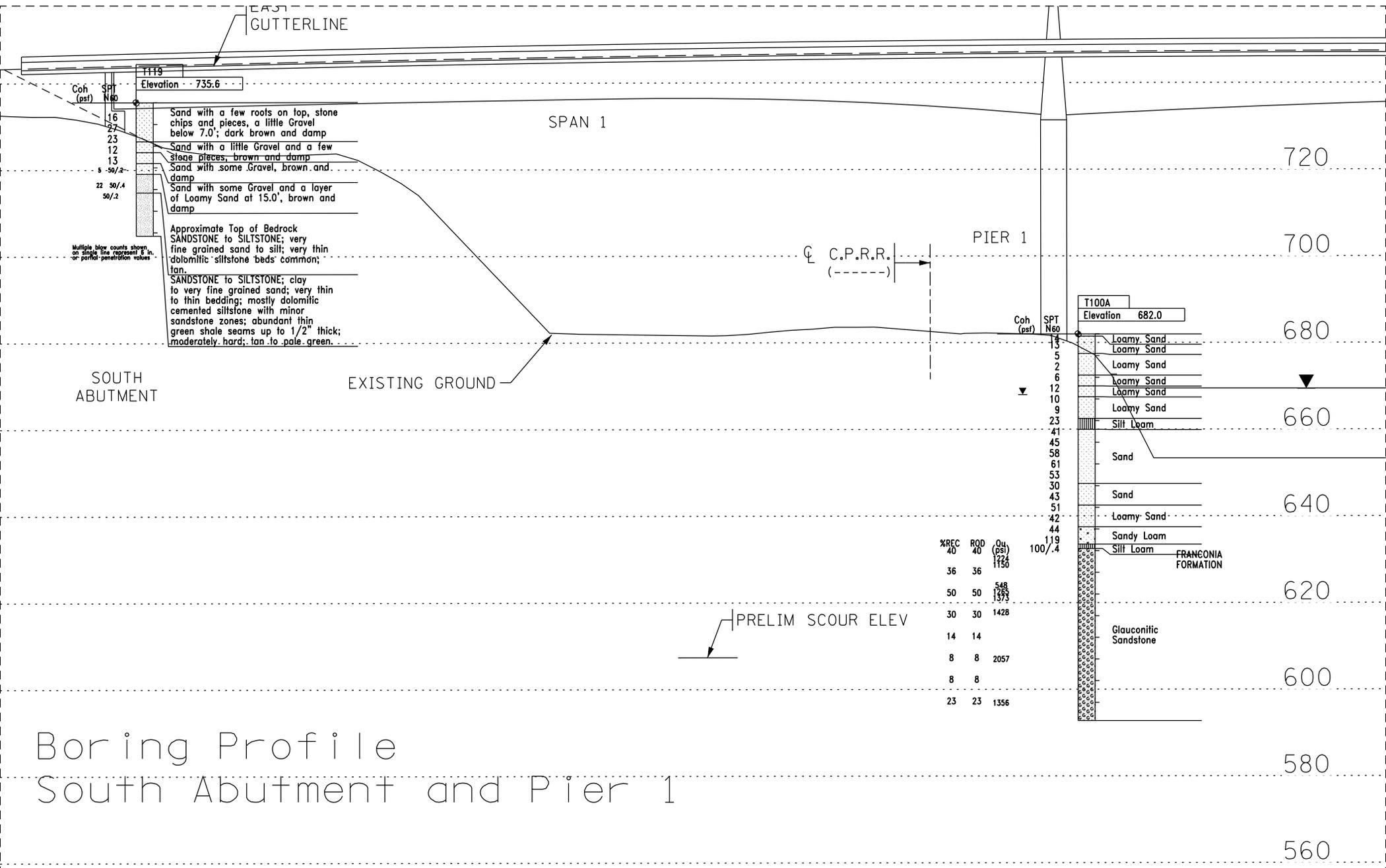
Resistivity Survey

T103

Mississippi R.

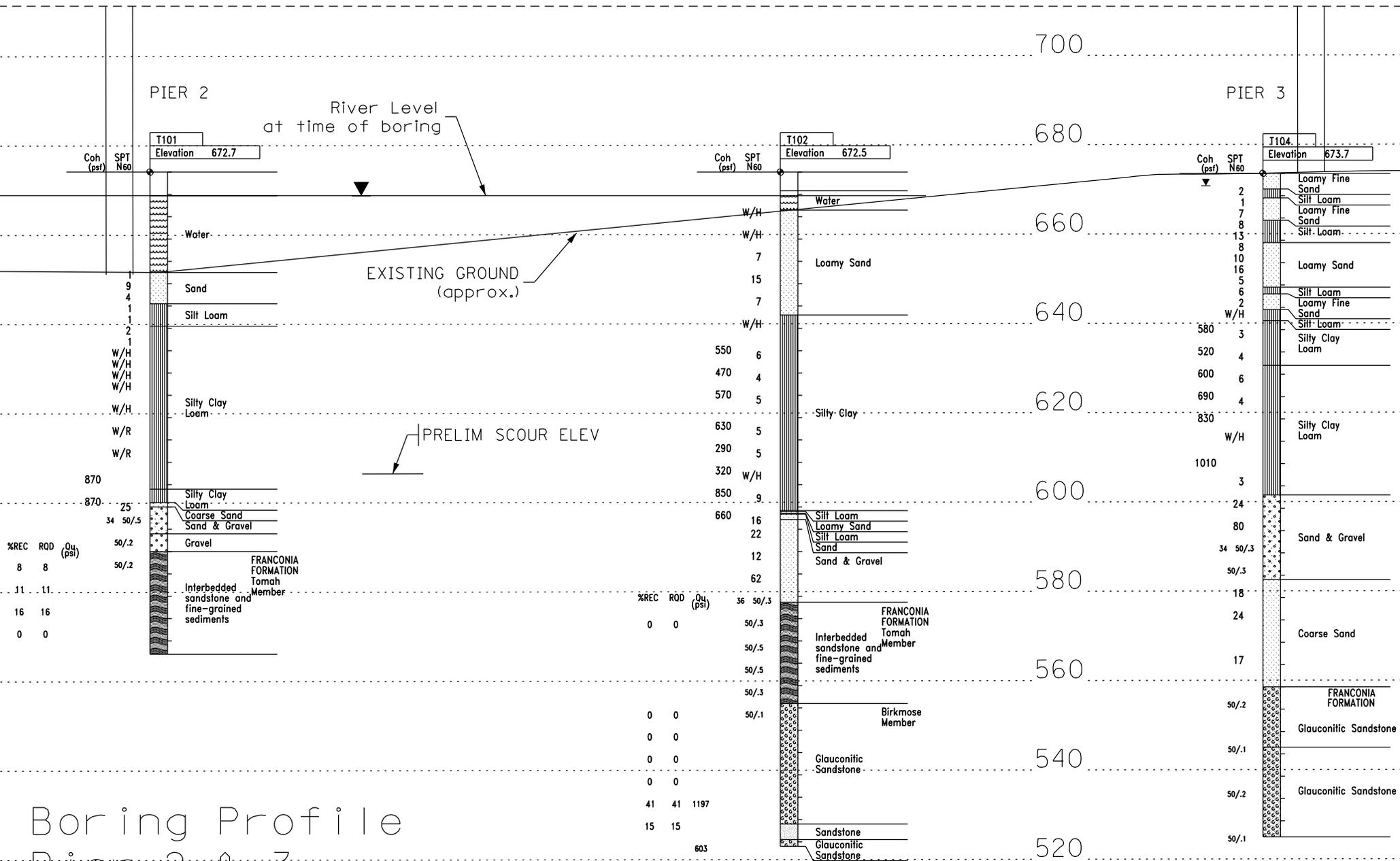
0 20 40 100ft.





Boring Profile  
South Abutment and Pier 1





Boring Profile  
Pier 2 & 3

SPAN 4

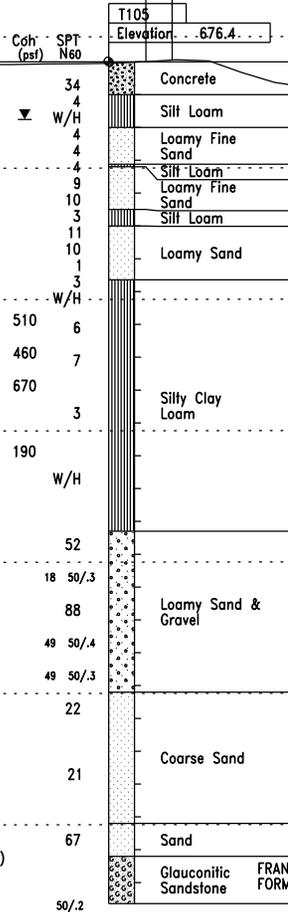
SPAN 5

SPAN 5

SPAN 6

PIER 4

PIER 5



%REC ROD Q<sub>u</sub> (psi)

720

700

680

660

640

620

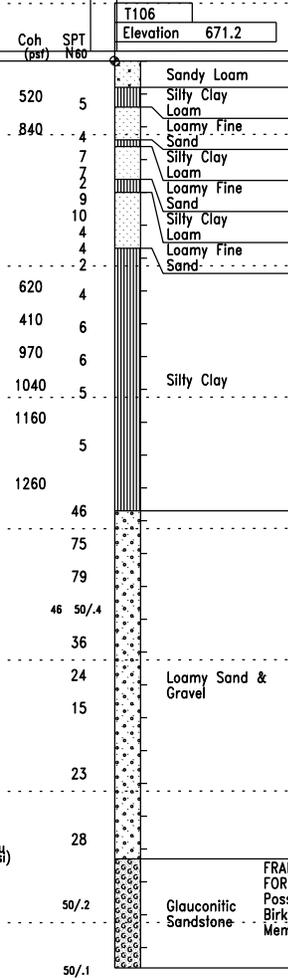
600

580

560

540

EXISTING GROUND



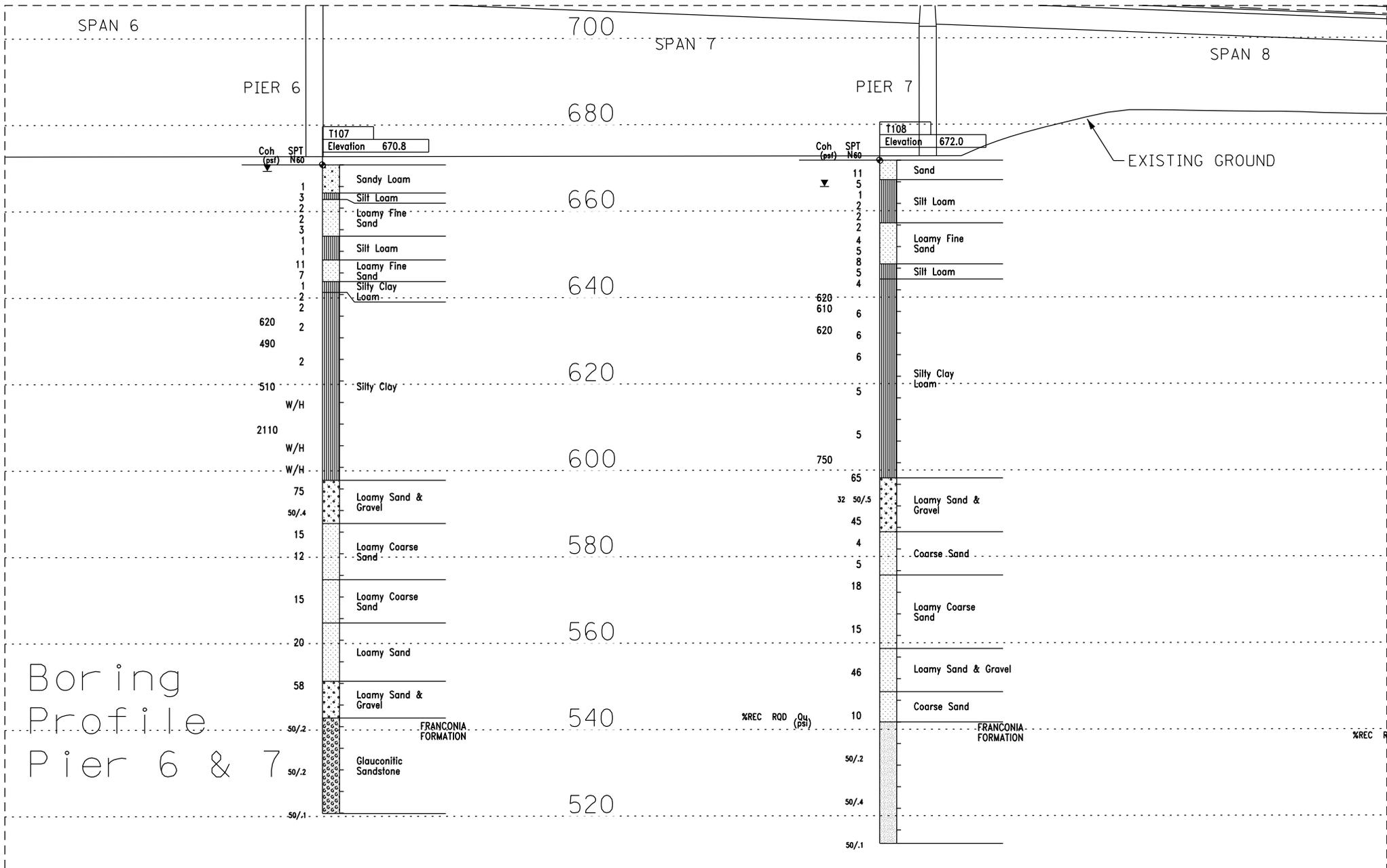
T106 Elevation 671.2

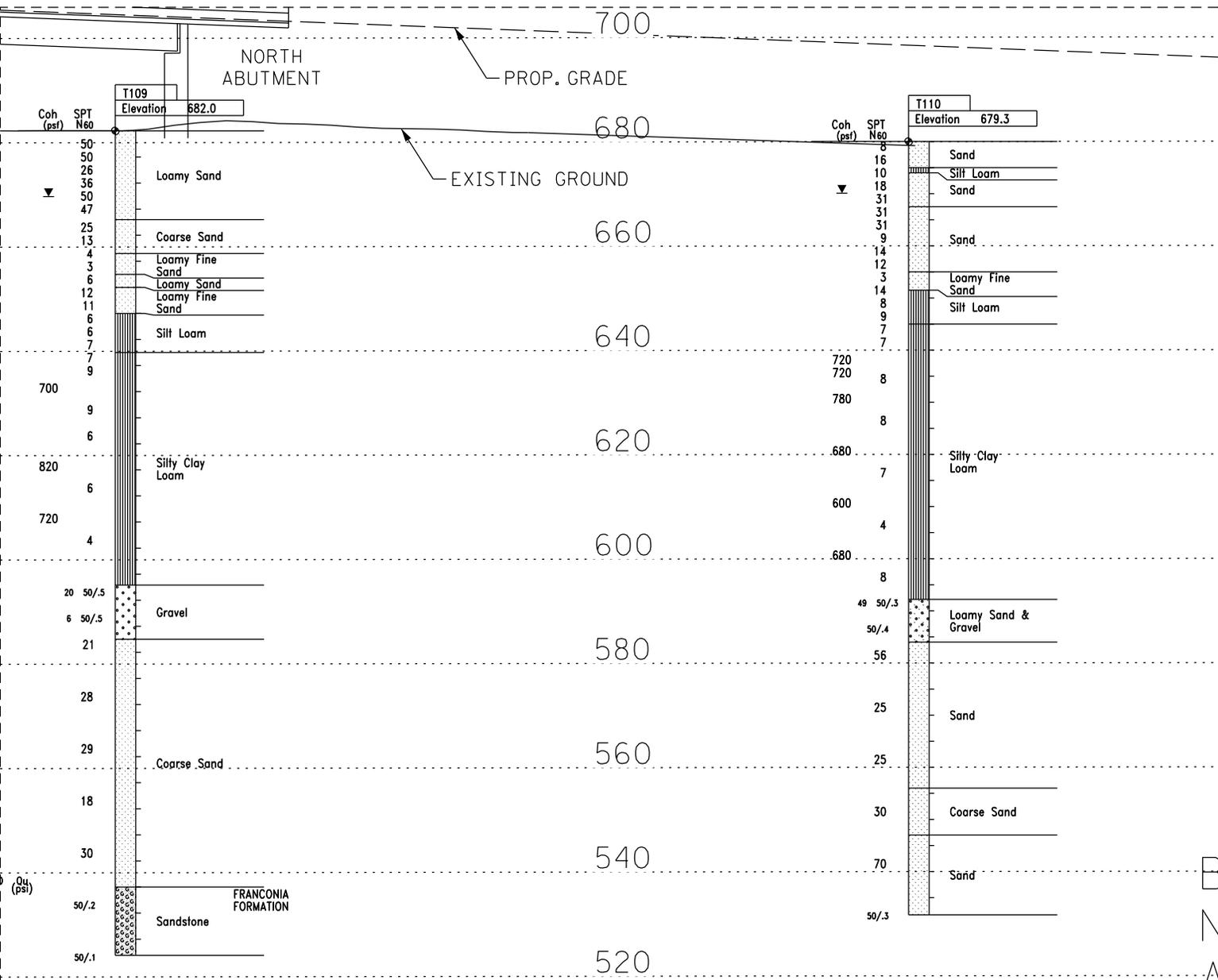
%REC ROD Q<sub>u</sub> (psi)

# Boring Profile Pier 4 & 5

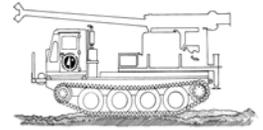
FRANCONIA FORMATION

FRANCONIA FORMATION Possible Birkmose Member





Boring Profile  
 North  
 Abutment



**USER NOTES, ABBREVIATIONS AND DEFINITIONS - Additional information available in Geotechnical Manual.**

This boring was made by ordinary and conventional methods and with care deemed adequate for the Department's design purposes. Since this boring was not taken to gather information relating to the construction of the project, the data noted in the field and recorded may not necessarily be the same as that which a contractor would desire. While the Department believes that the information as to the conditions and materials reported is accurate, it does not warrant that the information is necessarily complete. This information has been edited or abridged and may not reveal all the information which might be useful or of interest to the contractor. Consequently, the Department will make available at its offices, the field logs relating to this boring.

Since subsurface conditions outside each borehole are unknown, and soil, rock and water conditions cannot be relied upon to be consistent or uniform, no warrant is made that conditions adjacent to this boring will necessarily be the same as or similar to those shown on this log. Furthermore, the Department will not be responsible for any interpretations, assumptions, projections or interpolations made by contractors, or other users of this log.

Water levels recorded on this log should be used with discretion since the use of drilling fluids in borings may seriously distort the true field conditions. Also, water levels in cohesive soils often take extended periods of time to reach equilibrium and thus reflect their true field level. Water levels can be expected to vary both seasonally and yearly. The absence of notations on this log regarding water does not necessarily mean that this boring was dry or that the contractor will not encounter subsurface water during the course of construction.

- WH** ..... Weight of Hammer
- WR** ..... Weight of Rod
- Mud** ..... Drilling Fluids in Sample
- CS** ..... Continuous Sample

**SOIL/CORE TESTS**

- SPT N<sub>60</sub>** ..... ASTM D1586 Modified Blows per foot with 140 lb. hammer and a standard energy of 210 ft-lbs. This energy represents 60% of the potential energy of the system and is the average energy provided by a Rope & Cathead system.
- MC** ..... Moisture Content
- COH** ..... Cohesion
- γ** ..... Sample Density
- LL** ..... Liquid Limit
- PI** ..... Plasticity Index
- Φ** ..... Phi Angle
- REC** ..... Percent Core Recovered
- RQD** ..... Rock Quality Description (Percent of total core interval consisting of unbroken pieces 4 inches or longer)
- ACL** ..... Average Core Length (Average length of core that is greater than 4 inches long)
- Core Breaks** .... Number of natural core breaks per 2-foot interval.

- very loose ..... 0-4
- loose ..... 5-10
- medium dense ..... 11-24
- dense ..... 25-50
- very dense ..... >50

**Consistency - Cohesive Soils BPF**

- very soft ..... 0-1
- soft ..... 2-4
- firm ..... 5-8
- stiff ..... 9-15
- very stiff ..... 16-30
- hard ..... 31-60
- very hard ..... > 60

**COLOR**

- blk** ..... Black
- grn** ..... Green
- org** ..... Orange
- dk** ..... Dark
- IOS** ..... Iron Oxide Stained
- wht** ..... White
- brn** ..... Brown
- yel** ..... Yellow
- lt** ..... Light

**GRAIN SIZE /PLASTICITY**

- VF** ..... Very Fine
- F** ..... Fine
- Cr** ..... Coarse
- pl** ..... Plastic
- slpl** ..... Slightly Plastic

**SOIL/ROCK TERMS**

- C** ..... Clay
- L** ..... Loam
- S** ..... Sand
- Si** ..... Silt
- G** ..... Gravel (No. 10 Sieve to 3 inches)
- Bldr** ..... Boulder (over 3 inches)
- T** ..... till (unsorted, nonstratified glacial deposits)
- Lmst** ..... Limestone
- Sst** ..... Sandstone
- Dolo** ..... Dolostone
- wx** ..... weathered

**DISCONTINUITY SPACING**

- | Fractures  | Distance     | Bedding   |
|------------|--------------|-----------|
| Very Close | <2 inches    | Very Thin |
| Close      | 2-12 inches  | Thin      |
| Mod. Close | 12-36 inches | Medium    |
| Wide       | >36 inches   | Thick     |

**DRILLING SYMBOLS**

**WATER MEASUREMENT**

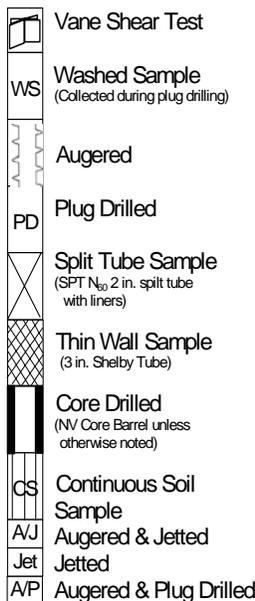
- AB** ..... After Bailing
- AC** ..... After Completion
- AF** ..... After Flushing
- w/C** ..... with Casing
- w/M** ..... with Mud
- WSD** ..... While Sampling/Drilling
- w/AUG** ..... with Hollow Stem Auger

**MISCELLANEOUS**

- NA** ..... Not Applicable
- w/** ..... with
- w/o** ..... with out
- sat** ..... saturated

**DRILLING OPERATIONS**

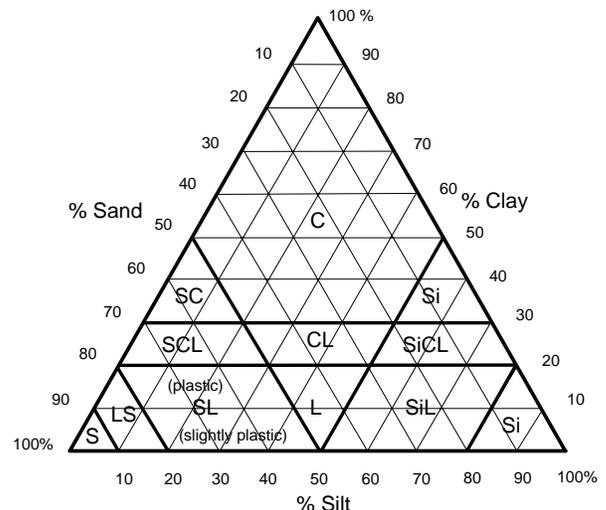
- AUG** ..... Augered
- CD** ..... Core Drilled
- DBD** ..... Disturbed by Drilling
- DBJ** ..... Disturbed by Jetting
- PD** ..... Plug Drilled
- ST** ..... Split Tube (SPT test)
- TW** ..... Thinwall (Shelby Tube)
- WS** ..... Wash Sample
- NSR** ..... No Sample Retrieved
- A/J** ..... Augered & Jetted
- Jet** ..... Jetted
- APV** ..... Augered & Plug Drilled



**RELATIVE DENSITY**

Compactness - Granular Soils BPF

**Mn/DOT Triangular Textural Soil Classification System**



MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 78968**  
 U.S. Customary Units

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T100</b>		Ground Elevation <b>682.0</b> (Surveyed)			
Location Goodhue Coord: X=656365 Y=237210 (ft.)						Drill Machine <b>205120 CME(LC55) Track</b>				SHEET 1 of 1	
Latitude (North)=44°34'10.19" Longitude (West)=92°32'00.11"						Hammer <b>CME Automatic Calibrated</b>				Drilling Completed <b>8/19/14</b>	
No Station-Offset Information Available										Other Tests Or Remarks	
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests Or Remarks	
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)			
					REC (%)	RQD (%)	ACL (ft)	Core Breaks	Rock	Formation or Member	
5	6.5 675.5	Loamy Sand and Gravel with a few stone pieces, dark browns and damp			12	15					
	9.0 673.0	Loamy Sand with Fine Gravel, brown and damp			9	11					
10	11.5 670.5	Loamy Sand and Gravel, gray-brown and very moist			3	12					
	14.0 668.0	Loamy Sand and Gravel, light gray-brown and moist			12	18					
15	16.0 666.0	malodorous Gravel and stone pieces with some Loamy Sand, dark brown and wet			10	8					
	22.0 660.0	samples provided to Consultant			29	N/A					
20					28	N/A					
					38	N/A					
25					19	12					
					63	10					
	28.0 654.0	Loamy Coarse Sand and Gravel, brown to light brown, wet		PD							
Bottom of Hole - 28.0' Water measured at 13.9' with auger											

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 79081**

**U.S. Customary Units**



This boring was taken by AET under a consultant contract for Mn/DOT

State Project		Bridge No. or Job Desc.		Trunk Highway/Location		Boring No.		Ground Elevation		
2515-21		25033		US Highway TH 63		T100A		682.0 (Surveyed)		
Location Goodhue Coord: X=656362 Y=237207 (ft.)						Drill Machine 41C				
Latitude (North)=44°34'10.16" Longitude (West)=92°32'00.15"						Hammer CME Automatic Calibrated				
No Station-Offset Information Available						SHEET 1 of 2				
						Drilling Completed 11/3/14				
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests
	Elev.				N60	(%)	(psf)	(pcf)		Or Remarks
					REC	RQD	ACL	Core Breaks	Rock	Formation or Member
					(%)	(%)	(ft)			
	0.5 681.5		GRAVELLY LOAMY SAND, brown, damp, A-1-b, fill		14	6				Hammer Calibration: 68% efficiency with 101-lb. hammer, 9/27/13  Water lever measured at 14' deep with HSA to 14.5' deep (maintained same level for 17 minutes)  2/.5 + 7/.5 + 16/.5 + 23/.5
	4.5 677.5		GRAVELLY LOAMY SAND, pieces of concrete and bituminous, dark brown, damp, A-1-b, fill		13	9				
	9.5 672.5		GRAVELLY LOAMY SAND, a little ashes/cinders and pieces of brick, dark brown, damp, A-1-b, fill		5	13				
	12.0 670.0		GRAVELLY LOAMY SAND, a little silt loam, dark grayish brown, damp, A-1-b, fill		2	14				
	14.5 667.5		BRICK PIECES, a little loamy sand, brown, damp, A-1-b, fill		6	14				
	19.5 662.5		GRAVEL, a little loamy sand, dark brown, saturated, A-1-b, fill (oily sheen, but no noticeable odor)		12					
	22.0 660.0		SLIGHTLY ORGANIC SILT LOAM, trace shells and roots, dark brown, wet, very stiff, A-6, alluvium		10					
	25				9					
	30				23	39				
	35				41	9				
	40				45	9				
	44.5				58	7				
			GRAVELLY SAND, grayish brown, saturated, dense to very dense, A-1-b, alluvium		61	7				
					53	7				
					30	10				
			SAND, light grayish brown, saturated, dense, A-1-b, alluvium		43	9				
					51	13				
					42	14				
			GRAVELLY LOAMY SAND, light brown, saturated, medium dense, A-1-b, alluvium							



MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 77947**  
 U.S. Customary Units

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T101</b>		Ground Elevation <b>672.7 (Surveyed)</b>			
Location Goodhue Coord: X=656097 Y=237556 (ft.)						Drill Machine <b>211304 CME Fat Tire</b>				SHEET 1 of 2	
Latitude (North)=44°34'13.63" Longitude (West)=92°32'03.78"						Hammer <b>CME Automatic Calibrated</b>				Drilling Completed <b>10/31/13</b>	
No Station-Offset Information Available										Other Tests Or Remarks	
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Formation or Member	
	Elev.				N60	(%)	(psf)	(pcf)			
					REC (%)	RQD (%)	ACL (ft)	Core Breaks	Rock		
5	5.3 667.4	Air									
10		Water									
22.5	22.5 650.2				1	N/A					
25		Sand, gray and saturated			9	26					
29.5	29.5 643.2				4	23					
30		organic plastic Silt Loam, gray and wet			1	42				high Fine Sand content 29.5'-34.5'	
34.5	34.5 638.2				1	56					
35					2	67					
40					1	66					
45					W/H	65					
45		organic Silty Clay Loam with a few shell fragments, gray and wet			W/H	75					
45					W/H	81					
45					W/H	77					
50					PD						
55					W/H	51					
55					PD						
60					W/R	64					
60					PD						

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 77947**  
 U.S. Customary Units

Mn/DOT GEOTECHNICAL SECTION - LOG & TEST RESULTS

SHEET 2 of 2

State Project <b>2515-21</b>	Bridge No. or Job Desc. <b>25033</b>	Trunk Highway/Location <b>US Highway TH 63</b>	Boring No. <b>T101</b>	Ground Elevation <b>672.7 (Surveyed)</b>
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DEPTH	Depth Elev.	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil Rock	Other Tests Or Remarks
					N <sub>60</sub>	(%)	(psf)	(pcf)		REC (%)
65			organic Silty Clay Loam with a few shell fragments, gray and wet (continued)	PD						
				⊗	W/R	92				
				PD						
				⊗		70	870	96		
70	71.0									
	601.7			PD						
			thinly varved organic Silty Clay Loam and plastic Silt Loam with traces of Fine Sand, grays and wet	⊗						
	74.0			⊗		77	870	95		
	598.7		Coarse Sand with a little Gravel, gray and saturated	⊗						
	75.0			⊗	25	17				
	597.7			PD						
			Sand and Gravel with a few stone chips, gray and saturated	⊗	34	16				
	81.0			⊗	50/5					
	591.7			PD						
			Gravel, gray and saturated	⊗	50/2	N/A				
	85.0		Approximate Top of Bedrock	⊗						
	587.7			⊗	50/2	N/A				
				⊗						FRANCONIA FORMATION Tomah Member
				⊗	85	8	0.40	>15		
				⊗				>15		
			INTERBEDDED SANDSTONE & SILTSTONE; vf sand to clay; laminated to thin bedding; thin 1/2" and less very soft grn gray micaceous siltstone/shale seams common; minor glauconite; likely a transition zone btw Reno & Tomah member; mod hard; brn to dark grn-gry.	⊗	95	11	0.56	>15		
				⊗				>15		
				⊗	80	16	0.40	>15		
				⊗				>15		
				⊗	100	0	N/A	>15		
				⊗				>15		

108.0  
564.7  
Bottom of Hole - 108.0'  
No water measured during drilling

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 77948**  
 U.S. Customary Units

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T102</b>		Ground Elevation <b>672.5 (Surveyed)</b>			
Location Goodhue Coord: X=656043 Y=237680 (ft.)						Drill Machine <b>211304 CME Fat Tire</b>				SHEET 1 of 2	
Latitude (North)=44°34'14.86" Longitude (West)=92°32'04.52"						Hammer <b>CME Automatic Calibrated</b>				Drilling Completed <b>11/13/13</b>	
No Station-Offset Information Available										Other Tests Or Remarks	
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests Or Remarks	
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)			
					REC (%)	RQD (%)	ACL (ft)	Core Breaks	Rock	Formation or Member	
	4.2		Air								
5	668.3										
	8.5		Water								
10	664.0				W/H	31					
15					W/H	40					
20			Loamy Sand with a few seams and thin seams of plastic Silt Loam, grays and saturated		7	26					
25					15	31					
30					7	27					
32.0	640.5										
35					W/H	48					
40					6	57	550	101			
45					4	53	470	102		%org-5.8; CCE-14.13	
50					5	66	570	97			
55			marly mixed organic Silty Clay and Silty Clay Loam, some layers crumbly, with shells and shell fragments, a few pockets of Silt; grays with light gray; very moist to wet		5	55	630	100			
60					5	50	290	102		%org-4.4	
65					5	58					
70					W/H	66	320	98		%org-6.2	
75					9	62	850	98		%org-5.7; CCE-20.62	
75.8	596.7		organic plastic Silt Loam with thin seams of Silt, light gray and very moist		9	63				%org-6.7	
76.0						60	660	102			
80			Loamy Sand with Silt mixed in, gray and wet		16	22					

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 77948**  
 U.S. Customary Units

Mn/DOT GEOTECHNICAL SECTION - LOG & TEST RESULTS

SHEET 2 of 2

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T102</b>		Ground Elevation <b>672.5 (Surveyed)</b>			
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests Or Remarks	
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)		REC (%)	RQD (%)
	596.5		plastic Silt Loam, gray and very moist	⊗	22	16					
	76.4		Sand, gray and saturated	⊗							
85	596.1		Sand and Gravel, gray and saturated (continued)	⊗	12	30					
	76.6										
	595.9										
	77.8										
90	594.7			⊗	62	13					
	96.3		Approximate Top of Bedrock	⊗	36	12					
	576.2			50/3	50/3						FRANCONIA FORMATION Tomah Member
				86	86	0	N/A	>15			
105			INTERBEDDED SANDSTONE & SILTSTONE; very fine sand to clay; thin layers of greenish gray micaceous siltstone/shale beds; pale gray-green.	PD	50/5	17					
					PD	50/5	21				
					PD	50/3	18				
					PD	50/1	18				
120	553.5				86	0	N/A	>15			Birkmose Member
125					98	0	N/A	>15			
130			GLAUCONITIC SANDSTONE; very fine grained sand to clay sized particles; thin bedded; highly glauconitic, bioturbated areas with clasts and thin seams of shale/siltstone, minor dolomite cemented zones, glauconite content decreases some at approximately 136'; moderately hard; dark green to greenish gray.		94	0	N/A	>15			
						91	0	N/A	15		
						98	41	0.51	10		
						88	15	0.73	14		
140											Possible transition from Franconia Formation to Wonewoc Sandstone - Conformable contact - approximately 146'.
145	146.0		SANDSTONE; fine to medium grained; thin bedded; black brachiopod fossils common; moderately hard; gray.					15			
	526.5										
	149.5		GLAUCONITIC SANDSTONE; same as interval 119'-146'								
	523.0										
	151.0		Bottom of Hole - 151.0'								
	521.5										

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 77949**  
 U.S. Customary Units

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T103</b>		Ground Elevation <b>672.8 (Surveyed)</b>			
Location Goodhue Coord:X=656156 Y=237633 (ft.)						Drill Machine <b>211304 CME Fat Tire</b>				SHEET 1 of 2	
Latitude (North)=44°34'14.39" Longitude (West)=92°32'02.96"						Hammer <b>CME Automatic Calibrated</b>				Drilling Completed <b>11/21/13</b>	
No Station-Offset Information Available										Other Tests Or Remarks	
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests Or Remarks	
	Elev.				N60	(%)	(psf)	(pcf)			
					REC	RQD	ACL	Core Breaks		Formation or Member	
					(%)	(%)	(ft)				
5	5.1 667.7	Air									
10		Water									
20	20.0 652.8	organic plastic Silt Loam with a few thin seams of Sand, gray with light gray, wet			50	38				Approximate river bottom at 20.0'	
25	23.0 649.8	Sand with wood piece at 24.5', light gray and saturated			60	20					
30					32	29					
35	32.0 640.8				3	21					
40					5	26					
45		Loamy Sand with wood shavings at 44.5', gray and saturated			5	24					
50					9	22					
55	52.0 620.8				9	47					
60		marly crumbly organic Silty Clay with shells and shell fragments, gray and very moist			7	65 57	910	98		%org-6.0	
65					8	77 64	930	94		%org-7.3	
70						65	670	96		%org-7.1	
75	73.5 599.3	Coarse Sand and Gravel, gray to light gray, saturated			W/H 16	19					
80					22	23					

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 77949**  
 U.S. Customary Units

Mn/DOT GEOTECHNICAL SECTION - LOG & TEST RESULTS

SHEET 2 of 2

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T103</b>		Ground Elevation <b>672.8 (Surveyed)</b>		
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)		Or Remarks
					REC	RQD	ACL	Core	Rock	Formation
					(%)	(%)	(ft)	Breaks		or Member
85	87.5	Coarse Sand and Gravel, gray to light gray, saturated (continued)	Approximate Top of Bedrock	X	10	10				
	585.3				28					
90		INTERBEDDED SANDSTONE & SILTSTONE; very fine sand to clay; thin layers of greenish gray micaceous siltstone/shale beds; pale gray-green.		PD	50/2	24				FRANCONIA FORMATION Tomah Member
95					30					
100					50/2					
105					50/2					
110	109.0	INTERBEDDED SANDSTONE & SILTSTONE; very fine sand to clay; laminated to thin bedding; thin 3/8" and less very soft greenish gray micaceous siltstone/shale beds; minor dolomite cemented zones; moderately hard; brown to dark green-gray.		PD	50/2	25				
115	563.8				90					
117.0	558.8	GLAUCONITIC SANDSTONE; very fine grained sand to clay sized particles; highly glauconitic and dolomitized; mod hard to hard; dark green and gray.		PD	100	23	0.59	>15		Birkmose Member
119.0	555.8				95	18	0.46	>15		Tomah Member
120	553.8	INTERBEDDED SANDSTONE & SILTSTONE; same as 109' - 114'.		PD	95	18	0.46	>15		Birkmose Member
125					98	7	0.35	15		
130		GLAUCONITIC SANDSTONE; very fine grained sand to clay; highly glauconitic with notable decrease starting at 134', bioturbated areas w/clasts & seams up to 1" of siltstone/shale, minor dolomite cemented zones, ; moderately hard; dark green to greenish gry.		PD	87	0	N/A	15		
135					62	0	N/A	N/A		
140					96	37	0.79	8		
145	528.8				88	7	0.36	>15		
146.2	526.6	SANDSTONE; fine to medium grained sand; thin bedded; black Brachiopod fossils common; moderately hard; gray.		PD	88	7	0.36	>15		Possible transition from Franconia Formation to Wonewoc Sandstone - Conformable contact - approximately 144'.
149.0	523.8				8					
		Bottom of Hole - 149.0'								

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 78969**  
 U.S. Customary Units

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T104</b>		Ground Elevation <b>673.7</b> (Surveyed)			
Location Goodhue Coord:X=655942 Y=237770 (ft.)						Drill Machine <b>211304 CME Fat Tire</b>				SHEET 1 of 2	
Latitude (North)=44°34'15.76" Longitude (West)=92°32'05.90"						Hammer <b>CME Automatic Calibrated</b>				Drilling Completed <b>9/11/14</b>	
No Station-Offset Information Available										Other Tests Or Remarks	
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests Or Remarks	
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)			
					REC (%)	RQD (%)	ACL (ft)	Core Breaks	Rock	Formation or Member	
▼	3.5		Loamy Fine Sand with a little Gravel, browns and moist			6				smooth and soft drilling to 35.0'	
5	670.2		plastic Silt Loam with wood and a few pockets of Fine Sand, gray with light gray, moist		2	33					
	5.5		Loamy Fine Sand with thin seams of plastic Silt Loam, light gray with gray, very moist		1	32					
	668.2				7	29					
10	10.5		plastic Silt Loam with thin seams and traces of Loamy Fine Sand, gray with light gray, very moist		8	29					
	663.2				13	38					
15	15.5		Loamy Sand with a few traces of organic matter, grays and wet	PD	8	22					
	658.2			PD	10	26					
20				PD	16	26					
25	25.5		plastic Silt Loam, gray and very moist	PD	5	27					
	648.2			PD	6	41					
	27.0		Loamy Fine Sand, light grays and wet	PD	2	35				high Silt content	
30	646.7		plastic Silt Loam with traces of Loamy Fine Sand and organic matter, gray with light gray, very moist	PD	W/H	42					
	30.5			PD		46	580	107			
	643.2		marly organic mixed Silty Clay Loam and plastic Silt Loam with a few shell fragments, gray and very moist	PD	3	53					
35	33.0			PD		51	520	101		drilling smooth and a little slow "sticky" to 72.0'	
	640.7			PD	4	50				%0rg-5.5; CCE-16.84	
40	43.0			PD		47	600	102			
	630.7			PD	6	65				%0rg-7.0; CCE-14.94	
45				PD		61	690	97			
50				PD	4	64					
55			marly organic Silty Clay Loam with some plastic Silt Loam, shell and shell fragments; grays and very moist	PD		51	830	101		%0rg-5.0; CCE-13.95	
60				PD	W/H	65					
65				PD		71	1010	94			
70				PD	3	67				%0rg-6.4; CCE-30.68	
75	72.0		Sand and Gravel with a seam of plastic Silt Loam at 79.0', gray and wet	PD		24	16			drilling rough 72.0'-72.5' then smooth 72.5'-73.5'	
	601.7			PD						drilling a little rough to 83.5'	
80				PD	80	17					

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 78969**  
 U.S. Customary Units

Mn/DOT GEOTECHNICAL SECTION - LOG & TEST RESULTS

SHEET 2 of 2

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T104</b>		Ground Elevation <b>673.7 (Surveyed)</b>		
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)		Or Remarks
					REC	RQD	ACL	Core	Rock	Formation
					(%)	(%)	(ft)	Breaks		or Member
85			Sand and Gravel with a seam of plastic Silt Loam at 79.0', gray and wet ( <i>continued</i> )	PD	34 50/3	12				drilling became rough 83.5'-88.5'
90	91.0 582.7			PD	50/3	N/A				still rough and hard with small layers of softer material
95				PD	18	16				soft and smooth to 115.0'
100			Coarse Sand, gray-brown and saturated	PD	24	18				
105				PD						
110				PD	17	20				
115	115.0 558.7		Possible Top of Bedrock	PD						FRANCONIA FORMATION
120			GLAUCONITIC SANDSTONE; silt-sized to fine grained; glauconitic, dolomitic; light yellow brown	PD	50/2	12				hard and just a little rough to 118.5'
125				PD						smooth and a little hard to 138.5'
130	128.5 545.2			PD	50/1	N/A				
135				PD						
140			GLAUCONITIC SANDSTONE; silt-sized to coarse grained; grain size increasing w/depth; slightly glauconitic; dolomitic; green gray	PD	50/2	17				drilling smooth and hard
145				PD						
	148.6 525.1		Bottom of Hole - 148.6' Water measured at 2.8' with auger		50/1	14				

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 78970**  
 U.S. Customary Units

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T105</b>		Ground Elevation <b>676.4 (Surveyed)</b>			
Location Goodhue Coord: X=655861 Y=237868 (ft.)						Drill Machine <b>211304 CME Fat Tire</b>				SHEET 1 of 2	
Latitude (North)=44°34'16.73" Longitude (West)=92°32'07.01"						Hammer <b>CME Automatic Calibrated</b>				Drilling Completed <b>9/4/14</b>	
No Station-Offset Information Available										Other Tests Or Remarks	
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Formation or Member	
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)			
					REC (%)	RQD (%)	ACL (ft)	Core Breaks	Rock		
5	5.0 671.4	Concrete rubble with some plastic Loam, light gray with brown, damp			34	10				rough and hard 0.0'-3.0' smooth and soft to 73.0'	
10	10.0 666.4	slightly plastic to plastic Silt Loam, grays and moist			4	34				high Silt content	
					W/H	36					
		Loamy Fine Sand, light grays and wet			4	30					
15	15.6 660.8	plastic Silt Loam, gray and very moist		PD	4	27					
	16.0 660.4	Loamy Fine Sand with a few thin seams of plastic Silt Loam, light gray with gray, wet		PD	4	44					
	22.5 653.9	plastic Silt Loam with traces of Loamy Fine Sand and some organic matter, gray and wet		PD	9	25					
	25.0 651.4			PD	10	30					
		Loamy Sand, light grays and wet		PD	3	41					
				PD	11	27					
				PD	10	25					
35	33.2 643.2			PD	1	32					
				PD	3	36					
				PD	W/H	49					
				PD		53	510	100			
40				PD	6	47					
				PD		50	460	102			
45				PD	7	61					
				PD		71	670	94			
50				PD							
		mixed Silty Clay Loam and plastic Silt Loam with shells and shell fragments, gray and very moist		PD	3	68					
55				PD							
				PD		55	190	99			
60				PD							
				PD	W/H	64					
65				PD							
				PD		66					
70	71.5 604.9			PD							
		Loamy Coarse Sand and Gravel with a few stone pieces, gray and wet		PD	52	12				rough and a little harder, bumpy to 96.0'	
75				PD							
80				PD	18 50/3	16					

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 78970**  
 U.S. Customary Units

Mn/DOT GEOTECHNICAL SECTION - LOG & TEST RESULTS

SHEET 2 of 2

State Project <b>2515-21</b>	Bridge No. or Job Desc. <b>25033</b>	Trunk Highway/Location <b>US Highway TH 63</b>	Boring No. <b>T105</b>	Ground Elevation <b>676.4</b> (Surveyed)
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DEPTH	Depth Elev.	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil Rock	Other Tests Or Remarks
					N <sub>60</sub>	(%)	(psf)	(pcf)		REC (%)
85		Loamy Coarse Sand and Gravel with a few stone pieces, gray and wet (continued)		PD	88	10				36 gal mud loss
90				PD	49 50/4	13				
95				PD	49 50/3	12				
96.0	580.4			PD						
100		Coarse Sand, gray and saturated		PD	22	21				smooth and fast 96.0'-98.0' smooth and soft drilling to 116.0'
105				PD						
110				PD	21	23				
115	116.0 560.4	Sand with a little Gravel and a thin seam of plastic Silt Loam, gray and very moist		PD						harder drilling 116.0'-118.0' drilling a little rough and hard to 121.0'
120	121.0 555.4			PD	67	19				
125		GLAUCONITIC SANDSTONE; likely weathered; silt sized to fine grained sand; glauconitic; light green, gray		PD						Driller notes possible bedrock due to mud change at 121 ft FRANCONIA FORMATION
128.2	548.2			PD	50/2	20				

Bottom of Hole - 128.2'  
 Water measured at 8.8' with auger

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 78971**  
 U.S. Customary Units

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T106</b>		Ground Elevation <b>671.2 (Surveyed)</b>		
Location Goodhue Coord: X=655792 Y=237951 (ft.)						Drill Machine <b>205120 CME(LC55) Track</b>		SHEET 1 of 2		
Latitude (North)=44°34'17.55" Longitude (West)=92°32'07.95"						Hammer <b>CME Automatic Calibrated</b>		Drilling Completed <b>10/8/14</b>		
No Station-Offset Information Available										
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)		Or Remarks
					REC	RQD	ACL	Core Breaks	Rock	Formation or Member
					(%)	(%)	(ft)			
4.0	667.2	slightly plastic Sandy Loam, brown and wet				17				soft drilling
5	664.2	mixed Silty Clay Loam and Silty Clay with a few seams of Sand at 5.9' and a little wood, gray and very moist			5	39	520	117		
10	659.2	Loamy Fine Sand with some organic matter and a few thin seams of Silty Clay Loam, grays and wet			4	28	840	103		
15	658.2	Silty Clay Loam, gray and wery moist			7	27				a little heave
20	653.2	Loamy Fine Sand, light gray and wet			7	24				
25	651.2	Silty Clay Loam with a few shell fragments, gray and wery moist			2	25				
30	642.7	Loamy Fine Sand with some seams and thin seams of Silty Clay Loam, light gray with gray, wet			9	37				
35					10	27				smooth drilling
40					4	31				
45					4	49				
50					2	51				
55					4	52	620	104		%org-5.8; CCE-12.08
60					6	53	410	102		%org-5.6; CCE-16.78
65					6	52	970	103		
70					5	63	1040	99		%org-7.1
75					5	63				
80					6	73	1160	100		slow drilling
					5	74				
					7	72	1260	94		%org-7.5; CCE-29.21
					5	74				
					46	15				drilling became rough at 69.5'
					75	12				
					79	N/A				drilling still rough

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 78971**  
 U.S. Customary Units

Mn/DOT GEOTECHNICAL SECTION - LOG & TEST RESULTS

SHEET 2 of 2

State Project <b>2515-21</b>	Bridge No. or Job Desc. <b>25033</b>	Trunk Highway/Location <b>US Highway TH 63</b>	Boring No. <b>T106</b>	Ground Elevation <b>671.2</b> (Surveyed)
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DEPTH	Depth Elev.	Lithology	Classification	Drilling Operation	SPT N <sub>60</sub>	MC (%)	COH (psf)	γ (pcf)	Soil Rock	Other Tests Or Remarks
					REC (%)	RQD (%)	ACL (ft)	Core Breaks		Formation or Member
				PD						rough then smooth
85				X	46 50/4	13				
				PD						
90				X	36	14				
				PD						
95				X	24	20				
				PD						
100				X	15	21				
			Loamy Sand and Gravel, gray and wet (continued)	PD						
105										
110				X	23	21				
				PD						smooth
115										
120				X	28	20				
			Approximate Top of Bedrock							
121.5 549.7				PD						FRANCONIA FORMATION Possible Birkmose Member Hard at 121' hard and smooth at 121.5'
125										
130			GLAUCONITIC SANDSTONE; Silt to fine Sand; very glauconitic decreasing slightly with depth; some thin green Shale seams; gray to green.		50/2	16				
135				PD						
138.1 533.1					50/1	16				

Bottom of Hole - 138.1'  
 No water encountered or measured during drilling

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION



**UNIQUE NUMBER 78972**  
 U.S. Customary Units

State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T107</b>		Ground Elevation <b>670.8 (Surveyed)</b>			
Location Goodhue Coord:X=655686 Y=238094 (ft.)						Drill Machine <b>207184 CME 850 Track</b>				SHEET 1 of 2	
Latitude (North)=44°34'18.97" Longitude (West)=92°32'09.40"						Hammer <b>CME Automatic Calibrated</b>				Drilling Completed <b>10/9/14</b>	
No Station-Offset Information Available										Other Tests Or Remarks	
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests Or Remarks	
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)			
					REC (%)	RQD (%)	ACL (ft)	Core Breaks	Rock	Formation or Member	
5	6.5 664.3	plastic Sandy Loam with a seam and pockets of plastic Silt Loam, dark brown with gray, moist to very moist			17						
10	8.0 662.8	plastic Silt Loam with some organic matter, gray with black, wet			42						
15	16.5 654.3	Loamy Fine Sand with a few thin seams and a 2" layer of plastic Silt Loam, light gray with gray, saturated			3						
20	22.0 648.8	Loamy Fine Sand with a few thin seams of plastic Silt Loam, light gray with gray, wet			25						
25	27.0 643.8	slightly plastic to plastic Silt Loam with thin seams of Loamy Fine Sand, gray with light gray, wet			2						
30	29.5 641.3	Loamy Fine Sand with a few thin seams of plastic Silt Loam, light gray with gray, wet			38						
35		Silty Clay Loam with a few traces of Very Fine Sand, gray with light gray, moist			30						
40					42						
45					38						
50					11						
55					7						
60					1						
65					45						
70					2						
75					53						
80					50						
					48		620	105			
					47						
					53		490				
					65						
					71		510				
					W/H						
					73		2110				
					W/H						
					78						
					W/H						
					75						
					10						
										rough drilling/rock at 73'	

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State Project <b>2515-21</b>	Bridge No. or Job Desc. <b>25033</b>	Trunk Highway/Location <b>US Highway TH 63</b>	Boring No. <b>T107</b>	Ground Elevation <b>670.8</b> (Surveyed)
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DEPTH	Depth Elev.	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil Rock	Other Tests Or Remarks
					N <sub>60</sub>	(%)	(psf)	(pcf)		REC (%)
	83.0 587.8		Loamy Sand and Gravel, gray and wet (continued)	PD	50/4	15				
85				⊗	15	19				softer drilling at 83'
90			Loamy Coarse Sand, gray and saturated	PD						
				⊗	12	15				
95	96.0 574.8			PD						
100			Loamy Coarse Sand with a little Fine Gravel, gray-brown and saturated	⊗	15	18				
105	106.0 564.8			PD						
110			Loamy Sand, gray-brown and saturated	⊗	20	19				
115				PD						
120	119.5 551.3			⊗	58	17				rough drilling at 119.5
125			Loamy Sand and Gravel, gray-brown and saturated							
128.0 542.8			Approximate Top of Bedrock	PD						rough drilling at 128'
130				—	50/2	N/A				FRANCONIA FORMATION hard smooth drilling at 128.5'
135				PD						
140			GLAUCONITIC SANDSTONE; Silt to fine Sand; very glauconitic decreasing slightly with depth; grain size slightly increasing with depth starting at 145'; some thin gray Shale seams; gray to green.	—	50/2	N/A				
145				PD						
150	150.1 520.7		Bottom of Hole - 150.1' Water measured at 1.4' with auger	—	50/1	N/A				

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State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T108</b>		Ground Elevation <b>672.0</b> (Surveyed)			
Location Goodhue Coord: X=655577 Y=238204 (ft.)						Drill Machine <b>205120 CME(LC55) Track</b>				SHEET 1 of 2	
Latitude (North)=44°34'20.06" Longitude (West)=92°32'10.90"						Hammer <b>CME Automatic Calibrated</b>				Drilling Completed <b>9/16/14</b>	
No Station-Offset Information Available										Other Tests Or Remarks	
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests Or Remarks	
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)			
					REC (%)	RQD (%)	ACL (ft)	Core Breaks	Rock	Formation or Member	
5	4.5 667.5		Sand, brown and moist		11	14					
10	14.5 657.5		plastic Silt Loam with thin seams and traces of Loamy Fine Sand, a layer of Loamy Fine Sand at at 85.0', traces of organic matter 123.5'-14.0', some roots on top; gray with light gray; moist to very moist		5	29					
15					1	37					
20					2	41					
25					2	48					
30					2	29					
35					4	30				mixed mud had heave	
40			Loamy Fine Sand with traces and a seam of plastic Silt Loam, light gray with gray, wet		5	40					
45					8	38					
50					5	45					
55					4	48					
60						48	620	105			
65						50	610	102			
70					6	51					
75						44	620	105			
80					6	48					
85						49					
					6	61					
						NSR					
					5	64					
						NSR					
					5	72					
						70	750	99			
						46					
						12					
						14					
						14					
						32					
						50/.5					
						14					
						14					

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State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T108</b>		Ground Elevation <b>672.0 (Surveyed)</b>		
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)		Or Remarks
					REC	RQD	ACL	Core	Rock	Formation
					(%)	(%)	(ft)	Breaks		or Member
	86.0 586.0			PD						
90			Coarse Sand with a little Gravel, gray-brown and wet	⊗	4	17				
				PD						
95	96.0 576.0			⊗	5	11				
				PD						
100				⊗	18	18				
				PD						
105			Loamy Coarse Sand with a little Gravel, brown and saturated	⊗						rough drilling 101.0.-102.5' smooth drilling
				PD						
110				⊗	15	22				
				PD						
115	113.0 559.0			⊗						
			Loamy sand and gravel brown, saturated	⊗	46	14				rough drilling
120				PD						
125	123.0 549.0			⊗						smoother drilling
			Coarse Sand with wood and a little gravel, gray and saturated	⊗						
130	130.0 542.0		Possible top of bedrock	⊗	10	19				
				PD						got harder and smoother FRANCONIA FORMATION Top of bedrock from driller notes-harder drilling at 130ft hard and smooth
135				—	50/2	N/A				
140				PD						smooth and hard
145			Possible SILTSTONE to SANDSTONE; samples from roller bit; clay sized to medium grained sands; light green to gray	⊗						
				—	50/4	9				
150				PD						rough on and off layered smoother drilling to bottom of hole
155				WS	50/1	NR				
	158.1 513.9		Bottom of Hole - 158.1' Water measured at 6.1' with auger							

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State Project <b>2515-21</b>		Bridge No. or Job Desc. <b>25033</b>		Trunk Highway/Location <b>US Highway TH 63</b>		Boring No. <b>T109</b>		Ground Elevation <b>682.0</b> (Surveyed)													
Location Goodhue Coord: X=655464 Y=238288 (ft.)						Drill Machine <b>205120 CME(LC55) Track</b>				SHEET 1 of 2											
Latitude (North)=44°34'20.90" Longitude (West)=92°32'12.45"						Hammer <b>CME Automatic Calibrated</b>				Drilling Completed <b>8/28/14</b>											
No Station-Offset Information Available						SPT N <sub>60</sub>		MC (%)		COH (psf)		γ (pcf)		Soil		Other Tests Or Remarks					
DEPTH		Depth Elev.		Lithology		Classification		Drilling Operation		REC (%)		RQD (%)		ACL (ft)		Core Breaks		Rock		Formation or Member	
5		17.0 665.0		Sand to Loamy Sand, brown, damp to very moist		Sand to Loamy Sand, brown, damp to very moist		50		5											
10		23.5 658.5		Coarse Sand with seams of Loamy Fine Sand, grays and wet		Coarse Sand with seams of Loamy Fine Sand, grays and wet		26		13										0.6 heave	
15		27.5 654.5		Loamy Fine Sand, gray and wet		Loamy Fine Sand, gray and wet		36		7										high Silt content to 35.0'	
20		30.0 652.0		Loamy Sand with seams of Loamy Fine Sand, gray and wet		Loamy Sand with seams of Loamy Fine Sand, gray and wet		50		14											
25		35.0 647.0		Loamy Fine Sand with a few seams of plastic Silt Loam, light gray with gray, wet		Loamy Fine Sand with a few seams of plastic Silt Loam, light gray with gray, wet		47		16											
30		42.5 639.5		plastic Silt Loam with traces of Very Fine Sand, gray with light gray, very moist		plastic Silt Loam with traces of Very Fine Sand, gray with light gray, very moist		25		14											
35								13		16											
40								4		20											
45								3		24											
50								6		18											
55								12		30											
60								11		32											
65								6		42											
70								6		42											
75								7		44											
80								7		50											
85								9		51											
								47		700		104								%Si-80.5; %C-19.4	
								9		46											
								6		58											
								60		820		96								%Si-72.7; %C-25.8	
								6		66											
								67		720		90								%Si-80.3; %C-18.4	
								4		75											
								NSR													

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State Project <b>2515-21</b>	Bridge No. or Job Desc. <b>25033</b>	Trunk Highway/Location <b>US Highway TH 63</b>	Boring No. <b>T109</b>	Ground Elevation <b>682.0</b> (Surveyed)
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DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)		Or Remarks
					REC	RQD	ACL	Core	Rock	Formation
					(%)	(%)	(ft)	Breaks		or Member
87.1	594.9			PD	20	12				
90			Gravel with stone chips and pieces, some Sand; gray-brown and saturated	PD	50/5					
95				PD	6	14				
97.5	584.5			PD	50/5					
100				PD	21	19				
105				PD						
110				PD	28	20				
115				PD						
120			Coarse Sand, gray-browns and saturated	PD	29	22				
125				PD						
130				PD	18	20				
135				PD						
140				PD	30	20				
145	537.0		Possible top of Bedrock	PD						
145				PD	50/2	16				FRANCONIA FORMATION Driller note's: Got harder at 145 ft
150			Possible SANDSTONE; silt to coarse grained; very slightly glauconitic; light gray w/some green	PD						
155				PD						
158.1	523.9		Bottom of Hole - 158.1' Water measured at 12.6' with auger	PD	50/1	13				