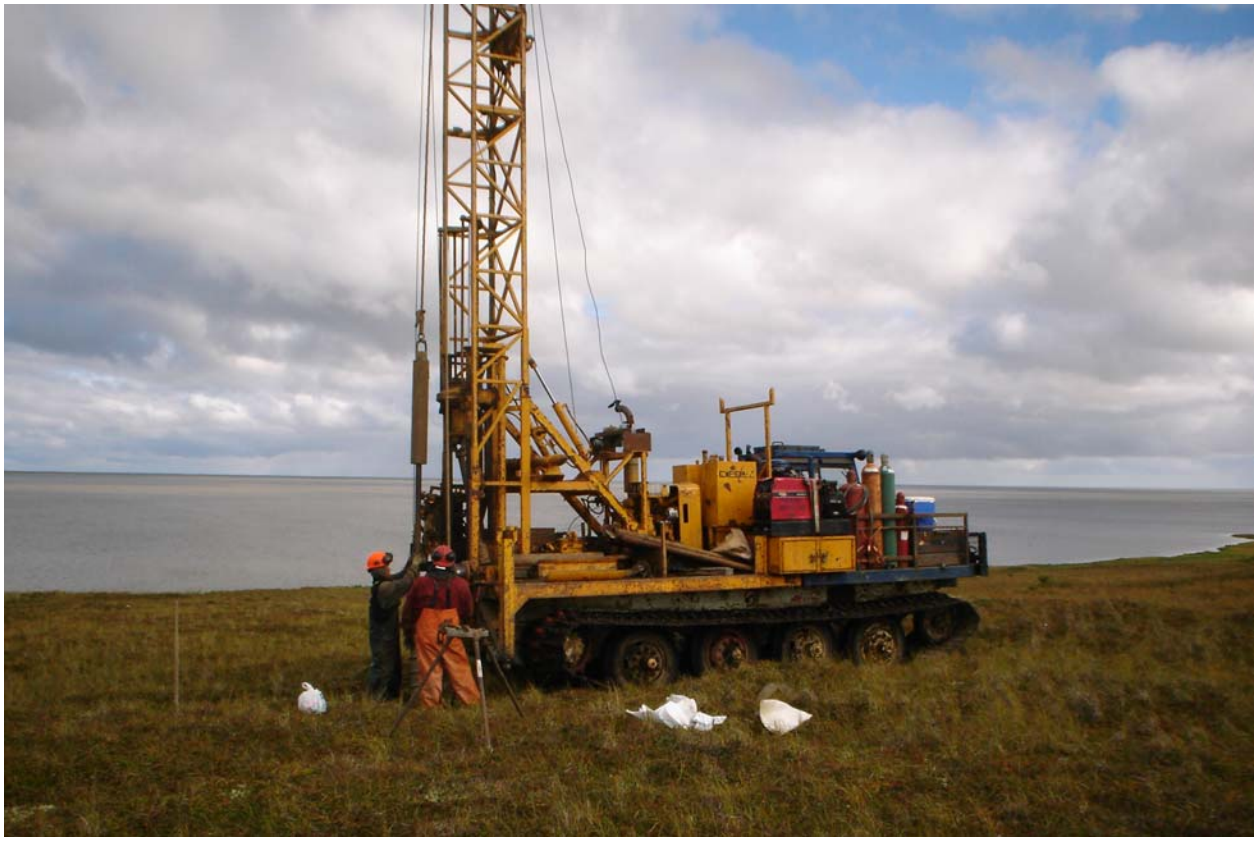
US Army Corps of Engineers
Alaska District
Soils and Geology Section

GEOTECHNICAL REPORT

MERTARVIK TOWNSITE

Newtok, Alaska



February 2008

CEPOA-EN-ES-SG February 2008

MEMORANDUM FOR CEPOA-PM-C

SUBJECT: Geotechnical Report, Mertarvik Townsite – Newtok, Alaska

1. Enclosed are five bound copies of the Geotechnical Report for the subject project. Included with the report are the Project Location and Vicinity Map, Explorations Location Map, Exploration logs, lab testing results and design recommendations for the development of the road and evacuation center.

2. Questions should be addressed to Gregory Carpenter at 753-2684 or to Chuck Wilson at 753-2687.

Encl.

JAMES W. PEKAR, PE
Chief, Geotechnical Services

CONCUR:
for Wilson
Carpenter

GEOTECHNICAL REPORT
MERTARVIK TOWNSITE
NEWTOK, ALASKA

FEBRUARY 2008

1. INTRODUCTION

The Alaskan Native Village of Newtok is located on the banks of the Ninglick and Kealavik Rivers, about 90 miles northwest of Bethel, in the Yukon-Kuskokwim Delta Region. The continued existence of the village at its present location is being threatened by advancing erosion caused by the Ninglick River which connects the Bering Sea with Baird Inlet. After years of erosion study, the Newtok Traditional Council concluded in 1994 that relocation of the entire village was the best solution, and has since been pursuing this action. The selected relocation site is known as Mertarvik shown in Photograph 1. This relocation requires an understanding of the subsurface conditions of the new site. Therefore, a geotechnical exploration was planned by the US Army Corps of Engineers - Alaska District (USACE-AD) for the summer of 2007.

The results of that exploration are presented in this report. The purpose of the investigation was to identify general surface and subsurface conditions pertinent to the design and development of the new community. In particular, it was to develop foundation recommendations and alternatives for an Evacuation Center and general considerations and recommendations for a Village Access Road. The exploration consisted of drilling test borings for proposed components of the townsite. This report presents the recommendations and alternatives and the results of the exploration and the laboratory testing program, as well as general site observations.

2. PROJECT DESCRIPTION AND LOCATION

This project consists of constructing a road from tidewater to a proposed village relocation site and an Evacuation Center that will be used if the existing village of Newtok is again flooded. In addition to the items mentioned above, the exploration also gathered preliminary information for other components of the relocation including a barge landing lay-down area, a village well, a landfill and sewage disposal area, and the general area of the village relocation site.

The proposed site is located on the north side of Nelson Island in western Alaska. The site is approximately 12 miles directly south of the village of Newtok, Alaska. A Project Location and Vicinity Map are enclosed as Figure 1.

Photograph 1. Drilling operation at Test Boring AP-21 showing vegetation and topography of Mertarvik with the Ninglick River in the background.

3. FIELD EXPLORATION

The subsurface exploration for the project was conducted from 6 through 15 September 2007. A total of 24 test borings were drilled to depths from about seven to 31.5 feet. These borings have been designated as AP-01 through AP-24. The exploration generally consisted of drilling and sampling from the ground surface to a predetermined depth depending on the boring location. However, several boring were terminated prior to reaching the predetermined depth due to auger refusal on rock. These borings were drilled with a track-mounted Mobile B-61 drill rig. The borings were advanced using 8-inch diameter hollow-stem auger. Denali Drilling, Inc. of Anchorage supplied the drilling equipment, landing craft used to move the equipment to the site, and personnel to perform the exploration. An engineer with the USACE-AD supervised the operation and logged the test borings. Field classification of the soils is in accordance with ASTM D 2488, “Standard Practice for Description

and Identification of Soils (Visual – Manual Procedure)."

The test borings were located in the field with a handheld GPS unit using predetermined boring location coordinates and are only as accurate as the method implies. The elevations of the borings were estimated by correlating horizontal coordinates to topographical information obtained by aerial photography. The approximate locations of the test borings and conceptual plans are shown on the Exploration Location Map enclosed as Figure 2.

Samples were collected at either two or five feet below the ground surface and 5-foot intervals thereafter. Soil samples were procured with a 2.5-inch inside diameter split spoon sampler driven with a 340-pound hammer falling 30 inches using a rope and cathead to lift the hammer. During drive sampling, the split spoon sampler was advanced 18 inches ahead of the auger or to driving refusal. The number of blows required to drive each 6-inch increment is recorded on the exploration logs. The blow count is an indication of the relative density or consistency of the soil although in the areas where permafrost was encountered the blow counts only indicate the hardness of the frozen soil.

4. LABORATORY TESTING AND SOILS CLASSIFICATION

A laboratory testing program was established to classify the soils encountered. These tests were performed in accordance with the current version of the following test methods:

- ASTM D 422, "Standard Test Method for Particle size Analysis of Soils".
- ASTM D 2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass".
- ASTM D 2487, "Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)".
- ASTM D 4318, "Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils".

The soil descriptions and classifications contained in this report and presented on the final exploration logs are the project engineer's interpretation of the field logs and results of the laboratory testing program. The stratification lines represent approximate boundaries between soil types; the transitions are often gradual or not discernible by drill action. The exploration logs are enclosed as Appendix A and the lab testing summary and grain size distribution curves are enclosed as Appendix B.

5. Regional Geology

Nelson Island is located in the lowlands between the mouth of the Yukon River

and the mouth of the Kuskokwim River. The island was formed by basalt flows from volcanic activity in the area and rises from the surrounding alluvial plane to an elevation of about 1485 feet. On the west coast of the island there are rock exposures that are several hundred feet high. In general the soils on the island are a product of the weathering of the basalt as exemplified in Photograph 2.

Photograph 2. Sample of material that is typical of the soil composed of residual basalt.

6. Site Conditions

Surface: The project is located on the north shoreline of Nelson Island and is bounded on the north by the Ninglick River which drains Baird Inlet. The barge landing and beginning of the road alignment is identified on the Location and Vicinity Map and can be related to the Test Boring Location Map. The relocation site is located on a hillside that slopes up to the south from sea level at the shoreline to an elevation of about 320 feet. The slope is relatively constant and generally is at about 15 percent.

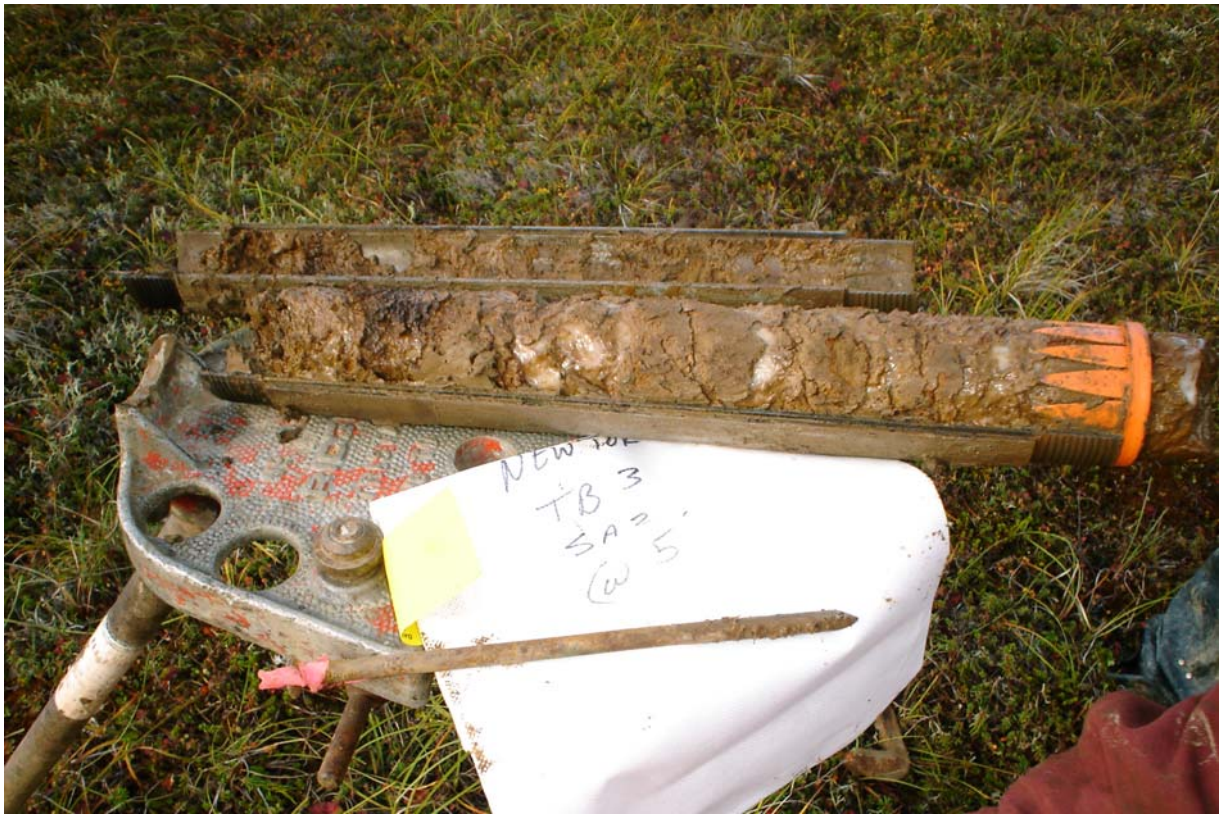
The vegetation generally consists of tundra plants with areas along the drainages that have willows to eight-feet in height. The willows do not grow more than half way up the slope. Rock exposures are present at one location on the shoreline and there are large rock fragments on the surface at many locations on the site.

Subsurface: The subsurface conditions vary across the site. The thickness of the soil over bedrock was encountered from as little as four feet to more than 31.5 feet. The permafrost conditions across the site are similarly variable. The table below summarizes the conditions encountered at each of the boring locations.

TABLE 1
SUMMARY OF BORING DATA

BORING	DEPTH OF BORING (ft)	PEAT THICKNESS (ft)	DEPTH TO ROCK (ft)	DEPTH TO PERMAFROST (ft)
AP-01	15.8	1.5	13.0	not encountered
AP-02	15.0	2	12	not encountered
AP-03	16.0	1.5	not encountered	2.0
AP-04	11.5	1.5	8.5	not encountered
AP-05	16.5	1.5	not encountered	2.0
AP-06	16.5	1.5	not encountered	2.0
AP-07	9.0	1.0	9.0	3.5
AP-08	16.5	1.5	not encountered	not encountered
AP-09	16.5	1.5	not encountered	not encountered
AP-10	9.0	1.5	9.0	not encountered
AP-11	16.5	1.0	not encountered	1.0
AP-12	15.8	1.0	not encountered	1.5
AP-13	11.0	1.0	11.0	2.0
AP-14	14.0	1.0	14.0	2.5
AP-15	22.0	2.0	13.0	3.0
AP-16	20.1	2.0	16.5	2.0
AP-17	12.0	1.5	9.0	2.5
AP-18	10.3	2.0	10.0	2.0
AP-19	10.2	1.5	9.0	not encountered
AP-20	7.0	1.5	4.0	not encountered
AP-21	21.5	2.0	12	not encountered
AP-22	22.0	1.0	21.0	not encountered
AP-23	31.5	1.5	not encountered	2.5
AP-24	13.5	1.5	13.5	3.0

In general, the soils above bedrock are relatively uniform and are a product of the weathering of the underlying bedrock. On the surface there is a peat layer that is generally about 18 inches in thickness but varies from one to two feet thick. Beneath the peat there is a layer of silt with organics that are a product of roots. The amount of organics varies and tends to decrease with depth. As the bedrock surface is approached, rock fragments become more prevalent in the residual soil. Finally, the rock surface is encountered. The rock becomes more competent with depth. Most of the soils are frost susceptible and have a frost classification of F4 although a few of the soil samples near the bedrock surface have a frost classification of F2. The soils are generally wet in thawed areas and at many locations water ponded around the tracks on the drill rig while drilling. In frozen areas the soil contains ice as small crystals to layers of ice several inches thick. From the observations during drilling, it appears that the seasonal thaw depth is about two feet due to the insulation provided by the tundra vegetation.



Photograph 3. Typical sample showing the ice content present in many of the frozen soils.

Photograph 4. Ice typical of many areas in the permafrost.

The permafrost conditions on the site vary greatly between boring locations. It appears that the permafrost has degraded at locations near drainage paths and in areas where water may pond. In general, the permafrost is either present within two to three feet of the ground surface or it is degraded to below the bedrock surface. One observation that was made at the site was that in some areas where permafrost degradation has occurred the subsidence of the ground surface was on the order of a couple of feet or more as shown in Photograph 5. For a detailed description of the subsurface conditions encountered at each boring location, see the exploration logs contained in Appendix A.

7. Analysis

The site is suitable for construction of the proposed road from the beach to the townsite and for the construction of the proposed evacuation center. Issues that require consideration and analysis for this project are the permafrost along the road alignment as well as the drainage along the proposed road

Photograph 5. One of many thaw features present on the site. Note the subsidence that has occurred as a result of thaw consolidation.

section. Another issue is the foundation type for support of the evacuation center. These issues are discussed below:

Roadway Design: The road from the barge landing to the proposed townsite will traverse various soil and thermal conditions. In general it would be appropriate to design the road as though the alignment was entirely on permafrost. It would be prudent to construct the road over the existing tundra with as little surface disturbance as practical. This may require the construction to be performed in the early spring when the ground remains frozen. The most important aspects of the road design will be the protection of the permafrost and drainage of water away from the road section. This must be considered for the structural section, construction technique and could be achieved by using a layer of insulation in the road section as well as a geotextile to reduce the impact of thaw settlements. The use of culverts at all drainage areas as well as at any location where ponding might occur should help remove water from the roadway section.

Evacuation Center Foundation: There are several options for the support of the proposed Evacuation Center. The foundation system with the least risk is a pile foundation installed with the pile tips on or embedded into the bedrock. Of special concern with a pile foundation is the elimination of frost jacking of the piles. A second option, with slightly more risk of movement due to frost action would be to construct a building pad of gravel or rock and then supporting the building on a triodetic foundation system. The foundation system with the most risk would be to construct a building pad with gravel or rock and then to support the building on a conventional foundation system.

8. Engineering Recommendations

Recommendations regarding design and construction of the access road and the foundation for the Evacuation Center are presented in this section. These recommendations are based on results of the test boring data, the results of laboratory testing, experience, and engineering judgment.

Access Road: The proposed access road from the barge landing to the proposed townsite will cross areas of permafrost alternating with thawed areas. The final design will be prepared by the design team for this project. It is recommended that the road be designed and constructed as if it were all on permafrost. The road should be constructed over the existing tundra with as little disturbance of the surface as practical. This may require that the construction occur in the spring when the ground remains frozen. Some leveling of the road alignment will be necessary to allow a geotextile to be placed as a separator on the roadbed. The road fill should consist of gravel or a crushed rock product with less than 5 percent fines. A surface layer with more than 5 percent fines may be considered for the driving surface. It would be prudent to include a layer of insulation in the road section. This insulation layer should be placed as near the surface of the road as possible while keeping sufficient cover to protect it from damage when road maintenance is performed. The road should be shaped to rapidly drain and sufficient culverts should be placed under the road (at the tundra surface) to ensure that water does not pond adjacent to the roadway section.

Evacuation Center Foundation: A pile foundation is recommended for support of the proposed Evacuation Center. The piles should be driven to a minimum depth of 30 feet or to bedrock if it is deeper than 30 feet. This may require drilling and driving the piles into the bedrock. The piles should have a protective shoe to prevent damage during driving. The shoe should be flush outside and have as large an annulus as possible. One appropriate type of shoe is manufactured by Tubex. Piles installed to or into bedrock will have an allowable capacity of 20 kips on six-inch pipe, 35 kips on eight-inch pipe, and

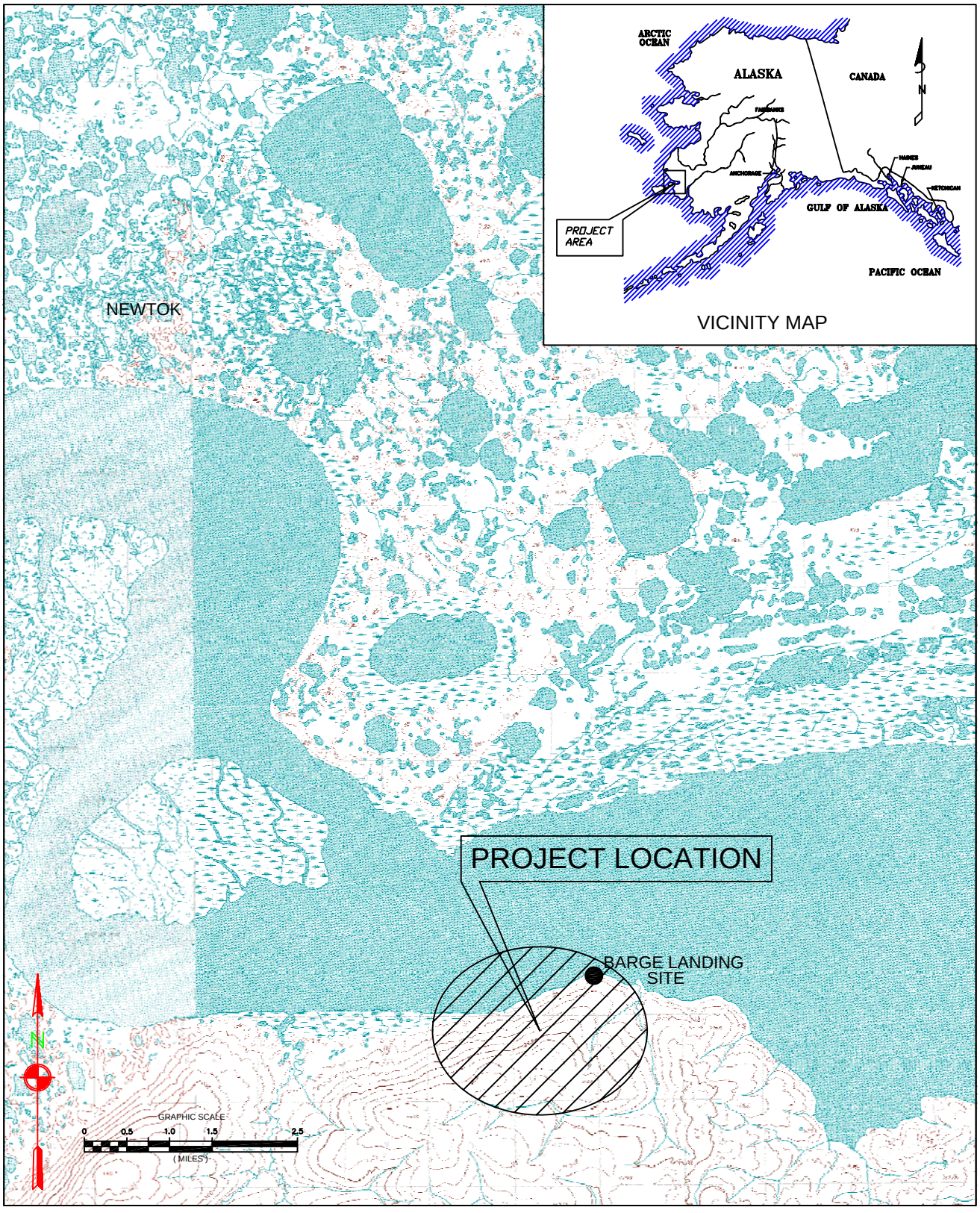
55 kips on ten-inch pipe. The contractor should not be allowed to predrill any holes larger than the pile diameter minus one inch. The piles must be driven into a tight predrilled hole to create sufficient friction to resist the frost jacking forces on the pile.

A foundation alternative would be to construct a building pad of gravel or processed rock product that is a minimum of five feet thick and to support the structure on a triodetic foundation system. This alternative does have some risk of differential settlement if the building footprint is above both frozen and thawed ground. With this type of foundation system the differential settlement would result in little or no structural damage to the building but the building would become unlevel.

The final foundation alternative and the alternative with the most risk of differential settlement is to create a building pad as described above and then support the building on a conventional foundation. This alternative is not recommended unless it is shown that the soils are thawed above the bedrock surface under the entire building footprint.

Enclosures:

Figure 1 - Project Location and Vicinity Map
Figure 2 - Exploration Location Map
Appendix A - Exploration logs
Appendix B - Grain size distribution curves



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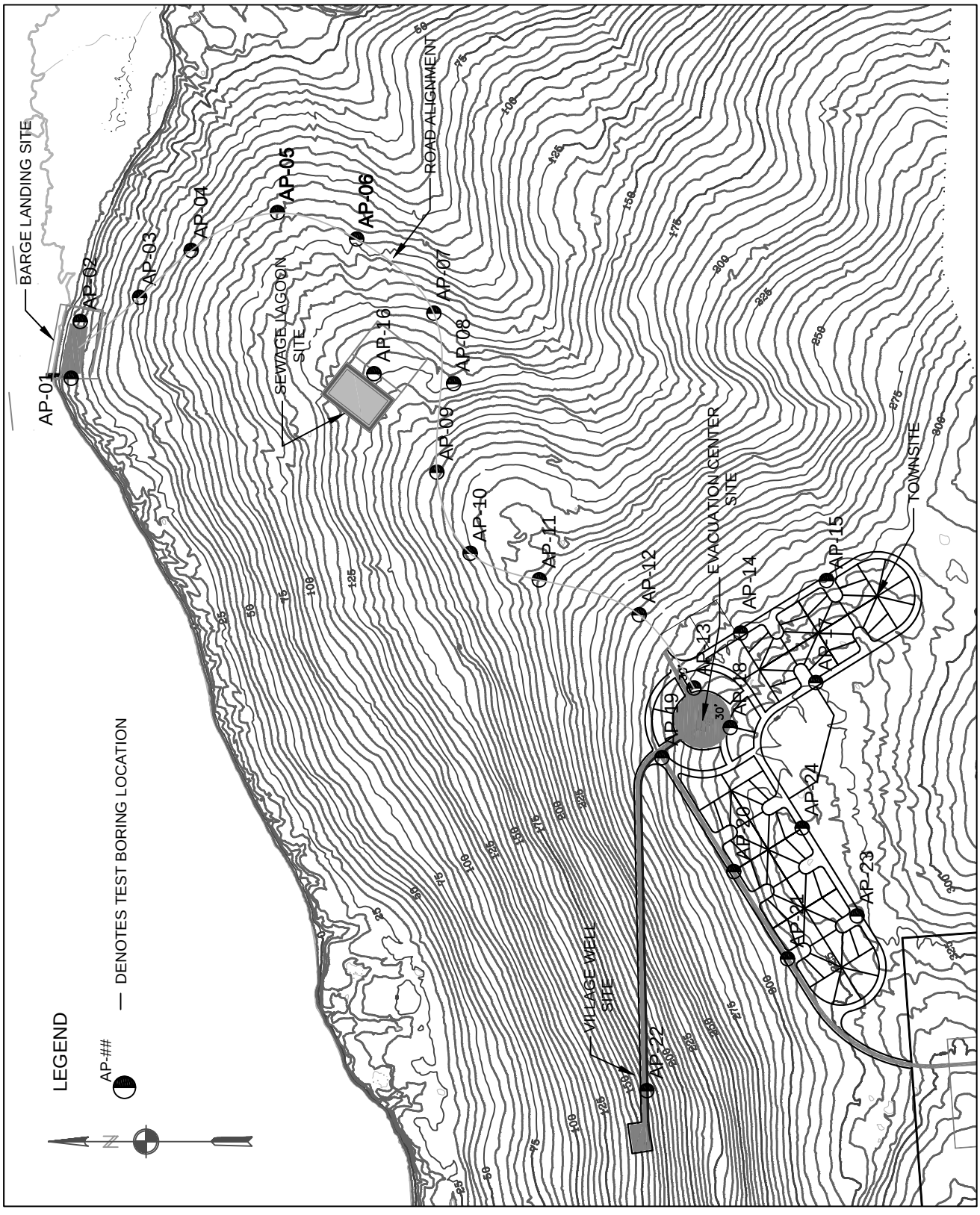
LOCATION AND VICINITY MAP
MERTARVIK TOWNSITE
NEWTOK, ALASKA

SCALE: GRAPHICAL
DATE: FEBRUARY 2008
DRAWN/RVW: IJR/GWC
FIGURE 1



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TEST BORING LOCATION MAP
MERTARVIK TOWNSITE
NEWTOK, ALASKA

SCALE: NTS
DATE: FEBRUARY 2008
DRAWN/RVW: IJR/GWC
FIGURE 2

Appendix A

Exploration Logs

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EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **8 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,497,012 ft. ±** Easting: **1,910,177 ft. ±**

Top of Hole Elevation: **12.5 ft. ±**

Hole Number, Field: **TB 1** Permanent: **AP-01**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **15.0 ft.**

Total Depth: **15.8 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: In willows near a drainage** **Dark brown peat to 18 inches**
2		1		F4*	3 4 6	OL	**Organic SILT**							20	**Light tan with brownish red organic root holes, wet, Organic Content= 6%, Atterbergs: Nonplastic (NP)**
6		2		F4*	1 3 6	OL	**Organic SILT**							40	**Grey with brownish red organic root holes, wet, Atterbergs: Nonplastic**
8															**Hitting pieces of rock at 8 feet**
10		3		F2*	7 13 20	GM	**Silty GRAVEL with Sand**	32	32	36		1			**Grey and brown mottled, wet, angular gravel, fine to coarse sand, NP fines**
14															**Hard drilling below 13 feet**
		4			18 50/3"	Bx	**BEDROCK**					2.5			**Grey, hard rock fragments**
16															**Bottom of Hole 15.8 ft.** **Elevation -3.3 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**
18															
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **9 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,496,947 ft. ±** Easting: **1,910,585 ft. ±**

Top of Hole Elevation: **11.0 ft. ±**

Hole Number, Field: **TB 2** Permanent: **AP-02**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **15.0 ft.**

Total Depth: **15.0 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	PEAT								Dark brown peat to 2 feet
2		1		F4*	2 7 8	ML	SILT							20	Grey with brown spots, wet, Atterbergs: Nonplastic
4															
6		2		F4*	3 7 10	ML	SILT							20	Grey with brown spots, moist, Atterbergs: Nonplastic
8															
10		3			5 4	ML	SILT								soil classified by cuttings, no recovery
12						Bx	BEDROCK								Rock at 12 feet
14															Auger Refusal at 15.0 feet
16															Bottom of Hole 15.0 ft. Elevation -4.0 ft. ± PID = (Cold/Hot) Photo Ionization Detector
18															
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
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Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **9 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,496,519 ft. ±** Easting: **1,910,759 ft. ±**

Top of Hole Elevation: **46.0 ft. ±**

Hole Number, Field: **TB 3** Permanent: **AP-03**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **15.0 ft.**

Total Depth: **16.0 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 18 inches**
2		1	Vx	F4*	4 7 14	ML	**SILT**							25	**Grey and brown mottled, frozen with ice as Vx to 1/4 inch, estimated 30 percent ice by volume, Atterbergs: Nonplastic (NP)**
4															
6		2	Vx Vr	F4*	5 7 15	ML	**SILT**							26	**Grey and brown mottled, frozen with ice as Vx and Vr to 1 inch, estimated 60 percent ice by volume, Atterbergs: Nonplastic**
8															
															Rocks at 9 feet
10		3	Vx Vr	F4*	5 11 19	ML	**Sandy SILT**	1	42	57		0.25			**Grey and brown mottled, frozen, estimated 50 percent ice by volume, fine to coarse sand, NP to low plasticity fines**
12															
14															
16		4	Vx	F4*	9 20	ML	**SILT with Gravel**					2			**Redish brown, frozen with ice as Vx to 1/4 inch, estimated 10 percent ice by volume, angular gravel, fine to coarse sand, NP fines**
															Bottom of Hole 16.0 ft. **Elevation 30.0 ft. ±**
18															**PID = (Cold/Hot) Photo Ionization Detector**
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **9 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,496,148 ft. ±** Easting: **1,911,097 ft. ±**

Top of Hole Elevation: **67.5 ft. ±**

Hole Number, Field:	Permanent:	Operator:	Inspector:
TB 4	**AP-04**	**Lyle Cain**	**Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **11.5 ft.**

Total Depth: **11.5 ft.**

Hammer Weight:	Split Spoon I.D.:	Size and Type of Bit:	Type of Equipment:	Type of Samples:
340 lbs	**2.5 in.**	**8 in. HSA**	**Mobile B-61 Nodwell**	**Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra, 25 feet from a drainage** **Dark brown peat to 18 inches**
2		1		F4*	3 4 4	ML	**SILT**							23	**Grey with brown spots, wet, Atterbergs: Nonplastic (NP)**
6		2		F4*	3 4 5	ML	**SILT**							22	**Grey with brown layers and spots, moist, occasional roots, NP fines**
8															**Hitting rocks from 8.5 to 10 feet**
10		3		F4*	19 50 50/3"	Bx-ML	**BEDROCK to SILT**								**Brown silt with rock fragments, moist, angular gravel, fine to coarse sand, NP fines** **Auger Refusal at 11.5 feet**
12															**Bottom of Hole 11.5 ft.** **Elevation 56.0 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**
14															
16															
18															
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

Project: **Mertarvik Townsite**

Hole Number: **AP-04**

EXPLORATION LOG NEWTOK.GPJ ACE_ANC.GDT 20/2/08

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **10 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,495,528 ft. ±** Easting: **1,911,370 ft. ±**

Top of Hole Elevation: **85.0 ft. ±**

Hole Number, Field: **TB 5** Permanent: **AP-05**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **15.0 ft.**

Total Depth: **16.5 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 18 inches**
2		1	Vx Vr	F4*	4 9 13	ML	**SILT**							40	**Grey, frozen, estimated 60 percent ice by volume, Atterbergs: LL=34, PI=3**
6		2	Vx Vr	F4*	5 10 16	ML	**SILT**							25	**Brown, frozen, estimated 50 percent ice by volume, NP fines**
10		3	Vx	F4*	7 50/5"	ML	**SILT with Gravel**								**Brown, frozen with ice as Vx to 1/4 inch, angular gravel, fine to coarse sand, NP fines**
16		4	Vx	F4*	6 19 35	ML	**SILT with Sand**								**Brown, grey and rust mottled, frozen with ice as Vx to 1/4 inch, fine sand, low plasticity fines**
															Bottom of Hole 16.5 ft. **Elevation 68.5 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **10 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,494,958 ft. ±** Easting: **1,911,178 ft. ±**

Top of Hole Elevation: **95.0 ft. ±**

Hole Number, Field: **TB 6** Permanent: **AP-06**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other ☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **15.0 ft.**

Total Depth: **16.5 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 18 inches**
2		1	Vx	F4*	4 6 8	ML	**SILT**							28	**Brown and grey mottled, frozen, estimated 35 percent ice by volume, Atterbergs: Nonplastic (NP)**
6		2	Vx Vr	F4*	4 6 5	ML	**SILT**							75	**Brown, frozen with ice as Vx and Vr to 1/4 inch, estimated 40 percent ice by volume, NP fines**
10		3	Vx	F2*	8 14 12	GM	**Silty GRAVEL**	54	11	35		2.5			**Brown and black, frozen, angular gravel, fine to coarse sand, NP fines**
16		4		F4*	4 5 9	ML	**SILT with Sand**								**Reddish brown with black spots, wet, fine sand, low plasticity fines**
															Bottom of Hole 16.5 ft. **Elevation 78.5 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **11 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,494,403 ft. ±** Easting: **1,910,645 ft. ±**

Top of Hole Elevation: **126.0 ft. ±**

Hole Number, Field: **TB 7** Permanent: **AP-07**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other ☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **9.0 ft.**

Total Depth: **9.0 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 12 inches**
2		1		F4*	4 8 15	ML	**Gravelly SILT**					2		6	**Brown, wet, angular gravel, nonplastic (NP) fines**
4															
6		2		F4*	5 7 12	ML	**SILT**					0.75		22	**Brown, frozen, angular gravel, Atterbergs: Nonplastic** **Rocks at 7 feet**
8															**Auger refusal on rock at 9 feet**
10															**Bottom of Hole 9.0 ft.** **Elevation 117.0 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**
12															
14															
16															
18															
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **11 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,494,260 ft. ±** Easting: **1,910,139 ft. ±**

Top of Hole Elevation: **148.0 ft. ±**

Hole Number, Field: **TB 8** Permanent: **AP-08**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **15.0 ft.**

Total Depth: **16.5 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	PEAT								Dark brown peat to 18 inches
2		1		F4*	1 3 4	ML	SILT							17	Grey and brown mottled, wet, Atterbergs: Nonplastic (NP)
6		2		F4*	2 4 4	ML	SILT							20	Grey and brown mottled, wet, NP fines
10		3		F4*	3 3 6	ML	SILT					0.75			Grey and brown mottled, wet, angular gravel, NP fines
16		4		F4*	5 4 5	ML	SILT					0.5			Grey and brown mottled, wet, angular gravel, NP fines
															Bottom of Hole 16.5 ft. Elevation 131.5 ft. ± PID = (Cold/Hot) Photo Ionization Detector

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
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Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **12 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,494,380 ft. ±** Easting: **1,909,501 ft. ±**

Top of Hole Elevation: **184.0 ft. ±**

Hole Number, Field: **TB 9** Permanent: **AP-09**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **15.0 ft.**

Total Depth: **16.5 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 18 inches**
2		1		S1*	5 9 13	GP-GM	**Poorly graded GRAVEL with Silt**	81	10	9		2.5		6	**Rocks at 2 feet** **Brown, wet, angular gravel (rock fragments), fine to coarse sand, nonplastic (NP) fines**
4															
6		2		F4*	12 17 9	ML	**Gravelly SILT**					2.5			**Brown, wet, angular gravel (rock fragments), NP fines**
8															
10		3		F4*	19 47	ML	**Gravelly SILT**					2			**Brown, moist, angular gravel (rock fragments), fine to coarse sand, NP fines**
12															
14															
16		4		F4*	2 2 5	ML	**SILT with Sand**								**Dark brown with yellow streaks, wet, fine sand, NP fines**
															Bottom of Hole 16.5 ft. **Elevation 167.5 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**
18															
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **12 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,494,141 ft. ±** Easting: **1,908,918 ft. ±**

Top of Hole Elevation: **198.0 ft. ±**

Hole Number, Field: **TB 10** Permanent: **AP-10**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **9.0 ft.**

Total Depth: **9.0 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	PEAT								SURFACE: Tundra Dark brown peat to 18 inches
2		1		F4*	2 2 7	ML	SILT					0.25		7	Brown and grey mottled, moist, fine to coarse sand, nonplastic (NP) fines
4															
6		2		F4*	21 50/4"	ML	SILT	4	7	89		1.5			Brown, moist, angular gravel, fine to coarse sand, NP fines (weathered rock)
8															Auger refusal on rock at 9 feet
10															Bottom of Hole 9.0 ft. Elevation 189.0 ft. ± PID = (Cold/Hot) Photo Ionization Detector
12															
14															
16															
18															
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **12 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,493,644 ft. ±** Easting: **1,908,726 ft. ±**

Top of Hole Elevation: **220.0 ft. ±**

Hole Number, Field: **TB 11** Permanent: **AP-11**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **15.0 ft.**

Total Depth: **16.5 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 12 inches**
2		1	Vx	F4*	4 19 21	ML	**SILT with Gravel**	19	8	73		2		21	**Brown, frozen with ice as Vx to 1/8 inch, angular gravel, fine to coarse sand, nonplastic (NP) fines**
4															
6		2	Vx Vr	F4*	7 21 28	ML	**Gravelly SILT**					1.5		18	**Brown, frozen with ice as Vx and Vr to 1/8 inch, angular gravel, fine to coarse sand, NP fines**
8															
10		3	Vr	F4*	10 15 21	ML	**Gravelly SILT**					1			**Brown, frozen with ice as Vr to 1 inch, estimated 40 percent ice by volume, angular gravel, NP fines**
12															
14															
16		4	Vr	F4*	7 15 20	ML	**Gravelly SILT**					0.75			**Reddish brown, frozen, estimated 30 percent ice by volume, angular gravel, fine to medium sand, NP fines**
18															**Bottom of Hole 16.5 ft.** **Elevation 203.5 ft. ±**
20															**PID = (Cold/Hot) Photo Ionization Detector**
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **13 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,492,925 ft. ±** Easting: **1,908,475 ft. ±**

Top of Hole Elevation: **268.0 ft. ±**

Hole Number, Field: **TB 12** Permanent: **AP-12**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **15.0 ft.**

Total Depth: **15.8 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: tundra, rock on surface in area** **Dark brown peat to 12 inches**
2		1	Vx Vr	F4*	4 11 15	ML	**SILT**							32	**Brown, frozen, estimated 50 percent ice by volume, nonplastic fines**
6		2	Vx	F4	6 13 18	ML	**Sandy SILT**	1	37	62				47	**Black and orange (volcanic ash), frozen with ice as Vx to 1/8 inch, estimated 30 percent ice by volume, fine sand, low plasticity fines**
10		3	Vx	F4*	7 12 14	ML	**SILT with Sand**								**Black and orange (volcanic ash), frozen with ice as Vx to 1/8 inch, estimated 15 percent ice by volume, fine sand, low plasticity fines**
16		4	Vx Vr	F3*	22 50/5"	ML	**SILT with Sand**					1			**Brown and black, frozen with ice as Vx and Vr to 1/8 inch, angular gravel, fine to medium sand, low plasticity fines** **Bottom of Hole 15.8 ft.** **Elevation 252.2 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **13 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,492,532 ft. ±** Easting: **1,907,947 ft. ±**

Top of Hole Elevation: **299.0 ft. ±**

Hole Number, Field:	Permanent:	Operator:	Inspector:
TB 13	**AP-13**	**Lyle Cain**	**Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **10.0 ft.**

Total Depth: **11.0 ft.**

Hammer Weight:	Split Spoon I.D.:	Size and Type of Bit:	Type of Equipment:	Type of Samples:
340 lbs	**2.5 in.**	**8 in. HSA**	**Mobile B-61 Nodwell**	**Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra, adjacent to a drainage** **Dark brown peat to 12 inches**
6		1	Vx Vr	F4*	5 9 20	ML	**SILT**								**Brown and reddish brown mottled, frozen with ice as Vx and Vr to 1/4 inch, estimated 30 percent ice by volume, nonplastic (NP)**
10		2	Vx	F3*	10 52	SM	**Silty SAND**							16	**Brown and grey, frozen with ice as Vx to 1/8 inch, fine sand, Atterbergs: Nonplastic (weathered rock)** **Auger refusal at 11.0 feet** **Bottom of Hole 11.0 ft.** **Elevation 288.0 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **13 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,492,915 ft. ±** Easting: **1,908,344 ft. ±**

Top of Hole Elevation: **301.0 ft. ±**

Hole Number, Field: **TB 14** Permanent: **AP-14**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other ☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **14.0 ft.**

Total Depth: **14.0 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
0						PT	**PEAT**								**SURFACE: Tundra, 15 feet from a drainage** **Dark brown peat to 12 inches**
6		1	Vx	F4*	4 8 13	ML	**SILT**							30	**Grey and brown mottled, frozen with ice as Vx to 1/8 inch, low plasticity**
10		2	Vx	F3*	8 23 32	SM	**Silty SAND**	7	49	44				29	**Black, yellow, orange and brown mottled, frozen with ice as Vx to 1/8 inch, angular gravel, fine sand, low plasticity fines (residual rock)**
14															**Auger refusal at 14 feet** **Bottom of Hole 14.0 ft.** **Elevation 287.0 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **14 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,491,578 ft. ±** Easting: **1,908,721 ft. ±**

Top of Hole Elevation: **300.0 ft. ±**

Hole Number, Field: **TB 15** Permanent: **AP-15**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **22.0 ft.**

Total Depth: **22.0 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
0						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 24 inches**
2															
4															
6		1	Vx Vr	F4*	1 4 6	ML	**SILT**							52	**Brown, frozen, estimated 60 percent ice by volume, Atterbergs: Nonplastic (NP)**
8															
10		2	Vx Vr	F3*	5 7 8	SM	**Silty SAND**	11	45	44				31	**Brown and black mottled, frozen, estimated 40 percent ice by volume, angular gravel, fine sand, NP fines (residual rock)** **Easy drilling from 11 to 15 feet**
12															
14															
16		3			3 3 4	Bx	**BEDROCK**							32	**Red, black and brown mottled, weathered basalt**
18															
20		4			10 20 17	Bx	**BEDROCK**							12	**Grey, weathered vasicular basalt**
22															**Auger refusal at 22 feet** **Bottom of Hole 22.0 ft.** **Elevation 278.0 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

Project: **Mertarvik Townsite**

Hole Number: **AP-15**

EXPLORATION LOG NEWTOK.GPJ ACE_ANC.GDT 20/2/08

ALASKA DISTRICT
CORPS OF ENGINEERS
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EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **10 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,494,834 ft. ±** Easting: **1,910,210 ft. ±**

Top of Hole Elevation: **148.0 ft. ±**

Hole Number, Field: **TB 16** Permanent: **AP-16**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **20.0 ft.**

Total Depth: **20.1 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
					PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 24 inches**
2														
4														
6	1	Nbe Vx	F4*	4 9 22	ML	**SILT**	7	5	88		2		25	**Brown, frozen, angular gravel, fine to coarse sand, nonplastic (NP)**
8														
10	2	Vx	F4	7 21 33	ML	**Sandy SILT**	12	36	52				19	**Reddish brown, frozen with ice as Vx to 1/8 inch, angular gravel, fine sand, NP fines**
12														
14														
16	3	Vx	F4*	12 30 50/5"	ML	**SILT with Gravel and Sand**							12	**Reddish brown, frozen, angular gravel, fine to coarse sand, NP fines**
18														**Weathered rock below 16.5 feet** **Hard drilling from 15 to 20 feet**
20	4			30/1"	Bx	**BEDROCK**								**Sampler refusal on rock** **Bottom of Hole 20.1 ft.** **Elevation 127.9 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**
22														
24														
26														
28														
30														
32														

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **14 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,491,654 ft. ±** Easting: **1,907,987 ft. ±**

Top of Hole Elevation: **323.0 ft. ±**

Hole Number, Field:	Permanent:	Operator:	Inspector:
TB 17	**AP-17**	**Lyle Cain**	**Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **12.0 ft.**

Total Depth: **12.0 ft.**

Hammer Weight:	Split Spoon I.D.:	Size and Type of Bit:	Type of Equipment:	Type of Samples:
340 lbs	**2.5 in.**	**8 in. HSA**	**Mobile B-61 Nodwell**	**Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra, 25 feet from a drainage** **Dark brown peat to 18 inches**
2															
4															
6		1	Vx Vr	F4*	6 10	ML	**SILT**							23	**Grey and dark brown mottled, frozen with ice as Vx and Vr to 3/8 inch, estimated 35 percent ice by volume, Atterbergs: Nonplastic (NP)**
8															
10		2	Vx		13 31 50/4"	Bx	**Weathered Rock**							28	**Dark grey and brown, frozen, weathered vasicular basalt with ice crystals in the voids**
12															**Auger refusal at 12 feet** **Bottom of Hole 12.0 ft.** **Elevation 311.0 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**
14															
16															
18															
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

Project: **Mertarvik Townsite**

Hole Number: **AP-17**

EXPLORATION LOG NEWTOK.GPJ ACE_ANC.GDT 20/2/08

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **13 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,492,270 ft. ±** Easting: **1,907,664 ft. ±**

Top of Hole Elevation: **316.0 ft. ±**

Hole Number, Field: **TB 18** Permanent: **AP-18**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **10.0 ft.**

Total Depth: **10.3 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
0						PT	PEAT								Dark brown peat to 24 inches
2															
4															
6		1	Vx	F4*	5 12 17	ML	SILT							33	Grey, black and brown mottled, frozen with ice as Vx to 1/8 inch, low plasticity (residual bedrock)
8															
10		2			50/4"	Bx	Weathered Rock								Weathered vasicular basalt
															Bottom of Hole 10.3 ft. Elevation 305.7 ft. ± PID = (Cold/Hot) Photo Ionization Detector
12															
14															
16															
18															
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **13 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,492,761 ft. ±** Easting: **1,907,446 ft. ±**

Top of Hole Elevation: **286.0 ft. ±**

Hole Number, Field: **TB 19** Permanent: **AP-19**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **10.0 ft.**

Total Depth: **10.2 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
0						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 18 inches**
2															
4															
6		1		F2*	4 6 20	SM	**Silty SAND with Gravel**	25	54	21		0.75		16	**Brown, moist, angular gravel, fine to coarse sand, nonplastic fines (weathered basalt)**
8															
10		2			50/2"	Bx	**BEDROCK**								**Rust colored vasicular basalt** **Bottom of Hole 10.2 ft.** **Elevation 275.8 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**
12															
14															
16															
18															
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **14 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,492,245 ft. ±** Easting: **1,906,627 ft. ±**

Top of Hole Elevation: **307.0 ft. ±**

Hole Number, Field: **TB20** Permanent: **AP-20**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other ☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **7.0 ft.**

Total Depth: **7.0 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	PEAT								SURFACE: Tundra Dark brown peat to 18 inches
2				F4*		ML	SILT								Brown, nonplastic (NP), no recovery (classified from cuttings)
4		1		S1*	17 28 20	Bx	Highly Weathered Bedrock					2.5		4	Brown, moist, angular gravel, fine to coarse sand, NP fines (weathered bedrock)
6															Auger refusal at 7 feet
8															Bottom of Hole 7.0 ft. Elevation 300.0 ft. ± PID = (Cold/Hot) Photo Ionization Detector
10															
12															
14															
16															
18															
20															
22															
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **15 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,491,858 ft. ±** Easting: **1,906,000 ft. ±**

Top of Hole Elevation: **311.0 ft. ±**

Hole Number, Field: **TB 21** Permanent: **AP-21**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **20.0 ft.**

Total Depth: **21.5 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 24 inches**
2															
4															
6		1		F4*	3 5 8	ML	**SILT**								**Reddish brown, wet, nonplastic (NP) fines, no recovery (classified from cuttings)**
8															
10		2		F3*	6 11 9	SM	**Silty SAND**	0	62	38				23	**Reddish brown with black spots, moist, fine sand, NP fines**
12															
14															
16		3			5 6 9	Bx	**Highly Weathered Bedrock**							30	**Red and black, weathered vasicular basalt**
18															
20		4			19 35 50	Bx	**Weathered Rock**							18	**Red, black and yellow, weathered vasicular basalt**
22															**Bottom of Hole 21.5 ft.** **Elevation 289.5 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**
24															
26															
28															
30															
32															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **15 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,492,870 ft. ±** Easting: **1,905,050 ft. ±**

Top of Hole Elevation: **167.0 ft. ±**

Hole Number, Field: **TB 22** Permanent: **AP-22**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **22.0 ft.**

Total Depth: **22.0 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 12 inches**
6		1		F2*	11 12 10	GM	**Silty GRAVEL with Sand**	59	18	23		2.5		11	**Brown silt and black gravel, moist, angular gravel, fine to coarse sand, nonplastic (NP) fines**
10		2		F4*	10 15 18	ML	**SILT**					>			**No recovery, driving on a rock, classified from cuttings**
16		3		F4*	10 15 21	ML	**SILT with Gravel**								**Brown, moist, angular gravel, NP fines**
20		4			20 26 16										**No recovery** **Grinding on rock at 21 feet** **Auger refusal at 22 feet**
															Bottom of Hole 22.0 ft. **Elevation 145.0 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **14 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,491,358 ft. ±** Easting: **1,906,308 ft. ±**

Top of Hole Elevation: **321.0 ft. ±**

Hole Number, Field: **TB 23** Permanent: **AP-23**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **30.0 ft.**

Total Depth: **31.5 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
					PT	PEAT								Dark brown peat to 18 inches
6	1	Vx	F4*	5 28 50	ML	SILT	5	18	77		2		27	Brown and grey mottled, frozen, (one rock in the sample), nonplastic (NP) fines
10	2	Vx	F4*	5 10 14	ML	SILT							43	Brown, black and orange, frozen with ice as Vx to 1/8 inch, Atterbergs: Nonplastic Hard drilling from 10 to 15 feet
16	3	Vx	F4*	5 13 17	ML	SILT					0.5		43	Brown and rust mottled, frozen with ice as Vx to 1/8 inch, angular gravel, fine to medium sand, NP fines
20	4	Vx Vr		7 14 42	ML	SILT							44	Reddish brown with random black streaks, frozen with ice as Vx and Vr to 1/4 inch, NP fines
26	5	Vx		6 9 17	ML	SILT							50	Brown, black and orange mottled, frozen, Atterbergs: Nonplastic
30	6	Vx	*	8 16 22	ML	SILT							45	Brown, black and yellow mottled, frozen, fine sand, low plasticity fines
32														Bottom of Hole 31.5 ft. Elevation 289.5 ft. ± PID = (Cold/Hot) Photo Ionization Detector

* Indicates Estimated Frost Classification

EXPLORATION LOG NEWTOK.GPJ ACE_ANC.GDT 20/2/08

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: **Mertarvik Townsite**
Newtok, Alaska

Date: **14 Sep 2007**

Drilling Agency: ☐ Alaska District ☒ Other **Denali Drilling**

Datum: Vertical / Horizontal

Location: Northing: **2,491,753 ft. ±** Easting: **1,906,941 ft. ±**

Top of Hole Elevation: **320.0 ft. ±**

Hole Number, Field: **TB 24** Permanent: **AP-24**

Operator: **Lyle Cain**

Inspector: **Gregory Carpenter**

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: **13.5 ft.**

Total Depth: **13.5 ft.**

Hammer Weight: **340 lbs**

Split Spoon I.D.: **2.5 in.**

Size and Type of Bit: **8 in. HSA**

Type of Equipment: **Mobile B-61 Nodwell**

Type of Samples: **Drive-Rope & Cathead**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
0						PT	**PEAT**								**SURFACE: Tundra** **Dark brown peat to 18 inches**
6		1	Vx Vr	F4*	4 7 11	ML	**SILT**							30	**Grey and brown mottled, frozen with ice as Vx and Vr to 1/4 inch, estimated 30 percent ice by volume, Atterbergs: Nonplastic (NP)** **Hard drilling from 6 to 10 feet**
10		2	Vx Vr	F4*	10 14 50/4"	ML	**SILT**					1.5		26	**Grey, black and brown mottled, frozen with ice as Vx and Vr to 3/8 inch, estimated 30 percent ice by volume, angular gravel, NP fines**
14															**Auger refusal at 13.5 feet** **Bottom of Hole 13.5 ft.** **Elevation 306.5 ft. ±** **PID = (Cold/Hot) Photo Ionization Detector**

* Indicates Estimated Frost Classification

Appendix B

Grain-size distribution curves

U.S. ARMY CORPS OF ENGINEERS
SOILS AND GEOLOGY SECTION, ALASKA DISTRICT

Newtok Relocation

Boring I.D (Field)	Sample Number	Depth Interval Top	Depth Interval Bottom	Moisture Content (%)	Organic Content (%)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Particle Size Analysis Gravel	Particle Size Analysis Sand	Particle Size Analysis Silt	Passing -#200 (%)	Passing 0.02mm (%)	Frost Class.	Unified Soil Classification
TB-1	SA-1	2.0	3.5	**20.3**	**5.7**		**NP**								
TB-1	SA-2	5.0	6.5	**39.6**			**NP**								
TB-1	SA-3	10.0	11.5						**31.9**	**31.8**	**36.3**				**(GM) Silty gravel with sand**
TB-2	SA-1	2.0	3.5	**19.7**			**NP**								
TB-2	SA-2	5.0	6.5	**19.9**			**NP**								
TB-3	SA-1	2.0	3.5	**25.1**			**NP**								
TB-3	SA-2	5.0	6.5	**26.2**			**NP**								
TB-3	SA-3	10.0	11.5						**1.0**	**42.5**	**56.5**				**(ML) Sandy silt**
TB-4	SA-1	2.0	3.5	**22.5**			**NP**								
TB-4	SA-2	5.0	6.5	**21.6**											
TB-5	SA-1	2.0	3.5	**39.7**		**34**	**31**	**3**							
TB-5	SA-2	5.0	6.5	**24.9**											
TB-6	SA-1	2.0	3.5	**27.6**			**NP**								
TB-6	SA-2	5.0	6.5	**74.9**											
TB-6	SA-3	10.0	11.5						**54.2**	**10.4**	**35.4**				**(GM) Silty gravel**
TB-7	SA-1	2.0	3.5	**5.7**											
TB-7	SA-2	5.0	6.5	**22.0**			**NP**								
TB-8	SA-1	2.0	3.5	**17.0**			**NP**								
TB-8	SA-2	5.0	6.5	**19.6**											
TB-9	SA-1	2.0	3.5	**5.5**					**80.8**	**9.7**	**9.5**				**(GP-GM) Poorly graded gravel with silt**
TB-10	SA-1	2.0	3.5	**7.0**											
TB-10	SA-2	5.0	5.8						**3.6**	**7.5**	**88.9**				**(ML) Silt**
TB-11	SA-1	2.0	3.5	**21.3**					**18.7**	**7.7**	**73.6**				**(ML) Silt with gravel**
TB-11	SA-2	5.0	6.5	**18.1**											
TB-12	SA-1	2.0	3.5	**32.4**			**NP**								
TB-12	SA-2	5.0	6.5	**46.6**					**0.9**	**36.9**	**62.2**				**(ML) Sandy silt**
TB-13	SA-1	5.0	6.5												
TB-13	SA-2	10.0	11.0	**16.4**			**NP**								
TB-14	SA-1	5.0	6.5	**29.7**			**NP**								
TB-14	SA-2	10.0	11.0	**29.0**					**6.9**	**48.9**	**44.2**				**(SM) Silty sand**
TB-15	SA-1	5.0	6.5	**51.8**			**NP**								
TB-15	SA-2	10.0	11.5	**31.2**					**11.1**	**45.4**	**43.5**				**(SM) Silty sand**
TB-15	SA-3	15.0	16.8	**32.2**											

U.S. ARMY CORPS OF ENGINEERS
SOILS AND GEOLOGY SECTION, ALASKA DISTRICT

Newtok Relocation

TB-15	SA-4	20.0	21.5	**11.9**											
TB-16	SA-1	5.0	6.5	**25.2**					**7.4**	**4.6**	**88.0**				**(ML) Silt**
TB-16	SA-2	10.0	11.5	**18.7**					**12.1**	**36.2**	**51.7**				**(ML) Sandy silt**
TB-16	SA-3	15.0	16.4	**12.4**											
TB-17	SA-1	5.0	6.5	**23.0**			**NP**								
TB-17	SA-2	10.0	11.3	**28.2**											
TB-18	SA-1	5.0	6.5	**33.2**			**NP**								
TB-19	SA-1	5.0	6.5	**15.8**					**25.0**	**53.5**	**21.5**				**(SM) Silty sand with gravel**
TB-20	SA-1	5.0	6.5	**4.1**					**66.8**	**25.9**	**7.3**				**(GP-GM) Well graded gravel with silt and sand**
TB-21	SA-2	10.0	11.5	**22.9**					**0.0**	**62.0**	**38.0**				**(SM) Silty sand**
TB-21	SA-3	15.0	16.8	**30.2**											
TB-21	SA-4	20.0	21.5	**17.9**											
TB-22	SA-1	5.0	6.5	**10.7**					**59.5**	**18.0**	**22.5**				**(GM) Silty gravel with sand**
TB-23	SA-1	5.0	6.5	**27.4**					**5.1**	**18.0**	**76.9**				**(ML) Silt with sand**
TB-23	SA-2	10.0	11.5	**43.3**			**NP**								
TB-23	SA-3	15.0	16.8	**42.8**											
TB-23	SA-4	20.0	21.5	**43.7**											
TB-23	SA-5	25.0	26.5	**49.9**			**NP**								
TB-23	SA-6	30.0	31.5	**44.5**											
TB-24	SA-1	5.0	6.5	**30.0**			**NP**								
TB-24	SA-2	10.0	11.5	**25.6**											

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Anchorage, AK 99515

TERRA FIRMA TESTING

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www.nge-tft.com

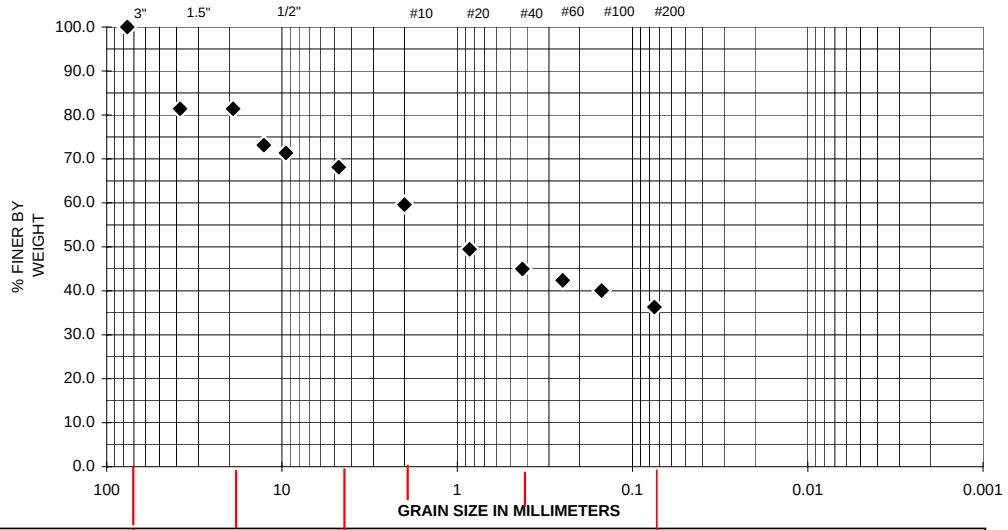
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-1**
SAMPLE NO/ DEPTH	**SA-3 (10.0'-11.5')**
DESCRIPTION:	**Silty gravel w/ sand**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**31.9**	USC:	**GM**
% SAND:	**31.8**	FC:	
% SILT/CLAY:	**36.3**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**12.7**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

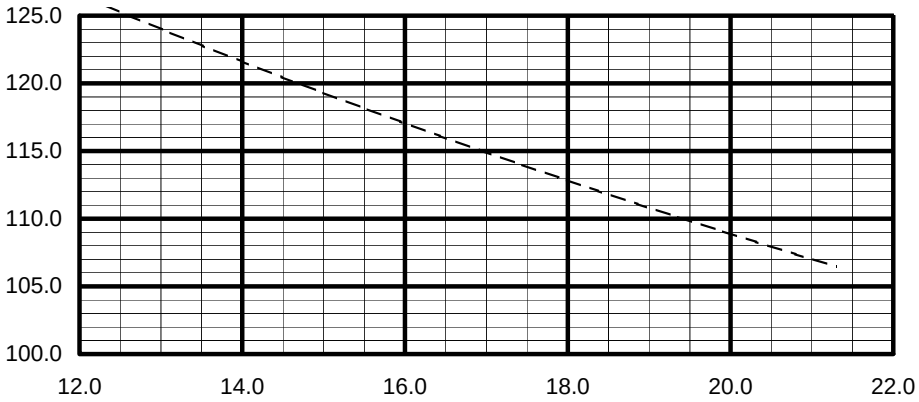
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"	**100**	
38.1	1.5"	**81**	
19.05	3/4"	**81**	
12.7	1/2"	**73**	
9.5	3/8"	**71**	
4.75	# 4	**68**	
2	#10	**60**	
0.85	#20	**49**	
0.425	#40	**45**	
0.25	# 60	**42**	
0.15	#100	**40**	
0.075	#200	**36.3**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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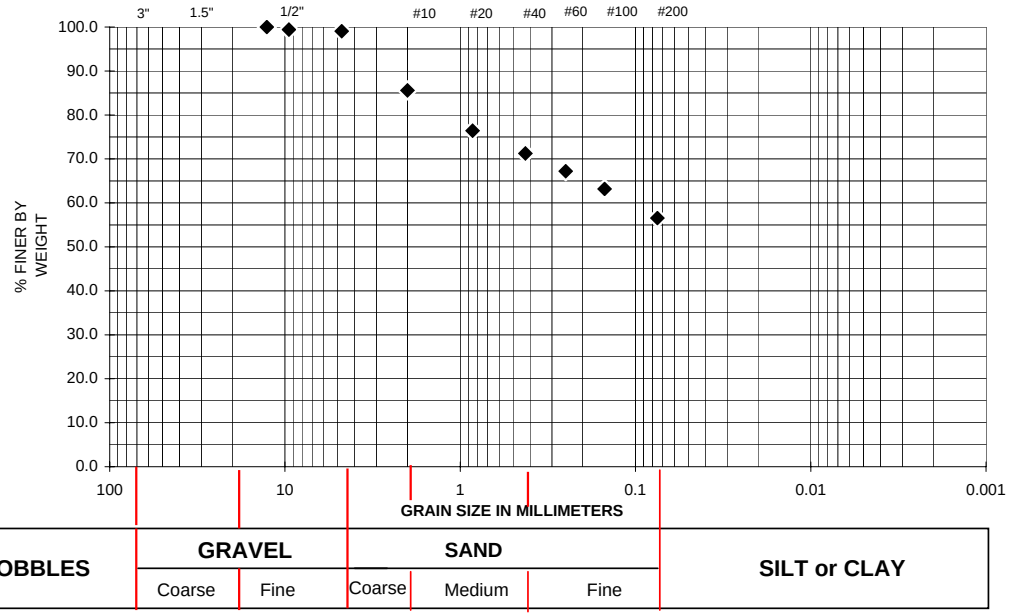
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-3**
SAMPLE NO/ DEPTH	**SA-3 (10.0'-11.5')**
DESCRIPTION:	**Sandy silt**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**1.0**	USC:	**ML**
% SAND:	**42.5**	FC:	
% SILT/CLAY:	**56.5**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**23.8**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

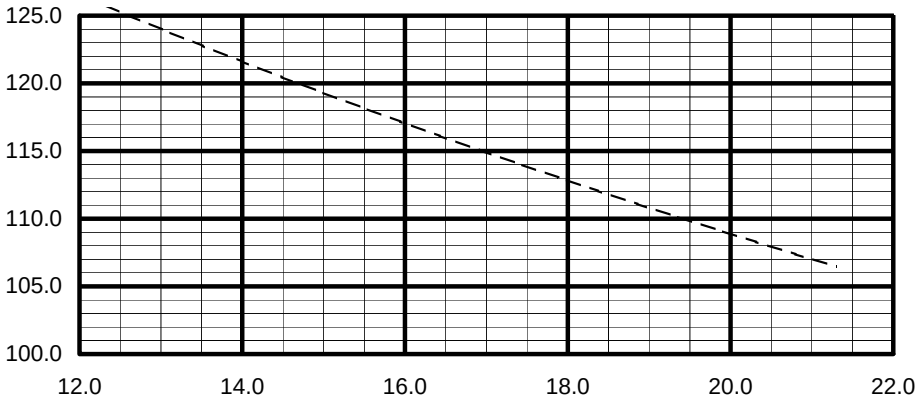
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"	**100**	
9.5	3/8"	**99**	
4.75	# 4	**99**	
2	#10	**86**	
0.85	#20	**76**	
0.425	#40	**71**	
0.25	# 60	**67**	
0.15	#100	**63**	
0.075	#200	**56.5**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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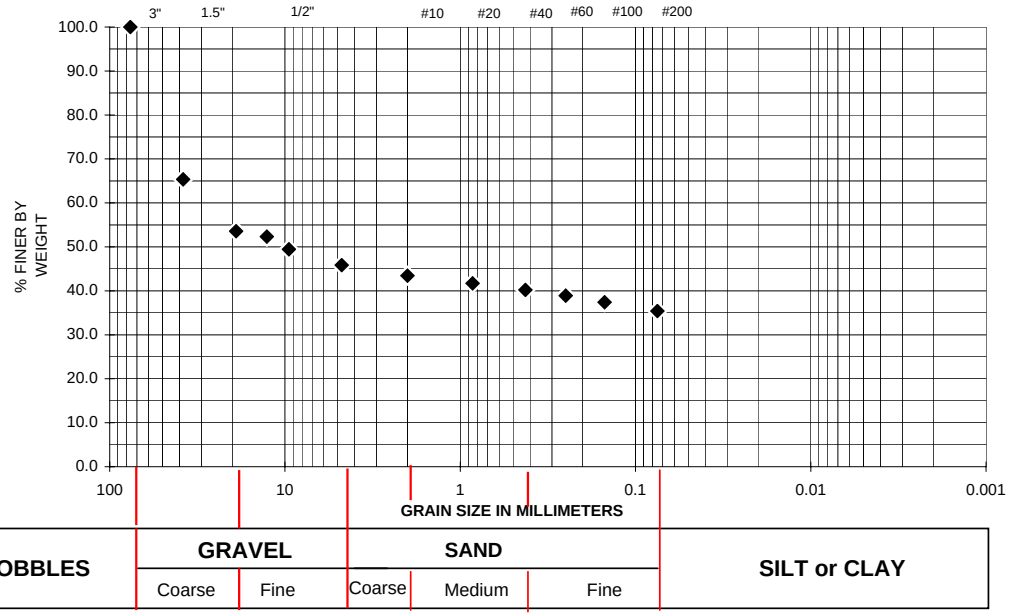
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-6**
SAMPLE NO/ DEPTH	**SA-3 (10.0'-11.5')**
DESCRIPTION:	**Silty gravel**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**54.2**	USC:	**GM**
% SAND:	**10.4**	FC:	
% SILT/CLAY:	**35.4**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**10.3**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

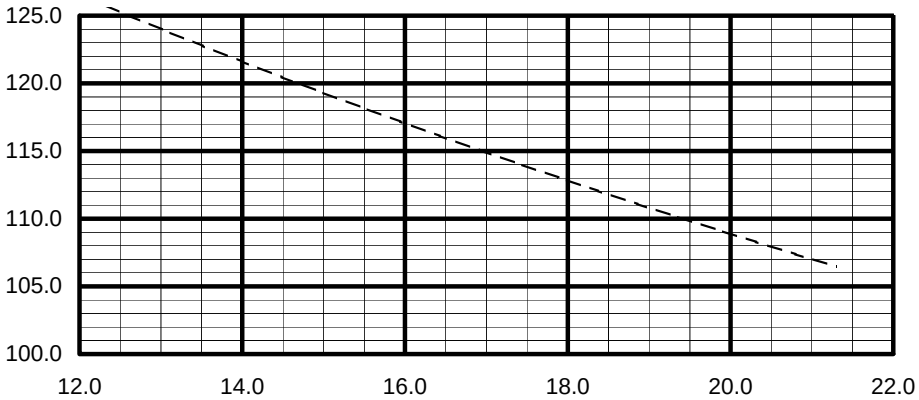
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"	**100**	
38.1	1.5"	**65**	
19.05	3/4"	**54**	
12.7	1/2"	**52**	
9.5	3/8"	**49**	
4.75	# 4	**46**	
2	#10	**43**	
0.85	#20	**42**	
0.425	#40	**40**	
0.25	# 60	**39**	
0.15	#100	**37**	
0.075	#200	**35.4**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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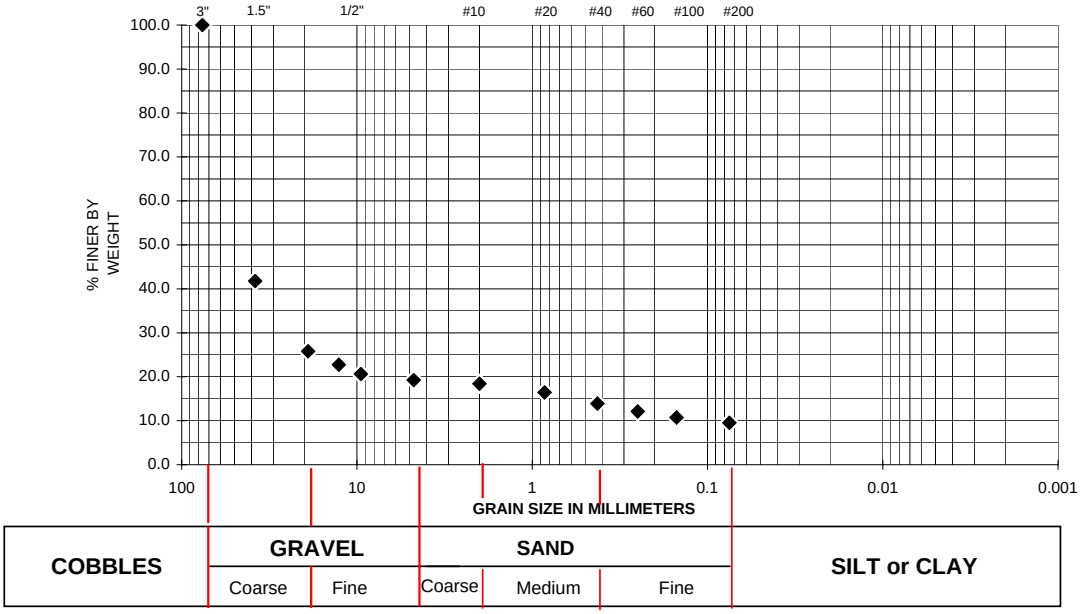
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-9**
SAMPLE NO/ DEPTH	**SA-1 (2.0'-3.5')**
DESCRIPTION:	**Poorly grd. gravel w/ silt**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**80.8**	USC:	**GP-GM**
% SAND:	**9.7**	FC:	
% SILT/CLAY:	**9.5**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**5.5**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

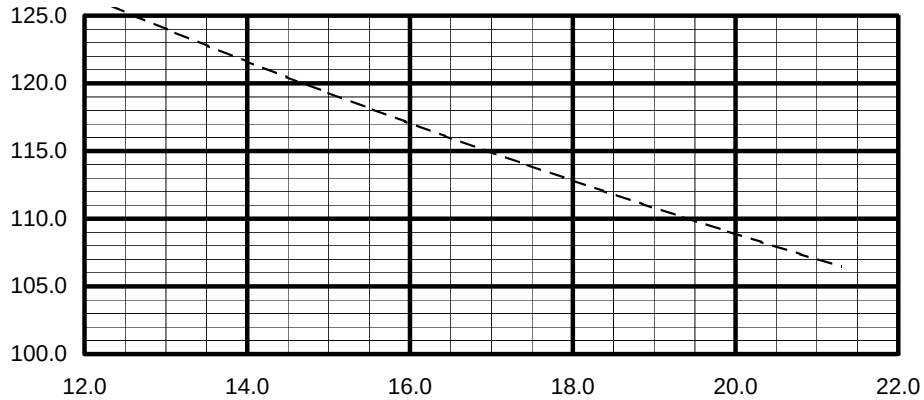
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"	**100**	
38.1	1.5"	**42**	
19.05	3/4"	**26**	
12.7	1/2"	**23**	
9.5	3/8"	**21**	
4.75	# 4	**19**	
2	#10	**18**	
0.85	#20	**16**	
0.425	#40	**14**	
0.25	# 60	**12**	
0.15	#100	**11**	
0.075	#200	**9.5**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
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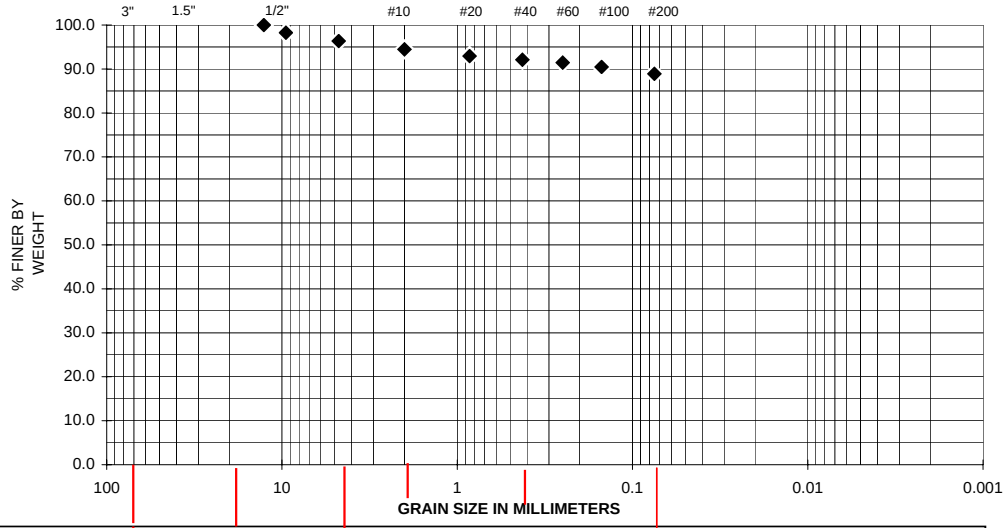
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-10**
SAMPLE NO/ DEPTH	**SA-2 (5.0'-8.3')**
DESCRIPTION:	**Silt**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**3.6**	USC:	**ML**
% SAND:	**7.5**	FC:	
% SILT/CLAY:	**88.9**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**22.5**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

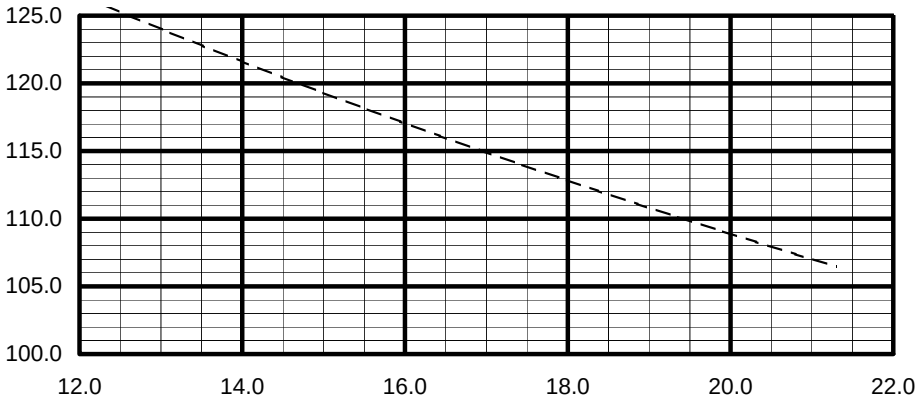
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"	**100**	
9.5	3/8"	**98**	
4.75	# 4	**96**	
2	#10	**94**	
0.85	#20	**93**	
0.425	#40	**92**	
0.25	# 60	**91**	
0.15	#100	**90**	
0.075	#200	**88.9**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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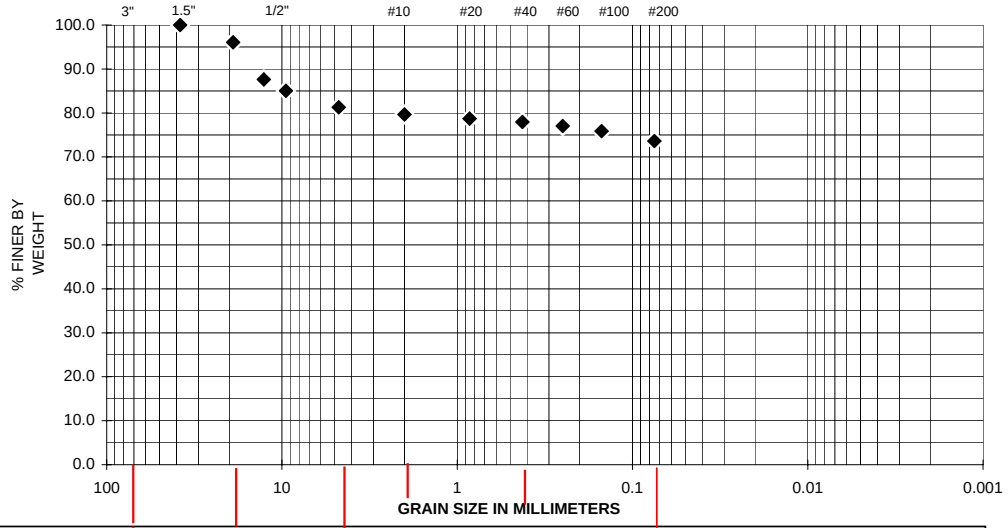
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-11**
SAMPLE NO/ DEPTH	**SA-1 (2.0'-3.5')**
DESCRIPTION:	**Silt with gravel**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**18.7**	USC:	**ML**
% SAND:	**7.7**	FC:	
% SILT/CLAY:	**73.6**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**21.3**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

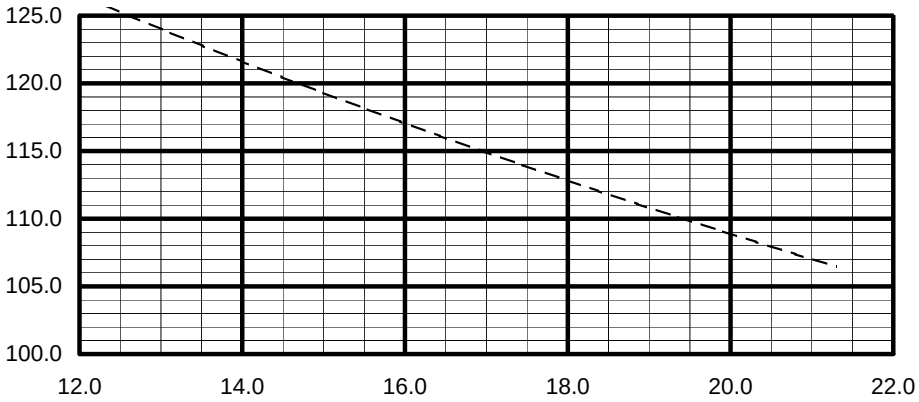
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	**100**	
19.05	3/4"	**96**	
12.7	1/2"	**88**	
9.5	3/8"	**85**	
4.75	# 4	**81**	
2	#10	**80**	
0.85	#20	**79**	
0.425	#40	**78**	
0.25	# 60	**77**	
0.15	#100	**76**	
0.075	#200	**73.6**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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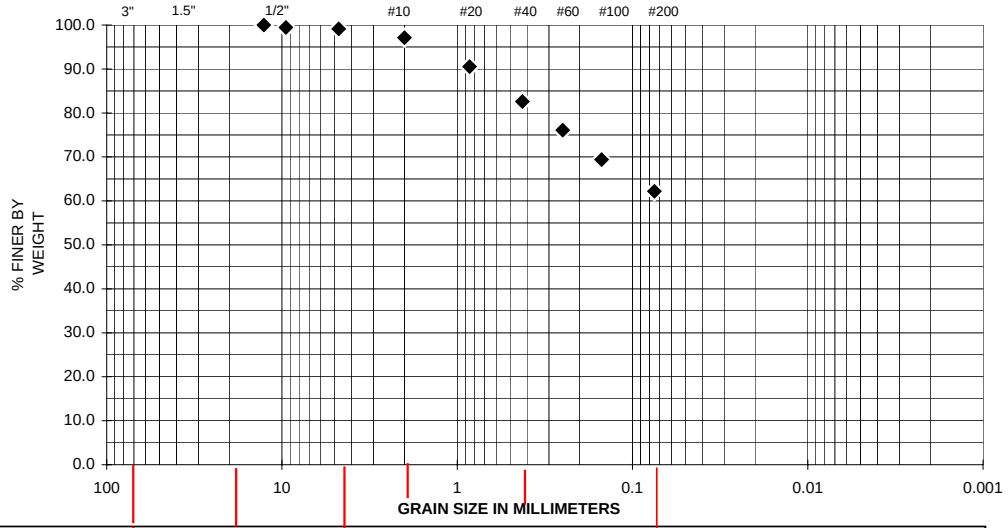
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-12**
SAMPLE NO/ DEPTH	**SA-2 (5.0'-6.5')**
DESCRIPTION:	**Sandy silt**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**0.9**	USC:	**ML**
% SAND:	**36.9**	FC:	
% SILT/CLAY:	**62.2**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**46.6**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

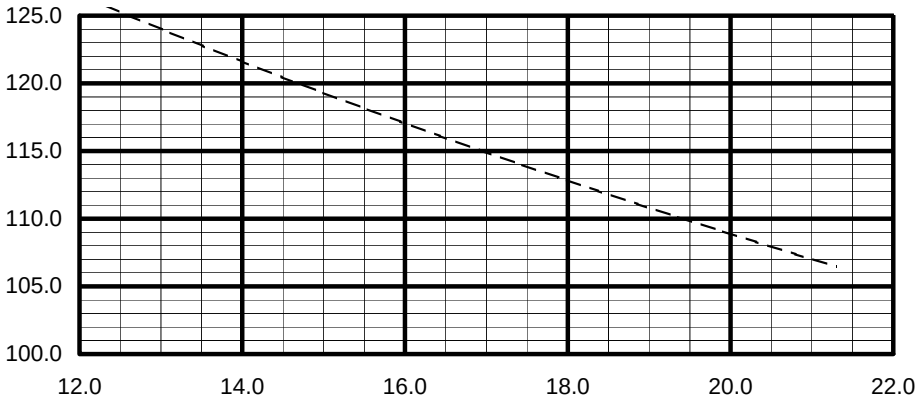
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"	**100**	
9.5	3/8"	**99**	
4.75	# 4	**99**	
2	#10	**97**	
0.85	#20	**91**	
0.425	#40	**83**	
0.25	# 60	**76**	
0.15	#100	**69**	
0.075	#200	**62.2**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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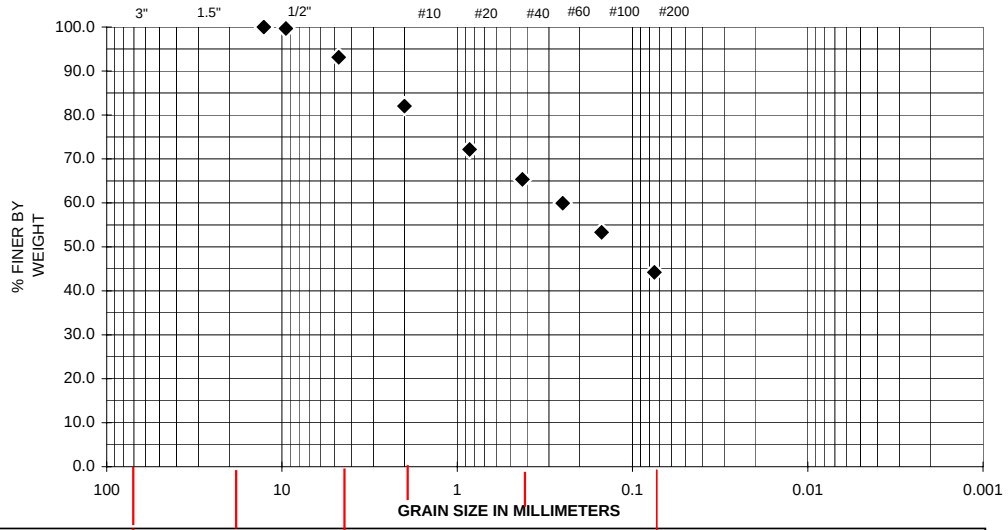
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-14**
SAMPLE NO/ DEPTH	**SA-2 (10.0'-11.5')**
DESCRIPTION:	**Silty sand.**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**6.9**	USC:	**SM**
% SAND:	**48.9**	FC:	
% SILT/CLAY:	**44.2**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**29.0**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

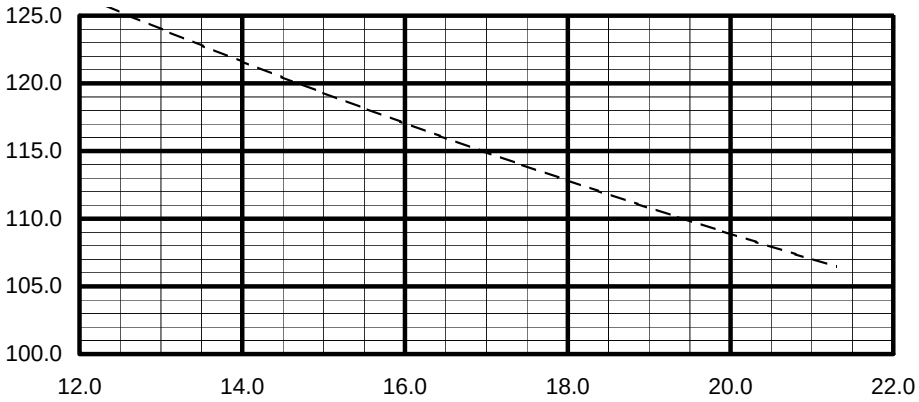
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"	**100**	
9.5	3/8"	**100**	
4.75	# 4	**93**	
2	#10	**82**	
0.85	#20	**72**	
0.425	#40	**65**	
0.25	# 60	**60**	
0.15	#100	**53**	
0.075	#200	**44.2**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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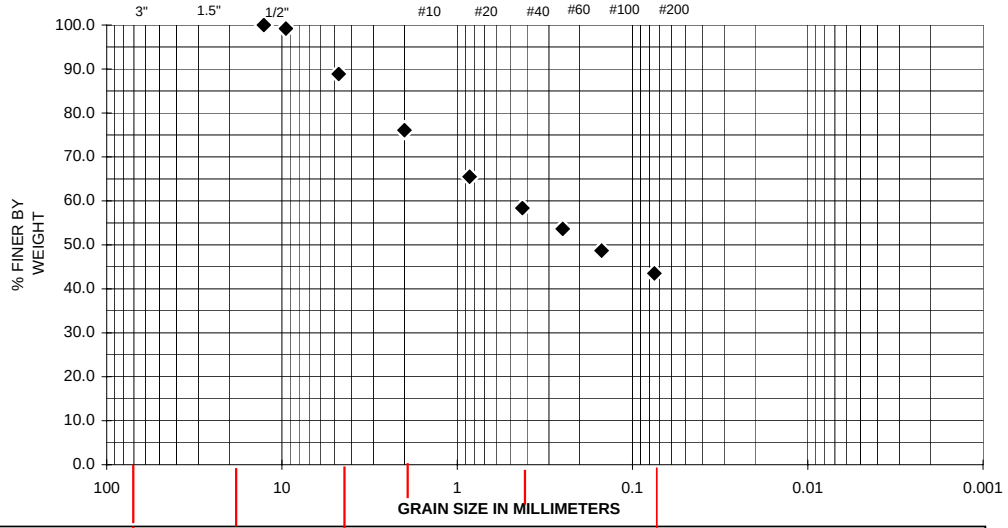
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-15**
SAMPLE NO/ DEPTH	**SA-2 (10.0'-11.5')**
DESCRIPTION:	**Silty sand.**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**11.1**	USC:	**SM**
% SAND:	**45.4**	FC:	
% SILT/CLAY:	**43.5**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**31.2**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

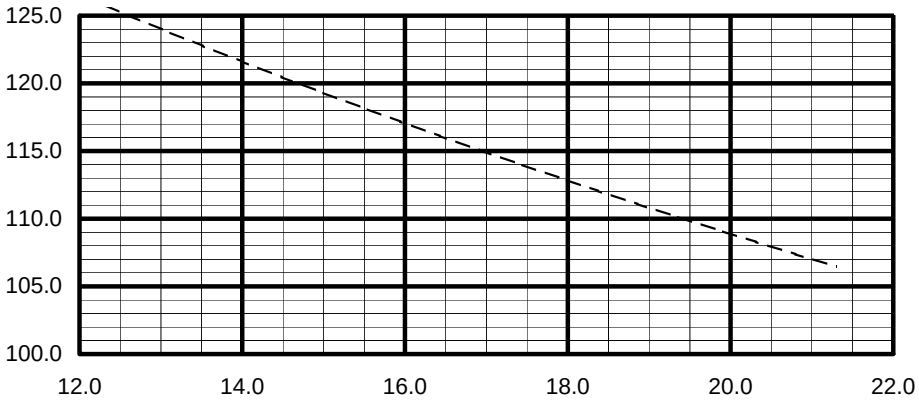
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"	**100**	
9.5	3/8"	**99**	
4.75	# 4	**89**	
2	#10	**76**	
0.85	#20	**66**	
0.425	#40	**58**	
0.25	# 60	**54**	
0.15	#100	**49**	
0.075	#200	**43.5**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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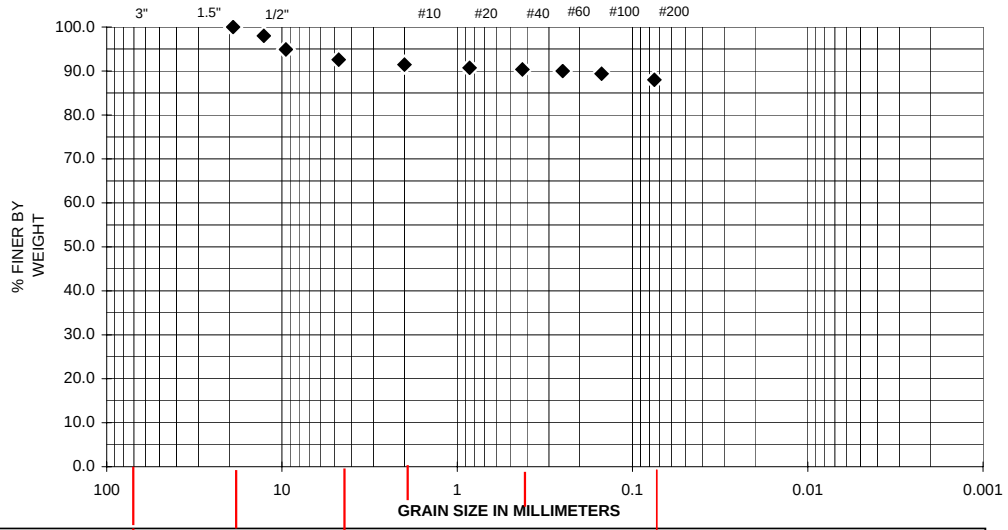
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-16**
SAMPLE NO/ DEPTH	**SA-1 (5.0'-6.5')**
DESCRIPTION:	**Silt**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**7.4**	USC:	**ML**
% SAND:	**4.6**	FC:	
% SILT/CLAY:	**88.0**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**25.2**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

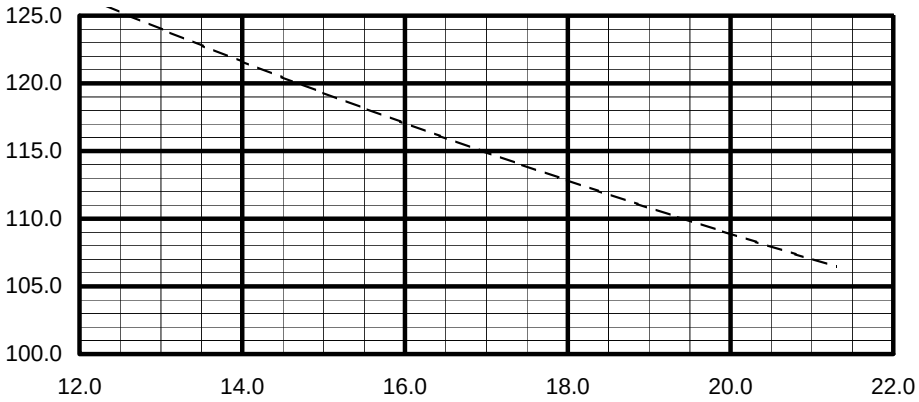
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"	**100**	
12.7	1/2"	**98**	
9.5	3/8"	**95**	
4.75	# 4	**93**	
2	#10	**91**	
0.85	#20	**91**	
0.425	#40	**90**	
0.25	# 60	**90**	
0.15	#100	**89**	
0.075	#200	**88.0**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

11301 Olive Lane
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TERRA FIRMA TESTING

Laboratory Testing / Construction Monitoring

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Fax: (907) 344-5993
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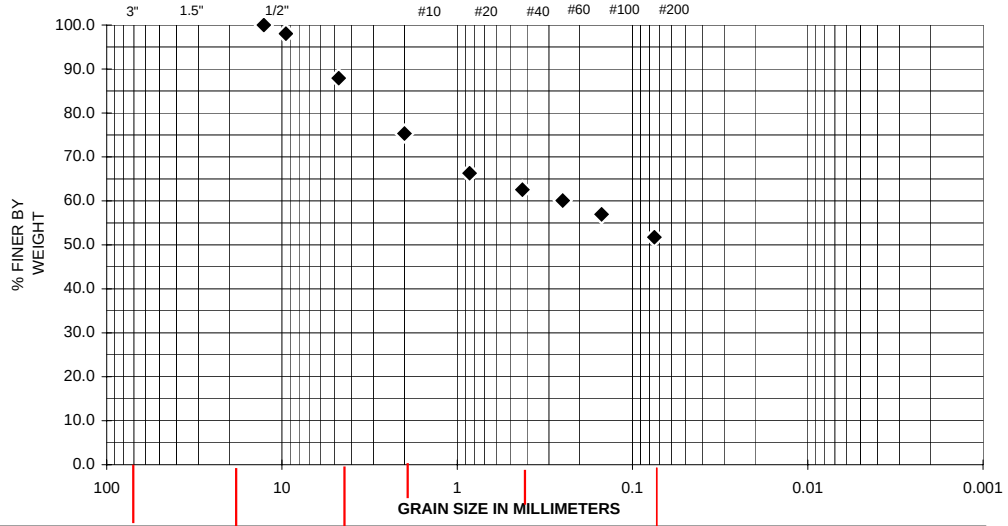
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-16**
SAMPLE NO/ DEPTH	**SA-2 (10.0'-11.5')**
DESCRIPTION:	**Sandy silt**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**12.1**	USC:	**ML**
% SAND:	**36.2**	FC:	
% SILT/CLAY:	**51.7**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**18.7**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

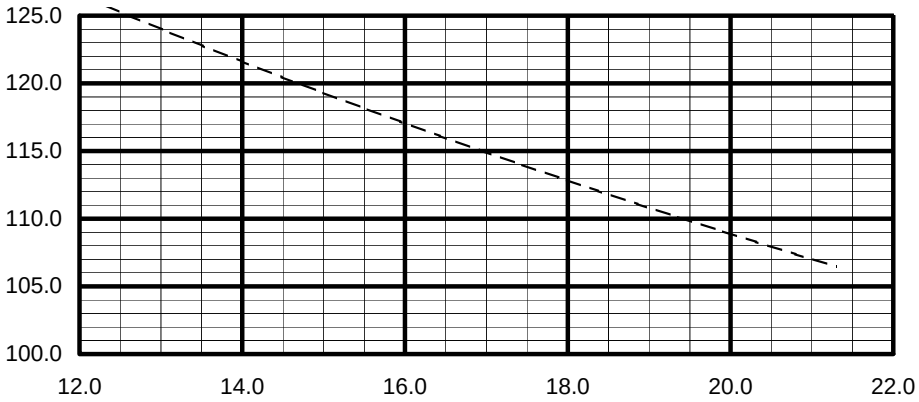
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"	**100**	
9.5	3/8"	**98**	
4.75	# 4	**88**	
2	#10	**75**	
0.85	#20	**66**	
0.425	#40	**63**	
0.25	# 60	**60**	
0.15	#100	**57**	
0.075	#200	**51.7**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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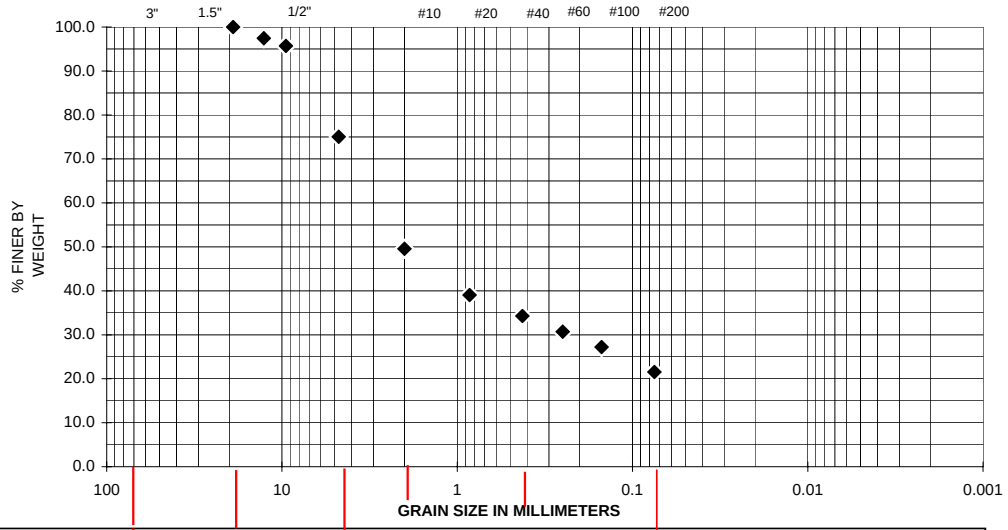
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-19**
SAMPLE NO/ DEPTH	**SA-1 (5.0'-6.5')**
DESCRIPTION:	**Silty sand w/ gravel**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**25.0**	USC:	**SM**
% SAND:	**53.5**	FC:	
% SILT/CLAY:	**21.5**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**15.8**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

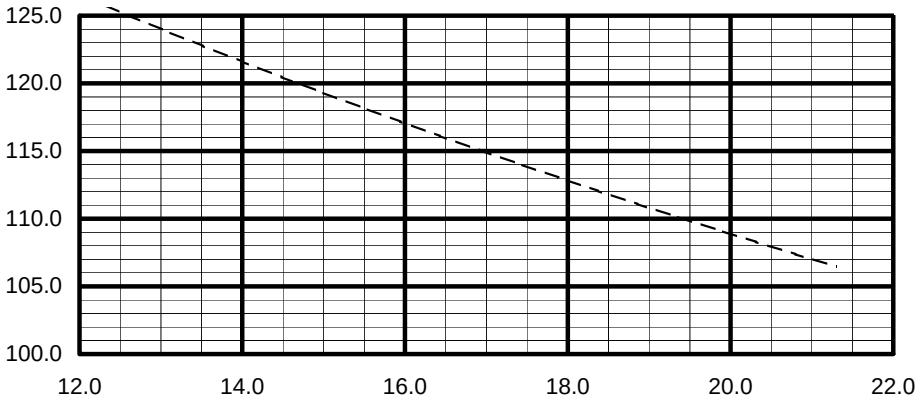
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"	**100**	
12.7	1/2"	**97**	
9.5	3/8"	**96**	
4.75	# 4	**75**	
2	#10	**50**	
0.85	#20	**39**	
0.425	#40	**34**	
0.25	# 60	**31**	
0.15	#100	**27**	
0.075	#200	**21.5**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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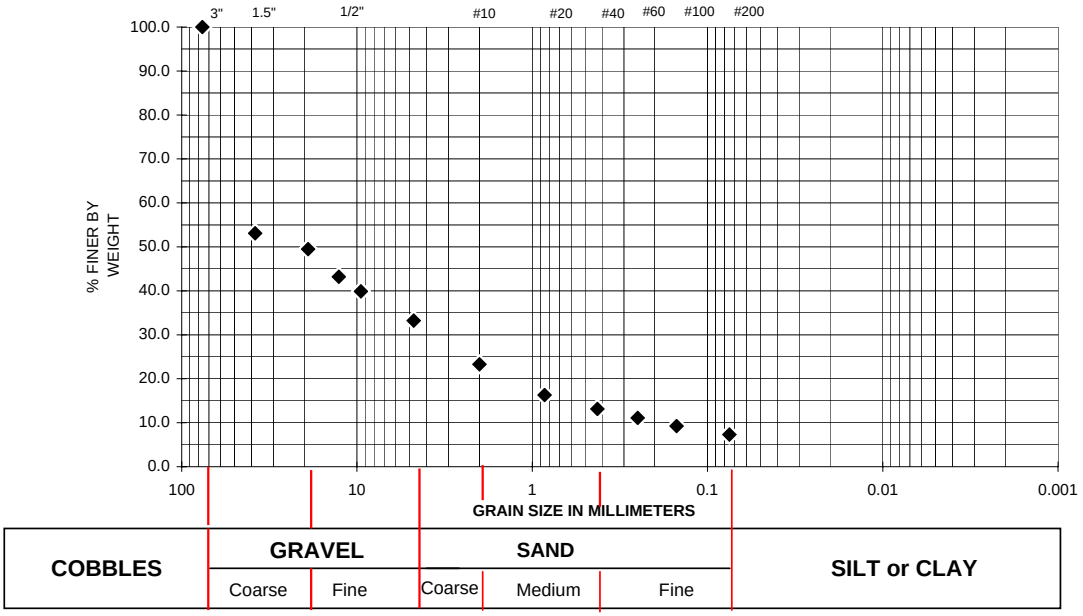
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-20**
SAMPLE NO/ DEPTH	**SA-1 (5.0'-6.5')**
DESCRIPTION:	**Well grd. gravel w/ silt & sand**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**66.8**	USC:	**GW-GM**
% SAND:	**25.9**	FC:	
% SILT/CLAY:	**7.3**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**4.1**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

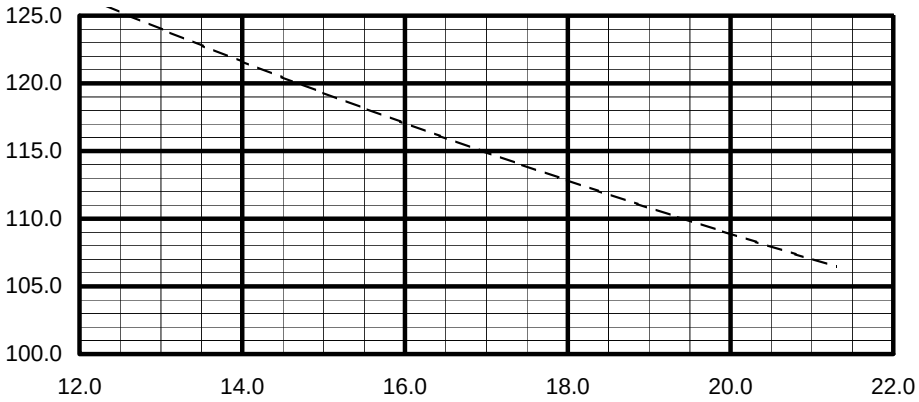
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"	**100**	
38.1	1.5"	**53**	
19.05	3/4"	**49**	
12.7	1/2"	**43**	
9.5	3/8"	**40**	
4.75	# 4	**33**	
2	#10	**23**	
0.85	#20	**16**	
0.425	#40	**13**	
0.25	# 60	**11**	
0.15	#100	**9**	
0.075	#200	**7.3**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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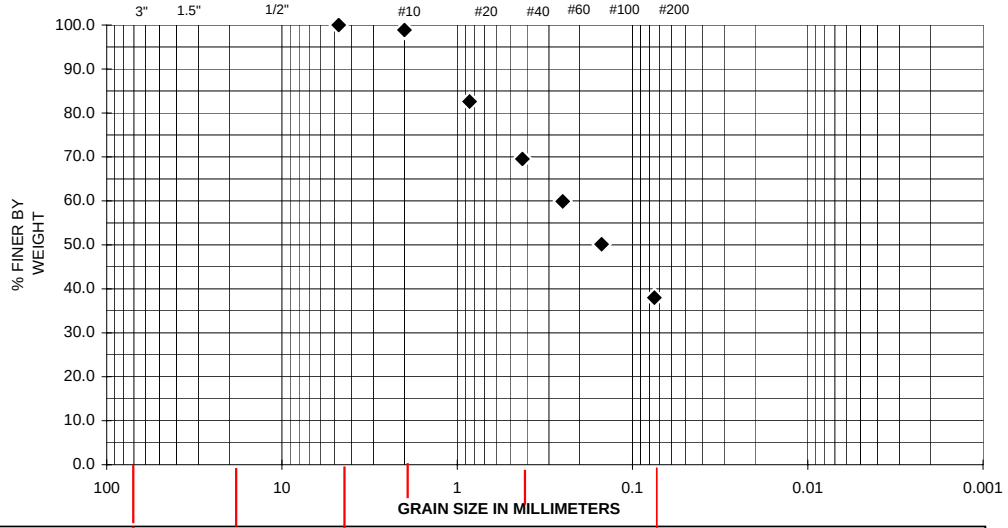
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-21**
SAMPLE NO/ DEPTH	**SA-2 (10.0'-11.5')**
DESCRIPTION:	**Silty sand.**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**0.0**	USC:	**SM**
% SAND:	**62.0**	FC:	
% SILT/CLAY:	**38.0**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**22.9**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

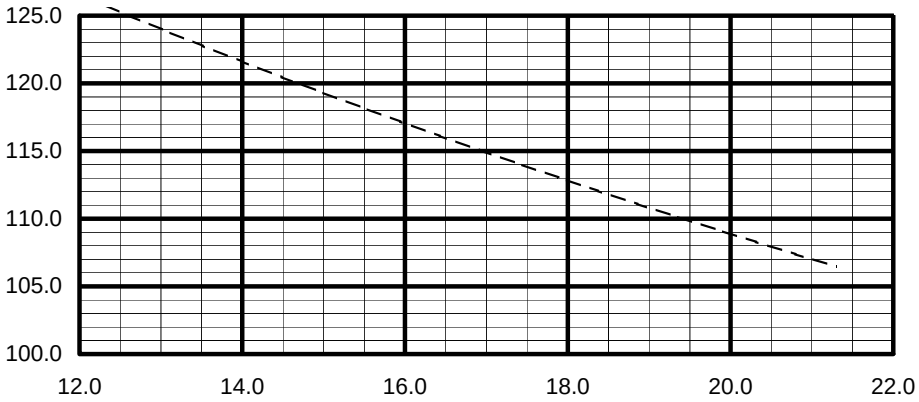
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"		
9.5	3/8"		
4.75	# 4	**100**	
2	#10	**99**	
0.85	#20	**83**	
0.425	#40	**70**	
0.25	# 60	**60**	
0.15	#100	**50**	
0.075	#200	**38.0**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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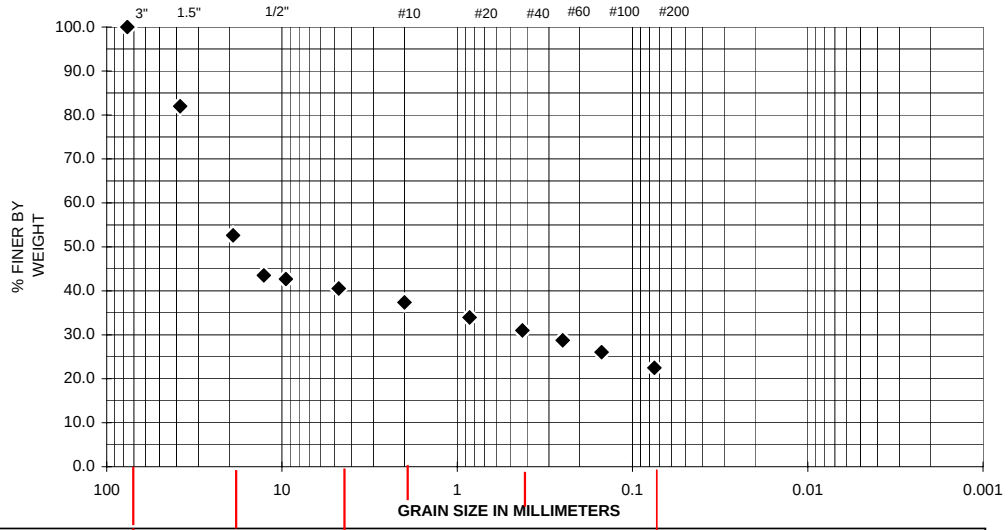
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-22**
SAMPLE NO/ DEPTH	**SA-1 (5.0'-6.5')**
DESCRIPTION:	**Silty gravel w/ sand**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**59.5**	USC:	**GM**
% SAND:	**18.0**	FC:	
% SILT/CLAY:	**22.5**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**10.7**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

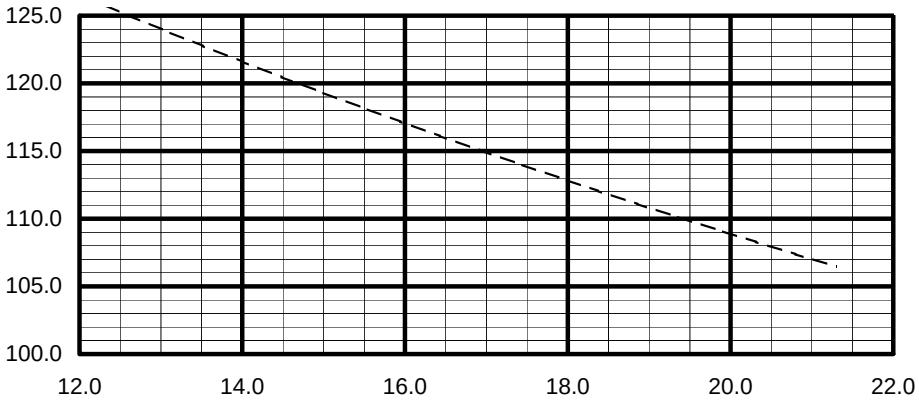
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"	**100**	
38.1	1.5"	**82**	
19.05	3/4"	**53**	
12.7	1/2"	**44**	
9.5	3/8"	**43**	
4.75	# 4	**41**	
2	#10	**37**	
0.85	#20	**34**	
0.425	#40	**31**	
0.25	# 60	**29**	
0.15	#100	**26**	
0.075	#200	**22.5**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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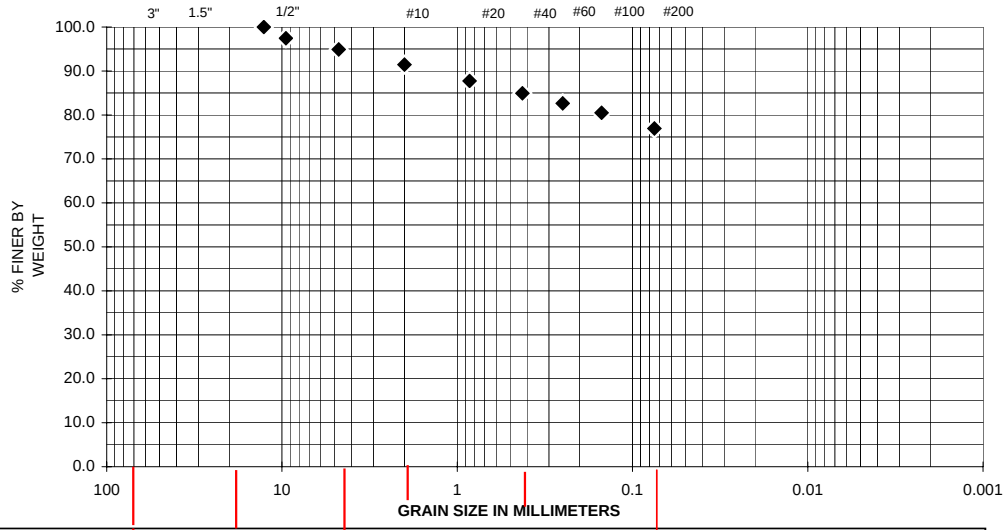
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**1811-07**
SAMPLE LOCATION:	**TB-23**
SAMPLE NO/ DEPTH	**SA-1 (5.0'-6.5')**
DESCRIPTION:	**Silt with sand**
DATE TESTED:	**11/7/2007**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**5.1**	USC:	**ML**
% SAND:	**18.0**	FC:	
% SILT/CLAY:	**76.9**	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**27.4**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



SIEVE ANALYSIS RESULT

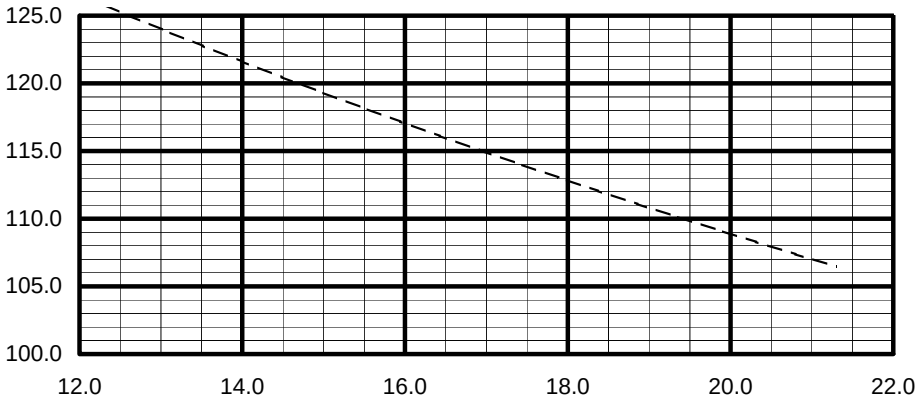
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"	**100**	
9.5	3/8"	**97**	
4.75	# 4	**95**	
2	#10	**91**	
0.85	#20	**88**	
0.425	#40	**85**	
0.25	# 60	**83**	
0.15	#100	**80**	
0.075	#200	**76.9**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

ADDENDUM

GEOTECHNICAL REPORT
MERTARVIK TOWNSITE
NEWTOK, ALASKA

January 2009

ADDENDUM

GEOTECHNICAL REPORT
MERTARVIK TOWNSITE
NEWTOK, ALASKA

JANUARY 2009

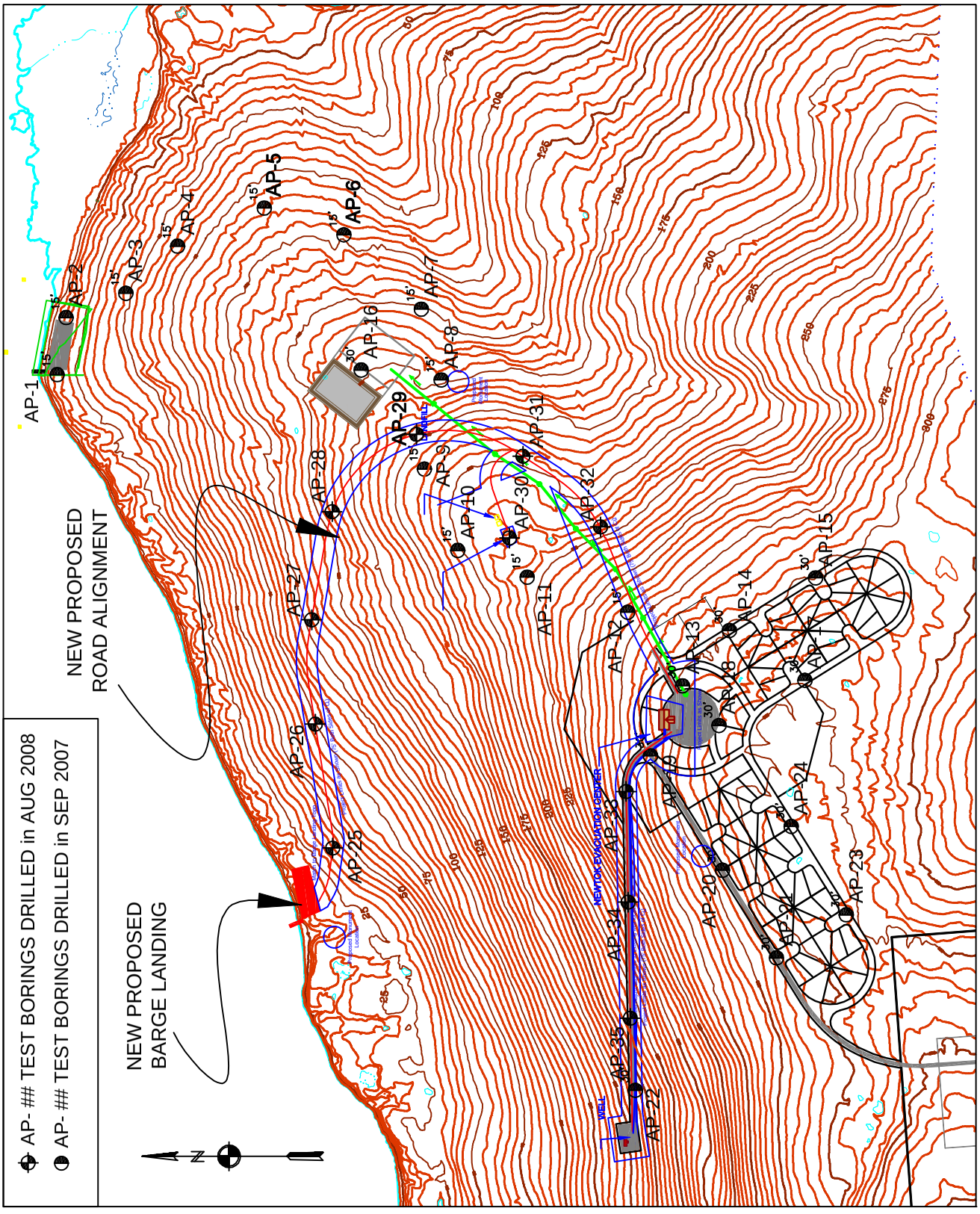
Since the exploration was performed and the report prepared during the fall of 2007 and the spring of 2008 the location of the barge landing has been relocated. This resulted in the realignment of the road leading from the barge landing to the proposed town site. A total of 11 new borings were drilled, sampled and logged along the new proposed roadway alignment from 20 to 21 August 2008. The locations of the borings were located and staked by standard survey methods by R&M Engineers under contract to USACE-AD prior to the drilling. A map showing the locations of the borings is attached as Figure A-1. Copies of the exploration logs are attached in Appendix Addendum – Exploration Logs.

Laboratory testing was performed on selected samples from the exploration. The results of those tests are presented on the exploration logs and in the Appendix Addendum – Grain-Size Distribution Curves.

The results of the additional exploration were generally consistent with the previous exploration. The subsurface conditions generally consist of about two feet of surface organics over silt with some sand and gravel (ML). The soils are a product of weathering of the underlying basalt rock and generally have a frost classification of F4. The silts generally contain more sand and gravel with depth and become more competent as the rock surface is approached. In general the rock surface is encountered between ten and 15 feet below grade.

The entire area is generally wet with water in the organic mat. Intermittent permafrost is present in the area and was encountered in several of the borings.

None of the findings of this exploration effort changes the findings or recommendations of the previous exploration.



ALASKA DISTRICT
CORPS OF ENGINEERS
SOILS AND GEOLOGY

TEST BORING LOCATION MAP
NEWTOK RELOCATION
NEWTOK, ALASKA

SCALE: 1 in = 1000 ft
DATE: DEC 2008
DRAWN/RVW: RTW/CRW
FIGURE 1-A

APPENDIX
ADDENDUM

Exploration Logs

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 20 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denali Drilling

Datum: Vertical Horizontal

Location: Northing: 2,495,038 ft. Easting: 1,906,786 ft.

Top of Hole Elevation: 46.4 ft.

Hole Number, Field: TB-25

Permanent: AP-25

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 5.2 ft.

Total Depth: 5.2 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT-OL	Peat with Organic Silt								SURFACE: Tundra Dark brown organics and roots
2		1	Vr	F4*	9 23 25	ML	SILT with Sand	8	20	72		0.75		35	Brown, frozen, angular gravel, fine to medium sand, nonplastic (NP) fines
4		2			42/1 inch	Rock	Rock								Auger encountering cobbles at 4.5 feet Pieces of basalt in catcher Auger refusal at 5.2 feet Bottom of Hole 5.2 ft. Elevation 41.2 ft.
6															PID = (Cold/Hot) Photo Ionization Detector
8															
10															
12															
14															
16															
18															

* Indicates Estimated Frost Classification

Project: Mertarvik Townsite

Hole Number: AP-25

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 20 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denali Drilling

Datum: Vertical Horizontal

Location: Northing: 2,495,163 ft. Easting: 1,907,673 ft.

Top of Hole Elevation: 80.7 ft.

Hole Number, Field: TB-26

Permanent: AP-26

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 15.0 ft.

Total Depth: 15.9 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT-OL	Peat with Organic Silt								SURFACE: Tundra Dark brown organics and roots
2		1	Vx	F4*	7 6 6	ML	SILT with Sand	10	15	75		0.75		29	Brown, frozen to moist, angular gravel, fine sand, nonplastic (NP) fines
4															
6		2		F4	7 10 8	SM	Silty SAND	10	42	48	26.5	0.5		27	Brown, moist, angular gravel, fine sand, NP fines, residual basalt
8															
10		3		F2*	14 20 15	SM	Silty SAND					0.375			Brown, moist, fine sand, NP fines, residual or weathered basalt
12															
14															Hard drilling below 13 feet
16		4	Vx	F3*	16 50/5 inches	SM	Silty SAND								Brown, mottled, fine sands, NP fines, residual basalt
18															Bottom of Hole 15.9 ft. Elevation 64.8 ft. PID = (Cold/Hot) Photo Ionization Detector

* Indicates Estimated Frost Classification

Project: Mertarvik Townsite

Hole Number: AP-26

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 20 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denali Drilling

Datum: Vertical Horizontal

Location: Northing: 2,495,188 ft. Easting: 1,908,420 ft.

Top of Hole Elevation: 111.9 ft.

Hole Number, Field: TB-27

Permanent: AP-27

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 15.0 ft.

Total Depth: 15.3 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT-OL	Peat with Organic Silt								SURFACE: Tundra Dark brown organics and roots
2		1		F4*	3 3 8	ML	Sandy SILT with Gravel	16	20	64		0.75		43	Brown, wet, angular gravel, fine sand, nonplastic (NP) fines, roots
4															
6		2		F3*	4 5 7	SM	Silty SAND with Gravel	20	39	41		0.5		43	Brown, yellow and orange, wet, angular gravel, fine sand, NP fines, weathered or residual basalt Plastic Limit= Nonplastic
8															
10		3		F3	16 30 25	SM	Silty SAND with Gravel	15	49	36	15.7	0.375		24	Reddish brown, mottled yellow, dry, angular gravel, fine sand, NP to low plasticity fines, residual basalt Plastic Limit= Nonplastic
12															
14		4			50/3 inches	Rock	Rock								Hard drilling below 13 feet Rock fragments recovered in sampler.
16															Bottom of Hole 15.3 ft. Elevation 96.6 ft. PID = (Cold/Hot) Photo Ionization Detector
18															

* Indicates Estimated Frost Classification

Project: Mertarvik Townsite

Hole Number: AP-27

EXPLORATION LOG NEWTOK.GPJ ACE_ANC.GDT 7/1/09

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 20 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denail Drilling

Datum: Vertical / Horizontal

Location: Northing: 2,495,042 ft. Easting: 1,909,195 ft.

Top of Hole Elevation: 143.7 ft.

Hole Number, Field: TB-28

Permanent: AP-28

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 12.5 ft.

Total Depth: 12.5 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT-OL	Peat with Organic Silt								SURFACE: Tundra Dark brown organics and roots
2		1		F4*	2 5 7	ML	SILT	9	22	69		1		26	Brown, wet, angular gravel, fine sand, nonplastic fines, roots
4															Hard drilling at 4.5 feet
		2			52 48 43	Rock	Rock					1			Weathered rock and silt
6															
8															
10		3			9 53	Rock	Rock					0.5			Weathered rock
12															
															Auger refusal at 12.5 feet Bottom of Hole 12.5 ft. Elevation 131.2 ft. PID = (Cold/Hot) Photo Ionization Detector
14															
16															
18															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 20 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denail Drilling

Datum: Vertical
Horizontal

Location: Northing: 2,494,437 ft.
Easting: 1,909,750 ft.

Top of Hole Elevation: 180.3 ft.

Hole Number, Field: TB-29
Permanent: AP-29

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 9.5 ft.

Total Depth: 9.5 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT-OL	Peat with Organic Silt								SURFACE: Tundra Dark brown organics and roots
2		1		F4	3 3 9	ML	SILT	6	7	87	63.4	0.5		28	Grey, wet, nonplastic (NP) fines, roots
4		2	Vr	F4*	10 26 46	ML	Gravelly SILT	27	12	61		0.75		23	Brown, frozen with ice lenses to 1/8-inch, angular gravel, fine sand
6															
8						Rock	Rock								Very hard drilling at nine feet (rock)
10															Auger refusal at 9.5 feet Bottom of Hole 9.5 ft. Elevation 170.8 ft. PID = (Cold/Hot) Photo Ionization Detector
12															
14															
16															
18															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 21 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denail Drilling

Datum: Vertical
Horizontal

Location: Northing: 2,493,771 ft.
Easting: 1,909,007 ft.

Top of Hole Elevation: 219.5 ft.

Hole Number, Field: TB-30
Permanent: AP-30

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 15.0 ft.

Total Depth: 16.5 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT-OL	Peat with Organic Silt								SURFACE: Tundra Dark brown organics and roots
2		1		F4*	6 5 8	ML	SILT	0	2	98				28	Grey and brown mottled, wet to frozen, nonplastic (NP) fines
4															
6		2	Vx & Vr	F4	6 13 18	ML	SILT	0	2	98	48.1			31	Grey, mottled brown, NP fines, ice to 1/4-inch
8															
10		3	Vx & Vr	F4*	11 31 35	ML	SILT	1	4	95				26	Grey, mottled brown, frozen, NP fines, ice to 1/2-inch, 25% ice by volume
12															
14															
16		4	Vx & Vr	F4*	9 13 18	ML	SILT								Grey, mottled brown, frozen, NP fines, ice to 3/4-inch, 40% ice by volume
															Bottom of Hole 16.5 ft. Elevation 203.0 ft. PID = (Cold/Hot) Photo Ionization Detector
18															

* Indicates Estimated Frost Classification

Project: Mertarvik Townsite

Hole Number: AP-30

EXPLORATION LOG NEWTOK.GPJ ACE_ANC.GDT 7/1/09

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 21 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denail Drilling

Datum: Vertical Horizontal

Location: Northing: 2,493,676 ft. Easting: 1,909,593 ft.

Top of Hole Elevation: 204.3 ft.

Hole Number, Field: TB-31

Permanent: AP-31

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 15.0 ft.

Total Depth: 16.5 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT-OL	Peat with Organic Silt								SURFACE: Tundra Dark brown organics and roots
2		1		F4*	9 9 11	ML	Gravelly SILT with Sand	27	23	50		1		30	Brown, moist, angular gravel, fine sand, nonplastic (NP) fines
4															
		2		F2	7 12 14	GM	Silty GRAVEL with Sand	41	31	28	18.4	1		26	Brown, moist, angular gravel, fine sand, NP fines
6															
8															
10		3	Vr	F4*	18 33 42	ML	SILT with Sand	8	18	74		0.5		35	Brown and black, frozen, angular gravel, fine sand, NP fines Plastic Limit= Nonplastic
12															
14															
16		4	Vr	F4*	11 15 23	ML	SILT								Brick red, frozen, low plasticity, 30% ice by volume
															Bottom of Hole 16.5 ft. Elevation 187.8 ft. PID = (Cold/Hot) Photo Ionization Detector
18															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 21 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denail Drilling

Datum: Vertical Horizontal

Location: Northing: 2,493,120 ft. Easting: 1,909,085 ft.

Top of Hole Elevation: 225.9 ft.

Hole Number, Field: TB-32

Permanent: AP-32

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 8.5 ft.

Total Depth: 8.5 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT-OL	Peat with Organic Silt								Dark brown organics and roots
2		1		F4*	7 10 6	ML	SILT					1			Brown, wet, angular gravel, nonplastic (NP) fines
4															
		2		F4*	3 5 7	ML	SILT								Brick red, mottled yellow, wet, NP fines
6															
8															
															Auger refusal on rocks at 8.5 feet Bottom of Hole 8.5 ft. Elevation 217.4 ft. PID = (Cold/Hot) Photo Ionization Detector
10															
12															
14															
16															
18															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 21 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denail Drilling

Datum: Vertical Horizontal

Location: Northing: 2,492,936 ft. Easting: 1,907,191 ft.

Top of Hole Elevation: 279.4 ft.

Hole Number, Field: TB-33 Permanent: AP-33

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 10.0 ft.

Total Depth: 10.3 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
						PT-OL	Peat with Organic Silt								SURFACE: Tundra Dark brown organics and roots
2		1		F4*	3 4 6	ML	SILT with Sand	9	10	81		1		26	Grey, mottled brown, wet, angular gravel, fine sand, nonplastic (NP) fines
4															
6		2		F2	6 11 25	SM	Silty SAND with Gravel	28	48	24	14.7	1		27	Brown and black, wet, angular gravel, fine to medium sand, NP fines, residual basalt
															Hard drilling at 6.5 feet
8															
10		3			50/3 inches	Rock	Rock								Weathered black basalt
															Bottom of Hole 10.3 ft. Elevation 269.1 ft.
12															PID = (Cold/Hot) Photo Ionization Detector
14															
16															
18															

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 21 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denail Drilling

Datum: Vertical Horizontal

Location: Northing: 2,492,921 ft. Easting: 1,906,398 ft.

Top of Hole Elevation: 229.4 ft.

Hole Number, Field: TB-34

Permanent: AP-34

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 15.0 ft.

Total Depth: 16.5 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
															SURFACE: Tundra
2						PT-OL	Peat with Organic Silt								Dark brown organics and roots
4		1		F4*	3 4 6	ML	SILT	0	4	96				27	Brown with rust spots, wet, nonplastic (NP) fines
6		2		F3*	6 17 23	SM	Silty SAND with Gravel	29	33	38		1		21	Brown, wet, angular gravel, fine to coarse sand, NP fines
8															Encountered cobbles at eight feet, able to continue drilling
10		3		F2	24 30 15	SM	Silty SAND with Gravel	40	44	16	9.6	1		15	Brown and black, moist, angular gravel, fine to coarse sand, NP fines, residual basalt
12															Very hard drilling at 12 feet
14															
16		4		F4*	6 10 13	ML	Sandy SILT					0.5			Brown, black and red, wet, angular gravel, fine to coarse sand, NP fines, residual basalt
18															Bottom of Hole 16.5 ft. Elevation 212.9 ft. PID = (Cold/Hot) Photo Ionization Detector

* Indicates Estimated Frost Classification

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section

EXPLORATION LOG

Project: Mertarvik Townsite
Newtok, Alaska

Date: 21 Aug 2008

Drilling Agency: ☐ Alaska District ☒ Other Denail Drilling

Datum: Vertical Horizontal

Location: Northing: 2,492,906 ft. Easting: 1,905,567 ft.

Top of Hole Elevation: 183.2 ft.

Hole Number, Field: TB-35

Permanent: AP-35

Operator: Kelli Hill

Inspector: Gregory Carpenter

Type of Hole: ☐ other _____
☐ Test Pit ☒ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater:

Depth Drilled: 15.0 ft.

Total Depth: 16.5 ft.

Hammer Weight: 340 lbs

Split Spoon I.D.: 2.5 in.

Size and Type of Bit: 8 in. HSA

Type of Equipment: Mobile B-61 Nodwell

Type of Samples: Drive-Rope & Cathead

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size %Gravel	%Sand	%Fines	% Finer 0.02mm	Max Size (in.)	PID (ppm)	% Water	Description and Remarks
															SURFACE: Tundra
2						PT-OL	Peat with Organic Silt								Dark brown organics and roots
4		1		F2	6 8 9	GM	Silty GRAVEL with Sand	53	20	27	18.5	1		16	Brown and black, wet, angular gravel, fine to coarse sand, nonplastic (NP) fines
															Drilling on cobbles at four feet
6		2		F3*	10 11 24	SM	Silty SAND with Gravel	27	41	32		1		18	Brown and black, wet, angular gravel, fine to coarse sand, NP fines
8															
10		3		F1	7 7 7	GM	Silty GRAVEL with Sand	50	36	14	8.0	1		29	Brown, mottled red, wet, angular gravel, fine to coarse sand, NP fines, residual basalt
12															
14															Hard drilling below 14 feet
16		4		F4*	6 8 8	ML	SILT with Sand					1			Brown and black, moist, angular gravel, fine to coarse sand, NP fines, residual basalt
															Bottom of Hole 16.5 ft. Elevation 166.7 ft.
18															PID = (Cold/Hot) Photo Ionization Detector

* Indicates Estimated Frost Classification

APPENDIX
ADDENDUM

Grain-size distribution curves

U.S. ARMY CORPS OF ENGINEERS
SOILS AND GEOLOGY SECTION, ALASKA DISTRICT

Newtok Relocation
Newtok, Alaska

Permanent I.D (Field)	Sample Number	Depth Interval Top	Depth Interval Bottom	Moisture Content (%)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Particle Size Analysis Gravel	Particle Size Analysis Sand	Particle Size Analysis Silt	Passing #200 (%)	Passing 0.02mm (%)	Frost Class.	Unified Soil Classification
TB-25	1	2.5	4.0	35.4				7.6	20.1	72.3				(ML) Silt with sand
TB-26	1	2.5	4.0	29.3				10.2	14.5	75.3				(ML) Silt with sand
TB-26	2	4.5	6.0	26.9				10.3	42.4	47.4		26.5	F4	(SM) silty sand
TB-27	1	2.5	4.0	42.6				16.4	19.9	63.7				(ML) Sandy silt with gravel
TB-27	2	4.5	6.0	43.1		NP		20.0	38.7	41.3				(SM) Silty sand with gravel
TB-27	3	14.5	16.0	23.5		NP		15.6	48.8	35.6		15.7	F3	(SM) Silty sand with gravel
TB-28	1	2.5	4.0	26.1				9.4	21.6	69.0				(ML) Sandy silt
TB-29	1	2.5	4.0	27.6				5.9	7.0	87.1		63.4	F4	(ML) Silt
TB-29	2	4.5	6.0	23.3				27.4	11.9	60.7				(ML) Gravelly silt
TB-30	1	2.5	4.0	27.6				0.0	1.8	98.2				(ML) Silt
TB-30	2	4.5	6.0	30.6				0.0	1.7	98.3		48.1	F4	(ML) Silt
TB-30	3	9.5	11.0	25.8				1.4	3.5	95.1				(ML) Silt
TB-31	1	2.5	4.0	29.8				27.3	22.6	50.1				(ML) Gravelly silt with sand
TB-31	2	4.5	6.0	25.7				41.2	30.5	28.3		18.4	F2	(GM) Silty gravel with sand
TB-31	3	9.5	11.0	35.3		NP		8.4	18.2	73.4				(ML) Silt with sand
TB-33	1	2.5	4.0	26.2		NP		9.3	10.1	80.6				(ML) Silt with sand
TB-33	2	4.5	6.0	27.1				27.8	47.7	24.5		14.7	F2	(SM) Silty sand with gravel
TB-34	1	2.5	4.0	27.0				0.0	3.8	96.2				(ML) Silt
TB-34	2	4.5	6.0	21.3				28.8	33.2	38.0				(SM) Silty sand with gravel
TB-34	3	9.5	11.0	15.4				39.5	44.2	16.3		9.6	F2	(SM) Silty sand with gravel
TB-35	1	2.5	4.0	16.0				52.9	19.8	27.3		18.5	F2	(GM) Silty gravel with sand
TB-35	2	4.5	6.0	18.4				26.5	41.3	32.2				(SM) Silty sand with gravel
TB-35	3	9.5	11.0	28.7				50.2	36.0	13.8		8.0	F1	(GM) Silty gravel with sand

11301 Olive Lane
Anchorage, AK 99515

TERRA FIRMA TESTING

Laboratory Testing / Construction Monitoring

Telephone: (907) 344-5934
Fax: (907) 344-5993
www.nge-tft.com

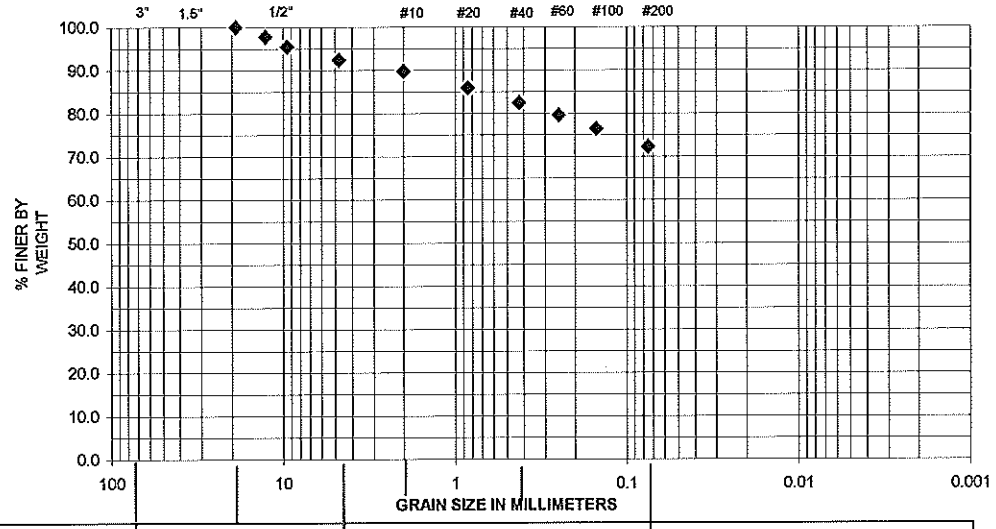
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-25
SAMPLE NO/ DEPTH	(Depth 2.5' - 4.0')
DESCRIPTION:	Silt with sand
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	7.6	USC:	ML
% SAND:	20.1	FC:	
% SILT/CLAY:	72.3	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	35.4

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

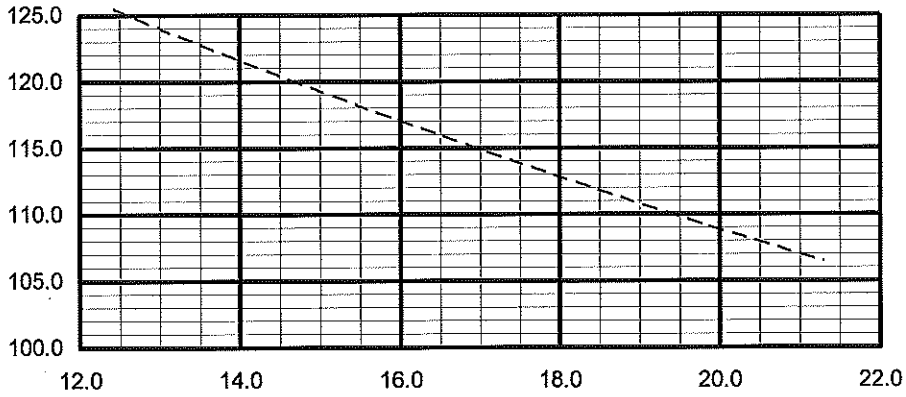
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"	100	
12.7	1/2"	98	
9.5	3/8"	95	
4.75	# 4	92	
2	#10	90	
0.85	#20	86	
0.425	#40	82	
0.25	# 60	80	
0.15	#100	76	
0.075	#200	72.3	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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Anchorage, AK 99515

TERRA FIRMA TESTING

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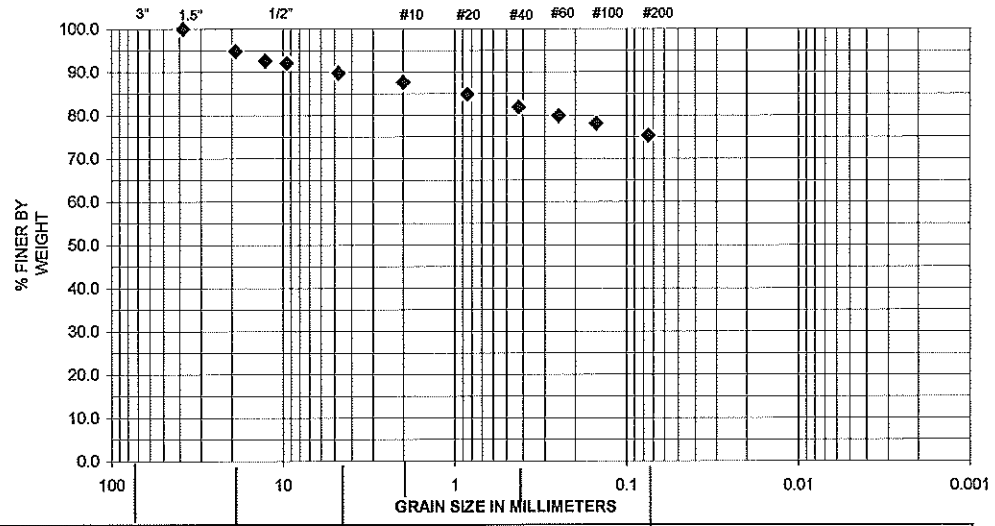
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-26
SAMPLE NO/ DEPTH	SA-1 (Depth 2.5' - 4.0')
DESCRIPTION:	Silt with sand
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	10.2	USC:	ML
% SAND:	14.5	FC:	
% SILT/CLAY:	75.3	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	29.3

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

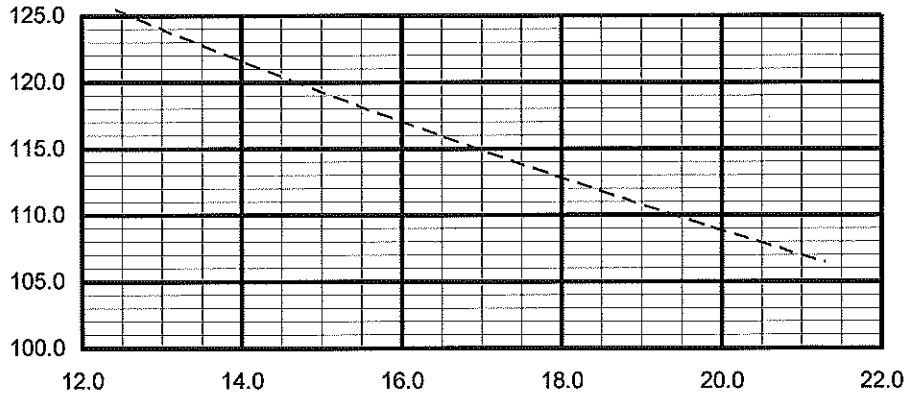
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	95	
12.7	1/2"	93	
9.5	3/8"	92	
4.75	# 4	90	
2	#10	88	
0.85	#20	85	
0.425	#40	82	
0.25	# 60	80	
0.15	#100	78	
0.075	#200	75.3	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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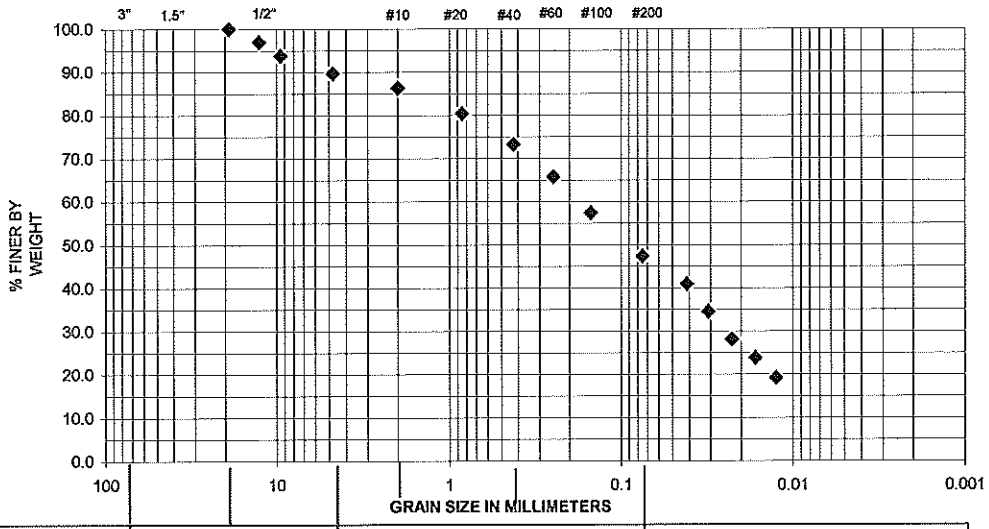
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-26
SAMPLE NO/ DEPTH	SA-2 (Depth 4.5' - 6.0')
DESCRIPTION:	Silty sand.
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	10.3	USC:	SM
% SAND:	42.4	FC:	F4
% SILT/CLAY:	47.4	.02 mm:	26.5

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	26.9

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

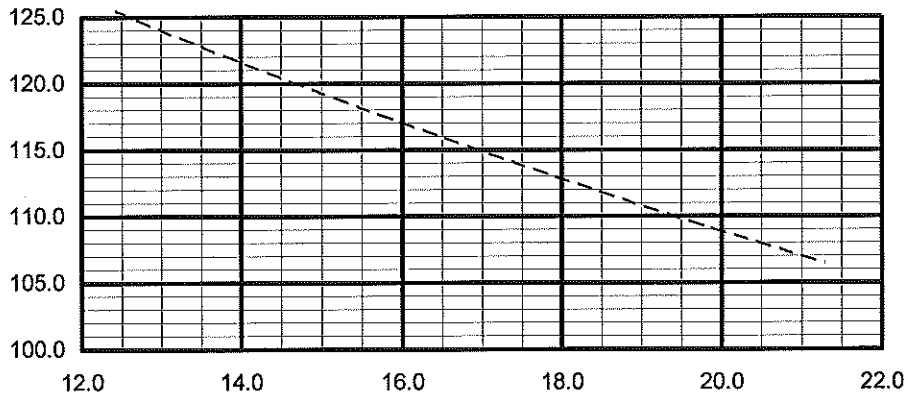
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"	100	
12.7	1/2"	97	
9.5	3/8"	94	
4.75	# 4	90	
2	#10	86	
0.85	#20	80	
0.425	#40	73	
0.25	# 60	66	
0.15	#100	57	
0.075	#200	47.4	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0412	41.0
2	0.0309	34.6
4	0.0226	28.2
8	0.0166	23.9
15	0.0125	19.2
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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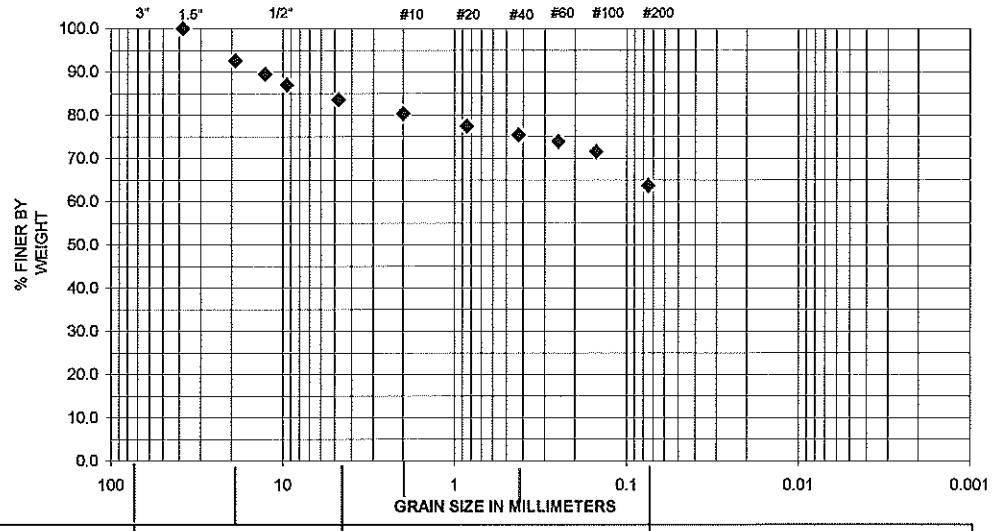
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-27
SAMPLE NO/ DEPTH	SA-1 (Depth 2.5' - 4.0')
DESCRIPTION:	Sandy silt with gravel
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	16.4	USC:	ML
% SAND:	19.9	FC:	
% SILT/CLAY:	63.7	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	42.6

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

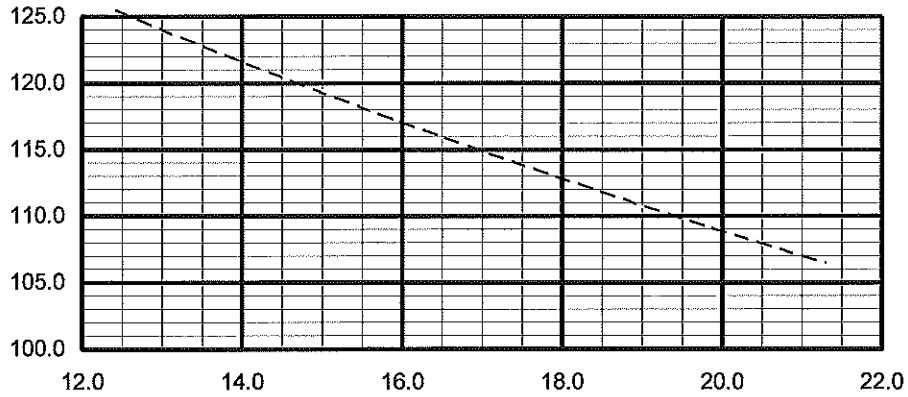
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	93	
12.7	1/2"	90	
9.5	3/8"	87	
4.75	# 4	84	
2	#10	80	
0.85	#20	77	
0.425	#40	75	
0.25	# 60	74	
0.15	#100	72	
0.075	#200	63.7	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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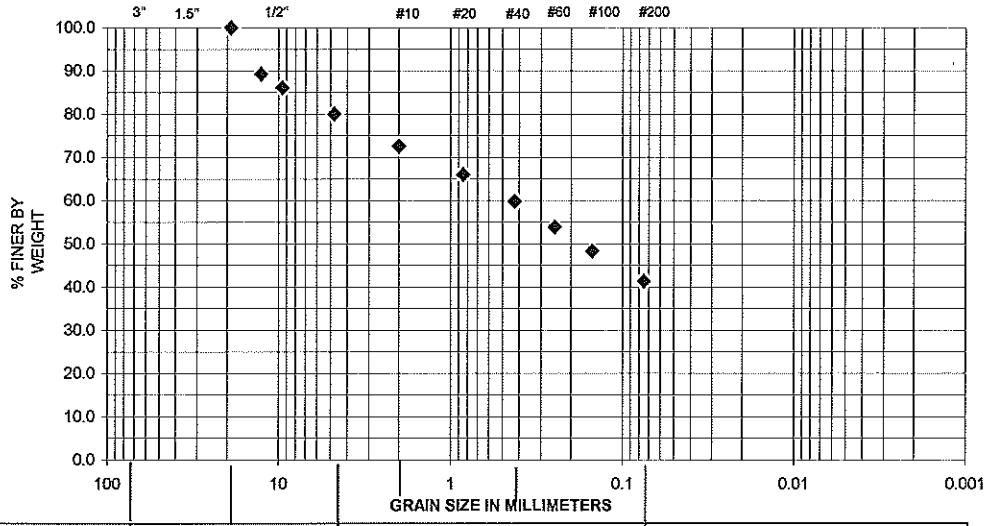
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-27
SAMPLE NO/ DEPTH	SA-2 (Depth 4.5' - 6.0')
DESCRIPTION:	Silty sand w/ gravel
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	20.0	USC:	SM
% SAND:	38.7	FC:	
% SILT/CLAY:	41.3	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	43.1

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

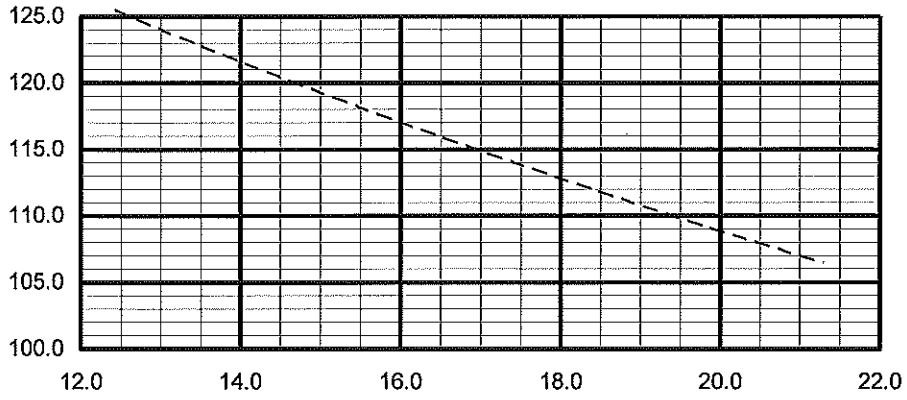
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"	100	
12.7	1/2"	89	
9.5	3/8"	86	
4.75	# 4	80	
2	#10	73	
0.85	#20	66	
0.425	#40	60	
0.25	# 60	54	
0.15	#100	48	
0.075	#200	41.3	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	**Non Plastic**

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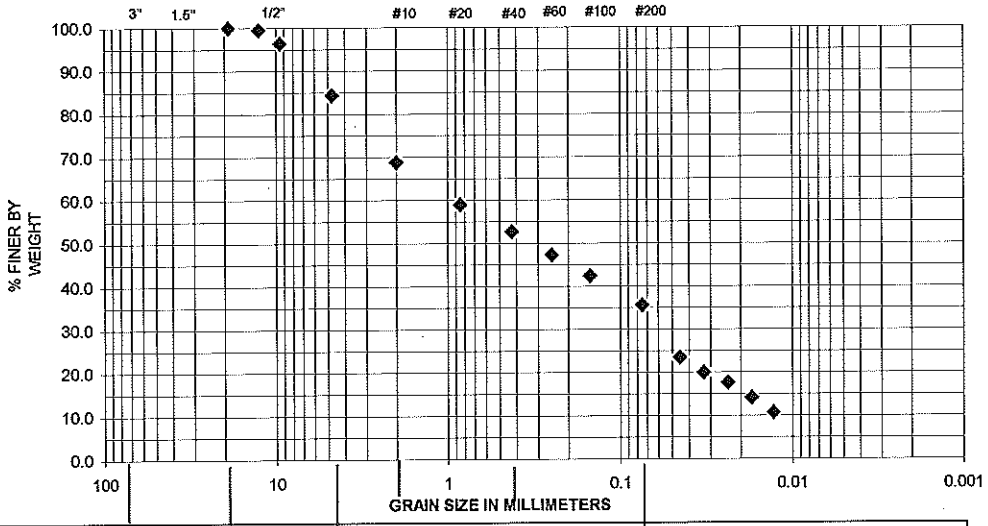
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-27
SAMPLE NO/ DEPTH	SA-3 (Depth 14.5' - 16.0')
DESCRIPTION:	Silty sand w/ gravel
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	15.6	USC:	SM
% SAND:	48.8	FC:	F3
% SILT/CLAY:	35.6	.02 mm:	15.7

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	23.6

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

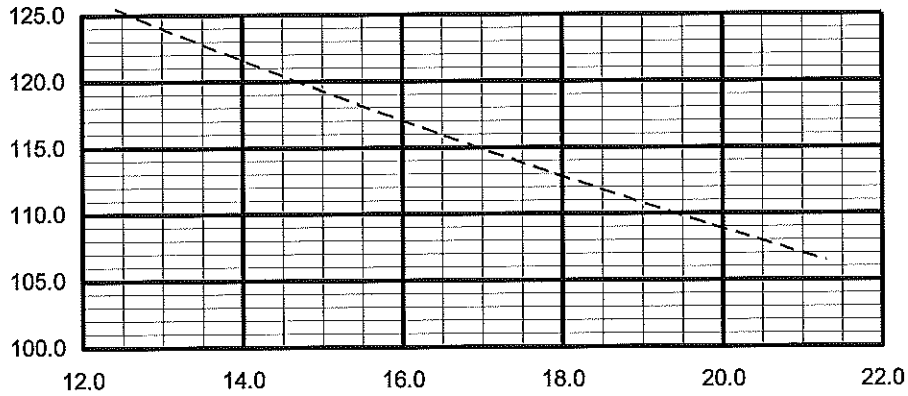
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"	100	
12.7	1/2"	99	
9.5	3/8"	96	
4.75	# 4	84	
2	#10	69	
0.85	#20	59	
0.425	#40	53	
0.25	# 60	47	
0.15	#100	42	
0.075	#200	35.6	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0452	23.5
2	0.0328	20.1
4	0.0237	17.6
8	0.0173	14.2
15	0.0129	10.7
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	**Non Plastic**

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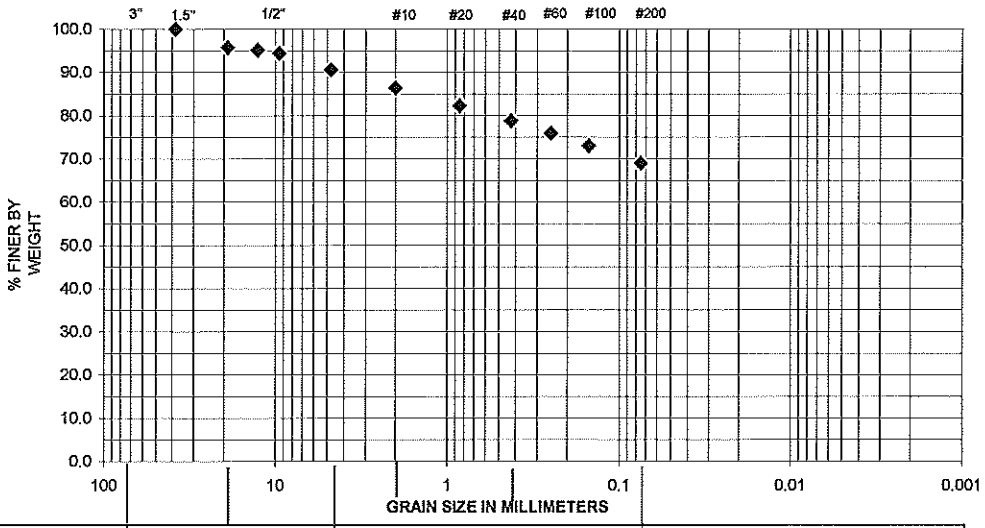
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-28
SAMPLE NO/ DEPTH	SA-1 (Depth 2.5' - 4.0')
DESCRIPTION:	Sandy silt
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	9.4	USC:	ML
% SAND:	21.6	FC:	
% SILT/CLAY:	69.0	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	26.1

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

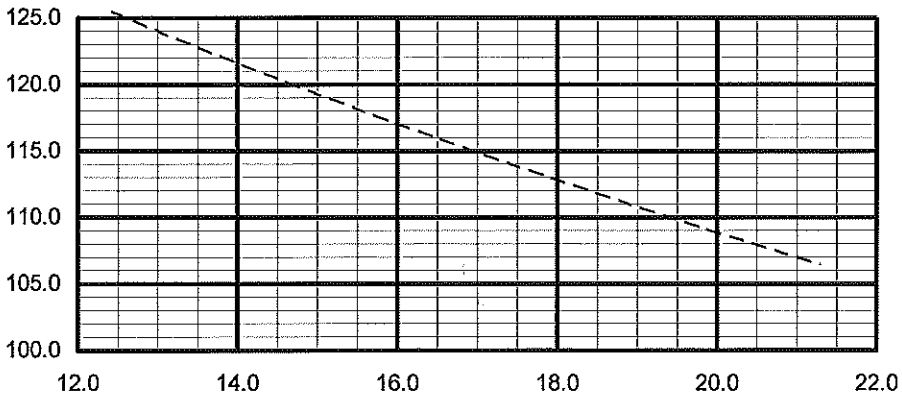
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	96	
12.7	1/2"	95	
9.5	3/8"	94	
4.75	# 4	91	
2	#10	86	
0.85	#20	82	
0.425	#40	79	
0.25	# 60	76	
0.15	#100	73	
0.075	#200	69.0	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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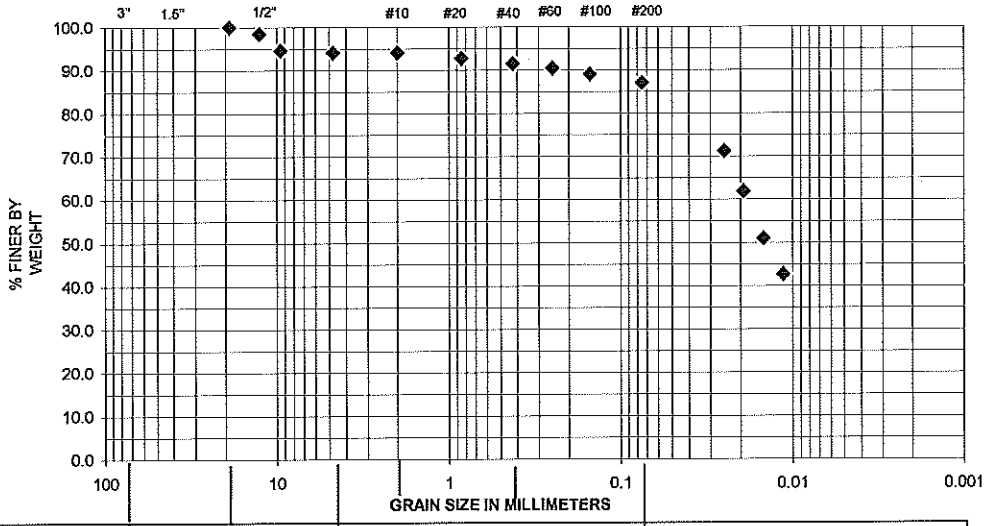
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-29
SAMPLE NO/ DEPTH	SA-1 (Depth 2.5' - 4.0')
DESCRIPTION:	Silt
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	5.9	USC:	ML
% SAND:	7.0	FC:	F4
% SILT/CLAY:	87.1	.02 mm:	63.4

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	27.6

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

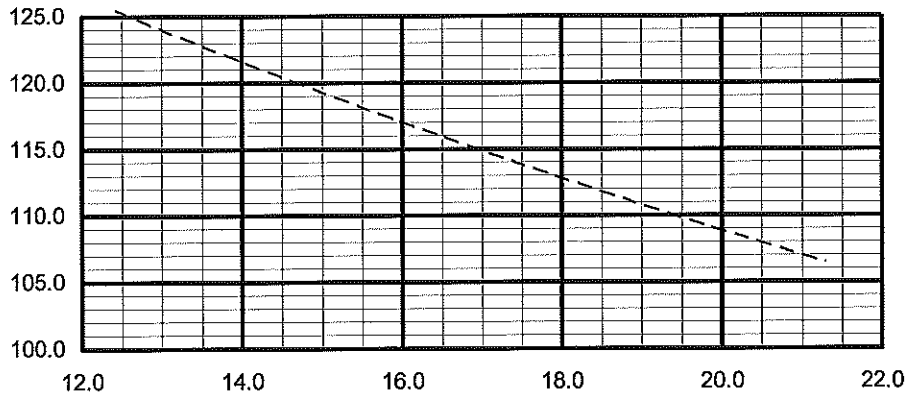
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"	100	
12.7	1/2"	99	
9.5	3/8"	95	
4.75	# 4	94	
2	#10	94	
0.85	#20	93	
0.425	#40	92	
0.25	# 60	90	
0.15	#100	89	
0.075	#200	87.1	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2	0.0249	71.3
4	0.0193	61.9
8	0.0148	51.0
15	0.0113	42.7
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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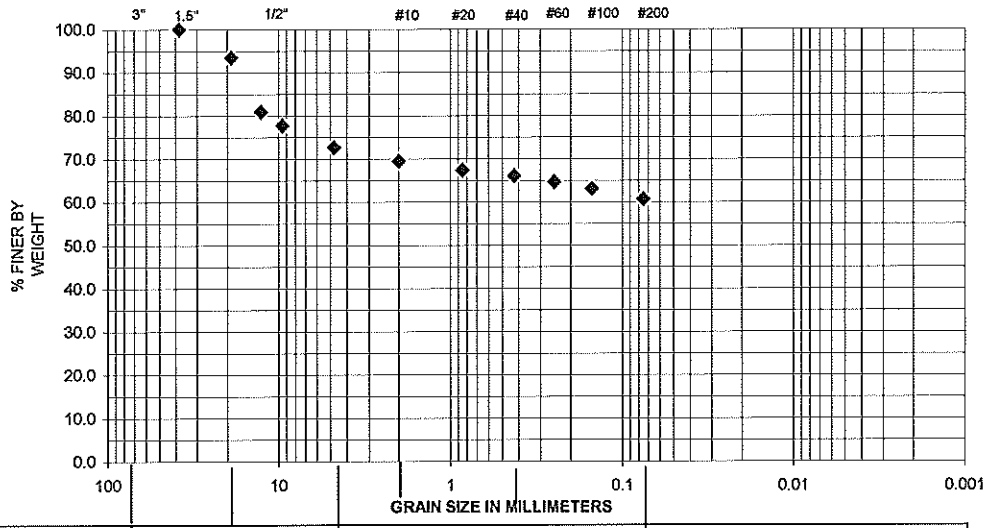
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-29
SAMPLE NO/ DEPTH	SA-2 (Depth 4.5' - 6.0')
DESCRIPTION:	Gravelly silt
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	27.4	USC:	ML
% SAND:	11.9	FC:	
% SILT/CLAY:	60.7	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	23.3

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

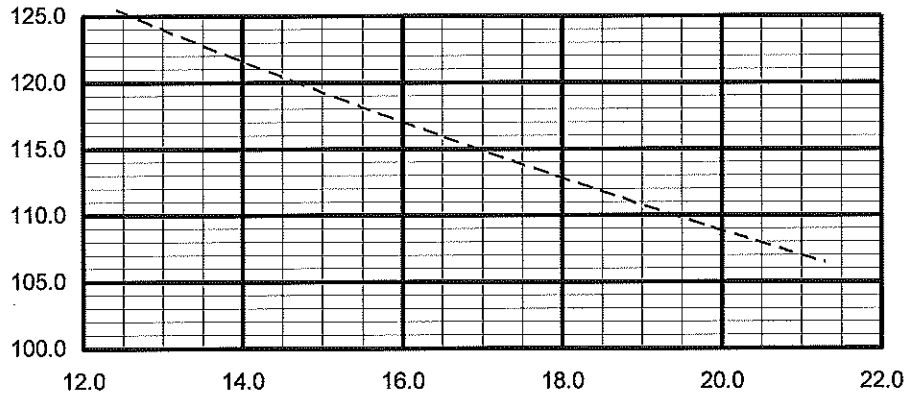
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	93	
12.7	1/2"	81	
9.5	3/8"	78	
4.75	# 4	73	
2	#10	69	
0.85	#20	67	
0.425	#40	66	
0.25	# 60	65	
0.15	#100	63	
0.075	#200	60.7	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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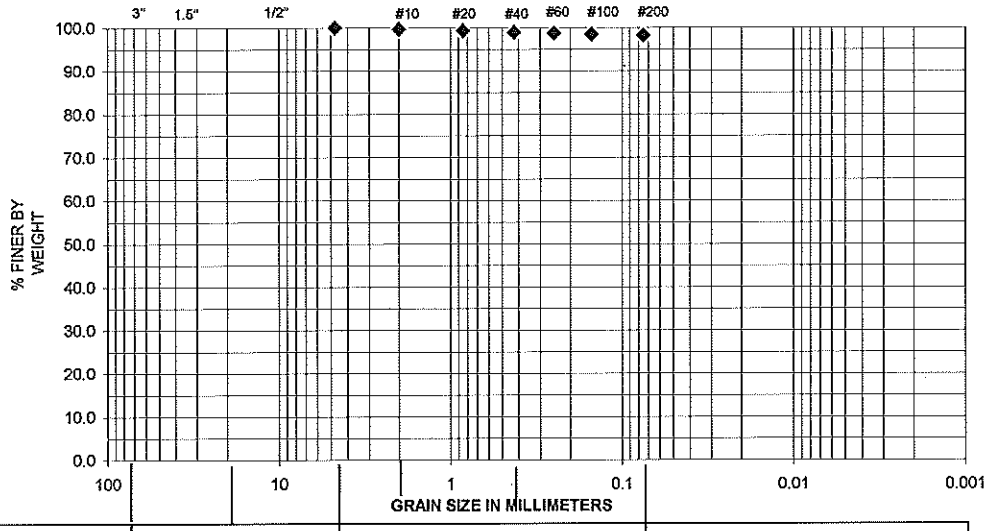
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-30
SAMPLE NO/ DEPTH	SA-1 (Depth 2.5' - 4.0')
DESCRIPTION:	Silt
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	0.0	USC:	ML
% SAND:	1.8	FC:	
% SILT/CLAY:	98.2	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	27.6

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

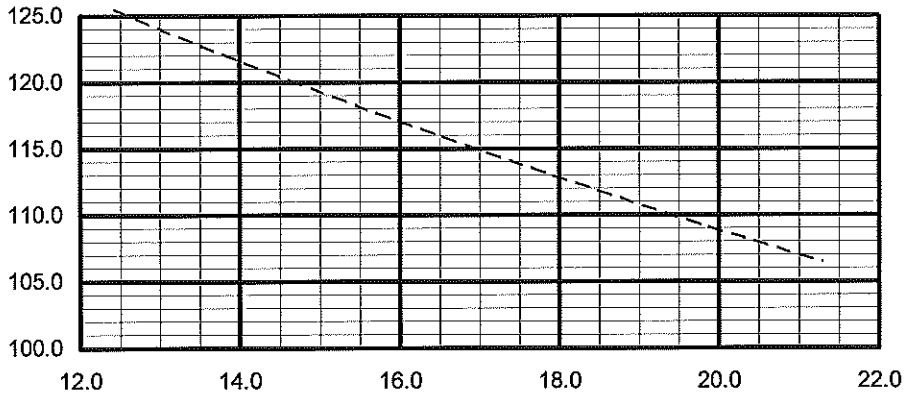
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"		
9.5	3/8"		
4.75	# 4	100	
2	#10	100	
0.85	#20	99	
0.425	#40	99	
0.25	# 60	99	
0.15	#100	99	
0.075	#200	98.2	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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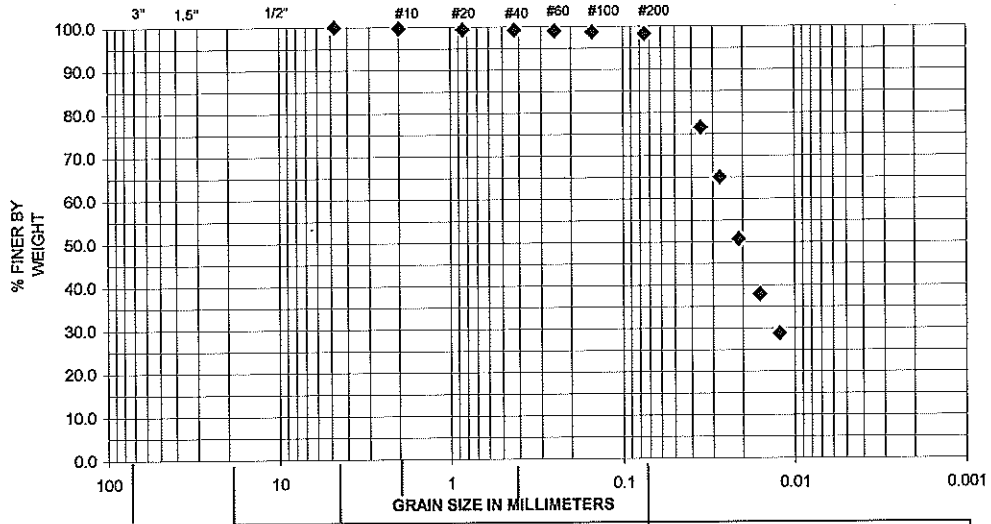
PROJECT CLIENT:	**Corps of Engrs - Alaska District**
PROJECT NAME:	**Newtok Relocation**
PROJECT NO.:	**2076-08**
SAMPLE LOCATION:	**TB-30**
SAMPLE NO/ DEPTH	**SA-2 (Depth 4.5' - 6.0')**
DESCRIPTION:	**Silt**
DATE TESTED:	**10/17/2008**
TESTED BY:	**DP**
REVIEWED BY:	**Ron Caron C.E.T.**

% GRAVEL:	**0.0**	USC:	**ML**
% SAND:	**1.7**	FC:	**F4**
% SILT/CLAY:	**98.3**	.02 mm:	**48.1**

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	**30.6**

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

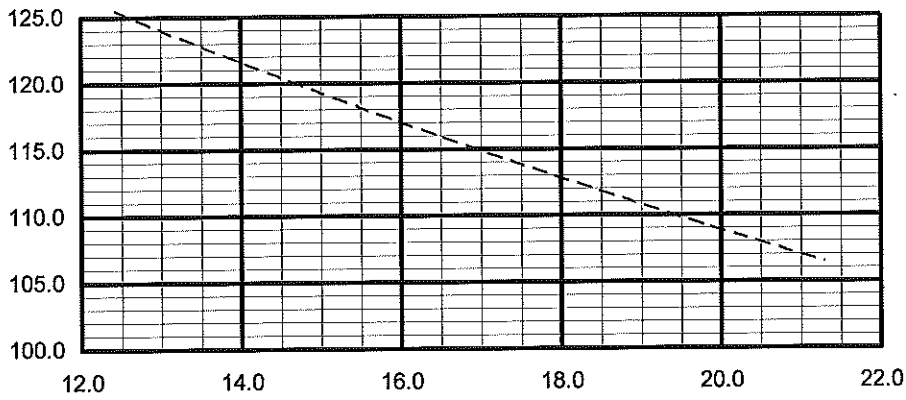
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"		
9.5	3/8"		
4.75	# 4	**100**	
2	#10	**100**	
0.85	#20	**99**	
0.425	#40	**99**	
0.25	# 60	**99**	
0.15	#100	**99**	
0.075	#200	**98.3**	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0352	76.6
2	0.0273	65.1
4	0.0212	50.7
8	0.0160	38.0
15	0.0123	28.8
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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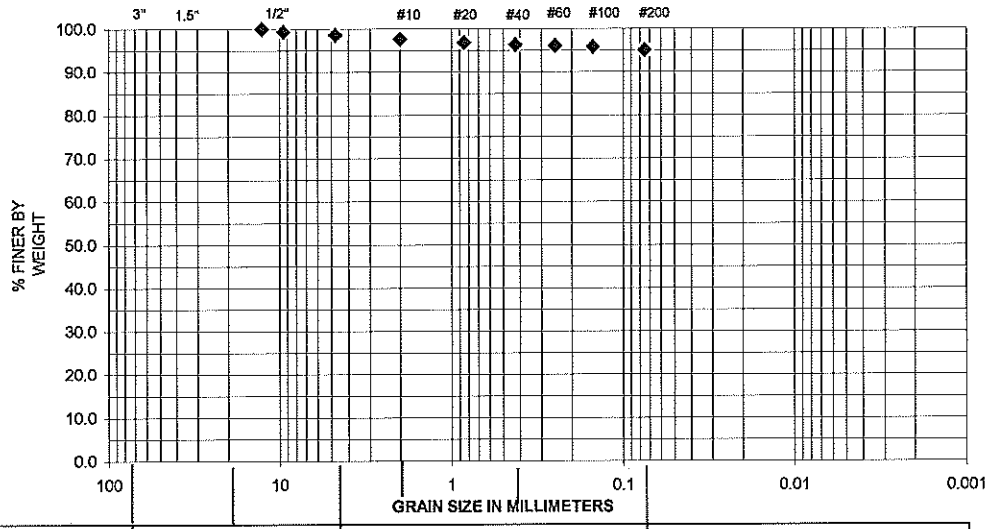
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-30
SAMPLE NO/ DEPTH	SA-3 (Depth 9.5' - 11.0')
DESCRIPTION:	Silt
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	1.4	USC:	ML
% SAND:	3.5	FC:	
% SILT/CLAY:	95.1	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	25.8

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

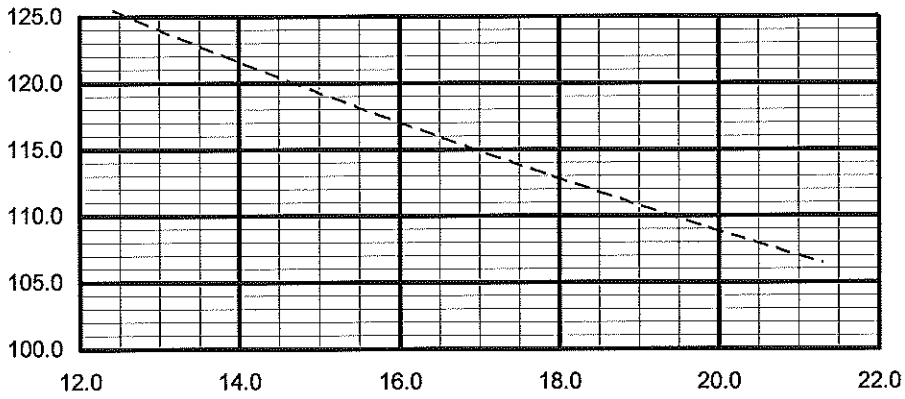
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"	100	
9.5	3/8"	99	
4.75	# 4	99	
2	#10	98	
0.85	#20	97	
0.425	#40	96	
0.25	# 60	96	
0.15	#100	96	
0.075	#200	95.1	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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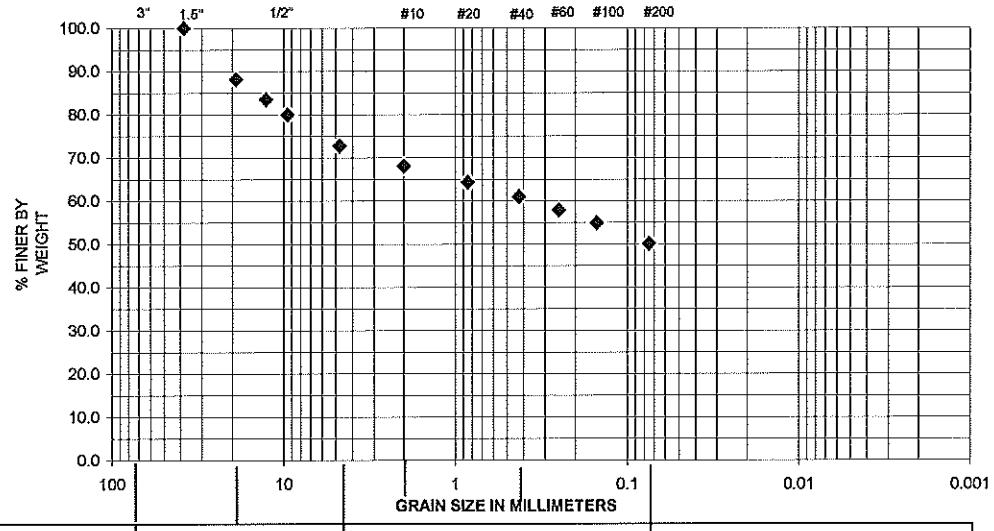
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-31
SAMPLE NO/ DEPTH	SA-1 (Depth 2.5' - 4.0')
DESCRIPTION:	Gravelly silt with sand
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	27.3	USC:	ML
% SAND:	22.6	FC:	
% SILT/CLAY:	50.1	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	29.8

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

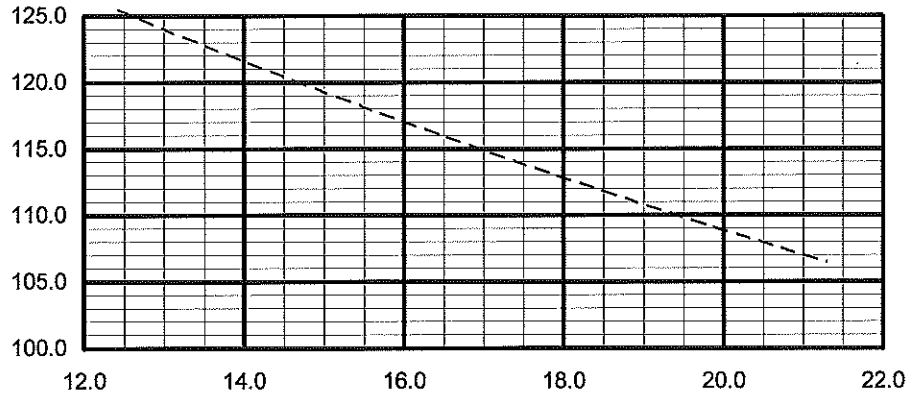
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	88	
12.7	1/2"	83	
9.5	3/8"	80	
4.75	# 4	73	
2	#10	68	
0.85	#20	64	
0.425	#40	61	
0.25	# 60	58	
0.15	#100	55	
0.075	#200	50.1	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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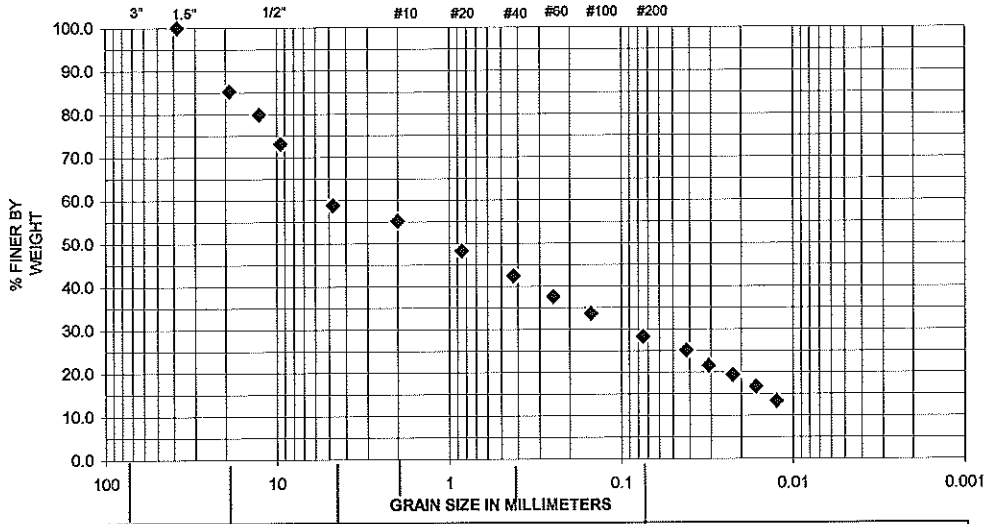
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-31
SAMPLE NO/ DEPTH	SA-2 (Depth 4.5' - 6.0')
DESCRIPTION:	Silty gravel w/ sand
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	41.2	USC:	GM
% SAND:	30.5	FC:	F2
% SILT/CLAY:	28.3	.02 mm:	18.4

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	25.7

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

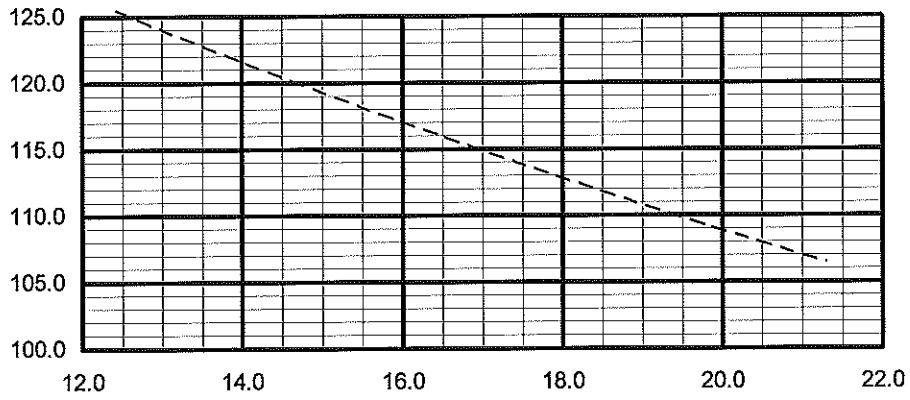
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	85	
12.7	1/2"	80	
9.5	3/8"	73	
4.75	# 4	59	
2	#10	55	
0.85	#20	48	
0.425	#40	42	
0.25	# 60	38	
0.15	#100	34	
0.075	#200	28.3	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0419	25.2
2	0.0309	21.6
4	0.0224	19.4
8	0.0164	16.7
15	0.0124	13.4
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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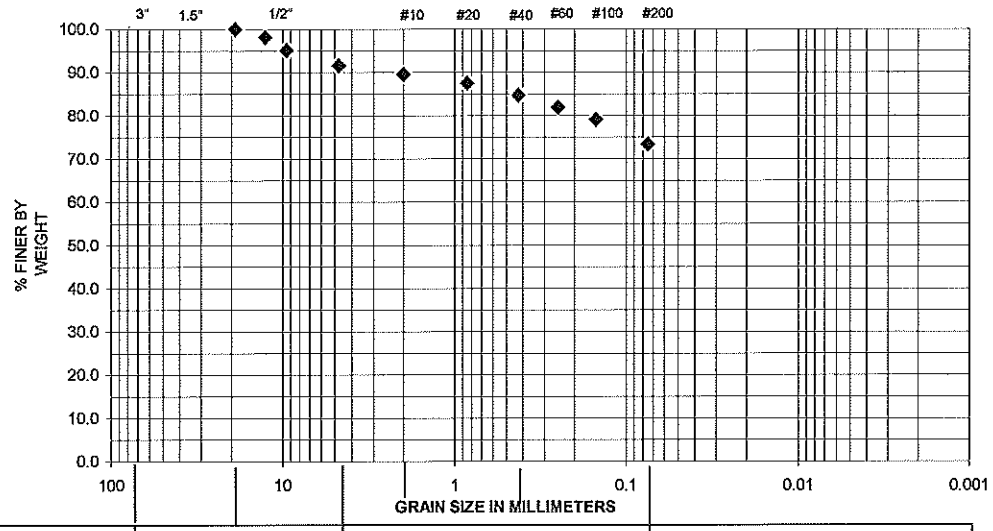
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-31
SAMPLE NO/ DEPTH	SA-3 (Depth 9.5' - 11.0')
DESCRIPTION:	Silt with sand
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	8.4	USC:	ML
% SAND:	18.2	FC:	
% SILT/CLAY:	73.4	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	35.3

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

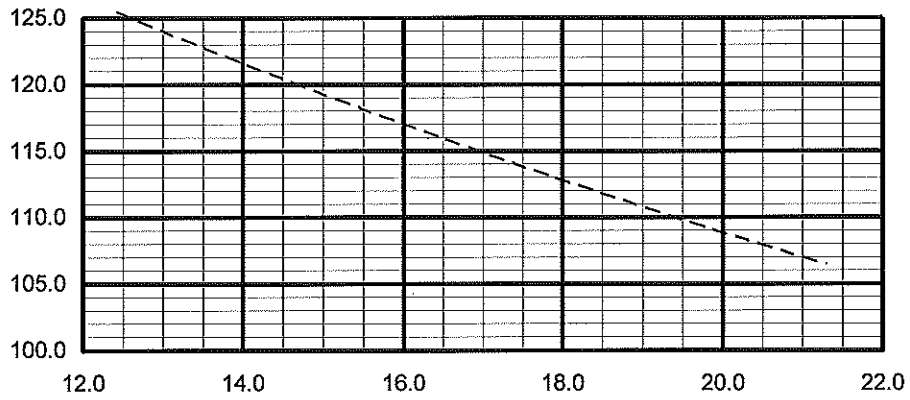
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"	100	
12.7	1/2"	98	
9.5	3/8"	95	
4.75	# 4	92	
2	#10	90	
0.85	#20	87	
0.425	#40	85	
0.25	# 60	82	
0.15	#100	79	
0.075	#200	73.4	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	Non Plastic

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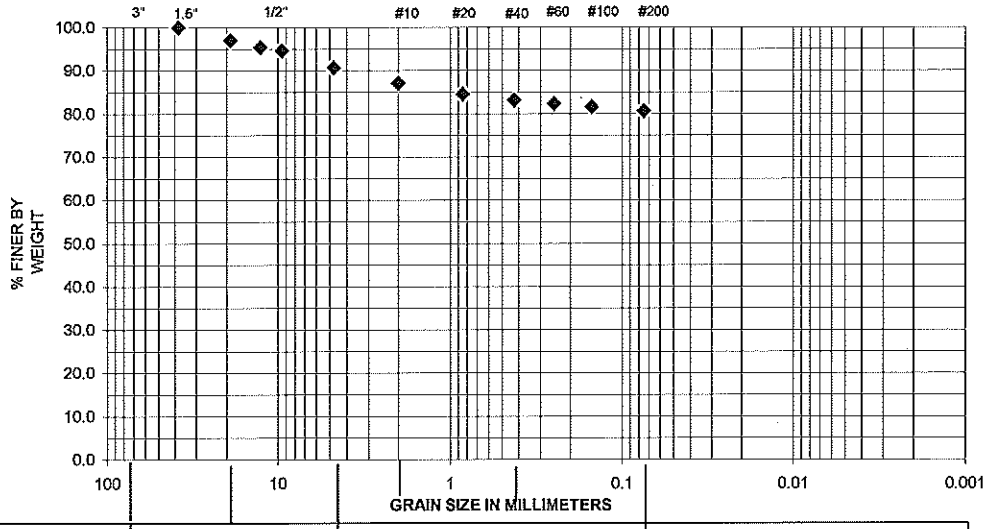
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-33
SAMPLE NO/ DEPTH	SA-1 (Depth 2.5' - 4.0')
DESCRIPTION:	Silt with sand
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	9.3	USC:	ML
% SAND:	10.1	FC:	
% SILT/CLAY:	80.6	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	26.2

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

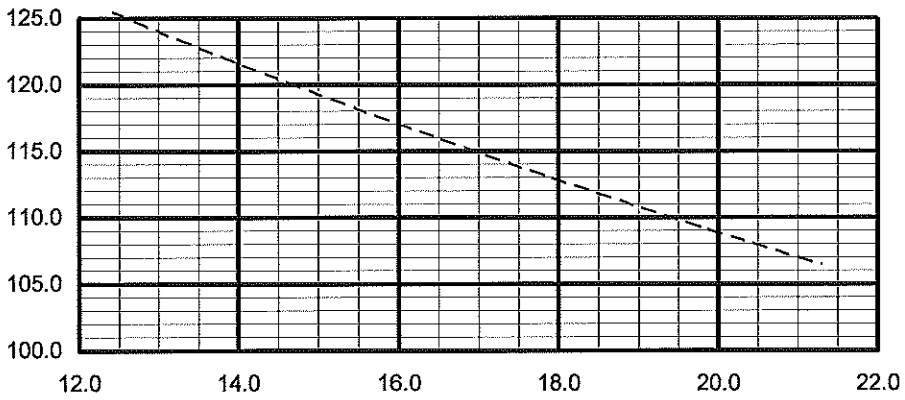
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	97	
12.7	1/2"	95	
9.5	3/8"	95	
4.75	# 4	91	
2	#10	87	
0.85	#20	85	
0.425	#40	83	
0.25	# 60	82	
0.15	#100	82	
0.075	#200	80.6	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	**Non Plastic**

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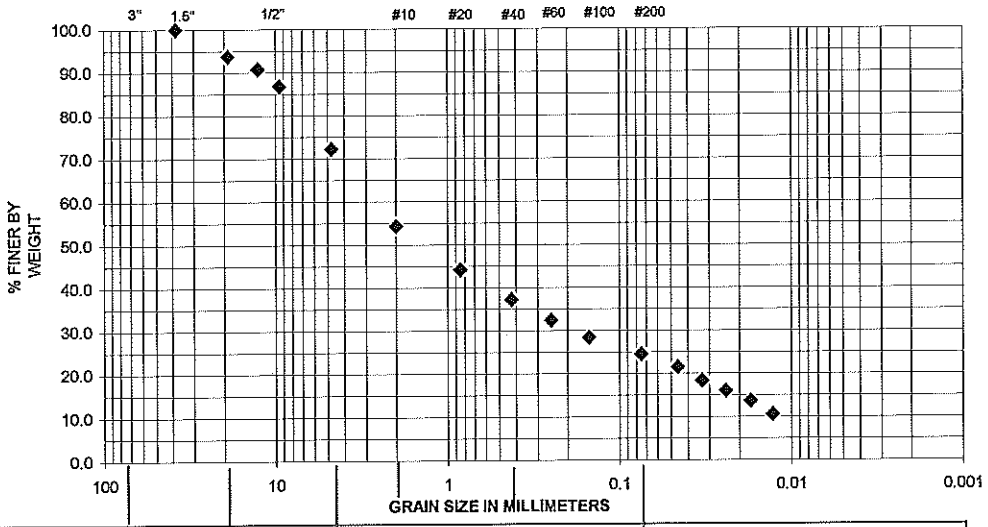
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-33
SAMPLE NO/ DEPTH	SA-2 (Depth 4.5' - 6.0')
DESCRIPTION:	Silty sand w/ gravel
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	27.8	USC:	SM
% SAND:	47.7	FC:	F2
% SILT/CLAY:	24.5	.02 mm:	14.7

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	27.1

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

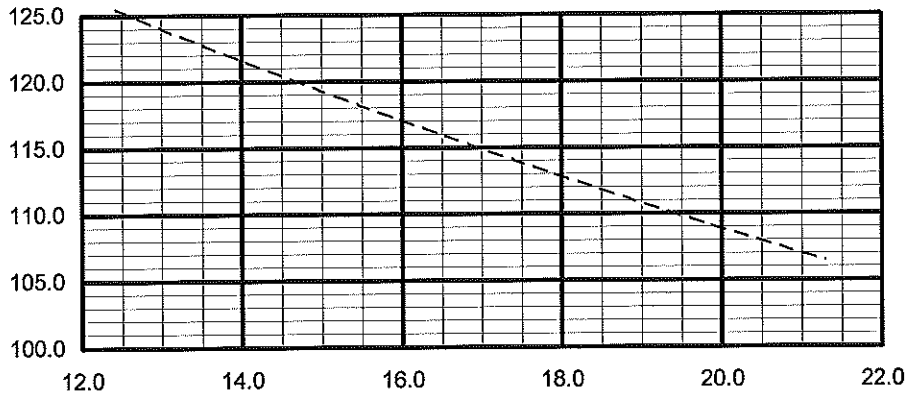
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	94	
12.7	1/2"	91	
9.5	3/8"	87	
4.75	# 4	72	
2	#10	54	
0.85	#20	44	
0.425	#40	37	
0.25	# 60	32	
0.15	#100	28	
0.075	#200	24.5	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0458	21.5
2	0.0331	18.4
4	0.0240	16.0
8	0.0173	13.7
15	0.0129	10.6
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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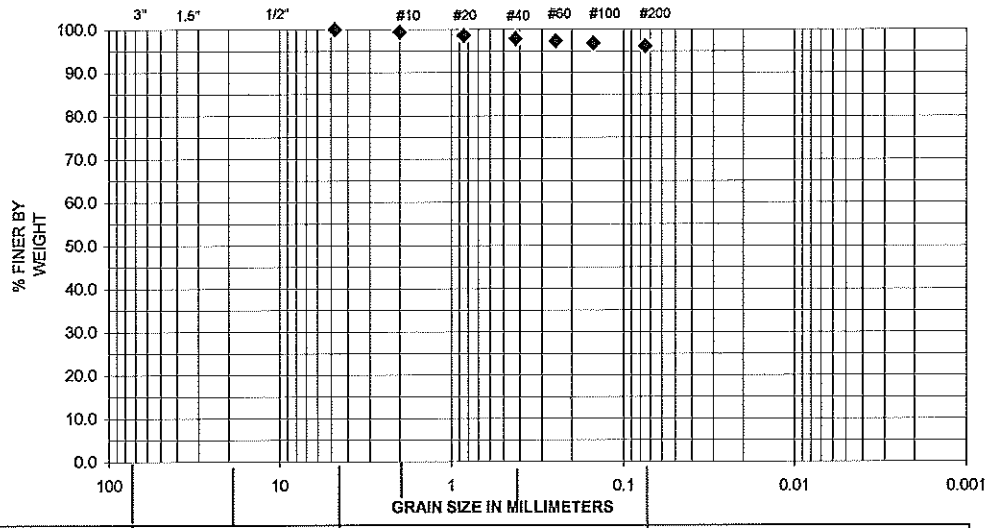
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-34
SAMPLE NO/ DEPTH	SA-1 (Depth 2.5' - 4.0')
DESCRIPTION:	Silt
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	0.0	USC:	ML
% SAND:	3.8	FC:	
% SILT/CLAY:	96.2	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	27.0

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

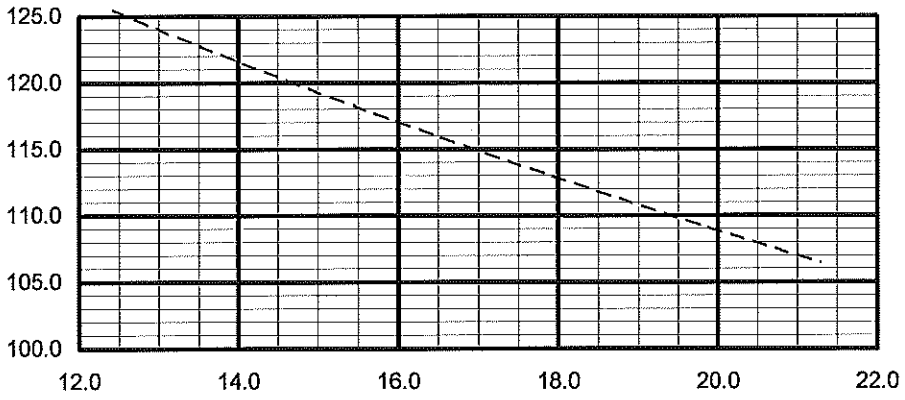
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"		
19.05	3/4"		
12.7	1/2"		
9.5	3/8"		
4.75	# 4	100	
2	#10	99	
0.85	#20	99	
0.425	#40	98	
0.25	# 60	97	
0.15	#100	97	
0.075	#200	96.2	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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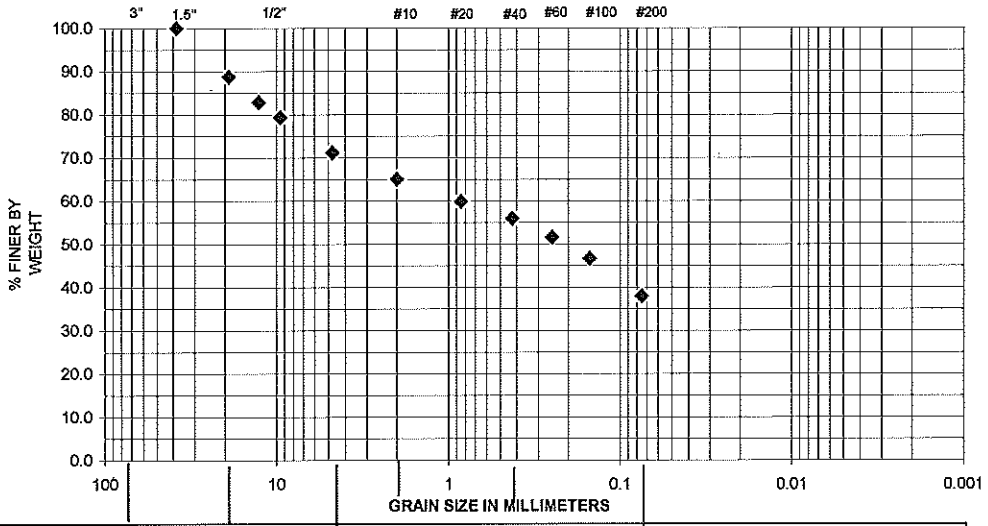
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-34
SAMPLE NO/ DEPTH	SA-2 (Depth 4.5' - 6.0')
DESCRIPTION:	Silty sand w/ gravel
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	28.8	USC:	SM
% SAND:	33.2	FC:	
% SILT/CLAY:	38.0	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	21.3

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

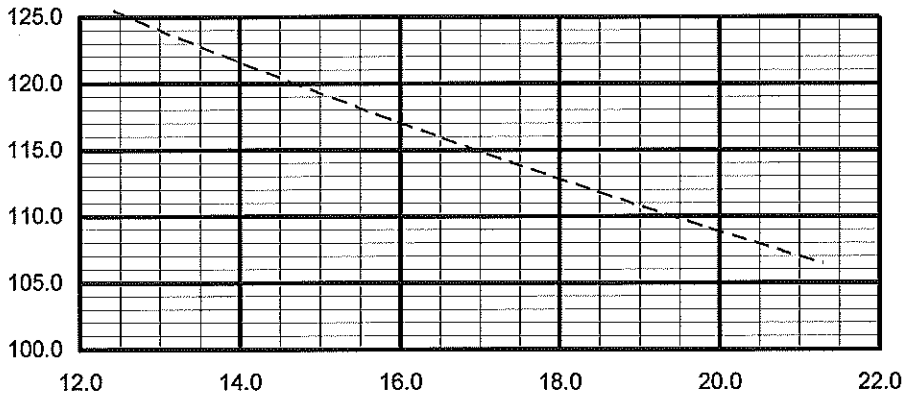
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	89	
12.7	1/2"	83	
9.5	3/8"	79	
4.75	# 4	71	
2	#10	65	
0.85	#20	60	
0.425	#40	56	
0.25	# 60	52	
0.15	#100	47	
0.075	#200	38.0	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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TERRA FIRMA TESTING

Laboratory Testing / Construction Monitoring

Telephone: (907) 344-5934
Fax: (907) 344-5993
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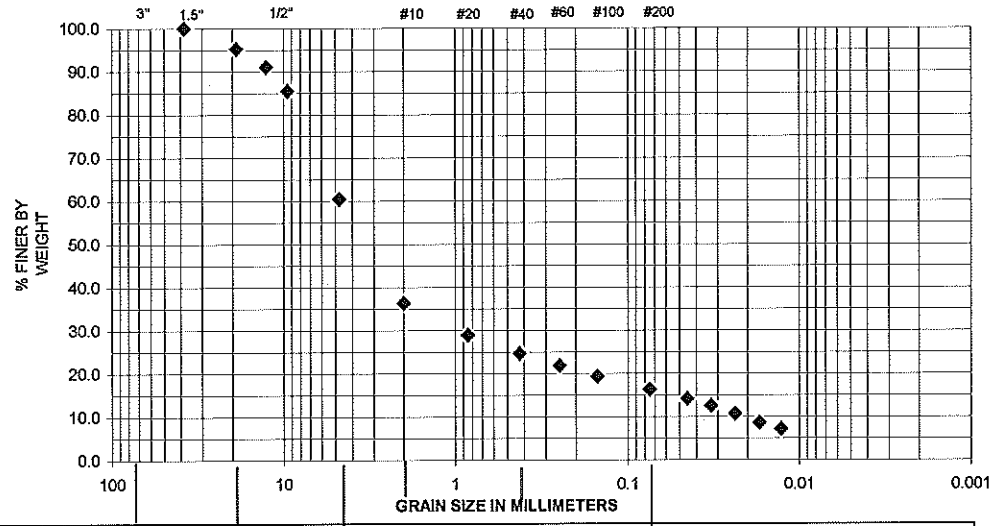
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-34
SAMPLE NO/ DEPTH	SA-3 (Depth 9.5' - 11.0')
DESCRIPTION:	Silty sand w/ gravel
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	39.5	USC:	SM
% SAND:	44.2	FC:	F2
% SILT/CLAY:	16.3	.02 mm:	9.6

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	15.4

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

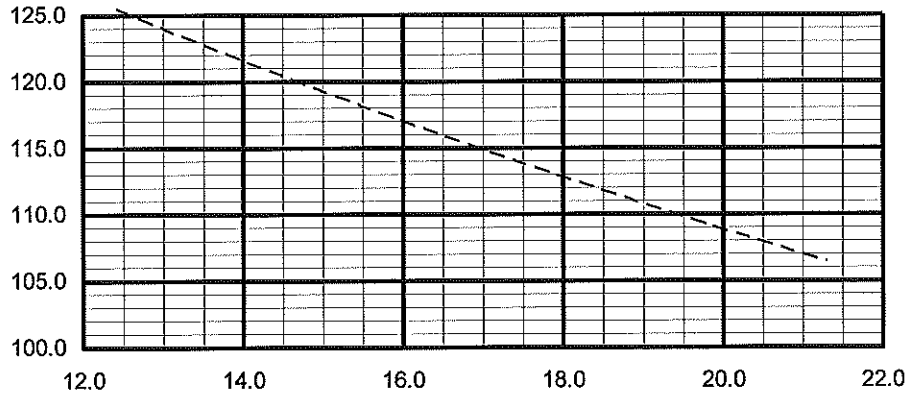
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	95	
12.7	1/2"	91	
9.5	3/8"	86	
4.75	# 4	60	
2	#10	36	
0.85	#20	29	
0.425	#40	25	
0.25	# 60	22	
0.15	#100	19	
0.075	#200	16.3	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0452	14.2
2	0.0328	12.5
4	0.0237	10.7
8	0.0171	8.6
15	0.0128	7.2
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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TERRA FIRMA TESTING

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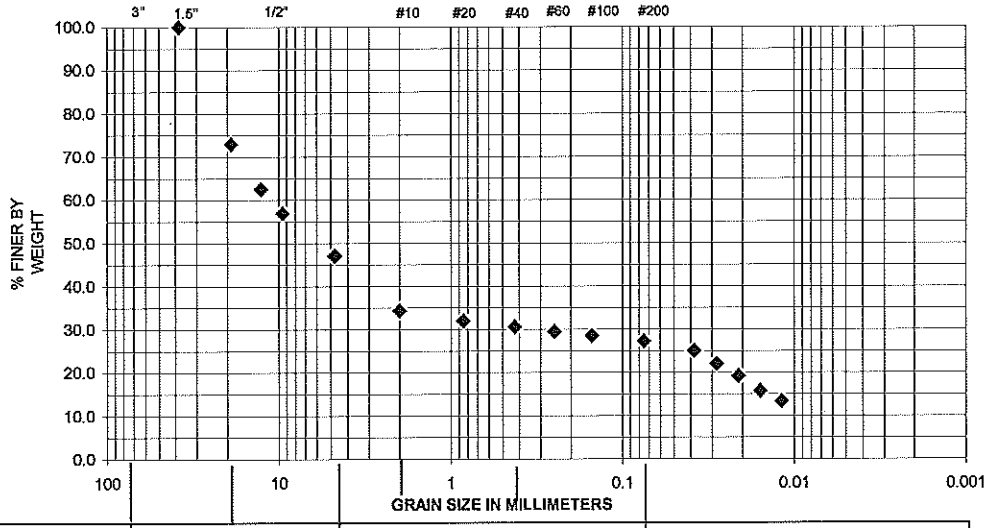
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-35
SAMPLE NO/ DEPTH	SA-1 (Depth 2.5' - 4.0')
DESCRIPTION:	Silty gravel w/ sand
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	52.9	USC:	GM
% SAND:	19.8	FC:	F2
% SILT/CLAY:	27.3	.02 mm:	18.5

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	16.0

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

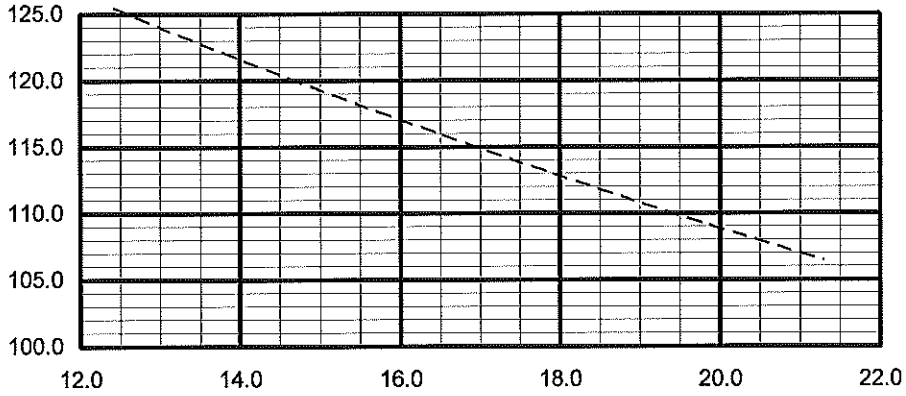
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	73	
12.7	1/2"	63	
9.5	3/8"	57	
4.75	# 4	47	
2	#10	34	
0.85	#20	32	
0.425	#40	31	
0.25	# 60	30	
0.15	#100	29	
0.075	#200	27.3	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0381	25.0
2	0.0283	22.0
4	0.0212	19.2
8	0.0158	15.8
15	0.0118	13.4
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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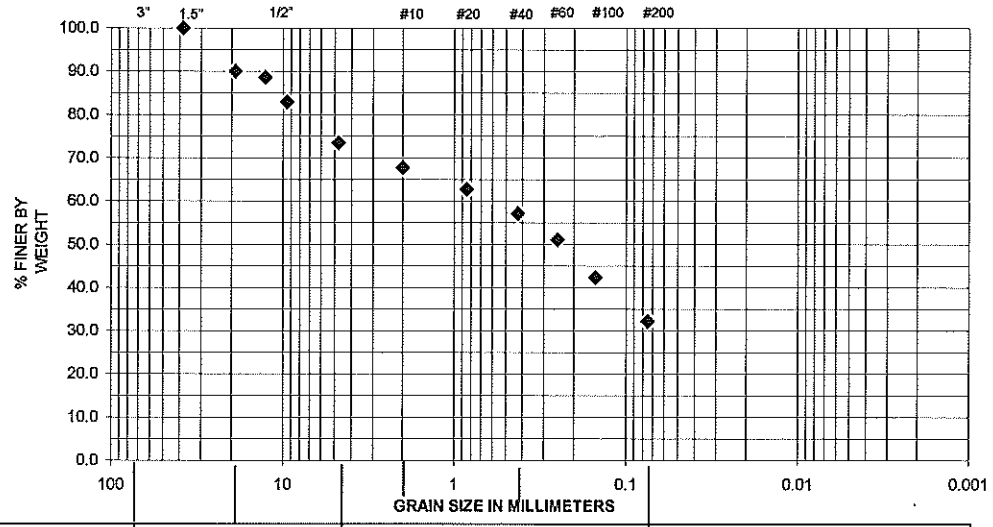
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-35
SAMPLE NO/ DEPTH	SA-2 (Depth 4.5' - 6.0')
DESCRIPTION:	Silty sand w/ gravel
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	26.5	USC:	SM
% SAND:	41.3	FC:	
% SILT/CLAY:	32.2	.02 mm:	

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	18.4

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

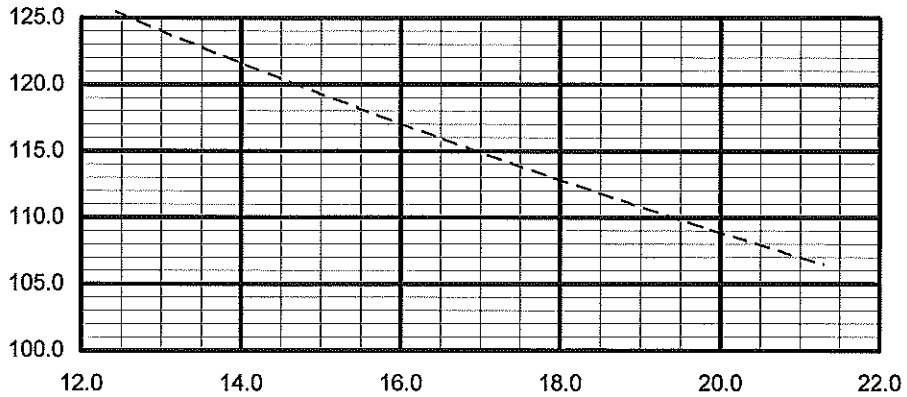
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	90	
12.7	1/2"	89	
9.5	3/8"	83	
4.75	# 4	73	
2	#10	68	
0.85	#20	63	
0.425	#40	57	
0.25	# 60	51	
0.15	#100	42	
0.075	#200	32.2	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	

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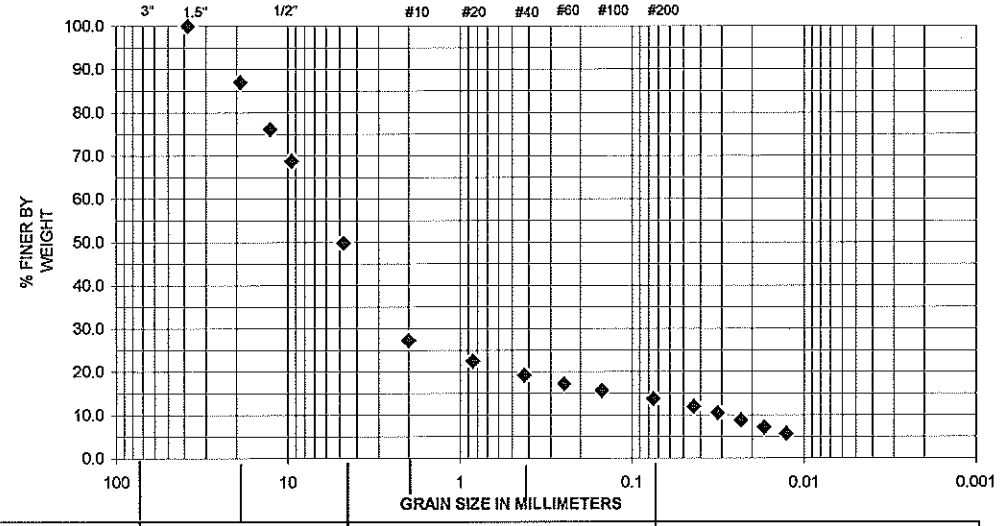
PROJECT CLIENT:	Corps of Engrs - Alaska District
PROJECT NAME:	Newtok Relocation
PROJECT NO.:	2076-08
SAMPLE LOCATION:	TB-35
SAMPLE NO/ DEPTH	SA-3 (Depth 9.5' - 11.0')
DESCRIPTION:	Silty gravel w/ sand
DATE TESTED:	10/17/2008
TESTED BY:	DP
REVIEWED BY:	Ron Caron C.E.T.

% GRAVEL:	50.2	USC:	GM
% SAND:	36.0	FC:	F1
% SILT/CLAY:	13.8	.02 mm:	8.0

ASTM D1557(uncorrected)	pcf
ASTM D4718 (corrected)	pcf
OPTIMUM M.C.% (corrected)	
NATURAL M.C. %	28.7

PARTICLE SIZE ANALYSIS

ASTM D422/ C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

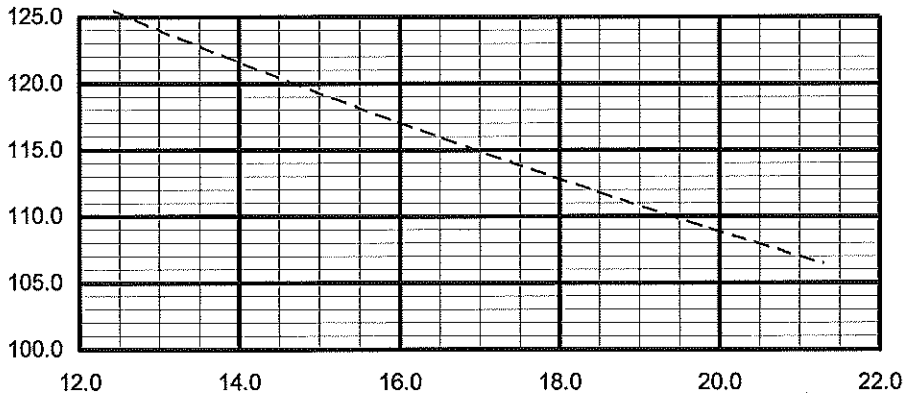
SIEVE SIZE (mm)	SIEVE SIZE (in.)	TOTAL % PASSING	SPEC
152.4	6"		
76.2	3"		
38.1	1.5"	100	
19.05	3/4"	87	
12.7	1/2"	76	
9.5	3/8"	69	
4.75	# 4	50	
2	#10	27	
0.85	#20	22	
0.425	#40	19	
0.25	# 60	17	
0.15	#100	16	
0.075	#200	13.8	

HYDROMETER RESULT

ELAPSED TIME	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1	0.0437	12.0
2	0.0317	10.5
4	0.0232	8.8
8	0.0170	7.2
15	0.0127	5.7
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP

ASTM D1557



Perm. (ASTM D2438)	
Degradation (ATM T-13)	
Atterberg Limit ASTM 4318	