# PRELIMINARY GEOTECHNICAL STUDY
# INWOOD FARMS PROPERTY
# BALTIMORE COUNTY, MARYLAND

HERBST/BENSON & ASSOCIATES
GEOTECHNICAL ENGINEERS

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GEOTECHNICAL ENGINEERS

414 MAIN STREET
REISTERSTOWN, MD 21136
410-526-7200
800-800-0275
FAX 410-526-7268

June 21, 2005

Jay and Cynthia Giralt
4064 Kilmartin Drive
Tallahassee, Florida 32309

Re: Preliminary Geotechnical Study
Inwood Farms Property
Baltimore County, Maryland

Dear Mr. and Mrs. Giralt:

In accordance with the request of Little & Associates and with your authorization, we have completed a preliminary geotechnical study of the above-referenced property. The purpose of the study was to determine (1) general suitability of this site for development; (2) any particular problematic soil conditions encountered in the test borings; (3) general feasibility of subsurface conditions at low elevation borings for possible storm water disposal by infiltration; (4) suitability of sampled possible cut soils from higher elevations for reuse as controlled compacted fill; and (5) excavation characteristics of the subsurface materials encountered within the test borings. The methods of explorations and tests, the subsurface data, the laboratory test results, and our general conclusions and recommendations concerning residential development of the property are as follows:

## I. SUBSURFACE PROGRAM

The subsurface exploratory program consisted of fourteen standard penetration test borings (B-1 through B-14) located as shown on PLATE 1, BORING LOCATION PLAN. The boring locations were proposed by the site engineer, Little & Associates, with some revisions made by Herbst/Benson & Associates to cover specific areas of the property. Borings were advanced by an ATV mounted drill rig using hollow stem continuous flight helical augers to advance the boreholes. We had planned extending all borings to a 20-foot termination depth. In the majority of cases, however, auger or rig refusal was encountered above the scheduled termination depth. Auger refusal is defined as the depth at which further advancement of the auger cannot be obtained due to resistant material. Rig refusal is defined as the point when the standard penetration test results in a penetration of 1 inch or less with 100 blows of the driving hammer.

The information obtained from the test borings along with the rig and auger refusal depths are shown on PLATES 2 through 5, BORING PROFILES. The method of classification used in preparation of the boring profiles is presented on the enclosure CLASSIFICATION OF SOILS included in the back of this report.

## II. LABORATORY TESTING

Two bulk soil samples from near the shallow depth in borings B-2 and B-13 were returned to the laboratory for existing moisture, moisture/compacted density relationship, and classification testing to determine compaction properties and suitability for reuse as controlled, compacted fill. One additional split spoon sample of apparent high-plasticity clay was also subjected to classification testing to determine behavior characteristics for building and roadway support. The results of these laboratory tests are presented on TABLE 1, CLASSIFICATION TEST DATA and SHEETS 1 and 2, COMPACTION TEST.

## III. SITE DESCRIPTION

The site is located in western Baltimore County immediately east of the Patapsco State Park and south of interstate 70. More specifically, the site is located at the far west end of Inwood Road bounded by Inwood Road to the north, Patapsco State Park to the west, and Cedar Branch to the south. The ground topography slopes throughout the property ranging from a high of elevation 430 at the center of the north property line to elevation 324 in the center of the south property line. The slope drops relatively uniformly from the north to south. In the south portion of the property, the ground surface flattens before dropping very steeply to the Cedar Branch floodplain.

The property is occupied by two residences, a 1950's or 1960's vintage one story brick ranch house in the north and a 1890's or 1900's vintage 2-story farm house and barn in the southwest property corner. A horse barn is located on the north half of the property and much of the parcel is fenced off as horse pastures.

Vegetation consists mostly of meadow grass with woodland and undergrowth on the south slope. The west side of the property is covered with sporadic surface rock outcrops. The southeast corner of the property is strewn with surface boulders and tree stumps where oak trees had been removed to form a pasture. The center of the south end has surface standing water and some vegetation seen in wet ground areas.

## IV. SUBSURFACE MATERIALS

Fill or probable existing fill was evident in borings B-8, B-13 and B-12. Test boring B-8 found very dense rock pieces mixed with sand and clay to auger refusal at depths of 2 to 3.8 feet below the existing ground surface. In boring B-12 the fill consisted of silty clay with some sand and concrete fragments in a stiff to very hard condition to auger and rig refusal depth at 7.6 feet. Probable existing fill, defined more by the loose condition of the soil in place rather than by the material type, was encountered in boring B-13 to a depth of 6 feet overlying native soils. The B-13 fill appears to be from minor grading to level areas around the older house and barn. It is our understanding that the source of the existing fill through the center of the property was the mass grading for Security Square Mall which was constructed in the late 1960's or early 1970's. Typically, materials hauled off a construction site are less suitable for reuse as controlled compacted fill and, with the Woodlawn geology, likely would include large residual rock pieces or boulders and high plasticity clays. Rock or concrete pieces were likely the obstructions found in the test borings in fill areas.

The underlying native soils are residual in origin having been formed from in-place weathering and decomposition of the underlying bedrock formation. As is typical with the residual soil profile in this area, the upper soils appear to be predominantly fine-grained and somewhat cohesive. The cohesive layer was found in all borings except B-8 and B-12, which penetrated only fill, and B-3, B-7 and B-10, where granular soils were encountered immediately below the surface topsoil layer. These predominantly fine-grained cohesive materials ranged from medium stiff to hard, lower plasticity sandy silt & clay to higher plasticity sandy silty clay. The surface layer, where encountered, ranged from 3 to 8 feet in thickness. The underlying native soils were predominantly granular consisting of medium dense to very dense, non-plastic silty sand or low-plasticity clayey silty sand.

Generally, the relative compactness of these residual sands increased with depth. Below the sand layer in borings B-2, B-3, B-4, B-5, B-7, B-10, B-11 and B-13, very dense, damp to dry, light gray to greenish gray rock fragments were recovered in the split spoon sampling tube. The standard penetration resistances for these materials exceeded 100 blows per foot. The recovered materials represent the weathered rock deposit below the more soil-like material and above the hard, unweathered rock. Auger and rig refusal generally represents the surface of the relatively unweathered rock.

Geologic mapping for the area indicates that metamorphic/igneous Layered Ultramafite and Serpentine rock underlay the site. These rock types, outside fracture zones, are generally found to be massive. The depths at which 100+ blow count material and rig and auger refusal were encountered at each boring are presented in the BORING PROFILES. Examination of the ground surface indicates that the Serpentine rock underlies the western portion of the property with the Gabbro formation on the east.

## V. GROUND WATER CONDITIONS

Ground water was encountered above borehole cave-in depth one day following drilling operations in borings B-5, B-6, B-9 and B-14. Ground water was encountered in boring B-9 at a depth of 5.7 feet, or approximate elevation 387, and at depths of 8.2 to 9.4 feet in borings B-5, B-6 and B-14, corresponding to an elevation range of 395 to 404. Although no free water was encountered in one day water readings for boring B-11, the borehole cave-in depth and very moist condition of soil sample #3 indicated that ground water may be in the vicinity of the 6-foot depth or approximate elevation 345. From the ground water information, it appears that the water table likely drops from north to south across the site as a subdued replica of the ground topography.

Ground water levels will vary with changes in seasons and precipitation generally rising during the late winter and spring season and receding throughout the rest of the year with normal precipitation patterns.

## VI. PROPOSED CONSTRUCTION

No preliminary site plan has yet been developed for this property, however we understand that the preferable development plan would be single family homes and related infrastructure.

## VII. DEVELOPMENT CONSIDERATIONS

The test borings, in our opinion, show that the site can be developed for residential use; however, additional expense would be incurred during site grading, utility installation, and possibly basement excavation. Our preliminary conclusions and recommendations are presented below:

### A. House Construction

The native soils on site, as well as the properly controlled compacted fill placed over competent native soils, would be suitable to support normal residential foundations which typically are designed for bearing pressures of 2,000 to 3,000 PSF. The houses should not be supported on existing fill or on new fill placed over existing fill. We recommend that house foundations contain at least two #4 steel reinforcing bars for continuity of support. Over-excavation of rock in some basement excavations and replacement with controlled compacted aggregate fill may be required to allow placement of utilities and foundations below the ground slab.

Exterior footing drains are recommended for the residences with basements to collect water which may pool in loose basement wall backfills surrounded by dense soils or rock. House foundations should be kept at least 3 feet above ground water levels to prevent the need for more extensive foundation and slab drains.

B. Utility Installation

Utility installation in some areas will require rock removal. Utility lines will need to be over-excavated to allow placement of bedding material to provide uniform support. Removed rock material will likely be unsuitable for utility trench backfill unless crushed to a smaller size. Ground water can be expected in utility excavations extending below the levels indicated on the test borings. In dense residual materials, ground water seepage is generally slow and can be controlled by a series of trenches, sump pits and pumps. Heavier flow, however, may be found in very permeable broken rock veins such as broken quartzite and pegmetite seams.

C. Roadway

For roadway construction in hard rock areas the subgrade should be undercut 1 foot and replaced with crushed aggregate fill to provide a more uniform bedding medium.

D. Storm Water Management

Due to the dense nature of the native soils, presence of existing fill, and high ground water table in some areas, it does not appear that storm water disposal by infiltration would be feasible on the lower end of this site even though some of the soils may conform to a Sandy Loam or Loamy Sand USDA classification.

E. Excavation Characteristics

The expected excavation characteristics of the materials encountered in the test borings are presented on the enclosed TABLE 2, ESTIMATED EXCAVATION CHARACTERISTICS. As can be seen, rock excavation could be extensive depending on the selected finished grades. With the large quantity of rock expected, it may be economical to bring a mobile rock crusher on site to reduce excavated materials to a size sufficient for use as controlled compacted fill. The

ground surface to the west of the site road is covered with areas of rock outcroppings. Although some of the borings penetrated significant depth, others met resistant materials at higher elevations. It is expected that excavation characteristics in this area will be predominantly rock-like, but may encounter seams of more soil-like materials.

Existing fill was evident in borings B-8 and B-12; however, refusal on rock pieces or concrete was encountered at both locations and the exact depth of fill could not be determined since the borings could not penetrate through the fill into competent native soils. This fill is expected to be unsuitable for direct support of building pads, although it may be sufficient for roadway subgrade support.

To better define the type, extent and location of fill, we are attempting to obtain a 1950's or 1960's 200-scale map of this portion of Baltimore County which would possibly show the original ground topo. Also, we would recommend performing a test pit investigation of the fill areas to better determine the extent and type of fill material. We can provide an estimated price for this additional work.

F. Suitability of Cut as Fill

The two samples of near surface soil from upper portions of the project had acceptably high compacted maximum dry densities and moisture contents close to the optimum for most efficient compaction. This is somewhat unusual for these soil formations since the residual clayey, near surface soils of the Gabbro (ultramafite) and Serpentine rock formations have typically very high existing moisture contents, normally well above optimum for most efficient compaction.

Once the grading plan is approved, additional testing should be performed to determine the excavation characteristics and moisture content of the proposed cut soils as to their suitability for reuse as controlled, compacted fill. Typically, the upper clayey soils of the residual ultramafic rock profile have moisture contents which are high and cannot be lowered sufficiently by air drying to obtain the proper degree of compaction.

The moisture content of the near surface soils will vary with changes in seasons and precipitation. The most efficient air drying would occur during the normally warm, dry summer and early fall construction seasons. Earthwork during the wetter winter and spring season may result in saturated or frozen exposed grades which will require undercutting and replacement with better soil materials. It may not be possible to sufficiently dry high moisture soils during these times of year to allow reuse as controlled, compacted fill.

## VIII. GENERAL CONDITIONS

This report has been prepared in accordance with generally accepted geotechnical engineering practice to aid in the evaluation and design of this project. In the event of changes in the proposed construction (types, elevations, locations, etc.) the conclusions and recommendations presented in this report should not be considered valid unless changes are reviewed and the conclusions of this report are modified or approved in writing by our office.

The analyses and recommendations included in this report are based upon the data obtained from the test borings performed at the approximate locations indicated on the boring location plan. This report does not reflect variations which may occur between or away from the borings. The nature and extent of the variations may not become evident until the time of construction. If significant variations then become evident, it may be necessary for us to reevaluate the recommendations of this report.

We appreciate the opportunity to provide the preliminary geotechnical study for this project. As can be seen, there are several factors which make development of this project more difficult and likely more costly than average for a property with a deep native soil profile. We would suggest our continuing participation in the design of the project to evaluate the cut and fill conditions and suitability of proposed cut soils for reuse as controlled, compacted fill. On this project it is critical that we again evaluate the subsurface conditions once a preliminary grading plan has been established.

Please keep us advised as to when our further services on the project are requested.

Most Sincerely,

HERBST/BENSON & ASSOCIATES

By: Robert C. Benson, P.E.
Principal

RCB/flh

04210MD

cc: Dwight Little, P.E. - Little & Associates (2 copies)

PRELIMINARY GEOTECHNICAL STUDY
INWOOD FARMS PROPERTY
BALTIMORE COUNTY, MARYLAND
04210MD JUNE 2005

TABLE 1

CLASSIFICATION TEST DATA

| Sieve/Particle Size | % by Weight Passing Indicated Size | | | |
|---|---|---|---|---|
| | B-1 (1.0'-2.5') | B-2 (1.0'-3.0') | B-12 (3.5'-5.0') | B-13 (1.0'-3.0') |
| 3/4" | | | 100 | 100 |
| 1/2" | | | 93 | 96 |
| 3/8" | | 100 | 93 | 95 |
| #4 | | 98 | 89 | 92 |
| 10 | 100 | 92 | 86 | 82 |
| #40 | 91 | 81 | 74 | 72 |
| #60 | 85 | 75 | 69 | 66 |
| #200 | 70 | 60 | 57 | 48 |
| Atterberg Limits | | | | |
| Liquid Limit (LL) | 51 | 31 | 39 | 33 |
| Plasticity Index (PI) | 18 | 9 | 19 | 8 |
| Classification | | | | |
| Unified | MH | CL | CL | SM |
| AASHTO | A-7-5(13) | A-4(4) | A-6(8) | A-4(1) |
| Natural Moisture Content (%) | 36.9 | 16.1 | 21.3 | 17.8 |

HERBST/BENSON & ASSOCIATES - GEOTECHNICAL ENGINEERS

## COMPACTION TEST

PROJECT = INWOOD FARMS PROPERTY

SAMPLE IDENT. = B-2, (1'-3')

CURVE NO. = 1, 04210MD

MAXIMUM DRY DENSITY - PCF = 113.7

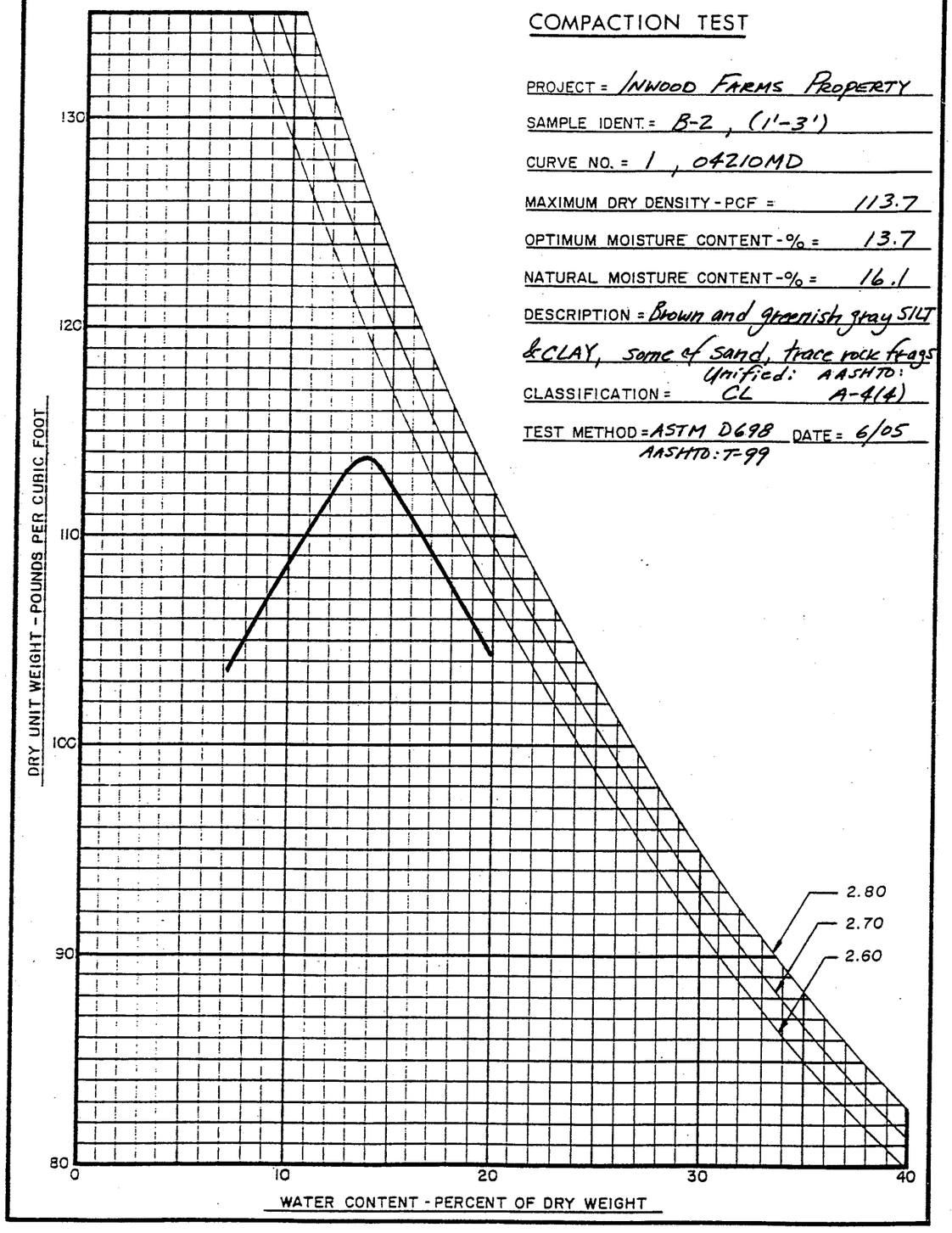
OPTIMUM MOISTURE CONTENT - % = 13.7

NATURAL MOISTURE CONTENT - % = 16.1

DESCRIPTION = Brown and greenish gray SILT & CLAY, some of sand, trace rock frags

CLASSIFICATION = Unified: CL AASHTO: A-4(4)

TEST METHOD = ASTM D698 AASHTO: T-99 DATE = 6/05




SHEET 1

## COMPACTION TEST

PROJECT = INWOOD FARMS PROPERTY

SAMPLE IDENT. = B-13, (1'-3')

CURVE NO. = Z, 04210MD

MAXIMUM DRY DENSITY - PCF = 108.6

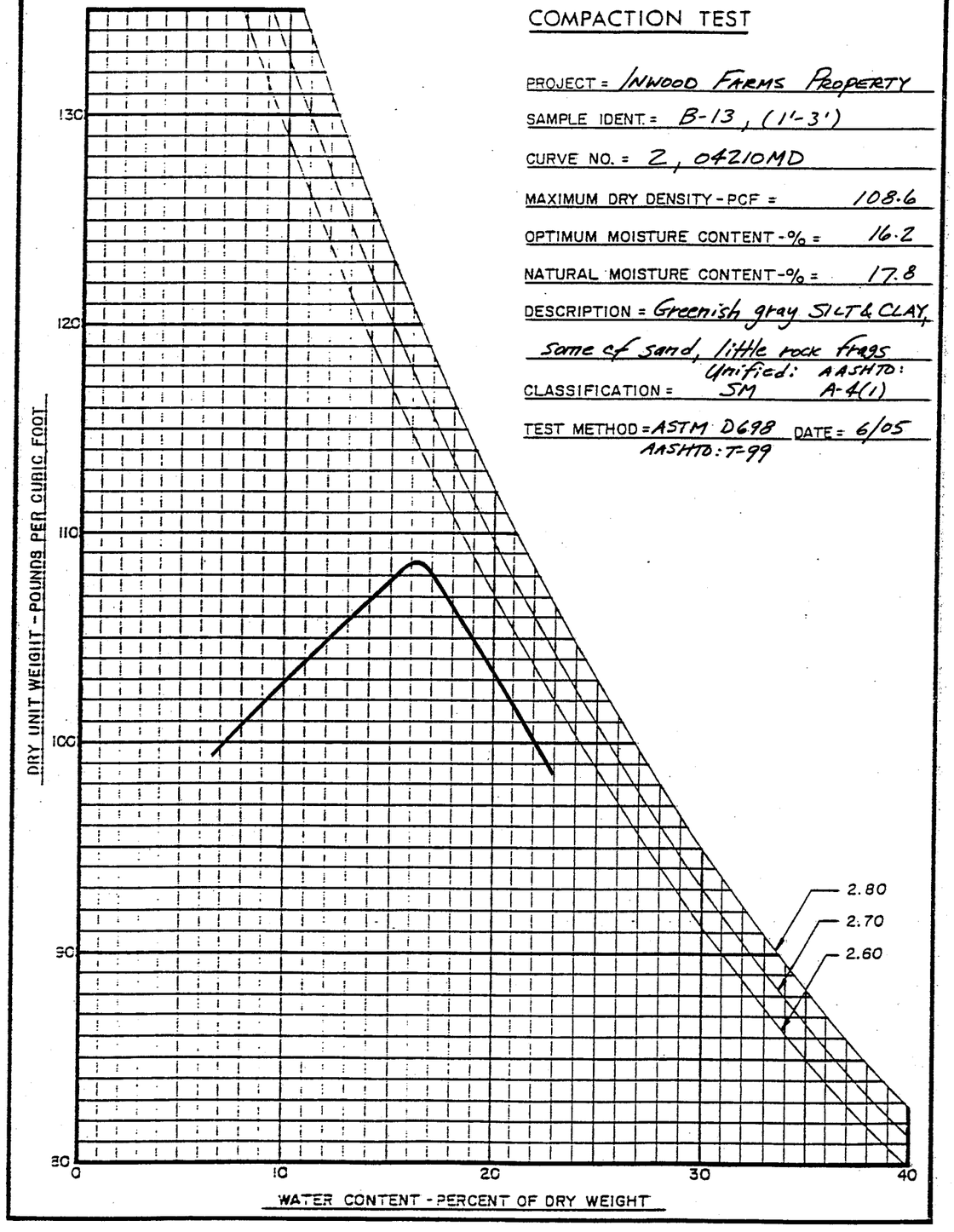
OPTIMUM MOISTURE CONTENT - % = 16.2

NATURAL MOISTURE CONTENT - % = 17.8

DESCRIPTION = Greenish gray SILT & CLAY, some of sand, little rock frags

CLASSIFICATION = Unified: SM AASHTO: A-4(1)

TEST METHOD = ASTM D698 DATE = 6/05
AASHTO: T-99



PRELIMINARY GEOTECHNICAL STUDY
INWOOD FARM PROPERTY
BALTIMORE COUNTY, MARYLAND
04210MD JUNE 2005

TABLE 2

ESTIMATED EXCAVATION CHARACTERISTICS

| Boring No. | Approximate Limits (Feet below existing ground surface) *Normal Excavation | ** Very Dense Disintegrated Rock | *** Hard Rock |
|---|---|---|---|
| B-1 | 0 - 20+ | | |
| B-2 | 0 - 12 | | 12 |
| B-3 | 0 - 3 | 7 - 12 | 3 - 7, 12 |
| B-4 | 0 - 8 | | 8 |
| B-5 | 0 - 12 | 12 - 15 | 15 |
| B-6 | 0 - 20+ | | |
| B-7 | 0 - 2 | 2 - 8 | 8 |
| B-8 | Fill (excavation properties unknown) | | |
| B-9 | 0 - 20+ | | |
| B-10 | 0 - 2 | | 2 |
| B-11 | 0 - 8 | 8 - 9 | 9 |
| B-12 | Fill (excavation properties unknown) | | |
| B-13 | 0 - 12 | | 12 |
| B-14 | 0 - 20+ | | |

* Removal by 973 loader or equivalent

** Pre-ripping in mass excavations by D-8 dozer equipped with ripping shank or equivalent equipment, with possible limited blasting at scattered locations. Pre-ripping combined with blasting or jack hammering required for trench excavations.

*** Blasting required for all types of excavations carried below the indicated depths.

# CLASSIFICATION OF SOILS

The soil descriptions on the Boring Profiles are in accordance with the criteria outlined below. The principal constituents are written in capital letters with other constituents preceded by descriptive terminology used to denote the percentages by weight of each component. The soil descriptions are based upon visual examinations except where laboratory gradation and Atterberg limits tests are available.

## Descriptive Terms Denoting Component Proportions

| Descriptive Terms | Range of Proportion |
|---|---|
| Trace | 1 - 10% |
| Little | 10 - 20% |
| Some | 20 - 35% |
| And | 35 - 50% |

## Component Definitions by Gradation

| Soil Component | | Sieve Limits Upper | Lower |
|---|---|---|---|
| *GRAVEL/ ROCK FRAGS | Coarse | 3 in. | 1 in. |
| | Medium | 1 in. | 3/8 in. |
| | Fine | 3/8 in. | No. 10 (2.0mm) |
| SAND | Coarse | No. 10 (2.0mm) | No. 30 (0.590mm) |
| | Medium | No. 30 (0.590mm) | No. 60 (0.250mm) |
| | Fine | No. 60 (0.250mm) | No. 200(0.074mm) |
| SILT, CLAY and COLLOIDS: (fines) (defined by degree of plasticity) | | No. 200 (0.074mm) | |

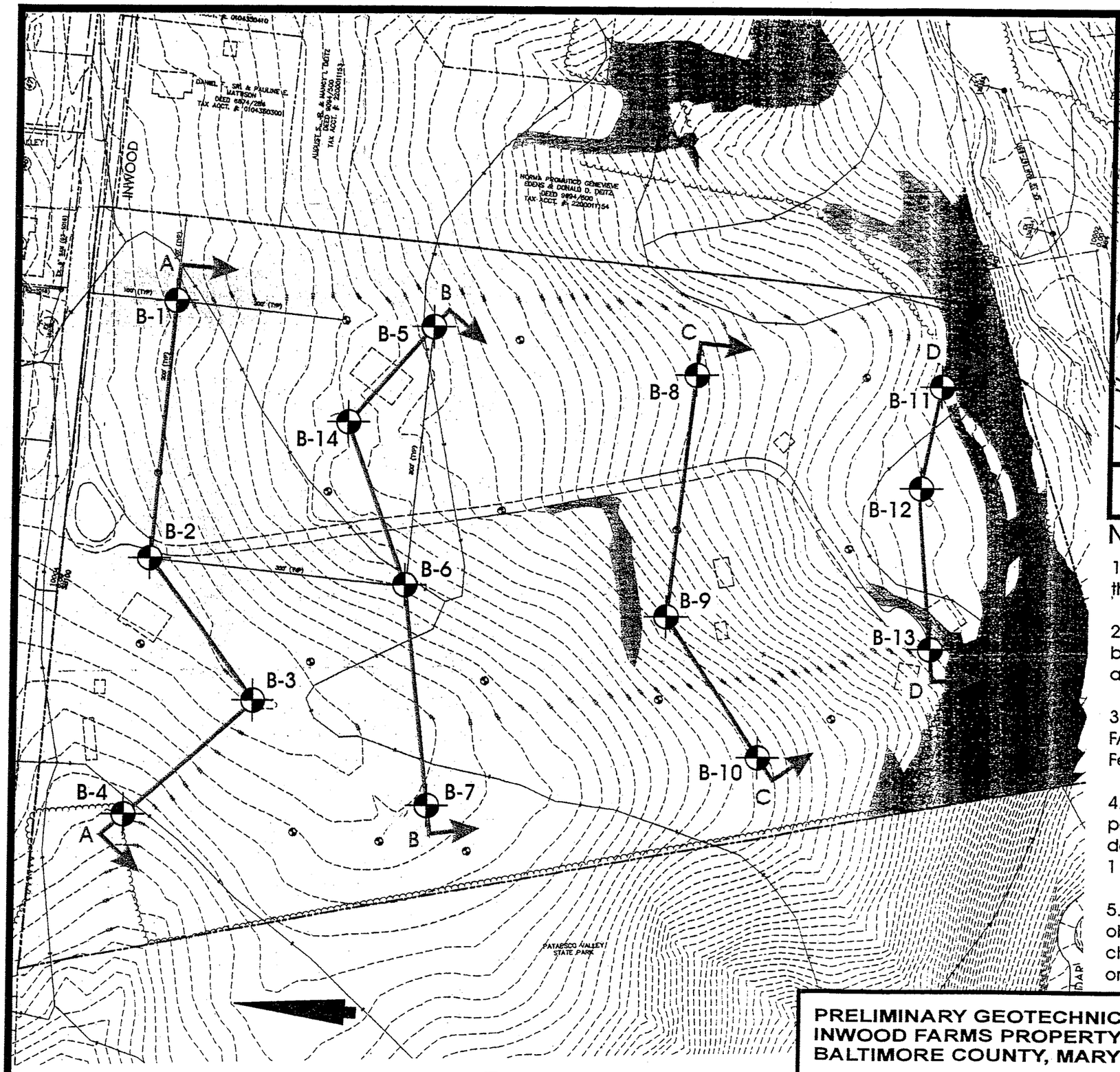
*This component is classified as "GRAVEL" in sedimentary soils and as "ROCK FRAGS" in residual soils.

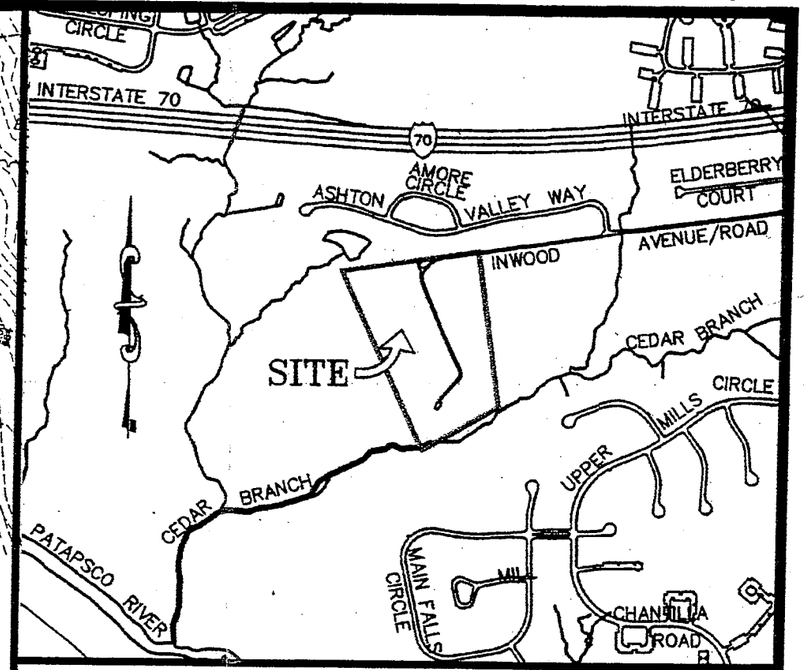
## Component Definitions by Degree of Plasticity

| Descriptive Term | Degree of Plasticity | Plasticity Index Range |
|---|---|---|
| SILT | None | Non-plastic (NP) |
| Clayey SILT | Slight | 1 - 5 |
| SILT & CLAY | Low | 5 - 10 |
| CLAY & SILT | Medium | 10 - 20 |
| Silty CLAY | High | 20 - 40 |
| CLAY | Very High | Over 40 |

## Gradation Terms of Granular Components

| Gradation Designation | Symbol | Defining Proportions |
|---|---|---|
| coarse to fine | cf | All fractions greater than 10% of the component |
| coarse to medium | cm | Less than 10% fine |
| medium to fine | mf | Less than 10% coarse |
| coarse | c | Less than 10% medium and fine |
| medium | m | Less than 10% coarse and fine |
| fine | f | Less than 10% coarse and medium |




# VICINITY MAP

## NOTES:

1. Borings B-1 through B-14 were performed at the direction of the Geotechnical Engineer during April and May 2005.

2. Boring locations staked and elevations determined the field by Little & Associates, Inc.. Locations and elevations shown are approximate.

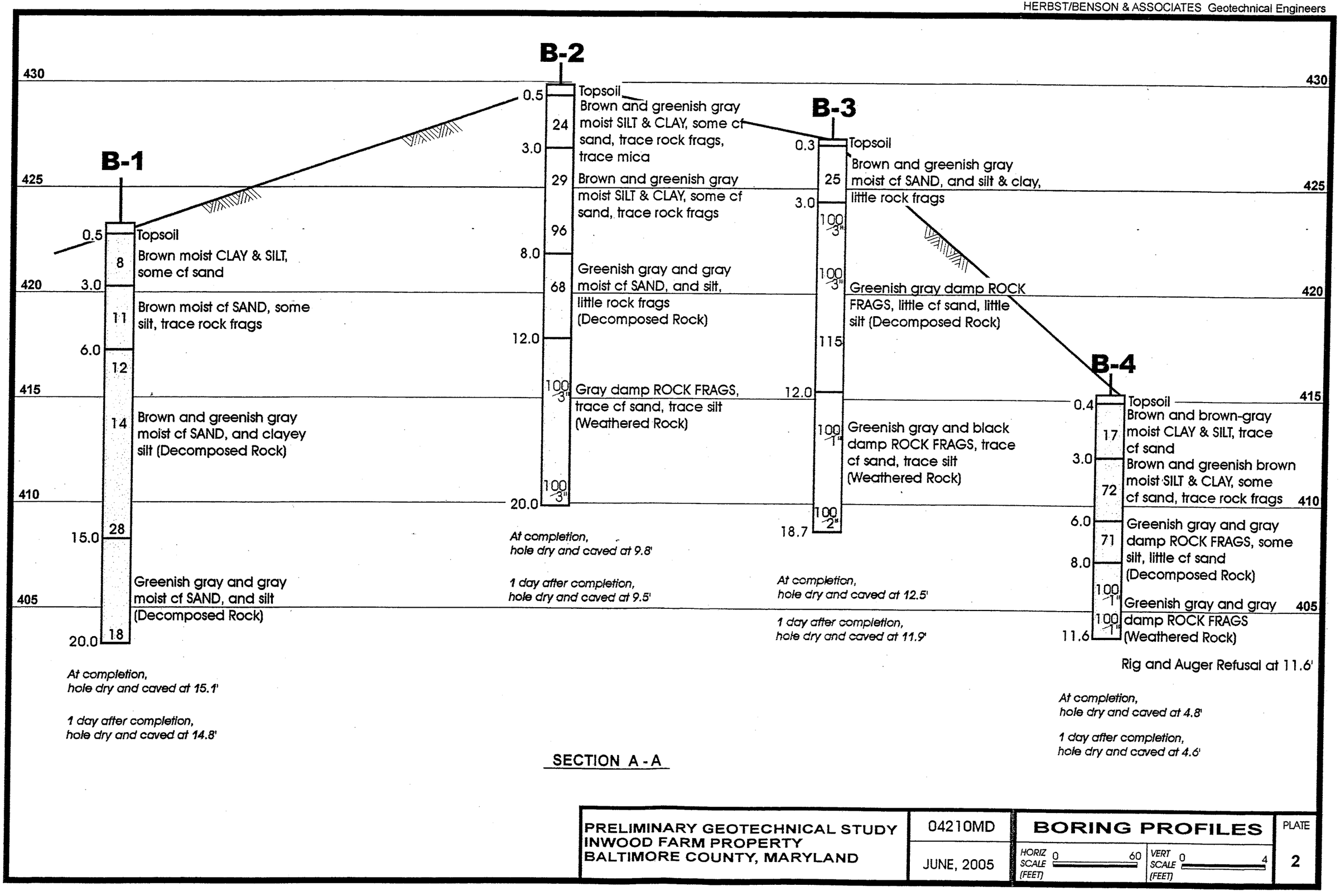
3. Boring Location Plan taken from a plan entitled, INWOOD FARMS, BORING PLAN. by Little & Associates, Inc., dated February 4, 2005.

4. Figures in columns on boring profiles represent the standard penetration resistance (N) in blows per foot, or as noted, as determined by the ASTM D1586 procedure using a 2" O.D. - 1 3/8" I.D. sampler.

5. Stratification on boring profiles estimated from driller's observations and recovered soil samples. Actual strata changes may vary from those shown and may be either abrupt or gradual.

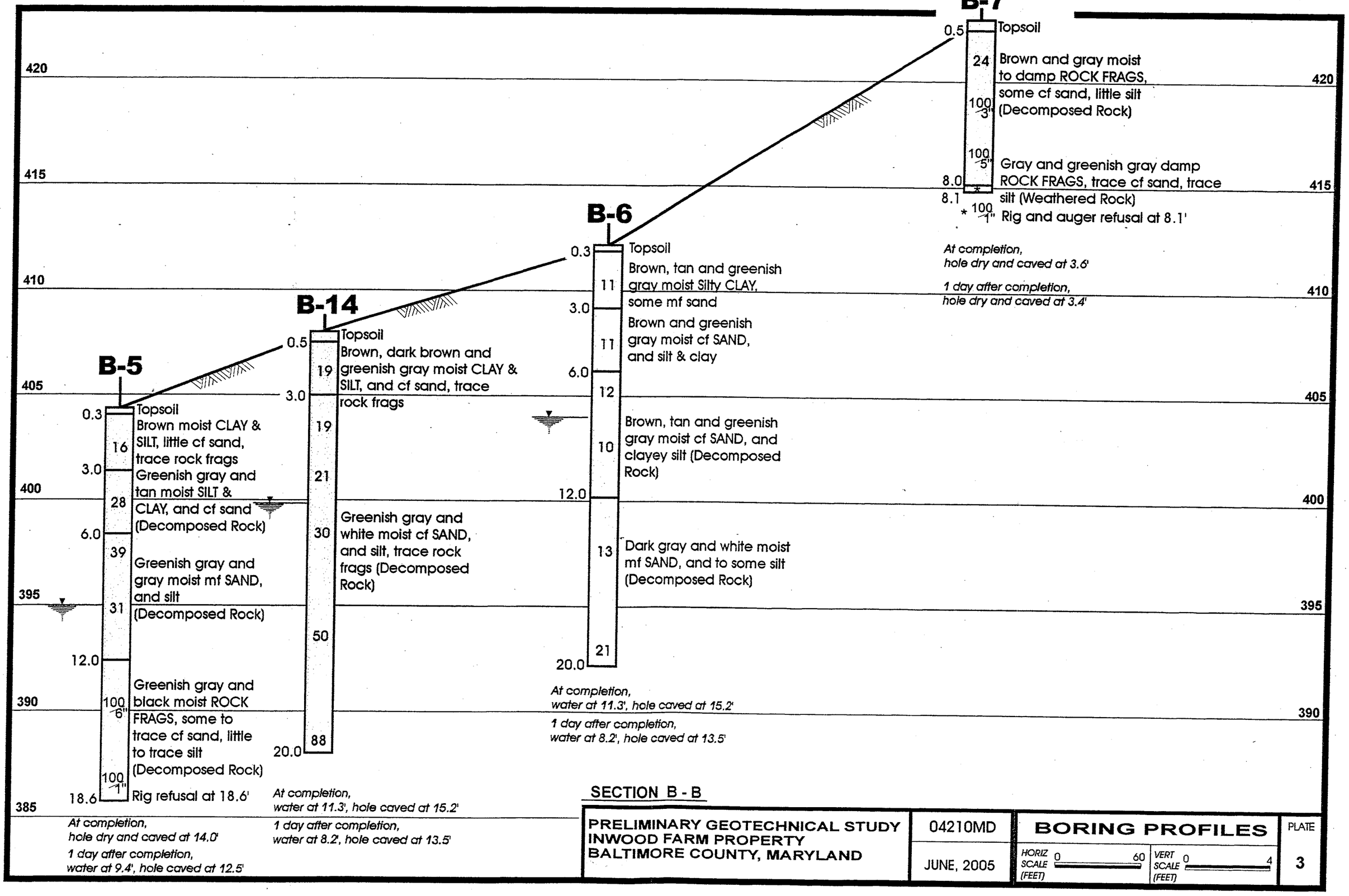
**PRELIMINARY GEOTECHNICAL STUDY**
**INWOOD FARMS PROPERTY**
**BALTIMORE COUNTY, MARYLAND**

| BORING LOCATION PLAN | | PLATE |
|---|---|---|
| HORIZ SCALE (FEET) 0 — 120 | 04210MD | 1 |
| | JUNE, 2005 | |



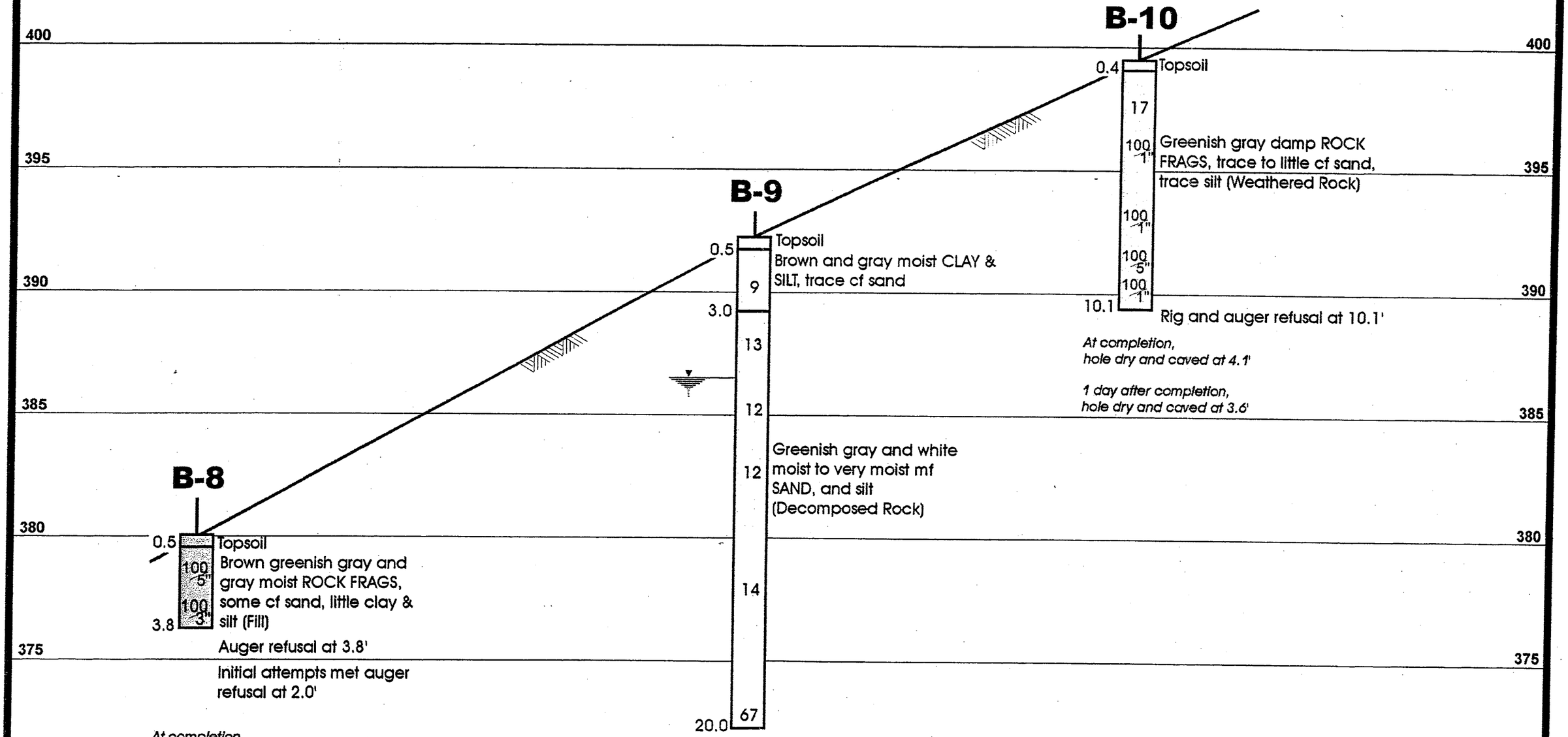

SECTION A - A

| | | | |
|---|---|---|---|
| PRELIMINARY GEOTECHNICAL STUDY<br>INWOOD FARM PROPERTY<br>BALTIMORE COUNTY, MARYLAND | 04210MD<br>JUNE, 2005 | BORING PROFILES<br>HORIZ SCALE (FEET) 0 60 VERT SCALE (FEET) 0 4 | PLATE<br>2 |



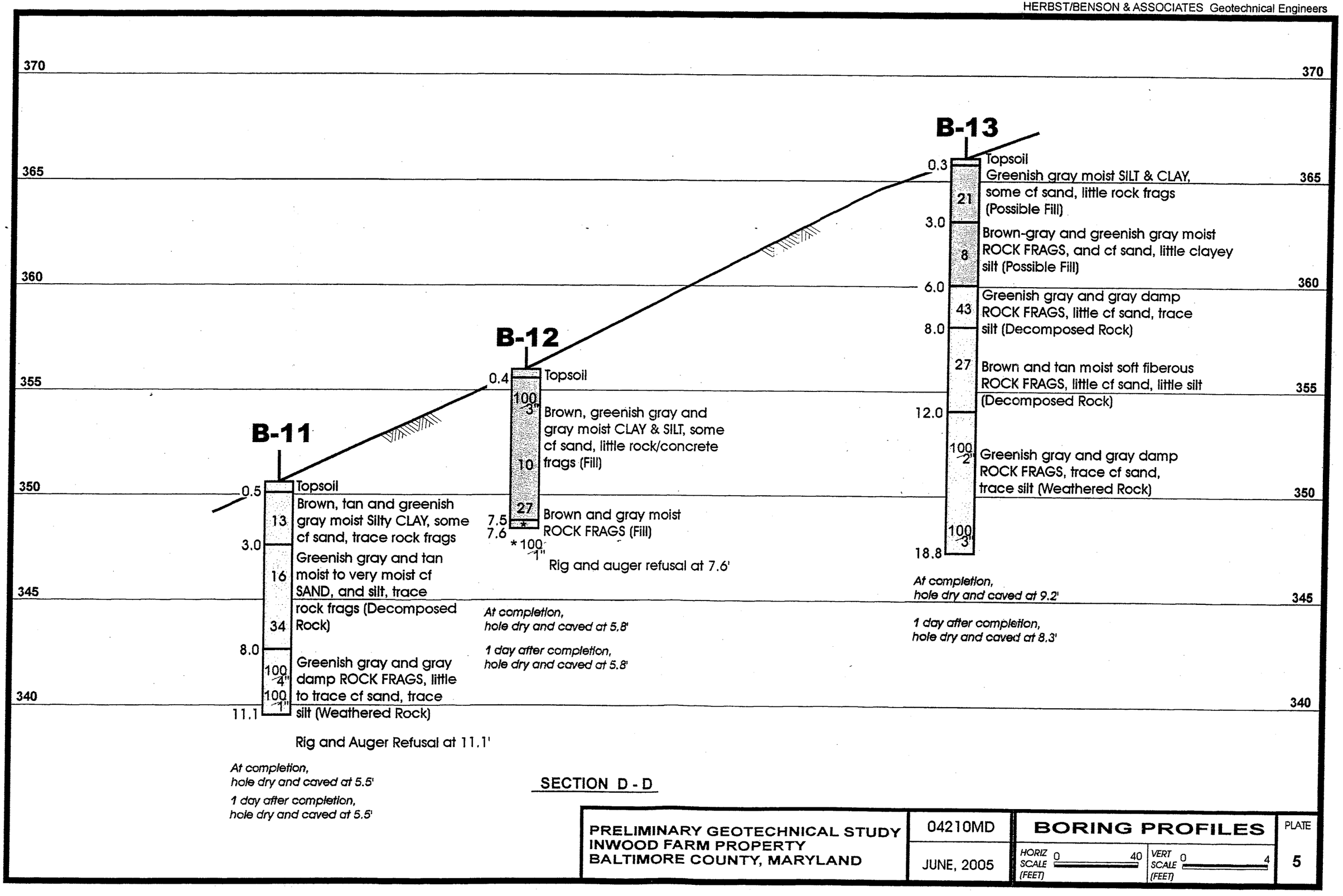

SECTION B - B

| | | | |
|---|---|---|---|
| PRELIMINARY GEOTECHNICAL STUDY<br>INWOOD FARM PROPERTY<br>BALTIMORE COUNTY, MARYLAND | 04210MD<br>JUNE, 2005 | BORING PROFILES<br>HORIZ SCALE (FEET) 0 60 — VERT SCALE (FEET) 0 4 | PLATE<br>3 |




SECTION C - C

| | | | |
|---|---|---|---|
| PRELIMINARY GEOTECHNICAL STUDY<br>INWOOD FARM PROPERTY<br>BALTIMORE COUNTY, MARYLAND | 04210MD<br>JUNE, 2005 | BORING PROFILES<br>HORIZ SCALE (FEET) 0 50 VERT SCALE (FEET) 0 4 | PLATE<br>4 |




SECTION D - D

| | | | |
|---|---|---|---|
| PRELIMINARY GEOTECHNICAL STUDY<br>INWOOD FARM PROPERTY<br>BALTIMORE COUNTY, MARYLAND | 04210MD<br>JUNE, 2005 | BORING PROFILES<br>HORIZ SCALE (FEET) 0 — 40 VERT SCALE (FEET) 0 — 4 | PLATE<br>5 |