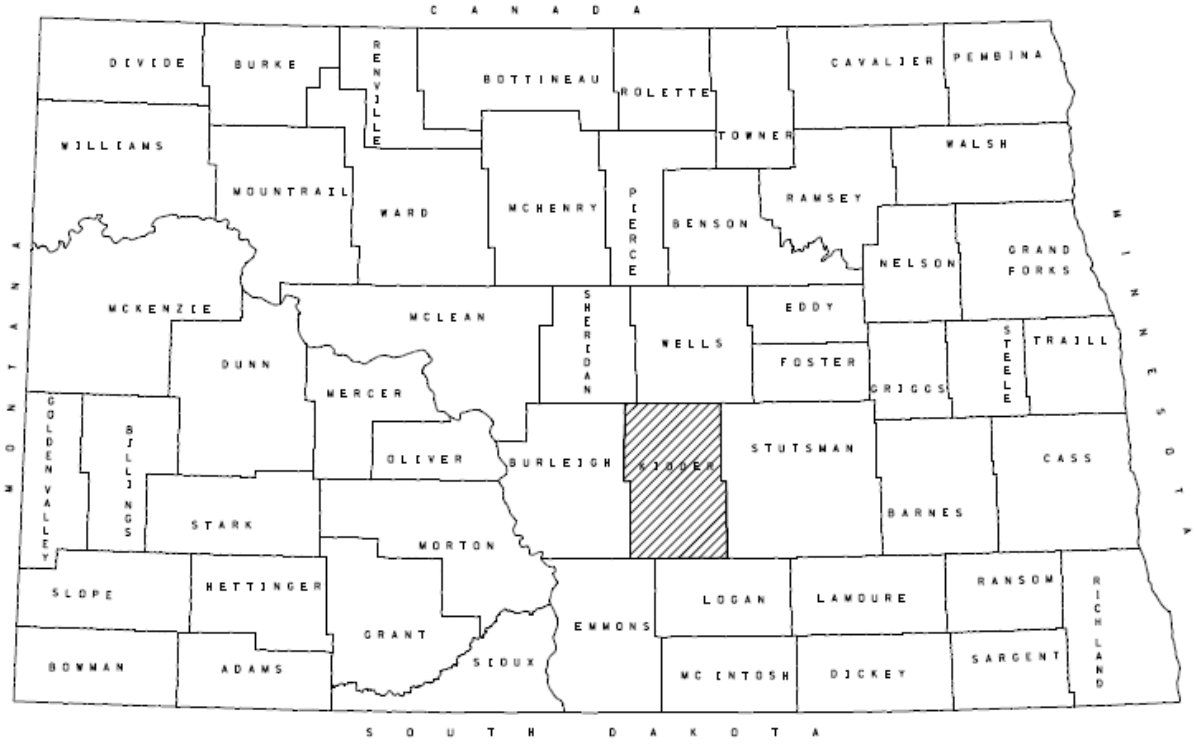
Deep Foundation Report and Analysis

PROJECT NO. IM-2-094(186)217

PCN 23344

COUNTY Kidder

Bridge #: 0094-217.145



PREPARED BY: Riley McAdoo-Roesler

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

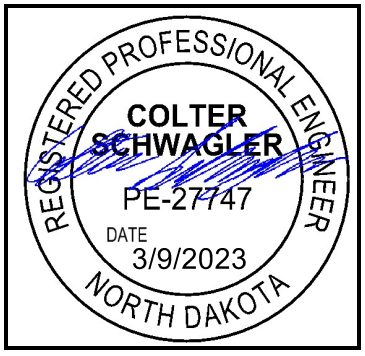
March 2023

IM-2-094(186)217

I-94/Pettibone Interchange
Bridge #: 0094-217.145

CERTIFICATION

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of North Dakota. This document was originally issued and sealed by Colter Schwagler, Registration number PE-27747 on 03/09/2023 and the original document is stored at the North Dakota Department of Transportation.



Pettibone Interchange Bridge
Deep Foundation Borings

Project: IM-2-094(186)217
PCN: 23344
Bridges: 0094-217.145
Scope: New Structure
Location: Pettibone Int.



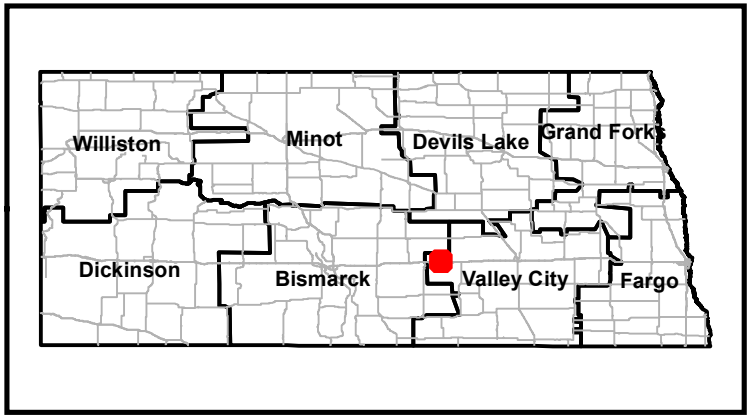


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Appendix A - Boring Logs

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Introduction

The purpose of the project is to address the existing deficiencies of the current structure by removing and replacing the bridge on the same alignment along the I-94 corridor.

This report will provide foundation, settlement, and bridge end slope recommendations for the construction of the new structure.

Existing Structure Information

There is an existing bridge on I-94 that will be removed as part of the project. The information for this structure is below.

Bridge #0094-217.145
Main Structure Type: Prestressed Conc. Stringer
Length: 224'
Foundation Type: Steel Piling/Spread footing
Year Constructed: 1958

Soil Borings

A total of 2 borings were completed near the proposed structure. See the project location map for the boring locations.

Boring #1
Boring #1 has an elevation of approximately 1832 feet at the top of boring and is located near the proposed north abutment. This boring extends to a depth of 206 feet.

Boring #2
Boring #2 has an elevation of approximately 1831 feet at the top of boring and is located near the proposed south abutment. This boring extends to a depth of 221 feet.

Sampling and Testing Procedures:

Shelby tube sampling and split spoon sampling were used to extract the samples from a hollow stem auger.

Shelby tube sampling provides an "undisturbed" sample of fine-grained soils for laboratory testing via a thin wall tube that is slowly pushed into the soils to be sampled. Densities were calculated according to AASHTO test method T-296.

Split spoon samplers are utilized during advancement of the boring to perform the Standard Penetration Test (SPT). The samples are considered "disturbed", due to the driving nature in which they are obtained. The SPT results in an N-value, or number of

blows required to drive the split spoon sampler 1 foot. This N-value is used to estimate the friction angle of non-cohesive soils and define the consistency of cohesive soils.

For cohesive soils, the shear strength values were determined from the Unconsolidated Undrained and Consolidated Undrained tests utilizing Shelby tubes samples.

The samples from the split spoon and Shelby tubes are submitted to the laboratory for determination of AASHTO classification, moisture content, dry density, sieve analysis, and Atterberg limits.

Test Results

A summary of the lab analysis has been included in the Appendix B.

Proposed Structures

Main Structure Type: 2 Span
Foundation Type: Steel H-Piles

Foundation Recommendation

Steel Piling

Pile recommendations are given as termination elevations. The pile sizes that have been analyzed are HP10x42, HP14x73 and HP14x102. See table 3 below for the recommended termination elevations.

The software “APile” was used in conjunction with engineering judgment and past experience in pile driving in these types of soils to estimate the pile lengths. The output from this analysis is available upon request from the NDDOT Geotechnical Section.

Below are simplified soil profiles for each boring that was used to predict the unfactored nominal geotechnical resistance in APile. A graphical representation of the unfactored nominal geotechnical resistance is also shown below in figures 1-3. The nominal geotechnical resistance is used to help predict the pile termination elevations which can be found in table 3 below.

Table 1 - Boring #1 Simplified Soil Profile-North Abutment

Layer	Depth (feet)	Elevation (feet)	Cohesion (lb/ft^2)	Friction Angle	Effective Unit Weight (lb/ft^3)
Medium Stiff to Stiff Brown Clayey Sand	0.0-21.0	1832.0-1811.0	-	ϕ=30.1°	126.0
Medium Stiff to Stiff Brown Clayey Sand	21.0-29.0	1811.0-1803.0	-	ϕ=30.1°	63.6
Medium Dense Brown Silty Sand	29.0-41.0	1803.0-1791.0	-	ϕ=35.1°	63.6
Dense to Very Dense Brown Silty/Clayey Sand	41.0-59.0	1791.0-1773.0	-	ϕ=42.1°	63.6
Dense Gray/Black Silty Sand	59.0-104.0	1773.0-1728.0	-	ϕ=38.3°	63.6
Soft to Stiff Gray Silt	104.0-134.0	1728.0-1698.0	c=1358 psf	-	56.7
Very Stiff Gray Sandy Clay	134.0-194.0	1698.0-1638.0	c=2205 psf	-	58.8
Hard Gray Elastic Silt	194.0-206.0	1638.0-1626.0	c=5000 psf	-	58.8

Table 2 - Boring #2 Simplified Soil Profile-South Abutment

Layer	Depth (feet)	Elevation (feet)	Cohesion (lb/ft^2)	Friction Angle	Effective Unit Weight (lb/ft^3)
Loose Brown Silty, Clayey Sand with Gravel	0.0-14.0	1831.0-1817.0	-	ϕ=30.7°	126.0
Medium Dense Brown Silty Sand with & Gravel	14.0-21.0	1817.0-1810.0	-	ϕ=37.8°	126.0
Medium Dense Brown Silty Sand with & Gravel	21.0-32.0	1810.0-1799.0	-	ϕ=37.8°	63.6
Medium Dense to Dense Brown Well-Graded Sand with Silt & Gravel	32.0-49.0	1799.0-1782.0	-	ϕ=45.2°	63.6
Medium Dense Brown Silty Sand	49.0-109.0	1782.0-1722.0	-	ϕ=37.3°	63.6
Medium Stiff to Stiff Gray Silt	109.0-149.0	1722.0-1682.0	c=1358 psf	-	56.7
Very Stiff Gray Sandy Clay	149.0-179.0	1682.0-1652.0	c=2205 psf	-	58.8
Hard Gray Elastic Silt	179.0-221.0	1652.0-1610.0	c=8000 psf	-	58.8

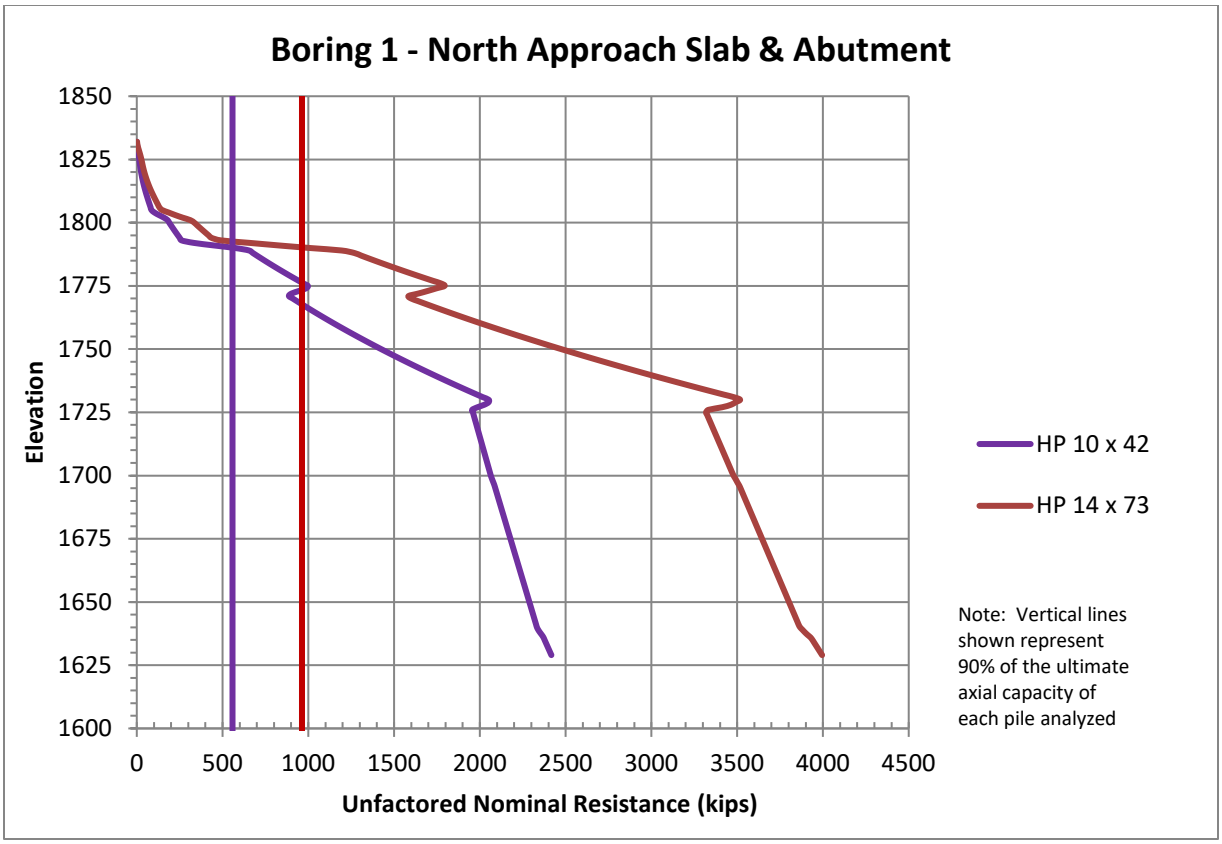


Figure 1: Nominal Resistance for Pile at North Approach Slab & Abutment

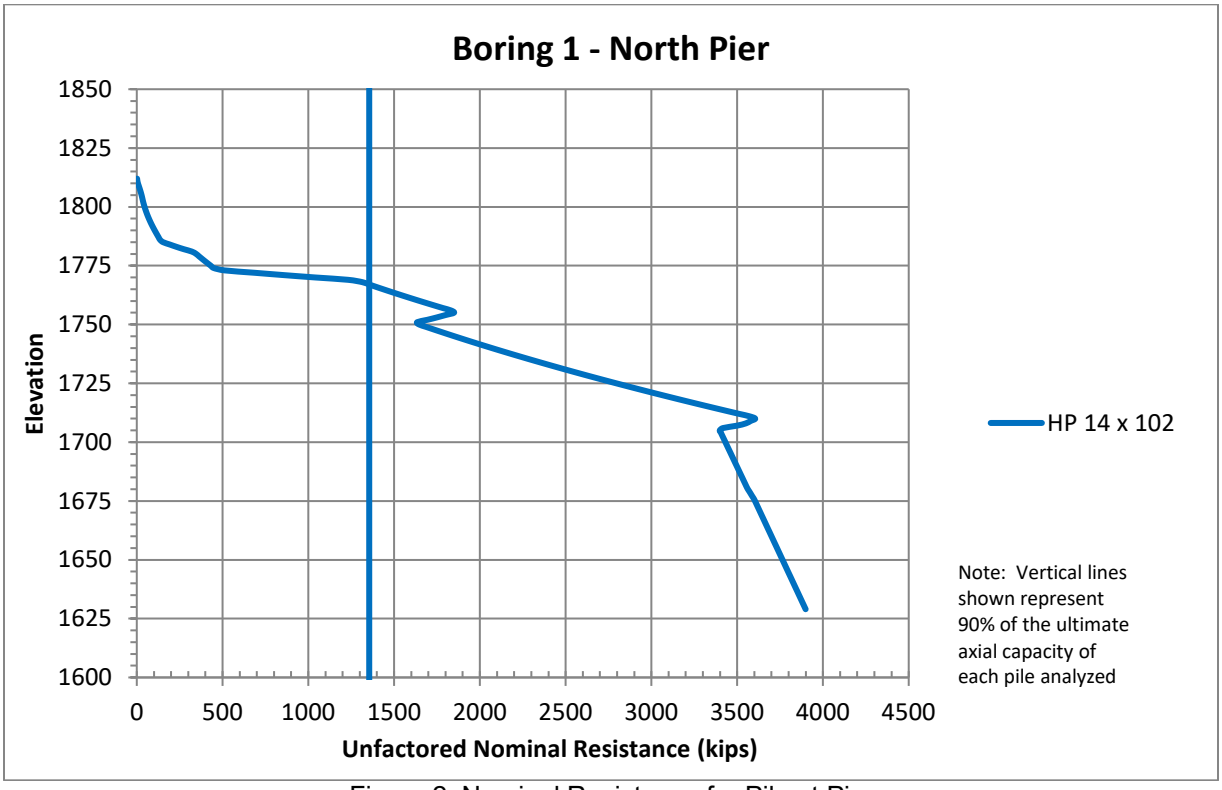


Figure 2: Nominal Resistance for Pile at Pier

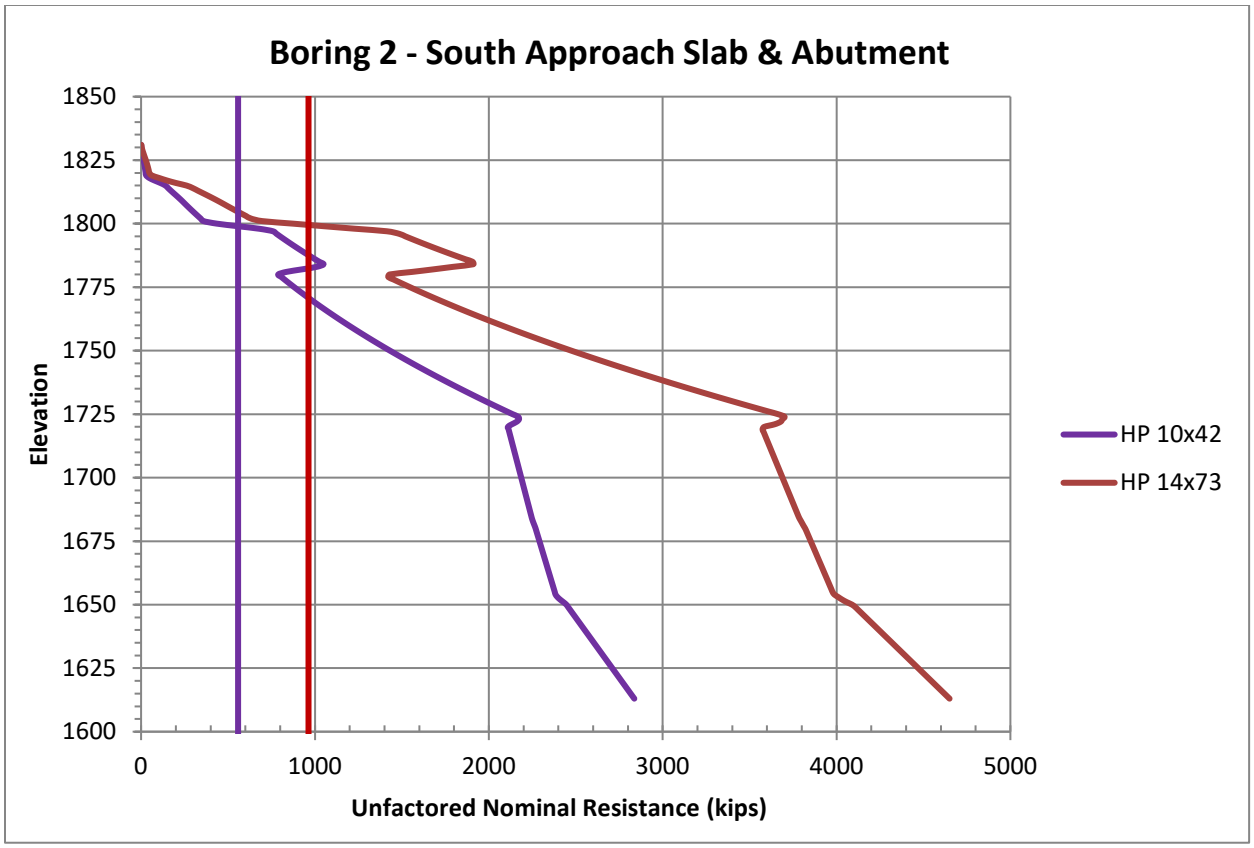


Figure 3: Nominal Resistance for Pile at South Approach Slab & Abutment

Based on the Apile information, past experience, and engineering judgement the pile termination elevations were selected as shown in the table below.

Table 3 - Pile Length Information

Pile Type	90% Ultimate Axial Capacity	North Approach Slab	North Abutment	Pier	South Abutment	South Approach Slab
	kips	Termination Elevation	Termination Elevation	Termination Elevation	Termination Elevation	Termination Elevation
HP10X42	558	1790	-	-	-	1798
HP14x73	963	-	1790	-	1799	-
HP14x102	1355	-	-	1766	-	-

Based on the sandy nature of the soil where some of the piles are estimated to reach bearing, the piles may go deeper than necessary. If the pile has not reached bearing 10 feet beyond the estimated depth, stop driving the pile and wait 24 hours to allow pile setup to occur. After 24 hours warm the hammer with a minimum of 20 blows by striking the ground or timber mats. Restrike the pile with 10 blows to determine if bearing has been achieved. If bearing was not achieved during restrike, continue to drive the pile until bearing is achieved.

Uplift capacity

Estimated unfactored uplift capacity of the piles can be found below. The uplift capacity is based on the estimated termination elevations of the pile as shown in table 3 above. The actual uplift capacity of the piles will be determined by the depth they are driven in the field. If the piles terminate before the elevations shown in table 3 the uplift capacity will be less than shown in the table 4 below.

Table 4 - Pile Uplift Information

Pile Type	North Approach Slab	North Abutment	Pier	South Abutment	South Approach Slab
	Uplift capacity (KIPs)	Uplift capacity (KIPs)	Uplift capacity (KIPs)	Uplift capacity (KIPs)	Uplift capacity (KIPs)
HP10X42	223.5	-	-	-	237.1
HP14x73	-	363.6	-	370.5	-
HP14x102	-	-	1394.1	-	-

Pile Tips

It is not anticipated that pile tips will be required for this bridge.

Downdrag

Due to the minimal amount of fill being placed at the structures downdrag is not applicable.

Scour

This bridge is not over a water crossing therefore there is no scour.

Compaction Recommendation

Compact roadway embankment material to at least 90 percent of the maximum dry density with moisture content no less than the optimum moisture and no more than 5.0 percentage points above the optimum moisture. The Engineer will determine the maximum dry density and optimum moisture content as specified in ND T 180.

Compact the aggregate transitions at the bridge ends according to section 714.04 A.10.

Slope Recommendation

A slope stability analysis was conducted with Slope/W developed by Geo-Slope International. The analysis was a two-dimensional limit equilibrium method. Bridge division requested analysis of 2.5:1 end slopes for the bridge ends. Slope stability

analysis shows that 2.5:1 slopes do not meet the required factor of safety for the North End slope. Based on our analysis it is recommended to construct slopes no steeper than 2.8:1 at the North End slope and 2.5:1 at the South End slope. The stability analysis outputs can be found in Appendix C.

Drainage Recommendation

The drainage off the bridge should be controlled so that water does not drain directly off the bridge ends and cause erosion around the wing-wall. A combination of inlets, downdrains, and/or deckdrains should be used to control water runoff. Water should not be allowed to drain off the bridge as to allow the in slopes and end slopes to become saturated, which is a common cause of slope failure.

Settlement Analysis/Recommendation

Minimal fill is proposed to be placed with this project, therefore settlement mitigation is not recommended.

Pre-Boring

Minimal fill is proposed to be placed with this project, therefore pre-boring is not recommended.

APPENDIX A

Boring Logs

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

LOG OF BORING SB - 1

PROJECT NUMBER IM-2-094(186)217 **DATE STARTED** 7/25/22 **COMPLETED** 7/25/22

PCN 23444 **ELEVATION** 1832 ft

LOCATION Kidder County **RP+Feet** 217+0766 ft **Offset** 108 N

DRILLED BY Dallan **LOGGED BY** Jamie **DRILLING METHOD**

ENGINEER

NOTES North Abutment

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	AASHTO	USCS	SAMPLE TYPE & NUMBER	RECOVERY (%)	SPT N VALUE	MC / PL / LL / CLAY FRACTION (%)	TESTS & REMARKS
1830	0	Medium Stiff to Stiff Moist/Wet Brn Clayey/Silty Sand. Water Bearing at 24' & 26'.	A-2-4	SC-SM	340	80	6		
			A-2-6	SC	341	20	4		
1820	10		A-2-4	SC	342	85	9	0 18 38	γ_d = 106.8 pcf γ = 126.1 pcf Con-1-22
			A-2-6	SC	343	40			
			A-2-4	SM	344	85	28	0 19 34	
1810	20		A-6	SC	345	75	7	0	
			A-6	CL	346	85	8		
			A-2-4	SM	347	75	16	0	
			A-2-6	SC	348	85	8		
		1803.0 ft 29.0 ft	A-2-4	SM	349	65	18	0 231	
1800	30	Medium Dense Moist Brn Silty Sand.	A-1-b	SP-SM	350	25	14		
			A-4	ML	351	15	20		
			A-2-4	SM	352	65	38		
			A-2-4	SM	353	60	31	0 226	
1790	40	1791.0 ft 41.0 ft	A-1-b	SM	354	60	23	0	
		Dense to Very Dense Moist/Wet Brn Silty/Clayey Sand. Water bearing at 59'.	A-1-b	SP-SM	355	50	55		
			A-1-b	SC-SM	356	60	35	0 225	
1780	50		A-1-b	SM	357	60			
			A-1-b	SW-SM	358	50			
			A-1-b	SC-SM	359	60			
		1773.0 ft 59.0 ft				65	21	0	
1770	60	Dense Gr/Blk/Brn Wet Silty Sand	A-1-b	SM	360	65	24	230	
			A-1-b	SM	361	75	24	0	
			A-1-b	SM	362	55	16	0	
1760	70		A-1-b	SM	363	65			
						60			
1750	80		A-2-4	SM	364	65	23	0	
						60			
						70	24	0	
1740	90		A-1-a	SP-SM	365	65			
		1728.0 ft 104.0 ft					7	0	
1730	100	Soft to Stiff Moist/Wet Gry Silt. Water bearing at 104' ,114', & 124'.	A-4	ML	366	90			
			A-4	ML	367	95	3	337	
1720	110								
					368	95	13	28 42	
1710	120								
		1698.0 ft 134.0 ft						24 47	
1700	130	Very Stiff Moist/Wet Gry Sandy Fat Clay. Water bearing at 136', 146', 154', & 164'.	A-7-6	CL	369	65	22	23 46	γ_d = 94.7 pcf γ = 120.6 pcf UU=2555psf
			A-7-6	CL	370	60			
1690	140							1629	
			A-6	SC	371	75	14	25 50	γ_d = 94.2 pcf γ = 121.9 pcf UU=1856psf
			A-7-6	CH	372	95			
1680	150						16	24 48	
			A-7-6	CL	373	100			
1670	160						16	26 54	
			A-7-6	CH	374	10			
1660	170						24	25 54	
			A-7-6	CH	375	100			
1650	180						19		
						5			
		1638.0 ft 194.0 ft					34	33 66	
1640	190	Hard Moist Gry Elastic Silt.	A-7-5	MH	376	90			
1630	200	1626.0 ft 206.0 ft					69	38 66	
			A-7-5	MH	377	95			

Bottom of borehole at 206.0 ft

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NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

LOG OF BORING SB - 2

PROJECT NUMBER IM-2-094(186)217 **DATE STARTED** 7/25/22 **COMPLETED** 7/25/22

PCN 23444 **ELEVATION** 1831 ft

LOCATION Kidder County **RP+Feet** 217+0766 ft **Offset** 120 S

DRILLED BY Dallan **LOGGED BY** Jamie **DRILLING METHOD**

ENGINEER

NOTES South Abutment

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	AASHTO	USCS	SAMPLE TYPE & NUMBER	RECOVERY (%)	SPT N VALUE	MC / PL / LL / CLAY FRACTION (%)	TESTS & REMARKS
1830	0	Loose Moist Brn Silty, Clayey Sand w/Gravel	A-1-b	SC-SM	378	40	8 7	124	
1820	10	1817.0 ft 14.0 ft	A-1-b	SC-SM	379	50	42	125 124	
		Medium Dense Moist Brn Silty Sand w/Gravel	A-2-4	SC-SM	380	60	17	0	
1810	20		A-2-4	SM	381	65	24	0	
			A-1-b	SP-SM	382	70	21	0	
1800	30	1799.0 ft 32.0 ft	A-1-b	SW-SM	383	75	37	0	
		Dense Moist Brn Well-Graded Sand w/Silt & Gravel	A-1-b	SW-SM	384	70	44	0	
1790	40		A-1-b	SW-SM	385	75	43	0	
		1782.0 ft 49.0 ft	A-1-b	SW-SM	386	90		0	
1780	50	Medium Dense Moist/Wet Brn/Gry Silty Sand. Water bearing from 54'-79'	A-2-6	SC	387	85	23	2436	
			A-1-b	SM	388	70	26	0	
1770	60		A-2-4	SM	389	90	18	0	
			A-1-b	SM	390	90	24	0	
1760	70		A-1-b	SM	391	75	17	0	
1750	80		A-2-4	SP-SM	392	90	14	0	
1740	90		A-3	SP-SM	393	75	12	0	
1730	100		A-1-b	SM	394	80	24	0	
		1722.0 ft 109.0 ft							
1720	110	Medium Stiff to Stiff Moist Gry Silt. Water bearing at 139'.	A-6	ML	395	90	8	2739	
1710	120		A-7-5	ML	396	100	5	30 46	
1700	130		A-7-6	CL	397	85		23 46	γ_d = 86.7 pcf γ = 119.1 pcf UU=1358psf
1690	140		A-4	ML	398	80	10	234	
		1682.0 ft 149.0 ft							
1680	150	Very Stiff Moist Gry Sandy Fat Clay	A-7-6	CH	399	90	24	27 53	
1670	160		A-7-6	CH	400	60	20	23 50	
1660	170					0	19		
		1652.0 ft 179.0 ft							
1650	180	Hard Moist/Wet Gry Elastic Silt. Water bearing at 179'.			401	20	40		
1640	190		A-7-5	MH	402	90	36	32 58	
1630	200		A-7-5	MH	403	90	41	33 66	
1620	210		A-7-5	CH	404	90		100 33 74	
		1610.0 ft 221.0 ft							
1610	220		A-7-5	MH	405	100		100 37 74	

Bottom of borehole at 221.0 ft

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APPENDIX B

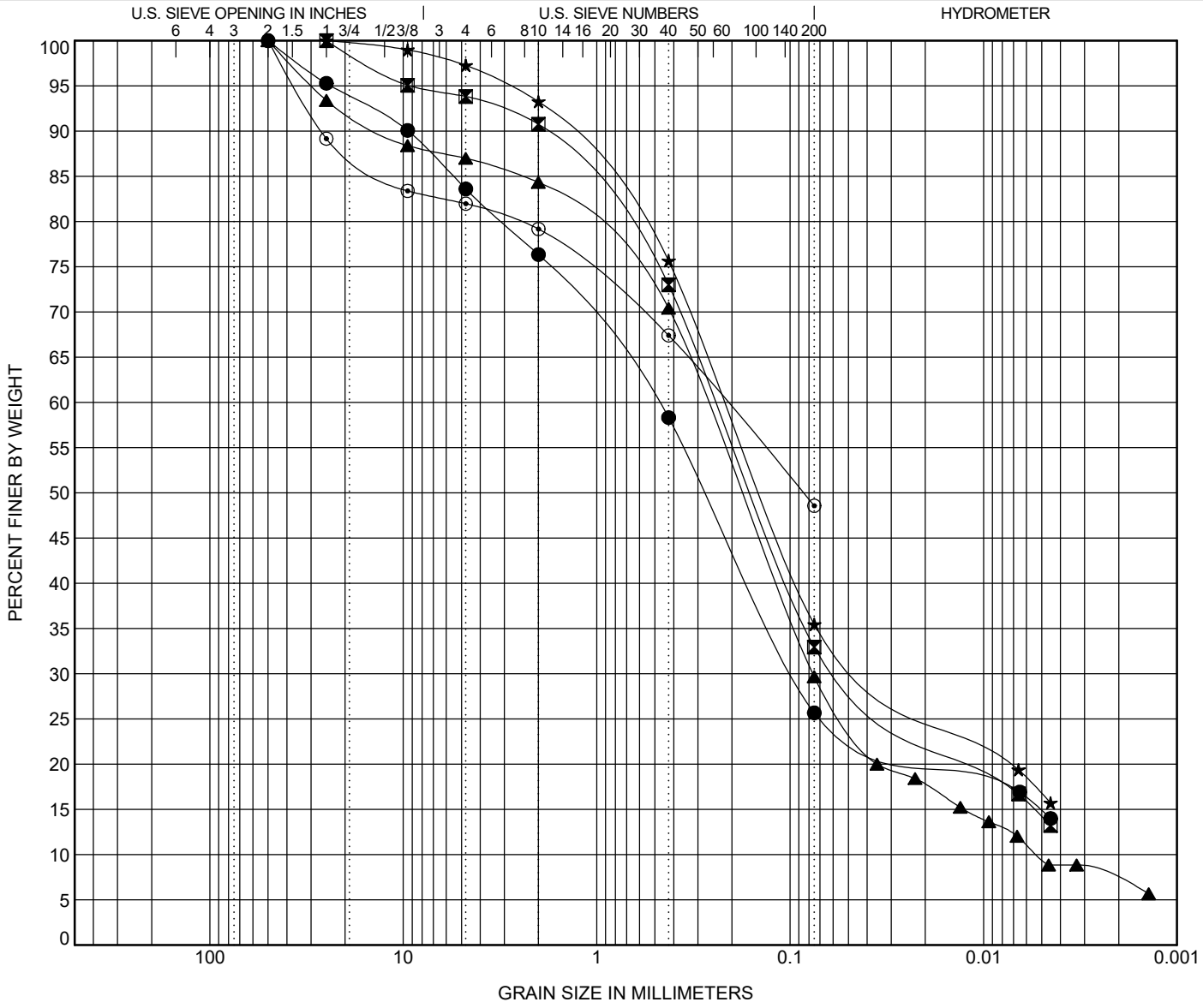
Lab Results

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(186)217 **LOCATION** Kidder County

PCN 23444



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 1	4.0	A-2-4 (0)	SC-SM	23	16	7		
⊠	SB - 1	6.0	A-2-6 (0)	SC	25	14	11		
▲	SB - 1	9.0	A-2-4 (0)	SC	25	15	10	4.02	51.79
★	SB - 1	11.0	A-2-6 (0)	SC	26	15	11		
⊙	SB - 1	14.0	A-6 (6)	SC	38	19	19		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 1	4.0	50	0.273	0.094	0.005	16.4	57.9	25.7	
⊠	SB - 1	6.0	25	0.157	0.048	0.005	6.2	60.9	32.9	
▲	SB - 1	9.0	50	0.178	0.076	0.013	13.0	57.3	22.7	7.0
★	SB - 1	11.0	25	0.14	0.033		2.7	61.8	35.5	
⊙	SB - 1	14.0	50	0.086			18.0	33.4	48.6	

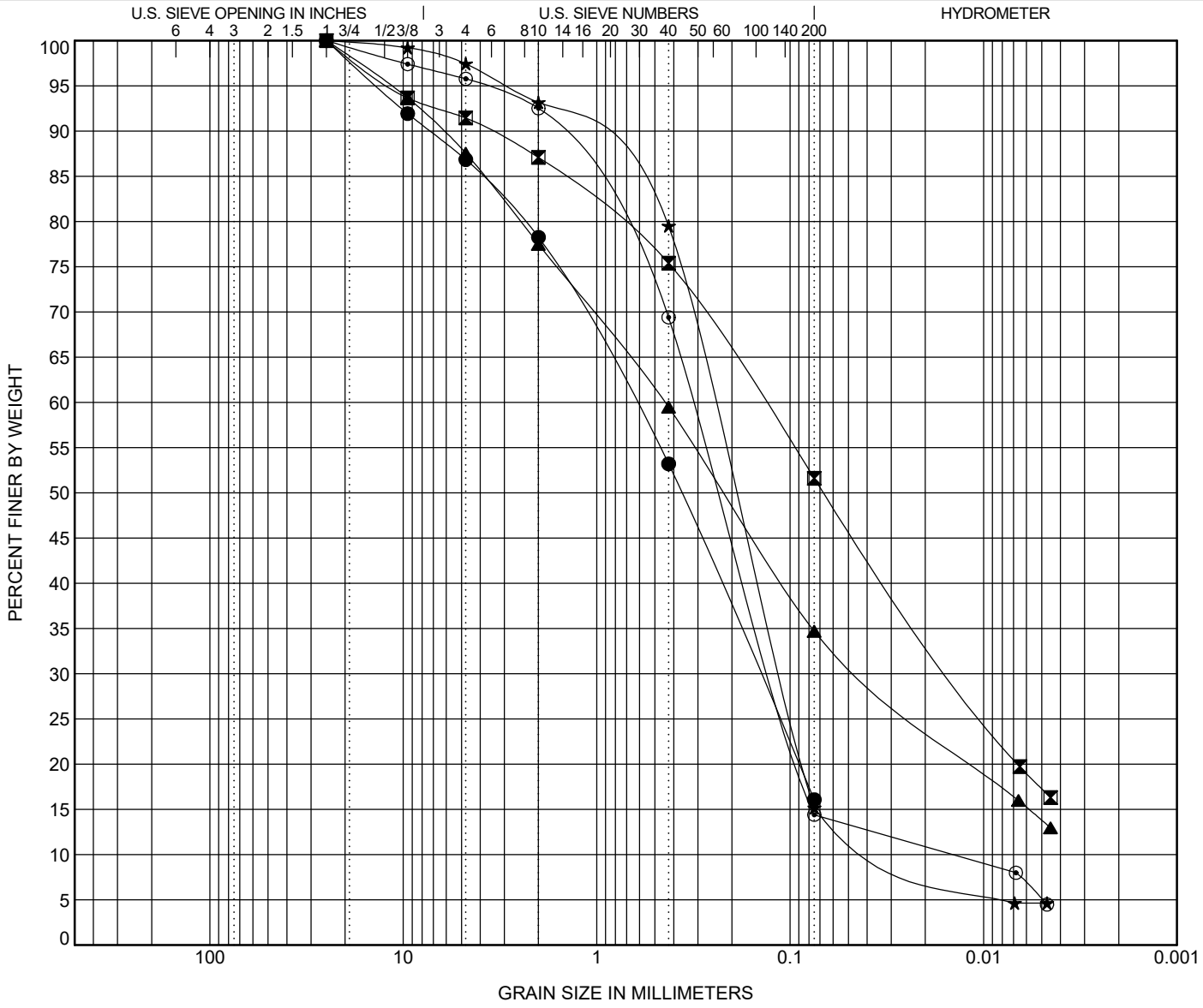
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GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(186)217 **LOCATION** Kidder County

PCN 23444



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 1	14.1	A-2-4 (0)	SM	NP	NP	NP		
⊠	SB - 1	16.0	A-6 (4)	CL	31	18	13		
▲	SB - 1	19.0	A-2-6 (1)	SC	34	19	15		
★	SB - 1	19.1	A-2-4 (0)	SM	NP	NP	NP	2.14	10.80
⊙	SB - 1	21.0	A-2-4 (0)	SM	NP	NP	NP	3.30	21.89

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 1	14.1	25	0.366	0.144		13.2	70.8	16.1	
⊠	SB - 1	16.0	25	0.066	0.014		8.6	39.8	51.6	
▲	SB - 1	19.0	25	0.219	0.041	0.006	12.5	52.8	34.7	
★	SB - 1	19.1	25	0.192	0.112	0.072	2.6	82.3	15.2	
⊙	SB - 1	21.0	25	0.23	0.123	0.076	4.2	81.4	14.4	

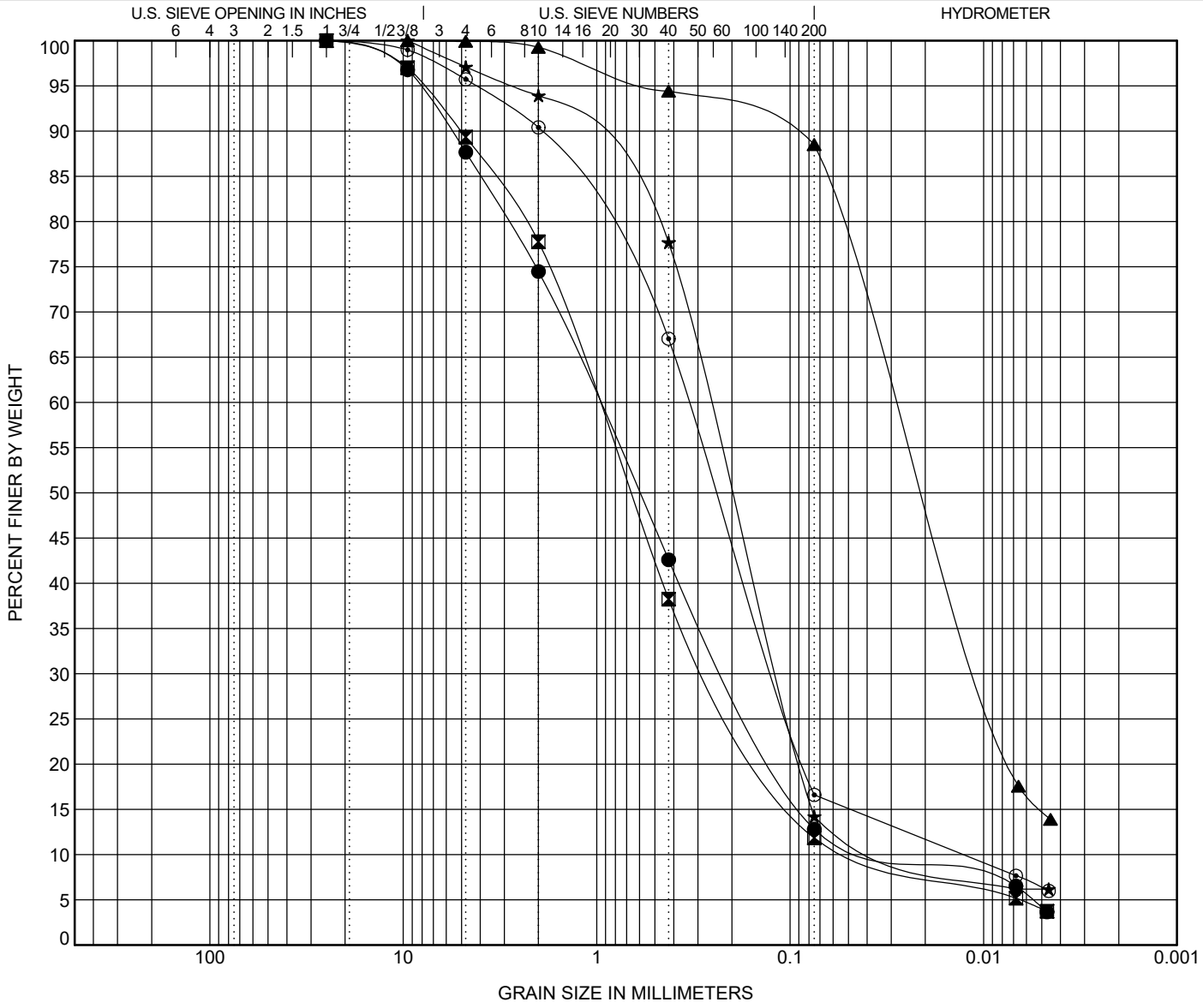
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GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(186)217 **LOCATION** Kidder County

PCN 23444



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 1	24.0	A-1-b (0)	SM	NP	NP	NP	1.64	38.66
⊠	SB - 1	29.0	A-1-b (0)	SP-SM	NP	NP	NP	1.59	25.79
▲	SB - 1	31.0	A-4 (7)	ML	31	23	8		
★	SB - 1	34.0	A-2-4 (0)	SM	NP	NP	NP	2.39	12.32
⊙	SB - 1	36.0	A-2-4 (0)	SM	NP	NP	NP	3.32	26.14

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 1	24.0	25	0.609	0.204	0.085	12.3	74.9	12.8	
⊠	SB - 1	29.0	25	0.674	0.247	0.092	10.7	77.5	11.8	
▲	SB - 1	31.0	9.5	0.02	0.01	0.005	0.1	11.4	88.5	
★	SB - 1	34.0	9.5	0.199	0.115	0.077	2.9	82.9	14.2	
⊙	SB - 1	36.0	25	0.237	0.119	0.049	4.3	79.1	16.6	

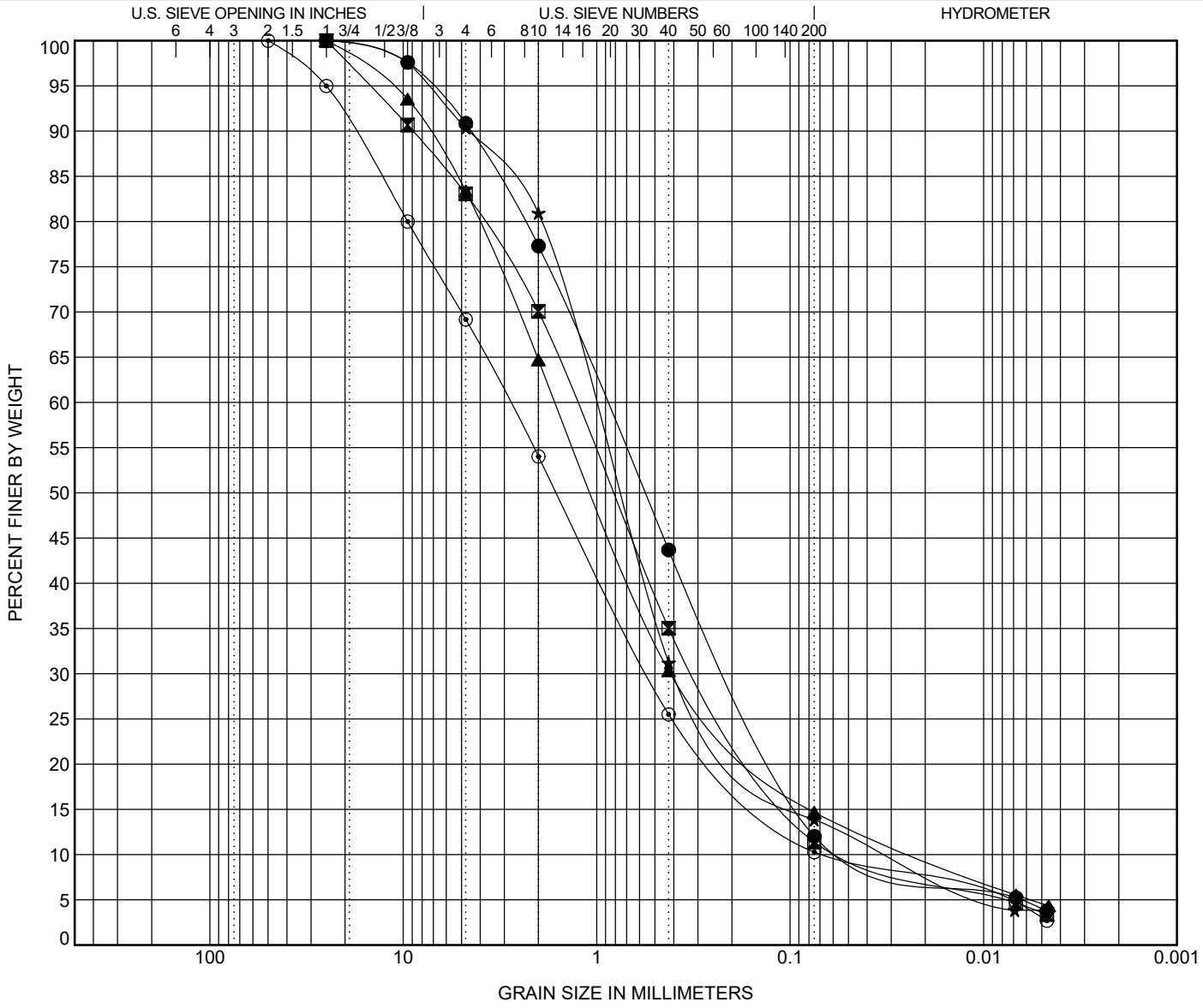
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300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(186)217 **LOCATION** Kidder County

PCN 23444



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 1	39.0	A-1-b (0)	SM	NP	NP	NP	1.22	24.56
⊠	SB - 1	41.0	A-1-b (0)	SP-SM	NP	NP	NP	1.48	28.07
▲	SB - 1	44.0	A-1-b (0)	SC-SM	26	20	6	4.71	73.54
★	SB - 1	46.0	A-1-b (0)	SM	NP	NP	NP	4.54	34.78
⊙	SB - 1	49.0	A-1-b (0)	SW-SM	NP	NP	NP	1.57	42.32

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 1	39.0	25	0.569	0.201	0.088	9.1	78.8	12.0	
⊠	SB - 1	41.0	25	0.824	0.294	0.098	16.9	71.7	11.4	
▲	SB - 1	44.0	25	1.031	0.41	0.078	16.6	68.7	14.7	
★	SB - 1	46.0	25	0.763	0.376	0.084	9.7	76.5	13.9	
⊙	SB - 1	49.0	50	1.607	0.542	0.128	30.8	58.9	10.3	

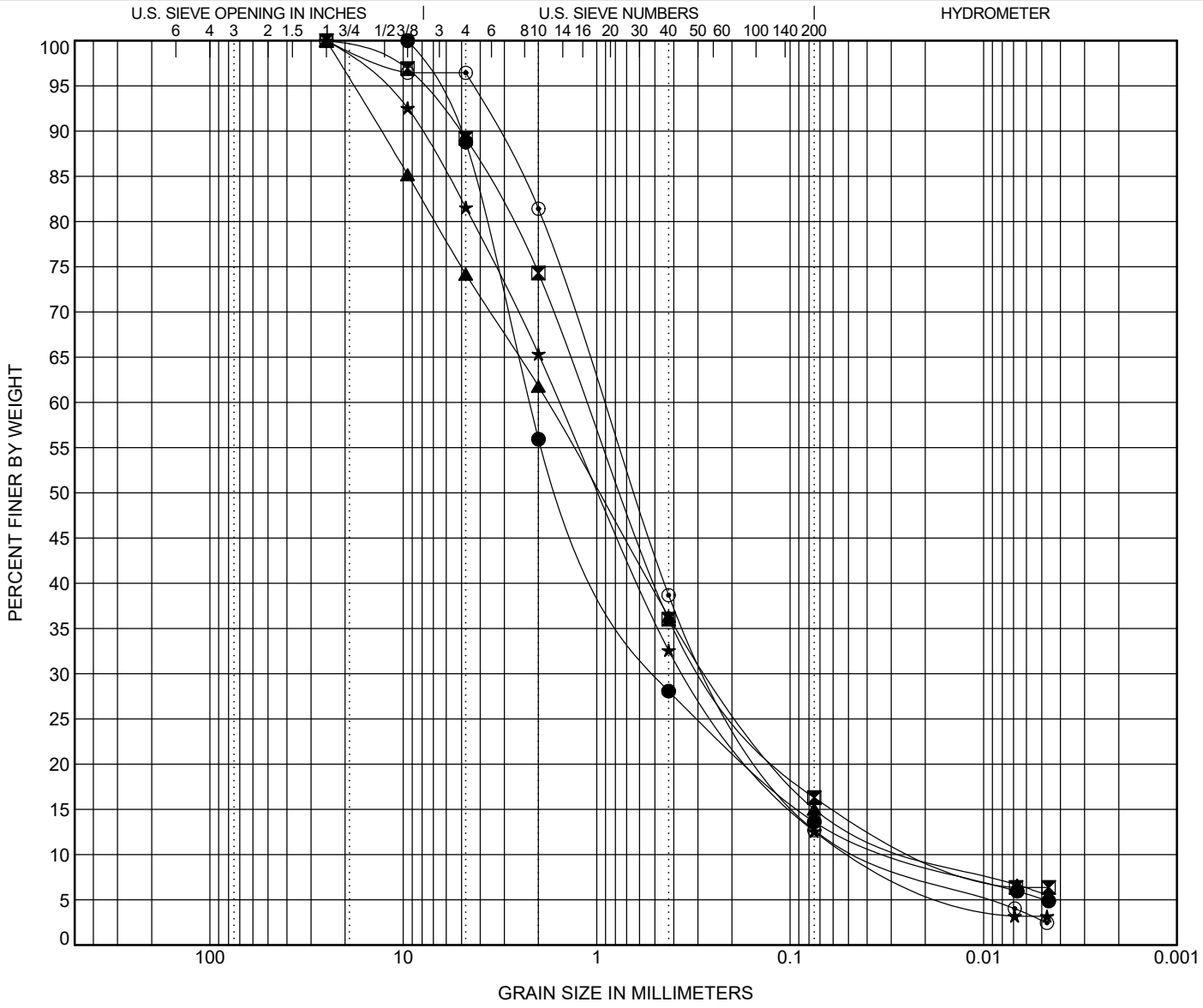
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 1	51.0	A-1-b (0)	SC-SM	25	20	5	4.19	92.73
⊠	SB - 1	59.0	A-1-b (0)	SM	NP	NP	NP	3.40	68.37
▲	SB - 1	64.0	A-1-b (0)	SM	30	24	6	2.04	101.86
★	SB - 1	69.0	A-1-b (0)	SM	NP	NP	NP	1.90	39.79
⊙	SB - 1	74.0	A-1-b (0)	SM	NP	NP	NP	1.72	25.72

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 1	51.0	9.5	1.438	0.473	0.089	11.2	75.2	13.6	
⊠	SB - 1	59.0	25	0.748	0.25	0.055	10.8	72.9	16.3	
▲	SB - 1	64.0	25	0.977	0.254	0.075	25.8	59.2	15.0	
★	SB - 1	69.0	25	0.968	0.34	0.093	18.5	69.0	12.6	
⊙	SB - 1	74.0	25	0.64	0.238	0.088	3.6	83.8	12.7	

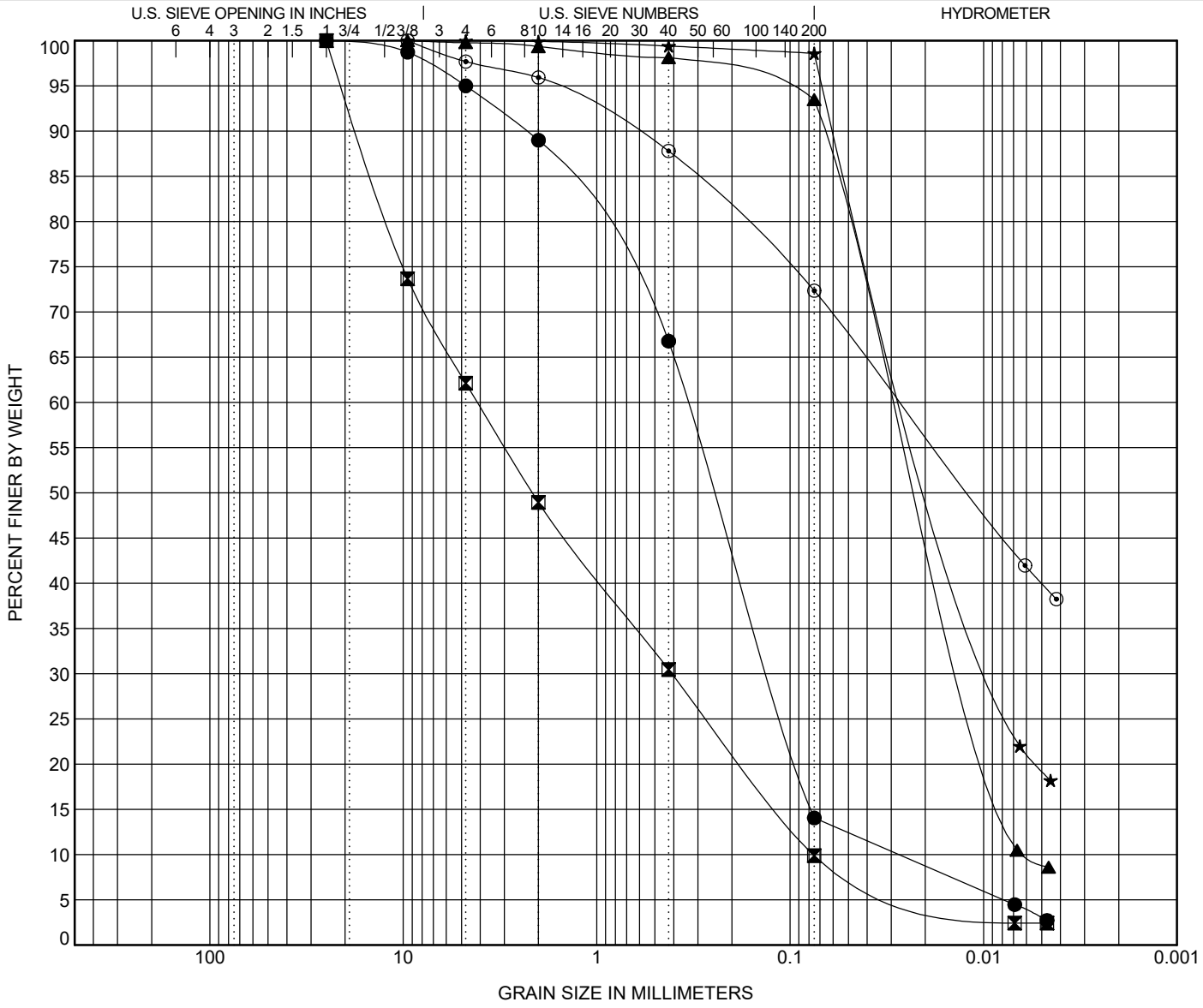
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300 AIRPORT ROAD
BISMARCK, ND 58504

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PCN 23444



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● SB - 1	84.0	A-2-4 (0)	SM	NP	NP	NP	1.73	12.43
⊠ SB - 1	94.0	A-1-a (0)	SP-SM	NP	NP	NP	0.53	54.59
▲ SB - 1	104.0	A-4 (0)	ML	NP	NP	NP	0.81	4.66
★ SB - 1	114.0	A-4 (9)	ML	37	30	7		
⊙ SB - 1	134.0	A-7-6 (16)	CL	47	24	23		

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● SB - 1	84.0	25	0.245	0.127	0.077	5.0	80.9	14.1	
⊠ SB - 1	94.0	25	2.144	0.409	0.115	37.9	52.2	9.9	
▲ SB - 1	104.0	9.5	0.021	0.012	0.008	0.2	6.3	93.5	
★ SB - 1	114.0	9.5	0.016	0.008		0.0	1.4	98.6	
⊙ SB - 1	134.0	9.5	0.012			2.3	25.3	72.4	

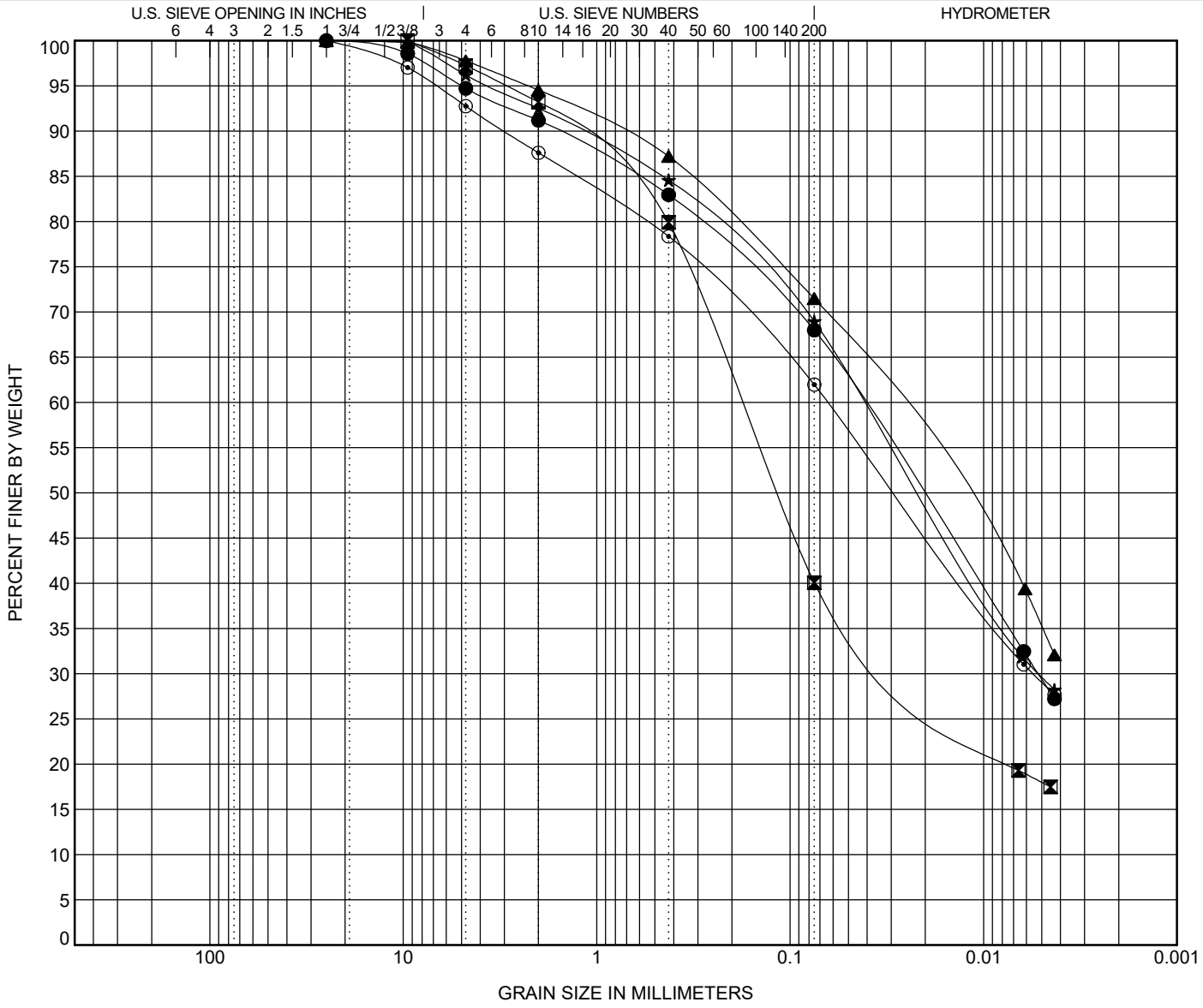
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BISMARCK, ND 58504

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PCN 23444



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 1	136.0	A-7-6 (14)	CL	46	23	23		
⊠	SB - 1	144.0	A-6 (1)	SC	29	16	13		
▲	SB - 1	146.0	A-7-6 (17)	CH	50	25	25		
★	SB - 1	154.0	A-7-6 (16)	CL	48	24	24		
⊙	SB - 1	164.0	A-7-6 (16)	CH	54	26	28		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 1	136.0	25	0.021	0.005		5.3	26.7	68.0	
⊠	SB - 1	144.0	9.5	0.116	0.023		2.7	57.2	40.1	
▲	SB - 1	146.0	25	0.014			2.2	26.3	71.5	
★	SB - 1	154.0	25	0.021	0.005		3.8	27.2	69.0	
⊙	SB - 1	164.0	25	0.029	0.006		7.2	30.8	62.0	

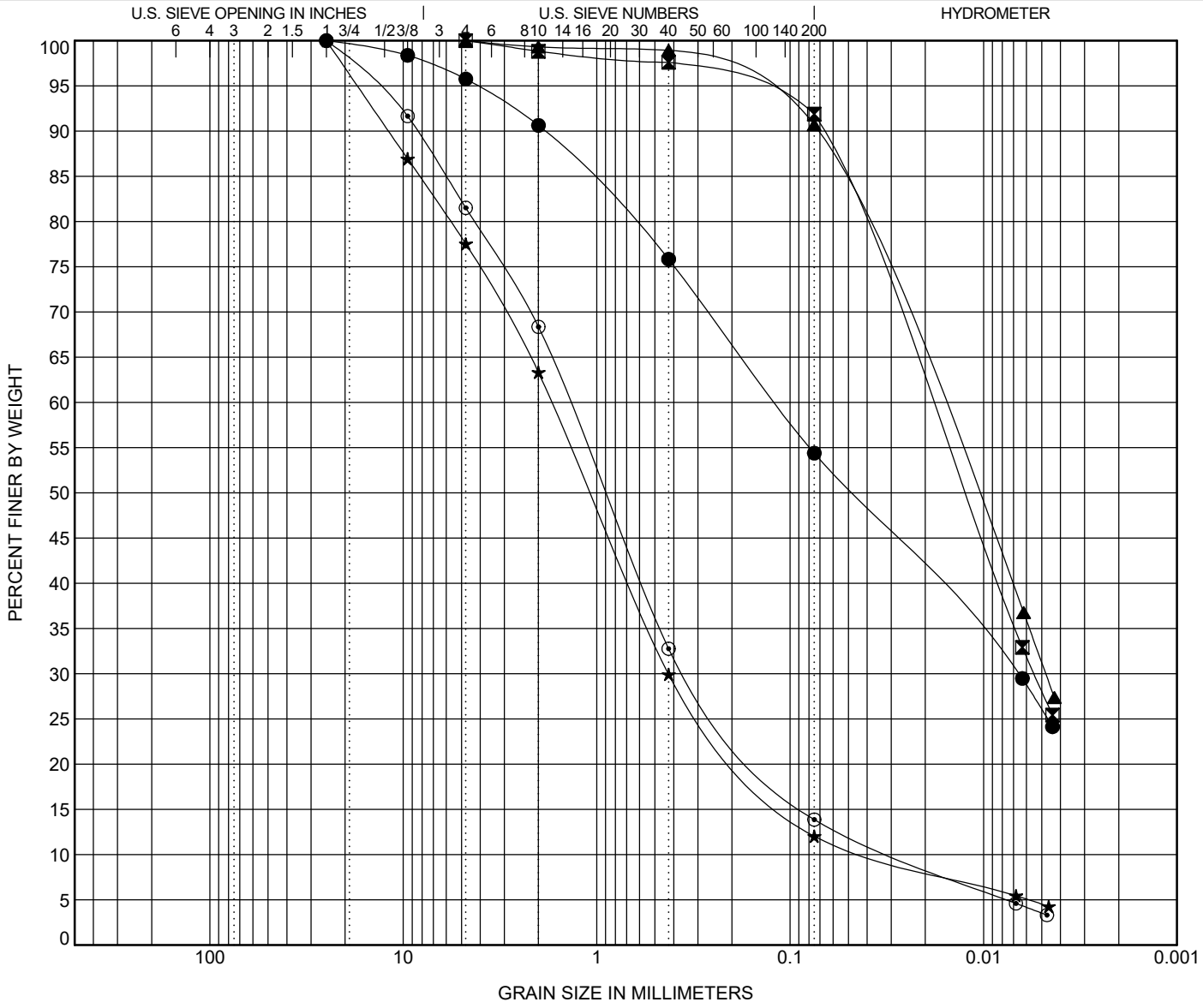
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300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(186)217 **LOCATION** Kidder County

PCN 23444



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 1	174.0	A-7-6 (13)	CH	54	25	29		
⊠	SB - 1	194.0	A-7-5 (37)	MH	66	33	33		
▲	SB - 1	204.0	A-7-5 (32)	MH	66	38	28		
★	SB - 2	4.0	A-1-b (0)	SC-SM	24	18	6	2.97	48.02
⊙	SB - 2	9.0	A-1-b (0)	SC-SM	25	19	6	2.84	50.52

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 1	174.0	25	0.048	0.007		4.2	41.4	54.4	
⊠	SB - 1	194.0	4.75	0.013	0.005		0.0	8.1	91.9	
▲	SB - 1	204.0	4.75	0.011	0.005		0.0	9.3	90.7	
★	SB - 2	4.0	25	1.079	0.427	0.1	22.5	65.5	12.0	
⊙	SB - 2	9.0	25	0.9	0.33	0.083	18.5	67.6	13.9	

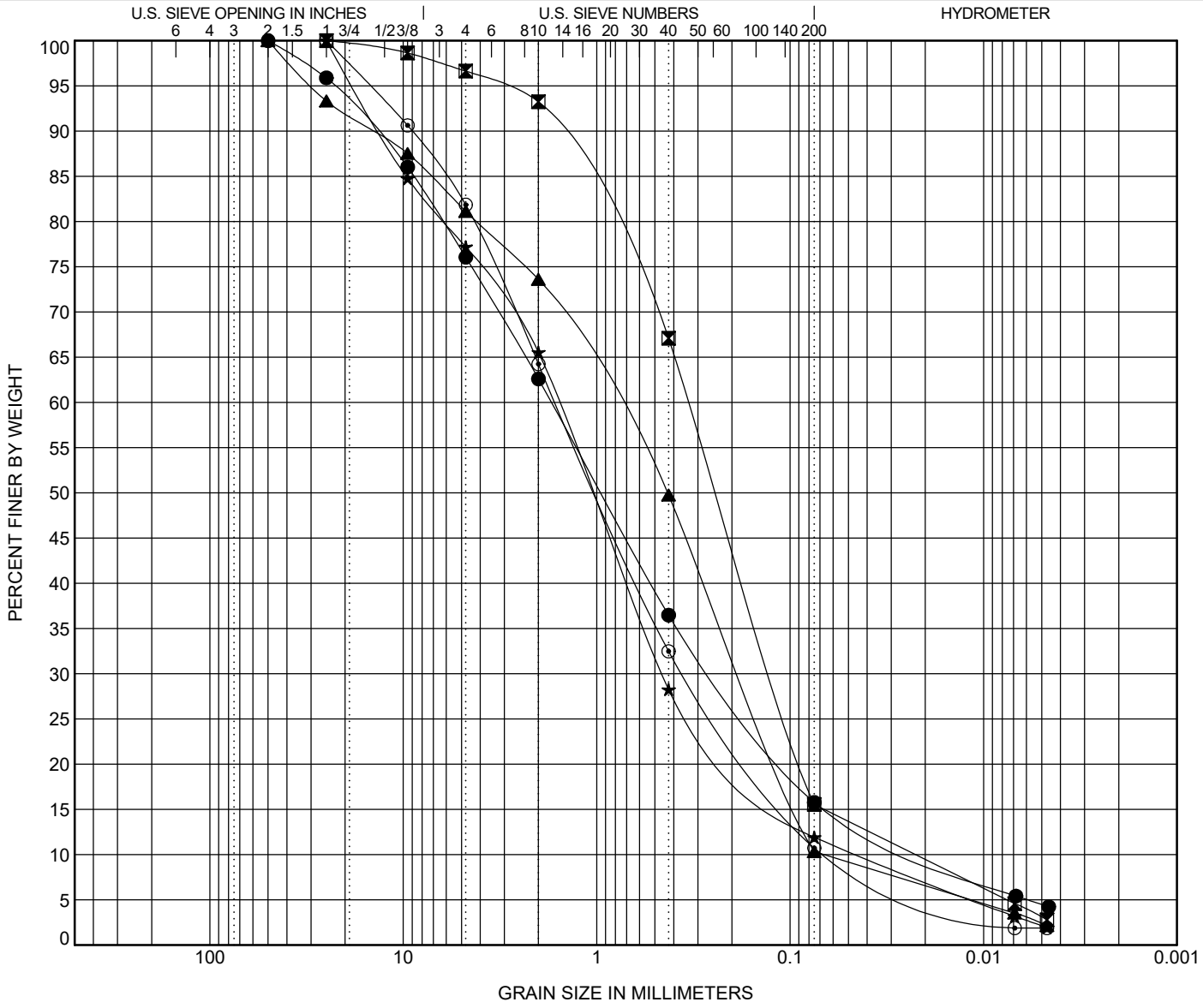
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 2	14.0	A-2-4 (0)	SC-SM	24	17	7	1.81	86.98
⊠	SB - 2	19.0	A-2-4 (0)	SM	NP	NP	NP	1.98	14.93
▲	SB - 2	24.0	A-1-b (0)	SP-SM	NP	NP	NP	0.57	12.33
★	SB - 2	29.0	A-1-b (0)	SW-SM	NP	NP	NP	2.96	35.78
⊙	SB - 2	34.0	A-1-b (0)	SW-SM	NP	NP	NP	1.21	26.39

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 2	14.0	50	0.948	0.247	0.063	23.9	60.3	15.8	
⊠	SB - 2	19.0	25	0.239	0.122	0.066	3.4	81.1	15.6	
▲	SB - 2	24.0	50	0.432	0.178	0.092	18.9	70.8	10.3	
★	SB - 2	29.0	25	1.049	0.457	0.104	22.8	65.3	11.9	
⊙	SB - 2	34.0	25	0.999	0.349	0.105	18.2	71.1	10.7	

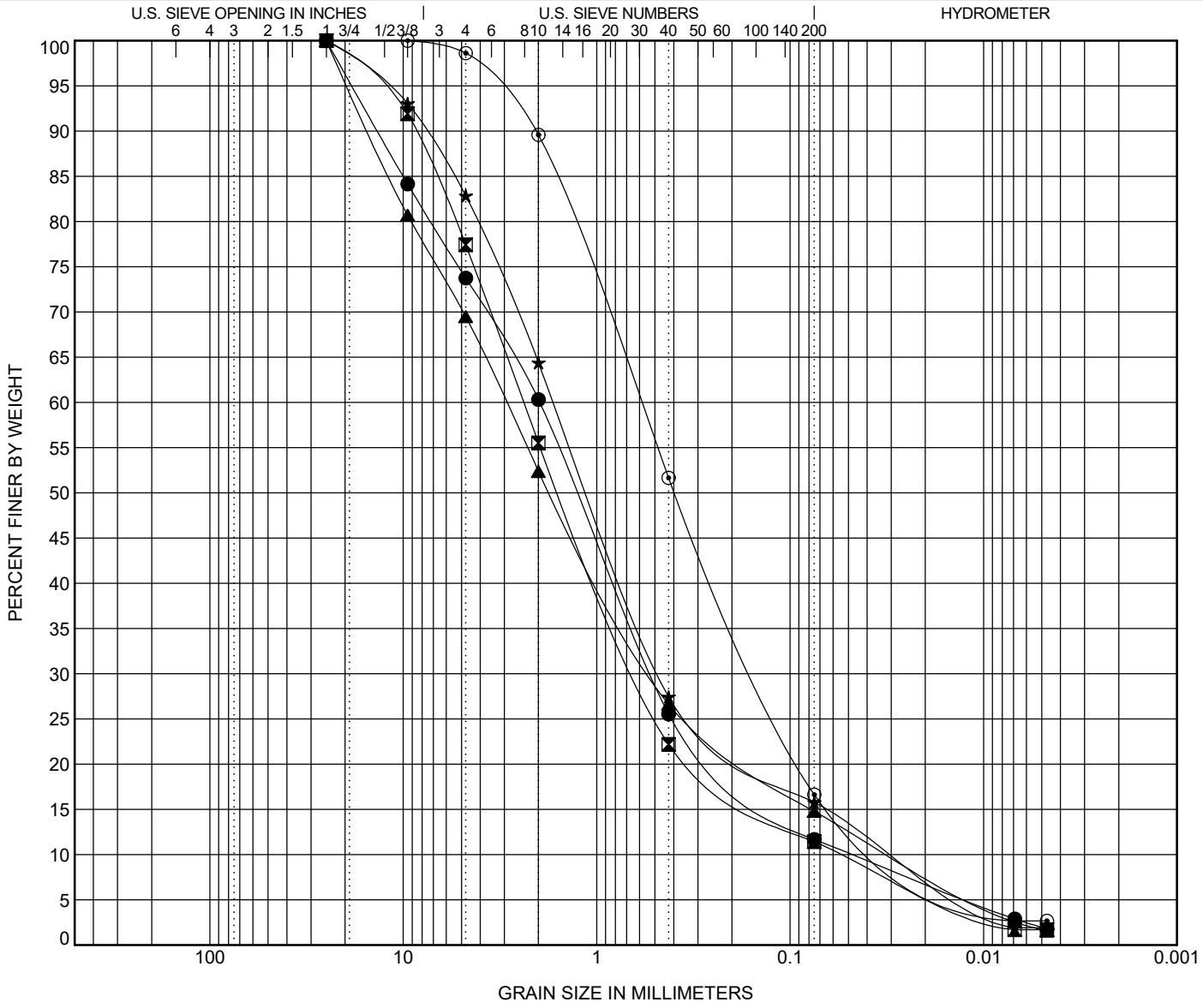
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300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(186)217 **LOCATION** Kidder County

PCN 23444



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 2	39.0	A-1-b (0)	SW-SM	NP	NP	NP	2.86	41.44
⊠	SB - 2	44.0	A-1-b (0)	SW-SM	NP	NP	NP	2.95	45.01
▲	SB - 2	49.0	A-2-6 (0)	SC	36	24	12	3.12	99.54
★	SB - 2	54.0	A-1-b (0)	SM	NP	NP	NP	4.84	59.92
⊙	SB - 2	59.0	A-2-4 (0)	SM	NP	NP	NP	1.47	24.73

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 2	39.0	25	1.263	0.518	0.114	26.3	62.1	11.7	
⊠	SB - 2	44.0	25	1.549	0.611	0.134	22.6	66.0	11.4	
▲	SB - 2	49.0	25	1.735	0.521	0.077	30.5	54.7	14.8	
★	SB - 2	54.0	25	1.094	0.473	0.066	17.2	67.1	15.8	
⊙	SB - 2	59.0	9.5	0.391	0.145	0.057	1.4	82.0	16.6	

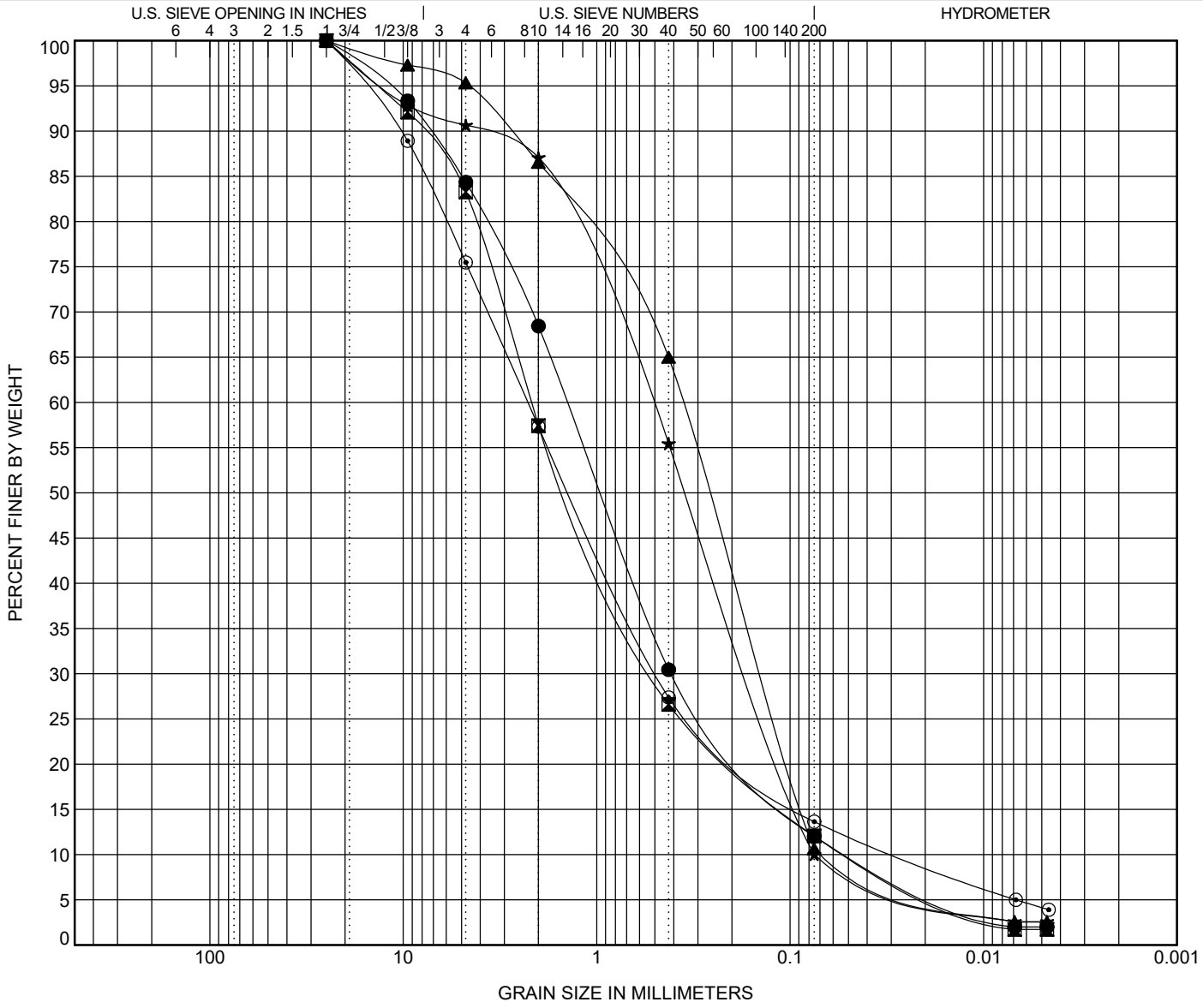
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 2	64.0	A-1-b (0)	SM	NP	NP	NP	2.53	30.65
⊠	SB - 2	69.0	A-1-b (0)	SM	NP	NP	NP	2.50	46.67
▲	SB - 2	79.0	A-2-4 (0)	SP-SM	NP	NP	NP	0.86	5.81
★	SB - 2	89.0	A-3 (0)	SP-SM	NP	NP	NP	0.65	7.13
⊙	SB - 2	99.0	A-1-b (0)	SM	NP	NP	NP	3.82	83.29

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 2	64.0	25	0.943	0.408	0.099	15.6	72.3	12.0	
⊠	SB - 2	69.0	25	1.377	0.504	0.107	16.7	71.2	12.0	
▲	SB - 2	79.0	25	0.263	0.139	0.086	4.7	84.7	10.6	
★	SB - 2	89.0	25	0.345	0.161	0.091	9.3	80.6	10.0	
⊙	SB - 2	99.0	25	1.37	0.487	0.089	24.5	61.8	13.6	

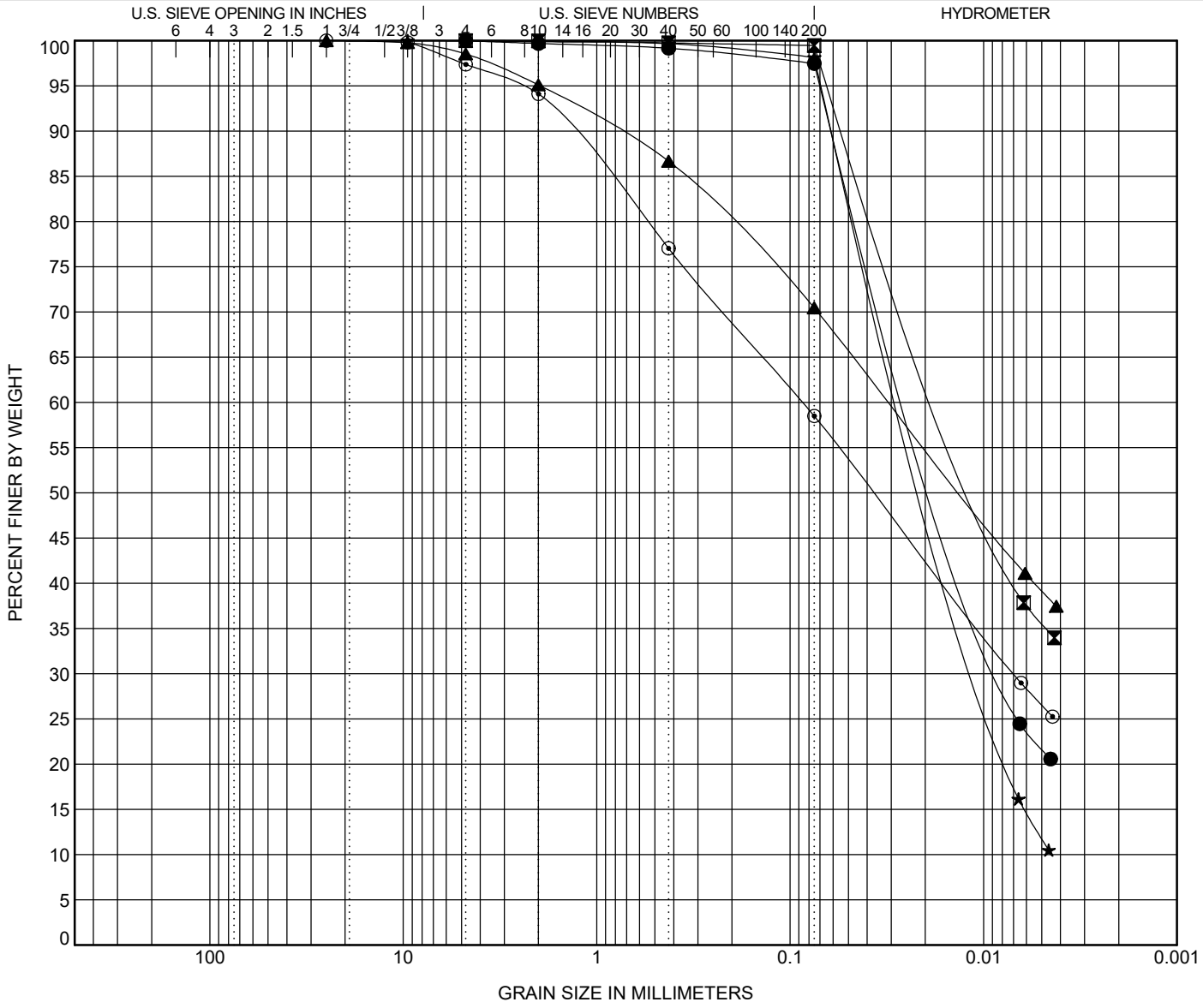
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PCN 23444



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 2	109.0	A-6 (14)	ML	39	27	12		
⊠	SB - 2	119.0	A-7-5 (20)	ML	46	30	16		
▲	SB - 2	129.0	A-7-6 (15)	CL	46	23	23		
★	SB - 2	139.0	A-4 (7)	ML	34	28	6		
⊙	SB - 2	149.0	A-7-6 (13)	CH	53	27	26		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 2	109.0	4.75	0.015	0.008		0.0	2.5	97.5	
⊠	SB - 2	119.0	4.75	0.01			0.0	0.5	99.5	
▲	SB - 2	129.0	25	0.013			1.5	28.1	70.5	
★	SB - 2	139.0	9.5	0.018	0.01	0.006	0.0	1.8	98.2	
⊙	SB - 2	149.0	25	0.037	0.007		2.6	38.9	58.5	

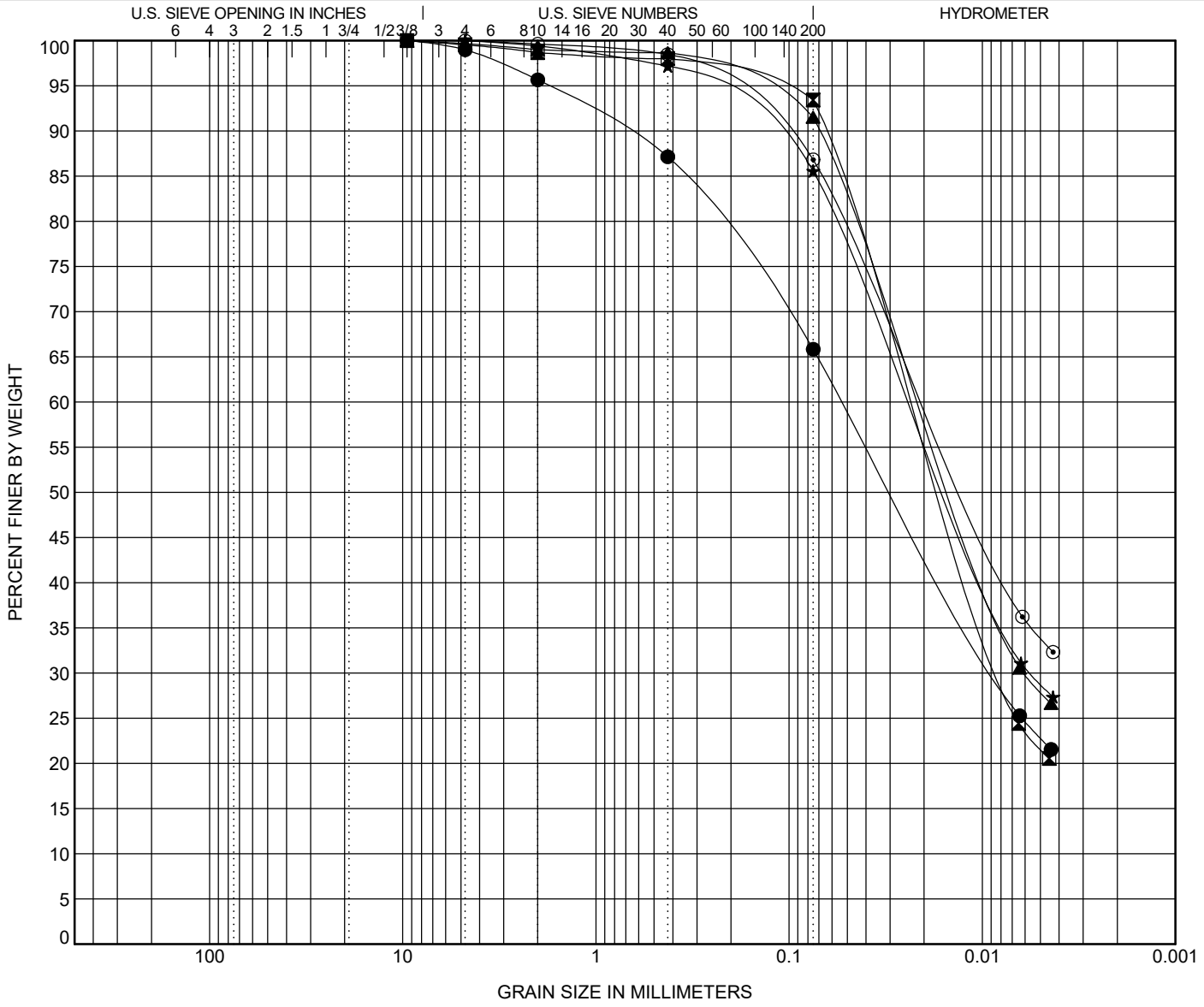
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PCN 23444



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 2	159.0	A-7-6 (16)	CH	50	23	27		
⊠	SB - 2	189.0	A-7-5 (29)	MH	58	32	26		
▲	SB - 2	199.0	A-7-5 (37)	MH	66	33	33		
★	SB - 2	209.0	A-7-5 (41)	CH	74	33	41		
⊙	SB - 2	219.0	A-7-5 (39)	MH	74	37	37		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	SB - 2	159.0	9.5	0.029	0.009		1.0	33.1	65.8	
⊠	SB - 2	189.0	9.5	0.016	0.008		0.5	6.1	93.4	
▲	SB - 2	199.0	9.5	0.014	0.006		0.3	8.2	91.5	
★	SB - 2	209.0	4.75	0.015	0.006		0.0	14.4	85.6	
⊙	SB - 2	219.0	9.5	0.012			0.0	13.2	86.8	

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SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(186)217 **LOCATION** Kidder County

PCN 23444

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
SB - 1	4.0	23	16	7	50	26	A-2-4 (0)	SC-SM	13.4	13.4			
SB - 1	6.0	25	14	11	25	33	A-2-6 (0)	SC	14.0	14.0			
SB - 1	9.0	25	15	10	50	30	A-2-4 (0)	SC	18.0	18.0	106.8		
SB - 1	11.0	26	15	11	25	35	A-2-6 (0)	SC	17.8	17.8			
SB - 1	14.0	38	19	19	50	49	A-6 (6)	SC	19.7	19.7			
SB - 1	14.1	NP	NP	NP	25	16	A-2-4 (0)	SM	10.5	10.5			
SB - 1	16.0	31	18	13	25	52	A-6 (4)	CL	21.9	21.9			
SB - 1	19.0	34	19	15	25	35	A-2-6 (1)	SC					
SB - 1	19.1	NP	NP	NP	25	15	A-2-4 (0)	SM	15.1	15.1			
SB - 1	21.0	NP	NP	NP	25	14	A-2-4 (0)	SM	11.9	11.9			
SB - 1	24.0	NP	NP	NP	25	13	A-1-b (0)	SM	10.2	10.2			
SB - 1	26.0								16.5	16.5			
SB - 1	29.0	NP	NP	NP	25	12	A-1-b (0)	SP-SM	5.7	5.7			
SB - 1	31.0	31	23	8	9.5	89	A-4 (7)	ML	30.6	30.6			
SB - 1	34.0	NP	NP	NP	9.5	14	A-2-4 (0)	SM	7.5	7.5			
SB - 1	36.0	NP	NP	NP	25	17	A-2-4 (0)	SM	20.6	20.6			
SB - 1	39.0	NP	NP	NP	25	12	A-1-b (0)	SM	13.3	13.3			
SB - 1	41.0	NP	NP	NP	25	11	A-1-b (0)	SP-SM	8.4	8.4			
SB - 1	44.0	26	20	6	25	15	A-1-b (0)	SC-SM	10.8	10.8			
SB - 1	46.0	NP	NP	NP	25	14	A-1-b (0)	SM	16.1	16.1			
SB - 1	49.0	NP	NP	NP	50	10	A-1-b (0)	SW-SM	12.5	12.5			
SB - 1	51.0	25	20	5	9.5	14	A-1-b (0)	SC-SM	8.4	8.4			
SB - 1	59.0	NP	NP	NP	25	16	A-1-b (0)	SM	19.6	19.6			
SB - 1	64.0	30	24	6	25	15	A-1-b (0)	SM	14.2	14.2			
SB - 1	69.0	NP	NP	NP	25	13	A-1-b (0)	SM	16.7	16.7			
SB - 1	74.0	NP	NP	NP	25	13	A-1-b (0)	SM	20.6	20.6			
SB - 1	84.0	NP	NP	NP	25	14	A-2-4 (0)	SM	21.8	21.8			
SB - 1	94.0	NP	NP	NP	25	10	A-1-a (0)	SP-SM	9.9	9.9			
SB - 1	104.0	NP	NP	NP	9.5	93	A-4 (0)	ML	39.9	39.9			
SB - 1	114.0	37	30	7	9.5	99	A-4 (9)	ML	40.8	40.8			
SB - 1	124.0	42	28	14					36.1	36.1			
SB - 1	134.0	47	24	23	9.5	72	A-7-6 (16)	CL	27.3	27.3	94.7		
SB - 1	136.0	46	23	23	25	68	A-7-6 (14)	CL	30.1	30.1			
SB - 1	144.0	29	16	13	9.5	40	A-6 (1)	SC	29.4	29.4	94.2		
SB - 1	146.0	50	25	25	25	71	A-7-6 (17)	CH	31.3	31.3			
SB - 1	154.0	48	24	24	25	69	A-7-6 (16)	CL	31.3	31.3			
SB - 1	164.0	54	26	28	25	62	A-7-6 (16)	CH	32.4	32.4			
SB - 1	174.0	54	25	29	25	54	A-7-6 (13)	CH	28.6	28.6			
SB - 1	194.0	66	33	33	4.75	92	A-7-5 (37)	MH	34.0	34.0			
SB - 1	204.0	66	38	28	4.75	91	A-7-5 (32)	MH	31.8	31.8			
SB - 1	204.1								24.4	24.4			
SB - 2	4.0	24	18	6	25	12	A-1-b (0)	SC-SM	6.9	6.9			
SB - 2	9.0	25	19	6	25	14	A-1-b (0)	SC-SM	10.9	10.9			

LAB SUMMARY - 20171219.GDT - 3/1/23 13:28 - F:\LAB\PROJECTS\GINT\2-094(186)217.GPJ

SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(186)217 **LOCATION** Kidder County

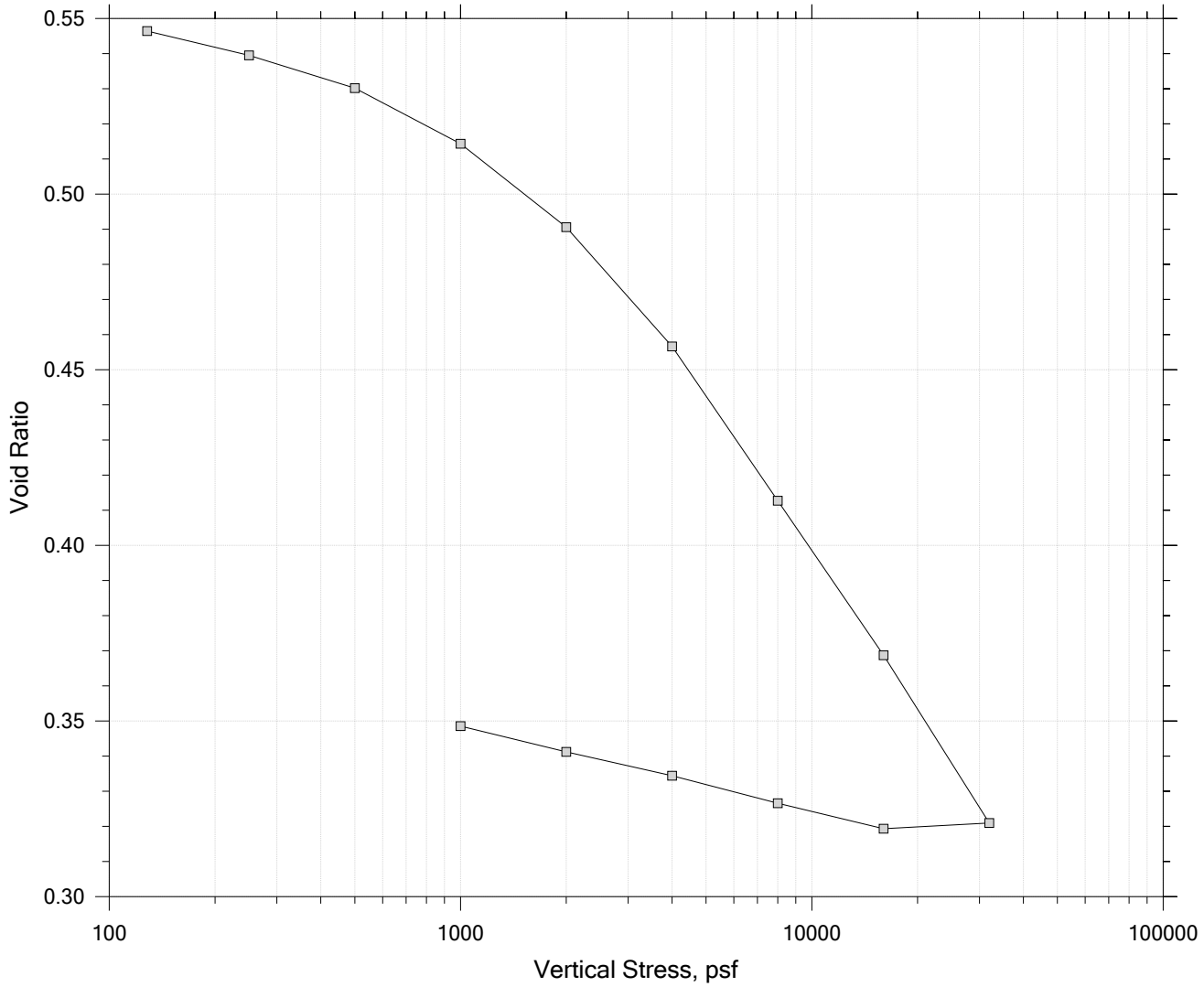
PCN 23444

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
SB - 2	14.0	24	17	7	50	16	A-2-4 (0)	SC-SM	9.3	9.3			
SB - 2	19.0	NP	NP	NP	25	16	A-2-4 (0)	SM	12.2	12.2			
SB - 2	24.0	NP	NP	NP	50	10	A-1-b (0)	SP-SM	8.7	8.7			
SB - 2	29.0	NP	NP	NP	25	12	A-1-b (0)	SW-SM	11.5	11.5			
SB - 2	34.0	NP	NP	NP	25	11	A-1-b (0)	SW-SM	11.9	11.9			
SB - 2	39.0	NP	NP	NP	25	12	A-1-b (0)	SW-SM	15.5	15.5			
SB - 2	44.0	NP	NP	NP	25	11	A-1-b (0)	SW-SM	11.3	11.3			
SB - 2	49.0	36	24	12	25	15	A-2-6 (0)	SC	22.3	22.3			
SB - 2	54.0	NP	NP	NP	25	16	A-1-b (0)	SM	18.2	18.2			
SB - 2	59.0	NP	NP	NP	9.5	17	A-2-4 (0)	SM	32.9	32.9			
SB - 2	64.0	NP	NP	NP	25	12	A-1-b (0)	SM	15.2	15.2			
SB - 2	69.0	NP	NP	NP	25	12	A-1-b (0)	SM	63.7	63.7			
SB - 2	79.0	NP	NP	NP	25	11	A-2-4 (0)	SP-SM	30.5	30.5			
SB - 2	89.0	NP	NP	NP	25	10	A-3 (0)	SP-SM	25.2	25.2			
SB - 2	99.0	NP	NP	NP	25	14	A-1-b (0)	SM	18.0	18.0			
SB - 2	109.0	39	27	12	4.75	97	A-6 (14)	ML	39.8	39.8			
SB - 2	119.0	46	30	16	4.75	99	A-7-5 (20)	ML	41.8	41.8			
SB - 2	129.0	46	23	23	25	70	A-7-6 (15)	CL	37.5	37.5	86.7		
SB - 2	139.0	34	28	6	9.5	98	A-4 (7)	ML	29.9	29.9			
SB - 2	149.0	53	27	26	25	58	A-7-6 (13)	CH	28.9	28.9			
SB - 2	159.0	50	23	27	9.5	66	A-7-6 (16)	CH	29.6	29.6			
SB - 2	179.0								30.5	30.5			
SB - 2	189.0	58	32	26	9.5	93	A-7-5 (29)	MH	31.8	31.8			
SB - 2	199.0	66	33	33	9.5	92	A-7-5 (37)	MH	31.9	31.9			
SB - 2	209.0	74	33	41	4.75	86	A-7-5 (41)	CH	32.5	32.5			
SB - 2	219.0	74	37	37	9.5	87	A-7-5 (39)	MH	33.3	33.3			

LAB SUMMARY - 20171219.GDT - 3/1/23 13:28 - F:\LAB\PROJECTS\GINT\2-094(186)217.GPJ

Consolidation Test

Summary Report



				Before Test	After Test
Current Vertical Effective Stress: 0 psf				Water Content, %	19.11	14.50
Preconsolidation Stress: 0 psf				Dry Unit Weight, pcf	106.83	122.72
Compression Ratio: 0				Saturation, %	92.25	110.26
Diameter: 2.5 in		Height: 1 in		Void Ratio	0.55	0.35
LL: ---	PL: ---	PI: ---	GS: 2.65	Back Pressure, psf	0.024	0.024

YOUR COMPANY'S LOGO

Create your logo in a bitmap format not JPEG, if you have a jpeg you will to convert it to bmp and must name it logo.bmp.Next you must copy this file in the same directly where the software program is located. Close and open the program for the logo to show up.

Project: IM-2-094(186)217	Location:	Project No.:
Boring No.: 1	Tested By: MD	Checked By: DT
Sample No.: SS- 342 -22	Test Date: 11/28/22	Depth: 10.5 - 10.6
Test No.: CON -1- 22	Sample Type:	Elevation:
Description: Brn Silty Cly with Rock up to 1/2"		
Remarks:		
Displacement at End of Primary		

Consolidation Test

Square Root of Time Coefficients

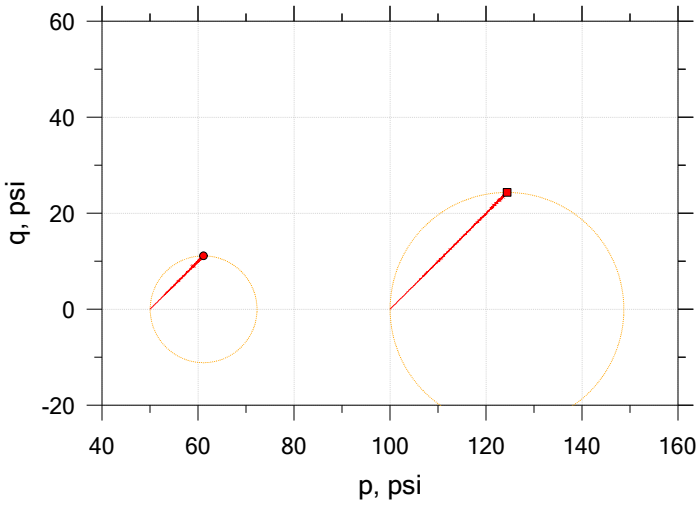
Step	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft²/s	Mv 1/psf	k ft/day
1	128.	0.001742	0.546	0.174	15.436	1.59e-06	1.36e-05	1.16e-04
2	250.	0.006196	0.540	0.620	113.461	2.15e-07	3.66e-05	4.23e-05
3	500.	0.01224	0.530	1.22	18.331	1.31e-06	2.42e-05	1.71e-04
4	1.00e+03	0.02244	0.514	2.24	12.078	1.96e-06	2.04e-05	2.16e-04
5	2.00e+03	0.03779	0.491	3.78	8.458	2.73e-06	1.53e-05	2.26e-04
6	4.00e+03	0.05971	0.457	5.97	10.412	2.13e-06	1.10e-05	1.26e-04
7	8.00e+03	0.08805	0.413	8.80	5.332	3.95e-06	7.08e-06	1.51e-04
8	1.60e+04	0.1165	0.369	11.6	6.720	2.94e-06	3.55e-06	5.64e-05
9	3.20e+04	0.1473	0.321	14.7	7.510	2.46e-06	1.93e-06	2.56e-05
10	1.60e+04	0.1483	0.319	14.8	23.871	7.46e-07	-6.63e-08	-2.67e-07
11	8.00e+03	0.1436	0.327	14.4	2.199	8.14e-06	5.87e-07	2.58e-05
12	4.00e+03	0.1386	0.334	13.9	12.390	1.46e-06	1.26e-06	9.95e-06
13	2.00e+03	0.1342	0.341	13.4	13.943	1.31e-06	2.19e-06	1.55e-05
14	1.00e+03	0.1295	0.349	12.9	44.539	4.15e-07	4.74e-06	1.06e-05

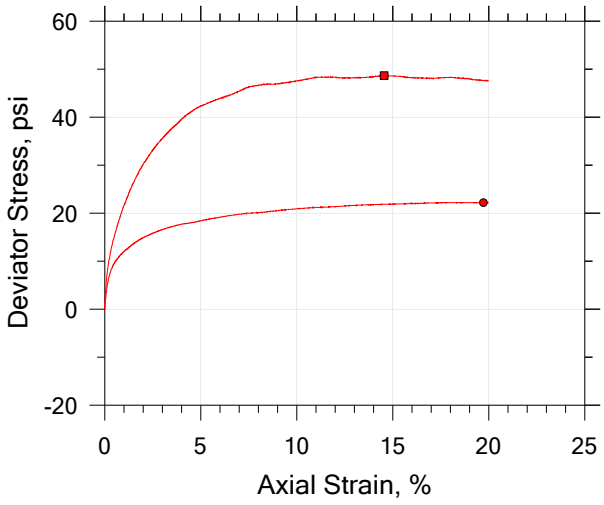
YOUR COMPANY'S LOGO

Create your logo in a bitmap format not JPEG, if you have a jpeg you will to convert it to bmp and must name it logo.bmp.Next you must copy this file in the same directly where the software program is located. Close and open the program for the logo to show up.

Project: IM-2-094(186)217	Location:	Project No.:
Boring No.: 1	Tested By: MD	Checked By: DT
Sample No.: SS- 342 -22	Test Date: 11/28/22	Depth: 10.5 - 10.6
Test No.: CON -1- 22	Sample Type:	Elevation:
Description: Brn Silty Cly with Rock up to 1/2"		
Remarks:		
Displacement at End of Primary		

Unconsolidated Undrained by ASTM D4767



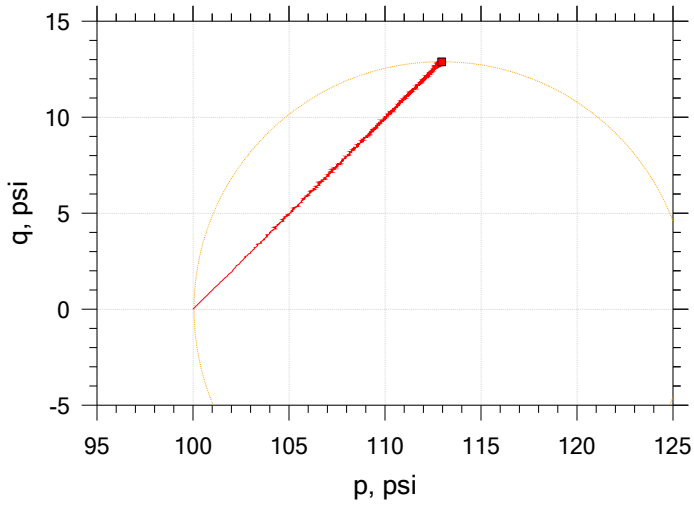


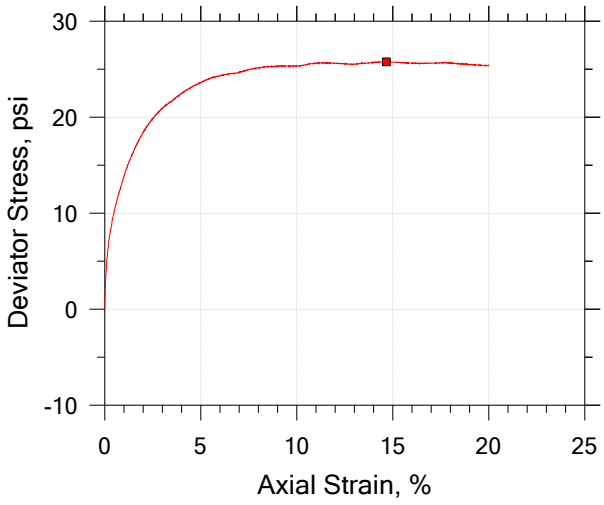
Symbol		■	●		
Sample ID		SS -369 - 22	SS -369 - 22		
Depth		134.0 - 136.0	134.0 - 136.0		
Test Number		UU -53- 22	UU -54- 22		
Initial	Height, in	5.750	5.752		
	Diameter, in	2.837	2.818		
	Moisture Content (from Cuttings), %	27.3	28.8		
	Dry Density, pcf	95.4	94.0		
	Saturation (Wet Method), %	97.2	99.2		
	Void Ratio	0.753	0.779		
Final	Moisture Content, %	27.5	28.6		
	Dry Density, pcf	96.3	94.7		
	Cross-Sectional Area (Method A), in²	6.284	6.209		
	Saturation, %	100.0	100.0		
	Void Ratio	0.738	0.767		
	Back Pressure, psi	0.0000	0.0000		
Vertical Effective Consolidation Stress, psi		99.98	49.99		
Horizontal Effective Consolidation Stress, psi		99.99	49.99		
Vertical Strain after Consolidation, %		0.0000	0.0000		
Volumetric Strain after Consolidation, %		0.0000	0.0000		
Time to 50% Consolidation, min		0.0000	0.0000		
Shear Strength, psi		24.35	11.13		
Strain at Failure, %		14.5	19.7		
Strain Rate, %/min		0.01000	0.01000		
Deviator Stress at Failure, psi		48.69	22.25		
Effective Minor Principal Stress at Failure, psi		100.1	50.19		
Effective Major Principal Stress at Failure, psi		148.8	72.44		
B-Value		---	---		

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

	Project Name: IM-2-094(186)217	Location:	Project Number:
	Boring Number: 1	Tester: MD	Checker: DT
	Sample Number: SS -369 - 22	Test Date: 11/15/22	Depth: 134.0 - 136.0
	Test Number: UU -53- 22	Preparation:	Elevation:
	Description: 24" Gry Silty Cly with Rock up to 1/4"		
	Remarks: Sample Test Depth 134.3 - 134.8		

Unconsolidated Undrained by ASTM D4767



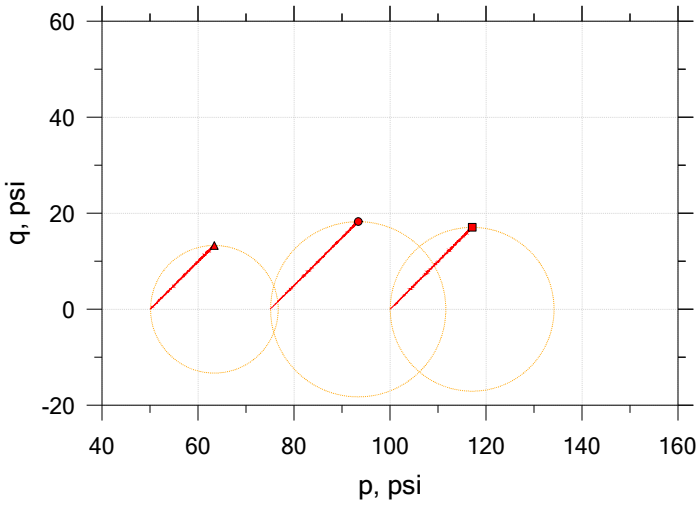


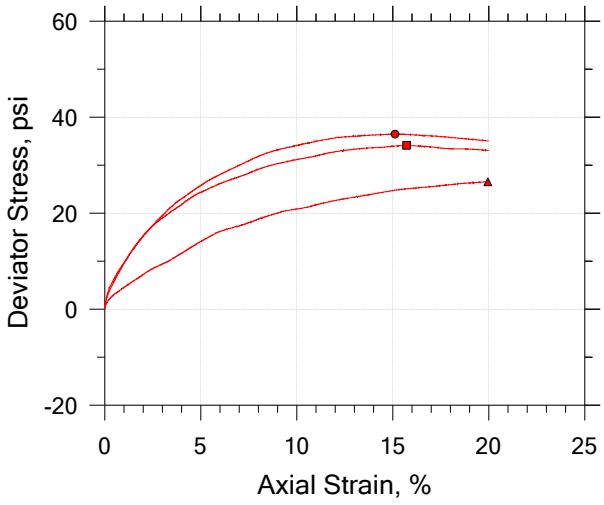
Symbol		
Sample ID		SS -371 - 22
Depth		144.0 - 146.0
Test Number		UU -55- 22
Initial	Height, in	5.740
	Diameter, in	2.842
	Moisture Content (from Cuttings), %	29.4
	Dry Density, pcf	94.2
	Saturation (Wet Method), %	101.4
	Void Ratio	0.777
Final	Moisture Content, %	28.4
	Dry Density, pcf	95.0
	Cross-Sectional Area (Method A), in²	6.306
	Saturation, %	100.0
	Void Ratio	0.761
	Back Pressure, psi	0.0000
Vertical Effective Consolidation Stress, psi		99.99
Horizontal Effective Consolidation Stress, psi		100.0
Vertical Strain after Consolidation, %		0.0000
Volumetric Strain after Consolidation, %		0.0000
Time to 50% Consolidation, min		0.0000
Shear Strength, psi		12.89
Strain at Failure, %		14.7
Strain Rate, %/min		0.01000
Deviator Stress at Failure, psi		25.79
Effective Minor Principal Stress at Failure, psi		100.2
Effective Major Principal Stress at Failure, psi		126.0
B-Value		---

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

Project Name: IM-2-094(186)217	Location:	Project Number:
Boring Number: 1	Tester: MD	Checker: DT
Sample Number: SS -371 - 22	Test Date: 11/16/22	Depth: 144.0 - 146.0
Test Number: UU -55- 22	Preparation:	Elevation:
Description: 24" Gry Silty Cly with Rock up to 1/4"		
Remarks: Sample Test Depth 144.7 - 145.2		

Unconsolidated Undrained by ASTM D4767





Symbol		■	●	▲	
Sample ID		SS -397 - 22	SS -397 - 22	SS -397 - 22	
Depth		129.0 - 131.0	129.0 - 131.0	129.0 - 131.0	
Test Number		UU -56- 22	UU -57- 22	UU -58- 22	
Initial	Height, in	5.759	5.748	5.726	
	Diameter, in	2.813	2.821	2.821	
	Moisture Content (from Cuttings), %	37.5	36.6	34.7	
	Dry Density, pcf	85.5	85.6	88.9	
	Saturation (Wet Method), %	105.0	102.6	105.3	
	Void Ratio	0.957	0.955	0.883	
Final	Moisture Content, %	35.4	35.2	32.8	
	Dry Density, pcf	85.8	86.1	89.1	
	Cross-Sectional Area (Method A), in²	6.199	6.226	6.240	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	0.949	0.944	0.878	
	Back Pressure, psi	0.0000	0.0000	0.0000	
Vertical Effective Consolidation Stress, psi		99.99	74.99	49.99	
Horizontal Effective Consolidation Stress, psi		100.0	75.00	49.99	
Vertical Strain after Consolidation, %		0.0000	0.0000	0.0000	
Volumetric Strain after Consolidation, %		0.0000	0.0000	0.0000	
Time to 50% Consolidation, min		0.0000	0.0000	0.0000	
Shear Strength, psi		17.07	18.25	13.29	
Strain at Failure, %		15.7	15.1	19.9	
Strain Rate, %/min		0.01000	0.01000	0.01000	
Deviator Stress at Failure, psi		34.13	36.51	26.58	
Effective Minor Principal Stress at Failure, psi		100.2	75.20	50.28	
Effective Major Principal Stress at Failure, psi		134.3	111.7	76.86	
B-Value		---	---	---	

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

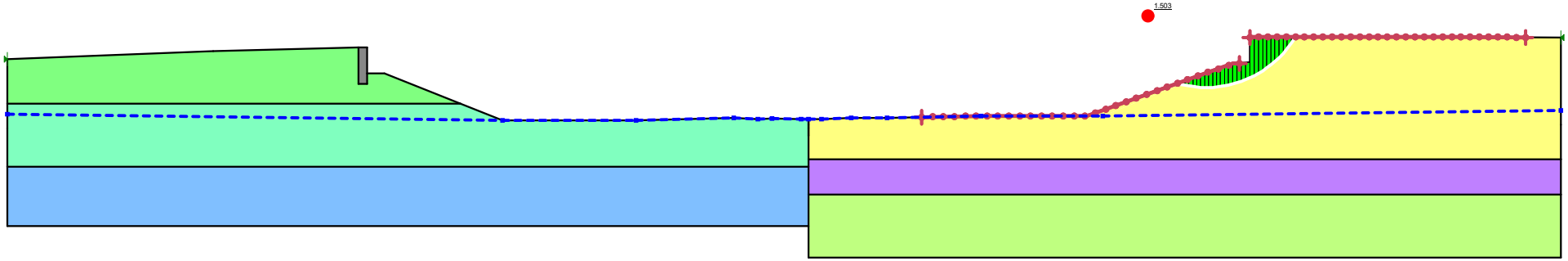
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	Boring Number: 2	Tester: MD	Checker: DT
	Sample Number: SS -397 - 22	Test Date: 11/16/22	Depth: 129.0 - 131.0
	Test Number: UU -56- 22	Preparation:	Elevation:
	Description: 24" Gry Silty Cly		
	Remarks: Sample Test Depth 129.3 - 129.8		

APPENDIX C

Stability Analysis Outputs

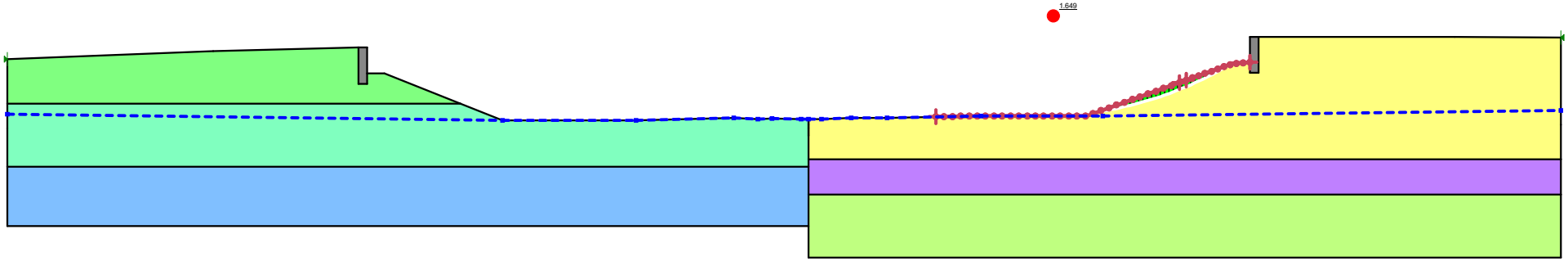
North side, 2.8:1

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Line
	A N Layer 1	Mohr-Coulomb	126	0	30.1	0	1
	B N layer 3	Mohr-Coulomb	126	0	42.1	0	1
	C S layer 1	Mohr-Coulomb	126	0	30.7	0	1
	D S layer 2	Mohr-Coulomb	126	0	37.8	0	1
	E S layer 3	Mohr-Coulomb	126	0	45.2	0	1
	F CONC	Mohr-Coulomb	150	10,000	0	0	1
	G N layer2	Mohr-Coulomb	126	0	35.1	0	1



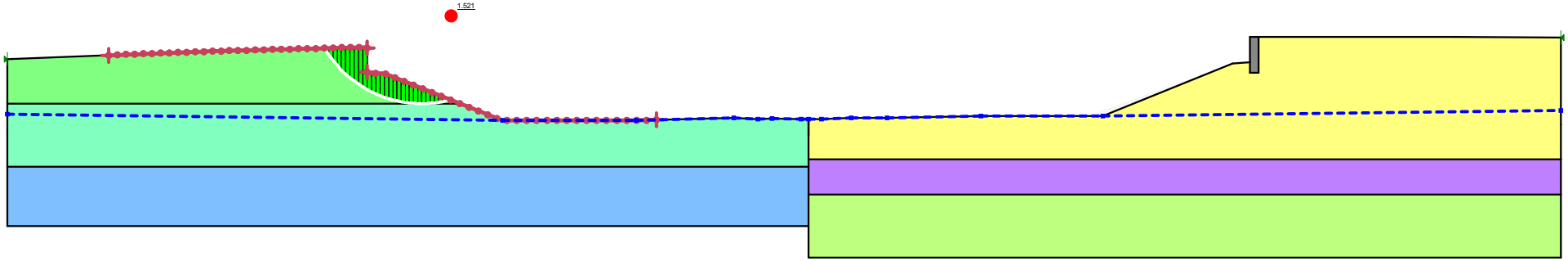
North side, 2.8:1

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Line
	A N Layer 1	Mohr-Coulomb	126	0	30.1	0	1
	B N layer 3	Mohr-Coulomb	126	0	42.1	0	1
	C S layer 1	Mohr-Coulomb	126	0	30.7	0	1
	D S layer 2	Mohr-Coulomb	126	0	37.8	0	1
	E S layer 3	Mohr-Coulomb	126	0	45.2	0	1
	F CONC	Mohr-Coulomb	150	10,000	0	0	1
	G N layer2	Mohr-Coulomb	126	0	35.1	0	1



South side, 2.5:1

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Line
	A N Layer 1	Mohr-Coulomb	126	0	30.1	0	1
	B N layer 3	Mohr-Coulomb	126	0	42.1	0	1
	C S layer 1	Mohr-Coulomb	126	0	30.7	0	1
	D S layer 2	Mohr-Coulomb	126	0	37.8	0	1
	E S layer 3	Mohr-Coulomb	126	0	45.2	0	1
	F CONC	Mohr-Coulomb	150	10,000	0	0	1
	G N layer2	Mohr-Coulomb	126	0	35.1	0	1



South side, 2.5:1

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Line
	A N Layer 1	Mohr-Coulomb	126	0	30.1	0	1
	B N layer 3	Mohr-Coulomb	126	0	42.1	0	1
	C S layer 1	Mohr-Coulomb	126	0	30.7	0	1
	D S layer 2	Mohr-Coulomb	126	0	37.8	0	1
	E S layer 3	Mohr-Coulomb	126	0	45.2	0	1
	F CONC	Mohr-Coulomb	150	10,000	0	0	1
	G N layer2	Mohr-Coulomb	126	0	35.1	0	1

