APPENDIX B – REPORT OF PRELIMINARY SOIL BORINGS TESTING

INTRODUCTION

The following report is from the soil borings completed on the Dickinson Theodore Roosevelt Regional Airport in February of 2014. This report provides useful information on the existing pavement section subbase depth, condition, and the soils underneath the pavement section.

REPORT OF

PRELIMINARY SOIL TESTING

DICKINSON THEODORE ROOSEVELT
REGIONAL AIRPORT RUNWAY EXPANSION
PROJECT #: AIP 3-38-0013-029-2013
KLJ 1513301
DICKINSON, NORTH DAKOTA

For
Attn: Mr. Charlie Baker
Dickinson Municipal Airport Authority
c/o KLJ
PO Box 1157
Bismarck, North Dakota 58502

Laboratory Number 14-019

February 27, 2014

Material Testing Services, LLC

Material Testing Services, LLC

February 27, 2014

Attn: Mr. Charlie Baker
Dickinson Municipal Airport Authority
c/o KLJ
PO Box 1157
Bismarck, North Dakota 58502

re: **PRELIMINARY SOIL TESTING**
RUNWAY EXPANSION
DICKINSON THEODORE ROOSEVELT REGIONAL AIRPORT
DICKINSON, NORTH DAKOTA
LAB NO. 14-019

Dear Mr. Baker:

Enclosed is the report of the preliminary soil testing conducted at the Dickinson Municipal Airport. The work was conducted in general accordance with the solicitation for the project.

A total of 12 soil borings were drilled for the project along proposed taxiway and runway.

This report contains the logs of the borings and the evaluation of the soil conditions encountered at the site. The soil samples will be stored at the laboratory for at least 14 days from the report date at which time they will be discarded.

Please call me if you have any questions or comments concerning this report.

Sincerely,
MATERIAL TESTING SERVICES, LLC

Rusten R.L. Roteliuk, PE
Geotechnical Engineer

TABLE OF CONTENTS

Report of Preliminary Soil Testing

Proposed Dickinson Municipal Airport Runway Expansion– Dickinson, North Dakota
Laboratory Number 14-019

1. Introduction

The work was conducted in general accordance with the solicitation for the soil testing services for the project. The soil testing was conducted to aid in the design and construction of the taxiway and runway expansion at the Dickinson Municipal Airport.

2. Procedures

The field work was conducted on January 22 and 23, 2014. The borings were drilled at the locations staked by KLJ. A site sketch showing boring locations is included in Appendix A. The borings were backfilled on the day of drilling.

A total of 12 borings were planned for the project. Six borings were drilled for the taxiway and six borings for the runway. All twelve were accessible and drilled. The borings were drilled with standard penetration split-spoon methods, in accordance with ASTM D 1586. Soils were classified in accordance with ASTM Visual-Manual methods (ASTM D 2488). Additional information regarding drilling procedures and soils classification is given on the sheets included in Appendix A.

3. Subsurface Observations

Information on the subsurface conditions is given on the attached boring logs. The logs include: descriptions and classifications of soils encountered, the depths to noted soil changes, water level measurements, and soil test results. Standard penetration resistance values are given in the N columns of the logs. A sheet included in Appendix A describes symbols and descriptive terminology used on the boring logs. Also included in Appendix A is a soil classification chart.

The soil conditions encountered in this exploration may not be typical of the conditions across the site. Particularly on sites with fill, soil conditions may vary significantly within small distances.

3.1. Existing Bituminous Pavement and Aggregate Base

Bituminous pavement was encountered at the surface of six of the borings. The pavement thicknesses ranged from approximately 2.5 inches to 6.5 inches, but were generally 5 to 6 inches. The lowest measured pavement thickness was at boring 6 and was measured to be approximately 2.5 inches thick.

The aggregate base material below the pavement consisted of silty sand with a little gravel (SM). The aggregate base thicknesses ranged from approximately 6 inches to 17.5 inches, but were generally around 6 to 7 inches.

The following table lists the thicknesses of the asphalt pavement and aggregate base encountered in the borings.

Boring	Asphalt Thickness* (in.)	Agg Base Thickness* (in.)
1	n/a	n/a
2	n/a	n/a
3	n/a	n/a
4	6.0	12.0
5	n/a	n/a
6	2.5	6.0
7	6.5	17.5
8	n/a	n/a
9	5.25	7.0
10	5.25	7.0
11	n/a	n/a
12	6.0	6.0

*Measurements are approximate

3.2. Subgrade Soils

Fill was encountered below the pavement and aggregate base layers in all of the borings that extended through the pavement (boring 4, 6, 7, 9, 10, and 12). Fill soils were also identified in all of the remainder of the borings except boring 1. The fill consisted of mostly sandy lean clay (CL) and clayey sand (SC) that contained pockets of topsoil. The fill in boring 6 consisted of mostly silty sand (SM) and sandy fat clay (CH). The depth of fill encountered ranged from approximately 2 feet to 6.5 feet. Borings 3, 5, and 11 encountered a surficial layer of topsoil (OL) fill. Boring 1 encountered a surficial layer of topsoil that extended to approximately 2 feet below the surface.

The following table represents the amount of fill and topsoil encountered in the borings.

Boring	Depth to Bottom of Topsoil (feet)	Depth to Bottom of Fill (feet)
1	2.0	n/a
2	n/a	4.0
3	1.0	3.0
4	n/a	6.5
5	0.6	6.5
6	n/a	3.0
7	n/a	5.5
8	n/a	2.0
9	n/a	5.5
10	n/a	4.0
11	0.5	2.0
12	n/a	4.0

*Layer of topsoil below fill.

Generally, below the fill and at depths greater than 3 to 4 feet below the surface, the naturally deposited soils consisted of mostly fat clay (CH) and shale with a textural classification of fat clay. The clays contained some lenses and laminations of silt and sand,

with notable layers of silty sand (SM) and sand with silt (SP-SM) in borings 1, 3, and 6. Other notable naturally deposited soil types encountered in our exploration included clayey sand (SC) (borings 1, 5, and 11), silty clay (CL-ML) (borings 3 and 8), and lean clay (CL) (boring4). Based on the standard penetration resistance ("N") values, the natural clays ranged from soft to very hard, but were generally firm to hard in consistency. The natural deposited sands and sand with silts were generally medium dense to dense in consistency.

No cobbles and boulders were encountered during drilling. However boulders and cobbles could be encountered during excavations.

3.3. Groundwater

Groundwater measurements were taken at the completion of drilling. No groundwater entered any of the borings prior to backfilling.

Water levels can be expected to fluctuate both yearly and seasonally. The water levels at the time of construction may differ significantly from those encountered during our exploration program. Long term monitoring of the groundwater was not included in the scope of services.

4. Laboratory Evaluation

The soil samples obtained and classified in the field were returned to the laboratory and examined for verification of the field classification. After reviewing the soils, in-situ moisture contents were determined on selected soil samples at depths greater than one foot below the ground surface. Moisture content tests were conducted on the subgrade soils. The moisture contents ranged from 13% to 22% on the clay samples. One test performed on a silty sand tested 9% moisture. Moisture test results to the nearest 1 percent are noted on the attached boring logs.

Three composite bulk samples of the clayey subgrade soils were tested for particle-size, Atterberg limits, moisture-density relationship, and laboratory California Bearing Ratio (CBR). Soils for Bulk 1 were collected from 4 to 7 feet in borings 1, 2, 3, and 5; soils for Bulk 2 were collected from borings 6 and 11 from 1 to 5 feet; and soils for bulk 3 were collected from borings 10 and 12 from depths of 2 to 5 feet. Three CBR points were tested for each sample. For each set, the soil was remolded to approximately 95% of standard Proctor density (ASTM D 698) at moisture contents of 3% below optimum, at optimum, and 3% above optimum moisture content. The CBR penetration tests were performed after the 96 hour soaking for swell determination. The test report sheets are attached in Appendix B.

The lowest CBR values were achieved when remolded below and above optimum moisture. The highest values were achieved when remolded near the optimum moisture content. Generally, swell increased with lower initial moisture contents and changes in moisture content after soaking were also greatest when soils were remolded at lower moisture contents.

The following is a summary of the subgrade test results:

Sample No.	Soil Class	Max Density	Opt. Moist.	LL	PL	PI	CBR 0.1 pen	CBR 0.2 pen
Bulk 1	CL	111.2	16.2	30	14	17		
-3%							2.9	2.7
at							4.7	4.1
+3							2.9	2.5
Bulk 2	CL	108.7	18.0	39	18	21		
-3%							1.4	1.4
at							4.1	4.1
+3							2.9	2.7
Bulk 3	CL	107.1	19.3	46	17	29		
-3%							2.3	1.8
at							3.3	2.8
+3							3.0	2.5

5. Conclusions and Recommendations

5.1. Existing Subgrade Conditions

The existing non-organic soils on the site are considered poor to fair as subgrade soils for pavements. In addition, the subgrade soils are frost susceptible; therefore, some frost movement and/or frost damage can be expected during the life of the pavement. Since the existing subgrade soils are susceptible and will soften due to moisture and frost penetration, it is imperative that adequate drainage be provided/maintained to remove surface water that could penetrate the surface.

It is our understanding that the existing pavement has performed satisfactorily and therefore the subgrade has also performed satisfactorily. We assumed that the subgrade below the aggregate base was prepared and the existing fill was placed with compaction control. Judging from laboratory tests, we estimate that the in-situ CBR values of existing subgrade soils below the aggregate base range from approximately 2.0 to 3.0. Based on the soil conditions encountered in the borings, laboratory tests and our experience with similar soils, it is our opinion that a maximum design CBR value of 2.5 should be used for the existing subgrade conditions.

5.2. Areas To Be Expanded or Reconstructed

If there are areas to be expanded or removed and reconstructed, the subgrade should be prepared as described below.

Again, since the existing subgrade soils are frost susceptible and will soften due to moisture and frost penetration, it is imperative that adequate drainage be provided/maintained to remove surface water that could penetrate the surface. Care should also be taken during construction to prevent excessive drying or wetting of the subgrade soils prior to surfacing.

In new construction areas, topsoil should be removed from the surface. In areas to be reconstructed, we assume that the pavement and aggregate base material will be removed and salvaged. Once the topsoil or surfacing is removed, the exposed subgrade should then be thoroughly scarified and disked a minimum of six inches deep and moisture conditioned to between 2 percent below and 2 percent above optimum. The soils should then be compacted to at least 95 % of standard Proctor density (ASTM D 698). In addition, the subgrade should be proof rolled with a heavy wheeled vehicle (such as a loaded dump truck) to detect soft spots. Soft spots should be stabilized prior to placing new fill or base course.

Based on the data reviewed, the Asphalt Institute Manual MS 1 and our experience with similar projects, we recommend that a CBR value of 2.5 be used for the existing clayey subgrade soils.

All fills and fill operations for the project should be evaluated by a qualified soils engineering firm prior to and during placement.

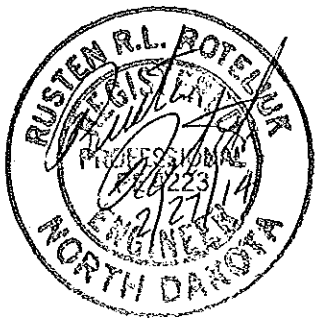
If earthwork is done during periods of freezing temperatures, we recommend protecting the fill from freezing once it has been placed. No frozen soils should be used as fill and fill should not be placed on frozen ground. Earthwork could be difficult in the spring or late fall when conditions are often cool and wet.

The existing subgrade soils were generally sandy lean clays (CL). From past experience, these types of subgrade soils can become very soft and unstable in the spring when frost is coming out of the ground. Particularly if site work is performed in spring or early summer, it may be necessary to scarify and rework more than the 6 inches to stabilize the subgrade and provide a stable platform for new fill or pavements.

This report was written by:

Jake Wieland, EIT

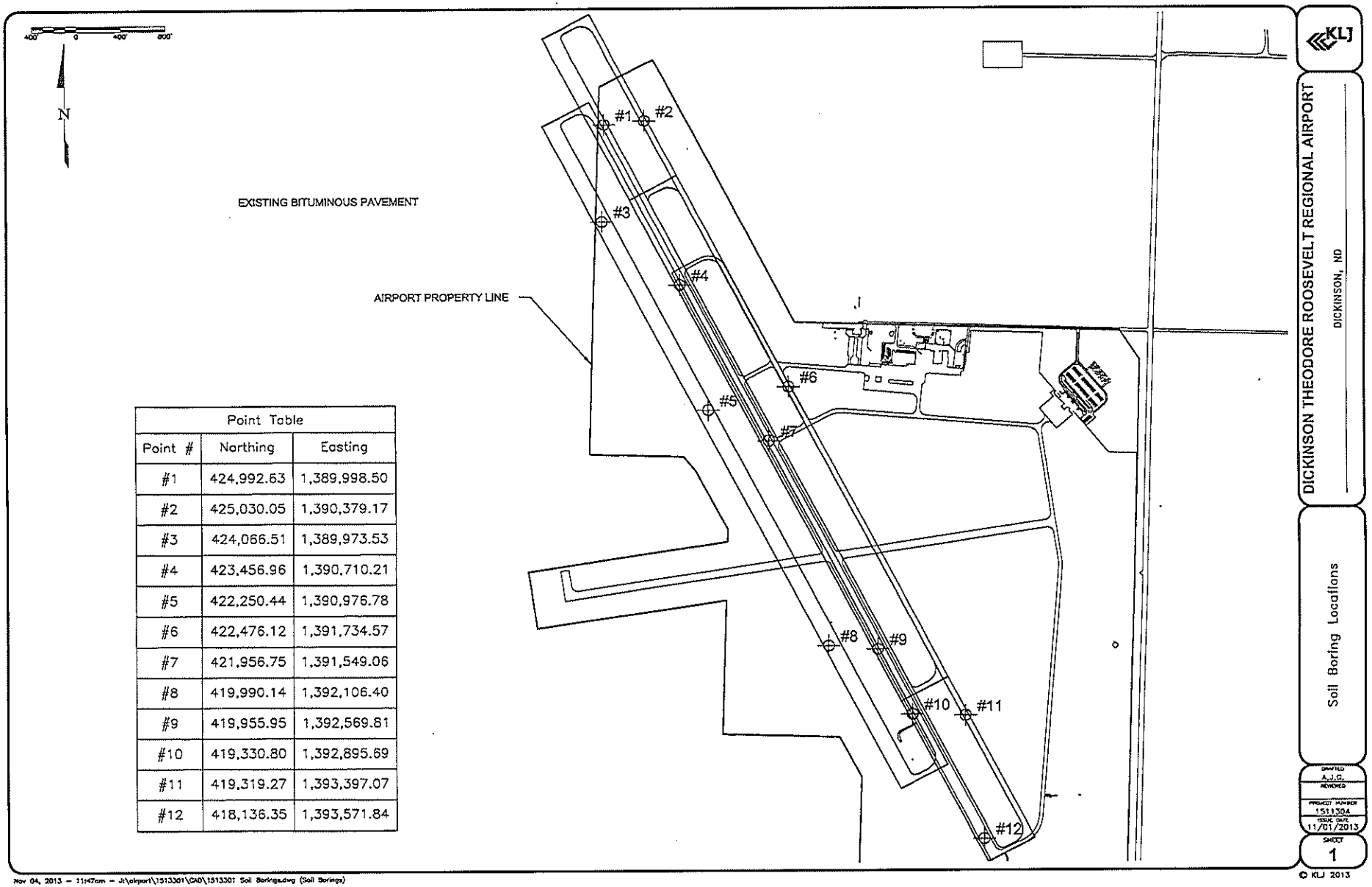
This report was reviewed by:



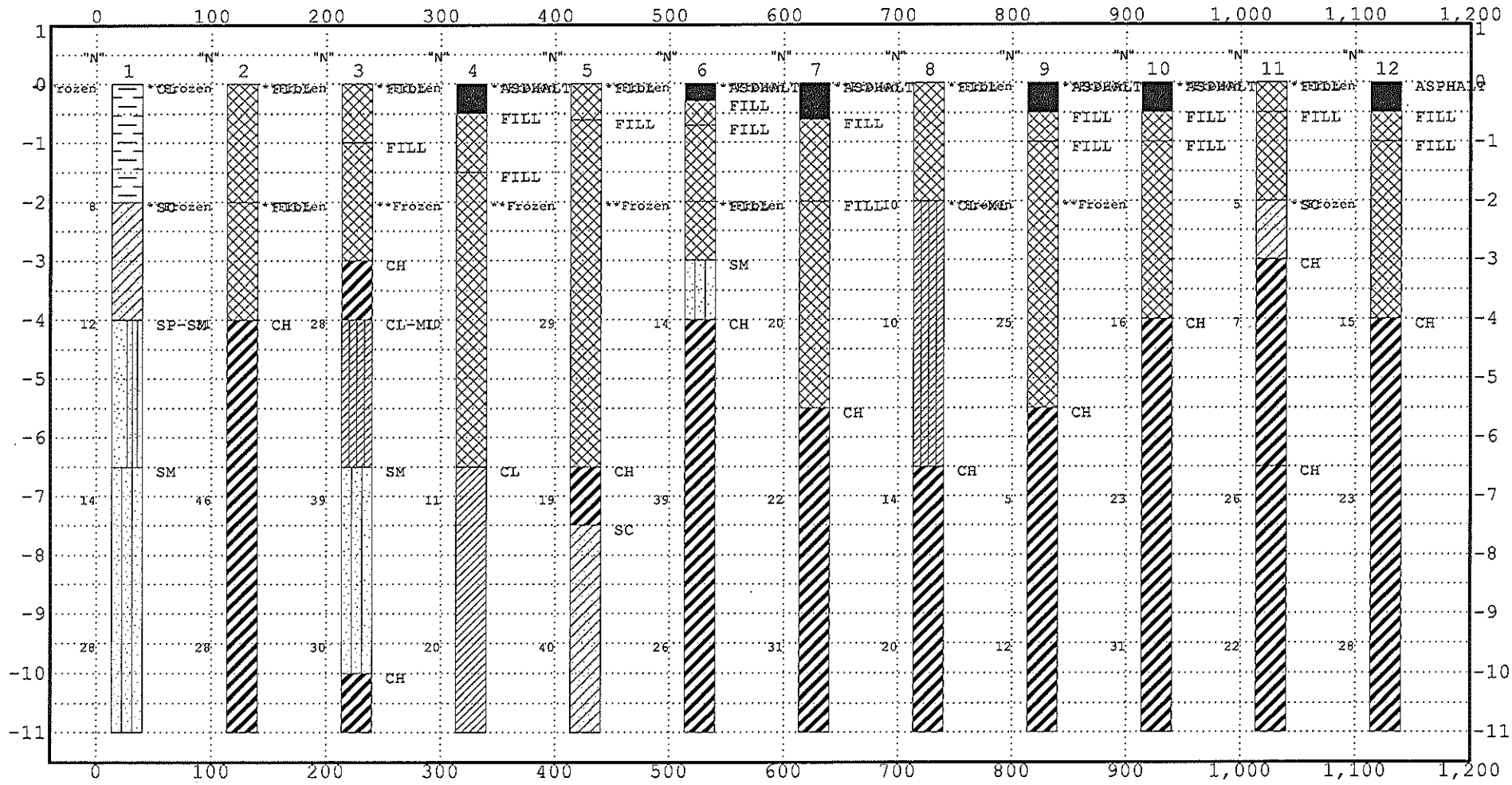
Rusten R.L. Roteliuk, PE

Appendix A

Site Sketch
Profile and Boring Logs
Symbols and Descriptive Terminology used on Logs
Soil Classification Chart



Point Table		
Point #	Northing	Easting
#1	424,992.63	1,389,998.50
#2	425,030.05	1,390,379.17
#3	424,066.51	1,389,973.53
#4	423,456.96	1,390,710.21
#5	422,250.44	1,390,976.78
#6	422,476.12	1,391,734.57
#7	421,956.75	1,391,549.06
#8	419,990.14	1,392,106.40
#9	419,955.95	1,392,569.81
#10	419,330.80	1,392,895.69
#11	419,319.27	1,393,397.07
#12	418,136.35	1,393,571.84



Boring	North	East	Elev.	Depth
1	0	100	0.0	11.0
2	0	200	0.0	11.0
3	0	300	0.0	11.0
4	0	400	0.0	11.0
5	0	500	0.0	11.0
6	0	600	0.0	11.0
7	0	700	0.0	11.0
8	0	800	0.0	11.0
9	0	900	0.0	11.0
10	0	1000	0.0	11.0
11	0	1100	0.0	11.0
12	0	1200	0.0	11.0

SOIL PROFILE DIAGRAM

Material Testing Services

Runway Expansion

Dickinson, North Dakota

PROJECT #	DATE	PLATE
14-019	Feb 14	1

MATERIAL TESTING SERVICES, LLC
Box 634
Minot, North Dakota 58702
(701) 852-5553

SOIL BORING RECORD

BORING NUMBER	1	SHEET 1 OF 1	
PROJECT	Runway Expansion		
PROJECT LOCATION	Dickinson, North Dakota		
PROJECT NUMBER	14-019		
START DATE	1/22/14	FINISH DATE	1/22/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT (%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
	Topsoil, Organic Lean Clay, dark brown, frozen, (OL)		0 0.0	Topsoil	SB			**Frozen					
2.0													
-2.0	**Clayey Sand**, brown, frozen to 3' then moist, (SC)			Mixed Alluvium	SB			8					
4.0													
-4.0	**Sand with Silt**, brown, fine to medium grained sand, moist, medium dense, (SP-SM)			Coarse Alluvium	SB			12					
			5 -5.0										
6.5													
-6.5	**Silty Sand**, light brown with gray mottling, fine to medium grained sand, a few laminations of clay, moist, medium dense, (SM)			Golden Valley Formation	SB			14					
					SB			28					
			10 -10.0										
11.0													
-11.0	End of Boring												
	NM = None Measurable												

DRILLER	CW
METHOD	4" FA
LOGGER	HD
REVIEWER	JW
DRILL RIG	CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/22/2014	1245	11		9.0		NM

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SOIL BORING RECORD

BORING NUMBER	2	SHEET 1	OF 1
PROJECT	Runway Expansion		
PROJECT LOCATION	Dickinson, North Dakota		
PROJECT NUMBER	14-019		
START DATE	1/22/14	FINISH DATE	1/22/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT (%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
	Fill, mostly Sandy Lean Clay, brown and dark brown mixed, a trace of gravel, pockets of topsoil, a few fine roots, frozen, (CL)		0 0.0	Fill	SB			**Frozen		13			
2.0													
-2.0	**Fill, mostly Clayey Sand**, brown and dark brown mixed, a trace of gravel, traces of topsoil, a few fine roots, frozen, (SC)				SB			**Frozen					
4.0													
-4.0	**Shale**, highly weathered, light brown, numerous lenses and laminations of silt and sand, dry to moist, hard to very hard, (Textural Classification: Fat Clay (CH))		5 -5.0	Golden Valley Formation	SB			21					
					SB			46					
			10 -10.0		SB			28					
11.0													
-11.0	End of Boring												
	NM = None Measurable												

DRILLER	CW
METHOD	4" FA
LOGGER	HD
REVIEWER	JW
DRILL RIG	CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/22/2014	1310	11		10.7		NM

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SOIL BORING RECORD

BORING NUMBER 3 SHEET 1 OF 1
PROJECT Runway Expansion
PROJECT LOCATION Dickinson, North Dakota
PROJECT NUMBER 14-019
START DATE 1/22/14 FINISH DATE 1/22/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT (%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
	Fill, mostly Organic Lean Clay, dark brown, frozen, (OL)		0 0.0	Fill	SB			**Frozen					
1.0													
-1.0	**Fill, mostly Sandy Lean Clay**, brown and dark brown mixed, a trace of gravel, pockets of topsoil, frozen, (CL)				SB			**Frozen					
3.0													
-3.0	**Shale**, highly weathered, light brown, lenses and laminations of silt, frozen, (Textural Classification: Fat Clay (CH))			Golden Valley Formation									
4.0													
-4.0	**Silty Clay**, light brown, numerous lenses and laminations of silt, dry, hard, (CL-ML)		5 -5.0		SB			28					
6.5													
-6.5	**Silty Sand**, light brown, fine to medium grained sand, a few laminations of clay, dry, medium dense to dense, (SM)				SB			39					
10.0					SB			30					
-10.0	**Shale**, highly weathered, light brown, numerous lenses and laminations of silt, dry, hard, (Textural Classification: Fat Clay (CH))		10 -10.0										
11.0													
-11.0	End of Boring NM = None Measurable												

DRILLER	CW
METHOD	4" FA
LOGGER	HD
REVIEWER	JW
DRILL RIG	CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/22/2014	1340	11		10.2		NM

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SOIL BORING RECORD

BORING NUMBER 4 SHEET 1 OF 1
PROJECT Runway Expansion
PROJECT LOCATION Dickinson, North Dakota
PROJECT NUMBER 14-019
START DATE 1/22/14 FINISH DATE 1/22/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT (%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
0.5	**6" Asphalt**		0 0.0	Fill	SB			**Frozen					
-0.5	**12" Base-Course, mostly Silty Sand,** dark brown, a little gravel, fine to coarse grained sand, frozen, (SM)												
1.5													
-1.5	**Fill, mostly Sandy Lean Clay,** brown and dark brown mixed, a trace of gravel, traces of topsoil, frozen to 4' then moist, (CL)									19			
					SB			**Frozen					
					SB			10					
			5 -5.0										
6.5													
-6.5	**Lean Clay,** light gray, numerous lenses and laminations of silt, moist, firm to hard, (CL)			Golden Valley Formation	SB			11					
					SB			20					
			10 -10.0										
11.0													
-11.0	End of Boring												
	NM = None Measurable												

DRILLER	CW
METHOD	4" FA
LOGGER	HD
REVIEWER	JW
DRILL RIG	CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/22/2014	1525	11		10.9		NM

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SOIL BORING RECORD

BORING NUMBER 5 SHEET 1 OF 1
PROJECT Runway Expansion
PROJECT LOCATION Dickinson, North Dakota
PROJECT NUMBER 14-019
START DATE 1/22/14 FINISH DATE 1/22/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT(%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
0.6	Fill, mostly Organic Lean Clay, dark brown, frozen, (OL)		0 0.0	Fill	SB			**Frozen					
-0.6	Fill, mostly Sandy Lean Clay, brown and dark brown mixed, a trace of gravel, frozen to 5' then dry, (CL)				SB			**Frozen					
					SB			29					
			5 -5.0										
6.5													
-6.5	Shale, highly weathered, light brown, lenses and laminations of silt, dry, hard, (Textural Classification: Fat Clay (CH))			Golden Valley Formation	SB			19					
7.5													
-7.5	Clayey Sand, light brown, numerous lenses and laminations of silt and clay, dry, hard to very hard, (SC)				SB			40					
			10 -10.0										
11.0													
-11.0	End of Boring												
	NM = None Measurable												

DRILLER	CW
METHOD	4" FA
LOGGER	HD
REVIEWER	JW
DRILL RIG	CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/22/2014	1420	11		10.4		NM

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SOIL BORING RECORD

BORING NUMBER 6 SHEET 1 OF 1
PROJECT Runway Expansion
PROJECT LOCATION Dickinson, North Dakota
PROJECT NUMBER 14-019
START DATE 1/23/14 FINISH DATE 1/23/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT (%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
0.3	2.5" Asphalt		0 0.0	Fill	SB			**Frozen					
-0.3	6" Base-Course, mostly Silty Sand, brown, a little gravel, fine to coarse grained sand, frozen, (SM)									10			
0.7 -0.7	Fill, mostly Silty Sand, light brown, fine to medium grained sand, frozen, (SM)												
2.0 -2.0	Fill, mostly Sandy Fat Clay, light brown and dark brown mixed, a few asphalt fragments, frozen, (CH)				SB			**Frozen					
3.0 -3.0	Silty Sand, light brown, fine to medium grained sand, frozen, (SM)			Coarse Alluvium									
4.0 -4.0	Shale, highly weathered, light brown with gray mottling, numerous lenses and laminations of silt, a few lenses of silty sand, moist, firm to very hard, (Textural Classification: Fat Clay (CH))		5 -5.0	Golden Valley Formation	SB			14					
					SB			39					
			10 -10.0		SB			26					
11.0 -11.0	End of Boring												

NM = None Measurable

DRILLER	CW
METHOD	4" FA
LOGGER	HD
REVIEWER	JW
DRILL RIG	CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/23/2014	1035	11		10.8		NM

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SOIL BORING RECORD

BORING NUMBER 7 SHEET 1 OF 1
PROJECT Runway Expansion
PROJECT LOCATION Dickinson, North Dakota
PROJECT NUMBER 14-019
START DATE 1/22/14 FINISH DATE 1/22/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT(%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
0.6	6.5" Asphalt		0 0.0	Fill	SB			**Frozen					
-0.6	17.5" Base-Course, mostly Silty Sand, dark brown, a little gravel, frozen, (SM)												
2.0													
-2.0	Fill, mostly Sandy Lean Clay, brown and dark brown mixed, a little gravel, pockets of topsoil, frozen to 3.5' then moist, (CL)				SB			**Frozen					
					SB			20					
5.5			5 -5.0										
-5.5	Shale, highly weathered, light brown, numerous lenses and laminations of silt and silty sand, dry to moist, hard to very hard, (Textural Classification: Fat Clay (CH))			Golden Valley Formation									
					SB			22					
					SB			31					
11.0			10 -10.0										
-11.0	End of Boring												
	NM = None Measurable												

DRILLER CW
METHOD 4" FA
LOGGER HD
REVIEWER JW
DRILL RIG CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/22/2014	1555	11		10.9		NM

MATERIAL TESTING SERVICES, LLC
Box 634
Minot, North Dakota 58702
(701) 852-5553

SOIL BORING RECORD

BORING NUMBER 8 SHEET 1 OF 1
PROJECT Runway Expansion
PROJECT LOCATION Dickinson, North Dakota
PROJECT NUMBER 14-019
START DATE 1/22/14 FINISH DATE 1/22/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT(%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
	Fill, mostly Sandy Lean Clay, brown and dark brown mixed, a trace of gravel, frozen, (CL)		0 0.0	Fill	SB			**Frozen					
2.0 -2.0	**Silty Clay**, light brown, lenses and laminations of silt, frozen to 3' then moist, firm, (CL-ML)			Fine Alluvium	SB			10		22			
					SB			10					
			5 -5.0										
6.5 -6.5	**Shale**, highly weathered, light brown with rust color mottling, lenses and laminations of silt and silty sand, moist, firm to hard, (Textural Classification: Fat Clay (CH))			Golden Valley Formation	SB			14					
					SB			20					
			10 -10.0										
11.0 -11.0	End of Boring NM = None Measurable												

DRILLER	CW
METHOD	4" FA
LOGGER	HD
REVIEWER	JW
DRILL RIG	CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/22/2014	1455	11		10.5		NM

MATERIAL TESTING SERVICES, LLC
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(701) 852-5553

SOIL BORING RECORD

BORING NUMBER 9 SHEET 1 OF 1
PROJECT Runway Expansion
PROJECT LOCATION Dickinson, North Dakota
PROJECT NUMBER 14-019
START DATE 1/22/14 FINISH DATE 1/22/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT(%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
0.5	**5.25" Asphalt**		0 0.0	Fill	SB			**Frozen					
-0.5 1.0 -1.0	**7" Base-Course, mostly Silty Sand,** dark brown, a little gravel, fine to coarse grained sand, frozen, (SM)												
	Fill, mostly Sandy Lean Clay, brown and dark brown mixed, a little gravel, traces of topsoil, a few asphalt fragments, frozen to 4' then moist, (CL)				SB			**Frozen					
					SB			25					
5.5			5 -5.0										
-5.5	**Shale,** highly weathered, light brown, numerous lenses and laminations of silt, moist, soft to firm, (Textural Classification: Fat Clay (CH))			Golden Valley Formation									
					SB			5					
					SB			12					
11.0			10 -10.0										
-11.0	End of Boring												
	NM = None Measurable												

DRILLER	CW
METHOD	4" FA
LOGGER	HD
REVIEWER	JW
DRILL RIG	CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/22/2014	1630	11		11.1		NM

MATERIAL TESTING SERVICES, LLC
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(701) 852-5553

SOIL BORING RECORD

BORING NUMBER	10	SHEET 1	OF 1
PROJECT	Runway Expansion		
PROJECT LOCATION	Dickinson, North Dakota		
PROJECT NUMBER	14-019		
START DATE	1/22/14	FINISH DATE	1/22/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT (%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
0.5	5.25" Asphalt		0 0.0	Fill	SB			**Frozen					
-0.5 1.0 -1.0	7" Base-Course, mostly Silty Sand, dark brown, a little gravel, fine to coarse grained sand, frozen, (SM)												
	Fill, mostly Sandy Lean Clay, brown and dark brown mixed, a trace of gravel, traces of topsoil, frozen, (CL)				SB			**Frozen		16			
4.0													
-4.0	Shale, highly weathered, light brown, numerous lenses and laminations of silt and silty sand, dry to moist, hard to very hard, (Textural Classification: Fat Clay (CH))			Golden Valley Formation	SB			16					
			5 -5.0										
					SB			23					
			10 -10.0		SB			31					
11.0													
-11.0	End of Boring												
	NM = None Measurable												

DRILLER	CW
METHOD	4" FA
LOGGER	HD
REVIEWER	JW
DRILL RIG	CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/22/2014	1700	11		10.8		NM

MATERIAL TESTING SERVICES, LLC
Box 634
Minot, North Dakota 58702
(701) 852-5553

SOIL BORING RECORD

BORING NUMBER	11	SHEET 1	OF 1
PROJECT	Runway Expansion		
PROJECT LOCATION	Dickinson, North Dakota		
PROJECT NUMBER	14-019		
START DATE	1/23/14	FINISH DATE	1/23/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT(%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
0.5 / -0.5	Fill, mostly Organic Lean Clay, dark brown, frozen, (OL)		0 / 0.0	Fill	SB			**Frozen					
	Fill, mostly Sandy Lean Clay, brown and dark brown mixed, a few fine roots, traces of topsoil, frozen, (CL)												
2.0 / -2.0	Clayey Sand, brown to light brown,			Mixed Alluvium	SB			5					
3.0 / -3.0	Fat Clay, light brown, numerous lenses and laminations of silt, frozen to 4' then moist, soft, (CH)			Fine Alluvium	SB			7					
			5 / -5.0										
6.5 / -6.5	Shale, highly weathered, light brown, numerous lenses and laminations of silt, moist, hard, (Textural Classification: Fat Clay (CH))			Golden Valley Formation	SB			26					
					SB			22					
			10 / -10.0										
11.0 / -11.0	End of Boring												
	NM = None Measurable												

DRILLER	CW
METHOD	4" FA
LOGGER	HD
REVIEWER	JW
DRILL RIG	CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/23/2014	1100	11		10.4		NM

MATERIAL TESTING SERVICES, LLC
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Minot, North Dakota 58702
(701) 852-5553

SOIL BORING RECORD

BORING NUMBER 12 SHEET 1 OF 1
PROJECT Runway Expansion
PROJECT LOCATION Dickinson, North Dakota
PROJECT NUMBER 14-019
START DATE 1/22/14 FINISH DATE 1/22/14

LAYER DEPTH/ ELEVATION (FT)	SOIL DESCRIPTION	SYMBOLIC LOG	ELEVATION/ DEPTH (FT)	GEOLOGY	SAMPLE TYPE	SAMPLE LEGEND	SAMPLE D (pcf)	SAMPLE N VALUES BLOWS/FT	SAMPLE WATER LEVEL	TEST RESULTS MOISTURE CONTENT(%)	TEST RESULTS LIQUID LIMIT (%)	TEST RESULTS PLASTIC LIMIT (%)	TEST RESULTS Qu (psf)
0.5	6" Asphalt		0 0.0	Fill	SB			**Frozen					
-0.5 1.0 -1.0	6" Base-Course, mostly Silty Sand, dark brown, a little gravel, fine to coarse grained sand, frozen, (SM)												
	Fill, mostly Sandy Lean Clay, brown and dark brown mixed, a trace of gravel, pockets of fat clay, traces of topsoil, frozen, (CL)				SB			**Frozen		14	35	14	
4.0													
-4.0	Shale, highly weathered, light brown, numerous lenses and laminations of silt and silty sand, moist, firm to hard, (Textural Classification: Fat Clay (CH))			Golden Valley Formation	SB			15					
			5 -5.0										
					SB			23					
					SB			28					
			10 -10.0										
11.0													
-11.0	End of Boring												
	NM = None Measurable												

DRILLER CW
METHOD 4" FA
LOGGER HD
REVIEWER JW
DRILL RIG CME 45

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING MUD LEVEL	WATER LEVEL
1/22/2014	1725	11		10.8		NM

SYMBOLS AND DESCRIPTIVE TERMINOLOGY ON TEST BORING LOG

SYMBOLS FOR DRILLING AND SAMPLING

Symbol	Description
HSA	3 1/4" I.D. hollow stem auger
_FA	4", 6" or 10" diameter flight auger
_HA	2", 4" or 6" hand auger
_DC	2 1/2", 4", 5" or 6" steel drive casing
_RC	Size A, B or N rotary casing
PD	Pipe drill or cleanout tube
CS	Continuous split barrel sampling
DM	Drilling mud
JW	Jetting water
SB	2" O.D. split barrel sampling
_L	2 1/2" or 3 1/2" O.D. SB liner sample
_T	2" or 3" thin walled tube sample
3TP	3" thin walled tube using pitcher sampler
_TO	2" or 3" thin walled tube using Osterberg sampler
W	Wash sample
B	Bag sample
P	Test pit sample
_Q	BQ, NQ, or PQ wireline system
_X	AX, BX, or NX double tube barrel
N	Standard penetration test, blows per foot
CR	Core recovery, percent
WL	Water level
▾▾	Water level
NMR	No measurement recorded, primarily due to presence of drilling or coring fluid

SYMBOLS FOR LABORATORY TESTS

Symbol	Description
W	Water content
D	Dry density - pounds per cubic foot
LL	Liquid limit - ASTM** D 4318
PL	Plastic limit - ASTM D 4318
	--- Inserts in Last Column (Qu or RQD) ---
Qu	Unconfined compressive strength, psf - ASTM D 2166
Pq	Penetrometer reading, tsf
Ts	Torvane reading, tsf
G	Specific gravity
SL	Shrinkage limits - ASTM D 427
OC	Organic content - Combustion method
SP	Swell pressure, tsf
PS	Percent swell under pressure
FS	Free swell, percent
SS	Shrink swell, percent
pH	Hydrogen ion content - Meter Method
SC	Sulfate content, parts/million or mg/l
CC	Chloride content, parts/million or mg/l
C*	One dimensional consolidation - ASTM D 2435
Qc*	Triaxial compression
D.S.*	Direct shear - ASTM D 3080
K*	Coefficient of permeability, cm/sec
DH*	Double hydrometer - ASTM D 4221
MA*	Particle size analysis - ASTM D 422
R	Laboratory electrical resistivity, ohm-cm - ASTM G 57
E*	Pressuremeter deformation modulus, tsf
PM*	Pressuremeter test
VS*	Field vane shear - ASTM D 2573
IR*	Infiltrometer test - ASTM D 3385
RQD	Rock quality designation, percent
*	Results shown on attached data sheet or graph
**	ASTM designates American Society for Testing and Materials

DESCRIPTIONS OF N-VALUES VS. SOIL PROPERTIES

N Value	Density	N Value	Consistency
0 - 4	Very loose	0 - 4	Very soft
5 - 10	Loose	5 - 8	Soft
11 - 30	Medium dense	9 - 15	Firm
31 - 50	Dense	16 - 30	Hard
Over 50	Very dense	Over 30	Very hard

DESCRIPTIONS OF SOIL CONDITIONS

Condition	Description
Lamination	Up to 1/2" thick stratum
Layer	1/2" to 6" thick stratum
Dry	Powdery, no noticeable water
Moist	Below saturation
Wet	Saturated, above liquid limit
Waterbearing	Pervious soil below water
Varved	Alternating laminations of any combinations of clay, silt and fine grained sand

DESCRIPTIONS OF GRAVEL PROPORTIONS IN SOILS

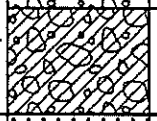
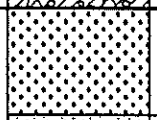
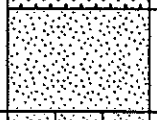
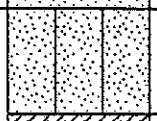
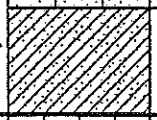
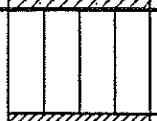
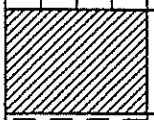
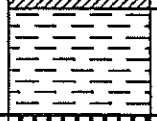
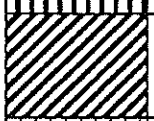
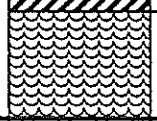
Soil Type	Description	Range, %
Coarse grained soils	A little gravel	2 - 14
Coarse grained soils	With gravel	15 - 49
Fine grained soils:		
71-85% passing #200 sieve	A little gravel	2 - 7
71-85% passing #200 sieve	With gravel	8 - 29
70% passing #200 sieve	A little gravel	2 - 14
70% passing #200 sieve	With gravel	15 - 24
70% passing #200 sieve	Gravelly	16 - 49

DESCRIPTIONS OF PARTICLE SIZES

Material Type	Size
Boulders	Over 12"
Cobbles	3" - 12"
Coarse gravel	3/4" - 3"
Fine gravel	#4 sieve - 3/4"
Coarse sand	#4 - #10 sieve
Medium sand	#10 - #40 sieve
Fine sand	#40 - #200 sieve
Silt	100% passing #200 sieve and > 0.002mm
Clay	100% passing #200 sieve and < 0.002mm

c:\wpwin\forms\desc

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Appendix B

Laboratory Test Reports

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

CALIFORNIA BEARING RATIO - ASTM 1883

PROJECT: RUNWAY EXPANSION
DICKINSON MUNICIPAL AIRPORT
DICKINSON, NORTH DAKOTA

DATE: 18-Feb-14

REPORTED TO: KLJ
128 Soo Line Drive
Bismarck, ND 58501-3310

Laboratory Number 14-019

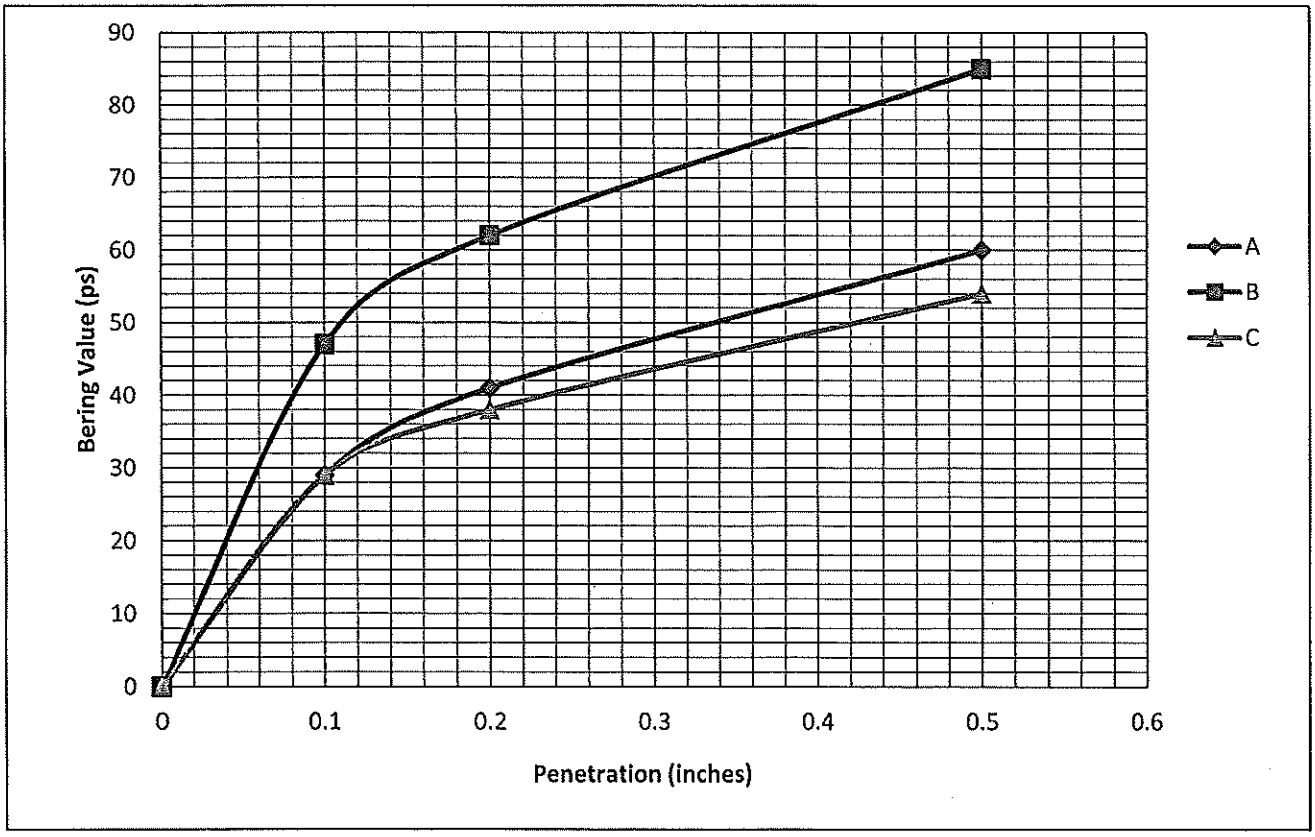
SAMPLE IDENTIFICATION: Bulk 1, auger cuttings, borings 1,2,3,5; 4 to 7 feet

SOIL DESCRIPTION: SANDY LEAN CLAY (LL-30, PL-14, PI-17)

MOISTURE-DENSITY RELATION: (ASTM D 698)

Maximum Dry Density	111.2	pcf
Optimum Moisture	16.2	%

TEST TRIAL:	A (-3)	B (at)	C (+3)
Dry Density, at molding	105.6	105.5	106.2
Moisture Content, at molding	13.4	16.4	19.4
% of Maximum Dry Density	95.0	94.9	95.5
Moisture Content after soaking	19.4	19.3	19.9
CORRECTED BEARING RATIO:			
at 0.1" penetration	2.9	4.7	2.9
at 0.2" penetration	2.7	4.1	2.5
SWELL, % of initial heights	2.36	0.84	0.40
SURCHARGE WEIGHT (pounds):	12.55	12.70	12.45



MATERIAL TESTING SERVICES, LLC

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P.O. Box 1093
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(701) 572-4226

CALIFORNIA BEARING RATIO - ASTM 1883

PROJECT: RUNWAY EXPANSION
DICKINSON MUNICIPAL AIRPORT
DICKINSON, NORTH DAKOTA

DATE: 18-Feb-14

REPORTED TO: KLJ
128 Soo Line Drive
Bismarck, ND 58501-3310

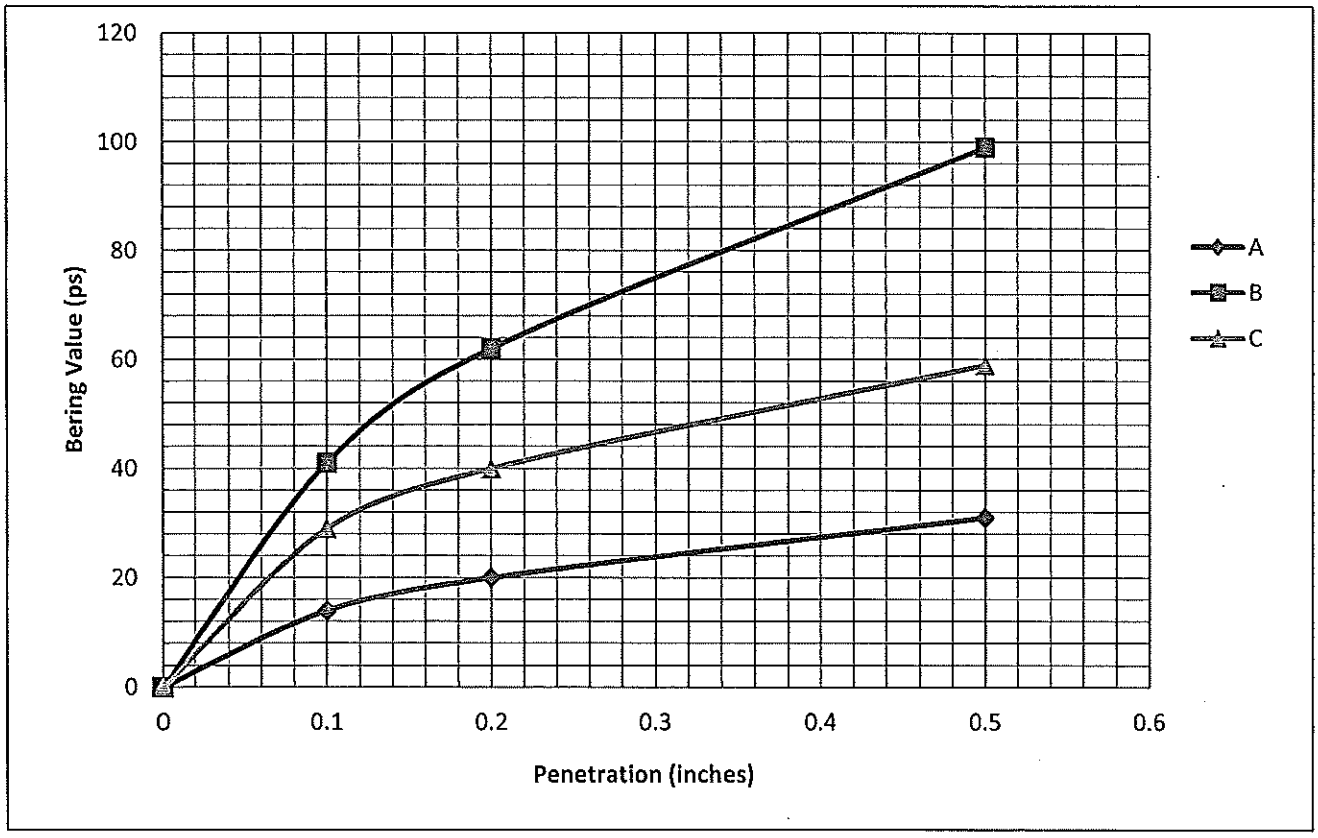
Laboratory Number 14-019

SAMPLE IDENTIFICATION: Bulk 2, auger cuttings, borings 6, 11; 1 to 5 feet

SOIL DESCRIPTION: LEAN CLAY with SAND (LL-39, PL-18, PI-21)

MOISTURE-DENSITY RELATION: (ASTM D 698)
Maximum Dry Density 108.7 pcf
Optimum Moisture 18.0 %

TEST TRIAL:	A (-3)	B (at)	C (+3)
Dry Density, at molding	102.4	104.9	103.0
Moisture Content, at molding	15.0	18.0	21.0
% of Maximum Dry Density	94.2	96.5	94.8
Moisture Content after soaking	22.8	21.7	22.3
CORRECTED BEARING RATIO:			
at 0.1" penetration	1.4	4.1	2.9
at 0.2" penetration	1.4	4.1	2.7
SWELL, % of initial heights	5.11	1.38	0.78
SURCHARGE WEIGHT (pounds):	12.51	12.53	12.55



MATERIAL TESTING SERVICES, LLC

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CALIFORNIA BEARING RATIO - ASTM 1883

PROJECT: RUNWAY EXPANSION
DICKINSON MUNICIPAL AIRPORT
DICKINSON, NORTH DAKOTA

DATE: 18-Feb-14

REPORTED TO: KLJ
128 Soo Line Drive
Bismarck, ND 58501-3310

Laboratory Number 14-019

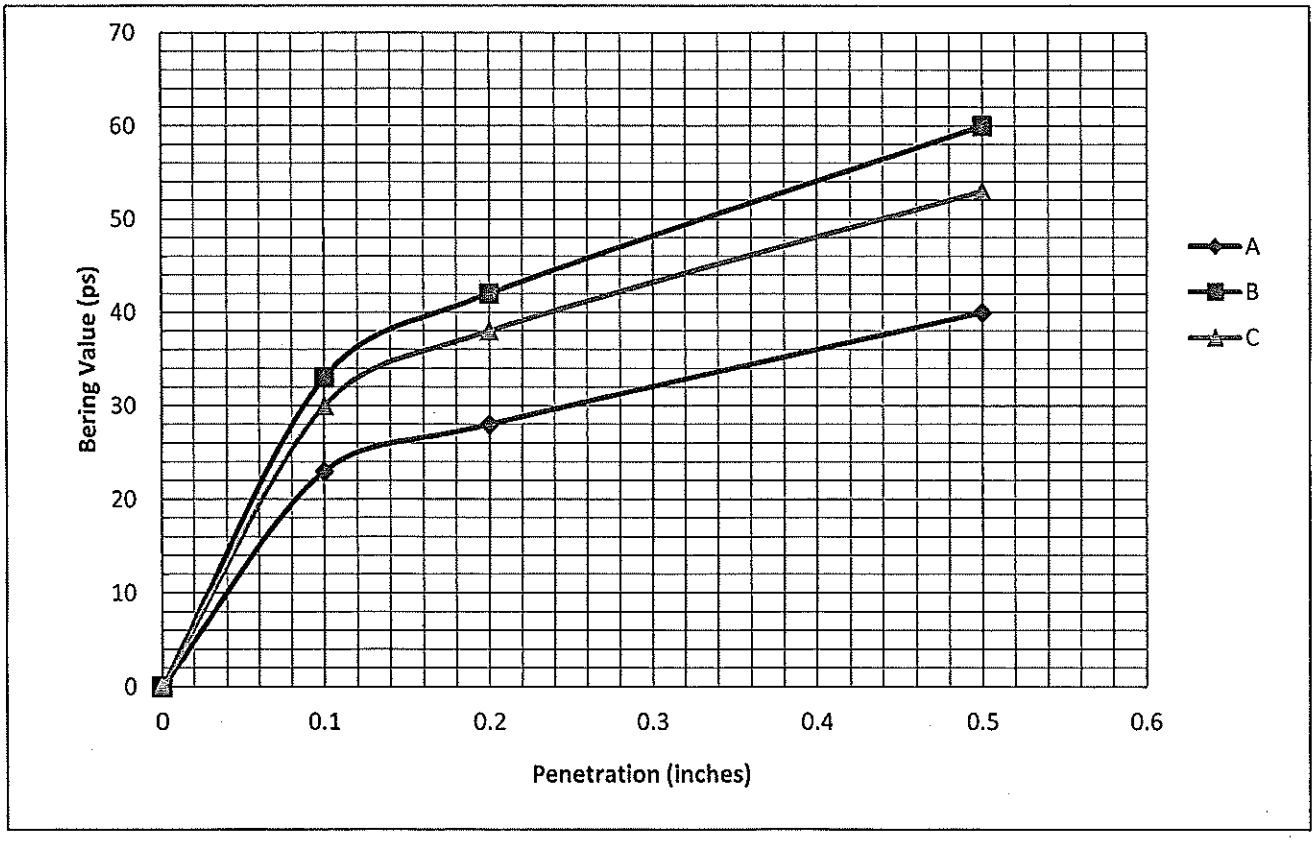
SAMPLE IDENTIFICATION: Bulk 3, auger cuttings, borings 10, 12; 2 to 5 feet

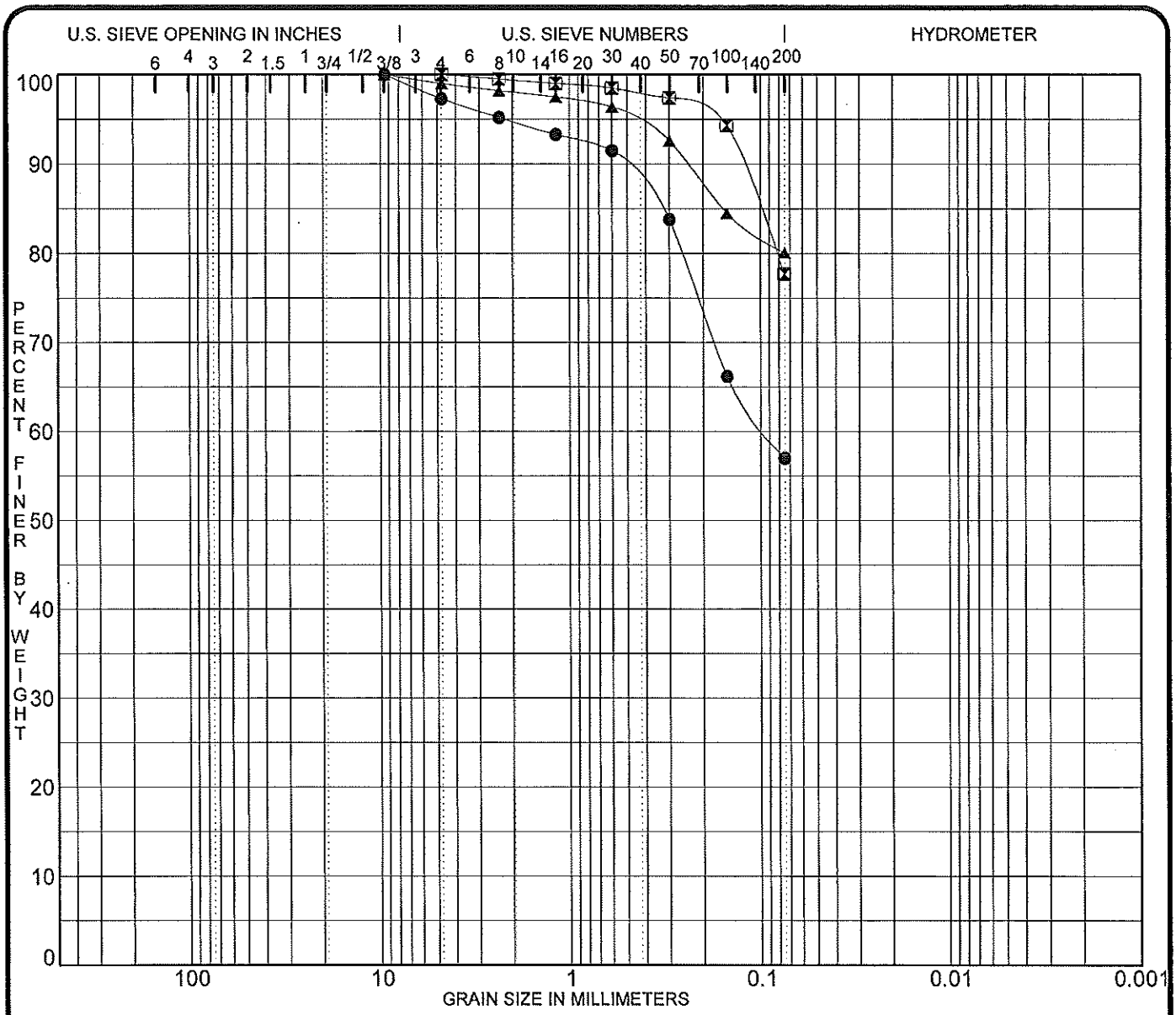
SOIL DESCRIPTION: LEAN CLAY with SAND (LL-46, PL-17, PI-29)

MOISTURE-DENSITY RELATION: (ASTM D 698)

Maximum Dry Density	107.1	pcf
Optimum Moisture	19.3	%

TEST TRIAL:	A (-3)	B (at)	C (+3)
Dry Density, at molding	101.7	101.4	101.7
Moisture Content, at molding	16.3	19.3	22.3
% of Maximum Dry Density	94.9	94.6	95.0
Moisture Content after soaking	23.6	23.2	24.1
CORRECTED BEARING RATIO:			
at 0.1" penetration	2.3	3.3	3.0
at 0.2" penetration	1.8	2.8	2.5
SWELL, % of initial heights	4.04	1.93	0.33
SURCHARGE WEIGHT (pounds):	12.51	12.53	15.65





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring No.	Depth (ft)	Classification	MC%	LL	PL	PI	Cc	Cu
●	Bulk-1	2.0	SANDY LEAN CLAY CL		30	14	17		
⊠	Bulk-2	1.0	LEAN CLAY with SAND CL		39	18	21		
▲	Bulk-3	2.0	LEAN CLAY with SAND CL		46	17	29		

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	Bulk-1	2.0	9.50	0.09			2.7	40.3	57.0	
⊠	Bulk-2	1.0	4.75				0.0	22.3	77.7	
▲	Bulk-3	2.0	9.50				1.0	18.9	80.1	

PROJECT **Runway Expansion, Dickinson, North Dakota**

JOB NO. **14-019**

DATE **2/12/14**

PARTICLE SIZE ANALYSIS

Material Testing Services

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

MOISTURE-DENSITY RELATIONSHIP

PROJECT: RUNWAY EXPANSION
DICKINSON MUNCIPAL AIRPORT
DICKINSON, NORTH DAKOTA

DATE: 17-Feb-14

COPIES TO:

REPORTED TO: KLJ
128 Soo Line Drive
Bismarck, ND 58501-3310

Laboratory Number 14-019

Sample Number: Bulk 1

Sample ID: borings 1, 2, 3, 5; 4 to 7 feet

tested 2/4/2014

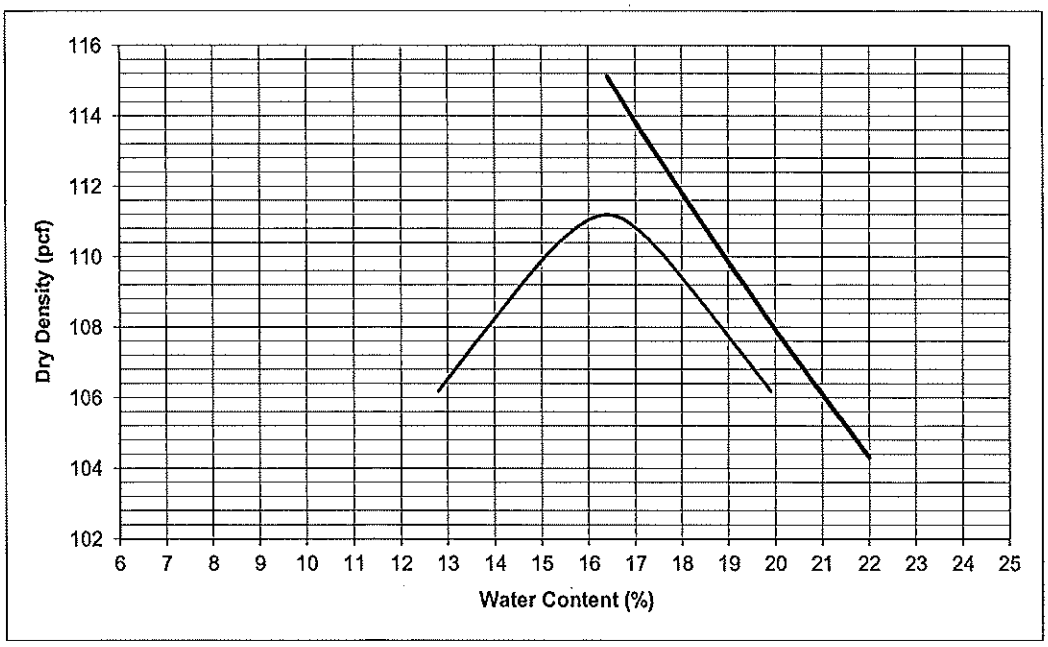
Soil Description: SANDY LEAN CLAY

Unified Soil Classification: CL

Results:

Method	**ASTM D 698, Method B**	
Maximum Dry Density	**111.2**	pcf
Optimum Moisture Content	**16.4**	%

Specific Gravity (estimated): 2.65



Material Testing Services, LLC

by

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MOISTURE-DENSITY RELATIONSHIP

PROJECT: RUNWAY EXPANSION
DICKINSON MUNCIPAL AIRPORT
DICKINSON, NORTH DAKOTA

DATE: 17-Feb-14

COPIES TO:

REPORTED TO: KLJ
128 Soo Line Drive
Bismarck, ND 58501-3310

Laboratory Number 14-019

Sample Number: Bulk 2

Sample ID: borings 6, 11; 1 to 5 feet

tested 2/4/2014

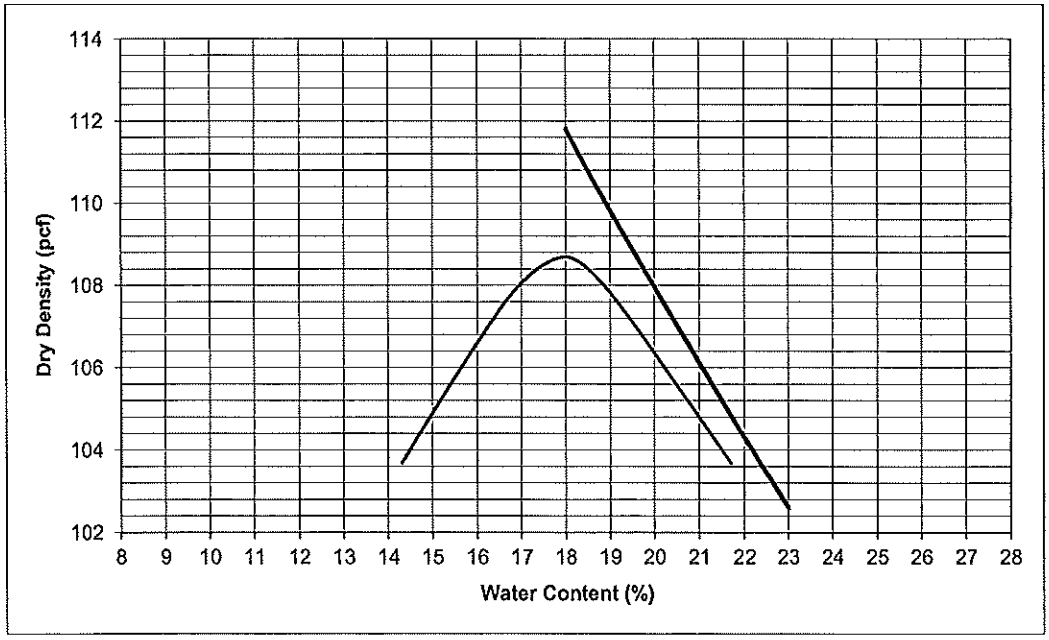
Soil Description: LEAN CLAY with SAND

Unified Soil Classification: CL

Results:

Method	**ASTM D 698, Method B**	
Maximum Dry Density	**108.7**	pcf
Optimum Moisture Content	**18.0**	%

Specific Gravity (estimated): 2.65



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MOISTURE-DENSITY RELATIONSHIP

PROJECT: RUNWAY EXPANSION
DICKINSON MUNCIPAL AIRPORT
DICKINSON, NORTH DAKOTA

DATE: 17-Feb-14

COPIES TO:

REPORTED TO: KLJ
128 Soo Line Drive
Bismarck, ND 58501-3310

Laboratory Number 14-019

Sample Number: Bulk 3

Sample ID: borings 10, 12; 2 to 5 feet

tested 2/4/2014

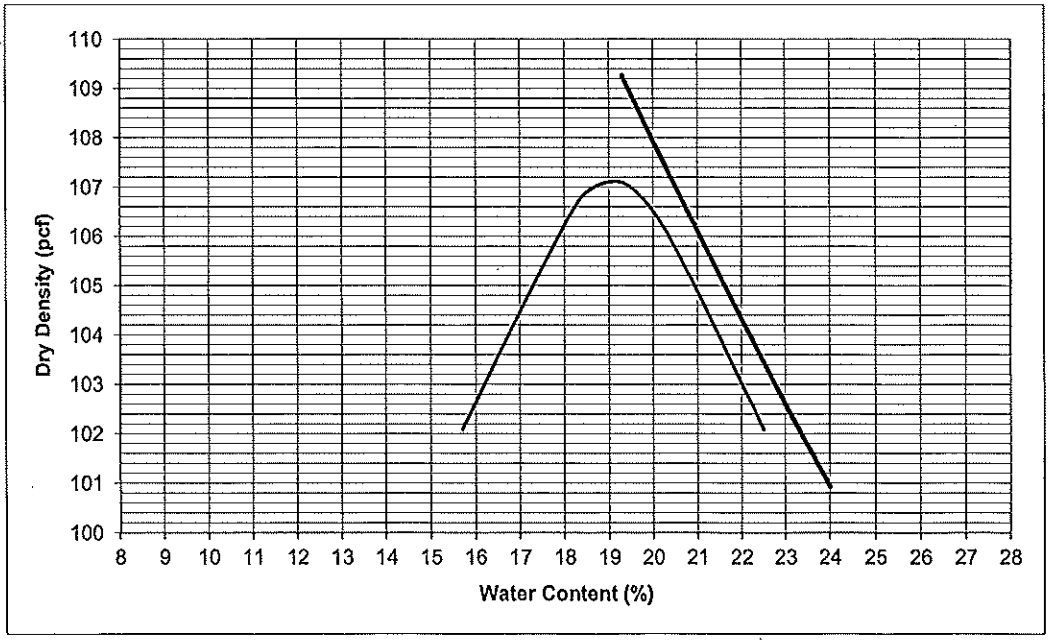
Soil Description: LEAN CLAY with SAND

Unified Soil Classification: CL

Results:

Method	**ASTM D 698, Method B**	
Maximum Dry Density	**107.1**	pcf
Optimum Moisture Content	**19.3**	%

Specific Gravity (estimated): 2.65



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by

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