GEOTECHNICAL REPORT

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GEOTECHNICAL SUBSURFACE INVESTIGATION RECOMMENDATIONS FOR THE PROPOSED CAESAR AVENUE RECONSTRUCTION 6TH STREET TO 7TH KINGSVILLE, TEXAS

RETL REPORT NUMBER: G118392

PREPARED FOR: CITY OF KINGSVILLE
PO BOX 1458
KINGSVILLE, TEXAS 78364

OCTOBER 26, 2018

PREPARED BY:

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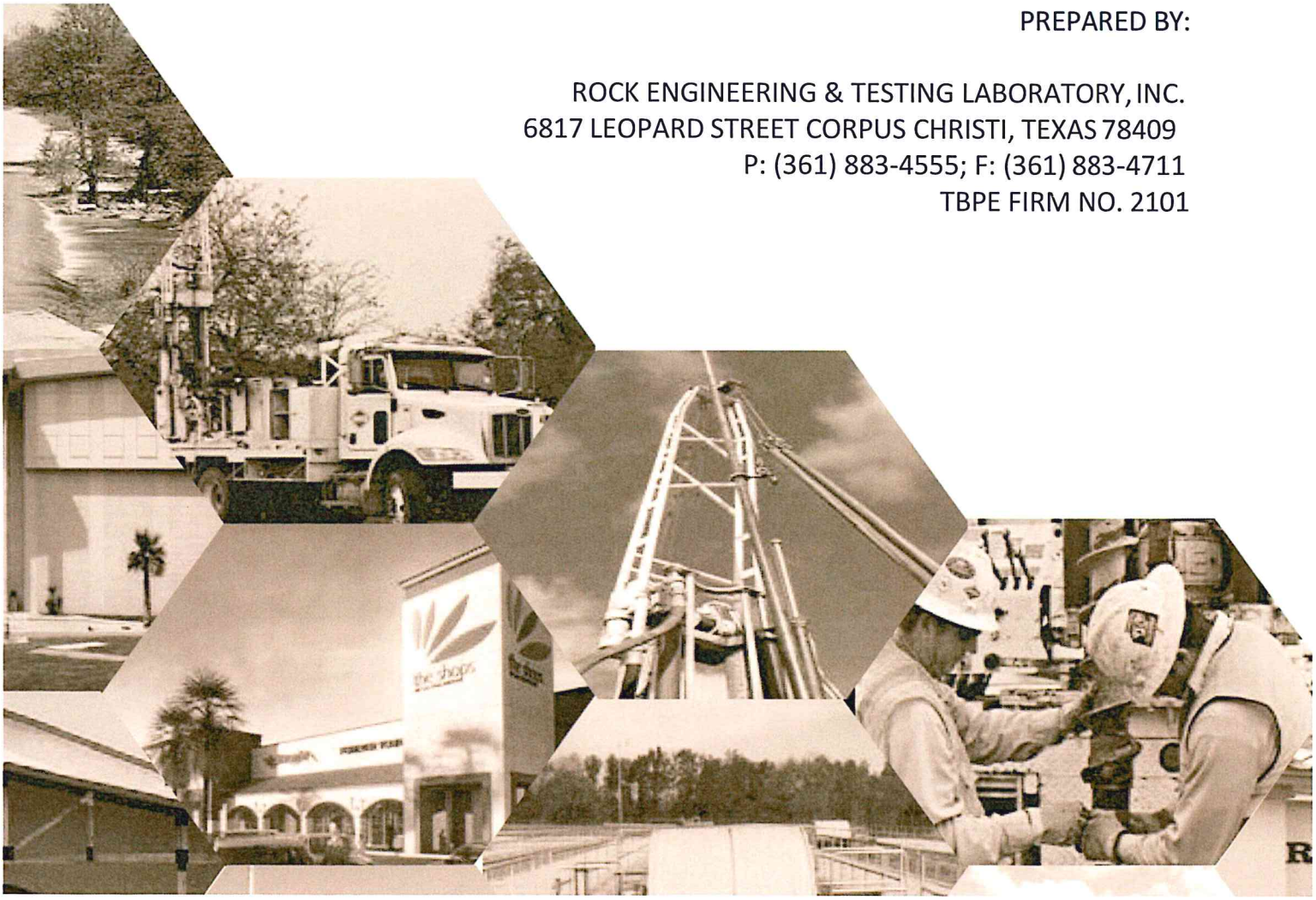

· Geotechnical Engineering
· Construction Materials Engineering & Testing
· Soils · Asphalt · Concrete

October 26, 2018

City of Kingsville
PO Box 1458
Kingsville, Texas 78364

Attention: Bill Donnell

SUBJECT: **SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM, AND PAVEMENT RECOMMENDATIONS FOR THE PROPOSED CAESAR AVENUE RECONSTRUCTION 6th Street to 7th Street Kingsville, Texas RETL Job No. – G118392**

Dear Mr. Donnell,

In accordance with our agreement, we have conducted a subsurface investigation, laboratory testing program, and pavement evaluation for the above referenced project. The results of this investigation, together with our recommendations, are to be found in the accompanying report, one electronic copy of which is being transmitted herewith for your records and distribution to the design team.

Often, because of design and construction details that occur on a project, questions arise concerning soil conditions, and Rock Engineering and Testing Laboratory, Inc. (RETL), Texas Professional Engineering Firm No. – 2101, would be pleased to continue its role as Geotechnical Engineer during the project implementation.

RETL also has great interest in providing materials testing and observation services during the construction phase of this project. If you will advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience. If you have any questions, or if we can be of further assistance, please contact us at (361) 883-4555.

Sincerely,

Brian Geiger

Brian J. Geiger, P.E.
Project Engineer

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INTRODUCTION

This report presents the results of a soils exploration for the proposed Caesar Avenue Reconstruction Project with limits from 6th Street to 7th Street in Kingsville, Texas. This study was conducted for the City of Kingsville.

Authorization

The work for this project was performed in accordance with Rock Engineering and Testing Laboratory, Inc. (RETL) proposal number P080718B dated August 8, 2018. The scope of work and fee was approved by the issuance of City of Kingsville Purchase Order 182030 dated August 6, 2018.

Purpose and Scope

The purpose of this exploration was to evaluate the roadway, soil, and groundwater conditions and to provide flexible pavement sections suitable for 15 and 20-year pavement design.

The Geotechnical Engineer states that the findings, recommendations, specifications or professional advice contained herein have been presented after being prepared in a manner consistent with that level of care and skill ordinarily exercised by reputable members of the Geotechnical Engineer's profession practicing contemporaneously under similar conditions in the locality of the project. No other representations are expressed or implied, and no warranty or guarantee is included or intended.

The scope of services did not include an environmental assessment. Any statements in this report, or on the boring logs, regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of the client.

General

The exploration and analysis of the subsurface conditions reported herein are considered sufficient in detail and scope for providing pavement recommendations for the subject project. The information submitted for the proposed project is based on project details provided by the City of Kingsville and the soil information obtained at the sample locations. If the designers require additional soil parameters to complete the design of the proposed pavement systems and this information can be obtained from the soil data and laboratory tests performed within the scope of work included in our proposal for this project, RETL will provide the additional information requested as a supplement to this report.

This report has been prepared for the exclusive use of the City of Kingsville for the specific application to the proposed Caesar Avenue Reconstruction Project with limits from 6th Street to 7th Street in Kingsville, Texas.

FIELD EXPLORATION

Scope

The field exploration, to evaluate the engineering characteristics of the subsurface materials, included performing the soil borings and determining strength and classification of the subgrade soil samples obtained.

The summary of boring, boring depth, location, and thickness of pavement constituents encountered are provided in the table below:

SUMMARY OF BORINGS				
Caesar Avenue, 6th Street to 7th Street				
Boring/Core Number	**Boring Depth (ft)**	**GPS Coordinates**	**Depth of HMAC (in)**	**Depth of Base (in)**
B-1	5'	N 27.50663° W 97.86629°	2½	9½
B-2	5'	N 27.50674° W 97.86710°	2½	9½

The borings performed for this project were used to determine the classification and strengths of the in-situ soils and thickness of existing pavement constituents. The information obtained on the boring logs includes boring depth, thickness of pavement constituents, soil classification, soil strengths, laboratory test results and GPS coordinates obtained using a commercially available GPS at the boring locations. The boring logs are included in the Appendix.

Drilling and Sampling Procedures

At each boring location, pavement cores were performed to provide access to the subsurface soils. The pavement cores were obtained using a coring machine equipped with a diamond bit to penetrate the existing pavement constituents to a depth at which the subgrade soils were encountered.

Once the pavement constituents were penetrated and the existing pavement constituents removed, the borings were advanced using a hand auger to the termination depth of the borings. Sampling operations at the borings were performed in accordance with the procedures for "*Standard Practice for Soil Exploration and Sampling by Auger Boring,* (ASTM D1452)."

The samples were placed in plastic bags, marked according to boring number, depth and any other pertinent field data, stored in special containers and delivered to the laboratory for testing.

Field Tests and Measurements

Static Cone Penetrometer Tests – Portable static cone penetrometer tests were performed at each sampling interval. The portable static cone penetrometer is a device used for measuring soil consistency. The device is equipped with dual rods enabling the cone stress to be measured directly. Soil friction on the outer rod does not influence the reading. The cone is forced into the soil in increments and retracted slightly after each increment to zero the gauge, and then the cone is advanced to obtain the cone index (Qc). The cone index is always read directly from the gauge. It has units of kg/cm^2, which is approximately equal to $tons/ft^2$. The results of the portable static cone penetrometer tests are provided on the boring log using the notation Qc.

The correlation between the cone index and soil constants is not absolute. The following empirical formulas were provided by the portable static cone penetrometer manufacturer, Boart Longyear Company, and have been determined through extensive field use of the unit:

1. Standard Penetration Test Value "N"
   N = Qc/4

2. Unconfined Compressive Strength "Qu" (tsf)
   Uniform clay and silty clays: Qu = Qc/5
   Clayey silts: Qu = Qc/(10 to 20)

3. Cohesion "C" or Undrained Shear Strength (tsf)
   Uniform clay and silty clays: C = Qc/10
   Clayey silts: C = Qc/(20 to 40)

Water Level Observations - Water level observations were obtained during the test boring operations and are noted on the boring logs provided in the Appendix. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. In relatively impervious soils, a suitable estimate of the groundwater depth may not be possible, even after several days of observation. Seasonal variations, temperature, land-use, proximity to a creek, river or lake and recent rainfall conditions may influence the depth to the groundwater. The amount of water in open boreholes largely depends on the permeability of the soils encountered at the boring locations.

Ground Surface Elevations - The ground surface elevations at the boring locations were not provided. Therefore, the depths referred to in this report are measured from the actual ground surface at the boring locations during the time of our field investigation.

LABORATORY TESTING PROGRAM

In addition to the field investigation, a laboratory testing program was conducted to determine additional pertinent engineering characteristics of the subsurface materials necessary in analyzing the behavior of the pavement systems for the proposed project.

The laboratory testing program included supplementary visual classification (ASTM D2487) and water content tests (ASTM D2216) on the samples. In addition, selected samples were subjected to Atterberg limits tests (ASTM D4318) and percent material finer than the #200 sieve tests (ASTM D1140).

The laboratory testing program was conducted in general accordance with applicable ASTM Specifications. The results of these tests are to be found on the accompanying boring logs provided in the Appendix.

SUBSURFACE CONDITIONS

General

The types of soils encountered in the test borings have been visually classified and are described in detail on the boring logs. The results of the strength tests, water level observations and other laboratory tests are presented on the boring logs in numerical form. Representative samples of the soils were placed in polyethylene bags and are now stored in the laboratory for further analysis, if desired. Unless notified to the contrary, the samples will be disposed of 3-months after issuance of this report.

The stratification of the soil, as shown on the boring logs, represents the soil conditions at the actual boring locations. Variations may occur between, or beyond, the actual boring locations. Lines of demarcation represent the approximate boundary between different soil types, but the transition may be gradual, or not clearly defined.

It should be noted that, whereas the test borings were drilled and sampled by experienced drillers, it is sometimes difficult to record changes in stratification within narrow limits. In the absence of foreign substances, it is also difficult to distinguish between discolored soils and clean soil fill.

Soil Conditions

The generalized soil conditions encountered have been summarized and soil properties including soil classification, strength, angle of internal friction and effective unit weight are provided in the following table:

Soil Profile Table

D	Description	LL	PI	C	ϕ	γ_e
0-1	Ex. HMAC Pavement	Not Applicable				
1-5	Fat/Lean **CLAY**	46-57	23-39	2,000	0	120

Where:

D = Depth in feet below existing grade
LL = Liquid limit (%)
PI = Plasticity index
C = Soil Cohesion, psf (undrained)
ϕ = Angle of Internal Friction, deg. (undrained)
γ_e = Effective soil unit weight, pcf

The Atterberg limits test results for the caliche base material encountered indicate that the materials encountered are low to moderate in plasticity. The liquid limits ranged from 35 to 45-percent and plasticity indices ranged from 8 to 25. Minus #200 sieve tests performed on selected caliche base samples obtained indicated that these soils contain approximately 23 to 24-percent silt and clay size particles.

Groundwater Observations

Groundwater was not observed at the boring locations during drilling operations and was not observed in the boreholes upon completion of the drilling operations. Therefore, based on the observations made in the field during the drilling operations it is RETL's opinion that the groundwater at this site is at depths greater than 5-feet, the termination depth of the borings performed at this site for this project. It should be emphasized that water levels in open boreholes may require several hours to several days to stabilize depending on the permeability of the soils and that groundwater levels at this site will be subject to seasonal conditions, recent rainfall, drought or temperature effects.

PAVEMENT RECOMMENDATIONS

The proposed roadway rehabilitation includes reconstruction of the subject roadway section utilizing new pavement materials. The roadway is expected to follow the same horizontal alignment. The vertical alignment may warrant some minor changes to improve drainage. The capacity of the roadway and roadway classification will remain the same. In designing the proposed roadway, the existing subgrade conditions must be considered together with the expected traffic use and loading conditions.

The conditions that influence pavement design can be summarized as follows:

- Bearing values of the subgrade. These can be represented by a California Bearing Ratio (CBR) for the design of flexible pavements.

- Vehicular traffic, in terms of the number and frequency of vehicles and their range of axle loads.

- Probable increase in vehicular use over the life of the pavement.

- The availability of suitable materials to be used in the construction of the pavement and their relative costs.

Specific laboratory testing to define the subgrade strength (i.e. CBR) has not been performed for this analysis. **Based upon local experience and soil classification, the estimated CBR value for the predominate in-situ fat/lean clay soils encountered at this site is 3.**

Based on the information provided to RETL, it is recommended that the construction of subject streets be designed based on the following pavement design parameters:

PAVEMENT DESIGN PARAMETERS: CAESAR AVENUE	
Reliability Level	80%
Standard Deviation	0.45
Initial/Terminal Serviceability	4.2/2.0
Percent Trucks	24.5%
Total ADT	3,788
Growth Rate	2%
Required 18-KIP ESALs (15-year)	208,594
Required 18-KIP ESALs (20-year)	294,733
Soil Resilient Modulus	4,000 psi
HMAC Type D	0.42
Crushed Limestone Base (Type A Gr. 1-2)	0.14
Lime Stabilized Subgrade	0.08

Full reconstruction will require the following flexible pavement sections:

RECOMMENDED PAVEMENT SECTIONS – CAESAR AVENUE (6th Street to 7th Street)				
Pavement Constituent	**Flex. Pvmt. No. 1**	**Flex. Pvmt. No. 2**	**Flex. Pvmt. No. 3**	**Flex. Pvmt. No. 4**
Design Life (years)	15	15	20	20
HMAC Type D	2"	2"	2.5"	2.5"
Limestone (Type A Gr. 1-2)	12"	10"	11"	10"
Lime Stabilized Subgrade (5%)	8"	No	8"	No
Tensar TX5	---	Yes	---	Yes
Compacted Subgrade	---	Yes	---	Yes
Minimum Structural Number Required	3.06	3.06	3.22	3.22
Structural Number Provided	3.16	3.15	3.23	3.29

After all surface organics, deleterious materials and existing roadway materials have been removed to the desired subgrade elevation, the upper 12-inches of exposed raw subgrade shall be compacted to a minimum density of 98-percent of the maximum dry density as determined by the standard Proctor test (ASTM D698) and at, or above, the optimum moisture content. Any soft areas identified shall be removed and properly recompacted in place.

Where specified in the table above, a single layer of TENSAR TX5 geogrid shall be placed in accordance with the manufacturer's recommendations on top of 12-inches of raw subgrade.

Lime placement and mixing operations should be performed in accordance with TxDOT Item 260, *"LIME TREATMENT FOR MATERIALS USED AS SUBGRADE (ROAD MIXED)."* Lime shall be mixed with the natural in-situ soils at a rate of 5-percent based on the maximum dry unit weight of the raw subgrade soils as determined by the standard Proctor test (ASTM D698). After proper curing time, usually 48 to 72 hours, the lime stabilized soils should be remixed and compacted to a minimum density of 98% of the maximum dry unit weight of the lime stabilized subgrade soils as determined by a standard Proctor test (ASTM D698) and at, or above, the optimum moisture content.

The flexible base materials utilized shall meet the minimum physical requirements for 2014 TxDOT Item 247, Type A, Grade 1-2. Base materials in flexible pavement areas should be placed in maximum 8-inch thick loose lifts and compacted to a minimum density of 98-percent of the maximum dry density as determined by the modified Proctor test (ASTM D1557) and within 1½ percentage points of the optimum moisture content.

RETL recommends placing a single course seal coat or a prime coat (MC-30 or AE-P) on the finished base material prior to placing the HMAC surface courses. A single course surface treatment shall be applied after the base material has been primed.

Hot mix asphaltic concrete should meet the requirements set forth in 2014 TxDOT Item 340; Type D. Minimum and maximum thickness of HMAC placement for the types of HMAC recommended are provided in the following table:

Minimum/Maximum Recommended HMAC Compacted Lift Thickness		
HMAC Mixture Type	**Minimum Compacted Lift Thickness**	**Maximum Compacted Lift Thickness**
Type D HMAC	1.5"	3"

Any other pay items not specifically referenced shall be TxDOT specifications. All TxDOT specifications are referenced from the 2014 Texas Department of Transportation, "STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS AND BRIDGES."

Allowances for proper drainage and proper material selection of base materials are most important for performance of asphaltic pavements. Ruts and areas that hold water in asphalt pavements allow for quick deterioration of the pavement primarily due to saturation of the underlying base and subgrade.

Routine Maintenance of Flexible Pavement Systems

The pavement sections provided in this report are designed to provide adequate serviceability over the design life of the pavement. During the design life, the roadway will require routine maintenance such as crack sealing and seal coats for flexible pavements. Without proper maintenance moisture infiltration into the base material and subgrade will result in rapid deterioration of the pavement system. RETL recommends that the City of Kingsville protect their investment by incorporating an aggressive maintenance program.

Roadway Construction and Design Considerations

Roadways will be subject to movements when constructed over moderate to highly plastic soils. Changes in moisture content of the supporting moderate to highly plastic soils cause volumetric changes resulting in differential movements.

Provisions in the site development and design should be made in order to maintain relatively uniform moisture contents of the supporting soils. A number of measures may be used to attain a reduction in subsoil moisture content variations, thus reducing the soil's shrink/swell volume change potential. Some of these measures are outlined below:

- During construction, a positive drainage scheme should be implemented to prevent ponding of water on the subgrade.

- We recommend that an effective site drainage plan be devised by others prior to commencement of construction to provide positive drainage away from the site improvements and off the site, both during, and after construction.

- The top 2-feet of utility trenches should be backfilled with low plasticity clays to assure the trenches do not serve as aqueducts that could transport water beneath the pavement due to excessive surface water infiltration.

- Pavements should be designed to drain quickly with a minimum positive slope of 1 percent. Behind the curb and gutter it is recommended to incorporate a properly compacted clay cap at the surface to prevent moisture from entering the pavement base materials.

All project features beyond the scope of those discussed above should be planned and designed similarly to attain a region of relatively uniform moisture content within the pavement areas. Poor drainage schemes are generally the primary cause of pavement problems on clay soils.

Earthwork and Foundation Acceptance

Exposure to the environment may weaken the soils if excavations remain open for long periods of time. Therefore, it is recommended that all excavations be extended to final grade and the utilities, boxes, and manholes be installed as soon as possible to minimize potential damage to the bearing soils. The bearing level should be free of loose soil, ponded water or debris and should be observed by the Geotechnical Engineer, or his designated representative.

Concrete, pavement constituents, bedding materials and backfill materials should not be placed on soils that have been disturbed by rainfall or seepage. If the bearing soils are softened by surface water intrusion, or by desiccation, the unsuitable soils must be removed from the excavation and replaced with properly compacted fill.

Backfill materials should be placed in maximum 8-inch thick loose lifts and compacted to a minimum density of 95-percent of the maximum dry density as determined by the standard Proctor test (ASTM D698) and the moisture content should be maintained within –1 to +3 percentage poinnts of the optimum moisture content.

The Geotechnical Engineer or his designated representative should monitor the placement of roadway constituents, bedding material, backfill and backfill behind the curb. As a guideline, density tests should be performed on the exposed subgrade soils and each subsequent lift of compacted pavement constituents at a rate of one test per 200-linear feet of roadway or a minimum of three in-place nuclear tests per testing interval, whichever is greater. Any areas not meeting the required compaction should be recompacted and retested until compliance is met.

GENERAL COMMENTS

If there are any revisions to the plans for the proposed project, or if deviations from the subsurface conditions noted in this report are encountered during construction, RETL should be retained to determine if changes in the recommendations are required. If RETL is not retained to perform these functions, RETL will not be responsible for the impact of those conditions on the performance of the project.

It is recommended that RETL be retained to provide observation and testing during the construction of the proposed project. RETL cannot accept any responsibility for any conditions which deviate from those described in this report, nor for the performance of the project if not engaged to also provide construction observation and testing. If it is required for RETL to accept any liability, then RETL must agree with the plans and perform such observation during construction as we recommend.

All sheeting, shoring, and bracing of trenches, pits and excavations should be made the responsibility of the contractor and should comply with all current and applicable local, state and federal safety codes, regulations and practices, including the Occupational Safety and Health Administration.