KFM
E2 / T1 PROJECT
KIEWIT / FCI / MANSON, A JV

November 17, 2006 Serial Letter: KFM-LET-000220

California Department of Transportation
SFOBB – E2T1 Project
333 Burma Road
Oakland, CA 94607

Attention: Pedro Sanchez

Reference: SAS E2/T1 Foundation Project
Caltrans Contract No 04-0120E4
KFM Job No. 364/4347
State Letter # 05.003.01-002210, dated November 6, 2006

Subject: Construction of Pier E2 Cofferdam - Sheet Pile Installation
Cone Penetrometer Test Results

Dear Pedro:

Attached, please find Cone Penetrometer Test results. This testing was completed to verify soil conditions at Pier E2 for sheet pile installation.

Please review the attached results and make a determination whether or not an adjustment of the contract is warranted as described in Special Provision Section 5-1.116.

If you have any comments or questions, please contact this office.

Sincerely,
KIEWIT/FCI/MANSON, a JV

Lee Zink
Project Director

cc: file

220 Burma Road, Oakland, CA 94607 • PO Box 23223, Oakland, CA 94623
Phone (510) 419-0120 • Fax (510) 832-1456

AN EQUAL OPPORTUNITY EMPLOYER

GREGG IN SITU, INC.

GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION SERVICES

November 7, 2006

KFM
Attn: Eric Edwards
220 Burma Rd.
Oakland, California 94607

Subject: CPT Site Investigation
Coffer Dam - Bay Bridge
San Francisco, California
GREGG Project Number: 06-001MARINE

Dear Mr. Edwards:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☒
2	Pore Pressure Dissipation Tests	(PPD)	☐
3	Seismic Cone Penetration Tests	(SCPTU)	☐
4	Resistivity Cone Penetration Tests	(RCPTU)	☐
5	UVIF Cone Penetration Tests	(UVIFCPTU)	☐
6	Groundwater Sampling	(GWS)	☐
7	Soil Sampling	(SS)	☐
8	Vapor Sampling	(VS)	☐
9	Vane Shear Testing	(VST)	☐
10	SPT Energy Calibration	(SPTE)	☐

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (925) 313-5800.

Sincerely,
GREGG Drilling & Testing, Inc.

Mary Walden
Operations Manager

950 Howe Rd • Martinez, California 94553 • (925) 313-5800 • FAX (925) 313-0302
OTHER OFFICES: LOS ANGELES • HOUSTON • SOUTH CAROLINA
www.greggdrilling.com

Cone Penetration Test Sounding Summary

-Table 1-

CPT Sounding Identification	Date	Termination Depth (Feet)	Depth to Mudline (Feet)	Depth of Soil Samples (Feet)	Depth of Pore Pressure Dissipation Tests (Feet)
CPT-01	11/02/06	27.4	46	-	-
CPT-02	11/02/06	24.6	42	-	-
CPT-03	11/04/06	12.6	45.5	-	-
CPT-04	11/03/06	9.6	47	-	-
CPT-05	11/04/06	13.1	50	-	-
CPT-06	11/04/06	17.0	41	-	-

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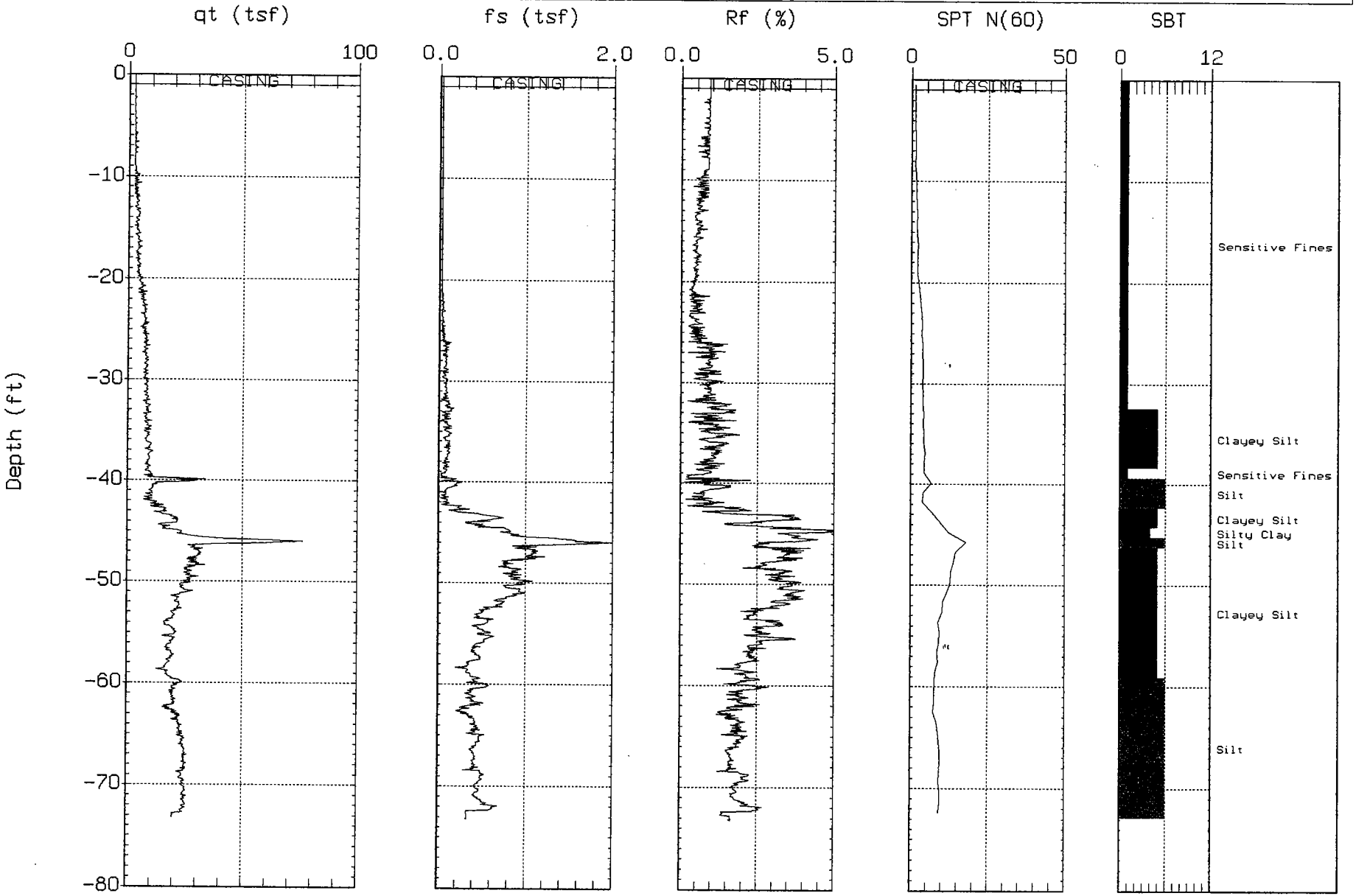
Site: COFFER DAM
Location: CPT-1

Geologist: E.EDWARDS
Date: 11:02:06 11:42



Max. Depth: 73.24 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

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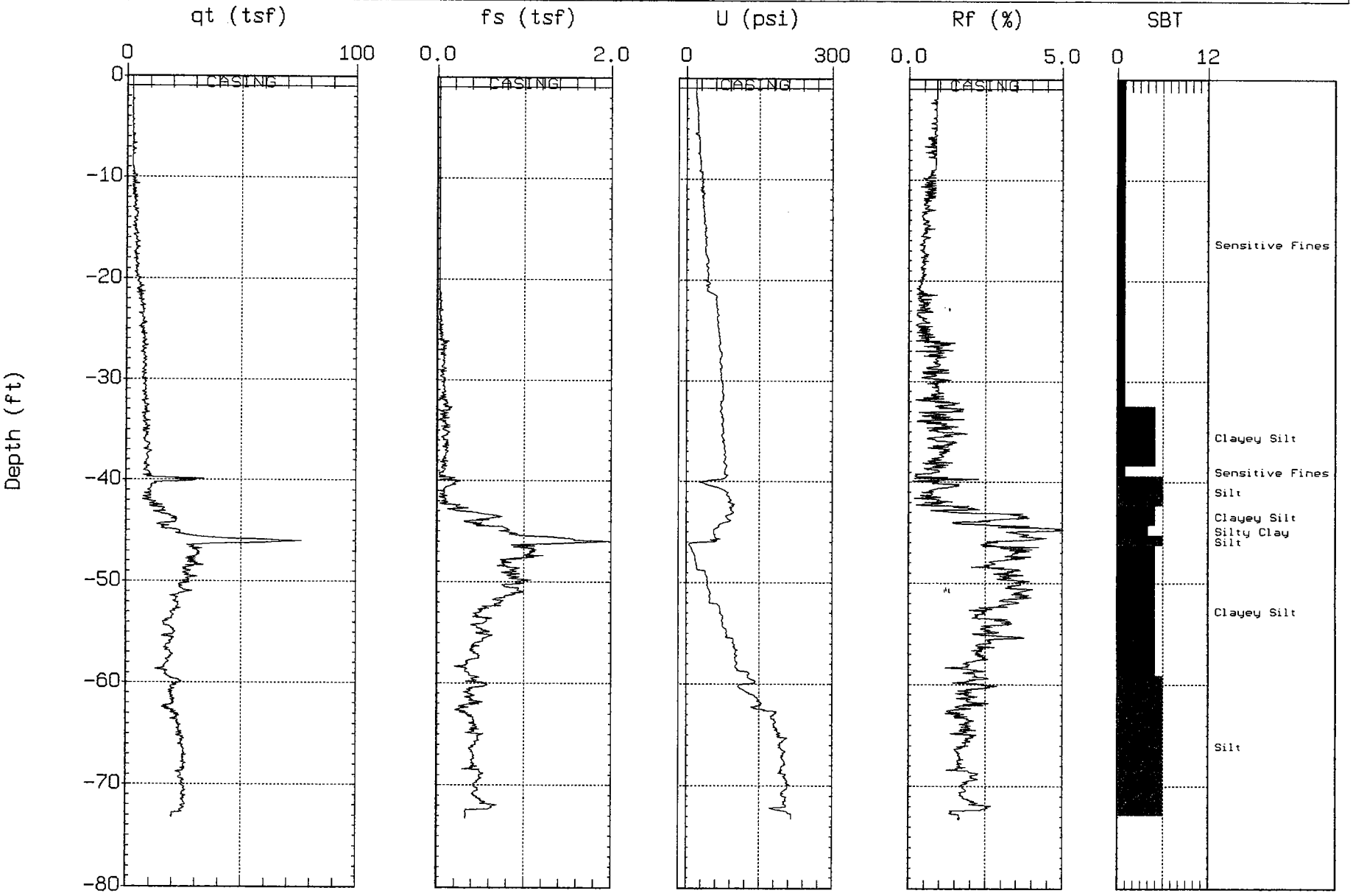
Site: COFFER DAM
Location: CPT-1

Geologist: E.EDWARDS
Date: 11:02:06 11:42



Max. Depth: 73.24 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

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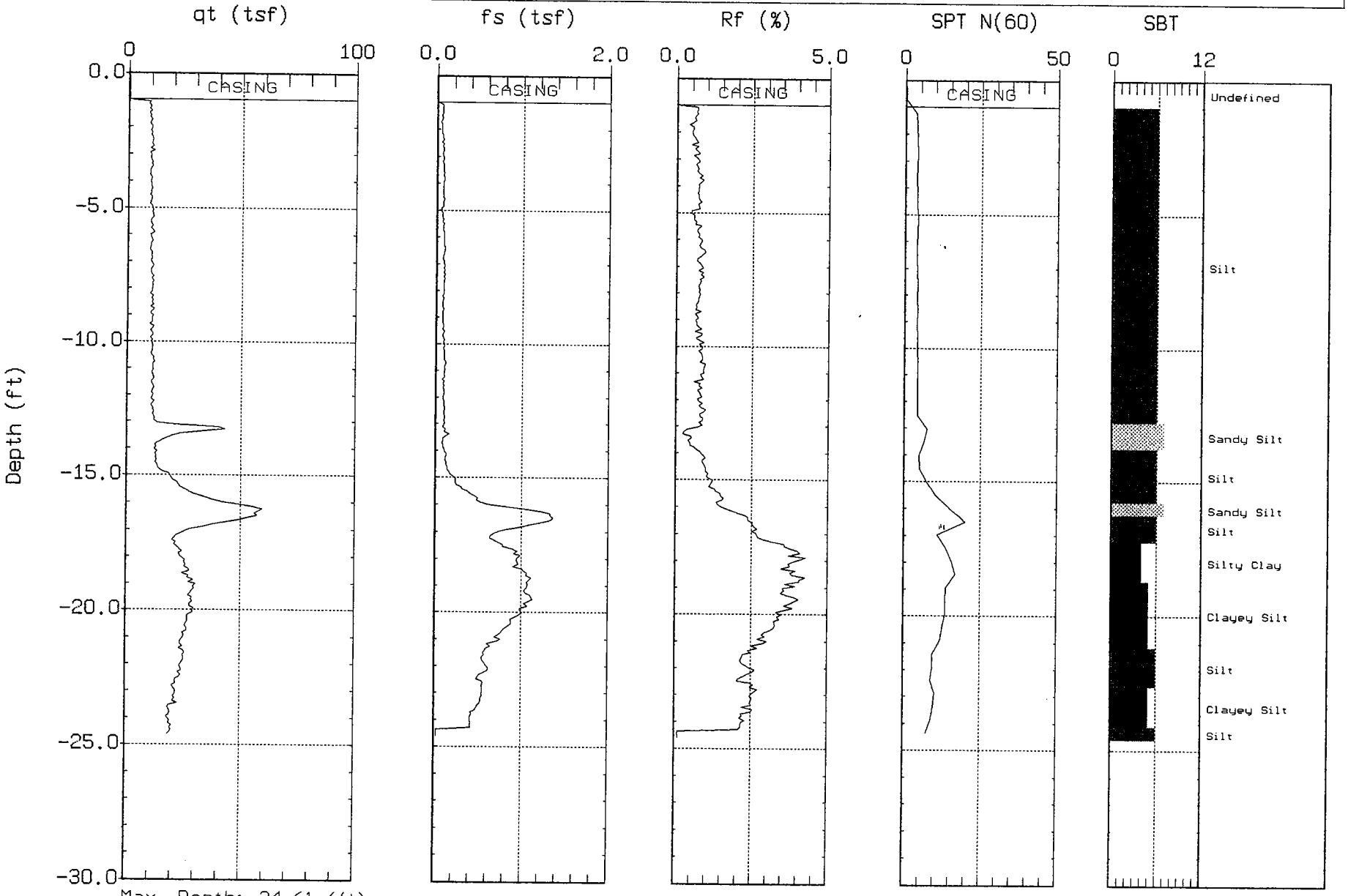
Site: COFFER DAM
Location: CPT-2

Geologist: E.EDWARDS
Date: 11:02:06 16:20



Max. Depth: 24.61 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG

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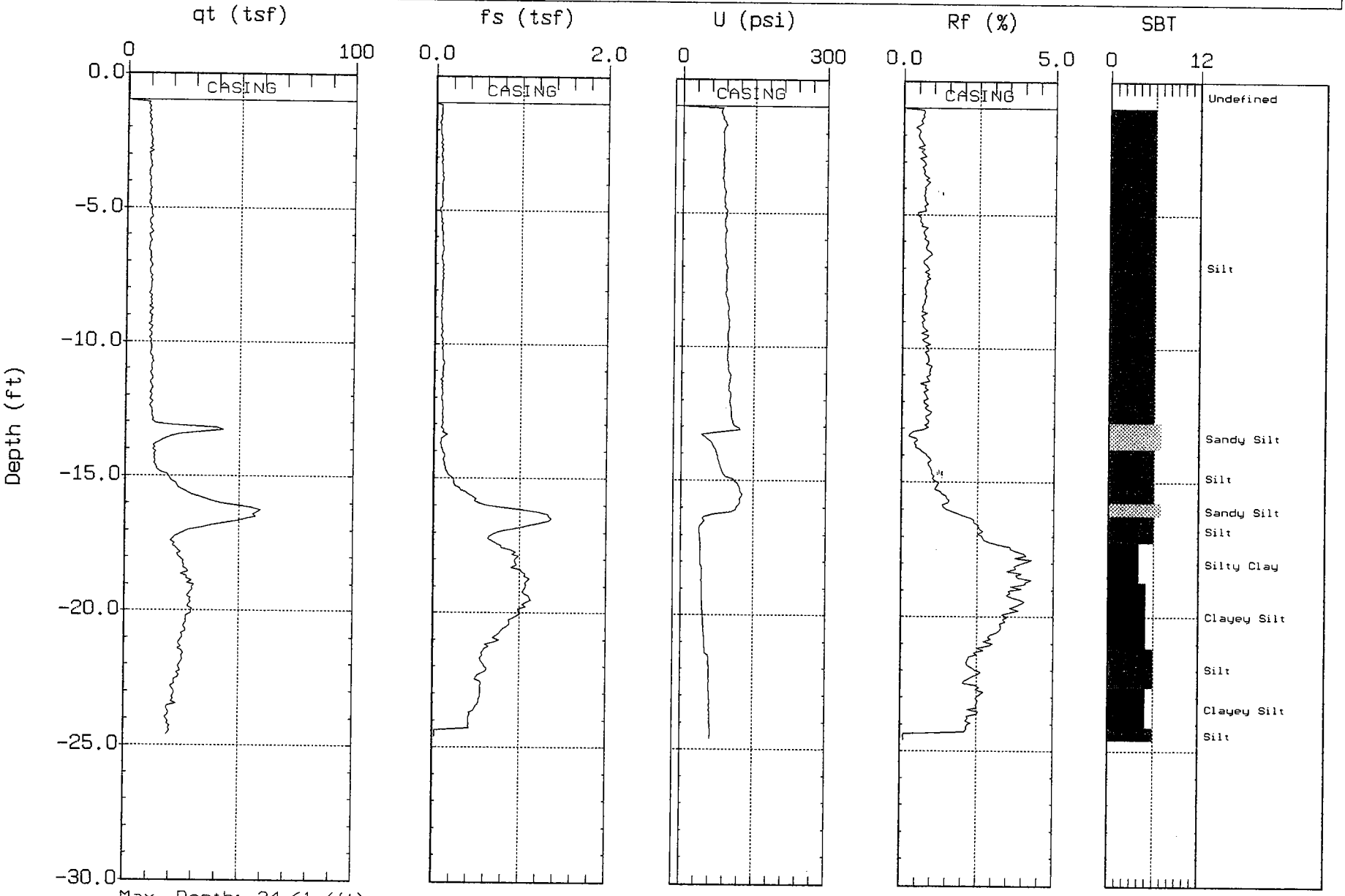
Site: COFFER DAM
Location: CPT-2

Geologist: E.EDWARDS
Date: 11:02:06 16:20



Max. Depth: 24.61 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

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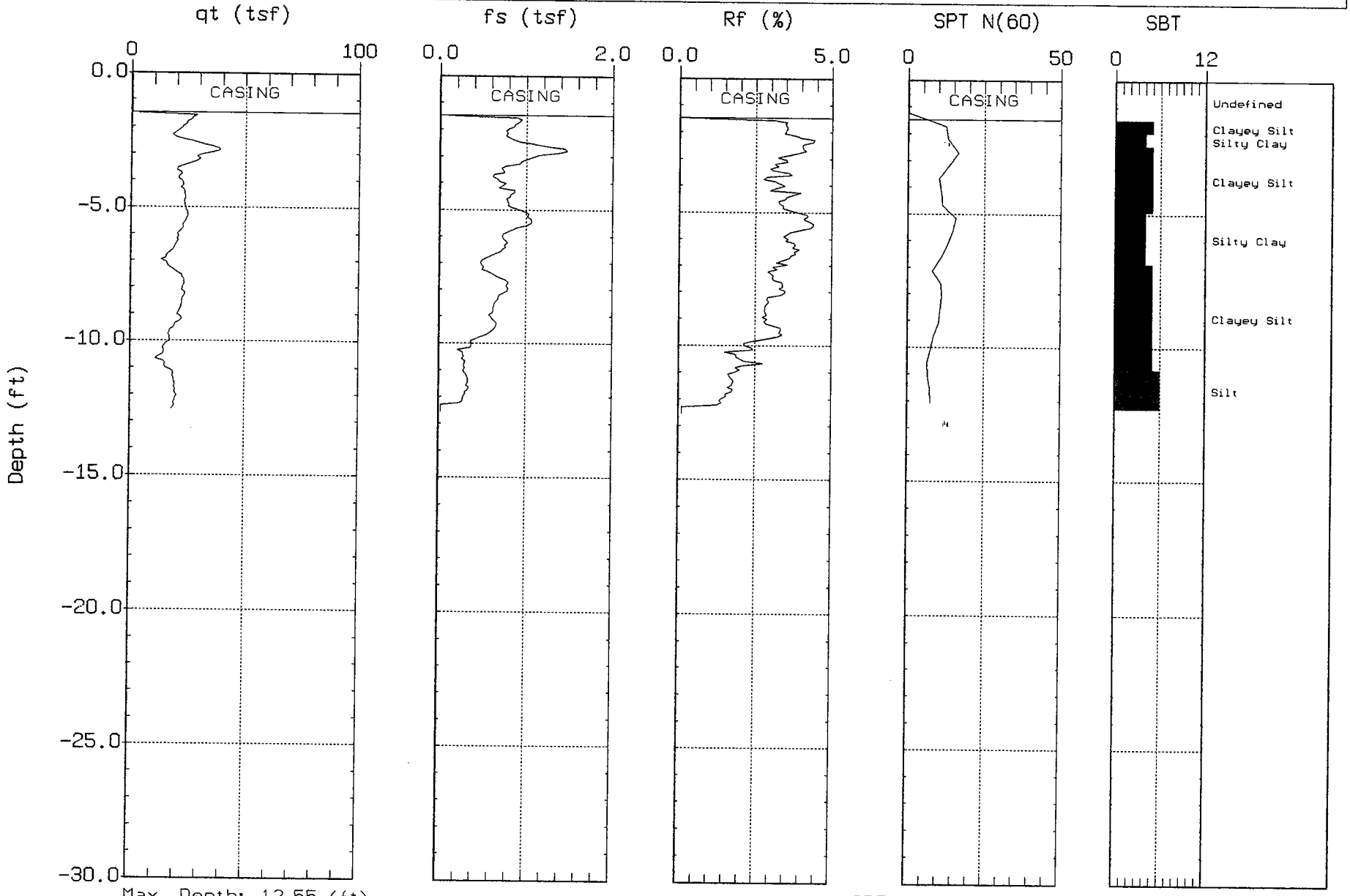
Site: COFFER DAM
Location: CPT-3

Geologist: E.EDWARDS
Date: 11:04:06 08:30



Max. Depth: 12.55 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

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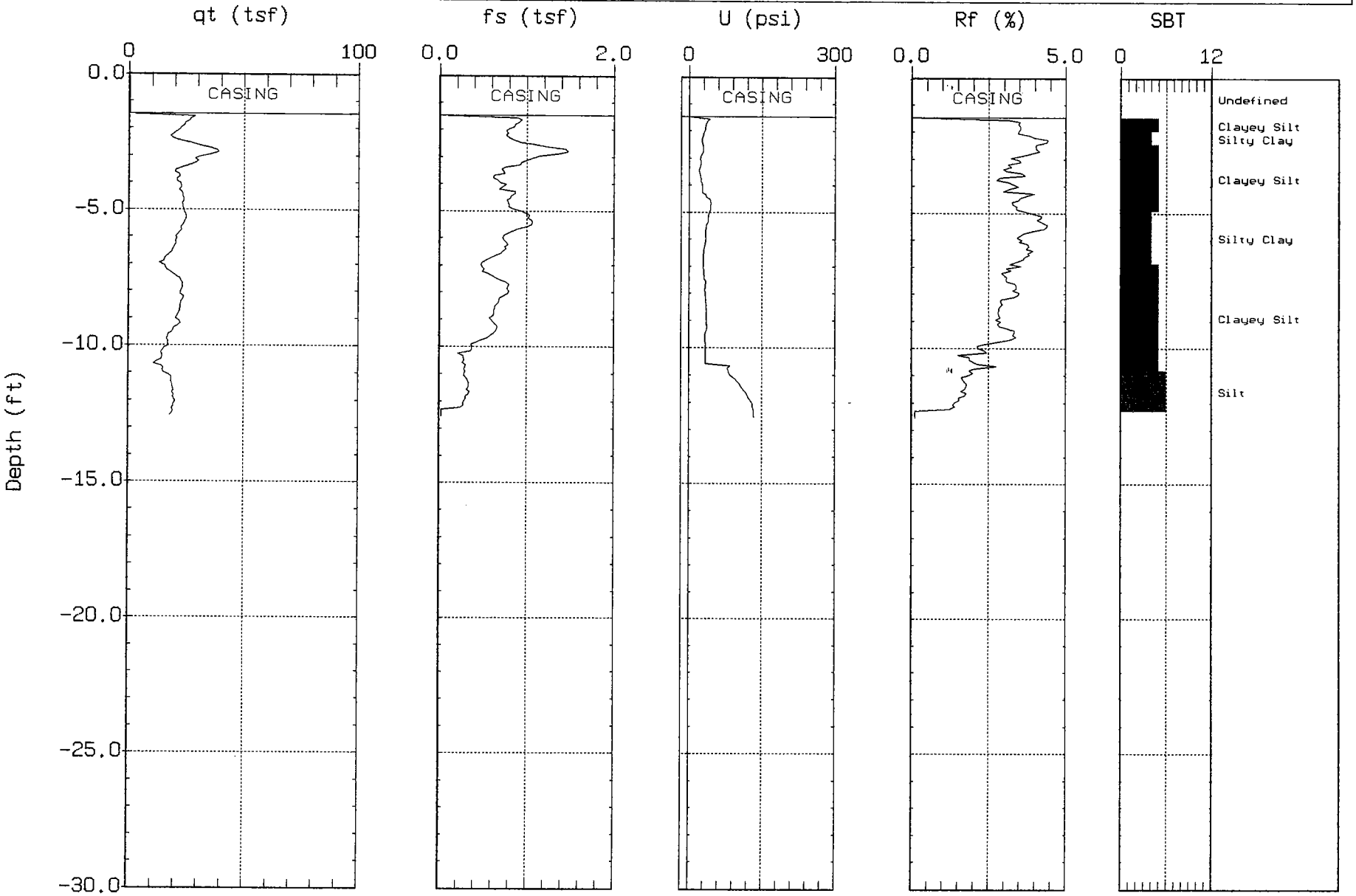
Site: COFFER DAM
Location: CPT-3

Geologist: E.EDWARDS
Date: 11:04:06 08:30



Max. Depth: 12.55 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

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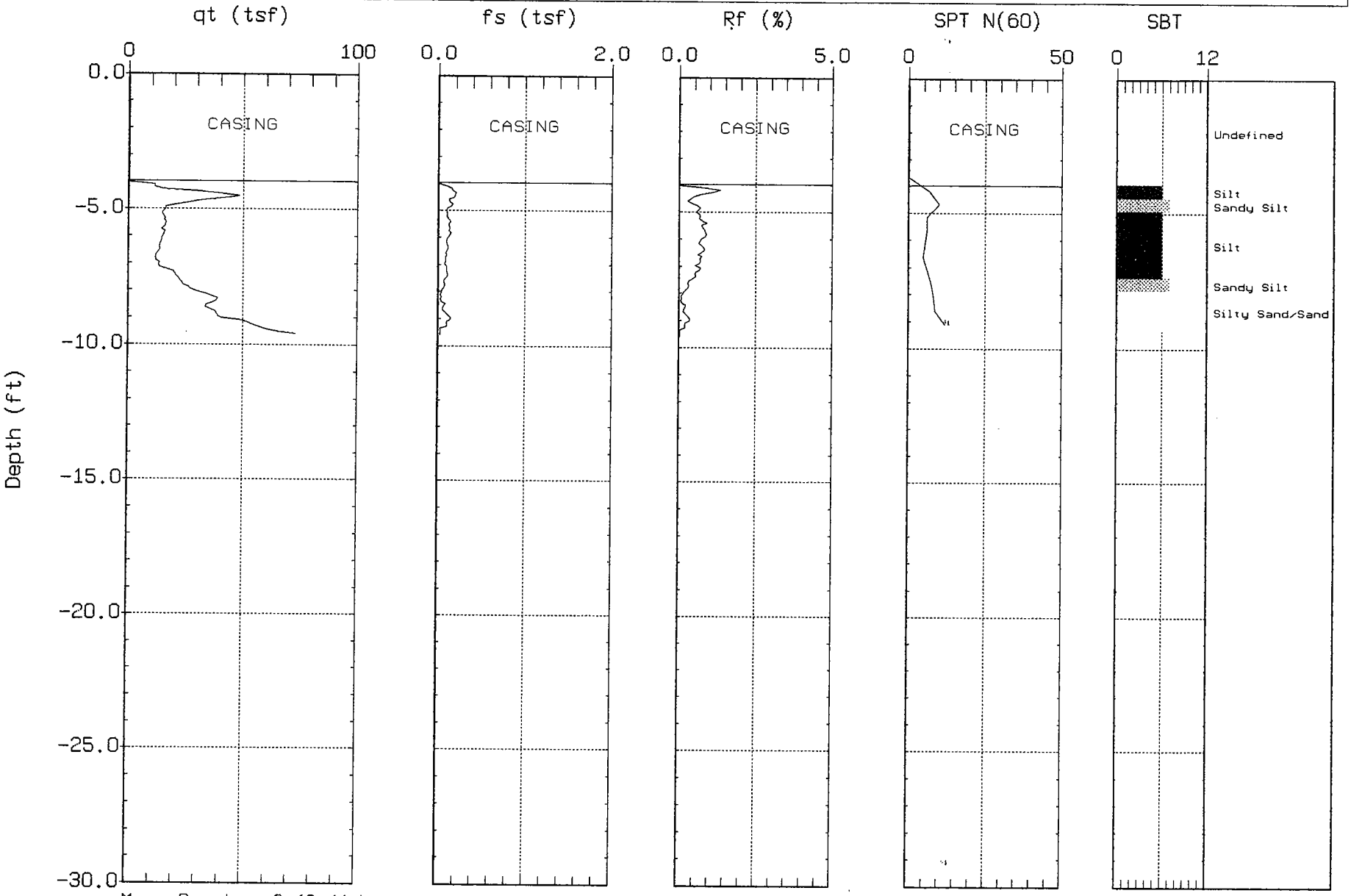
Site: COFFER DAM
Location: CPT-4

Geologist: E.EDWARDS
Date: 11:03:06 13:28



Max. Depth: 9.60 (ft)
Depth Inc.: 0.082 (ft)

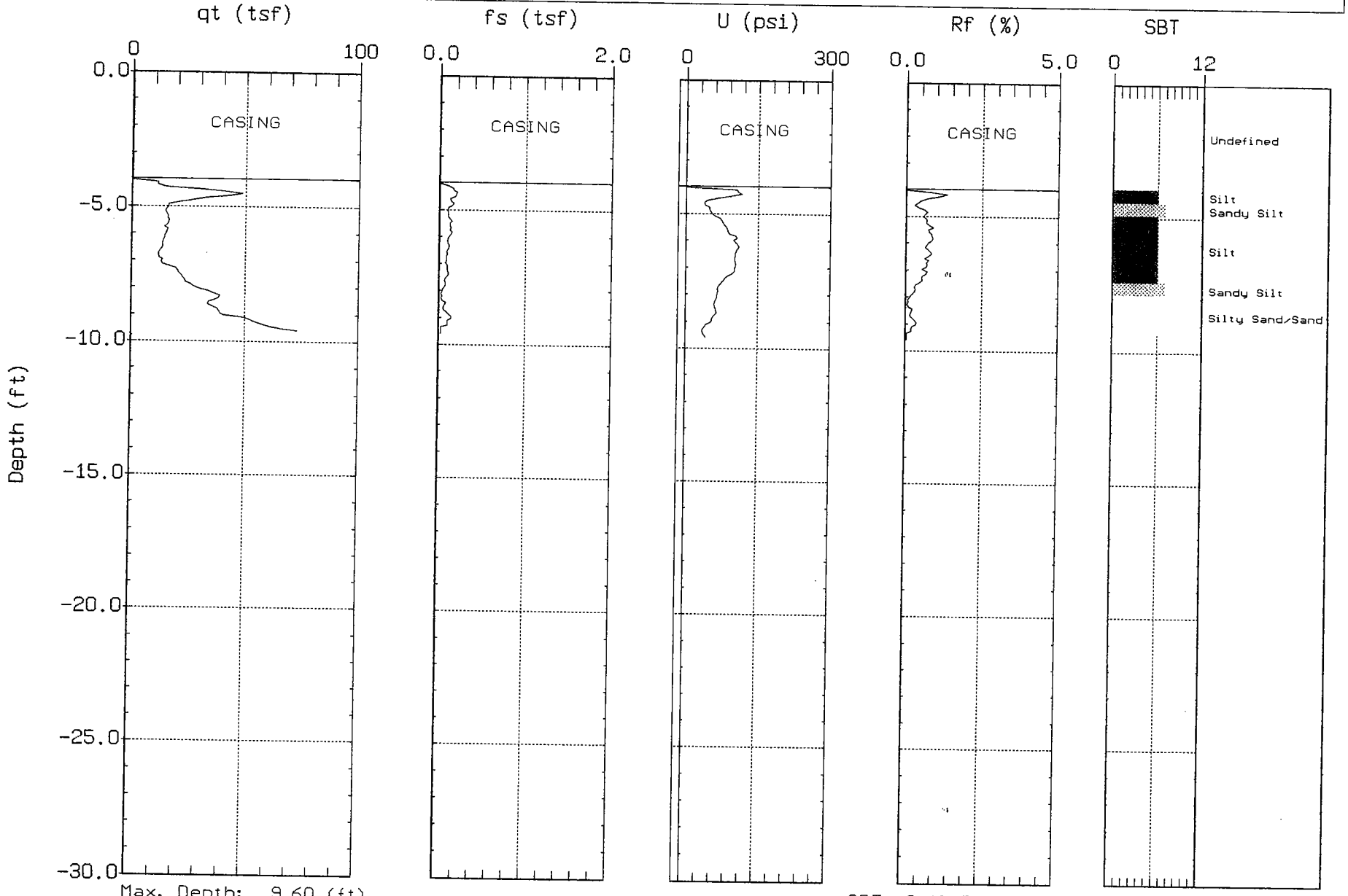
SBT: Soil Behavior Type (Robertson 1990)

GREGG

KFM

Site: COFFER DAM
Location: CPT-4

Geologist: E.EDWARDS
Date: 11:03:06 13:28



Max. Depth: 9.60 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

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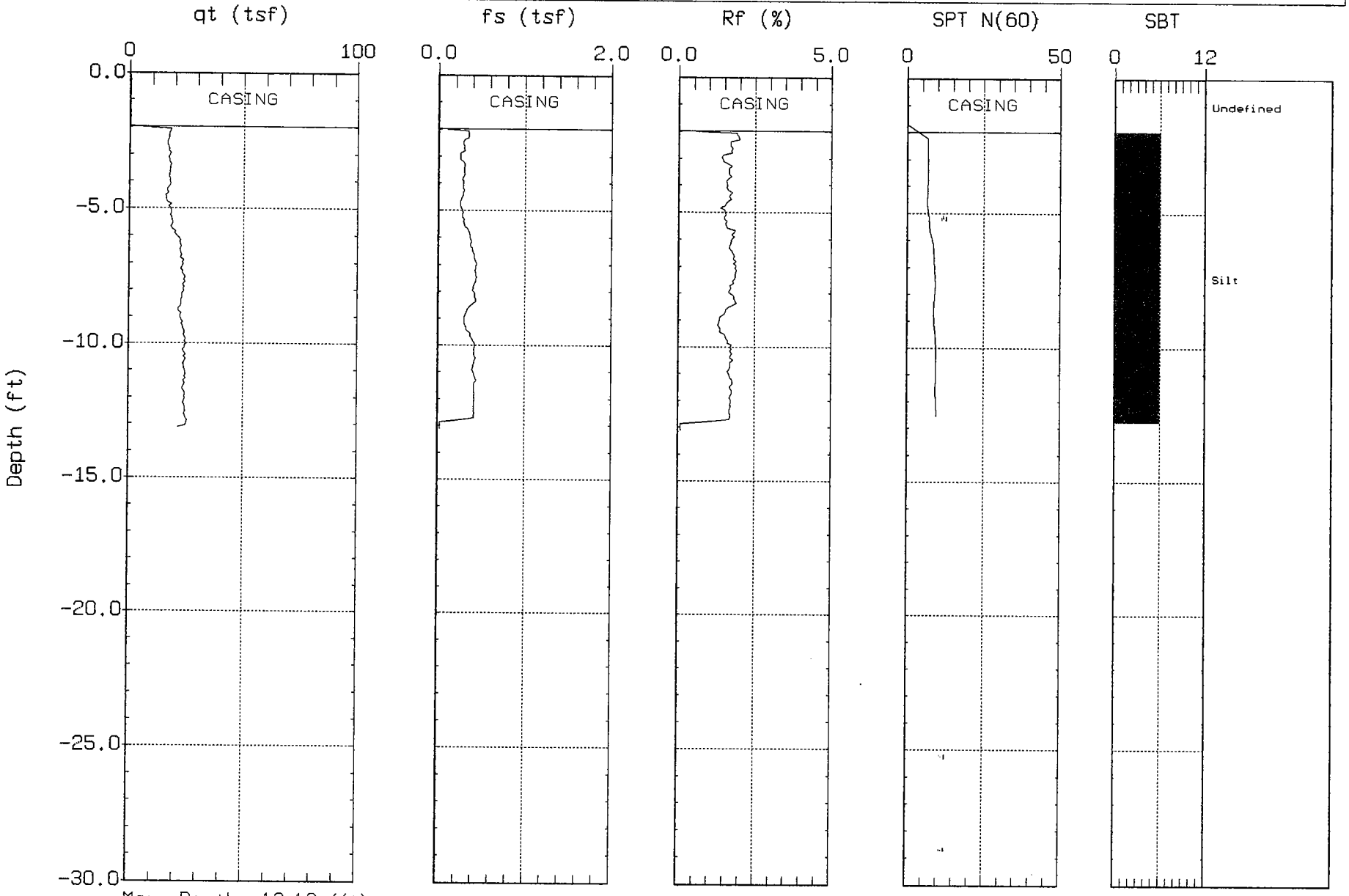
Site: COFFER DAM
Location: CPT-5

Geologist: E.EDWARDS
Date: 11:04:06 12:13



Max. Depth: 13.12 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

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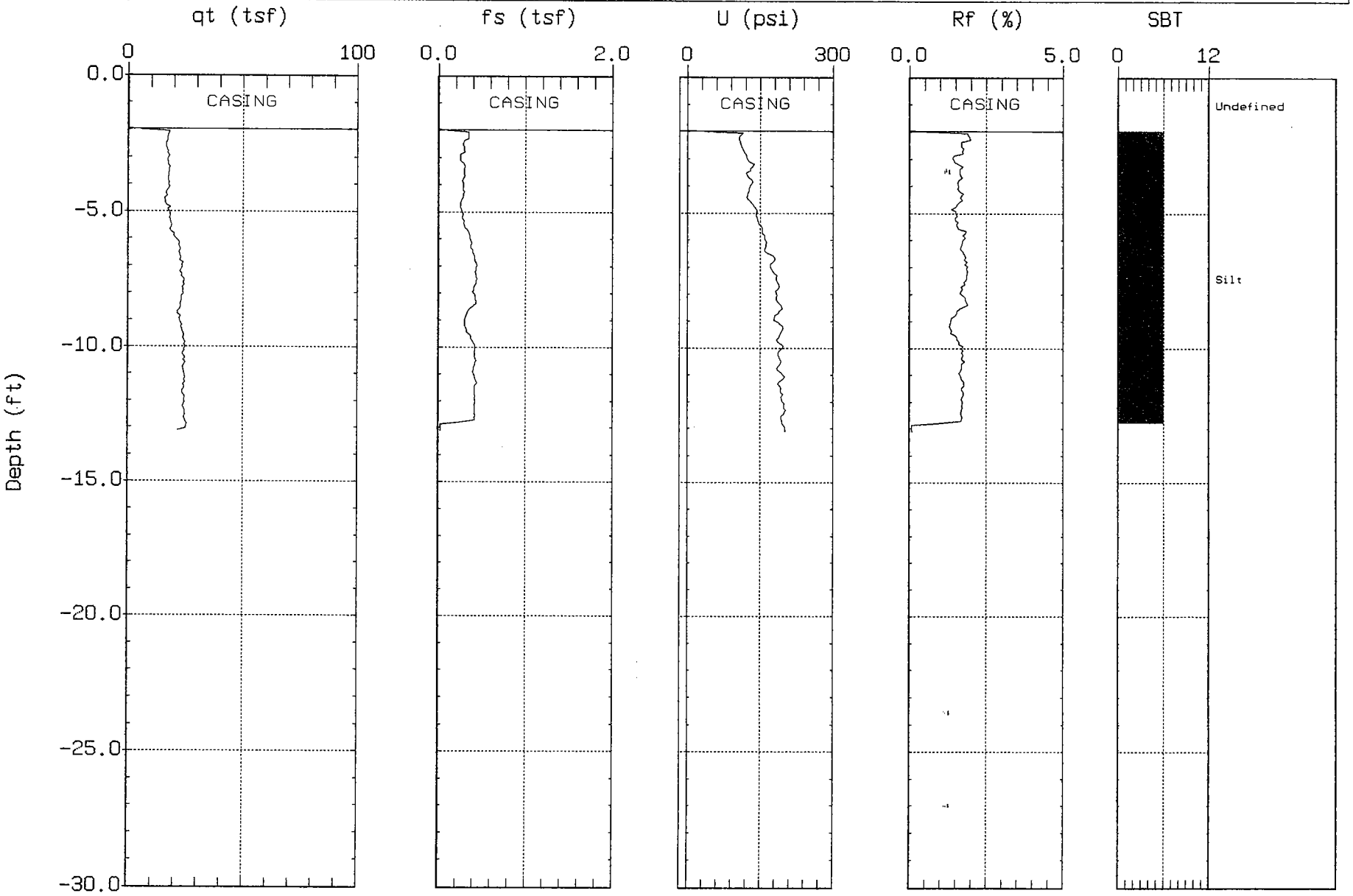
Site: COFFER DAM
Location: CPT-5

Geologist: E.EDWARDS
Date: 11:04:06 12:13



Max. Depth: 13.12 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

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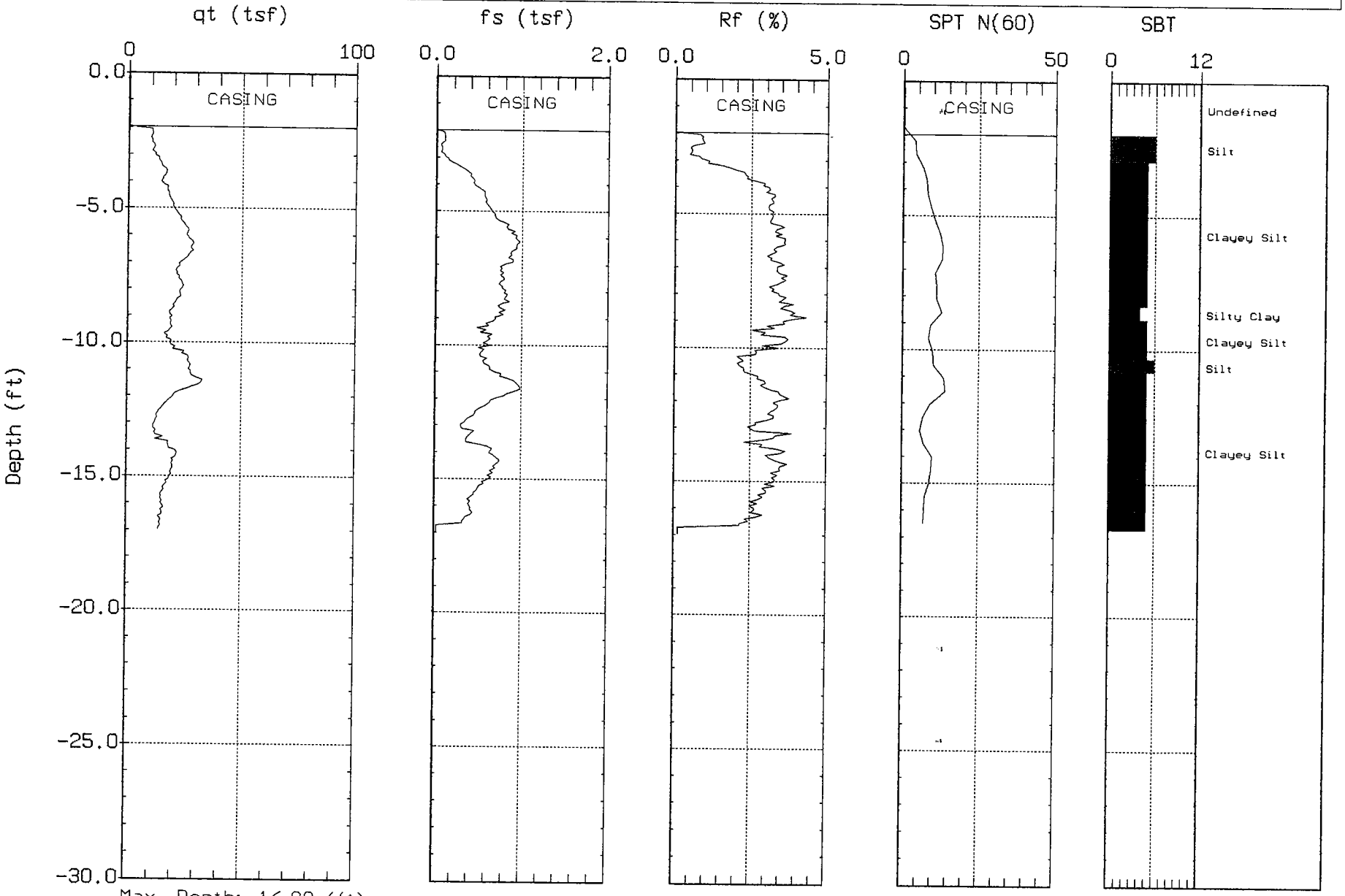
Site: COFFER DAM
Location: CPT-6

Geologist: E.EDWARDS
Date: 11:04:06 15:18



Max. Depth: 16.98 (ft)
Depth Inc.: 0.082 (ft)

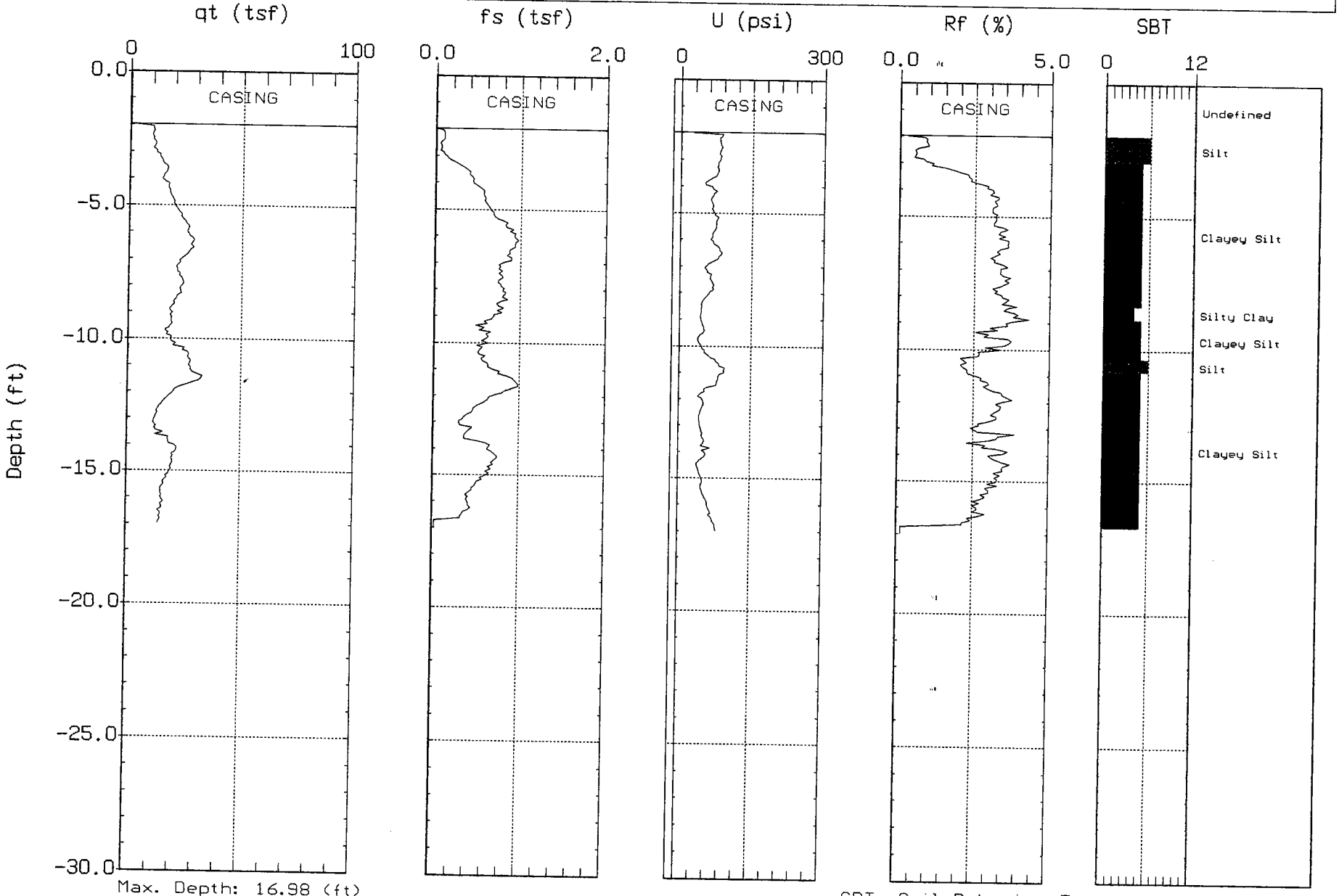
SBT: Soil Behavior Type (Robertson 1990)

GREGG

KFM

Site: COFFER DAM
Location: CPT-6

Geologist: E.EDWARDS
Date: 11:04:06 15:18



Max. Depth: 16.98 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

APPENDIX CPT

Cone Penetration Test Data & Interpretation

Soil behavior type and stratigraphic interpretation is based on relationships between cone bearing (q_c), sleeve friction (f_s), and pore water pressure (u_2). The friction ratio (R_f) is a calculated parameter defined by $100 f_s/q_c$ and is used to infer soil behavior type. Generally:

Cohesive soils (clays)

- High friction ratio (R_f) due to small cone bearing (q_c)
- Generate large excess pore water pressures (u_2)

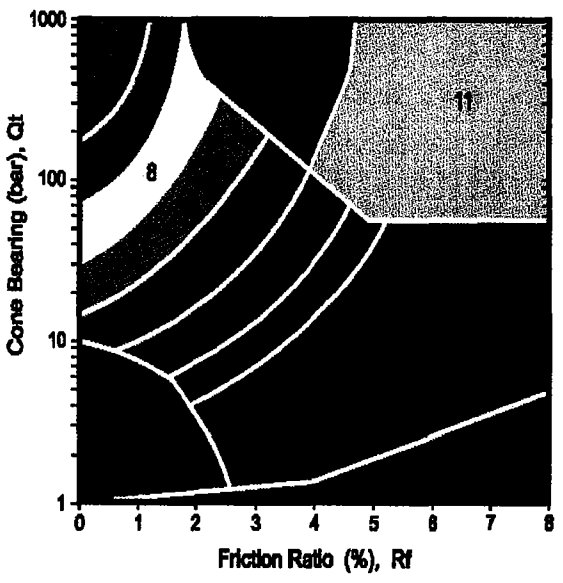
Cohesionless soils (sands)

- Low friction ratio (R_f) due to large cone bearing (q_c)
- Generate very little excess pore water pressures (u_2)

A complete set of baseline readings are taken prior to and at the completion of each sounding to determine temperature shifts and any zero load offsets. Corrections for temperature shifts and zero load offsets can be extremely important, especially when the recorded loads are relatively small. In sandy soils, however, these corrections are generally negligible.

The cone penetration test data collected from your site is presented in graphical form in Appendix CPT. The data includes CPT logs of measured soil parameters, computer calculations of interpreted soil behavior types (SBT), and additional geotechnical parameters. A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Soil interpretation for this project was conducted using recent correlations developed by Robertson, 1990, *Figure SBT*. Note that it is not always possible to clearly identify a soil type based solely on q_c, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the soil behavior type.



ZONE	Qt/N		SBT
1	2		Sensitive, fine grained
2	1		Organic materials
3	1		Clay
4	1.5		Silty clay to clay
5	2		Clayey silt to silty clay
6	2.5		Sandy silt to clayey silt
7	3		Silty sand to sandy silt
8	4		Sand to silty sand
9	5		Sand
10	6		Gravely sand to sand
11	1		Very stiff fine grained*
12	2		Sand to clayey sand*

*over consolidated or cemented

Figure SBT

Cone Penetration Testing Procedure (CPT)

Gregg In Situ, Inc. carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*. The soundings were conducted using a 20 ton capacity cone with a tip area of 15 cm^2 and a friction sleeve area of 225 cm^2. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.85.

The cone takes measurements of cone bearing (q_c), sleeve friction (f_s) and penetration pore water pressure (u_2) at 5-cm intervals during penetration to provide a nearly continuous hydrogeologic log. CPT data reduction and interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored on disk for further analysis and reference. All CPT soundings are performed in accordance with revised (2002) ASTM standards (D 5778-95).

The cone also contains a porous filter element located directly behind the cone tip (u_2), *Figure CPT*. It consists of porous plastic and is 5.0mm thick. The filter element is used to obtain penetration pore pressure as the cone is advanced as well as Pore Pressure Dissipation Tests (PPDT's) during appropriate pauses in penetration. It should be noted that prior to penetration, the element is fully saturated with silicon oil under vacuum pressure to ensure accurate and fast dissipation.

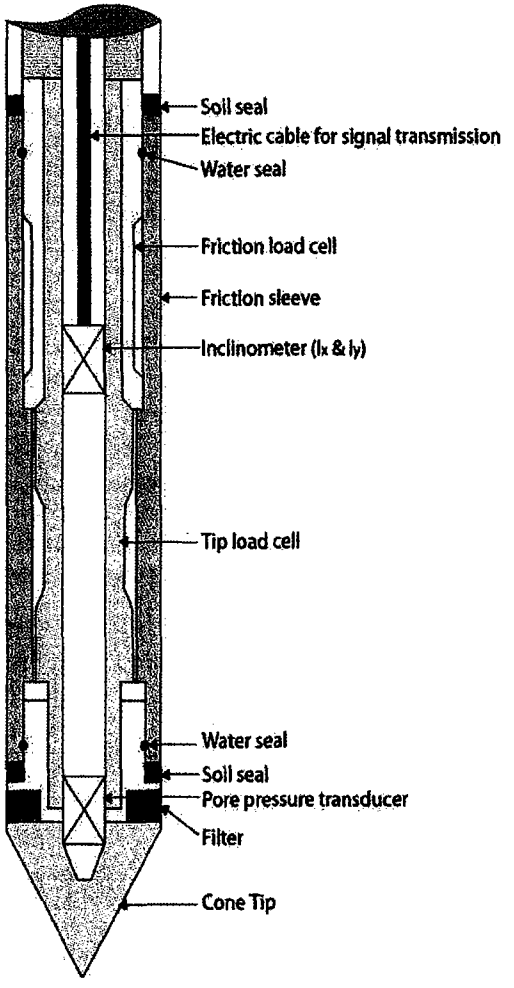


Figure CPT

When the soundings are complete, the test holes are grouted using a Gregg In Situ support rig. The grouting procedures generally consist of pushing a hollow CPT rod with a "knock out" plug to the termination depth of the test hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

Bibliography

Lunne, T., Robertson, P.K. and Powell, J.J.M., "Cone Penetration Testing in Geotechnical Practice" E & FN Spon. ISBN 0 419 23750, 1997

Roberston, P.K., "Soil Classification using the Cone Penetration Test", Canadian Geotechnical Journal, Vol. 27, 1990 pp. 151-158.

Mayne, P.W., "NHI (2002) Manual on Subsurface Investigations: Geotechnical Site Characterization", available through www.ce.gatech.edu/~geosys/Faculty/Mayne/papers/index.html, Section 5.3, pp. 107-112.

Robertson, P.K., R.G. Campanella, D. Gillespie and A. Rice, "Seismic CPT to Measure In-Situ Shear Wave Velocity", Journal of Geotechnical Engineering ASCE, Vol. 112, No. 8, 1986 pp. 791-803.

Robertson, P.K., Sully, J., Woeller, D.J., Lunne, T., Powell, J.J.M., and Gillespie, D.J., "Guidelines for Estimating Consolidation Parameters in Soils from Piezocone Tests", Canadian Geotechnical Journal, Vol. 29, No. 4, August 1992, pp. 539-550.

Robertson, P.K., T. Lunne and J.J.M. Powell, "Geo-Environmental Application of Penetration Testing", Geotechnical Site Characterization, Robertson & Mayne (editors), 1998 Balkema, Rotterdam, ISBN 90 5410 939 4 pp 35-47.

Campanella, R.G. and I. Weemees, "Development and Use of An Electrical Resistivity Cone for Groundwater Contamination Studies", Canadian Geotechnical Journal, Vol. 27 No. 5, 1990 pp. 557-567.

DeGroot, D.J. and A.J. Lutenegger, "Reliability of Soil Gas Sampling and Characterization Techniques", International Site Characterization Conference - Atlanta, 1998.

Woeller, D.J., P.K. Robertson, T.J. Boyd and Dave Thomas, "Detection of Polyaromatic Hydrocarbon Contaminants Using the UVIF-CPT", 53rd Canadian Geotechnical Conference Montreal, QC October pp. 733-739, 2000.

Zemo, D.A., T.A. Delfino, J.D. Gallinatti, V.A. Baker and L.R. Hilpert, "Field Comparison of Analytical Results from Discrete-Depth Groundwater Samplers" BAT EnviroProbe and QED HydroPunch, Sixth national Outdoor Action Conference, Las Vegas, Nevada Proceedings, 1992, pp 299-312.

Copies of ASTM Standards are available through www.astm.org