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932013
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Woodward-Clyde Consultants

July 31, 1986
83C2236-8

#73

E.I. duPont de Nemours & Co., Inc.
Buffalo Avenue and 26th Street
Niagara Falls, New York 14302

Attention: Mr. Richard Gentilucci
Operations Manager
Environmental Officers

Re: Permeability Testing of Rochester Shale-Lockport Dolomite via J-Zone Monitoring Wells

Dear Mr. Gentilucci:

Pursuant to our letter dated June 25, 1986, Woodward-Clyde Consultants (WCC) has prepared the attached scope of work for conducting the permeability testing of the Rochester Shale and Lockport Dolomite by the J-zone monitoring wells at the Niagara Plant. The scope of work includes evaluating the hydrostatic head in the J-zone and conducting permeability tests in three stages in each J-zone well. The location of the four (1,4,8, and 15) J-zone wells is highlighted on Figure 1, and a monitoring well report and boring logs have been included for each J-zone well in the attachment to this scope of work.

The permeability testing will be conducted in a similar fashion to the way the monitoring wells at Necco Park are being evaluated, to determine if the zones are water bearing or not. The permeability will be evaluated by a single packer coupled to a pressurized water delivery system for high permeability zones and with a constant head system test for low permeability zones.

In accordance with Section 5.2.5, Permeability Testing of J-zone Well (WCC - Draft Report, Remedial Action Program Niagara Plant, Niagara Falls, New York; June 23, 1986), WCC is proposing the following program to evaluate the permeability of the Rochester Shale-Lockport Formation contact which is defined as the J-zone. The proposed program would include evaluating the static water level in at least one of the J-zone wells by means of a pneumatic piezometer installed below a pneumatic packer placed near the contact between the Lockport Formation and the Rochester Shale. The packer would be inflated and the pore water pressure monitored on at least a daily basis until the pressure is stabilized. This is expected to take less than 5 days.

This data is required because we don't have a static water level for the J-zone. Review of the J-zone monitoring wells indicates that they do not recover completely between sampling. Previous data collected at the site on the J-zone wells indicated recovery rates for these wells ranging from 0.4 to 2.0 feet/day with comparable permeabilities of 1 x 10^{-7} to 10^{-9} cm/sec and a permeability of 1 x 10^{-4} cm/sec based upon slug test data. Based on these recovery rates and permeabilities, it is expected that the permeability of various sections in the J-zone wells will be sufficiently low that it will be necessary to run the permeability tests using a constant head test method with small volumes of water manually added.

Following the evaluation of the static pressure in the J-zone, the pneumatic packer would be installed to seal off portions of the monitoring wells that are cored into the bedrock. The sequence of testing will be as follows:

- The packer will be located 5 feet from the bottom of the core hole so that the permeability of the Rochester Shale can be determined.
- The packer will then be placed at an elevation 5 feet above the suspected J-zone fracture (or the contact between the Lockport Formation and the Rochester Shale).
- The packer will then be raised to just below the top of the monitoring zone (approximately 3 feet below the bottom of the casing in the J-zone monitoring wells). The packer will be located below the bottom of the casing to evaluate the permeability of the rock and not the integrity of the grout seal.

The coefficient of permeability will be estimated for each of the above intervals and an overall permeability for the entire open interval of the J-zone wells. The permeability for each of the intervals will be included by means of a constant head permeability test by the attached procedures. The limiting factor for the constant head test using a Constant Pressure System is the sensitivity of the flowmeter in the system. The sensitivity of the flow meter is about 0.1 gallons, such that flows less than 0.1 gallons may not be detected. With this lower limit of sensitivity of 0.1 gallons, it would then be necessary to use an alternate permeability procedure using a constant head that is manually restored at a rate slower than would be detected by the flowmeter.

Based upon our experience in the Niagara Falls area, a permeability of greater than 10^{-6} cm/sec can be evaluated using the Constant Pressure System and a permeability of less than 10^{-6} cm/sec can be evaluated using a constant head test. WCC is experienced at conducting both of these tests, as required.

With authorization to provide this service, WCC should be able to collect the data and present the results by the end of October 1986. If you have any questions, do not hesitate to contact us.

Very truly yours,

WOODWARD-CLYDE CONSULTANTS

Richard M. Coad

Richard M. Coad, P.E.
Senior Project Engineer

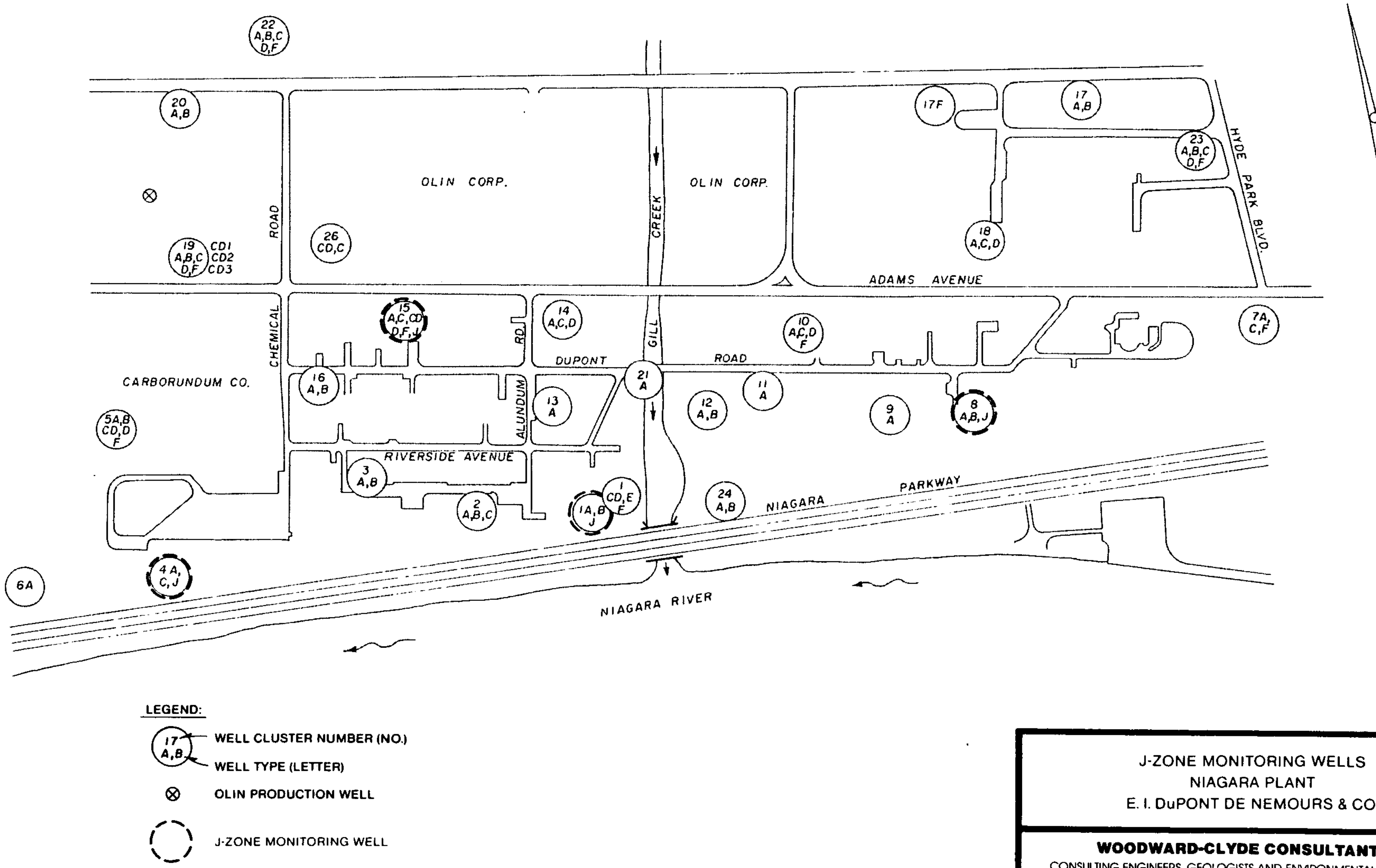
Frank S. Waller /KRM

Frank S. Waller, P.E.
Principal

RMC/ten/5B

cc: Mark N. Gallagher
David W. Buzzell

Attachment



J-ZONE MONITORING WELLS
NIAGARA PLANT
E. I. DuPONT DE NEMOURS & CO.

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

Drawn by: T.P.	SCALE IN FEET 0 — 300	Date: 7/29/86
Checked by: R.M.C.		Job: 83C2236-8

FIGURE 1

Appendix A

PROPOSED IN SITU PERMEABILITY TEST ROCHESTER SHALE-LOCKPORT DOLOMITE DUPONT NIAGARA PLANT NIAGARA FALLS, NEW YORK

1.0 SCOPE

The following general procedures will be used to conduct the in situ permeability testing in the Lockport Formation/Rochester Shale. The in situ permeability test will be performed using a single packer system coupled to a pressurized water delivery system. The purpose of this program will be to test the permeability of the Lockport Formation and Rochester Shale in the four J-zone monitoring wells at the site (1J, 4J, 8J, and 15J), see Figure A-1. The test will be performed in the cored section of the Lockport Formation and Rochester Shale section of the J-zone monitoring wells. Water-bearing zones will be confirmed by a test permeability of greater than 1×10^{-4} cm/sec. The Inspecting Engineer/Geologist shall have overall responsibility in the field for the in situ permeability testing.

In 1983 Woodward-Clyde Consultants conducted rising head permeability tests at the Niagara Plant on the uncased section of monitoring wells 4J, 8J, and 15J and calculated permeabilities of 1×10^{-7} to 1×10^{-9} cm/sec. A slug test was performed on monitoring well 1J and a permeability of 1×10^{-4} cm/sec was calculated. Based upon these data, a constant head test would be more appropriate for the proposed scope of work. In addition, for permeability tests that have results less than 1×10^{-6} cm/sec, WCC believes that a manually filled constant head test is most appropriate.

The static water level is important information in the analysis of the permeability test data. A review of the water level data for the J-zone wells indicate that the wells do not completely recover between sampling events. Due to the slow recovery rate of the J-zone wells, WCC is proposing to use a pneumatic piezometer installed below an inflated pneumatic packer to evaluate the static water level in one of the J-zone wells. Following the installation of the pneumatic packer and piezometer, the piezometer would be monitored on at least a daily basis until the pressure is stabilized. This is expected to occur in less than 5 days.

2.0 STATIC WATER LEVELS

The static water level in one of the J-zone monitoring wells would be measured by means of a pneumatic piezometer installed below a pneumatic packer. The piezometer would be located close to the Rochester Shale-Lockport Formation contact. The pneumatic piezometer has a low volume displacement diaphragm that balances the hydrostatic and pneumatic forces that allows the conversion of the hydrostatic pressure to a pneumatic pressure. Due to the low volume displacement of the piezometer, the time needed to respond to the static water level should be quite small in comparison to the filling of the borehole.

2.1 INSTALLATION AND DATA COLLECTION

The pneumatic piezometer will be installed in one of the four J-zone monitoring wells below a single pneumatic packer to a known depth. The pneumatic packer will be inflated with sufficient pressure to hold the packer in place. A schematic representation of the system is shown on Figure A-2.

The pneumatic piezometer will be monitored using a pneumatic indicator, which balances the pneumatic pressure with the hydrostatic pressure. Successive readings on at least a daily basis will be taken until the pressure stabilizes. This stabilized pressure represents the hydrostatic pressure exerted on the bottom of the piezometer. This pressure will be converted to feet of water above the piezometer tip by multiplying by 2.31. The 2.31 factor converts pressure in psi to equivalent head measured in feet of water. ok

3.0 IN SITU PERMEABILITY TESTING AND DOCUMENTATION

The following testing and documenting procedures will be followed while performing the in situ permeability tests. It is extremely important that all data be properly recorded. No change in the test procedures are permitted without authorization of the Project Manager.

3.1 IN SITU PERMEABILITY TEST PROCEDURES

Testing shall be in accordance with the following:

Step a. Perform a pretest of the equipment and determine that required hoses, pipes, pressure gauges, flowmeter and valves are organized properly and in good working condition. All gauges and flowmeters are to be calibrated prior to the permeability testing. Copies of calibration records will be maintained in the project files. The principal components of the Constant Pressure System are shown on Figure A-3. The single packer system is shown on Figure A-4.

Step b. Measure and record the depth to water and bottom of corehole from the top of casing. Confirm the inside diameter of the corehole from the drilling logs. The packer is designed for optimum performance in an NX corehole (OD = 3 inches), but should perform satisfactorily in an over-reamed corehole (OD = 3-7/8 inches).

Step c. Position the packer in the borehole at the test depth. For the first test, place the packer at a distance of 5 feet from the bottom of the corehole.

Step d. Inflate packer to a pressure greater than the maximum total pressure to be used in the test (generally 20 to 30 psi greater than maximum pressure for test). If packer starts to move, increase the pressure until packer stops moving. If packer continues to move, reposition, and repressurize.

Step e. Close flow control throttle valve, pressurize system, and check for leaks. Allow system to stabilize. Measure and record the vertical distance from static water level to the top of casing. This water level measurement will be compared with the water level measured during the test.

Step f. Perform test by slowly opening flow control throttle valve and constant pressure reducing valve until 1/4 of the maximum test pressure (Pm) is reached. Where Pm at the packer is not to exceed 0.9 D psi, when D is the depth to the bottom of the packer and the existing pressure at the bottom of the packer is P_{HS} = 0.433 x head of water above the packer, and P_L is the pressure loss due to friction in the testing apparatus (see Step h). Thus, the maximum test pressure is $Pm = (0.9\ D - P_{HS}) + P_L$. Record flow rate for 5-minute periods, raising gauge pressure in 1/4-Pm increments so that each section is tested at 1/4 Pm, 1/2 Pm, 3/4 Pm, and Pm gauge pressure for a minimum of 5 minutes. Lower pressure to 3/4 Pm, 1/2 Pm, and 1/4 Pm gauge pressure, again using 5-minute periods to record flow rate.

WARNING: DO NOT APPLY MORE THAN 0.9 PSI PRESSURE PER FOOT DEPTH (e.g., if test depth is 40 feet, maximum test pressure is not to exceed 36 psi) or hydrofracturing may occur. Carefully observe flow rates; if flow rates increase dramatically between the 1/4 Pm increments in pressure, then hydrofracturing may have occurred. An example data plot from an in situ permeability test which may represent hydrofracturing is shown on Figure A-5.

The test durations and the pressure increments may be varied at the discretion of the Inspecting Engineer/Geologist.

Step g. While conducting Step f above, record flowmeter and pressure gauge readings (including fluctuations) at 0.1 gpm increments. Make sure sufficient water is available at supply source to finish test at anticipated flow rates. Measure water level above packer during test. If the water level increases, leakage may be occurring around packers. If leakage around packer occurs, repeat Step d. Record the time at which leakage was noted.

If flow for the test is not being recorded on the flowmeter, the test shall be stopped. Water shall be added to the riser pipe by means of a measuring device that can account for smaller quantities and the test conducted as a constant head test. In this situation, permeability will be calculated as in Step j.

Step h. To calculate the corrected head in feet:

(1) Convert gauge reading (P_p) in psig to head (H_p) in feet

$$H_p = P_p \times 2.31$$

The 2.31 factor converts pressure in psi to equivalent head measured in feet of water.

(2) Measure the vertical distances from the static water level to the top of the casing (Hw) and from the top of the well casing to pressure gauge (Hg), prior to placing the packer in the borehole.

(3) Determine the head loss ($H_L = 2.31 \times P_L$) in the piping system from the H_L vs Q graph developed during the calibration of equipment. Low flows (less than 6 gpm) will result in negligible head loss, (assumed to be zero).

(4) Calculate the corrected head (H_c) by:

$$H_c = H_p - H_L + H_w + H_g$$

Step i. Plot the recorded flow rate (Q in gallons per minute) and corrected head (H_c = feet) on the data sheet (Figure A-6) during the progress of Step f above.

Step j. Compute the maximum and minimum permeability based on the test results, where:

$$K = \frac{0.0108(Q)(F)}{(L)(H_c)} \quad \text{and}$$

K = permeability (cm/sec)
Q = flow rate (gal/min)
F = ln L/r
L = test length of open core hole (See Figure A-4) (ft)
H_c = corrected head (ft)
r = radius of core hole (ft)
0.0108 = unit conversion from gal/min $(ft)^2$ to cm/sec divided by 2Π.

3.2 TESTING DOCUMENTATION

The test shall be documented on a form, an example of which is shown as Figure A-6. The information to be recorded includes the following:

a. Date
b. Boring, Fracture Interval obtained from the boring log
c. Type of Test (Single or Double Packer)
d. Time: Start, Finish
e. Ground Surface Elevation (if available)
f. Depth to Upper Packer

g. Depth to Groundwater (before test, and 24 hours after test)

h. Test Length of open core hole (L)

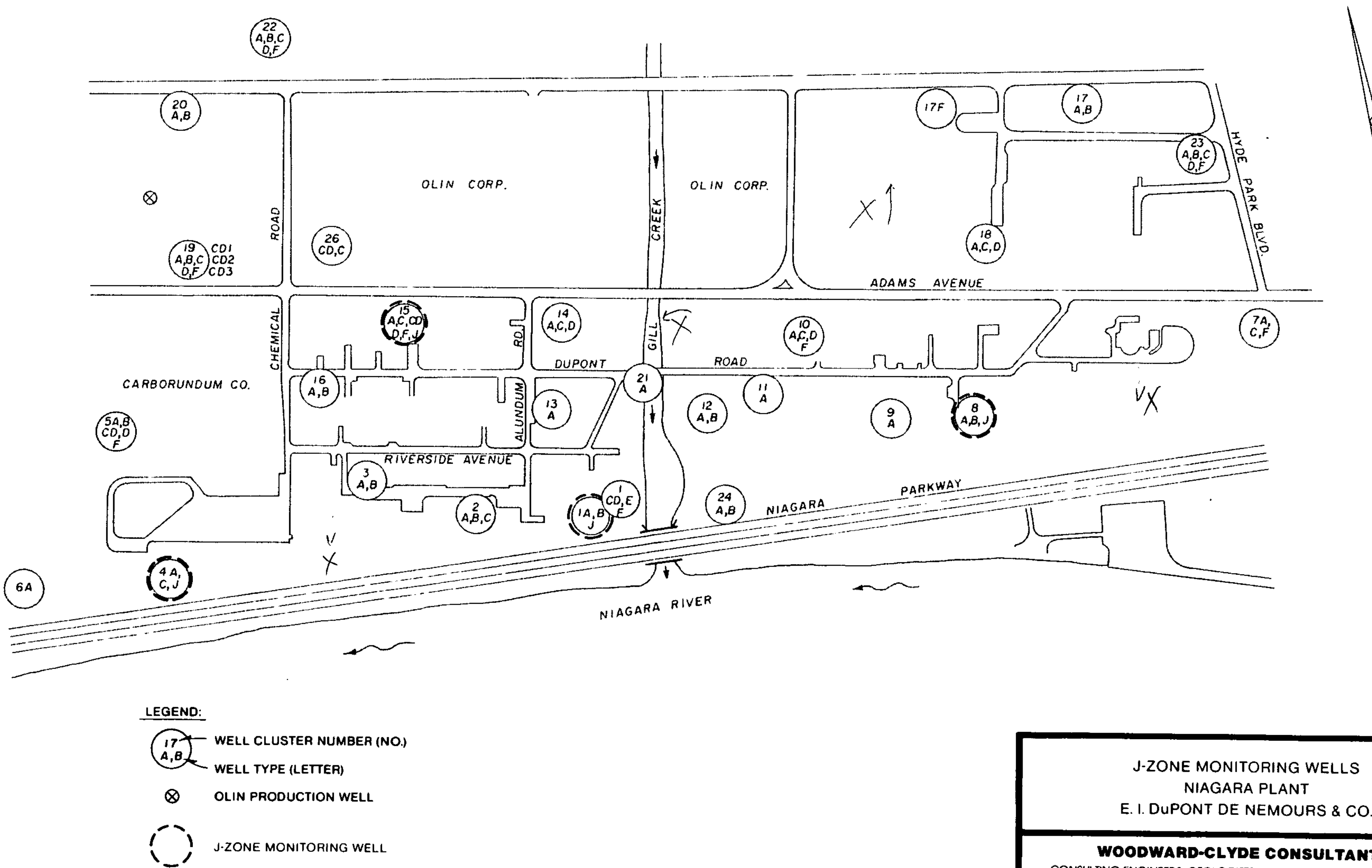
i. Height of Pressure Gauge above well casing (Hg)

j. Length and Diameter of Riser Stem for Packers.

3.3 EQUIPMENT CALIBRATION

Pressure gauges and the flowmeter shall be checked to determine that they are functioning properly prior to, during, and after completion of the testing program. Pressure meters and flowmeters shall be calibrated prior to use. All gauges and flowmeters will be calibrated prior to use at the site.

The testing apparatus shall be field-calibrated under the direction of the Engineer/Geologist for pressure losses at various flow rates and pipe lengths prior to commencement of the testing program.

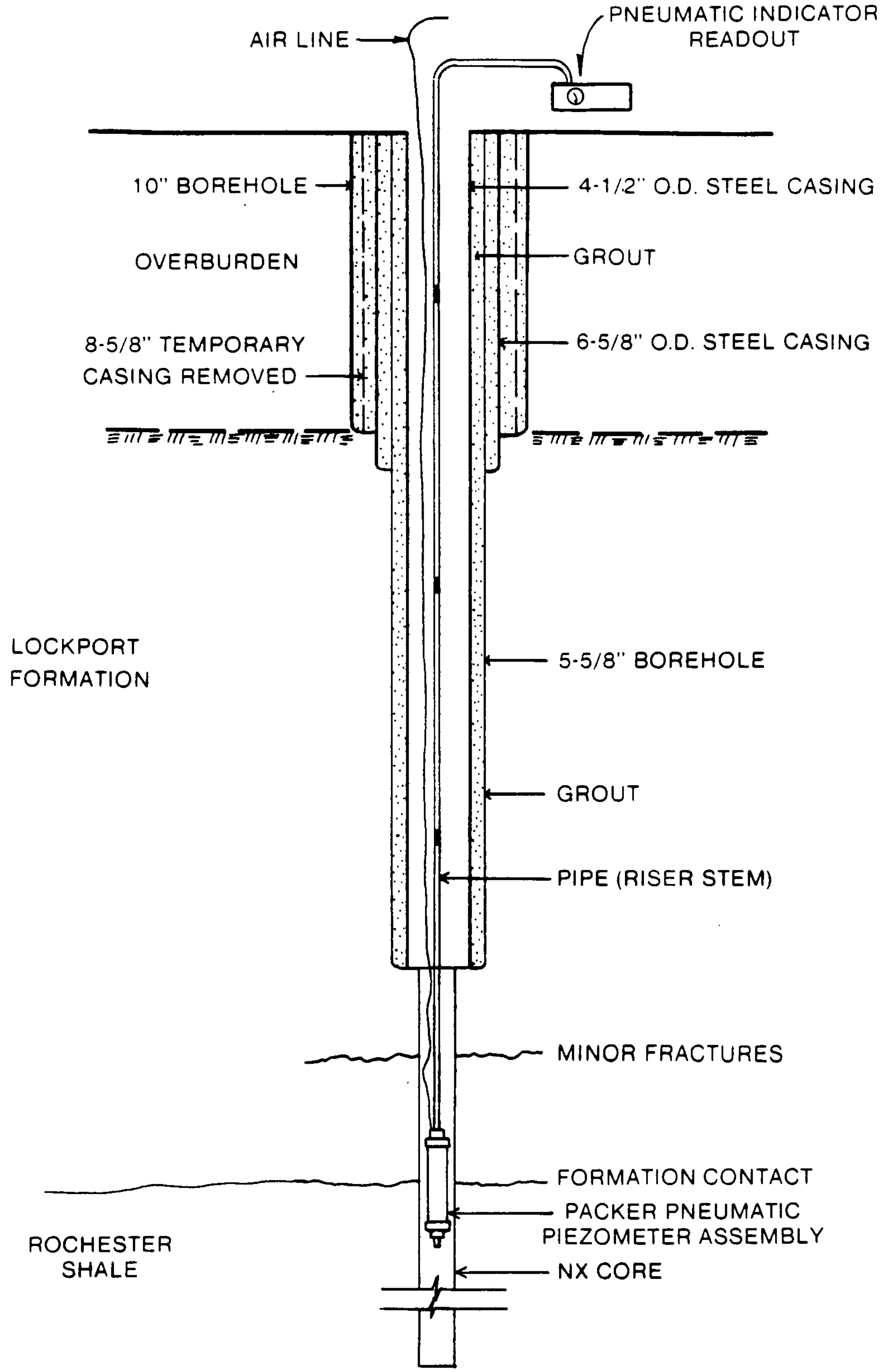


J-ZONE MONITORING WELLS
NIAGARA PLANT
E. I. DuPONT DE NEMOURS & CO.

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

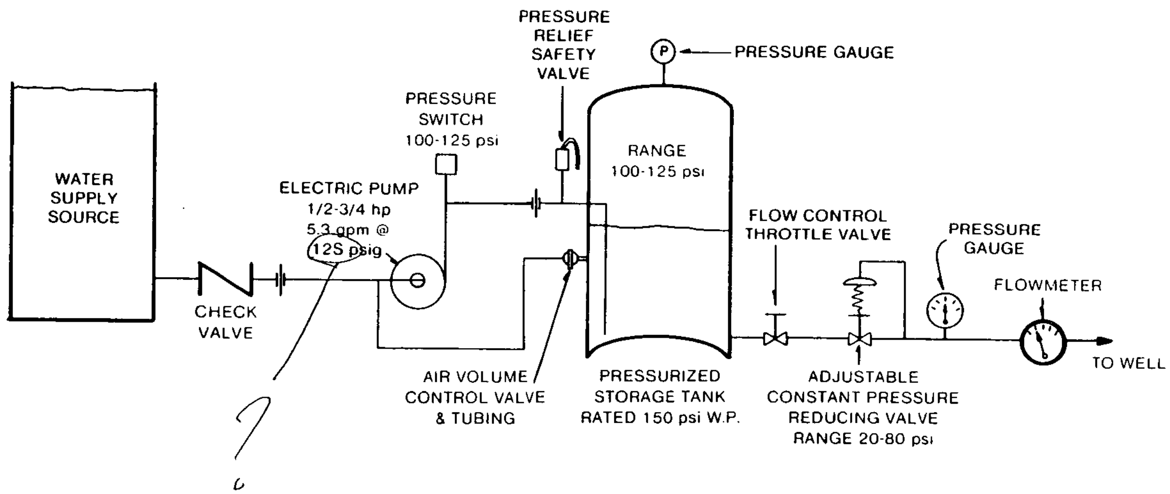
Drawn by: T.P.	SCALE IN FEET 0 300	Date: 7/29/86
Checked by: R.M.C.		Job: 83C2236-8

FIGURE A-1



PIEZOMETER - PACKER ASSEMBLY
IN-SITU PERMEABILITY TEST
NIAGARA PLANT
NIAGARA FALLS, NEW YORK

FIGURE A-2



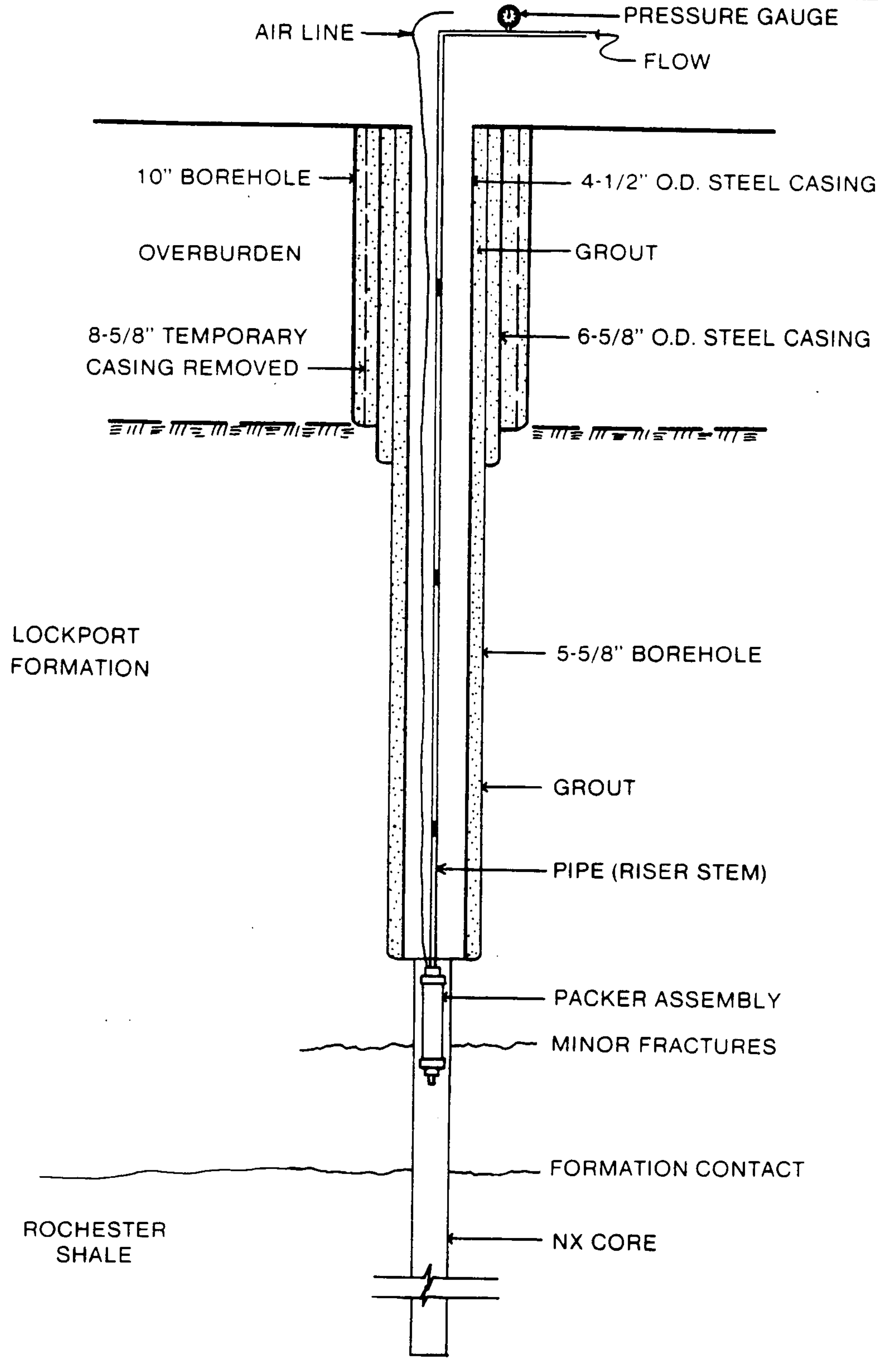
NOTE: CONSTANT PRESSURE SYSTEM
RANGE 20/80 psi FLOW 0 to 6 gpm

CONSTANT PRESSURE SYSTEM
IN-SITU PERMEABILITY TEST
NIAGARA PLANT
NIAGARA FALLS, NEW YORK

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIROMENTAL SCIENTISTS

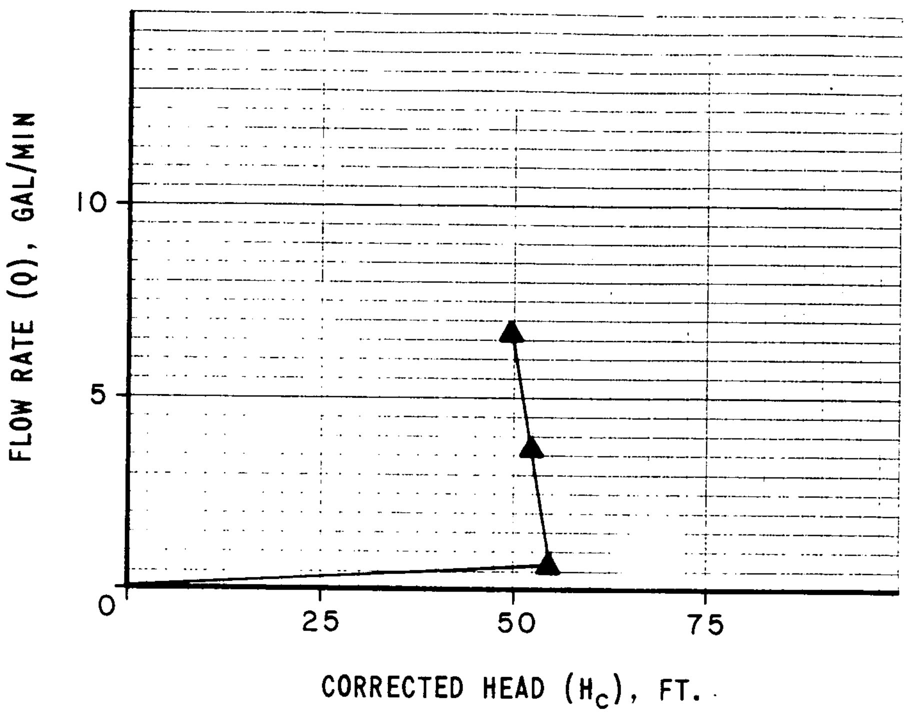
Drawn By T.P.	SCALE IN FEET	Date 10/30/85
Checked M.N.G.		Job 83C2238-21

FIGURE A-3



PACKER ASSEMBLY
IN-SITU PERMEABILITY TEST
NIAGARA PLANT
NIAGARA FALLS, NEW YORK

FIGURE A-4



NOTE: FLOW INCREASING WHILE HEAD DROPPING IS EVIDENCE OF HYDRO-FRACTURING

IN-SITU PERMEABILITY TEST
MONITORING WELL VH-149C
NIAGARA PLANT
NIAGARA FALLS, NEW YORK

FIGURE A-5

Woodward-Clyde Consultants

BEDROCK PERMEABILITY TEST: PACKER METHOD

INSPECTOR: ____________ OPERATOR: ____________ REVIEWED: ____________ DATE: ____________

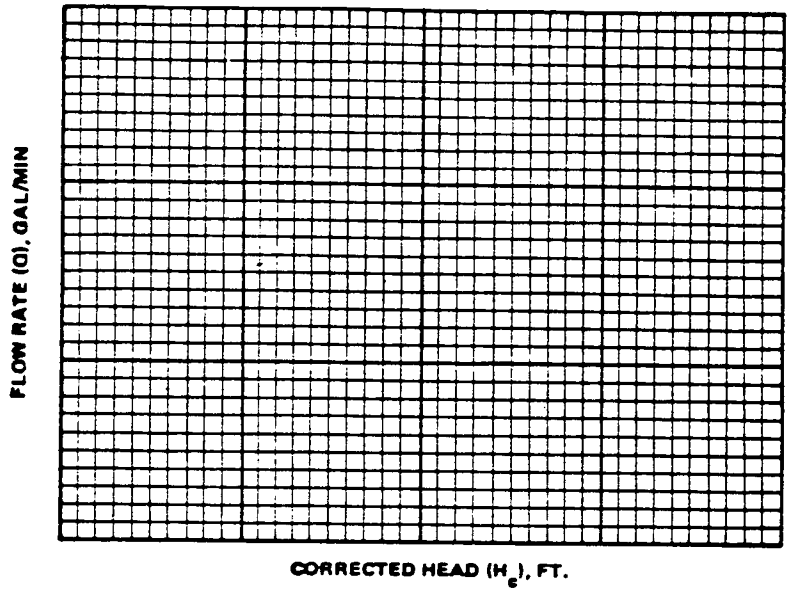
DATE: ____________ BORING: ____________ FRACTURE INTERVAL: ____________ RADIUS (r) ____________ IN. ____________ FT.

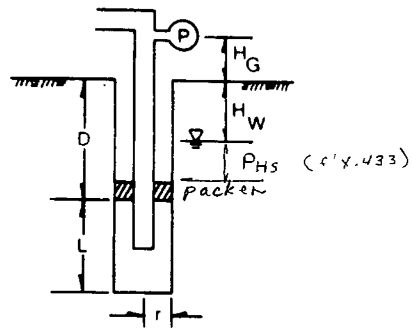
GROUND SURFACE EL. ____________ FT. DEPTH TO GROUNDWATER (H_W) ____________ FT. TEST LENGTH (L) ____________ FT.

DEPTH TO UPPER PACKER (D): V ____________ FT.

DEPTH TO LOWER PACKER, V ____________ FT. $\frac{L}{r}$ ____________ $F = \ln \frac{L}{r}$ ____________

WATER PIPE DIA. ____________ IN. LENGTH ____________ FT.





*1 PSI = 2.31 FT. WATER

$K = \frac{.0106\,(Q)\,(F)}{(L)\,(H_c)} =$ ____________ CM/SEC

Q IN GAL/MIN., H_c IN FEET

L IN FEET

REMARKS: ____________

CLOCK TIME	TEST TIME (MIN)	FLOW METER READING (GAL)				FLOW RATE GAL/MIN	GAGE READING		PIPE LOSS H_L (FT)	HEIGHT GAGE H_G (FT)	ΔH (FT) $\Delta H = H_W + H_G$	CORRECTED HEAD H_c (FT) $H_c = H_p - H_L + \Delta H$
		START	STOP	FLOW	CUM. FLOW		PSI	H_p (FT)*				

FIGURE A-6

Attachments

CONOCO

PROJECT NO. ______ PAGE 1 OF 1 BORING NO. WELL #1-J

PROJECT DUPONT EXPLORATORY WELLS

CLIENT DUPONT

ELEVATION ______ INSPECTOR JAMES ANTHONY WEATHER ______

DATE STARTED 3/2/83 COMPLETED 3/3/83 TECHNICIAN ______

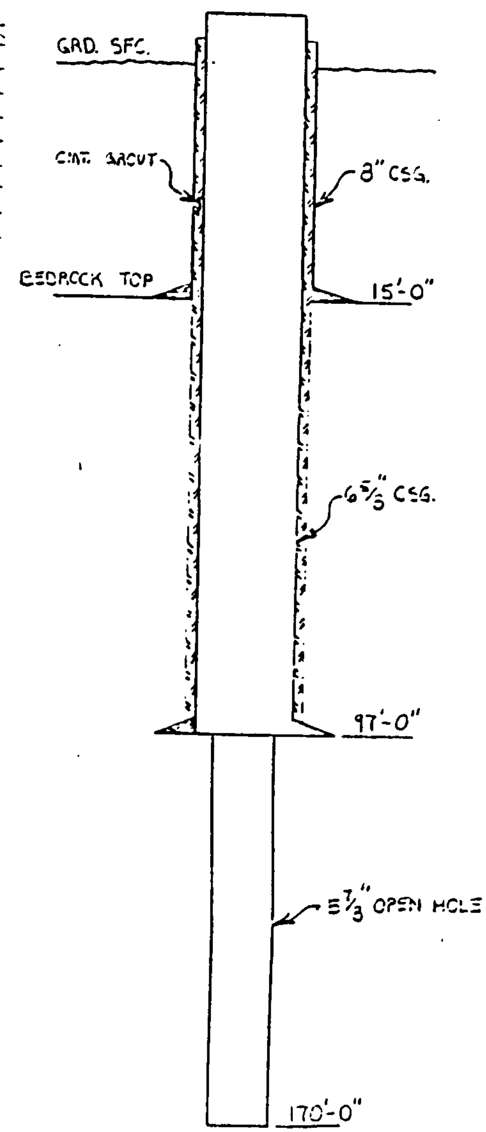
GROUND WATER – CASING IN – ______ AT COMPLETION / TIME ______

BELOW SURFACE – CASING OUT – ______ –WELLPOINT AT ______

DEPTH BELOW SURFACE	C	BLOWS ON SAMPLER 0"/6"	6"/12"	12"/18"	18"/24"	N	SAMPLE NO.	DEPTH OF SAMPLE	SOIL AND ROCK CLASSIFICATION REMARKS
									– BLDRS. & ROCKS & GEN. FILL – NO SAMPLES
									– DRILL 10" O.D. HOLE TO BEDROCK @ 15'-0"
									– 8" I.D. CSG. SET AGAINST BDR. (NO CMT. GROUT)
10'									– BEDROCK HIT @ DEPTH OF 15'-0"
									– DRILLED 7 7/8" O.D. HOLE F/ 15'-0" TO 17'-0"
									– 6 5/8" O.D. CSG. SET TO 17'-0"
									– DRILLED 5 7/8" O.D. HOLE F/ 97'-0" TO 170'-0"
20'									– DEVELOPMENT YIELDED 2 GAL./MIN. FROM 125'-0" WATER-BEARING FRAC., WATER WAS GREEN IN COLOR & HAD HEAVY SULFUR SMELL
30'									

NOTES: N = NO. OF BLOWS TO DRIVE ______ SPOON ______ WITH ______ LB. WT. ______
C = NO. OF BLOWS TO DRIVE ______ CASING ______ WITH ______ LB. WT. ______

WELL #1-J



GEOLOGY OF #1-J
(SEE #1-J)

CONOCO

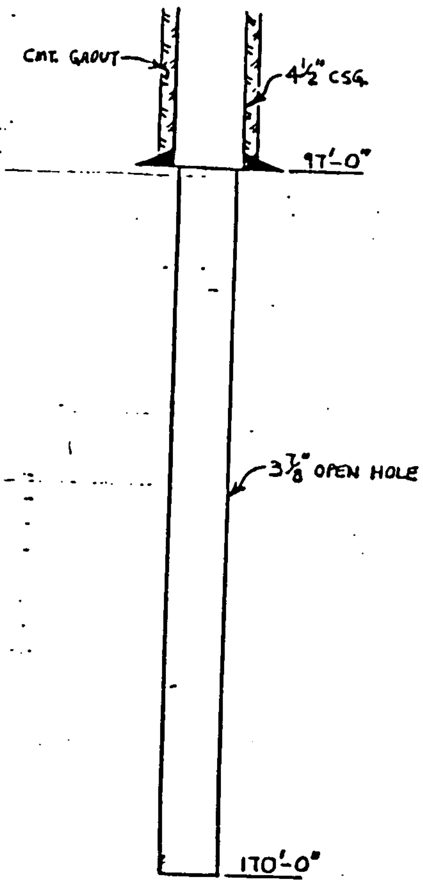
PROJECT NO. ____
DUPONT EXPLORATORY WELLS
[illegible] DUPONT
LOCATION ____
DATE STARTED 5/5/03
GROUND WATER - CASING IN -
BELOW SURFACE - CASING OUT -

PAGE 2 OF 2 BORING NO. WELL #1-G
INSPECTOR [illegible] WEATHER ____
COMPLETED 5/24/03 TECHNICIAN JOE KEMP
AT COMPLETION / TIME ____
-WELLPOINT AT ____

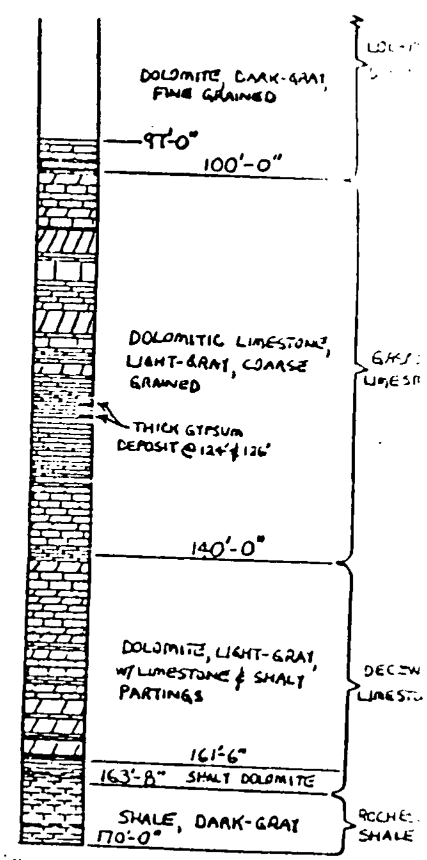
DEPTH BELOW SURFACE	C	BLOWS ON SAMPLER 0"-6"	6"-12"	12"-18"	18"-24"	N	SAMPLE NO.	DEPTH OF SAMPLE	SOIL AND ROCK CLASSIFICATION REMARKS
								RUN #8	
40'								RUN #9 124'-6" TO 140'-0" REC. 15'-1"	— REAMED F/ 97'-0" TO 170'-0" W/ 3 7/8" BIT
								RUN #10 140'-0" TO 155'-3" REC. 15'-1½"	— DEVELOPMENT YIELDED NO WATER FLOW AT ALL (DRY HOLE) AT FIRST. AFTER 3 WEEKS A SLOW LEAK IN THE CSG. (TESTS SHOWED A HOLE @ 13'-0") FILLED 70' OF THE OPEN HOLE. SAMPLE HAD ORGANIC SMELL W/ HEAVY SULPER SMELL AS WELL & WAS GREENISH-BLACKISH IN COLOR
60'								RUN #11 155'-3" TO 161'-6"	
								RUN #12 161'-6" TO 170'-0" REC. 8'-5½"	
80'									

NOTES: N = NO. OF BLOWS TO DRIVE ____ SPOON ____ WITH ____ LB. WT. ____ EA. BL
C = NO. OF BLOWS TO DRIVE ____ CASING ____ WITH ____ LB. WT. ____ EA. BL

WELL #1-G



GEOLOGY OF #1-G



Du Pont Monitoring Wells

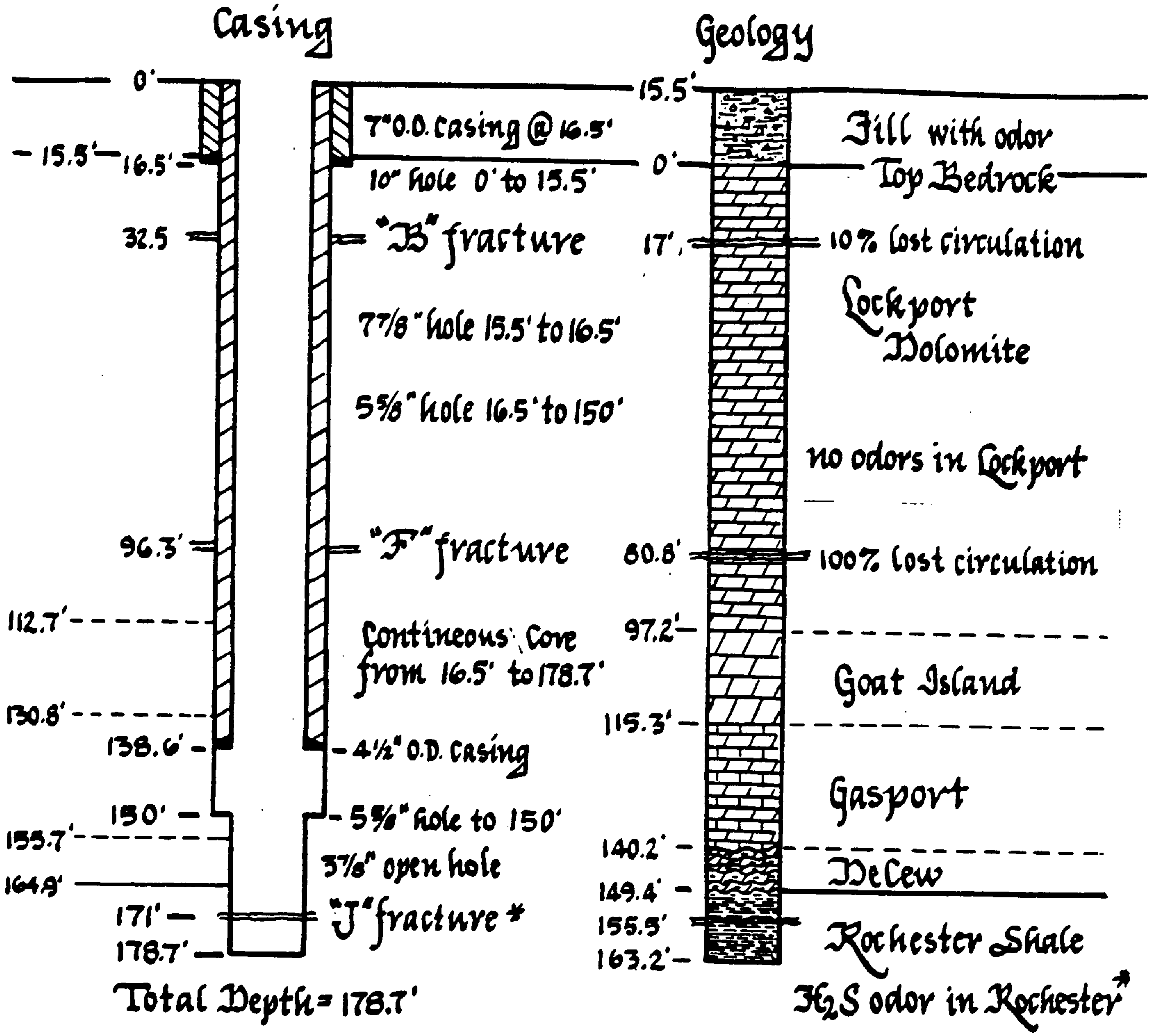
Plant Well No. 1J

1J

Plant Site 1

Spudded October 15, 1985 — Hassell Hunter — October 25 1985

Plant Well # 1J



HH 10-25-85

* "J" fracture contained natural hydrocarbon gas with an H_2S odor. Gas pressure blew water out of hole. Pressure depleted quickly. Killed well with water. Continued to core.

Vertical Scale 1" = 25'

LOG OF TEST BORING

DUPONT

DATE BEGUN 10-31-83
DATE COMPLETED
RIG NUMBER
PROJECT NUMBER
HOLE DIA.
PROJECT NAME
LOCATION Plant Site 4
METHOD USED
FIELD PARTY
WEATHER

HOLE NUMBER 4-J
SHEET ___ OF ___
TOTAL DEPTH
LOGGER Samuel L. Jones

GROUND WATER			
DEPTH IN FT			
TIME			
DATE			

LOCATION NOTES AND DIAGRAM:

TRAFFIC. DITCH.

VEGETATION:

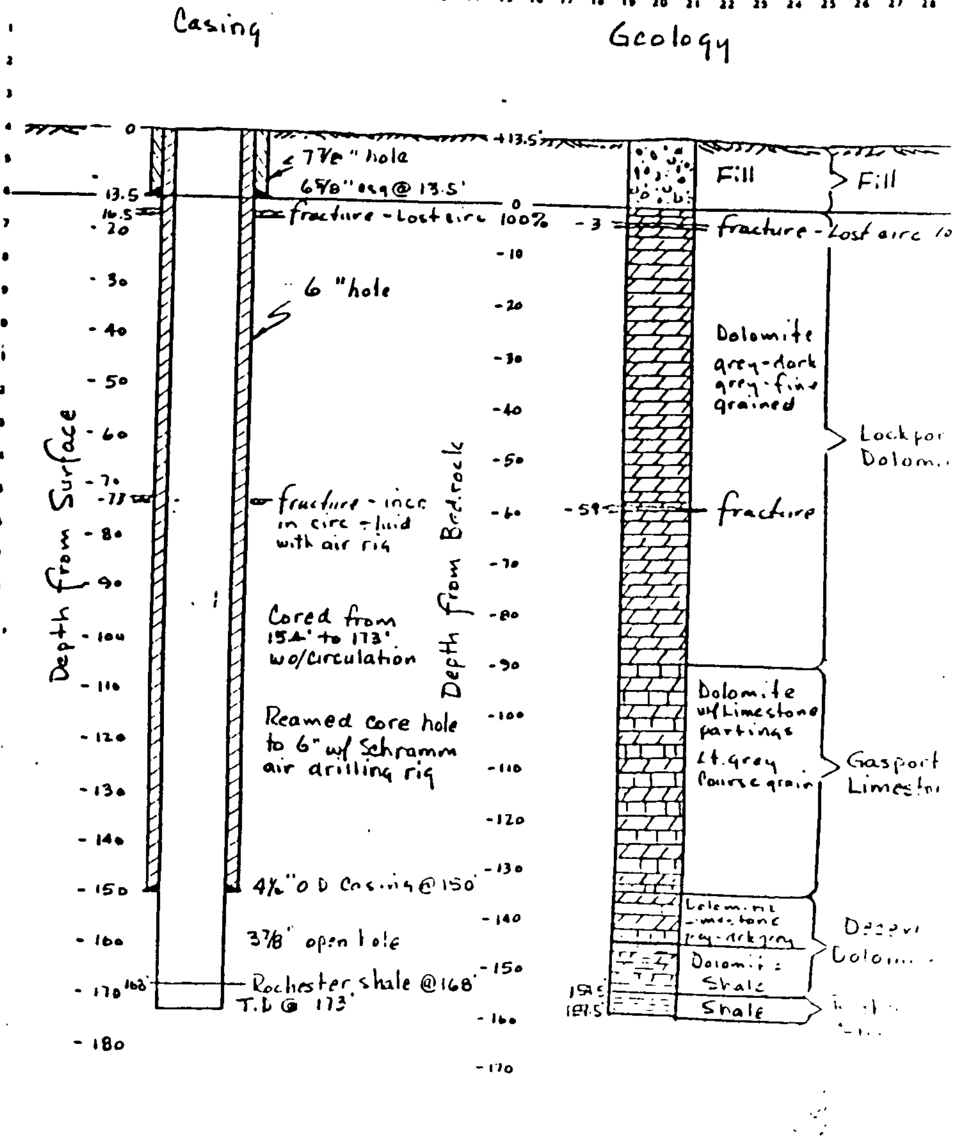
SAMPLING METHOD	SAMPLE NUMBER	BLOW COUNT	LOCATION SAMPLED	RECOVERY	DEPTH IN FEET	SOIL GRAPH	MOISTURE	CONSISTENCY	RQD	DESCRIPTION: SOIL TYPE, COLOR, TEXTURE, ESTIMATED PARTICLE SIZE, SAMPLER DRIVING NOTES, DEPTHS CIRCULATION LOST, NOTES ON DRILLING EASE, BITS USED, ETC.
										Fill 0-13.5' - Top bedrock @ 13.5'
					13.5			6½		
					16.5					Fracture at 16.5', lost 100% circ
										Cored 13.5' to 173'
										Reamed core hole to 6⅞" (6" nominal)
					73					Fracture at ≈73' - increase in fluid produced when reaming core hole with air circulation
										3⅞" open hole below 4½" casing
					150			4½"		4½" OD Casing set at 150' Cemented to surface
					173					Total Depth @ 173'
										Top Rochester Shale @ 168'

UNLESS OTHERWISE NOTED ALL SAMPLES ARE TAKEN WITH A STANDARD PENETRATION SAMPLER DRIVEN WITH 140 LB HAMMER 30"

ENGINEERING DUPONT COMPUTATION SHEET

SHEET NO

TITLE OF PROJ OR STUDY DuPont Exploratory Drilling
PROJ OR STUDY NO
SUBJECT Well No. 4-J
WORKS Plant S
COMPUTER H.E. Hunter DATE 11- - 85

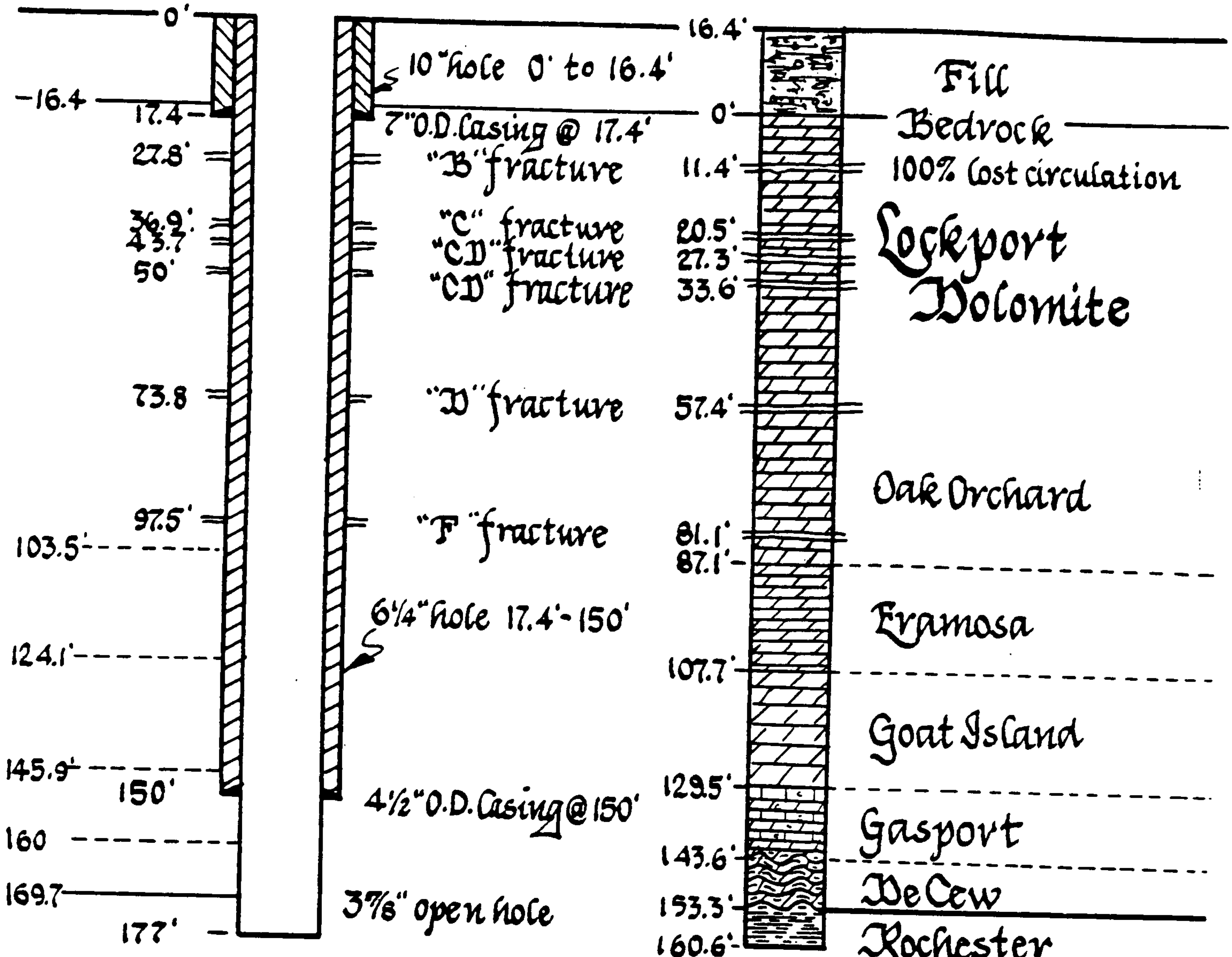


Vertical Scale 1 cm = 10 ft.

Du Pont Monitoring Wells
Plant Well No. 4-J (R)
Spudded November 25 '85   Hassell Hunter   December 11, 1985

4-J (R)
Plant Site 4

Plant Well # 4-J (R)



Total Depth = 177'

Contineous Core 17.4' to 177'

HH 12-11-85

Vertical Scale 1" = 30'

LOG OF TEST BORING

DUPONT

DATE BEGUN 11-3-83
DATE COMPLETED
RIG NUMBER
PROJECT NUMBER
PROJECT NAME
LOCATION Plant Site 8
METHOD USED
FIELD PARTY
WEATHER
HOLE DIA.
HOLE NUMBER 8-J
SHEET ___ OF ___
TOTAL DEPTH
LOGGER Harold Hunter

GROUND WATER TABLE			
DEPTH IN FT			
TIME			
DATE			

SAMPLING METHOD	SAMPLE NUMBER	BLOW COUNT	LOCATION SAMPLE	RECOVERY	DEPTH IN FEET	SOIL GRAPH	MOISTURE	CONSISTENCY	ROD	DESCRIPTION: SOIL TYPE, COLOR, TEXTURE, ESTIMATED PARTICLE SIZE, SAMPLER DRIVING NOTES, DEPTHS CIRCULATION LOST, NOTES ON DRILLING EASE, BITS USED, ETC.
					12'			6⅝		Fill 0-12' Top of Bedrock at 13'
										6⅝" Casing set at 12' - on 2nd attempt first hole abandoned because of junk in hole. Junk encountered on 2nd hole also.
										Cored from 13'-170.5'
										Reamed core hole to 6" to casing point. Strong odor encountered while reaming with air 0'-38'. Changed circulation system to water to ream remainder of hole. No returns to surface.
										3⅞" open hole below casing
										Top Rochester Shale @ 165'
					170.5		T.D.			Total Depth @ 170.5'

LOCATION NOTES AND DIAGRAM:

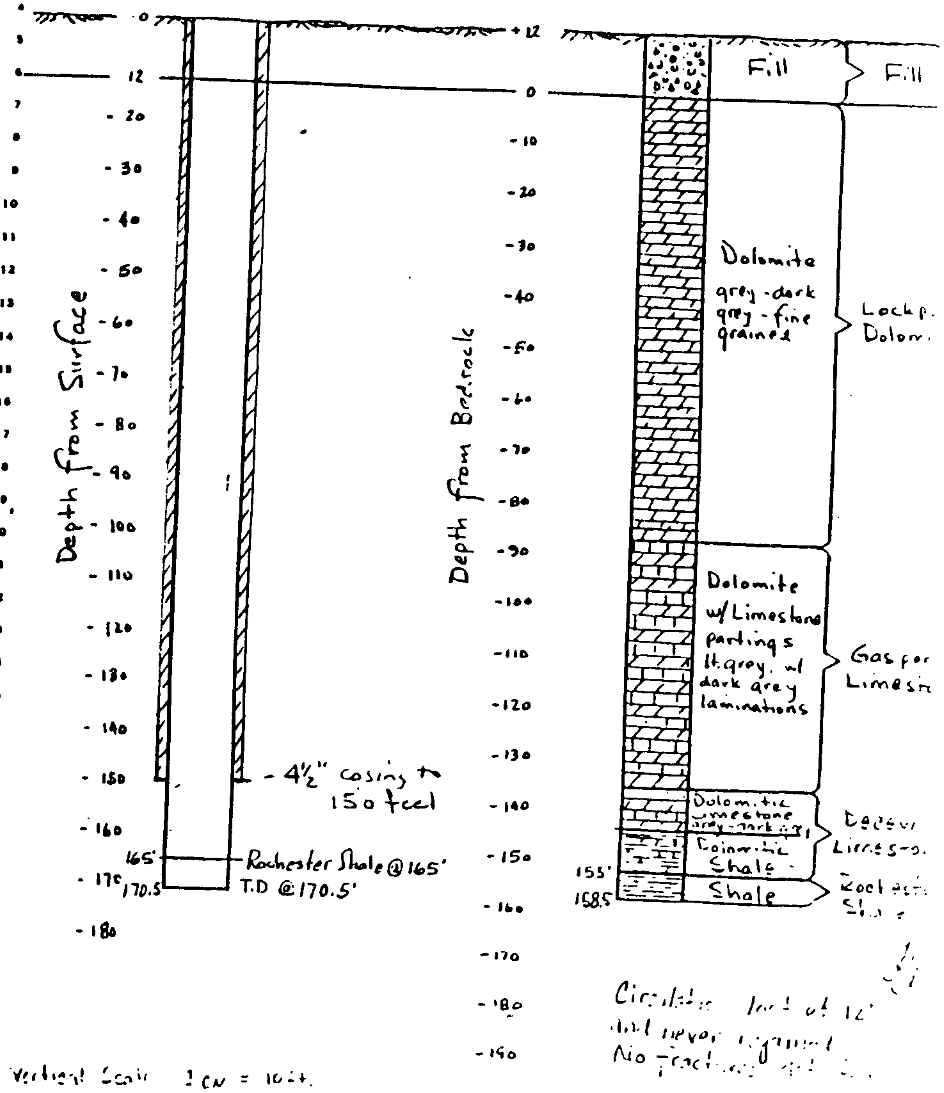
TRAFFIC. DITCH.

VEGETATION:

UNLESS OTHERWISE NOTED ALL SAMPLES ARE TAKEN USING STANDARD PENETRATION SAMPLER DRIVEN BY 140 LB HAMMER

ENGINEERING DUPONT COMPUTATION SHEET

TITLE OF PROJ OR STUDY DuPont Exploratory Drilling
SUBJECT Well No. 8-J
PROJ OR STUDY NO.
WORKS Plant 8
COMPUTER H.E. Hunter
DATE
SHEET



Circulation lost at 12' and never regained. No fractures ...

Vertical Scale 1 cm = 10 ft.

LOG OF TEST BORING

DUPONT

DATE BEGUN	10-31-83
DATE COMPLETED	
FILE NUMBER	
PROJECT NUMBER	HOLE DIA.
PROJECT NAME	
LOCATION	Plant Site 15
METHOD USED	
FIELD PARTY	
WEATHER	

HOLE NUMBER 15-J
SHEET ___ OF ___
TOTAL DEPTH ___
LOGGER [signature]

GROUND WATER TABLE			
DEPTH IN FT			
TIME			
DATE			

LOCATION NOTES AND DIAGRAM:

TRAFFIC. DITCH.

VEGETATION:

SAMPLING METHOD	SAMPLE NUMBER	BLOW COUNT	LOCATION SAMPLED	RECOVERY	DEPTH IN FEET	SOIL GRAPH	MOISTURE	CONSISTENCY	R.Q.D.	DESCRIPTION (SOIL TYPE, COLOR, TEXTURE, ESTIMATED PARTICLE SIZE, SAMPLER DRIVING NOTES, DEPTHS CIRCULATION LOST, NOTES ON DRILLING EASE, BITS USED, ETC.)
					6'					Fill 0-6' Top bedrock @ 6'
										Drilled hole with 6" bit using the Schramm air rig from 6' to 150'
										6" hole
										No fractures detected while drilling with air.
					150					4½" O.D. Casing at 150' - Cemented to surface
										Cored 154.5-169.5 - Top Rochester Shale 162.5
										Reamed open hole to 3⅞"
					169.5			T.D.		Total Depth - 169.5'

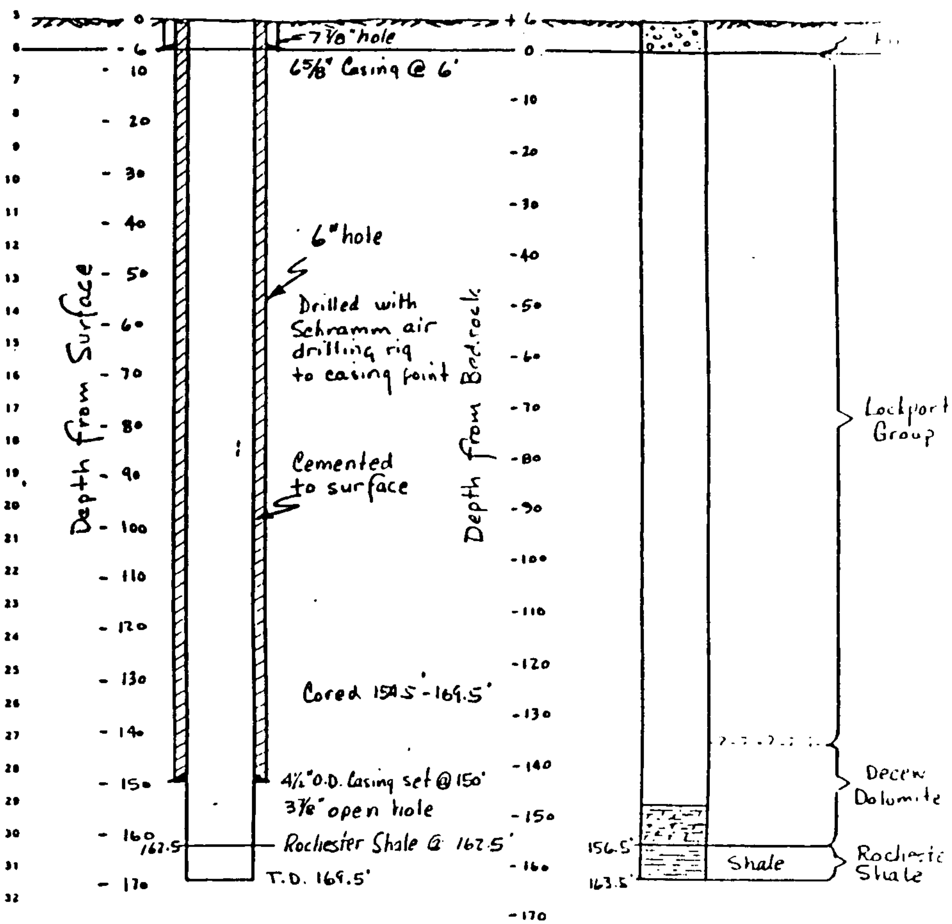
UNLESS OTHERWISE NOTED ALL SAMPLES ARE TAKEN WITH 2" STANDARD PENETRATION SAMPLER DRIVEN WITH 140 LB HAMMER 30"

ENGINEERING DUPONT COMPUTATION SHEET

SHEET NO. ___

TITLE OF PROJ OR STUDY: DuPont Exploratory Drilling
SUBJECT: Well No. 15-J
WORKS: Plant Site
COMPUTER: H.E. Hunter DATE ___

Casing Geology



Vertical Scale 1 cm = 10 ft.

[initials] 11/11/8[?]