CBJ PUBLIC WORKS CONSOLIDATED FACILITIES
Geotechnical Investigation

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R&M Project No. 081100.1

INDEX

Appendix

1.0 INTRODUCTION

1.1 Work Purpose and Scope

This report represents the findings of a geotechnical investigation performed by R&M Engineering Inc. (R&M) for the proposed City and Borough of Juneau (CBJ) Public Works Consolidated Facilities in Juneau, Alaska. The Site Option 1, Priority I of the Consolidated Facilities will feature Streets Building, Fleet Maintenance Building and fuel bays, parking, and other ancillary facilities.

The CBJ Consolidated Public Works Facilities will be located adjacent to Glacier Highway just west of the State of Alaska Department of Transportation and Public Facilities (ADOT/PF) 7-mile complex. Vehicle access to the site will be directly from Glacier Highway. Toner Nordling Associates (TNA) provided a CBJ Consolidated Public Works Site Option Priority I site plan showing buildings that was used by R&M to determine test pit and drill test hole locations.

The proposed scope of work for this geotechnical investigation was described in the R&M fee proposal letter dated December 26, 2007 to Tetra Tech/KCM, Inc. The R&M letter indicates the geotechnical scope of work will include:

- Digging five test pits to a maximum depth of 15';
- Drilling seven drill test holes with our truck mounted CME-55 drill truck and skid mounted CME -45;
- Collecting samples and performing laboratory analysis on selected samples, findings, conclusions;
- Preparation of a geotechnical report with test hole logs, laboratory results and foundation design recommendations for pre-engineered metal buildings;

This geotechnical investigation report summarizes the site and project description, investigation methods, findings, conclusions, and recommendations for the project.

1.2 Summary of Previous Geotechnical Data

Preparation of this geotechnical report included a review of record information on file with R&M from previous projects in the proximity of the CBJ Public Works Consolidated Facilities project. The site was previously considered for an Alaska Army National Guard Armory facility and in 1999, R&M performed field work and prepared a Geotechnical Investigation for this proposed project.

2.0 SITE AND PROJECT DESCRIPTION

2.1 Site Location

The proposed CBJ Public Works Consolidated Facilities site is located on CBJ owned property currently zoned LC (Light Commercial) by CBJ zoning maps. The legal description is Lots 2, 3, 4, 21, 22 and 23, U.S. Survey No. 3258. CBJ plans on consolidating all of these lots into one lot. The CBJ Consolidated Facilities will be located along Glacier Highway, adjacent to the State of Alaska Department of Transportation and Public Facilities 7-Mile location, just north of Sunny Point, along the lower, south facing slope of Heintzleman Ridge. See Appendix A for the topographic survey and subsurface location mapping.

INDEX

Appendix

The project site is currently forested with some delineated forested wetlands. The site slopes gently to the south and has occasional isolated hummocks around tree roots. Second growth Sitka Spruce and Hemlock trees make up the main canopy in the forested area. Underbrush is primarily blueberry brush and muskeg. General site geology of the lands under study consists of an organic peat material, silty sands, and hard silty sandy gravel till. Two minor (non-anadromous) streams flow across the eastern side of the project site. The project site does not fall within the limits of the landslide and avalanche areas as defined in the CBJ 1987 boundaries.

2.2 Geography

Located on the mainland of Southeast Alaska, opposite Douglas Island, Juneau was built at the heart of the Inside Passage along the Gastineau Channel. It lies 900 air miles northwest of Seattle and 577 air miles southeast of Anchorage. It lies at approximately 58.30194°N Latitude and -134.41972°W Longitude (Sec.23, T041S, R067E, Copper River Meridian). Juneau is located in the Juneau Recording District. The area encompasses 2,716.7 sq. miles of land and 538.3 sq. miles of water.

2.3 Site Development History

Based on aerial photography interpretation and historical knowledge of the property, the site has been developed on a very limited basis. The property to the east owned by ADOT/PF encroached on the site with the development of a materials/equipment storage yard. It appears from the drill test hole data and observations made during the excavation of test pit 5 that the encroaching development consisted of cutting down existing trees and filling over the site with imported shot rock and select borrow material of unknown origin to create a drivable materials/ equipment storage yard. Other development includes the Heintzleman Ridge trail from Glacier Highway to Thunder Mountain which runs north/south through the middle of the property, and previous evidence of logging operations (cut stumps) on the north side of the site.

2.4 Project Description

The proposed CBJ Consolidated Public Works Facility will consolidate the following public works divisions: streets, fleet maintenance and public works administration. CBJ has identified the project be constructed in the following priorities:

Priority 1 – Site access driveway, parking lot areas, Fleet and Street Maintenance buildings, Fuel Bays, Wash Racks and a portion of the Maintenance Yard. Phasing within this priority is as follows:

- Phase 1: Site access, parking and maintenance yard constructed towards the east to the extent that the existing $1 million budget will allow.
- Phase 2: The remainder of the maintenance yard (as necessary to allow moving out of the Downtown and Valley shop locations) and the buildings as noted in Priority 1.

Priority II – Bulk Material storage, Vactor Dump, Sweepings Receiving Facility and Streets Unheated Chemical Storage Building.

Priority III – Streets and Fleets covered vehicle storage buildings, sand storage building and Hazmat building.

Priority A – Finalize any unfinished development of the Site Plan, including construction of the Public Works Administration Building near the entrance to the site.

Sewer and water services for the CBJ Public Works Consolidated Facilities will connect to the existing underground utilities located along Glacier Highway. Storm water surface runoff will be collected in area drains and underground culverts. The entire drainage system will be routed to the subsurface collection system along the eastern edge of the access driveway into the site. This run off will be routed through an oil/water separator and will discharge into the existing ditch system along Glacier Highway.

Access to the CBJ Public Works Consolidated Facilities will be made directly from Glacier Highway approximately 7 miles from Downtown Juneau.

3.0 GEOLOGICAL CONDITIONS

Soils in the area are geologically young, having been deposited since the retreat of the last regional glacier. The height of the last glacial period was approximately 18,000 years before present, when the ice thickness in Southeast Alaska is believed to have ranged between 4,000 and 5,000 feet thick. Melting started about 1,000 years later and the landscape is believed to have become ice-free by 11,000 to 7,500 years before present as far north as the present toe of the Mendenhall glacier.

During deglaciation, sedimentation in the area consisted of marine deposits followed by glacial outwash. From 10,000 to 4,500 years before present, the site of the Consolidated Facilities was below sea level, resulting in deposition of marine clay, silt, sand and fossils mixed with rocks from glacier melt and icebergs. After about 4,500 years before present, sedimentation shifted from marine to terrestrial, dominated by 'glacial outwash deposits'. Outwash accumulated over the marine deposits in a graded plane.

Near surface soils in the immediate vicinity of the proposed Consolidated Facilities are of the glacialmarine, Gastineau Channel Formation as described by R.D. Miller in 1975[1]. The outwash is described as gray silty sand that is locally rich in boulders.

In addition to in situ natural material, the east portion of the property contains a portion of the ADOT/PF materials and equipment storage yard, and the Heinzleman Trail as described in section 2.3.

3.1 Local Climate

Juneau is located within the maritime climate zone of Southeast Alaska and generally experiences relatively small temperature variations, high humidity, and heavy precipitation. The following summarizes local weather conditions:

Precipitation: 57.1-inches of average annual precipitation (rain and melted snow) are received at Juneau International Airport and 85.8-inches are received in downtown Juneau. A rainfall record was set on October 10, 1946 with 4.62 inches of rain in a 24-hour period.

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[1] R.D. Miller, 1975, Surficial Geologic Map of the Juneau Urban Area and Vicinity: USGS Miscellaneous Investigation Series, Map I-885.

Wettest Months: Juneau averages 219 rainy days a year. The rainiest months are September and October with averages of 6.73 and 7.84-inches respectively.

Driest Month: April is Juneau's driest month with an annual average of 2.77-inches.

Snow: The average yearly snowfall is 104.5-inches. Records reflect a 197.8-inch maximum in 2006/07, and a 14.9-inch minimum in 1987. The daily snowfall record was set on March 21, 1948 with 30.6 inches of snow.

Cloud Cover: Juneau averages 278 cloudy days a year with an average of 2 to 3 sunny days a week in May and June.

Temperature: The average daytime summer temperatures are in the 50's and 60's, while in the evenings they can dip to the 40's. A record high was 90°F degrees in July 1975, while the record low was -22°F in January 1972. The average temperature for all records since 1943 is 41.0°F.

Daylight: The maximum daylight is 18 hours and 18 minutes on June 21st (summer solstice). Minimum winter daylight is 6 hours 21 minutes on December 21st (winter solstice).

3.2 Geologic Hazards

CBJ Public Works Consolidated Facility site is located below Heintzleman Ridge at an elevation between 36 feet and 86 feet, M.L.L.W. The ridge crest elevation is 2,600 feet. Heintzleman Ridge is the scene of numerous avalanches and landslides. Most of the slides are restricted to the upper elevations and do not extend downslope below the 1,200 foot level. However, 1.5 miles west of this site, there is a slide zone with a history of debris crossing Glacier Highway (30-foot elevation). The CBJ Public Works Consolidated Facility site is generally protected from Heintzleman Ridge slides by a low ridge and associated steep southeast trending drainage.

Considered as a whole, soils forming processes are relatively inactive in the project area. No modern surficial deposits of coarse rock particles and tree trunks exist in a recognizable form. In summary, no evidence exists to suggest that the site is an area threatened by the geophysical hazards of mass wasting (land slide or avalanche).

4.0 SUBSURFACE INVESTIGATION

4.1 Fieldwork

To accurately assess the existing subsurface conditions two types of field exploration methods were employed within the project site; machine dug test pits and truck or skid mounted drill test holes.

4.2 Machine Dug Test Pits

Fieldwork was conducted on January 18, 2007 using a Volvo EC210CL excavator rented from Construction Machinery Industrial, LLC and operated by Randy Held of DuRette Construction. The Volvo EC210CL excavator has an operating weight of 46,920 lbs., a maximum digging depth of 20' 9" and a bucket digging force of 27,560 lb. Each test pit was photographed and ground water conditions, when encountered, were noted in the field log book. Test pits were field staked prior to digging by the TNA field survey team in accordance with the test pit location map. Locations of test pits are shown on the Test Hole Location Map and Topographical survey (Appendix A). The weather at the time of the test pit exploration was rain (1.17" for the day) with a temperature of 37°F. The fieldwork was performed under the direction of Mark Pusich, P.E., R&M.

A total of 21 bulk soil samples were collected from 5 test pits (TP). Samples were obtained from the excavator bucket or from the excavation stockpile during excavation of the test pits. All bulk samples collected were placed in water tight sample bags, identified and transported to the R&M lab for testing and evaluation of selected samples.

All test pits were left open to allow the ground water to reach an equilibrium level prior to measuring the water table depth below the ground surface. After measurements were made the test pits were backfilled with the native excavated material and machine compacted with the excavator bucket. Photographs of the test pit operations were taken by R&M personnel.

4.3 Drill Test Holes

Seven drill test holes (TH) were conducted on site from January 9 to January 22, 2007, using R&M's CME 55 truck mounted rotary drill and CME 45 skid mounted rotary drill. An excavator was utilized in pioneering access roads through the forested area to expedite excavator assisted access of the skid mounted drill to test hole locations. Drill test holes were field staked prior to drilling by the TNA field survey team in accordance with the test pit location map. The location of drill test holes is shown on the Test Hole Location Map and Topographic Survey (Appendix A). The drilling by both the CME-55 and CME-45 drills utilized an 8" hollow stem auger with 1-3/8" I.D. split spoon sampler driven into the bottom of the borehole in accordance with ASTM D1586-84 methods. This test is called the "Standard Penetration Test" (STP) and is conducted by recording the N-value, which is the number of blow-counts recorded using a 140-lb hammer free falling 30-inches to drive the spilt spoon sampler 18 inches into the ground. The sum of the blow counts required to drive the sampler from 6 inches to 18 inches is presented as the penetration resistance (e.g. blows per foot). Samples collected with this method are identified as "SS" on the drill test hole logs. Split spoon soil samples were generally taken at 5' intervals to the bottom of the test hole (typically 20 feet). The water table depth was measured and noted during the drilling operations. Photographs of the drilling operations were taken by R&M personnel. All split spoon samples collected were placed in water tight sample bags, identified and transported to the R&M lab for testing and evaluation of selected samples. The weather at the time of the test hole drilling was overcast and calm, with temperatures ranging from 20-35° F. The fieldwork was performed under the direction of Mark Pusich, P.E., R&M.

4.4 Soil Logs and Lab Testing

Soil logs for each type of field geotechnical investigation method are presented in Appendix B. Soil identification and classification was accomplished in accordance with the Unified Soil Classification System (USCS). Soil classifications are based on visual classifications and were supplemented by laboratory gradation on selected samples. The results of the laboratory testing were used to verify and refine field visual classifications. A summary of lab test results and complete laboratory reports are presented in Appendix D.

The laboratory testing was conducted in conformance with the following test procedures:

- ASTM D422 Particle Size Analysis;
- ASTM D2216 Moisture Content of Soils; and
- ASTM D4318 Atterberg Limits

5.0 DISCUSSION OF SUBSURFACE CONDITIONS

The surface geology observed in the investigation area is consistent with the outwash deposits described by R.D. Miller 1975. Local variations are described below.

Common to most of the investigated surface is a layer of forest mat ranging in depth from 3” to 2’. Below this surficial layer, peat deposits are present and vary in thickness from 3’ to 8’. The peat layer consists of light brown wet and soft fibrous organic mat mixed with sticks, roots, and logs near the bottom. There is very little resistance in this layer and the weight of the hammer in TH-1 through TH-4 at the 2.5-foot and 5-foot depth, filling the split spoon sampling tube.

Underlying the organic peat layer in each of the test pits and test holes was a transition layer of grey sandy gravely silt which was generally saturated and soft. This layer varied from a thin transition layer mixed with peat in Test Pit-3, up to a thickness of 6.5’ in Test Pit-1. In Test Pits 1, 2, 4, and 5, this layer of sandy gravely silt transitioned into a drier, firmer gray till which continued to become drier and firmer with increased depth. This material eventually becomes dense glacial marine till which refuses further excavation. In the test pits, refusal occurred at depths of 12’ to 14’. Drill test holes were able to penetrate beyond 14’ and did not meet medium dense or dense resistance until 18’ to 19’ depths.

Environmentally hazardous materials were not found in any of the test pits or drill test holes.

Drill Test Hole Blow Count Summary								
Forested Site					**DOT/PF Equipment Yard**			
Depth	**TH 1**	**TH 2**	**TH 3**	**TH 4**	**TH 5**	**TH 6**	**TH 7**	**Average**
2.5’	1 *	1 *	1 *	1 *	32	14	3	8
5’	1 *	1 *	1 *	2	14	3	2	3
10’	10	8	3	18	31	3	2	11
15’	15	33	8	67	5	5	1	19
20’	No data	137	No data	Refusal	25	50	38	63
25’	No data	No data	No data	No data	No data	No data	99	99
* = weight of hammer.								Avg = 33

6.0 GROUNDWATER CONDITIONS

A water table was not readily apparent in any of the test holes or test pits. A substantial amount of water is retained in the peat layer and upper soil layers. With increased depth, the moisture content decreases. Soil conditions just below the peat layer are generally wet to moist and in some cases were “soupy”. Water from the peat and upper soil layers wept into the test pits and tended to heave into the hollow stem auger during drilling operations.

Moisture contents from the analyzed soil samples varied from 8% in TH-2 at a depth of 14’-15.5’ to 96% in TH -4 in the peat layer at 3’ – 4.5’ depth below ground surface.

7.0 BUILDING LOAD CRITERIA

Every structure and portion thereof, shall as a minimum, be designed and constructed to resist the effects of earthquake motions per the 2003 edition of the International Building Code (IBC). Seismic loads are based upon the estimated ground motion anticipated at the site for 98% probability of not being exceeded in 50 years, the site classification, the building construction, and the building hazard or importance

Based on Chapter 16, Table 1615.1.1 of the IBC the site class for this site is “D” as the standard penetration resistance (N) for the top 25’ of soil averages 33. Projecting this to 100’ would increase this value as evidenced by the pentrometer readings from TH-1 and TH-3 where blow counts exceed 80 blows per foot. Therefore this value falls within the 15 to 50 range and is a considered to be a stiff soil profile type.

The 2003 IBC loading requirements, as adopted and modified by CBJ, for the CBJ Public Works Consolidated Facilities are as follows:

Floor Live Load (office) = 50 psf
Floor Live Load (partition) = 20 psf
Floor Live Load (corridors) = 100 psf
Floor Live Load (mechanical) = 125 psf
Floor Live Load (heavy storage) = 150 psf
Roof Snow Load = 70 psf ground snow load
(Design for drifting and unbalanced snow)
Basic Wind Speed and Exposure = 120 mph, Exposure B, 3 second gust
Soil Site Classification = D
Spectral Accelerations = $S_S = 0.64$; $S_1 = 0.30$

We assume the buildings on this site would fall under a Category II classification, which requires an increase of the above loads with importance factors for seismic, snow and wind of 1.0, 1.0 and 1.0, respectively.

7.1 Seismic Environment

Juneau’s seismic environment is moderately active. It lies to the east of the highly active Fairweather and Queen Charlotte Faults where earthquakes with a magnitude of 8.5 and greater on the Richter Scale have occurred in the last hundred years.

R. D. Miller of the United States Department of the Interior notes several lesser faults in the local area[2]. These faults include the Peterson Creek, Gold Creek, Fish Creek, Tee Harbor, Point Louisa and Gastineau/Montana Creek faults. It is presumed that these faults are inactive.

Site classifications and spectral accelerations for this site are given in Section 7.0 above.

7.2 Liquefaction Potential

The term “liquefaction” has been used to cover several types of phenomena associated with the increase in pore water pressures in cohesionless soils during earthquake ground motion

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[2] Miller, R.D., 1972, Surficial Geology of the Juneau Urban Area and Vicinity, Alaska, with Emphasis on Earthquake and Other Geologic Hazards, United States Department of the Interior, Open File Report.

(acceleration and frequency content), with a resulting decrease of strength and/or stiffness. Loss of strength typically occurs in low density cohesionless soils or combinations of these soil types during seismic events. Four kinds of ground failure typically result from liquefaction: lateral spread, flow failure, ground oscillation and loss of bearing strength. Loss of strength is generally associated with excessive buildup of increased pore water pressure within the soil and loss of intergranular grain-to-grain contact within the soil. The site was evaluated for potential liquefaction hazard.

Liquefaction potential of sandy soils was evaluated using a procedure suggested by R.B. Seed, University of California, Berkley. The procedure uses SPT results (blow counts) to estimate the average shear stress induced in the soil during an earthquake and compares it to the shear stress required for liquefaction. Soils with low blow counts (loose) were evaluated for the design ground acceleration of 0.1g, and in each case, the average shear stress did not exceed the required shear stress for liquefaction.

The “Modified Chinese Criteria” for determining liquefaction potential as modified by the U.S. Army Corps of Engineers provides for a means to evaluate fine grained soil types to determine if they are susceptible to liquefaction potential. The following criteria are used to determine if potentially liquefiable soils exist:

- Fraction finer than 0.005 mm must be less than or equal to 10%.
- Liquid limit, LL, must be less than or equal to 36%.
- Natural moisture content must be greater then or equal to 0.9 x LL + 2%.
- Liquidity index must be less than or equal to 0.75.

In order to be considered susceptible to liquefaction all of the above criteria must be met. Results from the R&M laboratory testing indicate that none of the criteria listed are met and therefore liquefaction of the silty sand and clayey sand soils at this site are not considered likely.

8.0 CONCLUSIONS

In evaluating the different soils encountered during the exploration program for the proposed CBJ Public Works Consolidated Facilities project in Juneau, we have developed a sequence of events that may explain the spatial distribution of soil types present today.

The silt-rich soils observed suggest deposition of material in a low-energy environment, such as on the inside of a river meander belt or on a floodplain. In these environments, silt and sand are allowed to settle slowly over time. On floodplains, vegetation is often able to grow seasonally. This vegetation may then be buried in times of higher river levels such as during periods of higher ice-melt or following heavy rain. Gravels reflect a period of higher river energy when a larger channel was able to carry and then deposit larger material such as gravel and sand. As these higher energy environments are transient, the gravels were then overlain by slower-moving water that deposited higher proportions of silt.

The most recent geological event is the deposition of silty sand and the formation of a thick organic peat layer. Peat and organic rich soils are extremely soft and unconsolidated superficial deposits consisting of subsurface of wetland ecosystems. Peat is considered as unsuitable material for engineering construction. The uniform characteristics of these materials over this area suggest that the area encompassing these field exploration locations were subject to glacial marine deposits and uplift.

The building structures are assumed to be supported with perimeter, reinforced concrete, strip footings and individual reinforced concrete column footings founded on engineered fill. The concrete building slab would be reinforced and founded on engineered fill.

9.0 RECOMMENDATIONS

From the perspective of engineering, the choice of construction method in areas underlain by organic rich peat deposits is a matter of finding optimal solutions between economics and technical factors, available construction time and the target performance standards (settlement). Our recommendation is complete removal of the organic rich peat soils to bearing soils and replacement with imported shot rock embankment. Although this may be the most conservative approach, it reduces the possibility of long-term differential settlement of future buildings, roadways and underground utilities on this property. Differential settlement of buildings, roadways and utilities causes severe damage and is very expensive to repair and mitigate.

9.1 Building Foundations

It is recommended that all organic peat type and soft subsoils beneath the proposed buildings be removed. The following site preparation methods are recommended for this site:

1. Install erosion and sediment control devices prior to beginning construction.
2. Clear and grub trees and vegetation designated for removal within the project site.
3. Install dewatering devices as necessary to maintain a dry work zone.
4. Over-excavate and remove all organic rich peat soils and soft, loose, wet sand/silt soils beneath the building foundations (10’ outside each side of building foundations) until firm bearing soils are encountered. This is assumed to be a minimum of 1.0’ into the sand/silt soils.
5. Place 12” minus well graded shot rock borrow, 3’ minimum depth and compact with a vibratory grid roller (minimum centrifugal force shall be 50,000 lb) with minimum of 8 passes prior to placement of subsequent lifts. One pass is considered down and back. Initial lift thickness shall be a maximum of 24” in depth; all other lifts 12”. Shot rock gradation should include enough fines such that the surface will seal and not be subject to voids from loss of fine material.
6. Place select borrow material above the shot rock borrow in maximum 12” lifts compacted to 95% of the maximum dry density unit weight as determined by modified proctor (ASTM D1557). This material shall be placed up to the bottom of the base coarse below the building floor slab.
7. Shot rock embankment should be placed at 1½ : 1 slopes. Other earthen cut or fill slopes should be constructed at 2:1 slopes. Cut slopes shall be dressed with 10” minus shot rock to increase slope stability and control erosion in the peat and wet sand soils.
8. Perimeter ditches constructed in the peats or wet sands should be 3’ wide flat bottom and rock lined with 6” minus rock, 1 foot thick.

9. A sub-drain should be installed in the shot rock or select borrow materials as low as possible to allow positive drainage to the surrounding ground outside the building area. Size of drain pipe to be a minimum of 12".
10. The contract documents should include a contingency bid item for subgrade reinforcing fabric as a measure to stabilize any soft areas below subcut depth.

Non-frost susceptible (N.F.S.) select borrow material shall consist of sand, gravel, fractured rock or combination thereof containing no muck, frozen materials, roots or other deleterious materials. The material shall have a plasticity index not greater than 6 as determined by AASHTO T90 and shall contain no more than 6% passing the #200 sieve based on material that passes a 3-inch screen.

The engineered embankment will have an allowable soil bearing pressure of 2,500 psf if constructed in accordance with the above guidelines. The majority of overall building site settlement should occur during embankment construction. After construction, settlement is estimated at less than 1½" with differential settlement of less than 1".

Construction of access roads and parking lots will follow the same recommendations as those stated for the building foundation prep work with the exception that a 2' depth of shot rock borrow would be placed.

9.2 Lateral Pressures on Retaining Walls

Walls that retain earth will need to be designed for the lateral earth pressures imposed upon them. Cast-in-place concrete walls are relatively rigid and should be designed for two conditions: 1) saturated earth at rest and 2) active earth pressure with pressures due to seismic accelerations. Retaining walls beneath the building footprint will likely be backfilled with compacted shot-rock material or selected borrow (sand/gravel). These will be drained with a foundation drainage system. Saturated soils will have a wet density of approximately 145 pounds per cubic foot and have an internal angle of friction of approximately 35 degrees. Walls should be designed for the triangular distribution of lateral at-rest earth pressures and the rectangular soil pressure distribution due to the surcharge of the soil due to loads on slabs and the slab weight itself. We recommend the walls be designed for 50 psf/ft at rest soil pressure and a water pressure of 62.4 pcf.

The second earth pressure loading condition consists of earth in an active state with lateral pressures from seismic activity. The triangular distribution of active earth pressures can be established using the characteristics listed in the previous paragraph. Seismic pressures should follow the recommendations of Seed and Whitman using an inverted triangular pressure distribution. The lateral earth acceleration should be two-thirds of the peak horizontal acceleration of 0.13g provided by the USGS.

We recommend a well-drained soil for backfill and positive foundation wall and footing drainage. We recommend water proofing the foundation with a membrane, water stops in the concrete construction joints and other appropriate measures to maintain a waterproof barrier.

9.3 Underground Utilities

Water and sewer utilities will be connected to the CBJ public systems located within the Glacier Highway Right-of-Way. No onsite disposal of wastewater or private water well use is anticipated. No unusual difficulties are foreseen provided standard design and construction techniques are employed, such as, proper bedding of buried pipes, compacting trench backfill to 95% of modified proctor and sufficient pipe embedment to prevent freezing (5' to top of waterline). Sanitary sewer and water lines should be constructed in accordance with applicable codes and standards of the CBJ Engineering Department. Use of a subgrade reinforcing fabric beneath the pipe bedding material should be considered to provide for a more stable pipe foundation bearing area. All organic rich peat soils beneath utilities shall be removed and replaced with shot rock. Underground utilities are not recommended to "float" over organic soils. Sanitary sewer lines may require deep trench excavation and consideration of trench shoring or a trench box should be made to conform with required safety regulations.

9.4 Drainage and Dewatering

Engineering measures must be initiated to prevent water inflow into the foundation excavation and all other areas during construction. The excavation bottom must be kept dry as possible. If the silty sands are allowed to become saturated they may become unmanageable even if they were originally found to be dry. Excessive rain or snow might have a similar effect during construction. When groundwater is encountered during building site preparation operations, it will be necessary to control the influx of water by installation of well points. Well points are a means to mechanically dewater the bottom of the excavation with mechanical pumping systems.

Post construction surface and groundwater problems should not occur as long as:

1. All below-grade portions of the building are properly water and moisture-proofed by waterproofing the below grade foundation walls and placement of a plastic vapor barrier below the floor slabs.
2. Surface water is effectively isolated from entering all soils below foundation footings and floor slabs.
3. Surface grading is accomplished in a manner that will positively divert surface water runoff away from the structure.
4. Concentrated runoff is controlled by installing perimeter foundation and roof drain systems to route surface and subsurface drainage away from the building.
5. Construct a cut-off trench or drain on the uphill portion of the site to intercept subsurface groundwater and route to the sides of the project to control influx of water into the project.

9.5 Frost Protection

To protect against the affects of seasonal frost heave, we recommend that the bottom of foundation footings be a minimum of 32" below finished grade, per the City and Borough of Juneau Title 19 guidelines.

10.0 LIMITATIONS

This report was prepared in accordance with generally accepted professional principles and practices in the field of geotechnical engineering at the time this report was prepared. The conclusions and recommendations submitted in this report are based upon information provided to us describing the proposed site grading and construction and on the 7 drill test holes, 5 test pits and laboratory testing conducted and used in preparation of this report. The nature and extent of subsurface variations across the site may not become evident until construction. If during construction, fill, soil, rock, bedrock, surface water, or groundwater conditions appear to be different from those described herein, R&M's geotechnical engineer should be advised at once so re-evaluation of the recommendations can be made.

R&M is not responsible for safety programs, methods or procedures of operation, or the construction of the design recommendations provided in this report. Where recommendations are general or not called out, the recommendations shall conform to standards of the industry. This geotechnical report is not to be used in a manner that would constitute a detriment directly or indirectly to R&M.

Section 1.2 of this report provides a synopsis of additional geotechnical data researched and obtained in the preparation of this geotechnical report. The information is provided for informational purposes only and R&M makes no warranty either expressed or implied as to the suitability or accuracy of this information.

We would appreciate the opportunity to review final site design and foundation plans to verify that our assumptions of the proposed facilities are correct and that our recommendations have been adequately incorporated.

Thank you for the opportunity to be of service to Tetra-Tech/KCM on this important community project. Should you have questions concerning this report, please contact us at 780-6060.

Sincerely,

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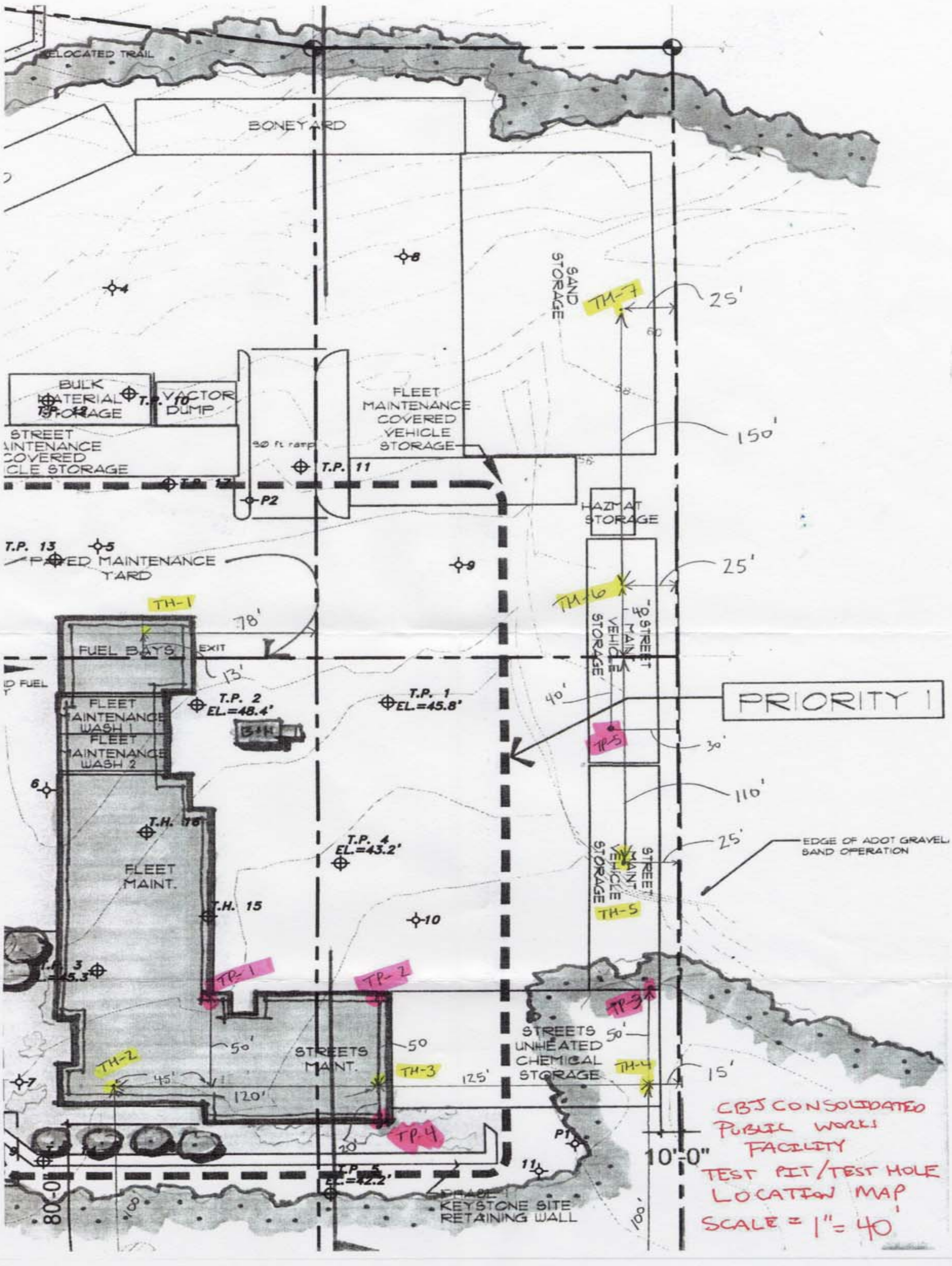
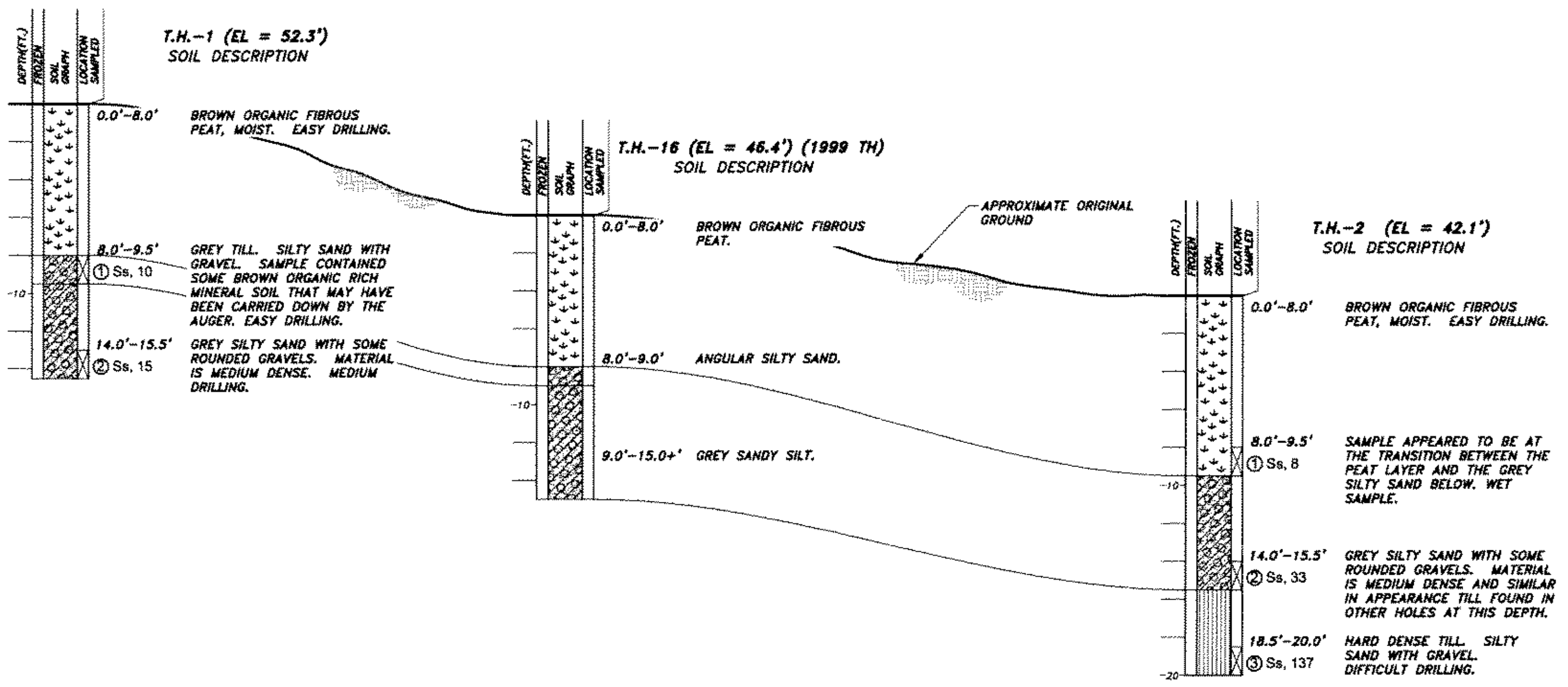


CBJ CONSOLIDATED PUBLIC WORKS FACILITY
TEST PIT/TEST HOLE LOCATION MAP
SCALE = 1" = 40'



T.H.-1 (EL = 52.3')
SOIL DESCRIPTION

0.0'-8.0' BROWN ORGANIC FIBROUS PEAT, MOIST. EASY DRILLING.

8.0'-9.5' ① Ss, 10 GREY TILL. SILTY SAND WITH GRAVEL. SAMPLE CONTAINED SOME BROWN ORGANIC RICH MINERAL SOIL THAT MAY HAVE BEEN CARRIED DOWN BY THE AUGER. EASY DRILLING.

14.0'-15.5' ② Ss, 15 GREY SILTY SAND WITH SOME ROUNDED GRAVELS. MATERIAL IS MEDIUM DENSE. MEDIUM DRILLING.

T.H.-16 (EL = 46.4') (1999 TH)
SOIL DESCRIPTION

0.0'-8.0' BROWN ORGANIC FIBROUS PEAT.

8.0'-9.0' ANGULAR SILTY SAND.

9.0'-15.0+' GREY SANDY SILT.

T.H.-2 (EL = 42.1')
SOIL DESCRIPTION

0.0'-8.0' BROWN ORGANIC FIBROUS PEAT, MOIST. EASY DRILLING.

8.0'-9.5' ① Ss, 8 SAMPLE APPEARED TO BE AT THE TRANSITION BETWEEN THE PEAT LAYER AND THE GREY SILTY SAND BELOW. WET SAMPLE.

14.0'-15.5' ② Ss, 33 GREY SILTY SAND WITH SOME ROUNDED GRAVELS. MATERIAL IS MEDIUM DENSE AND SIMILAR IN APPEARANCE TILL FOUND IN OTHER HOLES AT THIS DEPTH.

18.5'-20.0' ③ Ss, 137 HARD DENSE TILL. SILTY SAND WITH GRAVEL. DIFFICULT DRILLING.

SOIL PROFILE A-A

VERTICAL SCALE: 1" = 10'
HORIZONTAL GRAPHIC SCALE
0' 10' 20' 40' 80'

SOIL PROFILE LOGS
FOR
CBJ PUBLIC WORKS
CONSOLIDATED FACILITES
CITY & BOROUGH OF JUNEAU, ALASKA

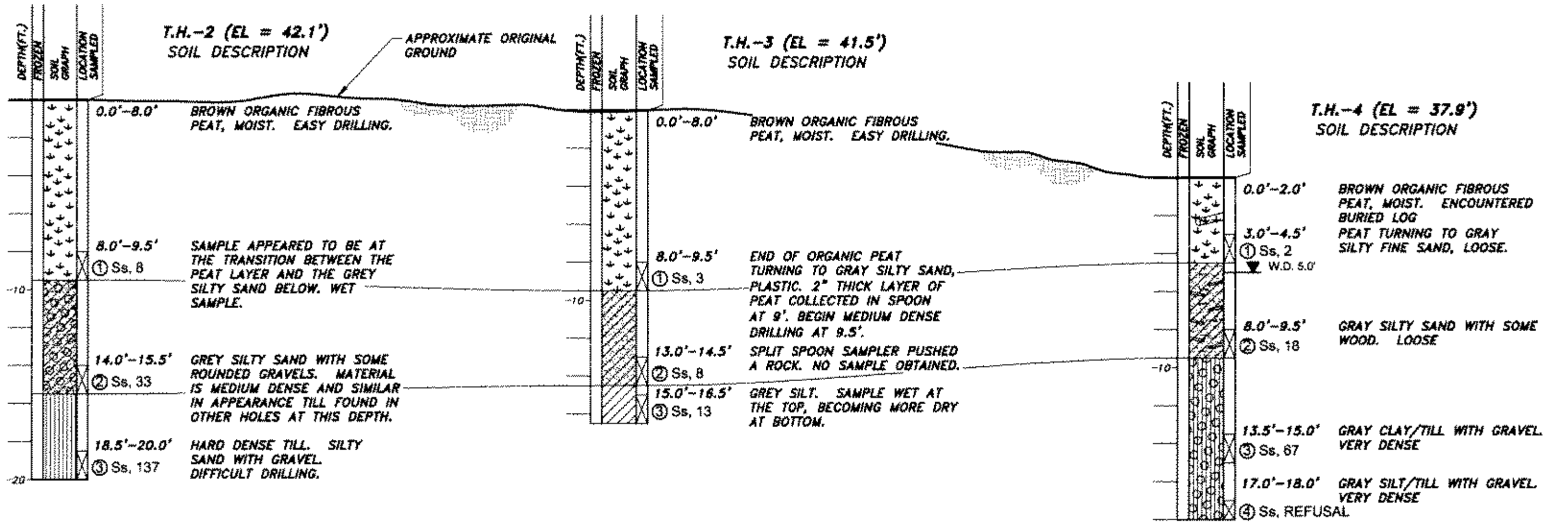
CLIENT:
TETRA TECH/KCM
230 S FRANKLIN ST. #212
JUNEAU, ALASKA 99801
DATE: FEBRUARY 2008

SHEET 1 OF 3

ENGINEER:
R&M ENGINEERING, INC.
6205 GLACIER HIGHWAY
JUNEAU, ALASKA 99801
R&M PROJ. NO. 081100.1

I:\2008\081100.1\Soil Logs\Soil Profiles.dwg PLOT: June 18, 2008 at: 7:03am

R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS



T.H.-2 (EL = 42.1')
SOIL DESCRIPTION

0.0'-8.0'	BROWN ORGANIC FIBROUS PEAT, MOIST. EASY DRILLING.
8.0'-9.5' ① Ss, 8	SAMPLE APPEARED TO BE AT THE TRANSITION BETWEEN THE PEAT LAYER AND THE GREY SILTY SAND BELOW. WET SAMPLE.
14.0'-15.5' ② Ss, 33	GREY SILTY SAND WITH SOME ROUNDED GRAVELS. MATERIAL IS MEDIUM DENSE AND SIMILAR IN APPEARANCE TILL FOUND IN OTHER HOLES AT THIS DEPTH.
18.5'-20.0' ③ Ss, 137	HARD DENSE TILL. SILTY SAND WITH GRAVEL. DIFFICULT DRILLING.

T.H.-3 (EL = 41.5')
SOIL DESCRIPTION

0.0'-8.0'	BROWN ORGANIC FIBROUS PEAT, MOIST. EASY DRILLING.
8.0'-9.5' ① Ss, 3	END OF ORGANIC PEAT TURNING TO GRAY SILTY SAND, PLASTIC. 2" THICK LAYER OF PEAT COLLECTED IN SPOON AT 9'. BEGIN MEDIUM DENSE DRILLING AT 9.5'.
13.0'-14.5' ② Ss, 8	SPLIT SPOON SAMPLER PUSHED A ROCK. NO SAMPLE OBTAINED.
15.0'-16.5' ③ Ss, 13	GREY SILT. SAMPLE WET AT THE TOP, BECOMING MORE DRY AT BOTTOM.

T.H.-4 (EL = 37.9')
SOIL DESCRIPTION

0.0'-2.0'	BROWN ORGANIC FIBROUS PEAT, MOIST. ENCOUNTERED BURIED LOG
3.0'-4.5' ① Ss, 2	PEAT TURNING TO GRAY SILTY FINE SAND, LOOSE.
8.0'-9.5' ② Ss, 18	GRAY SILTY SAND WITH SOME WOOD. LOOSE
13.5'-15.0' ③ Ss, 67	GRAY CLAY/TILL WITH GRAVEL. VERY DENSE
17.0'-18.0' ④ Ss, REFUSAL	GRAY SILT/TILL WITH GRAVEL. VERY DENSE

SOIL PROFILE B-B

VERTICAL SCALE: 1" = 10'
HORIZONTAL GRAPHIC SCALE
0' 10' 20' 40' 80'

SOIL PROFILE LOGS
FOR
CBJ PUBLIC WORKS
CONSOLIDATED FACILITES
CITY & BOROUGH OF JUNEAU, ALASKA

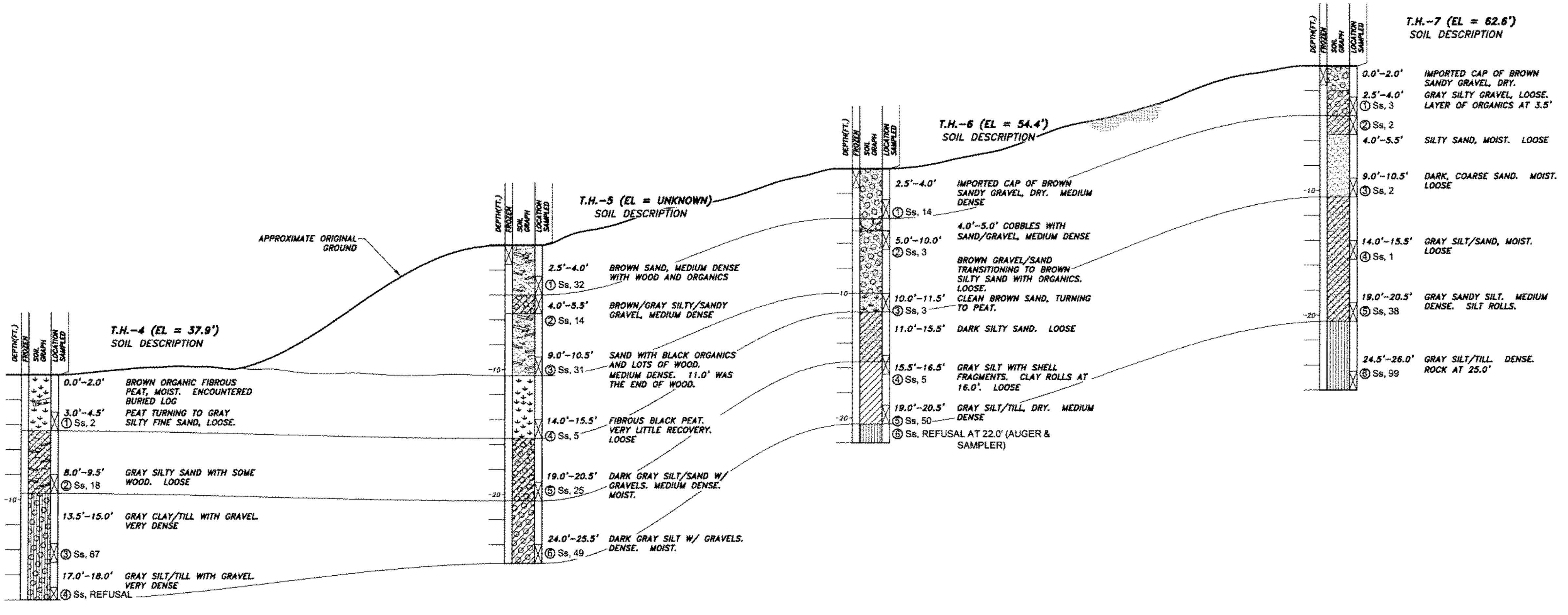
CLIENT:
TETRA TECH/KCM
230 S FRANKLIN ST. #212
JUNEAU, ALASKA 99801
DATE: FEBRUARY 2008

SHEET 2 OF 3

ENGINEER:
R&M ENGINEERING, INC.
6205 GLACIER HIGHWAY
JUNEAU, ALASKA 99801
R&M PROJ. NO. 081100.1

I:\2008\081100.1\Soil Logs\Soil Profiles.dwg PLOT: June 18, 2008 at: 7:03am

R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS



T.H.-4 (EL = 37.9')
SOIL DESCRIPTION

0.0'-2.0' BROWN ORGANIC FIBROUS PEAT, MOIST. ENCOUNTERED BURIED LOG

3.0'-4.5' PEAT TURNING TO GRAY SILTY FINE SAND, LOOSE.
① Ss, 2

8.0'-9.5' GRAY SILTY SAND WITH SOME WOOD. LOOSE
② Ss, 18

13.5'-15.0' GRAY CLAY/TILL WITH GRAVEL. VERY DENSE
③ Ss, 67

17.0'-18.0' GRAY SILT/TILL WITH GRAVEL. VERY DENSE
④ Ss, REFUSAL

T.H.-5 (EL = UNKNOWN)
SOIL DESCRIPTION

2.5'-4.0' BROWN SAND, MEDIUM DENSE WITH WOOD AND ORGANICS
① Ss, 32

4.0'-5.5' BROWN/GRAY SILTY/SANDY GRAVEL, MEDIUM DENSE
② Ss, 14

9.0'-10.5' SAND WITH BLACK ORGANICS AND LOTS OF WOOD. MEDIUM DENSE. 11.0' WAS THE END OF WOOD.
③ Ss, 31

14.0'-15.5' FIBROUS BLACK PEAT. VERY LITTLE RECOVERY. LOOSE
④ Ss, 5

19.0'-20.5' DARK GRAY SILT/SAND W/ GRAVELS. MEDIUM DENSE. MOIST.
⑤ Ss, 25

24.0'-25.5' DARK GRAY SILT W/ GRAVELS. DENSE. MOIST.
⑥ Ss, 49

T.H.-6 (EL = 54.4')
SOIL DESCRIPTION

2.5'-4.0' IMPORTED CAP OF BROWN SANDY GRAVEL, DRY. MEDIUM DENSE
① Ss, 14

4.0'-5.0' COBBLES WITH SAND/GRAVEL, MEDIUM DENSE

5.0'-10.0' BROWN GRAVEL/SAND TRANSITIONING TO BROWN SILTY SAND WITH ORGANICS. LOOSE.
② Ss, 3

10.0'-11.5' CLEAN BROWN SAND, TURNING TO PEAT.
③ Ss, 3

11.0'-15.5' DARK SILTY SAND. LOOSE

15.5'-16.5' GRAY SILT WITH SHELL FRAGMENTS. CLAY ROLLS AT 16.0'. LOOSE
④ Ss, 5

19.0'-20.5' GRAY SILT/TILL, DRY. MEDIUM DENSE
⑤ Ss, 50

⑥ Ss, REFUSAL AT 22.0' (AUGER & SAMPLER)

T.H.-7 (EL = 62.6')
SOIL DESCRIPTION

0.0'-2.0' IMPORTED CAP OF BROWN SANDY GRAVEL, DRY.

2.5'-4.0' GRAY SILTY GRAVEL, LOOSE. LAYER OF ORGANICS AT 3.5'
① Ss, 3
② Ss, 2

4.0'-5.5' SILTY SAND, MOIST. LOOSE

9.0'-10.5' DARK, COARSE SAND. MOIST. LOOSE
③ Ss, 2

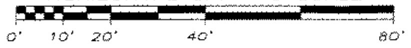
14.0'-15.5' GRAY SILT/SAND, MOIST. LOOSE
④ Ss, 1

19.0'-20.5' GRAY SANDY SILT. MEDIUM DENSE. SILT ROLLS.
⑤ Ss, 38

24.5'-26.0' GRAY SILT/TILL. DENSE. ROCK AT 25.0'
⑥ Ss, 99

SOIL PROFILE C-C

VERTICAL SCALE: 1" = 10'
HORIZONTAL GRAPHIC SCALE



SOIL PROFILE LOGS
FOR
CBJ PUBLIC WORKS
CONSOLIDATED FACILITES
CITY & BOROUGH OF JUNEAU, ALASKA

CLIENT:
TETRA TECH/KCM
230 S FRANKLIN ST. #212
JUNEAU, ALASKA 99801
DATE: FEBRUARY 2008

SHEET 3 OF 3

ENGINEER:
R&M ENGINEERING, INC.
6205 GLACIER HIGHWAY
JUNEAU, ALASKA 99801
R&M PROJ. NO. 081100.1

I:\2008\081100.1\Soil Logs\Soil Profiles.dwg PLOT: June 18, 2008 at: 7:03am

SOILS CLASSIFICATION AND CONSISTENCY

CLASSIFICATION: IDENTIFICATION AND CLASSIFICATION OF THE SOIL IS ACCOMPLISHED IN GENERAL ACCORDANCE WITH THE ASTM VERSION OF THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) AS PRESENTED IN ASTM STANDARD D 2487-93. THE STANDARD IS A QUALITATIVE METHOD OF CLASSIFYING SOIL INTO THE FOLLOWING MAJOR DIVISIONS: (1) COARSE GRAINED; (2) FINE-GRAINED; (3) HIGHLY ORGANIC SOILS. CLASSIFICATION IS PERFORMED ON THE SOILS PASSING THE 75mm (3-INCH) SIEVE AND IF POSSIBLE THE AMOUNT OF OVERSIZE MATERIAL (>75mm PARTICLES) IS NOTED ON THE SOIL LOGS. THIS IS NOT ALWAYS POSSIBLE FOR DRILLED TEST HOLES BECAUSE THE OVERSIZE PARTICLES ARE TYPICALLY TOO LARGE TO BE CAPTURED IN THE SAMPLING EQUIPMENT. OVERSIZE MATERIALS GREATER THAN 300mm (12 INCHES) ARE TERMED BOULDERS, WHILE MATERIALS BETWEEN 75mm AND 300mm ARE TERMED COBBLES. COARSE-GRAINED SOILS ARE THOSE HAVING 50% OR MORE OF THE NON-OVERSIZE SOIL RETAINED ON THE NO. 200 SIEVE; IF A GREATER PERCENTAGE OF THE COARSE GRAINS IS RETAINED ON THE NO. 4 SIEVE THE COARSE-GRAINED SOIL IS CLASSIFIED AS GRAVEL, OTHERWISE IT IS CLASSIFIED AS SAND. FINE-GRAINED SOILS ARE THOSE HAVING MORE THAN 50% OF THE NON-OVERSIZE MATERIAL PASSING THE NO. 200 SIEVE; THESE MAY BE CLASSIFIED AS SILT OR CLAY DEPENDING ON THEIR ATTERBERG LIQUID AND PLASTIC LIMITS OR OBSERVATIONS OF FIELD CONSISTENCY. REFER TO ASTM D 2487-93 FOR A COMPLETE DISCUSSION OF THE CLASSIFICATION METHOD.

SOIL CONSISTENCY - CRITERIA: SOIL CONSISTENCY AS DEFINED BELOW AND DETERMINED BY NORMAL FIELD AND LABORATORY METHODS APPLIES ONLY TO NON-FROZEN MATERIAL. FOR THESE MATERIALS, THE INFLUENCE OF SUCH FACTORS AS SOIL STRUCTURE (I.E. FISSURE SYSTEMS, SHRINKAGE CRACKS, SLICKENSIDES, ETC.) MUST BE TAKEN INTO CONSIDERATION IN MAKING ANY CORRELATION WITH THE CONSISTENCY VALUES LISTED BELOW. IN PERMAFROST ZONES, THE CONSISTENCY AND STRENGTH OF FROZEN SOILS MAY VARY SIGNIFICANTLY AND INEXPLICABLY WITH ICE CONTENT, THERMAL REGIME AND SOIL TYPE.

RELATIVE DENSITY OF SANDS ACCORDING TO RESULTS OF STANDARD PENETRATION TEST

CONSISTENCY	N*(BLOWS/FT)	RELATIVE DENSITY
LOOSE	0-10	0-40%
MEDIUM DENSE	10-30	40-70%
DENSE	30-60	70-90%
VERY DENSE	> 60	90-100%

* STANDARD PENETRATION, "N": BLOWS PER FOOT OF A 140-POUND HAMMER FALLING 30 INCHES ON A 1.4" ID SPLIT-SPOON SAMPLER EXCEPT WHERE NOTED.

CONSISTENCY OF CLAY IN TERMS OF UNCONFINED COMPRESSIVE STRENGTH (TSF)

VERY SOFT	0-0.25
SOFT	0.25-0.5
STIFF	0.5-1.0
FIRM	1.0-2.0
VERY FIRM	2.0-4.0
HARD	> 4.0

TSF = TONS PER SQUARE FOOT

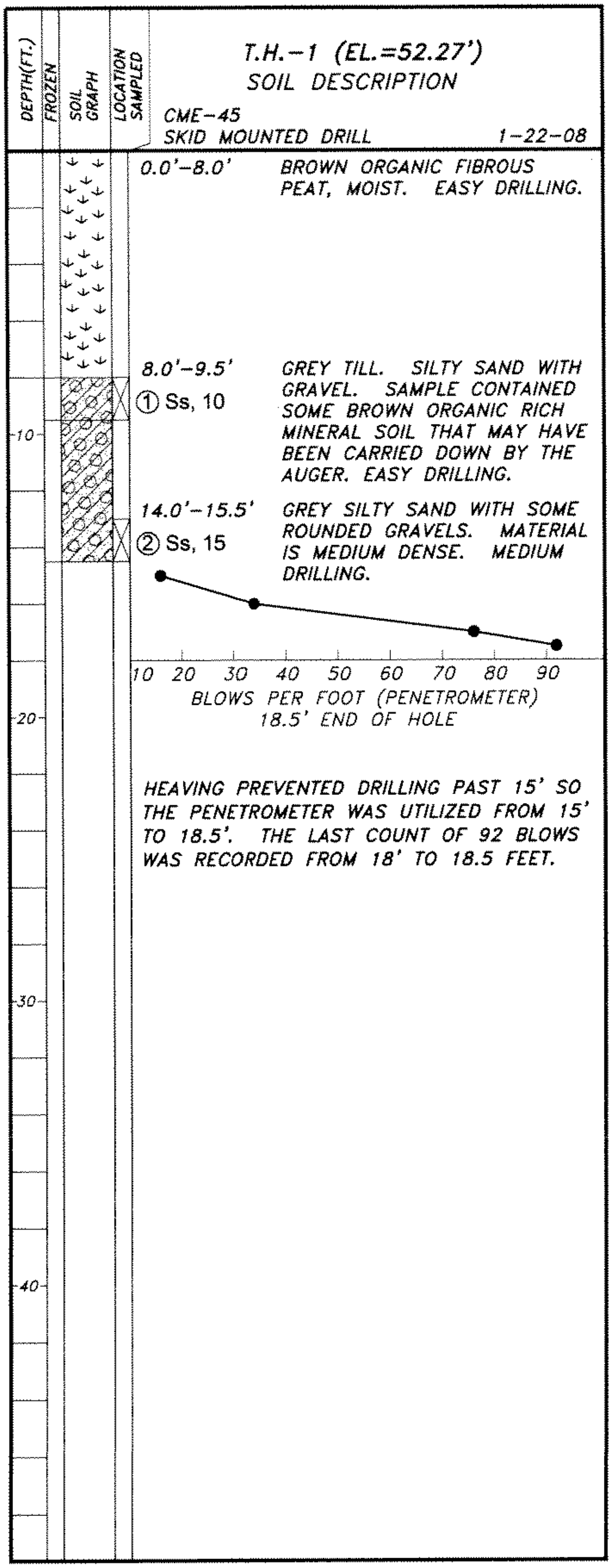
I:\2008\081100.1\Soil Logs\Soil Log Notes.dwg PLOT: June 18, 2008 at: 7:11am Michael Limbaugh

DWN: JMN
CKD: JMP
DATE: 2-14-08
SCALE: N.T.S.

R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS
SOILS CLASSIFICATIONS

CBJ PUBLIC WORKS
CONSOLIDATED FACILITIES
GEOTECHNICAL INVESTIGATION
JUNEAU, ALASKA

SOILS LOG.DWG
GRID:
PROJ.NO: 081100.1
DWG.NO: 1 OF 1



T.H.-1 (EL.=52.27')
SOIL DESCRIPTION

CME-45
SKID MOUNTED DRILL 1-22-08

0.0'-8.0'	BROWN ORGANIC FIBROUS PEAT, MOIST. EASY DRILLING.
8.0'-9.5' ① Ss, 10	GREY TILL. SILTY SAND WITH GRAVEL. SAMPLE CONTAINED SOME BROWN ORGANIC RICH MINERAL SOIL THAT MAY HAVE BEEN CARRIED DOWN BY THE AUGER. EASY DRILLING.
14.0'-15.5' ② Ss, 15	GREY SILTY SAND WITH SOME ROUNDED GRAVELS. MATERIAL IS MEDIUM DENSE. MEDIUM DRILLING.

18.5' END OF HOLE

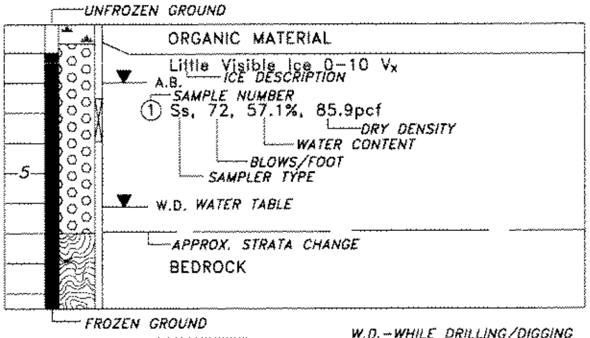
HEAVING PREVENTED DRILLING PAST 15' SO THE PENETROMETER WAS UTILIZED FROM 15' TO 18.5'. THE LAST COUNT OF 92 BLOWS WAS RECORDED FROM 18' TO 18.5 FEET.

LOCATION SKETCH

No Scale

SEE ATTACHED
TEST HOLE AND TEST PIT
LOCATION MAP

EXPLANATION



W.D.-WHILE DRILLING/DIGGING
A.B.-AFTER BORING

TYPICAL SOILS LOG

Ss	1.4" SPLIT SPOON WITH 140 LB. HAMMER
Sz	1.4" SPLIT SPOON WITH 340 LB. HAMMER
Sh	2.5" SPLIT SPOON WITH 340 LB. HAMMER
Sp	2.5" SPLIT SPOON, PUSHED
A	AUGER SAMPLE
Ts	SHELBY TUBE
Tm	MODIFIED SHELBY TUBE
Bs	BULK SAMPLE

SAMPLER TYPE SYMBOLS

ORGANIC MATERIAL	GRAVEL
CLAY/SHALE	COBBLES & BOULDERS
SILT	BEDROCK
SAND	GLACIAL TILL

SOIL SYMBOLS

I:\2008\081100.1\Soil Logs\Soil Logs.dwg PLOT: June 18, 2008 at: 7:00am Michael Limbaugh

DWN: JDM
CKD: JMP
DATE: 2-14-08
SCALE: 1" = 3'

R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS
SOILS LOG

CBJ PUBLIC WORKS
CONSOLIDATED FACILITY
GEOTECHNICAL INVESTIGATION
JUNEAU, ALASKA

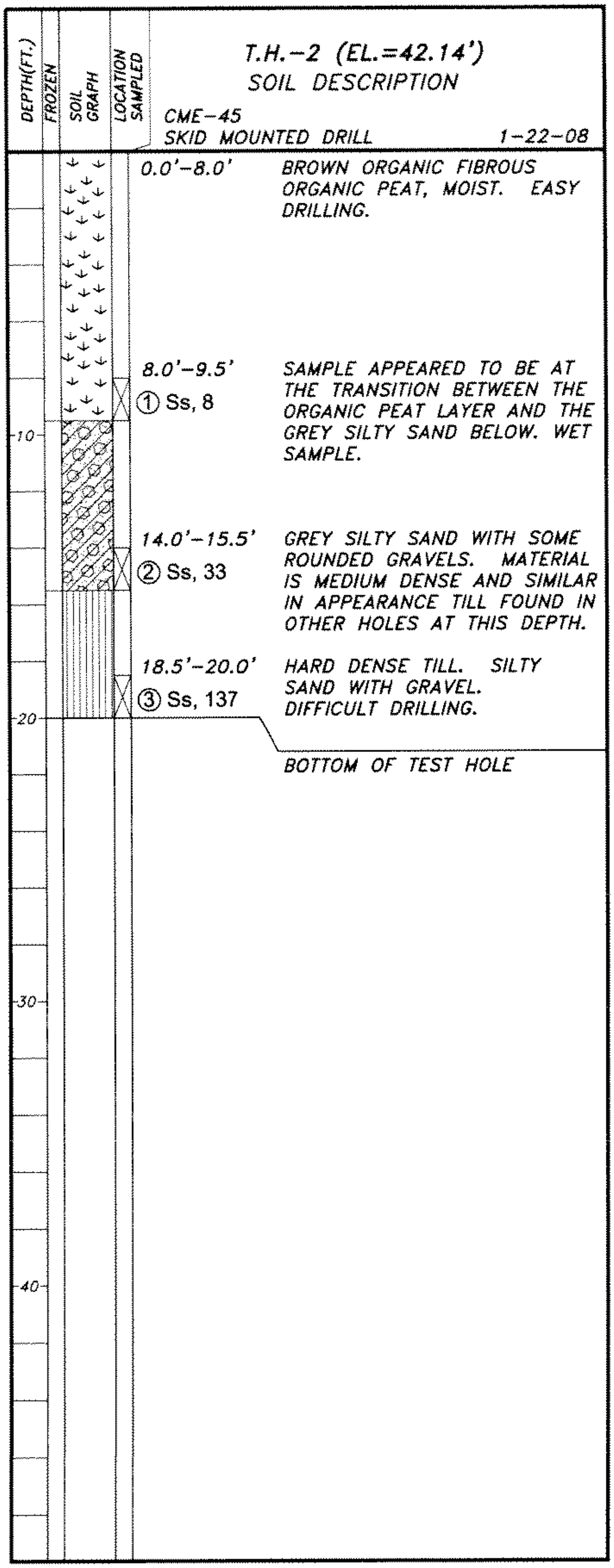
SOILS LOG.DWG
GRID:
PROJ.NO: 081100.1
DWG.NO: 1 OF 7

R&M

T.H.-2 (EL.=42.14')

SOIL DESCRIPTION

CME-45
SKID MOUNTED DRILL 1-22-08



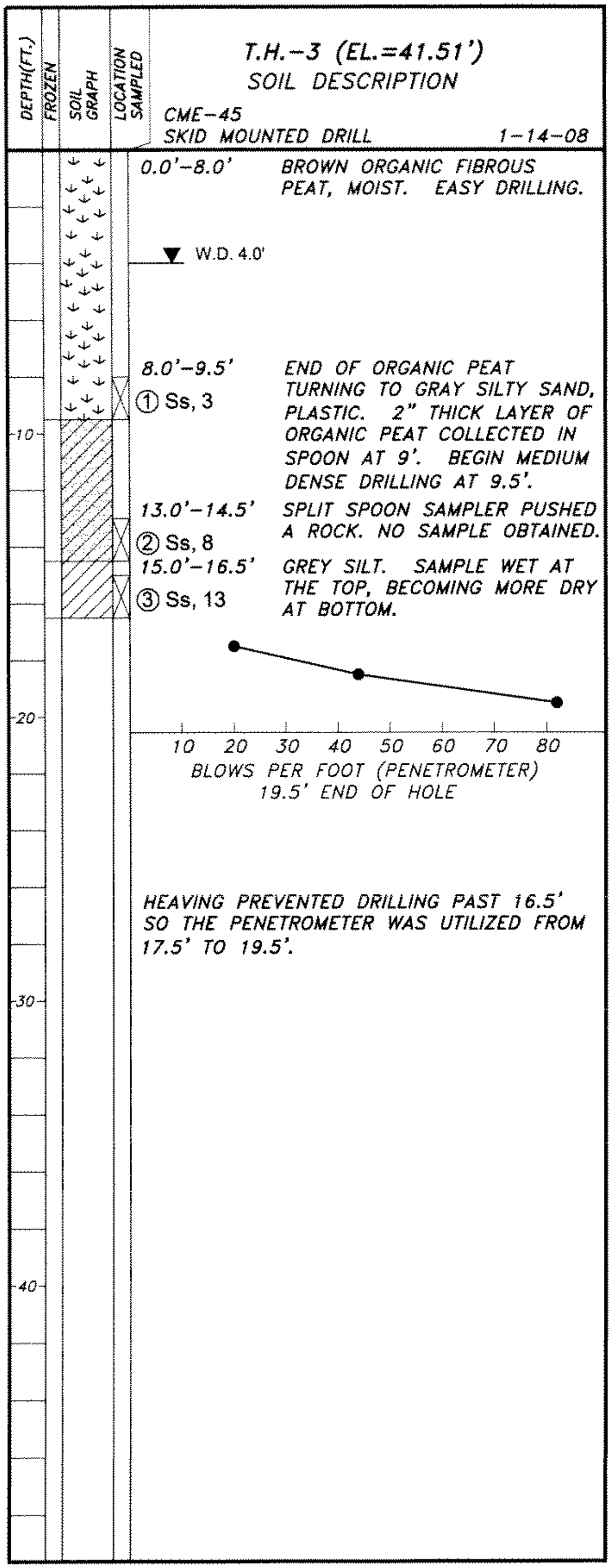
0.0'-8.0'		BROWN ORGANIC FIBROUS ORGANIC PEAT, MOIST. EASY DRILLING.
8.0'-9.5'	① Ss, 8	SAMPLE APPEARED TO BE AT THE TRANSITION BETWEEN THE ORGANIC PEAT LAYER AND THE GREY SILTY SAND BELOW. WET SAMPLE.
14.0'-15.5'	② Ss, 33	GREY SILTY SAND WITH SOME ROUNDED GRAVELS. MATERIAL IS MEDIUM DENSE AND SIMILAR IN APPEARANCE TILL FOUND IN OTHER HOLES AT THIS DEPTH.
18.5'-20.0'	③ Ss, 137	HARD DENSE TILL. SILTY SAND WITH GRAVEL. DIFFICULT DRILLING.

BOTTOM OF TEST HOLE

T.H.-3 (EL.=41.51')

SOIL DESCRIPTION

CME-45
SKID MOUNTED DRILL 1-14-08



0.0'-8.0'		BROWN ORGANIC FIBROUS PEAT, MOIST. EASY DRILLING.
8.0'-9.5'	① Ss, 3	END OF ORGANIC PEAT TURNING TO GRAY SILTY SAND, PLASTIC. 2" THICK LAYER OF ORGANIC PEAT COLLECTED IN SPOON AT 9'. BEGIN MEDIUM DENSE DRILLING AT 9.5'.
13.0'-14.5'	② Ss, 8	SPLIT SPOON SAMPLER PUSHED A ROCK. NO SAMPLE OBTAINED.
15.0'-16.5'	③ Ss, 13	GREY SILT. SAMPLE WET AT THE TOP, BECOMING MORE DRY AT BOTTOM.

HEAVING PREVENTED DRILLING PAST 16.5' SO THE PENETROMETER WAS UTILIZED FROM 17.5' TO 19.5'.

I:\2008\081100.1\Soil Logs\Soil Logs.dwg PLOT: June 18, 2008 at: 7:00am Michael Limbaugh

DWN: JDM
CKD: JMP
DATE: 2-14-08
SCALE: 1" = 3'

R&M
R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS
SOILS LOG

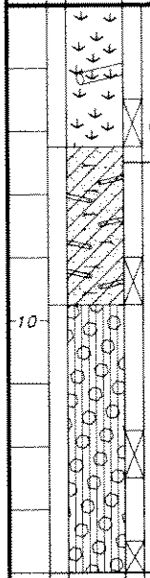
CBJ PUBLIC WORKS
CONSOLIDATED FACILITY
GEOTECHNICAL INVESTIGATION
JUNEAU, ALASKA

SOILS LOG.DWG
GRID:
PROJ.NO: 081100.1
DWG.NO: 2 OF 7

T.H.-4 (EL.=37.94')
SOIL DESCRIPTION

DEPTH(FT.) | FROZEN | SOIL GRAPH | LOCATION SAMPLED

CME-45
SKID MOUNTED DRILL 1-14-08



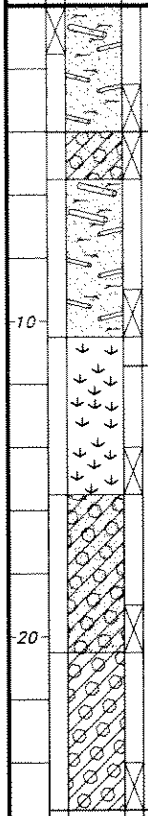
0.0'-2.0'		BROWN ORGANIC FIBROUS ORGANIC PEAT, MOIST. ENCOUNTERED BURIED LOG
3.0'-4.5'	① Ss, 2	ORGANIC PEAT TURNING TO GRAY SILTY FINE SAND, LOOSE.
▼ W.D. 5.0'		
8.0'-9.5'	② Ss, 18	GRAY SILTY SAND WITH SOME WOOD. LOOSE
13.5'-15.0'	③ Ss, 67	GRAY CLAY/TILL WITH GRAVEL. VERY DENSE
17.0'-18.0'	④ Ss, REFUSAL	GRAY SILT/TILL WITH GRAVEL. VERY DENSE

BOTTOM OF TEST HOLE

T.H.-5 (EL.=39.91')
SOIL DESCRIPTION

DEPTH(FT.) | FROZEN | SOIL GRAPH | LOCATION SAMPLED

CME-55
DRILL TRUCK 1-10-08



2.5'-4.0'	① Ss, 32	BROWN SAND, MEDIUM DENSE WITH WOOD AND ORGANICS
4.0'-5.5'	② Ss, 14	BROWN/GRAY SILTY/SANDY GRAVEL, MEDIUM DENSE
9.0'-10.5'	③ Ss, 31	SAND WITH BLACK ORGANICS AND LOTS OF WOOD. MEDIUM DENSE. 11.0' WAS THE END OF WOOD.
▼ W.D. 11.5'		
14.0'-15.5'	④ Ss, 5	FIBROUS BLACK ORGANIC PEAT. VERY LITTLE RECOVERY. LOOSE
19.0'-20.5'	⑤ Ss, 25	DARK GRAY SILT/SAND W/ GRAVELS. MEDIUM DENSE. MOIST.
24.0'-25.5'	⑥ Ss, 49	DARK GRAY SILT W/ GRAVELS. DENSE. MOIST.

BOTTOM OF TEST HOLE

I:\2008\081100.1\Soil Logs\Soil Logs.dwg PLOT: June 18, 2008 at: 7:01am Michael Limbaugh

DWN: JDM
CKD: JMP
DATE: 2-14-08
SCALE: 1" = 3'

R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS
SOILS LOG

CBJ PUBLIC WORKS
CONSOLIDATED FACILITY
GEOTECHNICAL INVESTIGATION
JUNEAU, ALASKA

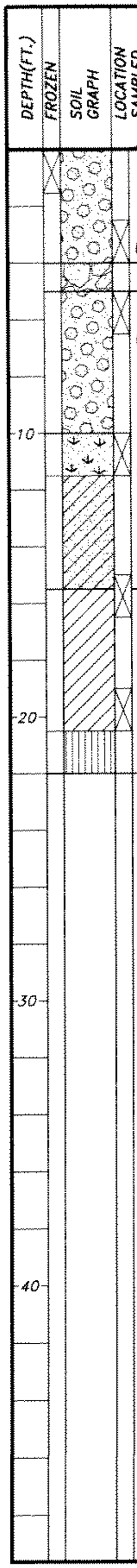
SOILS LOG.DWG
GRID:
PROJ.NO: 081100.
DWG.NO: 3 OF 7

R&M

T.H.-6 (EL.=54.38')

SOIL DESCRIPTION

CME-55
DRILL TRUCK 1-9-08



2.5'-4.0' IMPORTED CAP OF BROWN SANDY GRAVEL, DRY. MEDIUM DENSE

① Ss, 14

▼ W.D. 5.0'

4.0'-5.0' COBBLES WITH SAND/GRAVEL, MEDIUM DENSE

5.0'-10.0'
② Ss, 3

BROWN GRAVEL/SAND TRANSITIONING TO BROWN SILTY SAND WITH ORGANICS. LOOSE.

10.0'-11.5' CLEAN BROWN SAND, TURNING TO PEAT.
③ Ss, 3

11.0'-15.5' DARK SILTY SAND. LOOSE

15.5'-16.5' GRAY SILT WITH SHELL FRAGMENTS. CLAY ROLLS AT 16.0'. LOOSE
④ Ss, 5

19.0'-20.5' GRAY SILT/TILL, DRY. MEDIUM DENSE
⑤ Ss, 50

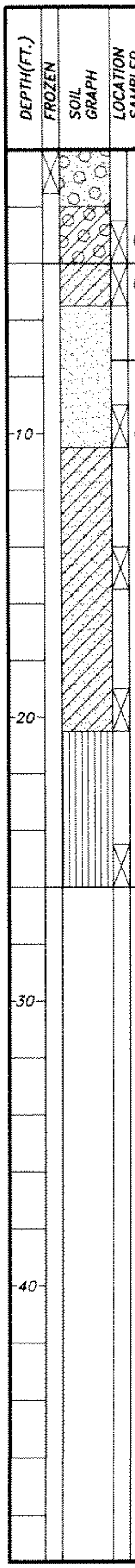
⑥ Ss, REFUSAL AT 22.0' (AUGER & SAMPLER)

BOTTOM OF TEST HOLE

T.H.-7 (EL.=62.59')

SOIL DESCRIPTION

CME-55
DRILL TRUCK 1-10-08



0.0'-2.0' IMPORTED CAP OF BROWN SANDY GRAVEL, DRY.

2.5'-4.0' GRAY SILTY GRAVEL, LOOSE. LAYER OF ORGANICS AT 3.5'
① Ss, 3

② Ss, 2

4.0'-5.5' SILTY SAND, MOIST. LOOSE

▼ W.D. 7.5'

9.0'-10.5' DARK, COARSE SAND. MOIST. LOOSE
③ Ss, 2

14.0'-15.5' GRAY SILT/SAND, MOIST. LOOSE
④ Ss, 1

19.0'-20.5' GRAY SANDY SILT. MEDIUM DENSE. SILT ROLLS.
⑤ Ss, 38

24.5'-26.0' GRAY SILT/TILL. DENSE. ROCK AT 25.0'
⑥ Ss, 99

BOTTOM OF TEST HOLE

I:\2008\081100.1\Soil Logs\Soil Logs.dwg PLOT: June 18, 2008 at: 7:01am Michael Limbaugh

DWN: JDM
CKD: JMP
DATE: 2-14-08
SCALE: 1" = 3'

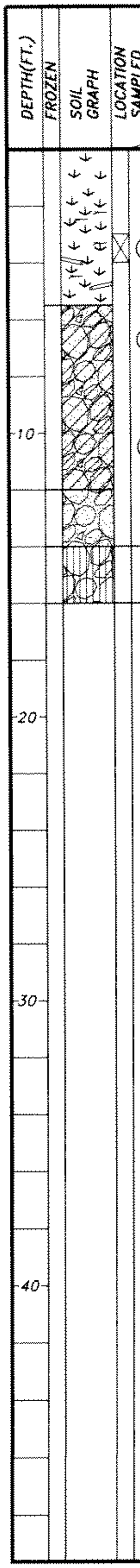
R&M
R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS
SOILS LOG

CBJ PUBLIC WORKS
CONSOLIDATED FACILITY
GEOTECHNICAL INVESTIGATION
JUNEAU, ALASKA

SOILS LOG.DWG
GRID:
PROJ.NO: 081100.1
DWG.NO: 4 OF 7

T.P.-1 (EL.=44.19')
SOIL DESCRIPTION

VOLVO EC210CL
EXCAVATOR 1-18-08

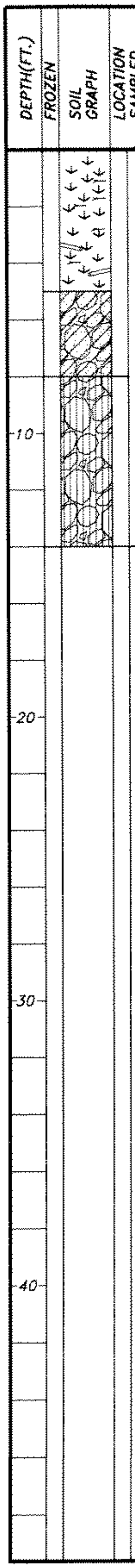


0.0'-5.5' ① Bs	ORGANIC PEAT WITH NO MINERAL AGGREGATES. WET WITH WATER WEEPING THROUGH INTO PIT.
5.5'-12.0' ② Bs ③ Bs	GRAY SANDY GRAVEL WITH POCKETS OF COARSE SAND. COBBLES TO 12".
12.0'-14.0'	DARK GRAY SANDY GRAVEL WITH SOME BROWN SOILS AND COBBLES TO 18".
14.0'-16.0'	LIGHT GRAY SILTY SANDY GRAVEL WITH COBBLES TO 12". DENSE TILL. MATERIAL TOO DENSE TO CONTINUE DIGGING.

BOTTOM OF TEST PIT

T.P.-2 (EL.=44.44')
SOIL DESCRIPTION

VOLVO EC210CL
EXCAVATOR 1-18-08



0.0'-5.0'	ORGANIC PEAT WITH STICKS AND ROOTS. SMALL AMOUNT OF WATER WEEPING INTO THE PIT.
5.0'-8.0'	GRAY SANDY GRAVELY SILT WITH COBBLES TO 18". POCKETS OF COARSE GRANITE SAND.
8.0'-14.0'	GRAY CLAY WITH GRAVELS AND OCCASIONAL COBBLES. MATERIAL AT 8' WAS SATURATED AND EASY DIGGING. AS DEPTH INCREASED, MOISTURE DECREASED AND DENSITY INCREASED.

BUCKET REFUSAL
BOTTOM OF TEST PIT

I:\2008\081100.1\Soil Logs\Soil Logs.dwg PLOT: June 18, 2008 at: 7:01am Michael Limbaugh

DWN: JDM
CKD: JMP
DATE: 2-14-08
SCALE: 1" = 3'

R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS
SOILS LOG

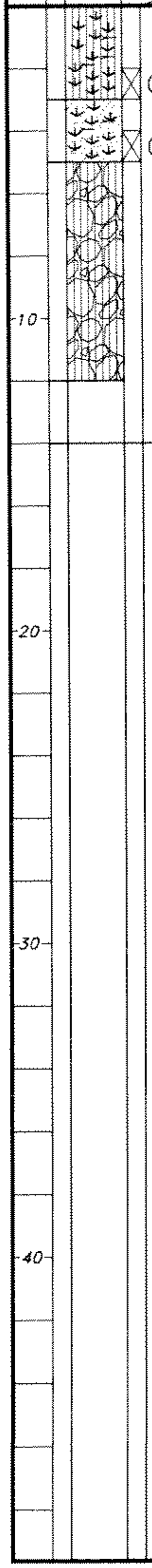
CBJ PUBLIC WORKS
CONSOLIDATED FACILITY
GEOTECHNICAL INVESTIGATION
JUNEAU, ALASKA

SOILS LOG.DWG
GRID:
PROJ.NO: 081100.1
DWG.NO: 5 OF 7

T.P.-3 (EL.=38.83')

SOIL DESCRIPTION

VOLVO EC210CL
EXCAVATOR 1-18-08



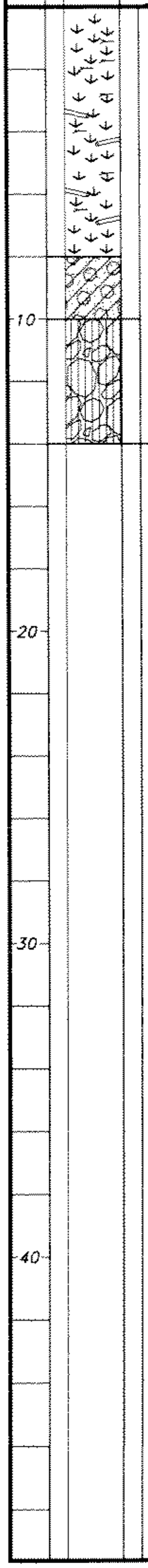
0.0'-3.0'	ORGANIC PEAT, LAYERS OF SILTY PEAT THROUGHOUT.
① Bs	
3.0'-5.0'	TRANSITION FROM ORGANIC PEAT TO GRAY SANDY GRAVEL.
② Bs	
5.0'-12.0'	SILT/CLAY WITH GRAVEL AND COBBLES. EASY TO MEDIUM DIGGING.
12.0'-14.0'	ANGULAR COBBLES TO 18" WITH GRAVELY SILTY SAND. MATERIAL APPEARS TO HAVE BEEN TRANSPORTED VIA LANDSLIDE OR SIMILAR EVENT AS TEST PIT IS LOCATED NEAR STREAM BED.

BOTTOM OF TEST PIT

T.P.-4 (EL.=41.80')

SOIL DESCRIPTION

VOLVO EC210CL
EXCAVATOR 1-18-08



0.0'-8.0'	ORGANIC PEAT WITH STICKS ROOTS AND LOGS THROUGHOUT. NO MINERAL AGGREGATES. WET WITH WATER WEEPING THROUGH INTO PIT.
8.0'-10.0'	GRAY SANDY GRAVELY SILT. SATURATED AND SOFT CONSISTENCY. APPEARS THAT IF THE WATER WAS DRAINED OUT, THE MATERIAL WOULD SET UP AND BE HARD.
10.0'-14.0'	GRAY TILL. SILTY SAND WITH GRAVELS AND COBBLES TO 12". VERY DENSE AND DIFFICULT TO DIG.

BOTTOM OF TEST PIT

I:\2008\081100.1\Soil Logs\Soil Logs.dwg PLOT: June 18, 2008 at: 7:01am Michael Limbaugh

DWN: JDM
CKD: JMP
DATE: 2-14-08
SCALE: 1" = 3'

R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS
SOILS LOG

CBJ PUBLIC WORKS
CONSOLIDATED FACILITY
GEOTECHNICAL INVESTIGATION
JUNEAU, ALASKA

SOILS LOG.DWG
GRID:
PROJ.NO: 081100.1
DWG.NO: 6 OF 7

R & M ENGINEERING, INC.

PROJECT NO. 081100.1

DATE: January 31, 2008

PROJECT NAME: CBJ Public Works Consolidated Facilities

REPORT NO. 1

SUMMARY OF LABORATORY TEST DATA

TEST HOLE NO.	DEPTH (ft.)	3"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	4	10	40	200	NMC %	USCS CLASS	PLASTICITY INDEX
TH-1	8'-9.5'			100	98	98	96	92	84	74	49	23.5	33%	SM-SC*	
TH-2	14'-15.5'			100	87	79	76	72	58	52	43	25.5	8%	SM-SC	
TH-3	8'-9.5'				100	96	92	84	69	64	52	30.5	16%	SC	3
TH-4	3'-4.5'				100	93	93	83	75	62	42	13.6	96%	PT	
TH-5	2.5'-4'					100	95	91	77	62	38	17.4	18%	SM*	
TH-6	15'-16.5'					100	97	93	84	76	60	33.1	16%	SC	
TH-7	9'-10.5'					100	99	98	94	79	27	6.2	28%	SW-SM	
TP-1	14'	100	70	63	62	58	55	52	44	34	18	4.9	20%	GP	
TP-2	9'			100	98	96	93	91	81	75	62	38.0	19%	SM-SC	
TP-3	14'	100	85	80	80	80	79	78	70	64	53	30.3	12%	SM-SC	
TP-4	9'			100	99	96	93	89	78	64	42	10.4	30%	GW-GP	
TP-5	15'			100	92	87	86	84	77	70	59	32.8	16%	SM-SC	

*Samples from TH-1 at 8'-9.5' and TH-5 at 2.5'-4' contained organics

REMARKS: Gradation per AASHTO T-88 and ASTM C-136

NOTES:1) SIEVE ANALYSIS = PERCENT PASSIN
2) USCS = UNIFIED SOIL CLASSIFICATION SYST
3) NMC = NATURAL MOISTURE CONTENT

R&M LAB TECHNICIAN

R&M APPROVAL

R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS
6205 Glacier Highway, P.O.Box 34278, Juneau, Alaska 99801

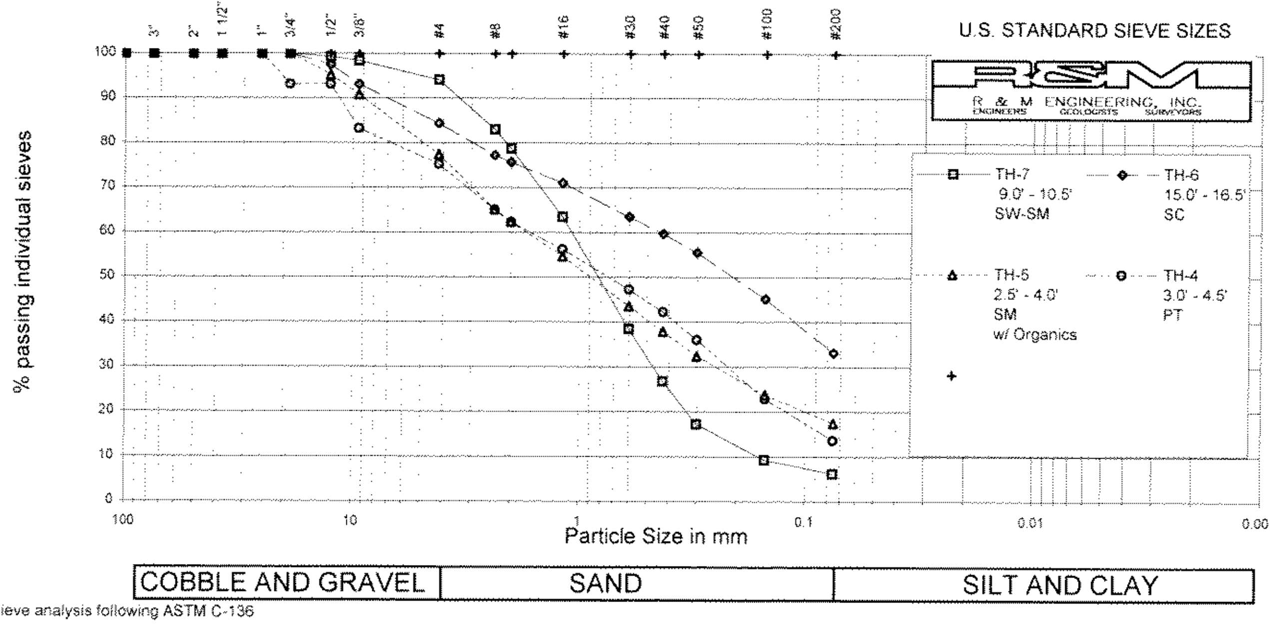
R&M PROJECT NUMBER: 081101.1

PROJECT : CBJ Consolidated PW
CLIENT:
DATE RECEIVED: 1/16/2008
MATERIAL TYPE: Insitu Test Holes and Test Pits
SAMPLE SOURCE: Insitu Test Holes and Test Pits
DATE REPORTED: 1/17/2008
SAMPLE SUBMITTED BY: J. Fabiano & J. McElwain

Moisture	28%		16%		18%		96%	
SIEVE SIZE	Percent passing of **TH-7 9.0' - 10.5' SW-SM**	Required specs	Percent passing of **TH-6 15.0' - 16.5' SC**	Required specs	Percent passing of **TH-5 2.5' - 4.0' SM w/ Organics**	Required specs	Percent passing of **TH-4 3.0' - 4.5' PT**	Required specs
4 "								
3 "								
2 "								
1 1/2 "								
1 "							100	
3/4 "	100		100		100		93	
1/2 "	99		97		95		93	
3/8 "	98		93		91		83	
No 4	94		84		77		75	
No 8	83		77		65		65	
No 10	79		76		62		62	
No 16	63		71		55		56	
No 30	38		63		43		47	
No 40	27		60		38		42	
No 50	17		56		32		36	
No 100	9		45		24		23	
No 200	6.2		33.1		17.4		13.6	

Grain size distribution for soils of the

CBJ Consolidated PW



Sieve analysis following ASTM C-136
Moisture content determination following ASTM C-566

R&M PROJECT NUMBER: **081101.1**

R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS

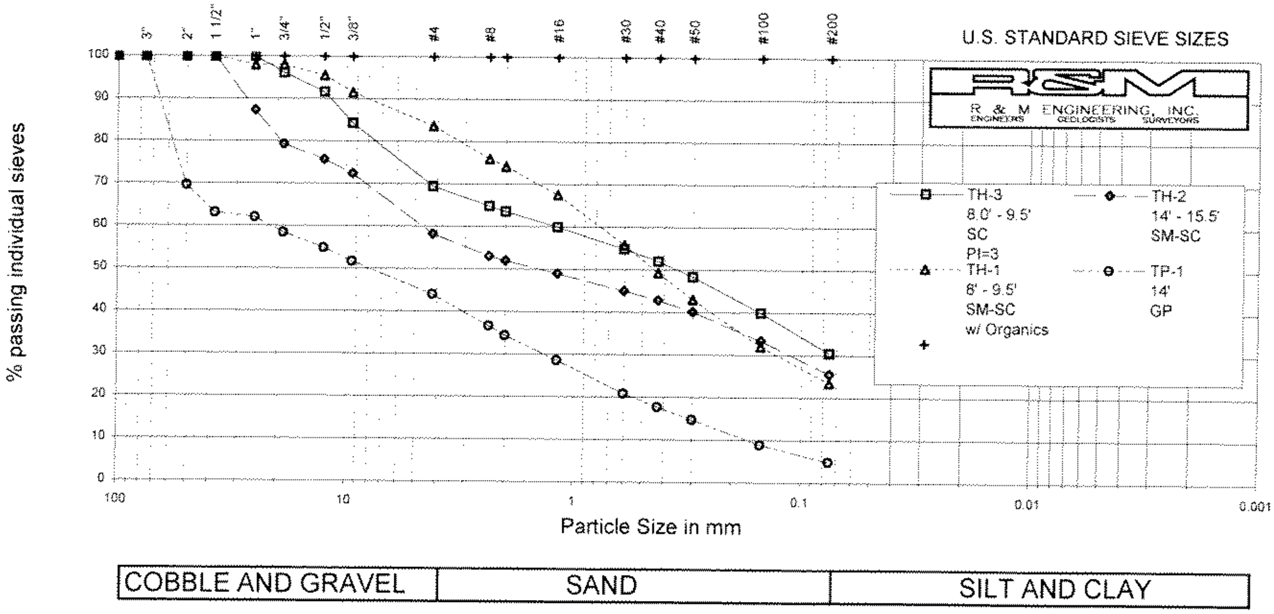
PROJECT : CBJ Consolidated PW
CLIENT:
DATE RECEIVED: 1/16/2008
DATE REPORTED: 1/17/2008

MATERIAL TYPE: Insitu Test Holes and Test Pits
SAMPLE SOURCE: Insitu Test Holes and Test Pits
SAMPLE SUBMITTED BY: J. Fabiano & J. McElwain

Moisture	16%		8%		33%		20%	
SIEVE SIZE	Percent passing of **TH-3 8.0' - 9.5' SC PI=3**	Required specs	Percent passing of **TH-2 14' - 15.5' SM-SC**	Required specs	Percent passing of **TH-1 8' - 9.5' SM-SC w/ Organics**	Required specs	Percent passing of **TP-1 14' GP**	Required specs
4 "								
3 "							100	
2 "							70	
1 1/2 "			100		100		63	
1 "	100		87		98		62	
3/4 "	96		79		98		58	
1/2 "	92		76		96		55	
3/8 "	84		72		92		52	
No 4	69		58		84		44	
No 8	65		53		76		37	
No 10	64		52		74		34	
No 16	60		49		68		29	
No 30	55		45		56		21	
No 40	52		43		49		18	
No 50	48		40		43		15	
No 100	40		33		32		9	
No 200	30.5		25.5		23.5		4.9	

Grain size distribution for soils of the

CBJ Consolidated PW



R & M ENGINEERING, INC.
ENGINEERS GEOLOGISTS SURVEYORS

R&M PROJECT NUMBER: 081101.1

PROJECT : CBJ Consolidated PW
CLIENT:
DATE RECEIVED: 1/16/2008
DATE REPORTED: 1/17/2008

MATERIAL TYPE: Insitu Test Holes and Test Pits
SAMPLE SOURCE: Insitu Test Holes and Test Pits
SAMPLE SUBMITTED BY: J. Fabiano & J. McElwain

Moisture	19%		12%		30%		16%	
SIEVE SIZE	Percent passing of **TP-2 9' SM-SC**	Required specs	Percent passing of **TP-3 14' SM-SC**	Required specs	Percent passing of **TP-4 9' GW-GP**	Required specs	Percent passing of **TP-5 15' SM-SC**	Required specs
4 "								
3 "			100					
2 "			85					
1 1/2 "	100		80		100		100	
1 "	98		80		99		92	
3/4 "	96		80		96		87	
1/2 "	93		79		93		86	
3/8 "	91		78		89		84	
No 4	81		70		78		77	
No 8	76		65		66		72	
No 10	75		64		64		70	
No 16	71		60		57		66	
No 30	65		55		47		61	
No 40	62		53		42		59	
No 50	58		49		36		55	
No 100	49		40		20		46	
No 200	38.0		30.3		10.4		32.8	

Grain size distribution for soils of the

CBJ Consolidated PW