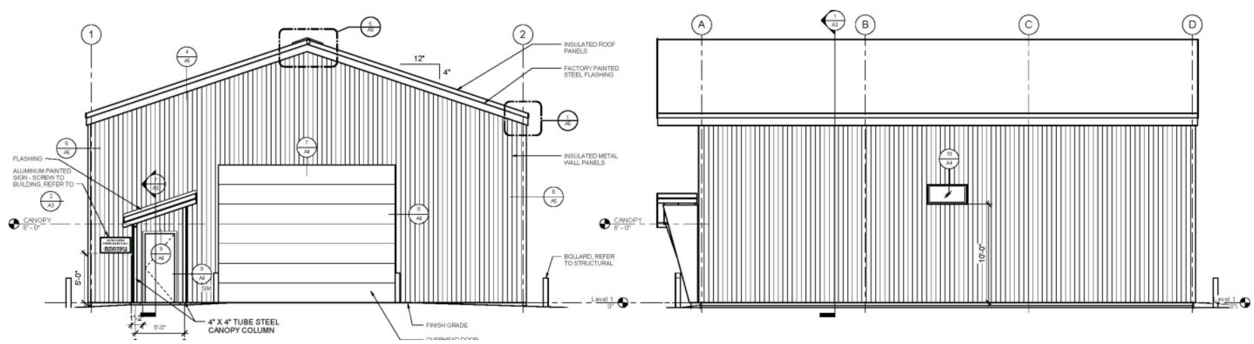
GEOTECHNICAL FOUNDATION REPORT

SNOW REMOVAL EQUIPMENT BUILDING
AMBLER AIRPORT REHABILITATION
(AIP 3-02-0354-2014/61303)
AMBLER, ALASKA



Prepared For: **ALASKA DEPARTMENT OF TRANSPORTATION & PUBLIC FACILITIES**
Northern Region
2301 Peger Road
Fairbanks, Alaska 99709-5603

Prepared By: **R&M CONSULTANTS, INC.**
9101 Vanguard Drive
Anchorage, Alaska 99507

31 JANUARY 2014

GEOTECHNICAL FOUNDATION REPORT
SNOW REMOVAL EQUIPMENT BUILDING
AMBLER AIRPORT REHABILITATION (AIP 3-02-0354-2014/61303)
AMBLER, ALASKA

This report presents geotechnical recommendations for the planned new Snow Removal Equipment Building (SREB) at the Ambler Airport. The geotechnical engineering was performed following the scope of work authorized in NTP 1 of our *Professional Service Agreement* No. 025-3-1-031.

The discussions in this report reflect our interpretation of the cited information, the findings from the DOT&PF's geotechnical explorations at the site, and our understanding of the project as described hereinafter. This report is intended solely for use by the DOT&PF and its contractors directly involved with the Ambler Airport SREB project, under the condition that the reader possesses a basic understanding of geotechnical terminology and principals, and the 2009 International Building Code; the reader understands the differences between, and nature of factual versus interpretative information; and the reader is familiar with the DOT&PF policies and procedures related to geotechnical investigations.

R&M Consultants, Inc. performed this work in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No warranty, express or implied, beyond exercise of reasonable care and professional diligence, is made.

R&M's services for this project where performed by, or under the responsible charge of the individuals listed below.

ROBERT L. SCHER, P.E.
Senior Geotechnical Engineer

REVIEWED BY:

CHARLES H. RIDDLE, C.P.G.
Senior Vice President

TABLE OF CONTENTS

Page

PART 1: INTRODUCTION 1
PART 2: GEOTECHNICAL SITE CONDITIONS 2
2.1 **REGIONAL SETTING** 2
2.2 **APRON/SREB HISTORY** 2
2.3 **SOIL COLUMN**...3
2.4 **PERMAFROST, SEASONAL FROST & GROUNDWATER** 3
PART 3: GEOTECHNICAL RECOMMENDATIONS 4
3.1 **SEISMIC CONSIDERATIONS** 4
3.2 **BUILDING FOUNDATION**...5
3.3 **FOUNDATION EARTHWORK** 5
3.4 **GEOTECHNICAL MATERIALS**...6
PART 4: REFERENCES 6

TABLES:

1: Uniform Hazard Seismic Ground Motion Parameters... 4

FIGURES:

1: Project Vicinity Map.. 1
2: Ambler Airport Apron 2

APPENDIX A – DOT&PF APRON TEST HOLES

GEOTECHNICAL FOUNDATION REPORT
SNOW REMOVAL EQUIPMENT BUILDING
AMBLER AIRPORT, ALASKA

PART 1: INTRODUCTION

The Alaska Department of Transportation and Public Facilities (DOT&PF) intends to construct a new, double-bay Snow Removal Equipment Building (SREB) at the Ambler Airport in northwest Alaska (Figure 1). This report presents R&M Consultants' (R&M) geotechnical recommendations for designing and constructing the new SREB foundation.

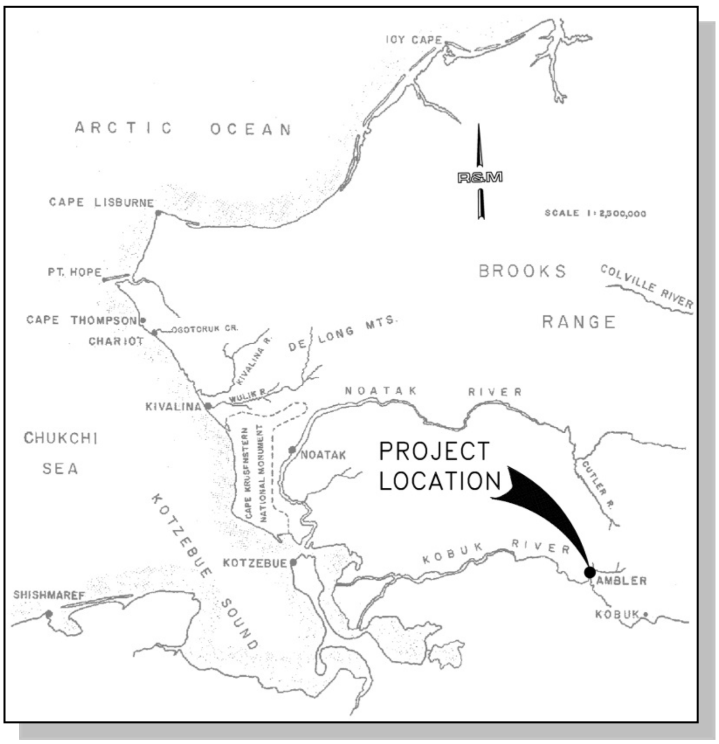


FIGURE 1: PROJECT VICINITY MAP

The existing SREB in the southeast corner of the airport apron will be demolished and replaced with a new, single-story steel framed structure with a concrete floor, covering an area of about 44 ft x 50 ft, and supported on a shallow concrete foundation.

FIGURE 2: AMBLER AIRPORT APRON (*DOT&PF*)

The following summarizes our interpretations of the geotechnical conditions at the project, based on field explorations (Appendix A) and laboratory testing completed by the DOT&PF; and provides geotechnical recommendations for design and construction of the new SREB foundation.

PART 2: GEOTECHNICAL SITE CONDITIONS

2.1 REGIONAL SETTING

The regional geology, seismic environment, and climate conditions are reported in DOT&PF (2013).

2.2 APRON/SREB HISTORY

The apron was originally constructed in 1978. The DOT&PF record drawings indicate that all organic matter was removed within five feet of the finish grade across the entire apron; however, neither the final grade elevations or as-built fill thickness were noted. The original equipment storage building was constructed along the south end of the apron, next to the end of the airport access road, and just west of the present SREB.

The apron was improved in 1991/92. That work included: 'squaring-out' the southeast corner of the apron using borrow containing ≤10 percent particles, by mass, passing the No. 200 sieve (P200); and erecting a new SREB (just east of the original building) on a subgrade consisting of a minimum 6-inches of 'aggregate surface course' over a minimum 12-inches borrow containing a P200 ≤10 percent. Note that the DOT&PF record drawings did not indicate if or how the ground surface was to be prepared (e.g. no information of clearing and grubbing), the final apron and building floor elevations, or the as-built fill thickness.

We understand the original equipment storage building and present SREB were both supported on timber sill footings, and with ‘gravel’ floors. We are not aware of any information pertaining to the seasonal or long-term performance of those foundations (e.g. inadequate bearing capacity, excessive settlements or seasonal heave, etc.).

2.3 SOIL COLUMN

The DOT&PF completed geotechnical explorations within the apron in 1973 (one boring), 1985 (four borings), and 2013 (2 borings) (see Appendix A). Based on that information, the general soil column under the new SREB site reportedly consists of about six inches ‘base course’; overlying silt with variable sand to a depth of at least 20 feet. The following paragraphs summarize the reported characteristics of these two general soil units:

***Base Course* -** The DOT&PF test hole logs describe the material surfacing the apron as brown, “silty sand with gravel”. We are not aware of any laboratory test data on samples of this soil unit collected from the apron (i.e. grain-size distribution, moisture content, relative density, etc.). Naturally occurring asbestos particles have been identified in samples of base course collected at the airport[1] (DOT&PF, 2013).

***Silt with Sand* -** All of the DOT&PF test holes across the apron reported the foundation soils as variable layers of brown “silty sand”, “sandy silt”, and “silt”. Based on the DOT&PF laboratory testing on samples collected from the entire airport, this unit contains no gravel or larger sized particles (> No. 4 sieve), P200 values range between about 40 and 95 percent; and the particles passing the No. 40 sieve are non-plastic (e.g. liquid and plastic limits could not be determined). Further, moisture contents measured in samples collected from the apron borings ranged from about 14 to 19 percent where unfrozen (two tests), and about 13 to 26 percent where frozen (six tests; see Section 2.4, below). For the purpose of the subject project, we assumed the soils in this general unit to be medium dense, and saturated or nearly saturated. Naturally occurring asbestos particles were identified in samples of this soil unit collected at the airport, including the apron borings (DOT&PF, 2013).

2.4 PERMAFROST, SEASONAL FROST & GROUNDWATER

Ambler is in an area of mapped continuous permafrost (Jorgenson et al., 2008). At the airport, the depth to permafrost appears to range from several feet to over 30 feet deep; and may be as shallow as about 10 to 12 feet under the apron (e.g. DOT&PF borings 85-2 and 85-3; see Appendix A). All of the soil samples recovered from the two 2013 DOT&PF apron borings (13-53 and 13-54; drilled in February) were in a frozen state (seasonal and/or permafrost), and described as either ‘poorly bonded or friable’ (*Nf*) or ‘well bonded with no excess or visible pore ice’ (*Nbn*). However, those samples were collected from auger cuttings (i.e. completely disturbed, and accurate sample depth unknown), so there is a possibility that the permafrost contains some segregated ice forms (which could indicate a potential for detrimental thaw settlements under the new SREB).

[1] We are not aware of any base course samples from the apron borings being tested for asbestos.

No groundwater was reported in any of the DOT&PF test holes completed within the apron. However, the DOT&PF's 1985 test holes noted the moisture condition as "wet" below a depth of six to eight feet.

For the purpose of the subject SREB project we assumed: seasonal freezing can reach depths of eight to 12 feet in the apron where the surface is kept clear of snow and ice[2]; the permafrost under the SREB is 'ice-poor' and reasonably thaw stable (see Part 3); and intermittent groundwater could be expected, perched on the top of permafrost. Further, the foundation soils at the SREB site are expected to be moderately susceptible to seasonal frost heave and thaw weakening, subject to the water content. We estimate[2] that the apron surface (away from heated foundations) could experience seasonal vertical movements on the order of one to four inches, depending on the snow cover, soil saturation, and groundwater conditions.

PART 3: GEOTECHNICAL RECOMMENDATIONS

The following geotechnical recommendations apply to design and construction of the new SREB under the 2009 International Building Code (IBC) (ICC, 2009). Note that these recommendations reflect our understanding that the existing SREB is being replaced due to age and function; as opposed to damage associated with detrimental geotechnical conditions (e.g. excessive settlements, poor bearing under the footings, or seasonal frost heave).

3.1 SEISMIC CONSIDERATIONS

Site Class - Based on the DOT&PF explorations (Appendix A), we consider that the geotechnical conditions under the SREB correspond with a *Site Class D* designation.

Ground Motions - Table 2 summarizes the uniform hazard seismic ground motion parameters predicted[3] at the SREB site (approximately Latitude 67.1 °N, Longitude 157.8564 °W), for a building with an *Occupancy Category* I or II (IBC Table 1604.5). Based on these ground motions, the new SREB is *Seismic Design Category* D structure (IBC 1613.5.6).

TABLE 1: UNIFORM HAZARD SEISMIC GROUND MOTION PARAMETERS

Maximum Considered Earthquake Spectra Acceleration Parameters:	
Short-period (0.2-sec) Coefficient, S_S, [IBC Figure 1613.5(11)]	0.824
Long-period (1.0-sec) Coefficient, S_1, [IBC Figure 1613.5(12)]	0.216
Site Coefficients:	
Short-period factor, F_a, [IBC Table 1613.5.3(1)]	1.170
Long-period factor, F_v, [IBC Table 1613.5.3(2)]	1.968
Design Spectra Response Acceleration Parameters:	
Short Period (0.2-sec) Coefficient, S_{DS}, [IBC Equations 16-36 & 16-38]	0.643
Long Period (1.0-sec) Coefficient, S_{D1}, [IBC Equations 16-37 & 16-39]	0.283

[2] The depth of seasonal freeze/thaw was estimated using the computer program MUT1D (Braley and Zarling, 1990), the climate parameters in DOT&PF (2013). The estimate of frost heave followed a model by Konrad (2005).

[3] http://geohazards.usgs.gov/designmaps/us/application.php

Earthquake-Induced Ground Failure Potential - Based on simplified screening procedures (e.g. Youd and Perkins, 1987), we consider there is a "low" likelihood that the foundation soils would liquefy, or experience a notable temporary reduction on strength and stiffness during a design earthquake. Further, we consider that potential earthquake-induced ground failures at the site would be limited to minor settlements, likely less than an inch, and isolated ground cracking caused by surface oscillations, especially in winter when the surface is frozen.

3.2 BUILDING FOUNDATION

The geotechnical conditions at the site are conducive for supporting the new SREB on shallow concrete footings, so long as the underlying permafrost is ice-poor (as suggested by the DOT&PF data). However, should isolated zones of more ice-rich soil exist the consequences of excessive settlements under the new building, associated with long-term thaw, can be mitigated by constructing the floor slab independent of (versus rigidly connected to) the perimeter foundation and column footings. Further, the risk of vertical movements associated with seasonal frost action can be reduced, and the stiffness of the subgrade soils to bridge deep-seated settlements can be improved, by replacing the upper five feet of existing soils with non-frost susceptible materials (see Part 3.3).

- The shallow perimeter foundation and column footings should be dimensions considering an allowable bearing pressure of 2,000 psf. Further, the perimeter footings should be buried at least 48-inches below finish grade.
- The concrete floor slab should be designed using a coefficient of subgrade reaction, *k*, of 250 pci.
- The nominal sliding resistance of the footings (e.g. under wind loading) can be determined using a friction coefficient, μ, of 0.5 (passive soil resistance against the footing should be neglected).
- The exterior vertical face of all perimeter foundations should be covered with rigid insulation having an effective R-value of at least 15 $hr \cdot ft^2 \cdot °F/BTU$, and extending from the base of the footing to the level of insulation in the exterior walls.

3.3 FOUNDATION EARTHWORK

The following earthwork recommendations are intended to minimize the potential for or magnitude of detrimental vertical movements in the SREB foundation associated with seasonal frost action, or long-term thawing of the underlying permafrost.

General:

- It is understood that the contractor will be responsible for identifying and developing the source(s) it uses to obtain any of the classified materials required for the project.
- All excavations should be inspected by an experienced geotechnical engineer or geologist to verify that the conditions are consistent with those described in this report. Further, subsurface conditions revealed during construction that are considered to possibly differ from those anticipated should be investigated without delay to evaluate the influence of

the new information on the project design and plans.

- The construction documents should alert the contractor to the presence of naturally occurring asbestos particles in the surfacing materials, embankment fill, and foundation/subgrade soils across the entire airport, including the apron (DOT&PF, 2013); as well as at the local known and potential borrow sources (R&M, 2005 and 2009).

Bearing Fill:

- Improve the foundation bearing conditions under the entire building by replacing the upper five feet of existing fill with well-draining, coarse-grained materials (*subbase*). This fill section is intended to distribute thaw settlements under the structure, and to function as a capillary break.
- Excavate the existing fill to a depth of five feet below finish floor, under the entire building footprint. The excavation should extend at least five feet beyond the perimeter of the building, and the side-slopes should be cut no steeper than 1:1. Dewater the excavation, if water accumulates, to assure that the bottom of excavation can be inspected and the backfill is placed under dry conditions.
- Excavate a test pit to a depth of at least 10 feet below the SREB floor. Inspect the test pit for frozen soil that contains excess ice or visible ice features as defined in ASTM D 4083, *Description of Frozen Soils (Visual-Manual Procedure)*. If such frozen soil is observed in the test pit, continue the excavation under the full building area to a depth sufficient to remove said frozen material, and backfill to the bottom to five feet below the building with classified fill.
- After completing the test pit, described above, compact the bottom of the excavation to the extent necessary to ensure the first lift of backfill (see below) can be compacted as specified. Replace any subgrade materials that are soft or rut with classified fill.
- After completing the building excavation as described above, line the base of the excavation with separation geotextile, placed following DOT&PF Item P-681; and backfill with subbase that is placed in maximum eight inch lifts (loose) and compacted to at least 95% of its maximum unit weight, as determined by test method AASHTO T180.

3.4 GEOTECHNICAL MATERIALS

- The separation geotextile should be a nonwoven product meeting the requirements in DOT&PF Item P-681.
- The subbase should meeting the requirements in DOT&PF Item P-154.
- All foundation insulation should be non-water absorbing, and approved for exterior and below ground use, considering subjection to a wet and cyclic freeze-thaw environment.

PART 4: REFERENCES

Braley, W.A., and J.P. Zarling. 1990. MUT1D, Multilayer User-Friendly Model 1 Dimension. *FHWA-AK-RD-90-02*.

DOT&PF. 2013. *Geotechnical Report*, Ambler Airport Rehabilitation and Ambler Sewage Lagoon Road, AKSAS 61303 and 61056. Northern Region Materials.

DOT&PF. 1986. Engineering Geology & Soils Report, Ambler Airport, Project No. D-5522, Change No. 30385522. Northern Region Design and Construction.

DOT&PF. 1973. Ambler Materials Investigation: Existing Alignments, Proposed Alignments, Access Rd. and Material Sites. Division of Aviation, Design Section

International Code Council (ICC). 2009. 2009 International Building Code.

Jorgenson, T. et al. 2008. Permafrost Characteristics of Alaska. Institute of Northern Engineering, University of Alaska Fairbanks.

Konrad, J-M. 2005. Estimation of the segregation potential of fine-grained soils using the frost heave response of two reference soils. *Can. Geotech. J.*, 42:38-50.

R&M Consultants, Inc. (R&M). 2005. *Material Site Investigation*, Ambler Airport Rehabilitation, AKSAS Project No. 61303. Prepared for DOT&PF, Northern Region.

R&M Consultants, Inc. (R&M). 2009. *Geotechnical Memorandum*, Task 10 – Additional Asbestos Testing, Ambler Airport Rehabilitation (AKSAS Project No. 61303). Prepared for DOT&PF, Northern Region.

Youd, T.L., and D.M. Perkins. 1987. Mapping of liquefaction severity index. *J. Geotechnical Engineering*, 113(11):1374-1392.

APPENDIX A

DOT&PF APRON TEST HOLES

The DOT&PF completed geotechnical test borings at the Ambler airport in 1973, 1985, 1986, and 2013 (DOT&PF 1973, 1986, 2013). The following summarizes the seven test holes drilled to-date within the apron (Figure A1); the DOT&PF logs are provided on pages A-2 through A-4.

Test Hole No.	Date Drilled	Total Depth, ft	Frozen Soil, ft
053 054	Feb 2013	20 16	0 – 20 0 – 16
2 3 4 5	Sep 1985	15 11 11 11	11.5 – 15 10 – 11 Not reported Not reported
15	Jul 1973	10	Not reported

FIGURE A1: APPROXIMATE LOCATION OF DOT&PF APRON TEST HOLES

STATE OF ALASKA DOT/PF
Northern Region Materials
Geology Section

TEST HOLE LOG

Project	Ambler Airport Rehibilation
Project Number	AKSAS 61303
Field Geologist	T. WEISS
Field Crew	S. Parker and P. Lanigan
Equipment Type	Mobile B-24
Weather	p/cloudy and cold
Vegetation	none
Test Hole Number	TH13-053
Total Depth	20 feet
Dates Drilled	2/12/2013
Station, Offset	103+50, 100R
Latitude, Longitude	N67.10096°, W157.85691°
Elevation	

Ground Water Data

	While Drilling	After Drilling
Depth in (ft.)		
Time		
Date		
Symbol		

GENERAL COMMENTS: Existing Apron, West

Drilling Method: S-S Auger

Method	Number	Sample Interval (ft)
AUGER	13-2004	3.2-3.7
AUGER	13-2005	4.0-7.0
AUGER	13-2006	7.8-8.2
AUGER	13-2007	13.8-14.2
AUGER	13-2008	17.8-18.2

SUBSURFACE MATERIAL

Depth (ft)	Description
0–1	Bn Silty SAND w/ Gravel (fill) Nbn
1–2	Bn Silty SAND Nbn
2–7	Bn SILT w/ Sand Nbn SAMPLE 13-2004 (3.2-3.7): NM 24.9%, ORG 0.6%, NV, NP SAMPLE 13-2005 (4.0-7.0): ML, 75.7% -200, NV, NP
7–13	Bn Sandy SILT Nbn SAMPLE 13-2006 (7.8-8.2): NM 24.7%
13–16	Bn Silty SAND Nbn SAMPLE 13-2007 (13.8-14.2): NM 12.8%
16–20	Bn-Rd Sandy SILT Nbn, Iron staining SAMPLE 13-2008 (17.8-18.2): NM 14.2%
20	BOH

Note: Unless otherwise noted, all samples are taken with 1-3/8-in. ID Standard Penetration Sampler driven with 140 lb. hammer with 30-in. drop. ☐ CME Auto Hammer ☐ Cathead Rope Method

NR AKDOT TEST HOLE LOG - USCS LOGS LATEST.GPJ NR_AKDOT_PRECON_USCS_06_28_07.GDT 4/25/13

DRAFT

TEST HOLE 13-53 (*DOT&PF, 2013*)

STATE OF ALASKA DOT/PF
Northern Region Materials
Geology Section

TEST HOLE LOG

Project	Ambler Airport Rehibilitation	Test Hole Number	TH13-054
Project Number	AKSAS 61303	Total Depth	16 feet
Field Geologist	T. WEISS	Dates Drilled	2/12/2013
Field Crew	S. Parker and P. Lanigan	Station, Offset	103+00, 300R
Equipment Type	Mobile B-24	Latitude, Longitude	N67.10037°, W157.85781°
Weather	p/cloudy and cold	Elevation	
Vegetation	none		

Ground Water Data

	While Drilling	After Drilling
Depth in (ft.)		
Time		
Date		
Symbol		

GENERAL COMMENTS: Existing Apron, East

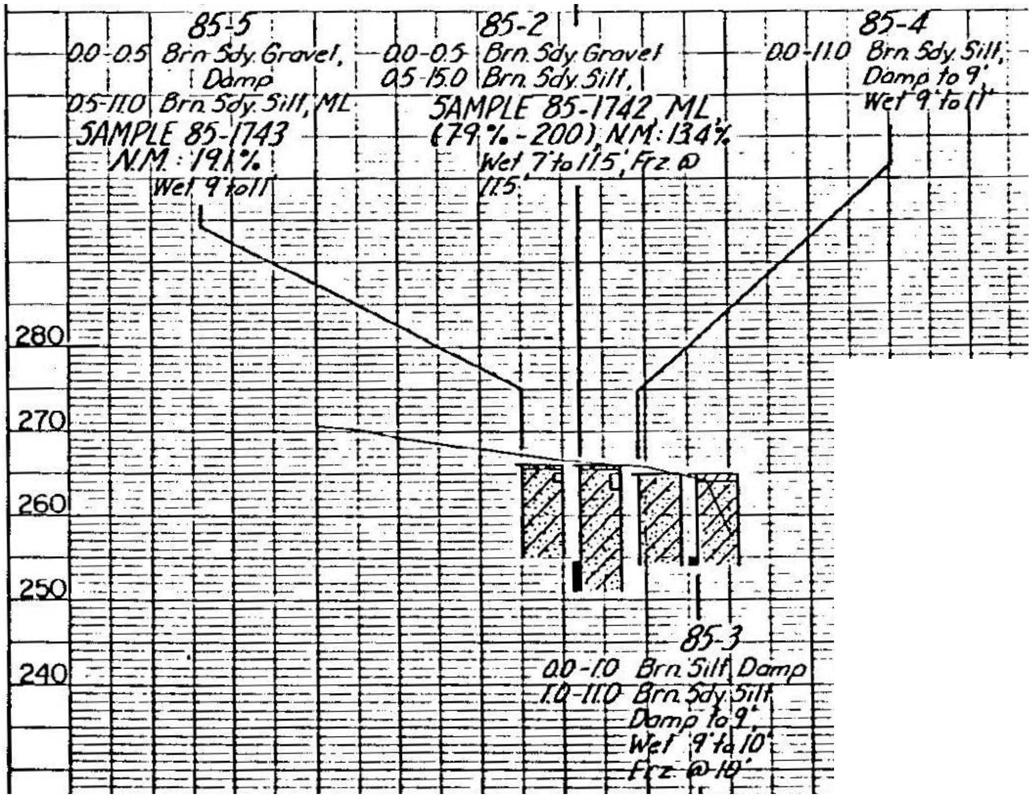
Drilling Method: S-S Auger

Depth (ft)	Sample Method	Sample Number	Subsurface Material
0–0.5			Bn Silty SAND w/ Gravel (fill)
0.5–3.5			Bn Silty SAND Nf
2.3–2.7	AUGER	13-2000	SAMPLE 13-2000 (2.3-2.7):
3.5–5.5			Bn SILT w/ Sand Nbn
5.5–8.5			Tn Silty SAND Nf
8.2–8.7	AUGER	13-2001	SAMPLE 13-2001 (8.2-8.7): NM 26.1%
8.5–16			Bn SILT w/ Sand Nbn
9.0–13.0	AUGER	13-2002	SAMPLE 13-2002 (9.0-13.0): ML, 77.8% -200, NV, NP
~13			Consistent
14.3–14.7	AUGER	13-2003	SAMPLE 13-2003 (14.3-14.7): NM 20.4%
16			BOH

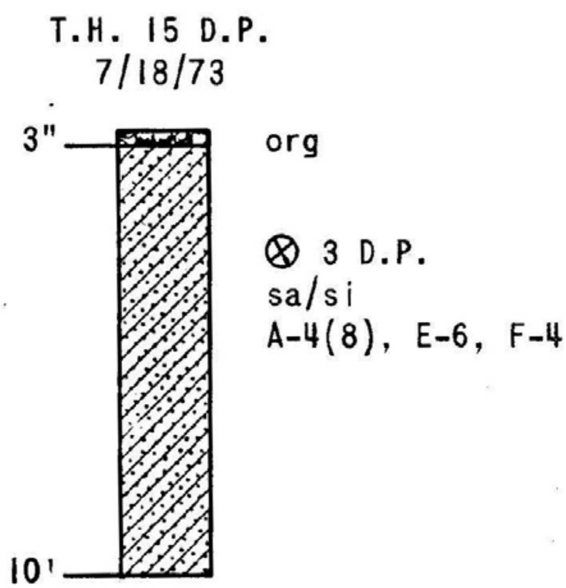
Note: Unless otherwise noted, all samples are taken with 1-3/8-in. ID Standard Penetration Sampler driven with 140 lb. hammer with 30-in. drop. ☐ CME Auto Hammer ☐ Cathead Rope Method

NR AKDOT TEST HOLE LOG - USCS LOGS LATEST.GPJ NR_AKDOT_PRECON_USCS_06_28_07.GDT 4/25/13

LOG OF TEST HOLE 13-54 (*DOT&PF, 2013*)



LOG OF TEST HOLE 85-2, 3, 4 & 5 (*DOT&PF, 1986*)



LOG OF TEST HOLE 73-15 (*DOT&PF, 1975*)