UNIVERSITY HEALTH SYSTEM
RECYCLED WATER MAIN PROJECT
SAWS Job No. 11-8606-202
SAWS Solicitation No. B-12-032-DD

ADDENDUM NO. 2
July 24, 2012

To Bidder of Record:

This addendum, applicable to work referenced above, is an amendment to the bidding documents and as such will be a part of and included in the Contract Documents. Acknowledge receipt of this addendum by entering the addendum number and issue date in the space provided in submitted copies of the proposal. Failure to do so may subject Bidder to disqualification.

Geotechnical Engineering Report:

The Geotechnical Engineering Report provided by this addendum is for informational purposes only and in no way should be construed as an exact depiction of the condition of the soils along the project limits. Existing subsurface conditions shall be confirmed by the Contractor. Contractor shall assess soil conditions and confirm construction method with no separate pay item.

The accuracy and completeness of the information provided is not guaranteed and it is not construed as part of the project Specifications governing construction of the project. The CONTRACTOR shall hire an independent Geotechnical Engineer licensed in the State of Texas, and shall perform additional geotechnical investigation as required by the plans and specifications and as deemed necessary for the construction activities. There shall not be any additional payment or extension of contract time provided to the CONTRACTOR for additional geotechnical investigation and resulting additional work that he may require to complete the project. If damages occur to existing facilities due to the CONTRACTOR's actions, it will be the CONTRACTOR's full responsibility to repair, replace, or pay for the repair or replacement of any damaged items at no additional cost to SAWS.

The remainder of the bid documents remains unchanged.

This Addendum, including this page, is forty one (41) pages in its entirety.

Each bidder is requested to acknowledge receipt of this Addendum No. 2 by his/her signature affixed hereto and to file same as an attachment to his/her bid.

2012.07.24 15:09:07 -05'00'

Kum Wing Chan, P.E.
Project Manager
K.M. Ng & Associates
TBPE Firm No. F-442

STATE OF TEXAS
KUM WING CHAN
65399
REGISTERED
PROFESSIONAL ENGINEER

The Undersigned acknowledges receipt of this Addendum No. 2 and the bid submitted herewith is in accordance with the information and stipulation set forth.

____________________________ ____

Date **Signature of Bidder**

END OF ADDENDUM

Subsurface Exploration and Geotechnical Data Report
Recycled Waterline A STA 0+00 to 21+60
Recycled Waterline B STA 0+61.88 to 16+21
Recycled Waterline C STA 21+60 to 23+00
University System Recycled Water Main
San Antonio, Texas

K. M. Ng Associates, Inc.
Consulting Engineers
6243 IH 10
San Antonio, Texas 78201

Attention: Mr. K.W. Chan, P.E.

Integrated Testing and Engineering Company of San Antonio, L.P.

12028 Radium, San Antonio, Texas 78216—Phone: (210) 525 9033—Fax: (210) 525 9032

inTEC Integrated Testing and Engineering Company of San Antonio, L.P.
Geotechnical & Environmental Engineering • Construction Services • Geologic Assessment

E.A. Palaniappan, Ph. D., P.E.
Murali Subramaniam, Ph. D., P.E.
Kaushi Subramaniam, B.S.

July 23, 2012

K. M. Ng Associates, Inc.
Consulting Engineers
6243 IH 10
San Antonio, Texas 78201

Attention: **Mr. K.W. Chan, P.E.**

Re: **Subsurface Exploration and Geotechnical Data Report**
Recycled Waterline A STA 0+00 to 21+60
Recycled Waterline B STA 0+61.88 to 16+21
Recycled Waterline C STA 21+60 to 23+00
University System Recycled Water Main
San Antonio, Texas

InTEC Project No. S121652

Gentlemen:

Integrated Testing and Engineering Company (InTEC) **completed a Subsurface Exploration and Soil and Geotechnical Data Report** at the above referenced project site. The results of the exploration with recommendations are presented in this report.

We **appreciate and wish to thank you for the opportunity** to be of service to you on this project. **If we can be of additional assistance during the materials testing-quality control phase of construction, please call us.**

Respectfully Submitted,

Very Truly Yours,
InTEC of San Antonio, L.P.

STATE OF TEXAS
E. A. PALANIAPPAN
49065
LICENSED
PROFESSIONAL ENGINEER

InTEC of SAN ANTONIO
F-7623

Murali Subramaniam, Ph.D., P.E.

E.A. "Paul" Palaniappan, Ph.D., P.E.
CHIEF ENGINEER

Copies Submitted: Above (1)

12028 Radium • San Antonio, Texas 78216 • Office (210) 525-9033 • Fax (210) 525-9032 • www.InTECtesting.com

Austin (512) 252-1218 fax (512) 252-1219
Denver (303) 463-9317 fax (303) 463-9321
DFW Metro (817) 858-0870 fax (817) 858-0036
Houston (281) 371-3330 fax (281) 371-3334
Louisiana (985) 878-8690 fax (985) 878-8692

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The soil conditions at the proposed **SAWS Recycled Waterlines A, B and C, University System Recycled Water Main Project in San Antonio, were explored by drilling 5 borings to depths varying from 4 to 30 feet.** Laboratory tests were performed on selected specimens to evaluate the engineering characteristics of various soil strata encountered in our borings.

The results of our exploration, laboratory testing and engineering evaluation of varying soils are presented in this report. This study has been performed to provide information for construction related challenges for the above referenced project.

Recommendations for site Excavations for the Recycled Waterlines, Excavation Support Systems, Dewatering, Pipe Subgrade, Trench Backfill and Structural Fill on-site fill compaction requirements are presented in this report.

Recommendations for Horizontal Directional Drilling are also presented in this report.

Construction Guidelines at the time of installation of the Recycled waterline, including Earth work, Placement and Compaction, Erosion and Sediment Control Recommendations are also presented in this report.

1. INTRODUCTION

1.1 General

1.1.1 This report presents the results of our subsurface exploration and geotechnical data report for the proposed **SAWS Recycled Waterlines along Wurzbach Road – from Floyd Curl Drive to Merton Minter Blvd., and Recycled Waterline along Merton Minter Blvd., from Wurzbach Road to Water Cooler Tower on Merton Minter in San Antonio, Texas.** This project was **authorized by Mr. K.W. Chan, P.E. of K.M. Ng and Associates, Inc.**

1.1.2 This project consists of installing a Recycled Waterline A along Wurzbach Road by Horizontal Directional Drilling or Pipe Jacking Process. The Recycled Waterlines B and C will be installed by Cut and Cover Method. The depth of the cut will be approximately to a depth of 6 to 7-ft.

1.1.3 A Geotechnical Exploration Plan that is in conformance with the project was prepared by K. M. Ng and Associates, Inc. InTEC of San Antonio, L.P. prepared the Geotechnical Data Report (GDR) for the installation of the Recycled Waterline. The Boring Locations were selected by Mr. K.W. Chan and E.A. Palaniappan at the Project Site.

1.2 Purpose and Scope of Services

The purpose of our geotechnical investigation was to evaluate the site's subsurface and ground water conditions and provide geotechnical engineering parameters and recommendations for the installation of Recycled Waterlines. Our scope of services includes in the following:

1) Drilling and sampling of five borings – to depths varying from 4 to 30 feet;

2) Observation of the ground water conditions during drilling operations;
3) Performing laboratory tests such as **Atterberg Limits, Dry Unit Weight, Moisture Content tests, Unconfined Compression tests and Percent Minus 200 Sieve tests**;
4) **Review and evaluation of the field and laboratory test programs** during their execution with modifications of these programs, when necessary, to adjust to subsurface conditions revealed by them;
5) **Compilation, generalization, and analysis of the field and laboratory data in relation to the project requirements;**
6) **Development of recommendations for the construction and earthwork phases of the project**;
7) **Consultations with Prime Professional and members of the design team** on findings and recommendations; and preparation of a written geotechnical engineering report for use by the members of the design team in their preparation of contract documents and specifications.

1.2.2. The **Scope of Services did not include any environmental assessment** for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.

2. SUBSURFACE EXPLORATION

2.1 Scope

2.1.1 The field exploration to determine the engineering characteristics of the subsurface materials included a reconnaissance of the project site, drilling the borings, collecting relatively undisturbed Shelby Tube samples, performing standard penetration tests and obtaining Split spoon samples.

2.1.2 **Five borings were drilled** at the locations shown on the Boring Location Plan, Plates 1 and 1A included in the Illustration Section of this report. These borings were drilled to depths of **4 to 30 feet below the presently existing ground surface.** Boring B-5 was abandoned because of its proximity for several utility lines. Boring B-6 encountered refusal at a depth of 4-ft.

2.2 Drilling and Sampling Procedures

2.2.1 The soil borings were performed with a drilling rig equipped with a rotary head. Conventional solid stem augers were used to advance the holes and samples of the subsurface materials were obtained **using a standard Split-barrel sampler (ASTM D 1586) or Shelby Tube sampler (ASTM D 1587).** The samples were identified according to boring number and depth, encased in polyethylene plastic wrapping to protect against moisture loss, and transported to our laboratory in special containers. In summary, the samples presented in Table No. 1 were collected as a part of our field exploration procedure:

2.2.2 **Table No. 1**

Type of Sample	Number Collected
Split Spoon Samples	**20**
Shelby Tube Samples	**16**

2.3 Field Tests and Measurements

2.3.1 Penetration Tests - During the sampling procedures, **standard penetration tests were performed** in the borings in conjunction with the split-barrel sampling. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer, falling thirty inches, required to advance the split-spoon sampler one foot into the soil. The sampler is lowered to the bottom of the drill hole and the number of blows recorded for each of the three successive increments of six inches penetration. The "N" value is obtained by adding the second and third incremental numbers. The results of the standard penetration test indicate the relative density and comparative consistency of the soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components.

2.3.2 Water Level Measurements – **Ground water was encountered at a depth of 28.5-ft in Boring B-3 only at the time of drilling.** In relatively pervious soils, such as sandy soils, the indicated elevations are considered reliable ground water levels. In relatively impervious soils, the accurate determination of the ground water elevation may not be possible even after several days of observation. Seasonal variations, temperature and recent rainfall conditions may influence the levels of the ground water table and volumes of water will depend on the permeability of the soils.

2.4 Field Logs

A field log was prepared for each boring. Each log contained information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as silt, clay, gravel or limestone and observations of ground water. It also contained an interpretation of subsurface conditions between samples. Therefore, these logs included both factual and interpretive information.

2.5 Presentation of the Data

The final logs represent our interpretation of the contents of the field logs for the purpose delineated by our client. The final logs are included on Plates 2 thru 7 included in the Illustration Section. A key to classification terms and symbols used on the logs is presented on Plate 8.

3. LABORATORY TESTING PROGRAM

3.1 Purpose

In addition to the exploration, a supplemental laboratory testing program was implemented to determine **additional pertinent engineering characteristics of the subsurface materials necessary in evaluating the soil parameters.**

3.2 Laboratory Tests

3.2.1 All phases of the laboratory testing program were performed in general accordance with the applicable ASTM Specifications as indicated.

3.2.2 In the laboratory, each sample was observed and classified by a geotechnical engineer. As a part of this classification procedure, the natural water contents of selected specimens were determined. Liquid and plastic limit tests were performed on representative specimens to determine the plasticity characteristics of the different soil strata encountered. Unconfined Compression tests were performed to evaluate the strength characteristics of the underlying soils. Soil classifications were done in accordance with **ASTM D 2487** and **ASTM D 2488** procedures.

3.3 Presentation of the Data

In summary, the tests as presented in Table No. 2 in the following page were conducted in the laboratory to evaluate the engineering characteristics of the subsurface materials:

Table No. 2

Type of Test	Number Conducted
Natural Moisture Content	36
Atterberg Limits	22
Unconfined Compression Tests	8
Percent Minus 200 Sieve	11
Dry Unit Weight	8

The results of all these tests are presented on appropriate boring logs Plates 2 thru 7 and on Laboratory Test Result Summary Sheets, Plates 9 and 10. A key of Terms and Symbols used on the Boring logs is presented on Plate 8.

4. SITE CHARACTERIZATION

4.1 Soil Stratigraphy

4.1.1 Our interpretation of soil and ground water conditions at the project site is based on information obtained at 5 boring locations only. This information has been used as the basis for our conclusions and recommendations. Significant variations at areas not explored by the project borings may require reevaluation of our findings and conditions.

4.1.2 Subsurface conditions along the project alignment were evaluated by drilling a total number of 5 borings designated as B-1 thru B-4 and B-6 to the termination depths varying from 4 to 30-ft. Based on the investigation, brown clay, tan silty clay, tan clay, tan and gray clay, tan calcareous clay to marl were encountered at the surface and extended to depths varying from 4 to 30-ft.

4.1.3 Hard soils such as calcareous clay to tan marl will provide high resistances for Directional Drilling and other Pipe Installation Processes.

4.1.4 Detailed descriptions of the materials encountered in our Boring B-1 thru B-4, and B-6 are presented on Plates 2 thru 7.

4.2 Engineering Properties of Brown Clays, Tan Clays, Tan Silty Clays and Tan and Gray Clays

4.2.1 Brown Clays, Tan Silty Clays, Tan Clays and Tan and Gray Clays are moderately plastic to highly plastic with tested liquid limits varying from 33 to 80 and tested plasticity indices ranging from 15 to 63. The results of 12 Unconfined Compression tests were used to evaluate the Shear

Strengths of these soils. The Shear Strength values ranged from 0.67 to 2.12 TSF. These values are presented in Table No. 3.

Table No. 3

Soil Description	Liquid Limit, Range	Plasticity Index, Range	Shear Strength, TSF Range
Brown Clays, Tan Silty Clays, Tan Clays and Tan and Gray Clays	33 - 80	15 - 63	0.67- 2.12

4.2.2 Tan calcareous clays to marl stratum was encountered at depths ranging from 8 to 15-ft and extended to 30-ft, the maximum depth explored. These soils are moderately plastic with tested liquid limits varying from 32 to 37 and plasticity indices ranging from 20 to 24.

4.2.3 The tan calcareous clay to marl stratum was too hard to push Shelby Tubes. So, Standard penetration Tests were performed within this Stratum and Split Barrel Samples were collected. The results of the Standard Penetration Tests varied from 34 to 50/2" per foot.

Table No. 5.

Soil Description	Liquid Limit, Range	Plasticity Index, Range	Standard Penetration Test Results
Tan Calcareous Clay to Marl	32 - 37	20 - 24	34 – 50/2"

4.3 Ground Water

Ground water was encountered at a depth to 28.5-ft in Boring B-3 only. Groundwater levels may fluctuate with seasonal climatic variations and changes in land use. It is not unusual to encounter shallow groundwater during or after periods of rainfall. The surface water tends to percolate down through the surface until it encounters a relatively imperious layer.

The contractor should drill and set Monitor Wells at the time of Construction.

5. GEOTECHNICAL ENGINEERING EVALUATION

5.1 General

5.1.1 Geotechnical Engineering Evaluations had been performed to provide recommendations for the proposed Recycled Waterline Installation Project.

5.1.2 In general, these evaluations and recommendations have been based on the results of the subsurface investigation and laboratory testing program conducted as part of this study, published correlations with soil properties and the minimum requirements of the International Building Code (IBC) with local amendments, 2009 Edition. In addition, recommended design criteria are based on performance tolerances, such as allowable settlement, that are understood to be applicable for similar structures. Potential construction-related challenges are discussed in this section.

5.2 Recycled Waterline by Cut and Cover Method (Lines B and C)

5.2.1 Cut and cover techniques are planned for construction of the portion of Recycled Waterline B along Merton Minter Blvd. from Water Cooler to Wurzbach Road. The Cut and Cover depth may vary from 5 to 7-ft.

5.3 Site Excavation

5.3.1 It is anticipated that overburden soils can be removed using conventional earth moving equipment. Two Borings were planned to be drilled in this area. Unfortunately, Boring B-5 was abandoned because of the existing numerous utility lines in this area. Boring B-6 encountered refusal at a depth of 4-ft. **The Contractor, before bidding, should excavate some test pits through these soils and evaluate the feasibility of excavation.**

5.3.2 At locations which can be made as open-cut excavations, side slopes of the excavations should be designed and sloped in accordance with OSHA regulations. A very limited soil data is available at this location. The Contractor should excavate test pits in this area and collect soil stratigraphy data.

5.4 Excavation Support Systems

5.4.1 The use of excavation support systems will be necessary where there is not sufficient space to allow the excavation side slopes to be laid back and allow the excavation to be performed as an open cut. The use of the excavation support is required 1) to limit the excavation quantity, 2) to assist in the control of groundwater and 3) to protect adjacent structures.

5.4.2 Excavation support systems may consist of interlocking steel sheeting or soldier pile and lagging. The selection of the type of excavation support system will be performed by the contractor. Trench boxes may be sufficient for some of the shallow utility excavations.

5.4.3 The design of the excavation support systems should be performed by a Registered Professional Engineer in the State of Texas under the employment of the contractor. Where applicable, the design of the excavation support system should be performed in conjunction with the design of dewatering systems.

5.4.4 Any sheeting installed within the zone of influence of any existing or new building, tank, or structures should be left in place to avoid disturbing bearing soils as a result of the sheeting removal process. The zone of influence is defined as the one extending 2.0 feet beyond the bottom exterior edge of the foundation then down and away at a one horizontal to one vertical (1H:1V) slope. Undermining of existing foundations must not occur.

5.5 Dewatering

5.5.1 Excavations for the below-grade structures and pipe jacking pits in some areas are anticipated to extend below the groundwater level. InTEC recommends that the groundwater levels during excavation be maintained at least 2 feet below the excavation level at all times during excavation and construction.

5.5.2 Infiltration into excavations from surface runoff, precipitation, and other sources should be limited to the extent possible but will likely require some pumping. Dewatering is anticipated to consist of sumps and/or wells in order to lower the groundwater below the lowest level of the excavation. In addition, excavated material to be reused as fill should be stockpiled in such a manner that promotes runoff and limits saturation of the material.

5.5.3 The contractor must be prepared to operate the dewatering system continuously, as required to complete the work and avoid floatation or uplift prior to completion of the facility. During periods when failure of the system would adversely impact work completed, the contractor should provide a back-up system to ensure continuous operation.

5.6 Pipe Subgrade

5.6.1 In general, underground utilities should be installed by cut and cover methods in excavated trenches. Excavations in clay and silt should be performed using a smooth edge bucket to excavate the last one foot of depth. The existing naturally deposited soils encountered at the proposed pipe subgrade level are suitable for support of the proposed pipe provided the subgrade soils can be adequately compacted and are firm and stable. Any soft or loose material encountered at subgrade level during excavation should be removed and replaced with at least 12 inches of compacted structural fill. The lateral limit of the prepared subgrade should be defined as a line extending horizontally outward and downward at a 1H:1V slope from the springline of the pipe.

5.7 Trench Backfill

5.7.1 In paved areas, material placed above the pipe bedding material should consist of final backfill. In unpaved areas, material placed above bedding material and to at least one foot over the pipe should consist of select fill; the remainder of the pipe trench should be backfilled with excavated material and compacted.

5.8 Protection and Preparation of Subgrade

5.8.1 Care should be taken to avoid excess traffic on the excavated subgrades prior to placement of fill, pipe bedding, pavement subbase or concrete foundation. Soil subgrade should be protected against precipitation and subgrade should not be allowed to freeze.

5.8.2 Subgrade excavations in clay and silt should be performed using a smooth-edge bucket to excavate the last one foot of depth. The subgrade should be proof-rolled or compacted using hand-guided equipment prior to placement of fill, pavement subbase, or concrete foundations. Any unstable or unsuitable material, such as “soft” or “loose” material, present at the subgrade level should be removed and replaced with 12 inches of compacted structural fill placed in 6-inch layers, loose measure, and compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D698.

5.9 Structural Fill

5.9.1 Structural fill should be placed in layers no thicker than 8 inches, as placed, and compacted with suitable compaction equipment to at least 95 percent of maximum dry density as determined by ASTM D1557 at or near its optimum moisture content (minus 2 to plus 3 percent). Lift thickness should be reduced to 6 inches in confined areas accessible only to hand guided compaction equipment. Structural fill should be used as backfill in areas where passive soil resistance is required.

5.10 Horizontal Directional Drilling (Line A)

5.10.1 Horizontal Directional Drilling (HDD) installation methods are planned to be used along Wurzbavh Road. **The pipe invert depths may vary from 12 to 25-ft below existing grade.** Horizontal directional drilling is meant as a method of trenchless pipe installation using a steerable drilling operation which directly installs a pipe along a linear alignment (not necessarily horizontal) without an open hole or open face.

5.10.2 The pipe shall be installed from either a pit which allows the pipe installation along the proposed grade directly or by drilling an artificial sacrificial tangent section outside the limits of the roadway which is then excavated and cut-off or turned down to make the pipe connection at the grades indicated. The drill bit and reamers shall have a closed face and shall be capable of supporting the excavation area during excavation and shutdown. The bit shall be fully directional in both the horizontal and vertical directions so that the alignment can be maintained during the entire drilling operation. The pilot hole should be reamed to a diameter which is sufficiently sized to reduce forces applied to the pipe during pull back. To reduce the exterior friction and possibility of the pipe seizing in place, proper lubrication should be maintained during sleeve installation. Annular space around the final pipe should pressure grouted in the final ream produces a theoretical annular space of more than 0.2 cubic feet per linear foot of pipe. The HDD drilling rig should include remote sensing to maintain alignment of the drilling operation and provide profile and plan locations of the as-installed pipes.

5.10.3 Hard light tan calcareous clay to marl may be encountered at the Pipe Installation depth. **The soil parameters presented in the Boring Logs B-1 thru B-4 may be used by the Contractor as a guidance.**

5.10.4 The HDD contractor performing the work should be trained and certified to operate the HDD equipment with at least 5 years experience in directional drilling.

6. CONSTRUCTION GUIDELINES

6.1 Construction Monitoring

6.1.1 The purpose of this section is to discuss issues related to geotechnical aspects of construction as required for development of the project specifications. This section is intended to identify potential construction-related challenges which must be addressed as part of the design.

6.1.2 Geotechnical Engineer of Record for this project, InTEC, should be involved in monitoring the pipeline installation and earthwork activities. Performance of any foundation system is not only dependent on the foundation design, but is strongly influenced by the quality of construction. InTEC recommends that the field condition be evaluated prior to construction. Please contact our office prior to construction so that a plan for pipeline installation and earthwork monitoring can be incorporated in the overall Project Quality Control Program.

6.1.3 In any geotechnical investigation, the design recommendations are based on a limited amount of information about the subsurface conditions. In the analysis, the geotechnical engineer must assume the subsurface conditions are similar to the conditions encountered in the borings. However, quite often during construction anomalies in the subsurface conditions are revealed. Therefore, it is recommended that InTEC of San Antonio, L.P. engineers be retained to observe earthwork and pipeline and pavement (if any) installation and perform materials evaluation and testing during the construction phase of the project. This enables the geotechnical engineer to stay abreast of the project, to conduct additional tests if required and, when necessary, to recommend alternative solutions to unanticipated conditions.

6.1.4 Recommended that the project Geotechnical Engineer or an experienced technician under the direction of the project Geotechnical Engineer be present during construction to confirm that the contractor complies with the intent of these recommendations. Specifically, the field representative would undertake the observing responsibilities:

1) Observe that the subgrade preparation for structures is performed as recommended herein for adequate support;
2) Observe, test and document placement and compaction of fill and backfill materials where appropriate. Samples of imported fill should be submitted to the engineer for approval prior to starting work;
3) Observe that proper dewatering methods are employed;
4) Monitor the installation of excavation support systems;
5) Evaluate settlement and vibration monitoring data;
6) Observe and document the installation of the pipe line.

In addition, the field representative would be present to identify and provide response should conditions encountered differ from those assumed during preparation of report.

6.2 Site Preparation

6.2.1 The subgrade should be firm and able to support the construction equipment without displacement. Soft or yielding subgrade should be corrected and make stable before construction proceeds. The subgrade should be proof rolled to detect soft sports, which if exist, should be reworked to provide a firm and otherwise suitable subgrade. Proof rolling should be performed using a heavy pneumatic tired roller, loaded dump truck, or similar piece of equipment. The proof rolling operations should be observed by the project geotechnical engineer or his representative. Prior to fill placement, the subgrade should be scarified to a minimum depth of 6 inches, its moisture content adjusted, and recompacted to the moisture and density recommended for fill.

6.3 Placement and Compaction

6.3.1 Fill material should be placed in loose lifts no exceeding 8 inches in uncompacted thickness. The uncompacted lift thickness should be reduced to 4 inches for structure backfill zones requiring hand-operated power compactors or small self-propelled compactors. The fill material should be uniform with respect to material type and moisture content. Clods and chunks of material should be broken down and the fill material mixed by disking, blading, or plowing, as necessary, so that a material of uniform moisture and density is obtained for each lift. Water required for sprinkling to bring the fill material to the proper moisture content should be applied evenly through each layer.

6.3.2 The fill material should be compacted to a minimum of 95 percent of the maximum dry density determined by the Standard Proctor test, ASTM D 698. In conjunction with the compacting operation, the fill material should be brought to the proper moisture content. The moisture content for general earth fill should range from optimum to 4 percentage points above optimum (0 to +4). These ranges of moisture contents are given as maximum recommended ranges. For some soils and under some conditions, the contractor may have to maintain a more narrow range of moisture content (within the recommended range) in order to consistently achieve the recommended density.

6.3.3 Field density tests should be taken as each lift of fill material is placed. As a guide, one field density test per lift for each 5,000 square feet of compacted area is recommended. For small areas or critical areas the frequency of testing may need to be increased to one test per 2,500 square feet. A minimum of 3 tests per lift should be required. The earthwork operations should be observed and tested on a continuing basis by an experienced Technician working in conjunction with the project geotechnical engineer.

6.3.4 Each lift should be compacted, tested and approved before another lift is added. The purpose of the field density tests is to provide some indication that uniform and adequate compaction is being obtained. The actual quality of the fill, as compacted, should be the responsibility of the contractor and satisfactory results from the tests should not be considered as a guarantee of the quality of the contractor's filling operations.

6.4 Excavation

6.4.1 The borings did not indicate any unusual materials along the utility lines. The upper soils should be rippable with a heavy-duty excavation equipment. The contractor's competent person or a qualified engineer should evaluate soil structure, soil hardness, and surrounding conditions prior to allowing work below the soil cut. Test pits may be excavated; feasibility of excavation may be studied.

6.4.2 The side slopes of excavations through the overburden soils should be made in such a manner to provide for their stability during construction. Existing structures, pipelines or other facilities, which are constructed prior to or during the currently proposed construction and which require excavation, should be protected from loss of end bearing or lateral support.

6.4.3 Temporary construction slopes and/or permanent embankment slopes should be protected from surface runoff water. Site grading should be designed to allow drainage at planned areas where erosion protection is provided, instead of allowing surface water to flow down unprotected slopes.

6.4.4 Trench safety recommendations are beyond the scope of this report. The contractor must comply with all applicable safety regulations concerning trench safety and excavation, including, but not limited to OSHA regulations 29CFR Part 1926.650 through 1926.652.

6.5 Erosion and Sediment Control

All disturbed areas should be protected from erosion and sedimentation during construction, and all permanent slopes and other areas subject to erosion or sedimentation should be provided with permanent erosion and sediment control facilities. All applicable ordinances and codes regarding erosion and sediment control should be followed.

7. LIMITATIONS

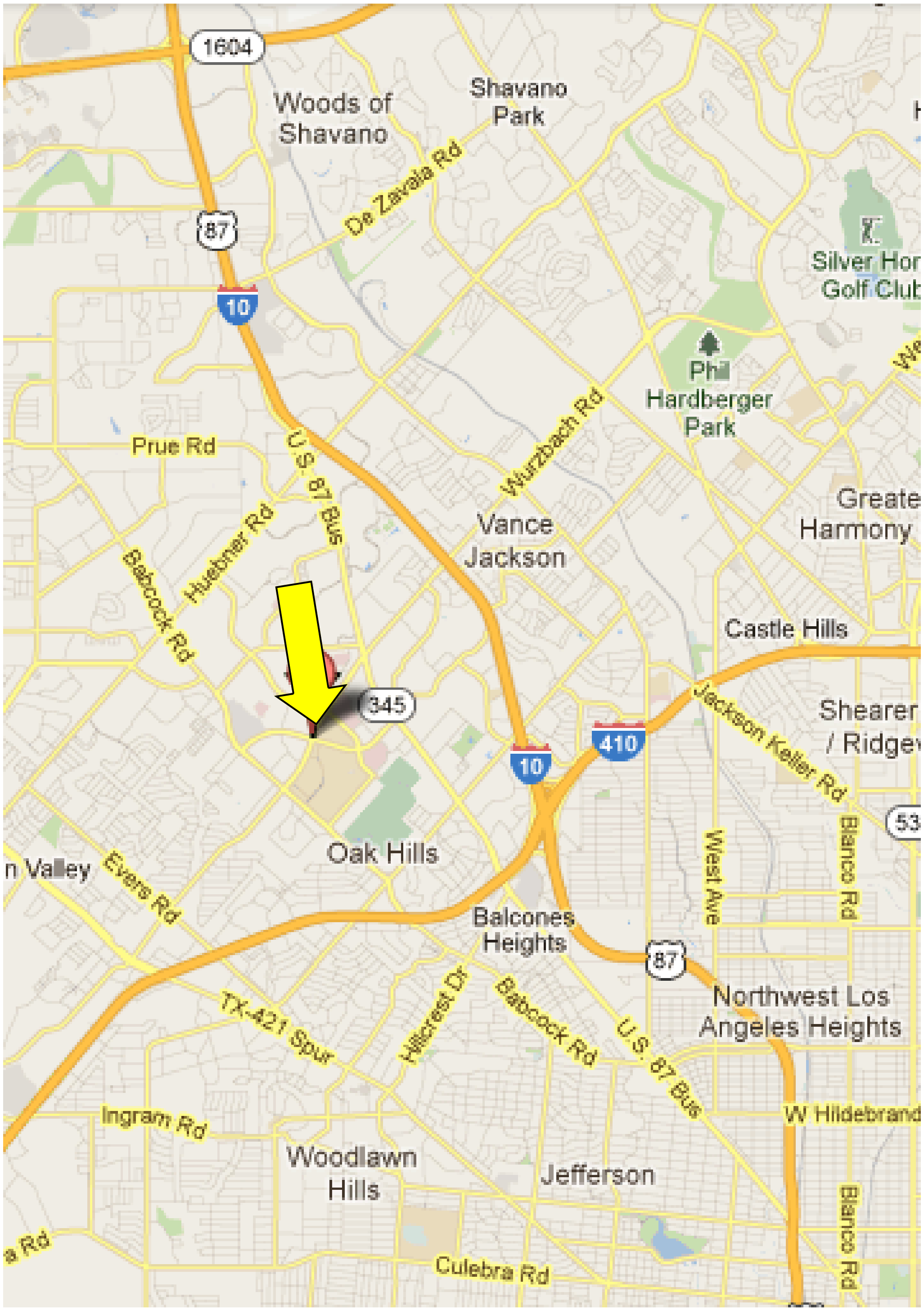
7.1 The analysis and recommendations submitted in this report are based upon **the data obtained from five borings drilled at the site.** This report may not reflect the exact variations of the soil conditions across the site. The nature and extent of the variations across the site may not become evident, until construction commences; if variations occur during construction it will be necessary to re-evaluate our recommendations after performing on-site observations and tests to establish the engineering significance of any variations.

7.2 The project geotechnical engineer declares that the findings, recommendations or professional advice contained herin have been made and this report prepared in accordance with generally accepted professional engineering practice in the fields of geotechinical engineering and engineering geology. No other warranties are implied or expressed.

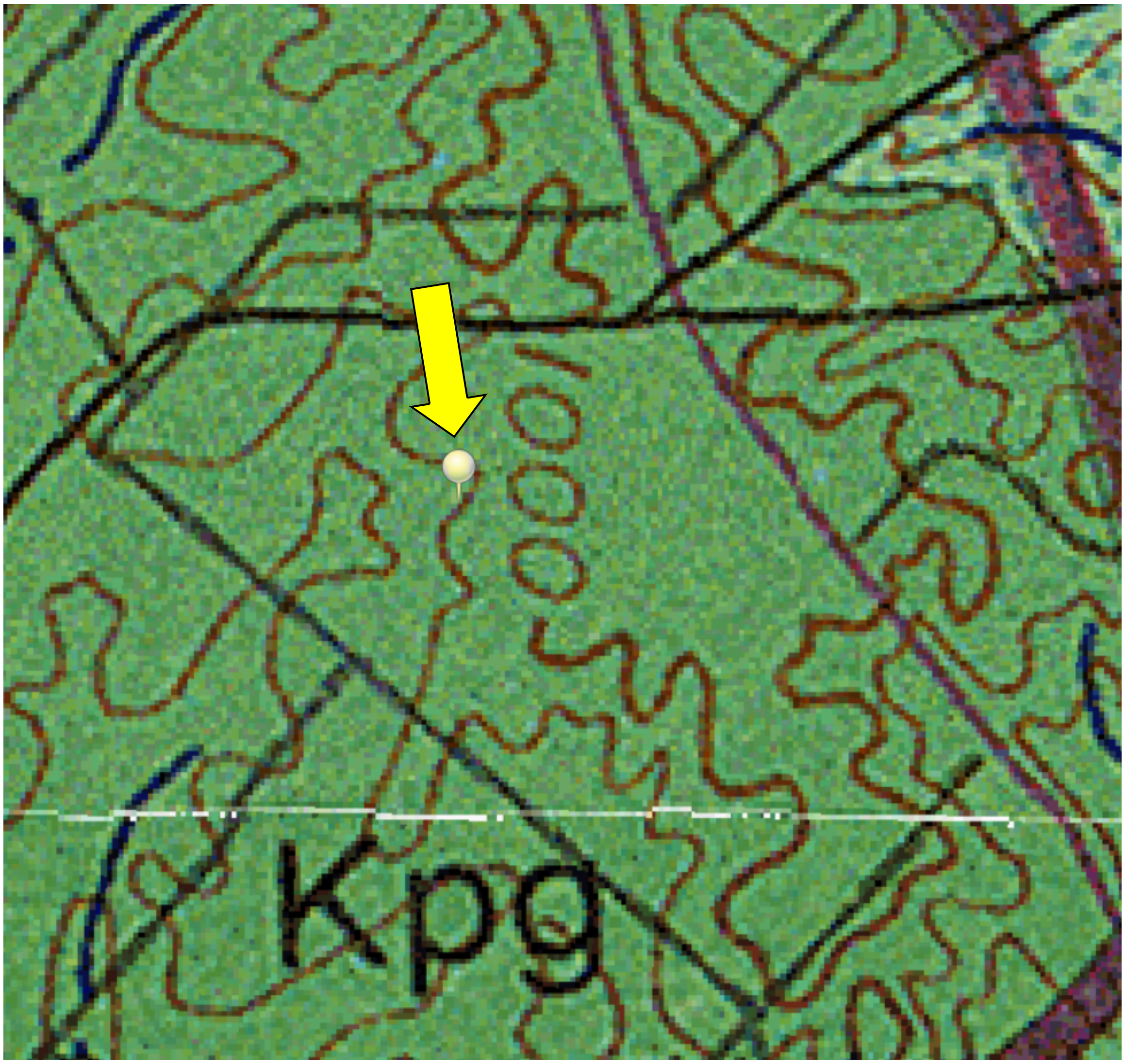
7.3 This report has been prepared for the exclusive use of K. M. ng and Associates and their Project team for the subsurface evaluation for the proposed **SAWS Recycled Waterline A, Recycled Waterline B and Recycled Waterline C – University System Recycled Waterline project in San Antonio, Texas.**

Illustration Section

Subsurface Exploration and Geotechnical Data University System Recycled Water Main San Antonio, Texas	InTEC Project Number: **S121652**	Date: 07/23/2012



Subsurface Exploration and Geotechnical Data University System Recycled Water Main San Antonio, Texas	**Vicinity Map**	
	InTEC Project Number: **S121652**	Date: 07/23/2012



Kpg (Pecan Gap) Formation

Subsurface Exploration and Geotechnical Data University System Recycled Water Main San Antonio, Texas	**Geologic Map—Approximate Location**	
	InTEC Project Number: **S121652**	Date: 07/23/2012

Subsurface Exploration and Geotechnical Data University System Recycled Water Main San Antonio, Texas	**Approximate Boring Locations**	
	InTEC Project Number: **S121652**	Date: 07/23/2012

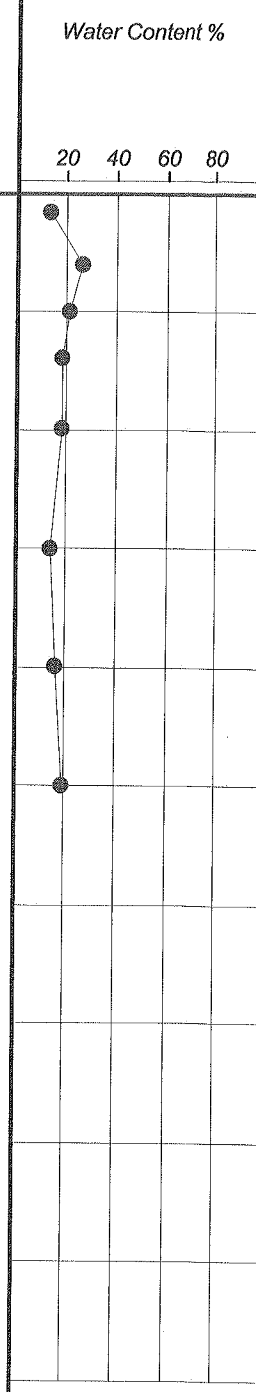
LOG OF BORING NO. B-1

PROJECT: Recycled Water Line, Wurzbach Road and
LOCATION: Merton Minter Blvd., San Antonio, Texas

DATE: 07/18/2012
PROJECT NO: S121652

SUBSURFACE PROFILE

DEPTH	SAMPLES	SOIL DESCRIPTION (Surf. Elev.)	UNIT DRY WT. IN PCF	S.S. BY P.P.	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
	ST	Very Stiff Brown Clay (CH)	98			1.36	57	39
	SS	- with a Trace of Caliche and Gravel - Percent Minus 200 Sieve at 1-ft = 73 %			12			
5	ST	Very Stiff Tan Clay to Tan Silty Clay (CH) - with Caliche	97			1.12	49	29
	ST	- Percent Minus 200 Sieve at 7-ft = 93 %		1.2			59	40
	ST	Very Stiff to Hard Tan and Gray Clay (CH)						
10		- with Tan and Gray Calcareous Clay - Percent Minus 200 Sieve at 9-ft = 88 %	99			1.68		
15	SS				36			
20	SS				30		73	53
	SS	- Percent Minus 200 Sieve at 24-ft = 74 %						
25					38		74	54
30								
35								
40								
45								
50								



Completion Depth 25'

Ground Water Observed No

Date: 07/18/2012

S.S. by P.P.- Shear Strength in TSF by Hand Penetrometer

S.S.- Split Spoon Sample
S.T.- Shelby Tube Sample
AU- Auger Sample

L.L- Liquid Limit
P.L.- Plastic Limit
M.C.- Moisture Content

Plate: 2

LOG OF BORING NO. B-2

PROJECT: Recycled Water Line, Wurzbach Road and

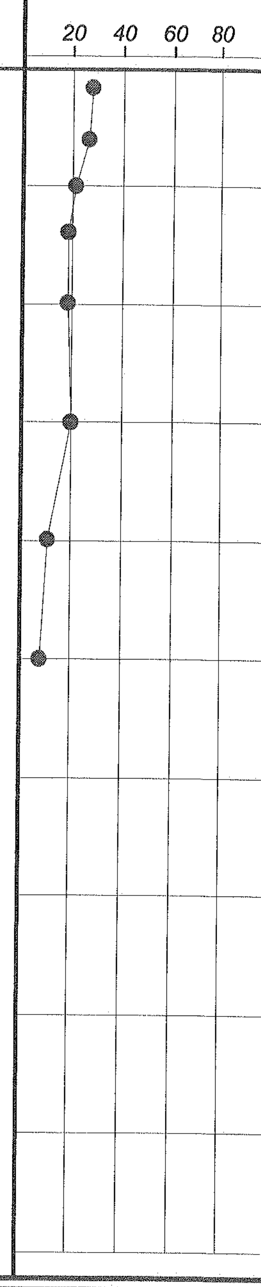
LOCATION: Merton Minter Blvd., San Antonio, Texas

DATE: 07/18/2012

PROJECT NO: S121652

SUBSURFACE PROFILE

DEPTH	SYMBOL	SAMPLES	SOIL DESCRIPTION Surf. Elev.	UNIT DRY WT. IN PCF	S.S. BY P.P.	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
		ST	Stiff to Very Stiff Dark Brown Clay (CH) - Percent Minus 200 Sieve at 1-ft = 75 %	98.6			0.67	97	72
		ST	Stiff to Very Stiff Tan Silty Clay - with Abundant Caliche		0.9			41	24
5		ST	- Percent Minus 200 Sieve at 3-ft = 81 %	103.1			1.05		
		ST	Very Stiff Tan and Gray Clay		1.7			68	51
		ST							
10					2.2			72	55
		SS							
15			Hard Light Tan Calcareous Clay to Light Tan Marl	104.8			2.01		
		SS							
20						50/5"			
		SS							
25						50/3"		32	20
30									
35									
40									
45									
50									



Completion Depth 25'

Ground Water Observed No

Date: 07/18/2012

S.S. by P.P.- Shear Strength in TSF by Hand Penetrometer

S.S.- Split Spoon Sample
S.T.- Shelby Tube Sample
AU- Auger Sample

L.L- Liquid Limit
P.L.- Plastic Limit
M.C.- Moisture Content

Plate: 3

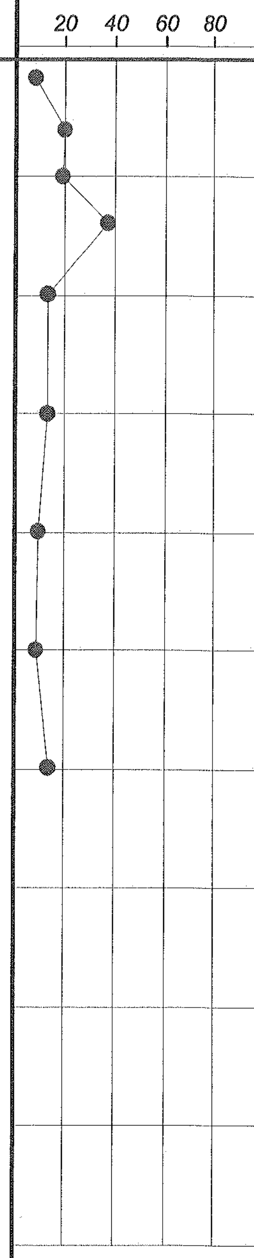
LOG OF BORING NO. B-3

PROJECT: Recycled Water Line, Wurzbach Road and
DATE: 07/18/2012
LOCATION: Merton Minter Blvd., San Antonio, Texas
PROJECT NO: S121652

SUBSURFACE PROFILE

DEPTH	SYMBOL	SAMPLES	SOIL DESCRIPTION Surf. Elev.	UNIT DRY WT. IN PCF	S.S. BY P.P.	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
		ST	Fill: Very Stiff to Hard Tan Silty Clay with Abundant Caliche	99			1.72	43	28
		ST	Very Stiff to Hard Dark Brown Clay	98			2.12	83	63
5		ST	Very Stiff Tan Silty Clay - with Caliche	97			1.17	46	30
		ST	Dense Gravel with Some Clay - Percent Minus 200 Sieve at 7-ft = 55 %			40		80	56
10		ST	Hard Light Tan Calcareous Clay to Light Tan Marl			38			
15		SS				34		37	24
20		SS				50/4"			
25		SS	- Percent Minus 200 Sieve at 24-ft = 83 %			50/4"			
30		SS				50/3"			
			Marl may be as hard as Limestone at Some Locations and Depths						
35									
40									
45									
50									

Water Content %



Completion Depth 30'
Ground Water Observed No
Date: 07/18/2012

S.S. by P.P.- Shear Strength in TSF by Hand Penetrometer
S.S.- Split Spoon Sample
S.T.- Shelby Tube Sample
AU- Auger Sample
L.L.- Liquid Limit
P.L.- Plastic Limit
M.C.- Moisture Content

Plate: 4

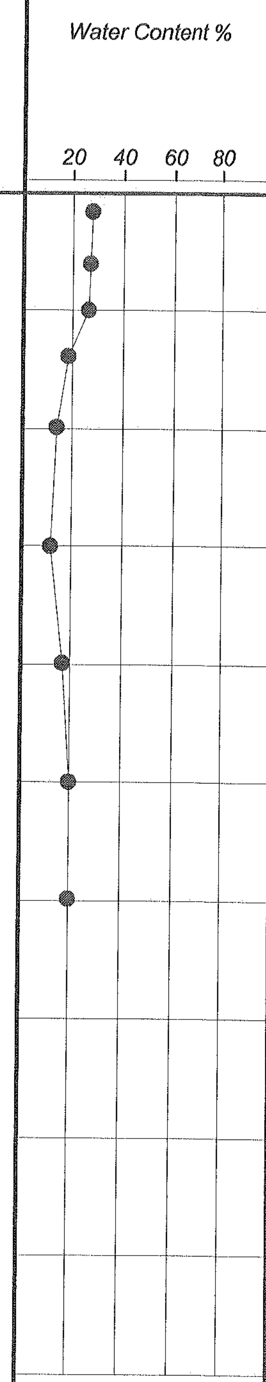
LOG OF BORING NO. B-4

PROJECT: Recycled Water Line, Wurzbach Road and
DATE: 07/18/2012

LOCATION: Merton Minter Blvd., San Antonio, Texas
PROJECT NO: S121652

SUBSURFACE PROFILE

DEPTH	SAMPLES	SOIL DESCRIPTION Surf. Elev.	UNIT DRY WT. IN PCF	S.S. BY P.P.	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
	ST	Stiff to Very Stiff Dark Brown Clay - with a Trace of Caliche and Gravel	97			1.16	74	50
	ST	- Percent Minus 200 Sieve at 3-ft = 79 %		1.1			70	46
5	ST	Stiff to Very Stiff Tan Silty Clay - with Abundant Caliche		0.9			33	15
	ST	- Percent Minus 200 Sieve at 7-ft = 79 %	98			1.38		
	ST	Very Stiff to Hard Light Tan Calcareous Clay to Light Tan Marl						
10					27		36	20
	SS	- Percent Minus 200 Sieve at 14-ft = 84 %						
15					50/3"			
	SS							
20					50/2"			
	SS	- Tan an Gray Clay at 24-ft						
25					36		73	52
	SS							
30					50/2"			
35								
40								
45								
50								



Completion Depth 30'
Ground Water Observed No
Date: 07/18/2012

S.S. by P.P.- Shear Strength in TSF by Hand Penetrometer
S.S.- Split Spoon Sample
S.T.- Shelby Tube Sample
AU- Auger Sample
L.L- Liquid Limit
P.L.- Plastic Limit
M.C.- Moisture Content

LOG OF BORING NO. B-5

InTEC

PROJECT: Recycled Water Line, Wurzbach Road and

DATE: 07/18/2012

LOCATION: Merton Minter Blvd., San Antonio, Texas

PROJECT NO: S121652

SUBSURFACE PROFILE											
DEPTH	SYMBOL	SAMPLES	SOIL DESCRIPTION Surf. Elev.	UNIT DRY WT. IN PCF	S.S. BY P.P.	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX	Water Content % 20 40 60 80
			Boring B-5 was Not Drilled Because of Its Proximity to Numerous Utility Lines							
5										
10										
15										
20										
25										
30										
35										
40										
45										
50										

Completion Depth

Ground Water Observed

Date: 07/18/2012

S.S. by P.P.- Shear Strength in TSF by Hand Penetrometer

S.S.- Split Spoon Sample
S.T.- Shelby Tube Sample
AU- Auger Sample

L.L- Liquid Limit
P.L.- Plastic Limit
M.C.- Moisture Content

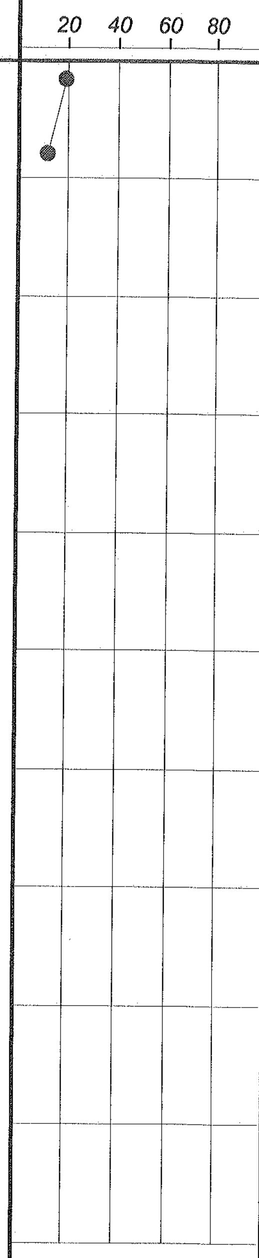
Plate: 6

LOG OF BORING NO. B-6

PROJECT: Recycled Water Line, Wurzbach Road and **DATE:** 07/18/2012

LOCATION: Merton Minter Blvd., San Antonio, Texas **PROJECT NO:** S121652

SUBSURFACE PROFILE										
DEPTH	SYMBOL	SAMPLES	SOIL DESCRIPTION Surf. Elev.	UNIT DRY WT. IN PCF	S.S. BY P.P.	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX	Water Content %
		ST	Very Stiff to Hard Brown Clay - with Some Gravel	98			1.63	60	39	
		ST			2.2			52	35	
5			Auger Refusal at 4-ft							
10										
15										
20										
25										
30										
35										
40										
45										
50										



Completion Depth 4' Ground Water Observed No Date: 07/18/2012

S.S. by P.P.- Shear Strength in TSF by Hand Penetrometer

S.S.- Split Spoon Sample
S.T.- Shelby Tube Sample
AU- Auger Sample

L.L- Liquid Limit
P.L.- Plastic Limit
M.C.- Moisture Content

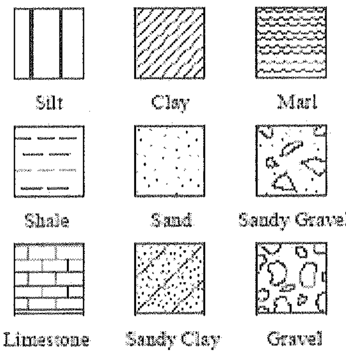
Plate: 7

KEY TO CLASSIFICATIONS AND SYMBOLS

Soil Fractions

Component	Size Range
Boulders	Greater than 12"
Cobbles	3" - 12"
Gravel	3" - #4 (4.76mm)
Coarse	3" - ¾"
Fine	¾" - #4
Sand	#4 - #200 (0.074mm)
Coarse	#4 - #10 (2.00mm)
Medium	#10 - #40 (0.42mm)
Fine	#40 - #200 (0.074mm)
Silt and Clay	Less than #200

Soil or Rock Types
(Shown in symbols column)
(Predominate Soil Types Shown Heavy)



TERMS DESCRIBING SOIL CONSISTENCY

Description (Cohesive Soils)	Unconfined Compression TSF	Blows/Ft. Std. Penetration Test	Description (Cohesionless Soils	Blows/Ft. Std. Penetration Tests
Very Soft	0.25	<2	Very Loose	0 – 4
Soft	0.25 – 0.50	2 – 4	Loose	4 – 10
Firm	0.50 – 1.00	4 – 8	Medium Dense	10 – 30
Stiff	1.00 – 2.00	8 – 15	Dense	30 – 50
Very Stiff	2.00 – 4.00	15 – 30	Very Dense	50
Hard	>4.00	>30		

SOIL STRUCTURE

Calcareous	Containing deposits of calcium carbonate; generally nodular.
Slickenside	Having inclined planes of weakness that are slick and glossy in appearance.
Laminated	Composed of thin layers of varying color and texture.
Fissured	Containing shrinkage cracks frequently filled with fine sand or silt. Usually more or less vertical.
Interbedded	Composed of alternate layers of different soil types.
Jointed	Consisting of hair cracks that fall apart as soon as the confining pressure is removed.
Varved	Consisting of alternate thin layers of sand, silt or clay formed by variations in sedimentations during the various seasons of the year, of often exhibiting contrasting colors when partially dried. Each layer is generally less than ½" in thickness.
Stratified	Composed of, or arranged in layers (usually 1 inch or more)
Well-graded	Having a wide range of grain sizes and substantial amount of all intermediate particle sizes.
Poorly or Gap-graded	Having a range of sizes with some intermediate sizes missing.
Uniformly-graded	Predominantly of one grain size.

Subsurface Exploration and Geotechnical Data University System Recycled Water Main San Antonio, Texas	InTEC Project Number: **S121652**	Date: 07/23/2012

LABORATORY TEST RESULTS

Boring No:	Depth, Ft	Water Content %	Liquid Limit	Plasticity Index	Shear Strength TSF	Percent Minus 200 Sieve	SPT Value Blows per Foot	Unit weight PCF
B-1	0 – 2	13	57	39	1.36	73	-	98
	2 – 4	26	-	-	-	-	12	-
	4 – 6	21	49	29	1.12	-	-	97
	6 – 8	18	59	40	-	93	-	-
	8 – 10	18	-	-	1.68	-	-	99
	13 – 15	14	-	-	-	-	36	-
	18 – 20	16	73	53	-	88	30	-
	23 – 25	19	74	54	-	74	38	-
B-2	0 – 2	28	97	72	0.67	75	-	99
	2 – 4	26	41	24	-	81	-	-
	4 – 6	21	-	-	1.05	-	-	103
	6 – 8	18	68	51	-	-	-	-
	8 – 10	18	72	55	-	-	-	-
	13 – 15	20	-	-	2.01	-	-	105
	18 – 20	11	-	-	-	-	50/5”	-
	23 – 25	08	32	20	-	-	50/3”	-

InTEC Project No: S121652

Plate No. 9

LABORATORY TEST RESULTS

Boring No:	Depth, Ft	Water Content %	Liquid Limit	Plasticity Index	Shear Strength TSF	Percent Minus 200 Sieve	SPT Value Blows per Foot	Unit weight PCF
B-3	0 – 2	8	43	28	1.72	-	-	99
	2 – 4	20	83	63	2.12	-	-	98
	4 – 6	19	46	30	1.17	-	-	97
	6 – 8	37	80	56	-	55	-	-
	8 – 10	13	-	-	-	-	40	-
	13 – 15	13	37	24	-	-	34	-
	18 – 20	10	-	-	-	-	50/4”	-
	23 – 25	09	-	-	-	83	50/4”	-
	28 – 30	14	-	-	-	-	50/3”	-
B-4	0 – 2	28	74	50	1.16	-	-	97
	2 – 4	27	70	46	-	79	-	-
	4 – 6	26	33	15	-	-	-	-
	6 – 8	18	-	-	1.38	79	-	98
	8 – 10	14	36	20	-	-	27	-
	13 – 15	12	-	-	-	84	50/3”	-
	18 – 20	17	-	-	-	-	50/2”	-
	23 – 25	20	73	52	-	-	36	-
	28 – 30	20	-	-	-	-	50/2”	-
B-6	0 –2	19	60	39	1.63	-	-	-
	2 – 4	12	56	35	-	-	-	-

InTEC Project No: S121652

Plate No. 10

InTEC of San Antonio L.P., 12028 Radium, San Antonio, Texas 78216 Ph: 210-525-9033 Fax: 210-525-9032