REMEDIATION TECHNOLOGIES, INC. (RETEC)

PUGET SOUND RESOURCES SITE SEATTLE, WASHINGTON

RAPID OPTICAL SCREENING TOOL AND CONE PENETROMETER TEST SUMMARY REPORT

SEPTEMBER 1995

(Project No. H621)

Prepared for:

RETEC, Inc.
1011 Southwest Klickitat Way
Seattle, WA 98134

LORAL

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Paoli, Pennsylvania 19301
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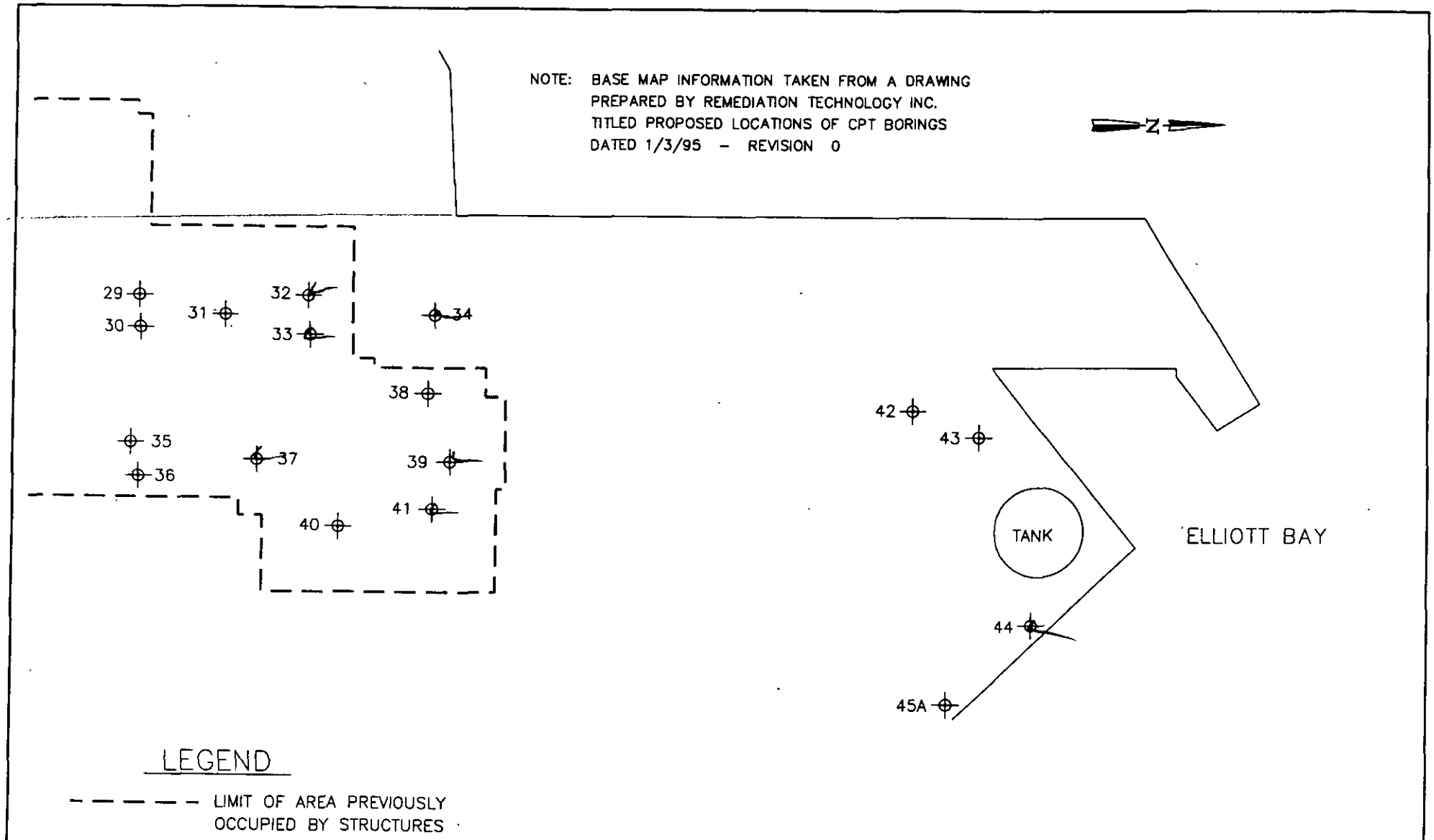
NOTE: BASE MAP INFORMATION TAKEN FROM A DRAWING PREPARED BY REMEDIATION TECHNOLOGY INC. TITLED PROPOSED LOCATIONS OF CPT BORINGS DATED 1/3/95 – REVISION 0



DATE	9/1/95
SCALE	1"=100'
DRAWN BY:	D.A.P.
CHK. BY:	A.J.S.
PROJ. MGR.:	A.J.S.
PROJ. NO.:	H621
ISSUED:	9/7/95

SEATTLE PORT AUTHORITY
PORT OF SEATTLE
SEATTLE WASHINGTON
ROST/CPT TEST LOCATION MAP

LORAL

FIGURE 1

FILE NAME: C:\ROST\DWGS\H621\H621-01

As seen on some WTMs (e.g. WA4BH31A), particularly those obtained between 5 and 40 ft bgs, the spectroscopic patterns show fluorescence extending below 400 nm. Fluorescence occurring at these lower wavelengths is normally indicative of lower molecular weight PAHs or middle range PHC products. The patterns noted here with fluorescence extending from 500 nm to below 400 nm tend to indicate the presence of a middle range PHC product mixed with the high molecular weight PAH containing product.

An anomalous spectroscopic pattern occurring at the 320 nm wavelength was noted on 37 of the WTMs which were collected from ROST/CPT tests conducted after August 1 (e.g. WRA4BH34A). The appearance of this pattern coincides with when the ROST fiber optic cable and sapphire window assembly were changed due to technical problems with the CPT delivery system. This anomalous pattern is produced by Raman scattering which is generated by the laser light within the ROST optical fiber and is not indicative of any PHC product. Due to the short wavelength occurrence of this Raman scattering, the spectroscopic signatures and fluorescence emitted from the encountered PHCs were found to be unaffected.

Additional WTMs (e.g. WRA4BH31E) which exhibit little or no signal are representative of background fluorescence. Fluorescence appearing at wavelengths shorter than 300 nm on some of these background WTMs is residual laser light which is sourced from the 290 nm excitation light generated by the laser and not by fluorescence emitted from PHCs.

3.3 Cone Penetrometer Test Data

During this project, standard cone penetrometer test data, tip resistance and sleeve friction (both in Tons Per Square Foot), were collected. The ratio of these two measurements was used to develop the general soil classification found on the integrated ROST/CPT logs. As expected within a near-shore environment, sandy lithologies were found to be dominant across the site. From 20 to 40 feet bgs, the sand and silty sand layers were found to be interbedded with thicker silt lenses. Thin lenses of silt were also encountered below 40 feet, however, they were not wide spread and were generally confined to depths between 40 to 60 feet bgs.

As mentioned in Section 1, all test locations were predrilled and backfilled with sand to a depth of approximately 20 feet bgs. Due to this sandy backfill material CPT data was collected from the 0 to 20 ft interval. The lithologic units as defined from this data, however, are not representative of actual in-situ conditions for this interval. The CPT data plots (as provided by NWCE) from all test locations can be found in Appendix B.

4.0 METHODS AND PROCEDURES

Loral incorporates standard operating procedures, performs services in accordance with applicable health and safety standards, and follows site specific protocols to address decontamination and hole abandonment procedures. The following section summarizes our methods and procedures.

4.1 Equipment Decontamination

Decontamination of down hole equipment consisted of drawing the CPT rods through a rubber "O" ring assembly which was located beneath the CPT vehicle. This "O" ring assembly sufficiently removed all soils from the rod and produced minimal waste product. Decontamination of all down hole equipment was conducted by the CPT contractor.

4.2 Health and Safety

All work was performed in accordance with Loral (ROST Program) health and safety policy as well as with the site specific health and safety plan. In accordance with Level D and site specific personal protection requirements, all Loral personnel wore steel-toed shoes, hard hats, safety glasses, and reflective orange safety vests while on site. Air quality was periodically monitored by Loral personnel with a photoionization detector to ensure that no upgrade in respiratory protection was required.

4.3 Hole Abandonment

All test hole abandonment procedures were conducted by NWC under the supervision of RETEC. Abandonment consisted of grouting the small diameter holes with a bentonite slurry mixture which was continuously introduced to the test hole from the surface during the

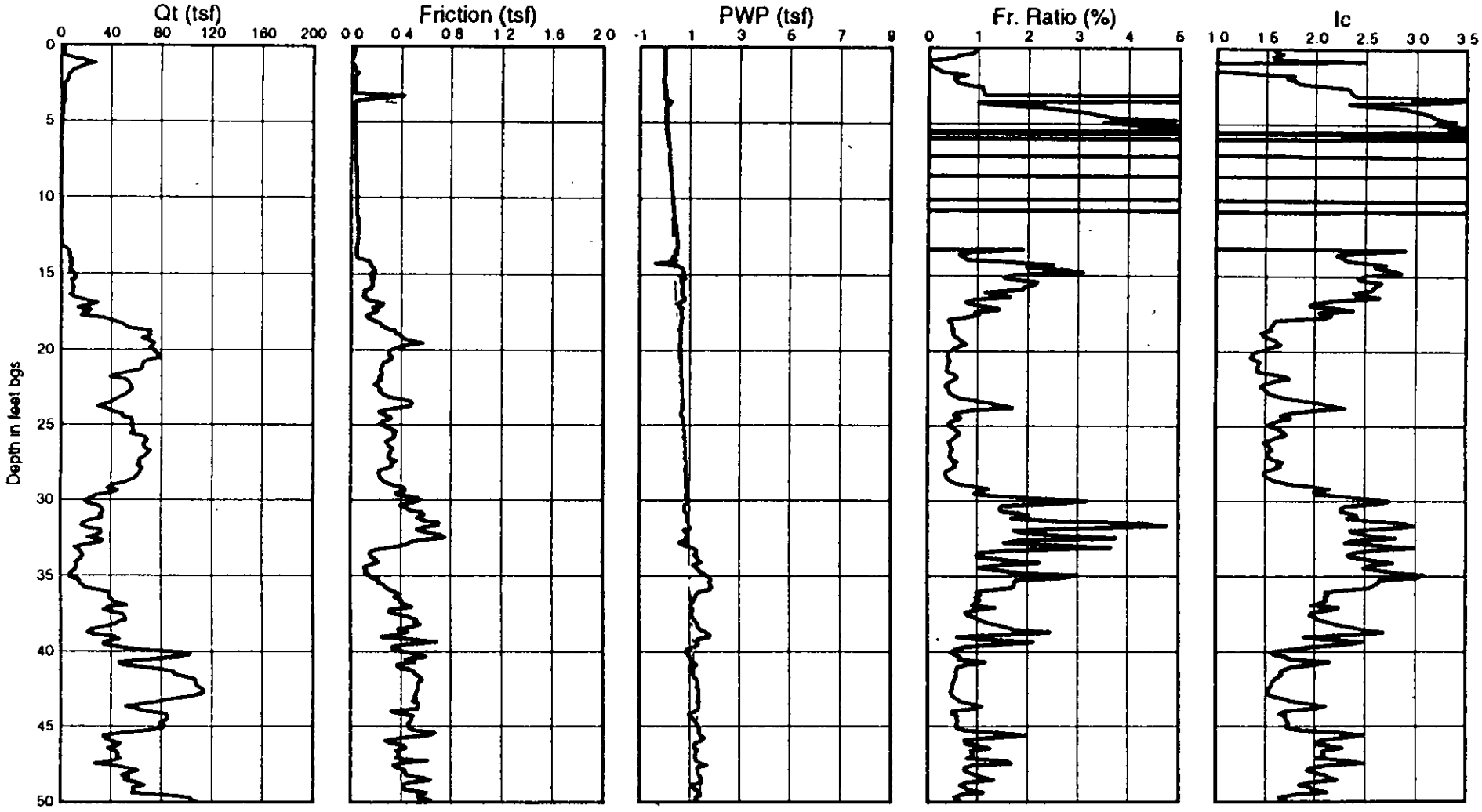
penetration test and CPT tool retrieval process. In order to assure a proper seal, the grout was continuously placed until it over-topped at the surface of the boreholes.

Cone Penetration Test - RA4BH-29

Test Date : Jul 28, 1995
Location : Puget Sound Resources Site, Port of Seattle

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY: Keith Brown

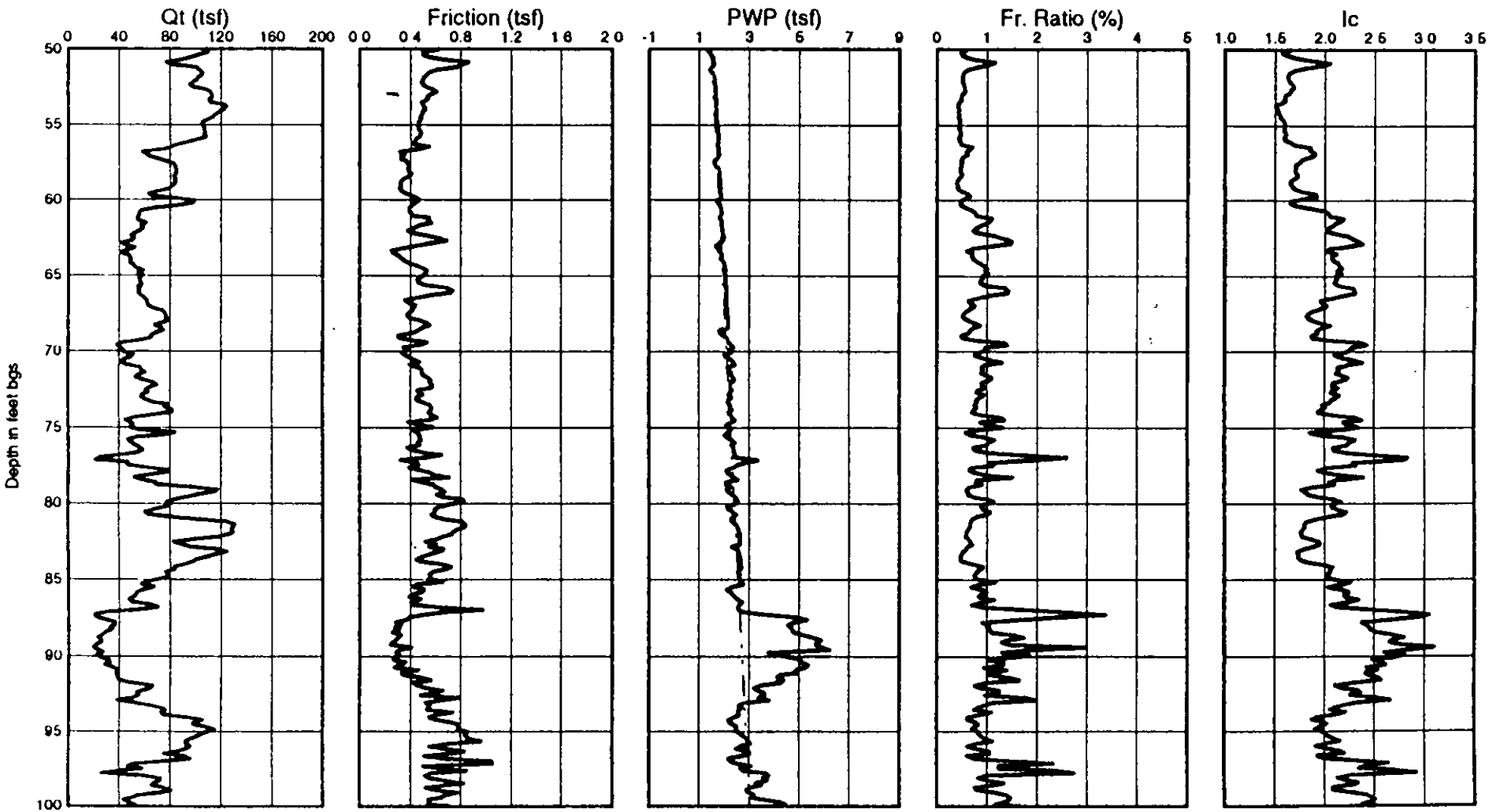
RETEC Inc.

Cone Penetration Test - RA4BH-29

Test Date : Jul 28, 1995
Location : Puget Sound Resources Site, Port of Seattle

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



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PROJECT NO 3-1335 540 DATE. August 4, 1995 DRAWN BY. Keith Brown

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Test Date : Jul 28, 1995
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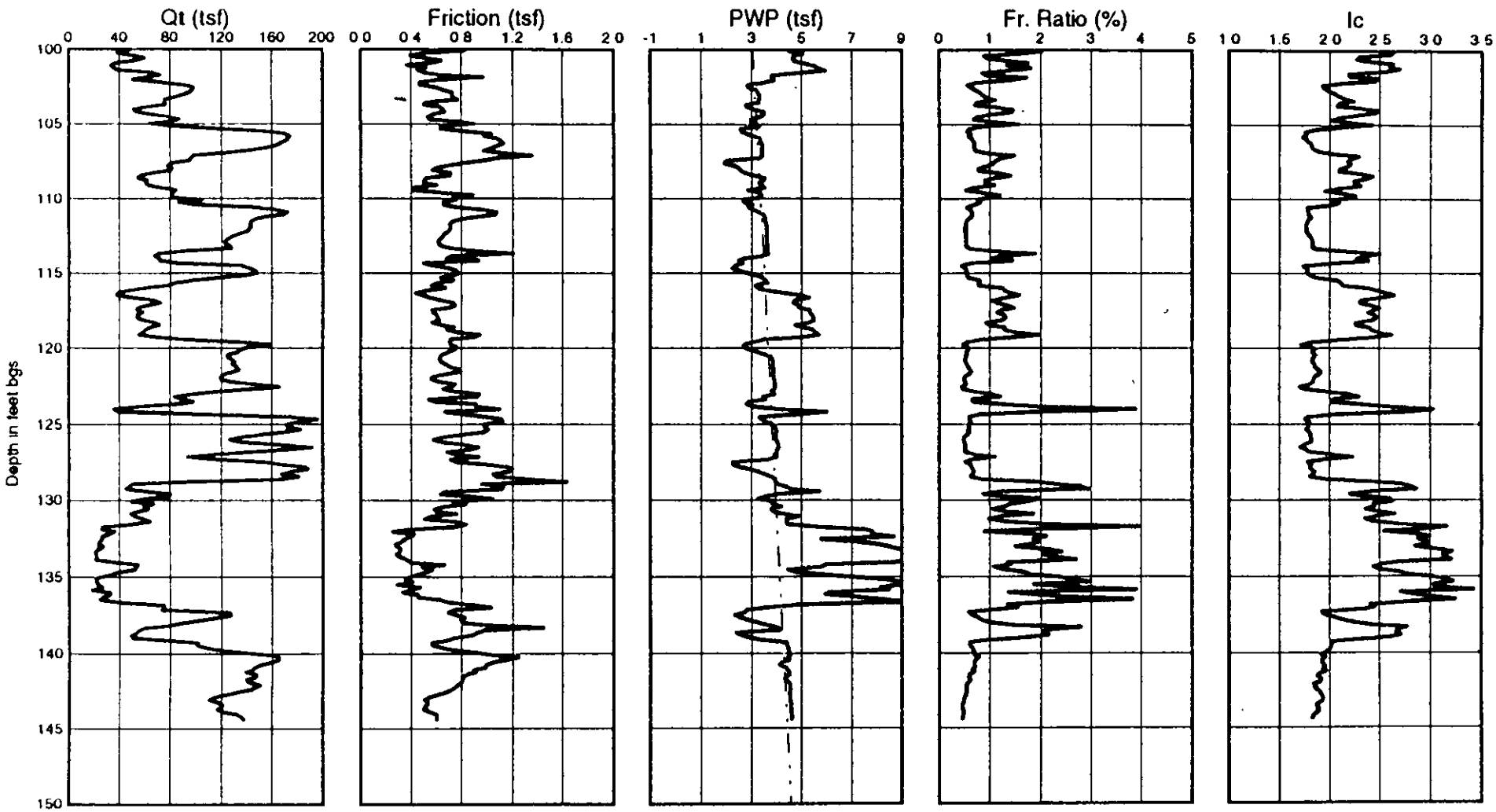

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PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY. Keith Brown

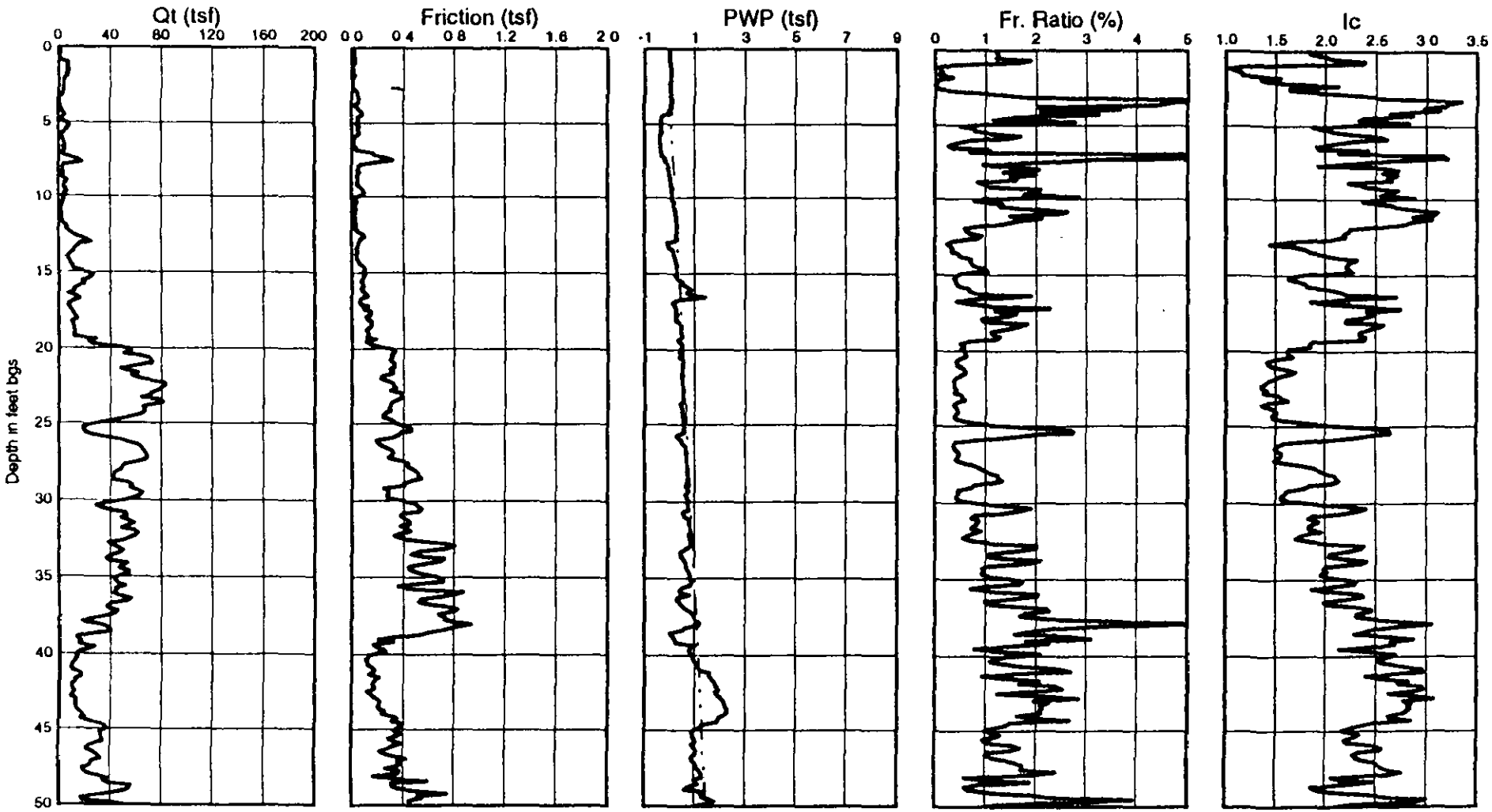
RETEC Inc.

Cone Penetration Test - RA4BH-30

Test Date : Jul 31, 1995
Location : Puget Sound Resources Site, Port of Seattle

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



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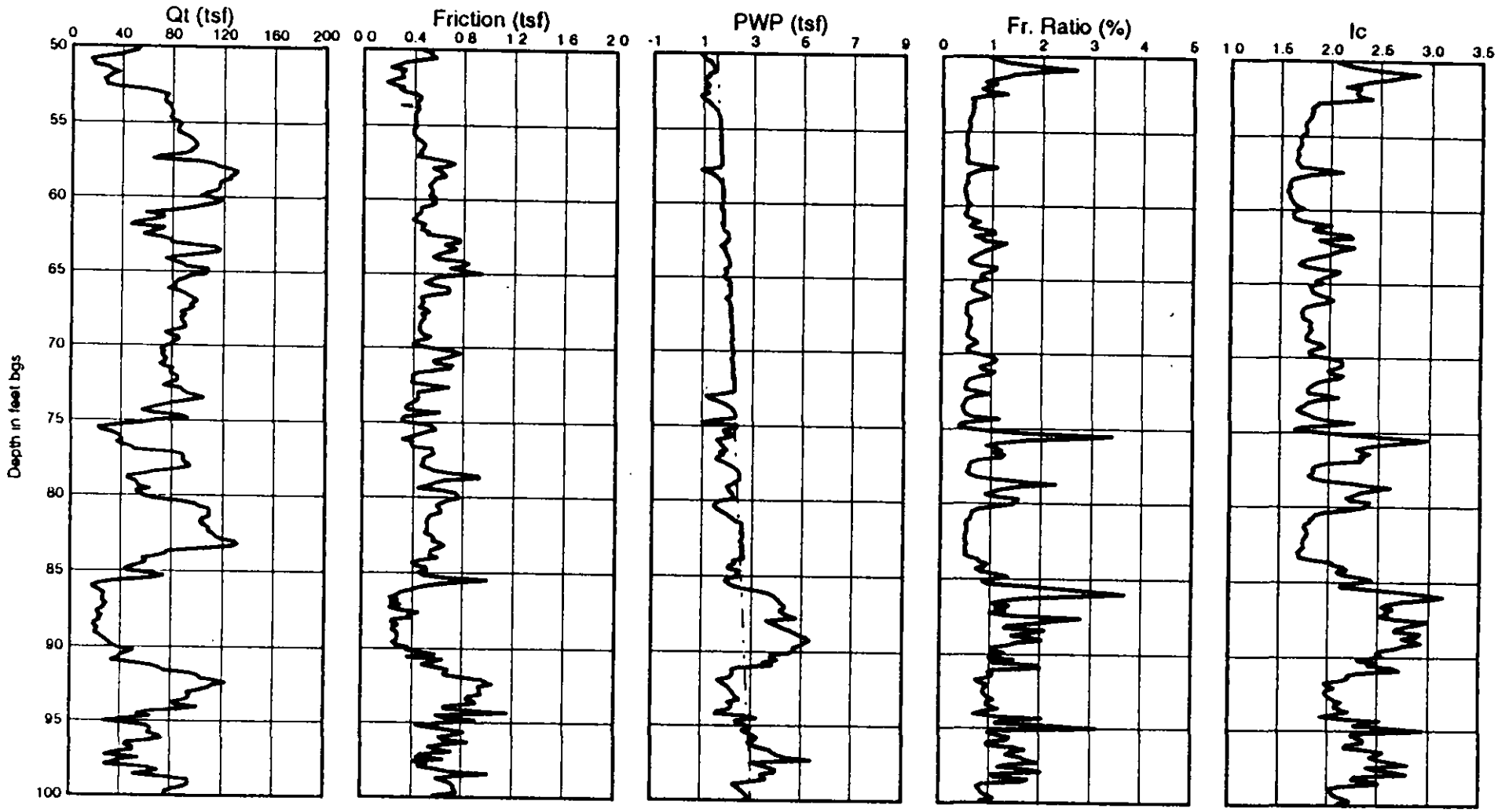

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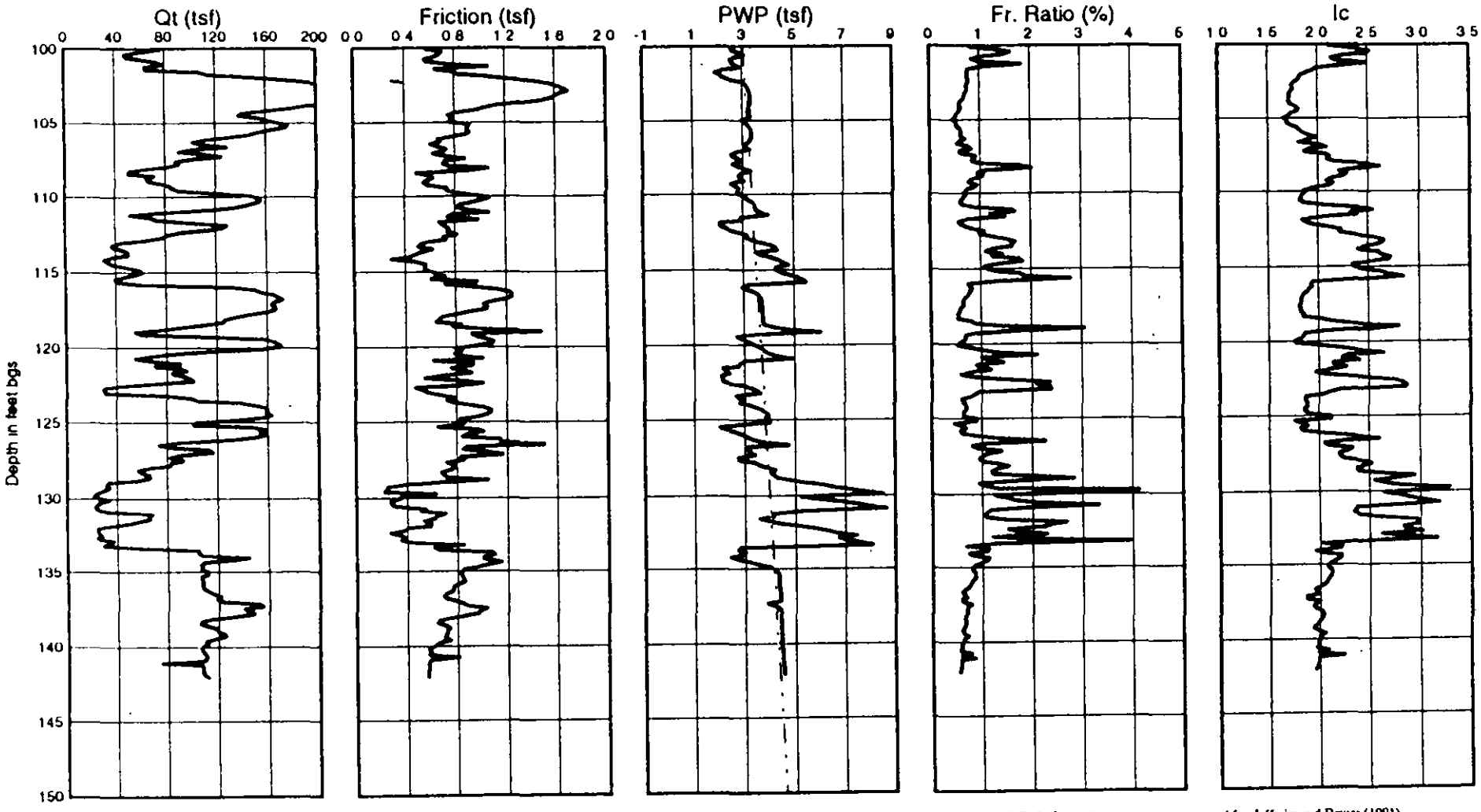

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PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY. Keith Brown

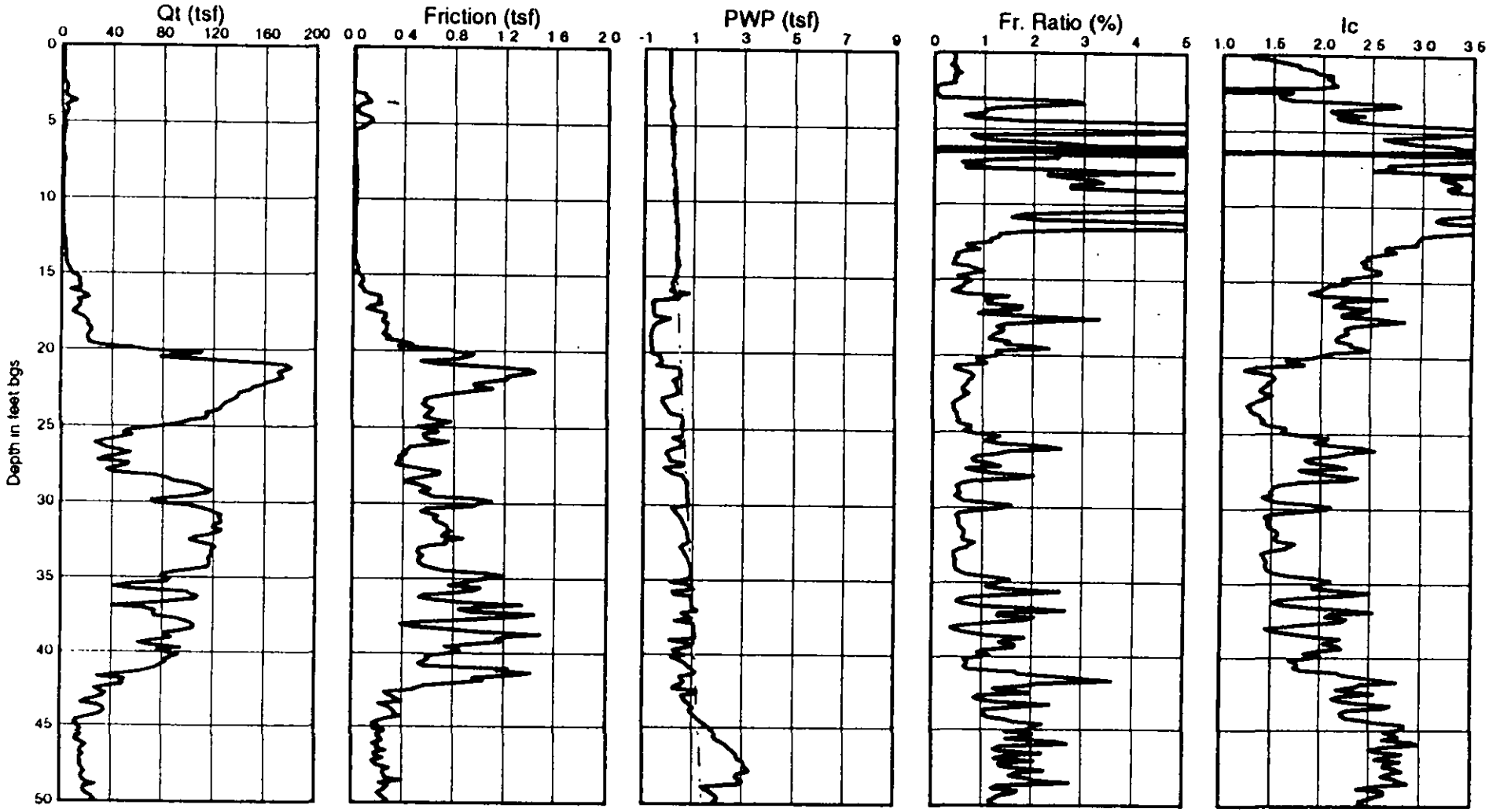
RETEC Inc.

Cone Penetration Test - RA4HB-31

Test Date : Jul 27, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 5.00



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Cone Penetration Test - RA4HB-31

Test Date : Jul 27, 1995
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Ground Surf. Elev. : 0.00
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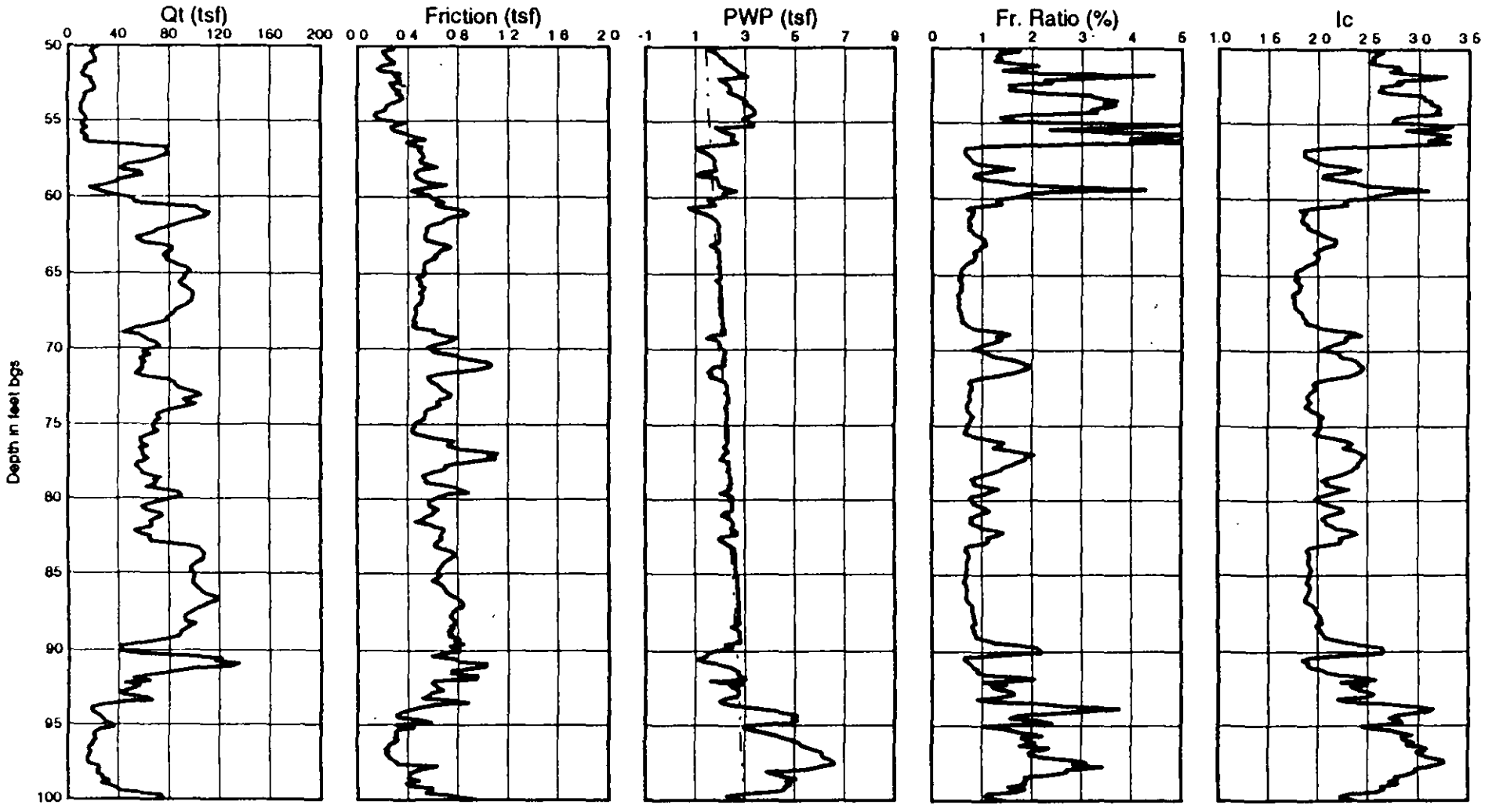

Qt normalized for unequal end area effects

Fr Ratio = 100*Fr/(Qt-Sigmav)
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After Jefferson and Davies (1991)
Ic < 1.25 - Gravelly sands
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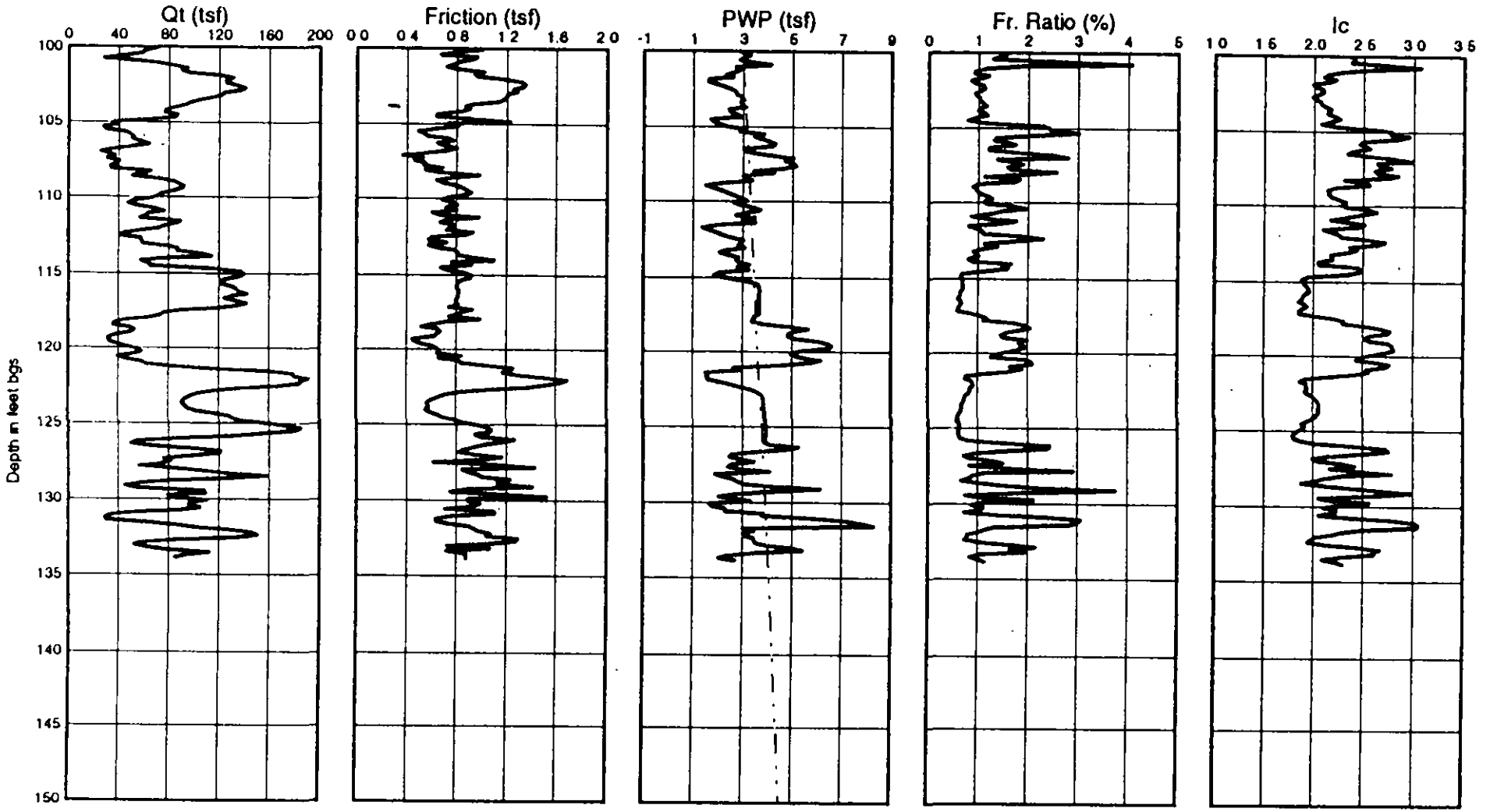

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PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY: Keith Brown

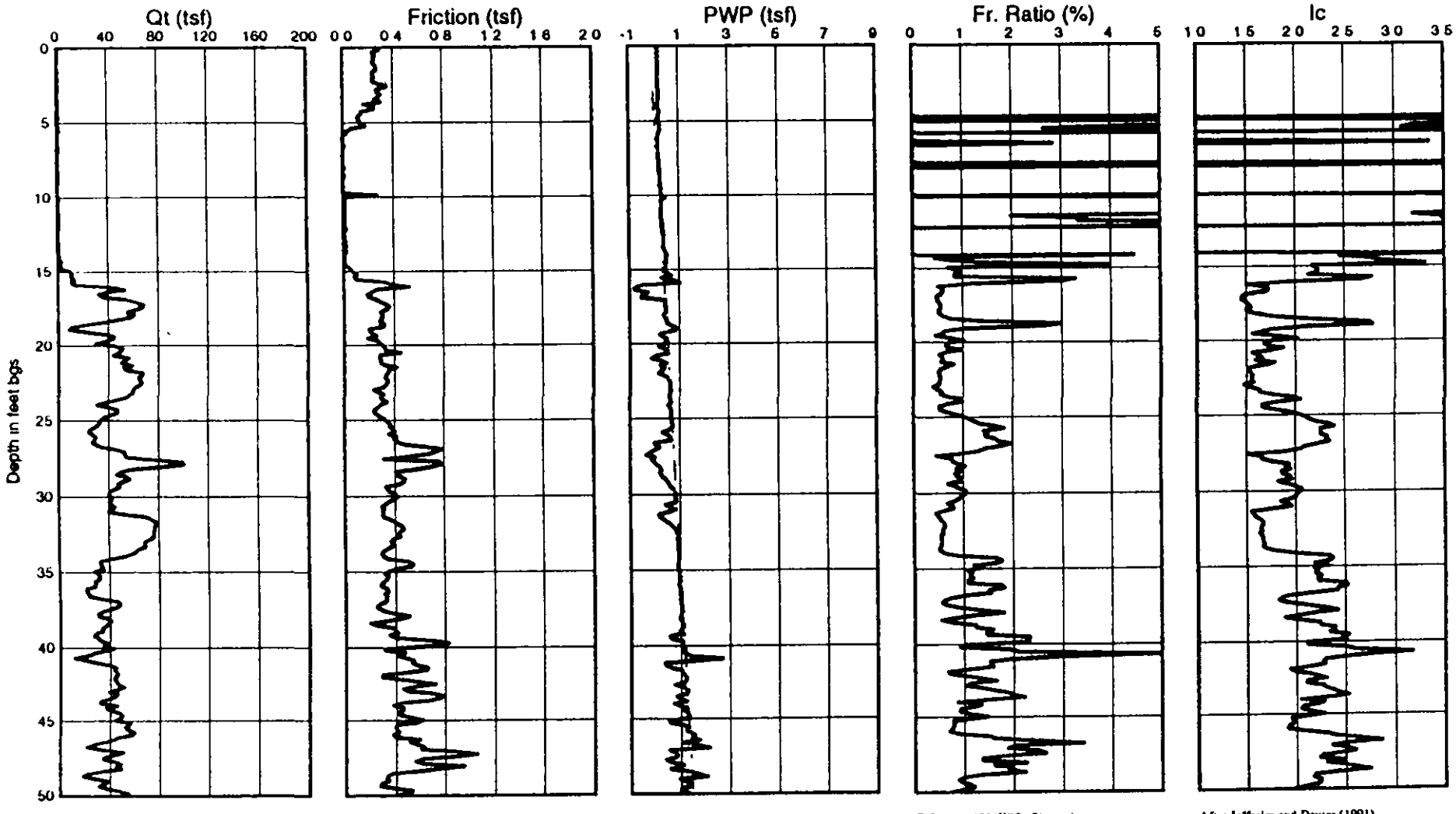
RETEC Inc.

Cone Penetration Test - RA4HB-32

Test Date Jul 28, 1995
Location Puget Sound Resources Site, Seattle, Washington

Operator . Northwest Cone Exploration

Ground Surf Elev . 0 00
Water Table Depth : 3 00



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2 54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3 22 - Clays

PROJECT NO 3 1335 540 DATE August 4 1995 DRAWN BY Keith Brown

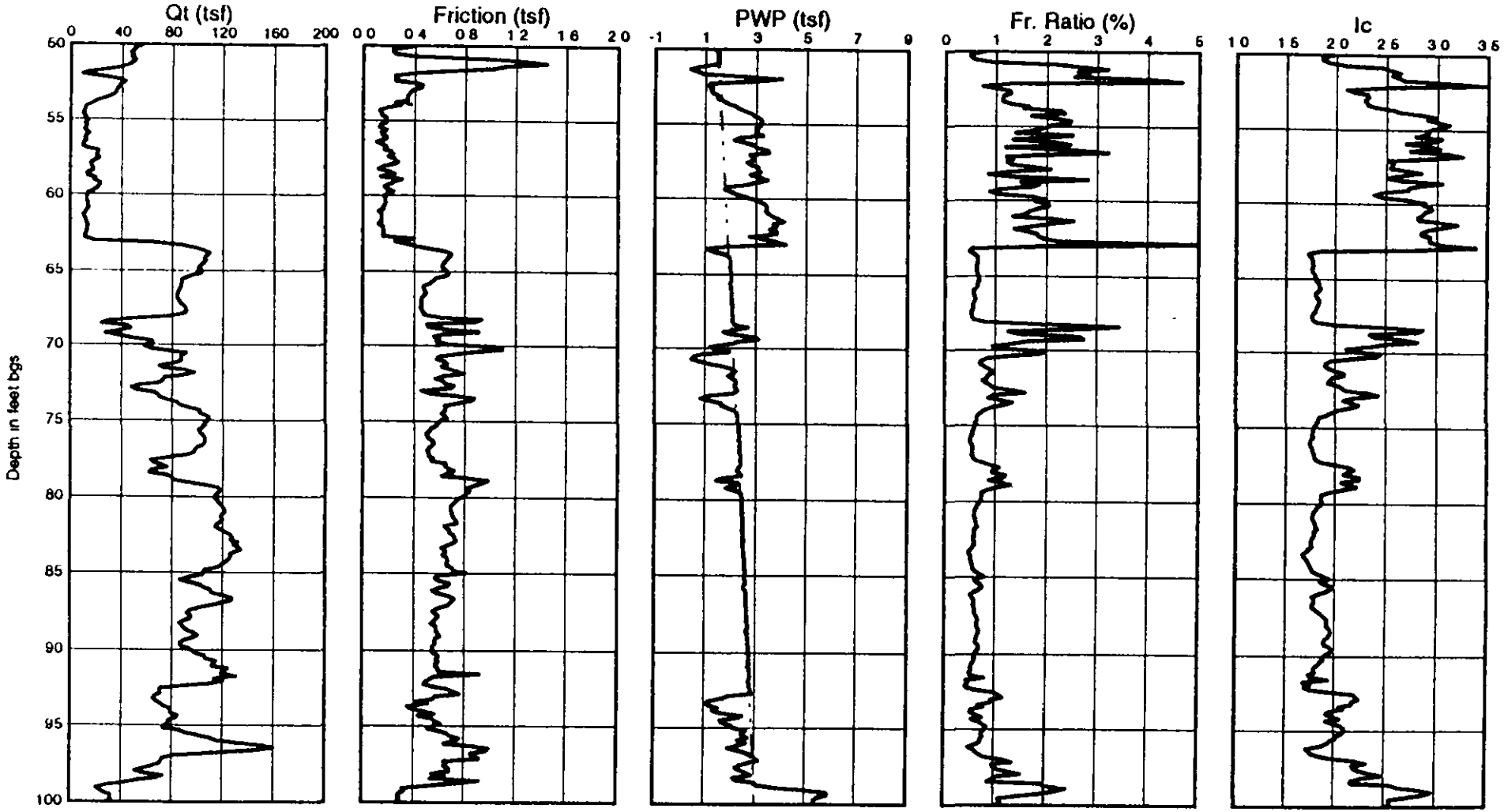
RETEC Inc.

Cone Penetration Test - RA4HB-32

Test Date Jul 28, 1995
Location Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf Elev 0 00
Water Table Depth : 3 00



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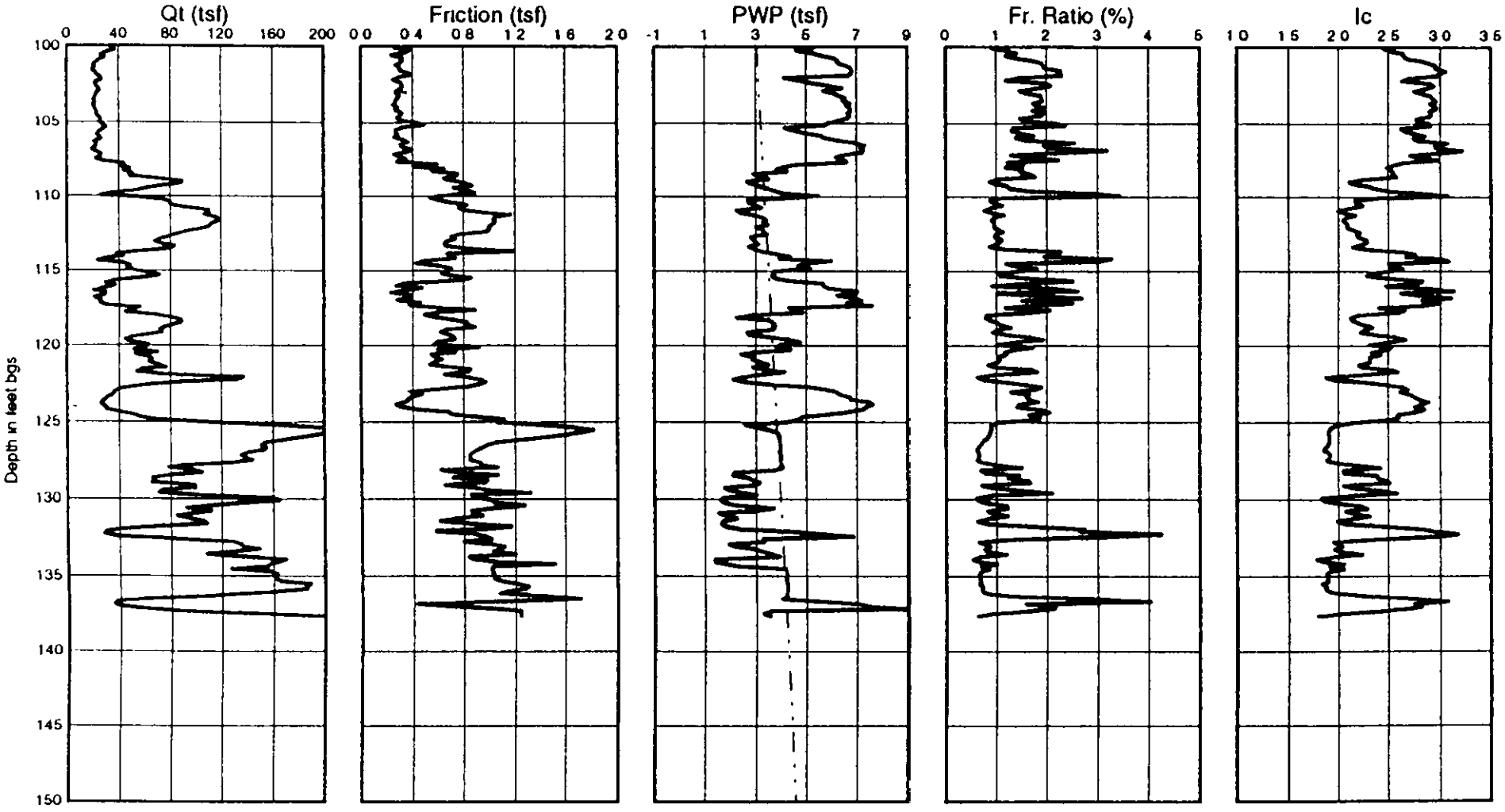

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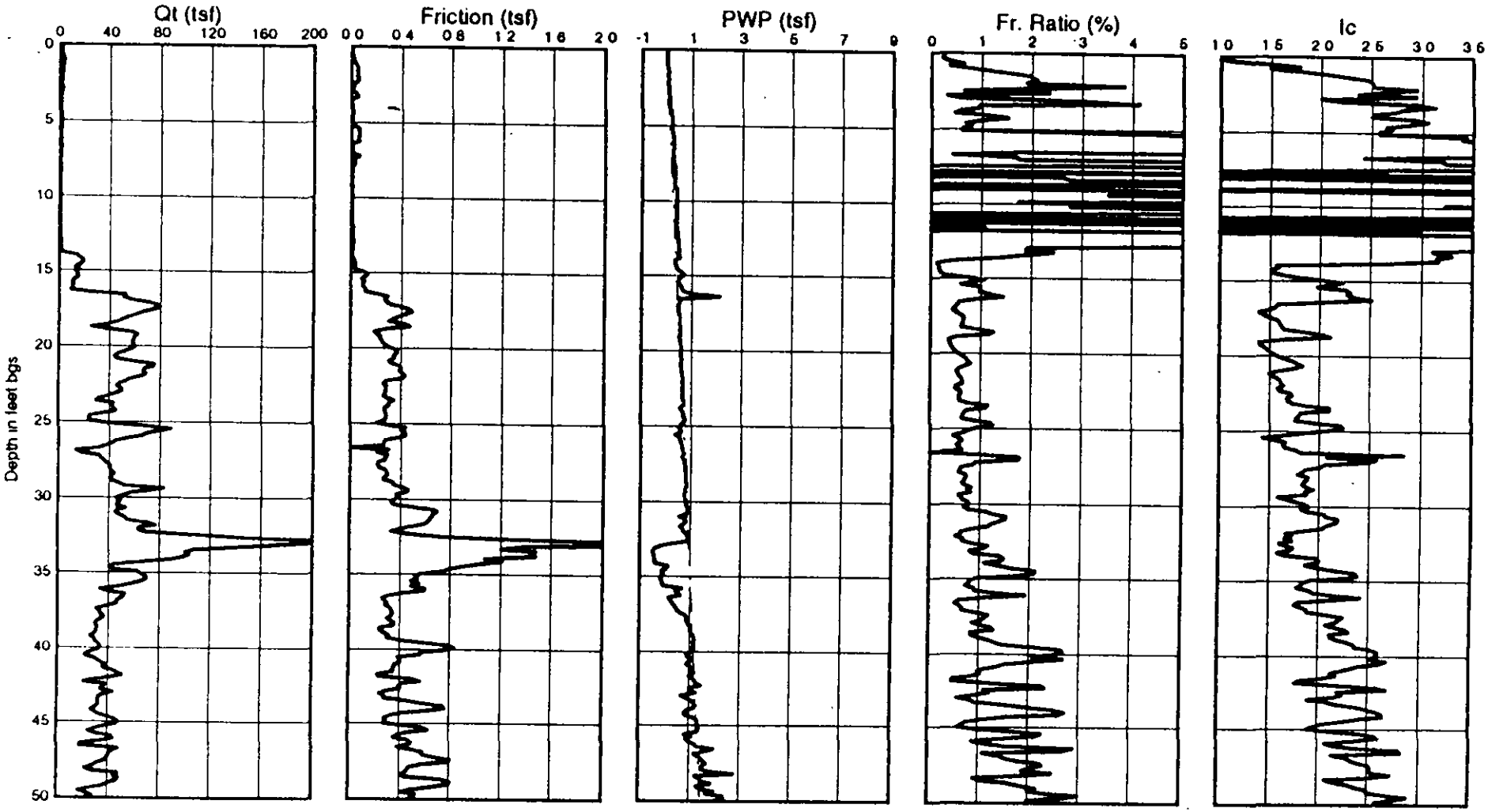
Cone Penetration Test - RA4BH-33

Test Date : Jul 28, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



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Cone Penetration Test - RA4BH-33

Test Date : Jul 28, 1995
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Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
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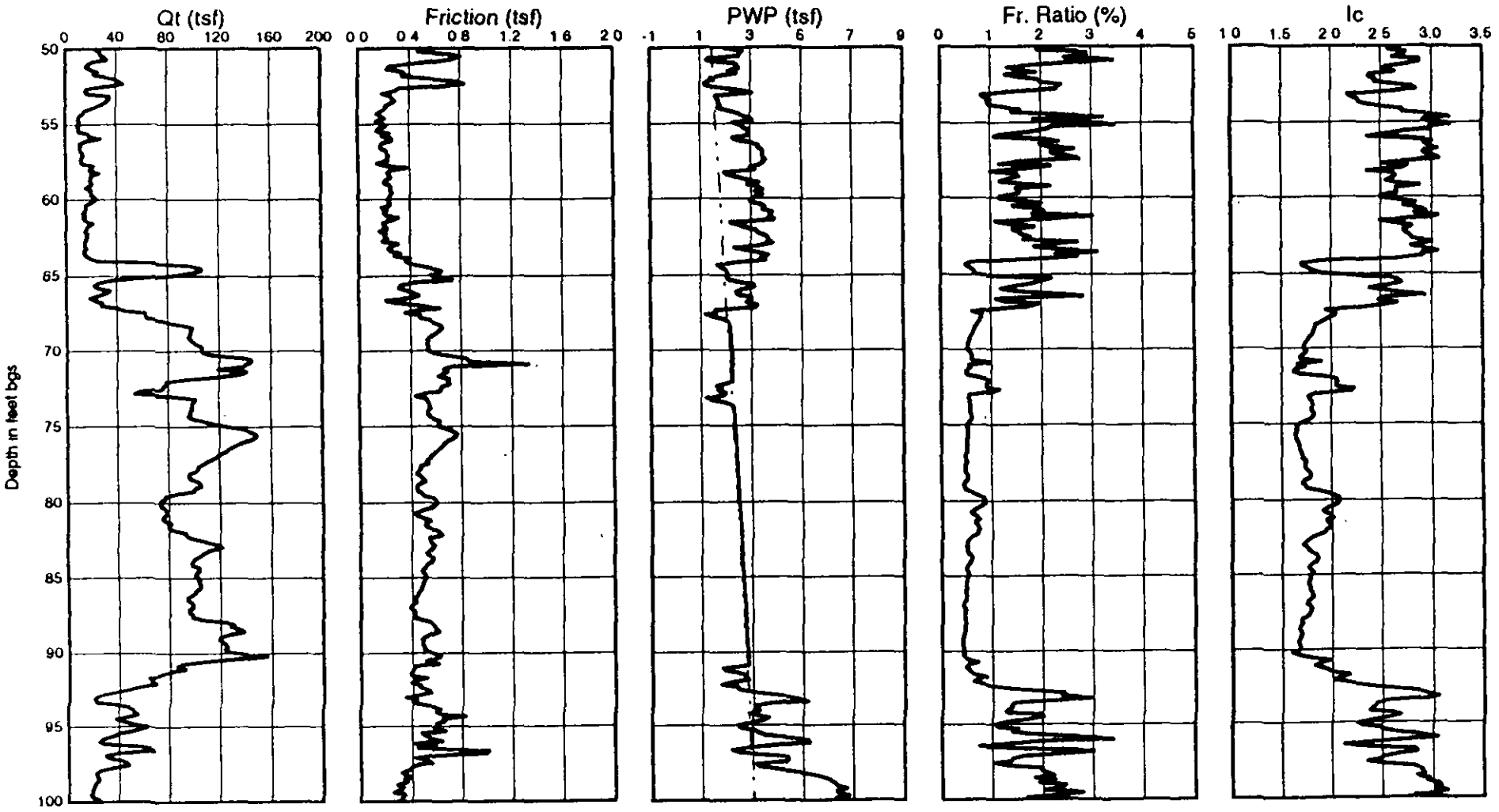

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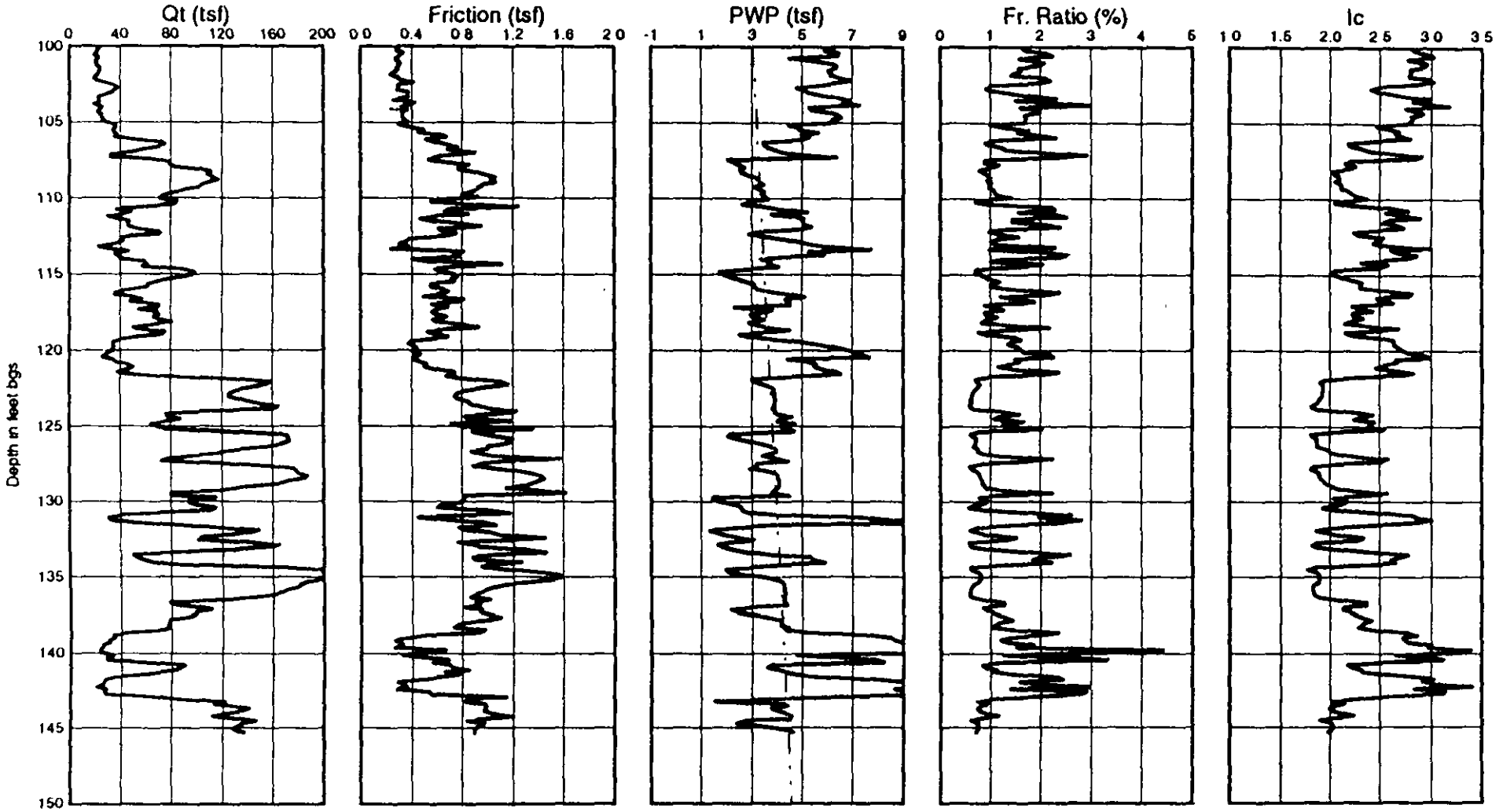

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PROJECT NO 3 1335 540 DATE. August 4, 1995 DRAWN BY: Keith Brown

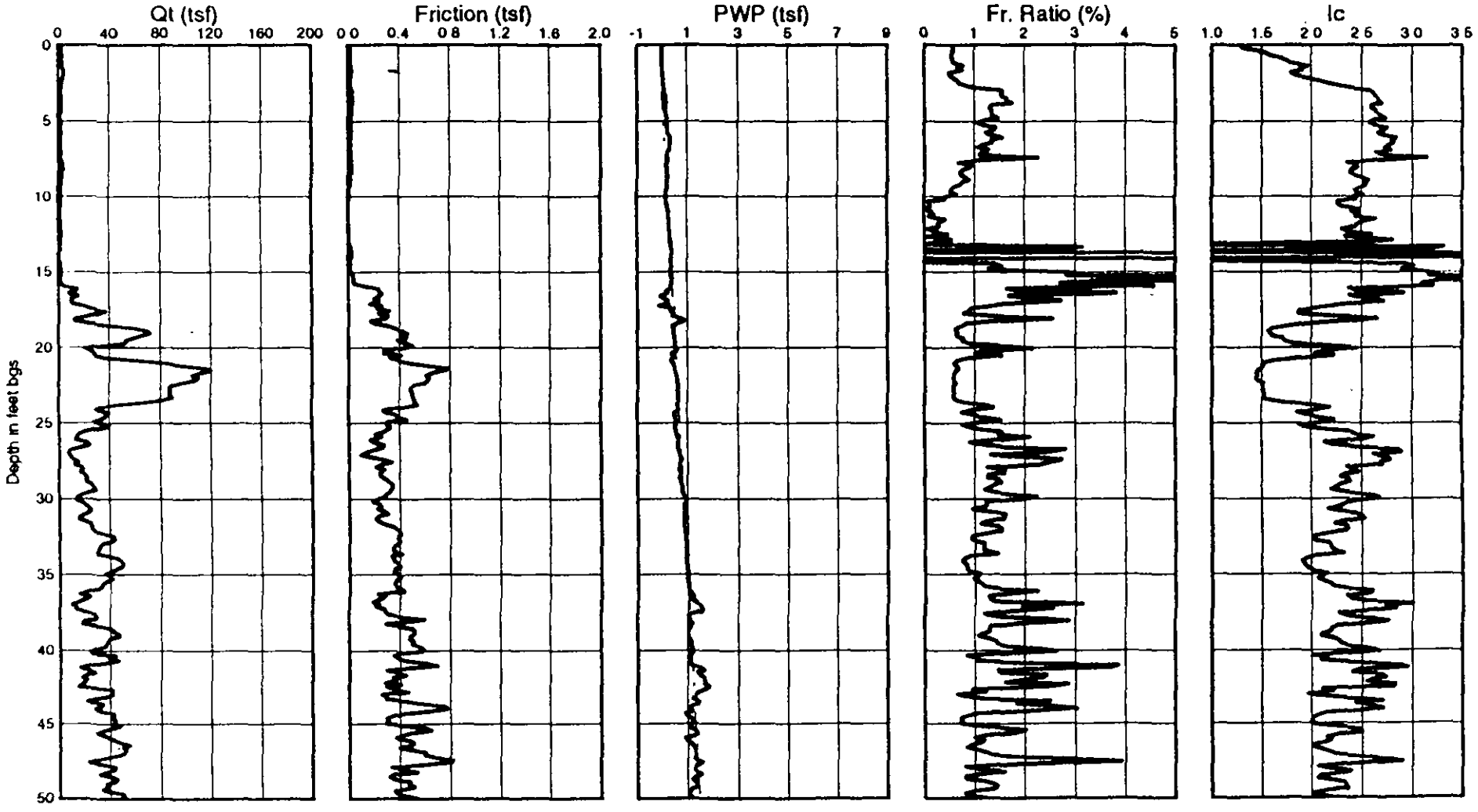
RETEC Inc.

Cone Penetration Test - RA4BH-34

Test Date : Aug 02, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



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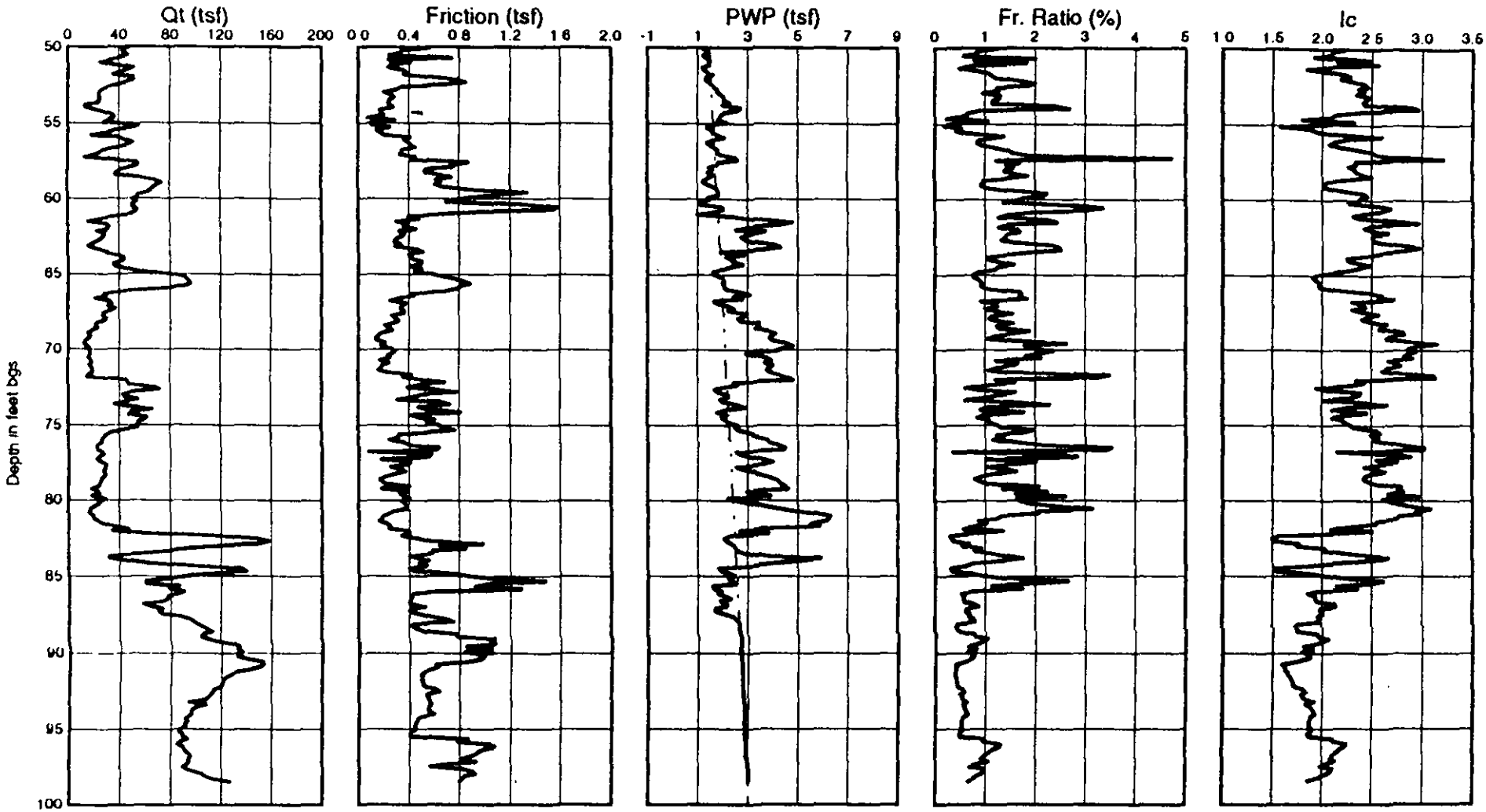
RETEC Inc.

Cone Penetration Test - RA4BH-34

Test Date : Aug 02, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



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PROJECT NO 3-1335 540 DATE. August 4, 1995 DRAWN BY: Keith Brown

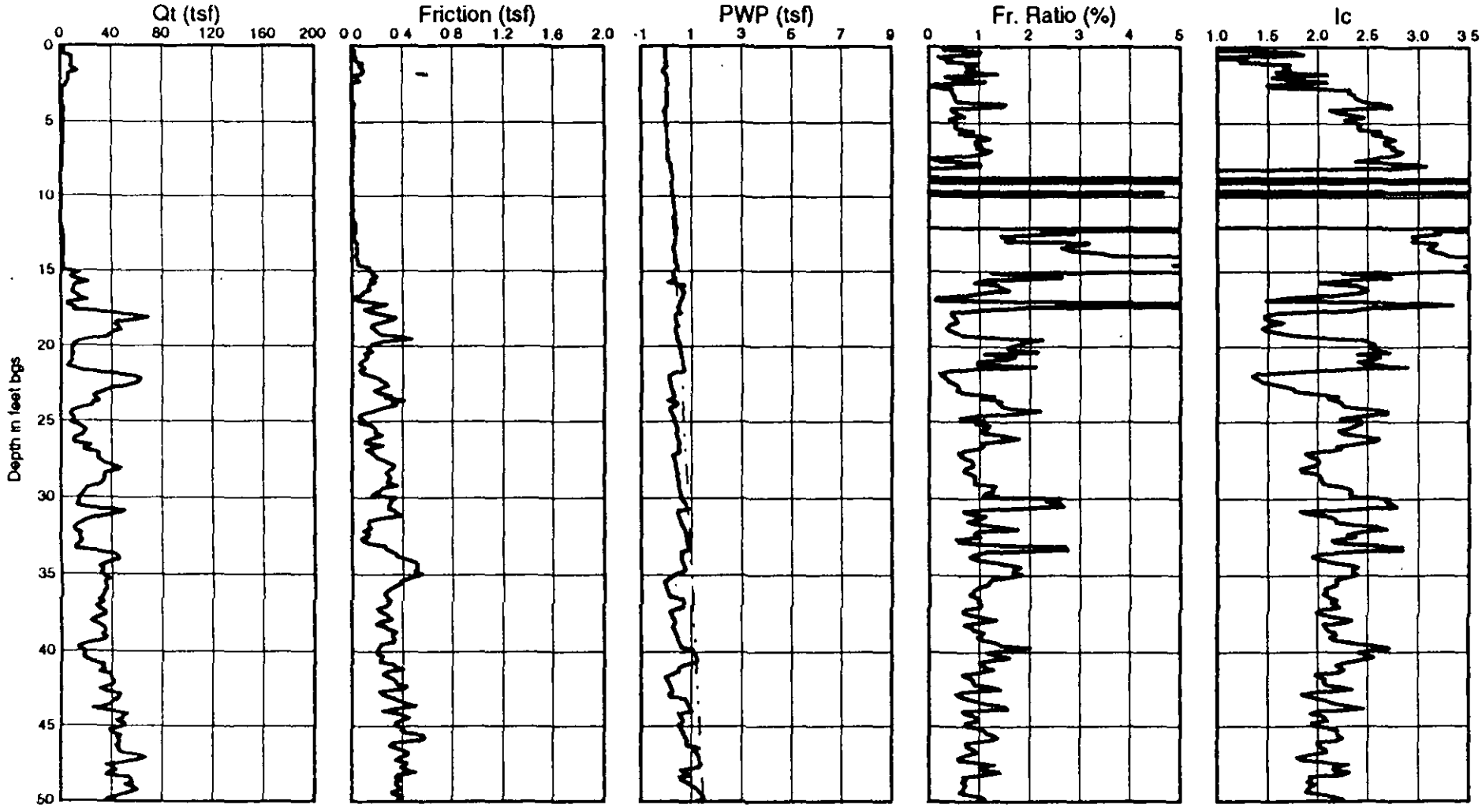
RETEC Inc.

Cone Penetration Test - RA4BH-35

Test Date Jul 29, 1995
Location . Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



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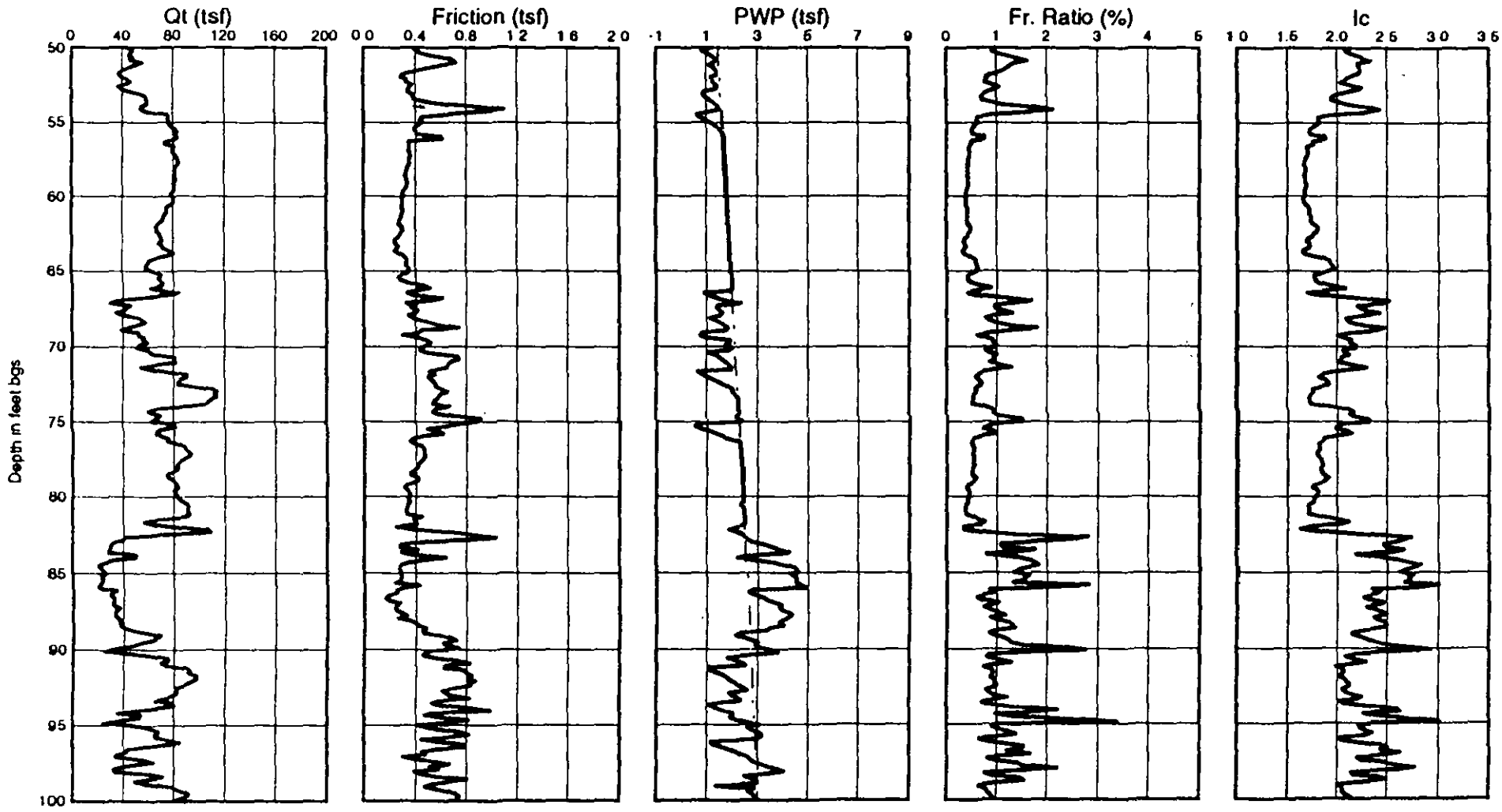

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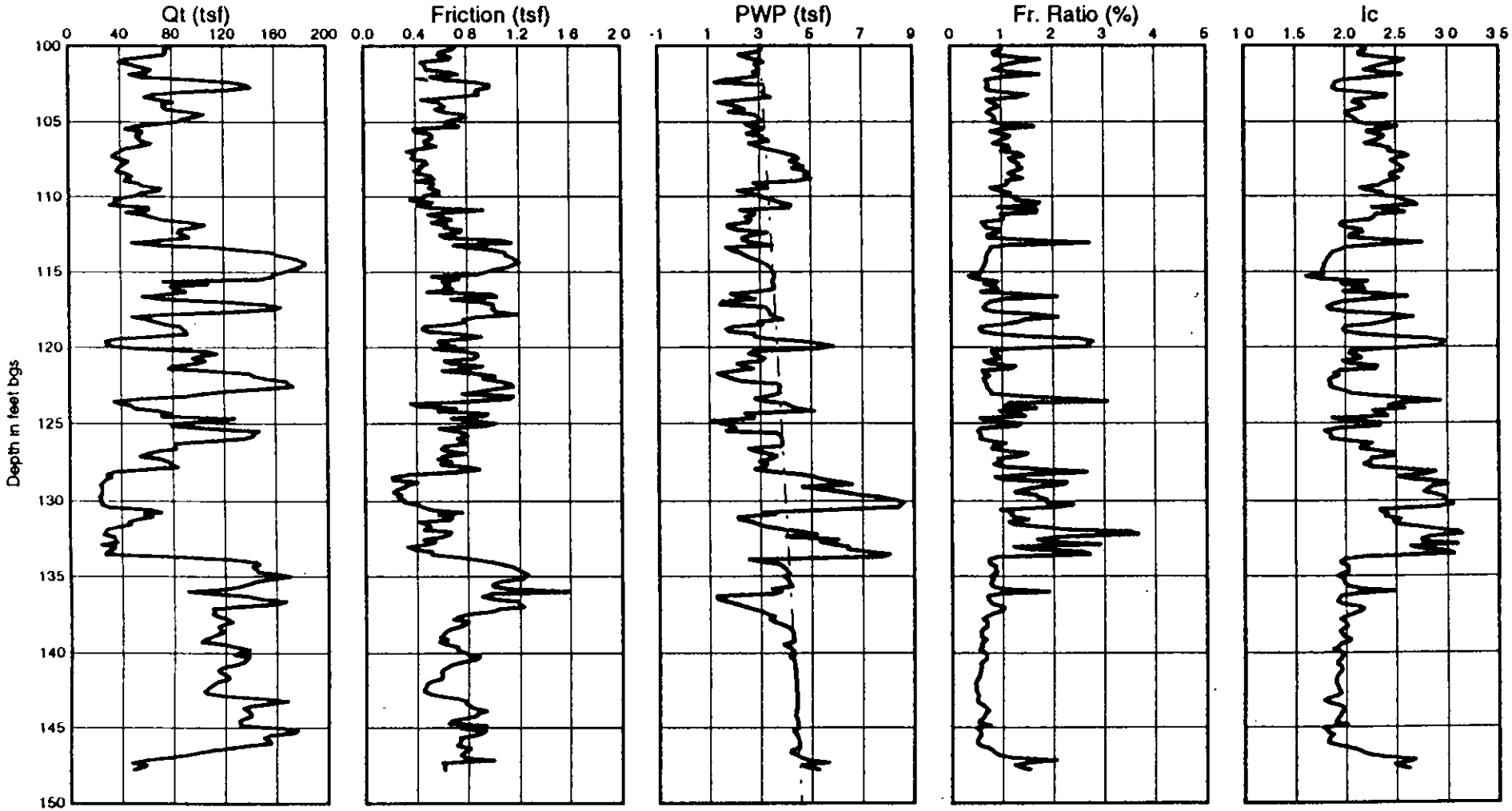
Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3-1335 540 DATE August 4, 1995 DRAWN BY: Keith Brown

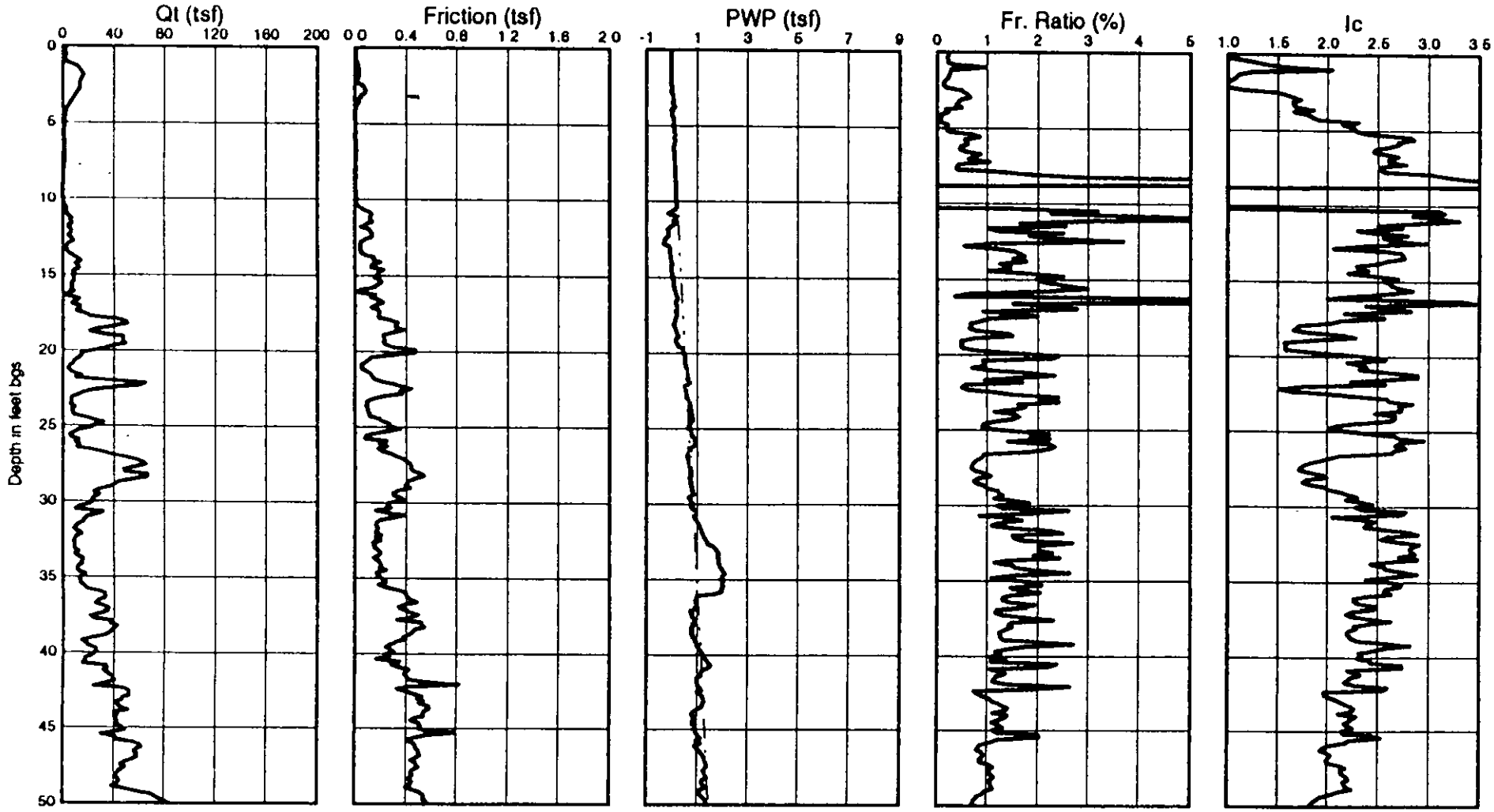
RETEC Inc.

Cone Penetration Test - RA4BH-36

Test Date : Jul 31, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE. August 4, 1996 DRAWN BY: Keith Brown

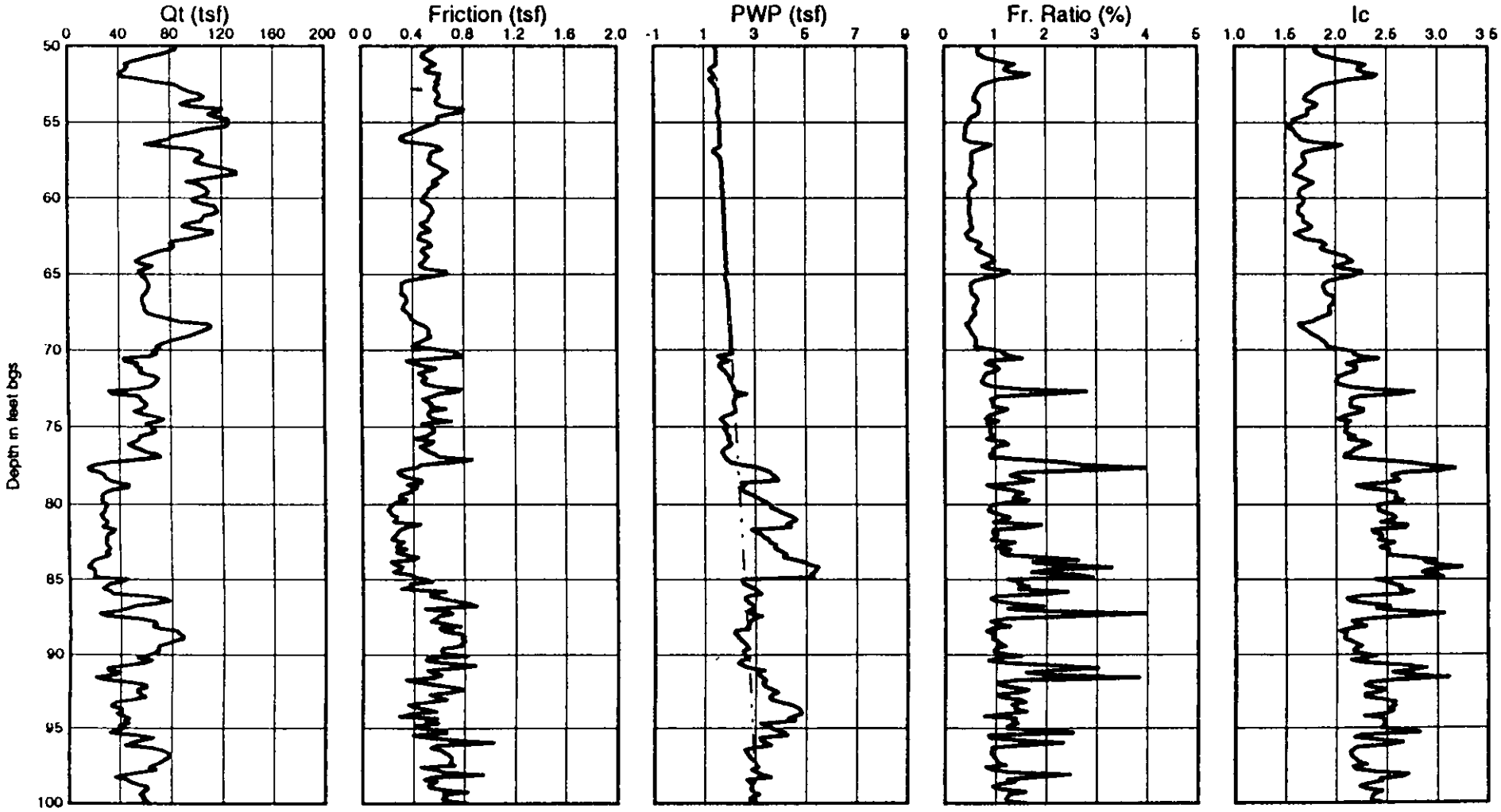
RETEC Inc.

Cone Penetration Test - RA4BH-36

Test Date . Jul 31, 1995
Location . Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
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2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3-1335 540 DATE: August 4, 1995 DRAWN BY: Keith Brown

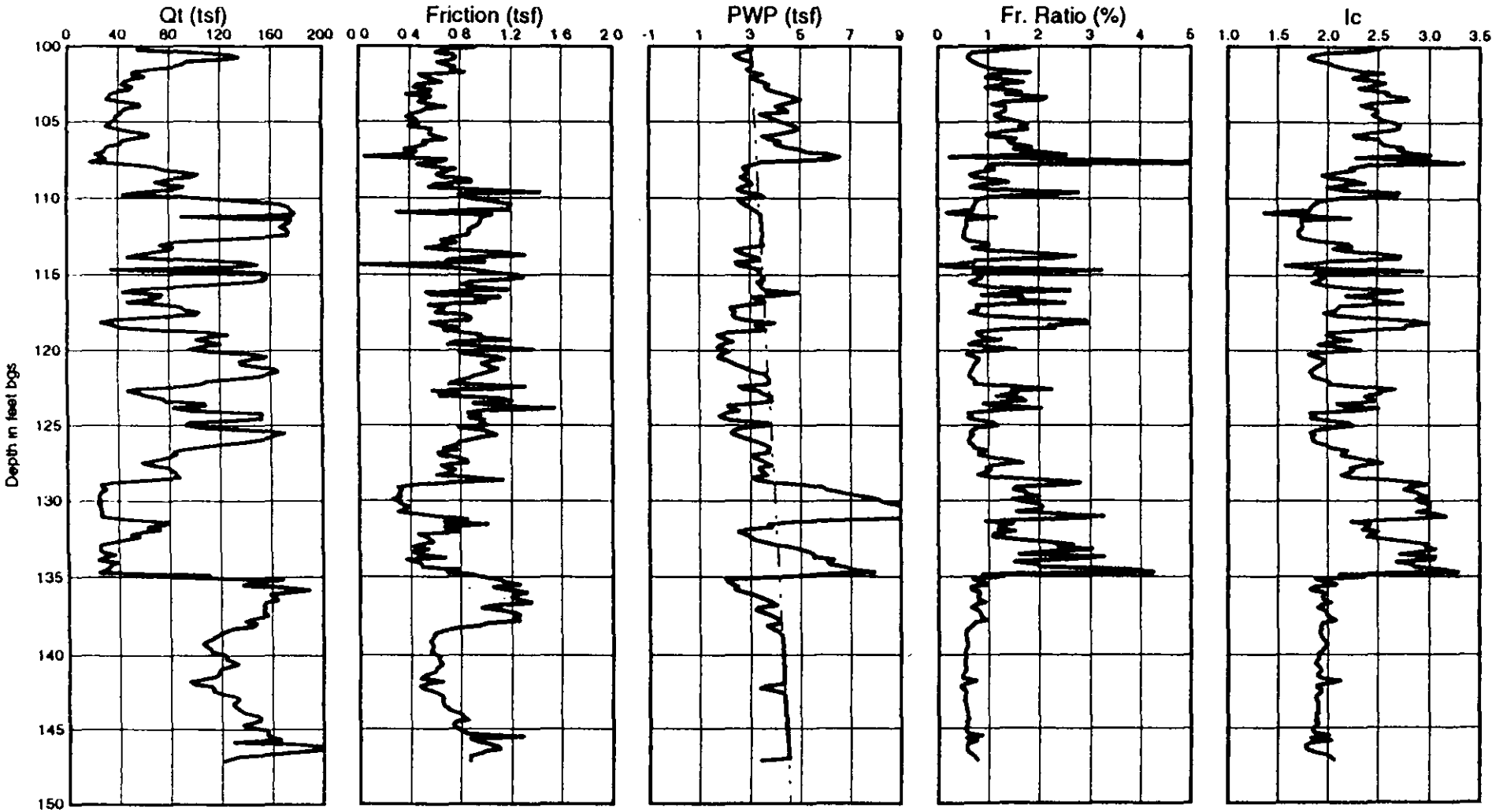
RETEC Inc.

Cone Penetration Test - RA4BH-36

Test Date : Jul 31, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for
unequal end area effects

Fr Ratio = 100*Pf/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY: Keith Brown

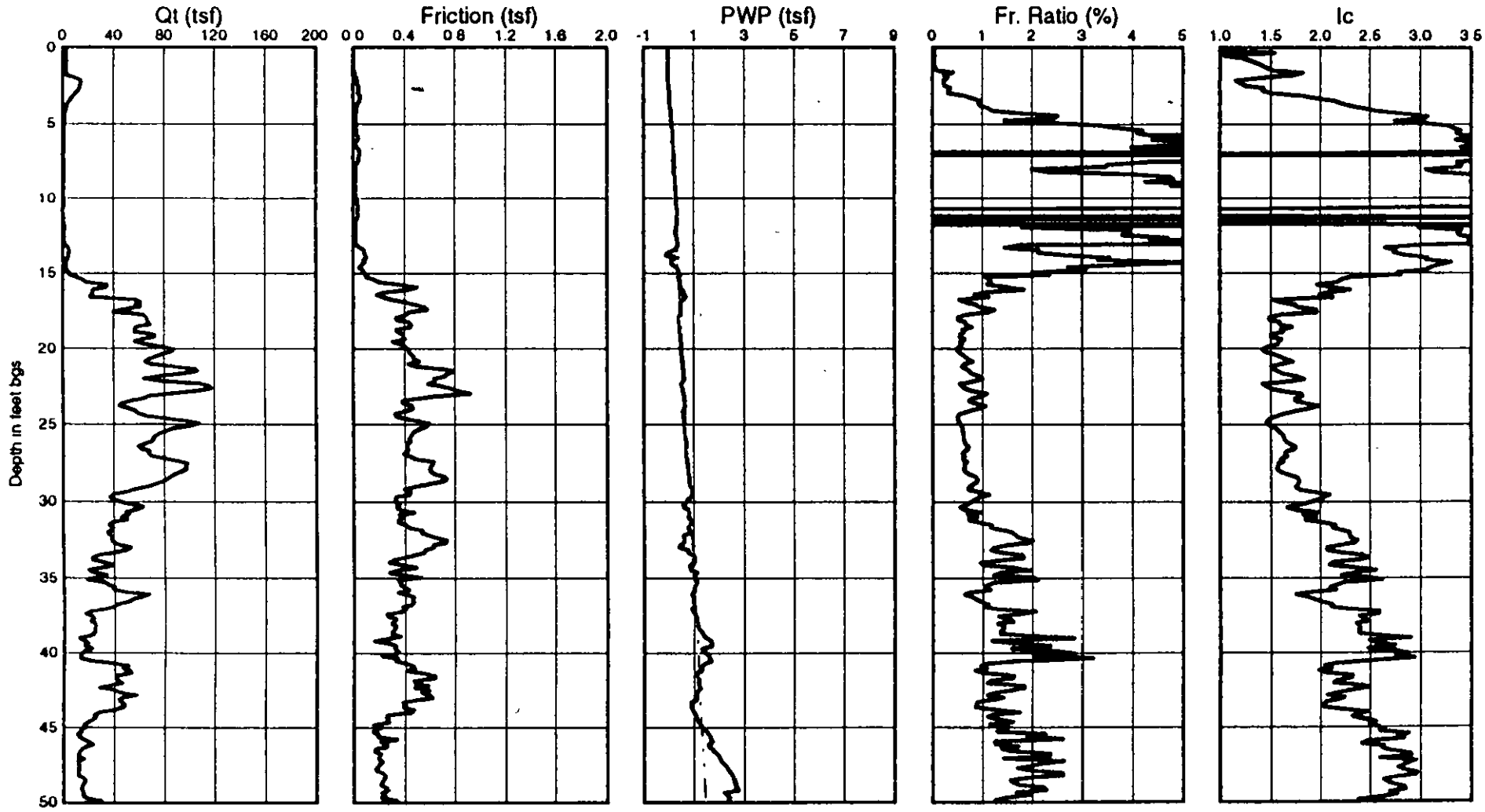
RETEC Inc.

Cone Penetration Test - RA4BH-37

Test Date : Jul 31, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335-540 DATE. August 4, 1996 DRAWN BY. Keith Brown

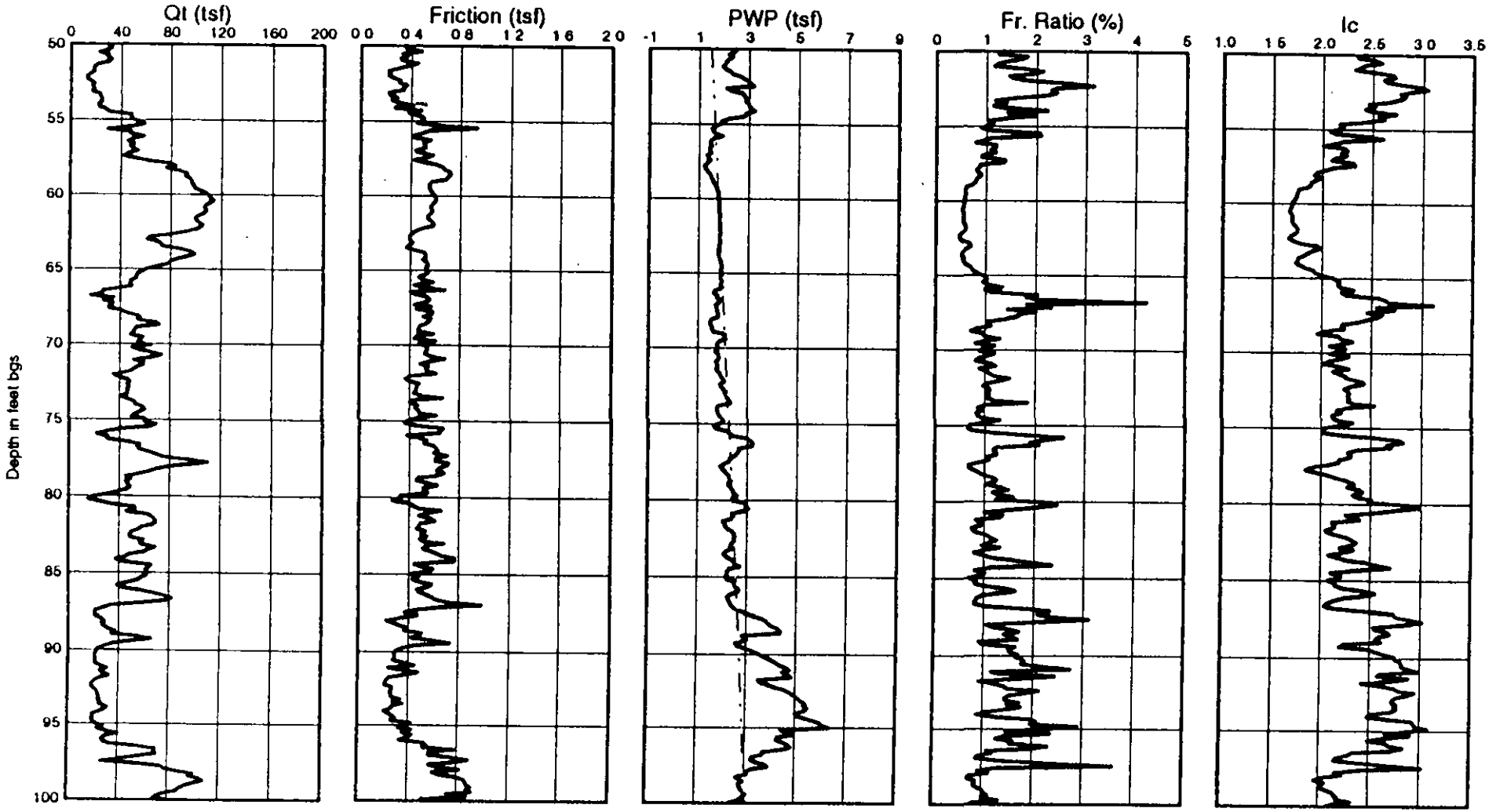
RETEC Inc.

Cone Penetration Test - RA4BH-37

Test Date Jul 31, 1995
Location . Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

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Gamma = 120 pcf

After Jefferies and Davies (1991)
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1.25 <Ic < 1.90 - Clean to silty sand
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2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY: Keith Brown

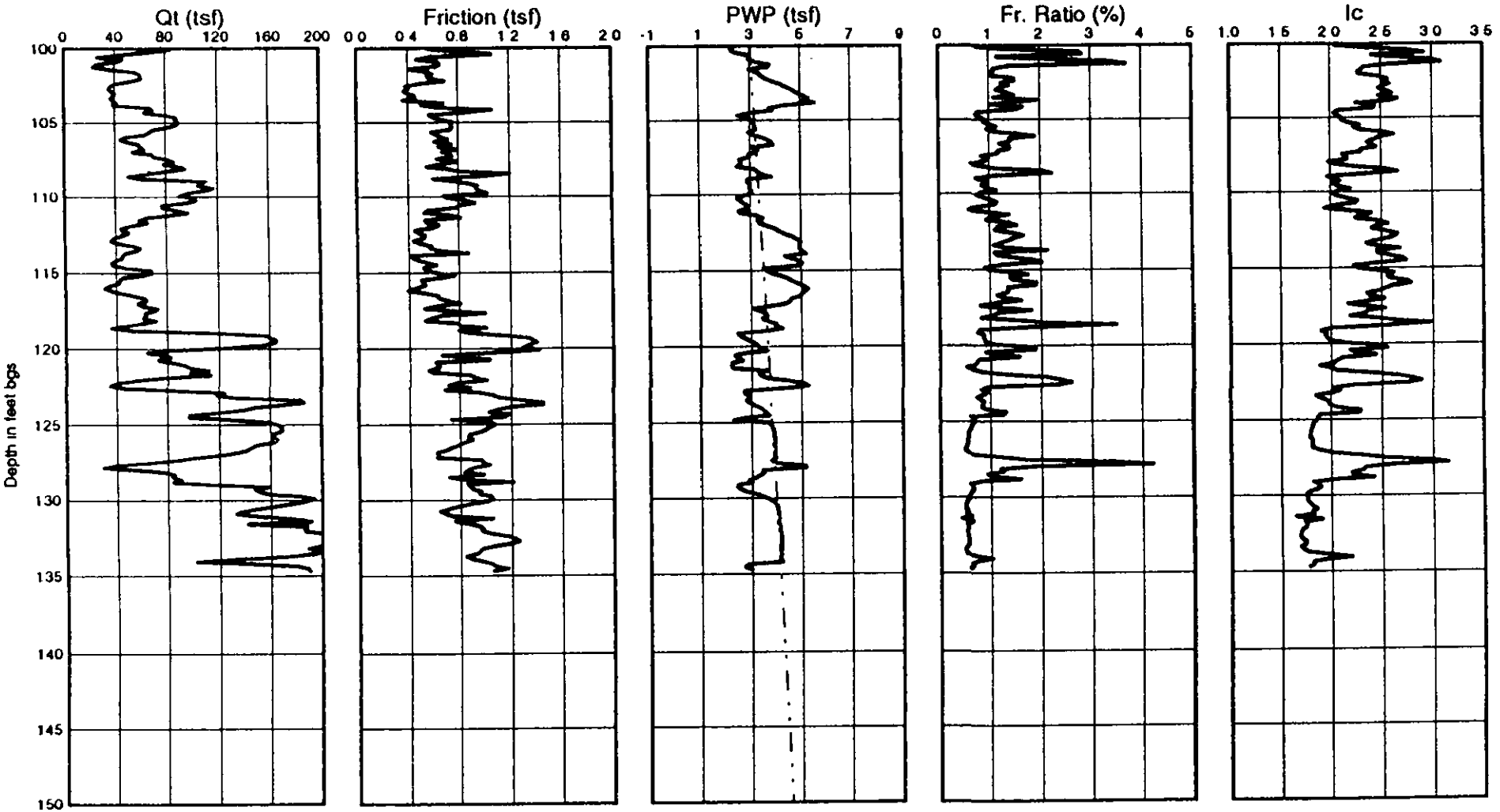
RETEC Inc.

Cone Penetration Test - RA4BH-37

Test Date : Jul 31, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

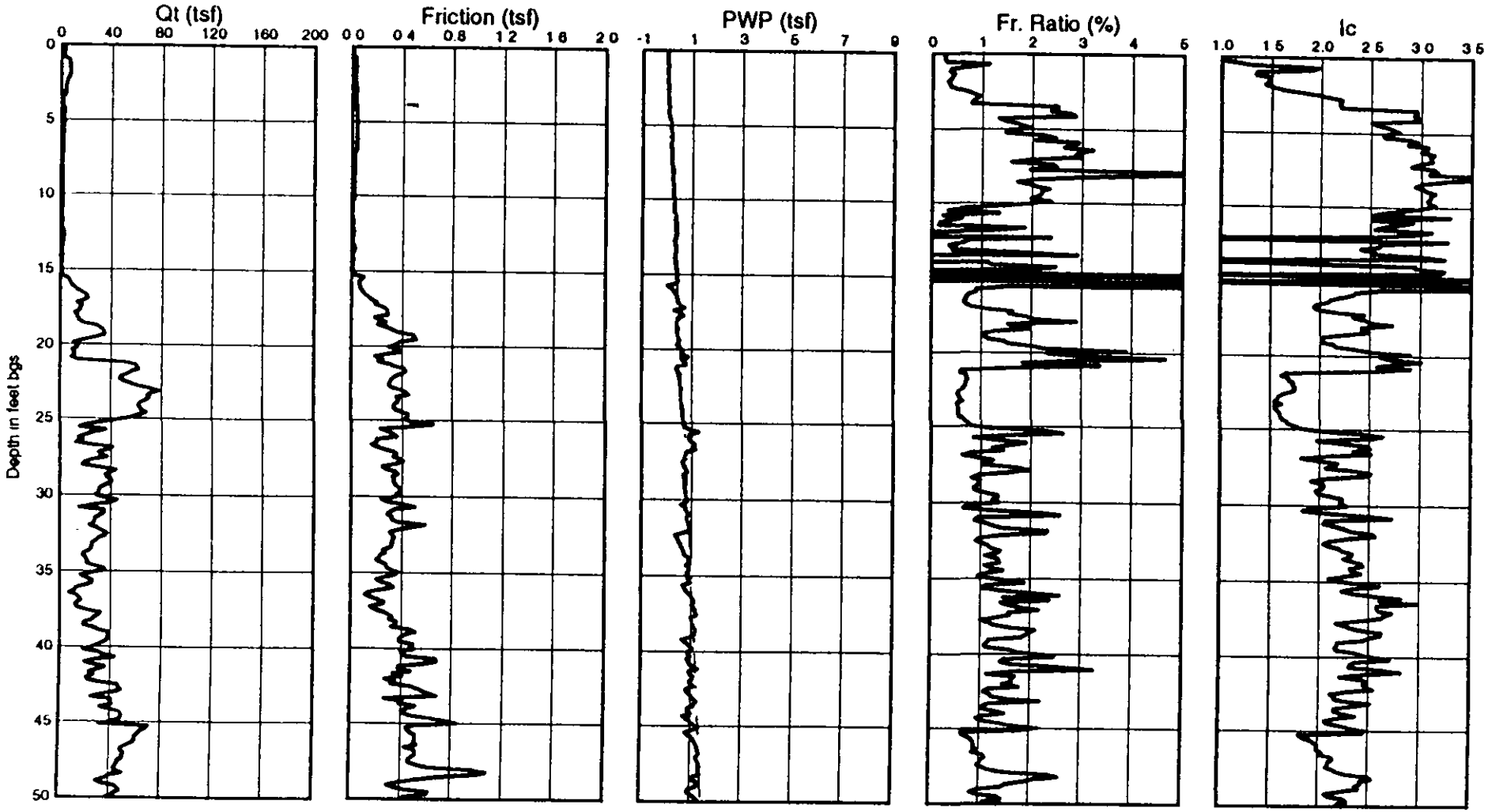
After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

Cone Penetration Test - RA4BH-38

Test Date : Aug 02, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY: Keith Brown

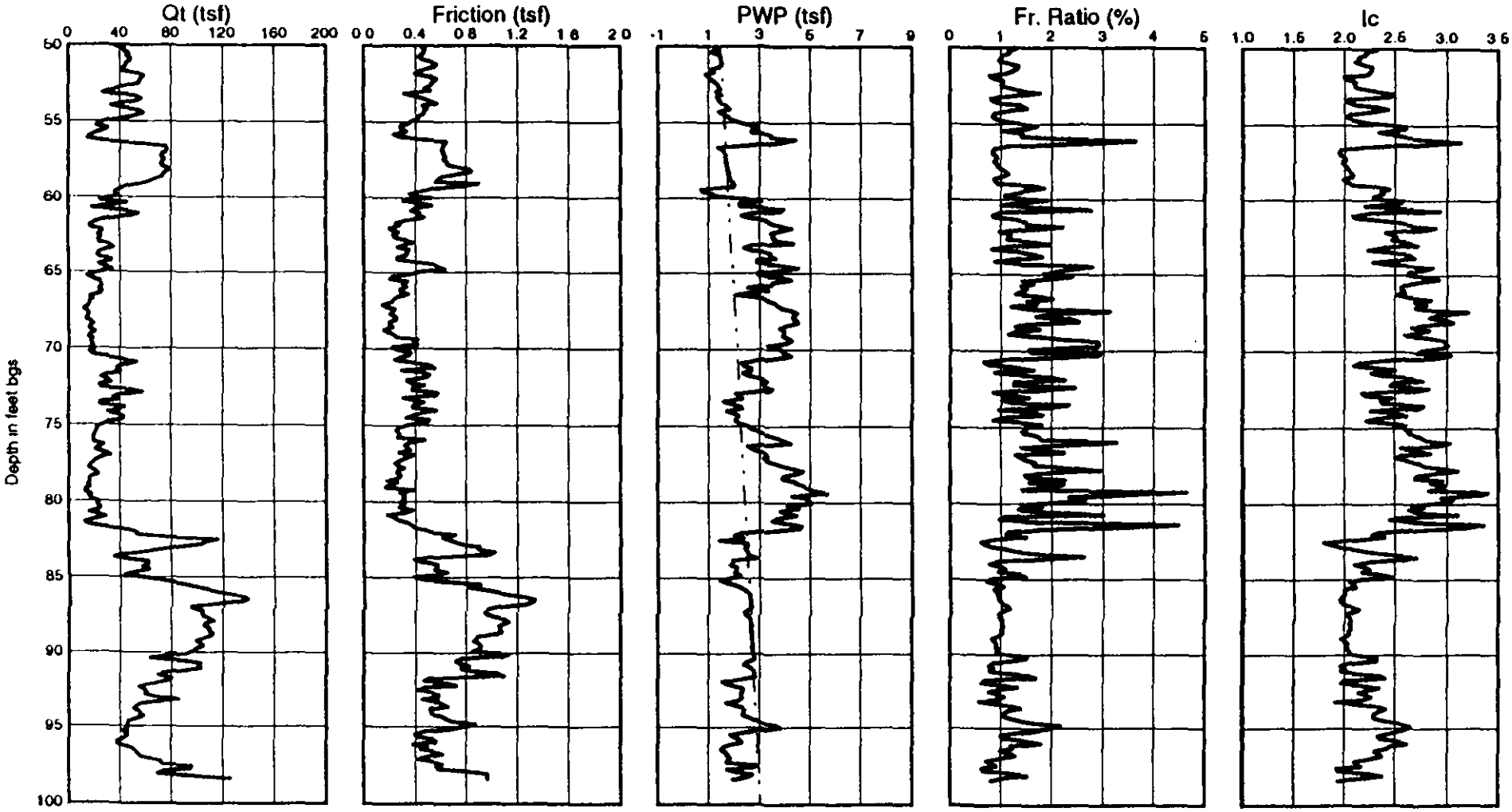
RETEC Inc.

Cone Penetration Test - RA4BH-38

Test Date : Aug 02, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE. August 4, 1996 DRAWN BY: Keith Brown

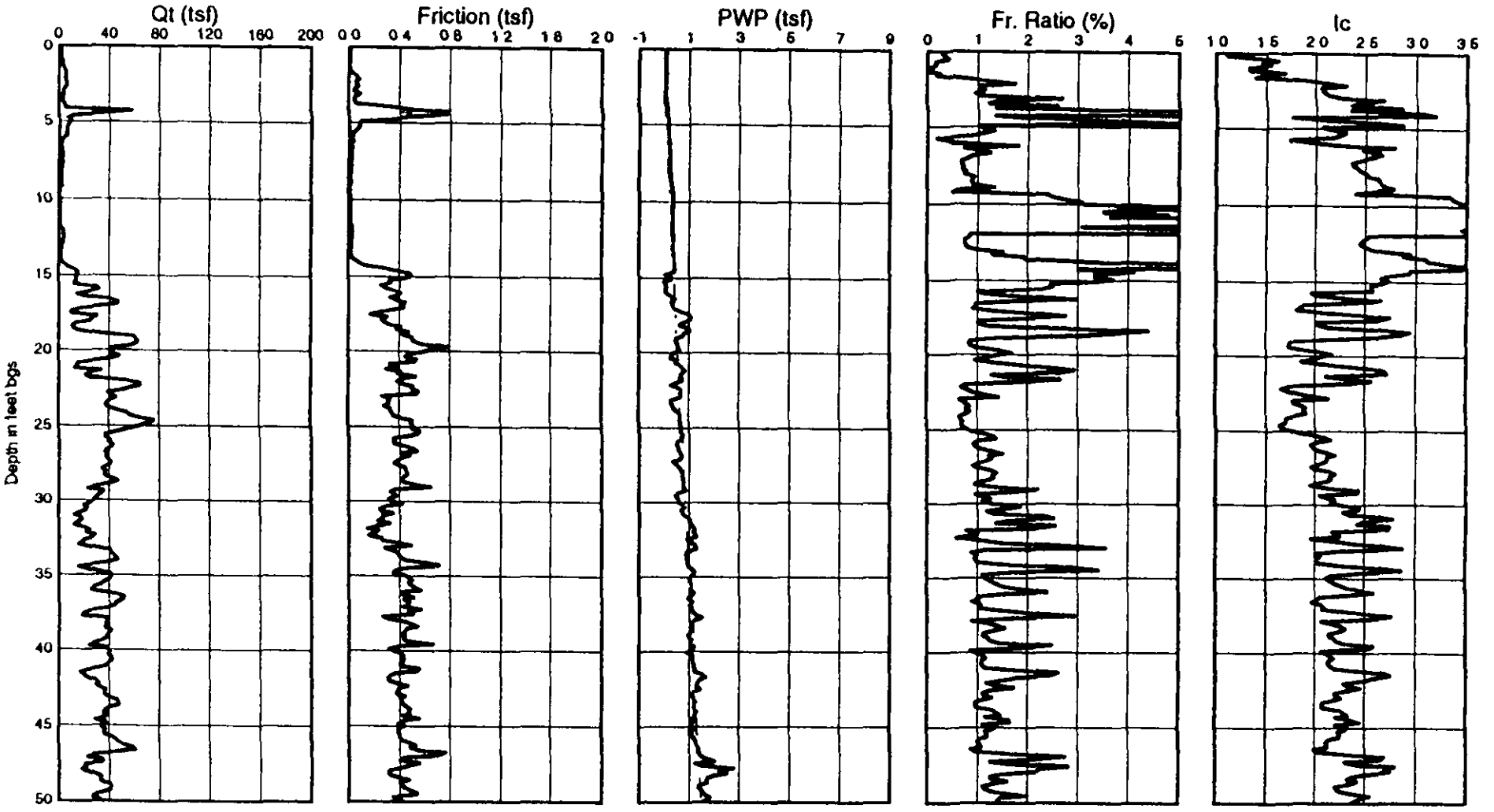
RETEC Inc.

Cone Penetration Test - RA4BH-39

Test Date Aug 02, 1995
Location Puget Sound Resources Site, Seattle, Washington

Operator . Northwest Cone Exploration

Ground Surf Elev · 0 00
Water Table Depth : 3 00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1 25 - Gravelly sands
1 25 <Ic < 1 90 - Clean to silty sand
1 90 <Ic < 2 54 - Silty sand to sandy silt
2 54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3 22 - Clays

PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY Keith Brown

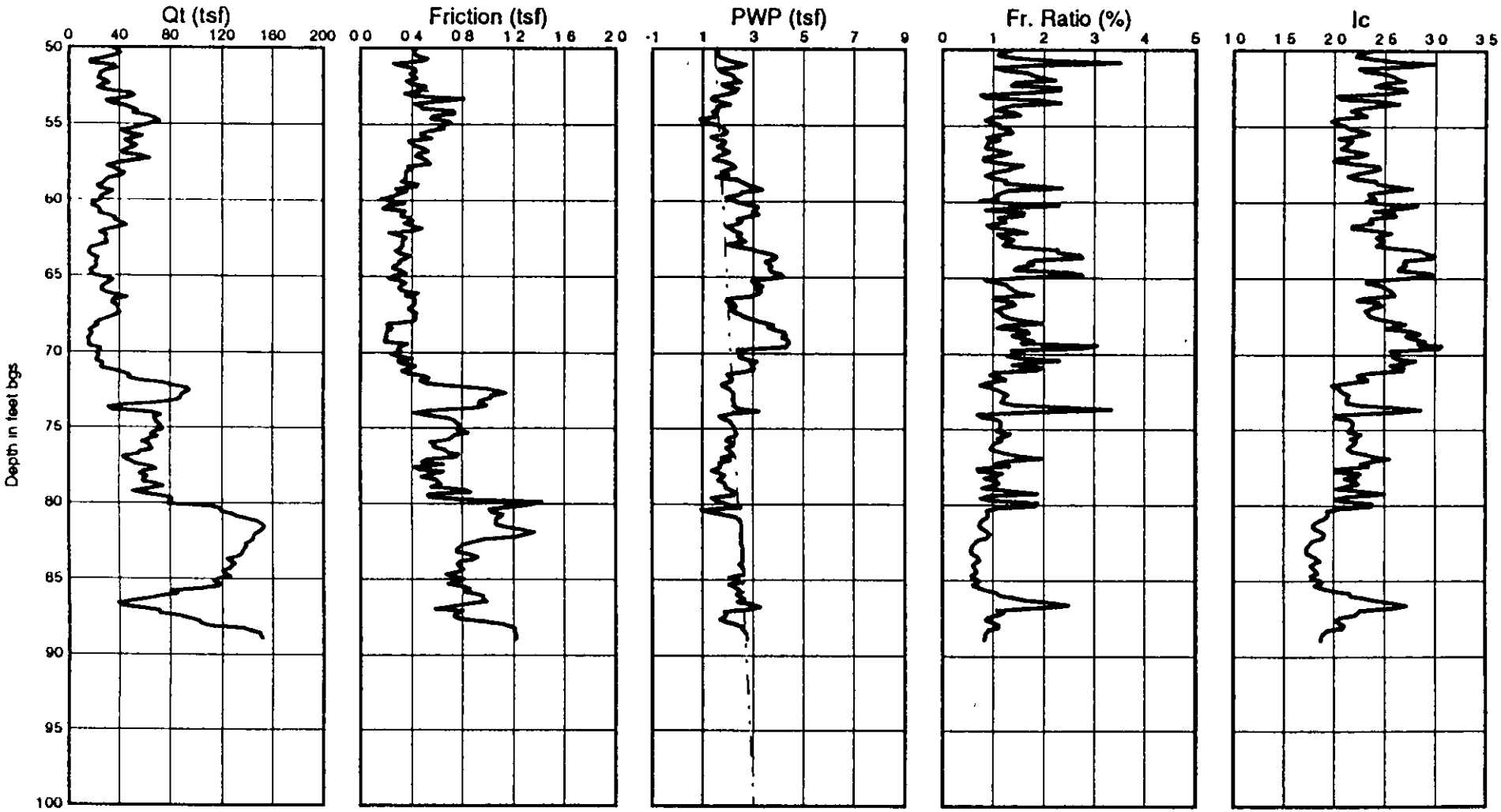
RETEC Inc.

Cone Penetration Test - RA4BH-39

Test Date Aug 02, 1995
Location Puget Sound Resources Site, Seattle, Washington

Operator . Northwest Cone Exploration

Ground Surf Elev. : 0 00
Water Table Depth : 3 00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fr/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1 25 - Gravelly sands
1 25 <Ic < 1 90 - Clean to silty sand
1 90 <Ic < 2 54 - Silty sand to sandy silt
2 54 <Ic < 2.82 Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY Keith Brown

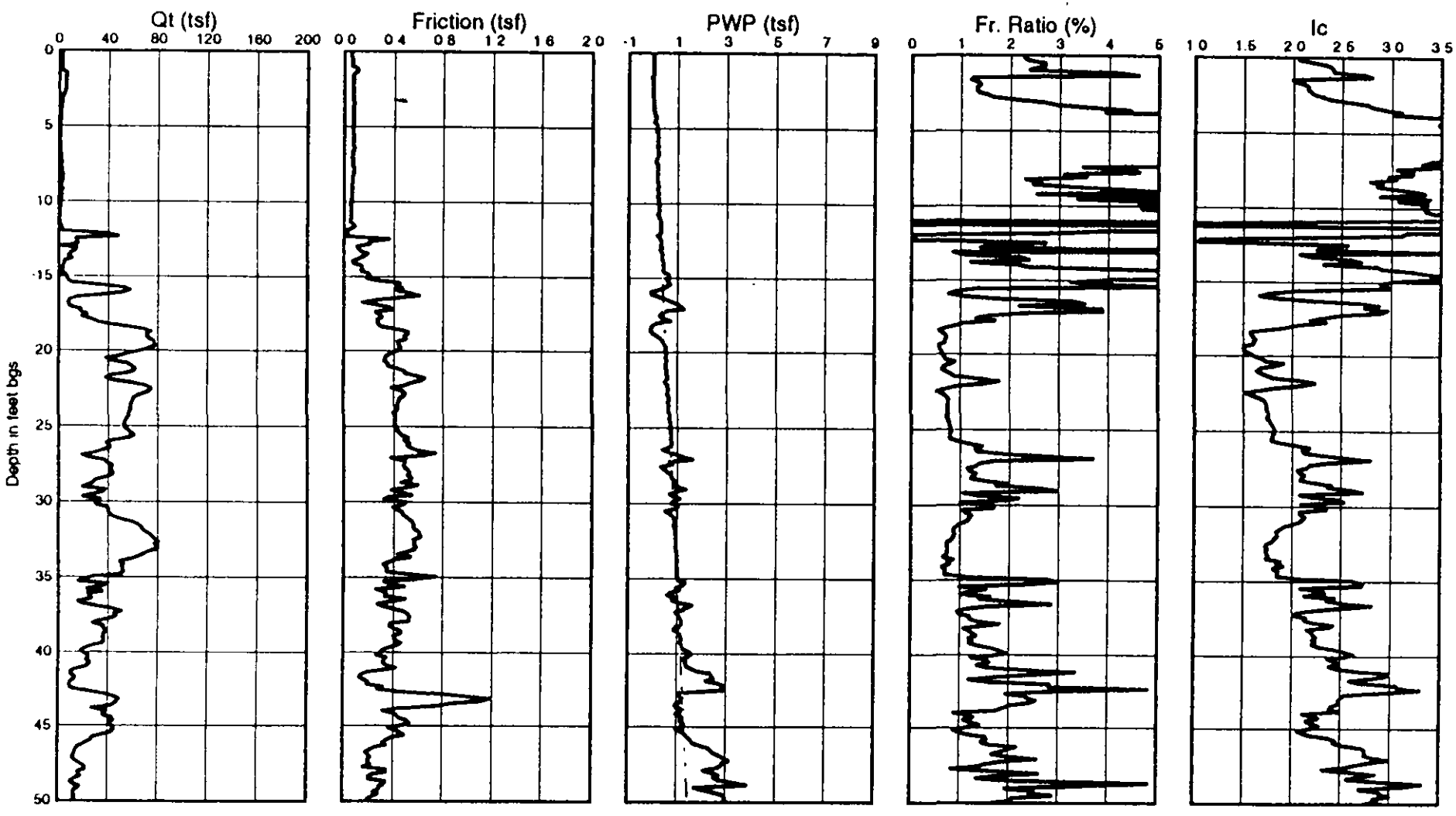
RETEC Inc.

Cone Penetration Test - RA4BH-40

Test Date Aug 01, 1995
Location . Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3 00



Qt normalized for
unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1 25 - Gravelly sands
1.25 <Ic < 1 90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2 54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY: Keith Brown

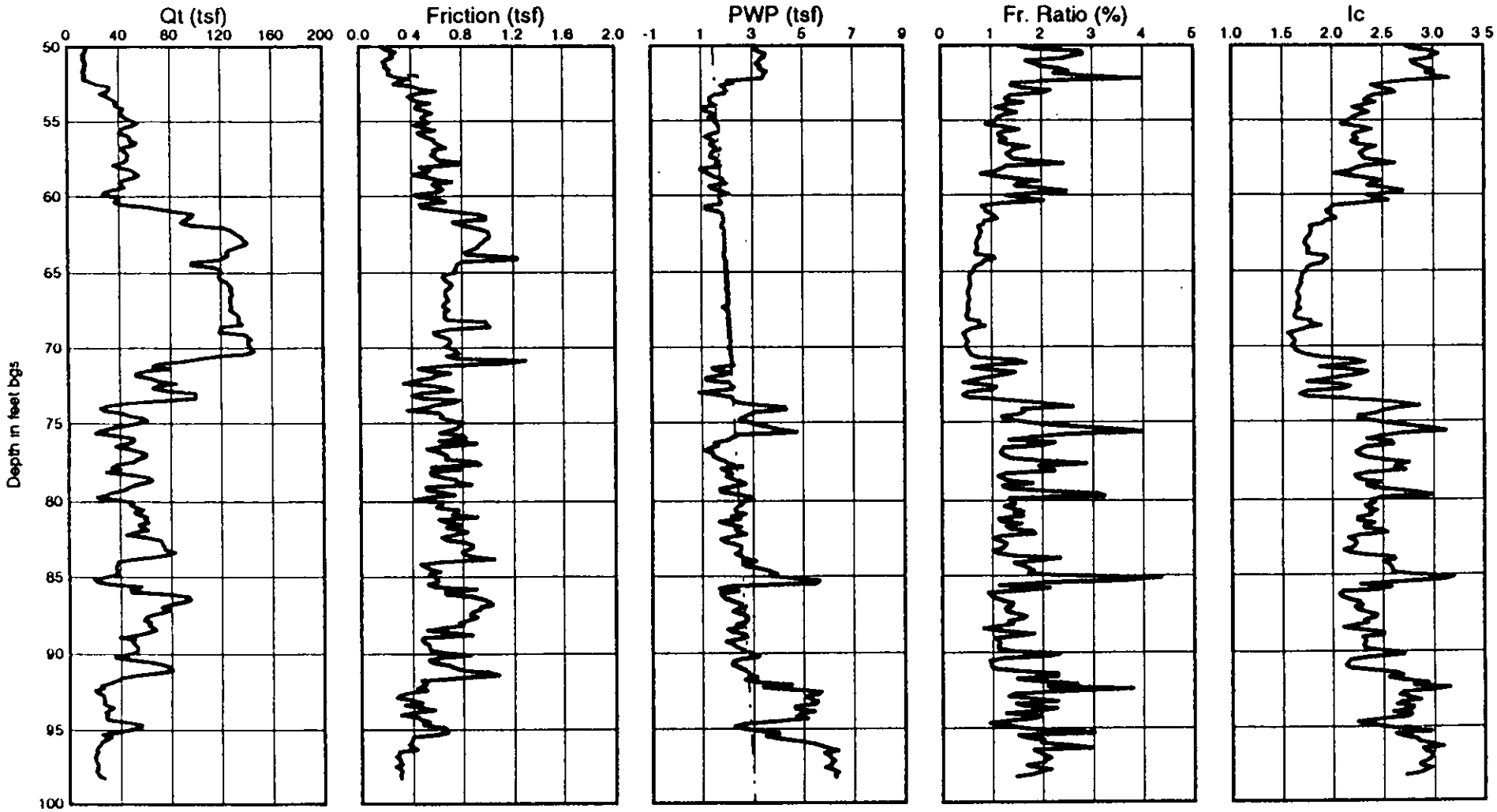
RETEC Inc.

Cone Penetration Test - RA4BH-40

Test Date : Aug 01, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Signav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE. August 4, 1995 DRAWN BY: Keith Brown

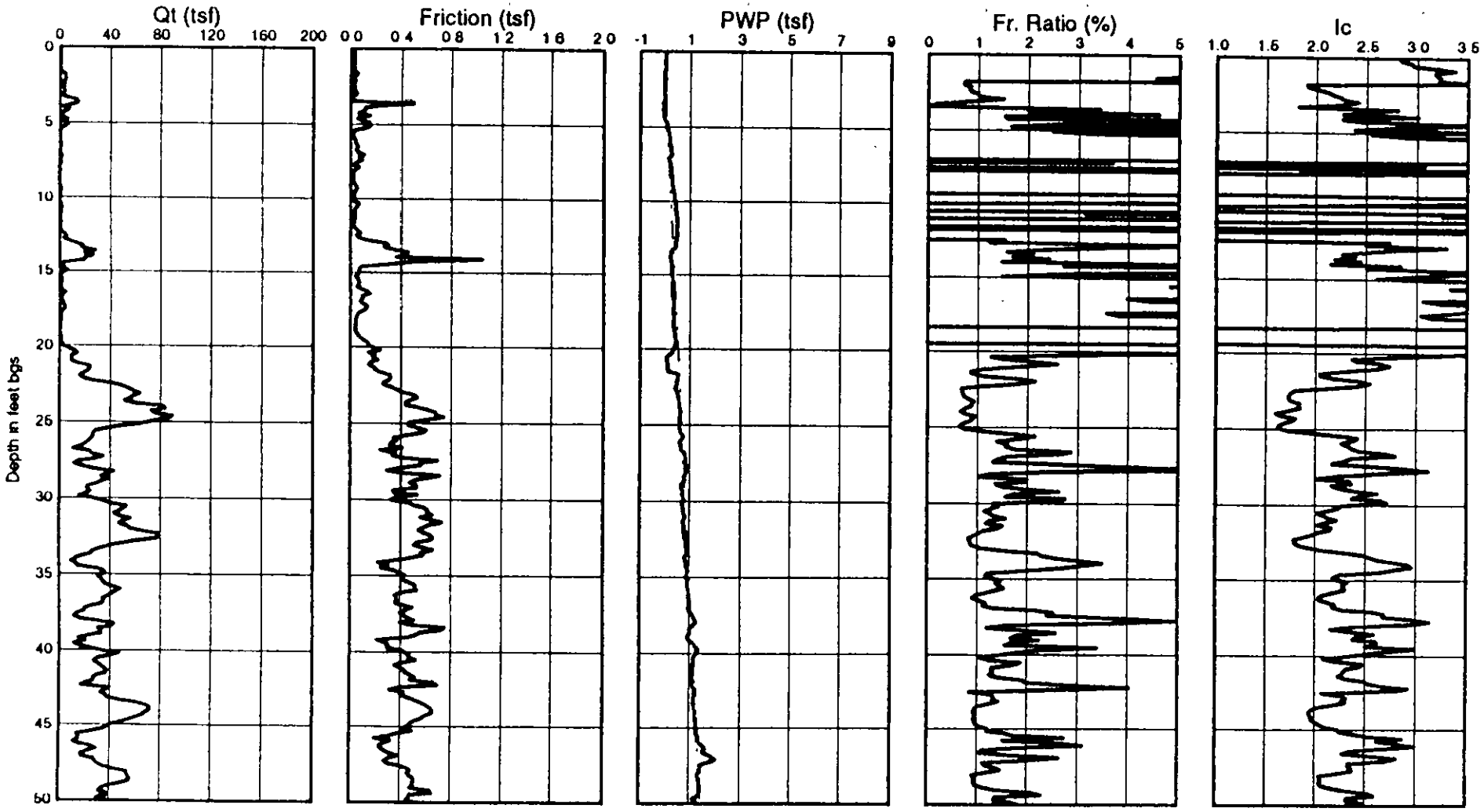
RETEC Inc.

Cone Penetration Test - RA4BH-41

Test Date Aug 04, 1995
Location Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY: Keith Brown

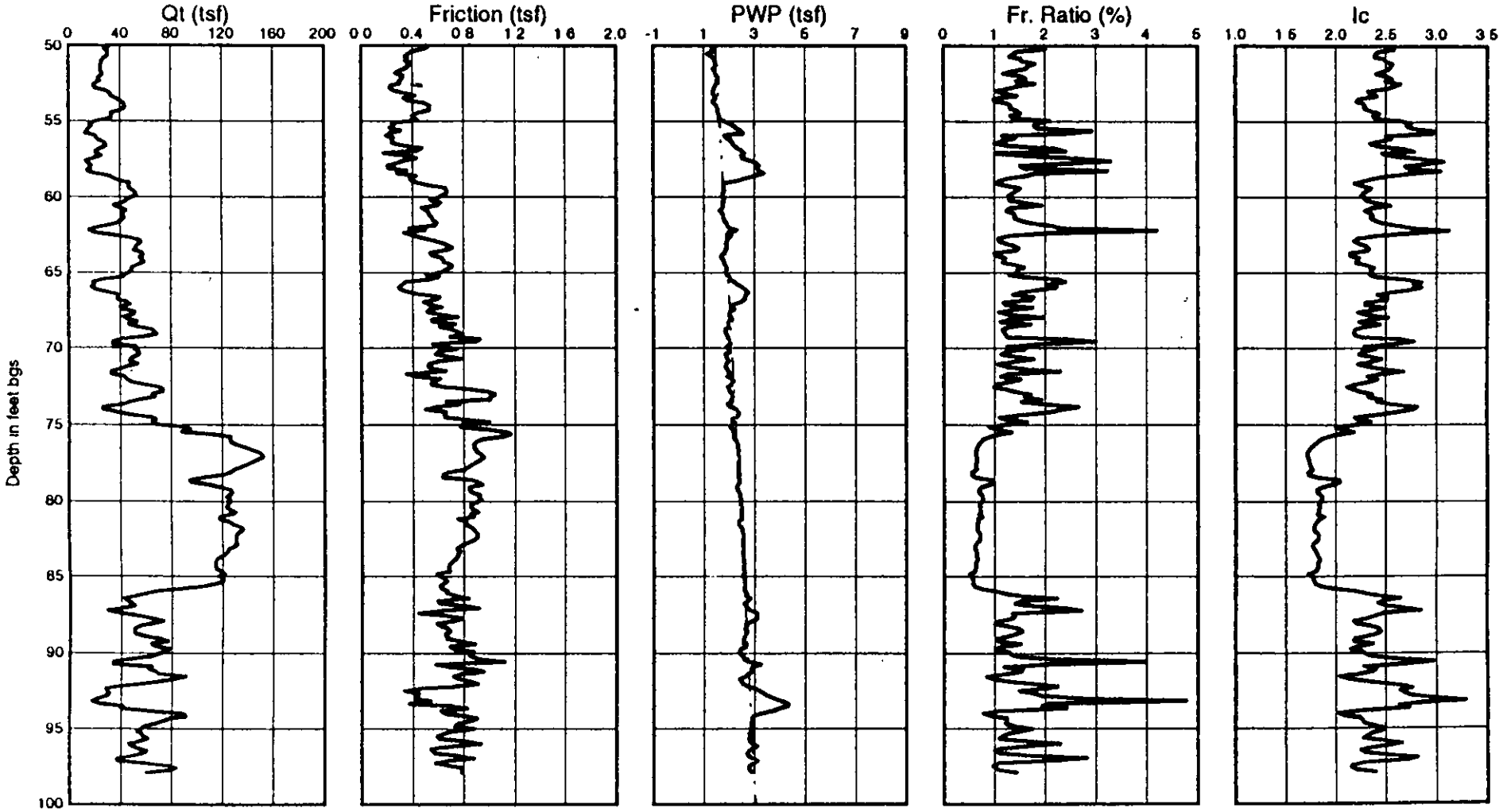
RETEC Inc.

Cone Penetration Test - RA4BH-41

Test Date : Aug 04, 1995
Location : Puget Sound Resources Site, Seattle, Washington

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 3.00



Qt normalized for unequal end area effects

Fr Ratio = 100*Fs/(Qt-Sigmav)
Gamma = 120 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silt clay
2.82 <Ic < 3.22 - Clays

PROJECT NO 3 1335 540 DATE August 4, 1995 DRAWN BY: Keith Brown

RETEC Inc.