Geotechnical Engineering Report

Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

Prepared for:

CDS/Muery Services

San Antonio, Texas

Prepared by:

Drash Consultants, LLC

San Antonio, Texas

December 19, 2013

Drash Project No. 113G1004

Drash
CONSULTANTS

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SUBJECT:
Geotechnical Engineering Report
Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

Drash Project No. 113G1004

Mr. John Rothe, P.E.
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Dear Mr. Rothe:

Drash Consultants, LLC (Drash) is pleased to submit this geotechnical engineering report for the above referenced project. If you have any questions regarding our report, or if additional services are needed, please do not hesitate to contact us.

Thank you for selecting Drash to provide the geotechnical engineering services for this phase of the project. We would appreciate the opportunity to continue our involvement in this project by providing the construction materials testing and observation services during the construction phase. One of our client representatives will contact you to discuss these services.

We appreciate the opportunity to work with you, and we look forward to working with you on future projects.

Respectfully Submitted,
Drash Consultants, LLC

Susan E Trout for
Chris Nungesser
Project Manager

STATE OF TEXAS
ANTHONY F. ADAMO
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EXECUTIVE SUMMARY

This geotechnical engineering report has been prepared for the Callaghan Road (Project) that is being planned in San Antonio, Texas. The Project will involve the design and construction of improvements to the existing Callaghan Road from Evers Road to Centerview Drive. The Project is located on the north side of San Antonio, Texas. The purpose of the Project is to add an additional lane to the roadway, improve the sidewalk along the east side of the road, and improve the drainage along Callaghan Road between Centerview Drive and Evers Road.

Based on the information provided to us for this study and from data developed as part of our engineering service, the site is suitable for the planned improvements. A general summary of our findings, conclusions, and recommendations with regard to the geotechnical engineering aspects of the Project are provided below:

- Surface conditions consist of asphaltic concrete and base material underlain by fat clay, lean clay, and clayey gravel.
- Subsurface conditions consist of clayey soils of low to high shrink/swell potential.
- Subsurface water was encountered at one boring location (B-20) at a depth of 11 feet below ground surface. Subsurface water was not encountered in the remaining 19 borings during our field activities on November 6, 7, 8, 11 and 12, 2013
- The roadway is expected to be an asphaltic concrete pavement system.
- The proposed retaining walls may be MSE or cast-in-place.
- The near surface soils along the sides and bottom of the creek are fine-grained soils susceptible to erosion.

This summary is provided for convenience only. For those individuals and entities that may need more details or technical information from this report for their use, it must be read in its entirety to have an understanding of the information and recommendations provided for the Project.

GEOTECHNICAL ENGINEERING REPORT
CALLAGHAN ROAD
EVERS ROAD TO CENTERVIEW DRIVE
SAN ANTONIO, TEXAS

INTRODUCTION

Drash Consultants, LLC (Drash) is pleased to submit this report for the Callaghan Road (Project) that is being in San Antonio, Texas. The Project will involve the design and construction of improvements to the existing Callaghan Road from Evers Road to Centerview Drive. The Project is located on the north side of San Antonio, Texas. The purpose of the Project is to add an additional lane to the roadway, improve the sidewalk along the east side of the road, and improve the drainage along Callaghan Road between Centerview Drive and Evers Road.

Authorization

This Project was authorized by Mr. John Rothe, through issuance of a Subconsultant Agreement dated August 22, 2013. This agreement is based on our Agreement for Services, No. PG1131088-2, dated July 17, 2013.

Purpose and Scope of Services

The purposes of this engineering service were to evaluate the general subsurface conditions (soil, rock, subsurface water) within the Project limits by drilling exploratory borings, conducting tests on samples recovered during drilling of the exploratory borings, analyzing and evaluating the test data, performing engineering analyses using the data analyzed and evaluated from the field and laboratory programs to develop geotechnical engineering recommendations and guidelines with respect to:

- Subsurface soil properties
- Subsurface stratigraphy
- Subsurface water conditions
- Earthwork as applicable
- Pavement design and construction
- Slope and retaining wall design

The scope of services was performed in general accordance with Exhibit A of our Agreement for Services.

PROJECT INFORMATION

The following information was provided to us by the Client, design professionals working on the Project, or was collected by our firm:

Project Location	The Project is located along Callaghan Road from Evers Road to Centerview Drive in San Antonio, Texas. The general vicinity of the Project is illustrated on Exhibit 1, the Project Location Map.

Project	The Project will involve the following: • Construction of an additional lane to Callaghan Road; • Reconstruction of the existing pavement; • Sidewalk improvements; • Drainage improvements; • Retaining wall construction; and • Slope construction.
Current Site Conditions	The Project site consists of an asphaltic concrete pavement system.
Proposed Topography	Proposed grading was not provided at the time of this report.

SITE AND SUBSURFACE CONDITIONS

Site Conditions

The site, as noted previously, consists of an asphaltic concrete pavement system. Based on visual observations, there were no noticeable or obvious conditions within the site that would affect the geotechnical engineering aspects of this Project.

Subsurface Conditions

Subsurface conditions within the Project limits were evaluated by drilling exploratory borings at the locations shown on the Boring Location Plan (Exhibit 2). Information retrieved from the exploratory borings is summarized herein.

Subsurface Stratigraphy

Subsurface stratigraphy, based on the exploratory borings, can be generalized as follows:

Layer Identification	Approximate Depth To and Thickness Of Layer (feet)	Description of Layer
Surface	0 to 1½	Asphaltic concrete over base material
Layer 1	0 to 1	FILL: LEAN CLAY; gray and brown; hard; with sand. *Only encountered in Boring B-19.*
Layer 2	0 to 7½	FAT CLAY; dark brown, brown, dark gray, and gray; very stiff to hard; with sand and gravel
Layer 3	1 to 8	CLAYEY GRAVEL; dark brown, brown, tan, and gray; medium dense to very dense
Layer 4	½ to 30	LEAN CLAY; dark brown, dark gray, brown, gray, tan, and white; stiff to hard; with sand, gravel, and calcareous deposits; partially cemented in places
Layer 5	1½ to 30	FAT CLAY; brown, gray, light gray, tan, and light brown; very stiff to hard; with sand, gravel, and calcareous deposits

The logs of borings, presenting more specific information about the subsurface stratigraphy encountered at each exploratory boring location, are provided in the Exhibits section of this report.

Subsurface Water

Subsurface water was encountered only in Boring B-20 at a depth of 11 feet below ground surface. Drilling activities were suspended for 15 minutes and subsurface water remained at 11 feet. Each exploratory boring was then backfilled with the spoils generated during drilling operations. The upper 2 feet were backfilled with a non-shrink grout and the ground surface was then patched with asphalt cold patch.

Subsurface water is generally encountered as a *'true'* or permanent water source or as a *'perched'* or temporary water source. Permanent subsurface water is generally present year round, which may or may not be influenced by seasonal and climatic changes. Temporary subsurface water generally develops as a result of seasonal and climatic conditions.

Based on the planned development, subsurface water is not expected to affect or impact the planned construction activities. The subsurface water conditions should be rechecked by the contractor or applicable subcontractors if any excavations greater than 5 feet are performed at the Project site.

GEOTECHNICAL RECOMMENDATIONS AND GUIDELINES

Based on the information provided to us by CDS/Muery Services, our exploratory borings drilled at the site, results of laboratory tests performed on samples recovered during the subsurface exploration program, and our engineering analyses, the following statements can be made regarding the Project site:

- The site is suitable for the planned roadway improvements.
- Subsurface soil conditions exhibit a Plasticity Index (PI) greater than 20 in just over half of the boring locations.
- Flexible (asphaltic concrete overlying granular base) pavements can be used.

The following geotechnical recommendations and guidelines have been prepared based on the data collected or developed during this Project, our experience with similar projects, and our knowledge of sites with similar site and subsurface conditions.

Pavements

We understand that a flexible pavement system will be considered for the proposed street improvements. The following flexible pavement sections were designed in general accordance with the American Association of State Highway and Transportation Officials (AASHTO) and the City of San Antonio (COSA) guidelines.

Pavement Earthwork

Highly expansive soils are present at the Site. Subsurface soil conditions exhibit a Plasticity Index (PI) greater than 20; thus, special earthwork is required by COSA for the southwestern half of the roadway. The soils will underlie the proposed roadway, which over time, can reduce

the serviceability of the roadway and lead to deterioration in the quality of the pavement system. The following earthwork recommendations must be performed prior to pavement construction.

- Strip vegetation, loose topsoil, existing pavements and any otherwise unsuitable materials from the pavement area. The pavement area is defined as the area that extends at least 3 feet (horizontal) beyond the perimeter of the proposed pavement and any adjacent flatwork.
- Excavate the on-site soils to the design pavement subgrade elevation (also referenced as the bottom of the base course).
- After achieving the required excavation, and before placing any fill, the exposed excavation subgrade should be proofrolled with at least a 20-ton roller, or equivalent equipment, to evidence any weak yielding zones. A technical representative of our firm should be present to observe the proofrolling operations. If any weak yielding zones are present, they should be over-excavated, both vertically and horizontally, until competent soils are exposed. The excavated soil can be used to restore the excavation subgrade, provided that the soils are relatively free and clean of deleterious material or materials exceeding 3 inches in maximum dimension. The excavated soil, or imported fill soil, shall be placed in maximum 6-inch compacted lifts. Each lift of soil shall be moisture conditioned between +1 and +4 percentage points of the optimum moisture content and compacted between 93 and 98 percent of the maximum dry density determined in accordance with the Standard compaction effort (TEX-114-E).
- The final 8 inches below the design pavement subgrade elevation should be lime treated in accordance with COSA standards and TxDOT Item 260. The lime shall be in slurry form. It is anticipated that approximately 6 percent hydrated lime will be required; however, the actual percentage required shall be determined by laboratory tests on samples of the subgrade prior to construction. The soil-lime mixture shall be placed between +1 and +4 percentage points of the optimum moisture content and shall be compacted between 93 and 98 percent of the maximum dry density determined in accordance with the Standard compaction effort (TEX-114-E).
- This earthwork option will result in approximately 8 inches of lime treated soil below the design pavement subgrade elevation.
- The pavement system, base and surface courses, shall then be constructed over the lime treated and moisture conditioned soils.

Pavement Design Considerations

The classification of the streets at the Project site are unknown; however, according to COSA design guidelines, streets are classified as Local Type A streets without bus traffic, Local Type A streets with bus traffic, Local Type B Streets and Collector Streets or Primary and Secondary Arterials. The following pavement sections are based on a California Bearing Ratio (CBR) of

1.8%, a Resilient Modulus (M_r) value of 3,200 psi, and a Modulus of Subgrade Reaction (k) value of 100 pci. Based on the COSA design guidelines, the following design parameters must be used for the streets:

	Local Type A without Bus Traffic	Local Type A with Bus Traffic	Local Type B and Collector Streets	Primary and Secondary Arterials
Reliability, %	70	70	90	95
Initial Serviceability Index, p_o	4.2	4.2	4.2	4.2
Terminal Serviceability Index, p_t	2.0	2.0	2.5	2.5
Standard Deviation, S_o	0.45	0.45	0.45	0.45
Design Life, years	20	20	20	20
Minimum Structural Number, SN	2.08	2.58	2.92	3.80
Maximum Structural Number, SN	3.18	4.20	5.08	5.76
18-kip ESALs	100,000	1,000,000	2,000,000	3,000,000

FLEXIBLE PAVEMENT SYSTEM		
	Pavement Material Thickness, Inches	
Component	Local Type B and Collector Streets	Primary and Secondary Arterials
Hot Mixed Asphaltic Concrete Surface Course (Type C or D)	1½	1½
Hot Mixed Asphaltic Concrete Base Course (Type C)	2½	2½
Prime Coat	Yes	Yes
Asphaltic Base Course (Type B)	7	9
Lime Treated Subgrade	8	8

FLEXIBLE PAVEMENT SYSTEM				
	Pavement Material Thickness, Inches			
Component	Local Type A without Bus Traffic (Option 1)	Local Type A without Bus Traffic (Option 2)	Local Type A with Bus Traffic (Option 1)	Local Type A with Bus Traffic (Option 2)
Hot Mixed Asphaltic Concrete Surface Course (Type C or D)	2	2½	1½	1½
Hot Mixed Asphaltic Concrete Base Course (Type C)	0	0	2½	2½
Prime Coat	Yes	Yes	Yes	Yes
Asphaltic Base Course (Type B)	4	0	4½	0
Granular Base Course	0	8	0	12
Lime Treated Subgrade	8	8	8	8

General Guidelines for Pavements

All pavement design and construction shall conform to the 2012 COSA Design Guidance Manual requirements and current COSA Standards.

Proper perimeter drainage is very important and should be provided so infiltration of surface water from unpaved areas surrounding the pavements is minimized.

If curbs are needed in certain areas, it is important that proper perimeter drainage be provided so that infiltration of surface water from unpaved areas surrounding the pavement is reduced, or if this is not possible, curbs should extend through the base and into the clay subgrade for a depth of at least 3 inches. A crack sealant compatible to both asphalt and concrete should be provided at all concrete-asphalt interfaces.

Pavement design methods are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support. The support characteristics of the subgrade for pavement design do not account for shrink/swell movements of an expansive clayey subgrade. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade. It is, therefore, important to minimize moisture changes in the subgrade to reduce shrink/swell movements.

On most projects, rough site grading is accomplished relatively early in the construction phase. Fills are placed and compacted in a uniform manner. However, as construction proceeds, excavations are made into these areas; dry weather may desiccate some areas; rainfall and surface water saturates some areas; heavy traffic from concrete and other delivery vehicles disturbs the subgrade; and many surface irregularities are filled in with loose soils to improve

trafficability temporarily. As a result, the pavement subgrade should be carefully evaluated as the time for pavement construction approaches. This is particularly important in and around utility trench cuts. All pavement areas should be moisture conditioned and properly compacted to the recommendations in this Report immediately prior to paving. Thorough proofrolling of pavement areas using appropriate construction equipment weighing at least 20 tons should be performed no more than 24 hours prior to surface paving. Any problematic areas should be reworked and compacted at that time.

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventive maintenance. The following recommendations should be considered at a minimum:

- Maintain and promote proper surface drainage away from pavement edges;
- Consider appropriate edge drainage systems;
- Install drainage in areas anticipated for frequent wetting (e.g. landscape beds, discharge area, collection areas, etc.);
- Install joint sealant and seal cracks immediately;
- Seal all landscaped areas in, or adjacent to pavements, to minimize or prevent moisture migration to subgrade soils;
- Placing compacted, low permeability backfill against the exterior side of curb and gutter; and,
- Placing curb and gutters through the base material and directly into subgrade soils.

Preventive maintenance should be planned and provided for through an on-going pavement management program. These activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. This consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance.

Pavement Section Materials

Presented below are selection and preparation guidelines for various materials that may be used to construct the pavement sections. Submittals should be made for each pavement material. The submittals should be reviewed by Drash and any appropriate members of the Project Team. The submittals should provide test information necessary to verify full compliance with the recommended or specified material properties.

Hot Mix Asphaltic Concrete Surface Course - The asphaltic concrete surface course should be plant mixed, hot laid Type C or D Surface meeting the master

specification requirements of 2004 TXDOT Standard Specifications Item 340, Item SS 3224 (2011) and specific criteria for the job mix formula. The mix should be compacted between 91 and 95 percent of the maximum theoretical density as measured by TEX-227-F. The asphalt cement content by percent of total mixture weight should fall within a tolerance of ±0.3 percent asphalt cement from the specific mix. In addition, the mix should be designed so 75 to 85 percent of the voids in the mineral aggregate (VMA) are filled with asphalt cement. The grade of the asphalt cement should be PG 64-22 or higher performance grade. Aggregates known to be prone to stripping should not be used in the hot mix. If such aggregates are used, measures should be taken to mitigate this concern. The mix should have at least 70 percent strength retention when tested in accordance with TEX-531-C.

Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method TEX-207-F. The nuclear-density gauge or other methods which correlate satisfactorily with results obtained from Project pavement specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required pavement specimens at their expense and in a manner and at locations selected by the Engineer.

Prime Coat - The prime coat should consist of sealing the base with an oil such as an MC-30 or an emulsion. The prime coat should be applied at a rate of about 0.2 to 0.5 gallons per square yard with materials which meet TxDOT Item 300. The prime coat will help to minimize penetration of rainfall and other moisture that penetrates the base.

Asphaltic Base Course - The asphaltic base material should meet the specification requirements of 2004 TxDOT Standard Specification Item 340, Type A or B.

Granular Base Material - Base material may be composed of crushed limestone base meeting all of the requirements of 2004 TxDOT Item 247, Type A, Grade 1 or 2; and should have no more than 15 percent of the material passing the No. 200 sieve. The base should be compacted to at least 95 percent of the maximum dry density determined in accordance with test method TEX-113-E at moisture contents ranging between -2 and +3 percentage points of the optimum moisture content.

Modified Subgrade - Due to the presence of clay at this Site, the subgrade shall be treated with hydrated lime in accordance with COSA standards and TxDOT Item 260 in order to improve its strength and improve its load carrying capacity. The quantity of hydrated lime required should be determined after the Site is stripped of the loose topsoil and the subgrade soils are exposed. In addition, the

soils should be checked for sulfates prior to the use of lime. We anticipate that approximately 6 percent hydrated lime will be required. This is equivalent to about 25 pounds of hydrated lime per square yard for an 8-inch treatment depth. However, the actual percentage should be determined by laboratory tests on samples of the subgrade materials prior to construction. The optimum hydrated lime content should result in a soil-cement mixture with a pH of at least 12.4 when tested in accordance with ASTM C 977, Appendix XI.

The hydrated lime should initially be blended with a mixing device such as a pulvermixer. After sufficient moisture conditioning, the treated soil mixture shall be compacted to at least 95 percent of the maximum dry density as determined in accordance with the Standard effort (TEX-114-E) at moisture contents from optimum to +3 percentage points of the optimum moisture content. If the in-place gradation requirements can be achieved during initial mixing, the remixing after the curing period can be eliminated.

Moisture Conditioned Raw Subgrade - The subgrade should be moisture conditioned and compacted between 93 and 98 percent of the maximum dry density determined in accordance with test method TEX-114-E at moisture contents ranging between +1 and +4 percentage points of the optimum moisture content.

Soil Corrosivity

Laboratory testing was conducted on soil samples recovered from the borings to assess the corrosivity risk of the soils at the boring locations. The soil samples were submitted to an analytical lab to determine the sulfate contents. The results of the laboratory tests are provided below.

Summary of Laboratory Sulfate Tests		
Boring No.	**Sample Depth (ft)**	**Sulfate (ppm)**
B-16	2.5 to 4	421
B-20	0.5 to 2	165

According to the 2012 IBC, concrete that will be exposed to sulfate-containing solutions should be designed in accordance with ACI 318. The sulfate test results indicate that the sulfate exposure levels are negligible. Therefore, lime and Type I or Type II cement may be used at this site.

Earthwork

The recommendations presented for design and construction are contingent upon following the recommendations and guidelines outlined in this section. Earthwork on the Project should be evaluated by our firm. The evaluation of earthwork should include observation and testing of all

fill soils placed at the site, subgrade preparation beneath culverts and pavements, and any load-bearing requirements within the Project.

The contractor or its applicable subcontractor(s) are responsible for designing and constructing stable, temporary excavations, as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

Box Culverts

Installation of several box culverts is part of the planned improvements for the Project. Depending on the bearing depth of the culverts, the subgrade may consist of fat or lean clay materials. The following culvert preparation recommendations shall be performed prior to installation of the culverts:

- Excavate the existing soil from the culvert area to the desired bearing depth for the culvert.
- Before placing any fill, the exposed subgrade in the culvert area should be proofrolled with at least a 20-ton roller, or equivalent equipment, to evidence any weak yielding zones. A technical representative of our firm should be present to observe proofrolling operations. If any weak yielding zones are present, they should be over excavated, both vertically and horizontally, to expose competent soil. The excavated soil can be used to restore grade provided that the material is relatively free and clean of deleterious material or materials exceeding 3 inches in maximum dimension.
- At least four inches of crushed stone base material should then be placed between the subgrade and the box culvert in accordance with COSA standards. The base material (crushed limestone) shall meet the requirements of Type A, Grades 1, 2, or 3 materials as specified in the 2004 TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. The base material shall be compacted to at least 95 percent of the maximum dry density as determined by the Modified effort (TEX-113-E); the materials should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content.
- In order to provide proper drainage and prevent subsurface water from weakening the subgrade, the crushed stone base material shall daylight at the outfall of the box culvert.

Fill Materials and Placement

Unless noted otherwise in another section of this report, select fill should meet the following criteria.

Specification for Fill Materials

Fill Type [3]	Acceptable Location for Placement
Select Granular Fill [1]	All locations including culvert areas.
Select Soil Fill [2]	Grade adjustments within pavements.
On-Site Soils	The on-site Fat Clay (CH) and Lean Clay (CL) and Clayey Gravel (GC) materials do not meet the requirements and shall not be used in pavement areas, fill slopes, or as backfill behind retaining walls.

[1] Select Granular Fill shall meet one of the following criterion:

- Crushed stone (limestone) meeting Type A, Grades 1, 2, or 3 of the 2004 TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. Designation as a GC or GM in accordance with the Unified Soil Classification System (USCS).
- Crushed or uncrushed gravel meeting Type B, Grades 1, 2, or 3 of the 2004 TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. Designation as a GC or GM in accordance with the USCS.
- Crushed concrete meeting Type D, Grades 1, 2, or 3 of the 2004 TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. Designation as a GC or GM in accordance with the USCS.
- Clayey gravel (may locally be referred to as "pit-run" material) or caliche having no particle sizes greater than 3 inches in any dimension, at least 50 percent of total material retained on the No. 200 sieve, a Liquid Limit (LL) no greater than 40, and a PI between 7 and 20. Designation as a GC in accordance with the USCS.
- Commercial Grade Base (may locally be referred to as "three-quarters to dust" material) that is produced by some local/regional quarries having nothing retained on the 2 inch sieve, at least 60 percent retained on the No. 40 sieve, at least 80 percent retained on the No. 200 sieve, an LL no greater than 30, and a PI of 7 or less. Designation as a GM in accordance with the USCS.

[2] Select Soil Fill shall meet one of the following criterion:

- Clayey sand or silty clayey sand (may locally be referred to as "pit-run" material) having no particle sizes greater than 3 inches in any dimension, at least 50 percent of total material retained on the No. 200 sieve, an LL no greater than 40, and a PI between 7 and 20. Designation as an SC in accordance with the USCS.
- Lean clay having no more than 50 percent of total material retained on the No. 200 sieve, an LL no greater than 40, and a PI between 7 and 20. Designation as a CL in accordance with the USCS.

[3]

- Fill, whether select or non-select, that is being placed in a controlled and compacted manner shall meet the above specifications, be free of debris (i.e. trash, rubble, organic materials, vegetation, roots), have no particles exceeding 3 inches in maximum dimension.
- Prior to any filling operations, samples of the fill materials, whether select or non-select, to be used for construction shall be submitted for approval at least 3 days before beginning earthwork operations, which will include performing laboratory tests to verify compliance to the above specifications.

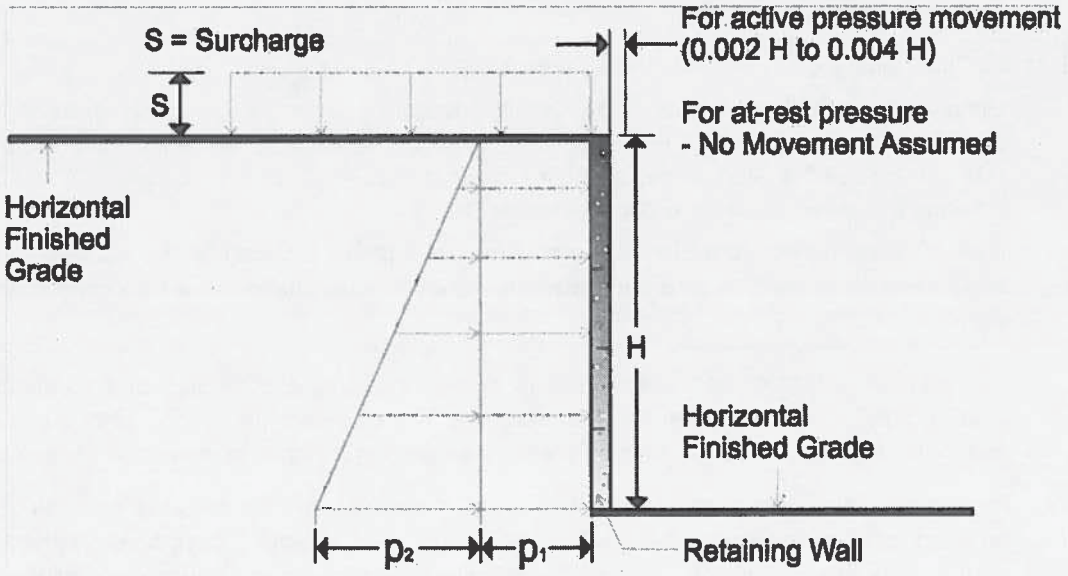
Placement and Compaction Requirements for Fill Materials

Item	Description
Fill and Backfill Lift Thickness	All fill and backfill, select and non-select, should be placed in thin, loose lifts not to exceed 8 inches, with compacted thickness of about 6 inches.
Moisture Content and Compaction of Select Soil or Granular Fill and Select Soil or Granular Backfill	At least 95 percent of the maximum dry density as determined by the Standard effort (TEX-114-E); the materials should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content.
Moisture Content and Compaction of On-Site Soils for Pavement	At least 95 percent of the maximum dry density as determined by the Standard effort (TEX-114-E); the GC and CL material should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content. The CH material shall be moisture conditioned to at least 2 percentage points above the optimum moisture content.

Lateral Earth Pressures

Presented below are active and passive earth pressure coefficients and equivalent fluid pressures for various backfill types adjacent to any retaining walls. Active earth pressures are typically utilized in cases where the walls can exhibit a certain degree of horizontal movement such as cantilevered retaining walls or mechanically stabilized earth (MSE) retaining walls.

The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure or vehicle loads on the walls.



EARTH PRESSURE COEFFICIENTS

EARTH PRESSURE CONDITIONS	COEFFICIENT FOR BACKFILL TYPE	EQUIVALENT FLUID DENSITY (pcf)	SURCHARGE PRESSURE, p1 (psf)	EARTH PRESSURE, p2 (psf)
Retaining walls that can tolerate some movement - Designed for Active Pressures				
Active (Ka)	Granular - 0.33 Lean Clay - 0.50	40 60	(0.33)S (0.50)S	(40)H (60)H
Passive (Kp)	Granular – 3.0 Lean Clay – 2.0	390 240	--- ---	--- ---

Applicable conditions to the above table include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 **H** to 0.004 **H**, where **H** is wall height.
- To develop the passive pressure, the wall shall be allowed a movement of 0.005T (**T** is the thickness of the footing plus thickness of the key, if any).
- The passive pressure should be neglected in the upper 12 inches below the surface in front of the wall.
- The passive pressure will be less for a sloped surface in front of the wall. If slopes are planned in front of the walls, we should be consulted to provide lower passive pressures than given in the table above.
- Uniform surcharge, where **S** is surcharge pressure.
- In-situ soil backfill, use a unit weight of 120 pcf.
- Horizontal backfill compacted between 95 and 98 percent of standard Proctor maximum dry density.
- No hydrostatic pressure acting on wall.
- No loading from compaction equipment or vehicles.
- No loading from nearby footings or slabs.
- No dynamic loading.
- No safety factor included in soil parameters.

Backfill placed against retaining wall structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively. However, for MSE walls, granular materials should be used in the reinforcement zone of the geogrids. As an alternative, a vertical drainage layer can be provided behind walls other than MSE walls, and low plasticity (i.e. lean) cohesive backfill can be used beyond the drainage layer. It will be necessary to extend the lean clay backfill out from the base of the wall at an angle of at least 45 degrees from the horizontal. For this scenario, lateral

pressures for lean clay backfill should be used for design of the walls. If the lean clay backfill is not extended out as noted above, it would be necessary to design the walls for much higher lateral pressures.

Granular backfill should consist of free-draining sand or gravel. The sand should have 100 percent passing the No. 16 sieve and not more than 5 percent passing the No. 200 sieve. The gravel should consist of a washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel with 100 percent passing the 1½ inch sieve and not more than 5 percent passing the No. 4 sieve. Lean clay backfill should have a PI less than 25 percent. CLAY (CH) soils or soils with a PI exceeding 25 percent should not be considered for use as wall backfill.

To calculate the resistance against sliding, a value of 0.50 should be used as the ultimate coefficient of friction between the footing and the underlying soil. A maximum footing bearing capacity of 2,000 psf should be considered for a footing founded at least 30 inches below finished grade. All retaining walls should be checked against failure due to overturning, sliding, and overall global stability. Such an analysis can only be performed once the dimensions of the wall are known.

A wall drain is recommended for collection and removal of surface water percolation and/or groundwater along the base of any below-grade walls or site retaining walls. In general, wall drains should consist of at least a 2-foot thick section of free-draining sand or gravel (as previously described) immediately behind the wall. The free-draining material should be wrapped in a geotextile filter fabric. A slotted or perforated PVC pipe should be situated at the base of the 2-foot section and be sloped to drain to a sump or other appropriate outlet such as weep holes. In unpaved areas, to reduce the chances for surface water infiltration into wall drains or wall backfill, the final 24 inches of backfill for walls should preferably consist of cohesive lean clay soil having a PI between 15 and 25 percent. This will help to reduce percolation of surface water into the backfill. If a drainage system is not provided behind the wall as recommended, then the wall should be designed using active and at-rest equivalent fluid densities of 90 pcf and 100 pcf, respectively.

Soil Nail Walls

A soil nail wall is being considered as a retaining structure for the cut face of the alignment between Inspiration Drive and Clearview Drive on the northwest side of Callaghan Road. The ground conditions consist of very stiff to very hard, fine-grained soils (clay), which are suitable for installation of soil nail walls for both temporary and permanent applications. Due to the limited site access on the hill that will be cut, no borings were drilled in the area where the proposed wall will be located. Borings B-9 through B-14 were located within the curb limits of Callaghan Road though this area. These borings encountered the very stiff to very hard, clay soils in this area. The estimated parameters for soil nail design are as follows:

Bond Strength:	850 to 2,100 psf (5.8 to 14.5 psi)
Cohesion:	2,500 to 6,000 psf

Friction Angle:	0° for undrained conditions (short-term)
	14° to 17° for drained conditions (long-term)

Additionally, these types of soils may develop creep deformation that can adversely affect the lateral deflection of soil nail walls. This can be directly evaluated during the field testing of individual soil nail load tests. To prevent water pressure from developing behind the wall facing or eroding the face of the wall vertical and lateral drains conveying water away from the wall during construction and after the wall is completed should be designed and installed. Finally, a global stability analysis should be performed on the wall prior to finalizing the design.

Slope Stability

We understand that slopes will be present at this site. Proposed grading and slope plans were not provided, therefore, analysis for the slope stability and slope performance evaluation were not performed. However, general information regarding slope stability is presented in the following paragraphs.

Slopes will be created or constructed at this site with cuts into the existing subsurface soils (natural slopes) and by constructing fill pads or embankments for the construction. The stability of a created or constructed slope is dependent on several criteria and include:

- The height of the slope;
- The material comprising the slope;
- The slope angle; and
- Erosion considerations.

For natural slopes at this site, we do not anticipate a slope stability failure or a rotational failure (bearing capacity failure) of the subsurface soil along the proposed project alignment provided the slopes of the natural soils do not exceed a 4H:1V.

We anticipate that relocated (excavated soils) on-site soils and/ or imported select fill materials will be used to construct any proposed fill pads or embankments. For fill slopes constructed of relocated on-site soils and/or imported select fill material placed and compacted as recommended in this report, a slope of four (4) horizontal to one (1) vertical (4H:1V) can be used. This slope is generally considered to be the steepest slope that can be properly maintained using commercially available equipment. Steeper slopes might be considered if the face of the slope is protected from erosion and/or if the fill section is reinforced with soil reinforcement such as geogrid. Steeper slopes would generally have to be "maintenance free" since available construction equipment would not be usable on some slopes. Any surcharge loads should not be placed within 10 feet of the crest of any fill or natural slope at this site.

Once the proposed grading has been finalized, slope stability analyses shall be performed to evaluate the potential for global instability.

Erosion of fill slopes from surface runoff could potentially weaken the strength of the material comprising the slope, and thus, the slopes stability. Erosion control such as riprap, gabions, erosion control blankets, turf reinforcement mats, or other stabilization methods should be addressed to protect the fill slope. Further protection of the sloped section may be provided with the use of concrete terrace drains or other interceptor drains designed to protect the slope from surface water. Maintenance of the slope should be done on an "as needed basis".

OSHA Trench Safety Guidelines

Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926 Revised, 1997) require that all trenches in excess of five (5) feet deep be shored or appropriately sloped unless the trench sidewalls are comprised of "solid" rock. Rock was not encountered at this site within the depths explored.

Our recommendations are intended for use in conjunction with OSHA safety regulations and not as a replacement of those regulations. Based on the laboratory results, we feel that soils encountered at the boring locations would be considered as Type C soils according to OSHA soil classification guidelines.

As stated previously, OSHA requires all soil trenches in excess of five (5) feet be shored or appropriately sloped. Currently available and practiced methods for achieving slope and/or trench wall stability includes sloping, benching, combinations of sloping and benching, and installation of shoring systems (hydraulic, timber, etc.). Trench shields may also be considered for use. However, these shields only provide protection to workers; they are not a means for providing slope or trench wall stability.

OSHA addresses construction slopes in large excavations that are less than 20 feet deep. The table shown below is a reproduction of the OSHA Table B-1:

OSHA TABLE B-1
MAXIMUM ALLOWABLE SLOPES

Soil or Rock Type	Maximum Allowable Slopes (H:V)[1] for Excavations Less Than 20 Feet Deep[3]
Stable Rock	VERTICAL(90°)
Type A	¾:1 (53°)
Type B	1:1 (45°)
Type C	1 ½:1 (34°)

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. A short-term maximum allowable slope of ½H: 1V (63°) is allowed in excavations in Type A soil that are 12 feet or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet in depth shall be ¾H: 1V (53°).
3. Sloping or benching for excavations greater than 20 feet shall be designed by a registered professional engineer.

The OSHA regulations define short-term as a period of 24 hours or less.

Erosion and Scour

We understand the existing outfall west of Postwood Drive has eroded and scoured during high water events. Since all of the soils encountered are fine-grained, they are all susceptible to erosion and scour. Armoring the sides and bottom of the creek at the outfall is the only means available for remediating this situation. The channel width is fixed due to development on both sides eliminating the possibility of flattening the slope to reduce the possibility of slope failure due to the erosion and scour.

INTERPRETATION OF REPORT

Drash understands that its geotechnical engineering report is used by the Client and various individuals and firms involved with the design and construction of the Project. Drash should be invited to attend Project meetings (in person or teleconferencing) or be contacted in writing to address applicable issues relating to the geotechnical engineering aspects of the Project. Drash should also be retained to review the final construction plans and specifications to evaluate if the information and recommendations in our geotechnical engineering report has been properly interpreted and implemented in the design and specifications.

CONSTRUCTION MONITORING AND TESTING

The performance of the foundation system for the proposed structure will be highly dependent upon the quality of construction. As the Geotechnical Engineer of Record for this Project, Drash should be retained to provide construction observation and materials testing services during the Project, particularly the construction activities relating to foundations, building pad, pavements, excavation and site grading.

LIMITATIONS OF REPORT

This geotechnical engineering report is based upon the information provided to us by the Client and various other individuals and entities associated with the Project, exploratory borings drilled within the Project limits, laboratory testing of randomly selected soil or rock samples recovered during drilling of the exploratory borings, and our engineering analyses and evaluation. The Client and readers of this geotechnical engineering report, should realize that subsurface variations and anomalies can and will exist across the site and between the exploratory borings. The Client and readers should realize that site conditions will change due to the modifying effects of seasonal and climatic conditions.

The nature and extent of such site or subsurface variations may not become evident until construction commences or is in progress. If site and subsurface anomalies or variations exist or develop, Drash should be contacted immediately so that the situation can be evaluated and addressed with applicable recommendations. The contractor and applicable subcontractors should familiarize themselves with this report prior to the start of their construction activities, contact Drash for any interpretation or clarification of the report, retain the services of their own

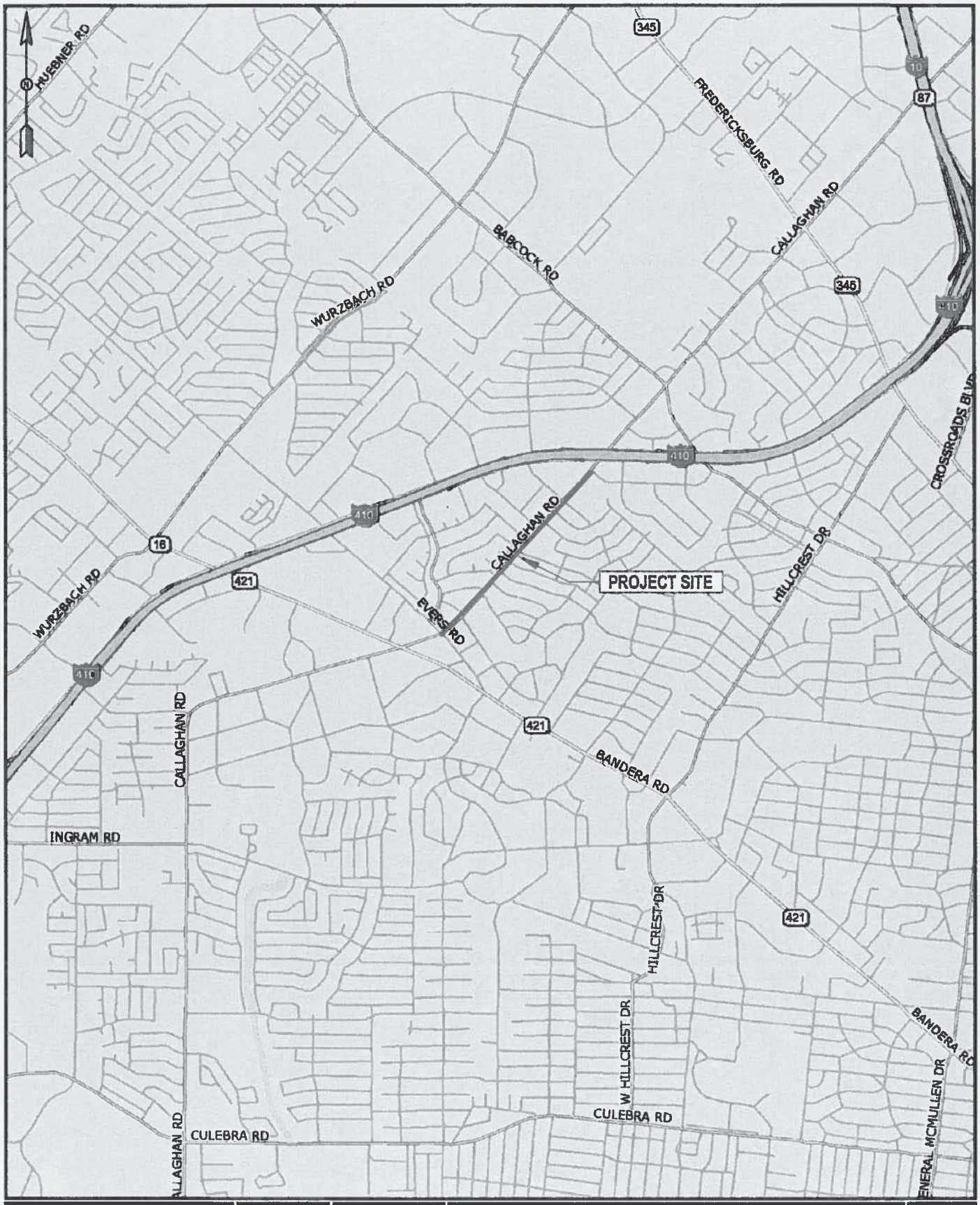
consultants to interpret this report, or perform additional geotechnical testing prior to bidding and construction.

Unless stated otherwise in this report or in the contract documents between Drash and Client, our scope of services for this Project did not include, either specifically or by implication, any environmental or biological assessment of the site or buildings, or any identification or prevention of pollutants, hazardous materials or conditions at the site or within buildings. If the Client is concerned about the potential for such contamination or pollution, Drash should be contacted to provide a scope of services to address the environmental concerns. Also, permitting, site safety, excavation support, and dewatering requirements are the responsibility of others.

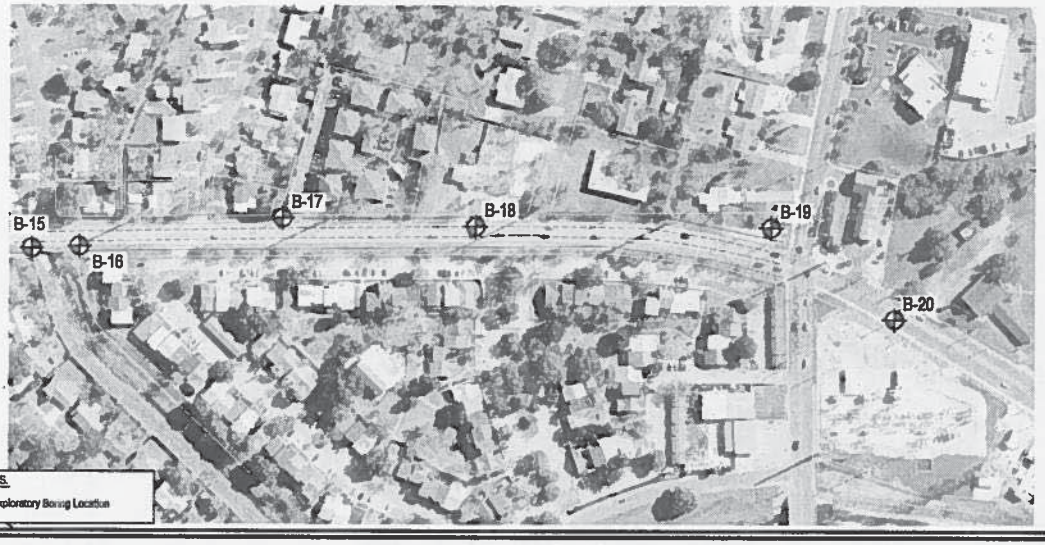
This geotechnical engineering report has been prepared for the exclusive use of our Client for specific application to this Project. This geotechnical engineering report has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, express or implied, are intended or made.

Should the nature, design, or location of the Project, as outlined in this geotechnical engineering report, be modified, geotechnical engineering recommendations and guidelines provided in this document will not be considered valid unless Drash reviews the changes and either verifies or modifies the applicable Project changes in writing.

EXHIBITS



Drash CONSULTANTS 1045 Central Parkway North, Suite 103 • San Antonio, Texas 78232 Office: 210.340.5004 • Facsimile: 210.340.5009	Project Mngr: GCN Drawn By: GCN Checked By: AFA Reviewed By: AFA	Project No: 113G1004 Scale: NOT TO SCALE Date: 12-09-2013	**PROJECT LOCATION MAP** **CALLAGHAN ROAD** **EVERS ROAD TO CENTERVIEW DRIVE** **SAN ANTONIO, TEXAS**	EXHIBIT 1



SYMBOLS

⊕ Exploratory Boring Location

BORE LOCATION PLAN

CALLAGHAN ROAD
EVERS ROAD TO CENTERVIEW DRIVE
SAN ANTONIO, TEXAS

Project Mngr:	GCN
Drawn By:	GCN
Checked By:	AFA
Approved By:	AFA
Project No.	113G1004
Scale:	NOT TO SCALE
Date:	12-09-13

Drash CONSULTANTS
1103 Central Parkway North, Suite 100 • San Antonio, Texas 78232
Office 210.545.5004 • Fax/Phone 210.545.5009

EXHIBIT 2

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-1
DATE 11/7/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT, P: TONS/SQ FT, T: TONS/SQ FT, PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%): LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 3.5 inches asphalt over 11 inches of base material
			N=22	22	53	19	34					79	**Layer 2** FAT CLAY; gray and dark gray; very stiff; with sand
			N=21	24	47	26	21						**Layer 4** LEAN CLAY; gray and tan; very stiff to hard; with sand
	5		N=37	23								75	
			N=44	28	60	35	25						**Layer 5** FAT CLAY; tan, gray, and white; hard; with calcareous deposits
			N=46	29									
	10												Boring Terminated at 10 feet.

DRILLING METHOD(S):
Dry augered from 0 to 10 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 3

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-2
DATE 11/8/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 3.5 inches asphalt over 4.5 inches of base material
			N=16	26	39	27	12						**Layer 4** LEAN CLAY; tan and gray; very stiff; with sand
			N=8	33								75	- becomes tan, gray, white, and stiff below 2.5 feet
	5		N=34	29	46	30	16						- becomes hard below 4.5 feet
			N=34	22								90	- becomes tan and light gray with trace sand below 6.5 feet
			N=87/11.5"	19	46	21	25						
	10												Boring Terminated at 10 feet.

DRILLING METHOD(S):
Dry augered from 0 to 10 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 4

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-3
DATE 11/11/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 5 inches asphalt over 6.5 inches of base material
			N=25	11	42	23	19						**Layer 4** LEAN CLAY; brown and dark gray; very stiff; with sand
			N=26	23								78	- becomes tan, white, and gray with calcareous deposits below 2.5 feet
	5		N=53	24	37	23	14						- becomes hard below 4.5 feet
			N=50/5"	20									
			N=50/5.5"	16	39	23	16						- becomes tan and gray below 8.5 feet
	10												
			N=50/5"	16								72	
	15												
			N=ref/3"	14									
	20												Boring Terminated at 20 feet.

DRILLING METHOD(S):
Dry augered from 0 to 20 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash

EXHIBIT 5

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-4
DATE 11/11/2013
SURFACE ELEVATION Existing Grade

FIELD DATA				LABORATORY DATA								
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
			N=61	32	39	28	11					
			N=38	31								72
	5		N=42	27	33	23	10					
			N=44	22								90
			N=100/11"	20								
	10											
			N=50/5.5"	19	38	21	17					
	15											
			N=ref/5"	13								
	20											

DRILLING METHOD(S):
Dry augered from 0 to 20 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

DESCRIPTION OF STRATUM

- 4.5 inches asphalt over 6 inches of base material

Layer 4
LEAN CLAY; dark brown; hard; with sand
- becomes tan and white with calcareous deposits below 1.5 feet

- becomes tan and light gray with trace sand below 6.5 feet

Boring Terminated at 20 feet.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 6

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-5
DATE 11/6/2013
SURFACE ELEVATION Existing Grade

DRILLING METHOD(S):
Dry augered from 0 to 20 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LL	PL	PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 4 inches asphalt over 8 inches of base material
			N=12	24	30	20	10						**Layer 4** LEAN CLAY; tan and light gray; very stiff; with sand
			N=2	23								69	- becomes soft below 2.5 feet
	5		N=2	29	39	27	12						
			N=3	31								71	
			N=33	25	39	23	16						- becomes hard below 8.5 feet
	10												
			N=50/3"	17									
	15												
			N=76	14									
	20												Boring Terminated at 20 feet.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 7

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-6
DATE 11/6/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 12 inches asphalt over 6 inches of base material
			N=40	17	36	27	9					35	**Layer 4**
			N=30	17								77	LEAN CLAY; dark brown and tan; hard; with gravel seams to 2.5 feet
	5		N=65	16	35	22	13						- becomes tan and white with calcareous deposits below 2.5 feet
			N=84	16									- becomes tan and light gray below 4.5 feet
			N=75	16	35	21	14						
	10												
			N=50/3.5"	14									- becomes partially cemented below 13.5 feet
	15												
			N=ref/4"	11									
	20												Boring Terminated at 20 feet.

DRILLING METHOD(S):
Dry augered from 0 to 20 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 8

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-7
DATE 11/6/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT, P: TONS/SQ FT, T: TONS/SQ FT, PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%): LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N=36	18	51	26	25						- 2 inches asphalt over 5 inches of base material
													Layer 2
													FAT CLAY; dark brown; hard
			N=14	14								43	**Layer 4**
													LEAN CLAY; tan and white; stiff to very stiff; sand seams from 2.5 to 4 feet; with calcareous deposits
	5		N=11	8	36	24	12						
			N=23	8									
			N=35	15								95	- becomes hard with trace sand below 8.5 feet
	10												
			N=92/10"	12	34	18	16						
	15												
			N=40	9									- becomes tan, brown, and gray below 18.5 feet
	20												Boring Terminated at 20 feet.

DRILLING METHOD(S):
Dry augered from 0 to 20 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 9

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-8
DATE 11/6/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N=28	19	34	25	9						- 2 inches asphalt over 5 inches of base material
			N=23	21								88	**Layer 4** LEAN CLAY; brown and dark brown; very stiff to hard - becomes tan and white with trace sand and calcareous deposits below 1.5 feet
	5		N=48	19	37	23	14						
			N=50/3.5"	16								80	- becomes tan, white, and gray with sand below 6.5 feet
			N=50/3.5"	15	33	20	13						
	10												Boring Terminated at 10 feet.

DRILLING METHOD(S):
Dry augered from 0 to 10 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 10

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-9
DATE 11/6/2013
SURFACE ELEVATION Existing Grade

DRILLING METHOD(S):
Dry augered from 0 to 20 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%): LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 5.25 inches asphalt over 4 inches of base material
			N=17	27	39	25	14						**Layer 4** LEAN CLAY; brown and dark brown; very stiff; with gravel
			N=16	24								84	- becomes tan and light gray below 2 feet
	5		N=68	21	40	26	14						- becomes hard below 4.5 feet
			N=50/6"	17								86	
			N=50/4.5"	17									
	10												
			N=81	19	55	26	29						- fat clay seams from 13.5 to 15 feet
	15												
			N=76/10"	19									- becomes gray and tan below 18.5 feet
	20												Boring Terminated at 20 feet.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONS

EXHIBIT 11

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-10
DATE 11/8/2013
SURFACE ELEVATION Existing Grade

DRILLING METHOD(S):
Dry augered from 0 to 30 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%): LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N=ref/5.5"	4									**Layer 4** LEAN CLAY; dark brown; very stiff to hard; with gravel
			N=25	21	49	25	24						- becomes tan and light gray with sand below 3 feet
	5		N=41	20	44	24	20						
			N=56	20								79	- becomes brown, gray, and light brown below 6.5 feet
			N=53	18									
	10												
			N=48	31	77	40	37						**Layer 5** FAT CLAY; brown, gray, and light brown; hard
	15												
			N=70	30									
	20												Boring Terminated at 20 feet.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 12

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-11
DATE 11/12/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 4 inches asphalt over 6.5 inches of base material
			N=21	20	51	21	30						**Layer 2** FAT CLAY; dark brown and brown; very stiff
			N=37	19								68	**Layer 5** FAT CLAY; tan, light brown, and light gray; hard; gravelly
	5		N=52	17	54	23	31						- becomes tan, light brown, light gray, and gravelly below 2.5 feet
			N=68	18									
			N=66	21								88	- trace gravel below 8.5 feet
	10												
			N=66	29	61	33	28						
	15												
			N=39	29									- ferrous staining present from 18.5 to 20 feet
	20												
			N=ref/2.5"	19									- becomes gray, brown and partially cemented below 23.5 feet
	25												
			N=ref/1.5"	13									
	30												Boring Terminated at 30 feet.

DRILLING METHOD(S):
Dry augered from 0 to 30 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 13

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-12
DATE 11/12/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 4 inches asphalt over 7.5 inches of base material
			N=20	26	55	30	25					73	**Layer 2** FAT CLAY; brown and dark brown; very stiff; with sand
			N=33	27	61	37	24						**Layer 5** FAT CLAY; tan; hard; with sand
	5		N=33	30								71	- becomes gray and tan below 4.5 feet
			N=35	32	62	41	21						
	10		N=35	32									
			N=24	47									- becomes very stiff from 13.5 to 15 feet
	15												
			N=50/6"	18									
	20												Boring Terminated at 20 feet.

DRILLING METHOD(S):
Dry augered from 0 to 20 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash

EXHIBIT 14

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-13
DATE 11/12/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LL	PL	PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 4 inches asphalt over 6 inches base material
			N=51	14	51	23	28						**Layer 2** FAT CLAY; brown and dark brown; hard; with sand
			N=42	16	66	31	35					75	**Layer 5** FAT CLAY; tan and brown; hard; with sand
	5		N=56	31									- becomes tan, white, and light gray below 4.5 feet
			N=44	34	86	49	37						
			N=77/8"	44								60	- becomes sandy below 8.5 feet
	10												
			N=ref/4"	13									- partially cemented below 13.5 feet
	15												
			N=ref/3"	11									
	20												
			N=ref/6"	16									
	25												
			N=ref/1"	17									
	30												Boring Terminated at 30 feet.

DRILLING METHOD(S):
Dry augered from 0 to 30 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 15

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-14
DATE 11/7/2013
SURFACE ELEVATION Existing Grade

DRILLING METHOD(S):
Dry augered from 0 to 20 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 4 inches asphalt over 7 inches of base material
			N=21	23	42	20	22						**Layer 4** LEAN CLAY; dark brown; very stiff to hard; sandy; with gravel
			N=33	19								68	
	5		N=40	14	44	18	26						
			N=53	15									- becomes dark brown and brown below 6.5 feet
	10		N=76/10.5"	15	41	19	22						- becomes light gray and tan with calcareous deposits below 8.5 feet
			N=ref/3"	11								67	- partially cemented below 13.5 feet
	15												
			N=50/3"	16									
	20												Boring Terminated at 20 feet.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 16

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-15
DATE 11/8/2013
SURFACE ELEVATION Existing Grade

DRILLING METHOD(S):
Dry augered from 0 to 30 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%): LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 6 inches asphalt over 6 inches of base material
			N=25	18	36	18	18					32	**Layer 3** CLAYEY GRAVEL; dark brown and brown; medium dense
			N=14	17	45	21	24						
	5		N=22	20								44	
			N=60/9.5"	20									**Layer 4** LEAN CLAY; tan and light gray; hard
	10		N=ref/3"	15	35	17	18						
	15		N=53	19									
	20		N=50/5.5"	16									
	25		N=ref/2"	15									- becomes gray and partially cemented below 23.5 feet
	30		N=ref/1.5"	13									Boring Terminated at 30 feet.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash

EXHIBIT 17

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-16
DATE 11/7/2013
SURFACE ELEVATION Existing Grade

DRILLING METHOD(S):
Dry augered from 0 to 30 feet.

GROUNDWATER INFORMATION:
Groundwater was encountered at 16.1 ft during drilling. Drilling suspended for about 15 minutes and groundwater rose to 16 ft.

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N=18	25	65	26	39						**Layer 2** FAT CLAY; dark brown and brown; very stiff; with trace sand
			N=33	21	70	24	46					89	
	5		N=82/11.5"	12								35	**Layer 3** CLAYEY GRAVEL; tan and gray; very dense
			N=64	13								24	
			N=ref/4"	14	38	21	17						**Layer 4** LEAN CLAY; tan and light gray; hard; with gravel
	10												
			N=66	15									
	15												
			N=ref/2"	17									- becomes gray and partially cemented below 18.5 feet
	20												
			N=ref/1.5"	11									
	25												
			N=ref/1"	32									
	30												Boring Terminated at 30 feet.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 18

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-17
DATE 11/12/2013
SURFACE ELEVATION Existing Grade

SC SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY / ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LL	PL	PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 4 inches asphalt over 6 inches of base material
			N=2[illegible]	24	75	29	46						**Layer 2** FAT CLAY; dark gray and dark brown; very stiff; with trace gravel
			N=24	7	54	19	35						
	5		N=13	19								84	**Layer 4** LEAN CLAY; tan and gray; very stiff to hard; with gravel and sand
			N=68	16	39	20	19						
			N=ref/2"	22								75	- partially cemented below 8.5 feet
	10												Boring Terminated at 10 feet.

DRILLING METHOD(S):
Dry augered from 0 to 10 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 19

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-18
DATE 11/12/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 4.5 inches asphalt over 8 inches of base material
			N=20	12	45	22	23						**Layer 4** LEAN CLAY; light gray and tan; very stiff to hard; with gravel
			N=53	20								80	
	5		N=73	16	58	22	36						**Layer 5** FAT CLAY; tan and gray; hard; with gravel
			N=66	16								84	
			N=62	17	55	26	29						
	10												Boring Terminated at 10 feet.

DRILLING METHOD(S):
Dry augered from 0 to 10 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 20

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO. 113G1004
BORING NO. B-19
DATE 11/7/2013
SURFACE ELEVATION Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Layer 1
			N=74/10"	7	36	22	14						FILL: LEAN CLAY; gray and brown; hard; with sand
			N=ref/2.5"	10								66	**Layer 4** LEAN CLAY; tan and gray; hard; with sand; partially cemented
	5		N=ref/4"	15	37	17	20						
			N=50/5"	14								78	
			N=ref/4"	13	40	17	23						
	10												Boring Terminated at 10 feet.

DRILLING METHOD(S):
Dry augered from 0 to 10 feet.

GROUNDWATER INFORMATION:
Subsurface water was not encountered during drilling.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 21

LOG OF BORING

PROJECT: Callaghan Road
Evers Road to Centerview Drive
San Antonio, Texas

CLIENT: CDS/Muery Services
San Antonio, Texas

PROJECT NO.	113G1004
BORING NO.	B-20
DATE	11/11/2013
SURFACE ELEVATION	Existing Grade

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	LABORATORY DATA: MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LL	PL	PI	DRY DENSITY (POUNDS/CU FT)	COMPRESSIVE STRENGTH (POUNDS/SQ IN)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													- 5 inches asphalt over 4 inches of base material
			N=24	30	70	27	43						**Layer 2** FAT CLAY; dark brown; very stiff; with trace gravel
			N=23	30								86	
	5		N=19	32	79	26	53						
			N=22	28								89	
			N=26	21	54	18	36						**Layer 5** FAT CLAY; gray; very stiff to hard
	10	▽ ▼											
			N=40	27									- becomes tan and gray below 13.5 feet
	15												
			N=72/12"	24									
	20												Boring Terminated at 20 feet.

DRILLING METHOD(S):
Dry augered from 0 to 20 feet.

GROUNDWATER INFORMATION:
Groundwater was encountered at 11 ft during drilling. Drilling suspended for about 15 minutes and groundwater remained at 11 ft.

REMARKS
The boring was backfilled with cuttings after completion of the subsurface water level observations.

Drash CONSULTANTS

EXHIBIT 22

APPENDIX – FIELD AND LABORATORY

EXPLORATORY DRILLING PROGRAM

LABORATORY TESTING PROGRAM

NOTES REGARDING SOIL AND ROCK

EXPLORATORY DRILLING PROGRAM

A truck-mounted, drilling rig was used to drill the exploratory borings and to recover soil/rock samples during the drilling. Soil samples were obtained by pushing thin wall tube samplers ("Shelby tube") or with a split-barrel ("split-spoon") sampler while performing the Standard Penetration Test ("SPT"). Rock samples were obtained by performing the SPT or coring.

When a soil sample was recovered using a Shelby tube sampler, a pocket penetrometer test ("PPT") or hand torvane ("TV") was conducted and recorded on the applicable exploratory field log of boring ("field log"). When a soil/rock sample was recovered using a split-barrel sampler, the SPT N-value was recorded on the applicable field log. The SPT procedure consists of driving the split-barrel into the subsurface stratum with a 140-pound hammer falling a distance of 30 inches. The number of blows ("N") required to advance the split-spoon sampler the last 12 inches during a normal 18-inch penetration is the SPT resistance value or N-value. These N-values are indicated on each applicable field log at the depths of occurrence. The samples were sealed and transported to the laboratory for testing and classification.

Our field representative prepared the field logs as part of the drilling operations. The field logs included visual classifications of the materials encountered during drilling, our field representative interpretation of the subsurface conditions between samples, and recording the results of various tests (N-values, PPT, and TV) performed during drilling and sampling. Each field log included with this report represents our technical interpretation of the field log and includes modifications based on visual observations and testing of the samples in the laboratory.

The scope of services for our geotechnical engineering services does not include addressing any environmental issues pertinent to the site.

LABORATORY TESTING PROGRAM

Samples retrieved during the field exploration were taken to the laboratory for further observation by one of our technical representatives, and they were classified in accordance with the Unified Soil Classification System (USCS). At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine the physical (index) and engineering properties of the soil/rock.

Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM or other accepted standards. The following tests were conducted:

- Moisture Content
- Atterberg Limits
- Amount of Material In-Soil Finer than the N^{o} 200 Mesh (75-µm) Sieve

Sample Disposal

All samples were returned to our laboratory. Unless stated otherwise in this report or the Project contract, the samples not tested in the laboratory will be stored for a period of 30 days subsequent to submittal of this report and will be discarded after this period, unless other arrangements are made prior to the disposal period.

NOTES REGARDING SOIL AND ROCK

GEOTECHNICAL SAMPLING SYMBOLS:

SS: Split Barrel (Split Spoon)
AG: Auger Sample, Grab Sample, or Bulk Sample
ST: Thin-Walled Tube (Shelby tube)
RC: Rock Coring Sample

WATER LEVEL MEASUREMENT SYMBOLS:

▽ Water Level Encountered While Drilling and Sampling.
▼ Water Level Measurement After Initial Water Level Encountered During Drilling and Sampling.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System (ASTM D2487). Coarse Grained Soils have more than 50 percent of their dry weight retained on a No. 200 sieve. The primary descriptors of these soils are: boulders, cobbles, gravel, or sand. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density. Fine Grained Soils have less than 50 percent of their dry weight retained on a No. 200 sieve. These soils are principally described as clays if they are plastic (have binding/molding characteristics), and silts if they are slightly plastic or non-plastic. Fine-grained soils are defined on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Undrained Shear c_u, psf	Standard Penetration Test (SPT) N-value Blows Per Foot	Consistency
< 250	< 2	Very Soft
250 – 500	2 - 3	Soft
500 – 1,000	4 - 6	Medium Stiff
1,000 – 2,000	7 - 12	Stiff
2,000 – 4,000	13 - 26	Very Stiff
4,000+	26+	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration Test (SPT) N-Value Blows Per Foot	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 49	Dense
50+	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Terms	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

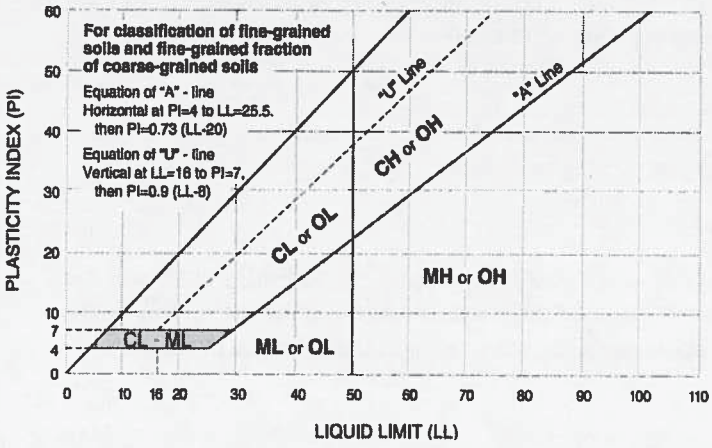
Major Constituent of Soil Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to No. 4 sieve (75mm to 4.75 mm)
Sand	No. 4 to No. 200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing No. 200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF CLAYS AND SILTS

Descriptive Terms	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index (PI)
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	30+



CLASSIFICATION OF ROCK WITH RESPECT TO STRENGTH

Very Low Strength	18 – 72 ksf
Low Strength	72 – 288 ksf
Medium Strength	288 – 1,152 ksf
High Strength	1,152 – 4,608 ksf
Very High Strength	4,608 – 18,432 ksf

RQD	DESCRIPTION OF ROCK QUALITY
0 – 25	Very Poor
25 – 50	Poor
50 – 75	Fair
75 – 90	Good
90 - 100	Excellent

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