A report prepared for

CE2 Engineers, Inc.
P.O. Box 232946
Anchorage, AK 99523-2946

GEOTECHNICAL INVESTIGATION
Water and Sewer Projects
Chefornak, Alaska

by

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DM&A Job No. 4149.02

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May 11, 1998

DRAFT REPORT

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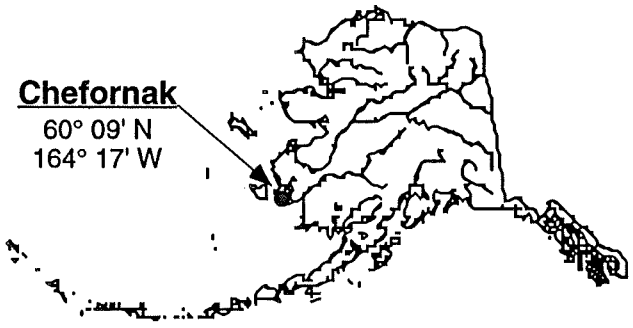
INTRODUCTION

This report presents the results of a soil investigation for the proposed water and sewer projects in the village of Chefornak (see Plate 1). Three sites were investigated. The proposed sewage lagoon west of the airport is shown on Plate 2. The proposed water treatment and water tank site southeast of the village and the boardwalk alignment connecting the water treatment plant to the village are shown on Plate 3.



This work was performed in accordance with our agreement with CE2 Engineers, Inc., dated February 9, 1998. During the work, we have consulted with Messrs. Chuck Eggener, P.E., Paul Weisner, P.E., Lloyd Pearson and Brian Ecklin of CE2 Engineers, Inc. In Chefornak, we were assisted by Mr. Hubert Tunuchuk, mayor of the City of Chefornak.

The object of the investigation was to explore the soil and permafrost conditions at the three sites and to develop conclusions and recommendations regarding the following:

- Use of the soils at the sewage lagoon site for dike construction,
- Site grading and foundation design for the water treatment plant and tank, and
- Foundation support for the water line and boardwalk.

INVESTIGATION

Existing data

We started our work by reviewing previous geotechnical investigations performed in the village. A soil and foundation investigation of the secondary school site was originally performed by R&M Consultants (report dated March 1979). They drilled and sampled three borings to depths of 20 to 31 feet at the building site and measured ground temperatures. Based on the warmest temperature measured with the thermistor string shortly after drilling, they recommended a ground temperature of 30.5°F. for foundation design.

In 1991 we reviewed the R&M data and provided consultation during the installation of piling for the addition to the school. Conditions found during the pile installation were similar to those found in 1979, and the timber piles were installed to depths of 25 in predrilled holes and were backfilled with sand-water slurry.

In Dec. 1995 we evaluated the piling installed for support of the proposed general store. The piles had been installed to depths of about 18 feet and had experienced severe frost jacking in the first two winters. Measurements inside the piling showed temperatures or 31.0 to 31.1° F at the tip of the piling.

In 1994, a series of water wells were drilled on the eastern edge of the village along the south bank of the Kinia River. Those borings encountered surficial silts and organics overlying a layer of basalt rock. Discontinuous permafrost was found in the area. The locations of those wells are shown on Plate 1 and the logs are included at the end of this report.

Reconnaissance exploration

In October, 1997, Mr. Mike Hendee, engineer with DM&A, made a reconnaissance trip to determine whether the three sites were underlain by permafrost and to investigate the possibility of mining the area east of the sewage lagoons for embankment material. The active layer depth was measured by pushing a 1/8-inch iron-pipe by hand. Shallow test pits were also hand dug with a shovel. The locations of the test pits are shown on Plates 2 and 3. Logs of

the test pits and the depths of the active layer probing are shown on Plates 4 and 5. It was determined that a more in-depth investigation was needed and a drilling program was developed and scheduled to follow one planned by the Alaska DOT&PF for the airport.

Drilling program

Mr. Hendee and Mr. Eklin arrived in Chefornak on March 6, 1998, via scheduled air service from Bethel. The drill crew was already in the village completing another job. The weather in Chefornak was cool with overcast skies and a 20-knot east wind. A skid mounted CME-45 drill rig that is owned and operated by Denali Drilling was used to drill the borings to depths of 8 to 31 feet. The drill rig was towed to the boring locations with a John Deere 455D track loader that is owned by the City of Chefornak.

Mr. Hendee logged the borings as they were drilled using six-inch OD hollow stem auger. Samples were obtained by grabbing soil off the auger flights and by driving a 1.4-inch I.D. split spoon with a 140–pound manually operated hammer falling 30 inches (the Standard Penetration Test). The locations of the borings were determined by comparing topographical features at the site with aerial photographs and a topographical survey provided by CE2 Engineers. Locations along the boardwalk alignment were also determined by measuring swing ties to existing structures. Closed 3/4-inch I.D. PVC pipe was installed in the borings at the water treatment plant site to allow for future temperature measurements.

Laboratory testing

In the laboratory, the samples were re-examined to confirm the field classification and to select samples appropriate for testing. The laboratory testing included moisture content, particle size analysis, Atterberg Limits, organic content, and salinity tests. Salinity tests were performed by measuring the electrical conductivity of the soil's pore water diluted with additional water, comparing the conductivity with published sea water relationships and then correcting for the amount of dilution.

The locations of the borings are shown on Plates 2 and 3. The logs of the borings are presented on Plates 6 through 12. The soils and ice have been

classified in accordance with the Unified Soil Classification System described on Plate 13. The results of the moisture content and salinity tests are shown on the logs of the borings and on the Summary of Samples on Plate 14. The particle size analysis and plasticity charts are presented on Plates 15 and 16.

A bulk sample of the very plastic organic silt (OH) that underlies the lagoon area was compacted in a $1/30^{th}$ cubic foot mold. At a moisture content of 52% (near the natural moisture content) the compacted dry density was 68 pounds per cubic foot (pcf). The shear strength of the compacted sample was then estimated by performing both Torvane and pocket penetrometer tests on the top and bottom of the sample. Both methods showed shear strengths on the bottom of the sample varying from 500 psf to 800 psf and averaging 600 psf.

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The black, highly plastic, organic silt exhibits a thixotropic behavior. It flowed from the hole when it was disturbed by the drilling, but when it was allowed to rest without disturbance it regained strength. Based on the moderate sampling blow counts (SPT N-values of 3 to 7) and the consistency in the sampler, we estimate that the undisturbed material is medium stiff (a shear strength of 500 to 1000 psf). The bulk sample of the liquefied material was allowed to sit for 3 weeks in a plastic fabric bag and firmed up over the period.

Seasonal frost was encountered in the borings to depths of 2.3 to 4.5 feet. The underlying material was unfrozen to the depth of the holes. Probes conducted in October, 1997 along the access road and on the above slope, encountered hard resistance between 1.6 and 2.4 feet, excluding evident boulders. The test pit hand dug in the higher ground near the northeast corner of the boundary encountered frozen ground at 2.1 feet.

Water Treatment Plant & Water Tank Site

The proposed site for the water treatment plant and water tank is east of the village and south of the Kinia River. The site is on ground approximately 4 feet higher than the surrounding terrain. The knoll slopes gradually to the west and has slopes of 2:1 to 3:1 on the north and south sides. There is a steeper bank on the eastern side. At the time of this investigation, numerous skiffs were stored at the site with snow drifted around and above them to 3 feet deep.

Two borings were drilled at the site. Boring B-3 was drilled on the north end of the knoll and Boring B-4 was drilled on the south end. Both borings show a thin surficial peat mat with organic silt to depths of 18 to 24 inches. The surface organic soils are underlain by gray, icy silt over black, plastic organic silt.

Both borings were fully frozen to the depths explored, 30 and 15.5 feet. Ice lenses 1/4-inch to 2-inches thick were encountered in the black plastic organic silt. An 18-inch thick layer of massive ice was found at a depth of 15 feet in Boring B-3. Active layers measured just at the start of freeze-up in October 1997 encountered hard resistance at depths of 2.0 and 2.8 feet. The two hand dug test pits encountered frozen ground at 2.5 feet. Probes of the surrounding lower ground encountered no resistance to 5.0 feet, the depth of the probe.

Moisture (ice) contents in the frozen soils are high and show that the soil is not thaw stable. The salinity tests show a salt content averaging about 2 parts per thousand (ppt). For comparison, seawater has a salt content of about 33 ppt. A salt content as high as 4 was measured for the sample at 9 feet in Boring B-3. The salt depresses the freezing point of the soil about 0.1°F per ppt, so for 4 ppt the soil would freeze at 31.6°F.

Boardwalk Alignment

The proposed boardwalk alignment connects the proposed water treatment plant with the existing boardwalk near the National Guard Armory. The alignment crosses a small drainage slough with standing water. The ground elevation at the slough is approximately 7 feet lower than the knoll at the water treatment plant site. Snow depths varied from 0.5 feet to 1.5 feet deep along the alignment. Three borings were drilled along the alignment: Boring B-5 in the slough, Boring B-6 230 feet west of the slough and Boring B-7 270 feet east of the slough. The borings peat and organic silt to depths of 2 to3 feet. The organic soil is underlain by a layer of gray silt over black plastic organic silt. The boring in the slough encountered rock at 13.5 feet. The black plastic organic silt exhibited the same thixotropic behavior as the material encountered at the sewage lagoon site.

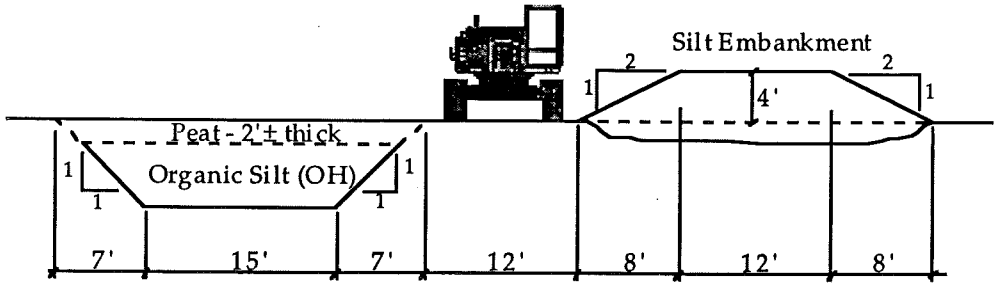
The boring at the slough was unfrozen below 4 feet and the other two were fully frozen to the depths drilled, 15.5 feet. A small amount of visible ice was evident in the frozen material.

DISCUSSION and RECOMMENDATIONS

Sewage Lagoon Site

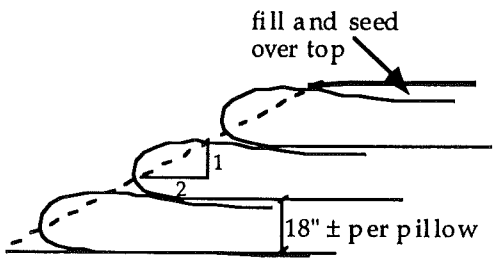
The proposed sewage lagoon can be enclosed with a dike constructed of the organic silt mined from beneath the surface peat layer. The material is wet and can become very soft when disturbed. Consequently, the material should be mined by digging with a track-mounted excavator that is working on the undisturbed natural ground. If the ground is unfrozen, the excavator will probably have to work on mats. After a frozen crust has developed in the winter, the ground will support a tracked excavator.

Mr. Ecklin says that the excavation work will most likely be performed in the spring when the surface of the ground is frozen and air temperatures are moderating. The surface layer of peat will first be stripped and removed from the side-borrow area and then the organic silt will be excavated and placed to build the embankment.



The preceding schematic shows the four-foot high embankment and the side-borrow excavation required to construct the dike if two feet of peat is initially stripped from the borrow area.

The material is highly frost susceptible and with several seasons of freeze-thaw cycles, the slopes of the dike are expected to flatten significantly. To reduce this effect, the slopes of the organic silt should be encapsulated in engineering fabric. The height of each pillow should be about 18 inches and the fabric should be rolled back over the top of the fill slope and be buried by the next layer. The



bottom layer of fabric does not have to be the full width of the embankment, but should extend at least back to the top of slope. Fabrics such as Amoco's nonwoven geotextiles are sold in widths of 15 feet and one piece is adequate to place an eight-foot long section on the base, enclose the front of the pillow, and bury at least four feet of the top piece.

Each layer or pillow of the organic silt should be track-walked to densify the material as much as possible considering the very wet condition of the soil. If the material softens so that the bulldozer cannot work on its surface, the excavator and dozer should move onto the next section of embankment and give the fill material time to regain strength. If the material is frozen when placed, the compaction will have to be performed the following summer when the silt is unfrozen. If the silt is not compacted, the dike will not have the permeability needed to retain water.

The embankment is expected to settle when the underlying peat thaws. The settlement is expected to be one to two feet depending on the thickness of underlying peat. Consequently, the dike should be built high to accommodate settlement or extra material should be stockpiled to provide for remedial grading as the settlement occurs.

The top of the dike should be capped with a layer of organic silt that is at least six inches thick. The surface should be fertilized and seeded to promote a growth of vegetation. Vegetation on the surface of the dike will reduce the annual depth of freeze and thaw.

Water Treatment Plant & Water Tank Site

The new water treatment plant will be housed in a 2400 square foot building. The adjacent steel water tank will provide 66,000 gallons of storage. The building and water tank could be supported on pile foundation system. But because of the warm ground temperatures, piles in the permafrost would have relatively small adfreeze capacity. An at-grade foundation system will provide positive support for the tank and building if the permafrost underlying the site is kept frozen. If the permafrost thaws, large settlements will occur. The design team has selected the at-grade foundation system for the new facilities.

The building will be supported on spread footings at shallow depth and the underlying permafrost will be protected from thaw by an insulated, gravel fill pad with passive, thermal syphons beneath the insulation. The thermal syphons are manufactured in Anchorage by Arctic Foundations, Inc. The thermal syphons remove heat from the ground in the winter with no moving parts (no fans or pumps). The fill pad will be insulated with a continuous layer of extruded polystyrene board insulation. The thermal syphons are spaced close enough in the fill so that they fully refreeze any soil that might thaw each summer when they are not operating. The thermal syphons must be sloped so that condensate flows to the tip of the pipe.

The fill beneath the insulation layer is expected to thaw each summer when the thermal syphons are not operating. The depth of thaw depends on the floor temperature of the building or tank, the thickness of insulation, the moisture content of the fill, and the amount of cooling provided each winter by the thermal syphons. To reduce the amount of annual movement from thaw and refreezing of the fill layer, the fill should be a clean, non-frost-susceptible sand or sandy gravel.

If the natural soils are unfrozen when the new fill is placed as an overlay, the unfrozen soil will compress under the weight of the fill. Additional movement will occur when the organic and silty soil refreezes. To prevent these movements from effecting the building, the fill , insulation and thermal syphons will be constructed the year before the building and tanks are erected. Once the underlying soil is refrozen, an at-grade foundation system will provide positive support for the new building and tank and foundation differential movements after the first year are expected to be less than one half inch.

A layer of engineering fabric should be placed on the subgrade prior to the placement of fill. The fabric should be Mirafi 500 or equivalent.

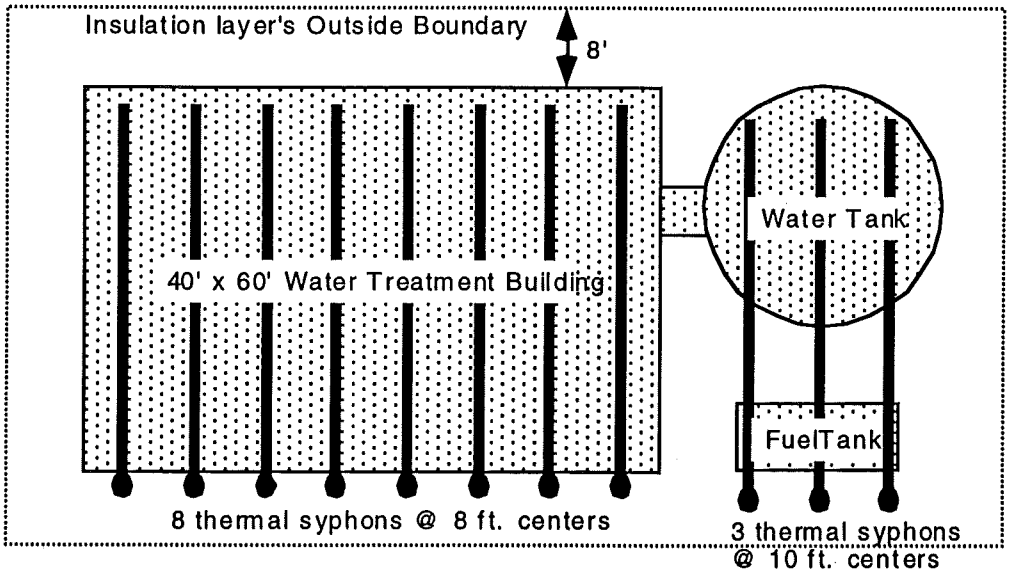
The fill material should be a sand or a mixture of sand and gravel containing less than 10% material passing the #200 sieve size. The sand and gravel should be unfrozen when placed and should be free of muck, organic matter or other deleterious material. The sand and gravel should be placed in thin lifts and each lift should be compacted with a roller to at least 95% of the maximum dry density of the same material as determined by the ASTM D-1557

test procedure (relative compaction). The fill material should be at or slightly wet of optimum moisture content when placed and compacted.

Depending on the strength of the unfrozen silt, the compaction of the initial lift of fill might have to be lighter than 95% relative compaction. If the subgrade material is too soft and starts to pump under the compactive force, the compactive effort should be stopped and the fill placement continued.

The footings and tank should be underlain by insulation over fill material with a cooling system in the sand and gravel fill or underlying silt. For the thermal analysis we have assumed that the water tank will be as warm as 55°F and the building will have a floor temperature of 70° F. The fill surface under the fuel tank will have a heat gain roughly equivalent to a floor temperature of 55°F.

Schematic of insulation and thermal syphon layout

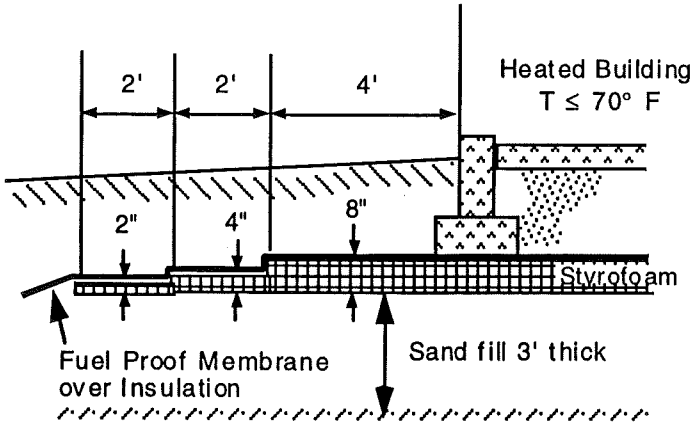


The thermal syphons should be constructed of 3-inch diameter steel pipe and should have a radiator section with at least 70 square feet of area. The thermal syphons should be properly coated to prevent corrosion. The vertical section of the thermal syphons can be free standing or can be bracketed to the building. They should be protected from vehicle damage with bollards or bull rails or from falling ice or snow from the roof. The radiators should be temporarily braced and protected during completion of the fill placement and construction of the building.

Adequate cooling can be provided with the thermal syphons spaced at 8-foot centers and running under the narrow direction of the building as shown in the preceding sketch. The thermal syphons can be placed inside the outer boundary of the insulation. Under the two tank, three thermal syphons spaced at 10-foot centers will be adequate for the cooler temperatures. The thermal syphons should be buried in or under the sand and gravel fill with a slope of at least 5 percent (at least 2 feet of fall in 40 feet of length). The trenches should be backfilled with saturated sand and gravel.

Three-inch diameter pipe can be bent in the field using conventional tools. This allows the shipment of straight pipes and condensers. The bottom of the radiator section should be above the expected level of snow drifts.

Based on a floor temperature of 70° F and an underlying fill that is 3- feet thick, an 8-inch thick layer of insulation should be placed beneath the water treatment plant building. With an average internal temperature of 55° F, the insulation layer under the tanks area can be 6-inches thick. The insulation should be a closed cell, extruded polystyrene such as Styrofoam®. The insulation is available in boards that are two-inches thick by two feet wide by eight feet long. The insulation should be installed in layers on a smooth, fill surface. The joints of each layer should be staggered. The insulation should be continuous under the building and tank and should extend beyond the building's or tank's perimeter as shown in the adjacent sketch. Thinner layers of insulation can be used at greater distances out from the building or tank.



The insulation should be protected from spills of deleterious fluids by a fuel-proof membrane such as Permalon® with a thickness of at least 20 mil placed over the insulation. The membrane should extend at least 2 feet beyond the edge of the insulation.

To avoid long term creep deformation of the extruded polystyrene foam, Dow Chemical recommends that loads on the insulation be limited to no more than 1/3 of the compressive strength of the board. Dow Styrofoam Brand High Load is supplied in compressive strengths of 40 psi, 60 psi and 115 psi at 5% compression. Using the allowable 1/3 of the compressive strength, the 40 psi board can be loaded to a pressure of 1,900 psf (13.3 psi), and the 60 psi board can be loaded to 2,900 psf. With the base of the footing about 12 inches above the insulation layer, the footing load will be distributed and reduced at the insulation depth. Therefore, for a strip footing up to two feet wide, a footing bearing pressure of 3,000 psf can be used above the HI-40 Styrofoam or 4,500 psf above the HI-60 Styrofoam.

The temperatures under the building and water tank should be monitored with thermistors installed during construction. Regular readings should be taken fortnightly or monthly and sent to DM&A so that the performance of the design can be monitored.

One vertical array should be placed under the tank and two should be placed under the building. Each vertical array should be placed midway between two thermal syphons and near the quarter points of the long axis of the building or within the middle third of the tank's area.

Three thermistors should be installed at each of the vertical arrays. The top thermistor should be 6± inches above the top of the insulation (midway between the base of the tank or slab and top of insulation), the second thermistor should be at the base of the insulation, the third should be at the base of the fill. The lead wires from the thermistors under the insulation should be brought to the edge of the insulation and fuel proof membranes and then extended into the water treatment building and terminated at an electrical box with a rotary switch. All of the thermistors should be a single point beads on individual lead wires.

A thermistor should also be installed on a thermal syphon at each end of the building to measure outside air temperatures. The lead wire can be brought up the thermal syphon and the bead mounted on the valve guard at the top of the thermal syphon. The wire should have sufficient slack to accommodate thermal changes, but the thermistor at the end should be firmly attached to the steel so that it doesn't flex in the wind.

A precision, fixed resistor should be installed in the readout box to monitor the performance of the multimeter used to obtain readings. The fixed thermistor should have a resistance near 16,000 ohms and be accurate to ±0.1%.

The above plan results in 12 readings per set of data (11 thermistors + 1 resistor). The thermistors and fixed resistor should be numbered consecutively and the locations and depths of each of the thermistors should be measured and recorded when they are installed.

The thermistor strings should be fabricated using interchangeable glass bead thermistors (such as YSI 44034) with an accuracy of ±0.1° C. The fabricated strings should be checked in an ice-bath to verify they are water proof, to confirm that their calibration has not drifted and to establish an individual resistance at the ice-point. The leads should have sufficient length to be continuous from the installed point to a convenient interior point where readings can be easily obtained. The lead wire should be 12-gauge, shielded, water proof and suitable for direct burial and should be buried with slack in the line. The readout point should have a wall mounted electrical box with a rotary switch and exterior terminal posts for connecting a 4.5 digit multimeter.

Boardwalk Alignment

The boardwalk will provide access from the water treatment plant to the main part of the village. The design load consists of a 4-wheeler ATV towing a water tank. Fully loaded the ATV and tank trailer impose about 4,000 pounds. With the boardwalk supports spaced on 12-foot centers, the dead load of the material in the walkway adds 2,800 pounds per bent.

The alignment crosses thawed and frozen ground and must be able to withstand vertical frost action movement. With a Chance Anchor that has a1.75-inch square shaft, the calculated frost heave is about 10,000 pounds. The force would be less if the shaft through the active layer is covered with a heat-shrink epoxy covering.

The Chance Anchors are supplied with several different helical configurations. In frozen ground, the anchor should have at least one, 10-inch diameter helix anchor. The section of the shaft from ground surface to a depth of three feet below grade should be coated with the heat-shrink epoxy. The anchor

should be embedded at a total depth below grade of 8.5 feet (about 5.5 feet below the base of the active layer).

For the anchors that are placed in the unfrozen ground near the slough (approximately Stations 4+20 to 6+20), the Chance Anchor should be supplied and with a triple helix (12", 10" and 8" at the tip). The shaft through the active layer should also be covered with the epoxy heat shrink.

To prevent large frost heave forces from jacking the anchors, none of connecting joints should be in the active layer. The joint above grade should be at least six-inches above grade. The shallowest connection below grade should be at least 3 feet below ground surface.

The boardwalk should be high enough above grade so that a clear space of 18 inches height is proved under the wood.

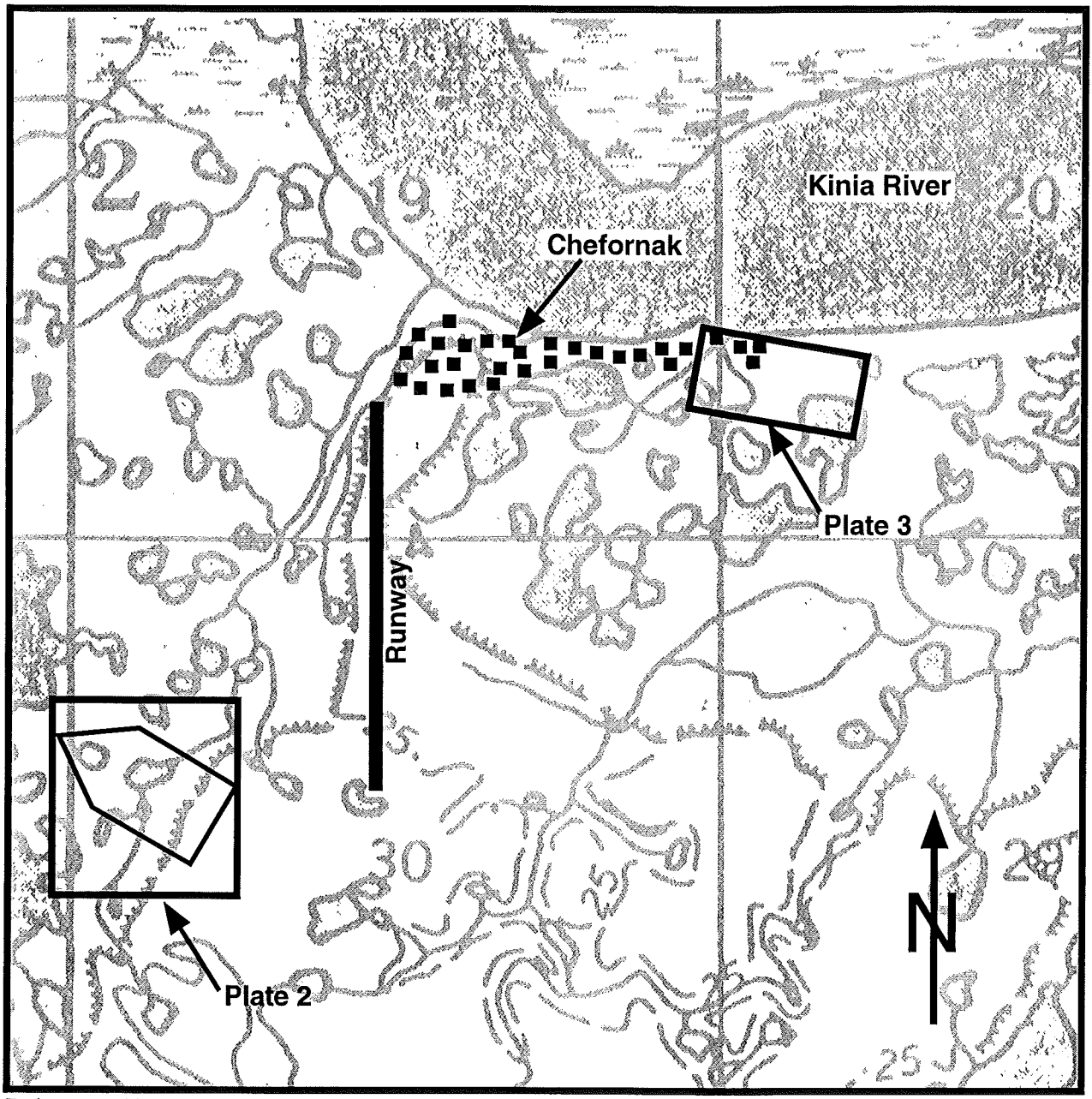
Review and Inspection

We should review the plans and specifications to verify that they are in accordance with the intent of the recommendations in this report.

An experienced inspector should be present full time during the placement and compaction of fill, installation and backfill of the thermal syphons and insulation and the placement of the thermistors and Chance Anchors. Inspection will permit verification of the soil and permafrost conditions and documentation of the installed system. The moisture content of the new fill should be determined. The slope of the thermal syphons should be confirmed and documented by survey measurements. Locations of thermistors also should be as-built by level survey.

ILLUSTRATIONS

Plate 1	Vicinity Map
Plates 2 and 3	Boring Locations
Plates 4 and 5	Logs of Test Pits
Plates 6 through 12	Logs of Borings
Plate 13	Soil Classification Chart
Plate 14	Summary of Samples
Plate 15	Particle Size Analysis
Plate 16	Plasticity Chart



Reference: USGS Quad Map, Baird Inlet (A-7) (1954).

0 1/8 1/4

Scale in Miles

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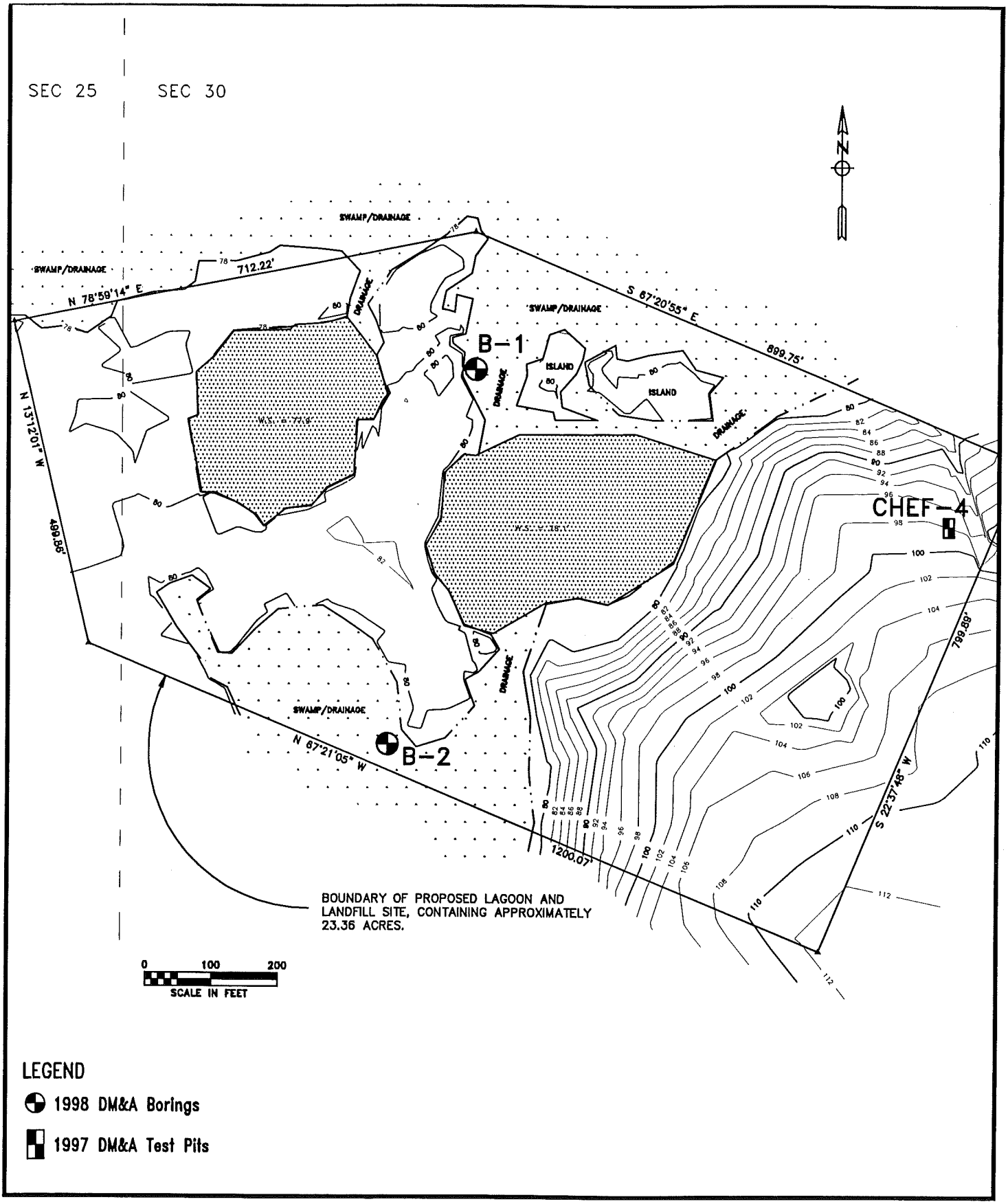
Arctic & Geotechnical Engineering
Job No.: 4149.02
Date : April 1998

VICINITY MAP
Water & Sewer Project
Chefornak, Alaska

Plate
1



LEGEND

1998 DM&A Borings

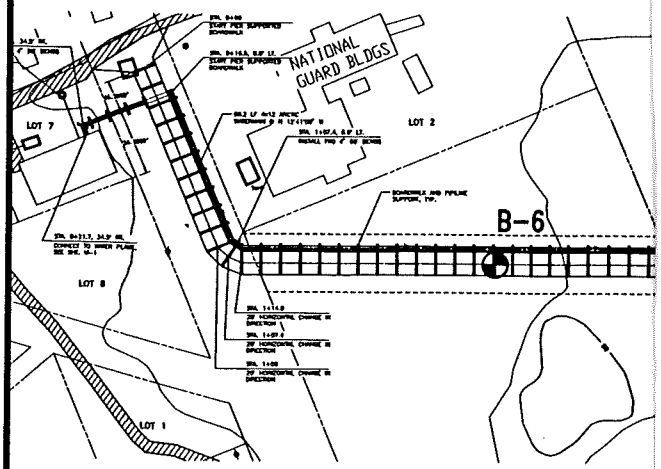
1997 DM&A Test Pits

Reference: Drawing prepared for CE2 Engineers by McClintok Land Associates, Inc., dated September 1997.

Duane Miller & Associates
Arctic & Geotechnical Engineering
Job No. 4149.02
Date: April 1998

BORING LOCATIONS
Water & Sewer Project
Chefornak, Alaska

Plate
2



WW10

WW7

WW9

CHEF-3

WW

N

0 50 100

SCALE IN FEET

LEGEND

1998 DM&A Borings

1997 DM&A Test Pits

1994 Water Wells

998.

BORING LOCATIONS

Water & Sewer Project

Chefornak, Alaska

Plate

3

DUANE MILLER & ASSOCIATES

Project: **Chefornak Water & Sewer**

DM&A Job No. :4149.02

Logged By: M. Hendee

Log of HOLE : CHEF-1

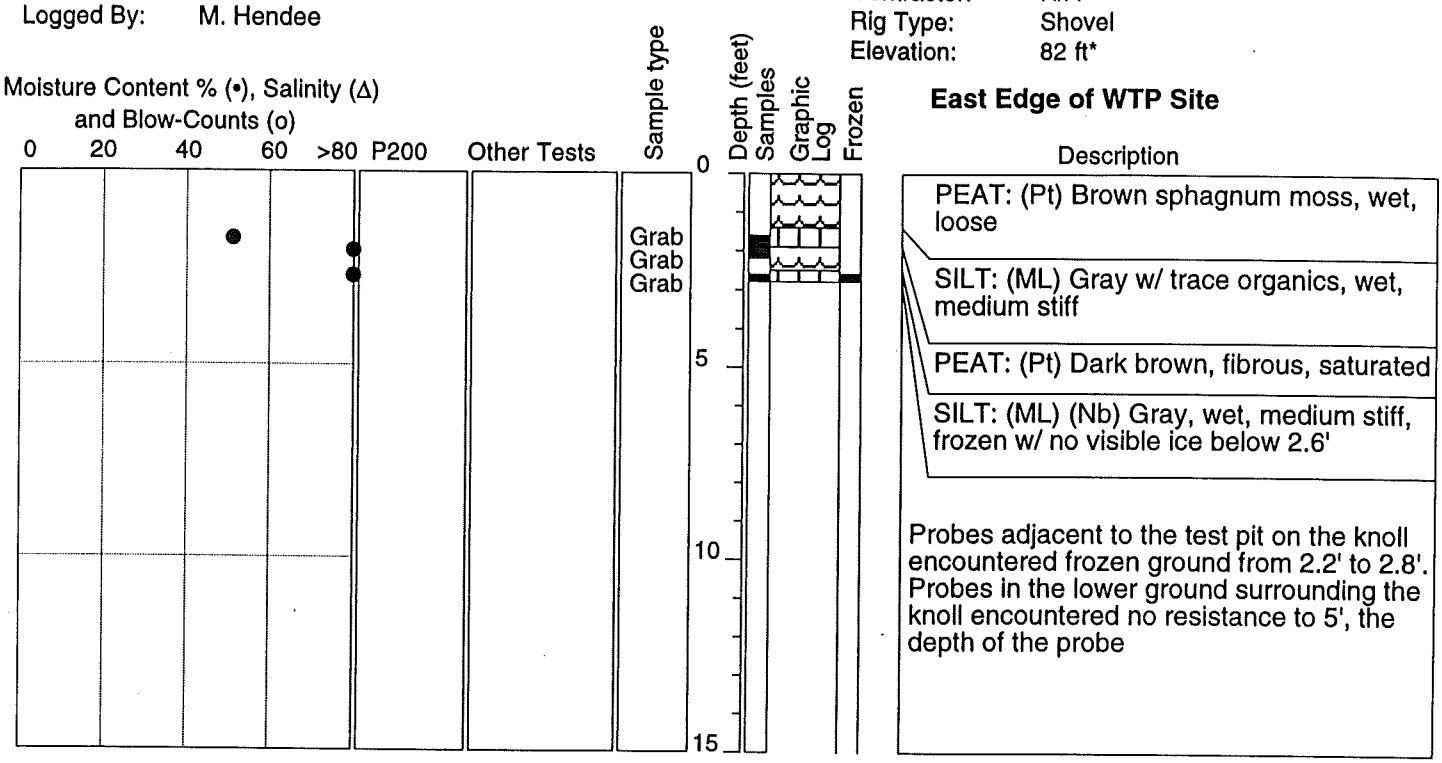
Date Drilled: October 2, 1997

Contractor: N/A

Rig Type: Shovel

Elevation: 82 ft*

East Edge of WTP Site



*Elevation interpolated from a site survey provided by CE2 Engineers, Inc.

DUANE MILLER & ASSOCIATES

Project: **Chefornak Water & Sewer**

DM&A Job No. :4149.02

Logged By: M. Hendee

Log of HOLE : CHEF-2

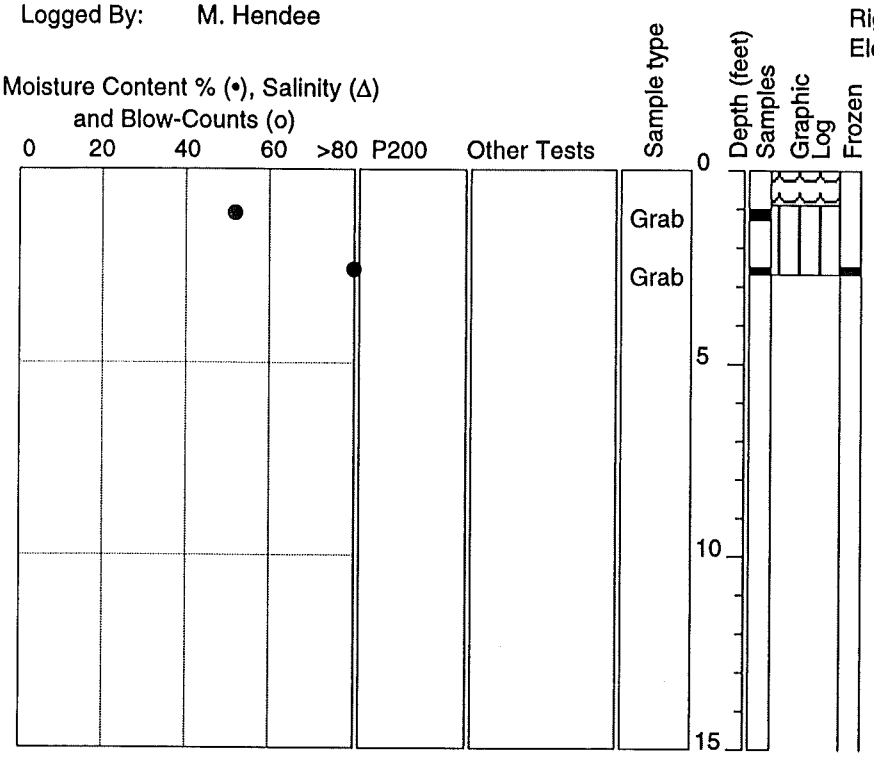
Date Drilled: October 2, 1997

Contractor: N/A

Rig Type: Shovel

Elevation: 82 ft*

Center of WTP Site



Description

PEAT: (Pt) Dark brown, fibrous, saturated

SILT: (ML) (Vx) Gray, wet, medium stiff, frozen w/ 2% visible ice as crystals below 2.5'

Probes adjacent to the test pit on the knoll encountered frozen ground from 2.2' to 2.8'. Probes in the lower ground surrounding the knoll encountered no resistance to 5', the depth of the probe

DUANE MILLER & ASSOCIATES

Project: **Chefornak Water & Sewer**

DM&A Job No. :4149.02

Logged By: M. Hendee

Log of HOLE : CHEF-3

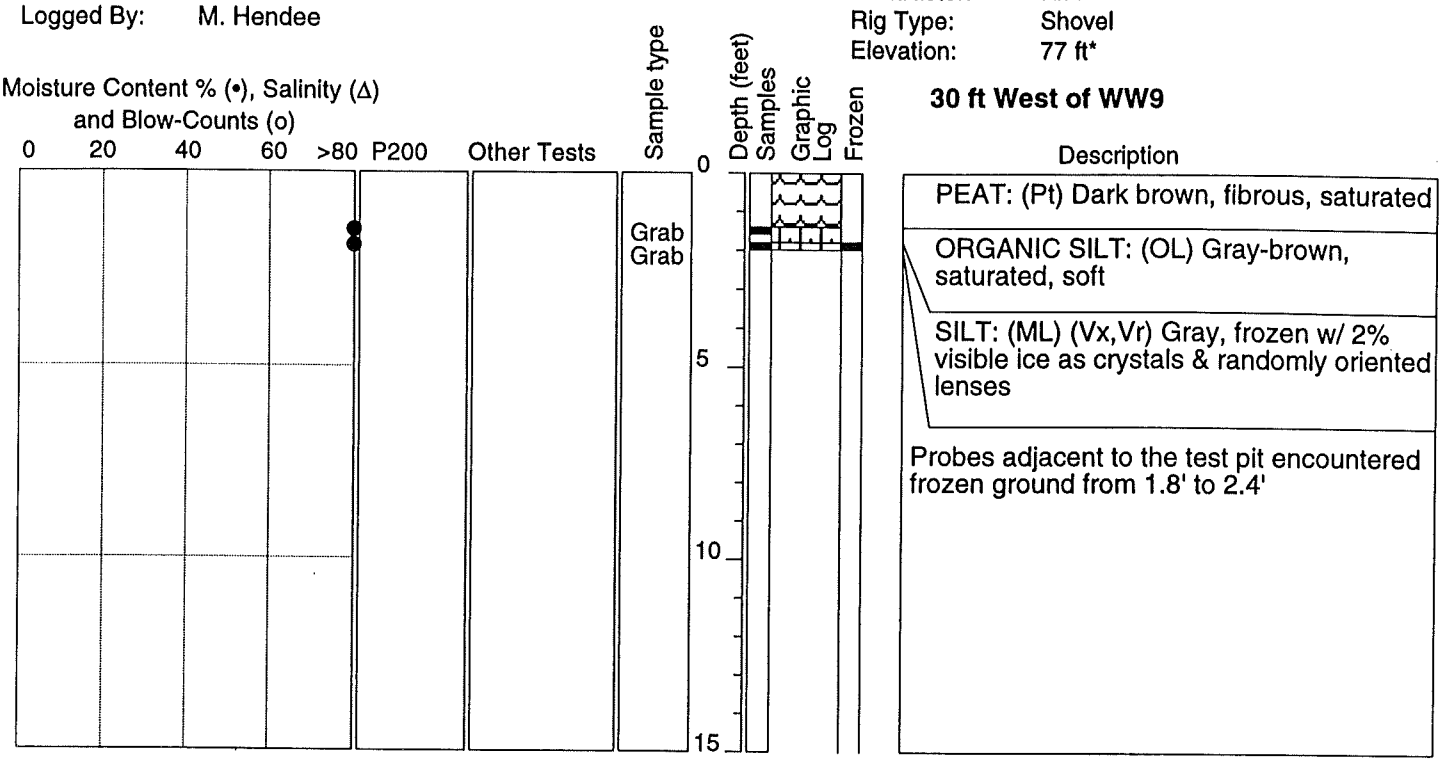
Date Drilled: October 2, 1997

Contractor: N/A

Rig Type: Shovel

Elevation: 77 ft*

30 ft West of WW9



*Elevation interpolated from a site survey provided by CE2 Engineers, Inc.

DUANE MILLER & ASSOCIATES

Project: **Chefornak Water & Sewer**

DM&A Job No. :4149.02

Logged By: M. Hendee

Log of HOLE : CHEF-4

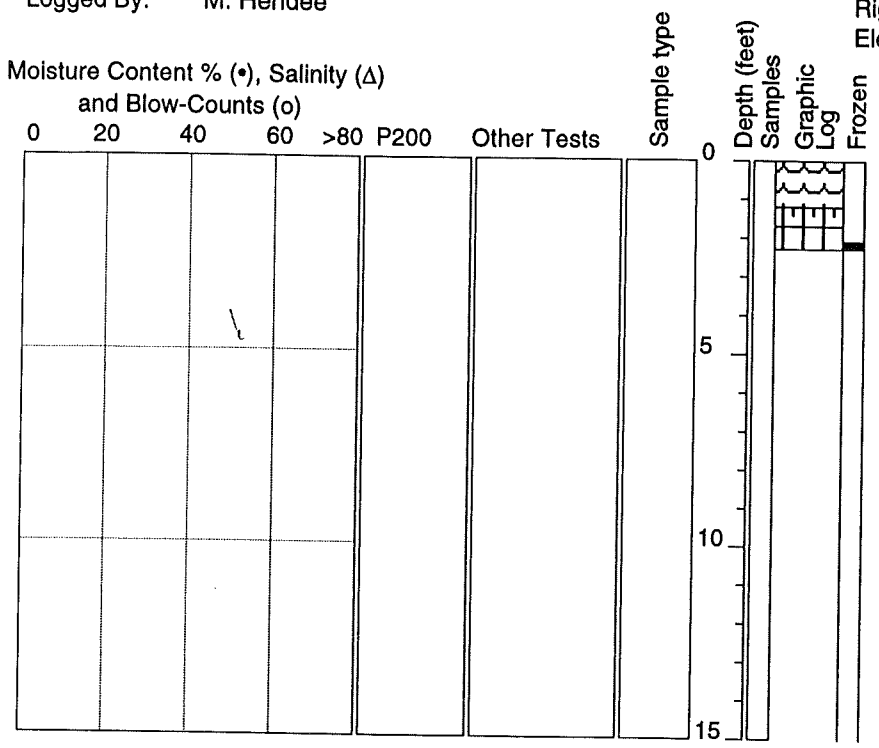
Date Drilled: October 2, 1997

Contractor: N/A

Rig Type: Shovel

Elevation: 96 ft*

NE Corner of Sewage Lagoon Boundary

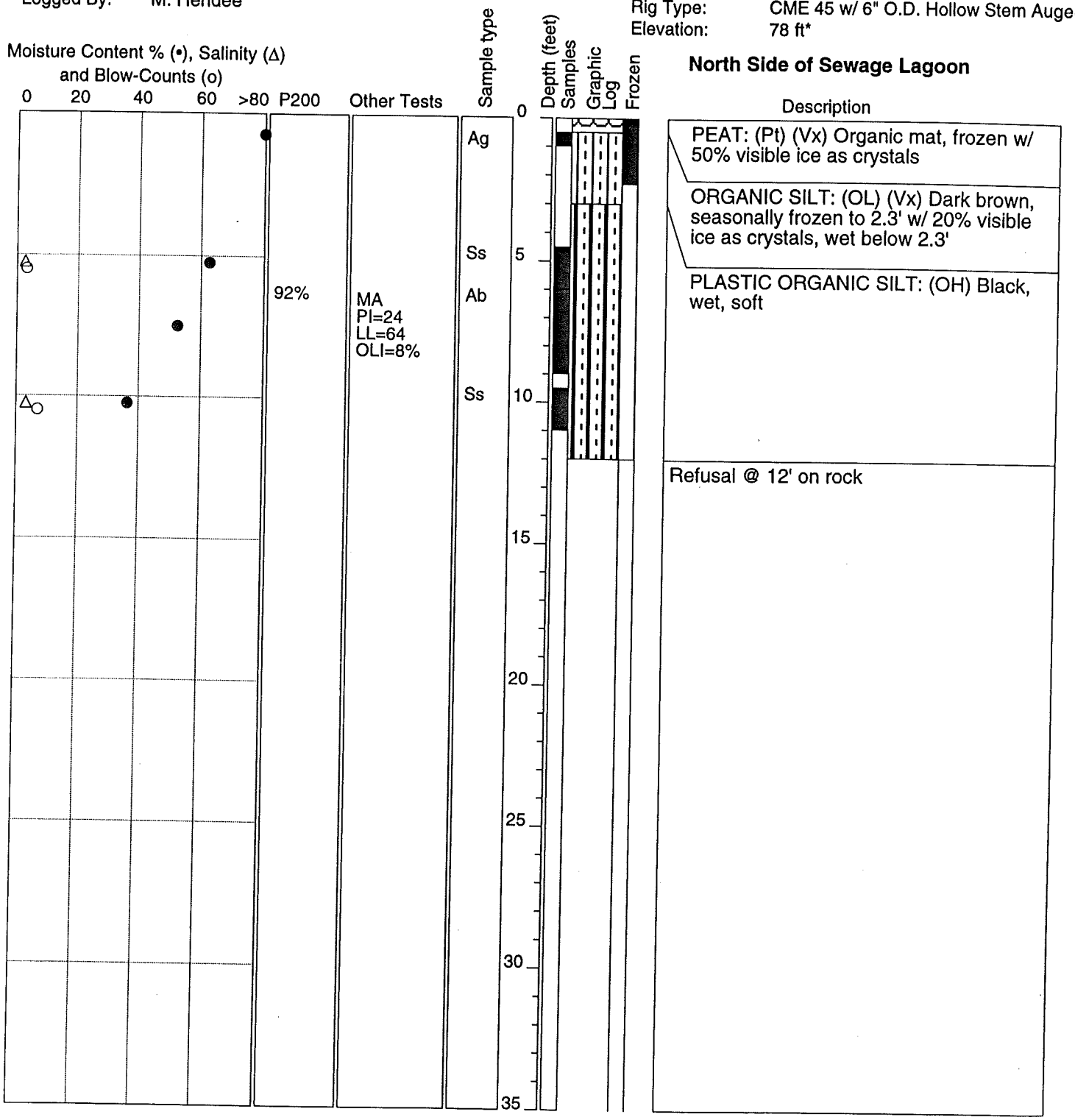


Description
PEAT: (Pt) Dark brown, fibrous, saturated
ORGANIC SILT: (OL) Dark brown, saturated, soft
SILT: (ML) (Vx,Vr) Gray, wet, medium stiff, frozen below 2.1' w/ 10% visible ice as crystals & randomly oriented lenses
Probes adjacent to the test pit encountered frozen ground @ 2.0'

DUANE MILLER & ASSOCIATES
Project: **Chefornak Water & Sewer**
DM&A Job No. :4149.02
Logged By: M. Hendee

Log of HOLE : B-1
Date Drilled: March 6, 1998
Contractor: Denali Drilling
Rig Type: CME 45 w/ 6" O.D. Hollow Stem Auger
Elevation: 78 ft*

North Side of Sewage Lagoon



*Elevation interpolated from a site survey prepared by McClintok Land Associates, Inc., dated September 1997.

DUANE MILLER & ASSOCIATES

Project: **Chefornak Water & Sewer**

DM&A Job No. :4149.02

Logged By: M. Hendee

Log of HOLE : B-2

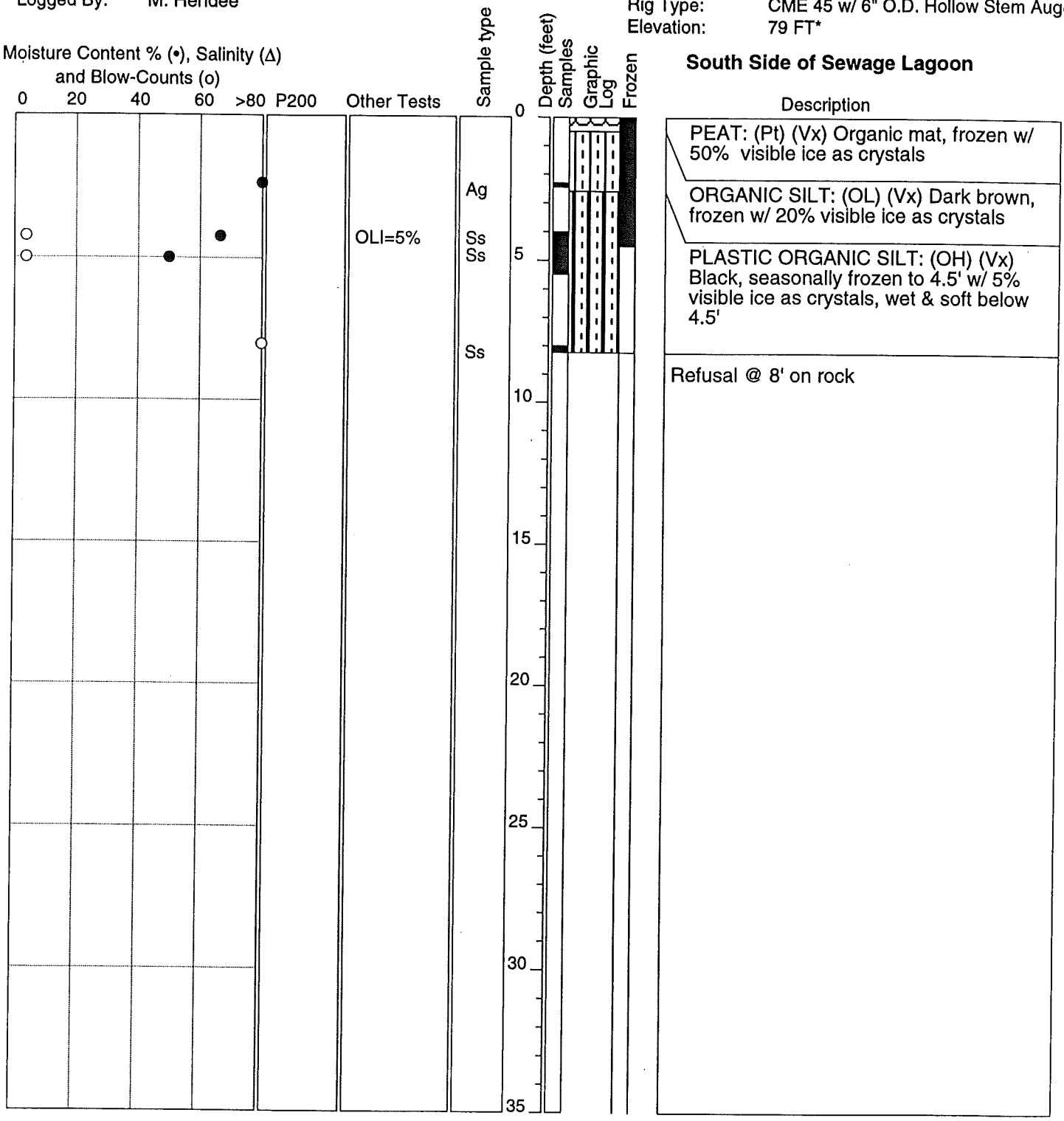
Date Drilled: March 6, 1998

Contractor: Denali Drilling

Rig Type: CME 45 w/ 6" O.D. Hollow Stem Auger

Elevation: 79 FT*

South Side of Sewage Lagoon



Description

PEAT: (Pt) (Vx) Organic mat, frozen w/ 50% visible ice as crystals

ORGANIC SILT: (OL) (Vx) Dark brown, frozen w/ 20% visible ice as crystals

PLASTIC ORGANIC SILT: (OH) (Vx) Black, seasonally frozen to 4.5' w/ 5% visible ice as crystals, wet & soft below 4.5'

Refusal @ 8' on rock

*Elevation interpolated from a site survey prepared by McClintok Land Associates, Inc., dated September 1997.

DUANE MILLER & ASSOCIATES

Project: **Chefornak Water & Sewer**

DM&A Job No. :4149.02

Logged By: M. Hendee

Log of HOLE : B-3

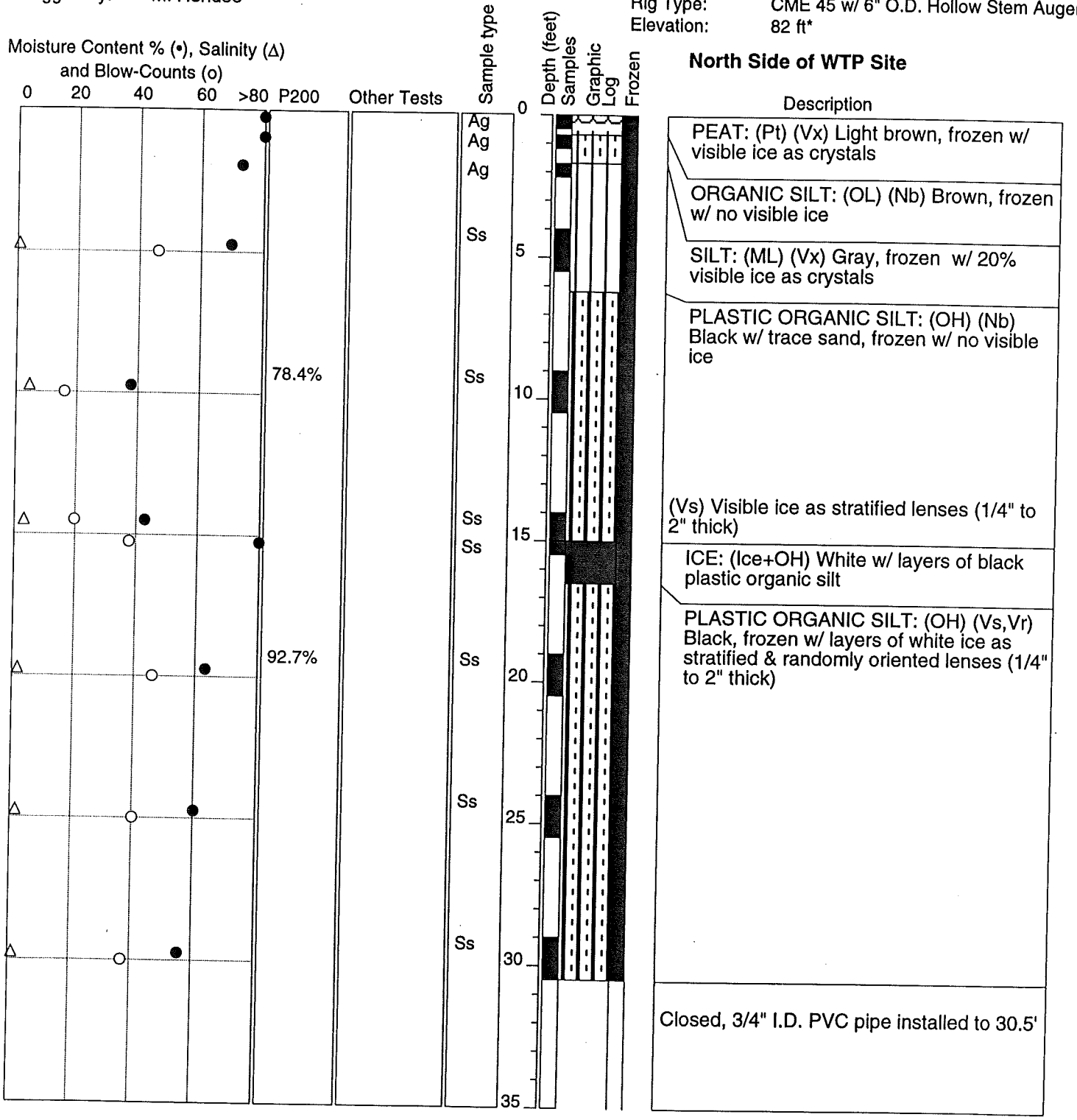
Date Drilled: March 7, 1998

Contractor: Denali Drilling

Rig Type: CME 45 w/ 6" O.D. Hollow Stem Auger

Elevation: 82 ft*

North Side of WTP Site



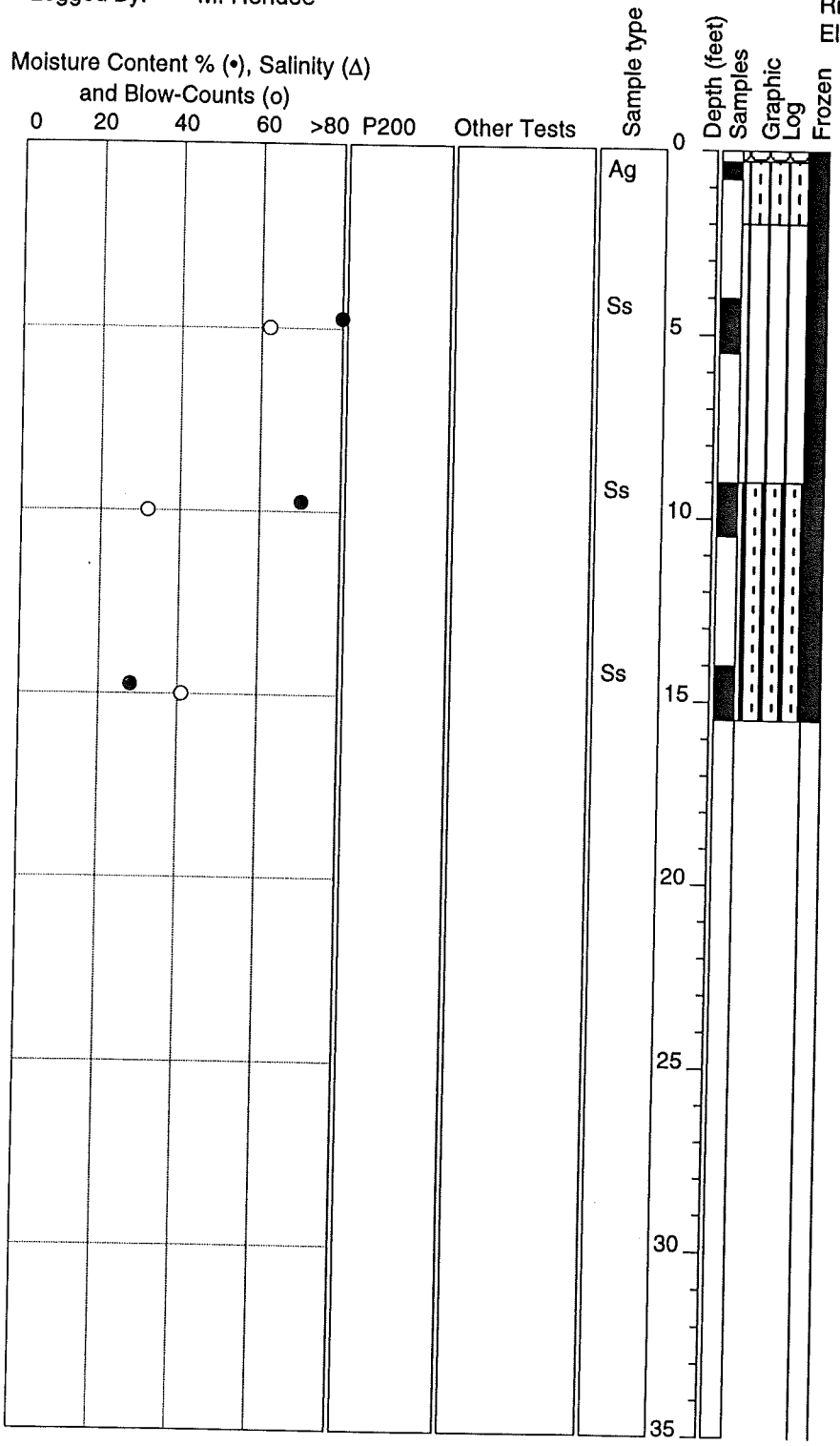
Description
PEAT: (Pt) (Vx) Light brown, frozen w/ visible ice as crystals
ORGANIC SILT: (OL) (Nb) Brown, frozen w/ no visible ice
SILT: (ML) (Vx) Gray, frozen w/ 20% visible ice as crystals
PLASTIC ORGANIC SILT: (OH) (Nb) Black w/ trace sand, frozen w/ no visible ice
(Vs) Visible ice as stratified lenses (1/4" to 2" thick)
ICE: (Ice+OH) White w/ layers of black plastic organic silt
PLASTIC ORGANIC SILT: (OH) (Vs,Vr) Black, frozen w/ layers of white ice as stratified & randomly oriented lenses (1/4" to 2" thick)
Closed, 3/4" I.D. PVC pipe installed to 30.5'

*Elevation interpolated from a site survey provided by CE2 Engineers, Inc.

DUANE MILLER & ASSOCIATES
Project: **Chefornak Water & Sewer**
DM&A Job No. :4149.02
Logged By: M. Hendee

Log of HOLE : B-4
Date Drilled: March 7, 1998
Contractor: Denali Drilling
Rig Type: CME 45 w/ 6" O.D. Hollow Stem Auger
Elevation: 82 ft*

South Side of WTP Site



Description
PEAT: (Pt) (Vx) Light brown, frozen w/ visible ice as crystals
ORGANIC SILT: (OL) (Vx) Brown, frozen w/ 20% visible ice as crystals
SILT: (ML) (Vx,Vr) Gray w/ trace sand, frozen w/ 40% visible ice as crystals & randomly oriented lenses
PLASTIC ORGANIC SILT: (OH) (Vx,Vr) Black w/ trace sand, frozen w/ 10% visible ice as crystals & randomly oriented lenses
Closed, 3/4" I.D. PVC pipe installed to 15.5'

*Elevation interpolated from a site survey provided by CE2 Engineers, Inc.

DUANE MILLER & ASSOCIATES

Project: **Chefornak Water & Sewer**

DM&A Job No. :4149.02

Logged By: M. Hendee

Log of HOLE : B-5

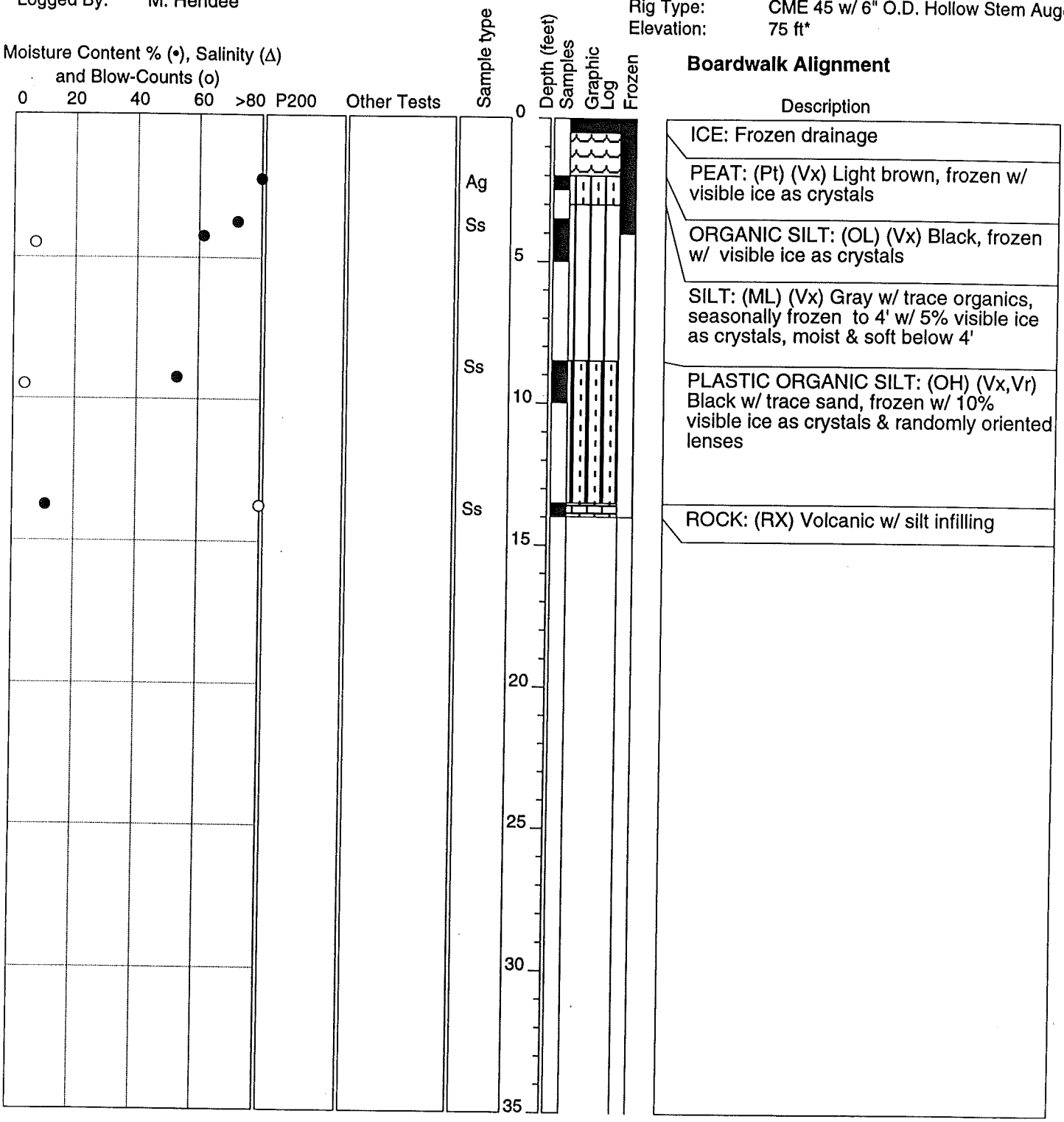
Date Drilled: March 8, 1998

Contractor: Denali Drilling

Rig Type: CME 45 w/ 6" O.D. Hollow Stem Auger

Elevation: 75 ft*

Boardwalk Alignment



*Elevation interpolated from a site survey provided by CE2 Engineers, Inc.

Duane Miller & Associates
Arctic & Geotechnical Engineering
Job No.: 4149.02
Date : April 1998

LOG of BORING B-5
Water & Sewer Project
Chefornak, Alaska

Plate
10

DUANE MILLER & ASSOCIATES

Project: **Chefornak Water & Sewer**

DM&A Job No. :4149.02

Logged By: M. Hendee

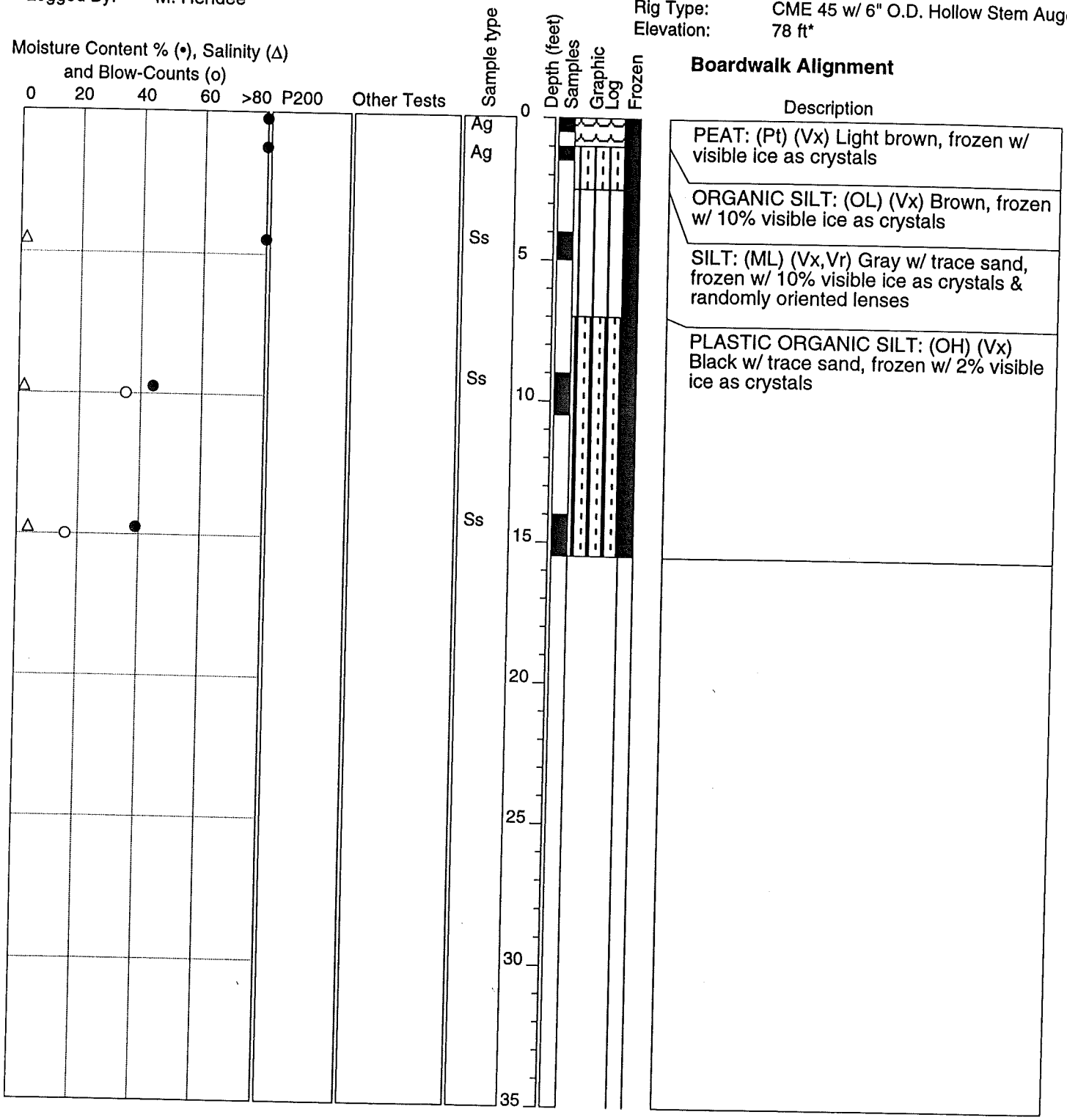
Log of HOLE : B-6

Date Drilled: March 8, 1998

Contractor: Denali Drilling

Rig Type: CME 45 w/ 6" O.D. Hollow Stem Auger

Elevation: 78 ft*



Boardwalk Alignment

Description

PEAT: (Pt) (Vx) Light brown, frozen w/ visible ice as crystals

ORGANIC SILT: (OL) (Vx) Brown, frozen w/ 10% visible ice as crystals

SILT: (ML) (Vx,Vr) Gray w/ trace sand, frozen w/ 10% visible ice as crystals & randomly oriented lenses

PLASTIC ORGANIC SILT: (OH) (Vx) Black w/ trace sand, frozen w/ 2% visible ice as crystals

*Elevation interpolated from a site survey provided by CE2 Engineers, Inc.

DUANE MILLER & ASSOCIATES

Project: **Chefornak Water & Sewer**

DM&A Job No. :4149.02

Logged By: M. Hendee

Log of HOLE : B-7

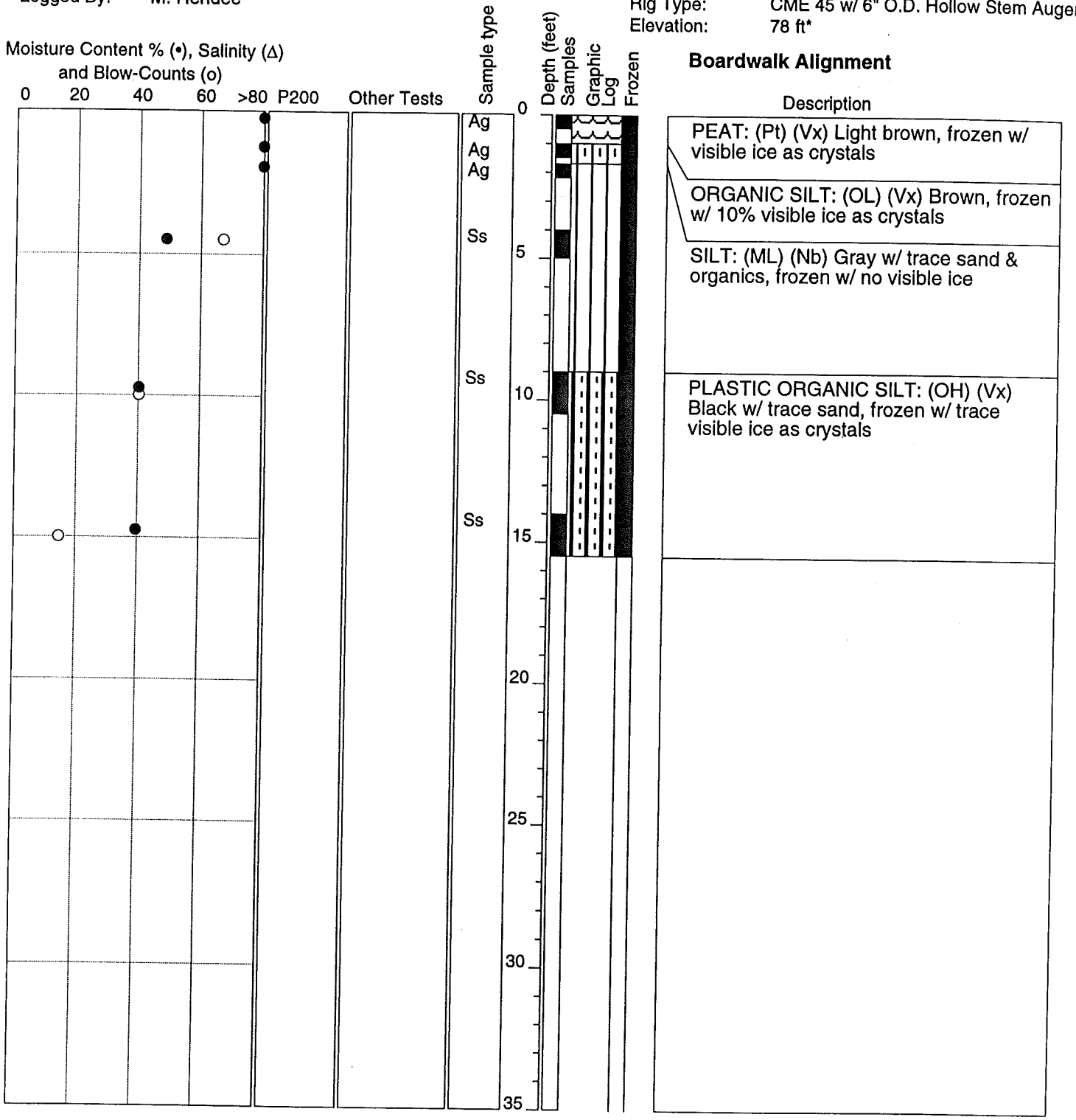
Date Drilled: March 8, 1998

Contractor: Denali Drilling

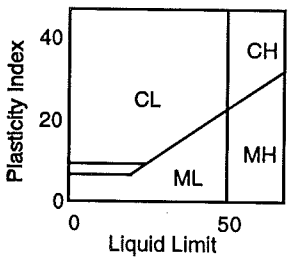
Rig Type: CME 45 w/ 6" O.D. Hollow Stem Auger

Elevation: 78 ft*

Boardwalk Alignment



*Elevation interpolated from a site survey provided by CE2 Engineers, Inc.

MAJOR DIVISIONS			SYMBOL	TYPICAL NAMES
COARSE GRAINED SOILS More than 50% larger than #200 sieve, 0.07 mm	**GRAVELS** More than half of the coarse fraction is larger than #4 sieve size, > 4.75 mm.	Clean gravels with little or no fines	GW	Well graded gravels, sandy gravel
			GP	Poorly graded gravels, sandy gravel
		Gravels with more than 12% fines	GM	Silty gravels, silt sand gravel mixtures
			GC	Clayey gravels, clay sand gravel mixtures
	SANDS More than half of the coarse fraction is smaller than #4 sieve size	Clean sands with little or no fines	SW	Well graded sand, gravelly sand
			SP	Poorly graded sands, gravelly sand
		Sands with more than 12% fines	SM	Silty sand, silt gravel sand mixtures
			SC	Clayey sand, clay gravel sand mixtures
FINE GRAINED SOILS >50%finer than #200 sieve, 0.07 mm	Plasticity Chart 	**SILTS and CLAYS** Liquid limit less than 50	ML	Inorganic silt and very fine sand, rock flour
			CL	Inorganic clay, gravelly and sandy clay, silty clay
			OL	Organic silts and clay of low plasticity
		SILTS and CLAYS Liquid limit greater than 50	MH	Inorganic silt
			CH	Inorganic clay, fat clay
			OH	Organic silt and clay of high plasticity
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soil

KEY TO TEST DATA

Dd = Dry Density (pcf)
TC = Thaw Consolidation
TCf = Thaw Consolidation (field)
UU = Unconsolidated Undrained Triaxial
CU = Consolidated Undrained Triaxial
CD = Consolidated Drained Triaxial
LL = Liquid Limit
PL = Plastic Limit
PI = Plastic Index
SpG = Specific Gravity
SA = Sieve Analysis
MA = Sieve and Hydrometer Analysis
OLI = Organic Loss

KEY TO SAMPLE TYPE

Ag = Auger grab
Ab = Auger bulk
Ac = Air chip
Ss = 1.4" ID split barrel w/140 lb. manual hammer
Sh = 2.5" ID split barrel w/340 lb. manual hammer
Sha= 2.5" ID split barrel w/340 lb. automatic hammer
Sha*=Sha w/140 lb. hammer
Tw = Shelby tube

UNIFIED SOIL CLASSIFICATION SYSTEM

GROUP	ICE VISIBILITY	DESCRIPTION		SYMBOL	
N	Segregated ice not visible by eye	Poorly bonded or friable		Nf	
		Well bonded	No excess ice	Nb	Nbn
			Excess microscopic ice		Nbe
V	Segregated ice is visible by eye and is one inch or less in thickness	Individual ice crystals or inclusions		Vx	
		Ice coatings on particles		Vc	
		Random or irregularly oriented ice		Vr	
		Stratified or distinctly oriented ice		Vs	
ICE	Ice greater than one inch in thickness	Ice with soil inclusions		ICE + soil type	
		Ice without soil inclusions		ICE	

ICE CLASSIFICATION SYSTEM

Boring	Sample Depth	Soil Type (USCS)	Frz?	Sampling Type	Blows/ft	Moisture Content	Salinity	Passing #200	Organic Loss	Other Tests
CHEF-1	1.6 ft.	ML	No	Grab		51.4%				
CHEF-1	1.9 ft.	Pt	No	Grab		298.3%				
CHEF-1	2.6 ft.	OL	Yes	Grab		141.7%				
CHEF-2	1.0 ft.	ML	No	Grab		51.7%				
CHEF-2	2.5 ft.	ML	Yes	Grab		193.8%				
CHEF-3	1.4 ft.	OL	No	Grab		130.8%				
CHEF-3	1.8 ft.	ML	Yes	Grab		183.7%				
B-1	0.5 ft.	OL	Yes	Grab		2035.7%				
B-1	4.5 ft.	OH	No	Ss	3	62.4%	2 ppt			
B-1	6.0 ft.	OH	No	Bulk		52.8%*	2 ppt	92.0%	8%	MA, PI=24, LL=64
B-1	9.5 ft.	OH	No	Ss	7	36.8%	3 ppt			
B-2	2.3 ft.	OL	Yes	Grab		263.0%				
B-2	4.0 ft.	OH	Yes	Ss	4	66.3%			5%	
B-2	4.5 ft.	OH	No	Ss	4	49.9%				
B-2	8.0 ft.	RX	No	Ss	960					
B-3	0.0 ft.	Pt	Yes	Grab		437.9%				
B-3	0.7 ft.	OL	Yes	Grab		154.0%				
B-3	1.7 ft.	ML	Yes	Grab		72.8%				
B-3	4.0 ft.	ML	Yes	Ss	46	69.9%	1 ppt			
B-3	9.0 ft.	OH	Yes	Ss	16	37.5%	4 ppt	78.4%		
B-3	14.0 ft.	OH	Yes	Ss	20	42.7%	3 ppt			
B-3	15.0 ft.	ICE+OH	Yes	Ss	38	261.0%				
B-3	19.0 ft.	OH	Yes	Ss	46	63.4%	2 ppt	92.7%		
B-3	24.0 ft.	OH	Yes	Ss	40	60.3%	2 ppt			
B-3	29.0 ft.	OH	Yes	Ss	37	55.6%	1 ppt			
B-4	0.3 ft.	OL	Yes	Grab						
B-4	4.0 ft.	ML	Yes	Ss	62	88.1%				
B-4	9.0 ft.	OH	Yes	Ss	32	70.3%				
B-4	14.0 ft.	OH	Yes	Ss	41	28.0%				
B-5	2.0 ft.	OL	Yes	Grab		541.2%				
B-5	3.5 ft.	ML	Yes	Ss		72.4%				
B-5	4.0 ft.	ML	No	Ss	7	61.6%				
B-5	8.5 ft.	OH	No	Ss	4	52.9%				
B-5	13.5 ft.	RX	No	Ss	100	10.6%				
B-6	0.0 ft.	Pt	Yes	Grab		441.9%				
B-6	1.0 ft.	OL	Yes	Grab		149.5%				
B-6	4.0 ft.	ML	Yes	Ss	80	82.7%	2 ppt			
B-6	9.0 ft.	OH	Yes	Ss	35	44.3%	2 ppt			
B-6	14.0 ft.	OH	Yes	Ss	16	38.8%	4 ppt			
B-7	0.0 ft.	Pt	Yes	Grab		551.3%				
B-7	1.0 ft.	OL	Yes	Grab		358.4%				
B-7	1.7 ft.	ML	Yes	Grab		102.8%				
B-7	4.0 ft.	ML	Yes	Ss	67	48.7%				
B-7	9.0 ft.	OH	Yes	Ss	40	40.2%				
B-7	14.0 ft.	OH	Yes	Ss	15	39.6%				

*After setting in fabric bag

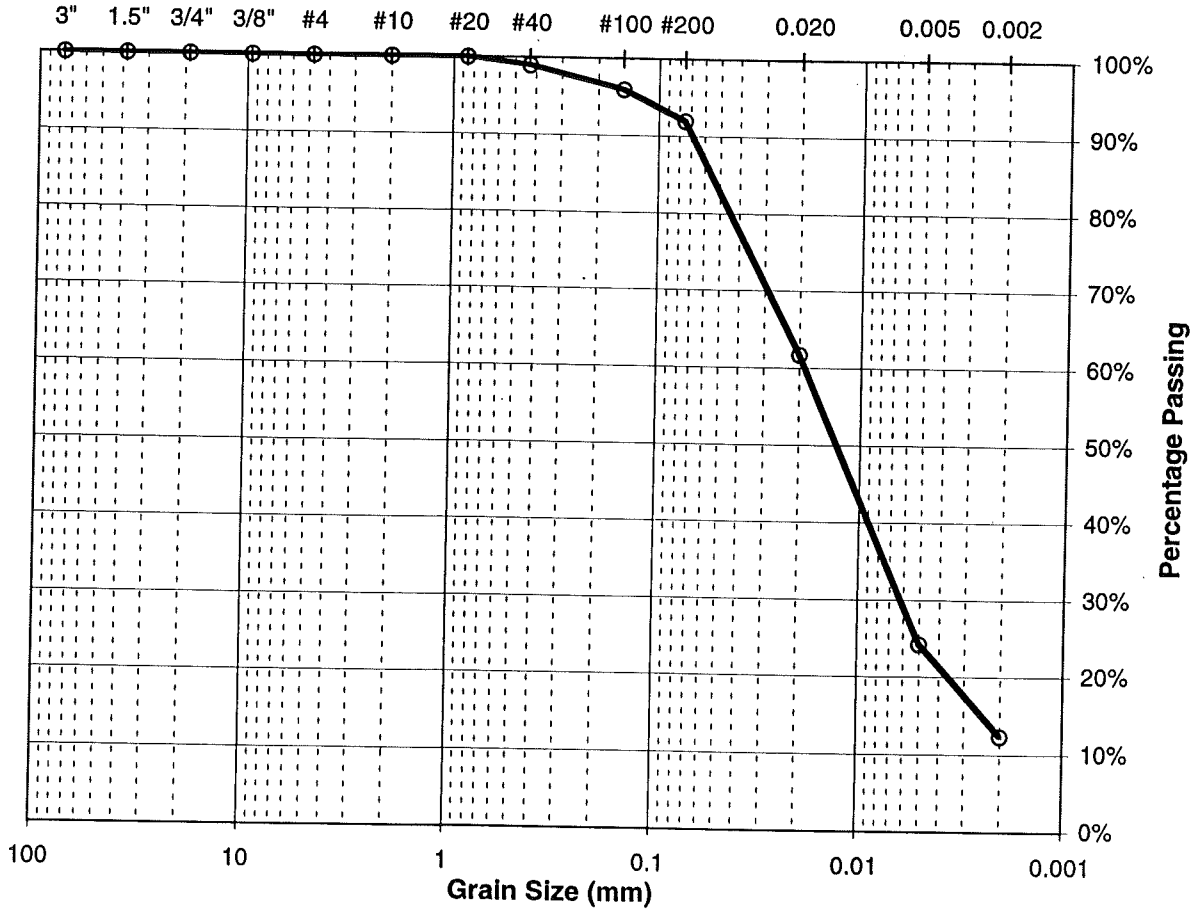
SUMMARY OF SAMPLES

Water & Sewer Project
Chefornak, Alaska

Duane Miller & Associates
Job No. 4149.02
April 1998

Plate
14

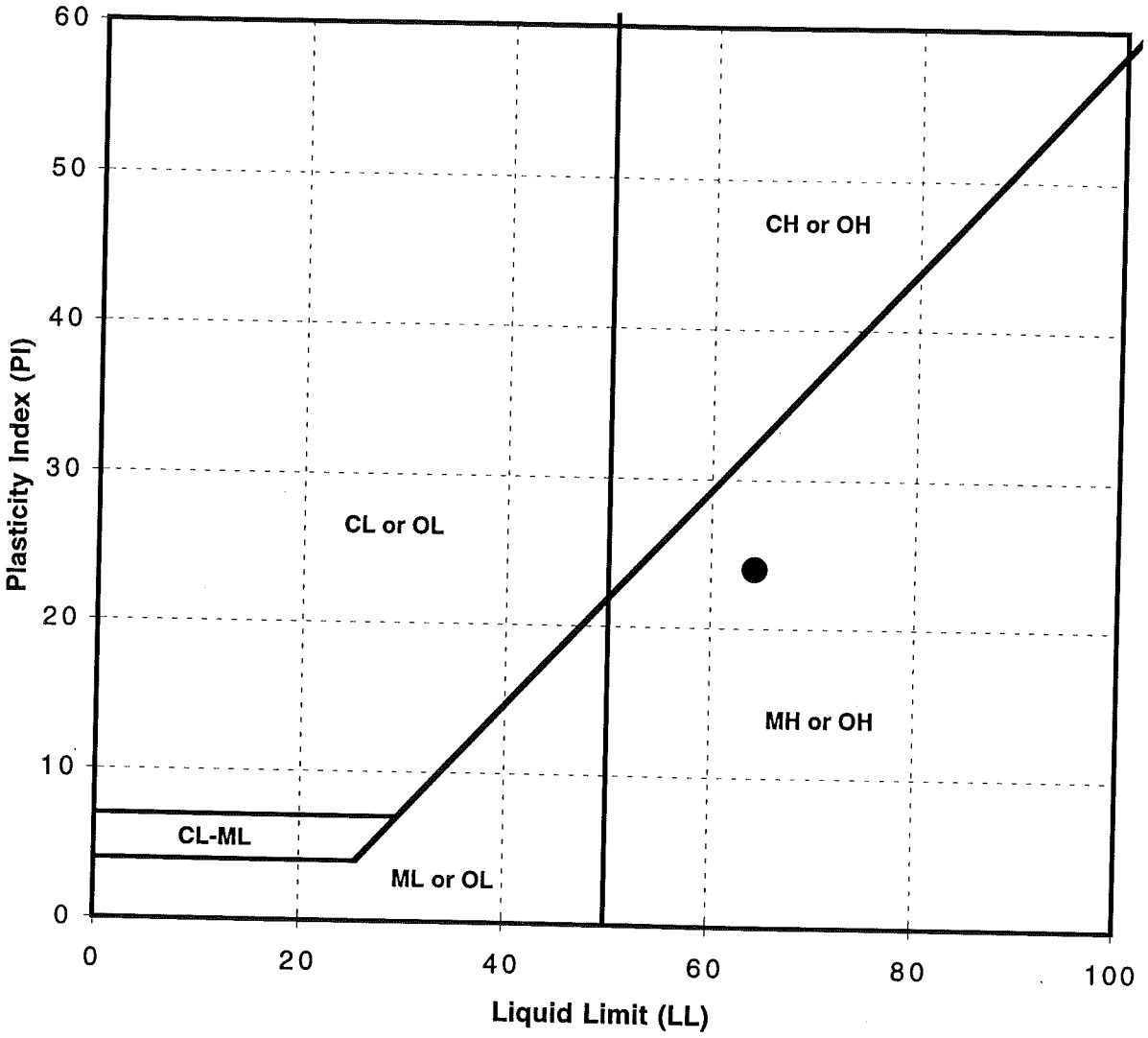
Boring =>	B-1
Depth =>	6.0 ft.
3" =>	100.0%
1 1/2" =>	100.0%
3/4" =>	100.0%
3/8" =>	100.0%
#4 =>	100.0%
#10 =>	100.0%
#20 =>	100.0%
#40 =>	99.0%
#100 =>	96.0%
#200 =>	92.0%
0.02 mm	62%
0.005 mm	24%
0.002 mm	12%
Analysis of Data	
D10 size =>	
D30 size =>	
D50 size =>	
D60 size =>	
Coeff. of Uniformity, Cu =	
Coeff. of Curvature, Cc =	
Gravel (+#4) percentage =	0.0%
Sand percentage =	8.0%
Fines percentage =	92.0%
Unified Soil Class Symbol =	**OH**



Duane Miller & Associates
Job No. 4149.02
April 1998

Particle Size Analysis
Water & Sewer Project
Chefornak, Alaska

Plate
15



	Sample Location	Plastic Limit	Liquid Limit	Plasticity Index	Organic Loss	Natural Moisture Content	USCS
●	B-1 @ 6.0 ft. (Bulk)	40	64	24	8.0%	52.8%	OH

Duane Miller & Associates
Job No. 4149.02
April 1998

PLASTICITY CHART
Water & Sewer Project
Chefornak, Alaska

Plate
16

Please mail WHITE copy of log to:
DNR/DIVISION OF MINING & WATER MGMT
PO BOX 107005
ANCHORAGE AK 99510-7005

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING & WATER MGMT
WATER WELL RECORD

LOCATION OF WELL, named: WW2						TOWNSHIP		RANGE		
BOROUGH/CITY	SUBDIVISION	LOT	BLOCK	SECTION QUARTERS	SECTION	1	(X)N		( )E	MERIDIAN
Chefornak	na	na	na	na	na		( )S	83	(X)W	SB

LOCATION / SKETCH: LKSD Property, 280 ft from city well, 90 ft from Kinia River and 218 ft from BIA well.

WELL OWNER: City of Chefornak

CONTRACTOR: Lynn Enloe — DATE

SIGNATURE — 08/26/94

DEPTHS MEASURED FROM: ( )top of casing, or (X)ground surface

WELL STRUCTURE: Multi screen steel packer with 2 screens

DEPTH OF BOREHOLE: 140 ft — DATE OF COMPLETION

DEPTH OF CASING: 76 ft — 08/26/94

WELL: (X) useable, or ( ) abandoned WATER QUALITY DATA? (X)Y or ( )N LITHOLOGY:	SEE (**)	Depth From	Depth To
Surficial Peat	UA	0 ft	1 ft
Silt	UA	1	12 ft
Fractured Basalt, with pebbles	F	12	34 ft
Hard basalt	F	34	40 ft
Sandy silt with ice layers	F	40	70 ft
Silty sand	U	70	75 ft
Sand with pea gravel, wood, mica,	U	75	85 ft
compacted sand	U	85	99 ft
Sand with wood, mica & water	U	99	103 ft
Dense sand & silt	U	103	111 ft
Sand & silt	U	111	140 ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft

STATIC WATER LEVEL: 4.86 ft — SURFACE WATER AT 38 ft

FROM (X) top of casing, or ( ) ground surface

DRILLING METHOD: ( ) air rotary, (X) cable tool, or ( ) other

WELL USE: ( )domestic, ( )irrigation, ( )monitor, (X)public supply, or ( ) other:

CASING: Outer Stick-up: .83 ft — Diameter: 10 in. to 13.8 ft

Inner Stick-up: 2.7 ft — 6 in. to 76 ft

WELL: ( )open pipe, (X)screened, ( )perforated, ( )open hole ( ) single or (X) multiple intakes, how many? 2

Depth to openings: 73 -83 & 98 - 108 ft

SCREEN: Type slotted, Diam. 5 in., length 10 ft, slot/mesh size 8

Type slotted, Diam. 5 in., length 10 ft, slot/mesh size 8

Type , Diam. in., length ft, slot/mesh size

GRAVEL PACK TYPE:

Description:

GROUT TYPE: bentonite & sand

Description: 8 bags in annulus, 2 bags at 120-125 ft, sand below

DEVELOPMENT METHOD: Pumped & Surge , at multiple levels?

Durations: Pumped 15 hrs, Surged 11 hrs.

PUMPING: Yield: 3.5 gpm

Level: 49.7 ft after 16 hrs pumping at 3 gpm.

PUMP INTAKE DEPTH: ft, Horsepower:

WELL DISINFECTED UPON COMPLETION? (X)yes, ( )no

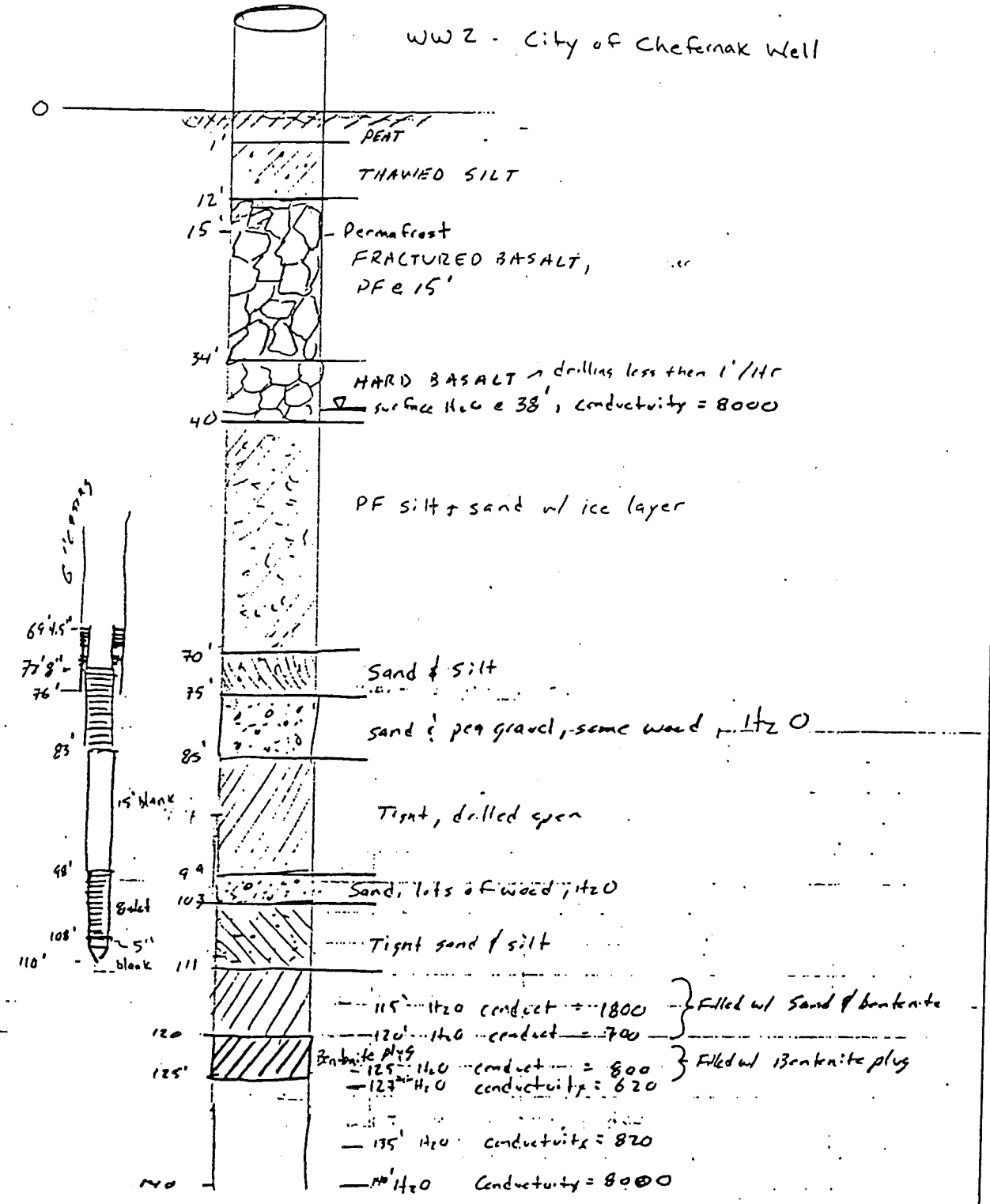
(**) F=PERMAFROST, U=UNFROZEN, W=WET, D=DRY, B=BEDROCK, A=ANNULUS, O=OTHER - ^C

REMARKS: Some equipment failure. 8000 mhos/cm encountered at 140 ft; sealed at 120-125 ft with two bags Wyo-Ben coarse hole plug. Casing withdrawn to 76 ft and screened as indicated, with bottom of well at 110 ft. Conductivities increased from 570 mhos/cm at 83 ft to 800 mhos/cm at 90 ft & 900 mhos/cm at 110 ft. Conductivities decreased to 820 mhos/cm during development and down to 620 mhos/cm after pumping tests. Water levels fluctuate with tidal influence, static water level by 1.2 ft. First screened between 75 ft & 95 ft, producing 2 gpm - later rescreened as indicated.

Depth (08/10/94)	Conductivity mhos/cm	Chlorides ppm
38 ft	6400	> off scale
70 ft	2400	-
83 ft	8200	-
83 ft	7000	-
83 ft	570	43
85 ft	670	28
90 ft	740	82

Depth	Conductivity	Chlorides
95 ft	720	58
99 ft	800	97
99 ft (08/13/94)	880	67
83 ft	560	-
85 ft	625	-
90 ft	690	-
95 ft	660	-

WW2 well log



Drilled by Lynn Enloe - City of Chefornak temporary employee

Drill dates: 8/4/94 → 8/14/94, 8/21/44 → 8/23/44
developed: 8/23/44 → 8/25/94

Please mail WHITE copy of log to:
DNR/DIVISION OF MINING & WATER MGMT
PO BOX 107005
ANCHORAGE AK 99510-7005

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING & WATER MGMT
WATER WELL RECORD

LOCATION OF WELL, named: WW3						TOWNSHIP		RANGE		
BOROUGH/CITY	SUBDIVISION	LOT	BLOCK	SECTION QUARTERS	SECTION	1	(X)N		( )E	MERIDIAN
CHEFORNAK	na	na	na	na	na		( )S	83	(X)W	SB

LOCATION / SKETCH: 300 ft from BIA well, 95 ft from Kinia River, near small creek

WELL OWNER: City of Chefornak

CONTRACTOR: Lynn Enloe | DATE

SIGNATURE | 08/07/94

DEPTHS MEASURED FROM: ( )top of casing, or (X)ground surface

WELL STRUCTURE: Dual screened packer, welded steel

WELL: (X) useable, or ( ) abandoned WATER QUALITY DATA? (X)Y or ( )N LITHOLOGY:	SEE (**)	Depth From	Depth To
Peat	U	0 ft	.5 ft
Silt (blue)	U	.5	2 ft
Silt	F	2	20 ft
Basalt, fractured & hard, clear ice	F	20	47 ft
Sandy silt	F	47	55 ft
Sand with water, clogs bailer	U	55	72 ft
Silty sand	U	72	89 ft
Sand with water, wood, mica	U	89	109 ft
Silty sand	U	109	130 ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft

DEPTH OF BOREHOLE: 130 ft | DATE OF COMPLETION 08/06/94

DEPTH OF CASING: 60 ft

STATIC WATER LEVEL: 3.08 ft SURFACE WATER AT ft
FROM (X) top of casing, or ( ) ground surface

DRILLING METHOD: ( ) air rotary, (X) cable tool, or ( ) other

WELL USE: ( )domestic, ( )irrigation, ( )monitor, (X)public supply, or ( ) other:

CASING: Outer Stick-up: 1.87 ft Diameter: 10 in. to 10 ft
Inner Stick-up: 3 ft 6 in. to 60 ft

WELL: ( )open pipe, (X)screened, ( )perforated, ( )open hole
( ) single or (X) multiple intakes, how many? 2
Depth to openings: 60 -70 & 91 - 101 ft

SCREEN: Type 20x40 , Diam. 5 in., length 10 ft, slot/mesh size 12
Type 20x40 , Diam. 5 in., length 10 ft, slot/mesh 12 size
Type , Diam. in., length ft, slot/mesh size

GRAVEL PACK TYPE:
Volume used: , Depth to top:

GROUT TYPE: , Volume
Depth: from ft to ft

DEVELOPMENT METHOD: pump and surge & pump
Durations: 8 hrs pump, 6 hrs surge & pump

PUMPING: Yield: 5 gpm
Level: 47.6 ft after 13 hrs pumping at 5 gpm.

PUMP INTAKE DEPTH: ft, Horsepower:

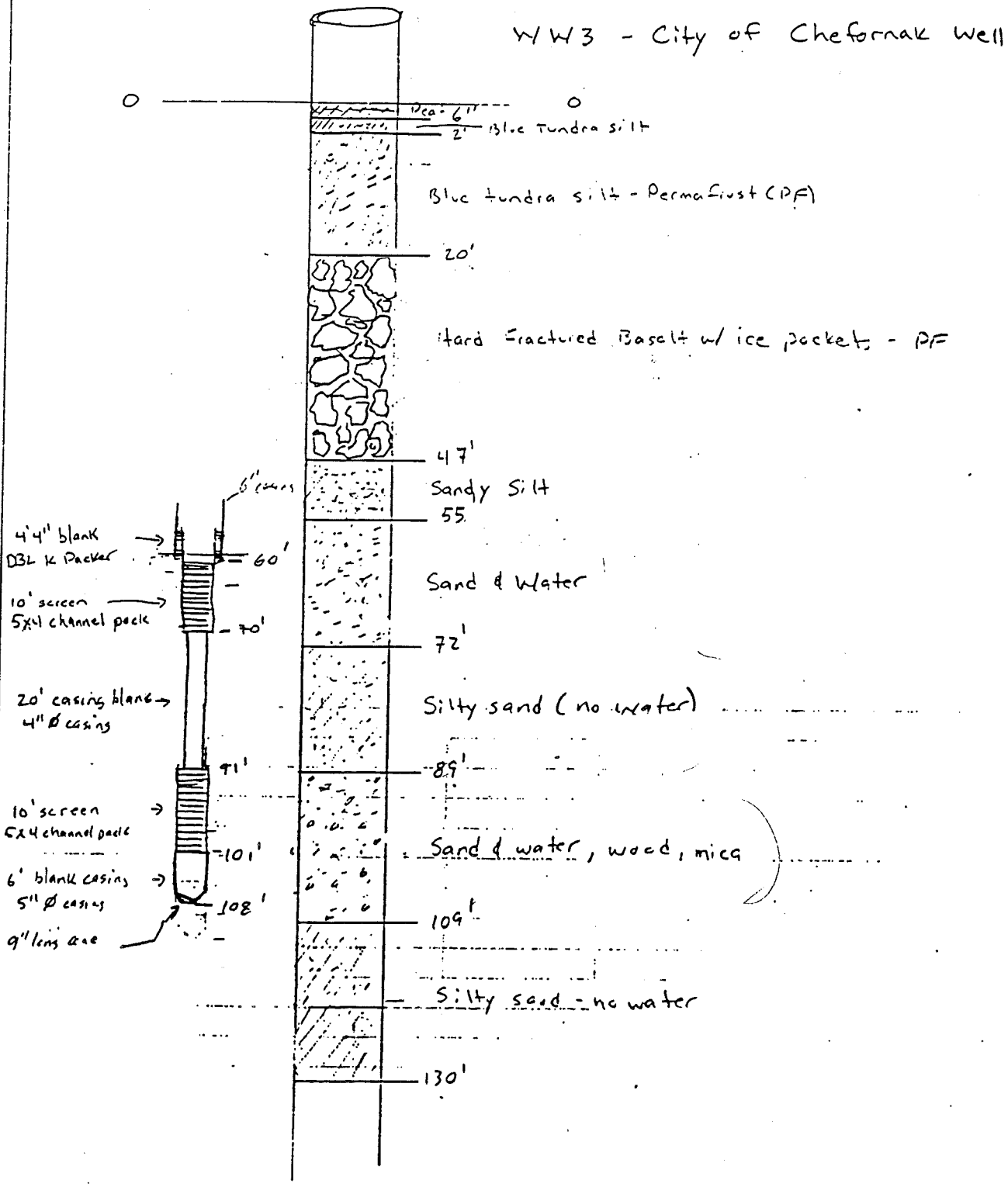
WELL DISINFECTED UPON COMPLETION? (X)yes, ( )no

(**) F=PERMAFROST, U=UNFROZEN, W=WET, D=DRY, B=BEDROCK, A=ANNULUS, O=OTHER - ^C

REMARKS: Conductivity declined on developing, from 700 μmhos/cm to 480 μmhos/cm. Sand layer between 55 & 72 ft caved and heaved. Miscellaneous equipment failures. Land surface elevation : 20.8 ft, top of 6" casing elevation: 23.82 ft.

From 55 ft to 72 ft chlorides were 28 ppm and conductivity was 500 μmhos/cm

WW3 well log



Drilled by Lynn Enloe - City of Chefornak temporary employee

Drill dates: 8/30/94 → 9/6/94
developed: 9/6/94 → 9/7/94

Please mail WHITE copy of log to:
DNR/DIVISION OF MINING & WATER MGMT
PO BOX 107005
ANCHORAGE AK 99510-7005

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING & WATER MGMT
WATER WELL RECORD

LOCATION OF WELL, named: WW4						TOWNSHIP		RANGE		
BOROUGH/CITY	SUBDIVISION	LOT	BLOCK	SECTION QUARTERS	SECTION	1	(X)N		( )E	MERIDIAN
CHEFORNAK	na	na	na	na	na		( )S	83	(X)W	SB

LOCATION / SKETCH: 200 ft up river from WW3, 100 ft from Kinia River

WELL OWNER: City of Chefornak

CONTRACTOR: Lynn Enloe — DATE

SIGNATURE — 09/15/94

DEPTHS MEASURED FROM: ( )top of casing, or (X)ground surface

WELL STRUCTURE: Abandoned, welded lid 2 ft below surface

WELL: ( ) useable, or (X) abandoned WATER QUALITY DATA? (X)Y or ( )N LITHOLOGY:	SEE (**)	Depth From	Depth To
Peat	U	0 ft	2 ft
Silt, blue	F	2	12 ft
Silt, blue	U	12	22 ft
Basalt	F	22	52 ft
Sandy silt	F	52	109 ft
Basalt & silt	F	109	114 ft
Sandy silt	U	114	130 ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft

DEPTH OF BOREHOLE: 130 ft — DATE OF COMPLETION 09/15/94

DEPTH OF CASING: 2.5 ft

STATIC WATER LEVEL: _ ft — SURFACE WATER AT 22 ft

FROM ( ) top of casing, or ( ) ground surface

DRILLING METHOD: ( ) air rotary, (X) cable tool, or ( ) other

WELL USE: ( )domestic, ( )irrigation, ( )monitor, (X)public supply, or (x) other: abandoned

CASING: Stick-up: ft — Diameter: 10 in. to 52 ft

Type: — 8 in. to 114 ft

WELL: ( )open pipe, ( )screened, ( )perforated, ( )open hole

( ) single or ( ) multiple intakes, how many?

Depth to openings: ft

SCREEN: Type , Diam. in., length ft, slot/mesh size

Type , Diam. in., length ft, slot/mesh size

Type , Diam. in., length ft, slot/mesh size

GRAVEL PACK TYPE:

Volume used: , Depth to top:

GROUT TYPE: drill cuttings

Description: Borehole backfilled with drill cuttings

DEVELOPMENT METHOD: , at multiple levels? ( )

Durations:

PUMPING: Yield: 0 gpm

Level: ft after hrs pumping at gpm.

PUMP INTAKE DEPTH: ft, Horsepower:

WELL DISINFECTED UPON COMPLETION? ( )yes, (X)no

(**) F=PERMAFROST, U=UNFROZEN, W=WET, D=DRY, B=BEDROCK, A=ANNULUS, O=OTHER - ^C

REMARKS: No water found, well abandoned. Ground level surface elevation 21.1 ft.

Please mail WHITE copy of log to:
DNR/DIVISION OF MINING & WATER MGMT
PO BOX 107005
ANCHORAGE AK 99510-7005

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING & WATER MGMT
WATER WELL RECORD

LOCATION OF WELL, named: WW5						TOWNSHIP		RANGE		
BOROUGH/CITY	SUBDIVISION	LOT	BLOCK	SECTION QUARTERS	SECTION	1	(X)N		( )E	MERIDIAN
CHEFORNAK	na	na	na	na	na		( )S	83	(X)W	SB

LOCATION / SKETCH: 300 ft from WW4 & 50 ft from Kinia River

WELL OWNER: City of Chefornak
CONTRACTOR: Lynn Enloe
SIGNATURE
DATE 09/18/94

DEPTHS MEASURED FROM: ()top of casing, or (X)ground surface

WELL STRUCTURE: abandoned, equipment withdrawn

DEPTH OF BOREHOLE: 30 ft
DEPTH OF CASING: ft
DATE OF COMPLETION 09/18/94

STATIC WATER LEVEL: ft SURFACE WATER AT 27 ft
FROM ( ) top of casing, or (X) ground surface

DRILLING METHOD: ( ) air rotary, (X) cable tool, or ( ) other

WELL USE: ( )domestic, ( )irrigation, ( )monitor, (X)public supply, or ( ) other:

CASING: Stick-up: 1 ft
Type: steel
Diameter: 10 in. to 30 ft
in. to ft

WELL: ()open pipe, ()screened, ( )perforated, ( )open hole
( ) single or ( ) multiple intakes, how many?
Depth to openings: ft

SCREEN: Type , Diam. in., length ft, slot/mesh size
Type , Diam. in., length ft, slot/mesh size
Type , Diam. in., length ft, slot/mesh size

GRAVEL PACK TYPE:
Volume used: , Depth to top:

GROUT TYPE: , Volume
Depth: from ft to ft

DEVELOPMENT METHOD: , at multiple levels? ( )
Durations:

PUMPING: Yield: gpm
Level: ft after hrs pumping at gpm.

PUMP INTAKE DEPTH: ft, Horsepower:

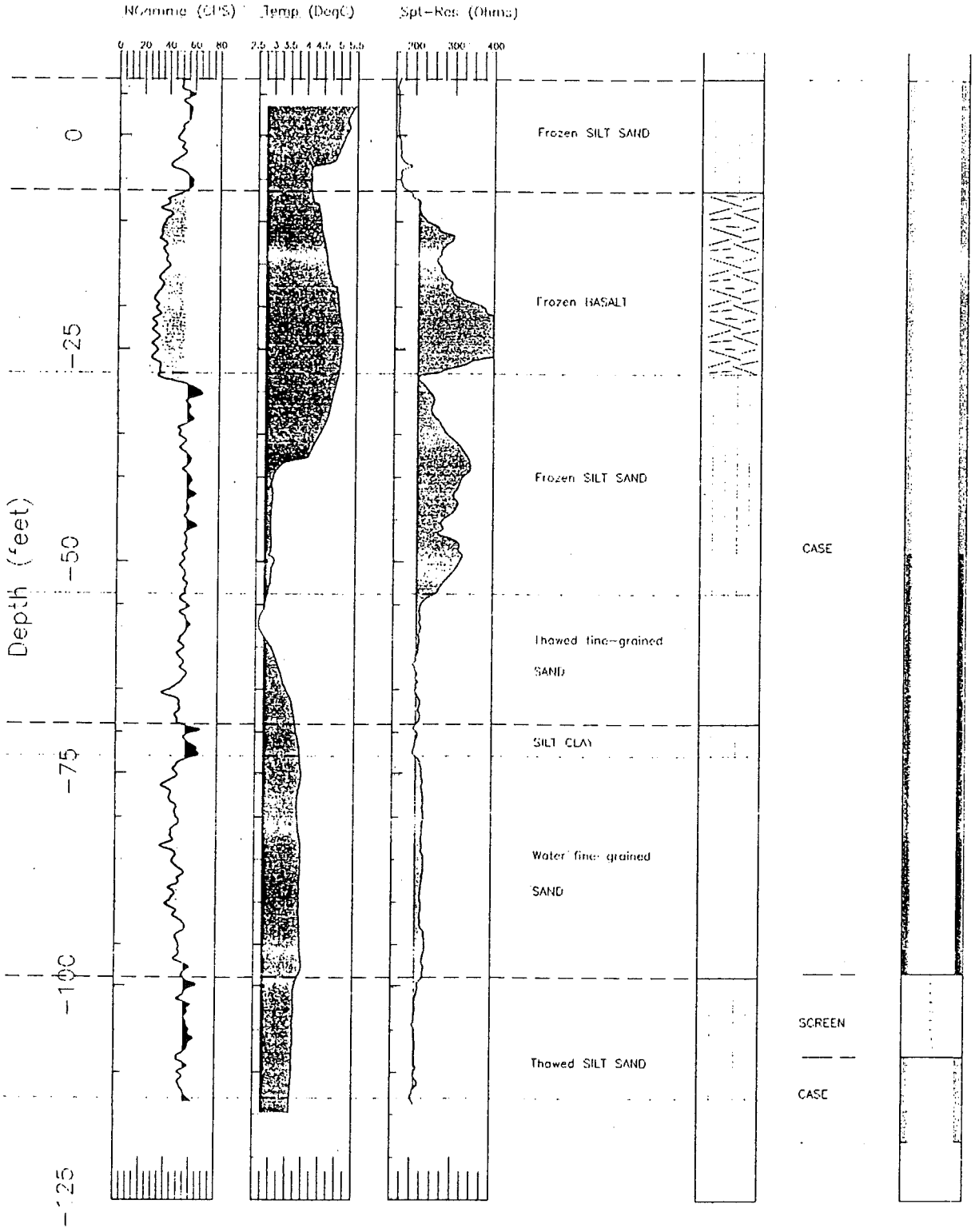
WELL DISINFECTED UPON COMPLETION? ()yes, (X)no

WELL: ( ) useable, or (X) abandoned WATER QUALITY DATA? (X)Y or ( )N LITHOLOGY:	SEE (**)	Depth From	Depth To
Peat	U	0 ft	2 ft
Silt, blue black	F	2	18 ft
Silt, blue black	U	18	27 ft
Loose fractured basalt with water	U	27	30 ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft
			ft

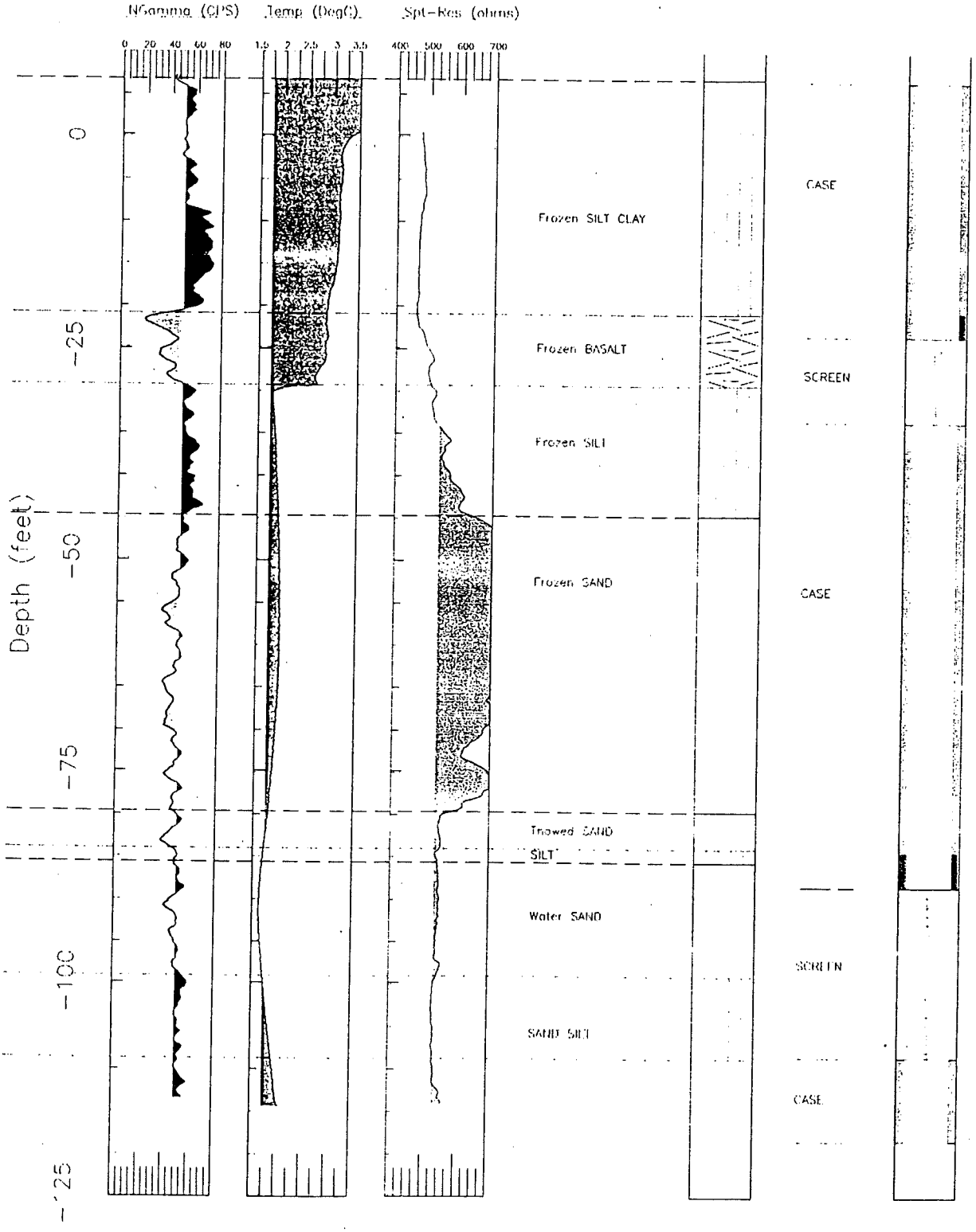
(**) F=PERMAFROST, U=UNFROZEN, W=WET, D=DRY, B=BEDROCK, A=ANNULUS, O=OTHER - ^C

REMARKS: Continued mechanical failures, well slumping and back filling - abandoned and equipment withdrawn. Land surface elevation is 18.7 ft.

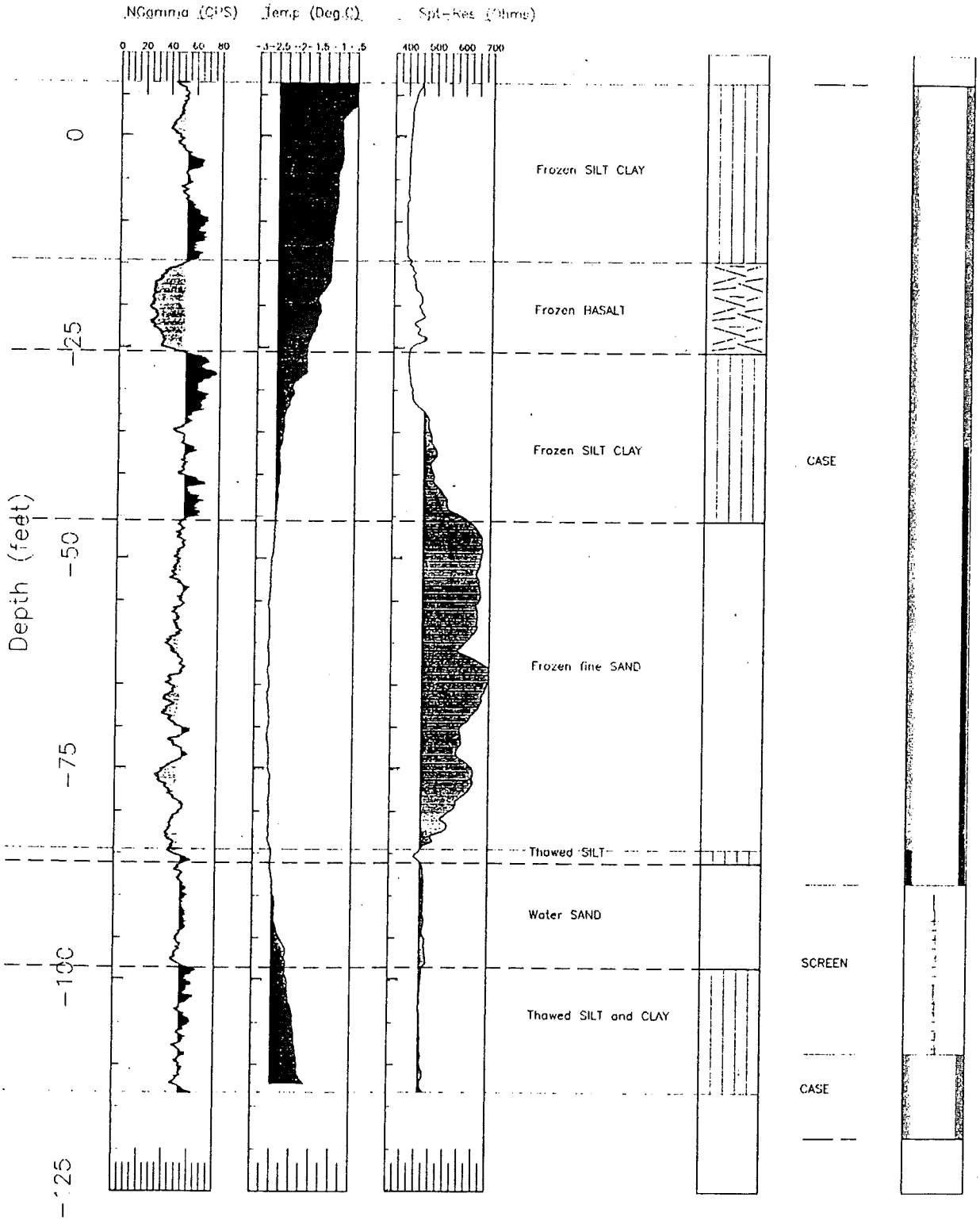
Well Name: Chefornak WW-6
File Name: GAMMA-3
Location: near small slough
Elevation: 10 Reference: Ground Surface



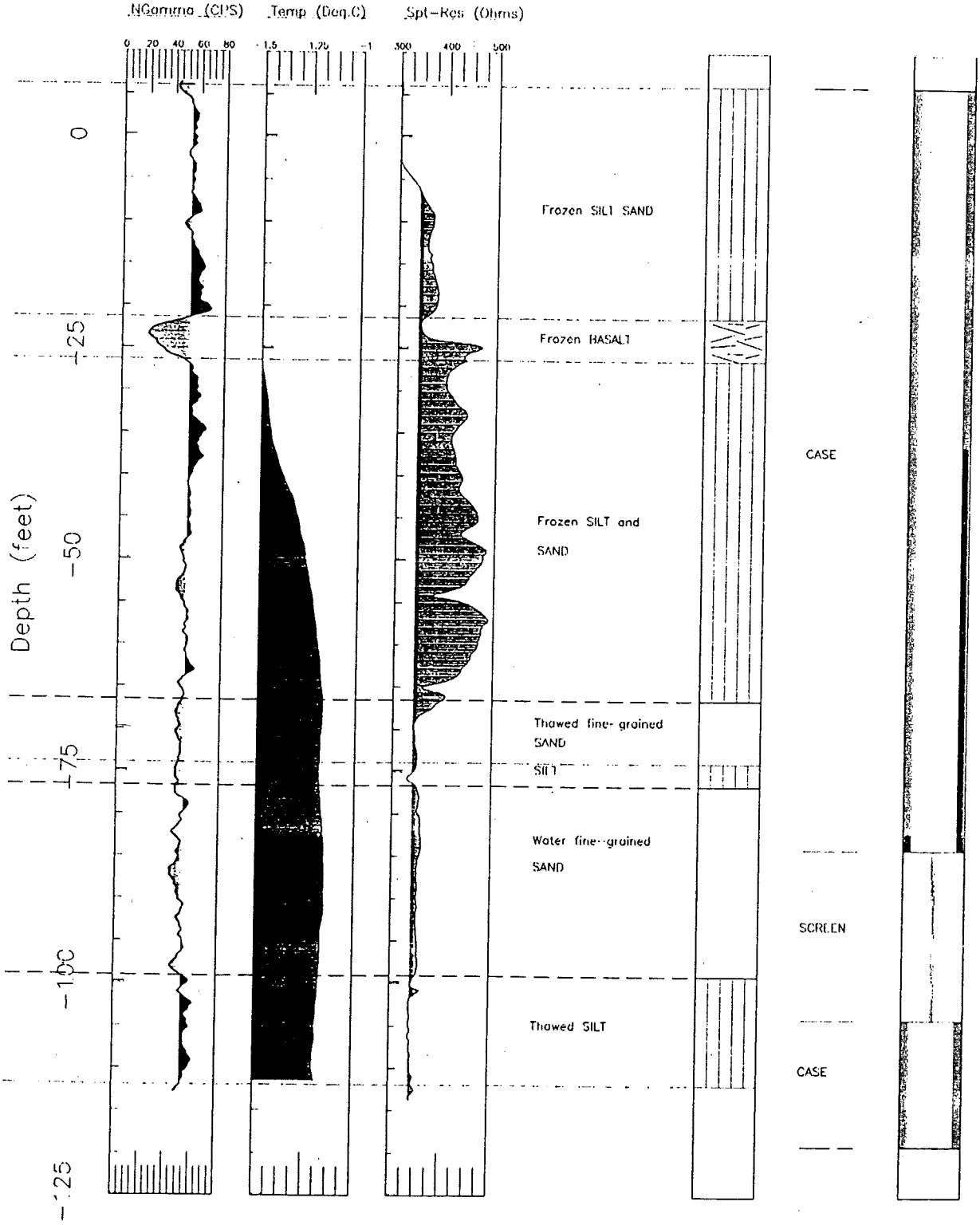
Well Name: Chefornak WW-1
File Name: TMP2DWN2
Location: 300 feet East of WW-6
Elevation: 10 Reference: Ground Surface



Well Name: Chefornak WW-8
File Name: EMDWN2
Location: Between WW-6 and WW-7
Elevation: 10 Reference: Ground Surface



Well Name: Chefornak WW-9 10
File Name: MXFLOGS
Location: East of WW-7
Elevation: 10 Reference: Ground Surface



Well Name: CHEFORNAK WW-10
File Name: COMPOS
Location:
Elevation: 10 Reference: Ground Surface