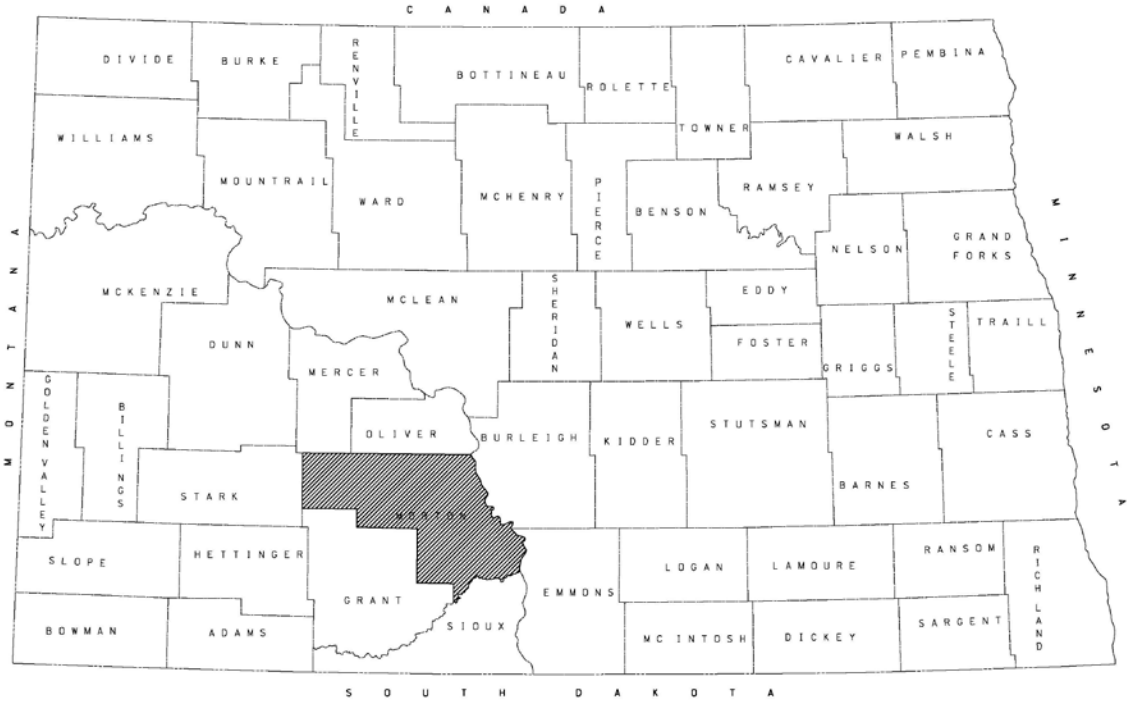
LINEAR SOILS SURVEY AND RECOMMENDATIONS

PROJECT NO. SS-NH-1-049(027)067

PCN 20677

COUNTY Morton

Glen Ullin E & N to County Line



PREPARED BY: Matthew C. Kurle, P.E.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

September 2015

SS-NH-1-049(027)067

Highway 49: Glen Ullin Bypass E & N to Morton County Line.

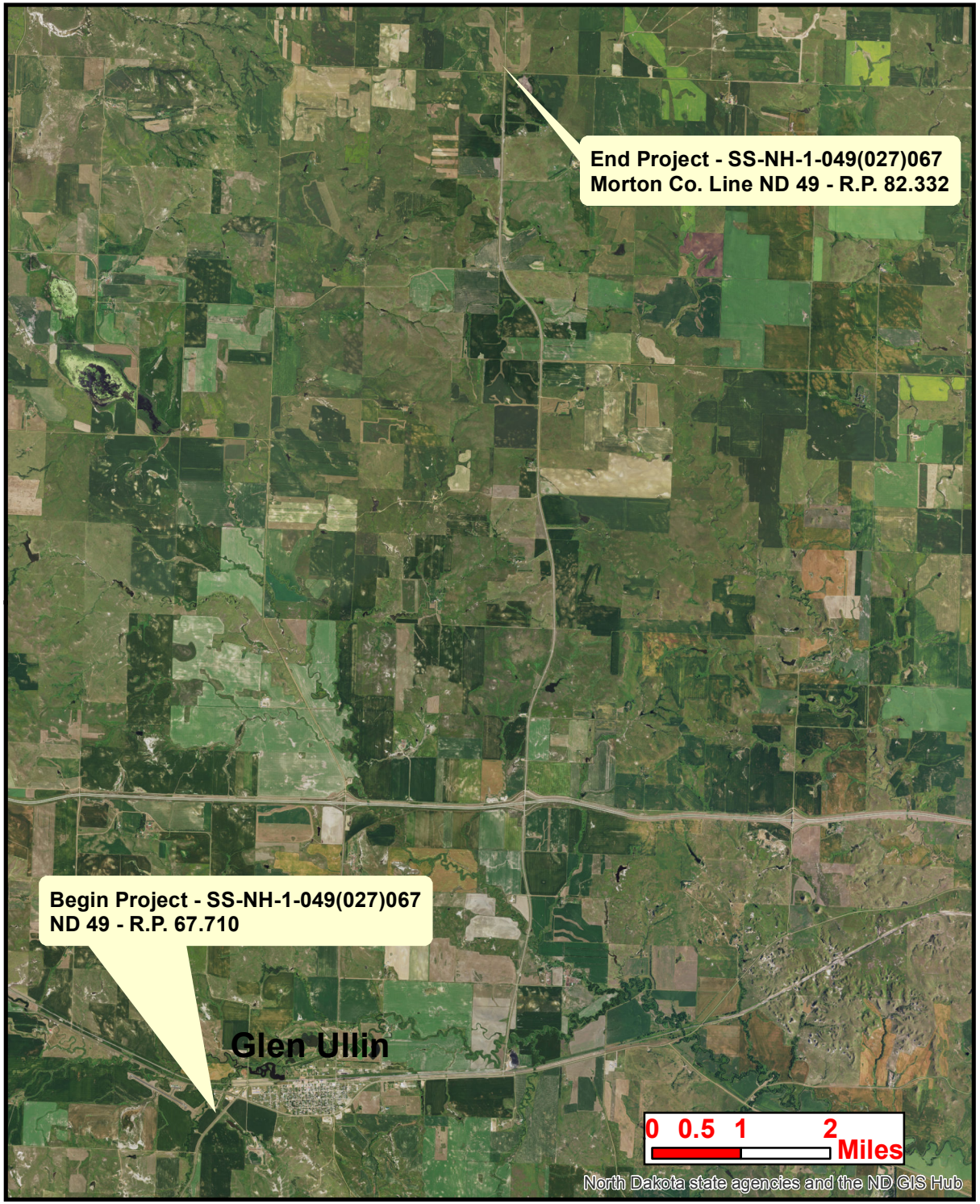
CERTIFICATION

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 Matthew C. Kurle, Registration number PE-8777 on 9/10/15 and the original document is stored at the North Dakota Department of Transportation.

REGISTERED PROFESSIONAL ENGINEER
MATTHEW C. KURLE
PE-8777
DATE 9-10-2015
NORTH DAKOTA

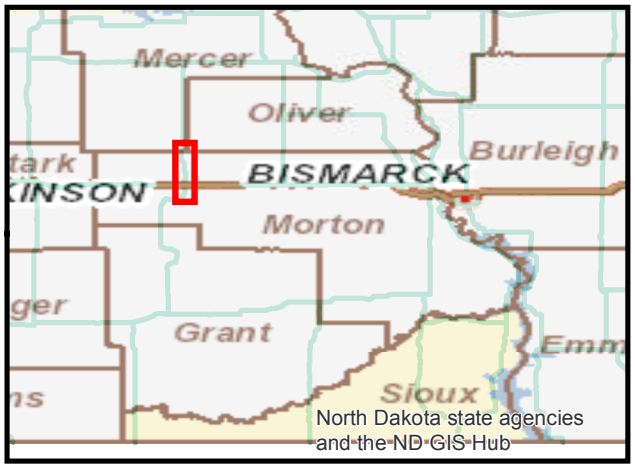
Matthew C. Kurle, P.E.

9-10-2015
Date



Linear Soils Report and Recommendation

Project: SS-NH-1-049(027)067
PCN: 20677
Scope: Widening, Sliver Grading, HBP Overlay, Guardrail, Bridge Railing
Length: 14.622 Miles
Location: Highway 49: Glen Ullin E & N to Morton County Line



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Introduction

Location: Highway 49: Glen Ullin Bypass E & N to Morton County Line.
Reference Points: 67.710 to 82.332
Project Length: 14.622
Proposed Project Scope: Widening, Sliver Grading, HBP Overlay, Guardrail, Bridge Railing
Investigation Scope: Maintenance Areas

Existing Roadway Section

Construction History

Table 1 - Construction History (RP 67.710 to RP 69.500)

Construction History				
Year	**Construction**	**Depth (in)**	**Width (ft)**	**Oil**
1945	Grade		42.0	
1945	Aggregate Base	3.5	26.0	
1945	Stabilized Base	7.0	38.0	
1945	Cold Bituminous Pavement	2.0	22.0	MC-5
1983	Hot Bituminous Pavement	2.0	27.0	120-150
1992	Contract Chip Seal		27.0	MC-3000
1997	Int Cont Patch – 1.25”		24.0	120-150
1998	Contract Chip Seal		24.0	MC-3000
2007	Hot Bituminous Pavement	1.5	1.5,24.0,1.5	PG 58-28
2010	Federal Aid Chipseal		27.0	CRS2P

Table 2 - Construction History (RP 69.500 to RP 70.856)

Construction History				
Year	**Construction**	**Depth (in)**	**Width (ft)**	**Oil**
1937	Grade		36.0	
1937	Stabilized Base	4.5	27.0	
1937	Cold Bituminous Pavement	1.5	22.0	RUBRIZD
1945	Stabilized Base	7.0	32.0	
1945	Cold Bituminous Pavement	2.0	22.0	MC-5
1978	Hot Bituminous Pavement	1.5	24.0	120-150
1985	Drive Slope Flattening			
1989	Contract Chip Seal		24.0	HFMS-2
1996	Int Cont Patch – 1.25”		24.0	120-150
1998	Contract Chip Seal		24.0	MC-3000
2007	Hot Bituminous Pavement	1.5	1.5,24.0,1.5	PG 58-28
2010	Federal Aid Chipseal		24.0	CRS2P

Table 3 - Construction History (RP 70.856 to RP 82.332)

Construction History				
Year	**Construction**	**Depth (in)**	**Width (ft)**	**Oil**
1959	Grade		38.0	
1959	Aggregate Base	3.5	36.0	
1959	Emulsified Base	3.5	34.0	SS-1
1978	Hot Bituminous Pavement	1.5	24.0	120-150
1985	Drive Slope Flattening			
1989	Contract Chip Seal		24.0	HFMS-2
1996	Int Cont Patch – 1.25”		24.0	120-150
1998	Contract Chip Seal		24.0	MC-3000
2007	Hot Bituminous Pavement	1.5	1.5,24.0,1.5	PG 58-28
2010	Federal Aid Chipseal		27.0	CRS2P

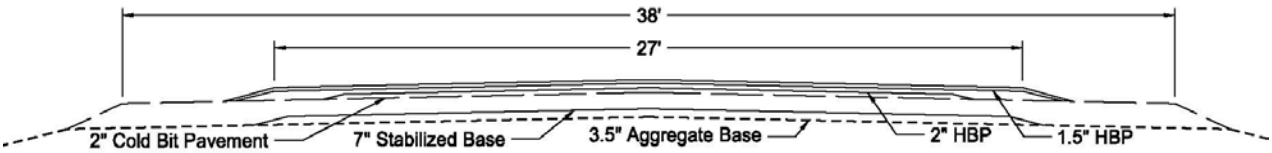


Figure 1 - Existing Typical Section (RP 67.710 to RP 69.500)

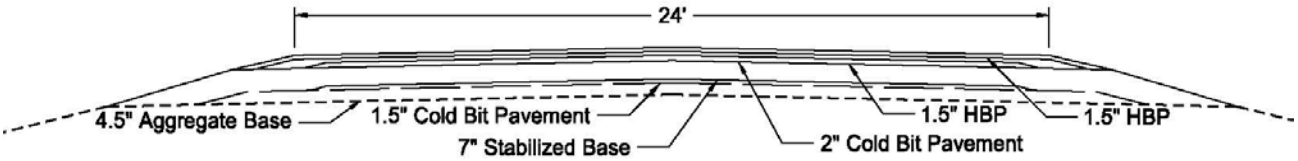


Figure 2 - Existing Typical Section (RP 69.500 to RP 70.856)

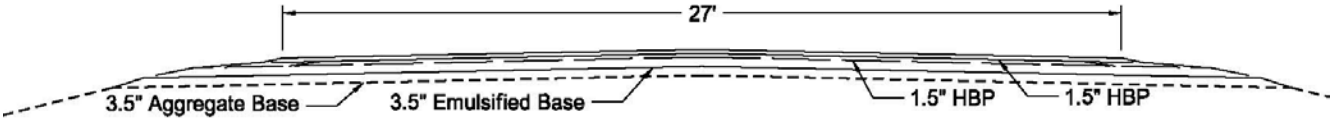


Figure 3 - Existing Typical Section (RP 70.856 to RP 82.332)

Existing Roadway Condition

Distress Data

Table 4 - Distress Data (2014)

Reference Point	Alligator Cracking (0-9)	Longitudinal Cracking (0-9)	Transverse Cracking (0-9)	Block Cracking (0-9)	Bituminous Patching (0-9)	Rutting (0-9)
67	3	0	7	0	0	0
68	0	0	4	0	6	0
69	3	1	1	0	0	0
70	0	0	7	0	6	0
71	0	1	1	0	6	0
72	0	1	4	0	6	0
73	3	1	7	0	6	0
74	0	1	4	0	6	0
75	0	1	4	0	6	0
76	3	1	1	0	6	0
77	0	1	7	0	6	0
78	3	1	4	0	6	0
79	0	1	4	0	6	0
80	3	1	1	0	6	0
81	3	0	7	0	6	0
82	3	1	7	0	6	0
Average	**1.5**	**0.75**	**4.4**	**0**	**5.25**	**0**

Ride Data

Table 5 - Ride Data (2014)

Reference Point	Distress Score		Rut (inches)		International Roughness Index (inches/mile)	
	Excellent	**≥ 98**	**Excellent**	**< 0.25**	**Excellent**	**< 61**
	Good	**88 - 97**	**Good**	**0.25 - 0.375**	**Good**	**61 - 99**
	Fair	**77 - 87**	**Fair**	**0.376 - 0.50**	**Fair**	**100 - 145**
	Poor	**≤ 76**	**Poor**	**> 0.50**	**Poor**	**>145**
67	89		0.10		112	
68	89		0.08		112	
69	94		0.08		107	
70	86		0.10		110	
71	91		0.08		110	
72	88		0.08		113	
73	82		0.09		119	
74	88		0.08		102	
75	88		0.08		110	
76	88		0.07		88	
77	85		0.08		103	
78	85		0.07		76	
79	88		0.08		107	
80	88		0.10		158	
81	83		0.11		205	
82	82		0.07		85	
Average	**87.1**		**0.08**		**113.6**	

Maintenance Review

Date of Maintenance Review: 7/16/2015
Materials and Research Person Conducting the Review: Jamie Naumann
District Maintenance Person Conducting Review: Charles Schirado – Glen Ullen

The summary of the identified maintenance areas are shown in the following table. The pavement evaluation log can be found in Appendix B.

Table 6 - Identified Maintenance Areas

Location RP + Feet	Distress Identified	Drilling Required (Yes or No)
Project Length	Depressed Transverse Cracking Spaced at approximately 20'	No
72+1766 to 72+1800	Rutting in Wheel Path (Southbound Lane) Pictures 1&2	Yes
73+0986 to 73+1200	Spalling Asphalt, Rutting in Wheel Path, Hand Patched Yearly. Picture 3	Yes
78+4730 to 78+4760	Rutting, Pushing, Shoving. Hand Patched Multiple Times per Year in Northbound Lane Lt Wheel Path. Pictures 4-6	Yes
79+4490 to 79+4800 79+5200 to 80+0280	Alligator Cracking, Rutting, Shoving, Blade Patched up to 8" in Both Lanes. Picture 7	Yes

Summary of Soil Analysis

Soil Sample Distribution

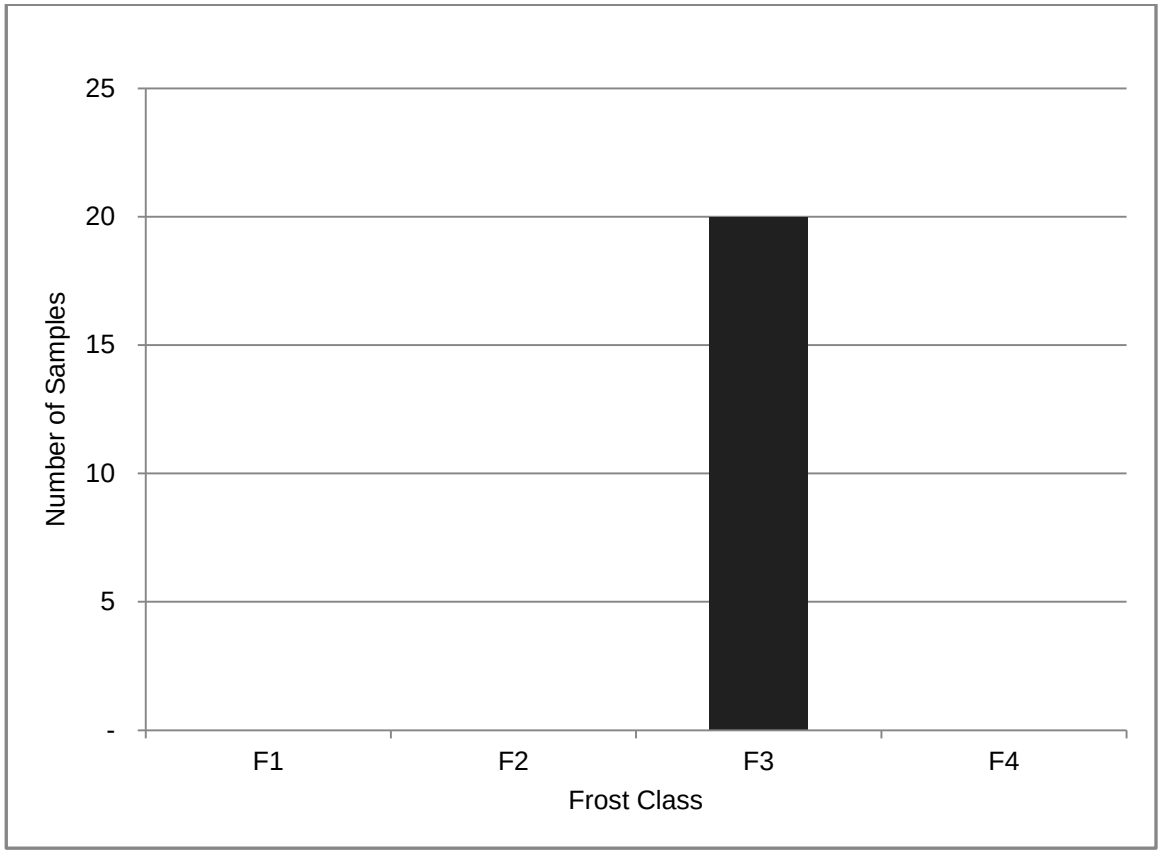


Figure 4 - Soil Sample Distribution

Moisture

The moisture contents provided in this report and summarized below have been obtained from samples taken on 7/27/15.

Table 7 - Summary of In-Place and Optimum Moisture Contents

Quantity	AASHTO Classification	In-Place Moisture Range (%)	In-Place Moisture Average (%)	T-180 Optimum Moisture Average (%)	Difference Between Average In-Place and T-180 Optimum Moistures (%)
1	A-4	-	23	12.1	10.9
6	A-6	16.1-26	20	10.9	9.1
13	A-7-6	23.6-29.5	26.7	13.8	12.9

Table 8 - Summary of In-Place versus Optimum Moisture Content

In-Place Moisture vs. Optimum Moisture						
Quantity	**AASHTO Classification**	**Below Optimum**	**Optimum to Moderate** (0 to 6% over optimum)	**Moderate to High** (6 to 10% over optimum)	**High** (10 to 16% over optimum)	**Very High** (> 16% over optimum)
1	A-4	0%	0%	0%	100%	0%
6	A-6	0%	33%	33%	33%	0%
13	A-7-6	0%	0%	0%	100%	0%

Atterberg Limits

Table 9 - Summary of Atterberg Limits

AASHTO Classification	Liquid Limit Range (%)	Liquid Limit Average (%)	Plastic Limit Range (%)	Plastic Limit Average (%)	Plasticity Index Range (%)	Plasticity Index Average (%)
A-4	-	28	-	22	-	6
A-6	28-40	36	15-19	17	11-23	18
A-7-6	41-64	50	18-26	22	22-39	28

Swell Potential

The swell potential, which is based on the Plasticity Index (PI), is shown in the following table.

Table 10 - Swell Potential

Low (Plasticity Index < 25)	**Marginal** (25 ≤ Plasticity Index ≤ 35)	**High** (Plasticity Index > 35)
55%	35%	10%

Frost Susceptibility

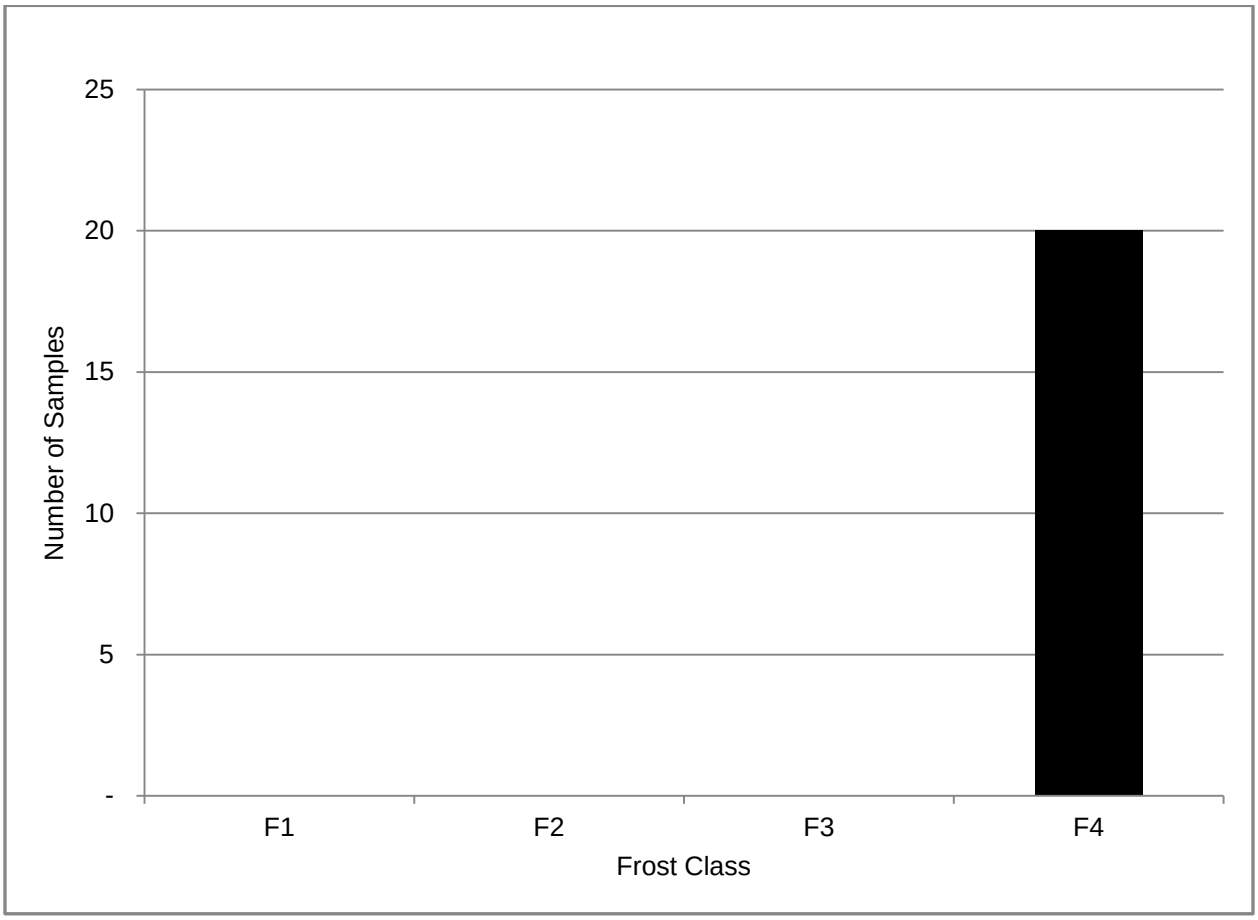


Figure 5 - Frost Susceptibility Distribution

Group Index

The Group Index is a parameter used to evaluate the quality of a soil as a subgrade material. The group index is always zero for A-1, A-2 and A-3 soils (Granular Soils). A group index of 20 or greater indicates a “very poor” subgrade material. The group indices are summarized in the following table.

Table 11 - Group Indices

AASHTO Classification	Group Index Range	Group Index Average
A-4	NA	NA
A-6	1-18	11
A-7-6	18-42	27

Existing Surface and Base Section at the Boring Locations

The soil borings were performed on 7/16/15 using a 6 inch solid flight auger. The following table represents the pavement section as reported in the field log at the boring locations.

Table 12 - Surface and Base Section at the Boring Locations

RP + Feet	Offset	Surfacing Thickness (ft)	Base Thickness (ft)
72+1692	Rt 10 SB	0.6	0.5
72+1705	Rt 10 SB	0.9	0.2
72+1719	Rt 10 SB	0.9	0.2
72+1783	Rt 10 SB	0.8	0.3
73+0886	Lt 8 SB	0.9	0.4
73+0933	Rt 8 NB	0.8	0.4
73+1004	Lt 8 SB	0.9	0.4
73+1054	Rt 8 NB	0.8	0.3
73+1157	Lt 8 SB	0.8	0.5
78+4637	Rt 9 NB	0.8	0.6
78+4708	Rt 3 NB	1.2	0.7
78+4770	Rt 8 NB	0.9	0.3
79+4250	Rt 8 NB	0.7	0.4
79+4450	Rt 8 NB	1.0	0.5
79+4650	Rt 8 NB	1.0	0.4
79+4990	Rt 8 NB	0.7	0.5
79+5113	Lt 8 SB	0.7	0.4
80+0000	Lt 8 SB	1.1	0.4
80+0175	Lt 8 SB	1.0	0.3
80+0350	Lt 8 SB	0.7	0.4
Average		**0.9**	**0.4**

Design Recommendations

Table 13 - Recommendations

Location RP + Feet	Distress Identified	Recommendation*	Justification
Project Length	Transverse Cracking	Do Nothing	• The transverse cracking is a pavement distress that is not related to the subgrade No subgrade work required
72+1766 to 72+1800	Rutting in Wheel Path (Southbound Lane)	Do Nothing	• Rutting was identified as only occurring as of 2014 therefore it is not a subgrade issue
73+0986 to 73+1200	Spalling Asphalt, Rutting in Wheel Path, Hand Patched Yearly.	Subcut	• High group indices of soils indicate poor subgrade material. • Elevated moisture content • Subcut to 2/3 of extreme frost depth below top of pavement (Extreme Frost Depth = 74" per NOAA) • Subcut depth = 35" below top of existing subgrade (Pavement Section - on average in area = 12" per measured pavement and base)
78+4730 to 78+4760	Rutting, Pushing, Shoving. Hand Patched Multiple Times per Year in Northbound Lane Lt Wheel Path.	Replace Pavement Section/Reinforcement	• Severe distress in the area • Requires maintenance multiple times per year
79+4490 to 79+4800	Alligator Cracking, Rutting, Shoving, Blade Patched up to 8" in Both Lanes.	Replace Pavement Section/Reinforcement	• Deep rutting and shoving indicate that the existing Pavement Section may not be adequate
79+5200 to 80+0280	Alligator Cracking, Rutting, Shoving, Blade Patched up to 8" in Both Lanes.	Replace Pavement Section/Reinforcement	• Deep rutting and shoving indicate that the existing Pavement Section may not be adequate

*See Design Information Below

Design Information

Compaction Method: T-180

Subgrade Prep: None

Subcut: Calculate the subcut quantity based on the lengths and depths as shown in Table 14 and adhere to the guidelines stated below.

Table 14 – Subcut Recommendations

Location	Length	Depth
73+0950 to 73+1250	300’	35 Inches

Remarks: Subcut 35” below the top of the existing subgrade. Place reinforcement fabric (R1) at the bottom of all subcut excavations and backfill with Class 3 or Class 5 aggregate. Place 12” of aggregate on the fabric prior to compacting. Do not scarify the bottom of the subcut.

Replace Pavement Section & Subgrade Reinforcement:

Table 15 – Reinforcement Recommendations

Location	Length
78+4700 to 78+4800	100’
79+4450 to 79+4850	400’
79+5150 to 80+0300	Approx.430’

Remarks: Remove the existing pavement, aggregate base, and subgrade to a depth to accommodate the section as outlined in the Pavement Design Recommendation Addendum. Place Geogrid Type G directly on the subgrade prior to reconstructing the aggregate base and pavement.

Drainage: 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 AND FROST SUSCEPTIBILITY

AASHTO Soil 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%)

Frost Susceptibility Index (Bases on US Army Corps of Engineers)

Frost Class	Frost Susceptibility	Soil Type	Percent Finer than 0.02 mm by weight %
F1	Negligible to Low	• Gravely Soils	3 – 10
F2	Low to Medium	• Gravely Soils • Sands	10 – 20 3 – 15
F3	High	• Gravelly Soils • Sands, except very fine silty sands • Clays, PI > 12	Greater than 20 Greater than 15 ----
F4	Very High	• All Silts • Very Fine Silty Sands • Clays, PI > 12 • Varved Clays and other fine-grained banded sediments	--- Greater than 15 --- ---

APPENDIX B

PAVEMENT EVALUATION AND PHOTOS

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
NH-1-049(027)067		7/16/2015

Section Maintenance Contact	Completed By
Chuck Schirado	Jamie Naumann

Highway Reference Points	Surface Type
67+0000 to 82+1780	Asphalt

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
72+1766 to 72+1800	Rutting	Rutting in left wheel track SBL only	Just started in fall of 2014.	1-2	Yes
73+0986 to 73+1200	Rutting	MHP, Spalling and rutting in both lanes.	Patching every year for two years.	3	Yes
78+4730 to 78+4760	Rutting	Pushing and shoving. MHP	Patched a couple times a year for past two years. North bound lane only. Left wheel path.	4-6	Yes
79+4490 to 80+0280	Raveling & Weather	MBP, Alligator cracks, pushing and shoving.	3 separate lifts up to 8" in spots. Both lanes, July 2015.	7	Yes
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One

Comments

Pavement Evaluation Sheet – Asphalt Surface

Project Number: SS-1-049(027)067 Date: 7-16-15

Section Contact: chuck schirado Initials: [illegible]

Location RP + Feet to RP + Feet	Distress Type (Low Severity)	Distress Type (Medium Severity)	Distress Type (High Severity)
67+0000 to 82+1780	TC-D		
72+1766 to 72+1800		RT-WP	
73+0486 to 73+1200		RT-WP	
78+4730 to 78+4760		RT-WP	
79+4490 to 79+4800			mBP
79+5200 to 80+0280			mBP

Distress Legend

Cracking:
Alligator Cracking (**AC**)
Block Cracking (**BC**)

Longitudinal Cracking:
- Wheel Path (**LC-WP**)
- Non-Wheel Path (**LC-NWP**)

Transverse Cracking:
- Depressed (**TC-D**)
- Tenting (**TC-T**)

Approx. Crack Spacing: 20'

Last Date of Crack Seal: 2015

Surface Deformation:
Bituminous Patching:
- Blade Patch (**BP-MBP**)
- Hand Patch (**BP-MHP**)
- Scotch Patch (**BP-MSP**)
- Paver-Laid Patch (**BP-PLP**)

Rutting (**RT**)
Approx. Depth: 0.5"
Shoving (**SV**)

Miscellaneous Defects:
Water Pumping (**WP**)
Area of Greatest Distress (**AGD**)
- Location
- Possible Cause(s) of Distress(es)

Miscellaneous Defects:
Frost Heave (**FH**)
- Seasonal
- Centerline Pipe
- Previously Repaired
- Signed
- Evidence of Spring

Slough Area
- Water Present
- Spring
- Cattails
- Location of Slough Area
  - Right (**SA-R**)
  - Left (**SA-L**)

General Comments

What is the area of greatest distress on the project? MBP

What is the location? 79+4490 to 80+0280 2 patches

What are the causes contributing to the distress? Spring

Is there a frost heave on the project? no

Is it seasonal? NO

Is there a centerline pipe? no

Has it been previously repaired? no

Is it signed? yes

Is there evidence of a spring? yes

Filled in Wheele tracks 2008. Paved

72+1760 to 72+1800 Rut in RT WP SBL only
Just Started fall of 2014. Pics ~~7-8~~ 1&2

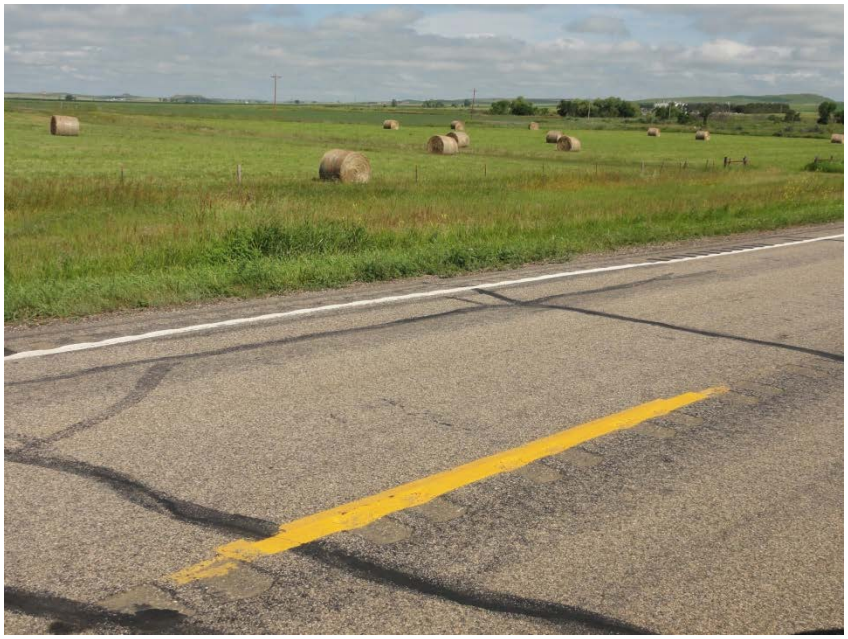
73+0980 to 73+1200 Spalling, RT in WP BLanes.
MHP - Yearly Last couple years ~~9&10~~ 3 pics

78+4730 to ~~78~~+4760 RT, Pushing, Showing
MHP couple times a year for the last 2 years
NBL only Left WP. pics ~~11-14~~ 4-6

79+4490 to 79+4800, 79+5200 to 80+0280 MBP AC RT, SV

3 Separate Lifts, up to 8" mix in spots Both lanes
Lanes, July 2015 BP, Picture 7

1



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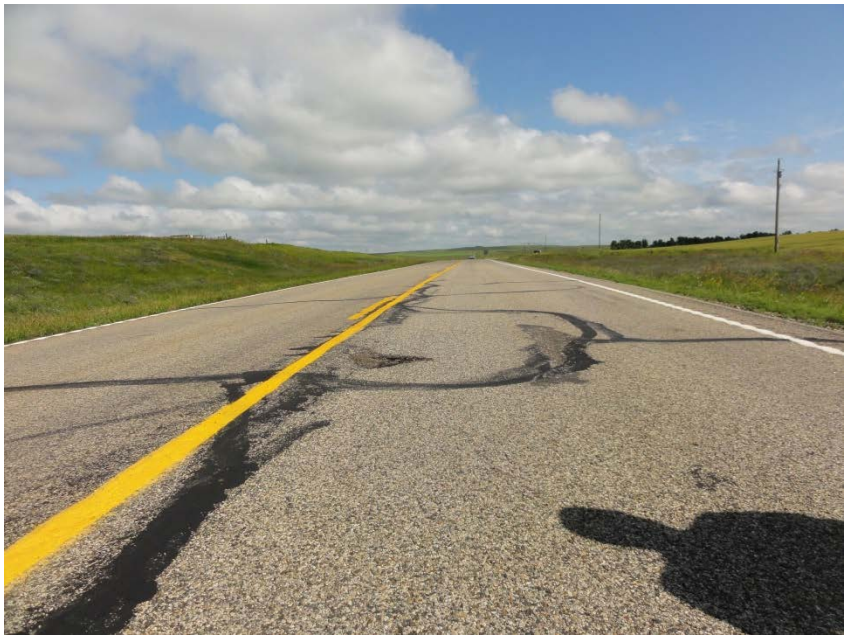

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5

6

7

APPENDIX C

BORING LOCATIONS

Legend

- Boring
- Reference Points
- Sections

Project Number: SS-NH-049(027)067

Legend

- Boring
- Reference Points
- Sections

Project Number: SS-NH-049(027)067

Legend

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Legend

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Legend

- Boring
- Reference Points
- Sections

Project Number: SS-NH-049(027)067

Legend

- Boring
- Reference Points
- Sections

Project Number: SS-NH-049(027)067

APPENDIX D

SUMMARY OF SOILS ANALYSIS

Project No.: SS-1-049(027)067

PCN: 20677

Color Key

Swell Potential:	Low	Marginal	High	Moisture Content:	Below PL	0-5% Over PL	>5% Over PL
Group Index:	GI≤20	GI>20		Ave. 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.

Lab No.	STA	Offset	Depth of Sample (ft)	Plastic Limit (PL)	AASHTO Class	Group Index	Optimum Moisture	Swell Potential (PI)	Ave. In-Place Moisture	Moisture Content @ Depth (ft) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Frost Class
958	72+1692	Rt 10 SB	0.6-5	17.8	A-7-6(20)	20	12.2	23	25.6	28.7	22.9	25.9	25.0																					F3
957	72+1705	Rt 10 SB	0.9-5	19.3	A-7-6(35)	35	13.1	33	23.6	24.1	22.0	25.2	23.3																					F3
956	72+1719	Rt 10 SB	0.9-5	17.6	A-6(18)	18	11.6	23	21.3	19.3	22.8	19.2	23.9																					F3
955	72+1783	Rt 10 SB	0.8-5	22.1	A-4(0)	0	12.1	6	23.0	20.1	21.5	25.0	25.3																					F3
963	73+0886	Lt 8 SB	0.9-5	19.6	A-7-6(25)	25	14.5	26	27.4	26.3	25.8	28.3	29.1																					F3
959	73+0933	Rt 8 NB	0.8-5	23.2	A-7-6(35)	35	15.6	33	29.5	27.4	31.8	28.4	30.5																					F3
962	73+1004	Lt 8 SB	0.9-5	20.5	A-7-6(28)	28	14.5	27	28.1	25.1	26.9	32.1	28.2																					F3
960	73+1054	Rt 8 NB	0.8-5	22.8	A-7-6(31)	31	14.6	29	28.3	26.0	27.8	30.2	29.1																					F3
961	73+1157	Lt 8 SB	0.8-5	20.3	A-7-6(22)	22	13.5	23	28.1	25.4	26.3	30.1	30.7																					F3
964	78+4637	Rt 9 NB	0.8-5	15.1	A-6(9)	9	10.1	19	16.1	13.3	14.5	15.4	21.2																					F3
965	78+4708	Rt 3 NB	1.2-5	17.6	A-6(1)	1	10.3	11	16.1	14.8	18.1	14.7	16.9																					F3
966	78+4770	Rt 8 NB	0.9-5	16.4	A-6(5)	5	10.3	16	16.2	15.4	14.4	17.6	17.6																					F3
967	79+4250	Rt 8 NB	0.7-5	21.9	A-7-6(20)	20	14.7	24	26.8	26.4	25.0	27.9	27.9																					F3

Project No.: SS-1-049(027)067

PCN: 20677

Color Key

Swell Potential:	Low	Marginal	High	Moisture Content:	Below PL / 0-5% Over PL / >5% Over PL
Group Index:	GI≤20	GI>20		Ave. 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.

Lab No.	STA	Offset	Depth of Sample (ft)	Plastic Limit (PL)	AASHTO Class	Group Index	Optimum Moisture	Swell Potential (PI)	Ave. In-Place Moisture	Moisture Content @ Depth (ft) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Frost Class
968	79+4450	Rt 8 NB	1-5	19.1	A-6(14)	14	12.2	20	24.3	25.0	22.9	24.5	24.7																					F3
969	79+4650	Rt 8 NB	0.2-5	25.7	A-7-6(18)	18	12.1	22	24.0	24.4	24.4	22.3	24.7																					F3
970	79+4990	Rt 8 NB	0.7-5	21.3	A-7-6(21)	21	13.4	25	27.0	24.9	20.3	28.3	34.5																					F3
974	79+5113	Lt 8 SB	0.7-4.7	19.6	A-7-6(20)	20	12.2	25	25.7	26.4	27.8	20.5	28.2																					F3
973	80+0000	Lt 8 SB	0.2-5	24.6	A-7-6(42)	42	15.5	39	26.2	23.5	27.3	27.5	26.3																					F3
972	80+0175	Lt 8 SB	0.2-5	23.7	A-7-6(36)	36	13.6	37	27.1	26.7	27.1	27.1	27.6																					F3
971	80+0350	Lt 8 SB	0.7-4.7	19.0	A-6(18)	18	10.8	20	26.0	23.1	23.3	22.2	35.2																					F3

APPENDIX E

LAB RESULTS

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-35-2015	**Date Reported**	7/27/2015	**District**	Bismarck
County	MORTON	**Submitted By**	Naumann	**Project Number**	SS-1-049(027)067
		AASHTO Test Method		**PCN**	20677

Comments

Lab Number	958	957	956	955
Reference Pt + Feet	72+1692	72+1705	72+1719	72+1783
Distance From CenterLine (Ft.)	Rt 10 SB	Rt 10 SB	Rt 10 SB	Rt 10 SB
Depth, Ft.	0.6 - 5.0	0.9 - 5.0	0.9 - 5.0	0.8 - 5.0
Field Sample No.	958	957	956	955
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	100	100	100	100
% Pass. No. 10 Sieve	100	100	99	99
% Coarse Sand (-No. 10 + No. 40)	1	0	2	1
% Fine Sand (-No. 40 + No. 200)	12	2	15	56
% Silt (0.074 - 0.005 mm)	46	44	50	21
% Clay (-0.005 mm)	41	54	32	21
Liquid Limit (-No. 40)	41	52	40	29
Plasticity Index (-No. 40)	23	33	23	6
Plastic Limit	18	19	18	22
Soil Color	BRN/GRY	BRN/GRY	BRN/GRY	BRN/GRY
Textural Class	CLY	CLY	CLY	SNDY CLY LM
Soil Class (AASHTO M-145)	A-7-6(20)	A-7-6(35)	A-6(18)	A-4(0)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	12.2	13.1	11.6	12.1
Maximum Dry Density (pcf)	122.8	121.1	124.1	119.7
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 28.7	2 | 24.1	2 | 19.3	2 | 20.1
	3 | 22.9	3 | 22.0	3 | 22.8	3 | 21.5
	4 | 25.9	4 | 25.2	4 | 19.2	4 | 25.0
	5 | 25.0	5 | 23.3	5 | 23.9	5 | 25.3
Avg. Moisture of Sample Depth	25.6	23.6	21.4	23.0

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 8/27/2015

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-35-2015	**Date Reported**	7/27/2015	**District**	Bismarck
County	MORTON	**Submitted By**	Naumann	**Project Number**	SS-1-049(027)067
		AASHTO Test Method		**PCN**	20677

Comments

Lab Number	963	959	962	960
Reference Pt + Feet	73+0886	73+0933	73+1004	73+1054
Distance From CenterLine (Ft.)	Lt 8 SB	Rt 8 NB	Lt 8 SB	Rt 8 NB
Depth, Ft.	0.9 - 5.0	0.8 - 5.0	0.9 - 5.0	0.8 - 5.0
Field Sample No.	963	959	962	960
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	100	100	100	100
% Pass. No. 10 Sieve	99	99	100	100
% Coarse Sand (-No. 10 + No. 40)	1	1	0	1
% Fine Sand (-No. 40 + No. 200)	7	4	4	2
% Silt (0.074 - 0.005 mm)	38	33	40	39
% Clay (-0.005 mm)	53	62	56	58
Liquid Limit (-No. 40)	46	56	48	52
Plasticity Index (-No. 40)	26	33	27	29
Plastic Limit	20	23	21	23
Soil Color	BRN/BLK	BLK/GRY	BRN/BLK	BLK/GRY
Textural Class	CLY	CLY	CLY	CLY
Soil Class (AASHTO M-145)	A-7-6(25)	A-7-6(35)	A-7-6(28)	A-7-6(31)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	14.5	15.6	14.5	14.6
Maximum Dry Density (pcf)	115.9	113.2	116.5	113.8
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 26.3	2 | 27.4	2 | 25.1	2 | 26.0
	3 | 25.8	3 | 31.8	3 | 26.9	3 | 27.8
	4 | 28.3	4 | 28.4	4 | 32.1	4 | 30.2
	5 | 29.1	5 | 30.5	5 | 28.2	5 | 29.1
Avg. Moisture of Sample Depth	27.4	29.5	28.1	28.3

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Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-35-2015	**Date Reported**	7/27/2015	**District**	Bismarck
County	MORTON	**Submitted By**	Naumann	**Project Number**	SS-1-049(027)067
		AASHTO Test Method		**PCN**	20677

Comments

Lab Number	961	964	965	966
Reference Pt + Feet	73+1157	78+4637	78+4708	78+4770
Distance From CenterLine (Ft.)	Lt 8 SB	Rt 9 NB	Rt 3 NB	Rt 8 NB
Depth, Ft.	0.8 - 5.0	0.8 - 5.0	1.2 - 5.0	0.9 - 5.0
Field Sample No.	961	964	965	966
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	100	100	100	100
% Pass. No. 10 Sieve	99	100	100	100
% Coarse Sand (-No. 10 + No. 40)	1	1	1	1
% Fine Sand (-No. 40 + No. 200)	7	36	56	46
% Silt (0.074 - 0.005 mm)	44	26	20	22
% Clay (-0.005 mm)	47	38	23	31
Liquid Limit (-No. 40)	43	34	28	32
Plasticity Index (-No. 40)	23	19	11	16
Plastic Limit	20	15	18	16
Soil Color	BRN/BLK	BRN/TAN	BRN	BRN
Textural Class	CLY	CLY	SNDY CLY LM	CLY
Soil Class (AASHTO M-145)	A-7-6(22)	A-6(9)	A-6(1)	A-6(5)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	13.5	10.1	10.3	10.3
Maximum Dry Density (pcf)	119.1	127.3	127.3	130.7
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 25.4	2 | 13.3	2 | 14.8	2 | 15.4
	3 | 26.3	3 | 14.5	3 | 18.1	3 | 14.4
	4 | 30.1	4 | 15.4	4 | 14.7	4 | 17.6
	5 | 30.7	5 | 21.2	5 | 16.9	5 | 17.6
Avg. Moisture of Sample Depth	28.1	16.1	16.1	16.3

Scott W. Wutzke, Testing Lab Supervisor
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Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-35-2015	**Date Reported**	7/27/2015	**District**	Bismarck
County	MORTON	**Submitted By**	Naumann	**Project Number**	SS-1-049(027)067
		AASHTO Test Method		**PCN**	20677

Comments

Lab Number	967	968	969	970
Reference Pt + Feet	79+4250	79+4450	79+4650	79+4990
Distance From CenterLine (Ft.)	Rt 8 NB	Rt 8 NB	Rt 8 NB	Rt 8 NB
Depth, Ft.	0.7 - 5.0	1.0 - 5.0	0.2 - 5.0	0.7 - 5.0
Field Sample No.	967	968	969	970
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	100	100	100	100
% Pass. No. 10 Sieve	99	100	99	99
% Coarse Sand (-No. 10 + No. 40)	3	2	3	3
% Fine Sand (-No. 40 + No. 200)	14	24	20	15
% Silt (0.074 - 0.005 mm)	32	33	35	32
% Clay (-0.005 mm)	50	42	42	49
Liquid Limit (-No. 40)	46	39	48	47
Plasticity Index (-No. 40)	24	20	22	25
Plastic Limit	22	19	26	21
Soil Color	BRN/GRY/BLK	BRN/GRY	BRN/GRY	BRN/GRY
Textural Class	CLY	CLY	CLY	CLY
Soil Class (AASHTO M-145)	A-7-6(20)	A-6(14)	A-7-6(18)	A-7-6(21)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	14.7	12.2	12.1	13.4
Maximum Dry Density (pcf)	114.9	121.0	121.5	119.1
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 26.4	2 | 25.0	2 | 24.4	2 | 24.9
	3 | 25.0	3 | 22.9	3 | 24.4	3 | 20.3
	4 | 27.9	4 | 24.5	4 | 22.3	4 | 28.3
	5 | 27.9	5 | 24.7	5 | 24.7	5 | 34.5
Avg. Moisture of Sample Depth	26.8	24.3	24.0	27.0

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 8/27/2015

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-35-2015	**Date Reported**	7/27/2015	**District**	Bismarck
County	MORTON	**Submitted By**	Naumann	**Project Number**	SS-1-049(027)067
		AASHTO Test Method		**PCN**	20677

Comments

Lab Number	974	973	972	971
Reference Pt + Feet	79+5113	80+0000	80+0175	80+0350
Distance From CenterLine (Ft.)	Lt 8 SB	Lt 8 SB	Lt 8 SB	Lt 8 SB
Depth, Ft.	0.7 - 4.7	0.2 - 5.0	0.2 - 5.0	0.7 - 4.7
Field Sample No.	974	973	972	971
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	100	100	100	100
% Pass. No. 10 Sieve	99	100	100	100
% Coarse Sand (-No. 10 + No. 40)	2	1	1	2
% Fine Sand (-No. 40 + No. 200)	17	4	10	11
% Silt (0.074 - 0.005 mm)	33	24	39	41
% Clay (-0.005 mm)	47	71	50	46
Liquid Limit (-No. 40)	45	64	61	40
Plasticity Index (-No. 40)	25	39	37	21
Plastic Limit	20	25	24	19
Soil Color	BRN/GRY	BRN/GRY/BLK	BRN	BRN
Textural Class	CLY	CLY	CLY	CLY
Soil Class (AASHTO M-145)	A-7-6(20)	A-7-6(42)	A-7-6(36)	A-6(18)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	12.2	15.5	13.6	10.8
Maximum Dry Density (pcf)	120.5	110.0	114.9	123.7
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 26.4	2 | 23.5	2 | 26.7	2 | 23.1
	3 | 27.8	3 | 27.3	3 | 27.1	3 | 23.3
	4 | 20.5	4 | 27.5	4 | 27.1	4 | 22.2
	5 | 28.2	5 | 26.3	5 | 27.6	5 | 35.2
Avg. Moisture of Sample Depth	24.9	26.1	27.1	22.9

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