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January 5, 1999

Project No. 97-1734

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New York Power Authority
123 Main Street
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TRANSMITTAL
REPORT
SOUTH ACCESS ROAD SLIDE AREA EVALUATION
BLENHEIM-GILBOA PUMPED STORAGE PROJECT
NEW YORK POWER AUTHORITY
FERC PROJECT NO. 2685-NY

Dear Mr. Lee:

Transmitted herewith are ten copies of the above mentioned Report. We are also submitting copies of the report to the other two members of the Board of Consultants - Professor A. J. Hendron and Mr. T.S. Lee.

If you have any questions or require any additional information, please contact the undersigned.

Very truly yours,
Paul C. Rizzo Associates

Jeffrey M. Bair
Project Supervisor

JMB/dha
Enclosure

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REPORT

SOUTH ACCESS ROAD SLIDE AREA EVALUATION
BLENHEIM-GILBOA PUMPED STORAGE POWER PROJECT
NEW YORK POWER AUTHORITY
FERC PROJECT NO. 2685-NY
JANUARY 5, 1998

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1.0 INTRODUCTION

The purpose of this report is to provide the New York Power Authority (NYPA) with a description of Paul C. Rizzo Associates' geotechnical engineering investigation of the landslide along the South Access Road, (South Access Road Slide Area) at the Blenheim-Gilboa Pumped Storage Power Project. This work was completed in accordance with the Revised Scope of Work dated September 15, 1997, additional Field Work memorandum dated October 5, 1997, and Revised Cost Estimate, dated November 14, 1997.

According to an aerial infrared image obtained by NYPA (Plate 1-1), we believe that the main Transmission Lines exiting the Project are located on a massive ancient landslide that traverses the South Access Road (sometimes referred to as the Lower Access Road). We suspect the age of the original slide pre-dates construction of the Project, but it was probably inactive until the construction of the Access Road and Transmission Lines and the filling of the Lower Reservoir in 1973. There is evidence in the Project files that re-activated movement began shortly after construction, with practically continuous movement for the past 25 years. Remediation since that date has consisted of drainage relief and localized toe berm construction. It is our view that the magnitude of the slide may not have been fully appreciated until recent remote imagery became available. Hence, previous remediation efforts, though properly directed, have not corrected the problem because of its magnitude.

This notion was, to a limited degree, recognized in 1979 by NYPA's outside design engineers, but no action was taken.

The focus of this 1997-1998 effort is to develop a complete understanding of the problem and develop potential conceptual remedial measures that will arrest the slide on a permanent basis. The effort also includes an assessment of the general nature, timing, and possible consequences of a failure prior to the remediation. The consequences are particularly critical if a massive slide would, in addition to disrupting transmission service and Project access, propagate a failure or major damage to the Dam and Gate Structure impounding the Lower Reservoir. Our analysis, discussed in context, indicates that this is highly unlikely, but nevertheless, it is a consideration to be addressed.

The geologic setting and the history of slides in the area of the Project are discussed in Section 2.0. The field investigation completed as part of this investigation is discussed in Section 3.0. Section 4.0 presents the results of the laboratory-testing program and Section 5.0 discusses the results of our stability and stabilization analyses. Section 6.0 presents construction topics related with the stabilization procedures. Section 7.0 discusses the consequences associated with a postulated mass slope failure. Finally, our conclusions are presented in Section 8.0.

2.0 GEOLOGIC SETTING

The Blenheim-Gilboa Pump Storage Project, and specifically the South Access Road Slide Area, is located in the Catskill Mountains of the Appalachian Plateau Physiographic Province as shown on Plate 2-1. This area is glaciated and is characterized by rugged topography with steep mountains and narrow valleys. Elevations commonly reach 2,000 feet above mean sea level (ft., MSL) with relief of 1,000 feet or more. The elevation of the Lower Reservoir is approximately 900 ft., MSL while the elevation of the Upper Reservoir is approximately 2,000 ft., MSL.

The discussion of the surficial and bedrock geology in this section has been modified from New York State Museum/Geological Survey's Education Leaflet Number 28 (1991) and Geological Highway Map (1990). Additional information was obtained from previous Safety Inspection Reports completed for the Project over the last 20 years.

2.1 SURFICIAL GEOLOGY

The surficial geology at the site is primarily related to the glacial history of the Catskill Mountains, as indicated by the formations illustrated on Plate 2-1. In this area, mountain glaciers commonly merged with continental ice sheets. To further complicate the surficial geology, large lakes often formed in front of the glaciers as they retreated. This resulted in deltaic (sands and gravels) and lacustrine (clays and silts) sediments being deposited with glacial sediments in the site area.

Four major intervals of glaciation reportedly occurred during the Pleistocene Epoch (which occurred from 10,000 to 2,000,000 years ago), often characterized by multiple advances and retreats of ice. The most recent ice sheet advance was the Laurentide, which occurred during the late part of the Wisconsian Stage (Woodfordian Substage) approximately 8,000 to 15,000 years ago. This glacial advancement destroyed most of the evidence left by earlier glaciers.

Both the thickness of soil deposits and the depth to bedrock are highly variable at the site. Drilling activities at the site indicate thick sequences of glacial till deposits and thinner interbedded lacustrine (clay) layers which overlie the bedrock. Thin varved clay layers (ten feet or less) are interpreted to be the potential failing layers beneath the South Access Road Slide Area. These units are characterized as gray to reddish gray, varved clays with red silt laminations. The clay unit is very thin to absent uphill (east of) the Upper Access Road, but it ranges from 2 to 15 feet thick near the South Access Road. Previous investigations have shown this clay layer to be of uniform thickness and dipping at about 12 degrees toward the lower reservoir.

It is believed that there are at least three possible explanations for the geometry and dip of the lacustrine clay unit which likely results from its depositional history:

- Scenario 1- The clay unit was deposited as flat lying lacustrine sediments in typical fashion. After one or more additional glacial advances/retreats, the clay was overlain by till. During the retreat of an ice sheet, steep erosion of the valley occurred, resulting in both the till and clay units slumping into the valley, leading to the dip of the lacustrine clay unit.
- Scenario 2- The clay unit was deposited in the valley as a wedge shape deposit (see Boggs, 1987 for additional discussion). As a result of the wedge, the clay is absent (or pinches out) at some elevation on the side of the slope, similar to what we observe at the site. This scenario would indicate that the clay unit would be thicker near the axis of the basin.
- Scenario 3- The clay was deposited as subhorizontal lacustrine sediment. This type of deposition may occur subaqueously over a paleoterrace formed before Lake Deposition.

Additional investigation would be required to determine the actual origin of the clay layer, but it is beyond the scope of this investigation and deemed unnecessary.

2.2 BEDROCK GEOLOGY

Rock outcrops exist all around the Project site. The Powerhouse, located immediately north of the South Access Road Slide Area, is founded on rock. Only two borings drilled at the site reached bedrock (Borings RB-3 and RB-5). Boring RB-3 was drilled adjacent to the Upper Access Road (Valenti Road Extension) and encountered bedrock at a depth of 186.5 feet below ground surface (b.g.s.), which corresponds to an elevation of 935.5 ft., MSL.
Boring RB-5 was drilled adjacent to the South Access Road and encountered bedrock at a depth of

85 ft. b.g.s. which corresponds to an elevation of 853 ft., MSL.

The following discussion of the bedrock geology is taken from the literature and previous reports, primarily from NYPA (November 1994). Limited information was obtained from the bedrock encountered in Borings RB-3 and RB-5.

The bedrock geologic units at the site are reported to be the upper to middle Devonian-age Genesee and Hamilton Groups (See Plate 2-2). The youngest exposed member is the Oneonta Formation, which includes the Kaaterskill Sandstone Member. The thickness of the Kaaterskill varies from 200 to 500 feet depending upon the extent of both non-glacial and glacial erosion. It is described as an interbedded sandstone and red shale which formed the cap of the plateau between Brown Mountain (north of the Upper Reservoir) and Reed Mountain (south of the Upper Reservoir). Therefore, the Kaaterskill underlies the entire Upper Reservoir area. It is noted that the bedrock observed in borings RB-3 and RB-5 was described as medium gray, weathered, fractured, fine-grained sandstone to sandy shale.

The Moscow Formation underlies the Oneonta Formation and is composed of approximately 400 to 500 feet of interbedded shale, siltstone, and sandstone. It is reported that the vertical shaft between the Upper Reservoir and the Power Tunnel penetrated the entire thickness of the Moscow Formation. Below the Moscow Formation is the Panther Mountain Formation. The horizontal portion of the Power Tunnel and the Powerhouse are constructed on the Panther Mountain Formation which is described as an interbedded sandstone and shale unit.

3.0 *FIELD INVESTIGATION*

A field investigation was designed and performed from August 1997 to June 1998 to investigate the existence of the suspected landslide and quantify its movement. As part of this investigation, several tasks (including reconnaissance field mapping and drilling/sampling program) were completed. The following is a chronology of the field activities completed for this project:

Date: August 1997
Task Description: Initial Field Mapping (Phase I)
Purpose: Verify the existence of the slide and delineate scarps.

Date: September – October 1997
Task Description: Drilling Phase No. I
Purpose: Gather additional subsurface soil information and drill/install additional inclinometers

Date: November 1997
Task Description: Additional Field Mapping (Phase II)
Purpose: Conduct detailed mapping of the scarps and initial mapping of surface water within scarp zone.

Date: March 1998
Task Description: Borrow Area Evaluation
Purpose: Characterize (and initially quantify) potential borrow areas for materials used for berm construction.

Date: April 1998
Task Description: Additional Field Mapping and Lower Reservoir Test Pits (Phase III)
Purpose: Conduct detailed mapping of the surface water within scarp zone, map the rock face at Borrow Area 6B, and attempt to locate clay unit near the Lower Reservoir.

Date: May – June 1998
Task Description: Drilling Phase No. III – Barge Borings, Lower Reservoir Test Pits, and Quarry Borings.
Purpose: Gather additional subsurface soil information: (1) to locate clay beneath the Lower Reservoir; (2) to locate the clay at the Lower Reservoir shoreline; and (3) to characterize the material above the rock face in borrow Area 6B.

The methods and results of the Borrow Area Evaluation were documents in a separate report (Paul C. Rizzo Associates, March 1998). The methods and results of the additional investigations related to the Borrow Areas (including the Quarry Borings) were included in a separate addendum (Addendum No. 1) to the Borrow Area Evaluation Report.

The objectives of these tasks are restated from planning documents below:

- Map, confirm, and check the ground truth of scarp lines observed on an infrared photograph of the slide area (see Plate 1-1). This effort is particularly critical as it provides the primary evidence of the extent and plan geometry of the slide area, particularly the heel area of the slide.

- Collect sufficient field information to allow for the development of geotechnical cross-sections of the slide area. The sections were used for stability analysis and for development of remediation concepts.

- Obtain undisturbed samples for laboratory strength testing of the material comprising the primary (and possible secondary) failing layers. We believe that shear failure is occurring in a particular varved, gray clay layer and/or a red, varved clay, with the latter occasionally classified as silt or a clay rich in silt. We believe that the varved clay may be a "summer" clay varved rich in silt.

- Install two inclinometers at new locations and one inclinometer to replace one that was sheared (at the location of Inclinometer IC-1). The purpose of replacing IC-1 was to maintain a continuous record of the slope movement to allow for estimates of the level of strain occurring on the failure surface. (Incidentally, we believe that the magnitude of strain to date is well in excess of 5 percent and probably closer to 15 or 20 percent). Also, and by no means less important, the inclinometers allow for monitoring of the slope from a safety perspective.

- Install nine vibrating wire piezometers (and one standpipe) in six boreholes to allow for assessment of the water levels above, within, and below the clays present at the site (and any related possible fluctuations in these zones). Multiple piezometers were installed in a single borehole (at three of the locations) in an attempt to distinguish between aquifers.

Additional objectives:

- Map the location of streams, standing water, and areas of poor drainage within the slide zone in an attempt to design a plan to divert this water away from the slide area.

- Obtain additional information regarding the thickness and orientation of the potential failing clay layer near and beneath the Lower Reservoir to aid in designing an appropriate remediation.

The above-stated objectives have been accomplished with the field investigations conducted at the site as shown in the text above. These investigations consisted of reconnaissance field mapping of the slide area, the excavation of five test pits, and the drilling/sampling of 16 test borings at the locations shown on Plate 3-1 to supplement existing boring logs. Three new inclinometers were installed. Furthermore, a vibrating wire piezometer was installed along side the replacement inclinometer. A total of eight other vibrating wire piezometers (and one standpipe) were installed in the remaining new borings. Additionally, slug testing was performed in four site piezometers (including the two installed during this investigation).

3.1 RECONNAISSANCE FIELD MAPPING OF THE SOUTH ACCESS ROAD SLIDE AREA

Field mapping was conducted in three phases on August 15, 1997 (Phase I), November 19-20, 1997 (Phase II), and April 6-7,1998 (Phase III). Phases I and II were conducted to verify the ground truth of surface features observed on an infrared photograph suggestive of scarp lines and disturbed surfaces in the slide area as well as other features of a landslide-prone area. The purpose of the Phase III was to provide detailed mapping of surface water features which would provide the basis for a drainage plan.

Phase I involved collecting evidence to verify that the suspected landslide actually existed at the site. Phase II involved a more detailed mapping effort of the actual scarp area (or detachment zone) and the initial mapping of surface water features. Phase II involved confirming the actual locations of surface water features identified in Phase III including streams, standing water, and areas of poor drainage. The field mapping was conducted by walking the hillside and observing/photographing relevant and characteristic features.

During Phase I, the upper portion of the slope between the Upper Access Road (Valenti Road Extension - See Plate 3-1) and the "upper detachment zone" was mapped. Next, the lower portion of the slope from the Upper Access Road down to the Lower Reservoir was mapped. This "heel to toe" approach was followed to assure that the lateral extent of the slide would be properly captured and not masked by the vegetation as the work progressed.

During Phase II, work began at the northwest extent of the scarp line, continued east to the top of the slope, south across the top of the hillside, and then west to the bottom of the slope. Stakes were placed along the scarp boundary and marked to allow for surveying the scarp (if it is required in the future). Surface water mapping (within the landslide area) was also completed as part of the second mapping phase. The purpose of the surface water mapping was to provide information for a conceptual design for diverting surface water away from the slide area.

In addition to the scarp lines, there are numerous other surface features available for assessing the extent (or limits) of the landslide area, particularly on both the Upper Access Road and the Lower (or South) Access Road. Photographs of many of these features, plus the scarp lines, are provided below.

Photograph Nos.1 and 2 illustrate the primary scarp lines, which are several hundred feet high, and the secondary scarps, which are about 10 to 20 feet high.

Photograph No. 1 *- View of Steep Zone Believed to be a Large Scarp (Transmission Line East of Valenti Road Extension)*

***Photograph No. 2** - View of Scarp Zone - Approx. 20 ft High (South of the Transmission Line on Valenti Road Extension)*

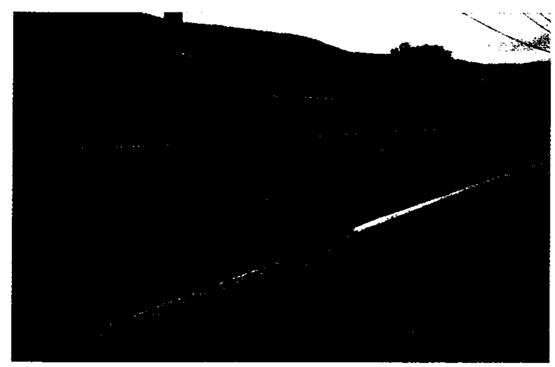
The Upper Access road is vertically disrupted with offsets (interpreted as scarps) that traverse the road at the boundaries of the slide. These are illustrated on Photograph Nos. 3 and 4 below.

***Photograph No. 3** - View of Scarp Line Crossing the Upper Road (South of the Transmission Line, Valenti Road Extension)*

***Photograph No. 4** - View of Scarp Line Crossing the Upper Road (South of the Transmission Line, Valenti Road Extension)*

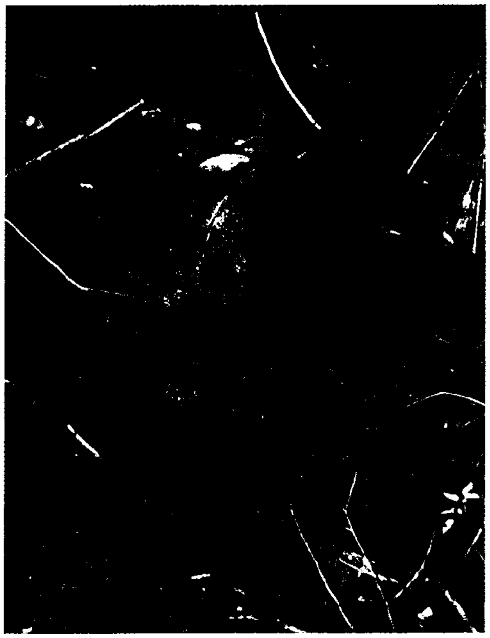
Similarly, vertical offsets associated with the bounding scarps are evident on the Lower Access Road as illustrated below on Photograph Nos. 5 and 6.

***Photograph No. 5** - View of Road Showing Several Cracks/Dips (South Access Road, Southern Portion)*



***Photograph No. 6** - View of Scarp in Road Looking NW (South Access Road South of the Switchyard)*

Surface drainage has been abruptly interrupted along scarp lines as illustrated by the small waterfall (4 to 6 feet high) in hillside streams as shown below on Photograph No. 7.



Photograph No. 7 - *View of Scarp in a Stream with a 6 ft. High Waterfall (Slope East of Valenti Road Extension)*

Additionally, several features were observed within the landslide area and are interpreted to be related to the slide movement

The swampy area on the surface of the slide shown on Photograph No. 8 is suggestive of a "new" interruption of the surface drainage system.

Photograph No. 8 - *View of a Swamp on the Side of the Slope East of the Upper Road (Upper Valenti Road Extension)*

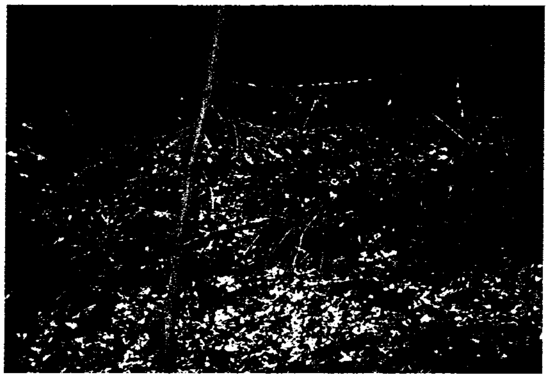
Similarly, the abrupt change in stream alignment and angular meanders as shown on Photograph No. 9 coupled with parallel dry stream channels (approximately 20 to 30 feet apart – Photograph No. 10) are evidence of recent and ongoing movement.

Photograph No. 9 - *View of Meandering Stream within Suspected Slide Area (South Access Road South of the Switchyard)*

Photograph No. 10 - *View of Parallel Dry Stream Beds (South Access Road South of the Switchyard)*

Finally, areas with high densities of overturned trees were observed as illustrated on Photograph Nos. 11 and 12 in the slide area, but not outside the slide area.

Photograph No. 11 - *One of the Several Overturned Trees on the Steep Slope (Heel of Slide Area, East of Valenti Road Extension)*



***Photograph No. 12** - View of a Small Slump at the Base of the Steep Slope (Heel of Slide Area, East of Valenti Road Extension)*

The locations of these features were overlaid onto the infrared image of the site area to confirm the location of the limits of the landslide. For all practical purposes, the interpretation of the infrared photograph was confirmed and enhanced with this field mapping effort. This information was also used to aid in locating the new test borings discussed in the following sections.

During Phase III, surface water mapping within the slide zone began at the north end of Valenti Road Extension (in the area of Photograph No. 8 as shown on Plate 3-1) and proceeded south. The observed surface water features were mapped by walking their entire length both above (to their headwaters) and below the road (often the entire distance to the Lower Reservoir). Areas of standing water or poor drainage were marked with colored flagging for future surveying (if required). Base maps were developed showing the approximate location and extent of the surface water features.

3.2 SUBSURFACE EXPLORATION

As shown on Plate 3-1, a total of 16 borings and five test pits were completed in three phases (1, 2, and 3) during the field investigation conducted by Paul C. Rizzo Associates. The following borings were drilled during the various drilling phases:

- Test Borings RB-1, RB-2, RB-3, RB-3A, RB-4, and RB-5;
- Inclinometes IC-1B, IC-3, and IC-4; and
- Barge Borings BB-1 through BB-7 (in the Lower Reservoir).

Additionally, five test pits (RTP-1, RTP-2, RTP-3, LR-1, and LR-2) were excavated and logged during the subsurface investigation. The purpose of the test pits was to locate the clay layer suspected to be the failing layer.

Section 3.2.1 presents the general description of the drilling and sampling methodology. Sections 3.2.2 through 3.2.4 present discussions of the three drilling phases. The drilling, sampling, and installation of the inclinometers is discussed in Section 3.3.

3.2.1 DRILLING AND SAMPLING METHODOLOGY

Standard Penetration Test (SPT) Samples, undisturbed (Shelby Tube) samples, and HQ wireline core samples were collected during the investigation. Boreholes were advanced using wash rotary or diamond bit coring. Water was used as the drilling fluid in all borings where samples were collected. In boring RB-3A, a bentonite slurry was used. Samples were not collected from Borings RB-1 and RB-3A. These borings were drilled near existing borings for piezometer installation. Sampling and testing of subsurface materials were performed at select locations to confirm previous findings and to obtain additional data to represent the subsurface conditions along the Upper Access Road (Valenti Road Extension) and the South Access Road.

SPT blow counts varied considerably above and below the suspected failing clay layer. Above this layer SPT blow counts ranged from 20 to 50 blows per 6 inches of sample. Below the suspected failing layer blow counts were in excess of 50 and were often higher than 100. During coring activities, sample recovery was improved below the upper clay layer. Boring logs showing blow counts and recoveries are provided in Appendix A. Plate 3-2 provides a drawing showing the Boring Logs.

A total of four undisturbed samples were collected for laboratory shear strength testing. Two were obtained in gray varved clay and one was extracted from a red clay (or silt) zone--with both considered the probable failing materials. The fourth undisturbed sample was obtained in the till material immediately above the suspected failing clay layer. Details about the laboratory testing are provided in Section 4.0.

3.2.2 DRILLING PHASE NO. I

The first phase of drilling at the site was conducted in September and October 1997. During this phase, test Borings RB-1 and RB-2 were completed using wash rotary methods. In addition, two Inclinometers IC-3 and IC-4 were also drilled and installed (discussed in Section 3.3). The locations of these borings are shown on Plate 3-1.

Based on the boring logs from nearby wells, Boring RB-2 was destructively drilled (no samples collected) to a depth of 54 feet below ground surface (ft., b.g.s.) where the collection of SPT samples began at approximate five-foot intervals and continued to a depth of 98 ft., b.g.s. Two vibrating wire piezometers were installed in the borehole at depths of 72 and 96 ft., b.g.s.

Boring RB-1 was drilled based on the results of Boring RB-2 and other nearby wells. Boring RB-1 was destructively drilled (no samples collected) to a depth of 59.8 ft, b.g.s. Again, two vibrating wire piezometers (VWPs) were installed in the borehole at depths of 40.5 and 59 feet, b.g.s. When the piezometers were installed in the boreholes, they were isolated by the use of pelletized bentonite and sand. The boring logs for the test borings are included in Appendix A while the piezometers installation details are presented in Appendix C.

3.2.3 DRILLING PHASE NO. II

Drilling Phase II was conducted in December 1997 through January 1998. During this phase, four additional test borings (RB-3, RB-3A, RB-4, and RB-5) and three test pits (RTP-1 through RTP-3) were completed at the site using HQ wireline coring techniques. The locations of these borings and pits are shown on Plate 3-1.

Boring RB-3 was drilled to a depth of 200.5 ft., b.g.s. with a VWP installed at a depth of 130 ft. Boring RB-3A was destructively drilled (no samples collected) to a depth of 92 ft., b.g.s. where an additional VWP was installed. Boring RB-4 was drilled and sampled to a depth of 158 ft., b.g.s. with a VWP installed at 104.5 ft., b.g.s. Finally, Boring RB-5 was drilled and sampled to 91.5 ft., b.g.s. An open 1¼-inch inside diameter polyvinyl chloride (PVC) standpipe was installed in Boring RB-5. The standpipe consisted of solid PVC casing from the ground surface to a depth of 59.5 feet and a five-foot section of well screen (with 0.02-inch slots) from 59.5 to 64.5 ft., b.g.s.

Drilling encountered cobbles/boulders, till, clay, and sand/gravel layers throughout the unconsolidated portion of the borings. The consolidated (or bedrock) portion of the borings encountered primarily sandstone and shale units of varying thickness. The boring logs for the test borings are included in Appendix A.

At the request of NYPA, three test pits were also excavated during Phase II of drilling program. Test Pits RTP-1 through RTP-3 were excavated northeast of Inclinometer IC-4 near the base of the scarp (or detachment) zone in an attempt to locate the suspected failing clay layer. The test pits were excavated to depths of 17 ft., 16 ft., and 16 ft. b.g.s., respectively. The subsurface materials in these test pits were primarily composed of silty sand and clayey silt with cobbles and large boulders. The clay layer was not found in any of the test pits. The test pit logs are included in Appendix A.

3.2.4 DRILLING PHASE NO. III

The third phase of drilling was conducted during May and June of 1998. Seven test borings (BB-1 through BB-7) were drilled from a barge in the Lower Reservoir during this phase. Additionally, three test borings (RQB-1 through RQB-3) were completed in Borrow Area 6B. The methods and results of the quarry borings are discussed in a separate letter report (Addendum #1 to the Borrow Area Evaluation Report). Prior to commencing with Phase III, two test pits (LR-1 and LR-2) were excavated at the shoreline of the Lower Reservoir on April 6, 1998. These locations are shown on Plate 3-1.

Test Pits LR-1 and LR-2 were excavated to depths of 12.5 ft. and 13 ft., b.g.s., respectively in an attempt to locate the suspected failing clay layer. In Test Pit LR-1, what is believed to be the suspected clay layer (gray with thin red silt seams) was encountered at a depth of 9.2 ft., b.g.s. The clay extended to the bottom of the pit (12.5 ft.) which could not be advanced deeper because water entered the pit and caused sidewall collapse. Above the clay unit, a sandy silt material was encountered. In Test Pit LR-2, another clay layer (gray with no visible silt seams) was encountered from the ground surface to a depth of 6 ft., b.g.s. Beneath the clay layer was a till unit which existed to the total depth of the pit (13 ft.) which was also limited by water entering the pit.

As previously mentioned, seven borings (BB-1 through BB-7) were drilled from a barge in the Lower Reservoir. The depths at which the suspected failing clay layer was encountered and the total depth of these borings are summarized on Table 3.1.

Boring ID	Suspected Failing Clay Zone (ft., b.g.s.)	Total Depth (ft., b.g.s.)
BB-1	10 - 13.5	46.5
BB-2	6 - 20	47.4
BB-3	6 - 42	50
BB-4	12 - 52	54
BB-5	11 - 21.5	52.4
BB-6	12 - 18	40
BB-7	35 - 37 (approximate)	77

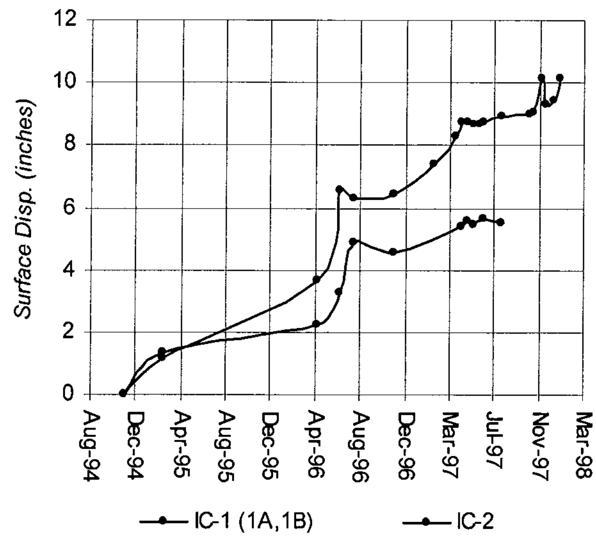
Table 3.1 – Failing Clay Layer Depth

With the exception of Boring BB-7, SPT samples were collected continuously in the borings. Because of time constraints related to the rising water level in the Lower Reservoir at the time of drilling, SPT samples were collected at five-foot intervals in Boring BB-7. Because of this sampling interval, the depth and thickness of the clay layer in Boring BB-7 is approximate. These borings also encountered layers of silt, sand, gravel, cobbles, and boulders of varying thickness.

3.3 REPLACEMENT INCLINOMETERS

Due to past slope movement, all inclinometers installed during previous investigations had sheared off and were inoperable prior to or shortly following the start of this investigation. In order to continue monitoring the slope movement, Paul C. Rizzo Associates installed three inclinometers (IC-1B, IC-3 and IC-4). Two of the inclinometers (IC-3 and IC-4) were installed along Valenti Road Extension. The third inclinometer (IC-1B) was installed to replace IC-1A near tower GF5 1/3. All Inclinometers were anchored in competent material to prevent the bottom of the inclinometer from moving. Inclinometers were constructed of 3.34" OD ABS casing manufactured by ROCTEST. Appendix B shows typical inclinometer installation details. NYPA personnel conducted baseline readings after installation and are continuing to monitor movement.

Figure 3-1 shows inclinometer readings recorded over the last three years. The high rate of movement recorded from April through July of 1996 corresponds to unusually high precipitation during the spring thaw period. Surface movement in this period was recorded at a rate of nearly one inch per month. Inclinometers along Valenti Road Extension are moving less than inclinometer IC-1B and IC-2, which are closer to the South Access Road.



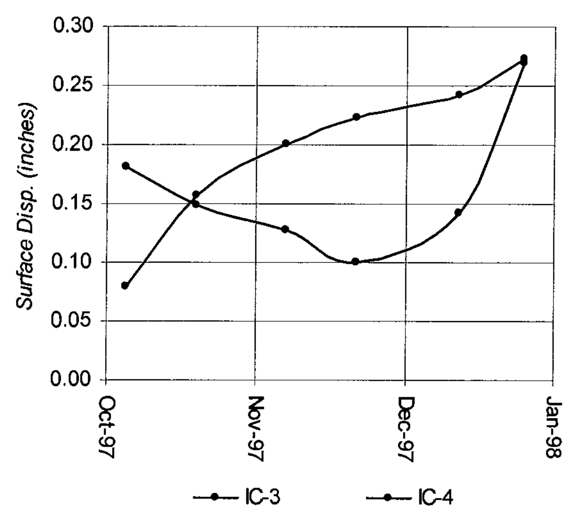


***Figure 3-1** Surface Displacements obtained from Inclinometer Readings*

3.4 PIEZOMETER INSTALLATION

During the site investigation, vibrating wire piezometers and screened PVC standpipe piezometers were installed. Piezometer installation details are shown in Appendix C. In Borings RB-1 and RB-2, both vibrating wires and PVC standpipes were installed. This allowed for slug testing of the lower till layer through the standpipe. After completion of the slug testing, vibrating wire piezometers were placed inside the standpipe for water level measurement. Standpipes were then cut off below ground surface so as not to interfere with mowing activities at the site. NYPA personnel will be responsible for trenching to place piezometer cables below the ground surface.

Piezometers were connected to electronic measurement and control units (MCUs) for data collection. MCUs are fitted with radio link options so that data can be retrieved remotely. Piezometers at RB-3 and RB-3A are not connected to an MCU and must be read manually by NYPA

Piezometer installation details are included in Appendix C.

3.5 SLUG TESTING

Initially, slug tests were conducted to determine the hydraulic conductivity of the failing clay layer. These tests were performed to assess the feasibility of installing a drainage system as part of a potential remediation scheme.

The pore pressure in the failing layers is of vital importance. For this reason, additional vibrating wire piezometers were installed beneath the suspected failing clay layer. Furthermore, additional slug tests were performed to determine the hydraulic conductivity of the materials surrounding the clay.

3.5.1 CLAY HYDRAULIC CONDUCTIVITY

Six of the existing site piezometers (NB-4, NB-6, NB-7, NB-8, NB-10, and NB-13) constructed during previous field investigation, were reportedly screened in the subject clay layer and therefore, were considered candidates for the initial slug testing. However, three of the piezometers were dry (NB-6, NB-7, and NB-8) and one piezometer (NB-10) had an artesian water level (above the ground surface). Piezometer NB-10 is located within 10 feet of the lower reservoir and its water level was measured at 1.33 feet below the top of polyvinyl chloride (PVC) casing. This left only Piezometers NB-4 and NB-13, which were slug tested on September 10-11, 1997.

Slug tests (often called "falling head tests") were conducted by introducing a slug (water or a solid material) of known volume into a well/piezometer casing which raises the water level in the casing. Water levels are then recorded as the water equilibrates (or falls) back to the static level. This method allows only for an order-of-magnitude estimate of the hydraulic conductivity, but this is considered adequate for assessing the feasibility drainage schemes for remediation. A known volume of water was used as the slug in Piezometer NB-4 while a solid PVC slug of known volume was used in Piezometer NB-13. A water slug was used in Piezometer NB-4 because the water level measured in the boring (0.1 foot of water above the bottom of the casing).

The procedures for slug testing in each piezometer proceeded as follows:

Piezometer NB-4:

- The initial water level was measured;
- Distilled water (5 gallons) was rapidly poured into the piezometer casing, and
- The water levels were measured at various time increments (at a high frequency during the beginning of the test and less frequently as the test proceeded) and recorded on Field Data Sheets for 1½ hours

Piezometer NB-13:

- The initial water level was measured;
- A solid PVC slug with a volume of 0.069 ft^3 was lowered into the piezometer thus raising the water level, and
- Water levels were measured at various time increments (at a high frequency during the beginning of the test and less frequently as the test proceeded) and recorded on Field Data Sheets for 1½ hours.

The slug test data were reduced following the procedures for a confined, infinite or semi-infinite depth, anisotropic, incompressible aquifer discussed in Dawson and Istok (1991). Drawdown was plotted versus time on semi-logarithmic scale. The time lag (T_L) was determined from the slope of the graph and a "shape factor (F)" variable was calculated based on a well which fully penetrates the aquifer. These two terms were used to calculate the horizontal hydraulic conductivity (Kr) of the aquifer. The

5.0 STABILITY ANALYSIS AND SLOPE STABILIZATION

The stability of the slope adjacent to the South Access Road was analyzed at three critical cross sections as shown in plan on Plate 3-1. A rapid drawdown case was considered, whereby the water level in the Lower Reservoir was dropped 40 feet over a 2-day period. Stabilization analysis was performed for berm placement at the toe of the slide. This remediation alternative presents a cost-effective method of stopping or reducing the movement of the potential toe slides in slope beneath the Transmission Lines.

5.1 DEVELOPMENT OF STABILITY MODEL

We have developed geotechnical cross sections for three representative maximum sections through the slope. Section BB is a refined expansion of the one provided by NYPA, and Sections CC and DD were developed during the current investigation. These sections are presented on Plate 5-1. Ground surface elevations were interpreted from a topographic map of the site provided by NYPA.

The cross sections extend from the Lower Reservoir up the slope to a point past the visible scarps. Slip surfaces correspond to three groups:

- Slip surfaces failing along the upper varved clay layers.
- Slip surfaces failing along the lower varved clay layers.
- Toe slip surfaces, detaching closer to the Lower Reservoir and joining the clay layers at the toe.

Piezometers installed at the site were used to determine the position of the phreatic surface. Although readings have not been continuous, we consider them to be adequate for assessing the position of the phreatic surface. As previously discussed, the water level is considerably higher, up to 70 feet above the failing surfaces in the upper portions of the slope.

5.2 ALTERNATE STABILIZATION SCHEMES

Given that the slope is moving and is a threat to the integrity of the Transmission Lines, we considered four alternate stabilization schemes. The design objective is to achieve a 15% increase in the FS for the toe slip surfaces.

- Excavation of the driving mass from the heel of the slope;
- Installation of a permanent dewatering and/or drainage system to increase the effective stress on the failure surface;
- Construction of one or multiple tied-back walls to increase the effective stress on the failure surface; and
- Construction of a massive toe berm along the shoreline of the Lower Reservoir.

5.2.1 HEEL EXCAVATION

Excavation of the driving mass from the heel of the slope (in conjunction with berm construction) is a conventional, brute force means of stabilizing the slide area. Because of the remote nature of the site and the expected cost to haul fill material to the site, excavation of the driving mass of the slide for berm construction was considered. This approach has a double effect in that the driving mass is being reduced while the resisting mass is being simultaneously increased.

Due to the environmental impact of mass excavation of a wooded hillside immediately across from a State park and because more suitable fill material is expected to be available on or near the Project site, this option, specifically the heel excavation, was dismissed as unacceptable.

5.2.2 DRAINAGE

We considered three possible drainage schemes including inclined (nearly horizontal) drains, a drainage gallery, and vertical deep wells. All drainage schemes must consider the density of the till and its permeability, discussed in Section 3 of this report.

A review of the cross-sections presented in Plate 5-1 indicates that inclined gravity drains penetrating the failing clay layers would have to be 500 to 600 feet in length. Using an estimated horizontal drilling cost of $40 per foot, each drain would cost $20,000. To lower the piezometric line below El. 860, approximately 100 drains would be required along the slide area to achieve the maximum benefit possible. The total cost would be roughly two million dollars. The lack of effectiveness to increase the Factor of Safety, combined with the maintenance cost of the drains and a total life span on the order of 20 years suggests that this option is not cost-effective.

We also considered a horizontal drainage gallery (designed for gravity flow) at an elevation near the South Access Road as a means of dropping the phreatic surface. This approach would definitely require upward inclined and vertical drains drilled from the gallery up through the lower varved clay so as to drop the water pressure between the two clay layers. Also, because of the large plan area of the sliding mass, conduits off the main gallery may also be necessary. We dismissed this alternate on the basis of perceived capital cost, maintenance cost, and effectiveness.

Vertical wells drilled from pads on the slope with a permanent pumping system were considered as an alternate to horizontal drains or a drainage gallery. We dismissed this alternate based on perceived long-term maintenance cost associated with maintaining the wells and operating the pumps.

During the field investigation and mapping activities discussed in Section 3, surface water throughout the slide area was mapped. Several streams and one swamp are evident within the slide area. Diverting the surface water away from the slide area would have a beneficial effect on the stability of the slope. To that end, a drainage ditch (likely running along the Upper Access Road) should be constructed in conjunction with any of the remedial options considered. This ditch will intercept the visible streams, drain adjacent swamp areas and intercept much of the water from rainfall and snowmelt. Rainfall and snow melt stand as possible triggers of the landslide.

5.2.3 *MULTIPLE TIED-BACK WALLS*

Construction of one or multiple tied-back walls along the slope is another means of increasing the effective stress on the failure surface that we have used successfully on large slide areas. This concept involves the use of tied-back walls with anchors extending to a stable zone behind the failure surface. A tied-back wall is typically used when space constraints preclude using a toe berm or drainage. If space permits, the construction of a berm of adequate size is usually more cost-effective.

Preliminary estimates indicate that the cost to construct a tied-back wall would be approximately $50 per square foot. The dimensions of a single wall along the lower access road would be on the order of 50 feet deep by 2,000 feet long for a total cost of five million dollars. As with a dewatering system, a tied-back wall would require maintenance and monitoring over time. Although a stabilization analysis of this concept has not been executed, we suspect that multiple tied-back walls may be required to fully arrest the slope movement. Consequently, we dismissed this alternate on the basis of capital cost and cash flow.

5.2.4 *MASSIVE TOE BERM*

A massive toe berm of free draining material (sand, gravel and/or rock) constructed along the shoreline of the Lower Reservoir in the area of the slide is viewed as the most cost-effective solution. The primary advantages of this alternative are as follows.

- Suitable material for at least part of the berm can be made available from sources on the NYPA property within a short distance from the slide area.
- Once constructed, a berm requires minimal maintenance and its life span will be commensurate with or exceed that of the Power Project.
- A sizable berm can be constructed without having to relocate either the Lower Access Road or the Transmission Lines.

We recommend the toe berm be the alternate of choice for slide stabilization. The following analyses were developed to verify its stabilizing benefits.

5.2.5 *BERM AND KEY TRENCH*

This alternative consists of placing the berm over an excavated key trench. The purpose of the trench is to remove the weak material and replace it with free draining rock soil. This option involves a similar amount of earth movement as the massive toe berm, and represents a better technical approach to the problem. Unfortunately, its implementation will result in higher construction costs due to the following inconveniences:

- The depth and thickness of the clay in the area of a majority of the Lower Reservoir shoreline is such that excavation would be very challenging and costly.

- Excavation will involve modifications to the operating schedule of the Blenheim-Gilboa Pumped-Storage Power Project, which will translate in additional costs for NYPA.

Alternative	Estimated Capital Cost (millions)	Technical Merit	Miscellaneous
Drainage	$3 - $5	Does not achieve minimum FS requirements due to the presence of the lower reservoir.	Easy to implement. High maintenance cost. Not very good past experience at BG.
Tie-Back Walls	$6-$8	Not evaluated	Usually less economic than a stabilization berm. High maintenance costs.
Massive Toe Berm	$5-$7	Achieves minimum FS objectives.	Challenging construction Low maintenance cost Very good past experience at BG.
Key Trench and Berm	$5-$7	Achieves minimum FS objectives. Interrupts failing layers.	Challenging construction. Only feasible at north end. Involves modifications to the operating schedule at BG.

Table 5.1 *Remediation alternative comparison*

5.2.6 ALTERNATIVE COMPARISON

Table 5.1 presents a comparison chart in terms of the advantages and disadvantages of the several remediation schemes.

The massive toe berm is chosen as the remediation scheme. Of the alternatives that achieve the minimum technical requirements, it is the one with lowest capital costs. Maintenance costs will be minimized and successful past experience with localized berms is a proof of its effectiveness. Drainage is an economic alternative that deserves later attention to support stabilization efforts.

Note that the costs presented in Table 5.1 are for comparison purposes only. A detailed cost estimate was outside of the scope of this investigation. Total construction costs for any option are probably higher than those presented in Table 5.1

5.3 RECOMMENDED STABILIZATION SCHEME

Plate 5-1 shows the arrangement of a proposed berm for sections BB and CC. Section DD is located where a toe berm was previously constructed. The berm shown at Sections BB and CC is intended to tie with the existing berm at Section DD.

5.4 BACK CALCULATION OF RESIDUAL SHEAR STRENGTH

The slope has been moving at a slow rate for over 24 years. As such, stability models at each section should yield a factor of safety of 1.0 for the critical surface, thus allowing for a back calculation of the residual shear strength. This was accomplished by assuming a factor of safety of 1.0 in the stability analysis and back calculating, on a trial and error basis, the apparent existing shear strength.

The back-calculated residual strength provides a good initial estimation of the strength of the failing clay layer at its current strain. The best estimate of the current residual strength of the varved clays on this basis is about 14.5 degrees. The back-calculation process was executed for those slip surfaces that have been best identified. For example, the upper varved clay at Section BB is a representative slip surface of the landslide process, and was used to back calculate the residual shear strength.

The back-calculated value is higher than the 13.5 degree obtained from the laboratory testing. We expect this to be associated with the fact that the strain level has not yet, but is very close, to reaching an asymptotic value over the entire failing surface.

The till material at the site is highly competent, with SPT blow counts in excess of 100 in many cases, especially in the tills located below the clay layers. Based on laboratory data collected by others, a friction angle of 45 degrees has been used in the back calculations. This value was verified using a correlation between the shear strength of granular soils and SPT blow counts developed by Peck et. al., (1974).

5.5 STABILITY AND SLOPE STABILIZATION

The results of two analysis processes are presented together on Plate 5-1. Stability analysis of existing conditions corresponds to all cases noted as "Current." Stabilization analysis refers to stability calculations resulting from the berm remediation.

The design objective with the berm is to achieve a 15% increase in the FS for the toe slip surfaces, which otherwise negatively affect the integrity of the Transmission Lines and the Lower Access Road.

5.5.1 DATA INTERPRETATION

The following interpretative parameters were used for all calculations:

- The shear strength of the materials follows a conventional Mohr-Coulomb failure envelope.
- The interpreted values for the different materials are presented in Table 5.2.

Material	Cohesion (psf)	Friction Angle (deg)	Unit Weight (pcf)
1	0	14	120-125
2	250	45	150
3	150	35	150
4	0	40	130

1. Clays (varved, gray, gray-red)
2. Tills
3. Tills (between clay failing layers)
4. Assumed berm material parameters

***Table 5.2** Shear strength parameters used for stability and stabilization calculations*

- These values (except for the berm materials) are representative according to the laboratory results and previous back calculations.
- Rapid drawdown is analyzed with the high water level (HWL) condition, neglecting the surface water pressures induced by the Lower Reservoir at the toe of the slide. Strictly speaking, a second stage calculation should be performed, using both peak and residual strength envelopes to account for a decrease in the shear strength friction angle of the soil when it reaches undrained conditions. The change is minimal and for practical purposes it may be neglected. Furthermore, cohesion is neglected and using a model with only residual friction angle is satisfactory and conservative.
- The slip surfaces are determined based on the subsurface exploration, a general understanding of the landslide process, and computer searches performed in the stability analysis.
- The zones between the surface and the failure (clay layers) is considered to be a detachment zone, that does not contribute to sliding resistance.

These interpretations were applied consistently to all sections, slip surfaces and cases of analysis.

5.5.2 RESULTS

The "Current Condition" Factors of Safety (FS) and the effects of the berm are shown on Plate 5-1. All assumptions were applied consistently to all cases. This is of key importance, since changing one assumption can change the value of the FS. The assumptions are designed to reflect the problem as close as possible, with the natural limitations associated with this type of phenomenon.

The values of the FS should be viewed in relative terms between the different cases and not as absolute. This is appropriate as the objective of the stabilization analysis is to analyze the influence of building a multistage berm along the toe of the slide. Our results indicate that the berm will arrest or reduce the toe slides for the rapid drawdown case. However, the ancient slide process could continue but at a much slower and acceptable rate. These facts are reflected in Table 5.3 as percentage increase in the Factor of Safety with the proposed remediation (Rapid Drawdown Case).

		Factor of Safety		
Section	Surface	Current	Berm	% Increase
	A-L	1.07	1.10	2.8
BB	A-U	0.96	1.00	4.2
	Toe	0.92	1.09	18.5
	A-L	-	-	-
CC	A-U	0.98	1.03	5.1
	Toe	0.93	1.08	16.1
A-L: Ancient slide on lower clay A-U: Ancient slide on upper clay Toe: Potential toe slides				

Table 5.3 *Percent Increase in Factor of Safety*

The analysis indicates that the stability of the portion of the slope that has the greater impact on the Transmission Line integrity will be stabilized with a major toe berm.

Finally, these results indicate that the behavior of groundwater, and the overall stability (or the lack thereof) of the lower portion of the slope are impacted by the operation of the Lower Reservoir. The operation of the Lower Reservoir has been somewhat of a trigger to instability

.

6.0 BERM CONSTRUCTION TOPICS

This chapter provides NYPA with guidelines and recommendations to be considered during the detail design and construction of the multistage berm. This chapter describes construction issues such as:

- Rock Fill Volumes
- Rock Fill Material Characteristics
- Underwater Construction Considerations

6.1 ROCK FILL VOLUMES

A plan view of the berm that satisfies the FS increase requirements described in the previous section is shown in Plate 6-1. The approximate total rock volume is 240,000 yd^3.

6.2 ROCK FILL MATERIAL CHARACTERISTICS

The material to be used for the berm should fall with the band of grain distribution curves shown on Figure 6-1.

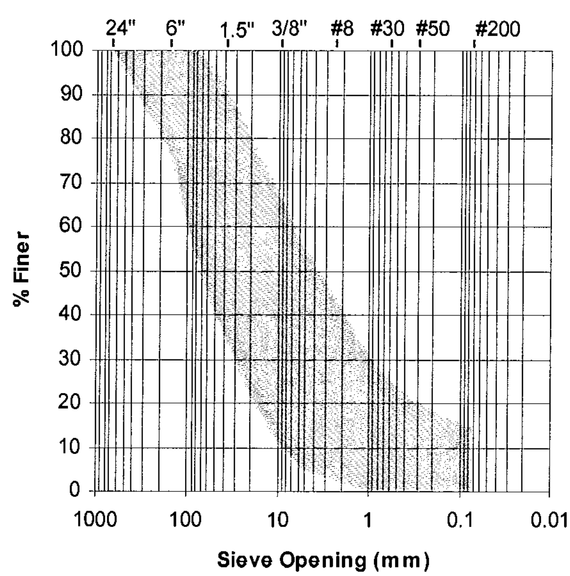


Figure 6-1 *Grain size and grain size distribution*

A good gradation of the rock fill will allow reduction of voids and increase the weight and effectiveness of the berm.

6.3 UNDERWATER CONSTRUCTION CONSIDERATIONS

The berm construction will involve the placement of the free draining material under water along the shoreline of the Lower Reservoir. We believe that there are four major considerations to be dealt with during the detail phase of the work listed as follows:

- Placement of material in the Lower Reservoir will require permits from the State of New York and the US Army Corps of Engineers

- The placement of the material will by dumping, and therefore, the material must be free draining. Compaction efforts will be limited and silt control will be necessary.

- Small toe slides associated with the rapid placement of material must be considered in the design and counter acted to be sure that they do not propagate in to larger slides.

6.3.1 PERMITTING

The construction of the berm will require a joint application permit submitted to the New York Department of Environmental Conservation and the US Army Corps of Engineers. Also, the Federal Energy Regulatory Commission (FERC) will have to be notified and we suspect that they will want to exert approval rights. In addition, depending on the sources of material for the berms, a mining permit may be required form the State. Finally, we understand that the project must go through the NYPA's in-house code compliance group.

All of this permitting effort will involve time, perhaps as much as one year. This should be undertaken in parallel with the detailed design using the drawings and information in this report.

6.3.2 SHORT TERM STABILITY-CONSTRUCTION CASE

Relatively soft material exists at the toe that, if not properly dealt with, may cause excessive settlement or propagate a toe failure.

An undrained construction case was analyzed to consider short-term stability (Section BB). The assigned strength parameters for the clay under the berm are 590 psf (4.1 psi) and no friction angle. The FS obtained for the rapid drawdown case is presented in Table 6.1. The results indicate that short-term stability for the toe failure surface is assured with a FS of 1.26. In fact, using undrained strength parameters accounts for an increase in stability, but this is only for a short time after construction.

Section	Surface	Berm
BB	A-L	1.13
	A-U	1.04
	Toe	1.26

Table 6.1 *Short Term Stability*

Although short-term stability is appropriate, some sections have thicker clay layers and considerable settlement is expected (approximately 2 to 3 feet). Construction should be performed starting at the toe of the berm in order to avoid "small" local slides.

6.3.3 PLACEMENT OF BERM MATERIAL

The placement of the berm material will be by end dumping from trucks, possibly on to a wet surface and possibly underwater. We suggest that this work be coordinated in detail with the operation of the Lower Reservoir. For example, the lower most portion of the berm should be started at the end of filling the Upper Reservoir, say on Sunday night or early Monday morning. We recommend that the material be free draining with grain size characteristics as shown above on Figure 6-1, with the coarser material being placed initially on the existing foundation material.

The primary goal of the berm is to provide weight at the toe, and therefore, compaction is not as critical as it might be in a structural fill. However, compaction must be adequate such that deformation of the slope is immediately taken up by the berm without significant deformation of the berm material itself. Hence, we recommend, that the 40 foot thick berm be placed in 10-4 foot thick lifts, with each lift being compacted with a minimum of 4 passes of a heavy dozer (D9 or D10 equivalent). Each lift should be visually inspected to ensure relatively uniform rock gradation distribution within the specified bounds and with relatively large void spaces.

7.0 CONSEQUENCE ANALYSIS

To develop a cost-effective remediation scheme, one must consider the cost and consequences associated with a "do nothing" strategy. To that end, this section presents the likely result if the current slide is allowed to run its natural course. Also, this section outlines possible failure modes, which may occur during construction of remedial measures. Through careful pre-construction planning and quality assurance during construction, the possibility of failure during construction can be minimized.

In the event of a failure, specifically a non-construction type of failure, we currently envision three major consequences to be addressed:

- Failure and loss of the capability to transmit energy from the plant and from north to south. It is our understanding that NYPA is considering such options as re-routing the Transmission Lines, the cost of a shutdown, etc.

- Failure and loss of the South Access Road, perhaps with personnel on the road at the time of the failure. Our analysis indicates that movement will continue at a slow rate, and not at a catastrophic rate which would preclude preventive action. Nevertheless, we understand that NYPA is considering various alternatives.

- Landslide blockage of Schoharie Creek and the Lower Reservoir, which causes a surge wave to migrate toward the Dam and Gate Structure and a rapid increase in the water level in the Lower Reservoir.

The following discussion and analysis generally dismisses the possibility of a surge wave developing in the Lower Reservoir. However, continuous movement and/or a toe slide could cause partial blockage of Schoharie Creek. Indeed, the consequences would not be catastrophic.

7.1 LITERATURE REVIEW

An extensive review of geotechnical literature was conducted to develop a better understanding of the record of catastrophic landslides with respect to their impact on reservoirs and impounding dams. A great deal has been written in the literature and there is a tendency toward sensationalism by the media, especially in cases such as the failure at Lake Vaiont in Italy. Consequently, we deem it appropriate to place the slide conditions at Blenheim-Gilboa in proper context.

7.1.1 LANDSLIDE TYPES AND PROCESSES

Landslides are generally classified according to type of material and type of movement. The material generally falls into three categories - bedrock, coarse soil and fine soil. Landslide movement falls into several categories as follows:

- **Fall** Detachment of a soil or rock from a steep slope;

- **Topple** Forward rotation of a mass of soil or rock out of a slope;

- **Slide** Movement of a soil or rock mass along thin failure plane;

- **Spread** A layer of weaker material overlain by significant overburden pressure; and

- **Flow** Movement similar to a viscous liquid, with continuously changing shear surfaces.

The geometry and geotechnical characteristics of the slope determine the type of movement which, in turn, provides an indication of the rate of failure. That is, a rock fall occurs much more rapidly than a clay or sand flow. Another useful term in defining a landslide is the travel angle. The travel angle is the overall angle from the horizontal of the gross slide area.

7.1.2 CHARACTERIZATION OF THE SOUTH ACCESS ROAD SLIDE AREA

The South Access Road Slide area is characterized as an active earth slide. The rate of movement over the last several years is on the order of one to two inches per year and the total volume of the slide is estimated to range from to 5 million cubic yards of earth. The travel angle is the weighted average of the slope of the potential failure plane. For the South Access Road Slide Area, the travel angle of 11.6 degrees is in the same range as current estimated shearing resistance of the failing clay layer at 10 to 13.5 degrees.

7.1.3 CASE HISTORY REVIEW

Several case histories of past landslides were reviewed in an attempt to estimate the natural coarse of the South Access Slide. In terms of dam safety consequences, the Vaiont Landslide, occurring in Italy in 1963, is probably the most significant.

7.1.3.1 Vaiont Landslide

A large rock mass over 200 million cubic yards moving along a thin clay layer within the rock mass fell into Lake Vaiont. The rock slide reached speeds up of to 90 feet per second and produced a several hundred foot high waves, which overtopped and partially failed the concrete arch Vaiont Dam. The new Vaiont Reservoir and particularly high rainfalls are believed to have triggered the slide. The movement was monitored and recorded for a number of years before this catastrophic slide occurred. Movements preceding the mass slide failure were slow and predictable and were not expected to increase. Prior to the slide, the existence of the thin clay layers was not known.

The travel angle of the rock slide was about 23 degrees and the best estimate of the residual strength of the failing clay layer is about 12 degrees. The strength of the clay layer was determined through laboratory testing conducted after the slide had occurred.

The volume of the slide was large enough to completely fill the cross-section of the valley in front of the slide. This large volume of rapidly displaced water initiated the 300-foot high wave that overtopped the Vaiont Dam.

7.1.3.2 Mayunmarca Landslide

This landslide blockage on the Mantaro River occurred in Peru in 1974. The total volume of rock mass was estimated at 3,000 million cubic yards. Rock fell nearly 5,000 feet at velocities approaching 120 feet per second. The rising water behind the new dam resulted in more landslides. The dam was breached and the rapid drawdown resulted in still more landslides. Flood waves of up to 100 feet high were reported.

7.1.3.3 Fort Henry and Ardclooney Embankments

A rapid drawdown triggered four landslides in a very low permeability boulder clay. A drawdown of four feet in ten days triggered the movement. However, no significant wave was generated in the impounded reservoir.

Case histories reviewed for this evaluation involving a significant surge wave were caused by rock slides. We found no case histories in which a soil landslide generated a wave. The way in which the slide energy is transmitted to a body of water is different for a soil or rock mass. In a soil slide, a portion of the energy of the slide causes deformation of the soil mass, thereby reducing the energy available for wave generation. Also, rock slopes are typically much steeper than soil slopes. The slope angle directly impacts on the energy of the slide.

7.2 MASS SLIDE POTENTIAL

The potential for a rapid, mass slide is governed by several factors. First, there must be some event which causes a rapid loss of resistance along a possible failure surface. Second, the geometry of the slope must be able to generate enough downward inertia to cause a rapid acceleration of the sliding mass. Other natural events, which could cause a massive slope failure, such as earthquakes or volcanic eruptions, are beyond the scope of this report and are not addressed herein.

7.2.1 TRIGGERING MECHANISMS

The trigger for a landslide is generally an external stimulus such as intense rainfall, earthquake shaking, volcanic eruption, storm wave, rapid snow melt, sudden reservoir drawdown or rapid stream erosion--any of which can cause a near immediate response in the form of a landslide by rapidly reducing the strength of the slope materials. Several triggers applicable to the South Access Road Slide are discussed in the sections that follow.

7.2.1.1 *Intense Rainfall/Rapid Snow Melt*

An intense rainfall event with or without rapid snow melt provides a continuous supply of moisture to the soil and may raise the pore-water pressure along the failure surface. The increased pore-water pressure can cause a decrease in the effective stress along a particular failure plane, resulting in significantly lower resisting forces. The magnitude of pore-water pressure increase is dependent on the permeability of the soil.

At the South Access Road, the failure surface passes through a red clay layer (Plate 5-1). A significant rainfall/snow melt event causing a rise in the phreatic surface above the failure surface would likely cause water to flow along the interface between the clay and the underlying till material. The flow of ground water, in addition to the reduction of effective stress along the failure surface, may be enough to initiate a slope movement. This failure mode is partially supported by the inclinometer data which may indicate increased movement during periods of high rainfall.

7.2.1.2 *Sudden Reservoir Drawdown*

A change in the phreatic surface due to sudden drawdown of a reservoir can cause significant slope movement. The mechanics causing the movement are very similar to those described above for the rainfall/snow melt scenario. These failures usually follow a significant flood, in which rapidly receding floodwaters can cause failure of earth embankment dams.

The Blenheim-Gilboa Pumped Storage Power Project operates in such a manner where both the Lower and Upper Reservoirs fluctuate dramatically on a weekly schedule. The Lower Reservoir level drops 40 feet from Friday evening to Monday morning as the Upper Reservoir is filled.

As documented in the case histories listed above and in many others presented in the literature, drawdowns of much less than 40 feet have caused slope failure. However, the drop in Lower Reservoir elevation is small when compared to the overall height of the slope (400 feet). Further, preliminary stability analysis indicates that the rise in pore water pressure in the clay during a rapid drawdown event is not a major factor contributing to the instability of a large wedge failure surface. On the other hand, it has a clear negative effect on the stability of the lower most portion of the slope, including the Transmission Line Towers nearest the South Access Road.

More specifically, a change in the water surface elevation may reduce the FS by as much as 0.1, enough to trigger a slide. Also, a possible reduction in the shear strength of the clay may result from the flow of water between the till and clay during a rapid drawdown event.

7.2.2 DYNAMIC MODELING

A dynamic model of the South Access Road Slide was created to develop an estimate of the maximum velocity during a postulated massive slide in order to determine if large inertia forces could develop. The main parameters that determine the maximum velocity are:

- The travel angle of the sliding mass;
- The residual shear strength of the failing material;
- The postulated acceleration distribution; and
- The total horizontal displacement of the sliding mass.

As stated above, the travel angle calculated for the South Access Road Slide is approximately 11.6 degrees. The basic components of the dynamic model are highlighted in Figure 6-1.

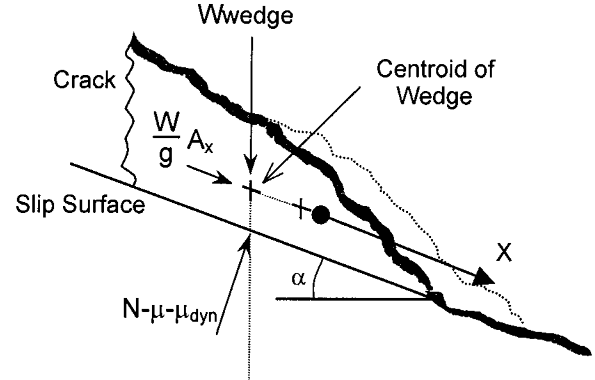


Figure 7-1 *Free Body Diagram of Sliding Mass*

Following the development of the dynamic model and the results for the South Access Road Slide, the model was applied to the Vaiont Slide as a calibration check. The calculated velocity has been compared to the values published in the literature. This comparison provides added confidence in the validity of the modeling assumptions.

7.2.2.1 *Residual Shear Strength*

The best-estimate of the current strength of the failing clay layer is in the range of 10 to 15 degrees. We used 14 degrees in our analysis

7.2.2.2 *Acceleration Versus Time Distribution*

The initial acceleration is based on the geometry of the problem and the shearing resistance. The initial acceleration based on a free-body diagram of the sliding mass is:

$$a_o = g\left(\sin\alpha + \frac{A_x}{g} - \cos\alpha \tan\phi' + \frac{\mu+\mu_{dyn}}{W}\tan\phi'\right)$$

where:

a_o	=	Initial acceleration of moving mass
g	=	Acceleration of gravity
α	=	Failure surface slope anngle
A_x	=	Earthquake acceleration component, acting parallel to the sliding surface
ϕ'	=	Effective residual shear strength
μ	=	Static pore pressure converted to a force
μ_{dyn}	=	Dynamic pore pressure, if applicable, converted to a force
W	=	Weight of the moving slide block

The most conservative acceleration versus time distribution would involve constant acceleration versus time with a linearly increasing velocity distribution over the entire distance of movement. The block would continuously accelerate and come to an abrupt halt at the end of the movement, usually in contact with a body of water or an impeding slope such as the opposite wall of a valley. The acceleration and velocity distribution will have the shape shown in Figure 7-2.

A slightly less conservative and more realistic acceleration distribution was selected for our dynamic model. The acceleration is postulated to begin at a maximum and decrease linearly to zero at the maximum distance of movement. We believe this distribution is closer to reality from the perspective that a moving mass tends toward a more stable position as it moves, thus decelerating (Figure 7-3).

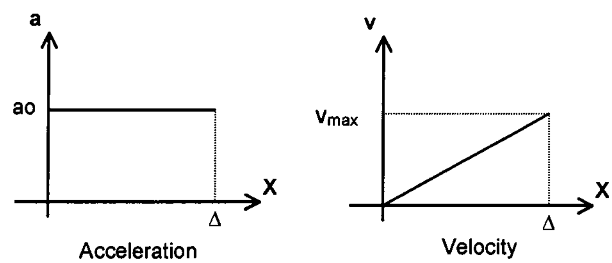


***Figure 7-2** Constant acceleration distribution*

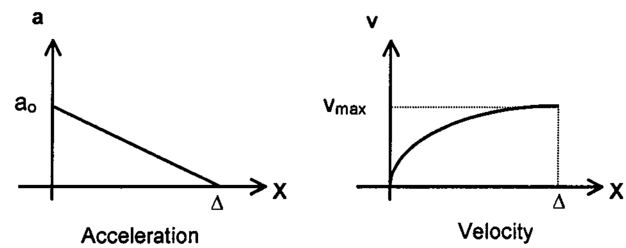


***Figure 7-3** Linear acceleration distribution*

This also results in a block with increasing velocity and coming to an abrupt halt at the end of movement. The velocity distribution is parabolic shaped with a sharp drop at the end of movement. Eliminating the earthquake component of the acceleration function, and estimating μ to be a fraction of W, say F W, the maximum velocity as a function of distance is calculated from the function given below:

$$v = \sqrt{g\,\Delta\,(\sin\alpha - \cos\alpha\tan\phi' + F\tan\phi')}$$

7.2.2.3 *Maximum Slide Distance*

The maximum slide distance Δ was estimated from the cross section and a postulated post-failure surface. The travel angle at the top of the slope is 15 degrees. At about mid-way down the slope the travel angle drops to 7 degrees. Once the majority of the sliding mass is on the 7-degree slope, the movement will slow considerably. Further, the bottom of the slope and the Lower Reservoir bottom are also limiting factors in determining the slide distance. A maximum slide distance of 200 feet was conservatively chosen for the analysis.

7.2.2.4 Maximum Velocity

Table 7-1 shows the maximum slide velocity based on the residual strength of the failed material and the distance of the slide for the Vaiont Slide and Blenheim-Gilboa.

	ϕ' (°)	α (°)	F	Δ (m)	V_{max} (m/s)
B-G	14	11.6	0.17	61	0.0
Vaiont	12	23	0.25	300	27.0

Table 7.1 Estimated Maximum Velocity

The model presented above applies to rock slope failures (i.e., rigid body motion) and is presented herein only to give an indication of upper bound velocity of a slide movement. The deformation of a soil mass as it moves will reduce significantly the maximum velocity. Laboratory test results indicate that the current failure surface is very near to its residual value and a drop in residual strength of even two degrees seems unlikely.

7.2.2.5 Wave Generation Potential

At the low elevation of the Lower Reservoir, there is adequate freeboard to eliminate possible dam safety consequences because of a landslide induced flood wave. This analysis focuses on a landslide that occurs when the Lower Reservoir is at its maximum pool elevation, say on a Friday after a full week of generation.

Three parameters required to estimate the magnitude of a potential flood wave are:

- The estimated maximum velocity of the slide as discussed in the preceding section.
- The cross-sectional area of the sliding mass as estimated from the scarp lines shown on Plate 3-1 and the infrared image presented as Plate 1-1. We believe the slide area is approximately 2,000 feet wide.
- The volume of the portion of the slide that actually displaces water.

In this case, the majority of the volume of a postulated slide will not reach the Lower Reservoir. We estimate that maximum volume of slide material that would encroach on the reservoir would be 400,000 cubic yards. This is to be compared with the volume of water at the maximum level of the Lower Reservoir or about 25 million cubic yards. Thus the slide material would in the worst case be about 1.5 percent of the total volume of the Lower Reservoir. If the slide were to occur when the level of the Lower Reservoir is at a minimum, no wave would be generated because the backwater limit of the reservoir is down stream of the Slide Area.

8.0 CONCLUSIONS

- The South Access Road Slide Area is in an area of glacial tills and lacustrine clays known to have landslide problems. Slides have occurred elsewhere in the area, including the Project site, in the past. This particular slide began (or more probably reactivated movement) upon initial filling of the lower reservoir over 24 years ago.

- The South Access Road Slide Area involves two types of slides requiring consideration. The first is a massive ancient slide that extends from the Lower Reservoir up slope approximately 2000 feet. The heel of this slide is an old scarp line approximately 300 feet high.

- The second consideration is a slide at the toe of the massive slide mentioned above. This toe slide is currently impacting the Transmission Lines at specific towers.

- The failure surface for the two slides coalesce at the toe and the failing material is a red varved clay with silt seams. We estimate the strain, after at least 25 years of movement, to be in the range of 15 to 20 percent, leading to a back calculated governing residual strength angle on the order of 14.5 degrees.

- Laboratory strength test results (slow direct shear tests to strains of 20 percent) indicate a residual strength in the range of 10 to 13.5 degrees.

- Remediation measures undertaken in the past, while properly directed, did not account for the massive nature of the sliding mass. The measures were simply not broad enough in scope to fully arrest the slide.

- We conclude that a rapid catastrophic failure, with dam safety implications of the type that occurred at Lake Vaiont, is highly unlikely and should not be the focus of remediation efforts. A surge wave is highly unlikely. Stream blockage associated with a slide would be of a magnitude that NYPA can deal with on a relatively rapid basis.

- The integrity of the Transmission Line and the integrity of the South Access Road are in jeopardy. But here again, we conclude that a rapid, catastrophic failure is unlikely. This conclusion stems from the fact that the drained residual strength friction angle (a) as measured in the laboratory and (b) back calculated from the field conditions is in the range of 10 to 14.5 degrees. This is about equal to the slope angle of the failure surface.

- Movement at rates of the same order as experienced in the recent past will continue, and if remediation is not undertaken on a timely basis, failure will occur and disruption of transmission and access should be anticipated.

- A berm placed along the toe of the slide is the recommended method for stabilizing the slide.

- The stabilization effort should include (1) construction of a ditch along the Upper Access Road and (2) other similar measures to drain swamp areas and to intercept run-off before it enters the groundwater.

Respectfully submitted,
Paul C. Rizzo Associates

Paul C. Rizzo
President

Jeffrey Bair
Project Supervisor

Mathew J. Valentine
Senior Project Geologist

Antonio Fernandez
Project Engineer

PCR/JMB/MJV/AF/dha

PLATES

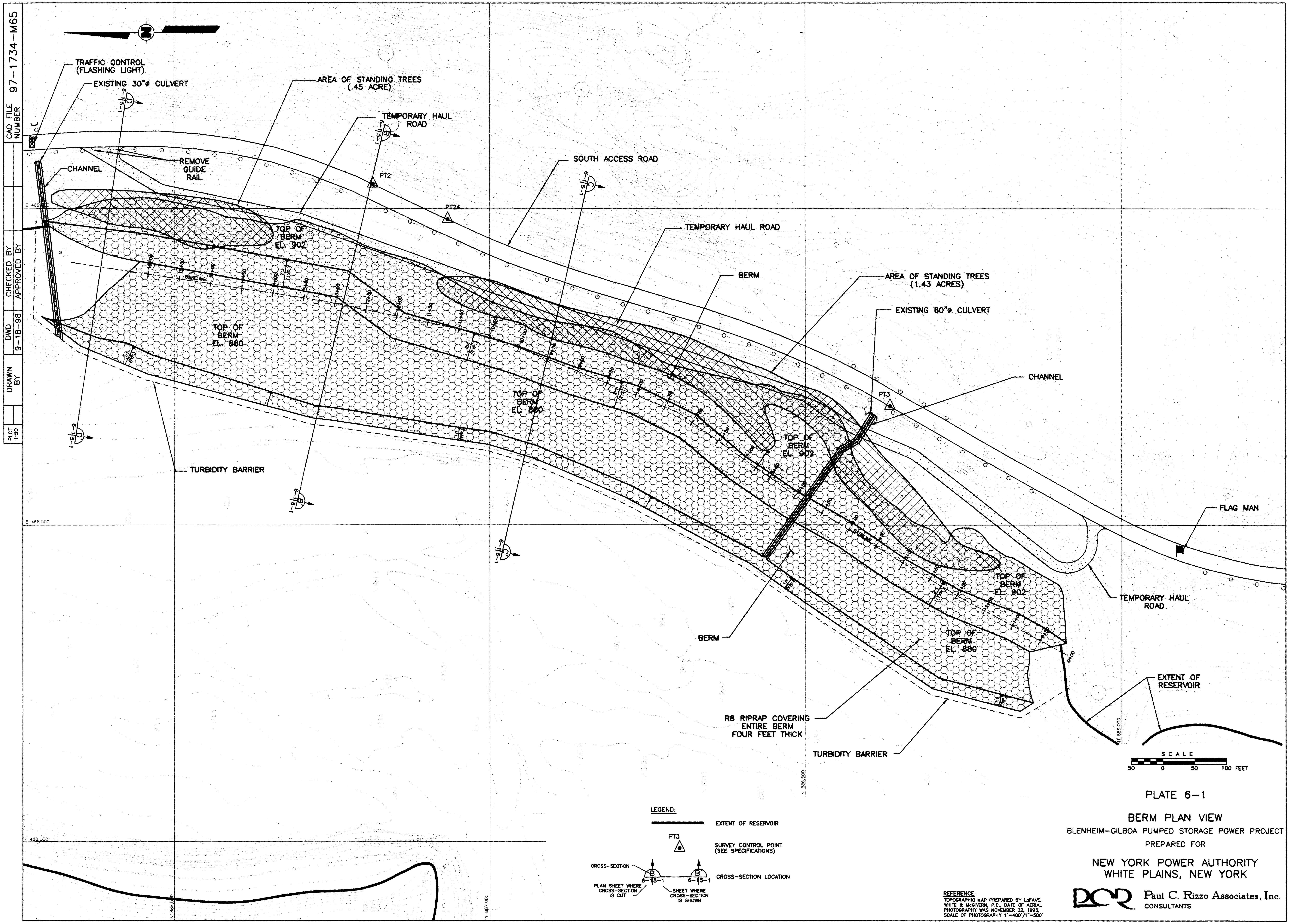


PLATE 6–1

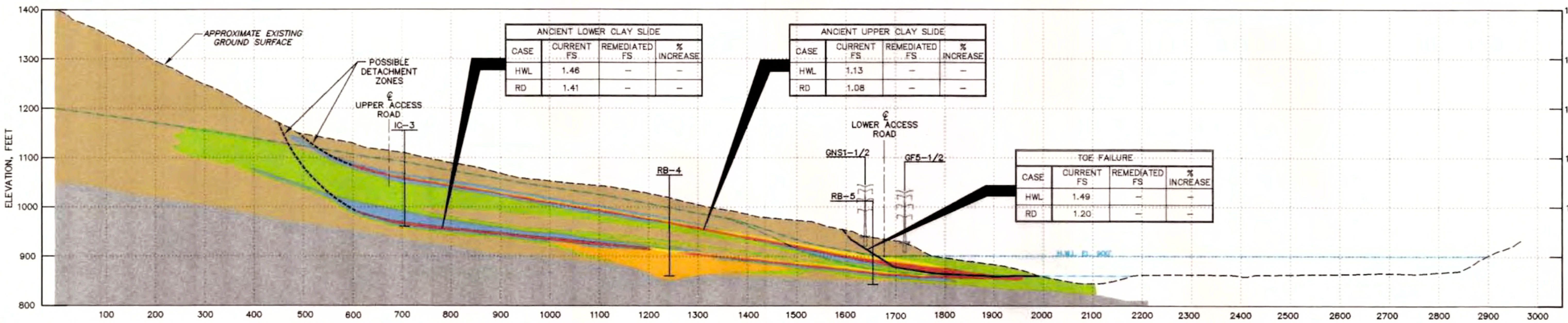
BERM PLAN VIEW

BLENHEIM–GILBOA PUMPED STORAGE POWER PROJECT

PREPARED FOR

NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

Paul C. Rizzo Associates, Inc.
CONSULTANTS

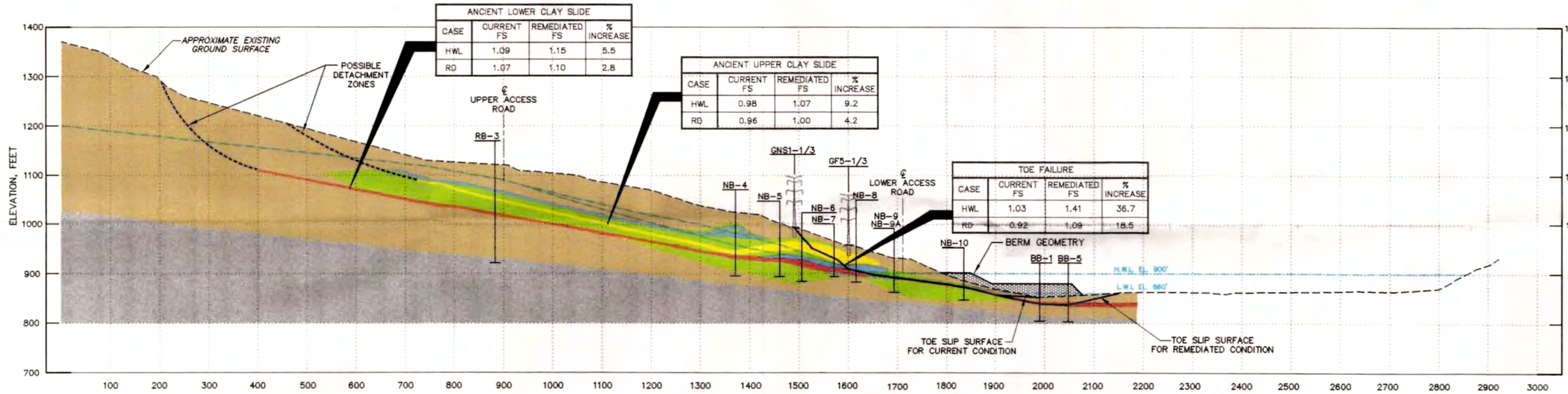


ANCIENT LOWER CLAY SLIDE			
CASE	CURRENT FS	REMEDIATED FS	% INCREASE
HWL	1.46	–	–
RD	1.41	–	–

ANCIENT UPPER CLAY SLIDE			
CASE	CURRENT FS	REMEDIATED FS	% INCREASE
HWL	1.13	–	–
RD	1.08	–	–

TOE FAILURE			
CASE	CURRENT FS	REMEDIATED FS	% INCREASE
HWL	1.49	–	–
RD	1.20	–	–

SECTION D
3-1,6-1 | 5-1

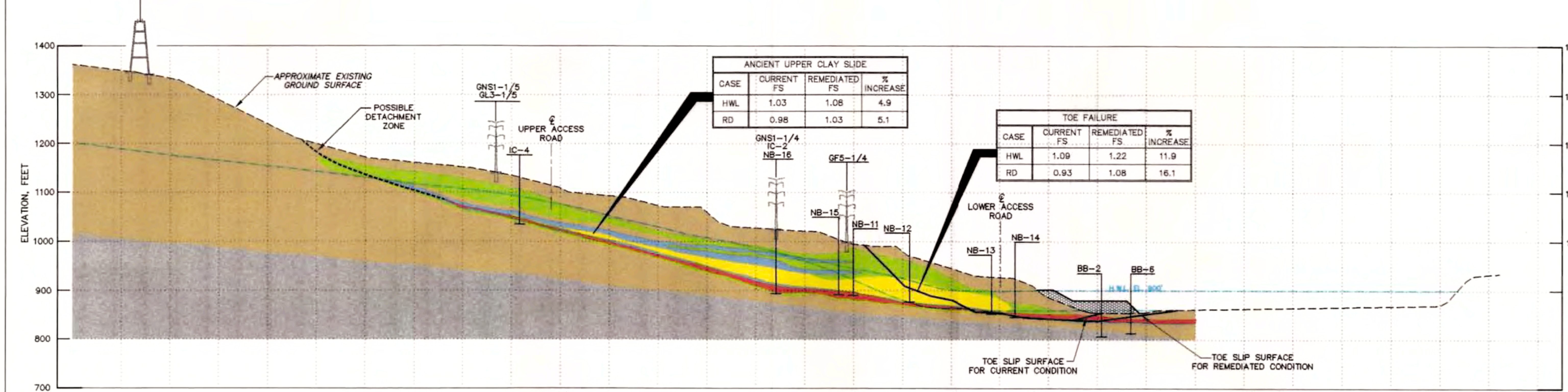


ANCIENT LOWER CLAY SLIDE			
CASE	CURRENT FS	REMEDIATED FS	% INCREASE
HWL	1.09	1.15	5.5
RD	1.07	1.10	2.8

ANCIENT UPPER CLAY SLIDE			
CASE	CURRENT FS	REMEDIATED FS	% INCREASE
HWL	0.98	1.07	9.2
RD	0.96	1.00	4.2

TOE FAILURE			
CASE	CURRENT FS	REMEDIATED FS	% INCREASE
HWL	1.03	1.41	36.7
RD	0.92	1.09	18.5

SECTION B
3-1,6-1 | 5-1



ANCIENT UPPER CLAY SLIDE			
CASE	CURRENT FS	REMEDIATED FS	% INCREASE
HWL	1.03	1.08	4.9
RD	0.98	1.03	5.1

TOE FAILURE			
CASE	CURRENT FS	REMEDIATED FS	% INCREASE
HWL	1.09	1.22	11.9
RD	0.93	1.08	16.1

SECTION C
3-1,6-1 | 5-1

REFERENCE:
NB SERIES BORINGS WERE OBTAINED FROM NEW YORK AUTHORITY, SOUTH ACCESS ROAD SLIDE AREA EVALUATION FOR BLENHEIM-GILBOA PUMPED STORAGE PROJECT, INQUIRY NO. Q-02-1905 REQUEST FOR PROPOSAL, DATED APRIL 7, 1997.

NOTES:

1. ASSUMED STRENGTH PROPERTIES FOR THE FAILING CLAY LAYERS ARE Ø' = 14 DEGREES WITH NO COHESION.
2. FACTORS OF SAFETY LESS THAN 1.0 ARE THE RESULTS OF POSSIBLE OVER CONSERVATIVE MODELING ASSUMPTIONS. CONSISTENT MODELING ASSUMPTIONS WERE USED THROUGHOUT TO SHOW RELATIVE STABILITY BETWEEN SECTIONS, BERM STAGES, AND PHREATIC SURFACES.
3. FACTORS OF SAFETY INDICATED ARE INTENDED TO SHOW THE EFFECTS OF VARYING STAGES OF BERM CONSTRUCTION AND PHREATIC SURFACES.
4. THE BORING LOGS AND RELATED INFORMATION DEPICT SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED. SOIL CONDITIONS AND WATER LEVELS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THESE BORING LOCATIONS. ALSO THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THESE BORING LOCATIONS.
5. THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS AND IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE INDICATED.
6. DOTTED PATTERN INDICATES ESTIMATED LOCATION OF STRATA.

LEGEND:

- GRAY CLAY, FAT, VARVED WITH RED SILT SEAMS
- GRAY CLAY, FAT, VARVED
- GRAY FAT CLAY SLIGHT TO NO VARVING
- CLAYS AND SILTS, SILTY CLAY, PRIMARY FINE SOILS BROWN AND GRAY BROWN
- SILTY SANDS WITH GRAVEL GRAY, GRAY BROWN (TILL)
- SANDS AND GRAVELS, COBBLES TILL (BROWN)
- BEDROCK

SECTION B — SECTION NO.
3-1,6-1 | 5-1
SHEET WHERE SECTION IS CUT — SHEET WHERE SECTION IS SHOWN

SCALE
100 0 100 200 FEET

PLATE 5-1

CROSS SECTION
BLENHEIM-GILBOA PUMPED STORAGE POWER PROJECT
PREPARED FOR
NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

Paul C. Rizzo Associates, Inc.
CONSULTANTS

CAD FILE NUMBER 97-1734-M62
CHECKED BY / APPROVED BY
DWD 9-16-98
DRAWN BY
PLOT 1-1

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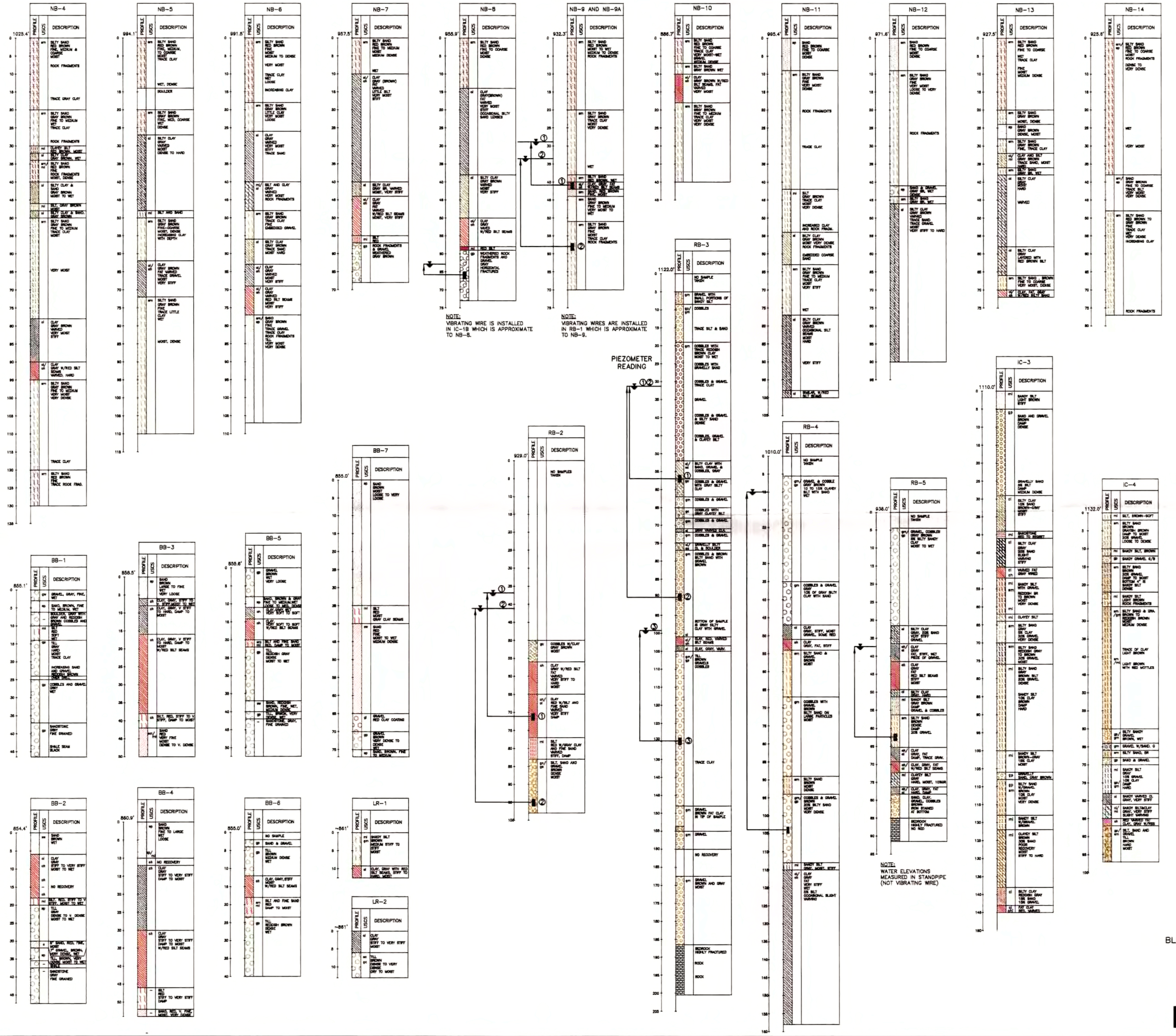

NOTE:
THE DEPTH AND THICKNESS OF THE LAYERING STRATA INDICATED ON THE IC AND NB SERIES BORING LOGS IS GENERALIZED FROM AND INTERPOLATED BETWEEN SAMPLES OBTAINED FROM THE FIELD.

REFERENCE:
NB SERIES BORINGS WERE OBTAINED FROM NEW YORK AUTHORITY, SOUTH ACCESS ROAD SLIDE AREA EVALUATION FOR BLENHEIM-GILBOA PUMPED STORAGE PROJECT, INQUIRY NO. Q-02-1905 REQUEST FOR PROPOSAL, DATED APRIL 7, 1997.

SCALE 10 0 10 20 FEET

PLATE 3-2

BORING LOGS AND PIEZOMETER LEVELS

BLENHEIM-GILBOA PUMPED STORAGE POWER PROJECT

PREPARED FOR

NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

Paul C. Rizzo Associates, Inc.
CONSULTANTS

CAD FILE NUMBER 97-1734-M4

DRAWN BY | DWD 2-13-98 | CHECKED BY | APPROVED BY

PLOT 1=1

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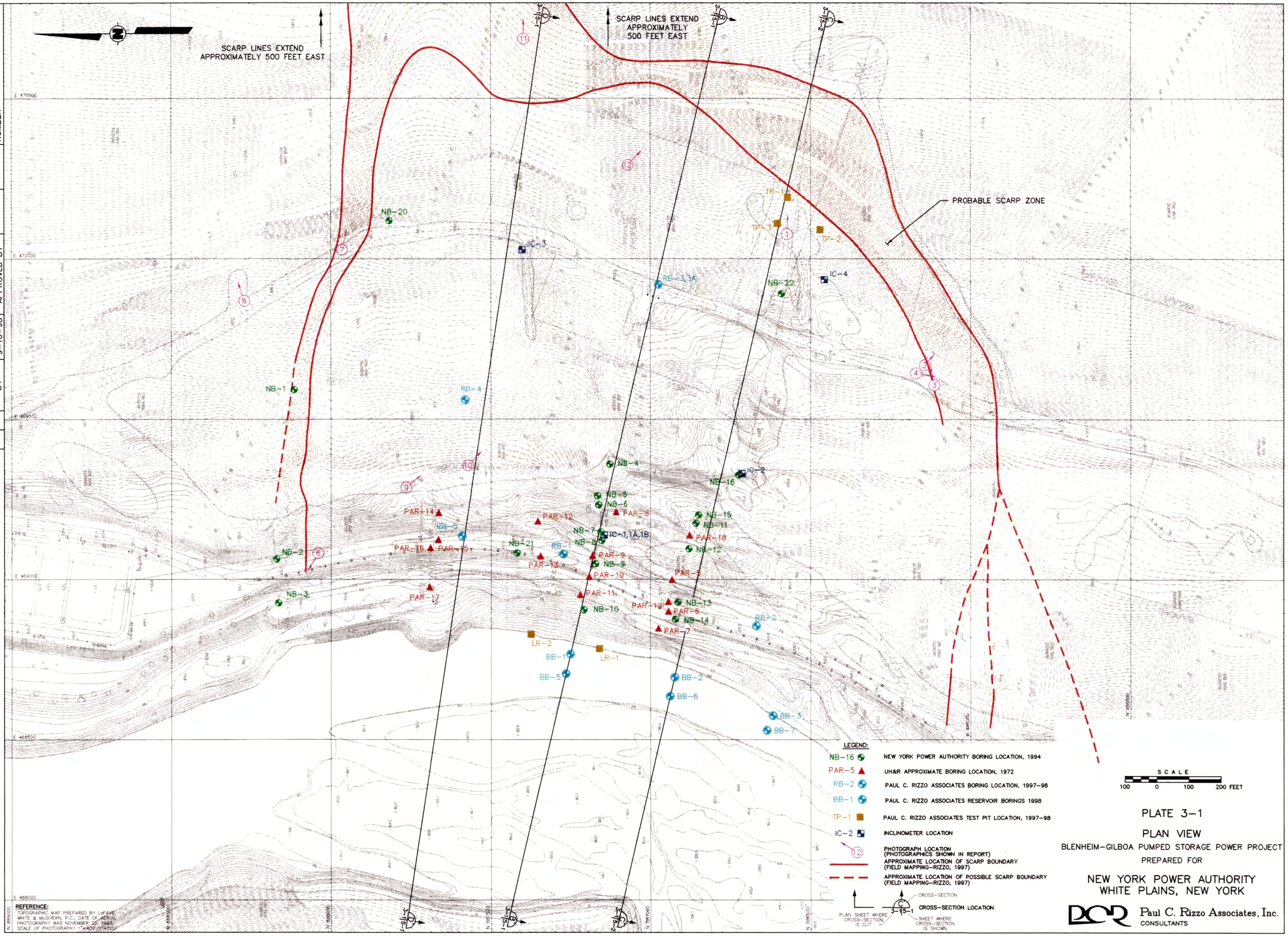


PLATE 3-1

PLAN VIEW

BLENHEIM-GILBOA PUMPED STORAGE POWER PROJECT

PREPARED FOR

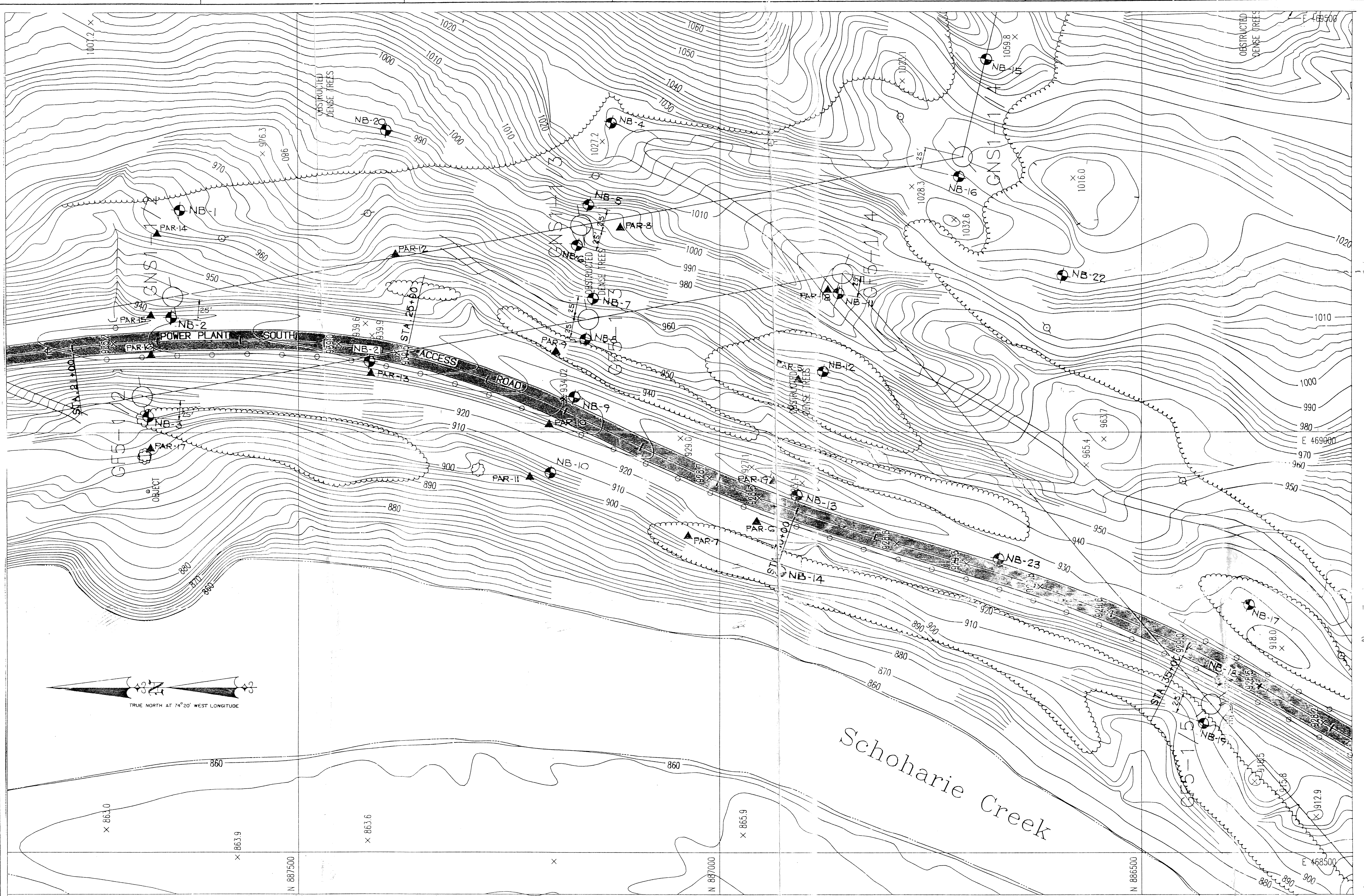
NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

Paul C. Rizzo Associates, Inc.
CONSULTANTS

CAD FILE NUMBER	97-1734-M63
CHECKED BY	
APPROVED BY	
DRAWN BY	DWD
	9-16-98
PLOT	1:100

APPENDIX A

BORING LOGS



BORING LOCATION PLAN

50 0 25 50 100 150 FEET

GRAPHIC SCALE

BORING SCHEDULE

BORING NO.	ESTIMATED BORING DEPTH (FT)	ESTIMATED PIEZOMETER DEPTH (FT)	REMARKS
NB-1	100		
NB-2	80		
NB-3	50		
NB-4	130	70	
NB-5	100		
NB-6	90	60	
NB-7	70	60	
NB-8	70	60	
NB-9	60	60	
NB-10	50	50	
NB-11	100		
NB-12	90		
NB-13	70		
NB-14	50		
NB-15	130		
NB-16	130		
NB-17	60		
NB-18	60		
NB-19	50		
NB-20	100		
NB-21	70		
NB-22	100		
NB-23	50		

NOTES:

1. BORINGS SHALL BE CONDUCTED IN ACCORDANCE WITH NYPA TECHNICAL SPECIFICATION FOR SUBSURFACE EXPLORATION, SECTION 1100.

2. BORING AND PIEZOMETER LOCATION, DEPTHS AND NUMBERS ARE ESTIMATED ONLY. THE AUTHORITY RESERVES THE RIGHT TO CHANGE THE LOCATION, TO INCREASE OR DECREASE THE DRILLING DEPTHS AND TO DELETE OR ADD BORINGS AND PIEZOMETERS IT DEEMS NECESSARY.

LEGEND:

NB-1 — BORING AND BORING NO. FOR THIS INVESTIGATION

PAR-5 — BORING AND BORING NO. CONDUCTED IN 1973 (LOCATIONS APPROXIMATE).

GF-5 1/3 — TOWER LOCATION AND TOWER NO.

REV NO	DATE	DESCRIPTION	DWN/CHK	LD/DDD	DE/DD	PROJ MGR
0	6/9/94	ISSUED FOR BID	TKL/KD	KD/ma	Ly/AK	-

REVISIONS

DWN/CHK'D TKL/KD
DIRECTOR D&D M. Ansari
DISCIPLINE ENG L. Yao
DISCIPLINE DIR
PROJ APPROVAL -
DATE 6-9-94

BLENHEIM GILBOA PROJECT

SOUTH ACCESS ROAD
SLOPE STABILIZATION
BORING LOCATION PLAN

CIVIL/STRUCTURAL

NewYorkPower Authority

SCALE AS SHOWN
DWG NO 939061-FC-200
REV 0
SHEET OF

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA — PROJECT NO. 97-1734

LOG OF BORING NO. IC-3

COORDINATES N ______ E ______

SURFACE EL: 1110'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	S-1	3-9 13-18	24"		SANDY SILT- 20% rock fragments, 5% organics medium stiff to stiff, light brown, dry.	ml	
5	S-2	26-24 34-35	2"		SAND & GRAVEL- 10 % silt, dense, brown, damp.	gp	poor recovery
10	S-3	35-11 8- 6	10"		SIMILAR (loose to dense, moist)	gp	
15	S-4	9-8 12-9	5"		SIMILAR,	gp	poor recovery
20					Driller says that drill is in boulders. Sample will be taken when bit is through. Change from 6" diameter casing to 4" diameter casing. 6" will be advanced later.		
25	S-5	9-21 41-18	5"		GRAVELLY SAND- 5% silt, loose to dense, brown, damp.	gp	
30	S-6	10-7 7-14	5"		SILTY CLAY- 10% sand, 10% rock fragments, stiff, brown-gray, moist.	cl	*1.25
	S-7	6-6 6-11	7 "		SIMILAR- 20% sand, stiff, brown, moist	cl	

DATE BEGAN: 9/10/97 DATE COMPLETED: 9/26/97 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Wash Rotary, 3 7/8" Tri-cone roller	NOTES: * pocket penetrometer (tons/sq. ft.)
DRILLING CO.: Maxim Tech.	DRILLER: Ed Cole HELPER: Jeff Hammond,Walt Ketter	RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA — PROJECT NO. 97-1734

LOG OF BORING NO. IC-3

COORDINATES N ______ E ______

SURFACE EL: 1110'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	S-7				See Page 1		
40	S-8	20-31 21-25	1"		Gray to red gray BOULDER (fine grained sandstone).	gw	poor recovery
	S-9	30-21 11-28	8"		SILTY CLAY- 20% sand and gravel, stiff, gray, moist.	cl	*1.8,1.5
	S-10	9-10 11-13	8"		SIMILAR - very stiff	cl	*3.25
45	S-11	17-27 17-16	6"		SILTY CLAY- 30% sand, 10% rock fragments, stiff to very stiff, gray, moist.	cl	*2.0,1.75
	S-12	10-12 18-24	6"		SIMILAR - 10% sand, soft to med. stiff, gray, moist, slight varving.	cl	*0.75
50	S-13	7-9 21-65	12"		Gray and red varved FAT CLAY (bottom 6"), 5% silt, hard (top 6" silty clay).	ch	*>4.0
					attempt to push 3" shelby, material too hard.		
	S-14	55-90 167-220	6"		SANDY SILT w/ GRAVEL- 10% clay, hard,	ml sm	sample taken using 3" shelby tube inside a 3.5" split spoon.
55	S-15	30-60 63-65	1"		SIMILAR	ml sm	(poor recovery)
	S-16	95-110 100/.2'	8"		SIMILAR	ml sm	*>4.0, >4.0
	S-17	45-54 55-58	19"		SIMILAR	ml sm	*>4.0
60	S-18	24-43 58-55	12"		SANDY SILT- 10% clay, 10% gravel, hard, damp, reddish-brown to brown.	ml	*>4.0
	S-19	24-32 72-77	14"		CLAYEY SILT- 30% sand, 10% gravel, very stiff to hard, gray brown, damp, (2" silt seam at top).	ml	*2.5,>4.0,>4.0
65	S-20	46-39 38-40	8"		SILTY SAND- 20% gravel, 5% clay, dense, gray and brown, moist.	sm	
	S-21	62-100/.1'	4"		SIMILAR- rock stuck in end of spoon, driller says cobble below sampling point.	sm	
	S-22	32-38 60-81	14"		SIMILAR	sm	

DATE BEGAN: 9/10/97
DATE COMPLETED: 9/26/97
FIELD GEOLOGIST: S. Putnam
CHECKED BY: JMS
DRILLING CO.: Maxim Tech.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: Wash Rotary, 3 7/8" Tri-cone roller
DRILLER: Ed Cole HELPER: Jeff Hammond,Walt Ketter

NOTES:
* pocket penetrometer (tons/sq. ft.)

RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA — PROJECT NO. 97-1734

LOG OF BORING NO. IC-3

COORDINATES N ______ E ______

SURFACE EL: 1110'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	S-23	17-40 58-90	15"		SILTY SAND- 30% gravel, med. dense to very dense, reddish gray to brown, moist.	sm	
	S-24	47-46 75-55	12"		SIMILAR - (more rock fragments).	sm	
75	S-25	68-65 60-76	15"		SIMILAR - (4" seam of rock at 8" from top).	sm	*3.5,>4.0
	S-26	40-52 85-75	14"		SILTY SAND- 20% gravel, dense gray gravel , sand and silt (brown).	sm	*>4.0
	S-27	26-65 100/.4'	10"		SIMILAR - 10% rock fragments.	sm	
80	S-28	63-39 61-93	8"		SIMILAR - 2" layer of rock fragments in middle of sample.	sm	
	S-29	50-100/.3'	4"		SIMILAR - 20% gravel, 5% clay.	sm	
85	S-30	63-52 100/.4'	12"		SANDY SILT with rock fragments, 10% clay, hard, brown, damp.	ml	*>4.0,>4.0
	S-31	50-70-90-100/.3'	16"		SIMILAR - large piece of rock (2" diameter by 2" long, 10" from bottom).	ml	*>4.0
	S-32	108-73 95-83	18"		SIMILAR	ml	*>4.0
90	S-33	23-54 91-95	14"		SIMILAR	ml	*>4.0
	S-34	65-100/.1'	4"		SIMILAR - (rock in end of spoon), drill through 1' of boulder.	ml	*>4.0
95	S-35	103-77 100/.4'	4"		SIMILAR - rock fragment at top of sample.	ml	*>4.0
	S-36	50-87 73-93	0"		No recovery		
	S-37	32-48 83-65	10"		SANDY SILT- 30% rock fragments, hard, brown, moist.	ml	*>4.0
100	S-38	18-32 84-104	16"		SIMILAR - 20% clay, 15% rock fragments, stiff to hard, brown-gray, moist.	ml	*2.0,>4.0,>4.0
	S-39	25-65 100/.1'	8"		SIMILAR - 10% clay, 15% rock fragments.	ml	*1.75,>4.0
	S-40	32-60-62-84	8"		SIMILAR - 20% rock fragments.		

DATE BEGAN: 9/10/97
DATE COMPLETED: 9/26/97
FIELD GEOLOGIST: S. Putnam
CHECKED BY: JMS
DRILLING CO.: Maxim Tech.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: Wash Rotary, 3 7/8" Tri-cone roller
DRILLER: Ed Cole HELPER: Jeff Hammond,Walt Ketter

NOTES:
* pocket penetrometer (tons/sq. ft.)
RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. IC-3

COORDINATES N ________ E ________

SURFACE EL: 1110'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	S-40				See Page 3		
	S-41	22-58 100/.4	8"		GRAVELLY SAND- 30% silt, medium dense to very dense, gray brown, moist.	gp	
	S-42	40-84 100/.3'	12"		SILTY SAND w/ GRAVEL- 5% clay, dense to v. dense, brown, moist.	gp sm	
110	S-43	38-60 100/.3'	8"		SIMILAR	gp sm	
	S-44	19-89 82-70	11"		SIMILAR - 10% clay, m.dense to v. dense.	gp sm	
115	S-45	33-44 55-66	12"		SIMILAR - 20% clay.	gp sm	
	S-46	37- 100/.3'	3"		SIMILAR (poor recovery)	gp sm	
	S-47	45- 100/.3'	6"		SANDY SILT w/ GRAVEL- 10% clay, hard, brown, moist (rock in end of spoon).		
120	S-48	36-58 100/.4'	3"		SIMILAR	gp sm	(poor recovery)
	S-49	36-85 93-100/.3'	1"		CLAYEY SILT- 30% sand, hard, brown, damp-moist, poor recovery.	ml	*>4.0
125	S-50	33-90 100/.4'	8"		SIMILAR- 20% sand, 10% rock fragments, brown, hard, damp-moist.	ml	*>4.0
	S-51	55-64 100/.2'	4"		SIMILAR	ml	*>4.0
	S-52	47-63 100/.1'	1"		COBBLE (fine-grained sandstone)	--	
130	S-53	60-60 100/.4'	12"		SANDY CLAYEY SILT- 15% rock fragments, hard, brown, moist.	ml	*>4.0
	S-54	26-48 60-100/.3'	13"		CLAYEY SILT- 20% sand, 15% rock fragments, hard, light brown-brown, damp.	ml	*>4.0
135	S-55	106- 50/0.0'	4"		SIMILAR rock at tip of spoon, driller says cobble under sample.	ml	
	S-56	58-90 100/.2'	0"		No recovery		
	S-57	63-83 78 116	24"		SILTY CLAY- 15% sand, 15% gravel, reddish gray to gray, hard, damp to moist.	cl	*>4.0,>4.0,>4.0

DATE BEGAN: 9/10/97
DATE COMPLETED: 9/26/97
FIELD GEOLOGIST: S. Putnam
CHECKED BY: JMS
DRILLING CO.: Maxim Tech.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: Wash Rotary, 3 7/8" Tri-cone roller
DRILLER: Ed Cole HELPER: Jeff Hammond,Walt Ketter

NOTES:
* pocket penetrometer (tons/sq. ft.)

RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. IC-3

COORDINATES N ______ E ______

SURFACE EL: 1110'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	S-58	49-112 100/.3'	3"		SIMILAR	ml	
	S-59	20-36 63-100/.4'	24"		SILTY CLAY- (top 1'), brownish gray, 20% sand, some gravel, FAT CLAY, reddish gray, non horizontal varving, interbedded 5% sand, hard, damp, rock in tip of spoon.	cl	*>4.0
145	S-60	84-100/.1'	0"		No recovery, see note		Sample taken with 3" shelby tube inside a 3.5" split spoon driven with a 300 pound hammer with an 18" fall
					Drilling through very hard material (BOULDER, ROCK, OR TILL?)		
150					Inclinometer set @ 149.0 ' 9/26/97		

DATE BEGAN: 9/10/97 DATE COMPLETED: 9/26/97 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Wash Rotary, 3 7/8" Tri-cone roller	NOTES:
DRILLING CO.: Maxim Tech.	DRILLER: Ed Cole HELPER: Jeff Hammond, Walt Ketter	RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA PROJECT NO. 97-1734

LOG OF BORING NO. IC-4

COORDINATES N ______ E ______

SURFACE EL: 1132'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	S-1	2-3 3-4	10"		SILT- 10% fine sand and rock fragments, brown, very soft, damp.	ml	*0.25
	S-2	3-4 3-4	10"		SILTY SAND- 10% rock fragments, brown, very soft to stiff, damp.	sm	*1.25,<0.25
5	S-3	2-5 5-5	8"		SILTY SAND- 15% rock fragments, brown, very loose, damp.	sm	
	S-4	10-11 12-15	12"		SIMILAR- grayish brown	sm	
	S-5	9-8 13-44	10"		SIMILAR- brown, 30% gravel, loose to dense, moist.	sm	
10	S-6	5-12 16-18	8"		SANDY SILT- 20% gravel, stiff to very stiff, brown, moist.	ml	*1.25,2.5
	S-7	32-19 14-11	6"		SANDY GRAVEL - 10% silt and sand, gray and brown, medium dense to dense, moist.	gp	
15	S-8	15-24 21-19	12"		SILTY SAND- 20% gravel, med. dense, brown, moist.	sm	
	S-9	12-12 12-19	10"		SIMILAR- 10% gravel.	sm	
	S-10	14-14 14-14	14"		SIMILAR	sm	
20	S-11	14-11 14-48	15"		SIMILAR- 20% gravel, SANDY SILT (bottom 4"), 10% clay, stiff to hard, brown, damp.	sm	*>4.0
	S-12	106-27 12-14	4"		SANDY SILT- rock fragments on top, dark brown, soft to m. stiff, moist.	ml	*0.5
25	S-13	5-8 7-10	2"		SIMILAR- rock fragments, trace clay, light brown, moist.	ml	
	S-14	10-20 24-20	16"		SILTY SAND and GRAVEL- med. dense, brown to reddish brown, moist.	sm gm	
	S-15	17-18 14-14	6"		SIMILAR	sm gm	
30	S-16	12-19 20-25	14"		SIMILAR	sm gm	
	S-17	16-20 34-50	15"		SILTY SAND- 25% gravel, med. dense to dense, brown, moist.	sm	
	S-18	30-53			SIMILAR- 30% gravel, rock in end of spoon.		

DATE BEGAN: 9/29/97 DATE COMPLETED: 10/7/97 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Wash Rotary, 3 7/8" Tri-cone roller	NOTES: * pocket penetrometer (tons/sq.ft.)
DRILLING CO.: Maxim Tech.	DRILLER: Ed Cole HELPER: Tom Teal	RIG: CME-075

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. IC-4

COORDINATES N ______ E ______

SURFACE EL: 1132'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		43-107			See Page 1		
	S-19	62-100/.2'	2"		SIMILAR- trace clay, light brown, very dense.	sm	
	S-20	26-21 22-45	13"		SILTY SAND - fine to med., 30% gravel, med. dense to dense, trace clay, lt. brown, moist.	sm	
40	S-21	32-32 35-57	14"		SIMILAR- 25% gravel, 10% clay, light brown w/ red mottles.	sm	
	S-22	34-24 33-36	18"		SILTY SAND and GRAVEL- trace clay, dense brown, moist, (till).	sm gp	
45	S-23	36-31 24-30	10"		SIMILAR	sm gp	
	S-24	18-15 22-19	19"		SIMILAR	sm gp	
	S-25	18-26 66-97	16"		SILTY SAND- 20% gravel, dense to v. dense, brown, moist.	sm	
50	S-26	19-100/.2'	0"		No recovery, drill through boulder.		
	S-27	15-21 30-59	10"		SILTY SAND- 20% gravel, m. dense to v. dense, light brown, moist.	sm	
55	S-28	81-20 21-19	0"		No recovery		
	S-29	19-18 29-30	10"		SIMILAR to S-27	sm	
	S-30	27-21 26-27	13"		SIMILAR	sm	
60	S-31	10-17 80-86	9"		SILTY SANDY GRAVEL- brown, m. dense to v. dense, light brown, wet.	gp gm	
	S-32	100/.2'	0"		No recovery, drill through cobble.		
65	S-33	150/.4'	1"		GRAVEL with SAND and CLAYEY SILT, gray, moist.	gp ml	64.3' wash color change from brown to gray, boulder from 64.3 to 65.5.
	S-34	21-21 25-44	11"		SILTY SAND (fine to medium), 15% gravel, brown, m. dense to dense, moist.	sm	
	S-35	28-40 18-24	2"		SAND and GRAVEL- trace silt and clay, gray and brown, moist.	gp	

DATE BEGAN: 9/29/97 DATE COMPLETED: 10/7/97 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Wash Rotary, 3 7/8" Tri-cone roller	NOTES: * pocket penetrometer (tons/sq. ft.)
DRILLING CO.: Maxim Tech.	DRILLER: Ed Cole (EC) HELPER: Tom Teal	RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. IC-4

COORDINATES N ________ E ________

SURFACE EL: 1132'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	S-36	39-31 34-36	17"		SANDY SILT-10% gravel,10% clay, hard, gray, damp.	ml	*>4.0,>4.0
	S-37	31-30 46-57	3"		SIMILAR	ml	
75	S-38	18-32 33-32	1"		SIMILAR (poor recovery), one piece of gravel covered w/ gray silt and clay and sand.	gp gm	
	S-39	16-11 10-13	13"		SANDY SILT-loose to med. dense, gray, moist, silty sand like S-36 top 4" of sample.	sm	
	S-40	14-26 31-44	14"		SANDY CLAY- varved, gray, very stiff clay with sand seams ~ 1/16" thick, moist.	cl	*3.25,3.75
80					Driller miscalculated, overdrilled to 81.1		
	S-41	21-23 24-32	14"		SANDY SILT and CLAY-very stiff to hard, slightly varving, gray, damp.	cl ml	*3.5,3.75,>4.0
	S-42	26-44 56-59	14"		SANDY SILT-very fine, med. dense to very dense.	ml	
85	S-43	21-21 56-100	11"		GRAY CLAY- varved, red silt seams, very stiff to hard, damp, top 3", same as above, bottom 3", reddish brown varved clay.	cl	*3.75,>4.0,>4.0
	S-44	87- 125/.5'	8"		SILT, SAND, GRAVEL, brown, hard, moist, trace clay.	gp	
90	S-45	56- 115/.4'	5"		SIMILAR	gp	
	S-46	42-102 50/0.0	8"		SIMILAR	gp	
	S-47	100/0.5'	0"		No recovery		
95	S-48	100/.05'	0"		No recovery		
					Bottom of Boring = 98.0' inclinometer set at 97'		
100							

DATE BEGAN: 9/29/97
DATE COMPLETED: 10/7/97
FIELD GEOLOGIST: S. Putnam
CHECKED BY: JMS
DRILLING CO.: Maxim Tech.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: Wash Rotary, 3 7/8" Tri-cone roller
DRILLER: Ed Cole (EC) HELPER: Tom Teal

NOTES:
* pocket penetrometer (tons/sq.ft.)
RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA | PROJECT NO. 97-1734

LOG OF BORING NO. RB-2

COORDINATES: N ________ E ________

SURFACE EL: 927.8'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
					Boring was destructively drilled from the surface to 54.0'.		
55	S-1	23 - 28 41	2"		Rock fragment covered with gray clay	gc	
60	S-2	16 - 21 23 - 26	15"		CLAY with gray silt seams, trace sand, gray, varved, moist, stiff to hard	ch	* 3.0, 2.75
65	S-3	8 - 15 28 - 32	18"		top 12" SIMILAR. bottom 12" CLAY with interbedded fine sand and silt seams, red, very stiff, moist	ch	* 3.25
70	S-4	10 - 19 25 - 32	16"		CLAY, with fine sand and silt seams, red, very stiff to hard, damp, varved	ch/ cl	* 3.0, 3.25
75	S-5	11 - 19 24 - 38	15"		SIMILAR, less silt.	ch/ cl	
80	S-6	17 - 30 39 - 57	18"		red SILT with gray clay and fine sand seams.	ml	
							82.6' hit hard material

DATE BEGAN: 10/17/97 DATE COMPLETED: 10/24/97 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Wash Rotary	NOTES: * pocket penetrometer (tons/sq.ft.)
DRILLING CO.: Maxim Tech.	DRILLER: Ed Cole HELPER: Tom Teal	RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-2

COORDINATES N ______ E ______

SURFACE EL: 927.8'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	S-7	55-64-82 100/0.4'	24"		SILT SAND AND GRAVEL,	gp/sm	
90	S-8	100 - 100/0.4'	6"		SIMILAR	gp/sm	
95	S-9	74 - 100/.3'	2"		SIMILAR	gp/sm	
					bottom of boring @ 98.0'		
100							
105							
110							
115							

DATE BEGAN: 10/17/97
DATE COMPLETED: 10/24/97
FIELD GEOLOGIST: S. Putnam
CHECKED BY: JMS
DRILLING CO.: Maxim Tech.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: Wash Rotary
DRILLER: Ed Cole HELPER: Tom Teal

NOTES:
* pocket penetrometer (tons/sq.ft.)
RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-3

COORDINATES N ______ E ______

SURFACE EL: 1122'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	0–5					No Sample taken		4" casing at 5.0'
	5	R1		1.1'		GRAVEL, gray, 10% brown sandy silt, moist, medium stiff.	gm/sm	
	10	R2		1.3'		COBBLES and GRAVELS, gray, wet	gp/gm	
	15	R3		3.3'		COBBLES, 15% brown silty sand, gray, moist, medium loose.	gm/sm	
	20	R4		1.0'		COBBLES and GRAVELS, gray, with trace reddish brown clay on particles.	gm/gc	
	25	R5		3.0'		SIMILAR, gravelly sand seam (0.8') brown, dense, moist.	gm/gc	
	30	R6		2.0'		SIMILAR, trace gray clay on larger particles	gm/gc	
		R7				See Page 2		

DATE BEGAN: 12/3/97 DATE COMPLETED: 12/16/97 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: HQ Wireline Coring	NOTES:
DRILLING CO.: Maxim Technologies	DRILLER: Ed Cole HELPER: Jeff Hammond	RIG: CME-075

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-3

COORDINATES N ________ E ________

SURFACE EL: 1122'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R7		1.5'		GRAVELS, gray, wet, rounded	gm/ gc	
	40	R8		1.7'		COBBLES and GRAVELS gray, wet. water color change to reddish brown (40.0' -40.5')	gm/ gc	
	45	R9		1.1'		COBBLES and GRAVELS gray, wet. silty sand seam (0.3') brown, moist	gm/ sm	
	50	R10		3.3'		COBBLE and GRAVELS, clayey SILT with sand(1.5'), brown, moist, soft to medium stiff.	gm/ ml	
	55	R11		1.4'		silty CLAY, gray, with sand gravel and cobbles (gravel stuck in core lifter)	cl/ sc	
	60	R12		1.4'		COBBLES and GRAVELS, 15% gray silty CLAY soft, moist trace sand.	gc	
		R13		1.1'		COBBLES and GRAVELS core block (see note)	gc	
	65	R14		0.5'		COBBLE with clayey silt gray, soft, moist		
						over drill to 68' with 4" casing to remove broken core barrel		
		R15		2.0'		COBBLES and GRAVELS, stiff, gray CLAY with silt varving stuck in core lifter	gc/ cl	

DATE BEGAN: 12/3/97 DATE COMPLETED: 12/16/97 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: HQ Wireline Coring	NOTES: gravel sized particle wedged sideways in inner barrel blocking any more material from being collected.
DRILLING CO.: Maxim Technologies	DRILLER: Ed Cole HELPER: Jeff Hammond	RIG: CME-075

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-3

COORDINATES N ______ E ______

SURFACE EL: 1122'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R15				R15 CONTINUED FROM PAGE 2		
	75	R16		2.2'		SIMILAR	gm	
	80	R17		3.9'		Top 0.3' gravelly silty CLAY, gray, moist 2.4' BOULDER 1.2' silty SAND, brown, dense, moist	gc cl	
	85	R18		2.4'		COBBLES and silty SAND, 15% gravel, brown, very dense. (Till)	gc/ sm	
	90	R19		3.5'		SIMILAR	gc/ sm	
	95	R20		3.4'		SIMILAR	gc/ sm	
	100	R21		2.3'		SIMILAR, bottom 0.8' silty CLAY, 20% gravel and sand, gray, moist, soft to medium stiff	gc/ sm	
		R22		5.0'		101.0'-103.5' fat CLAY with gray silt and fine sand seams, red, varved, stiff to hard, damp 103.5'-104.6' varved clay, gray 104.6'-105.5' silty SAND, with cobbles and gravel, brown, moist, very dense	ch/ cl	

DATE BEGAN: 12/3/97 DATE COMPLETED: 12/16/97 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: HQ Wireline Coring	NOTES:
DRILLING CO.: Maxim Technologies	DRILLER: Ed Cole HELPER: Jeff Hammond	RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-3

COORDINATES N ______ E ______

SURFACE EL: 1122'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R23		4.9'		silty SAND with GRAVEL and COBBLES brown, very dense, damp	gc/sm	
	110	R24		2.7'		silty SAND with GRAVEL and COBBLES brown, very dense, damp	gc/sm	
	115	R25		1.7'		GRAVEL, gray, wet	gw	
	120	R26		1.2'		SIMILAR	gw	
	125	R27		2.0'		SIMILAR, 10% silty SAND with gravel, brown, moist, dense to very dense	gp/sm	
	130	R28		1.3'		SIMILAR,	gm/sm	
	135	R29		0.9'		SIMILAR core block		
		R30		2.1'		SIMILAR, 10% cobbles, brown clay stuck to larger particles	gm/sm	

DATE BEGAN: 12/3/97	GWL: DEPTH: DATE/TIME:	NOTES:
DATE COMPLETED: 12/16/97	GWL: DEPTH: DATE/TIME:	
FIELD GEOLOGIST: S. Putnam	DRILLING METHOD: HQ Wireline Coring	
CHECKED BY: JMS		
DRILLING CO.: Maxim Technologies	DRILLER: Ed Cole HELPER: Jeff Hammond	RIG: CME-075

NYPA - BLENHEIM/GILBOA | PROJECT NO. 97-1734

LOG OF BORING NO. RB-3

COORDINATES N ____ E ____

SURFACE EL: 1122'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R31		1.0'		SIMILAR,	gm/ sm	
	145	R32		1.3'		SIMILAR,	gm/ sm	
	150	R33		2.2'		SIMILAR, increasing sandy silty CLAY brown to grayish brown, sticky, moist	gm/ sm	
	155	R34		0.5'		GRAVEL	gp	
	160	R35		0'		NO RECOVERY		
	165	R36		0'		NO RECOVERY		4" casing at 88.0' Core barrel broke off at ~ 98'
		R37		1.3'		GRAVEL, brown and gray, wet	gm	
	170	R38		1.3'		SIMILAR, 20% cobbles, 5% sand	gm	

DATE BEGAN: 12/3/97 DATE COMPLETED: 12/16/97 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: HQ Wireline Coring	NOTES:
DRILLING CO.: Maxim Technologies	DRILLER: Ed Cole HELPER: Jeff Hammond	RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-3

COORDINATES N ______ E ______

SURFACE EL: 1122'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	176–181	R39		1.8'		COBBLES and GRAVEL, gray	gm	
	181–186	R40		1.8'		GRAVEL and COBBLES, gray	gp	
	186–191	R41		5.0'		Bedded Rock, shaly sandstone, gray to gray brown, highly fractured		top of rock at 186.5'
	191–196	R42		5.0'		SIMILAR		
	196–200.5	R43		5.0'		SIMILAR		
						bottom of boring @ 200.5'		

Depth scale: 180, 185, 190, 195, 200, 205

DATE BEGAN: 12/3/97
DATE COMPLETED: 12/16/97
FIELD GEOLOGIST: S. Putnam
CHECKED BY: JMS
DRILLING CO.: Maxim Technologies

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: HQ Wireline Coring
DRILLER: Ed Cole HELPER: Jeff Hammond

NOTES:
RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-4

COORDINATES N ______ E ______

SURFACE EL: 1010'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	0–5					No Sample Taken		4" casing at 4.5'
	5–10	R1		0.4'		GRAVEL, gray, wet	gw	
	10–11.5	R2		0.7'		COBBLE with gravel, gray	gw	
	11.5–16.5	R3		1.5'		COBBLE with rounded gravel, 15% clayey silt with sand, gray-brown, wet	gm	
	16.5–21.5	R4		0.5'		COBBLE, 5% clayey silt, brownish gray, wet	gm	
	21.5–26.5	R5		0.2'		GRAVEL, gray, rounded	gw	
	26.5–31.5	R6		1.2'		GRAVEL and clayey SILT, 15% sand, brown to gray, wet, medium stiff to stiff	gm	
	31.5–	R7		1.7'		SIMILAR, some cobbles	gm	

DATE BEGAN: 1/13/98
DATE COMPLETED: 1/22/98
FIELD GEOLOGIST: S. Putnam
CHECKED BY: JMS
DRILLING CO.: Maxim Tech.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: HQ Wireline Coring
DRILLER: Scott Breeds HELPER: Al Burr

NOTES:
RIG: CME-850

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-4

COORDINATES N ______ E ______

SURFACE EL: 1010'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						R7 CONTINUED FROM PAGE 1		
	40	R8		1.8'		COBBLES and GRAVEL, 10% silty CLAY with sand, gray, soft to medium stiff, wet	gc	
	45	R9		0.4'		silty CLAY, gray, moist, stiff (material was stuck in core lifter)	cl	
	50	R10		0.5'		SIMILAR, 25% gravel, 5% red clay	cl	
	55	R11		3.3'		top 1.8' fat CLAY, varved, gray, very stiff to hard, moist bottom silty SAND, 25% gravel and cobbles, brownish gray, dense, moist	ch/ sm	
	60	R12		4.2'		silty SAND and GRAVEL, 5% cobbles, brown, very dense, moist.	gm sm	
	65	R13		3.3'		silty SAND, 20% gravel, 5% cobbles, brown, very dense, moist.	sm gm	
		R14		1.7'		COBBLES and GRAVEL, 10% silty SAND on large particles, brown, moist	gw	

DATE BEGAN: 1/13/98 DATE COMPLETED: 1/22/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: HQ Wireline Coring	NOTES:
DRILLING CO.: Maxim Tech.	DRILLER: Scott Breeds HELPER: Al Burr	RIG: CME-850

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-4

COORDINATES N ______ E ______

SURFACE EL: 1010'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						R14 CONTINUED FROM PAGE 2		
	75	R15		2.1'		SIMILAR	gw	
	80	R16		2.1'		SIMILAR fewer cobbles	gw	
		R17		1.7'		SIMILAR	gw	
	85	R18		1.5'		SIMILAR, 10% silty sand	gw sm	84.7' gravel wedged in core barrel
	90	R19		0.6'		silty SAND 20% gravel, 5% clay, brown, very dense to dense, moist.	sm gp	
		R20		1.7'		SIMILAR, 10% gravel, 0.7' cobble	sm gp	92.3'
	95	R21		1.5'		COBBLES and GRAVEL, 20% silty sand, brown, moist, very dense to dense	sm gp	
	100	R22		1.3'		SIMILAR, 10% silty sand	sm gp	
		R23				CONTINUED ON NEXT PAGE		

DATE BEGAN: 1/13/98 DATE COMPLETED: 1/22/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: HQ Wireline Coring	NOTES:
DRILLING CO.: Maxim Tech.	DRILLER: Scott Breeds HELPER: Al Burr	RIG: CME-850

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-4

COORDINATES N ______ E ______

SURFACE EL: 1010'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R23		1.0'		SIMILAR	sm gp	
	110	R24		0.2'		GRAVEL	gw	
	115	R25		3.3'		top 0.8' sandy SILT, gray, moist, very stiff to hard, 5% gravel bottom fat CLAY, gray, slight varving, 5% silt, hard, damp.	sm ch	
	120	R26		4.7'		SIMILAR, 5% silt, medium stiff to very stiff, wet	ch	
	125	R27		5.0'		SIMILAR, hard	ch	
	130	R28		2.5'		SIMILAR	ch	
	135	R29		4.0'		SIMILAR	ch	
		R30				CONTINUED ON NEXT PAGE		

DATE BEGAN: 1/13/98 DATE COMPLETED: 1/22/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: HQ Wireline Coring	NOTES:
DRILLING CO.: Maxim Tech.	DRILLER: Scott Breeds HELPER: Al Burr	RIG: CME-850

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-4

COORDINATES N ______ E ______

SURFACE EL: 1010'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R30		5.0'		SIMILAR, some red clay spots (not varving) near bottom of sample	ch	
	145	R31		4.7'		SIMILAR, trace of red silt varving	ch	
	150	R32		4.0'		SIMILAR	ch	
	155	R33		0.4'		clayey SILT, 10% clay, red, hard, dry	mh	
	160					bottom of boring 157.0'		
	165							
	170							

DATE BEGAN: 1/13/98
DATE COMPLETED: 1/21/98
FIELD GEOLOGIST: S. Putnam
CHECKED BY: JMS
DRILLING CO.: Maxim Tech.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: HQ Wireline Coring
DRILLER: Scott Breeds HELPER: Al Burr

NOTES:

RIG: CME-850

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-5

COORDINATES N ______ E ______

SURFACE EL: 938'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
	0–5					No Sample taken		4" casing at 4.0'
	5	R1		1.2'		GRAVEL, gray and brownm, 5% brownish gray sandy silty clay, moist	gm/gp	
	10	R2		1.9'		COBBLES, gray and gray brown, 15% gravel, moist	gm/gp	
	15	R3		0.6'		GRAVEL, gray, moist	gm/gp	
	20	R4		0.3'		GRAVEL, 5% sandy silt,brown moist	gm/gp	
	25	R5		0.0'		NO RECOVERY	gm/gp	
	30	R6		0.0'		NO RECOVERY	gm/gp	After R6, the outer core barrel was pulled and found to be clogged. The inner barrel contained 1.8' of gray GRAVEL.
		R7		1.1'		silty CLAY, 20% sand, 5% gravel, gray, very stiff to hard, moist	cl	

DATE BEGAN: 1/6/98
DATE COMPLETED: 1/8/98
FIELD GEOLOGIST: S. Putnam
CHECKED BY: JMS
DRILLING CO.: Maxim Tech.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: HQ Wireline Coring
DRILLER: Ed Cole HELPER: Jeff Hammond

NOTES:
RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-5

COORDINATES N ____ E ____

SURFACE EL: 938'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R7				Continued from Page 1		
	40	R8		0.2'		GRAVEL with a covering of fat CLAY, gray, moist.	cl/ gc	
	45	R9		5.0'		fat CLAY with red silt varves, gray, very stiff to hard, moist.	ch/ cl	
	50	R10		5.0'		top 2.8' SIMILAR, fat CLAY, gray and red . 1.7' silty CLAY, 10% sand an gravel, gray, very stiff to hard, damp, 0.5' sandy SILT, 20% gravel, 10% clay, brown, hard, moist	ch/ cl/ ml	
	55	R11		3.3'		top 1.8' SIMILAR, damp to moist bottom 1.5' GRAVEL and COBBLES, 10% sandy SILT, 10% clay, gray	ml/ gm	
	60	R12		2.8'		silty SAND, 20% gravel, brown, very dense, damp, 5% cobble bottom 0.5' clayey SILT, 15% sand, 5% gravel, brown, stiff to very stiff, damp	sm	
	65	R13		2.7'		top 0.8' COBBLE, gray 0.9' silty SAND, 10% gravel, brown, very dense, moist 1.0' fat CLAY, 10% silt, gray, very stiff to hard, damp	sm/ ch	
		R14		5.0'		SIMILAR 5% gravel, hard, damp red clay seam from 69.0' to 69.5' depth		

DATE BEGAN: 1/6/98 DATE COMPLETED: 1/8/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: HQ Wireline Coring	NOTES:
DRILLING CO.: Maxim Tech.	DRILLER: Ed Cole HELPER: Jeff Hammond	RIG: CME-075

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. RB-5

COORDINATES N ________ E ________

SURFACE EL: 938'

ELEVATION (FEET MSL)	DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOW/6" & (N) OR % REC. & (RQD)	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R14				R14 CONTINUED FROM PAGE 2		
	75	R15		3.0'		top 0.8' SIMILAR to R14 bottom 2.2' clayey SILT, 10% sand and gravel, gray, hard, moist	ml	
	80	R16		3.5'		Top 1.8' fat CLAY, 10% gravel, gray, hard, damp bottom 1.7'silty SAND, 15% gravel, brown, very dense to dense, moist 1.2' silty SAND, brown, dense, moist	ch/ sm	
	85	R17		3.4'		top 1.3' silty CLAY, 15% sand, brown, hard, moist bottom 2.1' COBBLES and GRAVEL with iron staining, brown	cl	85.2' gravel wedged in core barrel
		R18		1.3'		light to med. gray bedded rock, shaly sandstone, gray		top of rock 85.7'
	90	R19		4.3'		SIMILAR highly fractured		
	95, 100					bottom of boring 91.5'		

DATE BEGAN: 1/6/98 DATE COMPLETED: 1/8/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: JMS	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: HQ Wireline Coring	NOTES:
DRILLING CO.: Maxim Tech.	DRILLER: Ed Cole HELPER: Jeff Hammond	RIG: CME-075

NYPA - BLENHEIM/GILBOA **PROJECT NO.: 97-1734**

LOG OF BORING NO. BB - 1

COORDINATES: N 887,241 E 468,767

SURFACE EL: 855.1'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-1	1 - 2 2 - 2	3"		GRAVEL - 15% coarse sand, fine, rounded, gray, wet.	gw		
	S-2	3 - 2 1 - 1	3"		SAND - 10% gravel, fine to medium, sub-angular, brown, wet.	sp		
5	S-3	2 - 2 4 - 18	10"		trace organics, gravel in tip coated with silt.			
	S-4	70/0.4'	0"		NO RECOVERY			begin coring @ 6.2'
	R-1	0%	2.5'		BOULDER - gray, with gray and reddish brown cobbles and gravel.	-		
10	S-5	4 - 12 15 - 20	3"		SILT - 5% gray clay, red, soft, wet,	ml		
	S-6	12 - 22 29 - 28	24"		clay varving bottom 6" TILL, damp to moist, brown			
15	S-7	10 - 23 35 - 48	20"		TILL - gray, moist, hard	gp		
	S-8	28 - 110/0.5'	10"					
	S-9	22 - 23 31 - 40	8"		trace clay			
20	S-10	37 - 55/0.5'	11"		increasing sand and gravel			
	S-11	21 - 70 50/0.3'	12"		some reddish brown coloring			
					OVER DRILL (drilling through hard material)			
25	S-12	50/0.0'						begin coring @ 25.0'
	R-2	0%	3.9'		COBBLES AND GRAVEL, gray, wet	gp		
30	R-3	0%	1.9'					
	R-4	0%	2.9'					

DATE BEGAN: 6/2/98
DATE COMPLETED: 6/2/98
FIELD GEOLOGIST: S. Putnam
CHECKED BY: MJV

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: Cont. SPT to rock, and NQ wireline

NOTES:

DRILLING CO.:Parratt-Wolff, Inc. | DRILLER: Ron Bush | HELPER: Doug Thoma | RIG: CME model 55

NYPA - BLENHEIM/GILBOA — PROJECT NO. 97-1734

LOG OF BORING NO. BB - 1

COORDINATES: N 887,241 E 468,767

SURFACE EL: 855.1'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
					SEE PREVIOUS PAGE			
40	R-5	85%	3.9'		SANDSTONE - gray, fine grained			top of rock at 37.5'
45	R-6	72%	4.8'		8" shale seam, black (2.5' from bottom)			
50					Bottom of Boring = 46.5'			
55								
60								
65								

DATE BEGAN: 6/2/98 DATE COMPLETED: 6/2/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: MJV	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Cont. SPT to rock, and NQ wireline	NOTES:
DRILLING CO.:Parratt-Wolff, Inc.	DRILLER: Ron Bush HELPER: Doug Thoma	RIG: CME model 55

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. BB-2

COORDINATES
N 868925 E 468695

SURFACE EL: 854.4'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-1	12-70 31-17	5"		SAND - 15% silt, 5% gravel, brown, wet			
	S-2	10-12 32-17	6"		SIMILAR, 25% silt	sw		Appears similar to till
5	S-3	20-7 8-9	8"					
	S-4	6-7 9-10	2"		CLAY - 15% sand, gray, stiff to very stiff, moist to wet	cl		
	S-5	9-20 11-17	4"		SIMILAR, red and gray, no varves noted	ch		
10	S-6	2-4 5-6	3"		SIMILAR, red, poor recovery			
	S-7	5-5 7-8	3"		SIMILAR, poor recovery	ch		
15	S-8	8-13 17-18	0"		NO RECOVERY	–		
	S-9	12-13 26-50/0.1'	8"		SIMILAR, soft, mixed sand and gray silt varves. Piece of gravel stuck in tip.	ch		
	S-10	11-16 40-65	16"		SILT - red, stiff to v. stiff, moist to wet, gray clay varves. Bottom 3" gray sand and silt, hard.	ml	1.25 2.75 2.25	
20	S-11	65- 100/0.3'	8"		TILL - gray, dense to v. dense, moist to wet			
	S-12	34- 67/0.5'	7"					
25	S-13	47- 62/0.5'	7"			sp		
	S-14	41-33 38-52	14"		10 % clay, gravel in tip			
	S-15	50- 90/0.5'	11"		damp to moist, increasing clay			
30	S-16	52- 85/0.5'	12"		top 5" SAND - 15% silt, fine, red, moist bottom 7" GRAVEL - 25% sand, brown, v. dense, wet.	s		
	S-17	48- 75/0.5'	8"		TILL - 25% gravel, 15% silt, brown, v. dense, moist to wet	sp		
	S-18	50-70/0.3'	8"					

DATE BEGAN: 6/3/98 DATE COMPLETED: 6/3/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: MJV	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Cont. SPT and NQ wireline core	NOTES:
DRILLING CO.: Parratt Wolff, Inc.	DRILLER: Ron Bush HELPER: Doug Thoma	RIG: CME model 55

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. BB-2

COORDINATES
N 886925 E 468695

SURFACE EL: 854.4'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
					overdrill			top of rock 35.7'
	R-1		1.1'		SHALE- some interbedded sandstone, highly fractured	-		
40	R-2	42%	4.7'		top 6" Similar to R-1 remainder, SANDSTONE, gray, fine grained, some interbedded shale	-		
45	R-3	61%	5.1'					
50					BOTTOM OF BORING = 47.4'			
55								
60								
65								

DATE BEGAN: 6/3/98 DATE COMPLETED: 6/3/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: MJV	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Cont. SPT and NQ wireline core	NOTES:
DRILLING CO.: Parratt Wolff, Inc.	DRILLER: Ron Bush HELPER: Doug Thoma	RIG: CME model 55

NYPA - BLENHEIM/GILBOA **PROJECT NO. 97-1734**

LOG OF BORING NO. BB-3

COORDINATES
N 886629 E 468580

SURFACE EL: 858.5'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-1	1-12 17-10	8"		SAND - 20% gravel, 10% silt, large to fine, brown, wet, v. loose.			
	S-2	6-9 5-6	3"		trace clay and organics	sp		
5	S-3	6-6 10-10	0"		NO RECOVERY			gray clay on outside of spoon
	S-4	8-8 8-11	8"		CLAY - 5% gravel, gray, stiff to very stiff, moist to wet	ch	- 2.0 1.7	
10	S-5	6-7 10-15	21"		SIMILAR, varved, v. stiff to hard, damp to moist, gray silt in varving.	ch	2.7 3.5 >4	
	S-6	16-16 18-18	24"		fine to medium sand	ch	3.7 3.5 >4 2.7	
	S-7	7-7 11-10	0"		POOR RECOVERY (some clay)	–		gray clay on outside of spoon
15	S-8	5-6 8-8	8"		10% gravel, Poor Recovery	ch		
	S-9	4-4 5-7	21"		varved with red silt seams	ch		
20	S-10	5-5 6-6	24"		some silt seams dipping at ~20 degrees	ch	1.0 2.0 2.5	
	S-11	5-6 7-8	20"		increasing silt with depth	ch	0.5 2.0 1.5	
	S-12	9-9 10-11	17"		silt and clay not in distinct layers	ch	- 2.5 >4	
25	S-13	3-4 6-8	20"		some horizontal silt seams	ch	1.0 2.7 1.7	
	S-14	8-8 8-8	24"		increased spacing between silt seams	ch	- 2.0 1.5	
30	S-15	6-7 9-10	24"		SIMILAR		2.7 3.0 2.7	
	S-16	7-8 11-12	24"		SIMILAR		1.2 2.7 3.0	
	S-17	4-6 9-9	22"		SIMILAR		3.5 3.7 2.5	
	S-18	10-11	24"		SIMILAR			

DATE BEGAN: 6/4/98
DATE COMPLETED: 6/4/98
FIELD GEOLOGIST: S. Putnam
CHECKED BY: MJV
DRILLING CO.: Parratt Wolff, Inc.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: Cont. SPT
DRILLER: Ron Bush HELPER: Doug Thoma

NOTES:

RIG: CME model 55

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. BB-3

COORDINATES
N 886629 E 468580

SURFACE EL: 858.5'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
		13-16				ch	1.7 2.0	
	S-19	6-6 8-14	24"		SIMILAR	ch	2.0 3.5 3.5	
	S-20	13-14 16-19	24"		SILT - red stiff to v. stiff, damp to moist, gray clay seams.	ml	- 1.7 2.5	
40	S-21	8-12 14-21	20"		some gray sand seams, increasing red fine sand	sm/ ml	2.5 3.0 2.5	
	S-22	19-26 38-47	24"		SAND - 25% silt, v. fine, red, moist, dense to v. dense, some gray clay seams near top.	sm/ ml		
45	S-23	31-38 42-50/0.4'	12"			sm/ ml		
	S-24	15-16 32-33	20"			sm/ ml		
	S-25	7-23 41-75	18"		decreased silt, damp to moist, v. dense.	sm/ ml		
50					BOTTOM OF BORING = 50'			
55					Boring was terminated because spud length was not long enough to reach bottom, and barge started moving.			
60								
65								

DATE BEGAN: 6/4/98 DATE COMPLETED: 6/4/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: MJV	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Cont. SPT	NOTES:
DRILLING CO.: Parratt Wolff, Inc.	DRILLER: Ron Bush HELPER: Doug Thoma	RIG: CME model 55

NYPA - BLENHEIM/GILBOA **PROJECT NO. 97-1734**

LOG OF BORING NO. BB-4

COORDINATES
N 886381 E 468418

SURFACE EL: 860.9'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-1	5-8 11-16	8"		SAND - 15% silt and gravel, trace clay, brown, fine to large, loose, wet.	sp		
	S-2	18-12 19-14	14"		no gravel, moist to wet, m. dense to dense	sp		
5	S-3	15-24 32-15	10"		10% gravel, some gray sand	sp		
	S-4	23-14 23-17	9"		grayish brown, red gravel 20% silt 5% clay	sp		
	S-5	40-13 11-16	6"		increasing silt	sp/ ml		
10	S-6	10-10 11-15	0"		NO RECOVERY	ch		gray clay and sand on outside of spoon
	S-7	15-14 15-18	10"		CLAY - 10 % fine sand and silt, gray, stiff to v. stiff, damp to moist.	ch	- 3.0 1.5	
15	S-8	8-11 17-28	4"		5% fine sand, slight varving, Poor Recovery	ch		
	S-9	20-20 21-22	8"		increasing sand, gray silt varving tightly spaced	ch	- 1.0 1.5	
	S-10	6-6 8-12	20"		1" black silt seam 5" from bottom, no sand	ch	2.0 2.5 1.7	
20	S-11	12-14 18-21	10"		5% sand	ch	- 2.0 1.7	
	S-12	4-4 6-7	20"		fine grained sand seams	ch	2.0 1.5 1.0	
25	S-13	9-9 9-10	24"		damp	ch	0.5 1.0 2.0	
	S-14	4-4 5-6	14"		poor sample. gravel pushed ahead of spoon	ch		
	S-15	8-8 8-10	24"		SIMILAR	ch	- 1.0 2.5	
30	S-16	4-6 8-10	22"		red silt seams bottom 8"	ch	2.7 3.5 3.7	
	S-17	8-9 9-10	24"		silt seams entire length some horizontal some tilted		- 2.5 2.0	
	S-18	7-10	18"		increasing silt		>4	

DATE BEGAN: 6/5/98 DATE COMPLETED: 6/5/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: MJV	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Cont. SPT	NOTES:
DRILLING CO.: Parratt Wolff, Inc.	DRILLER: Ron Bush HELPER: Doug Thoma	RIG: CME model 55

NYPA - BLENHEIM/GILBOA | PROJECT NO. 97-1734

LOG OF BORING NO. BB-4

COORDINATES
N 886381 E 468418

SURFACE EL: 860.9'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-18	10-13					2.7	
	S-19	10-14 11-11	24"		SIMILAR		2.5 2.5 2.5	
	S-20	3-5 8-8	20"		some silt seams		1.0 2.0 3.5	
40	S-21	9-11 12-12	23"		some gray sand seams, increasing red fine sand		1.2 2.7 3.5	
	S-22	4-6 7-12	20"		SIMILAR		2.5 1.5 2.0	
45	S-23	9-10 10-12	16"		increasing silt		2.0 2.5 2.0	
	S-24	10-14 12-12	24"		SILT - red, stiff to v. stiff, damp, large clay layers		2.5 2.0 2.2	
50	S-25	10-10 12-14	24"		less clay		2.2 3.0 2.5	
	S-26	4-7 9-10	22"		red fine sand in tip		1.5 2.7 3.5	
	S-27	9-18 26-48	24"		SAND - v. fine, red, v. dense, moist.			
55					Bottom of Boring = 54.0'			
60								
65								

DATE BEGAN: 6/5/98 DATE COMPLETED: 6/5/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: MJV	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Cont. SPT	NOTES:
DRILLING CO.: Parratt Wolff, Inc.	DRILLER: Ron Bush HELPER: Doug Thoma	RIG: CME model 55

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA — PROJECT NO. 97-1734

LOG OF BORING NO. BB-5

COORDINATES: N 887255 E 468709

SURFACE EL: 855.6'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-1	1-1 1-1	0"		NO RECOVERY			
	S-2	2-2 2-1	3"		GRAVEL - 30% sand, brown, wet, v. loose.	gp		
5	S-3	2-2 1-3	0"		NO RECOVERY, trace medium sand			
	S-4	50/0.4'	2"		GRAVEL - 10% medium sand, very little silt, brown, wet, v. loose.	gp		
	S-5	4-12 16-42	17"		SAND - 5% gravel, fine to medium, brown and gray, loose to m. dense, wet	sp		
10	S-6	26-7 5-5	11"		top 4" Similar CLAY - gray, v. soft to soft, wet	sc ch	- - 0.5	
	S-7	5-6 3-3	1"		10 % fine sand and silt, stiff to v. stiff, damp to moist.	ch		
15	S-8	3-3 3-3	24"		v. soft to m. stiff, moist to wet, red silt varves	ch	1.0 <0.25 0.5	
	S-9	1-2 4-6	20"		increasing silt bottom 3" SILT and fine SAND, red damp	ch	0.75 <0.25 1.0	
	ST-1	NA	21"		push 2" shelby tube 23" for 21" recovery			
20	S-11	5-8 29-35	21"		SILT and fine SAND, red, damp to moist, gray clay seams bottom 4" TILL	sm ml	3.5 3.7 2.5	top of till at 21.7'
	S-12	16-29 50/0.3'	13"		TILL - silt, sand, gravel, reddish gray,dense, moist to wet.	gp		
25	S-13	26-26 26-25	18"		reddish gray, moist to wet gray and black in color			
	S-14	23-24 35-36	20"		poor sample. gravel pushed ahead of spoon			
	S-15	15-16 34-35	21"		SIMILAR			
30	S-16	36- 60/0.5'	8"		SIMILAR			
	S-17	10-29 32-38	18"		SIMILAR			
	S-18	21-50/0.2'	8"		moist			

DATE BEGAN: 6/9/98
DATE COMPLETED: 6/9/98
FIELD GEOLOGIST: S. Putnam
CHECKED BY: MJV
DRILLING CO.: Parratt Wolff, Inc.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: Cont. SPT and NQ wireline core
DRILLER: Ron Bush HELPER: Doug Thoma

NOTES:

RIG: CME model 55

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. BB-5

COORDINATES
N 887255 E 468709

SURFACE EL: 855.6'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-18				SEE PREVIOUS PAGE			
	S-19	22-44 19-12	17"		top 12" SIMILAR, brown	gp		
					SAND - fine, reddish brown, m. dense			
	S-20	26- 50/0.1'	7"		brown, dense to v. dense, wet, gravel in tip of spoon	sw		
40	S-21	27-47 50/0.4'	10"		TILL - brown, v. dense, wet	gp		top of rock at 41.4 begin coring at 42.2'
	R-1	16%	1.9'		SANDSTONE - gray, fine grained, horizontal and vertical fractures, brown clay noted in fracures			
45					bottom 3" SHALE gray to black			
	R-2	53%	4.1'		top 6" black SHALE SANDSTONE - gray, fine grained, horizontal and vertical fractures, interbedded shale			
50	R-3	80%	4.0'					
					Bottom of Boring = 52.4'			
55								
60								
65								

DATE BEGAN: 6/9/98
DATE COMPLETED: 6/9/98
FIELD GEOLOGIST: S. Putnam
CHECKED BY: MJV

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: Cont. SPT and NQ wireline core

NOTES:

DRILLING CO.: Parratt Wolff, Inc. | DRILLER: Ron Bush | HELPER: Doug Thoma | RIG: CME model 55

NYPA - BLENHEIM/GILBOA | PROJECT NO. 97-1734

LOG OF BORING NO. BB-6

COORDINATES N 886954 E 468639

SURFACE EL: 855.0'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
					NO SAMPLE			
	S-1	1-8 5-2	3"		SAND & GRAVEL (poor recovery)	gp		
5	S-2	9-17 21-28	22"		TILL - brown, medium dense, wet	gp		
	S-3	9-21 32-21	15"		reddish brown			
	S-4	14-17 15-11	12"					
10	S-5	15-10 6-4	14"					
	S-6	4-5 5-4	12"		CLAY - gray, sticky, stiff, moist,varved with red silt seams	ch		
15	S-7	2-1 2-2	16"		some large sand (10%), medium stiff			
	S-8	2-4 6-7	24"		damp to moist, increasing silt with depth			
	S-9	9-10 12-14	22"		SILT and fine SAND, some clay seams, red, damp to moist	sm ml		
20	S-10	12-14 16-16	24"		moist			
	S-11	5-9 25-36	21"		top 18" same			
25	S-12	41-39 56/0.5'	17"		TILL - reddish brown, dense, wet	gp		
	S-13	25-39 60-75	15"					
30	S-14	79- 50/0.1	6"					
	S-15	20-24 32-63	16"					
	S-16	62- 75/0.5	12"					
	S-17	65-75/0.2	8"					

DATE BEGAN: 6/12/98 DATE COMPLETED: 6/12/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: MJV	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: Cont. SPT	NOTES:
DRILLING CO.: Parratt Wolff, Inc.	DRILLER: Ron Bush HELPER: Doug Thoma	RIG: CME model 55

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA | **PROJECT NO. 97-1734**

LOG OF BORING NO. BB-6

COORDINATES
N 886954 E 468639

SURFACE EL: 855.0'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-18	18-24 26-26	13"		similar, moist to wet	gp		
40	S-19	23-24 36-31	15"		wet			
					Bottom of Boring = 40'			
45								
50								
55								
60								
65								

DATE BEGAN: 6/12/98 DATE COMPLETED: 6/12/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: MJV	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: 3" ID flush joint - cont SPT	NOTES:
DRILLING CO.: Parratt Wolff, Inc.	DRILLER: Ron Bush HELPER: Doug Thoma	RIG: CME model 55

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA

PROJECT NO. 97-1734

LOG OF BORING NO. BB-7

COORDINATES
N 886647 E 468533
SURFACE EL: 853.5'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-1	6-9 47-42	11"		SAND, 20% silt, 15% gravel, brown, wet, loose to v. dense	sp		
5					Drill through boulder 4.5' - 8.5'			
	S-2	48-16 14-14	3"		SIMILAR gray, red clay and silt on outside of spoon	sp		
10								
15	S-3	11-20 15-15	12"		SIMILAR 30% silt, 10% gravel, moist	sp		
20	S-4	10-18 11-10	10"		SIMILAR 15% silt, 15% clay, 5% gravel, damp to moist	sp		
25	S-5	12-10 31-65	12"		SIMILAR 15% gravel	sp		
30	S-6	11-15 16-9	14"		SIMILAR gray brown, moist	sp		

DATE BEGAN: 6/11/98 DATE COMPLETED: 6/11/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: MJV	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: SPT 5' Sample Interval	NOTES:
DRILLING CO.: Parratt Wolff, Inc.	DRILLER: Ron Bush HELPER: Doug Thoma	RIG: CME model 55

NYPA - BLENHEIM/GILBOA **PROJECT NO. 97-1734**

LOG OF BORING NO. BB-7

COORDINATES N 886647 E 469533
SURFACE EL: 853.5'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-7	8-8 8-9	6"		SILT - red, moist, gray clay seams poor recovery (rock pushed ahead of spoon)	ml		
40	S-8	15-16 21-27	20"		SAND - 20% silt, red, fine, medium dense, moist to wet, some clay seams (gray)	sw		
45	S-9	15-16 16-27	23"		SIMILAR some varving, reddish brown	sw		
50	S-10	10-14 21-24	22"		SIMILAR brown	sw		
55	S-11	9-12 21-29	21"		SIMILAR reddish brown	sw		
60	S-12	19-32 65/0.5	24"		SAND - fine to medium, dense to v. dense, 5% silt, moist, brown	sw		gravel in tip
65	S-13	68/0.5	1"		GRAVEL - some red clay coating	gl		

DATE BEGAN: 6/11/98
DATE COMPLETED: 6/11/98
FIELD GEOLOGIST: S. Putnam
CHECKED BY: MJV
DRILLING CO.: Parratt Wolff, Inc.

GWL: DEPTH: DATE/TIME:
GWL: DEPTH: DATE/TIME:
DRILLING METHOD: SPT 5' Sample Interval
DRILLER: Ron Bush HELPER: Doug Thoma

NOTES:
RIG: CME model 55

Paul C. Rizzo Associates, Inc.
CONSULTANTS

NYPA - BLENHEIM/GILBOA — PROJECT NO. 97-1734

LOG OF BORING NO. BB-7

COORDINATES: N 886647 E 469533

SURFACE EL: 853.5'

DEPTH (FEET)	SAMPLE NO. OR RUN NO.	BLOWS / 6" or % RQD.	RECOVERY	PROFILE	DESCRIPTION	USCS SYMBOL	Pocket Penetrometer (tsf)	REMARKS
	S-14	19-18 25-41	14"		GRAVEL - 30% sand, 5% clay, brown, v. dense to dense, wet.	gp		
75	S-15	25-17 15-33	11"		SAND - 20% gravel, 10% silt, fine to medium, brown.	sp		
					Bottom of Boring = 77'			
80								
85								
90								
95								
100								

DATE BEGAN: 6/11/98 DATE COMPLETED: 6/11/98 FIELD GEOLOGIST: S. Putnam CHECKED BY: MJV	GWL: DEPTH: DATE/TIME: GWL: DEPTH: DATE/TIME: DRILLING METHOD: SPT 5' Sample Interval	NOTES:
DRILLING CO.: Parratt Wolff, Inc.	DRILLER: Ron Bush HELPER: Doug Thoma	RIG: CME model 55

Paul C. Rizzo Associates, Inc.
CONSULTANTS

TEST PIT LOG: LR-1

PROJECT NAME: NYPA -BLENHEIM GILBOA | PROJ. NO: 97-1734 | PAGE 1 OF 1

FIELD ENG/GEO: MJV/SJP | DATE: 4-6-98 | TEST PIT NO: LR-1

ELEVATION: ~ 861 feet, MSL

COORD. (N):

(E):

DEPTH (ft)	SAMPLE NO. AND TYPE	SOIL PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
0–9.2			Sandy Silt - with gravel, cobbles, and boulders, brown, medium stiff to stiff, moist SIMILAR - increasing moisture with depth	ml-gm	
9.2–12.5	9.2'		Clay - with gravel & cobbles, gray with red silt seams, stiff to hard, moist	cl	Water entering Pit at 12'.
			Bottom of LR-1 at 12.5 feet		

NOTES: Excavator: John Deere 310 SE backhoe
Operator: Arnold Jagger
- Water entering the pit and collapsing the sidewalls limited test pit depth.

Paul C. Rizzo Associates, Inc.
CONSULTANTS

TEST PIT LOG: LR-2

PROJECT NAME:	NYPA -BLENHEIM GILBOA	PROJ. NO:	97-1734.03	PAGE 1 OF 1	
FIELD ENG/GEO:	MJV/SJP	DATE:	4-6-98	TEST PIT NO:	LR-2
ELEVATION:	~ 861 feet, MSL				
COORD. (N):					
(E):					

DEPTH (ft)	SAMPLE NO. AND TYPE	SOIL PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
0–6			Clay - trace silt and fine sand, gray, stiff to very stiff, moist	cl	
6–13	6'		Till - sandy clay and gravel, brown, dense to very dense, dry to moist	sc-gc	Water entering Pit at 12'.
13			Bottom of LR-2 at 13 feet		

NOTES: Excavator: John Deere 310 SE backhoe
Operator: Arnold Jagger
- Water entering the pit and collapsing the sidewalls limited test pit depth.

Paul C. Rizzo Associates, Inc.
CONSULTANTS

TEST PIT LOG: RTB-1

PROJECT NAME: NYPA -BLENHEIM GILBOA | PROJ. NO: 97-1734 | PAGE 1 OF 1

FIELD ENG/GEO: AFA | DATE: 12-10-97 | TEST PIT NO: RTB-1

ELEVATION:

COORD. (N):

(E):

DEPTH (ft)	SAMPLE NO. AND TYPE	SOIL PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
0–13			Silty Sand - with gravel, brown, dry large boulders (0.5 ft. to 3 ft. diameter)	sm	
13–15	13'		Clayey silt with gravel, reddish brown, moist, increasing sand content	ml	
15–17	15'		Sandy silt with gravel and large boulders	ml	
			Bottom of RTP-1 at 17 feet		

NOTES: Excavator: John Deere 310 SE backhoe
Operator: Arnold Jagger
- Water entering the pit and collapsing the sidewalls limited test pit depth.
- No traces of fat clay.

Paul C. Rizzo Associates, Inc.
CONSULTANTS

TEST PIT LOG: RTB-2

PROJECT NAME:	NYPA -BLENHEIM GILBOA	PROJ. NO:	97-1734	PAGE 1	OF 1
FIELD ENG/GEO:	AFA	DATE:	12-10-97	TEST PIT NO:	RTB-2
ELEVATION:					
COORD. (N):					
(E):					

DEPTH (ft)	SAMPLE NO. AND TYPE	SOIL PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
0–11			Silty Sand - with gravel, brown, dry large boulders (0.5 ft. to 3 ft. diameter)	sm	
				ml	
11–16	11'		Clayey silt with gravel, reddish brown, moist, increasing sand content		
16			Bottom of RTP-2 at 16 feet		

Depth scale: 5, 10, 15, 20, 25

NOTES: Excavator: John Deere 310 SE backhoe
Operator: Arnold Jagger
- Water entering the pit and collapsing the sidewalls limited test pit depth.
- No traces of fat clay.

Paul C. Rizzo Associates, Inc.
CONSULTANTS

TEST PIT LOG: RTB-3

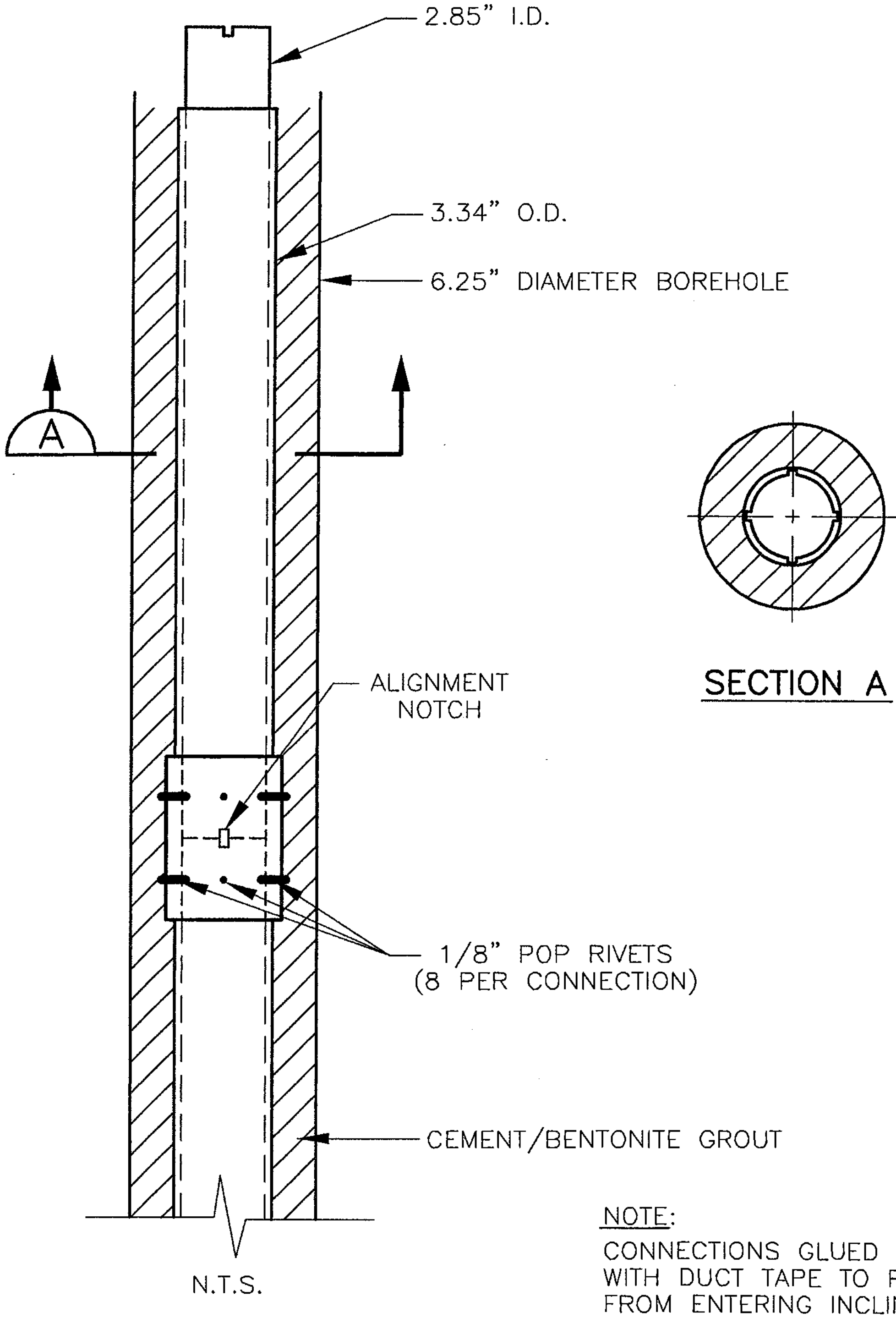
PROJECT NAME: NYPA -BLENHEIM GILBOA
PROJ. NO: 97-1734
PAGE 1 OF 1
FIELD ENG/GEO: AFA
DATE: 12-10-97
TEST PIT NO: RTB-1
ELEVATION:
COORD. (N):
(E):

DEPTH (ft)	SAMPLE NO. AND TYPE	SOIL PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
			Silty Sand - with gravel, brown, dry	sm	
	2'		Silty Clay - with sand	cl	
5	4'		Clayey Silt - brown, increasing gravel and boulders	ml	
10	12'		Clayey silt with gravel, reddish brown, moist, increasing clay content	ml	
15			Bottom of RTP-3 at 16 feet		
20					
25					

NOTES: Excavator: John Deere 310 SE backhoe
Operator: Arnold Jagger
- Water entering the pit and collapsing the sidewalls limited test pit depth.
- No traces of fat clay.

APPENDIX B

INCLINOMETER INSTALLATION DETAILS



NOTE:
CONNECTIONS GLUED AND WRAPPED WITH DUCT TAPE TO PREVENT GROUT FROM ENTERING INCLINOMETER CASING.

INCLINOMETER INSTALLATION DETAIL

BLENHEIM–GILBOA POWER PROJECT

PREPARED FOR

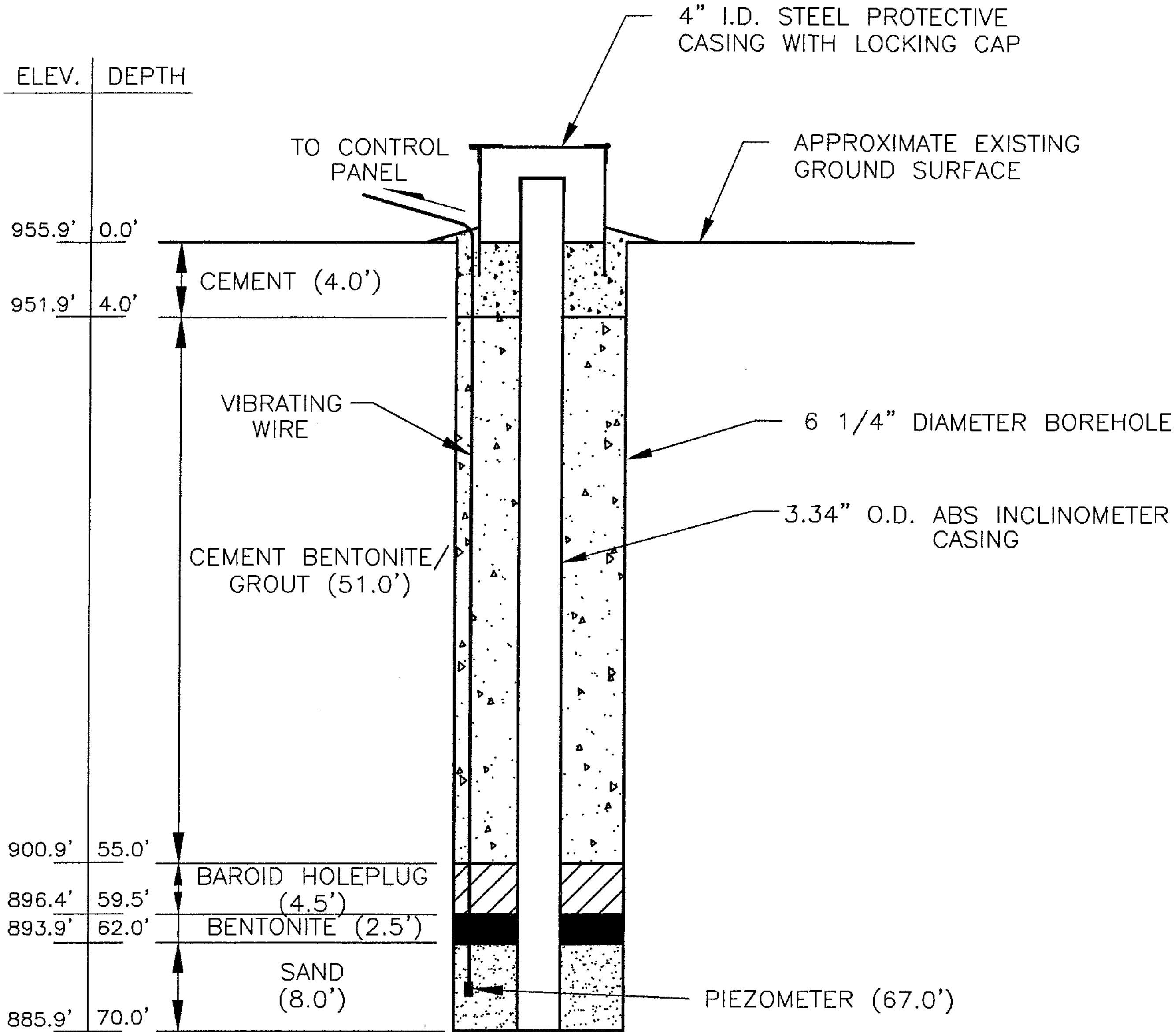
NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

Paul C. Rizzo Associates, Inc.
CONSULTANTS

DRAWN BY	DWD
	11-11-97
CHECKED BY	
APPROVED BY	
DRAWING NUMBER	97-1734-A6

APPENDIX C

PIEZOMETERS INSTALLATION DETAILS



(N.T.S.)

BORING IC-1B
PIEZOMETER AND INCLINOMETER
INSTALLATION DETAIL

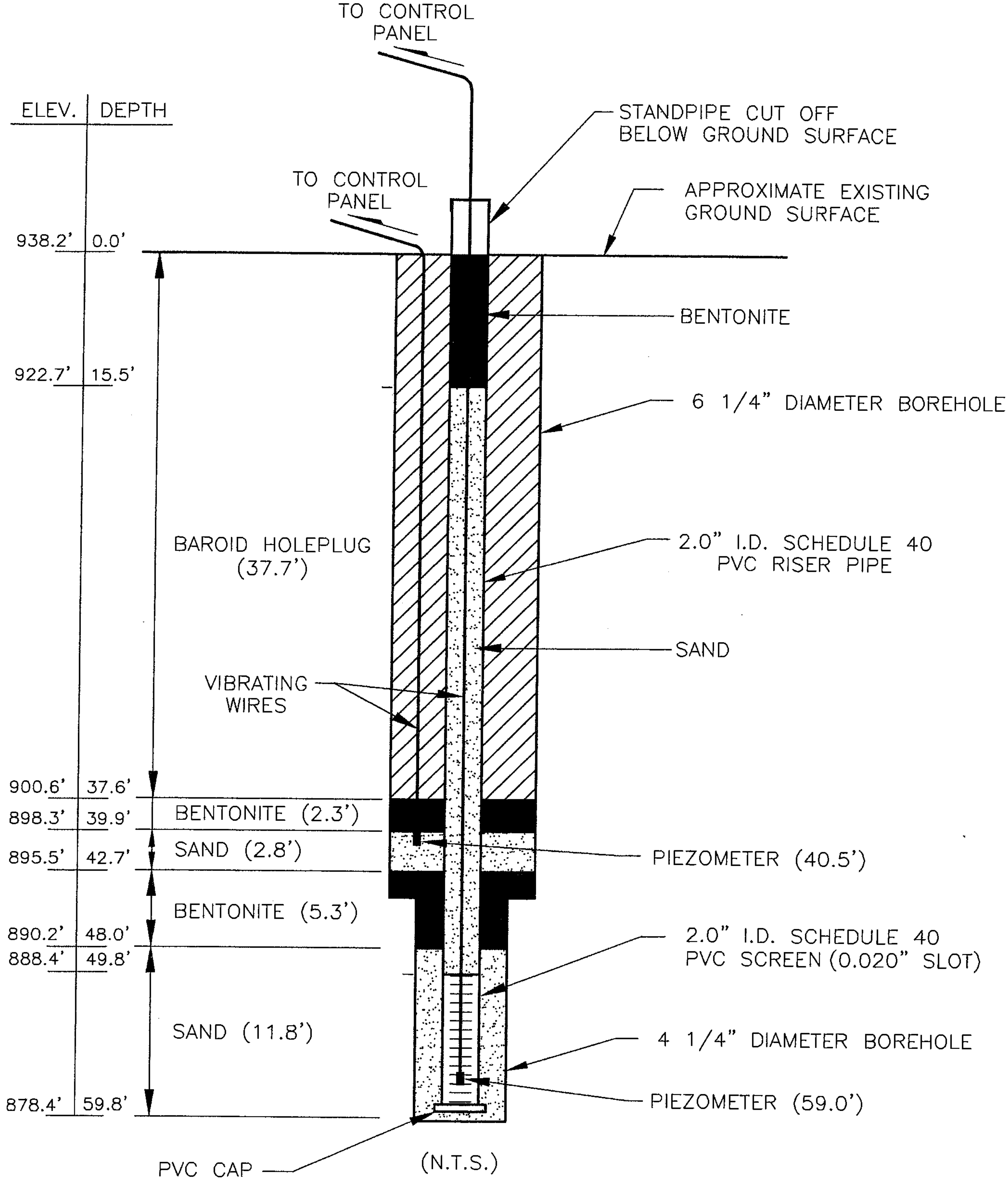
BLENHEIM-GILBOA POWER PROJECT

PREPARED FOR

NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

Paul C. Rizzo Associates, Inc.
CONSULTANTS

DRAWING NUMBER	97-1734-A5
CHECKED BY	
APPROVED BY	
DWD	11-11-97
DRAWN BY	



DRAWING NUMBER 97-1734-A3

CHECKED BY | APPROVED BY

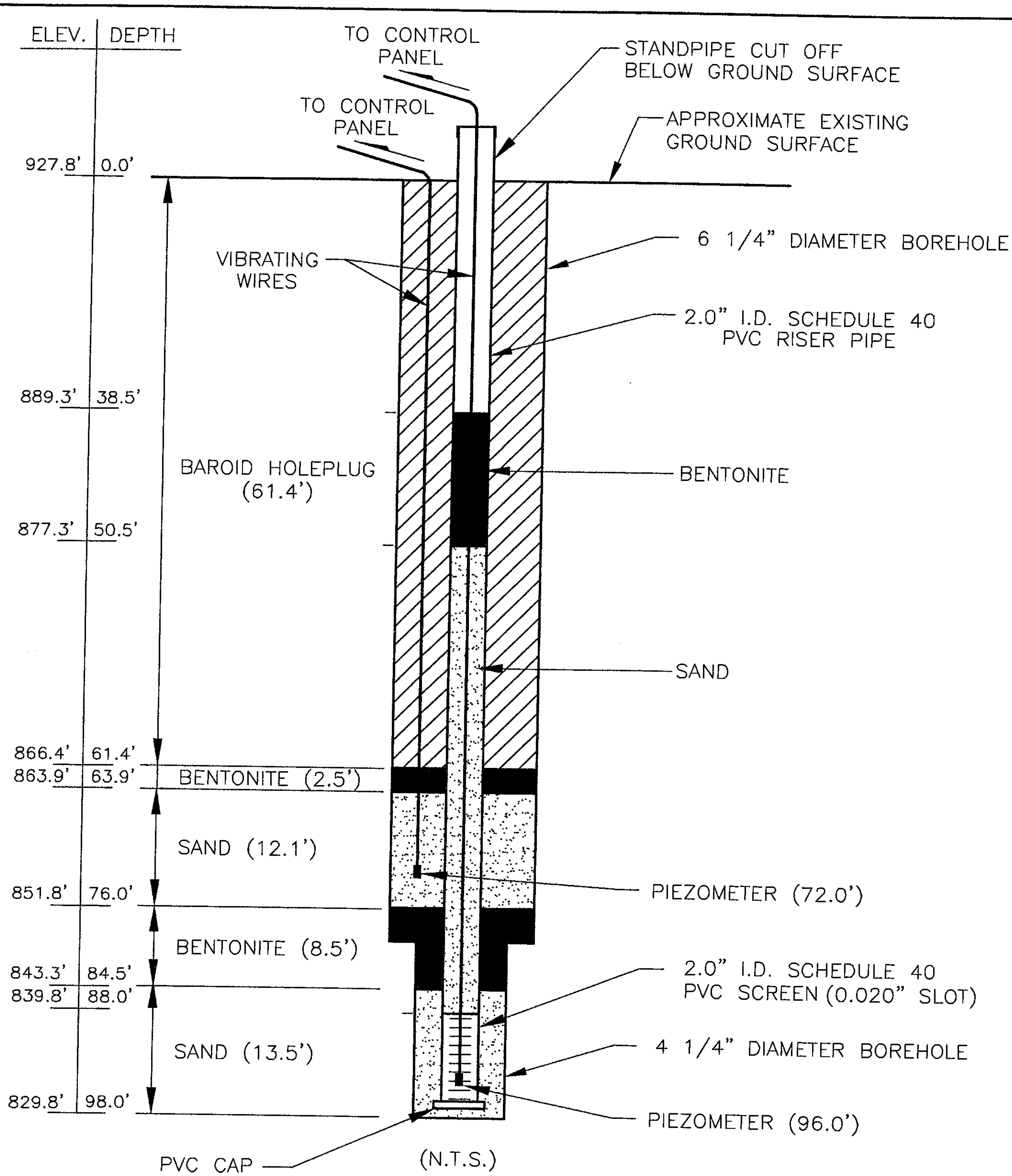
DRAWN BY DWD 11-6-97

BORING RB-1
PIEZOMETER INSTALLATION DETAIL
BLENHEIM-GILBOA POWER PROJECT

PREPARED FOR

NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

Paul C. Rizzo Associates, Inc.
CONSULTANTS



DRAWING NUMBER 97-1734-A4

CHECKED BY

APPROVED BY

DWD 11-6-97

DRAWN BY

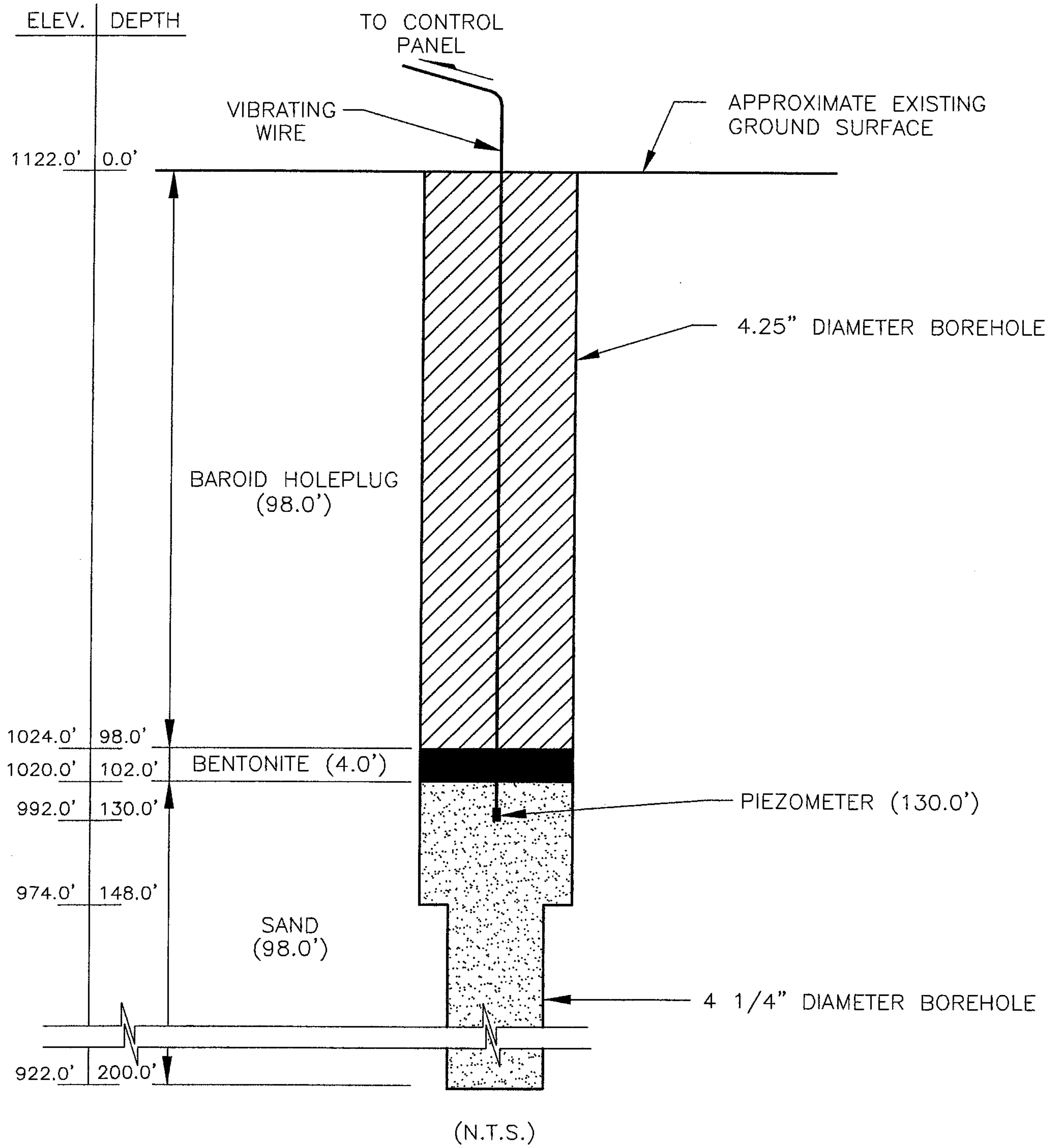
BORING RB-2
PIEZOMETER INSTALLATION DETAIL

BLENHEIM-GILBOA POWER PROJECT

PREPARED FOR

NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

Paul C. Rizzo Associates, Inc.
CONSULTANTS



DRAWING NUMBER 97-1734-A7

DRAWN BY: DWD 11-6-97

CHECKED BY

APPROVED BY

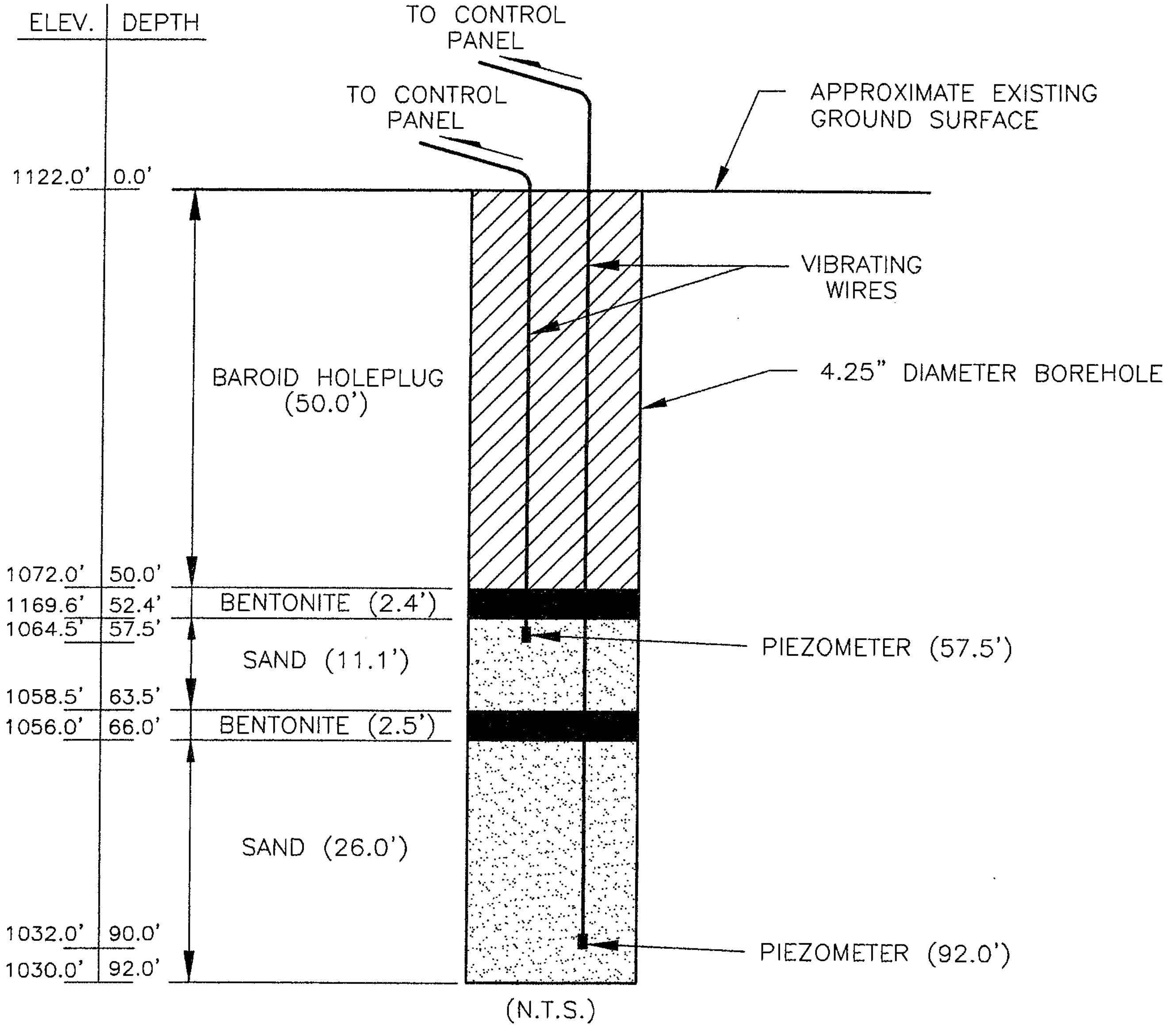
BORING RB-3
PIEZOMETER INSTALLATION DETAIL

BLENHEIM-GILBOA POWER PROJECT

PREPARED FOR

NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

Paul C. Rizzo Associates, Inc.
CONSULTANTS



DRAWING NUMBER 97-1734-A8

CHECKED BY | APPROVED BY

DWD 11-11-97

DRAWN BY

BORING RB-3A
PIEZOMETER INSTALLATION DETAIL

BLENHEIM-GILBOA POWER PROJECT

PREPARED FOR

NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

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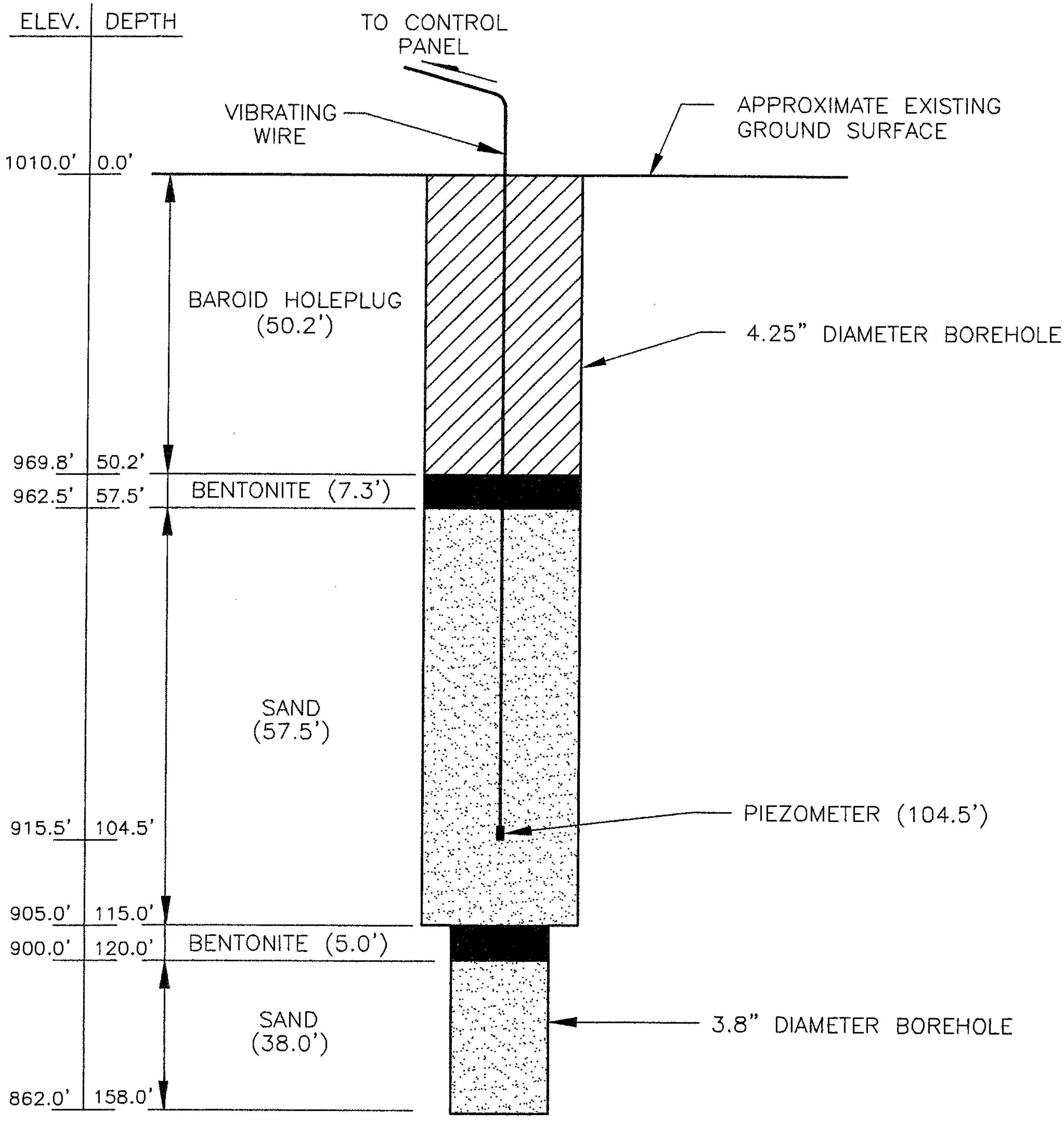

(N.T.S.)

BORING RB-4
PIEZOMETER INSTALLATION DETAIL

BLENHEIM-GILBOA POWER PROJECT

PREPARED FOR

NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

Paul C. Rizzo Associates, Inc.
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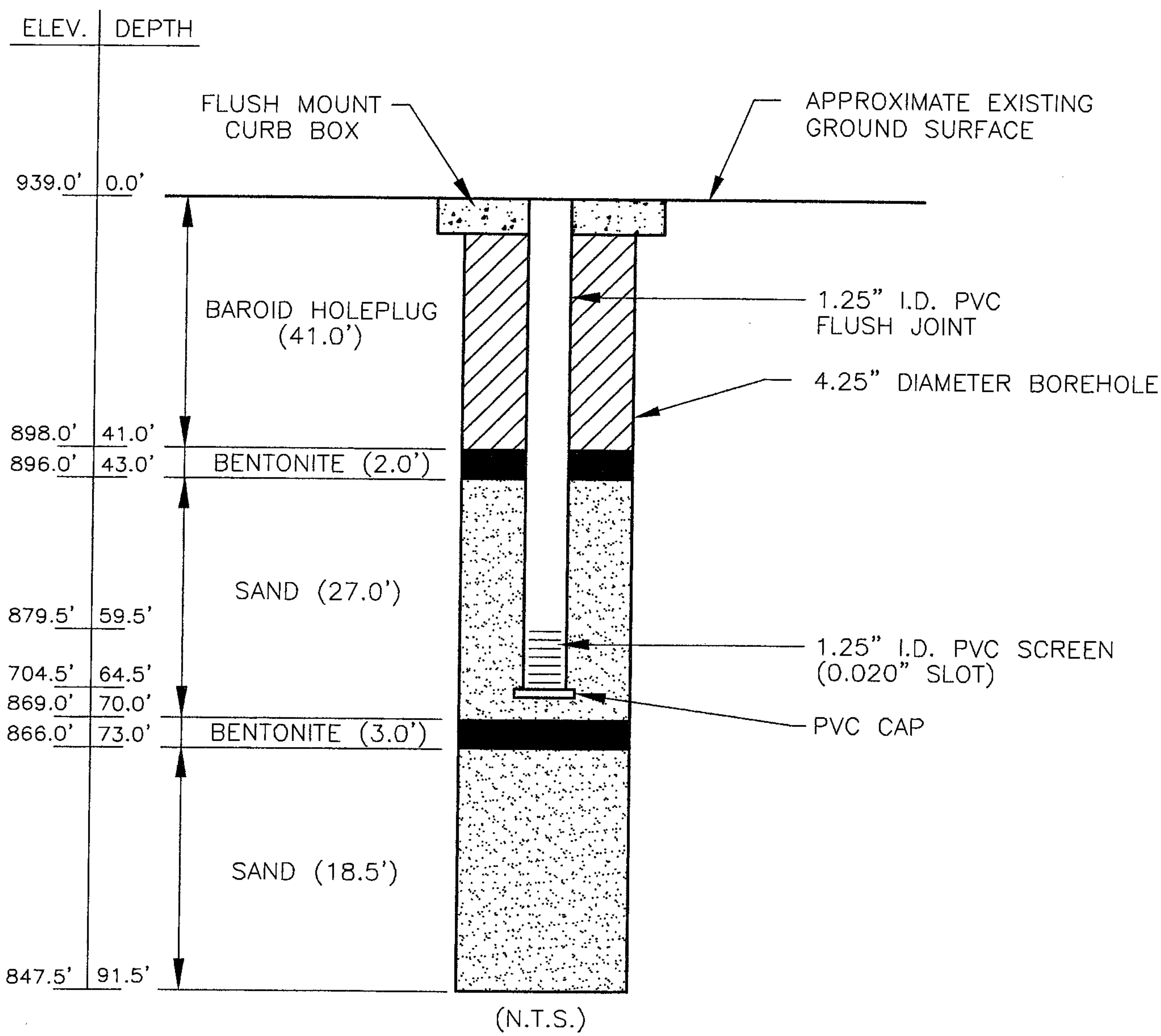

BORING RB-5
PIEZOMETER INSTALLATION DETAIL

BLENHEIM-GILBOA POWER PROJECT

PREPARED FOR

NEW YORK POWER AUTHORITY
WHITE PLAINS, NEW YORK

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