GEOTECHNICAL REPORT

DOUGLAS HARBOR UPLANDS AND MOORAGE EXPANSION

(C3) RFP No. E99-247

DOUGLAS, ALASKA

Prepared for

City and Borough of Juneau
Engineering Department
155 South Seward Street
Juneau, Alaska 99801

Prepared by

Peratrovich, Nottingham & Drage, Inc.
3220 Hospital Drive, Suite 200
Juneau, Alaska 99801

July 2000

PND 3064

TABLE OF CONTENTS

DOUGLAS HARBOR UPLANDS AND MOORAGE EXPANSION

GEOTECHNICAL REPORT

CBJ CONTRACT NO. E99-247

1.0 INTRODUCTION

This report presents findings and recommendations resulting from a 1999 geotechnical investigation of Douglas Harbor in Douglas, Alaska. Investigation activities were conducted by, or under the direction of, Peratrovich, Nottingham & Drage, Inc. (PN&D) for the City and Borough of Juneau (CBJ) as part of CBJ Contract Number E99-247. The investigation included the following activities:

- Review of previous geotechnical and geological information.
- Drilled test holes at intertidal and offshore locations.
- Laboratory analysis of selected soil samples.
- An independent geophysical sub-bottom profiling investigation.
- An independent environmental investigation of soils in proposed dredge areas.

The investigation findings are being utilized to evaluate the construction feasibility and estimated costs of proposed improvement concepts in and around the harbor. The following sections present background information, report the investigation methods and findings, provide design recommendations for proposed harbor improvements, and discuss the appropriate use of this report.

2.0 BACKGROUND

2.1 Harbor History

The existing Douglas Harbor facility is shown on Figure A-1. The harbor basin was constructed by dredging an approximately 5.2 acre area. The basin is partially protected from waves by the Juneau Island Causeway, Juneau Island, an existing rubble mound breakwater on the south side of the harbor entrance, and the Dock Street fill structure. Existing improvements within the basin include moorage spaces for approximately 140 vessels, a boat grid, a boat launch ramp and limited parking for harbor users.

The existing improvements were constructed in a number of phases as summarized below:

- In the 1940's rock fill materials were placed from the existing Douglas Island shoreline towards the city dock to create the existing Dock Street embankment.
- 1948: The Juneau Island Causeway was constructed to provide a vehicle access between the Bureau of Mines facility on the island and nearby Douglas. A containment dike was later constructed along the existing Savikko Road alignment to provide a confined disposal area for the planned dredging of the harbor basin.
- 1961: The U.S. Army Corps of Engineers (COE) completed site investigations and prepared plans and specifications for dredging the harbor basin and providing wave protection at the harbor entrance.
- 1962: The harbor basin was dredged to elevation -12' MLLW and construction of the existing entrance breakwater was completed as a COE construction project. The dredge materials were placed on the onshore side of Savikko Road and provided the base for the roadways, parking areas, ball fields, and other recreational facilities of Savikko Park.
- 1963: The State of Alaska completed the first phase of construction for the inner harbor facilities, which provided the primary float system, access dock, gangway and boat ramp.
- 1965: The State of Alaska completed the 2nd phase of construction, which provided additional stall floats and the boat grid.
- 1997: The COE dredged 25,000 cubic yards of material to straighten the harbor entrance channel and lower the northern areas of the basin to approximately –14 feet MLLW.
- 1998: The CBJ constructed seven stall floats along the north side of C Float bringing Douglas Harbor to its present configuration.

2.2 Climate

The Juneau area is located within the maritime climate zone of Southeast Alaska and generally experiences small temperature variations, high humidity, and heavy precipitation.

Douglas Harbor itself is located approximately 2 miles from downtown Juneau in an active wind environment with significant seasonal variations in wind direction and velocity. Southeast winds are common during the spring, summer, and fall. Juneau Island, and its connecting causeway, provide the harbor's main protection from southeast winds. This protection is most effective during low tides, when the harbor floats are located in the wind shadow of the causeway. Less protection is provided during high tides, when floats and other harbor improvements are more exposed.

The greatest danger potential from southeast winds happens when storms occur concurrently with extreme tidal fluctuations. An example of this situation is the 1984 Thanksgiving Day storm that generated waves large enough to sweep over the causeway into the harbor basin.

Gusty winter winds, locally known as "Taku" winds, often originate from the coastal mountains northeast of the harbor. Douglas Harbor is highly exposed to Taku winds, which have particular impact on the north end of the harbor near the entrance. Previous reports have noted accounts of roofs blowing off buildings, boats blowing out of the water, and other structural damage resulting from Taku winds. Harbor icing also occurs during the winter months and is most predominate in the inner basin in areas of fresh water inflow.

The Arctic Environmental Information and Data Center[1] maintains records of climate information for sites throughout the state, including five locations along the Juneau road system. Review of the information reveals average annual rainfalls varying from a low of approximately 53 inches at the Juneau airport to a high of 92 inches downtown. The following table presents a summary of climate data collected at a downtown Juneau weather station located approximately 2 miles from of the project site:

Table 2.2.1: Climate Data collected at Juneau, Alaska for the period 1965-1974 and 1976-1987. Station located at Latitude 58°-18' N, Longitude 134°-25' W, Elevation 30 feet.

Month of Year	Mean Monthly Temp (°F)	Heating Degree Days (°F - Days)	Mean Monthly Rainfall (in.)	Mean Monthly Snowfall (in.)
January	28.4	1129.4	7.27	19.7
February	31.9	923.8	6.03	13.3
March	35.4	911.8	6.03	8.7
April	41.2	706.5	5.37	1.1
May	48.1	516.8	5.58	0.0
June	54.5	311.3	4.26	0.0
July	57.0	244.6	5.84	0.0
August	56.3	264.1	7.70	0.0
September	50.9	415.2	10.66	0.0
October	43.9	647.8	13.98	0.1
November	35.0	891.8	8.57	6.1
December	30.6	1057.6	7.42	18.2
Year	**42.8 Avg.**	**8020 Total**	**88.7 Total**	**67.1 Total**

Additional climate data and engineering recommendations are presented in the Environmental Atlas of Alaska[2]. The atlas includes iso-line maps of heating and freezing degree day data throughout the state which were reviewed to obtain the information of the following table:

---

1 Alaska Climate Summaries, 2nd Edition, Alaska Climate Center Technical Note Number 5, Arctic Environmental Information and Data Center, University of Alaska, Anchorage.

2 Hartman, Charles W. and Johnson, Philip R., Environmental Atlas of Alaska, 2nd Edition, Institute of Water Resources/Engineering Experiment Station, University of Alaska, Fairbanks, May 1984.

Table 2.2.2: Freezing, thawing and heating degree data for the Juneau, Alaska area

Design Freezing Index	1,500 degree days below freezing
Thawing Index	4,000 degree days above freezing
Design Thawing Index	4,700 degree days above freezing
Heating Degree Index	10,000 heating degree days

The information of Table 2.2.2 may be used to estimate the design annual heat loss of constructed facilities, depths of seasonal frost penetration, and other characteristics of the site.

2.3 Regional Geology

Southeast Alaska is situated on the outer margin of the Cordilleran Range, an extensive coastal mountain range extending along the western edge of North America from Southern California to the Alaskan Peninsula. The Cordilleran is composed of numerous rugged interconnected mountain ranges that are the product of the tectonic interaction between the North American and Pacific plates.

The present topography and geology of Southeast Alaska occurred as the result of a prolonged major uplift, the waning stages of a world glacial epoch, and the slow, persistent movement of the ocean crust in relation to the North American Continent. Uplift of the land mass began about 50 million years ago and continues today.

The region is noted for it's steep mountains, islands and extensive fjords carved during the ice ages of the Pleistocene epoch (1 million to 10,000 years ago). Major fjords in the region run southeast to northwest, with numerous lesser fjords and valleys cutting obliquely to the northeast. This orientation is the result of the northwest movement of the ocean crust along the periphery of the North American land mass, followed by glacial scouring of weakened and broken rock along the fault zones. Local examples of this alignment include Gastineau Channel and Lynn Canal.

Overburden material at the harbor site consists mainly of sand and silt soils on top of bedrock. The predominant near surface materials in the vicinity of the Juneau Island Causeway, and at nearby Sandy Beach, are silty sands which were deposited as mine tailings during operation of the former Treadwell Mine. The Treadwell mine was located on the Douglas Island shoreline approximately ½ mile south of the harbor and earlier studies[3] note that that a navigable channel once existed between Juneau and Douglas Islands. The channel was apparently filled during the operation of the Treadwell Mine when tailings were pumped onto the beach in an effort to seal off fractures that were allowing seawater to seep into the deeper workings of the mine. Over time, much of the tailing material was pushed up the channel by wind and wave forces and filled the former navigation channel.

---

3 U.S. Army Engineer District, Alaska, Corps of Engineers, Report of Foundations and Materials Investigations, Douglas Small Boat Basin, Anchorage, Alaska, 21 March 1961.

An upper layer of marine sediments, consisting of sand, silt, and varying amounts of organics and shell fragments occurs at the northwest end of the harbor. These materials are in a generally soft state and are easily excavated and eroded and provide little support for pile foundations.

The marine sediments at the northwest end of the harbor overly dense glacial till soils, consisting of approximately equal amounts of silt, sand, and gravel. The till soils began as rock fragments, which were scraped and broken away from the underlying bedrock, and pushed forward as the glacial ice moved along Gastineau Channel. The movement of the glacial ice ground the rock into smaller particles and compressed them into a dense soil deposit. Glacial till soils are typically difficult to excavate, and drive piles into, and are difficult to compact and stabilize after they have been disturbed. The glacial till soils are underlain by bedrock.

Juneau Island itself is a predominantly gneissic granite intrusive structure. Much of the surrounding rock consists of metamorphosed greenstone and slate.

2.4 Previous Geotechnical Investigations

Douglas Harbor has been the focus of a number of earlier geotechnical investigations to provide information for the original harbor construction and various smaller improvement projects in the years since. PN&D's preparation for the 1999 investigation included the review of the reports noted below:

- March 21,1961 COE Study: Report of Foundations and Materials Investigations, Douglas Small Boat Basin. This geotechnical study for original harbor design describes approximate soil conditions in harbor basin as determined from churn drill investigation methods with limited soil sampling.

- 1987 R&M Engineering Investigation: Report of Three Test Holes Driven with a Portable Casing Driver. Presents findings of a preliminary geotechnical investigation for earlier harbor expansion project at the northwest end of existing harbor basin.

- 1987 PN&D Report: Eight test holes drilled with hollow stem auger. An additional geotechnical investigation for proposed improvements noted above.

- 1990 R&M Engineering Investigation: Presents the results of six test holes and nine test pits to provide geotechnical information at west end of existing harbor.

- December 1991 PN&D Report: Douglas Harbor Geotechnical Report. An additional contaminants and geotechnical investigation for the earlier harbor expansion concept at the northwest end of the existing basin.

The findings of these prior investigations were reviewed as part of the planning process for the field program of this project. The 1961 COE study provides good background information for the existing dredge basin and harbor access channel. The remaining four reports provide useful information in the vicinity of the proposed basin and fill expansion areas of the current project.

PN&D's 1999 investigation expanded the scope of the previous studies and explored new areas not previously considered. The new investigation areas included both sides of the Juneau Island Causeway, additional investigation of the harbor entrance, the shoreline along Savikko Road, and other selected locations within the basin.

2.5 Local Seismic Environment

Juneau is situated in an area of moderate seismic activity located to the east of the highly active Queen Charlotte and Fairweather faults that trace the western edge of Southeast Alaska. Major earthquakes, with magnitudes in excess of 8.5, have occurred along the Queen Charlotte and Fairweather faults in recent times.

Studies by the United States Geological Survey (USGS) of the local area[4] also note a number of lesser, presumably inactive faults, in the Juneau area. These include the Montana Creek/Gastineau Channel, Fish Creek, Gold Creek, and Peterson Creek faults.

Recent estimates of earthquake induced Peak Ground Accelerations (PGA's) are presented in USGS Geologic Investigation Series I-2679 titled "Seismic-Hazard Maps for Alaska and the Aleutian Islands"[5]. The 1999 mapping includes the following approximate estimates of horizontal ground accelerations in Juneau:

Table 2.5.1: USGS Estimations of Peak Ground Accelerations for Juneau, Alaska

Ref. Sheet	Return Period	Probability of Exceedance	Peak Horizontal Acceleration Estimate	Remarks
1 of 2	50 Years	10 percent	0.12g	This combination of return period and probability of exceedance often used as seismic design criteria for bridge and marine facilities.
2 of 2	50 Years	2 percent	0.25g	More conservative design criteria typically used on high risk or high importance facilities.

The USGS estimates noted above are frequently used as an input value to determine an appropriate coefficient of horizontal force for the pseudo static analysis of slope stability using

---

4 Miller, Robert D., Surficial Geology of the Juneau Urban Area and Vicinity, Alaska with emphasis on Earthquake and Other Geologic Hazards, United States Department of the Interior, Geological Survey, Open File Report, 1972.

5 Robert L. Wesson, Arthur D. Frankel, Charles S. Mueller, and Stephen C. Harmse, Geologic Investigations Series 1-2679, Seismic-Hazard Maps for Alaska and the Aleutian Islands, United States Geological Survey, Denver, Colorado, 1999.

the method of slices. Recent engineering studies[6] recommend the slope stability analysis should be conducted with a seismic coefficient, Ka, equal to one-half of the peak ground acceleration noted on the appropriate map.

3.0 1999 GEOTECHNICAL INVESTIGATION

The 1999 geotechnical investigation consisted of a tidal zone and offshore drilling program supplemented by a geophysical subbottom profiling study. Preparation for the investigation consisted of comparing the findings and investigation limits of previous studies to the currently proposed improvement concepts. Review of the previous reports revealed that the existing basin and the proposed basin expansion area were fairly well covered during earlier studies, but that additional information was needed for the other proposed improvements.

Drilling for the project was accomplished by Denali Drilling Company utilizing the landing craft "Poundstone" operated by Southeast Alaska Lighterage (SEAL). Drilling was done with a CME 55 drill rig mounted on a Nodwell track chassis. A total of 17 test holes were drilled at the intertidal and offshore locations.

3.1 Drilling Methods

3.1.1 Intertidal Zone Test Holes

Seven of the test holes were drilled at intertidal zone locations, which were accessed by drilling equipment directly during low tides. These test holes were drilled using hollow stem augers combined with split spoon sampling equipment.

3.1.2 Offshore Test Holes

The remaining ten offshore test holes were drilled from the landing craft using a four point anchoring system or by securing the landing craft to existing dock structures. These test holes were drilled using rotary wash methods with 4 1/2" diameter casing, a tri-cone bit, split-spoon samplers and rock coring equipment. Drilling at each offshore location was begun by driving hollow steel casing until firmly embedded into the near surface soil layers. Once the casing was embedded, the soils inside were removed by advancing the rotating hollow drill rod, equipped with a tri-cone drill bit, into the casing. Wash water was pumped downward through the rotary wash equipment as it was advanced in order to flush the soil particles upward and out the top of the casing. In fine-grained silt/clay soils, it was usually possible to keep the test hole open below the bottom of the casing by maintaining a constant water head in the casing during the drilling process. In coarser sand/gravel soils it was sometimes necessary to continue driving the casing after each sampling interval to prevent the surrounding soils from collapsing.

---

6 Marcuson, W.F., Hynes, M.E. and Franklin, A.G., Seismic Stability and Permanent Deformation Analysis, The Last 25 Years, Stability and Performance of Slopes and Embankments-II, Proceedings of a Specialty Conference Sponsored by the American Society of Civil Engineers, Berkley California, June 29-July 1, 1992, ASCE Geotechnical Specialty Publication NO. 31.

Upon reaching each sampling elevation the test hole was flushed for several minutes and the inner drill rod and bit was withdrawn from the casing while maintaining a constant water head to prevent sidewall collapse. Split-spoon sampling equipment was then inserted into the test hole and driven into the underlying undisturbed soil with a conventional drop hammer and the sampler was then retrieved.

At the completion of each sampling interval, the process was continued by advancing the rotary wash equipment to the next sampling elevation and repeating the sampling process. Upon reaching bedrock, the underlying conditions were evaluated by observing wash cuttings or by switching to rock coring equipment to obtain undisturbed bedrock core samples.

3.2 Soil and Bedrock Sampling and Classifications

The Unified Soil Classification System (USCS) was utilized to identify and classify soil samples as summarized in Appendix B, Figures B-1 and B-2. The test hole logs of this investigation are presented as Figures B-3 through B-19.

Soil Sampling

Soil sampling was conducted by utilizing two size combinations of split-spoon sampling equipment as summarized below:

- Standard Penetration Test (SPT) Sampling consisting of a 1.4" I.D./2.0" O.D. split-spoon sampler and driven by a 140-pound hammer falling 30 inches for each blow. Samples collected with this method are identified as "Ss" on the test hole logs. The Ss sampler is best suited for silts, sands and gravel with a maximum particle size, which is smaller than the 1.4" I.D. of the sampler.

- Large split-spoon sampling consisting of a 2.4" I.D./3.0" O.D. split-spoon sampler driven by a 300 pound hammer falling 30 inches for each blow. Samples collected with this method are identified as "Sm" on the test hole logs. The larger Sm sampling equipment allows more material to be collected and facilitates the sampling of coarser soils.

Each split-spoon sampler was typically driven a minimum of 18 inches with blow counts being recorded for each 6-inch penetration interval. The sum of the number of blow counts required to drive the sampler from 6 inches to 18 inches is presented on the test hole logs as the "penetration resistance." For sampling locations where it was not possible to drive the sampler a full 18 inches, the penetration resistance is presented as the number of blows for the driving interval (e.g. 85 blows/7 inches).

PN&D's experience with the Ss and Sm sampling methods indicates that, given the same soil conditions, approximately 2 to 5 times as many blows are required to drive a Ss sampler combination the same depth as are required to drive the Sm sampler combination.

Bedrock Sampling

Bedrock sampling was conducted in locations where drill performance indicated that bedrock was near enough to the surface to have a potential impact on the installation of driven piles.

The sampling equipment consisted of a 5-foot long conventional core barrel system equipped with a diamond impregnated drill bit.

The sampling process consisted of flushing all soil particles out of the outer casing, changing over to the core equipment, lowering it downward until bedrock was contacted, and drilling the core sample. Upon retrieval, the samples were preserved in core boxes and the rock characteristics were recorded on the test hole log.

3.3 Laboratory Soils Testing

Selected soil samples were submitted to Alaska Test Lab for laboratory gradation and Atterberg limits testing in order to confirm and refine visual soil classifications. The results of the laboratory testing were added to the test hole logs. The complete report of laboratory test results is presented in Appendix C.

3.4 Geophysical Subbottom Profiling Investigation

An independent geophysical subbottom profiling investigation was conducted in the existing harbor and proposed improvement areas to provide additional geotechnical information. The geophysical investigation was conducted by Northwest Geosciences, of Bothell, Washington, with the assistance of a locally owned survey vessel.

The investigation utilized multiple frequency profiling equipment capable of penetrating to a maximum depth of approximately 150-feet below the ground surface. The geophysical report is presented in Appendix D. The conclusions of the report are consistent with the findings of the drilling investigation and do not indicate any significant anomalies between test holes.

4.0 DISCUSSION OF RESULTS AND RECOMMENDATIONS

The following paragraphs discuss investigation findings and present design recommendations for currently proposed harbor improvements. The discussion of each major component summarizes the anticipated work, presents a description of the soil and/or rock conditions found in the area, and presents geotechnical recommendations for the proposed improvement options. For complete soils information readers should refer to the test hole location drawing, soil logs, and laboratory test results presented in the appendices of this report.

Wherever possible, recommendations for soil and rock construction materials comply with the January 26, 2000 Draft version of the CBJ Standard Construction Specifications[7].

---

7 City and Borough of Juneau, Engineering Department, Standard Construction Specifications. Draft January 26, 2000

4.1 Savikko Road

A geosynthetic-reinforced retaining wall is proposed along Savikko Road to provide increased parking capacity combined with enhanced pedestrian and vehicle access for harbor and park users. The retaining wall is expected to extend from a minimum exposed base elevation of approximately +5 feet MLLW to a maximum top elevation of +25 feet MLLW. A contaminated soil containment cell is planned along the back side of the retaining wall reinforcement zone to provide a disposal location for contaminated spoils which will be dredged from the city's cruise ship berthing area in downtown Juneau.

Test holes PND-99-6, PND-99-7 and PND-99-8 were drilled to provide foundation design information along the retaining wall alignment and are summarized below:

Test hole PND-99-6

Elev. (feet)	Generalized Description of Soil Conditions
+6' to +5'	Brown sand with gravel and silt
+5' to –8'	Gray medium stiff silt
-8' to –19'	Gray stiff silty gravel with sand

Test hole PND-99-7

Elev. (feet)	Generalized Description of Soil Conditions
+10' to +8.5'	Brown sand with gravel and silt
+8.5' to –12'	Gray stiff silt with sand
-12' to –13'	Transition
-13' to –16'	Gray firm sandy silt with gravel

Test hole PND-99-8

Elev. (feet)	Generalized Description of Soil Conditions
+8' to +5.5'	Brown gravelly sand with approximately 50% cobbles
+5.5' to –5'	Gray loose to medium dense silty sand
-5' to –15.5'	Gray medium stiff silt
-15.5' to –19'	Dark gray medium stiff silt

The findings of the test holes along Savikko Road indicate suitable foundation conditions for the proposed retaining wall system discussed below:

- A mechanically stabilized earth (MSE) retaining wall system is recommended. The wall should utilize synthetic fabric or geogrid material for the soil reinforcement. The design of the reinforced earth system should clearly specify the gradation, frictional, and porosity characteristics of the wall backfill material as well as all material properties of the reinforcement layers.

- The wall facing may be preserved wood or a pre-cast concrete block system with aggressive interlocks. A minimum batter of 1(H):20(V) is recommended for the face of the retaining wall.

- The base of the wall should be founded on a concrete sill with the top surface located a minimum of 4 feet below the finish ground surface at the foot of the wall. The sill itself should be founded on a minimum of 6-inches of gravel leveling material placed above a minimum 2.5-foot thick base fill layer of shot rock.

- The first five feet of finish ground along the harbor side of the wall should be sloped at a maximum of 5 percent towards the basin.

- The containment cell for contaminated dredge soil will be located on the Savikko Park side of the of the wall reinforcement zone. The containment cell is anticipated to be segregated form adjacent fill by a geotextile separation layer. The design of the cell must include an effective means of insuring the free flow of groundwater around the cell. This may be accomplished by placing a network of wash rock and drain tile beneath the containment cell. The wash rock should be also surrounded by a geotextile filter fabric to prevent clogging and should extend upwards along the uphill side of the containment cell to insure that all ground water is intercepted and allowed to drain.

- Existing storm drain pipes will require extension through the fill materials to the face of the new wall.

4.2 Harbor Basin Expansion Area

Expansion of the harbor basin will involve the dredging of approximately 65,000 cubic yards of material from 5.5 acres of area located on the northwest side of the existing floats. The dredge area is expected to have a bottom elevation of –14' MLLW and 4(H):1(V) side slopes. Improvements within the dredge area will include a new harbor access ramp, approximately 385 linear feet of main float, two 300-foot long finger floats, 56 40-foot vessel stalls, and 30 skiff stalls.

Test holes PND-99-2 and PND-99-3, PND-99-4 and PND-99-5 were drilled to explore the basin expansion area.

Test hole PND-99-2

Elev. (feet)	Generalized Description of Soil Conditions
0' to –3.5'	Dark gray silty sand with shell fragments
-3.5' to –13'	Dark gray firm gravelly silt with sand
-13' to –14'	Transition
-14' to –43'	Gray very dense silty gravel with sand

Test hole PND-99-3

Elev. (feet)	Generalized Description of Soil Conditions
+3' to –1.5'	Dark gray loose poorly graded sand
-1.5' to –13.5'	Gray dense clayey sand with gravel
-13.5' to –33'	Gray dense silty sand with gravel
-33' to –39'	Black highly weathered bedrock

Test hole PND-99-4

Elev. (feet)	Generalized Description of Soil Conditions
0' to –3.5'	Gray medium dense silty sand with shell fragments
-3.5' to –14'	Gray medium dense silty sand with gravel and shell fragments
-14' to –40.5'	Gray stiff to hard sandy silt with gravel (cobbles also noted from 32' to 40.5')

Test hole PND-99-5

Elev. (feet)	Generalized Description of Soil Conditions
-8' to –11'	Gray silty sand
-11' to –20'	Gray stiff silt with sand
-20' to –24'	Gray medium dense porrly graded sand with silt gravel and shell fragments
-24' to –26'	Transition
-26' to –55'	Gray dense silty gravelly sand

The test holes above indicated that the dredging operation will encounter marine soils and over consolidated till soils best.

The majority of dredged material will be utilized as a portion of the fill for the new boat launch and parking area next to the dredge area. A smaller percentage of the dredge materials are expected to be disposed offshore at the nearby Gastineau Channel disposal area used during the 1997 COE maintenance dredging of Douglas Harbor. Recommendations for harbor dredging are presented below:

- Dredging of the generally "stiff" to "hard" soils can be most effectively accomplished with a large hydraulic excavator or a crane equipped with a clamshell bucket. Dredging equipment access may be provided by a spud barge or alternately by constructing temporary low tide access roads within the basin area.

  The above dredging equipment options can effectively excavate the dense soils at the base of the dredge area. This method will minimize the amount of water transferred to the boat launch and parking area fill.

- Dredge slopes may be cut to a maximum of 4(H):1(V) provided they are adequately protected by properly sized riprap. The riprap should extend throughout the full range of tidal variation and be well keyed at the base to prevent slumping. The scheduling of dredging operations will require coordination with local environmental and conservation agencies to avoid and minimize impacts on the marine habitat. Work restrictions, for in-water activities, typically prevent dredging between April 1 and June 15 each year in the Juneau area.

The installation of float mooring piles is expected to encounter difficult driving conditions in the dense soils underlying the dredge area. Recommendations for pile installation are presented below:

- All piles should be specified with thick wall sections and should be fitted with inside flange cutting shoes to protect them from installation damage. Pre-drilling may be required at some pile installation locations. Pre-drilling pilot holes between to 50% and 75% of the specified pile diameter is anticipated. Pre-drilling should initially be conducted with the smaller 50% diameter equipment prior to driving the pile. If driving resistance is too great with the 50% diameter pilot hole, the engineer may authorize the use of the larger 75% pre-drilling equipment.

4.3 New Boat Launch and Parking Area

The new boat launch and trailer parking area is planned for construction at the northwest corner of the harbor. These improvements will be constructed on dredge fill materials contained by a rock perimeter berm along the harbor basin and Gastineau Channel sides. The rest of the fill will be contained by the existing rock fill along Dock Street and the along First Street shoreline.

Test holes PND-99-16 and PND-99-17 were drilled within the proposed fill placement area and their findings are summarized below:

Test hole PND-99-16

Elev. (feet)	Generalized Description of Soil Conditions
+4.5' to +0.5'	Gray silty sand with shell fragments
+0.5' to –8'	Gray dense silty sand with gravel

Test hole PND-99-17

Elev. (feet)	Generalized Description of Soil Conditions
+2.5' to –7.5'	Gray firm clayey sand with gravel
-7.5' to –9.5'	Transition
-9.5' to –17.5'	Gray dense silty sand with gravel

The test holes above indicate favorable foundation conditions for the fill placement of the proposed boat launch and parking area improvements. Recommendations for construction of these improvements are presented below:

- The containment berm of the fill area should be constructed of angular shot quarry rock of suitable size to resist the design wave forces in the construction area. Berm side slopes may be constructed to a steepness of 1.5(H):1(V) if the rock is carefully keyed into place with a hydraulic excavator or similar equipment. A bench area with a minimum width of 20-feet should be maintained between the base of the containment berm and the upper edges of proposed dredging areas.

- The dredge spoils containment berm should be lined with geotextile separation fabric prior to the placement of dredge spoils. The fabric should meet the survivability requirements for Geotextile Class I as specified by AASHTO M 288-96. The dredge spoils may be placed within the containment area to a maximum elevation of 5-feet below finish grade.

  The settlement of the dredge spoils should be monitored by installing settlement-monitoring assemblies at selected locations and elevations in the containment area. Each assembly should consist of a 3-foot by 3-foot piece of horizontal steel plate welded to a vertical steel pipe extending to the ground surface. The top elevation of the pipe will project above the ground surface to allow settlement to be monitored at the completion of fill placement and at various intervals after construction.

- Upon the completion of dredge spoils placement the area should be covered with another layer of Geotextile Class I separation fabric prior to the placement of classified fill materials.

- Soils within 5-feet of the finish ground surface should consist of the following materials:

Depth Below Finish Surface (Inches)	City and Borough of Juneau Material Specification
0" to 6"	BASE COURSE, GRADATION C-1
6" to 18"	SUBBASE, GRADING A
18" to 60"	SHOT ROCK BORROW

  Each material should be placed in lift thicknesses and compacted as noted in the CBJ Standard Specifications. Upon the completion of the fill placement, all surfaces should be allowed to settle for approximately 2 years prior to pavement construction. The settling time may be adjusted based on the results of the settlement monitoring.

4.4 Harbor Entrance

The Master Plan for expanding Douglas Harbor recognizes the need for enhanced protection of the harbor entrance to protect new harbor floats, vessels, launch ramps, and other improvements. The city is currently working with the COE to develop entrance protection alternatives and cost estimates[8]. To date various combinations of the following types of entrance protection structures are under consideration:

- Rubble mound breakwaters

- Vertical wave barriers integrated with platform dock structures or directly embedded into soil

---

[8] Navigation Improvements, Douglas, Alaska, Checkpoint I Report, Prepared for Alaska District, Civil Works Branch, US Army Corps of Engineers, Anchorage, Alaska, Prepared by Tryck Nyman Hayes, Inc., Anchorage, Alaska, April 2000.

- Anchored or pile retained floating wave barriers
- Open-cell sheet pile bulkhead structures

Final design of the harbor entrance improvements is awaiting the findings of the COE study. The following test holes provide soils and bedrock information near the harbor entrance:

Test holes PND-99-1 and PND-99-15 were drilled on the south and north sides of the existing Douglas Cold Storage Dock and are summarized below:

Test hole PND-99-1

Elev. (feet)	Generalized Description of Soil Conditions
-4' to –6.5'	Gray silty gravel with sand
-6.5' to –12'	Dark gray medium dense fine sand with silt and shell fragments
-12 to –19'	Black soft sandy silt with shell fragments
-19 to –23'	Dark gray firm silt
-23' to –27.5'	Gray hard sandy silt with gravel
-27.5' to –44.5'	Gray very dense silty gravel with sand

Test hole PND-99-15

Elev. (feet)	Generalized Description of Soil Conditions
-17' to –27.5'	Black soft organic silt with numerous shell fragments
-27.5' to –32.5'	Gray soft silt with occasional shell fragments and wood fibers
-32.5' to –36'	Transition
-36' to –60'	Gray very dense silty sand with gravel grading to Silty gravel with sand

Test hole PND-99-14 was drilled off the east end of the Douglas Cold Storage Dock and is summarized below:

Test hole PND-99-14

Elev. (feet)	Generalized Description of Soil Conditions
-33' to –46'	Gray loose sand with silt and shell fragments
-46' to –62'	Black highly weathered bedrock

Test hole PND-99-13 was drilled off the west end of the existing rubble mound breakwater on Juneau Island to evaluate foundation soil conditions for a possible breakwater extension and is summarized below:

Test hole PND-99-13

Elev. (feet)	Generalized Description of Soil Conditions
-13' to –16'	Gray fine sand with silt and shell fragments
-16' to –21'	Gray dense well graded sand with gravel
-21' to –34'	Gray hard sandy silt with gravel and occasional cobbles

4.5 Juneau Island Causeway

The Juneau Island Causeway was constructed in 1948 to provide access between Juneau Island and Douglas. The causeway is reported to be a rock fill structure founded on the sand tailings materials that were deposited during the operation of the former Treadwell Mine. The top elevation of the causeway is at an elevation of approximately +22 feet MLLW and is subject to wave overtopping when extreme high tides and storm events coincide. Four test holes were drilled along the causeway to provide soils information for potential fill and boat launch improvements.

Test holes PND-99-9 and PND-99-10 were drilled on the harbor side of the causeway and are summarized below:

Test hole PND-99-9

Elev. (feet)	Generalized Description of Soil Conditions
+8' to +4.5'	Gray gravel with sand and silt
+4.5' to –10'	Gray loose to medium dense silty sand.
-10' to –19'	Gray stiff sandy silt

Test hole PND-99-10

Elev. (feet)	Generalized Description of Soil Conditions
+5' to +2'	Brown gravelly sand with approximately 50% cobbles
+2' to –7.5'	Dark gray loose poorly graded sand with silt
-7.5' to –9.5'	Transition
-9.5' to –17'	Gray medium stiff silt

Test holes PND-99-11 and PND-99-12 were drilled on the Sandy Beach side of the causeway and are summarized below:

Test hole PND-99-11

Elev. (feet)	Generalized Description of Soil Conditions
+2' to –24.5'	Gray loose to medium dense sand
-24.5' to –25'	Gray soft silt

Test hole PND-99-12

Elev. (feet)	Generalized Description of Soil Conditions
+6' to –24'	Gray loose to medium dense silty sand

Proposed improvements and repairs to the causeway include widening, placing additional slope protection materials, raising the top grade to provide additional freeboard during extreme storm and tide events, and paving the road surface.

5.0 LIMITATIONS

This report was prepared by PN&D to meet the specific design needs of this project. The recommendations for the current design concepts were developed after evaluation of the soil conditions found in the investigation. Unless otherwise noted, PN&D is directly involved in the design improvements discussed in this document and continuing communication and review is on going among the design team.

Subsurface problems are the principal cause of construction delays, cost overruns claims, and construction related disputes. As such, it is important to understand the limitations of the geotechnical information provided and the potential risks associated with its improper use. As an aid in understanding the appropriate use of this geotechnical report please refer to the attached article, presented in Appendix E, titled "Important Information About Your Geotechnical Engineering Report". Readers with questions regarding the findings and recommendations of this report are urged to contact PN&D who will be pleased to provide answers.

PND 3082

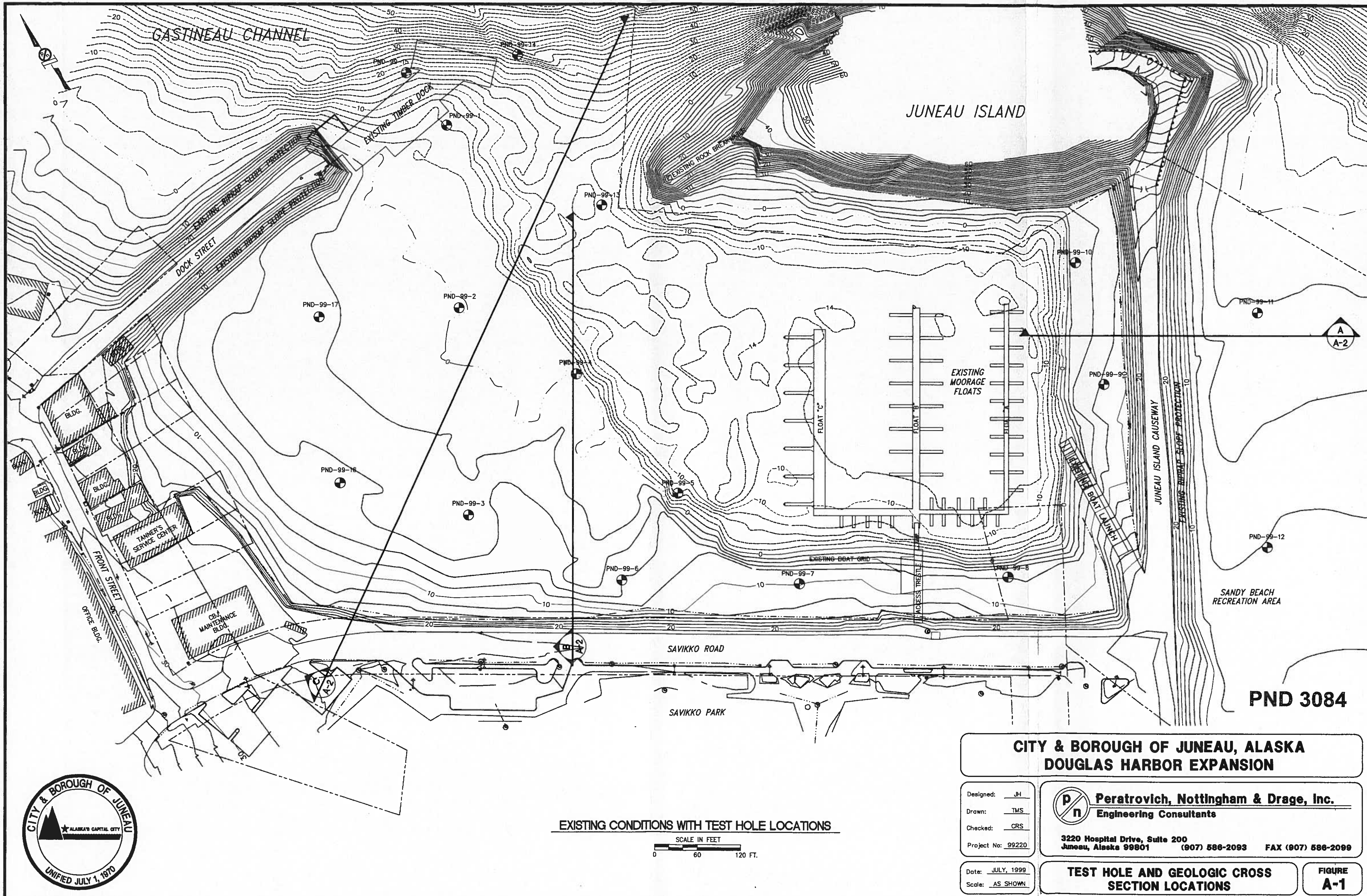
APPENDIX A

SITE SURVEY

and

GEOLOGIC CROSS-SECTIONS

PND 3083



CITY & BOROUGH OF JUNEAU, ALASKA
DOUGLAS HARBOR EXPANSION

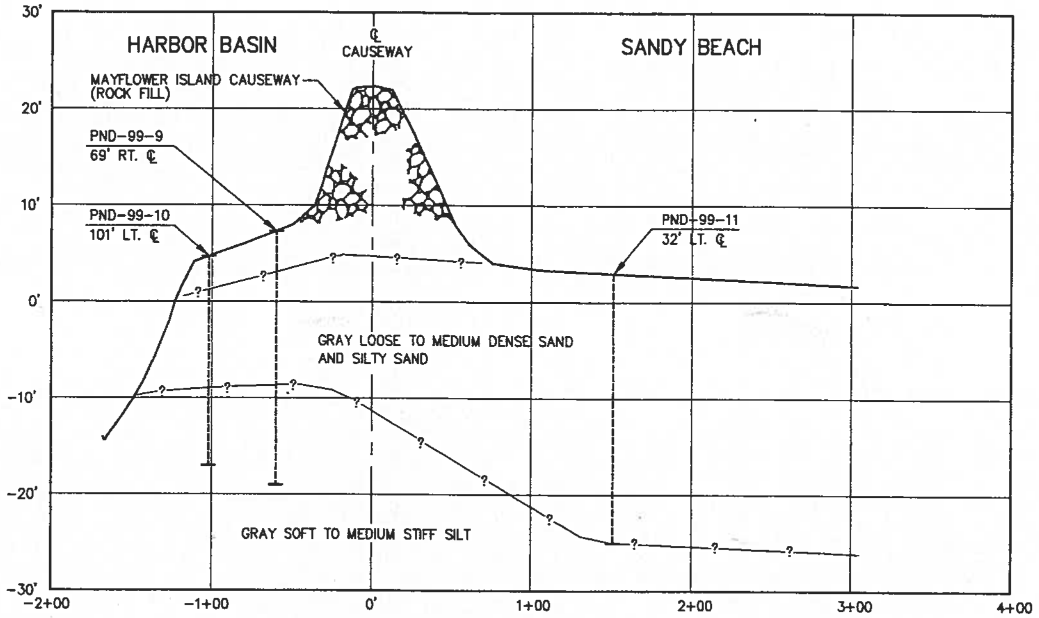
Designed: JH
Drawn: TMS
Checked: CRS
Project No: 99220

Peratrovich, Nottingham & Drage, Inc.
Engineering Consultants
3220 Hospital Drive, Suite 200
Juneau, Alaska 99801 (907) 586-2093 FAX (907) 586-2099

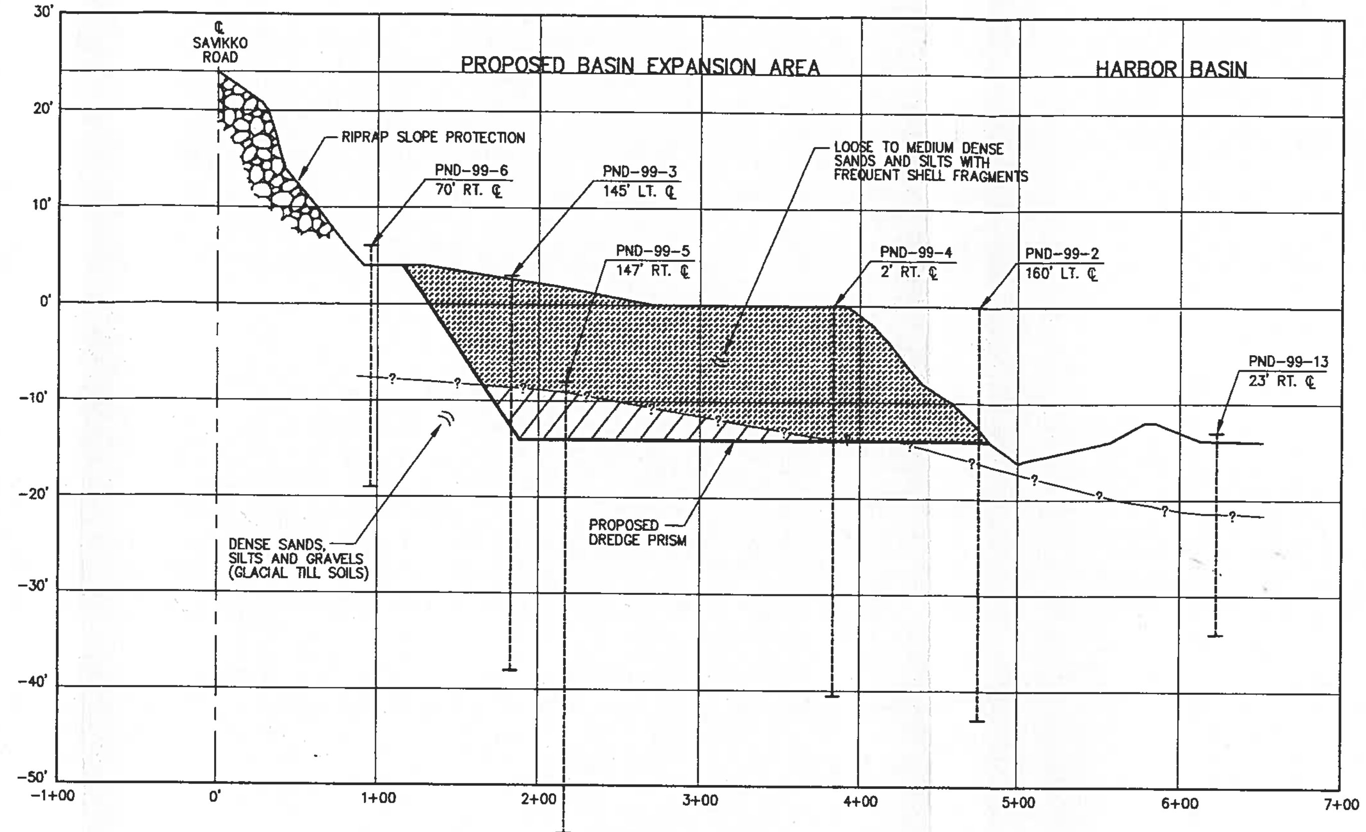
Date: JULY, 1999
Scale: AS SHOWN

TEST HOLE AND GEOLOGIC CROSS SECTION LOCATIONS

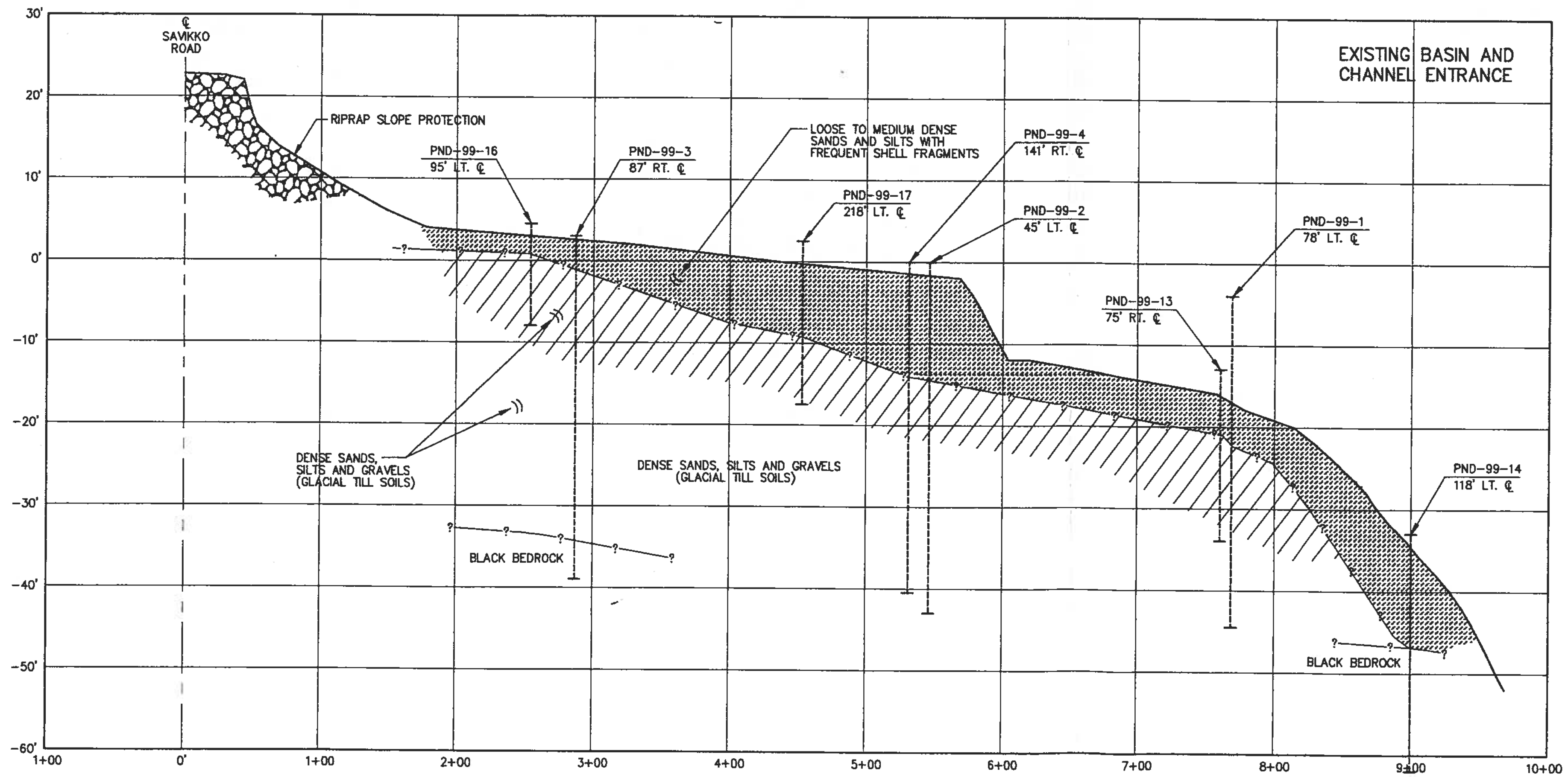
FIGURE A-1



SECTION A-A



SECTION B-B



SECTION C-C

PND 3085

CITY & BOROUGH OF JUNEAU, ALASKA
DOUGLAS HARBOR EXPANSION

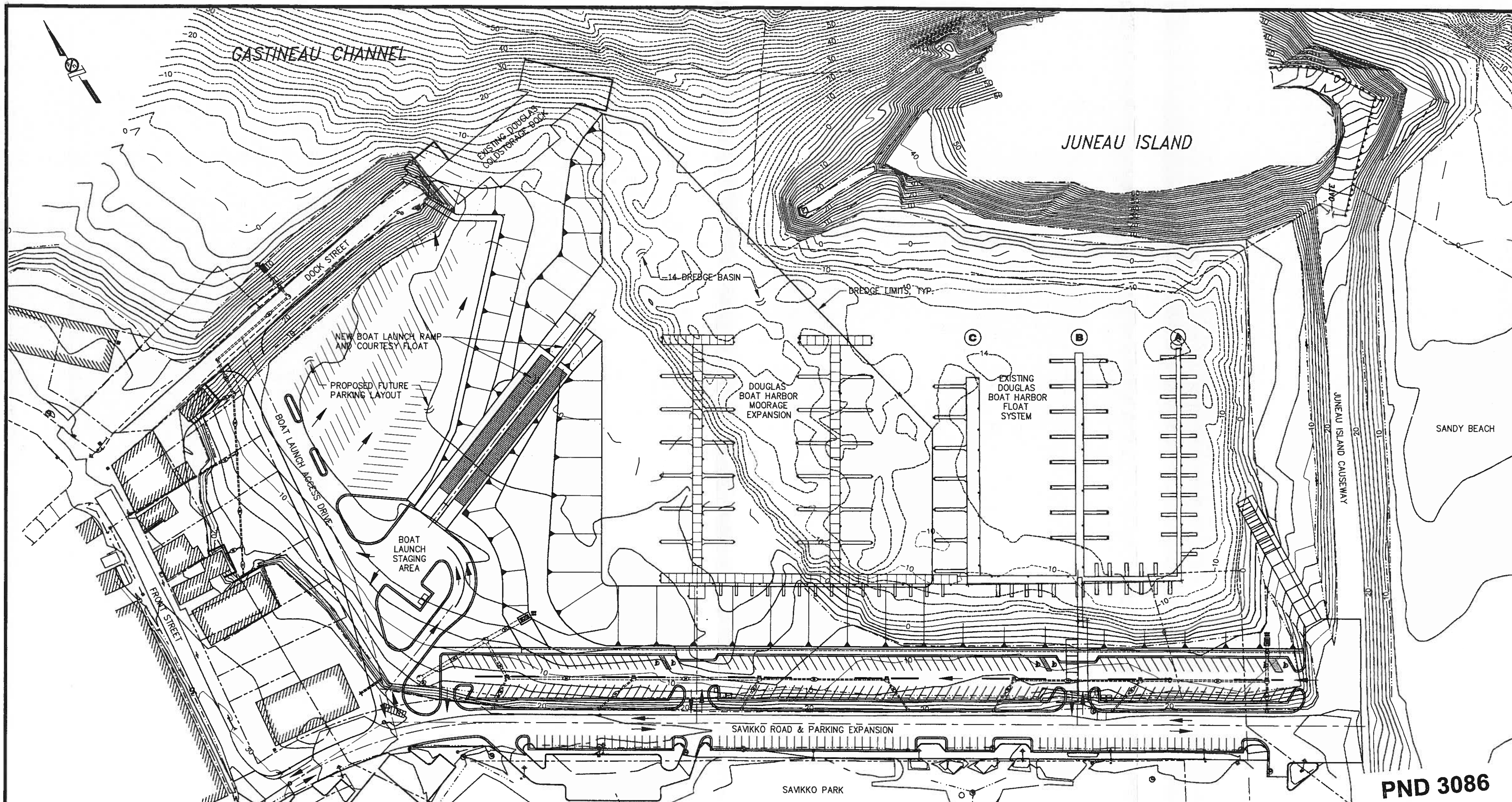
Designed:	JH
Drawn:	TMS
Checked:	CRS
Project No:	99220

Peratrovich, Nottingham & Drage, Inc.
Engineering Consultants
3220 Hospital Drive, Suite 200
Juneau, Alaska 99801 (907) 586-2093 FAX (907) 586-2099

Date:	JULY, 1999
Scale:	AS SHOWN

GEOLOGIC CROSS SECTIONS

FIGURE A-2



PND 3086

CITY & BOROUGH OF JUNEAU, ALASKA
DOUGLAS HARBOR EXPANSION

Designed: JH
Drawn: TMS
Checked: CRS
Project No: 99220

Peratrovich, Nottingham & Drage, Inc.
Engineering Consultants
3220 Hospital Drive, Suite 200
Juneau, Alaska 99801 (907) 586-2093 FAX (907) 586-2099

Date: JULY, 2000
Scale: AS SHOWN

PROPOSED INNER HARBOR IMPROVEMENTS

FIGURE **A-3**

CITY & BOROUGH OF JUNEAU
ALASKA'S CAPITAL CITY
UNIFIED JULY 1, 1970

APPENDIX B

TEST HOLE LOGS

PND 3087

SOILS

CLASSIFICATION, CONSISTENCY AND SYMBOLS

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, and (3) highly organic soils. Classification is performed on the soils passing the 75 mm (3 inch) sieve and if possible the amount of oversize material (> 75 mm 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 300 mm (12 inches) are termed boulders, while materials between 75 mm and 300 mm 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 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, shinkage 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 unexplainably with ice content, thermal regime and soil type.

Relative Density of Sands According to results of Standard Penetration Test

	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%

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

* 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.

DRILLING SYMBOLS

WO:	Wash Out	WD:	While Drilling
WL:	Water Level	BCR:	Before Casing Removal
WCI:	Wet Cave In	ACR:	After Casing Removal
DCI:	Dry Cave In	AB:	After Boring
WS:	While Sampling	TD:	Total Depth

Note: Water levels indicated on the boring logs are the levels measured in the boring at the time(s) indicated. In pervious unfrozen soils, the indicated elevations are considered to represent actual ground water conditions. In impervious and frozen soils, accurate determinations of ground water elevations cannot be obtained within a limited period of observation and other evidence of ground water elevations and conditions are required.

PND 3088

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B-1

Peratrovich, Nottingham & Drage, Inc.

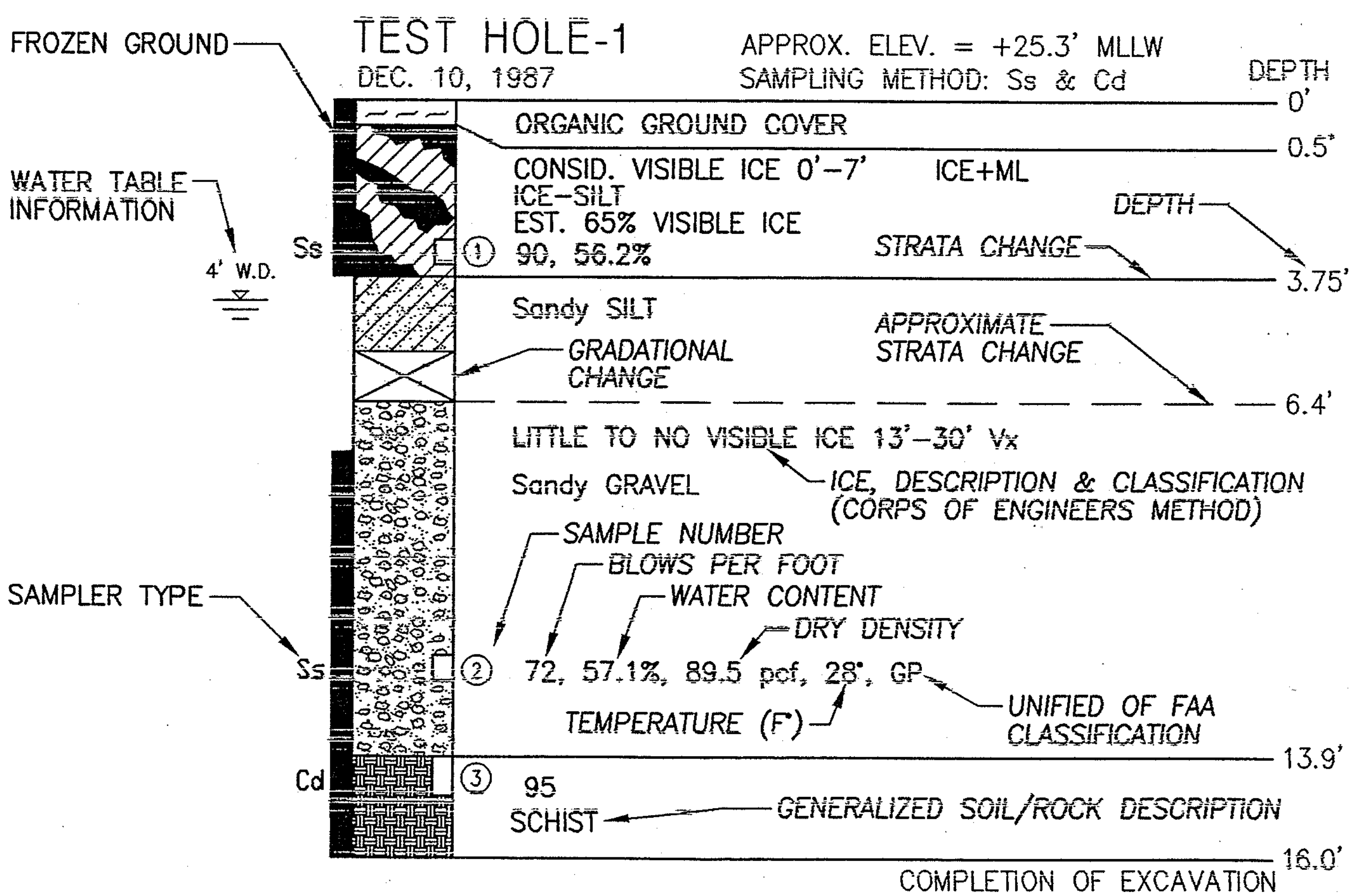
SAMPLER TYPE SYMBOLS

St .... 1.4" Split Spoon W/ 47# Hammer
Ss .... 1.4" Split Spoon W/ 140# Hammer
Sl .... 2.5" Split Spoon W/ 140# Hammer
Sm .... 2.5" Split Spoon W/ 300# Hammer
Sh .... 2.5" Split Spoon W/ 340# Hammer
Sp .... 2.5" Split Spoon, Pushed
Hs .... 1.4" Split Spoon Driven W/ Air Hammer
Hl .... 2.5" Split Spoon Driven W/ Air Hammer
Sx .... 2.0" Split Spoon Driven W/ 140# Hammer

Ts .... Shelby Tube
Tm .... Modified 2.5'O.D. Shelby Tube
Pb .... Pitcher Barrel
Cs .... Core Barrel W/ Single Tube
Cd .... Core Barrel W/ Double Tube
Bs .... Bulk Sample
A .... Auger Sample
G .... Grab Sample

NOTES:
1. SAMPLER TYPES ARE EITHER NOTED ABOVE THE BORING LOG OR ADJACENT TO IT AT THE RESPECTIVE DEPTH.
2. SPLIT SPOON SAMPLER SIZES PRESENTED ABOVE REFER TO THE INSIDE DIAMETER OF THE SAMPLER.

TYPICAL BORING LOG



NOTE: W.D. = WHILE DRILLING, A.D. = AFTER DRILLING

PND 3089

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B-2

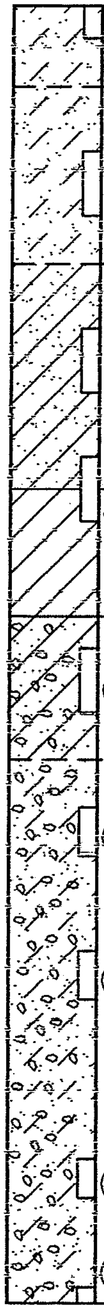
Peratrovich, Nottingham & Drage, Inc.

PND-99-1

JUNE 24, 1999

ELEV. = -4' MLLW

SAMPLING METHOD: Sh, Ss & G



Sample Method	Sample	Description	DEPTH	(ELEV.)
			0'	(-4')
G	(1A)	GM (SEE NOTE 2.) Gray Silty GRAVEL with Sand		
			2.5'	(-6.5')
		Dark Gray, medium dense, fine, SAND with Silt & Shell Fragments		
Sh	(1)	5 Blows/foot		
			8'	(-12')
		Black, soft, Sandy SILT with Shell Fragments		
Ss	(2)	2 blows/foot		
Ss			15'	(-19')
	(3)	9 blows/foot, ML, PI=Non-Plastic		
		Dark gray, firm, SILT		
			19'	(-23')
		Gray, hard, Sandy Silt with Gravel		
Sh	(4)	15 blows/foot		
			23.5'	(-27.5')
Sh	(5)	44 blows/foot, GM		
		Gray, very dense, Silty GRAVEL with Sand (Glacial Till)		
Sh	(6)	107 blows/foot		
Sh	(7)	Refusal at 75 blows/2 inches		
Sh	(8)	Refusal at 250 blows/6 inches		
		COMPLETION OF DRILLING	40.5'	(-44.5')

NOTES: 1. TEST HOLE DRILLED USING ROTARY WASH METHODS.
2. SAMPLE 1A WAS A GRAB SAMPLE COLLECTED DURING LOW TIDE.

PND 3090

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B-3

Peratrovich, Nottingham & Drage, Inc.

PND-99-2

JUNE 26, 1999

ELEV. = 0' MLLW

SAMPLING METHOD: Sh & Cs

DEPTH (ELEV.)

0' (0')

G — (1A) SM (SEE NOTE 2.)

Dark gray, Silty SAND with Shell Fragments

3.5' (3.5')

Dark, gray, firm Gravelly SILT with Sand

Sh — (1) 4 blows/foot, ML

Sh — (2) 4 blows/foot, ML

13' (-13')

TRANSITION

14' (-14')

Sh — (3) 23 blows/foot

Gray, Very Dense, Silty Gravel with Sand
(Glacial Till)

Sh — (4) Refusal at 100 blows/6 inches

Cs — (5) GM

Cs — (6)

Cs — (7)

43' (-43')

COMPLETION OF DRILLING

NOTES: 1. TEST HOLE DRILLED USING ROTARY WASH METHODS.
2. SAMPLE 1A WAS A GRAB SAMPLE COLLECTED DURING LOW TIDE.

PND 3091

Peratrovich, Nottingham & Drage, Inc.

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

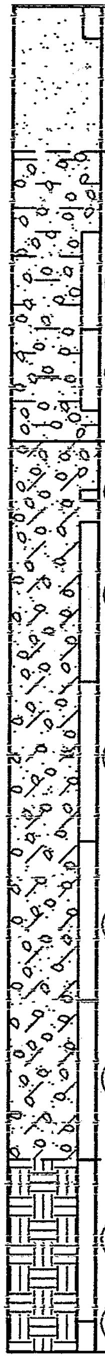
FIGURE B-4

PND-99-3

JUNE 27, 1999

ELEV. = +3' MLLW

SAMPLING METHOD: Sh & Cs



Sampling	Sample	Description	DEPTH (ELEV.)
			0' (+3')
G	(1A)	SP (SEE NOTE 2.)	
		Dark gray, loose, Poorly Graded SAND	
			4.5' (-1.5')
		Gray, dense, Clayey SAND w/ Gravel	
Sh	(1)	10 blows/foot, SC-SM, LL=20.2,PI=6.4	
Sh	(2)	18 blows/foot, SC-SM, LL=20.2,PI=6.4	
			13.5' (-13.5')
Sh	(3)	Refusal at 150 blows/4 inches	
Cs	(4)		
		Gray, dense, Silty SAND w/ Gravel	
Cs	(5)		
Cs	(6)	SM	
Cs	(7)		
			36' (-33')
		Black, highly weathered, BEDROCK	
Cs	(8)		
Cs	(9)		
			42' (-39')

COMPLETION OF DRILLING

NOTES: 1. TEST HOLE DRILLED USING ROTARY WASH METHODS.

2. SAMPLE 1A WAS A GRAB SAMPLE COLLECTED DURING LOW TIDE.

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

PND 3092

TEST HOLE LOGS

FIGURE B-5

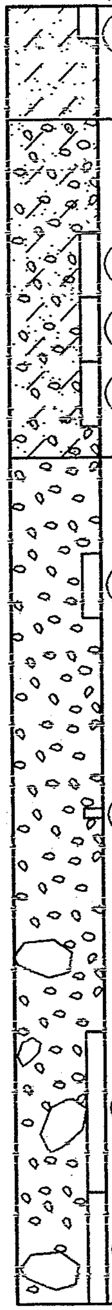
Peratrovich, Nottingham & Drage, Inc.

PND-99-4

JUNE 25, 1999

ELEV. = 0' MLLW
SAMPLING METHOD: Sh, Ss & G

DEPTH (ELEV.)



Sampling	Sample	Description / Result	Depth (Elev.)
			0' (0')
G	(1A)	(SEE NOTE 2.)	
		Gray, Medium dense, Silty SAND with Shell Fragments	
			3.5' (-3.5')
		Gray, Medium dense, Silty SAND with Gravel and Shell Fragments	
Sh	(1)	11 blows/foot	
Sh	(2)	6 blows/foot	
Sh	(3)	6 blows/foot, SM, PI=Non-Plastic	
			14' (-14')
Sh	(4)	62 blows/foot	
		Gray, Stiff to hard, Sandy SILT w/ Gravel	
Sh	(5)	Refusal at 150 blows/3 inches	
		32'-40.5' Approximatly 15% cobbles noted in core samples.	
Cs	(6)		
Cs	(7)		
		COMPLETION OF DRILLING	40.5' (-40.5')

NOTES: 1. TEST HOLE DRILLED USING ROTARY WASH METHODS.
2. SAMPLE 1A WAS A GRAB SAMPLE COLLECTED DURING LOW TIDE.

PND 3093

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B-6

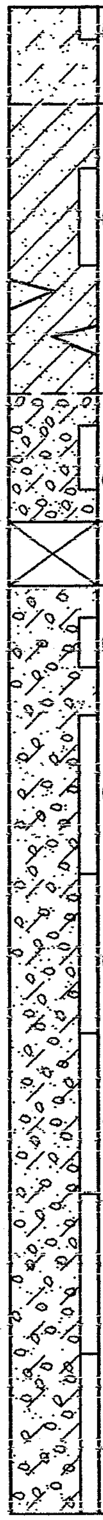
Peratrovich, Nottingham & Drage, Inc.

PND-99-5

JUNE 28, 1999

ELEV. = -8' MLLW

SAMPLING METHOD: Sh, Cs & G



Sampling Method	Sample	Description	DEPTH	(ELEV.)
			0'	(-8')
G	1A	SM (SEE NOTE 2.) Gray Silty SAND		
			3'	(-11')
		Gray, stiff, SILT with Sand		
Sh	1	4 blows/foot, ML		
		10'-12' OCCASIONAL Sand Lenses		
			12'	(-20')
		Gray, medium dense, Poorly graded, SAND with Silt, Gravel and Shell Fragments		
Sh	2	30 blows/foot, SP-SM		
			16'	(-24')
		TRANSITION		
			18'	(-26')
Sh	3	220 blows/foot		
Cs	4			
Cs	5			
		Gray, dense, Silty Gravelly SAND (Glacial Till)		
Cs	6			
Cs	7			
Cs	8			
			47'	(-55')

COMPLETION OF DRILLING

NOTES:
1. TEST HOLE DRILLED USING ROTARY WASH METHODS.
2. SAMPLE 1A WAS A GRAB SAMPLE COLLECTED DURING LOW TIDE.

PND 3094

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B-7

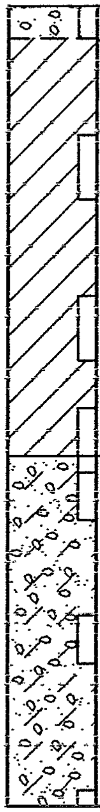
Peratrovich, Nottingham & Drage, Inc.

PND-99-6

JUNE 30, 1999

ELEV. = +6' MLLW

SAMPLING METHOD: GRAB



	Sample	Description	DEPTH	(ELEV.)
			0'	(+6')
G	(1A)	Brown SAND with Gravel and Silt	1'	(+5')
Ss	(1)	8 blows/foot, ML, PI=Non-Plastic		
		~~Gray, medium stiff, SILT~~		
Ss	(2)	6 blows/foot, No Retrieval		
Ss	(3)	16 blows/foot, No Retrieval	14'	(-8')
Sh	(4)	8 blows/foot, GM		
		Gray, stiff, Silty GRAVEL with Sand (Glacial Till)		
Sh	(5)	79 blows/foot		
Sh	(6)	Refusal @ 100 blows/6 inches	25'	(-19')

COMPLETION OF DRILLING

NOTES: 1. TEST HOLE DRILLED USING HOLLOW STEM AUGER METHODS

PND 3095

Peratrovich, Nottingham & Drage, Inc.

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

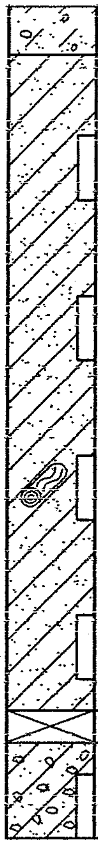
TEST HOLE LOGS

FIGURE B-8

PND-99-7

JUNE 30, 1999

ELEV. = +10' MLLW
SAMPLING METHOD: Ss



Sample Method	Sample	Description	DEPTH (ELEV.)
			0' (+10')
G	(1A)	Brown, SAND with Gravel and Silt	
			1.5' (+8.5')
Ss	(1)	18 blows/foot, ML	
		Gray, stiff, SILT with Sand	
Ss	(2)	12 blows/foot	
Ss	(3)	13 blows/foot, sample included 1 piece wood debris (Not Saved)	
Ss	(4)	7 blows/foot	
			22' (-12')
		TRANSITION	
			23' (-13')
		Gray, Firm, Sandy SILT with Gravel (Glacial Till)	
Ss	(5)	30 blows/foot	
		COMPLETION OF DRILLING	26' (-16')

NOTES: 1. TEST HOLE DRILLED USING HOLLOW STEM AUGER METHODS

PND 3096

Peratrovich, Nottingham & Drage, Inc.

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B-9

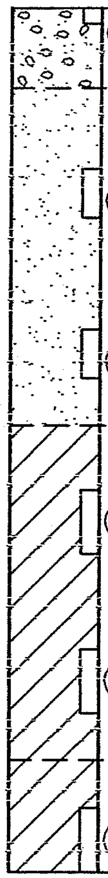
PND-99-8

JUNE 17, 1999

ELEV. = +8' MLLW

SAMPLING METHOD: G, Ss & Sh

DEPTH (ELEV.)



Sample type	Sample	Description	Depth (Elev.)
			0' (+8')
G	1	Brown, Gravelly SAND with approximately 50% cobbles	
			2.5' (+5.5')
Sh	2	16 blows/foot	
		Gray, loose to medium dense, Silty, SAND	
Ss	3	9 blows/foot	
			13' (-5')
Ss	4	6 blows/foot	
		Gray, medium stiff, SILT	
Ss	5	13 blows/foot	
			23.5(-15.5')
		Dark gray, medium stiff, SILT	
Ss	6	12 blows/foot, T.U.=1.75 TSF	
		COMPLETION OF DRILLING	27' (-19')

NOTES: 1. TEST HOLE DRILLED USING HOLLOW STEM AUGER METHODS

PND 3097

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

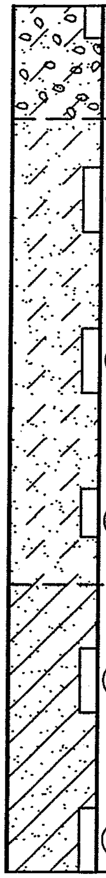
FIGURE B-10

Peratrovich, Nottingham & Drage, Inc.

PND–99–9

JUNE 17, 1999

ELEV. = +8' MLLW
SAMPLING METHOD: Ss



Sample type	Sample	Description / Blows	Depth (Elev.)
			0' (+8')
G	1A	Gray, GRAVEL with Sand and Silt	
			3.5' (+4.5')
Ss	1	11 blows/foot	
Ss	2	4 blows/foot	
		Gray, loose to medium dense, Silty SAND	
Ss	3	5 blows/foot	
			18' (–10')
		Gray, stiff, Sandy SILT	
Ss	4	10 blows/foot	
Ss	5	14 blows/foot	
		COMPLETION OF DRILLING	27' (–19')

NOTES: 1. TEST HOLE DRILLED USING HOLLOW STEM AUGER METHODS

PND 3098

Peratrovich, Nottingham & Drage, Inc.

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

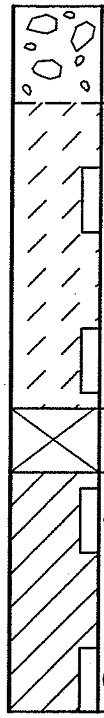
TEST HOLE LOGS

FIGURE B–11

PND-99-10

JUNE 17, 1999

ELEV. = =5' MLLW
SAMPLING METHOD: Ss



Sample	Description	DEPTH (ELEV.)
		0' (+5')
	Brown Gravelly SAND with Approximately 50% Cobbles	
		3' (+2')
	Dark, gray, loose, poorly graded, SAND with Silt	
Ss	(1) 4 blows/foot, SP-SM	
Ss	(2) 6 blows/foot	
		12.5'(-7.5')
	TRANSITION	
		14.5'(-9.5')
Ss	(3) 5 blows/foot, ML	
	Gray, medium stiff SILT	
Ss	(4) 16 blows/foot	
	COMPLETION OF DRILLING	22' (-17')

NOTES: 1. TEST HOLE DRILLED USING HOLLOW STEM AUGER METHODS

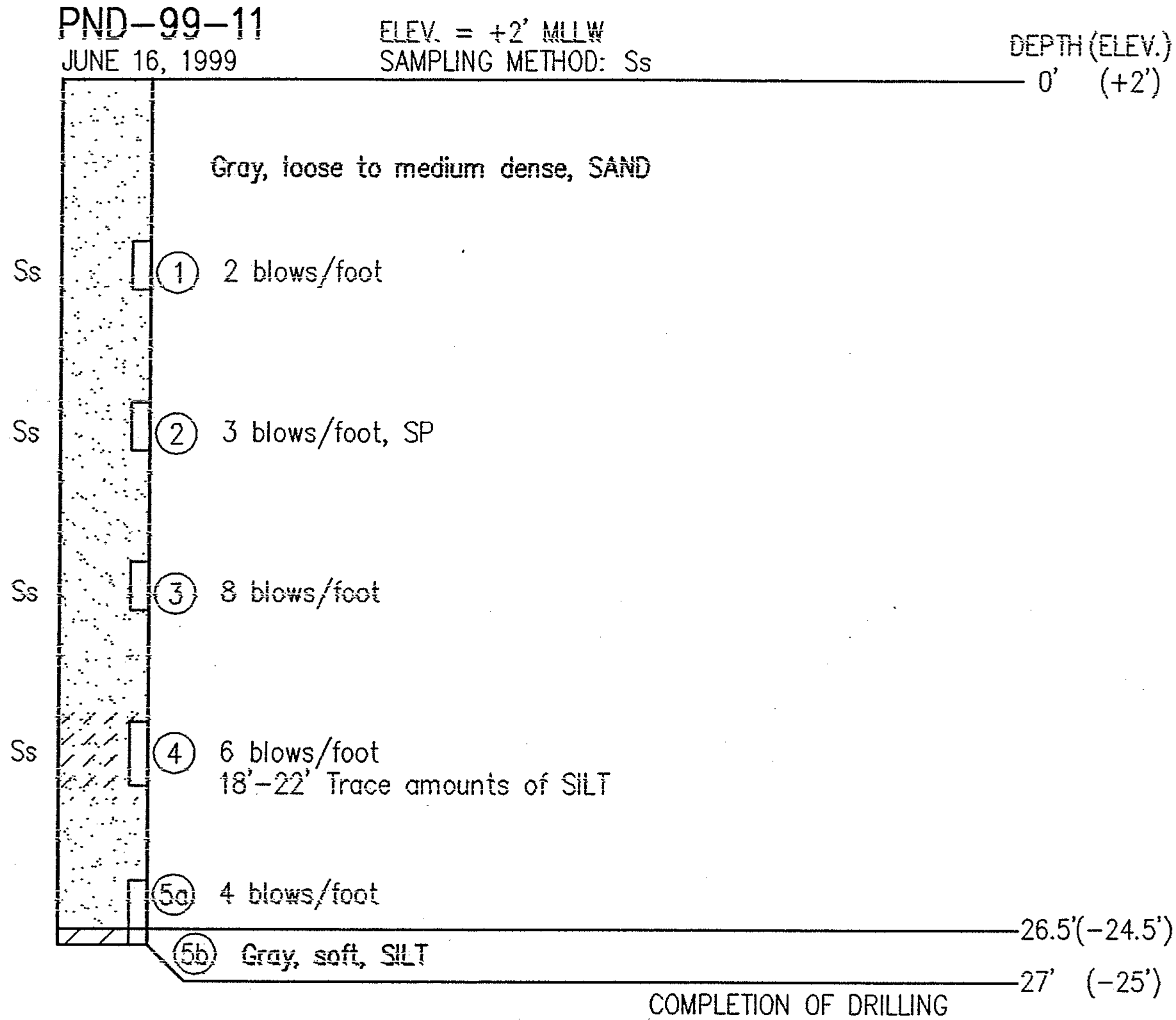
PND 3099

Peratrovich, Nottingham & Drage, Inc.

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B-12



NOTES: 1. TEST HOLE DRILLED USING HOLLOW STEM AUGER METHODS

PND 3100

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

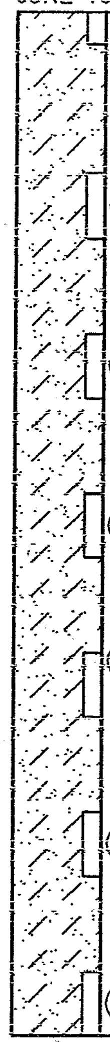
FIGURE B-13

Peratrovich, Nottingham & Drage, Inc.

PND-99-12
JUNE 16, 1999

ELEV. = +6' MLLW
SAMPLING METHOD: Ss

DEPTH (ELEV.)
0' (+6')



G	1A	
Ss	1	10 blows/foot
Ss	2	11 blows/foot
Ss	3	10 blows/foot
Ss	4	7 blows/foot
Ss	5	8 blows/foot
Ss	6	12 blows/foot

Gray, soft to medium dense, Silty SAND

32' (-24')
COMPLETION OF DRILLING

NOTES: 1. TEST HOLE DRILLED USING HOLLOW STEM AUGER METHODS

PND 3101

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B-14

Peratrovich, Nottingham & Drage, Inc.

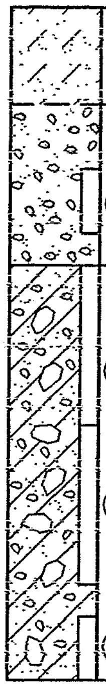
PND–99–13

JUNE 23, 1999

ELEV. = –13' MLLW

SAMPLING METHOD: Sh & Cs

DEPTH (ELEV.)



0' (–13')

Gray, fine, SAND with Silt and Shell Fragments

3' (–16')

Gray, dense, well graded, SAND with Gravel

Sh (1) 23 blows/foot, SW

8' (–21')

Gray, hard, Sandy SILT with Gravel and occasional cobbles (Glacial Till)

Cs (2)

Cs (3)

Sh (4) 75 blows/foot

21' (–34')

COMPLETION OF DRILLING

NOTES: 1. TEST HOLE DRILLED USING ROTARY WASH METHODS.

PND 3102

Peratrovich, Nottingham & Drage, Inc.

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B–15

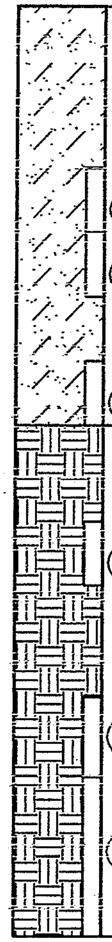
PND-99-14

JUNE 23, 1999

ELEV. = -33' MLLW

SAMPLING METHOD: Sh & Cs

DEPTH (ELEV.)



0' (-33')

Gray, loose SAND with Silt and Shell Framents
(SEE NOTE 2.)

Sh (1) 5 blows/foot (No Retrivial)

Sh (2) 10 blows/foot (No Retrievial)

Sh (3) 9 blows/foot

13' (-46')

Black, highly weathered, BEDROCK

Sh (4) 62 blows/foot

Cs (5)

Cs (6)

29' (-62')

COMPLETION OF DRILLING

NOTES: 1. TEST HOLE DRILLED USING ROTARY WASH METHODS.
2. SOIL CLASSIFICATION FROM 0' TO 13' DEPTH IS BASED ON OBSERVATION OF ROTARY WASH CUTTINGS DUE TO POOR SAMPLE RETRIEVAL

PND 3103

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B-16

Peratrovich, Nottingham & Drage, Inc.

PND–99–15
JULY 1, 1999

ELEV. = –17' MLLW
SAMPLING METHOD: Sh & Cs

Sample	DEPTH (ELEV.)	Description
	0' (–17')	Black, soft, organic SILT with numerous Shell Fragments
	10.5'(–27.5')	Gray, soft, SILT with occasional Shell Fragments & Wood Fibers
Sh (1)		4 blows/foot, ML
	15.5'(–32.5')	TRANSITION
	19' (–36')	Gray, very dense, Silty SAND with Gravel grading to Silty GRAVEL with Sand (Glacial Till)
Sh (2)		104 blows/foot
Sh (3)		Refusal @ 72 blows/6 inches
Cs (4)		
Cs (5)		
Cs (6)		
	43' (–60')	COMPLETION OF DRILLING

NOTES: 1. TEST HOLE DRILLED USING ROTARY WASH METHODS.

PND 3104

Peratrovich, Nottingham & Drage, Inc.

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

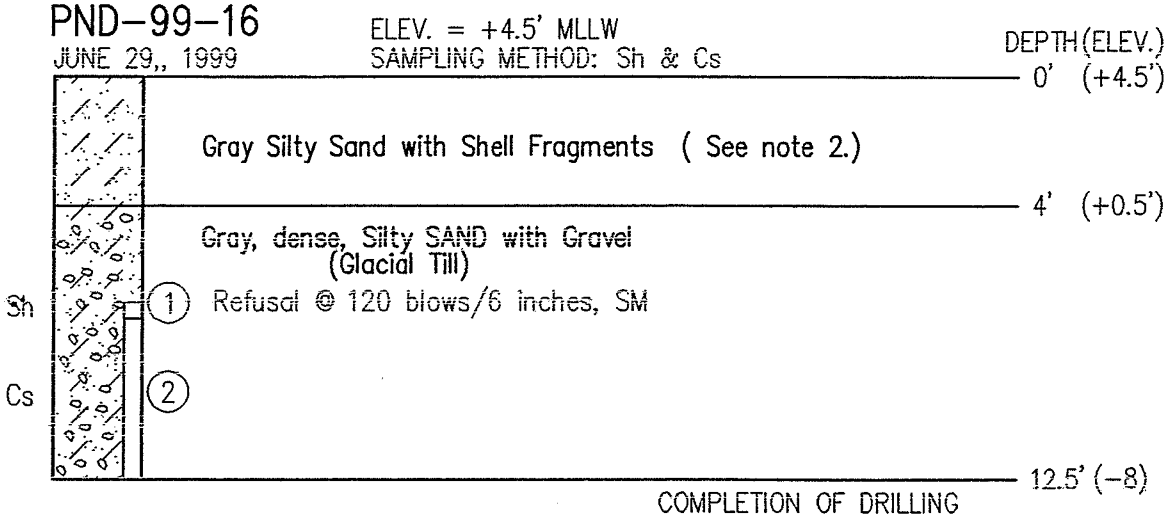
FIGURE B–17

PND-99-16

JUNE 29,, 1999

ELEV. = +4.5' MLLW

SAMPLING METHOD: Sh & Cs



NOTES: 1. TEST HOLE DRILLED USING ROTARY WASH METHODS.
2. SOIL CLASSIFICATION FROM 0' TO 4' DEPTH IS BASED ON OBSERVATION OF ROTARY WASH CUTTINGS.

PND 3105

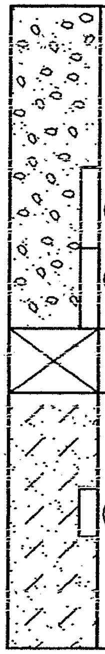
Peratrovich, Nottingham & Drage, Inc.

DOUGLAS HARBOR PARKING & MOORAGE EXPANSION PN&D PROJECT NO. 99220.03
TEST HOLE LOGS
FIGURE B-18

PND-99-17
JUNE 29,, 1999

ELEV. = +2.5' MLLW
SAMPLING METHOD: Sh

DEPTH (ELEV.)



Sampling	Description	Depth (Elev.)
		0' (+2.5')
	Gray, firm, Clayey SAND with Gravel	
Sh	(1) 6 blows/foot, SC-SM, LI=21, PI=6	
Sh	(2) 13 blows/foot	
		10' (-7.5')
	TRANSITION	
		12' (-9.5')
	Gray, dense, Silty SAND with Gravel (Glacial Till)	
Sh	(3) 73 blows/foot	
	COMPLETION OF DRILLING	20' (-17.5')

NOTES: 1. TEST HOLE DRILLED USING ROTARY WASH METHODS.

PND 3106

Peratrovich, Nottingham & Drage, Inc.

DOUGLAS HARBOR
PARKING & MOORAGE EXPANSION
PN&D PROJECT NO. 99220.03

TEST HOLE LOGS

FIGURE B-19

APPENDIX C

LABORATORY TEST RESULTS

PND 3107

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

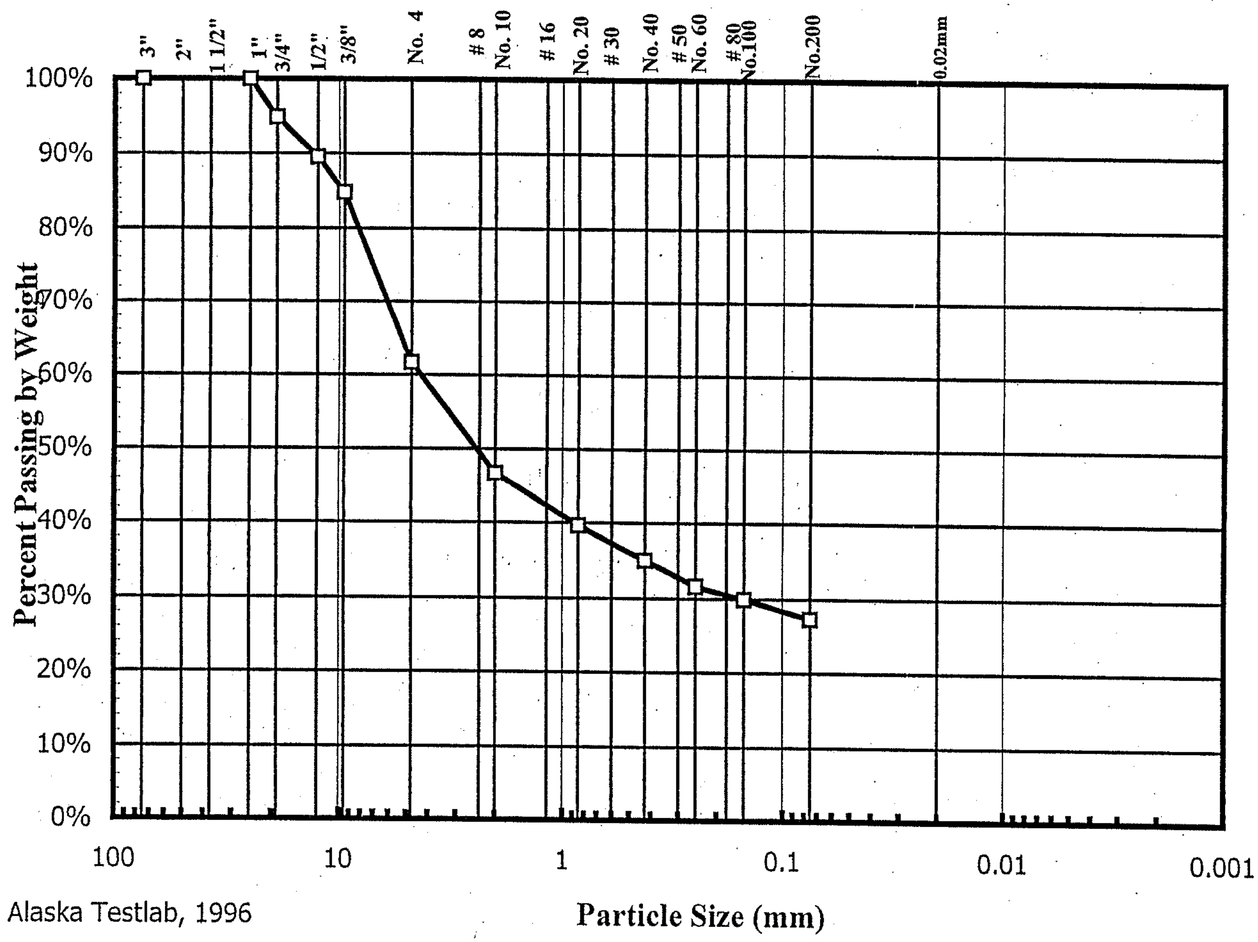
Project: Douglas Harbor 99220.03

PARTICLE-SIZE DIST. ASTM D422/C136

Location: PND-99-1, SA-1A @ 0'-1', By Client

W.O. A28435
Lab No. 1739
Received: July 27, 1999
Reported: 7/30/99

Engineering Classification: Silty GRAVEL with Sand, GM
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"	100%	
3/4"	95%	
1/2"	90%	
3/8"	85%	
No. 4	62%	
Total Wt. of Coarse Fraction = 645.7g		
No. 8		
No. 10	47%	
No. 16		
No. 20	40%	
No. 30		
No. 40	35%	
No. 50		
No. 60	32%	
No. 80		
No. 100	30%	
No. 200	27%	
Total Wt. of Fine Fraction = 399g		
0.02 mm		

David L. Andersen, P.E., General Manager

PND 3108

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

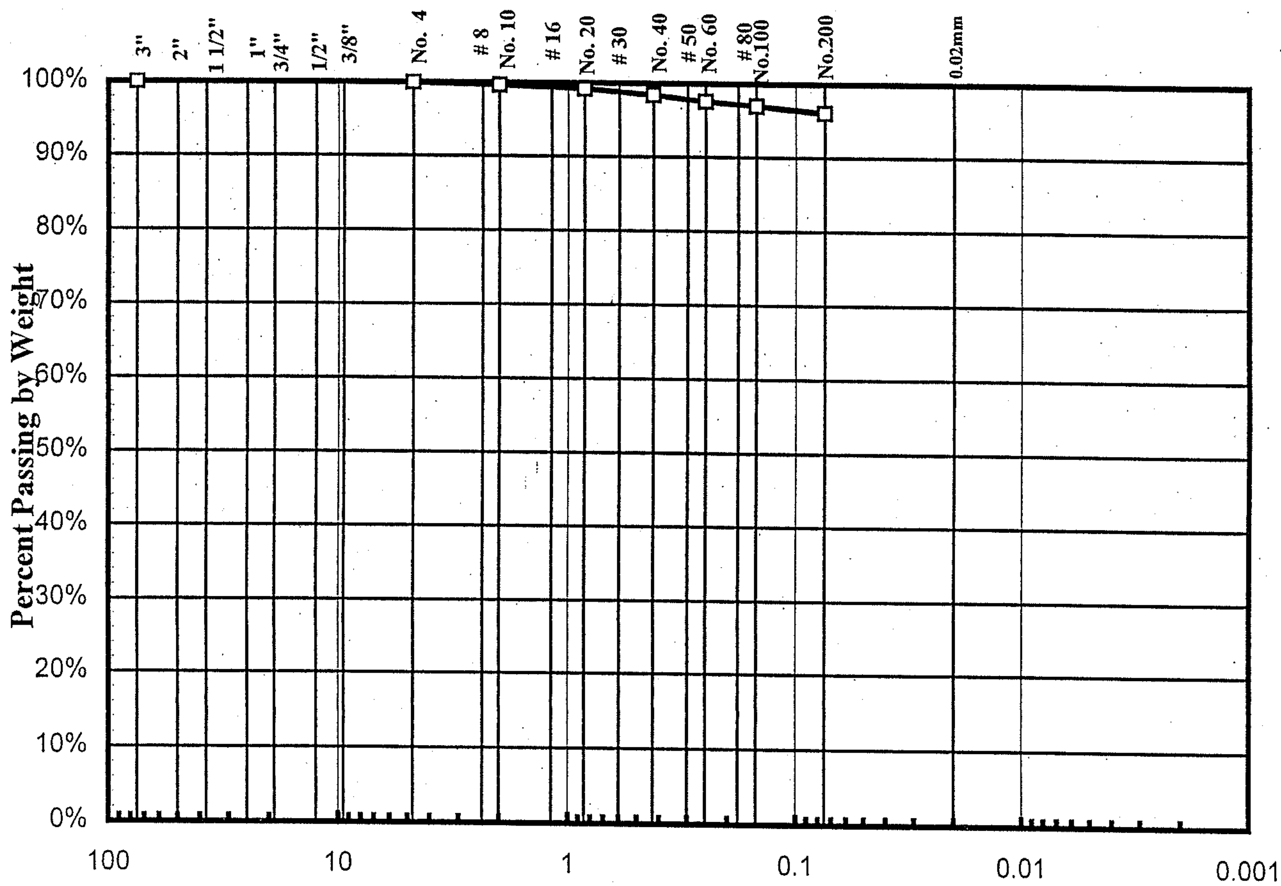
Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

PARTICLE-SIZE DIST. ASTM D422/C136

Location: PND 99-1, SA-3 @ 15'-16'
By Client
PI = Non Plastic
Engineering Classification: SILT, ML
Frost Classification: F4

W.O. A28435
Lab No. 1576
Received: July 13, 1999
Reported: 7/21/99



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4	100%	
Total Wt. of Coarse Fraction = 301g		
No. 8		
No. 10	100%	
No. 16		
No. 20	99%	
No. 30		
No. 40	98%	
No. 50		
No. 60	98%	
No. 80		
No. 100	97%	
No. 200	96%	
Total Wt. of Fine Fraction = 152.1g		
0.02 mm		

David L. Andersen, P.E., General Manager
4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

PND 3109

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

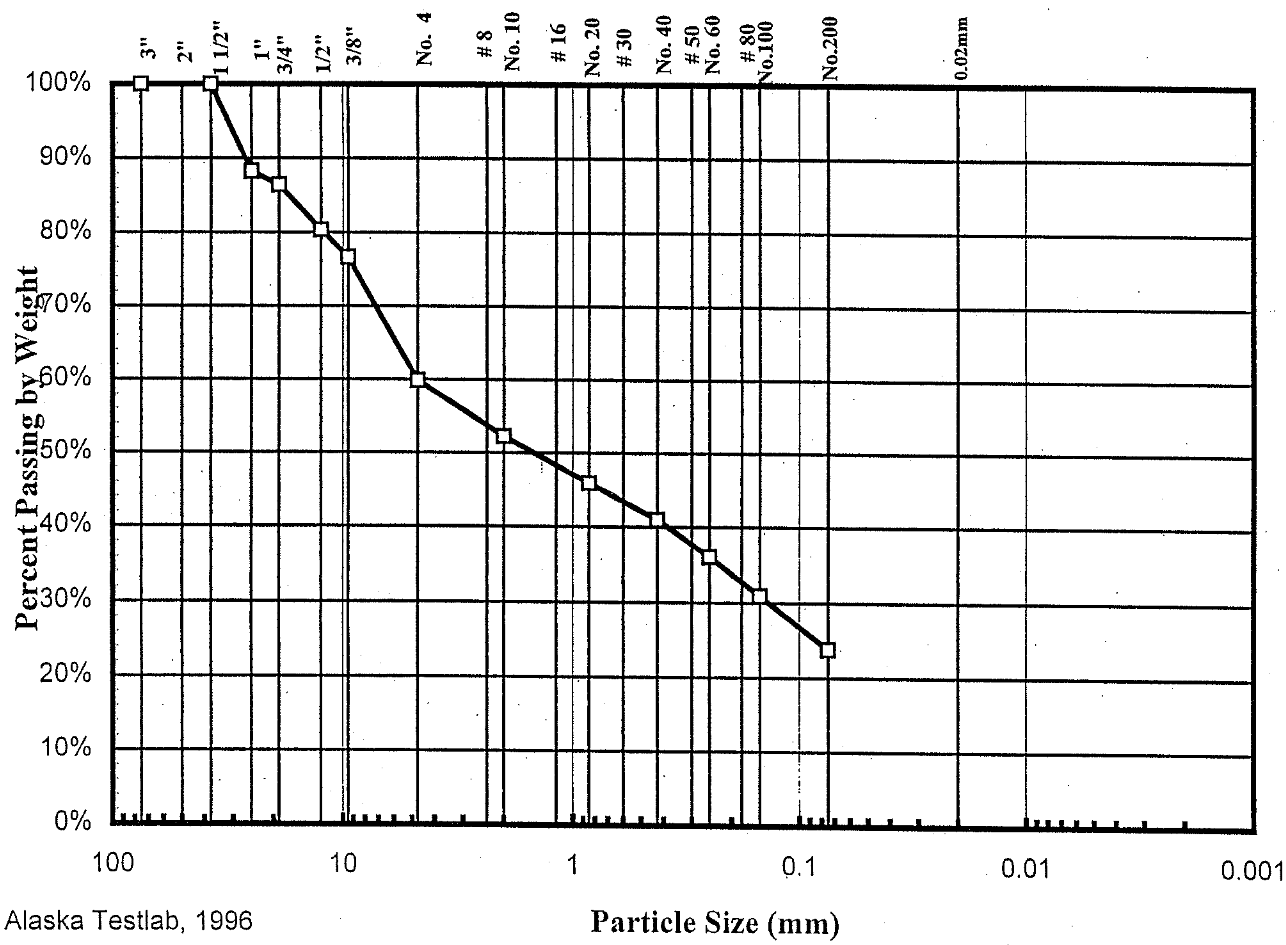
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND 99-1, SA-5 @ 25'-26.5'
By Client
PI = Non Plastic
Engineering Classification: Silty GRAVEL with Sand, GM
Frost Classification: Not Measured

W.O. A28435
Lab No. 1577
Received: July 13, 1999
Reported: 7/21/99

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"	100%	
1"	88%	
3/4"	86%	
1/2"	80%	
3/8"	77%	
No. 4	60%	
Total Wt. of Coarse Fraction = 1557g		
No. 8		
No. 10	52%	
No. 16		
No. 20	46%	
No. 30		
No. 40	41%	
No. 50		
No. 60	36%	
No. 80		
No. 100	31%	
No. 200	24%	
Total Wt. of Fine Fraction = 301.3g		
0.02 mm		



David L. Andersen, P.E., General Manager
4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

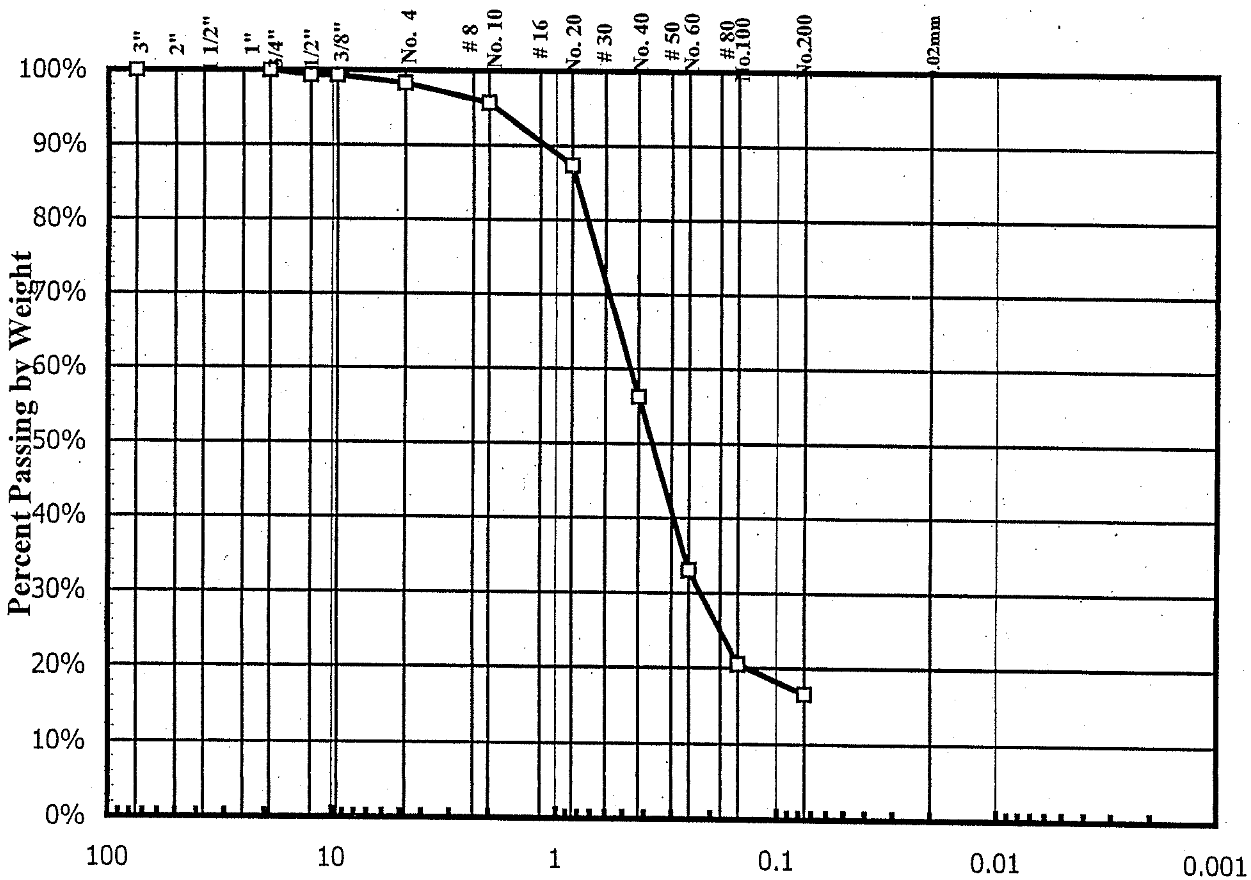
Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

Location: PND-99-2, SA-1A @ 0'-1', By Client

Engineering Classification: Silty SAND , SM

Frost Classification: Not Measured



PARTICLE-SIZE DIST. ASTM D422/C136

W.O. A28435

Lab No. 1740

Received: July 27, 1999

Reported: 7/30/99

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	99%	
3/8"	99%	
No. 4	98%	
Total Wt. of Coarse Fraction = 568g		
No. 8		
No. 10	96%	
No. 16		
No. 20	87%	
No. 30		
No. 40	56%	
No. 50		
No. 60	33%	
No. 80		
No. 100	21%	
No. 200	17%	
Total Wt. of Fine Fraction = 559.6g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

PND 3111

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

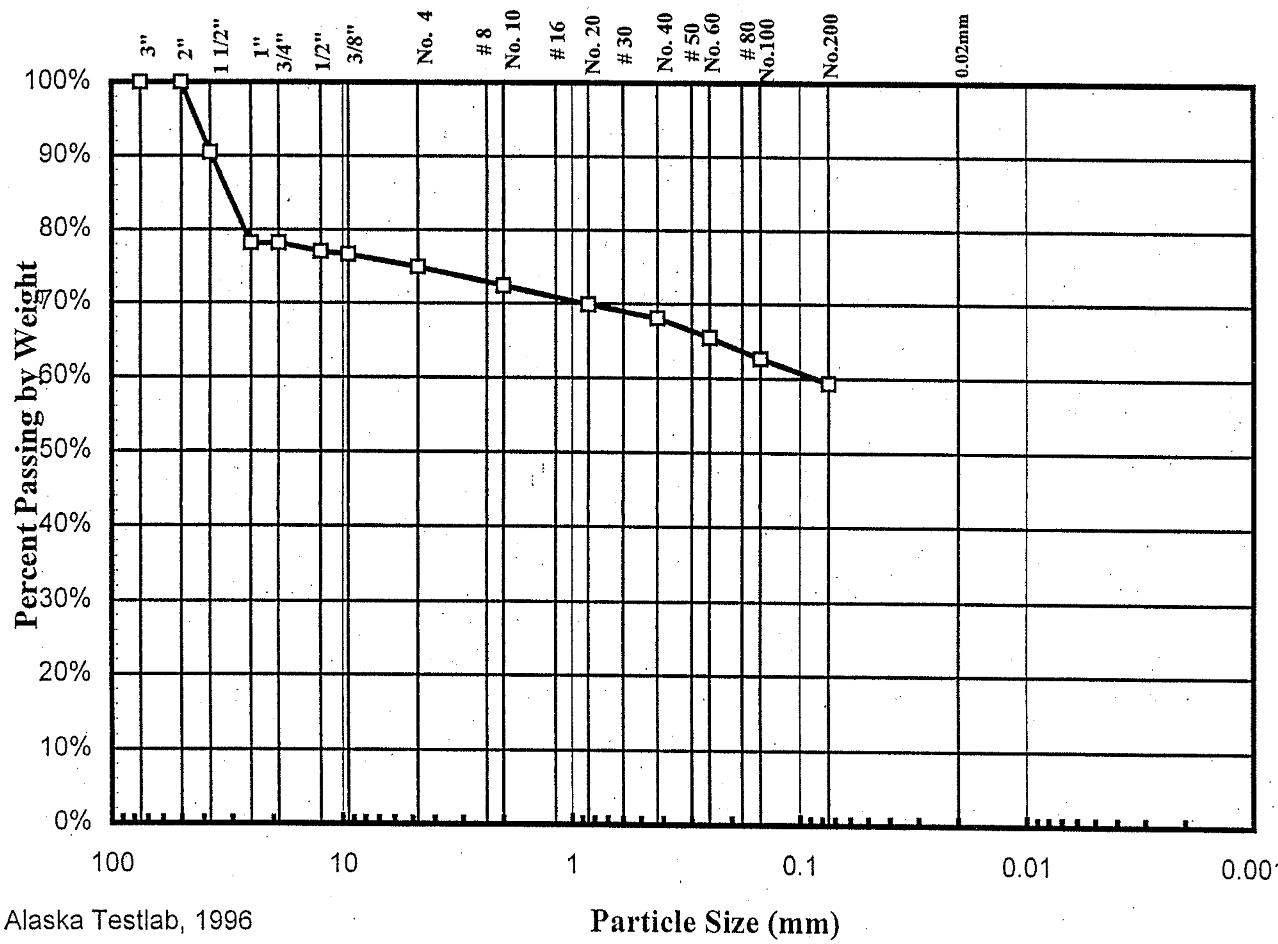
PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND 99-2, SA-1&2 @ 7'-12'
By Client

Engineering Classification: Gravelly SILT with Sand, ML

Frost Classification: F4

W.O. A28435
Lab No. 1578
Received: July 13, 1999
Reported: 7/21/99



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"	100%	
1 1/2"	90%	
1"	78%	
3/4"	78%	
1/2"	77%	
3/8"	77%	
No. 4	75%	
Total Wt. of Coarse Fraction = 1251g		
No. 8		
No. 10	72%	
No. 16		
No. 20	70%	
No. 30		
No. 40	68%	
No. 50		
No. 60	65%	
No. 80		
No. 100	63%	
No. 200	59%	
Total Wt. of Fine Fraction = 328.5g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

PND 3112

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

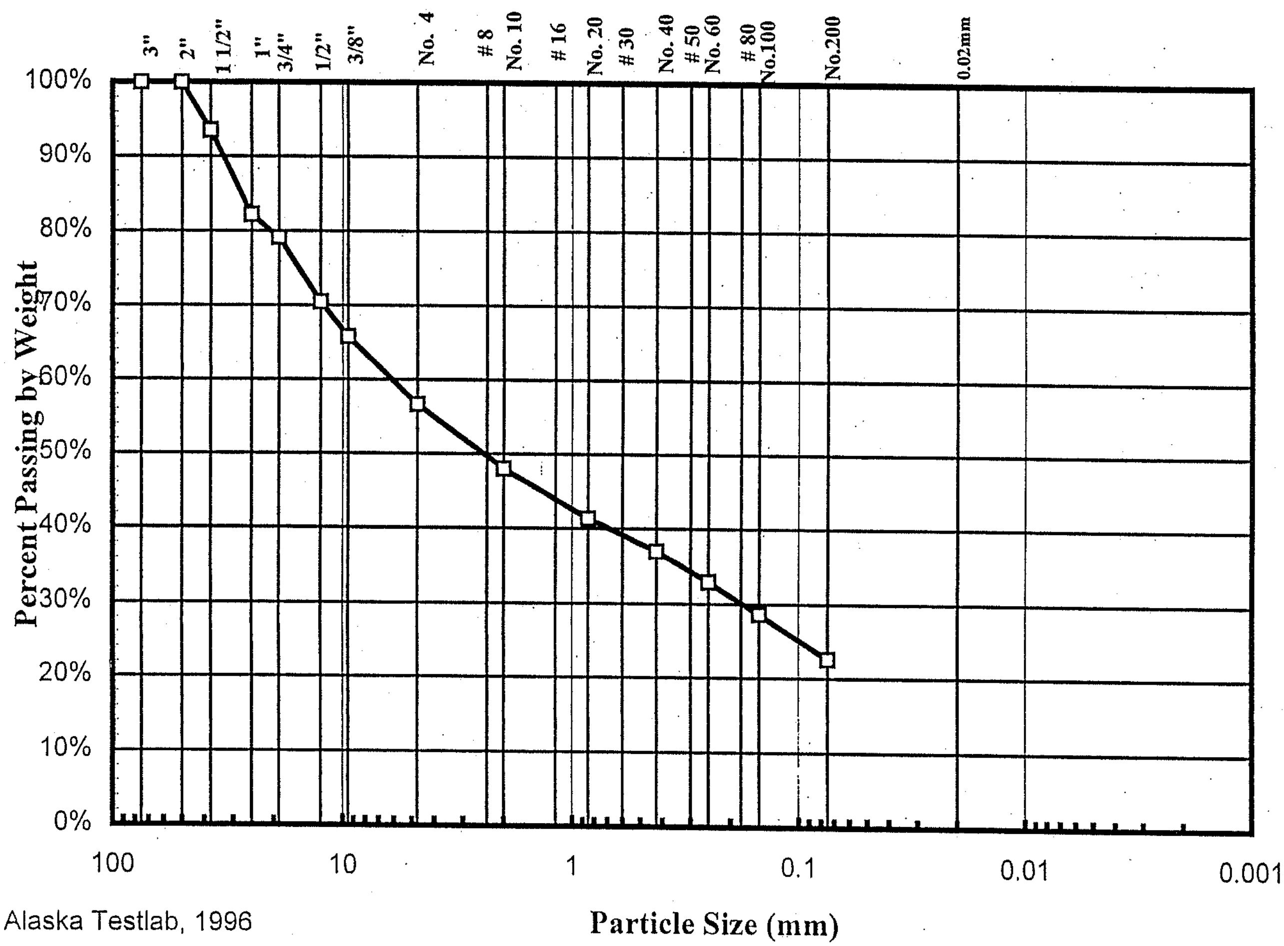
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99=2, SA-5 @ 28.5'-33.5'
By Client

W.O. A28435
Lab No. 1579
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Silty GRAVEL with Sand, GM
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"	100%	
1 1/2"	94%	
1"	82%	
3/4"	79%	
1/2"	70%	
3/8"	66%	
No. 4	57%	
Total Wt. of Coarse Fraction = 4085g		
No. 8		
No. 10	48%	
No. 16		
No. 20	41%	
No. 30		
No. 40	37%	
No. 50		
No. 60	33%	
No. 80		
No. 100	29%	
No. 200	23%	
Total Wt. of Fine Fraction = 328.6g		
0.02 mm		

David L. Andersen, P.E., General Manager

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

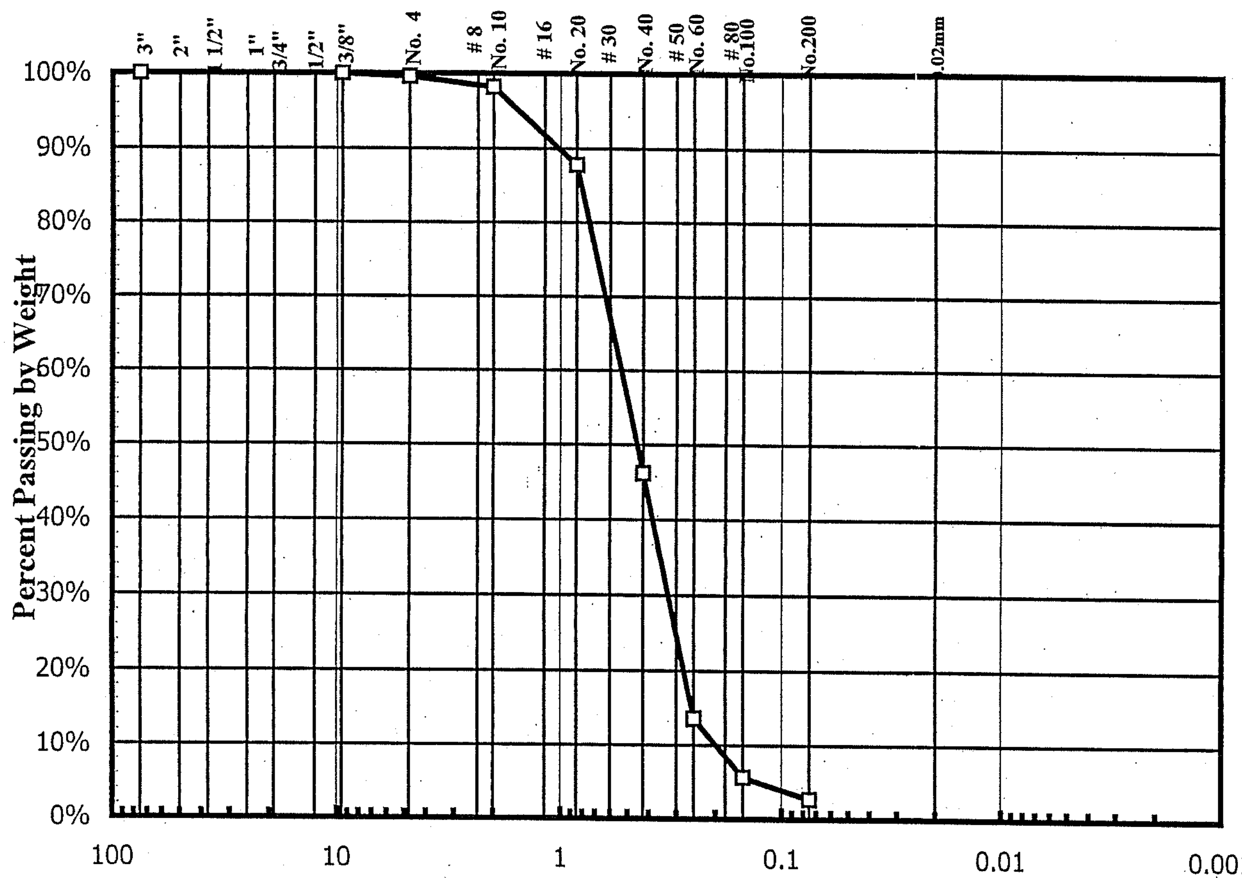
Project: Douglas Harbor 99220.03

PARTICLE-SIZE DIST. ASTM D422/C136

Location: PND-99-3, SA-1A @ 0'-1', By Client

W.O. A28435
Lab No. 1741
Received: July 27, 1999
Reported: 7/30/99

Engineering Classification: Poorly Graded SAND , SP
Frost Classification: NFS (MOA)



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"	100%	
No. 4	100%	
Total Wt. of Coarse Fraction = 1197g		
No. 8		
No. 10	98%	
No. 16		
No. 20	88%	
No. 30		
No. 40	46%	
No. 50		
No. 60	14%	
No. 80		
No. 100	6%	
No. 200	2.7%	
Total Wt. of Fine Fraction = 308.7g		
0.02 mm		

David L. Andersen, P.E., General Manager

PND 3114

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

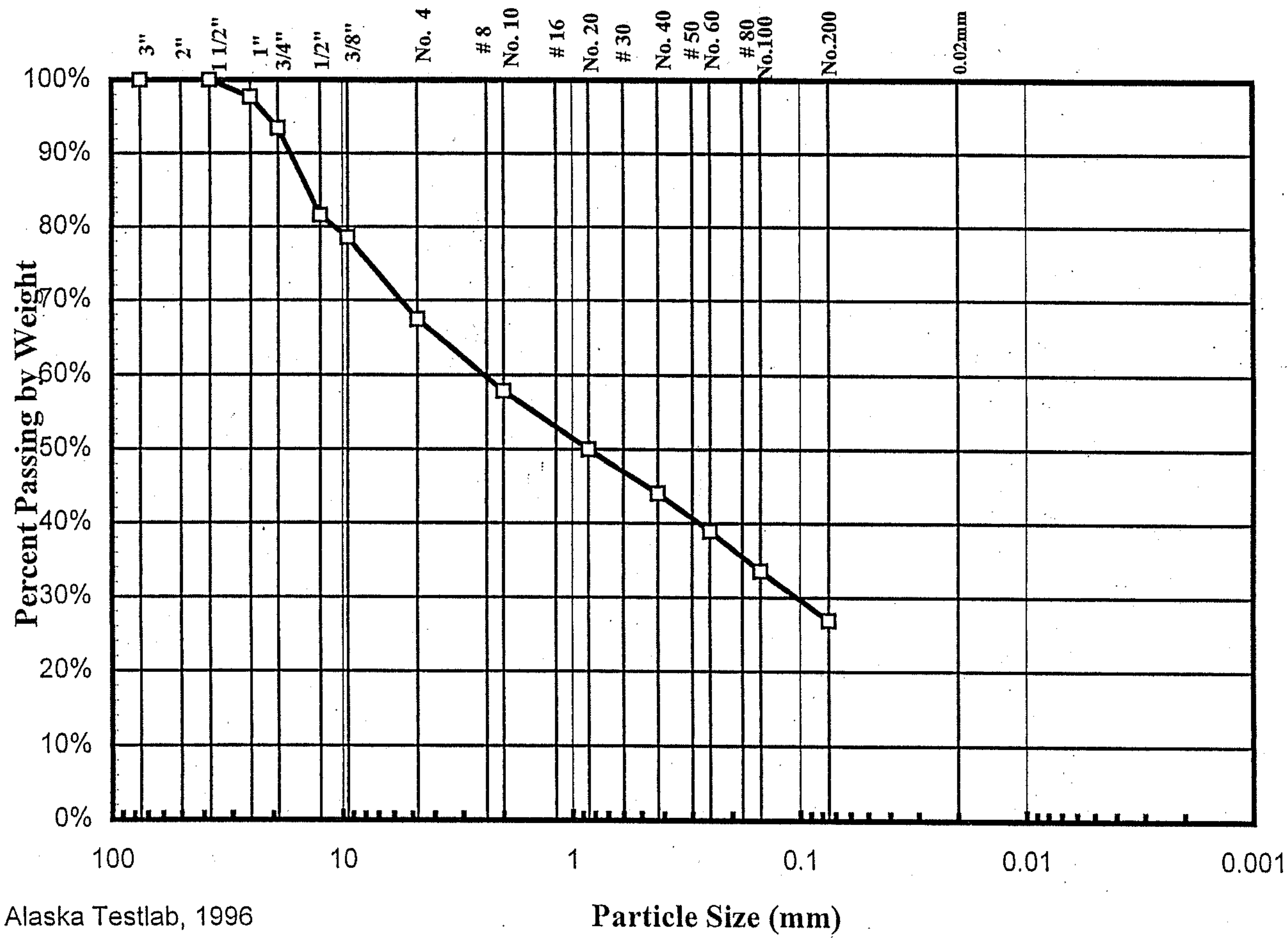
PARTICLE-SIZE DIST. ASTM D422/C136

Location: PND99-3, SA-1 & 2 @ 7'-12.5'
By Client
LL = 20, PI = 6

Engineering Classification: Silty, Clayey SAND with Gravel, SC-SM

Frost Classification: Not Measured

W.O. A28435
Lab No. 1580
Received: July 13, 1999
Reported: 7/21/99



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"	100%	
1"	98%	
3/4"	93%	
1/2"	82%	
3/8"	78%	
No. 4	67%	
Total Wt. of Coarse Fraction = 874.4g		
No. 8		
No. 10	58%	
No. 16		
No. 20	50%	
No. 30		
No. 40	44%	
No. 50		
No. 60	39%	
No. 80		
No. 100	34%	
No. 200	27%	
Total Wt. of Fine Fraction = 310.6g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

PND 3115

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

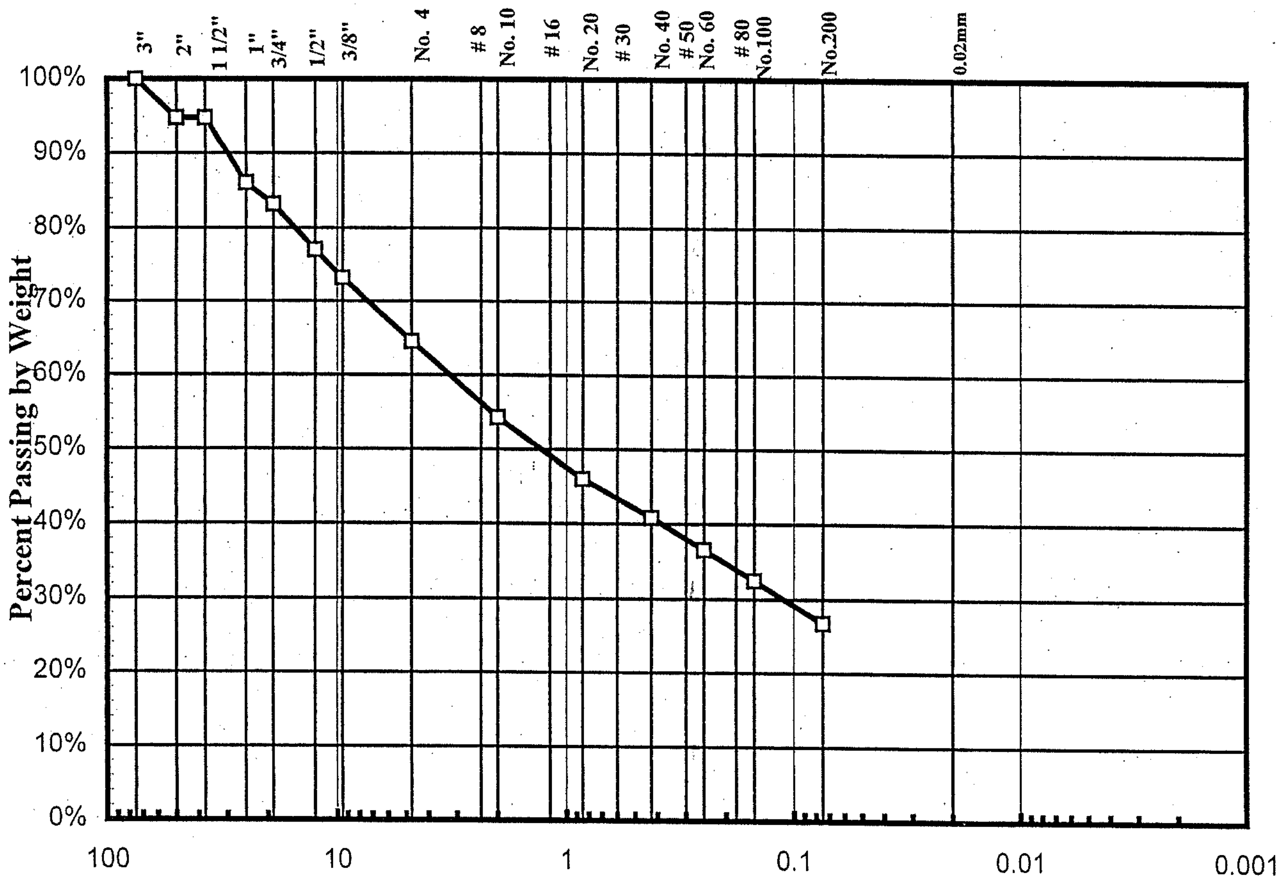
Project: Douglas Harbor 99220.03

PARTICLE-SIZE DIST. ASTM D422/C136

Location: PND99-3, SA-6 @ 26'-31'
By Client

W.O. A28435
Lab No. 1581
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Silty SAND with Gravel, SM
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"	100%	
2"	95%	
1 1/2"	95%	
1"	86%	
3/4"	83%	
1/2"	77%	
3/8"	73%	
No. 4	64%	
Total Wt. of Coarse Fraction = 4584g		
No. 8		
No. 10	54%	
No. 16		
No. 20	46%	
No. 30		
No. 40	41%	
No. 50		
No. 60	37%	
No. 80		
No. 100	32%	
No. 200	27%	
Total Wt. of Fine Fraction = 379.5g		
0.02 mm		

David L. Andersen, P.E., General Manager
4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

PND 3116

ALASKA TESTLAB
A Division of DOWL LLC

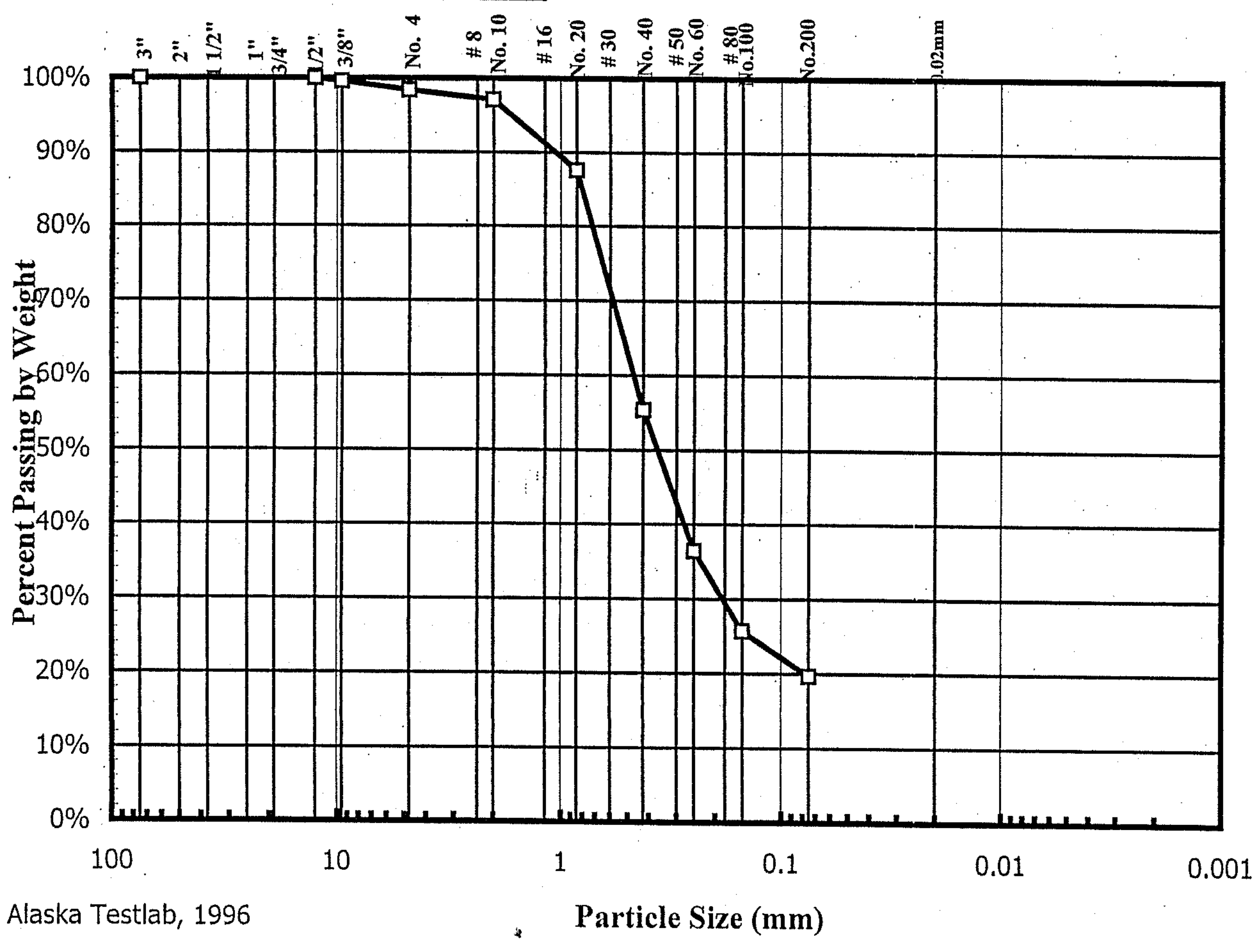
Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

Location: PND-99-4, SA-1A @ .5'-1', By Client

Engineering Classification: Silty SAND , SM

Frost Classification: Not Measured



PARTICLE-SIZE DIST. ASTM D422/C136

W.O. A28435
Lab No. 1742
Received: July 27, 1999
Reported: 7/30/99

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"	100%	
3/8"	100%	
No. 4	98%	
Total Wt. of Coarse Fraction = 886.1g		
No. 8		
No. 10	97%	
No. 16		
No. 20	88%	
No. 30		
No. 40	55%	
No. 50		
No. 60	36%	
No. 80		
No. 100	26%	
No. 200	20%	
Total Wt. of Fine Fraction = 323.1g		
0.02 mm		

David L. Andersen, P.E., General Manager

PND 3117

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

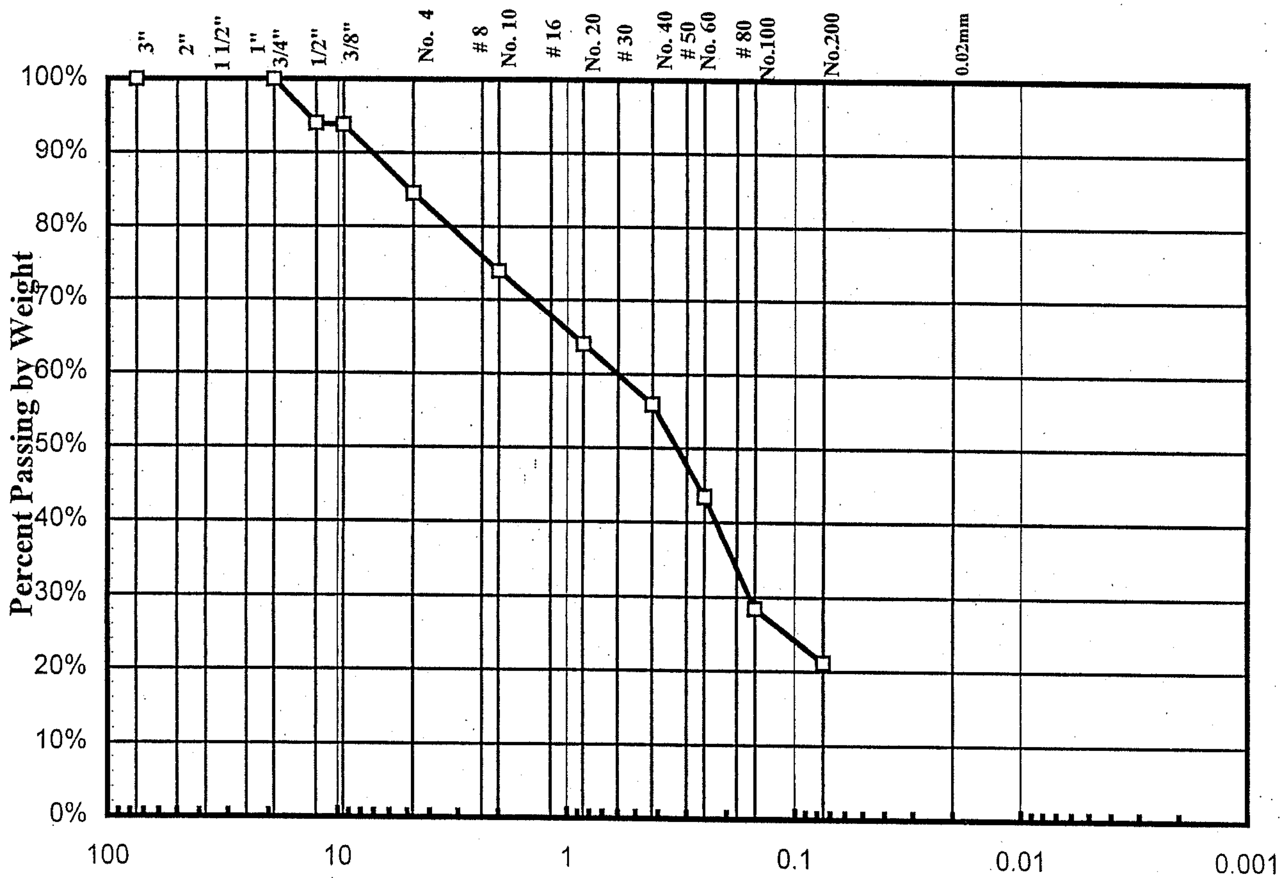
Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99-4, SA-3 @ 11'-13'
By Client
PI = Non Plastic
Engineering Classification: Silty SAND with Gravel, SM
Frost Classification: Not Measured

W.O. A28435
Lab No. 1582
Received: July 13, 1999
Reported: 7/21/99



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	94%	
3/8"	94%	
No. 4	84%	
Total Wt. of Coarse Fraction = 131.6g		
No. 8		
No. 10	74%	
No. 16		
No. 20	64%	
No. 30		
No. 40	56%	
No. 50		
No. 60	44%	
No. 80		
No. 100	28%	
No. 200	21%	
Total Wt. of Fine Fraction = 111.1g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

PND 3118

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

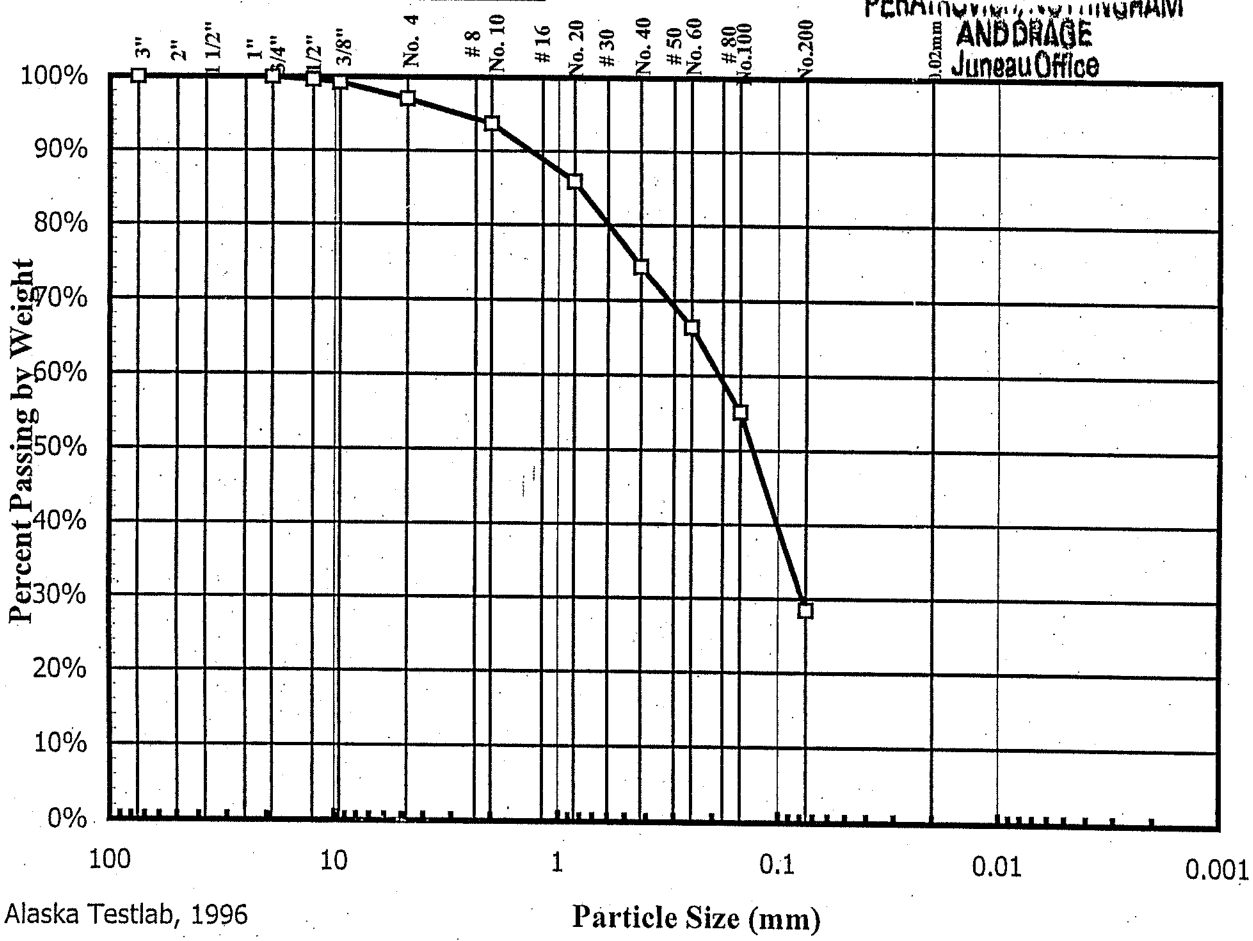
PARTICLE-SIZE DIST. ASTM D422/C136

Location: PND-99-5, SA-1A @ 0'-1', By Client

W.O. A28435
Lab No. 1743
Received: July 27, 1999
Reported: 7/30/99

RECEIVED
PERATROVICH, NOTTINGHAM AND DRAGE Juneau Office

Engineering Classification: Silty SAND , SM
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	100%	
3/8"	99%	
No. 4	97%	
Total Wt. of Coarse Fraction = 1040.7g		
No. 8		
No. 10	94%	
No. 16		
No. 20	86%	
No. 30		
No. 40	74%	
No. 50		
No. 60	66%	
No. 80		
No. 100	55%	
No. 200	28%	
Total Wt. of Fine Fraction = 300.2g		
0.02 mm		

David L. Andersen, P.E., General Manager

PND 3119

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

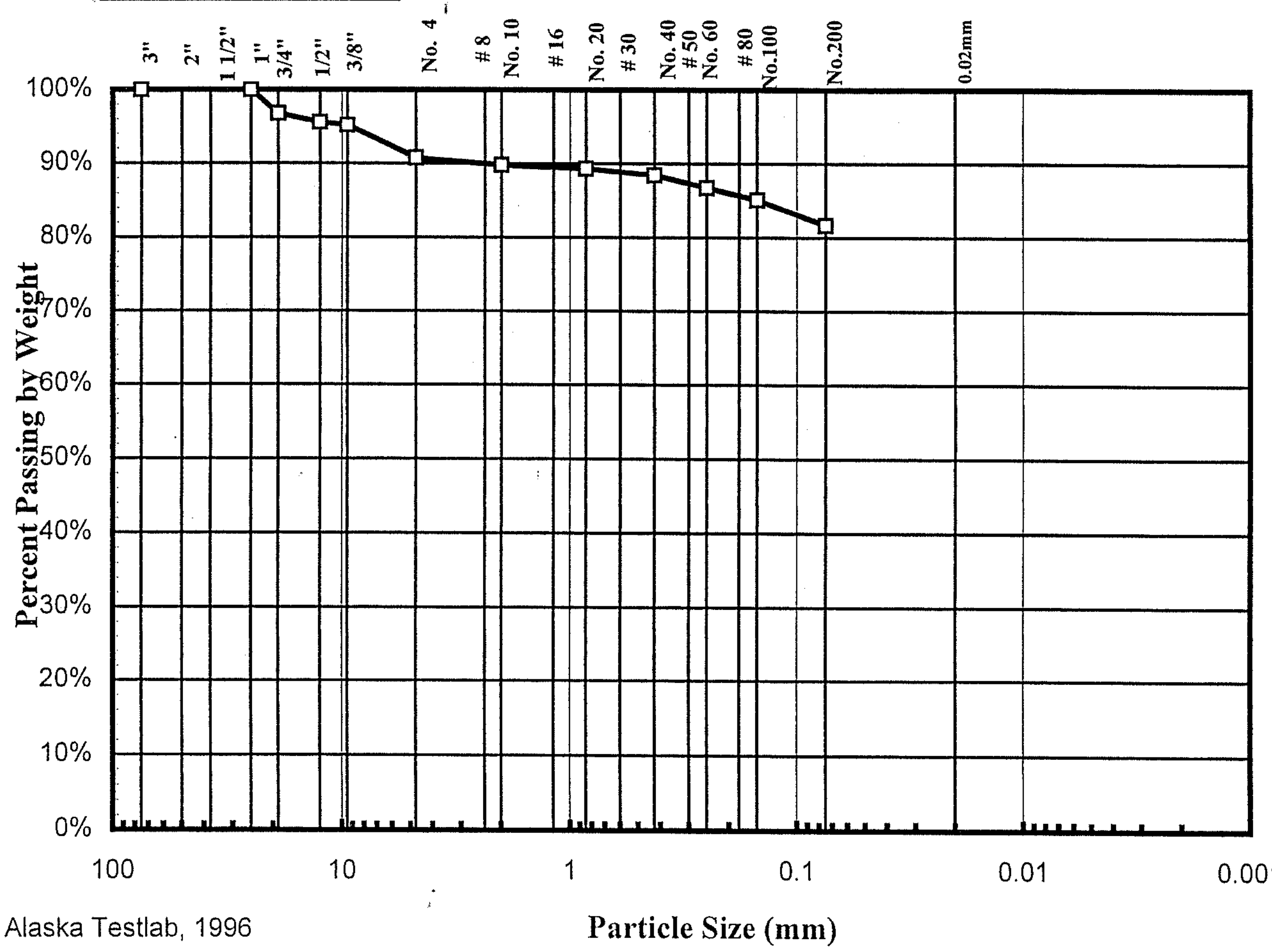
PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99-5, SA-1 @ 5'-8'
By Client

W.O. A28435
Lab No. 1583
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: SILT with Sand, ML

Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"	100%	
3/4"	97%	
1/2"	96%	
3/8"	95%	
No. 4	91%	
Total Wt. of Coarse Fraction = 498g		
No. 8		
No. 10	90%	
No. 16		
No. 20	89%	
No. 30		
No. 40	88%	
No. 50		
No. 60	87%	
No. 80		
No. 100	85%	
No. 200	82%	
Total Wt. of Fine Fraction = 250.3g		
0.02 mm		

David L. Andersen, P.E., General Manager

PND 3120

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

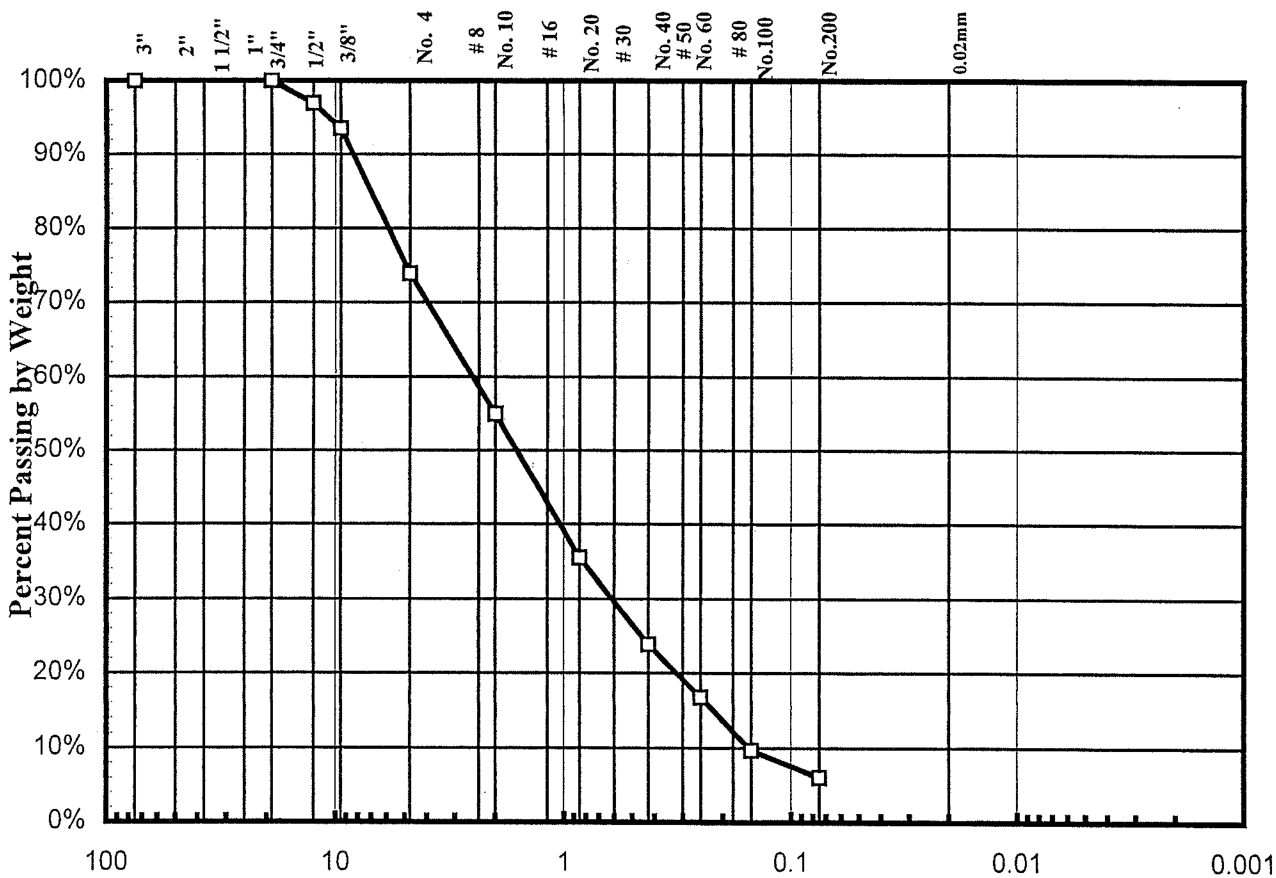
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99-5, SA-2 @ 13'-15'
By Client

W.O. A28435
Lab No. 1584
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Poorly Graded SAND with Silt and Gravel, SP-SM
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	97%	
3/8"	94%	
No. 4	74%	
Total Wt. of Coarse Fraction = 555.2g		
No. 8		
No. 10	55%	
No. 16		
No. 20	35%	
No. 30		
No. 40	24%	
No. 50		
No. 60	17%	
No. 80		
No. 100	10%	
No. 200	6%	
Total Wt. of Fine Fraction = 307.2g		
0.02 mm		

David L. Andersen, P.E., General Manager

PND 3121

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

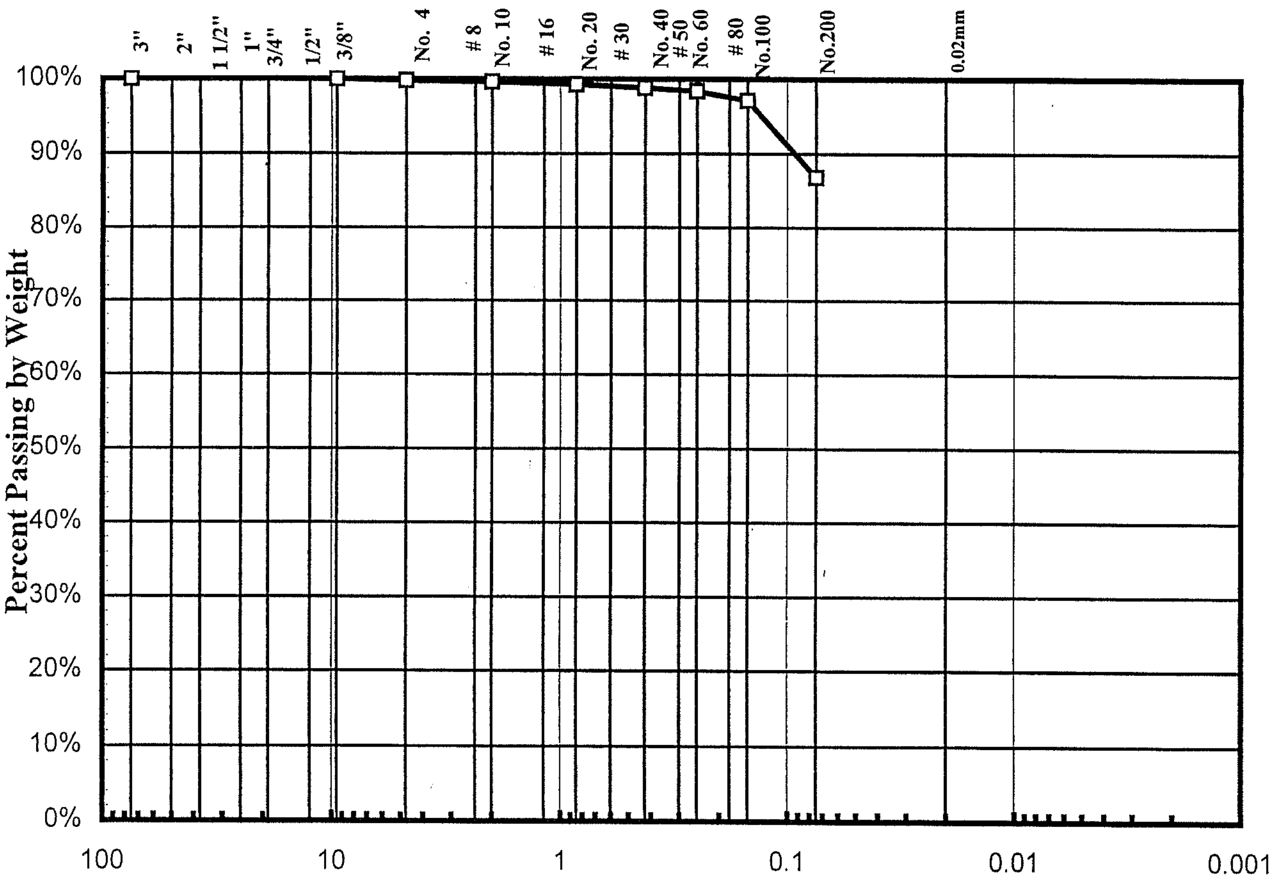
Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

W.O. A28435
Lab No. 1585
Received: July 13, 1999
Reported: 7/21/99

Location: PND99-6, SA-1 @ 4'-6'
By Client
PI = Non Plastic
Engineering Classification: SILT, ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"	100%	
No. 4	100%	
Total Wt. of Coarse Fraction = 469g		
No. 8		
No. 10	100%	
No. 16		
No. 20	99%	
No. 30		
No. 40	99%	
No. 50		
No. 60	98%	
No. 80		
No. 100	97%	
No. 200	87%	
Total Wt. of Fine Fraction = 241.6g		
0.02 mm		

David L. Andersen, P.E., General Manager

PND 3122

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

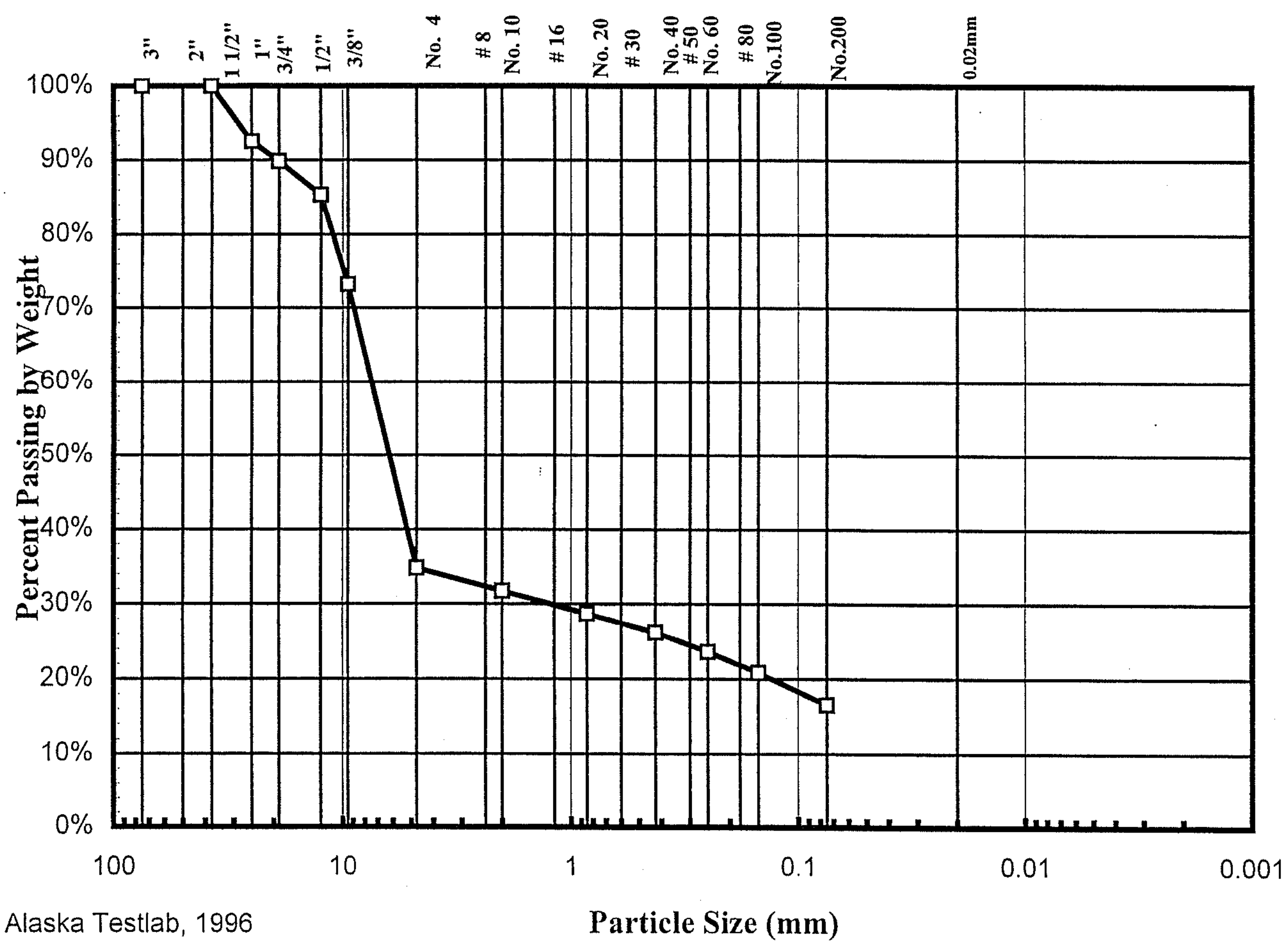
PARTICLE-SIZE

DIST. ASTM D422/C136

W.O. A28435
Lab No. 1586
Received: July 13, 1999
Reported: 7/21/99

Location: PND99-6, SA-4 @ 14.5'-16'
By Client

Engineering Classification: Silty GRAVEL with Sand, GM
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"	100%	
1"	93%	
3/4"	90%	
1/2"	85%	
3/8"	73%	
No. 4	35%	
Total Wt. of Coarse Fraction = 2325.4g		
No. 8		
No. 10	32%	
No. 16		
No. 20	29%	
No. 30		
No. 40	26%	
No. 50		
No. 60	24%	
No. 80		
No. 100	21%	
No. 200	17%	
Total Wt. of Fine Fraction = 331.1g		
0.02 mm		

David L. Andersen, P.E., General Manager
4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

PND 3123

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

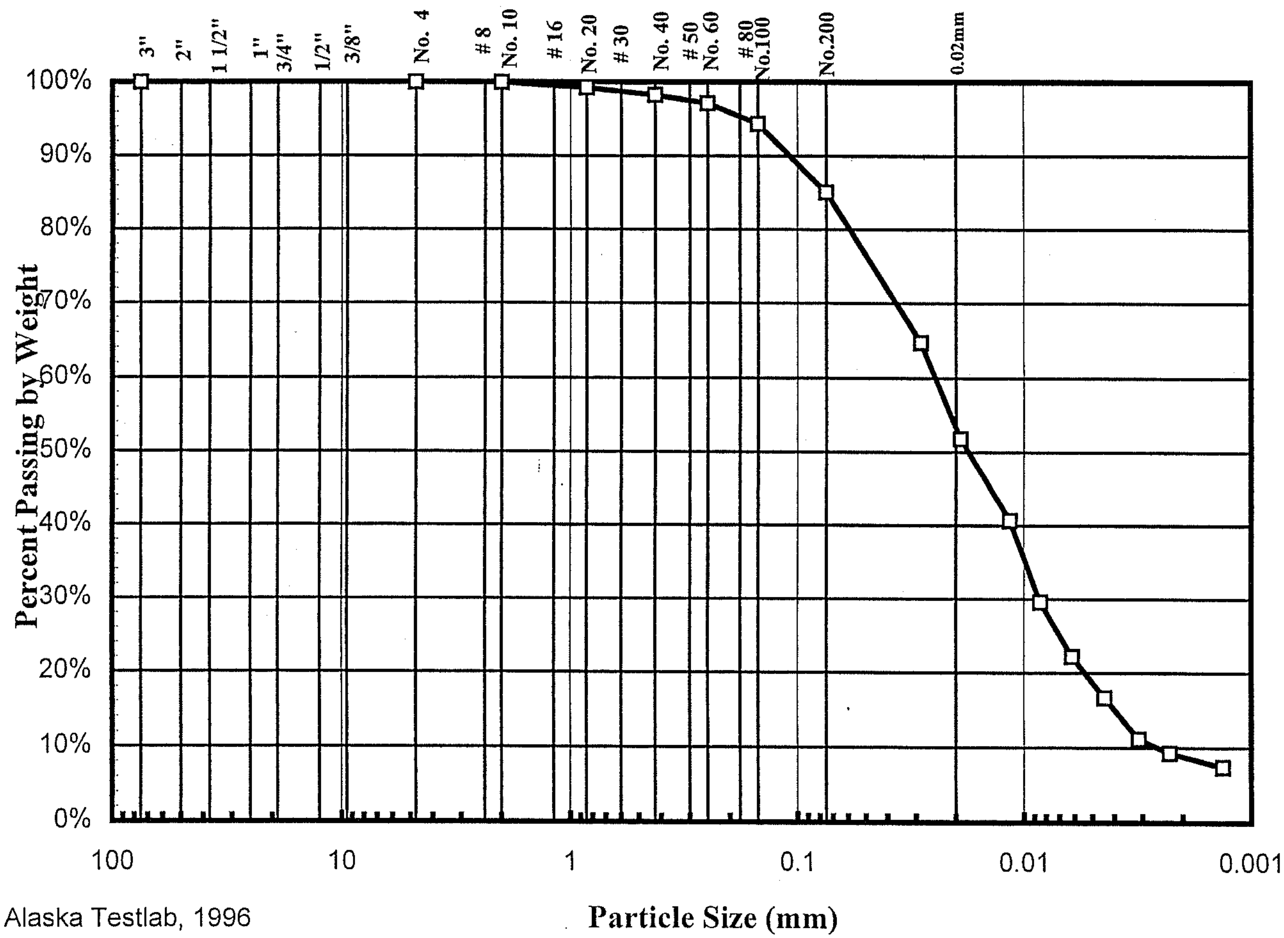
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND 99-7, SA-1 @ 4'-6'
By Client

W.O. A28435
Lab No. 1587
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: SILT with Sand, ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4	100%	
Total Wt. of Coarse Fraction = 470g		
No. 8		
No. 10	100%	
No. 16		
No. 20	99%	
No. 30		
No. 40	98%	
No. 50		
No. 60	97%	
No. 80		
No. 100	94%	
No. 200	85%	
Total Wt. of Fine Fraction = 252.4g		
0.02 mm	53.3%	

David L. Andersen, P.E., General Manager

PND 3124

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

PARTICLE-SIZE

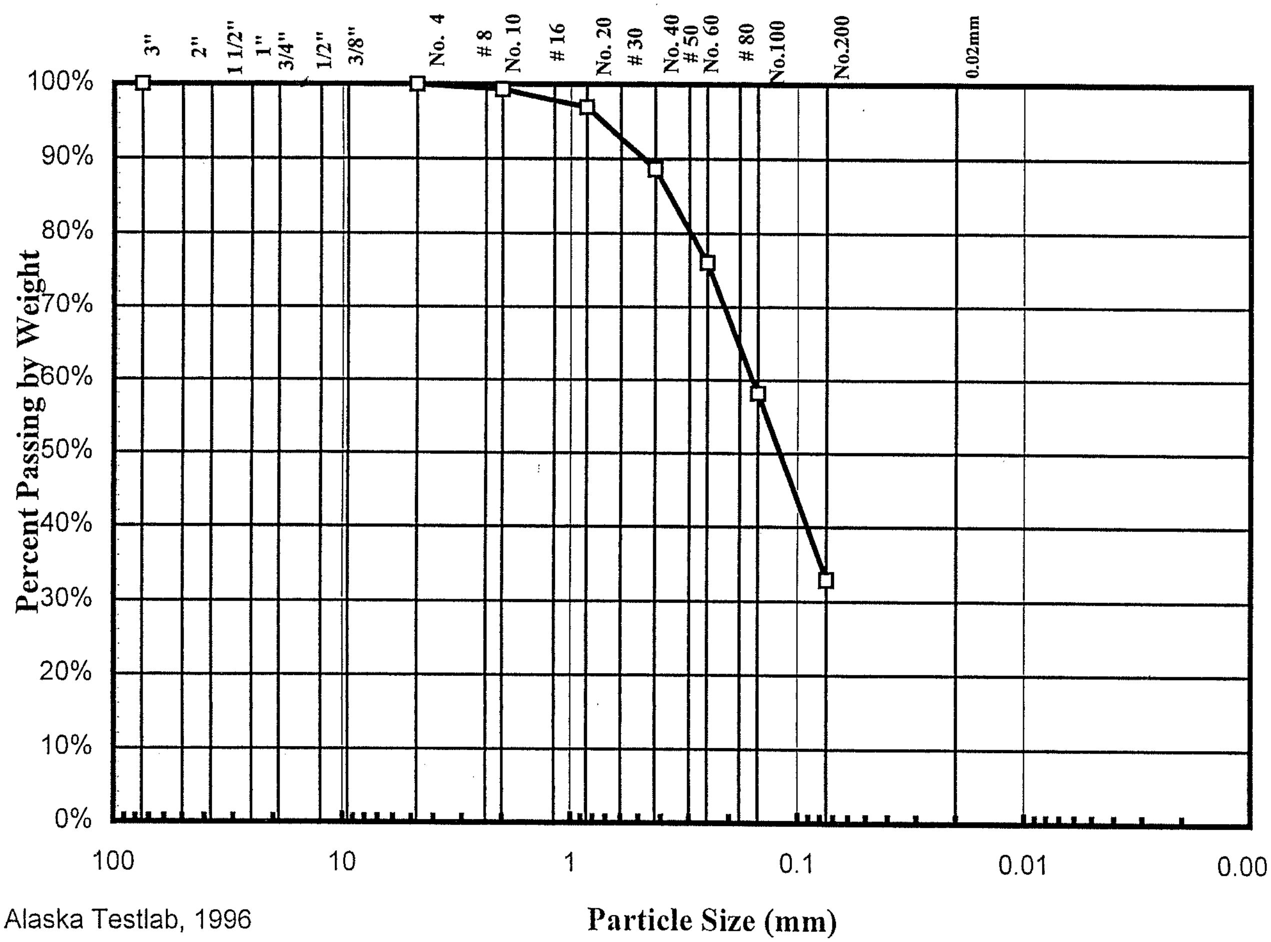
DIST. ASTM D422/C136

Location: PND99-8, SA-2 @ 5'-6.5'
By Client

W.O. A28435
Lab No. 1588
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Silty SAND , SM

Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4	100%	
Total Wt. of Coarse Fraction = 350.8g		
No. 8		
No. 10	99%	
No. 16		
No. 20	97%	
No. 30		
No. 40	89%	
No. 50		
No. 60	76%	
No. 80		
No. 100	58%	
No. 200	33%	
Total Wt. of Fine Fraction = 350.8g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

PND 3125

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

PARTICLE-SIZE

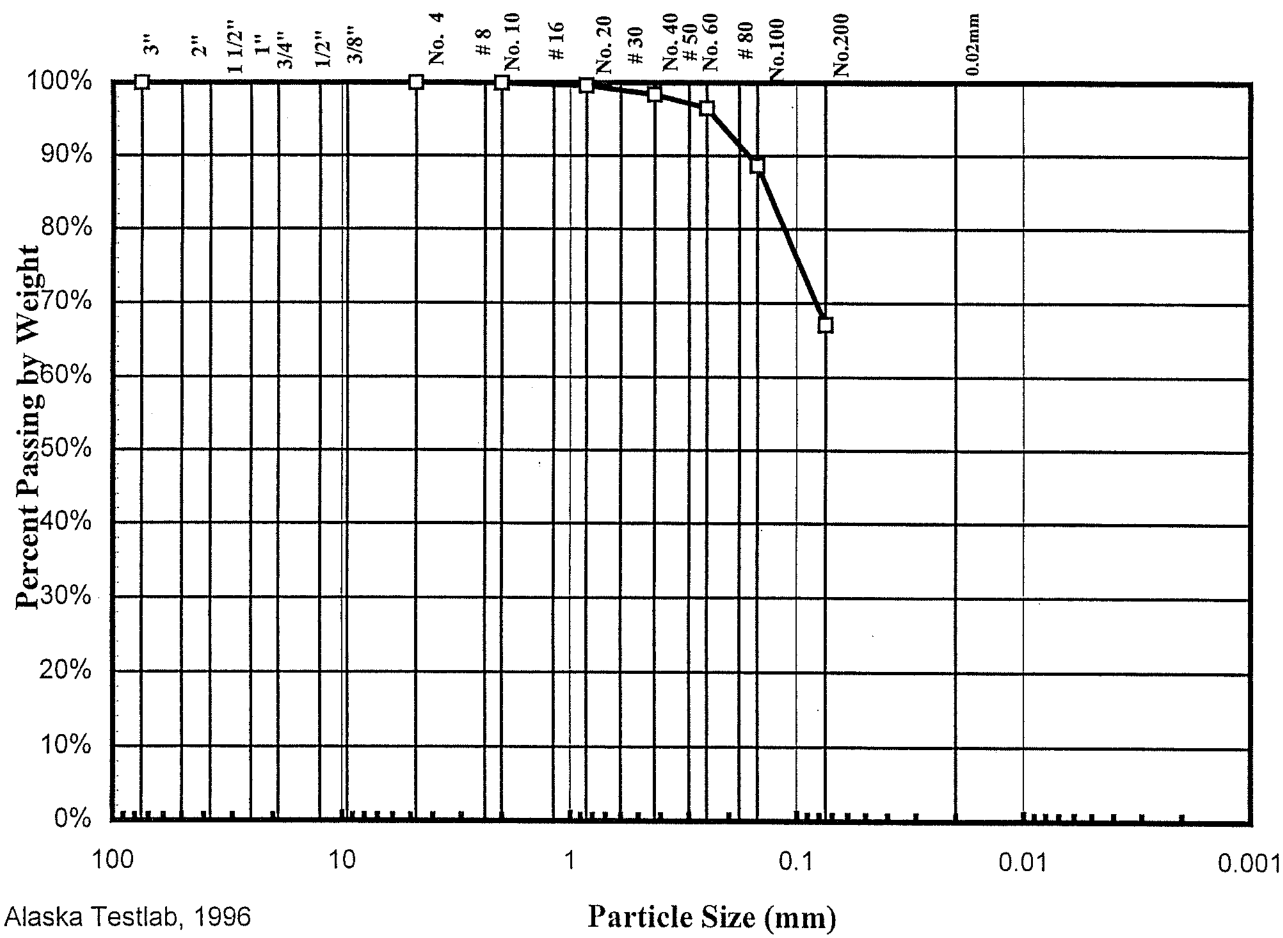
DIST. ASTM D422/C136

Location: PND99-8, SA-5 @ 20'-22'
By Client

W.O. A28435
Lab No. 1589
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Sandy SILT, ML

Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4	100%	
Total Wt. of Coarse Fraction = 325.4g		
No. 8		
No. 10	100%	
No. 16		
No. 20	100%	
No. 30		
No. 40	98%	
No. 50		
No. 60	97%	
No. 80		
No. 100	89%	
No. 200	67%	
Total Wt. of Fine Fraction = 325.4g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

PND 3126

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

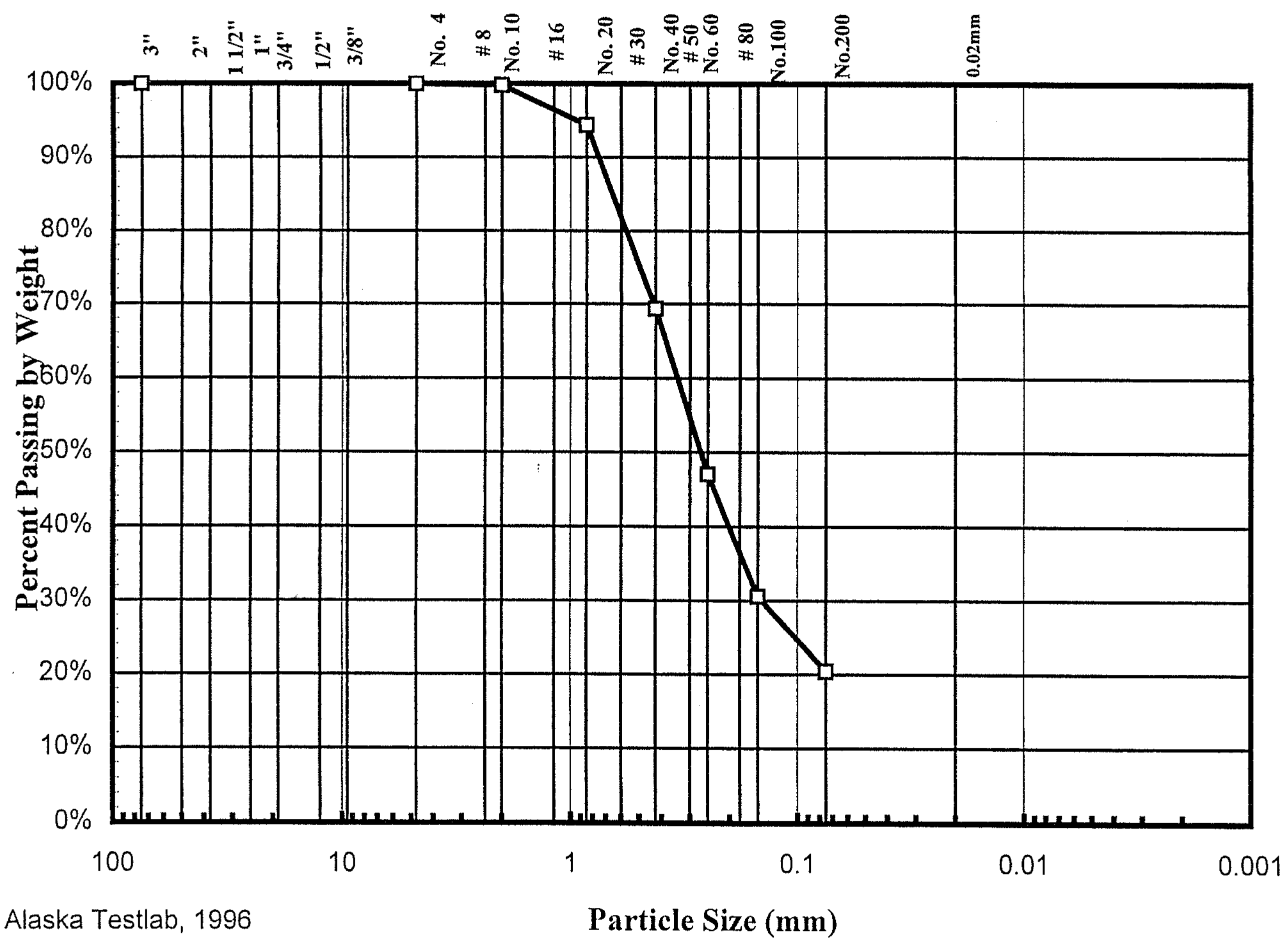
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99-9, SA-1 @ 5'-7'
By Client

W.O. A28435
Lab No. 1590
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Silty SAND , SM
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4	100%	
Total Wt. of Coarse Fraction = 366.6g		
No. 8		
No. 10	100%	
No. 16		
No. 20	94%	
No. 30		
No. 40	69%	
No. 50		
No. 60	47%	
No. 80		
No. 100	31%	
No. 200	20%	
Total Wt. of Fine Fraction = 366.58g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

PND 3127

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

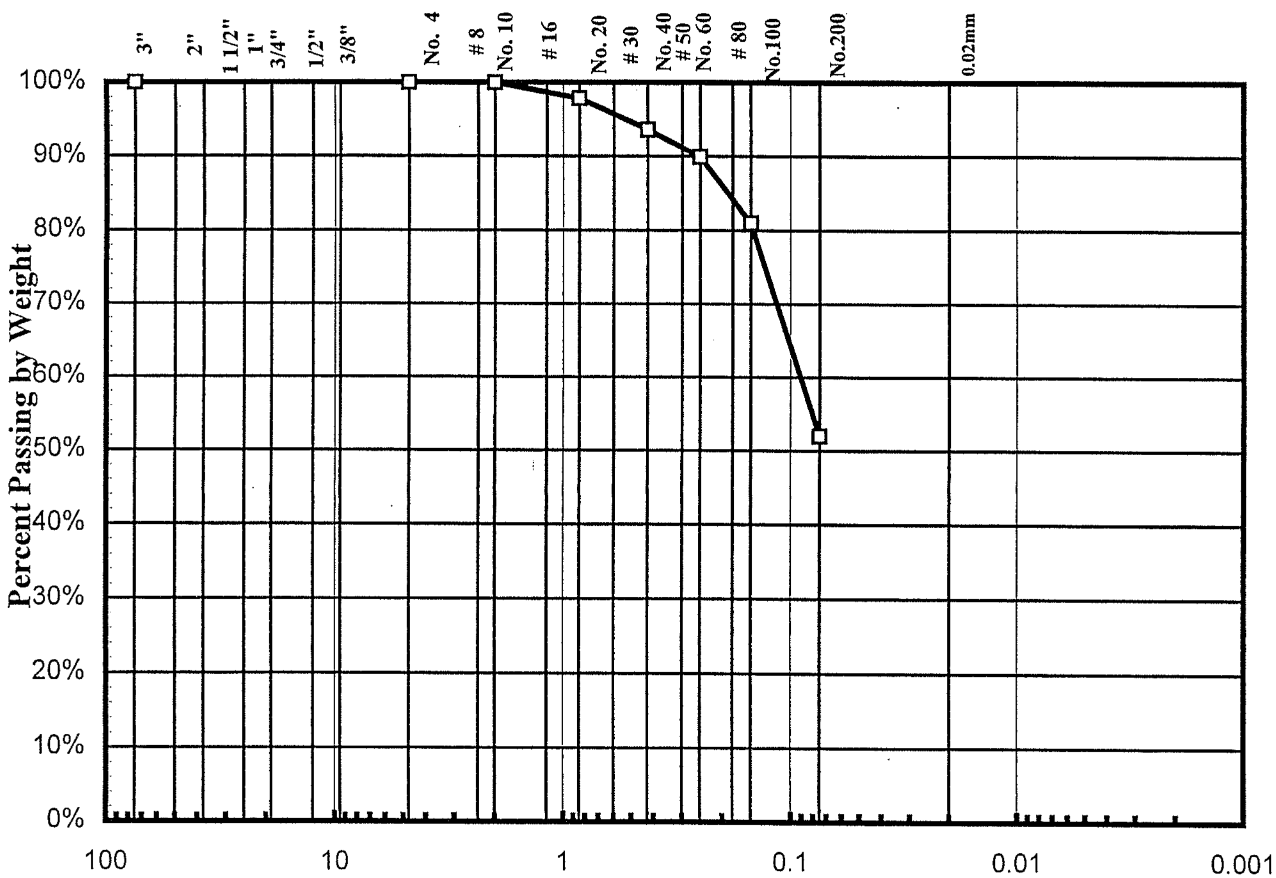
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

W.O. A28435
Lab No. 1591
Received: July 13, 1999
Reported: 7/21/99

Location: PND99-9, SA-4 @ 20'-22'
By Client

Engineering Classification: Sandy SILT, ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4	100%	
Total Wt. of Coarse Fraction = 317.5g		
No. 8		
No. 10	100%	
No. 16		
No. 20	98%	
No. 30		
No. 40	94%	
No. 50		
No. 60	90%	
No. 80		
No. 100	81%	
No. 200	52%	
Total Wt. of Fine Fraction = 317.5g		
0.02 mm		

David L. Andersen, P.E., General Manager
4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

PND 3128

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

PARTICLE-SIZE

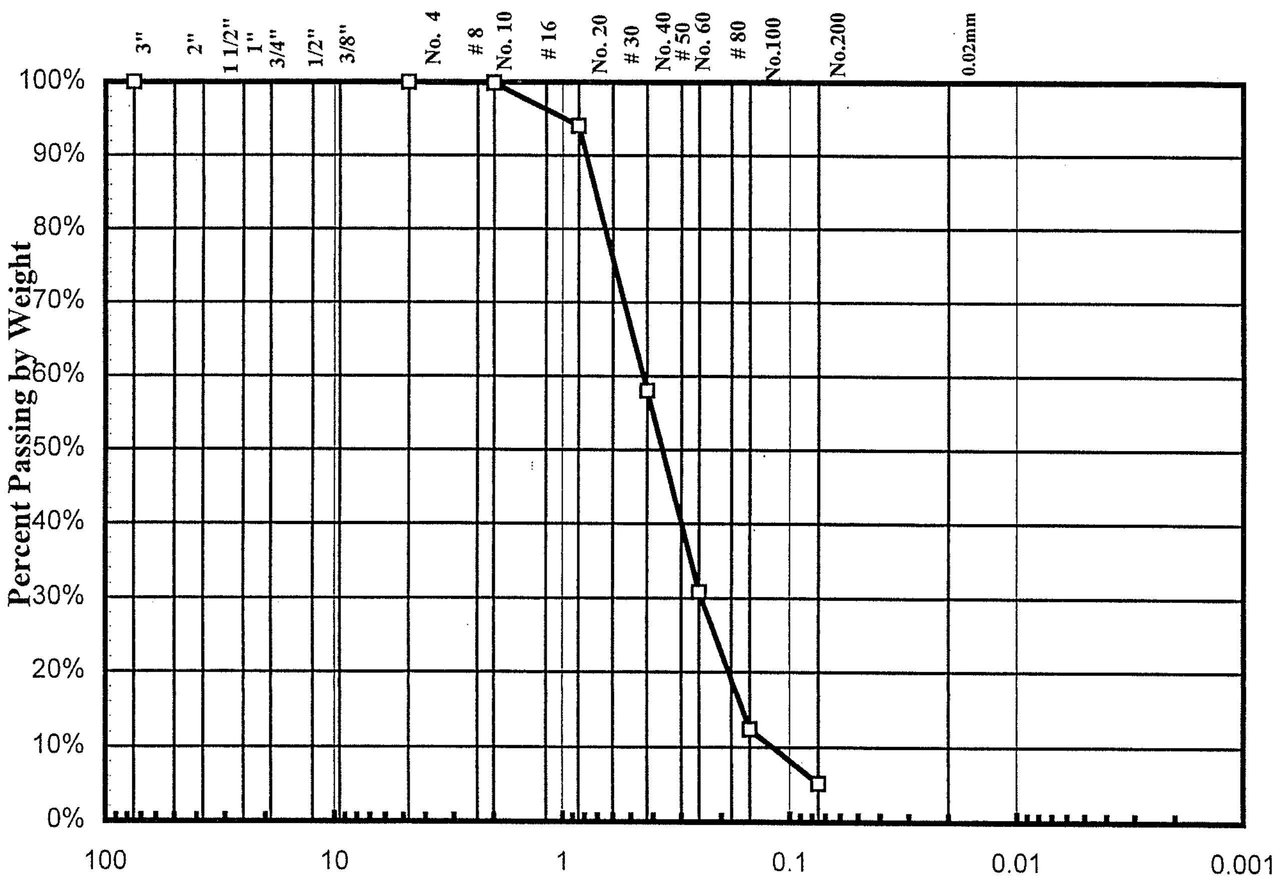
DIST. ASTM D422/C136

Location: PND99-10, SA-1 @ 5.5'-7'
By Client

W.O. A28435
Lab No. 1592
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Poorly Graded SAND with Silt , SP-SM

Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4	100%	
Total Wt. of Coarse Fraction = 397.8g		
No. 8		
No. 10	100%	
No. 16		
No. 20	94%	
No. 30		
No. 40	58%	
No. 50		
No. 60	31%	
No. 80		
No. 100	12%	
No. 200	5.2%	
Total Wt. of Fine Fraction = 397.8g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

PND 3129

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

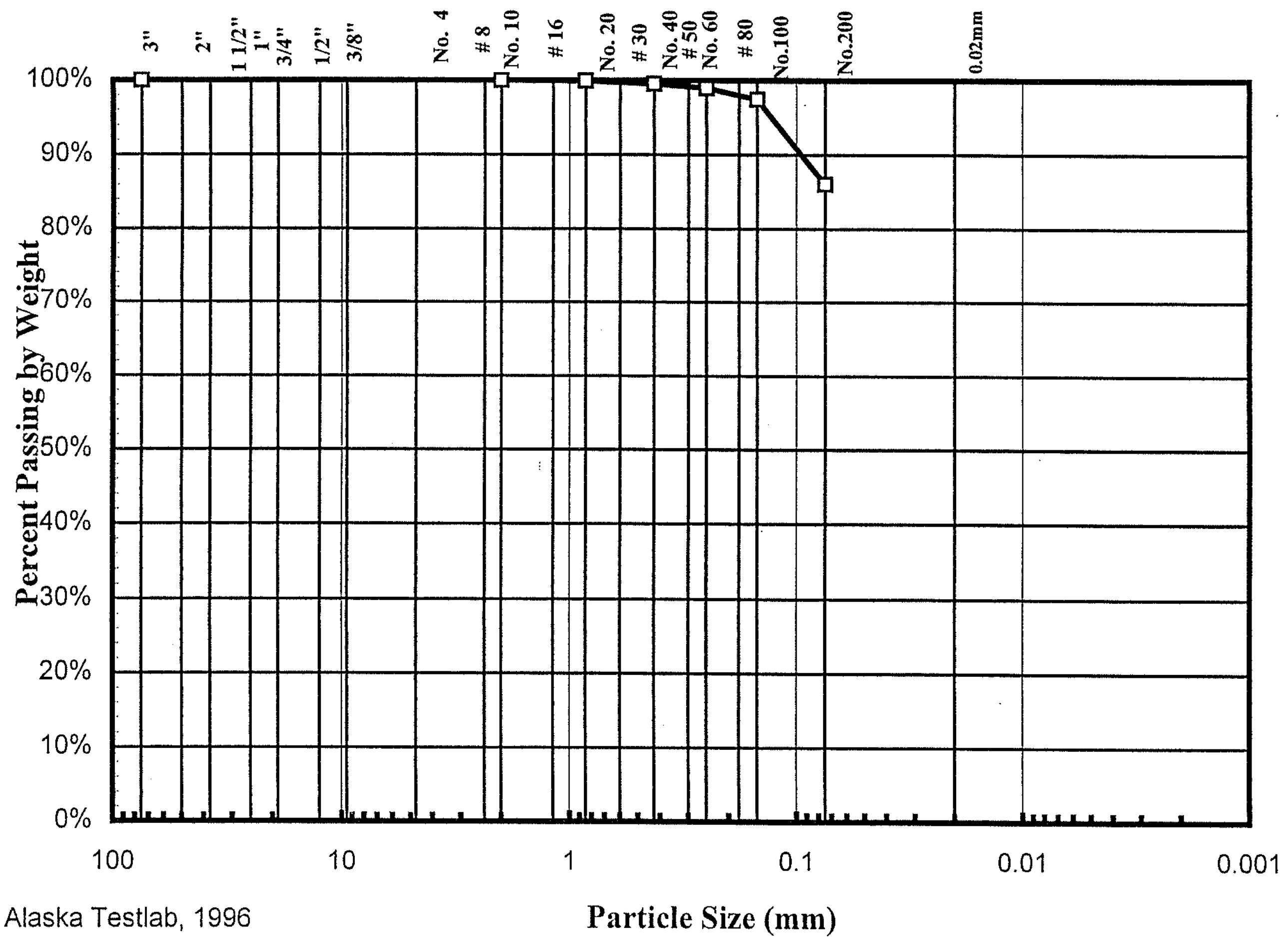
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99-10, SA-3 @ 15'-17'
By Client

Engineering Classification: SILT, ML
Frost Classification: F4

W.O. A28435
Lab No. 1593
Received: July 13, 1999
Reported: 7/21/99



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4		
Total Wt. of Coarse Fraction = 326.7g		
No. 8		
No. 10	100%	
No. 16		
No. 20	100%	
No. 30		
No. 40	100%	
No. 50		
No. 60	99%	
No. 80		
No. 100	97%	
No. 200	86%	
Total Wt. of Fine Fraction = 326.7g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

PND 3130

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

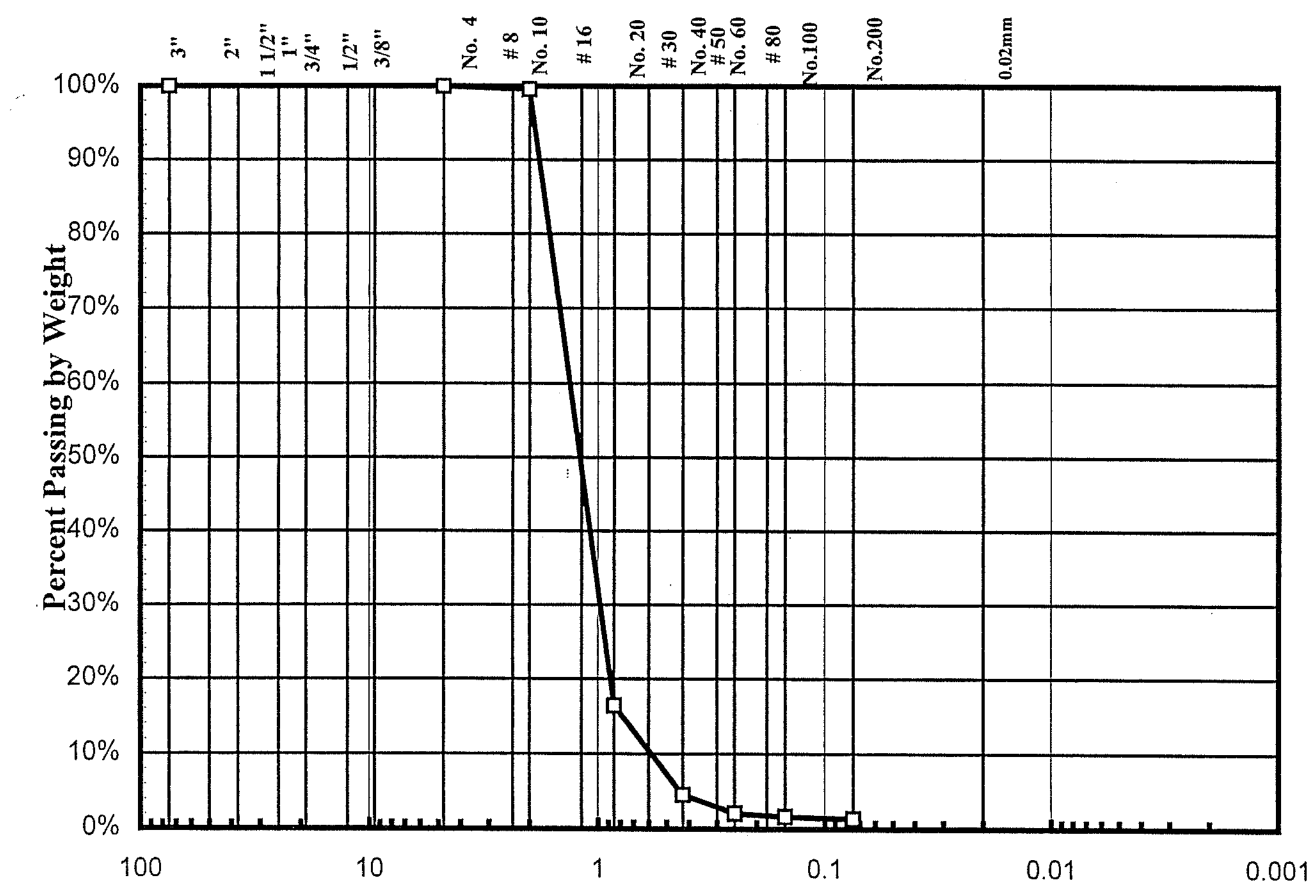
PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99-11, SA-2 @ 10'-11.5'
By Client

Engineering Classification: Poorly Graded SAND , SP

Frost Classification: NFS (MOA)

W.O. A28435
Lab No. 1594
Received: July 13, 1999
Reported: 7/21/99



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4	100%	
Total Wt. of Coarse Fraction = 315.9g		
No. 8		
No. 10	100%	
No. 16		
No. 20	16%	
No. 30		
No. 40	5%	
No. 50		
No. 60	2%	
No. 80		
No. 100	2%	
No. 200	1.3%	
Total Wt. of Fine Fraction = 315.9g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

PND 3131

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

PARTICLE-SIZE

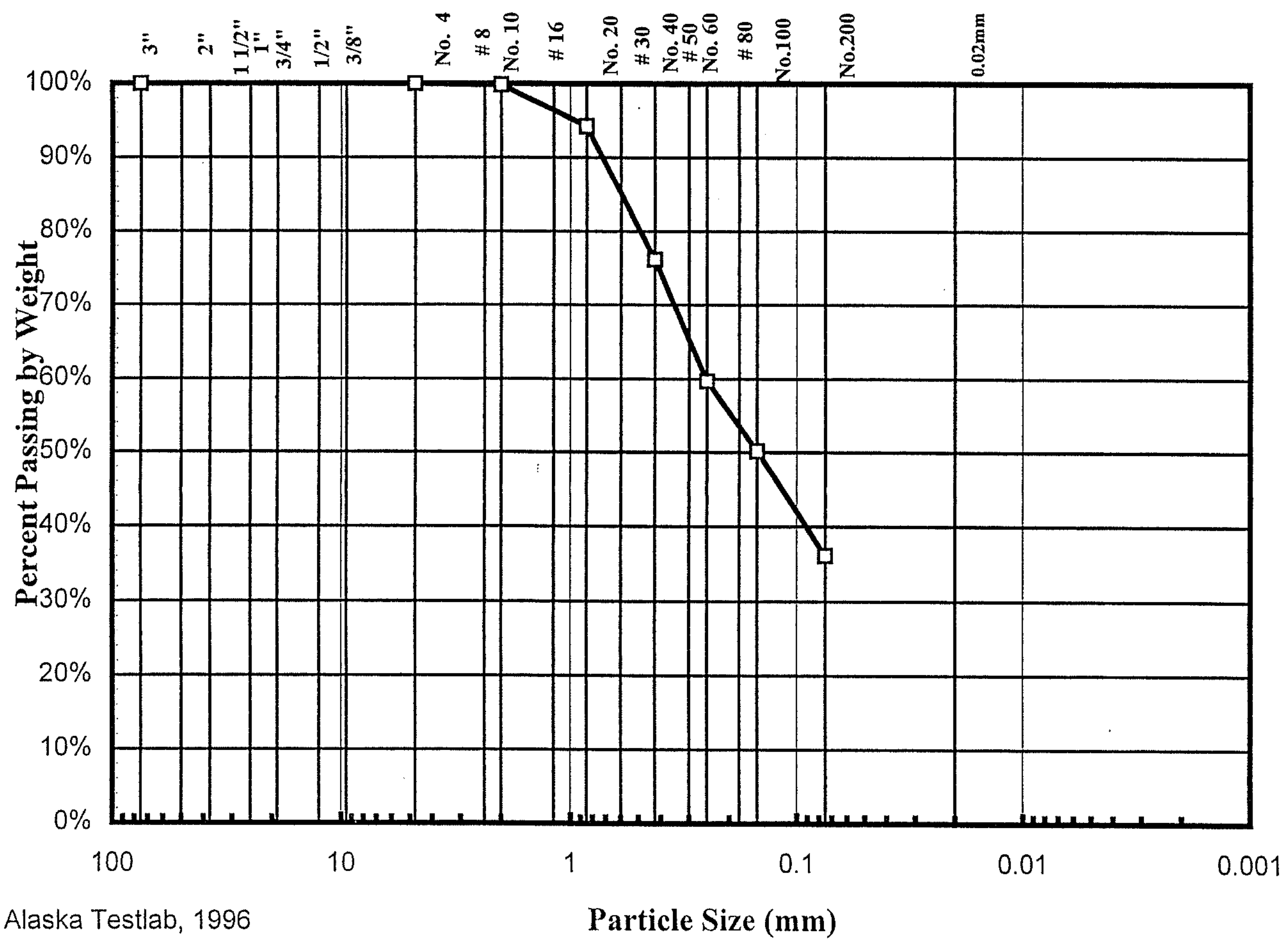
DIST. ASTM D422/C136

Location: PND99-12, SA-1 @ 5.5'-7'
By Client

W.O. A28435
Lab No. 1595
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Silty SAND , SM

Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4	100%	
Total Wt. of Coarse Fraction = 373g		
No. 8		
No. 10	100%	
No. 16		
No. 20	94%	
No. 30		
No. 40	76%	
No. 50		
No. 60	60%	
No. 80		
No. 100	50%	
No. 200	36%	
Total Wt. of Fine Fraction = 373g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET · ANCHORAGE · ALASKA · 99503 · 907/562-2000 · 907/563-3953

PND 3132

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

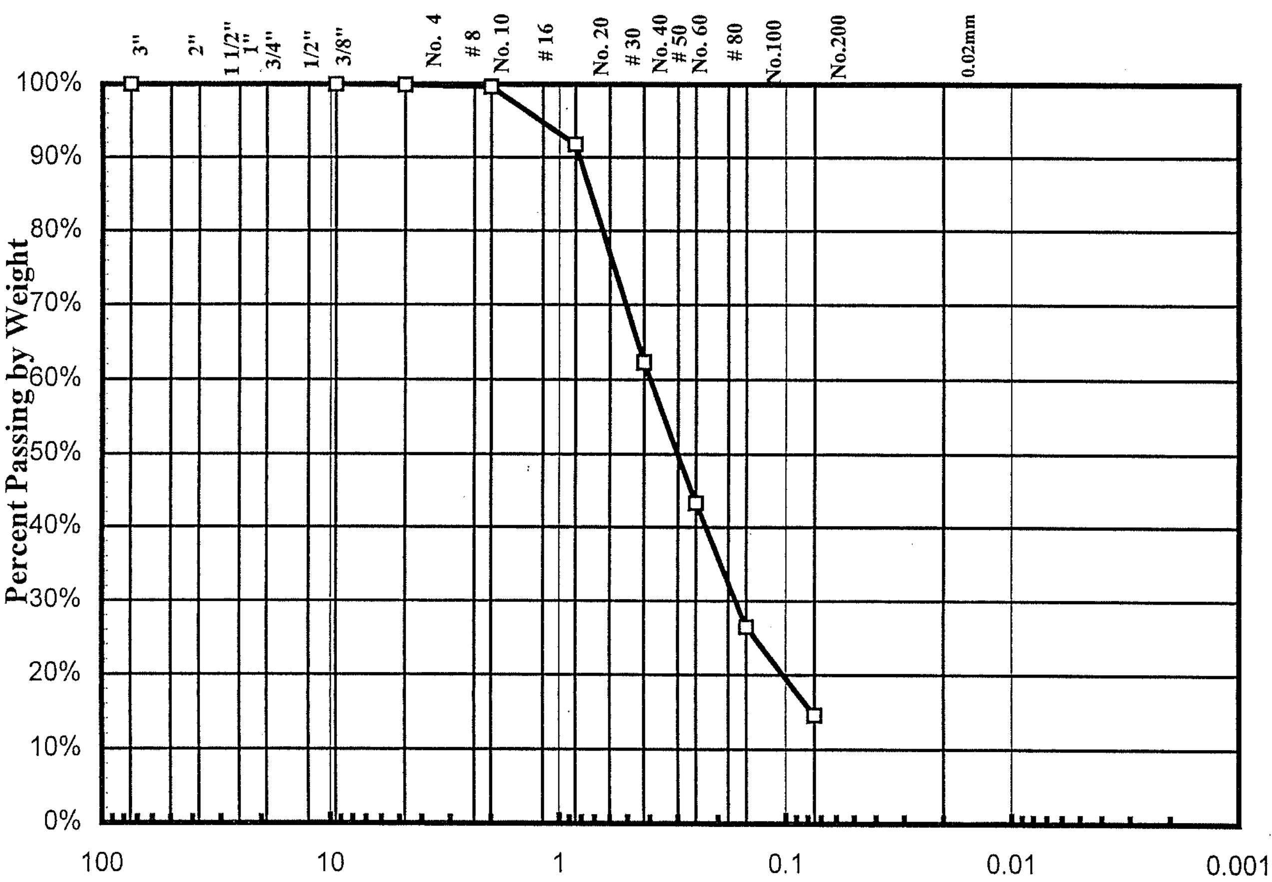
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99-12, SA-5 @ 25'-27'
By Client

W.O. A28435
Lab No. 1596
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Silty SAND , SM
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"	100%	
No. 4	100%	
Total Wt. of Coarse Fraction = 698.4g		
No. 8		
No. 10	100%	
No. 16		
No. 20	92%	
No. 30		
No. 40	62%	
No. 50		
No. 60	43%	
No. 80		
No. 100	26%	
No. 200	15%	
Total Wt. of Fine Fraction = 326g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

PND 3133

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

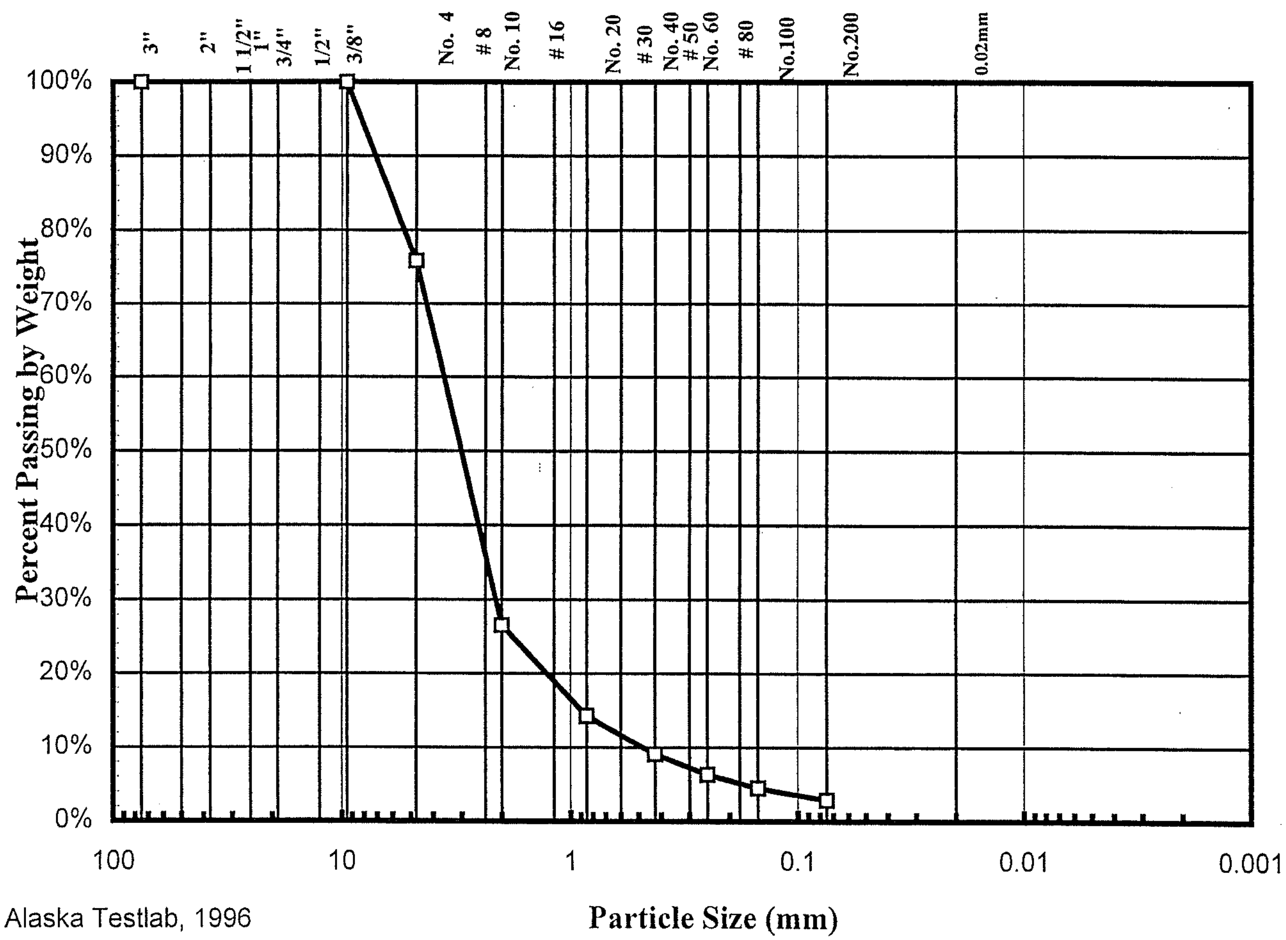
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99-13, SA-1 @ 5'-7'
By Client

W.O. A28435
Lab No. 1597
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Well Graded SAND with Gravel, SW
Frost Classification: NFS (MOA)



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"	100%	
No. 4	76%	
Total Wt. of Coarse Fraction = 291.4g		
No. 8		
No. 10	27%	
No. 16		
No. 20	14%	
No. 30		
No. 40	9%	
No. 50		
No. 60	6%	
No. 80		
No. 100	4%	
No. 200	2.9%	
Total Wt. of Fine Fraction = 221.2g		
0.02 mm		

David L. Andersen, P.E., General Manager

PND 3134

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

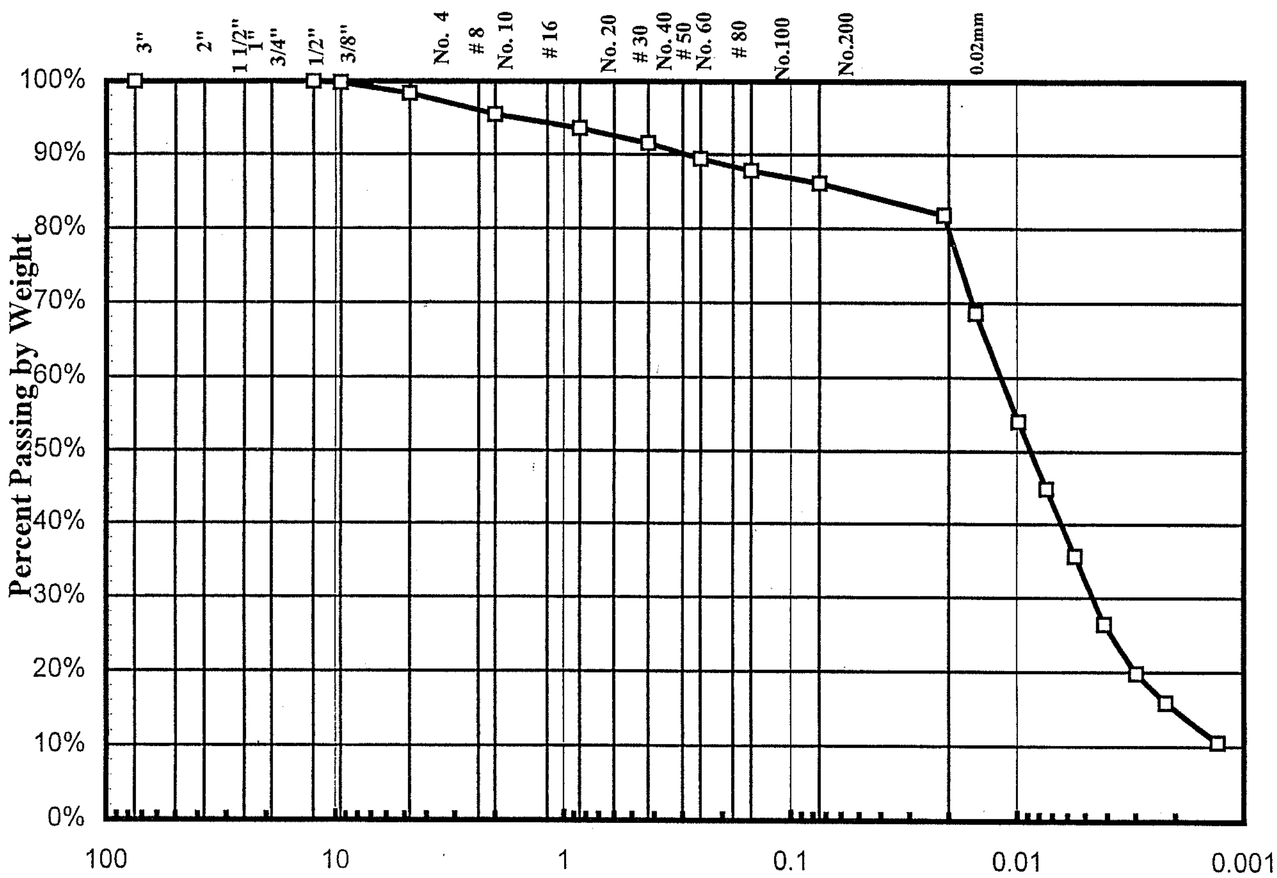
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99-15, SA1 @ 12'-14.5'
By Client

W.O. A28435
Lab No. 1599
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: SILT, ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"	100%	
3/8"	100%	
No. 4	98%	
Total Wt. of Coarse Fraction = 2524g		
No. 8		
No. 10	95%	
No. 16		
No. 20	94%	
No. 30		
No. 40	92%	
No. 50		
No. 60	89%	
No. 80		
No. 100	88%	
No. 200	86%	
Total Wt. of Fine Fraction = 291.5g		
0.02 mm	79.8%	

David L. Andersen, P.E., General Manager

PND 3135

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

Project: Douglas Harbor 99220.03

PARTICLE-SIZE

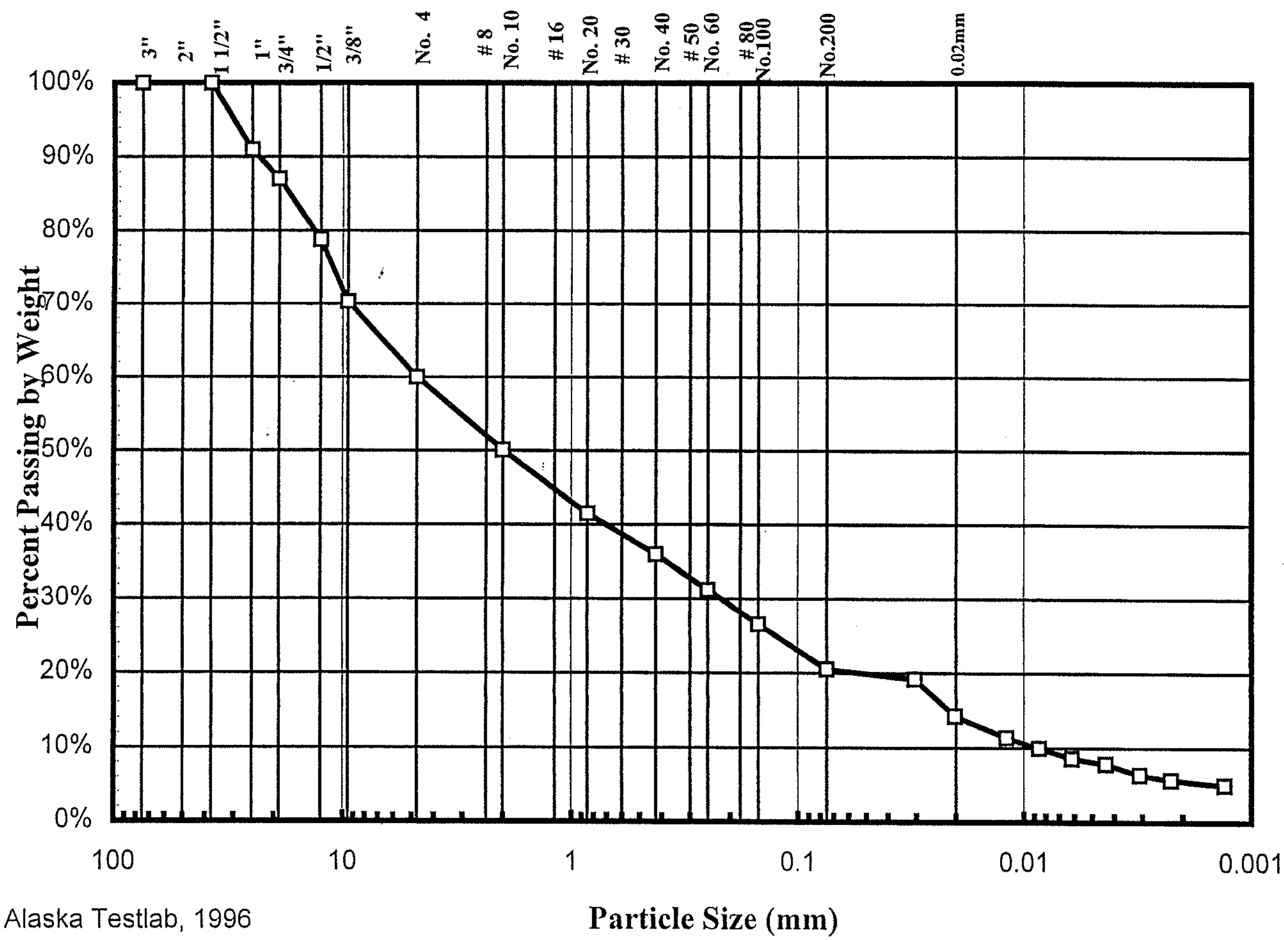
DIST. ASTM D422/C136

Location: PND 99-15, SA-4 @ 28'-33'
By Client

W.O. A28435
Lab No. 1600
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Silty GRAVEL with Sand, GM

Frost Classification: F2



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"	100%	
1"	91%	
3/4"	87%	
1/2"	79%	
3/8"	70%	
No. 4	60%	
Total Wt. of Coarse Fraction = 3021g		
No. 8		
No. 10	50%	
No. 16		
No. 20	41%	
No. 30		
No. 40	36%	
No. 50		
No. 60	31%	
No. 80		
No. 100	27%	
No. 200	21%	
Total Wt. of Fine Fraction = 371.4g		
0.02 mm	14.2%	

PND 3136

David L. Andersen, P.E., General Manager

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

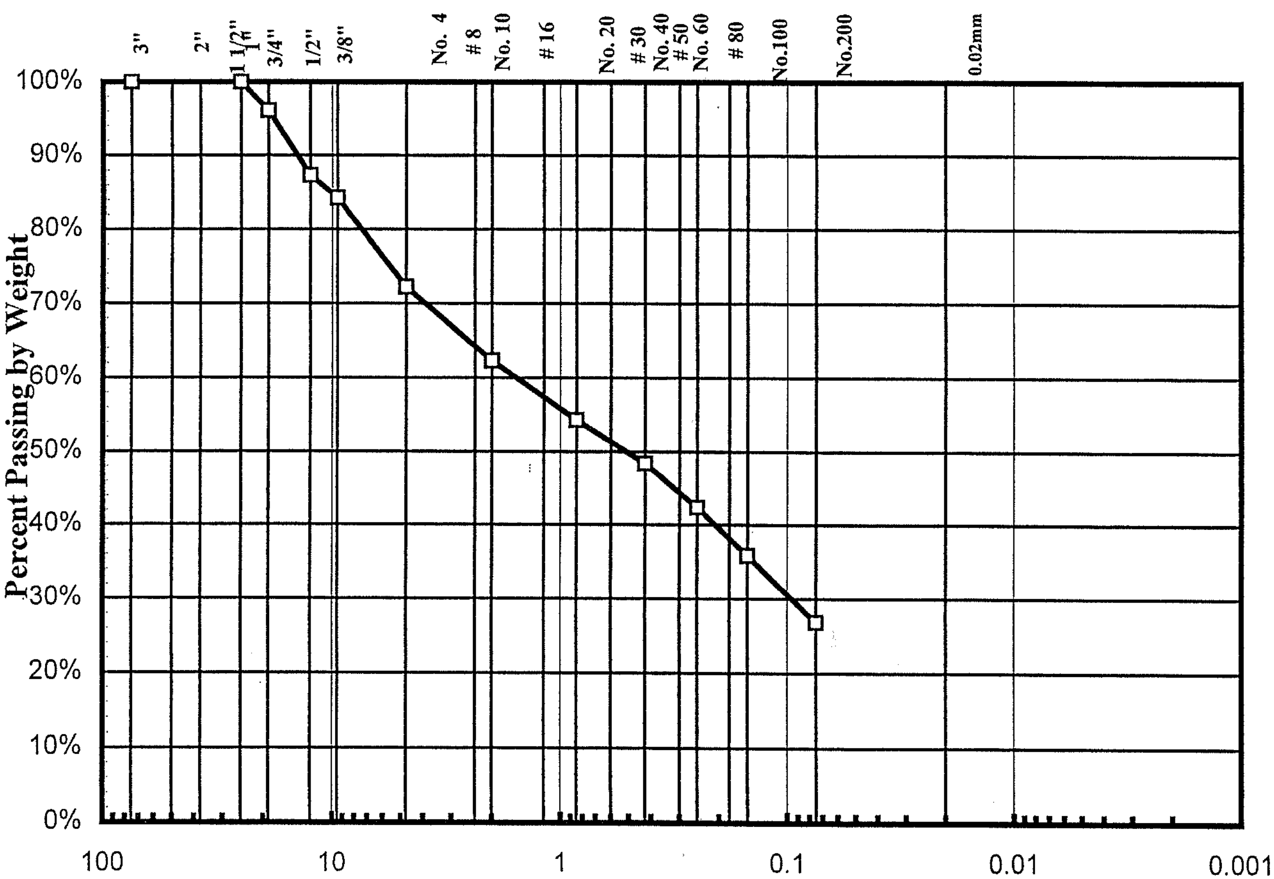
Project: Douglas Harbor 99220.03

PARTICLE-SIZE
DIST. ASTM D422/C136

Location: PND99-16, SA-1 @ 7'-7.5'
By Client

W.O. A28435
Lab No. 1601
Received: July 13, 1999
Reported: 7/21/99

Engineering Classification: Silty SAND with Gravel, SM
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"	100%	
3/4"	96%	
1/2"	87%	
3/8"	84%	
No. 4	72%	
Total Wt. of Coarse Fraction = 891.1g		
No. 8		
No. 10	62%	
No. 16		
No. 20	54%	
No. 30		
No. 40	48%	
No. 50		
No. 60	42%	
No. 80		
No. 100	36%	
No. 200	27%	
Total Wt. of Fine Fraction = 335.1g		
0.02 mm		

David L. Andersen, P.E., General Manager

4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

ALASKA TESTLAB
A Division of DOWL LLC

Client: Peratrovich Nottingham & Drage

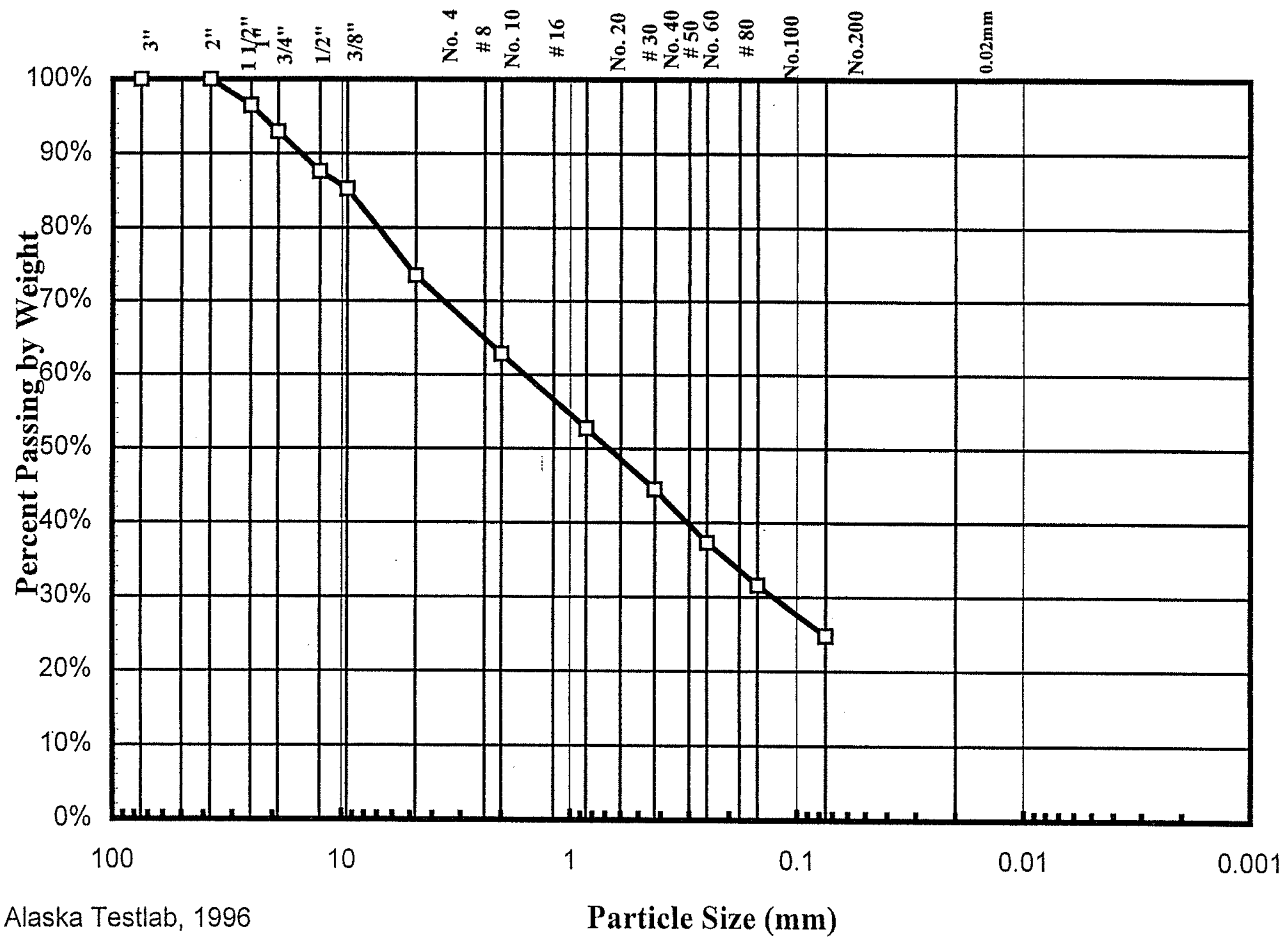
Project: Douglas Harbor 99220.03

PARTICLE-SIZE

DIST. ASTM D422/C136

Location: PND99-17, SA-1 @ 5'-7.5'
By Client
LL = 21, PI = 6
Engineering Classification: Silty, Clayey SAND with Gravel, SC-SM
Frost Classification: Not Measured

W.O. A28435
Lab No. 1602
Received: July 13, 1999
Reported: 7/21/99



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"	100%	
1"	96%	
3/4"	93%	
1/2"	88%	
3/8"	85%	
No. 4	73%	
Total Wt. of Coarse Fraction = 769g		
No. 8		
No. 10	63%	
No. 16		
No. 20	53%	
No. 30		
No. 40	44%	
No. 50		
No. 60	37%	
No. 80		
No. 100	32%	
No. 200	25%	
Total Wt. of Fine Fraction = 305g		
0.02 mm		

David L. Andersen, P.E., General Manager
4040 B STREET • ANCHORAGE • ALASKA • 99503 • 907/562-2000 • 907/563-3953

PND 3138

APPENDIX D

NORTHWEST GEOSCIENCES GEOPHYSICAL REPORT

PND 3139

NW-GEO
NORTHWEST GEOSCIENCES

July 20, 1999

James Heumann, PE
Peratrovich, Nottingham, and Drage, Inc.
3220 Hospital Drive, Suite 200
Juneau, Alaska 99801

Re: Douglas Harbor Geophysical Study

Dear Mr. Heumann

A geophysical study was performed at the current Douglas Harbor near Juneau Alaska on April 28-30. The objectives of the geophysical study were as follows:

- Determine the characteristics of sediment found in the harbor
- Use the geophysical data to target and better plan a geotechnical drilling program in and around the harbor
- Assist in the engineering design and dredging of the next phase of the harbor expansion
- Tie subsurface sediment types identified in geophysical data to previous geotechnical borings and better understand the geological setting at the study site.

INVESTIGATION METHODS

The geophysical investigation was conducted from a 25 foot survey vessel and utilized two types of profiling equipment, a differential global positioning system, and a Triton Elics data acquisition system. The survey vessel was navigated along predetermined survey lines which were displayed on a computer screen. The subbottom profile data was displayed both on a real time "ISIS" data acquisition system and a thermal paper graphic recorder

The two types of geophysical profilers were used to help define and map materials at varying depths in and around the harbor. To define the low compaction and fine sediments a high frequency 3.5 kHz system was deployed. The 3.5 kHz system allows for good resolution but is limited in penetration, typically 10-15 feet. The second type of subbottom profile system was a low frequency uniboom system designed to allow penetration from 15 – 150 feet.

The accuracy of the vessel and the acoustic sensors position with the survey area is approximately 2-3 meters. The geophysical records included water depth measurements and noted variations in soil density. After the field work was completed the recorded

PND 3140

water depths were combined with local tidal information to calculate true elevations of the mudline and underlying soil layers.

RESULTS

The results of the geophysical survey data are presented in the attached plan and profile drawings. A composite drawing of water depths, shoreline and shoreline features, docks, 1999 Peratrovich, Nottingham and Drage, (PND) borings and survey tracklines are presented as figure 1. Profiles of the subsurface data along the tracklines are presented as figures 2-15.

South Side of Juneau Island Causeway

Review of the geophysical subbottom survey lines south of the Juneau Island Causeway, indicates a silt/sand lens material. This material appears to extend from the shoreline out to a point were the bottom drops off sharply south of Juneau Island. The analog subbottom profile of lines 6, 6A and 7 exhibited a ringing noise that may suggest biogenic gas causing a very distinct multiple on the record. The same interference was noted on the fathometer traces. The ringing acoustic signal causes interference in the subbottom data and hindered determination of the thickness of the silt/sand lens. The geophysical data along the three lines present the same type of acoustic return. At approximately –3 feet Mean Low Lower Water, (MLLW), the biogenic gas seems to disappear and the record is free from the ringing interference and subsurface data is more easily defined. Near the island, these subbottom survey lines indicate a bedrock/till material near the mudline that dives down as one moves toward away from shore, (figure 10).

Existing Harbor Basin

The interpreted geophysical survey lines collected inside the existing harbor are presented in figure 9. Cross line 6 was run south and east around the existing harbor floats. A silt/sand lens was identified along most of the line with a more dense till underlying the unconsolidated material. Survey data collected in water depths less than 5-6 ft, present little or no subsurface data. This is due to the acoustic properties of the profile instruments inability to transmit and receive acoustic signals in shallow water depths. The time for the acoustic signal to resolve density variations is determined by the instruments wave length. The time for the sensors wave front to travel through the water column and reach the bottom and back to the receiver sensor is very short and is not able to resolve changes in the horizontal lenses. As the profiler instruments were towed from deep into shallow water, some subsurface data was collected.

Proposed Harbor Expansion Area

Lines 24 and 25 indicate silt/sand over a more dense bottom material indicating the more dense horizon rising to –1 on line 24 and –6 feet on line 25 below mudline at event numbers 57-58 and 65 respectively. After review of the existing geotechnical boring data, the dense till layer is identified on some of the geophysical lines. Line 2 and X-line 6 present data exhibiting a less dense silt/sand lens over lying a more dense till/bedrock substrate.

Harbor Entrance Area

Along the harbor entrance the geophysical survey line 22 travels from deeper water to shallow. This survey line indicates the more dense till/bedrock horizon rises to approximately 3 feet of the mudline and correlates well with (PND) boring data at the boring PND-99-14. Little overburden material was noted along the geophysical survey lines at sections were the slope outside of the harbor entrance was quite steep. At the toe of these slopes, data indicates a softer sediment lens overlying a till/bedrock horizon. The overburden, silt/sand and till material, in the harbor entrance area appears be less than at other areas within the harbor study area.

Outside the Harbor

North of the Douglas dock outside of the harbor entrance, figures 11 and 12 indicate a silt/sand lens overlying a more dense horizon. The silt/sand lens is approximately 20 feet thick on line 39 with the soft sediment veneer thinning along the profile as the water depth increase, (figure 11). Line 40 has less silt/sand material than line 39 near the shore end of the track but thins out as the line traverses to deep water

CONCLUSIONS

The geophysical survey indicates several items of interest. Soft low density sediment, (silt/sand) was identified where water depths and other acoustic conditions would allow penetration. The vertical extent of the overburden sediments was correlated with the existing and PND-99 borings to ground truth the geophysical data and was found to correlate well. The more dense glacial till material identified in the northwest section of the harbor was noted on the raw data. The profiles indicate the interface horizons are lost as the profiles move from deeper water to the more shallow water inside the harbor, thus making it difficult to measure the vertical extent of the till material.

The more dense material underlying the silt/sand was very difficult to establish a distinct boundary between bedrock and glacial till. The bedrock material as displayed on Juneau Island is composed of very dense rock and the bedding appears tilted and thrust vertically. Glaciation appears to have deposited glacial till around the island. Bedrock interfaces are more easily identified on the east side of the island than the west. Also the steep slope of the bedrock adjacent to the island makes it difficult to identify the overburden contact.

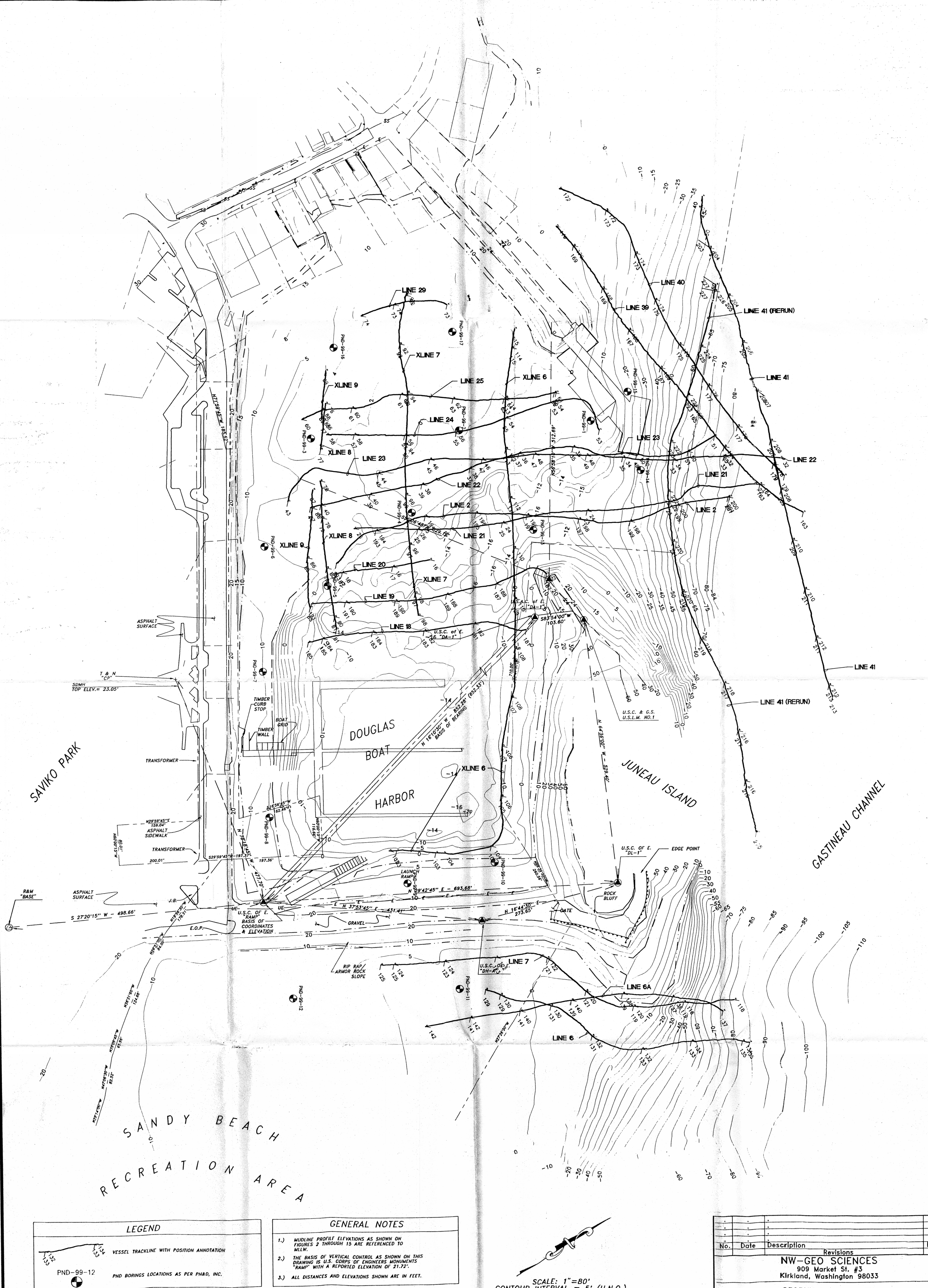
In conclusion several items were observed and mapped throughout the study area.

- The soft unconsolidated silt/sand material appears to become thinner from south to the north within the study area.
- In the area of the proposed harbor expansion a very dense till material was identified and may create problems for future dredging programs.
- Near the harbor entrance, bedrock rises closer to the mudline than any area within the survey site.

NW-GEO was pleased for the opportunity to assist you with this project. If you have any questions please call me at (425) 576-9377.

Sincerely

Gerald Douthit
NW-GEO



LEGEND

(vessel trackline symbol)	VESSEL TRACKLINE WITH POSITION ANNOTATION
PND-99-12	PND BORINGS LOCATIONS AS PER PN&D, INC.

TABLE OF CONTROL POINTS

POINT	NORTHERLY	EASTERLY	ELEV	DESCRIPTION
USLM 1	2,354,398.22	2,547,344.33	26.84'	4" BRASS TABLET IN ROCK
DL-1	2,354,171.15	2,547,822.56	63.07'	C. of E. BRASS CAP "3-1/2"
DH-4	2,353,909.10	2,547,743.74	22.52'	C. of E. BRASS CAP "3-1/2"
RAMP	2,353,568.67	2,547,478.75	21.72'	C. of E. BRASS CAP "3"
BASE	2,353,125.71	2,547,249.75	35.49'	1" DIA. RED PLASTIC CAP "R&M CTRL"
CP	2,353,655.46	2,547,010.96	23.46'	MAG NAIL IN ASPHALT 1" MAG

GENERAL NOTES

1.) MUDLINE PROFILE ELEVATIONS AS SHOWN ON FIGURES 2 THROUGH 15 ARE REFERENCED TO MLLW.

2.) THE BASIS OF VERTICAL CONTROL AS SHOWN ON THIS DRAWING IS U.S. CORPS OF ENGINEERS MONUMENTS "RAMP" WITH A REPORTED ELEVATION OF 21.72'.

3.) ALL DISTANCES AND ELEVATIONS SHOWN ARE IN FEET.

SURVEYOR:

R&M ENGINEERING, INC.
P.O. BOX 34278
JUNEAU, ALASKA 99803
R&M PROJ. NO. 991713

FIGURE 1

No.	Date	Description	By
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.

Revisions

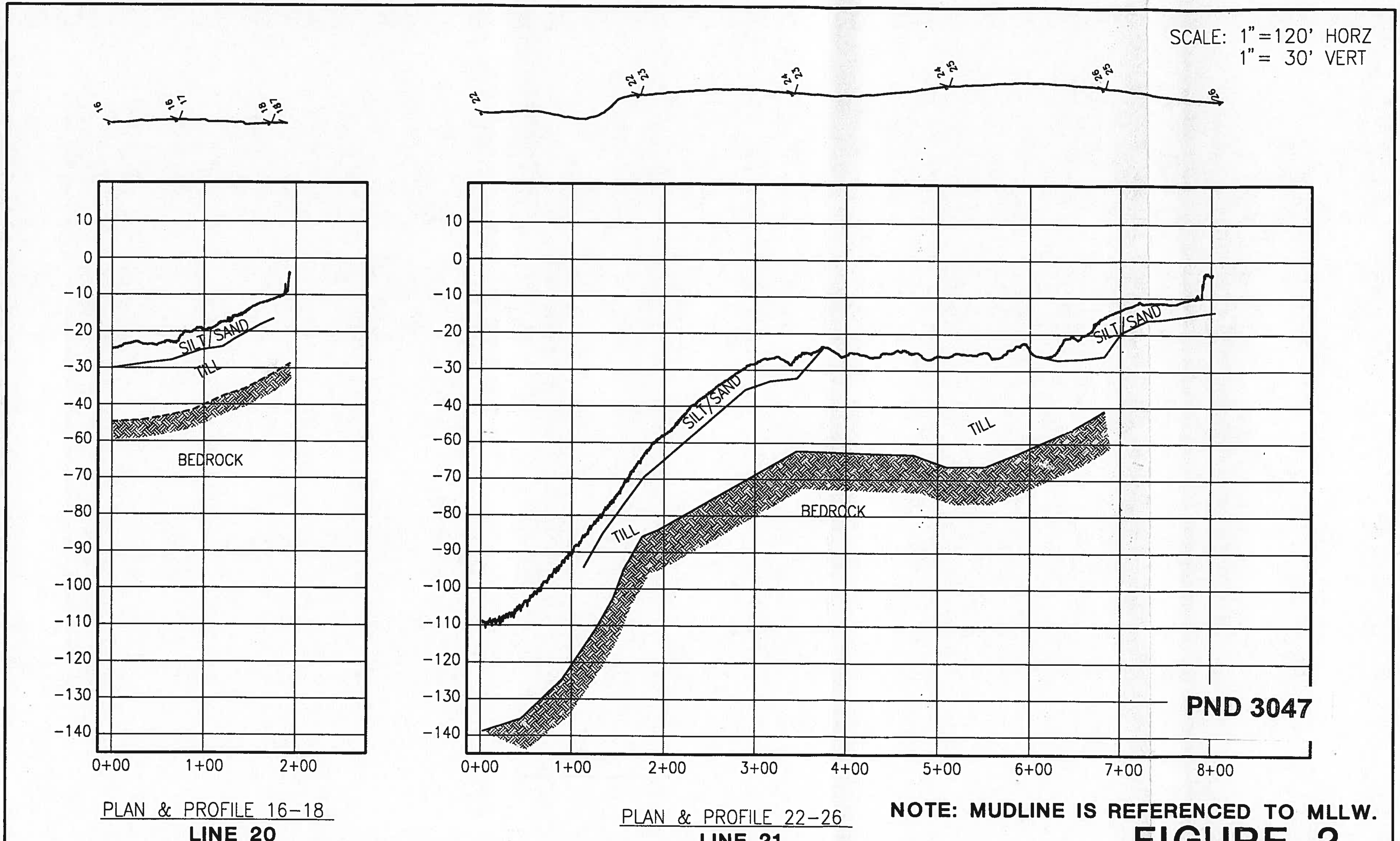
NW-GEO SCIENCES
909 Market St. #3
Kirkland, Washington 98033

GEOPHYSICAL SURVEY
PROFILE. LINE LOCATIONS
DOUGLAS HARBOR, JUNEAU, AK.

PERATROVICH, NOTTINGHAM & DRAGE INC.
ENGINEERING CONSULTANTS
3220 Hospital Dr., Suite 200
Juneau, Alaska 99801

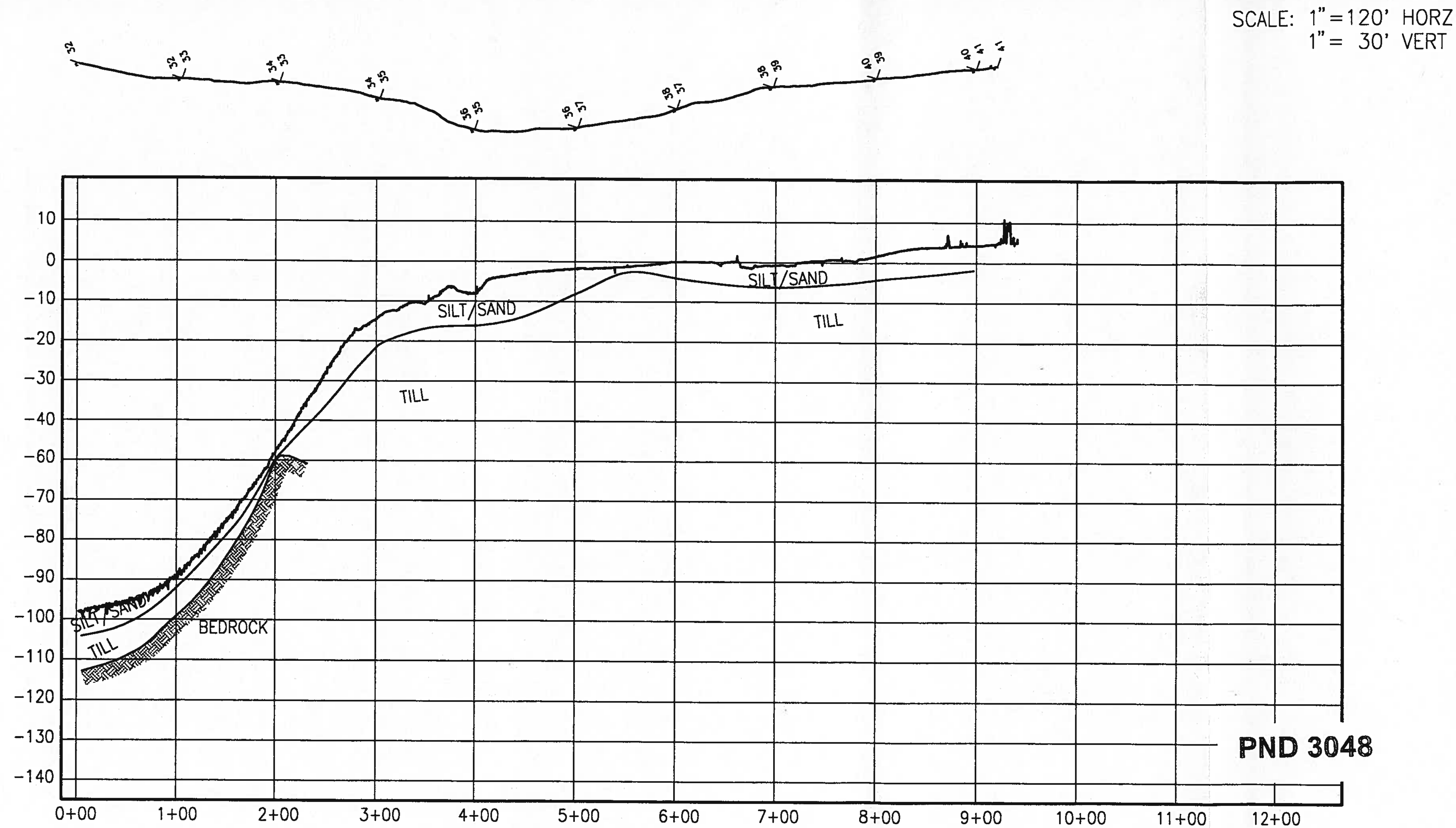
PND 3046

Surveyed	Drawn	Checked	Submitted	Date
GD	CC	GD	.	7/20/99



NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 2

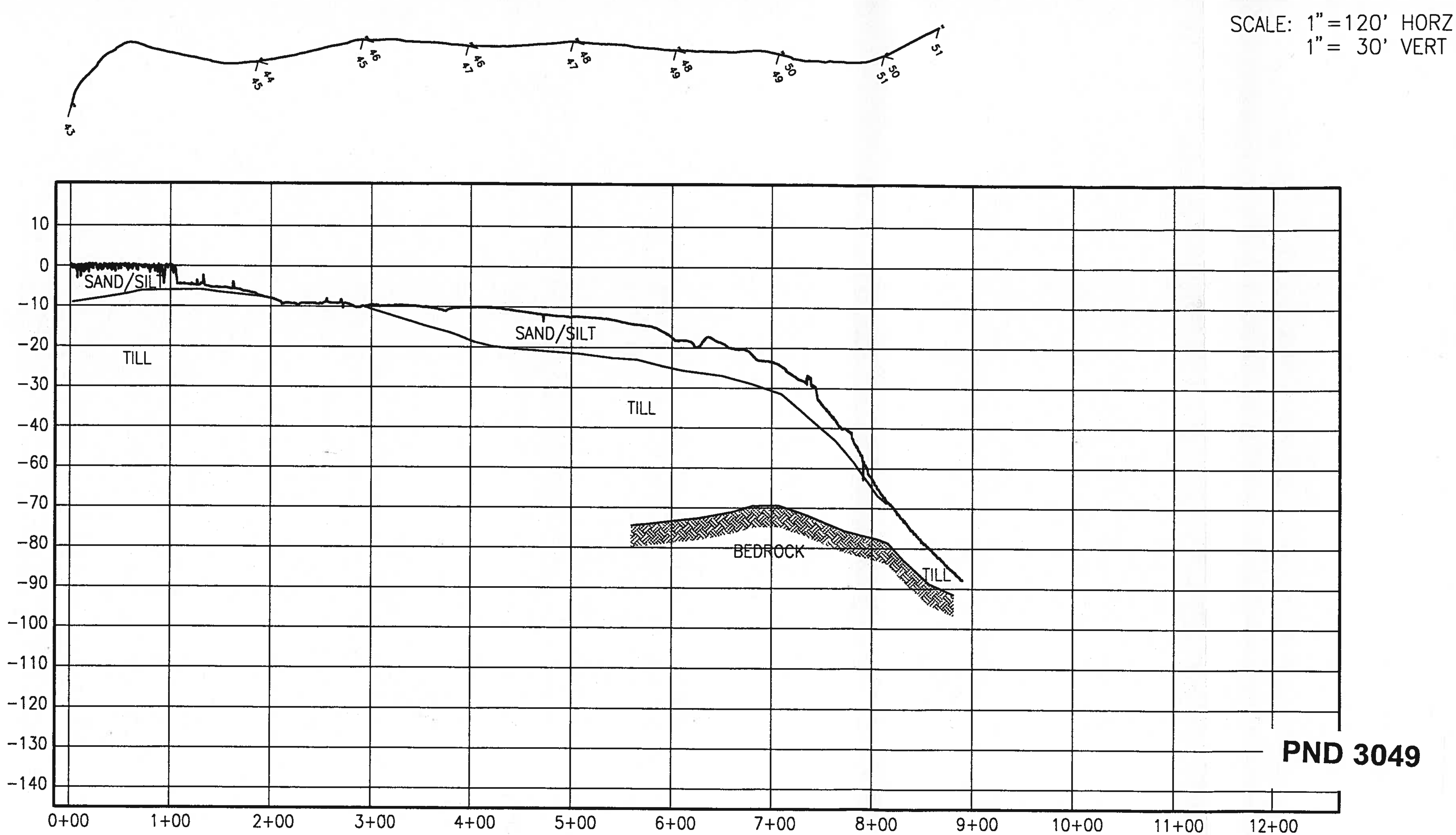


PLAN & PROFILE 32-41

LINE 22

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 3



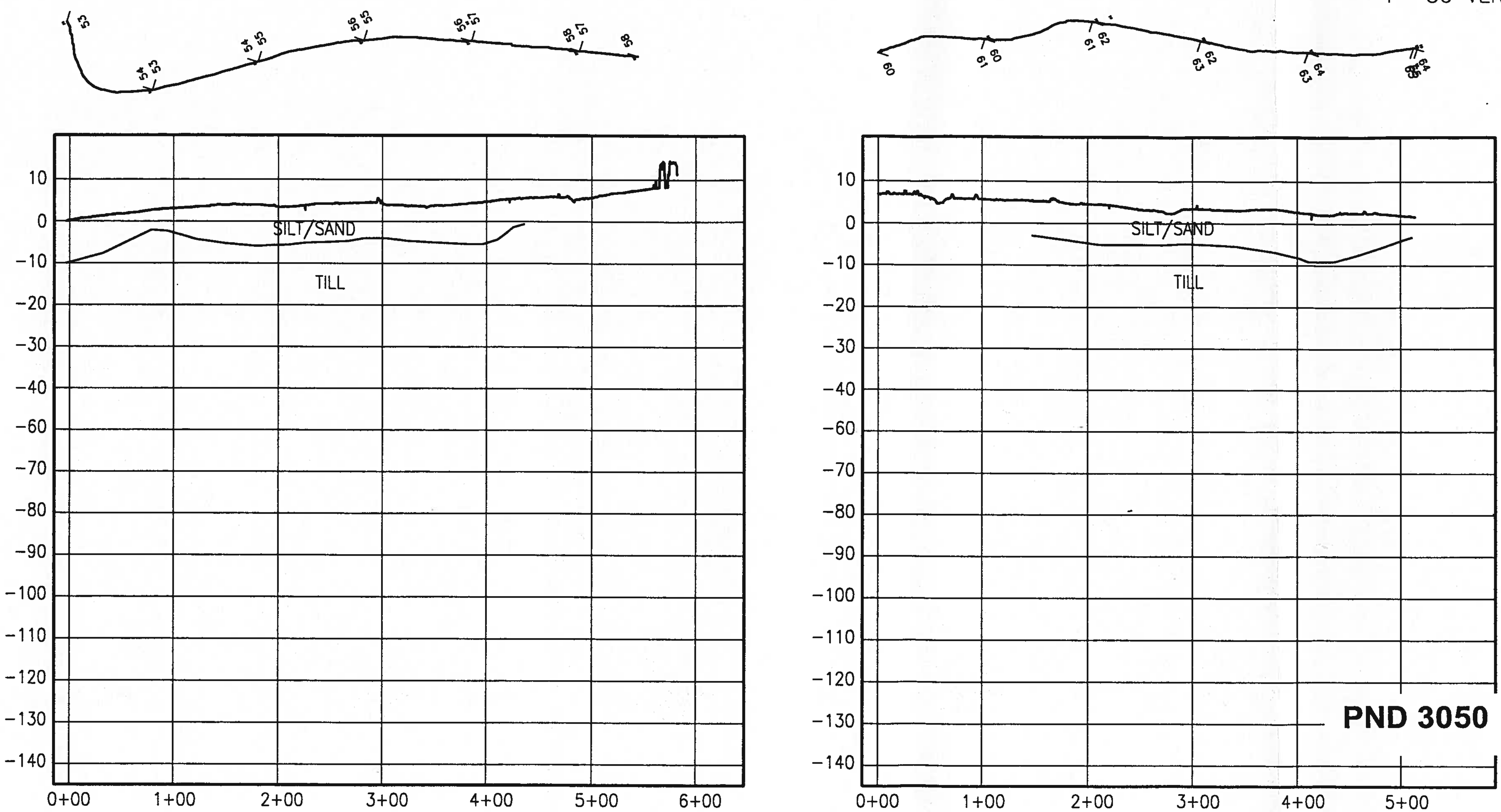
PLAN & PROFILE 43–51

LINE 23

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 4

SCALE: 1=120 HORZ
1= 30 VERT



PLAN & PROFILE 53−58

LINE 24

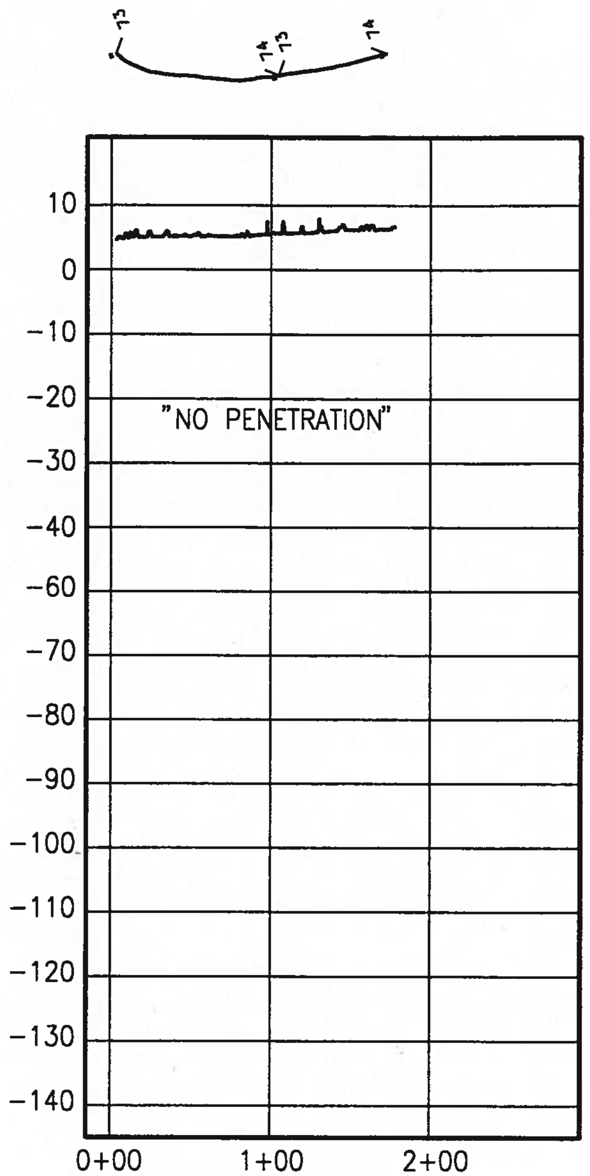
PLAN & PROFILE 60−65

LINE 25

NOTE: MUDLINE IS REFERENCED TO MLLW.

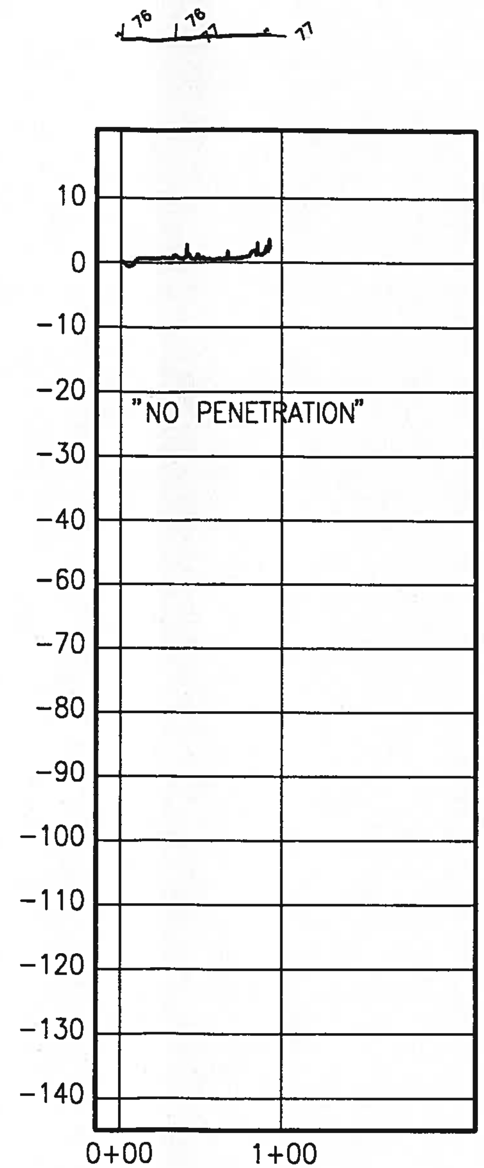
FIGURE 5

SCALE: 1"=120' HORZ
1"= 30' VERT



PLAN & PROFILE 73-74

LINE 29



PLAN & PROFILE 76-77

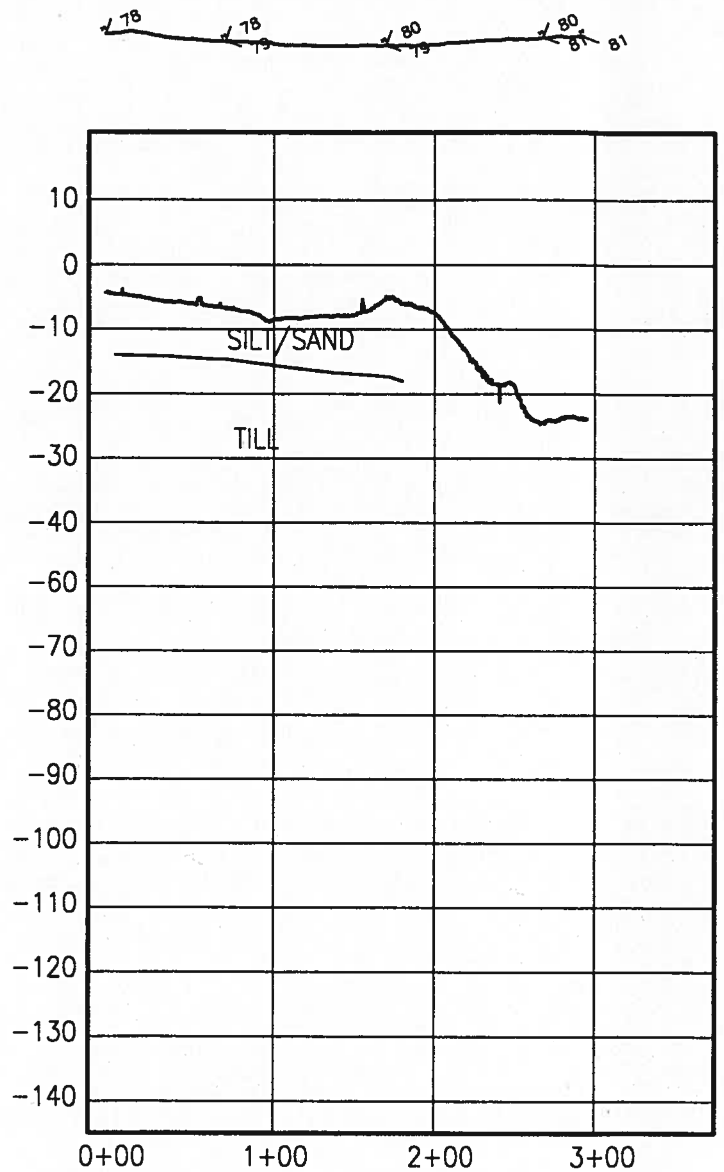
XLINE 8

PND 3051

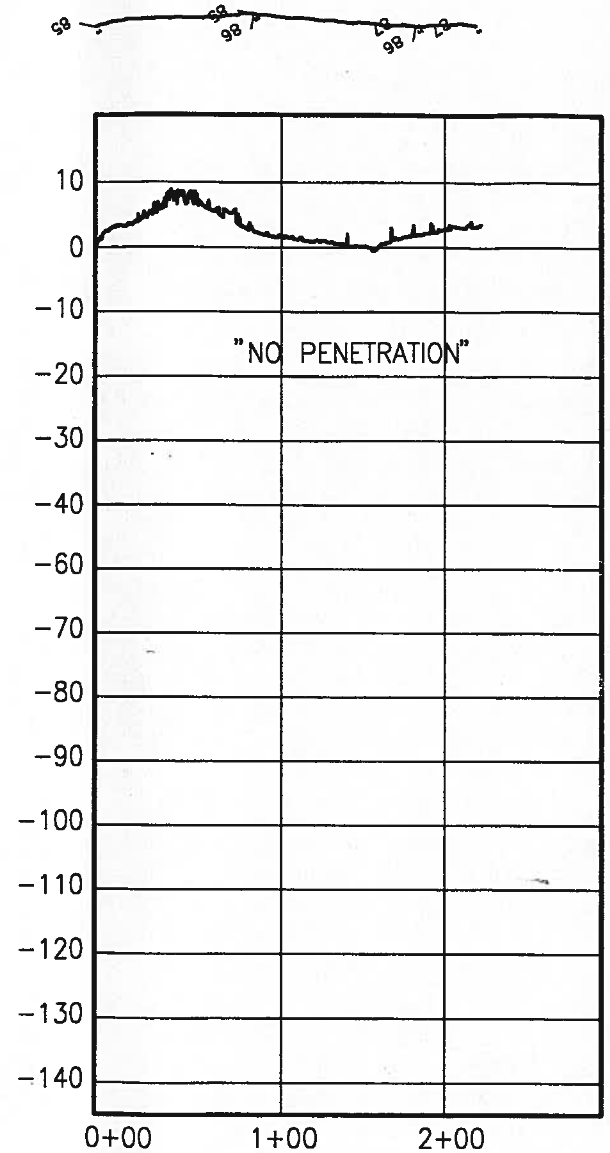
NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 6

SCALE: 1" = 120' HORZ
1" = 30' VERT



PLAN & PROFILE 78–81
XLINE 8

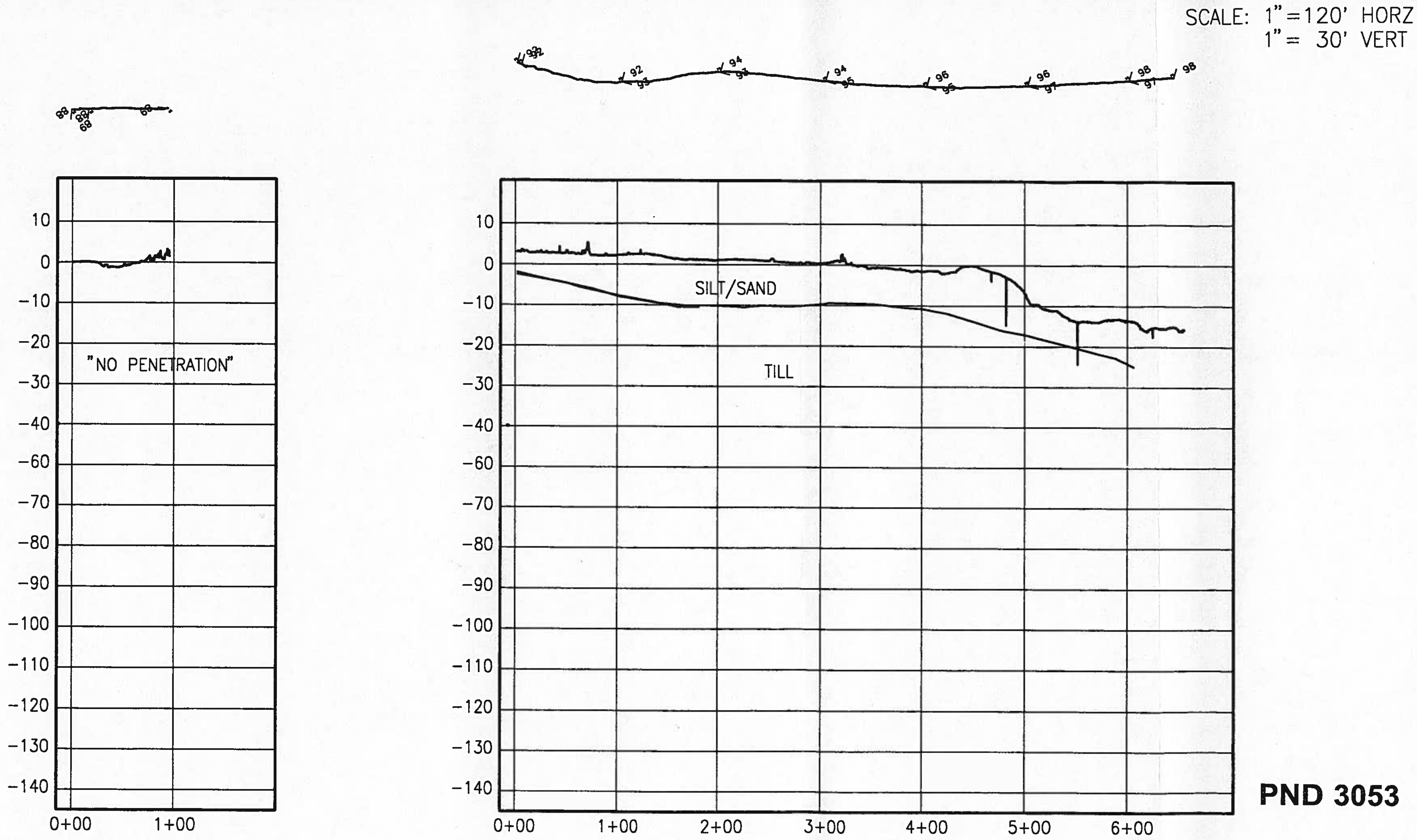


PLAN & PROFILE 85–87
XLINE 9

PND 3052

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 7

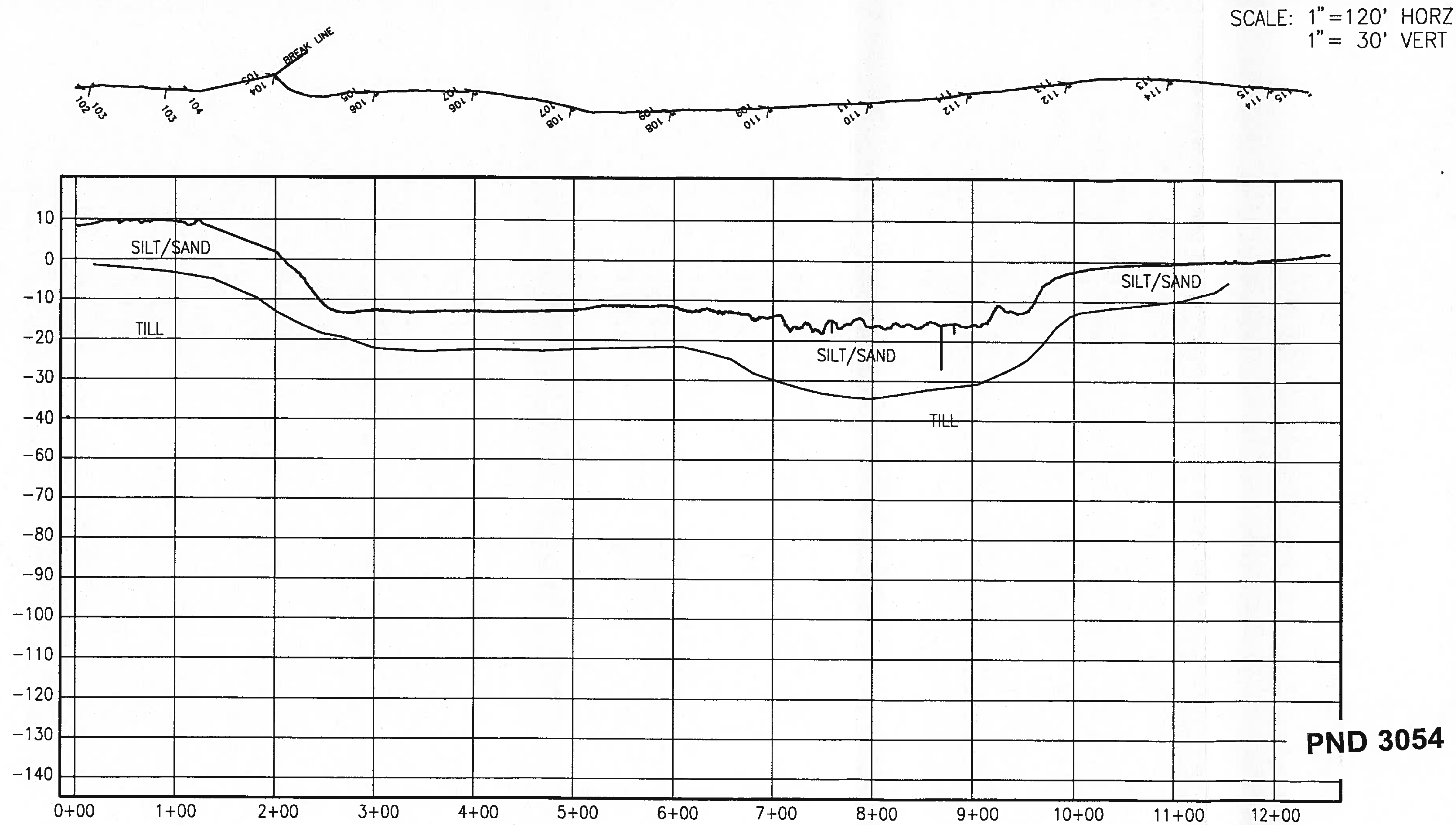


PLAN & PROFILE 88-89
XLINE 9

PLAN & PROFILE 92-98
XLINE 7

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 8



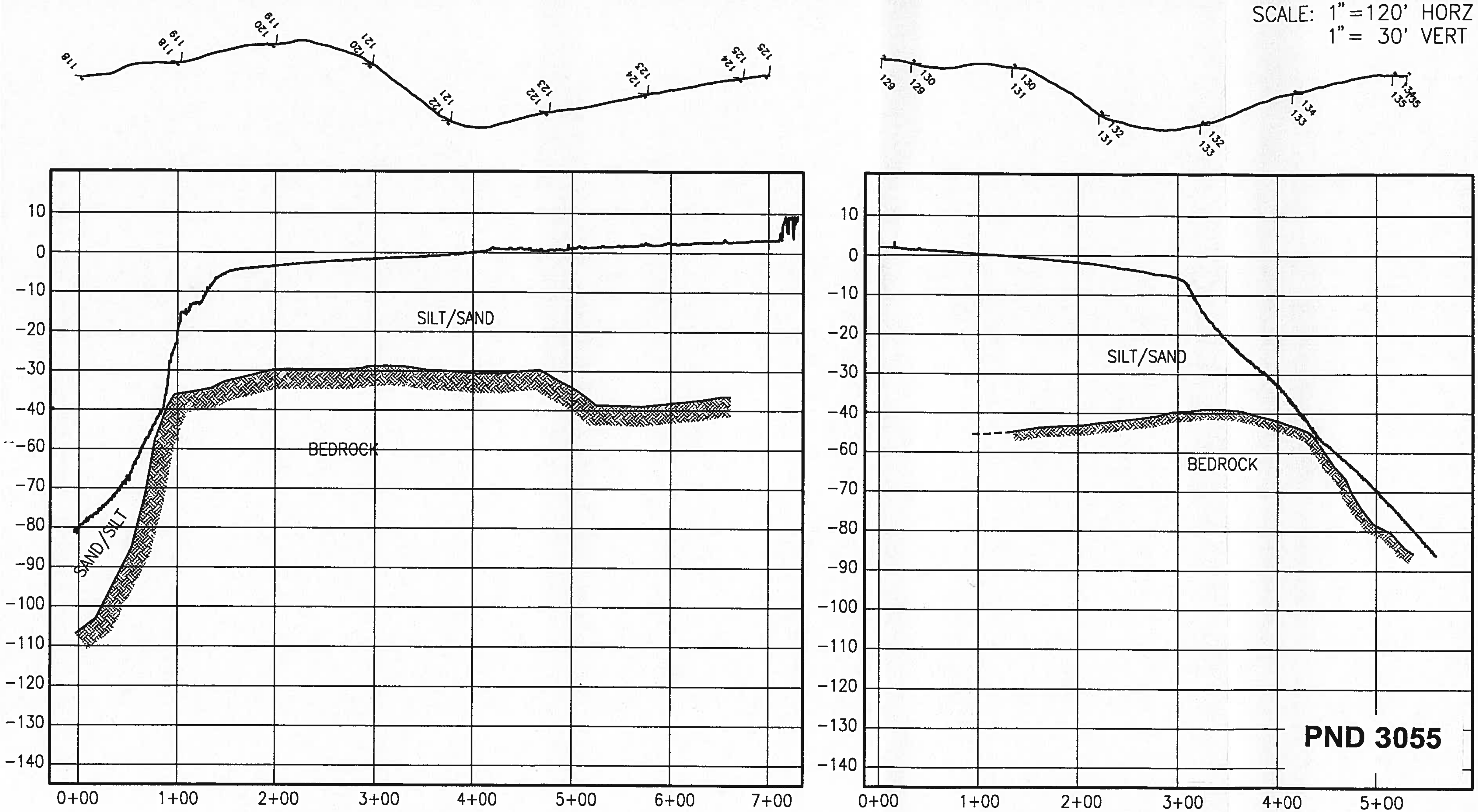
PND 3054

PLAN & PROFILE 102-115

XLINE 6

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 9

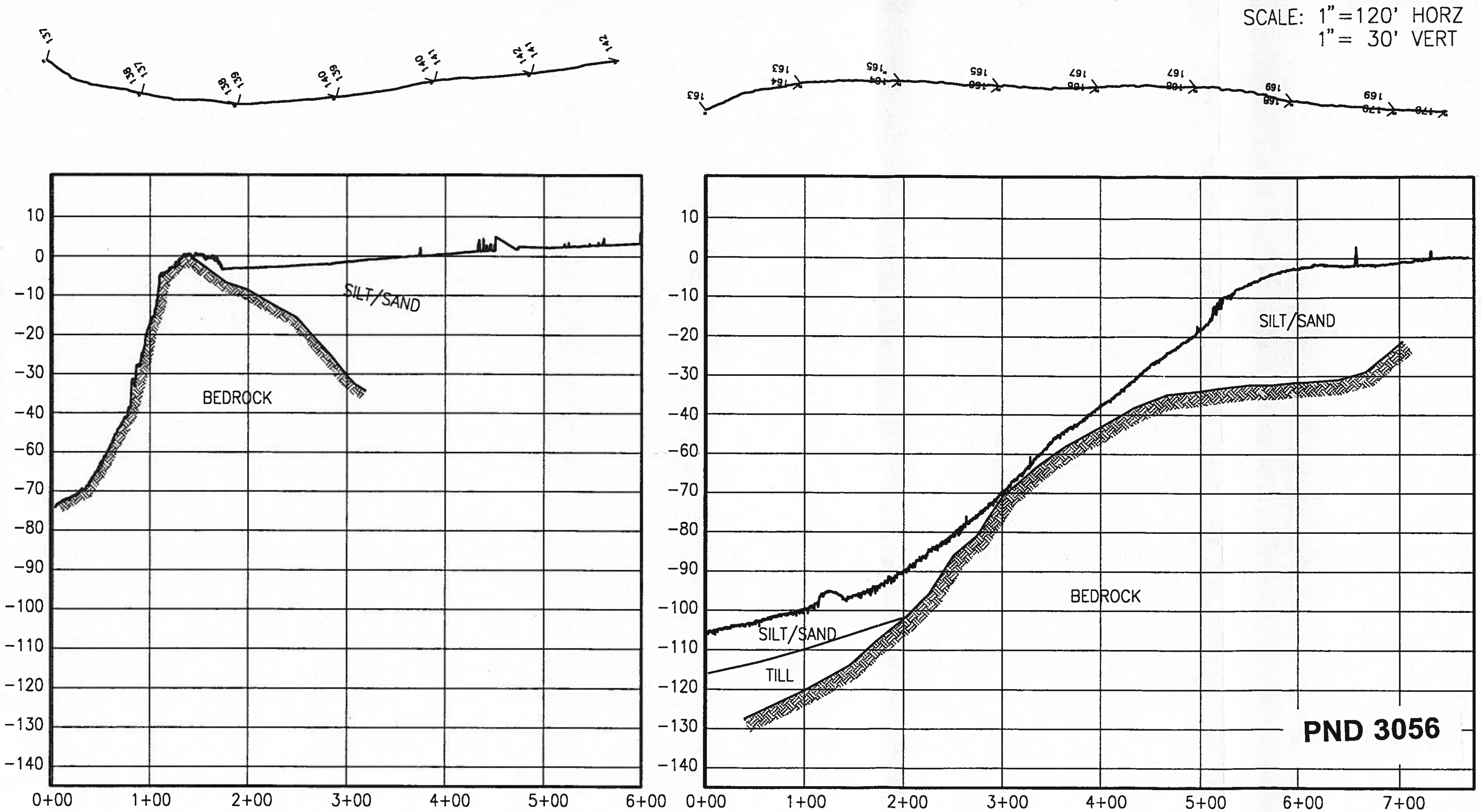


PLAN & PROFILE 118-125
LINE 7

PLAN & PROFILE 129-135
LINE 6

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 10



PLAN & PROFILE 137-142

LINE 6A

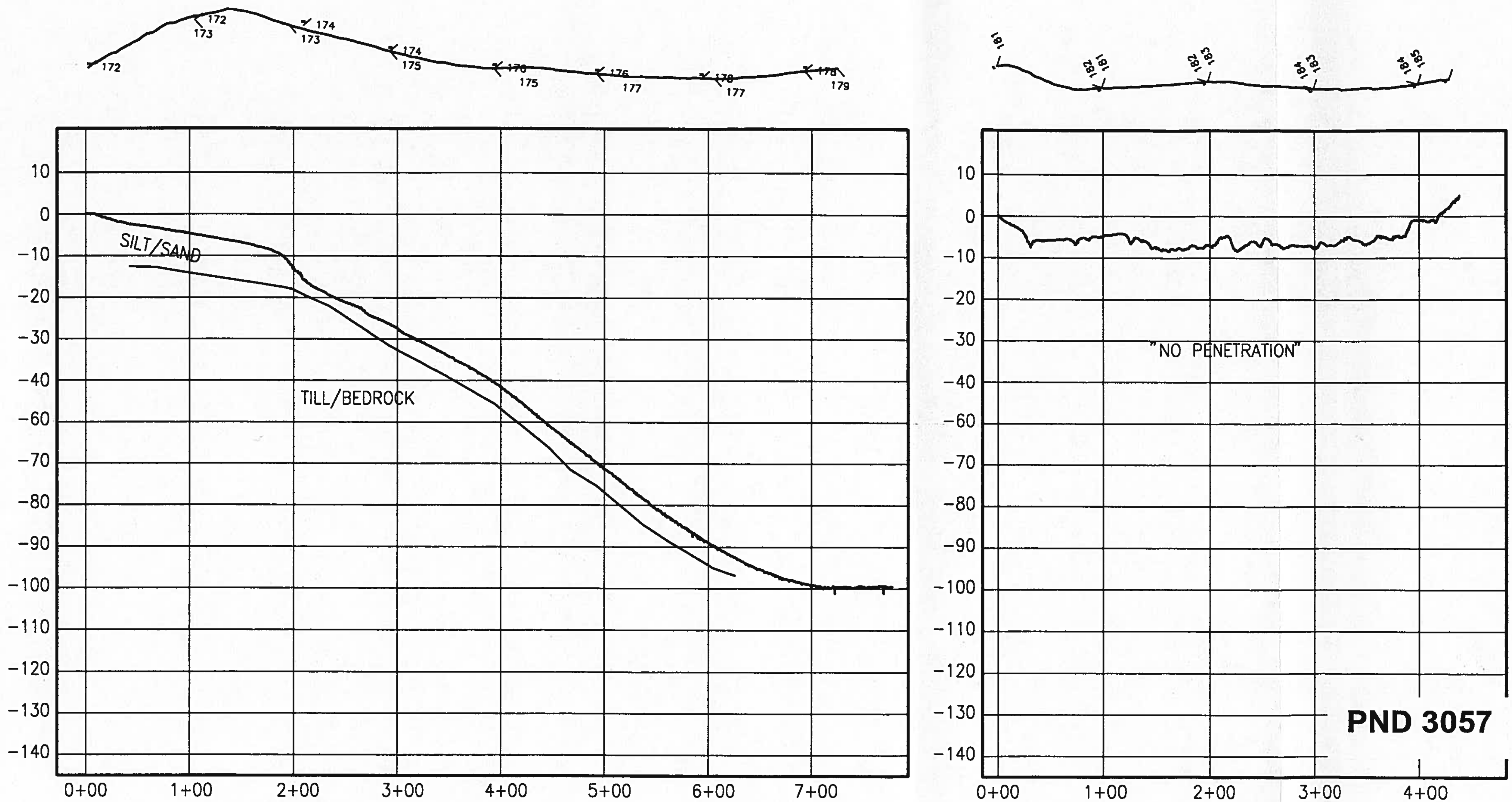
PLAN & PROFILE 163-170

LINE 39

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 11

SCALE: 1" = 120' HORZ
1" = 30' VERT



PLAN & PROFILE 172–179

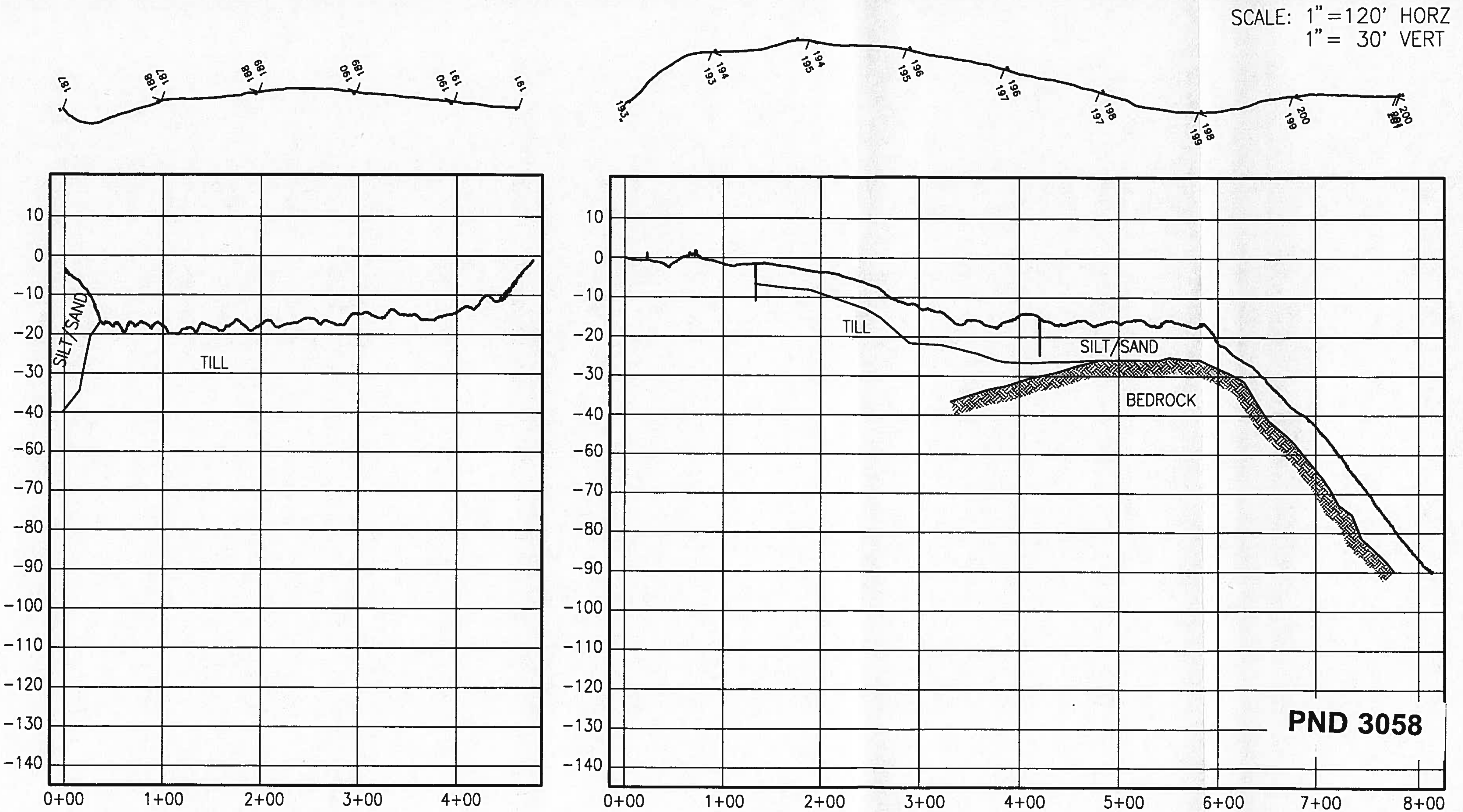
LINE 40

PLAN & PROFILE 181–185

LINE 18

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 12



PLAN & PROFILE 187-191

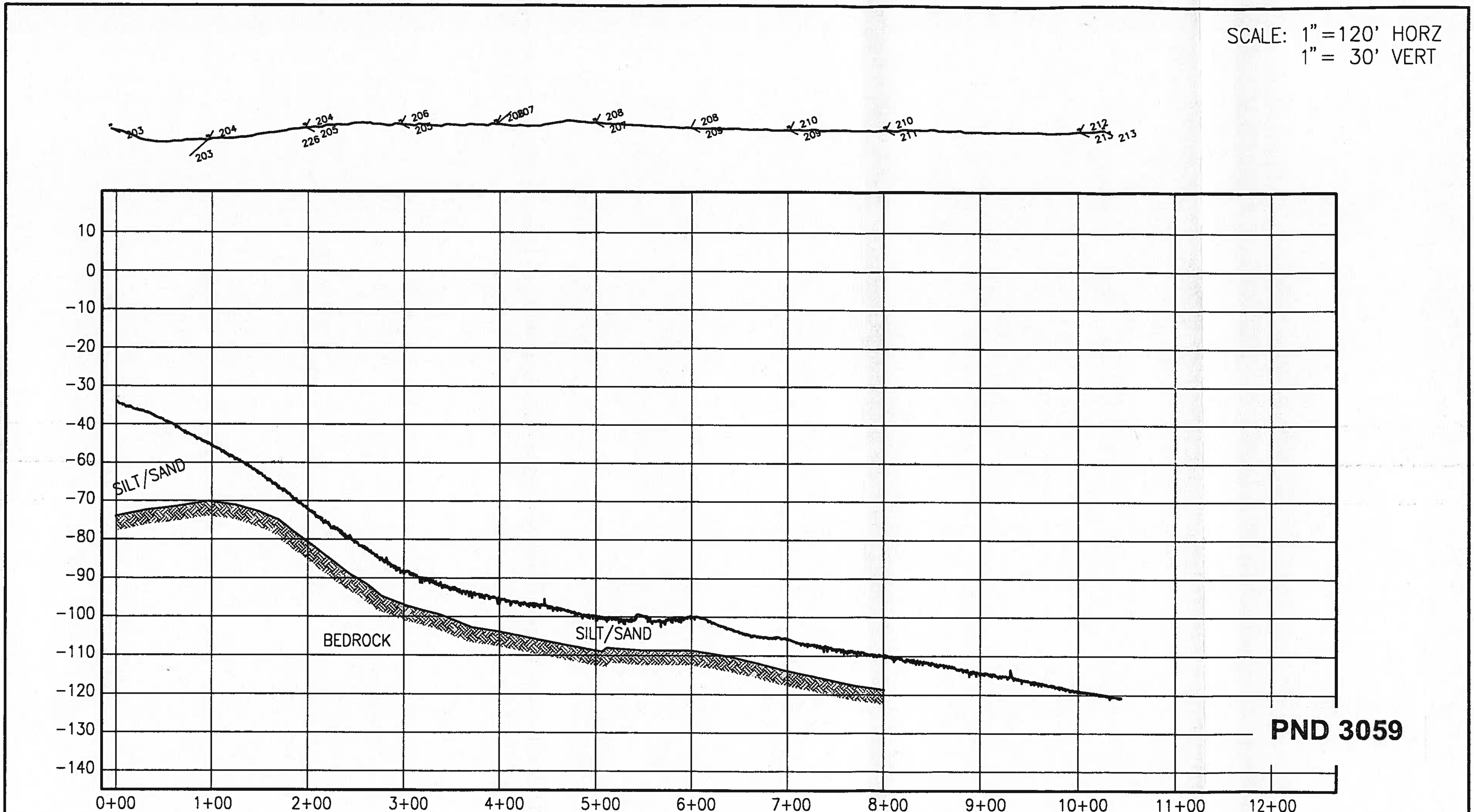
LINE 19

PLAN & PROFILE 193-201

LINE 2

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 13



PLAN & PROFILE 203-213

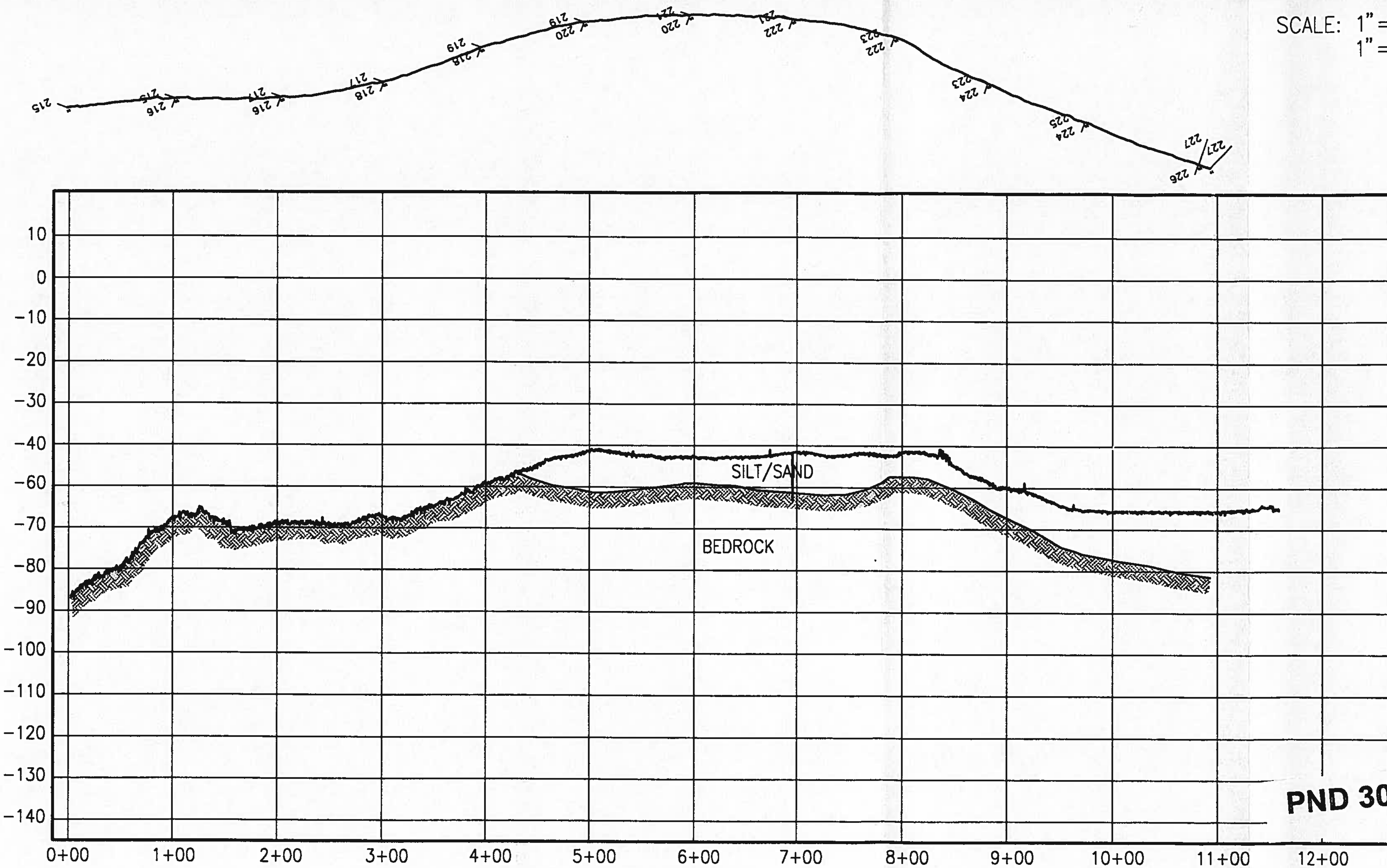
LINE 41

PND 3059

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 14

SCALE: 1"=120' HORZ
1"= 30' VERT



PND 3060

PLAN & PROFILE 215-227

LINE 41 (RERUN)

NOTE: MUDLINE IS REFERENCED TO MLLW.

FIGURE 15

APPENDIX E

ARTICLE

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNCIAL ENGINEERING REPORT

PND 3061

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one—not even you*—should apply the report for any purpose or project except the one originally contemplated.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject To Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations", many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE PROFESSIONAL FIRMS PRACTICING IN THE GEOSCIENCES
8811 Colesville Road Suite G106 Silver Spring, MD 20910
Telephone: 301-565-2733 Facsimile: 301-589-2017
email: info@asfe.org www.asfe.org

IIGER06983.5M