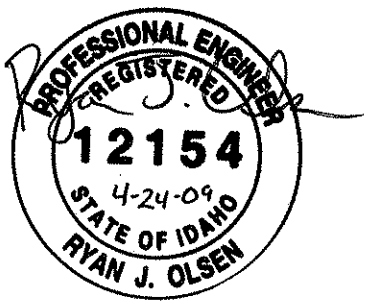
GEOTECHNICAL ENGINEERING REPORT

Proposed Remote Transmitter/Receiver Shelters
Boise Air Terminal
Boise, Idaho

Terracon Project No. 62095017
April 24, 2009

Prepared for:

FEDERAL AVIATION ADMINISTRATION
Renton, Washington



Prepared by:

TERRACON CONSULTANTS, INC.
Boise, Idaho

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TERRACON
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INTRODUCTION

This report contains the results of our geotechnical exploration for the proposed east and west Federal Aviation Administration (FAA) Remote Transmitter/Receiver (RTR) shelters to be located at the Boise Air Terminal in Boise, Idaho. A vicinity map showing the general locations of the two proposed RTR shelters is presented in Appendix A. The exploration consisted of drilling two borings in the area of each of the two shelters (total of four borings) to determine subsurface conditions, performing laboratory testing on representative soil samples, performing engineering analyses of the subsurface soils, and preparing this report, which summarizes the exploration and presents our conclusions and recommendations.

The recommendations contained in this report are based upon the results of our field exploration, laboratory testing, engineering analyses, and our understanding of the proposed project.

PROJECT DESCRIPTION

We understand the proposed project will include removing and replacing the existing RTR shelters at their current locations. The existing structures will be demolished and removed from the site prior to construction of the new shelters. Demolition and construction will be staged to allow operation of one shelter while the other shelter is being replaced. The east RTR shelter is located east of the Boise Terminal, southwest of the intersection of South Development Avenue and West Commerce Avenue. The west RTR shelter is located west of the Boise Terminal between Taxiways “D” and “P”. The two shelters are located on Boise Airport property and in areas leased by the FAA.

The shelters will consist of prefabricated single-story, steel-framed, steel-clad buildings measuring about 24 feet by 24 feet in plan dimensions. Each shelter will weigh approximately 40,000 pounds, including installed equipment.

Proposed site grading plans were not available at the time this report was prepared. We understand the shelters will be constructed near the existing site grade. As the existing ground surface is relatively level, we anticipate that site grading will be relatively minor, generally consisting of cuts and fills of less than 3 feet. We understand there will not be any retaining walls or basements associated with this project.

In the event these structural or grading details are inconsistent with final design criteria, we should be contacted so that we may update our recommendations as needed.

SITE EXPLORATION PROCEDURES

Field Exploration

The subsurface exploration consisted of drilling two borings in the area of each of the proposed shelters (total of four borings). The approximate locations of the borings are shown on the Boring Location Plans, included in Appendix A.

The boring locations were selected by FAA and Terracon personnel, based on locations of underground utilities and drill-rig accessibility. In the field the borings locations were identified by Terracon by measuring from existing site features with a measuring tape. Relative ground surface elevations at the boring locations were measured by Terracon using an engineer's level. Relative elevations reported on the boring logs are rounded to the nearest ½ foot. A temporary benchmark (TBM) was used at each shelter location. The elevation of each TBM was assumed to be 100 feet. Descriptions and approximate locations of the TBMs are shown on each of the Boring Location Plans in Appendix A. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled to depths ranging from about 20 to 21½ feet below the existing ground surface with a CME-75 truck-mounted drill rig. Continuous-flight hollow-stem augers were used to advance the borings. A Terracon field geologist recorded logs of the borings during the drilling operations and scanned the soil samples with a photoionization detector (PID) to record general levels of volatile organic compound vapors. The results of the PID scan are presented on the boring logs.

Disturbed soil samples were obtained at various depths in the borings using a 2-inch-outside-diameter split-spoon sampler driven in general accordance with the Standard Penetration Test (SPT). The result of the SPT is an N-value. The N-value is the number of blows from a 140-pound hammer falling from a height of 30 inches that are required to drive the split-spoon sampler the last 12 inches of an 18-inch interval (or the distance indicated). N-values and descriptions of the materials encountered are on the boring logs.

The N-value provides a reasonable estimate of the relative in-place density of sandy type materials. However, the N-value only provides an indication of the relative stiffness of cohesive materials, since the penetration resistance of these soils may be affected by the moisture content. Considerable care must be exercised in interpreting the N-value in gravelly soils, particularly where the size of the gravel particles exceeds the inside diameter of the sampling spoon.

An automatic SPT hammer was used to advance the split-spoon sampler in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the cathead and rope method. The higher efficiency of the automatic hammer affects the standard penetration resistance blow count (N-value) by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Laboratory Testing

Samples obtained during the field exploration were transferred to the laboratory and were visually classified in general accordance with the Unified Soil Classification System described in Appendix C. Representative samples were selected for testing to determine physical and engineering properties of the subsurface materials. Laboratory tests conducted included moisture content and gradation analysis tests. Results of the laboratory tests are summarized on the boring logs in Appendix A. The graphical results of the gradation tests are presented in Appendix B.

SITE CONDITIONS

East Shelter

The proposed east shelter will be located east of the Boise Air Terminal near the west end of West Commerce Avenue. An existing shelter is in the location of the proposed shelter. Five self-supported antennas and associated equipment were located near the existing shelter. Portions of the ground surface around the existing shelter were covered with gravel fill and portions were bare soil.

West Shelter

The proposed west shelter will be located west of the Boise Air Terminal between Taxiways "D" and "P". An existing shelter is in the location of proposed west shelter. A steel-frame tower is located east of the existing shelter, and a storage shed and electrical transformer are located south of the existing shelter. The ground surface around the existing shelter and tower is covered with areas of asphalt paving and gravel surfacing.

Based on a conversation with representatives of the FAA, we understand that an underground storage tank was previously located south of the existing west shelter. The tank was removed from the site. We understand that the proposed shelter will not be constructed over the area excavated during removal of the tank.

SUBSURFACE CONDITIONS

Soil Conditions

Subsurface conditions encountered at the boring locations are presented on the individual boring logs in Appendix A. Stratification boundaries on the logs represent the approximate depths of changes in soil types; in situ, the transition between materials may be gradual.

East Shelter

Undocumented fill soils were encountered to a depth of about 2 feet below the existing ground surface in each boring drilled for the proposed east shelter (borings B-1 and B-2). The fill encountered generally consisted of mixtures of gravel, sand, and silt to a depth of about ½ to 1 foot, underlain by fill composed of clay with sand to a depth of approximately 2 feet. These soils were underlain by silty sand to depths of about 7½ to 8½ feet. Portions of these soils were cemented. These soils were followed by gravel with sand and varying amounts of silt to the maximum depths explored.

West Shelter

The ground surface at boring B-3 was covered with a thin layer of gravel. Asphalt pavement covered the ground surface at boring B-4. Undocumented fill composed of lean to fat clay with varying amounts of sand was encountered to a depth of about 6 feet below the existing site grade within both borings B-3 and B-4. The fill was generally underlain by mixtures of sand, gravel, and silt to the maximum depths explored. In boring B-3 an interbedded stratum of clayey sand was encountered at a depth of about 6 to 7 feet, and a basalt boulder was encountered at a depth of about 16 to 18 feet below the existing ground surface.

Groundwater Conditions

The borings were monitored during drilling for the presence and level of groundwater. Groundwater was not encountered during our drilling activities. Fluctuations of the depth to groundwater may occur due to seasonal variations in the amount of irrigation, rainfall, runoff, and other factors not evident at the time the borings were performed. Evaluation of these factors is beyond the scope of this exploration.

We reviewed logs available from the Idaho Department of Water Resources of four wells on properties located within approximately 1,500 feet of either shelter location. Groundwater was recorded on these logs at depths greater than approximately 100 feet below the existing ground surface.

ENGINEERING RECOMMENDATIONS

Geotechnical Considerations

Based on information obtained from the subsurface exploration, the RTR sites appears suitable to support lightly loaded shallow footings and floor slabs. The primary geotechnical consideration identified during our exploration is the presence of uncontrolled fill encountered within the proposed east and west shelter areas to depths of about 2 feet and 6 feet below the existing ground surface, respectively. This undocumented fill is not suitable for support of the proposed RTR shelters. Specific conclusions and recommendations regarding the undocumented fill and other geotechnical aspects of design and construction are presented in the following sections.

Earthwork

Prior to construction, deleterious materials such as vegetation, root systems, topsoil, existing fill, and debris, as well as soft, wet, frozen, or otherwise unsuitable materials should be removed from the proposed building areas.

Undocumented fill was encountered in the borings for the east and west shelters to depths of about 2 feet and 6 feet below the existing site grade, respectively. This fill is not suitable for support of the proposed RTR shelters and should be removed from the proposed building areas. In addition, any soils disturbed during demolition of the existing structures should be removed prior to construction. Removal of these soils should extend laterally beyond the edges of the proposed footings at least a distance equal to the depth of removed soils below the footing.

After the recommended soils have been removed and the subgrade cut to grade, the top 8 inches of the subgrade soils in building areas should be scarified and moisture conditioned to near optimum moisture content and compacted to the requirements outlined in Table 1 – Compaction Requirements. The construction area should be free of mounds and depressions that could prevent uniform compaction.

Structural fill placed beneath the building areas should be 6-inch minus soil and rock meeting the requirements of the Idaho Standards for Public Works Construction (ISPWC), Section 801. Fill should be placed in maximum 8-inch thick loose lifts, adjusted to near optimum moisture content, and compacted to the minimum percentages of either maximum dry density or relative density shown in Table 1, whichever is appropriate for the material being used. Fill and backfill should be approved by the geotechnical engineer. Each lift of fill should be tested at various locations within the building areas to verify it meets the density requirements in Table 1.

TABLE 1 – COMPACTION REQUIREMENTS

Location	Percent of Maximum Dry Density, ASTM D698	Percent Relative Density, ASTM D4253/D4254
Beneath buildings and slabs	98	80
Other areas of fill and backfill, including exterior building backfill	95	75

Grading operations should be controlled to prevent water from flowing into construction areas. Excessive wetting or drying of the foundation soils should be avoided during construction. Excess water should be promptly removed.

The near surface fine-grained soils will likely be susceptible to rutting or pumping under construction traffic when wet. Soils that become rutted, pumped, or otherwise disturbed are not suitable for support of foundations or floor slabs and should be removed and replaced with structural fill.

Measures that may help reduce the potential for soil disturbance include performing earthwork during warm, dry weather when wet soil may be scarified and allowed to dry. Other measures that may be considered include the use of light track-mounted equipment and avoidance of heavy repeated traffic over a given area.

A note to the contractor should be included in the project documents indicating the potential for encountering moisture sensitive subgrade soils on this project. The note should indicate that these soils may be prone to rutting or pumping under construction equipment when wet. The note should also indicate the contractor is solely responsible for protecting the subgrade from rutting and pumping during construction. The contractor should be responsible for determining how this is best achieved.

The contractor is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom and for protecting existing facilities/utilities. Excavations should be sloped or shored in accordance with local, state, and federal regulations, including current OSHA excavation and trench safety standards.

Foundation Systems

As discussed in the Earthwork Section of this report, undocumented fill was encountered in the borings for the east and west shelters to depths of about 2 feet and 6 feet below the existing site grade, respectively. This fill is not suitable for support of the proposed RTR shelters and should be removed from the proposed building areas. In addition, any soils disturbed during demolition of the existing structures and any other deleterious material should be removed prior to construction.

Footings bearing on native soil or on structural fill, as described in the Earthwork Section of this report, may be sized using an allowable bearing pressure of 2,000 pounds per square foot (psf) based on minimum footing widths of 18 inches for strip footings and 30 inches for isolated column footings. This allowable bearing capacity may be increased by 1/3 for support of temporary loads such as those generated by wind and seismic events. Exterior footings should be founded a minimum of 30 inches below the adjacent finished grade for frost protection.

To evaluate the sliding resistance of footings, an ultimate coefficient of friction value of 0.35 should be used. A minimum factor of safety of 1.5 should be applied for sliding.

Footings designed and constructed as recommended are expected to experience about 1 inch or less of settlement. Differential settlements are typically about ½ to ¾ of total settlements for similarly supported footings.

Care should be taken when excavating the foundations to avoid disturbing the supporting soils. Soils that become excessively rutted, pumped, or otherwise disturbed are not suitable for support of foundations or slabs and should be removed and replaced with compacted granular fill, lean concrete, or gravel.

Floor Slab Design and Construction

We anticipate that floor slabs will be lightly loaded. After placing structural fill, floor slabs on grade should be supported on at least 6 inches of ¾-inch-minus crushed aggregate base. The crushed aggregate base should conform to the requirements of the ISPWC, Section 802 – ¾ inch Type I, and should be compacted in accordance with Table 1.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will support equipment sensitive to moisture, or when the slab will be covered with wood, tile, carpet or other moisture-sensitive or impervious coverings. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302 and ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Seismic Considerations

Based on the nature of the subsurface materials, Site Class C should be used for the design of structures for the proposed project (2006 International Building Code, Table No. 1613.5.2). Interpolations of mapped spectral accelerations (Site Class B) for short periods, S_s, and for a 1-second period, S_1, are 0.30g and 0.10g, respectively.

Due to the anticipated depth to groundwater and the very dense soils encountered, it is our opinion that the potential risk of soil liquefaction is low.

GENERAL COMMENTS

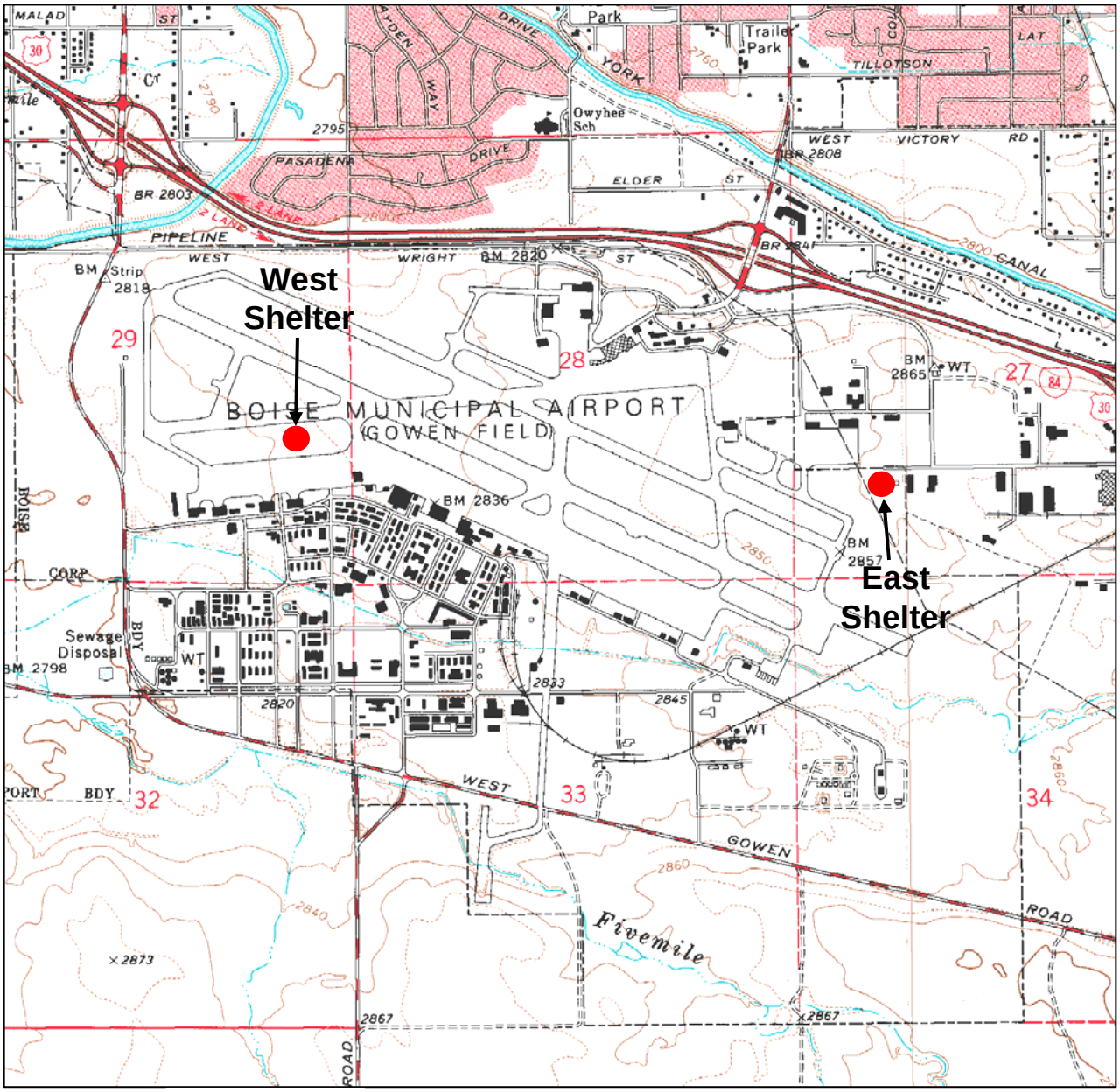
Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide testing and observation during excavation, grading, foundation, and construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this report does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A



SCALE 1:24,000

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

Solid Contour Interval 20 feet

N

U.S.G.S. 7.5 MINUTE SERIES TOPOGRAPHIC MAP

BOISE SOUTH, IDAHO QUADRANGLE

Dated 1972, Photoinspected 1976

FIGURE 1 - VICINITY MAP
FAA Remote Transmitter/Receiver Shelters
Boise Air Terminal
Boise, Idaho

Proj. Mngr: KCH	Terracon	Proj. #62095017
Designed by: BLP	11849 W. Executive Drive, Suite G Boise, Idaho 83713	FN: Figure1.ppt
Drawn by: BLP		Date: 04/20/09

APPROXIMATE SCALE:

0 25 50 feet

N

NOTES:

1. Locations are approximate.
2. Temporary Benchmark is the top of a concrete pad (northeast corner) supporting a shed with an assumed elevation of 100 feet.

LEGEND:

Boring Location

Temporary Benchmark (TBM)

FIGURE 2 – BORING LOCATION PLAN
East FAA RTR Shelter
Boise, Idaho

Proj. Mngr: KCH	Terracon	Proj. # 62085017
Designed by: BLP	11849 W. Executive Drive, Suite G Boise, Idaho 83713	FN: Figure2.ppt
Drawn by: BLP		Date: 04/21/09

APPROXIMATE SCALE:

0 40 80 feet

N

NOTES:

1. Locations are approximate.
2. Temporary Benchmark is the top center of an FAA manhole cover with an assumed elevation of 100 feet.

LEGEND:

Boring Location

Temporary Benchmark (TBM)

FIGURE 3 – BORING LOCATION PLAN
West FAA RTR Shelter
Boise, Idaho

Proj. Mngr: KCH	Terracon	Proj. # 62085017
Designed by: BLP	11849 W. Executive Drive, Suite G Boise, Idaho 83713	FN: Figure3.ppt
Drawn by: BLP		Date: 04/21/09

LOG OF BORING NO. B-1

CLIENT **Federal Aviation Administration**

PROJECT **Remote Transmitter/Receiver (RTR) Shelters Boise, Idaho**

SITE **East Shelter**

Approx. Surface Elev.: 100.5 ft

GRAPHIC LOG	DESCRIPTION		DEPTH, ft	SAMPLES: SAMPLE TYPE	RECOVERY, ft	SPT - N, BLOWS / ft	TESTS: WATER CONTENT, %	ATTERBERG LIMITS, LL / PI	%<NO. 200 SIEVE	IN-PLACE DRY UNIT WEIGHT,pcf	P.I.D. (PPM)
	0.5 FILL: Gravel with Silt and Sand; medium dense, moist, brown	100		SS	1.1	16					3
	2 FILL: Clay with Sand; very stiff, moist, trace of gravel, brown	98.5									
	Silty Sand; medium dense to very dense, moist, scattered strata of cemented soils, trace of gravel, light brown			SS	0.9	18	24		30		2
			5	SS	1.5	61	27				1
	7.5	93									
	Gravel with Sand; dense to very dense, moist, light brown			SS	0.7	48					4
			10	SS	0.3	50/0.4					2
			15	SS	1.1	78					1
	20.2	80.3	20	SS	0.2	50/0.2					1
	BOTTOM OF BORING										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL DEPTH(S), ft		
WL	N/E	WD
WL		
WL		

Terracon

BORING STARTED	4-7-09		
BORING COMPLETED	4-7-09		
RIG	CME-75	LOGGED BY	BLP
APPROVED	RJO	JOB #	62095017

LOG OF BORING NO. B-2

CLIENT **Federal Aviation Administration**

PROJECT **Remote Transmitter/Receiver (RTR) Shelters Boise, Idaho**

SITE **East Shelter**

Approx. Surface Elev.: 101 ft

GRAPHIC LOG	DESCRIPTION			DEPTH, ft	SAMPLES: SAMPLE TYPE	RECOVERY, ft	SPT - N, BLOWS / ft	TESTS: WATER CONTENT, %	ATTERBERG LIMITS, LL / PI	%<NO. 200 SIEVE	IN-PLACE DRY UNIT WEIGHT,pcf	P.I.D. (PPM)
	FILL: Silty Sand with Gravel; medium dense, moist, brown	1	100		SS	1.2	13					3
	FILL: Clay with Sand; stiff, moist, scattered lenses of sandy silt,brown	2	99									
	Silty Sand; very dense, moist, moderately to strongly cemented, light brown				SS	1.3	72					3
				5	SS	0.9	50/0.5					3
	More silt and trace of gravel below 7 feet				SS	1.2	55	13		42		10
	Gravel with Silt and Sand; very dense, moist, brown	8.5	92.5									
				10	SS	0.5	50/0.2	2		8		5
	Lenses of Sand with Gravel 12.5 to 15 feet											
				15	SS	0.5	50/0.2					5
				20	SS	0.9	89/0.9					1
		21.4	79.6									
	BOTTOM OF BORING											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL DEPTH(S), ft			
WL	N/E	WD	
WL			
WL			

Terracon

BORING STARTED	4-7-09		
BORING COMPLETED	4-7-09		
RIG	CME-75	LOGGED BY	BLP
APPROVED	RJO	JOB #	62095017

LOG OF BORING NO. B-3

CLIENT **Federal Aviation Administration**

PROJECT **Remote Transmitter/Receiver (RTR) Shelters Boise, Idaho**

SITE **West Shelter**

Approx. Surface Elev.: 99.5 ft

DEPTH, ft	DESCRIPTION	SAMPLE TYPE	RECOVERY, ft	SPT - N, BLOWS / ft	WATER CONTENT, %	ATTERBERG LIMITS, LL / PI	%<NO. 200 SIEVE	IN-PLACE DRY UNIT WEIGHT,pcf	P.I.D. (PPM)
0.1	FILL: Gravel; loose, gray (99.4)	SS	1.1	8					3
2	FILL: Clay with Sand; medium stiff to stiff, moist, trace of gravel, brown (97.5)								
4.5	FILL: Clay; stiff, moist, brown (95)	SS	1.2	9					3
6	FILL: Fat Clay; stiff, moist, trace of gravel, brown (93.5)	SS	1.2	16					3
7	Clayey Sand; medium dense, moist, trace of gravel, orange brown (92.5)								
9	Silty Gravel with Sand; very dense, moist, orange brown (90.5)	SS	0.4	50/0.4	7		12		2
14	Gravel with Sand; very dense, moist, brown (85.5)	SS	0.8	50/0.5					3
18	Silty Gravel with Sand; medium dense, moist, scattered clay layers, brown to orange brown Basalt boulder from 16 to 18 feet (81.5)	SS	0.8	50/0.4					0
20.3	Gravel with Silt and Sand; very dense, dry, brown (79.2)	SS	0.3	50/0.3					0
	BOTTOM OF BORING								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL DEPTH(S), ft		
WL	▽ N/E	WD ▼
WL	▼	▼
WL		

Terracon

BORING STARTED	4-7-09		
BORING COMPLETED	4-7-09		
RIG	CME-75	LOGGED BY	BLP
APPROVED	RJO	JOB #	62095017

LOG OF BORING NO. B-4

CLIENT **Federal Aviation Administration**

PROJECT **Remote Transmitter/Receiver (RTR) Shelters Boise, Idaho**

SITE **West Shelter**

Approx. Surface Elev.: 100 ft

DEPTH, ft	DESCRIPTION	SAMPLE TYPE	RECOVERY, ft	SPT - N, BLOWS / ft	WATER CONTENT, %	ATTERBERG LIMITS, LL / PI	%<NO. 200 SIEVE	IN-PLACE DRY UNIT WEIGHT,pcf	P.I.D. (PPM)
0.25	Asphaltic Concrete (3 inches) 99.7	SS	1.1	4					3
	Fill: Clay with Sand; medium stiff to stiff, moist, trace of gravel, brown								
		SS	1.1	13					3
5		SS	1.0	15					6
6	94								
7	Silty Sand; medium dense, moist, orange brown 93								
	Silty Sand with Gravel; very dense, moist, orange brown	SS	0.9	50/0.2					4
9.5	90.5								
	Gravel with Silt and Sand; very dense, moist, brown								
10		SS	0.5	50/0.2					1
14.5	85.5								
	Sand with Silt; medium dense, moist, trace of gravel, brown								
15		SS	1.4	28	7		10		2
17	83								
	Gravel with Silt and Sand; very dense, moist, brown								
20		SS	0.5	50/0.2					1
20.7	79.3								
	BOTTOM OF BORING								

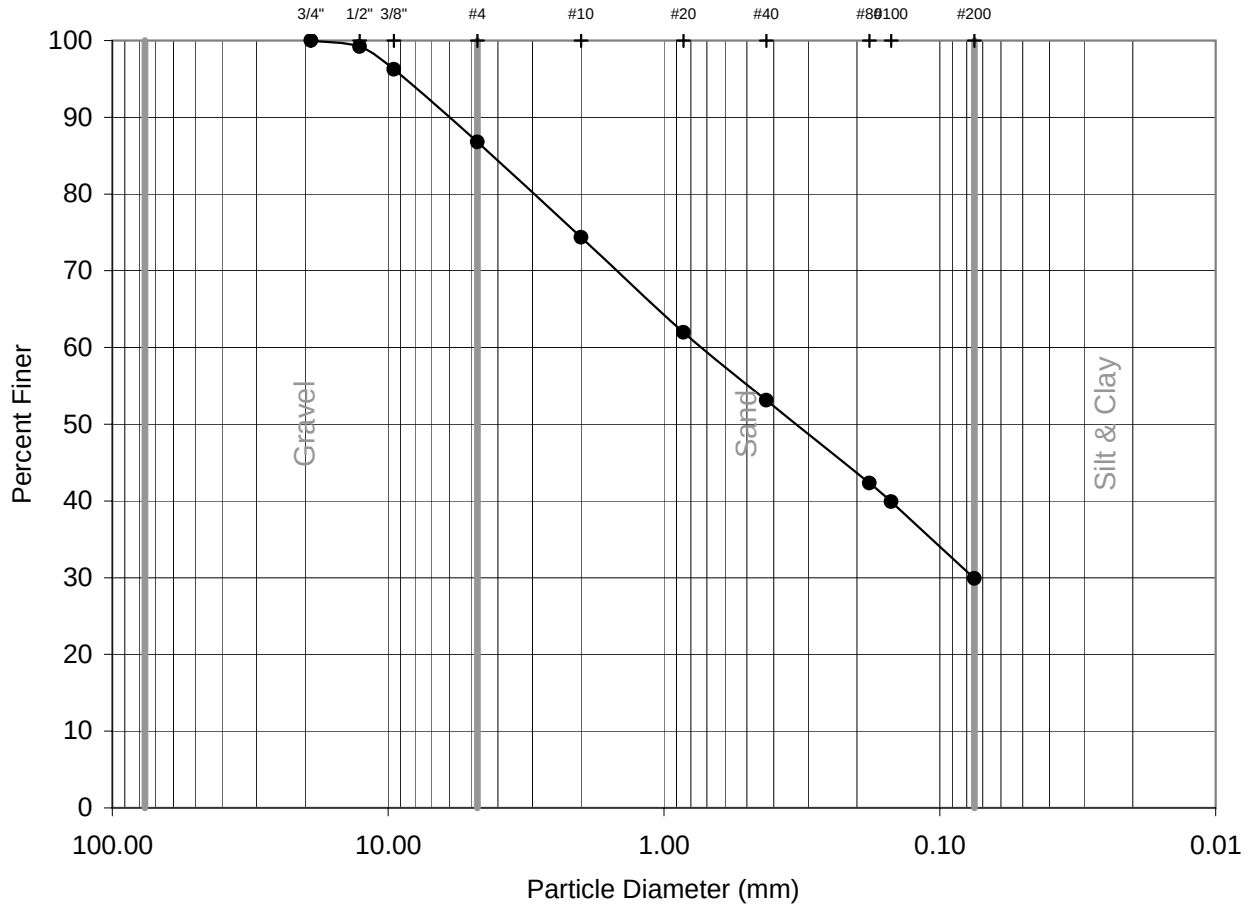
The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL DEPTH(S), ft		
WL	N/E	WD
WL		
WL		

Terracon

BORING STARTED	4-7-09		
BORING COMPLETED	4-7-09		
RIG	CME-75	LOGGED BY	BLP
APPROVED	RJO	JOB #	62095017

APPENDIX B

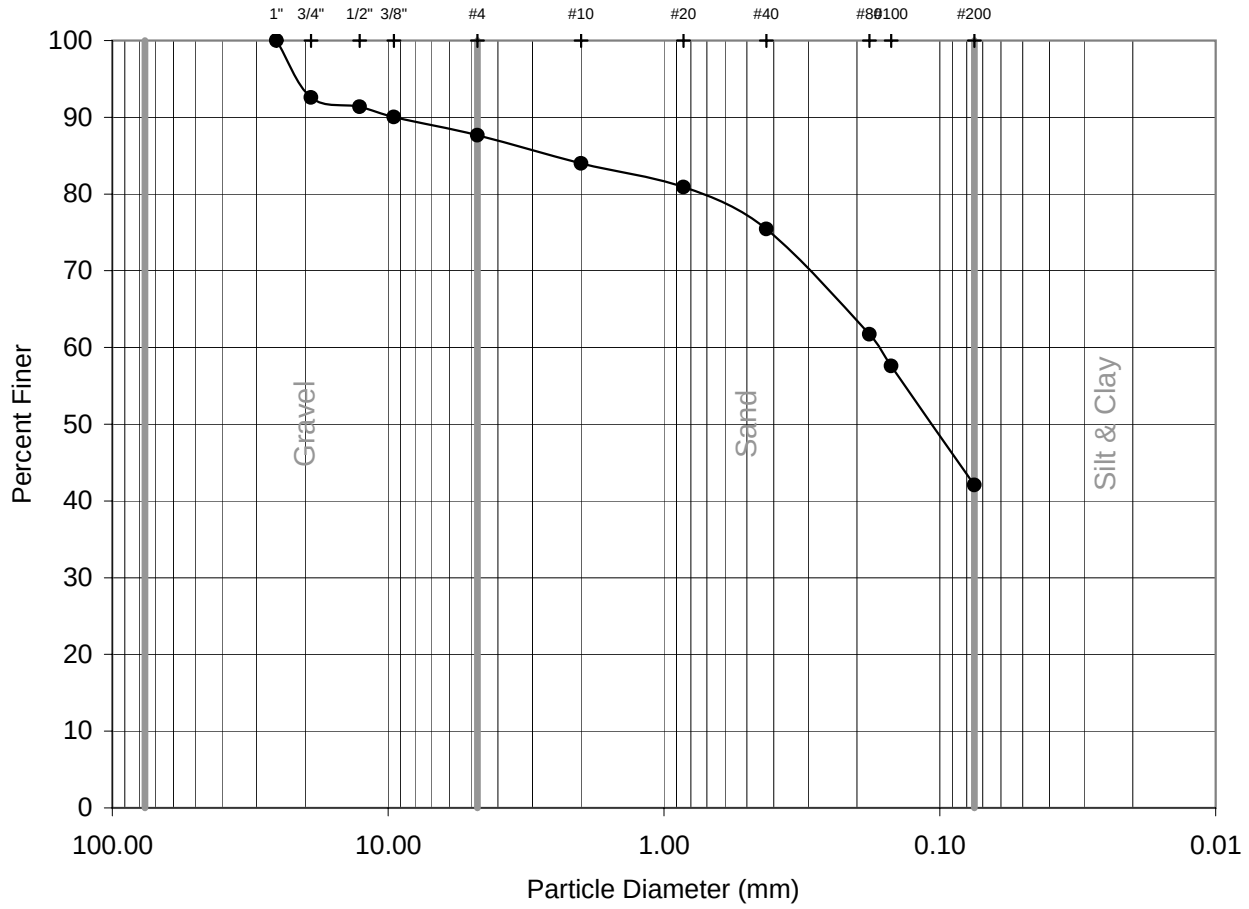


Sieve	Opening (mm)	% Passing	Specification
3/4"	19.050	100	-
1/2"	12.700	99	-
3/8"	9.525	96	-
No. 4	4.750	87	-
No. 10	2.000	74	-
No. 20	0.850	62	-
No. 40	0.425	53	-
No. 80	0.180	42	-
No. 100	0.150	40	-
No. 200	0.075	30	-

Job Name:	FAA RTR Shelters
Job Number:	62095017
Sample Identification:	B-1, 2.5 - 4'
Tested By:	JT
Date Received:	4/9/2009
Date of Test:	4/22/2009
Moisture Content:	24%

D60 = 0.73 mm
D30 = 0.08 mm
%Gravel = 13
%Sand = 57
%Silt/Clay = 30

Terracon



Sieve	Opening (mm)	% Passing	Specification
1"	25.400	100	-
3/4"	19.050	93	-
1/2"	12.700	91	-
3/8"	9.525	90	-
No. 4	4.750	88	-
No. 10	2.000	84	-
No. 20	0.850	81	-
No. 40	0.425	75	-
No. 80	0.180	62	-
No. 100	0.150	58	-
No. 200	0.075	42	-

Job Name:	FAA RTR Shelters
Job Number:	62095017
Sample Identification:	B-2, 7.5 - 8.5'
Tested By:	JT
Date Received:	4/9/2009
Date of Test:	4/22/2009
Moisture Content:	13%

D60 = 0.17 mm

%Gravel = 12
%Sand = 46
%Silt/Clay = 42

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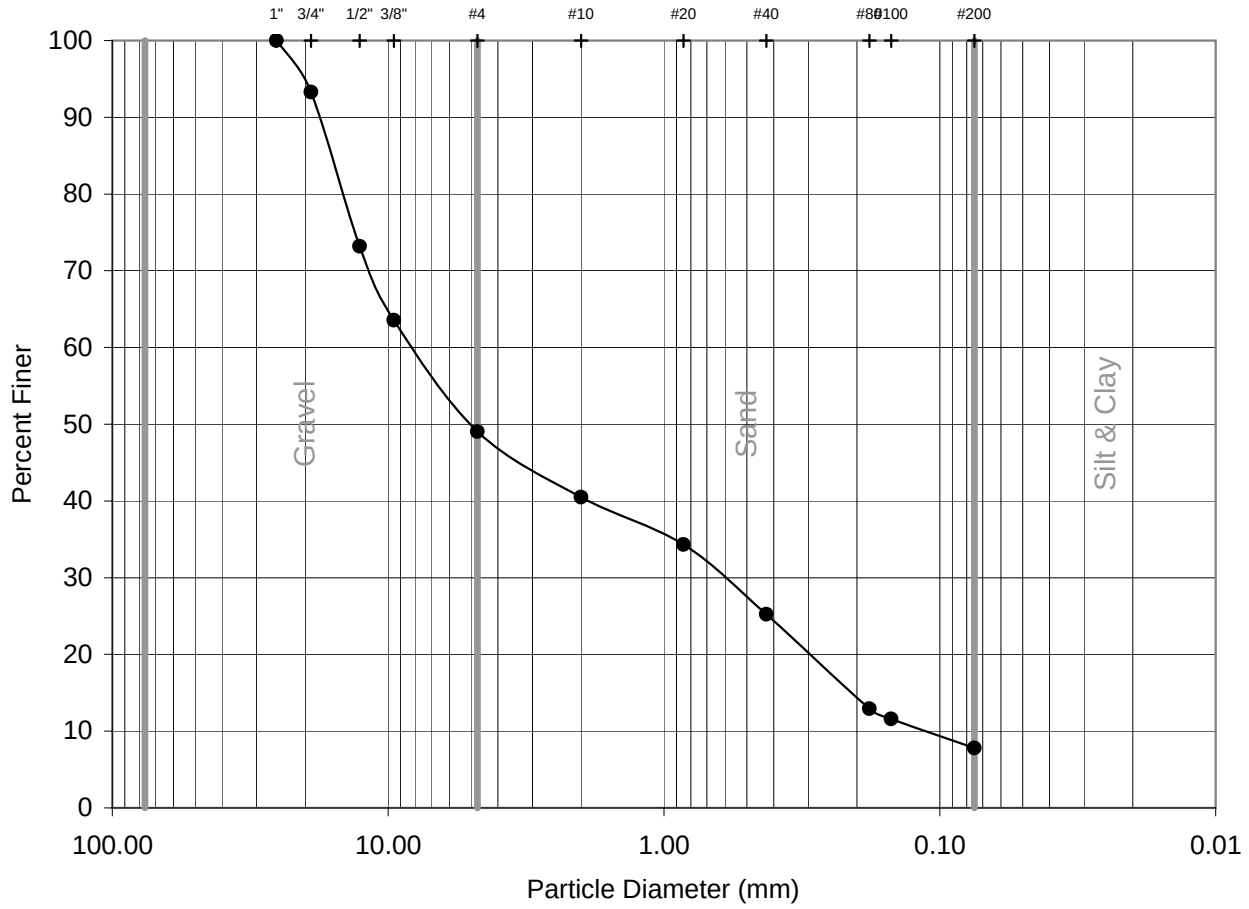

Sieve	Opening (mm)	% Passing	Specification
1"	25.400	100	-
3/4"	19.050	93	-
1/2"	12.700	73	-
3/8"	9.525	64	-
No. 4	4.750	49	-
No. 10	2.000	41	-
No. 20	0.850	34	-
No. 40	0.425	25	-
No. 80	0.180	13	-
No. 100	0.150	12	-
No. 200	0.075	8	-

Job Name:	FAA RTR Shelters
Job Number:	62095017
Sample Identification:	B-2, 10 - 10.7'
Tested By:	JT
Date Received:	4/9/2009
Date of Test:	4/22/2009
Moisture Content:	2%

D60 = 8.03 mm
D30 = 0.61 mm
D10 = 0.11 mm
Cu = 71.41
Cc = 0.41
%Gravel = 51
%Sand = 41
%Silt/Clay = 8

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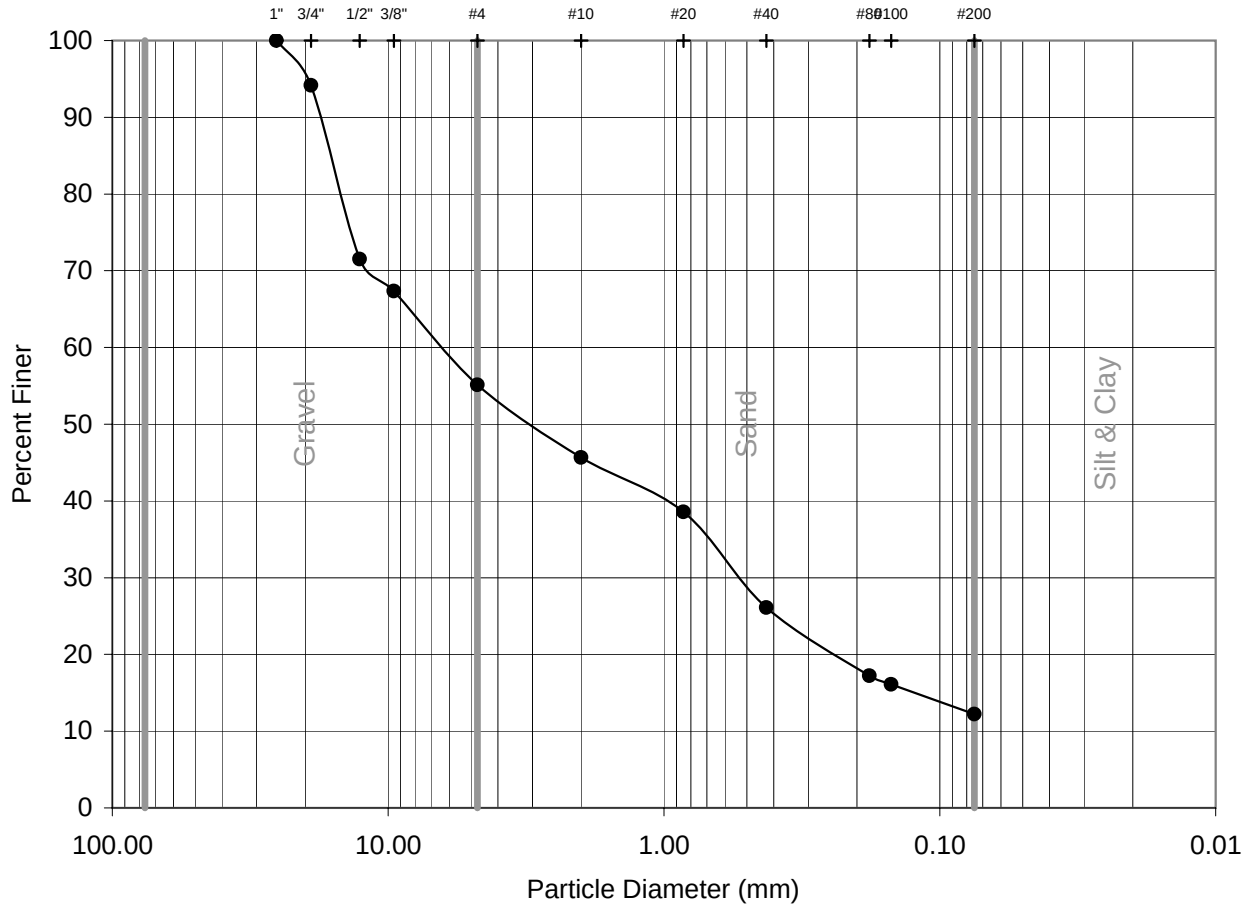

Sieve	Opening (mm)	% Passing	Specification
1"	25.400	100	-
3/4"	19.050	94	-
1/2"	12.700	71	-
3/8"	9.525	67	-
No. 4	4.750	55	-
No. 10	2.000	46	-
No. 20	0.850	39	-
No. 40	0.425	26	-
No. 80	0.180	17	-
No. 100	0.150	16	-
No. 200	0.075	12.2	-

Job Name:	FAA RTR Shelters
Job Number:	62095017
Sample Identification:	B-3, 7.5 - 7.9'
Tested By:	JT
Date Received:	4/9/2009
Date of Test:	4/22/2009
Moisture Content:	7%

D60 = 6.27 mm
D30 = 0.53 mm
%Gravel = 45
%Sand = 43
%Silt/Clay = 12

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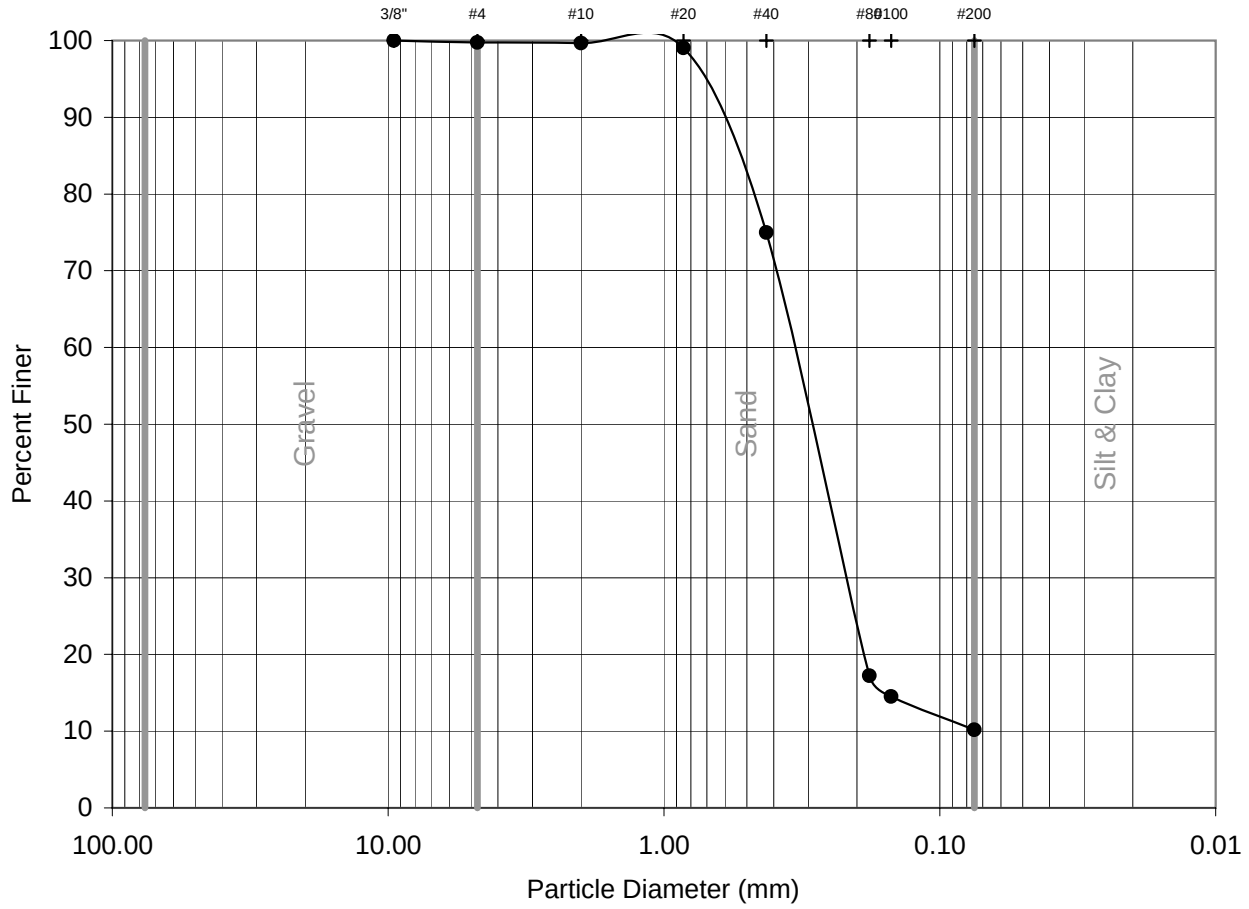

Sieve	Opening (mm)	% Passing	Specification
3/8"	9.525	100	-
No. 4	4.750	100	-
No. 10	2.000	100	-
No. 20	0.850	99	-
No. 40	0.425	75	-
No. 80	0.180	17	-
No. 100	0.150	15	-
No. 200	0.075	10	-

Job Name:	FAA RTR Shelters
Job Number:	62095017
Sample Identification:	B-4, 15 - 16.5'
Tested By:	JT
Date Received:	4/9/2009
Date of Test:	4/22/2009
Moisture Content:	7%

D60 = 0.34 mm
D30 = 0.22 mm
%Gravel = 0
%Sand = 90
%Silt/Clay = 10

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APPENDIX C

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	<2	Very Soft
500 – 1,000	2-3	Soft
1,001 – 2,000	4-6	Medium Stiff
2,001 – 4,000	7-12	Stiff
4,001 – 8,000	13-26	Very Stiff
8,000+	26+	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 49	Dense
50+	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	30+

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UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification	
					Group Symbol	Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3^E$		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$		SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3^E$		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	$PI > 7$ and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			$PI < 4$ or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OL	Organic clay[K,L,M,N]
			Liquid limit - not dried			Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI lots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OH	Organic clay[K,L,M,P]
			Liquid limit - not dried			Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

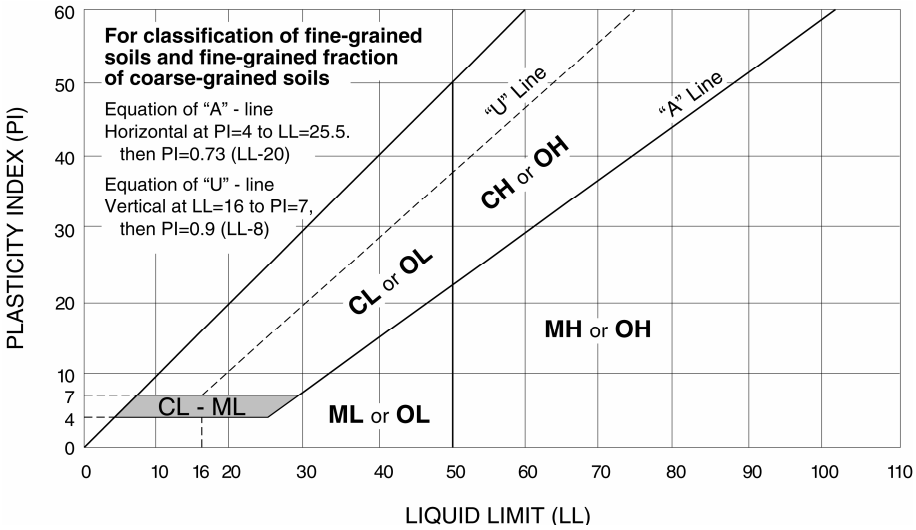
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



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