EMPIRE
SOILS INVESTIGATIONS INC. S-5167 SOUTH PARK AVENUE • HAMBURG, NY 14075-1503 • 716/649-8110 FAX 716/649-8051

Duplicate

SUBSURFACE REPORT
ON-SHORE INVESTIGATION
GILL CREEK REMEDIATION
DUPONT CHEMICALS
NIAGARA FALLS, NEW YORK

Prepared for:

DuPont Chemicals
Buffalo Avenue and Chemical Road
Niagara Falls, New York 14302

Attention: Mr. Joe Clark

BTA-92-073
APRIL 24, 1992

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SUBSURFACE REPORT
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INTRODUCTION

Empire Soils Investigations, Inc. (Empire) was requested and authorized by Mr. Joe Clark of DuPont Chemicals (DuPont) to collect and compile subsurface data for Gill Creek Remediation project at DuPont's facility located on Buffalo Avenue in Niagara Falls, New York. The purpose of this investigation is to obtain geotechnical and environmental data with respect to the proposed cofferdam at the creek.

This project was completed in accordance with a work plan provided by DuPont titled "DuPont Chemicals, Niagara Falls Plant - Sampling and Testing Scope of Work on the Robert Moses Parkway and in the Niagara River for Relocating 006/007 Outfalls to the Niagara River Project and Gill Creek Remediation Project". This document included a general layout plan and Figure 4-4 which show the proposed locations of one (1) test pit and two (2) test borings. A copy of these drawings is included in Appendix A.

The subsurface investigation program included test borings TH-1 and TH-2, and test pit PTP-4. The number and locations of the test borings and test pit were selected by others. Neal R. Klettke, L.S., contracted by DuPont, staked the test locations in the field and determined ground surface elevations. These elevations are referenced to the DuPont datum.

Empire coordinated the subsurface investigation program with DuPont representatives and Woodward-Clyde Consultants, civil engineers for DuPont. The test pit was excavated by Sevenson Environmental Services, a subcontractor for DuPont, using a track-mounted Komatsu 300 backhoe. The test borings were drilled by Empire. The test pit and borings were logged in the field by an Empire Environmental Geologist. The Empire geologist monitored air quality

and excavated soils with an organic vapor analyzer (OVA) during the field work for health and safety purposes. The test pit and boring logs are enclosed in Appendix B. Empire conducted packer and/or gravity permeability testing within the rock strata in test borings. The results of these tests are included in Appendix C.

Empire collected samples of overburden materials during the test pit excavation for geotechnical and chemical laboratory analyses. Geotechnical and chemical analytical parameters for the overburden samples were selected by DuPont and/or Woodward-Clyde personnel. The results of geotechnical laboratory testing, which included gradation (sieve) analysis and Atterberg Limits tests, are enclosed in Appendix D. Geotechnical analyses were completed by Huntingdon Analytical Services (HAS) of Middleport, New York; a subsidiary of Empire. Chemical analyses were completed by Recra Laboratories of Amherst, New York, contracted by DuPont.

Our interpretation of the subsurface conditions is based on the soils sampled at the test pit and boring locations and the results of laboratory soil tests. Variations from inferred soil characterization and ground water observations should be expected. The subsurface logs should be referred to for a detailed description of the subsurface conditions at each test location. The lines designating the interfaces between various strata on the logs are approximate. The transition between strata may actually be gradual.

A review of geotechnical and chemical analytical data for the soil and ground water samples for this project and preparation of associated environmental and geotechnical recommendations was not in Empire's scope of services.

TEST BORINGS TH-1 AND TH-2

Test borings TH-1 and TH-2 were completed by Empire between March 23-27, 1992 using a CME-55 track-mounted drilling rig. Boring TH-1 was located on the western and boring TH-2 was situated on the eastern sides of Gill Creek and at the bank of Niagara River. The borings were advanced generally per ASTM D-1586 in overburden and ASTM D-2113 in rock.

The test borings TH-1 and TH-2 revealed fill materials extending to depths of about 14.2 and 13.1 feet, respectively, below grade. The fill consists of an upper layer of clayey silt with variable amounts of sand to 4.0 feet (TH-1) and 3.5 feet (TH-2). This upper layer is underlain by shot rock in TH-2 and gravel to sand sized crushed limestone in TH-1. Boring TH-2 was offset to several locations in its vicinity as auger refusal within the shot rock was encountered. Rock coring was performed to depths of 45 feet in TH-1 and 45.9 feet in TH-2. The rock is gray dolomitic limestone. An apparent void was noted at depths of 16.8 to 17 feet in TH-1. The rock is highly fractured and weathered to depths of 17.5 feet in TH-1 and 24 feet in TH-2. An allowable load bearing pressure of 25 tons per square foot may be considered for competent rock below the fractured or weathered zones.

The Empire geologist scanned the recovered soil and rock samples in the field with a Photoionization Detector (PID) for the presence of volatile organic compounds. The background PID readings were 0.2 to 0.8 parts per million (ppm) within the fill materials. The rock samples had PID readings up to approximately 400 ppm and exhibited a noticeable chemical-type odor.

TEST PIT PTP-4

Test pit PTP-4 was completed on March 20, 1992. The pit was located on the eastern bank of Gill Creek at Niagara River and just south of Robert Moses Parkway.

Grass and a thin layer of topsoil were observed at the ground surface. Below the topsoil, miscellaneous fill materials consisting of clayey silt with sand, gravel and boulders were encountered to a depth of approximately 4 feet. Excavation through these fill materials using the backhoe was relatively easy. Fill materials consisting of crushed limestone rock and boulders ("shot rock") were encountered between depths of 4 feet and test pit termination depth of 16 feet. The diameter of some of the large boulders was as much as 4 feet. Water was encountered in the excavation at a depth of approximately 11 feet. Excavation effort was moderate to difficult through the shot rock.

PID readings on excavated fill materials from test pit PTP-4 were at background levels. The Empire geologist collected separate samples of both the upper finer-grained fill materials and the shot rock fill for geotechnical laboratory analysis.

PACKER AND GRAVITY PERMEABILITY TESTS

Empire conducted packer and gravity tests in rock strata to estimate rock permeability in general accordance with Section 118 of the Design of Small Dams (Department of the Interior, Bureau of Reclamation, 1977, pp 193-196). Detailed results of these tests are provided in Appendix C.

The constant head gravity test in boring TH-2 between a depth of 13.5 and 25.9 feet indicated a rock permeability of approximately 2.1×10^{-3} feet per second. Packer tests in borings TH-1 between 19.5-45.5 feet and TH-2 between 25.9-45.9 feet indicate a permeability typically ranging from 0.4×10^{-5} feet per second to 4.4×10^{-5} feet per second.

Grout injection test was attempted in borehole TH-1 between 19 and 45 feet depths. The rock formation accepted approximately 20 gallons of grout in about 6 minutes. The test was terminated as subsequent grout intake stopped. Grout mix proportion was 25 gallons water with four (4) 94-pound bags of portland cement.

REMARKS

This report is intended for use by the client and its designated professionals to make site evaluations and to advance the design of the project. Use of this report for other purposes is not permitted without the written authorization of Empire Soils Investigations, Inc.

This report has been prepared in accordance with generally accepted geotechnical and environmental engineering practices. No warranty or guarantee, either expressed or implied, is made.

We appreciate the opportunity of service on this project. If there are any questions regarding the report, please contact us.

Respectfully Submitted,
EMPIRE SOILS INVESTIGATIONS, INC.

David R. Steiner
Senior Environmental Geologist

Sunil K. Mital
Geotechnical Engineer

Mohamed M. Yasin
Dr. Mohamed M. Yasin, P.E.
Senior Environmental Engineer

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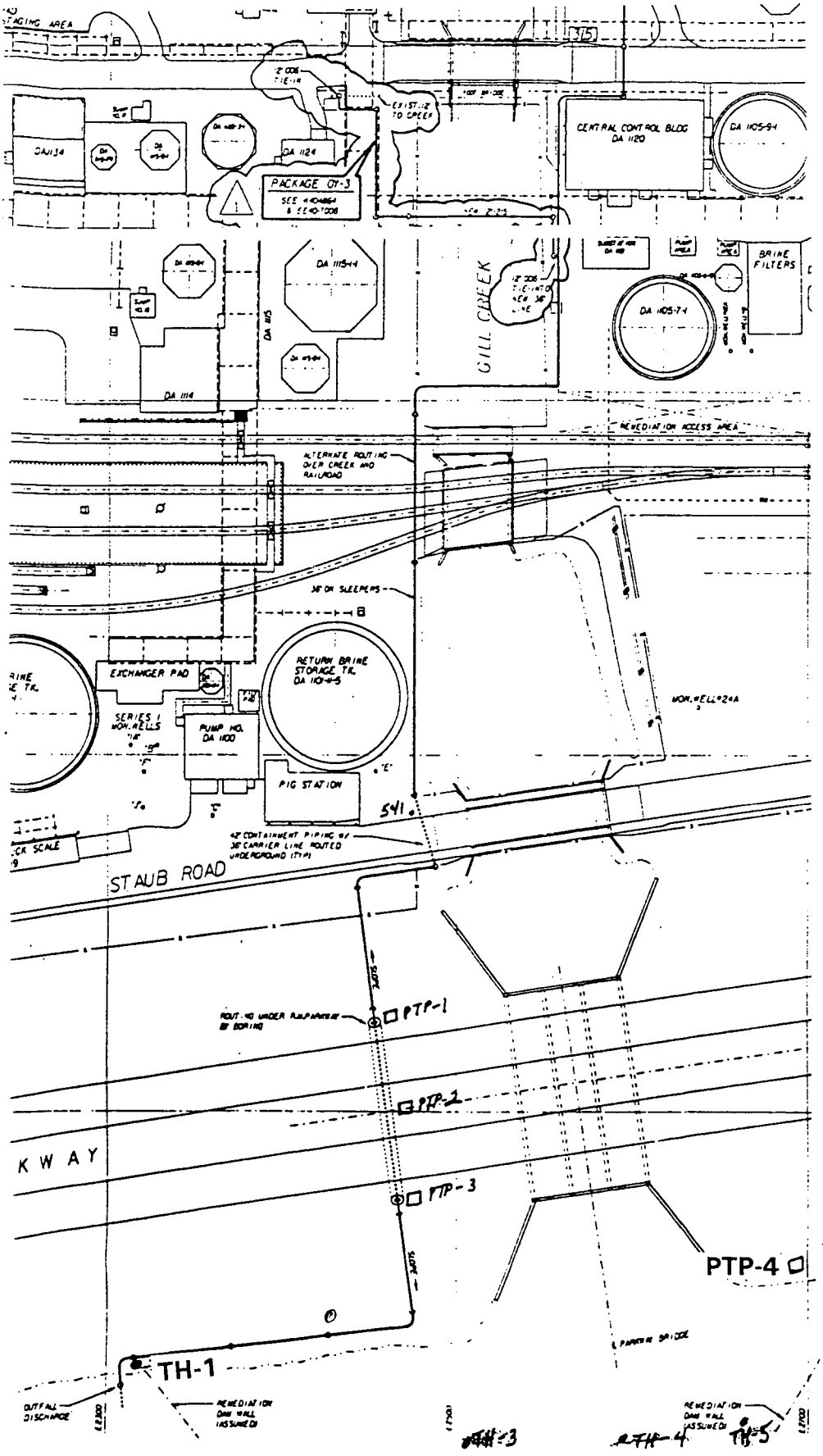
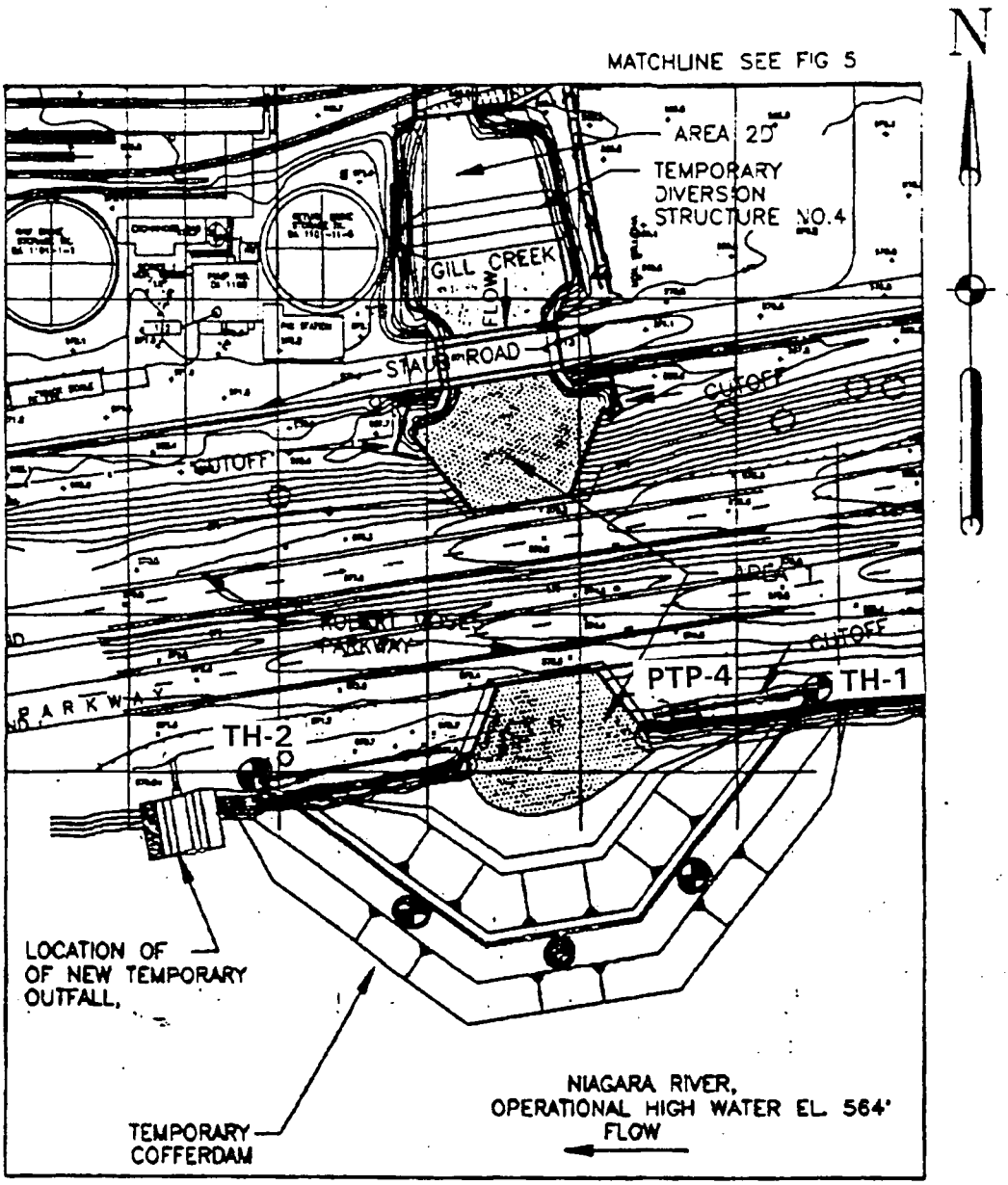
APPENDIX A



EMPIRE SOILS INVESTIGATIONS INC.	SITE LOCATION MAP ON-SHORE INVESTIGATION GILL CREEK REMEDIATION NIAGARA FALLS, NEW YORK	PROJECT: BTA-92-073	DRAWING NO: A
		SCALE: N.T.S.	DRAWN BY: ---
		DATE: APRIL 1992	CHECKED BY: ---

TEST BORING AND TEST PIT
LOCATIONS ARE APPROXIMATE

Woodward-Clyde Consultants



SCALE: 1" = 100'

E.I. duPONT deNEMOURS & CO OLIN CORPORATION	Job No. : 22915 Prepared by : LDF Date : 2/14/92	PLAN VIEW OF TEMP. DIVERSION STR. NO. 4 & TEMP. COFFERDAM FIG. 4-4

TEST BORING AND TEST PIT
LOCATIONS ARE APPROXIMATE

EMPIRE SOILS INVESTIGATIONS INC.

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APPENDIX B

GENERAL INFORMATION & KEY TO SUBSURFACE LOGS

The Subsurface Logs attached to this report present the observations and mechanical data collected by the driller at the site, supplemented by classification of the material removed from the borings as determined through visual identification by technicians in the laboratory. It is cautioned that the materials removed from the borings represent only a fraction of the total volume of the deposits at the site and may not necessarily be representative of the subsurface conditions between adjacent borings or between the sampled intervals. The data presented on the Subsurface Logs together with the recovered samples will provide a basis for evaluating the character of the significance relative to each other. Often analyses of standard boring data indicate the need for additional testing or sampling procedures to more accurately evaluate the subsurface conditions. Any evaluation of the contents of this report and the recovered samples must be performed by Professionals. The information presented in the following defines some of the procedures and terms used on the Subsurface Logs to describe the conditions encountered.

1. The figures in the Depth column defines the scale of the Subsurface Log.

2. The sample column shows, graphically, the depth range from which a sample was recovered. See Table 1 for a description of the symbols used to signify the various types of samples.

3. The Sample No. is used for identification on sample containers and/or Laboratory Test Reports.

4. Blows on Sampler - shows the results of the "Penetration Test", recording the number of blows required to drive a split spoon sampler into the soil. The number of blows required for each six inches of penetration is recorded. The first 6 inches of penetration is considered to be a seating drive. The number of blows required for the second and third 6 inches of penetration is termed the penetration resistance, N. The outside diameter of the sampler, the hammer weight and the length of drop are noted at the bottom of the Subsurface Log.

5. PID - Organic vapor measurements taken with a Photoionization Detector (PID). Measurements recorded in parts per million (ppm).

6. Symbol - Material symbol which indicates the type of soil that was encountered during classification of the recovered soil at the approximate depth. The symbol indicated represents an approximate boundary between soil types and the transition may be gradual.

7. All recovered soil samples are reviewed in the laboratory by an engineering technician, geologist, or geotechnical engineer, unless note otherwise. The visual descriptions are made on the basis of a combination of the driller's field descriptions and observations and the sample as received in the laboratory. The method of visual classification is based primarily on the United Soil Classification (ASTM D 2487-83) with regard to the particle size and plasticity. (See Table No. II) Additionally, the relative portion, by weight, of two or more soil types is Burmister, ASTM Special Technical Publication 479, June 1970. (See Table III) The description of the relative soil density or consistency is based upon the penetration records as defined on Table No. IV. The description of the soil moisture is based upon the relative wetness of the soils as recovered and is described as dry, moist, wet and saturated. Water introduced in the boring either naturally or during drilling may have affected the moisture condition of the recovered sample. Special terms are used as required to describe materials in greater detail; several such terms are listed in Table V. When sampling gravelly oils with a standard two inch diameter split spoon, the true percentage of gravel is often not recovered due to the relatively small sampler diameter. The presence of boulders and large gravel is sometimes, but not necessarily detected by an evaluation of the casing and samplers blows or through the "action" of the drill rig as reported by the driller.

8. The description of the rock shown is based on the recovered rock core and the driller's observations. The terms frequently used in the description are included in Table VI.

9. The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Solid stratification lines are based on the driller's field observations.

10. Miscellaneous observations and procedures noted by the driller are shown in this column, including water level observations. It is important to realize the reliability of the water level observations depends upon the soil type (water does not readily stabilize in a hole through fine grained soils), and that drill water used to advance the boring may have influenced the observations. The ground water level typically will fluctuate seasonally. One or more perched or trapped water levels may exist in the ground seasonally. All the available readings should be evaluated. If definite conclusions cannot be made, it is often prudent to examine the conditions more thoroughly through test pit excavations or water observations wells.

11. The length of core run is defined as the length of penetration of the core barrel. Core recovery is the length of core recovered divided by the core run. The RQD (Rock Quality Designation) is the total pieces of NX core exceeding 4 inches in length divided by the core run. The size core barrel used is also noted.

DATE
STARTED: 5-7-91
FINISHED: 5-7-91

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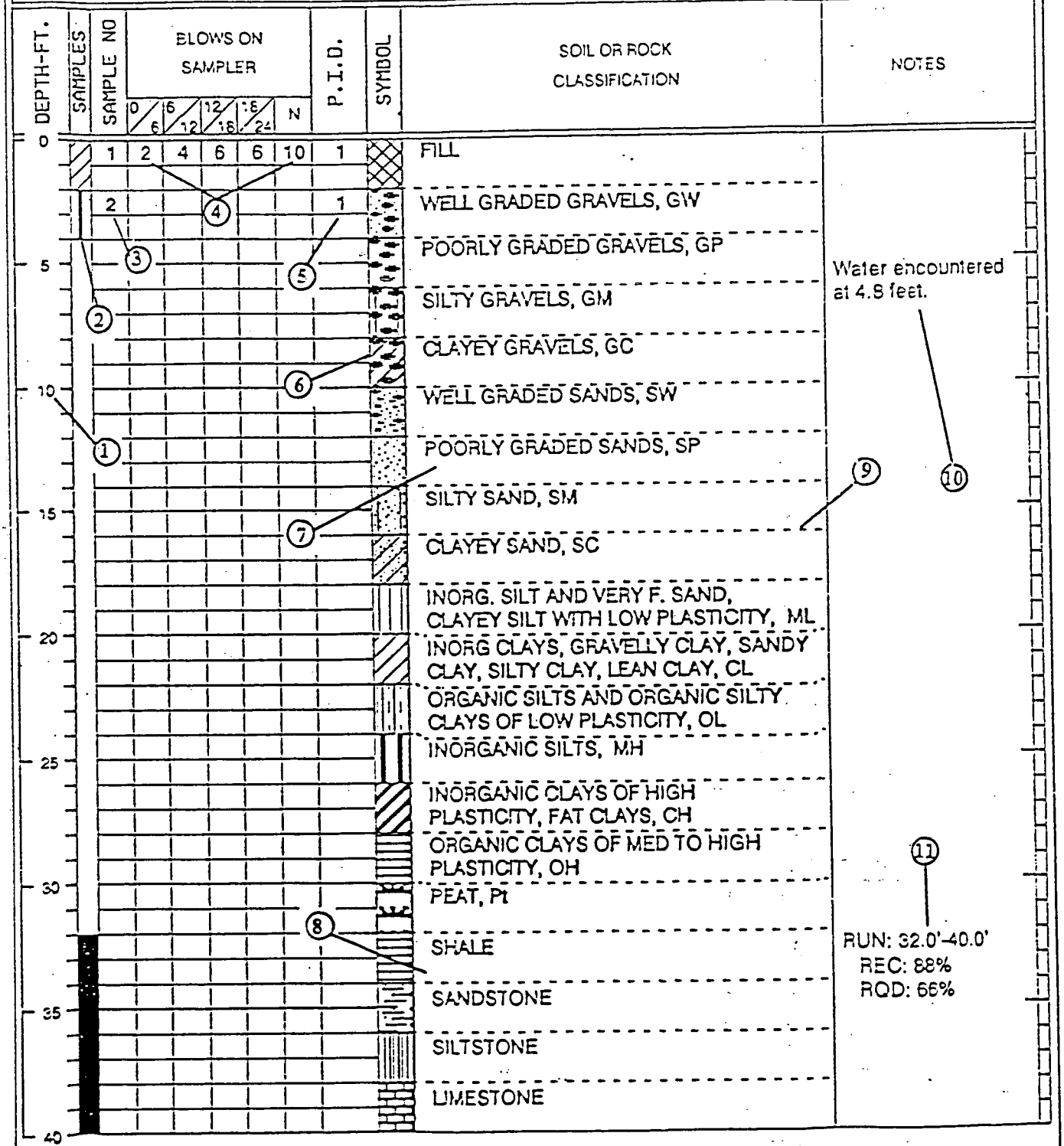
SUBSURFACE LOG

BORING NO.: B-1
SURF. ELEV.: 100.0 ±
SHEET 1 OF 1

PROJECT: SAMPLE SUBSURFACE LOG
PROJECT NO: _____
LOCATION: _____
CLIENT: _____



DRILLER: _____
DRILL RIG: CME - 45
METHOD OF INVESTIGATION: ASTM D-1586 Using Hollow Stem Augers
WEATHER: Sunny, 70 F
CLASSIFIED BY: By Geologist

TABLE I


Split Spoon Sample


Shelby Tube Sample


Auger or Test Pit Sample


Rock Core

TABLE III

The following terms are used in classifying soils consisting of mixtures of two or more soil types. The estimate is based on weight of total sample.

Term	Percent of Total Sample
"and"	35 - 50 %
"some"	20 - 35 %
"little"	10 - 20 %
"trace"	less than 10 %

(When sampling gravelly soils with a standard split spoon, the true percentage of gravel is often not recovered due to the relatively small sampler diameter.)

TABLE V

Varved	-	Horizontal uniform layers or seams of soil(s).
Layer	-	Soil deposit more than 6" thick.
Seam	-	Soil deposit less than 6" thick.
Parting	-	Soil deposit less than ⅛" thick.
Laminated	-	Irregular, horizontal and angled seams and parings of soil(s).

TABLE II

Identification of soil types is made on basis of an estimate of particle sizes, and in the case of fine grained soils also on basis of plasticity.

Soil Type	Soil Particle Size	
Boulder	> 12"	Course Grained (Granular)
Cobble	3" - 12"	
Gravel-Coarse	3" - ¾"	
-Fine	¾" - #4	
Sand-Coarse	#4 - #10	
-Medium	#10 - #40	
-Fine	#40 - #200	
Silt: Non-Plastic (Granular)	< #200	Fine Grained
Clay: Plastic (Cohesive)		

TABLE IV

The relative compactness or consistency is described in accord with the following terms.

Granular Soils		Cohesive Soils	
Term	Blows per Foot, N	Term	Blows per Foot, N
Loose	< 11	Very Soft	< 3
Firm	11 - 30	Soft	3 - 5
Compact	31 - 50	Medium	6 - 15
Very Compact	> 50	Stiff	16 - 25
		Hard	> 25

(Large particles in the soils will often significantly influence the blows per foot recorded during the Penetration Test.)

TABLE VI

Rock Classification Terms		Meaning
Hardness:	Soft	Scratched by fingernail.
	Medium Hard	Scratched easily by penknife.
	Hard	Scratched with difficulty by penknife.
	Very Hard	Cannot be scratched by penknife.
Weathering:	Very Weathered	Judged from the relative amounts of disintegration iron staining, core recovery, clay seams, etc.
	Weathered	
	Sound	
Bedding:	Laminated	Natural Breaks in Rock Layers (< 1")
	Thin Bedded	(1" - 4")
	Bedded	(4" - 12")
	Thick Bedded	(12" - 36")
	Massive	(> 36")

(Fracturing refers to natural breaks in the rock oriented at some angle to the rock layers.)

DATE
STARTED: 3-23-92
FINISHED: 3-25-92

EMPIRE
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SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-1
SURF. ELEV.: 569.9 ±
SHEET 1 OF 2

PROJECT: Dupont - Gill Creek Remediation
CLIENT: E. I. DuPont de Nemours & Co.
LOCATION: Mouth of Gill Creek, Niagara Falls, N.Y.

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	P.I.D.	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	4	9	50/0.2'		REF.	BG		Brown Clayey SILT, little fine Sand, tr. slag, tr. glass (moist, FILL)	BG PID = 0.2-0.8 ppm
		2	28	100/0.2			REF.	BG			Poor Recovery S-2
5		3	25	21	18	13	39	BG		Gray Crushed Limestone ROCK, Gravel and Sand-Sized, tr. silt (wet, FILL)	
10		4	25	10	17	9	27	--			No Recovery S-4
		5	3	16	17	18	33	50-100		Gray and Black f-c Sand, little Gravel (Crushed Limestone), little Silt (wet, FILL)	S-5 has chemical-odor
										Auger Refusal at 14.2'	
15										Gray dolomite Limestone ROCK, very weathered to sound, hard, occasional styolites Vertical fracture 15.2' - 16.7' Very weathered and fractured 14.2' - 17.2' Apparent void 16.8'-17.0', possible core loss Becomes sound at 17.5'	NX Core Core Run #1 14.2'-24.2' REC=9.8'/10.0' RQD = 6.8/10.0' PID = 2-5 ppm on rock core
20											
25											

DRILLER: A. Koske
DRILL RIG: CME-55 Track
METHOD OF INVESTIGATION: ASTM D-1586 USING HOLLOW STEM AUGERS
WEATHER: Partly Cloudy, 30's
CLASSIFIED BY: D.R. Steiner

DATE
STARTED: 3-23-92
FINISHED: 3-25-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-1
SURF. ELEV.: 569.9 ±
SHEET 2 OF 2

PROJECT: Dupont - Gill Creek Remediation
CLIENT: E. I. DuPont de Nemours & Co.

LOCATION: Mouth of Gill Creek
Niagara Falls, N.Y.

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER (0/6 6/12 12/18 18/24 N)	P.I.D.	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
25							Run 2:24.2-29.8' REC= 5.6/5.6=100% RQD = 5.3/5.6' PID = 1.3 ppm on rock core
30							Run 3:29.8-39.8' REC=10.0/10.0' RQD = 9.3/10.0' PID = 300-400 ppm on rock core
35						Fractured Rock 35.1' - 35.4' Fractured and Vuggy 36.8' - 37.5', Highest PID in this zone	Drillers say rock has odor-like "NAPL"
40							Run 4:39.8-45.0' REC= 100% RQD = 100% PID=30-50 ppm on rock core
45						Boring Complete at 45.0'.	BOH at 45.0' at 8:30 AM on 3/25/92 Free Standing Water at 8.5'
50							

DRILLER: A. Koske
DRILL RIG: CME-55 Track
METHOD OF INVESTIGATION: ASTM D-1586 USING HOLLOW STEM AUGERS
WEATHER: Partly Cloudy, 30's
CLASSIFIED BY: D.R. Steiner

DATE
STARTED: 3-26-92
FINISHED: 3-27-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-2
SURF. ELEV.: 569.6 ±
SHEET 1 OF 2

PROJECT: Dupont - Gill Creek Remediation
CLIENT: E. I. DuPont de Nemours & Co.
LOCATION: Mouth of Gill Creek, Niagara Falls, N.Y.

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER (0/6, 6/12, 12/18, 18/24, N)	P.I.D.	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	3 13 27 100/0.5 REF	BG		Brown Clayey SILT, little f-c Sand, little Crushed Limestone Rock (moist, FILL)	BG PID=0.2-0.8 ppm
						Shotrock FILL, very difficult drilling	Auger Refusal at approx. 4.5'; Moved ~ 2.0'west and refusal at ~4.0'; Moved 5' east and refusal at 6.5'; Advanced hole with 3-3/4" roller bit. Set 3" Flush-Joint (F.J.) temporary casing to 10.4'.
5							
10							NX Core: Run 1: 10.2'-15.8' Apparent Boulder & Fill to 13.1'(Top of Bedrock) REC = 2.7'/2.7' RQD = 1.0'/2.7' PID=BG on rock core Advanced 3" F.J. casing to 13.5'; Flushed inside of F.J. casing with water in an attempt to remove debris. Hole open to 13.2' after flushing.
15						Gray dolomitic Limestone Rock, weathered, hard, frequent styolites, frequent horizontal to angular fractures	
20						Frequent horizontal fractures 16.0' - 17.2' Frequent angular fractures 17.2' - 18.2' Becomes vuggy 18.6' - 19.1'	
25						Contains frequent horizontal fractures and vugs; possible core loss 19.5' - 22.4' Frequent horizontal fractures 23.0' - 24.1'	Run 2: 15.8-16.0' (core block)

DRILLER: A. Koske
DRILL RIG: CME-55 Track
METHOD OF INVESTIGATION: ASTM D-1586 USING HOLLOW STEM AUGERS
WEATHER: Overcast, Occasional Rain, 30's
CLASSIFIED BY: D.R. Steiner

DATE
STARTED: 3-26-92
FINISHED: 3-27-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-2
SURF. ELEV.: 569.6 ±
SHEET 2 OF 2

PROJECT: Dupont - Gill Creek Remediation
CLIENT: E. I. DuPont de Nemours & Co.
LOCATION: Mouth of Gill Creek
Niagara Falls, N.Y.

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER (0/6 6/12 12/18 18/24 N)	P.I.D.	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
25						Becomes sound at 24.1'	Run 3: 16.0-19.2'(core block) REC = 100% RQD = 1.0'/3.2' PID=BG on rock core RUN 4:19.2'-25.9' REC=5.2/6.7 RQD=2.7/6.7 PID on Vuggy Zone=50-100 ppm on sound rock=1-3 ppm RUN 5: 25.9'-34.7' REC=10.0/8.8' RQD = 8.4/10.0' PID = 3-10 ppm on rock core Recovered 1.2' of "extra" core not obtained during Run 4. Run 6: 34.7'-35.9' REC = 100% RQD = 0.9/1.2' Run 7: 35.9-45.9' REC=100% RQD=98% PID=50-100ppm on rock core Approximtely 50-75% of water return during coring.
30							
35						Contains vugs and fractures 30.5' - 31.7' and 33.6' - 34.7'	
40						Sound rock with chemical-odor	
45						Boring Complete at 45.9'. Approximately 50-75% of water return during coring.	
50							

DRILLER: A. Koske
DRILL RIG: CME-55 Track
METHOD OF INVESTIGATION: ASTM D-1586 USING HOLLOW STEM AUGERS
WEATHER: Overcast, Occasional Rain, 30's
CLASSIFIED BY: D.R. Steiner

TEST PIT FIELD LOG

EMPIRE SOILS INVESTIGATIONS INC

PROJECT
DESCRIPTION: Line Relocation
LOCATION: DuPont/Robert Moses Pkwy

TEST PIT NO. PTP-4
FILE NO. BTA-92-073
DATE 3-20-92

ENGINEER D.R. Steiner
WEATHER Cold, Breezy, 20's

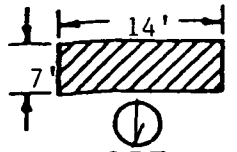
EXCAVATION EQUIPMENT
CONTRACTOR Sevenson
OPERATOR
MAKE Komatsu MODEL Track Hoe
CAPACITY C.Y. REACH FT.

GROUND ELEV. 569.8
TIME STARTED 10:15 AM
TIME COMPLETED 11:35 AM

DEPTH	SOIL DESCRIPTION	EXCAV. EFFORT	BOULDER COUNT QTY. CLASS.	PID
0'	Grass @ Surface			
1'	Brown Clayey SILT, also contains Sand, Gravel, Boulders	E		BG
2'	(FILL)	E		BG
3'		M		BG
4'		M		BG
5'	Crushed Gray Limestone ("Shot Rock") Contains large amount of Boulders, 0.5-2' Diameter, some 3'-4' Diameter.	M		BG
6'		M		BG
7'		D		BG
8'		D		BG
9'		D		BG
10'	Encountered Water @ 11.0'	D		BG
11'		D		BG
12'		D		BG
13'		D		BG
14'	Test Pit Terminated at 16.0'	D		BG

REMARKS: PID = Photoionization Detector Readings (ppm)
Background (BG) PID = -0.2 - 0.8 ppm

TEST PIT PLAN



VOLUME = _____ C.Y.

LEGEND:

BOULDER COUNT

SIZE RANGE CLASSIFICATION	LETTER DESIGNATION
6"-18"	A
18"-36"	B
36" AND LARGER	C

PROPORTIONS USED

TRACE (TR.)	0-10%
LITTLE (LI.)	10-20%
SOME (SO.)	20-35%
AND	35-50%

ABBREVIATIONS

F - FINE
M - MEDIUM
C - COARSE
F/M - FINE TO MEDIUM
F/C - FINE TO COARSE
V - VERY
GR. - GRAY
BN. - BROWN
YEL. - YELLOW

EXCAVATION EFFORT

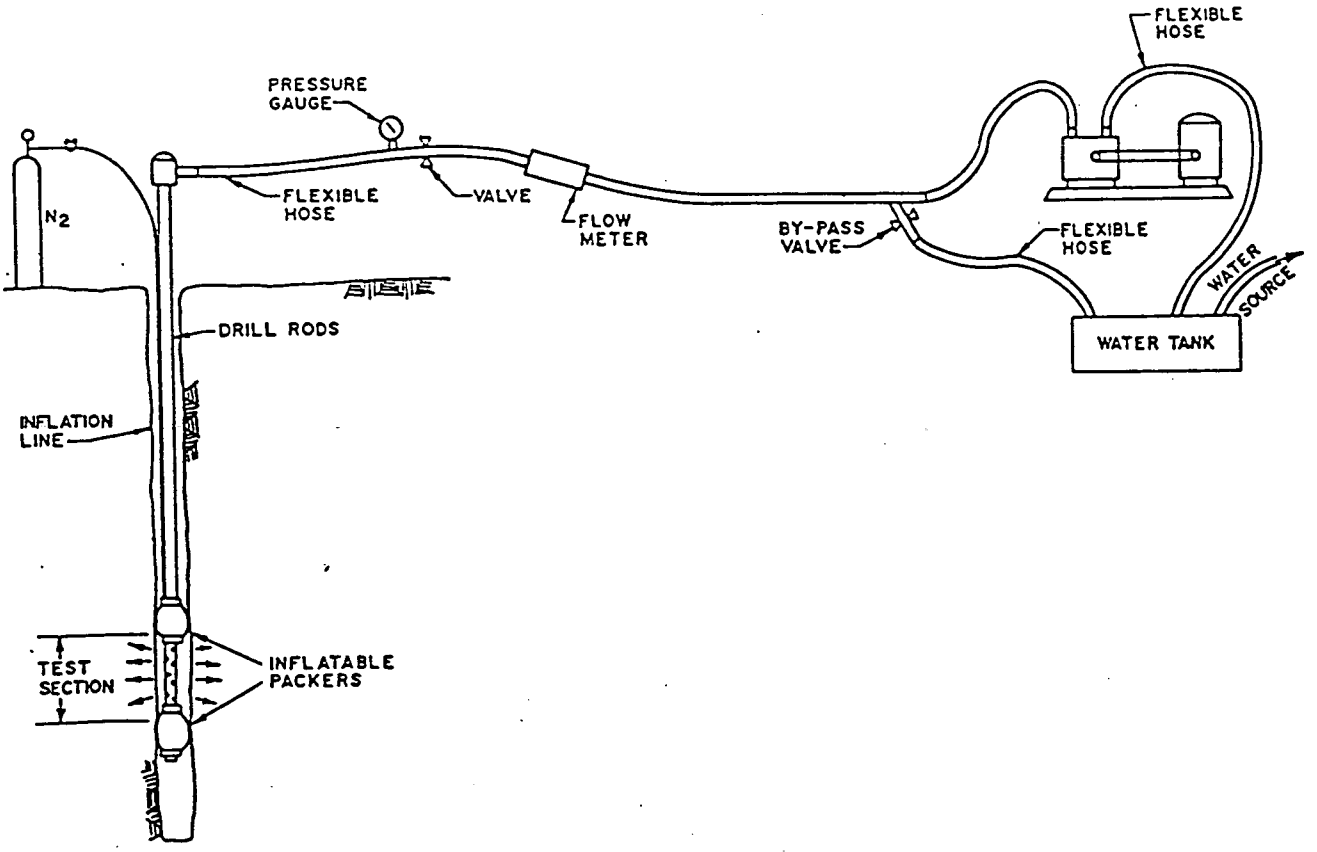
EASY — E
MODERATE — M
DIFFICULT — D

GROUNDWATER

ELAPSED TIME TO READING (HRS.) 2 G.W.L.

EMPIRE
SOILS INVESTIGATIONS INC.

APPENDIX C



EMPIRE SOILS INVESTIGATIONS INC

PACKER TYPE PRESSURE TEST APPARATUS

GENERAL EQUIPMENT SET-UP

DR.BY:	SCALE: none	PROJ. NO. BTA-92-073
CK'D.BY:	DATE: 4-92	DRWG.NO. B

R/T FORM R-1

Single Packer Test

K = coefficient of permeability, feet per second under a unit gradient

Q = steady flow into well, ft^3/sec

$H = h_1 + h_2 - L$ = effective head, ft

h_1 = (below water table) = distance between gage and water table, ft

h_2 = applied pressure at gage, 1 lb/in^2 = 2.307 ft of water

L = head loss in pipe due to friction, ft; ignore head loss for $Q<4$ gal/min in 1¼-inch pipe; use length of pipe between gage and top of test section for computations

A = length of test section, ft

r = radius of test hole, ft.

C_s = conductivity coefficient for semi-spherical flow in saturated materials through partially penetrating cylindrical test wells

S = thickness of saturated material, ft

a = surface area of test section, ft^2; area of wall plus area of bottom for method 1; area of wall for method 2

Limitations:

$Q/a \leq 0.10$, $S \geq 5A$, $A \geq 10r$, thickness of each packer must be $\geq 10r$ in method 2

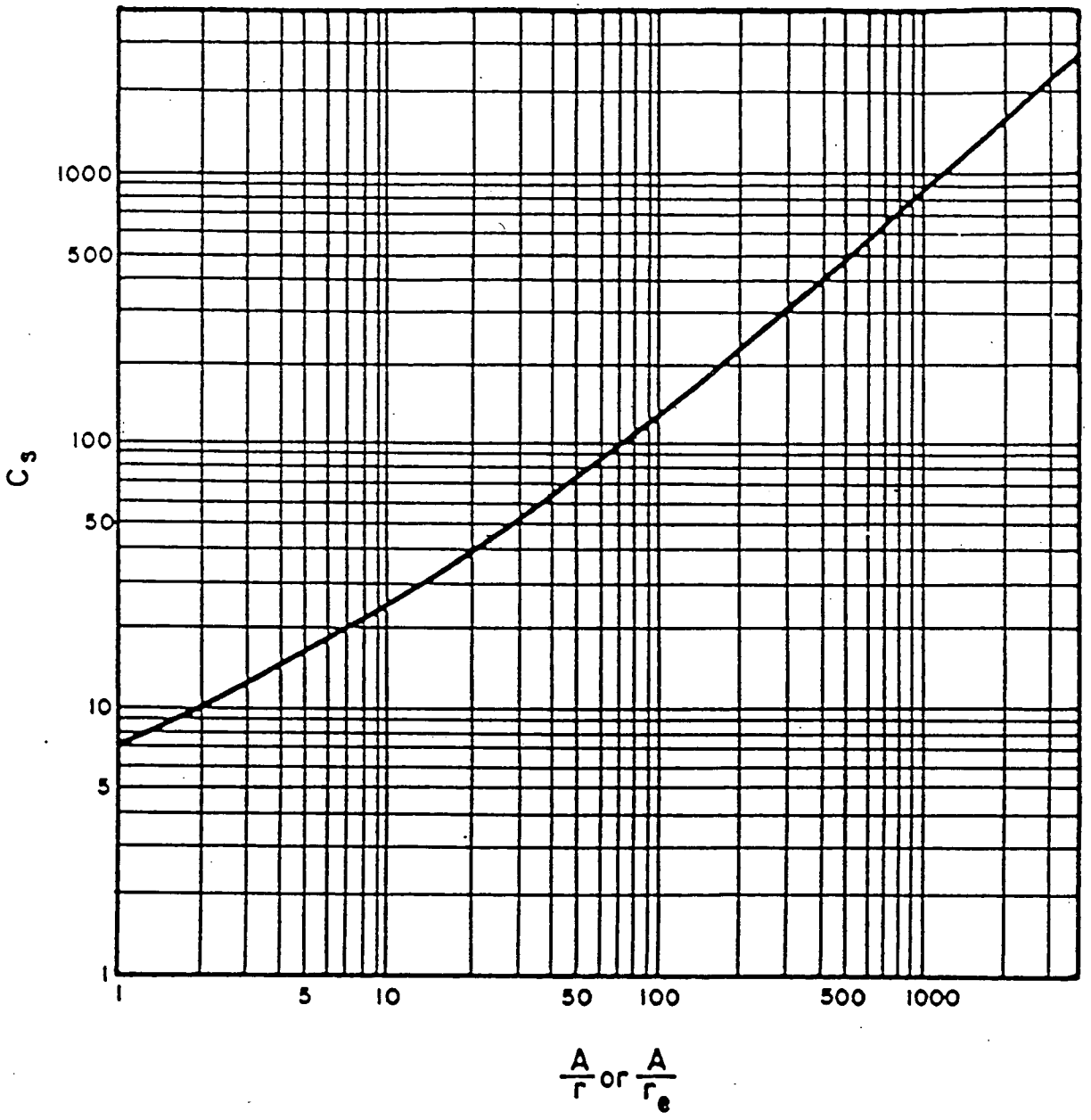


FIGURE 10-8.—Conductivity coefficients for semispherical flow in saturated materials through partially penetrating cylindrical test wells [4]. 103-D-1477.

$$\frac{A}{r}=\frac{10}{0.5}=20 \text{ and } C_s=39.5$$

IPIRE
VESTIGATIONS INC

REPORT OF PRESSURE PERMEABILITY TESTS IN STABLE ROCK

Project BTA-92-073 Logged by SKM Ground Elevation 569.9

Hole No. TH-1 Date Started 3-24-92 Rock Elevation

Location A Date Completed 3-24-92 Water Depth During Test 7.9 FT

Single Packer Test

Test No.	Depth FT. To Bottom of Borehole 1	Depth FT. To Bottom of Top Packer 2	Length of Interval Tested (1-2) FT A	Radius of Test Hole FT R	A/R	Gauge Pressure x 2.31 FT h_2	Vertical Distance from Gauge to Water Table (5.3+7.9) FT h_1	Head Loss in Pipe Length From Gauge to Top Packer L	$(h_1 + h_2 - L)$ FT H	Water Loss (ft^3)	Elapsed Time SEC	Rate of Flow ft^3/sec * 10^{-4} Q	Thickness of Saturated Layer S	Conductivity Coefficient Cs	$\frac{Q}{(C_s + 4)(R)(H)} * 10^{-5}$ FT/SEC K
1A	30.3	19.5	10.8	0.1242	87	9.24	13.8	—	23.04	2.01	300	66.85		110	2.0
1B						16.17			29.97	3.02	300	100.72			2.4
1C						20.79			34.59	2.95	300	98.49			2.0
1D						30.03			43.83	4.80	300	159.99			2.6
1E						23.1			36.9	3.70	300	123.45			2.4
1F						16.17			29.97	2.74	300	91.36			2.2

NOTE: This form is for pressure permeability test performed below the water table.

IPIRE
ESTIGATIONS INC

REPORT OF PRESSURE PERMEABILITY TESTS IN STABLE ROCK

Project BTA-92-073 Logged by SKM Ground Elevation 569.9

Hole No. TH-1 Date Started 3-25-92 Rock Elevation

Location B Date Completed 3-25-92 Water Depth During Test 7.9 FT

Single Packer Test

Test No.	Depth FT: To Bottom of Borehole 1	Depth FT: To Bottom of Top Packer 2	Length of Interval Tested (1-2) FT A	Radius of Test Hole FT R	A/R	Gauge Pressure x 2.31 FT h_2	Vertical Distance from Gauge to Water Table FT h_1 (569.9 − 562 = 7.9)	Head Loss in Pipe Length From Gauge to Top Packer L	$(h_1 + h_2 - L)$ FT H	Water Loss (ft^3)	Elapsed Time SEC	Rate of Flow ft^3/sec $*10^{-4}$ Q	Thickness of Saturated Layer S	Conductivity Coefficient Cs	$\frac{Q}{(C_s + 4)(R)(H)} * 10^{-5}$ FT/SEC K
2A	45.0	30.3	14.7	0.1242	118	13.86	12.9		26.76	2.06	300	68.67		145	1.4
2B						27.72			40.62	3.73	300	124.33			1.65
2C						41.58			54.48	5.58	300	186.0			1.84
2D						55.44			68.34	6.30	300	210.0			1.66
2E						41.58			54.48	4.97	300	165.67			1.64
2F						27.72			40.62	3.44	300	114.67			1.52
2G						13.86			26.76	0.59	300	19.67			0.4

NOTE: This form is for pressure permeability test performed below the water table.

IPIRE
ESTIGATIONS INC.

REPORT OF PRESSURE PERMEABILITY TESTS IN STABLE ROCK

Project BTA - 92 - 073 Logged by SKM Ground Elevation 569.6

Hole No. TH - 2 Date Started 3-27-92 Rock Elevation

Location A Date Completed 3-27-92 Water Depth During Test 8.2 FT

Single Packer Test

Test No.	Depth FT: To Bottom of Borehole 1	Depth FT: To Bottom of Top Packer 2	Length of Interval Tested (1-2) A FT	Radius of Test Hole R FT	A/R	Gauge Pressure x 2.31 h_2 FT	Vertical Distance from Gauge to Water Table h_1 FT	Head Loss in Pipe Length From Gauge to Top Packer L	$(h_1 + h_2 - L)$ H FT	Water Loss (ft^3)	Elapsed Time SEC	Rate of Flow $ft^3/sec * 10^{-4}$ Q	Thickness of Saturated Layer S	Conductivity Coefficient Cs	$\frac{Q}{(C_S + 4)(R)(H)} * 10^{-5}$ FT/SEC K
1A	35.9	25.9	10	0.1242	80	11.55	11.2		22.75	4.01	300	133.67		105	4.34
1B						23.10			34.3	6.02	300	200.67			4.32
1C						34.65			45.85	7.33	300	244.33			3.94
1D						46.20			57.4	8.52	300	284.0			3.65
1E						34.65			45.85	6.62	300	220.67			3.55
1F						23.10			34.3	4.63	300	154.33			3.32
1G						11.55			22.75	0.23	180	12.78			0.41

NOTE: This form is for pressure permeability test performed below the water table.

IPIRE
VESTIGATIONS INC

REPORT OF PRESSURE PERMEABILITY TESTS IN STABLE ROCK

Project BTA - 92-073 Logged by SKM Ground Elevation 569.6

Hole No. TH - 2 Date Started 3-27-92 Rock Elevation

Location B Date Completed 3-27-92 Water Depth During Test 8.2 FT

Single Packer Test

Test No.	Depth FT: To Bottom of Borehole 1	Depth FT: To Bottom of Top Packer 2	Length of Interval Tested (1-2) A FT	Radius of Test Hole R FT	A/R	Gauge Pressure x 2.31 h_2 FT	Vertical Distance from Gauge to Water Table 3+8.2 h_1 FT	Head Loss in Pipe Length From Gauge to Top Packer L FT	$(h_1 + h_2 - L)$ H FT	Water Loss (ft^3)	Elapsed Time SEC	Rate of Flow ft^3/sec $*10^{-4}$ Q	Thickness of Saturated Layer S	Conductivity Coefficient Cs	$\frac{Q}{(C_s + 4)(R)(H)} *10^{-5}$ FT/SEC K
2A	45.9	35.9	10	0.1242	80	16.17	11.2	–	27.37	1.78	300	59.33		105	1.60
2B						32.34			43.54	1.02	180	56.67			0.96
2C						50.82			62.02	2.54	180	141.11			1.68
2D						66.99			78.19	1.87	180	103.89			0.98
2E						50.82			62.02	1.06	180	58.89			0.70
2F						32.34			43.54	0.49	180	27.22			0.46
2G						–			–	–	–	–			–

NOTE: This form is for pressure permeability test performed below the water table.

EMPIRE SOILS INVESTIGATIONS, INC.

SUBSURFACE EXPLORATION

PRESSURE TESTING IN ROCK

Project: DUPONT - GILL CREEK REM. File No.: _____ Hole No.: TH-1

Location: _____ Sheet No.: ___ of ___ Date: 3-24-92

Ground Elev.: _____ GWL: 7.9' Type & Capacity Pump: _____

No. of Meter: _____ Meter Reads In: _____ Driller: _____

Inspector: _____ Calculations Checked By: _____ Date: _____

PART I – HOLDING TEST:

Test No.	Section of hole tested				Meter read. start test	Time for ea. 10 psi pressure drop at gage pressure intervals from						Meter read. end test
	Depth		Elevation			60-50 psi	50-40 psi	40-30 psi	30-20 psi	20-10 psi	10-0 psi	
	From	To	From	To								

PART II – PUMPING TEST:

Test No.	Section of hole tested				Press. gage height ft.	Press. gage read. psi	Total pressure psi	Time min.	Meter Read.		Total Flow	Total Flow GPM per ft.
	Depth		Elevation						Start of test	End of test		
	From	To	From	To								
1A	19.5'	30.3'			5.9' ~~6.0'~~	~~24~~		5	93428.2	93443.2	15G	3GPM
B						7		5	93453.0	93475.6	22.6G	
C						~~19~~		5	93484.0	93506.1	22.1G	
D						13		5	93524.0	93559.9	35.9G	
E						10		5	93580.0	93607.7	27.7	
F						7		5	93660	93636.5	20.5	

Remarks:
PACKER INFLATION PRESSURE = 150 PSI

EMPIRE SOILS INVESTIGATIONS, INC.	SUBSURFACE EXPLORATION PRESSURE TESTING IN ROCK

Project: DUPONT-GILL CREEK REMEDIATION File No.: _____ Hole No.: TH-1

Location: ROBERT MOSES PKWY. @ GILL CREEK Sheet No.: ___ of ___ Date: 3-25-92

Ground Elev.: _____ GWL: _____ Type & Capacity Pump: _____

No. of Meter: _____ Meter Reads In: _____ Driller: _____

Inspector: _____ Calculations Checked By: _____ Date: _____

PART I – HOLDING TEST:

Test No.	Section of hole tested				Meter read. start test	Time for ea. 10 psi pressure drop at gage pressure intervals from						Meter read. end test
	Depth		Elevation			60-50 psi	50-40 psi	40-30 psi	30-20 psi	20-10 psi	10-0 psi	
	From	To	From	To								

PART II – PUMPING TEST:

Test No.	Section of hole tested				Press. gage height ft.	Press. gage read. psi	Total pressure psi	Time min.	Meter Read.		Total Flow	Total Flow GPM per ft.
	Depth		Elevation						Start of test	End of test		
	From	To	From	To								
1	30.3	45.0			5.0	6		5	93196.0	93211.4	15.4	
						12		5	93232.0	93259.7	27.9	
						18		5	93279.8	93320.7	41.7	
						24		5	93345.0	93392.1	47.1	
						18		5	93418.0	93455.2	37.2	
						12		5	93469.0	93489.7	25.7	
						6		5	93502.0	93506.4	4.4	

Remarks:

Packer Inflation Pressure = 150 psi

Water Injection.

EMPIRE SOILS INVESTIGATIONS, INC.	SUBSURFACE EXPLORATION PRESSURE TESTING IN ROCK

Project: DUPONT-GILL CREEK REMEDIATION File No.: _____ Hole No.: TH-1

Location: ROBERT MOSES PKWY. @ GILL CREEK Sheet No.: ___ of ___ Date: 3-25-92

Ground Elev.: _____ GWL: _____ Type & Capacity Pump: _____

No. of Meter: _____ Meter Reads In: _____ Driller: _____

Inspector: _____ Calculations Checked By: _____ Date: _____

PART I – HOLDING TEST:

Test No.	Section of hole tested				Meter read. start test	Time for ea. 10 psi pressure drop at gage pressure intervals from						Meter read. end test
	Depth		Elevation			60-50 psi	50-40 psi	40-30 psi	30-20 psi	20-10 psi	10-0 psi	
	From	To	From	To								

PART II – PUMPING TEST:

Test No.	Section of hole tested				Press. gage height ft.	Press. gage read. psi	Total pressure psi	Time min.	Meter Read.		Total Flow	Total Flow GPM per ft.
	Depth		Elevation						Start of test	End of test		
	From	To	From	To								
1	30.3	45.0	DIDN'T WORK									
2	19	45			4	10 psi						

Remarks:

GROUT INJECTION TEST.

GROUT MIX: 25 GAL. WATER, 4 - 94# BAGS PORTLAND CEMENT.

TEST 2: FORMATION TOOK ≈ 20 GAL. OF GROUT IN ≈ 6 MIN. & THEN STOPPED TAKING GRSUT.

EMPIRE SOILS INVESTIGATIONS, INC.

13.5' = 259' TH-2

Constant head test

trash pump = 5gal / 25.5 sec.

15:54.15 Start test

15:54:45 30 sec. to fill to TOC 5.88 gal

15:56:10 60 sec to fill to TOC 11.76 gal

15:57:35 65 sec To fill to TOC 12.75 gal

15:59:00 56 sec To fill to TOC 10.98

16:00.00 hrs end test 41.37 gal

5 min / 45 sec

345 sec / 41.37 gal =

7.19 GPM

Depth to Ground Water below grade = 8.2 feet

$K = Q / 5.5 \gamma H$

Ht of gauge above grade = 3.0 feet

$\gamma = 0.1242$ feet

REF: DESIGN OF SMALL DAMS

$H = 11.2$ feet

$K = 209 * 10^{-5}$ feet/sec

$= 2.09 * 10^{-3}$ feet/sec

TH-2

27 MAR 92

WEATHER 0900 RAIN COLD T = 35°F
Wind ≈ 5-10 mph ↑ N

TH-2
0900 - 0920 Cored 25.9 - 34.7
Rec = 10.4/18.8
RQD = 8.4/100

Pm = 0.9(25.9) - 0.433(8) = 20 psi
P3/4 = 15 psi
P1/2 = 10 psi
P1/4 = 5 psi

0930 - 0935 - cored from 34.7 - 35.9
Rec = 01.2/1.2
25.9-35.9 RQD = 0.9/1.2
116 = 3.0

Time	dwell	Start	Stop	Press	K√Q Gals
1050	5	3654.0	3684.0	5	30.0
1150	5	3689.0	3734.0	10	45.0
1401	5	47.0	101.8	15	54.8
1107	5	18.0	81.7	20	63.7
1114	5	94.0	143.5	15	49.5
1120	5	51.0	85.6	10	34.6
1127	5	8[illegible]1.1	90.8	5	1.7

27 MAR 92

1207 Cored 35.9 - 45.9
Rec = 10/10.0'
RQD = 9.8/10.0'
D fw = 8.2 (16.5)
Pm = 0.9(35.9) - 0.433(8) = 29
3/4 = 22
1/2 = 14
1/4 = 7

Time	dwell	Start	Stop	Psi	Q Gals
1242	5	91.7	105.0	7	13.3
1247	3	08.5	16.1	14	7.6
1251	3	12.5	31.5	22	19.0
1256	7	37.0	51.0	29	14.0
1300	3	53.4	61.3	22	7.9
1305	3	65.0	68.7	14	3.7

no psi. test could not maintain press.

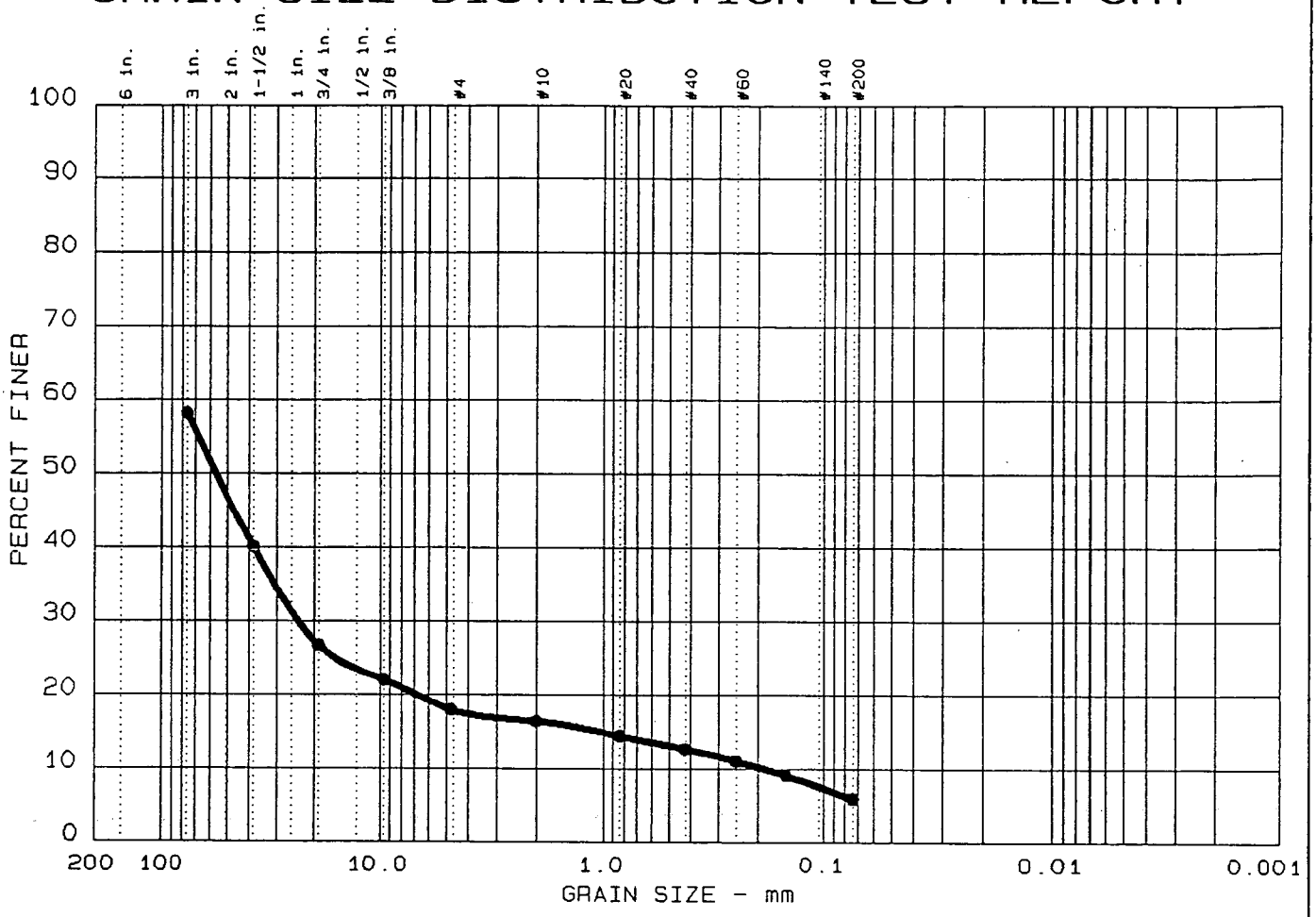
mixing grout 4 bags Type I
= 25 gal H2O 3% bentonite

1345 tremie grouting hole.
placed = 20 gal grout. noted grout at surface.
1355 pulled 5 ft of temp casing tremie grouting bore hole

EMPIRE
SOILS INVESTIGATIONS INC.

APPENDIX D

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	5	41.8	40.2	12.0	6.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	31	12	76.20	76.20	56.29	23.738	1.0010	0.1864	39.67	408.8

MATERIAL DESCRIPTION	USCS	AASHTO
● BROWN GRAVEL, Little Sand, trace fines	GP-GC	

Project No.: BTA-92-073
Project: DUPONT GILL CREEK REMEDIATION
● Location: PTP-4 COARSE
DEPTH 4.0' - 10.0'
Date: APRIL 14, 1992

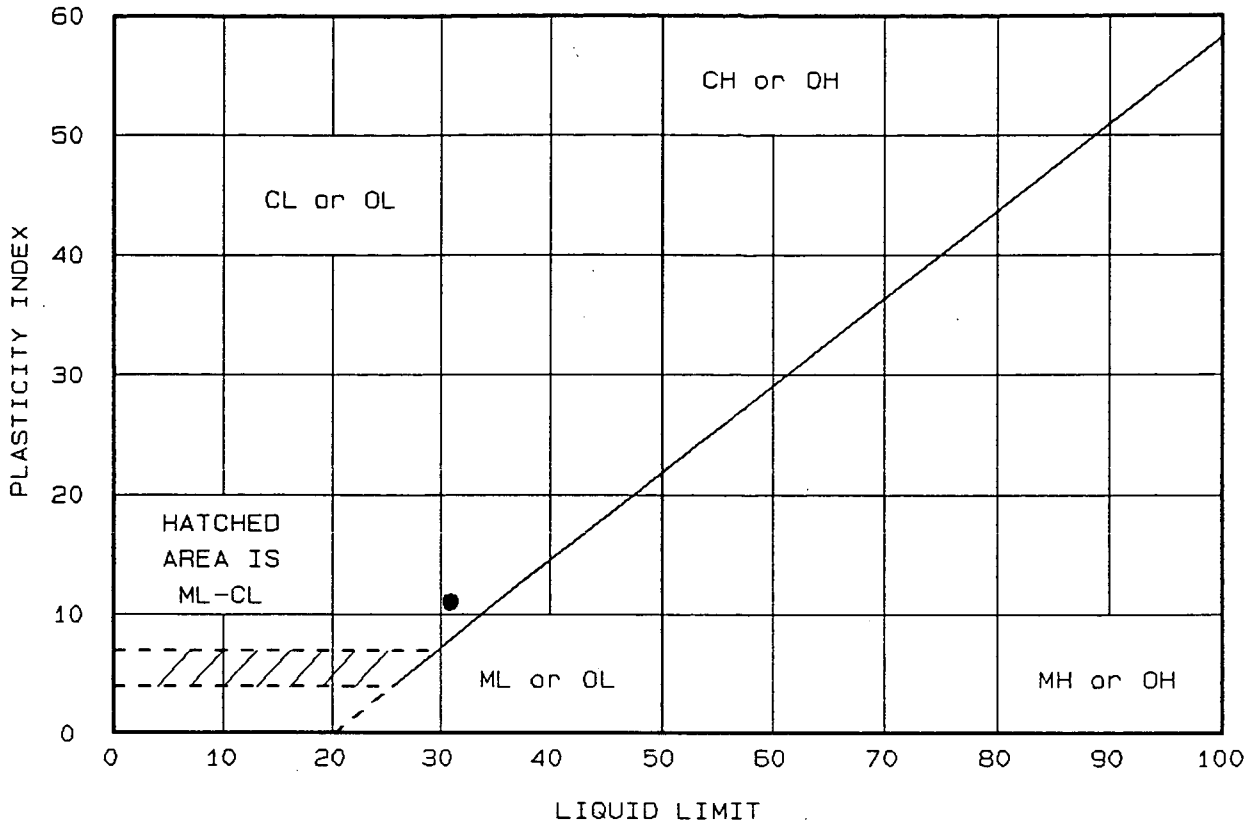
GRAIN SIZE DISTRIBUTION TEST REPORT

EMPIRE SOILS INVESTIGATIONS, INC

Remarks:
CLIENT: DUPONT
NIAGARA FALLS, NY
WATER CONTENT: 6.6%
LAB NO. 1192.005

Figure No. 1

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	ASTM D 2487-85
● PTP-4 COARSE	31	20	11	6	GP-GC, Poorly graded gravel with clay

Project No.: BTA-92-073
Project: DUPONT GILL CREEK REMEDIATION

Client: DUPONT
Location: NIAGARA FALLS, NEW YORK
DEPTH 4.0' - 10.0'
Date: APRIL 16, 1992

Remarks:
SIEVED ON #40 SIEVE
WATER CONTENT: 6.6%

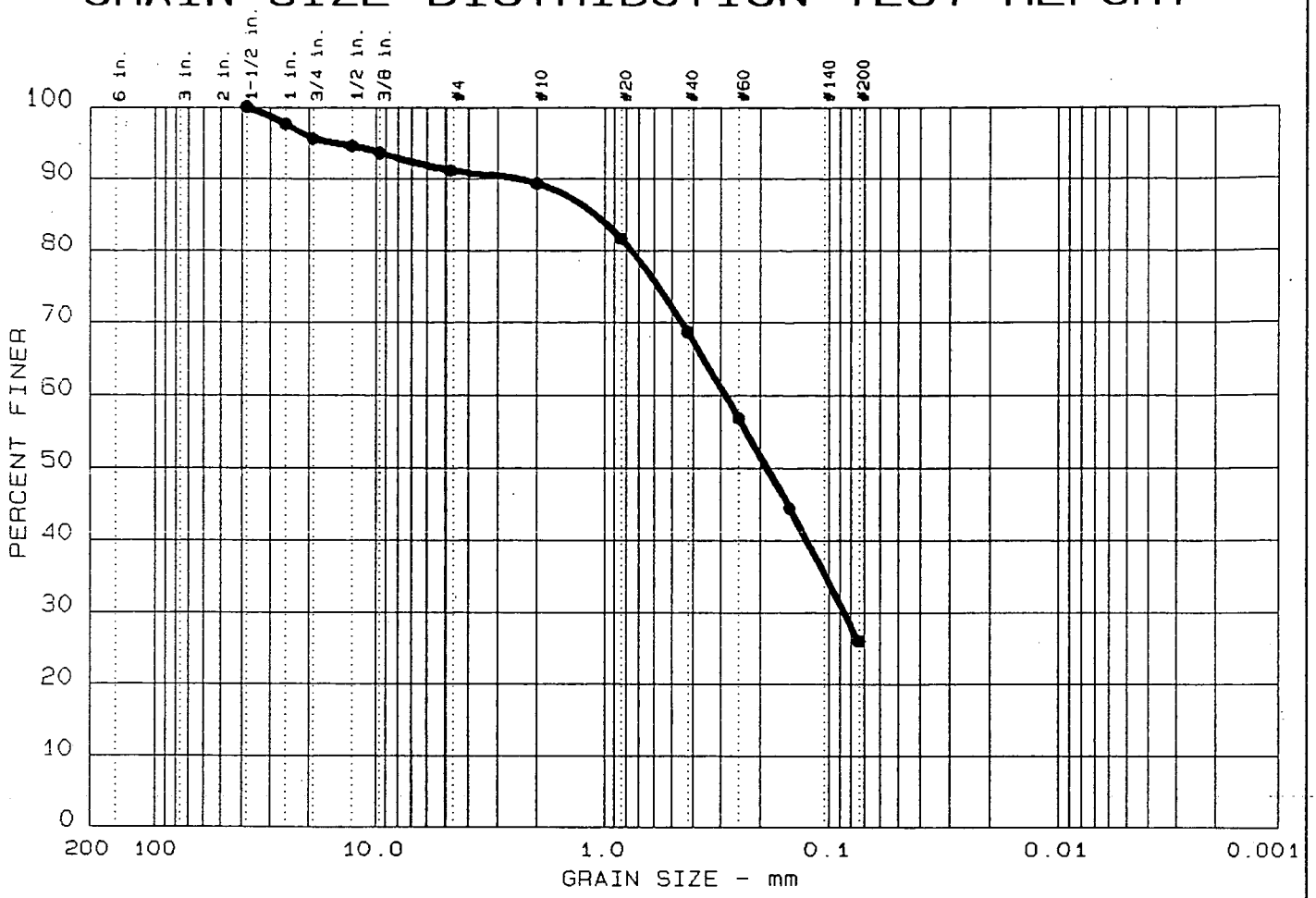
LIQUID AND PLASTIC LIMITS TEST REPORT

EMPIRE SOILS INVESTIGATIONS, INC

LAB NO. 1192.005

Fig. No. 1

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	8.8	65.2	26.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	34	14	1.08	0.29	0.19	0.086				

MATERIAL DESCRIPTION	USCS	AASHTO
● BROWN SAND, Some Fines, trace gravel	SC	

Project No.: BTA-92-073
Project: DUPONT GILL CREEK REMEDIATION
● Location: PTP-4
DEPTH 0.5' - 4.0'
Date: APRIL 9, 1992

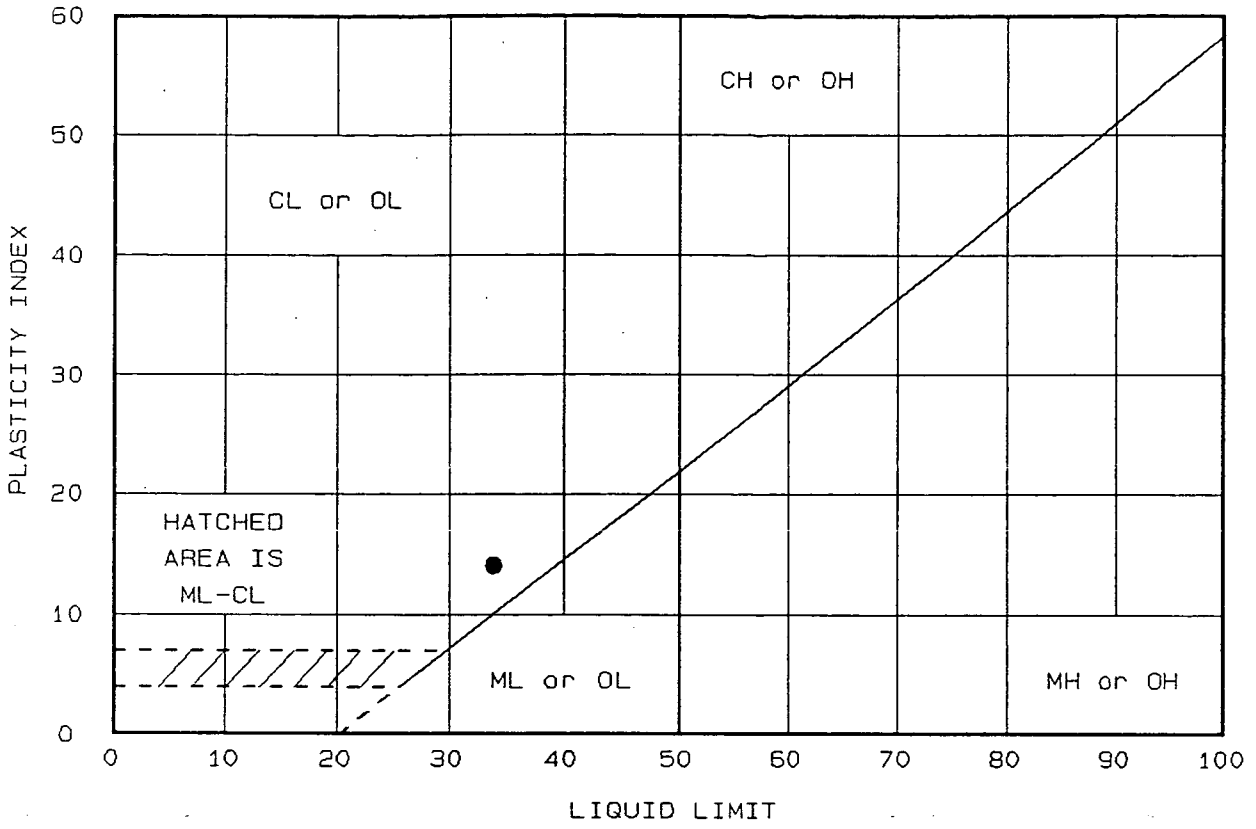
GRAIN SIZE DISTRIBUTION TEST REPORT

EMPIRE SOILS INVESTIGATIONS, INC

Remarks:
CLIENT: DUPONT
NIAGARA FALLS, NY
WATER CONTENT: 16.9%
LAB NO. 1192.006

Figure No. 1

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-85
●	PTP-4	34	20	14	26	SC, Clayey sand

Project No.: BTA-92-073
Project: DUPONT GILL CREEK REMEDIATION

Client: DUPONT
Location: NIAGARA FALLS, NEW YORK
DEPTH 0.5' - 4.0'
Date: APRIL 10, 1991

Remarks:
SIEVED ON #40 SIEVE

LIQUID AND PLASTIC LIMITS TEST REPORT

EMPIRE SOILS INVESTIGATIONS, INC

LAB NO. 1192.006

Fig. No. 1