ENGINEERING REPORT

for

CONTRACT NUMBER DACW-33-81-D-0005
WORK ORDER NUMBER 0006

SUBSURFACE INVESTIGATION

for

RUBBLE MOUND BREAKWATER
BRISTOL HARBOR, RHODE ISLAND

BRIGGS

RECEIVED

JUL 1 1982

TABLE OF CONTENTS

1.0 General

1.1 Authorization
1.2 Project Site
1.3 Purpose of the Investigation
1.4 Scope of the Investigation

2.0 SUBSURFACE CONDITIONS

2.1 Subsurface Materials

3.0 QUALITY CONTROL

3.1 General
3.2 Equipment
3.3 Records
3.4 Procedures
3.5 Safety
3.6 Survey

4.0 QUALITY CONTROL CERTIFICATION

Chain of Custody Log
Safety Reports
Exploration Location Plan
Appendix A Field Exploration Logs
Appendix B Survey Field Notes

1.0 GENERAL

1.1 Authorization

The subsurface exploration work for the proposed rubble mound breakwater in Bristol, Rhode Island, reported herein was performed under Contract DACW-33-81-D-0005, Work Order No. 0006, dated 08 June 1982. The authority for this project is derived from Section 101 of the 1968 Rivers & Harbors Act, PL 90-483. The contracting officer is Arthur N. Rappaport, Lt. Col.

1.2 Project Site

The site is located in Bristol Harbor, Bristol, Rhode Island. Bristol Harbor is bounded on the east by Bristol Neck and on the west by Popaquash Neck.

1.3 Purpose of the Investigation

The purpose of the test borings and undisturbed sampling information is to determine the thickness of soft material below the harbor bottom.

1.4 Scope of the Investigation

The work performed under this work order consisted of the following:

a. Drilling 3 test borings and taking 4 undisturbed samples at the locations shown on the Subsurface Exploration Plan. Boring A was advanced to a depth of 42 feet below harbor bottom. Borings B and C were advanced to 34.4 and 30.25 feet below harbor bottom, respectively, where refusal was encountered and a 12 inch core taken. The drilling and sampling operations were conducted between 4 June and 10 June 1982 by Briggs Engineering & Testing Company, Inc. of Norwell, Massachusetts. Field Exploration logs are included in Appendix A.

b. Surveying the location of the borings. This work was performed by Briggs Engineering and Testing Company, Inc. on 4 June 1982.

2.0 SUBSURFACE CONDITIONS

2.1 Subsurface Materials

The following subsurface materials were encountered when the borings where drilled at the site.

a. Harbor Bottom Sediments consisting of very soft, moderately plastic, organic silty clay were

encountered in all borings. These sediments range in thickness from 9.5 feet in Boring C to 29.0 feet in Boring A.

b. Interbedded Silty Clay and Silty Sand underlie the harbor bottom sediments in Borings A and B. The silty clay is silty plastic and very stiff and the silty sand is medium to fine sand with varying amounts of slightly plastic fines. The deposits extend to a depth of 42 below harbor bottom in Boring A and to 32.5 feet in Boring B where bedrock was apparently encountered.

c. Sand and Silty Gravels underlie the harbor bottom seiments in Boring C and extend to 30.25 feet below harbor bottom where bedrock was apparently encountered.

3.0 QUALITY CONTROL

3.1 General

All work was conducted in accordance with the procedures outlined in ASTM D-1586, Penetration Test and Split-Barrel Sampling of Soils and ASTM D-1587-74, Thin-Walled Tube Sampling of Soils. The equipment utilized by Briggs Engineering and Testing to perform the required drilling work is described below. All equipment was in satisfactory working condition at the start of the project work.

3.2 Equipment

The following equipment was used to perform the subsurface exploration:

a. Core Drill: A portable skid type rig manufactured by Acker Drill Company and mounted on a barge was used to perform all subsurface explorations.

b. Drilling Platform: A 16 by 20 ft wooden barrel float was used as a working and drilling platform for the borings and undisturbed sampling. The Acker drill rig was positioned on the center of the barge. The final positioning of the drilling platform was accomplished by adjusting the tie-off lines which were afixed to bottom anchors.

c. Drive Hammer: The drive hammer used to advance both the casing and split-spoon barrel weighed approximately 140 pounds.

c. Casing and Rods: BW (2 3/8 in.) flush joint casing was used to keep the borehole open when performing the test borings and HW (4 in) flush joint casing was used to keep the borehole open when performing undisturbed sampling. AW size drill rods were used in washing out the borehole, driving the split-spoon sampler and pushing the tubes.

d. Samplers: The equipment employed to obtain disturbed soil samples was a 1-3/8 inch I.D. by 18 inch split-spoon sampler with a ball check head and spring type retainer. A 3 inch I.D. by 36 inch tubes were used to obtain the undisturbed samples.

3.3 Records

NED Forms 58 and 58A, dated March 1971 and entitled "Field Log of Test Boring" were used to record pertinent drilling and sampling data. The logs include the following:

a. Site location, boring location and number.

b. Make and model of drilling equipment.

c. Type of drilling and sampling operation by depth.

d. Depths at which soil samples were recovered, including top and bottom depth of each run. Classification or description of the soil and rock samples obtained. Indication of penetration resistance such as drive hammer blows given in blows per 6 in. penetration depth for driving sample spoons.

e. Length of sample of soil recovered per sampling run.

3.4 Procedures

a. Boreholes were advanced by sampling in which either a 1-3/8 inch by 18 inch split-spoon barrel or 3 inch tube was advanced below the bottom of the casing into undisturbed soil. The split spoon sampler was advanced either by the weight of rods, the weight of rods and a hammer weighing approximately 140 pounds or by the impact of a hammer weighing approximately 140 pounds falling 30 inches or, depending on the strength of the soil. Refusal was defined as 100 blows for penetration of less than 18 inches. The tube sampler was advanved by the weight of two men.

b. The sample spoon shoes were kept reasonably sharp at all times. Dull, bent, or otherwise damaged samplers were not used. Following sampling the casing was

advanced and cleaned out using appropriately sized upward discharging chopping bits.

c. Samples were classified in the field immediately following the taking of the sample. Classification was in accordance with ASTM D-2487 and D-2488. Representative samples were take from each soil sampling run and placed in 16 oz. glass jars with hermetically sealed lids. Jars were labeled with sample number, sampling interval, boring number,date, location, and soil description. Tube samples were sealed with microcrystalline wax and capped immediately after the tube was taken. Tubes were kept in an upright position and handled with care to minimize disturbance. A chain of custody log was maintained documenting custody of the samples between the field and transportation and delivery to the laboratory at NED.

3.5 Safety

The work was performed without personal injury or accident. The contractor's personnel wore hard hats and life jackets for personal protection. The geotechnical inspector conducted weekly safety briefings. The Safety Reports are included in Appendix A.

3.6 Survey

The location of each test boring was established by turning an angle and measuring a distance from a known point on shore. This was accomplished by using a theodolite and an EDM(Electonic Distance Measurer). The test boring locations were marked with floats. The survey field notes are included in Appendix B.

4.0 QUALITY CONTROL CERTIFICATION

I hereby certify that the above mentioned records, equipment and procedures were used to perform the subsurface exploration described herein. I also certify that the work was performed in a professional manner and meets the requirements set forth in the work order.

COMMONWEALTH OF MASSACHUSETTS
NICHOLAS ANTHONY LANNEY
No. 30789
REGISTERED PROFESSIONAL ENGINEER

CERTIFIED 27 June 1982

Nicholas A. Lanney

Nicholas A. Lanney, P.E.
Massachusetts No. 30789

BRIGGS ENGINEERING CORPORATION

Chain of Custody Log

Project: Proposed Rubble Mound Breakwater-Bristol, RI

Items: Tubes 4

Jar Samples 35 . 3 Boxes

Core Boxes 1

Sampling Logs Borings FD-82-1, FD-82-2, FD-82-3, UDT-82-1, UDT-82-

	Date & Time Received	Date & Time Transfered	Comments	Condition
1.	as Sampled	6/14/82 0800		RF Bates
2.	6/14/82	6/14/82 1400		[illegible]
3.	6/14/82 1400	6/14/82 1515		[illegible]
4.	Rec'd 6/14/82	1515		JP Ruggs
5.				

BRIGGS ENGINEERING CORPORATION

WEEKLY SAFETY MEETING

TO: Safety Office, NED

FROM: Field Engineer Date held 04 June 1982

THRU: Project Engineer Time 0600

Weekly safety meeting was held this date for the following personnel:
Contract No. DACW 33-81-D-0005 Personnel present: R. Jones
Work Order No. 0006 W. Souza
Conducted By: R.F. Bukoski

1. Subjects discussed (Note, delete, or add):

x Individual Protective Equipment -
x Prevention of Falls -
Safe Lifting Techniques -
Emergency Communications -
Fire Prevention -
Sanitation, First Aid -
x Tripping Hazards - trash, hose, nails in lumber -
Staging, Ladders, Concrete Forms -
Hand Tools -
Portable Power Tools -
Woodworking Machinery -
x Equipment Maintenance (Zero defects) -
x Hoisting Equipment -
x Ropes, Hooks, Chains and Slings -
Electrical Grounding, Temporary Wiring -
Lockouts for safe clearance procedures -
Electrical, pressure, moving parts -
Welding -
Excavations -
Loose Rock and Steep Slopes -
Explosives -
x Water Safety -Life Jackets
x Other - Fire extinguisher on raft

Prepared by: R.F. Bukoski
Field Engineer

2. Exposure:

Start of new work order. No previous exposure.

Signature: Nicholas Lamm
Project Engineer

3. Forwarded: NED, Waltham, MA

BRIGGS ENGINEERING CORPORATION

WEEKLY SAFETY MEETING

TO: Safety Office, NED

FROM: Field Engineer Date held 09 June 1982

THRU: Project Engineer Time 0800

Weekly safety meeting was held this date for the following personnel:
Contract No. DACW 33-81-D-0005 Personnel present: R. Jones
Work Order No. 0006 W. Souza
Conducted By: R.F. Bukoski

1. Subjects discussed (Note, delete, or add):

x Individual Protective Equipment -
Prevention of Falls -
Safe Lifting Techniques -
Emergency Communications -
Fire Prevention -
Sanitation, First Aid -
Tripping Hazards - trash, hose, nails in lumber -
Staging, Ladders, Concrete Forms -
Hand Tools -
Portable Power Tools -
Woodworking Machinery -
x Equipment Maintenance (Zero defects) -
x Hoisting Equipment -
x Ropes, Hooks, Chains and Slings -
Electrical Grounding, Temporary Wiring -
Lockouts for safe clearance procedures -
Electrical, pressure, moving parts -
Welding -
Excavations -
Loose Rock and Steep Slopes -
Explosives -
Water Safety
Other -

Prepared by: R.F. Bukoski
Field Engineer

2. Exposure:

For the week ending May 31, 1982, covering 3 men for a total of 30 manhours

Signature: Nicholas Lanny
Project Engineer

3. Forwarded: NED, Waltham, MA

BRIGGS ENGINEERING CORPORATION

WEEKLY SAFETY MEETING

TO: Safety Office, NED

FROM: Field Engineer Date held No meeting held

THRU: Project Engineer Time_____

Weekly safety meeting was held this date for the following personnel:
Contract No. DACW 33-81-D-0005 Personnel present:_____
Work Order No. 0006 _____
Conducted By:_____ _____

1. Subjects discussed (Note, delete, or add):

Individual Protective Equipment -
Prevention of Falls -
Safe Lifting Techniques -
Emergency Communications -
Fire Prevention -
Sanitation, First Aid -
Tripping Hazards - trash, hose, nails in lumber -
Staging, Ladders, Concrete Forms -
Hand Tools -
Portable Power Tools -
Woodworking Machinery -
Equipment Maintenance (Zero defects) -
Hoisting Equipment -
Ropes, Hooks, Chains and Slings -
Electrical Grounding, Temporary Wiring -
Lockouts for safe clearance procedures -
Electrical, pressure, moving parts -
Welding -
Excavations -
Loose Rock and Steep Slopes -
Explosives -
Water Safety
Other -

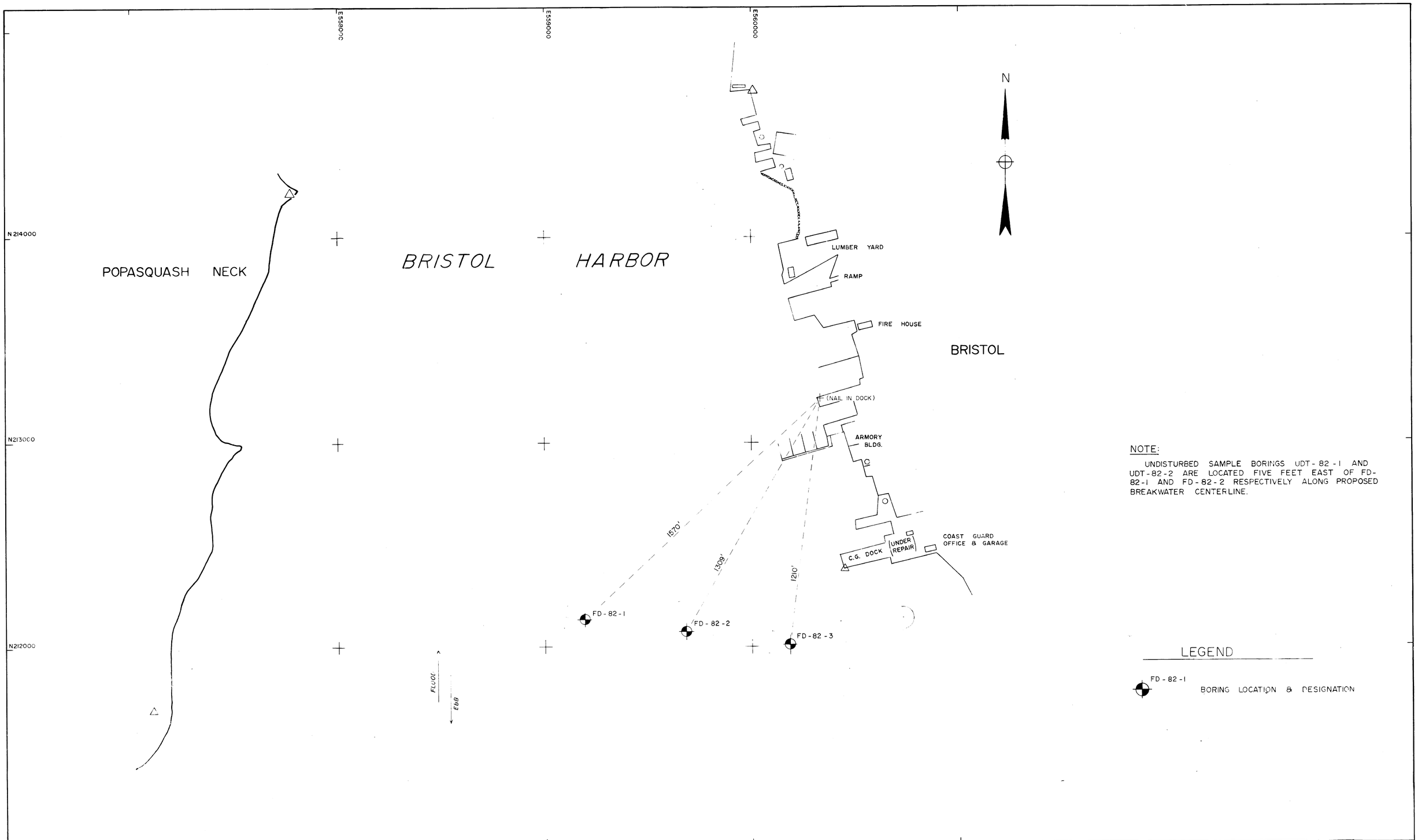
Prepared by: C.F. Burkosh
Field Engineer

2. Exposure:

For the week ending June 7, 1982, covering 3 men for a total of 93 manhours

Signature: Nicholas [illegible]
Project Engineer

3. Forwarded: NED, Waltham, MA



BRIGGS ENGINEERING & TESTING CO.
164 WASHINGTON ST. NORWELL, MA.

TITLE:	BORING LOCATION PLAN BRISTOL, RHODE ISLAND
SCALE: 1" = 200'	DATE: 6/7/82
DRAWN: J.C.C.	CHECKED: R.F.B.
SHEET 1 of 1	

APPENDIX A

Field Exploration Logs

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site BRISTOL HARBOR, RI — Page 1 of 3 Pages

Boring No. FD 82-1 Desig. A Diam. (Casing) 2-3/8"

Co-ordinates. N NOT GIVEN E

Elevation Top of Boring -17.1'± M.L.W. ~~M.S.L.~~ — Hammer Wt. 140 lb — Boring Started 6-4-82

Total Overburden Drilled 42.0 Feet — Hammer Drop 30" — Boring Completed 6-4-82

Elevation Top of Rock NONE ENCOUNTERED M.S.L. — Casing Left NONE

Total Rock Drilled N/A Feet — Subsurface Water Data N/A Page

Elevation Bottom of Boring -59.1'± M.L.W. M.S.L. — Obs. Well NO

Total Depth of Boring 42.0 Feet — Drilled By BRIGGS ENGINEERING & TESTING CO.

Core Recovered N/A % — No. Boxes N/A — Mfg. Des. Drill ACKER - RAFT MOUNTED

Core Recovered N/A Ft: — Diam. — In. — Inspected By: RONALD F. RUKOSKI

Soil Samples 1-3/8 In. Diam. 16 No. — Classification By: RONALD F. RUKOSKI

Soil Samples ____ In. Diam. ____ No. — Classification By: ____

DEPTH 1" = 2.0'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1.0', 2.0'	S-1 1 JAR	1-3/8"	0.0 TO 2.0'	WEIGHT OF RODS (AW)	SPLIT BARREL SAMPLER, 1-3/8 by 24", ATTACHED TO 20.0' OF AW DRILL RODS SETTLED 2.0' UNDER WEIGHT OF RODS. RECOVERED 6-0".	MARINE HARBOR SEDIMENTS: ORGANIC CLAYEY SILT, MODERATELY PLASTIC, MODERATE DRY STRENGTH, MODERATE ORGANIC ODOR, 5-10 % SHELLS AND SHELL FRAGMENTS, DARK GRAY, (OL).
3.0', 4.0', 5.0'	NO SAMPLE		2.0 TO 5.0'		HOLE CASED FROM HARBOR BOTTOM TO 5.0' USING 2-3/8" I.D. CASING. CASING HUNG FROM RAFT'S DECK TO AVOID FURTHER SETTLEMENT OF CASING UNDER OWN WEIGHT.	
6.0', 7.0'	S-2 1 JAR	1-3/8"	5.0 TO 7.0'	WEIGHT OF RODS	CASING WASHED OUT USING SIDE DISCHARGING CHOPPING BIT. SPLIT BARREL SAMPLER, 1-3/8 by 24-0" USED FOR SAMPLING FROM 5.0 TO 7.0'. SAMPLER SETTLED 2.0' UNDER WEIGHT OF AW DRILL RODS. RECOVERED 5-0".	MARINE HARBOR SEDIMENTS: ORGANIC CLAYEY SILT, MODERATELY PLASTIC, MODERATE DRY STRENGTH, MODERATE ORGANIC ODOR, 5-10 % SHELL FRAGMENTS, DARK GRAY, (OL).
8.0', 9.0', 10.0'	NO SAMPLE		7.0 TO 10.0'		PUSHED CASING FROM 5.0 TO 10.0' AND HUNG FROM RAFT TO AVOID ADDITIONAL SETTLEMENT.	

GENERAL REMARKS: BORING DEPTHS ARE REFERENCED TO HARBOR BOTTOM, ELEVATIONS ARE REFERENCED TO M.L.W.

WHEN SUFFICIENT SAMPLE WAS RECOVERED AT DEPTH IT WAS PLACED IN A SECOND JAR AND LABELED WITH A "W".

Site: BRISTOL HARBOR	Boring No. FD 82-1	Page 2 of 3

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0' 11.0' 12.0'	S-3 1 JAR	1-3/8"	10.0 TO 12.0'	WEIGHT OF RODS AND HAMMER	SPLIT BARREL SAMPLER, 1-3/8 by 24-0" USED FOR SAMPLING FROM 10.0 TO 12.0'. SAMPLER SETTLED 2.0' UNDER WEIGHT OF AW RODS AND HAMMER. RECOVERED 6-0".	MARINE HARBOR SEDIMENTS: ORGANIC CLAYEY SILT, MODERATELY PLASTIC, MODERATE ORGANIC ODOR, 5-10% SHELL FRAGMENTS, DARK GRAY, (OL).
13.0' 14.0' 15.0'	NO SAMPLE		12.0 TO 15.0'		PUSHED CASING FROM 10.0 TO 15.0' AND WASHED OUT USING SIDE DISCHARGING CHOPPING BIT.	
16.0' 17.0'	S-4 2 JARS	1-3/8"	15.0 TO 17.0'	WEIGHT OF RODS AND HAMMER	SPLIT BARREL SAMPLER 1-3/8 x 24-0" USED FOR SAMPLING FROM 15.0 TO 17.0' SAMPLER SETTLED 2.0' UNDER WEIGHT OF AW RODS AND HAMMER.	MARINE HARBOR SEDIMENTS: ORGANIC CLAYEY SILT, MODERATELY PLASTIC, MODERATE ORGANIC ODOR, 10-15% SHELL FRAGMENTS, DARK GRAY, (OL).
18.0' 19.0' 20.0'	NO SAMPLE		17.0 TO 20.0'		DROVE CASING FROM 15.0 TO 20.0' AND WASHED OUT USING SIDE DISCHARGING CHOPPING BIT.	
21.0' 22.0'	S-5 2 JARS	1-3/8"	20.0 TO 22.0'	WEIGHT OF RODS AND HAMMER	PUSHED 1-3/8 x 24" SPLIT BARREL SAMPLER FROM 20.0 TO 22.0'. RECOVERED 8-0".	MARINE HARBOR SEDIMENTS: ORGANIC CLAYEY SILT, MODERATELY PLASTIC, MODERATE ORGANIC ODOR, 5-15% SHELL FRAGMENTS, DARK GRAY, (OL).
23.0' 24.0' 25.0'	NO SAMPLE		22.0 TO 25.0'		DROVE CASING FROM 20.0 TO 25.0' AND WASHED OUT USING SIDE DISCHARGING CHOPPING BIT.	
26.0' 27.0'	S-6 2 JARS	1-3/8"	25.0 TO 27.0'	WEIGHT OF RODS AND HAMMER	PUSHED 1-3/8 x 24" SPLIT BARREL SAMPLER FROM 25.0 TO 27.0'. RECOVERED 20-0"	MARINE HARBOR SEDIMENTS: ORGANIC CLAYEY SILT, MODERATELY PLASTIC, MODERATE ORGANIC ODOR 10-15% SHELL FRAGMENTS, DARK GRAY, (OL).

Site: BRISTOL HARBOR	Boring No. FD 82-1	Page 3 of 3

DEPTH (+2.0')	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
28.0'	NO SAMPLE		27.0 TO 29.0'		DROVE CASING TO RESISTANCE AT 29.0'. WASHED OUT CASING USING SIDE DISCHARGING CHOPPING BIT.	
29.0'	S-7 1 JAR	1-3/8"	29.0 TO 30.0'	4 / 12	DROVE SPLIT BARREL SAMPLER FROM 29.0 TO 30.0' USING 140 LB HAMMER. RECOVERED 5-0". CLAY IN TIP OF SPOON	SILTY SAND, COARSE TO FINE SAND, 15-20% FINE GRAVEL, 10-20% MODERATELY PLASTIC FINES, DARK GRAY, (SM).
30.0'	NO SAMPLE		30.0-30.5'			
31.0'	S-8 2 JARS	1-3/8"	30.5 TO 32.5'	9 / 14 / 18 / 17	DROVE CASING FROM 29.0 TO 30.0' WASHED OUT USING CHOPPING BIT. DROVE 1-3/8 x 24" SPLIT BARREL SAMPLER FROM 30.5 TO 32.5'. RECOVERED 12-0"	SILTY CLAY, THINLY VARVED, MODERATELY PLASTIC GRAY, (CL).
32.0'						
33.0'	NO SAMPLE		32.5 TO 35.0'		WASHED OUT HOLE FROM 30.0 TO 35.0 USING SIDE DISCHARGING CHOPPING BIT. HOLE UNCASED AND REMAINED OPEN.	
34.0'						
35.0'	S-9 2 JARS	1-3/8"	35.0 TO 37.0'	7 / 11 / 14 / 14	DROVE 1-3/8 x 24" SPLIT BARREL SAMPLER FROM 35.0 TO 37.0'. RECOVERED 14-0".	SILTY CLAY, THINLY VARVED, LOW PLASTICITY, GRAY, (CL).
36.0'						
37.0'	NO SAMPLE		37.0 TO 40.0'		WASHED OUT HOLE FROM 35.0 TO 40.0' USING SIDE DISCHARGING CHOPPING BIT.	
38.0'						
39.0'						
40.0'	S-10 1 JAR	1-3/8"	40.0 TO 41.8	4 / 10 / 10	DROVE 1-3/8 x 24" SPLIT BARREL SAMPLER FROM 40.0 TO 42.0'. RECOVERED 12.0".	SILTY CLAY, THINLY VARVED, LOW TO MODERATE PLASTICITY, GRAY, (CL). SOME VARVES ARE COMPOSED OF SILT.
41.0'						
42.0'	S-11 1 JAR	1-3/8"	41.8 42.0'	17	BOTTOM OF BORING 42.0'	SILTY SAND, MOSTLY FINE SAND, 25-35% SLIGHTLY PLASTIC FINES, <10% FINE SUBANGULAR GRAVEL, DARK GRAY, (SM).

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FIELD LOG OF TEST BORING

Site BRISTOL HARBOR, RI — Page 1 of 3 Pages

Boring No. FD 82-2 Desig. B Diam. (Casing) 2-3/8"

Co-ordinates. N NOT GIVEN E

Elevation Top of Boring -12.5' ± M.L.W. ~~M.S.L.~~ — Hammer Wt. 140 lb — Boring Started 6-9-82

Total Overburden Drilled 34.4 Feet — Hammer Drop 30 in. — Boring Completed 6-9-82

Elevation Top of Rock 51.9' ± M.L.W. ~~M.S.L.~~ — Casing Left NONE

Total Rock Drilled 1.25' Feet — Subsurface Water Data N/A Page

Elevation Bottom of Boring -53.15' ± M.L.W. ~~M.S.L.~~ — Obs. Well NO

Total Depth of Boring 35.65 Feet — Drilled By BRIGGS ENGINEERING & TESTING CO.

Core Recovered 100 % No. Boxes 1 — Mfg. Des. Drill ACKER - RAFT MOUNTED

Core Recovered 1.25 Ft 1-3/8" Diam. In. — Inspected By: RONALD F. BUKOSKI

Soil Samples 1-3/8 In. Diam. 10 No. — Classification By: RONALD F. BUKOSKI

Soil Samples — In. Diam. — No. — Classification By:

DEPTH 1"=2.0'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1.0' 2.0' 3.0' 4.0' 5.0' 6.0' 7.0' 8.0' 9.0' 10.0'	S-1 1 JAR	1-3/2"	0.0 TO 10.0'	WEIGHT OF RODS	SPLIT BARREL SAMPLER 1-3/8" x 24" SETTLED FROM 0.0 TO 7.0' UNDER WEIGHT OF AW DRILL RODS (30'). THE WATER SURFACE WAS TOO ROUGH, DUE TO WINDY CONDITIONS, TO ATTEMPT TO HANG CASING FROM THE RAFT'S DECK AND SAMPLE AT 5.0'. THEREFORE, THE DRILL ROD AND 140 lb HAMMER WERE ATTACHED AND THE SPOON SETTLED FROM 7.0 TO 10.0' AT WHICH POINT THE SAMPLER WAS RETRIEVED AND CASING WAS PUSHED FROM 0.0 TO 10.0'.	MARINE HARBOR SEDIMENTS: ORGANIC CLAYEY SILT, MODERATELY PLASTIC 10-20 % SHELLS. MODERATELY STRONG ORGANIC ODOR, DARK GRAY, (OL).
				WEIGHT OF RODS AND HAMMER	RECOVERED 10-0" in SPLIT BARREL SAMPLER. CASING WAS WASHED OUT USING SIDE DISCHARGING CHOPPING BIT.	

GENERAL REMARKS: BORING DEPTHS ARE REFERENCED TO HARBOR BOTTOM.

REFUSAL - 100 BLOWS WITH NO PENETRATION

Site: BRISTOL HARBOR, RI	Boring No. FD 82-2	Page 2 of 3

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
11.0' 12.0' 13.0' 14.0' 15.0'	S-2 2 JARS	1-3/8"	10.0 TO 15.0'	WEIGHT OF RODS AND HAMMER	CASING PARTIALLY SUPPORTED ON PART'S DECK. SPLIT BARREL SAMPLER, 1-3/8 x 24" SETTLED FROM 10.0 TO 15.0' UNDER WEIGHT OF AW RODS AND 140 lb HAMMER. RECOVERED 20-0". PUSHED 2-3/8" I.D. CASING FROM 10.0 TO 15.0' AND WASHED OUT USING SIDE DISCHARGING CHOPPING BIT.	MARINE HARBOR SEDIMENTS: ORGANIC CLAYEY SILT, MODERATELY PLASTIC, 10-20% SHELL FRAGMENTS, MODERATELY STRONG ORGANIC ODOR, DARK GRAY, (OL).
16.0' 17.0' 18.0' 19.0'	S-3 2 JARS	1-3/8"	15.0 TO 19.5'	WEIGHT OF RODS AND HAMMER	SPLIT BARREL SAMPLER 1-3/8" I.D. x 24" SETTLED FROM 15.0 TO 19.5' UNDER WEIGHT OF AW RODS AND 140 lb HAMMER. RECOVERED 14-0". PUSHED CASING TO 19.5 AND WASHED OUT USING SIDE DISCHARGE CHOPPING BIT	MARINE HARBOR SEDIMENTS: ORGANIC CLAYEY SILT, MODERATELY PLASTIC, 10-15% SHELL FRAGMENTS 5-10% PARTIALLY DECAYED WOOD, MODERATELY STRONG ORGANIC ODOR, DARK GRAY, (OL).
20.0' 21.0'	S-4 1 JAR	1-3/8"	19.5 TO 21.5'	15 / 29 / 36 / 36	DROVE 1-3/8 I.D. x 24" SPLIT BARREL FROM 19.5 TO 21.5'. RECOVERED 7-0"	SILTY SAND, UNIFORM FINE MEDIUM SAND, 10-20% SLIGHTLY PLASTIC FINES, GRAY, (SM).
22.0' 23.0' 24.0' 25.0'	NO SAMPLE		21.5 TO 25.0'		DROVE 2-3/8" I.D. CASING FROM 19.5 TO 25.0' AND WASHED OUT USING SIDE DISCHARGE CHOPPING BIT.	
26.0' 27.0'	S-5 1 JAR	1-3/8"	25.0 TO 27.0'	16 / 35 / 45 / 60	DROVE 1-3/8 I.D. x 24" SPLIT BARREL SAMPLER FROM 25.0 TO 27.0'. RECOVERED 9-0".	SILTY CLAY, MODERATELY PLASTIC, THINLY VARVED IN SEVERAL LOCATIONS, GRAY, (CL).

Site: BRISTOL HARBOR, RI	Boring No. FD 82-2	Page 3 of 3

DEPTH (1"=2.0')	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
28.0'	110 CAMPLE		27.0 TO 30.0'		DROVE 2-3/8" I.D. CASING FROM 25.0 TO 30.0' AND WASHED OUT USING SIDE DISCHARGE CHOPPING BIT.	
29.0'						
30.0'						
31.0'	S-6 2 JAR	1-3/8"	30.0 TO 32.0'	12 / 21 / 21 / 24	DROVE 1-3/8 I.D. x 24" SPLIT BARREL SAMPLER FROM 30.0 TO 32.0' RECOVERED 12-0"	SILTY CLAY, LOW PLASTICITY, THINLY VARVED, GRAY, (CL).
32.0'						
32.0'	S-7 1 JAR	1-3/8"	32.5 TO 34.4'	45 / 45 / 34 / 135/0.4'	WASHED OUT UNCASED HOLE FROM 30.0 TO 32.5. CHANGE IN SOIL AT 32.5. DROVE 1-3/8" I.D. x 24"	SILTY SAND AND ROCK FRAGMENTS, TOP OF WEATHERED ROCK
34.0'	CORED	1-3/8"	34.4 TO 35.65'		SPLIT BARREL SAMPLER FROM 32.5 TO 34.4'. RECOVERED 4 1/2". ATTEMPTED TO DRIVE O.E. AW RCD NO PENETRATION AT 34.4' DROVE 2-3/8" I.D. CASING FROM 30.0 TO 32.5 AND WASHED OUT. CORED ROCK FROM 34.4 TO 35.65' RECOVERED 15". BOTTOM OF BORING 35.65'	SAND STONE, MASSIVE SLIGHTLY WEATHERED, HARD, FINE GRAINED, GRAY.
35.0'						
36.0'						
37.0'						
38.0'						
39.0'						
40.0'						

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FIELD LOG OF TEST BORING

Site BRISTOL HARBOR, RI — Page 1 of 3 Pages

Boring No. FD 82-3 Desig. C Diam. (Casing) 2-3/8"

Co-ordinates: N NOT GIVEN E

Elevation Top of Boring 16.0' ± M.L.W. ~~M.S.L.~~ — Hammer Wt. 140 lb — Boring Started 6-10-82

Total Overburden Drilled 30.25 Feet — Hammer Drop 30 in. — Boring Completed 6-10-82

Elevation Top of Rock 48.25' M.L.W. ~~M.S.L.~~ — Casing Left NONE

Total Rock Drilled 1.0' Feet — Subsurface Water Data — Page

Elevation Bottom of Boring 49.25' M.L.W. ~~M.S.L.~~ — Obs. Well NO

Total Depth of Boring 31.25 Feet — Drilled By BRIGGS ENGINEERING & TESTING CO.

Core Recovered 100 % No. Boxes 1 — Mfg. Des. Drill ACKER - RAFT MOUNTED

Core Recovered 1.0 Ft: 1-3/8" Diam. ___ In. — Inspected By: RONALD F. BUKOSKI

Soil Samples 1-3/8 In. Diam. 9 No. — Classification By: RONALD F. BUKOSKI

Soil Samples ___ In. Diam. ___ No. — Classification By:

0700 MLG

0800

DEPTH 1"=2.0'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1.0' 2.0' 3.0'	S-1 2 JARS	1-3/8"	0.0 TO 3.0'	WEIGHT OF RODS	SPLIT BARREL SAMPLER SETTLED FROM 0.0 TO 3.0' UNDER WEIGHT OF AW RODS. RECOVERED 18-0". PUSHED 2-3/8" CASING FROM 0.0 TO 5.0' AND HUNG FROM RAFT'S DECK TO AVOID ADDITIONAL SETTLEMENT. WASHED OUT CASING USING SIDE DISCHARGE CHOPPING BIT.	MARINE HARBOR SEDIMENTS: ORG. SILT, MUCKY, MODERATELY + STRONG ORGANIC/OILY ODOR, BLACK, (OL).
4.0' 5.0'	NO SAMPLE		3.0 TO 5.0'			
6.0' 7.0' 8.0' 9.0' 10.0'	S-2 2 JARS	1-3/8"	5.0 TO 9.5'	WEIGHT OF RODS AND HAMMER	SPLIT BARREL SAMPLER, 1-3/8" I.D. x 24" SETTLED FROM 5.0 TO 9.5' UNDER WEIGHT OF AW DRILL RODS AND HAMMER. RECOVERED 24-0". DROVE 2-3/8" I.D. CASING FROM 5.0 TO 10.0' AND WASHED OUT.	MARINE HARBOR SEDIMENTS ORGANIC SILT, MUCKY, MODERATELY + STRONG ORGANIC/OILY ODOR, BLACK, (OL).

GENERAL REMARKS: BORING DEPTHS ARE REFERENCED TO HARBOR BOTTOM. REFUSAL - 100 BLOW WITH NO PENETRATION.

NED ...56(Test)

Boring No. FD 82-3

Site: BRISTOL HARBOR, RI	Boring No. FD 82-3	Page 2 of 3

DEPTH (0=2.0')	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VT	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
10.0'	S-3 1 JAR	1-3/8"	10.0 TO 12.0'	22, 23, 23, 23	DROVE SPLIT BARREL SAMPLER 1-3/8" I.D. x 24" FROM 10.0 TO 12.0'. RECOVERED 10 1/2".	SILTY GRAVEL, FINE SUBANGULAR GRAVEL, 15-20% LOW PLASTICITY FINES, 25-35% COARSE TO FINE SAND, GRAY, (GM).
12.0' 13.0' 14.0' 15.0'	NO SAMPLE		12.0 TO 15.0'		DROVE 2-3/8" FROM 10.0 TO 15.0' AND WASHED OUT USING ROLLER BIT. CHANGE IN FOIL AT APPROX. 14.0' NOTED WHILE DRIVING CASING.	
16.0' 17.0'	S-4 1 JAR	1-3/8"	15.0 TO 17.0'	40, 36, 21, 25	DROVE 1-3/8" I.D. x 24" SPLIT BARREL SAMPLER FROM 15.0 TO 17.0'. RECOVERED 24.0".	SAND, UNIFORM FINE MEDIUM SAND - 5-10% FINES, GRAY, (SP-SM).
18.0' 19.0' 20.0'	NO SAMPLE		17.0 TO 20.0'		DROVE 2-3/8" I.D CASING FROM 15.0 TO 20.0' AND WASHED OUT USING ROLLER ROCK BIT.	
21.0' 22.0'	S-5 1 JAR	1-3/8"	20.0 TO 22.0'	7, 6, 5, 9	DROVE 1-3/8" I.D. x 24" SPLIT BARREL SAMPLER FROM 20.0 TO 22.0'. RECOVERED 4-1/2".	SAND, WELL GRADED, COARSE TO FINE, 5-10% LOW PLASTICITY FINES, 5-10% FINE GRAVEL, GRAY, (SW-SM).
23.0' 24.0' 25.0'	NO SAMPLE	1-3/8"	22.0 TO 25.0'		DROVE 2-3/8" I.D CASING FROM 20.0 TO 25.0 AND WASHED OUT USING ROLLER ROCK BIT.	
26.0' 27.0'	S-6 1 JAR	1-3/8"	25.0 TO 27.0'	26, 16, 18, 19	DROVE 1-3/8" I.D. SPLIT BARREL SAMPLER FROM 25.0 TO 27.0'. RECOVERED 6.0".	SAND, FINE MEDIUM TO FINE SAND, 5-10% LOW PLASTICITY FINES, GRAY, (SP-SM).

Site: BRISTOL HARBOR, RI	Boring No. FD 82-3	Page 3 of 3

DEPTH 1"=2.0'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
28.0'					DROVE 2-3/8" I.D. CASING FROM 25.0 TO 28.0 AND WASHED OUT USING SIDE DISCHARGE CHOPPING BIT.	
29.0'	S-7 1 JAR	1-3/8"	28.0 TO 30.0'	15 / 28 / 65/5" / 43/7" 300 lb	DROVE 1-3/8" I.D. SPLIT BARREL SAMPLER FROM 28.0 TO 30.0'.	SILTY GRAVEL AND ROCK FRAGMENTS, COARSE TO FINE ANGULAR & SUBANGULAR GRAVEL 15-25% LOW PLASTICITY FINES, 15-25% COARSE TO FINE SAND DARK GRAY, (GM).
30.0'						
31.0'	CORED	1-3/8"	30.25 TO 31.25'		RECOVERED 18.0. DROVE 2-3/8" CASING FROM 28.0 TO 30.25' AND WASHED OUT.	SHALE, SLIGHTLY WEATHERED, MEDIUM HARD, FINE GRAINED, BLACK WITH SOME RUST STAINS.
32.0'					CORED ROCK FROM 30.25 TO 31.25'	
33.0'					BOTTOM OF BORING 30.25'.	
34.0'						
35.0'						
36.0'						
37.0'						
38.0'						
39.0'						
40.0'						

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FIELD LOG OF TEST BORING

Site Bristol Harbor RI — Page 1 of 2 Pages

Boring No. UDT 82-1 Desig. A Diam. (Casing) 4.0"

Co-ordinates. N Not Given E

Elevation Top of Boring -17.1' ± M.L.W. ~~M.S.~~L. Hammer Wt. 300 lb Boring Started 6-11-82

Total Overburden Drilled 7.0' Feet Hammer Drop —

Elevation Top of Rock N/A M.S.L. Casing Left None Boring Completed 6-11-82

Total Rock Drilled N/A Feet Subsurface Water Data — Page —

Elevation Bottom of Boring -24.1' ± M.L.W. M.S.L. Obs. Well No

Total Depth of Boring 7.0' Feet Drilled By Briggs Engineering & Testing Co.

Core Recovered N/A % No. Boxes — Mfg. Des. Drill Acker - Raft Mounted

Core Recovered N/A Ft: — Diam. — In. Inspected By: Ronald F. Bukoski

Soil Samples UDT 3.0 In. Diam. 1 No. Classification By: Ronald F. Bukoski

Soil Samples — In. Diam. — No. Classification By:

DEPTH 1"=2.0'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1.0' 2.0' 3.0' 4.0' 5.0'	NO SAMPLE		0.0 TO 5.0'		HUNG 4" CASING FROM RAFT'S DECK TO 5.0' BELOW HARBOR BOTTOM. WASHED OUT CASING USING SIDE DISCHARGE CHOPPING BIT.	
6.0' 7.0'	UDT 1	3.0" O.D.	5.0 TO 7.0'	HAND PUSHED	PUSHED BY HAND IN CONTINUOUS MOTION THIN-WALLED TUBE SAMPLER 3.0" O.D. x 30.0" FROM 5.0 TO 7.0' RECOVERED 30.0" OF USABLE SAMPLE. TOP 4" WATER & MUCK. TUBE ENDS SEALED WITH WAX AND CAPPED WITH PLASTIC COVERS AND DIPPED IN WAX.	MARINE HARBOR SEDIMENTS; ORGANIC CLAYEY SILT, MODERATELY PLASTIC, 10-20% SHELL FRAGMENTS, MODERATELY (+) STRONG ORGANIC ODOR, DARK GRAY, (OL).
8.0' 9.0' 10.0'	Bottom of Boring 7.0'					

GENERAL REMARKS:

Site: Bristol Harbor, PI	Boring No. UDT 82-1	Page 2 of 2

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
11.0'	NO SAMPLE		7.0 TO 15.0'		4" CASING PUSHED BY WEIGHT OF 300 lb HAMMER FROM 5.0 TO 15.0'. CASING WAS WASHED OUT USING SIDE DISCHARGE CHOPPING BIT.	
12.0'						
13.0'						
14.0'						
15.0'	UDT 2	3.0" O.D.	15.0 TO 17.0'	HAND PUSHED	PUSHED 3.0" O.D. x 20.0" THIN-WALLED TUBE SAMPLER FROM 15.0 TO 17.0'. RECOVERED 24-0".	MARINE HARBOR SEDIMENTS; ORGANIC CLAYEY SILT. MODERATELY PLASTIC, 10-20% SHELL FRAGMENTS, MODERATELY STRONG ORGANIC ODOR, DARK GRAY, (OL).
16.0'						
17.0'	NO SAMPLE		17.0 TO 25.0'		PUSHED 4.0" CASING FROM 15.0 TO 25.0' USING 300 lb HAMMER. WASHED OUT CASING USING SIDE DISCHARGE CHOPPING BIT.	
18.0'						
19.0'						
20.0'						
21.0'						
22.0'						
23.0'						
24.0'						
25.0'	UDT 3	3.0" O.D.	25.0 TO 27.0'	HAND PUSHED	THIN-WALLED TUBE 3.0" O.D. by 23.0" PUSHED FROM 25.0 TO 27.0'. RECOVERED 23.0". BOTTOM OF BORING 27.0'	MARINE HARBOR SEDIMENTS; ORGANIC CLAYEY SILT, MODERATELY PLASTIC, 15-30% SHELL FRAGMENTS DARK GRAY, (OL).
26.0'						
27.0'						

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FIELD LOG OF TEST BORING

Site BRISTOL HARBOR — Page 1 of 2 Pages

Boring No. UDT 82-2 — Desig. B — Diam. (Casing) 4.0"

Co-ordinates. N NOT GIVEN — E

Elevation Top of Boring -12.5' M.L.W. ~~M.S.L.~~ — Hammer Wt. N/A — Boring Started 6-10-82

Total Overburden Drilled 12.0' Feet — Hammer Drop N/A — Boring Completed 6-10-82

Elevation Top of Rock NOT ENCOUNTERED M.S.L. — Casing Left NONE

Total Rock Drilled 0.0 Feet — Subsurface Water Data — Page —

Elevation Bottom of Boring 22.5' M.L.W. ~~M.S.L.~~ — Obs. Well NO

Total Depth of Boring 12.0 Feet — Drilled By BRIGGS ENGINEERING & TESTING CO.

Core Recovered N/A % — No. Boxes N/A — Mfg. Des. Drill ACKER - RAFT MOUNTED

Core Recovered — Ft : — Diam. — In. — Inspected By: RONALD F. BUKOSKI

Soil Samples UDT 3.0" O.D. In. Diam. 1 No. — Classification By: RONALD F. BUKOSKI

Soil Samples In. Diam. No. — Classification By:

DEPTH 1"=2.0'	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1.0'					PUSHED 4" CASING FROM HARBOR BOTTOM TO 10.0'. WASHED OUT CASING USING SIDE DISCHARGE CHOPPING BIT. CASING HUNG FROM RAFT'S DECK TO AVOID ADDITIONAL SETTLEMENT INTO HARBOR BOTTOM.	
2.0'						
3.0'	NO SAMPLE		0.0 TO 10.0'			
4.0'						
5.0'						
6.0'						
7.0'						
8.0'						
9.0'						
10.0'						

GENERAL REMARKS:

Site: BRISTOL HARBOR, RI	Boring No. UDT B2-2	Page 2 of 2

DEPTH	CORE/SAMPLE NO.	SIZE	DEPTH RANGE	BLOWS PER FT. / CORE REC'VY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATER ALS
1.20	UDT 1	3.0" O.D.	10.0 TO 12.0	HAND PUSHED	THIN-WALLED TUBE SAMPLER 30.0" LONG PUSHED IN ONE CONTINUOUS MOTION BY HAND FROM 10.0 TO 12.0'. RECOVERED 25.0". TUBE ENDS SEALED WITH WAX AND CAPPED WITH PLASTIC COVERS AND DIPPED IN WAX. BOTTOM OF BORING 12.0'	MARINE HARBOR SEDIMENTS ORGANIC SANDY SILT, MODERATELY PLASTIC, MODERATELY STRONG ORGANIC ODOR, 10-20% SHELL FRAGMENTS, DARK GRAY, (OL).
11.0'						
12.0'						
13.0'						
14.0'						
15.0'						

APPENDIX B

Survey Field Notes

Trav.

BRISTOL RHo De Island

RJ, KL 92
6/ /82

T@ 2 site on 1 949.365

12-28-00	714.060	89-22-50	(A)	Left cor. Brick Bldg
6-50-55	701.985	89-46-05	(B)	Water Tower
21-39-45	492.210	88-43-30	(C)	right side Brick stack in front of White Brick Bldg.
27-31-55	62.205	90-07-00	(D)	Left cor white Bldg
108-34-25	30.465	90 32-45	(E)	Right cor white Bldg
202-57-45	13.73	100-50-10	(F)	cor. of Pier (wooden Post)
174-05-05	143.850	90-31-25	(G)	Pole w/ Light on it, 25± from end of Pier
1-2-3	177-26-10	609.010	90-09-55	nail in wooden Pier

T@ 3 site on 2

154-19-15	162.975	90-17-10	(H)	Left outer corner former Armory
163-24-55	273.290	89-33-45	(I)	for right outer corner of Armory
188-31-40	38.100	92-21-20	(J)	cor. of Pier
305-34-30	20.000	87-53-40	(K)	cor. of Pier
226-39-30	338.085	90-00-00	(L)	℄ 10' end of Pier
2-3-4	171-45 30	552 09	89-59-50	Tacked STK.

T@ 4 site on 3

24-44-00	192.420	90-15-30	(M)	℄ water Tower
22-09-25	168.080	90-23-00	(N)	Bldg. cor.
27-51-50	119.805	90-23-30	(O)	" "
75-34-35	74 235	90-45-20	(P)	" "
105-42-20	109.735	90-09-50	(Q)	Water Tower
224-55-15	92.265	89-44-45	(R)	Flag Pole
140-44-25	169.790	90-19-25	(S)	Bldg. Cor
3-4-5	[illegible]	[illegible]	89-[illegible]	Tacked STK.

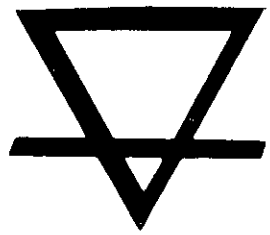
74-20-00	28.510	87-40-40	(T)	Coast Guard Sta. bldg. cor
148-07-10	21.055	76-35-05	(U)	" " "
298-19-50	156 155	88-37-50	(V)	Pier corner
3-4-6	220-21-50	124.510	90-07-35	D.H. in Elks Club Pier

BRISTOL CONN 13151

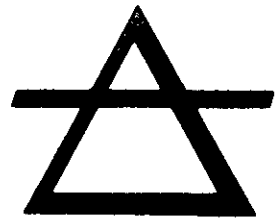
COORDINATE FILE: [illegible] = 45 POINTS; TIME OF FILE: 0 01 30.30
[illegible] ***** JOB [illegible]

********** COOD **********

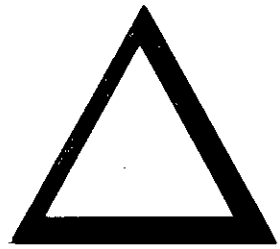
FROM	TITLE	BEARING	DISTANCE	TO	NORTHING	EASTING	ELEVATION
START				2	213,800.0000	560,160.0000	
2	INV SE	15 50 43.79	609.0075	3	213,214.1339	560,326.2860	
3	S.S. SW	7 09 16.21	1210.0000	30	212,013.5551	560,175.5861	
3	S.S. SW	30 09 16.21	1310.0000	31	212,081.4110	559,668.2291	
3	S.S. SW	40 35 16.21	1570.0000	32	212,136.4921	559,184.5381	
START				32	212,136.4921	559,184.5381	
32	INV SE	83 30 12.00	486.8171	31	212,081.4110	559,668.2291	
31	INV SE	82 22 50.00	511.8745	30	212,013.5551	560,175.5861	
30	INV NW	82 55 43.40	998.6439	32	212,136.4921	559,184.5381	
32	TRAV SE	82 55 43.40	449.3219	31	212,081.1786	559,630.4424	
31	INV NE	31 33 27.30	1325.5310	3	213,214.1339	560,326.2860	
START				3	213,214.1339	560,326.2860	
3	INV SW	7 09 16.21	1210.0000	30	212,013.5551	560,175.5861	
30	INV NW	82 55 43.40	549.3220	31	212,081.1786	559,630.4424	
31	INV NW	82 55 43.40	449.3219	32	212,136.4921	559,184.5381	
32	TRAV SE	82 55 43.40	499.3219	31	212,075.0236	559,680.0620	
31	INV SE	22 32 5[illegible]	1309.6479	3	213,214.1339	560,326.2860	



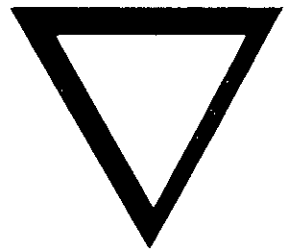
EARTH



AIR



FIRE



WATER

In ancient times
Greek and Hindu philosophers
believed that there were
four elements in the material universe
— EARTH, AIR, FIRE and WATER.
Over the years
man's knowledge has expanded
and the world of materials
is now known to be extremely complex.
The unravelling of these complexities
is the continuing goal of
Briggs Engineering & Testing Company.

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