



**FINAL
SUBSURFACE EXPLORATION
AND
FOUNDATION RECOMMENDATIONS**

**NULLAGVIK HOTEL
KOTZEBUE, ALASKA**

ENGINEERING



PLANNING



SURVEYING



June 4, 2008
W.O. D58405A
Area 8
Report No. 4747

Ms. Carolyn Smith
NANA Development Corporation
1001 East Benson Boulevard
Anchorage, Alaska 99508

Subject: FINAL Subsurface Exploration and Foundation Recommendations
Nullagvik Hotel, Kotzebue, Alaska

Dear Ms. Smith:

The attached report presents the results of our subsurface exploration and our draft foundation recommendations for the proposed Nullagvik Hotel in Kotzebue, Alaska. This report includes the logs of sixteen test borings drilled during the current investigation, previous test borings, the results of laboratory tests, and recommendations regarding foundations, earthwork, and parking areas.

If you have any questions regarding this report or its use, or if we may provide additional services, please call.

Sincerely,
DOWL Engineers



Maria E. Kampsen, P.E.
Geotechnical Engineer

D58405A.Smith.060408.tla

Attachment(s): As stated

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AND
FOUNDATION RECOMMENDATIONS
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KOTZEBUE, ALASKA**

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TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	I
1.0 INTRODUCTION	1
1.1 Planned Development	1
1.2 Purpose of Investigation	3
1.3 Scope of Work	3
2.0 PHYSICAL SETTING	4
2.1 Regional Setting and Geology	4
2.2 Climate	4
3.0 SITE CONDITIONS	6
3.1 Surface	6
3.2 Subsurface	6
3.3 Groundwater	8
3.4 Permafrost	9
4.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS	11
4.1 Foundation Systems	11
4.2 Thermopile Foundation System	11
4.3 Earthwork	16
4.4 Drainage	17
4.5 Utilities	17
4.6 Observations	18
5.0 RESEARCH AND FIELD EXPLORATION	19
5.1 Research	19
5.2 Field Exploration	19
6.0 LABORATORY TESTS	22
6.1 Visual Classification	22
6.2 Moisture Content	22
6.3 Particle Size Distribution Tests	23
6.4 Plasticity Index Tests	23
6.5 Thaw Consolidation Tests	23
6.6 Torvane	24
6.7 Pocket Penetrometer	24
6.8 Organic Content Tests	24
6.9 Chloride Content	25
6.10 Soil Salinity	25
6.11 Consolidation Tests	26
7.0 REFERENCES	27

TABLE OF CONTENTS (cont'd)

FIGURES

Page

Figure 1: Vicinity Map.....	2
Figure 2: Typical Detail	14

TABLES

Table 1: Average Monthly Temperatures and Precipitation.....	5
Table 2: Observed and Measured Groundwater Levels.....	9
Table 3: Pile Capacity	12
Table 4: Thaw Consolidation Test Results	24
Table 5: Torvane/Pocket Penetrometer Test Results	24
Table 6: Sample Organic Content Test.....	25
Table 7: Soil Salinity Test Results.....	26
Table 8: Consolidation Test Results	26

APPENDICES

Appendix A	Test Boring Location Maps
Appendix B	Test Boring Logs and Descriptive Guide
Appendix C	Shelby Tube/Brass Liner Logs
Appendix D	Laboratory test Results
Appendix E	Thermistor Measurements

EXECUTIVE SUMMARY

The planned Nullagvik Hotel project is a four-story facility with parking areas and subsurface utilities. The project is located southeast of Shore Avenue and southwest of Tundra Way, immediately southwest of the existing hotel in Kotzebue, Alaska.

A geotechnical investigation was conducted in September 2007. The field investigation consisted of drilling, sampling, and logging 16 test borings to varying depths, and collecting subsurface temperature data.

Based on field and laboratory testing, the general soils within the project area were relatively consistent. Fill material and organics are present over sands and gravels. The sands and gravels become siltier with depth before transitioning to silts. The site has been previously disturbed which appears to have degraded the permafrost. The depth to permafrost ranged from about 8 to 15 feet below the existing ground surface and in several test borings, the soils appeared to be predominantly thawed.

The existing hotel site was investigated and several foundation systems evaluated in the DOWL Engineers 2004 report titled "Subsurface Exploration - Nullagvik Hotel." These systems included:

- a conventional shallow foundation,
- a refrigerated gravel pad and shallow foundation,
- driven piles, and
- thermopiles.

Based on the historic performance of the existing hotel, its foundation system, long-term maintenance requirements, and general information collected to date, thermopiles are the planned foundation system for the new hotel.

The site already consists of a gravel pad. However, the addition of insulation would help to limit heat transfer into the soils below. Section 4.2, Thermopile Foundation System addresses this in greater detail. The building pad should be constructed by removing sufficient fill material to allow two inches of insulation (four inches along southern side of

building) to be placed 18 inches below finished grade, and then covered with existing, non-organic fill material.

For utilities, even with the use of arctic pipe, additional heat will be transferred to the soils below. An additional two-inch layer of insulation should be placed below the utility lines and extend a minimum of two feet beyond the edges of the utility line. This will reduce the amount of settlement that will occur, although some annual grading across the site will be necessary.

The recommendations described in this report provide additional information regarding site development and should be read in their entirety.

1.0 INTRODUCTION

NANA Development Corporation (NDC) plans to replace the existing hotel with a new multistory hotel on an adjacent site along Shore Avenue in Kotzebue, Alaska (Figure 1). This report presents the results of our field exploration, laboratory soil testing program, and our recommendations regarding foundation design and site development in support of the proposed Nullagvik Hotel project.

1.1 Planned Development

The proposed hotel will consist of a three- to four-story, L-shaped, wood-framed building planned to be constructed in two phases. The main leg of the building is parallel to Tundra Way and will be approximately 169 feet in length by 61 feet wide in plan, with the shorter wing paralleling Shore Avenue and approximately 84 feet in length by 64 feet in width. The second phase will be an additional 95 feet of length to the shorter wing (Figure A-1, Test Boring Location Map, Appendix A). At this time, the spacing for the column loads will be about 14 feet on center.

In addition to the building, handicap ramp access, gravel parking, and utilities are planned. The lobby will be at grade (elevation 9 feet) with the rest of the structure's finish floor at elevation 19 feet.

This report documents observed subsurface geotechnical conditions at the site and provides analyses and interpretations of anticipated site conditions within the project area. It also presents recommendations for design and construction of the foundation for the building and for earthwork required for construction of the facility. This report is valid only for the planned development as it is currently understood. Any changes to the current plans may impact the recommendations contained herein and should be evaluated by the project geotechnical engineer.

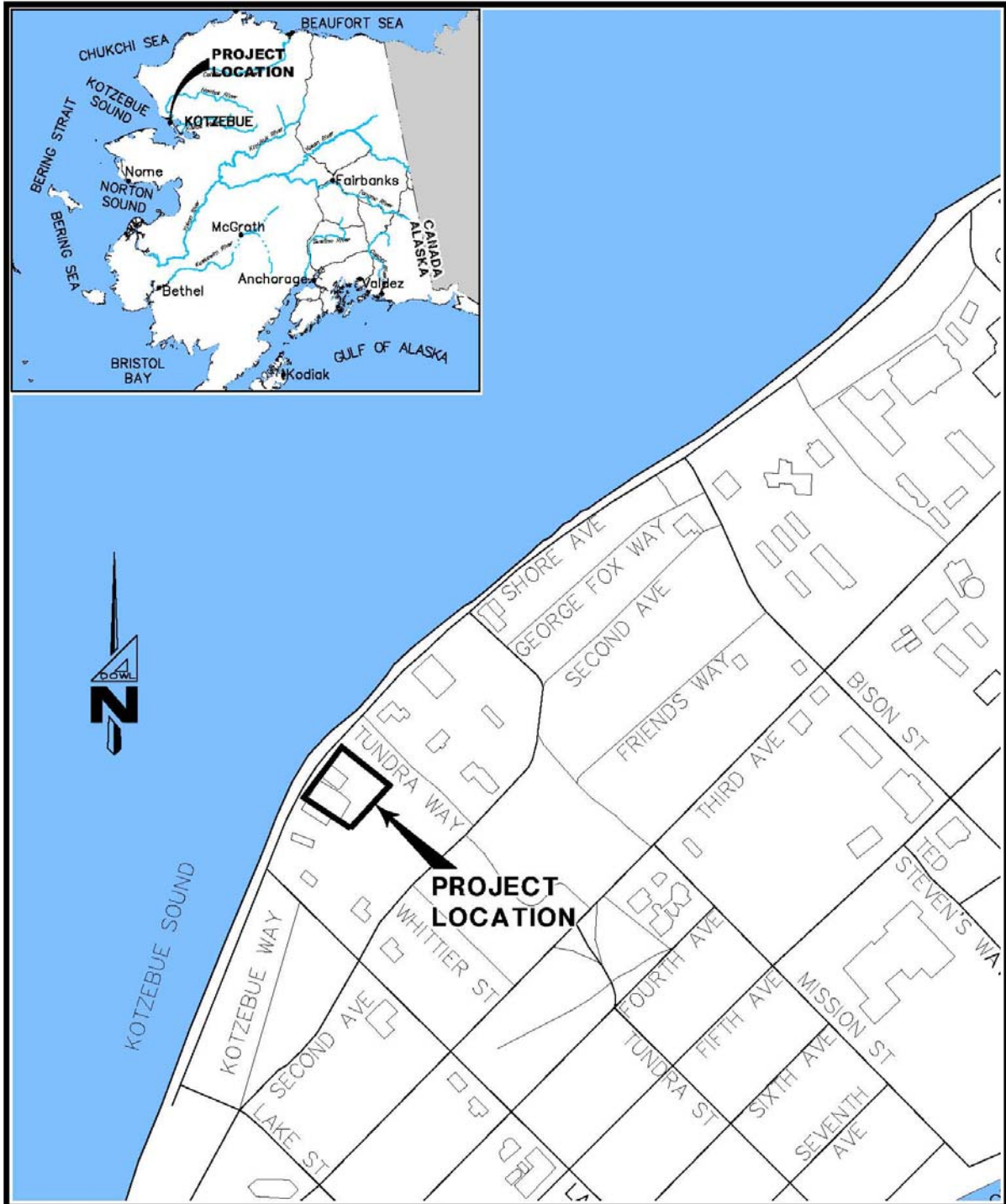


Figure 1: Vicinity Map

1.2 Purpose of Investigation

The purpose of this investigation was to determine subsurface soil conditions and extent of permafrost at the site in order to provide design recommendations regarding foundations, earthwork, drainage, frost protection, utilities, and traffic areas.

1.3 Scope of Work

A geotechnical exploration program was described in a proposal to NDC dated September 2006. On April 4, 2007, a second revision of that proposal was signed by NDC and DOWL Engineers (DOWL) received Notice to Proceed. In accordance with that proposal, the exploration was performed. Sixteen test borings were drilled, sampled, and logged in the vicinity of the proposed building footprint and parking areas to depths varying from 30 to 50 feet.

The approximate locations of the test borings, as well as test borings completed during a previous investigation, are shown in Figure A-1, Test Boring Location Map.

2.0 PHYSICAL SETTING

The site of the proposed Nullagvik Hotel is southwest of the existing hotel on the adjacent lot. The new hotel site is situated at the edge of Kotzebue Sound at the location formerly known as Hanson's Trading Company. The site is bounded by Shore Avenue and Kotzebue Sound to the northwest and commercial property to the northeast, southwest, and southeast.

2.1 Regional Setting and Geology

Kotzebue is located on the Baldwin Peninsula in Kotzebue Sound. This peninsula is composed of Quaternary fine-grained glacial deposits. It is located near the discharges of the Kobuk and Noatak Rivers, 26 miles north of the Arctic Circle and 549 air miles northeast of Anchorage. Kotzebue is at approximately 66° 54' North Latitude and 162° 35' West Longitude and lies in the continuous permafrost region. Permafrost has been reported to be at least 200 feet thick and can be locally absent near bodies of water.

2.2 Climate

Kotzebue is located in an arctic maritime climate zone which is characterized by long, cold winters and cool summers. Weather patterns are influenced by Kotzebue Sound. The climatological data presented below was taken from a range of sources; including the State of Alaska Department of Commerce, Community, and Economic Development Community Database, Environmental Atlas of Alaska, and the Alaska Climate Research Center.

Mean Annual Precipitation	10.0 in
Mean Annual Snowfall	49.4 in
Mean Maximum Temperature July	60°F
Mean Maximum Temperature January	3.7°F
Mean Minimum Temperature July	49.4°F
Mean Minimum Temperature January	-8.7°F
Average Summer Temperature	50.5°F
Average Winter Temperature	-2°F
Freezing Degree Days (°F-day)	5,900*
Thawing Degree Days (°F-day)	2,000
Heating Degree Days (°F-day)	16,200

Average monthly temperatures and precipitation amounts for Kotzebue and the vicinity, for the period between 1971 and 2000 are shown in Table 1.

Table 1: Average Monthly Temperatures and Precipitation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°F)	-2.5	-3.5	-0.3	11.5	31.6	44.8	54.7	52.1	41.8	23.2	8.3	-0.2
Precipitation (including snowfall) (in)	0.55	0.42	0.38	0.41	0.33	0.57	1.42	2	1.7	0.95	0.71	0.6

* According to the Alaska Climate Research Center, Kotzebue has experienced an increase in the annual average temperature of 2°F since 1970 and 3°F since 1950 for a current mean annual temperature of 23.3°F. For design of this structure, a warming trend of about 0.5°F per decade over the life of the hotel should be assumed, resulting in the following design values:

- Design Freezing Degree Days = 6,350
- Design Thawing Degree Days = 2,950
- Annual Mean Temperature °F = 24.8

3.0 SITE CONDITIONS

This section reports interpretations and opinions concerning the surface and subsurface soil and groundwater conditions at the site. The site conditions described are valid for the data collected within the scope of work. If additional data becomes available, some or all of the interpretations and opinions expressed herein could change. We should be notified immediately if the conditions found at the site are different from those encountered during this investigation.

The soil descriptions contained herein and the classifications shown on the test boring logs are the project geotechnical engineer's *interpretation* of the field logs, the visual soil classification performed in the laboratory, and the results of the laboratory soil testing. The largest particle size that can be recovered with standard drill hole samplers is often smaller than the maximum particle size in a gravelly soil deposit. Therefore, the soil descriptions and test results for gravelly soils tend to be biased toward the finer particle sizes.

Refer to the Test Boring Log-Descriptive Guide in Appendix B immediately following the test boring logs for a more detailed presentation on sample sizes, sample quality, frost classifications, soil types, and the soil classification procedures.

3.1 Surface

The entire site and general area are relatively flat with a slight slope towards the Sound. The roads and area around the proposed hotel are unpaved. Hansen's Trading Post, Hansen's Dry Goods store, the Honda shop, and assorted support structures were located on the site of the proposed hotel (Figure A-2). In August and September 2007, the structures were demolished and debris removed by Drake Construction. Fill material was brought to the site and spread across the property to level the area. On average, the depth of fill added to the site was less than one foot.

3.2 Subsurface

The subsurface soils below the site are consistent across the site, and generally can be described as a five layer system for engineering purposes:

1. Fill material, overlying
2. Peat, overlying
3. Poorly graded sands and gravels, over
4. A transition layer of silty sand, over
5. Silts.

Fill Material. The fill material that comprises Layer 1 extends from the ground surface to a depth ranging from one foot to five feet. The material is primarily gravels and sands, with a variable silt content. The material quality varies from non frost susceptible (NFS) to highly frost susceptible (F4) with *in situ* moisture contents of 4 to 23 percent.

Peat. Layer 2 consists of peat which is located within the upper five feet of the soil profile and generally less than three feet thick. The peat layer is indicative of the original ground surface, has compressed, and is highly frost susceptible. The water content of the peat varies between 37 percent and 226 percent.

Poorly Graded Sands and Gravels. Layer 3 is composed of medium dense to dense poorly graded and silty sands and gravels. The silt content is typically less than five percent below the peat layer and becomes siltier with depth. The sands and gravels extend to depths of 10 to 20 feet below the ground surface. The moisture content of the material varies widely as some of the sands and gravels are frozen, partially thawed, or below the water table. Where the gravels were frozen, no excess ice was observed.

Silty Sand. Underlying the sands and gravels is a transition layer of silty sand. The silty sand contains minimal gravel quantities that decrease with depth and a corresponding silt content that increases with depth, resulting in a fine grained silty sand deposit. This transition layer is typically frozen, likely contains excess ice in the form of crystals and small (less than one-quarter inch) lenses, and may contain traces of organics (roots). The silty sand layer extends to a depth of 20 to 30 feet with moisture contents ranging from 10 to 50 percent. In the majority of the samples recovered, no excess ice was observed. Where ice was observed, there generally was less than ten percent ice by volume.

Silts. Underlying the Kotzebue region is a layer of dark silt that extends to depths greater than 80 feet. These silts, when not frozen, are compressible and soft, with interbedded layers that classify as organic silt. Organics (rootlets) are frequently encountered in retrieved samples and shells are abundant throughout this layer. Although frozen, the majority of the samples contained no excess ice. The *in situ* water content ranges from 15 percent to 58 percent. The undrained shear strength of these materials generally is low ($s_u = 200$ to 500 psf).

3.3 Groundwater

Groundwater was observed in all of the test borings while drilling. In general, the water table on this site will be encountered as a perched water table. The permafrost below the active layer prevents the downward migration of water and the granular texture of the soils above the permafrost results in lateral water movement. During the summer/fall season as the active layer thaws and where the permafrost has degraded, water will be present above the permafrost.

Slotted PVC standpipes were installed in all but two of the test borings and the depth to the water table varied. In general, the groundwater level was about 7 to 9 feet below the ground surface, above the permafrost layer. In areas where permafrost was not observed, the depth to the water table was significantly deeper. The amount of groundwater will tend to fluctuate depending on the thickness of the active layer and the amount of precipitation received during the summer months.

The groundwater level observed while drilling is shown on each test boring log and the measured groundwater level is noted at the end of each boring log. Table 2 summarizes our observations of the water table within the project area. “N.O.” indicates the groundwater table was “not observed” while the test boring was drilled or during subsequent measurements through the standpipes.

Table 2: Observed and Measured Groundwater Levels

Test Boring No.	While Drilling (September 11-19, 2007)	Measured Depth (September 16-20, 2007)
	Depth to Water (ft)	
1	7.5	14.5
2	6	8
3	6	9.5
4	8	31
5	8	7
6	7	6
7	6	N.O.
8	5	N.O.
9	8	N.O.
10	5	19
11	10	PVC not installed
12	5	27
13	5	23
14	7	5.5
15	7	PVC not installed
16	5	9

3.4 Permafrost

Kotzebue is located in a region of the state that is generally underlain by moderately thick to thin continuous permafrost. The near surface soils are a part of the active layer that freezes and thaws each year. In undisturbed areas in Kotzebue, the active layer is typically about three to five feet thick. At the site of the existing hotel and the adjacent site of the proposed hotel, the depth to permafrost varies substantially. This is due to site disturbance causing changes in the thermal regime over time, and may be due, to a lesser degree, to the close proximity of Kotzebue Sound.

The soil sample temperatures shown on the graphic test boring logs only give a qualitative indication of the *in situ* soil temperatures. The temperature of samples can be significantly influenced by the ambient air temperature and friction during drilling and sampling. To allow more accurate reading of subsurface temperatures, a 3/4-inch PVC standpipe was installed in each test boring before the auger was extracted. A thermistor string with resistor nodes located at four-foot intervals was lowered into each standpipe and allowed to stabilize

over a period of several hours. A multimeter was used to measure the resistance at each node and converted to temperature. The temperature measurements obtained indicate the extent of the permafrost and are shown in Appendix E, Thermistor Measurements. Test borings are subject to warming during drilling. A second set of measurements was obtained in October 2007 to observe differences in the ground temperature after some time had passed. Those measurements are also included in Appendix E.

4.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

This section of the report includes interpretations and opinions concerning the interaction of the planned development with the surface and subsurface conditions detected by the field exploration and laboratory tests. It reflects an evaluation of the data collected during the field exploration and soil laboratory tests, and an understanding of the planned development. The analysis is valid for the data collected within the scope of work. The collection of additional data, or a change in the development plans, could provide information, which would alter some or all the interpretations and opinions expressed herein.

These recommendations are based on professional judgment and experience and the data collected during the site exploration and soil laboratory tests. These recommendations generally are not the only design options available; there may be several acceptable alternatives. These recommendations are not intended to represent the only way, but rather to indicate one appropriate option based on the information available.

4.1 Foundation Systems

There are several foundation systems that are suitable for support of the hotel. These systems include thermosyphons with a spread footing foundation, driven piles, and thermopiles. All of these systems were addressed in detail in the DOWL 2004 report for the existing hotel site. Of the systems discussed, either thermosyphons or thermopiles would be appropriate for use on this current site and both systems are based on refreezing of the subsurface soils. However, over the last 20 years, there have been a number of issues associated with the thermosyphon system in place around the existing hotel. For the planned hotel, it is important that the foundation system require minimal maintenance and reliability over the life of the structure. For these reasons, a thermopile foundation system is recommended for the proposed hotel. Should a thermosyphon system be considered instead, we should be notified to provide recommendations.

4.2 Thermopile Foundation System

The thermopile foundation system keeps the soils below the structure frozen. A thermopile is a load bearing two-phase passively refrigerated pile with rings around the perimeter. Each pile location is pre-drilled about six inches larger than the diameter of the piles, including the

rings. The pile is positioned within the hole, and slurried. Thermopiles extract heat from the ground when the air temperature is colder than ground temperature. The piles keep the ground below the active layer frozen. The thermopile capacities and minimum embedment depths are shown in Table 3 below. A minimum of three feet of air space should be maintained between the bottom of the glulam beams and the top of the building pad. A minimum spacing of five augered hole diameters, center to center should be maintained. Lateral loads can be resisted by using the bending in the steel with a point of fixity three feet below the top of the gravel pad.

Table 3: Pile Capacity

Pile Diameter	Minimum Embedment Depth (ft)	Ultimate Axial Capacity (kips)	Minimum Pre-Drilled Hole Width (in)
10	20	35	24
10	25	47	24
12	20	40	24
12	25	56	24
14	25	66	24
16	25	75	30
18	25	84	30
20	25	94	30

Elevator Pits. We understand that two elevators will be incorporated into the design of the new hotel. The elevator pits will likely extend into the free air space below the structure, or even into the ground. Insulation will be required below the elevator pits. The pits will be located in the lobby, and protected by the flat loop system described in further detail herein.

Subsurface Temperatures for Capacity. The thermopiles should have sufficient capacity to maintain the ground temperature at a maximum of 32 degrees a depth of three feet below finish grade in the summer and decrease linearly to 25 degrees at 25 feet.

Slurry. The thermopiles will be placed in a pre-drilled hole that is a minimum of six inches larger than the maximum diameter of the pile (which should include the helices or rings along the bottom two-thirds of the pile). The annulus between the pile and the soil should be backfilled with a well-graded sand and gravel slurry. The slurry should not have particles larger than one inch diameter, should be mixed by machine, easily flowable around the pile,

and contain fresh water (non-saline) not warmer than 40°F. The slurry should be filled and vibrated at a rate that ensures air voids are removed and bridging prevented. The upper two feet could be backfilled with cuttings. Cuttings should be mounded around the pile to prevent ponding. After the first season of thaw, any depressions around the piles that form should be backfilled with granular material.

Installation. The piles should be installed during late winter or early spring when the active layer is frozen. As each pile location requires pre-drilling, if thawed soils are encountered, casing of the hole could be necessary to prevent water infiltration. In addition, the piles cannot begin to be loaded until the slurry backfill and surrounding soils have set and are at a minimum temperature of 30 degrees or colder. The piles should not be fully loaded until a temperature of 28 degrees at 25 feet has been reached. The exposed portions of the piles should be painted white to increase the reflectivity of the piles and reduce the heat conduction along the pile and into the ground.

Thermistors. A 30-foot PVC pipe should be installed adjacent to every other thermopile for future ground temperature measurements. In addition, five thermistor tubes should be installed at an equal spacing beneath the building and not immediately adjacent to any piles. These pipes should be 3/4-inch Schedule 40 or 80 PVC, capped at both ends, water tight, and extend above the ground surface a distance of two feet. The thermistors should be protected from water infiltration and vandalism.

Lobby Area. The lobby area will be at grade bearing on the existing gravel pad with no free air space. The design of the insulated lobby pad is based on the following assumptions.

- Lobby area will be maintained year-round at a temperature of 70°F.
- Lobby will have in-floor radiant heat with an average temperature of 100°F to 120°F.
- The elevator pit is expected to have a temperature at or below the lobby temperature.
- Design freezing and thawing degree days and mean annual temperature as provided at the end of Section 2.2, Climate.
- Predominant wind direction is to the east.

The permafrost should be protected from degradation by a flat loop cooling system designed by Arctic Foundations, Inc. The system will likely consist of 3/4-inch diameter steel pipe, four to six feet on center. The flat loops will be connected to the laterals that maintain a minimum one foot vertical for 30 feet horizontal (1:30 slope) or connect directly into risers, followed by the condensers. A fuel proof membrane should be placed below the lobby, above the insulation and sloped away from the building. Figure 2 is a preliminary sketch of the pad below the lobby. The final design of the pad will vary and will be based on the design assumptions above as well the design degree days.

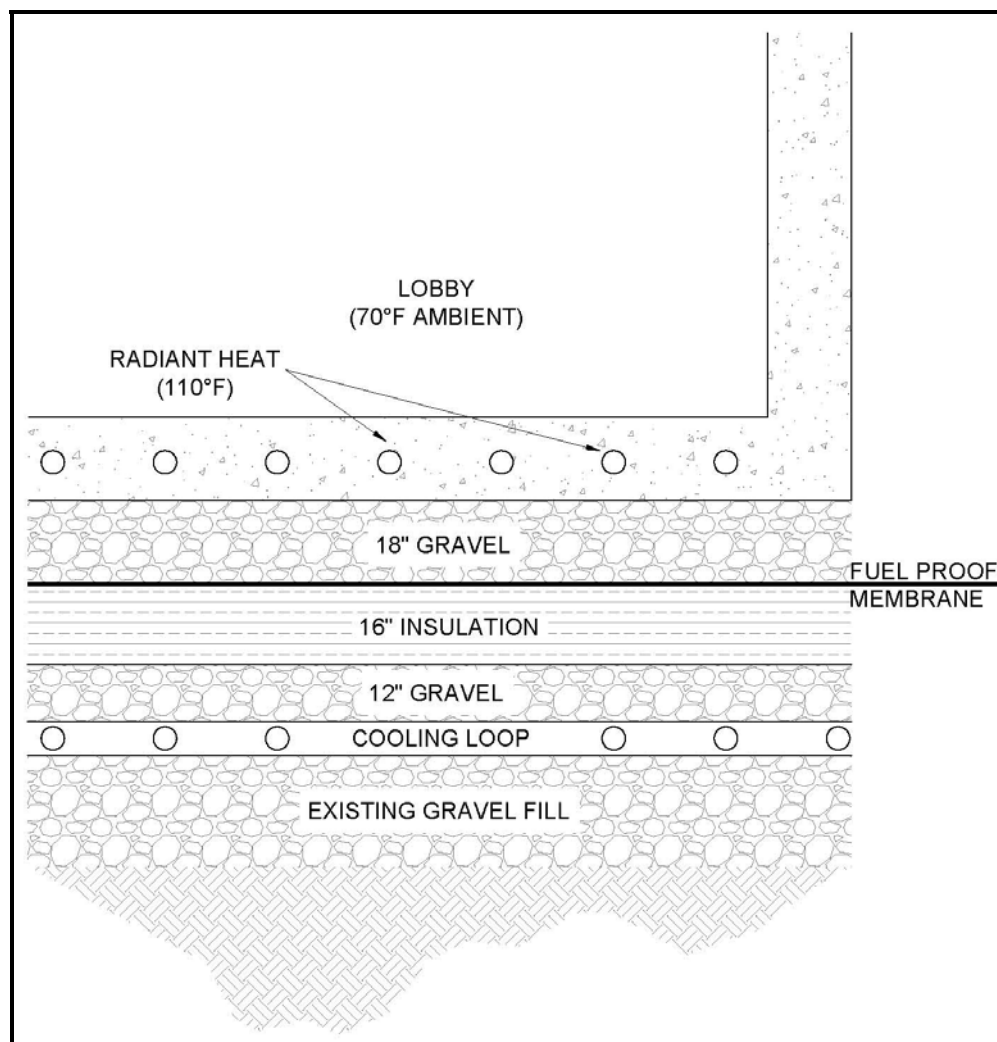


Figure 2: Typical Detail

Building Pad. The building pad should be constructed prior to installing the thermopiles and in the early summer when the ground is still frozen. As the site is already covered in a gravel fill material, the pad can be constructed by removing some thickness of gravel such that insulation is located 18 inches below finish grade, placing two inches of rigid closed cell extruded polystyrene on the exposed soils, and backfilling with the excavated, non-organic granular material. The insulation should extend outward 12 feet from the edge of the building. If 2009/2010 construction is planned, the insulation should be installed in April, May, or early June 2009.

Along the southern and western sides of the building, solar rays reflecting off the building will transfer more heat into the ground and these areas will be warmer. The insulation should be increased to four inches and extend a minimum of 16 feet out from the edge of the building. The insulation should be placed level and the two layers staggered.

Pad Construction. Construction in the late summer/early fall when the ground is fully thawed is not recommended. The placement of insulation over the thawed soils may decrease the depth of freeze. A shallow depth of freeze can prevent the active layer from fully refreezing, resulting in a thawed layer with water present at depth. This thawed layer could cause difficulties when pre-drilling for pile installation, and when it refreezes, may cause pile movement. In addition, this thawed layer reduces the capacity of the thermopiles.

As the foundation system refreezes the ground, it should be anticipated that some movement of the pad will occur during the first year or two, until the pad stabilizes. Minor grading may be required and water cannot be permitted to pond on the site.

It is important for the long-term performance of the hotel that snow drifting not occur beneath the structure. Snow drifting will inhibit the performance of the thermopiles and could result in permafrost degradation and decreased capacity.

Water Storage Tank. A water storage tank, or several water tanks, will be required on-site for emergencies. An estimated 30,000 gallons of storage capacity is planned and the water will be heated to an estimated temperature of 40 degrees Fahrenheit, to prevent freezing. At this time, the storage tanks can be constructed on a thickened concrete pad or on a ringwall.

Both will require some additional insulation depending on the configuration. For preliminary design, an allowable bearing capacity of 2,000 psf can be assumed for the ringwall/thickened slab. As the design progresses we will work with the structural engineer to determine the appropriate placement of the insulation based on the tank(s) sizes and foundation system.

4.3 Earthwork

Excavation. With a thermopile foundation, the only excavation should be that which is required for installation of utilities and placement of the insulation. The underlying peat layer on the site should be disturbed as little as possible.

Excavations should be done utilizing a backhoe with a smooth-bladed bucket from outside the excavation to minimize disturbance of the subgrade soils. Soils that are disturbed, pumped, or rutted by construction activity should be redensified, if possible, or completely removed and replaced with structural fill. Some of the removed fill can be reused as structural fill if it meets the requirements for structural fill as described herein.

Fuel-Proof Membrane. Wherever hydrocarbon products are in use, and below all tanks and lines, a fuel-proof membrane should be installed over the insulation. Hydrocarbon products will compromise the integrity of the insulation, could thaw permafrost, and will reduce the effectiveness of the thermopiles.

Temporary Cut Slopes. Temporary cut slopes for utility trenches and for foundation excavations in both granular and fine-grained soils have been known to stand temporarily at very steep angles; however, they also have been known to fail suddenly, without warning, claiming lives. It is the responsibility of the contractor to determine appropriate temporary cut slopes or shoring for excavations and trenches for the site soils, and surface loading conditions. As a minimum, the contractor should be in full compliance with all federal, state, and local safety requirements for trenching and shoring.

Permanent Cut and Fill Slopes. Permanent cut and fill slopes should not be steeper than 2 horizontal to 1 vertical.

Frozen Soils. Do not fill or backfill with frozen soils.

Structural Fill. Structural fill is defined as load-bearing fill placed under slabs, roads, and parking areas. All structural fill should consist of NFS sand or gravel meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Finer</u>
3"	100*
1-1/2"	70-100
3/4"	30-100
1/2"	25-100
No. 4	20-49
No. 40	0-25
No. 200	0-6
0.02mm	0-3

* The fill may contain up to 10 percent cobbles.

Other NFS fill material, which does not meet this gradation requirement, may be acceptable for use. However, the gradation of such material should be evaluated by the project geotechnical engineer prior to its use.

Fill Placement. Structural fill should be placed and compacted in lifts not exceeding twelve inches in loose thickness if a large vibratory compactor is used, or not exceeding six inches in loose thickness if a hand-operated compactor is used. Each lift of structural fill should be compacted throughout its entire depth to a density of at least 95 percent of the maximum index density determined in accordance with ASTM D6938. All excavations should be completely dewatered before placement of structural fill.

4.4 Drainage

Final grades and temporary construction grades should be constructed and maintained to rapidly drain surface and roof runoff away from the building. It is essential that ponding does not occur under the building or in the parking areas in order to reduce the potential for permafrost degradation.

4.5 Utilities

The water and sewer lines should be housed within arctic pipe. The utilities will be installed below the ground surface, and will transfer heat to the soils below. To reduce the potential

for thaw, a minimum of two inches of insulation extending a minimum of two feet beyond the edge of the pipe should be installed 12 inches below the utility line.

4.6 Observations

It is important to the performance of the planned project that the permafrost be protected and that structural fills consist of proper materials that are adequately compacted. All site work should be observed by qualified inspection/testing personnel under the supervision of a geotechnical engineer. Several in-place density tests should be performed in each lift of the structural fill to verify that minimum fill densities are being attained.

The pre-drilling, pile installation, slurry preparation, and thermistor installation should be observed by a qualified person under the general supervision of a geotechnical engineer. Records of the observations should be reviewed and analyzed by the engineer to help verify that each pile will have adequate load carrying capacity. Temperature data obtained from the thermistors should also be reviewed by a geotechnical engineer, prior to loading.

The inspection/testing personnel should be employed by the owner or owner's representative, not by the contractor, to avoid any inherent conflict of interest and to better ensure that the required level of quality assurance is achieved.

5.0 RESEARCH AND FIELD EXPLORATION

This section presents the technical data obtained from office research and the field investigation. The methods and procedures used in obtaining the data are presented. The data should be considered accurate only at the locations specified and only to the degree implied by the methods used. The data presented was obtained specifically to address the needs of the design, and may not be adequate for construction purposes.

5.1 Research

In 1976, Alaska Testlab conducted a subsurface investigation and foundation study of the existing hotel. At that time the hotel was approximately two years old and was exhibiting signs of differential settlement. The investigation consisted of five test borings to depths of 25 feet to 55 feet and provided foundation remediation recommendations. Over the years, there have been reports of additional building movement and continued settlement.

In 2003, a Facility Condition Survey of the Nullagvik Hotel was conducted by NANA/DOWL Engineers and ASCG, Inc. The survey addressed subjective assessments of the building exterior and interior in comparison with the 2000 International Building Code. In addition, an inspection of the existing thermoprobe system was performed by Mr. Ed Yarmak of Arctic Foundations, Inc.

In 2004, DOWL conducted a subsurface investigation around the existing hotel and developed foundation options for the reconstruction/renovation of the hotel. The report included a total of twenty test borings drilled at the site. The borings were drilled to depths ranging from 11.5 feet to 50 feet and have been included in this report.

5.2 Field Exploration

The test boring exploration for the Nullagvik Hotel project was conducted from September 11 through September 19, 2007. Sixteen test borings were drilled, sampled, and logged in the vicinity of the proposed hotel footprint to depths of 30 to 50 feet.

The test borings were located in the field by swing tying off existing landmarks using a fiberglass tape. This method is only as accurate as implied. In addition, a hand-held Garmin Global Positioning System (GPS) 12 unit was used to record the locations after drilling. The

accuracy of the GPS unit is dependent on several factors, including the number of satellites available and the position of the satellites. The approximate locations of the current and previous test borings in relation to the proposed hotel are shown on Figure A-1.

The test borings were drilled utilizing a CME-45 skid-mounted drill rig, which is owned and operated by Denali Drilling, Inc. The drill rig used in this investigation was fitted with continuous flight, hollow stem auger. The drilling was supervised and the samples logged by Mr. John Rego, a geologist with our firm.

Sampling. Samples were obtained at depths of five feet, and at five-foot intervals thereafter using a split-spoon sampler. Either Standard Penetration Tests (SPT) or modified penetration tests were performed in each of the test borings. The results are an indication of the relative density or consistency of the subsoil.

The SPT was performed in all of the test borings by driving a two-inch outside-diameter, split-spoon sampler a distance of 18 inches ahead of the auger with a 140-pound hammer falling 30 inches in accordance with ASTM D1586. The standard penetration resistance (N) value shown on the test boring logs indicates the number of blows required to drive the sampler the last 12 inches. The N-values shown in the logs are raw data from the field and have not been adjusted for sampling equipment type or overburden pressure.

Where brass liner samples were obtained, the samples were collected using a modified sampler which is a two and one-half inch inside-diameter, split-spoon sampler used to retrieve larger samples of soil. The sampler was advanced by using a 140-pound hammer falling 30 inches. The penetration test was performed by driving a distance of 18 inches ahead of the auger. The penetration resistance value shown on the test boring logs indicates the number of blows required to drive the sampler the last 12 inches.

As the soil samples were recovered, they were visually classified and sealed in plastic bags to preserve the natural water content. The samples were then transported to DOWL's laboratory, Alaska Testlab, in accordance with ASTM 4220, for further testing.

Brass Liner Samples. Brass liner samples were obtained from Test Borings 10 and 14. A brass liner is a thin-walled sleeve that fits into a split spoon sampler. When the sampler is

advanced through the soils, the soils are pushed into the sampler and into the sleeves. The sleeves are then removed and capped. The brass liner samples were kept frozen and returned to the laboratory where they were extracted from the tubes, and logged. Index testing on selected samples consisted of moisture contents, pocket penetrometer tests, and torvane tests. The logs of the brass liner samples are included in Appendix C, Shelby Tube/Brass Liner Logs.

Shelby Tube Samples. Shelby tube samples were obtained from Test Borings 5, 10, and 15 at depths greater than 40 feet. A Shelby tube is a thin-walled sampler designed to obtain relatively undisturbed samples in cohesive soils, such as clays, by pushing the sampler into the undisturbed soils. The Shelby samples were returned to the laboratory where they were extracted from the tubes, and logged. Index testing on the Shelby tube samples consisted of plasticity index tests, moisture contents, pocket penetrometer tests, torvane tests, organic content test, sieve analyses, and consolidation tests. The logs of the Shelby tube samples are included in Appendix C.

PVC Standpipe. Slotted PVC pipe was installed in all but two of the test borings and the depth to the groundwater was measured after the water levels appeared to have stabilized. A second solid PVC pipe capped on both ends was installed in each test boring for subsurface temperature measurements.

No environmental testing or monitoring was conducted as a part of this investigation.

6.0 LABORATORY TESTS

This section of the report presents the technical data obtained during the soil laboratory testing in narrative, tabular, and graphic form. The methods and procedures used in obtaining the data are described herein. The data should be considered accurate only to the degree implied by the methods used.

An engineering technician visually classified each sample recovered and the natural water content was measured. Index tests were performed on selected samples and consisted of grain size analyses, thaw consolidations, and plasticity index tests.

Soil samples will be stored until July 1, 2008, after which time they will be discarded unless other arrangements are made.

6.1 Visual Classification

In the laboratory, an engineering technician visually classified each soil sample obtained from the field exploration. The visual classification procedure consists of:

- identifying the color of the soil,
- estimating the percentages of gravel, sand, and minus No. 200 particle sizes,
- estimating the maximum particle size,
- estimating the size range of the sand particles,
- identifying the shape of the particles,
- estimating the dry strength of the soil when a water content test is performed,
- estimating the plasticity description of the soil and plasticity index,
- comparing the natural water content with respect to the Atterberg limits, and
- identifying the Unified Soil Classification System group.

6.2 Moisture Content

The natural water content of each sample was determined in accordance with ASTM D2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock. The water contents are reported on the graphic test boring logs, Appendix B.

6.3 Particle Size Distribution Tests

Ten particle-size distribution tests were performed on selected soil samples in accordance with ASTM D422. These tests consisted of mechanical sieving, the results of which are presented graphically as Appendix D, Laboratory Test Results.

6.4 Plasticity Index Tests

Six plasticity index tests were performed in accordance with ASTM D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. The liquid limit, plastic limit, and plasticity index numbers obtained from the test are plotted and used to classify the cohesive soil as silts or clays. In addition, the limits are used to estimate strength and settlement characteristics of these soils. The result of the plasticity testing is shown as Figure D-1. All of the samples tested were nonplastic.

6.5 Thaw Consolidation Tests

Thaw consolidation tests were performed on two selected soil samples. The testing method was based on ASTM D2435, One-Dimensional Consolidation Properties of Soils. ASTM 2435 determines the magnitude and rate of consolidation of soil when it is restrained laterally and drained axially while under a load using load increments. The testing performed on these samples used a single load being applied rather than controlled load increments. A load of 132 psf was applied to the sample. The load being applied was simply a load placed on a sample which will aid in obtaining the deformation upon thawing in a short amount of time; usually an hour to an hour and a half, the time necessary to melt the ice present in the sample. The test does not measure the long-term consolidation, or the amount of soil settlement which may occur under a load over a long period of time. Typically, the thaw consolidation tests overestimate the amount of consolidation by as much as a factor of two when compared to the actual settlement in the field. Table 4 shows the results of the testing. The figures are located in Appendix D.

Table 4: Thaw Consolidation Test Results

Test Boring	Sample Number	Depth (ft)	Soil Type	Moisture Content (%)	Diameter (in)	Initial Height (in)	Final Height (in)	Deformation on Thawing (%)
10	11-1	46-46.5	Silt	3	2.41	6.02	5.65	6.1
15	10-1	41-41.5	Silt	3	2.38	5.98	5.59	6.5

6.6 Torvane

A torvane is a hand held vane shear device for rapid estimation of undrained shear strength in cohesive soils in either the laboratory or the field. This test allows estimated undrained shear strength to be measured in the sides of test pits, trenches or excavations. It may also be used to evaluate shear strength of soils from thin wall samples. Torvane results are presented in Table 5, Torvane/Pocket Penetrometer Test Results.

6.7 Pocket Penetrometer

Pocket penetrometers are commonly used on split-spoon and thin-walled tube samples to evaluate the estimated unconfined compressive strength of saturated cohesive soils. They may also be used for the same purpose in freshly excavated trenches. Pocket penetrometer results are presented in Table 5:

Table 5: Torvane/Pocket Penetrometer Test Results

Test Boring	Sampler Type	Depth (feet)	Shear Strength (kips/ft ²)	Remolded Shear Strength (kips/ft ²)	Compressive Strength (kips/ft ²)
5	Shelby	35'-37'	0.20-0.45	0.1-0.20	1.0-2.25
5	Shelby	40'-42'	0.2-0.35	0.1-0.175	1.0-2.25
6	Shelby	30'-32'	0.2-0.4	0.075-0.15	0.75-2.0
10	Shelby	35'-37'	0.2-0.35	0.1	0.5-2.0
14	Shelby	30'-32'	0.225-0.3	0.075-0.125	0.75-2.25

6.8 Organic Content Tests

Two organic content tests were performed on selected soil samples in accordance with ASTM D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils. These tests were conducted to determine the *quantity* of organic matter in the material *by weight*. The results of these tests are presented on Test Borings 5 and 14

and in the table below. The percentage of organics shown in the narrative on the test boring logs is the percentage *by volume*, visually estimated in the field.

Table 6: Sample Organic Content Test

Test Boring No.	Sample No.	Sample Depth (ft)	Organic Content by Weight (%)	Organic Content by Volume (%)
5	9	35-37	3	14
14	7	30-32	2	10

6.9 Chloride Content

One water sample was collected and tested for chloride content using EPA Method 300.0-Determination of Inorganic Anions in Drinking Water by Ion Chromatography. This test determines the presence of chloride in the water. The salinity of the soils and water has an effect on the thermopile design as the freezing point is depressed. The chloride content of the water was determined to be 0.97 part per thousand (ppt).

6.10 Soil Salinity

Soil salinity was established using selected soil samples. Distilled water was added to the soil samples and Quantab[®] chloride titrators were placed in filtered solutions. Salt concentrations were obtained from the table provided by Quantab[®]. The results of the soil salinity tests are recorded on the test boring logs. Table 7 shows the results of the salinity testing in ppt, and the resulting freezing temperature. The general rule for freezing temperatures in saline water is that for every one ppt salinity, the freezing temperature will decrease 0.1 degree.

Table 7: Soil Salinity Test Results

Test Boring	Depth (ft)	% Salinity (ppt)	Freezing Temperature (°F)
1	25-26.5	0.261	31.7
2	15-16.5	0.032	32.0
3	30-31.5	0.104	31.9
5	16-16.5	0.032	32.0
6	10-11.5	0.032	32.0
7	20-21.5	0.162	31.8
9	10-11.5	0.032	32.0
9	20-21.5	0.125	31.9
12	40-41.5	0.324	31.7
16	20-21.5	0.032	32.0

6.11 Consolidation Tests

Consolidation tests are used to determine the rate and magnitude of soil consolidation when the soil is restrained laterally and loaded axially. Test results combined with theory are used to estimate the rate and amount of settlement. The consolidations test is performed in accordance with ASTM D2435, Standard Test Methods for One-Dimensional Consolidation of Properties of Soils using Incremental Loading. The test specimens were in three-inch diameter Shelby tubes and trimmed to a diameter of two and a half inches and a height of one inch. The consolidation test results are shown on the test boring logs and in the table below (Table 8). The figures are located in Appendix D.

Table 8: Consolidation Test Results

Test Boring No.	Depth (ft)	Compression Index (cc)
5	40	0.32
10	35	0.30

7.0 REFERENCES

DOWL, 2004, Subsurface Investigation Nullagvik Hotel, Kotzebue, Alaska, Anchorage, Alaska, DOWL Engineers, 21p.

Johnson & Hartman, 1984, Environmental Atlas of Alaska, 2nd Ed. Revised: Institute of Water Resources, University of Alaska, Fairbanks, 95p.

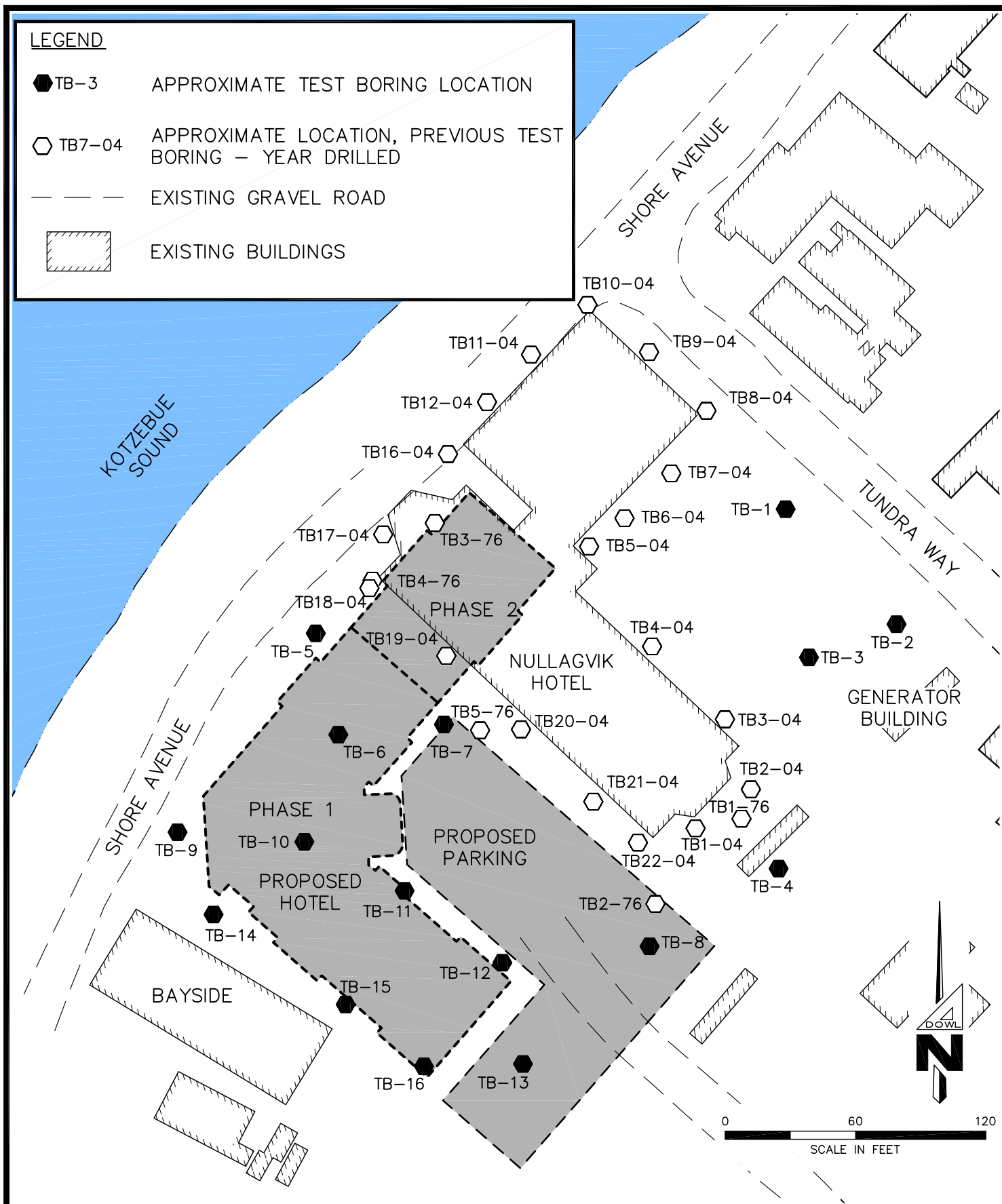
Pewe, T.L., 1975, Quaternary Geology of Alaska, U.S. Geological Survey, Professional Paper 835, U.S. Government Printing Office, Washington, 145p., 1 map, 2 tables in pocket.

Staff, 1996, Community Information Summary - Kotzebue, Department of Commerce, Community, and Economic Development, Research and Analysis Section, Anchorage, Alaska.

Wahrhaftig, Clyde, 1965. Physiographic Divisions of Alaska, U.S. Geological Survey Professional Paper 482, U.S. Government Printing Office, Washington D.C., 52p., 6 plates.

APPENDIX A

Test Boring Location Maps



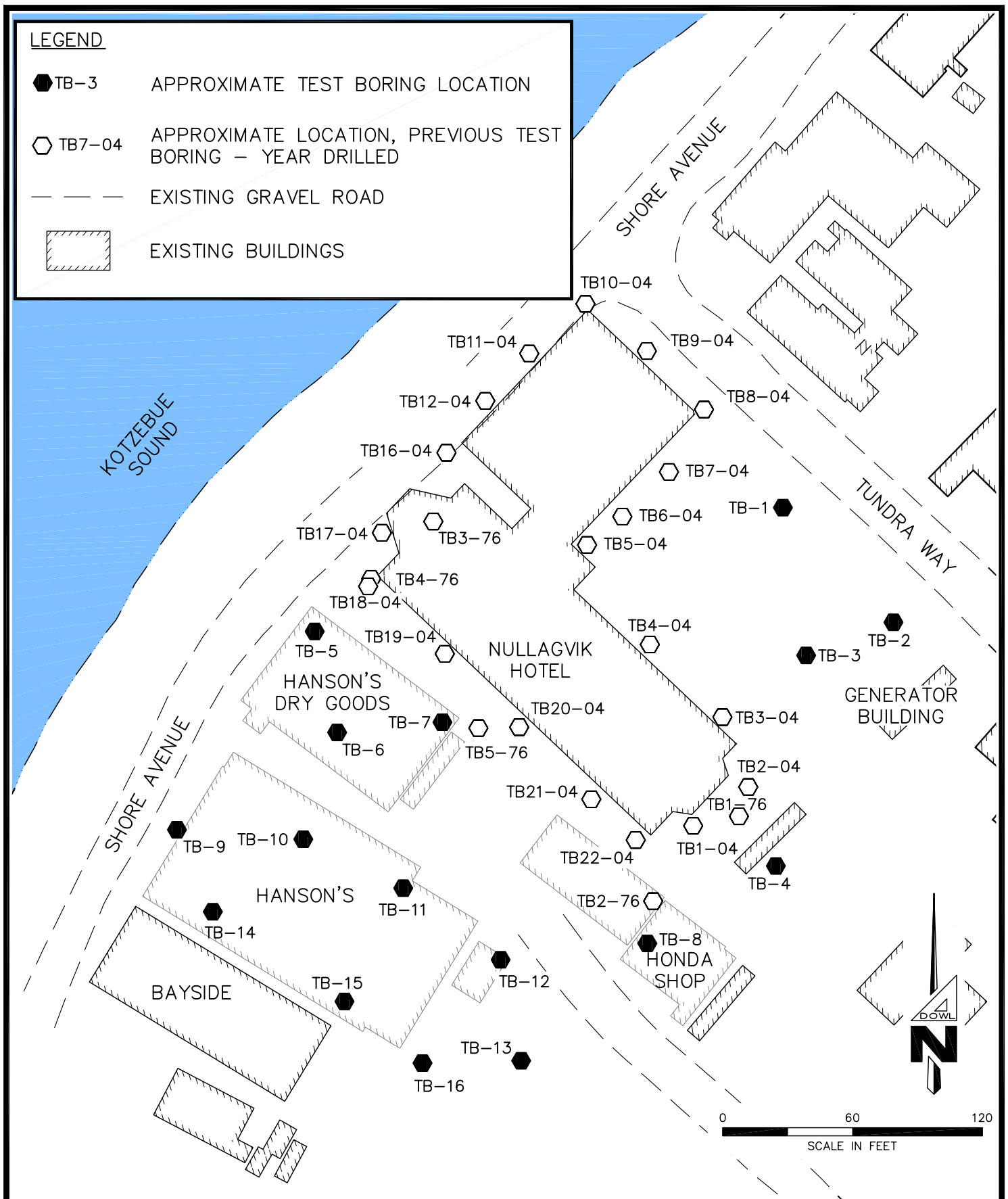
P:\Projects\D58405A\GEO\GTB-NUL.dwg NOV 26 2007 08:58:25 (MB)

SCALE: AS SHOWN



Test Boring Location Map
NULLAGVIK HOTEL
Kotzebue, Alaska

FIGURE A-1



P:\Projects\D58405A\GEO\GTB-NUL.dwg NOV 26 2007 08:58:25 (MB)

SCALE: AS SHOWN



Test Boring Location Map - Prior Conditions
NULLAGVIK HOTEL
Kotzebue, Alaska

FIGURE A-2

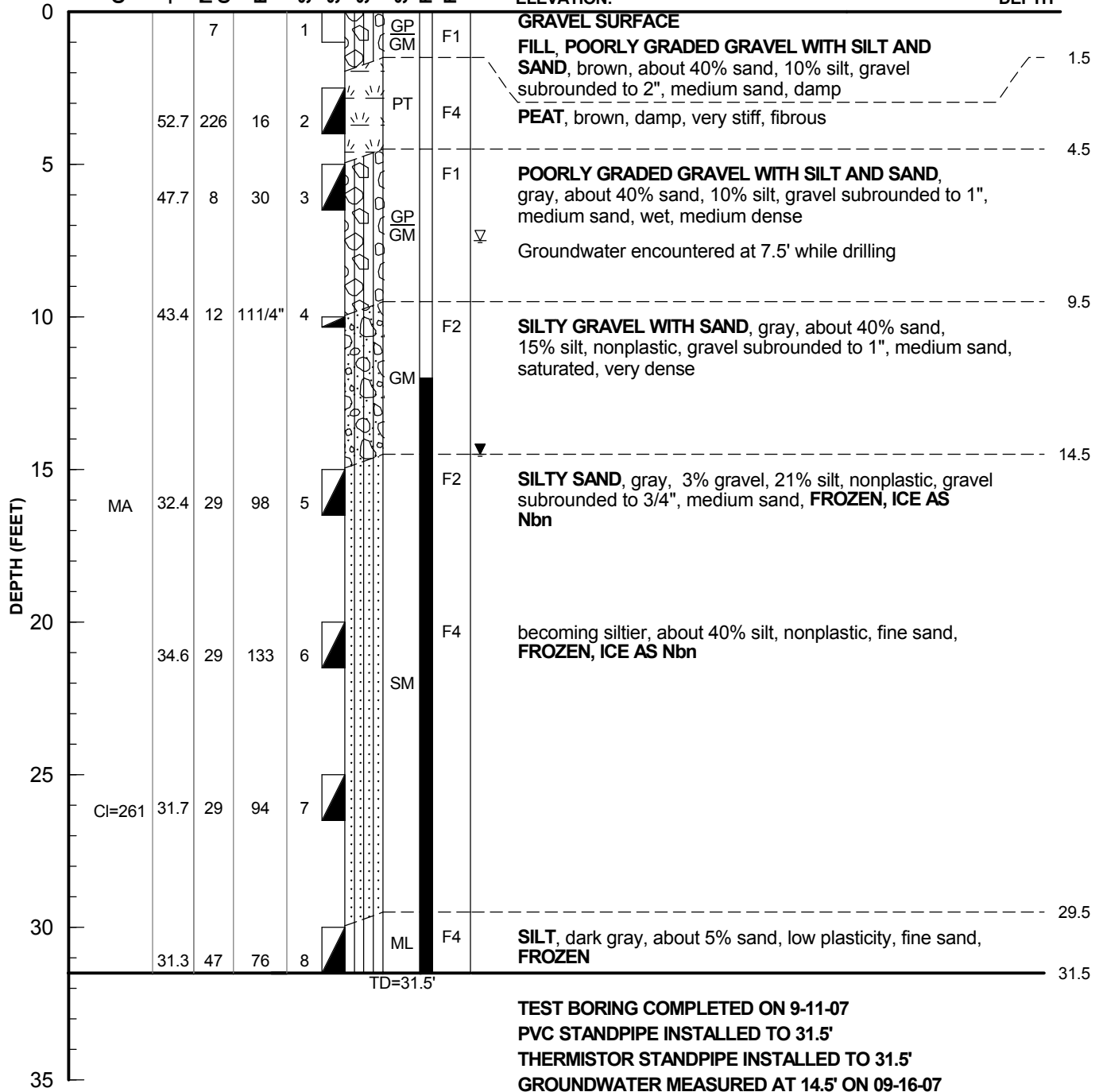
APPENDIX B

Test Boring Logs and Descriptive Guide

TEST BORING 1

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY

MA = Mechanical Analysis
CI = Salinity (Chloride) (ppm)
TD = Total Depth
= Groundwater After Drilling
Thaw Consol = Thaw Consolidation
= Grab Sample
= SPT Sample
= Shelby Tube - pushed
= 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.

EQUIPMENT: CME-45, Skid mounted

OPERATOR: Aaron Shaw

METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.

PROJECT: Nullagvik Hotel

LOGGED BY: John A. Rego, Jr.

TEST BORING COMPLETED: 9-11-07

W.O. D58405A



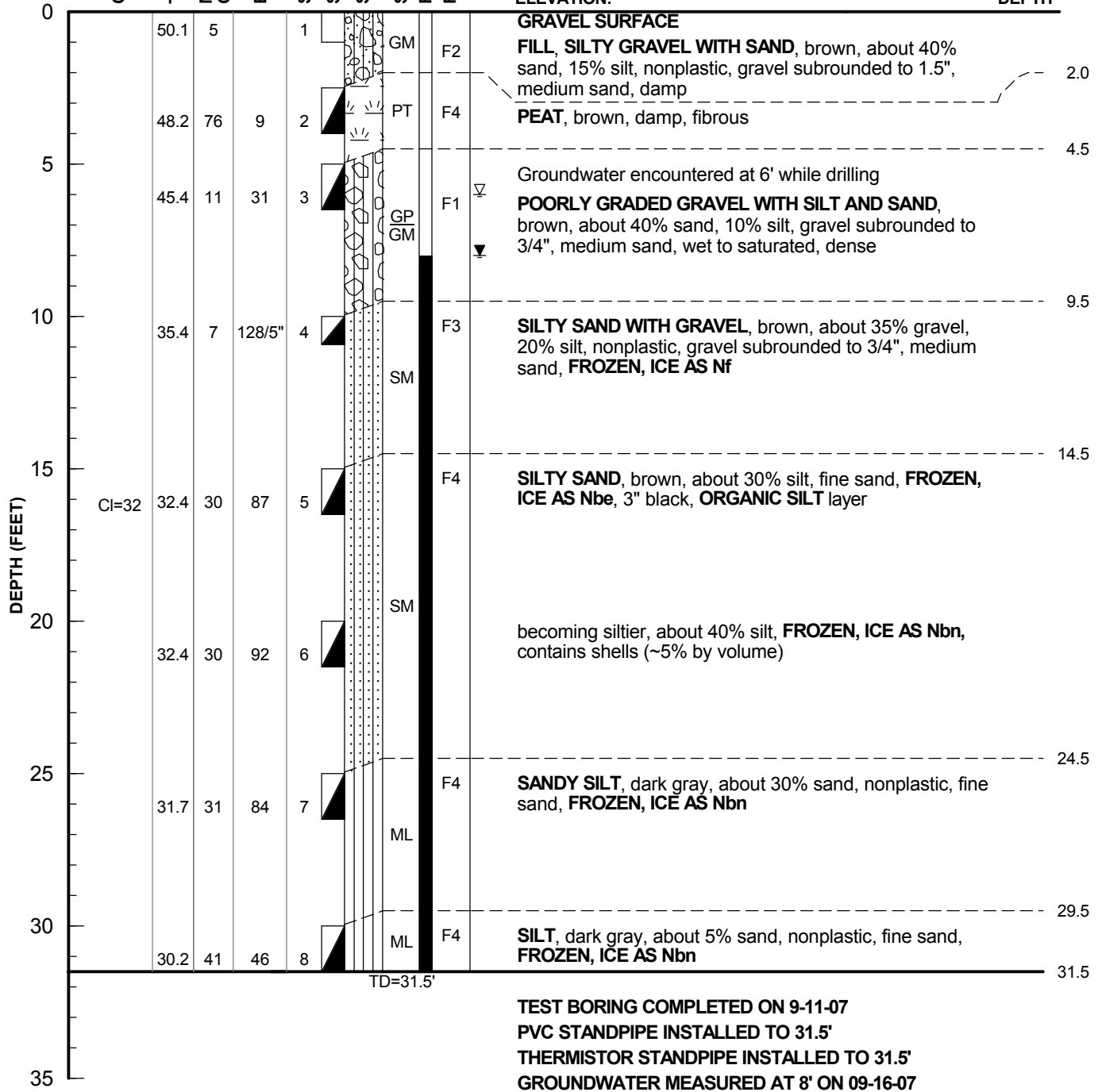
LOG OF TEST BORING 1

FIGURE B-1

TEST BORING 2

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY

CI = Salinity (Chloride) (ppm)
TD = Total Depth
= Groundwater After Drilling
Thaw Consol = Thaw Consolidation
= Grab Sample
= SPT Sample
= Shelby Tube - pushed
= 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-45, Skid mounted
OPERATOR: Aaron Shaw
METHOD: 6 in. OD hollow-stem auger

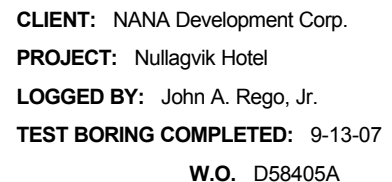
CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-11-07
W.O. D58405A



LOG OF TEST BORING 2

FIGURE B-2

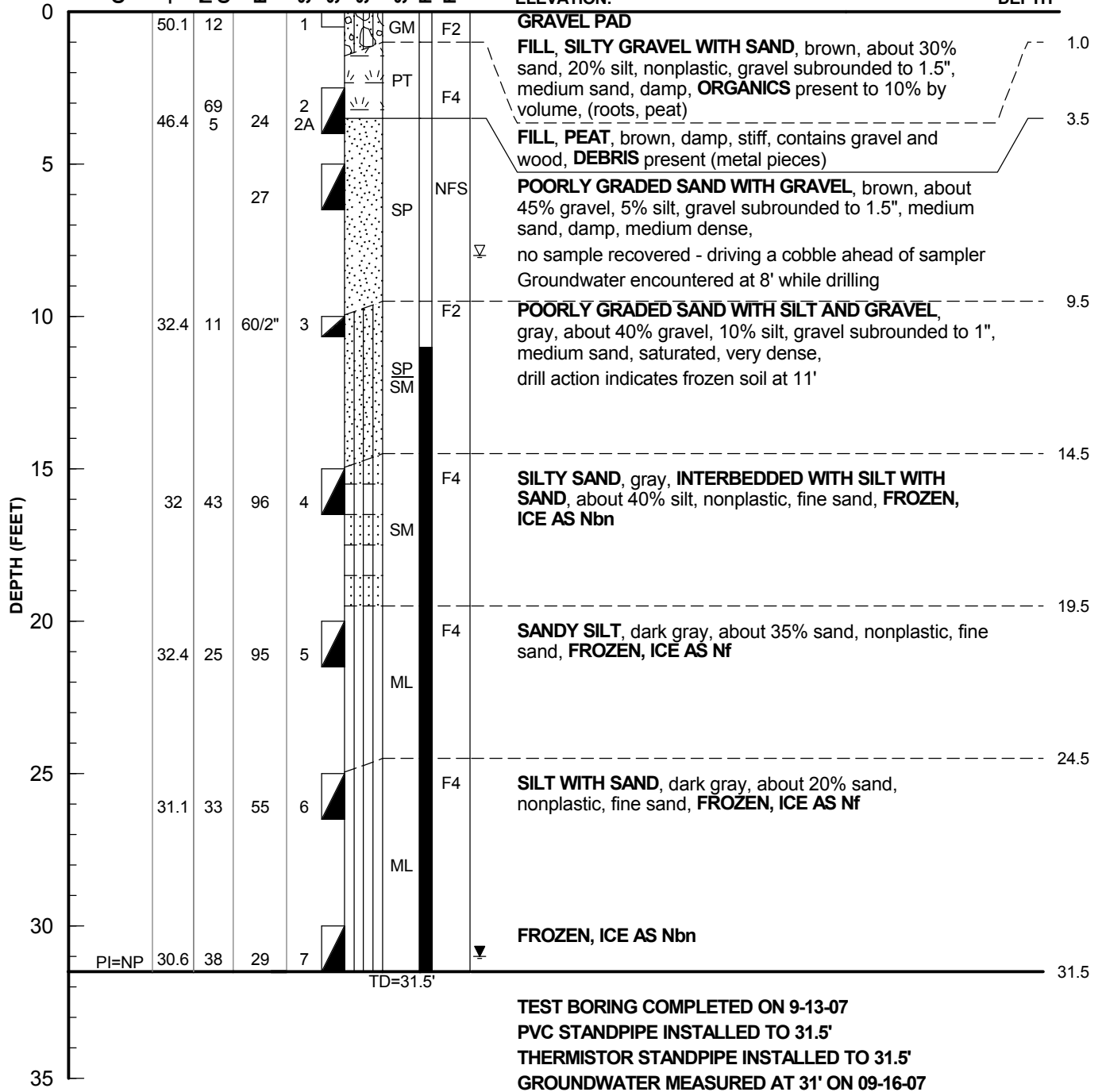
DEPTH



TEST BORING 4

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY
 PI = Plasticity Index
 LL = Liquid Limit
 TD = Total Depth
 = Groundwater After Drilling
 = Grab Sample
 = SPT Sample
 = Shelby Tube - pushed
 = 2.5" I.D. Spoon Sample
 340# weight, 30" fall
 T = Sample Temperature (°F) probably affected by sampling procedure

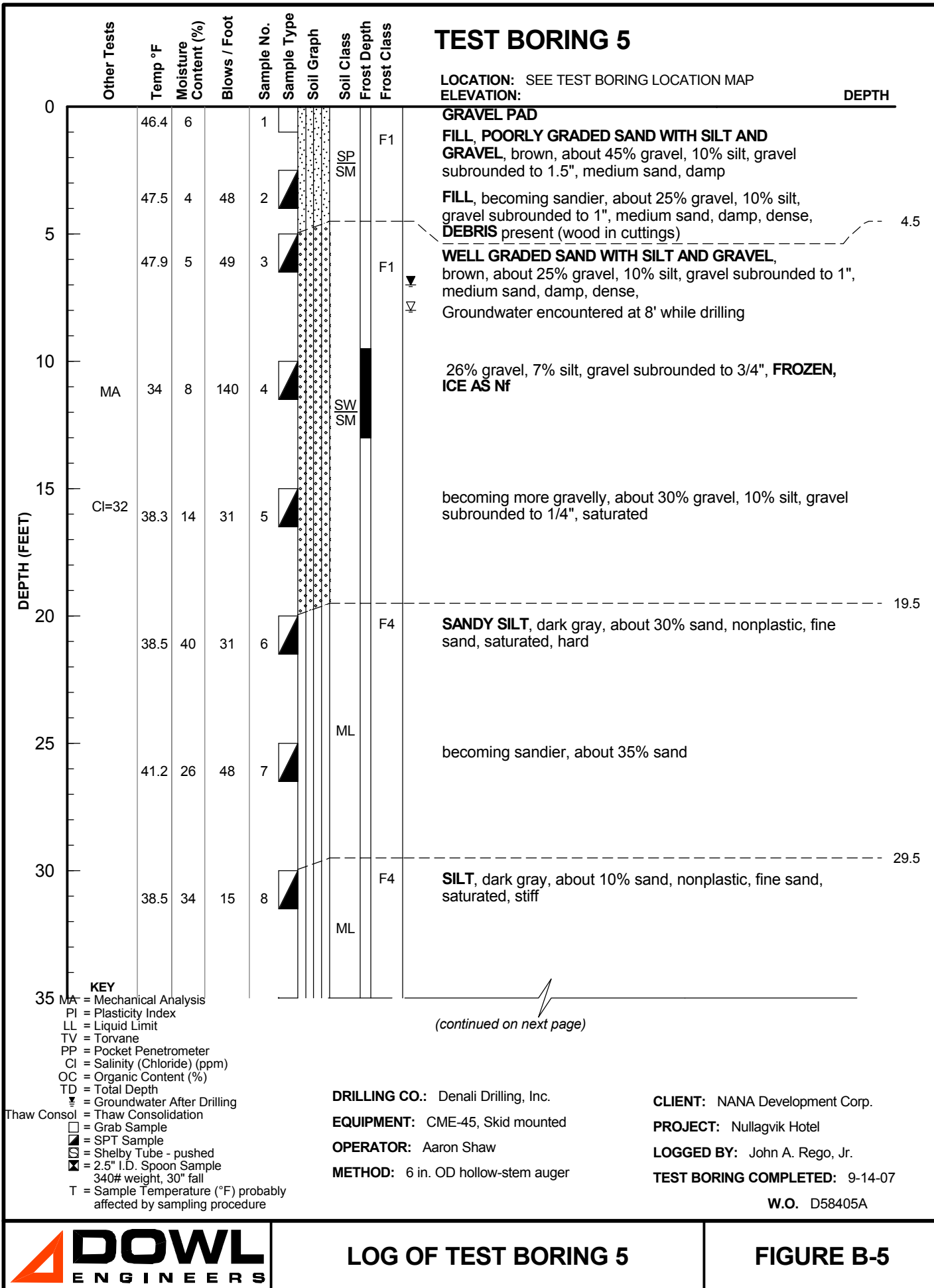
DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-45, Skid mounted
OPERATOR: Aaron Shaw
METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-13-07
W.O. D58405A



LOG OF TEST BORING 4

FIGURE B-4



TEST BORING 5 (Continued)

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH

Other Tests	Temp °F	Moisture Content (%)	Blows / Foot	Sample No.	Sample Type	Soil Graph	Soil Class	Frost Depth	Frost Class	DEPTH
MA TV PP OC=3%	35.6	33 35 40 28		9	S		ML			7% sand, PP= 1.25-2.0 TSF, TV= 0.20-0.45 (0.01-0.2R) TSF
PI=NP TV PP	36.9	46 43 41 40		10	S					about 10% sand, PP= 1.0-2.5 TSF, TV= 0.2-0.35 (0.10-0.175R) TSF
TD=42.0'										42.0

TEST BORING COMPLETED ON 9-14-07
PVC STANDPIPE INSTALLED TO 42'
THERMISTOR STANDPIPE INSTALLED TO 42'
GROUNDWATER MEASURED AT 7' ON 09-16-07

DEPTH (FEET)

KEY
MA = Mechanical Analysis
PI = Plasticity Index
LL = Liquid Limit
TV = Torvane
PP = Pocket Penetrometer
CI = Salinity (Chloride) (ppm)
OC = Organic Content (%)
TD = Total Depth
≡ = Groundwater After Drilling
Thaw Consol = Thaw Consolidation
☐ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-45, Skid mounted
OPERATOR: Aaron Shaw
METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-14-07
W.O. D58405A



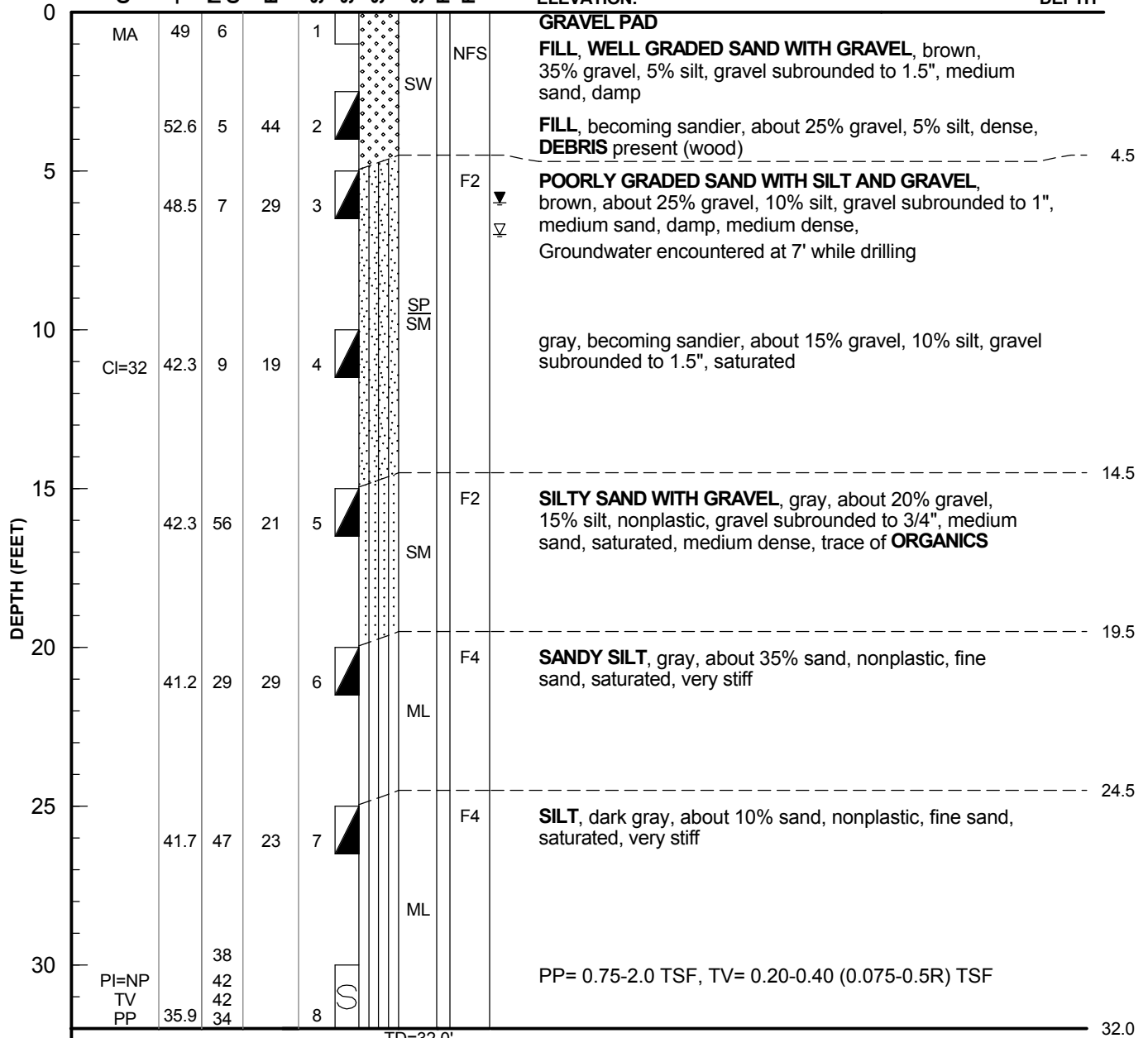
LOG OF TEST BORING 5

FIGURE B-5

TEST BORING 6

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



TEST BORING COMPLETED ON 9-14-07
PVC STANDPIPE INSTALLED TO 32'
THERMISTOR STANDPIPE INSTALLED TO 32'
GROUNDWATER MEASURED AT 6' ON 09-16-07

KEY

MA = Mechanical Analysis
PI = Plasticity Index
LL = Liquid Limit
TV = Torvane
PP = Pocket Penetrometer
CI = Salinity (Chloride) (ppm)
TD = Total Depth
= Groundwater After Drilling
Thaw Consol = Thaw Consolidation
= Grab Sample
= SPT Sample
= Shelby Tube - pushed
= 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-45, Skid mounted
OPERATOR: Aaron Shaw
METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-14-07
W.O. D58405A



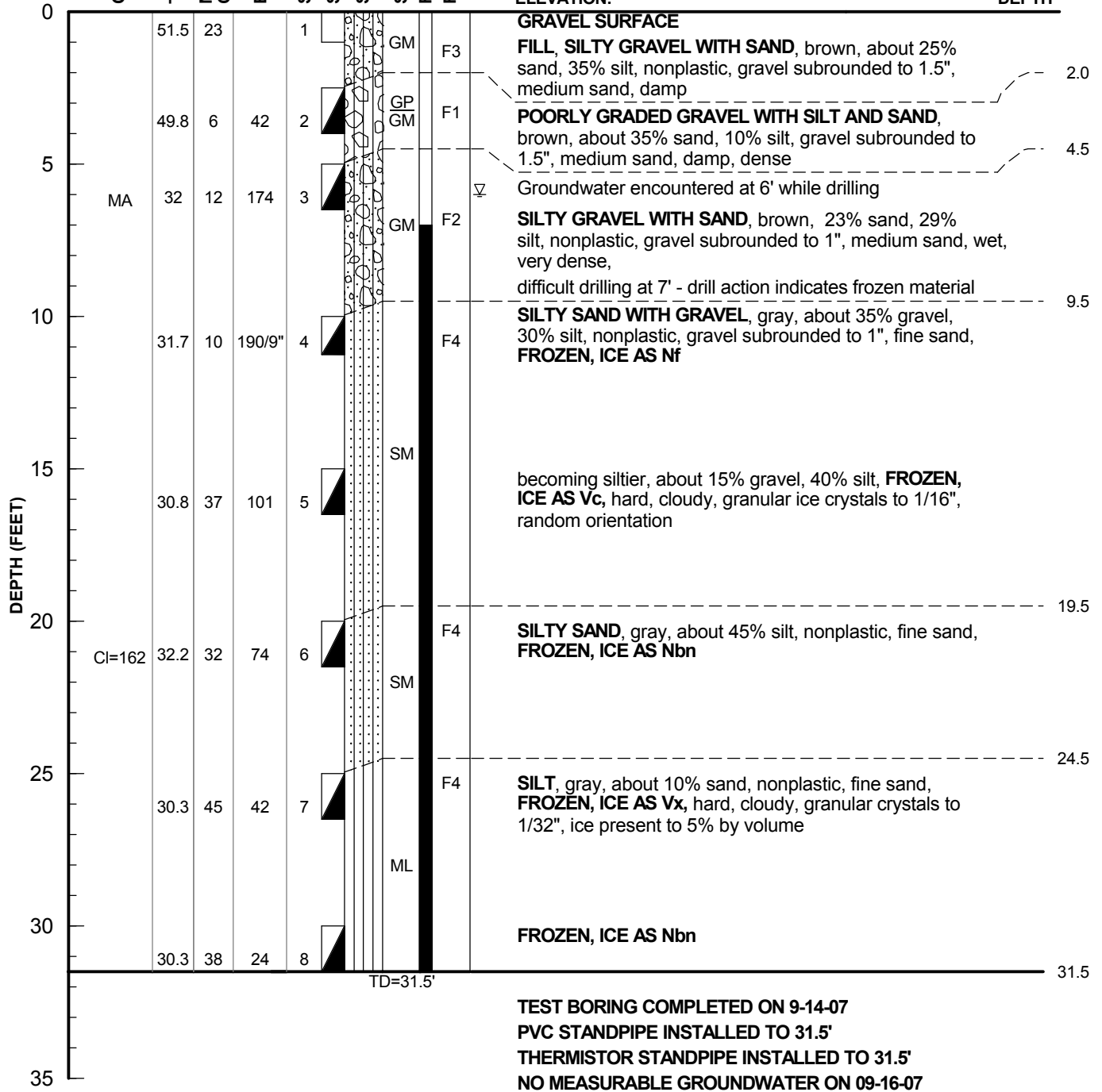
LOG OF TEST BORING 6

FIGURE B-6

TEST BORING 7

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY

MA = Mechanical Analysis
CI = Salinity (Chloride) (ppm)
TD = Total Depth

Thaw Consol = Thaw Consolidation

☐ = Grab Sample

☑ = SPT Sample

☑ = Shelby Tube - pushed

☑ = 2.5" I.D. Spoon Sample

340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.

EQUIPMENT: CME-45, Skid mounted

OPERATOR: Aaron Shaw

METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.

PROJECT: Nullagvik Hotel

LOGGED BY: John A. Rego, Jr.

TEST BORING COMPLETED: 9-14-07

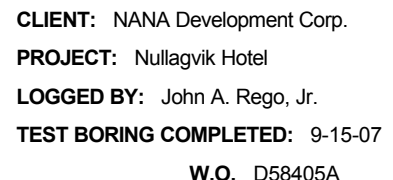
W.O. D58405A



LOG OF TEST BORING 7

FIGURE B-7

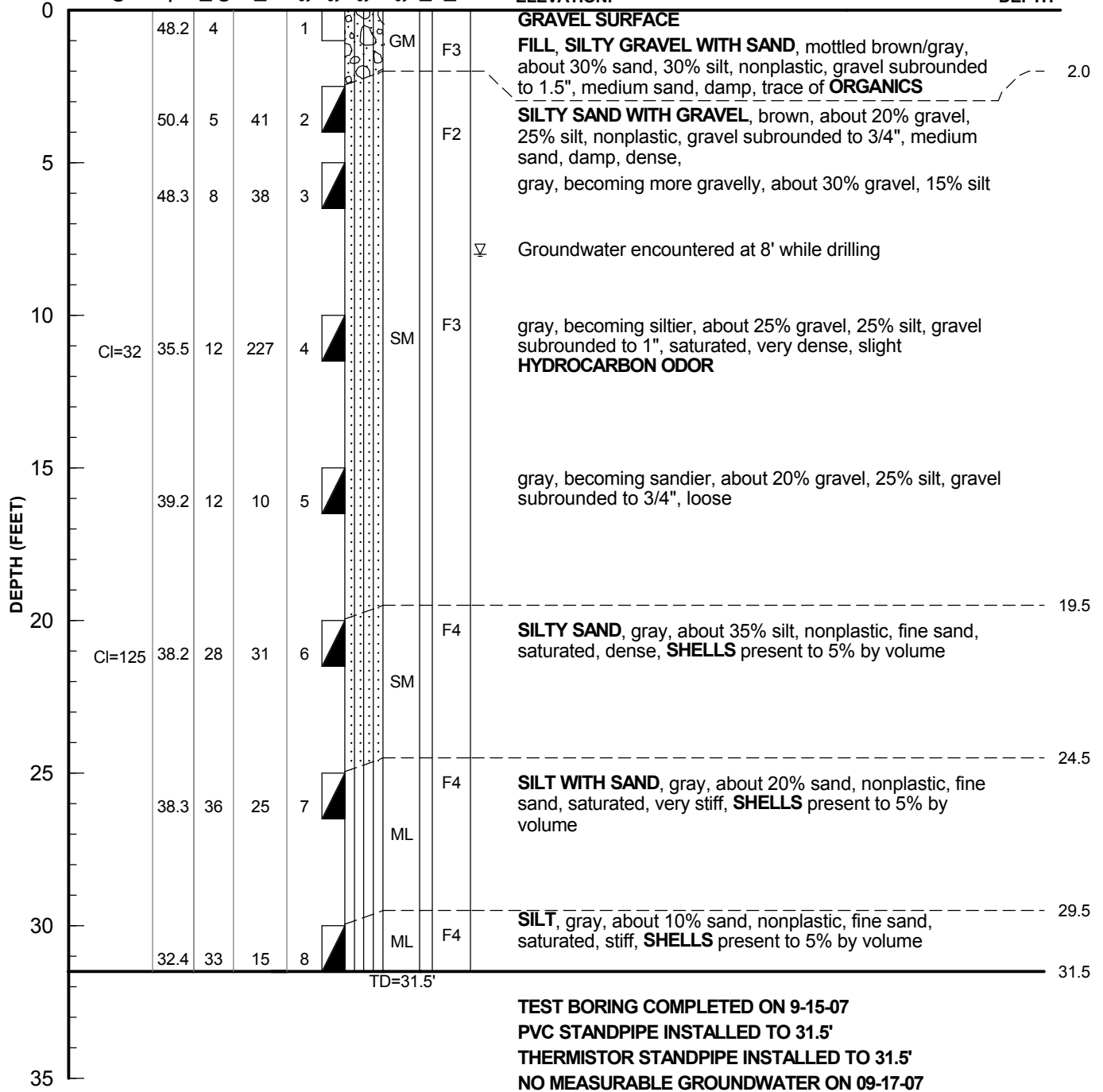
DEPTH



TEST BORING 9

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY

CI = Salinity (Chloride) (ppm)
TD = Total Depth
Thaw Consol = Thaw Consolidation
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-45, Skid mounted
OPERATOR: Aaron Shaw
METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-15-07
W.O. D58405A



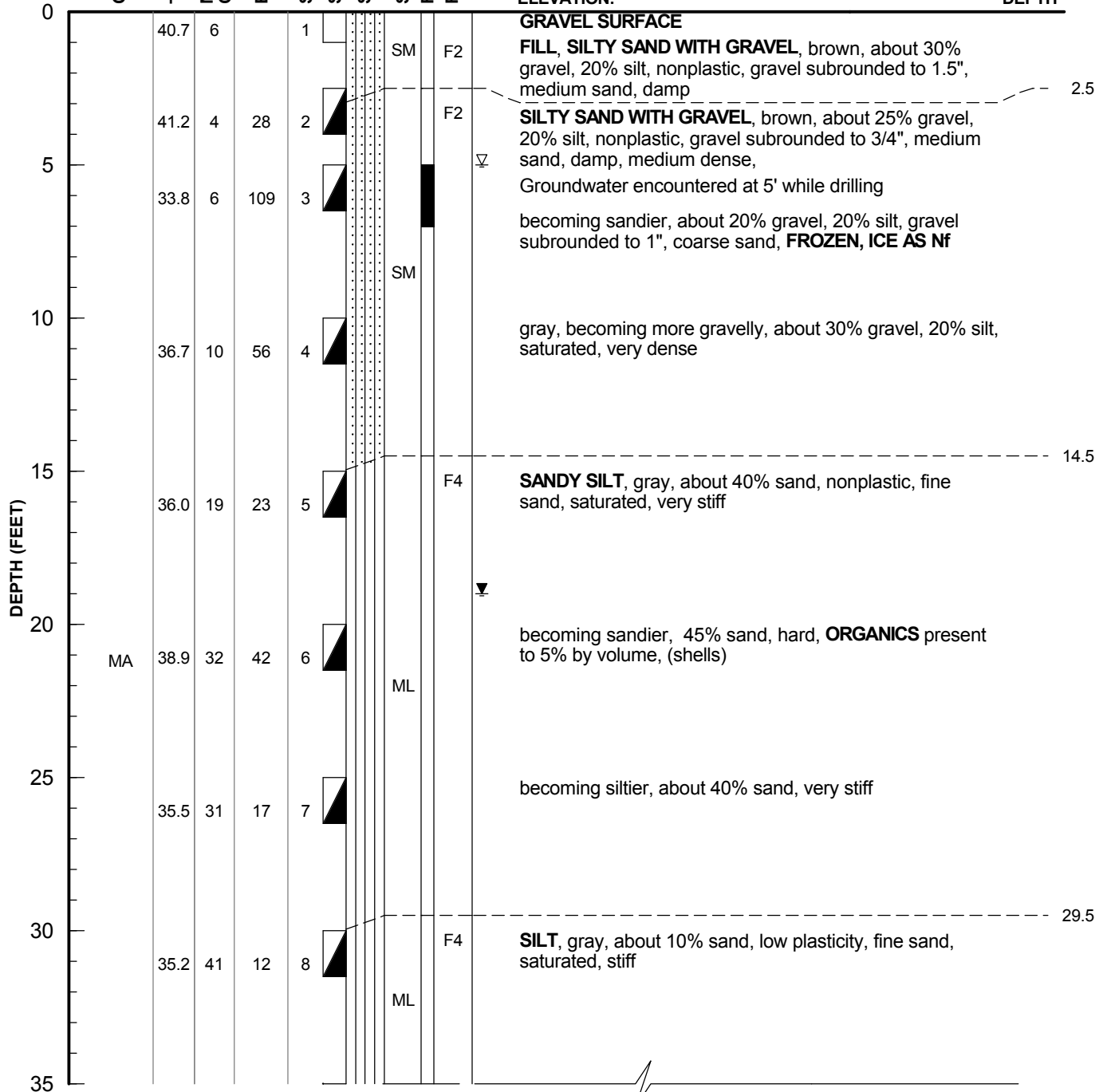
LOG OF TEST BORING 9

FIGURE B-9

TEST BORING 10

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



(continued on next page)

KEY

MA = Mechanical Analysis

PI = Plasticity Index

LL = Liquid Limit

TD = Total Depth

▽ = Groundwater After Drilling

Thaw Consol = Thaw Consolidation

□ = Grab Sample

▣ = SPT Sample

▤ = Shelby Tube - pushed

⊠ = 2.5" I.D. Spoon Sample

340# weight, 30" fall

T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.

EQUIPMENT: CME-45, Skid mounted

OPERATOR: Aaron Shaw

METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.

PROJECT: Nullagvik Hotel

LOGGED BY: John A. Rego, Jr.

TEST BORING COMPLETED: 9-19-07

W.O. D58405A



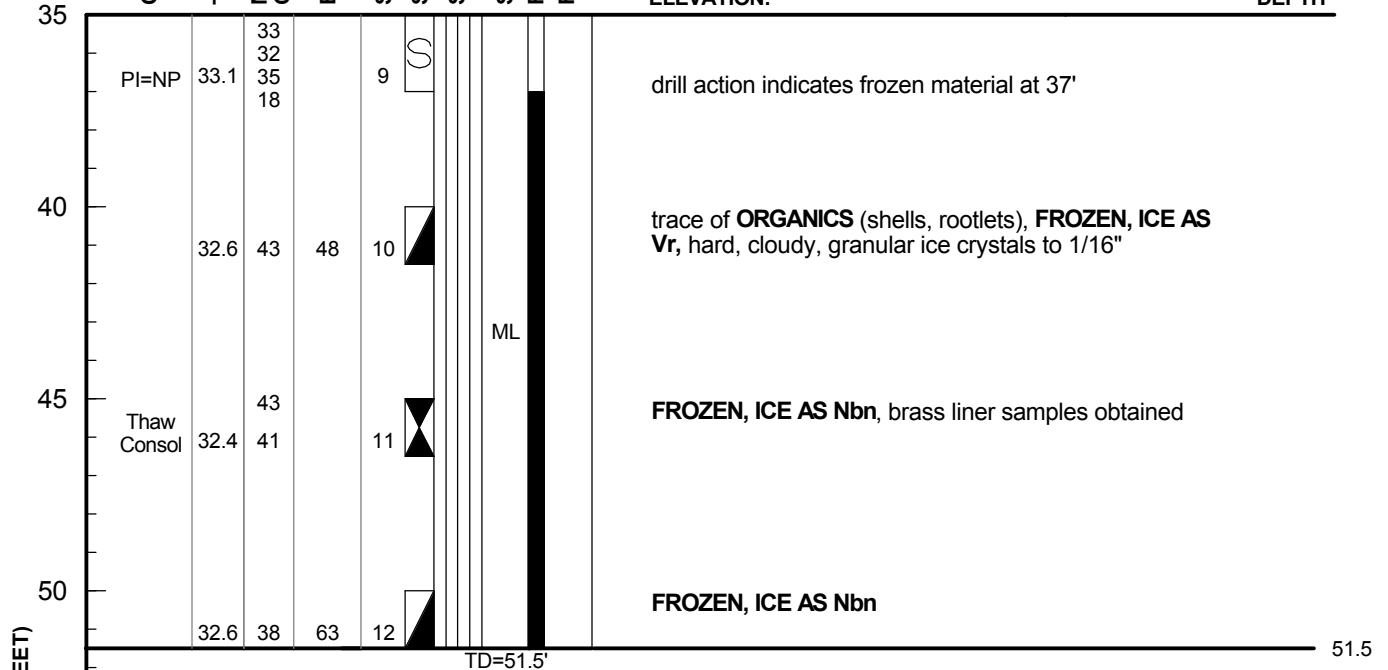
LOG OF TEST BORING 10

FIGURE B-10

TEST BORING 10 (Continued)

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



TEST BORING COMPLETED ON 9-19-07
PVC STANDPIPE INSTALLED TO 35.5'
THERMISTOR STANDPIPE INSTALLED TO 35.5'
GROUNDWATER MEASURED AT 19' ON 09-20-07

KEY

MA = Mechanical Analysis
PI = Plasticity Index
LL = Liquid Limit
TD = Total Depth
= Groundwater After Drilling
Thaw Consol = Thaw Consolidation
= Grab Sample
= SPT Sample
= Shelby Tube - pushed
= 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-45, Skid mounted
OPERATOR: Aaron Shaw
METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-19-07
W.O. D58405A



LOG OF TEST BORING 10

FIGURE B-10

DEPTH

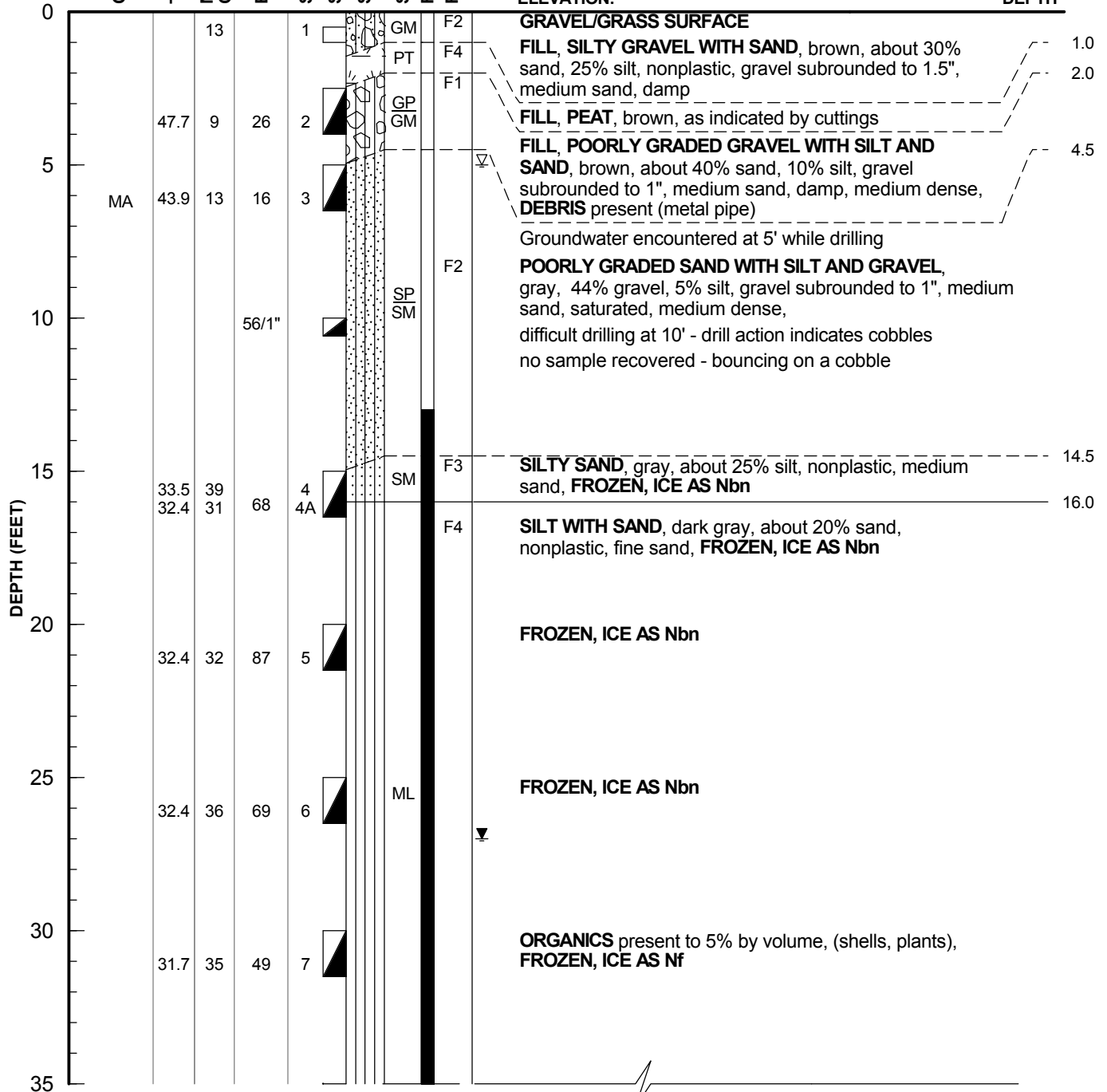


CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-19-07
W.O. D58405A

TEST BORING 12

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



(continued on next page)

KEY

MA = Mechanical Analysis
PI = Plasticity Index
LL = Liquid Limit
CI = Salinity (Chloride) (ppm)
TD = Total Depth
▽ = Groundwater After Drilling

Thaw Consol = Thaw Consolidation
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.

EQUIPMENT: CME-45, Skid mounted

OPERATOR: Aaron Shaw

METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.

PROJECT: Nullagvik Hotel

LOGGED BY: John A. Rego, Jr.

TEST BORING COMPLETED: 9-18-07

W.O. D58405A



LOG OF TEST BORING 12

FIGURE B-12

TEST BORING 12 (Continued)

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH

Other Tests	Temp °F	Moisture Content (%)	Blows / Foot	Sample No.	Sample Type	Soil Graph	Soil Class	Frost Depth	Frost Class	
PI=NP	31.1	33	59	8			ML			ORGANICS present to 5% by volume, (shells, plants), FROZEN, ICE AS Nbn
CI=324	31.1	45	48	9						FROZEN, ICE AS Vc, cloudy, poorly bonded
TD=41.5'										41.5

TEST BORING COMPLETED ON 9-18-07
PVC STANDPIPE INSTALLED TO 38'
THERMISTOR STANDPIPE INSTALLED TO 38'
GROUNDWATER MEASURED AT 27' ON 09-17-07

DEPTH (FEET)

KEY

MA = Mechanical Analysis
PI = Plasticity Index
LL = Liquid Limit
CI = Salinity (Chloride) (ppm)
TD = Total Depth
≡ = Groundwater After Drilling
Thaw Consol = Thaw Consolidation
☐ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-45, Skid mounted
OPERATOR: Aaron Shaw
METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-18-07
W.O. D58405A



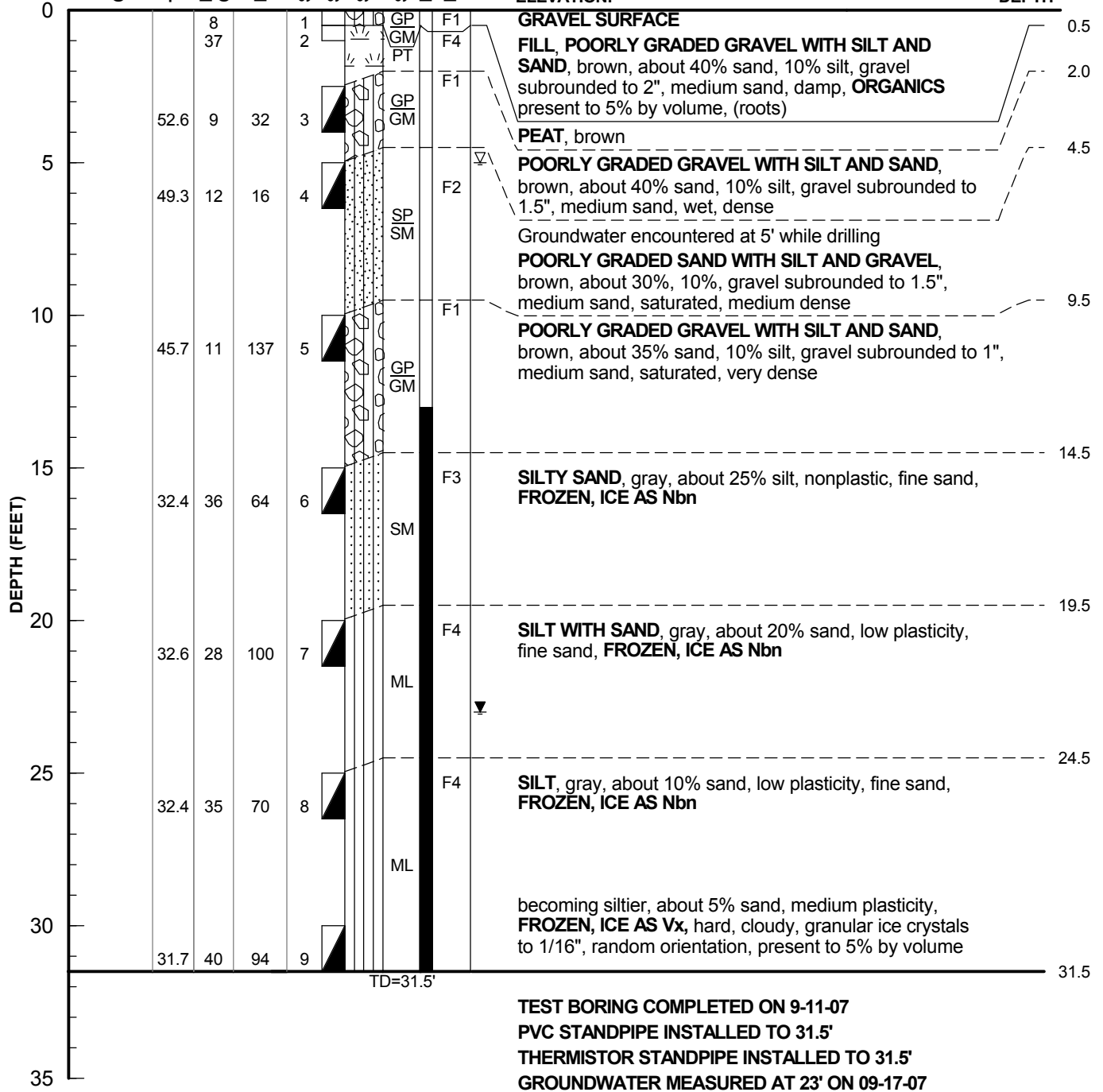
LOG OF TEST BORING 12

FIGURE B-12

TEST BORING 13

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY
 TD = Total Depth
 = Groundwater After Drilling
 = Grab Sample
 = SPT Sample
 = Shelby Tube - pushed
 = 2.5" I.D. Spoon Sample
 340# weight, 30" fall
 T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-45, Skid mounted
OPERATOR: Aaron Shaw
METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-11-07
W.O. D58405A



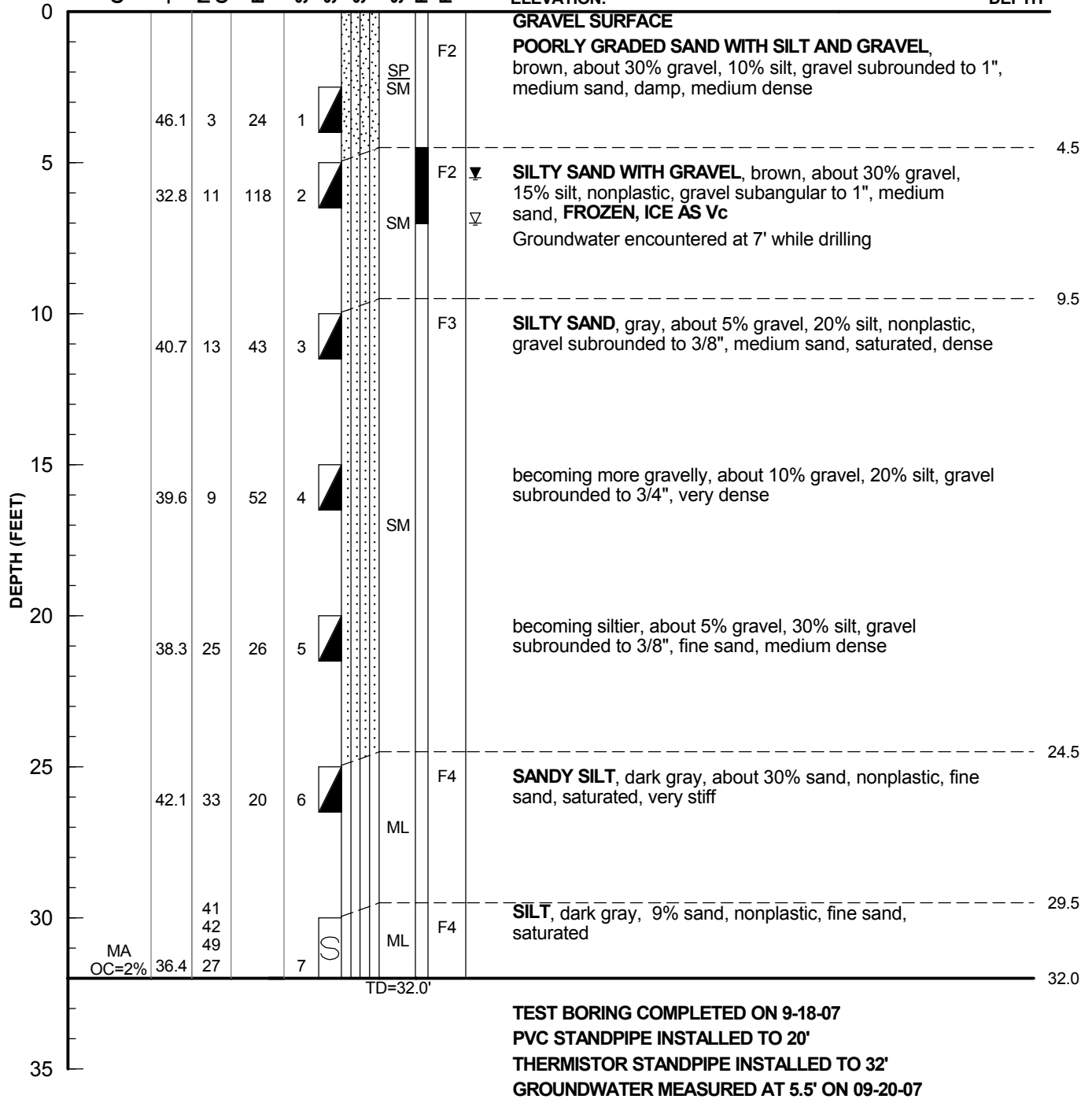
LOG OF TEST BORING 13

FIGURE B-13

TEST BORING 14

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY

MA = Mechanical Analysis
OC = Organic Content (%)
TD = Total Depth
= Groundwater After Drilling
= Grab Sample
= SPT Sample
= Shelby Tube - pushed
= 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.

EQUIPMENT: CME-45, Skid mounted

OPERATOR: Aaron Shaw

METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.

PROJECT: Nullagvik Hotel

LOGGED BY: John A. Rego, Jr.

TEST BORING COMPLETED: 9-18-07

W.O. D58405A



LOG OF TEST BORING 14

FIGURE B-14

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

GRAVEL SURFACE	
FILL, SILTY GRAVEL WITH SAND , brown, about 35% sand, 15% silt, nonplastic, gravel subrounded to 1.5", medium sand, damp	1.5
FILL, PEAT , brown, FROZEN, ICE AS Nbn, DEBRIS present (wood)	3.5
FILL, SANDY SILT , brown, about 5% gravel, 35% sand, nonplastic, gravel subrounded to 1/4", medium sand, FROZEN, ICE AS Nbn, DEBRIS present (wood)	4.5
HYDROCARBON ODOR	
POORLY GRADED SAND WITH SILT AND GRAVEL , brown, about 40% gravel, 10% silt, gravel subangular to 1", medium sand, wet, very dense, Groundwater encountered at 7' while drilling becoming sandier, about 15% gravel, 10% silt, saturated, dense	
SILTY SAND , gray, 5% gravel, 22% silt, nonplastic, gravel subrounded to 3/4", medium sand, saturated, medium dense becoming siltier, about 30% silt, very dense, sampler full with heaving sand - blow counts may not be representative	14.5
SANDY SILT , gray, about 30% sand, nonplastic, fine sand, FROZEN, ICE AS Nbn	24.5
SILT , gray, about 10% sand, nonplastic, fine sand, FROZEN, ICE AS Nbn	29.5

(continued on next page)

MA = Mechanical Analysis
TD = Total Depth
insol = Thaw Consolidation
☐ = Grab Sample
▣ = SPT Sample
◻ = Shelby Tube - pushed
⊗ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably
affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-45, Skid mounted
OPERATOR: Aaron Shaw
METHOD: 6 in. OD hollow-stem auger

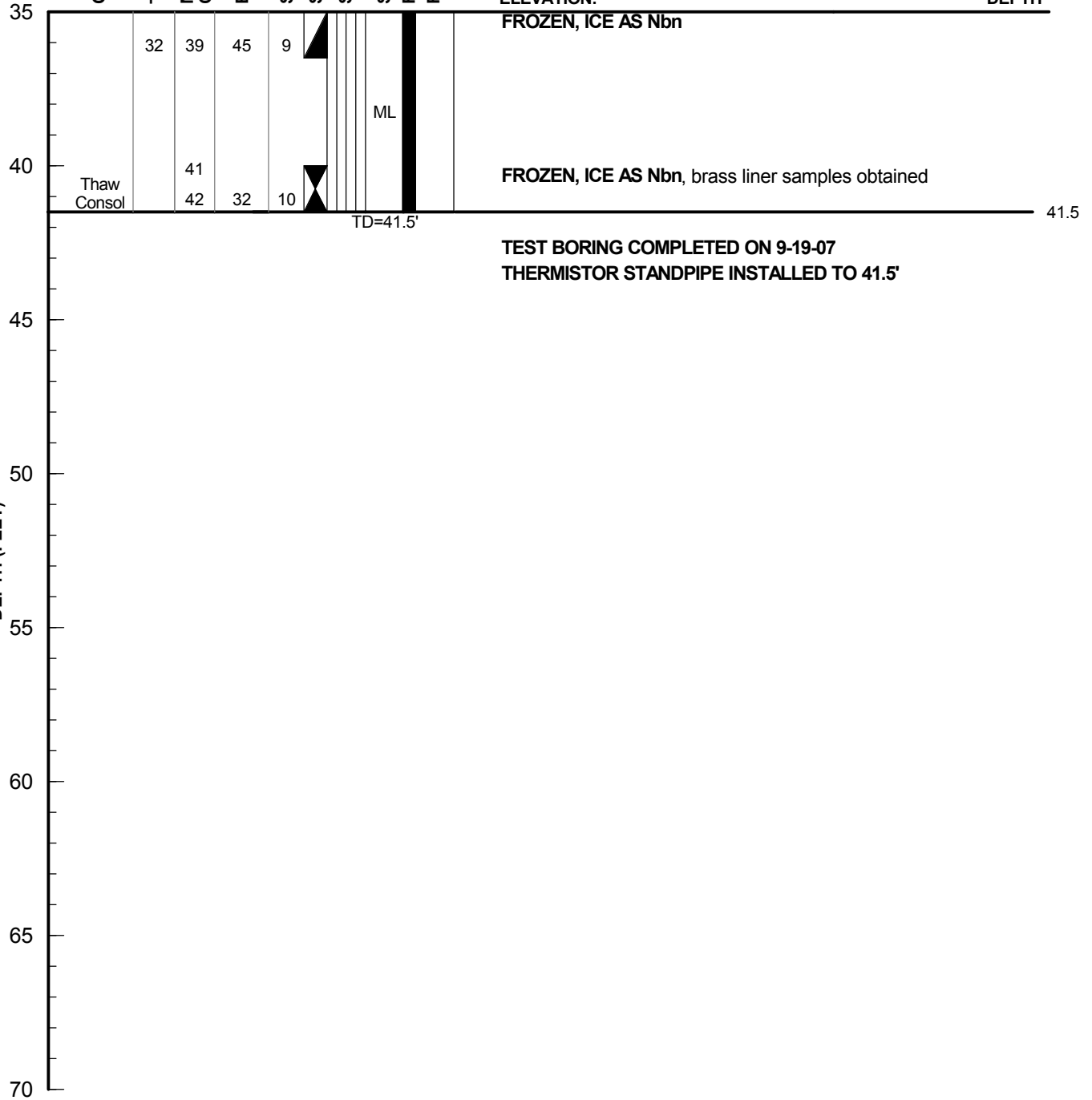
CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-19-07
W.O. D58405A

**FIGURE B-15**

TEST BORING 15 (Continued)

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY

MA = Mechanical Analysis

TD = Total Depth

Thaw Consol = Thaw Consolidation

□ = Grab Sample

▣ = SPT Sample

▤ = Shelby Tube - pushed

▥ = 2.5" I.D. Spoon Sample

340# weight, 30" fall

T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.

EQUIPMENT: CME-45, Skid mounted

OPERATOR: Aaron Shaw

METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.

PROJECT: Nullagvik Hotel

LOGGED BY: John A. Rego, Jr.

TEST BORING COMPLETED: 9-19-07

W.O. D58405A



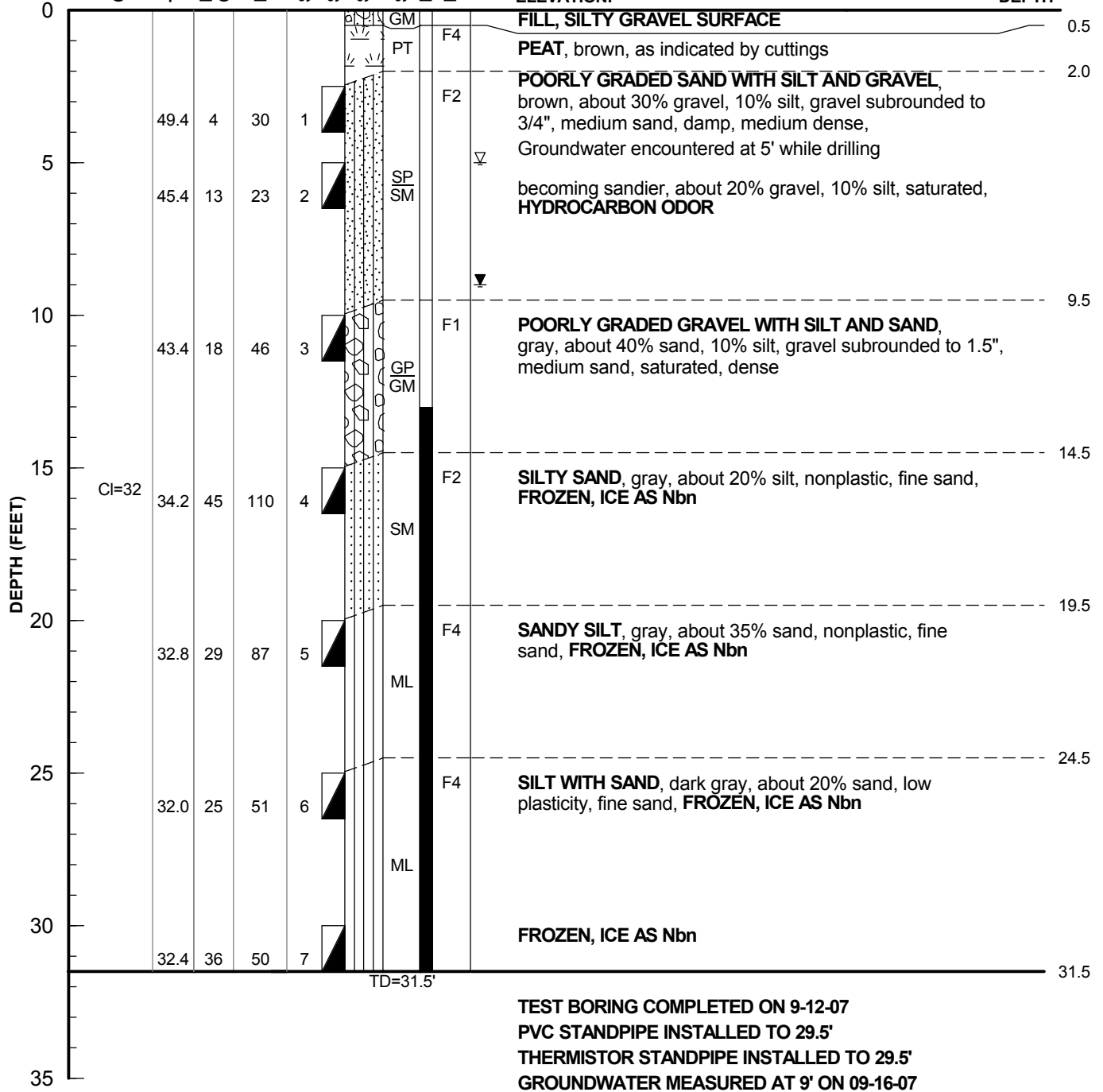
LOG OF TEST BORING 15

FIGURE B-15

TEST BORING 16

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY

Cl = Salinity (Chloride) (ppm)
TD = Total Depth
≡ = Groundwater After Drilling
Thaw Consol = Thaw Consolidation
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: Denali Drilling, Inc.
EQUIPMENT: CME-45, Skid mounted
OPERATOR: Aaron Shaw
METHOD: 6 in. OD hollow-stem auger

CLIENT: NANA Development Corp.
PROJECT: Nullagvik Hotel
LOGGED BY: John A. Rego, Jr.
TEST BORING COMPLETED: 9-12-07
W.O. D58405A



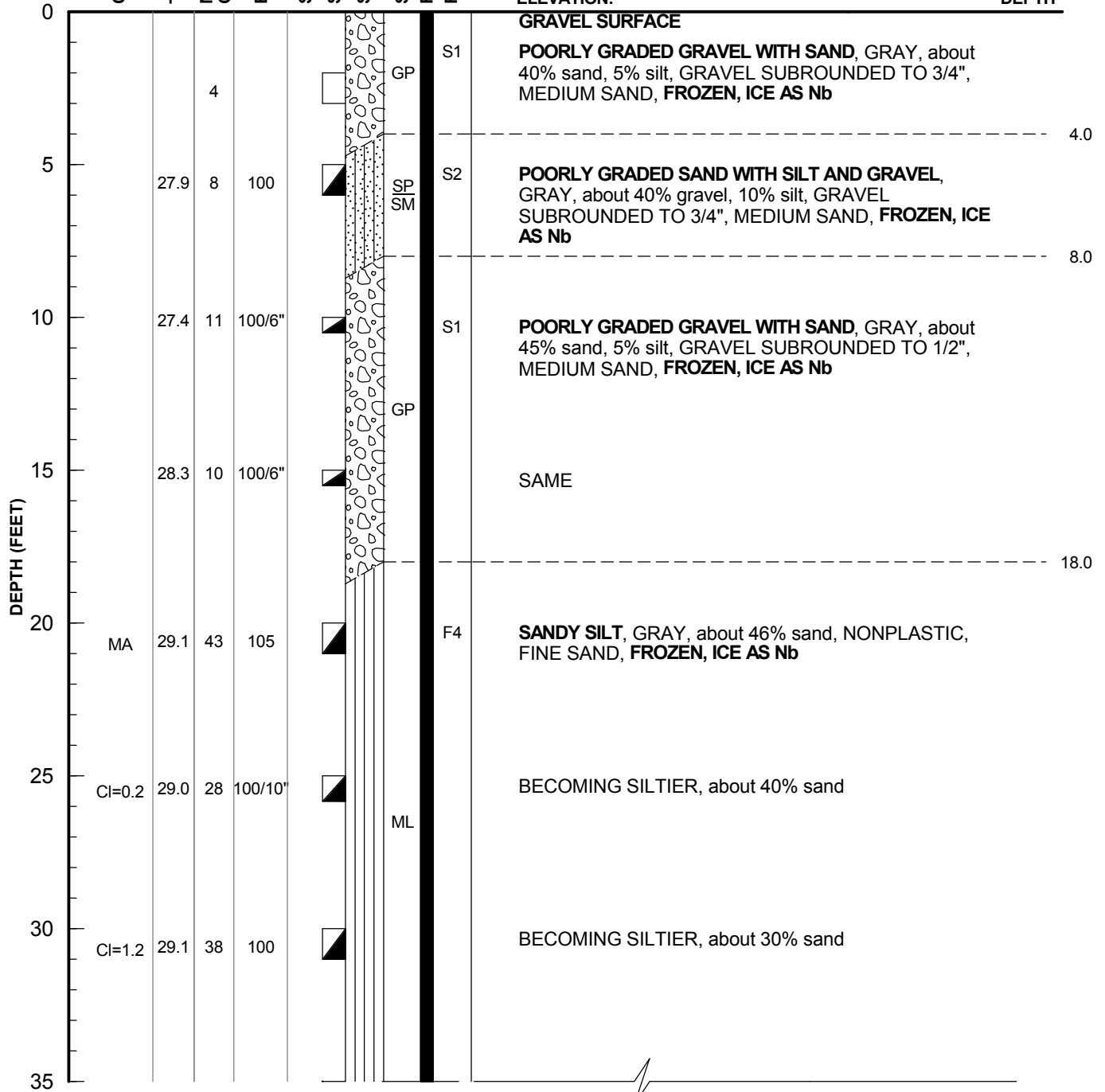
LOG OF TEST BORING 16

FIGURE B-16

TEST BORING 1-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



(continued on next page)

KEY
 MA = Mechanical Analysis
 CI = Salinity (Chloride) (ppm)
 TD = Total Depth
 □ = Grab Sample
 ▣ = SPT Sample
 ▤ = Shelby Tube - pushed
 ▥ = 2.5" I.D. Spoon Sample
 340# weight, 30" fall
 T = Sample Temperature (°F) probably affected by sampling procedure

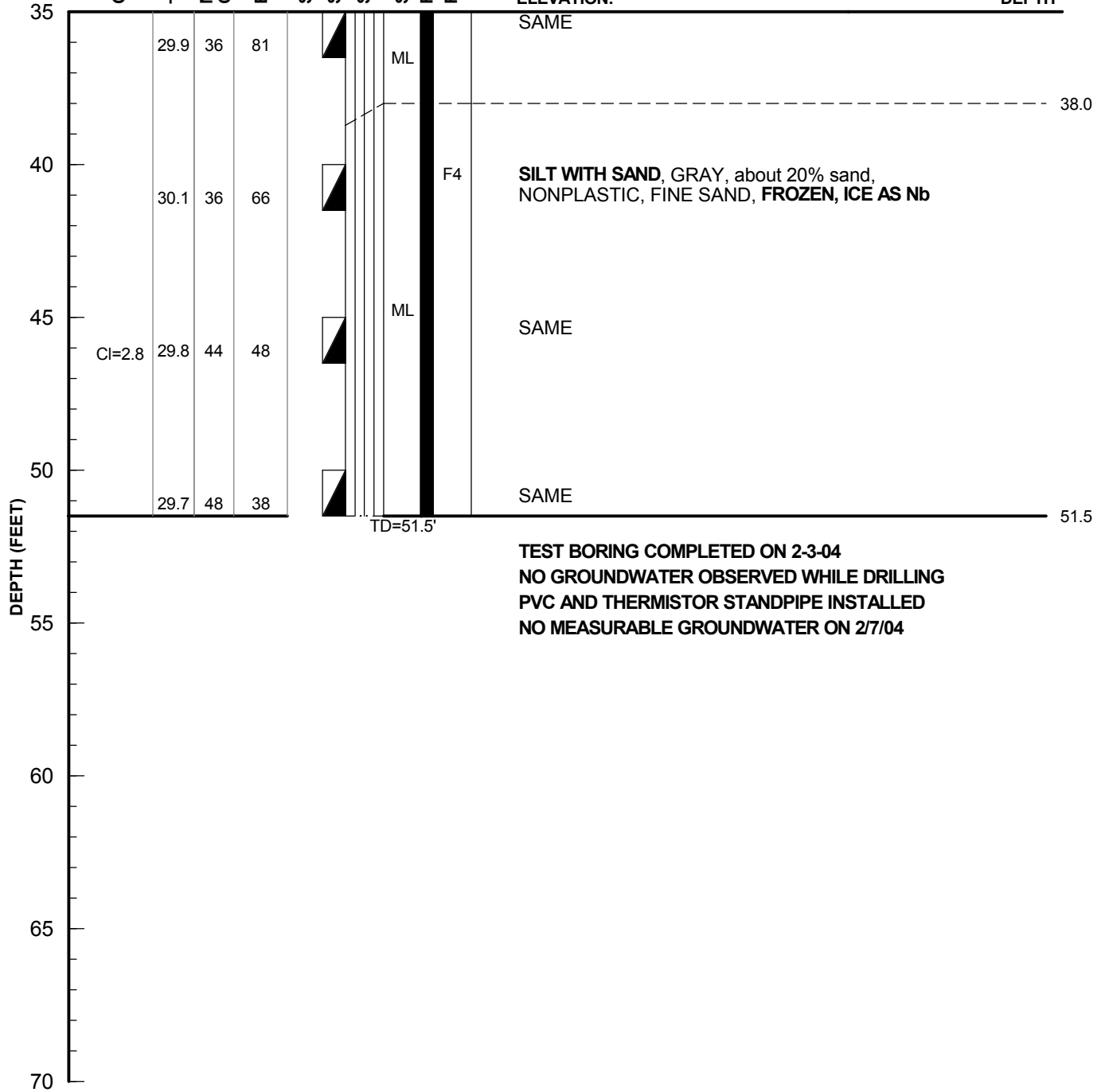
DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-3-04
W.O. D58405

TEST BORING 1-04 (Continued)

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



TEST BORING COMPLETED ON 2-3-04
NO GROUNDWATER OBSERVED WHILE DRILLING
PVC AND THERMISTOR STANDPIPE INSTALLED
NO MEASURABLE GROUNDWATER ON 2/7/04

KEY

MA = Mechanical Analysis
CI = Salinity (Chloride) (ppm)
TD = Total Depth
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

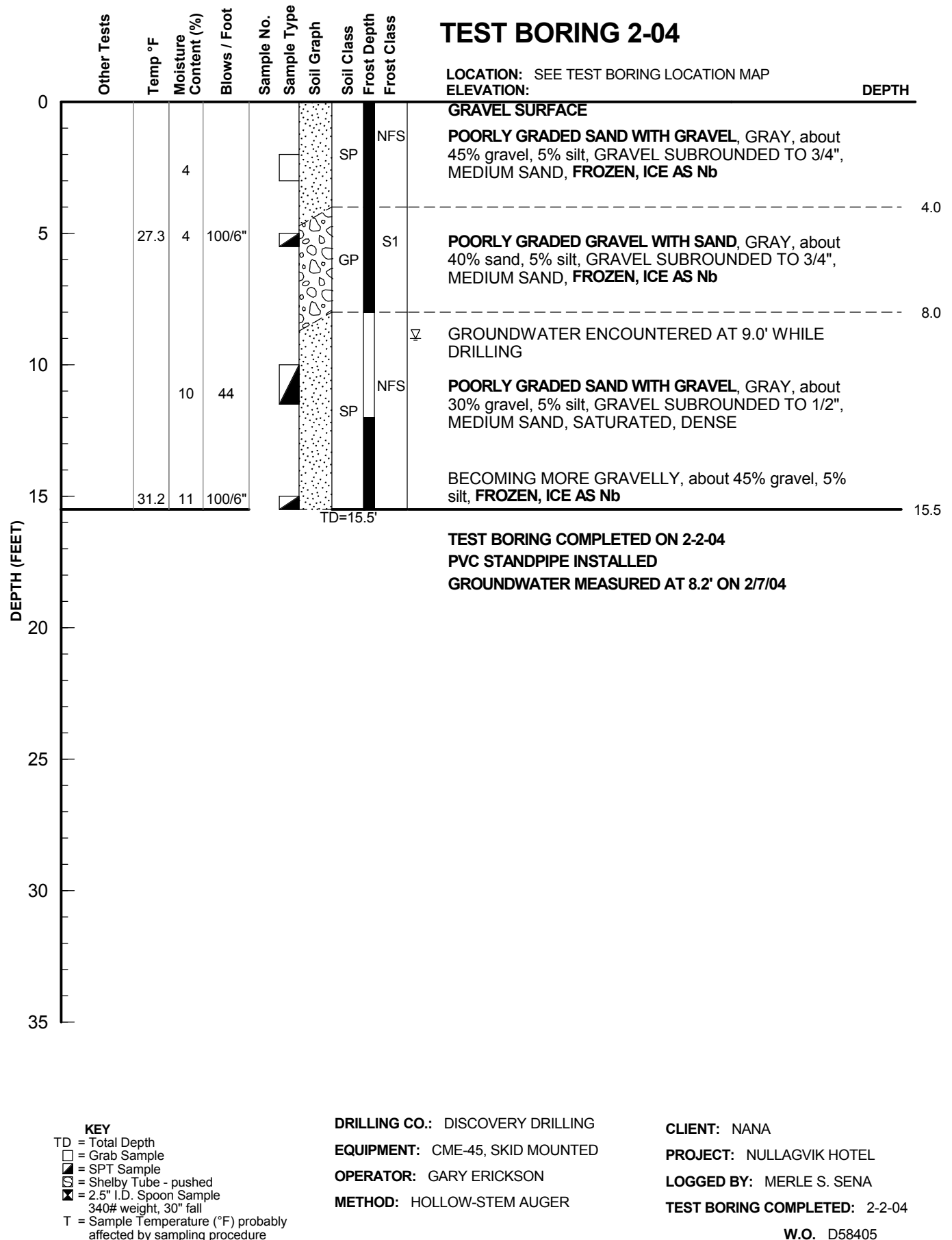
DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

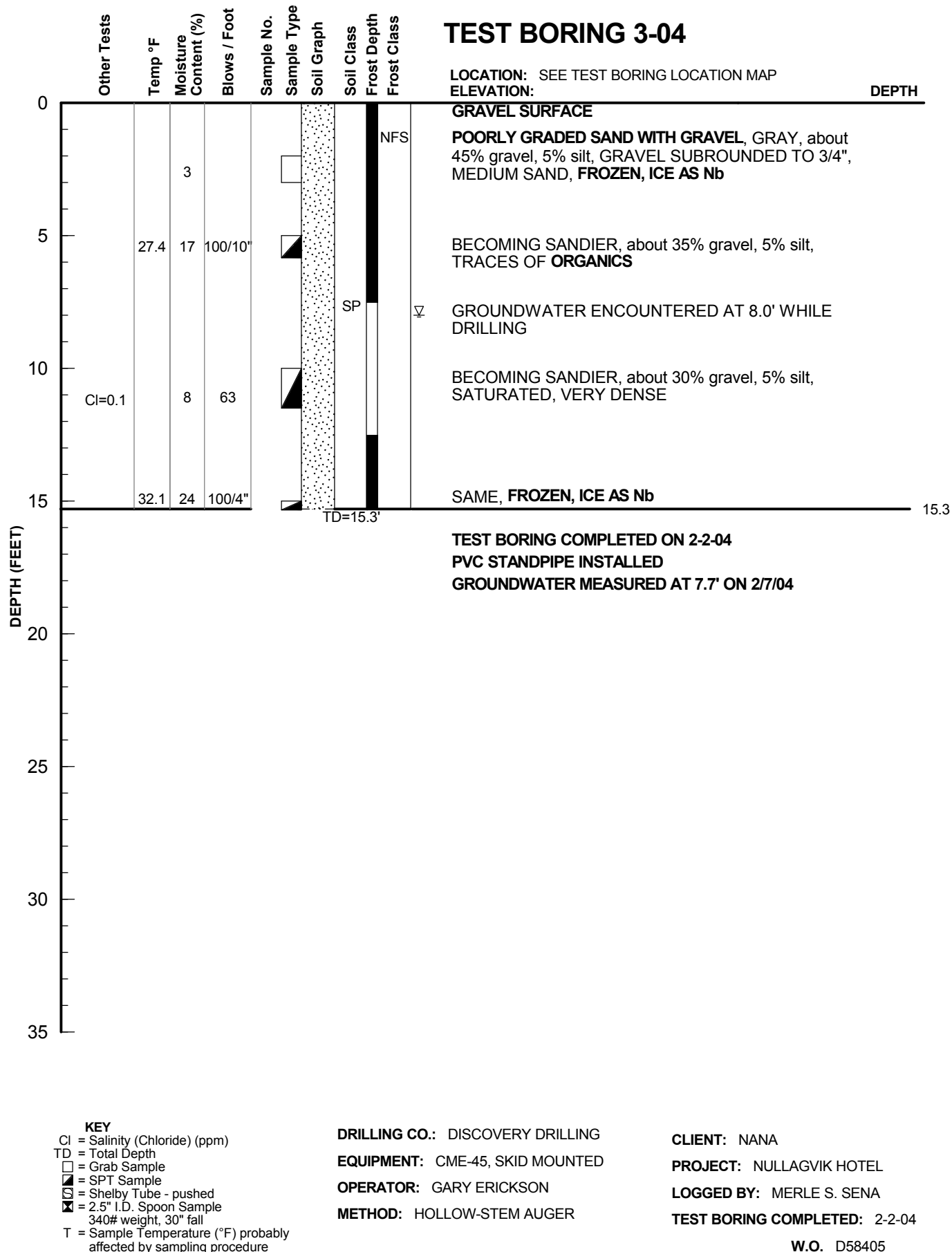
CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-3-04
W.O. D58405



LOG OF TEST BORING 1-04

FIGURE B-17

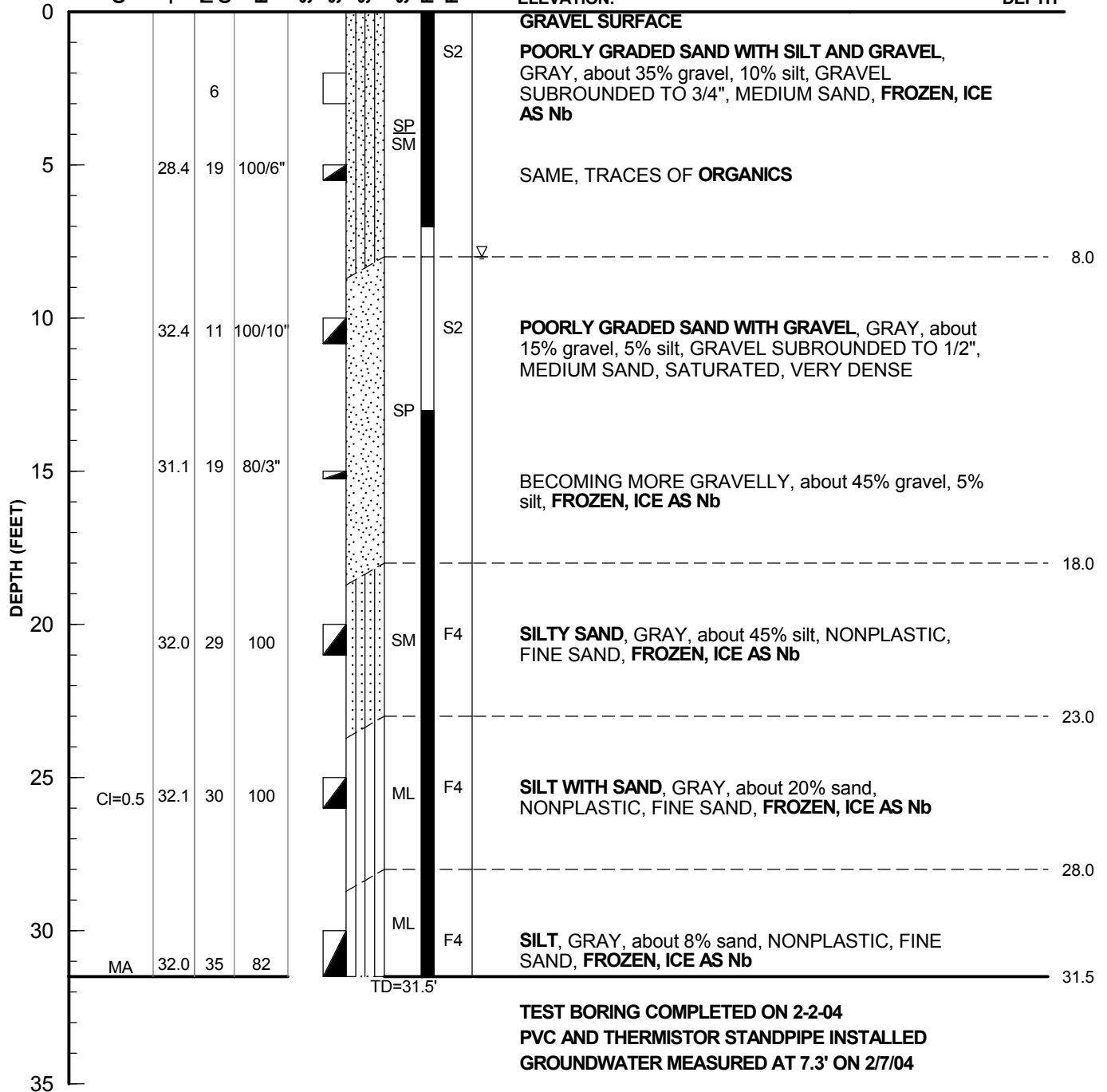




TEST BORING 4-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY
MA = Mechanical Analysis
Cl = Salinity (Chloride) (ppm)
TD = Total Depth
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

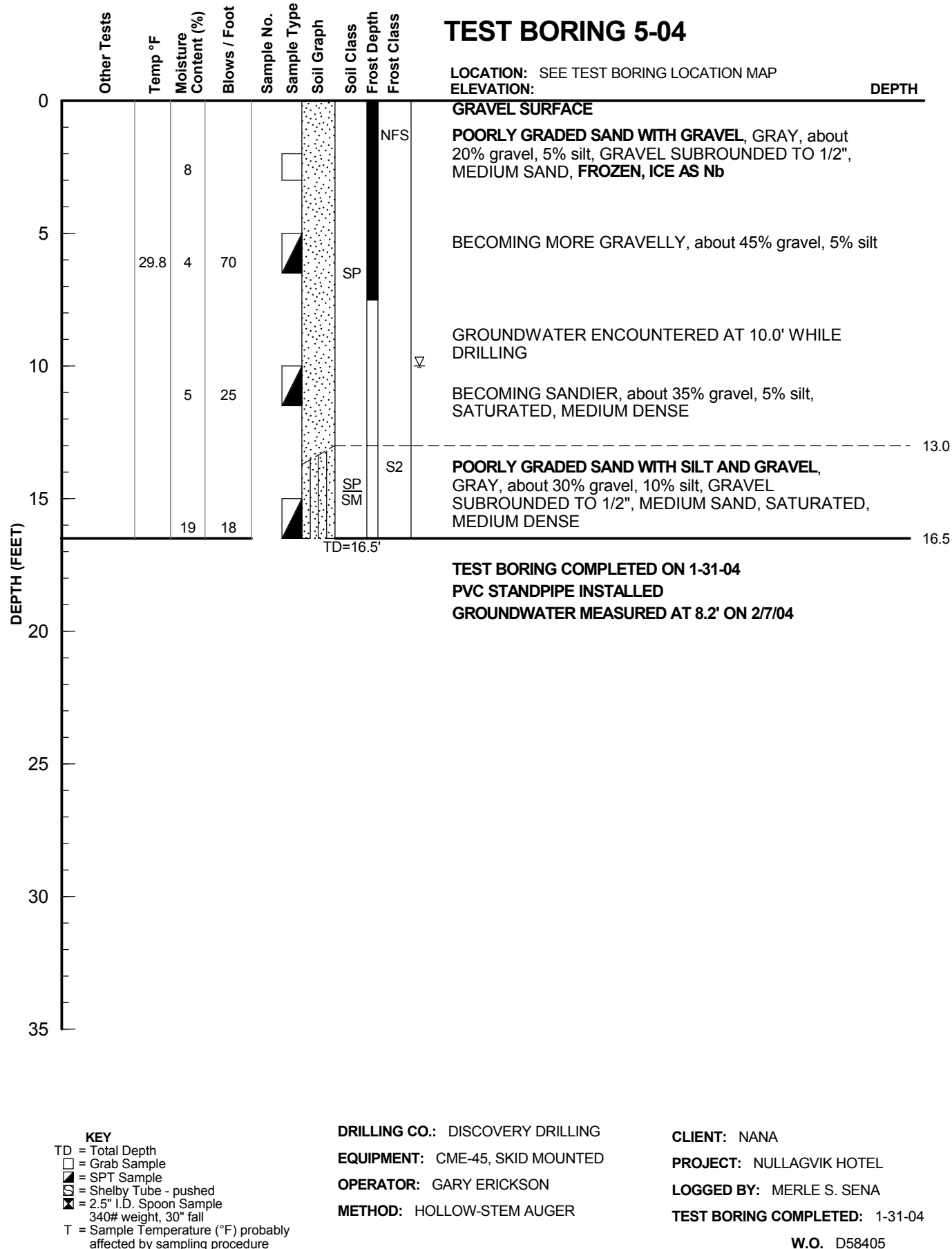
DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-2-04
W.O. D58405



LOG OF TEST BORING 4-04

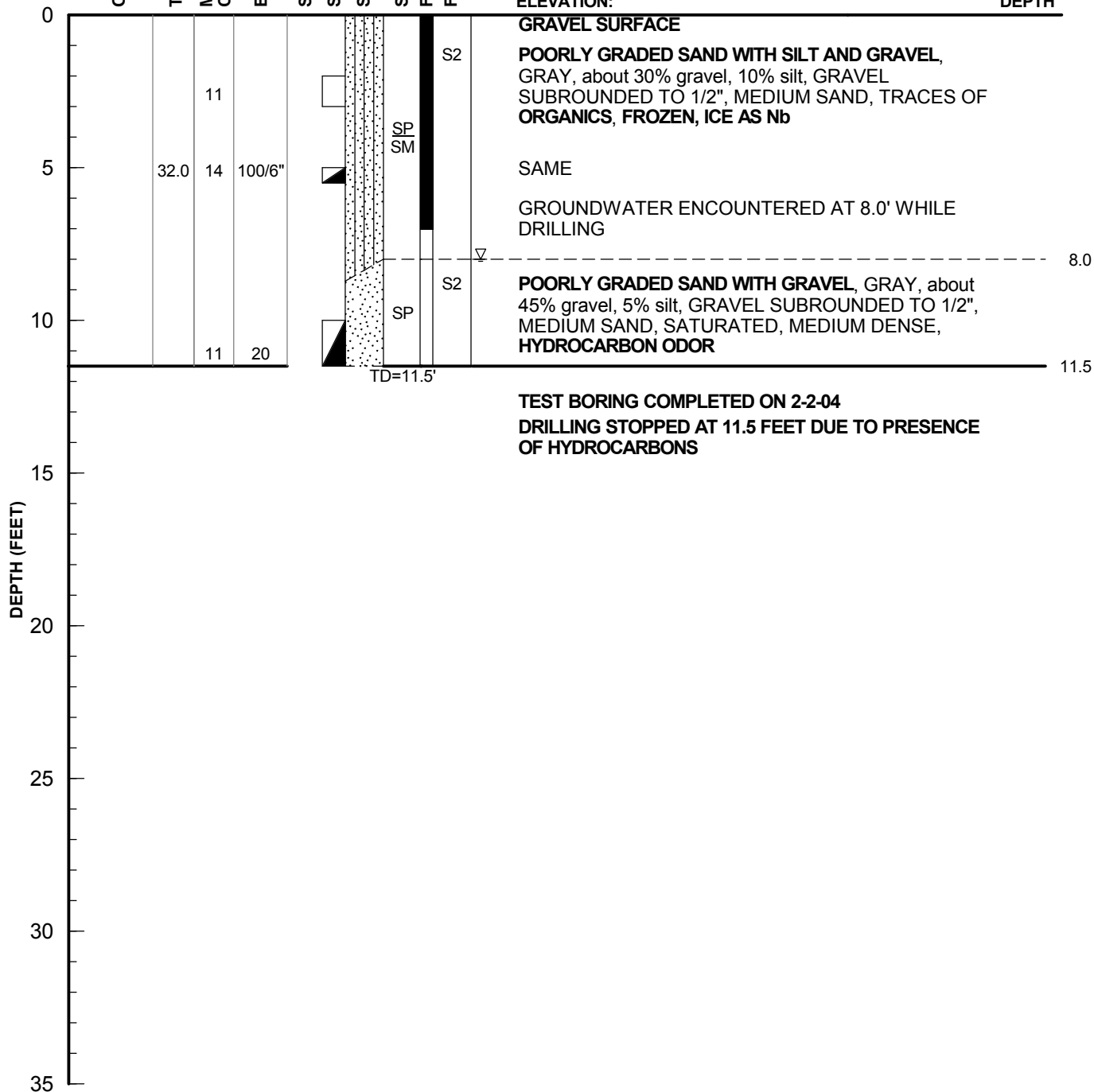
FIGURE B-20



TEST BORING 6-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY
 TD = Total Depth
 □ = Grab Sample
 ▣ = SPT Sample
 ▤ = Shelby Tube - pushed
 ▥ = 2.5" I.D. Spoon Sample
 340# weight, 30" fall
 T = Sample Temperature (°F) probably affected by sampling procedure

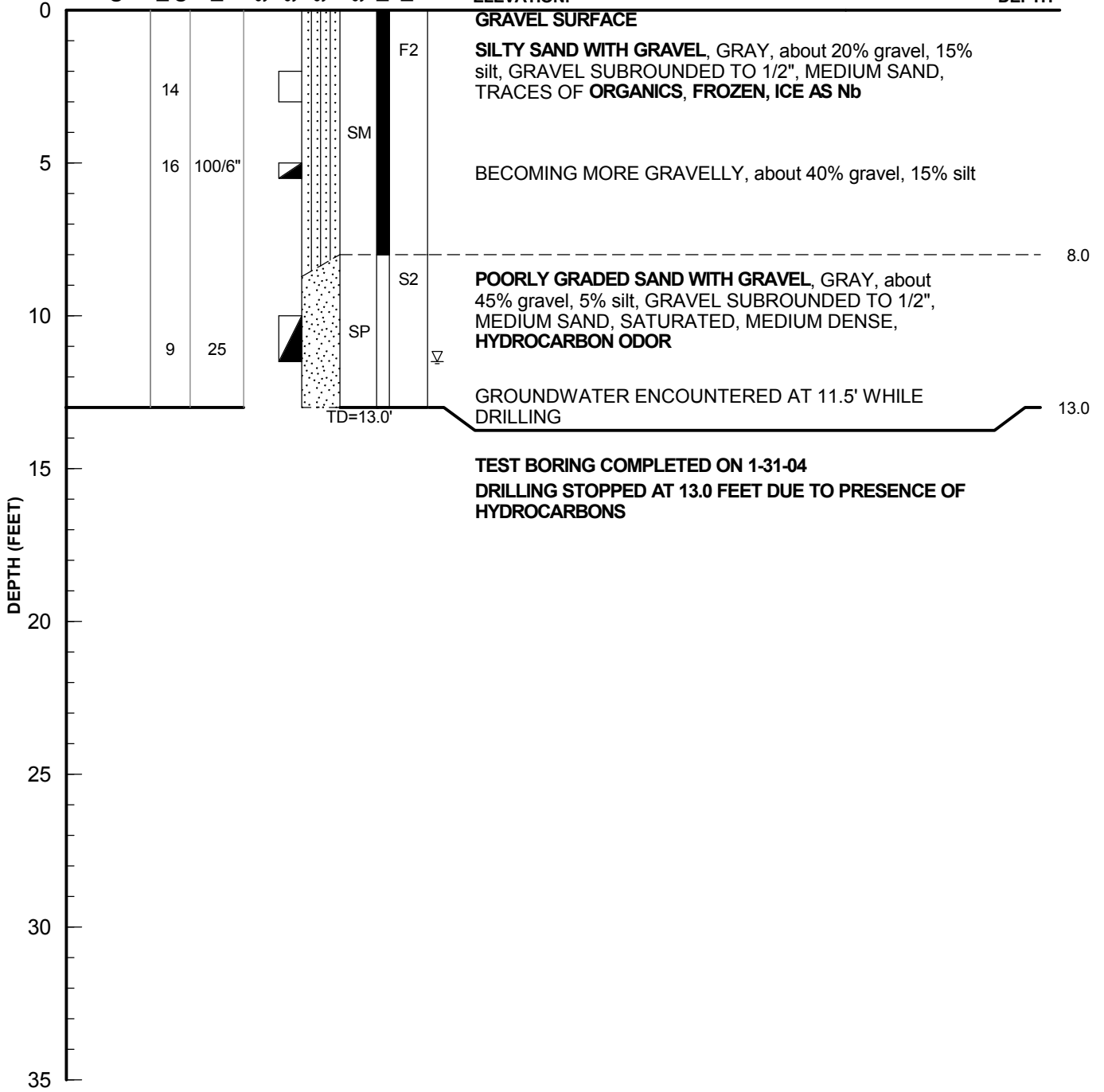
DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-2-04
W.O. D58405

TEST BORING 7-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY
 TD = Total Depth
 □ = Grab Sample
 ▨ = SPT Sample
 ▩ = Shelby Tube - pushed
 ▩ = 2.5" I.D. Spoon Sample
 340# weight, 30" fall

DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 1-31-04
W.O. D58405



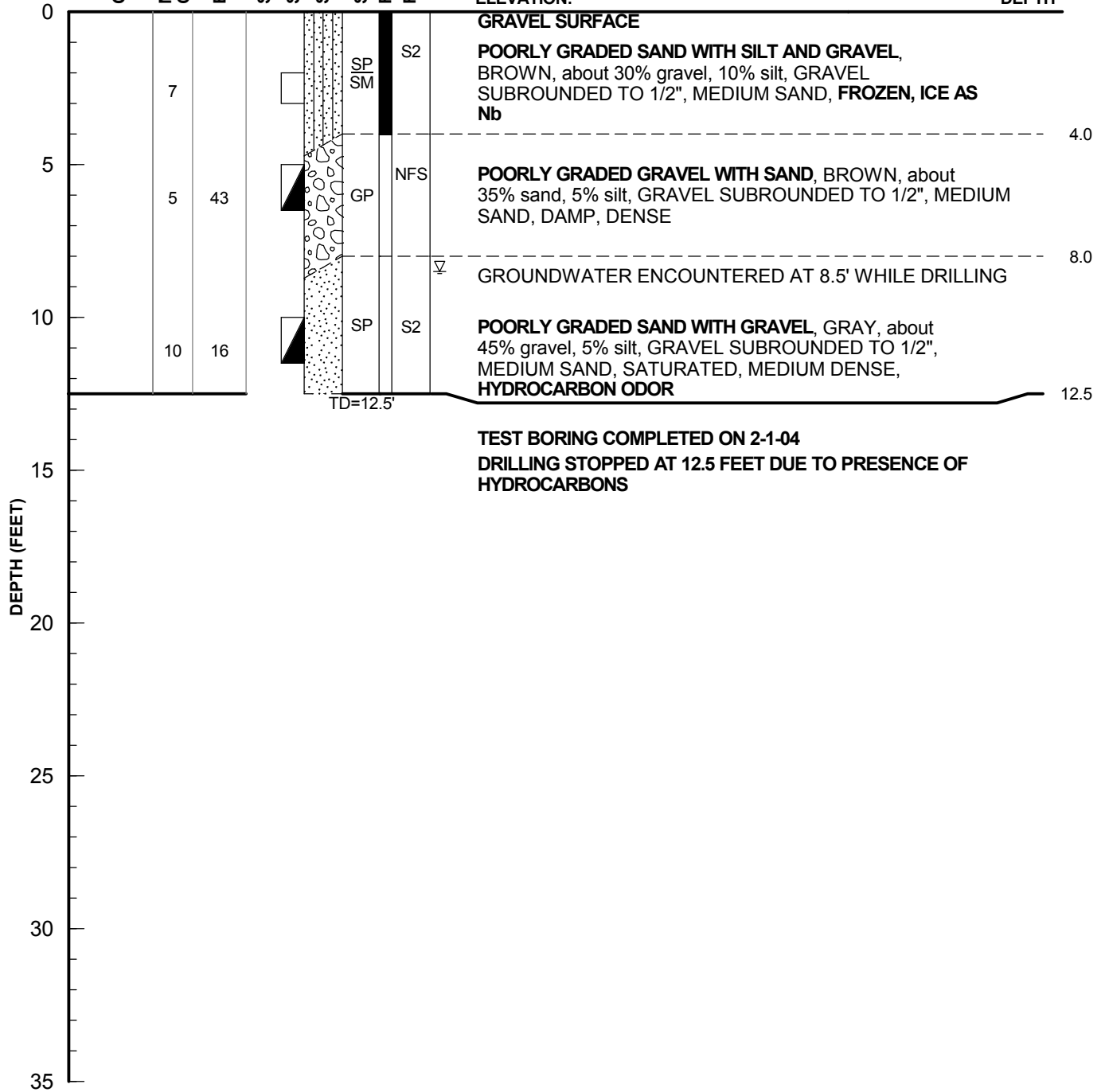
LOG OF TEST BORING 7-04

FIGURE B-23

TEST BORING 8-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY
 TD = Total Depth
 □ = Grab Sample
 ▣ = SPT Sample
 ▤ = Shelby Tube - pushed
 ▥ = 2.5" I.D. Spoon Sample
 340# weight, 30" fall

DRILLING CO.: DISCOVERY DRILLING
 EQUIPMENT: CME-45, SKID MOUNTED
 OPERATOR: GARY ERICKSON
 METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
 PROJECT: NULLAGVIK HOTEL
 LOGGED BY: MERLE S. SENA
 TEST BORING COMPLETED: 2-1-04
 W.O. D58405



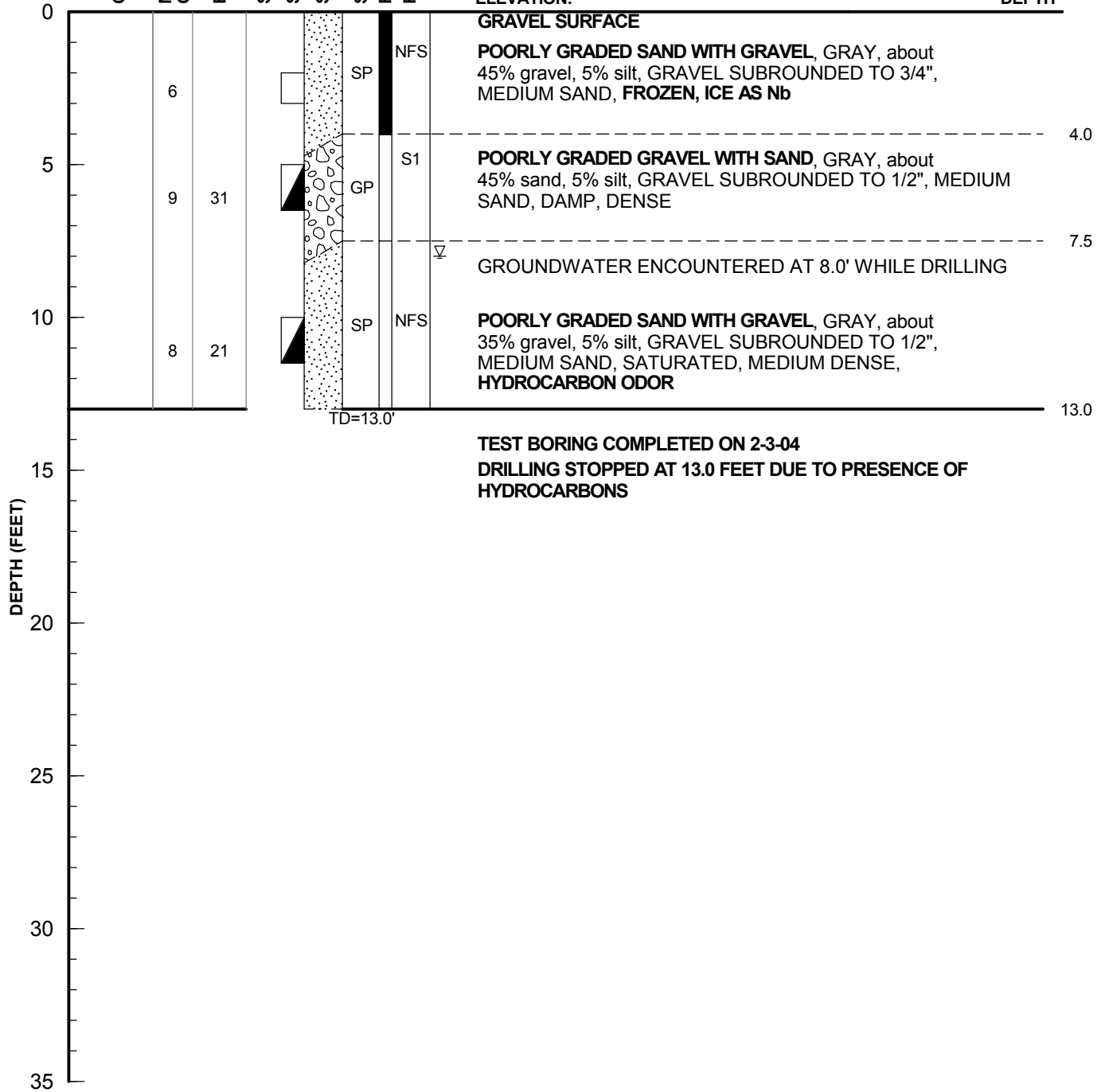
LOG OF TEST BORING 8-04

FIGURE B-24

TEST BORING 9-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY
 TD = Total Depth
 □ = Grab Sample
 ▣ = SPT Sample
 ▤ = Shelby Tube - pushed
 ▥ = 2.5" I.D. Spoon Sample
 340# weight, 30" fall

DRILLING CO.: DISCOVERY DRILLING
 EQUIPMENT: CME-45, SKID MOUNTED
 OPERATOR: GARY ERICKSON
 METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
 PROJECT: NULLAGVIK HOTEL
 LOGGED BY: MERLE S. SENA
 TEST BORING COMPLETED: 2-3-04
 W.O. D58405



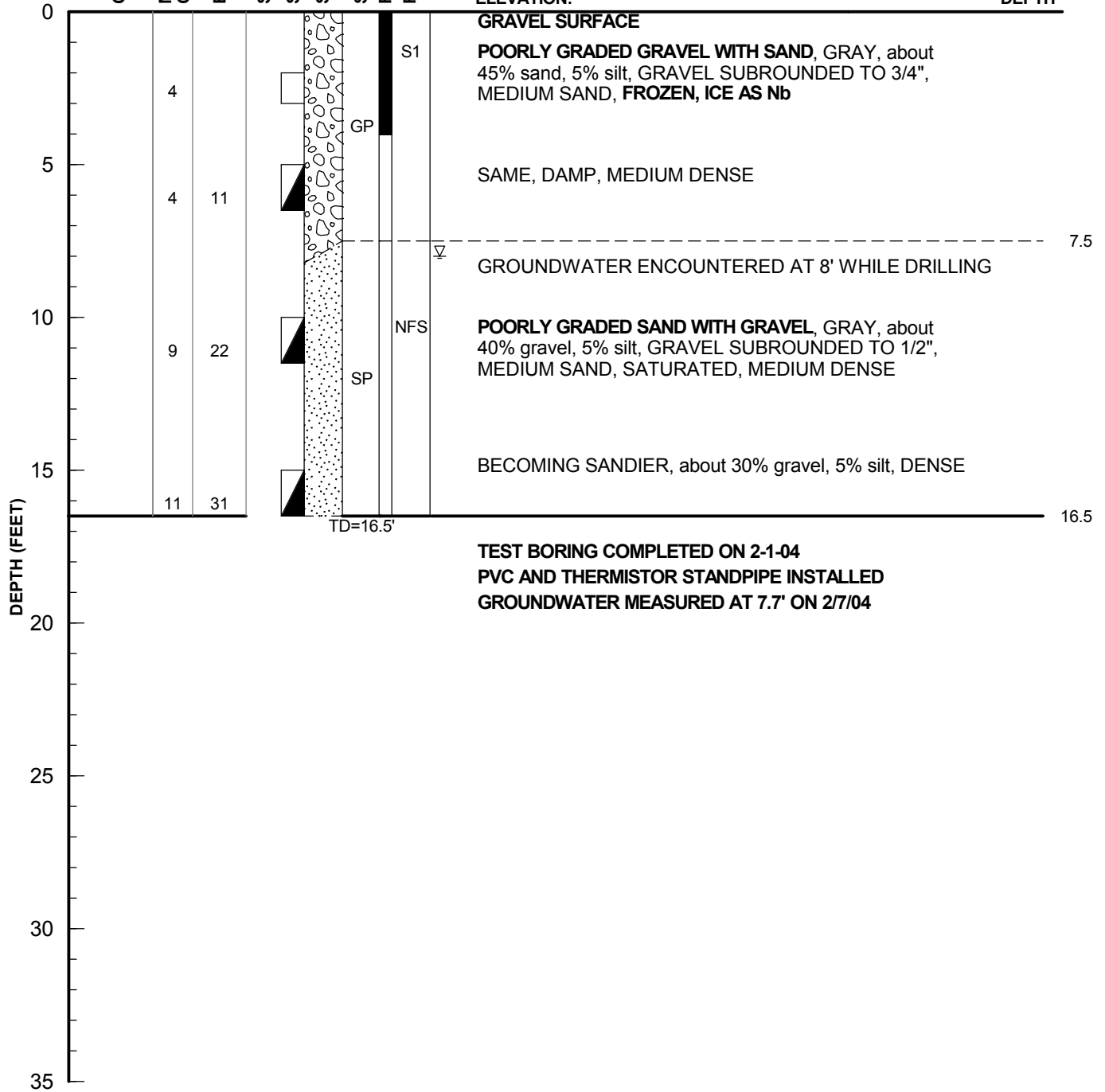
LOG OF TEST BORING 9-04

FIGURE B-25

TEST BORING 10-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-1-04
W.O. D58405

KEY
TD = Total Depth
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall



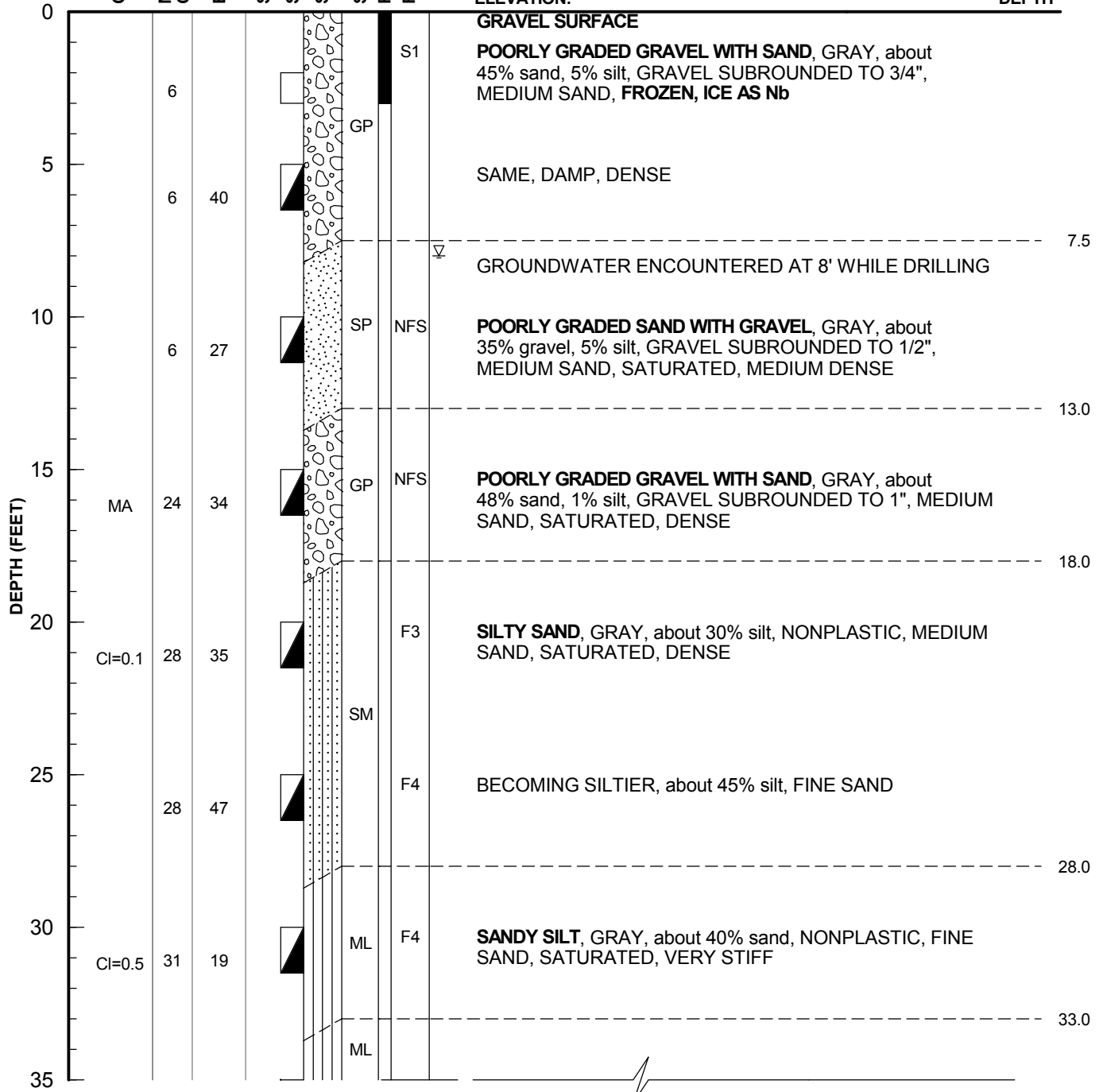
LOG OF TEST BORING 10-04

FIGURE B-26

TEST BORING 11-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



(continued on next page)

KEY
MA = Mechanical Analysis
CI = Salinity (Chloride) (ppm)
TD = Total Depth
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall

DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-3-04
W.O. D58405



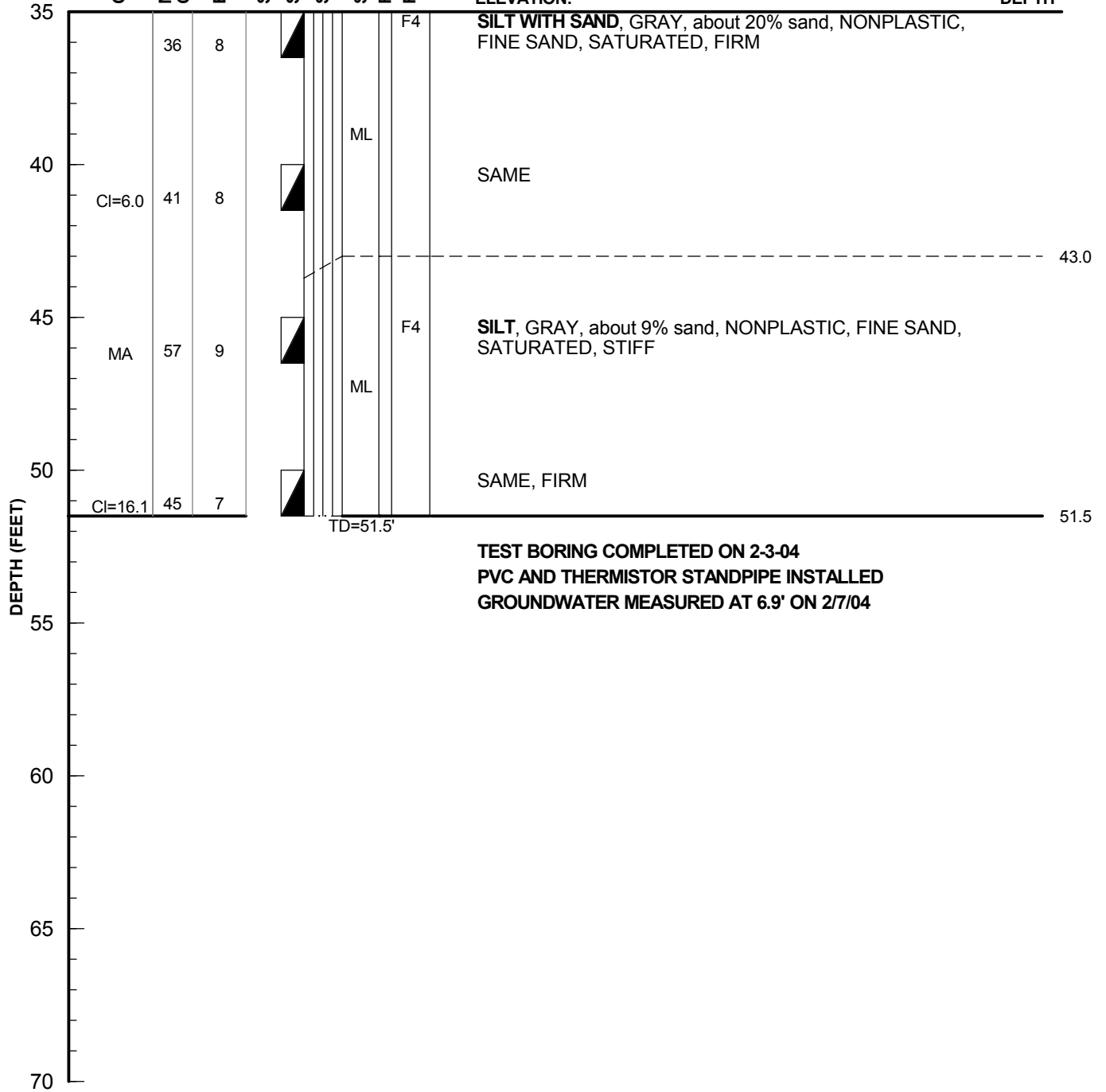
LOG OF TEST BORING 11-04

FIGURE B-27

TEST BORING 11-04 (Continued)

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



TEST BORING COMPLETED ON 2-3-04
PVC AND THERMISTOR STANDPIPE INSTALLED
GROUNDWATER MEASURED AT 6.9' ON 2/7/04

KEY
MA = Mechanical Analysis
CI = Salinity (Chloride) (ppm)
TD = Total Depth
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall

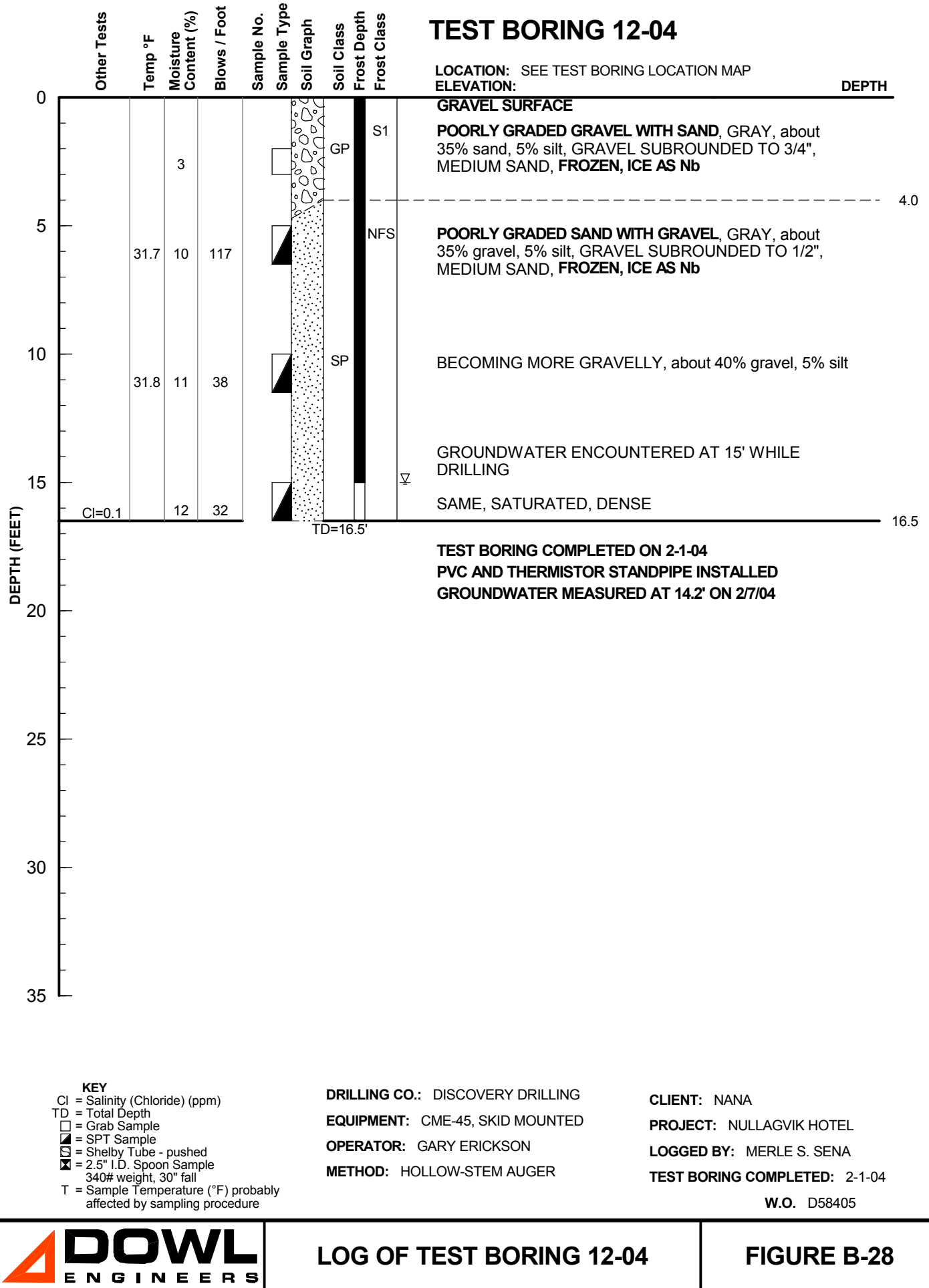
DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-3-04
W.O. D58405



LOG OF TEST BORING 11-04

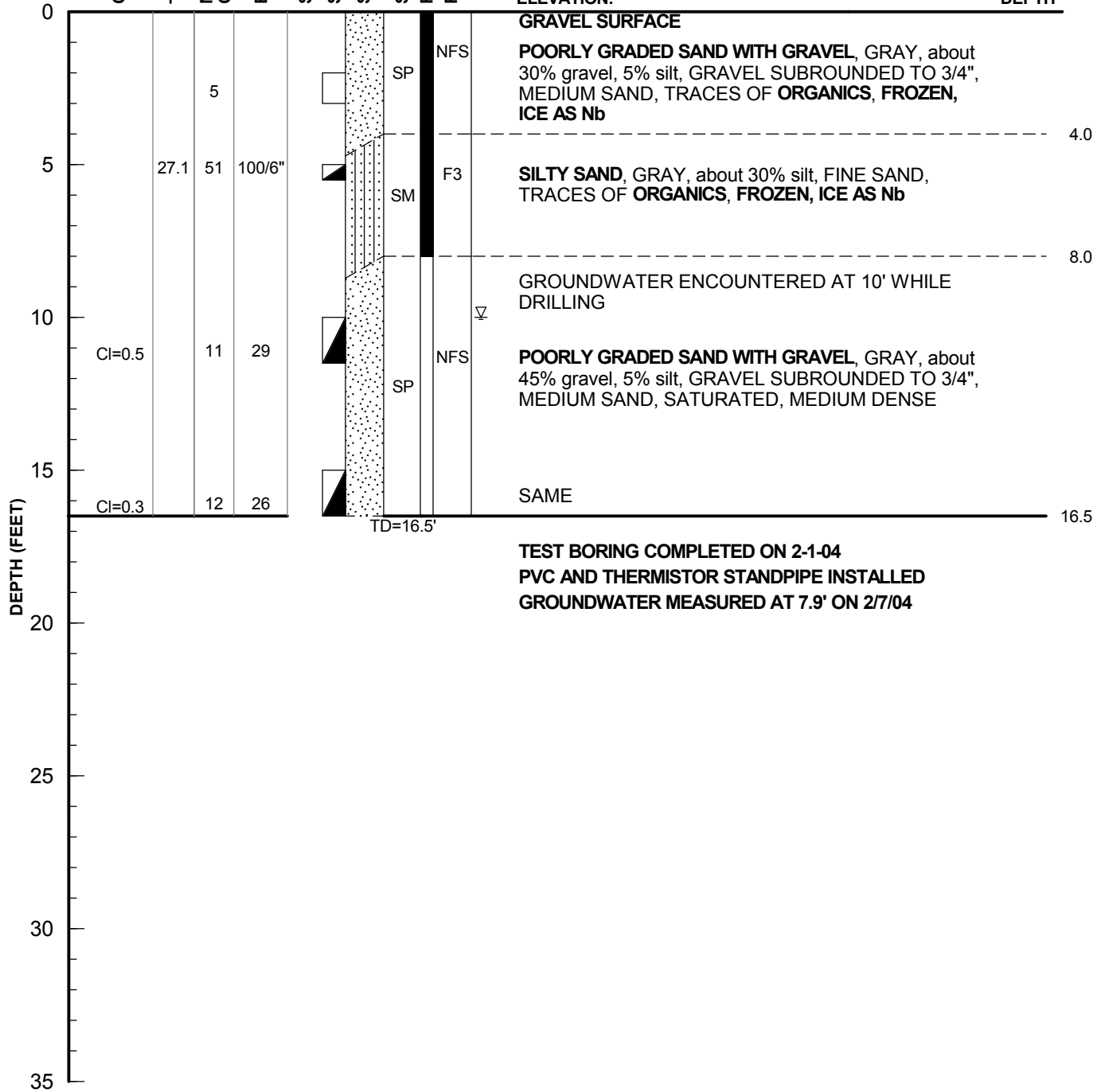
FIGURE B-27



TEST BORING 13-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



TEST BORING COMPLETED ON 2-1-04
PVC AND THERMISTOR STANDPIPE INSTALLED
GROUNDWATER MEASURED AT 7.9' ON 2/7/04

KEY
CI = Salinity (Chloride) (ppm)
TD = Total Depth
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-1-04
W.O. D58405



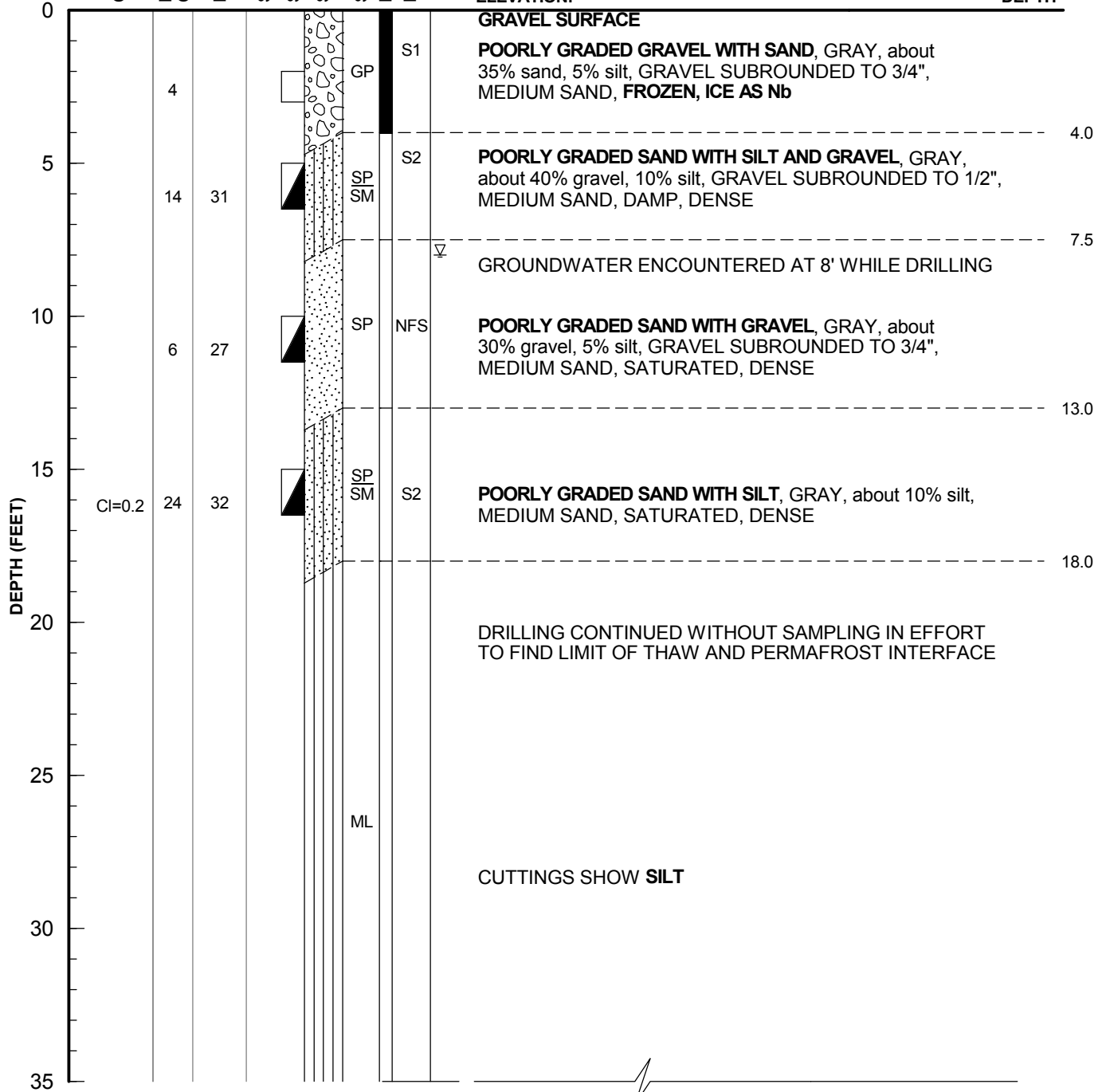
LOG OF TEST BORING 13-04

FIGURE B-29

TEST BORING 16-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



(continued on next page)

KEY
CI = Salinity (Chloride) (ppm)
TD = Total Depth
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall

DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-2-04
W.O. D58405



LOG OF TEST BORING 16-04

FIGURE B-30

TEST BORING 16-04 (Continued)

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH

35

CUTTINGS SHOW SILT

40

DRILLING STOPPED AT 40' WITH NO PERMAFROST
ENCOUNTERED

40.0

TD=40.0'

TEST BORING COMPLETED ON 2-2-04
PVC AND THERMISTOR STANDPIPE INSTALLED
GROUNDWATER MEASURED AT 7.1' ON 2/7/04

45

50

55

60

65

70

DEPTH (FEET)

KEY

- CI = Salinity (Chloride) (ppm)
- TD = Total Depth
- ☐ = Grab Sample
- ▣ = SPT Sample
- ◻ = Shelby Tube - pushed
- ◼ = 2.5" I.D. Spoon Sample
- 340# weight, 30" fall

DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-2-04
W.O. D58405



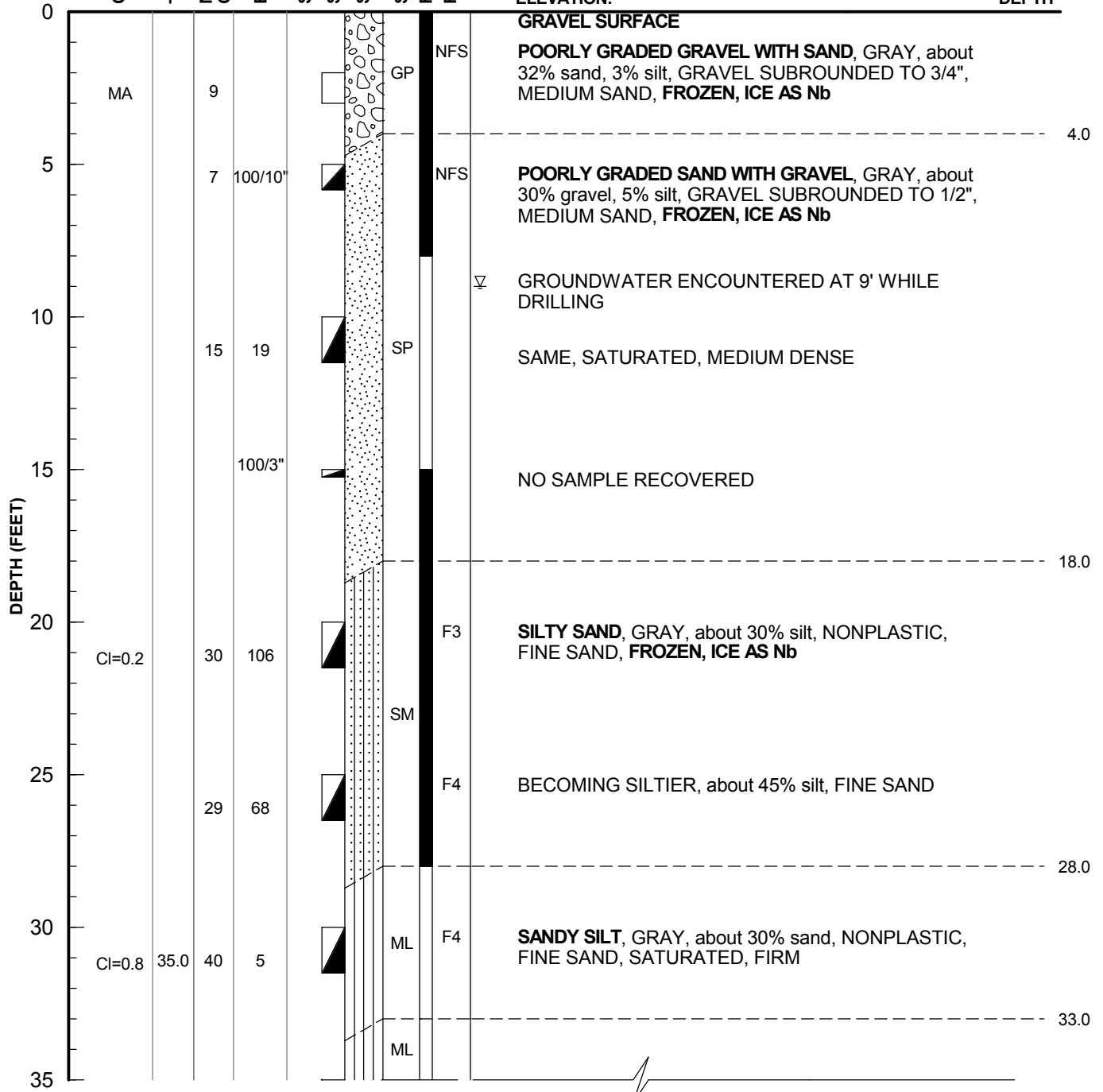
LOG OF TEST BORING 16-04

FIGURE B-30

TEST BORING 17-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



(continued on next page)

KEY
MA = Mechanical Analysis
CI = Salinity (Chloride) (ppm)
TD = Total Depth
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

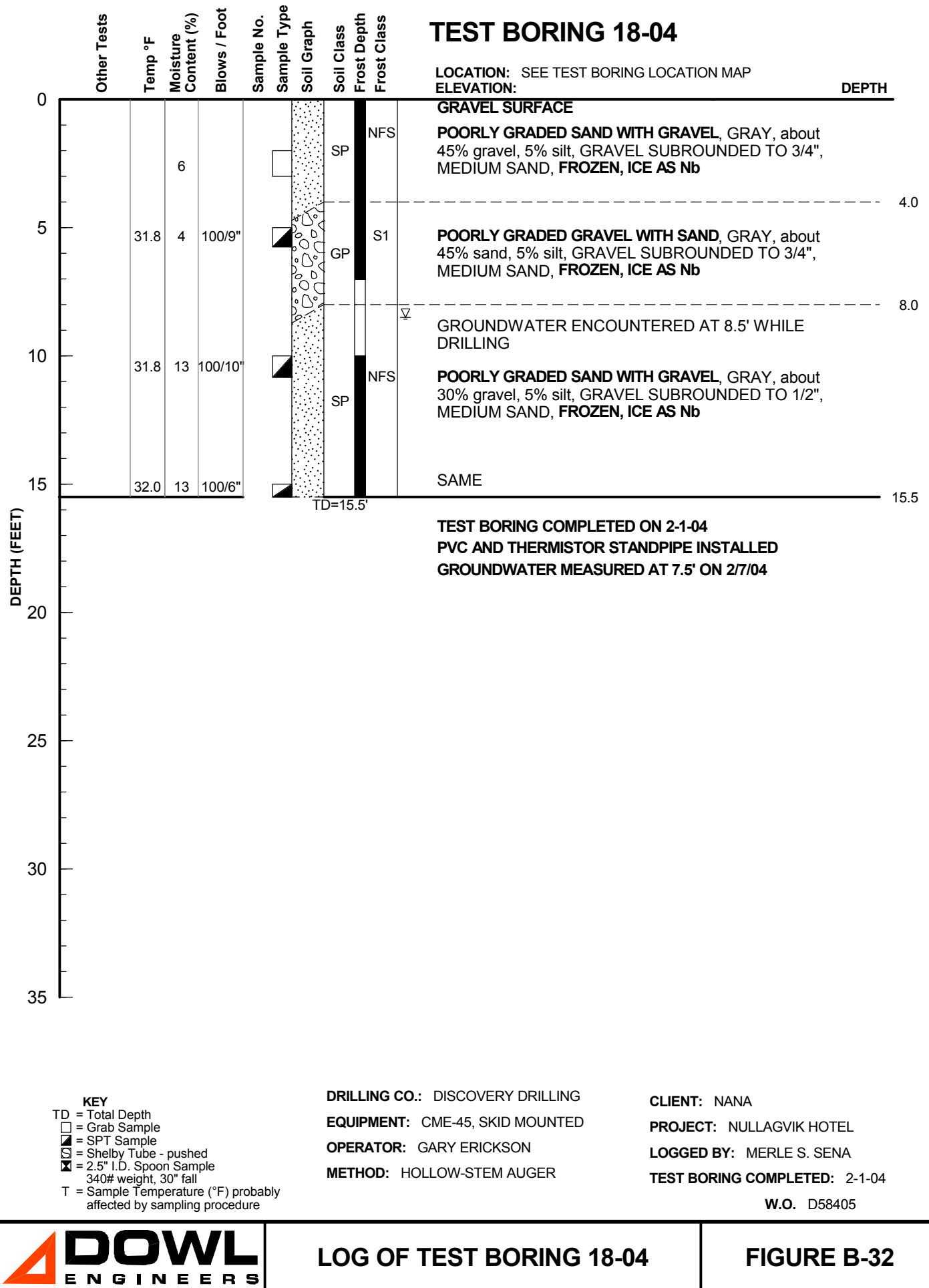
DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-5-04
W.O. D58405



LOG OF TEST BORING 17-04

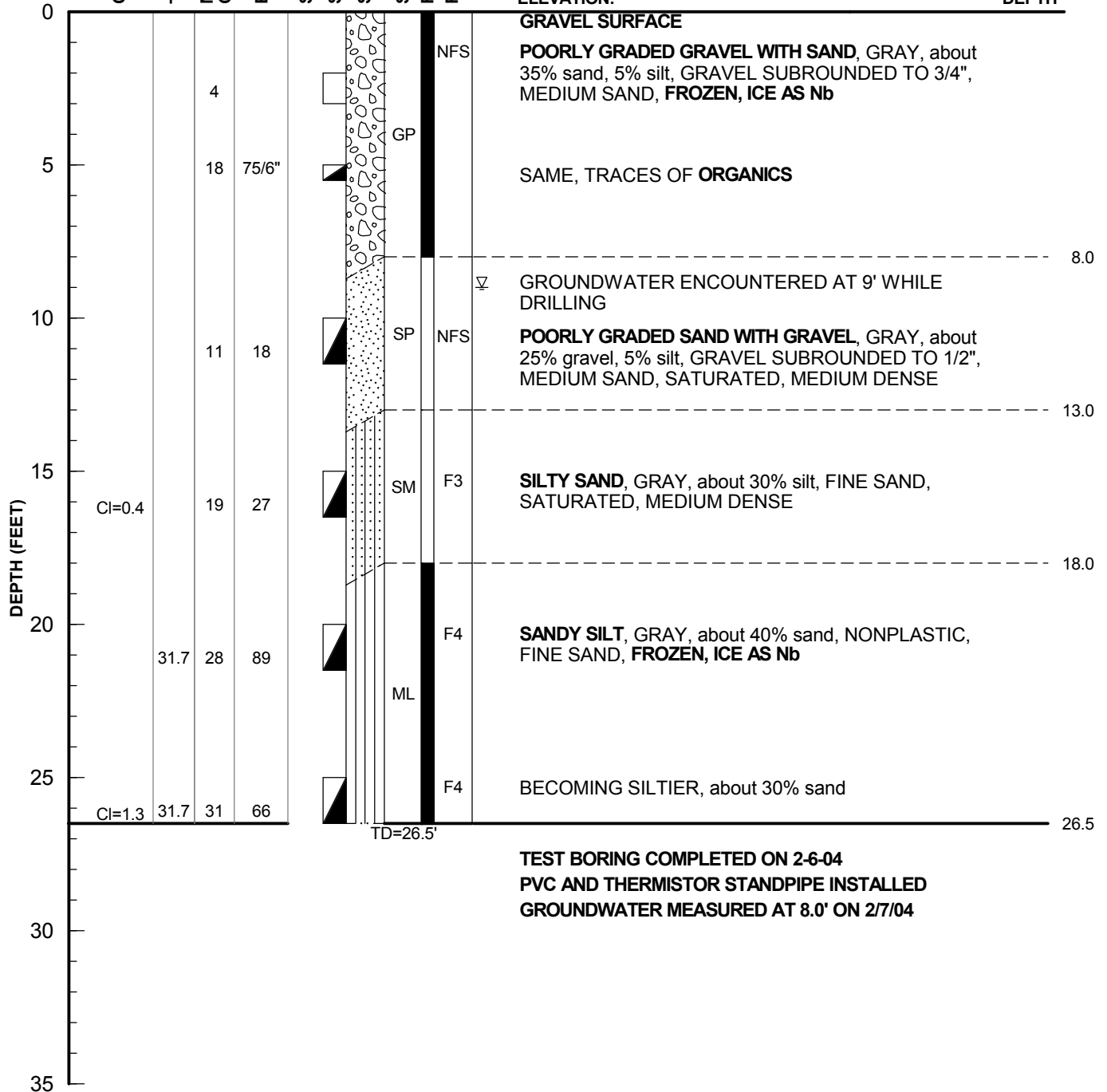
FIGURE B-31



TEST BORING 19-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



KEY
CI = Salinity (Chloride) (ppm)
TD = Total Depth
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

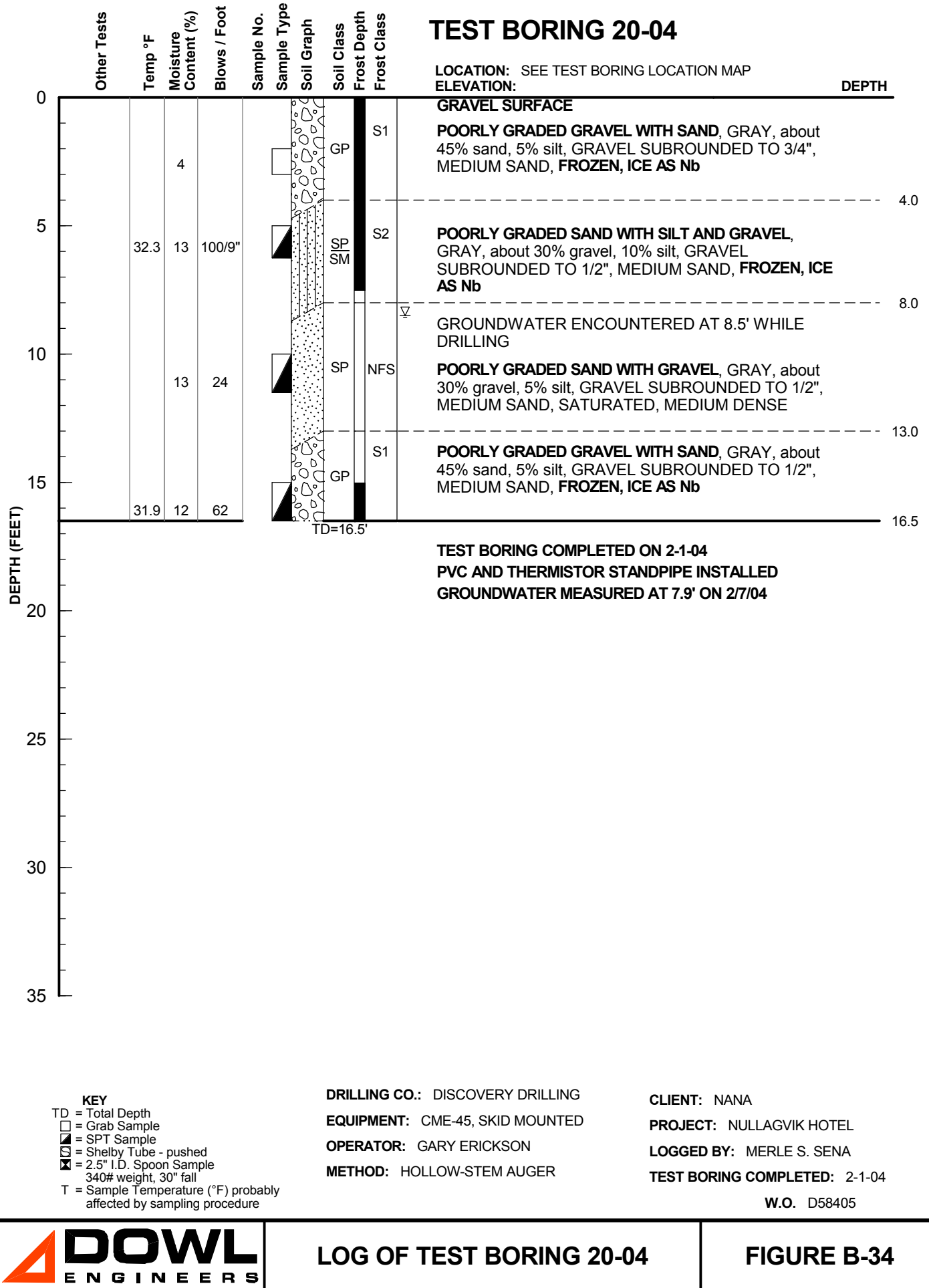
DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-6-04
W.O. D58405



LOG OF TEST BORING 19-04

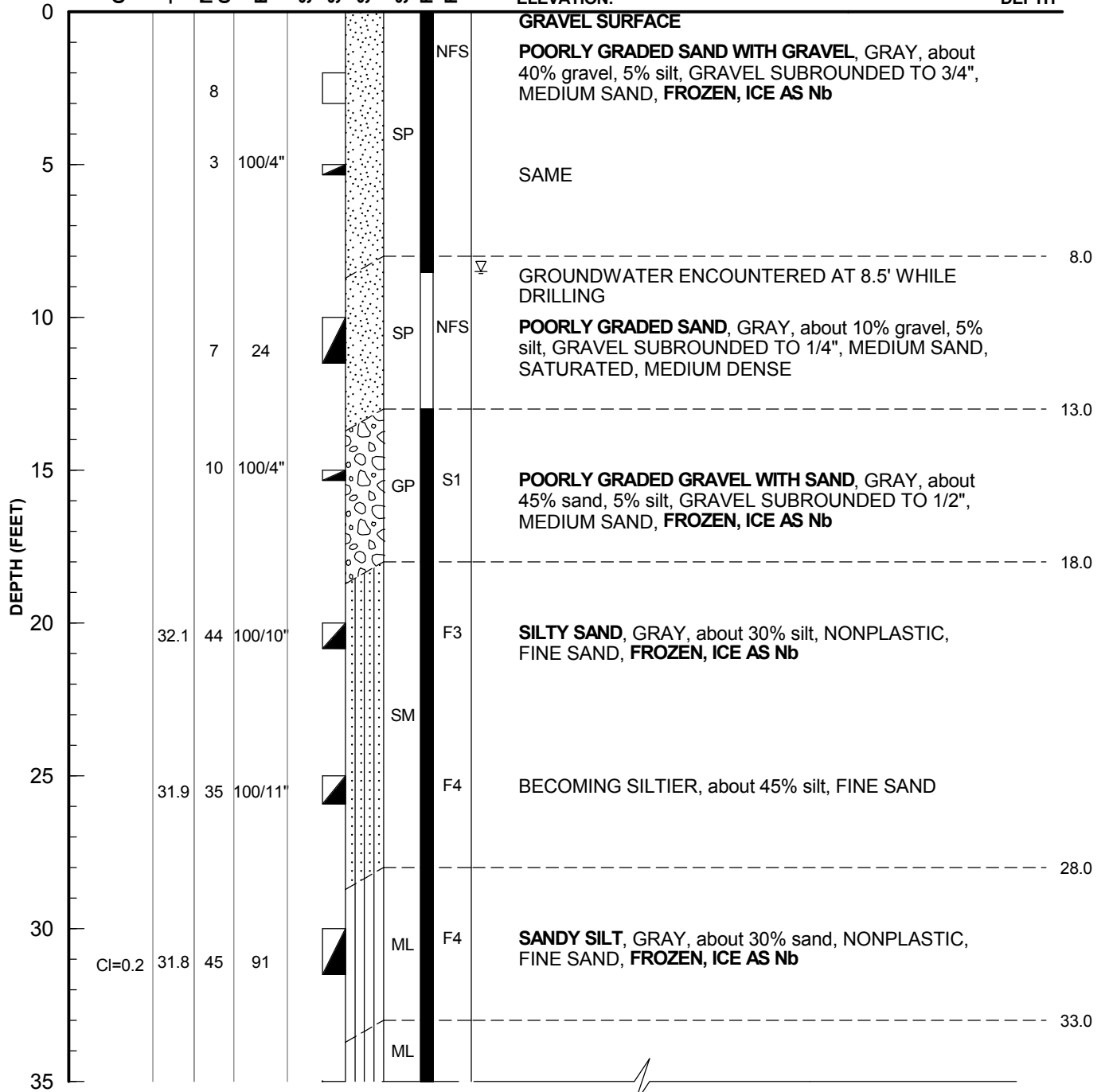
FIGURE B-33



TEST BORING 21-04

LOCATION: SEE TEST BORING LOCATION MAP
ELEVATION:

DEPTH



(continued on next page)

KEY
MA = Mechanical Analysis
CI = Salinity (Chloride) (ppm)
TD = Total Depth
□ = Grab Sample
▣ = SPT Sample
▤ = Shelby Tube - pushed
▥ = 2.5" I.D. Spoon Sample
340# weight, 30" fall
T = Sample Temperature (°F) probably affected by sampling procedure

DRILLING CO.: DISCOVERY DRILLING
EQUIPMENT: CME-45, SKID MOUNTED
OPERATOR: GARY ERICKSON
METHOD: HOLLOW-STEM AUGER

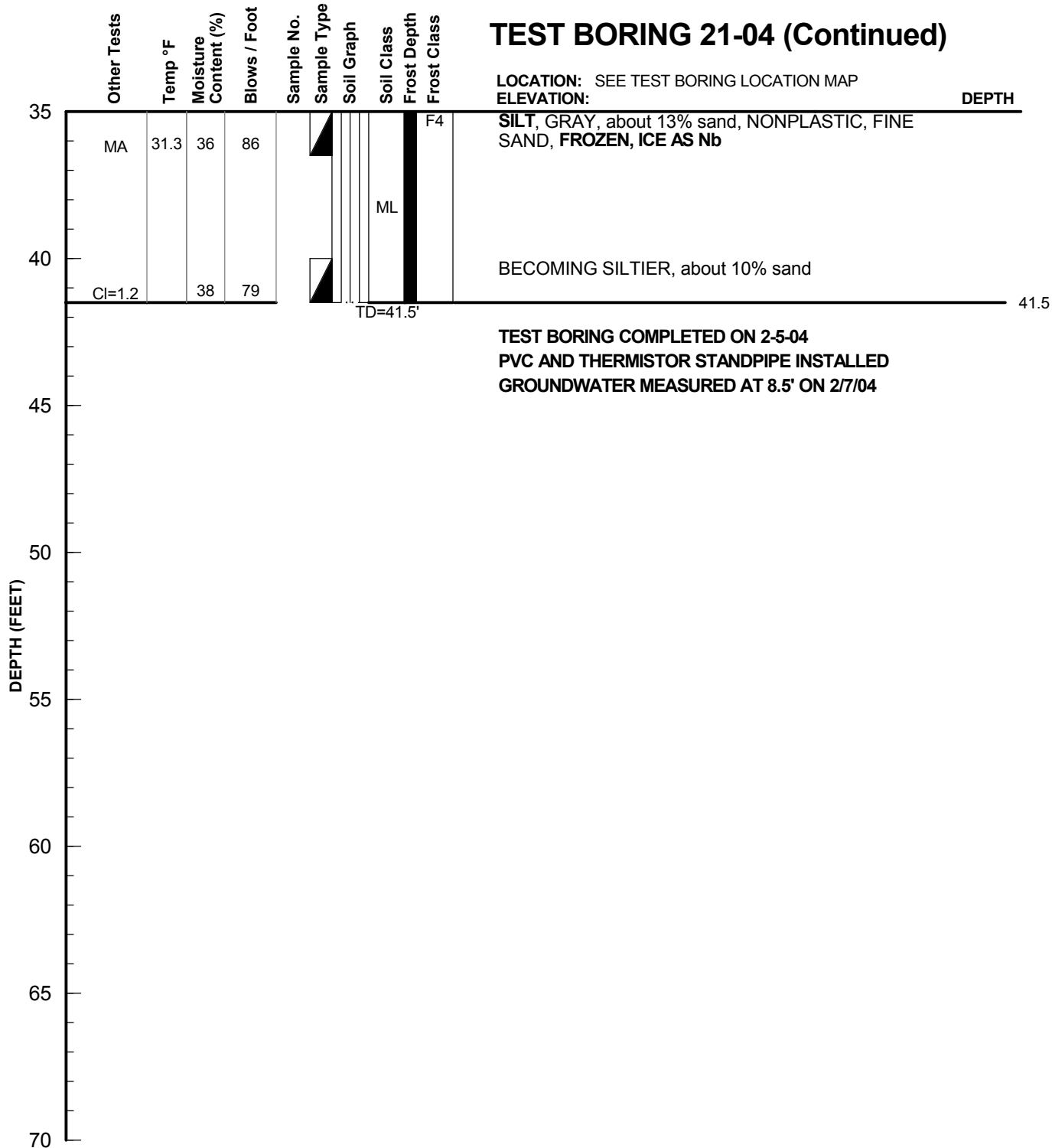
CLIENT: NANA
PROJECT: NULLAGVIK HOTEL
LOGGED BY: MERLE S. SENA
TEST BORING COMPLETED: 2-5-04
W.O. D58405



LOG OF TEST BORING 21-04

FIGURE B-35

TEST BORING 21-04 (Continued)



KEY

MA = Mechanical Analysis
 CI = Salinity (Chloride) (ppm)
 TD = Total Depth
☐ = Grab Sample
☒ = SPT Sample
☒ = Shelby Tube - pushed
☒ = 2.5" I.D. Spoon Sample
 340# weight, 30" fall
 T = Sample Temperature (°F) probably affected by sampling procedure

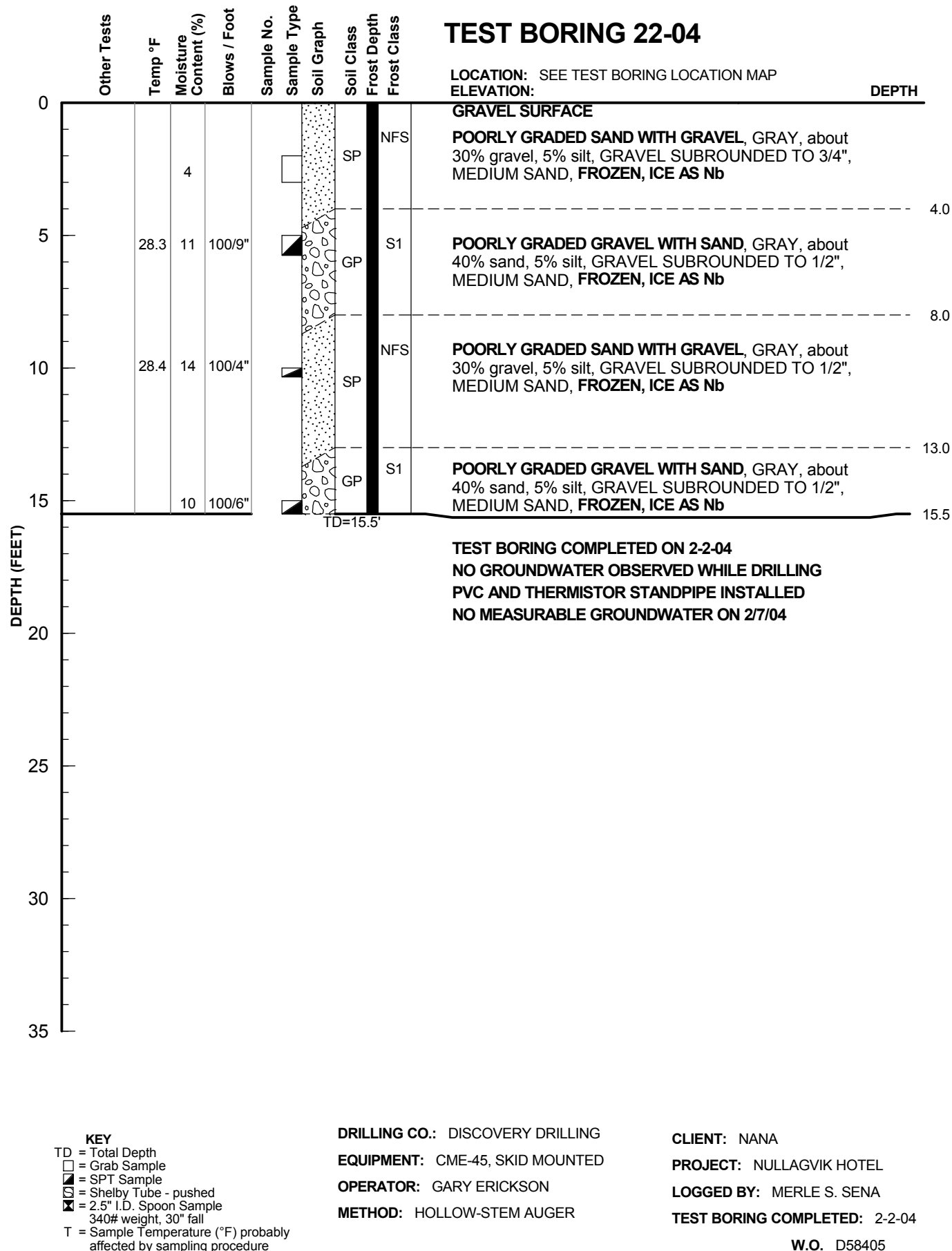
DRILLING CO.: DISCOVERY DRILLING
 EQUIPMENT: CME-45, SKID MOUNTED
 OPERATOR: GARY ERICKSON
 METHOD: HOLLOW-STEM AUGER

CLIENT: NANA
 PROJECT: NULLAGVIK HOTEL
 LOGGED BY: MERLE S. SENA
 TEST BORING COMPLETED: 2-5-04
 W.O. D58405



LOG OF TEST BORING 21-04

FIGURE B-35



TEST BORING LOG - DESCRIPTIVE GUIDE

Soil Descriptions - The soil is classified visually in the field based on drill action, auger cuttings, and sample information. The recovered soil samples are classified visually again in the laboratory. The soil description on the boring log is based on an interpretation of the field and laboratory visual classifications, along with the results of laboratory particle-size distribution analyses and Atterberg Limits tests which may have been performed.

The soil classification is based on ASTM Designation D2487 "Standard Test Method for Classification of Soils for Engineering Purposes" and ASTM D2488 "Standard Practice for Description and Identification of Soils (Visual - Manual Procedure)". The soil frost classification is based on the system developed by the U.S. Army Corps of Engineers and is performed in accordance with the Departments of the Army and Air Force Publication TM 5-822-5 "Pavement Design for Roads, Streets, Walks, and Open Storage Areas". Outlines of these classification procedures are presented on the following pages.

The soil color is the subjective interpretation of the individual logging the test boring.

The plasticity of the minus No. 40 fraction of the soil is described and the fine-grained soils are identified from manual tests using the following table as a guide:

Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	none to low	slow to rapid	low or thread cannot be formed
CL	medium to high	none to slow	medium
MH	low to medium	none to slow	low to medium
CH	high to very high	none	high

Plasticity Description	Criteria
Nonplastic	A 1/8" (3.2mm) thread cannot be rolled at any water content.
Low	A thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Laboratory Atterberg Limits tests usually are performed on a few of the plastic soils and results are reported on the test boring log. These laboratory tests are performed in accordance with ASTM D4318 "Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils."

The shape of the gravel particles is described based on this guide:

- Angular: particles have sharp edges and relatively plane sides with unpolished surfaces.
- Subangular: particles are similar to angular but have somewhat rounded edges.

Subrounded: particles exhibit nearly plane sides but have well-rounded corners and edges.

Rounded: particles have smoothly curved sides and no edges.

The size of gravel and sand particles is described using this guide:

	Gravel	Sand
Coarse:	Passes 3" (75 mm) sieve, retained on 3/4" (19 mm) sieve	Passes No. 4 sieve, retained on No. 10 sieve
Medium:	N/A	Passes No. 10 sieve, retained on No. 40 sieve
Fine:	Passes 3/4" (19 mm) sieve, retained on No. 4 sieve	Passes No. 40 sieve, retained on No. 200 sieve

The soil moisture is described as:

dry: powdery, dusty, no visible moisture.
damp: enough moisture to affect the color of the soil; moist.
wet: water in pores but not dripping; capillary zone above water table.
saturated: dripping wet, contains significant free water, or sampled below water table.

The subjective estimate of the density of coarse-grained soils is based on the observed drill action and on drive sample data. The guide below is used for sands with minor amounts of fine gravel; however, blowcounts can be affected strongly by gravel content, thermal state, drilling procedures, condition of equipment and performance of the test.

Standard Penetration Resistance N (blows / foot) or N (blows / 300 mm)	Soil Density
0 - 5	Very loose
6 - 10	Loose
11 - 30	Medium dense
31 - 50	Dense
More than 50	Very dense

An estimate of the consistency of fine-grained soils is based on the observed drill action and on drive sample data. The guide below is used:

Standard Penetration Resistance N (blows / foot) or N (blows / 300 mm)	Soil Consistency
0 - 2	Very soft
3 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
15 - 30	Very stiff
More than 30	Hard

Soil Layer Boundaries - Generally, there is a gradual transition from one soil type to another in a natural soil deposit, and it is difficult to determine accurately the boundaries of the soil layers.

- A *diagonal line* between soil layers on the graphic boring log indicates the general region of transition from one soil layer to another.
- A *dashed diagonal line* indicates the soil boundary was detected only by a change in the recovered samples and the actual boundary may be anywhere between the indicated sample depths.
- A *horizontal line* between soil layers indicates a relatively distinct transition between soil types was observed in the recovered samples and / or by a distinct change in drill action.

Sample Interval - The sample interval is shown graphically on the test boring log and generally is accurate to about 0.5 foot (0.15 meter).

Frost Depth and Soil Temperatures - If frozen ground is encountered during drilling, the interval of frozen soil is shown graphically on the test boring log. Generally, the temperature of a few soil samples is measured and shown on the boring log. These sample temperatures only give a qualitative indication of the *in situ* soil temperatures. The temperature of samples can be influenced significantly by the ambient air temperature and friction during drilling and sampling.

Soil Moisture Content - Generally, laboratory soil moisture content tests are performed on all recovered samples. Only about 30 grams of the minus No. 4 material typically is used for the moisture content test, so results reported on the log may not reflect accurately the *in situ* moisture content of gravelly soils.

Soil Density - The soil density shown on the test boring logs generally is determined by measuring the wet weight, moisture content, and physical dimensions of relatively undisturbed specimens.

Ground Water - The depth to ground water observed during drilling generally is shown on the test boring log. The depth to ground water observed during drilling can differ significantly from the depth to the actual ground water table, particularly in fine-grained soils. When more accurate water level measurements are desired, we typically install perforated PVC pipe in a boring to monitor the ground water level.

Penetration Resistance, N - Standard penetration tests (SPT) are performed in accordance with ASTM Designation D1586 "Standard Method for Penetration Test and Split-Barrel Sampling of Soils." A modified penetration test using a 2.5-inch (63.5 mm) I.D. split spoon driven with a 340-pound (154.2 kg) hammer falling 30 inches (.76 m) is performed to obtain larger samples, particularly in gravelly soils. The boring log key describes the graphic symbols used to differentiate between sample types.

Undisturbed Samples - Undisturbed Shelby tube samples are obtained in accordance with ASTM Designation D1587, "Standard Practice for Thin-Walled Tube Sampling of Soils." Generally, 3-inch (76.2 mm) O.D. Shelby tubes are used. Relatively undisturbed liner samples are obtained in accordance with ASTM Designation D3550, "Standard Practice for Ring-Lined Barrel Sampling of Soils," except a thick-walled cutting shoe is used. Typically, the sampler is driven using a 340-pound (154.2 kg) weight falling 30 inches (.76 m). The typical brass liner has an I.D. of 2.4 inches (91 mm).

Grab Samples - Grab samples are obtained from the auger flights. The sample depth and interval indicated on the test boring log should be considered a rough approximation. The grab samples may not be representative of *in situ* soils, particularly in layered soil deposits.

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM DESIGNATION: D2487
Based on the Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification	
				Group Symbol	Group Name ^B
Coarse-Grained Soils	Gravels	Clean Gravels	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well-graded gravel ^F
More than 50% retained on #200 sieve	More than 50% of coarse fraction retained on #4 sieve	Less than 5% fines ^C	$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel ^F
		Gravel with Fines	Fines classify as ML or MH	GM	Silty gravel ^{F,G,H}
		More than 12% fines ^C	Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}
		Sands	Clean Sands	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$	SW
	50% or more of coarse fraction passes #4 sieve	Less than 5% fines ^D	$Cu < 6$ and/or $1 > Cc > 3^E$	SP	Poorly graded sand ^I
		Sands with Fines	Fines classify as ML or MH	SM	Silty Sand ^{G,H,I}
		More than 12% fines ^D	Fines classify as CL or CH	SC	Clayey Sand ^{G,H,I}
		Fine-Grained Soils	Silts and Clays	Inorganic	$PI > 7$ and plots on or above "A" line ^J
50% or more passes the #200 sieve	Liquid limit less than 50		$PI < 4$ or plots below "A" Line ^J	ML	Silt ^{K,L,M}
		Organic	Liquid limit - oven dried <0.75	OL	Organic Clay ^{K,L,M,N}
			Liquid limit - not dried	OL	Organic silt ^{K,L,M,O}
		Silts and Clays	Inorganic	PI plots on or above "A" line	CH
	PI plots below "A" line			MH	Elastic silt ^{K,L,M}
	Organic		Liquid limit - oven dried <0.75	OH	Organic clay ^{K,L,M,P}
			Liquid limit - not dried	OH	Organic clay ^{K,L,M,Q}
	Highly organic soils		Primarily organic matter,	dark in color, and organic odor	PT

^A Based on the material passing the 3-in. (75mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols:

GW-GM well-graded gravel with silt
 GW-GC well-graded gravel with clay
 GP-GM poorly graded gravel with silt
 GP-GC poorly graded gravel with clay

^D Sands with 5 to 12% fines require dual symbols:

SW-SM well-graded sand with silt
 SW-SC well-graded sand with clay
 SP-SM poorly graded sand with silt

SP-SC poorly graded sand with clay

$$Cu = \frac{D_{60}}{D_{10}} \quad Cc = \frac{(D_{30})^2}{D_{10}D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg Limits plot in hatched area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.

^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.

DESCRIPTION OF FROZEN SOILS (Visual-Manual Procedure) ASTM Designation: D4083

DEFINITIONS

Part I Description of Soil Phase		Classify Soil Phase by ASTM D2487 or D2488			
Part II Description of Frozen Soil	Segregated ice is not visible by eye	Group Symbol	Subgroup		Field Identification
		N	Description	Symbol	
			Poorly bonded or friable	N _f	
	Segregated ice is visible by eye (ice 1-inch (25 mm) or less in thickness)	V	No excess ice Well-bonded Excess ice	N _b N _{bn} N _{be}	Identify by visual examination. To determine presence of excess ice, use procedures under Note 2 and hand magnifying lens as necessary. For soils not fully saturated, estimate degree of ice saturation; medium, low. Note presence of crystals or of ice coatings around larger particles. For ice phase, record the following when applicable: Location Structure Orientation Color Thickness Size Length Shape Spacing Hardness Pattern of arrangement Estimate volume of visible segregated ice present as percentage of total sample volume.
			Individual ice crystal or inclusions	V _x	
			Ice coatings on particles	V _c	
			Random or irregularly oriented ice formations	V _r	
Part III Description of Substantial Ice	Ice (greater than 1-inch (25 mm) in thickness)	ICE	Stratified or distinctly oriented ice formations	V _s	Designate material as ICE (Note 3) and use descriptive terms as follows, usually one item from each group, where applicable: <u>Hardness</u> HARD SOFT [of mass, not individual crystals] <u>Color</u> (Examples): COLORLESS GRAY BLUE <u>Structure</u> (Note 4) CLEAR CLOUDY POROUS CANDLED GRANULAR STRATIFIED <u>Admixtures</u> (Examples) CONTAINS FEW THIN SILT INCLUSIONS
			Uniformly distributed ice	V _u	
			Ice with soil inclusions	ICE + Soil Type	
			Ice without soil inclusions	ICE	

- 1) Ice coatings on Particles - discernible layers of ice found on or below the larger soil particles in a frozen soil mass.
- 2) Ice Crystal - a very small individual ice particle visible in the face of a soil mass. Crystals may be present alone or in combination with other ice formations.
- 3) Clear Ice - ice that is transparent and contains only a moderate number of air bubbles.
- 4) Cloudy Ice - ice that is translucent or relatively opaque due to the content of air or for other reasons, but which is essentially sound and impervious.
- 5) Porous Ice - ice that contains numerous voids, usually interconnected and usually resulting from melting at air bubbles or along crystal interfaces from presence of salt or other materials in the water, or from the freezing of saturated snow. Though porous, the mass retains its structural unity.
- 6) Candled Ice - ice that has rotted or otherwise formed into long columnar crystals, very loosely bonded together.
- 7) Granular Ice - ice that is composed of coarse, more or less equidimensional crystals weakly bonded together.
- 8) Ice Lenses - lenticular ice formations in soil occurring essentially parallel to each other, generally normal to the direction of heat loss, and commonly in repeated layers.
- 9) Ice Segregation - the growth of ice within soil in excess of the amount that may be produced by the in-place conversion of the original void moisture to ice. Ice segregation occurs most often as distinct lenses, layers, veins, and masses, commonly, but not always, oriented normal to the direction of heat loss.
- 10) Well-Bonded - a condition in which the soil particles are strongly held together by the ice so that the frozen soil possesses relatively high resistance to chipping or breaking.
- 11) Poorly-Bonded - a condition in which the soil particles are weakly held together by the ice so that the frozen soil has poor resistance to chipping and breaking.
- 12) Thaw Stable - the characteristics of frozen soils that, upon thawing, do not show loss of strength in comparison to normal, long-time thawed values nor produce detrimental settlement.

- Note 1: Frozen soils in the N group may, on close examination, indicate presence of ice within the voids of the material by crystalline reflections or by a sheen on fractured or trimmed surfaces. The impression received by the unaided eye, however, is that none of the frozen water occupies space in excess of the original voids in the soil. The opposite is true of frozen soils in the V group.
- Note 2: When visual methods may be inadequate, a simple field test to aid in evaluation of the volume of excess ice can be made by placing some frozen soil in a small jar, allowing it to melt, and observing the quantity of supernatant water as a percentage of total volume.
- Note 3: Where special forms of ice such as hoarfrost can be distinguished, more explicit description should be given.
- Note 4: Observer should be careful to avoid being misled by surface scratches or frost coating on the ice.

FROST DESIGN SOIL CLASSIFICATION¹

Frost ² Group	Kind of Soil	Percentage Finer than 0.02 mm by Weight	Typical Soil Types Under Unified Soil Classification System
NFS ³	(a) Gravels Crushed stone Crushed rock	0 to 1.5	GW and GP
	(b) Sands	0 to 3	SW and SP
PFS ⁴ (MOA NFS) (MOA F2)	(a) Gravels Crushed stone Crushed rock	1.5 to 3	GW and GP
	(b) Sands	3 to 10	SW and SP
S1 (MOA F1)	Gravelly soils	3 to 6	GW, GP, GW-GM, and GP-GM
S2 (MOA F2)	Sandy soils	3 to 6	SW, SP, SW-SM, and SP-SM
F1	Gravelly soils	6 to 10	GM, GW-GM, and GP-GM
F2	(a) Gravelly soils	10 to 20	GM, GW-GM, and GP-GM
	(b) Sands	6 to 15	SM, SW-SM, and SP-SM
F3	(a) Gravelly soils	Over 20	GM and GC
	(b) Sands, except very fine silty sands	Over 15	SM and SC
	(c) Clays, PI>12		CL and CH
F4	(a) All silts	Over 15	ML and MH
	(b) Very fine silty sands		SM
	(c) Clays, PI>12		CL and CL-ML
	(d) Varved clays and other fine-grained, banded sediments		CL and ML CL, ML, and SM CL, CH, and ML CL, CH, ML and SM

¹ Departments of the Army and Air Force Publication TM 5-822-5/AFM 88-7, "Pavement Design for Roads, Streets, Walks, and Open Storage Areas", Table 18-2.

² Corps of Engineers Frost groups directly correspond to the Municipality of Anchorage soil frost classification groups, except as noted.

³ Non Frost-Susceptible.

⁴ Possibly frost-susceptible, but requires laboratory test to determine frost design soil classification.

APPENDIX C

Shelby Tube/Brass Liner Logs

Client: NANA

Project: Nullagvik Hotel

Date: 9/25/07

Work Order: D58405A

Test Boring #: TB-5, Sample 9

Depth: from 35' to 37'

Sample Condition: Good

Technician: JAR

Specimen No.	Tests	Moisture Content (%)	LL (%)	PL (%)	PI (%)	Vane Shear (tsf)	Pocket Penetrometer (tsf)	Thumb Consistency	Dilatancy	Sample Length (in)	Pictorial Description	Remarks
1	PP	+ = 1.28 + + w = 5.22 + + d = 4.24 33%				0.25, 0.125	1	S	m	1	• PP	3 Dry
	PP, TV						1	m	m	2	• PP ⊕ TV	
	moist						1.25	m	m	3	• PP	
	PP						1.5	m	m	4	• PP ⊕ TV	
	TV, PP						0.25, 0.1R	f	m	5	• PP	
	PP						0.225, 0.125R	f	m	6	• PP ⊕ TV	
2	TV, PP	+ = 1.27 + + w = 6.56 + + d = 5.19 35%				0.20, 0.1R	1.25	m	m	7	• PP ⊕ TV	
	PP						1.25	m	m	8	• PP	
	TV, PP						0.25, 0.1R	m	m	9	• PP ⊕ TV	
										10		
										11		
										12		
3										13		Removed for poss Consol
										14		
										15		
										16		
										17		
										18		
4	moist	+ = 1.27 + + w = 5.56 + + d = 4.33 40%				0.25, 0.1R	2.0	f	m	19	• PP ⊕ TV	MA loss ignition
	TV, PP						1.75	f	m	20	• PP	
	PP						0.45, 0.15R	f	L	21	• PP ⊕ TV	
	TV, PP						2.25	f	L	22	• PP	
	MA, loss ig						2.5	f	L	23	• PP ⊕ TV	
	PP						0.45, 0.20R	f	L	24	• PP	
5	TV, PP	+ = 1.27 + + w = 6.34 + + d = 5.24 28%				0.20, 0.1R	1.25	f	L	25	• PP ⊕ TV	cracks
	PP									26		
	TV, PP									27		
										28		
										29		
										30		

Test Codes

A - Atterberg Limits

C - Consolidation

H - Hydrometer

M.A. - Mechanical Analysis

T - Triaxial Compression

Consistency

S - Soft

M - Medium

F - Firm

H - Hard

Dilatancy

N - Nondilatant

L - Low

M - Medium

H - High

f4 dark grey/black sandy silt
contains organics

Client: NANA

Project: Mullagvik Hotel

Date: 9/25/07

Work Order: D58405A

Test Boring #: TB 5, Sample 10

Depth: from 40' to 42'

Sample Condition: Good

Technician: JAR

Specimen No.	Tests	Moisture Content (%)	LL (%)	PL (%)	PI (%)	Vane Shear (tsf)	Pocket Penetrometer (tsf)	Thumb Consistency	Dilatancy	Sample Length (in)	Pictorial Description	Remarks
1	PP	$t = 1.27$ $\gamma_w = 8.39$ $\gamma_d = 6.14$ 46%				0.25, 0.1R	1.0	S	L	1	PP	Cracks
	TV, PP						1.25	S	L	2	PP ⊕ TV	
	moist						1.25	M	L	3	PP	
	PP						1.75	M	M	4	PP ⊕ TV	
	TV, PP						1.75	M	M	5	PP	
	PP						1.5	F	M	6	PP ⊕ TV	
	PP						0.25, 0.175R	F	M	7	PP	
2	TV, PP	$t = 1.26$ $\gamma_w = 15.02$ $\gamma_d = 10.85$ 43%				0.35, 0.15R	1.75	F	M	8	PP ⊕ TV	
	moist						2.25	F	M	9	PP ⊕ TV	
	PP						0.3, 0.15R	F	M	10	PP	
	TV, PP						2.25	F	M	11	PP ⊕ TV	
	PP						2.25	F	M	12	PP	
	PP						2.0	F	M	13	PP	
	TV						0.35, 0.15R	F	M	14	PP ⊕ TV	
3	moist	$t = 1.27$ $\gamma_w = 5.80$ $\gamma_d = 4.48$ 41%				0.35, 0.15R	2.0	F	M	15	PP	
	PP							F	M	16	PP ⊕ TV	
	PP							F	M	17	PP	
	TV							F	M	18	PP	
	moist							F	M	19	PP	
	PP							F	M	20	PP	
	TV							F	M	21	PP	
4	PP							F	M	22	PP	Removed for Consol
	PP							F	M	23	PP	
	TV							F	M	24	PP	
	moist							F	M	25	PP	
	PP							F	M	26	PP	
	TV							F	M	27	PP	
	PP							F	M	28	PP	
5	PP, PP	$t = 1.27$ $\gamma_w = 6.20$ $\gamma_d = 4.80$ 40%	NP	NP	NP		2.5	F	M	29	PP	ATT
	moist						2.0	M	M	30	PP	
	ATT							M	M		PP	
	PP							M	M		PP	
								M	M		PP	
								M	M		PP	
								M	M		PP	

Test Codes

A - Atterberg Limits

C - Consolidation

H - Hydrometer

M.A. - Mechanical Analysis

T - Triaxial Compression

Consistency

S - Soft

M - Medium

F - Firm

H - Hard

Dilatancy

N - Nondilatant

L - Low

M - Medium

H - High

f4, grey Sandy silt

Client: NANA

Project: Nallagvik

Date: 9/25/07
Work Order: D58405A
Test Boring #: TB6, Sample 8
Depth: from 30' to 32'
Sample Condition: Good
Technician: JAR

Specimen No.	Tests	Moisture Content (%)	LL (%)	PL (%)	PI (%)	Vane Shear (tsf)	Pocket Penetrometer (tsf)	Thumb Consistency	Dilatancy	Sample Length (in)	Pictorial Description	Remarks
1	PP PP TV, PP PP moist PP	t = 1.27 ++w = 8.09 ++d = 6.23 38%				0.25, 0.12	0.75 1.5 1.5 0.75 0.75	S S S S S	L M M M M	1 2 3 4 5	PP PP PP ⊕ TV PP PP	Cracks
2	TV, PP moist, PP PP PP TV PP	t = 1.27 ++w = 6.09 ++d = 4.67 42%				0.2, 0.12	0.75 1.5 1.75 1.5	S S M M	M L L L	6 7 8 9 10 11	PP ⊕ TV PP PP PP PP PP	
3	PP moist PP	t = 1.27 ++w = 5.16 ++d = 4.00 42%				0.35, 0.12 0.2, 0.12	1.25 1.5	M M	L L	12 13 14 15 16 17 18 19 20	PP ⊕ TV PP PP PP PP PP PP PP PP	
4										21 22 23 24 25 26 27 28 29 30		
5			NP	NP	NP							Removed for consol
6	PP TV, PP TV, PP moist PP	t = 1.27 ++w = 3.74 ++d = 3.12 34%				0.4, 0.12 0.25, 0.12	1.5 2.0 1.25 1.25	M M S S S	L M M M M			Removed for ATT
												Cracks

Test Codes

A - Atterberg Limits
C - Consolidation
H - Hydrometer
M.A. - Mechanical Analysis
T - Triaxial Compression

Consistency

S - Soft
M - Medium
F - Firm
H - Hard

Dilatancy

N - Nondilatant
L - Low
M - Medium
H - High

f4 dark grey sandy silt

Client: NANA

Project: Nullagråk Hotel

Date: 9/25/07

Work Order: 1758405A

Test Boring #: TB 14, Sample 7

Depth: from 30' to 32'

Sample Condition Good

Technician: JAR

Specimen No.	Tests	Moisture Content (%)	LL (%)	PL (%)	PI (%)	Vane Shear (tsf)	Pocket Penetrometer (tsf)	Thumb Consistency	Dilatancy	Sample Length (in)	Pictorial Description	Remarks
1	PP TV, PP moist PP PP PP	t = 1.27 +w = 8.56 +d = 6.415 41%				0.225, 0.075R	0.75 0.75 1.0 1.0 1.0	S S S S	L L L	1_ 2_ 3_ 4_ 5_ 6_ 7_ 8_ 9_ 10_ 11_ 12_ 13_ 14_ 15_ 16_ 17_ 18_ 19_ 20_ 21_ 22_ 23_ 24_ 25_ 26_ 27_ 28_ 29_ 30_ 31_ 32_ 33_ 34_ 35_ 36_ 37_ 38_ 39_ 40_ 41_ 42_ 43_ 44_ 45_ 46_ 47_ 48_ 49_ 50_ 51_ 52_ 53_ 54_ 55_ 56_ 57_ 58_ 59_ 60_ 61_ 62_ 63_ 64_ 65_ 66_ 67_ 68_ 69_ 70_ 71_ 72_ 73_ 74_ 75_ 76_ 77_ 78_ 79_ 80_ 81_ 82_ 83_ 84_ 85_ 86_ 87_ 88_ 89_ 90_ 91_ 92_ 93_ 94_ 95_ 96_ 97_ 98_ 99_ 100_ 101_ 102_ 103_ 104_ 105_ 106_ 107_ 108_ 109_ 110_ 111_ 112_ 113_ 114_ 115_ 116_ 117_ 118_ 119_ 120_ 121_ 122_ 123_ 124_ 125_ 126_ 127_ 128_ 129_ 130_ 131_ 132_ 133_ 134_ 135_ 136_ 137_ 138_ 139_ 140_ 141_ 142_ 143_ 144_ 145_ 146_ 147_ 148_ 149_ 150_ 151_ 152_ 153_ 154_ 155_ 156_ 157_ 158_ 159_ 160_ 161_ 162_ 163_ 164_ 165_ 166_ 167_ 168_ 169_ 170_ 171_ 172_ 173_ 174_ 175_ 176_ 177_ 178_ 179_ 180_ 181_ 182_ 183_ 184_ 185_ 186_ 187_ 188_ 189_ 190_ 191_ 192_ 193_ 194_ 195_ 196_ 197_ 198_ 199_ 200_ 201_ 202_ 203_ 204_ 205_ 206_ 207_ 208_ 209_ 210_ 211_ 212_ 213_ 214_ 215_ 216_ 217_ 218_ 219_ 220_ 221_ 222_ 223_ 224_ 225_ 226_ 227_ 228_ 229_ 230_ 231_ 232_ 233_ 234_ 235_ 236_ 237_ 238_ 239_ 240_ 241_ 242_ 243_ 244_ 245_ 246_ 247_ 248_ 249_ 250_ 251_ 252_ 253_ 254_ 255_ 256_ 257_ 258_ 259_ 260_ 261_ 262_ 263_ 264_ 265_ 266_ 267_ 268_ 269_ 270_ 271_ 272_ 273_ 274_ 275_ 276_ 277_ 278_ 279_ 280_ 281_ 282_ 283_ 284_ 285_ 286_ 287_ 288_ 289_ 290_ 291_ 292_ 293_ 294_ 295_ 296_ 297_ 298_ 299_ 300_ 301_ 302_ 303_ 304_ 305_ 306_ 307_ 308_ 309_ 310_ 311_ 312_ 313_ 314_ 315_ 316_ 317_ 318_ 319_ 320_ 321_ 322_ 323_ 324_ 325_ 326_ 327_ 328_ 329_ 330_ 331_ 332_ 333_ 334_ 335_ 336_ 337_ 338_ 339_ 340_ 341_ 342_ 343_ 344_ 345_ 346_ 347_ 348_ 349_ 350_ 351_ 352_ 353_ 354_ 355_ 356_ 357_ 358_ 359_ 360_ 361_ 362_ 363_ 364_ 365_ 366_ 367_ 368_ 369_ 370_ 371_ 372_ 373_ 374_ 375_ 376_ 377_ 378_ 379_ 380_ 381_ 382_ 383_ 384_ 385_ 386_ 387_ 388_ 389_ 390_ 391_ 392_ 393_ 394_ 395_ 396_ 397_ 398_ 399_ 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1498_ 1499_ 1500_ 1501_ 1502_ 1503_ 1504_ 1505_ 1506_ 1507_ 1508_ 1509_ 1510_ 1511_ 1512_ 1513_ 1514_ 1515_ 1516_ 1517_ 1518_ 1519_ 1520_ 1521_ 1522_ 1523_ 1524_ 1525_ 1526_ 1527_ 1528_ 1529_ 1530_ 1531_ 1532_ 1533_ 1534_ 1535_ 1536_ 1537_ 1538_ 1539_ 1540_ 1541_ 1542_ 1543_ 1544_ 1545_ 1546_ 1547_ 1548_ 1549_ 1550_ 1551_ 1552_ 1553_ 1554_ 1555_ 1556_ 1557_ 1558_ 1559_ 1560_ 1561_ 1562_ 1563_ 1564_ 1565_ 1566_ 1567_ 1568_ 1569_ 1570_ 1571_ 1572_ 1573_ 1574_ 1575_ 1576_ 1577_ 1578_ 1579_ 1580_ 1581_ 1582_ 1583_ 1584_ 1585_ 1586_ 1587_ 1588_ 1589_ 1590_ 1591_ 1592_ 1593_ 1594_ 1595_ 1596_ 1597_ 1598_ 1599_ 1600_ 1601_ 1602_ 1603_ 1604_ 1605_ 1606_ 1607_ 1608_ 1609_ 1610_ 1611_ 1612_ 1613_ 1614_ 1615_ 1616_ 1617_ 1618_ 1619_ 1620_ 1621_ 1622_ 1623_ 1624_ 1625_ 1626_ 1627_ 1628_ 1629_ 1630_ 1631_ 1632_ 1633_ 1634_ 1635_ 1636_ 1637_ 1638_ 1639_ 1640_ 1641_ 1642_ 1643_ 1644_ 1645_ 1646_ 1647_ 1648_ 1649_ 1650_ 1651_ 1652_ 1653_ 1654_ 1655_ 1656_ 1657_ 1658_ 1659_ 1660_ 1661_ 1662_ 1663_ 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Test Codes

A - Atterberg Limits

C - Consolidation

H - Hydrometer

M.A. - Mechanical Analysis

T - Triaxial Compression

Consistency

S - Soft

M - Medium

F - Firm

H - Hard

Dilatency

N - Nondilatant

L - Low

M - Medium

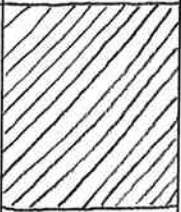

H - High

f4 dark grey sandy silt

Client: NANA

Project: Nullagvik Hotel

Date: 9/26/07
Work Order: D58405A
Test Boring #: TB10, Sample 9
Depth: from 35' to 37'
Sample Condition: Good
Technician: JAR

Specimen No.	Tests	Moisture Content (%)	LL (%)	PL (%)	PI (%)	Vane Shear (tsf)	Pocket Penetrometer (tsf)	Thumb Consistency	Dilatancy	Sample Length (in)	Pictorial Description	Remarks
4 1	PP TV, PP PP moist TV, PP PP TV, PP	t = 1.26 t+w = 6.64 t+d = 5.30 33%				0.2, 0.12	0.5 0.5	S S	L m	1 2 3	• PP ⊕ TV • PP • PP	
1 2	PP moist PP	t = 1.26 t+w = 5.76 t+d = 4.66 32%				0.25, 0.12	0.5 1.5 1.25	S m m	m L L L	4 5 6 7	⊕ TV • PP • PP • PP ⊕ TV • PP	
3	Consol									8 9 10 11 12 13		Removed for Consol
	TV, PP					0.35, 0.12	1.25	m m m	L N N	14 15 16 17	• PP ⊕ TV 	3" sand & gravel lens
2 4	PP, TV moist PP TV, PP PP PP	t = 1.27 t+w = 4.56 t+d = 3.71 35%				0.25, 0.12	1.25 1.75 2.0 1.75	m m m m	L L L L	18 19 20 21 22	• PP ⊕ TV • PP ⊕ TV • PP	
3 5	TV, PP moist PP	t = 1.27 t+w = 4.22 t+d = 3.78 18%				0.25, 0.12	1.5 1.75 1.75	m m S	L L L	23 24 25 26	• PP • PP ⊕ TV • PP	cracks
										27 28 29 30		

Test Codes

A - Atterberg Limits
C - Consolidation
H - Hydrometer
M.A. - Mechanical Analysis
T - Triaxial Compression

Consistency

S - Soft
M - Medium
F - Firm
H - Hard

Dilatancy

N - Nondilatant
L - Low
M - Medium
H - High

Date: November 20, 2007

Work Order: D58405A

Test Boring #: 10, Sample 11-2


Depth: from 46 to 46.5

Sample Condition GOOD - FROZEN

Technician: KAN

Client: NANA

Project: Nulagaik Hotel

Specimen No.	Tests	Moisture Content (%)	LL (%)	PL (%)	PI (%)	Vane Shear (tsf)	Pocket Penetrometer (tsf)	Thumb Consistency	Dilatancy	Sample Length (in)	Pictorial Description	Remarks
	1/2 M	t = 501.5g wet = 1361.1 D + t = 1101.6 43%								1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	 COAL Laminated	
												F-1, Black Silt with sand, fine sand, FROZEN ICE as N6 trace of organics (rootlets)

Test Codes

A - Atterberg Limits

C - Consolidation

H - Hydrometer

M.A. - Mechanical Analysis

T - Triaxial Compression

Consistency

S - Soft

M - Medium

F - Firm

H - Hard

Dilatency

N - Nondilatant

L - Low

M - Medium

H - High



Test Boring #: 10, Sample 11-3

Sample Condition GOOD - FROZEN

Technician: RAN

Project: Nullagvik Hotel

Specimen No.	Tests	Moisture Content (%)	LL (%)	PL (%)	PI (%)	Vane Shear (tsf)	Pocket Penetrometer (tsf)	Thumb Consistency	Dilatancy	Sample Length (in)	Pictorial Description	Remarks
	%M t=503.6 wet=1224.3 Dwt=1014.8 41%									1_ 2_ 3_ 4_ 5_ 6_ 7_ 8_ 9_ 10_ 11_ 12_ 13_ 14_ 15_ 16_ 17_ 18_ 19_ 20_ 21_ 22_ 23_ 24_ 25_ 26_ 27_ 28_ 29_ 30_	ASH Packet H. brown Bos	FA, Black Silt, vib. sand, fine sand, FROZEN ICE as Nbn, trace of organics (rootlets)

Dilatency

N - Nondilatant

L - Low

M - Medium

H - High




Test Boring #: 15, Sample 10-2

Sample Condition GOOD - FROZEN

Technician: KAN

Project: Nullagvik Hotel

Specimen No.	Tests	Moisture Content (%)	LL (%)	PL (%)	PI (%)	Vane Shear (tsf)	Pocket Penetrometer (tsf)	Thumb Consistency	Dilatancy	Sample Length (in)	Pictorial Description	Remarks
	1. M	L = 994.3 wet = 1196.7g Dry = 999.2g 41%								1_ 2_ 3_ 4_ 5_ 6_ 7_ 8_ 9_ 10_ 11_ 12_ 13_ 14_ 15_ 16_ 17_ 18_ 19_ 20_ 21_ 22_ 23_ 24_ 25_ 26_ 27_ 28_ 29_ 30_	 <p>Laminated w/ voids</p> <p>30s</p>	<p>F4, Black, Silt, 10% sand, fine sand. Froze as Non</p>

Dilatency

N - Nondilutant

L - Low

M - Medium

H - High

T - Triaxial Compression

Client: NANA

Project: Nallagvik Hotel

Date: November 20, 2007

Work Order: 058405A

Test Boring #: 15, Sample 10-3

Depth: from 41 to 41.5

Sample Condition: GOOD - FROZEN

Technician: KAN

Specimen No.	Tests	Moisture Content (%)	LL (%)	PL (%)	PI (%)	Vane Shear (tsf)	Pocket Penetrometer (tsf)	Thumb Consistency	Dilatency	Sample Length (in)	Pictorial Description	Remarks
	1. M	t=992.0 wte=1201.9g Ote=992.9g 42.1								1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	6" layers (same mat'l) ROS F4, Black, Gill w/20% sand, fine sand. FROZEN ICE as Nbn	

Test Codes

A - Atterberg Limits

C - Consolidation

H - Hydrometer

M.A. - Mechanical Analysis

T - Triaxial Compression

Consistency

S - Soft

M - Medium

F - Firm

H - Hard

Dilatency

N - Nondilatant

L - Low

M - Medium

H - High

APPENDIX D

Laboratory Test Results



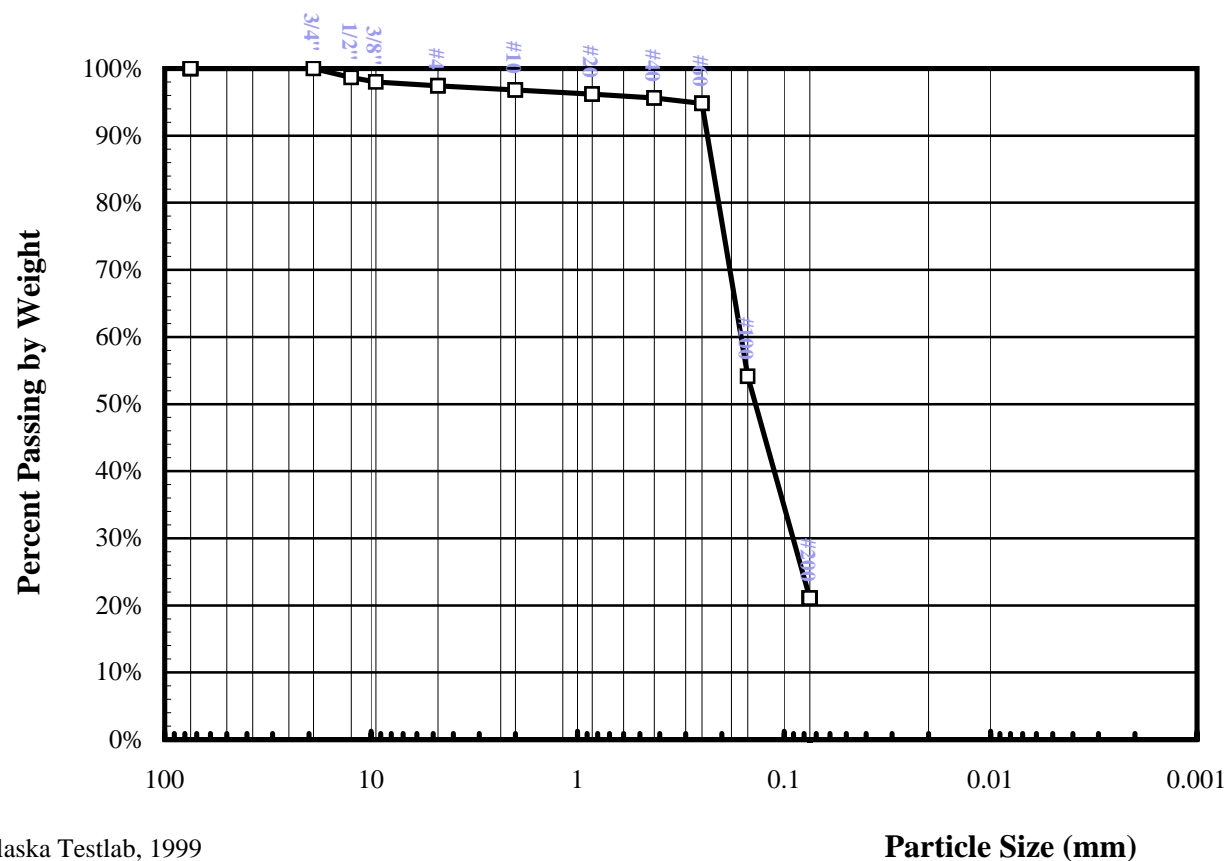
Client: NANA Development Corporation

Project: Nullagvik Pre-Planning

Location: Test Boring 1

Sample 5

Depth 15' - 16.5'

Engineering Classification: Silty SAND, SMFrost Classification: Not Measured

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David L Andersen

David L. Andersen, P.E., Technical Advisor

PARTICLE-SIZE**DIST. ASTM D422**

W.O. D58405A

Lab No. 2007-1601

Received: 9/14/07

Reported: 10/30/07

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	99%	
3/8"	98%	
No. 4	97%	
Total Wt. = 416.8g		
No. 8		
No. 10	97%	
No. 16		
No. 20	96%	
No. 30		
No. 40	96%	
No. 50		
No. 60	95%	
No. 80		
No. 100	54%	
No. 200	21%	
Total Wt. of Fine Fraction = 416.5g		
0.02 mm		



Client: NANA Development Corporation

Project: Nullagvik Pre-Planning

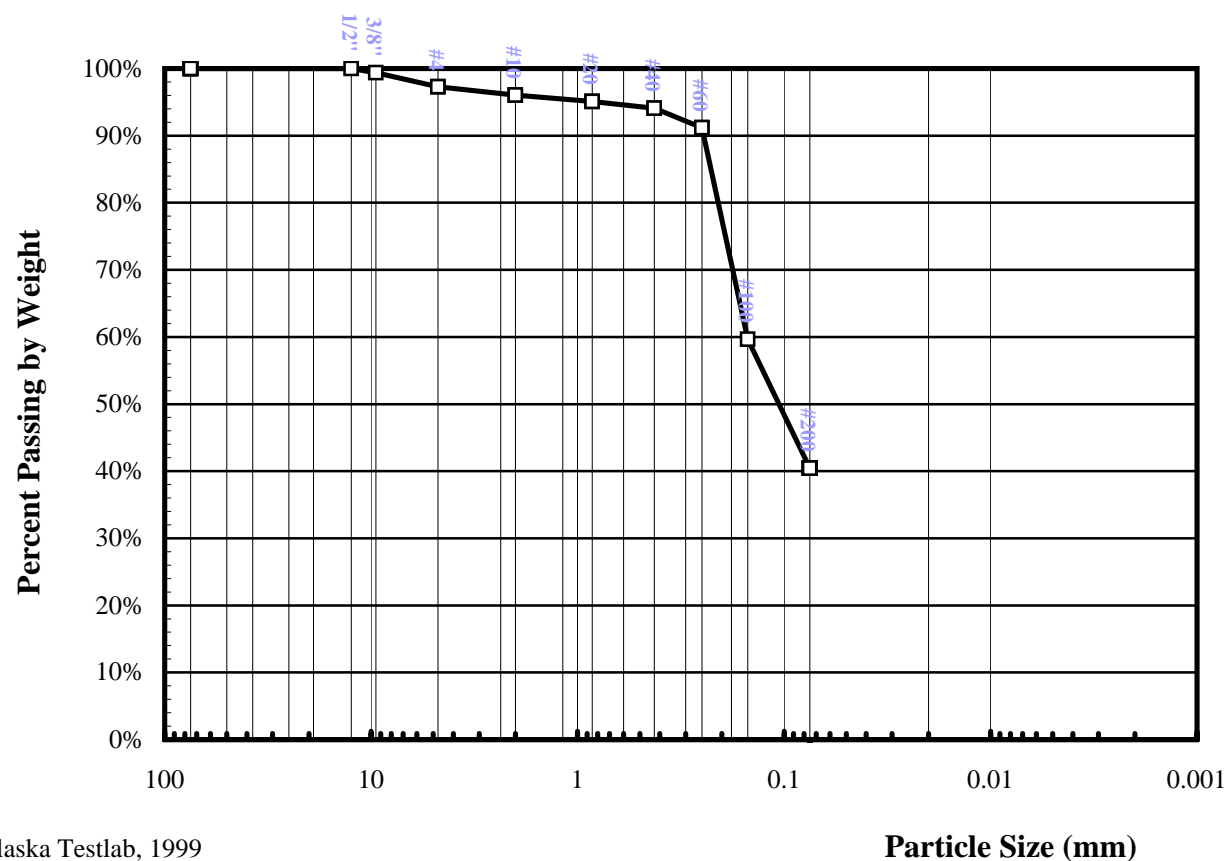
Location: Test Boring 3

Sample 5

Depth 15' - 16.5'

Engineering Classification: Silty SAND , SM

Frost Classification: Not Measured



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David L Andersen

David L. Andersen, P.E., Technical Advisor

PARTICLE-SIZE

DIST. ASTM D422

W.O. D58405A

Lab No. 2007-1602

Received: 9/14/07

Reported: 10/30/07

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"	100%	
3/8"	99%	
No. 4	97%	
Total Wt. = 407.5g		
No. 8		
No. 10	96%	
No. 16		
No. 20	95%	
No. 30		
No. 40	94%	
No. 50		
No. 60	91%	
No. 80		
No. 100	60%	
No. 200	40%	
Total Wt. of Fine Fraction = 396.1g		
0.02 mm		

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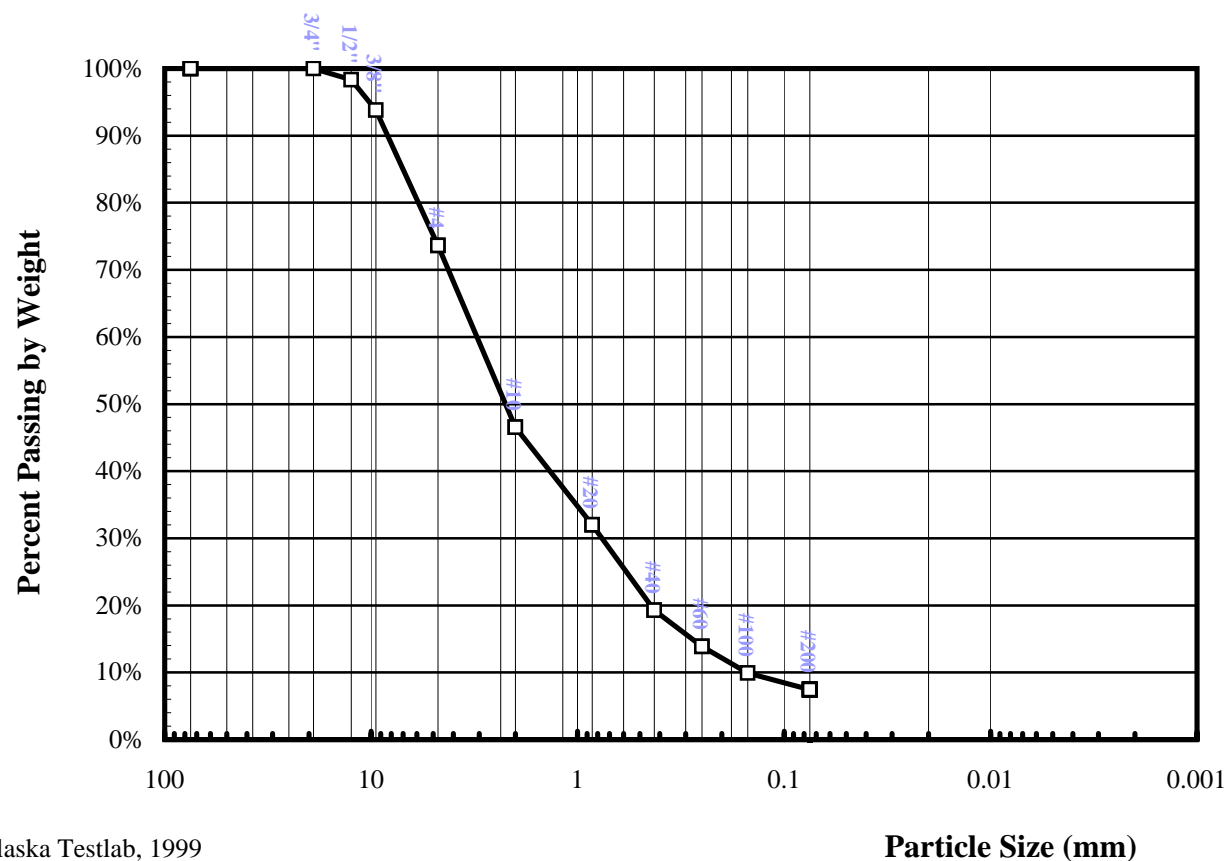
Client: NANA Development Corporation

Project: Nullagvik Pre-Planning

Location: Test Boring 5

Sample 4

Depth 10' - 11.5'

Engineering Classification: Well Graded SAND with Silt and Gravel, SW-SMFrost Classification: Not Measured

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PARTICLE-SIZE**DIST. ASTM D422**

W.O. D58405A

Lab No. 2007-1667

Received: 9/26/07

Reported: 10/30/07

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	98%	
3/8"	94%	
No. 4	74%	
Total Wt. = 596.2g		
No. 8		
No. 10	47%	
No. 16		
No. 20	32%	
No. 30		
No. 40	19%	
No. 50		
No. 60	14%	
No. 80		
No. 100	10%	
No. 200	7.4%	
Total Wt. of Fine Fraction = 438.9g		
0.02 mm		



Client: NANA Development Corporation

Project: Nullagvik Pre-Planning

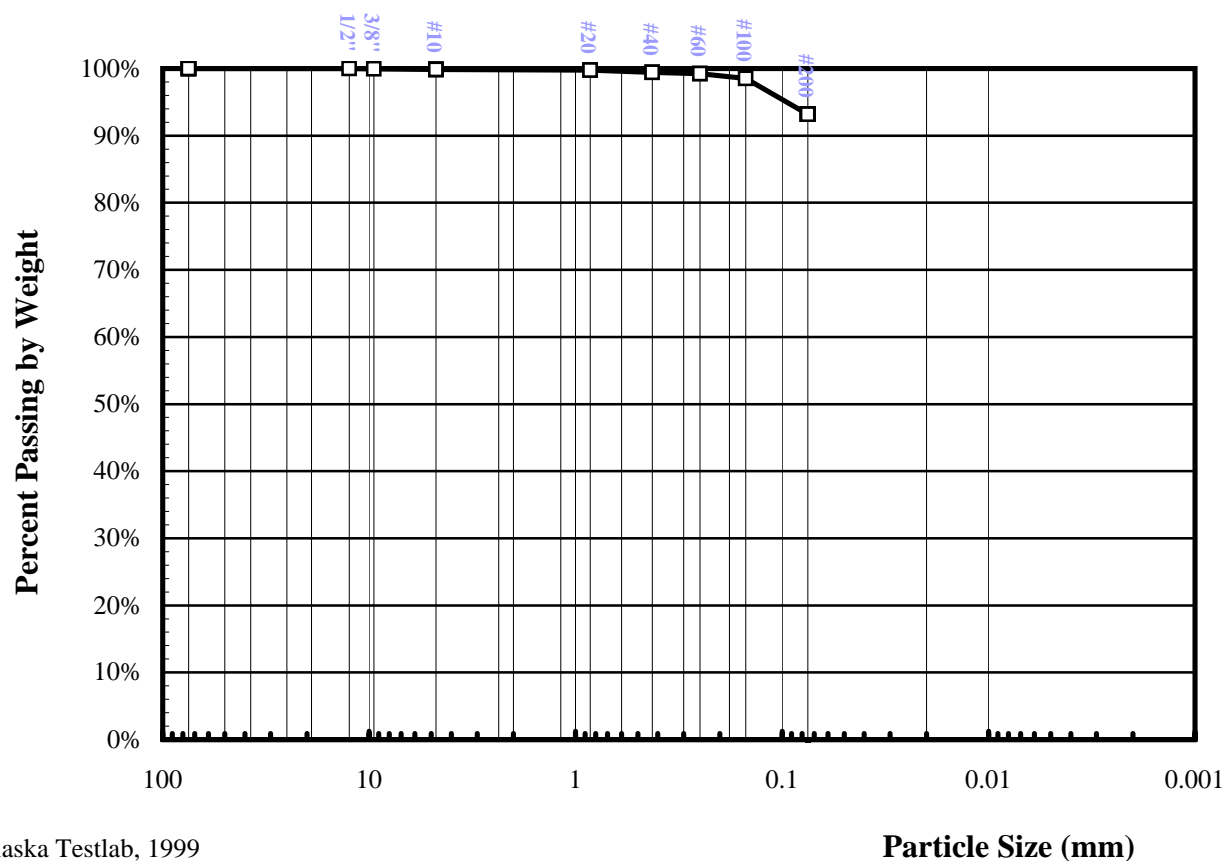
Location: Test Boring 5

Sample 9

Depth 35' - 37'

Engineering Classification: SILT, ML

Frost Classification: F4



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PARTICLE-SIZE

DIST. ASTM D422

W.O. D58405A

Lab No. 2007-1672

Received: 9/26/07

Reported: 10/30/07

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"	100%	
3/8"	100%	
No. 4		
Total Wt. = 338g		
No. 8		
No. 10	100%	
No. 16		
No. 20	100%	
No. 30		
No. 40	99%	
No. 50		
No. 60	99%	
No. 80		
No. 100	99%	
No. 200	93%	
Total Wt. of Fine Fraction = 97.1g		
0.02 mm		

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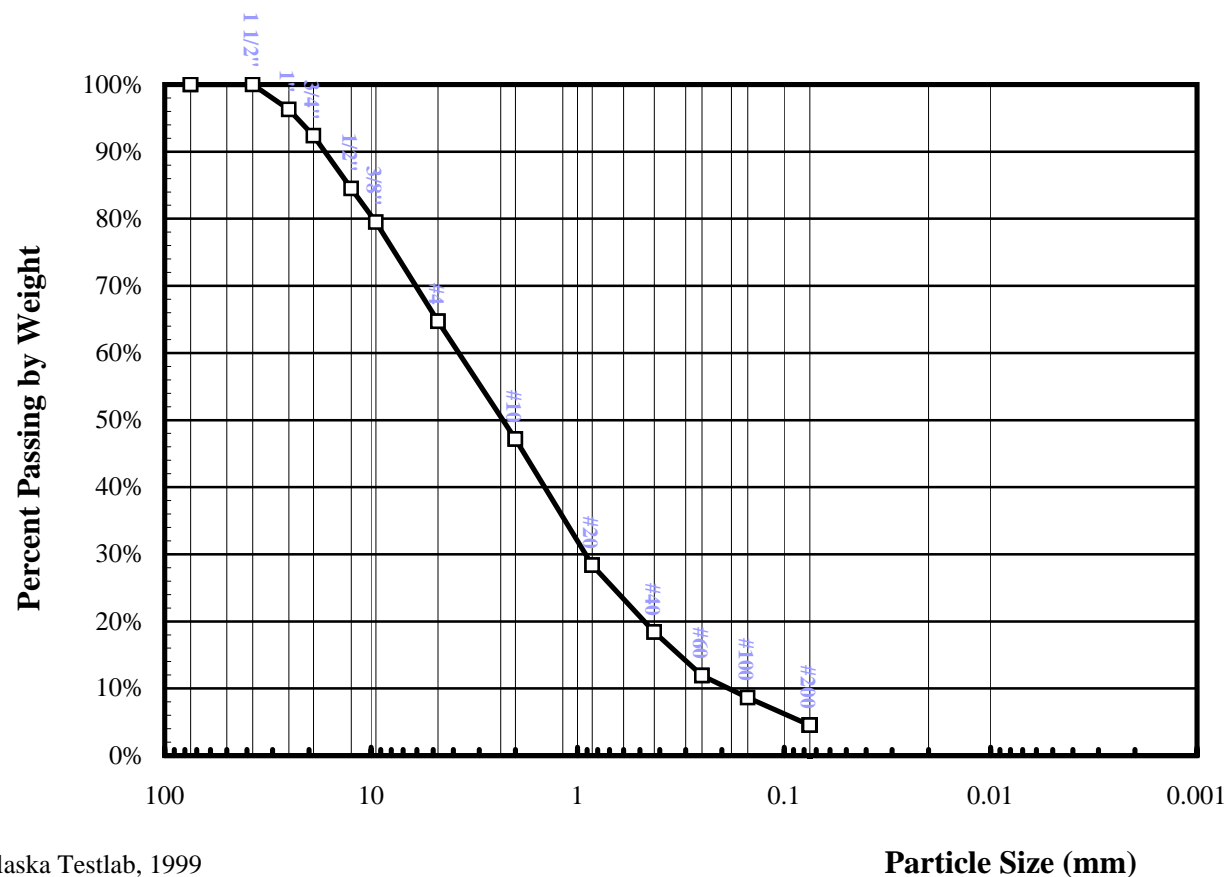
Client: NANA Development Corporation

Project: Nullagvik Pre-Planning

Location: Test Boring 6

Sample 1

Depth 0' - 1'

Engineering Classification: Well Graded SAND with Gravel, SWFrost Classification: Not Measured

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PARTICLE-SIZE**DIST. ASTM D422**

W.O. D58405A

Lab No. 2007-1668

Received: 9/26/07

Reported: 10/30/07

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~%		
3"		
2"		
1 1/2"	100%	
1"	96%	
3/4"	92%	
1/2"	85%	
3/8"	79%	
No. 4	65%	
Total Wt. = 6490.7g		
No. 8		
No. 10	47%	
No. 16		
No. 20	28%	
No. 30		
No. 40	18%	
No. 50		
No. 60	12%	
No. 80		
No. 100	9%	
No. 200	4.5%	
Total Wt. of Fine Fraction = 372.5g		
0.02 mm		



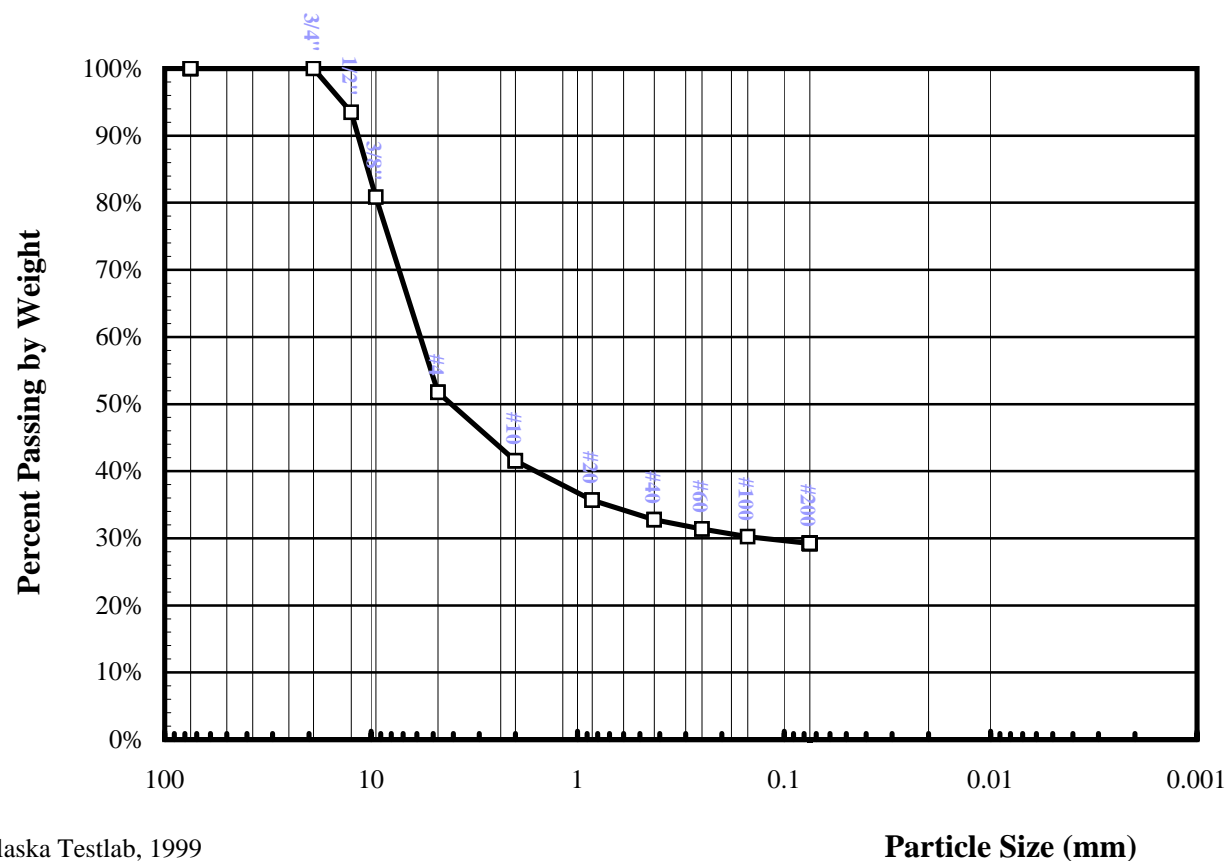
Client: NANA Development Corporation

Project: Nullagvik Pre-Planning

Location: Test Boring 7

Sample 3

Depth 5' - 6.5'

Engineering Classification: Silty GRAVEL with Sand, GMFrost Classification: Not Measured

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PARTICLE-SIZE**DIST. ASTM D422**

W.O. D58405A

Lab No. 2007-1669

Received: 9/26/07

Reported: 10/30/07

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	93%	
3/8"	81%	
No. 4	52%	
Total Wt. = 441.3g		
No. 8		
No. 10	42%	
No. 16		
No. 20	36%	
No. 30		
No. 40	33%	
No. 50		
No. 60	31%	
No. 80		
No. 100	30%	
No. 200	29%	
Total Wt. of Fine Fraction = 441.2g		
0.02 mm		



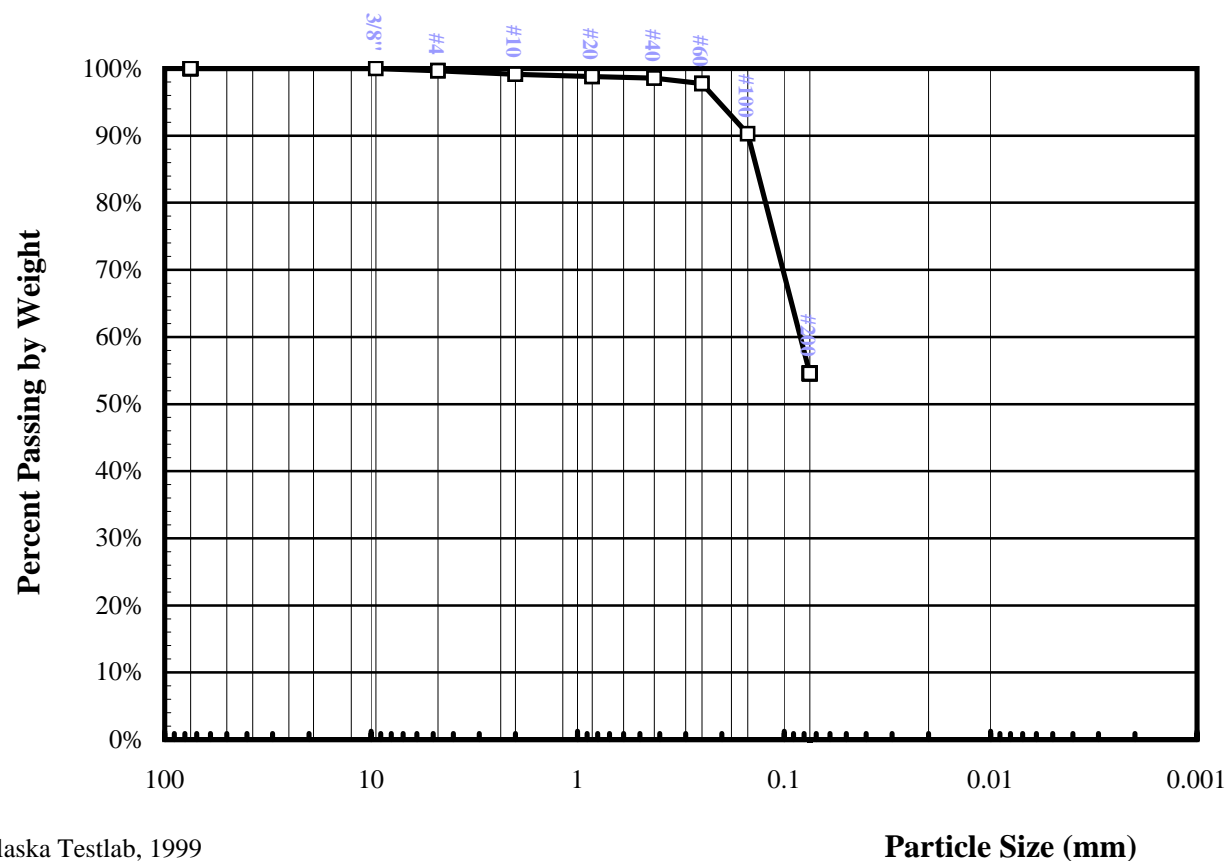
Client: NANA Development Corporation

Project: Nullagvik Pre-Planning

Location: Test Boring 10

Sample 6

Depth 20' - 21.5'

Engineering Classification: Sandy SILT, MLFrost Classification: F4

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PARTICLE-SIZE**DIST. ASTM D422**

W.O. D58405A

Lab No. 2007-1670

Received: 9/26/07

Reported: 10/30/07

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"	100%	
No. 4	100%	
Total Wt. = 445.8g		
No. 8		
No. 10	99%	
No. 16		
No. 20	99%	
No. 30		
No. 40	99%	
No. 50		
No. 60	98%	
No. 80		
No. 100	90%	
No. 200	55%	
Total Wt. of Fine Fraction = 444g		
0.02 mm		

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Client: NANA Development Corporation

Project: Nullagvik Pre-Planning

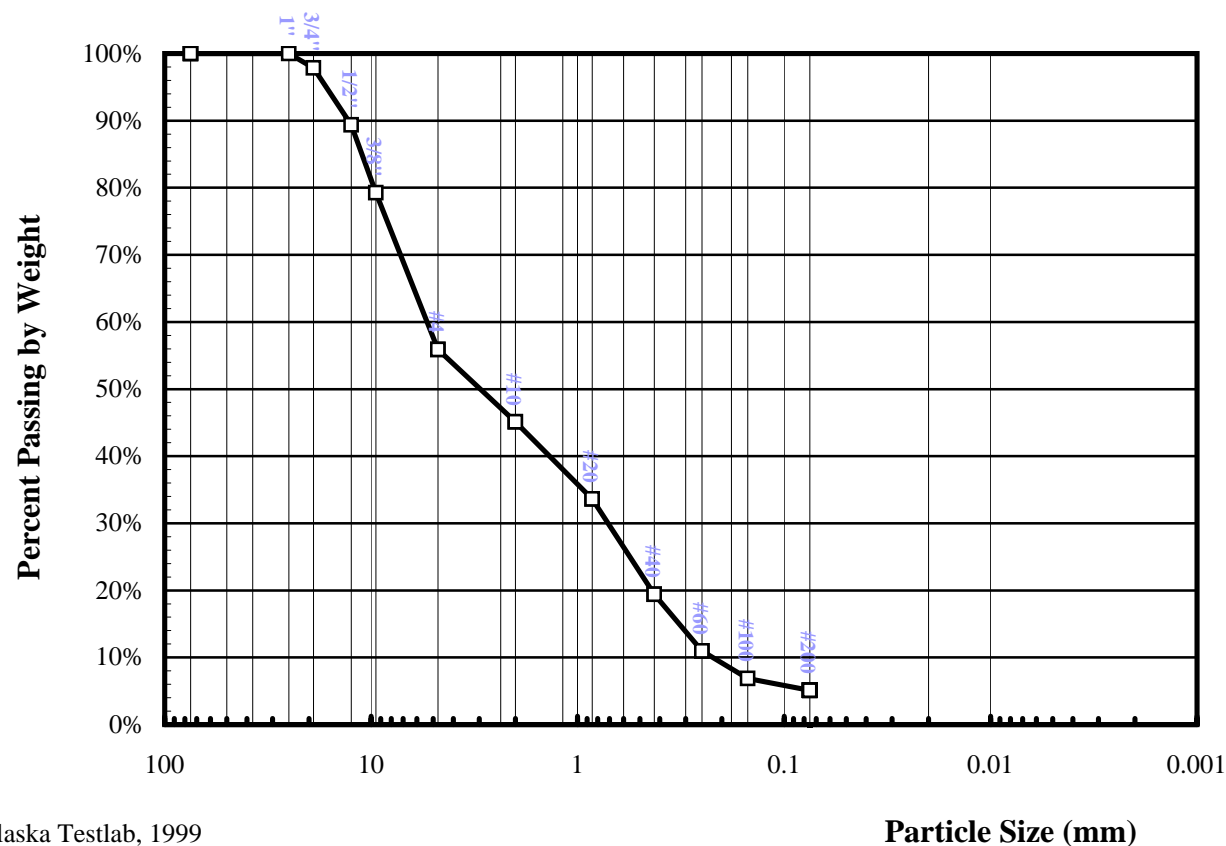
Location: Test Boring 12

Sample 3

Depth 5' - 6.5'

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

Frost Classification: Not Measured



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PARTICLE-SIZE

DIST. ASTM D422

W.O. D58405A

Lab No. 2007-1603

Received: 9/14/07

Reported: 10/30/07

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~%		
3"		
2"		
1 1/2"		
1"	100%	
3/4"	98%	
1/2"	89%	
3/8"	79%	
No. 4	56%	
Total Wt. = 614.9g		
No. 8		
No. 10	45%	
No. 16		
No. 20	34%	
No. 30		
No. 40	19%	
No. 50		
No. 60	11%	
No. 80		
No. 100	7%	
No. 200	5.1%	
Total Wt. of Fine Fraction = 343.6g		
0.02 mm		



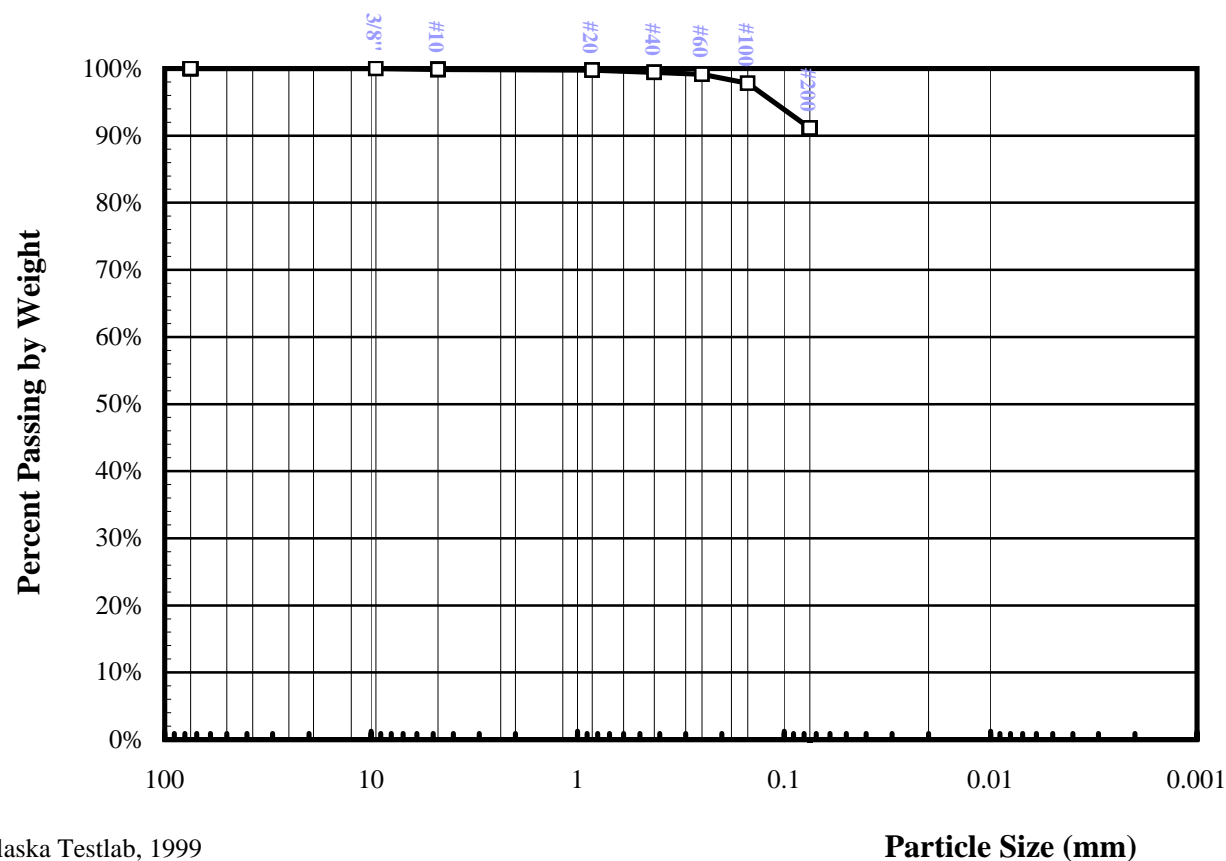
Client: NANA Development Corporation

Project: Nullagvik Pre-Planning

Location: Test Boring 14

Sample 7

Depth 30' - 32'

Engineering Classification: SILT, MLFrost Classification: F4

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PARTICLE-SIZE**DIST. ASTM D422**

W.O. D58405A

Lab No. 2007-1673

Received: 9/26/07

Reported: 10/30/07

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"	100%	
No. 4		
Total Wt. = 507.8g		
No. 8		
No. 10	100%	
No. 16		
No. 20	100%	
No. 30		
No. 40	99%	
No. 50		
No. 60	99%	
No. 80		
No. 100	98%	
No. 200	91%	
Total Wt. of Fine Fraction = 98.5g		
0.02 mm		



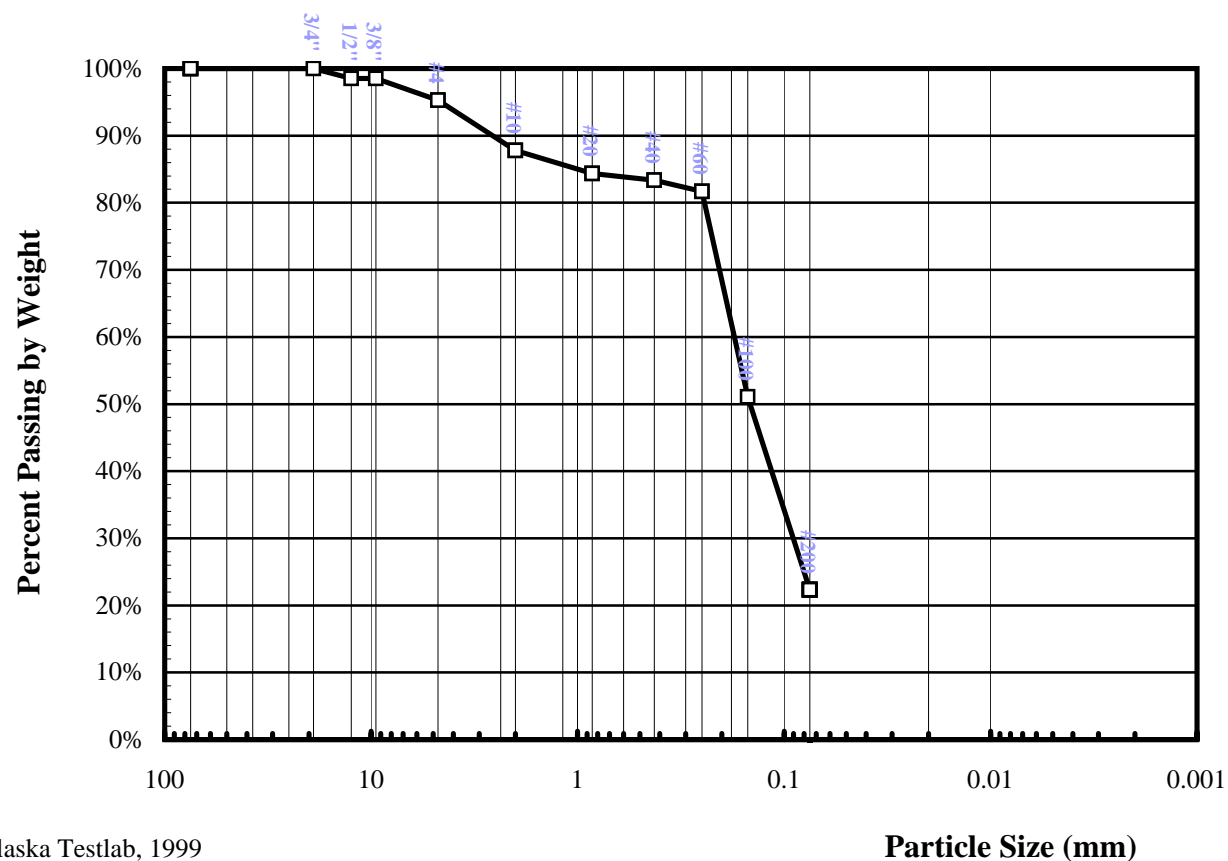
Client: NANA Development Corporation

Project: Nullagvik Pre-Planning

Location: Test Boring 15

Sample 5

Depth 15' - 16.5'

Engineering Classification: Silty SAND, SMFrost Classification: Not Measured

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PARTICLE-SIZE**DIST. ASTM D422**

W.O. D58405A

Lab No. 2007-1671

Received: 9/26/07

Reported: 10/30/07

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	99%	
3/8"	99%	
No. 4	95%	
Total Wt. = 277.7g		
No. 8		
No. 10	88%	
No. 16		
No. 20	84%	
No. 30		
No. 40	83%	
No. 50		
No. 60	82%	
No. 80		
No. 100	51%	
No. 200	22%	
Total Wt. of Fine Fraction = 277.5g		
0.02 mm		



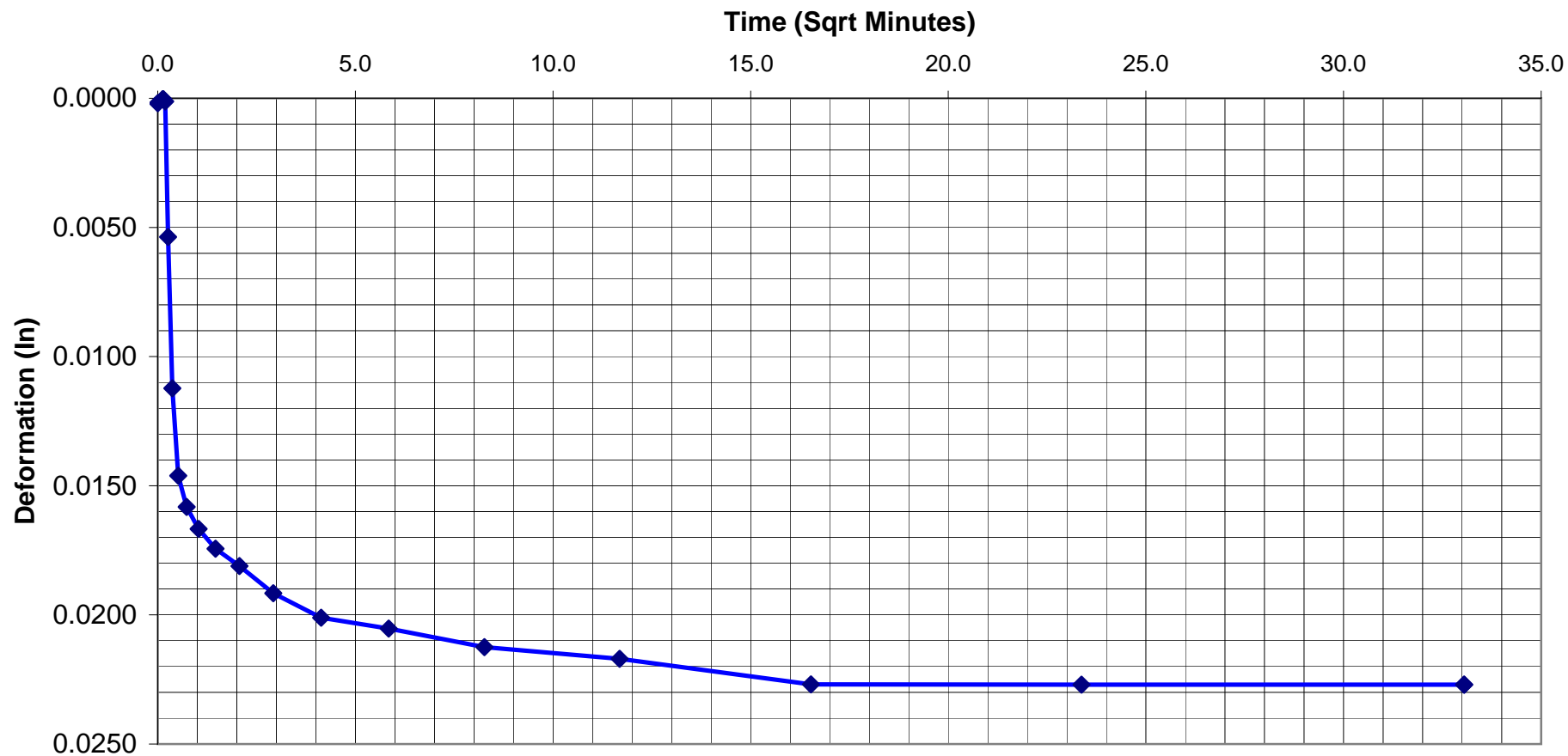
Time Rate of Consolidation

WO # D58405A
Lab # C2007030

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 925 psf
Deformation Correction (in): 0.0008

Boring : 10
Sample # 9
Depth : 35





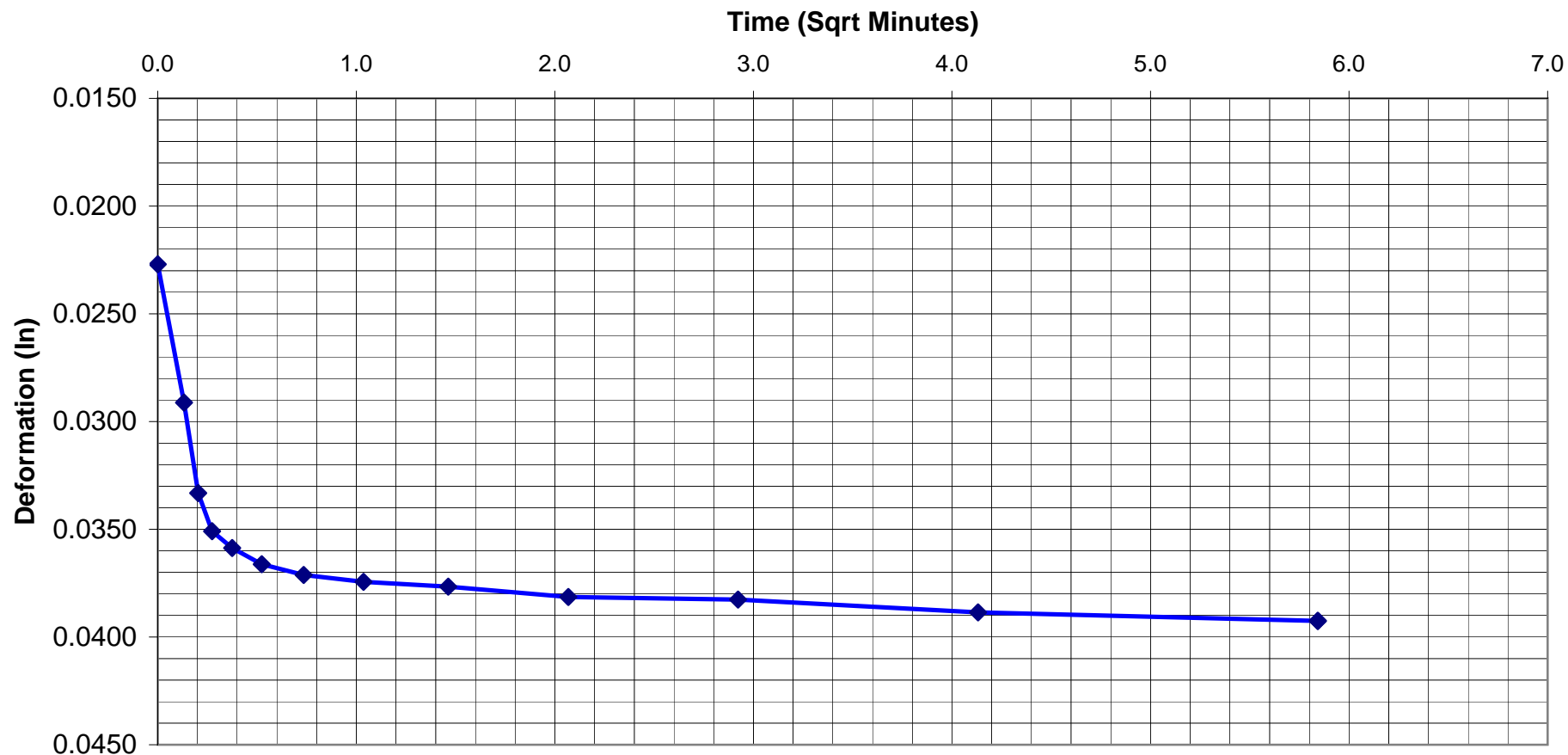
Time Rate of Consolidation

WO #	D58405A
Lab #	C2007030

Client : NANA Development Corporation
 Project : Nullagvik Hotel
 Date: 10/30/2007

Pressure: 2313 psf
 Deformation Correction (in): 0.0013

Boring : 10
 Sample # 9
 Depth : 35





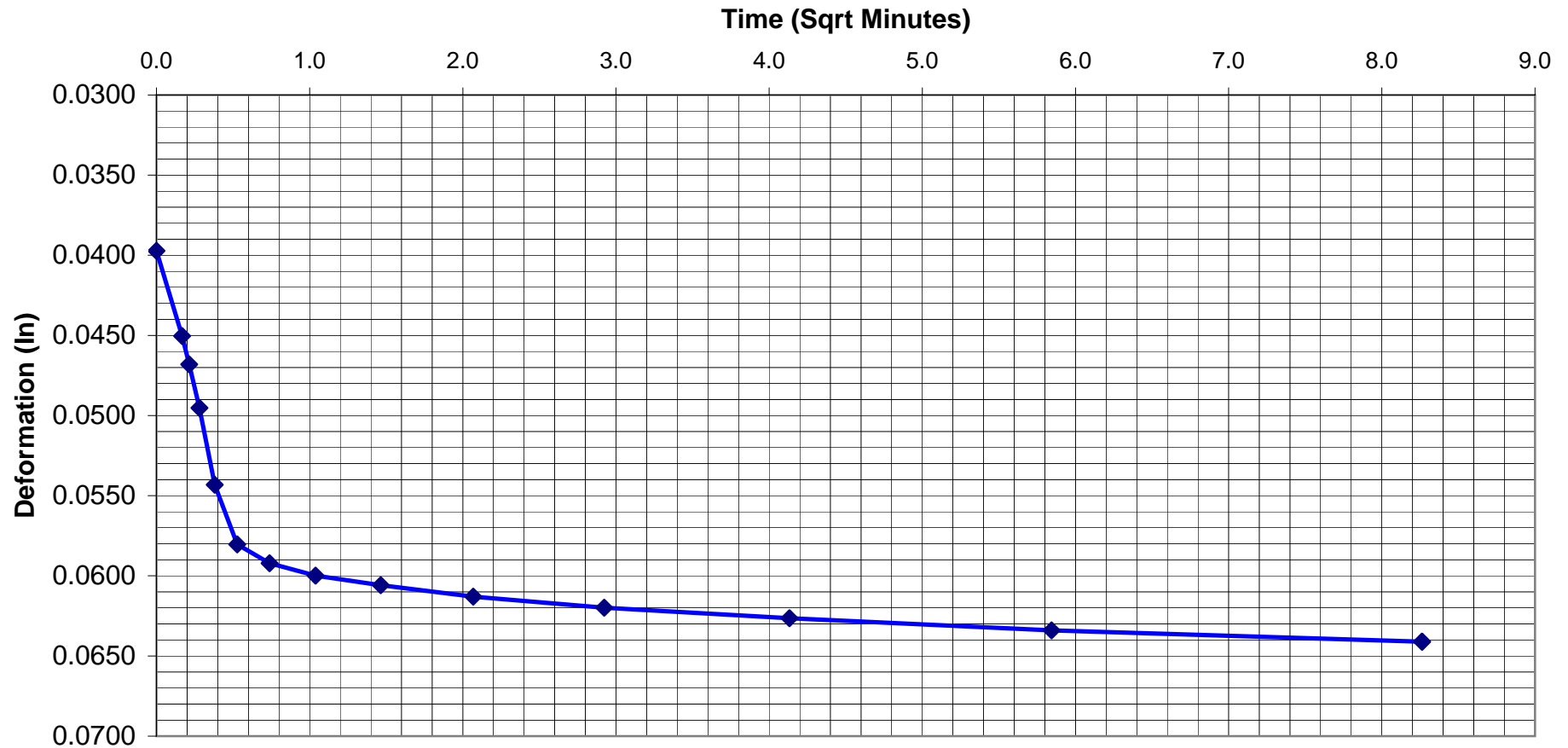
Time Rate of Consolidation

WO # D58405A
Lab # C2007030

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 6738 psf
Deformation Correction (in): 0.0022

Boring : 10
Sample # 9
Depth : 35





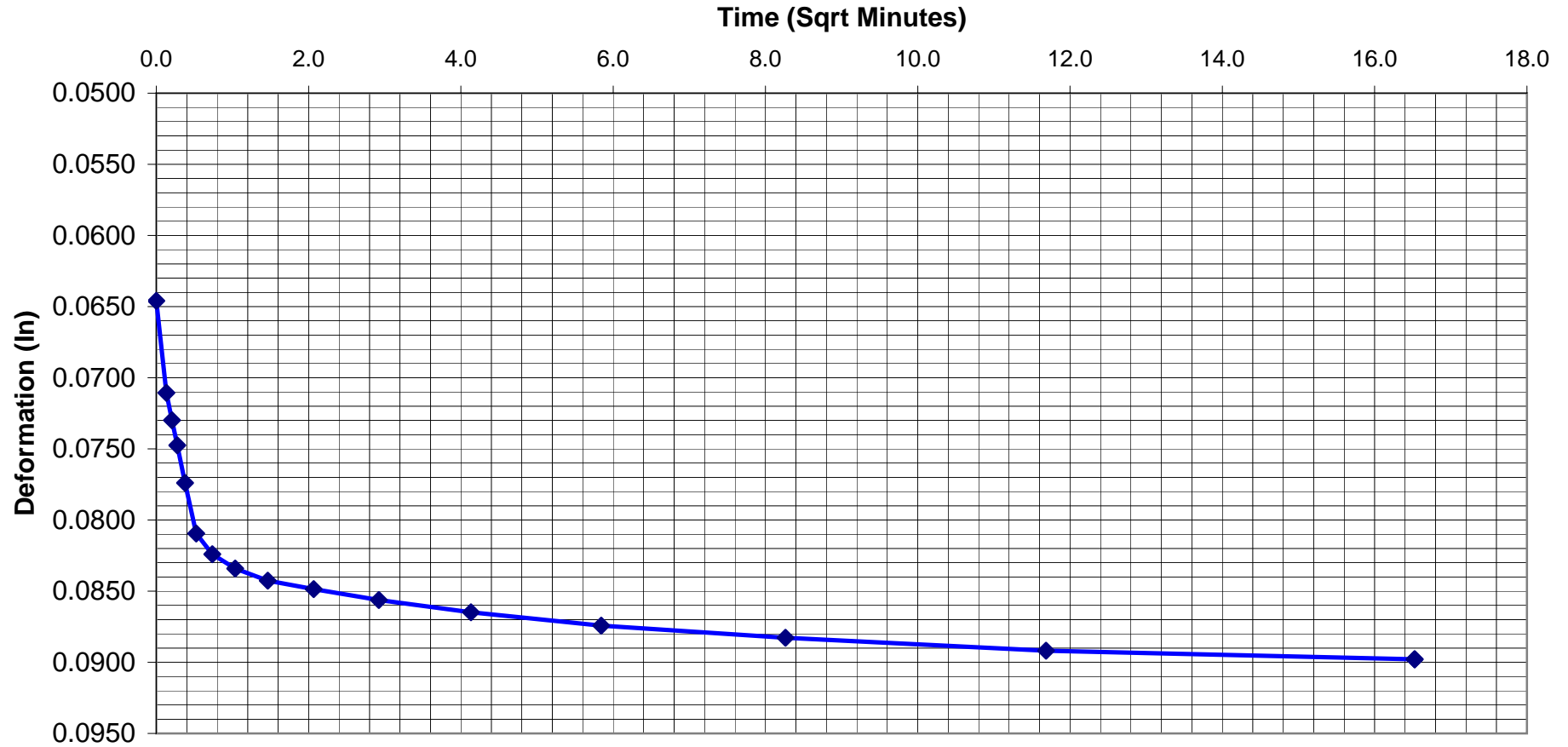
Time Rate of Consolidation

WO #	D58405A
Lab #	C2007030

Client : NANA Development Corporation
 Project : Nullagvik Hotel
 Date: 10/30/2007

Pressure: 14199 psf
 Deformation Correction (in): 0.0027

Boring : 10
 Sample # 9
 Depth : 35





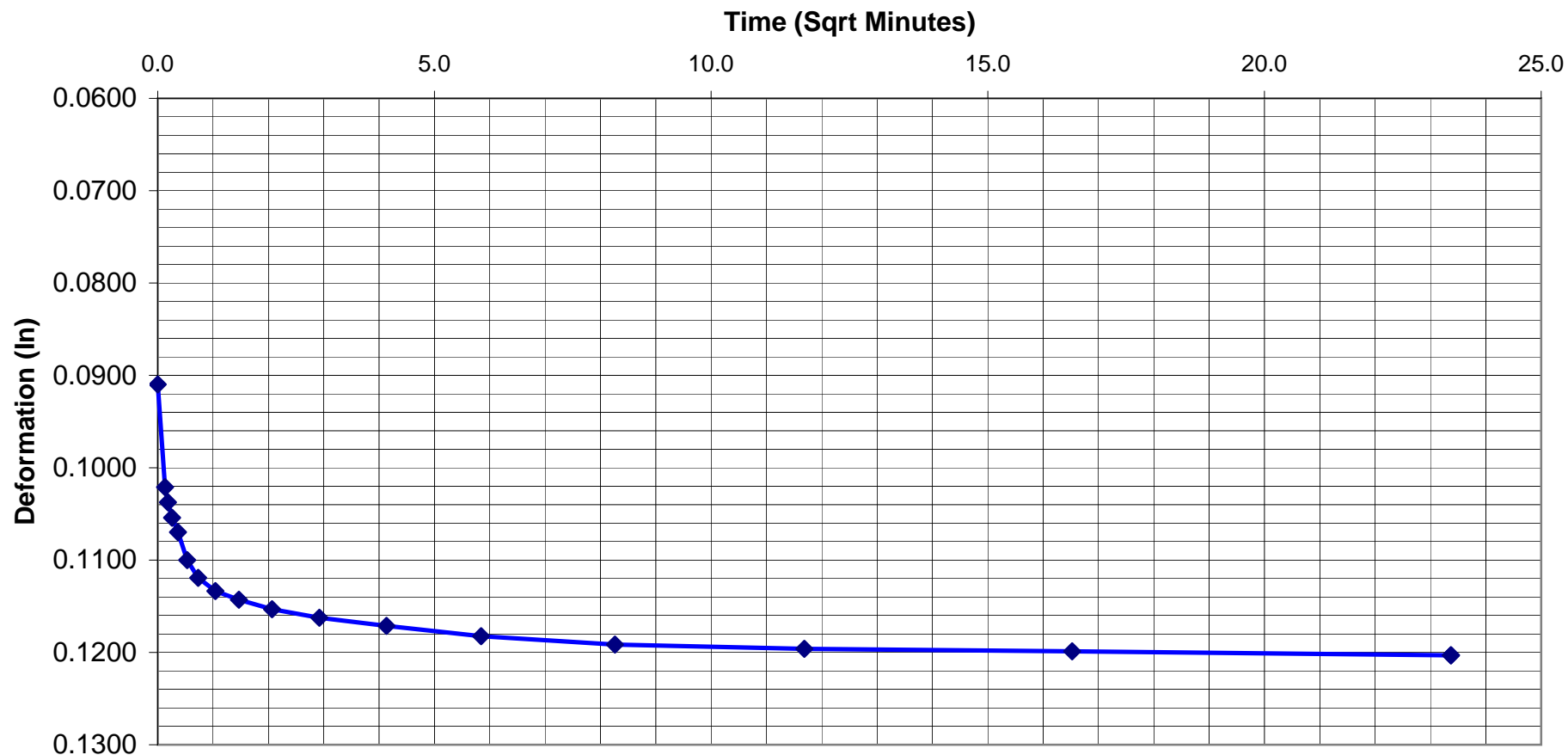
Time Rate of Consolidation

WO #	D58405A
Lab #	C2007030

Client : NANA Development Corporation
 Project : Nullagvik Hotel
 Date: 10/30/2007

Pressure: 29467 psf
 Deformation Correction (in): 0.0037

Boring : 10
 Sample # 9
 Depth : 35





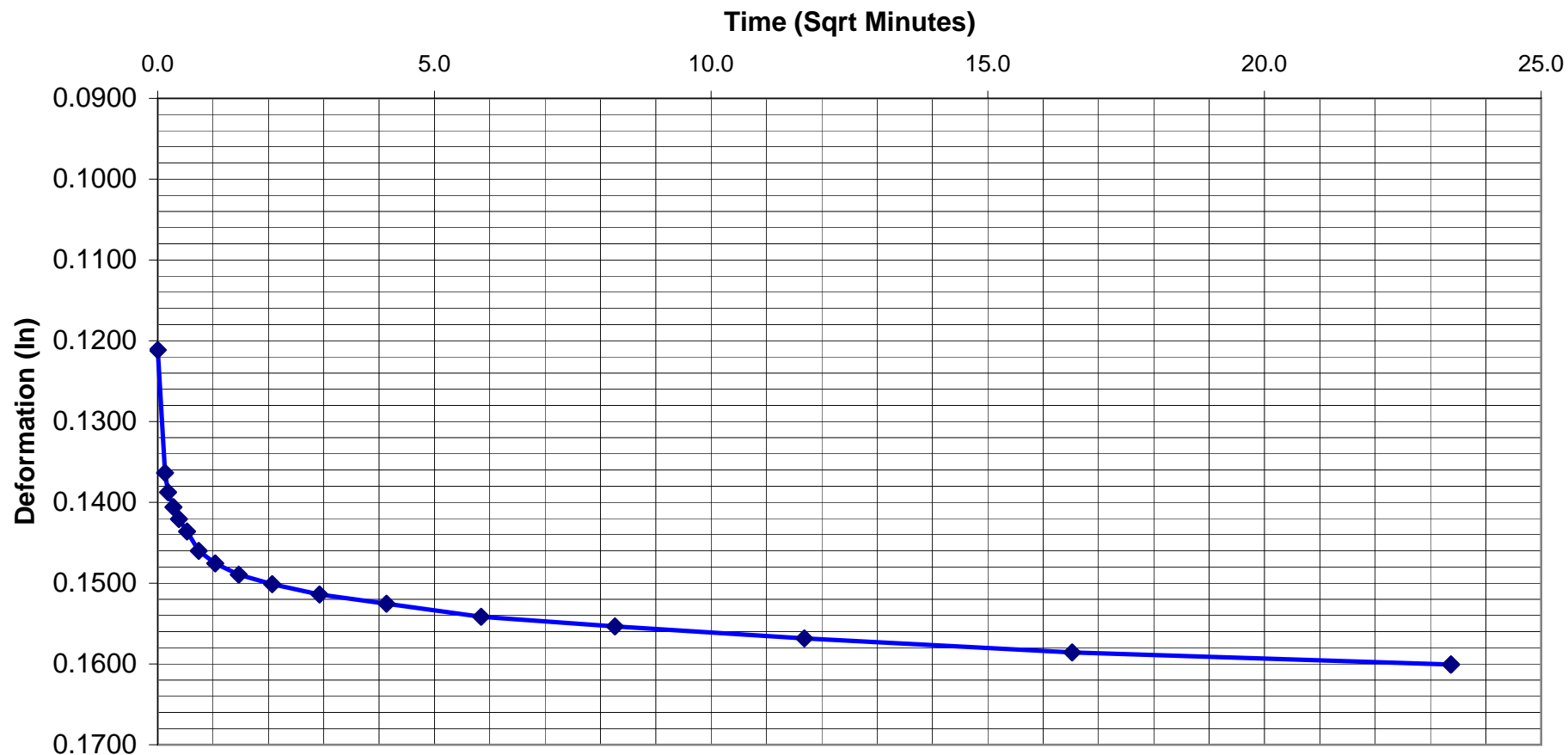
Time Rate of Consolidation

WO #	D58405A
Lab #	C2007030

Client : NANA Development Corporation
 Project : Nullagvik Hotel
 Date: 10/30/2007

Pressure: 60062 psf
 Deformation Correction (in): 0.0048

Boring : 10
 Sample # 9
 Depth : 35





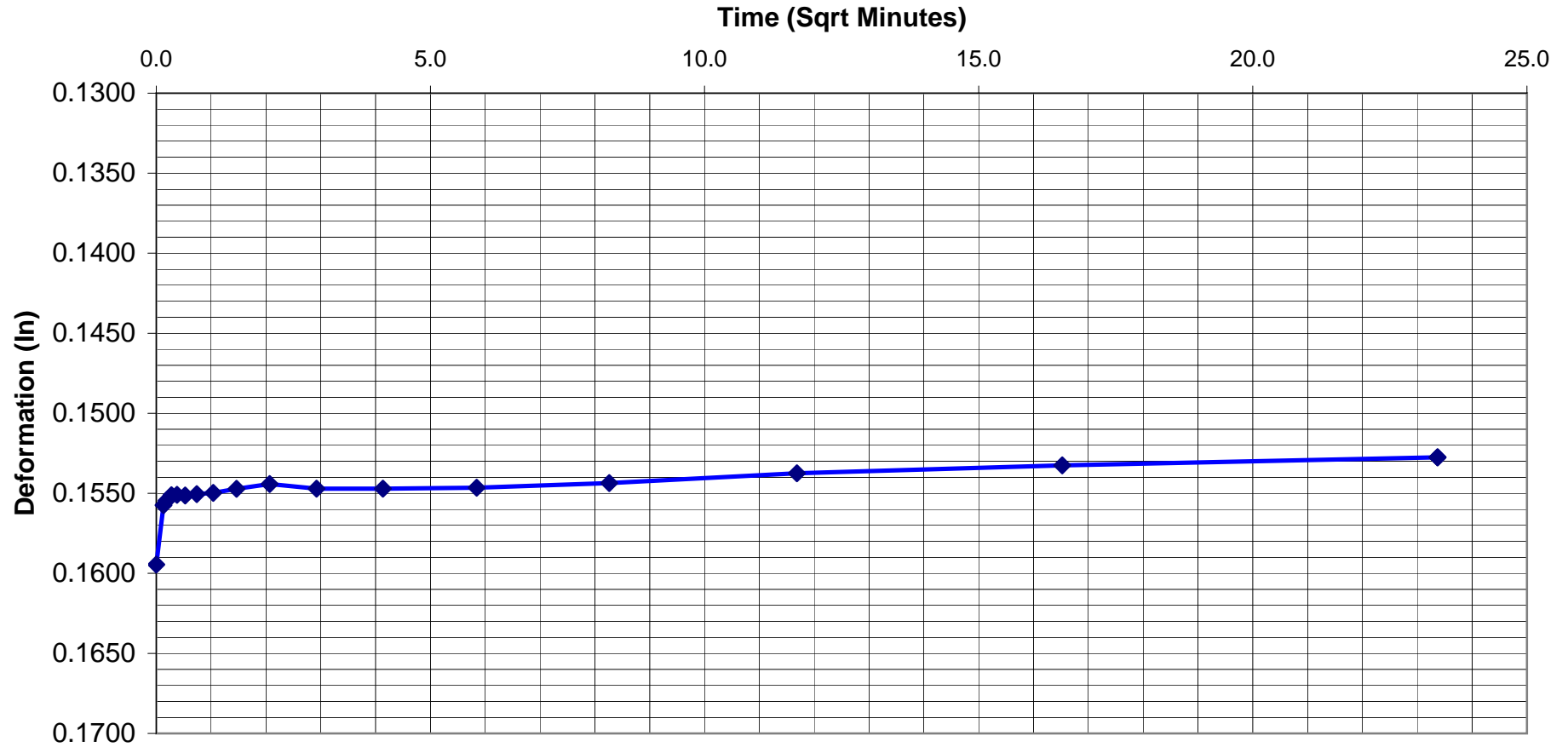
Time Rate of Consolidation

WO #	D58405A
Lab #	C2007030

Client : NANA Development Corporation
 Project : Nullagvik Hotel
 Date: 10/30/2007

Pressure: 14199 psf
 Deformation Correction (in): 0.0035

Boring : 10
 Sample # 9
 Depth : 35





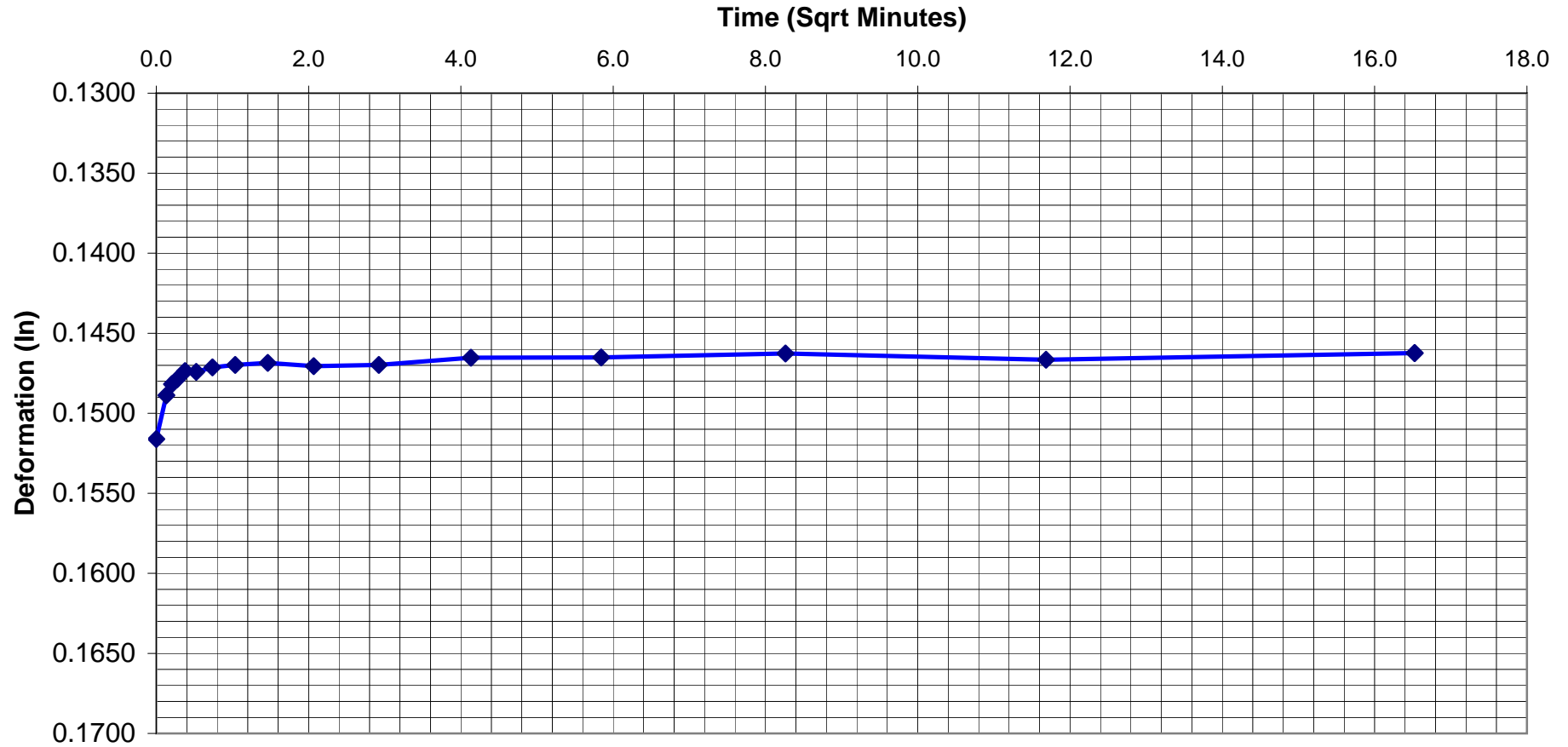
Time Rate of Consolidation

WO # D58405A
Lab # C2007030

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 3817 psf
Deformation Correction (in): 0.0023

Boring : 10
Sample # 9
Depth : 35





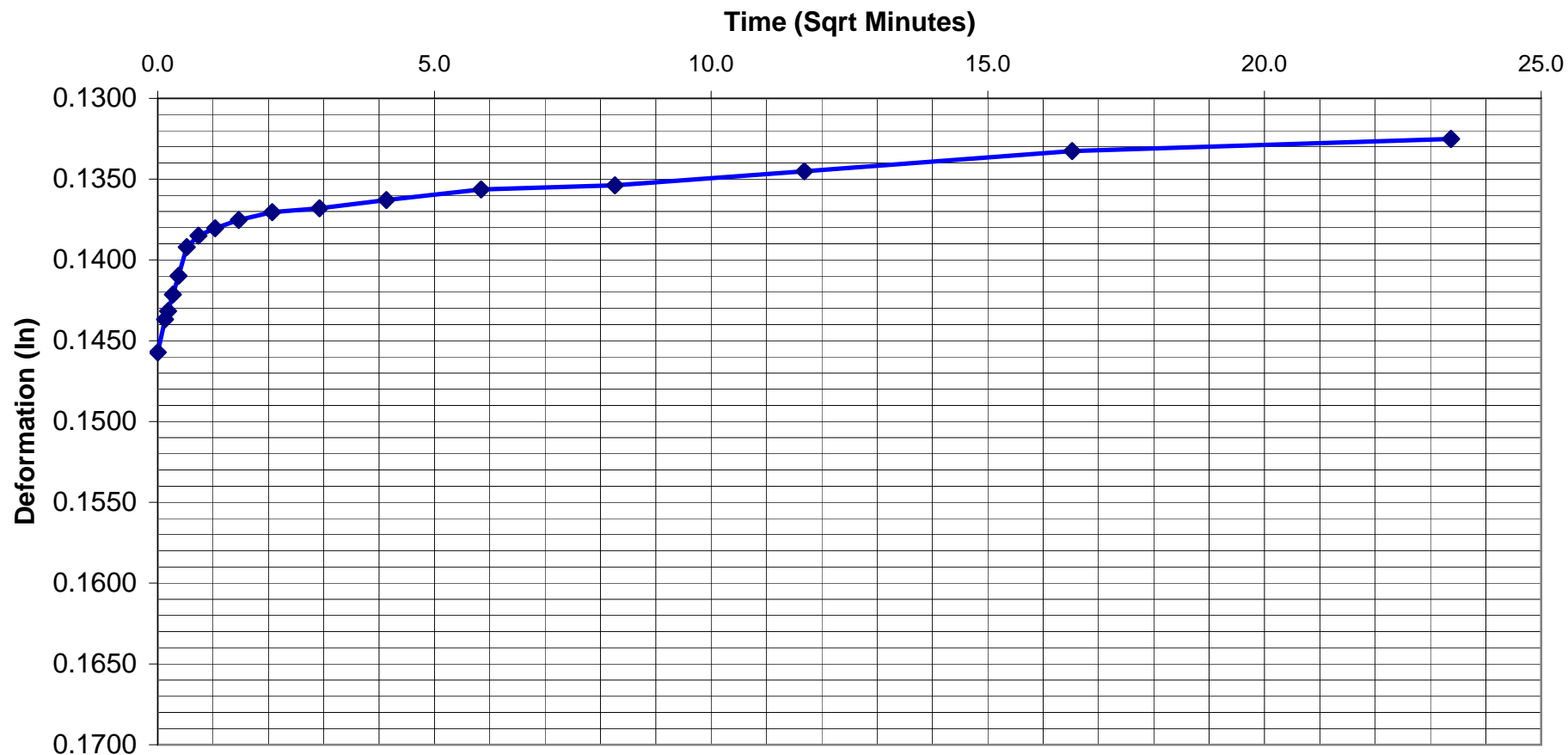
Time Rate of Consolidation

WO # D58405A
Lab # C2007030

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 925 psf
Deformation Correction (in): 0.0015

Boring : 10
Sample # 9
Depth : 35





Compression Curve (e vs. Log P)

WO # D58405A
Lab # C2007030

Client : NANA Development Corporation

Project : Nullagvik Hotel

Date: 10/30/2007

Moisture Content = 31.2 %

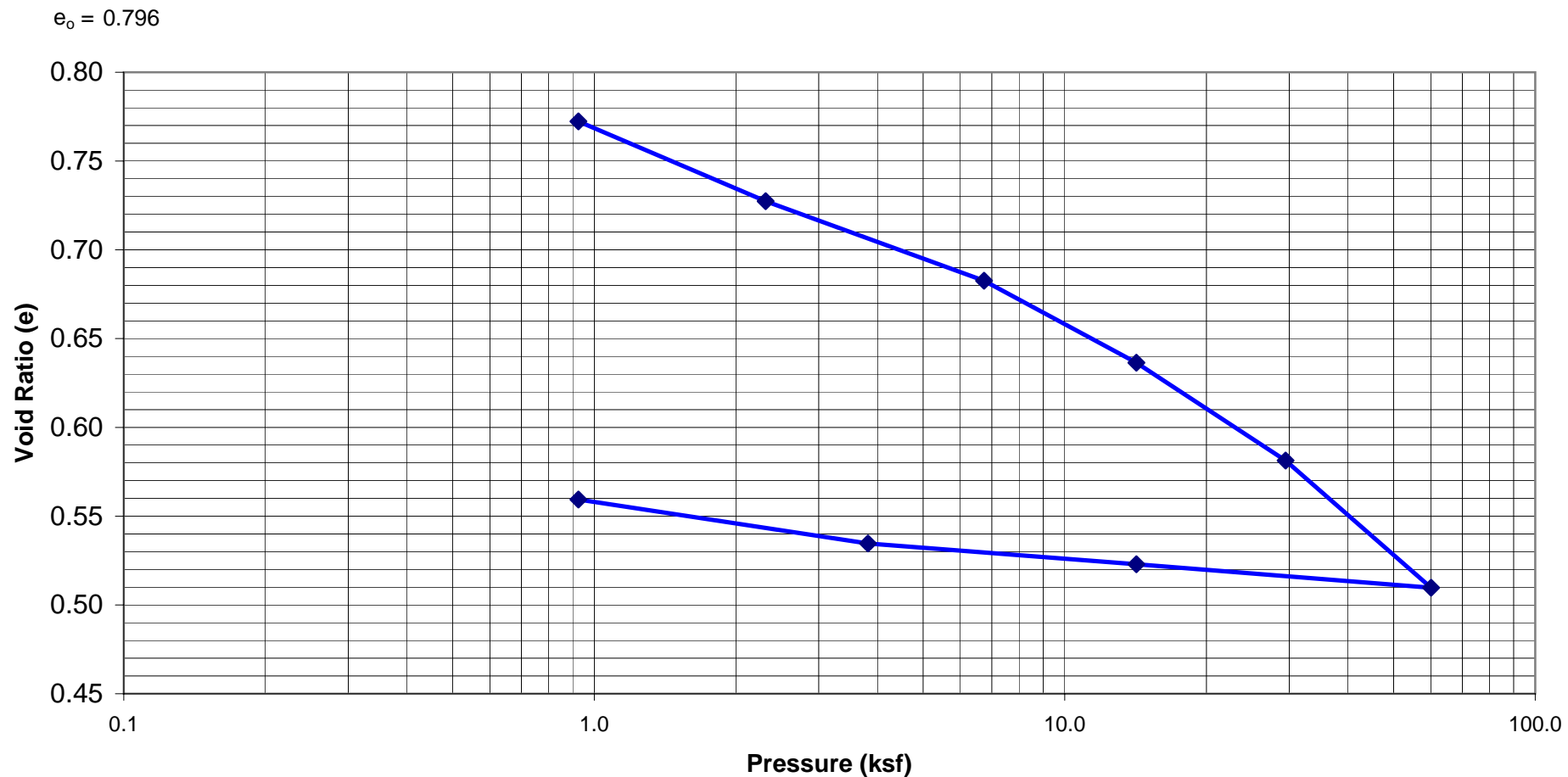
Dry Unit Weight (pcf) = 91.9

Wet Unit Weight (pcf) = 120.7

Boring : 10

Sample # 9

Depth : 35





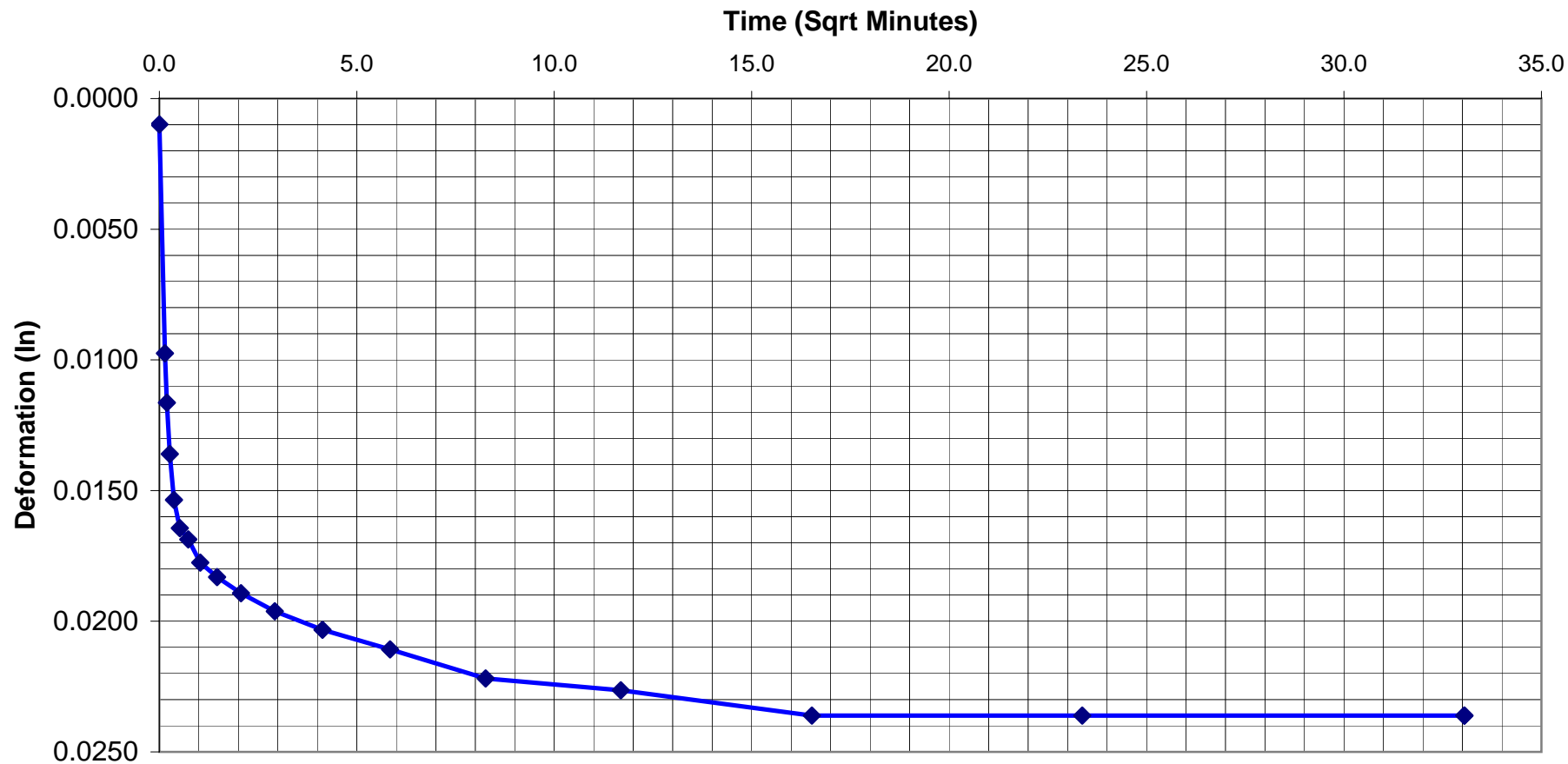
Time Rate of Consolidation

WO # D58405A
Lab # C2007029

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 840 psf
Deformation Correction (in): 0.0009

Boring : 5
Sample # 10
Depth : 40





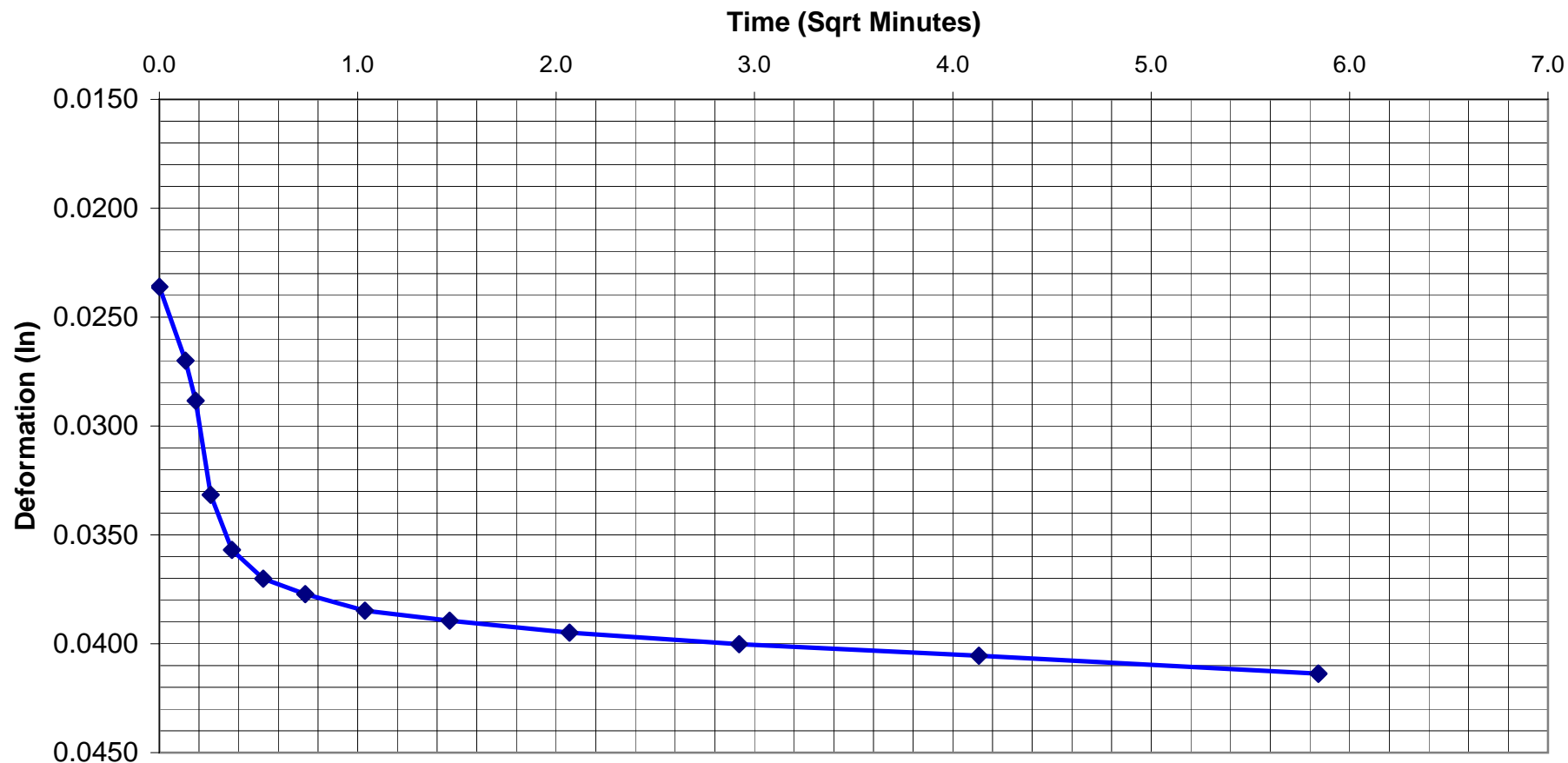
Time Rate of Consolidation

WO # D58405A
Lab # C2007029

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 2259 psf
Deformation Correction (in): 0.0018

Boring : 5
Sample # 10
Depth : 40





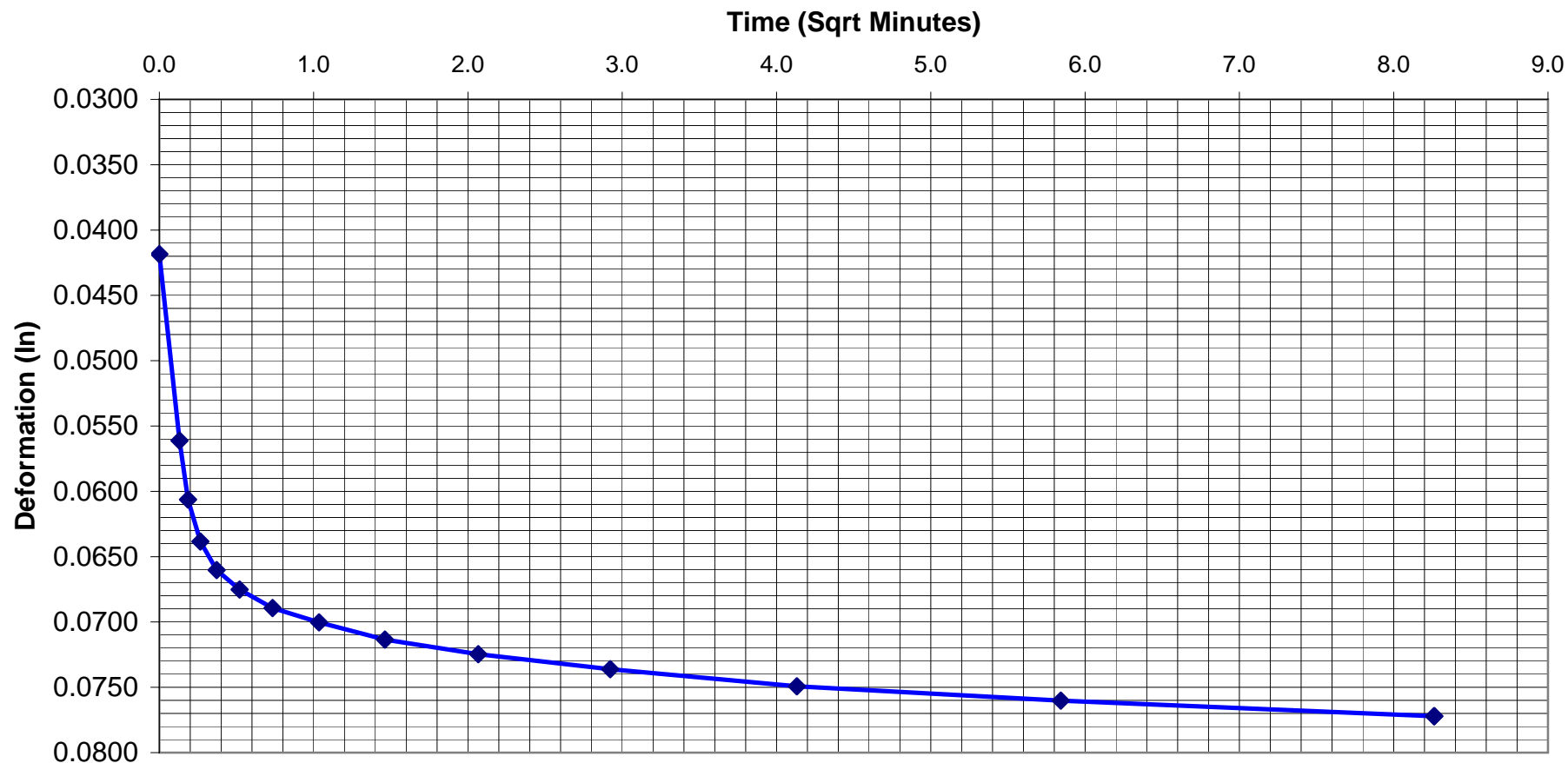
Time Rate of Consolidation

WO #	D58405A
Lab #	C2007029

Client : NANA Development Corporation
 Project : Nullagvik Hotel
 Date: 10/30/2007

Pressure: 6662 psf
 Deformation Correction (in): 0.0034

Boring : 5
 Sample # 10
 Depth : 40





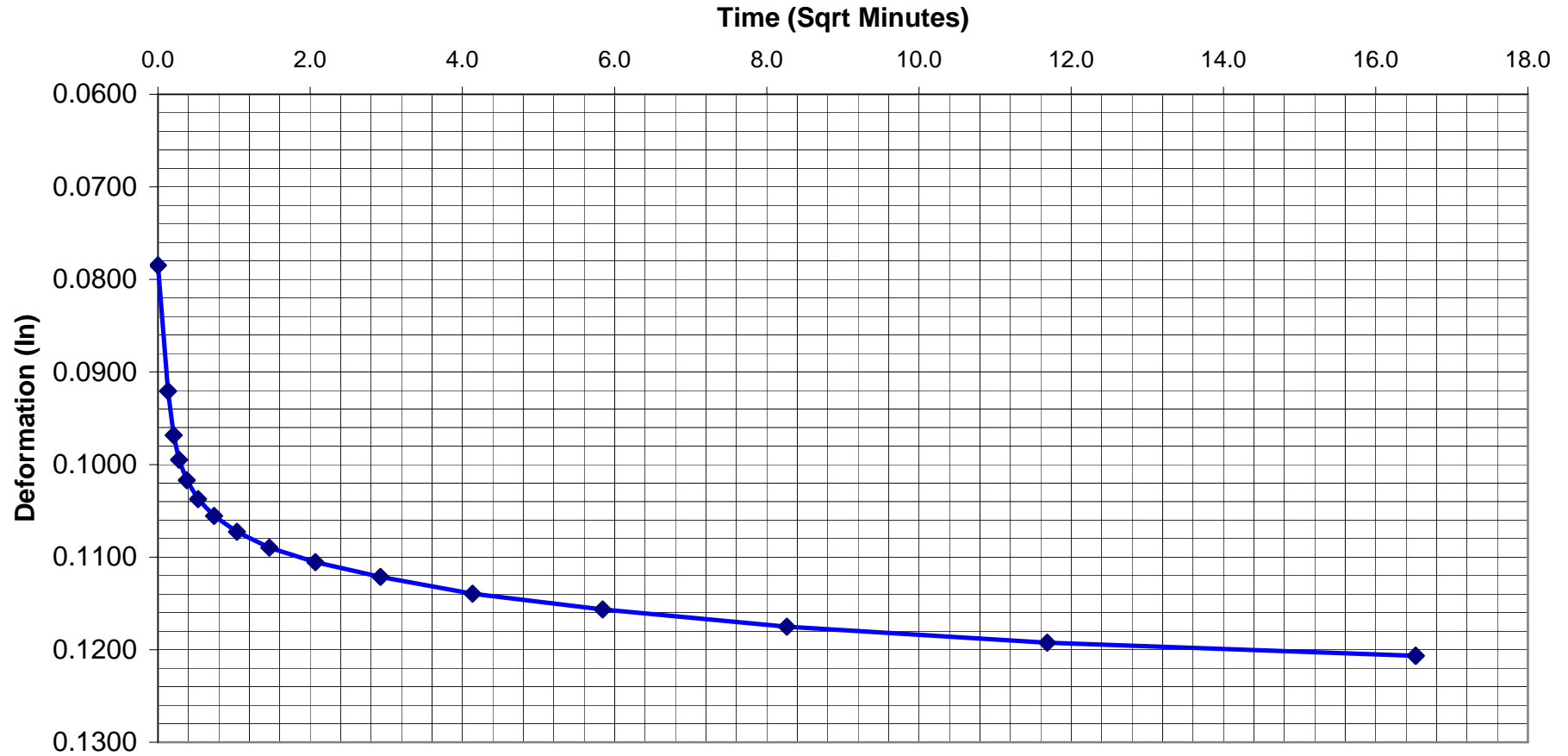
Time Rate of Consolidation

WO # D58405A
Lab # C2007029

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 14076 psf
Deformation Correction (in): 0.0048

Boring : 5
Sample # 10
Depth : 40





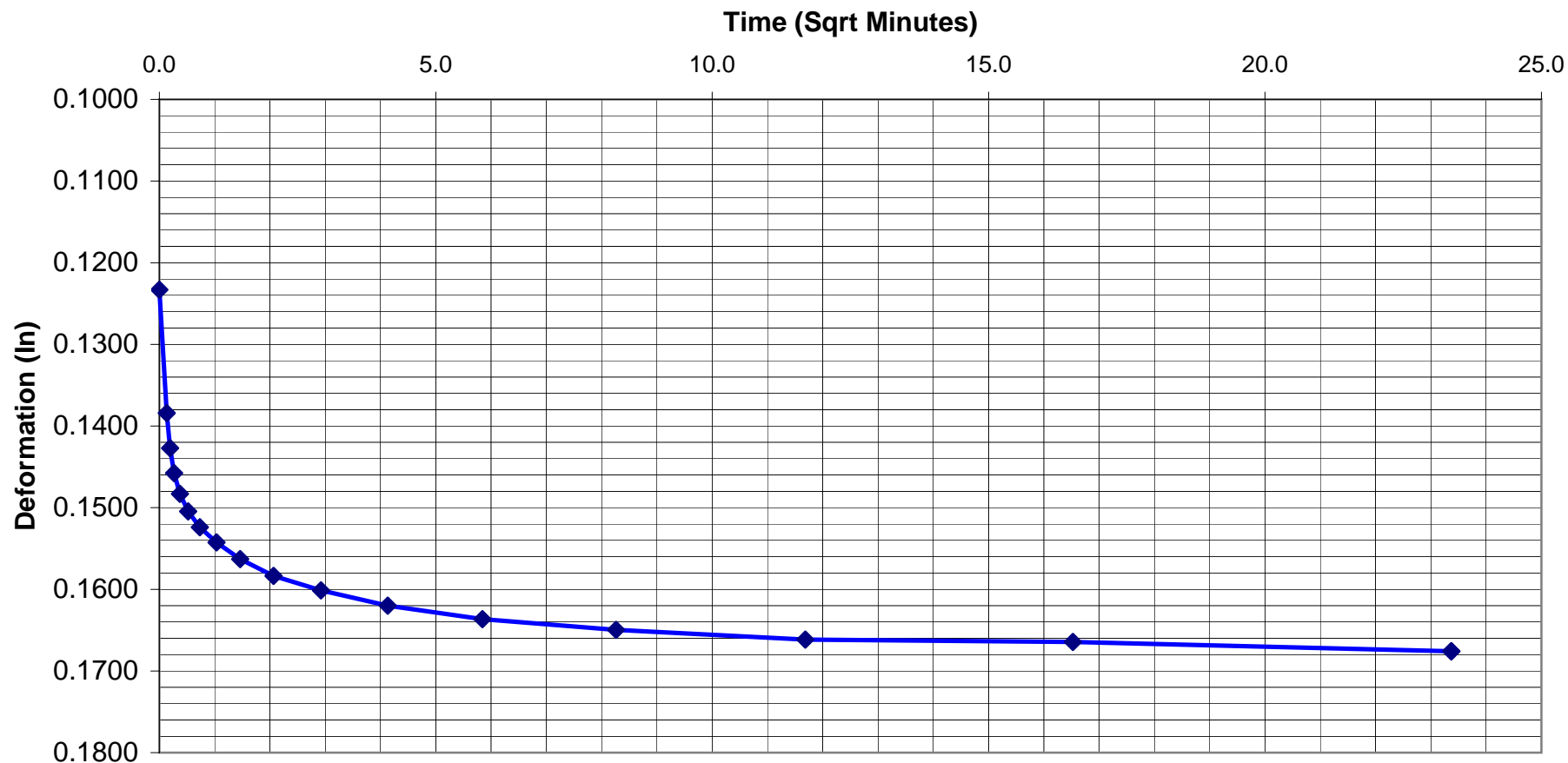
Time Rate of Consolidation

WO # D58405A
Lab # C2007029

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 29195 psf
Deformation Correction (in): 0.0062

Boring : 5
Sample # 10
Depth : 40





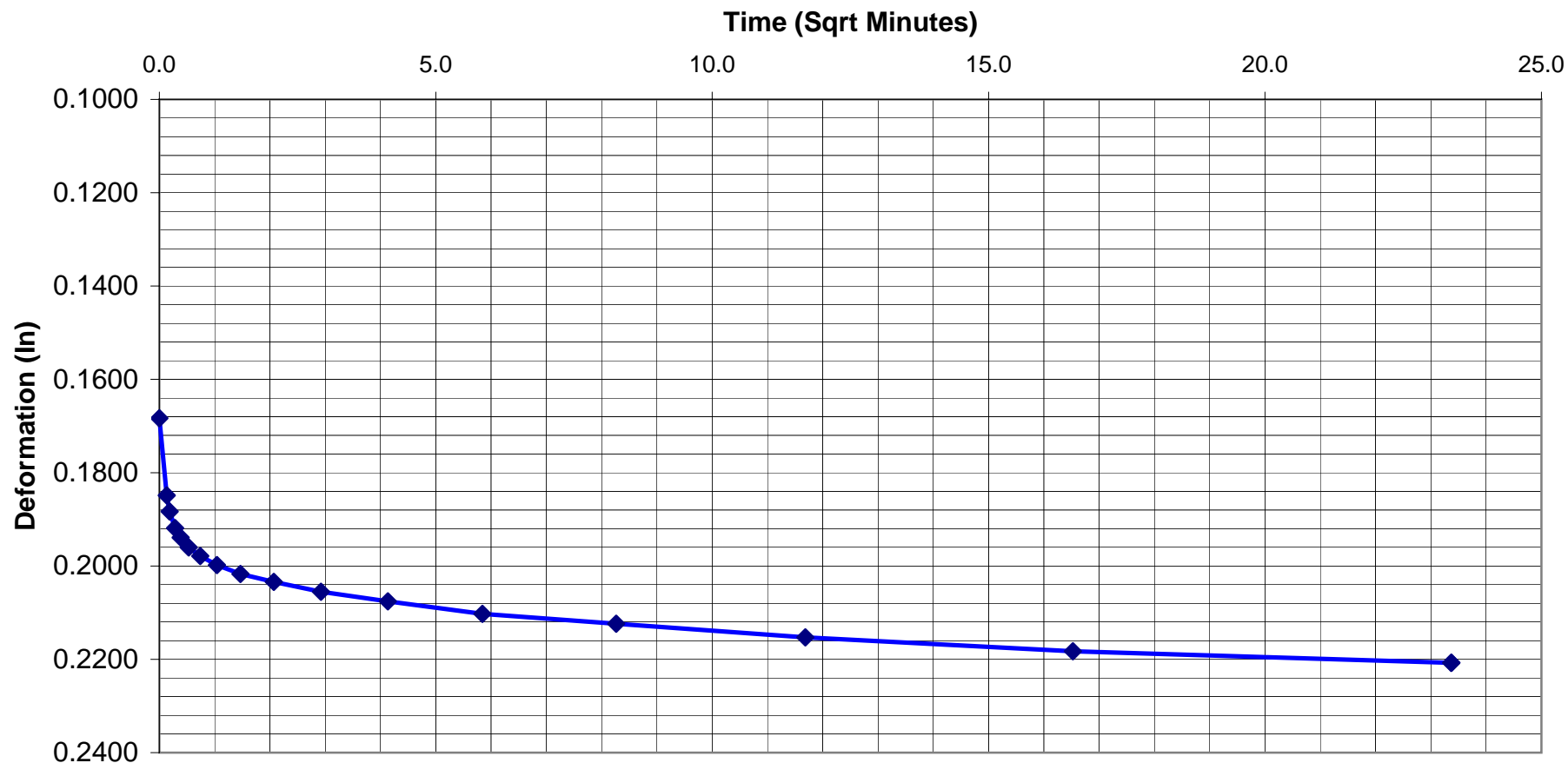
Time Rate of Consolidation

WO # D58405A
Lab # C2007029

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 59810 psf
Deformation Correction (in): 0.0078

Boring : 5
Sample # 10
Depth : 40





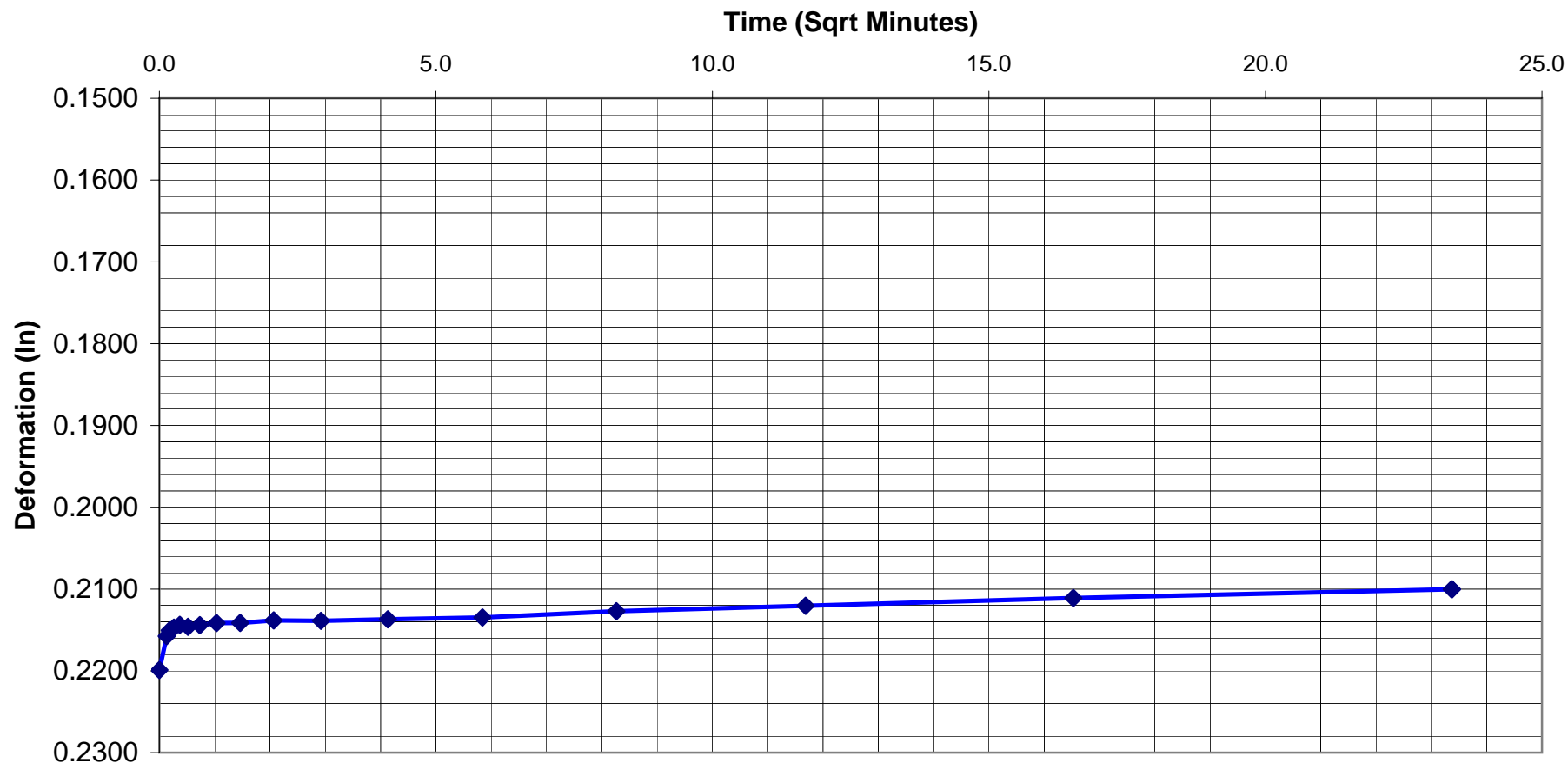
Time Rate of Consolidation

WO # D58405A
Lab # C2007029

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 14076 psf
Deformation Correction (in): 0.0061

Boring : 5
Sample # 10
Depth : 40





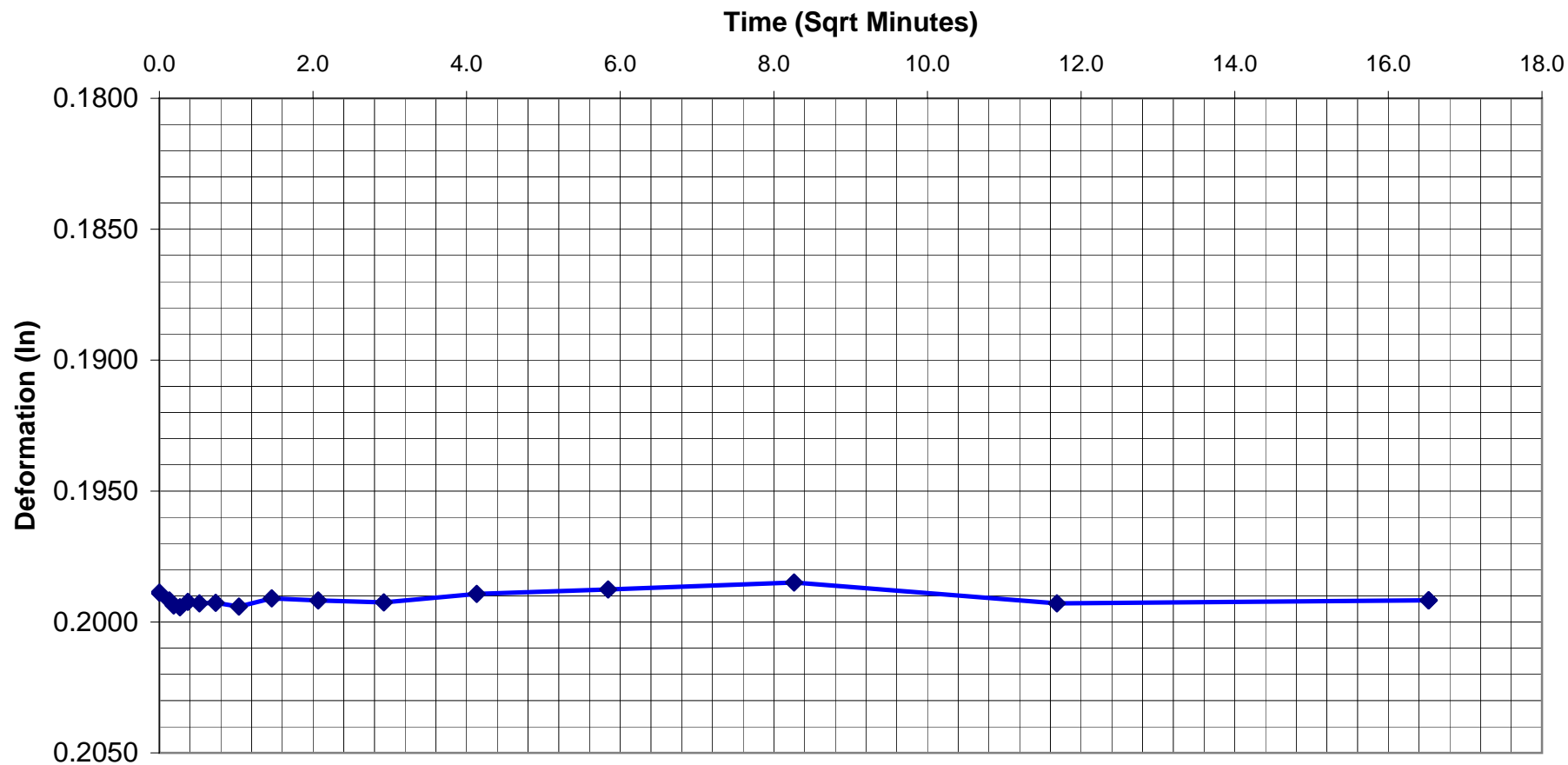
Time Rate of Consolidation

WO #	D58405A
Lab #	C2007029

Client : NANA Development Corporation
 Project : Nullagvik Hotel
 Date: 10/30/2007

Pressure: 3736 psf
 Deformation Correction (in): 0.0036

Boring : 5
 Sample # 10
 Depth : 40





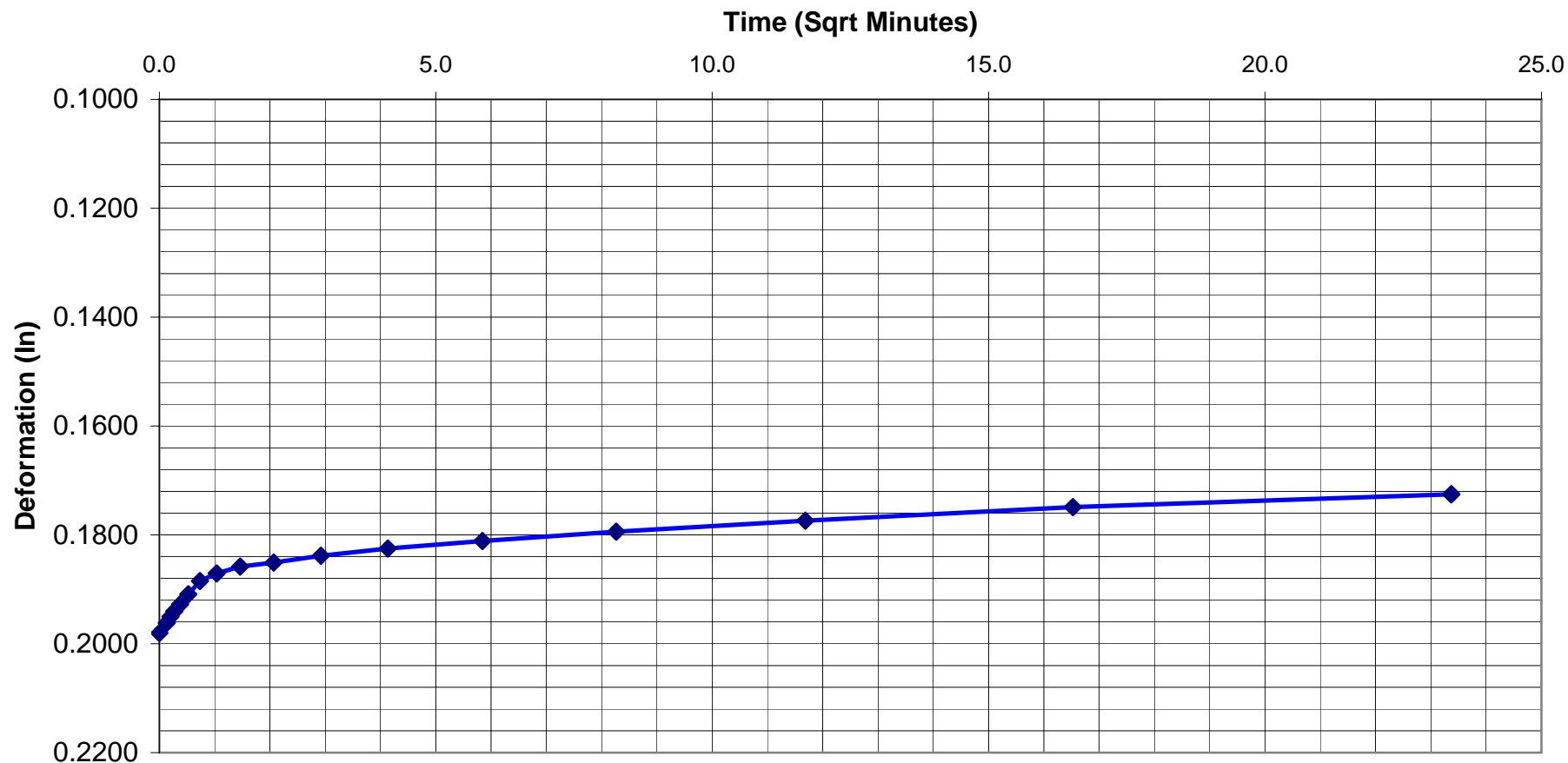
Time Rate of Consolidation

WO # D58405A
Lab # C2007029

Client : NANA Development Corporation
Project : Nullagvik Hotel
Date: 10/30/2007

Pressure: 840 psf
Deformation Correction (in): 0.0016

Boring : 5
Sample # 10
Depth : 40





Compression Curve (e vs. Log P)

WO # D58405A
Lab # C2007029

Client : NANA Development Corporation

Project : Nullagvik Hotel

Date: 10/30/2007

Moisture Content = 39.4 %

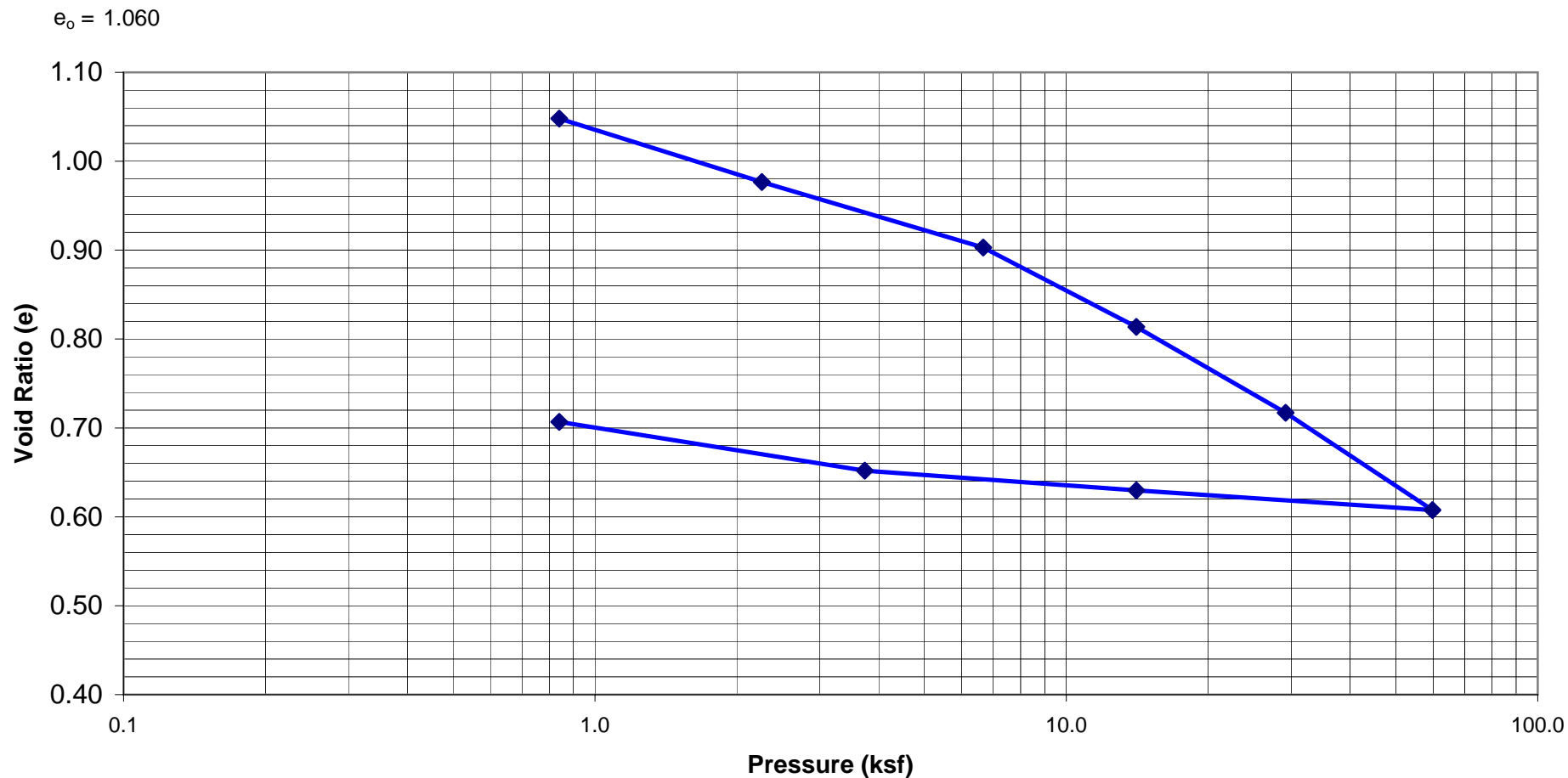
Dry Unit Weight (pcf) = 80.2

Wet Unit Weight (pcf) = 111.9

Boring : 5

Sample # 10

Depth : 40



APPENDIX E

Thermistor Measurements

Project Name:	Nullagvik Hotel
Client Name:	NANA Development Corporation
DOWL Work Order:	D58405A

Boring Number:	1	String Number:	06-1
Date of Reading:	9/16/2007	Air Temp (F):	50.8

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	9592	51.4
5	3.5	11336	45.2
6	7.5	15632	33.6
7	11.5	16363	32.0
8	15.5	16749	31.1
9	19.5	17709	29.2
10	23.5	18024	28.6
11	27.5	18161	28.3
12	31.5	18320	28.0

Boring Number:	2	String Number:	06-3
Date of Reading:	9/16/2007	Air Temp (F):	52

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	9440	52.0
5	3.5	11164	45.8
6	7.5	15374	34.2
7	11.5	16398	31.9
8	15.5	16709	31.2
9	19.5	17508	29.6
10	23.5	17850	28.9
11	27.5	18042	28.5
12	31.5	18193	28.2

Boring Number:	3	String Number:	06-4
Date of Reading:	9/16/2007	Air Temp (F):	49.9

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	9651	51.2
5	3.5	11288	45.3
6	7.5	15298	34.3
7	11.5	16369	31.9
8	15.5	16373	31.9
9	19.5	17392	29.8
10	23.5	17779	29.0
11	27.5	17808	29.0
12	31.5	18300	28.0

Boring Number:	4	String Number:	06-2
Date of Reading:	9/16/2007	Air Temp (F):	50.6

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	9978	49.9
5	3.5	11770	43.8
6	7.5	15792	33.2
7	11.5	16411	31.9
8	15.5	16566	31.5
9	19.5	16880	30.9
10	23.5	16883	30.9
11	27.5	17153	30.3
12	31.5	17430	29.7

Project Name:	Nullagvik Hotel
Client Name:	NANA Development Corporation
DOWL Work Order:	D58405A

Boring Number:	5	String Number:	06-1
Date of Reading:	9/16/2007	Air Temp (F):	49.3

Node No.	Depth ft	Resistance	Temperature (F)
1	Surface	9420	52.1
2	2	11320	45.2
3	6	14700	35.8
4	10	16387	31.9
5	14	16312	32.1
6	18	16290	32.1
7	22	16241	32.2
8	26	16226	32.3
9	30	16228	32.3
10	34	16262	32.2
11	38	16275	32.1
12	42	16331	32.0

Boring Number:	6	String Number:	06-3
Date of Reading:	9/16/2007	Air Temp (F):	48.4

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	11513	44.6
5	4	12533	41.5
6	8	16527	31.6
7	12	16720	31.2
8	16	16647	31.4
9	20	16891	30.8
10	24	16565	31.5
11	28	16605	31.4
12	32	16605	31.4

Boring Number:	7	String Number:	06-4
Date of Reading:	9/16/2007	Air Temp (F):	50.6

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	10254	48.9
5	3.5	10549	47.9
6	7.5	14852	35.4
7	11.5	16373	31.9
8	15.5	16385	31.9
9	19.5	16371	31.9
10	23.5	16416	31.8
11	27.5	16457	31.8
12	31.5	16438	31.8

Boring Number:	8	String Number:	06-1
Date of Reading:	9/17/2007	Air Temp (F):	42.7

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	11978	43.2
5	3.5	12570	41.4
6	7.5	16358	32.0
7	11.5	16360	32.0
8	15.5	16381	31.9
9	19.5	16417	31.8
10	23.5	16412	31.9
11	27.5	16419	31.8
12	31.5	16411	31.9



Thermistor Data

Figure E-2

Project Name:	Nullagvik Hotel
Client Name:	NANA Development Corporation
DOWL Work Order:	D58405A

Boring Number:	9	String Number:	06-4
Date of Reading:	9/17/2007	Air Temp (F):	43.2

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	11838	43.6
5	3.5	11954	43.2
6	7.5	14545	36.1
7	11.5	16401	31.9
8	15.5	16373	31.9
9	19.5	16353	32.0
10	23.5	16421	31.8
11	27.5	16429	31.8
12	31.5	16662	31.3

Boring Number:	10	String Number:	06-2
Date of Reading:	9/20/2007	Air Temp (F):	43.4

Node No.	Depth ft	Resistance	Temperature (F)
3	Surface	12269	42.3
4	3.5	12268	42.3
5	7.5	12438	41.8
6	11.5	15478	33.9
7	15.5	16089	32.6
8	19.5	16040	32.7
9	23.5	15958	32.8
10	27.5	15971	32.8
11	31.5	15879	33.0
12	35.5	15922	32.9

Boring Number:	11	String Number:	06-4
Date of Reading:	9/20/2007	Air Temp (F):	43.6

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	12065	42.9
5	3.5	16057	32.6
6	7.5	16410	31.9
7	11.5	16355	32.0
8	15.5	16359	32.0
9	19.5	16357	32.0
10	23.5	16385	31.9
11	27.5	16415	31.8
12	31.5	16770	31.1

Boring Number:	12	String Number:	06-2
Date of Reading:	9/16/2007	Air Temp (F):	44.6

Node No.	Depth ft	Resistance	Temperature (F)
2	Surface	11722	44.0
3	2	11993	43.1
4	6	14763	35.6
5	10	16360	32.0
6	14	16399	31.9
7	18	16402	31.9
8	22	16480	31.7
9	26	16693	31.3
10	30	16746	31.1
11	34	16888	30.8
12	38	17068	30.5

Project Name: **Nullagvik Hotel**
 Client Name: **NANA Development Corporation**
 DOWL Work Order: **D58405A**

Boring Number: **13** String Number: **06-3**
 Date of Reading: **9/17/2007** Air Temp (F): **44.3**

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	12583	41.4
5	3.5	12307	42.2
6	7.5	12088	42.8
7	11.5	14673	35.8
8	15.5	16368	31.9
9	19.5	16653	31.3
10	23.5	16673	31.3
11	27.5	16640	31.4
12	31.5	16629	31.4

Boring Number: **14** String Number: **06-1**
 Date of Reading: **9/20/2007** Air Temp (F): **43.7**

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	12483	41.7
5	4	15733	33.3
6	8	16375	31.9
7	12	16293	32.1
8	16	16350	32.0
9	20	16131	32.5
10	24	16352	32.0
11	28	16382	31.9
12	32	16408	31.9

Boring Number: **15** String Number: **06-3**
 Date of Reading: **9/20/2007** Air Temp (F): **43.3**

Node No.	Depth ft	Resistance	Temperature (F)
1	Surface	12466	41.7
2	1.5	12911	40.4
3	5.5	16384	31.9
4	9.5	16420	31.8
5	13.5	16215	32.3
6	17.5	16257	32.2
7	21.5	16350	32.0
8	25.5	16371	31.9
9	29.5	16375	31.9
10	33.5	16367	32.0
11	37.5	16442	31.8
12	41.5	16358	32.0

Boring Number: **16** String Number: **06-2**
 Date of Reading: **9/16/2007** Air Temp (F): **51.1**

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	9054	53.6
5	1.5	11384	45.0
6	5.5	12835	40.6
7	9.5	14432	36.4
8	13.5	15844	33.1
9	17.5	16395	31.9
10	21.5	16396	31.9
11	25.5	16491	31.7
12	29.5	16645	31.4

Project Name: **Nullagvik Hotel**
 Client Name: **NANA Development Corporation**
 DOWL Work Order: **D58405A**

Boring Number: **1** String Number: **06-1**
 Date of Reading: **10/6/2007** Air Temp (F): **30**

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	18329	28.0
5	3.5	18217	28.2
6	7.5	18186	28.3
7	11.5	16325	32.0
8	15.5	16202	32.3
9	19.5	16831	31.0
10	23.5	16951	30.7
11	27.5	17011	30.6
12	31.5	17142	30.3

Boring Number: **2** String Number: **06-2**
 Date of Reading: **10/6/2007** Air Temp (F):

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	18492	27.7
5	3.5	18265	28.1
6	7.5	18221	28.2
7	11.5	16359	32.0
8	15.5	16178	32.4
9	19.5	16435	31.8
10	23.5	16486	31.7
11	27.5	16502	31.7
12	31.5	16621	31.4

Boring Number: **3** String Number: **06-3**
 Date of Reading: **10/6/2007** Air Temp (F):

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	18971	26.8
5	3.5	16295	32.1
6	7.5	17198	30.2
7	11.5	17255	30.1
8	15.5	17292	30.0
9	19.5	17309	30.0
10	23.5	17410	29.8
11	27.5	17552	29.5
12	31.5	17638	29.3

Boring Number: **4** String Number: **06-4**
 Date of Reading: **10/6/2007** Air Temp (F):

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	19216	26.4
5	3.5	14354	36.6
6	7.5	15322	34.3
7	11.5	16506	31.7
8	15.5	16787	31.1
9	19.5	17100	30.4
10	23.5	17248	30.1
11	27.5	17339	29.9
12	31.5	17473	29.7



Thermistor Data

Figure E-5

Project Name:	Nullagvik Hotel
Client Name:	NANA Development Corporation
DOWL Work Order:	D58405A

Boring Number:	5	String Number:	06-1
Date of Reading:	10/7/2007	Air Temp (F):	

Node No.	Depth ft	Resistance	Temperature (F)
1	Surface	18266	28.1
2	2	18009	28.6
3	6	18150	28.3
4	10	18202	28.2
5	14	18189	28.3
6	18	18201	28.2
7	22	17880	28.9
8	26	15638	33.6
9	30	16344	32.0
10	34	16401	31.9
11	38	16527	31.6
12	42	16752	31.1

Boring Number:	6	String Number:	06-1
Date of Reading:	10/7/2007	Air Temp (F):	

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	18545	27.6
5	4	18279	28.1
6	8	18258	28.1
7	12	15426	34.0
8	16	15292	34.4
9	20	16303	32.1
10	24	16351	32.0
11	28	16386	31.9
12	32	16419	31.8

Boring Number:	7	String Number:	06-4
Date of Reading:	10/7/2007	Air Temp (F):	50.6

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	17574	29.5
5	3.5	15161	34.7
6	7.5	16110	32.5
7	11.5	16343	32.0
8	15.5	16369	31.9
9	19.5	16300	32.1
10	23.5	16276	32.1
11	27.5	16270	32.2
12	31.5	16281	32.1

Project Name:	Nullagvik Hotel
Client Name:	NANA Development Corporation
DOWL Work Order:	D58405A

Boring Number:	9	String Number:	06-4
Date of Reading:	10/7/2007	Air Temp (F):	

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	18632	27.4
5	3.5	18500	27.7
6	7.5	18459	27.7
7	11.5	15631	33.6
8	15.5	15589	33.7
9	19.5	16275	32.1
10	23.5	16391	31.9
11	27.5	16407	31.9
12	31.5	16444	31.8

Boring Number:	11	String Number:	06-1
Date of Reading:	10/7/2007	Air Temp (F):	43.6

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	18059	28.5
5	3.5	17972	28.7
6	7.5	17993	28.6
7	11.5	17056	30.5
8	15.5	15908	33.0
9	19.5	16479	31.7
10	23.5	16595	31.5
11	27.5	16803	31.0
12	31.5	17002	30.6

Boring Number:	12	String Number:	06-2
Date of Reading:	10/7/2007	Air Temp (F):	

Node No.	Depth ft	Resistance	Temperature (F)
2	Surface	17951	28.7
3	2	18012	28.6
4	6	18088	28.4
5	10	18018	28.6
6	14	18029	28.6
7	18	17046	30.5
8	22	16459	31.8
9	26	16330	32.0
10	30	16421	31.8
11	34	16632	31.4
12	38	16897	30.8



Thermistor Data

Figure E-7

Project Name: **Nullagvik Hotel**
 Client Name: **NANA Development Corporation**
 DOWL Work Order: **D58405A**

Boring Number: **13** String Number: **06-3**
 Date of Reading: **10/7/2007** Air Temp (F):

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	18403	27.8
5	3.5	16302	32.1
6	7.5	16531	31.6
7	11.5	16902	30.8
8	15.5	15863	33.1
9	19.5	16021	32.7
10	23.5	16198	32.3
11	27.5	16436	31.8
12	31.5	16704	31.2

Boring Number: **14** String Number: **06-1**
 Date of Reading: **10/7/2007** Air Temp (F):

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	18365	27.9
5	4	18157	28.3
6	8	18121	28.4
7	12	17361	29.9
8	16	17265	30.1
9	20	16372	31.9
10	24	16398	31.9
11	28	16515	31.6
12	32	16579	31.5

Boring Number: **15** String Number: **06-3**
 Date of Reading: **10/7/2007** Air Temp (F): **43.3**

Node No.	Depth ft	Resistance	Temperature (F)
1	Surface	18029	28.6
2	1.5	17922	28.8
3	5.5	18131	28.4
4	9.5	18112	28.4
5	13.5	18050	28.5
6	17.5	17976	28.7
7	21.5	16962	30.7
8	25.5	16077	32.6
9	29.5	16432	31.8
10	33.5	16547	31.6
11	37.5	16595	31.5
12	41.5	16688	31.3

Boring Number: **16** String Number: **06-2**
 Date of Reading: **10/7/2007** Air Temp (F):

Node No.	Depth ft	Resistance	Temperature (F)
4	Surface	18226	28.2
5	1.5	16223	32.3
6	5.5	14145	37.1
7	9.5	14831	35.4
8	13.5	15805	33.2
9	17.5	16391	31.9
10	21.5	16588	31.5
11	25.5	16706	31.2
12	29.5	16861	30.9



Thermistor Data

Figure E-8

