

MP000067

TO: Knight Piesold, Vancouver CC: Ministry of Employment and Investment, 90 George Headley, Fax No. 952-0481	FROM: Knight Piesold Ltd. Mount Polley Site Box 12, Likely B.C. Tel: 604-517-0439
DESTINATION FAX NO: 604-685-0147	APPROVED BY: ORIGIN FAX NO: 604-517-0256
ATTENTION: Ken Brouwer	SENDER: KDE / PJP
SUBJECT: Geotechnical Information Obtained from 1996 Borehole Investigation	DATE: July 26, 1996 TIME: 12:00 FILE NO: 1627.F01/F05 REFERENCE NO: 96/026 OPERATOR: pjp
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Ken:

As requested, I am enclosing a copy of the borehole logs (field notes produced by R. E. Graham Engineering), as well as a summary of the drilling methodology and results.

Between July 21 and July 24, 1996, R. E. Graham Engineering Ltd. and Peace Drilling & Research were contracted by North American to drill three 15m boreholes (labeled BH 96-A1, B1 and C1) at three locations along the centerline of the Main Embankment (see Drg. No. 1625.210). Two vibrating wire piezometers were installed in each borehole within the glaciolacustrine unit. Knight Piesold was frequently on-site to observe soil conditions and advise on installation depths for the piezometers. Mr. Jeff Clarke of R. E. Graham Engineering Ltd. will prepare formal drill logs of each of the boreholes.

A truck mounted drill rig equipped with both 150 mm diameter solid stem and 200 mm diameter hollow stem augers was used for the investigation. Standard Penetration Testing (SPT) was conducted using both solid stem and hollow stem augering methods depending upon the soil conditions encountered. A summary of which method was used over the depth interval is presented below.

Borehole	SPT using Solid Stem Drilling Method	SPT using Hollow Stem Drilling Method
BH 96-A1	0 - 4.9 m (16 ft)	4.9 - 15 m (16 - 50 ft)
BH 96-B1	0 - 15 m (0 - 50 ft)	-
BH 96-C1	0 to 7.3 m (0 - 24 ft)	7.3 - 15 m (24 - 50 ft)

Knight Piesold directed R. E. Graham Engineering to perform continuous sampling of the soil in the upper portion (approx. two thirds) of the borehole followed by one sample at 1.5 m frequency below that point. Pocket Penetrometer (PP) testwork was conducted on retrieved samples.

Standard Penetration Testing was carried out using a Rope - Cathead / Safety Hammer Drop System. A 0.6 m (2 ft) split barrel sampler was used. The SPT testing procedure is summarized below for both Solid Stem and Hollow Stem methods.

Solid Stem

This method was usually used at the top of the hole in competent material (i.e. till) where very little sloughing was encountered. After the solid stem augers have been advanced down to the desired elevation, the augers are removed from the hole. The split barrel sampler is connected to the sampling rods and lowered down to the bottom of the borehole. The hammer is gently connected to the sampling rods allowing static weight on the sampler. Often the sampler would advance slightly due to the combined weight of the sampling rods and hammer. The driller would then proceed to gently tap the anvil on the sampling rods 1 to 3 times by raising it 2 to 4 inches and letting it fall. Normally, the sampler would settle and encounter between 1 and 4 inches of sloughed material. Once the sampler was seated within undisturbed material, the sampling rods were marked at 6 inch intervals for 2 ft. The hammer (anvil) was subsequently lifted by hand (exact height not known) with the use of a rope over a cathead and allowed to fall freely. When observed closely, it was noticed that the 30 inch drop height typically varied approx. 2 inches. This procedure was continued at a steady pace until the full length of the sampler had advanced or the sampler reached 100 blows. Once complete, the hammer was lifted off the sampling rod and the sampling rod was removed. The split barrel was subsequently removed from the end of the sampling rod and opened up for sample removal. The augers were reattached in 5 foot lengths and lowered into the borehole. The augers were slowly rotated and advanced into the borehole down through the recently SPT bored out soil interval. Soil samples were occasionally collected from the auger flights. The period of time to complete one sampling period increased with depth due to the time to connect and disconnect 1.5 m auger flights.

Hollow Stem

Hollow stem was normally used when loose or sloughing material was encountered. Much of the sampling method is similar to the solid stem. Only the main differences are discussed below.

Once the hollow stem augers have been advanced down to the desired depth, the drill bit and rods were removed from the interior of the augers leaving an open 4.5 inch diameter hole exposed to the soil at the desired elevation. Some local disturbance from the drill bit could be expected directly below the bottom of the hole. The sampling rod and split barrel is subsequently lowered down the hole, seated and sampled as discussed above. The hollow stem auger system normally possesses a slower advancement rate than the solid stem. The time interval between the end of drilling and the beginning of sampling was not determined, but is estimated to take between 4 and 8 minutes at shallower depths (i.e. 5 to 10 m).

Results

For detailed results, please refer to the enclosed field notes. Logs to follow once received from R. E. Graham Engineering Ltd. However, in the interim, a summary of soil conditions encountered in each hole is enclosed below. Soil description summaries are taken from field notes provided by R. E. Graham Engineering Ltd. Reference should also be made to geology cross sections through the embankment (see Section 1/1625.210 and Section 2/1625.210). Note all piezometers were installed in a filters sand pack contained within a 3 inch diameter geo-sock to prevent blockage of the tip during installation.

BH 96-A1 (center of embankment)

- From 0 to 0.6 m: Intercepted moist, firm surficial glacial till composed of a clayey silt with some sand and gravel. It is estimated that approximately 0.5 m of topsoil and surficial till was removed for drill access. An N value of 4 was obtained.
- From 0.6 to 5.8 m: Approximately 5 m of glaciolacustrine clayey silts with variable very fine sand content normally in varves subhorizontal to surface was encountered below the till. Narrow fine to medium grained sand layers were infrequently interbedded in the finer sediments. Blow count N values for the unit were as follows: 14, 32, 18, 5, 10, 26, 24, and 24 (continuous sampling). A piezometer was installed in a sandier interval within the glaciolacustrine unit at a depth of 2.9 m.
- From 5.8 to 9.1 m, a grey, soft to stiff, wet, non to low plastic silt / very fine sand unit was encountered. The unit appeared to be stiff during drilling, but was observed to be considerably looser during SPT sampling. Blow count N values for the unit were as follows: 21, 11, 1, 0 and 12 (continuous sampling). The N values may be artificially low due to the drilling methods and ground conditions (open hole drilled into confined horizon with slightly elevated pore pressures) and additional investigations will be used to confirm and delineate this zone. Upon examination of the material, it appeared to be consolidated and dense, but it liquified when it was shaken. This unit is likely part of the glaciolacustrine unit discussed above. A piezometer was installed at the bottom portion of the lowest blow-count material (8.8 m).
- From 9.1 m to 15.0 m, a very dense silty, gravelly sand with trace to some clay. The massive, grey-brown unit is believed to be basal till. Non plastic silt layers were also intercepted from 12.3 to 12.6 m. Blow count N values for the unit were as follows: 100, >70, 100, >70, 74, >100, >100, 90 (1.5 m sampling).
- Slight artesian groundwater conditions were encountered when removing hollow stem augers. No information is available as to which unit it is attributed to.

BH 96-B1 (left abutment)

- From 0 to 4.9 m: Intercepted moist to wet, firm to very stiff surficial glacial till composed of a clayey silt with some sand and gravel. The composition of the till varied from clayey to sandy silt with infrequent, interbedded narrow layers of varved silt or fine to medium grained sand (glaciolacustrine) material. Blow count N values for the unit were as follows: 5, 30, 34, 45, 31, 40, 21, and 46 (continuous sampling).
- From 4.9 to 16.5 m (EOH): Below the upper till, greater than 10 m of glaciolacustrine and finer glaciofluvial soils were encountered. The cohesive unit appears to vary from stiff to hard and is likely overconsolidated. The unit is composed primarily of layered to varved low to moderately high plastic silts which grade into silty clay and silty sand. Occasional narrow water producing, fine to medium grained sand (with some silt) seams were interlayered with the silt. A more extensive sand rich unit was encountered from 7.3 to 8.3 m in which a piezometer was installed. Blow count N values for the unit were as follows: 46, 64, 41, 86, 61, (continuous sampling), 49, 100, 66, 84, 72, and 62 (1.5 m sampling). A second piezometer was installed in the bottom of the hole at 15.0 m.
- The installation of the piezometers was hampered by thick slurry water restricting the downward movement of the sand and bentonite. The lower piezometer was successfully installed, however, because the borehole was also squeezing in at the upper sandy section, the hole was backfilled with bentonite and abandoned. The second piezometer was installed in another borehole 2 m away within the sandy unit.

BH 96-C1 (right abutment)

- From 0 to 4.9 m: Intercepted moist, firm to very stiff surficial glacial till composed of a clayey silt with some sand and gravel. The till became more sandy below 3.0 m and was more homogeneous than BH 96-B1 but still contained infrequent, narrow layers of fine to medium grained sand (glaciolacustrine) seams below 3.0 m. Blow count N values for the unit were as follows: 3, 29, 29, 48, 267, 28, 52?, and 44 (continuous sampling).

- From 4.9 to 8.4 m: Approximately 3.5 m of moderately plastic glaciolacustrine clayey silts with variable sand content was encountered below the till. The glaciolacustrine unit graded from silty clay with occasional fine sand in varves to sandy silt at depth. The upper piezometer was installed in a sandier, water producing section at the upper glacial till / glaciolacustrine interface. A non to low plastic silt / fine grained sand unit (similar to the "sensitive silt unit" in BH 96-A1) was encountered just above the basal till from 7.3 to 8.4 m. The lower piezometer was installed within this material. Blow count N values for the unit were as follows: 23, 24, 18, 28 and 20, (continuous sampling).
- From 8.4 m to 15.4 m, a very dense silty, gravelly sand to sandy silt basal till with trace to some clay was encountered. As with BH 96-A1, non plastic silt layers were also intercepted from 12.0 to 12.5 m. Blow count N values for the unit were as follows: 50, 84, 76, 75, 74, 59 (silt) and 92 (1.5 m sampling).

Based on the above borehole information and previous geotechnical data, the following points can be made:

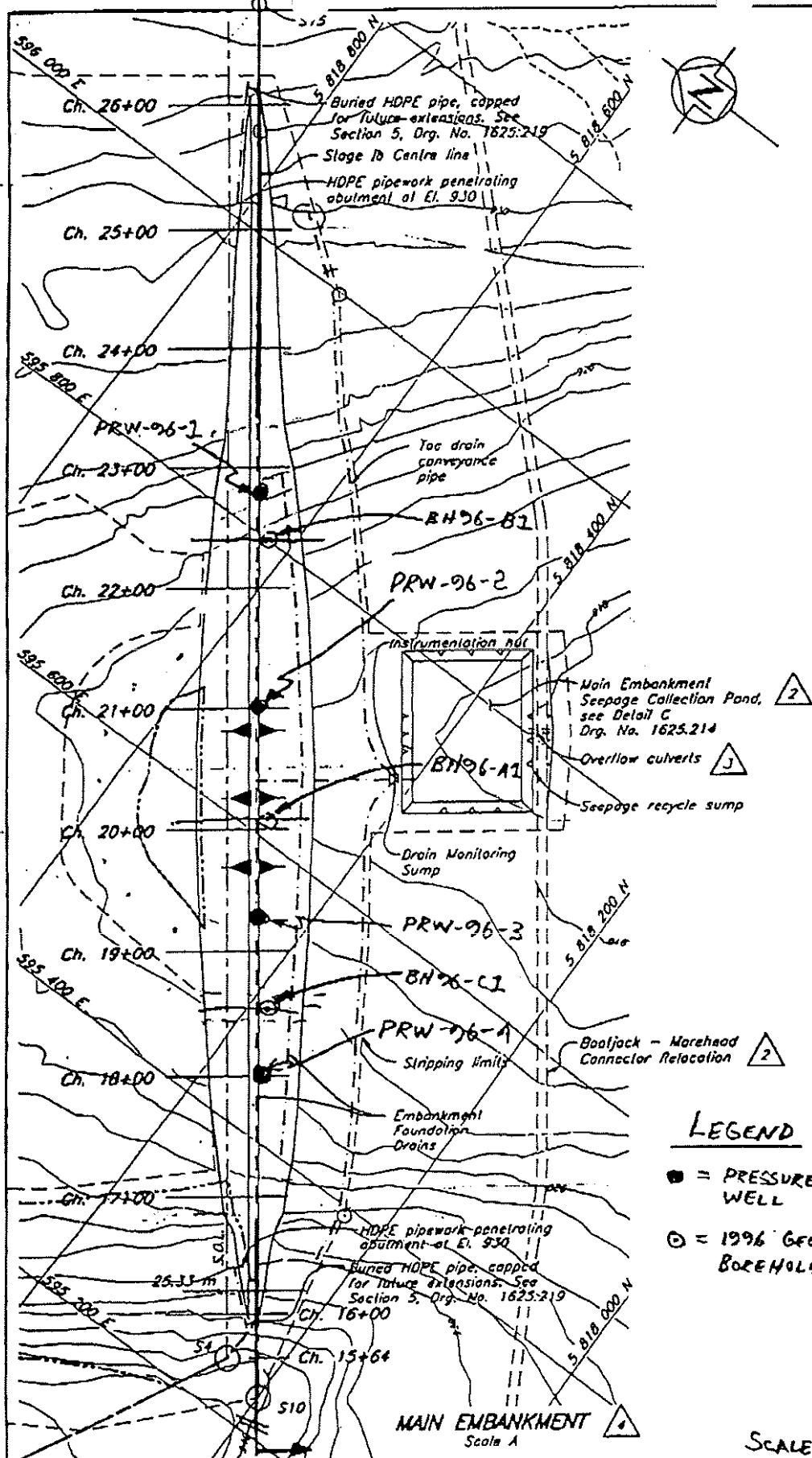
- The upper glacial till extends across the embankment alignment, as determined from testpitting. However, the material is fairly soft ($N = 4$) and thin (<1.2 m) in the middle of the basin.
- The glaciolacustrine sequence appears more highly consolidated on the right abutment compared to the rest of the area. This is likely related to the thinning of the surficial glacial till unit in this region. The sediments may be overconsolidated below BH 96-A1 and BH 96-C1 as they are in BH 96-B1.
- The non plastic "sensitive" silt / fine sand unit appears to directly overlie the basal till unit in BH 96-A1 and possibly BH 96-C1. Unfortunately BH 96-B1 (drilled first) was not drilled to the basal till and therefore its east lateral extent is not known. Driller reports indicated that the "sensitive" silt unit was dense to drill, but low SPT blow counts were obtained. This softening effect may be due to the combination of reducing confinement on the material (removing soil column above it through drilling), elevated pore water pressures in the unit and drilling disturbance.
- Further investigations are recommended to better define the geotechnical properties of the "sensitive" soft silt / fine sand unit and for delineation purposes. A Cone Penetration Testing program is being arranged.
- The piezometers are currently being read to determine the groundwater levels in the embankment foundation soils prior to fill placement. All piezometer readings taken to date indicate elevated pore pressures in the sandy units. Piezometer A2-PE2-01 (the tip in the low N-value material) is shown artesian conditions, with the water level approx. 1m above ground surface, as shown on the attached sketch.

If you have any further questions regarding the above information, let us know.

Regards,



Peter Procter



LEGEND

- = PRESSURE RELIEF WELL
- = 1996 GEOTECH BOREHOLE

JULY 25/96

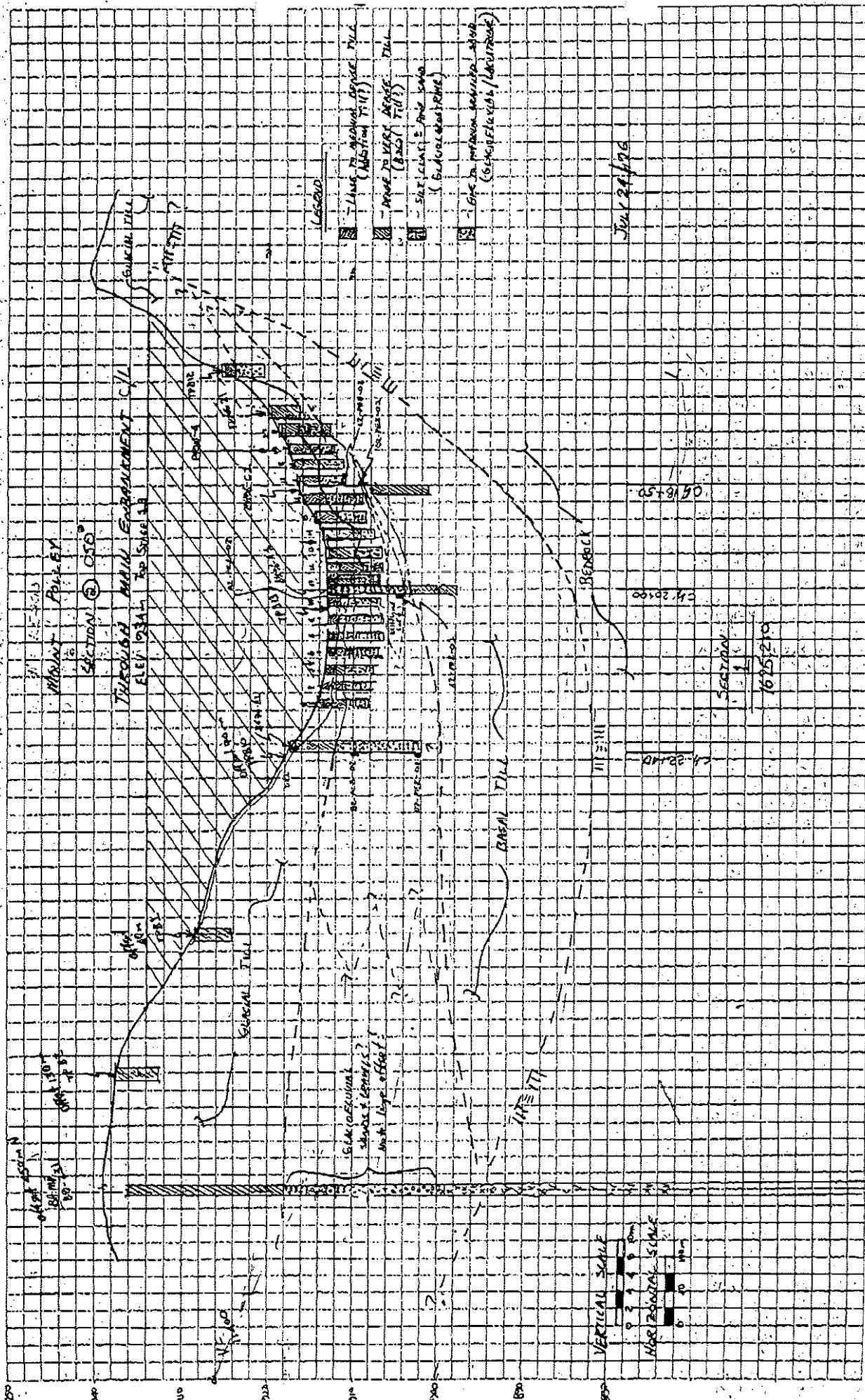
Drg. No. 1625.2

SCALE
0 25 50 75 100m

1625.202	TAILINGS STORAGE FACILITY - FOUNDATION PREPARATION AND BASIN LINER - SECTIONS AND DETAILS
1625.214	TAILINGS STORAGE FACILITY - SEDIMENT CONTROL AND SEEPAGE COLLECTION - SECTIONS AND DETAILS
ORG. NO.	DESCRIPTION

4	MAY 24/96	ISSUED FOR CONSTRUCTION
REV.	DATE	DESCRIPTION

REVISIONS



(1) R.R. GRAHAM SURVEYOR - LRA.

J-1245

NORTH AMERICAN SURVEYORS LTD. - POLLEY

BEST WISHES

96/03/21 - 24

JSL

JUL 26 '96 03:13PM MOUNT POLLEY MINING

P.9/21 9 of 21

(1)

Spr C-6'

23/23/23/28

N=45

Fall Rec.

96-B1 - Silty sand - Spr. C - d - 2'

0-15' - Silty sand - 1/2/3/5

Silt (red), 16/17, side - N=5

18/19, side - PP = 75-100

sand, some fine to silty

and gravel, brown

slight weathering, moist

soil sat.

most fine, dark brown 2'

N=30

A Fall rec.

gravelly silt 2-4'

17/14/16/20

soil sat.

Spr C-6'

16/16/18/23

N=34

Fall Rec.

soil sat.

(2)

(4)

A.32
15' 11" - 24' 0"
SPT C 16 - 18'
H. very dense to fine sandy 16/19/24/31
SPT, same fine sandy N=46
dense, non-plastic, no
fine Rcc

Specular, gray, damp
for sand
recalculated

- Warren in top 2" of layer

SPT C 18 - 20'
- 1.5' of water in
bottom of hole, density N=64
same sand sample 15.10 - 300cm Rcc, + strong
plasticity, no fine Rcc

SPT C 20 = 22'
- slightly clayey, low
plasticity, no fine Rcc

with occasional fine
sand in gravel

SPT C 22 - 24'
- fine sandy, no
plasticity, no fine Rcc

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250 - 260 + slope

(5)

24' 0" - 27' SPT C 24 - 25.5
Sands, fine grained,
silty, dense, gray,
wet. i. probably water - full Rcc

27' - 54' SPT C 26.5 - 28'
damp, medium sandy
dense, low plasticity,
N=42
Slight varved structure, fine Rcc
gray, moist -
- 2' water in hole

SPT C 27 - 30.5
- alternating silt, sand
<6" wide for the rest, sand
layer(s), wet, thin
- organic layers

27' wide for the rest
<6" wide for the rest, sand
layer(s), wet, thin
- organic layers

silt w/ sandy zones & thin
layers, sandy occasional wet
holes

JUL 26 '96 03:14PM MOUNT POLLEY MINING

P. 112912

(6)

Silt, sandy, ~~13:45 - 1:30 AM~~
plasticity, slight
moderate structure,
moist

Soil test - 13:45 - 1:30 AM
Wet - 10' to very active crust
soil - sandy, silty-clayey, D_e 33'
plastic, hard gray.
modest.

SPT C 39 = 49.5'

at 10' = 20m thick 17/34/50
sand & lenses in
sand & lenses in
soil

41 - 42.5', clay
silty, plasticity, hard, DC 42'

occasional white sand
seams (e.g. gravel) from
42.5' - 54'

41 - 42.5', clay
silty, plasticity, hard, DC 42'

51 - 54', sand
white sand
50' - 10' depth

20.312

varied, silt, clay SPT C 44 - 45.5'
a fine sand w/ N = 72
~ 10mm. white veins
gray-brown, nodules
20 mm thick laterite
(water percolating)
seams brown - 45.5'

mean 46 - 49' (incl.
plastic, silty, clay, gray - D_e 47'
brown w/ frequent - silt
laminations, very stiff
(no water veins).

not MP - moist (no contact)

SPT C 49: 50.5'
void, stiff, white - 19/20/34
sand - clay
(single ditch in sand, full hole
not MP - moist (no contact))

clayey
Faint - streaks = 5-10 cm, clayey
pebbles, - white, Fluoro. White
300 - 100 mm
300 - 100 mm

Faint 51 - 54', sand, white, low
MP - 10' depth

DE 53
30.312

(9)

B2 - P22-01

Area of Hole A 54'

Cessate from 15' to

24' - 23', 4' later

Observations boulders - glacial 23',
unit

unit

Stages - Research - Indication @ 5' per

- Indications B2 - 01, but cannot GSI

- Goss - Glacial SIC - 100' - glacio - because

- 100' thick at a locality in hole

→ LTR: hole still overburden

Finish: #3: Aire Et Cane C 9.30pm

96/07/22.

Start: 11:00 AM @ 7:00 AM

- Core: B2 - P22-01 Erosionary, scree

- Settling on one occasion, from C 40'

- Hole sonde in C 19' - mud 165'

To bottom of hole 165' - mud 165'

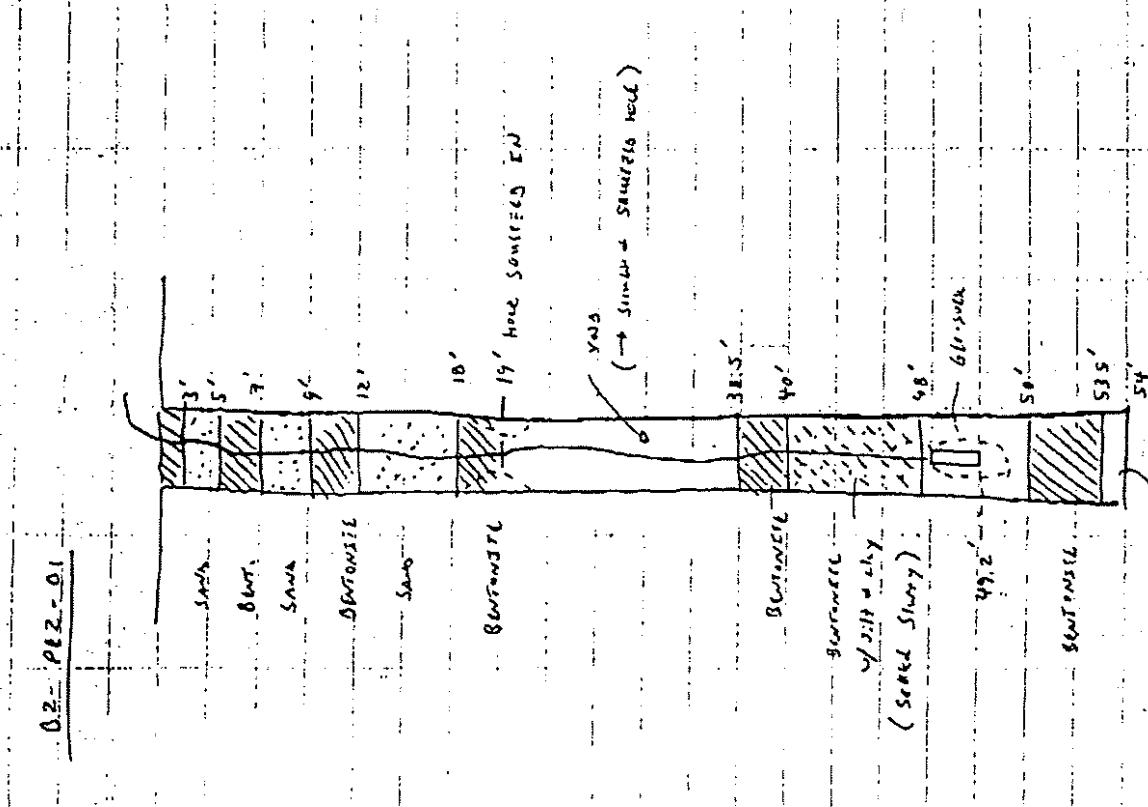
Elass, JHSW, DLSW, RMBW, RMBW

of hole 17TH Blower still in same

Mud to plane A

JL DRILLING CORP
TACOMA, WA 98401

No. 312



(9)

(10)

STC1A

- Confession w/ Ian Gordan - 96/07/12
- Q. Did Ian know Mac Phail (Race car) was
- TPA knew Smith, strong conversance about for sale.
- Asked him what he did best Essex PBC
- For projects or source of money at under
- TPA says very unknown we were lost
- D. Rob done id
- (1) base in time a passive investor
- Size of companies involved with
- Equilibrium i.e. cigarette (surface)
- (2) Acquired via low pressure, -
- Se as option and if Range (or 100 plus)
- d. Tim and Alfonso ~~the~~
- Summary when she brought
- Total fact we were plus by ~ 15 ' 11.00
- He said cost transparency is
- changes in stock - first ask
- desire installation is base side, new
- land area - after installation
- service and add good agricultural
- designation, such session
- business term

- (10)
- deposit @ string surface
in our hole (close to same end as top of hole)
 - 96-Al (Plant A) Section A 10.30 AM
 - 0 - 2' 2" SPT C 0 = 2'
 - 2' 2" - 19' SPT C 2 = 4'
 - 2' 2" - 19' fine fine sand, some silt, clayey, some sand, fine to medium, N=4 gravel, brown, moist. Full Res.
 - slight orange staining to
 - SPT C 2 = 4' in hole < 10m - 5/6/3/11
 - Silt, clayey, no red, varied structure, low to full Res.
 - Int. plasticity, brown, moist. SPT C 4 = 6'
 - 20/16/16/20
 - from 4.5' depth N=32
 - 2 - 100cm thick - Full Res.
 - estimated, due to initial soil - large products
 - from 5-6', frequent variability tree, do not sand layers (< 50mm thick), marsh.
- * ~ 0.45 m cut C until 10.11.1

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(6)

JUL 26 '96	16:25	Strat A 6-8'	Silt, fine sand, slightly wavy, N=12	Fn Rec.
		thin intercalations fine sand in ironed	bedded	
		- From 6' 0" - 8' fine to / square	bedrock, rock, silt, 3/2/3/0	
		and sand layer, silt, 3/2/3/0	interbedded & water protected clay	
		N=5		
		- From 8' - 10' silt, 3/2/3/0	Fn Rec.	
		thin 8' - 10' fine and, interbedded, water protected	bedrock, sand, silt, 3/2/3/0	
		thin layer, 8' - sand, silt, 3/2/3/0	plastic, silt/clay, wavy, 3/3/3/9	
		N=10	w/ fine sand in wavy	
			strong, wavy, bedded	
			to sand	
			12-14' fine sand	
			3/3/3/9	
			16/12/14/19	
			at ~ 20mm spacing, wavy, gray	
			bottom, sand	

JUL 26 '96	16:25	Strat C 14-16'	Silt, very wavy, 6/10/14/18 occasional fine sand, iron wavy N=24	Fn Rec.
		bedrock, hollow, angular, 0/16'	switched to hollow, angular, 0/16'	
		15' pied for back from 12:15' - 12:45pm	15' pied for back from 12:15' - 12:45pm	
		From 16.5 - 18.5' SPC. 6/16/18/	From 16.5 - 18.5' SPC. 6/16/18/	
		low - 40' w/ plastic, 5/n/13/16/	low - 40' w/ plastic, 5/n/13/16/	
		clayey silt, very soft, N=24	clayey silt, very soft, N=24	
		(pp: 225-325), varied, Full Rec.	(pp: 225-325), varied, Full Rec.	
		gray - brown - wavy	gray below 19'	
		from 11-21', iron	from 11-21', iron	
		ln. low - plst. gray	ln. low - plst. gray	
		5/16/15/0	5/16/15/0	
		soft Rec.	soft Rec.	
		5/16/	5/16/	
		gray, plastic, iron	gray, plastic, iron	
		3/3/B/B	3/3/B/B	
		solid iron	solid iron	
		5/16/	5/16/	
		gray, brown	gray, brown	
		12-14' fine sand	12-14' fine sand	
		3/3/3/9	3/3/3/9	
		16/12/14/19	16/12/14/19	
		at ~ 20mm spacing, wavy, gray	at ~ 20mm spacing, wavy, gray	
		bottom, sand	bottom, sand	

28-6

Rods save from 24-25' SPC 24-26' 24-30'
wavy, iron wavy, 0/16/1/6
- very wavy, sand, 1/6/1/6
Fn Rec.

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(14)

soil white SPT C 26.5 - 28.5'
water table about 0/10/10.
N=0
400 - Rec.
water over W.T. x D/4/8/7
at above
SPT C 29 - 31
water over W.T. x D/4/8/7
soil (1st), silty, gravelly
loamy fine sand, very
loose, grey-brown, moist

32 - 50.5' SPT C 31.5 - 33.5'
11/61/59/
N 2/100
13' pebbles & s.a.
5' Rec.

SPT C 34 - 36'
>30/-1 = 0.5'
5' Rec.
- long drilling

SPT C 50.5' - next
Water bearing zone /
D/4/8/7
at noted above
breccia

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(15)

not gravity them per
Top 3' of sample is 16/58/7 42'
non-plastic silt, thin fine N>100
sand just below this is 1.2" per.
sand (fine), gravelly, some 1.2" Rec.
silt, very fine, brown, biggest gravelly
material

From 40' 3' to 41' 9' +
non-plastic silt layer
SPT C 44 - 45.5'
7/11 sand, pale fine 22/66/7 12'
14" per.
14" Rec.

SPT C 49:50.5'
7.41 - 8.00 8/20/50
N=90
Full Rec.

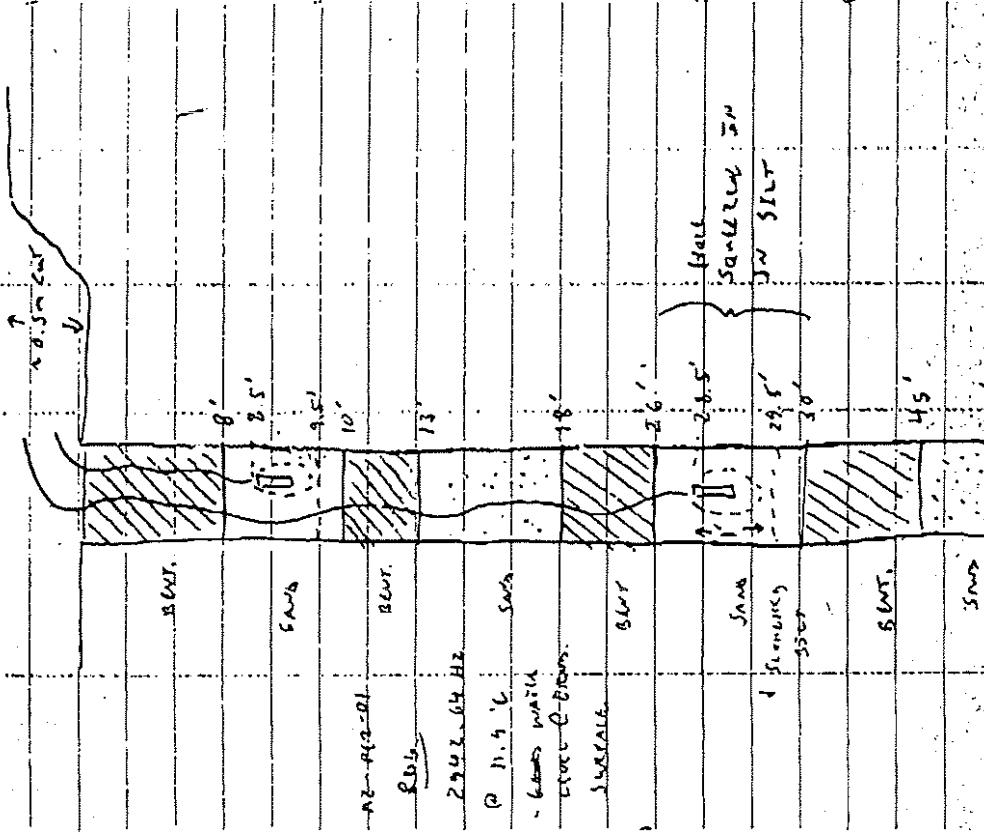
SPT C 50.5' - next
Water bearing zone /
D/4/8/7
at noted above
breccia

gravelly debris C 4:45pm 1. Since 6
D/4/8/7

(16)

AZ - PL2 - 01

Concretes... AZ - PL2 - 01
C... 8.00 - m... draw in car C by 40 ft



96/07/23

Start : Draw from car C - 7.00 AM

Stages... AZ - PL2 - 02 - INSTALLED C 3:40 AM

- INSTAL. TAB : 306.9 - 42. H2 - C - 14.6' L -

WATER C - 6000 - SURFACE

PILL... AZ - PL2 - 01 CALLS - CAVES SLIGHTLY BY

HELL RIVER WHICH IS IN DRAIN AND CALLS

JAMES - SICKLE - REQUEST : 29.3. & 2.10.2 -

@ 3.3' C... - CRANE IN C - 12.50 AM

Concretes... INSTALLED C 7.145 AM,

MATERIAL = TO PLATE C - STAGERS

DRAWING C - 10.00 AM

NO.312.

(1)

+ Average 0.5m Core Hail core/core

Soil profile

96-C1 (1st core)

SPT C 0 - 2'

0 - 16'

SPT C 16 - 23'

N= 3

Silt (crust), slightly sand, several fine to med. gravel/gold to gold

yellow, brown/marshy

brown & grey w. slight case

orange mottling in top 2'

Full Rec.

8 / 19 / 15 / 18

N = 29

Faster Rec.

N = 29

SPT C 4 - 6'

5 / 14 / 15 / 17

Full Rec.

N = 48

SPT C 6 - 8'

16 / 20 / 28 / 24

Full Rec.

N = 48

SPT C 16 - 18'

4 / 10 / 13 / 16

Full Rec.

N = 48

SPT C 16 - 18'

4 / 10 / 13 / 16

Full Rec.

N = 48

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(20)

16 - 21' SPT C

Clay, silty & sand with occasional
fine sand & small, vines
~ 10' max thick, very stiff to
hard, moist, at. plasticity

SPT C 18 - 20'

2" thick fine-grained
silts, some fine sand & silt
at 18.6", wet

Dp: ~ 450

J.L. DABUR INC. CORP.
REG'D. IN U.S.A.

SPT C 20 - 22'

below 21', thin to
low plasticity silt,
local, varied structure,
moist to wet

Dp: ~ 275

SPT C 22 - 24'

some fine sand
to fine sandy,
soil plasticity brown,
calcareous - dolomitic
desiccated soil

Dp:

16 - 21' SPT C 24'

fine sand to yellow, vines
~ 10' max thick, very stiff to
hard, moist, at. plasticity

SPT C 24 - 25.5'

below 24', gray, sensitive
4/9/ii
N= 20
full Rec.
~~27.5 - 29.5'~~

SPT C 26.5 - 28'

Sand (true) & gravelly
silts, n gray, moist,
dune
N= 450
full Rec.
(biggest separation)

SPT C 29 - 30.5'

13/42/42
N: 84
full Rec.

SPT C 31.5'

some gravel
9" pa
9" Rec.

SPT C 32.5 - 33.5'

24/26/-
N= 76
full Rec.

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(21) Test run parameters - Block 1 insulation test:

SER 0 35-36.5' 1
 25/48/22
 - bedding grain 18" pebbles
 - contact depth N > 7.5
 14" thick.
 SER 0 39-40.5'
 11/30/42
 from 39.5 - 41'
 H = 74
 SER + non-pelitic gray, fine, Rec.
 rec. - no obvious
 diag. Jephnky)
 structure

below 41', same structure, SER 44-45.5'
 as at 27.5'
 @ 44' 3' so thin that N = 59
 fine to dull sand some

SER 49-50.5'
 22/36/36
 sandy sand + gravel,
 wet (water probably), fine
 slight purple coloration

(22) - 022-02 - 309104 Hz C 22.9°C
 SN. 64119 → C = 8.81
 C2 - 022-01 → 2192.75 Hz C - 25.5°C
 SN. 64117 → D = 8.13
 A = 0.00014641. { A = 0.00015536
 C = 0.0 46355 { B = 0.0323718
 C = 1245.2 → C = 1290.1

(23) - 022-02 - 3150.8Hz, SN 64120
 Test insulation. C = 4.306m
 correlated insulation to top of
 Guitart shear face C2 = 02
 C = 6.40m
 D = 2.0m
 back - see case C. 7:20 pm

No. 312

(25)

06102/24

Start: 6:00AM end: 2:30AM

- Filled backfill in 96-PL

- 1st. 5' fill piezometers.

C2 - PEC - 01 : 2899.42 H2 R 14.2 °C

C2 - PEC - 02 : 3018.23 H2 R 10.1 °C

- P.T. 9:00 AM moves back to

92 - S1

No. 612

Bottom elevation is 10'.
 On Track 2, 2nd floor.
 w/ Electronic device
 front & middle
 Head of tunnel 10', H.S.
 Sensors, sealed w/ aluminum

CONCRETE

B2: 062-03 1:2.3

B2: PEC - 01 + 02 - PEC - 02

~ 0.5m car

5.5' 11' 15.5'

10'

13'

18'

25.5'

26'

27'

28'

29'

30'

31'

32'

33'

34'

35'

36'

37'

38'

39'

40'

41'

42'

43'

44'

45'

UL 26 '96 16:29

5.5'

11'

15.5'

10'

13'

18'

25.5'

26'

27'

28'

29'

30'

31'

32'

33'

34'

35'

36'

37'

38'

39'

40'

41'

42'

43'

44'

45'

5.5'

11'

15.5'

5.5'

11'

15.5'

10'

13'

18'

25.5'

26'

27'

28'

29'

30'

31'

32'

33'

34'

35'

36'

37'

38'

39'

40'

41'

42'

43'

44'

45'

5.5'

11'

15.5'

No. 312

No. 312

(25)

+ Note : depth 4' max water 2' 24'

B2-P2-02

- completed instrumented @ 12:20 pm
- Re - cements p16: 2663.43 Hz C 11.5°C
- Diesel fuel test @ 12:30 pm

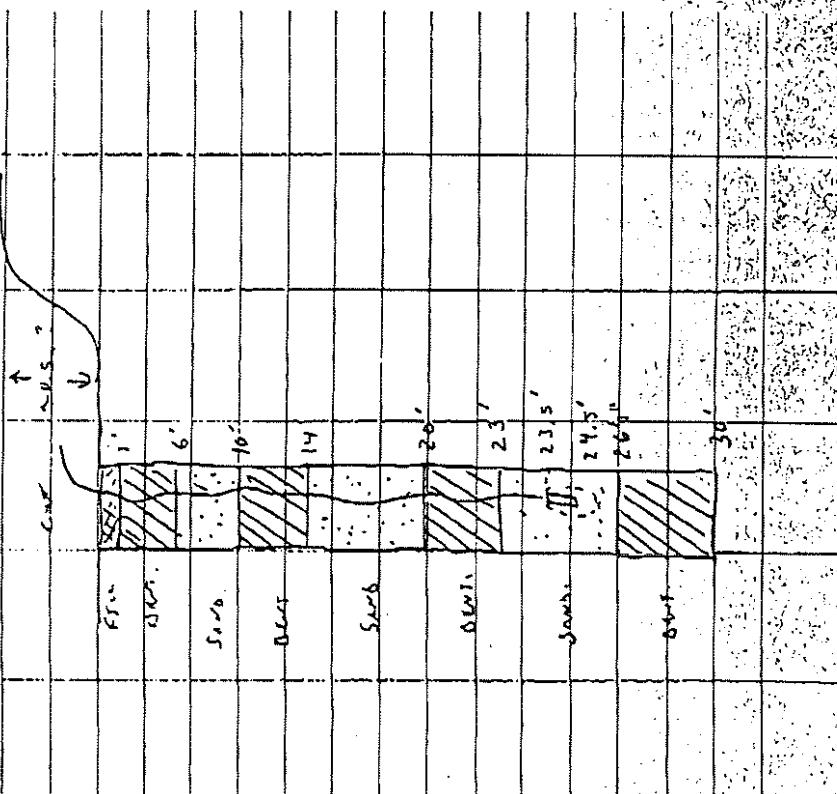


NO.512

(26)

América to test site p160
Hole 1 hole cleaned → P.M TD
use hammer - screen

- finished drilling C 10.45 m,
started cleaning



FAX COVER LETTER

TO: KP Vancouver cc: George Headley, MEI (604)952-0481	FROM: Knight Piesold Ltd. Mount Polley Site Box 12, Likely, B.C. Tel: 517 0439
ORIGIN FAX NO: 5170256	
ATTENTION: Graham Greenaway	SENDER: Ken Embree
SUBJECT: Mt. Polley CPT Investigations	DATE: 29-July - 1996 TIME: FILE NO: 1627.F01 /F05 REFERENCE NO: 96/029 OPERATOR: KOE
Page 1 of 7	

Graham,

We completed 4 relief wells (with CPT) and 5 additional CPT holes over the weekend. We are preparing a summary of the results at the current time. The preliminary CPT logs for CPT 96-1, PRW 96-2, PRW 96-3 and PRW 96-4 are attached, along with a location plan. Cone-Tec will be providing no other preliminary logs and results of pore pressure dissipation tests this evening. Peter Procter is also preparing drill logs which are based on the augering. These logs will include results of pocket penetrometer tests and forvane tests.

In summary, the soft ($N=0, N=1$) zone identified at Plane A was determined to be very dense when tested by the piezo cone (see log for CPT 96-1) at a depth of 7 to 9m. It appears that the only soft materials are at surface and this was known from previous investigations. Pore pressures are generally slightly artesian. We will be getting detailed results from Cone-Tec including correlated SPT N -values (please contact David Woeller to confirm this as a rush job).

I will keep you informed as the information is received.

Regards,
John Price.

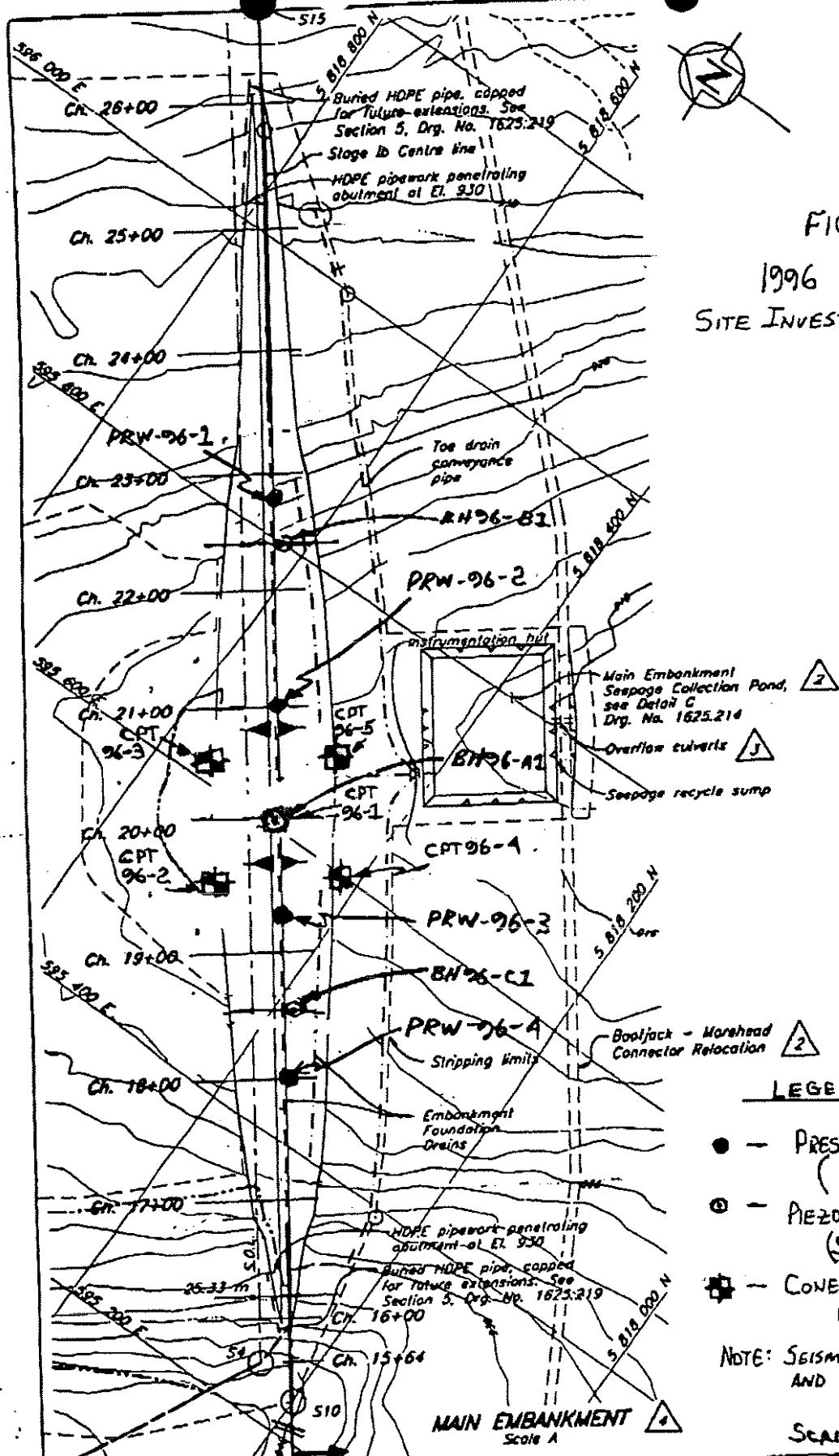


FIGURE 1

1996 GEOTECHNICAL
SITE INVESTIGATION / INSTRUMENTATION
PLAN

LEGEND

- — PRESSURE RELIEF WELL (PRW-96-1, CPT + SOLID STEM AUGER)
- — PIEZOMETER INSTALLATION (BH 96-1, SPT + VIBRATING WIRE PILEO)
- — CONE PENETRATION TEST HOLE (CPT 96-1, CPT + SEISMIC)

NOTE: SEISMIC CONDUCTED IN CPT 96-1 AND PRW 96-2 ONLY.

SCALE

25 50 75 100 m

Drg. No. 162
JULY 29/96

1625.202	TAILINGS STORAGE FACILITY - FOUNDATION PREPARATION AND BASIN LINER - SECTIONS AND DETAILS
1625.214	TAILINGS STORAGE FACILITY - SEDIMENT CONTROL AND SEEPAGE COLLECTION - SECTIONS AND DETAILS
ORG. NO.	DESCRIPTION

REFERENCE DRAWINGS

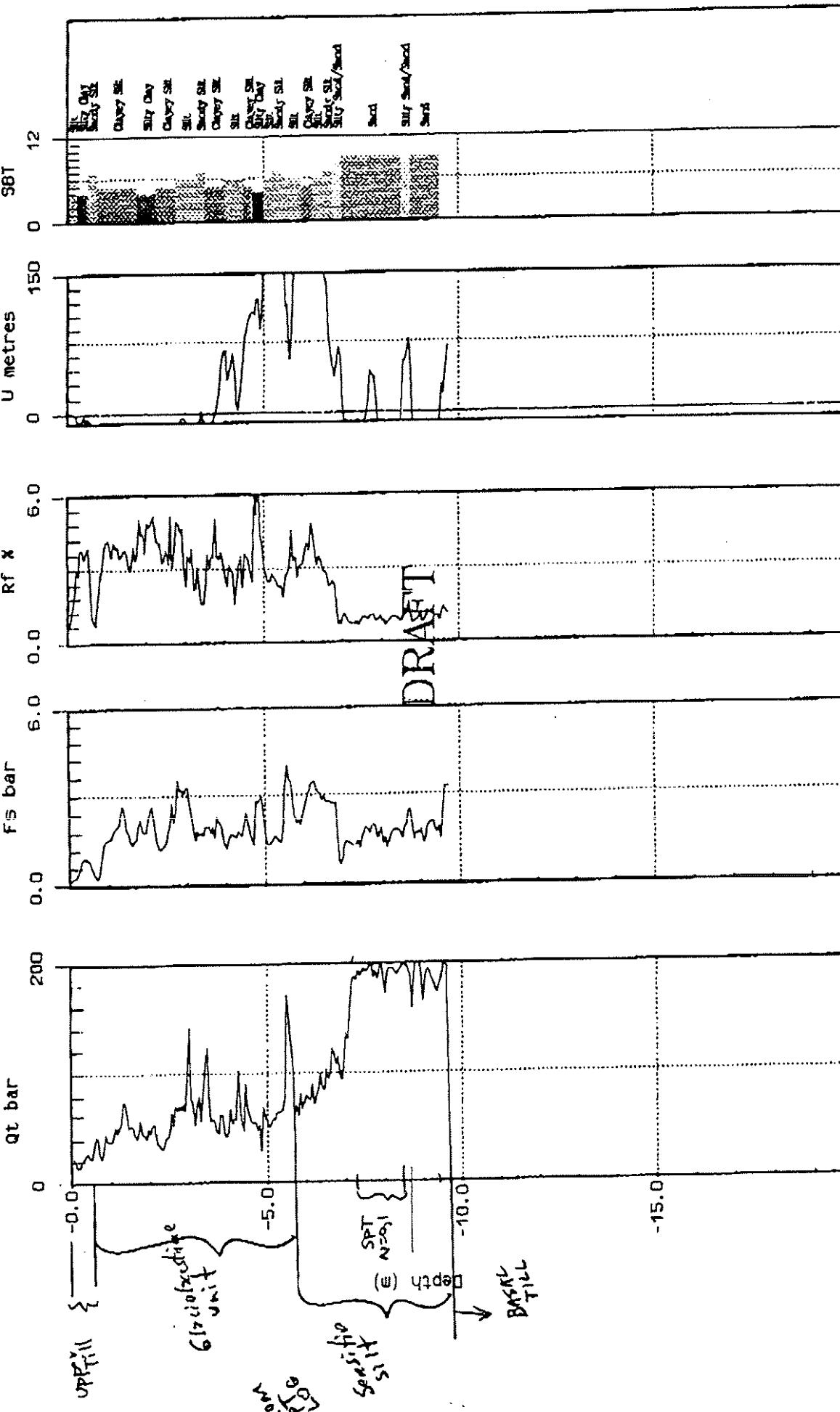
REV.	MAY 24/95	ISSUED FOR CONSTRUCTION
	DATE	DESCRIPTION

REVISIONS

KNIGHT PIESOLD
Site: CPT 95-1 (1)
Location: MT. PODDLE MINE

CONECTEC

JUL 29 '96 12:47



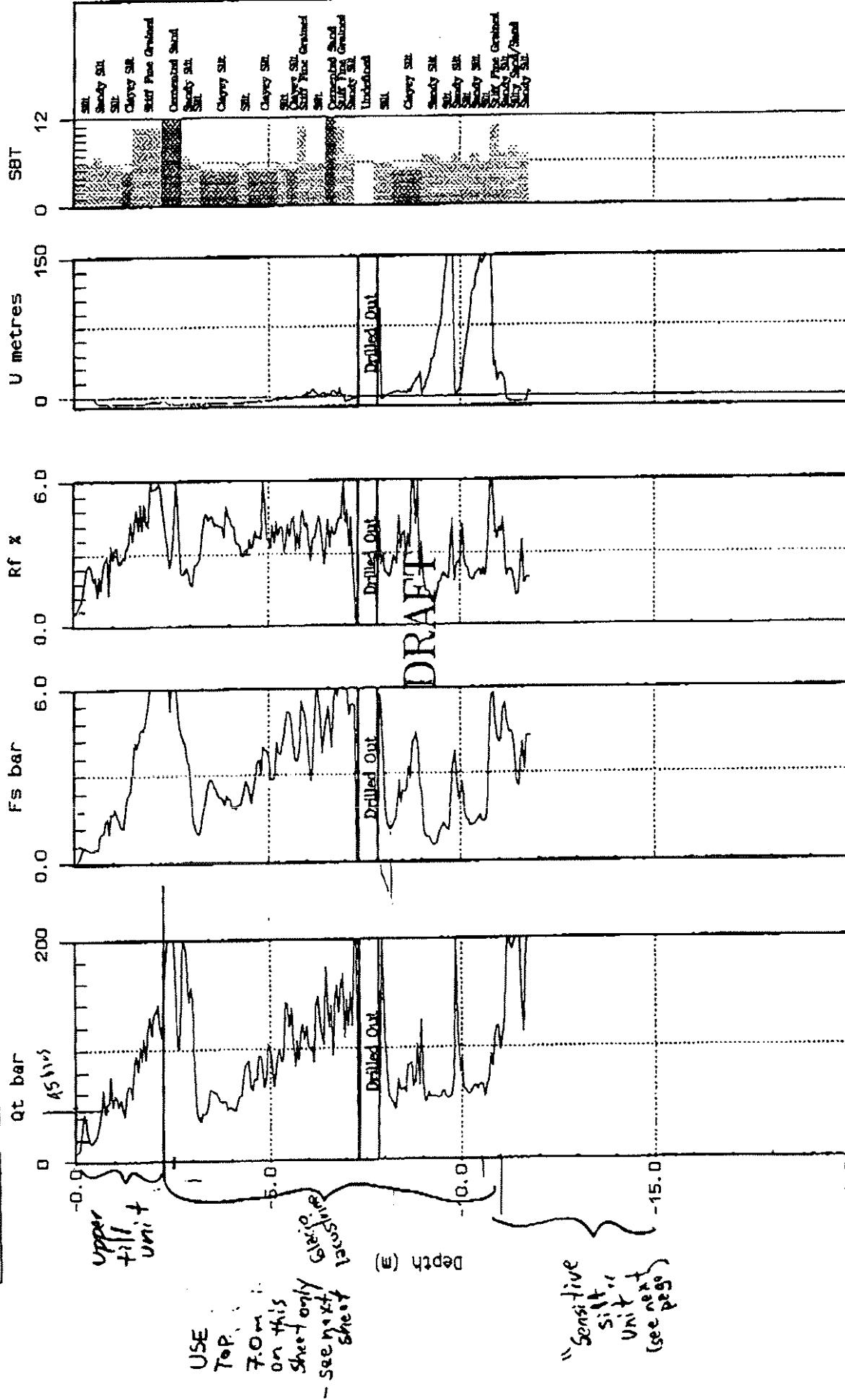
Max Depth: 0.70 (m)
Min Depth: 0.05 (m)

SGN Soil Behavior Type (Robertson and Campenelle 1988)



KNIGHT PIESOLD (4)
Site: PRW 96-1
Location: MT. POLLEY MINE

Core: 10 TON A 023
Date: 072796 1627

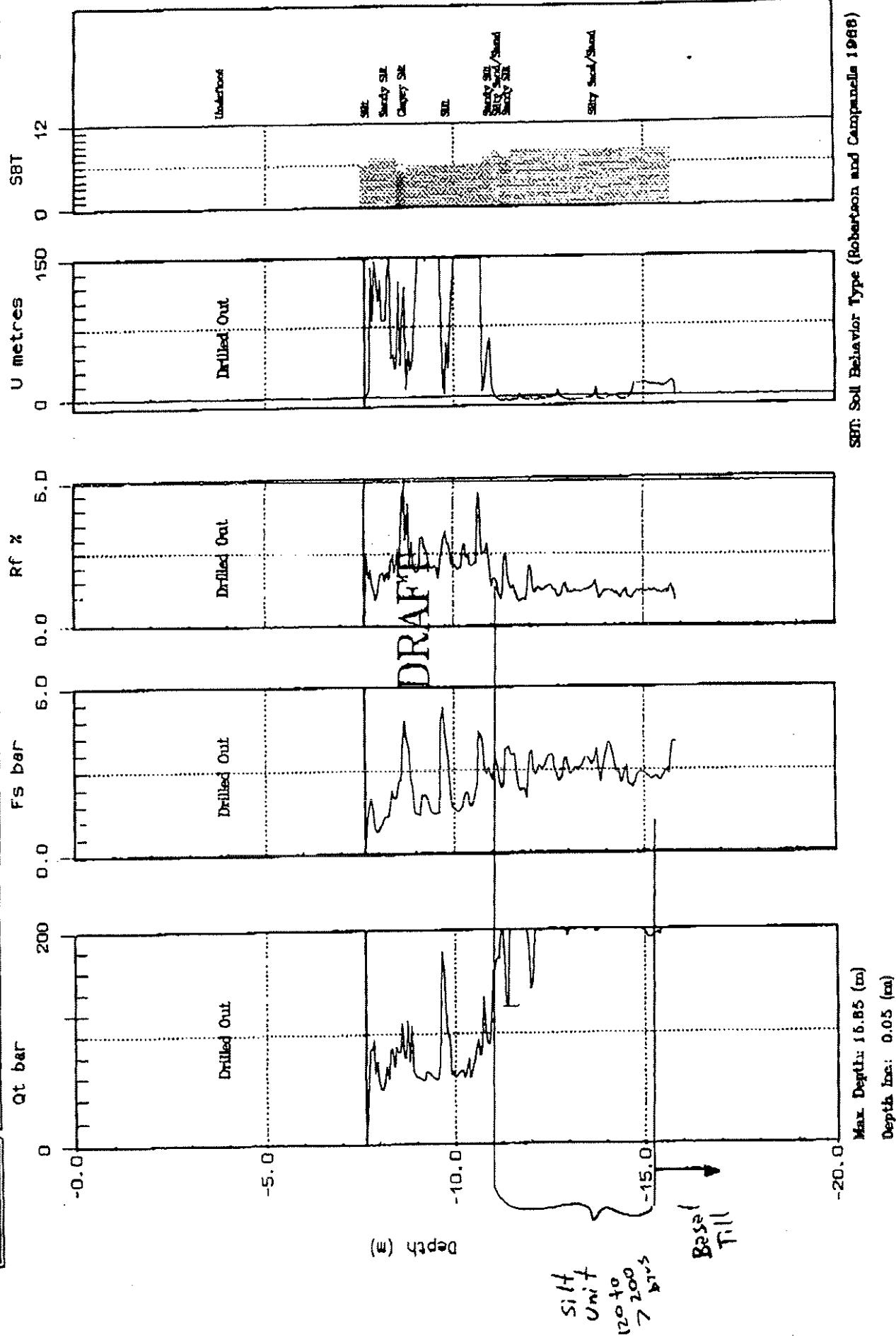




KNIGHT PIESOLD

Site: PAV 96-2 (4X)
Location: MT. POLLEY DAM

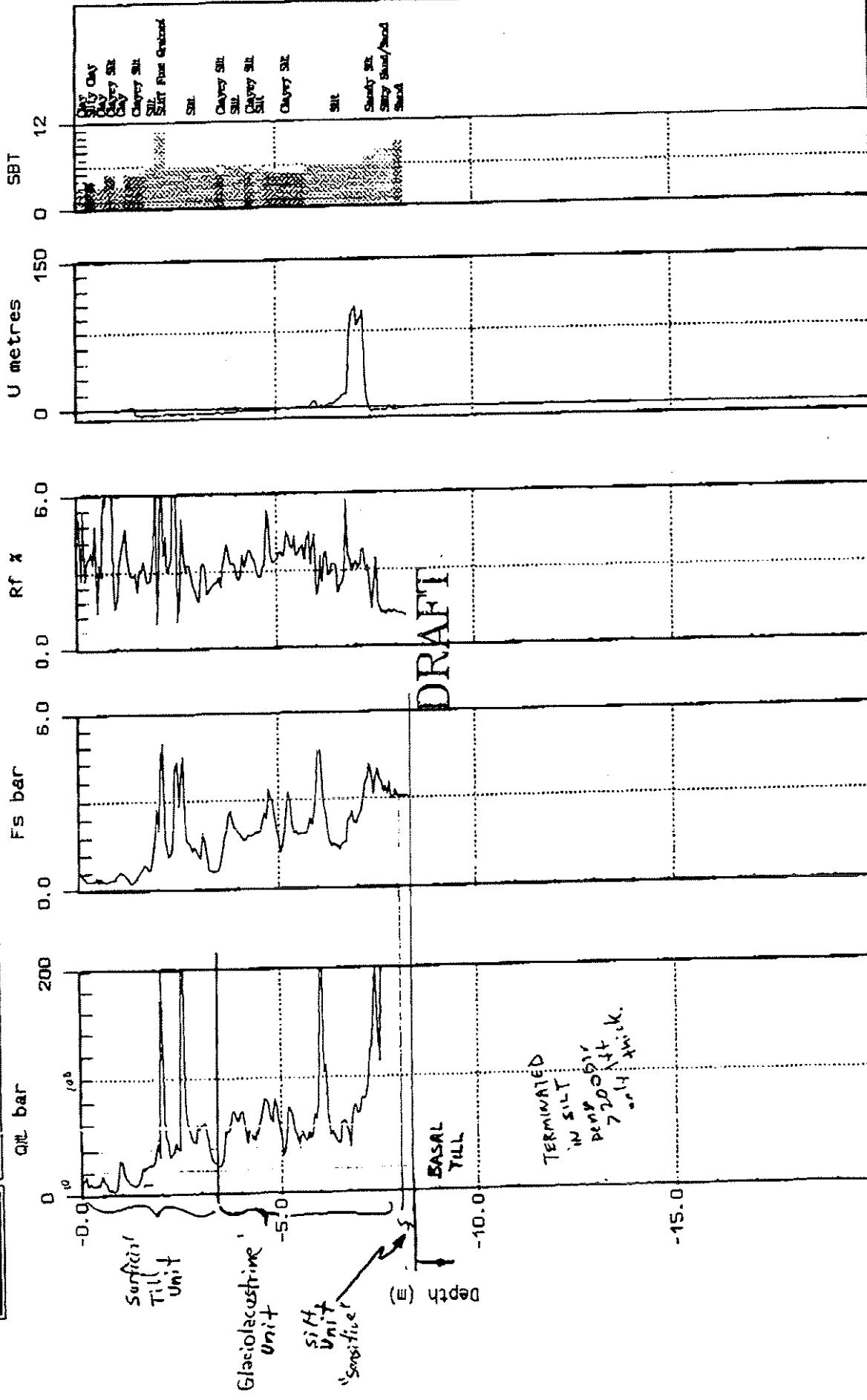
Cone: 10 TON A 023
Date: 07/29/96 08:43





KNIGHT PIESOLD
Site: PRW 96-3 (2)
Location: MT. POLLEY DAM

Cone: 10 TON A 023
Date: 07/27/96 11:43



P. 6/7 of 7

SBT: Soil Behavior Type (Robertson and Campanella 1988)



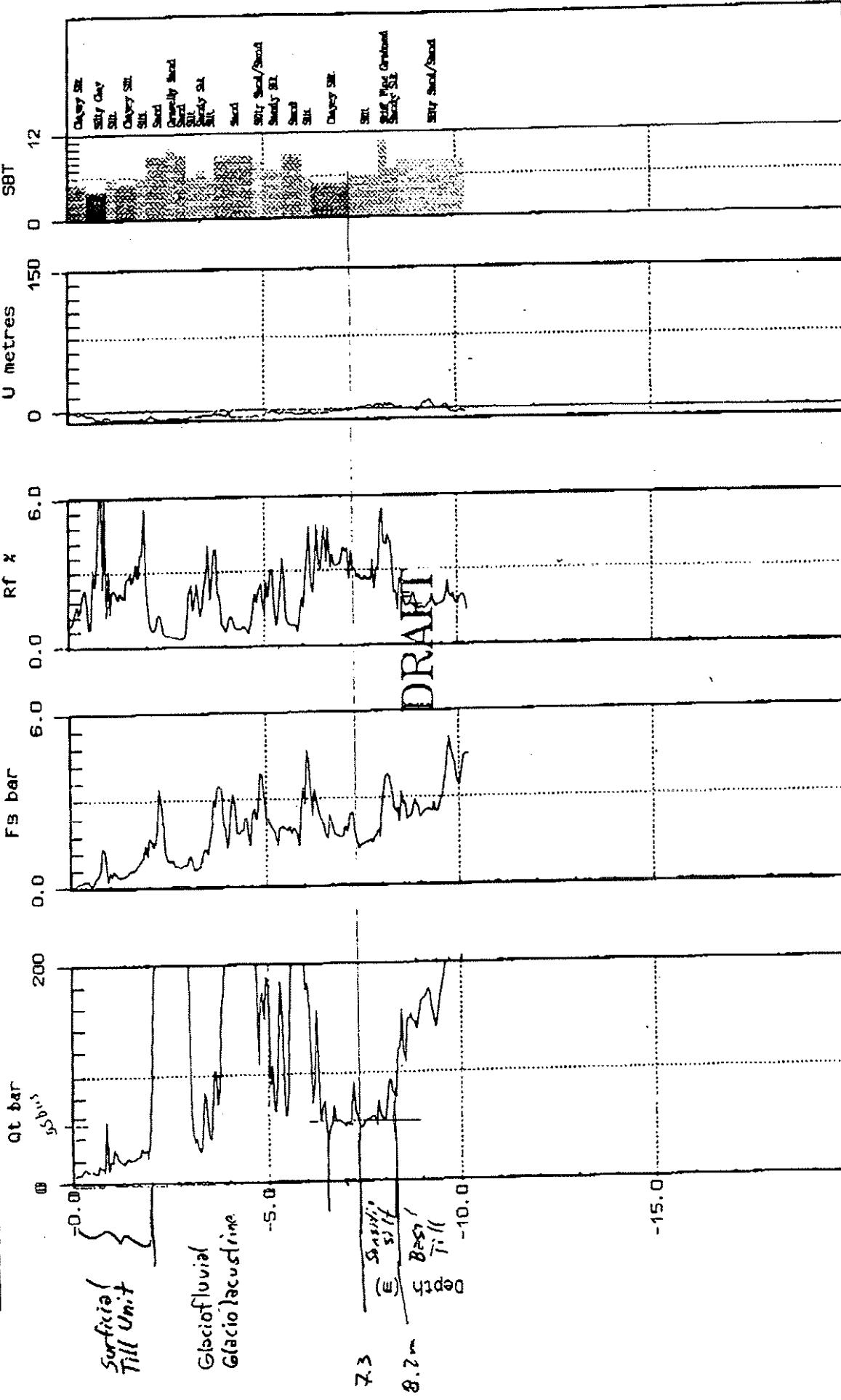
KNIGHT PIESOLD

Site: PRW 96-4 (3)
Location: MT. POLLEY MINE

Cone: 1C TON A 023
Date: 072796 1351

JUL 29 '96 11:41AM MOUNT POLLEY MINING

P.7/77 of 7



SBT: Soil Behavior Type (Robertson and Campanile 1985)

Max Depth: 10.25 (m)
Depth Km: 0.05 (m)

FAX COVER LETTER

TO: KP Vancouver cc: George Headley, MEI (604) 952-0481	FROM: Knight Piesold Ltd. Mount Polley Site Box 12, Likely, B.C. Tel: 5170439
(604) 685 0147	ORIGIN FAX NO: 5170256
ATTENTION: Graham Greenaway	SENDER: Ken Embree
SUBJECT: CPI Investigations @ main Embankment	DATE: 30-July-1996 TIME: 0715 FILE NO: 1627.F01/F05 REFERENCE NO: 96/030
Page 1 of 6	OPERATOR: KCE

Graham,

Please find attached the remaining preliminary logs for CPT holes CPT96-2, CPT96-3, CPT96-4, CPT96-5 and PRW96-1. The locations are shown on the plan sent yesterday.

We hope to complete our drill logs and fax them to you later today.

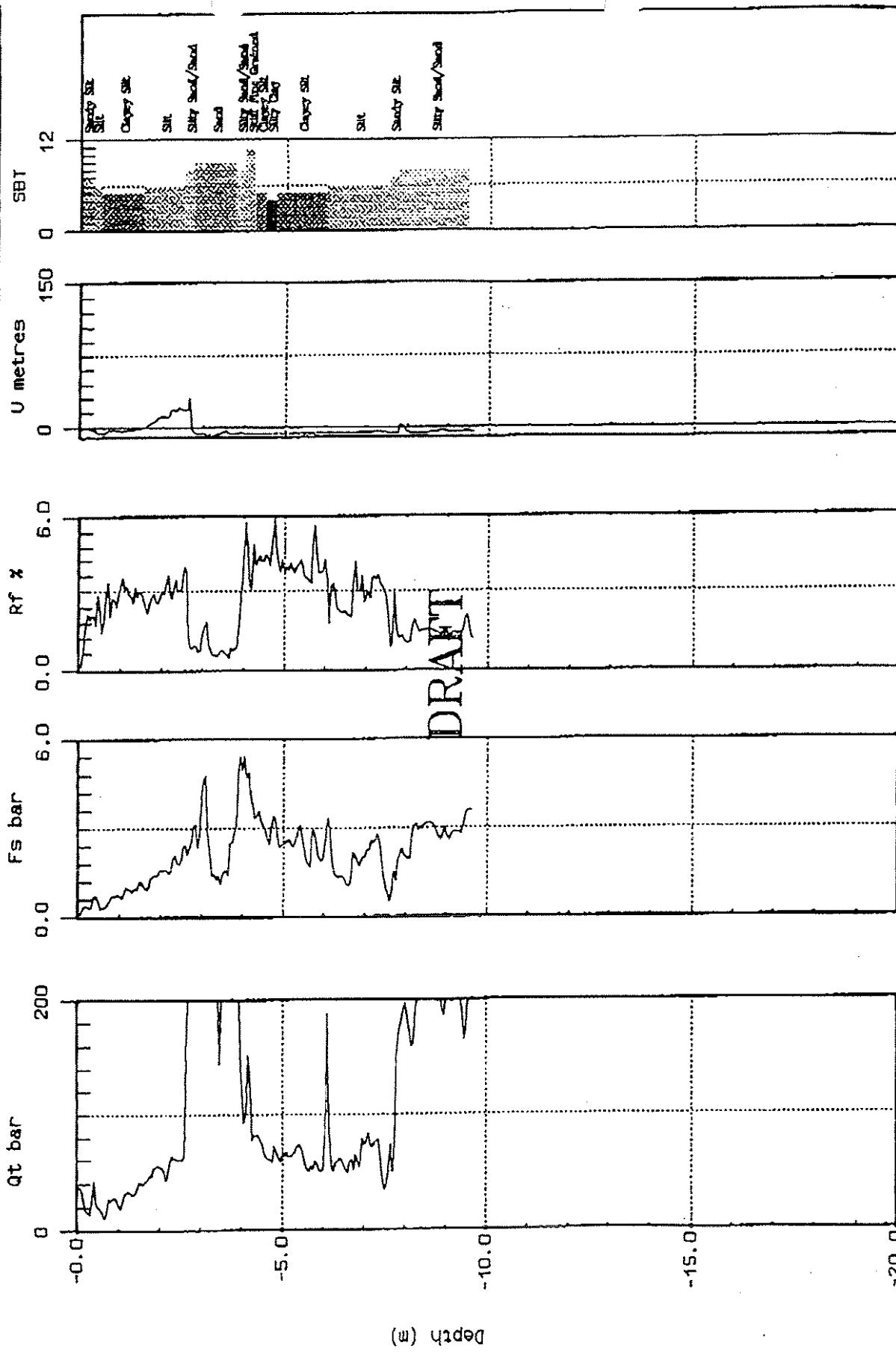
Regards,

Ken Embree



KNIGHT PIESOLD
Site: CPT 96-2 (6)
Locator: MT. POLLEY DAM

Core 10 TON A 023
Date: 07/28/96 13:48



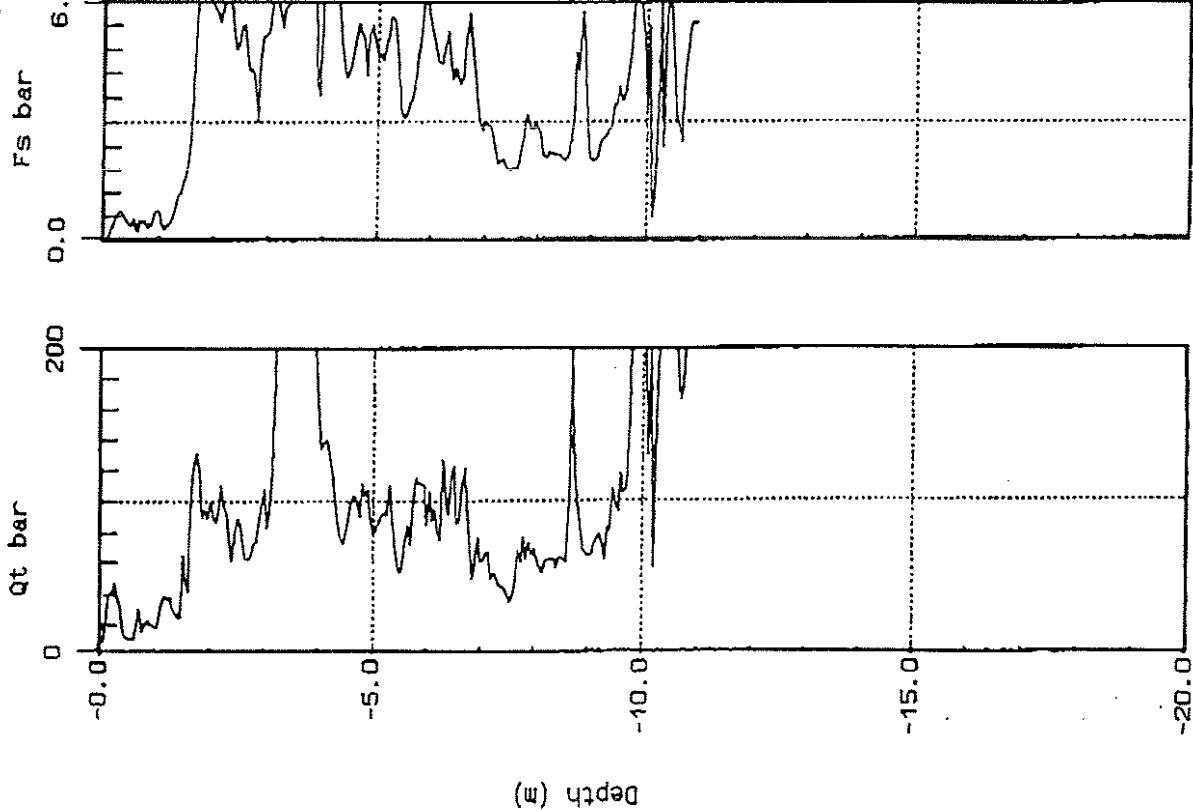
Max. Depth: 8.80 (m)
Depth Inc: 0.05 (m)



KNIGHT PIESOLD

Site: OPT 96-3 (7)
Locat at MT. POLLIE DAM

Done: 10 TON A 023
Date: 07/28/96 15:08



Max. Depth: 10.90 (m)
Depth Incr: 0.05 (m)

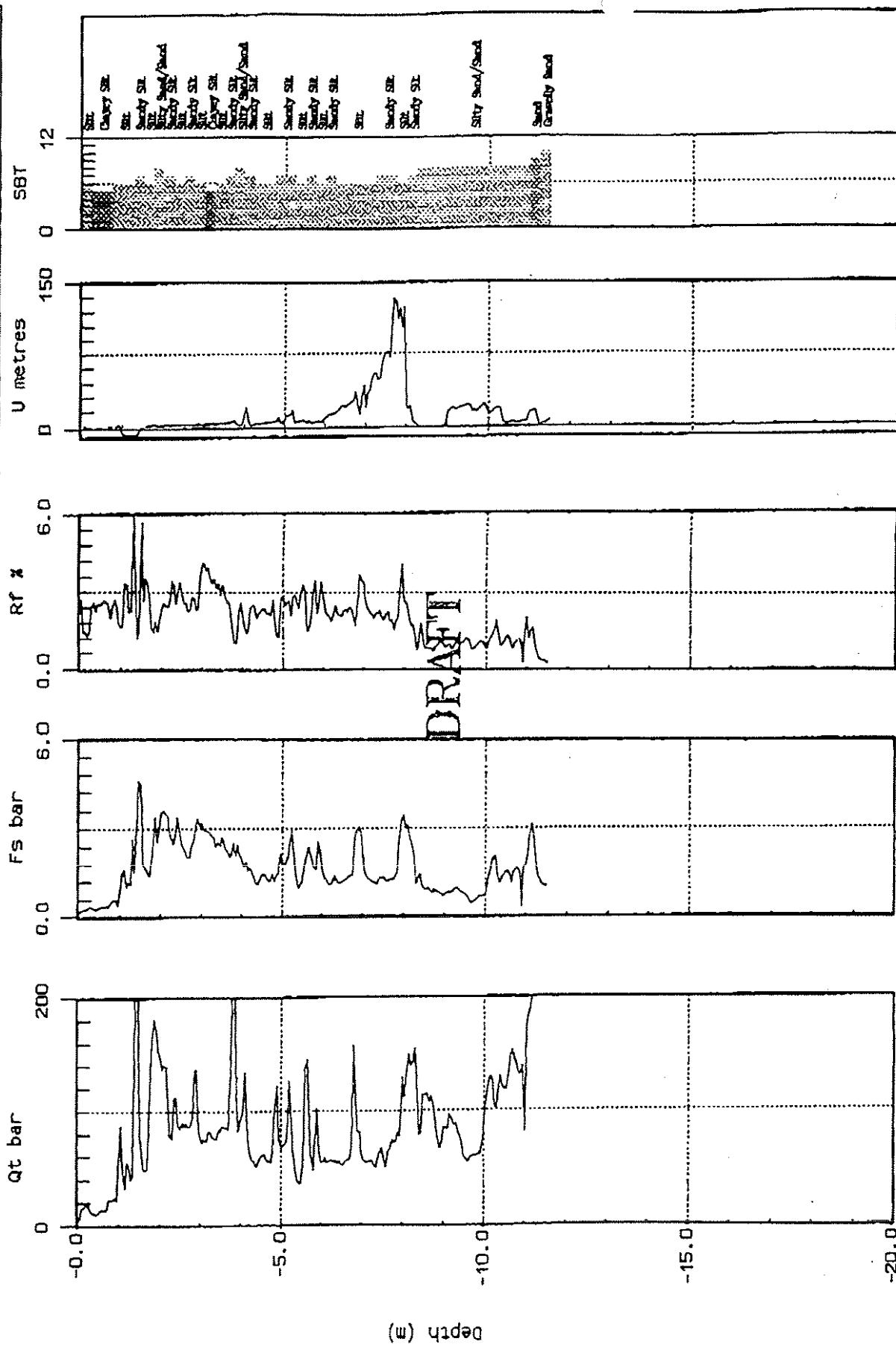
SBT: Soil Behavior Type (Robertson and Campanella 1988)



KNIGHT PIESOLD

Site: OPT 96-4 (B)
Location: Mt. Polley Dam

Date: 10 TDN A 027
Date: 072898 16/17



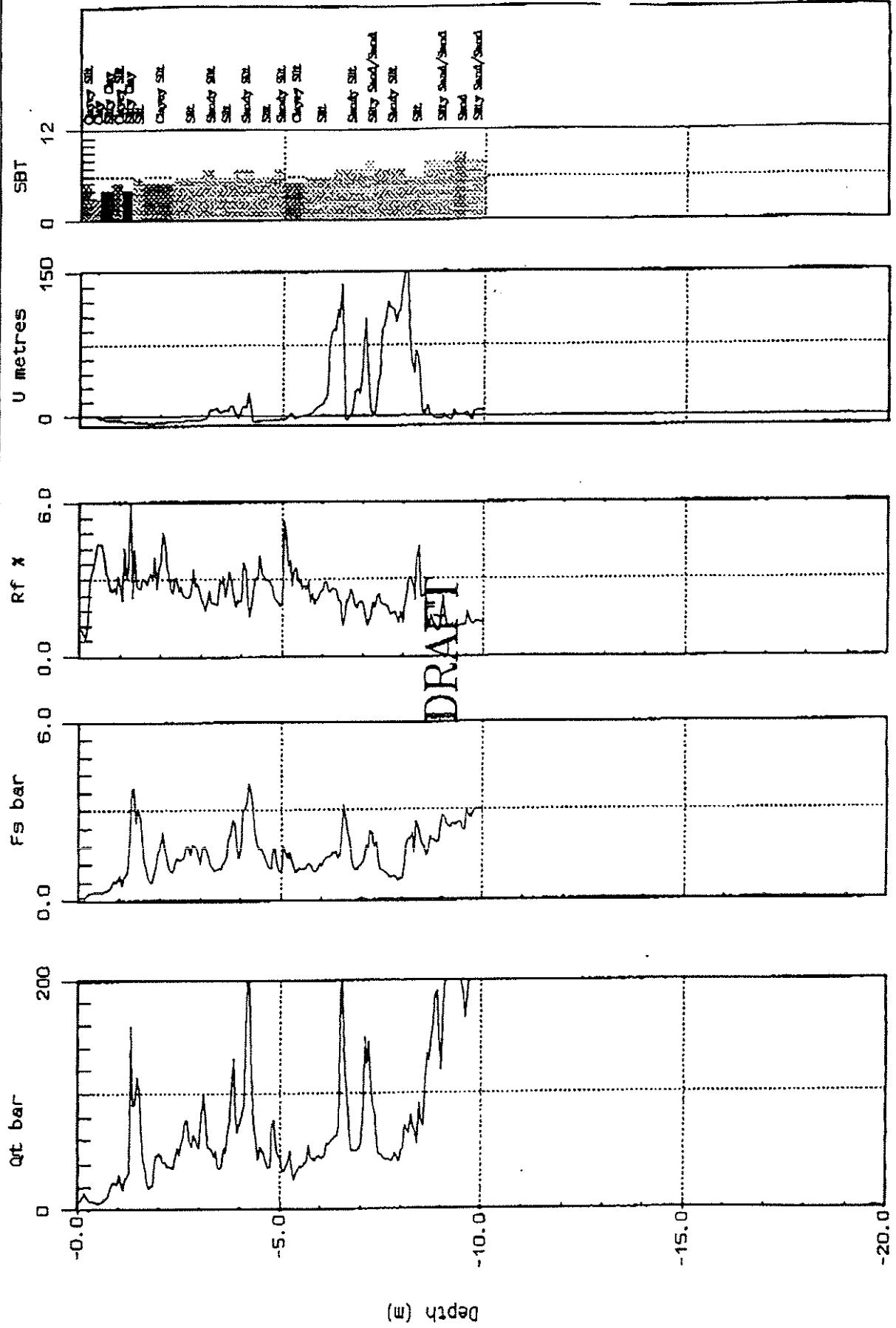
Max. Depth: 11.60 (m)
Depth Err.: 0.05 (m)



KNIGHT PIESOLD

Site: CPT 96-5 (9)
Locator Mt. POLLEY DAM

Done: 10 TON A 027
Date: 072896 1720



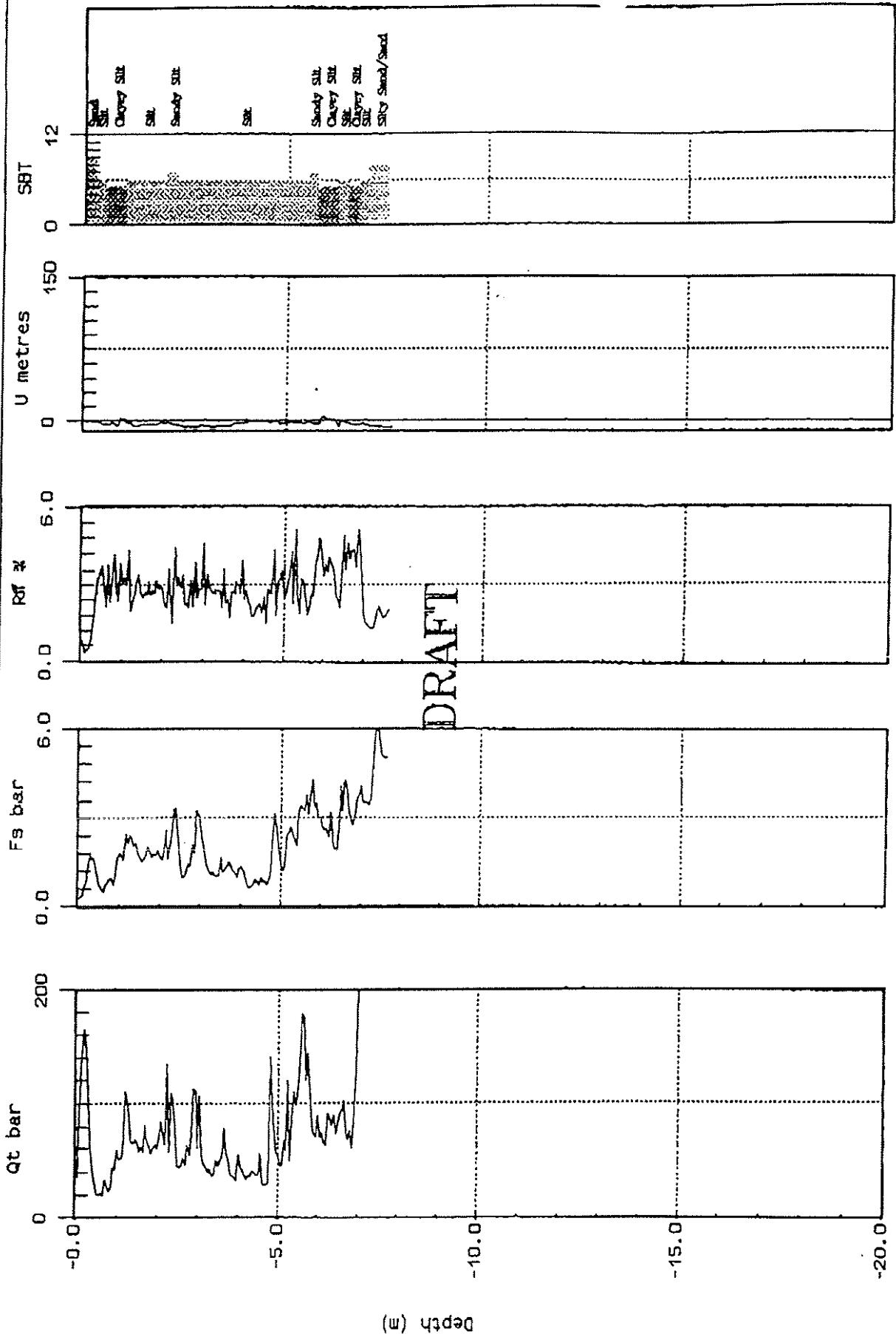
SBT: Soil Behavior Type (Robertson and Campanella 1988)



KNIGHT PIESOLD

Site 96-15
located MT. POLLEY DAM

Cone 10 TON A 023
Date 072886 1028



SBT: Soil Behavior Type (Robertson and Campanella 1988)

109

46/147/
149
150

TO: KP VANCOUVER cc: George Headley, MEI 604-952-0481	FROM: Knight Piesold Ltd Mount Polley Site Box 12, Likely B.C. Tel: 604-517-0439
DESTINATION FAX NO: 604-685-0147	APPROVED BY: VME ORIGIN FAX NO: 604-517-0256
ATTENTION: Graham Greenaway	SENDER: Peter Procter
SUBJECT: Borehole Logs for PRW 96-1 to 4	DATE: July 30, 1996 TIME: 12:00 FILE NO: 1627.F01/F05 REFERENCE NO: 96/031 OPERATOR: pjp
PAGE 1 OF 8	

Graham:

Here are the borehole logs for the holes drilled for Pressure Relief Wells along the foundation drain of the main embankment. They seem to correlate fairly well to the CPT logs, except for the apparently low densities observed in the "sensitive silt unit" which appeared loose on auger flights but the CPT indicated that the unit was in fact very stiff.

Regards,

Peter Procter
Knight Piesold Ltd.

**KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS**

TEST HOLE LOG

TEST HOLE No.
PRW 96-1
SHEET 1 of 2

PROJECT Mt Polley

PROJECT No. 1627

LOCATION OF TEST HOLE MAIN EMBANKMENT) - EAST

GROUND ELEVATION

DATE BEGUN JULY 28/96 DATE FINISHED JULY 28/96

LOGGED BY PJP

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

TEST HOLE LOG

TEST HOLE NO.
PRW96-2
SHEET 1 of 2

PROJECT MT POLLEY

PROJECT No. 1627

LOCATION OF TEST HOLE MAIN EMBANKMENT - EAST CENTRE

GROUND ELEVATION

DATE BEGUN JULY 27/96 DATE FINISHED JULY 27/96

LOGGED BY PJP

NOTES <small>Water loss, type and size of hole, drilling method, groundwater level, etc.</small>	POCKET PENETROMETER (KG/CM ²)	TORVANE (KG/CM ²)	MOISTURE CONTENT %	SAMPLES FOR TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION OF MATERIAL
SOLID STEM AUGER							
"					0.2	+ + + + +	ORGANICS (Topsoil) - soft, silt, some woody debris, roots, moist to wet, brown
					0.7	+ + + + +	SAND (TILL) - medium dense to dense, silty, some gravel, massive, mottled, low plasticity, moderate to highly consolidated, low permeability, moist to very moist, brown.
							- becoming dense
					2.4	+ + + + +	SAND (Glaciofluvial) - dense, fine to med grained, interbedded with irregular, narrow layers of silty clay (stiff to very stiff), wet to saturated, sand-grey; clay-brown.
					3.0	+ + + + +	CLAY (Glaciolacustrine) - very stiff, silty with rare narrow, saturated, fine to medium grained sand seams, highly consolidated, clay-moist, grey-brown.
	4.5	13.0					
	4.0	13.8					
	4.0	14.0					
					3.7	+ + + + +	SILT (Glaciolacustrine) - stiff to very stiff, irregularly interbedded with narrow discontinuous fine sand laminations and clayey zones, highly consolidated, clayey layers are moderate plasticity, moist, grey to grey-brown.
	3.2	10.0					
	3.5	12.5					
	2.8	16.0					
					6.0	+ + + + +	- becoming sandy silt to silty sand with depth, trace clay, low plasticity, stiff, very weakly laminated, low to moderate permeability.
	3.2						
	2.8						
	3.0						
					6.9	+ + + + +	SAND (Glaciofluvial) - very dense, fine to med grained, some silt, non-plastic, low to moderate permeability, highly consolidated, contains occasional silt - some clay rich layers, wet, grey.
					7.6	+ + + + +	

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CONSULTING ENGINEERS

TEST HOLE LOG

TEST HOLE No.
PRW96-2
SHEET 2 of 2PROJECT **MT POLLFY**PROJECT No. **1627**LOCATION OF TEST HOLE **MAIN EMBANKMENT-EAST CENTRE**DATE BEGUN **JULY 27/96** DATE FINISHED **JULY 27/96**GROUND ELEVATION
PJP

NOTES	POCKET PENETROMETER (kg/cm²)	TORVANE (kg/cm²)	MOISTURE CONTENT %	SAMPLES FOR TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION OF MATERIAL
	2.2	6.2			7.6	+ + + + + + + + + + + + + + + +	SILT (Glaciolacustrine) - stiff to very stiff, contains some clay to clayey zones as well as some sand, irregular layers, highly consolidated, moist, grey.
	2.2	4.2				+ + + + + + + + + + + + + + + +	
	-	-				+ + + + + + + + + + + + + + + +	
	2.0					+ + + + + + + + + + + + + + + +	
	1.8	5.2				+ + + + + + + + + + + + + + + +	
	36'				11.0	+ + + + + + + + + + + + + + + +	SILT (Glaciolacustrine) - soft on flights but dense to drill, trace fine sand, non plastic, structureless, sensitive to vibration → liquifies, saturated on flights, grey.
			18%	38' 40'		+ + + + + + + + + + + + + + + +	
	-					+ + + + + + + + + + + + + + + +	
	50'				15.2	+ + + + + + + + + + + + + + + +	SAND (Basal Till) - dense to very dense, gravelly, some silt, trace clay, massive, well graded, wet to saturated, grey.
					15.7	+ + + + + + + + + + + + + + + +	- becoming very dense and highly consolidated, moist to very moist, grey-brown.
	52'					+ + + + + + + + + + + + + + + +	
					16.8	+ + + + + + + + + + + + + + + +	EOT @ 16.8 m
Hole sloughed to 5' - put in 12 buckets of filter sand originally - borehole is seeping water.							

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

TEST HOLE LOG

TEST HOLE NO.
PRW 96-3
SHEET 1 of 1

PROJECT MT POLLEY

PROJECT No. 1627

LOCATION OF TEST HOLE MAIN EMBANKMENT - WEST CREST GROUND ELEVATION

DATE BEGUN JULY 27/96 DATE FINISHED JULY 27/96 LOGGED BY PJP

NOTES	POCKET PENETROMETER (kg/cm)	TORQUE (kg/cm²)	MOISTURE CONTENT %	SAMPLES FOR TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION OF MATERIAL
SOLID STEM AUGER					0	sk+	Organics (topsoil) - soft, silty and woody debris, roots, brown, very moist.
					0.8	o+ :-	SILT (Till) - stiff, sandy, clayey, some gravel, trace cobbles, massive, moderately well graded, low permeability, mottled texture, very moist, light brown
					1.5	o+ :-	- becoming very stiff
					2.3	o+ :-	SAND (TILL) - dense, silty, gravelly, trace clay, massive, very moist, grey-green.
					3.4	+- +	SILT (Glaciolacustrine) - stiff to very stiff, clayey, trace fine grained sand. Combinations and lesser narrow silty sand layers, very moist, light green-brown.
					6.3	+- +	CLAY (Glaciolacustrine) - stiff, some silt to silty, moderate to high plasticity, natural mlc < PL, moist, light brown.
					6.9	+- +	SAND (Glaciolacustrine / Glaciofluvial) - dense to drill but loose on flights, silty liquifies under vibration, non plastic, no visible fabric, saturated, light brown.
					8.2	+- +	SILT (Glaciolacustrine) - loose to medium dense on flights but dense to drill, trace fine grained sand, liquifies under vibration, massive, non plastic, saturated, grey.
Hole sloughed with fine grained sand to 16'. Filled to grade with 2 buckets of filter sand.			17%		8.5	+- +	SAND (Basal Till) - very dense, gravelly, some silt, trace clay, massive, highly consolidated, low permeability, moist to very moist, grey-brown
					9.9	+- +	EOH

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

TEST HOLE LOG

TEST HOLE NO.
PRW 96-4
SHEET 1 of 2PROJECT **MT POLLFY**PROJECT No. **1627**LOCATION OF TEST HOLE **MAIN EMBANKMENT - WEST**

GROUND ELEVATION _____

DATE BEGUN **JULY 27/96** DATE FINISHED **JULY 27/96**LOGGED BY **PJP**

NOTES Water loss, type and size of hole, drilling method, groundwater level, etc.	POCKET PENETROMETER (kg/cm ²)	TORVANE (kg/cm ²)	MOISTURE CONTENT %	SAMPLES FOR TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION OF MATERIAL
SOLID STEM AUGER					0.3	+++	ORGANICS (Topsoil) - soft, silty, some woody debris and roots, wet, brown.
					0.9	++	SILT (Till) - soft to firm, sandy, some gravel and clay, weakly consolidated, moderately low plasticity, mottled to massive texture, very moist to wet, blue-brown.
					1.2	++	- becoming stiff, very moist and brown.
					1.6	++	- becoming stiff to very stiff, mottled orange-brown to grey-brown.
					2.0	++	SAND (Transition Till to Glaciolacustrine) - stiff silt intermixed with irregular fine to med grained sand layers, loose on flights, saturated, brown.
					2.4	++	- sand is becoming interbedded with 50mm thick stiff, silty clay layers, sand is medium grained loose on flights and saturated
					3.0	++	SAND (Glacioluvial) - loose on flights but dense to drill, fine to med grained, massive to very weakly stratified, saturated, brown.
					4.0	++	- becoming interlayered with glaciolacustrine stiff silt, some clay layers with moderate plasticity and thicknesses up to 100mm, irregular
					5.5	++	CLAY (Glaciolacustrine) - stiff, highly irregular interbeds of clay some silt with silt, some clay, with silt some fine sand, looks like soft sediment deformation, clay rich zones moderate plasticity, discontinuous, moist, brown.
					7.3	++	SILT (Glaciolacustrine) - stiff, true fine grained sand, non plastic, laminated, periodic more clay rich layers, very moist to saturated, grey.
					8.2	++	SILT (Glaciolacustrine) - soft on sugar flights but dense to drill, liquifies easily upon shaking, massive, appears saturated, grey, true sand?, nonplastic
					8.8	++	

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

TEST HOLE LOG

TEST HOLE NO.
PRW 96-4
SHEET 2 of 2

PROJECT MT POLLEY

LOCATION OF TEST HOLE MAIN EMBANKMENT - WEST

DATE BEGUN July 27/96 DATE FINISHED July 27/96

PROJECT No. 1627

GROUND ELEVATION

LOGGED BY PJP

NOTES	POCKET PERMEABILITY (kg/cm ²)	TORVANE (kg/cm ²)	MOISTURE CONTENT %	SAMPLES FOR TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION OF MATERIAL
Hole sloughed to ~1.5m, with typically fine grained sand, backfilled to grade with 6 buckets (~200 psi) of filter sand. -hole is seeping.	-	-	-	-	8.8	++ + + + + + + + + + + + + + + +	SILT (Transition from Glaciocustrine to till) - stiff on flights but still somewhat sensitive to vibration → liquidlike, grades into sand, some silt and gravel with depth, modestly consolidated, massive, wet, grey -becoming more competent on flights and not sensitive to vibration/lipoturbation (weathered till?)
	-	-	-	-	9.1	+ + + + + + + + + + + +	
	-	-	-	-	9.7	+ + + + + + + + + + + + + +	
	-	-	-	-	11.6	+ + + + + +	EOT