SOIL INFORMATION MEMO

TO:	**File**
FROM:	**Geotechnical Section**
DATE:	**3/31/2025**
HIGHWAY:	**ND 32**
PROJECT NUMBER:	**SS-6-032(075)230**
PCN:	**23896**
LOCATION:	**ND 32, Walhalla to State Line**
SUBJECT:	**Soil Information for Culvert Replacements**

Project Background

This project is a minor rehabilitation with multiple replacement culverts proposed to be constructed on Highway 32 from Walhalla to the Canadian border. Soil investigations were performed at the 4 locations where existing pipes are proposed to be replaced with concrete box culverts.

Soil Information

A 31-foot soil boring was completed at each of the four culvert replacement locations with split spoon samples every 5 feet in depth and multiple thin-walled tube samples at each location. Standard soil laboratory index testing was performed on each soil sample, and CU and UU triaxial tests were completed on some of the thin-walled tube samples. The boring logs and lab testing results are attached to this memo. Soil boring surface elevations were obtained from Google Earth Pro.

Location 1
RP 233+0344, Boring 1

Boring 1 had a surface elevation of approximately 955 feet and was located at a mile + feet reference point (RP) of 233+0344, offset 10 feet east of centerline. Below the approximate 0.6 feet of asphalt and 0.6 feet of gravel, there were two soil layers. The first layer consisted of approximately 13 feet of black/brown moist/wet very loose to loose silty sand with blow count values ranging from 2 to 9 (blows per foot). The second layer consisted of approximately 17 feet of brown/grey wet stiff to very stiff silt with sand and had blow count values ranging from 8 to 24. The water table was encountered at a depth of approximately 11 feet from the top surface of the boring.

Location 2
RP 234+2588, Boring 2

Boring 2 had a surface elevation of approximately 949 feet and was located at RP 234+2588, offset 10 feet east of centerline. Below the approximate 0.6 feet of asphalt and 0.6 feet of gravel, there were two soil layers. The first layer consisted of approximately 12 feet of black/brown moist stiff sandy silty clay with blow count values ranging from 10 to 11. The second layer consisted of approximately 18 feet of grey moist medium stiff fat clay with blow count values ranging from 4 to 9. No water table was encountered in the soil layers in Boring 2.

Location 3
RP 235+1432, Boring 3

Boring 3 had a surface elevation of approximately 949 feet and was located at RP 235+1432, offset 10 feet east of centerline. Below the approximate 0.7 feet of asphalt and 0.7 feet of gravel, there were three soil layers. The first layer consisted of approximately 13 feet of

black/brown moist/wet medium dense silty sand with blow count values ranging from 18 to 19. The second layer consisted of approximately 5 feet of brown/grey wet medium stiff sandy silt with a blow count value of 5. The third layer consisted of approximately 12 feet of grey moist stiff fat clay with blow count values ranging from 3 to 4. The water table was encountered at a depth of approximately 9 feet from the top surface of the boring.

Location 4
RP 236+2062, Boring 4
Boring 4 had a surface elevation of approximately 941 feet and was located at RP 236+2062, offset 10 feet east of centerline. Below the approximate 0.5 feet of asphalt and 1.0 feet of gravel, there were three soil layers. The first layer consisted of approximately 8 feet of black/grey moist stiff fat clay with sand and had a blow count value of 13. The second layer consisted of black/grey moist/wet stiff sandy silty clay with gravel and had blow count values ranging from 10 to 11. The third layer consisted of grey moist medium stiff fat clay and had multiple blow count values of 5. The water table was encountered at a depth of approximately 14 feet from the top surface of the boring.

The boring logs are only representative of the exact location and time period from which the samples were taken. Fluctuations in the soil conditions may occur due to rainfall, spring thaw, drainage, and other seasonal factors not evident at the time the samples were taken. Construction planning should recognize the possibility of fluctuations. The NDDOT assumes no responsibility if the soil conditions encountered during construction differ from those shown. The boring locations were determined based on preliminary layouts of the proposed box culvert locations.

Limitations
This memo should be made available to prospective designers and contractors for information on factual data only and not as a warranty of subsurface conditions. This memo should not be used without approval if any of the following occurs:

- Conditions change due to natural forces or human activity under, at, or adjacent to the site.
- Assumptions stated in this memo have changed.
- Project details change or new information becomes available such that the analyses, conclusions, and recommendations may be affected.
- The site ownership or land use has changed.
- More than 5 years has passed since the date of this memo.

Unanticipated soil and water table conditions are commonly encountered.

Within the limitations of scope and schedule, the analyses, conclusions, and recommendations presented in this memo were prepared in accordance with generally accepted professional geotechnical and geological principles and practice in this area at the time this memo was prepared. We make no other warranty, either express or implied.

If there are any questions or concerns, please contact Aaron Lehman alehman@nd.gov or Colter Schwagler cschwagler@nd.gov of the NDDOT Geotechnical Section.



Legend

- Reference Point
- Boring Locations

0 5,000 10,000 Feet

Project Number: SS-6-032(075)230

LOG OF BORING SB - 1

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

PROJECT NUMBER SS-6-032(075)230 **DATE STARTED** 6/3/24 **COMPLETED** 6/4/24

PCN 23896 **ELEVATION** 955 ft

LOCATION Cavalier County **Northing** 5422315.15 ft **Easting** 580084.84 ft

DRILLED BY Austin **LOGGED BY** Jamie **RP+Feet** 233+0344 ft **Offset** 10 Rt

ENGINEER **DRILLING METHOD**

NOTES Coordinate System: NAD_1983_UTM_Zone_14N. Surface elevations based off of Google Earth.

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	AASHTO	USCS	SAMPLE TYPE & NUMBER	RECOVERY (%)	◎ SPT N VALUE (20 40 60 80)	● MC PL LL 20 40 60 80 / □ CLAY FRACTION (%) (20 40 60 80)	TESTS & REMARKS
955	0	Top 0.6' Asphalt	0.6 ft							
		954.4 ft	1.2 ft							
		0.6' Gravel								
		953.8 ft								
		Black/Brown Moist/Wet Very Loose to Loose Silty Sand. Water bearing at 11'.								
950	5			A-4	SM	SS 82	50	9	0	
945	10			A-2-4	SM	3TW 83	40		0	
				A-4	SM	SS 84	50	2	0	
		941.0 ft	14.0 ft							
940	15	Brown/Grey Wet Stiff to Very Stiff Silt with Sand		A-1-b	SM	SS 85	60	24	227	
935	20			A-4	ML	3TW 86	85		0	
				A-4	ML	SS 87	70	20	0	
930	25			A-4	ML	SS 88	100	12	27	
925	30			A-4	ML	SS 89	100	8	0	
		924.0 ft	31.0 ft							

Bottom of borehole at 31.0 ft

NDDOT LOG LAT/LONG - 20171219.GDT - 4/1/25 08:08 - F:\LAB\PROJECTS\GINT\6-032(075)230.GPJ

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

LOG OF BORING SB - 2

PROJECT NUMBER SS-6-032(075)230 **DATE STARTED** 6/3/24 **COMPLETED** 6/4/24

PCN 23896 **ELEVATION** 949 ft

LOCATION Cavalier County **Northing** 5424595.37 ft **Easting** 580024.49 ft

DRILLED BY Austin **LOGGED BY** Jamie **RP+Feet** 234+2588 ft **Offset** 10 Rt

ENGINEER **DRILLING METHOD**

NOTES Coordinate System: NAD_1983_UTM_Zone_14N. Surface elevations based off of Google Earth.

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	AASHTO	USCS	SAMPLE TYPE & NUMBER	RECOVERY (%)	SPT N VALUE (20 40 60 80)	MC / PL LL / CLAY FRACTION (%) (20 40 60 80)	TESTS & REMARKS
	0	Top 0.6' Asphalt								
		0.6 ft / 948.4 ft								
		0.6' Gravel								
		1.2 ft / 947.8 ft								
		Black/Brown Moist Stiff Sandy Silty Clay								
945	5			A-4	CL-ML	3TW 90	80		226	γ_d = 106.5 pcf, γ = 125.6 pcf, CU: c'=576 psf, phi=31.6°
				A-4	CL-ML	SS 91	80	11	227	
940	10			A-4	ML	3TW 92	85		0 227	γ_d = 109.0 pcf, γ = 130.5 pcf
				A-4	SM	3TW 92.1				
				A-6	CL	SS 93	75	10	16 37	
		936.0 ft / 13.0 ft								
		Grey Moist Medium Stiff Fat Clay								
935	15			A-7-6	CH	3TW 94	90		21 63	γ_d = 88.6 pcf, γ = 117.6 pcf, UU: Su=1092 psf
				A-7-6	CH	SS 95	90	8	21 67	
930	20			A-7-6	CH	SS 96	100	9	27 98	
925	25			A-7-6	CH	SS 97	100	5	28 91	
920	30			A-7-6	CH	SS 98	100	4	27 83	
		918.0 ft / 31.0 ft								

Bottom of borehole at 31.0 ft

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

LOG OF BORING SB - 3

PROJECT NUMBER SS-6-032(075)230 **DATE STARTED** 6/3/24 **COMPLETED** 6/4/24

PCN 23896 **ELEVATION** 949 ft

LOCATION Cavalier County **Northing** 5425851.85 ft **Easting** 580000.03 ft

DRILLED BY Austin **LOGGED BY** Jamie **RP+Feet** 235+1432 ft **Offset** 10 Rt

ENGINEER **DRILLING METHOD**

NOTES Coordinate System: NAD_1983_UTM_Zone_14N. Surface elevations based off of Google Earth.

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	AASHTO	USCS	SAMPLE TYPE & NUMBER	RECOVERY (%)	◎ SPT N VALUE	● MC / PL–LL / □ CLAY FRACTION (%)	TESTS & REMARKS
	0	Top 0.7' Asphalt								
		948.3 ft 0.7 ft								
		0.7' Gravel								
		947.6 ft 1.4 ft								
		Black/Brown Moist/Wet Medium Dense Silty Sand. Water bearing at 9'.								
945	5			A-4	ML	SS 99	70	19	0	
940	10			A-4	SM	3TW 100	80		0	
				A-4	SM	SS 101	100	18	0	
		935.0 ft 14.0 ft								
935	15	Brown/Grey Wet Medium Stiff Sandy Silt		A-4	ML	SS 102	100	5	0	
		930.0 ft 19.0 ft								
930	20	Grey Moist Stiff Fat Clay		A-7-6	CH	3TW 103	100		27 101	γ_d = 67.7 pcf γ = 105.5 pcf UU: Su=544 psf
				A-7-6	CH	SS 104	100	4	27 79	
925	25			A-7-6	CH	SS 105	100	3	27 84	
920	30			A-7-6	CH	SS 106	100	4	25 75	
		918.0 ft 31.0 ft								

Bottom of borehole at 31.0 ft

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

LOG OF BORING SB - 4

PROJECT NUMBER SS-6-032(075)230 **DATE STARTED** 6/3/24 **COMPLETED** 6/4/24

PCN 23896 **ELEVATION** 941 ft

LOCATION Cavalier County **Northing** 5427647.55 ft **Easting** 579969.91 ft

DRILLED BY Austin **LOGGED BY** Jamie **RP+Feet** 236+2062 ft **Offset** 10 Rt

ENGINEER **DRILLING METHOD**

NOTES Coordinate System: NAD_1983_UTM_Zone_14N. Surface elevations based off of Google Earth.

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	AASHTO	USCS	SAMPLE TYPE & NUMBER	RECOVERY (%)	SPT N VALUE (20 40 60 80)	MC / PL LL (30 60 90 120) / CLAY FRACTION (%) (20 40 60 80)	TESTS & REMARKS
	0	Top 0.5' Asphalt								
940		940.5 ft	0.5 ft							
		1.0' Gravel	1.5 ft							
		939.5 ft								
		Black/Grey Moist Stiff Fat Clay with Sand								
	5			A-7-6	CH	SS 108	40	13	20 54	
935										
		932.0 ft	9.0 ft							
		Black/Grey Moist/Wet Stiff Sandy Silty Clay with Gravel. Water bearing at 14'.								
	10			A-6	CL	3TW 109	85		21 35	γ_d = 99.6 pcf γ = 123.6 pcf CU: c'=258 psf, phi=33.5°
930				A-4	CL-ML	SS 110	75	11	22 8	
	15			A-6	SC	SS 111	50	10	23 3	
925										
		922.0 ft	19.0 ft							
		Grey Moist Medium Stiff Fat Clay								
	20			A-7-6	CH	3TW 112	75		29 106	γ_d = 77.6 pcf γ = 110.9 pcf UU: Su=786 psf
920				A-7-6	CH	SS 113	90	5	29 90	
	25			A-7-6	CH	SS 114	100	5	28 88	
915										
	30			A-7-6	CH	SS 115	100	5	27 82	
910		910.0 ft	31.0 ft							

Bottom of borehole at 31.0 ft

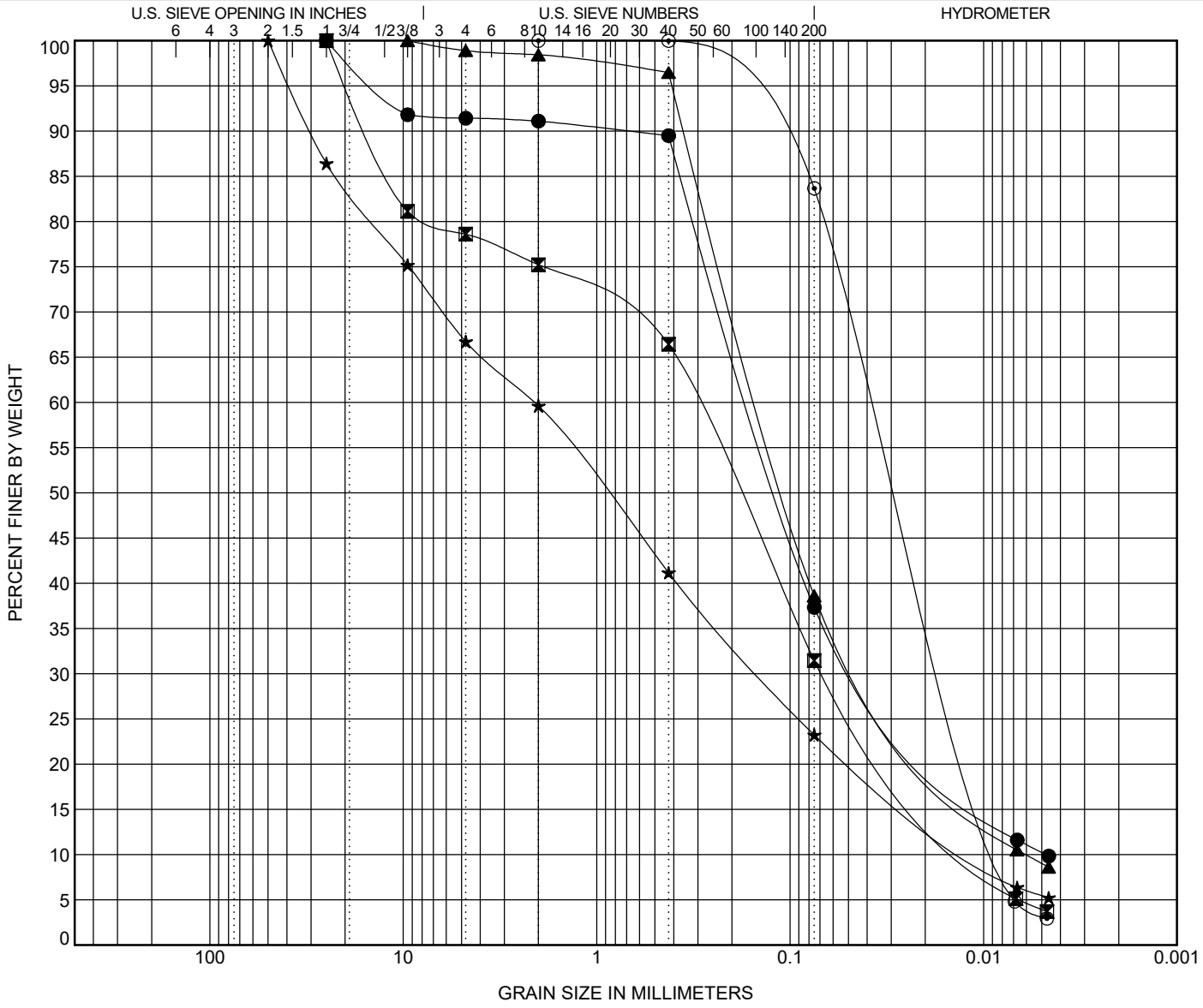
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GRAIN SIZE DISTRIBUTION

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300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SS-6-032(075)230 **LOCATION** Cavalier County

PCN 23896



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-4 (0)	SM	NP	NP	NP	1.87	33.48
⊠	SB - 1	9.0	A-2-4 (0)	SM	NP	NP	NP	1.32	29.16
▲	SB - 1	11.0	A-4 (0)	SM	NP	NP	NP	1.48	23.47
★	SB - 1	14.0	A-1-b (0)	SM	27	23	4	0.88	186.34
⊙	SB - 1	19.0	A-4 (0)	ML	NP	NP	NP	0.74	4.54

BOREHOLE		DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SB - 1	4.0	25	0.159	0.038	0.005	8.6	54.1	37.3	
⊠	SB - 1	9.0	25	0.309	0.066	0.011	21.4	47.2	31.4	
▲	SB - 1	11.0	9.5	0.142	0.036	0.006	1.1	60.3	38.6	
★	SB - 1	14.0	50	2.098	0.144	0.011	33.3	43.5	23.2	
⊙	SB - 1	19.0	2	0.037	0.015	0.008	0.0	16.3	83.7	

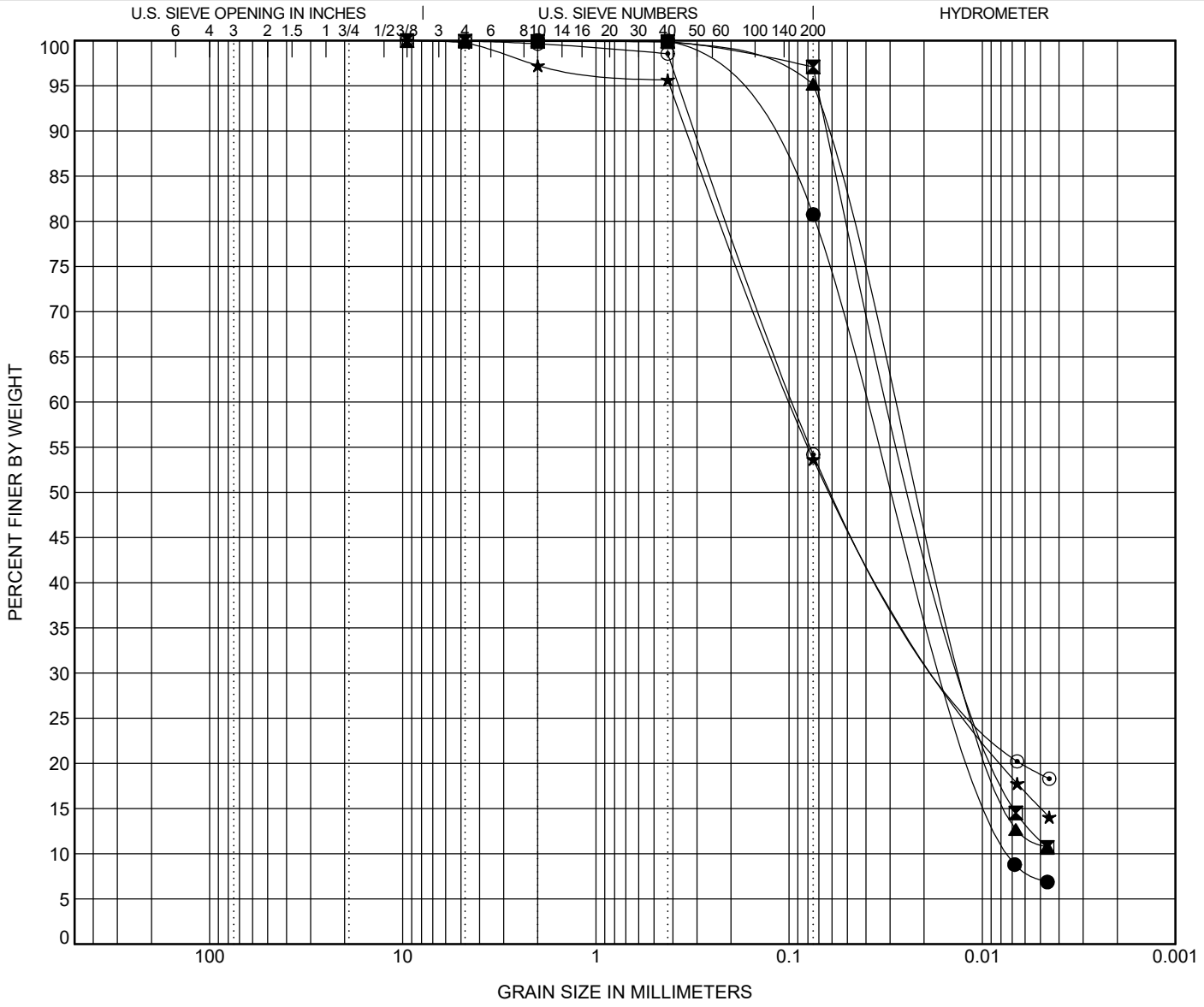
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300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SS-6-032(075)230 **LOCATION** Cavalier County

PCN 23896



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 1	21.0	A-4 (0)	ML	NP	NP	NP	0.72	5.30
⊠	SB - 1	24.0	A-4 (3)	ML	27	24	3		
▲	SB - 1	29.0	A-4 (0)	ML	NP	NP	NP		
★	SB - 2	4.0	A-4 (1)	CL-ML	26	21	5		
⊙	SB - 2	6.0	A-4 (1)	CL-ML	27	21	6		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SB - 1	21.0	2	0.038	0.014	0.007	0.0	19.2	80.8	
⊠	SB - 1	24.0	9.5	0.025	0.011		0.1	2.8	97.1	
▲	SB - 1	29.0	4.75	0.027	0.011		0.0	4.8	95.2	
★	SB - 2	4.0	9.5	0.097	0.015		0.2	46.1	53.7	
⊙	SB - 2	6.0	9.5	0.094	0.013		0.1	45.8	54.2	

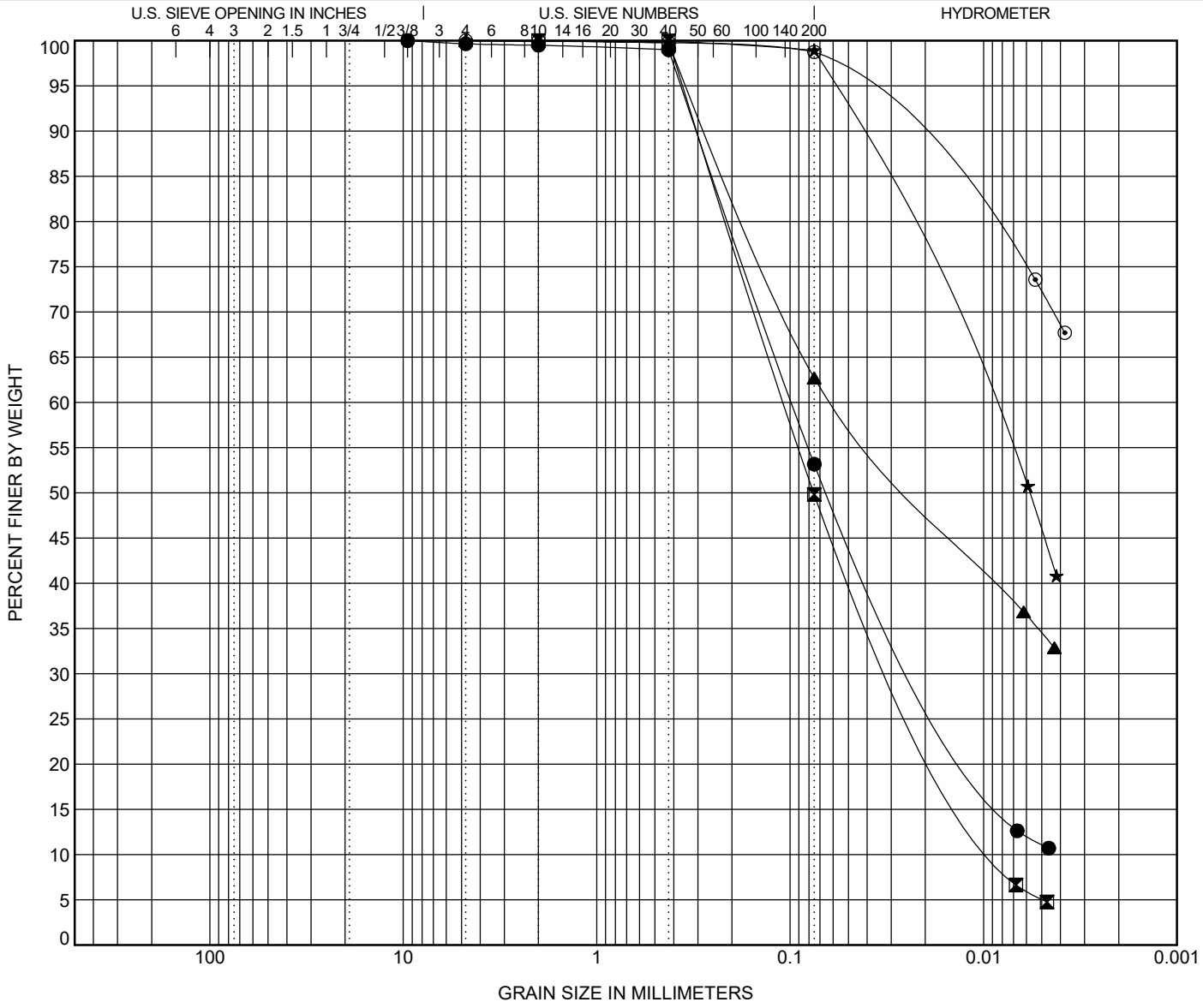
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300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SS-6-032(075)230 **LOCATION** Cavalier County

PCN 23896



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 2	9.0	A-4 (0)	ML	27	23	4		
⊠	SB - 2	10.0	A-4 (0)	SM	NP	NP	NP	0.71	13.01
▲	SB - 2	11.0	A-6 (10)	CL	37	16	21		
★	SB - 2	14.0	A-7-6 (47)	CH	63	21	42		
⊙	SB - 2	16.0	A-7-6 (52)	CH	67	21	46		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SB - 2	9.0	9.5	0.097	0.019		0.3	46.5	53.2	
⊠	SB - 2	10.0	2	0.107	0.025	0.008	0.0	50.2	49.8	
▲	SB - 2	11.0	4.75	0.058			0.0	37.3	62.7	
★	SB - 2	14.0	4.75	0.01			0.0	1.1	98.9	
⊙	SB - 2	16.0	4.75				0.0	1.2	98.8	

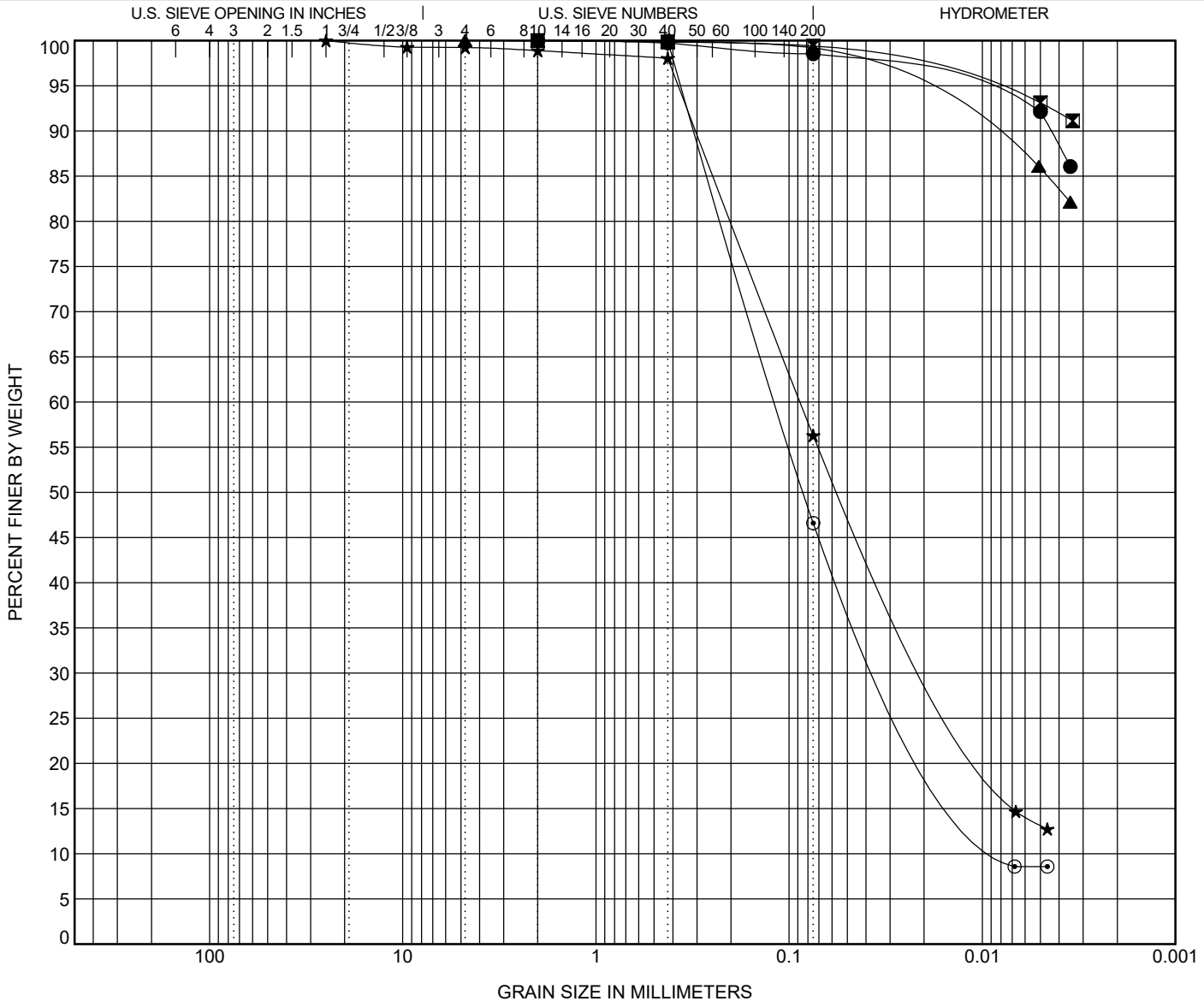
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NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SS-6-032(075)230 **LOCATION** Cavalier County

PCN 23896



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 2	19.0	A-7-6 (83)	CH	98	27	71		
⊠	SB - 2	24.0	A-7-6 (74)	CH	91	28	63		
▲	SB - 2	29.0	A-7-6 (65)	CH	83	27	56		
★	SB - 3	4.0	A-4 (0)	ML	NP	NP	NP		
⊙	SB - 3	9.0	A-4 (0)	SM	NP	NP	NP	0.80	15.59

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SB - 2	19.0	2				0.0	1.5	98.5	
⊠	SB - 2	24.0	2				0.0	0.6	99.4	
▲	SB - 2	29.0	4.75				0.0	0.8	99.2	
★	SB - 3	4.0	25	0.087	0.016		0.8	42.9	56.3	
⊙	SB - 3	9.0	2	0.116	0.026	0.007	0.0	53.4	46.6	

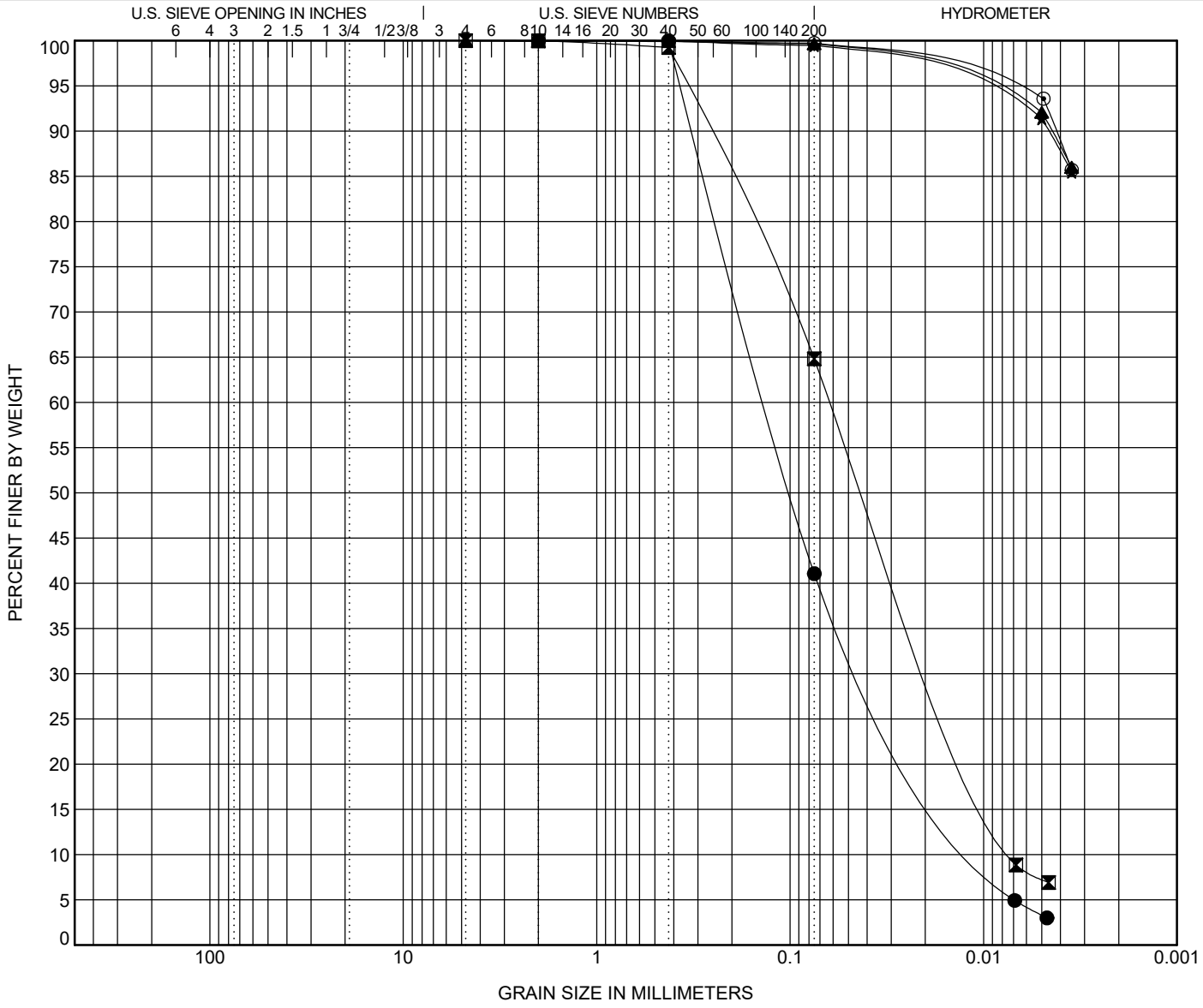
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NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SS-6-032(075)230 **LOCATION** Cavalier County

PCN 23896



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 3	11.0	A-4 (0)	SM	NP	NP	NP	1.03	13.58
⊠	SB - 3	14.0	A-4 (0)	ML	NP	NP	NP	0.65	8.54
▲	SB - 3	19.0	A-7-6 (87)	CH	101	27	74		
★	SB - 3	21.0	A-7-6 (61)	CH	79	27	52		
⊙	SB - 3	24.0	A-7-6 (67)	CH	84	27	57		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SB - 3	11.0	2	0.131	0.036	0.01	0.0	58.9	41.1	
⊠	SB - 3	14.0	4.75	0.061	0.017	0.007	0.0	35.2	64.8	
▲	SB - 3	19.0	4.75				0.0	0.3	99.7	
★	SB - 3	21.0	2				0.0	0.5	99.5	
⊙	SB - 3	24.0	2				0.0	0.3	99.7	

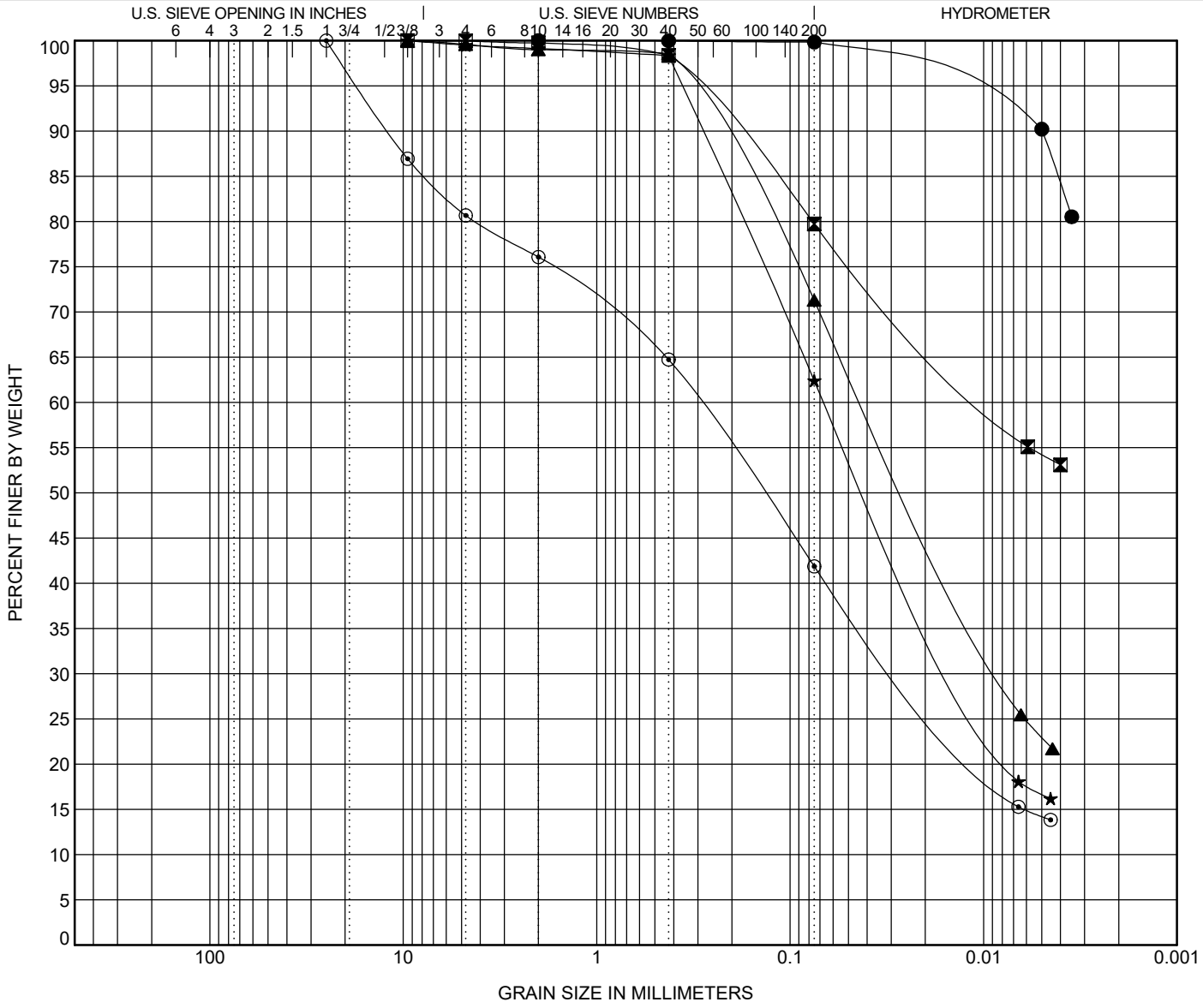
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300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SS-6-032(075)230 **LOCATION** Cavalier County

PCN 23896



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	SB - 3	29.0	A-7-6 (58)	CH	75	25	50		
⊠	SB - 4	4.0	A-7-6 (28)	CH	54	20	34		
▲	SB - 4	9.0	A-6 (9)	CL	35	21	14		
★	SB - 4	11.0	A-4 (2)	CL-ML	28	22	6		
⊙	SB - 4	14.0	A-6 (2)	SC	33	21	12		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SB - 3	29.0	2				0.0	0.2	99.8	
⊠	SB - 4	4.0	9.5	0.01			0.0	20.2	79.7	
▲	SB - 4	9.0	9.5	0.041	0.008		0.4	28.3	71.3	
★	SB - 4	11.0	9.5	0.066	0.013		0.5	37.1	62.4	
⊙	SB - 4	14.0	25	0.297	0.025		19.3	38.8	41.9	

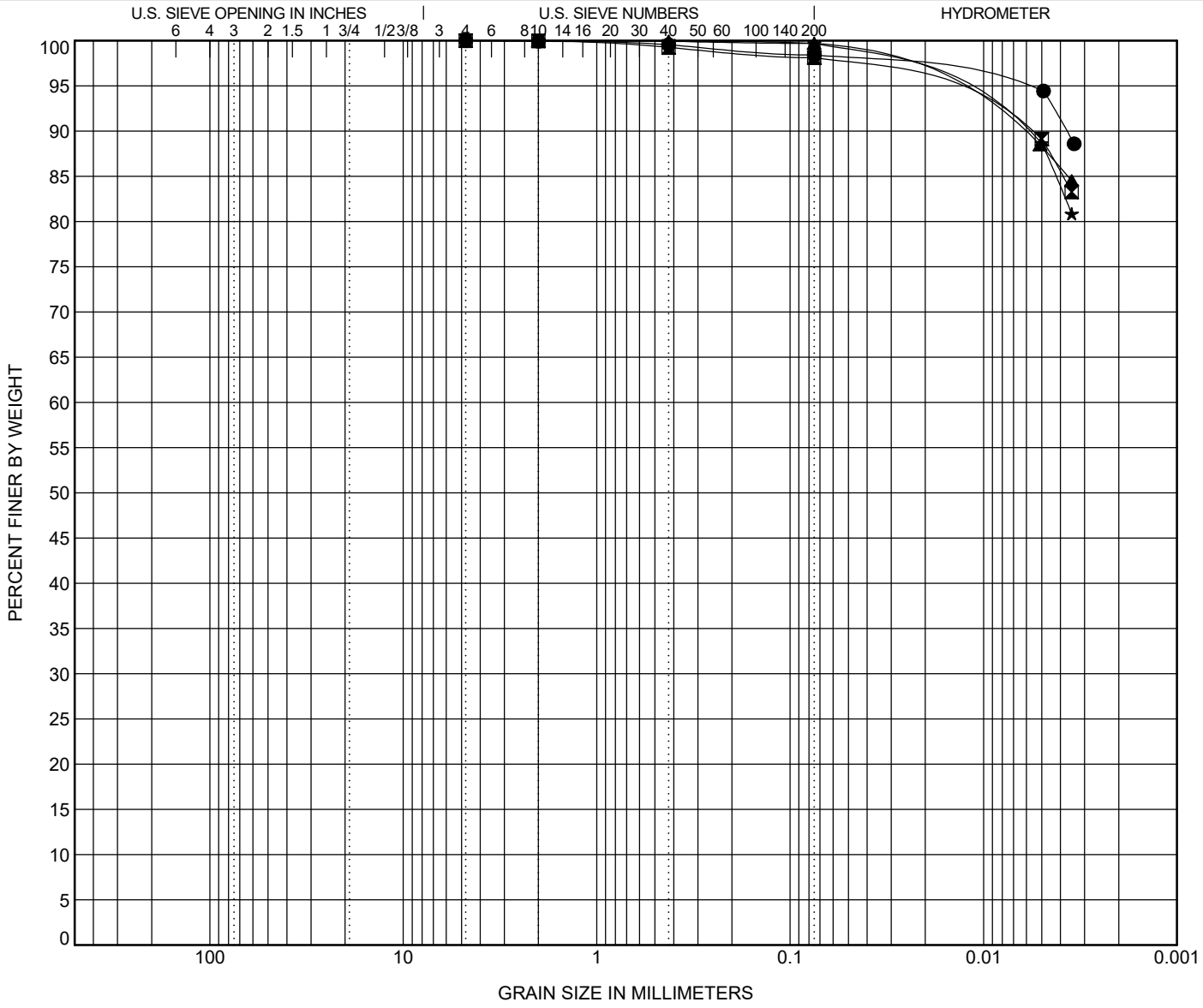
GRAIN SIZE - 20171219.GDT - 10/3/24 15:19 - F:\LAB\PROJECTS\GINT\6-032(075)230.GPJ

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER SS-6-032(075)230 **LOCATION** Cavalier County

PCN 23896



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● SB - 4	19.0	A-7-6 (89)	CH	106	29	77		
⊠ SB - 4	21.0	A-7-6 (71)	CH	90	29	61		
▲ SB - 4	24.0	A-7-6 (71)	CH	88	28	60		
★ SB - 4	29.0	A-7-6 (65)	CH	82	27	55		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● SB - 4	19.0	4.75				0.0	1.6	98.4	
⊠ SB - 4	21.0	4.75				0.0	1.9	98.1	
▲ SB - 4	24.0	2				0.0	0.3	99.7	
★ SB - 4	29.0	4.75				0.0	0.3	99.7	

GRAIN SIZE - 20171219.GDT - 10/3/24 15:19 - F:\LAB\PROJECTS\GINT\6-032(075)230.GPJ

SUMMARY OF LABORATORY RESULTS

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

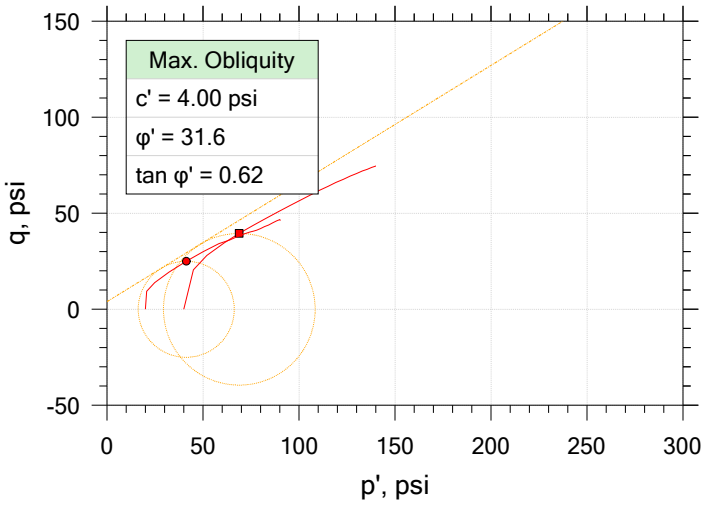
PROJECT NUMBER SS-6-032(075)230 **LOCATION** Cavalier County

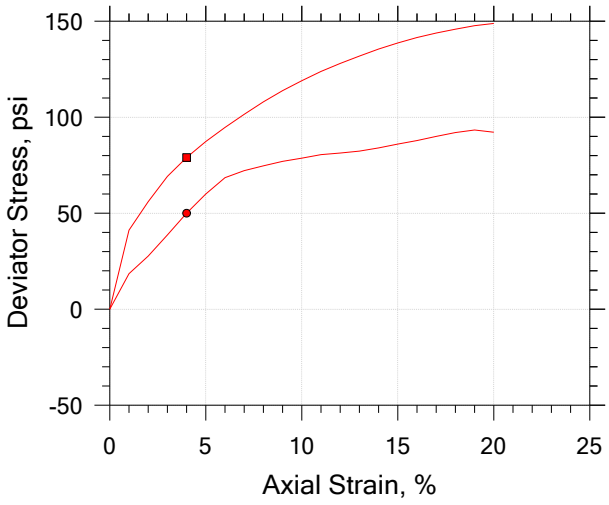
PCN 23896

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	NP	NP	NP	25	37	A-4 (0)	SM	16.9	16.9			
SB - 1	9.0	NP	NP	NP	25	31	A-2-4 (0)	SM	21.8	21.8			
SB - 1	11.0	NP	NP	NP	9.5	39	A-4 (0)	SM	27.9	27.9			
SB - 1	14.0	27	23	4	50	23	A-1-b (0)	SM	21.6	21.6			
SB - 1	19.0	NP	NP	NP	2	84	A-4 (0)	ML	21.3	21.3			
SB - 1	21.0	NP	NP	NP	2	81	A-4 (0)	ML	27.0	27.0			
SB - 1	24.0	27	24	3	9.5	97	A-4 (3)	ML	32.2	32.2			
SB - 1	29.0	NP	NP	NP	4.75	95	A-4 (0)	ML	30.8	30.8			
SB - 2	4.0	26	21	5	9.5	54	A-4 (1)	CL-ML	17.9	17.9	106.5		
SB - 2	6.0	27	21	6	9.5	54	A-4 (1)	CL-ML	20.0	20.0			
SB - 2	9.0	27	23	4	9.5	53	A-4 (0)	ML	21.7	21.7			
SB - 2	10.0	NP	NP	NP	2	50	A-4 (0)	SM	19.7	19.7	109.0		
SB - 2	11.0	37	16	21	4.75	63	A-6 (10)	CL	32.1	32.1			
SB - 2	14.0	63	21	42	4.75	99	A-7-6 (47)	CH	32.8	32.8	88.6		
SB - 2	16.0	67	21	46	4.75	99	A-7-6 (52)	CH	45.5	45.5			
SB - 2	19.0	98	27	71	2	99	A-7-6 (83)	CH	46.1	46.1			
SB - 2	24.0	91	28	63	2	99	A-7-6 (74)	CH	52.0	52.0			
SB - 2	29.0	83	27	56	4.75	99	A-7-6 (65)	CH	63.9	63.9			
SB - 3	4.0	NP	NP	NP	25	56	A-4 (0)	ML	20.4	20.4			
SB - 3	9.0	NP	NP	NP	2	47	A-4 (0)	SM	24.9	24.9			
SB - 3	11.0	NP	NP	NP	2	41	A-4 (0)	SM	32.0	32.0			
SB - 3	14.0	NP	NP	NP	4.75	65	A-4 (0)	ML	36.8	36.8			
SB - 3	19.0	101	27	74	4.75	100	A-7-6 (87)	CH	56.0	56.0	105.7		
SB - 3	21.0	79	27	52	2	99	A-7-6 (61)	CH	56.7	56.7			
SB - 3	24.0	84	27	57	2	100	A-7-6 (67)	CH	59.0	59.0			
SB - 3	29.0	75	25	50	2	100	A-7-6 (58)	CH	70.8	70.8			
SB - 4	4.0	54	20	34	9.5	80	A-7-6 (28)	CH	29.0	29.0			
SB - 4	9.0	35	21	14	9.5	71	A-6 (9)	CL	24.1	24.1			
SB - 4	11.0	28	22	6	9.5	62	A-4 (2)	CL-ML	25.9	25.9			
SB - 4	14.0	33	21	12	25	42	A-6 (2)	SC	26.9	26.9			
SB - 4	19.0	106	29	77	4.75	98	A-7-6 (89)	CH	43.0	43.0	77.6		
SB - 4	21.0	90	29	61	4.75	98	A-7-6 (71)	CH	48.0	48.0			
SB - 4	24.0	88	28	60	2	100	A-7-6 (71)	CH	51.2	51.2			
SB - 4	29.0	82	27	55	4.75	100	A-7-6 (65)	CH	56.8	56.8			

LAB SUMMARY - 20171219.GDT - 10/3/24 15:21 - F:\LAB\PROJECTS\GINT\6-032(075)230.GPJ

Consolidated Undrained by AASHTO T297



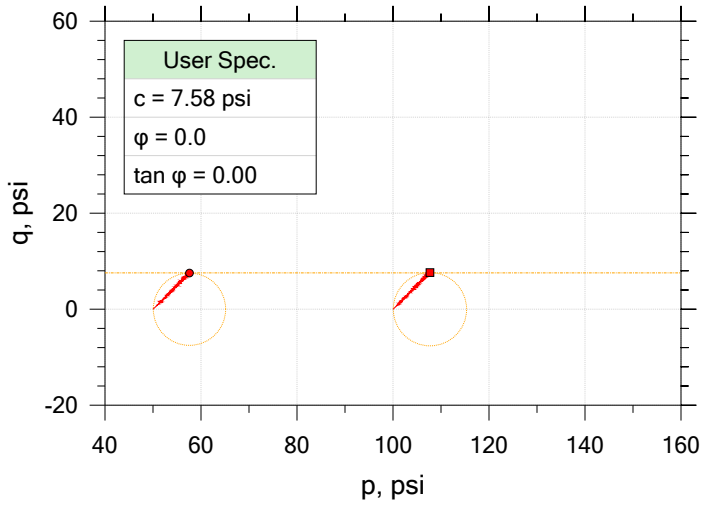


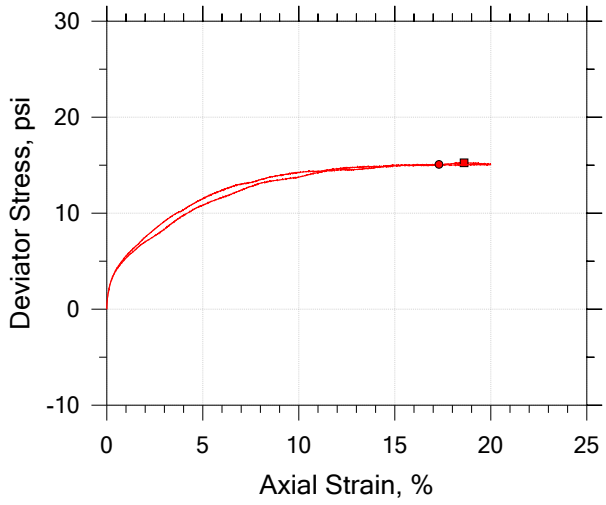
Symbol		■	●		
Sample ID		SS- 90-24	SS- 90-24		
Depth		4.0 - 6.0	4.0 - 6.0		
Test Number		CU- 34- 24	CU- 35- 24		
Initial	Height, in	2.796	2.797		
	Diameter, in	1.427	1.424		
	Moisture Content (from Cuttings), %	17.9	18.5		
	Dry Density, pcf	108.	105.		
	Saturation (Wet Method), %	90.0	84.2		
	Void Ratio	0.529	0.581		
Final	Moisture Content, %	17.3	19.6		
	Dry Density, pcf	113.	109.		
	Cross-Sectional Area (Method A), in²	1.544	1.550		
	Saturation, %	100.0	100.0		
	Void Ratio	0.458	0.519		
	Back Pressure, psi	95.97	88.00		
Vertical Effective Consolidation Stress, psi		39.90	19.82		
Horizontal Effective Consolidation Stress, psi		40.03	20.00		
Vertical Strain after Consolidation, %		1.093	1.169		
Volumetric Strain after Consolidation, %		4.363	3.633		
Time to 50% Consolidation, min		0.0000	0.0000		
Shear Strength, psi		39.50	25.01		
Strain at Failure, %		4.00	4.00		
Strain Rate, %/min		0.1000	0.1000		
Deviator Stress at Failure, psi		79.00	50.03		
Effective Minor Principal Stress at Failure, psi		29.38	16.22		
Effective Major Principal Stress at Failure, psi		108.4	66.24		
B-Value		0.95	0.95		

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: SS-6-032(075)230	Location: Bismarck, ND	Project Number: HWY 32
	Boring Number: 2	Tester: MD	Checker: DT
	Sample Number: SS- 90-24	Test Date: 9/12/24	Depth: 4.0 - 6.0
	Test Number: CU- 34- 24	Preparation:	Elevation:
	Description: 21" Dark Brn Silty Cly with Cly & I.O. Deposits, Rocks up to 1/4"		
	Remarks: Sample Test Depth 5.0 - 5.3		

Unconsolidated Undrained by ASTM D4767



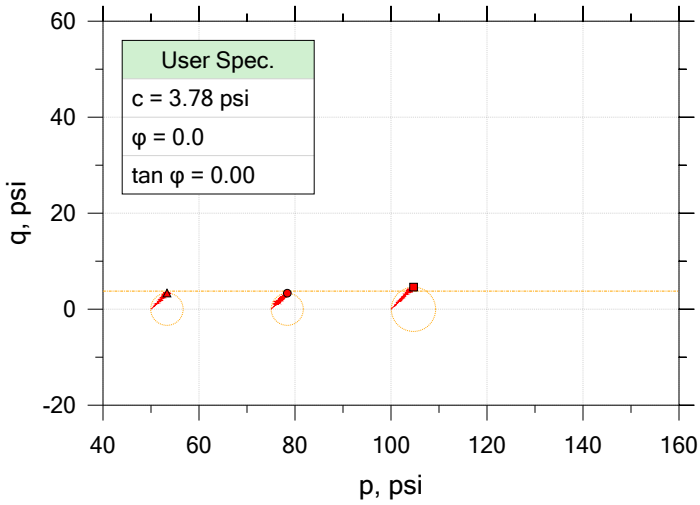


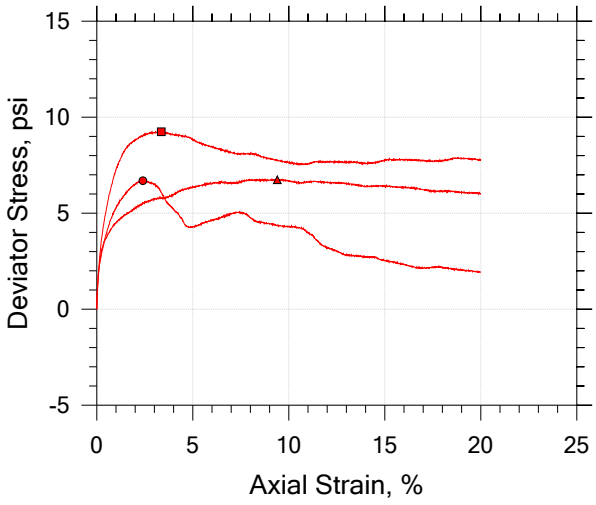
Symbol		■	●		
Sample ID		SS -94- 24	SS -94- 24		
Depth		14.0 - 16.0	14.0 - 16.0		
Test Number		UU -28- 24	UU -29- 24		
Initial	Height, in	5.745	5.758		
	Diameter, in	2.781	2.755		
	Moisture Content (from Cuttings), %	32.8	32.9		
	Dry Density, pcf	89.1	90.8		
	Saturation (Wet Method), %	100.0	104.7		
	Void Ratio	0.878	0.843		
Final	Moisture Content, %	32.1	31.0		
	Dry Density, pcf	90.0	91.4		
	Cross-Sectional Area (Method A), in²	6.033	5.934		
	Saturation, %	100.0	100.0		
	Void Ratio	0.859	0.830		
	Back Pressure, psi	0.0000	0.0000		
Vertical Effective Consolidation Stress, psi		100.0	49.99		
Horizontal Effective Consolidation Stress, psi		100.0	50.00		
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		7.627	7.542		
Strain at Failure, %		18.6	17.3		
Strain Rate, %/min		1.000	1.000		
Deviator Stress at Failure, psi		15.25	15.08		
Effective Minor Principal Stress at Failure, psi		100.1	50.10		
Effective Major Principal Stress at Failure, psi		115.3	65.18		
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: SS-6-032(075)230	Location: Bismarck, ND	Project Number: HWY 32
	Boring Number: 2	Tester: MD	Checker: DT
	Sample Number: SS -94- 24	Test Date: 09/17/24	Depth: 14.0 - 16.0
	Test Number: UU -28- 24	Preparation:	Elevation:
	Description: 19 1/2" Brn Gry Cly with I.O. Deposits		
	Remarks: Sample Test Depth 14.2 - 14.7		

Unconsolidated Undrained by ASTM D4767



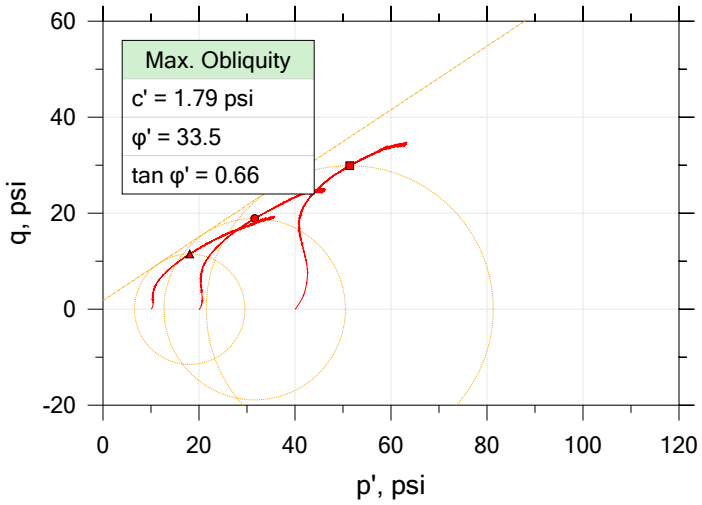


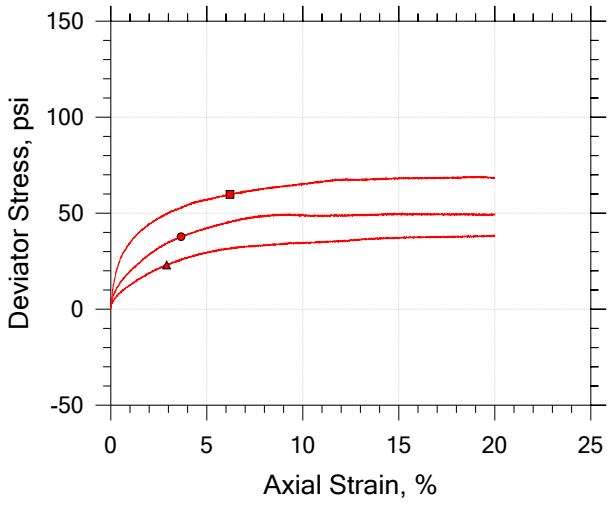
Symbol		■	●	▲	
Sample ID		SS -103 -24	SS -103 -24	SS -103 -24	
Depth		19.0 - 21.0	19.0 - 21.0	19.0 - 21.0	
Test Number		UU- 30- 24	UU- 31- 24	UU- 32- 24	
Initial	Height, in	5.753	5.748	5.752	
	Diameter, in	2.804	2.823	2.825	
	Moisture Content (from Cuttings), %	56.0	55.1	57.2	
	Dry Density, pcf	68.5	68.3	66.2	
	Saturation (Wet Method), %	104.1	101.9	100.4	
	Void Ratio	1.44	1.45	1.53	
Final	Moisture Content, %	53.2	54.7	56.9	
	Dry Density, pcf	68.9	67.9	66.3	
	Cross-Sectional Area (Method A), in²	6.151	6.284	6.262	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	1.43	1.46	1.52	
	Back Pressure, psi	0.008096	0.008096	0.0000	
Vertical Effective Consolidation Stress, psi		99.99	74.99	49.99	
Horizontal Effective Consolidation Stress, psi		99.99	74.99	50.00	
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		4.622	3.347	3.372	
Strain at Failure, %		3.36	2.40	9.40	
Strain Rate, %/min		1.000	1.000	1.000	
Deviator Stress at Failure, psi		9.243	6.695	6.745	
Effective Minor Principal Stress at Failure, psi		100.1	75.05	49.97	
Effective Major Principal Stress at Failure, psi		109.3	81.75	56.71	
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: SS-6-032(075)230	Location: Bismarck, ND	Project Number: HWY 32
	Boring Number: 3	Tester: MD	Checker: DT
	Sample Number: SS -103 -24	Test Date: 09/23/24	Depth: 19.0 - 21.0
	Test Number: UU- 30- 24	Preparation:	Elevation:
	Description: 27" Gry Cly		
	Remarks: Sample Test Depth 19.2 - 19.7		

Consolidated Undrained by ASTM D4767



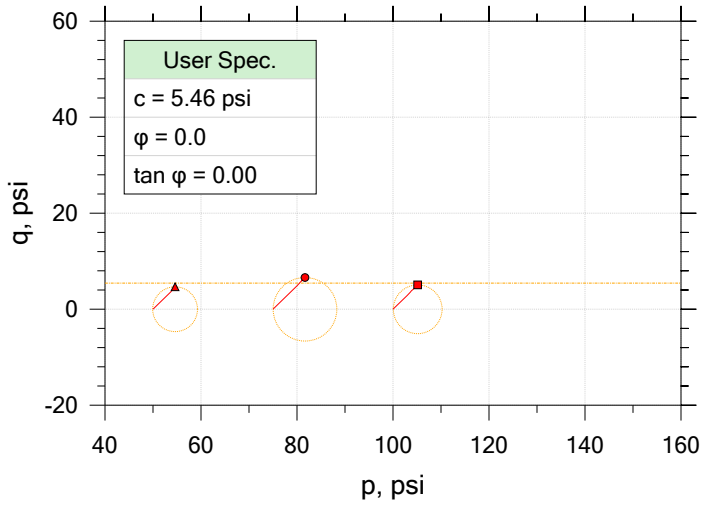


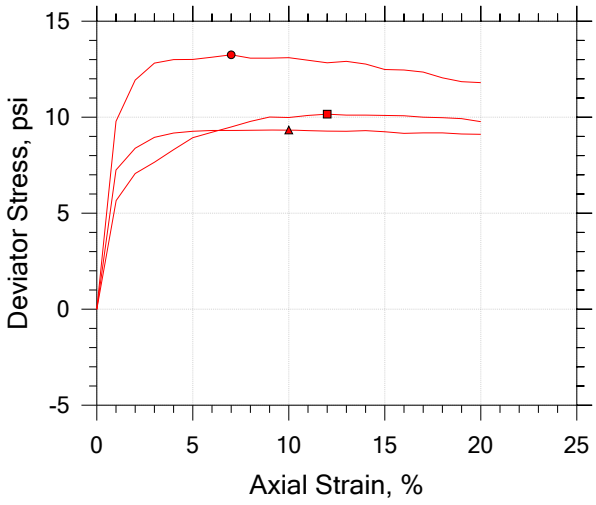
Symbol		■	●	▲	
Sample ID		SS- 109 -24	SS- 109 -24	SS- 109 -24	
Depth		9.0 - 11.0	9.0 - 11.0	9.0 - 11.0	
Test Number		CU -39- 24	CU -41- 24	CU -43- 24	
Initial	Height, in	2.799	2.801	2.792	
	Diameter, in	1.413	1.416	1.425	
	Moisture Content (from Cuttings), %	24.1	23.3	20.7	
	Dry Density, pcf	96.0	99.8	103.	
	Saturation (Wet Method), %	87.0	92.5	88.8	
	Void Ratio	0.743	0.676	0.625	
Final	Moisture Content, %	24.1	22.4	21.7	
	Dry Density, pcf	102.	105.	106.	
	Cross-Sectional Area (Method A), in²	1.501	1.520	1.566	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	0.645	0.600	0.582	
	Back Pressure, psi	77.99	97.99	106.0	
Vertical Effective Consolidation Stress, psi		39.82	19.83	9.907	
Horizontal Effective Consolidation Stress, psi		40.00	20.01	10.02	
Vertical Strain after Consolidation, %		1.422	1.022	0.9314	
Volumetric Strain after Consolidation, %		5.627	4.313	2.961	
Time to 50% Consolidation, min		0.0000	0.0000	0.0000	
Shear Strength, psi		29.90	18.90	11.50	
Strain at Failure, %		6.21	3.66	2.91	
Strain Rate, %/min		0.03000	0.03000	0.03000	
Deviator Stress at Failure, psi		59.81	37.81	22.99	
Effective Minor Principal Stress at Failure, psi		21.49	12.68	6.561	
Effective Major Principal Stress at Failure, psi		81.30	50.49	29.55	
B-Value		0.96	0.95	0.96	

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: SS-6-032(075)230	Location: Bismarck, ND	Project Number: HWY 32
	Boring Number: 4	Tester: MD	Checker: DT
	Sample Number: SS- 109 -24	Test Date: 09/24/24	Depth: 9.0 - 11.0
	Test Number: CU -39- 24	Preparation:	Elevation:
	Description: 23" Blk Gry Silty Cly with Organics		
	Remarks: Sample Test Depth 9.3 - 9.6		

Unconsolidated Undrained by AASHTO T297





		■	●	▲
Symbol				
Sample ID		SS -112- 24	SS -112- 24	SS -112- 24
Depth		19.0 - 21.0	19.0 - 21.0	19.0 - 21.0
Test Number		UU -33- 24	UU -34- 24	UU -35- 24
Initial	Height, in	5.736	5.748	5.755
	Diameter, in	2.859	2.855	2.854
	Moisture Content (from Cuttings), %	43.0	44.2	44.3
	Dry Density, pcf	78.8	77.2	76.7
	Saturation (Wet Method), %	103.6	102.4	101.5
	Void Ratio	1.10	1.14	1.16
Final	Moisture Content, %	41.2	42.3	42.7
	Dry Density, pcf	79.1	78.0	77.6
	Cross-Sectional Area (Method A), in²	6.407	6.357	6.346
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.09	1.12	1.13
	Back Pressure, psi	0.0000	0.0000	0.0000
Vertical Effective Consolidation Stress, psi		100.0	74.99	50.00
Horizontal Effective Consolidation Stress, psi		100.0	75.00	50.00
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		5.081	6.625	4.667
Strain at Failure, %		12.0	7.00	10.0
Strain Rate, %/min		1.000	1.000	1.000
Deviator Stress at Failure, psi		10.16	13.25	9.333
Effective Minor Principal Stress at Failure, psi		100.5	75.08	49.98
Effective Major Principal Stress at Failure, psi		110.6	88.33	59.32
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: SS-6-032(075)230	Location:	Project Number: HWY 32
Boring Number: 4	Tester: MD	Checker: DT
Sample Number: SS -112- 24	Test Date: 09/24/24	Depth: 19.0 - 21.0
Test Number: UU -33- 24	Preparation:	Elevation:
Description: 22 1/2" Brn Cly		
Remarks: Sample Test Depth 19.3 - 19.8		