BURNS COOLEY DENNIS, INC.

GEOTECHNICAL AND MATERIALS ENGINEERING CONSULTANTS

Corporate Office
551 Sunnybrook Road
Ridgeland, MS 39157
Phone: (601) 856-9911
Fax: (601) 853-2077

Mailing Address
Post Office Box 12828
Jackson, MS 39236

www.bcdgeo.com

Materials Laboratory
278 Commerce Park Drive
Ridgeland, MS 39157
Phone: (601) 856-2332
Fax: (601) 856-3552

November 13, 2020

Will Herrington, EIT
Engineering Service
Post Office Box 180429
Richland, Mississippi 39218

Report No.200560

Geotechnical Exploration
Proposed Additions
Senior Citizen Center Facility
Richland, Mississippi

Dear Mr. Herrington:

Submitted here is the report of our geotechnical exploration for the above-captioned project. This exploration was authorized by your email on October 14, 2020 and was generally performed in accordance with our Proposal No. 20001P-200 dated October 13, 2020.

We appreciate the opportunity to be of service. If you should have any questions concerning this report, please do not hesitate to call us.

Very truly yours,

BURNS COOLEY DENNIS, INC.

Marcos V. F. Rodrigues

Marcos V. F. Rodrigues, P.E.

G. Thomas Dunlap

G. Thomas Dunlap, P.E.

GARY THOMAS DUNLAP
REGISTERED PROFESSIONAL
ENGINEER
12909
STATE OF MISSISSIPPI

GTD/MR/khb
Copy Submitted: (via e-mail)

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1.0 INTRODUCTION

1.1 Project Description

Plans are being made for the construction of new additions to the existing Senior Citizen Center facility located at 371 Scarborough Street South in Richland, Mississippi. The proposed additions will include a new building addition and new parking lots. The proposed building addition will abut the west side of existing building and will generally consist of a lightly loaded, one-story structure encompassing approximately 2,800 sq ft. We understand that plans are to support the new building addition on a shallow foundation system. According to Mr. Will Herrington, project engineer, the existing building has not experienced noticeable differential movement. Grading plans have not been provided, but we expect that only minimal fill will be needed to match the grades of the existing building and to provide drainage away from the building and across the pavement areas. The construction areas for the additions are covered by an existing asphalt paved parking lot and a few scattered trees. A site plan showing the building and layout of the parking lots is presented on Figure 1 of this report.

1.2 Purposes

The specific purposes of this exploration were:

1) to make exploratory soil borings within the areas planned for construction of the new additions;

2) to verify field classifications and to evaluate pertinent physical properties of the soils encountered in the borings by means of visual examination of the soil samples in the laboratory and routine tests performed on the samples; and

3) after analysis of the soil boring and laboratory test data, to provide recommendations for site preparation, earthwork construction, and building foundation design and construction, and to also provide guideline recommendations for pavement design and construction. Detailed slope stability analyses have not been requested at this time and are not included in this current phase of study.

2.0 FIELD INVESTIGATION

2.1 General

Subsurface soil conditions within the areas planned for construction of the new additions were explored by means of five borings. The locations of the borings are shown on Figure 1 of this report. The borings were located in the field by means of visual sighting and taped measurements from existing site features using distances scaled from the site plan we were furnished.

All soils were classified in general accordance with the Unified Soil Classification System. A synopsis of the Unified Soil Classification System is presented on Figure 2 along with symbols and terminology typically utilized on graphical soil boring logs. Graphical logs of the borings are presented on Figures 3 through 7. The graphical logs illustrate the types of soil and stratification encountered with depth below the existing ground surface at the individual boring locations. Approximate GPS coordinates for the boring locations as determined by our drilling personnel using a hand-held device are shown at the bottom of the graphical boring logs within the “Comments” section.

2.2 Drilling Methods and Groundwater Observations

Borings 1, 2 and 3 were made to an exploration depth of 15 ft within the planned construction area for the building addition. Borings 4 and 5 were made to a depth of 6 ft within the pavement areas. The borings were advanced full depth by dry augering. Observations were made continuously during auger drilling to detect free water entering the open boreholes. Notes pertaining to groundwater observations are included at the bottom right corner of the graphic boring logs.

2.3 Sampling Methods

Relatively undisturbed samples of the soils encountered in Borings 1, 2 and 3 were obtained by pushing a 3-in. OD Shelby tube sampler approximately 2 ft into the soil. The Shelby tube samples were obtained within the depth intervals illustrated as shaded portions of the "Samples" column of the graphic logs for Borings 1, 2 and 3. A disturbed sample of soil encountered in Boring 2 was obtained by driving a standard 2-in. OD split-spoon sampler 18 in.

into the soil with a 140-lb hammer falling freely a distance of 30 in. The depth at which the split-spoon sample was taken is illustrated as a crossed rectangular symbol under the "Samples" column of the graphic log for Boring 2. The standard penetration test (SPT) blow count resulting from split-spoon sampling is recorded under the "Blows Per Ft" column of the graphic log for Boring 2. The Shelby tube and/or split-spoon samples were generally obtained in Borings 1, 2 and 3 at approximate 3-ft to 5-ft intervals of depth. Disturbed auger cutting samples were obtained at approximate 2-ft and 3-ft depth intervals in Borings 4 and 5. Disturbed auger cutting samples were also taken near the ground surface in Borings 1, 2 and 3. The depths at which the auger cutting samples were taken are illustrated as small I-shaped symbols under the "Samples" column of the graphic boring logs.

2.4 Field Classification, Sample Preservation and Borehole Abandonment

All soils encountered during drilling were examined and classified in the field by a geotechnical engineering technician. The Shelby tube samples were extruded from the sampling tube in the field. An approximate 6-in. long portion of each Shelby tube sample was sealed with melted paraffin in a cylindrical cardboard container to prevent moisture loss and structural disturbance. An additional portion of each Shelby tube sample, a representative portion of the split-spoon sample and the auger cutting samples were sealed in jars to provide material for visual examination and testing in the laboratory. The boreholes were plugged with soil cuttings after completion of drilling and sampling. Borings 1, 2, 3 and 5 were also patched at the surface with cold mix asphalt. Unless other disposition is requested, we routinely discard soil samples after about six months of storage.

3.0 LABORATORY TESTING

3.1 General

All of the soil samples from the borings were examined in the laboratory and tests were performed on selected samples to verify field classifications and to assist in evaluating the strengths and volume change properties of the soils encountered. The types of laboratory tests performed are described in the following paragraphs.

3.2 Strength Tests

The undrained shear strength characteristics of the fine-grained soils encountered in the borings were investigated by means of visual estimates of consistency and from the results of unconfined compression tests and an unconsolidated undrained (UU) triaxial compression test performed on selected undisturbed Shelby tube samples. The results of the unconfined compression tests in terms of cohesion are plotted as small open circles in the data section of the graphic logs for Borings 1, 2 and 3. The cohesion resulting from the UU triaxial compression test is plotted as a small open triangle in the data section of the graphic log for Boring 3. The water content and dry density were also determined for the unconfined and UU triaxial compression test specimen. The water contents are plotted as small shaded circles in the data section of the graphic logs. The dry densities are tabulated to the nearest lb per cu ft under the "Dry Density" column of the logs for Borings 1, 2 and 3.

3.3 Classification Tests

The classifications and volume change properties of soils encountered in the borings were investigated by means of Atterberg liquid and plastic limit tests performed on selected representative samples. The results of the liquid and plastic limit tests are plotted as small crosses interconnected by dashed lines in the data section of the graphic boring logs. In accordance with the Unified Soil Classification System, fine-grained soils are classified as either clays or silts of low or high plasticity based on the results of Atterberg limit tests. The numerical difference between the liquid limit and plastic limit is defined as the plasticity index (PI). The magnitudes of the liquid limit and plasticity index and the proximity of the natural water content to the plastic limit are indicators of the potential for a fine-grained soil to shrink or swell upon changes in moisture content or to consolidate under loading. The proximity of the natural water content to the plastic limit is also an indicator of soil strength.

The classifications of soils consisting predominantly of sand were investigated by means of one minus No. 200 sieve test performed on a selected sample from Boring 2. The percentage of fines resulting from the minus No. 200 sieve test is tabulated at the appropriate depth under the "% Passing No. 200 Sieve" column of the graphic log for Boring 2.

3.4 Water Content Tests

Water content tests were performed on samples to corroborate field classifications and to extend the usefulness of the strength, plasticity and field SPT blow count data. The results of the water content tests are plotted as small shaded circles in the data section of the graphic boring logs. The water content data have been interconnected on the logs to illustrate a continuous profile with depth.

4.0 GENERAL SUBSURFACE CONDITIONS

4.1 General

A general description of subsurface soil and groundwater conditions revealed by the borings made for this exploration is provided in the following paragraphs. The graphical logs shown on Figures 3 through 7 should be referred to for specific soil and groundwater conditions encountered at each boring location. Stick logs of the borings are shown in profile on Figure 8 to aid in visualizing subsurface soil conditions. Tabulated adjacent to the stick logs are Atterberg liquid and plastic limits, water contents, percentage of fines passing the No. 200 sieve, dry densities, cohesions and field SPT blow count.

4.2 Soil Stratification

Borings 1, 2, 3 and 5 were made within existing asphalt-paved areas. The thicknesses of the pavement were found to range from 2 in. to 4 in. at the locations of those borings. Some of the near surface soils encountered may represent fill material placed in the past, but documentation of earthwork or compaction has not been provided.

The asphalt pavement at Borings 2 and 5 were found to be underlain by slightly silty sand (SP-SM) fill materials to an approximate depth of 3.5 ft. The slightly silty sand (SP-SM) fill materials are characterized as medium dense and are considered to have moderate strength and low compressibility. The slightly silty sand (SP-SM) fill materials have no potential for shrinking and swelling. Other soils discussed herein may represent fill as well, but is difficult to distinguish from existing natural soils, so no designation is made on the logs.

The ground surface at Boring 4, the asphalt pavement at Borings 1 and 3, and the slightly silty sand (SP-SM) fill materials at Boring 5 were found to be underlain by apparent natural silty clays (CL). The silty clays (CL) were encountered to approximate depths of 2 ft at Boring 1 and 4 ft at Boring 3, to the 6-ft completion depth of Boring 4, and from a depth of about 3.5 ft to the 6-ft termination depth of Boring 5. Silty clays (CL) were also encountered within the approximate depth interval of 6 ft to 8 ft at Boring 1. The silty clays (CL) are classified as medium stiff and stiff with respect to consistency and are considered to have low-moderate to moderate strength and moderate to moderate-high compressibility. The silty clays (CL) are considered to have low shrink/swell potential.

Slightly silty clays (CH) were encountered within the approximate depth interval of 2 ft to 6 ft at Boring 1 and at approximate depths of 8 ft, 3.5 ft and 4 ft at Borings 1, 2 and 3, respectively. The slightly silty clays (CH) are classified as medium stiff, stiff and very stiff with respect to consistency and to have low-moderate to high strength and low to moderate-high compressibility. The slightly silty clays (CH) are considered to be expansive with low-moderate to moderate shrink/swell potential. The slightly silty clays (CH) extend to the 15-ft termination depth of Borings 1, 2 and 3.

4.3 Groundwater

Free water was not encountered during auger drilling for the borings. In our opinion, groundwater conditions at the site will primarily be influenced by rainfall, surface drainage, and by the rise and fall of water levels in nearby ditches, creeks, ponds or other bodies of water. Groundwater conditions at the site can also be influenced by man-made changes. Surficial soils can become saturated and weak to relatively shallow depths during periods of prolonged and heavy rainfall.

5.0 DISCUSSION

5.1 General Soil Conditions

Subsurface soils encountered within the 15-ft maximum exploration depth of the borings made for this exploration consist of slightly silty sand (SP-SM) fill materials and natural soils that include silty clays (CL) and slightly silty clays (CH). Some of the near surface soils may represent fill materials placed in the past, but documentation of earthwork or compaction has not been provided. Some soils are designated as obvious fill, but some soil may also represent fill but are difficult to distinguish from existing natural soils, so no designation is made on the logs. The subsurface soils were found to have low-moderate to high strength and low to moderate-high compressibility. The slightly silty sand (SP-SM) fill materials have no potential for shrinking and swelling. The silty clays (CL) are considered to have low shrink/swell potential. The slightly silty clays (CH) are considered to be expansive with low-moderate to moderate shrink/swell potential. Free water was not encountered during auger drilling of the borings.

5.2 Geotechnical-Related Design Considerations

From a geotechnical standpoint, the primary factors relevant to foundation design and construction are bearing capacity and settlement due to soil consolidation under fill and structural loading and the presence of the low-moderate to moderate shrink/swell potential clays (CH). A foundation system should be utilized for the addition that will accommodate the anticipated structural loads and minimize future differential vertical movements resulting from soil consolidation under fill and structural loadings. For the soil conditions revealed by the borings, it is our opinion that a slab-on-grade foundation made relatively stiff by means of perimeter and interior grade beams could be used for support of the addition, provided 1) column loads are not greater than 150 kips and wall loads do not exceed 7 kips per ft; and 2) our recommendations for site preparation and earthwork construction are implemented.

Relatively weaker medium stiff silty clays (CL) and clays (CH) were encountered at Borings 2, 3, 4 and 5. Due to the presence of soils having increased moisture conditions, pumping or yielding of the subgrade could occur during scarification/compaction and/or proofrolling. Depending on the time of year when earthwork is performed, the relatively weak silty clays (CL) could dry and become stronger. This would particularly be the case in the late summer and early fall. We recommend that a representative of Burns Cooley Dennis, Inc. be present during earthwork operations to observe the stability of the relatively weaker medium stiff soils in order to minimize the amount of excavation and assist in evaluating the depth and lateral extent of excavation required. If the relatively weak silty clays (CL) have not dried and become stronger by the time earthwork is initiated and pumping or yielding of the subgrade does occur, it may be necessary to either chemically stabilize or remove weak subgrade soils within the proposed construction areas.

The low-moderate to moderate shrink/swell clays potential (CH) encountered in the borings could exhibit volume change with changes in moisture content. We recommend that a buffer of at least 4 ft be maintained between these clays (CH) and the planned building slab or adjacent ground surface, whichever is lower. Currently, this 4-ft buffer exists in the borings completed for the investigation, so no remedial measures such as undercutting are required as long as degrading is not planned.

Details of our recommendations for site preparation, earthwork construction, and foundation design and construction are included in the following subsections of this report. Guideline recommendations for pavement design and construction are also provided.

6.0 RECOMMENDATIONS

6.1 Site Preparation and Earthwork Construction

Unless otherwise noted, our recommendations for earthwork construction are the same for the building and pavement areas. As an initial step of site preparation within the proposed construction areas, all existing pavements, foundations, underground utilities, and any other subsurface obstructions that might interfere with earthwork and foundation construction should be removed and/or relocated. Then, stripping should be performed to a sufficient depth to remove organic-laden surficial soils, vegetation, debris, topsoil, soils loosened by demolition and any weak or high moisture content surficial soils. Any obviously weak unstable surface soils encountered during stripping that cannot be improved by surface compaction or treatment should be completely removed. We note that many times, the soils exposed upon removal of existing pavements are frequently unstable with high moisture contents. As previously mentioned, medium stiff silty clays (CL) were encountered were encountered at Borings 2, 3, 4 and 5. The actual vertical and lateral extent of excavation required to remove weak soils must be determined in the field during earthwork construction. Excavation of weak soils should extend laterally a distance equal to the excavation depth beyond the edges of the addition that do not abut the existing building and not less than 2 ft beyond pavement edges.

In order to minimize the amount of excavation, we recommend that a representative of Burns Cooley Dennis, Inc. be present during earthwork operations to evaluate the stability of the soils exposed after stripping and any excavation. Additional excavation may be required to remove any unsuitable soils encountered during earthwork construction. Depending on the season when earthwork is performed, groundwater could be encountered during any excavation. The means and methods for intercepting, collecting and removing groundwater entering excavation areas should be the sole responsibility of the earthwork contractor.

Care should be taken during excavation adjacent to the existing structure to avoid undermining existing structural elements and utilities. The need to excavate immediately adjacent to the building should be evaluated during construction based on the inspection of the soils exposed during excavation. To minimize exposure of the existing structure foundation to undermining, excavation and backfilling adjacent to the existing structure should be conducted in relatively narrow segments, measured parallel to the structure.

The on-site fine-grained soils are susceptible to pumping when wet. The effort required to mitigate unstable soils will be influenced by the season of the year when earthwork is performed. The surficial soils may be drier during the hot late summer and could weaken during heavy rain events. We recommend that earthwork be performed during a dry summer or early fall season, if the schedule permits. The construction techniques, types of equipment utilized and site drainage provided during construction will also have an effect on the performance of the soils. The routing of heavy, rubber-tired equipment should be controlled to minimize, as much as possible, traffic in construction areas. All traffic should be discouraged during periods of inclement weather. <u>It should be recognized that soils which are demonstrated to be adequately stable during stripping, excavation or compaction in-place can become unstable if they are disturbed by construction traffic or are exposed to additional rainfall prior to filling.</u> If pumping is initiated in the fine-grained soils, as a construction expedient the pumping can be counteracted by treating these materials with hydrated lime. It is estimated that about 4 to 6 percent hydrated lime by dry weight of soil could be required. If required, lime treatment should extend 12 in. to 18 in. below the surface exposed after stripping and any excavation.

Prior to the placement of any fill materials, the soils exposed after stripping and any excavation should be scarified to a minimum depth of 6 in. and compacted to not less than 95 percent of standard Proctor maximum dry density (ASTM D 698) with stability present. Alternatively, the exposed soils could be proofrolled with loaded dump trucks to demonstrate stability. Stability is defined as the absence of significant pumping, rutting or yielding of soils during compaction or proofrolling. If stability is not evident in some areas, either additional excavation, drying by processing, treatment of the in-situ soils with an admixture, or a combination of these approaches, might be required to achieve stable conditions. The actual vertical and lateral extent of unstable and/or high moisture content soils must be determined in the field during earthwork construction.

We recommend that any required backfilling and filling be performed immediately after stripping, any excavation and scarification/compaction and/or proofrolling. Imported fill soils should consist of select, nonorganic and debris-free silty clays (CL) or sandy clays (CL) having a plasticity index (PI) within the range of 10 to 24 and a liquid limit less than 45 or sands (SC, SM) with a minimum PI of 3. Excavated on-site soils can be used as fill materials, provided they meet the requirements discussed in this paragraph. The fill soils should be compacted from lifts not exceeding 9 in. in loose thickness to not less than 95 percent of standard Proctor maximum dry density (ASTM D 698) at moisture contents within 3 percentage points of the optimum water content. All backfill in confined areas and over utilities, storm drains, etc., should be placed in accordance with the preceding recommendations, except the lift thickness should be reduced to about 4 in. to 5 in. where hand-operated compaction equipment is used. Stability must be evident during compaction of each lift before any subsequent lifts of fill material are added. As a construction expedient, fill soils that are unstable and/or pumping due to excessive moisture can be treated with hydrated lime in accordance with recommendations given previously for pumping on-site soils.

Laboratory classification tests, including Atterberg limit determinations and grain-size analyses, should be performed on the imported fill materials initially and routinely during earthwork operations to check for compliance with the recommendations provided herein. Field moisture/density tests should be performed in each compacted lift of fill to assist in evaluating whether the recommended moisture contents and dry densities are being achieved. As a guide for earthwork construction, we suggest one moisture/density test per lift for each 2,000 sq ft of surface area or portion thereof. A frequency of testing considered to be appropriate for the parking lot area is one test per lift for each 4,000 sq ft of surface area, or portion thereof.

Finished site grades should be sloped to promote quick runoff of storm water and provide positive drainage away from the addition on all sides that do not abut the existing building and across the pavement areas. Fill materials should extend laterally not less than 5 ft beyond the addition perimeters that do not abut the existing building and not less than 3 ft beyond the edges of the pavement, and then slope down to natural ground levels at an inclination not steeper than 3H:1V. Note: slope stability or trench excavation stability evaluation was not included in the geotechnical scope of this investigation.

6.2 Foundation Design Recommendations

The proposed addition could be supported by a shallow foundation system consisting of a slab-on-grade stiffened with perimeter grade beams, or turned-down edges, and interior grade or tie beams, provided column loads are less than 150 kips and wall loads do not exceed 7 kips per ft, and our recommendations for site preparation and earthwork construction are followed. Grade beams should be utilized to support all exterior walls and all interior load bearing walls, or otherwise they should be spaced in a grid pattern on not greater than about 10-ft to 15-ft centers in each direction. Any columns should be supported by widened portions of the grade beams. We recommend that grade beams or turned-down edges around the perimeter of the addition be brought to bear at a depth not less than 2 ft below finished outside grade. Interior tie or grade beams should be brought to bear at a depth not less than 1.5 ft below the bottom of the slab. We recommend that grade beams be proportioned for critical combinations of dead, live and wind loads utilizing a net allowable soil bearing pressure of 1,500 lbs per sq ft. A net allowable soil bearing pressure of 2,000 lbs per sq ft should be utilized to dimension widened portions of grade beams used to support column loads. We recommend a minimum base width of 12 in. for the grade beams. The grade beams should be reinforced for both positive and negative bending. The floor slab should be reinforced for anticipated loading conditions and deflections and to minimize slab cracking. We recommend that the slab be reinforced with a grid of relatively closely spaced reinforcing bars in lieu of welded wire fabric.

We recommend that foundation excavations be left open for the shortest possible duration to minimize exposure of the bearing soils to rainfall. Drainage should be maintained away from the foundation excavations during construction. Soils exposed in the bottom of the excavations should be observed prior to concrete placement. If these materials are found to be weak or loose, overexcavation and backfilling will be required to provide strong soils immediately beneath foundation elements.

With proper earthwork as recommended herein and the addition with column loads less than 150 kips and wall loads not greater than 7 kips per ft supported on a stiffened slab-on-grade foundation, total settlements under compressive structural loading are expected to be on the order of about 1 in. and differential movements are generally expected to be on the order of 3/4 in. over a horizontal distance of about 25 ft to 30 ft. It should be noted that differential movements of the magnitude stated in the preceding sentence could result in minor cracking of the foundation, walls and floor slab, but the structure performance will not be impaired. The actual magnitude of the settlement and differential movements can be influenced by any number of events or circumstances that occur during the life of the building. For example, surface drainage conditions, broken water pipes, trees and shrubs, etc., can influence the actual movements which develop.

6.3 Guideline Pavement Recommendations

In areas to be paved, there is often some delay between completion of earthwork operations and placement of the pavement structure materials, possibly resulting in deterioration of subgrade conditions. Therefore, we recommend that density and stability of the subgrade soils be confirmed or re-established immediately prior to construction of the pavement.

In our opinion, either flexible asphalt concrete or rigid Portland cement concrete (PCC) pavement can be utilized for the pavement areas. Site preparation and earthwork construction should be performed for the parking lots in accordance with the recommendations given in the "Site Preparation and Earthwork Construction" section of this report. Guideline pavement recommendations are given in the following paragraphs that represent typical construction practice. However, we recommend that pavement thicknesses be verified for the actual expected traffic volumes and loadings using appropriate design parameters for the subgrade soils and pavement structure materials. If the subgrade soils are prepared and select fill materials are placed within the areas to be paved in accordance with recommendations provided in this report, it is our opinion that a CBR of 5 would be appropriate to use as the subgrade support value for flexible asphalt concrete pavement. For PCC pavements, it is our opinion that a modulus of subgrade reaction (k) of 150 lbs per cu in. would be appropriate for the subgrade support value. Where a 6-in. thick granular subbase is utilized under PCC pavements as described in this report, the modulus of subgrade reaction can be increased up to 325 lbs per cu in.

It is our opinion that chemical treatment of the subgrade soils with hydrated lime will provide the best performing pavement system during construction and will extend the service life of the pavement. We recommend lime treatment for the top 12 in. of the subgrade utilizing 6 percent hydrated lime by dry weight of soil. The lime-treated subgrade soils should be compacted to not less than **98 percent** of standard Proctor maximum dry density (ASTM D 698). The lime treatment should be in accordance with Section 307 of the 2017 Edition of the Mississippi Standard Specifications for Road and Bridge Construction using the Class C lime treatment procedure. The lime treatment should extend not less than 2 ft beyond the back of curb or edge of pavement.

For light automobile and pickup truck traffic, the flexible pavement structure could consist of a 2-in. thick asphalt surface course and a 4-in. thick asphalt base course on the prepared subgrade soils. A thicker asphalt concrete pavement section should be utilized if the flexible pavement will be subjected to heavy truck traffic. For the heavier loading, the flexible pavement structure could consist of a 2-in. thick asphalt surface course and a 6-in. thick asphalt base course on the prepared subgrade soils. The asphalt concrete surface course materials should conform with all applicable specifications for SC-1, Type 8 presented in the 1990 Edition of the Mississippi Standard Specifications for Road and Bridge Construction. The asphalt concrete base course materials should conform with all applicable specifications for BB-1, Type 6.

For rigid pavement, jointed plain (un-reinforced) PCC pavement can be utilized with limited use of steel reinforcement such as described herein. The minimum compressive strength of the concrete mixture should be 4,000 lbs per sq in. It is our opinion that a 5-in. thick PCC pavement cast directly upon the prepared subgrade soils would be appropriate for light automobile and pickup truck traffic. For heavy truck traffic, a 7-in. thick PCC pavement directly underlain and separated from the prepared subgrade soils by a granular subbase would likely be required. We recommend the use of 8-in. thick PCC pavement directly underlain and separated from the prepared subgrade soils by a granular subbase immediately in front of any garbage dumpsters to provide support for the wheels of a garbage truck during loading.

We recommend the use of a 6-in. thick granular subbase directly under PCC pavements that support heavy truck traffic. This granular subbase is part of the pavement structure and prevents subgrade soils from pumping up through joints. We recommend that the granular subbase materials consist of No. 610 crushed limestone. The portion of the crushed limestone passing the No. 40 sieve should have a liquid limit not greater than 25 and a plasticity index not greater than 5. The crushed limestone should be compacted to not less than **100 percent** of standard Proctor maximum dry density (ASTM D 698) at moisture contents within 2 percentage points of the optimum water content. The pavement surface should be sufficiently elevated to allow drainage of the granular subbase.

General guidance for the design and construction of PCC pavements is presented in ACI 330 “Guide for the Design and Construction of Concrete Parking Lots,” including proper jointing, thickened edges that receive heavy truck traffic, thickened edges or load transfer devices at construction joints, tie-bars, and steel reinforcement in irregular shaped slabs or panels. Joints should form panels that are approximately square with the longest panel dimension no more the 1.25 times the shortest panel dimension. The maximum joint spacing should be 10 ft for 5-in. thick and 15 ft for the 7-in. or 8-in. thick PCC pavements. The pavement joints should be properly sealed and maintained. We recommend that a jointing plan and details be developed for construction of the PCC pavements. Burns Cooley Dennis, Inc. can be contracted to provide this additional service if we are provided with a CAD file of the proposed site. As an alternative, BCD can be contracted to review and approve jointing layouts and details that are generated by others. The surface of the pavement should be crowned and sloped to promote quick runoff of stormwater.

6.4 Other Design and Construction Considerations

The new building addition will abut the existing building. Differential movement will occur between the new addition and the existing building. The structural and architectural designs should incorporate connections between the existing building and the new addition which accommodate or aesthetically hide differential movement at the foundation/floor level, walls and roofs. To prevent abrupt differential vertical movement where the new building abut the existing building, the new and existing foundations could be doweled together. An expansion joint could be utilized between the new building and the existing building to accommodate differential movement.

If flower and shrub beds including sprinkler systems are placed adjacent to the addition, the beds should be prepared such that they do not trap water, and sprinklers should be operated only enough to satisfy the water demands of the plants and shrubs. Excessive watering and ponding within the flower and shrub beds could result in downward percolation of water into the underlying foundation soils causing them to lose strength and causing expansive clays (CH) to swell. Rainwater falling on the roof of the addition should be collected and prevented from reaching the ground immediately adjacent to the addition. Downspouts extending from roof gutters should be equipped with extensions at ground level that are sloped to emit collected rainwater not less than 6 ft away from the addition. The downspouts could be connected to solid discharge pipes buried beneath the ground. We caution that these pipes should be flexible enough to accommodate some differential movement and all pipe connections must be leak free.

Trees remove water from the ground by transpiration causing vertical and horizontal shrinkage of fine-grained soils. To minimize these effects, we recommend that any trees planted for landscaping purposes be located at least one-half their anticipated mature height away from the addition. If the risk of more movement is acceptable to the owner, a less strict building-to-tree spacing of about 25 ft for hardwoods and 15 ft for pines could be utilized.

Final grades around the addition should provide rapid and effective drainage of rainwater and downspout water away from the addition, with no areas allowed for water to pond. Underground sources of water such as leaking water lines, sewer lines, etc., should be prevented as much as possible in the initial construction, and any leaks that develop should be promptly repaired.

The site for the new additions at the Senior Citizen Center facility in Richland, Mississippi lies within a relatively low seismic activity region according to the seismic zone mapping referenced in the International Building Code. Given the site soil profile as revealed by the borings and anticipated for the area based on our experience, a Site Class D could be used in a seismic load evaluation.

7.0 REPORT LIMITATIONS

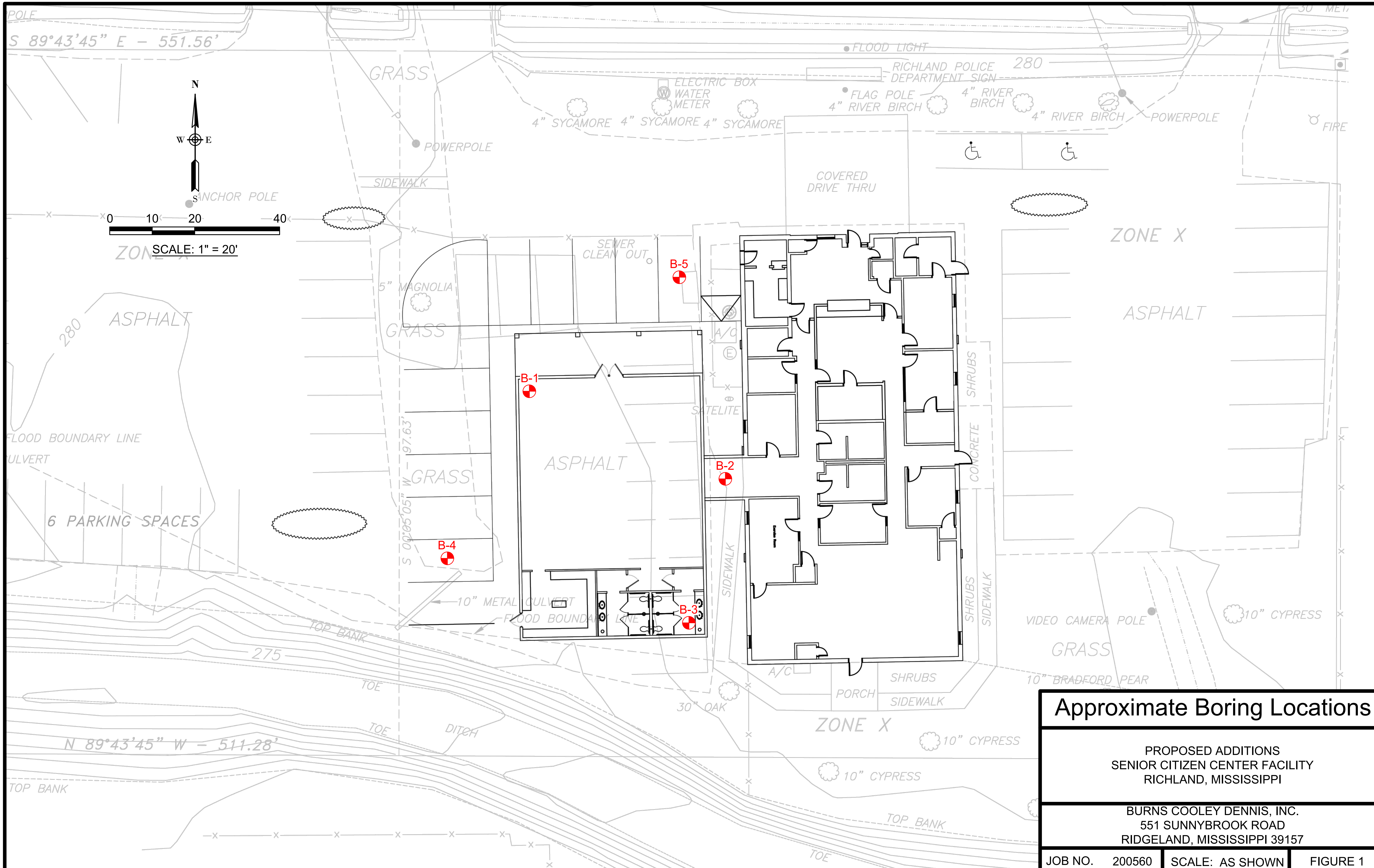
The analyses, conclusions, and recommendations discussed in this report are based on conditions as they existed at the time of our field exploration and further on the assumption that the exploratory borings are representative of subsurface conditions throughout the areas explored. It should be noted that actual subsurface conditions between and beyond the borings might differ from those encountered at the boring locations. If subsurface conditions are encountered during construction that vary from those discussed in this report, Burns Cooley

Dennis, Inc. should be notified immediately in order that we may evaluate the effects, if any, on earthwork, foundation and pavement design and construction.

Burns Cooley Dennis, Inc. should be retained for a general review of final design drawings and specifications. It is advised that we be retained to observe earthwork, foundation and pavement construction for the project in order to help confirm that our recommendations are valid or to modify them accordingly. Burns Cooley Dennis, Inc. cannot assume responsibility or liability for the adequacy of recommendations if we do not observe construction.

This report has been prepared for the exclusive use of Engineering Service for specific application to the geotechnical-related aspects of design and construction for the proposed additions at the Senior Citizen Center facility located at 371 Scarborough Street South in Richland, Mississippi. The only warranty made by us in connection with the services provided is we have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession practicing in the same or similar locality. No other warranty, express or implied, is made or intended.

FIGURES



Approximate Boring Locations

PROPOSED ADDITIONS
SENIOR CITIZEN CENTER FACILITY
RICHLAND, MISSISSIPPI

BURNS COOLEY DENNIS, INC.
551 SUNNYBROOK ROAD
RIDGELAND, MISSISSIPPI 39157

JOB NO. 200560	SCALE: AS SHOWN	FIGURE 1

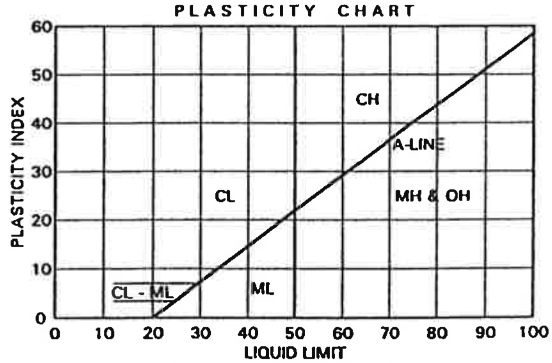
UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOL & LETTER	DESCRIPTION
COARSE-GRAINED SOILS More than half of material larger than No. 200 sieve size	GRAVELS More than half of coarse fraction larger than No. 4 sieve size	Clean Gravels (Little or no fines)	GW	WELL GRADED GRAVEL, GRAVEL-SAND MIXTURE
			GP	POORLY GRADED GRAVEL, GRAVEL-SAND MIXTURE
		Gravels with fines (Appreciable amount of fines)	GM	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURE
			GC	CLAYEY GRAVEL, GRAVEL-SAND-CLAY MIXTURE
	SANDS More than half of coarse fraction smaller than No. 4 sieve size	Clean Sands (Little or no fines)	SW	WELL GRADED SAND, GRAVELLY SAND
			SP	POORLY GRADED SAND, GRAVELLY SAND
		Sands with fines (Appreciable amount of fines)	SM	SILTY SAND, SAND-SILT MIXTURE
			SC	CLAYEY SAND, SAND-CLAY MIXTURE
FINE-GRAINED SOILS More than half of material smaller than No. 200 sieve	SILTS AND CLAYS	Liquid limit less than 50	ML	SILT WITH LITTLE OR NO PLASTICITY
			ML	CLAYEY SILT, SILT WITH SLIGHT TO MEDIUM PLASTICITY
			CL	SILTY CLAY, LOW TO MEDIUM PLASTICITY
			CL	SANDY CLAY, LOW TO MEDIUM PLASTICITY (30% TO 50% SAND)
	SILTS AND CLAYS	Liquid limit greater than 50	MH	SILT, FINE SANDY OR SILTY SOIL WITH HIGH PLASTICITY
			CH	CLAY, HIGH PLASTICITY
			OH	ORGANIC CLAY OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOIL

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	- Clays with polished and striated planes created as a result of volume changes related to shrinking, swelling and/or changes in overburden pressure.
Fissured	- Clays with a blocky or jointed structure generally created by seasonal shrinking and swelling.
Laminated	- Composed of thin alternating layers of varying color and texture.
Calcareous	- Containing appreciable quantities of calcium carbonate.
Parting	- Paper thin (less than 1/8 inch).
Seam	- 1/8 inch to 3 inch thickness.
Layer	- Greater than 3 inches in thickness.

PLASTICITY CHART



FOR CLASSIFICATION OF FINE GRAINED SOILS

DENSITY AND CONSISTENCY

COARSE-GRAINED SOILS		FINE-GRAINED SOILS		
DENSITY	PENETRATION RESISTANCE, N Blows per Foot	CONSISTENCY	COHESION Kips/Sq.Ft	PENETRATION RESISTANCE, N Blows per Foot
Very loose	0 - 4	Very Soft	<0.25	0 - 1
Loose	5 - 10	Soft	0.25 - 0.50	2 - 4
Medium Dense	11 - 30	Medium Stiff	0.50 - 1.00	5 - 8
Dense	31 - 50	Stiff	1.00 - 2.00	9 - 15
Very Dense	>50	Very Stiff	2.00 - 4.00	16 - 30
		Hard	>4.00	>30

SAMPLE TYPES
(Shown in Sample Column)

Shelby Tube
Split Spoon
No Recovery
Auger
Dennison Barrell

PARTICLE SIZE IDENTIFICATION

Cobbles	- Greater than 3 inches
Gravel	- Coarse - 3/4 inch to 3 inches Fine - 4.76 mm to 3/4 inch
Sand	- Coarse - 2 mm to 4.76mm Medium - 0.42 mm to 2 mm Fine - 0.074 mm to 0.42 mm
Silt & Clay	- Less than 0.074 mm

RELATIVE COMPOSITION

Slightly	5 - 15%
With	16 - 29%
Sandy (or gravelly)	30 - 50%

CLASSIFICATION, SYMBOLS AND TERMS USED ON GRAPHICAL BORING LOGS

LOG OF BORING NO. 1

PROPOSED ADDITIONS
SENIOR CITIZEN CENTER
RICHLAND, MISSISSIPPI

TYPE: 4" Short-flight auger

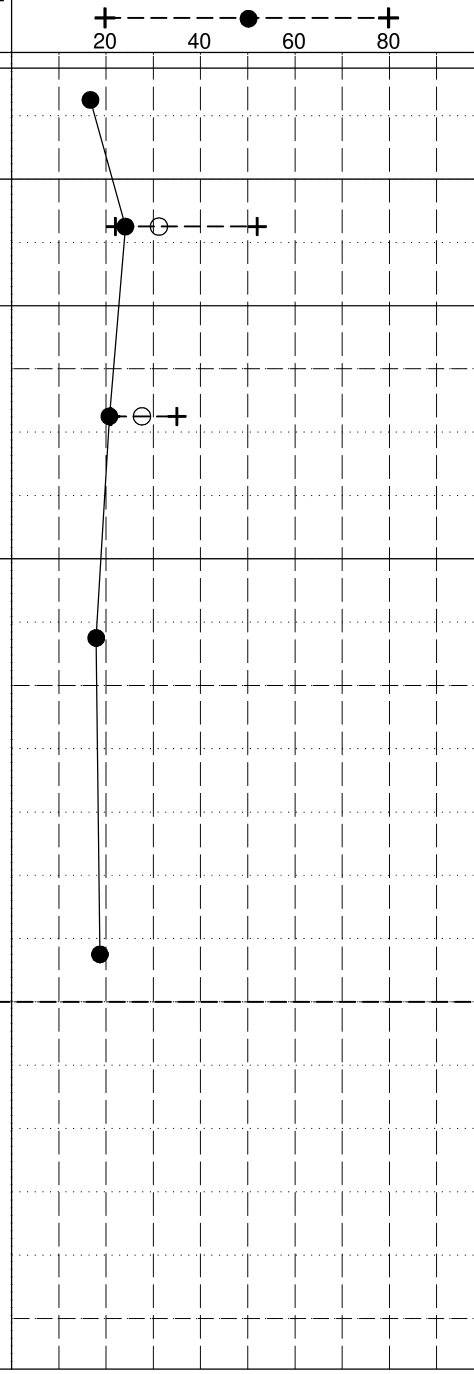
LOCATION: See Figure 1

DEPTH, ft	DESCRIPTION OF MATERIAL (SURFACE EL: ±ft)	BLOWS PER FT	DRY DENSITY LBS/CU FT
0	Asphalt Pavement (3")		
	Stiff gray and tan silty clay (CL)		
2	Stiff gray and tan clay (CH), slightly sandy		101
4	Stiff tan and light gray silty clay (CL), slightly sandy		104
8	Very stiff tan and light gray clay (CH), slightly sandy		
15			

○ - UC Cohesion, kips/sq ft △ - UU

1 2 3 4

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT



% PASSING NO. 200 SIEVE

Depth scale: 5, 10, 15, 20

BORING DEPTH: 15 ft

DATE: 10/26/20

COMMENTS: Borehole backfilled with soil cuttings and sealed at surface with an asphalt patch.
GPS Coordinates
N 32° 12' 48.8"
W 90° 9' 43.9"

GROUNDWATER DATA: No free water encountered during auger drilling.

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GEOTECHNICAL AND MATERIALS ENGINEERING CONSULTANTS

FIGURE 3

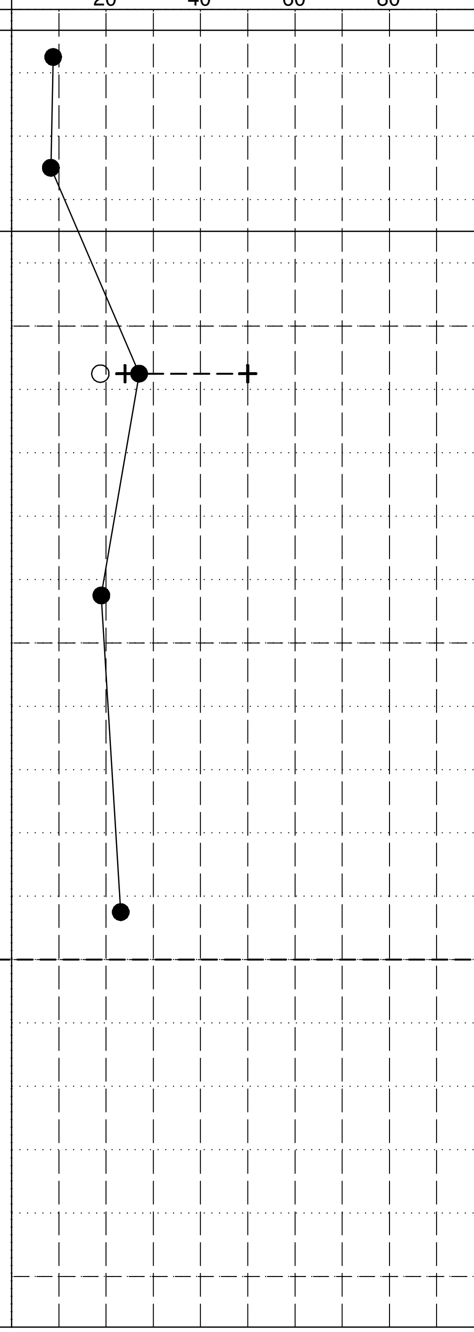
LOG OF BORING NO. 2

PROPOSED ADDITIONS
SENIOR CITIZEN CENTER
RICHLAND, MISSISSIPPI

TYPE: 4" Short-flight auger

LOCATION: See Figure 1

DEPTH, ft	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE EL: ±ft	BLOWS PER FT	DRY DENSITY LBS/CU FT	○ - UC Cohesion, kips/sq ft △ - UU (1, 2, 3, 4) PLASTIC LIMIT, WATER CONTENT %, LIQUID LIMIT (20, 40, 60, 80)	% PASSING NO. 200 SIEVE
			Asphalt Pavement (4")				
			Medium dense tan and red fine sand (SP-SM), slightly silty (FILL)	12			9.3
5			Medium stiff tan and light gray clay (CH), slighlty silty - stiff below 6'		97		
10							
15							
20							



BORING DEPTH: 15 ft

DATE: 10/26/20

COMMENTS: Borehole backfilled with soil cuttings and sealed at surface with an asphalt patch.
GPS Coordinates
N 32° 12' 48.6"
W 90° 9' 43.5"

GROUNDWATER DATA: No free water encountered during auger drilling.

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FIGURE 4

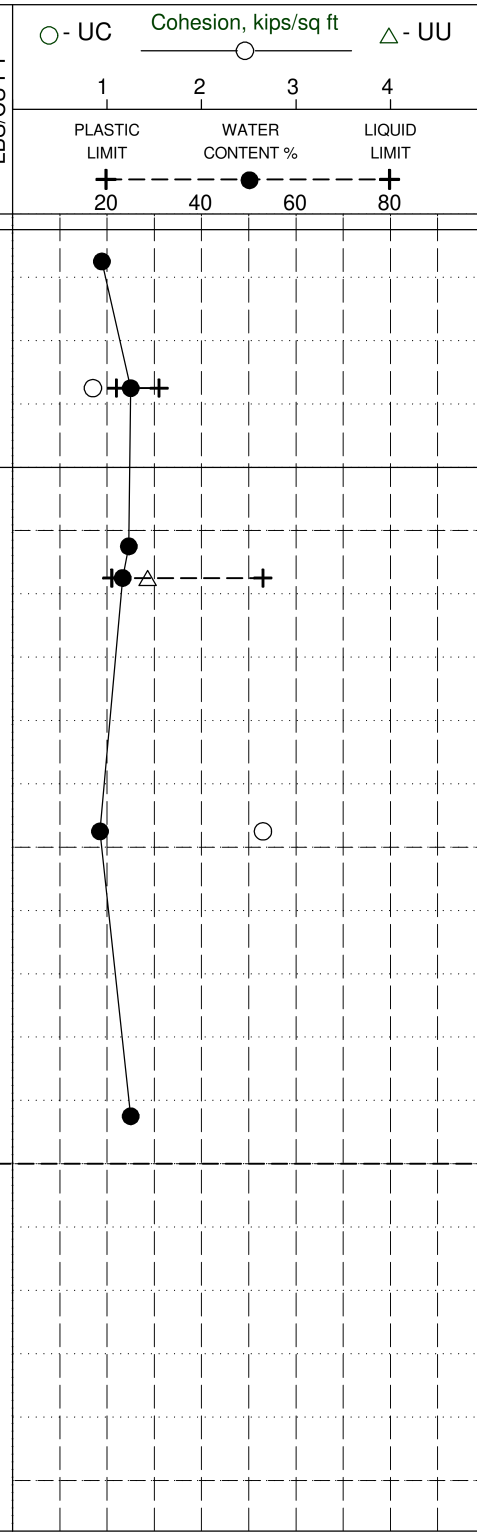
LOG OF BORING NO. 3

PROPOSED ADDITIONS
SENIOR CITIZEN CENTER
RICHLAND, MISSISSIPPI

TYPE: 4" Short-flight auger

LOCATION: See Figure 1

DEPTH, ft	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE EL: ±ft	BLOWS PER FT	DRY DENSITY LBS/CU FT	% PASSING NO. 200 SIEVE
			Asphalt Pavement (3")			
			Stiff tan and light gray silty clay (CL) - medium stiff, light gray and tan below 1.5'		96	
5			Stiff light gray and tan clay (CH) - slightly silty to 8' - very stiff 8' - 13' - light gray and tan, slightly sandy below 8'		101	
10					112	
15						
20						



BORING DEPTH: 15 ft

DATE: 10/26/20

COMMENTS: Borehole backfilled with soil cuttings and sealed at surface with an asphalt patch.
GPS Coordinates
N 32° 12' 48.1"
W 90° 9' 43.8"

GROUNDWATER DATA: No free water encountered during auger drilling.

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FIGURE 5

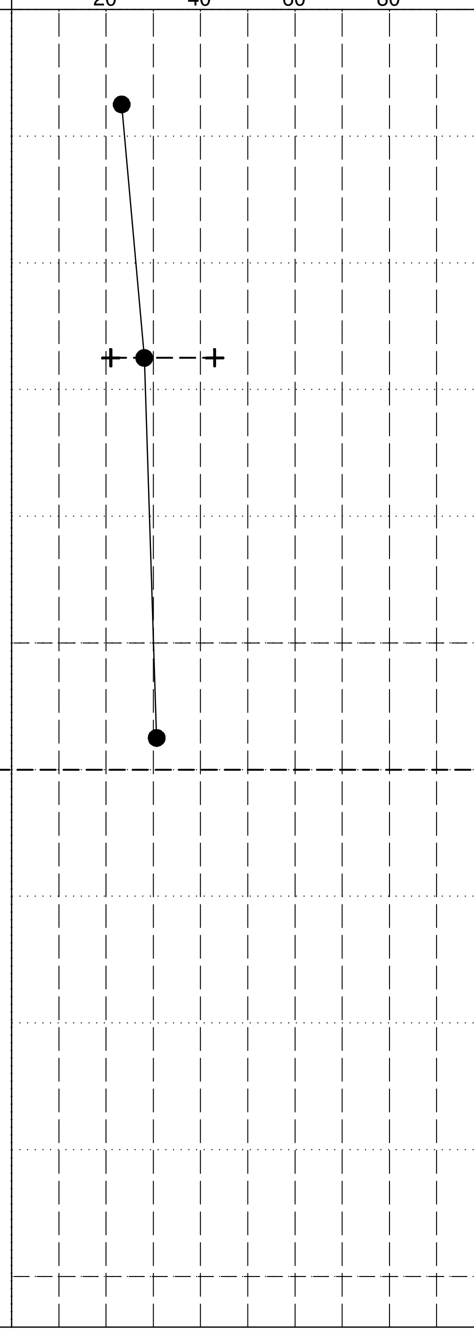
LOG OF BORING NO. 4

PROPOSED ADDITIONS
SENIOR CITIZEN CENTER
RICHLAND, MISSISSIPPI

TYPE: 4" Short-flight auger

LOCATION: See Figure 1

DEPTH, ft	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE EL: ±ft	BLOWS PER FT	DRY DENSITY LBS/CU FT	○ - UC Cohesion, kips/sq ft △ - UU (1, 2, 3, 4) PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT (20, 40, 60, 80)	% PASSING NO. 200 SIEVE
			Stiff tan silty clay (CL)				
			- medium stiff below 2'				
5							
10							



BORING DEPTH: 6 ft

DATE: 10/26/20

COMMENTS:
GPS Coordinates
N 32° 12' 48.4"
W 90° 9' 44.2"

GROUNDWATER DATA: No free water encountered during auger drilling.

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FIGURE 6

LOG OF BORING NO. 5

PROPOSED ADDITIONS
SENIOR CITIZEN CENTER
RICHLAND, MISSISSIPPI

TYPE: 4" Short-flight auger

LOCATION: See Figure 1

DEPTH, ft	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE EL: ±ft	BLOWS PER FT	DRY DENSITY LBS/CU FT	○ - UC Cohesion, kips/sq ft △ - UU 1 2 3 4 PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT 20 40 60 80	% PASSING NO. 200 SIEVE
			Asphalt Pavement (2")				
			Medium dense tan and red fine sand (SP-SM), slightly silty (FILL)				
			Medium stiff tan and light gray silty clay (CL)				
5							
10							

BORING DEPTH: 6 ft

DATE: 10/26/20

COMMENTS: Borehole backfilled with soil cuttings and sealed at surface with an asphalt patch.
GPS Coordinates
N 32° 12' 49.2"
W 90° 9' 43.6"

GROUNDWATER DATA: No free water encountered during auger drilling.

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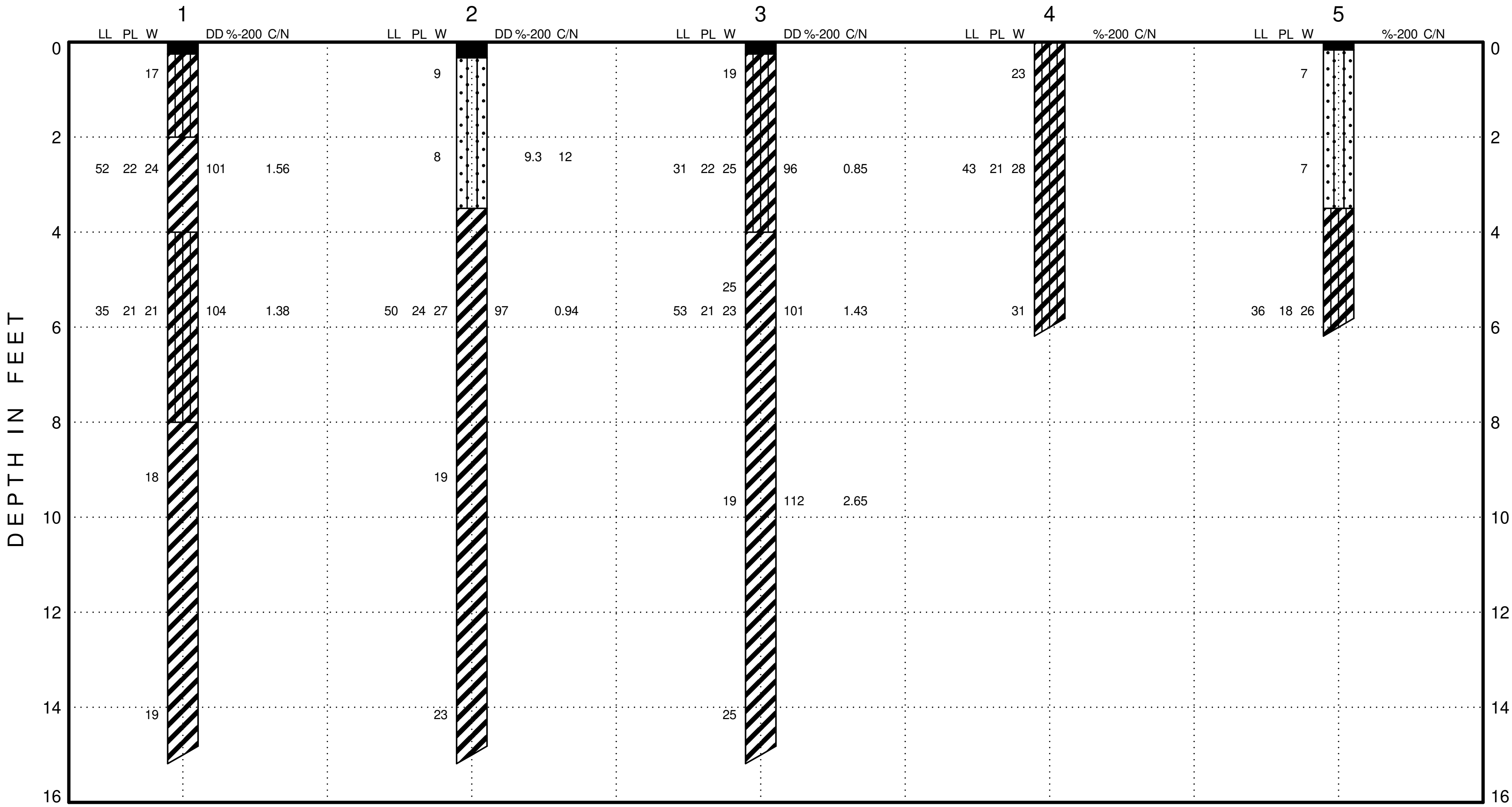
FIGURE 7



LEGEND:

LL = Liquid Limit
PL = Plastic Limit
W = Water Content
DD = Dry Density (pcf)
C/N = Cohesion (ksf)/Penetration Resistance, N (blows/ft) in the same column
MS = Matric Suction (tsf)
%-200 = % Passing No. 200 Sieve

NOTE: See Figure 2 for boring log legend.

SUBSURFACE SOIL PROFILE		
PROPOSED ADDITIONS SENIOR CITIZEN CENTER RICHLAND, MISSISSIPPI		
Job No. 200560	Date 11/13/20	Figure 8

GENERIC FENCE

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