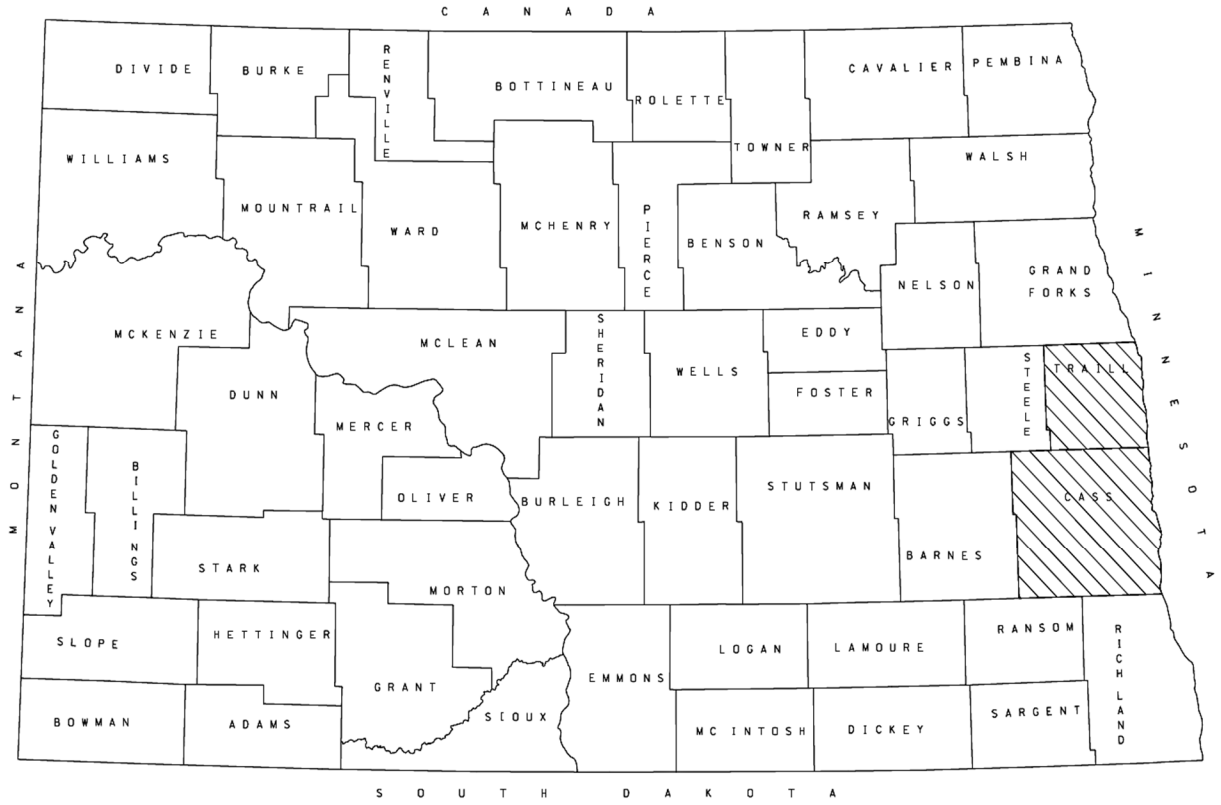
LINEAR SOILS SURVEY AND RECOMMENDATIONS

PROJECT NO. IM-8-029(135)088

PCN 18988

COUNTY Cass/Traill

I-29, RP 88.270 to 101.530



PREPARED BY: Jared Loegering, PE

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

February 2019

IM-8-029(135)088

I-29, Hunter Sep to Near Blanchard - NB

CERTIFICATION

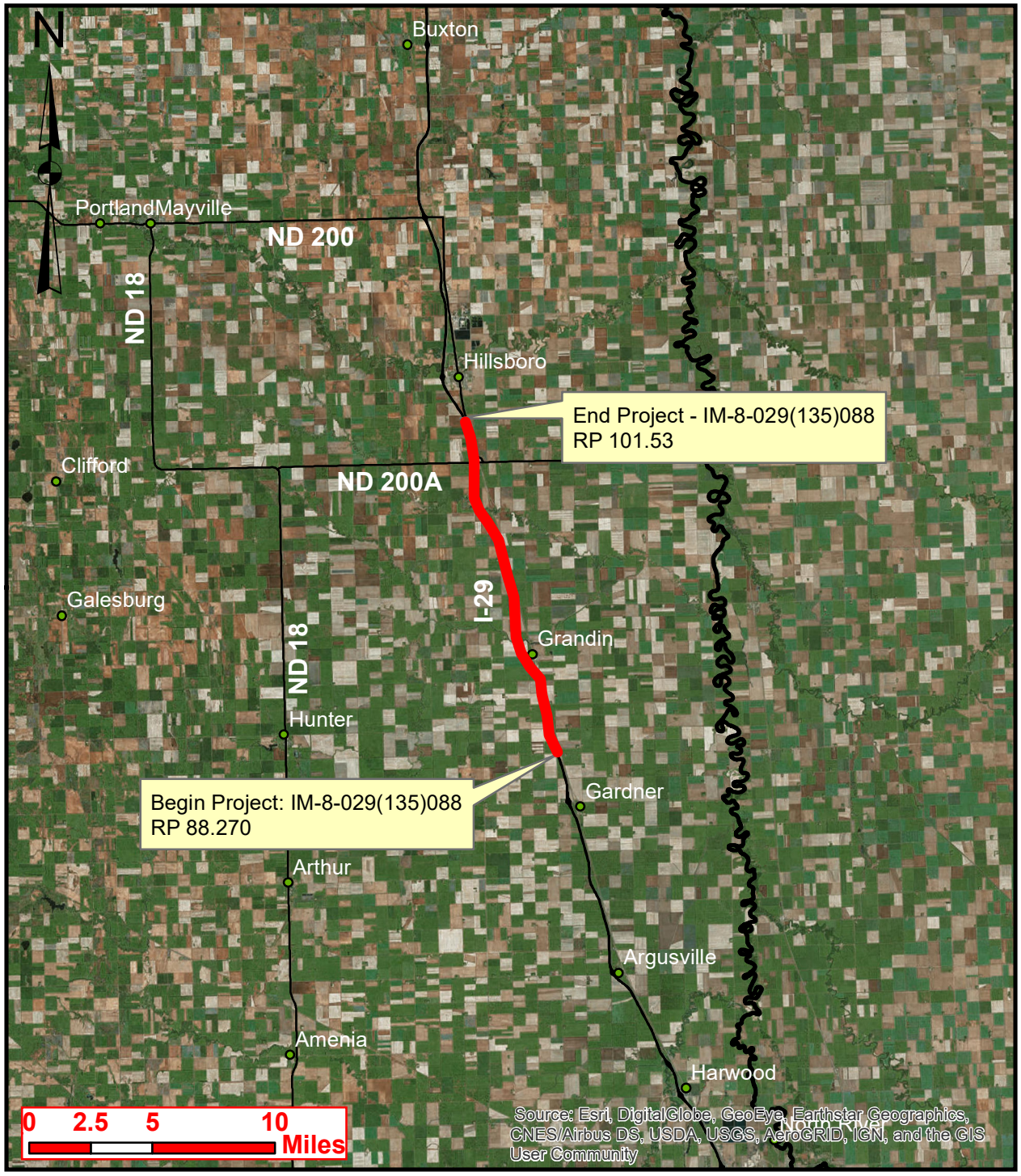
I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of North Dakota. This document was originally issued and sealed by Jared J. Loegering, Registration number PE-10931 on 02/28/2019 and the original document is stored at the North Dakota Department of Transportation.

Jared J. Loegering, P.E.

02-28-19
Date

Linear Soils Survey and Recommendations

Project: IM-8-029(135)088
PCN: 18988
Scope: Reconstruction
Length: 13.260 Miles
Location: I-29, Hunter Sep to Near Blanchard-NB



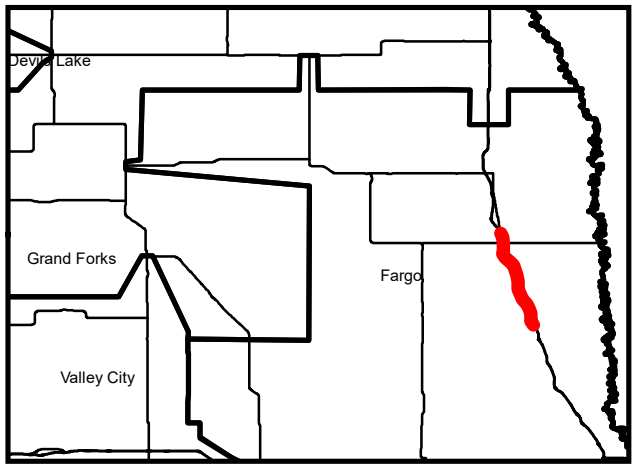


Table of Contents

List of Figures

List of Tables

Appendices

Introduction

Location: I-29, Hunter Sep to Near Blanchard - NB
Reference Points: 88.270 to 101.530
Project Length: 13.260 Miles
Proposed Project Scope: Reconstruction
Investigation Scope: 1000' Intervals and Identified Maintenance Areas

Maintenance Review

Date of Maintenance Review: 10/02/2018
Materials and Research Person Conducting the Review: Jamie Naumann
Maintenance Person Conducting Review: Brian Aune – Hillsboro Maintenance Section

Table 1 – Identified Maintenance Areas

Location RP + Feet	Distress Identified	Maintenance Comments	Drilling Required
88+1425 to 101+2798	Depressed Transverse Cracks	Every 200' - Break out, milled last 6 years, jack hammered last 20 years.	Yes, 1000' intervals throughout the project limits.
88+2694	Bituminous Blade Patch	Cut out 2018	Yes
88+2810	-	Triple Culvert	No
92+3647 to 92+3840	Bituminous Blade Patch	Full depth. Cut out 5 years ago. Driving lane only.	Yes
100+1286 to 101+2006	-	End asphalt overlay.	No

Summary of Soil Investigation

The soil investigation was completed between 10/03/18 and 10/04/18. The investigation consisted of 68 borings.

Table 2 – Boring Locations Summary

Boring Location	Justification for Boring	Boring depth	Location
88+1425 to 101+2798	Reconstruction	5-10 feet	Conducted borings every 1000' throughout the project limits. A total of approximately 68 borings.
88+2694	Identified Maintenance Area	10 feet	Conducted 1 boring in the identified area.
92+3647 to 92+3840	Identified Maintenance Area	10 feet	Conducted 1 boring in the identified area.

Maps of the boring locations are shown in Appendix C. The lab results are included in Appendix E.

Summary of Soil Analysis

Project Limits – 88+1425 to 101+2798: The majority of the soils within the project limits are lean and fat clays with an AASHTO classification of A-7-6. These soils have on average a maximum dry density of approximately 93 lb/ft^3 and an optimum water content of approximately 25.5%. The in-place moistures of the soils are on average 0% to 16% over optimum.

Identified Maintenance Area – 88+2694: The soils within the identified maintenance are fat clays with an AASHTO classification of A-7-6. These soils have a maximum dry density of approximately 91 lb/ft^3 and an optimum water content of approximately 27%. The in-place moistures of the soils are on average 6% to 10% over optimum.

Identified Maintenance Area – 92+3647 to 92+3840: The soils within the identified maintenance area are sandy fat clays with an AASHTO classification of A-7-6. These soils have a maximum dry density of approximately 94 lb/ft^3 and an optimum water content of approximately 24%. The in-place moistures of the soils are on average 6% to 10% over optimum.

Soil Sample Distribution

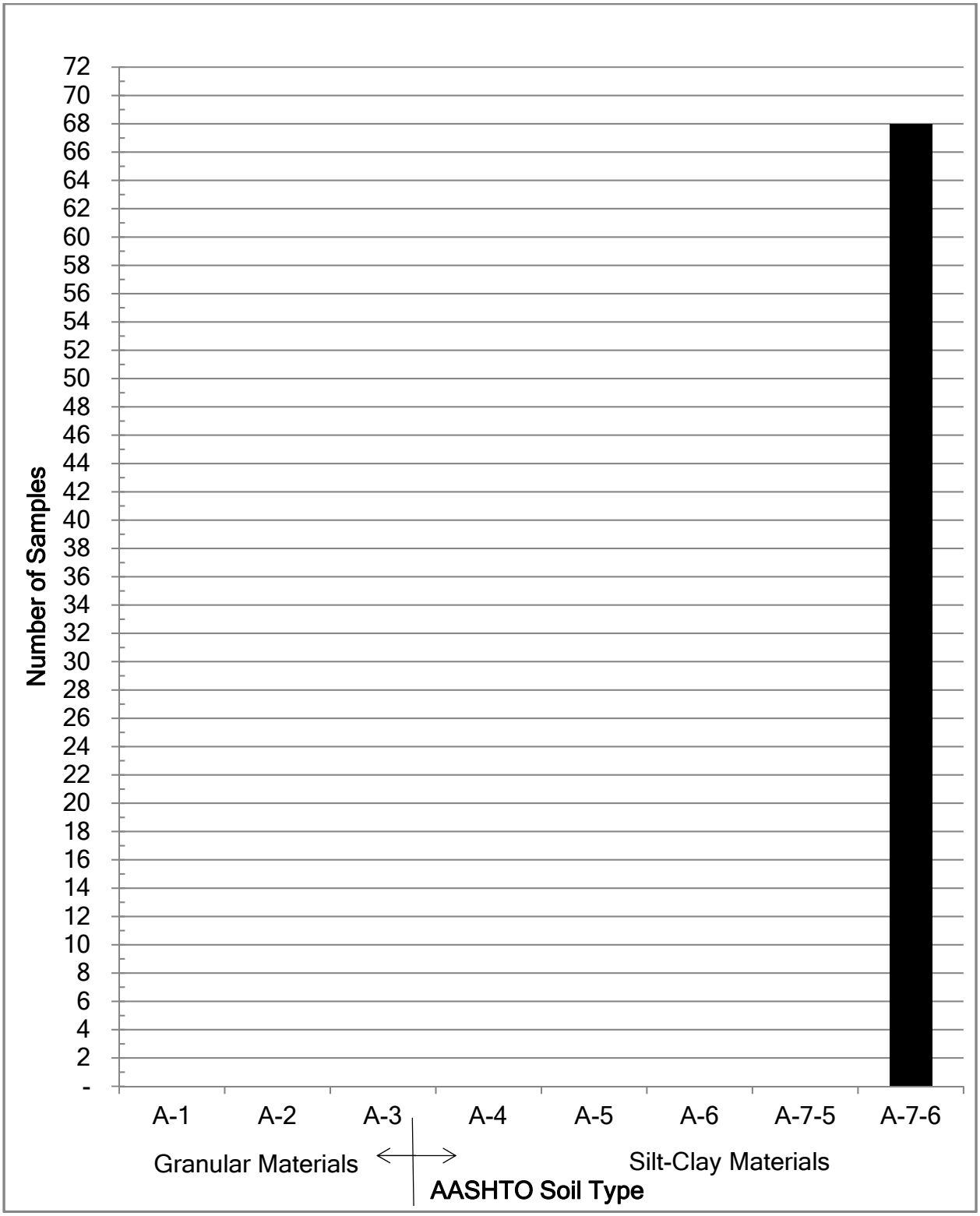


Figure 1 - Soil Sample Distribution

Design Recommendations

Project Limits – 88+1425 to 101+2798: Place Geosynthetic Geogrid (Type G) on top of the existing subgrade without disturbing or scarifying the subgrade. Place a minimum of 8 inches of base material over the geogrid prior to compacting the base material. This deviates from the minimum of 10 inches required in the Standard Specifications due to the proposed pavement design requiring 8 inches of base material

Identified Maintenance Area – 88+2694: The existing soils in this area are fat clays with high moisture contents. The soil analysis indicates average in-place moistures from 6% to 10% over optimum. The soil analysis in this area does not deviate from soils around it and there is no indication of subgrade issues. The maintenance area appears to be associated with a pavement distress. There are no recommendations at this time.

Identified Maintenance Area – 92+3647 to 92+3840: The existing soils in this area are sandy fat clays with high moisture contents. The soil analysis indicates average in-place moistures from 6% to 10% over optimum. The soil analysis in this area does not deviate from soils around it and there is no indication of subgrade issues. The maintenance area appears to be associated with a pavement distress. There are no recommendations at this time.

Design Information

Pipe Replacement: Pipe replacements on this project may require a non-standard pipe backfill detail. Contact the Materials and Research Geotechnical Section prior to the PS&E if any pipes are being installed or replaced on this project. Please include any pertinent information such as location, size, depth to inlet, etc.

Compaction Method: T-99

Subgrade Prep: None

Subcut Recommendations: None

Drainage: None

Plan Notes

None

The recommendations in this report are based on the scope specified in the Introduction. If the scope of work, vertical profile or horizontal alignment is changed, in either the conceptual phase or the design phase, the Geotechnical Engineer must be notified as soon as possible to ensure that there is adequate geotechnical information addressing these areas.

APPENDIX A

SOIL CLASSIFICATION

AASHTO Classification System

Table 5.1. AASHTO Classification System

General Classification	*Granular materials (35% or less passing No. 200 Sieve (0.075 mm)*							*Silt-clay Materials More than 35% passing No. 200 Sieve (0.075 mm)*			
Group Classification	*A—1*		*A—3*	*A—2*				*A—4*	*A—5*	*A—6*	*A—7*
	A—1—a	*A—1—b*		*A—2—4*	*A—2—5*	*A—2—6*	*A—2—7*				*A—7—5 A—7—6*
(*a*) Sieve Analysis: Percent Passing											
(*i*) 2.00 mm (No. 10)	50 max										
(*ii*) 0.425 mm (No. 40)	30 max	50 max	51 min								
(*iii*) 0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
(*b*) Characteristics of fraction passing 0.425 mm (No. 40)											
(*i*) Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
(*ii*) Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min*
(*c*) Usual types of significant Constituent materials	Stone Fragments Gravel and sand		Fine Sand	Silty or Clayey Gravel Sand				Silty Soils		Clayey Soils	
(*d*) General rating as subgrade.	Excellent to Good							Fair to Poor			

* If plasticity index is equal to or less than (liquid Limit—30), the soil is A—7—5 (*i.e.* PL > 30%)
If plasticity index is greater than (Liquid Limit—30), the soil is A—7—6 (*i.e.* PL < 30%)

Unified Soil Classification System, USCS

Table 5.2 Unified Soil Classification System (Based on Material Passing 76.2-mm Sieve)

Criteria for assigning group symbols				Group symbol
Coarse-grained soils More than 50% of retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[a]	$C_u \geq 4$ and $1 \leq C_c \leq 3$[c]	GW
			$C_u < 4$ and/or $1 > C_c > 3$[c]	GP
		Gravels with Fines More than 12% fines[a,d]	$PI < 4$ or plots below "A" line (Figure 5.3)	GM
			$PI > 7$ and plots on or above "A" line (Figure 5.3)	GC
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[b]	$C_u \geq 6$ and $1 \leq C_c \leq 3$[c]	SW
			$C_u < 6$ and/or $1 > C_c > 3$[c]	SP
		Sands with Fines More than 12% fines[b,d]	$PI < 4$ or plots below "A" line (Figure 5.3)	SM
			$PI > 7$ and plots on or above "A" line (Figure 5.3)	SC
Fine-grained soils 50% or more passes No. 200 sieve	Silts and clays Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above "A" line (Figure 5.3)[e]	CL
			$PI < 4$ or plots below "A" line (Figure 5.3)[e]	ML
		Organic	$\frac{\text{Liquid limit — oven dried}}{\text{Liquid limit — not dried}} < 0.75$; see Figure 5.3; OL zone	OL
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line (Figure 5.3)	CH
			PI plots below "A" line (Figure 5.3)	MH
		Organic	$\frac{\text{Liquid limit — oven dried}}{\text{Liquid limit — not dried}} < 0.75$; see Figure 5.3; OH zone	OH
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor			Pt

[a] Gravels with 5 to 12% fine require dual symbols: GW-GM, GW-GC, GP-GM, GP-GC.

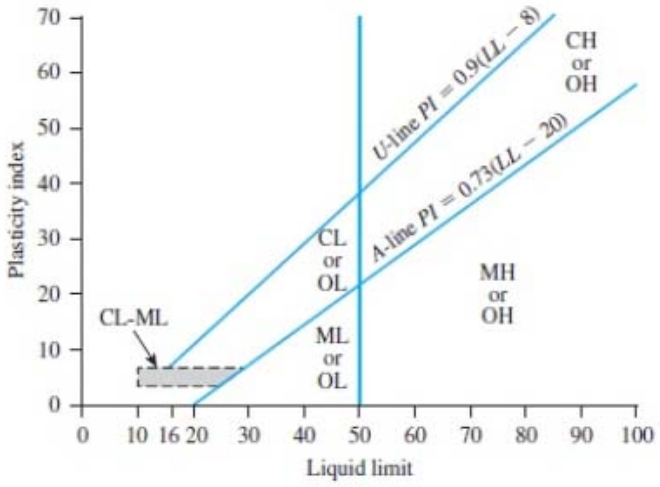
[b] Sands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.

[c] $C_u = \frac{D_{60}}{D_{10}}$; $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}}$

[d] If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 5.3, use dual symbol GC-GM or SC-SM.

[e] If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 5.3, use dual symbol CL-ML.

Plasticity Chart :



APPENDIX B

MAINTENANCE REVIEW AND SUBSURFACE INVESTIGATION SCOPE

PAVEMENT EVALUATION LOG FOR LINEAR SOIL SURVEY

North Dakota Department of Transportation, Materials & Research
SFN 60472 (9-2013)

Sheet 1 of 1

Project Number	PCN	Date of Survey
IM-8-029(135)088		10/2/2018

Section Maintenance Contact	Completed By
Brian Aune	Jamie Naumann

Highway Reference Points	Surface Type
88+1425 to 101+2798	Concrete

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
88+1425 to 101+2798	Transv. Cracks	Depressed	Every 200'-Break out, milled last 6 years, jack hammered last 20 years.		Yes, 1000' intervals throughout the project limits.
88+2694	Bituminous Patch	Blade Patch	Cut out 2018		Yes
88+2810	Culvert	Triple culvert			No
92+3647 to 92+3840	Bituminous Patch	Blade Patch	Full depth and cut out 5 years ago. Driving lane only.		Yes
100+1286 to 101+2006	Other	End of asphalt overlay.			No
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One

Comments

LINEAR SOILS SURVEY FIELD INVESTIGATION SCOPE

TO:	**File**
FROM:	**Jared Loegering – Materials and Research (Geotechnical)**
DATE:	**9/26/2018**
HIGHWAY:	**029.088**
PROJECT NUMBER:	**IM-8-029(135)088**
PCN:	**18988**
LOCATION:	**Hunter Sep to Near Blanchard NB**
IMPROVEMENT SCOPE:	**Reconstruction**
SUBJECT:	**Linear Soils Survey Subsurface Investigation Scope**

We have completed the Maintenance Review of the roadway (attached to this memo). The linear soils survey field investigation scope is based on the improvement strategy for the roadway as per Chapter 7 of the NDDOT Design Manual.

Improvement Strategy: Reconstruction
Investigation Scope: 1 boring every 1000'

The following table shows the proposed subsurface investigation scope.

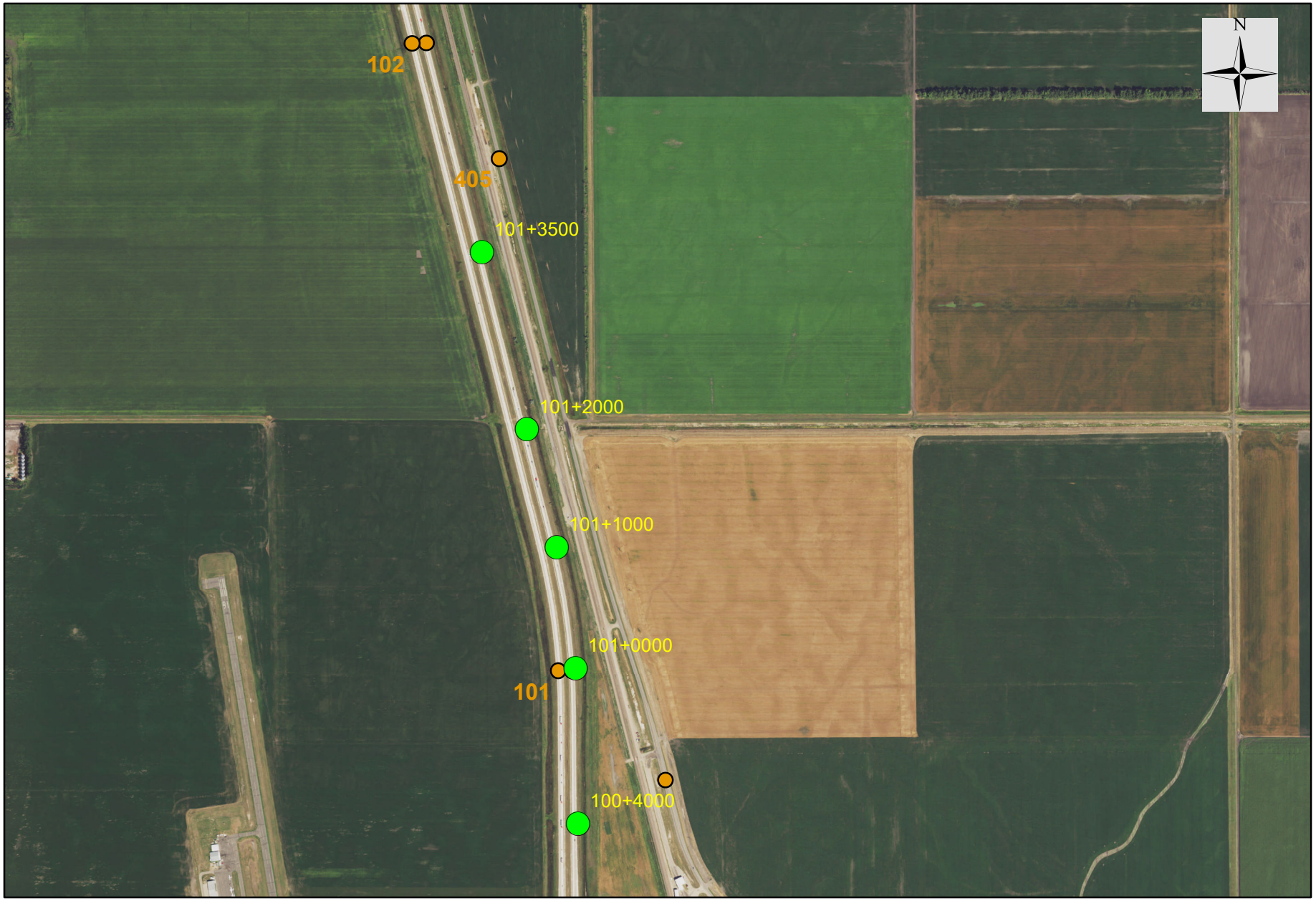
Boring Location	Justification for Boring	Boring Depth	Location
88+0000 to 101+2006 (NB)	Reconstruction	5 feet	Conduct boring every 1000' throughout the project limits. A total number of approximately 68 borings.
Unknown	Identified Maintenance Areas	10 feet	Meet maintenance on project prior to drilling to find if any additional areas need to be drilled.

The following are the associated tasks and dates for the completion of the Linear Soils Survey and Recommendations for this project.

Task	Completion (*Anticipated*) Date
Maintenance Review with District Maintenance Forces	N/A
Linear Soils Survey Field Work Complete	*10/4/2018*
Linear Soils Survey Lab Work	*12/31/2018*
Linear Soils Survey Report	*01/22/2019**
*Milestone Task	

APPENDIX C

BORING LOCATIONS



0 2,000 4,000 Feet

Legend

- Boring Locations
- Reference Point

Project Number: IM-8-029(135)088

0 2,000 4,000 Feet

Legend

- Boring Locations
- Reference Point

Project Number: IM-8-029(135)088

0 2,000 4,000 Feet

Legend

- Boring Locations
- Reference Point

Project Number: IM-8-029(135)088

Legend

- Boring Locations
- Reference Point

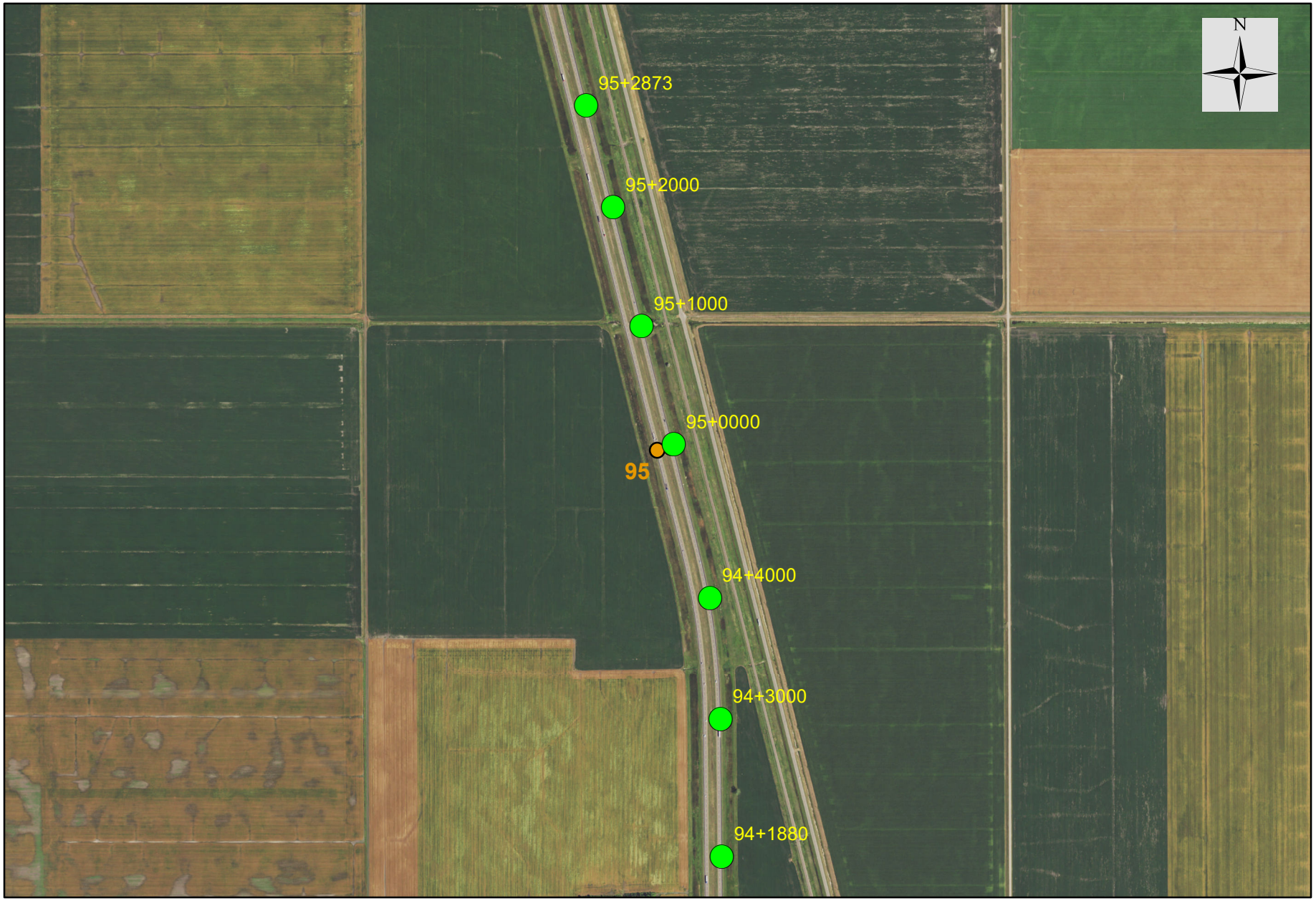
Project Number: IM-8-029(135)088

0 2,000 4,000
Feet

Legend

- Boring Locations
- Reference Point

Project Number: IM-8-029(135)088

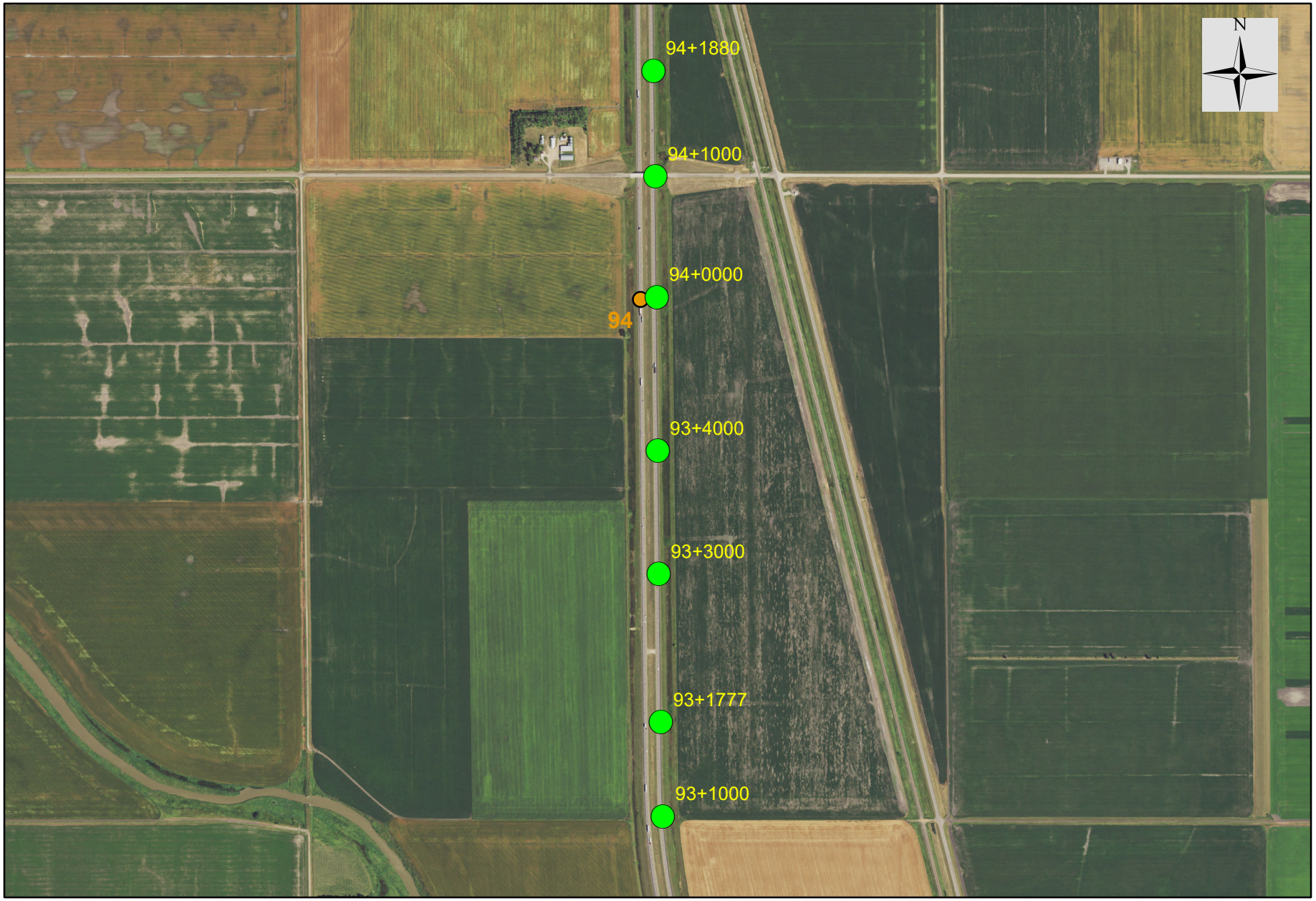


Legend

- Boring Locations
- Reference Point

0 2,000 4,000 Feet

Project Number: IM-8-029(135)088

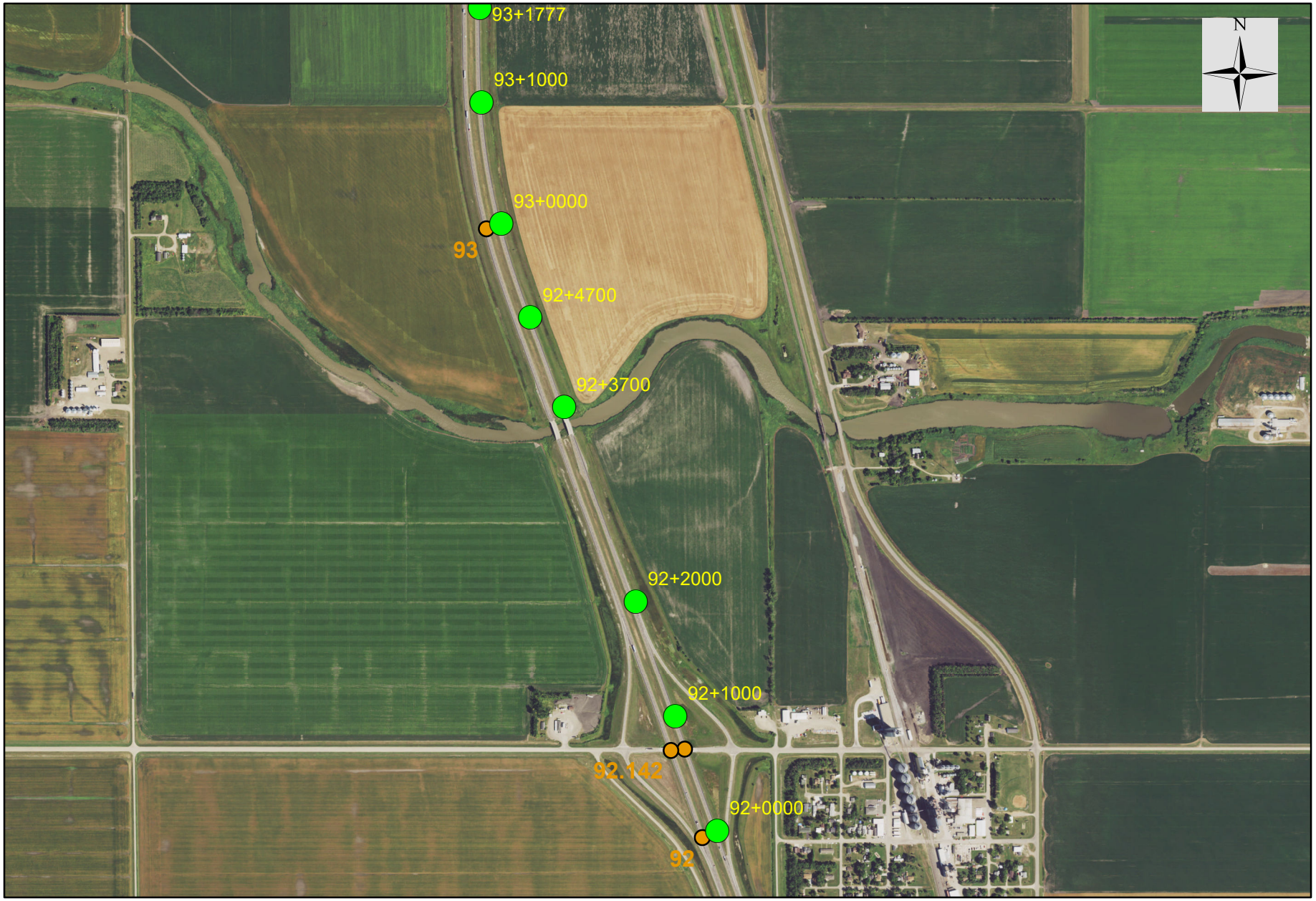


0 2,000 4,000 Feet

Legend

- Boring Locations
- Reference Point

Project Number: IM-8-029(135)088



0 2,000 4,000 Feet

Legend

- Boring Locations
- Reference Point

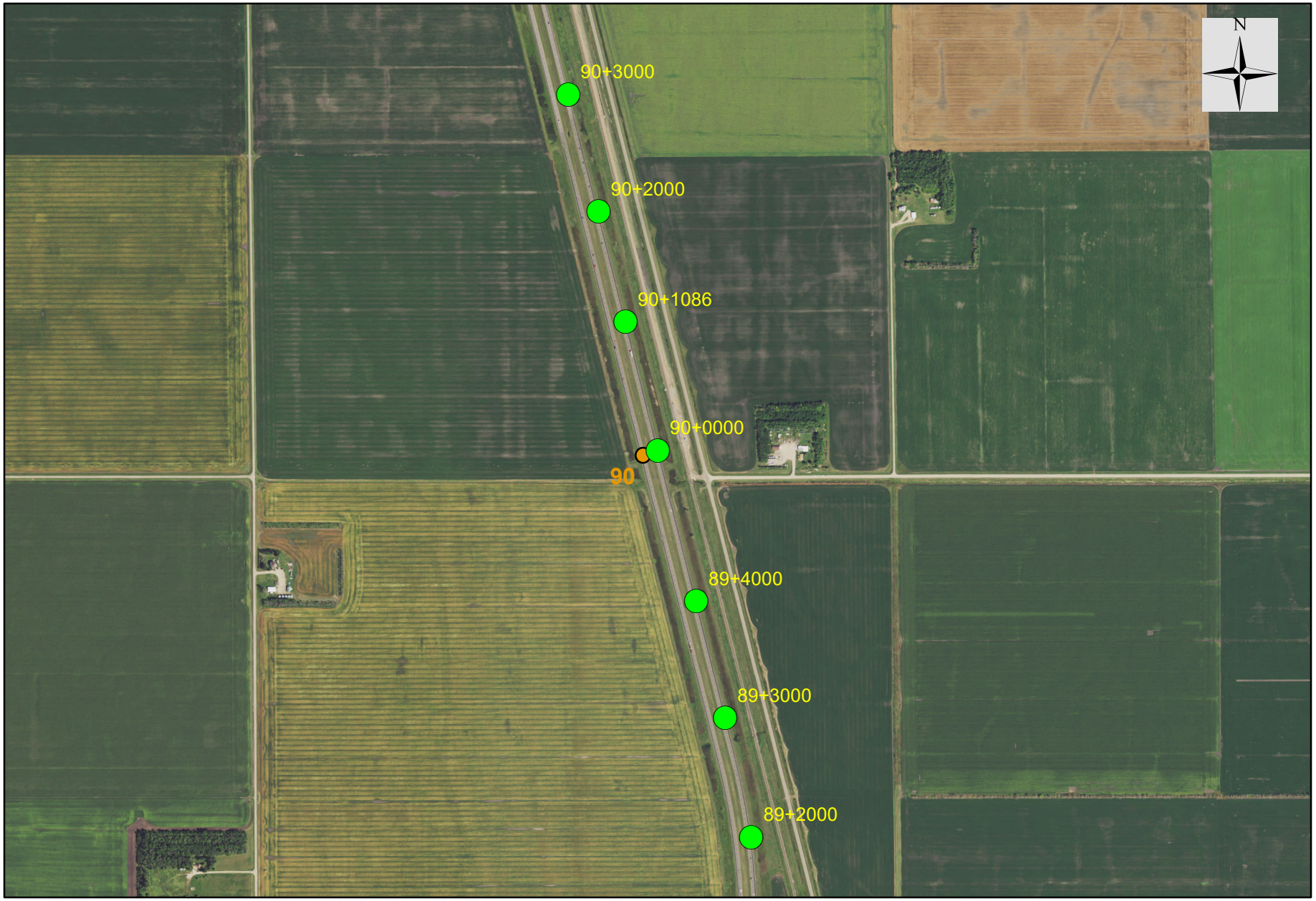
Project Number: IM-8-029(135)088

0 2,000 4,000 Feet

Legend

- Boring Locations
- Reference Point

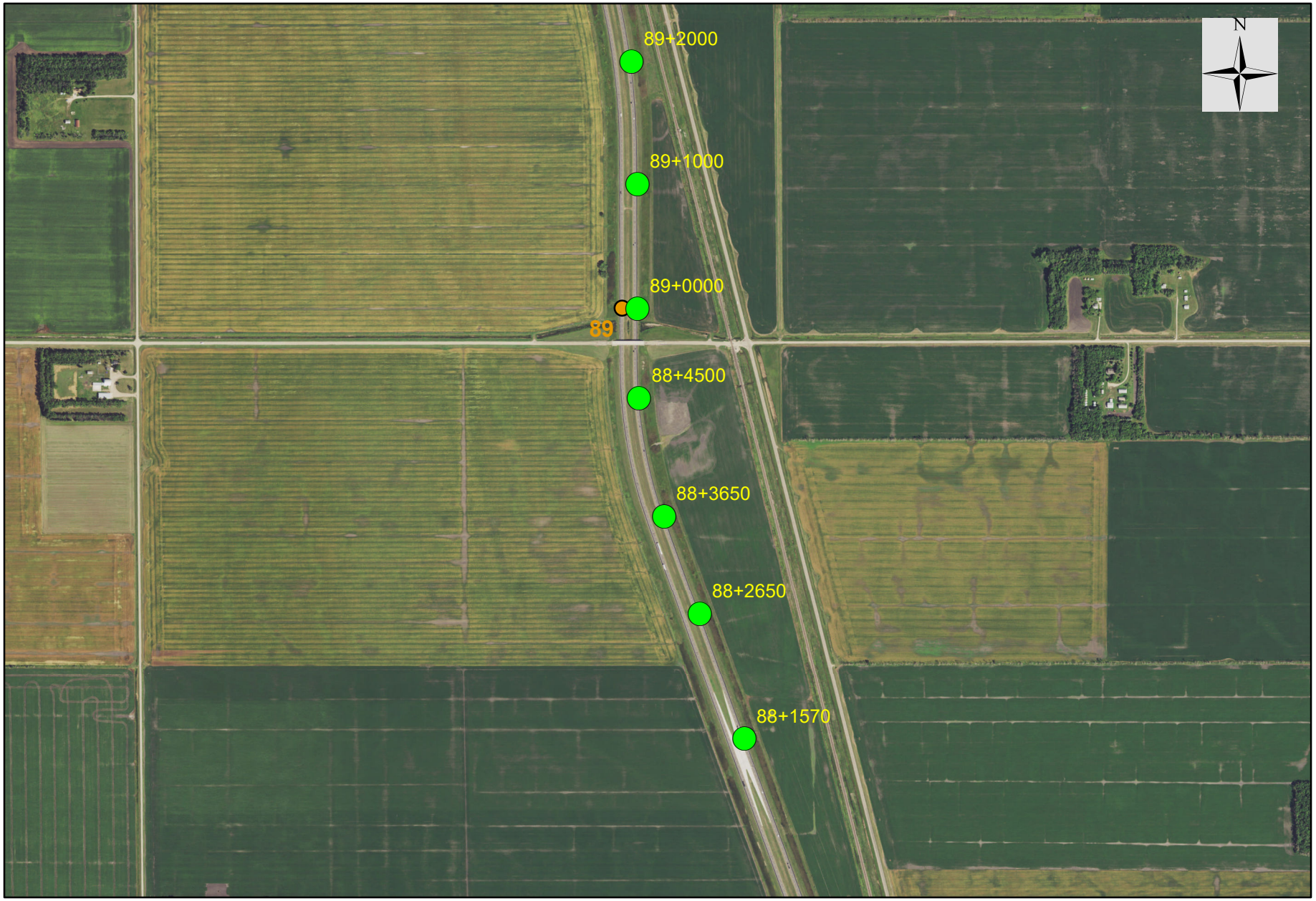
Project Number: IM-8-029(135)088



Legend

- Boring Locations
- Reference Point

Project Number: IM-8-029(135)088



0 2,000 4,000 Feet

Legend

- Boring Locations
- Reference Point

Project Number: IM-8-029(135)088

APPENDIX D

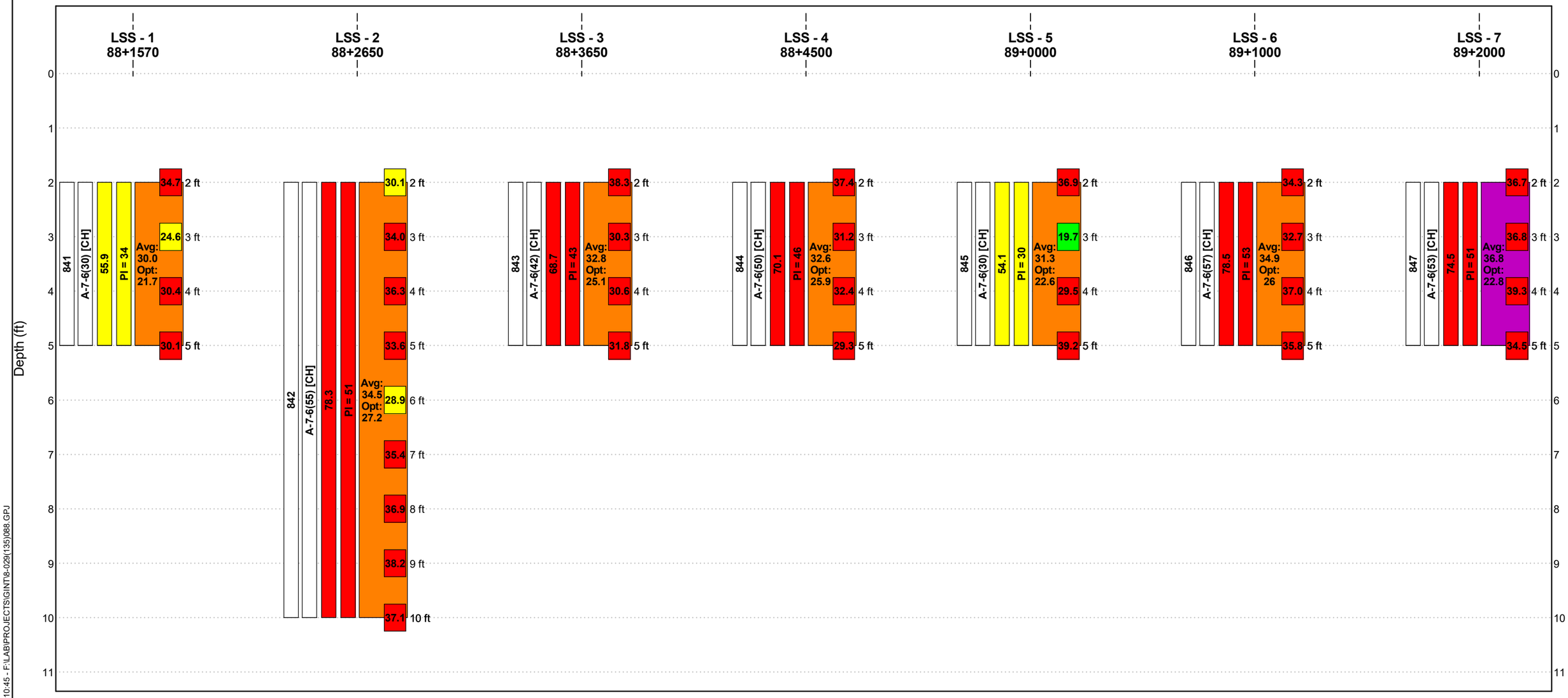
SUMMARY OF SOILS ANALYSIS

NDDOT
North Dakota Department of Transportation

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

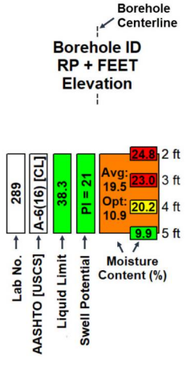
PROJECT NUMBER IM-8-029(135)088 **PCN** 18988

LOCATION Cass County

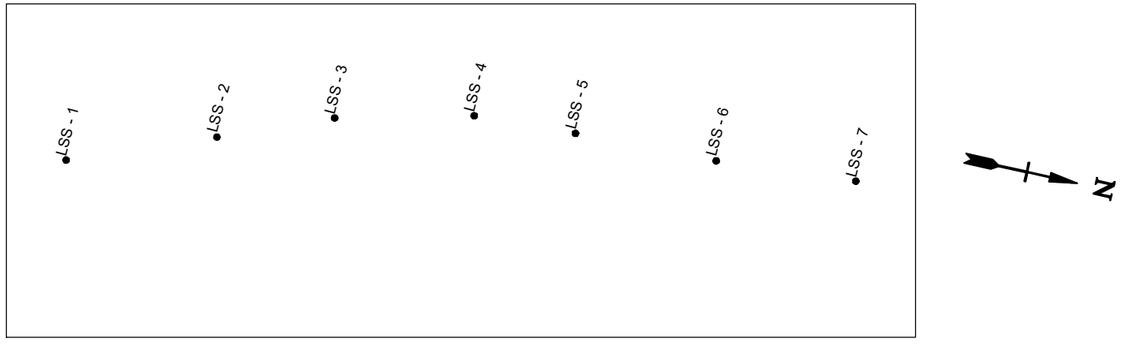


Boreholes Equally Spaced (0 to 1800 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



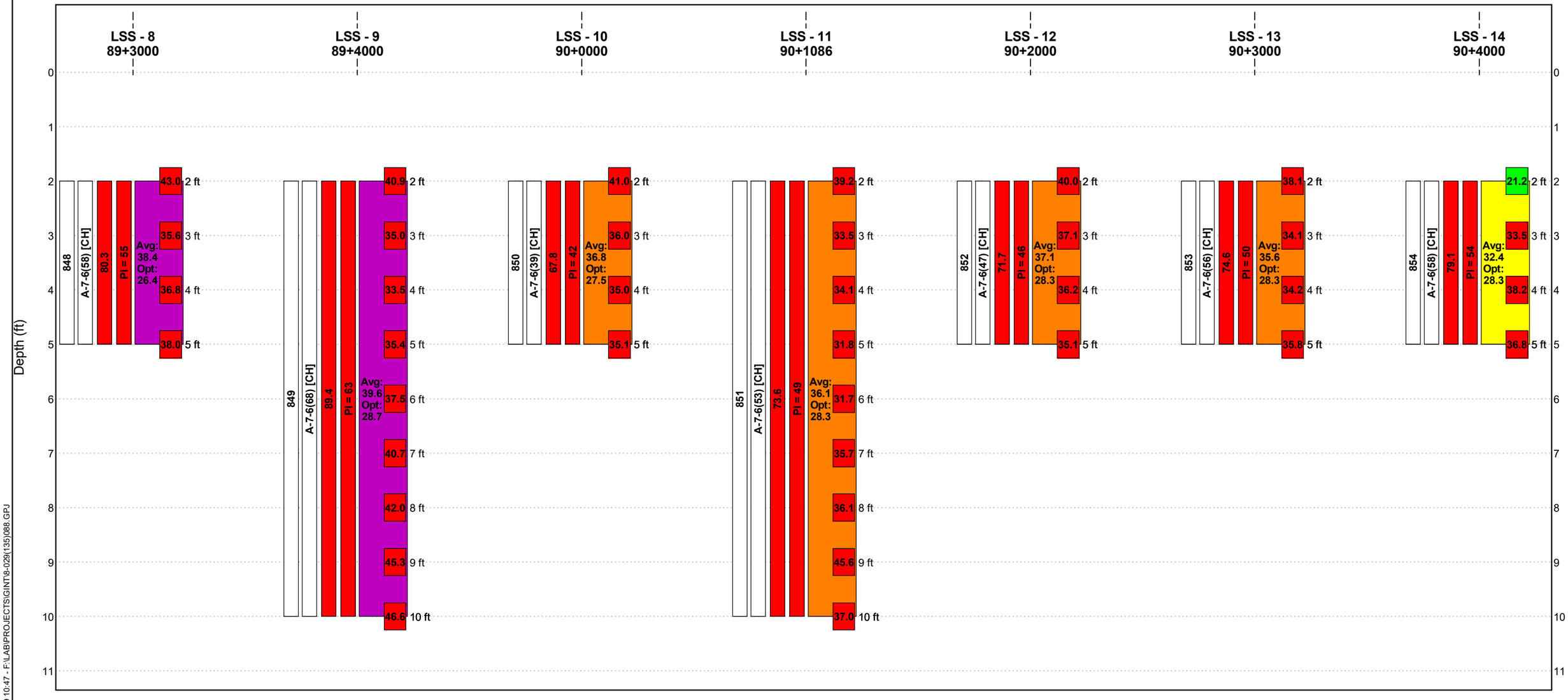
NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 2/25/19 10:45 - F:\LAB\PROJECTS\GINT\8-029(135)088.GPJ

NDDOT North Dakota Department of Transportation

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

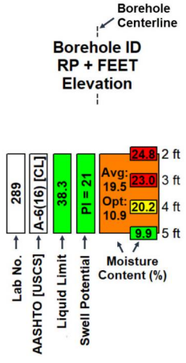
PROJECT NUMBER IM-8-029(135)088 **PCN** 18988

LOCATION Cass County

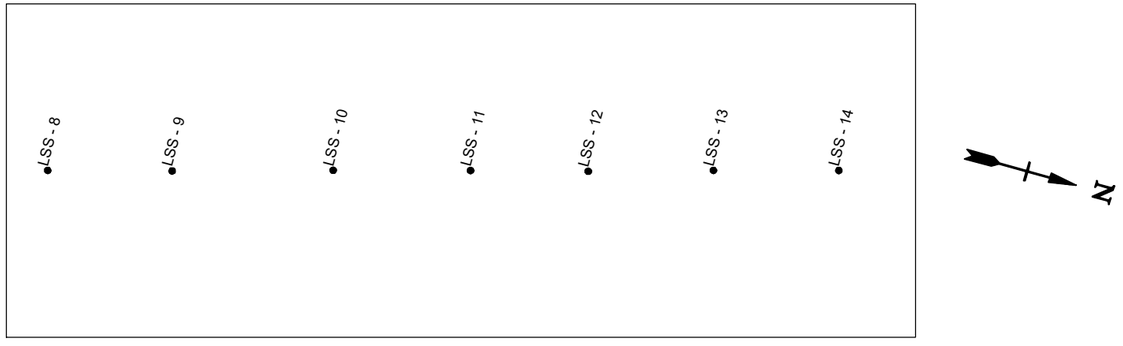


Boreholes Equally Spaced (0 to 2000 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



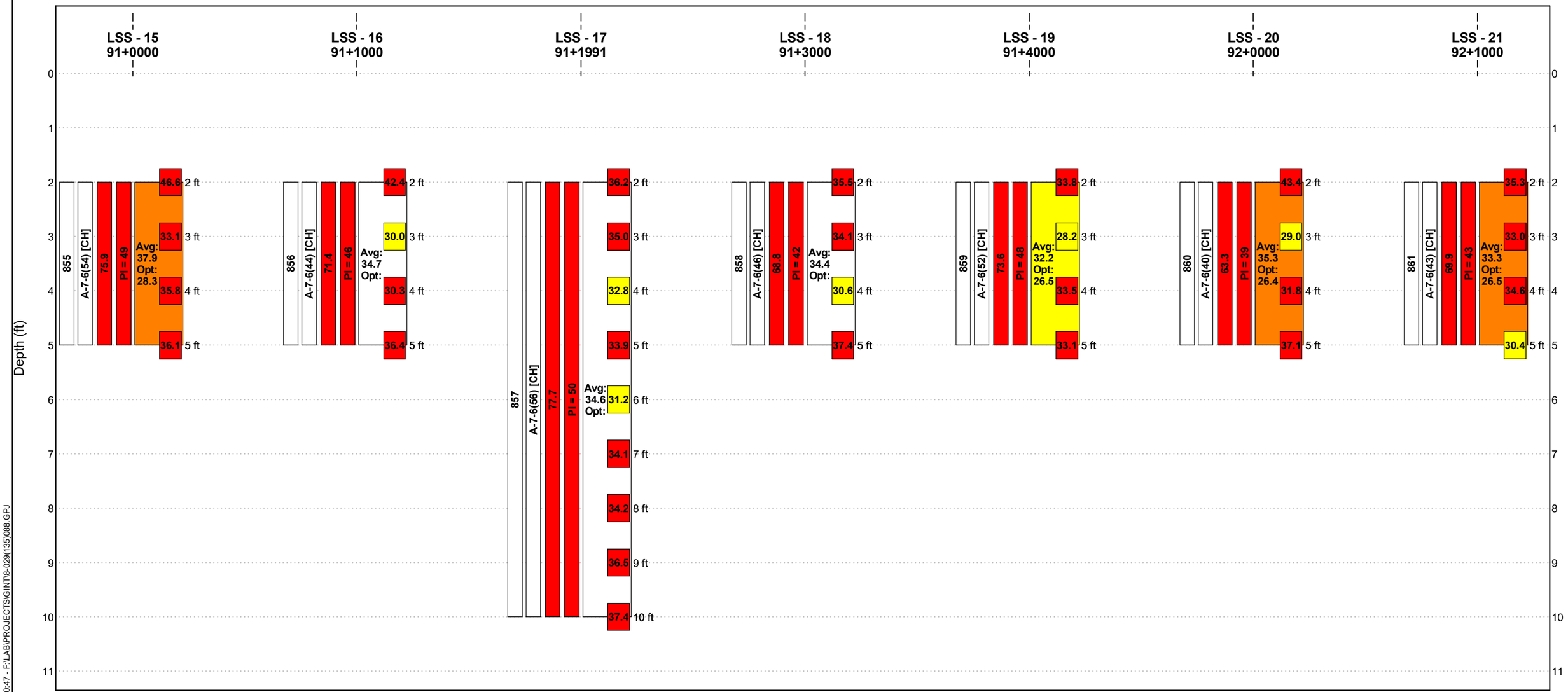
NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 2/25/19 10:47 - F:\LAB\PROJECTS\GINT\8-029(135)088.GPJ

NDDOT North Dakota Department of Transportation

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

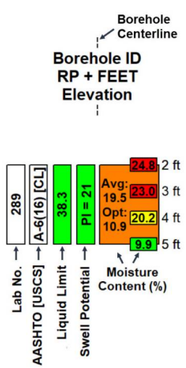
PROJECT NUMBER IM-8-029(135)088 **PCN** 18988

LOCATION Cass County

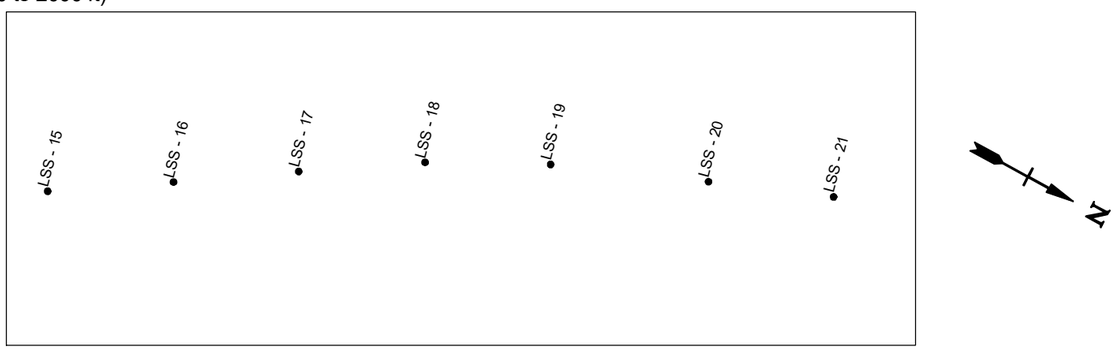


Boreholes Equally Spaced (0 to 2000 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60		
Swell Potential	Low	Marginal	High		
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic	
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



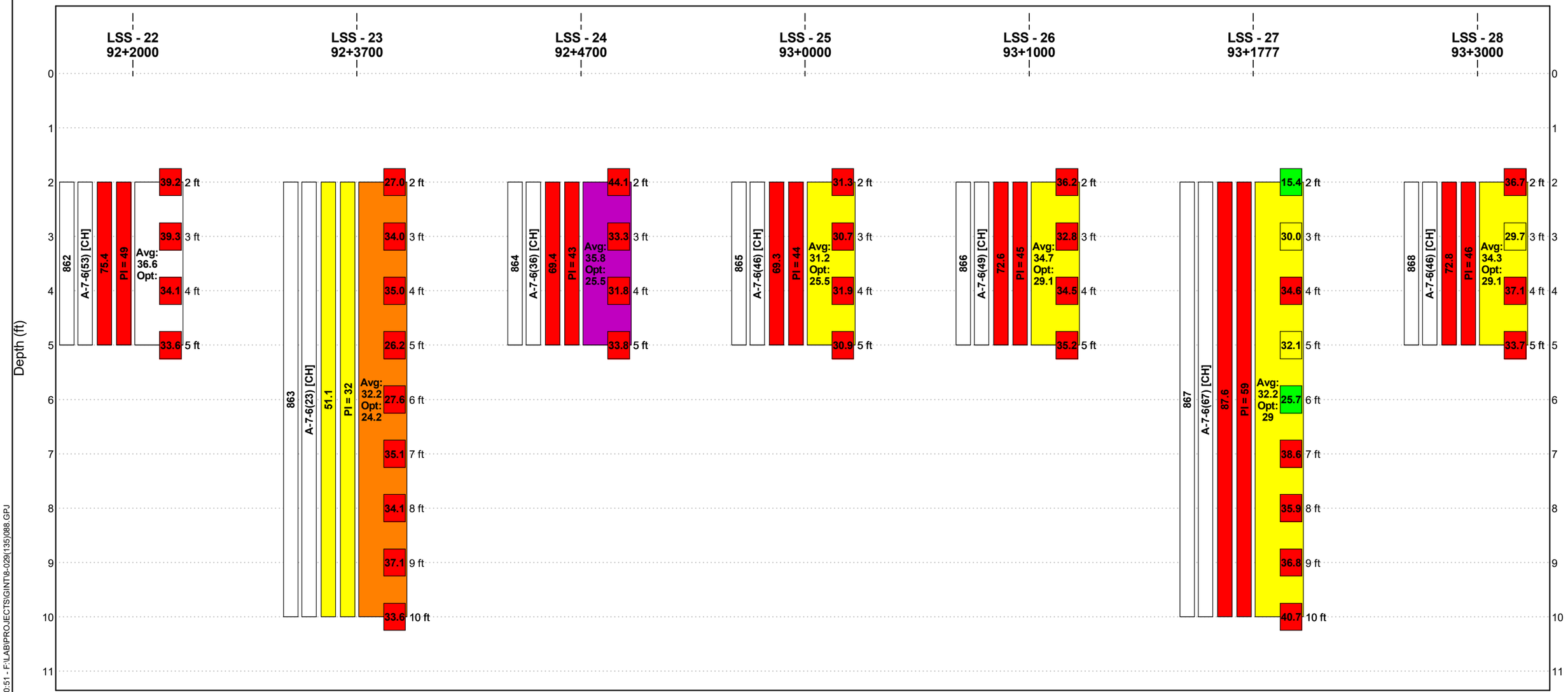
NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 2/25/19 10:47 - F:\LAB\PROJECTS\GINT\8-029(135)088.GPJ

NDDOT North Dakota Department of Transportation

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

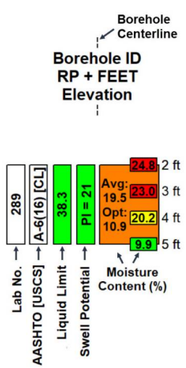
PROJECT NUMBER IM-8-029(135)088 **PCN** 18988

LOCATION Cass County

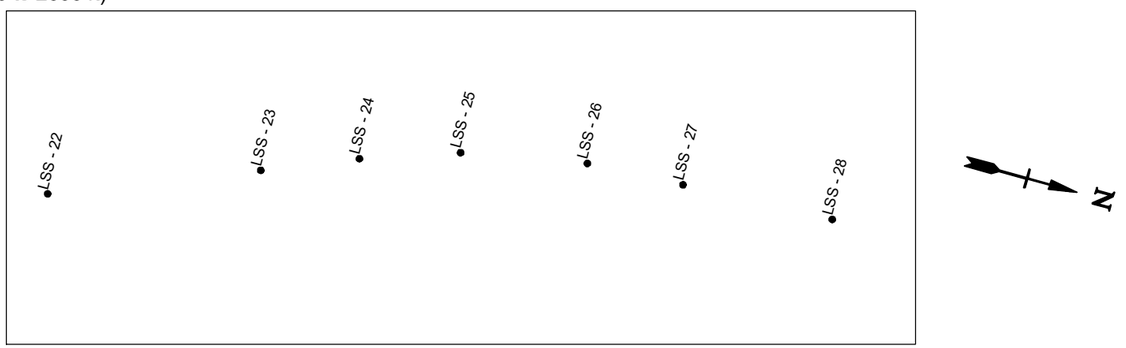


Boreholes Equally Spaced (0 to 2000 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



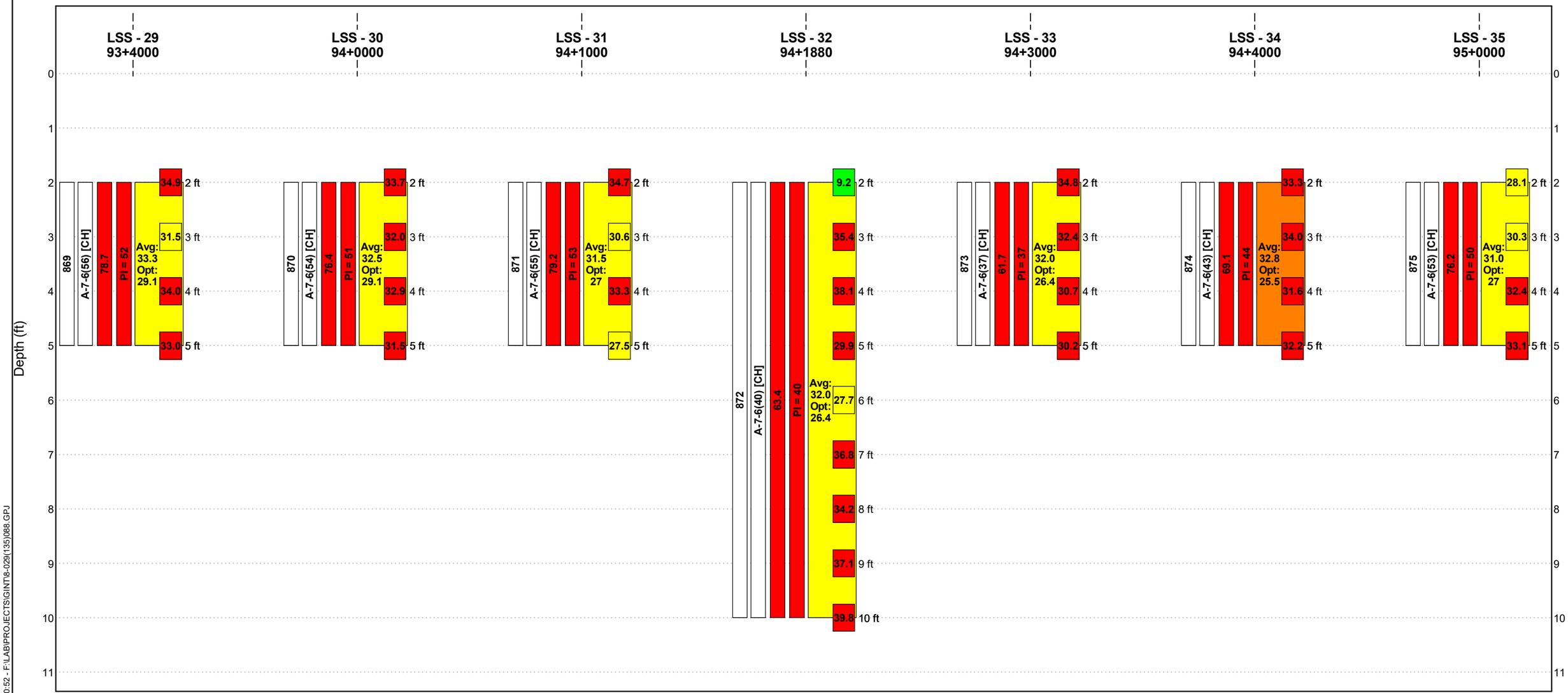
NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 2/25/19 10:51 - F:\LAB\PROJECTS\GINT\8-029(135)088.GPJ

NDDOT North Dakota Department of Transportation

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

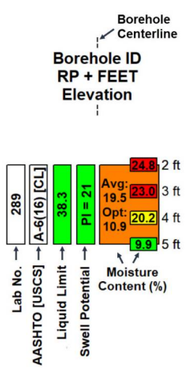
PROJECT NUMBER IM-8-029(135)088 **PCN** 18988

LOCATION Cass County



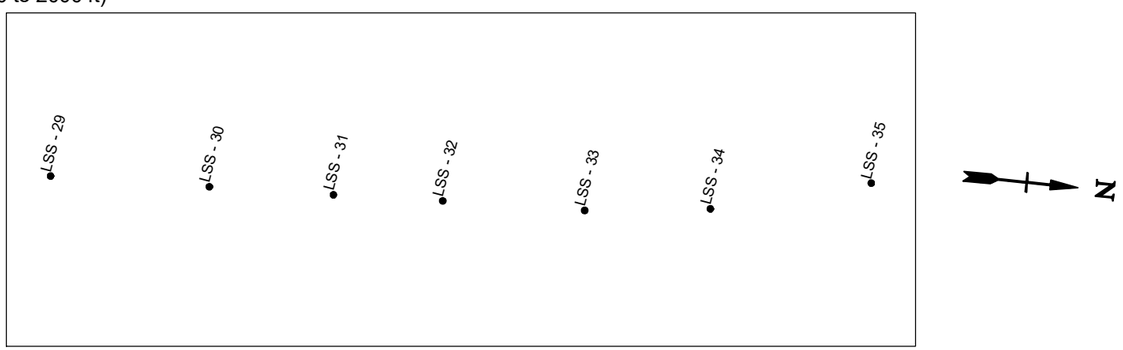
NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 2/25/19 10:52 - F:\LAB\PROJECTS\GINT\8-029(135)088.GPJ

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

Boreholes Equally Spaced (0 to 2000 ft)

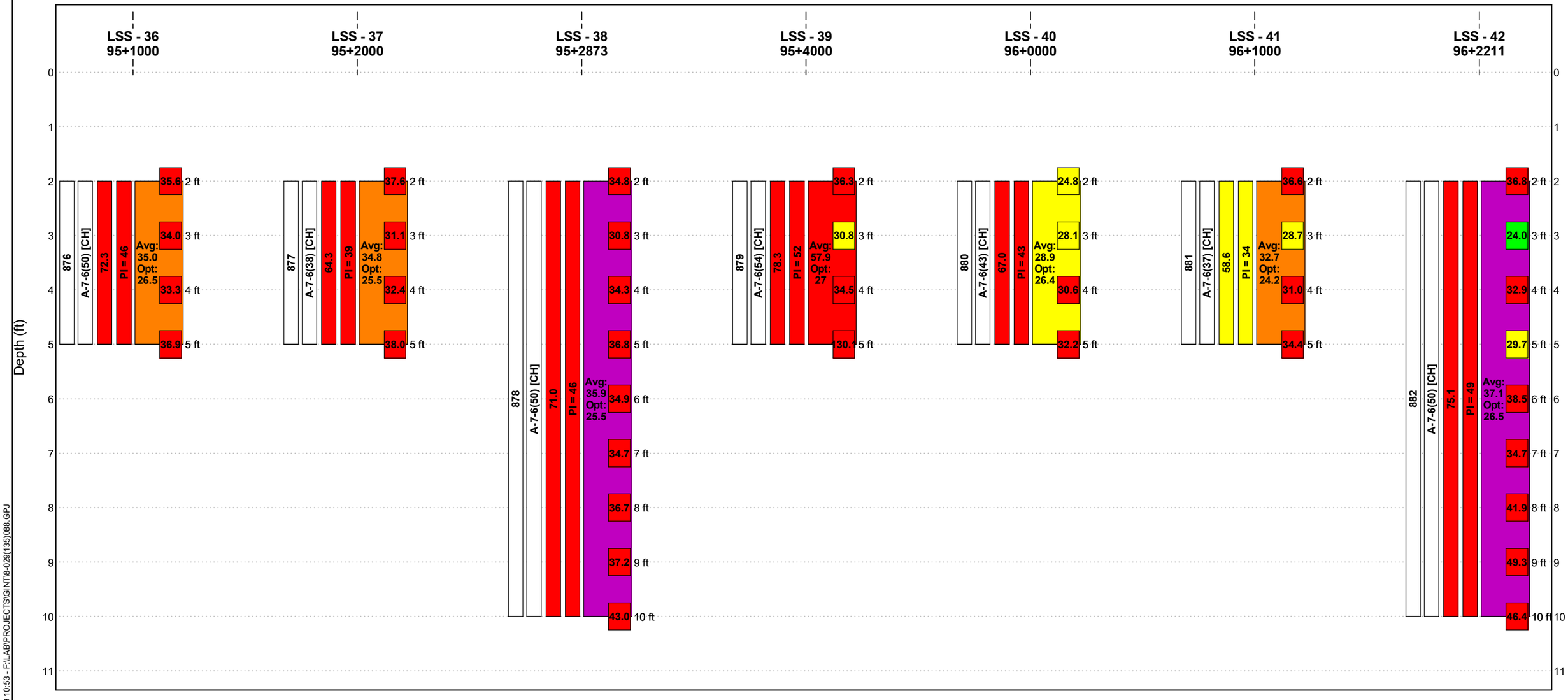


NDDOT
North Dakota Department of Transportation

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

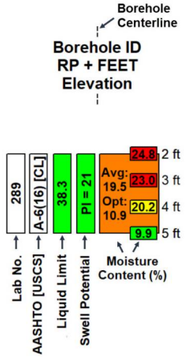
PROJECT NUMBER IM-8-029(135)088 **PCN** 18988

LOCATION Cass County

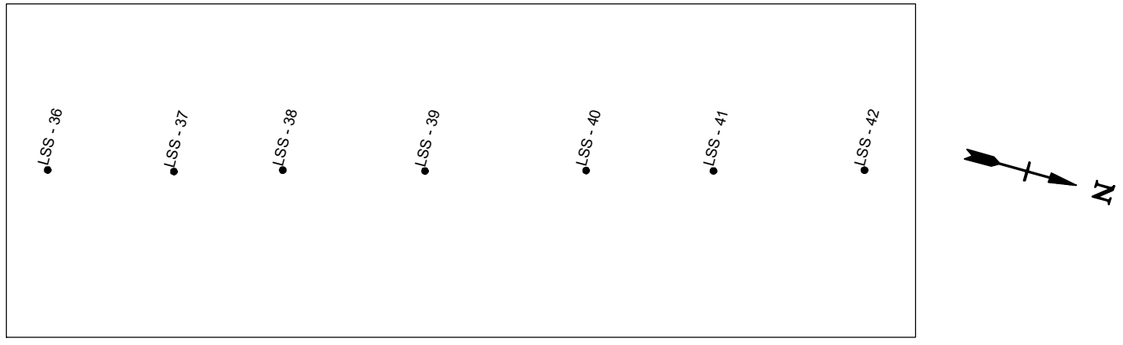


Boreholes Equally Spaced (0 to 2000 ft)

LEGEND



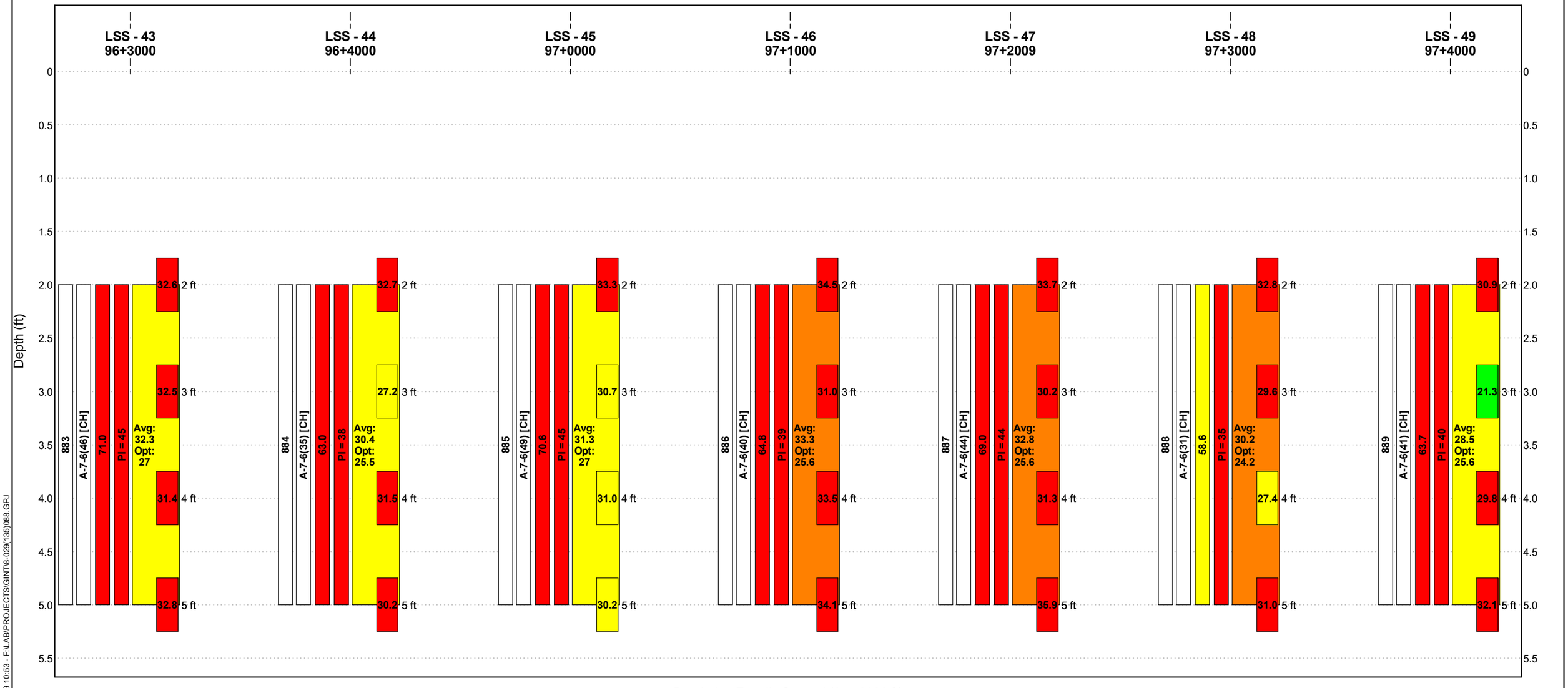
Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



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

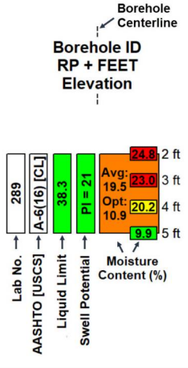
PROJECT NUMBER IM-8-029(135)088 **PCN** 18988

LOCATION Cass County

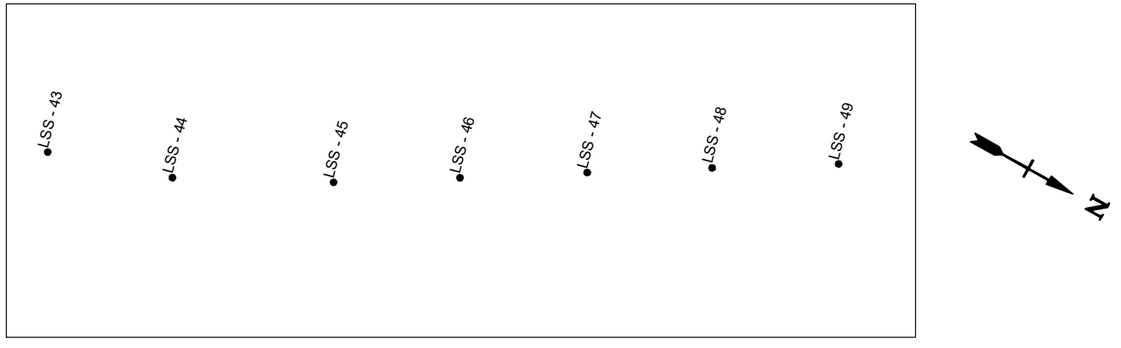


Boreholes Equally Spaced (0 to 2000 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



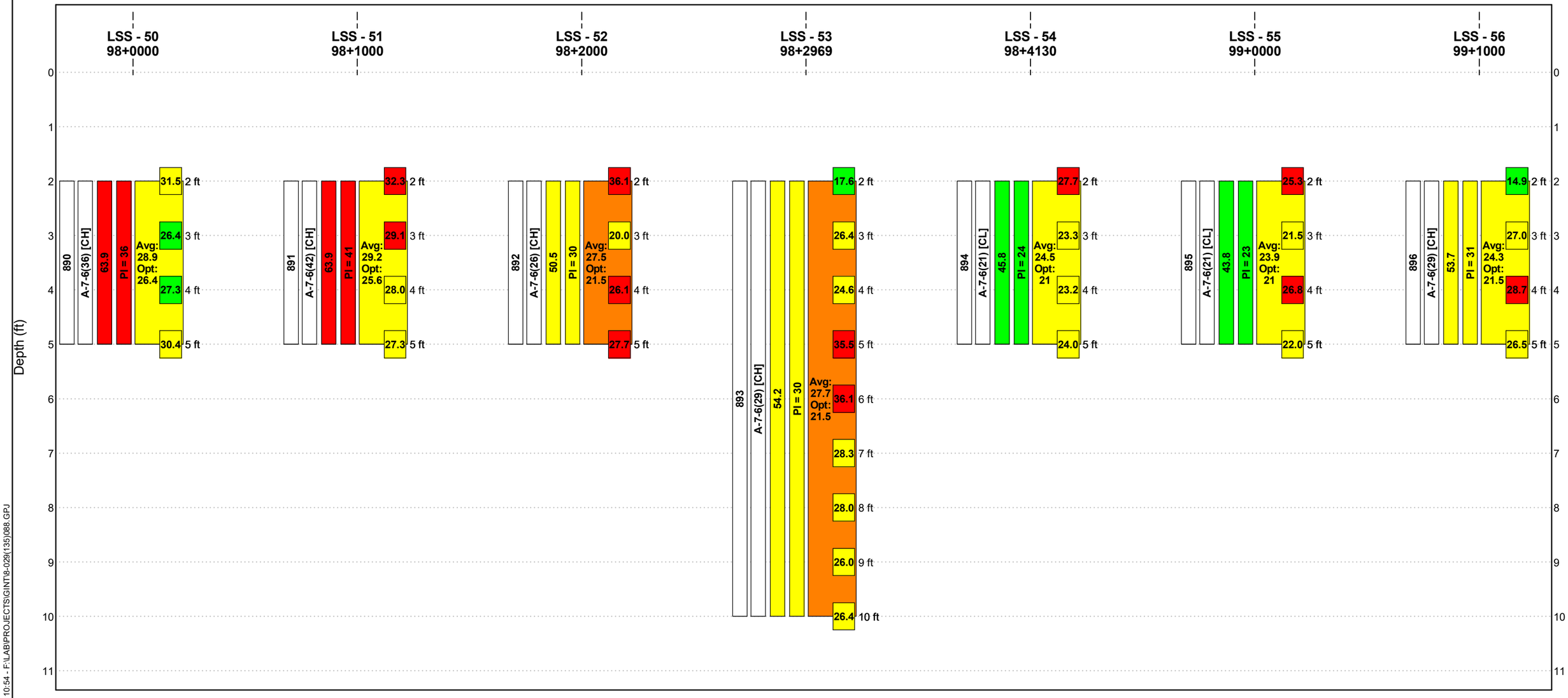
NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 2/25/19 10:53 - F:\LAB\PROJECTS\GINT\8-029(135)088.GPJ

NDDOT North Dakota Department of Transportation

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

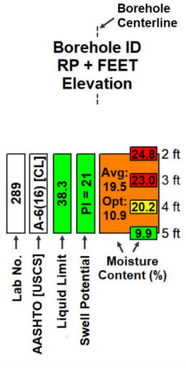
PROJECT NUMBER IM-8-029(135)088 **PCN** 18988

LOCATION Cass County

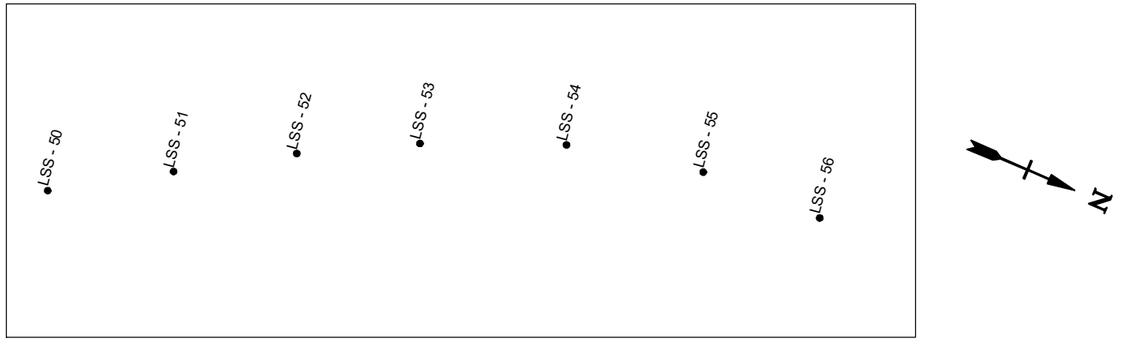


Boreholes Equally Spaced (0 to 2000 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

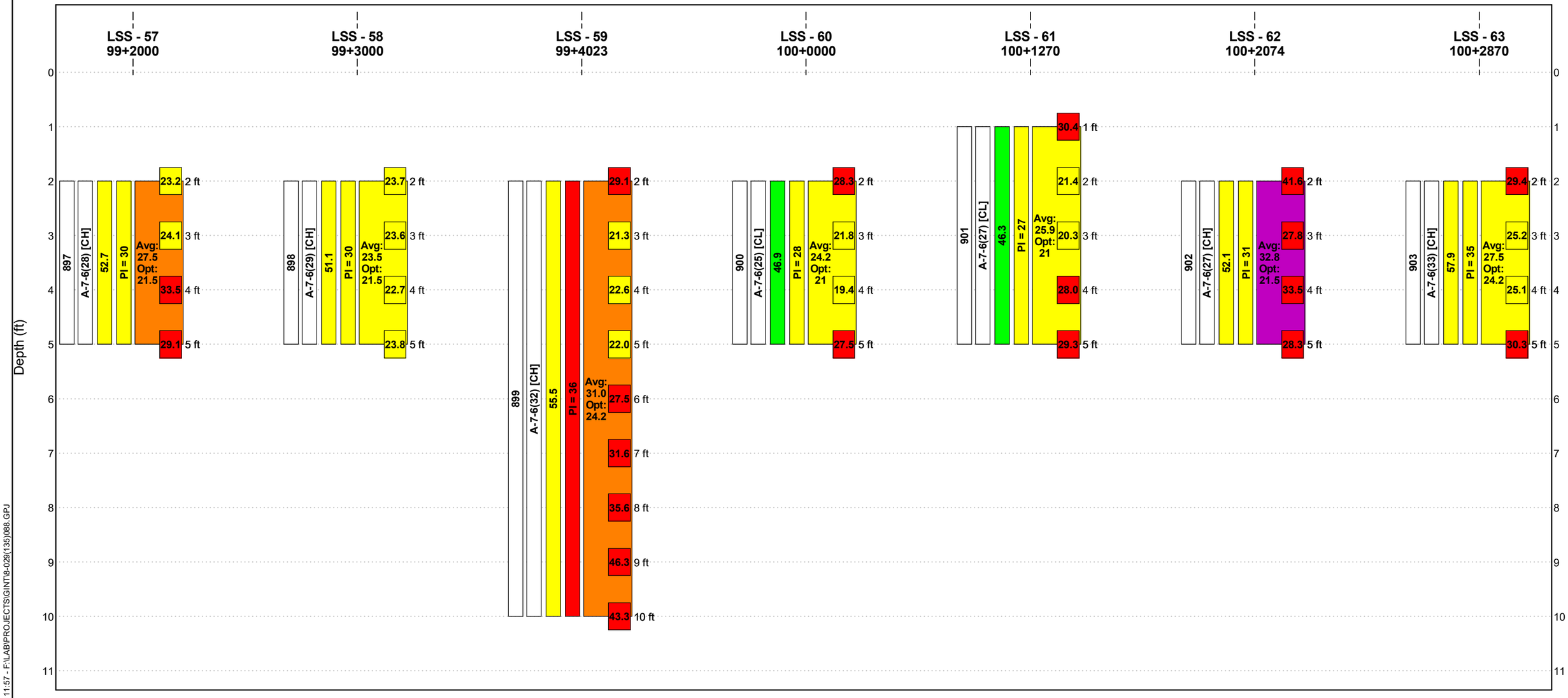


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 2/25/19 10:54 - F:\LAB\PROJECTS\GINT\8-029(135)088.GPJ

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

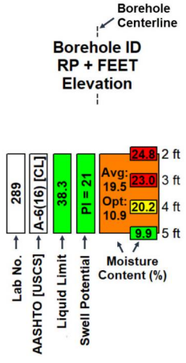
PROJECT NUMBER IM-8-029(135)088 **PCN** 18988

LOCATION Cass County

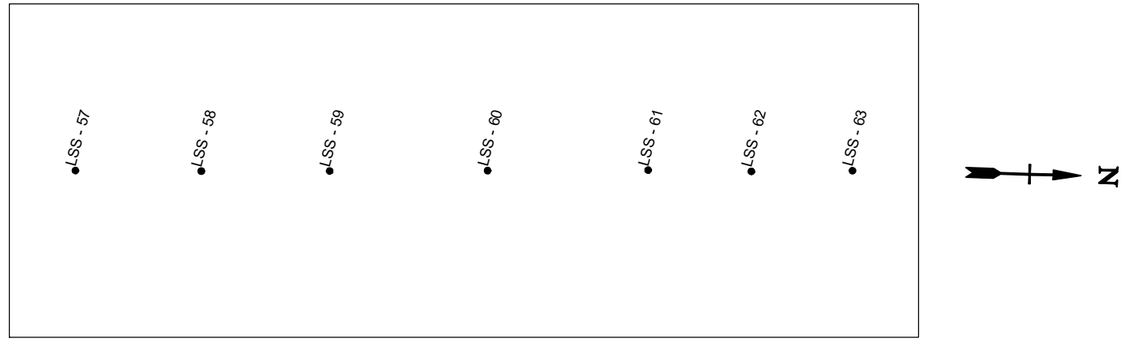


Boreholes Equally Spaced (0 to 2000 ft)

LEGEND



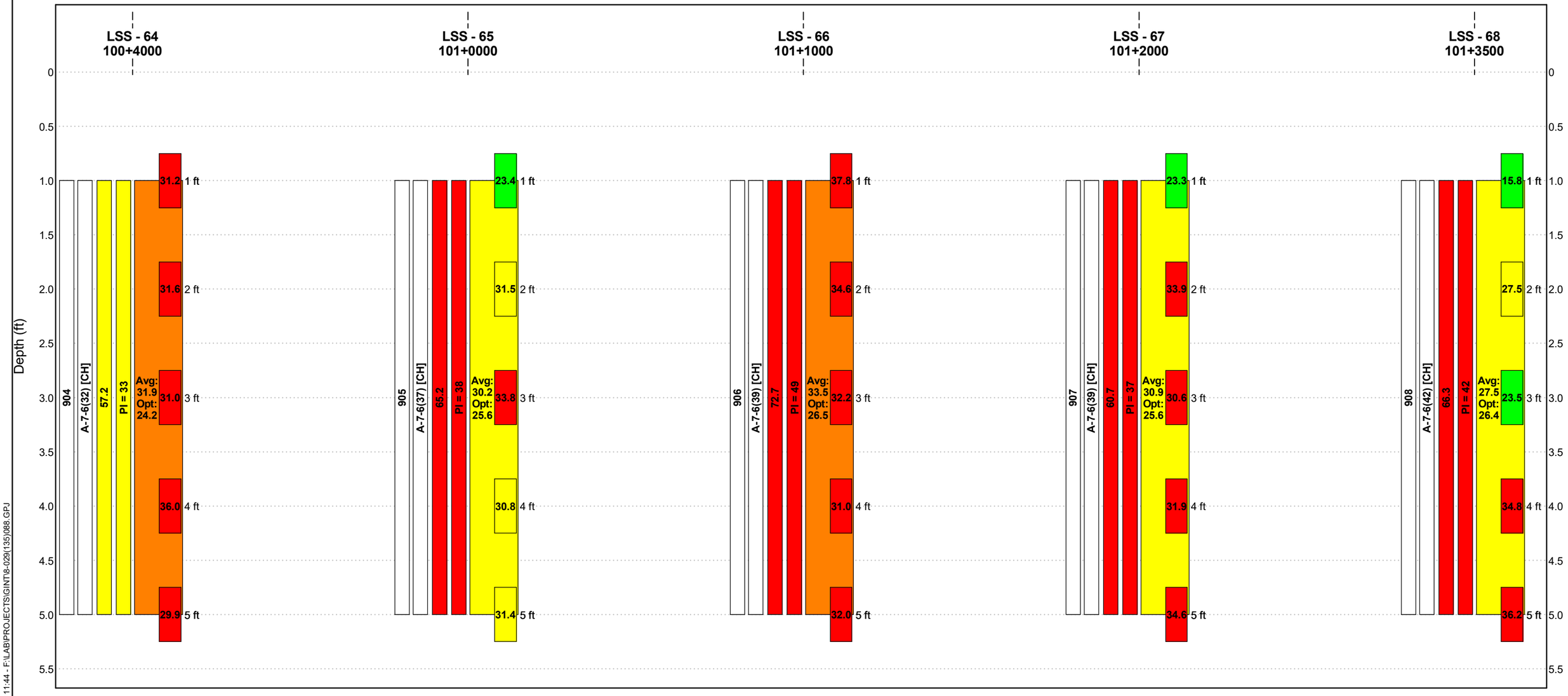
Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



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

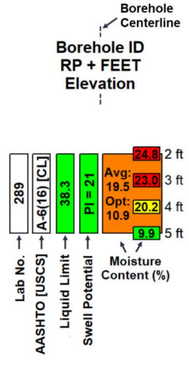
PROJECT NUMBER IM-8-029(135)088 **PCN** 18988

LOCATION Cass County

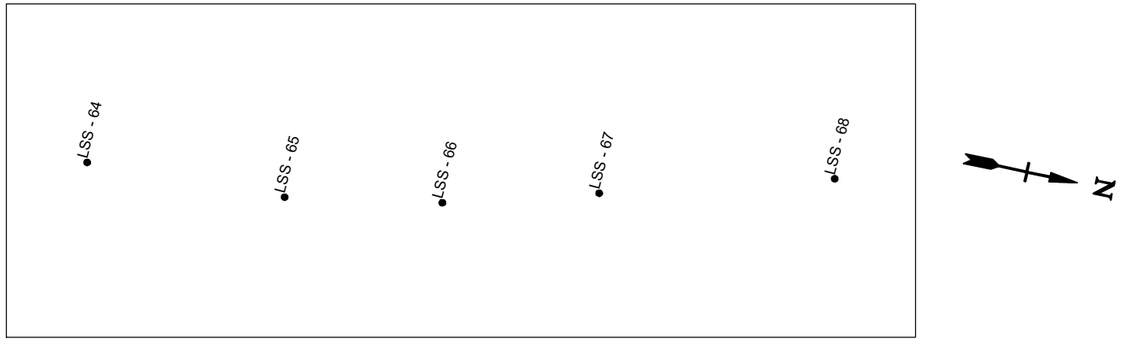


Boreholes Equally Spaced (0 to 1600 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 2/25/19 11:44 - F:\LAB\PROJECTS\GINT\8-029(135)088.GPJ

APPENDIX E

LAB RESULTS

SUMMARY OF LABORATORY RESULTS

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988

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
LSS - 1	2.0	56	22	34	9.5	83	A-7-6 (30)	CH	34.7	30.0			
LSS - 1	3.0								24.6	30.0			
LSS - 1	4.0								30.4	30.0			
LSS - 1	5.0								30.1	30.0			
LSS - 2	2.0	78	27	51	9.5	94	A-7-6 (55)	CH	30.1	34.5			
LSS - 2	3.0								34.0	34.5			
LSS - 2	4.0								36.3	34.5			
LSS - 2	5.0								33.6	34.5			
LSS - 2	6.0								28.9	34.5			
LSS - 2	7.0								35.4	34.5			
LSS - 2	8.0								36.9	34.5			
LSS - 2	9.0								38.2	34.5			
LSS - 2	10.0								37.1	34.5			
LSS - 3	2.0	69	25	44	9.5	87	A-7-6 (42)	CH	38.3	32.8			
LSS - 3	3.0								30.3	32.8			
LSS - 3	4.0								30.6	32.8			
LSS - 3	5.0								31.8	32.8			
LSS - 4	2.0	70	24	46	4.75	95	A-7-6 (50)	CH	37.4	32.6			
LSS - 4	3.0								31.2	32.6			
LSS - 4	4.0								32.4	32.6			
LSS - 4	5.0								29.3	32.6			
LSS - 5	2.0	54	24	30	9.5	90	A-7-6 (30)	CH	36.9	31.3			
LSS - 5	3.0								19.7	31.3			
LSS - 5	4.0								29.5	31.3			
LSS - 5	5.0								39.2	31.3			
LSS - 6	2.0	78	25	53	9.5	94	A-7-6 (57)	CH	34.3	34.9			
LSS - 6	3.0								32.7	34.9			
LSS - 6	4.0								37.0	34.9			
LSS - 6	5.0								35.8	34.9			
LSS - 7	2.0	74	23	51	9.5	93	A-7-6 (53)	CH	36.7	36.8			
LSS - 7	3.0								36.8	36.8			
LSS - 7	4.0								39.3	36.8			
LSS - 7	5.0								34.5	36.8			
LSS - 8	2.0	80	25	55	9.5	93	A-7-6 (58)	CH	43.0	38.4			
LSS - 8	3.0								35.6	38.4			
LSS - 8	4.0								36.8	38.4			
LSS - 8	5.0								38.0	38.4			
LSS - 9	2.0	89	26	63	2	94	A-7-6 (68)	CH	40.9	39.6			
LSS - 9	3.0								35.0	39.6			
LSS - 9	4.0								33.5	39.6			
LSS - 9	5.0								35.4	39.6			
LSS - 9	6.0								37.5	39.6			
LSS - 9	7.0								40.7	39.6			

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988

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
LSS - 9	8.0								42.0	39.6			
LSS - 9	9.0								45.3	39.6			
LSS - 9	10.0								46.6	39.6			
LSS - 10	2.0	68	26	42	9.5	85	A-7-6 (39)	CH	41.0	36.8			
LSS - 10	3.0								36.0	36.8			
LSS - 10	4.0								35.0	36.8			
LSS - 10	5.0								35.1	36.8			
LSS - 11	2.0	74	25	49	4.75	95	A-7-6 (53)	CH	39.2	36.1			
LSS - 11	3.0								33.5	36.1			
LSS - 11	4.0								34.1	36.1			
LSS - 11	5.0								31.8	36.1			
LSS - 11	6.0								31.7	36.1			
LSS - 11	7.0								35.7	36.1			
LSS - 11	8.0								36.1	36.1			
LSS - 11	9.0								45.6	36.1			
LSS - 11	10.0								37.0	36.1			
LSS - 12	2.0	72	25	47	9.5	89	A-7-6 (47)	CH	40.0	37.1			
LSS - 12	3.0								37.1	37.1			
LSS - 12	4.0								36.2	37.1			
LSS - 12	5.0								35.1	37.1			
LSS - 13	2.0	75	24	51	4.75	96	A-7-6 (56)	CH	38.1	35.6			
LSS - 13	3.0								34.1	35.6			
LSS - 13	4.0								34.2	35.6			
LSS - 13	5.0								35.8	35.6			
LSS - 14	2.0	79	25	54	9.5	94	A-7-6 (58)	CH	21.2	32.4			
LSS - 14	3.0								33.5	32.4			
LSS - 14	4.0								38.2	32.4			
LSS - 14	5.0								36.8	32.4			
LSS - 15	2.0	76	27	49	9.5	95	A-7-6 (54)	CH	46.6	37.9			
LSS - 15	3.0								33.1	37.9			
LSS - 15	4.0								35.8	37.9			
LSS - 15	5.0								36.1	37.9			
LSS - 16	2.0	71	25	46	9.5	87	A-7-6 (44)	CH	42.4	34.7			
LSS - 16	3.0								30.0	34.7			
LSS - 16	4.0								30.3	34.7			
LSS - 16	5.0								36.4	34.7			
LSS - 17	2.0	78	28	50	9.5	96	A-7-6 (56)	CH	36.2	34.6			
LSS - 17	3.0								35.0	34.6			
LSS - 17	4.0								32.8	34.6			
LSS - 17	5.0								33.9	34.6			
LSS - 17	6.0								31.2	34.6			
LSS - 17	7.0								34.1	34.6			
LSS - 17	8.0								34.2	34.6			

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988

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
LSS - 17	9.0								36.5	34.6			
LSS - 17	10.0								37.4	34.6			
LSS - 18	2.0	69	27	42	9.5	94	A-7-6 (46)	CH	35.5	34.4			
LSS - 18	3.0								34.1	34.4			
LSS - 18	4.0								30.6	34.4			
LSS - 18	5.0								37.4	34.4			
LSS - 19	2.0	74	25	49	9.5	93	A-7-6 (52)	CH	33.8	32.2			
LSS - 19	3.0								28.2	32.2			
LSS - 19	4.0								33.5	32.2			
LSS - 19	5.0								33.1	32.2			
LSS - 20	2.0	63	24	39	9.5	91	A-7-6 (40)	CH	43.4	35.3			
LSS - 20	3.0								29.0	35.3			
LSS - 20	4.0								31.8	35.3			
LSS - 20	5.0								37.1	35.3			
LSS - 21	2.0	70	26	44	9.5	88	A-7-6 (43)	CH	35.3	33.3			
LSS - 21	3.0								33.0	33.3			
LSS - 21	4.0								34.6	33.3			
LSS - 21	5.0								30.4	33.3			
LSS - 22	2.0	75	26	49	9.5	94	A-7-6 (53)	CH	39.2	36.6			
LSS - 22	3.0								39.3	36.6			
LSS - 22	4.0								34.1	36.6			
LSS - 22	5.0								33.6	36.6			
LSS - 23	2.0	51	20	31	9.5	76	A-7-6 (23)	CH	27.0	32.2			
LSS - 23	3.0								34.0	32.2			
LSS - 23	4.0								35.0	32.2			
LSS - 23	5.0								26.2	32.2			
LSS - 23	6.0								27.6	32.2			
LSS - 23	7.0								35.1	32.2			
LSS - 23	8.0								34.1	32.2			
LSS - 23	9.0								37.1	32.2			
LSS - 23	10.0								33.6	32.2			
LSS - 24	2.0	69	26	43	9.5	78	A-7-6 (36)	CH	44.1	35.8			
LSS - 24	3.0								33.3	35.8			
LSS - 24	4.0								31.8	35.8			
LSS - 24	5.0								33.8	35.8			
LSS - 25	2.0	69	25	44	4.75	92	A-7-6 (46)	CH	31.3	31.2			
LSS - 25	3.0								30.7	31.2			
LSS - 25	4.0								31.9	31.2			
LSS - 25	5.0								30.9	31.2			
LSS - 26	2.0	73	27	46	9.5	92	A-7-6 (49)	CH	36.2	34.7			
LSS - 26	3.0								32.8	34.7			
LSS - 26	4.0								34.5	34.7			
LSS - 26	5.0								35.2	34.7			

SUMMARY OF LABORATORY RESULTS

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988

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
LSS - 27	2.0	88	29	59	4.75	97	A-7-6 (67)	CH	15.4	32.2			
LSS - 27	3.0								30.0	32.2			
LSS - 27	4.0								34.6	32.2			
LSS - 27	5.0								32.1	32.2			
LSS - 27	6.0								25.7	32.2			
LSS - 27	7.0								38.6	32.2			
LSS - 27	8.0								35.9	32.2			
LSS - 27	9.0								36.8	32.2			
LSS - 27	10.0								40.7	32.2			
LSS - 28	2.0	73	27	46	9.5	89	A-7-6 (46)	CH	36.7	34.3			
LSS - 28	3.0								29.7	34.3			
LSS - 28	4.0								37.1	34.3			
LSS - 28	5.0								33.7	34.3			
LSS - 29	2.0	79	27	52	9.5	94	A-7-6 (56)	CH	34.9	33.3			
LSS - 29	3.0								31.5	33.3			
LSS - 29	4.0								34.0	33.3			
LSS - 29	5.0								33.0	33.3			
LSS - 30	2.0	76	26	50	4.75	94	A-7-6 (54)	CH	33.7	32.5			
LSS - 30	3.0								32.0	32.5			
LSS - 30	4.0								32.9	32.5			
LSS - 30	5.0								31.5	32.5			
LSS - 31	2.0	79	26	53	9.5	91	A-7-6 (55)	CH	34.7	31.5			
LSS - 31	3.0								30.6	31.5			
LSS - 31	4.0								33.3	31.5			
LSS - 31	5.0								27.5	31.5			
LSS - 32	2.0	63	24	39	9.5	92	A-7-6 (40)	CH	9.2	32.0			
LSS - 32	3.0								35.4	32.0			
LSS - 32	4.0								38.1	32.0			
LSS - 32	5.0								29.9	32.0			
LSS - 32	6.0								27.7	32.0			
LSS - 32	7.0								36.8	32.0			
LSS - 32	8.0								34.2	32.0			
LSS - 32	9.0								37.1	32.0			
LSS - 32	10.0								39.8	32.0			
LSS - 33	2.0	62	24	38	9.5	88	A-7-6 (37)	CH	34.8	32.0			
LSS - 33	3.0								32.4	32.0			
LSS - 33	4.0								30.7	32.0			
LSS - 33	5.0								30.2	32.0			
LSS - 34	2.0	69	25	44	9.5	88	A-7-6 (43)	CH	33.3	32.8			
LSS - 34	3.0								34.0	32.8			
LSS - 34	4.0								31.6	32.8			
LSS - 34	5.0								32.2	32.8			
LSS - 35	2.0	76	26	50	9.5	93	A-7-6 (53)	CH	28.1	31.0			

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988

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
LSS - 35	3.0								30.3	31.0			
LSS - 35	4.0								32.4	31.0			
LSS - 35	5.0								33.1	31.0			
LSS - 36	2.0	72	26	46	9.5	94	A-7-6 (50)	CH	35.6	35.0			
LSS - 36	3.0								34.0	35.0			
LSS - 36	4.0								33.3	35.0			
LSS - 36	5.0								36.9	35.0			
LSS - 37	2.0	64	25	39	9.5	87	A-7-6 (38)	CH	37.6	34.8			
LSS - 37	3.0								31.1	34.8			
LSS - 37	4.0								32.4	34.8			
LSS - 37	5.0								38.0	34.8			
LSS - 38	2.0	71	25	46	9.5	95	A-7-6 (50)	CH	34.8	35.9			
LSS - 38	3.0								30.8	35.9			
LSS - 38	4.0								34.3	35.9			
LSS - 38	5.0								36.8	35.9			
LSS - 38	6.0								34.9	35.9			
LSS - 38	7.0								34.7	35.9			
LSS - 38	8.0								36.7	35.9			
LSS - 38	9.0								37.2	35.9			
LSS - 38	10.0								43.0	35.9			
LSS - 39	2.0	78	26	52	9.5	91	A-7-6 (54)	CH	36.3	57.9			
LSS - 39	3.0								30.8	57.9			
LSS - 39	4.0								34.5	57.9			
LSS - 39	5.0								130.1	57.9			
LSS - 40	2.0	67	24	43	9.5	89	A-7-6 (43)	CH	24.8	28.9			
LSS - 40	3.0								28.1	28.9			
LSS - 40	4.0								30.6	28.9			
LSS - 40	5.0								32.2	28.9			
LSS - 41	2.0	59	24	35	4.75	93	A-7-6 (37)	CH	36.6	32.7			
LSS - 41	3.0								28.7	32.7			
LSS - 41	4.0								31.0	32.7			
LSS - 41	5.0								34.4	32.7			
LSS - 42	2.0	75	26	49	9.5	90	A-7-6 (50)	CH	36.8	37.1			
LSS - 42	3.0								24.0	37.1			
LSS - 42	4.0								32.9	37.1			
LSS - 42	5.0								29.7	37.1			
LSS - 42	6.0								38.5	37.1			
LSS - 42	7.0								34.7	37.1			
LSS - 42	8.0								41.9	37.1			
LSS - 42	9.0								49.3	37.1			
LSS - 42	10.0								46.4	37.1			
LSS - 43	2.0	71	26	45	9.5	90	A-7-6 (46)	CH	32.6	32.3			
LSS - 43	3.0								32.5	32.3			

SUMMARY OF LABORATORY RESULTS

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988

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
LSS - 43	4.0								31.4	32.3			
LSS - 43	5.0								32.8	32.3			
LSS - 44	2.0	63	25	38	9.5	85	A-7-6 (35)	CH	32.7	30.4			
LSS - 44	3.0								27.2	30.4			
LSS - 44	4.0								31.5	30.4			
LSS - 44	5.0								30.2	30.4			
LSS - 45	2.0	71	26	45	9.5	94	A-7-6 (49)	CH	33.3	31.3			
LSS - 45	3.0								30.7	31.3			
LSS - 45	4.0								31.0	31.3			
LSS - 45	5.0								30.2	31.3			
LSS - 46	2.0	65	25	40	9.5	90	A-7-6 (40)	CH	34.5	33.3			
LSS - 46	3.0								31.0	33.3			
LSS - 46	4.0								33.5	33.3			
LSS - 46	5.0								34.1	33.3			
LSS - 47	2.0	69	25	44	9.5	90	A-7-6 (44)	CH	33.7	32.8			
LSS - 47	3.0								30.2	32.8			
LSS - 47	4.0								31.3	32.8			
LSS - 47	5.0								35.9	32.8			
LSS - 48	2.0	59	24	35	9.5	83	A-7-6 (31)	CH	32.8	30.2			
LSS - 48	3.0								29.6	30.2			
LSS - 48	4.0								27.4	30.2			
LSS - 48	5.0								31.0	30.2			
LSS - 49	2.0	64	23	41	9.5	90	A-7-6 (41)	CH	30.9	28.5			
LSS - 49	3.0								21.3	28.5			
LSS - 49	4.0								29.8	28.5			
LSS - 49	5.0								32.1	28.5			
LSS - 50	2.0	64	28	36	9.5	88	A-7-6 (36)	CH	31.5	28.9			
LSS - 50	3.0								26.4	28.9			
LSS - 50	4.0								27.3	28.9			
LSS - 50	5.0								30.4	28.9			
LSS - 51	2.0	64	23	41	9.5	92	A-7-6 (42)	CH	32.3	29.2			
LSS - 51	3.0								29.1	29.2			
LSS - 51	4.0								28.0	29.2			
LSS - 51	5.0								27.3	29.2			
LSS - 52	2.0	51	20	31	4.75	81	A-7-6 (26)	CH	36.1	27.5			
LSS - 52	3.0								20.0	27.5			
LSS - 52	4.0								26.1	27.5			
LSS - 52	5.0								27.7	27.5			
LSS - 53	2.0	54	24	30	9.5	88	A-7-6 (29)	CH	17.6	27.7			
LSS - 53	3.0								26.4	27.7			
LSS - 53	4.0								24.6	27.7			
LSS - 53	5.0								35.5	27.7			
LSS - 53	6.0								36.1	27.7			

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988

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
LSS - 53	7.0								28.3	27.7			
LSS - 53	8.0								28.0	27.7			
LSS - 53	9.0								26.0	27.7			
LSS - 53	10.0								26.4	27.7			
LSS - 54	2.0	46	21	25	9.5	82	A-7-6 (21)	CL	27.7	24.5			
LSS - 54	3.0								23.3	24.5			
LSS - 54	4.0								23.2	24.5			
LSS - 54	5.0								24.0	24.5			
LSS - 55	2.0	44	20	24	9.5	86	A-7-6 (21)	CL	25.3	23.9			
LSS - 55	3.0								21.5	23.9			
LSS - 55	4.0								26.8	23.9			
LSS - 55	5.0								22.0	23.9			
LSS - 56	2.0	54	23	31	9.5	86	A-7-6 (29)	CH	14.9	24.3			
LSS - 56	3.0								27.0	24.3			
LSS - 56	4.0								28.7	24.3			
LSS - 56	5.0								26.5	24.3			
LSS - 57	2.0	53	23	30	9.5	87	A-7-6 (28)	CH	23.2	27.5			
LSS - 57	3.0								24.1	27.5			
LSS - 57	4.0								33.5	27.5			
LSS - 57	5.0								29.1	27.5			
LSS - 58	2.0	51	21	30	4.75	91	A-7-6 (29)	CH	23.7	23.5			
LSS - 58	3.0								23.6	23.5			
LSS - 58	4.0								22.7	23.5			
LSS - 58	5.0								23.8	23.5			
LSS - 59	2.0	55	20	35	9.5	86	A-7-6 (32)	CH	29.1	31.0			
LSS - 59	3.0								21.3	31.0			
LSS - 59	4.0								22.6	31.0			
LSS - 59	5.0								22.0	31.0			
LSS - 59	6.0								27.5	31.0			
LSS - 59	7.0								31.6	31.0			
LSS - 59	8.0								35.6	31.0			
LSS - 59	9.0								46.3	31.0			
LSS - 59	10.0								43.3	31.0			
LSS - 60	2.0	47	19	28	9.5	86	A-7-6 (25)	CL	28.3	24.2			
LSS - 60	3.0								21.8	24.2			
LSS - 60	4.0								19.4	24.2			
LSS - 60	5.0								27.5	24.2			
LSS - 61	1.0	46	20	26	9.5	95	A-7-6 (27)	CL	30.4	25.9			
LSS - 61	2.0								21.4	25.9			
LSS - 61	3.0								20.3	25.9			
LSS - 61	4.0								28.0	25.9			
LSS - 61	5.0								29.3	25.9			
LSS - 62	2.0	52	21	31	9.5	83	A-7-6 (27)	CH	41.6	32.8			

SUMMARY OF LABORATORY RESULTS

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988

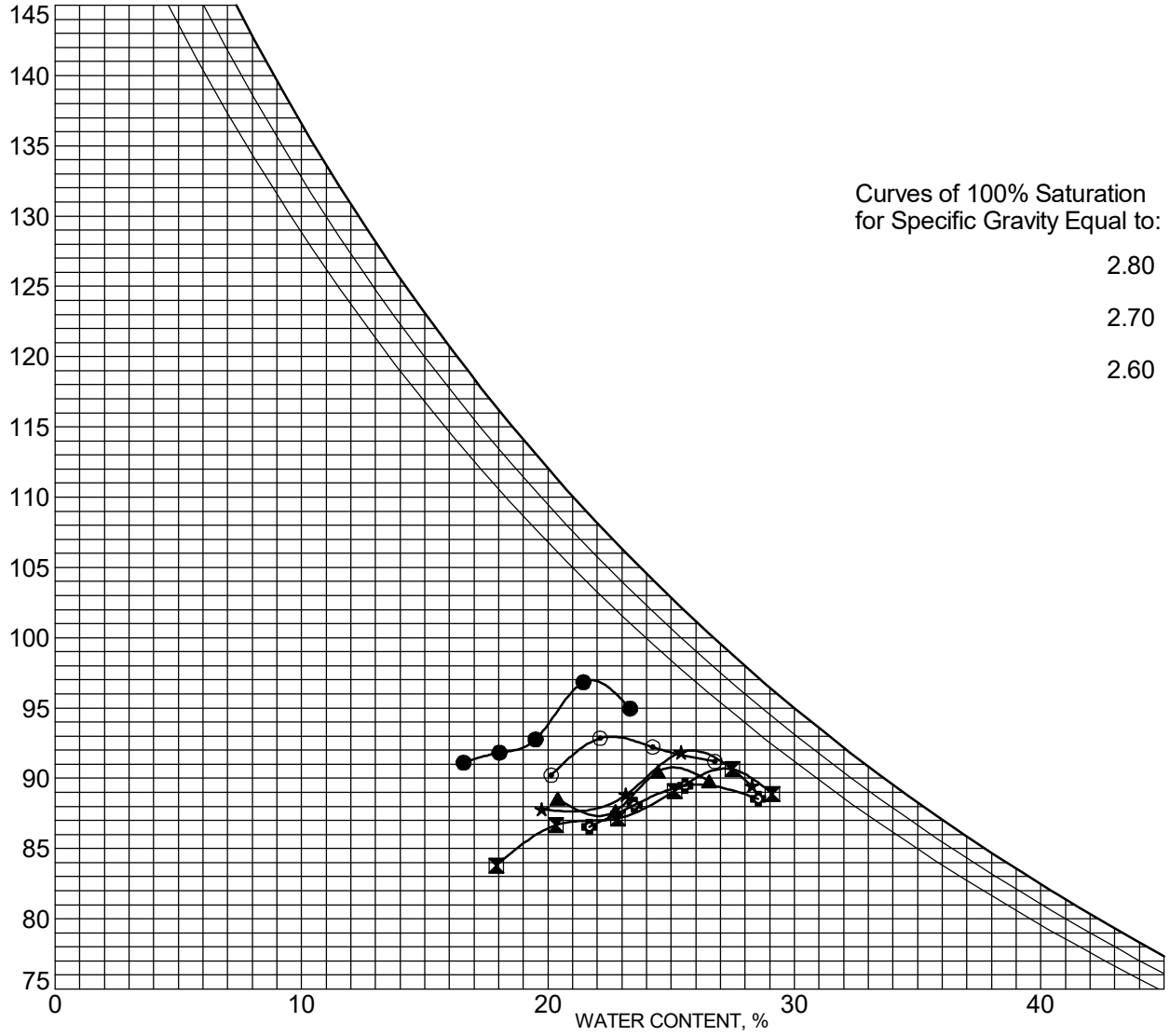
Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
LSS - 62	3.0								27.8	32.8			
LSS - 62	4.0								33.5	32.8			
LSS - 62	5.0								28.3	32.8			
LSS - 63	2.0	58	23	35	4.75	86	A-7-6 (33)	CH	29.4	27.5			
LSS - 63	3.0								25.2	27.5			
LSS - 63	4.0								25.1	27.5			
LSS - 63	5.0								30.3	27.5			
LSS - 64	1.0	57	24	33	9.5	89	A-7-6 (32)	CH	31.2	31.9			
LSS - 64	2.0								31.6	31.9			
LSS - 64	3.0								31.0	31.9			
LSS - 64	4.0								36.0	31.9			
LSS - 64	5.0								29.9	31.9			
LSS - 65	1.0	65	27	38	4.75	87	A-7-6 (37)	CH	23.4	30.2			
LSS - 65	2.0								31.5	30.2			
LSS - 65	3.0								33.8	30.2			
LSS - 65	4.0								30.8	30.2			
LSS - 65	5.0								31.4	30.2			
LSS - 66	1.0	73	23	50	25	76	A-7-6 (39)	CH	37.8	33.5			
LSS - 66	2.0								34.6	33.5			
LSS - 66	3.0								32.2	33.5			
LSS - 66	4.0								31.0	33.5			
LSS - 66	5.0								32.0	33.5			
LSS - 67	1.0	61	24	37	9.5	94	A-7-6 (39)	CH	23.3	30.9			
LSS - 67	2.0								33.9	30.9			
LSS - 67	3.0								30.6	30.9			
LSS - 67	4.0								31.9	30.9			
LSS - 67	5.0								34.6	30.9			
LSS - 68	1.0	66	24	42	9.5	90	A-7-6 (42)	CH	15.8	27.5			
LSS - 68	2.0								27.5	27.5			
LSS - 68	3.0								23.5	27.5			
LSS - 68	4.0								34.8	27.5			
LSS - 68	5.0								36.2	27.5			

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**LSS - 1**	**2.0**	**A-7-6 (30)**	**FAT CLAY with SAND(CH)**
⊠	**LSS - 2**	**2.0**	**A-7-6 (55)**	**FAT CLAY(CH)**
▲	**LSS - 3**	**2.0**	**A-7-6 (42)**	**FAT CLAY(CH)**
★	**LSS - 4**	**2.0**	**A-7-6 (50)**	**FAT CLAY(CH)**
⊙	**LSS - 5**	**2.0**	**A-7-6 (30)**	**FAT CLAY(CH)**
✿	**LSS - 6**	**2.0**	**A-7-6 (57)**	**FAT CLAY(CH)**

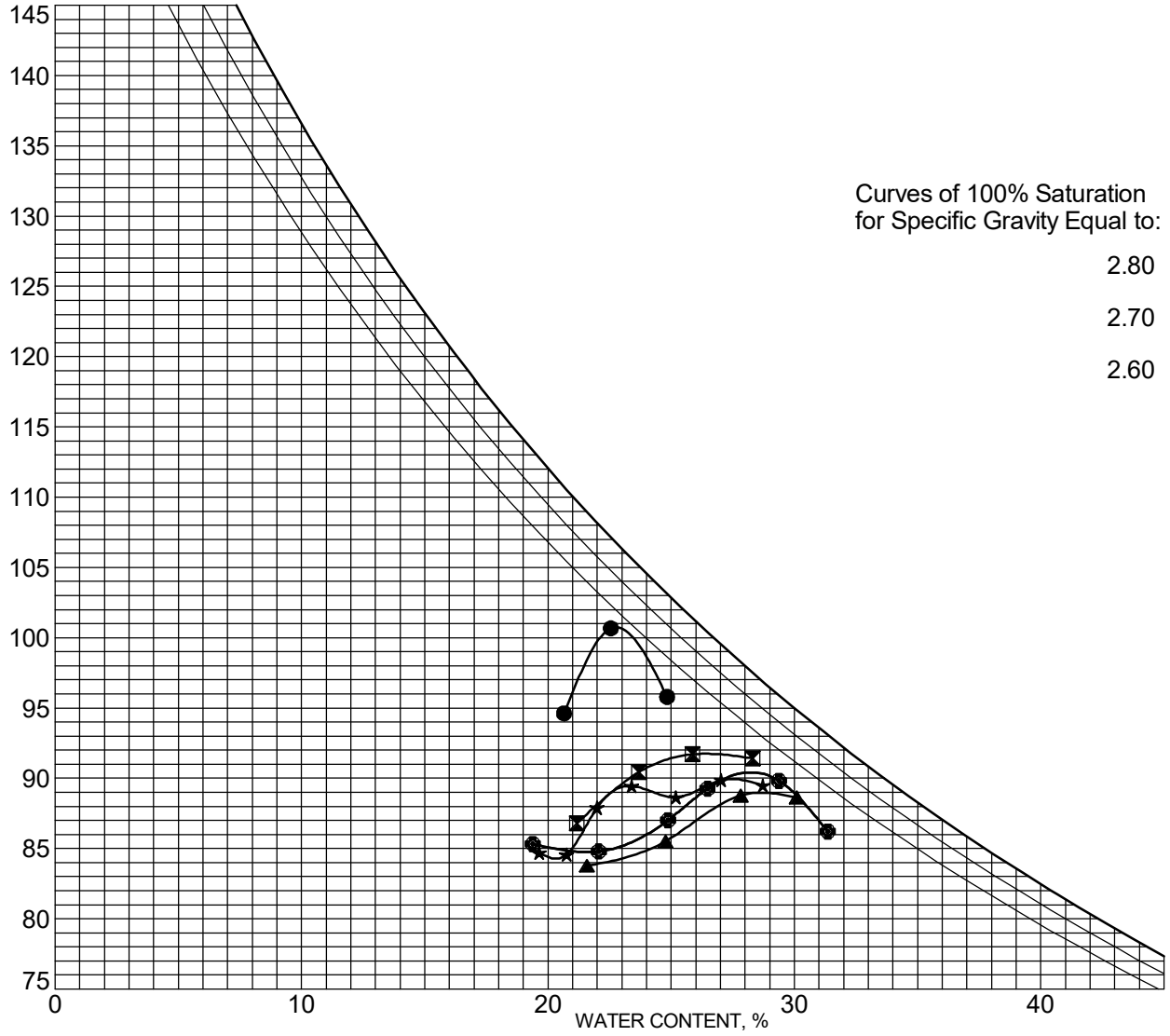
BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 1**	**2.0**	**AASHTO T-99 Method A**	**56**	**22**	**34**	**97.0 PCF**	**21.7 %**
⊠	**LSS - 2**	**2.0**	**AASHTO T-99 Method A**	**78**	**27**	**51**	**90.7 PCF**	**27.2 %**
▲	**LSS - 3**	**2.0**	**AASHTO T-99 Method A**	**69**	**25**	**44**	**90.8 PCF**	**25.1 %**
★	**LSS - 4**	**2.0**	**AASHTO T-99 Method A**	**70**	**24**	**46**	**92.0 PCF**	**25.9 %**
⊙	**LSS - 5**	**2.0**	**AASHTO T-99 Method A**	**54**	**24**	**30**	**93.0 PCF**	**22.6 %**
✿	**LSS - 6**	**2.0**	**AASHTO T-99 Method A**	**78**	**25**	**53**	**89.5 PCF**	**26.0 %**

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**LSS - 7**	**2.0**	**A-7-6 (53)**	**FAT CLAY(CH)**
⊠	**LSS - 8**	**2.0**	**A-7-6 (58)**	**FAT CLAY(CH)**
▲	**LSS - 9**	**2.0**	**A-7-6 (68)**	**FAT CLAY(CH)**
★	**LSS - 10**	**2.0**	**A-7-6 (39)**	**FAT CLAY(CH)**
⊙	**LSS - 11**	**2.0**	**A-7-6 (53)**	**FAT CLAY(CH)**
✪	**LSS - 12**	**2.0**	**A-7-6 (47)**	**FAT CLAY(CH)**

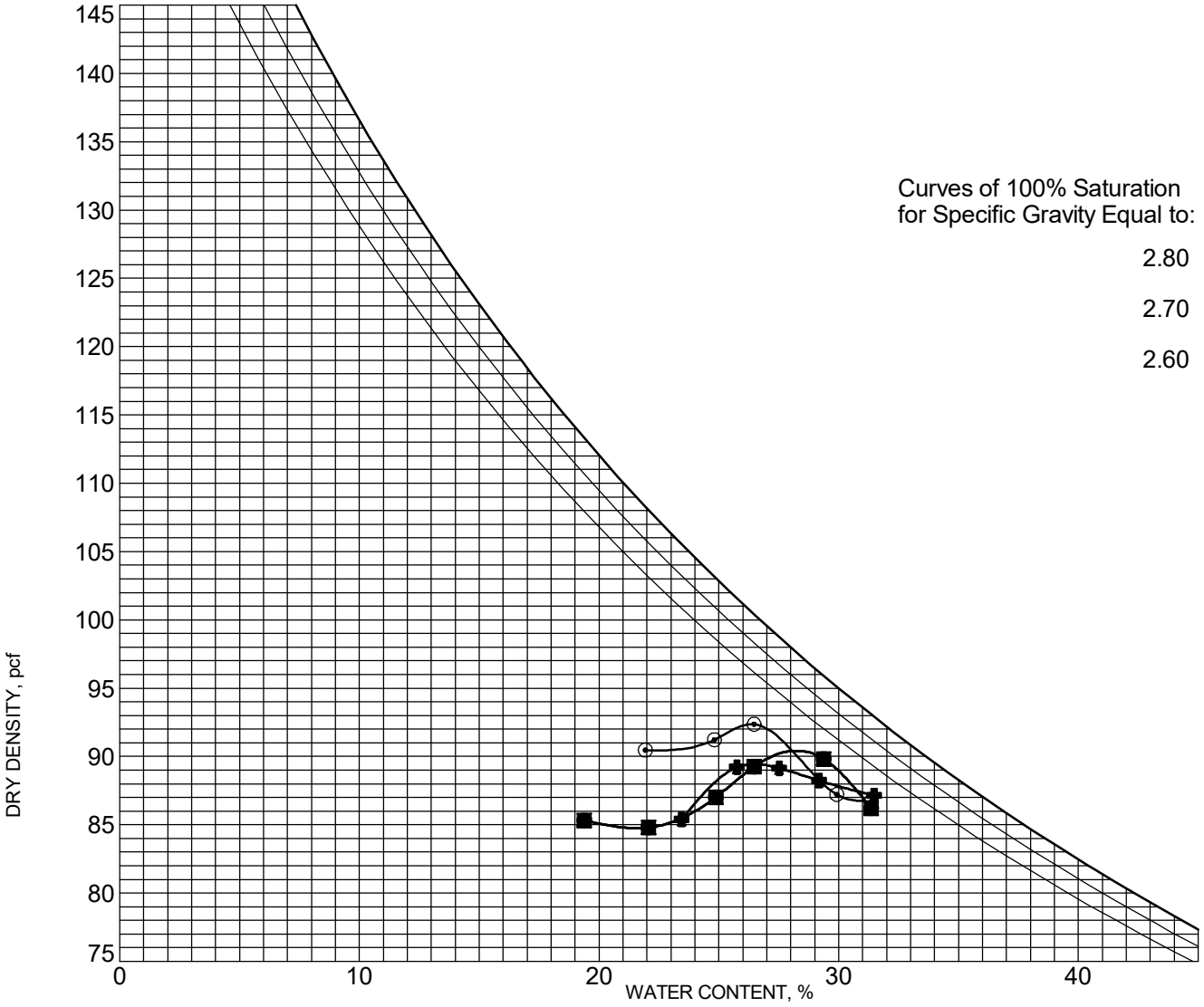
BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 7**	**2.0**	**AASHTO T-99 Method A**	**74**	**23**	**51**	**100.7 PCF**	**22.8 %**
⊠	**LSS - 8**	**2.0**	**AASHTO T-99 Method A**	**80**	**25**	**55**	**91.7 PCF**	**26.4 %**
▲	**LSS - 9**	**2.0**	**AASHTO T-99 Method A**	**89**	**26**	**63**	**89.0 PCF**	**28.7 %**
★	**LSS - 10**	**2.0**	**AASHTO T-99 Method A**	**68**	**26**	**42**	**90.0 PCF**	**27.5 %**
⊙	**LSS - 11**	**2.0**	**AASHTO T-99 Method A**	**74**	**25**	**49**	**90.4 PCF**	**28.3 %**
✪	**LSS - 12**	**2.0**	**AASHTO T-99 Method A**	**72**	**25**	**47**	**90.4 PCF**	**28.3 %**

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**LSS - 13**	**2.0**	**A-7-6 (56)**	**FAT CLAY(CH)**
⊠	**LSS - 14**	**2.0**	**A-7-6 (58)**	**FAT CLAY(CH)**
▲	**LSS - 15**	**2.0**	**A-7-6 (54)**	**FAT CLAY(CH)**
★	**LSS - 19**	**2.0**	**A-7-6 (52)**	**FAT CLAY(CH)**
⊙	**LSS - 20**	**2.0**	**A-7-6 (40)**	**FAT CLAY(CH)**
✿	**LSS - 21**	**2.0**	**A-7-6 (43)**	**FAT CLAY(CH)**

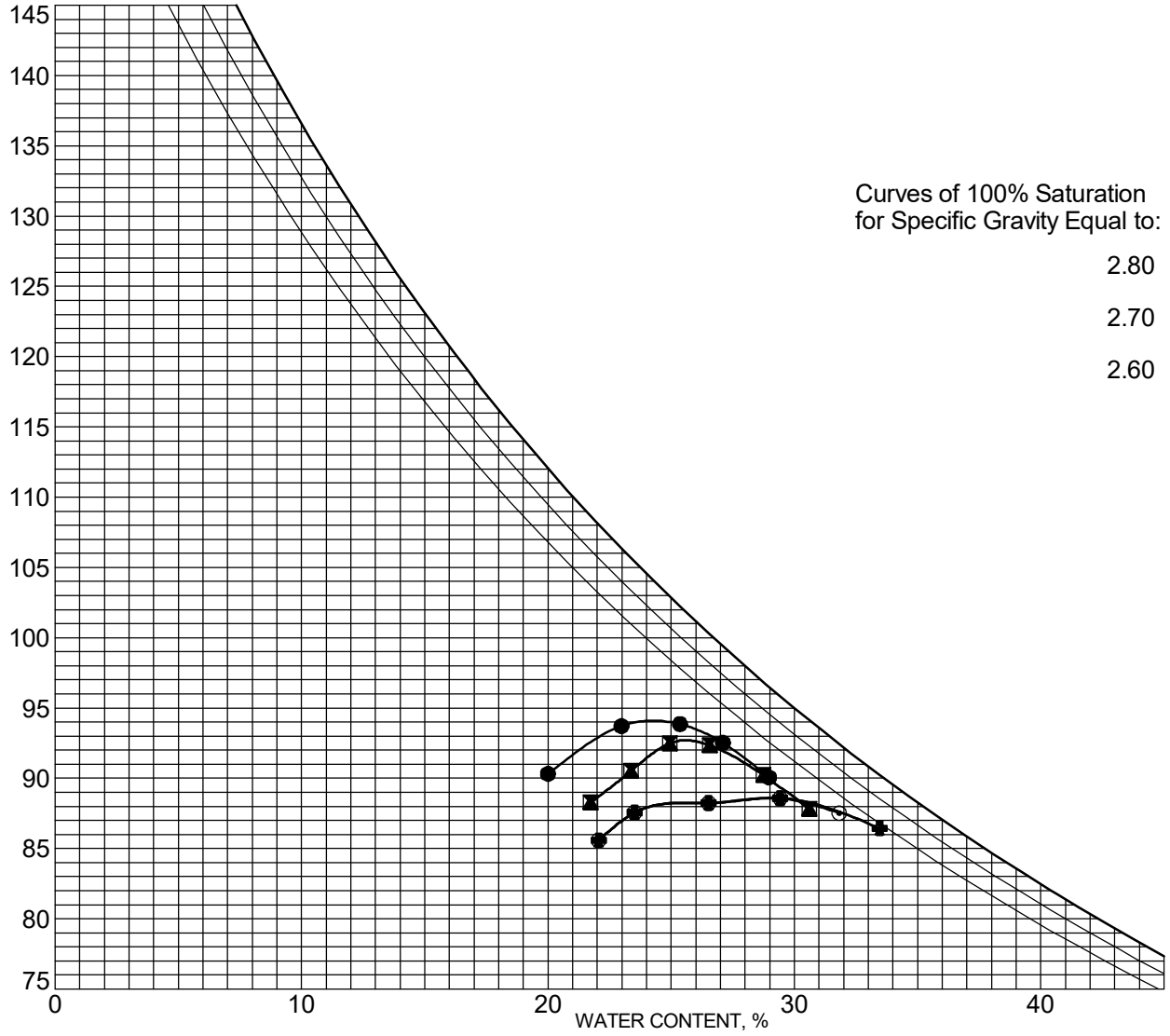
BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 13**	**2.0**	**AASHTO T-99 Method A**	**75**	**24**	**51**	**90.4 PCF**	**28.3 %**
⊠	**LSS - 14**	**2.0**	**AASHTO T-99 Method A**	**79**	**25**	**54**	**90.4 PCF**	**28.3 %**
▲	**LSS - 15**	**2.0**	**AASHTO T-99 Method A**	**76**	**27**	**49**	**90.4 PCF**	**28.3 %**
★	**LSS - 19**	**2.0**	**AASHTO T-99 Method A**	**74**	**25**	**49**	**89.5 PCF**	**26.5 %**
⊙	**LSS - 20**	**2.0**	**AASHTO T-99 Method A**	**63**	**24**	**39**	**92.4 PCF**	**26.4 %**
✿	**LSS - 21**	**2.0**	**AASHTO T-99 Method A**	**70**	**26**	**44**	**89.5 PCF**	**26.5 %**

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	**LSS - 23**	**2.0**	**A-7-6 (23)**	**FAT CLAY with SAND(CH)**
⊠	**LSS - 24**	**2.0**	**A-7-6 (36)**	**FAT CLAY with SAND(CH)**
▲	**LSS - 25**	**2.0**	**A-7-6 (46)**	**FAT CLAY(CH)**
★	**LSS - 26**	**2.0**	**A-7-6 (49)**	**FAT CLAY(CH)**
⊙	**LSS - 27**	**2.0**	**A-7-6 (67)**	**FAT CLAY(CH)**
✪	**LSS - 28**	**2.0**	**A-7-6 (46)**	**FAT CLAY(CH)**

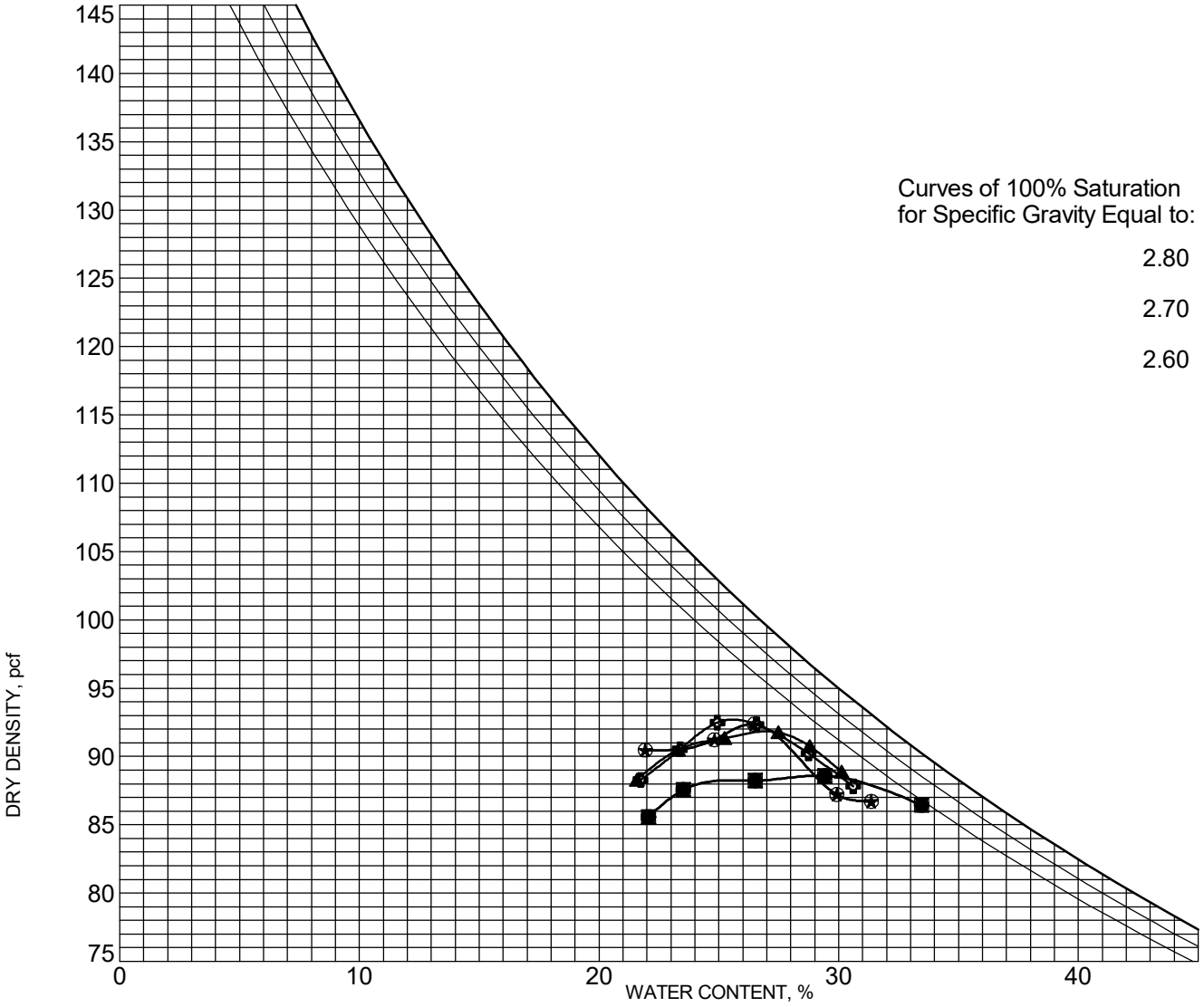
	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 23**	**2.0**	**AASHTO T-99 Method A**	**51**	**20**	**31**	**94.1 PCF**	**24.2 %**
⊠	**LSS - 24**	**2.0**	**AASHTO T-99 Method A**	**69**	**26**	**43**	**92.7 PCF**	**25.5 %**
▲	**LSS - 25**	**2.0**	**AASHTO T-99 Method A**	**69**	**25**	**44**	**92.7 PCF**	**25.5 %**
★	**LSS - 26**	**2.0**	**AASHTO T-99 Method A**	**73**	**27**	**46**	**88.6 PCF**	**29.1 %**
⊙	**LSS - 27**	**2.0**	**AASHTO T-99 Method A**	**88**	**29**	**59**	**88.6 PCF**	**29.0 %**
✪	**LSS - 28**	**2.0**	**AASHTO T-99 Method A**	**73**	**27**	**46**	**88.6 PCF**	**29.1 %**

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	**LSS - 29**	**2.0**	**A-7-6 (56)**	**FAT CLAY(CH)**
⊠	**LSS - 30**	**2.0**	**A-7-6 (54)**	**FAT CLAY(CH)**
▲	**LSS - 31**	**2.0**	**A-7-6 (55)**	**FAT CLAY(CH)**
★	**LSS - 32**	**2.0**	**A-7-6 (40)**	**FAT CLAY(CH)**
⊙	**LSS - 33**	**2.0**	**A-7-6 (37)**	**FAT CLAY(CH)**
✿	**LSS - 34**	**2.0**	**A-7-6 (43)**	**FAT CLAY(CH)**

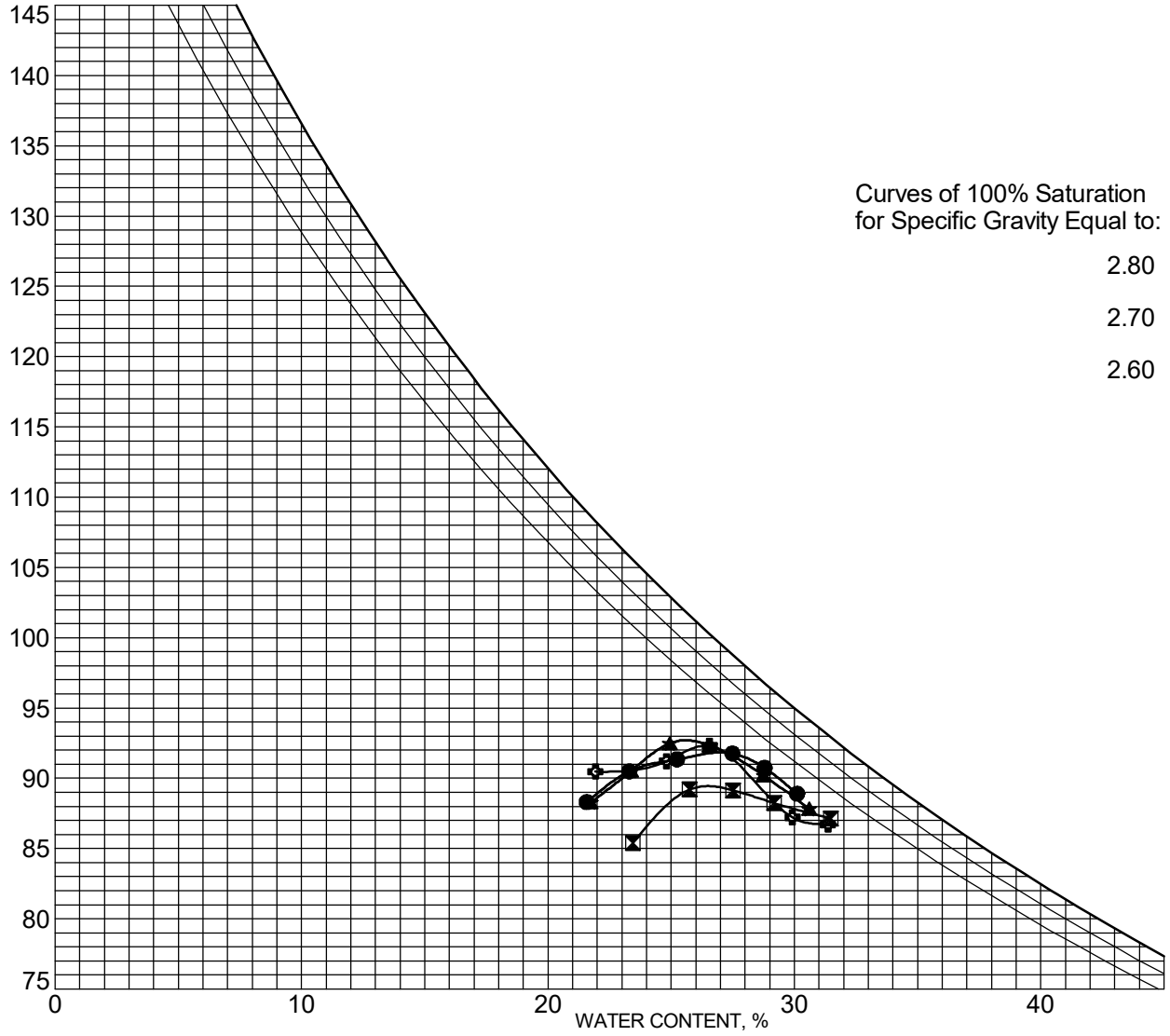
	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 29**	**2.0**	**AASHTO T-99 Method A**	**79**	**27**	**52**	**88.6 PCF**	**29.1 %**
⊠	**LSS - 30**	**2.0**	**AASHTO T-99 Method A**	**76**	**26**	**50**	**88.6 PCF**	**29.1 %**
▲	**LSS - 31**	**2.0**	**AASHTO T-99 Method A**	**79**	**26**	**53**	**91.8 PCF**	**27.0 %**
★	**LSS - 32**	**2.0**	**AASHTO T-99 Method A**	**63**	**24**	**39**	**92.4 PCF**	**26.4 %**
⊙	**LSS - 33**	**2.0**	**AASHTO T-99 Method A**	**62**	**24**	**38**	**92.4 PCF**	**26.4 %**
✿	**LSS - 34**	**2.0**	**AASHTO T-99 Method A**	**69**	**25**	**44**	**92.7 PCF**	**25.5 %**

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**LSS - 35**	**2.0**	**A-7-6 (53)**	**FAT CLAY(CH)**
⊠	**LSS - 36**	**2.0**	**A-7-6 (50)**	**FAT CLAY(CH)**
▲	**LSS - 37**	**2.0**	**A-7-6 (38)**	**FAT CLAY(CH)**
★	**LSS - 38**	**2.0**	**A-7-6 (50)**	**FAT CLAY(CH)**
⊙	**LSS - 39**	**2.0**	**A-7-6 (54)**	**FAT CLAY(CH)**
✿	**LSS - 40**	**2.0**	**A-7-6 (43)**	**FAT CLAY(CH)**

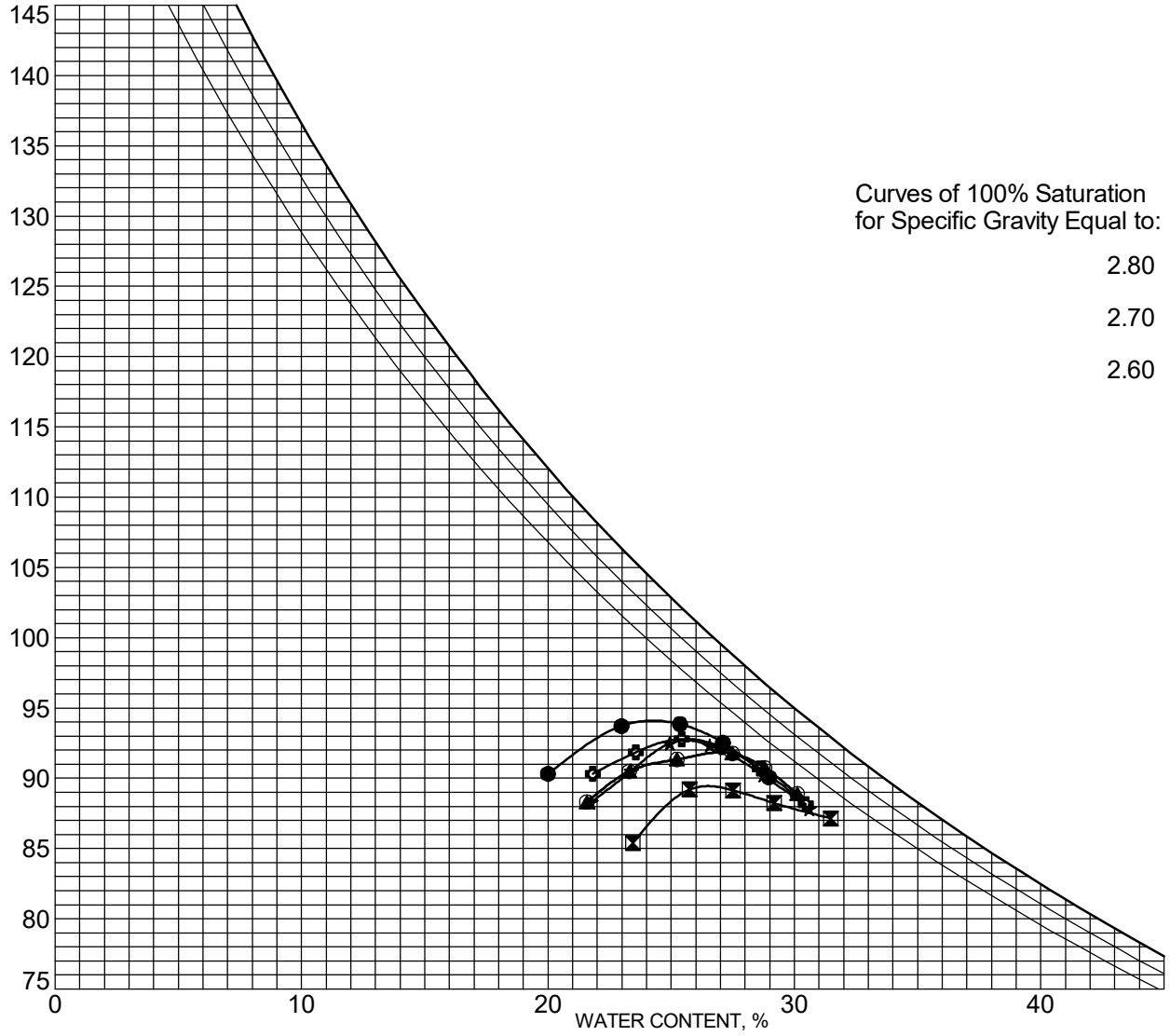
BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 35**	**2.0**	**AASHTO T-99 Method A**	**76**	**26**	**50**	**91.8 PCF**	**27.0 %**
⊠	**LSS - 36**	**2.0**	**AASHTO T-99 Method A**	**72**	**26**	**46**	**89.5 PCF**	**26.5 %**
▲	**LSS - 37**	**2.0**	**AASHTO T-99 Method A**	**64**	**25**	**39**	**92.7 PCF**	**25.5 %**
★	**LSS - 38**	**2.0**	**AASHTO T-99 Method A**	**71**	**25**	**46**	**92.7 PCF**	**25.5 %**
⊙	**LSS - 39**	**2.0**	**AASHTO T-99 Method A**	**78**	**26**	**52**	**91.8 PCF**	**27.0 %**
✿	**LSS - 40**	**2.0**	**AASHTO T-99 Method A**	**67**	**24**	**43**	**92.3 PCF**	**26.4 %**

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**LSS - 41**	**2.0**	**A-7-6 (37)**	**FAT CLAY(CH)**
⊠	**LSS - 42**	**2.0**	**A-7-6 (50)**	**FAT CLAY(CH)**
▲	**LSS - 43**	**2.0**	**A-7-6 (46)**	**FAT CLAY(CH)**
★	**LSS - 44**	**2.0**	**A-7-6 (35)**	**FAT CLAY(CH)**
⊙	**LSS - 45**	**2.0**	**A-7-6 (49)**	**FAT CLAY(CH)**
✿	**LSS - 46**	**2.0**	**A-7-6 (40)**	**FAT CLAY(CH)**

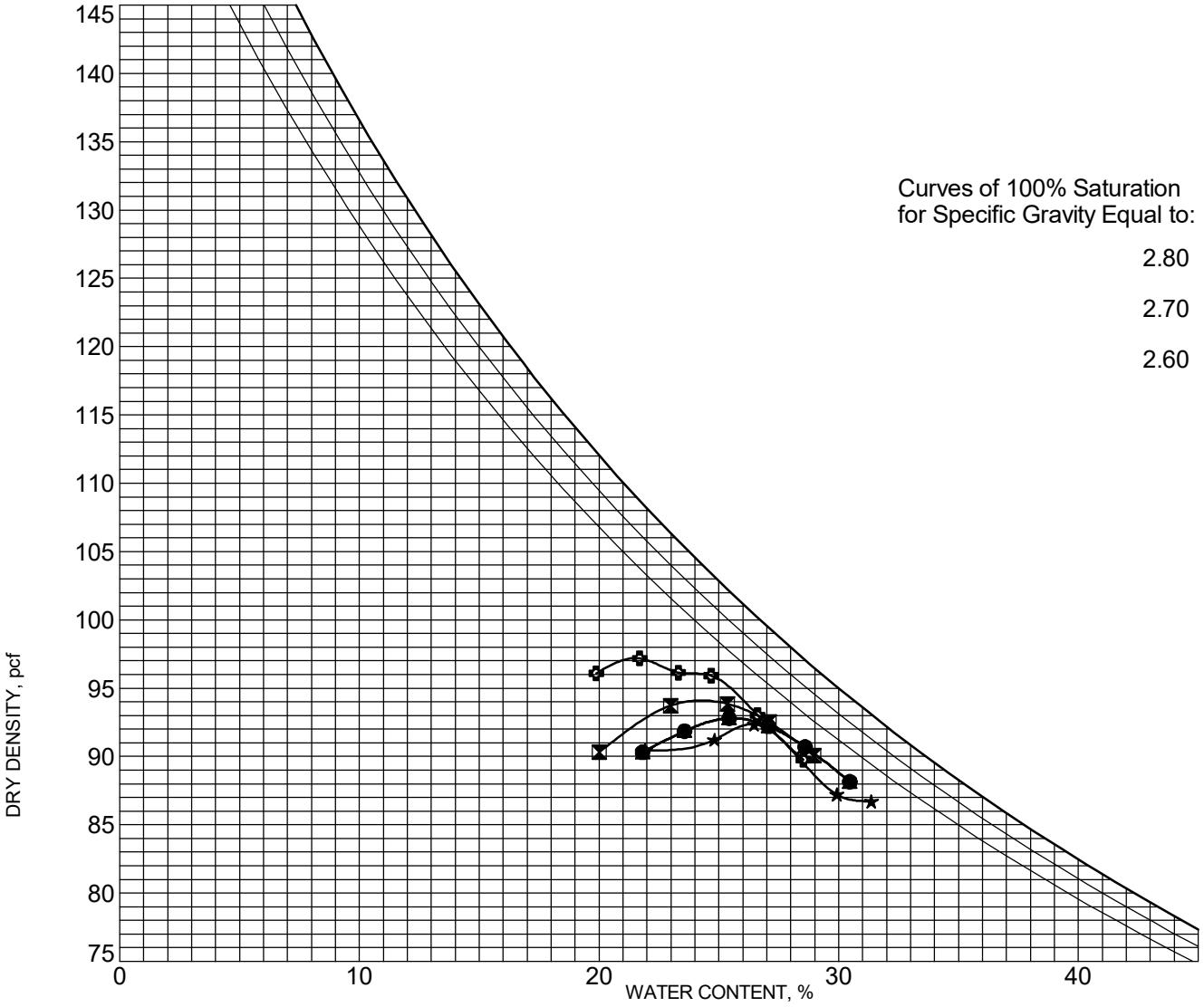
BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 41**	**2.0**	**AASHTO T-99 Method A**	**59**	**24**	**35**	**94.1 PCF**	**24.2 %**
⊠	**LSS - 42**	**2.0**	**AASHTO T-99 Method A**	**75**	**26**	**49**	**89.5 PCF**	**26.5 %**
▲	**LSS - 43**	**2.0**	**AASHTO T-99 Method A**	**71**	**26**	**45**	**91.8 PCF**	**27.0 %**
★	**LSS - 44**	**2.0**	**AASHTO T-99 Method A**	**63**	**25**	**38**	**92.7 PCF**	**25.5 %**
⊙	**LSS - 45**	**2.0**	**AASHTO T-99 Method A**	**71**	**26**	**45**	**91.8 PCF**	**27.0 %**
✿	**LSS - 46**	**2.0**	**AASHTO T-99 Method A**	**65**	**25**	**40**	**92.8 PCF**	**25.6 %**

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**LSS - 47**	**2.0**	**A-7-6 (44)**	**FAT CLAY(CH)**
⊠	**LSS - 48**	**2.0**	**A-7-6 (31)**	**FAT CLAY with SAND(CH)**
▲	**LSS - 49**	**2.0**	**A-7-6 (41)**	**FAT CLAY(CH)**
★	**LSS - 50**	**2.0**	**A-7-6 (36)**	**FAT CLAY(CH)**
⊙	**LSS - 51**	**2.0**	**A-7-6 (42)**	**FAT CLAY(CH)**
✿	**LSS - 52**	**2.0**	**A-7-6 (26)**	**FAT CLAY with SAND(CH)**

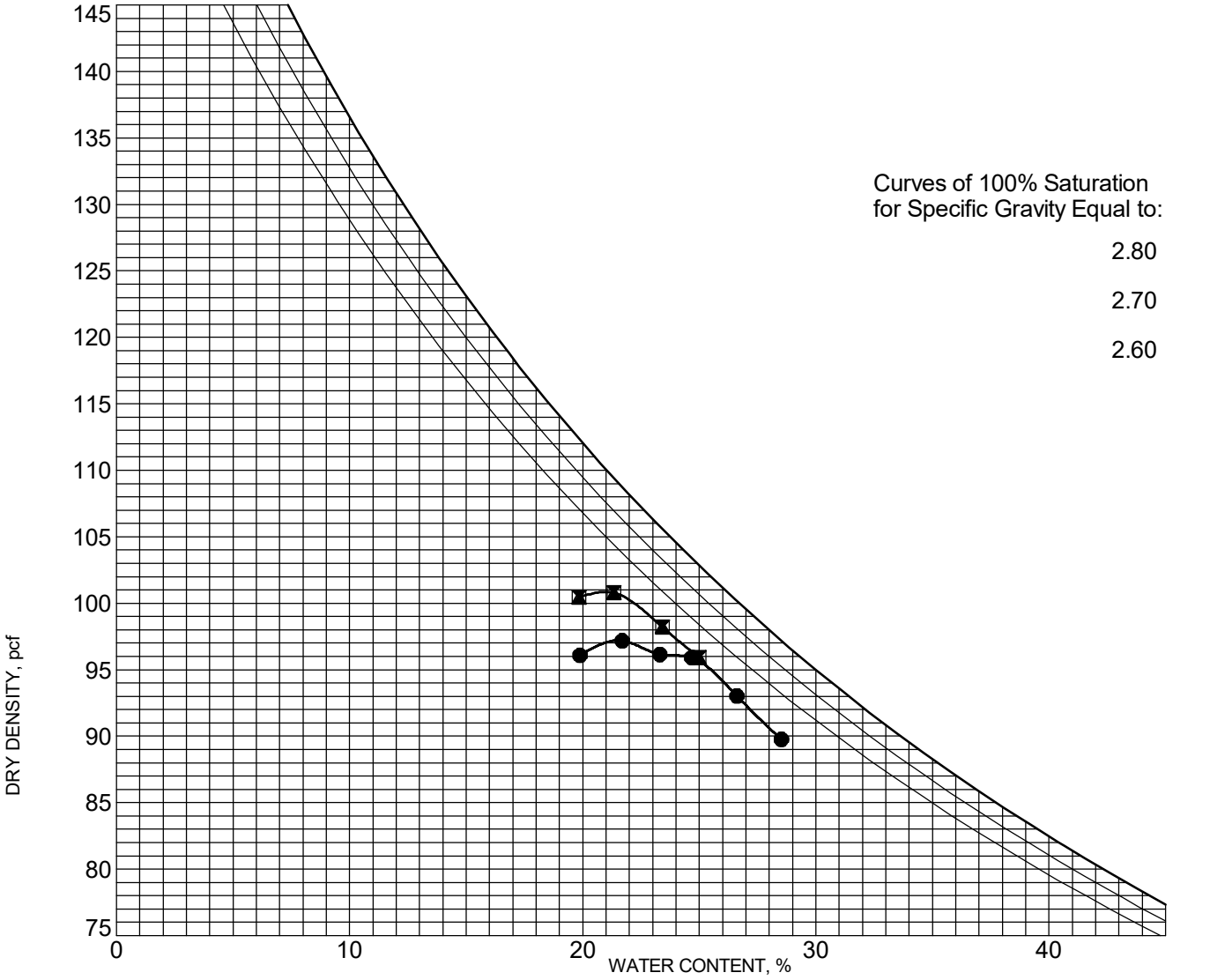
BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 47**	**2.0**	**AASHTO T-99 Method A**	**69**	**25**	**44**	**92.8 PCF**	**25.6 %**
⊠	**LSS - 48**	**2.0**	**AASHTO T-99 Method A**	**59**	**24**	**35**	**94.1 PCF**	**24.2 %**
▲	**LSS - 49**	**2.0**	**AASHTO T-99 Method A**	**64**	**23**	**41**	**92.8 PCF**	**25.6 %**
★	**LSS - 50**	**2.0**	**AASHTO T-99 Method A**	**64**	**28**	**36**	**92.4 PCF**	**26.4 %**
⊙	**LSS - 51**	**2.0**	**AASHTO T-99 Method A**	**64**	**23**	**41**	**92.8 PCF**	**25.6 %**
✿	**LSS - 52**	**2.0**	**AASHTO T-99 Method A**	**51**	**20**	**31**	**97.2 PCF**	**21.5 %**

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	**LSS - 53**	**2.0**	**A-7-6 (29)**	**FAT CLAY(CH)**
⊠	**LSS - 54**	**2.0**	**A-7-6 (21)**	**LEAN CLAY with SAND(CL)**
▲	**LSS - 55**	**2.0**	**A-7-6 (21)**	**LEAN CLAY(CL)**
★	**LSS - 56**	**2.0**	**A-7-6 (29)**	**FAT CLAY(CH)**
⊙	**LSS - 57**	**2.0**	**A-7-6 (28)**	**FAT CLAY(CH)**
✿	**LSS - 58**	**2.0**	**A-7-6 (29)**	**FAT CLAY(CH)**

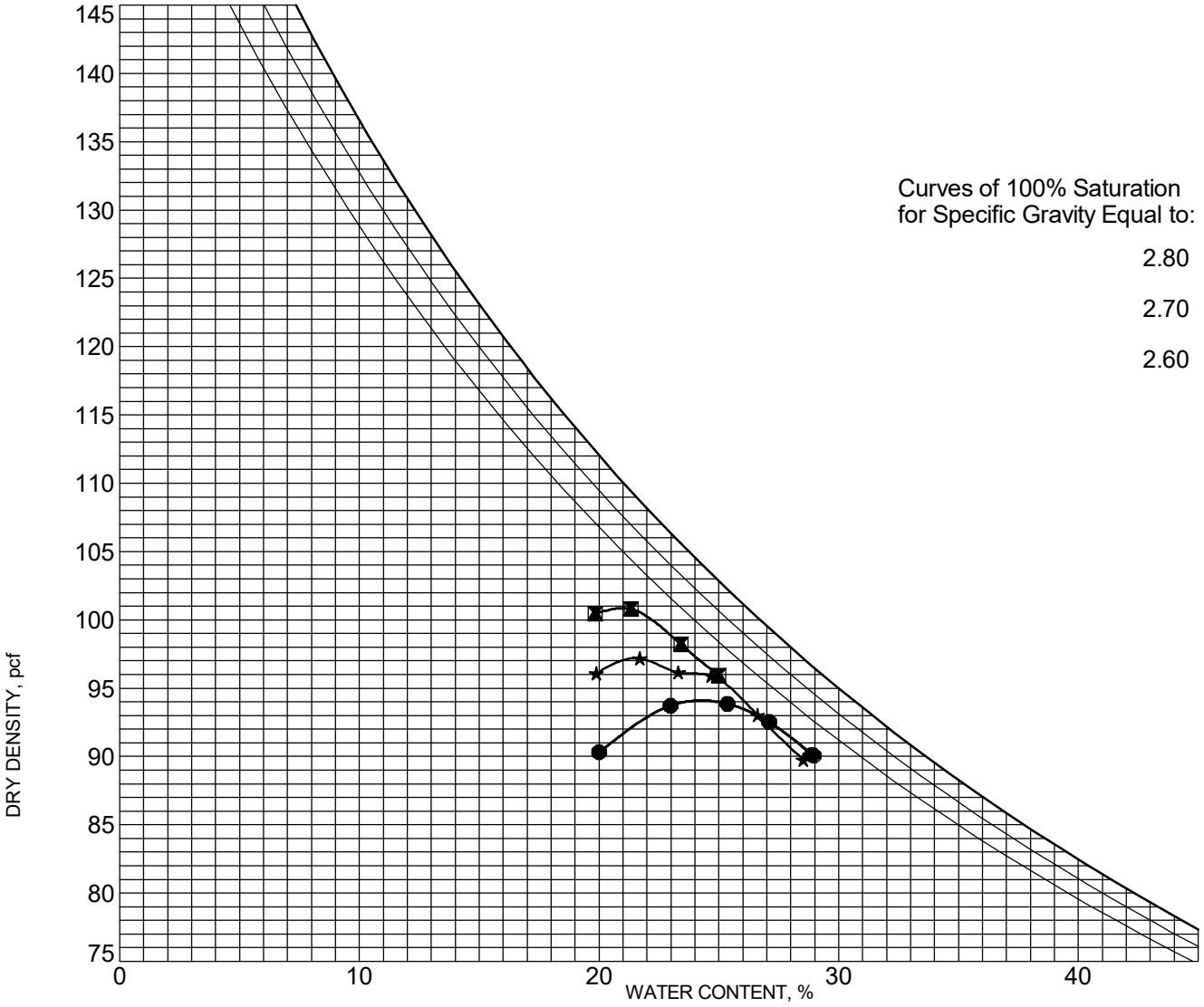
	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 53**	**2.0**	**AASHTO T-99 Method A**	**54**	**24**	**30**	**97.2 PCF**	**21.5 %**
⊠	**LSS - 54**	**2.0**	**AASHTO T-99 Method A**	**46**	**21**	**25**	**100.9 PCF**	**21.0 %**
▲	**LSS - 55**	**2.0**	**AASHTO T-99 Method A**	**44**	**20**	**24**	**100.9 PCF**	**21.0 %**
★	**LSS - 56**	**2.0**	**AASHTO T-99 Method A**	**54**	**23**	**31**	**97.2 PCF**	**21.5 %**
⊙	**LSS - 57**	**2.0**	**AASHTO T-99 Method A**	**53**	**23**	**30**	**97.2 PCF**	**21.5 %**
✿	**LSS - 58**	**2.0**	**AASHTO T-99 Method A**	**51**	**21**	**30**	**97.2 PCF**	**21.5 %**

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**LSS - 59**	**2.0**	**A-7-6 (32)**	**FAT CLAY(CH)**
⊠	**LSS - 60**	**2.0**	**A-7-6 (25)**	**LEAN CLAY(CL)**
▲	**LSS - 61**	**1.0**	**A-7-6 (27)**	**LEAN CLAY(CL)**
★	**LSS - 62**	**2.0**	**A-7-6 (27)**	**FAT CLAY with SAND(CH)**
⊙	**LSS - 63**	**2.0**	**A-7-6 (33)**	**FAT CLAY(CH)**
✪	**LSS - 64**	**1.0**	**A-7-6 (32)**	**FAT CLAY(CH)**

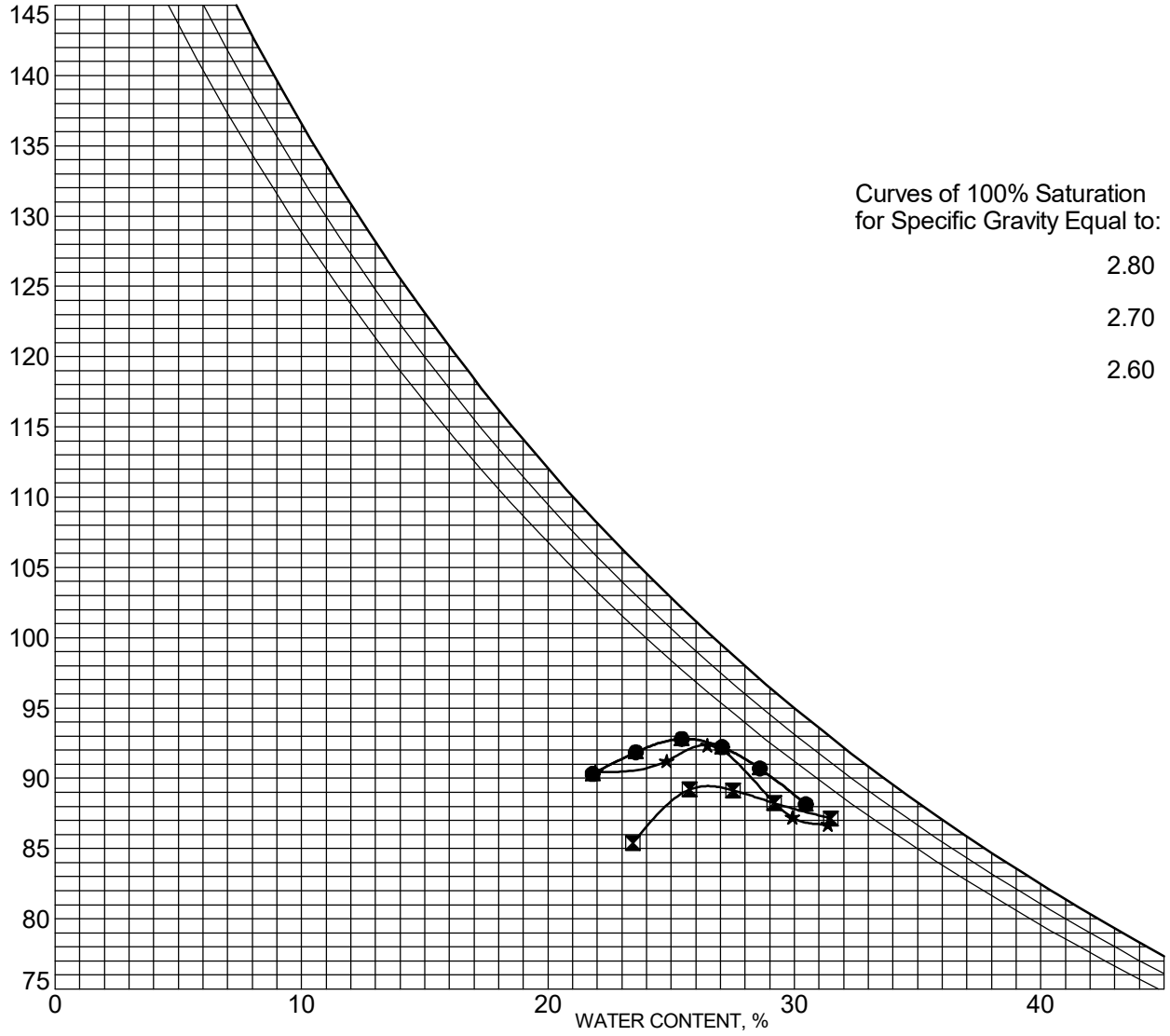
BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 59**	**2.0**	**AASHTO T-99 Method A**	**55**	**20**	**35**	**94.1 PCF**	**24.2 %**
⊠	**LSS - 60**	**2.0**	**AASHTO T-99 Method A**	**47**	**19**	**28**	**100.9 PCF**	**21.0 %**
▲	**LSS - 61**	**1.0**	**AASHTO T-99 Method A**	**46**	**20**	**26**	**100.9 PCF**	**21.0 %**
★	**LSS - 62**	**2.0**	**AASHTO T-99 Method A**	**52**	**21**	**31**	**97.2 PCF**	**21.5 %**
⊙	**LSS - 63**	**2.0**	**AASHTO T-99 Method A**	**58**	**23**	**35**	**94.1 PCF**	**24.2 %**
✪	**LSS - 64**	**1.0**	**AASHTO T-99 Method A**	**57**	**24**	**33**	**94.1 PCF**	**24.2 %**

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	**LSS - 65**	**1.0**	**A-7-6 (37)**	**FAT CLAY(CH)**
⊠	**LSS - 66**	**1.0**	**A-7-6 (39)**	**FAT CLAY with SAND(CH)**
▲	**LSS - 67**	**1.0**	**A-7-6 (39)**	**FAT CLAY(CH)**
★	**LSS - 68**	**1.0**	**A-7-6 (42)**	**FAT CLAY(CH)**

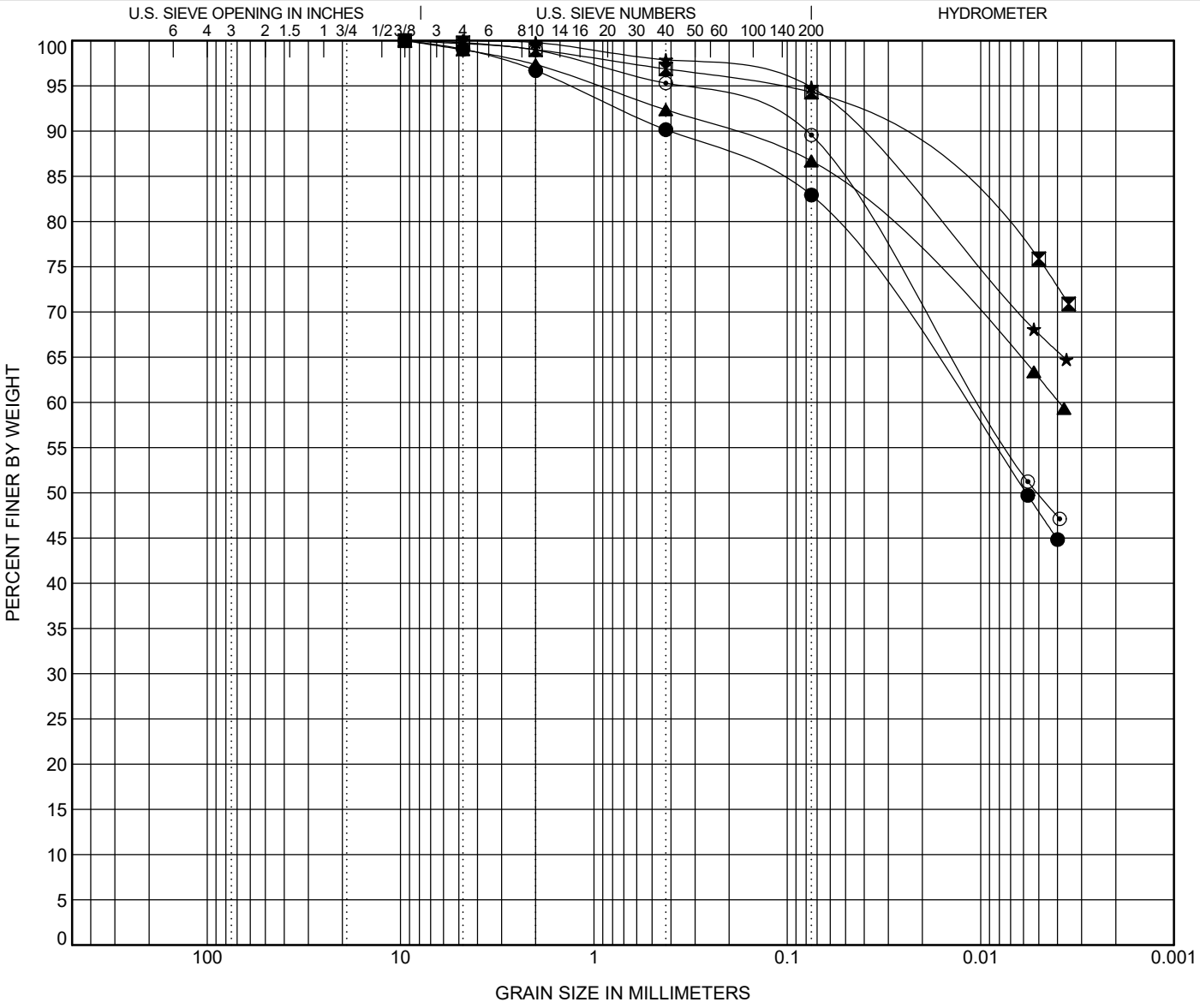
	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**LSS - 65**	**1.0**	**AASHTO T-99 Method A**	**65**	**27**	**38**	**92.8 PCF**	**25.6 %**
⊠	**LSS - 66**	**1.0**	**AASHTO T-99 Method A**	**73**	**23**	**50**	**89.5 PCF**	**26.5 %**
▲	**LSS - 67**	**1.0**	**AASHTO T-99 Method A**	**61**	**24**	**37**	**92.8 PCF**	**25.6 %**
★	**LSS - 68**	**1.0**	**AASHTO T-99 Method A**	**66**	**24**	**42**	**92.4 PCF**	**26.4 %**

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● LSS - 1	2.0	A-7-6 (30)	CH	56	22	34		
⊠ LSS - 2	2.0	A-7-6 (55)	CH	78	27	51		
▲ LSS - 3	2.0	A-7-6 (42)	CH	69	25	44		
★ LSS - 4	2.0	A-7-6 (50)	CH	70	24	46		
⊙ LSS - 5	2.0	A-7-6 (30)	CH	54	24	30		

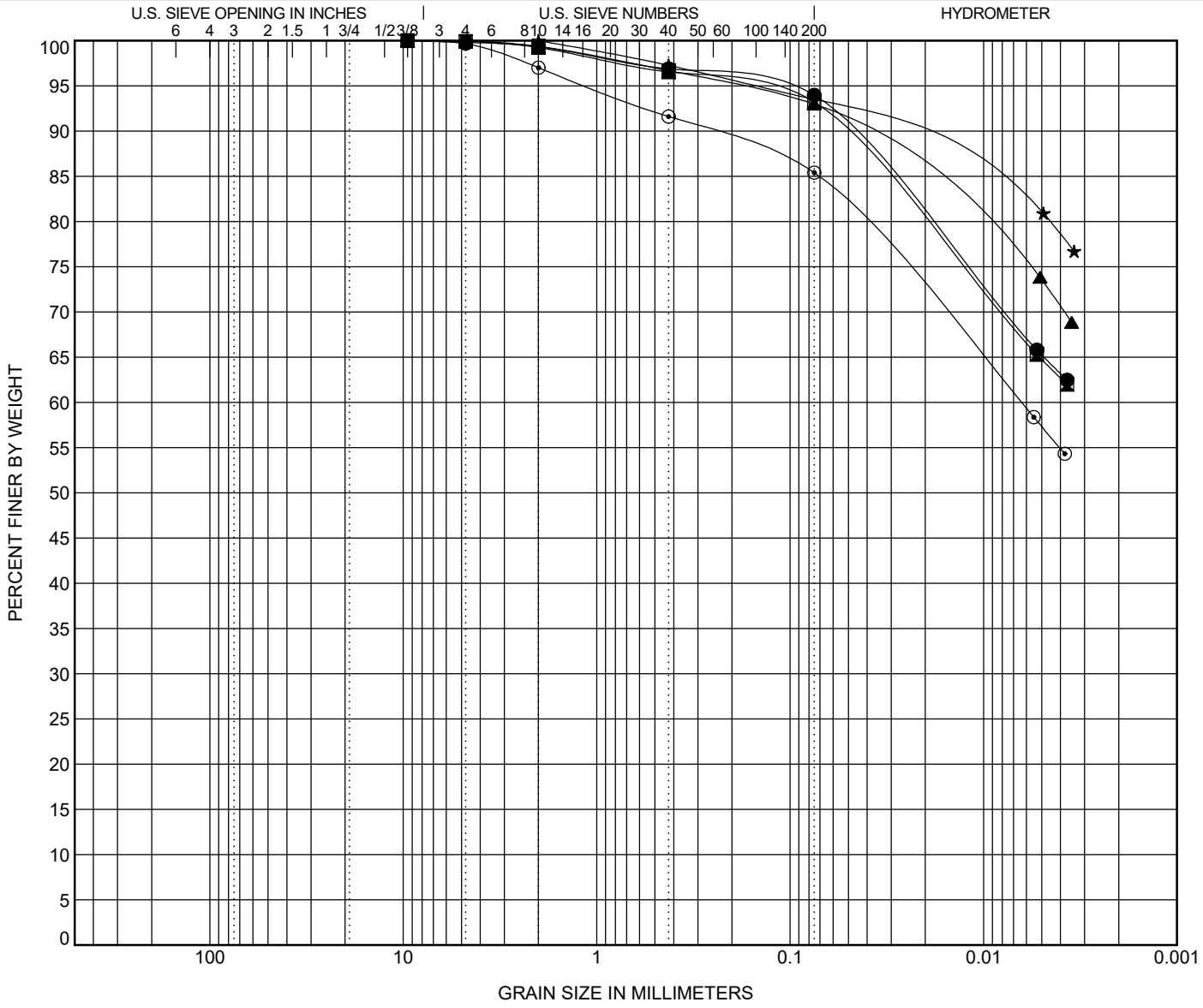
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 1	2.0	9.5	0.013			0.9	16.1	35.0	47.9
⊠ LSS - 2	2.0	9.5				0.2	5.5	18.4	75.9
▲ LSS - 3	2.0	9.5	0.004			1.0	12.3	24.0	62.7
★ LSS - 4	2.0	4.75				0.0	5.2	27.3	67.6
⊙ LSS - 5	2.0	9.5	0.01			0.3	10.1	39.7	49.8

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE		DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	**LSS - 6**	**2.0**	**A-7-6 (57)**	**CH**	**78**	**25**	**53**		
⊠	**LSS - 7**	**2.0**	**A-7-6 (53)**	**CH**	**74**	**23**	**51**		
▲	**LSS - 8**	**2.0**	**A-7-6 (58)**	**CH**	**80**	**25**	**55**		
★	**LSS - 9**	**2.0**	**A-7-6 (68)**	**CH**	**89**	**26**	**63**		
⊙	**LSS - 10**	**2.0**	**A-7-6 (39)**	**CH**	**68**	**26**	**42**		

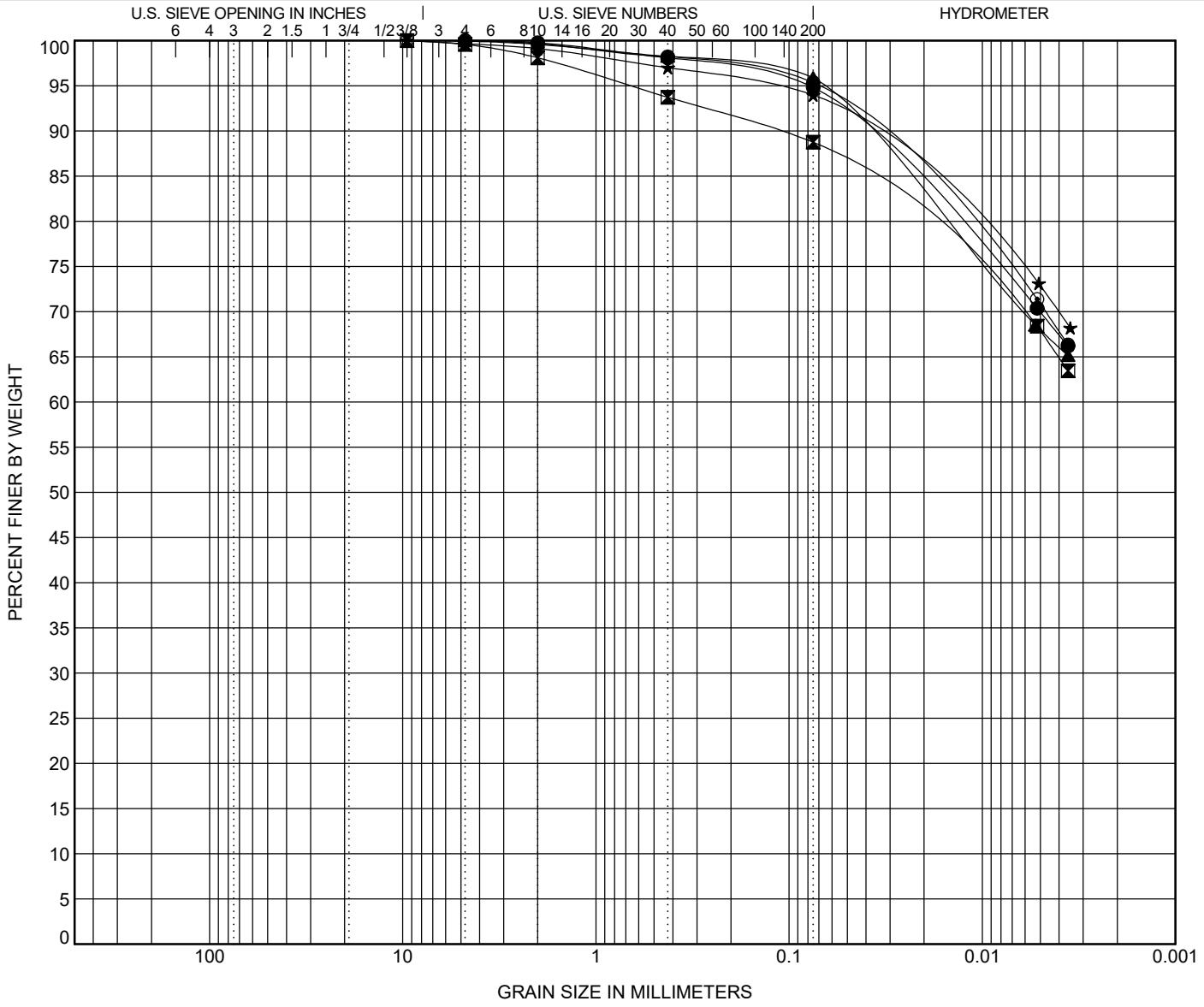
BOREHOLE		DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**LSS - 6**	**2.0**	**9.5**				**0.2**	**5.8**	**28.7**	**65.3**
⊠	**LSS - 7**	**2.0**	**9.5**				**0.1**	**6.7**	**28.5**	**64.8**
▲	**LSS - 8**	**2.0**	**9.5**				**0.0**	**7.0**	**19.4**	**73.6**
★	**LSS - 9**	**2.0**	**2**				**0.0**	**6.5**	**12.5**	**81.0**
⊙	**LSS - 10**	**2.0**	**9.5**	**0.006**			**0.3**	**14.3**	**28.1**	**57.3**

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● LSS - 11	2.0	A-7-6 (53)	CH	74	25	49		
⊠ LSS - 12	2.0	A-7-6 (47)	CH	72	25	47		
▲ LSS - 13	2.0	A-7-6 (56)	CH	75	24	51		
★ LSS - 14	2.0	A-7-6 (58)	CH	79	25	54		
⊙ LSS - 15	2.0	A-7-6 (54)	CH	76	27	49		

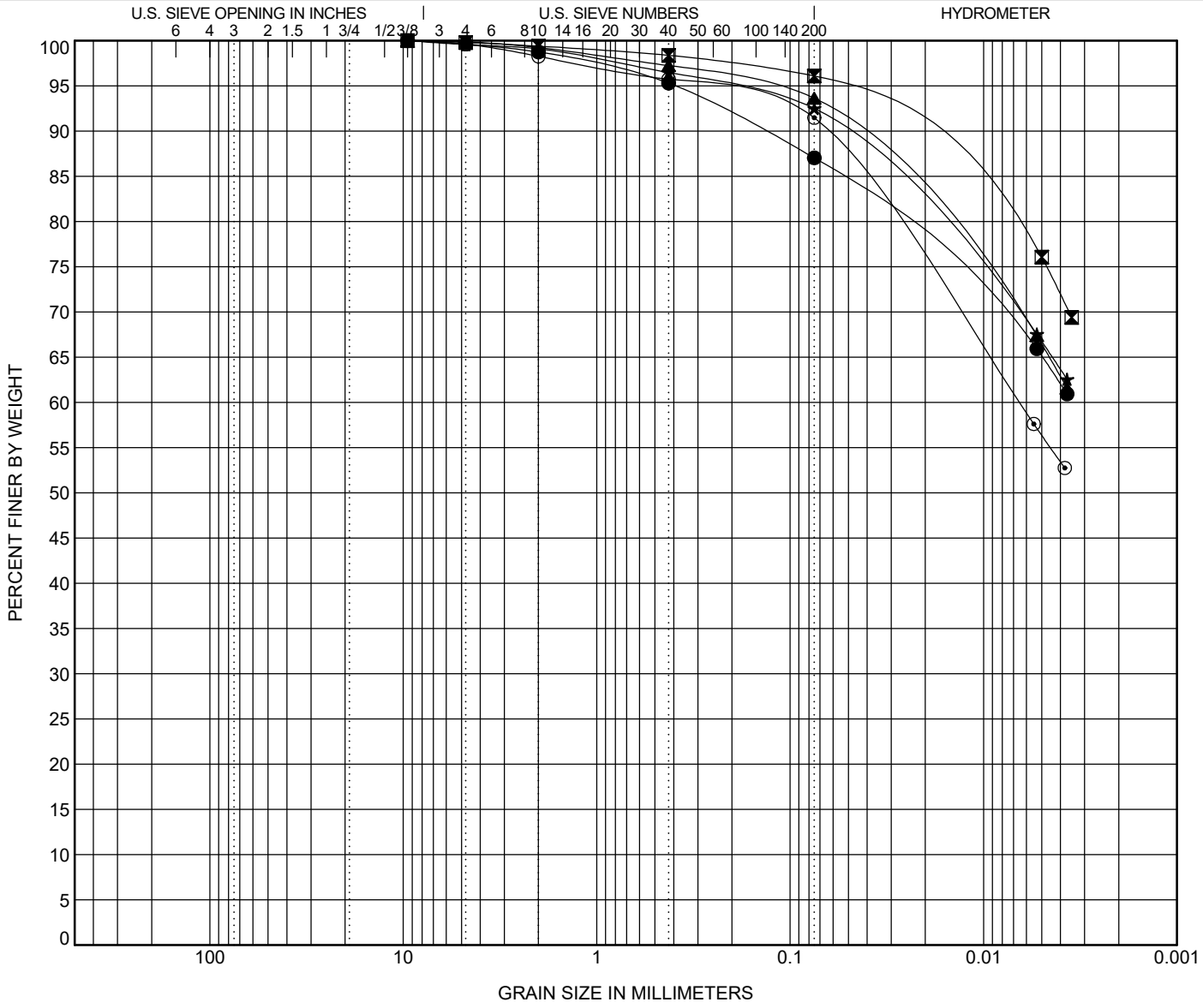
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 11	2.0	4.75				0.0	5.2	24.9	69.9
⊠ LSS - 12	2.0	9.5				0.4	10.8	20.9	67.9
▲ LSS - 13	2.0	4.75				0.0	4.1	27.9	68.0
★ LSS - 14	2.0	9.5				0.3	5.7	21.1	72.9
⊙ LSS - 15	2.0	9.5				0.1	4.6	24.5	70.8

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE		DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	**LSS - 16**	**2.0**	**A-7-6 (44)**	**CH**	**71**	**25**	**46**		
⊠	**LSS - 17**	**2.0**	**A-7-6 (56)**	**CH**	**78**	**28**	**50**		
▲	**LSS - 18**	**2.0**	**A-7-6 (46)**	**CH**	**69**	**27**	**42**		
★	**LSS - 19**	**2.0**	**A-7-6 (52)**	**CH**	**74**	**25**	**49**		
⊙	**LSS - 20**	**2.0**	**A-7-6 (40)**	**CH**	**63**	**24**	**39**		

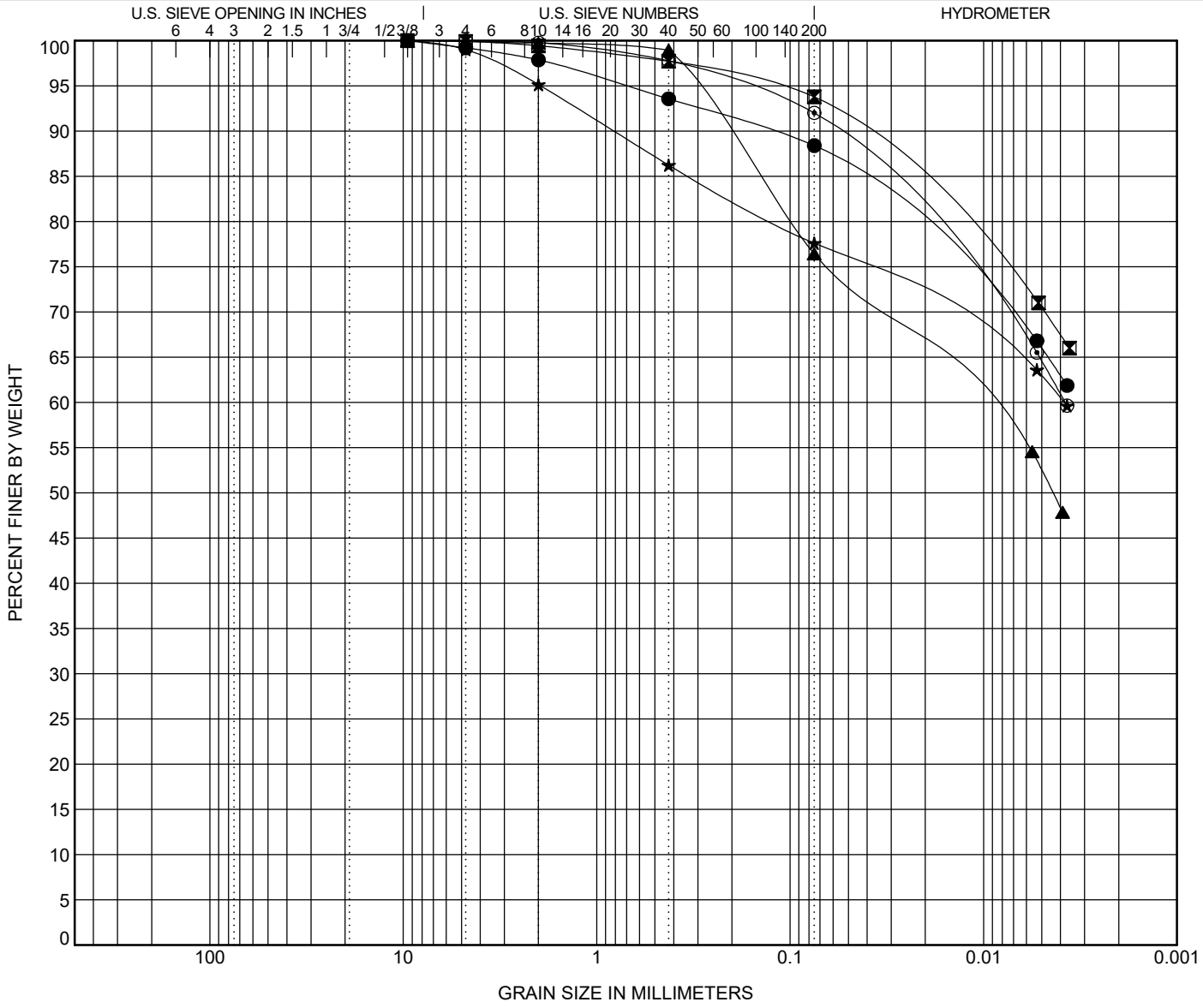
BOREHOLE		DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**LSS - 16**	**2.0**	**9.5**				**0.4**	**12.6**	**21.9**	**65.1**
⊠	**LSS - 17**	**2.0**	**9.5**				**0.2**	**3.7**	**20.0**	**76.1**
▲	**LSS - 18**	**2.0**	**9.5**				**0.1**	**6.2**	**27.2**	**66.4**
★	**LSS - 19**	**2.0**	**9.5**				**0.4**	**7.1**	**25.8**	**66.7**
⊙	**LSS - 20**	**2.0**	**9.5**	**0.007**			**0.4**	**8.1**	**35.1**	**56.4**

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	**LSS - 21**	**2.0**	**A-7-6 (43)**	**CH**	**70**	**26**	**44**		
⊠	**LSS - 22**	**2.0**	**A-7-6 (53)**	**CH**	**75**	**26**	**49**		
▲	**LSS - 23**	**2.0**	**A-7-6 (23)**	**CH**	**51**	**20**	**31**		
★	**LSS - 24**	**2.0**	**A-7-6 (36)**	**CH**	**69**	**26**	**43**		
⊙	**LSS - 25**	**2.0**	**A-7-6 (46)**	**CH**	**69**	**25**	**44**		

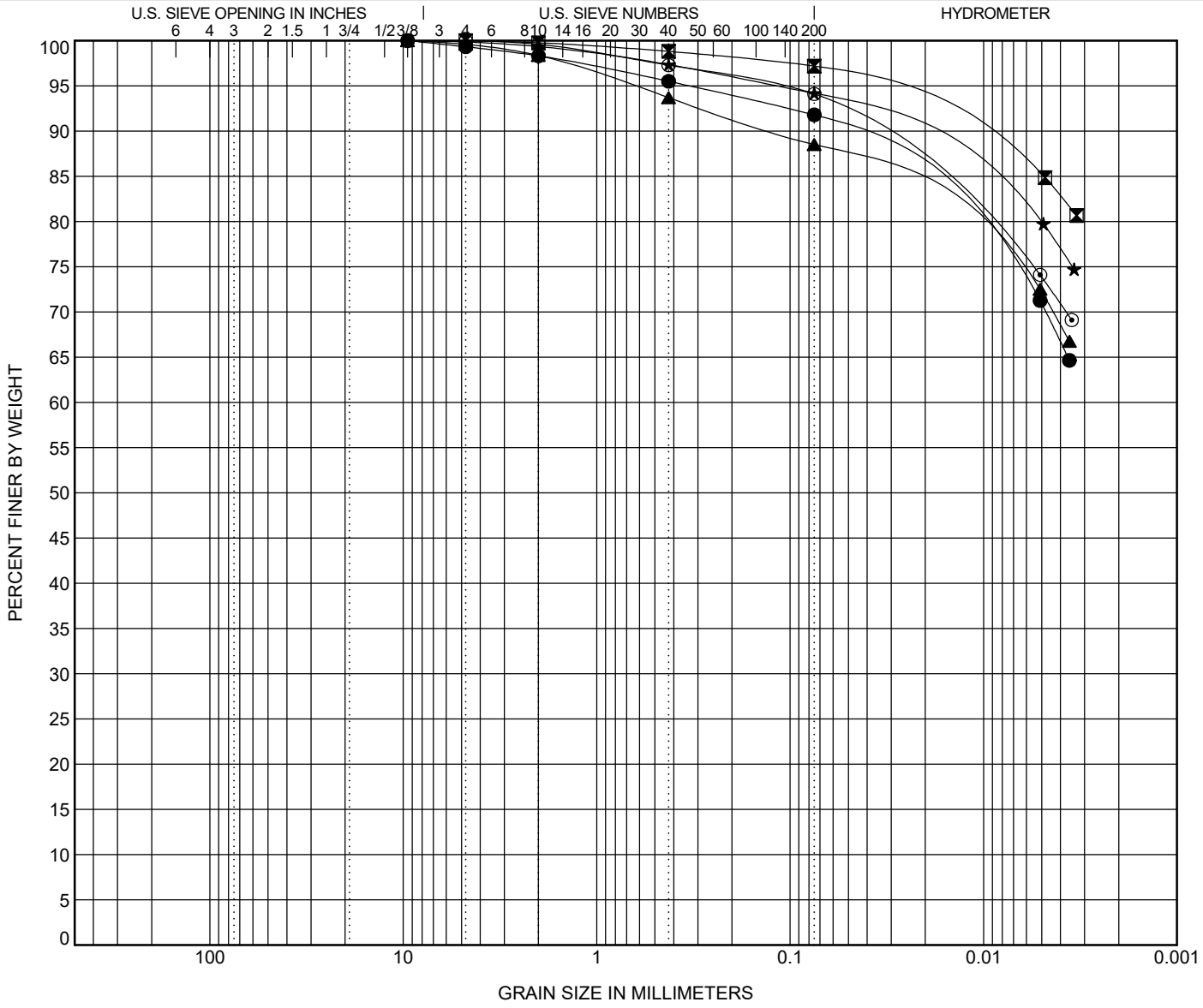
	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**LSS - 21**	**2.0**	**9.5**				**0.8**	**10.8**	**22.4**	**66.0**
⊠	**LSS - 22**	**2.0**	**9.5**				**0.1**	**6.1**	**23.3**	**70.5**
▲	**LSS - 23**	**2.0**	**9.5**	**0.011**			**0.1**	**23.5**	**24.0**	**52.4**
★	**LSS - 24**	**2.0**	**9.5**	**0.004**			**1.0**	**21.4**	**14.7**	**63.0**
⊙	**LSS - 25**	**2.0**	**4.75**	**0.004**			**0.0**	**8.0**	**27.5**	**64.6**

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● LSS - 26	2.0	A-7-6 (49)	CH	73	27	46		
⊠ LSS - 27	2.0	A-7-6 (67)	CH	88	29	59		
▲ LSS - 28	2.0	A-7-6 (46)	CH	73	27	46		
★ LSS - 29	2.0	A-7-6 (56)	CH	79	27	52		
⊙ LSS - 30	2.0	A-7-6 (54)	CH	76	26	50		

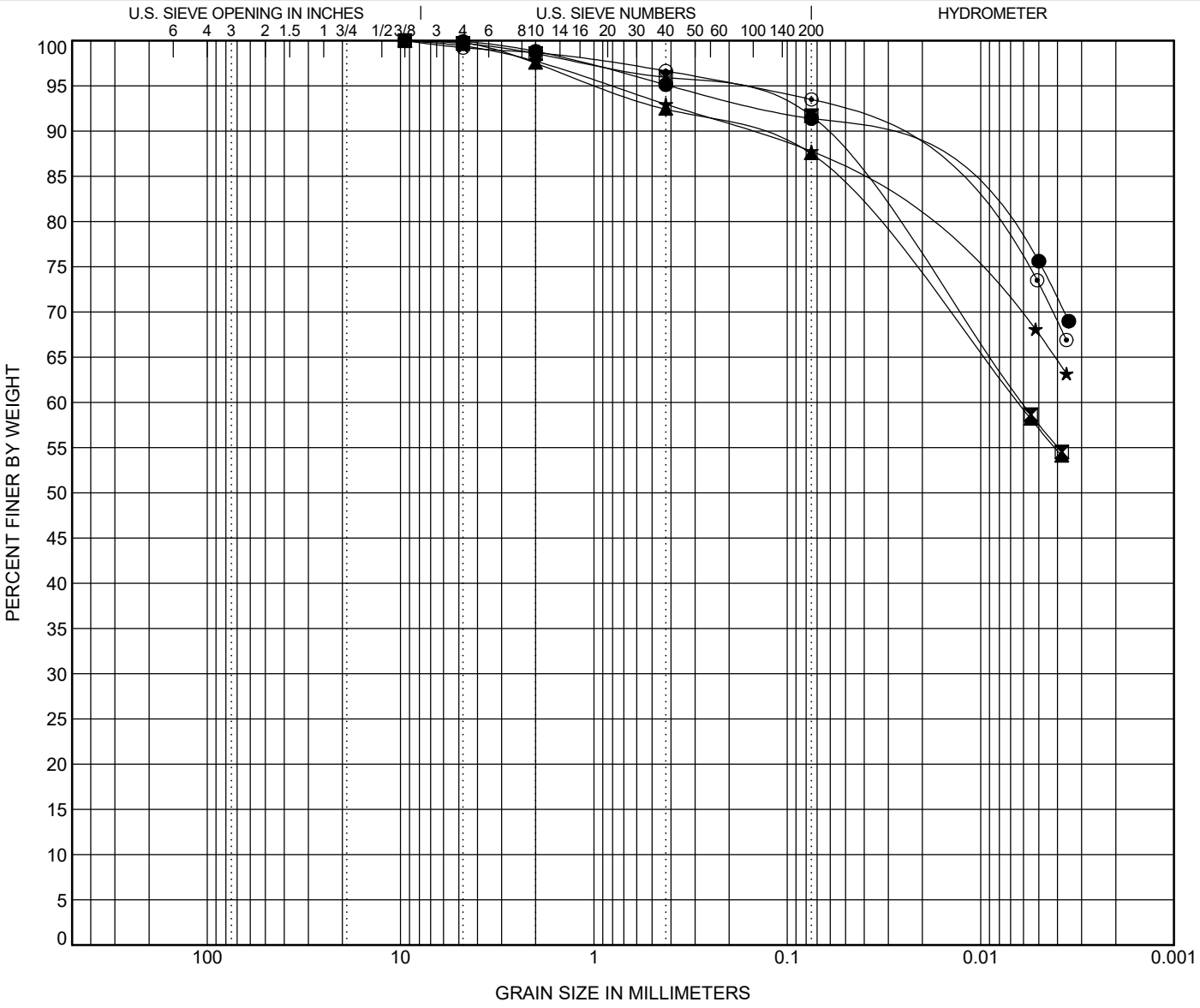
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 26	2.0	9.5				0.7	7.5	20.9	70.9
⊠ LSS - 27	2.0	4.75				0.0	2.8	12.2	85.0
▲ LSS - 28	2.0	9.5				0.4	11.1	16.3	72.2
★ LSS - 29	2.0	9.5				0.1	5.7	14.3	79.9
⊙ LSS - 30	2.0	4.75				0.0	5.9	20.3	73.8

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● LSS - 31	2.0	A-7-6 (55)	CH	79	26	53		
⊠ LSS - 32	2.0	A-7-6 (40)	CH	63	24	39		
▲ LSS - 33	2.0	A-7-6 (37)	CH	62	24	38		
★ LSS - 34	2.0	A-7-6 (43)	CH	69	25	44		
⊙ LSS - 35	2.0	A-7-6 (53)	CH	76	26	50		

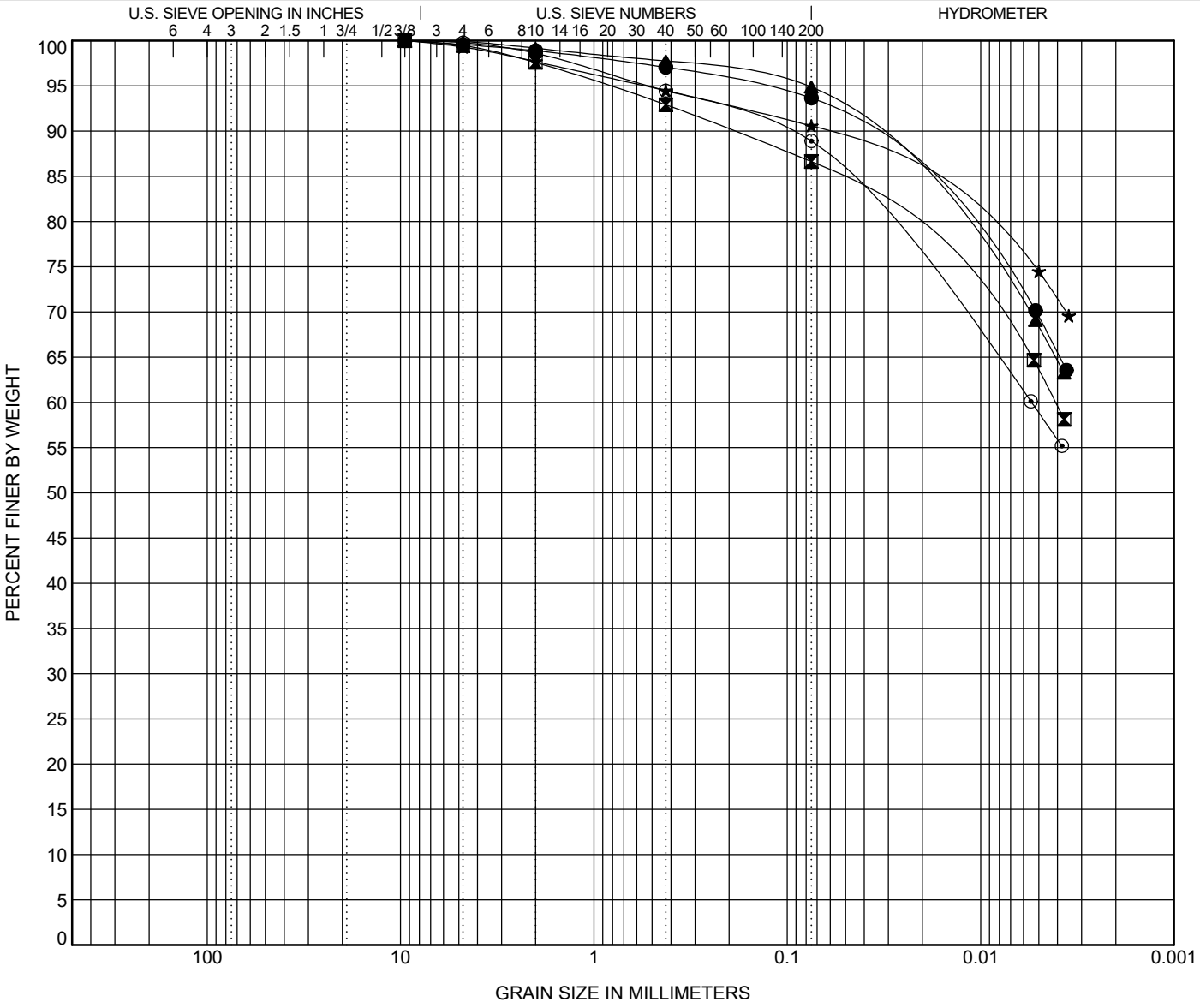
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 31	2.0	9.5				0.1	8.5	15.8	75.6
⊠ LSS - 32	2.0	9.5	0.006			0.3	8.0	34.1	57.6
▲ LSS - 33	2.0	9.5	0.006			0.2	12.3	30.4	57.1
★ LSS - 34	2.0	9.5				0.6	11.6	20.2	67.6
⊙ LSS - 35	2.0	9.5				0.8	5.7	20.4	73.1

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	**LSS - 36**	**2.0**	**A-7-6 (50)**	**CH**	**72**	**26**	**46**		
⊠	**LSS - 37**	**2.0**	**A-7-6 (38)**	**CH**	**64**	**25**	**39**		
▲	**LSS - 38**	**2.0**	**A-7-6 (50)**	**CH**	**71**	**25**	**46**		
★	**LSS - 39**	**2.0**	**A-7-6 (54)**	**CH**	**78**	**26**	**52**		
⊙	**LSS - 40**	**2.0**	**A-7-6 (43)**	**CH**	**67**	**24**	**43**		

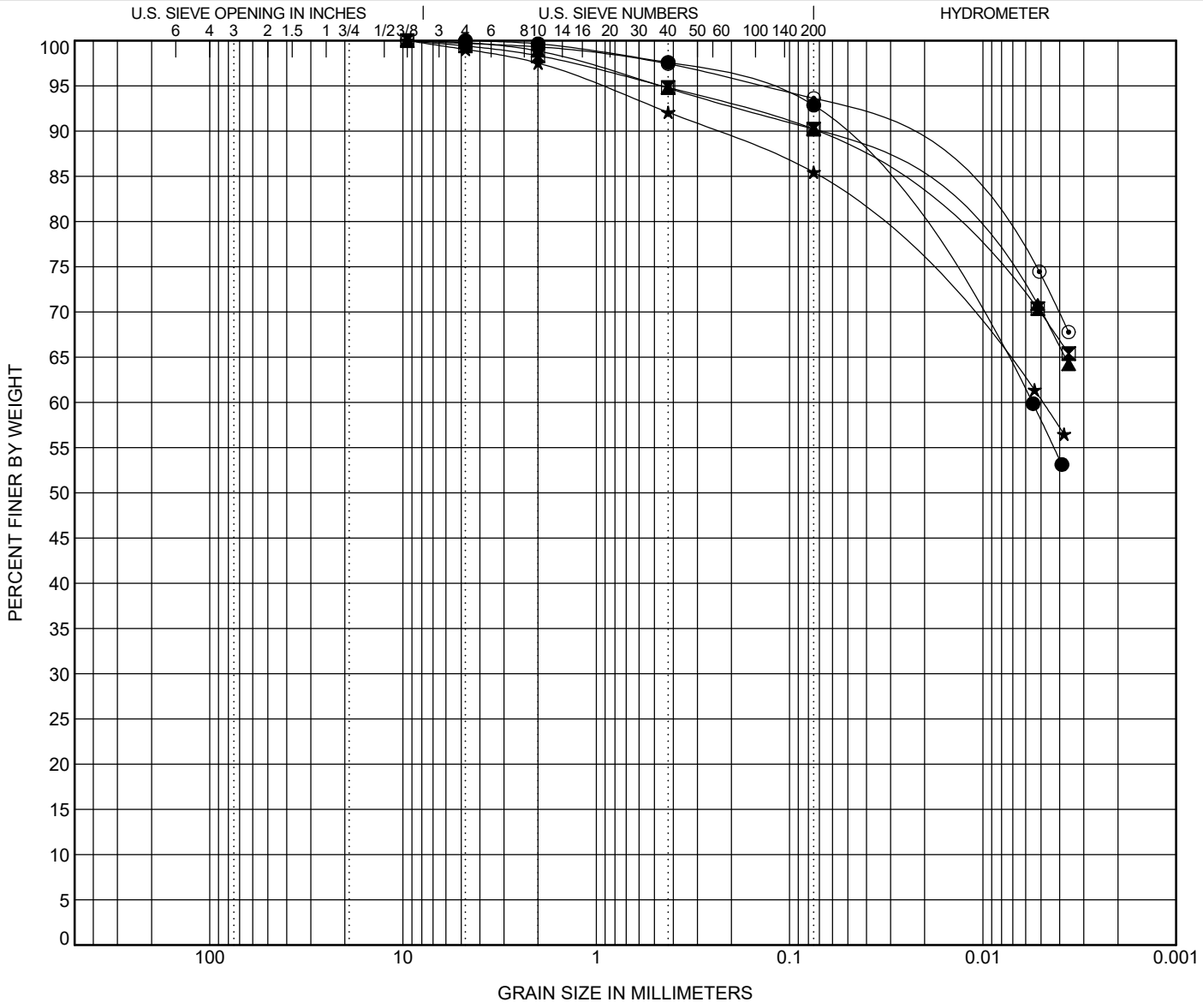
	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**LSS - 36**	**2.0**	**9.5**				**0.4**	**5.9**	**24.2**	**69.4**
⊠	**LSS - 37**	**2.0**	**9.5**	**0.004**			**0.5**	**12.8**	**23.0**	**63.6**
▲	**LSS - 38**	**2.0**	**9.5**				**0.1**	**5.0**	**26.5**	**68.4**
★	**LSS - 39**	**2.0**	**9.5**				**0.7**	**8.7**	**16.1**	**74.5**
⊙	**LSS - 40**	**2.0**	**9.5**	**0.005**			**0.2**	**10.9**	**30.1**	**58.8**

GRAIN SIZE DISTRIBUTION

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● LSS - 41	2.0	A-7-6 (37)	CH	59	24	35		
⊠ LSS - 42	2.0	A-7-6 (50)	CH	75	26	49		
▲ LSS - 43	2.0	A-7-6 (46)	CH	71	26	45		
★ LSS - 44	2.0	A-7-6 (35)	CH	63	25	38		
⊙ LSS - 45	2.0	A-7-6 (49)	CH	71	26	45		

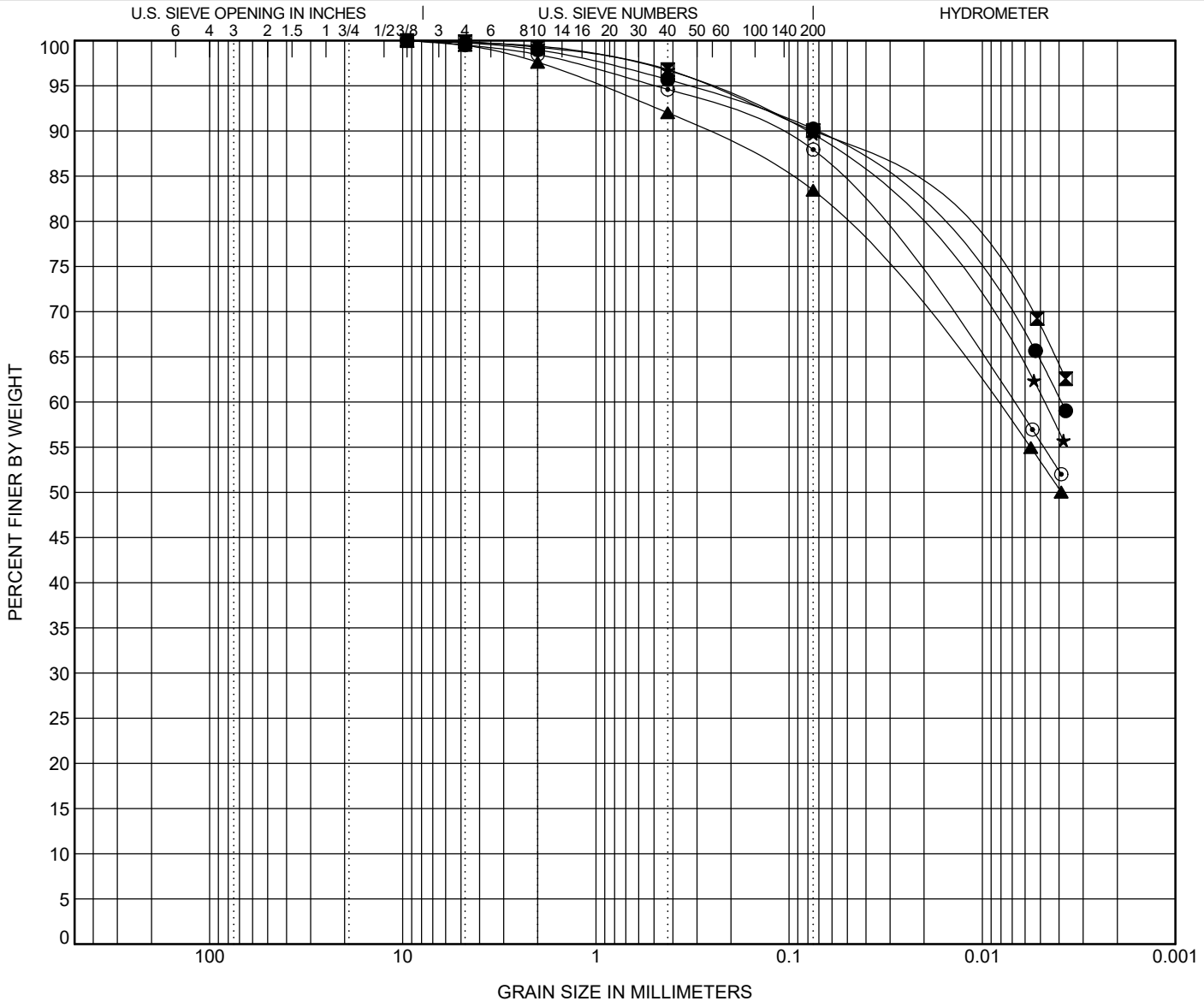
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 41	2.0	4.75	0.006			0.0	7.1	34.9	58.0
⊠ LSS - 42	2.0	9.5				0.6	9.2	20.4	69.8
▲ LSS - 43	2.0	9.5				0.2	9.6	20.1	70.1
★ LSS - 44	2.0	9.5	0.005			1.0	13.6	25.1	60.3
⊙ LSS - 45	2.0	9.5				0.3	6.1	19.6	74.1

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● LSS - 46	2.0	A-7-6 (40)	CH	65	25	40		
⊠ LSS - 47	2.0	A-7-6 (44)	CH	69	25	44		
▲ LSS - 48	2.0	A-7-6 (31)	CH	59	24	35		
★ LSS - 49	2.0	A-7-6 (41)	CH	64	23	41		
⊙ LSS - 50	2.0	A-7-6 (36)	CH	64	28	36		

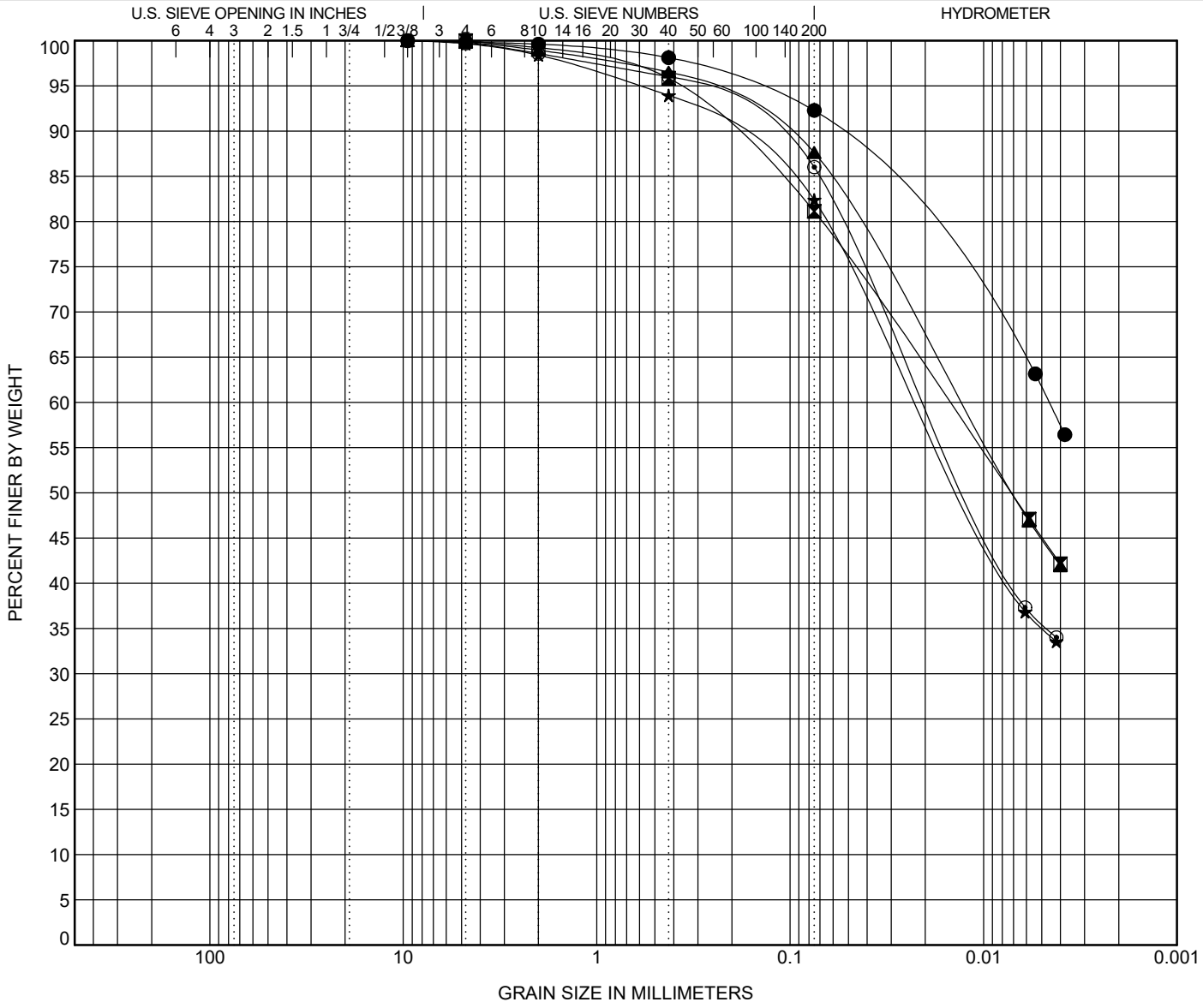
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 46	2.0	9.5	0.004			0.3	9.5	25.6	64.6
⊠ LSS - 47	2.0	9.5				0.1	9.9	21.6	68.5
▲ LSS - 48	2.0	9.5	0.009			0.5	16.0	30.0	53.4
★ LSS - 49	2.0	9.5	0.005			0.2	10.1	28.7	60.9
⊙ LSS - 50	2.0	9.5	0.007			0.5	11.6	32.4	55.6

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE		DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	**LSS - 51**	**2.0**	**A-7-6 (42)**	**CH**	**64**	**23**	**41**		
⊠	**LSS - 52**	**2.0**	**A-7-6 (26)**	**CH**	**51**	**20**	**31**		
▲	**LSS - 53**	**2.0**	**A-7-6 (29)**	**CH**	**54**	**24**	**30**		
★	**LSS - 54**	**2.0**	**A-7-6 (21)**	**CL**	**46**	**21**	**25**		
⊙	**LSS - 55**	**2.0**	**A-7-6 (21)**	**CL**	**44**	**20**	**24**		

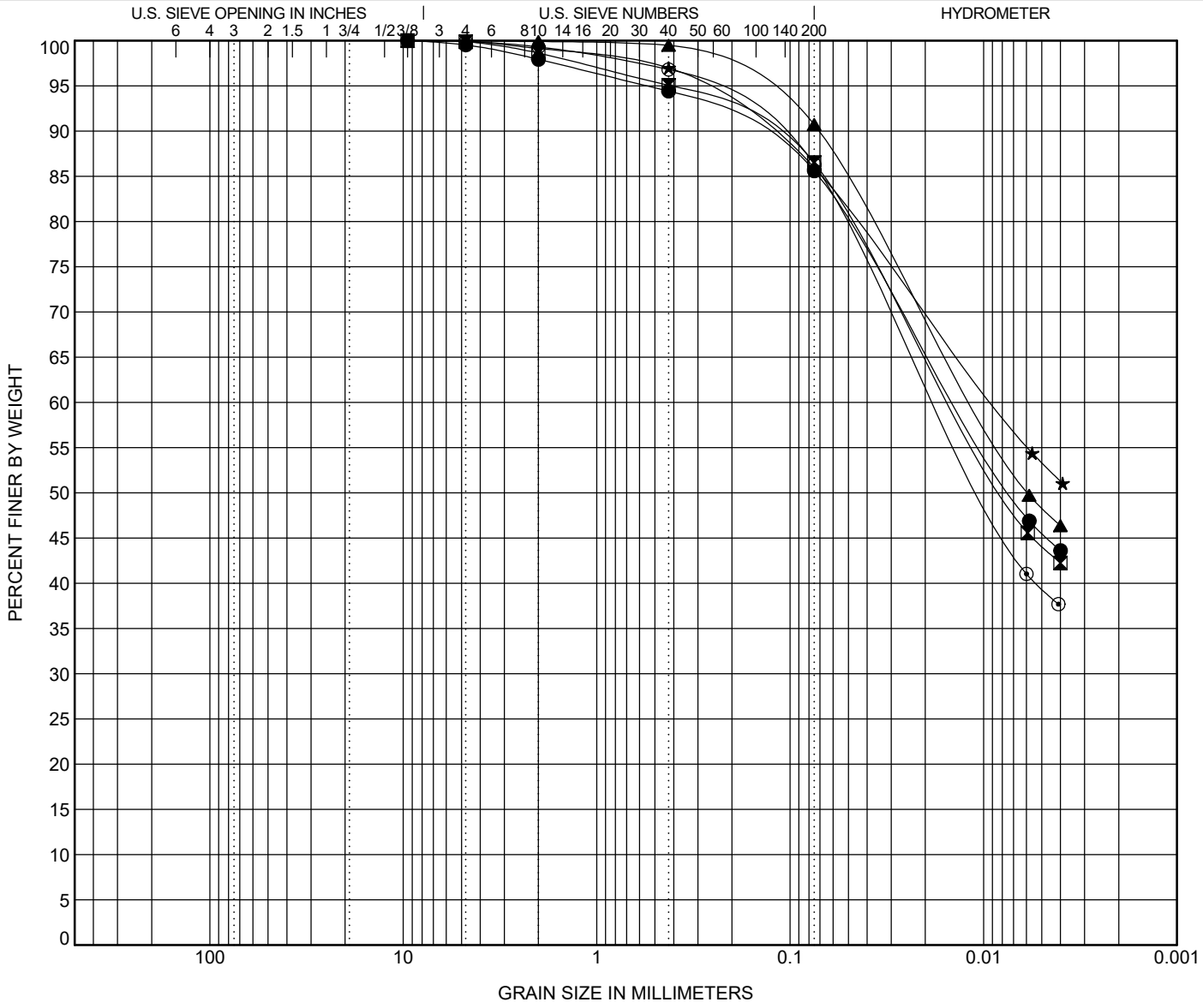
BOREHOLE		DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**LSS - 51**	**2.0**	**9.5**	**0.005**			**0.1**	**7.6**	**30.6**	**61.7**
⊠	**LSS - 52**	**2.0**	**4.75**	**0.015**			**0.0**	**18.9**	**36.0**	**45.1**
▲	**LSS - 53**	**2.0**	**9.5**	**0.013**			**0.2**	**12.2**	**42.7**	**44.9**
★	**LSS - 54**	**2.0**	**9.5**	**0.022**			**0.3**	**17.3**	**47.3**	**35.1**
⊙	**LSS - 55**	**2.0**	**9.5**	**0.02**			**0.3**	**13.7**	**50.5**	**35.6**

GRAIN SIZE DISTRIBUTION

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	**LSS - 56**	**2.0**	**A-7-6 (29)**	**CH**	**54**	**23**	**31**		
⊠	**LSS - 57**	**2.0**	**A-7-6 (28)**	**CH**	**53**	**23**	**30**		
▲	**LSS - 58**	**2.0**	**A-7-6 (29)**	**CH**	**51**	**21**	**30**		
★	**LSS - 59**	**2.0**	**A-7-6 (32)**	**CH**	**55**	**20**	**35**		
⊙	**LSS - 60**	**2.0**	**A-7-6 (25)**	**CL**	**47**	**19**	**28**		

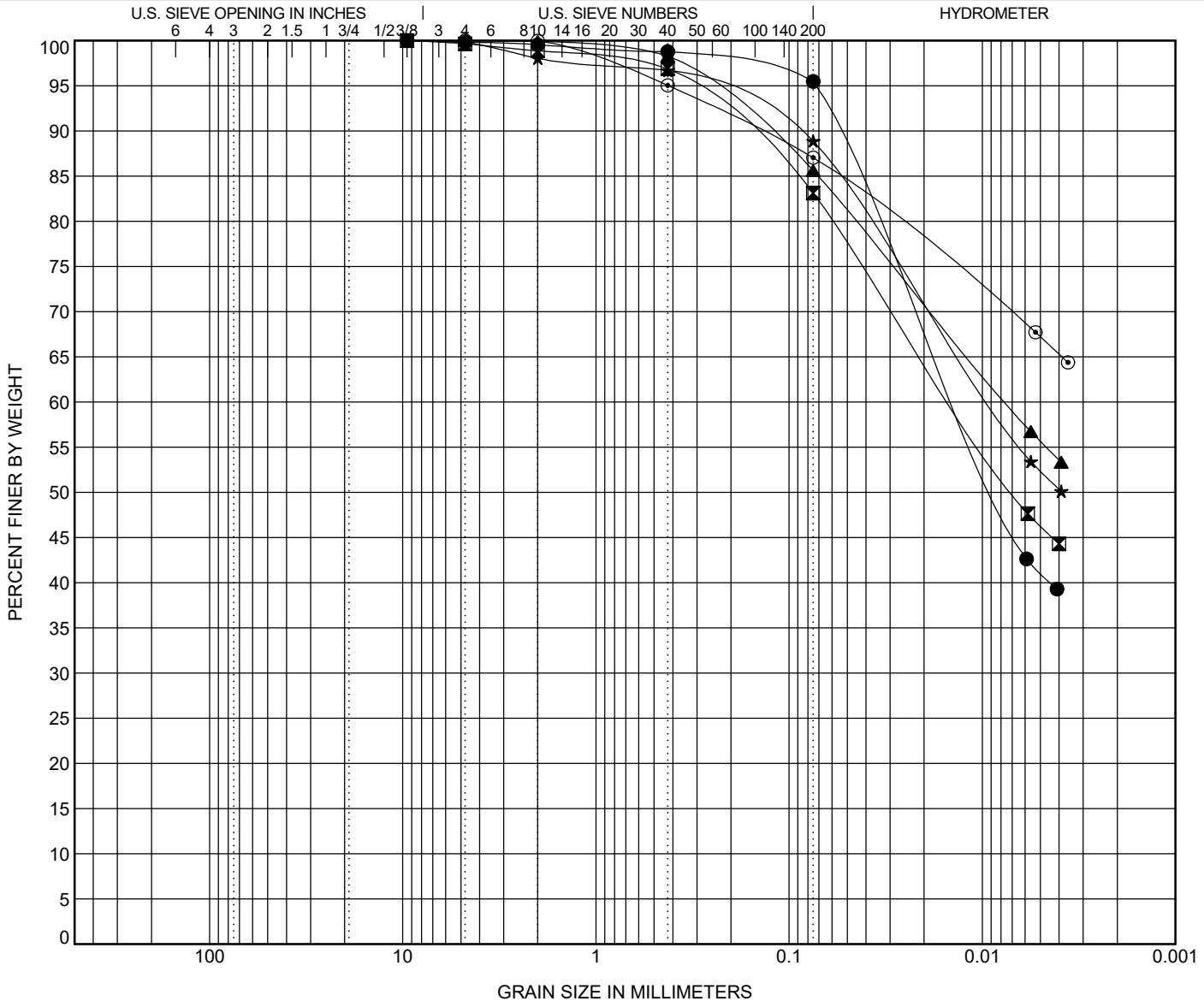
	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**LSS - 56**	**2.0**	**9.5**	**0.014**			**0.5**	**13.9**	**40.0**	**45.6**
⊠	**LSS - 57**	**2.0**	**9.5**	**0.014**			**0.1**	**13.4**	**42.3**	**44.2**
▲	**LSS - 58**	**2.0**	**4.75**	**0.011**			**0.0**	**9.3**	**42.3**	**48.4**
★	**LSS - 59**	**2.0**	**9.5**	**0.009**			**0.1**	**14.0**	**32.6**	**53.3**
⊙	**LSS - 60**	**2.0**	**9.5**	**0.017**			**0.1**	**13.6**	**46.9**	**39.4**

GRAIN SIZE DISTRIBUTION

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	LSS - 61	1.0	A-7-6 (27)	CL	46	20	26		
⊠	LSS - 62	2.0	A-7-6 (27)	CH	52	21	31		
▲	LSS - 63	2.0	A-7-6 (33)	CH	58	23	35		
★	LSS - 64	1.0	A-7-6 (32)	CH	57	24	33		
⊙	LSS - 65	1.0	A-7-6 (37)	CH	65	27	38		

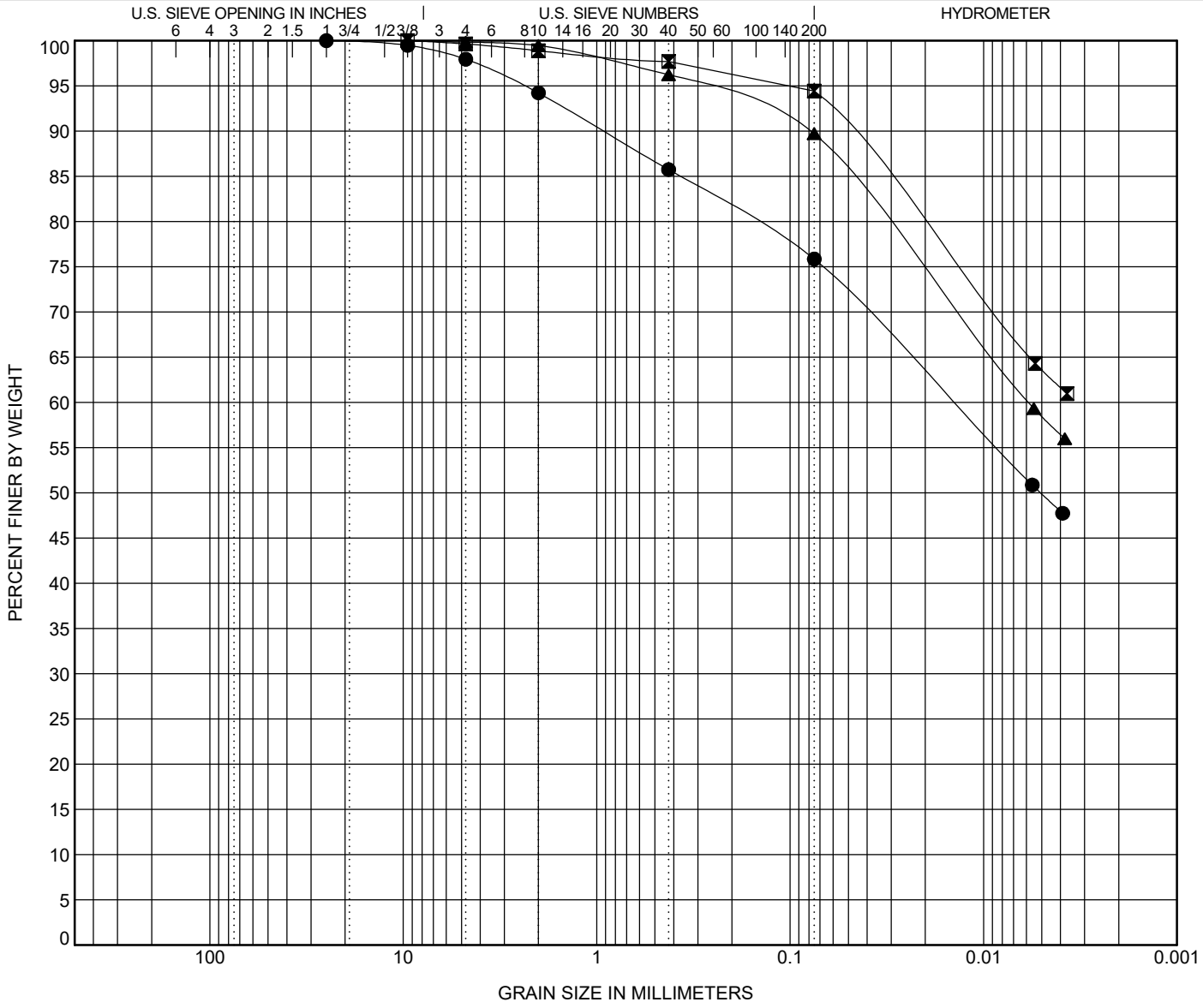
	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	LSS - 61	1.0	9.5	0.014			0.2	4.3	54.4	41.1
⊠	LSS - 62	2.0	9.5	0.014			0.4	16.5	36.8	46.3
▲	LSS - 63	2.0	4.75	0.008			0.0	14.4	30.0	55.7
★	LSS - 64	1.0	9.5	0.009			0.2	10.9	36.5	52.4
⊙	LSS - 65	1.0	4.75				0.0	13.0	19.8	67.2

GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER IM-8-029(135)088 **LOCATION** Cass County

PCN 18988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● LSS - 66	1.0	A-7-6 (39)	CH	73	23	50		
⊠ LSS - 67	1.0	A-7-6 (39)	CH	61	24	37		
▲ LSS - 68	1.0	A-7-6 (42)	CH	66	24	42		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 66	1.0	25	0.014			2.1	22.1	26.0	49.9
⊠ LSS - 67	1.0	9.5				0.4	5.2	30.8	63.6
▲ LSS - 68	1.0	9.5	0.006			0.2	10.1	31.3	58.5