GEOTECHNICAL INVESTIGATION

YAK- SRE & Sand/Chemical Storage Bldg.

Project No. 68017

Prepared by:

Alaska Department of Transportation and Public Facilities
Southeast Region Geotechnical Section
Juneau, Alaska

May 22, 2001

Prepared: Ralph Swedell

Ralph Swedell, CPG
Regional Geologist
Southeast Region

Approved: Bruce E. Brunette

Bruce Brunette, P.E.
Regional Material Engineer
Southeast Region

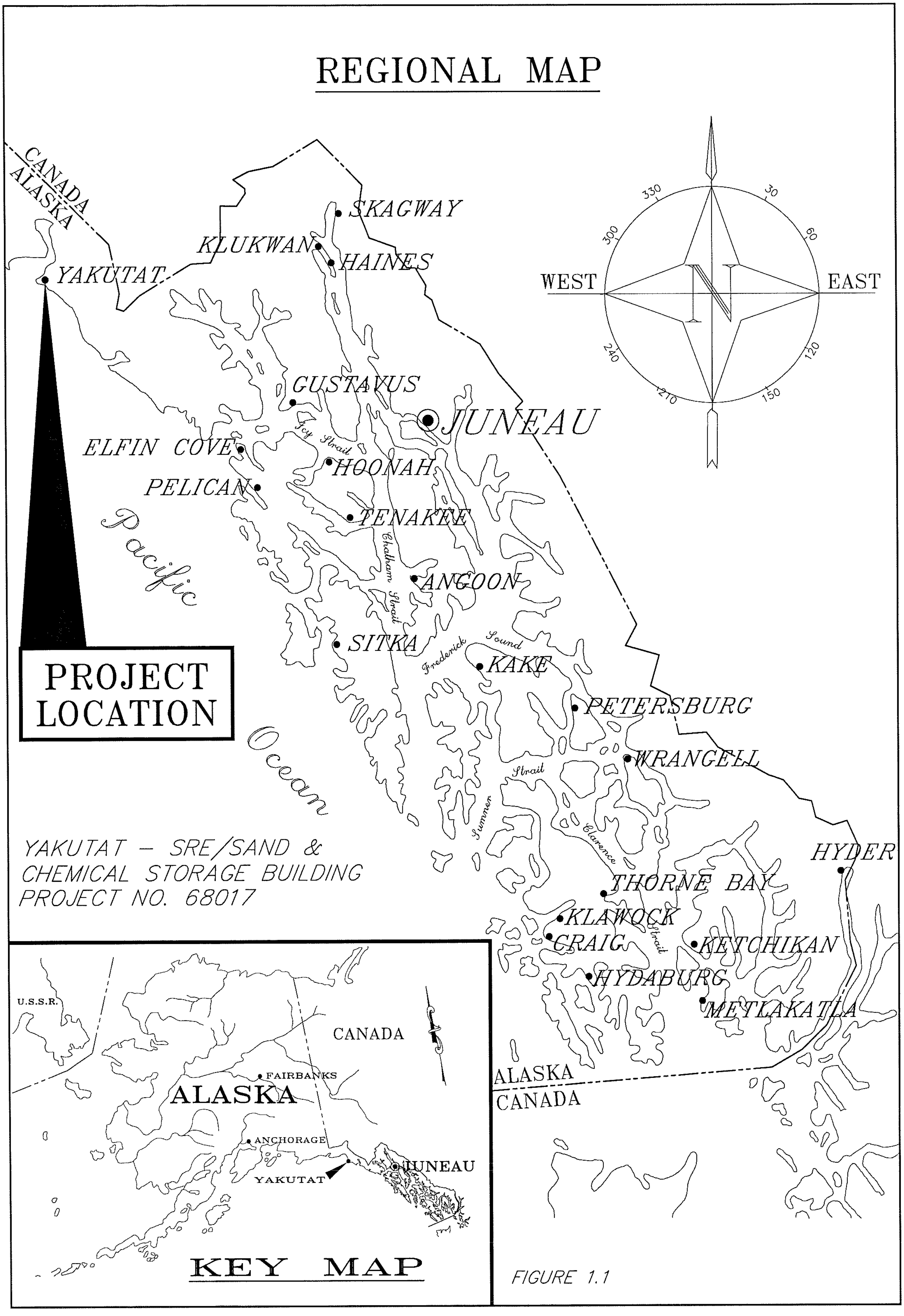

REGIONAL MAP
CANADA
ALASKA
YAKUTAT
SKAGWAY
KLUKWAN
HAINES
GUSTAVUS
JUNEAU
ELFIN COVE
HOONAH
PELICAN
Icy Strait
TENAKEE
Chatham Strait
ANGOON
Pacific Ocean
SITKA
Frederick Sound
KAKE
PETERSBURG
WRANGELL
Sumner Strait
Clarence Strait
HYDER
THORNE BAY
KLAWOCK
CRAIG
KETCHIKAN
HYDABURG
METLAKATLA
ALASKA
CANADA
PROJECT LOCATION
WEST
EAST
N
330
30
300
60
240
120
210
150
YAKUTAT – SRE/SAND & CHEMICAL STORAGE BUILDING
PROJECT NO. 68017
U.S.S.R.
CANADA
FAIRBANKS
ALASKA
ANCHORAGE
JUNEAU
YAKUTAT
KEY MAP
FIGURE 1.1

TABLE OF CONTENTS

Abstract
The purpose of this investigation was to determine the soil conditions and assess the liquefaction potential at the site proposed for the Yakutat airport maintenance building. The field investigation was conducted in two phases. In January 2001 three test pits were dug using a Hitachi EX 150 excavator and in April 2001 twelve test holes were drilled with a track mounted CME 55-drill rig.

The general soil profile at the building site is 0.2' to 9.0' of silt over relatively dense sand and gravel. The water table during the April drilling was approximately 5' below the existing ground surface, at an average estimated elevation of 21' MSL.

Three test holes were drilled to a depth of 50' to evaluate the liquefaction potential of the soils in the area of the building and water tank foundations. Five screening criteria were used to initially evaluate the sites for liquefaction potential. The Yakutat airport area soils exhibit four of the criteria: geologically recent deposits, liquefiable soil gradation, saturated soil, and liquefiable soil at shallow depth (<50'). The fifth screening criterion is soil density as defined by corrected SPT values, $(N_1)_{60}$. With the exception of a few zones in test holes 2, 4 and 10 the $(N_1)_{60}$ values are greater than 30, the threshold value above which liquefaction is unlikely.

The conclusion from the analysis is that liquefaction would be limited to one or two soil layers a few feet thick, with soil settlement being the most likely detrimental effect. The estimated maximum settlement is 3". Because of the intended use of the building and the belief that 3" of settlement would not compromise the building, we do not believe that the cost the foundation and soil improvements necessary to mitigate the liquefaction potential are warranted.

We suggest that spread-footing foundations would be suitable for this area. A soil bearing capacity of 2000 psf should be used for determining initial footing dimensions.

Introduction
Alaska DOT&PF is supervising the design and construction of a combined snow removal equipment and sand & chemical storage building at the Yakutat Airport. Bruce Wood, P.E., the project Engineering Manager requested the geotechnical investigation. The purpose of the investigation was to determine the soil conditions in the areas proposed for construction of the new building and road realignment. Additionally we undertook an investigation to specifically assess the liquefaction susceptibility of the soils at the building site.

The results of the geotechnical investigation include test pit logs, dynamic cone penetrometer data, laboratory test results and design recommendations.

Field Investigations
The field investigation for this project was conducted in two phases. In the time interval between field visits a new building site was selected. The new site has improved equipment operational parameters and takes advantage of a site with less organic overburden. Mitch McDonald, Engineering Geologist, conducted the field investigations

January 9 – 11 and April 9-15, 2001. During the January field visit a local contractor was hired to dig the test pits using a Hitachi EX 150 track-excavator. Data from the early field trip is included only to provide general information about the area soils. Only the site-specific data from the April visit should be used for design purposes.

During the April field visit a track mounted CME 55 was used to drill 10 test holes using 8" OD hollow-stem augers. Soil samples were taken using an 18" x 2" SPT split spoon sampler driven with a 140lb auto-hammer falling 30" (AASHTO T206-87). Soils were described in accordance with the Unified Soil Classification System (ASTM D 2488). Additionally samples were tested for maximum and minimum potential density (ASTM D4253 and D2454). See Log of Test Holes Appendix A for detailed soil descriptions.

CBR values were determined in several locations along the proposed road realignments, using a dynamic cone penetrometer. The DCP uses a 3.6-lb slide hammer falling 22.6" to drive a 60° cone point into the soil. The number of blows per 3.9" can then be converted to California Bearing Ratio.

Laboratory Investigation

Soil samples were shipped to the Southeast Region Materials Laboratory and the following suite of test performed: sieve analysis (ATM T-7), Atterberg limits (AASHTO T89), moisture content (ATM T-5), organic content (ATM T-6), Unified Soil Classification (ASTM D2487) and AASHTO Soils Classification (AASHTO M 145-91). Two additional tests were performed to determine the maximum and minimum potential unit weights of the soil (ASTM D 4253 and ASTM D 4254). These latter two tests, when compared with relative density, can be used to determine in situ soil unit weight.

The laboratory test results are included in Appendix B.

Climate Information

Yakutat has a stormy climate, with periods of torrential rains, strong winds and heavy snowfall. The climate needs to be considered when designing buildings and roads in this area. The periodic torrential rains coupled with the areas sluggish drainage causes extensive surface flooding in the airport area. During periods of heavy rainfall, water is often more than 2" deep on the existing terminal ramp. DOT maintenance personnel report that the floor of the existing shop floods during periods of heavy rain.

Yakutat can also receive heavy snowfall (9.7' is the record for one month). Large accumulations of snow plus the requirement for storage of snow removed from ramps, parking lots and roads should be considered when planning buildings and roads at the airport.

The following table summarizes average and extreme climate data for Yakutat obtained from the National Weather Service, Juneau Office.

Yakutat Monthly Normals (1960-1990) and Extremes (1948-2000)

Month	Normals					Extremes							
	Max Temp	Min Temp	Avg Temp	Pcpn	Snow	Hi Max	Hi Min	Low Max	Low Min	Hi Pcp	Low Pcp	Hi Snow	Low Snow
Jan	31.5	18.6	25.1	12.2	38.2	45.2	36.3	18.1	-4.6	31.8	1.6	116.2	0.4
Feb	35.0	21.1	28.0	10.7	37.4	42.8	32.9	26.4	5.9	32.1	0.2	92.1	0
Mar	38.2	23.7	31.0	10.7	36.6	46.1	32.8	32.4	10.5	37.3	2.1	111.0	0.6
Apr	43.5	29.1	36.3	9.9	16.9	51.0	36.0	36.6	20.9	19.1	1.9	55.6	0
May	50.0	36.5	43.3	9.7	1.3	58.3	43.4	44.2	31.0	18.9	2.7	15.0	0
Jun	55.6	43.3	49.4	7.3	0	62.4	47.3	50.4	38.1	18.3	0.7	37.2	0
Jul	59.3	47.8	53.6	8.2	0	64.5	51.9	55.8	44.6	21.5	1.7	0	0
Aug	59.8	46.5	53.2	11.5	0	65.5	50.7	55.9	39.9	27.7	2.4	0	0
Sep	55.3	41.0	48.2	18.7	0	60.5	47.2	51.0	35.5	48.3	2.4	0.8	0
Oct	47.1	34.7	40.9	23.0	5.5	51.1	40.6	41.5	28.0	48.8	6.7	36.0	0
Nov	37.3	25.2	31.3	14.5	22.6	44.3	36.5	29.0	12.2	43.9	3.2	110.8	0.5
Dec	33.1	21.1	27.1	14.9	39.6	40.8	32.6	25.2	6.4	35.2	3.8	91.6	4.9

The snowfall data is the 1948-2000 average.
Temperature is in degrees Fahrenheit and precipitation in inches.

- Mean Annual Precipitation 151 Inches
- Mean Annual Snowfall 198 Inches
- Mean Annual Temperature 39° F
- Design-Freezing **INDEX** 1500

Geology and Topography

A brief overview of the area geology will help explain the origin and nature of the natural soils and topography at the Yakutat airport.

The Yakutat airport lies on the seaward edge of a relatively flat plain that lies between the abrupt front of the St. Elias - Fairweather Mountains and the Gulf of Alaska. This plain is called the Yakutat Foreland and it extends 140 miles from Icy Point to Yakutat Bay. Its average width is 5 miles, at the airport it is 12 miles wide. The Yakutat Foreland is a gently sloping plain of outwash stream deposits that have been reworked by repeated cycles of advancing and retreating glaciers. The latest glacial melting probably took place only 500 to 600 years ago. The USGS mapped eight categories of surficial deposits in the Yakutat Foreland: artificial fill, organic, eolian, beach, delta-estuarine, alluvial, outwash and glacial moraine.

Seismic Considerations

Yakutat is in a seismically active area, affected by strong earthquakes. The Fairweather fault is located 9 miles north of Yakutat with the associated Transition fault zone 12 miles offshore to the south. These fault systems have historically produced very strong earthquakes. Five major earthquakes (Richter magnitude 7.0 to 8.6) have occurred within 80 miles of Yakutat since 1899. On September 10, 1899, the Yakutat Bay area experienced one of the notable earthquakes of the Nineteenth Century. This event rated 8.6 on the Richter scale and was preceded by an 8.2 quake a week earlier. These earthquakes produced the following effects: large tectonic uplifts (up to 47.5'), severe ground shaking, liquefaction of sediments, water-sand ejection, differential subsidence of sediments and landslides (USGS National Earthquake Information Center, http://neic.usgs.gov).

The USGS estimates the peak horizontal ground acceleration in the Yakutat area, with 10% probability of exceedance in 50 years, as 0.4g (Seismic-Hazard Maps For Alaska and the Aleutian Islands, USGS, 1999). The Uniform Building Code (1997, Fig. 16-2) places Yakutat in zone 4. UBC soil profile type (Table 16-j) is $S_{D.}$

The Yakutat airport area contains large deposits of saturated silty and sandy soils that are possibly susceptible to liquefaction. Spread footing foundations can be affected by liquefaction occurring to depths of 50' below the foundation footing.

Liquefaction

The SRE/S&CS building site was evaluated for liquefaction potential using the methodology outlined in FHWA Publication No. HI-99-012 *Geotechnical Earthquake Engineering*. Five screening criteria were used to initially evaluate the site for liquefaction potential:

1. Geologic age and origin.
2. Fines content and plastic index.
3. Saturation.
4. Depth below ground surface.
5. Soil penetration resistance

The proposed building site satisfies all but the last criterion. Because 4 of the 5 criteria were satisfied a more rigorous liquefaction analysis of test holes 1-3, 9 and 10 was conducted. The results of the analysis indicate a factor of safety against liquefaction varying 0.3 to 2.0. A 1.1 FOS is often recommended for highway structures, at the present time there is little general agreement on appropriate factors of safety against liquefaction. For the purposes of this report only those soils with **both** an $(N_1)_{60}$ value less than 30 and a calculated FOS less than 1 are considered likely to liquefy.

Using the above criteria liquefiable soils were identified in test holes 2, 4 and 10. Based on our analysis of the test hole logs and interpretation of the regional geology we believe that the liquefiable zones are limited to beds of less dense sand and silt less than 3' thick. Liquefaction of all these zones during a single earthquake event is unlikely. Of the three possible foundation failure modes (bearing capacity failure, lateral spreading and settlement) we believe that settlement is the most likely to occur at the proposed building site. Assuming 3' of silty sand increasing in relative density from 0.50 to .75 the maximum settlement would be approximately 1.5". Due to the degree of uncertainty with determining the thickness of the liquefiable zone and the amount of potential consolidation we assumed a factor of safety of 2, and estimate the maximum settlement as 3.0".

Consideration should be given to the intended use of the building to determine if the foundation and soil improvements necessary to mitigate the liquefaction potential are warranted. The principle uses for the building are to store sand and snowplow trucks. The building will not be accessible to the general public. The maximum occupancy at any one time will be five people.

The most effective way to decrease the potential for liquefaction would be to improve the soil or transfer the foundation loads to deeper non-liquefiable soils. Ground improvement could be accomplished by vibroflotation. The ground under the building footprint (+5') would be densified on 10' centers to a depth of 20'. An alternative would be to drive foundation piling below the zone of liquefaction influence, generally accepted as 50' below the floor elevation.

Soil Conditions
Three major soil types were identified at the proposed building site: silt fill material (overburden waste), sand with varying amounts of silt and gravel, and silt often interbedded with sand. 1) A large area of overburden waste overlaps a portion of the building site. This material varied from 5.5' to 9.0' thick. This silt is wet, soft and organic; with a bearing capacity of less the 1,000 psf. The aerial extent of this material is shown on the test hole location map, Appendix A. 2) The native soils in test holes 1-3, 5, 6, 9 and 10 were dense to very dense sand containing varying amounts of silt and gravel. 3) Silt was the dominant soil type in test holes 4, 7 and 8.

The test holes were drilled with hollow-stem auger. Sand often heaved into the auger core when the plug was pulled in preparation for sampling. Heaving sand indicates a soil gradation and moisture content favorable to liquefaction. Heaving sand can also affect the sampling process, disturbing the soil below the auger prior to sampling and causing friction along the sampler and rod during sampler driving. The magnitude and direction of these influences has not been determined.

Water Table and Drainage
During the April drilling the water table varied from 2.0' to 9.0' below the present ground surface with ground water surface elevations ranging from 19' to 25' MSL. The water table averaged 5' below the existing ground surface, at an estimated average elevation of 21' MSL. It is expected that it could rise to within a foot of the surface during the fall rainy season. During periods of high water table, subsurface drainage structures may be only marginally effective.

Surface drainage in the airport area is poor. The relatively flat nature of the Yakutat Foreland, coupled with the barrier nature of the emergent beach and glacial moraine deposits, causes sluggish drainage. Another contributing factor to poor drainage is the relative youth of the terrain. There has been relatively little time for an efficient drainage pattern to develop since glacial ice last melted from the area.

Recommendations
The following recommendations are based on the findings of the geotechnical investigation:

- **Building and Water Tank Foundations.**
  1. Because of the intended use of the building and the belief that 3" of settlement would not compromise the building we suggest that spread-footing foundations are suitable for this area.
  2. Liquefaction considerations should be limited to designing for a maximum differential settlement of 3". Drill data indicates that the area around TH 4 will experience the greatest settlement.
  3. The organic silty fill indicated in test holes 1 and 2 (aerial distribution shown on TH location sketch, Appendix A) should be removed from the

building footprint (+5') and wasted. Analysis indicates that this soil has a bearing capacity of less than 1,000 psf.

4. The bottom of spread footings should be a minimum of 2.5' below finished grade to reduce the effects of seasonal frost.
5. Foundations should be designed to withstand strong earthquakes using UBC or AASHTO criteria.
6. Initial soil bearing capacity analyses indicate 4,000 psf for TH 1-3 and 2,000 psf for TH 4. An initial soil bearing capacity of 2000 psf should be used for determining initial spread footing sizes. When footing size, embedment depth and loading are determined a detailed bearing capacity analysis should be performed to confirm the design's adequacy.

- **Parking and Building Access.**
  1. Remove and waste the organic silty fill described in item 3 above.
  2. Place a geotechnical fabric designed to provide reinforcement and separation. The geotechnical fabric should meet the requirements of AASHTO M 288 (high survivability).
  3. Overlaying with a minimum of 2.0' of clean compact granular material (Select Material, type A)
- **Airport Road Realignment.**
  1. Test holes 6 and 7 plus the dynamic cone penetrometer tests indicate that a suitable gravel road could be constructed around the proposed perimeter fence by overlaying the silty organic soil. Below 0.6-1.6 ' the CBR values ranged from 18-25%.
  2. The overlay should be placed on a geotechnical fabric designed for reinforcement and separation, AASHTO M 288 (high survivability)
  3. Overlaying with a minimum of 2.0' of clean compact granular material (Select Material, type A).

SELECTED REFERENCES

Coulter, H. W. and others, 1965, *Map Showing Extent of Glaciation in Alaska*, USGS Map I-415.

Gehrels, G. E. and Berg, H. C., 1992, *Geologic Map of Southeastern Alaska*, USGS Map I-1876.

Johnson, G. R. and Plafker, G., 1969, *Preliminary Geologic Interpretation of Aeromagnetic Data in the Yakutat District, Alaska,* USGS Open File Report.

Munfakh, G and others, 1998, *Geotechnical Earthquake Engineering*, FHWA Publication No. HI-99-012.

Schroeder, W. L., 1983, *Geotechnical Properties of Southeast Alaska Forest Soils*, USDA Forest Service.

Selkregg, L. L. and others, 1977, *Alaska Regional Profiles, Southeast Region*, University of Alaska.

Wahrhaftig, C., 1965, *Physiographic Divisions of Alaska*, USGS Professional Paper 482.

Winterkorn and Fang, 1975, *Foundation Engineering Manual.*

Wolff, E. N. and Heiner, L. E., 1971, *Mineral Resources of Southeastern Alaska*, University of Alaska MIRL Report No. 28.

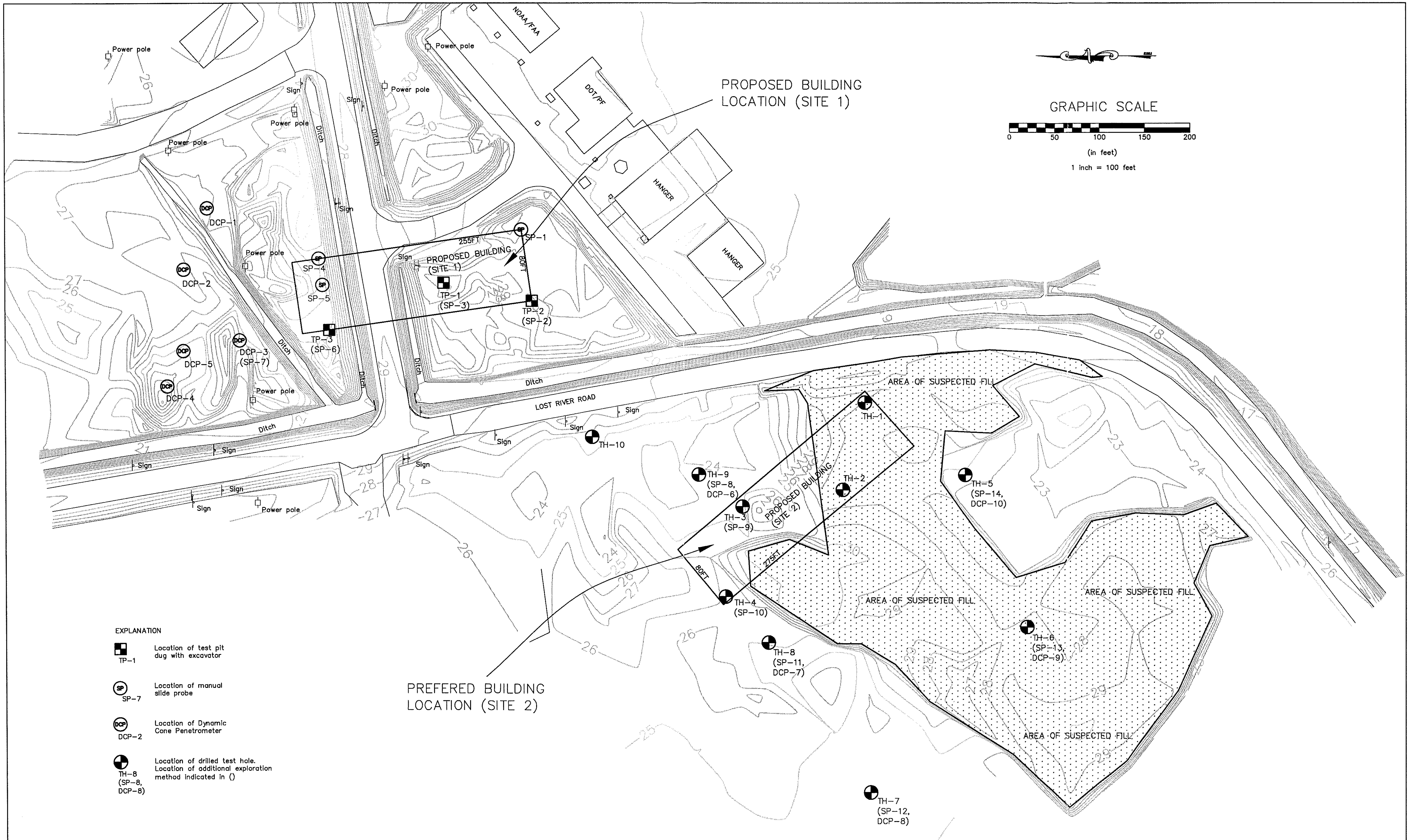
Yehle, L. A., 1979, *Reconnaissance Engineering Geology of the Yakutat Area, Alaska, with Emphasis on Evaluation of Earthquake and Other Geologic Hazards*, USGS Professional Paper 1074.

________, 1969, *Yakutat Beach, Alaska,* USGS Open File Maps.

________, 1993, *Seismic Awareness: Transportation Facilities*, DOT-VNTSC-OST-93-2

APPENDIX A

LOG OF TEST HOLES



PATH:	Q:\YAK\68017\GE\YAK_MAINSTA_FT\dwg\Location Map.dwg	
VIEW:	Location Map	
BY:	DATE:	DESCRIPTION OF CHANGE:

RECORD OF REVISIONS

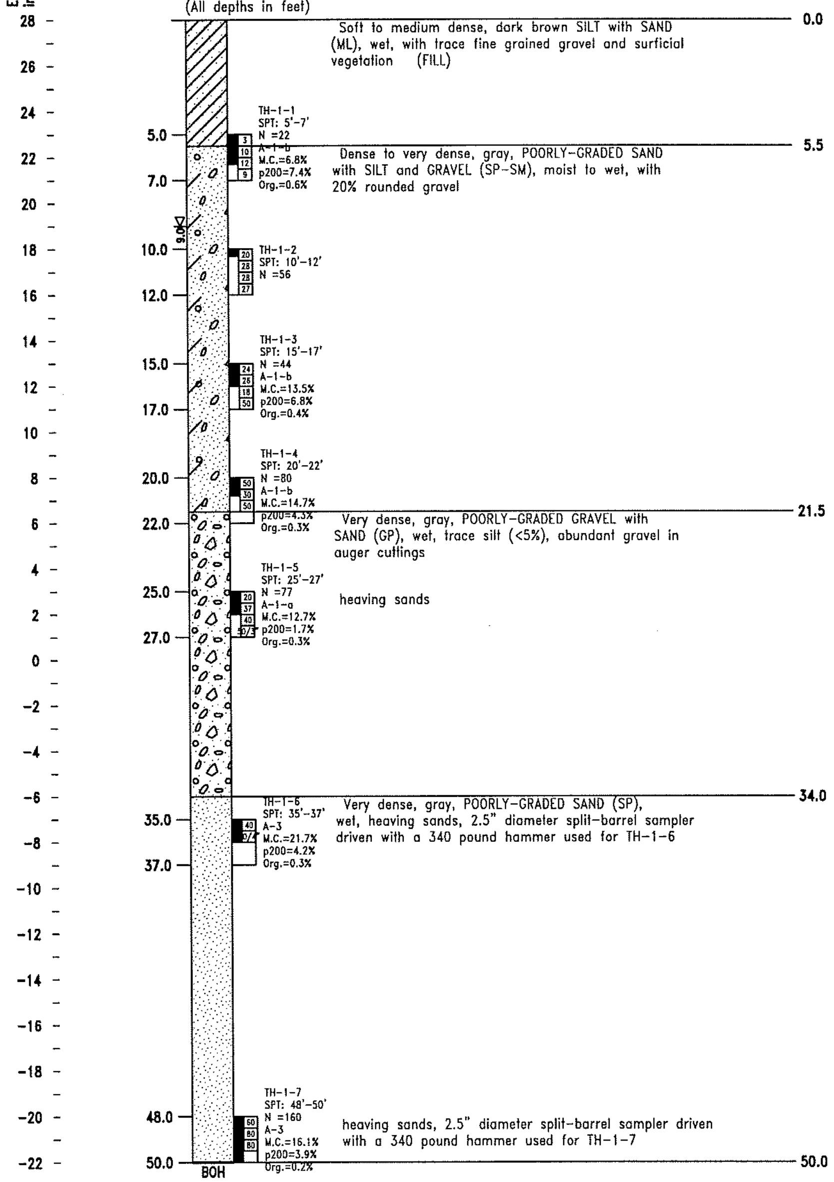
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
SOUTHEAST REGION DESIGN & CONSTRUCTION

YAKUTAT AIRPORT SRE / SAND & CHEMICAL STORAGE BUILDING ALASKA
PROPOSED SITE 1 AND SITE 2
PROJECT NO. 68017

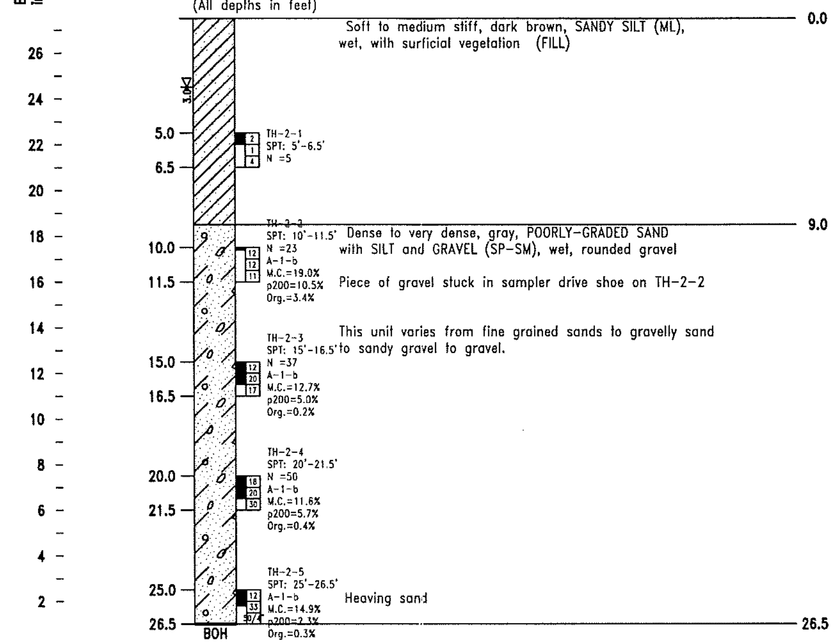
TEST HOLE LOCATION MAP

DATA BY: *M.McDONALD*	PROJECT NO. *68017*
DRAWN BY: *M.McDONALD*	DATE: *MAY, 2001*
CHECKED BY: *R.SWEDELL*	SHEET *1* OF *1*

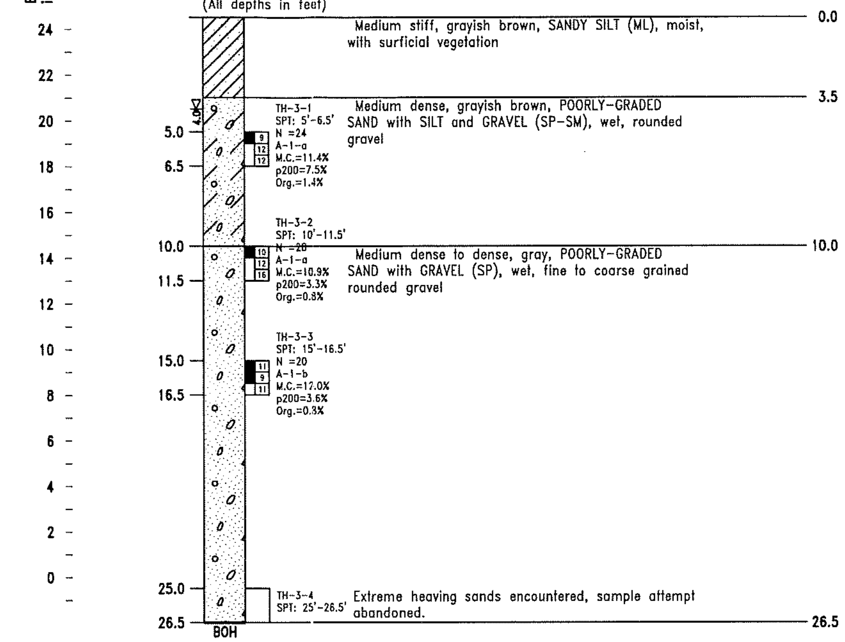
TH-1 Yakutat:Airport SRE & Sand & Chemical Storage Building – Site 2 (68017)
Location: Proposed building, SE corner
Elevation: 28.0
4/10/01
(All depths in feet)



TH-2 Yakutat:Airport SRE & Sand & Chemical Storage Building – Site 2 (68017)
Location: Proposed building, W side of building
Elevation: 27.5
4/13/01
(All depths in feet)

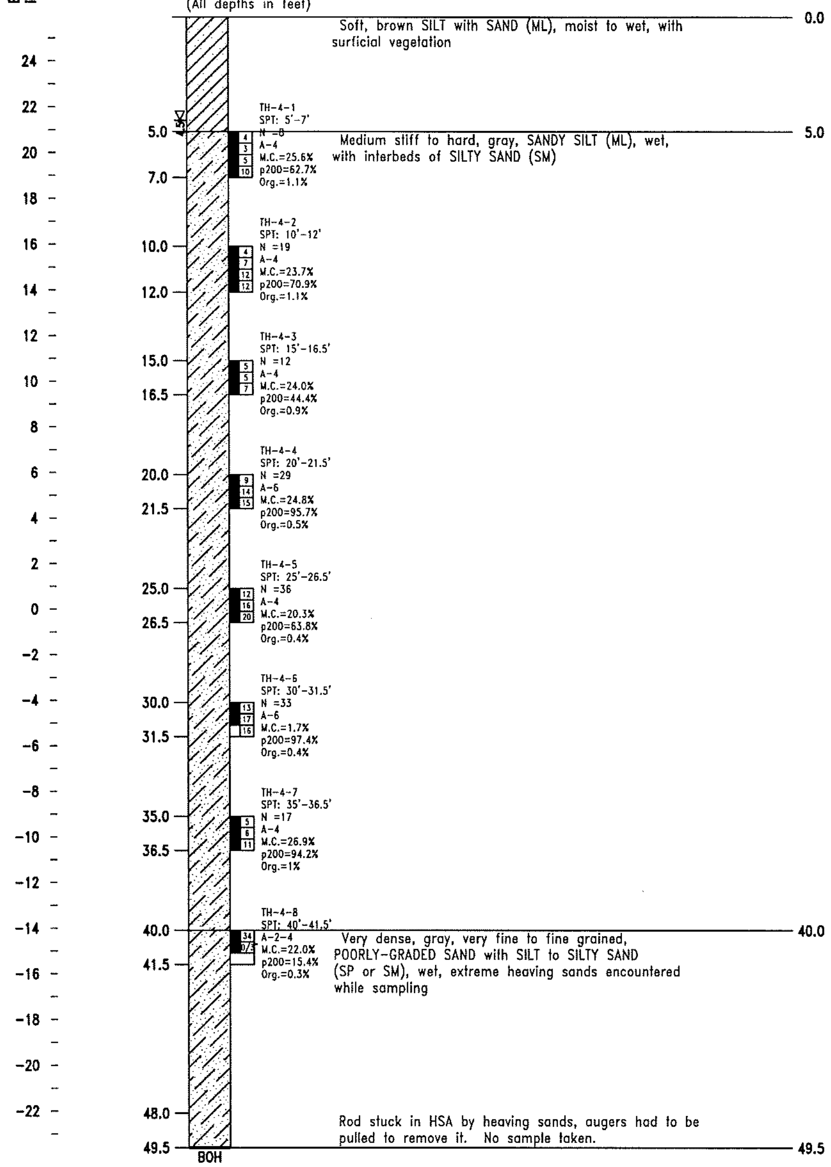


TH-3 Yakutat:Airport SRE & Sand & Chemical Storage Building – Site 2 (68017)
Location: Proposed building, E side
Elevation: 24.5
4/12/01
(All depths in feet)

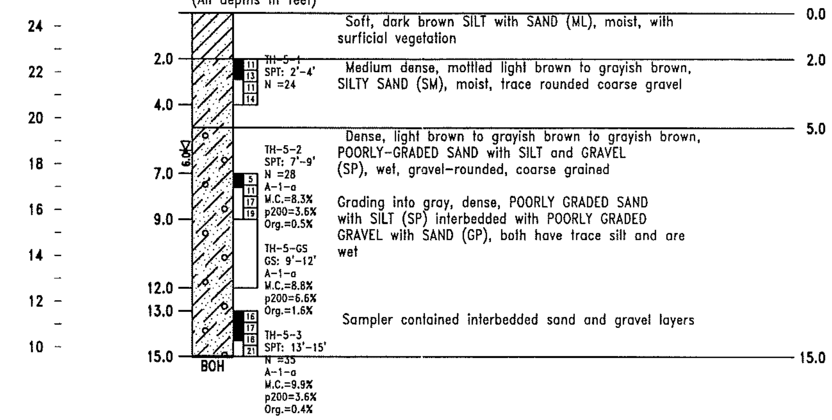


PATH: Q:\YAK\68017\GE\YAK_MAINSTA_FT\dwg\Logs.dwg VIEW: LAYOUT TH 1-3 BY: | DATE: | DESCRIPTION OF CHANGE: RECORD OF REVISIONS	STATE OF ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES SOUTHEAST REGION DESIGN & CONSTRUCTION	*YAKUTAT* *AIRPORT SRE/SAND & CHEMICAL STORAGE BUILDING SITE 2* *ALASKA* *PROJECT NO. 68017* ***BORING LOGS: TEST HOLES 1-3***	DATA BY: *M.McDONALD* DRAWN BY: *M.McDONALD* CHECKED BY: *R.SWEDELL*	PROJECT NO. *68017* DATE: *MAY, 2001* SHEET *1* OF *3*

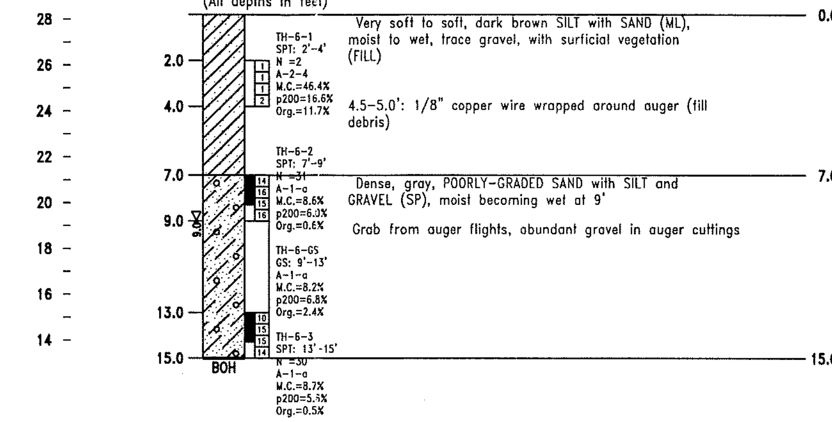
TH-4 Yakutat:Airport SRE & Sand & Chemical Storage Building - Site 2 (68017)
Location: Proposed building, NW corner
Elevation: 25.9
4/12/01
(All depths in feet)



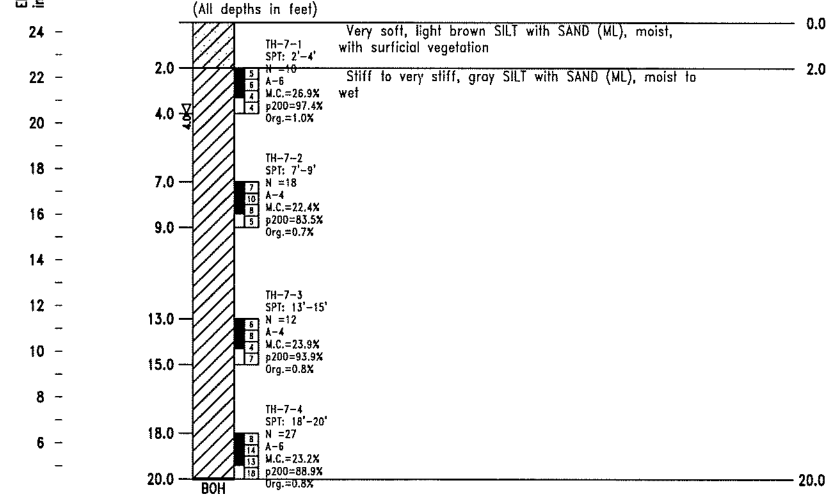
TH-5 Yakutat:Airport SRE & Sand & Chemical Storage Building - Site 2 (68017)
Location: Proposed parking area, SE of building
Elevation: 24.6
4/11/01
(All depths in feet)



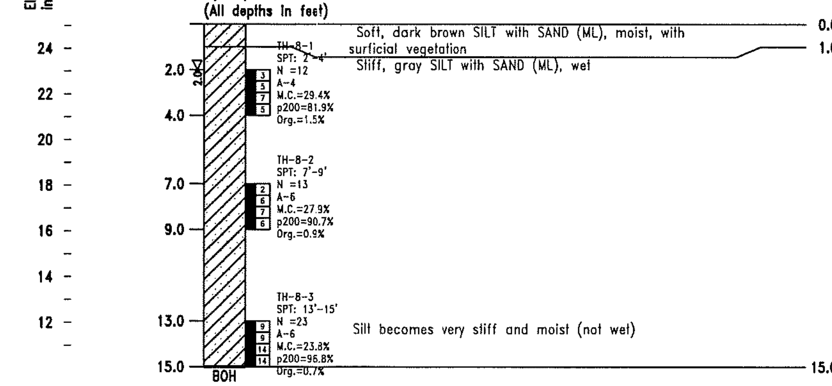
TH-6 Yakutat:Airport SRE & Sand & Chemical Storage Building - Site 2 (68017)
Location: Proposed road, SW of building
Elevation: 28.2
4/11/01
(All depths in feet)



TH-7 Yakutat:Airport SRE & Sand & Chemical Storage Building - Site 2 (68017)
Location: Proposed road, W of building
Elevation: 24.4
4/11/01
(All depths in feet)



TH-8 Yakutat:Airport SRE & Sand & Chemical Storage Building - Site 2 (68017)
Location: Proposed parking area, NWend of building
Elevation: 25.1
4/11/01
(All depths in feet)



PATH: *Q:\YAK\68017\GE\YAK_MAINSTA_FT\dwg\Logs.dwg*
VIEW: *LAYOUT TH 4-8*

BY:	DATE:	DESCRIPTION OF CHANGE:

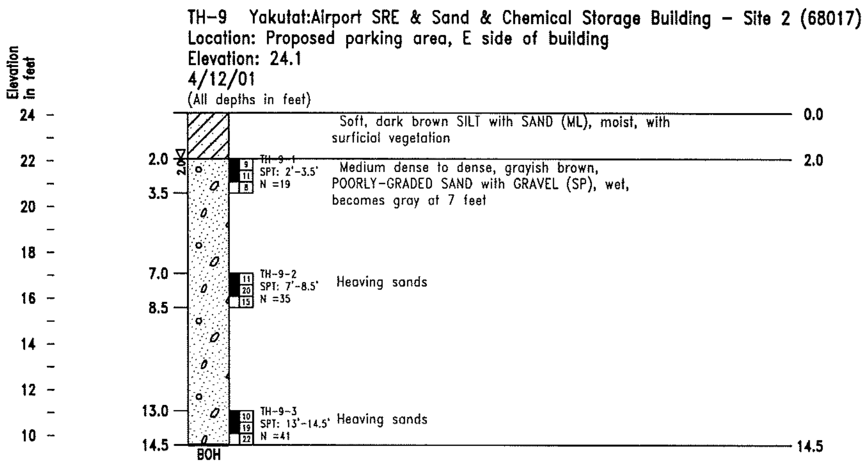
RECORD OF REVISIONS

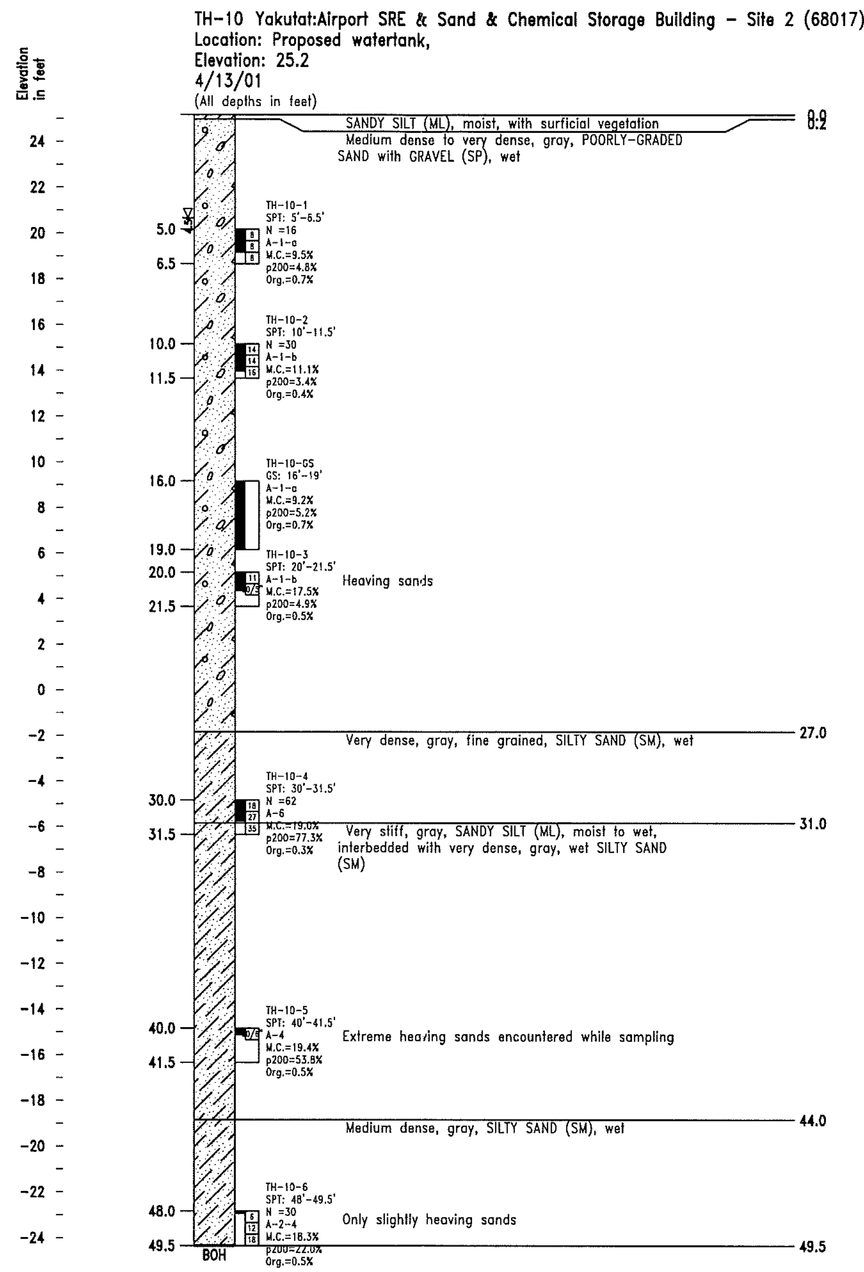
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
SOUTHEAST REGION DESIGN & CONSTRUCTION

YAKUTAT *AIRPORT SRE/SAND & CHEMICAL STORAGE BUILDING SITE 2* *ALASKA*
PROJECT NO. 68017

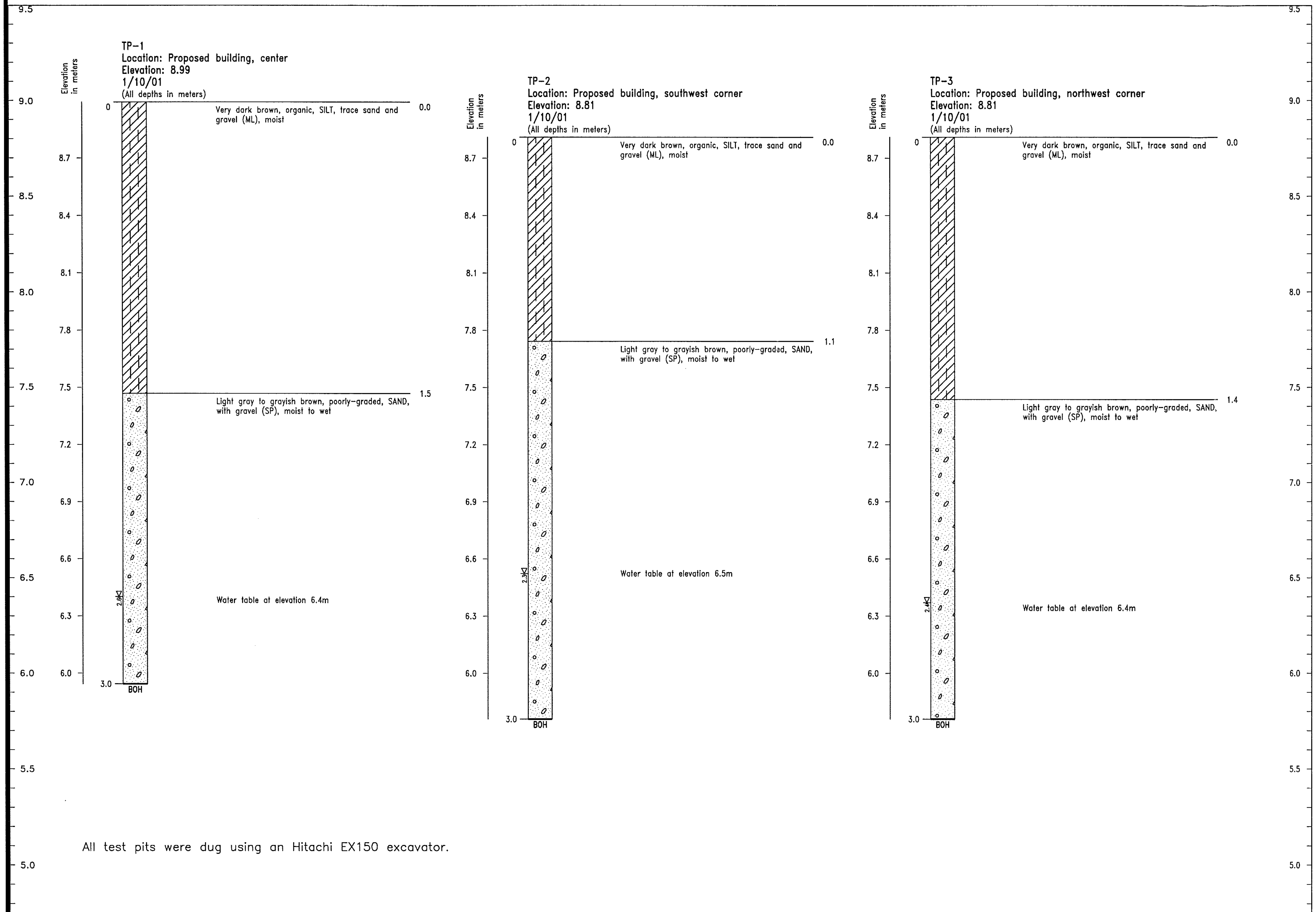
BORING LOGS: TEST HOLES 4-8

DATA BY: *M.McDONALD*
DRAWN BY: *M.McDONALD*
CHECKED BY: *R.SWEDELL*
PROJECT NO. *68017*
DATE: *MAY, 2001*
SHEET *2* OF *3*



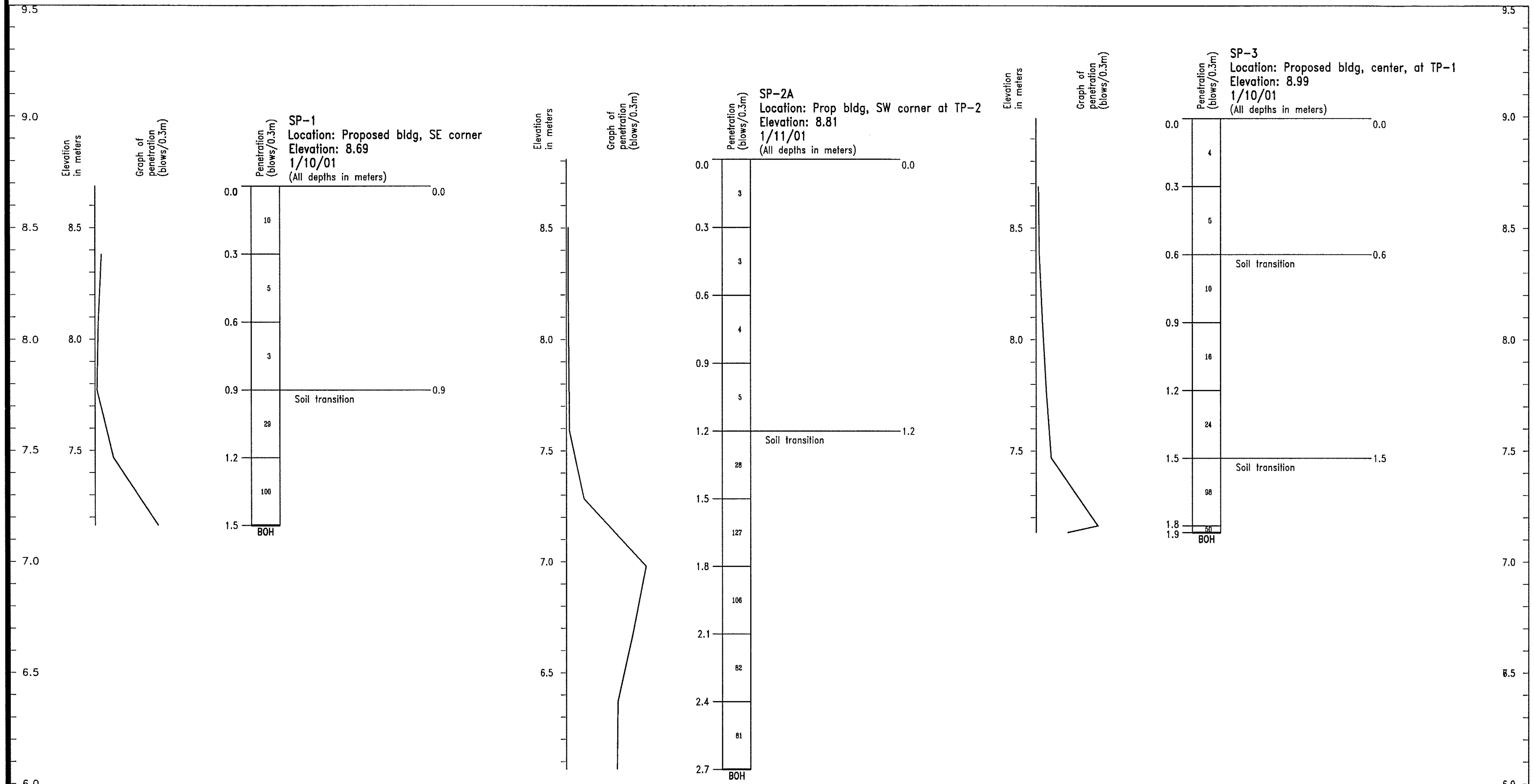


PATH: Q: \YAK\68017\GE\YAK_MAINSTA_FT\dwg\Logs.dwg	STATE OF ALASKA	YAKUTAT	AIRPORT SRE/SAND & CHEMICAL STORAGE BUILDING SITE 2	ALASKA	DATA BY: M.McDONALD	PROJECT NO. 68017
VIEW: LAYOUT TH 9-10	DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES		PROJECT NO. 68017		DRAWN BY: M.McDONALD	DATE: MAY, 2001
BY: / DATE: / DESCRIPTION OF CHANGE:	SOUTHEAST REGION DESIGN & CONSTRUCTION		BORING LOGS: TEST HOLES 9-10		CHECKED BY: R.SWEDELL	SHEET 3 OF 3
RECORD OF REVISIONS						



All test pits were dug using an Hitachi EX150 excavator.

PATH: Q: \YAK\68017\GE\YAK_MAINTSTA_MET\dwg\Logs.dwg VIEW: LAYOUT 1 BY: / DATE: / DESCRIPTION OF CHANGE: RECORD OF REVISIONS	STATE OF ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES SOUTHEAST REGION DESIGN & CONSTRUCTION	*YAKUTAT* *AIRPORT SRE & SAND & CHEM STORAGE BUILDING* *ALASKA* *SITE 1 : PROPOSED BUILDING & ROAD REALIGNMENT* *PROJECT NO. 68017* *TEST PIT LOGS*	DATA BY: *M.McDONALD* DRAWN BY: *M.McDONALD* CHECKED BY: *R.SWEDELL*
			PROJECT NO. *68017* DATE: *MAY 2001* SHEET *1* OF *6*



Slide Probe refers to 0.5" black iron water pipe driven by a manually operated 10 lb hammer dropped 36". The blows per foot recorded in the logs do not correlate to the Standard Penetration Test (ASTM D1586). Blow counts correlate to the soils relative resistance to the probes penetration and may be used to indicate major changes in soil density.

PATH: Q: \YAK\68017\GE\YAK_MAINTSTA_MET\dwg\Logs.dwg		
VIEW: LAYOUT 1		
BY:	DATE:	DESCRIPTION OF CHANGE:

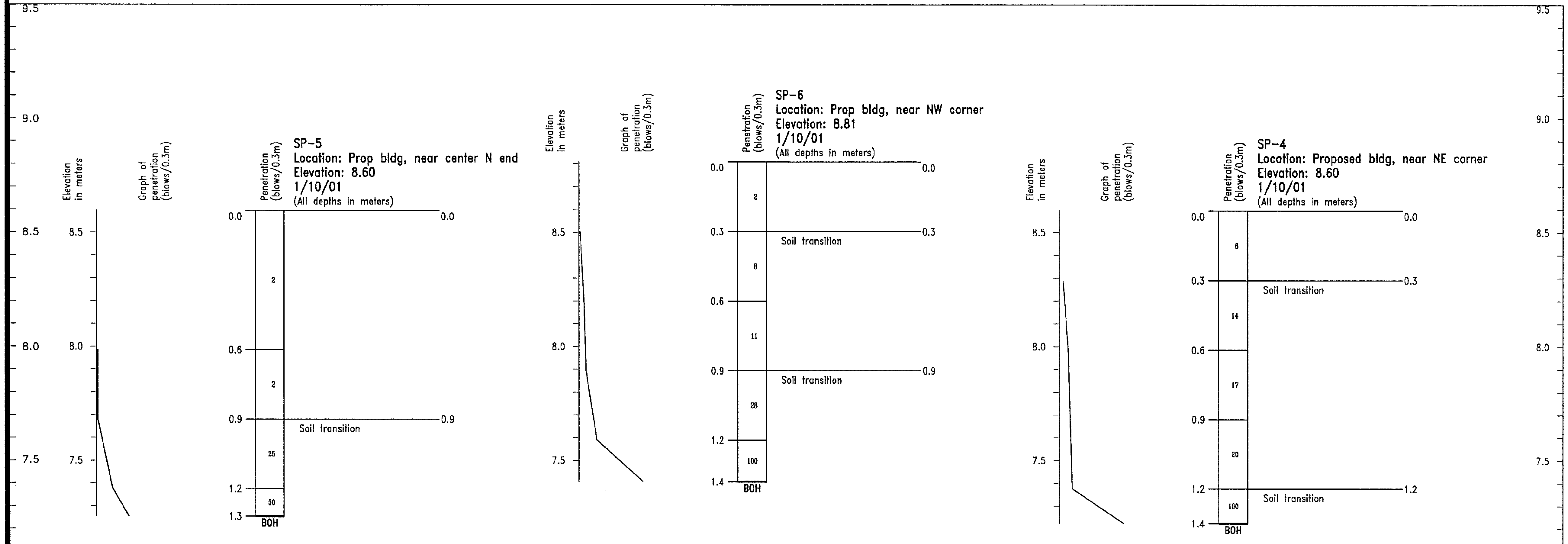
RECORD OF REVISIONS

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
SOUTHEAST REGION DESIGN & CONSTRUCTION

YAKUTAT *AIRPORT SRE & SAND & CHEM STORAGE BUILDING* *ALASKA*
SITE 1 : PROPOSED BUIILDING & ROAD REALIGNMENT
PROJECT NO. 68017

SLIDE PROBE LOGS

DATA BY: *M.McDONALD*	PROJECT NO. *68017*
DRAWN BY: *M.McDONALD*	DATE: *MAY 2001*
CHECKED BY: *R.SWEDELL*	SHEET *2* OF *6*



Slide Probe refers to 0.5" black iron water pipe driven by a manually operated 10 lb hammer dropped 36". The blows per foot recorded in the logs do not correlate to the Standard Penetration Test (ASTM D1586). Blow counts correlate to the soils relative resistance to the probes penetration and may be used to indicate major changes in soil density.

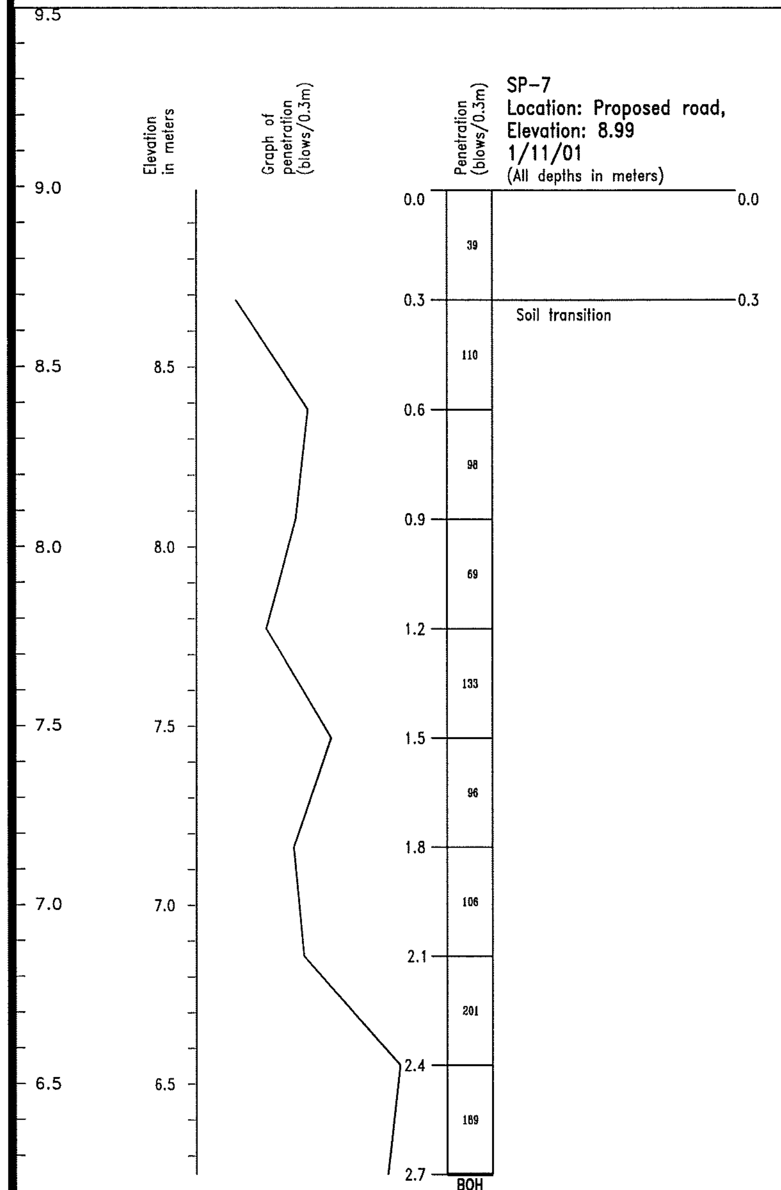
PATH: Q: \YAK\68017\GE\YAK_MAINTSTA_MET\dwg\Logs.dwg		
VIEW: LAYOUT 1		
BY:	DATE:	DESCRIPTION OF CHANGE:
RECORD OF REVISIONS		

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
SOUTHEAST REGION DESIGN & CONSTRUCTION

YAKUTAT *AIRPORT SRE & SAND & CHEM STORAGE BUILDING* *ALASKA*
SITE 1 : PROPOSED BUIILDING & ROAD REALIGNMENT
PROJECT NO. 68017

SLIDE PROBE LOGS

DATA BY: *M.McDONALD*	PROJECT NO. *68017*
DRAWN BY: *M.McDONALD*	DATE: *MAY 2001*
CHECKED BY: *R.SWEDELL*	SHEET *3* OF *6*



Slide Probe refers to 0.5" black iron water pipe driven by a manually operated 10 lb hammer dropped 36". The blows per foot recorded in the logs do not correlate to the Standard Penetration Test (ASTM D1586). Blow counts correlate to the soils relative resistance to the probes penetration and may be used to indicate major changes in soil density.

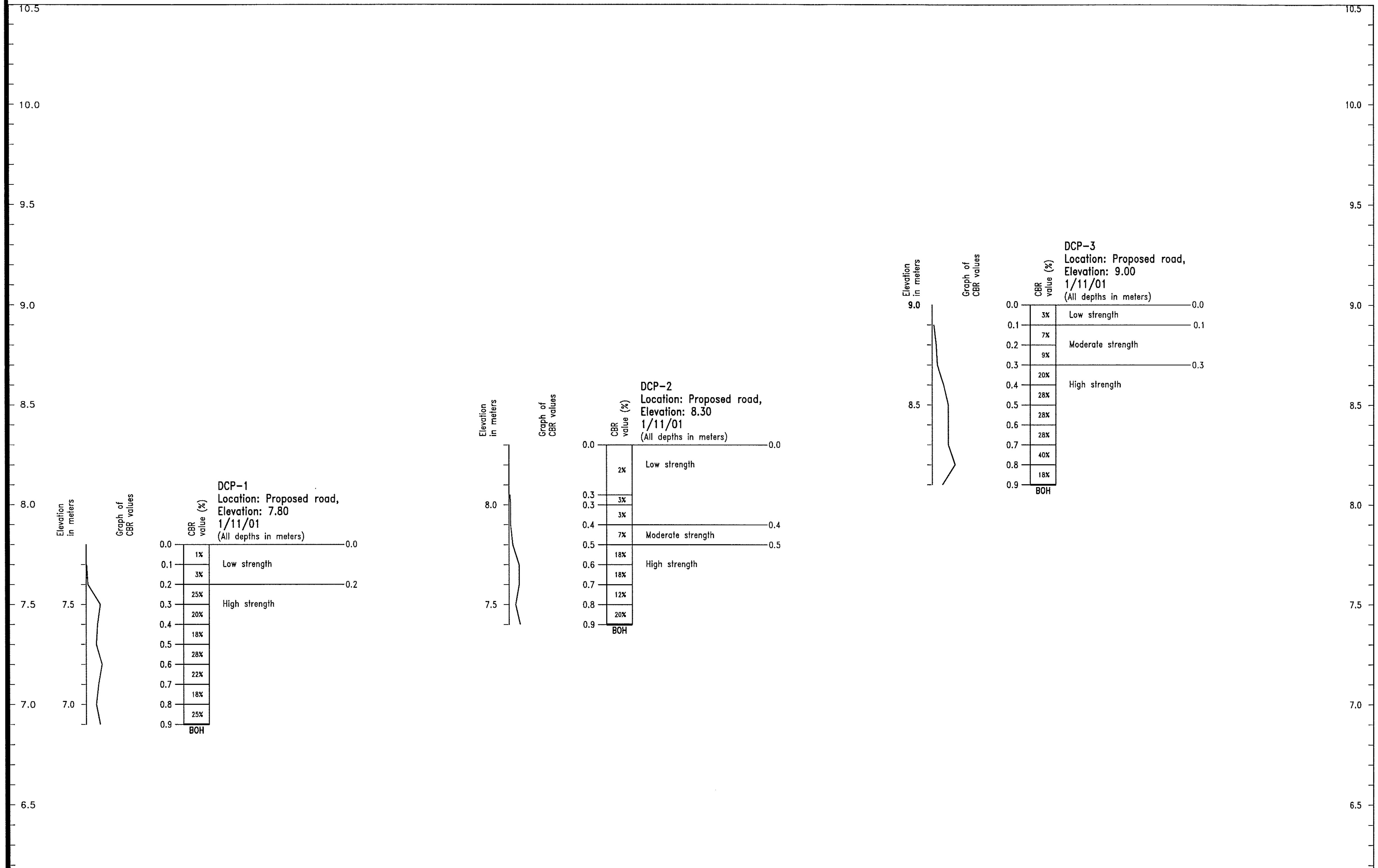
PATH:	Q: \YAK\68017\GE\YAK_MAINTSTA_MET\dwg\Logs.dwg	
VIEW:	LAYOUT 1	
BY:	DATE:	DESCRIPTION OF CHANGE:
RECORD OF REVISIONS		

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
SOUTHEAST REGION DESIGN & CONSTRUCTION

YAKUTAT *AIRPORT SRE & SAND & CHEM STORAGE BUILDING* *ALASKA*
SITE 1 : PROPOSED BUIILDING & ROAD REALIGNMENT
PROJECT NO. 68017

SLIDE PROBE LOGS

DATA BY: *M.McDONALD*	PROJECT NO. *68017*
DRAWN BY: *M.McDONALD*	DATE: *MAY 2001*
CHECKED BY: *R.SWEDELL*	SHEET *4* OF *6*



Dynamic Cone Penetrometer (DCP) refers to a 16mm steel rod driven by a manually operated 8kg hammer dropped 575mm. The DCP is specifically calibrated to allow for the calculation of the soils California Bearing Ratio in percent.

PATH: Q:\YAK\68017\GE\YAK_MAINTSTA_MET\dwg\Logs.dwg		
VIEW: LAYOUT 1		
BY:	DATE:	DESCRIPTION OF CHANGE:

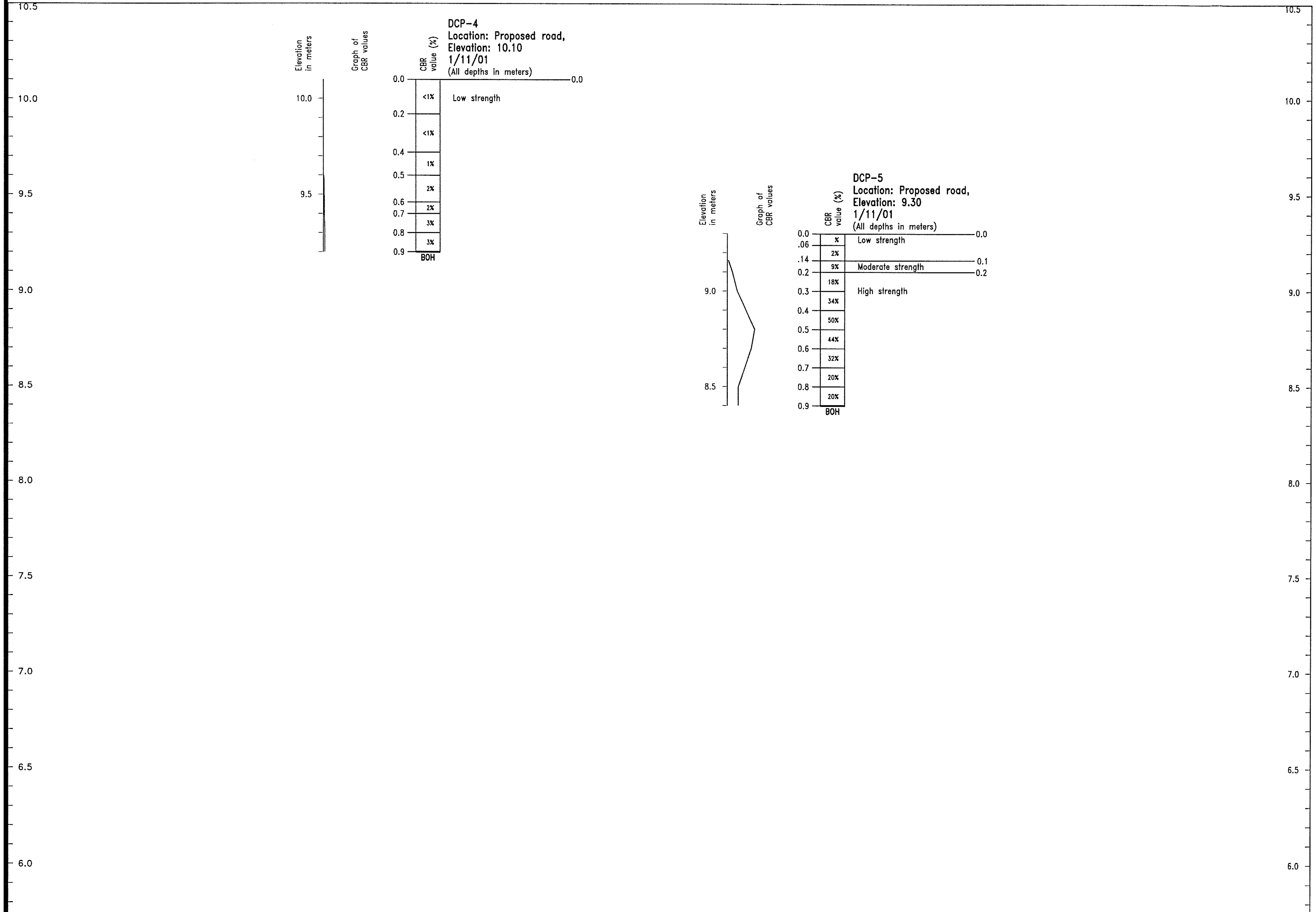
RECORD OF REVISIONS

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
SOUTHEAST REGION DESIGN & CONSTRUCTION

YAKUTAT — AIRPORT SRE & SAND & CHEM STORAGE BUILDING — ALASKA
SITE 1 : PROPOSED BUIILDING & ROAD REALIGNMENT
PROJECT NO. 68017

DYNAMIC CONE PENETROMETER LOGS

DATA BY: M.McDONALD	PROJECT NO. 68017
DRAWN BY: M.McDONALD	DATE: MAY 2001
CHECKED BY: R.SWEDELL	SHEET 5 OF 6



PATH:	Q:\YAK\68017\GE\YAK_MAINTSTA_MET\dwg\Logs.dwg
VIEW:	LAYOUT 1

BY:	DATE:	DESCRIPTION OF CHANGE:

RECORD OF REVISIONS

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
SOUTHEAST REGION DESIGN & CONSTRUCTION

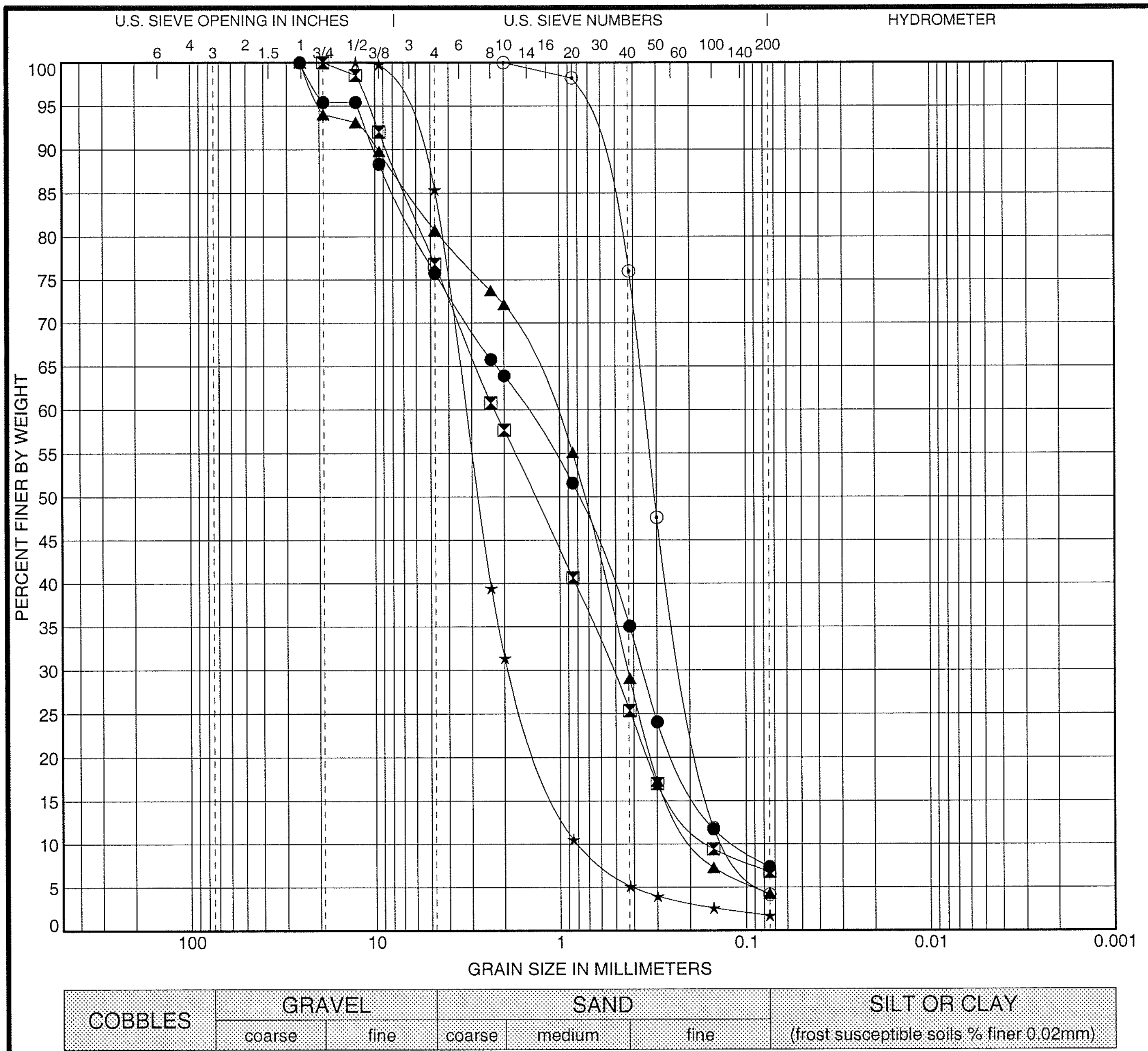
YAKUTAT — AIRPORT SRE & SAND & CHEM STORAGE BUILDING — ALASKA
SITE 1 : PROPOSED BUIILDING & ROAD REALIGNMENT
PROJECT NO. 68017

DYNAMIC CONE PENETROMETER LOGS

DATA BY: M.McDONALD	PROJECT NO. 68017
DRAWN BY: M.McDONALD	DATE: MAY 2001
CHECKED BY: R.SWEDELL	SHEET 6 OF 6

APPENDIX B

LABORATORY DATA



	Sample # / Depth	Lab #	USCS Classification (AASHTO Classification)	% Organics	% MC	LL	PL	PI
●	TH-1 5.0	01C-47	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM) (A-1-b)**	0.6	6.8	NV	NP	NP
⧗	TH-1 15.0	01C-49	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM) (A-1-b)**	0.4	13.5	NV	NP	NP
▲	TH-1 20.0	01C-50	**POORLY GRADED SAND with GRAVEL(SP) (A-1-b)**	0.3	14.7	NV	NP	NP
★	TH-1 25.0	01C-51	**POORLY GRADED SAND(SP) (A-1-a)**	0.3	12.7	NV	NP	NP
⊙	TH-1 35.0	01C-52	**POORLY GRADED SAND(SP) (A-3)**	0.3	21.7	NV	NP	NP

	Sample # / Depth	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Frost Susceptible Soils (% finer 0.02mm)
●	TH-1 5.0	0.75	13.41	25.4	1.525	0.36	0.114	24.2	68.4	7.4		
⧗	TH-1 15.0	0.76	14.32	19	2.263	0.521	0.158	23.2	70.0	6.8		
▲	TH-1 20.0	0.94	6.01	25.4	1.088	0.431	0.181	19.2	76.5	4.3		
★	TH-1 25.0	1.40	4.07	12.7	3.227	1.889	0.792	14.6	83.7	1.7		
⊙	TH-1 35.0	1.03	2.75	2	0.347	0.213	0.127	0.0	95.8	4.2		

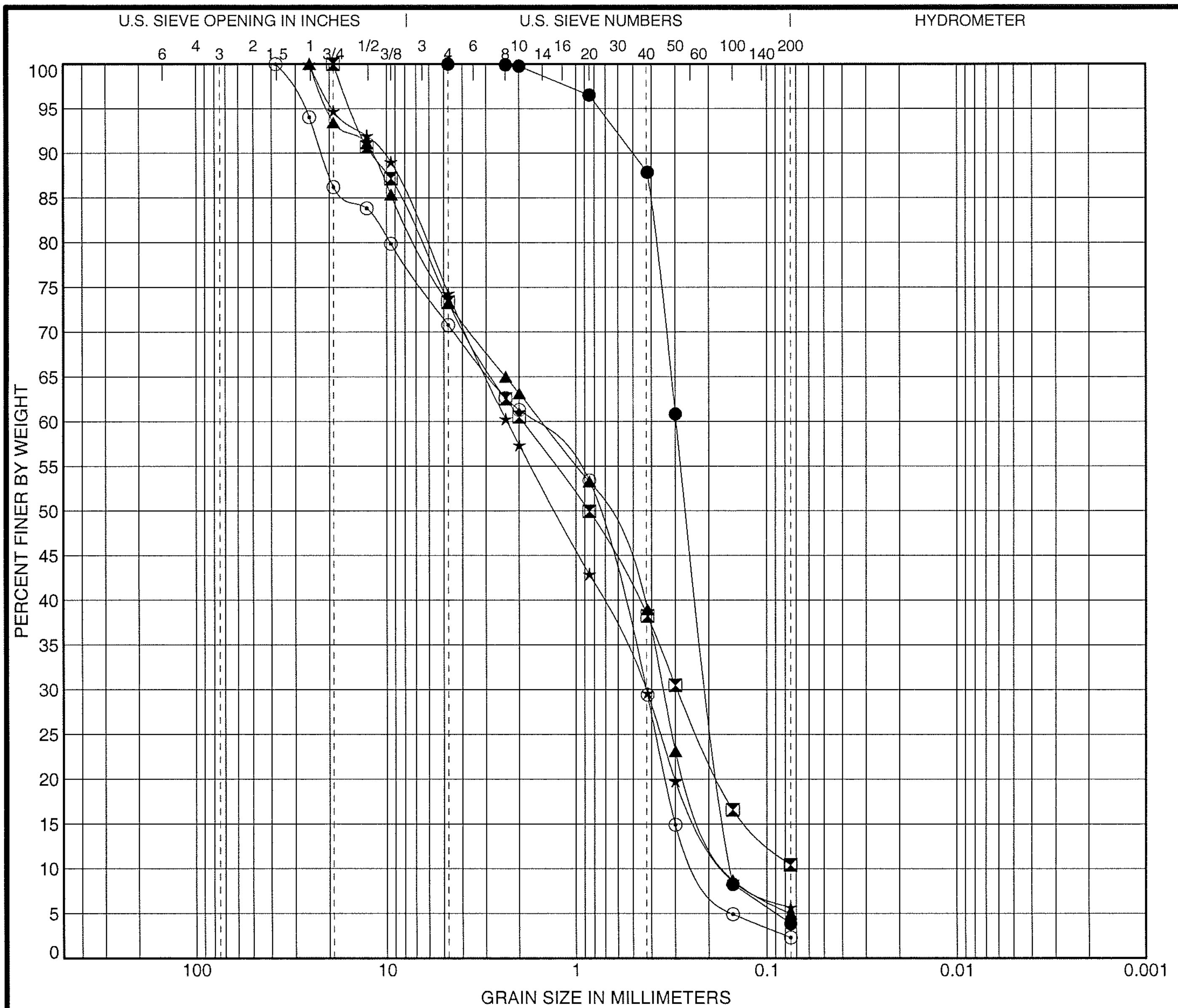
Alaska D.O.T./P.F. Southeast Region
6860 Glacier Hwy.
Juneau, Ak 99801-7999
Telephone: (907) 465-4454
Fax: (907) 465-3506

SUBSURFACE DATA: Results of Laboratory Testing

Location: Yakutat

Project: Airport SRE & Sand & Chemical Storage Building - Site 2

Number: 68017



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	(frost susceptible soils % finer 0.02mm)

	Sample # / Depth	Lab #	USCS Classification (AASHTO Classification)	% Organics	% MC	LL	PL	PI
●	TH-1 48.0	01C-53	**POORLY GRADED SAND(SP) (A-3)**	0.2	16.1	NV	NP	NP
⊠	TH-2 10.0	01C-55	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM) (A-1-b)**	3.4	19.0	NV	NP	NP
▲	TH-2 15.0	01C-56	**POORLY GRADED SAND with GRAVEL(SP) (A-1-b)**	0.2	12.7	NV	NP	NP
★	TH-2 20.0	01C-57	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM) (A-1-b)**	0.4	11.6	NV	NP	NP
⊙	TH-2 25.0	01C-58	**POORLY GRADED SAND with GRAVEL(SP) (A-1-b)**	0.3	14.9	NV	NP	NP

	Sample # / Depth	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Frost Susceptible Soils (% finer 0.02mm)
●	TH-1 48.0	0.88	1.93	4.75	0.297	0.2	0.153	0.0	96.1	3.9		
⊠	TH-2 10.0	0.63	26.92	19	1.918	0.293		26.7	62.9	10.5		
▲	TH-2 15.0	0.50	9.55	25.4	1.523	0.347	0.159	26.8	68.2	5.0		
★	TH-2 20.0	0.48	14.17	25.4	2.322	0.429	0.164	25.7	68.6	5.7		
⊙	TH-2 25.0	0.49	8.15	38	1.739	0.427	0.213	29.2	68.4	2.3		

Alaska D.O.T./P.F. Southeast Region
6860 Glacier Hwy.
Juneau, Ak 99801-7999
Telephone: (907) 465-4454
Fax: (907) 465-3506

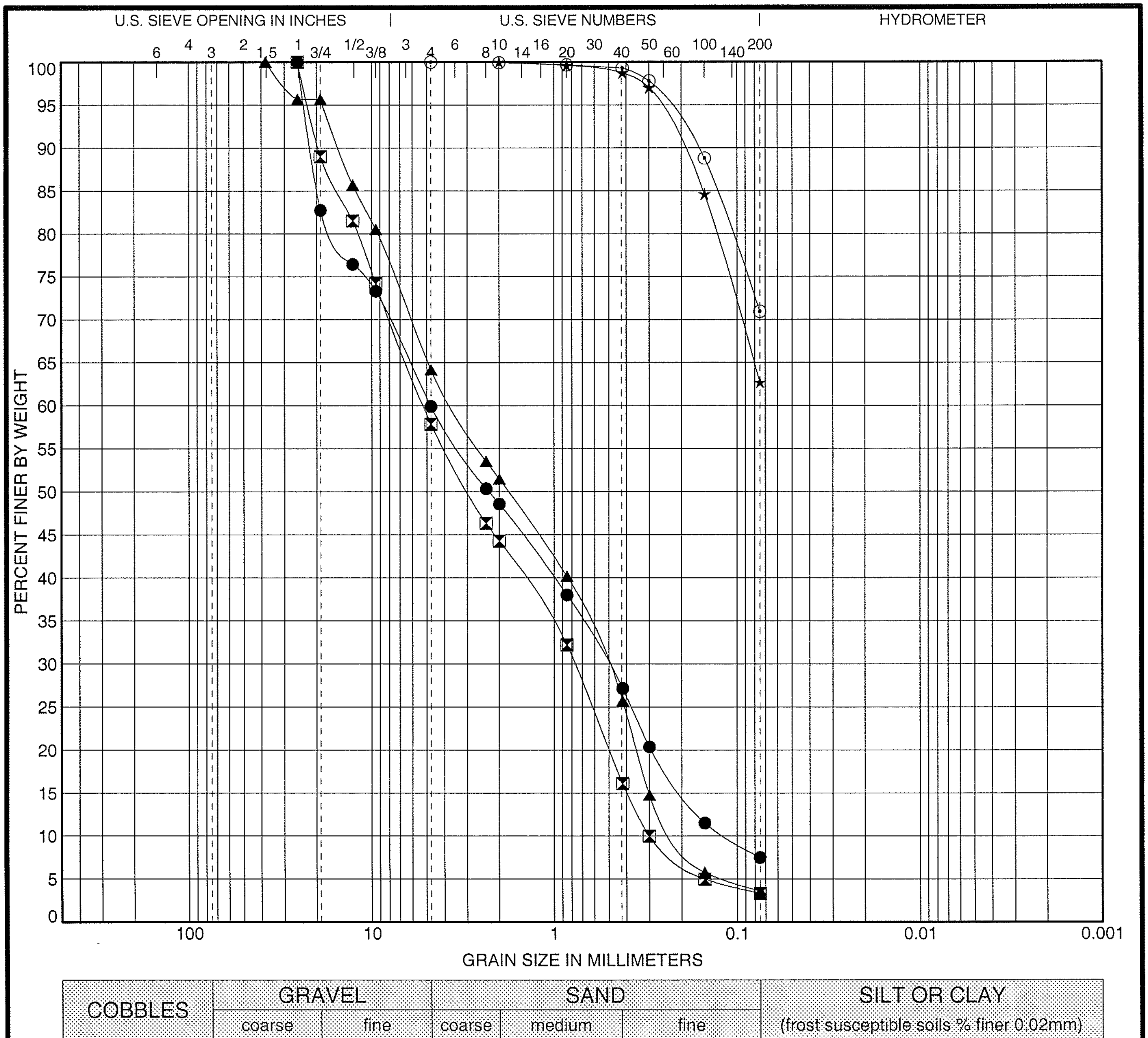
SUBSURFACE DATA: Results of Laboratory Testing

Location: Yakutat

Project: Airport SRE & Sand & Chemical Storage Building - Site 2

Number: 68017

US_GRAIN_SIZE_MODIFIED 68017_C.GPJ MODIFIED.GDT 5/15/01



Sample # / Depth	Lab #	USCS Classification (AASHTO Classification)	% Organics	% MC	LL	PL	PI
● TH-3 5.0	01C-59	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM) (A-1-a)**	1.4	11.4	NV	NP	NP
⊠ TH-3 10.0	01C-60	**POORLY GRADED SAND with GRAVEL(SP) (A-1-a)**	0.8	10.9	NV	NP	NP
▲ TH-3 15.0	01C-61	**POORLY GRADED SAND with GRAVEL(SP) (A-1-b)**	0.8	12.0	NV	NP	NP
★ TH-4 5.0	01C-62	**SANDY SILT(ML) (A-4)**	1.1	25.6	NV	NP	NP
⊙ TH-4 10.0	01C-63	**SILT with SAND(ML) (A-4)**	1.1	23.7	NV	NP	NP

Sample # / Depth	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Frost Susceptible Soils (% finer 0.02mm)
● TH-3 5.0	0.46	41.41	25.4	4.774	0.505	0.115	40.1	52.4	7.5		
⊠ TH-3 10.0	0.38	17.34	25.4	5.204	0.772	0.3	42.1	54.5	3.3		
▲ TH-3 15.0	0.36	17.40	38	3.616	0.518	0.208	35.8	60.5	3.6		
★ TH-4 5.0			2				0.0	37.3	62.7		
⊙ TH-4 10.0			4.75				0.0	29.1	70.9		

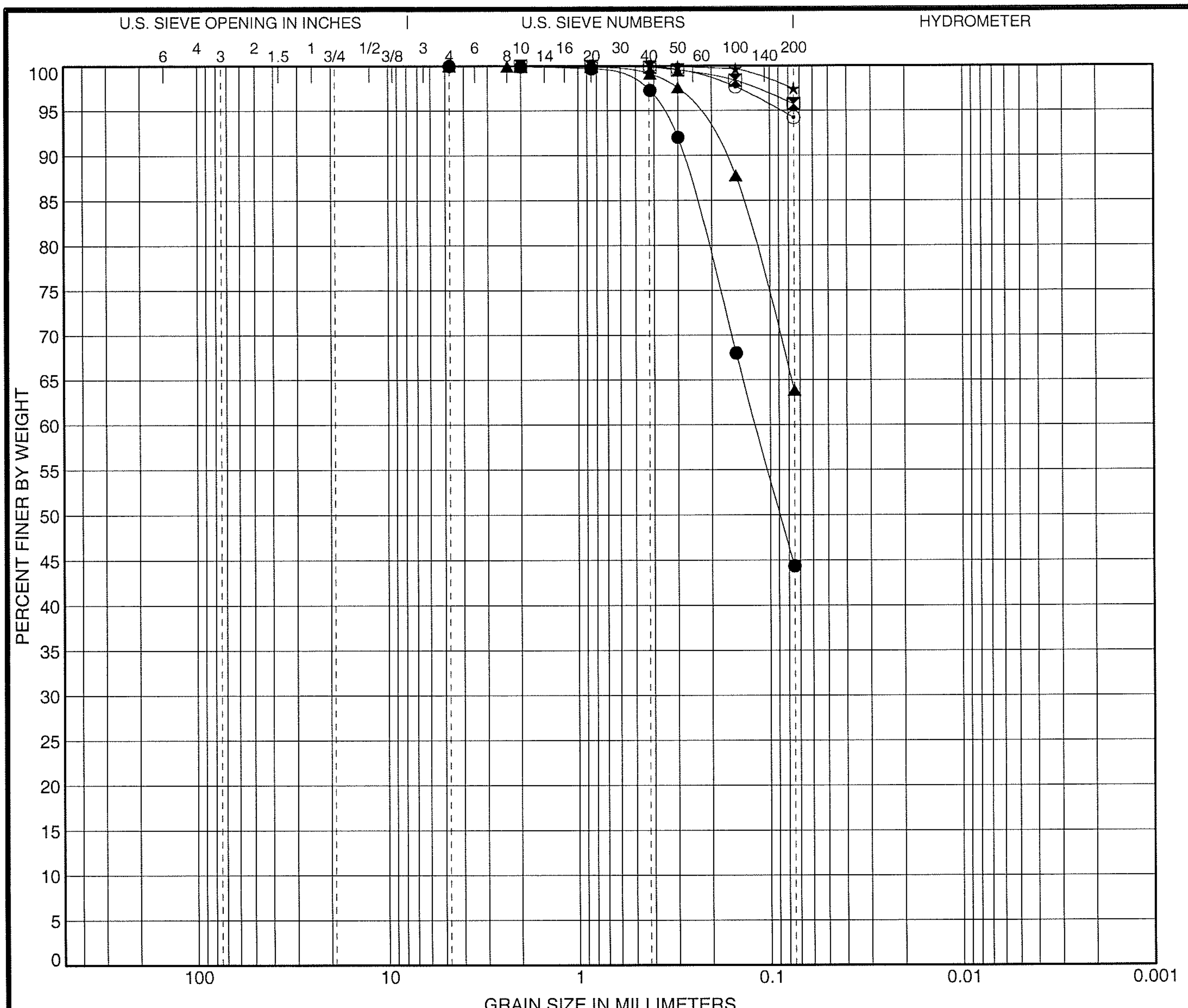
Alaska D.O.T./P.F. Southeast Region
6860 Glacier Hwy.
Juneau, Ak 99801-7999
Telephone: (907) 465-4454
Fax: (907) 465-3506

SUBSURFACE DATA: Results of Laboratory Testing

Location: Yakutat

Project: Airport SRE & Sand & Chemical Storage Building - Site 2

Number: 68017



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	(frost susceptible soils % finer 0.02mm)

	Sample # / Depth	Lab #	USCS Classification (AASHTO Classification)	% Organics	% MC	LL	PL	PI
●	TH-4 15.0	01C-64	**SILTY SAND(SM) (A-4)**	0.9	24.0	NV	NP	NP
⧗	TH-4 20.0	01C-65	**SILT(ML) (A-6)**	0.5	24.8	21	NP	NP
▲	TH-4 25.0	01C-66	**SANDY SILT(ML) (A-4)**	0.4	20.3	NV	NP	NP
★	TH-4 30.0	01C-73	**SILT(ML) (A-6)**	0.4	1.7	22	NP	NP
⊙	TH-4 35.0	01C-74	**SILT(ML) (A-4)**	1.0	26.9	23	20	3

	Sample # / Depth	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Frost Susceptible Soils (% finer 0.02mm)
●	TH-4 15.0			4.75	0.119			0.0	55.6	44.4		
⧗	TH-4 20.0			2				0.0	4.3	95.7		
▲	TH-4 25.0			4.75				0.0	36.2	63.8		
★	TH-4 30.0			0.85				0.0	2.6	97.4		
⊙	TH-4 35.0			0.85				0.0	5.8	94.2		

Alaska D.O.T./P.F. Southeast Region
6860 Glacier Hwy.
Juneau, Ak 99801-7999
Telephone: (907) 465-4454
Fax: (907) 465-3506

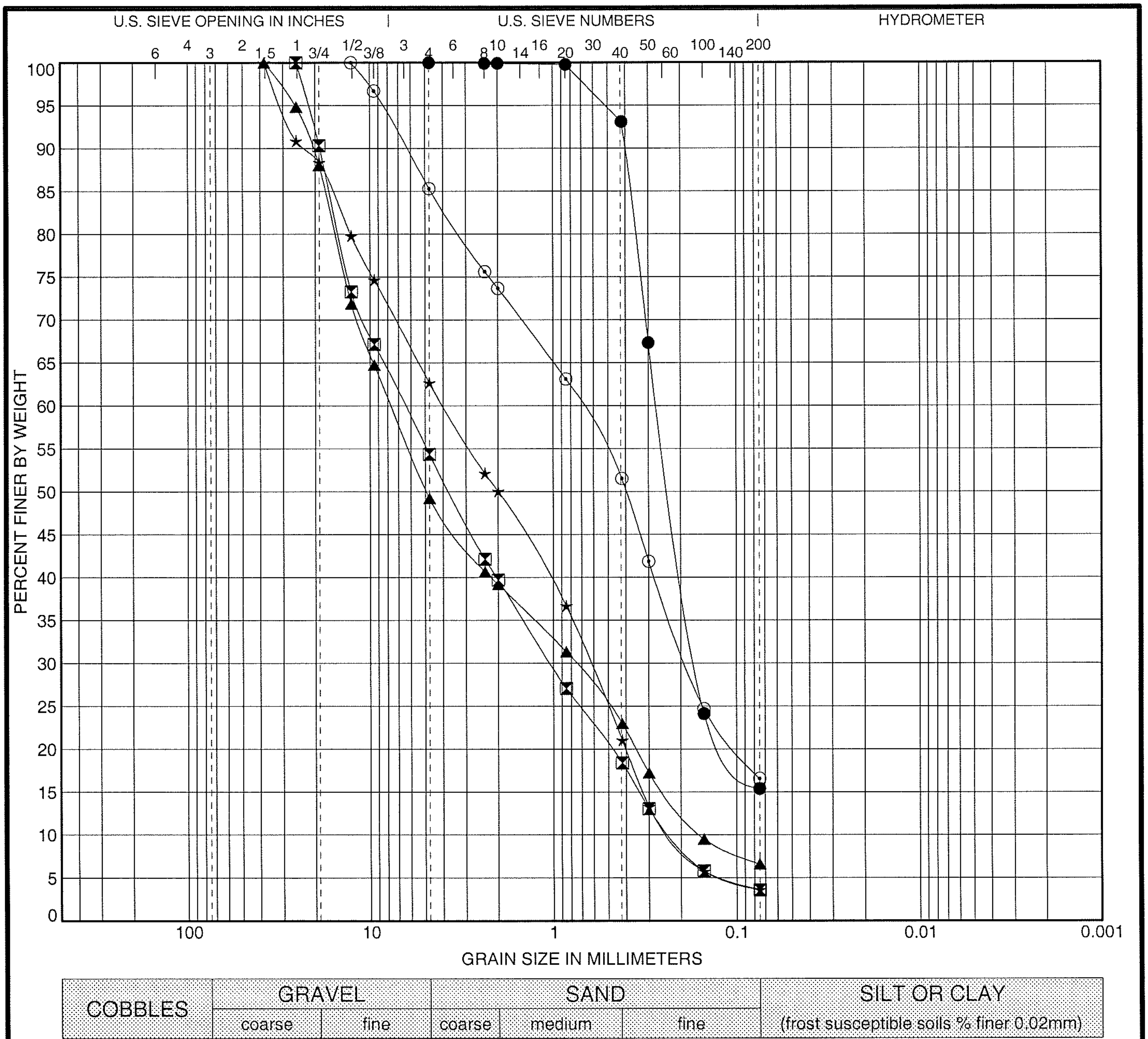
SUBSURFACE DATA: Results of Laboratory Testing

Location: Yakutat

Project: Airport SRE & Sand & Chemical Storage Building - Site 2

Number: 68017

US_GRAIN_SIZE_MODIFIED 68017_C.GPJ MODIFIED.GDT 5/15/01



	Sample # / Depth	Lab #	USCS Classification (AASHTO Classification)	% Organics	% MC	LL	PL	PI
●	TH-4 40.0	01C-75	**SILTY SAND(SM) (A-2-4)**	0.3	22.0	NV	NP	NP
⧗	TH-5 7.0	01C-77	**POORLY GRADED SAND with GRAVEL(SP) (A-1-a)**	0.5	8.3	NV	NP	NP
▲	TH-5 9.0	01C-78	**POORLY GRADED GRAVEL with SILT and SAND(GP-GM) (A-1-a)**	1.6	8.8	NV	NP	NP
★	TH-5 13.0	01C-79	**POORLY GRADED SAND with GRAVEL(SP) (A-1-a)**	0.4	9.9	NV	NP	NP
⊙	TH-6 2.0	01C-80	**SILTY SAND(SM) (A-2-4)**	11.7	46.4	NV	NP	NP

	Sample # / Depth	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Frost Susceptible Soils (% finer 0.02mm)
●	TH-4 40.0			4.75	0.267	0.165		0.0	84.6	15.4		
⧗	TH-5 7.0	0.75	28.77	25.4	6.448	1.038	0.224	45.6	50.8	3.6		
▲	TH-5 9.0	0.48	49.00	38	7.689	0.76	0.157	50.8	42.6	6.6		
★	TH-5 13.0	0.45	17.95	38	3.98	0.629	0.222	37.3	59.0	3.6		
⊙	TH-6 2.0			12.7	0.704	0.186		14.7	68.8	16.6		

Alaska D.O.T./P.F. Southeast Region
6860 Glacier Hwy.
Juneau, Ak 99801-7999
Telephone: (907) 465-4454
Fax: (907) 465-3506

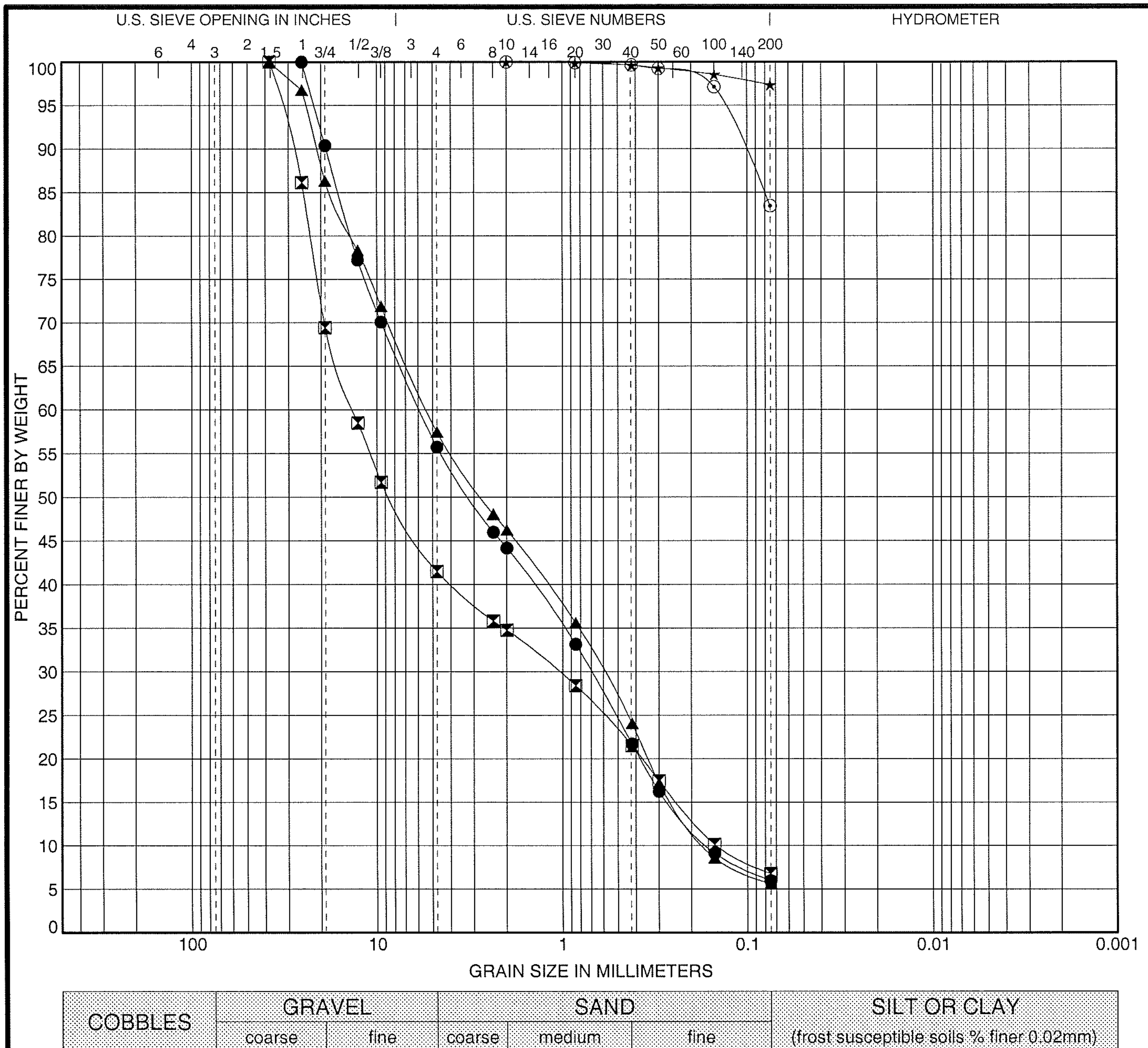
SUBSURFACE DATA: Results of Laboratory Testing

Location: Yakutat

Project: Airport SRE & Sand & Chemical Storage Building - Site 2

Number: 68017

US_GRAIN_SIZE_MODIFIED 68017_C.GPJ MODIFIED.GDT 5/15/01



	Sample # / Depth	Lab #	USCS Classification (AASHTO Classification)	% Organics	% MC	LL	PL	PI
●	TH-6 7.0	01C-81	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM) (A-1-a)**	0.6	8.6	NV	NP	NP
⊠	TH-6 9.0	01C-82	**POORLY GRADED GRAVEL with SILT and SAND(GP-GM) (A-1-a)**	2.4	8.2	NV	NP	NP
▲	TH-6 13.0	01C-83	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM) (A-1-a)**	0.5	8.7	NV	NP	NP
★	TH-7 2.0	01C-98	**SILT(ML) (A-6)**	1.0	26.9	24	NP	NP
⊙	TH-7 7.0	01C-99	**SILT with SAND(ML) (A-4)**	0.7	22.4	NV	NP	NP

	Sample # / Depth	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt / %Clay	Frost Susceptible Soils (% finer 0.02mm)
●	TH-6 7.0	0.51	35.75	25.4	5.841	0.701	0.163	44.3	49.7	6.0	
⊠	TH-6 9.0	0.57	92.09	38	13.431	1.056	0.146	58.5	34.7	6.8	
▲	TH-6 13.0	0.40	31.95	38	5.372	0.604	0.168	42.6	51.8	5.6	
★	TH-7 2.0			2				0.0	2.6	97.4	
⊙	TH-7 7.0			2				0.0	16.5	83.5	

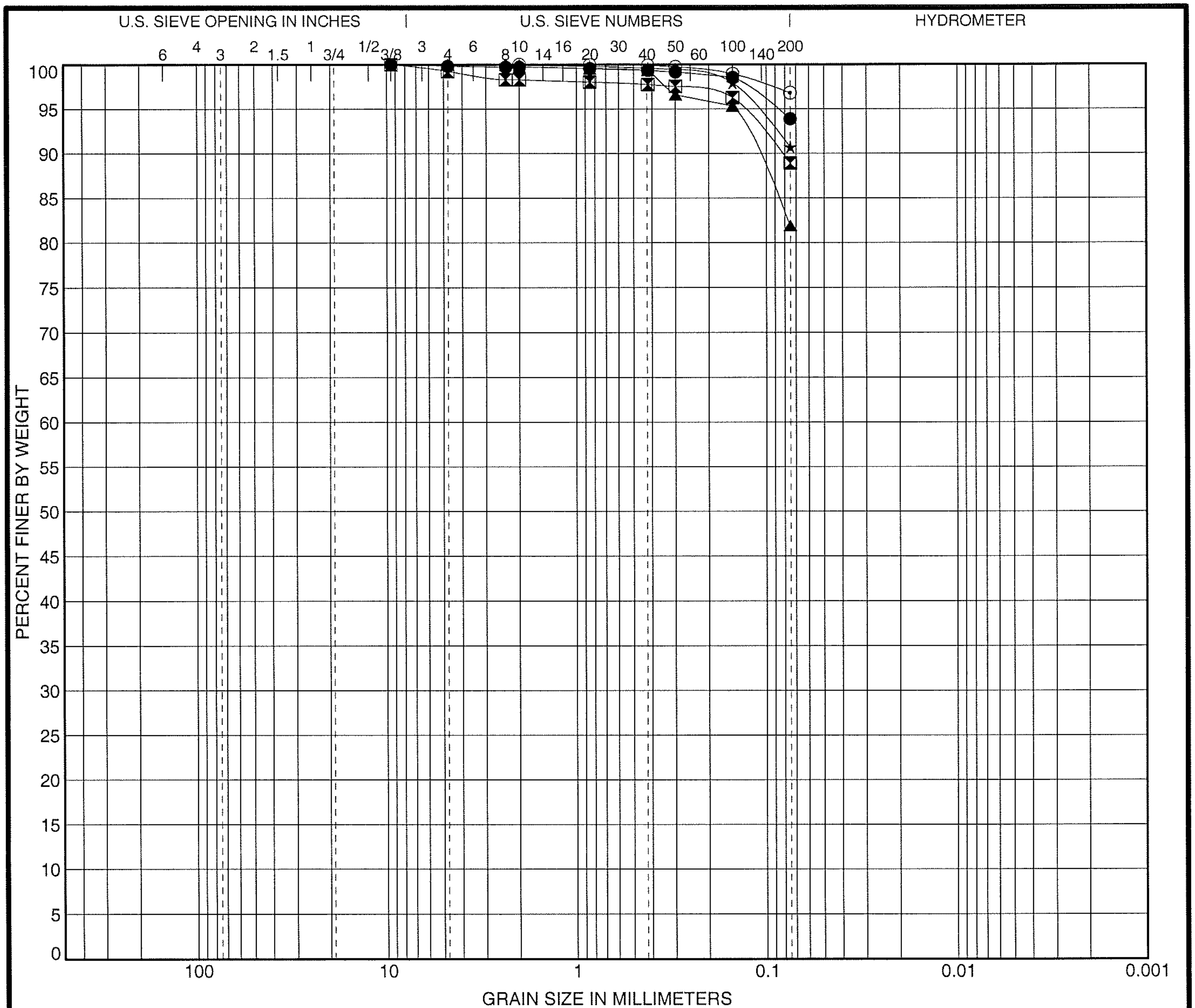
Alaska D.O.T./P.F. Southeast Region
6860 Glacier Hwy.
Juneau, Ak 99801-7999
Telephone: (907) 465-4454
Fax: (907) 465-3506

SUBSURFACE DATA: Results of Laboratory Testing

Location: Yakutat

Project: Airport SRE & Sand & Chemical Storage Building - Site 2

Number: 68017



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	(frost susceptible soils % finer 0.02mm)

	Sample # / Depth	Lab #	USCS Classification (AASHTO Classification)	% Organics	% MC	LL	PL	PI
●	TH-7 13.0	01C-100	**SILT(ML) (A-4)**	0.8	23.9	NV	NP	NP
⧗	TH-7 18.0	01C-101	**SILT(ML) (A-6)**	0.8	23.2	19	NP	NP
▲	TH-8 2.0	01C-102	**SILT with SAND(ML) (A-4)**	1.5	29.4	NV	NP	NP
★	TH-8 7.0	01C-103	**SILT(ML) (A-6)**	0.9	27.9	21	NP	NP
⊙	TH-8 13.0	01C-104	**SILT(ML) (A-6)**	0.7	23.8	21	NP	NP

	Sample # / Depth	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Frost Susceptible Soils (% finer 0.02mm)
●	TH-7 13.0			9.5				0.2	5.9	93.9		
⧗	TH-7 18.0			9.5				0.7	10.4	88.9		
▲	TH-8 2.0			4.75				0.0	18.1	81.9		
★	TH-8 7.0			2.36				0.0	9.3	90.7		
⊙	TH-8 13.0			2				0.0	3.2	96.8		

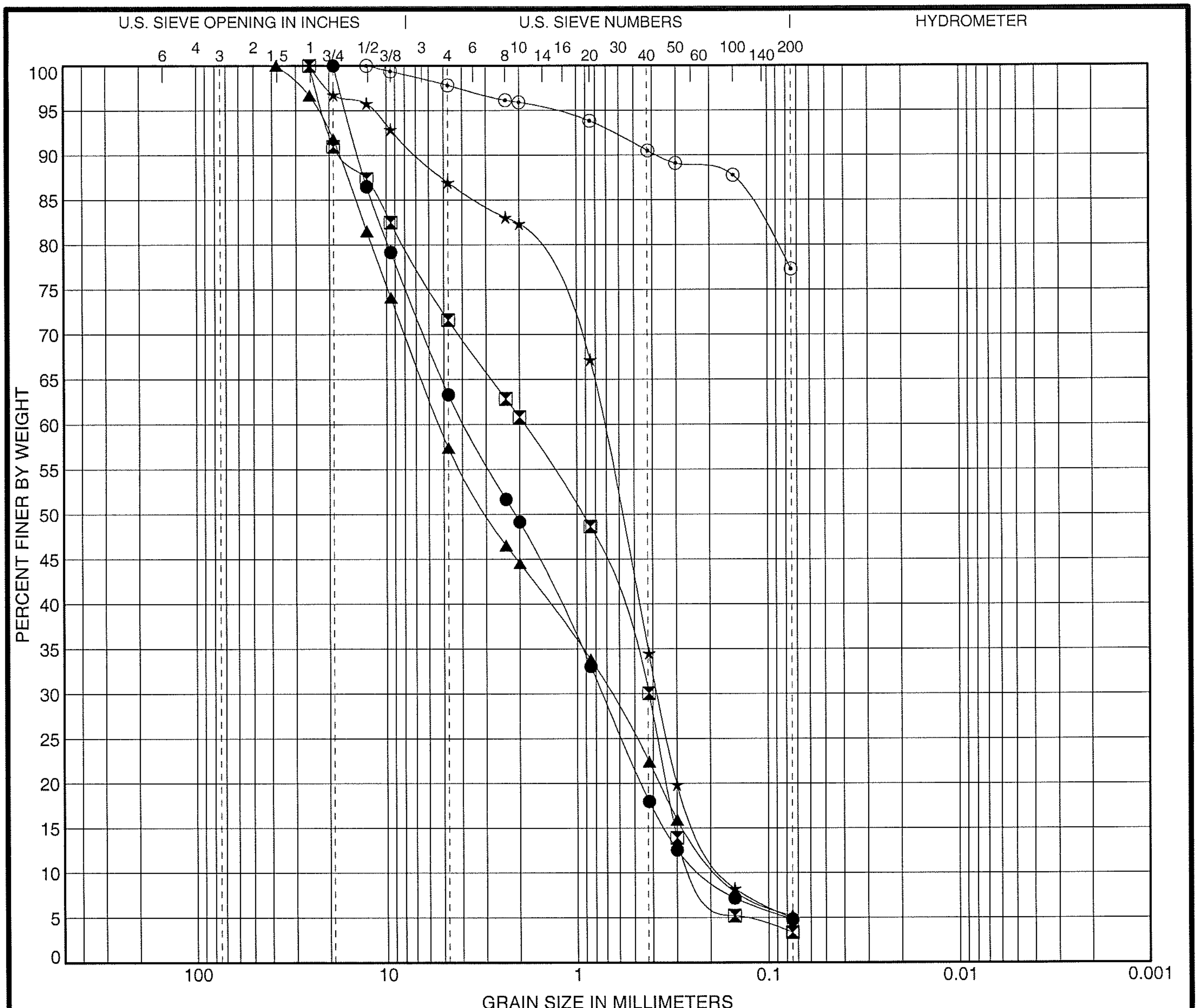
Alaska D.O.T./P.F. Southeast Region
6860 Glacier Hwy.
Juneau, Ak 99801-7999
Telephone: (907) 465-4454
Fax: (907) 465-3506

SUBSURFACE DATA: Results of Laboratory Testing

Location: Yakutat

Project: Airport SRE & Sand & Chemical Storage Building - Site 2

Number: 68017



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	(frost susceptible soils % finer 0.02mm)

	Sample # / Depth	Lab #	USCS Classification (AASHTO Classification)	% Organics	% MC	LL	PL	PI
●	TH-10 5.0	01C-105	**POORLY GRADED SAND with GRAVEL(SP) (A-1-a)**	0.7	9.5	NV	NP	NP
⊠	TH-10 10.0	01C-106	**POORLY GRADED SAND with GRAVEL(SP) (A-1-b)**	0.4	11.1	NV	NP	NP
▲	TH-10 16.0	01C-107	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM) (A-1-a)**	0.7	9.2	NV	NP	NP
★	TH-10 20.0	01C-108	**POORLY GRADED SAND(SP) (A-1-b)**	0.5	17.5	NV	NP	NP
⊙	TH-10 30.0	01C-109	**SILT with SAND(ML) (A-6)**	0.3	19.0	19	NP	NP

	Sample # / Depth	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt / %Clay	Frost Susceptible Soils (% finer 0.02mm)
●	TH-10 5.0	0.65	18.07	19	3.893	0.738	0.215	36.7	58.5	4.8	
⊠	TH-10 10.0	0.42	8.60	25.4	1.89	0.42	0.22	28.4	68.2	3.4	
▲	TH-10 16.0	0.47	29.37	38	5.292	0.671	0.18	42.6	52.2	5.2	
★	TH-10 20.0	1.18	4.37	25.4	0.728	0.379	0.167	13.0	82.0	4.9	
⊙	TH-10 30.0			12.7				2.2	20.5	77.3	

Alaska D.O.T./P.F. Southeast Region
6860 Glacier Hwy.
Juneau, Ak 99801-7999
Telephone: (907) 465-4454
Fax: (907) 465-3506

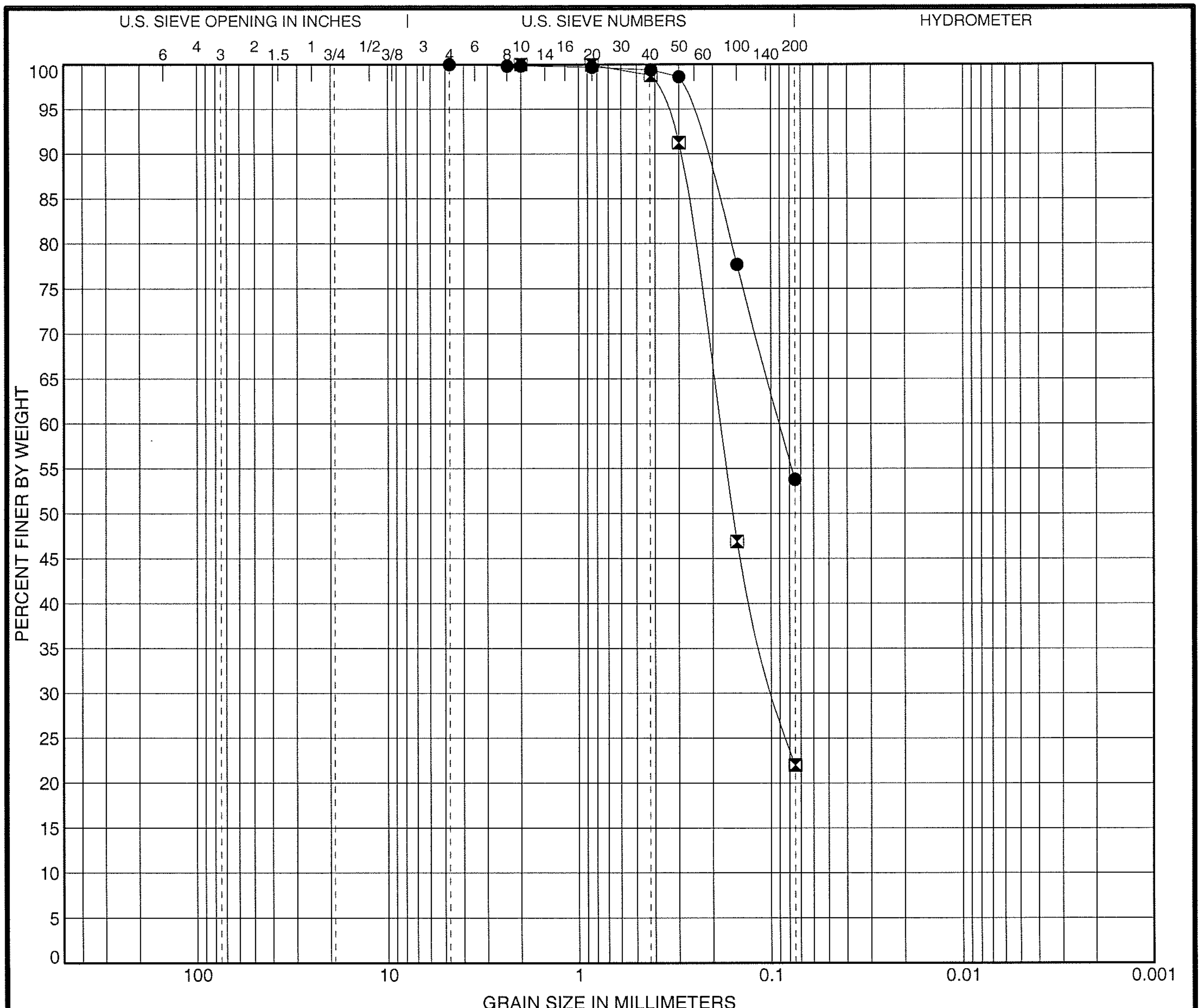
SUBSURFACE DATA: Results of Laboratory Testing

Location: Yakutat

Project: Airport SRE & Sand & Chemical Storage Building - Site 2

Number: 68017

US_GRAIN_SIZE_MODIFIED 68017_C.GPJ MODIFIED.GDT 5/15/01



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	(frost susceptible soils % finer 0.02mm)

	Sample # / Depth	Lab #	USCS Classification (AASHTO Classification)	% Organics	% MC	LL	PL	PI
●	TH-10 40.0	01C-110	**SANDY SILT(ML) (A-4)**	0.5	19.4	NV	NP	NP
⊠	TH-10 48.0	01C-111	**SILTY SAND(SM) (A-2-4)**	0.5	18.3	NV	NP	NP

	Sample # / Depth	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Frost Susceptible Soils (% finer 0.02mm)
●	TH-10 40.0			4.75	0.09			0.0	46.2	53.8		
⊠	TH-10 48.0			2	0.184	0.094		0.0	78.0	22.0		

Alaska D.O.T./P.F. Southeast Region
6860 Glacier Hwy.
Juneau, Ak 99801-7999
Telephone: (907) 465-4454
Fax: (907) 465-3506

SUBSURFACE DATA: Results of Laboratory Testing

Location: Yakutat

Project: Airport SRE & Sand & Chemical Storage Building - Site 2

Number: 68017

APPENDIX C

LIQUEFACTION ANALYSIS

Operational Level Event: $a_{max} =$ 0.4g, Magnitude =7.5

TH 1 English Units

Depth	N_{field}	PO_{total}	$PO_{effective}$	C_N Eq 5-10	C_{60} Tbl 5-2	$(N_1)_{60}$	r_{d0-30} Eq 8-1	r_{d30-75} Eq 8-1	k_m Fig 8-4	k_σ Fig 8-5	PGA a_{max}/g	CSR_{eq} Eq 8-3a	$CSR_{7.5}$ Fig 8-3	CSR_L Fig 8-3 & Eq 8-4	FS
7	22	703	703	1.7	1	37	0.98		1	1	0.4	0.26	0.50	0.50	2.0
12	56	1303	867	1.5	0.8	68	0.97		1	1	0.4	0.38	0.50	0.50	1.3
17	44	1903	1164	1.3	0.8	46	0.96		1	1	0.4	0.41	0.50	0.50	1.2
22	80	2503	1454	1.2	0.8	75	0.95		1	1	0.4	0.42	0.50	0.50	1.2
27	77	3128	1767	1.1	0.8	66	0.94		1	1	0.4	0.43	0.50	0.50	1.2
50	50	5923	2688	0.9	0.8	35		0.77	1	1	0.4	0.44	0.50	0.50	1.1

TH 2

Depth	N_{field}	PO_{total}	$PO_{effective}$	C_N Eq 5-10	C_{60} Tbl 5-2	$(N_1)_{60}$	r_{d0-30} Eq 8-1	r_{d30-75} Eq 8-1	k_m Fig 8-4	k_σ Fig 8-5	PGA a_{max}/g	CSR_{eq} Eq 8-3a	$CSR_{7.5}$ Fig 8-3	CSR_L Fig 8-3 & Eq 8-4	FS
6.5	5	618	399	2.2	1	11	0.98		1	1	0.4	0.40	0.11	0.11	0.3
11.5	23	1155	625	1.8	1	41	0.97		1	1	0.4	0.47	0.50	0.50	1.1
16.5	37	1755	913	1.5	0.8	44	0.96		1	1	0.4	0.48	0.50	0.50	1.0
21.5	50	2355	1201	1.3	0.8	52	0.95		1	1	0.4	0.48	0.50	0.50	1.0
26.5	66	2955	1489	1.2	0.8	61	0.94		1	1	0.4	0.48	0.50	0.50	1.0

TH 3

Depth	N_{field}	PO_{total}	$PO_{effective}$	C_N Eq 5-10	C_{60} Tbl 5-2	$(N_1)_{60}$	r_{d0-30}	r_{d30-75}	k_m Fig 8-4	k_σ Fig 8-5	PGA a_{max}/g	CSR_{eq} Eq 8-3a	$CSR_{7.5}$ Fig 8-3	CSR_L Fig 8-3 & Eq 8-4	FS
6.5	24	693	318	2.5	1	60	0.98		1	1	0.4	0.56	0.50	0.50	0.9
11.5	28	1293	606	1.8	1	51	0.97		1	1	0.4	0.54	0.50	0.50	0.9
16.5	20	1893	894	1.5	1	30	0.96		1	1	0.4	0.53	0.50	0.50	0.9

TH 4

Depth	N_{field}	PO_{total}	$PO_{effective}$	C_N Eq 5-10	C_{60} Tbl 5-2	$(N_1)_{60}$	r_{d0-30}	r_{d30-75}	k_m Fig 8-4	k_σ Fig 8-5	PGA a_{max}/g	CSR_{eq} Eq 8-3a	$CSR_{7.5}$ Fig 8-3	CSR_L Fig 8-3 & Eq 8-4	FS
7	8	705	548	1.9	1	15	0.98		1	1	0.4	0.33	0.16	0.16	0.5
12	19	1280	811	1.6	1	30	0.97		1	1	0.4	0.40	0.50	0.50	1.3
16.5	12	1798	1048	1.4	1	17	0.96		1	1	0.4	0.43	0.18	0.18	0.4
21.5	29	2373	1311	1.2	1	36	0.95		1	1	0.4	0.45	0.50	0.50	1.1
26.5	36	2948	1574	1.1	0.8	32	0.94		1	1	0.4	0.46	0.50	0.50	1.1
31.5	33	3523	1837	1.0	0.8	28		0.92	1	1	0.4	0.46	0.40	0.40	0.9
36.5	17	4098	2100	1.0	1	17		0.88	1	1	0.4	0.44	0.18	0.18	0.4

TH 9

Depth	N_{field}	PO_{total}	$PO_{effective}$	C_N Eq 5-10	C_{60} Tbl 5-2	$(N_1)_{60}$	r_{d0-30}	r_{d30-75}	k_m Fig 8-4	k_σ Fig 8-5	PGA a_{max}/g	CSR_{eq} Eq 8-3a	$CSR_{7.5}$ Fig 8-3	CSR_L Fig 8-3 & Eq 8-4	FS
3.5	19	370	181	3.3	1	63	0.99		1	1	0.4	0.53	0.50	0.50	0.9
8.5	35	658	469	2.1	0.8	58	0.98		1	1	0.4	0.36	0.50	0.50	1.4
14.5	41	946	757	1.6	0.8	53	0.97		1	1	0.4	0.31	0.50	0.50	1.6

TH 10

Depth	N_{field}	PO_{total}	$PO_{effective}$	C_N Eq 5-10	C_{60} Tbl 5-2	$(N_1)_{60}$	r_{d0-30}	r_{d30-75}	k_m Fig 8-4	k_σ Fig 8-5	PGA a_{max}/g	CSR_{eq} Eq 8-3a	$CSR_{7.5}$ Fig 8-3	CSR_L Fig 8-3 & Eq 8-4	FS
6.5	16	1920	540	1.9	1	31	0.98		1	1	0.4	0.91	0.50	0.50	0.5
11.5	30	1380	943	1.5	0.8	35	0.97		1	1	0.4	0.37	0.50	0.50	1.4
31.5	62	3802	2116	1.0	0.8	48		0.92	1	0.89	0.4	0.43	0.50	0.45	1.0
49.5	30	6025	3246	0.8	0.8	19		0.77	1	0.74	0.4	0.37	0.22	0.16	0.4