SCHOOR DEPALMA
Engineers and Design Professionals

May 14, 2002

Mr. Hemant Desai
Ansuya Enterprises
16 Fieldstone Drive
Clinton, NJ 08809

RE: Preliminary Geotechnical Engineering and Geological Investigative Report
Ansuya Enterprises, LLC
Proposed Hotel, Restaurant and Office Building
Block 17, Lot 2 and Block 18, Lots 2.04 and 6.0
Clinton, Hunterdon County, New Jersey
Our Project Number – E01284F

Dear Mr. Desai:

We are pleased to submit our Geotechnical Engineering and Geologic Investigation Report for the above referenced facility. This study entailed an evaluation of geotechnical, geological and hydro-geological factors affecting the proposed developments on the site. Although Clinton Township presently does not have any Carbonated Study Ordinance requirements, the guidelines of an administrative Phase I and II checklists, established by the New Jersey Sinkhole Committee, was implemented at this site. These services were conducted in accordance with our agreement dated March 5, 2002.

OBJECTIVE AND SCOPE

The proposed services included: (A) Subsurface Exploration, (B) Coordination, Layout and Inspection of the Subsurface Exploration, (C) Soil Laboratory Testing, and (D) a Preliminary Geotechnical Engineering/Geologic Assessment. The Preliminary Geotechnical Engineering/Geological Study included the evaluation of test boring, geological, soil test, and related structural data to develop the following:

1. Estimated subsurface conditions and groundwater levels within the area explored.

2. Preliminary foundation recommendations including feasible foundation systems and estimated range of bearing pressures or capacities.

Justin Corporate Center, 200 State Highway Nine, P.O. Box 900, Manalapan, NJ 07726-0900 Tel: 732.577.9000 Fax: 732.577.9888
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3. Recommendations for building pad preparation and floor slab support.

4. Review of published geological and hydro-geological information.

5. Discussion of pertinent construction considerations related to our recommendations.

Soil samples will be held until July 31, 2002, and will then be disposed of unless further storage is requested.

We appreciate the opportunity to provide geologic and geotechnical engineering services to you. Please give us a call with any questions you may have or if we may be of further assistance to you.

Very truly yours,

SCHOOR DEPALMA INC.

Moustafa A. Gouda, P.E., F.ASCE
Senior Vice President

Soheila Rahbari, P.E., P.G.
Senior Project Manager

Enclosure
MG:SR:c

SCHOOR DEPALMA
Engineers and Design Professionals

GEOTECHNICAL ENGINEERING AND GEOLOGICAL INVESTIGATIVE REPORT

for

ANSUYA ENTERPRISES, LLC

Proposed Hotel, Restaurant and Office Building

Clinton, Hunterdon County, New Jersey

Moustafa A. Gouda, P.E.
New Jersey Professional Engineer
License Number 20848

May 14, 2002
Schoor DePalma Project Number: E01284F

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EXECUTIVE SUMMARY

The information contained in this report has led us to the following summary of conclusions and recommendations:

1. The site is underlain by carbonate bedrock of the Allentown and Leithsville Formations. This bedrock is susceptible to development of karst features such as sinkholes.
2. Our evaluation of geologic and topographic maps, rock quality, hydrologic data, and proposed grading information indicates that this characterization is based on the site inspection, observations of the bedrock formation, variability in overburden thickness, presence of existing depressions and potential sinkholes, and depth to bedrock surface.
3. Unit prices should be obtained during bidding on this project for the work necessary to perform additional earthwork due to potential enhanced weathered zones, or investigate and plug sinkholes as discussed in the report. We recommend that the use of an unclassified excavation contract be considered for the bulk earthwork on this project.
4. Bedrock was encountered and cored at five locations across the site. Data from the rock cores indicated relatively poor to fair quality bedrock.
5. Auger refusal was encountered in Borings B-1 through B-4 completed within the proposed hotel, at depths of five to 13 feet below existing grades, and at depths of 5 and 12 feet in Borings B-8 and 9, completed within the proposed three story office building. Therefore, pending on the proposed grades foûndation and utility excavations may encounter disintegrated rock or rock. Fractures in this bedrock typically exhibit blocky-pattern joints; where the joints are poorly developed and irregularly spaced the bedrock is difficult to excavate.
6. Test borings completed on the site indicated that bedrock across most of the site is overlain by residual soils and decomposed rocky. This layer ranged from 5 to more than 13 feet in thickness and is composed of relatively low permeability clayey silt and silt.
7. Several depressions and potential sinkholes were identified during the site walk. We recommend that the areas where potential sinkholes were observed be further excavated utilizing a backhoe. The sinkholes should be remediated under the direction of a qualified professional geologist or engineer as noted in the Sinkhole Remediation Section of this report.
8. Based on the available data, groundwater may be encountered during general grading operations as well as excavations for deep utilities. We anticipate that groundwater, if encountered, can be controlled using conventional sumps and pumps. Fluctuations in the water table should be expected with variations in precipitation, surface runoff, pumping, and

evaporation occurring throughout the year. The contractor should be prepared to remove any accumulated water into the excavation within twenty-four hours.

9. Based on our preliminary geotechnical evaluation, it is feasible to construct the proposed buildings on shallow foundations as described in the geotechnical engineering report.

10. An excavated stormwater management system is planned to the western portion of the proposed hotel. It is our understanding that cuts on the order of 10 feet within the proposed basin is anticipated. Refusal on the auger was encountered in Boring B-5 completed in this area at a depth of about 10 feet below existing grade. We recommend that the stormwater management area be lined with a geocomposite clay liner or a minimum two feet of low permeability compacted structural fill to reduce the potential for sinkhole development.

11. It also should be noted that earthwork activities, such as regrading, compaction, and placement of a clay liner, would have a significant effect to reduce the infiltration rate.

12. A Geotechnical Engineer should be retained during construction to provide on-site observation and expertise related to the suitability of subgrade soils for footings, floor slabs, and compacted fill, and to provide consultation associated with site construction activities.

The conclusions and recommendations of this report are based on the information revealed by the following subsurface exploration and literature review, as well as the information provided by others. An attempt has been made to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction or in the course of later studies.

1.0 PROJECT BACKGROUND

1.1 Site Description

The site is located in the Town of Clinton, Hunterdon County, New Jersey. It is bordered on the west by the south branch of the Raritan River, on the south by Route 31, on the East by commercial property with office buildings on Moebus Place and on the North by residential property on River Bend Road. Access to the site is obtained from Route 31.

For the most part, the site is a wooded area with an exception of the center where the site is cleared with some evidence of construction debris. Figure 1 shows the site and its surrounding area. . The site within the area of the new building and parking lots gently slopes down in the southeast-northwest direction from El +260 to El +200. The existing grades slopes down sharply along the northwestern limit of the site.

1.2 Proposed Construction

The proposed construction will consist of two phases. Phase I of the project will consist of an approximately 42,000 square foot three-story hotel with associated pool and parking areas and a storm water basin. Phase II will consist of a 23,000 square foot three-story high office building, a 5,000 square foot, one-story restaurant, parking, and a storm water detention basin. Due to preliminary nature of the project the load schedules of the new buildings and the proposed grading information for Phase II were not available to us at the time of this report.

2.0 PRELIMINARY LITERATURE SEARCH

As part of this investigation, Schoor DePalma obtained and reviewed selected information regarding regional and local conditions. A list is provided in Appendix A. Information obtained during the literature review was used to design the investigation and to support site-specific interpretations of the data generated.

2.1 Previous Investigation Activities

It is our understanding that a Phase I Environmental Site Assessment (ESA) was performed at this site earlier this year 2002. The report is available for our review.

2.2 Regional Geology

Based on the review of the Engineering Soil Survey of New Jersey Report Number 6, Hunterdon County, New Jersey, the site is underlain by limestone bedrock, identified as Kittatinny Limestone. This formation is characterized as dense, hard, dolomitic limestone having a variable composition including slivery shale, quartzitic sandstone, chert, and flint interbedded in various localities.

A review of the Geology and Groundwater Resources of Hunterdon County, Special Report No. 24 dated 1966, prepared by Bureau of Geology and Topography, Division of Resource Development indicate that the site is underlain by Kittatinny Limestone, which underlies about 4% of the surface area of Hunterdon County overlying conformably upon the Hardysotne Quartzite. It can be divided into four members (from oldest to youngest, the Leithsville, Allentown, Rickenbach, and Epler Formations)(Markewicz, 1964) but it has been considered as one single unit in the Report No. 24 since all members seem to have essentially the same hydrologic properties. This formation has been described as a blue to gray dolomitic limestone with thin beds of chert, sandstone, and shale. The total thickness of the formation is estimated to be between 2,500 and 3,000 feet in other areas of the state. Faulting and folding in Hunterdon County repeat or eliminate some beds of the limestone so that the thickness cannot be measured within the county.

2.3 Local Geology

Local geology was evaluated through a review of the U.S.G.S. Bedrock Geologic Map of Northern New Jersey (Drake et al., 1996). A detail from the Bedrock Geologic Map of Northern New Jersey is provided in Plate 3, Appendix A. Published information indicates that the site is underlain by Allentown Dolomite Formation. Additionally, there is a geologic contact of Leithville Formation along the northeastern portion of the site.

The Allentown Formation is stratigraphically above the Leithsville Formation and is a light medium gray, fine to medium grained, thin to medium-bedded rock. This formation is approximately 1,300 feet thick and outcrops are common. Relevant literature indicates that joints and fractures in this unit are steeply dipping and moderately abundant. This formation is susceptible to solution activity and is often associated with bedrock pinnacles, subsurface cavities, and sinkhole activity throughout the region.

The Leithsville Formation consists of Middle to Lower Cambrian Age dark gray dolomite. Thick beds of greenish-gray, very fine-grained shale are found in the lower areas of this formation. The lowest beds are usually sandy and may contain small cavities. The mineral fluorite is also occasionally found. It is seldom exposed at the surface because it is found in low elevations such as valleys. It is an important source of groundwater, and is the most cavernous formation in the Kittantinny Group. Drake et al. (1996) described the Leithsville formation as a light to dark gray and light olive gray, fine to medium grain, thin to medium bedded dolomite. It grades downward though medium gray, grayish yellow or pinkish gray dolomite and dolomitic sandstone, silt stone, and shale to medium gray, medium grained, medium bedded dolomite containing quartz sand grains as stringers and lenses near the base.

The Leithsville Formation is underlain by the Lower Cambrian Hardyston Quartzite. The Hardyston Quartzie is a medium- to light-gray, fine- to coarse-grained, medium- to thick-bedded quartzite, arkosic sandstone, and dolomitic sandstone (Drake, et al, 1996).

2.4 Review Of Aerial Photographs

Aerial photographs dated 1959 and 1976 (scale = 1": 500' to 1" = 800') obtained from Robinson Aerial Surveys of Newton, New Jersey, were also reviewed for this site in an attempt to identify karst related features on and adjacent to the site. No signs of sinkholes, disappearing streams, or other karst features were observed on the site in the photographs. Our review revealed signs of surface mottling on the site. The mottling suggests that the surficial soils have variable moisture content typical of karst terrain. Copies of selected aerial photographs designated as Plates 1 and 2 are included in Appendix C.

The 1959 aerial photograph revealed the neighboring sites are primarily used for farming. The 1976 aerial photograph does not reveal much site development with an exception of the northwestern neighboring properties located across the South Branch of the Raritan River.

2.5 Regional Hydrogeology

According to Kasabach, 1966, the Kittatinny Limestone has virtually no primary permeability or porosity and groundwater must move through joints and fractures within the rock. Carbonate rocks differ from massive crystalline or well-cemented silicate sedimentary rocks because they are relatively soluble in weak acid solutions. Rain falling through the atmosphere picks up carbon dioxide thus forming a weak carbonic acid. The acid concentration may be further strengthened by more carbon dioxide and by weak organic acids as the rain enters and moves through the soil. The slightly acidic solution then percolates downward through joints, fractures, or bedding planes and slowly dissolves away the limestone until channels or even caverns are formed.

Solution channels are usually more abundant in valleys, depressions, and near streams. The distribution of the channels is usually irregular and unpredictable. However, sinkholes, the basin-like surface depressions in limestone area, are usually connected with large solution channels in the underlying limestone. Sinkholes may be aligned along an underground solution channel.

Groundwater in the Kittatinny Limestone is found under both semi artesian and water table conditions. Water table conditions prevail near the ground surface and semi-artesian conditions occur in some of the deeper solution channels, which are recharged through sinkholes or water table aquifers.

Most successful wells have encountered large openings between 50 and 300 feet. Reported yields from 70 domestic wells drawing from the Kittatinny Limestone range from 1/2 to 50 gpm with an average of 17 gpm. Thirty-seven of the wells yield 15 gpm or more. Only eight industrial well records are available form the Kittatinny. Their yield range from 1500 gpm (highest in the county) to 15 gpm, with an average of 414 gpm, and a median of 250 gpm, see attached, (Haig F. Kasabach 1966).

There are twenty-two industrial wells in Clinton Township. Two are drawing from the Brunswick Shale, two are drawing from the Martinsburg Shale, one is drawing from the baked Brunswick Shale, thirteen are drawing from the Precambrian (Undifferentiated), and four are drawing from the Kittatinny Limestone. A summary of the Hunterdon County Industrial Wells on all but the Precambrian wells in Clinton Township is included in Appendix A.

2.6 Site Reconnaissance

Personnel from our office performed a site walkover on May 3, 2002. . The purpose of the site inspection was to observe the surface conditions and to evaluate the soil types, potential presence of visible karst features, and bedrock exposures.

For the most part, the site is wooded with one major clearing at the center of the site, about 100 feet east of the Boring B-4 completed within the hotel area. Household trash, construction debris, wood, lumber, and a storage tank were observed in this area. During our site visit several surface depressions and drainage pathways into the ground were observed in the proximity of Borings B-1 through B-5. Additionally, a sinkhole and large voids of about 5 feet deep (washed beneath tree roots) were observed in the proximity of the Boring B-9. Several pictures of these areas were taken and are included in Appendix B of this report. The remainder of the site was covered with high brush and was not accessible.

Several small surface depressions, ranging in size from six inches to one foot in diameter, were noted in the high brush area in between Borings B-5 and B-2. Although rock was encountered at a depth of about five feet below ground surface at Boring B-1, no visibly rock outcrop was observed during our site walk.

2.7 Karst Features

Karstic features, consisting of an uneven bedrock surface with pinnacles, isolated boulders, ledges, troughs and seams, characterize dolomite rocks of the Allentown and Leithsville Formations. Pinnacles were encountered near the bottom of several borings, as was evidenced by grinding of the augers on a hard surface, bending of the sampling spoon during driving, a loss of plumbness, and large variations in refusal depth between offset borings.

Enhanced weathered zones exist in the soil over carbonate rock, such as the Allentown and Leithsville Formations. These enhanced weathered zones have increased moisture content and are extremely soft. These zones may vary in thickness and are caused by the relatively fast weathering of carbonate rock via solutioning that leaves a discrete soil-rock interface. Groundwater infiltrating from the ground surface tends to concentrate along this soil-rock interface, increasing the moisture content and further removing dissolved rock. The result is a very soft zone of unsuitable soil. This zone of unsuitable soil provides poor support for load bearing structures.

A fracture zone is a concentration of roughly parallel joints or faults. Fracture zones with open joints or faults provide avenues for water to flow in a concentrated manner through the site and increase the potential for weathering, subsidence, and sinkholes. Solutioning features are formed as water is stored in and moves through interconnected openings in carbonate rocks. Most openings present within the rock are created along bedding planes, joints, fractures, and faults, where they are enlarged by the solvent action of slightly acidic water coming in contact with the rocks. The process generally creates voids or cavities within otherwise competent hard limestone and dolomite rock strata. Overburden soils above such cavities can collapse into the voids forming sinkholes.

Downward migration, or subsurface erosion, of soil into underlying openings in bedrock can also occur. Once this erosion occurs, construction equipment loads and related vibrations, or new structural loads, could further induce a collapse of the cavities.

Another cause of surface instability could be a substantial decline in the water table which would result in: (a) loss of buoyant support, (b) increase in the velocity and movement of groundwater, (c) water level fluctuations at the base of unconsolidated deposits, and (d) enhanced recharge; all of which induce sinkhole activity.

3.0 SUBSURFACE EXPLORATION

3.1 General

Site Blauvelt Engineers of Mt. Laurel, New Jersey, performed the subsurface investigation using a truck rig on April 18 through 24, 2002 under the full-time supervision of a Geotechnical Engineer from Schoor DePalma. The site was partially cleared to access the boring locations. The investigation included advancing ten (10) Standard Penetration Test (SPT) borings, designated as Borings B-1 through B-10. Borings B-1 through B-4 were located in the proposed hotel area. Boring B-5 was completed within the proposed basin located to the west of the proposed hotel. Boring B-6 was located in the proposed restaurant area; and Boring B-7 was completed within the access road. Borings B-8 and B-9 were completed within the proposed office building; the approximate boring locations along with other pertinent site information are shown on Figure 2, included in Appendix C.

The drilling depth for the test borings range from of 6 to 20.5 feet including rock coring. All test borings were advanced using the hollow stem auger drilling method. Upon auger drilling refusal, bedrock was cored using a NX size split core barrel in selected Borings B-1, B-2, B-5, B-6 and B-8. All test borings were cement grouted upon completion of drilling.

Soil samples were recovered via a 2-inch O.D. split-spoon sampler; driven by a 140-pound hammer, free falling 30 inches (ASTM D-1586). The SPT N-values indicate the resistances encountered in a particular layer as determined from the number of blows required to drive a 2-inch O.D. split spoon sampler 1 foot of penetration. Soil samples were obtained continuously in the upper 10 feet and at 5-foot intervals thereafter.

The soil samples have been visually classified per the Burmister and Unified Soil Classification System (USCS). Criteria for these soil classifications are included in Appendix B. Some variation is likely to occur between the visual and laboratory classifications. Test boring logs are provided in Appendix B.

Decomposed rock in this report consists of residual material with N values in excess of 60 blows per foot and less than 100 blows for 2 inches of penetration. Penetration resistance of 100 blows or more per 2 inches is designated as refusal. Auger refusal was observed at depths of 5 to 13 feet in all the borings except B-7 where the boring was terminated at 5 feet below ground surface.

3.2 Stratification

Two to four inches of topsoil overlies the site. Based on the test borings, the following generalized soil strata underlie the site to the depths explored.

- **Stratum A – Residual Soil,** derived from the in-place chemical weathering of the underlying Leithsville and Allentown Formation rock. This stratum consists of soft to very stiff, light brown to orange mottled with yellow and black, Silt to Clayey Silt (ML to CL) with varying amounts of sand, trace of gravel. The soil of this stratum represent the residual soils derived from the in-place chemical and physical weathering of the parent bedrock. The SPT N-values of this stratum range from 3 to 28 with a typical value of 8. This stratum extends to depths of about 4 to 12 feet below existing grades at test boring locations.

- **Stratum B – Weathered to Decomposed Rock:** This stratum consists of very stiff, light brown to orange mottled with yellow and black, Silt to Clayey Silt mixed with rock fragments. The SPT N-values of this stratum range from 60 or higher. This stratum is about 2 to 4 feet in thickness. This material has undergone considerably less weathering than the overlying residual soils and maintains some of the strength and consistency characteristics of soft rock. Where this material was discernible in the borings, it has been segregated and referred to as decomposed rock.

- **Stratum C – Limestone of Allentown and Leithsville Formations:** The rock quality designation (RQD) ranged from 40% to 80% with a typical value of 50% indicating fair rock quality in general. RQD is defined as the length of rock pieces greater than 4 inches in length divided by the total length cored expressed as a percent. It is important to note that drilling water loss was reported in Boring B-1 at 13.5 feet depth and in boring B-8 at 7.5 feet depth during rock coring. This can be an indication of a void.

3.3 Groundwater Conditions

Groundwater could not be determined in most of the test borings. However, "wet" soil samples were encountered at a depth of about 6.5 feet below exiting grades in test borings B-6 and B-8 indicating possible groundwater or "perched water" locally above the bedrock. Shallow "perched" groundwater may occur intermittently if relatively less permeable soil units prevent the downward migration of surface water. Long-term water level readings were not obtained in these borings, as they were cement grouted upon completion for safety.

Soil moisture and groundwater conditions should be expected to fluctuate with season, precipitation amounts, and other on-site and off-site factors including site utilization.

3.4 Soils Laboratory Testing

All recovered soil samples were taken to Schoor DePalma's soils laboratory in Marlboro, NJ for soil classification purposes. The field classifications were confirmed or modified as necessary.

4.0 PRELIMINARY GEOTECHNICAL ENGINEERING ANALYSIS

4.1 Discussion

Auger refusal was encountered in Borings B-1 through B-4 completed within the proposed hotel, at depths of five to 13 feet below existing grades, and at depths of 5 and 12 feet in Borings B-8 and 9, completed within the proposed three story office building. Therefore, pending on the proposed grades foundation and utility excavations may encounter disintegrated rock or rock. Even with numerous test borings, the exact rock profile would be very difficult to predict due to the pinnacled nature of the rock in these formations. It is not uncommon for rock of this type to have a highly irregular surface.

Several surface depressions, sinkholes and drainage pathways into the ground were observed during our site walkover. These areas and any other soft zones encountered during the construction should be excavated and checked. The existing sinkhole area and the depression around it should be excavated and repaired based on the recommendations given in Section 7.5 of this report.

Based on our review of available data regarding the rock formation encountered and geologic trends in the area we have characterized the overall potential for future sinkhole formation as moderate.

Spread footings were evaluated for support of the proposed structures and are recommended. It should be noted that in developing this site, there would be some risk of sinkhole development both during and after construction. However, by taking precautions during design and construction, spread footings can be utilized and the probability of dealing with sinkhole development can be greatly reduced. Detailed recommendations for spread footings are discussed below.

4.2 Foundation Design

Based on our preliminary geotechnical analysis, we believe shallow spread footings are feasible to support the new buildings. Spread footings may be supported on suitable natural soils and/or on new compacted structural fill following removal of soft unsuitable material from beneath the footing bottoms. In the area of Boring B-l through B-4 soft soils were encountered within the upper 5 to 8 feet. These types of soils are not considered suitable for foundation support; therefore, the use of Geoprobe and hand augers should be used to further evaluate footing subgrade materials during construction, and soft soils encountered should be undercut and replaced.

Hand augers should be performed at 10-foot intervals in wall footings and at each column location. The probes should extend at least 6 feet below the planned wall and column footing grades unless bedrock is encountered at a shallower depth. Footing areas, which are found to contain very soft zones within the planned depths of the probes, should be undercut to remove this unsuitable material. Undercuts below footing depths of up to 5 feet may be required. Actual depths and locations of undercutting required should be based on the evaluation of the probe data by the Geotechnical Engineer. Footing subgrades requiring undercut may be backfilled to original subgrade elevations with concrete or compacted structural fill as previously described.

For preliminary planning purposes, footings for the planned buildings may be sized for an allowable soil bearing pressure of 3000 psf when founded on suitable natural soils and/or compacted structural fill. Where feasible, shallow foundations supported on the underlying disintegrated rock and rock may be designed for allowable bearing pressures in the range of 6 to 8 ksf. The actual design foundation bearing pressure recommended should be based upon limiting total and differential settlements. Exterior footing grades should extend at least 3 feet below final exterior grade for protection against frost.

Exterior footing grades should be at least 3 feet below the final exterior grade for protection against frost heave. All column footings should be a minimum of 24 inches wide for shear considerations.

Total foundation settlements due to structural loads are expected to be less than 1 inch, with differential settlements between similarly loaded adjacent foundation elements of about 1/2 inch.

The soils encountered at the test boring locations have a soil-profile type of S_1 which corresponds to a site coefficient of S = 1.0 for seismic activity. Information pertinent to seismic activity was obtained from the 1996 BOCA National Building Code.

4.3 Floor Slab

Slabs on-grade may be supported on suitable natural soils and new compacted structural fill following removal of any existing soft or unsuitable material and subgrade preparation as described below. Concrete floor slabs may be designed using a subgrade modulus value of 80 pci based on a one foot square steel plate. A minimum of 6-inch thick 3/4-inch clean, crushed stone or a 12-inch thick layer (minimum) of well-graded sand and gravel with no more than 12% non-plastic fines is recommended below the slab to assure uniform curing conditions. A 6-mil PVC vapor barrier may be placed between the slab and base course, as directed by the Architect, to minimize moisture migration to the surface. All structural fill supporting the floor slab should be compacted to 95% of the maximum dry density ASTM D 1557, Modified Proctor.

4.4 Stormwater Management Basin

A stormwater management system is planned for the western portion of the proposed hotel. It is our understanding that cuts on the order of 10 feet within the proposed basin are anticipated. Refusal on the auger was encountered in Boring B-5 completed in this area at a depth of about 10 feet below existing grade. We recommend that the stormwater management area be lined with a geocomposite clay liner or a minimum two feet of low permeability compacted structural fill to reduce the potential for sinkhole development.

It also should be noted that earthwork activities, such as regrading, compaction, and placement of a clay liner, would have a significant effect and reduce the infiltration rate.

4.5 Compacted Structural Fill

Areas to receive compacted fill should be stripped to remove cultivated soils, organic matter, and vegetation. After the initial stripping has been completed, subgrades should be proofrolled with a tandem-axle dump truck or ten-ton smooth-drum roller under the observation of the Geotechnical Engineer. Any loose or soft areas which exhibit excessive pumping or weaving should be removed at the discretion of the Geotechnical Engineer and replaced with new compacted fill as described below.

Compacted fill for building and pavement support should consist of material classifying SM or better in accordance with ASTM D2487 with a maximum particle size of 3 inches. It should be anticipated that some drying and reworking of the on-site soils will be necessary to achieve the required compaction as outlined above. Compacted fill should be placed in lifts not exceeding 8 inches in loose thickness and should be compacted to at least 95 percent of maximum dry density per ASTM D 1557, Modified Proctor. Only light hand-operated compaction equipment should be used adjacent to and within 5 feet of walls.

6.0 PROJECT DEVELOPMENT CONSIDERATIONS

The karst geology present beneath the site is susceptible to the development of sinkholes; therefore, it is important to incorporate as many design details as possible that will minimize the risk of subsidence due to sinkhole development. Design plans should incorporate measures that will inhibit surface water infiltration. A list of final design details, which tend to minimize the risk of sinkhole development, is provided below:

- Incorporate designs that will tend to maintain groundwater levels consistent with those prior to development. Placement of water supply wells in the vicinity of buildings should be avoided.
- Grading plans should reflect positive surface drainage away from buildings.
- Do not plan utilities adjacent to or beneath shallow foundations.
- Provide watertight joints for storm drain pipes.
- Tie roof drains directly into storm drainage systems.
- Seal pavement curbs and catch basins. Do not allow concentrated flows in unpaved or unlined ditches or swales near structures.
- Minimize landscaped areas and sprinkler systems adjacent to buildings.
- Use lined detention basins or keep away from building areas where possible.
- Avoid planting species that require large amounts of water or frequent watering.
- Avoidance of unlined swales or retention basins
- If any sinkholes or associated features are observed during construction, the features should be mitigated as directed by the Geotechnical Engineer. This may include excavating in the area to the bedrock and plugging the solution feature with cement grout or concrete.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Earthwork

No excavations should be allowed to pond water during construction. Any subgrade soils which have been weakened due to saturation or disturbance should be removed. Overexcavated areas should be replaced with compacted fill as previously described.

The contractor should schedule his work so that the construction traffic is controlled in an efficient manner such that compacted fill and subgrade work previously approved are not subsequently disturbed. This may result in costly reworking of previously approved areas, especially when wetted by surface water. The specification should delegate this responsibility to the contractor.

All footing excavations and utility excavations should be backfilled with suitable compacted fill. Compaction requirements are the same as for compacted fill previously discussed.

7.2 Foundations

Care should be exercised during excavation for spread footings so that disturbance at the foundation level is avoided. Loose or soft soils should be cleaned from the bottom of the excavation prior to concrete placement. Actual foundation grades should be observed by the Geotechnical Engineer to verify that subgrade soils meet the requirements given herein.

7.3 Carbonate Formation Solutioning Features

During construction, excavations should be backfilled or concreted as soon as possible after they are opened. Grading should be planned to avoid surface depressions or other features that could collect ponded water during construction. Ponded water that develops should be pumped out promptly. Any sinkholes or enhanced weathered zones encountered during construction should be immediately brought to the attention of the Geotechnical Engineer.

Where rock is expected to be present along some of the utility alignments, the rock should be fractured and/or excavated to the required depths during the bulk earthwork. Blasting of the limestone bedrock may create the potential for larger voids or fractures within the underlying bedrock mass. Therefore, blasting should be avoided if possible.

Blasting is not recommended. Where blasting is necessary, it should be carefully controlled within about two feet of finished grade in an effort to reduce the potential for creating larger fractures. This work should be performed by someone experienced in blasting techniques that can show a history of successful performance on similar projects in karst terrain. If blasting is performed, it should be completed prior to starting foundation construction to minimize the possibility of opening up sinkholes under structures in progress, and vibrations should be monitored to evaluate the potential for inducing sinkholes or damage to adjacent structures.

7.4 Sink Hole Remediation

Based on the location and the nature of potential sinkholes it is our recommendation the one of the following procedures be implemented for proper remediation. The remediation should be completed under the direction of a qualified professional geologist or engineer and that field conditions may require modification of the plan. Although several sinkhole remediation methods are available in the industry and can be approved by the Geotechnical Engineer, two alternative schemes are presented below:

- **Alternative No. 1**

  Where potential sinkhole conditions are observed or encountered within the building and pavement area during construction, soft soils should be excavated to reveal the throat of the sinkhole. The throat should be plugged with concrete if feasible. A low slump concrete may be used to form a plug so as not to utilize excessive amounts of concrete. Following a curing period, the remainder of the excavation may be filled with compacted soil fill. It should be assumed that rock pinnacles and crevices may be encountered which might inhibit compaction efforts. Pinnacles and overhangs should be removed, and crevices cleaned out and filled with lean concrete as necessary to facilitate compaction. If the throat cannot be revealed, alternative methods of capping the solution feature can be developed by the Geotechnical Engineer based on the site conditions.

- **Alternative No. 2**

  Where potential sinkhole conditions are observed or encountered within the building and pavement area during construction, the base of the sinkhole should be excavated to remove unstable soft soils and debris. The excavation should continue until competent rock or firm soil is exposed. If the base of the excavation is not in competent rock and a sinkhole throat is not identified, the excavation should be washed with a sufficient quantity of water to open any/or identify any remaining voids or fractures. Any voids, openings, fractures, or identified throats should be sealed with a sufficient quantity of high slump, sand mix concrete with added expander. The remainder of the excavation should then be filled with impermeable soil, compacted in eight-inch loose lifts to the ground surface. The ground surface in the vicinity of the remediated sinkhole should be graded to prevent erosion and accumulation of surface water runoff.

8.0 GENERAL

The conclusions of the report are based on the information revealed by this exploration. An attempt has been made to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction. An allowance should be established to account for possible additional costs that may be required to construct foundations and earthwork as recommended herein. Additional costs may be incurred for various reasons including variation of soil between borings, inability to use the on-site soils at the time earthwork proceeds, and undercutting of unsuitable soils and sinkhole repair.

We welcome the opportunity to review the final foundation plans and earthwork specifications as they pertain to this phase of the project, and to submit our comments based on this review. Any substantial change in location and in grade should be brought to our attention so that we may determine how this may affect our recommendations.

This study should be made available to prospective bidders for informational purposes. We would recommend that the project specifications contain the following statement:

> "A geotechnical engineering report has been prepared for this project by Schoor DePalma. This report is for informational purposes only and should not be considered part of the contract documents. The opinions expressed in this report are those of the Geotechnical Engineer and represent his interpretation of the subsoil conditions, tests, and the results of analyses which he has conducted. Should the data contained in this report not be adequate for the Contractor's purposes, the Contractor may make, prior to bidding, his own investigation, tests and analyses. This report may be examined by bidders at the office of the Architect/Engineer or copies may be procured from the Architect/Engineer at nominal charge."

LIST OF REFERENCES

U.S. Department of Interior: U.S. Geological Survey. "Bedrock Geologic Map of Northern New Jersey", by Avery Ala Drake, Jr., Richard A. Volkert, Donald H. Montverde, Gregory C. Herman, Hugh F. Houghton, Ronald A. Parker, and Richard F. Dalton, Miscellaneous Investigations Series 1996, Map I-2540-A.

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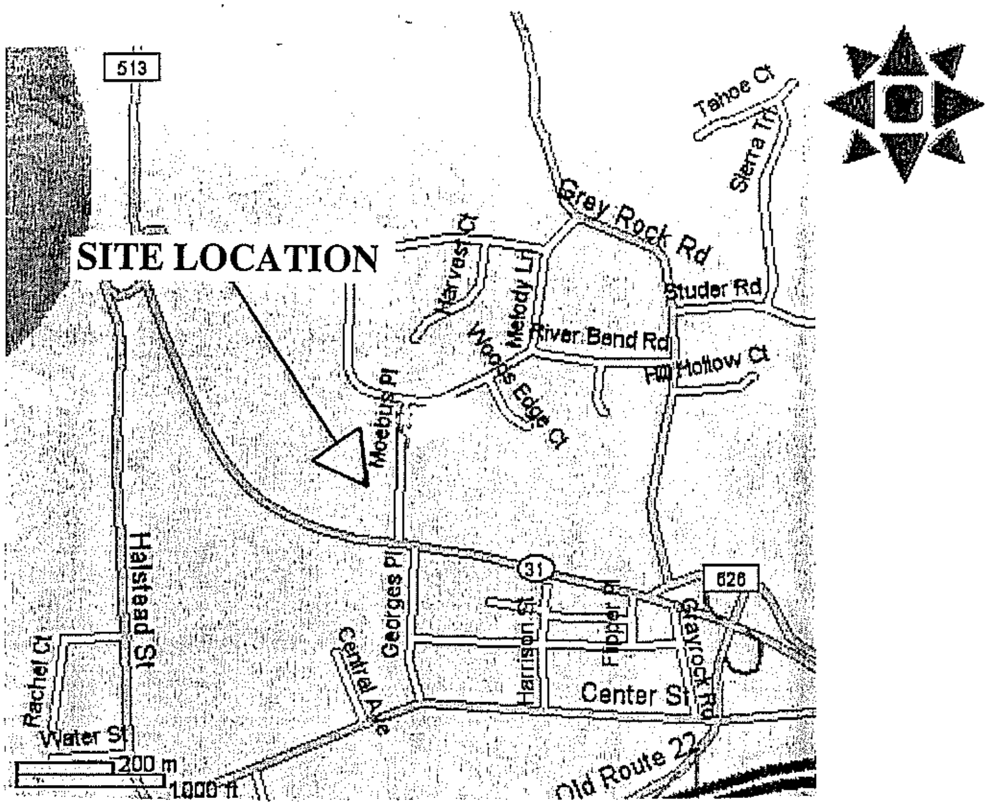

FIGURE 1

SITE LOCATION MAP

ANSUYA ENTERPRISES, LLC
CLINTON, NEW JERSEY

SCHOOR DEPALMA
Engineers and Design Professionals
200 STATE HIGHWAY NINE
P.O. BOX 900 MANALAPAN N.J. 07726-0900
TEL (732)577-9000 FAX. (732)577-9888

DATE	REVISIONS	ORDER NO.

SCALE	DATE	DRAWN BY	CHK'D BY	FILE NO.	FIELD BOOK
	5-8-02	EHJ	CH	E01284F	FB

TEST BORING LOG

Boring Contractor: SITE BLAUVELT ENGINEERS MT. LAUREL, NJ	SCHOOR DEPALMA Engineers and Design Professionals	Project:	RIVERBEND PH1 ENVIRONMENT
oring Foreman: WILL DEININGER		Project Location:	CLINTON, NJ
Drilling Method: HOLLOW STEM AUGER		Project Number:	E01284F
rilling Equipment: CME-45C		Boring Log:	B-1

D Representative: L. RIOS	GROUNDWATER OBSERVATIONS	Depth
Dates: Started: 4/20/2001 Finished: 4/23/2002	Encountered:	N/E
Ground Surface Elevation: 230±	Completion:	
	Location: SEE TEST BORING LOCATION PLAN	Page 1 of 1

SAMPLING DATA			STRATUM	DEPTH		CLASS	STRATA DESCRIPTION	% w	REMARKS
					-0		TOP SOIL 4"		
S-1		3-2-2-3		1	-		LIGHT BROWN TO ORANGE SILT, TRACE FINE SAND		
				2	-				
S-2		3-4-3-3		3	-		DO, MOTTLED DARK YELLOW AND BLACK		
				4	-				AUGER REFUSAL
S-3		15-50/3"			-5		PIECES OF LIMESTONE		AT 5'
				6	-	5 MIN	LIGHT GRAY TO WHITE LIMESTONE, INTERBEDDED WITH DOLOMITE,		
				7	-	6 MIN	UNWEATHERED TO SLIGHTLY WEATHERED, SOUND TO EXTREMELY		REC = 100%
R-1			5'-10'	8	-	3 MIN	FRACTURED		RQD = 52%
				9	-	5 MIN			
					-10	7 MIN			
				11	-	7 MIN	LIGHT GRAY TO WHITE LIMESTONE, INTERBEDDED WITH DOLOMITE,		
				12	-	8 MIN	UNWEATHERD TO SLIGHTLY WEATHERED, SOUND TO EXTREMELY		REC = 100%
R-2			10'-15'	13	-	7 MIN	FRACTURED		RQD = 52%
				14	-	4 MIN			WATER LOSE AT 13.5'
					-15	3 MIN			
				16	-		BOTTOM OF BORING @ 15.0'		
				17	-				
				18	-				
				19	-		BORE HOLE WAS CEMENT-GROUTED UPON THE COMPLETION OF DRILLING		
					-20				
				21	-				
				22	-				
				23	-				
				24	-				
					-25				
				26	-				
				27	-				
				28	-				
				29	-				
					- 30				
				31	-				
				32	-				
				33	-				
				34	-				
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				36					
				37					
				38					
				39					
					40				

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Air Reading P.M.)						

TEST BORING LOG

Boring Contractor:	SITE-BLAUVELT ENGINEERS MT. LAUREL, NJ
oring Foreman:	WILL DENNINGER
Drilling Method:	HOLLOW STEM AUGER
rilling Equipment:	CME-45C
D Representative:	LUIS RIOS
Dates: Started:	4/18/2002 Finished: 4/19/2002
Ground Surface Elevation:	

SCHOOR DEPALMA
Engineers and Design Professionals

Project:	RIVERBEND PHI ENVIR.
Project Location:	CLIFTON, NJ
Project Number:	E01284F
Boring Log:	B2

GROUNDWATER OBSERVATIONS	Depth
Encountered:	
Completion:	
Location: SEE TEST BORING LOCATION PLAN	Page 1 of 1

SAMPLING DATA		STRATUM	DEPTH		CLASS	STRATA DESCRIPTION	% W	REMARKS
				-0		3 INCHES OF TOP SOIL		
S1	2-2-1-2		1	-		LIGHT BROWN TO ORANGE SILT		
			2	-				
S2	3-4-4-8		3	-				
			4	-				
S3	2-3-2-4			-5				Drilling hard from 5 feet to 10 feet
			6	-				
S4	9-12-17-21		7	-		DO, CRUSHED ROCK AT BOTTOM OF SPOON		
			8	-		PULVARIZED GRAY ROCK AND PIECES OF ROCK		
S5	37-45-30-50/4"		9	-		DO, CRUSHED ROCK AT BOTTOM OF SPOON		
				-10				Auger Refusal at 10.5 ft.
			11	-		GRAY TO BLACK UNWEATHERED TO SLIGHTLY WEATHERED SAND TO EXTREMELY FRACTURED		REC = 93% RQD = 52% (Soil filled fracture (FUG) from 12-12'-4") Core rate is 6, 7, 3, 5, and 7 minutes respectively
			12	-				
			13	-				
			14	-				
				-15				
			16	-		GRAY TO BLACK UNWEATHERED TO SLIGHTLY WEATHERED SAND TO EXTREMELY FRACTURED		REC = 100% RQD = 80% Core rate is 5, 17, 4, 4, and 3 minutes respectively
			17	-				
			18	-				
			19	-				
				-20				
			21	-		BOTTOM OF BORING AT 20.5 FEET		
			22	-				
			23	-				
			24	-				
				-25				
			26	-				
			27	-				
			28	-				
			29	-				
				- 30				
			31	-				
			32	-				
			33	-				
			34	-				
				- 35				
			36					
			37					
			38					
			39					
				40				

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TEST BORING LOG

Boring Contractor:	SITE BLAUVELT ENGINEERS MT. LAUREL, NJ	SCHOOR DEPALMA Engineers and Design Professionals	Project: RIVERBEND PH1 ENVIRONMENT Project Location: CLINTON, NJ Project Number: E01284F Boring Log: B-3
ɔoring Foreman:	WILL DEININGER		
Drilling Method:	HOLLOW STEM AUGER		
?rilling Equipment:	CME-45C	GROUNDWATER OBSERVATIONS	Depth
D Representative:	L. RIOS	Encountered:	N/E
Dates: Started:	4/23/2002 Finished: 4/23/2002	Completion:	
Ground Surface Elevation:		Location: SEE TEST BORING LOCATION PLAN	Page 1 of 1

SAMPLING DATA			STRATUM	DEPTH		CLASS	STRATA DESCRIPTION	% W	REMARKS
					-0		TOP SOIL 2"		
S-1		5-5-6-5		1	-		LIGHT BROWN TO ORANGE SILT, TRACE FINE SAND		
				2	-				
S-2		6-5-4-3		3	-		DO, MOTTLED DARK YELLOW		
				4	-				DRILLING HARD FROM 6' TO 9'
S-3		2-2-2-1			-5				
				6	-				
S-4		2-1-2-1		7	-				
				8	-				
S-5		8-12-18-50/5"		9	-		PIECES OF LIMESTONE		
					-10				
				11	-				
				12	-				AUGER REFUSAL AT 13.0'
S-6		50/0"		13	-		NO RECOVERY		
				14	-		BOTTOM OF BORING @ 13.0'		
					-15				
				16	-		BORE HOLE WAS CEMENT-GROUTED UPON COMPLETION OF DRILLING		
				17	-				
				18	-				
				19	-				
					-20				
				21	-				
				22	-				
				23	-				
				24	-				
					-25				
				26	-				
				27	-				
				28	-				
				29	-				
					- 30				
				31	-				
				32	-				
				33	-				
				34	-				
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				38					
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TEST BORING LOG

Boring Contractor: SITE BLAUVELT ENGINEERS, MT. LAUREL, NJ	SCHOOR DEPALMA Engineers and Design Professionals	Project:	RIVERBEND PH1 ENVIRONMENT
Boring Foreman: WILL DEININGER		Project Location:	CLINTON, NJ
Drilling Method: HOLLOW STEM AUGER		Project Number:	E01284F
Drilling Equipment: CME-45C		Boring Log:	B-4
SD Representative: L. RIOS	GROUNDWATER OBSERVATIONS		Depth
Dates: Started: 4/23/2002 Finished: 4/23/2002	Encountered:		N/E
	Completion:		
Ground Surface Elevation:	Location: SEE TEST BORING LOCATION PLAN		Page 1 of 1

SAMPLING DATA		STRATUM	DEPTH	CLASS	STRATA DESCRIPTION	% w	REMARKS
			-0		TOP SOIL 4"		
S-1	2-3-4-5		1		LIGHT BROWN TO ORANGE SILT, TRACE FINE SAND		
			2				
S-2	5-5-4-3		3		DO, MOTTLED DARK YELLOW AND BLACK		
			4				
S-3	1-1-2-3		-5		DO, MOTTTLED DARK YELLOW, RED AND BLACK		
			6				
S-4	1-1-2-3		7				
			8				AUGER REFUSAL
S-5	4-5-4-5		9				AT 10.0'
			-10				
			11		BOTTOM OF BORING @10.0'		
			12		BORE HOLE WAS CEMENT-GROUTED UPON COMPLETION OF THE DRILLING		
			13				
			14				
			-15				
			16				
			17				
			18				
			19				
			-20				
			21				
			22				
			23				
			24				
			-25				
			26				
			27				
			28				
			29				
			-30				
			31				
			32				
			33				
			34				
			-35				
			36				
			37				
			38				
			39				
			40				

Time							
Air Reading (P.P.M.)							

TEST BORING LOG

Boring Contractor:	SITE-BLAUVELT ENGINEERS, MT. LAUREL, NJ	Project:	RIVERBEND PHI ENVIRONMEN.
Boring Foreman:	WILL DENNINGER	Project Location:	CLINTON, NJ
Drilling Method:	HOLLOW STEM AUGER	Project Number:	E01284F
Drilling Equipment:	CME-45C	Boring Log:	B-5
SD Representative:	L. RIOS		
Dates: Started:	4/18/2002 Finished: 4/18/2002		
Ground Surface Elevation:			

SCHOOR DEPALMA
Engineers and Design Professionals

GROUNDWATER OBSERVATIONS	Depth
Encountered:	N/E
Completion:	
Location: SEE TEST BORING LOCATION PLAN	Page 1 of 1

SAMPLING DATA		STRATUM	DEPTH	CLASS	STRATA DESCRIPTION	% W	REMARKS
			-0		2 INCHES OF TOP SOIL		
S1	2-2-2-3		1		LIGHT BROWN TO ORANGE SILT, TRACE FINE SAND		
			2				
S2	6-8-12-18		3		DO, MOTTLED BEIGE AND BLACK		
			4				
S3	3-3-4-8		-5		DO, LIGHT BROWN MOTTLED YELLOW		
			6				DRILLING HARD FROM 6' TO 10'
S4	6-11-12-11		7		PIECES OF PULVERIZED ROCK		
			8				
S5	30-50/4"		9				AUGER REFUSAL AT 10.0'
			-10				
			11	7 MIN	GRAY HARD DOLOMITE UNWEATHERED TO SLIGHTLY WEATHERED,		
R-1		10.0'-12.5'	12	6 MIN	SOUND TO EXTREMELY FRACTURED		REC = 80%
			13	10 MIN	15MIN		RQD = 60%
			14	10 MIN	GRAY HARD DOLOMITE UNWEATHERED TO SLIGHTLY WEATHERED,		
R-2		12.5'-17.5'	-15	9 MIN	SOUND TO EXTREMELY FRACTURED		REC = 100%
			16	9 MIN			RQD = 53%
			17	6 MIN			
			18	6 MIN	GRAY HARD ROCK DOLOMITE UNWEATHERED TO SLIGHTLY WEATHERED,		
R-3		17.5'-20.0'	19	6 MIN	SOUND TO EXTREMELY FRACTURED		REC = 93%
			-20	3 MIN			RQD = 40%
			21		BOTTOM OF BORING AT 20.5 FEET		
			22		BORE HOLE WAS CEMENT-GROUTED UPON THE COMPLETION OF DRILLING		
			23				
			24				
			-25				
			26				
			27				
			28				
			29				
			-30				
			31				
			32				
			33				
			34				
			-35				
			36				
			37				
			38				
			39				
			40				

Time							
Air Reading (P.P.M.)							

b-5/B5

TEST BORING LOG

Boring Contractor:	SITE BLAUVELT ENGINEERS MT. LAUREL, NJ	SCHOOR DEPALMA Engineers and Design Professionals	Project: RIVERBEND PH1 ENVIRONMENT Project Location: CLINTON, NJ Project Number: E01284F Boring Log: B-6
Boring Foreman:	WILL DEININGER		
Drilling Method:	HOLLOW STEM AUGER		
Drilling Equipment:	CME-45C	GROUNDWATER OBSERVATIONS	Depth
SD Representative:	L. RIOS	Encountered:	8.5'
Dates: Started:	4/24/2001 Finished: 4/24/2002	Completion:	
Ground Surface Elevation:		Location: SEE TEST BORING LOCATION PLAN	Page 1 of 1

SAMPLING DATA		STRATUM	DEPTH		CLASS	STRATA DESCRIPTION	% W	REMARKS
				-0		TOP SOIL 4"	•	
S-1	1-2-3-5		1	-		LIGHT BROWN TO ORANGE SILT, TRACE FINE SAND		
			2	-				
S-2	4-5-4-5		3	-		DO, MOTTLED DARK YELLOW AND BLACK		
			4	-				
S-3	4-4-6-4			-5		DO, DARK BROWN		
			6	-				
S-4	4-4-3-3		7	-		DO, DARK BROWN, WET		AUGER REFUSAL AT 8.5'
			8	-				
S-5	5-50/1"		9	-	5 MIN	LIGHT GRAY TO WHITE LIMESTONE, INTERBEDDED WITH DOLOMITE,		WATER LOSE AT 9.5'
				-10	9 MIN	UNWEATHERD TO SLIGHTLY WEATHERED, SOUND TO EXTREMELY		REC = 90%
R-1		8.5'-13.5'	11	-	6 MIN	FRACTURED		RQD = 45%
			12	-	5 MIN			
			13	-	4 MIN			
			14	-		BOTTOM OF BORING @ 13.5'		
				-15		BORE HOLE WAS CEMENT-GROUTED UPON THE COMPLETION OF DRILLING		
			16	-				
			17	-				
			18	-				
			19	-				
				-20				
			21	-				
			22	-				
			23	-				
			24	-				
				-25				
			26	-				
			27	-				
			28	-				
			29	-				
				- 30				
			31	-				
			32	-				
			33	-				
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			39					
				40				

Time							
Air Reading (P.P.M.)							

b-6/B5

TEST BORING LOG

Boring Contractor:	SITE BLAUVELT ENGINEERS MT. LAUREL, NJ	Project:	RIVERBEND PH1 ENVIRONMENT
Boring Foreman:	WILL DEININGER	Project Location:	CLINTON, NJ
Drilling Method:	HOLLOW STEM AUGER	Project Number:	E01284F
Drilling Equipment:	CME-45C	Boring Log:	B-7
SD Representative:	L. RIOS		
Dates: Started:	4/24/2002 Finished: 4/24/2002		
Ground Surface Elevation:			

SCHOOR DEPALMA
Engineers and Design Professionals

GROUNDWATER OBSERVATIONS	Depth
Encountered:	N/E
Completion:	
Location: SEE TEST BORING LOCATION PLAN	Page 1 of 1

SAMPLING DATA		STRATUM	DEPTH	CLASS	STRATA DESCRIPTION	% W	REMARKS
			-0		TOP SOIL 4"		
S-1	2-3-4-3		1		LIGHT BROWN TO ORANGE SILT, TRACE FINE SAND		
			2				
S-2	3-3-4-3		3		DO, TRACE FINE GRAVEL		
			4				
S-3	2-3-4-5		-5				
			6				
			7		BOTTOM OF BORING @ 6'		
			8		BORE HOLE WAS CEMENT-GROUTED UPON THE COMPLETION OF DRILLING		
			9				
			-10				
			11				
			12				
			13				
			14				
			-15				
			16				
			17				
			18				
			19				
			-20				
			21				
			22				
			23				
			24				
			-25				
			26				
			27				
			28				
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			31				
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			40				

Time							
Air Reading (P.P.M.)							

b-7/B5

TEST BORING LOG

Boring Contractor:	SITE BLAUVELT ENGINEERS MT. LAUREL, NJ	Project:	RIVERBEND PH1 ENVIRONMENT
Boring Foreman:	WILL DEININGER	Project Location:	CLINTON, NJ
Drilling Method:	HOLLOW STEM AUGER	Project Number:	E01284F
Drilling Equipment:	CME-45C	Boring Log:	B-8
SD Representative:	L. RIOS		
Dates:	Started: 4/24/2001 Finished: 4/24/2002		
Ground Surface Elevation:			

SCHOOR DEPALMA
Engineers and Design Professionals

GROUNDWATER OBSERVATIONS	Depth
Encountered:	6.5'
Completion:	
Location: SEE TEST BORING LOCATION PLAN	Page 1 of 1

SAMPLING DATA		STRATUM	DEPTH	CLASS	STRATA DESCRIPTION	% W	REMARKS
			-0		TOP SOIL 5"		
S-1	2-3-3-4		1		LIGHT BROWN TO ORANGE SILT, TRACE FINE SAND MOTTLED BLACK		DRILLING HARD FROM 2' TO 2.5'
			2				
S-2	3-4-3-2		3		DO, MOTTLED YELLOW		
			4				DRILLING HARD FROM
S-3	4-3-2-1		-5		DO, MOTTLED YELLOW		5' TO 7.5'
			6				PERCHED GW AT 6.5'
S-4	5-1-50/4"		7		DO, PIECES OF ROCK AT THE TIP OF THE SPOON		AUGER REFUSAL @ 7.5'
			8	5 MIN	LIGHT GRAY TO WHITE LIMESTONE, INTERBEDDED WITH DOLOMITE,		WATER LOSE AT 7.5'
			9	4 MIN	UNWEATHERD TO SLIGHTLY WEATHERED, SOUND TO EXTREMELY		REC = 88%
R-1		7.5'-12.5'	-10	5 MIN	FRACTURED (PINNACLE LIMESTONE SLOPING FROM THE HORIZONTAL AT		RQD = 50%
			11	5 MIN	40 DEGREES EAST)		
			12	6 MIN			
			13		BOTTOM OF BORING @ 12.5'		
			14		BORE HOLE WAS CEMENT-GROUTED UPON THE COMPLETION OF DRILLING		
			-15				
			16				
			17				
			18				
			19				
			-20				
			21				
			22				
			23				
			24				
			-25				
			26				
			27				
			28				
			29				
			- 30				
			31				
			32				
			33				
			34				
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			36				
			37				
			38				
			39				
			40				

Time						
Air Reading (P.P.M.)						

TEST BORING LOG

Boring Contractor:	SITE BLAUVELT ENGINEERS
Boring Foreman:	WILL DEININGER
Drilling Method:	HOLLOW STEM AUGER
Drilling Equipment:	CME-45C
SD Representative:	L. RIOS
Dates: Started:	4/23/2002 Finished: 4/23/2002
Ground Surface Elevation:	

SCHOOR DEPALMA
Engineers and Design Professionals

Project:	RIVERBEND PH1 ENVIRONMENT
Project Location:	CLINTON, NJ
Project Number:	E01284F
Boring Log:	B-9

GROUNDWATER OBSERVATIONS	Depth
Encountered:	N/E
Completion:	
Location: SEE TEST BORING LOCATION PLAN	Page 1 of 1

SAMPLING DATA		STRATUM	DEPTH	CLASS	STRATA DESCRIPTION	% w	REMARKS
			-0		TOP SOIL 5"		
S-1	2-3-4-3		1		LIGHT BROWN TO ORANGE SILT, TRACE FINE TO COARSE SAND		
			2		MOTTLED DARK BROWN		
S-2	3-3-4-4		3		DO, NOT MOTTLED		
			4				
S-3	2-4-6-2		-5				DRILLING HARD FROM 7' TO 12'
			6				
S-4	2-3-4-3		7				
			8				
S-5	7-10-5-5		9				
			-10				AUGER REFUSAL AT 12.0'
			11				
			12				
			13		BOTTOM OF BORING @ 12'		
			14		BORE HOLE WAS CEMENT-GROUTED UPON THE COMPLETION OF DRILLING		
			-15				
			16				
			17				
			18				
			19				
			-20				
			21				
			22				
			23				
			24				
			-25				
			26				
			27				
			28				
			29				
			- 30				
			31				
			32				
			33				
			34				
			- 35				
			36				
			37				
			38				
			39				
			40				

me							
Air Reading .P.M.)							

TEST BORING LOG

Boring Contractor:	SITE BLAUVELT ENGINEERS MT. LAUREL, NJ	Project:	RIVERBEND PH1 ENVIRONMENT
Boring Foreman:	WILL DEININGER	Project Location:	CLINTON, NJ
Drilling Method:	HOLLOW STEM AUGER	Project Number:	E01284F
Drilling Equipment:	CME-45C	Boring Log:	B-10
SD Representative:	L. RIOS		
Dates: Started:	4/23/2002 Finished: 4/23/2002		
Ground Surface Elevation:			

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GROUNDWATER OBSERVATIONS	Depth
Encountered:	N/E
Completion:	
Location: SEE TEST BORING LOCATION PLAN	Page 1 of 1

SAMPLING DATA		STRATUM	DEPTH	CLASS	STRATA DESCRIPTION	% w	REMARKS
			-0		TOP SOIL 4"		
S-1	2-2-3-4		1		LIGHT BROWN TO ORANGE SILT, TRACE FINE SAND		
			2				
S-2	4-5-5-6		3		DO, MOTTLED DARK YELLOW AND BLACK		
			4				
S-3	2-2-4-6		-5				
			6				
S-4	8-16-13-20		7		DO, MOTTLED DARK YELLOW AND BLACK, MOTTLED GRAY AT THE TIP		
			8				AUGER REFUSAL AT 10.0'
S-5	20-17-28-50/3"		9		PIECES OF ROCK AND PULVERIZED ROCK		
			-10				
			11		BOTTOM OF BORING @ 10.0'		
			12		BORE HOLE WAS CEMENT-GROUTED UPON THE COMPLETION OF DRILLING		
			13				
			14				
			-15				
			16				
			17				
			18				
			19				
			-20				
			21				
			22				
			23				
			24				
			-25				
			26				
			27				
			28				
			29				
			-30				
			31				
			32				
			33				
			34				
			-35				
			36				
			37				
			38				
			39				
			40				

Time							
Air Reading (P.P.M.)							

b-10/B5

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MODIFIED METHOD
FOR
IDENTIFICATION OF SOILS
AFTER
DR. D.M. BURMISTER

Soil Component	Descriptive Terms As Written on Log	Range of Proportions
PRINCIPAL COMPONENT (All Letters Capitalized)	--	35% of more
MINOR COMPONENTS (First Letter Capitalized)	and (a.)	35% to 50%
	some (s.)	20% to 35%
	little (l.)	10% to 20%
	trace (tr.)	1% to 10%

Coarse Grained Soils – Gradation of Components

Coarse to fine	Coarse to fine	cf	All sizes
Coarse to medium	Coarse to medium	cm	Less than 10% fine
Medium to fine	Medium to fine	mf	Less than 10% coarse
Coarse	Coarse	c	Less than 10% medium & fine
Medium	Medium	m	Less than 10% coarse & fine
Fine	Fine	f	Less than 10% coarse & medium

Component	Symbol	Sieve Range
Boulders		9" and larger
Cobbles		3" to 9"
Gravel	G	
Coarse		3/4" to 3"
Fine		#4 to 3/4"
Sand	S	
Coarse		#4 to #10
Medium		#10 to #40
Fine		#40 to #200

Fine Grained Soils-Plasticity of Components

Component	Symbol	Overall Plasticity	Plasticity Index
SILT	S	Non-Plastic	0
Clayey Silt	CyS	Slight	1 to 5
SILT & CLAY	S & C	Low	5 to 10
CLAY & SILT	C & S	Medium	10 to 20
Silty Clay	SyC	High	20 to 40
CLAY	C	Very High	Over 40

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FILES.
	MORE THAN 50% OF COURSE FRACTION <u>RETAINED</u> ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS <u>LARGER</u> THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITLE OR NO FINES
			SP	POORLY-GRADED SANDS,GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COURSE FRACTION <u>PASSING</u> NO. 4 SIEVE	SANDS WITH FINES (APRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT <u>LESS</u> THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDS CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT <u>GREATER</u> THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGH ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

GRADIATION*

	% FINER BY WEIGHT
TRACE	0% TO 10%
LITTLE	10% TO 20%
SOME	20% TO 35%
AND	35% TO 50%

COMPACTNESS*
SAND AND/OR GRAVEL

	RELATIVE DENSITY
LOOSE	0% TO 40%
MEDIUM DENSE	40% TO70%
DENSE	70% TO 90%
VERY DENSE	90% TO 100%

CONSISTENCY*
CLAY AND/OR SILT

	RANGE OF SHEARING STRENGTH IN POUNDS PER SQUARE FOOT
VERY SOFT	LESS THAN 250
SOFT	250 TO 500
MEDIUM	500 TO 1000
STIFF	1000 TO 2000
VERY STIFF	2000 TO 4000
HARD	GREATER THAN 4000

* VALUES ARE FROM LABORATORY OR FILED TEST DATA, WHERE APLICABLE. WHEN NO TESTING WAS PERFORMED, VALUES ARE ESTIMATED.

UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL CLASSIFICATION CHART

SCHOOR DEPALMA
Engineers and Design Professionals

GENERAL NOTES FOR TEST BORING LOGS

1. NUMBERS IN SAMPLING DATA COLUMN (3+6+27) INDICATE BLOWS REQUIRED TO DRIVE A 2 INCH O.D., 1 3/8 INCH I.D. SAMPLING SPOON 6 INCHES USING A 140 POUND HAMMER FALLING 30 INCHES ACCORDING TO ASTM D1586.

2. VISUAL CLASSIFICATION OF SOILS IS IN ACCORDANCE WITH TERMINOLOGY SET FORTH IN "IDENTIFICATION OF SOIL." THE GROUP CLASSIFICATION SYMBOLS SHOWN IN THE CLASSIFICATION COUMN ARE BASED ON VISUAL INSPECTION AND AVAILABLE LABORATORY DATA.

3. GROUNDWATER OBSERVATIONS: THE DEPTH OF WATER BELOW GRADE WAS MEASURED AT THE TIMES INDICATES. THE DEPTHS MAY VARY WITH PRECIPITATION, POROSITY OF THE SOIL, SITE TOPOGRAPHY, ETC.

4. REFUSAL AT THE SURFACE OF ROCK, BOULDER, OR OBSTRUCTION IS DEFINED AS A RESISTANCE OF 100 BLOWS FOR 2 INCHES PENETRATION OR LESS.

5. THE BORING LOGS AND RELATED INFORMATION DEPICT SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC LOCATIONS AND AT THE PARTICULAR TIME WHEN DRILLED. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THESE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE SUBSURFACE SOIL AND GROUNDWATER CONDITIONS AT THESE BORING LOCATIONS.

6. THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEENSOIL AND ROCK TYPES AS DETERMINED FROM THE DRILLING AND SAMPLING OPERATION. SOME VARIATION MAY ALSO BE EXPECTED VERTICALLY BETWEEN SAMPLES TAKEN. THE SOIL PROFILE, WATER LEVEL OBSERVATIONS, AND PENETRATION RESISTANCES PRESENTED ON THESE BORING LOGS HAVE BEEN MADE WITH REASONABLE CARE AND ACCURACY AND MUST BE CONSIDERED ONLY AS AN APPROXIMATE REPRESENTATION OF SUBSURFACE CONDITIONS TO BE ENCOUNTED AT THE PARTICULAR LOCATION.

7. TEST BORINGS DRILLED BY SITE-BLAUVELT ENGINEERS, MT. LAUREL, NJ, UNDER THE INSPECTION OF **SCHOOR DEPALMA INC.**

8. KEY TO SYMBOLS AND ABBREVIATIONS:

3 + 6 + 27	STANDARD PENETRATION TEST, ASTM D1586 DESIGNATION
3T 24/18	2" OR 3" UNDISTURBED TUBE SAMPLE, ASTM D1587 (LENGTH SAMPLED INCHES/SAMPLE RECOVERED INCHES)
REC REQ	NQ2, NX OR 2 INCH O.D. ROCK CORE RUN, ASTM D2113 (RECOVERY AND RQD AS SHOWN)

DO	=	DITTO
RQD	=	ROCK QUALITY DESIGNATION
REC	=	RECOVERY (%) (LENGTH RECOVERED/ LENGTH SAMPLED)
w	=	NATURAL MOISTURE CONTENT (%)
*	=	NO SAMPLE RECOVERY

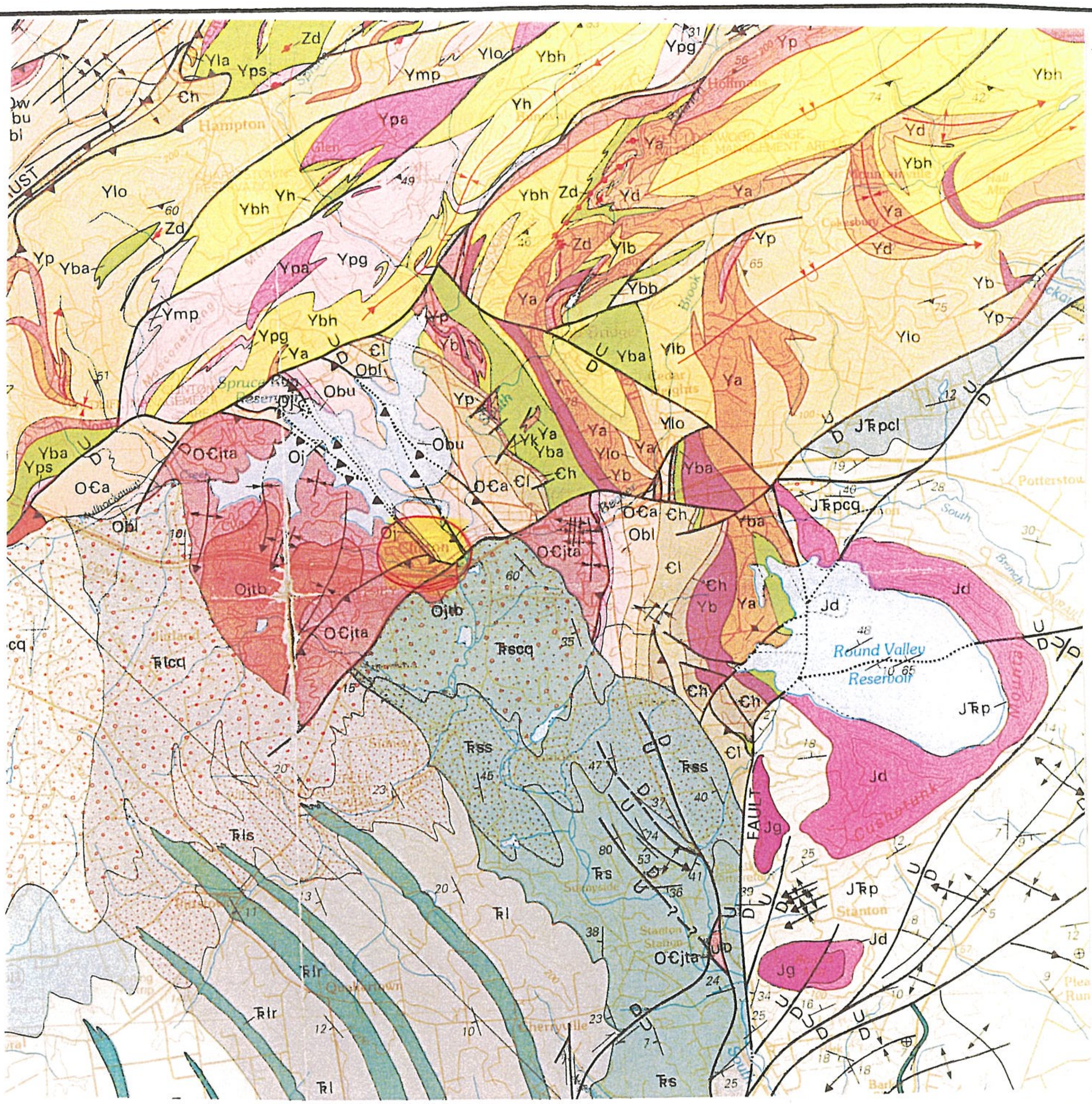

PLATE 3 APPROXIMATE SITE LOCATION OUTLINED ON A COPY OF THE USGS 7.5 MINUTE QUAD MAPS, HAMBURD AND WAWAYANDA QUADS

USGS MAP

ANSUYA ENTERPRISES, LLC
CLINTON, NEW JERSEY

SCHOOR DEPALMA
Engineers and Design Professionals
200 STATE HIGHWAY NINE
P.O. BOX 900 MANALAPAN N.J. 07726-0900
TEL (732)577-9000 FAX. (732)577-9888

DATE	REVISIONS	ORDER NO.

SCALE	DATE	DRAWN BY	CHK'D BY	FILE NO.	FIELD BOOK
1"=100,000'	5-8-02	EHJ	CH	E01284F	FB

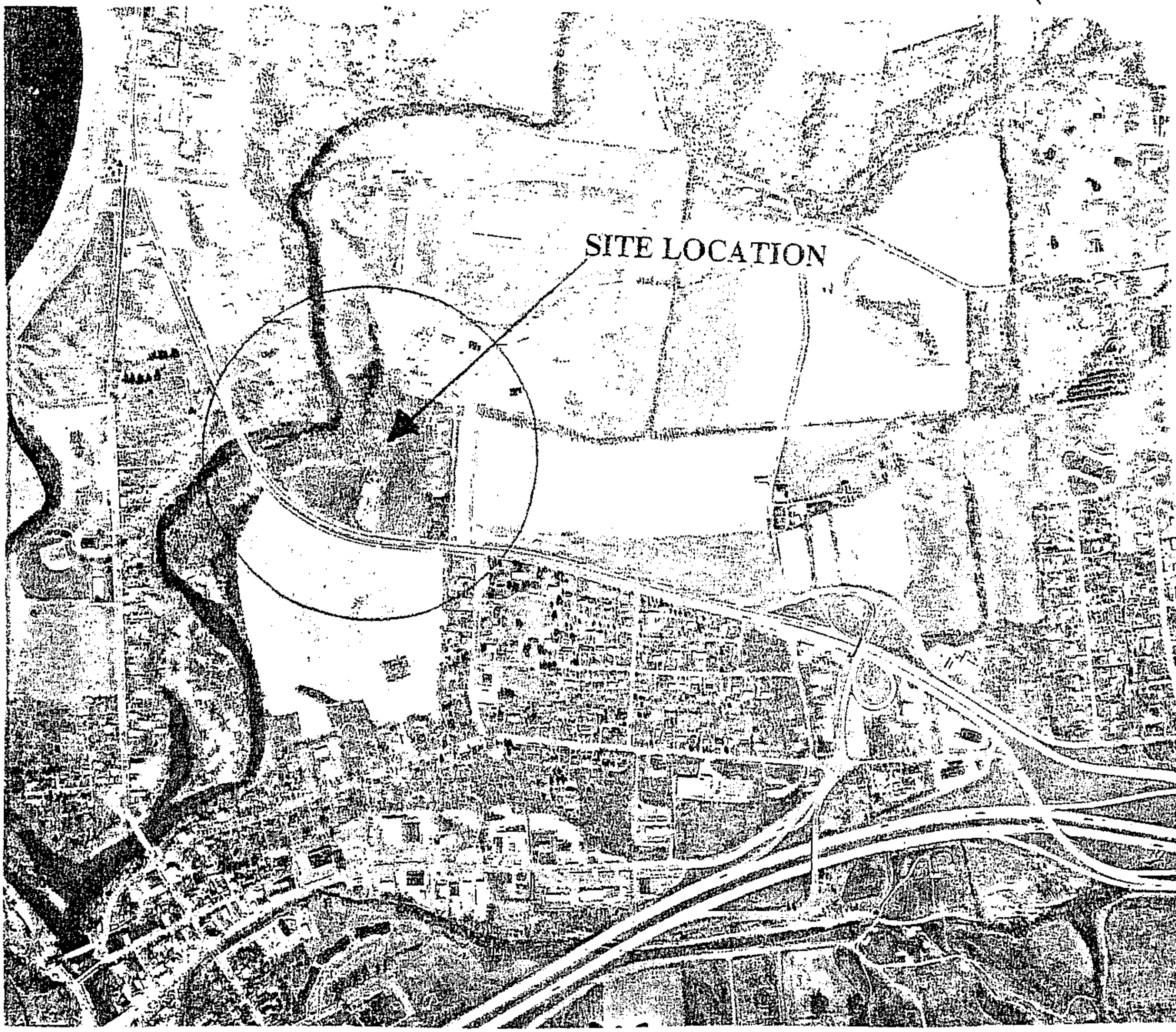

PLATE 1

AERIAL MAP

YEAR OF AIR PICTURE 1976

ANSUYA ENTERPRISES, LLC
CLINTON, NEW JERSEY

SCHOOR DEPALMA
Engineers and Design Professionals
200 STATE HIGHWAY NINE
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SCALE	DATE	DRAWN BY	CHK'D BY	FILE NO.	FIELD BOOK
1" = 800'	5-8-02	EHJ	CH	E01284F	FB

DATE	REVISIONS	ORDER NO.

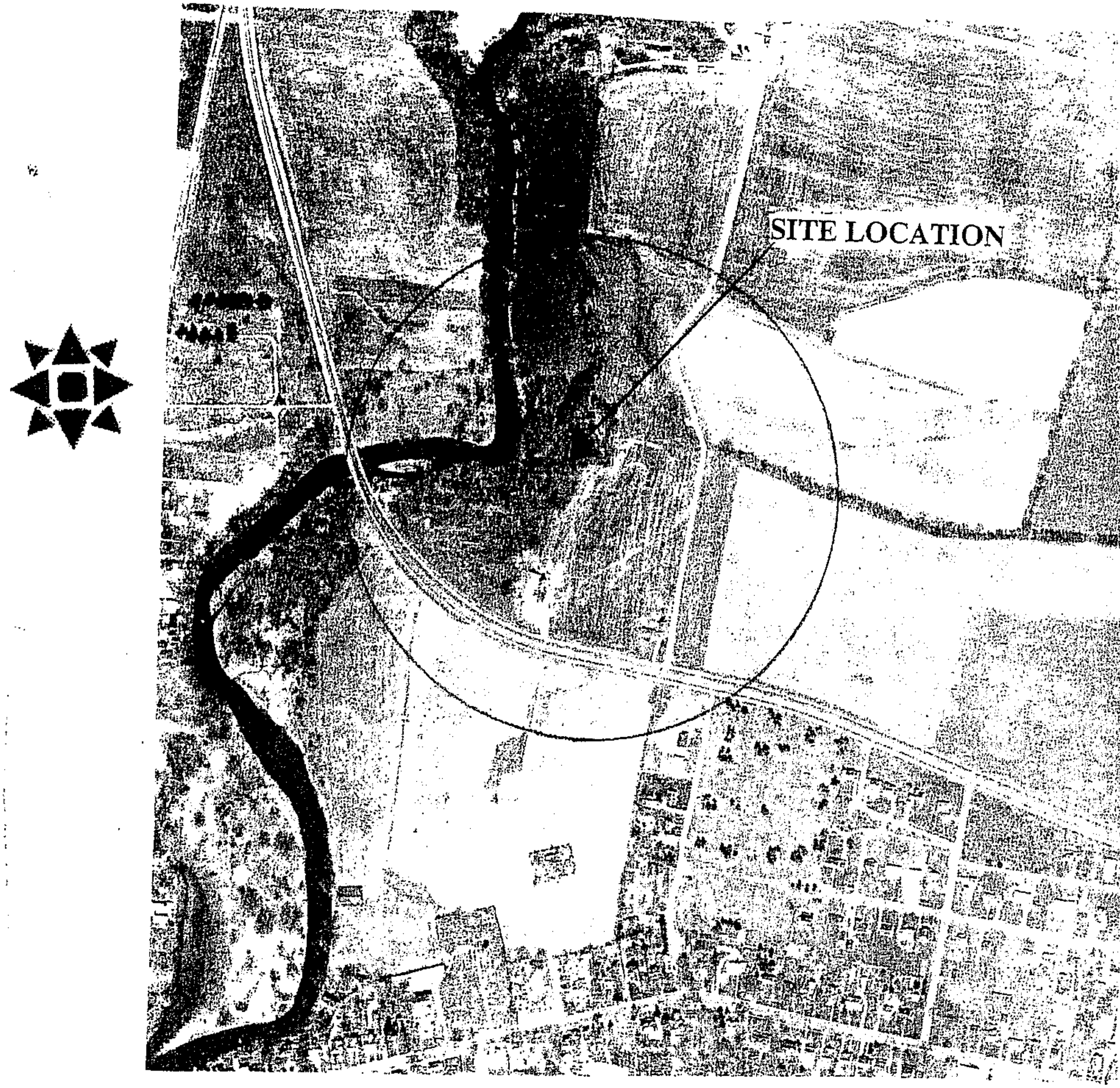

PLATE 2	AERIAL MAP YEAR OF AIR PICTURE 1959
ANSUYA ENTERPRISES, LLC CLINTON, NEW JERSEY	SCHOOR DEPALMA Engineers and Design Professionals 200 STATE HIGHWAY NINE P.O. BOX 900 MANALAPAN N.J. 07726-0900 TEL (732)577-9000 FAX. (732)577-9888

DATE	REVISIONS	ORDER NO.

SCALE	DATE	DRAWN BY	CHK'D BY	FILE NO.	FIELD BOOK
1" = 500'	5-8-02	EHJ	CH	E01284F	FB

LIMITATIONS

This report has been prepared in accordance with generally accepted geotechnical design practice for specific application to this project. This report has not been prepared to serve as the plans and specifications for actual construction without the appropriate interpretation by the project Architect, Structural Engineer, and/or Civil Engineer. This report has been based on assumed conditions and characteristics of the proposed development where specific information was not available. Available project information at the time of this report preparation included a schematic site plan only.

The conclusions and recommendations contained in this report are based upon the subsurface data obtained during this investigation and on details stated in this report. The validity of the projections, conclusions, and recommendations contained in this report is necessarily limited by the scope of field investigation and by the number of borings that were made. Should conditions arise which differ from those described in this report, Schoor DePalma should be notified immediately and provided with all information when available regarding subsurface conditions.

Our recommendations are based upon the assumption that the services of a qualified geotechnical engineer will be retained for the observation of stripping operations, proofrolling, structural fill placement, footing installation, and all critical earthwork operations.

The scope of this investigation was limited to the evaluation of the load-carrying capabilities and load stability of the subsurface soils. Oil, hazardous waste, radioactivity, irritants, pollutants, radon or other dangerous substances and conditions were not the subject of this study. Their presence and/or absence are not implied, inferred or suggested by this report or results of this study.

We have endeavored to prepare this report in accordance with generally accepted geotechnical engineering practices and make no warranties, either expressed or implied, as to the professional advice provided under the terms of our agreement and included in this report. Soil samples and pavement cores will be held until December 30, 2002 and will then be discarded unless further storage is requested.