TO: Roger Weigel
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ATTN: Garrett Hartl
Design Division

FROM: Ron Horner
Materials and Research Engineer
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PROJECT: BRN-3-281(109)128
Realignment

PCN: 18881

LOCATION: New Rockford – North to N JCT ND 15

LENGTH: 0.3719 miles

DATE: January 22, 2013

SUBJECT: Linear Soils Report and Recommendations

Attached is the Linear Soils Report and Recommendation for the above referenced project. If there are any changes made to the project after the report is issued that may require alteration to this recommendation or if you have any questions please contact Jeff Jirava at 328-6908 or jjirava@nd.gov.

BRN-3-281(109)128

New Rockford – North to N JCT ND 15

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 Jeff Jirava, Registration number PE-5950 on 1/22/13 and the original document is stored at the North Dakota Department of Transportation.

REGISTERED PROFESSIONAL ENGINEER
JEFF
JIRAVA
PE -5950
DATE 1/22/13
NORTH DAKOTA

Jeff Jirava, P.E

22 JAN 13
Date

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Linear Soils Report and Recommendations

Project: BRN-3-281(109)128

PCN: 18881

Scope: Realignment

Location: New Rockford – North to N JCT ND 15

Length: 0.3719 miles

Project Limits: New Rockford (RP 128.1321) and ND Junction 15 (RP 128.504)

Date: January 22, 2013

Introduction

This report will provide recommendations for the realignment of the roadway. The project will consist of realignment to the east of the existing roadway, a new bridge, and removal of the existing bridge on the roadway from New Rockford to the North junction of ND highway 15. Twelve borings were conducted to develop this recommendation. The borings extended to depths of up to 10.0 feet below the existing pavement surface. A total of 15 samples were taken from 12 borings from within the project limits. The project location is shown on Figure 1.

Figure 1 – Project Location Map

Existing Pavement Section

The existing driving lanes are 10” Hot Bituminous Pavement on 5” of base. The boring locations were along the proposed roadway path. The boring locations are shown on Figure 2.

Table 1 – Construction History – RP 128.1321 to RP 128.504

Year	Construction Type	Depth (in)	Roadway Width (ft)	Oil Type
1967	Grade	-	48.0	-
1967	Aggregate Base	5.0	45.0	-
1967	Hot Bit Pavement	6.0	40.0	85-100
1967	Hot Bit Pavement	2.0	24.0	85-100
1977	Contract Chip Seal	-	24.0	RC-250
1988	Contract Chip Seal	-	24.0	MC-3000
1999	Int Cont Patch – 1.5”	-	24.0	PG 58-28
2000	District Chip Seal	-	26.0	MC-3000
2010	Hot Bit Pavement	2.0	27.0	PG 58-28

Figure 2 - Boring Location Map

Existing Roadway Condition

Distress Data

Table 2 - 2010 Distress Data

Reference Point	Alligator Cracking (0-18)	Longitudinal Cracking (0-9)	Transverse Cracking (0-9)	Block Cracking (0-9)	Bituminous Patching (0-18)	Rutting (0-12)
128.000	0	0	4	0	0	4

Ride Data

Table 3 - 2010 Ride Data

Reference Point	Distress Score	Rut (in)	International Roughness Index (in/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
128.000	91	0.18	176

Summary of Soil Analysis

Soil Descriptions

Granular Materials:

The AASHTO A-2-4 soils consist primarily of granular materials containing 35 percent or less passing the No. 200 sieve. This includes such materials as gravel and coarse sand with silt contents or plasticity indexes in excess of the limitations of Group A-1. These soils function well as subgrade materials.

Silt-Clay Soils:

The AASHTO A-4 soils typically contain nonplastic silts. These may have an affinity for water and may swell unless they are properly compacted and drained.

The AASHTO A-6 soils typically consist of plastic clays. They usually have high volume change between wet and dry states. These soils have dry strength but lose much of this strength upon absorbing water. The A-6 soils will compress when wet and shrink and swell with changes in moisture content. They do not drain readily and may absorb water by capillarity with resulting loss in strength. These soils can also be highly frost susceptible although they will perform well when moisture is kept near the optimum value.

The AASHTO A-7-6 soil is a silt-clay material. These soils have high liquid limits and may be elastic as well as subject to extremely high volume changes. The plasticity index in these soils is high in relation to liquid limit.

Moisture

The moisture contents provided in this report and summarized below have been obtained from samples taken on 4/30/12.

Table 4 - 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 (%)
3	A-2-4	16.6-24.2	20.6	8.2	12.4
2	A-4	17.8-21.3	19.6	8.8	10.8
6	A-6	14.4-22.3	17.1	9.8	7.2
4	A-7-6	16.7-27.6	22.4	12.5	9.9

Table 5 - Summary of In-Place versus Optimum Moisture Contents

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-2-4	-	-	100%	-	-
2	A-4	-	-	50%	50%	-
6	A-6	-	50%	33%	17%	-
4	A-7-6	-	25%	25%	50%	-

*Samples without optimum moisture not included on this table.

Atterberg Limits

Table 6 - 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-2-4	0-24	8	NP-14	5	NP-10	3
A-4	-	25	-	15	-	10
A-6	29-34	31	12-18	17	12-18	14
A-7-6	41-58	52	15-21	17	26-42	35

Swell Potential

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

Table 7 - Swell Potential

Low (Plasticity Index < 25)	**Marginal** (25 ≤ Plasticity Index ≤ 35)	**High** (Plasticity Index > 35)
74%	13%	13%

Frost Susceptibility

Lab Number 295 which is located at RP 128+0650, was classified as an F4 soil. The F4 designation indicates that under the right conditions these soils have a higher probability of heaving during freeze/thaw cycles.

Group Index

All of the samples were classified as either A-2-4, A-4, A-6 or A-7-6. The Group Indexes from the samples ranged from a low of 0 to a high of 35 with an average of 7. A group index of 20 or greater indicates a “very poor” subgrade material.

Design Recommendations

The analysis of the soils shows that the moisture contents were on average high. Four samples had moisture contents between 10% and 16% above optimum, and one sample was classified as an F4 soil. The soils as a whole appear to have a low group index and a generally low swell potential.

Design Information

Provide 12” subgrade prep on the existing subgrade where the new alignment ties into the existing subgrade.

Plan Notes

None

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

APPENDIX A

SUMMARY OF SOIL ANALYSIS

Project No.: BRN-3-281(109)128

PCN: 18881

Color Key

Group Index:	GI≤20	GI>20			
Swell Potential:	Low	Marginal	High		
Moisture Content:	Below PL	0-5% Over PL	>5% Over PL		
Ave. In-Place: Moisture Content	MC < PL	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									Frost Class
										2 ft	3 ft	4 ft	5 ft	6 ft	7 ft	8 ft	9 ft	10 ft	
294	128+0650	Rt 10 NB	1.1-4.5	16.5	A-6(4)	4	9.6	13	14.4	15.9	13.8	13.6							F3
295	128+0650	Rt 10 NB	4.5-5	15.1	A-4(5)	5	9.4	10	21.3				21.3						F4
296	128+0900	Rt 10 NB	1-5	18.3	A-6(6)	6	11.3	16	17.2	13.4	18.9	18.7	17.9						F3
297	128+1150	Rt 28 NB	3-5	14.6	A-4(0)	0	8.2	10	17.8	21.9	16.5	22.5	14.4						F3
298	128+1400	Rt 48 NB	1-10	14.1	A-2-4(0)	0	8.2	10	16.6	13.7	16.2	21.7	14.4	24.9	30.5	27.9	30.9	24.4	F3
299	128+1475	Rt 49 NB	1-4.5	15.7	A-7-6(22)	22	11.5	42	16.7	14.8	17.1	19.8							F3
300	128+1475	Rt 49 NB	4.5-10	0.0	A-2-4(0)	0		0	24.2				22.8	26.3	25.2	25.9	25.2	19.9	F2
301	128+1550	Rt 50 NB	1-5	20.7	A-7-6(12)	12	13.5	31	23.8	27.0	26.5	27.4	17.9						F3
302	128+1550	Rt 50 NB	5-10	0.0	A-2-4(0)	0		0	20.9					21.1	23.2	21.9	19.7	18.6	F2
303	128+1850	Rt 50 NB	1.5-10	14.9	A-7-6(16)	16	12.7	26	21.5	23.6	19.5	21.6	20.5	22.0	19.9	17.9	15.5	17.5	F3
304	128+1925	Rt 49 NB	1.5-10	12.3	A-6(4)	4	10.2	18	15.3	16.5	14.2	16.6	16.0	23.1	22.6	20.0	19.2	18.5	F3
305	128+2175	Rt 41 NB	1.5-10	17.4	A-7-6(35)	35	12.4	39	27.6	30.5	25.9	23.7	30.4	21.8	22.8	20.3	20.1	22.0	F3
306	128+2425	Rt 20 NB	0.6-5	18.0	A-6(4)	4	10.1	15	22.3	27.4	13.4	24.2	23.9						F3
307	128+2925	Rt 9 NB	0.6-5	17.9	A-6(1)	1	8.7	12	17.6	18.7	10.8	22.1	18.9						F3
308	128+3175	Rt 9 NB	0.9-5	17.8	A-6(2)	2	9.2	12	15.7	18.3	14.5	14.8	15.2						F3

APPENDIX B

LAB RESULTS

Linear Laboratory Analysis

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

Report Number	SS-9-2012	**Date Reported**	5/8/2012	**District**	Devils Lake
County	EDDY	**Submitted By**	Naumann	**Project Number**	BRN-3-281(109)128
		AASHTO Test Method		**PCN**	18881

Comments Samples 300 & 302 did not do proctors, they were all sand.

Lab Number	294	295	296	297
Reference Pt + Feet	128+0650	128+0650	128+0900	128+1150
Distance From CenterLine (Ft.)	Rt 10 NB	Rt 10 NB	Rt 10 NB	Rt 28 NB
Depth, Ft.	1.1 - 4.5	4.5 - 5.0	1.0 - 5.0	3.0 - 5.0
Field Sample No.	294	295	296	297
% Pass. 3/8" Sieve	100	100	98	99
% Pass. No. 4 Sieve	97	99	97	98
% Pass. No. 10 Sieve	94	98	93	96
% Coarse Sand (-No. 10 + No. 40)	10	5	10	12
% Fine Sand (-No. 40 + No. 200)	30	23	30	48
% Silt (0.074 - 0.005 mm)	33	42	26	14
% Clay (-0.005 mm)	22	29	28	22
Liquid Limit (-No. 40)	29	25	34	25
Plasticity Index (-No. 40)	13	10	16	10
Plastic Limit	17	15	18	15
Soil Color	BRN	BRN/TAN	BLK	BLK
Textural Class	CLY LM	CLY LM	CLY LM	SNDY CLY LM
Soil Class (AASHTO M-145)	A-6(4)	A-4(5)	A-6(6)	A-4(0)
Frost Class	F3	F4	F3	F3
Optimum Moisture (%)	9.6	9.4	11.3	8.2
Maximum Dry Density (pcf)	126.5	127.4	122.2	129.7
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 15.9	5 | 21.3	2 | 13.4	2 | 21.9
	3 | 13.8		3 | 18.9	3 | 16.5
	4 | 13.6	21.3	4 | 18.7	4 | 22.5
Avg. Moisture of Sample Depth	14.4		5 | 17.9	5 | 14.4
			17.2	17.8

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 7/24/2012

Linear Laboratory Analysis

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

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County	EDDY	**Submitted By**	Naumann	**Project Number**	BRN-3-281(109)128
		AASHTO Test Method		**PCN**	18881

Comments Samples 300 & 302 did not do proctors, they were all sand.

Lab Number	298	299	300	301
Reference Pt + Feet	128+1400	128+1475	128+1475	128+1550
Distance From CenterLine (Ft.)	Rt 48 NB	Rt 49 NB	Rt 49 NB	Rt 50 NB
Depth, Ft.	1.0 - 5.0	1.0 - 4.5	4.5 - 10.0	1.0 - 5.0
Field Sample No.	298	299	300	301
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	100	100	99	100
% Pass. No. 10 Sieve	99	99	98	99
% Coarse Sand (-No. 10 + No. 40)	16	7	15	6
% Fine Sand (-No. 40 + No. 200)	52	32	71	42
% Silt (0.074 - 0.005 mm)	13	23	6	26
% Clay (-0.005 mm)	19	38	6	26
Liquid Limit (-No. 40)	24	58	0	51
Plasticity Index (-No. 40)	10	43	NP	31
Plastic Limit	14	16	0	21
Soil Color	DRK BRN	BRN/BLK	BRN/BLK	BRN/BLK
Textural Class	SNDY LM	CLY	SND	CLY LM
Soil Class (AASHTO M-145)	A-2-4(0)	A-7-6(22)	A-2-4(0)	A-7-6(12)
Frost Class	F3	F3	F2	F3
Optimum Moisture (%)	8.2	11.5		13.5
Maximum Dry Density (pcf)	129.8	122.9		115.8
% Organic Content				

Depth (Ft.) | Moisture (%)												
	1	17.2	1	15.2	5	22.8	1	20.4
	2	13.7	2	14.8	6	26.3	2	27.0
	3	16.2	3	17.1	7	25.2	3	26.5
	4	21.7	4	19.8	8	25.9	4	27.4
	5	14.4	16.7		9	25.2	5	17.9
	6	24.9			10	19.9	23.8	
	7	30.5			24.2			
	8	27.9						
	9	30.9						
	10	24.4						
Avg. Moisture of Sample Depth	16.6							

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 7/24/2012

Linear Laboratory Analysis

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

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County	EDDY	**Submitted By**	Naumann	**Project Number**	BRN-3-281(109)128
		AASHTO Test Method		**PCN**	18881

Comments Samples 300 & 302 did not do proctors, they were all sand.

Lab Number	302	303	304	305
Reference Pt + Feet	128+1550	128+1850	128+1925	128+2175
Distance From CenterLine (Ft.)	Rt 50 NB	Rt 50 NB	Rt 49 NB	Rt 41 NB
Depth, Ft.	5.0 - 10.0	1.5 - 3.0	1.5 - 3.5	1.5 - 5.0
Field Sample No.	302	303	304	305
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	100	100	99	100
% Pass. No. 10 Sieve	98	99	95	99
% Coarse Sand (-No. 10 + No. 40)	23	3	8	3
% Fine Sand (-No. 40 + No. 200)	64	27	43	10
% Silt (0.074 - 0.005 mm)	5	27	14	44
% Clay (-0.005 mm)	6	42	31	42
Liquid Limit (-No. 40)	0	41	30	56
Plasticity Index (-No. 40)	NP	27	18	39
Plastic Limit	0	15	12	17
Soil Color	LT GRY	BRN/GRY	WHITE	BRN
Textural Class	SND	CLY	SNDY CLY	CLY
Soil Class (AASHTO M-145)	A-2-4(0)	A-7-6(16)	A-6(4)	A-7-6(35)
Frost Class	F2	F3	F3	F3
Optimum Moisture (%)		12.7	10.2	12.4
Maximum Dry Density (pcf)		121.9	127.3	122.0
% Organic Content				

Depth (Ft.)	**Moisture (%)**								
	6	21.1	1	37.4	1	35.9	1	31.5
	7	23.2	2	23.6	2	16.5	2	30.5
	8	21.9	3	19.5	3	14.2	3	25.9
	9	19.7	4	21.6	4	16.6	4	23.7
	10	18.6	5	20.5	5	16.0	5	30.4
Avg. Moisture of Sample Depth	20.9		6	22.0	6	23.1	6	21.8
			7	19.9	7	22.6	7	22.8
			8	17.9	8	20.0	8	20.3
			9	15.5	9	19.2	9	20.1
			10	17.5	10	18.5	10	22.0
			21.5		15.3		27.6	

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		AASHTO Test Method		**PCN**	18881

Comments Samples 300 & 302 did not do proctors, they were all sand.

Lab Number	306	307	308
Reference Pt + Feet	128+2425	128+2925	128+3175
Distance From CenterLine (Ft.)	Rt 20 NB	Rt 9 NB	Rt 9 NB
Depth, Ft.	0.6 - 5.0	0.6 - 5.0	0.9 - 5.0
Field Sample No.	306	307	308
% Pass. 3/8" Sieve	99	98	97
% Pass. No. 4 Sieve	96	95	93
% Pass. No. 10 Sieve	91	90	88
% Coarse Sand (-No. 10 + No. 40)	20	22	17
% Fine Sand (-No. 40 + No. 200)	23	30	29
% Silt (0.074 - 0.005 mm)	30	24	28
% Clay (-0.005 mm)	17	14	15
Liquid Limit (-No. 40)	33	30	30
Plasticity Index (-No. 40)	15	12	12
Plastic Limit	18	18	18
Soil Color	BRN/BLK	BRN	BRN
Textural Class	SNDY LM	SNDY LM	SNDY LM
Soil Class (AASHTO M-145)	A-6(4)	A-6(1)	A-6(2)
Frost Class	F3	F3	F3
Optimum Moisture (%)	10.1	8.7	9.2
Maximum Dry Density (pcf)	125.1	127.8	128.6
% Organic Content			

Depth (Ft.)	**Moisture (%)**	**Depth (Ft.)**	**Moisture (%)**	**Depth (Ft.)**	**Moisture (%)**
2	27.4	2	18.7	2	18.3
3	13.4	3	10.8	3	14.5
4	24.2	4	22.1	4	14.8
5	23.9	5	18.9	5	15.2
Avg. Moisture of Sample Depth	22.3		17.6		15.7

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 7/24/2012