REPORT OF GEOTECHNICAL EXPLORATION

OAK POINTE SUBDIVISION
DAWN DRIVE

JEFFERSON COUNTY, KENTUCKY

Prepared for:

MACTEC Project Number 3143-05-0633
December 1, 2005

Mr. Robbie Popowell
7112 Cross Creek Boulevard
Louisville, Kentucky 40228

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TABLE OF CONTENTS

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December 1, 2005

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Mr. Robbie Popplewell
7112 Cross Creek Boulevard
Louisville, Kentucky 40228
Phone: 502-639-3473
Fax: 502-749-1296

Subject: **Report of Geotechnical Exploration**
Oak Pointe Subdivision, Jefferson County, Kentucky
MACTEC Project Number 3143-06-0633

Dear Mr. Popplewell:

MACTEC Engineering and Consulting, Inc. (MACTEC) has completed the requested geotechnical exploration for your project. Our services were provided in accordance with our Proposal Number PROP05LVLE Task 0176, dated October 18, 2005, which you accepted on October 24, 2005.

The attached report presents a review of the project information provided to us, a description of the site and subsurface conditions encountered, and a summary of our foundation, earthwork and pavement recommendations for the proposed residential development. The Appendix to the report contains site and test pit location plans, as well as the results of our field and laboratory testing.

MACTEC appreciates this opportunity to provide our services to you and we look forward to serving as your geotechnical consultant throughout this project. Please contact us if you have any questions regarding the information presented.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

STATE OF KENTUCKY
SCOTT E.
BONDS
17232

Scott E. Bonds, P.E.
Senior Engineer
Licensed Kentucky 17232

Nicholas G. Schmitt, P.E.
Senior Principal
Licensed Kentucky 10311

Attachment: Report of Geotechnical Exploration

1. PURPOSE AND SCOPE OF EXPLORATION

The purpose of this exploration was to obtain specific subsurface data at the site, review available geologic information, and to develop site preparation, foundation and pavement recommendations for the proposed project. The scope of our exploration was outlined in MACTEC's Proposal Number PROP05LVLE Task 0176. The scope of our field activities included excavating approximately 10 test pits, using a rubber-tire backhoe in the presence of an engineer from our office, to obtain subsurface information.

2. PROJECT INFORMATION

Project information has been provided by Mr. Popplewell to Mr. Bart Best of our office. We have been provided with a drawing entitled, *Oak Pointe Subdivision, Preliminary Plan,* dated July 17, 2003, prepared by Presnell Engineers, Inc. Also, a set of construction plans were provided to us, which included site grading information.

The subject property is located south of Dawn Drive and west of the Paducah & Louisville railroad in southwest Jefferson County, Kentucky. The site encompasses a total area of approximately 36 acres and includes an existing lake which is approximately 3 acres. We understand you plan to subdivide the subject property into 76 lots for the construction of single family homes. Site clearing, some grading activities, and sewer construction have been initiated at the site prior to this report.

Based upon review of the drawings provided to us, we estimate cut and fill heights will generally be less than 10 feet to achieve the planned grades.

3. EXPLORATORY FINDINGS

3.1 SURFACE CONDITIONS

We conducted a site reconnaissance on November 4, 2005, to observe and document surface conditions at the site. The information gathered was used to help us interpret the subsurface data, and to detect conditions which could affect our recommendations.

The site is located south of Dawn Drive and east of Dixie Highway and the Paducah & Louisville railroad in southwest Jefferson County, Kentucky. The area surrounding the site consists mostly of existing residential development. Site topography is moderately to steeply sloping. Existing site elevations range from about 470 feet National Geodetic Vertical Datum (NGVD) along the west boundary to about 570 feet NGVD along the east boundary, with approximately 100 feet of topographic relief. The site generally slopes downhill in the west and south directions. The site includes an approximately 3 acre lake near the southeast corner of the site which is over 40 years old. The earthen dam is located at the south end of the lake.

The ground cover at the site is a mixture of relatively clear land with grass and weeds. We also observed intermittent wooded areas around the site and wooded slopes along the eastern limits of the property. The site contractor has installed some short keystone retaining walls at the rear of the lots on the east slope of the site. The walls were less than about 5 feet in height. The site plan provided to MACTEC indicates that several small structures were located at the central portion of the site; however, they appear to have been removed during site clearing activities. Our information indicates that the property was operated as a private fishing lake in the past. Portions of the existing driveway that used to serve the house were still evident. The contractor has installed some of the sewer system and has rough graded most of the roadway areas for the development.

3.2 SITE GEOLOGY

A review of the *Geologic Map of Parts of the Louisville West and Lanesville Quadrangles, Jefferson County, Kentucky*, published by the United States Geological Survey (USGS), indicates the site is underlain by the following geologic formations: Loess and Eolian Sand of Quaternary Age and the New Providence Shale member of the Borden Formation of Mississippi Age. A description of each formation is provided in the following subsections.

3.2.1 Loess and Eolian Sand

The soil loess deposits are mapped at differing elevations across the entire site area. The loess within the area of the site is typically light brown clayey silt to silty fine sand, which was deposited by a westerly wind during the Wisconsinian glaciation. The thickness of the loess can vary over the quadrangle area from 0 to 30 feet. Loess mantles most of the upland area and is thickest near the base of slopes bordering the Ohio River valley.

3.2.2 New Providence Shale Member

The New Providence Shale Member of the Borden Formation is mapped at the site at approximate elevations between 500 feet and 570 feet NGVD. The New Providence Shale is moderately plastic clay shale, olive gray to grayish green in color. The member often contains iron oxide nodules. The unit is micaceous and potentially highly plastic. The member tends to slide and slump when exposed to the environment on steep slopes. The thickness of the shale ranges from 125 to 220 feet in the quadrangle area.

3.3 SUBSURFACE CONDITIONS

The subsurface conditions were explored with 10 backhoe-excavated test pits according to the procedures presented in the Appendix. The test pit locations and depths were selected by MACTEC. The actual test pit locations were determined by our engineer who paced distances in the field relative to property corners and boundaries, which were surveyed by others. The test pit locations shown in the Appendix should be considered approximate.

The subsurface conditions encountered at the test pit locations are shown on the Test Pit Records in the Appendix. These Test Pit Records represent our interpretation of the subsurface conditions based on the field logs, visual examination of field samples by an engineer, and tests of the field samples. The interface between various strata on the Test Pit Records represents the approximate interface location. In addition, the transition between strata may be gradual. Water levels shown on the Test Pit Records represent the conditions only at the time of our exploration.

In general, our test pits encountered 3 naturally occurring soil strata underlying about 4 to 7 inches of topsoil or miscellaneous fill material that was encountered in Test Pits TP-5, TP-8, TP-9, and TP-10. The miscellaneous fill material typically consisted of brown lean clay with varying amounts of organic material. The fill was sometimes mixed with some crushed limestone and occasionally orangish brown lean clay and silt. The fill materials were mixed with some small amounts of domestic and construction debris in Test Pit TP-5. The fill material was typically soft to firm in consistency and was less than 2.5 feet thick where encountered.

The first residual soil stratum (Stratum I) consisted of orangish brown, clayey silt to silty clay to depths ranging from about 4 to 10 feet. Dynamic cone penetrometer (DCP) values ranging from 4 blows per 1-¾-inch increment (bpi) to in excess of 25 bpi were obtained, with an average of about 8 bpi. Pocket penetrometer resistances ranging from 2 ton per square foot (tsf) to 4.5 tsf were obtained, with an average of about 3 tsf. These values generally correspond to soils with soft to very stiff consistency, but were typically considered firm to stiff.

Laboratory tests were performed on selected samples of the Stratum I soils. Soil plasticity tests (Atterberg limits) performed on selected samples of the soil from test pit TP-7 and TP-9, from a depth of about 2 and 6 feet, respectively, indicated Liquid Limits of 31 and 26, with Plasticity Indices of 9 and 2, respectively. These values correspond to borderline "CL/ML" type soils (lean clay/silt), according to the Unified Soil Classification System (USCS). The moisture content of the samples tested ranged from 16.9 to 33.0 percent. The Stratum I soils are consistent with the Loess soil deposits which are mapped in the site area.

Underlying the Stratum I soils, the Stratum II soils consisted of orangish brown and gray, silty lean clay with some siltstone pieces and sometimes traces of weathered shale. Dynamic cone penetrometer (DCP) values ranging from 3 blows per 1-¾-inch increment (bpi) to in excess of 25 bpi were obtained, with an average of about 8 bpi. Pocket penetrometer resistances ranging from 1 ton per square foot (tsf) to 4.5 tsf were obtained, with an average of about 3 tsf. These values generally correspond to soils with soft to very stiff consistency, but were typically considered firm to stiff.

Laboratory tests were performed on selected samples of the Stratum II soils. Soil plasticity tests (Atterberg limits) performed on selected samples of the soil from test pit TP-2 and TP-3, from a depth of about 2 and 5 feet, respectively, indicated Liquid Limits of 36 and 50, with Plasticity Indices of 17and 24, respectively. These values correspond to borderline "CL/ML" type soils (lean clay/silt), according to the Unified Soil Classification System (USCS). The moisture content of the samples tested ranged from 15.3 to 22.5 percent.

Stratum III soils were only encountered in Test Pit TP-5 and consisted of brown sandy silt which graded into brown silty sand. The stratum was firm to loose in consistency and was encountered below Stratum I. The soils were visually classified as "ML to SM", according to the Unified Soil

Classification System (USCS). A laboratory test was performed on one sample from this stratum obtained at a depth of 5 feet and indicated a moisture content of 4.4 percent. These soils are representative of eolian sands commonly associated with loess deposits.

The test pits were terminated at predetermined depths of about 10 feet. Refusal material was not encountered at the termination depths.

3.4 GROUND WATER CONDITIONS

Water was not detected in our test pits at the time of excavation. Typically, water conditions affecting construction projects in the site area are related to trapped or perched water which occurs in irregular, discontinuous locations within the soil overburden, or near the soil/rock interface. When these water bearing strata are exposed in excavations, such as cut slopes, utility or footing trenches, they can produce widely varying seepage durations and rates depending on recent rainfall activity and other hydrogeologic characteristics of the area. These perched water sources are often not linked to the more continuous relatively stable ground water table that typically occurs at greater depths.

We observed evidence of a small spring located north of the existing lake. The spring appears to be directed toward a culvert which flows under the new roadway. The spring was not actively running during our site work but we did observe some ponded water in the area. Additional springs may be encountered on the slopes at the site.

4. GEOTECHNICAL EVALUATION

4.1 GENERAL

Based on the conditions encountered at the site and our experience, we believe the proposed site is suitable for the proposed residential development. Most of the soils encountered in our test pits were firm to stiff consistency. We did not observe evidence of significant slope instability; however previous developments in the area have experienced significant geotechnical and structural distress which are related to slope instability and landslides. Our recommendations have been developed as a result of our experience in this area. Since building plans will be somewhat site specific for each lot, our recommendations may require modifications in some cases. The geotechnical engineer should be retained to monitor roadway construction and individual house foundation construction.

4.2 GEOLOGIC EVALUATION

The site is located in Southwest Jefferson County which has had a long history of hillside instability. Our experience indicates that areas underlain by New Providence Shale and the wind deposited loess often display evidence of marginal slope stability. The shale weathers rapidly to form weak soils which are prone to movement under increased loading such as those from the construction of fill slopes and the influence of water.

We anticipate that proposed grading may include cut and fill depths of 10 feet or more in sloped wooded areas. The existing hillsides have moderately steep to steep slopes (5H:1V or steeper), and natural drainage swales. The existing slopes appear stable in their present condition; however, significant grading changes, removal of vegetation or the formation of erosion gullies may adversely affect the stability of the slopes.

We anticipate that the New Providence shale will be encountered during site grading and during foundation construction on some building lots. This shale member easily degrades when exposed to moisture variations and weathering. The shale can degrade into plastic clay capable of volume changes when subjected to wetting or drying. The shale is generally suitable for fill if placed and compacted in accordance with Section 5.3.3 of this report. We anticipate excavation of this shale may be accomplished using heavy earth moving equipment with ripping tools. However, blasting may be required for removal of shale in areas of deep cuts.

4.3 HILLSIDE LOTS/ROADWAY CONSTRUCTION

The proposed development includes residential lots and roadways within sloped wooded areas. Some of these lots have steep slopes and drainage swales. Proposed grading information for the residential lots and roadways were not available at the time of this report. The steep slopes present a concern for mass instability in the natural and developed state. At the time of our site reconnaissance, we did not observe evidence of recent natural mass instability as evidenced by cracks in the surface, severely leaning trees or bulging slopes.

The movement of surface water (run-off) is in many cases, one of the primary driving forces for shaping the landscape and creating movements in slopes. Construction in several areas of the site will obstruct the natural drainage features. Where this occurs, we recommend re-directing surface run-off by construction ditching or providing culverts which allows the movement of surface water along existing drainage features and maintains positive surface drainage to prevent the accumulation of water. Where existing drainage features are to be filled, we recommend placement of underdrains beneath the fill material. Houses erected on sloped lots, where cut and fill may be used, should be constructed with direct roof drainage into sewers to minimize surface run-off and the erosion of slopes.

4.4 SITE PREPARATION

4.4.1 Erosion Potential

Based on a review of the *Soil Survey for Jefferson County, Kentucky*, published by the United States Department of Agriculture (USDA), our site observations and experience, the on-site silty soils are highly erodible. Erosion prevention planning should include the use of silt fences, rapid seeding, and placement of other erosion protection such as straw. Silt fences should be established prior to clearing areas. Furthermore, construction activities should be sequenced such that limited areas are opened up at one time and should include run-off velocity reduction measures. Run-off velocity reduction measures include rock check dams, straw bales, etc. Sediment ponds may be considered to collect sediment in areas where long slopes are present or where ditches drain large areas. A detailed evaluation of the site conditions should be performed immediately after each heavy rainfall during project construction. Significant erosion features should be repaired immediately. The geotechnical engineer can provide these services upon request.

4.4.2 Silty Soils

The on-site soils were formed in loess, or wind-blown deposits of silt and fine sand. Our experience and published data suggests that loess soils have a high silt content, often provide poor subgrade support, will deteriorate from repeated passes of construction equipment, are sensitive to moisture content, and are difficult to compact, especially when wet. Our experience with similar sites indicates that earthwork operations during wet periods will be problematic and that subgrade stabilization may be required.

4.4.3 Site Clearing

As previously mentioned, heavily wooded areas with many large mature trees exist at the site. Stump and root ball removal may produce large depressions. We recommend these depressions be backfilled with a properly compacted engineered fill as recommended in our compacted fill section of this report. Large depressions from root ball removals should be laid back or benched to allow access for earthwork equipment to compact fill in these areas. Removal of hillside trees should be limited to only those within actual construction areas. Trees assist removal of excess soil moisture and tree roots help hold soil in place, which will reduce the risk of slope movements.

4.4.4 Existing Fill Materials

As described in previous sections of this report some of our test pits encountered miscellaneous fill materials and these types of soils may exist in other areas at the site. Our experience indicates that undocumented fills often contain deleterious or miscellaneous materials which may decay over time, causing subsidence at the surface. In addition, old fills can contain zones of less compact materials which will settle under their own weight or under new loading. If a structure is founded in the old fill material, we expect a magnitude of settlement will occur that will be detrimental to the proposed structure; therefore, we recommend that the foundations penetrate these fill materials to bear in stiff, native soils or on newly placed and compacted suitable fill material. Whenever undocumented fill is encountered, there is a risk of differential settlement which could result in cracked floor slabs or cracking in the exterior surface veneer of the building. Construction planning should include undercutting these fill soils, laying back the side slopes, and placing structural fill soils in accordance with the requirements of this report. If these soils are encountered in roadway areas we also recommend they be undercut.

4.5 FOUNDATIONS

Individual house construction will likely consist of cutting into the hillside to form a level pad for construction of the walkout basement foundations. Based on our experience, weathered shale will likely be encountered in significant cut areas, which may result in differential support conditions with structures founded partly on rock and partly on soil. Our experience indicates the soil is compressible and will deflect under the weight of the structure and the weathered rock will not.

Therefore, cracking of the foundation and masonry work will likely occur at or near the point of transition. Structures encountering such a condition should be supported entirely on the weathered rock. This will require excavation through any fill and native soils encountered in the footing areas to engage the rock surface. In addition, because the shale is susceptible to weathering and slopes are prone to movement, the uphill portion of the walkout basement wall should be designed as a retaining wall, to resist lateral earth pressures uphill of the wall.

4.6 FILL SOIL

We anticipate that a substantial portion of the available fill material will consist of the wind-deposited Loess (Stratum I) which was encountered in our test pits. Loess is suitable for use as fill, but is very sensitive to moisture content. These soils may lose strength, become unstable, and "pump" when subjected to repeated passes of construction equipment, especially under wet conditions. Loess is typically prone to erosion when exposed to the environment on cut and fill slopes. Drainage swales constructed in loess should be provided with erosion protection immediately upon completion. Loess deposits when saturated may lose strength, become unstable, and deflect and rut under the weight of earth moving equipment. If such subgrade deflections are observed, the geotechnical engineer should be contacted.

The New Providence Shale may also be used as fill material. This shale is a non-durable shale. The shale is suitable for fill placement provided it is placed in accordance with the procedures outlined in this report. Our recommended guidelines for the placement of non-durable shale fill are provided in section 5.3.3 of this report.

5. GEOTECHNICAL RECOMMENDATIONS

5.1 HILLSIDE CONSTRUCTION

We recommend guidelines be established for the development on hillsides of this site. These guidelines can reduce the likelihood of slope movements induced by construction activity. The guidelines should include the following:

1. Fill embankments should not block natural swales or streams. Where fill is required at individual swale locations, construction plans should include continued

drainage along this feature by placement of a "French Drain" or a crushed limestone drainage media under the fill along the existing swale.

2. Because of the proportionately large influence of minor strata changes or soil lenses on slope stability, the stability of cuts in natural slopes is difficult to predict based on soil explorations. Conventional exploration patterns and sampling intervals may not disclose the presence of thin soft seams or local strata variances that can be critical to the stability of cuts in natural slopes. The stress history of the materials in the cut can also be an important factor, but it is one that conventional exploration does not measure. Further, the ground water effects or potential for saturation by surface percolation are significant factors that may not be discovered using short-term data. Given these unknowns, it is necessary to point out that there is an element of risk associated with cuts in natural slopes. Even though the recommended cut slope reflects the use of standard practices combined with prudent judgment, long-term performance is not completely certain.

3. Planned construction will likely require cut slopes and embankments to complete. Empirical guidelines for the successful construction of these slopes follow:

    a. Cut Slopes: Our experience indicates that cut slopes in soils should be matched to the existing slopes or a 2.5 horizontal to 1 vertical (2.5H:1V) ratio, whichever is flatter. Cut slopes in the shale can be steepened to 1.5H:1V. However, some sloughing of the exposed slope will occur as the shale weathers. A catchment bench at the toe of the slope can be used to catch sloughed material.

    b. Embankments (Fill Slopes): All fill slopes should be constructed in thin horizontal layers. Each horizontal fill layer should be tied into the existing natural slope using a level bench. Fill should not be placed on a sloping subgrade. Our experience indicates that small fill slopes of 2.5H: 1V are generally stable. Slopes of 3H: 1V or flatter are generally desirable for maintenance purposes (i.e. mowing).

4. Cuts and fills on natural site slopes should be limited to less than 8 feet, unless the stability of the natural slope is further evaluated for each specific condition. Contact the geotechnical engineer if cuts or fills greater than 8 feet are planned.

5.2 FOUNDATIONS

5.2.1 Design Considerations

Based on the soil conditions encountered in our test pits, our cursory site reconnaissance and limited laboratory testing, we believe conventional shallow spread foundations will be suitable for this development. Our previous experience indicates that the upper silty soils encountered in our test pits are capable of bearing capacities ranging from 1,500 to 2,500 pounds per square foot (psf). The underlying weathered rock (shale) is capable of higher bearing capacities ranging from 3,000 to 5,000 psf. It may be more desirable for many of the homes to bear on the underlying weathered rock formations which will reduce differential settlement and slope stability concerns.

Additional design considerations for project foundations are outlined as follows:

- Design continuous wall footings with a minimum width of 16 inches.
- Design column footings with a minimum horizontal dimension of 24 inches.
- Found all exterior footings at least 30 inches below finished exterior grade to provide protective embedment and help reduce the potential damage from frost heave or shrinkage or swelling due to moisture fluctuations.
- Interior footings not subjected to freezing weather, severe drying, or severe wetting either during or after construction may be founded at nominal depths.
- Include control joints at suitable intervals in the walls of structures to help accommodate differential foundation movements.

5.2.2 Construction Considerations

The soils encountered in this exploration may lose strength if they become wet during construction. Therefore, we recommend the foundation subgrades be protected from exposure to water. The following guides address protection of footing subgrades and our recommended remediation for any soft soils encountered.

- Protect foundation support materials exposed in open excavations from freezing weather, severe drying, and water accumulation.
- Remove any soils disturbed by exposure prior to foundation concrete placement.
- Place a "lean" concrete mud-mat over the bearing soils if the excavations must remain open overnight or for an extended period of time.
- Level or suitably bench the foundation bearing area.
- Foundation concrete should completely fill the opened foundation excavation. Forming the foundations then backfilling against them tends to allow moisture to penetrate and soften the bearing materials which may result in poor foundation performance.
- Remove loose soil, debris, and excess surface water from the bearing surface prior to concrete placement.

- Retain the geotechnical engineer to observe all foundation excavations and provide recommendations for treatment of any unsuitable conditions encountered.

5.3 EARTHWORK

5.3.1 Site Preparation

- Strip all organic material and debris from the area of fill construction. Waste these materials from the site or use as topsoil in non-structural areas.
- Proofroll the exposed subgrade to detect unstable conditions.
- Proofroll after a suitable period of dry weather to avoid degrading the subgrade.
- Perform proofrolling with a loaded dump truck or similar equipment judged acceptable by the geotechnical engineer.
- Make several passes over each section with the proofrolling equipment.
- Remove and replace soft, organic, or highly plastic soil encountered during proofrolling with properly compacted fill.
- Cut the existing slopes after clearing into dozer width level benches prior to placing new fill. Step the level benches in vertical increments no greater than 2 feet.
- Install underdrains in existing natural swales prior to placement of new fill. Underdrains should be constructed using open-graded crushed limestone, such as No. 3 stone, wrapped in a layer of non-woven geotextile fabric.
- Construct haul roads during earthwork operations to protect the subgrade soils from deterioration from construction traffic.
- Retain the geotechnical engineer to observe the proofrolling operations and make recommendations for any unstable or unsuitable conditions encountered.

5.3.2 Compacted Fill

Prior to beginning fill construction, we recommend representative samples of the proposed fill materials be collected and tested to determine their Proctor moisture-density relation, plasticity, and natural moisture content. These tests are needed to determine if the proposed fill material is acceptable and for quality control during compaction.

The following criteria are recommended for structural fill construction using the on-site silty clay and loess materials:

- Limit the fill materials to a Plasticity Index less than 35, a maximum particle size of 6 inches, and less than 3 percent by weight fibrous, organic matter.
- Construct compacted fill by spreading suitable soil in maximum 8-inch thick loose lifts.
- Compact the fill within structural areas (building lots) to at least 98 percent of the standard maximum dry density (ASTM D698). Compact backfill or fill within roadway embankments to at least 95 percent of the standard maximum dry density.
- Maintain the moisture content of the fill soils to within -3 to +1 percentage points of the soils' optimum moisture content.
- Perform one in-place density test in every 5,000 square feet for each one-foot thick fill layer.
- Retain the geotechnical engineer to observe, document and test the fill placement and compaction operations.

5.3.3 Non-Durable Shale Fill

The on-site shale rock pieces rapidly breakdown or slake to soil when subjected to variations in moisture. The shale is generally considered as a suitable source of fill material provided the breakdown of the shale is promoted during fill placement. Keys to the successful placement of the shale include placement of thin horizontal lifts and moistening each lift to promote the breakdown of the shale.

Non-durable shale can be successfully used for structural fill provided that it is placed and compacted in accordance with the following guidelines:

- The subgrade must be free of ponded water and stable prior to and during non-durable shale fill placement.
- Limit the maximum particle thickness to about 6 inches in order to place the fill in maximum 8-inch-thick loose lifts. Particles larger than 6 inches should

be broken-down further using passes of construction equipment prior to placement in the 8-inch thick loose lift.

- Thoroughly moisten each lift of non-durable shale to promote breakdown of the shale.
- Adequate compaction of non-durable shale fill normally requires six to eight passes of a Caterpillar 815 sheepsfoot roller in two directions on the fill surface (half the passes in each perpendicular direction) after moistening. Our experience has been that additional moistening of the shale lift may be required to further breakdown the shale.
- Compact the fill within the building lots to at least 98 percent of the standard maximum dry density (ASTM D698). Compact fill within roadway embankments to at least 95 percent of the standard maximum dry density.
- Maintain the moisture content of the non-durable shale fill soils to within ±2 percentage points of the soils' optimum moisture content.
- Perform one in-place density test in every 5,000 square feet for each one-foot-thick fill layer.
- Positive drainage of the non-durable shale fill layer must be provided to prevent water accumulation in the layer.
- Retain the geotechnical engineer to observe the non-durable shale fill placement and provide recommendations for any unsuitable conditions encountered.

5.3.4 Subgrade Stabilization

Depending on the selected time of construction and rainfall activity, some of the subgrade soils may become unstable during construction activities. There are several methods available to stabilize areas of unstable subgrade soil that include undercutting and replacement, bridging using granular material and geotextiles, and chemical stabilization using cement. The most appropriate method to stabilize soft subgrades is dependent on several factors and should be field determined during construction. We suggest the construction of test strips to determine the effectiveness of the selected stabilization technique prior to widespread application. Localized softer or wetter areas may require additional treatment. Maintain positive surface drainage to prevent water from ponding on the surface during all earthwork operations.

5.3.5 General

- Roll the fill surface with a rubber-tired or steel-drummed roller to improve surface runoff, if precipitation is expected.
- Contact the geotechnical engineer should the subgrade soils become excessively wet, dry, or frozen.

5.4 GROUND WATER CONTROL

Typically, ground water encroaching upon construction excavations can be removed by placing a sump near the source of seepage and then pumping from the sump. Should heavy seepage occur, or should there be evidence of soil particle migration, such as silting of the sump, then the geotechnical engineer should be contacted.

6. PAVEMENT RECOMMENDATIONS

6.1 GENERAL

In order for a pavement to perform satisfactorily, the subgrade soils must have sufficient strength and be stable enough to avoid deterioration from construction traffic and support the paving equipment. In addition, the completed pavement sections must resist freeze/thaw cycles and wheel loads from traffic. Generally, construction traffic loading is more severe than the traffic after construction. The recommended pavement sections given below are based on the assumption that the pavement subgrade soils have been compacted to at least 95 percent of the soil's standard maximum dry density at moisture contents as recommended in this report. This will require scarifying the subgrade soils to a depth of 6 to 12 inches, adjusting the moisture content if necessary, recompacting, and maintaining the recommended subgrade moisture content until the crushed stone base is placed. We have also assumed a detailed proofrolling of the subgrade soil will be performed to delineate soft areas. On this site, we anticipate some undercutting or stabilization of soft subgrade soils will be required to achieve a stable subgrade.

Minimizing infiltration of water into the subgrade and rapid removal of subsurface water are essential for the successful long-term performance of the pavement. Both the subgrade and the pavement surface should have a minimum slope of one-quarter inch per foot to promote surface drainage. Edges of the pavement should be provided a means of water outlet by extending the aggregate base course through to daylight or to surface drainage features such as storm inlets. We recommend pavement underdrains be constructed at and above the base of roadway slopes steeper than 5H:1V.

The materials should conform and be placed and compacted in accordance with the applicable sections of the Kentucky Department of Highways (DOH) Standard Specifications for Road and Bridge Construction, latest edition.

6.2 DESIGN METHODOLOGY

We have used the American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures (1993) as a basis for our pavement thickness analysis. The AASHTO design guide was developed based on the findings of the American Association of State Highway Officials (AASHO) Road Test. It defines pavement performance in terms of the present serviceability index (PSI), which varies from 0 to 5. The PSI of newly constructed flexible (asphaltic concrete) pavements was found to be about 4.2 in the Road Test. The end of service life was considered to be reached at a terminal PSI value of 2.0. Serviceability loss (ΔPSI), the required input parameter, is the difference between the initial and terminal serviceabilities.

The AASHTO design guide incorporates a reliability factor to account for uncertainties in traffic prediction and pavement performance. The reliability factor (R) indicates the probability that the pavement will not reach the terminal serviceability level before the end of the design period. We have assumed a design reliability of 85 percent at an overall standard deviation (S_o) of 0.45 for flexible pavements.

6.3 FLEXIBLE PAVEMENT

The total flexible pavement thickness requirement is a function of the resilient modulus (M_r) of the subgrade soils. We have estimated M_r through the empirical correlation with the California Bearing Ratio (CBR) suggested by AASHTO for fine-grained soils with a soaked CBR of 10 or less. No laboratory CBR tests were performed for this project. Our experience indicates that, for the soil types encountered, a CBR value of 3 is appropriate.

The total pavement thickness requirement is obtained from the AASHTO nomograph in terms of a structural number (SN), a weighted sum of the pavement layer thicknesses accounting for their structural and drainage properties. We have assumed layer coefficients of 0.44 and 0.14 for plant mix asphalt and crushed stone, respectively, and a drainage coefficient of 1.0 for the crushed stone base. The possible effect of drainage on the asphaltic concrete surface is not considered.

Detailed vehicle loading information has not been provided. We understand that the proposed roadways will be maintained by Jefferson County upon completion. Based on the information provided to us, the development will likely be zoned R-4. Based on the conditions encountered at the site and our experience with similar projects, we anticipate that the minimum pavement thickness, required by Jefferson County, will be adequate to support construction and residential traffic. The required pavement thickness is summarized in Table 1.

Table 1. Flexible Pavement

Material	Cul-de-sac & Local	Collector	Kentucky DOH Specification
Asphalt	3 inches	3 inches	Section 400
Crushed Stone Base	8 inches	10 inches	Section 303

Prepared By: SEB *Checked By:* NGS

7. BASIS FOR RECOMMENDATIONS

The recommendations provided are based in part on project information provided to MACTEC and only apply to the specific project and site discussed in this report. If the project information section in this report contains incorrect information or if additional information is available, you should convey the correct or additional information to us and retain us to review our recommendations. We can then modify our recommendations if they are inappropriate for the proposed project.

The assessment of site environmental conditions or the presence of contaminants in the soil, rock, surface water or ground water of the site was beyond the scope of this exploration.

Regardless of the thoroughness of a geotechnical exploration, there is always a possibility that conditions between test pits will be different from those at specific test pit locations and that conditions will not be as anticipated by the designers or contractors. In addition, the construction process may itself alter soil conditions. Therefore, experienced geotechnical personnel should observe and document the construction procedures used and the conditions encountered. Unanticipated conditions and inadequate procedures should be reported to the design team along with timely recommendations to solve the problems created. We recommend that the owner retain MACTEC to provide this service based upon our familiarity with the project, the subsurface conditions and the intent of the recommendations.

We recommend that this complete report be provided to the various design team members, the contractors and the project owner. Potential contractors should be informed of this report in the "instructions to bidders" section of the bid documents. The report should not be included or referenced in the actual contract documents.

We wish to remind you that our exploration services include storing the samples collected and making them available for inspection for 30 days. The samples are then discarded unless you request otherwise.

APPENDIX:

Site Location Map

Test Pit Location Plan

Field Testing Procedures

Key Sheet to Soil Classification for Test Pits

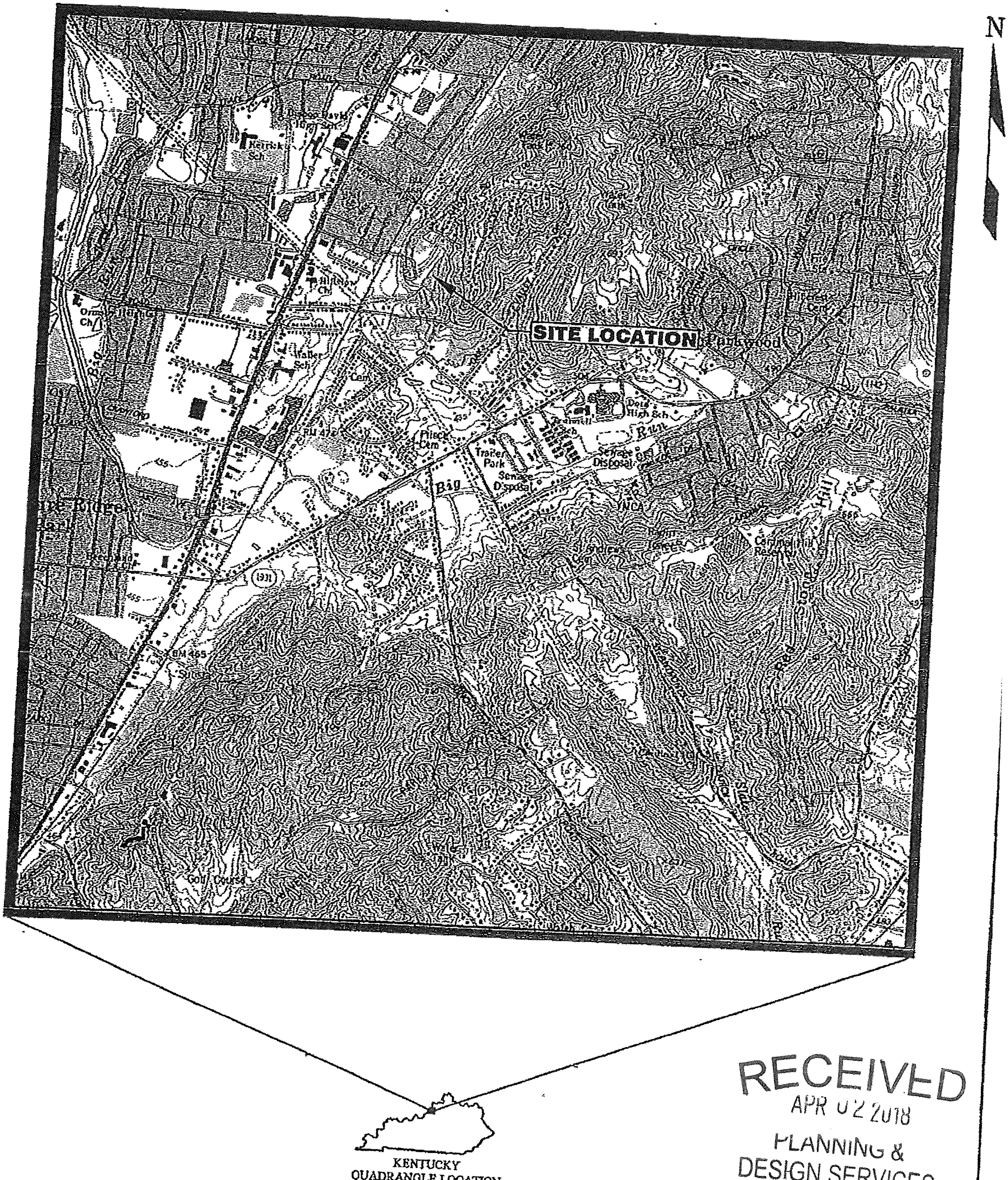
Test Pit Records

Laboratory Testing Procedures

Summary of Laboratory Test Data

Atterberg Limits

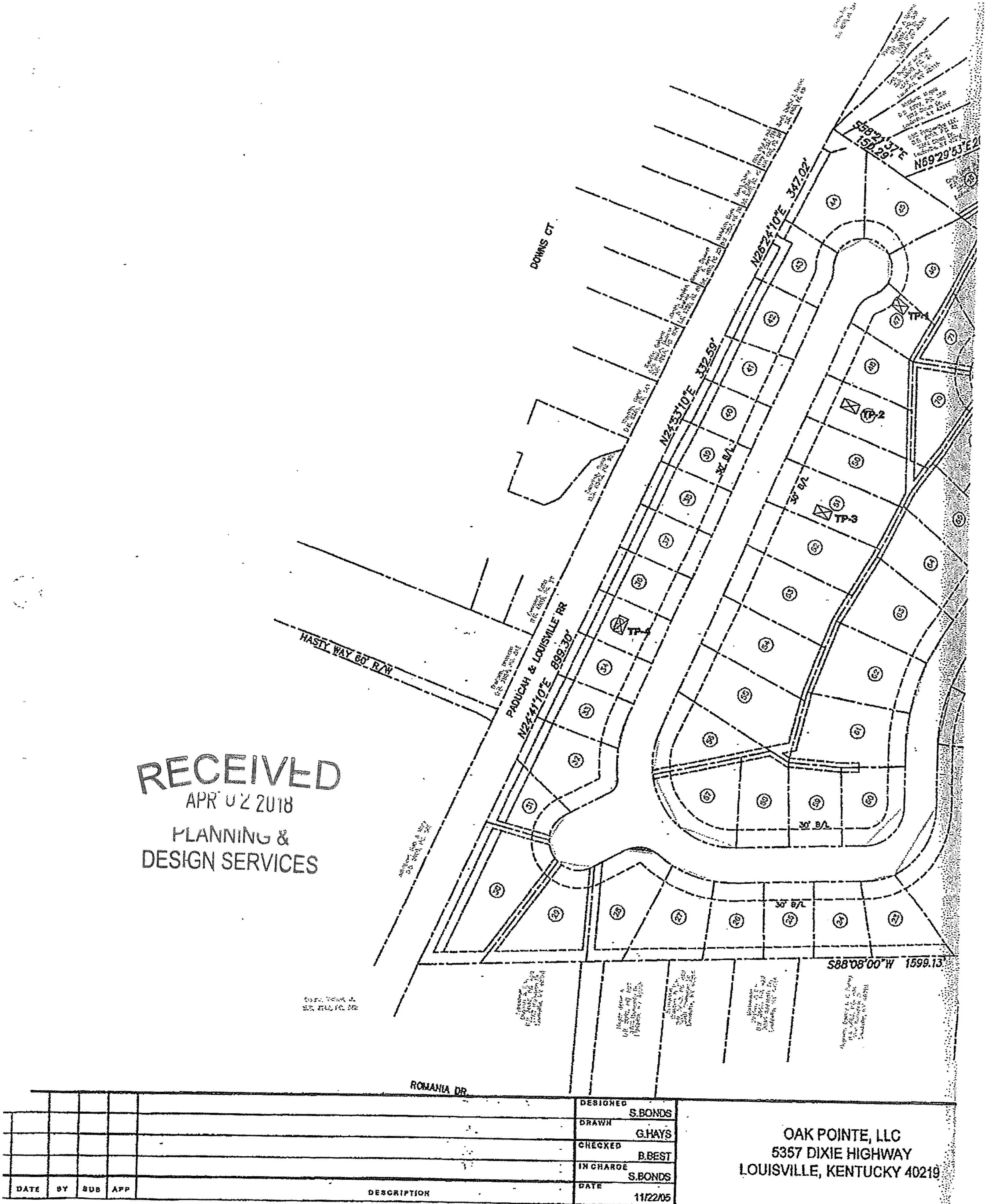
USGS TERRAIN NAVIGATOR, LOUISVILLE WEST QUADRANGLE.



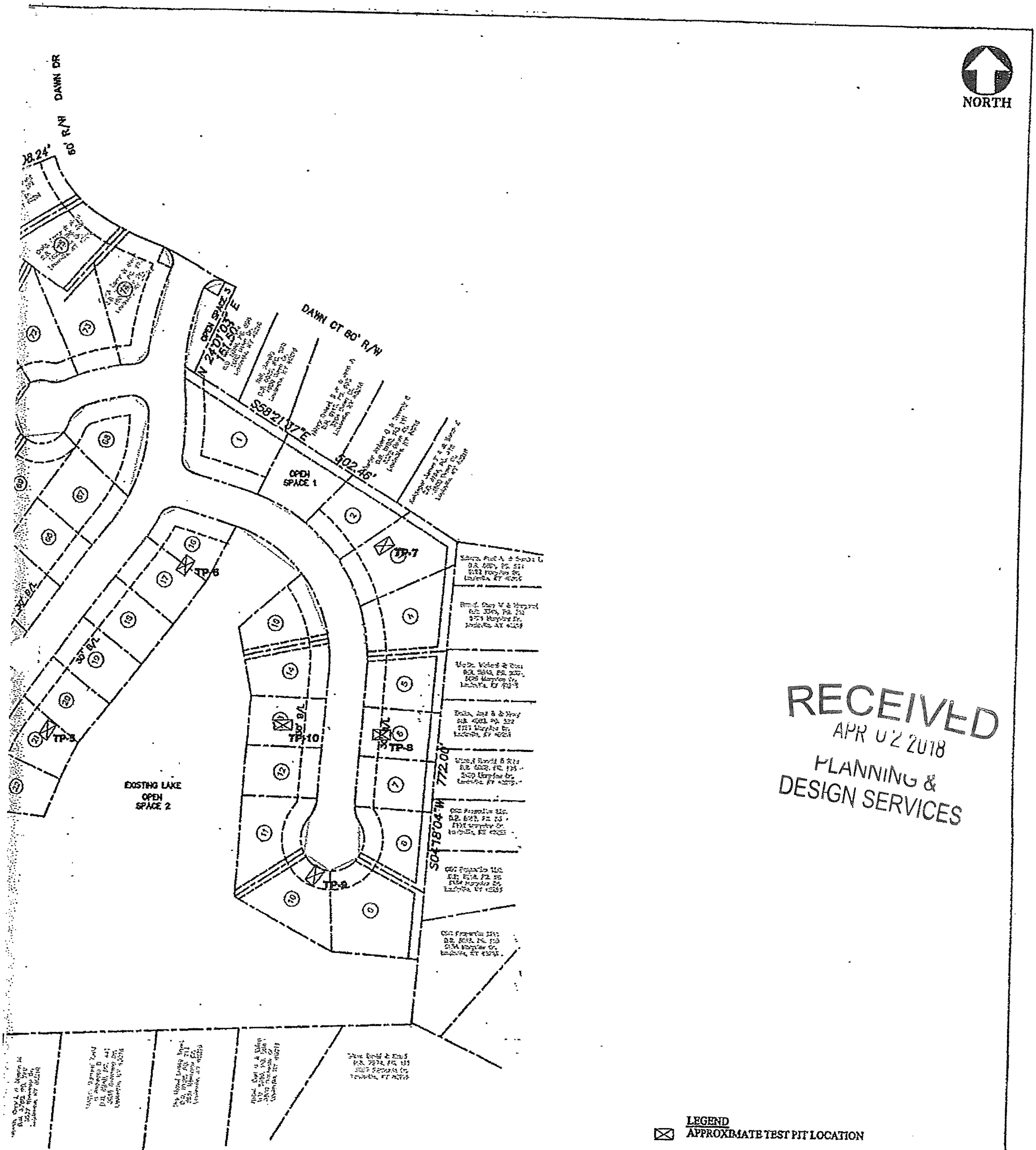
OAK POINTE, LLC 5357 DIXIE HIGHWAY LOUISVILLE, KENTUCKY 40219 PROJECT NO. 3143-05-0633	MACTEC 13425 Eastpoint Centre Drive, Ste 122 Louisville, KY. 40223 Phone: 502-253-2500 Fax: 502-253-2501 CHECKED BY: S.BONDS PREPARED BY: G.HAYS	SITE LOCATION MAP OAK POINTE SUBDIVISION LOUISVILLE, KENTUCKY CADD FILE: 050633_SLM PLOT DATE: 11/28/05 FIGURE 1

'18 SUBDIV 1004

ource: Drawing provided by Dunaway Engineering Inc.



18 SUBDIV 1004



LEGEND

☒ APPROXIMATE TEST PIT LOCATION

MACTEC
13425 Eastpoint Centre Drive, Ste 122
Louisville, KY. 40223
Phone: 502-253-2500 Fax: 502-253-2501

TEST PIT LOCATION PLAN
OAK POINTE SUBDIVISION
LOUISVILLE, KENTUCKY

SCALE			CADD FILE: 050633_TPLP	PLOT DATE: 11/22/05
1"=200'				
PROJECT NO. 3143-05-0633				
DWG NO. -	REV. -	FIGURE 2		

FIELD TESTING PROCEDURES

Test Pits: Borings with standard penetration tests usually give adequate information about the subsurface soils. However, to obtain additional information about shallow soil conditions, test pits are often desired. These pits allow close inspection of shallow soil conditions and give a good indication of excavation difficulty during construction. The pits are excavated with equipment expected to be used during the actual construction operations, if possible. A field engineer is present to examine the soil strata, the ease of excavation, the amount of subsurface water flowing into the pits, and the depths to which the pits can be excavated.

Dynamic Cone Penetrometer (DCP) Tests: At regular intervals, the soil consistency was measured with a cone penetrometer. The conical point was first seated 2 inches to penetrate any loose cuttings, then driven an additional 3½ inches in two 1¾-inch increments with blows from a 15-pound hammer falling 20 inches. The average number of hammer blows required to achieve the final two 1¾-inch increments was recorded, and is an index to the soil strength and density.

Pocket Penetrometer Test: The penetrometer testing device is inserted into the soil until the plunger penetrates the soil up to the calibration grade. The measured resistance provides an indication of the soil's consistency. The testing results are shown on the Test Pit Logs and are designated with PP.

Bag Sampling: We obtained bulk samples of soil at selected locations. These samples consist of soil obtained from test pits using hand tools. The samples were placed in sealed bags and were taken to our laboratory for testing. The locations of these samples are indicated on the appropriate logs.

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravels, gravel - sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel - sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel - sand - silt mixtures.
			GC	Clayey gravels, gravel - sand - clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 Sieve Size)	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand - silt mixtures.
			SC	Clayey sands, sand - clay mixtures.
FINE GRAINED SOILS (More than 50% of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts and with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils.

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

CLAY	SILT	SAND			GRAVEL		Cobbles	Boulders
		Fine	Medium	Coarse	Fine	Coarse		

0.005 mm — No.200 — No.40 — No.10 — No.4 — 3/4" — 3" — 12"

U.S. STANDARD SIEVE SIZE

	Undisturbed Sample (UD)
	Split Spoon Sample (SS)
	Rock Core (RC)
	Dilatometer
	Packer
▽	Water Table at time of drilling
	WOH - Weight of Hammer
	Auger Cuttings
	Bulk Sample
	Crandall Sampler
	Pressure Meter
○	No Recovery
▼	Water Table after 24 hours
◀	Loss of Water
C	Caved Depth of Boring

Correlation of Penetration Resistance (N) with Relative Density and Consistency

SAND & GRAVEL		SILT & CLAY	
No. of Blows	Relative Density	No. of Blows	Consistency
0 - 4	Very Loose	0 - 2	Very Soft
5 - 10	Loose	3 - 4	Soft
11 - 20	Firm	5 - 8	Firm
21 - 30	Very Firm	9 - 15	Stiff
31 - 50	Dense	16 - 30	Very Stiff
Over 50	Very Dense	Over 31	Hard

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Reference: The Unified Soil Classification System, Corps of Engineers, U.S. Army Technical Memorandum No. 3-357, Vol. 1, March, 1953 (Revised April, 1960)

KEY TO SYMBOLS AND DESCRIPTIONS

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLE IDENT.	SAMPLE TYPE	DCP (bpi)	POCKET PEN (tsf)	NATURAL MOISTURE CONTENT, %	REMARKS
0	TOPSOIL (5 INCHES)							
	VERY STIFF, orangish brown and gray, lean CLAY (CL) with sandstone pieces to cobbles							
2			BG-1		14-20-R	4.0	17.2	A BAG SAMPLE WAS OBTAINED AT 2.0 FEET
4			BG-2		16-R	4.5+	15.3	A BAG SAMPLE WAS OBTAINED AT 4.0 FEET
6			BG-3				15.8	A BAG SAMPLE WAS OBTAINED AT 6.0 FEET
8								
	NO REFUSAL AT 9.0 FEET; TEST PIT TERMINATED							TEST PIT DRY UPON COMPLETION OF EXCAVATION
10								
12								
14								

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EQUIPMENT: CASE BACKHOE
REMARKS:

TEST PIT RECORD

Project: Oakpoint Subdivision
Project No: 3143-05-0633
Checked By:

Test Pit No.: TP-1

MACTEC

16 SUBDIV 1004

MACTEC TEST PIT 3143050633.GPJ LAW_GIBB.GDT 11/23/05

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	LEGEND	ELEV (ft)	SAMPLE IDENT.	SAMPLE TYPE	DCP (bpi)	POCKET PEN (tsf)	NATURAL MOISTURE CONTENT, %	REMARKS
0	TOPSOIL (7 INCHES)								
	VERY STIFF, orangish brown and gray, lean CLAY (CL)								
2				BG-1		16-18-R	4.5+	16.5	A BAG SAMPLE WAS OBTAINED AT 2.0 FEET
4	FIRM to STIFF, gray with a little orangish brown, lean CLAY (CL)					5-7-9	2.5		
				BG-2				19.8	A BAG SAMPLE WAS OBTAINED AT 4.5 FEET
6							4.0		
8				BG-3					A BAG SAMPLE WAS OBTAINED AT 8.0 FEET
10	NO REFUSAL AT 10.0 FEET; TEST PIT TERMINATED ON WEATHERED SHALE								TEST PIT DRY UPON COMPLETION OF EXCAVATION
12									
14									

START DATE: 11/4/2005
CONTRACTOR: CONTRACTOR
EQUIPMENT: CASE BACKHOE
REMARKS:

TEST PIT RECORD

Project: Oakpoint Subdivision
Project No: 3143-05-0633 8
Checked By:
Test Pit No.: TP-2

SUBDIV 1004

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DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLE IDENT.	SAMPLE TYPE	DCP (bpi)	POCKET PEN (tsf)	NATURAL MOISTURE CONTENT, %	REMARKS
0	TOPSOIL (6 INCHES)								
	STIFF, orangish brown, lean CLAY (CL)								
2				BG-1		11-12-18	4.0	18.8	A BAG SAMPLE WAS OBTAINED AT 2.0 FEET
4						12-16-R	4.5+		
	VERY STIFF, gray with a little orangish brown, lean CLAY (CL)								
				BG-2			4.5+	17.4	A BAG SAMPLE WAS OBTAINED AT 5.0 FEET
6									
8									
10	NO REFUSAL AT 10.0 FEET; TEST PIT TERMINATED								TEST PIT DRY UPON COMPLETION OF EXCAVATION
12									
14									

START DATE: 11/4/2005
CONTRACTOR: CONTRACTOR
EQUIPMENT: CASE BACKHOE
REMARKS:

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Project: Oakpoint Subdivision
Project No: 3143-05-0633
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Test Pit No.: TP-3

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DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLE IDENT.	SAMPLE TYPE	DCP (bpi)	POCKET PEN (tsf)	NATURAL MOISTURE CONTENT, %	REMARKS
0	SOFT, dark brown, lean CLAY (CL) with abundant organic material including roots, wood and traces of domestic debris (FILL)								
1				BG-1					A BAG SAMPLE WAS OBTAINED AT 1.0 FOOT
2	FIRM to STIFF, orangish brown and gray, lean CLAY (CL)					4-4-3	1.0		
4				BG-2		4-5-6	2.0	21.5	A BAG SAMPLE WAS OBTAINED AT 4.0 FEET
6				BG-3				22.5	A BAG SAMPLE WAS OBTAINED AT 6.0 FEET
8									
10	NO REFUSAL AT 10.0 FEET; TEST PIT TERMINATED								TEST PIT DRY UPON COMPLETION OF EXCAVATION
12									
14									

START DATE: 11/4/2005
CONTRACTOR: CONTRACTOR
EQUIPMENT: CASE BACKHOE
REMARKS:

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Project: Oakpoint Subdivision
Project No: 3143-05-0633
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18 SUBDIV 1004

Test Pit No.: TP-4

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLE IDENT.	SAMPLE TYPE	DCP (bpi)	POCKET PEN (tsf)	NATURAL MOISTURE CONTENT, %	REMARKS
0	FIRM, dark brown, lean CLAY (CL) mixed with crushed limestone								
	FIRM to SOFT, orangish brown, lean CLAY (CL)								
2				BG-1		10-12-11	4.0	16.9	A BAG SAMPLE WAS OBTAINED AT 2.0 FEET
4	FIRM, tan SILT (ML) with fine sand					4-4-4	1.0		
	LOOSE, tan, silty, fine SAND (SM)			BG-2				4.4	A BAG SAMPLE WAS OBTAINED AT 5.0 FEET
6									
				BG-3					A BAG SAMPLE WAS OBTAINED AT 7.0 FEET
8									
	NO REFUSAL AT 9.0 FEET; TEST PIT TERMINATED								TEST PIT DRY UPON COMPLETION OF EXCAVATION
10									
12									
14									

START DATE: 11/4/2005
CONTRACTOR: CONTRACTOR
EQUIPMENT: CASE BACKHOE
REMARKS:

TEST PIT RECORD

Project: Oakpoint Subdivision
Project No: 3143-05-0633
Checked By:
Test Pit No.: TP-5

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLE IDENT.	SAMPLE TYPE	DCP (bpi)	POCKET PEN (tsf)	NATURAL MOISTURE CONTENT, %	REMARKS
0	TOPSOIL (7 INCHES)								
	STIFF to VERY STIFF, orangish brown and gray, lean CLAY (CL)								
2						R	4.5+		
4				BG-1		R	4.5+		A BAG SAMPLE WAS OBTAINED AT 4.0 FEET
6						R	4.5+		
	VERY STIFF, gray with a little orangish brown, lean CLAY (CL)								
8									
10	NO REFUSAL AT 10.0 FEET; TEST PIT TERMINATED								TEST PIT DRY UPON COMPLETION OF EXCAVATION
12									
14									

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EQUIPMENT: CASE BACKHOE
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TEST PIT RECORD

Project: Oakpoint Subdivision

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Project No: 3143-05-0633

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Test Pit No.: TP-6

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLE IDENT.	SAMPLE TYPE	DCP (bpi)	POCKET PEN (tsf)	NATURAL MOISTURE CONTENT, %	REMARKS
0	TOPSOIL (4 INCHES)								
	FIRM, orangish brown, clayey SILT (ML) with a little fine sand								
2				BG-1		6-7-8	2.5	19.6	A BAG SAMPLE WAS OBTAINED AT 2.0 FEET
4						6-6-6	2.0		
				BG-2				33.0	A BAG SAMPLE WAS OBTAINED AT 5.0 FEET
6									
8									
	NO REFUSAL AT 9.0 FEET; TEST PIT TERMINATED								TEST PIT DRY UPON COMPLETION OF EXCAVATION
10									
12									
14									

START DATE: 11/4/2005
CONTRACTOR: CONTRACTOR
EQUIPMENT: CASE BACKHOE
REMARKS:

TEST PIT RECORD

Project: Oakpoint Subdivision
Project No: 3143-05-0633
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Test Pit No.: TP-7

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLE IDENT.	SAMPLE TYPE	DCP (bpf)	POCKET PEN (tsf)	NATURAL MOISTURE CONTENT, %	REMARKS
0	FIRM, orangish brown, lean CLAY (CL)								
	SOFT, dark brown, lean CLAY (CL) with wood, mulch and roots								
2						4-4-4	1.0		
				BG-1				25.5	A BAG SAMPLE WAS OBTAINED AT 2.0 FEET
	FIRM, orangish brown, lean CLAY (CL)					4-5-5	1.25		
4				BG-2				24.2	A BAG SAMPLE WAS OBTAINED AT 4.0 FEET
6	FIRM to STIFF, gray with a little orangish brown, lean CLAY (CL)								
				BG-3			3.5	18.0	A BAG SAMPLE WAS OBTAINED AT 7.0 FEET
8									
10	NO REFUSAL AT 10.0 FEET; TEST PIT TERMINATED								TEST PIT DRY UPON COMPLETION OF EXCAVATION
12									
14									

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Project No: 3143-05-0633 18 SUBDIV 1004
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Test Pit No.: TP-8

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	ELEV (ft)	SAMPLE IDENT.	SAMPLE TYPE	DCP (bpf)	POCKET PEN (tsf)	NATURAL MOISTURE CONTENT, %	REMARKS
0	FIRM, orangish brown, lean CLAY (CL)							
	TOPSOIL with roots							
	FIRM, orangish brown, lean CLAY (CL)							
2					4-5-6	2.5		
			BG-1				23.9	A BAG SAMPLE WAS OBTAINED AT 3.0 FEET
4	FIRM, orangish brown, clayey SILT (ML) with a little fine sand, wet below 7.0 feet				4-5-5	2.0		
6			BG-2				26.1	A BAG SAMPLE WAS OBTAINED AT 6.0 FEET
8								
10	NO REFUSAL AT 10.0 FEET; TEST PIT TERMINATED							TEST PIT DRY UPON COMPLETION OF EXCAVATION
12								
14								

START DATE: 11/4/2005
CONTRACTOR: CONTRACTOR
EQUIPMENT: CASE BACKHOE
REMARKS:

TEST PIT RECORD

Project: Oakpoint Subdivision

Project No: 3143-05-0633 18 SUBDIV 1004

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Test Pit No.: TP-9

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DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	ELEV (ft)	SAMPLE IDENT.	SAMPLE TYPE	DCP (bpl)	POCKET PEN (tsf)	NATURAL MOISTURE CONTENT, %	REMARKS
0	FIRM, orangish brown, lean CLAY (CL)							
	TOPSOIL							
2					3-4-3	1.5		
	SOFT to FIRM, orangish brown and gray, lean CLAY (CL)		BG-1				21.9	A BAG SAMPLE WAS OBTAINED AT 2.5 FEET
4					5-6-6	2.5		
	STIFF, gray with a little orangish brown, lean CLAY (CL)							
6								
			BG-2				20.2	A BAG SAMPLE WAS OBTAINED AT 7.0 FEET
8								
	NO REFUSAL AT 9.0 FEET; TEST PIT TERMINATED							TEST PIT DRY UPON COMPLETION OF EXCAVATION
10								
12								
14								

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TEST PIT RECORD

Project: Oakpoint Subdivision
Project No: 3143050633 18 SUBDIV 1004
Checked By:
Test Pit No.: TP-10

MACTEC

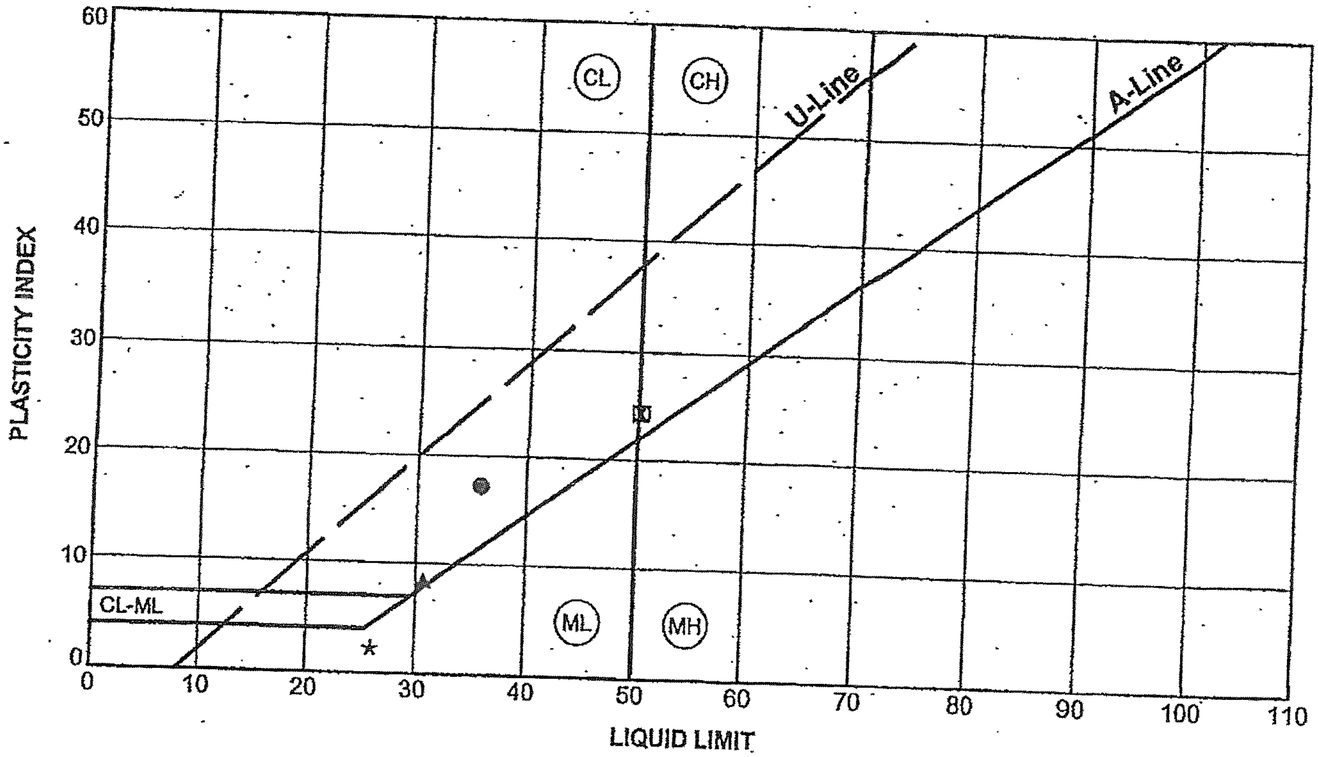
LABORATORY TESTING PROCEDURES

Soil Classification: Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply past experience to current situations. In our investigations, samples obtained during field operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from DCP and Pocket Penetrometer penetration tests), color and texture. These classification descriptions are included on our "Test Pit Records."

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary: grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D2487). Each of these classification systems and the in-place physical soil properties provide an index for estimating the soil's behavior. The soil classification and physical properties determined are presented in this report.

Atterberg Limits: Portions of the samples are taken for Atterberg Limits testing to determine the plasticity characteristics of the soil. The plasticity index (PI) is the range of moisture content over which the soil deforms as a plastic material. It is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil becomes sufficiently "wet" to flow as a heavy viscous fluid. The plastic limit is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into tiny threads. The liquid limit and plastic limit are determined in accordance with ASTM D4318.

Moisture Content: The Moisture Content is determined according to ASTM D2216.



Symbol	Location	Depth, feet	LL	PL	PI	Natural Moisture Content, %	LI	USCS	Soil Classification
●	TP-2	2	36	19	17	16.5	-0.1	CL	Light brown, silty, lean CLAY
⊠	TP-3	5	50	26	24	17.4	-0.3	CL	Dark gray, lean CLAY
▲	TP-7	2	31	22	9	19.6	-0.3	ML	Orangish brown, clayey SILT
*	TP-9	6	26	24	2	26.1	1.0	ML	Reddish brown, clayey SILT

Remarks:

Test Method - ASTM D4318

LL=Liquid Limit; PL= Plastic Limit; PI=Plasticity Index; LI=Liquidity Index

ATTERBERG LIMITS RESULTS

Project: Oakpoint Subdivision

Project No: 3143-05-0633

Checked By:

MACTEC

Test Location Number	Depth, feet	Sample Type*	Natural Moisture Content,%	Atterberg Limits			Percent Finer Than No. 200 Sieve	USCS Classification	Unconfined Compressive Strength, psf	Specific Gravity	Unit Weight, pcf		Compaction Tests		
				Liquid Limit	Plastic Limit	Plasticity Index					Wet	Dry	Std. Max. Dry Density, pcf	Opt. Moisture Content, %	CBR
TP-1	2.0	BG	17.2												
TP-1	4.0	BG	15.3												
TP-1	6.0	BG	15.8												
TP-10	2.5	BG	21.9												
TP-10	7	BG	20.2												
TP-2	2	BG	16.5	36	19	17		CL							
TP-2	4.5	BG	19.8												
TP-3	2	BG	18.8												
TP-3	5	BG	17.4	50	26	24		CL							
TP-4	4	BG	21.5												
TP-4	6	BG	22.5												
TP-5	2	BG	16.9												
TP-5	5	BG	4.4												
TP-7	2	BG	19.6	31	22	9		ML							
TP-7	5	BG	33.0												
TP-8	2	BG	25.5												
TP-8	4	BG	24.2												
TP-8	7	BG	18.0												
TP-9	3	BG	23.9												
TP-9	6	BG	26.1	26	24	2		ML							

Remarks:

* SS = Split-spoon
UD = Undisturbed sample
BG = Bulk / bag sample
RC = Rock core

Summary of Laboratory Results

Project: Oakpoint Subdivision
Project No: 3143-05-0633
Checked By:

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SUBDIV 1004