

FINAL GEOTECHNICAL REPORT

SECOND AND THIRD STREET REHABILITATION PROJECT

Manokotak, Alaska

Bristol Project No. 32150007

December 2017

Prepared for:

Manokotak Village Council
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TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
ACRONYMS AND ABBREVIATIONS	iv
1.0 INTRODUCTION	1
2.0 SITE & PROJECT DESCRIPTION	3
3.0 SUBSURFACE EXPLORATIONS.....	5
3.1 Existing Material Source.....	5
3.2 Proposed Roadway Alignments	5
3.2.1 Salmon Street	9
3.2.2 Second Street.....	9
3.2.3 C Street	9
3.2.4 Third Street	9
3.2.5 Alder Street	10
3.2.6 First Street	10
4.0 LABORATORY TESTING.....	11
5.0 ENGINEERING RECOMMENDATIONS	15
5.1 Earthworks	15
5.2 Permafrost	15
5.3 Road Sections	15
5.4 Drainage.....	19
6.0 CLOSING.....	21
7.0 REFERENCES.....	23

TABLES

Table 1 Laboratory Data Summary	13
Table 2 Roadway Structural Section	18
Table 3 E-1 Surface Course material.....	18
Table 4 Select Material (Type B).....	19

FIGURES

Figure 1 - Location & Vicinity Map.....	1
Figure 2 - Test Pit Locations.....	7
Figure 3 - Typical Road Sections.....	17

APPENDICES

Appendix A	Photographic Log
Appendix B	Graphical Exploration Logs
Appendix C	Laboratory Analysis of Samples
Appendix D	Design Calculations

ACRONYMS AND ABBREVIATIONS

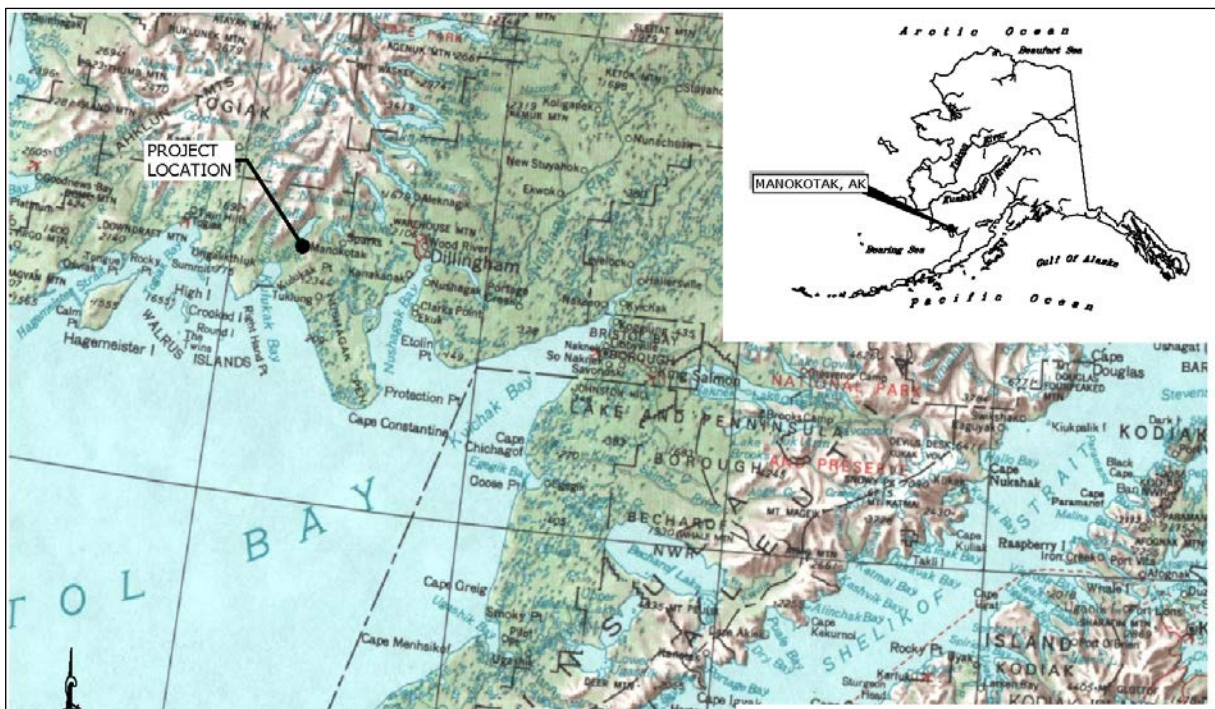
&	and
@	at
°	degrees
AASHTO	American Association of State Highway and Transportation Officials
ADOT&PF	Alaska Department of Transportation & Public Facilities
ASTM	American Society for Testing and Materials
Bristol	Bristol Engineering Services Corporation
FHWA	Federal Highway Administration
GPS	Global Positioning System
NRCS	Natural Resources Conservation Service
NFS	Non Frost Susceptible
ROW	Right-of-Way
UFC	Unified Facilities Criteria
USACE	US Army Corps of Engineers
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

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1.0 INTRODUCTION

The purpose of this report is to present the results of field explorations, laboratory testing, and geotechnical engineering services performed for the Second and Third Street Rehabilitation Project. Bristol Engineering Services Corporation (Bristol) evaluated subsurface conditions along proposed road alignments as part of developing geotechnical engineering recommendations for the proposed improvements in Manokotak, Alaska (Figure 1).

Figure 1 - Location & Vicinity Map



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2.0 SITE & PROJECT DESCRIPTION

Manokotak is located 25 miles southwest of Dillingham on the Igushik River. It lies 347 miles southwest of Anchorage. Manokotak is 58 degrees (°) 59 minutes (') and 23 seconds (") north latitude and 159 degrees (°) 2 minutes (') and 57 seconds west longitude, in Section 12, Township 14 South, Range 59 West, of the Seward Meridian. Manokotak is located in the Bristol Bay Recording District, and encompasses 36.4 square miles of land and 0.9 square miles of water.

Manokotak is located in a climatic transition zone. The primary influence is maritime, although the arctic climate affects the region. Average summer temperatures range from 40 to 70 °F; winter temperatures average from 4 to 30 °F. Annual precipitation averages 20 to 26 inches. Fog and high winds exist periodically through the year. The river is ice-free from June through mid-November (Alaska Department of Commerce, Community, and Economic Development, 2014).

The current project includes the rehabilitation of 0.9 miles of gravel surfaced roadway. The newly designed roads will relieve traffic congestion damage while improving roadway stability, drainage and dust control.

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3.0 SUBSURFACE EXPLORATIONS

Bristol conducted field explorations at the project site on October 1st 2014 to determine the subsurface conditions along the proposed road alignment and around the existing material sources. A photographic log is included in Appendix A.

During the field activities, Bristol contracted The City of Manokotak, who provided a CAT 420D Wheel Loader to excavate seven test holes along the proposed road alignments. Graphical exploration logs are included in Appendix B.

3.1 EXISTING MATERIAL SOURCE

During the geotechnical site investigation, two existing borrow pits were explored to evaluate their current condition for feasibility of working as a material source for the project. The local borrow pits were not analyzed but are anticipated to meet the needs of material requirements.

Dump Hard Rock Pit

The Dump Hard Rock Pit has been previously blasted for the FHWA road project completed in the summer of 2014. It is unknown whether the material will meet durability requirements; some of the rock was soft and fractured easily. No samples were taken of the material in this pit.

Airport Pit

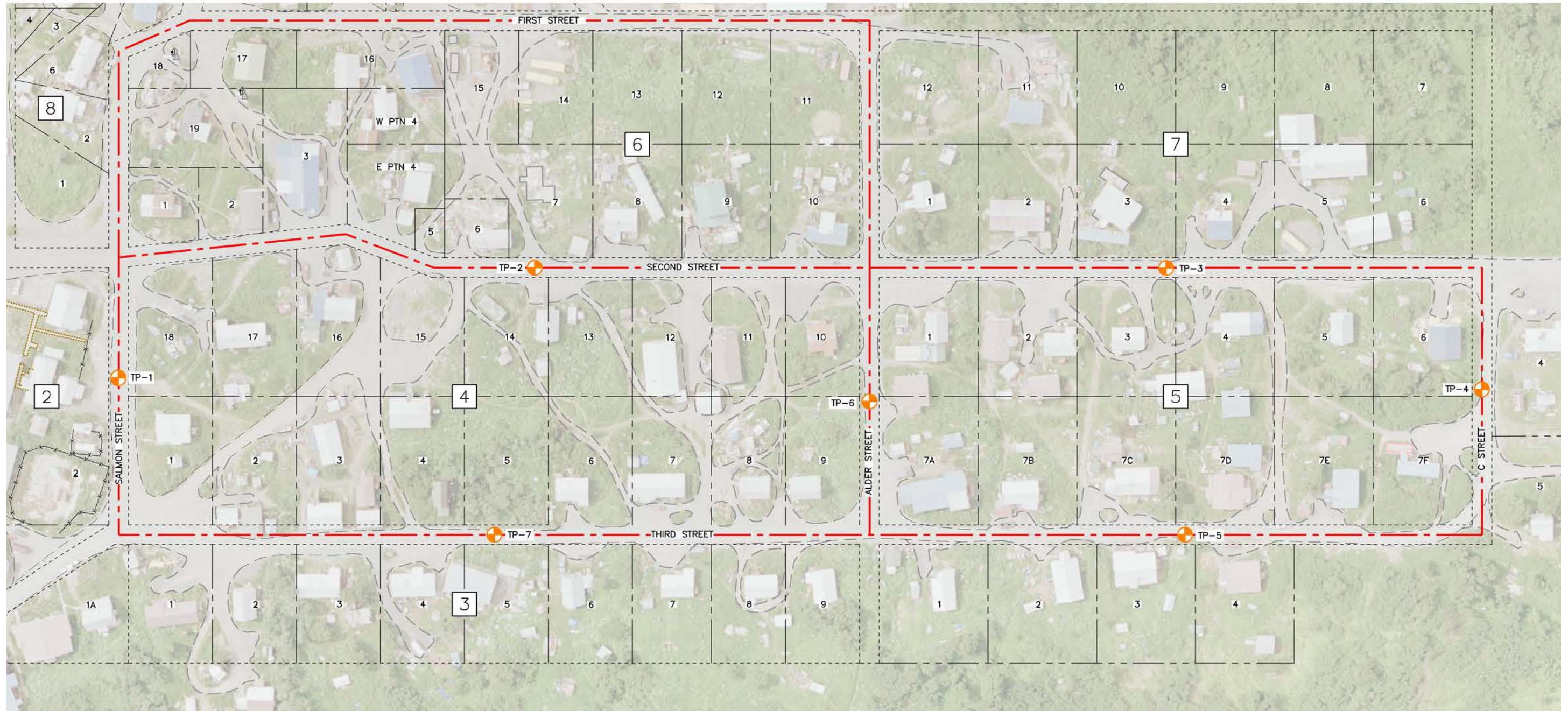
The Airport Pit is an open pit and has been used on previous road projects in the community. No samples were taken of the material in this pit.

3.2 PROPOSED ROADWAY ALIGNMENTS

During the geotechnical site investigation, seven test pits were excavated along the proposed roadway alignments to investigate the subsurface conditions and determine a

suitable roadway section for the proposed improvements. Locations of the test pits are shown on Figure 2.

Figure 2 - Test Pit Locations



- LEGEND:
- - - PROJECT ALIGNMENT
 - - - - - RIGHT OF WAY
 - LOT LINE
 - - - - - EXISTING ROAD
 - 2 LOT NUMBER
 - 3 BLOCK NUMBER
 - ⊕ TEST PIT

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3.2.1 Salmon Street

Test Pit #1

The in-situ excavation revealed dry silty gravel with sand to a depth of 1.5 feet, underlain by dry organic silt to a depth of 2.0 feet, underlain by moist silt to the bottom of the excavation at 5.0 feet. No groundwater was encountered.

3.2.2 Second Street

Test Pit #2

The in-situ excavation revealed dry silty gravel with sand to a depth of 1.0 feet, underlain by moist silt to the bottom of the excavation at 5.0 feet. No groundwater was encountered.

Test Pit #3

The in-situ excavation revealed dry well graded sand with silt and gravel to a depth of 3.0 feet, underlain by moist silt with sand to the bottom of the excavation at 5.0 feet. No groundwater was encountered.

3.2.3 C Street

Test Pit #4

The in-situ excavation revealed dry silty gravel with sand to a depth of 0.5 feet, underlain by dry organic silt to a depth of 1.0 feet, underlain by moist silt to the bottom of the excavation at 5.0 feet. No groundwater was encountered.

3.2.4 Third Street

Test Pit #5

The in-situ excavation revealed dry silty gravel with sand to a depth of 2.5 feet, underlain by moist silty gravel to the bottom of the excavation at 5.0 feet. No groundwater was encountered.

Test Pit #7

The in-situ excavation revealed dry poorly-graded sand with silt and gravel to a depth of 3.0 feet, underlain by moist silty gravel to the bottom of the excavation at 7.0 feet. No groundwater was encountered.

3.2.5 Alder Street

Test Pit #6

The in-situ excavation revealed dry silty gravel with sand to a depth of 0.5 feet, underlain by dry organic silt to a depth of 1.0 feet, underlain by dry brown sandy silt to a depth of 3.0 feet, underlain by dry white sandy silt to the bottom of the excavation at 5.0 feet. No groundwater was encountered.

3.2.6 First Street

No test pits were excavated for First Street as it was added to the project after the on-site investigation was completed. Due to the close proximity to the other routes we assume that its subsurface characteristics are similar to the streets that were explored for this project.

4.0 LABORATORY TESTING

A total of nine samples were sent to Northern Geotechnical Engineering, Inc. *d.b.a* Terra Firma Testing (NGE-TFT) for soil classification, moisture content, particle size analysis, and frost classification. The lab analyses, along with field observations, help facilitate the evaluation of the suitability of the materials located along the proposed road alignments.

Listed below are tests and ASTM test methods applied for all samples:

- Soil Classification – ASTM D-2487
- Soil Moisture Content – ASTM D-2216
- Grain Size Analysis – ASTM D-422
- Frost Class Analysis – ASTM D-5918

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Table 1 Laboratory Data Summary

Test Pit	Location	Sample Depth (FT)	Particle Size				MC (%)	UCS	FC	Description
			Gravel (%)	Sand (%)	Silt (%)	.02 (mm)				
TP-1	Salmon Street	0-1	45.6	36.9	17.5	10.2	7.3	GM	F2	Silty Gravel with Sand
TP-1	Salmon Street	3.5-4.5	2.6	20.9	76.5	42.1	52.2	ML	F4	Silt with Sand
TP-2	Second Street	4-5	0.7	25.7	73.6	36.7	51.2	ML	F4	Silt with Sand
TP-3	Second Street	1.5-2.5	38.8	52.2	9.0	3.1	4.2	SW-SM	S2	Well Graded Sand with Silt & Gravel
TP-4	C Street	2-3	3.9	22.7	73.4	40.9	65.5	ML	F4	Silt with sand
TP-5	Third Street	4-5	32.8	26.7	40.5	21.4	27.7	GM	F3	Silty Gravel with Sand
TP-6	Alder Street	1.5-2.5	2.9	28.7	68.4	40.7	70.7	ML	F4	Sandy Silt
TP-7	Third Street	2-3	23.4	66.6	10.0	2.7	3.5	SP-SM	PFS	Poorly Graded Sand with Silt & Gravel
TP-7	Third Street	6-7	47.5	30.9	21.6	11.2	28.8	GM	F2	Silty Gravel with Sand

Notes:

FC	=	Frost Class	TP	=	Test Pit
MC	=	Moisture Content	USC	=	Unified Soil Classification
N/A	=	Not Applicable	NFS	=	Non-Frost Susceptible

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5.0 ENGINEERING RECOMMENDATIONS

5.1 EARTHWORKS

The existing roadbed along the proposed road alignment consists of silty gravel approximately 0.5 to 1.5 feet thick, underlain by silt 2.0 to 5.0 feet thick. Existing road material shall be excavated so that a minimum of 1.5 feet of new NFS material can be placed.

Geotextile separation fabric should be placed on top of the existing ground in areas that have been excavated and in regions outside the existing road prism. It is recommended that the geotextile separation fabric used be a woven separation fabric, have minimum trapezoidal tear strength of 120 lbs. per ASTM D-4533-85, and a Mullen Bursting strength of 400 psi per ASTM D-3786. The apparent opening size should be approximately the same as a #50 sieve.

Cut slopes for the road sections should be 2 to 1 (horizontal to vertical) or flatter. Fill slopes for the road sections should be 2 to 1 (horizontal to vertical) or flatter.

5.2 PERMAFROST

The Dillingham region is generally underlain by isolated masses of permafrost (NSIDC, 2014). During excavation, no signs of permafrost were visible.

5.3 ROAD SECTIONS

The typical road section for this project has been developed using the methodology defined in the Unified Facilities Criteria (UFC) developed by the Department of Defense. Specifically, UFC 3-250-09FA was used for this project. The publication may also be referred to as Technical Manual (TM) 5-822-12 'Design of Aggregate Surfaced Roads and Airfields.'

The road is anticipated to have light residential traffic with the largest loading and vehicle passes per day occurring during construction. The road section design is based on the

construction loading scenario. See Appendix D for design calculations and Figure 3 for recommended typical road sections.

Figure 3 - Typical Road Sections

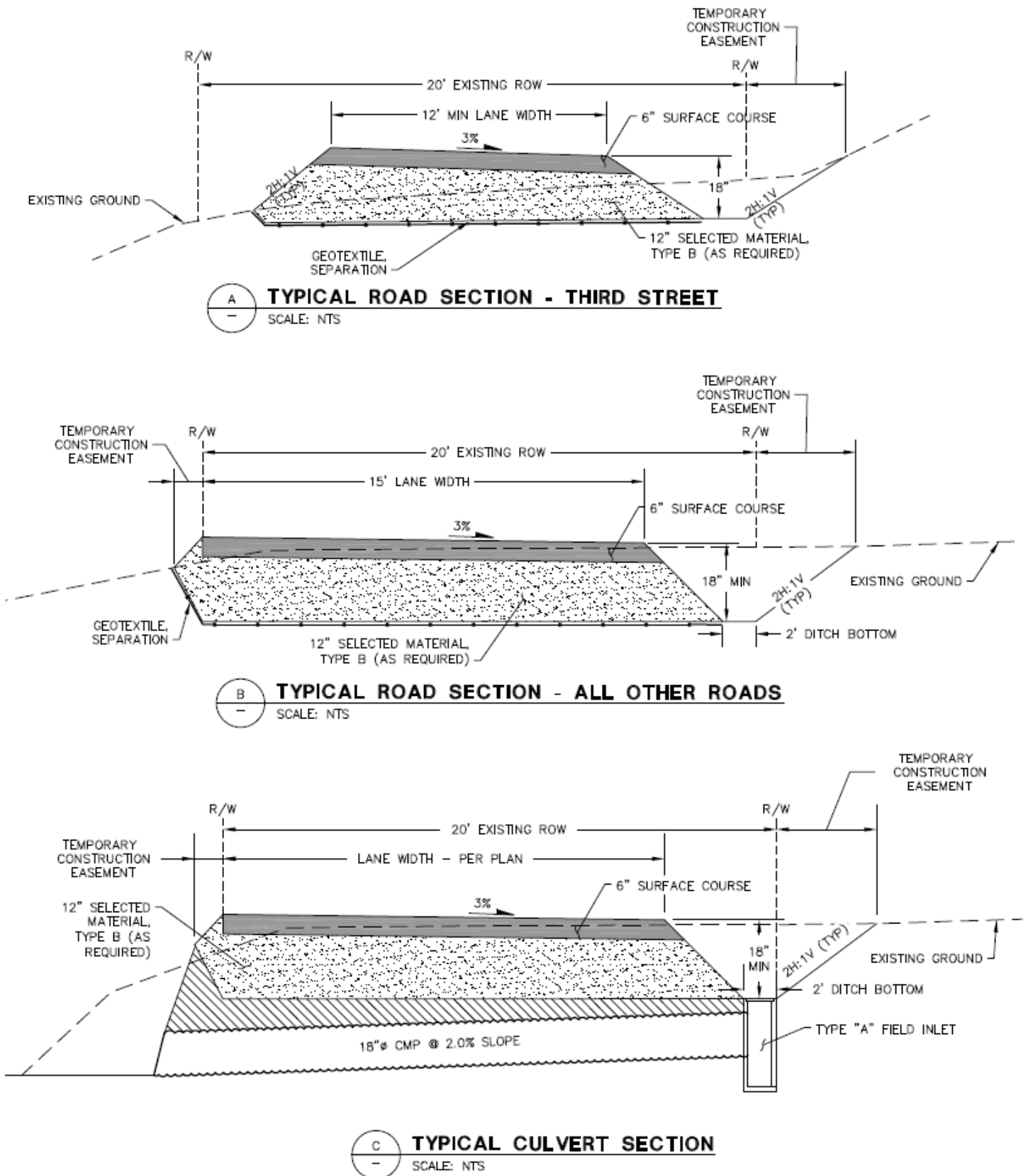


Table 2 Roadway Structural Section

Minimum Thickness (inch)	Material
-	Calcium Chloride, Dust Palliative
6	E-1 Surface Course
12	Select Material – Type B
-	Geotextile Fabric
-	Existing Native Material

The E-1 Surface Course material should be fluvial, alluvial, or hard rock in origin and free of organic and other deleterious matter. The material shall meet the requirements for E-1 material presented in Table 703-2 of the ADOT&PF Standard Specification for Highway Construction (2015).

Table 3 E-1 Surface Course material

Sieve Size	Percent Passing by Weight
1.0"	100
3/4"	70-100
3/8"	50-85
No. 4	35-65
No. 8	20-50
No. 50	15-30
No. 200	8-15

The Select Material (Type B) material can be sand or gravel mined from an approved source, and free of organic and other deleterious matter, contain no particles larger than 6-inches. The material shall meet the requirements for Select Material – Type B presented in Section 703-2.07 of the ADOT&PF Standard Specifications for Highway Construction (2015).

Table 4 Select Material (Type B)

Sieve Size	Percent Passing by Weight
No. 200	0-10

5.4 DRAINAGE

Excess water can have detrimental effects on road sections, so provisions should be included in the design to channel surface waters away from any road sections via engineered drainage control features (swales, culverts, etc.). Existing drainage paths will be maintained by installing cross road culverts, driveway culverts, roadside drainage ditches, and drainage swales. There should be at least 1-foot of base or surface material beneath, around, and above culverts placed in the road section. This material should be compacted to at least 95% relative compaction.

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6.0 CLOSING

Bristol prepared this report for The Manokotak Village Council for the sole purpose of use in the design of the proposed roads. In the event of any significant changes in the design or location of the proposed improvements, the conclusions and recommendations presented in this report may be reviewed and, if necessary, modified to include the proposed changes.

Due to the natural variability of earthen materials, variations in subsurface conditions across the site may exist other than those identified during the course of this report. Therefore, it is recommended that a qualified geotechnical engineer be consulted during construction activities to provide corrective recommendations for any unexpected conditions revealed during construction.

Bristol conducted this evaluation using available subsurface explorations of the project area and with the standard of care expected of professionals of the industry. No warranty expressed or implied is made.

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7.0 REFERENCES

- Alaska Department of Commerce, Community, and Economic Development. (2014). *Community: Manokotak*. Commerce.alaska.gov. Retrieved from <http://commerce.alaska.gov/cra/DCRAExternal/community/Details/b45416b3-6619-4f0a-9a0b-7e236e56992a>
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APPENDIX A

Photographic Log

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**Manokotak Village Council
P.O. Box 169
Manokotak, Alaska 99628**

**SECOND AND THIRD STREET REHABILITATION
PROJECT
MANOKOTAK, ALASKA**

GEOTECHNICAL INVESTIGATION
PHOTOGRAPHIC LOG

October, 2014

Bristol

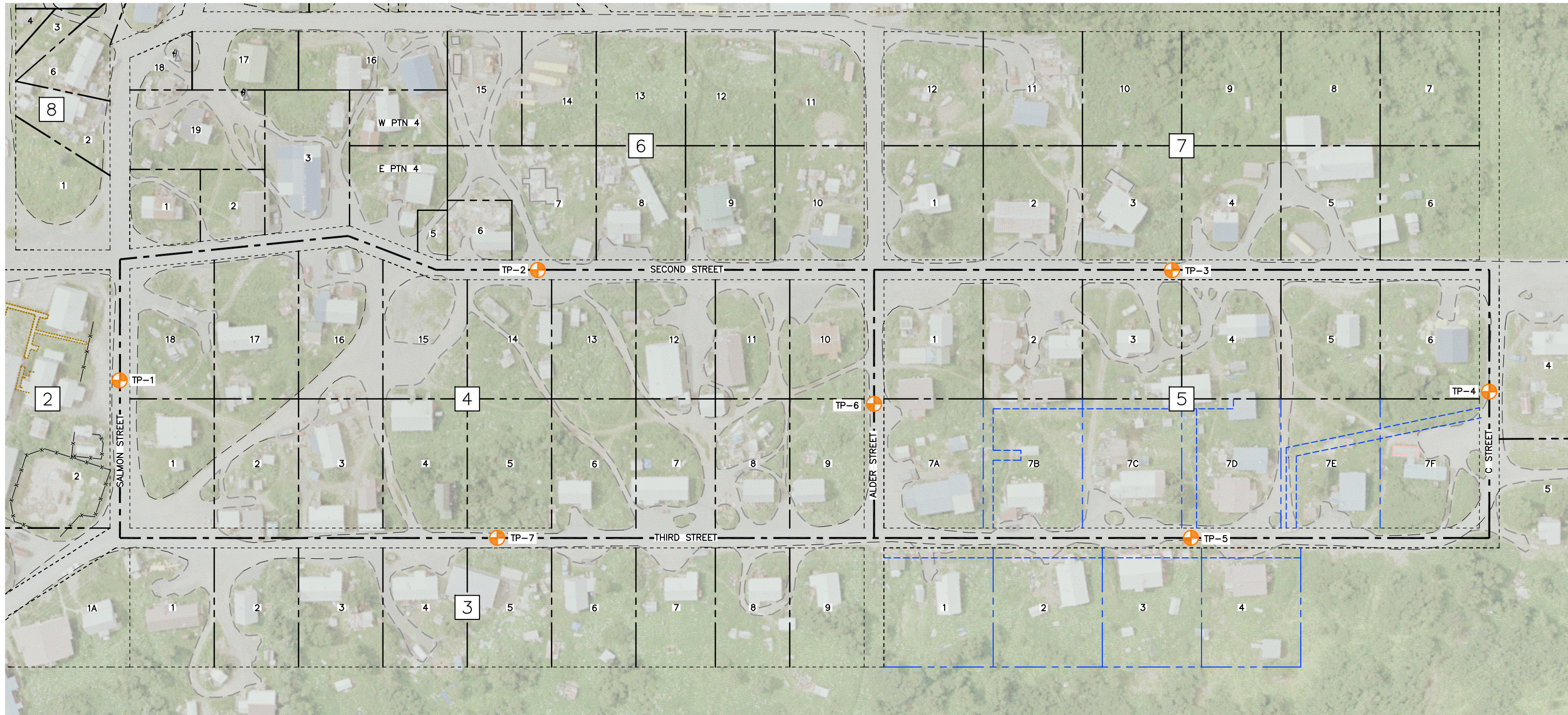


ENGINEERING
SERVICES CORPORATION

Project No. 32150007

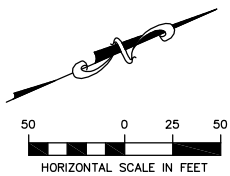
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User: RBURDICK Nov 19, 2014 - 8:51am
 Drawing: K:\JOBS\32150007 KMO REHAB\ACAD-DESIGN\GEOTECH\32150007_TEST PIT LOCATIONS.DWG - Layout: FIG 2
 Xrefs: BR22X34REV.DWG 32150007_BASE_MAP.DWG - Images: MANO1.TIF



LEGEND:

- PROJECT ALIGNMENT
- RIGHT OF WAY
- LOT LINE
- EXISTING ROAD
- LOT NUMBER
- BLOCK NUMBER
- TEST PIT
- 2010 MANOKOTAK SUBDIVISION LOT LINE
- 2010 MANOKOTAK SUBDIVISION EASEMENT



REVISIONS				REVISIONS			
NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

Project No. 32140044

Bristol
 ENGINEERING SERVICES CORPORATION
 Phone (907) 563-0013 Fax (907) 563-6713

SECOND AND THIRD STREET REHABILITATION PROJECT MANOKOTAK, ALASKA					SHEET NO.
GEOTECHNICAL INVESTIGATION TEST PIT LOCATIONS					FIG 2
SCALE: SHOWN	DESIGNED: RWB	CHECKED: IPP	DRAWN: RWB	DATE: NOV 2014	SHEET -- OF --

DRAFT

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PHOTOGRAPHIC SUMMARY

Photo 1 - CAT 420D Wheel Loader

Photo 2 - TP-1 Test Pit Location

Photo 3 - TP-1 Soil Profile

Photo 4 - TP-1 Excavation Material 3.5' BGS

Photo 5 - TP-1 Excavation Material

Photo 6 - TP-2 Test Pit Location

Photo 7 - TP-2 Soil Profile 5' BGS

Photo 8 - TP-2 Excavation Material

Photo 9 - TP-2 Excavation Material

Photo 10 - TP-3 Test Pit Location

Photo 11 - TP-3 Soil Profile 5' BGS

Photo 12 - TP-3 Excavation Material

Photo 13 - TP-4 Test Pit Location

Photo 14 - TP-4 Soil Profile 5' BGS

Photo 15 - TP-4 Excavation Material

Photo 16 - TP-5 Test Pit Location

Photo 17 - TP-5 Excavation Material 3.5' BGS

Photo 18 - TP-5 Soil Profile 5' BGS

Photo 19 - TP-5 Soil Profile 3.5' BGS

Photo 20 - TP-6 Test Pit Location

Photo 21 - TP-6 Soil Profile 5' BGS

Photo 22 - TP-6 Excavation Material 3.5' BGS

Photo 23 - TP-7 Test Pit Location

Photo 24 - TP-7 Soil Profile 6' BGS

Photo 25 - TP-7 Excavation Material

Photo 26 - Dump Hard Rock Pit

Photo 27 - Dump Hard Rock Pit

Photo 28 - Dump Hard Rock Pit

Photo 29 - Dump Hard Rock Pit - Mining Material

Photo 30 - Dump Hard Rock Pit

Photo 31 - Dump Hard Rock Pit

Photo 32 - Dump Hard Rock Pit

Photo 33 - Airport Pit

Photo 34 - Airport Pit

Photo 35 - Airport Pit

Photo 36 - Airport Pit

Photo 37 - Airport Pit

Photo 38 - Airport Pit

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Photo 1 - CAT 420D Wheel Loader



Photo 2 - TP-1 Test Pit Location



Photo 3 - TP-1 Soil Profile



Photo 4 - TP-1 Excavation Material 3.5' BGS



Photo 5 - TP-1 Excavation Material



Photo 6 - TP-2 Test Pit Location



Photo 7 - TP-2 Soil Profile 5' BGS



Photo 8 - TP-2 Excavation Material



Photo 9 - TP-2 Excavation Material



Photo 10 - TP-3 Test Pit Location



Photo 11 - TP-3 Soil Profile 5' BGS



Photo 12 - TP-3 Excavation Material



Photo 13 - TP-4 Test Pit Location



Photo 14 - TP-4 Soil Profile 5' BGS



Photo 15 - TP-4 Excavation Material



Photo 16 - TP-5 Test Pit Location



Photo 17 - TP-5 Excavation Material 3.5' BGS



Photo 18 - TP-5 Soil Profile 5' BGS



Photo 19 - TP-5 Soil Profile 3.5' BGS



Photo 20 - TP-6 Test Pit Location



Photo 21 - TP-6 Soil Profile 5' BGS



Photo 22 - TP-6 Excavation Material 3.5' BGS



Photo 23 - TP-7 Test Pit Location



Photo 24 - TP-7 Soil Profile 6' BGS



Photo 25 - TP-7 Excavation Material



Photo 26 - Dump Hard Rock Pit



Photo 27 - Dump Hard Rock Pit



Photo 28 - Dump Hard Rock Pit



Photo 29 - Dump Hard Rock Pit - Mining Material



Photo 30 - Dump Hard Rock Pit



Photo 31 - Dump Hard Rock Pit



Photo 32 - Dump Hard Rock Pit



Photo 33 - Airport Pit



Photo 34 - Airport Pit



Photo 35 - Airport Pit



Photo 36 - Airport Pit



Photo 37 - Airport Pit



Photo 38 - Airport Pit

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APPENDIX B

Graphical Exploration Logs

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Drawing: K:\JOBS\32150007 KMO REHAB\ACAD-DESIGN\GEO\TECH\32150007_GEO_GRAPHIC_LOGS.DWG -- Layout: LOG KEY
 User: RBURDIGK Jan 28, 2015 -- 11:19am Xrefs: BR_GEO_85X11P_TB.DWG BR_85X11P.DWG -- Images:

MAJOR DIVISION			GRAPHIC SYMBOL	USCS SYMBOL	TYPICAL DESCRIPTIONS	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL SAND MIXTURES, LITTLE OR NO FINES	
		MORE THAN 50% OF COARSE FRACTION RETAINED ON NO.4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF 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
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
		MORE THAN 50% OF COARSE FRACTION PASSING ON NO.4 SIEVE	SAND WITH FINES (APPRECIABLE AMOUNT OF FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SAND WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
FINE GRAINED SOILS	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	
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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, FAT CLAYS	
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

- Standard SPT with 140 pound hammer 30 inch drop and 2.0" O.D. Sampler
- Grab Sample

SECOND AND THIRD STREET REHABILITATION
MANOKOTAK, AK

UNIFIED SOIL CLASSIFICATION (ASTM D2487)

	DATUM:	DATE <u>10/10/14</u>	SHEET 1 of 9
	PROJECTION:	DWN. <u>RWB</u>	
	PROJECT No. 32150007	SCALE <u>NTS</u>	
		APPRVD. <u>IPP</u>	

Drawing: K:\JOBS\32150007 KMO REHAB\ACAD-DESIGN\GEO\TECH\32150007_GEO_GRAPHIC_LOGS.DWG -- Layout: FROST CLASS
 User: RBURDIGK Jan 28, 2015 -- 11:19am Xrefs: BR_GEO_85X11P_TB.DWG BR_85X11P.DWG -- Images:

FROST GROUP	SOIL TYPE	PERCENTAGE FINER THAN 0.02mm BY WEIGHT	TYPICAL SOIL TYPES UNDER UNIFIED SOIL CLASSIFICATION SYSTEM
NFS*	a. Gravels Crushed Stone Crushed Rock	0 - 1.5	GW,GP
	b. Sands	0-3	SW,SP
PFS+	a. Gravels Crushed Stone Crushed Rock	1.5 - 3	GW,GP
	b. Sands	3 - 10	SW,SP
S1	Gravelly Soils	3 - 6	GW, GP, GW-GM, GP-GM
S2	Sandy Soils	3 - 6	SW, SP, SW-SM, SP-SM
F1	Gravelly Soils	6 - 10	GM, GW-GW, GP-GM
F2	a. Gravelly Soils	10 - 20	GM, GW-GW, GP-GM
	b. Sands	6 - 15	SM, SW-SM, SP-SM
F3	a. Gravelly Soils	Over 20	GM, GC
	b. Sands, except very fine Silty Sands	Over 15	SM, SC
	c. Clays, PI > 12	----	CL, CH
F4	a. All Silts	-----	ML, MH
	b. Very Fine Silty Sands	Over 15	SM
	c. Clays, PI > 12	-----	CL, CL-ML
	d. Varved Clays and other fine grained banded sediments	-----	CL, CL-ML, CL & ML CL,CH,& ML CL, CH, ML, & SM
*Non-frost susceptible			
+Possibly frost susceptible, but requires lab testing to determine frost design soils classification			

SECOND AND THIRD STREET REHABILITATION
MANOKOTAK, AK

FROZEN SOIL CLASSIFICATION (ASTM D4083)

Bristol

ENGINEERING
SERVICES CORPORATION

DATUM:	DATE	10/10/14	SHEET 2 of 9
PROJECTION:	DWN.	RWB	
PROJECT No.	SCALE	NTS	
32150007	APPRVD.	IPP	

Drawing: K:\JOBS\32150007 KMO REHAB\ACAD-DESIGN\GEO\TECH\32150007_GEO_GRAPHIC_LOGS.DWG - Layout: TP1
 User: RBURDIGK Nov 19, 2014 - 11:20am Xrefs: BR_GEO_85X11P.DWG BR_85X11P.DWG -- Images:

Description	Graphic Log	Depth (ft.)	Sample Type	Sample I.D.	Field Blows (6"-12"-18")	MC (%)	Frost Depth	Remarks
Silty GRAVEL (GM) with sand, dry		0 0.5 1		TP1-GB		7.3		F.C. = F2 P200 = 17.5%
Organic SILT (OL), Dry		1.5 2						
Light brown SILT (ML) with sand, moist		2 2.5 3 3.5 4 4.5		TP1-GB2		52.2		F.C. = F4 P200 = 76.5%
		5 5.5 6 6.5 7 7.5 8 8.5 9 9.5 10 10.5 11 11.5						



TEST PIT 1
 SALMON STREET
 SECOND AND THIRD STREET REHABILITATION
 MANOKOTAK, AK
 GRAPHICAL SOIL LOG

Sample Method: Excavator Groundwater at Time of Excavation: - ' bgs
 Excavation Company: City of Manokotak Logged By: IPP
 Excavation Date: 10/10/2014 Total Depth: 5 ' bgs
 Equipment: CAT 420D Wheel Loader Drawn: RWB
 Approved: IPP

SHEET
3
 of
 9

Drawing: K:\JOBS\32150007 KMO REHAB\ACAD-DESIGN\GEO\TECH\32150007_GEO_GRAPHIC_LOGS.DWG - Layout: TP2
 User: RBURDIGK Nov 19, 2014 - 11:20am Xrefs: BR_GEO_85X11P.DWG BR_85X11P.DWG - Images:

Description	Graphic Log	Depth (ft.)	Sample Type	Sample I.D.	Field Blows (6"-12"-18")	MC (%)	Frost Depth	Remarks
Silty GRAVEL (GM) with sand, dry		0 0.5						
Medium brown SILT (ML) with sand, moist		1 1.5 2 2.5 3 3.5 4 4.5 5		TP2-GB		51.2		F.C. = F4 P200 = 73.6%
		5.5 6 6.5 7 7.5 8 8.5 9 9.5 10 10.5 11 11.5						

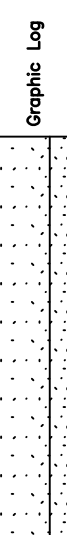

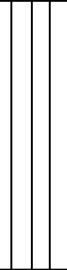


TEST PIT 2
 SECOND STREET
 SECOND AND THIRD STREET REHABILITATION
 MANOKOTAK, AK
 GRAPHICAL SOIL LOG

Sample Method: Excavator Groundwater at Time of Excavation: - ' bgs
 Excavation Company: City of Manokotak Logged By: IPP
 Excavation Date: 10/10/2014 Total Depth: 5 ' bgs
 Equipment: CAT 420D Wheel Loader Drawn: RWB
 Approved: IPP

SHEET
4
 of
 9

Drawing: K:\JOBS\32150007 KMO REHAB\ACAD-DESIGN\GEO\TECH\32150007_GEO_GRAPHIC_LOGS.DWG - Layout: TP3
 User: RBURDIGK Nov 19, 2014 - 11:20am Xrefs: BR_GEO_85X11P.DWG BR_85X11P.DWG -- Images:

Description	Graphic Log	Depth (ft.)	Sample Type	Sample I.D.	Field Blows (6"-12"-18")	MC (%)	Frost Depth	Remarks
Well graded SAND (SW-SM) with silt & gravel, dry		0 0.5 1 1.5 2 2.5		TP3-GB		4.2		F.C. = S2 P200 = 9.0%
Medium brown SILT (ML) with sand, moist		3 3.5 4 4.5 5						
		5.5 6 6.5 7 7.5 8 8.5 9 9.5 10 10.5 11 11.5						



TEST PIT 3
 SECOND STREET
 SECOND AND THIRD STREET REHABILITATION
 MANOKOTAK, AK
 GRAPHICAL SOIL LOG

Sample Method: Excavator Groundwater at Time of Excavation: - ' bgs
 Excavation Company: City of Manokotak Logged By: IPP
 Excavation Date: 10/10/2014 Total Depth: 5 ' bgs
 Equipment: CAT 420D Wheel Loader Drawn: RWB
 Approved: IPP

SHEET
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 of
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Drawing: K:\JOBS\32150007 KMO REHAB\ACAD-DESIGN\GEO\TECH\32150007_GEO_GRAPHIC_LOGS.DWG - Layout: TP4
 User: RBURDIGK Nov 19, 2014 - 11:20am Xrefs: BR_GEO_85X11P.DWG BR_85X11P.DWG - Images:

Description	Graphic Log	Depth (ft.)	Sample Type	Sample I.D.	Field Blows (6"-12"-18")	MC (%)	Frost Depth	Remarks
Silty GRAVEL (GM) with sand, dry		0						
Dark brown organic SILT (OL), Dry		0.5						
Light brown SILT (ML) with sand, moist		1						
		1.5						
		2						
		2.5		TP4-GB		65.5		F.C. = F4 P200 = 73.4%
		3						
		3.5						
		4						
		4.5						
		5						
		5.5						
		6						
		6.5						
		7						
		7.5						
		8						
		8.5						
		9						
		9.5						
		10						
		10.5						
		11						
		11.5						



TEST PIT 4
 C STREET
 SECOND AND THIRD STREET REHABILITATION
 MANOKOTAK, AK
 GRAPHICAL SOIL LOG

Sample Method: Excavator Groundwater at Time of Excavation: - ' bgs
 Excavation Company: City of Manokotak Logged By: IPP
 Excavation Date: 10/10/2014 Total Depth: 5 ' bgs
 Equipment: CAT 420D Wheel Loader Drawn: RWB
 Approved: IPP

SHEET
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 of
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Drawing: K:\JOBS\32150007 KMO REHAB\ACAD-DESIGN\GEO\TECH\32150007_GEO_GRAPHIC_LOGS.DWG - Layout: TP5
 User: RBURDIGK Nov 19, 2014 - 11:21am Xrefs: BR_GEO_85X11P.DWG BR_85X11P.DWG -- Images:

Description	Graphic Log	Depth (ft.)	Sample Type	Sample I.D.	Field Blows (6"-12"-18")	MC (%)	Frost Depth	Remarks
Silty GRAVEL (GM) with sand, dry		0						
		0.5						
		1						
		1.5						
		2						
Silty GRAVEL (GM) with sand, moist		2.5						
		3						
		3.5						
		4						
		4.5		TP5-GB		27.7		F.C. = F3 P200 = 40.5%
		5						
		5.5						
		6						
		6.5						
		7						
		7.5						
		8						
		8.5						
		9						
		9.5						
		10						
		10.5						
		11						
		11.5						



TEST PIT 5
 THIRD STREET
 SECOND AND THIRD STREET REHABILITATION
 MANOKOTAK, AK
 GRAPHICAL SOIL LOG

Sample Method: Excavator Groundwater at Time of Excavation: - ' bgs
 Excavation Company: City of Manokotak Logged By: IPP
 Excavation Date: 10/10/2014 Total Depth: 5 ' bgs
 Equipment: CAT 420D Wheel Loader Drawn: RWB
 Approved: IPP

SHEET
7
 of
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Drawing: K:\JOBS\32150007 KMO REHAB\ACAD-DESIGN\GEO\TECH\32150007_GEO_GRAPHIC_LOGS.DWG - Layout: TP6
 User: RBURDIGK Nov 19, 2014 - 11:21am Xrefs: BR_GEO_85X11P_TB.DWG BR_85X11P.DWG - Images:

Description	Graphic Log	Depth (ft.)	Sample Type	Sample I.D.	Field Blows (6"-12"-18")	MC (%)	Frost Depth	Remarks
Silty GRAVEL (GM) with sand, dry		0						
Organic SILT (OL), dry		0.5						
Brown sandy SILT (ML), moist		1						
		1.5						
		2		TP6-GB		70.7		F.C. = F4 P200 = 68.4%
		2.5						
White sandy SILT (ML), moist		3						
		3.5						
		4						
		4.5						
		5						
		5.5						
		6						
		6.5						
		7						
		7.5						
		8						
		8.5						
		9						
		9.5						
		10						
		10.5						
		11						
		11.5						



TEST PIT 6
 ALDER STREET
 SECOND AND THIRD STREET REHABILITATION
 MANOKOTAK, AK
 GRAPHICAL SOIL LOG

Sample Method: Excavator Groundwater at Time of Excavation: - ' bgs
 Excavation Company: City of Manokotak Logged By: IPP
 Excavation Date: 10/10/2014 Total Depth: 5 ' bgs
 Equipment: CAT 420D Wheel Loader Drawn: RWB
 Approved: IPP

SHEET
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 of
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Drawing: K:\JOBS\32150007 KMO REHAB\ACAD-DESIGN\GEO\TECH\32150007_GEO_GRAPHIC_LOGS.DWG - Layout: TP7
 User: RBURDIGK Nov 19, 2014 - 11:21am Xrefs: BR_GEO_85X11P.DWG BR_85X11P.DWG -- Images:

Description	Graphic Log	Depth (ft.)	Sample Type	Sample I.D.	Field Blows (6"-12"-18")	MC (%)	Frost Depth	Remarks
Poorly graded SAND (SP-SM) with silt & gravel, dry		0 0.5 1 1.5 2 2.5 3		TP7-GB1		3.5		F.C. = PFS P200 = 10.0%
Silty GRAVEL (GM) with sand, moist		3 3.5 4 4.5 5 5.5 6 6.5 7		TP7-GB2		28.8		F.C. = F2 P200 = 21.6%
		7.5 8 8.5 9 9.5 10 10.5 11 11.5						



TEST PIT 7
 THIRD STREET
 SECOND AND THIRD STREET REHABILITATION
 MANOKOTAK, AK
 GRAPHICAL SOIL LOG

Sample Method: Excavator Groundwater at Time of Excavation: - ' bgs
 Excavation Company: City of Manokotak Logged By: IPP
 Excavation Date: 10/10/2014 Total Depth: 7 ' bgs
 Equipment: CAT 420D Wheel Loader Drawn: RWB
 Approved: IPP

SHEET
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 of
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APPENDIX C

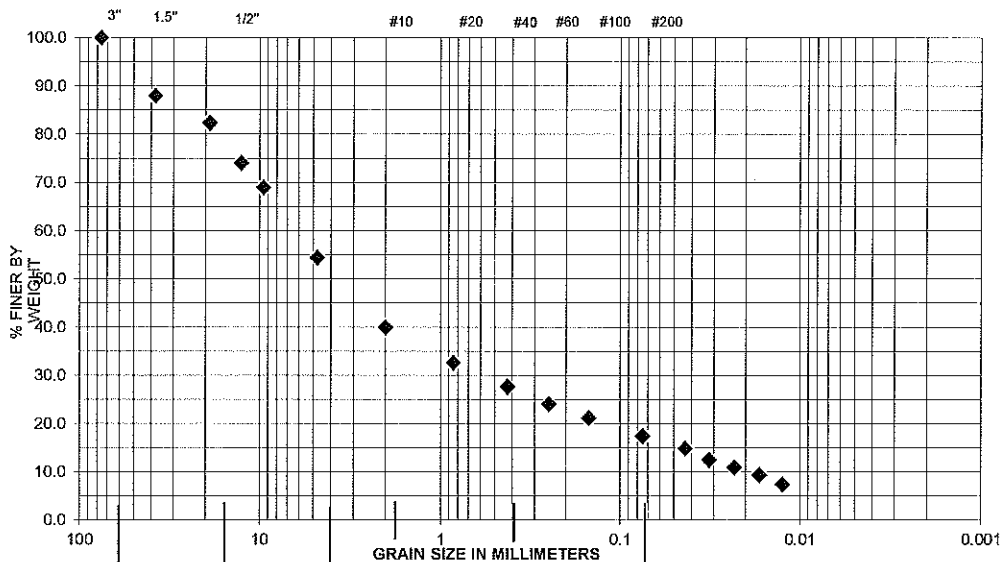
Laboratory Analysis of Samples

(Intentionally Blank)

PROJECT CLIENT:	BESC
PROJECT NAME:	Second and Third Street Rehab.
PROJECT NO.:	3909-14
SAMPLE LOCATION:	T.H. #1
SAMPLE NO/ DEPTH	14-S-1 (Surface)
DESCRIPTION:	Silty gravel w/ sand
DATE TESTED:	10/7/2014
TESTED BY:	JA
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	45.6	USC:	GM
% SAND:	36.9	FC:	F2
% SILT/CLAY:	17.5	.02 mm:	10.2
ASTM D1557(uncorrected)		pcf	
ASTM D4718 (corrected)		pcf	
OPTIMUM M.C. % (corrected)			
NATURAL M.C. %		7.3	

PARTICLE SIZE ANALYSIS ASTM D422/ C136



SIEVE ANALYSIS RESULT

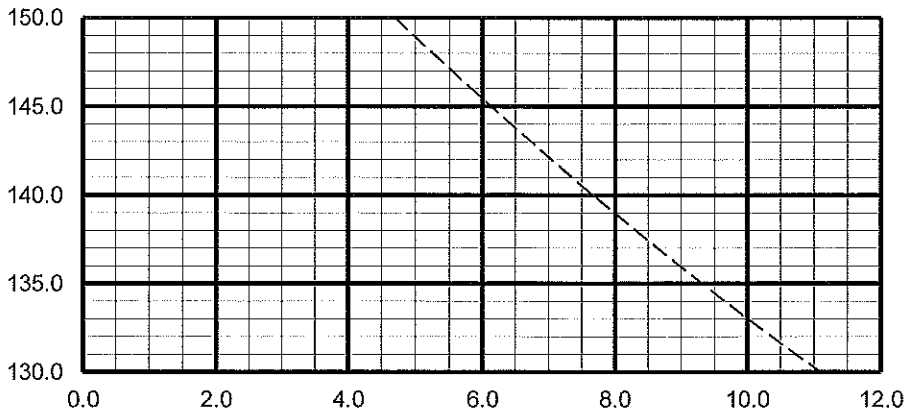
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"	100	
38.1	1.5"	88	
19.05	3/4"	82	
12.7	1/2"	74	
9.5	3/8"	69	
4.75	# 4	54	
2	#10	40	
0.85	#20	33	
0.425	#40	28	
0.25	# 60	24	
0.15	#100	21	
0.075	#200	17.5	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Crs.	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0436	14.8
2	0.0320	12.5
4	0.0231	10.9
8	0.0168	9.4
15	0.0125	7.4
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



Atterberg Limits

(AASHTO T90)

Degradation

(ATM T-13)

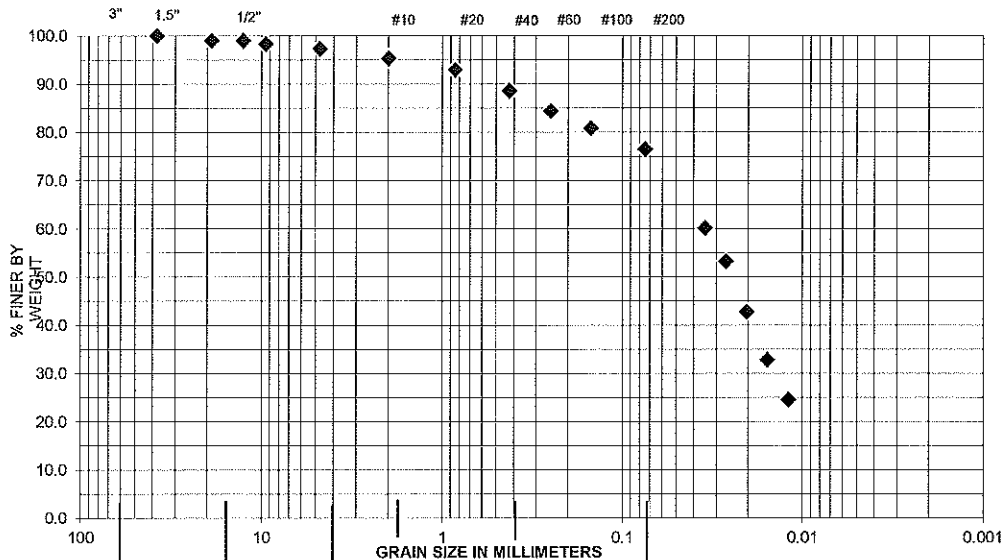
L.A. Abrasion

(AASHTO T 96)

PROJECT CLIENT:	BESC
PROJECT NAME:	Second and Third Street Rehab.
PROJECT NO.:	3909-14
SAMPLE LOCATION:	T.H. #1
SAMPLE NO/ DEPTH	14-S-2 (3.5' BGS)
DESCRIPTION:	Silt with sand
DATE TESTED:	10/7/2014
TESTED BY:	JA
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	2.6	USC:	ML
% SAND:	20.9	FC:	F4
% SILT/CLAY:	76.5	.02 mm:	42.1
ASTM D1557(uncorrected)			pcf
ASTM D4718 (corrected)			pcf
OPTIMUM M.C. % (corrected)			
NATURAL M.C. %			52.2

PARTICLE SIZE ANALYSIS ASTM D422/ C136



SIEVE ANALYSIS RESULT

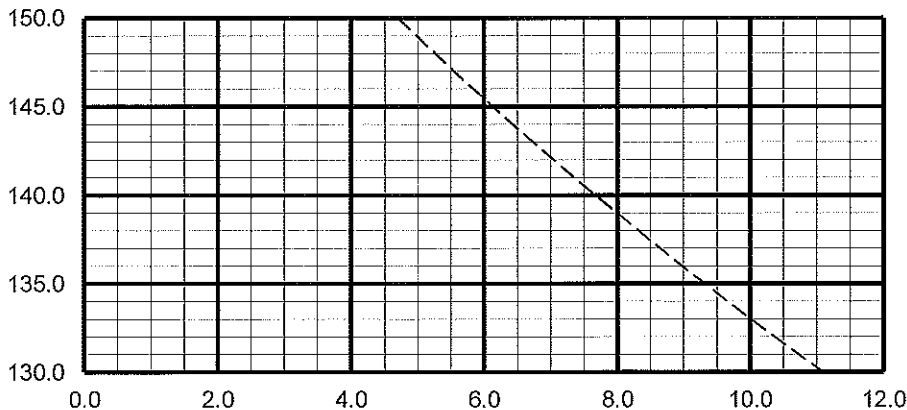
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	99	
12.7	1/2"	99	
9.5	3/8"	98	
4.75	# 4	97	
2	#10	95	
0.85	#20	93	
0.425	#40	89	
0.25	#60	84	
0.15	#100	81	
0.075	#200	76.5	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Crs.	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0348	60.2
2	0.0266	53.3
4	0.0204	42.8
8	0.0156	32.8
15	0.0120	24.6
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



Atterberg Limits

(AASHTO T90)

Degradation

(ATM T-13)

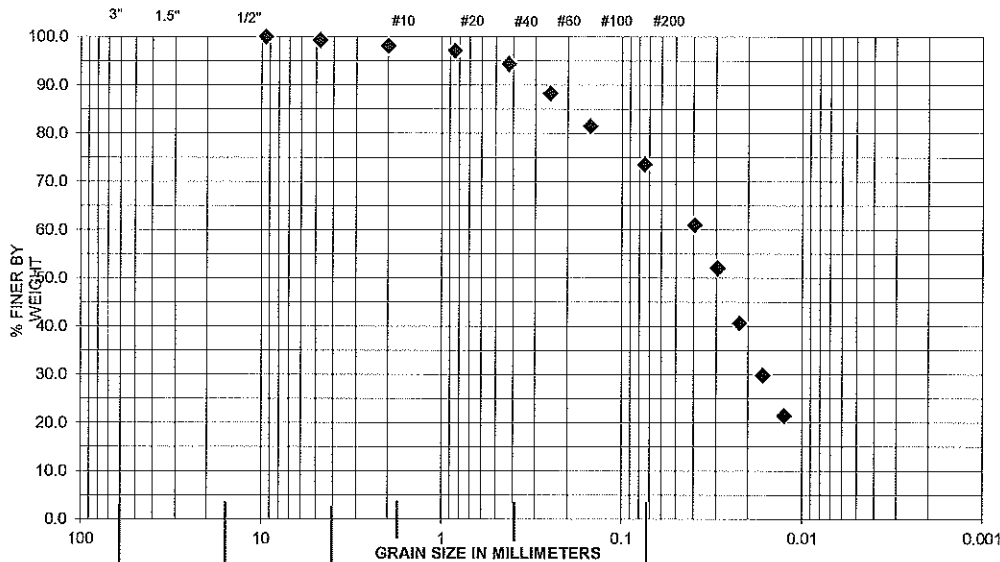
L.A. Abrasion

(AASHTO T 96)

PROJECT CLIENT:	BESC
PROJECT NAME:	Second and Third Street Rehab.
PROJECT NO.:	3910-14
SAMPLE LOCATION:	T.H. #2
SAMPLE NO/ DEPTH	14-S-1 (4' BGS)
DESCRIPTION:	Silt with sand
DATE TESTED:	10/7/2014
TESTED BY:	JA
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	0.7	USC:	ML
% SAND:	25.7	FC:	F4
% SILT/CLAY:	73.6	.02 mm:	36.7
ASTM D1557(uncorrected)			pcf
ASTM D4718 (corrected)			pcf
OPTIMUM M.C. % (corrected)			
NATURAL M.C. %			51.2

PARTICLE SIZE ANALYSIS ASTM D422/ C136



SIEVE ANALYSIS RESULT

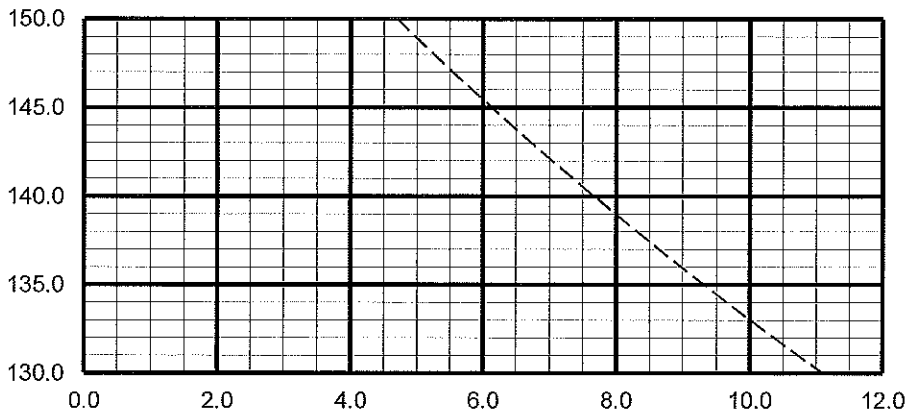
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"		
9.5	3/8"	100	
4.75	# 4	99	
2	#10	98	
0.85	#20	97	
0.425	#40	94	
0.25	# 60	88	
0.15	#100	82	
0.075	#200	73.6	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Crs.	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0396	61.0
2	0.0296	52.0
4	0.0223	40.7
8	0.0166	29.9
15	0.0127	21.5
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



Atterberg Limits

(AASHTO T90)

Degradation

(ATM T-13)

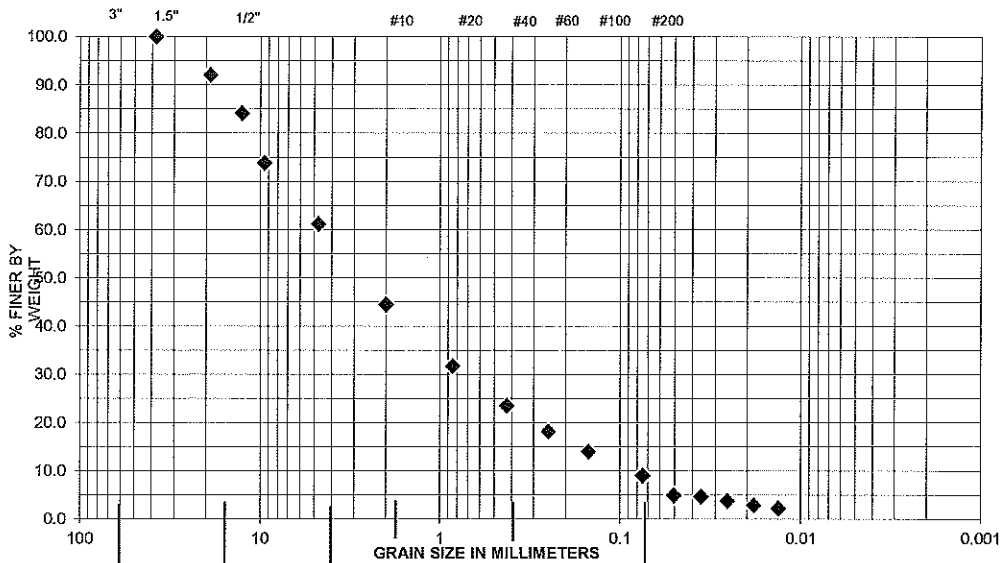
L.A. Abrasion

(AASHTO T 96)

PROJECT CLIENT:	BESC
PROJECT NAME:	Second and Third Street Rehab.
PROJECT NO.:	3909-14
SAMPLE LOCATION:	T.H. #3
SAMPLE NO/ DEPTH:	14-S-1 (1.5' BGS)
DESCRIPTION:	Well grd. sand w/ silt & gravel.
DATE TESTED:	10/7/2014
TESTED BY:	JA
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	38.8	USC:	SW-SM
% SAND:	52.2	FC:	S2
% SILT/CLAY:	9.0	.02 mm:	3.1
ASTM D1557(uncorrected)			pcf
ASTM D4718 (corrected)			pcf
OPTIMUM M.C. % (corrected)			
NATURAL M.C. %			4.2

PARTICLE SIZE ANALYSIS ASTM D422/ C136



SIEVE ANALYSIS RESULT

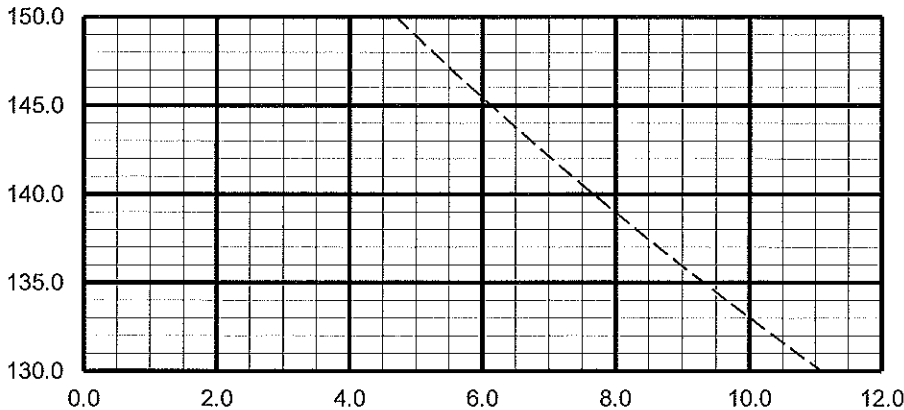
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	92	
12.7	1/2"	84	
9.5	3/8"	74	
4.75	# 4	61	
2	#10	45	
0.85	#20	32	
0.425	#40	23	
0.25	# 60	18	
0.15	#100	14	
0.075	#200	9.0	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Crs.	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0505	4.9
2	0.0360	4.7
4	0.0257	3.8
8	0.0183	2.9
15	0.0134	2.2
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



Atterberg Limits

(AASHTO T90)

Degradation

(ATM T-13)

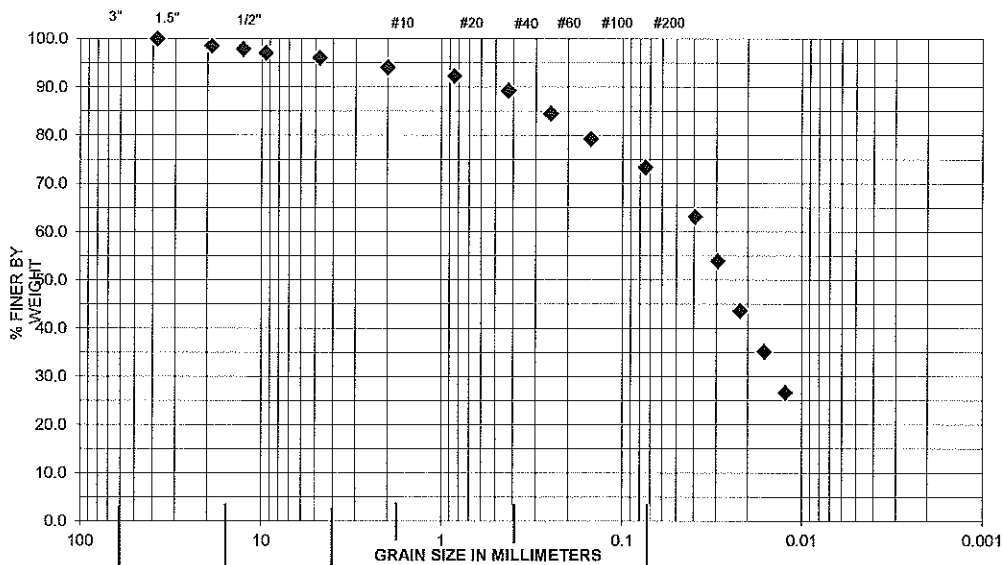
L.A. Abrasion

(AASHTO T 96)

PROJECT CLIENT:	BESC
PROJECT NAME:	Second and Third Street Rehab.
PROJECT NO.:	3909-14
SAMPLE LOCATION:	T.H. #4
SAMPLE NO/ DEPTH	14-S-1 (2' BGS)
DESCRIPTION:	Silt with sand
DATE TESTED:	10/7/2014
TESTED BY:	JA
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	3.9	USC:	ML
% SAND:	22.7	FC:	F4
% SILT/CLAY:	73.4	.02 mm:	40.9
ASTM D1557(uncorrected)			pcf
ASTM D4718 (corrected)			pcf
OPTIMUM M.C. % (corrected)			
NATURAL M.C. %			65.5

PARTICLE SIZE ANALYSIS ASTM D422/ C136



SIEVE ANALYSIS RESULT

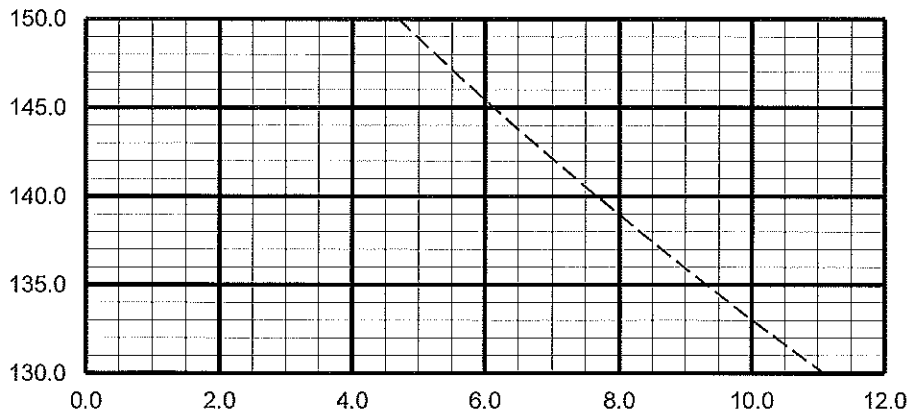
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	99	
12.7	1/2"	98	
9.5	3/8"	97	
4.75	# 4	96	
2	#10	94	
0.85	#20	92	
0.425	#40	89	
0.25	# 60	85	
0.15	#100	79	
0.075	#200	73.4	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Crs.	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0396	63.1
2	0.0296	54.0
4	0.0221	43.7
8	0.0162	35.2
15	0.0124	26.6
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



Atterberg Limits

(AASHTO T90)

Degradation

(ATM T-13)

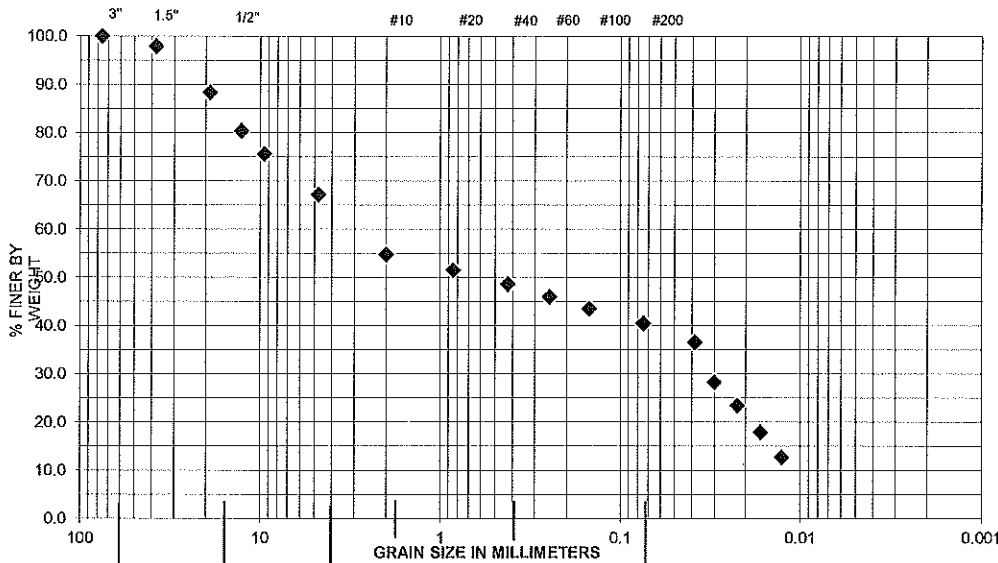
L.A. Abrasion

(AASHTO T 96)

PROJECT CLIENT:	BESC
PROJECT NAME:	Second and Third Street Rehab.
PROJECT NO.:	3909-14
SAMPLE LOCATION:	T.H. #5
SAMPLE NO/ DEPTH	14-S-1 (4' BGS)
DESCRIPTION:	Silty gravel w/ sand
DATE TESTED:	10/7/2014
TESTED BY:	JA
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	32.8	USC:	GM
% SAND:	26.7	FC:	F3
% SILT/CLAY:	40.5	.02 mm:	21.4
ASTM D1557(uncorrected)		pcf	
ASTM D4718 (corrected)		pcf	
OPTIMUM M.C. % (corrected)			
NATURAL M.C. %		27.7	

PARTICLE SIZE ANALYSIS ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Crs.	Medium	Fine	

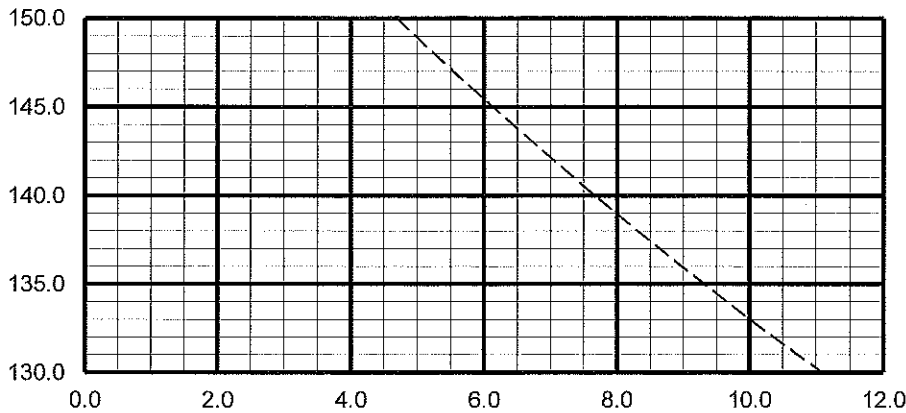
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"	100	
38.1	1.5"	98	
19.05	3/4"	88	
12.7	1/2"	80	
9.5	3/8"	76	
4.75	# 4	67	
2	#10	55	
0.85	#20	51	
0.425	#40	49	
0.25	# 60	46	
0.15	#100	43	
0.075	#200	40.5	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0388	36.6
2	0.0301	28.3
4	0.0223	23.4
8	0.0166	17.9
15	0.0127	12.7
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



Atterberg Limits

(AASHTO T90)

Degradation

(ATM T-13)

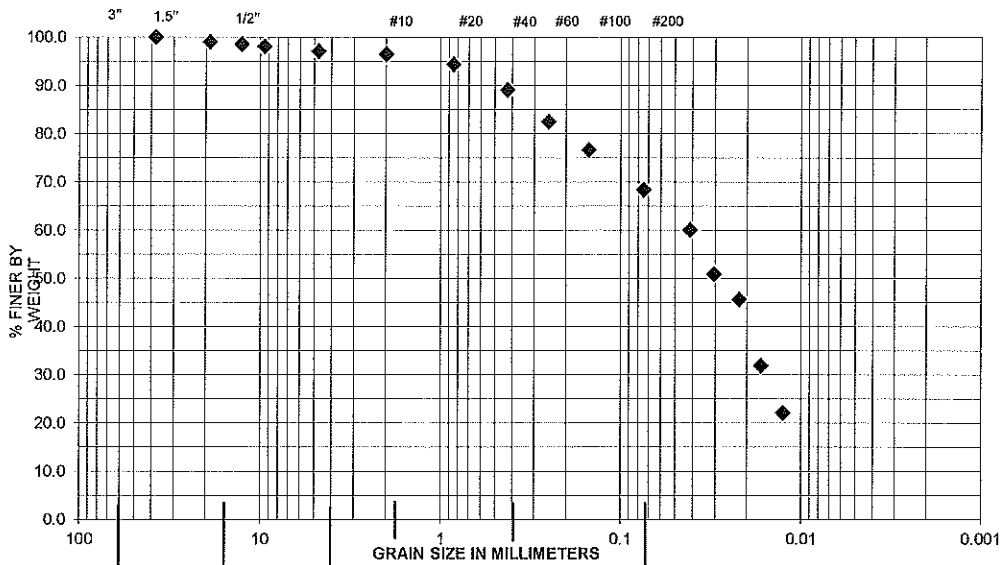
L.A. Abrasion

(AASHTO T 96)

PROJECT CLIENT:	BESC
PROJECT NAME:	Second and Third Street Rehab.
PROJECT NO.:	3909-14
SAMPLE LOCATION:	T.H. #6
SAMPLE NO/ DEPTH	14-S-1 (1.5' BGS)
DESCRIPTION:	Sandy silt
DATE TESTED:	10/7/2014
TESTED BY:	JA
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	2.9	USC:	ML
% SAND:	28.7	FC:	F4
% SILT/CLAY:	68.4	.02 mm:	40.7
ASTM D1557(uncorrected)			pcf
ASTM D4718 (corrected)			pcf
OPTIMUM M.C. % (corrected)			
NATURAL M.C. %			70.7

PARTICLE SIZE ANALYSIS ASTM D422/ C136



SIEVE ANALYSIS RESULT

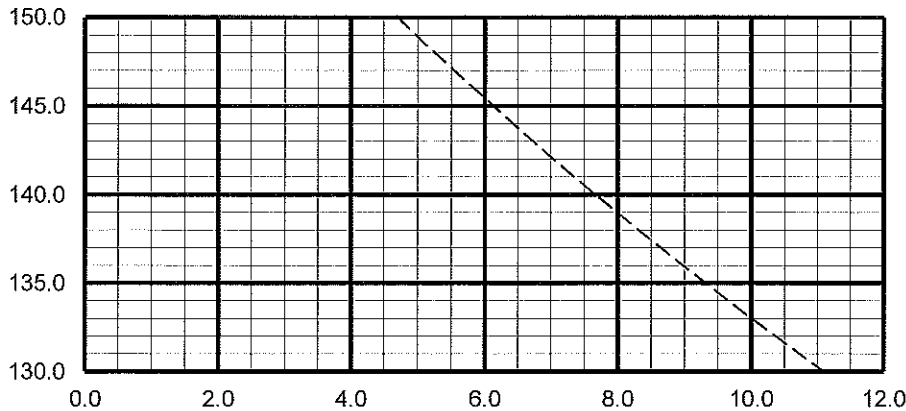
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	99	
12.7	1/2"	99	
9.5	3/8"	98	
4.75	# 4	97	
2	#10	96	
0.85	#20	94	
0.425	#40	89	
0.25	# 60	83	
0.15	#100	77	
0.075	#200	68.4	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Crs.	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0414	60.1
2	0.0305	50.9
4	0.0221	45.7
8	0.0168	31.9
15	0.0127	22.1
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



Atterberg Limits

(AASHTO T90)

Degradation

(ATM T-13)

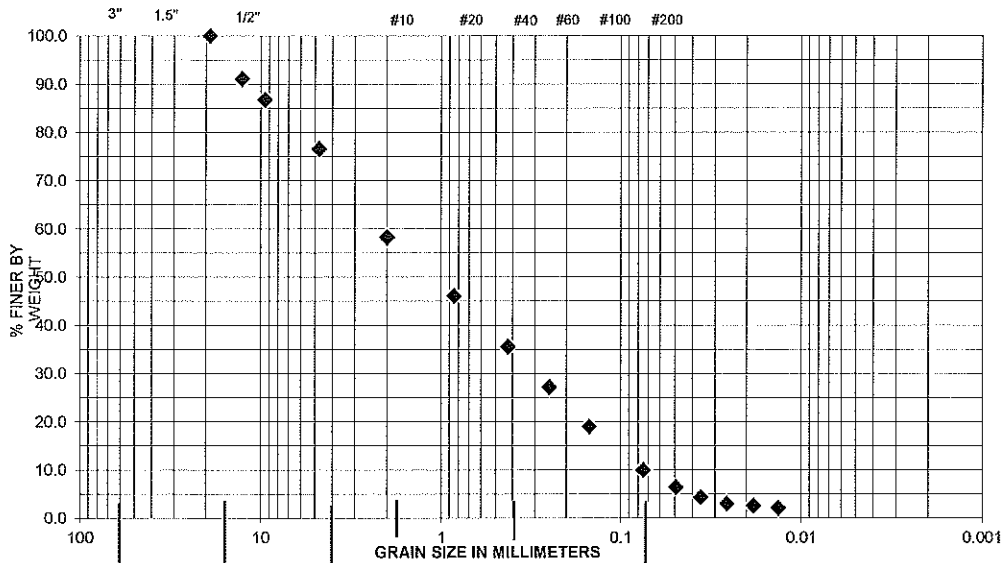
L.A. Abrasion

(AASHTO T 96)

PROJECT CLIENT:	BESC
PROJECT NAME:	Second and Third Street Rehab.
PROJECT NO.:	3909-14
SAMPLE LOCATION:	T.H. #7
SAMPLE NO/ DEPTH	14-S-1 (2' BGS)
DESCRIPTION:	Poorly grd. sand w/ silt & gravel.
DATE TESTED:	10/7/2014
TESTED BY:	JA
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	23.4	USC:	SP-SM
% SAND:	66.6	FC:	PFS
% SILT/CLAY:	10.0	.02 mm:	2.7
ASTM D1557(uncorrected)			pcf
ASTM D4718 (corrected)			pcf
OPTIMUM M.C. % (corrected)			
NATURAL M.C. %			3.5

PARTICLE SIZE ANALYSIS ASTM D422/ C136



SIEVE ANALYSIS RESULT

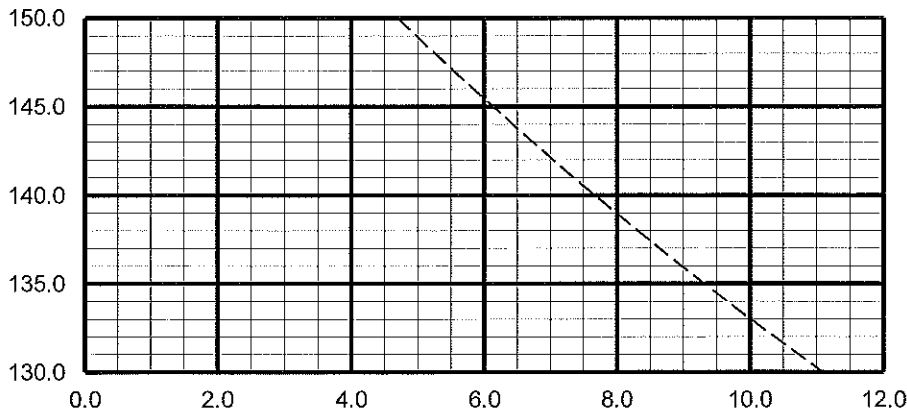
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"	100	
12.7	1/2"	91	
9.5	3/8"	87	
4.75	# 4	77	
2	#10	58	
0.85	#20	46	
0.425	#40	36	
0.25	# 60	27	
0.15	#100	19	
0.075	#200	10.0	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Crs.	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0494	6.5
2	0.0360	4.3
4	0.0257	3.0
8	0.0183	2.6
15	0.0134	2.1
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



Atterberg Limits

(AASHTO T90)

Degradation

(ATM T-13)

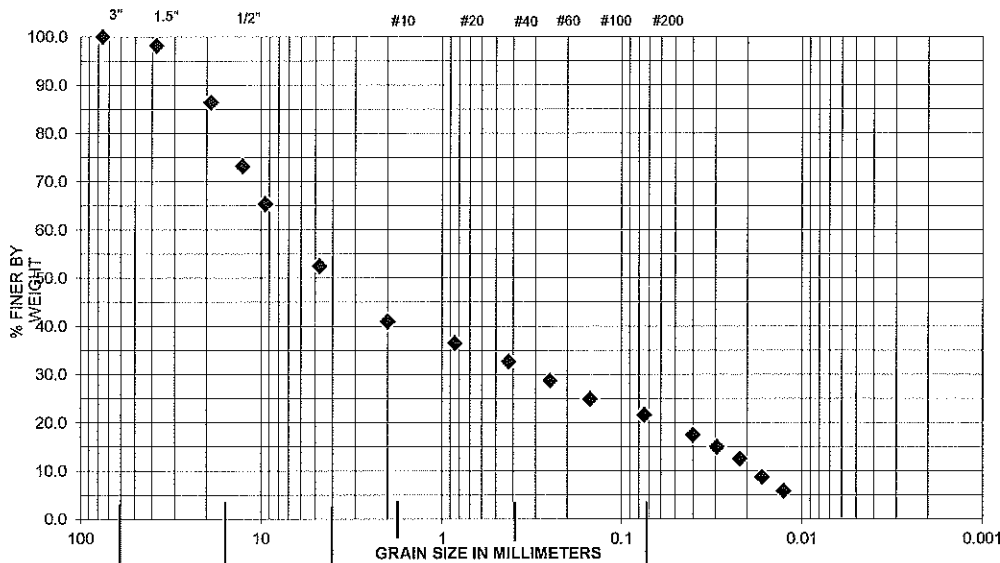
L.A. Abrasion

(AASHTO T 96)

PROJECT CLIENT:	BESC
PROJECT NAME:	Second and Third Street Rehab.
PROJECT NO.:	3909-14
SAMPLE LOCATION:	T.H. #7
SAMPLE NO/ DEPTH	14-S-2 (6' BGS)
DESCRIPTION:	Silty gravel w/ sand
DATE TESTED:	10/7/2014
TESTED BY:	JA
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	47.5	USC:	GM
% SAND:	30.9	FC:	F2
% SILT/CLAY:	21.6	.02 mm:	11.2
ASTM D1557(uncorrected)		pcf	
ASTM D4718 (corrected)		pcf	
OPTIMUM M.C. % (corrected)			
NATURAL M.C. %		28.8	

PARTICLE SIZE ANALYSIS ASTM D422/ C136



SIEVE ANALYSIS RESULT

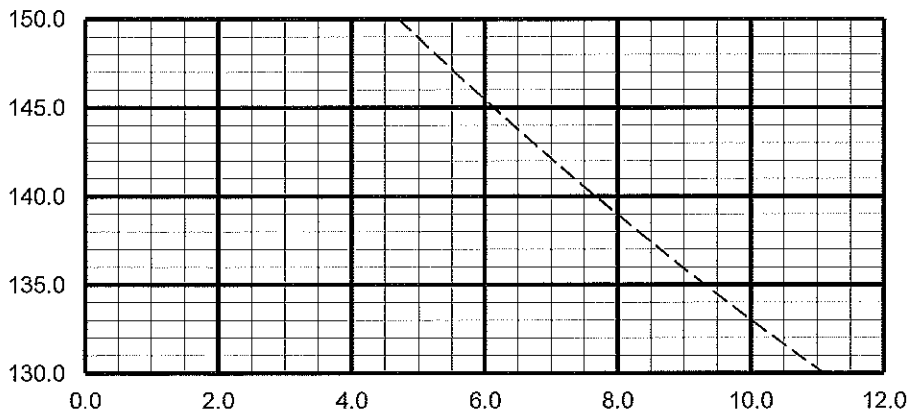
SIEVE SIZE (mm)	SIEVE SIZE (In.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"	100	
38.1	1.5"	98	
19.05	3/4"	86	
12.7	1/2"	73	
9.5	3/8"	65	
4.75	# 4	53	
2	#10	41	
0.85	#20	37	
0.425	#40	33	
0.25	# 60	29	
0.15	#100	25	
0.075	#200	21.6	

COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Crs.	Medium	Fine	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0400	17.4
2	0.0296	15.0
4	0.0221	12.5
8	0.0166	8.7
15	0.0127	5.9
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



Atterberg Limits

(AASHTO T90)

Degradation

(ATM T-13)

L.A. Abrasion

(AASHTO T 96)

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APPENDIX D

Design Calculations

(Intentionally Blank)

Project: SECOND + THIRD ST. REHAB

Computed: RWB

Date: 11/20/2014

Subject: GEOTECH DESIGN CALC'S

Checked:

Date:

Task: SECTION THICKNESS DETERMINATION

Sheet 1 of 2

REFERENCES:

- UFC 3-250-09FA [16 JAN 2004]

KNOWN:

- SOIL GRADATIONS + FROST CLASS OF EXISTING
 - SURFACE COURSE
 - SUBBASE
 - SUBGRADE
- FUTURE ADT OF 74 VEH/DAY

CALCULATIONS:

1) DETERMINE ROAD CLASS

⇒ TABLE 1 UFC 3-250-09FA

ROAD CLASS = E

2) DETERMINE DESIGN INDEX

a) DETERMINE ROAD CATEGORY

⇒ CATEGORY IV - BASED ON TRAFFIC DURING CONSTRUCTION

b) USE ROAD CLASS + CATEGORY TO DETERMINE DESIGN INDEX

⇒ TABLE 2 UFC 3-250-09FA

DESIGN INDEX = 3

Project: <u>SECOND + THIRD ST. REHAB</u>	Computed: <u>RWB</u>	Date: <u>11/20/2014</u>
Subject: <u>GEOTECH DESIGN COMP'S</u>	Checked:	Date:
Task: <u>SECTION THICKNESS DETERMINATION</u>		Sheet <u>2</u> of <u>2</u>

3) DETERMINE FROST SOIL SUPPORT INDEX

• USE WORST CASE FROST GROUP FROM GRADATIONS (F3-F4)

⇒ TABLE 5+6 UFC 3-250-09FA

SUPPORT INDEX = 3.5

4) CHECK CBR VALUE FOR WORST CASE

⇒ SUBGRADE CBR = 3 (ML-SILT)

CBR VALUE (3) < SUPPORT INDEX (3.5)

USE CBR = 3

5) DETERMINE MINIMUM DESIGN THICKNESS

• CBR = 3

• DESIGN INDEX = 3

⇒ FIGURE 1 - UFC 3-250-09FA

MINIMUM THICKNESS = 10.5" ≈ 11"

6) RECOMMENDED SECTION

• 6" SURFACE COURSE OVERLY

• 12" BASE COURSE