Exhibit 13.
Geotechnical Report

ENGINEERING CGS INCORPORATED

Town of Montgomery

Geotechnical Testing Laboratory, Inc.
Engineering and Construction Materials Testing Services

Geotechnical Report

November 6, 2018

Cothren, Graff, Smoak, Engineering, Inc.
6305 Westport Avenue
Shreveport, Louisiana 71129

Attention: Mr. K. Randal Smoak, P.E.

RE: Preliminary Geotechnical Investigation Services
Town of Montgomery – Industrial Site Verification
Montgomery, Grant Parish, Louisiana
Report No. 11-18-166

Dear Mr. Smoak:

Geotechnical Testing Laboratory, Inc. is pleased to submit this preliminary report of subsurface exploration for the above referenced project. Included in the report are the results of the exploration and general recommendations concerning the potential design and construction of the foundations.

We appreciate the opportunity to have provided you with our geotechnical engineering services and look forward to assisting you by providing additional investigation services for individual projects during the development of the subject tract. If you have any questions concerning this report, or if we may be of further service, please contact our office.

Respectfully submitted,
Geotechnical Testing Laboratory, Inc.

N. J. Gorsha, P.E.
Louisiana Registration No. 20082

11/6/18

STATE OF LOUISIANA
N.J. GORSHA
REG. No. 20082
REGISTERED
PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING

Ken Gorsha
President

Distribution: (3) Cothren, Graff, Smoak, Engineering, Inc.

NJG/kg

Preliminary Geotechnical Investigation Services

Town of Montgomery – Industrial Site Verification

Montgomery, Grant Parish, Louisiana

Report No. 11-18-166

Prepared For:

Cothren, Graff, Smoak, Engineering, Inc.
6305 Westport Avenue
Shreveport, Louisiana 71129

Prepared By:

Geotechnical Testing Laboratory, Inc.
226 Parkwood Drive
Alexandria, Louisiana 71301

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Preliminary Geotechnical Investigation Services
Town of Montgomery – Industrial Site Verification
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Introduction:

This report transmits the findings of a geotechnical investigation performed for the above-referenced project. The purpose of this investigation was to define and evaluate the general subsurface conditions in the general vicinity of a planned new industrial complex. Specifically, the study was planned to determine the following:

- Subsurface stratigraphy within the limits of our exploratory borings.
- Classification, strength, and compressibility characteristics of the foundation strata.
- Suitable foundation systems and allowable soil bearing pressures.
- Construction requirements for the placement of select earth fills.
- Recommendations for rigid and flexible pavement sections for unspecified traffic.

The purpose of this report is to provide the owner, structural engineer, civil engineer, and other design team professionals with preliminary recommendations to consider for the design and construction of the proposed project. This report should not be used by the contractor in lieu of project plans and specifications.

Project Authorization:

Formal authorization to perform the work on behalf of the Town of Montgomery (Client) was provided by Julianne Smoak by accepting our August 24, 2018 written proposal. Written authorization to proceed was provided on October 22, 2018. Field procedures were conducted on November 2, 2018. To accomplish the intended purposes, a three-phase study program was conducted which included:

- a field investigation consisting of two exploratory test borings with samples obtained at selected intervals;
- a lab testing program designed to evaluate the expansive and strength characteristics of the subsurface soils; and,
- an engineering analysis of the field and laboratory test data for preliminary foundation design recommendations.

No additional analysis was requested. A brief description of the field and laboratory test procedures are provided in the Appendix.

Project Description:

We understand the project will consist of characterizing a 31-acre site for the purpose of developing an industrial park with associated pavements. Preliminary sizes of the structures and structural information is not available. The rigid and/or flexible pavements will most likely consist of light duty for passenger cars and pickup trucks, and heavy-duty pavements for tractor-trailer trucks.

For the purposes of this report, we have assumed maximum concentrated loads will not exceed 150 kips (1 kip = 1,000 pounds), and that maximum continuous wall loads will not exceed one (1) to five (5) kips per linear foot. Based on the existing site topography, it appears that some building pads may experience cuts or fills that could exceed three (3) feet to reach the design grades. If larger grade changes are anticipated, these should be discussed with our geotechnical engineer prior to finalizing design.

Information pertaining to anticipated traffic loads and volumes was not available. For the purpose of our pavement analysis of this report, we assume that the industrial traffic could consist of up to 150 repetitions of light passenger cars and pick-up trucks, 15 medium-sized delivery trucks and vans, and up to 10 heavy tractor-trailer trucks per day.

If any of this information should change significantly or be in error, it should be brought to our attention so that we may review recommendations made in this report.

Site Conditions:

The project site is located east of U.S. Highway 71 in Montgomery, Grant Parish, Louisiana. Based upon data obtained from Google Earth, the east side of the site slopes downward on the order of 20 feet from north to south. At the time of drilling, the site was vegetated with dense timber and underbrush. The drilling rig experienced moderate difficulty moving about the site.

Subsurface Stratigraphy:

The subsurface conditions at the proposed building site were explored by drilling a total of two (2) borings to depths between approximately 25 and 50 feet. The borings were located in the field by the drilling crew as shown on the Plan of Borings included in the Appendix of this report.

The stratification of the soils encountered during field drilling operations is presented on the boring logs in the Appendix. The stratification of the subsurface materials shown on the boring logs represents the subsurface conditions encountered at the actual boring locations and variations may occur across the site. The lines of demarcation represent the approximate boundary between the soil types, but the actual transition may be gradual. The following subsurface descriptions are of a generalized nature to highlight the major stratification features. The boring logs should be reviewed for more detailed information.

In order of increasing depth, the borings generally encountered the following soil strata beneath the surface: slightly clayey silty sand (SC-SM), sandy lean clay (CL)s, clayey sand (SC), silty sand (SM) and fat clay (CH).

Groundwater Conditions:

Seepage was observed at depths of 18- and 20-feet during advancement of the test borings, and the borings caved at a depth of 22 feet upon completion of the drilling. These levels are not expected to impact shallow excavations during construction, but the subsurface water regime is always subject to change with variations in climatic conditions and will likely coincide seasonal fluctuations. Future construction activities may also alter the surface and/or subsurface drainage patterns of this site. Therefore, groundwater conditions should be explored at the start of construction by others due to short-term observations by our field crew.

Perched water may be briefly encountered in low quantities during earthwork and is typically due to storage of recent rainfall or by a barrier to capillary evaporation. Where perched water is encountered the contractor should expect to excavate gravity drainage ditches to divert it away from the construction area. The depth of the ditches should be at least two (2) to three (3) feet deeper than the lowest exterior footing elevation. Additionally, soft, wet and pumpable soils can be expected below perched water tables. In structural areas, these should be removed to firm ground and replaced with select fill soils compacted to project specifications as defined later in this report.

Foundation Recommendations:

The soil parameters represented herein are based on single borings placed at irregular intervals across the site. The deviations between the boring locations indicate variable subsurface conditions across the site and should not be assumed as representative of the entire site. Thus, the findings presented herein should be considered preliminary in nature and should be confirmed through further investigation prior to development of the subject parcel. Prior to developing any section of the tract, a specific subsurface investigation should be obtained and tailored to the individual project. This report should not be used in lieu of a final geotechnical investigation addressing site specific needs for the intended projects.

Detailed information on structural systems and planned grading is currently unavailable. Based on the size and type of anticipated structures, as well as the findings from this investigation, a system of shallow footings with an on-grade floor slab, in conjunction with the recommended subgrade preparation is believed to be the most practical and economical means of support. However, heavier building loads could result in the use of deep foundations. Recommendations for both foundation types are discusses separately below.

A Potential Vertical Rise (PVR) value of less than one (1) inch was determined for this site. One (1) inch of PVR is generally accepted as the maximum allowable value for design and construction in the geographical area. The surficial soils encountered by the borings are considered to be moderately expansive. There should be no required removal of swelling soils at this site.

Trees or tree stumps located within any of the building limits should be grubbed and removed. The diameter of the excavation should be at least three (3) feet larger than the tree diameter and dry soils and roots ½ inch in diameter or greater should be grubbed to a minimum depth of four (4) feet below finished subgrade elevation. The resulting depression should be backfilled and compacted with select fill as discussed in a subsequent section of this report.

After stripping and undercutting as required by the grading plan, the building area should be proof-rolled with a heavy, loaded pneumatic-tired vehicle such as a 20 to 25 ton loaded dump truck or scraper. It is recommended that all areas beneath the floor slab be proof-rolled to identify loose or soft soils. All proof-rolling and undercutting activities should be witnessed by GTL or authorized representative and should be performed during a period of dry weather. Any weak areas which yield under the proof-roll, or any areas with a tendency to pump should be mitigated. Such mitigation may include over-excavation and backfilling, reprocessing to remove moisture, modification with lime or cement admixture, or using geotextiles. In the event such mitigation is required, the geotechnical engineer should be contacted to design an appropriate procedure.

After stripping, excavating where required, and proof-rolling but prior to placing fill, the exposed soils should be scarified and then processed to a moisture content between one (1) percentage point below and three (3) percentage points above the Standard Proctor optimum. The subgrade soils should be re-compacted to a density of at least 95 percent of the Standard Proctor (ASTM D-698) maximum dry density for a depth of at least eight (8) inches below the surface.

Select Fill:

After the subgrade has been prepared and inspected, fill placement may begin. Select fill material should be free of organic or other deleterious materials, homogeneous mixture, have a maximum particle size of three (3) inches, have a liquid limit less than 40 and plasticity index between 8 and 20, and consist of silty-clayey sands (SM-SC), low plasticity sandy clays (CL), or clayey sands (SC) as defined by the Unified Soil Classification System. In addition to the above requirements, the material should have a maximum of 70 percent passing the No. 200 sieve. If a fine-grained material is used for fill, very close moisture content control will be required to achieve the recommended degree of compaction.

Fill should be placed in maximum lifts of eight (8) inches of loose materials and should be compacted within the range of one (1) percentage point below to three (3) percentage points above the optimum moisture content value and a minimum of 95 percent of the maximum density as determined by the Standard Proctor (ASTM D-698) test. If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying.

The building pads should extend at least five (5) feet beyond the edge of the structure prior to sloping. Each lift of compacted soil should be tested and inspected by the soils engineer or his representative prior to placement of subsequent lifts. As a guideline, it is recommended that field density tests be taken at a frequency of not less than one (1) test per 2,500 square feet of surface area per lift or a minimum of four (4) per lift for each tested area for the building.

Shallow Foundations:

Based on the limited information from our preliminary borings, the grading for the building pads should provide not less than 18 inches of density-approved select fill below the finished subgrade elevation for the slabs and should extend at least five (5) feet beyond the perimeter of the buildings. The fill can be used to elevate the building pads so that positive drainage is provided away from the buildings. Where feasible, elevating the building pad with fill is generally desirable because this aids in providing positive drainage away from the floor slabs and foundations and helps prevent water from collecting in the filled areas.

Shallow foundations may utilize individual or continuous footings bearing within the upper five (5) feet of the surficial zone. The provision of at least 18 inches of select fill should be anticipated to provide a suitable subgrade for the floor slabs. Typical bearing capacity values for shallow spread footings may vary from between approximately 2,000 psf to 2,500 psf for soils with consistencies of medium dense or medium stiff. Strip footings for continuous wall loads may be estimated between 1,500 and 2,000 pounds per linear foot.

Deep Foundations:

As previously discussed, consideration may be given to placing heavier structural or special equipment loads on deep foundations consisting of drilled shafts or driven piles. Recommendations for auger cast piles have been omitted since these piles are not economically competitive until the quantity exceeds 100. However, if auger cast piles are considered, this office should be contacted to provide additional recommendations.

Heavier structural loads should be supported on straight-sided, cast-in-place concrete shafts founded at a minimum depth of 25 feet and should not extend below a depth of 50 feet below the existing ground surface. The table below presents the estimated allowable single shaft capacities for 18- and 24-inch diameter shafts founded at depths between 25 and 50 feet below present ground surface.

Diameter of Shaft (inches)	Depth of Shaft (feet)	Allowable Single Shaft Capacity (kips) Compressive	Uplift
18	25	45	30
	30	50	35
	35	60	40
	40	75	50
	45	90	55
	50	105	65

Diameter of Shaft (inches)	Depth of Shaft (feet)	Allowable Single Shaft Capacity (kips) Compressive	Uplift
24	25	65	45
	30	70	50
	35	85	55
	40	110	70
	45	130	80
	50	150	95

The factor of safety for these calculations is estimated to be 2.0, and the estimated uplift capacities include the weight of the shaft. Shafts should have a minimum diameter of 18 inches even if the actual bearing pressure is less than the design value. Groundwater will most likely be encountered in the drilled shafts. Casing for installing drilled shafts is always a possible necessity when dealing with the unknowns inherent with subsurface conditions. It is prudent for contract documents to include this option.

Drilled Shaft Considerations:

Due to the presence of a shallow groundwater table with a hydrostatic head, consideration should be given to installing the drilled shafts using a slurry method which maintains a constant slurry level equal to or slightly above the hydrostatic water level. If the shafts can be sealed from water intrusion using casing, the slurry option may be eliminated.

It is recommended that the design and construction of drilled shafts should generally follow methods outlined in the manual titled Drilled Shafts: Construction Procedures and Design Methods (Publication No: FHWA-IF-99-025, August 1999).

We emphasize that close engineering supervision is essential during installation of the drilled shaft foundations in order to assure that construction is performed in accordance with the plans and specifications. Also, to insure proper construction of the drilled shafts at this site, close coordination between the drilling and concreting operations is considered to be of great importance. Detailed inspection of drilled shaft construction should be made to verify that the shafts are vertical and founded in the proper bearing stratum and to verify that all loose materials have been removed prior to concrete placement.

Driven Piles:

The superstructure loads may be supported on Class B creosote treated timber piles founded at a minimum depth of 30 feet below the existing ground surface. The following table presents preliminary allowable pile capacities.

Depth (feet)	Allowable Single Pile Capacity (kips) Compressive	Uplift
30	45	25
35	55	35
40	65	40
45	70	45
50	75	50

If the above allowable timber pile loads are found to be inadequate, consideration may be given to using 12-inch square per-cast, pre-stressed concrete piles. Such piles may be selected from the following table. The factor of safety for these and the above values is 2.0.

Depth (feet)	Allowable Single Pile Capacity (kips) Compressive	Uplift
30	50	30
35	65	40
40	70	45
45	80	50
50	85	55

Total settlement is estimated to be on the order of one (1) inch or less for driven piles. Differential settlements (between adjacent piles or clusters) are estimated to be on the order of ½ inch or less.

Seismicity:

Based on Section 1613 of the IBC-2012, a Site Class of D has been estimated for this site due to the lack of subsurface information to a depth of 100 feet. According to the USGS website for Seismic Hazard Design Parameters, the project site has a mapped 0.2 second spectral response acceleration (S_s) of 0.099 g. The project also has a mapped 1.0 second spectral response acceleration (S_l) of 0.063. The design spectral response accelerations, S_{DS} and S_{Dl}, were determined to be 0.105 g and 0.101 g, respectively. Based on Tables 1613.3.5(1) and 1613.3.5(2), the site has an assigned Seismic Design Category of B for structures classified as Risk Categories I, II, and III. For structures classified as Risk Category IV, site has an assigned Seismic Design Category of C.

The presence of loose sands at or below the water table results in a moderate to high potential for liquefaction to occur.

Pavements:

Information for this pavement analysis is inferred from the building borings. Our scope of services did not include extensive sampling and CBR testing of existing subgrade or potential sources of imported base material for the specific purpose of a detailed pavement analysis. Instead, we have assumed pavement related design parameters that are considered to be typical for the area soil types. It has been assumed that the constructed pavement subgrade will consist of well compacted soils. Based on experience, it is anticipated that the compacted native subgrade will yield a California Bearing Ratio (CBR) of between 8.0 and 10.0.

The satisfactory performance of pavements for parking and drive areas depends upon several factors including the characteristics of the supporting soil, the magnitude and frequency of wheel load applications, quality of construction materials, the contractor's placement and workmanship abilities, good drainage, and the desired period of design life.

The general pavement design information presented in this report is based on subsurface conditions inferred by the test borings, information published by The Asphalt Institute, the Portland Cement Association, and past experience in the locale. The published information was utilized in conjunction with the available field and laboratory test data to develop general pavement designs based on the AASHTO structural numbering system.

Pavements to be utilized by light vehicular traffic may be either flexible or rigid pavement sections supported on well-compacted subgrade or select fill. However, Portland cement concrete pavements should be utilized where large loads (i.e. waste disposal containers, etc.) are located. Both flexible and rigid pavement sections have been designed using general engineering design criteria referenced above.

The information for the design of the pavement system(s) are presented below. All referenced sections are in accordance with the State of Louisiana, Department of Transportation and Development, Standard Specifications for Roads and Bridges, 2016 Edition.

Subgrade:

It is paramount to the satisfactory performance of pavements that the subgrade be stable under loads and compacted prior to deployment of flexible base or concrete. All pavement subgrade should be proof rolled prior to beginning placement of pavement section materials. Stable subgrade is especially critical to the successful performance of flexible pavement sections.

Imported fill to complete the grading may consist of the aforementioned select fill or Usable Soils as determined by Section 203 of the *Louisiana Standard Specifications for Roads and Bridges, Current Edition.* Usable soils should have a maximum PI of 25 and a maximum organic content of five (5) percent. Soils with a silt content of 50 percent or greater and also a PI of 10 or less will not be allowed. An approved laboratory should test and classify the soil in accordance with DOTD TR423 from samples taken in the original locations or from designated sources. Soils which do not meet Liquid Limit or PI requirements should not be blended to reduce the Liquid Limit or PI. Instead, they may be treated with lime to reduce the PI in accordance with Subsection 203.06.5.

After stripping and undercutting, as required by the grading plan, the entire pavement area should be proof-rolled with a heavy, loaded pneumatic-tired vehicle such as a 20 to 25 ton loaded dump truck. It is recommended that all areas beneath the pavements be proof-rolled to identify loose or soft soils. All proof-rolling and undercutting activities should be witnessed by GTL or authorized representative and should be performed during a period of dry weather. Any weak areas which yield under the proof-roll, or any areas with a tendency to pump should be mitigated. Such mitigation may include over-excavation and backfilling, reprocessing to remove moisture, modification with lime or cement admixture, or using geotextiles. In the event such mitigation is required, the geotechnical engineer should be contacted to design an appropriate procedure.

After proof-rolling but prior to placing fill, the exposed soils should be scarified and then processed to a moisture content between one (1) percentage point below and three (3) percentage points above the Standard Proctor optimum. The subgrade soils should be re-compacted to a density of at least 95 percent of the Standard Proctor test DOTD TR 418 Method A (ASTM D-698) maximum dry density for a depth of at least eight (8) inches below the surface. As a guideline, it is recommended that field density tests be taken at a frequency of not less than one (1) test per 5,000 square feet of surface area per lift.

Subgrade may be, or become, wet and unstable under paving areas, depending on several factors, including construction season, groundwater fluctuations, contractor's maintenance of positive drainage, routing of equipment, weather, and scheduling constraints. Flexible base and concrete should be placed only on subgrade that has passed both stability and compaction requirements. Also, it is prudent for contract documents to accommodate over-excavation and replacement as needed or, more typically, to anticipate such remedial activity through the change order process. In any event, the owner should be advised that this risk is inherent in practically every construction project that involves site work.

Cement Treatment:

A bulk sample of the anticipated subgrade was subjected to standard laboratory tests to determine its' compatibility with cement for treatment purposes. The results of those tests indicate that the material is suitable for cement treatment. A copy of the aforementioned report is included in the Appendix of this report.

Cement treatment is primarily used for existing parking lot and roadbed materials and is typically a minimum of 12 inches thick, unless specified otherwise. The undeveloped area should be brought to finish soil grade utilizing materials that will stabilize with cement in accordance with DOTD TR432. Such materials are found in section 301.01.1, and are classified as A-1-a, A-1-b, A-2-4, A-2-6, A-4 and A-6 in accordance with DOTD TR423. Afterwards, the top 12 inches of existing material should be treated with not less than five (5) percent by volume of Portland cement in accordance with Section 303, and should generate a minimum compressive strength of 150 psi in seven (7) days. General mixing, pulverization, compacting and finishing, and acceptance should be in accordance with Section 303.

The treated mixture should be compacted at a moisture content at, or near, the optimum value as defined by DOTD TR 418 Method B (ASTM D698). Compaction should be at least 95 percent of the maximum dry density defined by this standard, and the percentage of moisture in the mixture should not vary more that ±two (2) percent at the time of compaction. As a guideline, it is recommended that field density tests be taken at a frequency of not less than one (1) test per 5,000 square feet of surface area.

Asphalt Curing Membrane:

Upon completion of intermediate finishing, immediately protect the base course against drying by applying an asphalt curing membrane in accordance with Section 506. Asphalt for the curing membrane should be an emulsified asphalt or an emulsified petroleum resin (EPR-1) complying with Section 1002. Water should comply with Section 1018.01.

Shrinkage Cracking:

Performance evaluations of soil cement mixtures have repeatedly found that the major problem with the process is not strength or durability but shrinkage cracking. The shrinkage of cement stabilized materials results from the loss of water by drying and from self-desiccation during the hydration of the cement. The factors which influence the severity and amount of cracking may include the amount of cement used, the water content used in the field, the aggregate properties, the adequacy of the curing procedures, weather conditions, the degree of subgrade restraint on the base, and the type and time of placement of the final surfacing.

Shrinkage cracks can result in reflective cracks in the asphaltic wearing course relatively soon after installation since soil-cement mixtures typically generate tensile strengths equal to approximately 20 percent of the compressive strength of the mixture. Consequently, additional cracking may occur from subbase stresses, poor drainage or slope failures. These cracks are aesthetically unsightly and invariably permit water intrusion of the soil subgrade. This intrusion invariably results in higher maintenance costs and reduces overall pavement life if the cracks are not sealed once they appear and exceed approximately 1/8 inch in width. Shrinkage cracks cannot be eliminated, but may be significantly reduced in the treated base by compacting the mixture at or below optimum moisture content, and be adequately cured.

The extent and severity of reflective cracking in the asphalt surface may be reduced by delaying placement of the hot-mixed asphalt (HMA) surface. This concept could involve placing a chip seal on the cured section and the final HMA surface two (2) to four (4) months later.

As an option, the owner or contractor may consider micro-cracking (or pre-cracking) the treated soils. This process consists of making a maximum of four passes of a steel wheel vibratory roller applied two (2) to four (4) days after finishing. The goal of micro-cracking is to form a network of fine cracks and prevent wider, more severe cracks from forming.

Base Course Aggregates:

Aggregates for base course should meet the requirements contained in Section 1003.03.1 or 1003.03.2. Stone should consist of 100 percent stone meeting the grading requirements in Table 1003-6, and have a maximum Liquid Limit of 25 and Plasticity Index of four (4). Recycled Portland cement concrete should meet the gradation in Table 1003-6, and the material passing the No. 40 sieve should be non-plastic. Compaction should be 95 percent of the maximum density defined by the Modified Proctor (DOTD TR418, Method G).

Asphaltic Concrete Mixtures for Mainline Roads:

These mixtures include wearing, binder, and base courses for travel lanes. The asphaltic concrete mixture should be furnished and constructed in accordance with Section 502 – Table 6. Field density results should be based on the Theoretical Maximum Specific Gravity in accordance with DOTD TR 327. Minimum density requirements should be a minimum of 90.0 percent for shoulders and 92.0 percent for Travel Lane Wearing, Binder and Base Courses. Placement and processes should follow the general guidelines set forth in Sections 502 and 503.

Asphaltic Concrete Mixtures for Non-Mainline Areas:

These include mixes used for parking lots, shoulders, and turnouts. The asphaltic concrete mixture should be furnished and constructed in accordance with Section 502 – Table 6. Field density results should be based on the Theoretical Maximum Specific Gravity in accordance with DOTD TR 327. Minimum density requirements should be a minimum of 90.0 percent. Placement and processes should follow the general guidelines set forth in Sections 502 and 503.

Portland Cement for Access Drives and Parking:

Portland cement concrete for all entrances and drives should be a Type B or D Pavement in accordance with the general guidelines set forth in Table 901-3 of Section 901.11. The mixture should achieve a minimum compressive strength of 4,000 psi at 28 days, and be designed with an air content between two (2) and seven (7) percent. Hot and cold weather limitation should be followed. The design of steel reinforcement should be in accordance with local or accepted codes.

Proper finishing of concrete pavement requires appropriate construction joints to reduce the potential for cracking. Construction joints (weakened planes) should be designed in accordance with current Portland Cement Association guidelines. It is recommended that such weakened plane joints be spaced no more than 15' c-c, or as specified by the structural engineer. The depth of such joints should be 1/3 of the pavement thickness. The joints should be cut as soon as the concrete will support the machinery. Joints should be sealed to reduce the potential for water infiltration into pavement joints and subsequent infiltration into the supporting soils.

Traffic and Design Data:

The pavement sections presented herein are based upon minimum material thicknesses as recommended by the Portland Cement Association (PCA). These sections are not based upon anticipated traffic loads as these were not available at the time this report was prepared. For the purposes of this report, we have assumed average traffic should consist of up to 150 repetitions of light passenger automobile and pick-up trucks, 15 medium-sized delivery trucks or vans, and 10 heavy tractor-trailer trucks per day. If traffic in excess of the normal to light to moderate duty commercial drive traffic is anticipated (i.e. heavy trucks, medium duty loaded trucks, high automobile traffic, etc.), GTL should be contacted for additional recommendations.

Recommended Pavement Sections:

The table below presents a summary of both rigid and flexible pavement sections for light and heavy-duty applications. It should be noted that the pavement sections as presented below are minimums. If it is desired to reduce potential cracking, greater thickness of select fill and/or greater pavement section thickness could be utilized. In addition, long term pavement performance requires good drainage and performance of periodic maintenance activities. Refer to the text for qualification of the designs and further discussion and limitations.

MINIMUM PAVEMENT RECOMMENDATIONS *		
Pavement Type	**Light Duty (Parking Stalls)**	**Heavy Duty (Entries & Drives)**
Portland Cement Concrete	5.0" Portland Cement Concrete 8.0" Density-Approved Subgrade or Imported Fill	8.0" Portland Cement Concrete 8.0" Density-Approved Subgrade or Imported Fill
Asphalt Over Crushed Stone Base	2.0" Item 501 Type 3 Surface 6.0" Item 1003.03 (b) Base 8.0" Density-Approved Subgrade or Imported Fill	3.0" Item 501 Type 3 Surface 9.0" Item 1003.03 (b) Base 8.0" Density-Approved Subgrade or Imported Fill
Asphalt Over Cement Treated Subgrade	2.0" Item 501 Type 3 Surface 12.0" Density Approved Cement-Treated Subgrade	3.0" Item 501 Type 3 Surface 12.0" Density Approved Cement-Treated Subgrade
*Materials should meet general requirements of the Louisiana DOTD Standard Specifications for Construction of Roads & Bridges, and specific requirements listed herein.		

Concrete thickness at trash receptacles should be a minimum of seven (7) inches. All paving recommendations are based on stable subgrade. Subgrade areas which are unstable should be over-excavated and replaced, or otherwise rendered stable prior to proceeding with base material placement.

Geotechnical Risk:

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations presented in the preceding sections constitutes GTL's professional estimate of those measures that are necessary for the proposed structure to perform according to the proposed design based on the information generated and referenced during this evaluation, and GTL’s experience in working with these conditions.

Limitations:

The exploration and analysis of the site conditions reported herein are considered preliminary in detail and scope and are not intended to form a basis for pavement and foundation design. The information submitted is based on the available soil information only and not on design details for the intended projects.

The findings, recommendations or professional advice contained herein have been made after being prepared in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology. No other warranties are implied or expressed.

The scope of services did not include any environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors, colors, or unusual or suspicious items or conditions are strictly for the information of the client. Prior to purchase or development of this site, an environmental assessment is advisable.

The scope of services did not include a geologic investigation to address any faults, large scale subsidence, or other macro geologic features not specifically addressed in this report or the agreement between GTL and the client.

After plans are more complete, it is recommended that the soils and foundation engineer be retained to provided a subsurface investigation tailored to meet the specific needs of the project.

This report has been prepared for the exclusive use of our client for the general application for the referenced project. GTL cannot be responsible for interpretations, opinions, or recommendations made by others based on the data contained in this report.

This report was prepared for general purposes only and should not be considered sufficient for purposes of preparing accurate plans for construction. Contractors reviewing this report are advised that the discussions and recommendations contained herein were provided exclusively to and for use by the project owner.

END OF REPORT TEXT

SEE FOLLOWING APPENDIX w/BORING LOGS & TEST RESULTS

APPENDIX A

FIELD AND LABORATORY PROCEDURES

Field and Laboratory Procedures
Town of Montgomery - Industrial Site Verification
Montgomery, Grant Parish, Louisiana
Report Number 11-18-166

I. <u>Field Operations</u>:

Subsurface conditions were evaluated by advancing two (2) intermittent sample borings on November 2, 2018 within the project area. Boring locations were selected and staked in the field by a representative of Geotechnical Testing Laboratory, Inc. An illustration of the approximate boring locations with respect to the areas investigated is provided on the Plan of Borings in the Appendix of this report. Descriptive terms and symbols used on the logs are in accordance with the Unified Soil Classification System.

A truck-mounted rotary drill rig was used to make the test borings. Each boring was advanced in the dry using flight auger drilling techniques. Intermittent undisturbed samples were obtained in the following manner.

Standard penetration tests were performed in accordance with ASTM D-1586 procedures. This test is conducted by recording the number of blows required for a 140-pound hammer falling 30 inches to drive a split-spoon sampler eighteen inches into the substrata. Depths at which split-spoon samples were taken are indicated by two crossed lines in the "Samples" column on the Log of Boring. The number of blows required to drive the sampler for each 6-inch increment were recorded. The penetration resistance is the number of blows required to drive the split-spoon sampler the final 12-inches of penetration. Information related to the penetration resistance is presented under the "Field Data" heading of the Log of Boring as the Standard Penetration (Blows/Foot). These samples were visually examined, logged, and packaged for transport to our laboratory.

The presence of ground water was monitored during drilling operations. Initial water seepage readings are provided under "Groundwater Information" in the right hand column of the Log of Boring. Upon boring completion, water levels were allowed to rise and stabilize for several minutes prior to final water readings. These readings are found under “Groundwater Information”. Soil sloughing from the walls of the boring are also recorded here as depth of cave-in.

II. <u>Laboratory Studies:</u>

Upon return to the laboratory, all samples were visually examined and representative samples were selected for testing. Tests were performed on selected samples recovered from the test borings to verify classification and to determine pertinent engineering properties of the substrata. Individual test and ASTM designations are provided below:

Test	ASTM Designations
Atterberg Limits	ASTM D4318
Moisture Content	ASTM D2216
Percent Minus #200	ASTM D1140
Hydrometer Analysis	ASTM D422

Results for soil classifications are located on the Log of Boring in their respective columns under "Laboratory Data."

Samples obtained during our field studies and not consumed by laboratory testing procedures will be retained free of charge for a period of 30 days. Arrangements for storage beyond that period of time must be made in writing to ***Geotechnical Testing Laboratory, Inc.***

APPENDIX B

PLAN OF BORINGS

Plan of Borings

PROJECT			
Town of Montgomery, Industrial Site Verification, Montgomery, Grant Parish, Louisiana			
SCALE Not to Scale	DATE 11/5/2018	FILENAME 11-18-166	***Cothern, Graff, Smoak, Engineering, Inc.***

N

APPENDIX C

BORING LOGS AND SOIL CLASSIFICATION CHART

LOG OF BORING B-1

Geotechnical Testing Laboratory, Inc.
226 Parkwood Drive
Alexandria, LA 71301
Telephone: (318) 443-7429

CLIENT: **Cothren, Graff, Smoak, Engineering, Inc.**
PROJECT: **Town of Montgomery - Industrial Site Verification**
LOCATION: **Montgomery, Grant Parish, Louisiana**
FILE NO.: **11-18-166**
DRILL DATE: **11/2/18**

DRILLING METHOD(S):
CME 45B, 4.5" I.D. Hollow Stem Auger

DRILLER: **R. Leggett** CHECKED BY: **K. Gorsha**

GROUNDWATER INFORMATION:
Water Seepage Noted @ 20.0 Feeet While Drilling
No Water Noted Upon Completion
Boring Walls Collapsed @ 22.0 Feet

SURFACE ELEVATION: **Not Determined**

DEPTH (FT)	N: BLOWS/FT P: TONS/SQ FT	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS NO. 200 SIEVE (%)	DRY DENSITY (Lbs./Cu.Ft.)	COMPRESSIVE STRENGTH (Lb./Sq. Ft.)	DESCRIPTION OF STRATUM
	N = 10	15							Medium Dense Red, Slightly Clayey, Silty SAND (SC-SM) 2.0'
	N = 14	16	30	18	12	63			Stiff to Very Stiff Red Sandy LEAN CLAY (CL)s
	N = 17	20							5.0'
5	N = 13	19	27	16	11	44			Medium Dense Red Clayey SAND (SC)
	N = 15	12							8.5'
10	N = 14	13	NP	NP	NP	37			Medium Dense Red Silty SAND (SM)
15	N = 14	8							
20	N = 4 ▽	25	NP	NP	NP	43			- loose @ 19.0 feet
25	N = 8	26							
30	N = 6	27							
35	N = 10	30	NP	NP	NP	23			- medium dense @ 34.0 feet 37.0'
40	N = 14	36							Stiff Reddish Brown & Gray FAT CLAY (CH)
45	N = 16	34	82	26	56	97			- very stiff below 44.0 feet
50	N = 18	36							50.0'

Boring Terminated @ 50.0 Feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE

NOTES:
See Plan of Borings for Location
GPS Coordinates: N 31° 40' 54.97" / W -92° 53' 38.22"
Stratification and Groundwater Depths Are Not Exact

LOG OF BORING B-2

Geotechnical Testing Laboratory, Inc.
226 Parkwood Drive
Alexandria, LA 71301
Telephone: (318) 443-7429

CLIENT: **Cothren, Graff, Smoak, Engineering, Inc.**
PROJECT: **Town of Montgomery - Industrial Site Verification**
LOCATION: **Montgomery, Grant Parish, Louisiana**
FILE NO.: **11-18-166**
DRILL DATE: **11/2/18**

DRILLING METHOD(S):
CME 45B, 4.5" I.D. Hollow Stem Auger

DRILLER: **R. Leggett** CHECKED BY: **K. Gorsha**

GROUNDWATER INFORMATION:
Water Seepage Noted @ 18.0 Feeet While Drilling
No Water Noted Upon Completion
Boring Walls Collapsed @ 22.0 Feet

SURFACE ELEVATION: **Not Determined**

DEPTH (FT)	N: BLOWS/FT P: TONS/SQ FT	MOISTURE CONTENT (%)	LL	PL	PI	MINUS NO. 200 SIEVE (%)	DRY DENSITY (Lbs./Cu.Ft.)	COMPRESSIVE STRENGTH (Lb./Sq. Ft.)	DESCRIPTION OF STRATUM
									Medium Dense Red, Slightly Clayey, Silty SAND (SC-CM)
	N = 12	13	23	17	6	42			
	N = 6	13							- loose w/silty sand (SM) layer @ 2.5 feet
	N = 15	8							- medium dense @ 4.0 feet
5									5.0'
									Medium Dense Red Clayey SAND (SC)
	N = 19	12	31	17	14	25			
	N = 36	10							- dense @ 7.0 feet
									8.5'
									Medium Dense Red Silty SAND (SM)
	N = 24	10							
10									
	N = 14	23	NP	NP	NP	13			
15									
	N = 20	24							
20									
	N = 6	26	NP	NP	NP	18			- loose @ 24.0 feet
25									25.0'
									Boring Terminated @ 25.0 Feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE

NOTES:
See Plan of Borings for Location
GPS Coordinates: N 31° 40' 50.24" / W -92° 53' 40.27"
Stratification and Groundwater Depths Are Not Exact

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, 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 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 SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

APPENDIX D

LABORATORY ANALYSIS OF USABLE SOILS
AND SOILS FOR CEMENT TREATMENT

Laboratory Analysis of Usable Soils And Soils For Cement Treatment

Report Date: 11/5/2018 **Sample Date:** 11/2/2018 **Project No.:** 11-18-166

Prepared For: **Cothren, Graff, Smoak, Engineering, Inc.**
6305 Westport Avenue
Shreveport, Louisiana 71129
Attention: Mr. K. Randal Smoak, P.E.

Project: Town of Montgomery - Industrial Site Verification, Montgomery, Grant Parish, Louisiana

Test Methods: DOTD TR407, TR413, TR423, TR428

Laboratory Results:

Test	Existing Subgrade	Cement Treatment Specifications	Usable Specifications for Portland Cement Concrete Paving	
Silt, %	18	60% Max.	< 50%	> 50%
Sand, %	58	79% Max.		
Clay, %	24			
Liquid Limit (LL)	35	40 Max.		
Plasticity Index (PI)	16	20 Max.	0 to 25	11 to 20
Organic Content, %	1.0	2.0 Max.	5% Max.	5% Max
Soil Group	A-6	A-6 or Better		
Soil Classification	Clayey Sand			
Results		Usable	Usable	

GEOTECHNICAL TESTING LABORATORY, INC.