

## **APPENDIX IIA**

### **ARCHEOLOGICAL AND CONSTRUCTION WORK PLAN FOR THE PROPOSED MILLENNIUM PIPELINE PROJECT BLACK DIRT AREA**

**FINAL ARCHAEOLOGICAL AND CONSTRUCTION WORK PLAN  
FOR THE  
PROPOSED) MILLENNIUM PIPELINE PROJECT  
BLACK DIRT AREA BETWEEN STATIONS 18503+50 AND 18697+10,  
TOWNS OF MINISINK AND WARWICK, ORANGE COUNTY, NEW YORK**

FERC Docket No. CP98-150-000 et al.

Prepared By

Millennium Pipeline Project

Prepared For

Federal Energy Regulatory Commission  
State of New York Department of Agriculture and Markets  
State of New York Office of Parks, Recreation, and Historic Preservation  
Orange County Soil and Water Conservation District  
Orange County Cornell Cooperative Extension  
And  
Walkkill Valley Drainage Improvement Association

19 December 2000

This final site-specific work plan presents the proposed archaeological and construction treatments of the black dirt areas to be crossed by the Millennium pipeline in the Towns of Minisink and Warwick, Orange County, New York. The work plan is divided into 2 parts. The first part provides the background data concerning the depth of the peat deposits, their inherent soil characteristics, and their age. The second part presents the site-specific plan for archaeological investigation and construction across the geological feature. This plan is presented as a supplement to Millennium's response to the Federal Energy Regulatory Commission Staff's June 9, 1999 Data Request No. 34. The data also addresses issues raised in the June 9, 1999 Data Request No. 35.

This plan has been reviewed by the New York State Office of Parks, Recreation and Historic Preservation (NYSHPO), New York Department of Agriculture and Markets (NY Ag & Markets), the Orange County Soil and Water Conservation District, Orange County Cornell Cooperative Extension, the Wallkill Valley Drainage Improvement Association as well as effected landowners. Millennium appreciates the time and effort spent by these agencies and individuals to develop this plan.

## BACKGROUND DATA

The black dirt of Orange County is a unique geological feature. It is comprised of peat soils which have been developing for at least the last 14,540 (BP) years. The peat deposits are centered in the Wallkill and Pochuck river drainages and are most extensively exploited today in the Towns of Warwick, Goshen, and Minisink and centered in the Pine Island vicinity. In this region, a complex system of dikes, primary and secondary drainage ditches, and levees effectively drains some 17,000 acres of so-called 'black' and 'gray' dirt agricultural fields. Without the system, the fields have minimal agricultural use and the peat would revert to the bog/swamp conditions present through most of the Holocene period and as late as 1910.

The black/gray soils are subject to degradation through various factors including aeolian erosion and redeposition, compression, and material decomposition. While these are natural factors, each of the factors is accelerated by the actual use of the peat soils for agricultural purposes. Thus, it is true that the soils degrade, they do not 'subside' in a classic geological sense.

Since 1997, Millennium has studied multiple route options across the portion of its proposed route in the Pine Island area. These routing options have been based on input from several agencies including NY Ag & Markets, NY Department of Environmental Conservation, US Fish & Wildlife Service, and the US Corps of Engineers, as well as the local landowners. In Spring, 1999, parts of one routing were subjected to geotechnical, geomorphological, and archaeological testing (Figure 1). Geotechnical and geomorphological testing was conducted in areas designated Segments A, B, and C on Figure 1 while the locations tested archaeologically are shown in dark blue on the same figure. Subsequent to this effort, a final route was delineated (Figure 2 provides a detail of the route

modification). The final route is a slight variation in close proximity to the route shown on Figure 1. It was developed in consideration of 2 landowners' (DeBuck and Shapiro) preferences for routing across their properties. Since the final route is immediately adjacent to the tested alternative, additional geotechnical and geomorphological testing was not required.

The geotechnical and geomorphological testing was conducted between March 8-12, 1999, in the drained peat fields located between Stations 18503+50 and 18697+10. Between these stations, 3 peat deposit concentrations occur. Each of the concentrations was tested. Segment A is located in the northern concentration between the Pine Island Turnpike (Route 1) and the re-intersection of that road south of the Wallkill River. Geotechnical testing was conducted between the beginning of the segment and the Wallkill River. The central concentration encompasses the peat soils between Merritt Island Road and Mission Land Road. In this area, the Segment B subsurface investigations were restricted to the exposed black dirt area between Merritt Island Road and Drumgoole Ditch. The southernmost concentration includes all peat soils between the Pochuck River and the re-routes' intersection with the existing A-5 ROW. Segment C within this concentration was between the river and Glenwood Road. Investigation south of the road was not completed because Millennium proposes to install the pipeline in an existing drainage ditch at this location.

Soil cores were extracted in each segment in order to acquire data on soil type, soil strength, depth of peat deposits, and age of peat deposits. The work was conducted jointly by Gray & Pape, Inc. (Gray & Pape), and Fluor Daniel Williams Brothers (FDWB) in support of Millennium cultural resources and engineering design tasks. The actual bores were completed by Resource International, Inc. (RI), Westerville, Ohio, under subcontract to Gray & Pape but following FDWB specifications concerning required geotechnical tests. RI also completed the geotechnical tests requested by FDWB. The Gray & Pape geomorphological bores were designed to address the issue of the depth of peat deposits and to acquire samples for radiocarbon dating. The FDWB geotechnical bores were completed to provide stratigraphic data, soil strength, soil type, etc.

The 6 geotechnical bores (designated PB-1 through PB-6) were evenly spaced in the selected portions of each segment and were located between the evenly spaced geomorphological bores. A general soil profile was created and was used for modeling purposes in order to predict buoyancy forces, total settlement, and allowable bearing capacities for the pipe. The boring logs for samples PB-1 through PB-6 are presented in Appendix A.

The geotechnical subsurface investigations indicate that the uppermost stratum in each tested segment is a fine sandy silt, highly organic soil containing 60+% organic matter. This surficial stratum ranges from 5 to 8 feet in thickness. Underlying the black and gray peat is a 3 to 8 foot thick stratum of 'green' peat. This silt with some clay stratum contained 18% organic matter. Underlying this stratum are various deposits of alluvial or lacustrine materials.

Ten geomorphological cores (AR-1 through AR-10) were taken and these also are summarized in Appendix A. The investigations indicated that the peat deposits stratigraphically occur at depths ranging from 1.5 feet (0.45 meters) to 8.25 feet (2.5 meters) below present ground surface. The deposits continue to depths below present ground surface ranging from 6.16 feet (1.87 meters) to 18.17 feet (5.53 meters). The peat deposits are internally stratified into 2 strata. The upper peat stratum is dark brown and is comprised of less decomposed organics. The underlying peat stratum is gleyed peat with decomposed organics and a softer, clay texture. There are no non-peat strata or lenses within these 2 peat strata though an intervening alluvial/peat layer is present in Segment A.

In Segment A, the lower peat stratum rests atop an extremely water-saturated clay that ranges in thickness from 4 to 9 feet (1.2 to 2.7 meters). This stratum, in turn, is underlain by alluvial sands and clays. In Segment B, the peat is underlain by a relatively thin strata of gravelly sand and gravelly clay followed by a clay layer comparable to that in Segment A. The southernmost segment, C, is slightly different. In 3 of the 4 geomorphological bores, the soil underlying the peat was a sand that heaved in the core. One core was taken below this friable sand layer and the underlying soil sequence is alluvial sand, silt, and clay lenses that reach a depth of 30 feet (9.1 meters). Underlying this alluvial zone are lacustrine sediments which continue to at least 41 feet (12.5 meters) below surface. Bedrock was not encountered in any core in any segment.

Ground water was present in most of the bores and ranged in depth from 5 to 12 feet (1.5 to 3.65 meters) below surface. Most commonly, however, the groundwater occurred between 9 and 10 feet (2.7 and 3.0 meters) below surface. In Segment A, the lower peat stratum and the underlying clay stratum were both incompetent materials because of extreme water saturation. These strata exhibited significantly less saturation in Segments B and C.

Radiocarbon dating was completed on peat materials recovered from 3 cores. The dates are summarized on Table 1 and indicate that the peat deposits date within the period of possible human habitation in the area.

## SITE-SPECIFIC WORK PLAN

The 3 peat soil segments in the Millennium project area each display slightly different characteristics. These characteristics do have impact on the approaches being proposed herein. In the northern concentration tested in Segment A, the soils are comprised of 'gray' dirt and alluvial deposits. The gray dirt extends from the Pine Island Turnpike to near the abandoned channel of the Walkkill River; it continues south of the river to the intersection with Pine Island Turnpike. Gray dirt is comprised of peat and alluvial deposits and it is not a pure peat soil. The alluvial deposits immediately adjacent to the river are typical of this type of soil.

In the central concentration tested by Segment B, the proposed route is aligned with a field access road for most of its distance (2,422 feet), with open peat deposits

present only in the northern 345 feet of the segment. The access road is raised about 4 feet (1.2 meters) above the peat deposits. The road is composed of foreign material and it does not contain peat. Finally, in the southernmost concentration between the Pochuck River and Glenwood Road, Millennium proposes to cross an existing golf course. The golf course upper stratum is also composed of foreign materials resting atop thick peat deposits.

Millennium proposes to complete construction using 3 methods. In the northern concentration, construction will be done using a pull-in method except at the crossings of the Wallkill River (Construction Bore [CB]-1 and CB-2) and Pine Island Turnpike (CB-3 and CB-4). Both of these features will be crossed with horizontal bores. The bore and receiving pits here and elsewhere will measure 20 by 60 feet (6.1 by 18.2 meters) and 20 by 20 feet (6.1 by 6.1 meters), respectively. Non-peat soils removed from the bore corings in the peat fields will be hauled away from the site so as not to mix these soils with upper strata in the fields. Should the initial attempt at a horizontal bore not be successful, Millennium will move over approximately 10 feet and try again. If after repeated attempts it becomes apparent that a horizontal bore will not be successful, Millennium will cease construction activities at that location and meet with the appropriate agencies and the landowner to discuss alternative crossing methods. Alternative crossing methods will not be used until there is a consensus that a horizontal bore is not feasible and an alternative procedure has been developed.

In the central concentration, the field and access road will be subjected to a stove-pipe construction technique. Both Merritt Island Road (CB-5 and CB-6) and Mission Land Road (CB-7 and CB-8) will be horizontally bored. In these 2 horizontal bore sets, CB-6 and CB-7 will be located in or partially in black dirt soils. Finally, in the southern concentration, horizontal bore, stove-pipe, and pull-in methods will be used. The Pochuck River (CB-9 and CB-10) and Glenwood Road (CB-11 and CB-12) will be bored. For these horizontal bores, all but CB-7 are in black dirt fields. The portion of the segment from the bore to the road will be stove-piped in an existing drainage ditch. The final section, from Glenwood Road to the realignment with Millennium's 1997 original Line A-5 route will also be installed in an existing drainage ditch using stove-pipe methods.

## SCHEDULING

Millennium proposes to complete its archaeological investigations and construction in a staged approach in late summer/early fall window. The timing of these operations are such that crop losses should be minimized while still ensuring that construction is completed before significant fall precipitation. Millennium will include crop loss compensation in its ROW negotiations with the individual landowners should some crop loss be unavoidable.

## ARCHAEOLOGICAL INVESTIGATIONS

The archaeological investigations are designed to test for the presence of cultural or paleontological deposits in a sample of the gray, alluvial, and black dirt locations. Because of the fragile nature of the soils and because of the depth of the peat deposits in some locations, all archaeological excavations will be confined to the location of construction bore pits in the 3 peat concentrations. Bore pits CB-1, CB-3, CB-6, CB-7, CB-10, and CB-12 will each be gridded into 20 by 20 foot (6 by 6 meter) blocks and excavated in controlled 4-inch (10-centimeter) levels to the base of the peat deposits in each location.

All excavation will be conducted using skim shoveling. One-quarter of each block will be sifted through ¼-inch hardware mesh. All screening will be conducted in a screening tent and completed by stratum. All excavated and screened dirt will be temporarily stored in clean silage bags. The upper and lower peat strata will be treated as separate units and stored separately. All excavation will be conducted within box shoring.

The archaeological investigations and the subsequent construction phases will be monitored by an agricultural consultant. The agricultural consultant will be chosen by Millennium in consultation with NY Ag & Markets. This person will have experience in black dirt soils.

On-site review of the results of the archaeological investigations by representatives of the FERC and the NYSHPO is proposed. Prior to the beginning of the archaeological investigations an unexpected discovery plan will be prepared and approved by the appropriate agencies. This plan will detail the response in the event that in situ cultural or paleontological deposits are encountered in this phase or during subsequent construction. In the subsequent construction phase, an archaeological monitor will be present during the actual construction and restoration phases.

## PRE-CONSTRUCTION PREPARATION

Pre-construction preparation will begin as soon as the results of the archaeological investigations have been reviewed and accepted. In the northern peat concentration, the construction work area (CWA) will be restricted to the width between 2 parallel drainage ditches. The working side, including the top soil conservation area, will be matted. In the central concentration, the CWA will be restricted to the width of the access road or the width between 2 parallel drainage ditches in the northern part of the segment. In the southern peat concentration, the CWA will be 125-foot wide, centered on the pipeline centerline. Vehicle or equipment movement across the agricultural fields will be restricted during this phase and during the subsequent phases. All wheeled equipment will be restricted to matted surfaces.

Millennium will enforce a no smoking policy in black dirt areas. Further, Millennium will require the contractor to use a fire retardant blanket or other suitable barrier in areas where pipe welding, grinding, and/or cutting will occur. Finally, Millennium will require that the contractor provide safety personnel with appropriate fire suppression equipment during activities that could cause ignition of the muck soils.

It was also recommended that black dirt fields in the construction area as well as adjacent areas be seeded to barley, oats, or some other crop prior to construction to help prevent soil loss. Millennium will work with willing landowners to accomplish this objective.

## PIPELINE CONSTRUCTION

At all locations in black and gray dirt, the pipe trench will measure 10 feet (3 meters) wide from top to bottom. The concrete coated pipe will be placed in a 9-foot (2.7-meter) deep trench, resulting in at least 5 feet (1.5 meters) of cover. There will be a minimum of 5 feet (1.5 meters) of cover under each stream and beneath the 3 drainage ditches that will be bored. The drainage ditches all occur within previously defined construction bore or receiving pit locations. The concrete coating is an anti-buoyancy measure. It will also serve as 'splinter' or mechanical protection.

The open-cut trench will be box shored in stove-piped areas. All bore pits will also be shored. Trench excavation will be completed mechanically and soil separation by soil type will be conducted. Separable soil strata will be identified by the agricultural consultant in conjunction with the project geomorphologist/geoarchaeologist. Topsoil stripping will only be carried out on areas where more than one piece of construction equipment will be used. A plastic barrier be used to insure complete separation of the organic soils. All spoil piles will be silt-fenced and covered to diminish loss to wind erosion. Soil pH will be tested before and after construction for the stockpile areas. Following the completion of the construction and testing phases, all soil will be returned to the trench in reverse stratigraphic order. The thickness of the peat deposits will be maintained. Any peat material lost through erosion will be replaced by comparable material. This material will be selected in consultation with NY Ag & Markets and the local landowners.

## RESTORATION

The pipeline trench and the CWA in northern peat concentration and the non-access road portions of the central concentration will be returned to grade. Millennium will contract with the landowner or other local firm to complete fine grading using the specialized grading equipment that is employed in these fields. Any drainage ditch damaged during construction will be repaired by Millennium to the landowner specifications. In the southern concentration and the access road portion of central peat concentration, a permanent access road built to the specifications negotiated with the landowners will be installed. At a minimum, Millennium will backfill the trench in this area with clay up to the original soil surface, with geotextile fabric

installed on top, followed by gravel. In addition, subsurface drainage will be installed on both sides of the access road to mitigate the drainage impacts that could potentially result from filling the ditches.

## MONITORING

Field monitoring will be conducted for a period of 5 years after restoration. Millennium will repair or pay for repairing any field crossed by the pipeline in the black or gray dirt areas that does not make crop yields annually in this period. Should annual crop yields decrease on or adjacent to the CWA, as a direct result of pipeline construction, Millennium will pay landowners for the difference in yield and will take the necessary steps to restore yields to normal production.

In order to insure safe operations, Millennium will routinely monitor the depth of cover through black dirt areas. Should the depth be determined inadequate, Millennium will take appropriate mitigative steps, such as placing additional, similar cover material over the pipeline.

## PLAN MODIFICATIONS

Millennium does not anticipate that any plan modifications will be required to complete construction across the black dirt areas. However, should such changes be necessary, Millennium will insure that FERC, landowners and NY Ag & Markets representatives are consulted and that the Black Dirt Plan is appropriately revised to take any realignment, along with any additional mitigation measures, into account.

**APPENDIX A**

**GEOTECHNICAL BORING LOGS PB-1 THROUGH PB-6**  
**AND**  
**GEOMORPHOLOGICAL CORE LOGS AR-1 THROUGH AR-10**

**Source: Resource International, Inc. May 1999. Subsurface Investigation Report  
ORA Peat Bog Investigation, Pine Island, New York. RI# W-9029. Submitted to  
Gray & Pape, Inc., Cincinnati, Ohio, and Millennium Pipeline, Binghamton, New  
York.**

Table 1. Orange County Peat Bog Radiocarbon Dates

Testing Segment	Core Designation	Stratum	Depth	Radiocarbon Date BP (BC)
A – north to Pine Island Turnpike	AR8		4.6-7.4 feet	7560±80 (±5610 BC, Middle Archaic) *
A				12,120±70 (±10,170 BC, Paleoindian and Pleistocene end)
B – under access road		III – upper peat	3.6-4.9 feet but under access road	7760±50 (±5810 BC, Middle Archaic)
C – Pochuck River to south end		II – upper peat	4.6-6.7 feet	8090±70 (±6140 BC, Middle Archaic)
C		III – lower peat	6.7-18 feet (sample recovered between 14-16 feet)	14,540±190 (±12,590 BC, Paleoindian and Pleistocene end)

# BORING LOGS

## Definitions of Abbreviations

- qh - unconfined compressive strength as determined by a hand penetrometer (kips per square foot)
- qu - unconfined compressive strength as determined by ASTM D-2166 (pounds per square foot)
- quu - unconsolidated-undrained triaxial compressive strength as determined by ASTM D-2850 (pounds per square foot)
- qr - unconfined compressive strength of intact rock core as determined by ASTM D-2938 (pounds per square inch)
- "in-situ" unit weight of soil (pounds per cubic foot)
- C - cohesion (pounds per square foot)
- A - adhesion (pounds per square foot)
- FA - angle of internal friction (degrees)
- FF - friction factor
- K - modulus of horizontal subgrade reaction (kips per cubic foot)
- percent organic content (by weight) as determined by ASTM D-2974 (loss by ignition test)
- S - sulfate concentration
- SS - soluble salts (conductivity)
- CL - chloride ion concentration (parts per million)



RESOURCE INTERNATIONAL, INC.  
281 ENTERPRISE DRIVE  
WESTERVILLE, OHIO 43081  
(614) 885-1959

### REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.  
Project ORA Peat Bog Investigation, Pine Island, NY  
Project Number W-9029

Boring Number PB-1  
Sheet 1 of 3  
Completion Depth 48.0'

Date Started: 3/8/99  
Date Finished: 3/8/99  
Drilled By: J.T.

Station See Boring Plan  
Offset \_\_\_\_\_  
Elevation N/A

Boring Method 3.25" HSA  
Hammer Weight 140 lbs.  
Hammer Drop 30 inches

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
SS-1	W 1	56	2.5	Black PEAT, highly organic. Very soft. Moist. -SS-1: LBI = 58.5%; qh = 0.4 ksf	336		
SS-2	W 1	11	5.0				
SS-3	W W 1	28	7.5	Green PEAT, highly organic (decomposed and non-decomposed). Very soft. Wet. -SS-3: qh = <0.1 ksf			
SS-4	W W W	0	10.0	-SS-3: pH = 6.4 (in distilled water)			
SS-5A	W W	100	14.5	-SS-5A: LBI = 18.2%	244		
SS-5B	W			Gray SILT, some clay, trace fine sand, trace			

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; N/A = Not Available

#### SAMPLE TYPE

SS - 2" OD Split Spoon  
GS - Geoprobe Sample  
ST - Shelby Tube  
RC - Rock Core  
AS - Auger Sample

#### GROUND WATER READING

At Completion 20.0(rods) Ft  
After 24 Hrs N/A  
Cave-in @ 8.5 feet

#### BORING METHOD

HSA - Hollow Stem Augers  
SFA - Solid Flight Augers  
MD - Mud Drilling  
WD - Wash Drilling  
RC - Rock Coring



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REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.  
 Project ORA Peat Bog Investigation, Pine Island, NY  
 Project Number W-9029

Boring Number PB-1  
 Sheet 2 of 3  
 Completion Depth 48.0'

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
			17.5	non-decomposed organics. Very soft. Wet.			
SS-6	W W W	100	20.0	-interbedded organics present in SS-6 -SS-6: USCS CL-ML; qh = 0.0 ksf	56	30	23
SS-7	5 10	100	22.5	Gray coarse to fine SAND, trace silt, trace fine gravel. Medium dense. Wet. -groundwater initially encountered @ 22.5'			
			25.0	-SS-7: USCS SP -"heaving" sand encountered @ 25.0'			
			27.5				
			28.0	Gray CLAY, little silt, trace fine sand (some coarse to fine sand present in seams). Very stiff to medium stiff. Moist.			
SS-8	5 9 12	100	30.0		31		
			32.5	-SS-8: qh = 6.0 ksf			
ST-9		92	35.0				

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; N/A = Not Available



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### REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.  
 Project ORA Peat Bog Investigation, Pine Island, NY  
 Project Number W-9029

Boring Number PB-1  
 Sheet 3 of 3  
 Completion Depth 48.0'

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG		
						LL	PL	
SS-10	2 3 4	100	40.0	-SS-10: $q_h = 3.0$ ksf	34	49	23	
			42.5					
SS-11	3 3 4	100	45.0	-SS-11: USCS CL; $q_h = 0.6$ ksf				
ST-12		100	47.5					
Bottom of Boring = 48.0 feet					48.0			

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; N/A = Not Available



# REPORT OF SOIL EXPLORATION

Boring Number \_\_\_\_\_

Sheet 1 of 2

Completion Depth 30.0'

Date Started 3/9/99

Date Finished: 3/9/99

Drilled By: J.T.

Station See Boring Plan

Offset \_\_\_\_\_

Elevation N/A

3.25" HSA

140 lbs.

30 inches

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
SS-1	1	17	2.5	Black PEAT (fine SANDY SILT, little clay), highly organic. Very soft. Moist.	340		
ST-2		83	5.0	-ST-2: LBI = 69%; uw = 63 pcf; pH = 5.9 (in distilled water)	296	NP	
SS-3	W W W	100	7.5	Green PEAT (SILT, some clay), highly organic - decomposed and non-decomposed. Very soft. Wet.	232		
ST-4		100	10.0	-SS-3: qh = 0.1 ksf -ST-4: quu = 187 psf @ 8% strain; uw = 75 pcf	222	NP	NP
			12.5	Gray CLAYEY SAND. Loose. Moist.			
ST-5		100	13.0	Gray SANDY CLAY, some silt. Medium stiff. Moist.			



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### REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.  
 Project ORA Peat Bog Investigation, Pine Island, NY  
 Project Number W-9029

Boring Number PB-2  
 Sheet 2 of 2  
 Completion Depth 30.0'

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
			17.5				
SS-6	3	89	18.0	Gray CLAY, little silt. Medium stiff. Moist. -SS-6: qh = 3.5 ksf -vertical sand seam in SS-6			
	3		20.0				
	5		22.5				
SS-7	3	100	25.0	-SS-7: USCS CL; qh = 1.5 ksf to 2.5 ksf	32	44	22
	3		27.0				
	3		27.5	Gray SILT and CLAY (clay seams), trace fine sand. Medium stiff. Wet.			
SS-8	3	100	30.0	-SS-8: USCS CL; qh = 2.0 ksf to 4.0 ksf -very thin sand seams in SS-8	27	26	16
	2						
	3						
				Bottom of Boring = 30.0 feet			

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; NP = non-plastic sample; no gas readings in hole or on samples; no gas reading recorded on headspace of SS-1; N/A = Not Available



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### REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.  
 Project ORA Peat Bog Investigation, Pine Island, NY  
 Project Number W-9029

Boring Number PB-3  
 Sheet 1 of 2  
 Completion Depth 30.0'

Date Started: 3/10/99  
 Date Finished: 3/10/99  
 Drilled By: J.T.

Station See Boring Plan  
 Offset \_\_\_\_\_  
 Elevation N/A

Boring Method 3.25" HSA  
 Hammer Weight 140 lbs.  
 Hammer Drop 30 inches

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
				Black PEAT, highly organic. Very soft. Moist.			
SS-1	1	17	2.5				
	1						
	1						
SS-2	1	17	5.0	-SS-2: pH = 5.7 (in distilled water)	133		
	1						
	W	17	7.5				
	W						
	1						
			8.0				
SS-4	W	50	10.0	Green PEAT, highly organic (decomposed and non-decomposed). Very soft. Wet. -SS-4: LBI = 17%; qh = <0.1 ksf	191		
	1						
			11.0				
SS-5	W	100	12.5	Gray CLAYEY SILT, trace fine sand (some sand present in seams). Very soft to stiff. Wet. -SS-5: USCS CL; LBI = 2%; qh = 0.2 ksf	28	-27	
	W						
	W						
ST-6		92		-2" sand seam in SS-5 -ST-6: USCS CL; quu = 1,775 psf @ 14% strain; uw = 129 pcf	24	26	17

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; no gas readings recorded for SS-1, SS-2, SS-3;  
 N/A = Not Available

**SAMPLE TYPE**  
 SS - 2" OD Split Spoon  
 GS - Geoprobe Sample  
 ST - Shelby Tube  
 RC - Rock Core  
 AS - Auger Sample

**GROUND WATER READING**  
 At Completion 7 N/A Ft  
 After 24 Hrs 7 N/A  
 Cave-in @ 10.0 feet

**BORING METHOD**  
 HSA - Hollow Stem Augers  
 SFA - Solid Flight Augers  
 MD - Mud Drilling  
 WD - Wash Drilling  
 RC - Rock Coring



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REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.  
 Project ORA Peat Bog Investigation, Pine Island, NY  
 Project Number W-9029

Boring Number PB-3  
 Sheet 2 of 2  
 Completion Depth 30.0'

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
			17.5	-increase in silt content in ST-6	25		
SS-7	3	0	20.0				
	4		22.5				
	6		25.0				
SS-8	1	100	25.0	-SS-8: $qh = 2.0$ ksf; trace fine gravel			
	2		27.5				
	2		30.0				
SS-9	1	67	30.0	-SS-9: $qh = 0.6$ ksf -very thin silt seams in SS-9			
	2		30.0	Bottom of Boring = 30.0 feet			

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; no gas readings recorded for SS-1, SS-2, SS-3;  
 N/A = Not Available



RESOURCE INTERNATIONAL INC.  
281 ENTERPRISE DRIVE  
WESTERVILLE, OHIO 43081  
(614) 885-1959

### REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.  
Project ORA Peat Bog Investigation, Pine Island, NY  
Project Number W-9029

Boring Number PB-4  
Sheet 1 of 2  
Completion Depth 30.0'

Date Started: 3/10/99  
Date Finished: 3/10/99  
Drilled By: J.T.

Station See Boring Plan  
Offset \_\_\_\_\_  
Elevation N/A

Boring Method 3.25" HSA  
Hammer Weight 140 lbs.  
Hammer Drop 30 inches

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
				Black PEAT, highly organic. Very soft. Moist.			
SS-1	1	11	2.5	-SS-1: qh = 0.4 ksf			
	1						
	1						
SS-2	W	39	4.0	Reddish brown to greenish brown PEAT, highly organic (decomposed and non-decomposed).			
	W						
	1						
ST-3		71	5.0	Very soft. Wet.			
				-SS-2: qh = 0.1 ksf			
			7.5				
SS-4	W	89	10.0	-SS-4: qh = 0.1 ksf	180		
	W						
	W						
	W						
SS-5	W	100	11.0	Gray CLAYEY SILT, trace fine sand. Very soft.	34	26	18
	W			Wet.			
	W			-SS-5: USCS CL			
			12.5				
SS-6	W	100					
	W						
	W						

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; no gas readings; faint sulphur odor in the hole;  
N/A = Not Available

**SAMPLE TYPE**  
SS - 2" OD Split Spoon  
GS - Geoprobe Sample  
ST - Shelby Tube  
RC - Rock Core  
AS - Auser Sample

**GROUND WATER READING**  
At Completion 22.0(rods) Ft  
After 24 Hrs N/A  
Cave-in @ 5.0 feet

**BORING METHOD**  
HSA - Hollow Stem Augers  
SFA - Solid Flight Augers  
MD - Mud Drilling  
WD - Wash Drilling  
RC - Rock Coring



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REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.  
 Project ORA Peat Bog Investigation, Pine Island, NY  
 Project Number W-9029

Boring Number PB-4  
 Sheet 2 of 2  
 Completion Depth 30.0'

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
			17.5				
SS-7	W W W	100	20.0				
			22.5				
SS-8	W 2 3	78	23.0	Gray medium to fine SANDY SILT, little clay, trace coarse sand, trace fine gravel. Loose. Wet. -groundwater initially encountered @ 23.0' -SS-8: Visual USCS ML			
			25.0				
	2 3 3	78	27.5	-"heaving" sands encountered @ 28.0' -SS-9A: Visual USCS ML			
			30.0	Bottom of Boring = 30.0 feet			

NOTES: W = weight of hammer and drill rod "pushed" split- spoon sampler 6 inches; no gas readings; faint sulphur odor in the hole;  
 N/A = Not Available



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REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.  
 Project ORA Peat Bog Investigation, Pine Island, NY  
 Project Number W-9029

Boring Number PB-5  
 Sheet 1 of 2  
 Completion Depth 20.0'

Date Started: 3/10/99  
 Date Finished: 3/10/99  
 Drilled By: J.T.

Station See Boring Plan  
 Offset \_\_\_\_\_  
 Elevation N/A

Boring Method 3.25" HSA  
 Hammer Weight 140 lbs.  
 Hammer Drop 30 inches

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
			2.5	Black to reddish brown PEAT, highly organic. Very soft. Moist.			
SS-1	1	17	5.0	-SS-1: pH = 5.9 (in distilled water)	138		
			7.5	Green PEAT, highly organic (decomposed and non-decomposed). Very soft. Wet.			
SS-2	W	100	10.0	-SS-2: qh = 0.2 ksf	251		
			12.5				
SS-3	W	100	13.0	Gray CLAYEY SILT, trace fine sand, trace organics. Very soft. Wet. -SS-3: LBI = 4%; qh < 0.1 ksf	44		

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; no gas readings in SS-1, SS-2, hole; faint sulphur odor in hole; N/A = Not Available

**SAMPLE TYPE**  
 SS - 2" OD Split Spoon  
 GS - Geoprobe Sample  
 ST - Shelby Tube  
 RC - Rock Core  
 AS - Auger Sample

**GROUND WATER READING**  
 At Completion ∇ N/A Ft  
 After 24 Hrs ∇ N/A  
 Cave-in @ 4.0 feet

**BORING METHOD**  
 HSA - Hollow Stem Augers  
 SFA - Solid Flight Augers  
 MD - Mud Drilling  
 WD - Wash Drilling  
 RC - Rock Coring



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### REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.

Boring Number PB-5

Project ORA Peat Bog Investigation, Pine Island, NY

Sheet 2 of 2

Project Number W-9029

Completion Depth 20.0'

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
			17.5				
SS-4	W W W	100	20.0	-SS-4: $q_h < 0.1$ ksf			
				Bottom of Boring = 20.0 feet			

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; no gas readings in SS-1, SS-2, hole; faint sulphur odor in hole; N/A = Not Available



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### REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.  
 Project ORA Peat Bog Investigation, Pine Island, NY  
 Project Number W-9029

Boring Number PB-6  
 Sheet 1 of 3  
 Completion Depth 40.0'

Date Started: 3/10/99  
 Date Finished: 3/10/99  
 Drilled By: J.T.

Station See Boring Plan  
 Offset \_\_\_\_\_  
 Elevation N/A

Boring Method 3.25" HSA  
 Hammer Weight 140 lbs.  
 Hammer Drop 30 inches

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG	
						LL	PL
			2.5	Black to reddish brown PEAT, highly organic. Very soft. Moist.			
SS-1A	1	61	4.0	-SS-1A: qh = 0.2 ksf	404		
SS-1B	1		5.0	Green PEAT, highly organic (decomposed and non-decomposed). Very soft. Wet. -SS-1B: qh = 0.2 ksf; pH = 7.6 (in distilled water)			
			7.5	Gray CLAYEY SILT, trace coarse to fine sand with water-bearing sand seams. Very soft. Moist.			
SS-2A	W	89	9.0	-groundwater initially encountered @ 7.0'	24		
SS-2B	6		10.0	Gray coarse to fine SAND, little silt and clay, trace fine gravel. Very loose. Wet to moist. -SS-2B: Visual USCS SM			
			12.5				
SS-3	W	78	13.5	Gray SILT, some coarse to fine sand, little clay. Very loose. Wet. -SS-3: Visual USCS ML	22		

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; N/A = Not Available

**SAMPLE TYPE**  
 SS - 2" OD Split Spoon  
 GS - Geoprobe Sample  
 ST - Shelby Tube  
 RC - Rock Core  
 AS - Auger Sample

**GROUND WATER READING**  
 At Completion ∇ N/A Ft  
 After 24 Hrs ∇ N/A  
 Cave-in @ 5.0 feet

**BORING METHOD**  
 HSA - Hollow Stem Augers  
 SFA - Solid Flight Augers  
 MD - Mud Drilling  
 WD - Wash Drilling  
 RC - Rock Coring



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REPORT OF    EXP ORATION

Client Gray & Pape, Inc.

Boring Num PB-6

Project ORA Peat Bog Investigation, Pine Island, NY

Sheet 2 3

Project Number W-9029

Completion Depth 40.0

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG		
						LL	PL	
				- "heaving" sands encountered @ 15.0'				
SS-4	W	00		Gray fine to coarse SAND trace fine gravel, trace silt, trace clay Very lo. Mois -SS-4 USCS SW SM				
				18.5				
				22.0				
SS-5				Gray CLAY, trace silt, trace coarse to fine sand. Very stiff. Moist.  -SS-5: USCS CL; qu = 3,000 psf @ 15% strain; uw = 125 pcf	28	43	21	
				27.0				
SS-6		00		G CLAY some silt trace to fine sand Medium stiff V  -SS- qh				
			30.					
ST-7		00						
NOTES	W	weight	hammer	drill rod	pushed	soft	sample 6 inches: N/A	Not Available



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### REPORT OF SOIL EXPLORATION

Client Gray & Pape, Inc.

Boring Number PB-6

Project ORA Peat Bog Investigation, Pine Island, NY

Sheet 3 of 3

Project Number W-9029

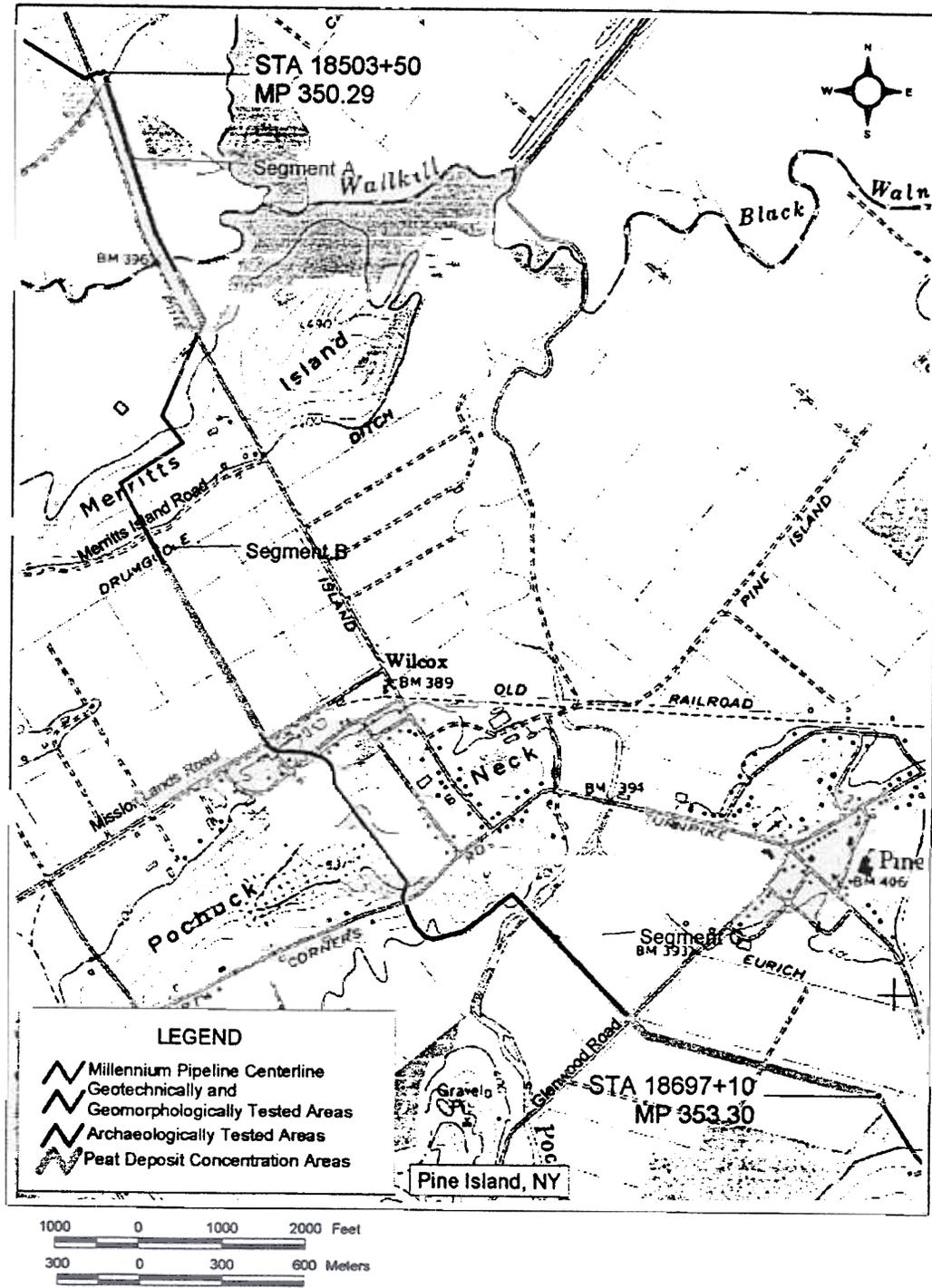
Completion Depth 40.0'

SAMPLE NO	BLOWS PER 6"	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT		ATTERBERG	
					W	C	LL	PL
SS-8	W	100						
	2							
	3		40.0	-SS-8: $qh = 1.0$ ksf	34			
				Bottom of Boring = 40.0 feet				

NOTES: W = weight of hammer and drill rod "pushed" split-spoon sampler 6 inches; N/A = Not Available

Core	Tube	Stratum	Thickness (cm)	Adj. Thick (cm)	Adj. Thick (Inches)	Munsell	Texture	Inclusions	Redox	Boundary	Origin	
1	1	I	2	5	2	10YR3/4	SIL	ROOTS		AS	MODERN A	
	1	II	20	49	19	10YR5/2	S			AS	FILL	
	1-5	III	62.5	198	78	5Y3/1	SIC	SI LENS		AW	BURIED A	
	5-7	IV	102.5	163	64	5Y2.5/2	C PEAT		R	DW	SWAMP	
	7-8	V	30	81	32	GLEYS 4/N	CS		R	CB	ALLUVIAL	
	9-10	VI	10	71	28	GLEYS 4/N	SIS		R	U	ALLUVIAL	
	10	VII	12	21	8	GLEYS 4/N	CS		R	DS	ALLUVIAL	
	10	VIII	1	2	1	GLEYS 4/N	S		R	AS	ALLUVIAL	
	10	IX	3	5	2	GLEYS 4/N	CS		R	AS	ALLUVIAL	
	10	X	1.5	3	1	GLEYS 4/N	S		R	AS	ALLUVIAL	
	10	XI	3	5	2	GLEYS 4/N	CS		R	AS	ALLUVIAL	
	10	XII	4	7	3	GLEYS 4/N	S		R	AS	ALLUVIAL	
	11-13	XIII	34	186	73	GLEYS 4/N	CSI		R	AS	ALLUVIAL	
	14	XIV	24	26	10	GLEYS 4/N	CS	SHELL	R	CB	ALLUVIAL	
	14-15	XV	89	105	41	5Y3/1	C	FINE GRAVEL	R	AS	ALLUVIAL	
	15-16	XVI	26	27	11	GLEYS 4/N	CS		R	GW	LACUSTRINE	
	16-17	XVII	62	62	24	GLEYS 4/N	C		R	AS	LACUSTRINE	
	17-18	XVIII	52	55	22	GLEYS 4/N	CSI		R	AS	LACUSTRINE	
	18-20	XIX	151	175	69	GLEYS 4/N	C		R	U	LACUSTRINE	
				Total Feet		40.77						
	1-2		50	102	40	10YR2/1	SICL	ROOTS		GW	A HORIZON	
	2-3	II	51	79	31	10YR2/1	SIC PEAT	NON-D ORG		AS	SWAMP	
	3	III	4	5	2	5Y3/2	C PEAT	D ORG	R	CB	SWAMP	
	4-5	IV	13	20	8	10YR2/1	C PEAT	D ORG		AW	SWAMP	
	5-6	V	194	212	83	5Y3/2	C PEAT	D ORG	R	AW	SWAMP	
	7	VI	16	16	6	GLEYS 4/N	S	SHELL	R	U	ALLUVIAL	
				Total feet		14						
AR-3	1		73	143	56	10YR2/1	CL	ROOTS		AS	A HORIZON	
	2-3	II	38	62	24	10YR3/2	SIC PEAT	NON-D ORG		AW	SWAMP	
	4-9	III	241	352	138	5Y3/2	C PEAT	D-ORG	R	AS	SWAMP	
	9	IV	1	3	1	GLEYS 4/N	S		R	U	ALLUVIAL	
			Total feet		18							
AR-4	1		40	47	18	10YR2/1	CL	ROOTS		GS	A HORIZON	
	2	II	49	90	36	10YR2/1	SIC PEAT	NON-D ORG		AS	SWAMP	
	3	III	28	41	16	10YR3/3	C PEAT	D ORG		AW	SWAMP	
	4-5	IV	66	131	52	5Y3/2	C PEAT	D ORG	R	CB	SWAMP	
	6-7	V	92	124	49	10YR3/1	S	SHELL	R	U	ALLUVIAL	
			Total feet		14							
AR-5	1		35	41	16	10YR2/1	SIL	ROOTS		GS	FLOWZONE	
	1-2	II	51	69	27	10YR2/1	SICL	ROOTS		AW	OLD FLOWZONE	
	2-3	III	28	40	16	10YR3/3	SIC PEAT	NON-D ORG		AW	SWAMP	
	3	IV	22	31	12	10YR4/1	GS		R	AW	ALLUVIAL	
	3-4	V	30	41	16	10YR4/1	GC		R	AW	ALLUVIAL	
	4-6	VI	95	151	59	5Y3/2	C		R	AW	ALLUVIAL	
	7	VII	6	62	24	GLEYS 4/N	GC		R	U	ALLUVIAL	
				Total feet		14						
	1-2		58	90	35	10YR2/1	SIL	ROOTS		AS	FLOWZONE	
	2	II	6	11	4	10YR3/4	SICL	NON-D ORG	O	AS	OLD FLOWZONE	
2-3	III	29	59	23	10YR2/1	SIC PEAT	NON-D ORG		AW	SWAMP		
3	IV	16	31	12	5Y3/2	C PEAT	D ORG		AW	SWAMP		
4-6	V	119	180	71	GLEYS 4/N	C		R	U	ALLUVIAL/SW		
			Total feet		12							
AR-7	1	I	42	48	19	10YR2/1	SICL	ROOTS		AW	FLOWZONE	
	1-2	II	71	108	42	10YR3/3	SIC PEAT	NON-D ORG	O	AS	SWAMP	
	3	III	8	16	6	10YR3/6	C PEAT	D ORG	O	AS	SWAMP	
	3-4	IV	79	105	41	5Y3/2	C PEAT	D ORG	R	DW	SWAMP	
	4-6	V	43	95	37	GLEYS 4/N	C		R	U	ALLUVIAL	
				Total feet		12						
	1-2		48	103	40	10YR2/1	SIL	ROOTS		DW	FLOWZONE	
	2-3	II	27	40	16	10YR3/3	SIC PEAT	NON-D ORG		DW	SWAMP	
	3-4	III	66	84	33	10YR3/6	SIC PEAT	NON-D ORG	O	AS	SWAMP	
	4-5	IV	123	134	53	5Y3/2	C PEAT	D ORG	R	DW	SWAMP	
6	V	12	12	5	GLEYS 4/N	C		R	U	ALLUVIAL		
			Total feet		12							





**FIGURE 1:** Millennium Pipeline Route Through Black Dirt Area Towns of Minisink and Warwick Orange County, New York