SUBSURFACE INVESTIGATION OF RECHARGE BASINS

EDWARD DUBLE SENIOR CENTER
WINSLOW TOWNSHIP
AND
CHESILHURST PUBLIC WORKS BUILDING
CHESILHURST BOROUGH

RFP-05-006
Camden County, New Jersey

PREPARED FOR:

The Pinelands Commission
P.O.Box 7
New Lisbon, New Jersey 08064

PREPARED BY:

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March 05

Princeton Hydro, LLC Project No. 0579.001

March 2, 2005

The Pinelands Commission
Mr. Edward Wengrowski
P.O. Box 7
New Lisbon, New Jersey 07728

Re: Geotechnical Services, RFP-05-006
Subsurface Investigation of Recharge Basins
Edward Duble Senior Center, Winslow Township
Chesilhurst Public Works Building, Chesilhurst Borough
Camden County, New Jersey
Princeton Hydro Project No. 0579.001

Mr. Wengrowski:

Princeton Hydro, LLC (Princeton Hydro) has completed the subsurface investigation for the above referenced site. The attached report describes the methods and assumptions used for the determination of infiltration basin failures, including two (2) retrofit/ rehabilitation scenarios for each basin.

The results of this investigation conclude, in general, that the sites are suitable for the installation and operation of infiltration basins. Through the course of the desktop and field investigation it was observed that several design/construction flaws and inadequate maintenance have contributed to the basin failures.

Two (2) solution scenarios are included for each basin, a short term repair and a long term repair/redesign/retrofit. The primary difference between these two (2) options are cost and quantity of work. The short term repair generally requires less material to be purchased and a minimum of field time. The long term repair requires more equipment, purchase of additional infrastructure, and a comprehensive redesign of the basin by a licensed Professional Engineer.

It has been a pleasure to be of assistance to The Pinelands Commission. If you have any questions, please contact me at your convenience.

Sincerely,

Keithe J. Merl, P.E.
Senior Project Manager

Attachments

c: file

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Executive Summary

Over the course of several months the Pineland Commission has cataloged and ranked the infiltration basins constructed in their management area. The result indicated that the infiltration basins located in Winslow Township, at the Edward Duble Senior Center, and in Chesilhurst Borough, at the Borough Building, have demonstrated the most significant reduction in efficiency.

This report and its associated field investigation have been designed to determine the cause of the basin failures, detail the procedures used to formulate those causes, and offer several corrective measures for the basin repair.

It was determined that the basins had been failing for two primary reasons:

1. The initial designs did not adequately take in account the effect hydraulically restrictive layers (below the infiltrative surface) had on the infiltration capacity of the basins and;
2. Inadequate or non-existent maintenance plans allowed clogging of the infiltrative surface.

The field investigation revealed the sites are generally suitable for the installation of infiltration basins, in compliance with New Jersey Administrative Code 7:9a and the New Jersey Stormwater Best Management Practices Manual. The infiltration rates measured at each basin are as follows:

- Winslow Township – 11 in/hr
- Chesilhurst Borough – 1 in/hr

For each basin a pair of remediation procedures have been recommended. The greatest difference in the two formulated repairs are the cost. The first is designed to minimize cost and offer adequate repair of the basin in the short-term (approximately one (1) year). However, this option will leave the basins in need of those repairs recommended in the second option. The second option includes a comprehensive redesign of the basin (by a Licensed Professional Engineer), major reconfiguration of the basin, and a significant amount of additional construction materials. *Both* require the need to create an adequate *maintenance plan* for the basins.

Construction procedures are very important when constructing or retrofitting an infiltration basin and several guidelines should be followed:

1. Earthwork should be performed from outside the basin footprint. When equipment must be used on the infiltrative surface of the basin construction should be completed with low ground pressure machines working out of the basin without moving over completed areas;
2. To help prevent subgrade clogging the equipment used to repair the basin should be kept clean of unsuitable soil materials. This can be accomplished by using equipment exclusively in the basin and increasing machine cleaning (i.e. twice daily and prior to entering the basin footprint);
3. Runoff should be diverted around the basin or into temporary control structures, this will reduce clogging and damage to the infiltrative surface;
4. The infiltrative surface should be mixed with lime, composted leaves, and grass clippings in order to increase the absorption capacity of the infiltrative surface, health of planted vegetation and maintain suitable void ratios in the upper soil surface.

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1.0 Introduction

Princeton Hydro, LLC. (Princeton Hydro) was contracted by The Pinelands Commission. (herein after referred to as the 'client') to investigate and determine (if possible) the cause for infiltration basin failures at the Edward Duble Senior Center in Winslow Township and the Chesilhurst Public Works Building in Chesilhurst Borough, Camden County, New Jersey. This report will provide procedures and guidance to aid in the reproduction of the methods used herein, and recommendations for the repair of the basins at each site.

2.0 Scope of Services

The objective of this investigation was to explore the subsurface soil and groundwater conditions and analyze these conditions as they relate to the infiltration basin failures.

To retrieve physical data specific to the site, the following tasks were completed:

- A review of secondary data, including published soils and geologic information;
- A review of original design plans, calculations, and geotechnical investigations completed for the sites;
- Performance of laboratory physical testing for infiltration rates and soil water capacities;
- Performance of field testing for infiltration rates.

Once obtained, the data was utilized to prepare observations, conclusions and recommendations.

3.0 Site Location

3.1 Basin No. 1

Basin No. 1 (Basin 1) is located adjacent to the Edward Duble Senior Center; Block 2504, Lot 7; on Cooper Folly Road in Winslow Township. The basin is bordered to the north and west by fallow forest, to the south by a wooded residential lot, and to the north and east by the Winslow Township Senior Center.

3.2 Basin No. 2

Basin No. 2 (Basin 2) is located adjacent to the Chesilhurst Borough Public Works Building; Block 703, Lot 3; on Grant Avenue (between 2nd & 3rd Streets) in Chesilhurst Borough. The basin is bordered to the north by Grant Avenue, the east be the Borough Municipal Building and to the south and west by fallow forest.

3.3 General

Both Basins 1 & 2 are located in Camden County New Jersey, within the Pinelands Management Boundary. As such, the basins were originally designed to infiltrate collected stormwater into the subsurface to recharge the underlying aquifer.

The sites are located entirely in the Coastal Plain Physiographic Province of New Jersey's landform profile. This province is the largest in the state, consuming about three-fifths of New Jersey's land area, and the youngest ranging in age from the early Cretaceous to Miocene Periods. The unconsolidated deposits that form this province gently dip to the southeast with a broad trough forming a saddle near Monmouth Junction at elevation 80 feet (AMSL). Adjacent to this trough is the drainage divide for the Delaware River and Atlantic Ocean. These sites are located

on the coastal plain side of the saddle where the maximum elevation is 391 feet (AMSL) in Crawford Hill.

4.0 Desktop Study

In order to ascertain the mapped subsurface features of the site several publications were reviewed including the United States Department of Agriculture (USDA) Soil Survey of Camden County [17] for agronomic features and the Bedrock Geologic Map of Central and Southern New Jersey, Owens, James P., et.al.[3] for geologic conditions.

Additional information was supplied by the client in the form of original site design plans and stormwater management calculations prepared by Oliver and Becica A.I.A., P.A., Architecture and Engineering, entitled Plan of Senior Citizens Center for the Township of Winslow, Route 73 Braddock, Camden County New Jersey, Sheets SP-1 through SP-3, latest revision August 1989, for Basin 1 and Adams, Rehman & Heggan, Engineers, Surveyors, Planners, entitled Proposed Maintenance Building, Block 41, Lots 1, 3, 5, 7, 9, 11, and 13, Borough of Chesilhurst, Camden County, New Jersey, Sheets 2 and 3 of 3, latest revision August 1995 for Basin 2.

Information collected as a result of these reviewed items are summarized herein.

4.1 Agronomy

Review of the USDA soil survey revealed the following soil series mapped as underlying or in close proximity of the basins:

4.1.1 Basin No. 1

Aura Series Soils (AugB)-

Consist of very deep, well drained loamy and gravelly alluvium formed on low hill and relic stream terrace landforms. Permeability is moderately low, internal free water occurrence is very deep to absent, with a depth to seasonal high water table reported as greater than 72 inches. The soil differs based on geographical location, but in general ranges from (very) dark grayish brown sandy loam to yellowish brown, yellowish red, or brown coarse sandy loam with gravel and red gravelly loamy sand at depth;

Downer Series Soils (DocB)-

Consist of very deep, well drained siliceous fluviomarine deposits formed on summit, shoulder, and back slopes of hills and ridges. Permeability is moderate to moderately rapid, internal free water occurrence is very deep to absent, with a depth to seasonal high water table reported as greater than 72 inches. The soil ranges from dark grayish brown to yellowish brown loamy sand at depth;

Mullica Series Soils (Mum)-

Consist of very deep, very poorly drained loamy siliceous marine sediments formed on broad flats adjacent to streams or in scattered low-lying areas. Permeability is moderate to rapid with depth, seasonal high water table is reported as six (6) inches above ground surface to 12 inches below ground surface, variable by location and season. The soil ranges from slightly decomposed leaves and twigs overlaying black sandy loam to gray and grayish brown sand with gravel at depth;

Woodstown and Glassboro Series Soils (WORB)-

Consist of a mixture of Woodstown and Glassboro Series Soils. The amounts of each constituent are not expressly reported, however (in general) the constituents are listed in descending order of concentration;

Woodstown Series Soils – consist of very deep, moderately well drained sandy marine/ old alluvial sediments formed in upland marine terraces and old stream terraces. Permeability is moderate, surface runoff is slow to medium, and depth to seasonal high water table reported as 18 to 24 inches, variable by season. The soil ranges from dark grayish brown sandy loam, light olive brown clay loam , to light grey loamy sand at depth.

Glassboro Series Soils – consist of very deep, somewhat poorly drained loamy fluviomarine deposits formed on flat or depressional areas. Permeability is moderately rapid, internal free water occurrence is shallow and common with a seasonal high water table reported as 12 to 8 inches below the surface, variable with season. The soil ranges from yellowish brown sandy loam to light brown/ brownish gray coarse sands and strong brown gravelly coarse sands at depth;

Basin 1 is mapped as entirely underlain by the Downer series soils. Aura series soils are to the east, the Mullica Series to the north, and the Woodstown and Glassboro Complex to the southwest.

4.1.2 Basin No. 2

Aura Series Soils (AucB)-

Consist of very deep, well drained loamy and gravelly alluvium formed on low hill and relic stream terrace landforms. Permeability is moderately low, internal free water occurrence is very deep to absent, with a depth to seasonal high water table reported as greater than 72 inches. The soil differs based on geographical location, but in general ranges from (very) dark grayish brown sandy loam to yellowish brown, yellowish red, or brown coarse sandy loam with gravel and red gravelly loamy sand at depth;

Evesboro Series Soils (EvfmB)-

Consist of very deep, excessively drained sandy marine and eolian deposits formed on summits and sideslopes. Permeability is moderately rapid to rapid with a depth to seasonal high water table reported as greater than 72 inches. The soil ranges from block matted fiberous organic matter overlying grayish brown sand to stratified light yellowish brown sand at depth;

Basin 2 is mapped as entirely underlain by the Aura Series soils, Evebsboro series soils are mapped to the north of the site.

4.2 Geologic Setting

Basin 1 & 2 reside in an area of the most recent geological sedimentary deposition. The unconsolidated sediments (young sedimentary rocks) that form the bedrock of the coastal plain have blurred boundaries with the surficial soil masses and sharp boundaries on basement rock (with considerable relief) up to 350 feet (107 meters) in thickness.

4.2.1 Underlying Geology

The underlying geology in this portion of New Jersey consists of unconsolidated marine sediment members of the Cenozoic Era, Upper Tertiary (Neogene) Period, Middle to Upper Miocene Epoch, Serravallian Age:

Cohansey Formation (Tch) -

> Consisting of gray to brown fine- to coarse-grained sand, locally gravelly in some locations, which weathers yellow to white. Where less weathered, small amounts (5-10 percent) of potassium feldspar is present. It is massive to cross-bedded, and the sand consists almost exclusively of quartz. Interbedded discrete layers of thin to thick-bedded, massive to finely laminated clay or silty clay are common and weather white, yellow, or red. Dark-gray beds commonly contain carbonized wood fragments, some of which are log size.

Basin 1 & 2 are mapped as completely underlain by this formation with inter-formational contacts mapped miles away from the site.

4.3 Design Documentation

The original design documentation was reviewed in an attempt to discern the intent, assumptions, and reasoning used to initially design these basins. This data was used forensically to determine the possibility of inadequate construction techniques and/or design parameters.

4.3.1 Basin No. 1

The site grading plan (drawing SP-1) reveals a rectangular shaped basin with dimensions of 222 feet in the east-west direction and 115 feet in the north-south direction, although the scaled dimensions do not match the labeled dimensions. The pre-construction grades ranged from a low of 162' in the western corner of the basin rising towards the east to elevation 166' resulting in a slope of approximately 30:1 (H:V). The top of berm elevation was designed to be at elevation 166' and the bottom of the basin at elevation 161', thereby required slight fills in the eastern portion of the berm and excavation throughout the footprint of the basin. The side slopes were designed to be a 5:1 slope.

The infrastructure proposed to service the basin is a 21 inch, round concrete pipe (RCP) terminating in the eastern berm toe with an endwall and rip-rap reinforced apron. The pipe invert is at elevation 161.67'. The bottom of the basin was proposed to receive an eight (8) inch thick layer of two (2) inch crushed stone.

One (1) subsurface sampling event was completed in the northern corner of the basin as indicated on sheet SP-1 as P&B #2. The sampling event was performed by Material Testing Services (6/3/88) by way of hand auger boring. The results of the boring reported a seasonal high water table at a depth of 90 inches, faint mottles beginning at 64 inches, groundwater encountered at 126 inches, and a laboratory testing infiltration rate of 15 inches per minute (in./min.) at 120 inches.

4.3.2 Basin No. 2

The Overall Site Plan (drawing 2 of 3) reveals a rectangular shaped basin with dimensions of 135 feet in the north-south direction and 30 feet in the east-west direction. The pre-construction grades were relatively level at elevation 163'. The top of berm elevation was designed to be at 162' and the bottom of basin elevation at 160', thereby requiring excavation throughout the footprint of the basin. The side slopes were designed to be a 4:1 slope.

The infrastructure proposed to service the basin consists of three (3) leaching pits fed by the maintenance building roof runoff via polyvinylchloride (PVC) piping of unspecified diameter. The leach pits consist of perforated reinforced concrete (RC) rings surrounded by an 18 inch thick ring of two (2) inch crushed stone. The whole system the rests on a four (4) inch thick bed of the same crushed stone and an additional eight (8) inches of K5 sand below that. The entire infiltration system would then be encapsulated on five sides by Mirafi 140N Fabric. Refer to the Typical Leaching Pit Detail (Sheet 3 of 3) in the original plans for more details.

One (1) subsurface sampling event was completed in the proposed basin footprint as indicated on sheet 2 of 3, labeled as Soil Boring Location (presumably the only boring on site). The test was performed by Adams, Rehmann, & Heggan (8/14/95) using an unknown advancement method (likely hand auger). The results of the exploration reported a seasonal high water table at 114 inches coincident with the observed mottling, groundwater was not encountered (to a depth of 158 inches) and no reported infiltration rates were reported.

Notes on sheet 3 of 3 detail a 'Retention Basin Management Schedule' indicating requirements and methods for maintenance of the basin. In general it is the responsibility of the borough (Chesilhurst) to inspect the basin and associated leach pits on a 'semi-annual basis' and after 'major storm events', without much detail on what each of those are. The sedimentation in the basin should be maintained to prevent reduction of infiltration rates in the basin, if in the event regular silt maintenance leaves the basin in-operable then the system should be replaced. Dense turf with extensive root growth was encouraged for the basin to increase infiltration into the subsurface. Mowing was also recommended to maintain aesthetic quality of the basin.

5.0 Field Investigation

Field operations included a visual site inspection to ascertain the current condition of the basins, to verify the observations as a result of the reviewed design plans (refer to Section 4.3, above), and retrieval of subsurface data via test pits and piezometers.

5.1 Surface Conditions – Visual Site Inspection

The site inspection revealed both Basins 1 & 2 were generally constructed to the dimensional requirements as indicated on the design plans and specifications. The following sections detail the observed condition of the basin.

5.1.1 Basin No. 1

The basin berm consists of groomed ornamental lawn. The grass is regularly maintained as part of standard Township operations. The bottom of the basin, however, consisted of a mixture of wetland plants (i.e. common reed/ *phragmites australis*) and standing water in between root tufts. There were several trees growing in front of the outfall structure.

The basin appears to be depressed, compared to surrounding grades, consistent with the design drawings elevations. There were wetlands delineated 300 feet to the north of the basin as

indicated on the design drawings and NJDEP has deciduous wooded wetlands mapped to the east of the site.

The bottom of the basin is relatively flat with exception the of an observed sediment delta at the inlet pipe discharge location.

5.1.2 Basin No. 2

The basin berm consists of groomed ornamental lawn on three (3) sides and aggregate on the side adjacent to the public works building. The lawn is regularly maintained as part of the standard township operations. The bottom of the basin, however, consists of a mixture of wetland plants and standing water.

The leaching pits were covered in approximately eight (8) inches of silt that needed to be excavated prior to opening of the manhole. The leach pits were filled up to the halfway point with water and approximately to one-third the height of the pit with silt and vegetation.

5.2 Subsurface Conditions

The subsurface conditions at each site were relatively uniform and consisted of the following generalized profiles:

5.2.1 Basin No. 1

Test pit TP1 was completed outside of the basin as a control test pit to observe a relatively undisturbed (pre-construction) subsurface condition. Review of the design plans revealed that this location was either undisturbed or slightly disturbed by the construction operations related to the basin. The following generalized profile was observed:

Label	*Depth*	Description
Topsoil	0” - 14”	Dark brown (10YR3/2) sandy loam, weak, granular, moist, loose. Boundary is abrupt, smooth/wavy. Few, fine roots and no mottling.
Stratum I	14” - 90”	Pale brown, brown, and light yellowish brown (10YR6/3, 10YR5/3, & 10YR6/4) sand, weak to moderate strength at depth, fine to medium grained, single grain to granular, moist, loose. Sub-horizon boundaries are gradual and wavy, the horizon boundary is abrupt and smooth. Common, fine, faint (10YR7/4, 7.5YR5/6) mottles observed at 72 inches.
Stratum IA	90” - 102”	Strong Brown (7.5YR5/8) sandy clay loam, moderate strength, sub angular blocky, moist, friable. Abrupt smooth boundary.
Stratum II	102” - 156”	Very Pale Brown (10YR7/4) silty clay, strong, massive, moist, firm

Table 1 - Test Pit TP1 Soil Log

Test pits TP2 through TP4 were completed within the footprint of the basin and reveal a general profile consistent with that observed in TP1 (the control pit), inferring the elevations due to soil excavation processes completed to construct the basin:

Label	*Depth*	Description
Topsoil – *Possible Fill*	0" - 6"	Dark brown (10YR3/2) sandy loam, weak, granular, moist, loose. Boundary is abrupt, smooth/wavy. Few, fine roots and no mottling.
Stratum IA	6" - 24"/44"	Strong Brown (7.5YR5/8, 7.5YR6/6) sandy clay loam, moderate strength, sub angular blocky, moist, friable. Abrupt smooth boundary.
Stratum II	24"/44" - 44"/86"	Very Pale Brown (10YR7/4) silty clay, strong, massive, moist, firm. This stratum was interbedded with Stratum IA in test pit TP-3.
Stratum III	48"/86" - 96"/132"	Brownish yellow and brown (10YR6/6 & 7.5YR5/4) sand, weak to moderate strength at depth, fine to medium grained, single grain to granular, moist, loose.

Table 2 - Winslow Twp. General Soil Profile

5.2.2 Basin No. 2

Test pit TP5 was completed outside of the basin as a control test pit to observe a relatively undisturbed (pre-construction) subsurface condition. Review of the design plans revealed that this location was either undisturbed or slightly disturbed by the construction operations related to the basin. The following generalized profile was observed:

Label	*Depth*	Description
Topsoil	0" - 8"	Dark brown (10YR3/3) loamy sand, moderate, medium, granular, slightly moist, loose. Boundary is abrupt, smooth. Many, fine-medium roots and no mottling.
Stratum I	8" - 12"	Grey (10YR5/1) sand, moderate strength, fine, granular, slightly moist, loose. Boundary is abrupt and smooth. Few, fine roots.
Stratum II	12" - 27"	Strong Brown (7.5YR5/6, 7.5YR5/8) loamy sand/ sand, moderate strength, fine-medium grained, granular, moist-wet, firm. Clear, smooth boundary.
Stratum III	27" - 80"	Yellowish red/ light Red(5YR5/8, 2.5YR6/8) clay loam/ clay, strong, fine, massive, moist, plastic. Boundary is abrupt smooth/wavy.
Stratum IIA	80" - 84"	Light Red (2.5YR6/8) loamy sand, weak, fine, granular, slightly moist, loose. Few fine roots.

Table 3 - Test Pit TP5 Soil Log

Test pits TP6 & TP7 were completed within the footprint of the basin and reveal a general profile consistent with that observed in TP5 (the control pit), inferring the elevations due to soil excavation processes completed to construct the basin:

Label	*Depth*	Description
Topsoil	0" - 8"/30"	Dark brown (10YR3/3) loamy sand, moderate, medium, granular, slightly moist, loose. Boundary is abrupt, smooth. Many, fine-medium roots and no mottling.
Stratum I *TP7 only*	30" - 39"	Yellowish brown (10YR5/6) sand, moderate strength, fine, granular, slightly moist, loose. Boundary is abrupt and smooth. Few, fine roots. Few, fine, faint mottles observed at 40".
Stratum II *TP6 only*	8" - 17"	Strong Brown/reddish yellow (7.5YR5/6, 7.5 YR7/6) loamy sand/ sand, moderate strength, fine-medium grained, granular, moist-wet, firm. Clear, smooth boundary.
Stratum III	17"/39" - 58"/66"	Yellowish red/reddish yellow (5YR5/8, 7.5YR 7/6) clay loam/clay, strong, fine, massive, moist, plastic. Boundary is abrupt smooth/wavy.
Stratum IIA	58"/66" - 120"	Strong brown (7.5YR5/6. 7.5YR5/8) sand, moderate, fine, granular, slightly moist, loose/firm.

Table 4 - Chesilhurst Boro. General Soil Profile

5.3 Groundwater Conditions

Groundwater was not encountered in any of the progressed test pits. Mottling was observed in test pit TP1 at 72 inches in Basin 1 and in TP7 at 40 inches in Basin 2. The mottling observed in each test pit were shallow with no evidence of groundwater fluctuations below the observed fine, faint and indistinct mottles.

5.4 Infiltration Testing

In order to determine the infiltrative capacity of the soils three (3) types of infiltration tests were completed. In compliance with N.J.A.C. 7:9A-6.1, Table 6.1 the methods included the Soil Permeability Class Rating Test (K Class) in conjunction with Piezometer Testing, and Tube Permeameter Testing. The K Class test method includes the hydrometer method detailed in ASTM D422 and as supplemented in N.J.A.C. 7:9A-6.3, the Tube Permeameter testing complies with methods outlined in N.J.A.C. 7:9A-6.2, and the piezometer test generally following procedure in N.J.A.C. 7:9A-6.6 with modifications to the method referenced in ASTM STP 746 – Measurement of the Hydraulic Conductivity of Fine-Grained Soils.

5.4.1 Basin No. 1

Samples were collected from each test pit within the footprint of the basin (i.e. From TP2, TP3, & TP4). The tube permeameter samples were collected from the surface of the basin, Stratum II (hydraulically restrictive layer) and Stratum III (proposed infiltrative layer). Test result sheets are included in Appendix E, the results are summarized in the tables and charts below:

Test Pit	*Sample*	*Depth*	*K-Class*	
			Preliminary	*Replicate*
TP-2,3,4	S1	1.5'	K-3	K-3
TP-2,3,4	S2	4.0'	K-0	K-0

Table 5 - Basin No. 1 Permeability Class Ratings

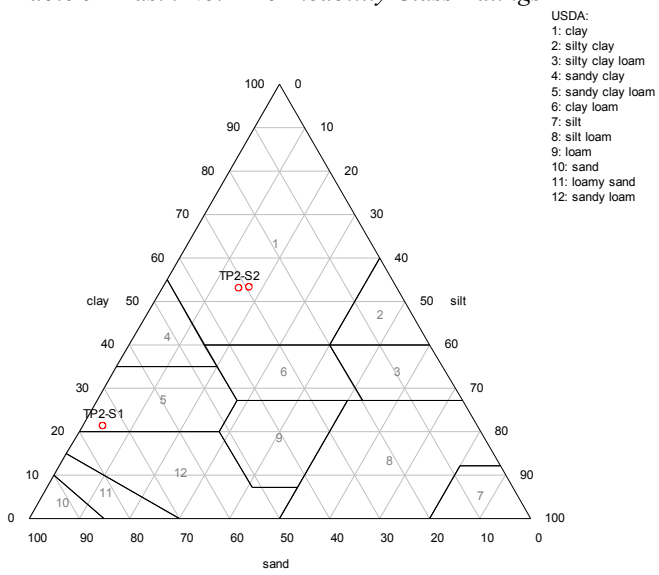


Illustration 1 - Basin No. 1 USDA Soil Plot

Test Pit	*Sample*	*Depth*	*Permeability (in/hr)*			
			Preliminary	*Replicate*	*Replicate*	*Replicate*
TP-2,3,4	S-3	7.0'	14.7	16.3	15.5	-
			11.4	14.5	14.5	-
			14.2	14.0	15.0	-
TP-2	S-2	4.0'	0.0130	0.0040	0.0760	0.0030
TP-3	S-1	4.0'	0.0030	0.0030	0.0090	-
TP-3	PZ-3	9.97'	21.47	23.04	-	-
TP-4	PZ-4	9.81'	18.17	18.63	18.33	-

Table 6 - Basin No. 1 Tube Permeameter/ Piezometer

Basin No. 2

Samples were collected from each test pit located in the footprint of the basin (i.e. From TP6 & TP7). The tube permeameter samples were collected from the surface of the basin, Stratum III (hydraulically restrictive layer) and Stratum IIA (proposed infiltrative layer). Test result sheets are included in Appendix E, the results are summarized in the tables and charts below:

Test Pit	*Sample*	*Depth*	*K-Class*	
			Preliminary	*Replicate*
TP-6,7	S-3,S-4	5.0'	K-4	K-4
TP-6,7	S-5	8.0'	K-0	K-0

Table 7 - Basin No. 2 Permeability Class Rating

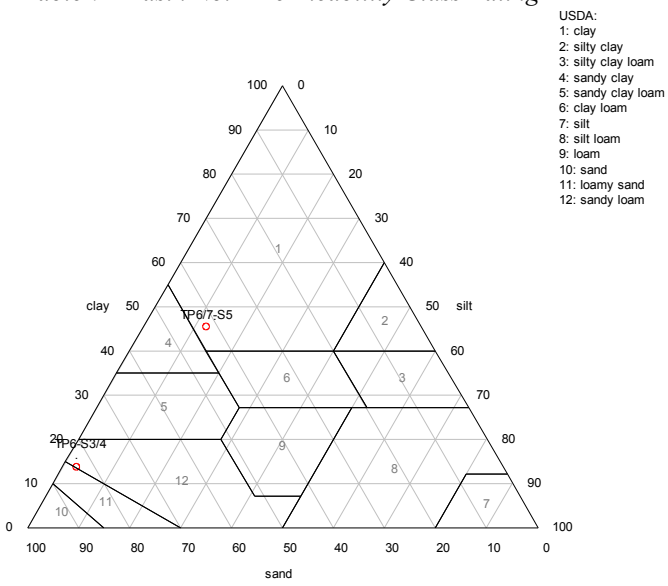


Illustration 2 - Basin No. 2 USDA Soil Plot

Test Pit	*Sample*	*Depth*	*Permeability (in/hr)*			
			Preliminary	*Replicate*	*Replicate*	*Replicate*
TP-5	S-1	4.0'	0.0039	0.0090	0.5280	0.1200
TP-6	S-1	0.5'	0.0120	0.0080	0.0150	-
TP-6	S-2	3.0'	0.0050	0.0040	0.0100	-
TP-6	S-3	6.0'	2.2000	3.6000	5.2000	-
			1.6000	3.3000	5.2000	-
			1.3000	3.2000	4.7000	-

Table 8 - Basin No. 2 Tube Permeameter/ Piezometer

6.0 Investigation Methods

The following list is intended to outline specific tasks that were used to inspect the conditions of these infiltration basins:

1. Sampling locations (i.e. Test pits[1]) should be chosen to ensure representative characterization of the basin footprint. Specifically pits should be advanced within the foot print of the basin outlined by the inside toe-of-slope. A minimum of two (2) sampling locations should be chosen with spacing not greater than 100 feet apart;

2. Test pits shall be excavated following safety provisions provided in OSHA Standards – 29 CFR part 1926.651(11) (Specific Excavation Requirements) and part 1926, subpart P, Appendix B(11) (Sloping and Benching);

3. Logging of the test pits shall conform to the USDA soil classification system as described in the Field Book for Describing and Sampling Soils(7), with additional guidance in N.J.A.C. 7:9A(15). Soil colors shall be determined using a Munsell Color chart (or approved equal);

4. Two(2) test pits should be excavated for each sampling location. The first should be used to ascertain the stratigraphic qualities of the subsurface in order to complete detailed soil logs and collect disturbed samples. The second test pit should be excavated in close proximity to the first for the purpose of collecting undisturbed samples and installing peizometers;

5. Undisturbed sampling shall be completed with a thin-walled (one (1) millimeter or less in thickness) metal tube, from one-and-one-half (1.5) to three (3) inches in diameter (refer to N.J.A.C. 7:9A-6.2 for a step-by-step procedure);

6. Subsequent to soil sampling operations piezometers should be installed in the basin footprint. Methods outlined in ASTM STP 746(18), hydraulic conductivity for a cased hole should be followed for those tests;

7. It was elected to install PVC casing in the bottom of the same test pit excavated to collect undisturbed samples. Installation of the PVC was completed using a hand auger to advance a hole through the hydraulically restrictive layer into the underlying sandy substratum. The PVC was installed flush with the bottom of the auger hold and tamped into place with a wooden block and mallet. The annular space between the PVC and soil was filled with bentonite clay to seal a minimum of 12 inches along the bottom of the casing. The benotnite should be allowed 24 hours to seal prior to infiltration testing;

8. Conductivity testing in the piezometers require two (2) rounds of presoak, which involves filling the piezometer to top of the casing with water and allowing the water to completely drain;

9. Subsequent to presoaking a minimum of two (2) rounds of conductivity measurements should be completed, or until test results fall within one (1) soil permeability class or two adjacent permeability classes (N.J.A.C. 7:9A-6.2(i)).

[1]It should be noted that hand advanced augers do not offer suitable subsurface information for the adequate design and investigation of a proposed or existing infiltration basin. Test pits or test trenches are the only method where a detailed visual inspection of the subsurface materials can be achieved.

7.0 Observations

As a result of the information retrieved for the investigations, Princeton Hydro has prepared the following observations:

1 The literature review and field investigation reveal both sites to be underlain by the Atlantic Coastal Plain, consisting of unconsolidated marine deposits of Serravallian Age (14.8 – 11.2 Ma), known as the Cohansey Formation. The USDA soils mapping for Camden County also revealed the site be underlain by sands interbedded with clays and gravels;

2 Groundwater was not observed in any test pits progressed, however, some faint mottling of the substratum was observed;

3 The visual inspection revealed the bottom of both basins to be in varying stages of disrepair. Although some maintenance (i.e. mowing) has been completed the infiltrative surfaces have not been maintained;

4 Neither basin was designed with thorough consideration for maintenance, including the formulation of maintenance plans, dedicated maintenance areas within the basin, manner of construction, or practical functionality of the basins;

5 Hydraulically restrictive layers were observed below the initial infiltrative surface, as confirmed by laboratory testing.

7.1 Basin No. 1

6 Basin No.1 appears to have been installed according to the grading plans reviewed, however there was no consideration for the removal of the observed hydraulically restrictive layer to allow for more suitable infiltrative capacity. Additionally there was no evidence of the proposed eight (8) inch deep crushed stone (as indicated on the drawings);

7 There was observed siltation throughout the basin, concentrated at the inlet pipe. This would likely have caused the formation of a less permeable layer over the infiltrative surface;

8 The original design did not offer adequate (or any) pre-treatment of the stormwater prior to discharge into the infiltration basin;

7.2 Basin No. 2

9 Basin No. 2 appears to have been installed according to the grading plans reviewed, the test pit logs indicate some clay layers are present under the level of infiltration;

10 This basin was extensively silted, likely due to the direct runoff of the paved areas directly into the southern portion of the basin. The run off from that portion of the drive is observed to be heavily laden with sediment, thereby clogging the infiltrative surface. This effect is verified by the laboratory testing.

8.0 Conclusions and Recommendations

Based on our observations, we offer these conclusions and recommendations (applicable only to locations investigated in this report):

8.1 Problems Related to Basin Failure

During the course of our investigation there were several items observed that could contribute to the failure of the infiltration basins:

1. The condition of the basins at the time of the investigation revealed a lack of proper maintenance due to inadequate maintenance plans, infrequent basin inspections, and unsuitable basin maintenance design;

2. Fine-grained subsurface materials were observed in close proximity to the basins infiltrative surfaces as verified by laboratory testing, acting as a hydraulically restrictive layer and reducing the effective infiltration of the basin. It appears the leach pits in basin 2 were an attempt to mitigate this issue;

3. Ineffective construction procedures possibly causing excessive compaction of the infiltrative surface;

4. Lack of pre-treatment for incoming stormwater, specifically to reduce the amount of siltation on the infiltrative surface. This is particularly the case at Basin 2, where the sediment laden runoff from the parking lot is drained directly into the stormwater basin;

5. The types of plants allowed to grow on the infiltrative surface produce dense tufts of roots, thereby reducing the ability of water to infiltrate the upper six (6) inches of the infiltrative media, effectively reducing the infiltrative capacity of the basin as a whole and preventing proper maintenance of the infiltrative surface due to standing water.

8.2 General Requirements for Rehabilitation/Repair

There are some general pre-, post- and during construction items that should be considered. For more detail on some of the recommendations included herein the New Jersey Stormwater Best Management Practices Manual[8] and The NJDEP Stormwater Management Facility Maintenance Manual[9] should be referenced.

8.2.1 Basin Maintenance

Research and experience has proven that the single most important requirement of a properly and efficiently operating infiltration basin is *maintenance (*proper construction technique is a close second). Whether constructing new, or retrofiting existing basins maintenance plans should be an integral part of both design and construction. Although there were some notes on the project drawings eluding to maintaining these basins, there are no formal maintenance plans in place.

The basins should have adequate maintenance plans in place conforming to the following general requirements:

1. Name, address, and telephone number of parties responsible for the preventative and corrective maintenance of the basin;

2. Detailed list of specific preventative and/or corrective measures required for these basins. The following measures are recommended:

    1. Removal of sediment, trash, and debris;

2. Mowing, pruning, and restoration of vegetation;
3. Repair of eroded areas;
4. Harrowing of the infiltrative surface;
5. Repair, replacement of the infiltrative surface;
6. Removal of sediment, trash, and debris from structural portions of the basins (i.e. Basin 2 – leach pits)

3. Maintenance equipment required to preform the corrective measures, including approved locations to dispose of removed sediment, trash and debris;
4. Schedule of regular inspections detailing required tasks and lists of individuals responsible for each inspection. The following inspection schedules are recommended for these basins;
    1. Quarterly and after every storm event exceeding one (1) inch of rainfall, visual inspections to ascertain the accumulation of sediment and debris;
    2. Bi-annual visual inspection to determine the vegetation health, density, and diversity (during the growing and non-growing season);
    3. Annual intrusive inspections of the basin for the removal of sediments, unwanted tree growth on the embankments, and inspection of the the infiltrative surface (using hand augers);
5. Cost estimates of maintenance tasks, including vegetation maintenance and removal of unwanted accumulated sediment, trash, and debris;
6. Detailed logs of all measures performed, submitted to the Pinelands Commission on a yearly basis.

It is recommended that municipalities not leave the public works departments with the sole responsibility of inspecting and maintaining these infiltration basins. It is suggested that the public works department be responsible for the equipment and man-power and the township engineer be responsible for the required inspections.

The engineer should submit inspection reports to the Pinelands Commission, the Township's Environmental Commission, Public Works department, and Planning department for review and filing.

8.2.2 Construction Procedures

Construction methods are an important consideration for the design of an infiltration basin by reducing the amount of compaction and contamination (clogging) of the subgrades, thereby increasing the long-term efficiency of the infiltrative media. The follow list details some procedures that should be followed in order to adequately repair these basins:

1. Earthwork should be performed from outside the basin footprint. When equipment must be used on the infiltrative surface of the basin construction should be completed with low ground pressure machines working out of the basin without moving over completed areas;
2. To help prevent subgrade clogging the equipment used to repair the basin should be kept clean of unsuitable soil materials. This can be accomplished by using equipment exclusively in the basin and increasing machine cleaning (i.e. twice daily and prior to entering the basin footprint);

3. Runoff should be diverted around the basin or into temporary control structures, this will reduce clogging and damage of the infiltrative surface;

4. The infiltrative surface should be mixed with lime, composted leaves, and grass clippings in order to increase the absorption capacity of the infiltrative surface, health of planted vegetation and suitable void ratios in the upper soil surface.

8.2.3 Landscaping Considerations

Plant material proposed for infiltration basins will affect, sometimes dramatically, the ability of the basin to perform at maximum efficiency. Additionally, exotic and non-indigenous plant materials should be avoided, especially in the Pinelands where the ecosystem is fragile.

Planting of shrubs and trees on the embankment and basin bottom should be avoided. These types of plant material increase the time and money required to properly maintain an infiltration basin and may cause damage to the embankment[16,12]. Deep, large rooting plants may cause structural weakening of the embankment by root decay. The embankment may be stable under dry conditions, but when it becomes saturated and loaded with water the weakened embankment would have a greater propensity to fail.

Grass to be planted in the basin bottom should consist of a mixture of native species accepted by the Pinelands Commission. The seeding should be accomplished immediately after installation of the final infiltrative layer. Sod should ***NOT*** be used, the thickened root mass associated with sod will create a hydraulically restrictive layer directly on the infiltrative surface.

8.3 Basin No. 1 – Winslow Township

The soils encountered during this investigation corroborate the mapped soil series definitions and geologic formations. The substratum generally allows for the construction of an infiltration basin on this site. The following recommendations should be completed in conjunction with a maintenance plan:

8.3.1 Basin No. 1 – Repair Option 1 – Light Maintenances

Prescribed as a short term repair, this option is offered in order to address the reduced infiltration capacity without a comprehensive redesign of the basin. This repair should assure proper operation of the basin for approximately one (1) year. It should be noted that further repair and construction may be required subsequent to the following procedures to exact a long term solution to the performance problems:

1. The topsoil layer of the basin should be excavated to a depth of approximately one (1) foot below the existing ground surface between the toe of slope on all four (4) sides. This topsoil should be stockpiled separately and disposed of at an offsite location, it cannot be reused in the basin;

2. The exposed subgrade material should be excavated to a depth of 36 inches using a 'dig-and-drop'[10] method. This method entails excavation of materials working from the southern edge of the basin , working towards the gate and placing the material back into the excavation without compacting. The materials should be mixed with composte, grass clippings, or mulch by turning the material over several times with the bucket. It is expected mounding of the soil will occur subsequent to this operation, the excessive material should be excavated from the surface, without operating equipment on the surface, and stockpiled to be used later or disposed of;

3. Elevations shall be reestablished to the pre-construction levels;

4. The rip-rap apron that was previously installed in front of the inlet pipe should be changed into a plunge pool. This will effectively reduce the sediment load that reaches the far end of the basin and will offer a more concentrated sediment maintenance location;

5. As the excavator works toward the basin exit no equipment shall be allowed on the bottom of the basin. This will prevent compaction of the infiltrative surface;

6. The basin should then be seeded by hand or by machine from the embankment edge.

8.3.2 Basin No. 1 – Repair Option 2 – Retrofit

This repair is prescribed as a long term solution for this basin by addressing original design flaws, creating an optimally operating infiltrative surface and a dedicated maintenance area. This will improve the maintenance capacity of the basin while reducing long term costs of upkeep.

Specifically this will require a comprehensive redesign of the basin dimensions analysis of stormwater inflow, soil replacement of a hydraulically restrictive layer (found just below the infiltration surface), construction and design of a forebay, and formulation of a maintenance plan. The following list details some of the requirements and construction steps:

1. The new basin should be designed with an infiltration rate of 11 in/hr (K4) based on the lowest infiltration measurement calculated as part of the field operations;

2. The topsoil layer of the basin should be excavated to a depth of approximately one (1) foot below the existing ground surface between the toe of slope on all four (4) sides. This topsoil should be stockpiled separately and disposed of at an offsite location, it cannot be reused in the basin;

3. The forebay energy dissipation berm should then be constructed. This will be a structural berm, therefore compaction will be required, and can be constructed using the exposed subgrade material (hydraulically restrictive layer). The face of the berm directly downstream of the inlet pipe should be constructed in conjunction with a method of mechanical soil stabilization such as Turf Reinforcement Mats (TRM's) or rip-rap;

4. Care should be take to avoid excessive compaction of the site with the construction equipment;

5. The remaining exposed subgrade material should be excavated to a depth below the observed hydraulically restrictive layer under the basin. This would include the infiltration portion of the basin and the bottom of the forebay. The depth of excavation will range from approximately 3'8" (44") to 7'2" (86") in depth, variable with the lower soil surface. Excess of this material should be removed from the site. An Engineer licensed in the State of New Jersey should be present during this operation to approve the exposed subgrades;

6. The material shall be excavated starting at the southern boundary of the basin and progress towards the exit;

7. The resultant excavation shall be backfilled with a sand rated as K-Class 5 (K5). This sand can be mixed with grass clippings, mulch, lime, or composted leaves to increase the water absorption capacity and voids in the soil;

8. This material shall be placed in loose thickness the full depth of the excavation. At no time shall equipment be permitted to be operated over this material;

9. The basin should then be seeded by hand or by machine from the embankment edge.

Appendix C includes a conceptual diagram of the basin configuration, this is for illustrative purposes only. The figure is not intended for use as construction drawings.

8.4 Basin No. 2 – Chesilhurst Borough

The soils encountered during this investigation corroborate the mapped soil series definitions and geologic formations. The substratum generally allows for the construction of an infiltration basin on this site, however the interbedded layers of silts, clays, and sands offer less than optimal conditions for infiltration. The following recommendations should be completed in conjunction with a maintenance plan:

8.4.1 Basin No. 2 – Repair Option 1 – Light Maintenances

Prescribed as a short term repair, this option is offered in order to address the reduced infiltration capacity without a comprehensive redesign of the basin. This repair should assure proper operation of the basin for approximately one (1) year. It should be noted that further repair and construction may be required subsequent to the following procedures to exact a more long term solution to the performance problems:

1. The topsoil layer of the basin should be excavated to a depth of approximately 0.5' below the existing ground surface between the toe of slope on all four (4) sides. This topsoil should be stockpiled separately and disposed of at an offsite location, it cannot be reused in the basin;
2. The tops of the leach pits should be removed and the concrete pits should be cleaned out. All sediment, trash and debris should be removed and the weep holes in the concrete ring cleaned out;
3. There are several options for the pits subsequent to cleaning them out:
    1. Replace the lid as previously installed and continue to repair the infiltrative surface;
    2. Leave the concrete lid off and fill the pits with either K5 sand or 3/4” clean stone capped with nonwoven geotextile fabric;
4. The exposed subgrade material should be excavated to a depth of thirty-six (36) inches using a 'dig-and-drop'[10] method. This method entails excavation of materials working from the northern edge of the basin towards the southern edge. The machine is to excavate the material and place it back into the excavation without compacting. The materials should be mixed with compost, grass clippings, or mulch by turning the material over several times with the bucket. It is expected mounding of the soil will occur subsequent to this operation, the excessive material should be excavated from the surface without operating equipment on the surface, and stockpiled to be used later or disposed of;
5. Elevations shall be reestablished to the pre-construction levels;
6. Stormwater flow collected in the basin directly from the southern parking area and Grant Avenue should be pre-treated by redirecting the runoff to a longer flow path using swales (along the pavement) or by some other stormwater treatment method;
7. As the excavator works toward the southern edge no equipment shall be allowed on the bottom of the basin. This will prevent compaction of the infiltrative surface;
8. The basin should then be seeded by hand or by machine from the embankment edge.

8.4.2 Basin No. 2 – Repair Option 2 – Retrofit

This repair is prescribed as a long term solution for this basin by addressing original design flaws, creating an optimally operating infiltrative surface and a dedicated maintenance area. This will improve the maintenance capacity of the basin while reducing long term costs of upkeep.

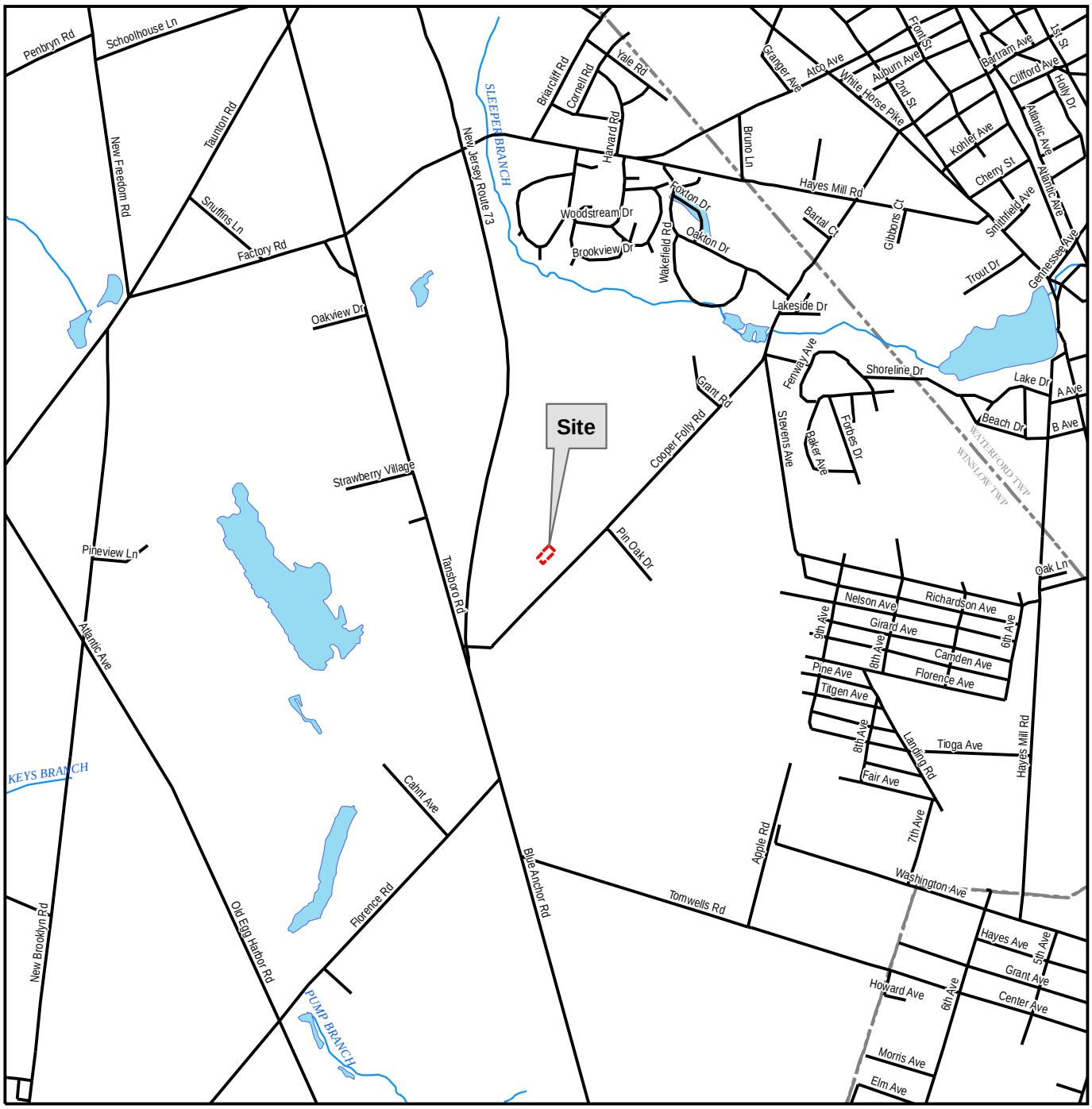
Specifically this will require a comprehensive redesign of the basin dimensions analysis of the stromwater inflow, soil replacement of a hydraulically restrictive layer (found just below the infiltration surface), construction and design of a forebay, and formulation of a maintenance plan. The following list details some of the requirements and construction steps:

1. The new basin should be designed with an infiltration rate of 1 in/hr (K2) based on the lowest infiltration measurement calculated as part of the field operations;
2. The topsoil layer of the basin should be excavated to a depth of approximately 0.5' below the existing ground surface between the toe of slope on all four (4) sides. This topsoil layer should be stockpiled separately and disposed of at an off site location, it cannot be reused in the basin;
3. The leach pits should be removed in their entirety, and the roof runoff from the maintenance build be redirected to the southern end of the basin;
4. A forebay energy dissipation berm should then be constructed. This will be a structural berm, therefore compaction will be required, and can be constructed using the exposed subgrade material (hydraulically restrictive layer);
5. Care should be take to avoid excessive compaction of the site with the construction equipment;
6. The remaining exposed subgrade material should be excavated to a depth of two (2) feet below the leaching pit bottoms to elevation ±154.50'. This would include the infiltration portion of the basin and the bottom of the forebay. The depth of excavation will be approximately 5'6" (66") in depth over the basin footprint. An engineering licensed in the State of New Jersey should be present during this operation to approve the exposed subgrade;
7. The resultant excavation shall be backfilled with the excavated material mixed with grass clippings, mulch, lime, or composted leaves to increase the water absorption capacity and voids in the soil. Supplementing material as needed with K5 sand;
8. This material shall be placed loose for the full depth of the excavation. At no time shall equipment be permitted to be operated over this material;
9. The basin should then be seeded by hand or by machine from the embankment edge.

Appendix C includes a conceptual diagram of the basin configuration, this is for illustrative purposes only. The figure is not intended for use as construction drawings.

APPENDICIES

APPENDIX A - SITE LOCATION MAP



Princeton Hydro

APPENDIX A - BASIN 1 LOCATION MAP

SUBSURFACE INVESTIGATION OF RECHARGE BASINS
BASIN 1
EDWARD DUBLE SENIOR CENTER
WINSLOW TOWNSHIP
CAMDEN COUNTY, NEW JERSEY

LEGEND

- Site Bounds
- Roads
- Streams
- Lakes
- Municipality Bnd.

0 500 1,000 2,000
Feet

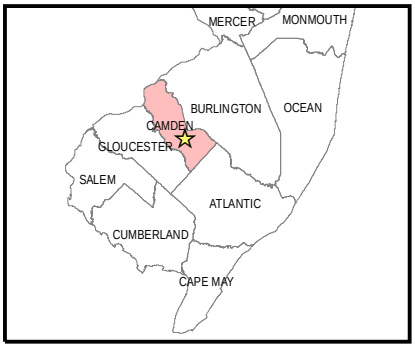
1 inch equals 2,000 feet

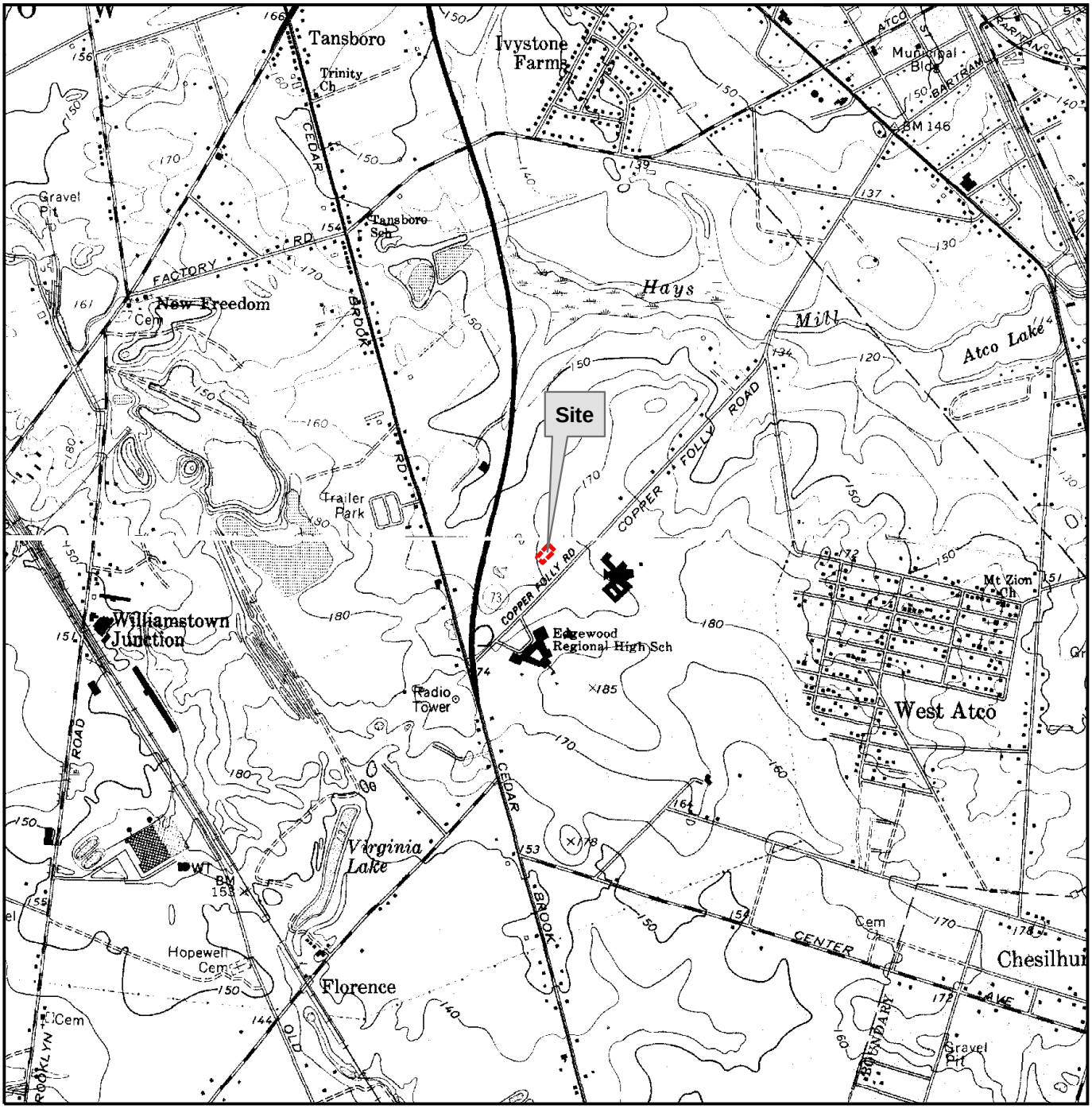
PRINCETON HYDRO, LLC.
1105 LAUREL OAK ROAD
SUITE 136
VOORHEES, NJ 08043

SOURCES:

1. Site boundary depicted herein is not, nor is intended to be an official property boundary. The site boundary depicts the estiated extents of the basin footprint.
2. Roads data shown are Tiger Census roads as obtained from the NJDEP GIS website.
3. Streams and Lakes data are shown as obtained from the NJDEP GIS website.

NEW JERSEY COUNTY MAP





Princeton Hydro

APPENDIX A - BASIN 1 USGS TOPOGRAPHIC MAP

SUBSURFACE INVESTIGATION OF RECHARGE BASINS
BASIN 1
EDWARD DUBLE SENIOR CENTER
WINSLOW TOWNSHIP
CAMDEN COUNTY, NEW JERSEY

LEGEND

Site Bounds

0 500 1,000 2,000
Feet

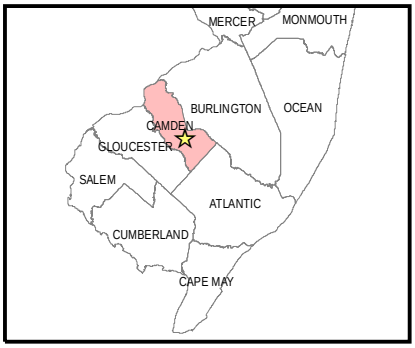
1 inch equals 2,000 feet

PRINCETON HYDRO, LLC.
1105 LAUREL OAK ROAD
SUITE 136
VOORHEES, NJ 08043

SOURCES:

1. Site boundary depicted herein is not, nor is intended to be an official property boundary. The site boundary depicts the estiated extents of the basin footprint.
2. Digital Raster Graphic (DRG) USGS 7.5 Minute Series, Topographical Quadrangles for portions of Clementon and Williamstown, NJ as obtained from the NJDEP GIS website (1976 with photo revisions, 1:24,000).

NEW JERSEY COUNTY MAP



Princeton Hydro

APPENDIX A - BASIN 1 AERIAL MAP

SUBSURFACE INVESTIGATION OF RECHARGE BASINS
BASIN 1
EDWARD DUBLE SENIOR CENTER
WINSLOW TOWNSHIP
CAMDEN, NEW JERSEY

LEGEND

Site Bounds

0 75 150 300
Feet

1 inch equals 300 feet

PRINCETON HYDRO, LLC.
1105 LAUREL OAK ROAD
SUITE 136
VOORHEES, NJ 08043

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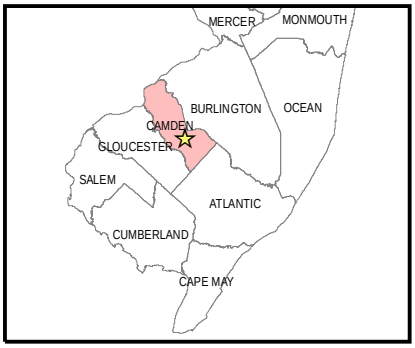
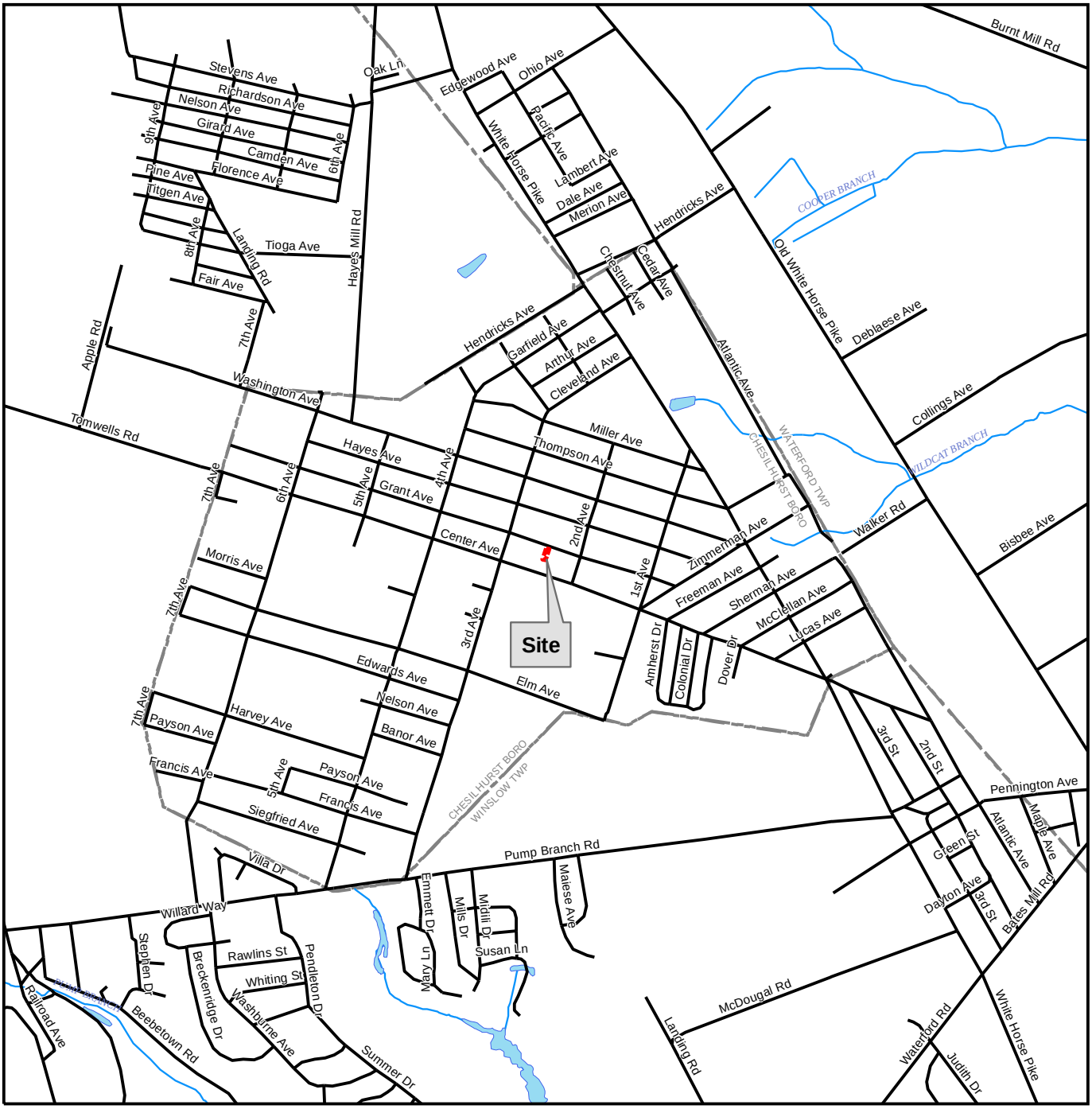
2. 2002 Ortho Aerial images shown as provided by the NJDEP.

NEW JERSEY COUNTY MAP





Princeton Hydro

APPENDIX A - BASIN 2 LOCATION MAP

SUBSURFACE INVESTIGATION OF RECHARGE BASINS
BASIN 2
CHESILHURST PUBLIC WORKS BUILDING
CHESILHURST BOROUGH
CAMDEN COUNTY, NEW JERSEY

LEGEND

- Site Bounds
- Roads
- Streams
- Lakes
- Municipal Bnd.

N

0 500 1,000 2,000
Feet

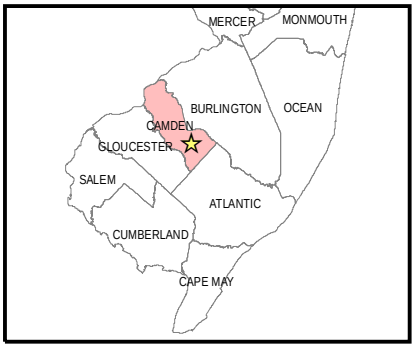
1 inch equals 2,000 feet

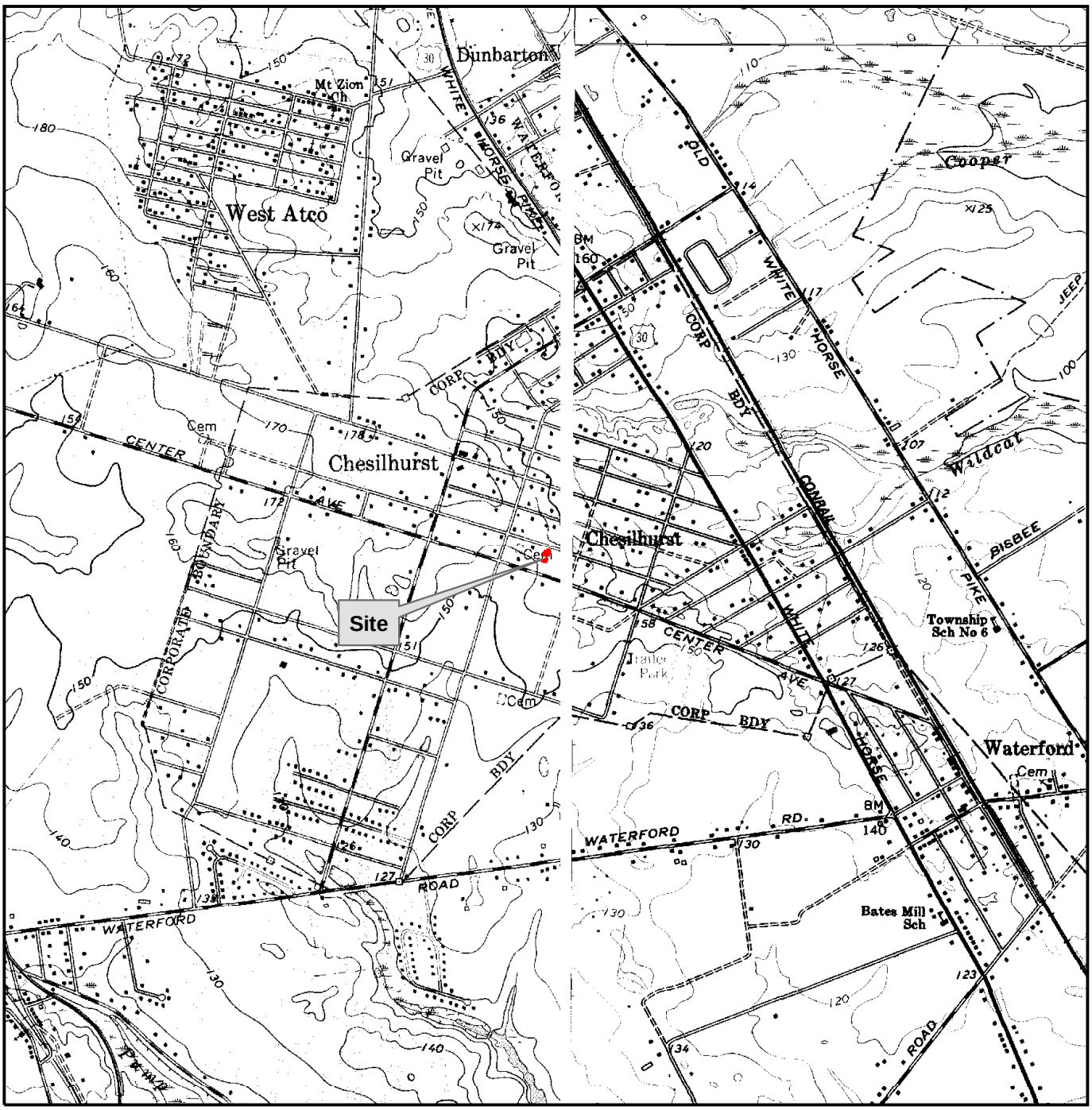
PRINCETON HYDRO, LLC.
1105 LAUREL OAK ROAD
SUITE 136
VOORHEES, NJ 08043

SOURCES:

1. Site boundary depicted herein is not, nor is intended to be an official property boundary. The site boundary depicts the estiated extents of the basin footprint.
2. Roads data shown are Tiger Census roads as obtained from the NJDEP GIS website.
3. Streams and Lakes data are shown as obtained from the NJDEP GIS website.

NEW JERSEY COUNTY MAP





Princeton Hydro

APPENDIX A - BASIN 1 USGS TOPOGRAPHIC MAP

SUBSURFACE INVESTIGATION OF RECHARGE BASINS
BASIN 2
CHESILHURST PUBLIC WORKS BUILDING
CHESILHURST BOROUGH
CAMDEN COUNTY, NEW JERSEY

LEGEND

Site Bounds

0 500 1,000 2,000
Feet

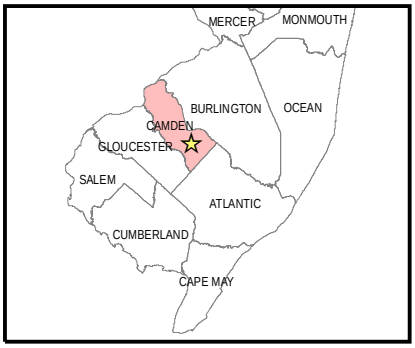
1 inch equals 2,000 feet

PRINCETON HYDRO, LLC.
1105 LAUREL OAK ROAD
SUITE 136
VOORHEES, NJ 08043

SOURCES:

1. Site boundary depicted herein is not, nor is intended to be an official property boundary. The site boundary depicts the estiated extents of the basin footprint.
2. Digital Raster Graphic (DRG) USGS 7.5 Minute Series, Topographical Quadrangles for portions of Clementon, Hammonton, Medford Lakes, and Williamstown (NJ) as obtained from the NJDEP GIS website (1976 with photo revisions, 1:24,000).

NEW JERSEY COUNTY MAP



Princeton Hydro

APPENDIX A - BASIN 2 AERIAL MAP

SUBSURFACE INVESTIGATION OF RECHARGE BASINS
BASIN 2
CHESILHURST PUBLIC WORKS BUILDING
CHESILHURST BOROUGH
CAMDEN COUNTY, NEW JERSEY

LEGEND

Site Bounds

0 25 50 100
Feet

1 inch equals 100 feet

PRINCETON HYDRO, LLC.
1105 LAUREL OAK ROAD
SUITE 136
VOORHEES, NJ 08043

SOURCES:

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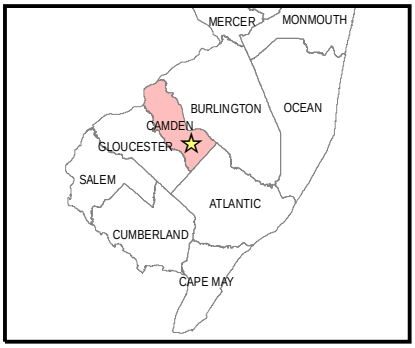
2. 2002 Ortho Aerial images shown as provided by the NJDEP.

NEW JERSEY COUNTY MAP



APPENDIX B - TEST PIT LOCATION MAP

Princeton Hydro

FIGURE 8: TEST PIT LOCATIONS POINTS

GEOTECH BASIN #1
PINELAND COMMISSION
WINSLOW TOWNSHIP
CAMDEN, NEW JERSEY

LEGEND

Site Bounds

N

0 25 50 100
Feet

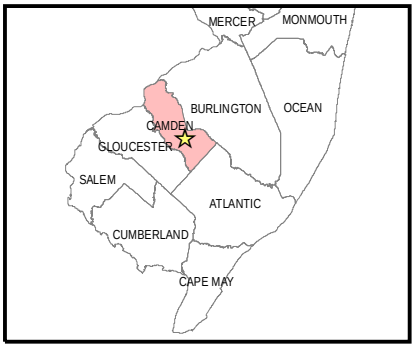
1 inch equals 100 feet

PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

SOURCES:

1. Site Boundary is not an official PLS survey. Property Boundary may be inaccurate.
2. 2002 Ortho Aerial images shown as provided by the NJDEP.
3. Test pit location points GPS'd by Princeton Hydro, LLC.

NEW JERSEY COUNTY MAP



Princeton Hydro

FIGURE 8: TEST PIT LOCATION POINTS

GEOTECH BASIN #2
PINELAND COMMISSION
CHESILHURST TOWNSHIP
CAMDEN, NEW JERSEY

LEGEND

Site Bounds

N

0 12.5 25 50
Feet

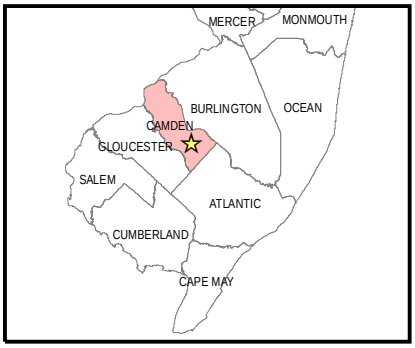
1 inch equals 50 feet

PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

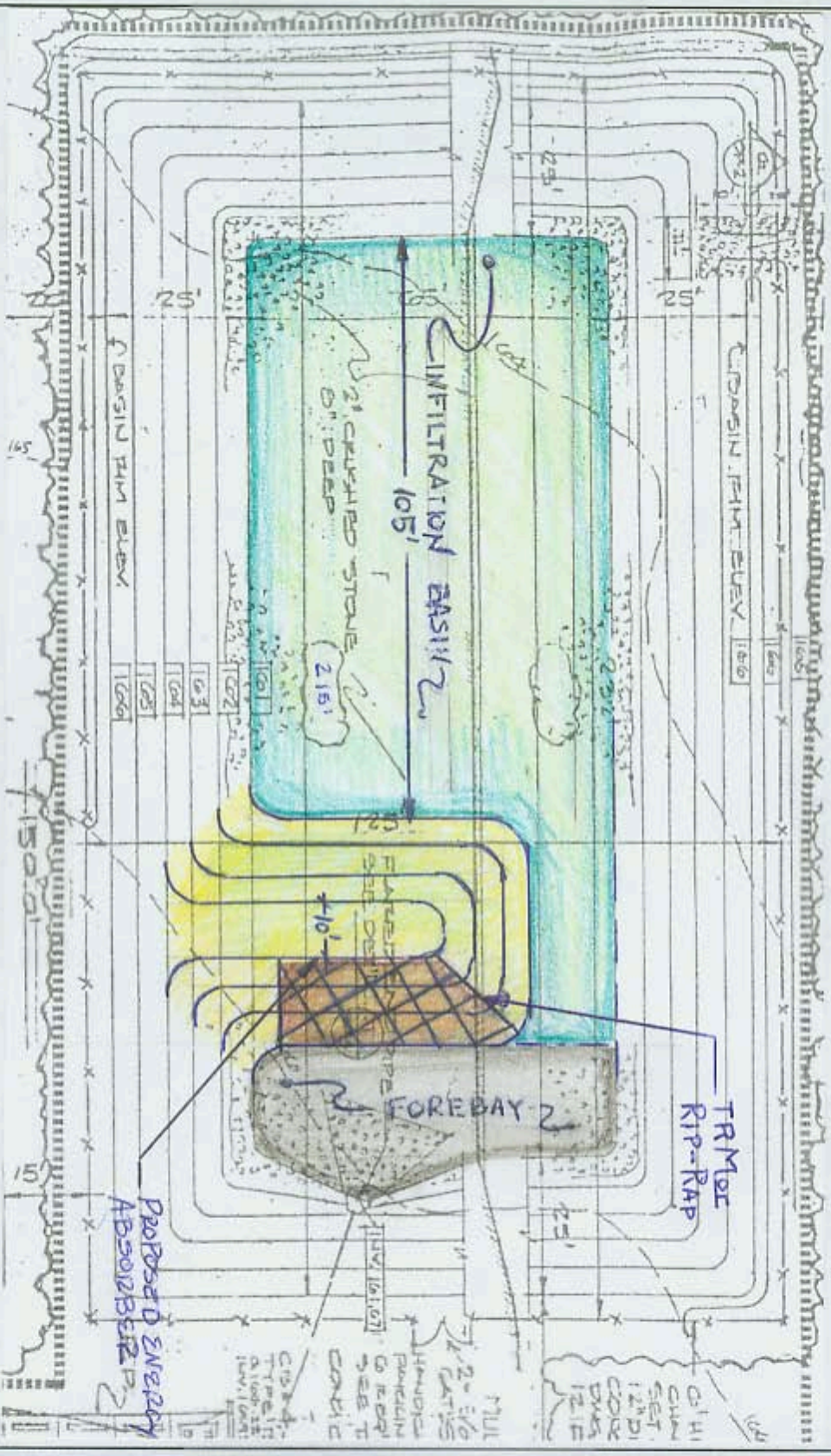
SOURCES:

1. Site Boundary is not an official PLS survey. Property Boundary may be inaccurate.
2. 2002 Ortho Aerial images shown as provided by the NJDEP.
3. Test pit location points GPS'd by Princeton Hydro, LLC.

NEW JERSEY COUNTY MAP



APPENDIX C -
CONCEPTUAL DESIGN
PLANS

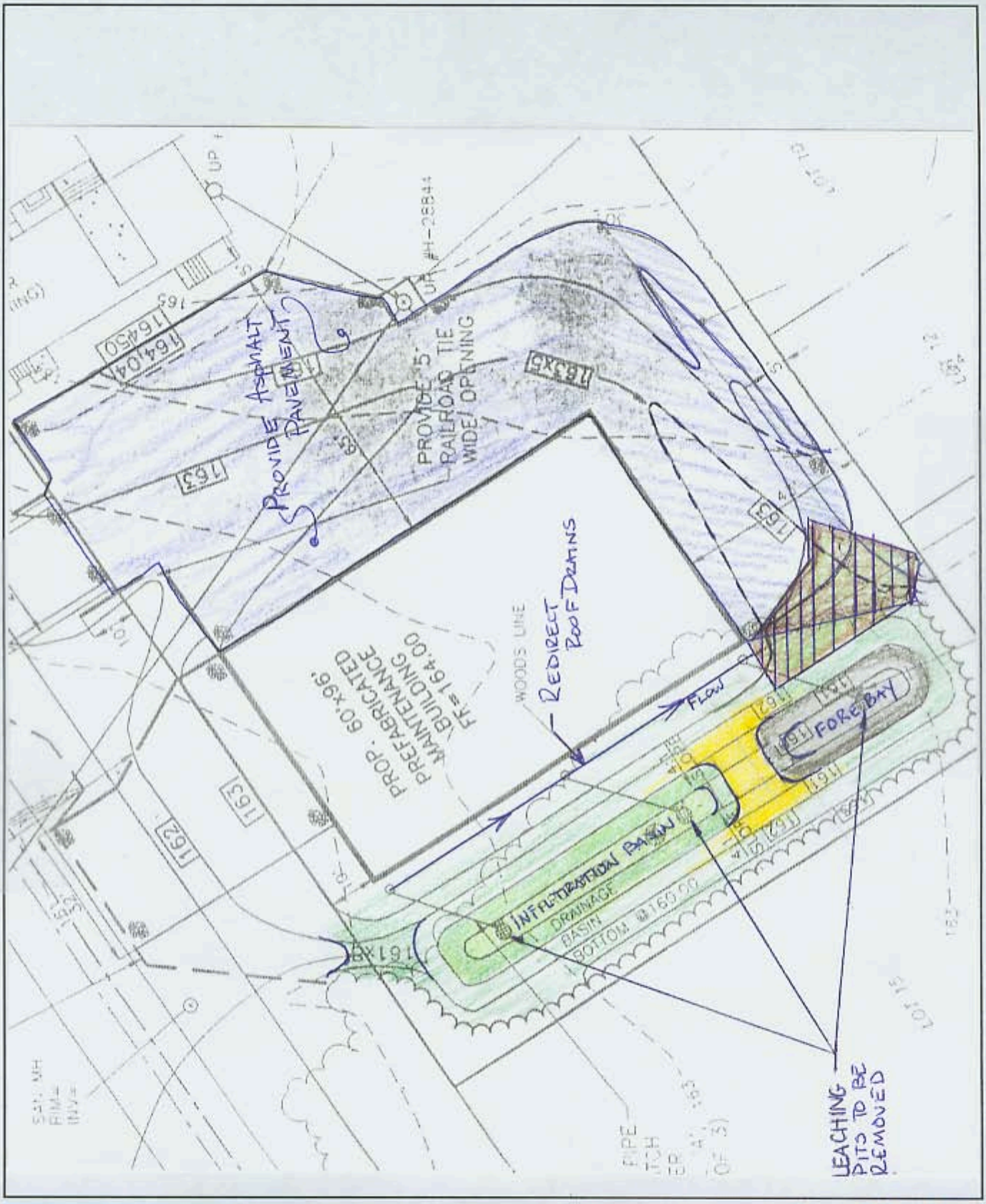


Princeton Hydro

APPENDIX C - CONCEPTUAL DESIGN PLAN

GEOTECH BASIN #1
PINELAND COMMISSION
CHESILHURST TOWNSHIP
CAMDEN, NEW JERSEY

PRINCETON HYDRO, LLC.
1105 LAUREL OAK ROAD
SUITE 136
VOORHEES, NJ 08043



Princeton Hydro

APPENDIX C - CONCEPTUAL DESIGN PLAN

GEOTECH BASIN #2
PINELAND COMMISSION
CHESILHURST TOWNSHIP
CAMDEN, NEW JERSEY

PRINCETON HYDRO, LLC.
1105 LAUREL OAK ROAD
SUITE 136
VOORHEES, NJ 08043

APPENDIX D -
SUBSURFACE LOGS

EL 166.17 N/A Township Health Department

BASIN ADJACENT TO SENIOR CENTER

LOCATED OUTSIDE OF BASIN

Client: PINELANDS COMMISSION

Project No.: 579.001

Date: 1/4/05

Soil Log No. TP1 Block: 2504 Lot: 7

Horizon A Topsoil/Fill Depth 0-14" Color 10YR 3/2

Soil Texture: sand; loamy sand; sandy loam; loam; silt loam; silt; sandy clay loam; clay loam; sandy clay; silty clay; clay; bedrock

Coarse Fragments: 0 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: weak; moderate; strong — fine; medium; coarse — angular blocky; subang. blocky; granular; single grain; platy; structureless; massive; wedge; prismatic; cloddy

water content: dry; moist; slightly moist; wet

consistency: loose; friable; firm; cemented; plastic; sticky

Boundary: abrupt < 1"; clear < 2.5"; gradual <5"; diffuse > 5" — smooth; wavy; irregular; broken

roots: few (5% max); common (20% max); many (>20%); none — fine; medium; coarse

mottling: Depth N/A Color N/A

few (5% max); common (20% max); many (>20%); none — fine (<5 mm); medium (15 mm); coarse (>15 mm) — faint; distinct; prominent

Horizon Topsoil/Fill Depth 14"-39" Color 10YR 6/3

Soil Texture: sand; loamy sand; sandy loam; loam; silt loam; silt; sandy clay loam; clay loam; sandy clay; silty clay; clay; bedrock

Coarse Fragments: 0 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: weak; moderate; strong — fine; medium; coarse — angular blocky; subang. blocky; granular; single grain; platy; structureless; massive; wedge; prismatic; cloddy

water content: dry; moist; slightly moist; wet

consistency: loose; friable; firm; cemented; plastic; sticky

Boundary: abrupt < 1"; clear < 2.5"; gradual <5"; diffuse > 5" — smooth; wavy; irregular; broken

roots: few (5% max); common (20% max); many (>20%); none — fine; medium; coarse

mottling: Depth N/A Color N/A

few (5% max); common (20% max); many (>20%); none — fine (<5 mm); medium (15 mm); coarse (>15 mm) — faint; distinct; prominent

Horizon Topsoil/Fill Depth 39"-54" Color 10YR 5/3

Soil Texture: sand; loamy sand; sandy loam; loam; silt loam; silt; sandy clay loam; clay loam; sandy clay; silty clay; clay; bedrock

Coarse Fragments: 0 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: weak; moderate; strong — fine; medium; coarse — angular blocky; subang. blocky; granular; single grain; platy; structureless; massive; wedge; prismatic; cloddy

water content: dry; moist; slightly moist; wet

consistency: loose; friable; firm; cemented; plastic; sticky

Boundary: abrupt < 1"; clear < 2.5"; gradual <5"; diffuse > 5" — smooth; wavy; irregular; broken

roots: few (5% max); common (20% max); many (>20%); none — fine; medium; coarse

mottling: Depth N/A Color N/A

few (5% max); common (20% max); many (>20%); none — fine (<5 mm); medium (15 mm); coarse (>15 mm) — faint; distinct; prominent

EL 166.17

N/A Township Health Department

BASIN ADJACENT TO SENIOR CENTER

LOCATED OUTSIDE OF BASIN

Client: PINELANDS COMMISSION

Project No.: 579.001

Date: 1/4/05

Soil Log No. TP-7 Block: 2504 Lot: 7

Horizon ____ Topsoil/Fill Depth 54" - 90" Color 10YR 6/6

Soil Texture: (sand) loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, sandy clay, silty clay, clay, bedrock

Coarse Fragments: 0 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: (weak) moderate, strong; (fine) medium, coarse; angular blocky, subang. blocky, granular, (single grain), platy, structureless, massive, wedge, prismatic, cloddy

water content: dry, (moist), slightly moist, wet

consistency: (loose), friable, firm, cemented, plastic, sticky

Boundary: (abrupt < 1"), clear < 2.5", gradual <5", diffuse > 5"; (smooth), wavy, irregular, broken

roots: few (5% max), common (20% max), many (>20%), (none); fine, medium, coarse

mottling: Depth 72" Color 10YR 7/4, 7.5YR 5/6

(few (5% max)), common (20% max), many (>20%), none; (fine (<5 mm)), medium (15 mm), coarse (>15 mm); (faint), distinct, prominent

Horizon ____ Topsoil/Fill Depth 90" - 102" Color 7.5YR 5/8

Soil Texture: sand, loamy sand, sandy loam, loam, silt loam, silt, (sandy clay loam), clay loam, sandy clay, silty clay, clay, bedrock

Coarse Fragments: 0 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: weak, (moderate), strong; (fine), medium, coarse; angular blocky, (subang. blocky), granular, single grain, platy, structureless, massive, wedge, prismatic, cloddy

water content: dry, (moist), slightly moist, wet

consistency: loose, (friable), firm, cemented, plastic, sticky

Boundary: (abrupt < 1"), clear < 2.5", gradual <5", diffuse > 5"; (smooth), wavy, irregular, broken

roots: few (5% max), common (20% max), many (>20%), (none); fine, medium, coarse

mottling: Depth Color

few (5% max), common (20% max), many (>20%), (none); fine (<5 mm), medium (15 mm), coarse (>15 mm); faint, distinct, prominent

Horizon ____ Topsoil/Fill Depth 102" - 156" Color 10YR 7/4

Soil Texture: sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, sandy clay, (silty clay), clay, bedrock

Coarse Fragments: 0 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: weak, moderate, (strong); (fine), medium, coarse; angular blocky, subang. blocky, granular, single grain, platy, structureless, (massive), wedge, prismatic, cloddy

water content: dry, (moist), slightly moist, wet

consistency: loose, friable, (firm), cemented, plastic, sticky

Boundary: abrupt < 1", clear < 2.5", gradual <5", diffuse > 5"; smooth, wavy, irregular, broken

roots: few (5% max), common (20% max), (many (>20%)), (none); fine, medium, coarse

mottling: Depth Color

few (5% max), common (20% max), (many (>20%)), (none); fine (<5 mm), medium (15 mm), coarse (>15 mm); faint, distinct, prominent

EL 161.34 N/A Township Health Department
BASIN ADJACENT TO SENIOR CENTER
WINSLOW, NJ

Client: AMELANDS COMM.
Project No.: 579.001
Date: 1/4/05

Soil Log No. TP-2 Block: 2504 Lot: 7 AGE lot 2

Horizon Topsoil/Fill Depth 0"-6" Color 10yr 3/2

Soil Texture
- sand
- loamy sand
- **sandy loam**
- loam
- silt loam
- silt
- sandy clay loam
- clay loam
- sandy clay
- silty clay
- clay
- bedrock

Coarse Fragments
- 5 % gravel (3" max)
- 0 % cobbles (10" max)
- 0 % boulders (>10")

Structure
- weak / moderate / strong
- fine / medium / coarse
- angular blocky / subang. blocky / granular / single grain / platy / structureless / massive / wedge / prismatic / cloddy

water content
- dry
- moist
- slightly moist
- wet

consistency
- loose
- friable
- firm
- cemented
- plastic
- sticky

Boundary
- abrupt < 1" / clear < 2.5" / gradual <5" / diffuse > 5"
- smooth / wavy / irregular / broken

roots
- few (5% max) / common (20% max) / many (>20%) / none
- fine / medium / coarse

mottling: Depth NA Color NA
- few (5% max) / common (20% max) / many (>20%) / none
- fine (<5 mm) / medium (15 mm) / coarse (>15 mm)
- faint / distinct / prominent

Horizon Topsoil/Fill Depth 6"-24" Color 7.5yr 6/6

Soil Texture
- sand
- loamy sand
- sandy loam
- loam
- silt loam
- silt
- **sandy clay loam**
- clay loam
- sandy clay
- silty clay
- clay
- bedrock

Coarse Fragments
- 0 % gravel (3" max)
- 0 % cobbles (10" max)
- 0 % boulders (>10")

Structure
- weak / moderate / strong
- fine / medium / coarse
- angular blocky / subang. blocky / granular / single grain / platy / structureless / massive / wedge / prismatic / cloddy

water content
- dry
- moist
- slightly moist
- wet

consistency
- loose
- friable
- firm
- cemented
- plastic
- sticky

Boundary
- abrupt < 1" / clear < 2.5" / gradual <5" / diffuse > 5"
- smooth / wavy / irregular / broken

roots
- few (5% max) / common (20% max) / many (>20%) / none
- fine / medium / coarse

mottling: Depth NA Color NA
- few (5% max) / common (20% max) / many (>20%) / none
- fine (<5 mm) / medium (15 mm) / coarse (>15 mm)
- faint / distinct / prominent

Horizon Topsoil/Fill Depth 24"-30" Color 10yr 7/6

Soil Texture
- sand
- loamy sand
- sandy loam
- loam
- silt loam
- silt
- sandy clay loam
- clay loam
- sandy clay
- **silty clay**
- clay
- bedrock

Coarse Fragments
- 0 % gravel (3" max)
- 0 % cobbles (10" max)
- 0 % boulders (>10")

Structure
- weak / moderate / strong
- fine / medium / coarse
- angular blocky / subang. blocky / granular / single grain / platy / structureless / massive / wedge / prismatic / cloddy

water content
- dry
- moist
- slightly moist
- wet

consistency
- loose
- friable
- firm
- cemented
- plastic
- sticky

Boundary
- abrupt < 1" / clear < 2.5" / gradual <5" / diffuse > 5"
- smooth / wavy / irregular / broken

roots
- few (5% max) / common (20% max) / many (>20%) / none
- fine / medium / coarse

mottling: Depth NA Color NA
- few (5% max) / common (20% max) / many (>20%) / none
- fine (<5 mm) / medium (15 mm) / coarse (>15 mm)
- faint / distinct / prominent

EL 161.39 N/A Township Health Department
BASIN ADJACENT TO SENIOR CENTER
WINSLOW, NJ

Client: Pinelands Comm.
Project No.: 579.001
Date: 1/4/05

Soil Log No. TP-2 Block: 2504 Lot: 7

Horizon ____ Topsoil/Fill Depth 60"-76" Color 7.5YR 5/4

Soil Texture
sand
loamy sand
(sandy loam)
loam
silt loam
silt
sandy clay loam
clay loam
sandy clay
silty clay
clay
bedrock

Coarse Fragments
0 % gravel (3" max)
0 % cobbles (10" max)
0 % boulders (>10")

Structure
(weak)
moderate
strong

(fine)
(medium)
(coarse)

angular blocky
subang. blocky
(granular)
single grain
platy
structureless
massive
wedge
prismatic
cloddy

water content
dry
(moist)
slightly moist
wet

consistency
loose
(friable)
firm
cemented
plastic
(sticky)

Boundary
abrupt < 1"
(clear < 2.5")
gradual <5"
diffuse > 5"

(smooth)
(wavy)
irregular
broken

roots
few (5% max)
common (20% max)
many (>20%)
(none)

fine
medium
coarse

mottling: Depth NA Color NA
(few (5% max))
common (20% max)
many (>20%)
(none)

fine (<5 mm)
medium (15 mm)
coarse (>15 mm)

faint
distinct
prominent

Horizon ____ Topsoil/Fill Depth 76"-132" Color 10YR 6/6

Soil Texture
(sand)
loamy sand
sandy loam
loam
silt loam
silt
sandy clay loam
clay loam
sandy clay
silty clay
clay
bedrock

Coarse Fragments
0 % gravel (3" max)
0 % cobbles (10" max)
0 % boulders (>10")

Structure
(weak)
moderate
strong

(fine)
(medium)
coarse

angular blocky
subang. blocky
granular
(single grain)
platy
structureless
massive
wedge
prismatic
cloddy

water content
dry
(moist)
slightly moist
wet

consistency
(loose)
friable
firm
cemented
plastic
sticky

Boundary
(abrupt < 1")
clear < 2.5"
gradual <5"
diffuse > 5"

(smooth)
wavy
irregular
broken

roots
few (5% max)
common (20% max)
many (>20%)
(none)

fine
medium
coarse

mottling: Depth NA Color NA
few (5% max)
common (20% max)
many (>20%)
(none)

fine (<5 mm)
medium (15 mm)
coarse (>15 mm)

faint
distinct
prominent

Horizon ____ Topsoil/Fill Depth ____ Color ____

Soil Texture
sand
loamy sand
sandy loam
loam
silt loam
silt
sandy clay loam
clay loam
sandy clay
silty clay
clay
bedrock

Coarse Fragments
____ % gravel (3" max)
____ % cobbles (10" max)
____ % boulders (>10")

Structure
weak
moderate
strong

fine
medium
coarse

angular blocky
subang. blocky
granular
single grain
platy
structureless
massive
wedge
prismatic
cloddy

water content
dry
moist
slightly moist
wet

consistency
loose
friable
firm
cemented
plastic
sticky

Boundary
abrupt < 1"
clear < 2.5"
gradual <5"
diffuse > 5"

smooth
wavy
irregular
broken

roots
few (5% max)
common (20% max)
many (>20%)
none

fine
medium
coarse

mottling: Depth ____ Color ____
few (5% max)
common (20% max)
many (>20%)
none

fine (<5 mm)
medium (15 mm)
coarse (>15 mm)

faint
distinct
prominent

EL 162.7

N/A Township Health Department

BASIN ADJACENT TO SENIOR CENTER

WINSLOW, NJ

Client: PINELANDS COMM.

Project No.: 579.001

Date: 1/4/05

Soil Log No. TP-3 Block: 2504 Lot: 7

Horizon: Topsoil/Fill — Depth: 0-6" — Color: 10YR 3/2

Soil Texture: sand; loamy sand; **sandy loam**; loam; silt loam; silt; sandy clay loam; clay loam; sandy clay; silty clay; clay; bedrock

Coarse Fragments: 5 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: **weak**; moderate; strong — **fine**; **medium**; coarse — angular blocky; subang. blocky; **granular**; single grain; platy; structureless; massive; wedge; prismatic; cloddy

water content: dry; **moist**; slightly moist; wet

consistency: **loose**; friable; firm; cemented; plastic; sticky

Boundary: **abrupt < 1"**; clear < 2.5"; gradual <5"; diffuse > 5" — **smooth**; wavy; irregular; broken

roots: **few (5% max)**; common (20% max); many (>20%); none — **fine**; **medium**; coarse

mottling: Depth NA Color NA

few (5% max); common (20% max); many (>20%); **none** — fine (<5 mm); medium (15 mm); coarse (>15 mm) — faint; distinct; prominent

Horizon: Topsoil/Fill — Depth: 6"-44" — Color: 7.5YR 6/6

Soil Texture: sand; loamy sand; sandy loam; loam; silt loam; silt; **sandy clay loam**; clay loam; sandy clay; silty clay; clay; bedrock

Coarse Fragments: 5 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: weak; **moderate**; strong — **fine**; **medium**; coarse — **angular blocky**; **subang. blocky**; **granular**; single grain; platy; structureless; massive; wedge; prismatic; cloddy

water content: **dry**; **moist**; slightly moist; wet

consistency: loose; **friable**; **firm**; cemented; plastic; sticky

Boundary: **abrupt < 1"**; clear < 2.5"; gradual <5"; diffuse > 5" — smooth; **wavy**; irregular; broken

roots: few (5% max); common (20% max); many (>20%); **none** — fine; medium; coarse

mottling: Depth NA Color NA

few (5% max); common (20% max); **many (>20%)**; **none** — fine (<5 mm); medium (15 mm); coarse (>15 mm) — faint; distinct; prominent

Horizon: Topsoil/Fill — Depth: 44"-56" — Color: 10YR 7/6

Soil Texture: sand; loamy sand; sandy loam; loam; silt loam; silt; sandy clay loam; clay loam; sandy clay; **silty clay**; clay; bedrock

Coarse Fragments: 0 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: weak; moderate; **strong** — **fine**; medium; coarse — angular blocky; subang. blocky; granular; single grain; platy; structureless; **massive**; wedge; prismatic; cloddy

water content: dry; **moist**; slightly moist; wet

consistency: loose; friable; **firm**; cemented; plastic; sticky

Boundary: **abrupt < 1"**; clear < 2.5"; gradual <5"; diffuse > 5" — smooth; **wavy**; irregular; broken

roots: few (5% max); common (20% max); many (>20%); **none** — fine; medium; coarse

mottling: Depth NA Color NA

few (5% max); common (20% max); many (>20%); **none** — fine (<5 mm); medium (15 mm); coarse (>15 mm) — faint; distinct; prominent

EL 162.7 N/A Township Health Department
BASIN ADJACENT TO SENIOR CENTER
UNION, NJ

Client: PINELANDS COMM.
Project No.: 579.001
Date: 1/4/05

Soil Log No. TP-3 Block: 2504 Lot: 7

Horizon Topsoil/Fill — Depth 56"- 64" — Color 7.5YR 5/4

Soil Texture: sand; loamy sand; sandy loam; loam; silt loam; silt; **sandy clay loam**; clay loam; sandy clay; silty clay; clay; bedrock

Coarse Fragments: 0 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: weak; **moderate**; strong — fine; **medium**; coarse — angular blocky; **subang. blocky**; **granular**; single grain; platy; structureless; massive; wedge; prismatic; cloddy

water content: dry; **moist**; slightly moist; wet

consistency: loose; **friable**; **firm**; cemented; plastic; sticky

Boundary: abrupt < 1"; **clear < 2.5"**; gradual <5"; diffuse > 5" — **smooth**; wavy; irregular; broken

roots: few (5% max); common (20% max); many (>20%); **none** — fine; medium; coarse

mottling: Depth ____ Color ____
few (5% max); common (20% max); many (>20%); **none** — fine (<5 mm); medium (15 mm); coarse (>15 mm) — faint; distinct; prominent

Horizon Topsoil/Fill — Depth 64"- 86" — Color 10YR 7/6

Soil Texture: sand; loamy sand; sandy loam; loam; silt loam; silt; sandy clay loam; clay loam; sandy clay; **silty clay**; clay; bedrock

Coarse Fragments: 0 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: weak; moderate; **strong** — **fine**; medium; coarse — angular blocky; subang. blocky; granular; single grain; platy; structureless; **massive**; wedge; prismatic; cloddy

water content: dry; **moist**; slightly moist; wet

consistency: loose; friable; **firm**; cemented; plastic; sticky

Boundary: abrupt < 1"; **clear < 2.5"**; gradual <5"; diffuse > 5" — smooth; **wavy**; irregular; broken

roots: few (5% max); common (20% max); many (>20%); **none** — fine; medium; coarse

mottling: Depth 76" Color 10YR 7/4
few (5% max); **common (20% max)**; many (>20%); none — **fine (<5 mm)**; medium (15 mm); coarse (>15 mm) — **faint**; distinct; prominent

Horizon Topsoil/Fill — Depth 86"- 117" — Color 7.5YR 5/4

Soil Texture: **sand**; loamy sand; sandy loam; loam; silt loam; silt; sandy clay loam; clay loam; sandy clay; silty clay; clay; bedrock

Coarse Fragments: 2 % gravel (3" max); 0 % cobbles (10" max); 0 % boulders (>10")

Structure: **weak**; moderate; strong — fine; **medium**; **coarse** — angular blocky; subang. blocky; **granular**; **single grain**; platy; structureless; massive; wedge; prismatic; cloddy

water content: dry; **moist**; slightly moist; wet

consistency: **loose**; friable; firm; cemented; plastic; sticky

Boundary: abrupt < 1"; clear < 2.5"; gradual <5"; diffuse > 5" — smooth; wavy; irregular; broken

roots: few (5% max); common (20% max); many (>20%); **none** — fine; medium; coarse

mottling: Depth NA Color NA
few (5% max); common (20% max); many (>20%); **none** — fine (<5 mm); medium (15 mm); coarse (>15 mm) — faint; distinct; prominent

EL 162.161 N/A Township Health Department

BASIN ADJACENT TO SENIOR CENTER

WINSLOW, NJ

Client: PINELANDS COMM.

Project No.: 579001

Date: 1/4/05

Soil Log No. TP-4 Block: 2504 Lot: 7

Horizon Topsoil/Fill Depth 0"-6" Color 10YR 3/2

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	0 % gravel (3" max)	weak	fine	angular blocky	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth NA Color NA		
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

Horizon Topsoil/Fill Depth 6"-38" Color 7.5YR 6/6

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	0 % gravel (3" max)	weak	fine	angular blocky	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth NA Color NA		
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

Horizon Topsoil/Fill Depth 38"-44" Color

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	0 % gravel (3" max)	weak	fine	angular blocky	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth NA Color NA		
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

EL 162.61 N/A Township Health Department
BASIN ADJACENT TO SENIOR CENTER
WINSLOW, NJ

Client: PINELANDS COMM.
Project No.: 579.001
Date: 1/4/05

Soil Log No. TP-4 Block: 2504 Lot: 7

Horizon ____ Topsoil/Fill Depth 44"-96" Color 7.5YR 5/4

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	2 % gravel (3" max)	(weak)	fine	angular blocky	dry	(loose)
loamy sand	0 % cobbles (10" max)	moderate	(medium)	subang. blocky	(moist)	friable
(sandy loam)	0 % boulders (>10")	strong	coarse	(granular)	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth NA Color NA		
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	(none)		(none)		

Horizon ____ Topsoil/Fill Depth ____ Color ____

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	____% gravel (3" max)	weak	fine	angular blocky	dry	loose
loamy sand	____% cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	____% boulders (>10")	strong	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth Color		
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

Horizon ____ Topsoil/Fill Depth ____ Color ____

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	____% gravel (3" max)	weak	fine	angular blocky	dry	loose
loamy sand	____% cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	____% boulders (>10")	strong	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth Color		
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

EL 161.16

N/A Township Health Department

Basin Adjacent To Maintenance Bld. Located Outside of Basin

Client: Pinelands Commission
Project No.: 579.001
Date: 1/7/05

Soil Log No. TP-5 Block: 41 Lot: 1, 3, 5, 7, 9, 11, 13

Horizon A Topsoil/Fill Depth 0-8" Color 10yr 3/3

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	0 % gravel (3" max)	weak	fine	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	slightly moist	firm
loam			angular blocky	wet	cemented
silt loam			subang. blocky		plastic
silt			granular		sticky
sandy clay loam			single grain		
clay loam			platy		
sandy clay			structureless		
silty clay			massive		
clay			wedge		
bedrock			prismatic		
			cloddy		

Boundary		roots		mottling: Depth N/A Color N/A		
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clrear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

Horizon Topsoil/Fill Depth 8"-12" Color 10yr 5/1

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	0 % gravel (3" max)	weak	fine	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	slightly moist	firm
loam			angular blocky	wet	cemented
silt loam			subang. blocky		plastic
silt			granular		sticky
sandy clay loam			single grain		
clay loam			platy		
sandy clay			structureless		
silty clay			massive		
clay			wedge		
bedrock			prismatic		
			cloddy		

Boundary		roots		mottling: Depth N/A Color N/A		
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clrear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

Horizon Topsoil/Fill Depth 12"-19" Color 7.5yr 5/6

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	20 % gravel (3" max)	weak	fine	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	slightly moist	firm
loam			angular blocky	wet	cemented
silt loam			subang. blocky		plastic
silt			granular		sticky
sandy clay loam			single grain		
clay loam			platy		
sandy clay			structureless		
silty clay			massive		
clay			wedge		
bedrock			prismatic		
			cloddy		

Boundary		roots		mottling: Depth N/A Color N/A		
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clrear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

EL 161.16

N/A Township Health Department
Basin Adjacent To Maintenance Bld.
Located Outside Of Basin

Client: Pinelands Commission
Project No.: 579.001
Date: 1/7/05

Soil Log No. TP-5 Block: 41 Lot: 1,3,5,7,9,11,13

Horizon Topsoil/Fill Depth 19" - 27" Color 7.5yr 5/8

Soil Texture	Coarse Fragments	Structure			water content	consistency
(sand)	50 % gravel (3" max)	weak	fine	angular blocky	dry	loose
loamy sand	0 % cobbles (10" max)	(moderate)	(medium)	subang. blocky	(moist)	friable
sandy loam	0 % boulders (>10")	strong	coarse	(granular)	slightly moist	(firm)
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth N/A Color N/A		
abrupt < 1"	(smooth)	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	(none)		(none)		

Horizon Topsoil/Fill Depth 27" - 36" Color

Soil Texture	Coarse Fragments	Structure			water content	consistency
sand	0 % gravel (3" max)	weak	(fine)	angular blocky	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	(moist)	friable
sandy loam	0 % boulders (>10")	(strong)	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		(plastic)
silt				structureless		sticky
sandy clay loam				(massive)		
(clay loam)				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth N/A Color N/A		
(abrupt < 1")	(smooth)	(few (5% max))	(fine)	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		(none)		

Horizon Topsoil/Fill Depth 36" - 80" Color 2.5yr 6/8

Soil Texture	Coarse Fragments	Structure			water content	consistency
sand	0 % gravel (3" max)	weak	(fine)	angular blocky	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	(moist)	friable
sandy loam	0 % boulders (>10")	(strong)	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		(plastic)
silt				structureless		sticky
sandy clay loam				(massive)		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
(clay)						
bedrock						

Boundary		roots		mottling: Depth N/A Color N/A		
abrupt < 1"	smooth	(few (5% max))	(fine)	few (5% max)	fine (<5 mm)	faint
(clear < 2.5")	(wavy)	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
(gradual <5")	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		(none)		

EL 159.50

N/A Township Health Department
Basin Adjacent To Maintenance Bld.
Chesilhurst, NJ

Client: Pinelands Commission
Project No.: 579.001
Date: 1/7/05

Soil Log No. TP-6 Block: 41 Lot: 1, 3, 5, 7, 9, 11, 13

Horizon Topsoil/Fill — Depth 0-1" — Color Green Slime

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	____% gravel (3" max)	weak	fine	angular blocky	dry	loose
loamy sand	____% cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	____% boulders (>10")	strong	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth	Color	
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clrear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

Horizon Topsoil/Fill — Depth 1" - 8" — Color 10yr 3/3

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	0 % gravel (3" max)	weak	fine	angular blocky	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth N/A	Color N/A	
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clrear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

Horizon Topsoil/Fill — Depth 8" - 16" — Color 7.5yr 5/6

Soil Texture	Coarse Fragments	Structure		water content	consistency
sand	1 % gravel (3" max)	weak	fine	angular blocky	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth N/A	Color N/A	
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clrear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

EL 159.50

N/A Township Health Department
Basin Adjacent To Maintenance Bld.
Chesilhurst, NJ

Client: Pinelands Commission
Project No.: 579.001
Date: 1/7/05

Soil Log No. TP-6 Block: 41 Lot: 1, 3, 5, 7, 9, 11, 13

Horizon ____ Topsoil/Fill Depth 16" - 66" Color 7.5yr 7/6

Soil Texture	Coarse Fragments	Structure			water content	consistency
sand	0 % gravel (3" max)	weak	(fine)	angular blocky	dry	loose
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	0 % boulders (>10")	(strong)	coarse	granular	(slightly moist)	(firm)
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				(massive)		
clay loam				wedge		
sandy clay				prismatic		
(silty clay)				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth N/A	Color N/A	
abrupt < 1"	(smooth)	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
(clear < 2.5")	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	(none)		(none)		

Horizon ____ Topsoil/Fill Depth 66" - 90" Color 7.5yr 5/6

Soil Texture	Coarse Fragments	Structure			water content	consistency
(sand)	0 % gravel (3" max)	(weak)	(fine)	angular blocky	dry	(loose)
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	(granular)	slightly moist	firm
loam				single grain	(wet)	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth N/A	Color N/A	
abrupt < 1"	(smooth)	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
(diffuse > 5")	broken	(none)		(none)		

Horizon ____ Topsoil/Fill Depth 90" - 120" Color 7.5yr 5/8

Soil Texture	Coarse Fragments	Structure			water content	consistency
(sand)	0 % gravel (3" max)	weak	(fine)	angular blocky	(dry)	loose
loamy sand	0 % cobbles (10" max)	(moderate)	medium	subang. blocky	(moist)	friable
sandy loam	0 % boulders (>10")	strong	coarse	(granular)	slightly moist	(firm)
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth N/A	Color N/A	
(abrupt < 1")	(smooth)	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	(many (>20%)	coarse	(many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	(none)		(none)		

EL 159.46

N/A Township Health Department
Basin Adjacent To Maintenance Bldg.
Chesilhurst, NJ

Client: Pinelands Commission
Project No.: 579.001
Date: 1/7/05

Soil Log No. TP-7 Block: 41 Lot: 1, 3, 5, 7, 9, 11, 13

Horizon Topsoil/Fill Depth 0-1" Color Green Slime

Soil Texture	Coarse Fragments	Structure			water content	consistency
sand	___% gravel (3" max)	weak	fine	angular blocky	dry	loose
loamy sand	___% cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	___% boulders (>10")	strong	coarse	granular	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth	Color	
abrupt < 1"	smooth	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	none		none		

Horizon Topsoil/Fill Depth 1"-30" Color 10yr 4/3

Soil Texture	Coarse Fragments	Structure			water content	consistency
sand	2 % gravel (3" max)	(weak)	(fine)	angular blocky	(dry)	(loose)
(loamy sand)	0 % cobbles (10" max)	moderate	(medium)	subang. blocky	(moist)	friable
sandy loam	0 % boulders (>10")	strong	coarse	(granular)	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth N/A	Color N/A	
abrupt < 1"	(smooth)	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
(gradual <5")	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	(none)		(none)		

Horizon Topsoil/Fill Depth 30"-39" Color 10yr 5/6

Soil Texture	Coarse Fragments	Structure			water content	consistency
(sand)	0 % gravel (3" max)	(weak)	(fine)	angular blocky	(dry)	(loose)
loamy sand	0 % cobbles (10" max)	moderate	(medium)	subang. blocky	(moist)	friable
sandy loam	0 % boulders (>10")	strong	coarse	(granular)	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth 39"	Color 7.5yr 5/6	
abrupt < 1"	(smooth)	few (5% max)	fine	(few (5% max))	(fine (<5 mm))	(faint)
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
(gradual <5")	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	(none)		none		

EL 159.46

N/A Township Health Department
Basin Adjacent To Maintenance Bld.
Chesilhurst, NJ

Client: Pinelands Commission
Project No.: 579.001
Date: 1/7/05

Soil Log No. TP-7 Block: 41 Lot: 1, 3, 5, 7, 9, 11, 13

Horizon ____ Topsoil/Fill Depth 39"-56" Color 5yr 5/8

Soil Texture	Coarse Fragments	Structure			water content	consistency
sand	0 % gravel (3" max)	(weak)	(fine)	angular blocky	dry	(loose)
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	(moist)	friable
sandy loam	0 % boulders (>10")	strong	coarse	(granular)	slightly moist	firm
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
(silty clay)				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth N/A Color N/A		
abrupt < 1"	(smooth)	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
(clear < 2.5")	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	(none)		(none)		

Horizon ____ Topsoil/Fill Depth 56"-90" Color 7.5yr 6/8

Soil Texture	Coarse Fragments	Structure			water content	consistency
(sand)	0 % gravel (3" max)	(weak)	(fine)	angular blocky	dry	(loose)
loamy sand	0 % cobbles (10" max)	moderate	medium	subang. blocky	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	(granular)	slightly moist	firm
loam				single grain	(wet)	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

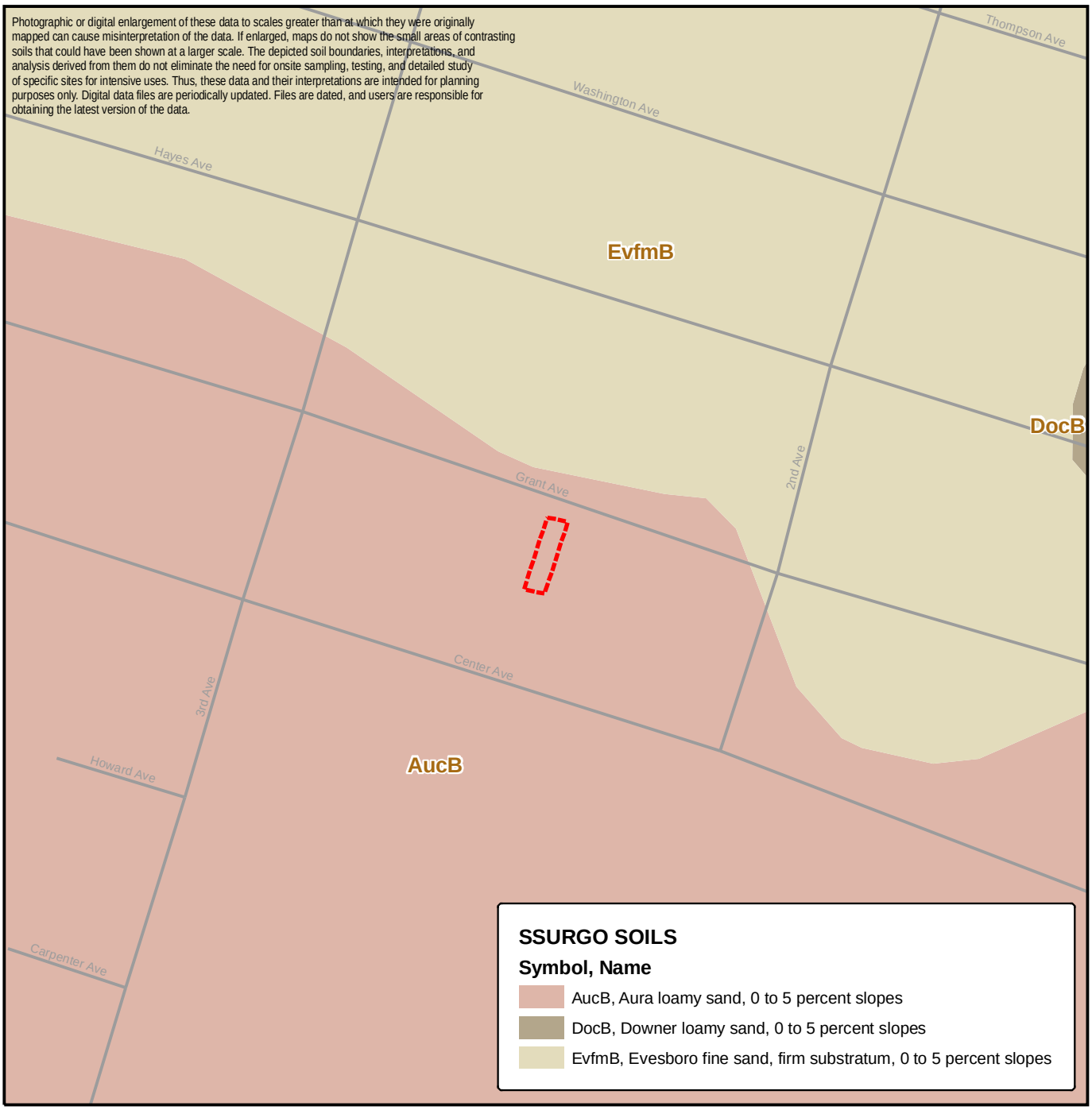
Boundary		roots		mottling: Depth N/A Color N/A		
abrupt < 1"	(smooth)	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
(clear < 2.5")	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	(none)		(none)		

Horizon ____ Topsoil/Fill Depth 90"-120" Color 7.5yr 5/8

Soil Texture	Coarse Fragments	Structure			water content	consistency
(sand)	0 % gravel (3" max)	weak	(fine)	angular blocky	dry	loose
loamy sand	0 % cobbles (10" max)	(moderate)	medium	subang. blocky	moist	friable
sandy loam	0 % boulders (>10")	strong	coarse	(granular)	(slightly moist)	(firm)
loam				single grain	wet	cemented
silt loam				platy		plastic
silt				structureless		sticky
sandy clay loam				massive		
clay loam				wedge		
sandy clay				prismatic		
silty clay				cloddy		
clay						
bedrock						

Boundary		roots		mottling: Depth N/A Color N/A		
(abrupt < 1")	(smooth)	few (5% max)	fine	few (5% max)	fine (<5 mm)	faint
clear < 2.5"	wavy	common (20% max)	medium	common (20% max)	medium (15 mm)	distinct
gradual <5"	irregular	many (>20%)	coarse	many (>20%)	coarse (>15 mm)	prominent
diffuse > 5"	broken	(none)		(none)		

APPENDIX E - USDA
SOIL SURVEY MAP



Princeton Hydro

APPENDIX E - BASIN 1 SSURGO SOIL MAP

SUBSURFACE INVESTIGATION OF RECHARGE BASINS
BASIN 1
EDWARD DUBLE SENIOR CENTER
WINSLOW TOWNSHIP
CAMDEN COUNTY, NEW JERSEY

LEGEND

Site Bounds

Roads

0 75 150 300
Feet

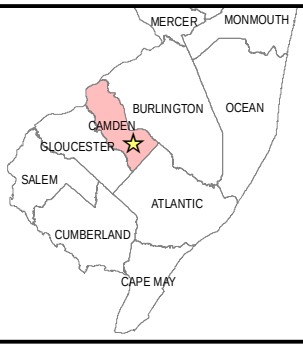
1 inch equals 300 feet

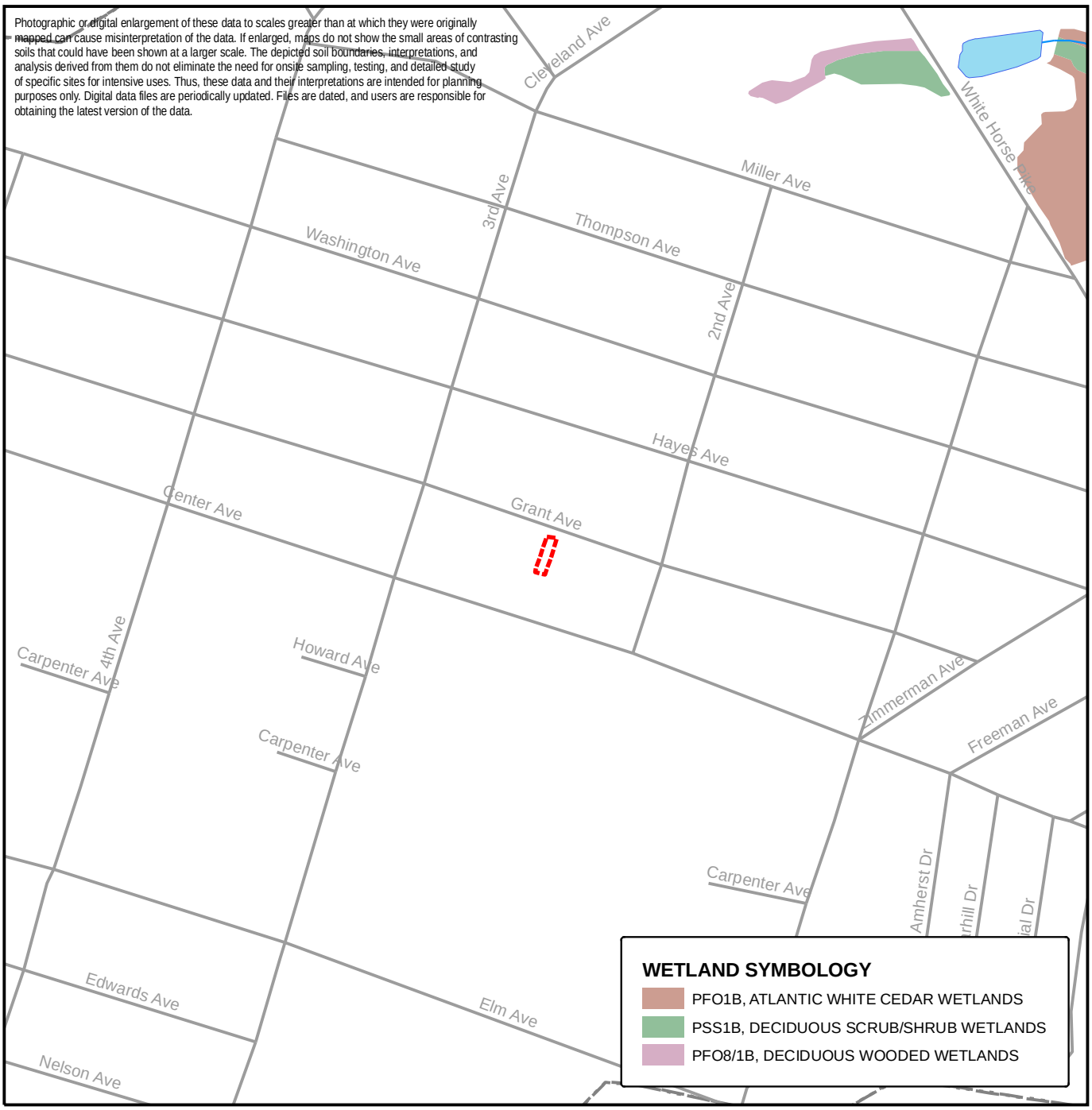
PRINCETON HYDRO, LLC.
1105 LAUREL OAK ROAD
SUITE 136
VOORHEES, NJ 08043

SOURCES:

1. Site boundary depicted herein is not, nor is intended to be an official property boundary. The site boundary depicts the estiated extents of the basin footprint.
2. SSURGO Soils data from NRCS soils survey of Camden County as obtained from the NJDEP GIS website (1999, 1:20,000, 5 acre Res.).

NEW JERSEY COUNTY MAP





Princeton Hydro

APPENDIX E - BASIN 2 SSURGO SOIL MAP

SUBSURFACE INVESTIGATION OF RECHARGE BASINS
BASIN 2
CHESILHURST PUBLIC WORKS BUILDING
CHESILHURST BOROUGH
CAMDEN COUNTY, NEW JERSEY

LEGEND

Site Bounds

Roads

0 150 300 600
Feet

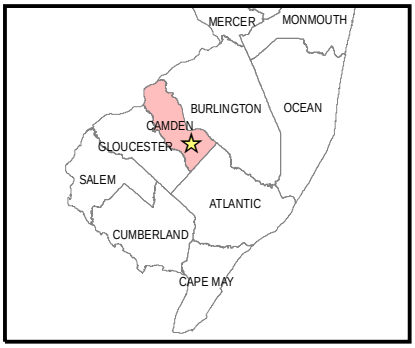
1 inch equals 600 feet

PRINCETON HYDRO, LLC.
1105 LAUREL OAK ROAD
SUITE 136
VOORHEES, NJ 08043

SOURCES:

1. Site boundary depicted herein is not, nor is intended to be an official property boundary. The site boundary depicts the estiated extents of the basin footprint.
2. SSURGO Soils data from NRCS soils survey of Camden County as obtained from the NJDEP GIS website (1999, 1:20,000, 5 acre Res.).

NEW JERSEY COUNTY MAP



APPENDIX F -
LABORATORY TEST
RESULTS

REPORT OF ANALYSIS

CLIENT	Princeton Hydro, LLC	REPORT DATE	02/15/05
ADDRESS	1105 Laurel Oak Road	JOB # 2073	LOT # 8449
CITY	Voorhees STATE NJ ZIP 08043	PO # ChofCu	INVOICE # 256764
TO ATTN. OF	Mattfew J. Rice	SAMPLE DATE	01/16/05

Sample #: 28969 **Client Sample ID: TP-2,3,4, S1**

II. Sample Depth: N/A Soil/Pit Boring Number: N/A Date Collected: 01/16/05

III. Coarse Fragment Content:

Total Weight of Sample, W.T.,grams: 1,446.64
Weight of Material Retained on 2mm sieve, W.C.F.,grams 43.48
Wt. % Coarse Fragment (W.C.F. / W.T. x 100): 3.01

I. Oven Dry Weight (24 hrs., 105°C) of 40 Gram Air Dry Sample, grams,Wt. 39.81 ; ***39.79***

II. Hydrometer Calibration, Rc^1/°F 5.0 / 65.7 ; ***5.0 / 67.5***
IIa. Hydrometer Calibration, Rc^2/°F 4.5 / 67.5 ; ***4.0 /68.4***

III. Hydrometer Reading at 40 seconds, grams, R1 15.5 ; ***15.0***
Temperature of Suspension, °F 65.7 ; ***67.5***

IV. Corrected Hydrometer Reading, grams, R1' 10.1 ; ***9.9***

V. Hydrometer Reading at 2 hours, grams, R2 13.0 ; ***12.5***
Temperature of Suspension, °F 67.5 ; ***68.4***

VI. Corrected Hydrometer Reading, grams, R2' 8.4 ; ***8.5***

VII. % sand = (wt. – R1') / Wt. X 100 = (39.81 - 10.1) / 39.81 x 100 = 74.63
(39.79 – 9.9) / 39.79 x 100 = 75.12

VIII. % clay = R2' / Wt. X 100 = 8.4 / 39.81 x 100 = 21.10
8.5 / 39.79 x 100 = 21.36

IX. Sieve Analysis:

a. Oven Dry Wt. (2hrs., 105°C) Total Sand Fraction
(Soil Retained in 0.045mm Sieve), grams 29.90 ; ***29.99***
b. Wt. Of Fine Plus Very Fine Sand Fraction
(Sand Passing 0.25mm Sieve), grams 9.92 ; ***9.18***

c. % Fine Plus Very Fine Sand (b / a) 33.18 ; ***30.61***

XI. **Soil Permeability Class Rating** (Based on textural triangle sample analysis) K – 3, K – 3
* Based on a > 50% Fine plus Very Fine Sand, the Soil Permeability Class Rating is adjusted to the next slowest level. (7:9A-6.3(h)2.)

NOTE: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate.***

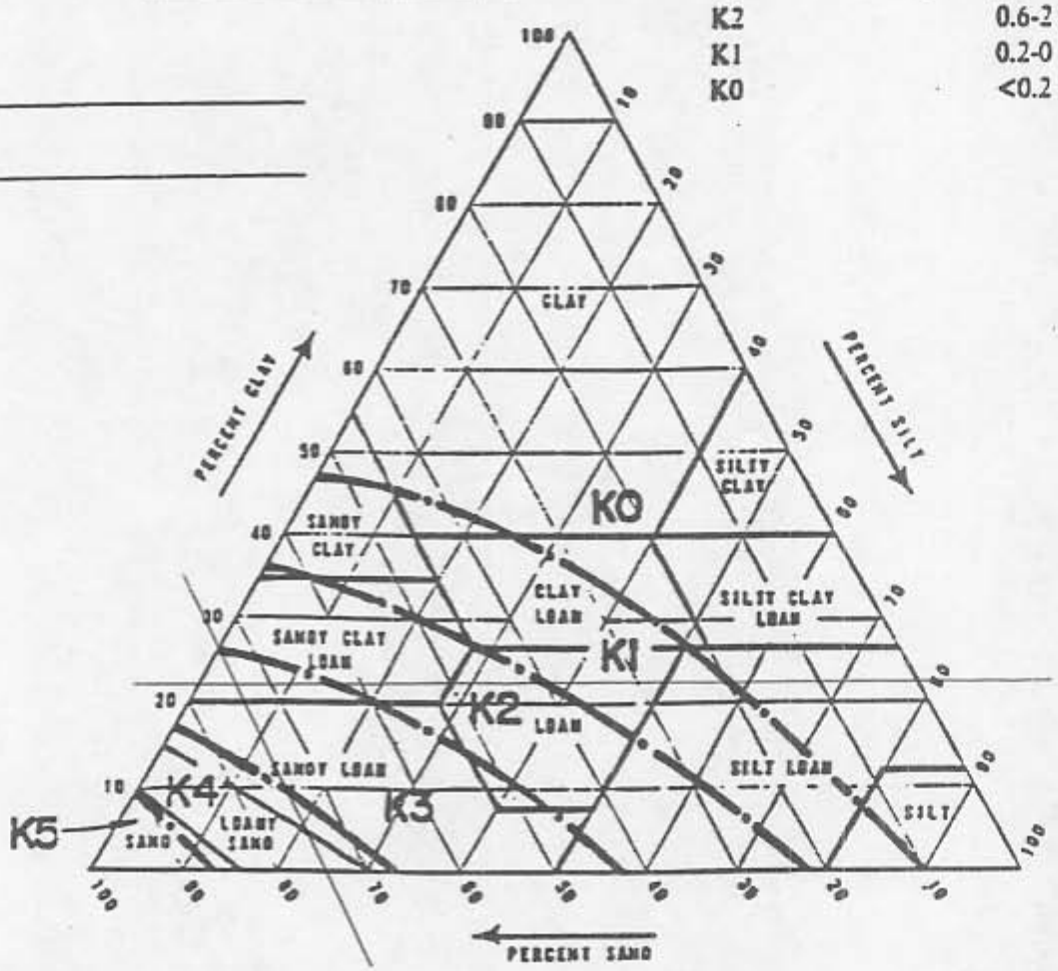
Approved: _____
Thomas Grenci, Laboratory Manager

Sample ID: 38969

Permeability Class (Adjusted)*: K-3

*

Legend: Permeability Class	Permeability (in/hr)
K5	>20
K4	6-20
K3	2-6
K2	0.6-2
K1	0.2-0
K0	<0.2



Adapted from N.N. Hantzsche et al. (1982) Soil Textural Analysis for Onsite Sewage Disposal Evaluation, Proc. 3rd Nat. Symposium on Individual and Small Community Sewage Treatment. Am. Soc. Agric. Eng., St. Joseph, Michigan

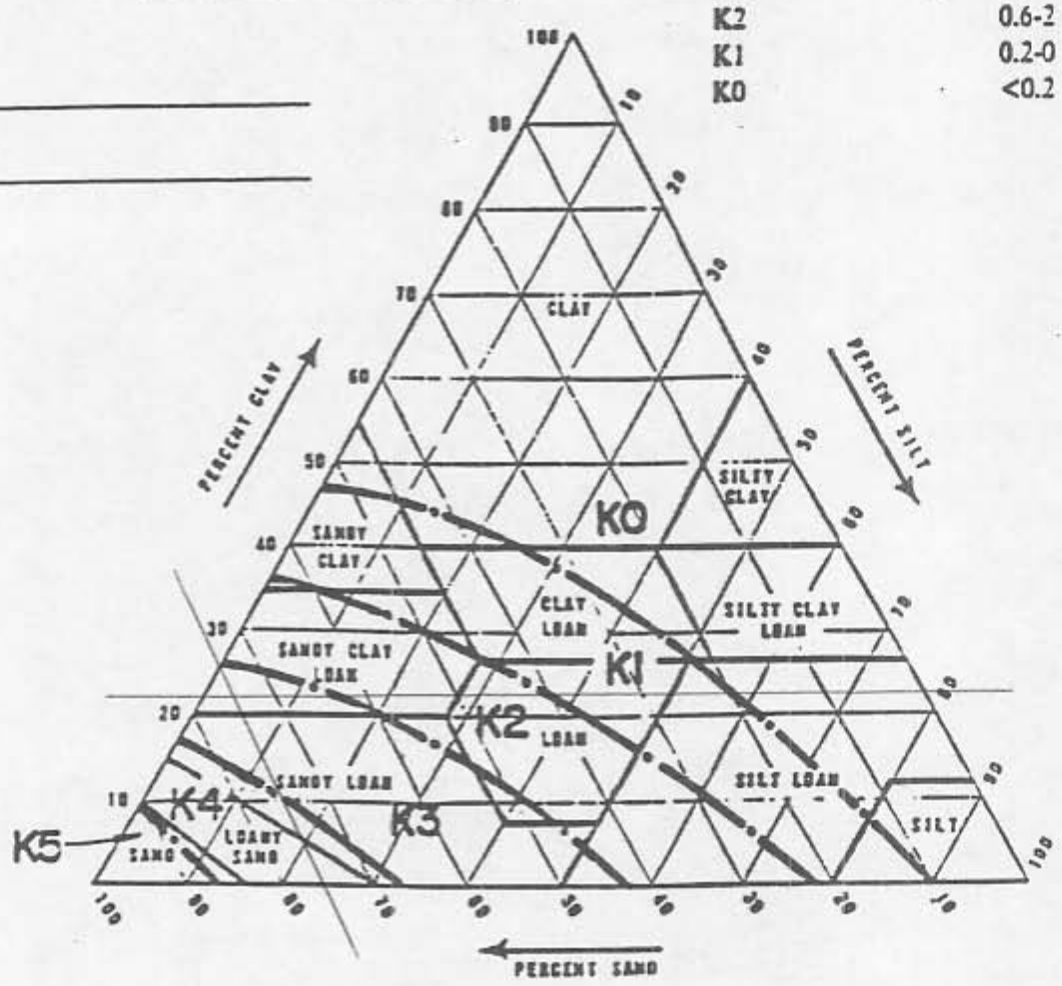
Figure 6. Soil Permeability/Textural Triangle

Sample ID: 28969 Replicate

Permeability Class (Adjusted)*: K-3

*

Legend: Permeability Class	Permeability (in/hr)
K5	>20
K4	6-20
K3	2-6
K2	0.6-2
K1	0.2-0
K0	<0.2



Adapted from N.N. Hantzsche et al. (1982) Soil Textural Analysis for Onsite Sewage Disposal Evaluation. Proc. 3rd Nat. Symposium on Individual and Small Community Sewage Treatment. Am. Soc. Agric. Eng., St. Joseph, Michigan

Figure 6. Soil Permeability/Textural Triangle

REPORT OF ANALYSIS

CLIENT Princeton Hydro, LLC — REPORT DATE 02/15/05

ADDRESS 1105 Laurel Oak Road — JOB # 2073 — LOT # 8449

CITY Voorhees — STATE NJ — ZIP 08043 — PO # ChofCu — INVOICE # 256764

TO ATTN. OF Mattfew J. Rice — SAMPLE DATE 01/16/05

Sample #: 28970 **Client Sample ID: TP-2,3,4, S2**

II. Sample Depth: N/A Soil/Pit Boring Number: N/A Date Collected: 01/16/05

III. Coarse Fragment Content:

Total Weight of Sample, W.T.,grams: 1,090.79
Weight of Material Retained on 2mm sieve, W.C.F.,grams 10.71
Wt. % Coarse Fragment (W.C.F. / W.T. x 100): 1.00

I. Oven Dry Weight (24 hrs., 105°C) of 40 Gram Air Dry Sample, grams,Wt. 39.63 ; ***39.57***

II. Hydrometer Calibration, Rc^1/°F 5.0 / 65.7 ; ***5.0 / 67.5***
IIa. Hydrometer Calibration, Rc^2/°F 4.5 / 67.5 ; ***4.0 /68.4***

III. Hydrometer Reading at 40 seconds, grams, R1 32.5 ; ***33.0***
Temperature of Suspension, °F 65.7 ; ***67.5***

IV. Corrected Hydrometer Reading, grams, R1' 27.1 ; ***27.9***

V. Hydrometer Reading at 2 hours, grams, R2 25.5 ; 25.0
Temperature of Suspension, °F 67.5 ; ***68.4***

VI. Corrected Hydrometer Reading, grams, R2' 21.0 ; 21.0

VII. % sand = (wt. – R1') / Wt. X 100 = (39.63 – 27.1) / 39.63 x 100 = 31.62
(39.57 – 27.9) / 39.57 x 100 = 29.49

VIII. % clay = R2' / Wt. X 100 = 21.0 / 39.63 x 100 = 52.99
21.0 / 39.57 x 100 = 53.07

IX. Sieve Analysis:

a. Oven Dry Wt. (2hrs., 105°C) Total Sand Fraction
(Soil Retained in 0.045mm Sieve), grams 10.81 ; ***11.15***
b. Wt. Of Fine Plus Very Fine Sand Fraction
(Sand Passing 0.25mm Sieve), grams 4.41 ; ***4.97***

c. % Fine Plus Very Fine Sand (b / a) 40.80 ; ***44.57***

XI. **Soil Permeability Class Rating** (Based on textural triangle sample analysis) K – 0; ***K – 0***
* Based on a > 50% Fine plus Very Fine Sand, the Soil Permeability Class Rating is adjusted to the next slowest level. (7:9A-6.3(h)2.)

NOTE: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate.***

Approved: Thomas Grenci, Laboratory Manager

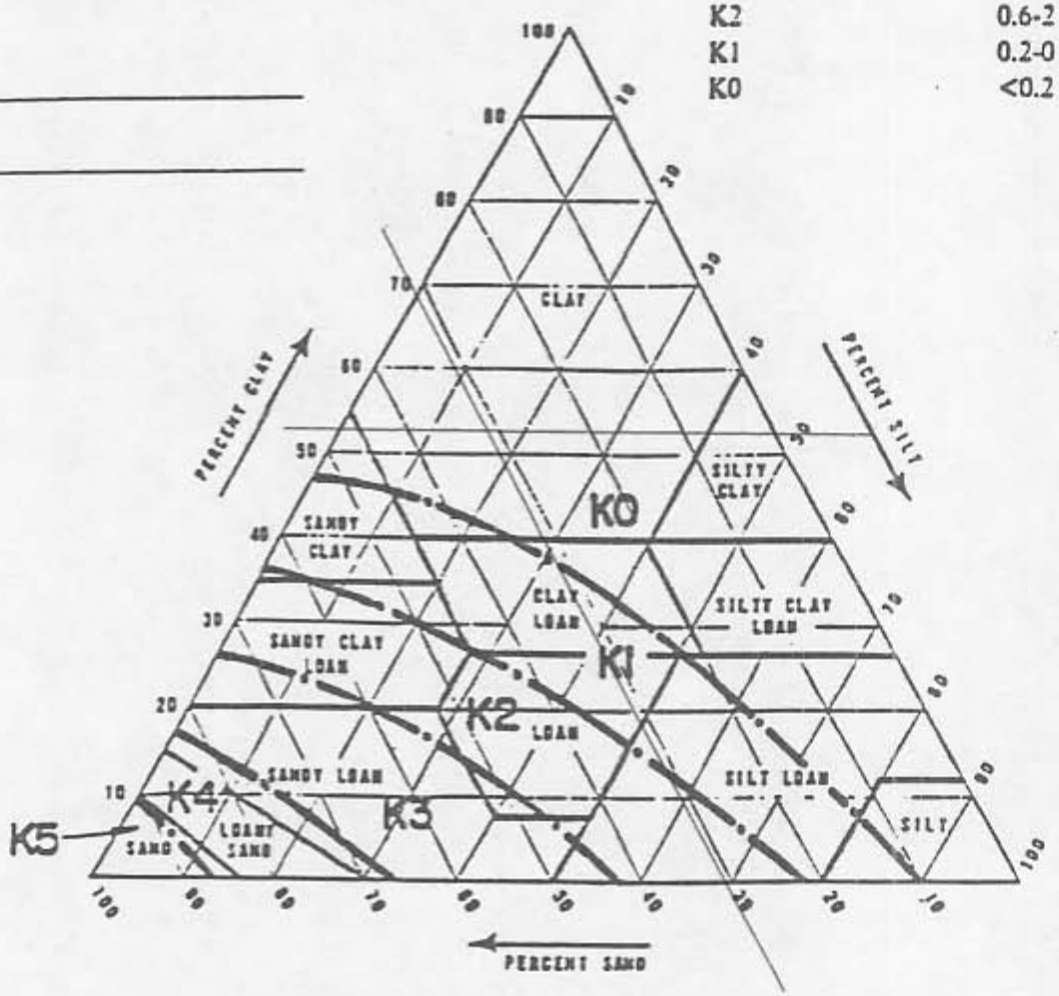
Sample ID: 28970

Permeability Class (Adjusted)*: K-0

*_____

_____

Legend: Permeability Class	Permeability (in/hr)
K5	>20
K4	6-20
K3	2-6
K2	0.6-2
K1	0.2-0
K0	<0.2



Adapted from N.N. Hantzsche et al. (1982) Soil Textural Analysis for Onsite Sewage Disposal Evaluation, Proc. 3rd Nat. Symposium on Individual and Small Community Sewage Treatment, Am. Soc. Agric. Eng., St. Joseph, Michigan

Figure 6. Soil Permeability/Textural Triangle

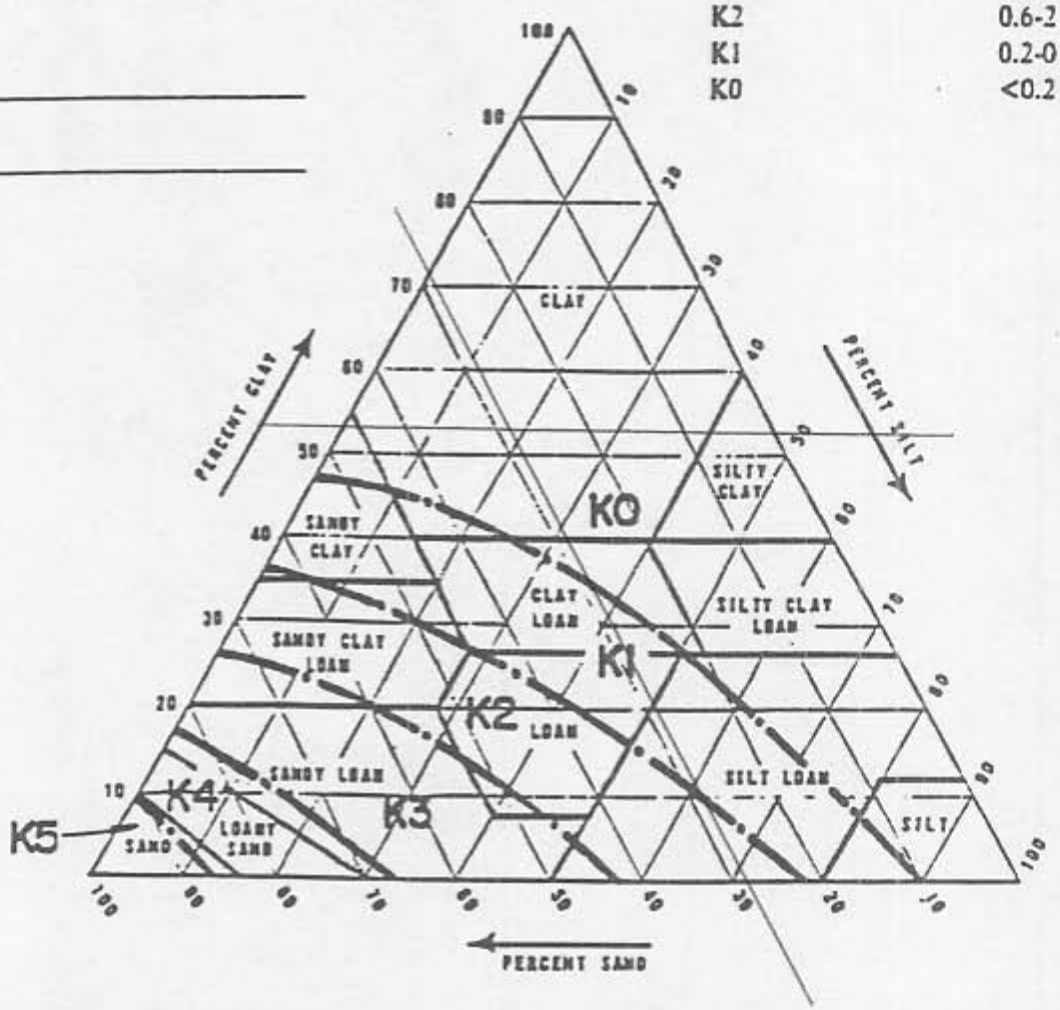
Sample ID: 28970-Replicate

Permeability Class (Adjusted)*: K-0

*_____

_____

Legend: Permeability Class	Permeability (in/hr)
K5	>20
K4	6-20
K3	2-6
K2	0.6-2
K1	0.2-0
K0	<0.2



Adapted from N.N. Hantzsche et al. (1982) Soil Textural Analysis for Onsite Sewage Disposal Evaluation, Proc. 3rd Nat. Symposium on Individual and Small Community Sewage Treatment. Am. Soc. Agric. Eng., St. Joseph, Michigan

Figure 6. Soil Permeability/Textural Triangle

REPORT OF ANALYSIS

CLIENT Princeton Hydro, LLC — REPORT DATE 02/15/05

ADDRESS 1105 Laurel Oak Road — JOB # 2073 — LOT # 8449

CITY Voorhees — STATE NJ — ZIP 08043 — PO # ChofCu — INVOICE # 256764

TO ATTN. OF Mattfew J. Rice — SAMPLE DATE 01/16/05

Sample #: 28971 **Client Sample ID: TP-6,7 S5**

II. Sample Depth: N/A Soil/Pit Boring Number: N/A Date Collected: 01/16/05

III. Coarse Fragment Content:

Total Weight of Sample, W.T.,grams: 878.22
Weight of Material Retained on 2mm sieve, W.C.F.,grams 6.91
Wt. % Coarse Fragment (W.C.F. / W.T. x 100): 0.81

I. Oven Dry Weight (24 hrs., 105°C) of 40 Gram Air Dry Sample, grams,Wt. 39.71 ; ***39.66***

II. Hydrometer Calibration, Rc^1/°F 5.0 / 65.7 ; ***5.0 / 67.5***
IIa. Hydrometer Calibration, Rc^2/°F 4.5 / 67.5 ; ***4.0 /68.4***

III. Hydrometer Reading at 40 seconds, grams, R1 29.0 ; ***28.0***
Temperature of Suspension, °F 65.7 ; ***67.5***

IV. Corrected Hydrometer Reading, grams, R1' 23.6 ; ***22.9***

V. Hydrometer Reading at 2 hours, grams, R2 22.5 ; ***22.0***
Temperature of Suspension, °F 67.5 ; ***68.4***

VI. Corrected Hydrometer Reading, grams, R2' 17.9 ; ***18.0***

VII. % sand = (wt. – R1') / Wt. X 100 = (39.71 – 23.6) / 39.71 x 100 = 40.57
(39.66 – 22.9) / 39.66 x 100 = 42.26

VIII. % clay = R2' / Wt. X 100 = 17.9 / 39.71 x 100 = 45.08
18.0 / 39.66 x 100 = 45.39

IX. Sieve Analysis:

a. Oven Dry Wt. (2hrs., 105°C) Total Sand Fraction
(Soil Retained in 0.045mm Sieve), grams 15.63 ; ***15.89***
b. Wt. Of Fine Plus Very Fine Sand Fraction
(Sand Passing 0.25mm Sieve), grams 7.44 ; ***7.94***

c. % Fine Plus Very Fine Sand (b / a) 47.60 ; 49.97

XI. **Soil Permeability Class Rating** (Based on textural triangle sample analysis) K – 0; ***K – 0***
* Based on a > 50% Fine plus Very Fine Sand, the Soil Permeability Class Rating is adjusted to the next slowest level. (7:9A-6.3(h)2.)

NOTE: Results in plain type reflect the first analysis; ***Results in Bold italic reflect the replicate.***

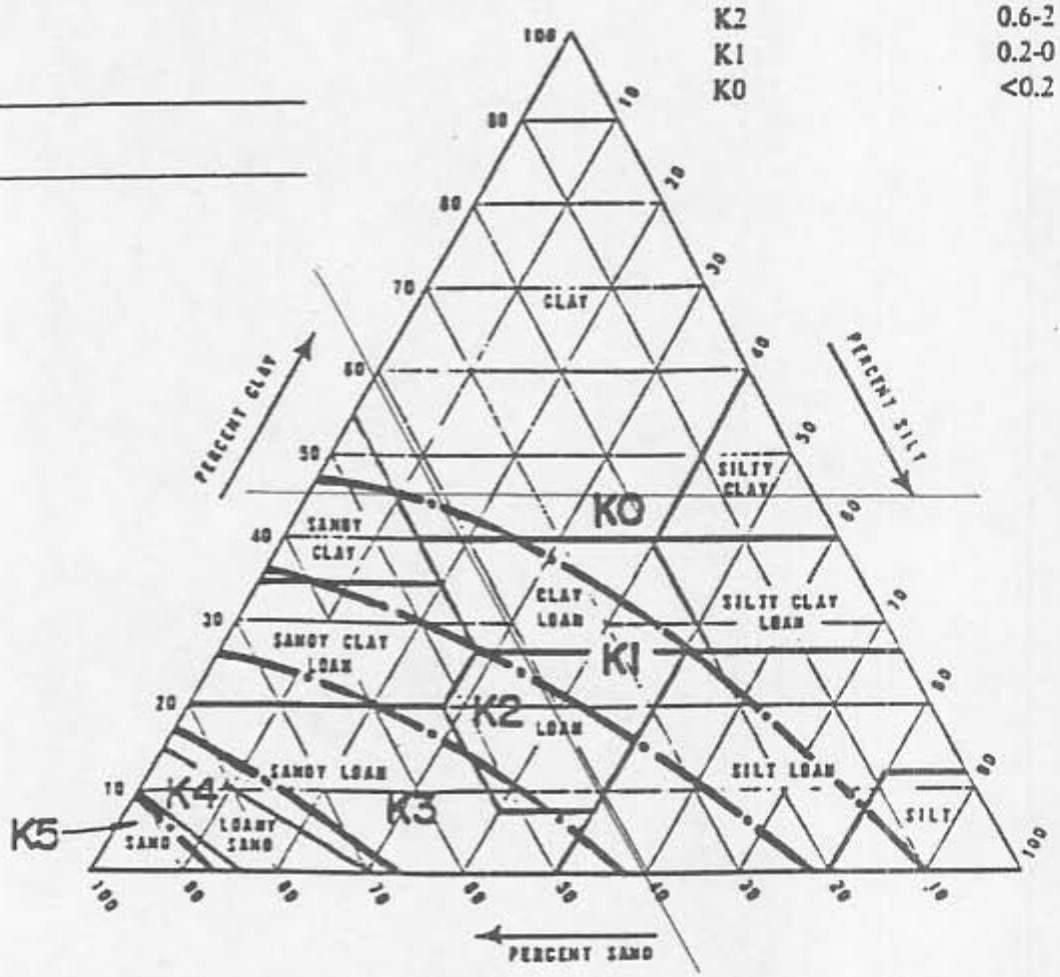
Approved: _____
Thomas Grenci, Laboratory Manager

Sample ID: 28971

Permeability Class (Adjusted)*: K-0

*

Legend: Permeability Class	Permeability (in/hr)
K5	>20
K4	6-20
K3	2-6
K2	0.6-2
K1	0.2-0
K0	<0.2



Adapted from N.N. Hantzsche et al. (1982) Soil Textural Analysis for Onsite Sewage Disposal Evaluation, Proc. 3rd Nat. Symposium on Individual and Small Community Sewage Treatment, Am. Soc. Agric. Eng., St. Joseph, Michigan

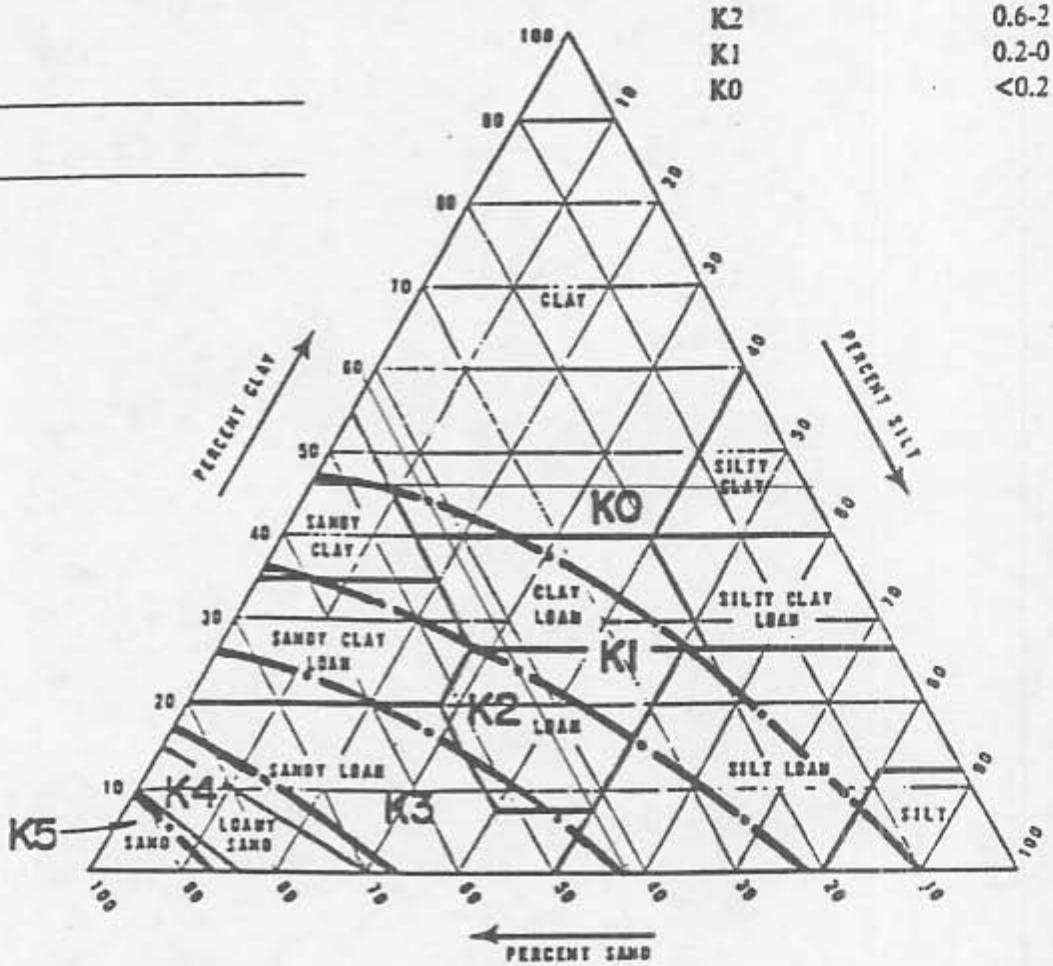
Figure 6. Soil Permeability/Textural Triangle

Sample ID: 28971 Replicate

Permeability Class (Adjusted)*: K-0

*

Legend: Permeability Class	Permeability (in/hr)
K5	>20
K4	6-20
K3	2-6
K2	0.6-2
K1	0.2-0
K0	<0.2



Adapted from N.N. Hantzsche et al. (1982) Soil Textural Analysis for Onsite Sewage Disposal Evaluation. Proc. 3rd Nat. Symposium on Individual and Small Community Sewage Treatment, Am. Soc. Agric. Eng., St. Joseph, Michigan

Figure 6. Soil Permeability/Textural Triangle

REPORT OF ANALYSIS

CLIENT	Princeton Hydro, LLC			REPORT DATE	02/15/05
ADDRESS	1105 Laurel Oak Road			JOB # 2085	LOT # 8449
CITY	Voorhees	STATE NJ	ZIP 08043	PO # ChofCu	INVOICE # 256764
TO ATTN. OF	Mattfew J. Rice			SAMPLE DATE	01/16/05

Sample #: 28972 **Client Sample ID: TP-6,7 S3-S4**

II. Sample Depth: N/A Soil/Pit Boring Number: N/A Date Collected: 01/16/05

III. Coarse Fragment Content:

Total Weight of Sample, W.T.,grams: 1,464.72
Weight of Material Retained on 2mm sieve, W.C.F.,grams 29.27
Wt. % Coarse Fragment (W.C.F. / W.T. x 100): 2.06

I. Oven Dry Weight (24 hrs., 105°C) of 40 Gram Air Dry Sample, grams,Wt. 39.88 ; ***39.86***

II. Hydrometer Calibration, Rc^1/°F 5.0 / 65.7 ; ***5.0 / 67.5***
IIa. Hydrometer Calibration, Rc^2/°F 4.5 / 67.5 ; ***4.0 /68.4***

III. Hydrometer Reading at 40 seconds, grams, R1 12.0 ; ***12.5***
Temperature of Suspension, °F 65.7 ; ***67.5***

IV. Corrected Hydrometer Reading, grams, R1' 6.6 ; ***7.4***

V. Hydrometer Reading at 2 hours, grams, R2 10.0 ; ***10.5***
Temperature of Suspension, °F 67.5 ; ***68.4***

VI. Corrected Hydrometer Reading, grams, R2' 5.4 ; ***6.5***

VII. % sand = (wt. – R1') / Wt. X 100 = (39.88 – 6.6) / 39.88 x 100 = 83.45
(39.86 – 7.4) / 39.86 x 100 = 81.44

VIII. % clay = R2' / Wt. X 100 = 5.4 / 39.88 x 100 = 13.54
6.5 / 39.86 x 100 = 16.31

IX. Sieve Analysis:

a. Oven Dry Wt. (2hrs., 105°C) Total Sand Fraction
(Soil Retained in 0.045mm Sieve), grams 32.72 ; ***32.64***
b. Wt. Of Fine Plus Very Fine Sand Fraction
(Sand Passing 0.25mm Sieve), grams 10.56; ***10.08***

c. % Fine Plus Very Fine Sand (b / a) 32.27 ; ***30.88***

XI. **Soil Permeability Class Rating** (Based on textural triangle sample analysis) K – 4; ***K – 4***
* Based on a > 50% Fine plus Very Fine Sand, the Soil Permeability Class Rating is adjusted to the next slowest level. (7:9A-6.3(h)2.)

NOTE: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate.***

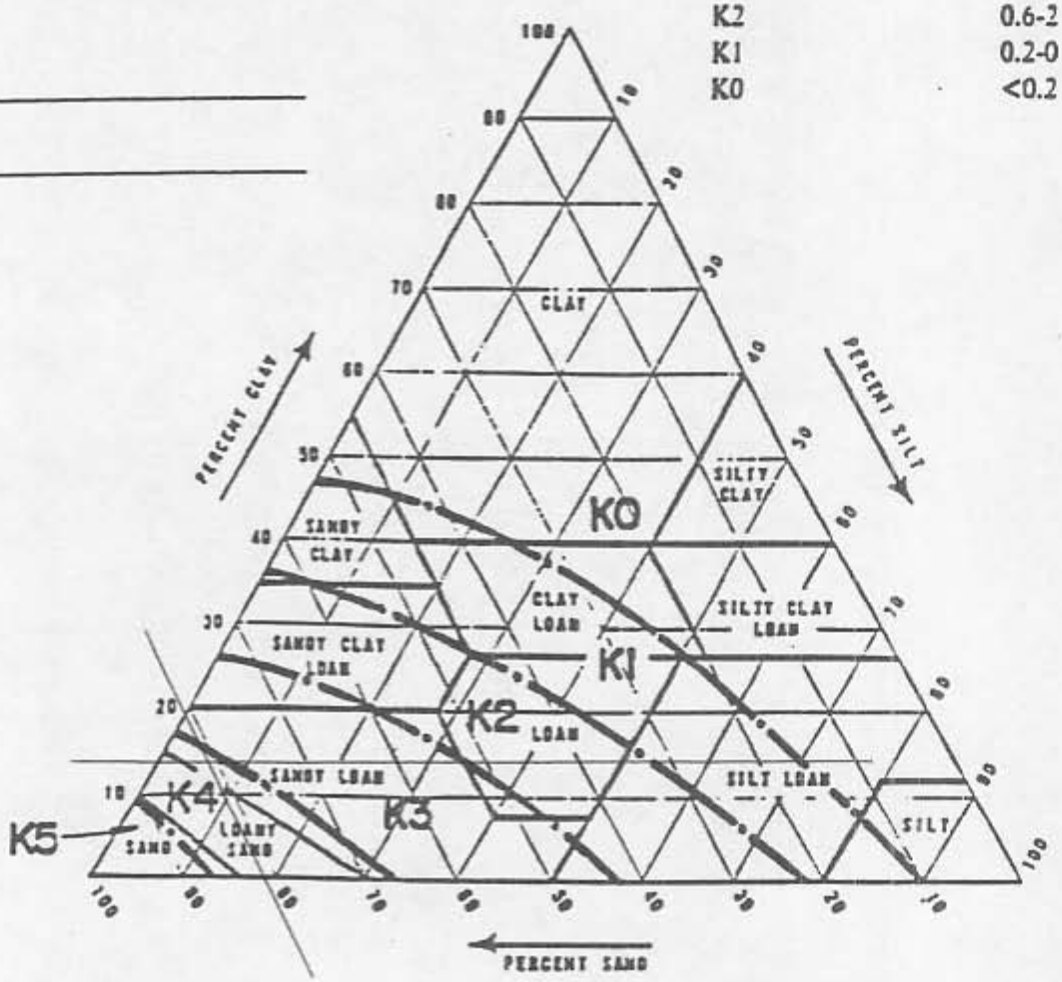
Approved: _____
Thomas Grenci, Laboratory Manager

Sample ID: 28972

Permeability Class (Adjusted)*: K-4

*

Legend: Permeability Class	Permeability (in/hr)
K5	>20
K4	6-20
K3	2-6
K2	0.6-2
K1	0.2-0
K0	<0.2



Adapted from N.N. Hantzsche et al. (1982) Soil Textural Analysis for Onsite Sewage Disposal Evaluation, Proc. 3rd Nat. Symposium on Individual and Small Community Sewage Treatment. Am. Soc. Agric. Eng., St. Joseph, Michigan

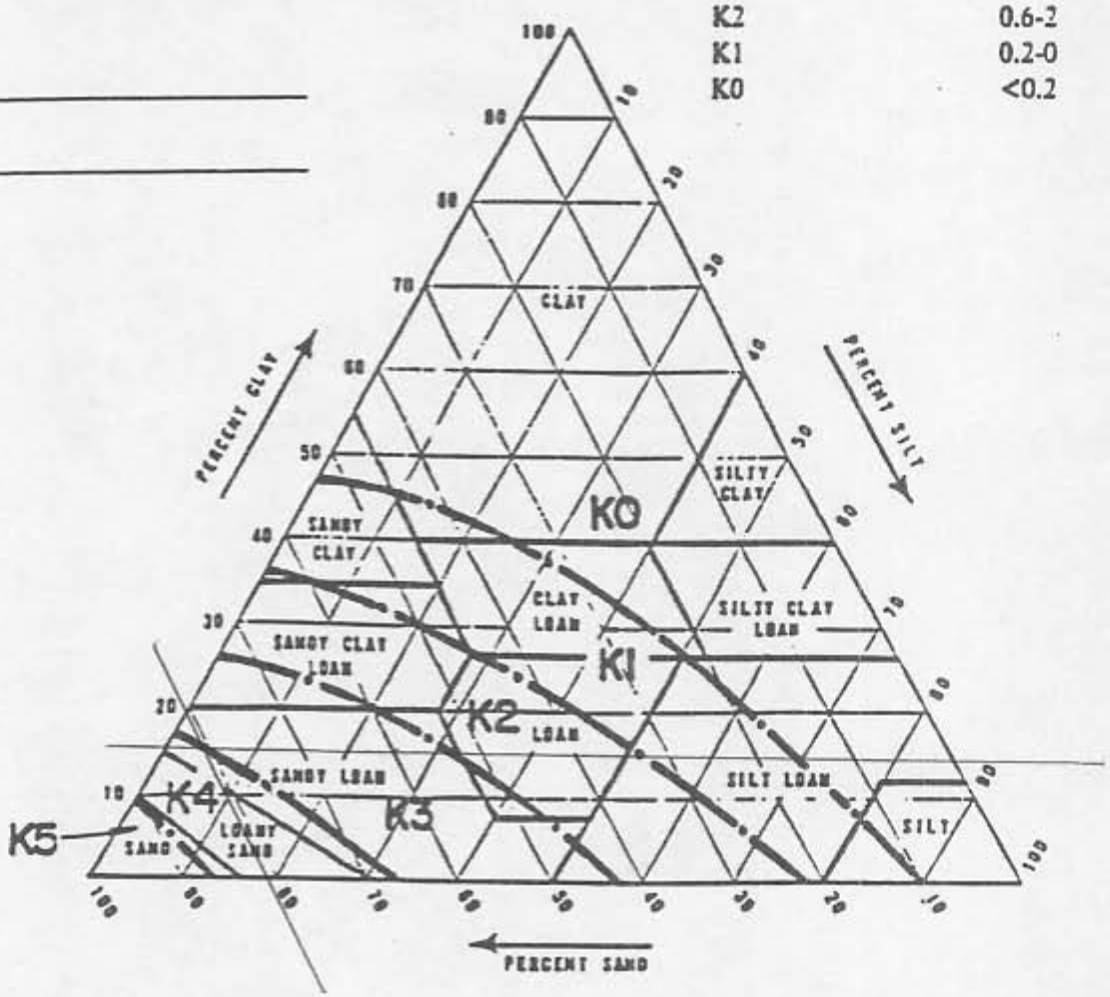
Figure 6. Soil Permeability/Textural Triangle

Sample ID: 28972-Replicate

Permeability Class (Adjusted)*: K-4

*

Permeability Class	Permeability (in/hr)
K5	>20
K4	6-20
K3	2-6
K2	0.6-2
K1	0.2-0
K0	<0.2



Adapted from N.N. Hantzsche et al. (1982) Soil Textural Analysis for Onsite Sewage Disposal Evaluation. Proc. 3rd Nat. Symposium on Individual and Small Community Sewage Treatment. Am. Soc. Agric. Eng., St. Joseph, Michigan

Figure 6. Soil Permeability/Textural Triangle

REPORT OF ANALYSIS

CLIENT	Princeton Hydro, LLC	REPORT DATE	02/15/05
ADDRESS	1105 Laurel Oak Road	JOB # 2073	LOT # 8449
CITY	Voorhees STATE NJ ZIP 08043	PO # ChofCu	INVOICE # 256764
TO ATTN. OF	Mattfew J. Rice	SAMPLE DATE	01/16/05

NJDEP – Soil Permeability Class*

ECM, Inc. Sample #: 28973 **Client Sample ID: TP-2, 3, 4 – S3 Composite**

Sample Chamber	Permeability Rate (in./hr.)	Soil Permeability Class
Sample Chamber 1:	14.7	Rapid
Sample Chamber 2:	11.4	Rapid
Sample Chamber 3:	14.2	Rapid
Sample Chamber 1:	***16.3***	***Rapid***
Sample Chamber 2:	***14.5***	***Rapid***
Sample Chamber 3:	***14.0***	***Rapid***
Sample Chamber 1:	***15.5***	***Rapid***
Sample Chamber 2:	***14.5***	***Rapid***
Sample Chamber 3:	***15.0***	***Rapid***

Note: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate of each test chamber.***

Approved: _____

Thomas Grenci, Laboratory Manager

* Soil permeability Class analysis was in conformance with the NJDEP Division of Water Resources, Water Quality Management Element, Bureau of Ground Water Discharge Permits – Procedure for Tube Permeameter Test.

REPORT OF ANALYSIS

CLIENT	Princeton Hydro, LLC	REPORT DATE	02/15/05
ADDRESS	1105 Laurel Oak Road	JOB # 2073	LOT # 8449
CITY	Voorhees STATE NJ ZIP 08043	PO # ChofCu	INVOICE # 256764
TO ATTN. OF	Mattfew J. Rice	SAMPLE DATE	01/16/05

NJDEP – Soil Permeability Class*

ECM, Inc. Sample #: 28976 **Client Sample ID: TP-2, S1**

Sample Chamber	Permeability Rate (in./hr.)	Soil Permeability Class
Sample Chamber 1:	23.0	Very Rapid
Sample Chamber 2:	18.3	Rapid
Sample Chamber 3:	18.9	Rapid
Sample Chamber 1:	***32.6***	***Very Rapid***
Sample Chamber 2:	***27.1***	***Very Rapid***
Sample Chamber 3:	***29.9***	***Very Rapid***
Sample Chamber 1:	***11.4***	***Rapid***
Sample Chamber 2:	***10.2***	***Rapid***
Sample Chamber 3:	***9.35***	***Rapid***

Note: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate of each test chamber.***

Approved: _____

Thomas Grenci, Laboratory Manager

* Soil permeability Class analysis was in conformance with the NJDEP Division of Water Resources, Water Quality Management Element, Bureau of Ground Water Discharge Permits – Procedure for Tube Permeameter Test.

REPORT OF ANALYSIS

CLIENT	Princeton Hydro, LLC	REPORT DATE	02/15/05
ADDRESS	1105 Laurel Oak Road	JOB # 2073 LOT #	8449
CITY	Voorhees STATE NJ ZIP 08043	PO # ChofCu INVOICE #	256764
TO ATTN. OF	Mattfew J. Rice	SAMPLE DATE	01/16/05

NJDEP – Soil Permeability Class*

ECM, Inc. Sample #: 28977 **Client Sample ID: TP-5**

Sample Chamber	Permeability Rate (in./hr.)	Soil Permeability Class
Sample Chamber 1:	0.0039	Slow
Sample Chamber 2:	0.009	Slow
Sample Chamber 3:	0.528	Moderately Slow
Sample Chamber 4:	0.12	Slow

Note: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate of each test chamber.***

Approved: _____

Thomas Grenci, Laboratory Manager

* Soil permeability Class analysis was in conformance with the NJDEP Division of Water Resources, Water Quality Management Element, Bureau of Ground Water Discharge Permits – Procedure for Tube Permeameter Test.

REPORT OF ANALYSIS

CLIENT	Princeton Hydro, LLC	REPORT DATE	02/15/05
ADDRESS	1105 Laurel Oak Road	JOB # 2073	LOT # 8449
CITY	Voorhees STATE NJ ZIP 08043	PO # ChofCu	INVOICE # 256764
TO ATTN. OF	Mattfew J. Rice	SAMPLE DATE	01/16/05

NJDEP – Soil Permeability Class*

ECM, Inc. Sample #: 28978 **Client Sample ID: TP-2 S2**

Sample Chamber	Permeability Rate (in./hr.)	Soil Permeability Class
Sample Chamber 1:	0.013	Slow
Sample Chamber 2:	0.004	Slow
Sample Chamber 3:	0.076	Slow
Sample Chamber 4:	0.003	Slow

Note: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate of each test chamber.***

Approved: _____

Thomas Grenci, Laboratory Manager

* Soil permeability Class analysis was in conformance with the NJDEP Division of Water Resources, Water Quality Management Element, Bureau of Ground Water Discharge Permits – Procedure for Tube Permeameter Test.

REPORT OF ANALYSIS

CLIENT	Princeton Hydro, LLC	REPORT DATE	02/15/05
ADDRESS	1105 Laurel Oak Road	JOB # 2073	LOT # 8449
CITY	Voorhees STATE NJ ZIP 08043	PO # ChofCu	INVOICE # 256764
TO ATTN. OF	Mattfew J. Rice	SAMPLE DATE	01/16/05

NJDEP – Soil Permeability Class*

ECM, Inc. Sample #: 28979 **Client Sample ID: TP-3 S1**

Sample Chamber	Permeability Rate (in./hr.)	Soil Permeability Class
Sample Chamber 1:	0.003	Slow
Sample Chamber 2:	0.003	Slow
Sample Chamber 3:	0.009	Slow

Note: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate of each test chamber.***

Approved: _____

Thomas Grenci, Laboratory Manager

* Soil permeability Class analysis was in conformance with the NJDEP Division of Water Resources, Water Quality Management Element, Bureau of Ground Water Discharge Permits – Procedure for Tube Permeameter Test.

REPORT OF ANALYSIS

CLIENT	Princeton Hydro, LLC			REPORT DATE	02/15/05
ADDRESS	1105 Laurel Oak Road			JOB # 2073	LOT # 8449
CITY	Voorhees	STATE NJ	ZIP 08043	PO # ChofCu	INVOICE # 256764
TO ATTN. OF	Mattfew J. Rice			SAMPLE DATE	01/16/05

NJDEP – Soil Permeability Class*

ECM, Inc. Sample #: 28980 **Client Sample ID: TP-6 Surface**

Sample Chamber	Permeability Rate (in./hr.)	Soil Permeability Class
Sample Chamber 1:	0.012	Slow
Sample Chamber 2:	0.008	Slow
Sample Chamber 3:	0.015	Slow

Note: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate of each test chamber.***

Approved: _____

Thomas Grenci, Laboratory Manager

* Soil permeability Class analysis was in conformance with the NJDEP Division of Water Resources, Water Quality Management Element, Bureau of Ground Water Discharge Permits – Procedure for Tube Permeameter Test.

REPORT OF ANALYSIS

CLIENT	Princeton Hydro, LLC	REPORT DATE	02/15/05
ADDRESS	1105 Laurel Oak Road	JOB # 2073	LOT # 8449
CITY	Voorhees STATE NJ ZIP 08043	PO # ChofCu	INVOICE # 256764
TO ATTN. OF	Mattfew J. Rice	SAMPLE DATE	01/16/05

NJDEP – Soil Permeability Class*

ECM, Inc. Sample #: 28981 **Client Sample ID: TP-6 Sand**

Sample Chamber	Permeability Rate (in./hr.)	Soil Permeability Class
Sample Chamber 1:	2.2	Moderately Rapid
Sample Chamber 2:	1.6	Moderate
Sample Chamber 3:	1.3	Moderate
Sample Chamber 1:	***3.6***	***Moderately Rapid***
Sample Chamber 2:	***3.3***	***Moderately Rapid***
Sample Chamber 3:	***3.2***	***Moderately Rapid***
Sample Chamber 1:	***5.2***	***Moderately Rapid***
Sample Chamber 2:	***5.2***	***Moderately Rapid***
Sample Chamber 3:	***4.7***	***Moderately Rapid***

Note: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate of each test chamber.***

Approved: _____

Thomas Grenci, Laboratory Manager

* Soil permeability Class analysis was in conformance with the NJDEP Division of Water Resources, Water Quality Management Element, Bureau of Ground Water Discharge Permits – Procedure for Tube Permeameter Test.

REPORT OF ANALYSIS

CLIENT	Princeton Hydro, LLC	REPORT DATE	02/15/05
ADDRESS	1105 Laurel Oak Road	JOB # 2073	LOT # 8449
CITY	Voorhees STATE NJ ZIP 08043	PO # ChofCu	INVOICE # 256764
TO ATTN. OF	Mattfew J. Rice	SAMPLE DATE	01/16/05

NJDEP – Soil Permeability Class*

ECM, Inc. Sample #: 28982 **Client Sample ID: TP-6**

Sample Chamber	Permeability Rate (in./hr.)	Soil Permeability Class
Sample Chamber 1:	0.005	Slow
Sample Chamber 2:	0.004	Slow
Sample Chamber 3:	0.010	Slow

Note: Results in plain type reflect the first analysis; ***Results in Bold Italic reflect the replicate of each test chamber.***

Approved: _____

Thomas Grenci, Laboratory Manager

* Soil permeability Class analysis was in conformance with the NJDEP Division of Water Resources, Water Quality Management Element, Bureau of Ground Water Discharge Permits – Procedure for Tube Permeameter Test.

Calculations for Piezometer Readings:

General equation for Hydraulic Conductivity:

$$K = \left(\frac{A}{FDt}\right) \ln\left(\frac{h1}{h2}\right)$$

Where:
A = area of the standpipe
F = dimensionless shape factor
t = time for required change in head
D = standpipe diameter
h = height of water

Modified equation for measurements taken at Basin No. 1:

$\left(\frac{A}{FD}\right) * 3600 * 12 = 3078.981$ Where A = 0.049ft; F=2.75; D=0.25'; 3600sec/hr; 12 in/ft

$$K = 3078.981 \left(\frac{1}{t}\right) \ln\left(\frac{h1}{h2}\right)$$

For PZ - 3

Test #1 t = 675 s, h1 = 9.97 ft, h2 = 0.10 ft
K = 21.47 in/hr

Test #2 t = 615 s, h1 = 9.9 ft, h2 = 0.10 ft
K = 23.04 in/hr

For PZ - 4

Test #1 t = 720 s, h1 = 9.81 ft, h2 = 0.14 ft
K = 18.17 in/hr

Test #2 t = 480 s, h1 = 9.81 ft, h2 = 0.51 ft
K = 18.63 in/hr

Test #3 t = 570 s, h1 = 9.81, h2 = 0.31
K = 18.33 in/hr

Calculations for Piezometer Readings:

General equation for Hydraulic Conductivity:

$$K = \left(\frac{A}{FDt}\right) \ln\left(\frac{h1}{h2}\right)$$

Where:
A = area of the standpipe
F = dimensionless shape factor
t = time for required change in head
D = standpipe diameter
h = height of water

Modified equation for measurements taken at Basin No. 1:

$\left(\frac{A}{FD}\right) = 0.0713$ Where A = 0.049ft; F=2.75; D=0.25'

$$K = 0.0713 \left(\frac{1}{t}\right) \ln\left(\frac{h1}{h2}\right)$$

For PZ – 5

Test #1 t = 0.4167 hr, h1 = 7.17 ft, h2 = 3.47 ft
K = 0.12 in/hr

Test #2 t = 0.4167 hr, h1 = 7.17 ft, h2 = 3.56 ft
K = 0.12 in/hr

APPENDIX G – USDA SOIL TEXTURAL CLASSIFICATIONS

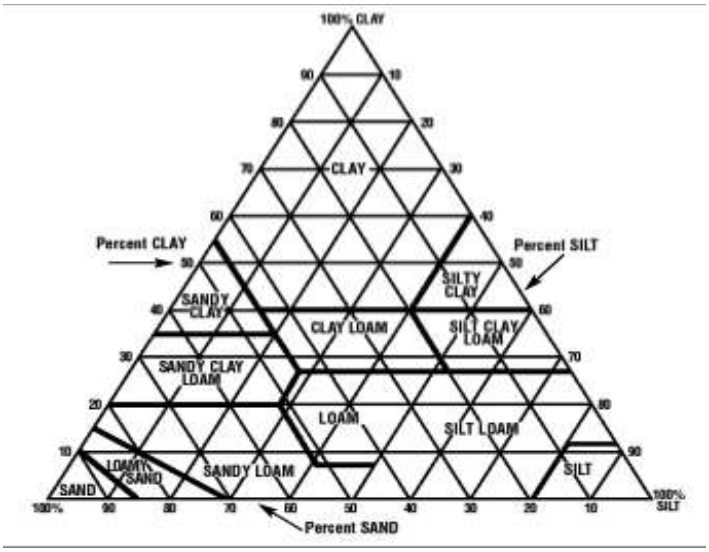


Table I: Soil separates and their diameter ranges

Soil Separate	Diameter (mm)	Visual Size Comparison of Maximum Size
Sand	**2.00 to 0.05**	
Very coarse	2.00 to 1.00	House key thickness
Coarse	1.00 to 0.50	Small pinhead
Medium	0.50 to 0.25	Sugar or salt crystals
Fine	0.25 to 0.10	Thickness of book page
Very fine	0.10 to 0.05	Invisible to naked eye
Silt	**0.05 to 0.002**	Visible under light microscope
Coarse	0.05 to 0.002	
Medium	0.02 to 0.005	
Fine	0.005 to 0.002	
Clay	**<0.002**	Visible with an electron microscope
Coarse	0.002 to 0.0002	
Fine	<0.0002	

Table II: General soil texture groups

General texture group terms	Texture classes
Sandy soil materials:	
Coarse-textured	Sands (coarse sand, sand, fine sand, very fine sand). Loamy sands (loamy coarse sand, loamy sand, loamy fine sand, and loamy very fine sand.)
Loamy soil materials:	
Moderately coarse-textured	Coarse sandy loam, sandy loam, fine sandy loam.
Medium-textured	Very fine sandy loam, loam, silt loam, silt.
Moderately fine-textured	Clay loam, sandy clay loam, silty clay loam.
Clayey soils:	
Fine-textured	Sandy clay, silty clay, clay.

APPENDIX H -
LIMITATIONS

Limitations

1. The test pit explorations were located in the field by Princeton Hydro, LLC using a Trimble Pro XRS Global Positioning System (GPS) survey equipment. Elevations of each test pit were determined using a site level measuring relatively from a known elevation from the provided original design drawings.

2. The stratification lines shown on each subsurface log represent an approximate boundary between soil types. As with any natural system the transition between soil types are gradual.

3. Field logs were prepared for each exploration location by a field engineer. The field log contains factual information and interpretation of the soil conditions between samples locations.

4. The conclusions and recommendations discussed within this report are based in part upon the data obtained from the test pits as part of this investigation, including interpretation of the field logs. The nature and extent of variations between the individual exploration locations may not become apparent until construction proceeds. If variations are disclosed during construction, it will be necessary to reevaluate the recommendations of this report.

5. Water level readings have been made in the explorations at times and under conditions stated on the individual subsurface logs. These data have been reviewed and interpretations made in the body of this report. However, it must be noted that fluctuations in the level of groundwater may occur due to variations in time of year, rainfall, temperature, and other factors at the time measurements were made.

6. Unless specifically indicated to the contrary within this report, the scope of our services was limited only to investigation and evaluation of the infiltrative aspects of the basins, and did not include any consideration of structural aspects of the basins or potential contamination by hazardous or regulated materials.

7. The observations, conclusions, and recommendations contained in this report are based upon the applicable standards of our profession at the time the report was prepared for the exclusive use of the client for specific application tot he property referenced in the submittal letter. No other warranty, expressed or implied, is made.

8. This report must not be utilized as the technical specifications for construction, as it was prepared for preliminary design purposes only. This document alone may not be sufficient to prepare an accurate bid. Contractors utilizing the information in the report should do so with the express understanding that its scope is limited to design considerations. Prospective bidders should obtain the owner's permission to perform whatever additional explorations or studies they deem necessary to prepare their bid in an accurate manner.

9. A qualified geotechnical engineer must be retained to provide continuous on-site observation during earthwork operations and sub-grade preparation. This will serve to ensure compliance with the design concepts and to allow changes in the event the conditions differ from those anticipated prior to the start of construction.

10. Information provided herein is the result of testing for areas explicitly accessible at the time of the investigation. Areas not accessed for this investigation do not apply to the conclusions and recommendations included in this report.

APPENDIX I - REFERENCES

References

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