LINEAR SOILS SURVEY AND RECOMMENDATIONS

PROJECT NO. IM-8-094(098)342

PCN 22203

COUNTY Cass

I-94, RP 342.803 to 345.538



PREPARED BY: Jared Loegering, PE

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION MATERIALS AND RESEARCH DIVISION

September 2019

IM-8-094(098)342

Near W Fargo E to Horace Rd – EB/WB

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 09/30/2019 and the original document is stored at the North Dakota Department of Transportation.



Jased Joiging

Jared J. Loegering, P.E.

09-30-19

Date



Linear Soils Survey and Recommendations

Project: IM-8-094(098)342 PCN: 22203 Scope: Structural Improvement Length: 2.8197 Miles Location: I-94, Near W Fargo E to Horace Rd-EB/WB



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Introduction

Location: I-94, Near W Fargo E to Horace Rd – EB/WB Reference Points: 342.803 to 345.538 Project Length: 2.8197 Miles Proposed Project Scope: Structural Improvement/Crack & Seat Investigation Scope: Identified Maintenance Areas

Maintenance Review

Date of Maintenance Review: 04/29/2019 Materials and Research Person Conducting the Review: Jamie Naumann Maintenance Person Conducting Review: Chris Myhre – Fargo West Maintenance Section

Table 1 – Io	entified Maintenance Areas	;

Location RP + Feet	Distress Identified	Maintenance Comments	Drilling Required
343+2350 to 343+5280	WB Main St to EB I-94. Transverse cracks are spalled out.	Yearly patching. Mastic rubber used on joints to raise them up. Slabs raise up, separate, and break off. Pictures show locations that are patched yearly.	Yes
343+1300	Longitudinal Cracking, EB I-94 Exit 343 to Main Ave (I-94 Business)	Broken slabs, transitions breaking up. Used mastic rubber to raise transitions.	Yes
343+1300	Longitudinal Cracking, EB I-94 Exit 343 to Main Ave (I-94 Business)	One side sank so used mastic rubber to level out transition.	Yes
343+1300	Longitudinal Cracking, EB I-94 Exit 343 to Main Ave (I-94 Business)	One side sank few years ago getting worse.	Yes
343+1300	Longitudinal Cracking, EB I-94 Exit 343 to Main Ave (I-94 Business)	Block cracking at end of EBR Main St.	Yes

Summary of Soil Investigation

The soil investigation was completed on 7/2/2019. The investigation consisted of 6 borings.

Boring Location	Justification for Boring	Boring depth	Location
EB I-94 Exit 343 to Main Ave., 342+2477.	Pavement settling.	10 feet	Conduct 1 boring on each side of the longitudinal crack through the concrete pavement. The boring located on the side that is settling should be as close to the longitudinal crack as possible. A total number of 2 borings.
WB on Main to EB I-94, 342+1000.	Pavement settling.	10 feet	Conduct 1 boring on each side of the longitudinal crack through the concrete pavement. The boring located on the side that is settling should be as close to the longitudinal crack as possible. A total number of 2 borings.
WB on Main Ave to WB I-94, 1+5701.	Pavement settling.	10 feet	Conduct 1 boring on each side of the longitudinal crack through the concrete pavement. The boring located on the side that is settling should be as close to the longitudinal crack as possible. A total number of 2 borings.

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

Summary of Soil Analysis

Identified Maintenance Area – 342+2477: The soils within the identified maintenance area are fat clays with an AASHTO classification of A-7-6. These soils have on average a maximum dry density of approximately 97.5 lb/ft³ and an optimum water content of approximately 23.5%. The in-place moistures of the soils are on average 0% to 6% over optimum.

Identified Maintenance Area – 342+1000: The soils within the identified maintenance area are fat clays with an AASHTO classification of A-7-6. These soils have a maximum dry density of approximately 93 lb/ft³ and an optimum water content of approximately 26%. The in-place moistures of the soils are on average 6% to 10% over optimum.

Identified Maintenance Area – 1+5701: The soils within the identified maintenance area are fat clays with an AASHTO classification of A-7-6. These soils have a maximum dry density of approximately 94 lb/ft³ and an optimum water content of approximately 44%. The in-place moistures of the soils are on average 0% to 10% over optimum.

Soil Sample Distribution



Figure 1 - Soil Sample Distribution

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Design Recommendations

Identified Maintenance Area – 342+2477: The existing soils in this area are fat clays. The soil analysis indicates average in-place moistures from 0% to 6% 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 based on the current improvement strategy.

Identified Maintenance Area – 342+1000: The existing soils in this area are fat clays. 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 based on the current improvement strategy.

Identified Maintenance Area – 1+5701: The existing soils in this area are fat clays. The soil analysis indicates average in-place moistures from 0% 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 based on the current improvement strategy.

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		10 0103511	ication by.	stem				
General Classification		Granular materials (35% or less passing No. 200 Sieve (0.075 mm) More				More t	Silt-clay Materials than 35% passing No. 200 Sieve (0.075 mm)				
	A-	_1	1246.00	1	A-	-2					A-7
Classification	A-1-a	А—1—b	A—3	A-2-4	A-2-5	A-2-6	A27	A4	A5	A6	A-7-5 A-7-6
(a) Sieve Analysis: Percent Passing									125		
(i) 2.00 mm (No. 10)	50 max		1.2				S. 1				1
(ii) 0.425 mm (No. 40)	30 max	50 max	51 min		1910						N
(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 n	nax	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		y Soils			
(d) General rating as subgrade.	Exe			cellent to Good			Fair to Poor				

Table 5.1. AASHTO Classification System

* 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 g	roup symbols			Group	
	Gravels More than 50%	Clean Gravels Less than 5% fines"	$C_u \ge 4$ and $1 \le C_c \le 3^c$ $C_u < 4$ and/or $1 > C_c > 3^c$		
Coarse-grained soils More than 50% of	retained on No. 4 sieve	Gravels with Fines More than 12% fines ^{ad}	Pl < 4 or plots below "A" line (Figure 5.3) Pl > 7 and plots on or above "A" line (Figure 5.3)	GM GC	
retained on No. 200 sieve	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines ^b	$C_u \ge 6$ and $1 \le C_c \le 3^c$ $C_u < 6$ and/or $1 > C_c > 3^c$	SW SP	
		Sands with Fines More than 12% fines ^{b,d}	PI < 4 or plots below "A" line (Figure 5.3)PI > 7 and plots on or above "A" line (Figure 5.3)	SM SC	
	Silts and clays Liquid limit less than 50 ees Silts and clays	Inorganic	PI > 7 and plots on or above "A" line (Figure 5.3)" PI < 4 or plots below "A" line (Figure 5.3)"	CL ML	
Fine-grained soils		Organic	Liquid limit — oven dried Liquid limit — not dried < 0.75; see Figure 5.3; OL zone	OL	
50% or more passes No. 200 sieve		Inorganic	Pl plots on or above "A" line (Figure 5.3) Pl plots below "A" line (Figure 5.3)	СН МН	
	Liquid limit 50 or more	Organic	Liquid limit — oven dried Liquid limit — not dried < 0.75; see Figure 5.3; OH zone	он	
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor			Pt	

Primarily organic matter, dark in color, and organic Highly Organic Soils

"Gravels with 5 to 12% fine require dual symbols: GW-GM, GW-GC, GP-GM, GP-GC. SW SM SW-SC SP-SM, SP-SC.

"Sands with 5 to 12% times require dual symbols: SW-SM, SW-SC, SP-SM, SP-S

$$D_{-}$$
 $(D_{-})^2$

$$^{c}C_{u} = \frac{D_{60}}{D_{10}}; \quad C_{c} = \frac{(D_{30})^{2}}{D_{60} \times D_{10}}$$

^d If $4 \le Pl \le 7$ and plots in the hatched area in Figure 5.3, use dual symbol GC-GM or SC-SM.

'If $4 \le Pl \le 7$ and plots in the hatched area in Figure 5.3, use dual symbol CL-ML.



APPENDIX B

MAINTENANCE REVIEW AND SUBSURFACE INVESTIGATION SCOPE

LINEAR SOILS SURVEY FIELD INVESTIGATION SCOPE

TO:	File
FROM:	Jared Loegering – Materials and Research (Geotechnical)
DATE:	6/24/2019
HIGHWAY:	094.342
PROJECT NUMBER:	IM-8-094(098)342
PCN:	22203
LOCATION:	Near W Fargo E to Horace RD – EB/WB
IMPROVEMENT SCOPE:	Structural Improvement
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: Structural Improvement Investigation Scope: Identified Areas Only

The following table shows the proposed subsurface investigation scope.

Boring Location	Justification for Boring	Boring Depth	Location
EB I-94 Exit 343 to Main Ave. See attached map for location	Pavement settling.	10 feet	Conduct 1 boring on each side of the longitudinal crack through the concrete pavement. The boring located on the side that is settling should be as close to the longitudinal crack as possible. A total number of 2 borings.
WB on Main to EB I-94. See attached map for location	Pavement settling.	10 feet	Conduct 1 boring on each side of the longitudinal crack through the concrete pavement. The boring located on the side that is settling should be as close to the longitudinal crack as possible. A total number of 2 borings.
WB on Main Ave to WB I-94. See attached map for location	Pavement settling.	10 feet	Conduct 1 boring on each side of the longitudinal crack through the concrete pavement. The boring located on the side that is settling should be as close to the longitudinal crack as possible. A total number of 2 borings.

The following are the associated tasks and dates for the completion of the Linear Soils Survey and Recommendations for this project. Task	Completion (<i>Anticipated</i>) Date
Maintenance Review with District Maintenance Forces	4/29/2019
Linear Soils Survey Field Work Complete	8/01/2019
Linear Soils Survey Lab Work	9/15/2019
Linear Soils Survey Report	10/01/2019*
*Milestone Task	

IM-8-094(098)342, PCN 22203

Complete borings on each side of longitudinal patched crack. Complete borings on roadway through the concrete pavement. The boring completed on the pavement that is lower than the other side should be as close to the longitudinal crack as possible.

N

500 ft

Boring 1 and 2, 10' Depth. EB I-94 Exit 343 to Main Ave.

10

Boring 3 and 4, 10' Depth. WB on Main to EB I-94

-



IM-8-094(098)342, PCN 22203

Complete borings on each side of longitudinal patched crack. Complete borings on roadway through the concrete pavement. The boring completed on the pavement that is lower than the other side should be as close to the longitudinal crack as possible.

Boring 5 and 6, 10' Depth. WB on Main Ave to WB I-94

3rd Ave NW

alapanta 1-0



© 2018 Google

1). (s)

10 80 B

1

N

Legend Soil Boring

PAVEMENT EVALUATION LOG FOR LINEAR SOIL SURVEY

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

011000472 (0-2010)			1	of	1							
Project Number IM-8-094(098)342	PCN 22203											
Section Maintenance Contact Chris Mayer	Completed By Jamie Naumann											
Highway Reference Points	Surface Type											
342+4239 to 345+2840	Concrete	Concrete										

Sheet

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
343+2350 to 343+5280	Transv. Cracks	WB Main St to EB I-94. Transverse cracks are spalled out.	Yearly patching. Mastic rubber used on joints to raise them up. Slabs raise up, separate, and break off. Pictures show locations that are patched yearly.	1-2	Yes
343+1300	Longitude Cracks	EB I-94 Exit 343 to Main Ave (I-94 Business)	Broken slabs, transitions breaking up. Used mastic rubber to raise transitions up.	3	Yes
343+1300	Longitude Cracks	EB I-94 Exit 343 to Main Ave (I-94 Business)	One side sank so used mastic rubber to level out transition.	4-5	Yes
343+1300	Longitude Cracks	EB I-94 Exit 343 to Main Ave (I-94 Business)	One side sank few years ago getting worse.	6-7	No
343+1300	Longitude Cracks	EB I-94 Exit 343 to Main Ave (I-94 Business)	Bock cracking at end of EBR Main St.	8	No
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One
Comments	<u> </u>		I	<u> </u>	



343+2350 to 343+5280



2 343+2350 to 343+5280



3 343+1300



4 343+1300



5 343+1300



6 343+1300



, 343+1300



8 343+1300

APPENDIX C

BORING LOCATIONS







Project Number: IM-8-094(098)342

APPENDIX D

SUMMARY OF SOILS ANALYSIS



APPENDIX E

LAB RESULTS



PROJECT NUMBER _ IM-8-094(098)342

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

LOCATION Cass County

Borehole Depth Liquid Limit Plastic Plasticity Index Maximum Size (mm) %<#200 Sieve AASHTO Classification USCS Class- ifcation Water Content (%) Avg. Water Content (%) Dry bensity (%) Saturation (%) LSS - 1 2.0 67 25 42 9.5 78 A-7-6 (35) CH 17.7 31.0 LSS - 1 3.0 30.7 31.0 LSS - 1 4.0 30.7 31.0 LSS - 1 5.0 32.8 31.0 LSS - 1 6.0 33.2 31.0 LSS - 1 7.0 31.4 31.0 LSS - 1 9.0	Void Ratio
LSS - 1 2.0 67 25 42 9.5 78 A-7-6 (35) CH 17.7 31.0 LSS - 1 3.0 30.7 31.0 30.7 31.0 36.8 31.0 LSS - 1 4.0 4.0 4.0 36.8 31.0 36.8 31.0 LSS - 1 5.0 5.0 32.8 31.0 32.8 31.0 33.2 LSS - 1 6.0 6.0 6.0 29.9 31.0 33.2 31.0 LSS - 1 7.0 7.0 7.0 33.2 31.0 31.4 31.0 LSS - 1 8.0 7.0 7.0 32.4 31.0 32.4 31.0 LSS - 1 9.0 7.0	
LSS - 1 3.0 30.7 31.0 LSS - 1 4.0 36.8 31.0 LSS - 1 5.0 32.8 31.0 LSS - 1 6.0 29.9 31.0 LSS - 1 7.0 33.2 31.0 LSS - 1 7.0 33.2 31.0 LSS - 1 8.0 31.4 31.0 LSS - 1 9.0 32.4 31.0	
LSS - 1 4.0 36.8 31.0 LSS - 1 5.0 32.8 31.0 LSS - 1 6.0 29.9 31.0 LSS - 1 7.0 33.2 31.0 LSS - 1 8.0 31.4 31.0 LSS - 1 9.0 32.4 31.0	
LSS - 1 5.0 32.8 31.0 LSS - 1 6.0 29.9 31.0 LSS - 1 7.0 33.2 31.0 LSS - 1 8.0 31.4 31.0 LSS - 1 9.0 32.4 31.0	
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LSS - 1 7.0 33.2 31.0 LSS - 1 8.0 31.4 31.0 LSS - 1 9.0 32.4 31.0	
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LSS - 1 9.0 32.4 31.0	
LSS - 1 10.0 34.2 31.0	
LSS - 2 2.0 75 27 48 9.5 91 A-7-6 (50) CH 16.8 31.1	
LSS - 2 3.0 31.3 31.1	
LSS - 2 4.0 33.1 31.1	
LSS - 2 5.0 32.8 31.1	
LSS - 2 6.0 34.8 31.1	
LSS - 2 7.0 33.3 31.1	
LSS - 2 8.0 32.1 31.1	
LSS - 2 9.0 32.4 31.1	
LSS - 2 10.0 33.3 31.1	
LSS - 3 2.0 66 23 43 9.5 90 A-7-6 (43) CH 31.2 28.3	
LSS - 3 3.0 27.6 28.3	
LSS - 3 4.0 28.2 28.3	
LSS - 3 5.0 27.4 28.3	
LSS - 3 6.0 24.1 28.3	
LSS - 3 7.0 27.0 28.3	
LSS - 3 8.0 31.4 28.3	
LSS - 3 9.0 28.7 28.3	
LSS - 3 10.0 28.7 28.3	
LSS - 4 2.0 71 26 45 25 88 A-7-6 (44) CH 31.9 29.1	
LSS - 4 3.0 30.3 29.1	
LSS - 4 4.0 30.0 29.1	
LSS - 4 5.0 25.8 29.1	
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LSS - 4 9.0 30.1 29.1	
LSS - 4 10.0 28.0 29.1	
LSS - 5 2.0 81 29 52 9.5 96 A-7-6 (59) CH 30.1 33.4	
LSS - 5 3.0 27.6 33.4	
LSS - 5 4.0 30.7 33.4	
LSS - 5 5.0 38.5 33.4	
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LSS - 5 8.0 32.1 33.4	



SUMMARY OF LABORATORY RESULTS NORTH DAKOTA DEPARTMENT OF TRANSPORATION 300 AIRPORT ROAD Department of Transportation BISMARCK, ND 58504

PROJECT NUMBER IM-8-094(098)342

PCN 22203													
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 - 5	9.0								34.7	33.4			
LSS - 5	10.0								33.1	33.4			
LSS - 6	2.0	80	29	51	9.5	94	A-7-6 (56)	СН	31.7	34.0			
LSS - 6	3.0								35.3	34.0			
LSS - 6	4.0								35.8	34.0			
LSS - 6	5.0								31.9	34.0			
LSS - 6	6.0								32.1	34.0			
LSS - 6	7.0								29.7	34.0			
LSS - 6	8.0								33.7	34.0			
LSS - 6	9.0								40.9	34.0			
LSS - 6	10.0								34.6	34.0			

LOCATION Cass County



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

GRAIN SIZE DISTRIBUTION

PR	OJEC	t nui	MBER IM-	-8-09	94(098)342											L	oc	ATI	ON	Ca	ass (Co	unt	y												
РС	N _22	203																																				
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\bullet	LSS	5 - 1			:	2.0					A- 7	7-6	6 (3	35)								С	Н					1	67		25	;	4	2				
	LSS	S - 2				2.0					A- 7	7-6) (S	50)								С	Н						75		27	'	4	8				
	LSS	S - 3				2.0					A- 7	7-6	6 (4	13)								С	Н						66		23	5	4	3				
*	LSS	6 - 4				2.0					A- 7	7-6	6 (4	4)								С	Н						71		26	;	4	5				
\odot	LSS	<u> - 5</u>				2.0					A-	7-6) (S	59)								С	Н						81		29)	5	52				
B	DRE	HOL	E		D	EP	TH	[D1(00			D	60			D3	30			D	10		%	6G	ira	vel		%S	and	d		%	Silt		%	Clay	
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NORTH DAKOTA DEPARTMENT OF TRANSPORATION 300 AIRPORT ROAD Department of Transportation BISMARCK, ND 58504

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