CHANGE ORDER NO. 3
CITY OF BRYAN CEMETERY EXPANSION PROJECT
CITY JOB NO. 572-D5-1303

April 5, 2016

CLM Energy Services, LLC
7607 Eastmark, Suite 240
College Station, TX 77840

We are submitting Change Order No.3 to your contract for City Job No. 572-D5-1303. This change order provides for the following additions and deductions. All work to be performed in compliance with contract specifications.

WASHINGTON REALIGNMENT (FUND 240)

A. **Add: 12"-3% cement stabilization, 8" flexible base for Washington Road in accordance with recommendations from Geotechnical Investigation. Connection apron from Kurten to the new Washington Realignment and turn assist at end of road for future development of area NE of Kurten Road. New items for drainage re-design required due to conflict with water line discovered during construction.**

ITEM	DESCRIPTION	UNIT	QTY	UNIT PRICE	TOTAL
32	8" - 3% Cement Stabilization	SY	242	$9.25	$ 2,238.50
33	6" Flexible Base Crushed Stone Limestone	SY	204	$11.00	$ 2,244.00
34	2" HMAC, Type D	SY	204	$15.00	$ 3,060.00
35	5'x2' Reinforced box culvert, ASTM C1577, structural backfill	LF	24	$525.00	$ 12,600.00
CO3.1	12" - 3% Cement Stabilization	SY	4,172	$19.04	$ 79,434.88
CO3.2	8" Flexible Base Crushed Stone Limestone	SY	3,386	$18.53	$ 62,742.58
CO3.3	General Fill, complete in place	CY	262	$18.20	$ 4,768.40
CO3.4	Installation of 8' of 36" HDPE Storm Sewer Pipe (ADS N-12) - Pipe to be supplied by COB	LS	1	$500.00	$ 500.00
CO3.5	Safety End Treatment for 36" RCP (6:1 slope)	EA	1	$5,890.00	$ 5,890.00
CO3.6	Wingwalls for 5'x2' RCBC	EA	2	$5,310.00	$ 10,620.00
CO3.7	5'x5' Reinforced Concrete Junction Box	EA	1	$6,705.00	$ 6,705.00
					$ -
					$ -
				SUB TOTAL A:	$ 190,803.36

B. **Deduct: 6" Lime stabilization and 6" flexible base for Washington Road not required in accordance with recommendations from Geotechnical Investigation. Deduct new driveway and demolition of portion of Kurten not needed for access to area NE of Kurten Road. Deduct drainage items not required for Washington drainage re-design.**

ITEM	DESCRIPTION	UNIT	QTY	UNIT PRICE	TOTAL
30	Excavation & Embankment	CY	280	$14.20	$ (3,976.00)
31	Demo Existing HMAC Pavement	SY	374	$6.33	$ (2,367.42)

CHANGE ORDER NO. 3
CITY OF BRYAN CEMETERY EXPANSION PROJECT
CITY JOB NO. 572-D5-1303

32	6" Lime Stabilization	SY	4,172	$7.25	$	(30,247.00)
33	6" Flexible Base Crushed Stone Limestone	SY	3,386	$11.00	$	(37,246.00)
37	30" RCP (ASTM C76, Class III, structural backfill)	LF	40	$110.00	$	(4,400.00)
38	30" HDPE Storm Sewer Pipe (ADS N-12)	LF	201	$55.00	$	(11,055.00)
41	Safety End Treatment for 30" RCP (6:1 slope)	EA	1	$3,150.00	$	(3,150.00)
42	Headwall for 30" HDPE Pipe	EA	2	$1,800.00	$	(3,600.00)
43	5" Concrete Driveway (including demo of existing driveway)	SF	1,300	$5.00	$	(6,500.00)
				SUB TOTAL B:	$	(102,541.42)
* 5 working days requested						
				TOTAL A+B (Fund 240):		**$88,261.94**

CEMETERY EXPANSION (FUND 705)

C.	**Add: 30" HDPE Storm Sewer Pipe and 6' Wood privacy fence that are required, but were not included in the bid items.**					
ITEM	**DESCRIPTION**	**UNIT**	**QTY**	**UNIT PRICE**	**TOTAL**	
14	30" HDPE Storm Sewer Pipe (ADS N-12)	LF	272	$55.00	$	14,960.00
CO3.8	6' Wood Fence, complete in place	LF	620	$21.50	$	13,330.00
					$	-
				SUB TOTAL D:	**$**	**28,290.00**
D.	**Deduct:**					
ITEM	**DESCRIPTION**	**UNIT**	**QTY**	**UNIT PRICE**	**TOTAL**	
					$	-
					$	-
				SUB TOTAL D:	$	-
* 0 working days requested						
				TOTAL C+D (Fund 705):		**$28,290.00**

ORIGINAL CONTRACT PRICE:	**$1,139,858.58**
INCREASE TO CONTRACT BY CHANGE ORDER NO. 1:	**$9,544.50**
INCREASE TO CONTRACT BY CHANGE ORDER NO. 2:	**$16,621.20**
INCREASE TO CONTRACT BY CHANGE ORDER NO. 3:	**$116,551.94**
NEW CONTRACT PRICE:	**$1,282,576.22**

PERCENT CHANGE TO ORIGINAL CONTRACT PRICE	
BY CHANGE ORDER NO. 1:	0.84%
BY CHANGE ORDER NO. 2:	1.46%
BY CHANGE ORDER NO. 3:	10.23%
TOTAL PERCENT CHANGE:	**12.52%**

CHANGE ORDER NO. 3

CITY OF BRYAN CEMETERY EXPANSION PROJECT

CITY JOB NO. 572-D5-1303

	FUND 240	**FUND 705**
ORIGINAL CONTRACT:	$244,730.35	$895,128.23
CHANGE TO CONTRACT BY CHANGE ORDER NO. 1:	$0.00	$9,544.50
CHANGE TO CONTRACT BY CHANGE ORDER NO. 2:	$0.00	$16,621.20
CHANGE TO CONTRACT BY CHANGE ORDER NO. 3:	$88,261.94	$28,290.00
NEW CONTRACT AMOUNT:	**$332,992.29**	**$949,583.93**

ORIGINAL CONTRACT TIME:	**120**	Working Days
CHANGE TO CONTRACT TIME BY CHANGE ORDER NO. 1:	2	Working Days
CHANGE TO CONTRACT TIME BY CHANGE ORDER NO. 2:	2	Working Days
CHANGE TO CONTRACT TIME BY CHANGE ORDER NO. 3:	5	Working Days
NEW CONTRACT TIME:	**129**	**Working Days**

CHANGE ORDER NO. 3
CITY OF BRYAN CEMETERY EXPANSION PROJECT
CITY JOB NO. 572-D5-1303

Your signature below will constitute your acceptance of this Change Order No. 3:

Party of the First Part
CITY OF BRYAN, TEXAS

Approved as to Form:

Janis Hampton, City Attorney

Approved:

Jason P. Bienski, Mayor

Prepared and Recommended:

Mary Lynne Stratta, City Secretary

W. Paul Kaspar, P.E., City Engineer

Date of Approval By City of Bryan:

Approved for Processing:

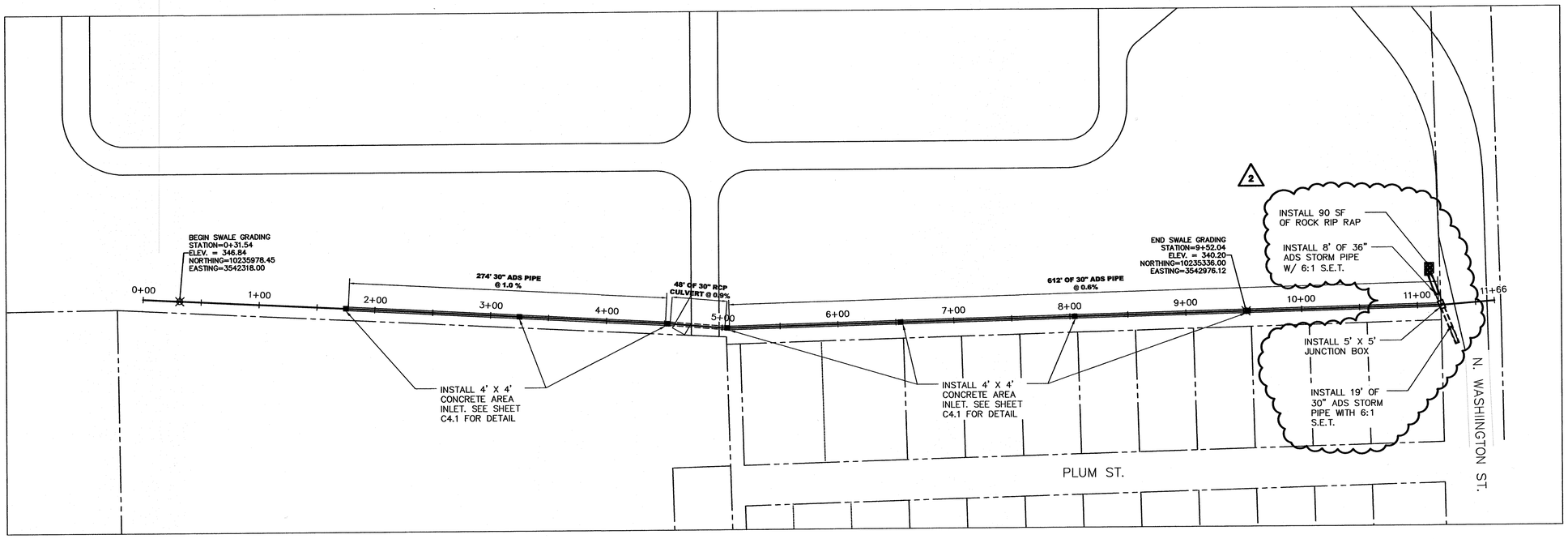
Party of the Second Part
CLM Energy Services, LLC

Jayson Barfknecht, P.E., PhD,
Director Public Works

President

Kean Register, City Manager

Witness:



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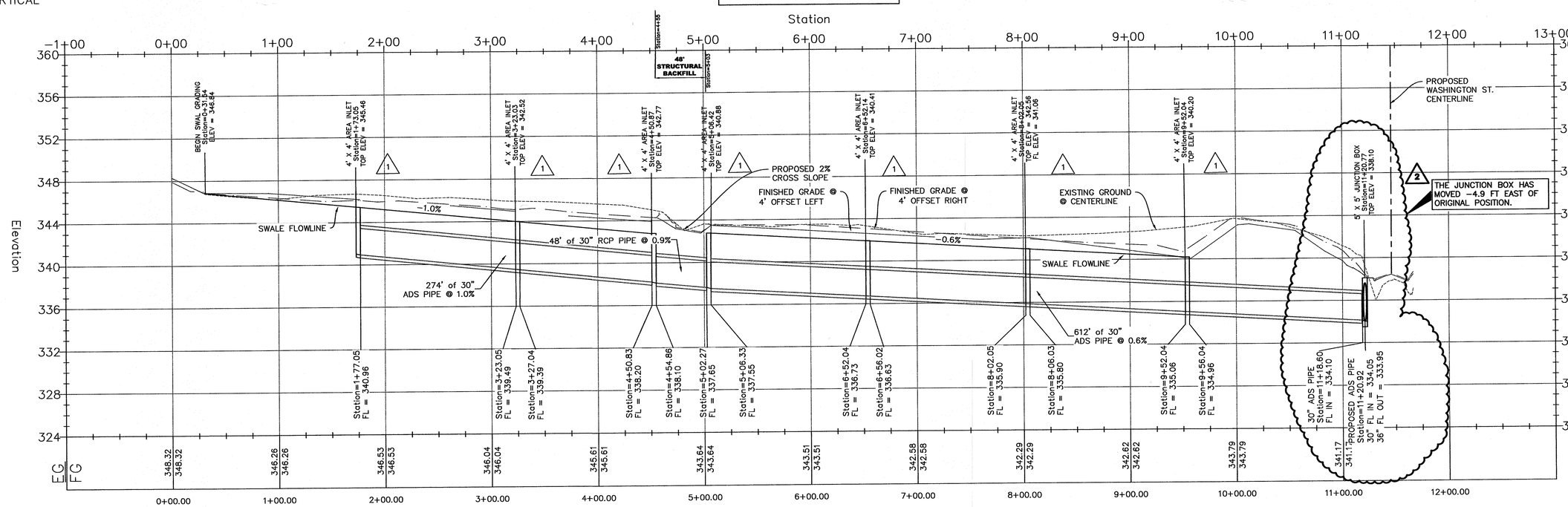
1"=5' VERTICAL

SWALE PROFILE



DESIGNED BY:	KML
DRAWN BY:	SJH
APPROVED:	KML
JOB NO:	E0506800

DON DURDEN, INC
d.b.a. CIVIL ENGINEERING CONSULTANTS
4101 S. TEXAS AVE. SUITE A
BRYAN, TEXAS 77802
TEL: (979) 846-6212
FAX: (979) 846-8252
REGISTRATION #F-2214
SAN ANTONIO / LAREDO
BRYAN / COLLEGE STATION

STATE OF TEXAS
KENT M. LAZA
65923
REGISTERED
PROFESSIONAL ENGINEER
10/20/16

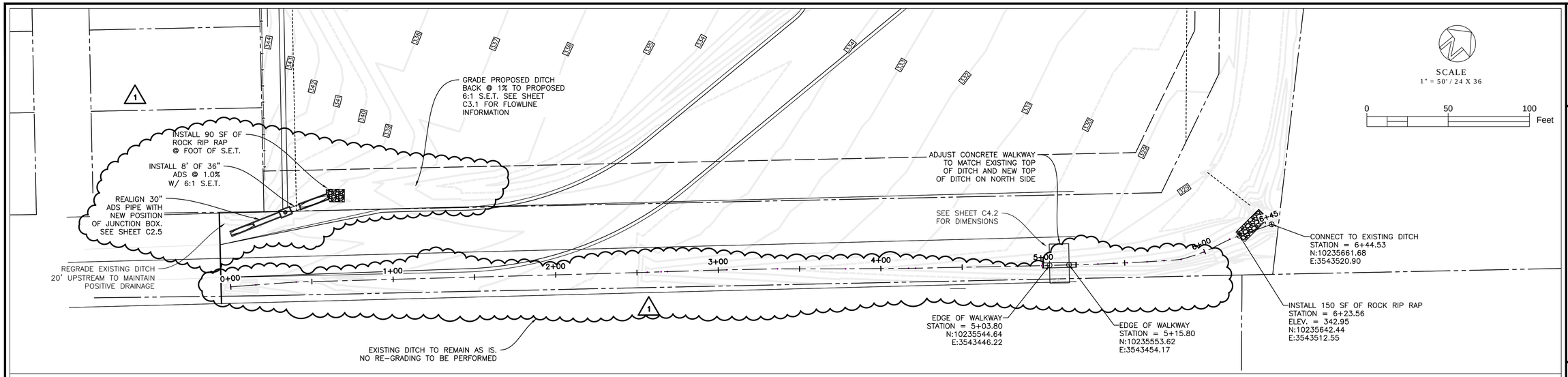
THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY KENT M. LAZA, P.E. #65923 ON OCTOBER 29, 2015
CIVIL ENGINEERING CONSULTANTS TEXAS BOARD OF PROFESSIONAL FIRM REGISTRATION #F-2214.

REV	DATE	DESCRIPTION
1	10/29/15	REVISION TO AREA INLET ELEVATIONS
2	03/16/16	STORM SEWER REVISIONS

CITY OF BRYAN PROJECT # 572-D5-1303

CITY OF BRYAN - CEMETERY EXPANSION
BRYAN, TX
SWALE PLAN & PROFILE

SHEET NO.
C2.5



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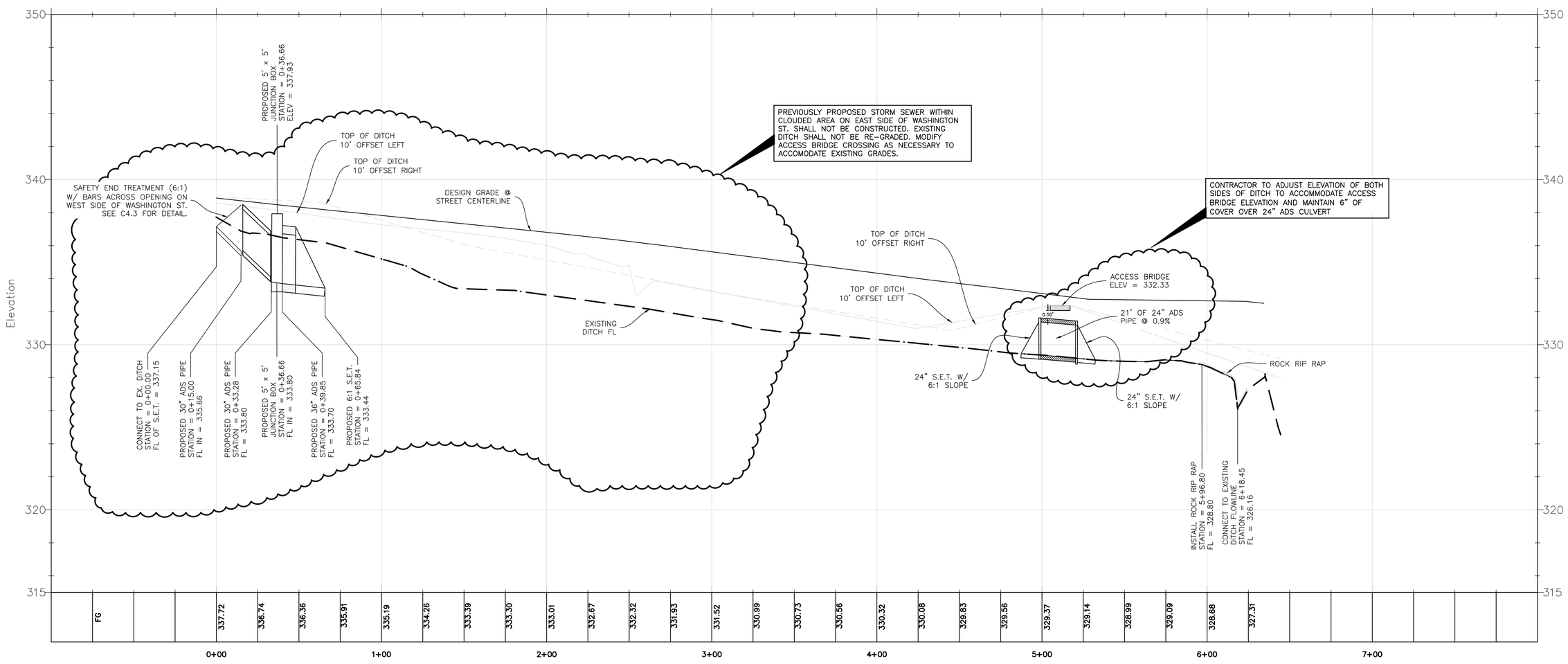
1"=3' VERTICAL

EXISTING DITCH PROFILE

Sta −1+00 − 8+00



DESIGNED BY:	KML
DRAWN BY:	SJH
APPROVED:	KML
JOB NO:	E0508800

DON DURDEN, INC
d.b.a. CIVIL ENGINEERING CONSULTANTS
4101 S. TEXAS AVE, SUITE A
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TEL: (979) 846-8212
FAX: (979) 846-8213
REGISTRATION #F-2214
SAN ANTONIO / LAREDO
BRYAN / COLLEGE STATION

STATE OF TEXAS
KENT M. LAZA
65923
PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY KENT M. LAZA, P.E. #65923 ON April 1, 2016
CIVIL ENGINEERING CONSULTANTS TEXAS BOARD OF PROFESSIONAL ENGINEERS FIRM REGISTRATION #F-2214

REV	DATE	DESCRIPTION
1	3/15/16	STORM SEWER REVISIONS

CITY OF BRYAN PROJECT # 572-D5-1303

CITY OF BRYAN - CEMETERY EXPANSION
BRYAN, TX
EXISTING DITCH MODIFICATION PROFILE

SHEET NO.
C2.6

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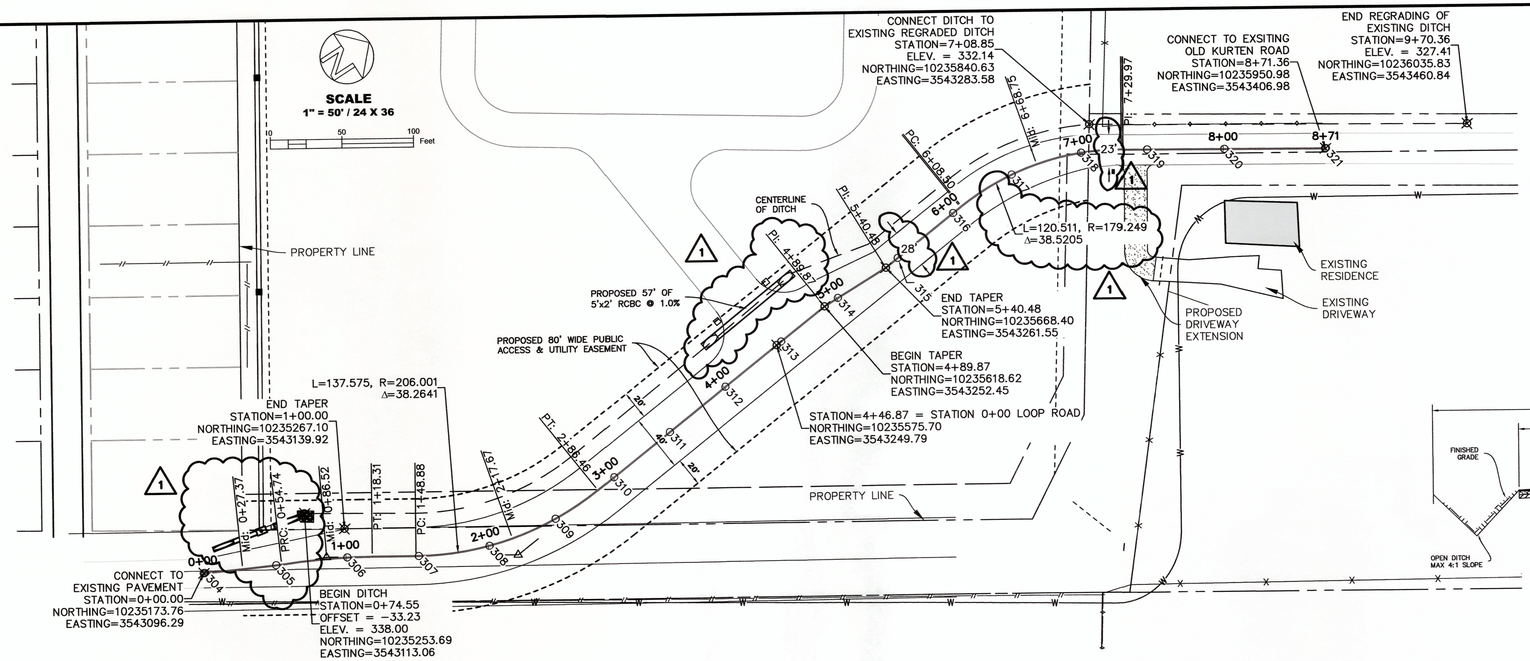
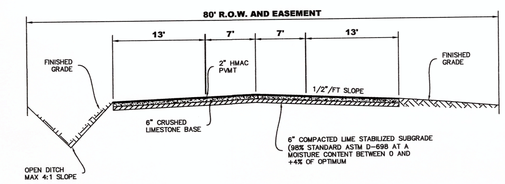
Point Table			
Point #	Northing	Easting	Description
304	10235174.48	3543096.82	CL
305	10235214.76	3543126.45	CL
306	10235255.00	3543156.08	CL
307	10235292.54	3543189.10	CL
308	10235333.71	3543217.24	CL
309	10235380.47	3543234.62	CL
310	10235430.00	3543240.76	CL
311	10235479.91	3543243.85	CL
312	10235529.81	3543246.95	CL
313	10235579.72	3543250.04	CL
314	10235629.46	3543254.43	CL
315	10235679.15	3543262.22	CL
316	10235728.70	3543265.29	CL
317	10235778.93	3543273.04	CL
318	10235823.04	3543294.47	CL
319	10235858.58	3543323.58	CL
320	10235898.67	3543359.76	CL
321	10235951.24	3543407.19	CL



REVISION NOTE:

NO STORM SEWER OR ASSOCIATED ROCK RIP RAP PROPOSED ON SHEET C2.6 SHALL BE CONSTRUCTED EXCEPT FOR THE CULVERT @ THE ACCESS BRIDGE CROSSING. PROPOSED ROCK RIP RAP @ EXISTING OUTFALL SHALL REMAIN. MODIFY ACCESS BRIDGE CROSSING AS NECESSARY.

WASHINGTON ST. ROAD SECTION



DRAWING N.T.S.

WASHINGTON ST. PROFILE

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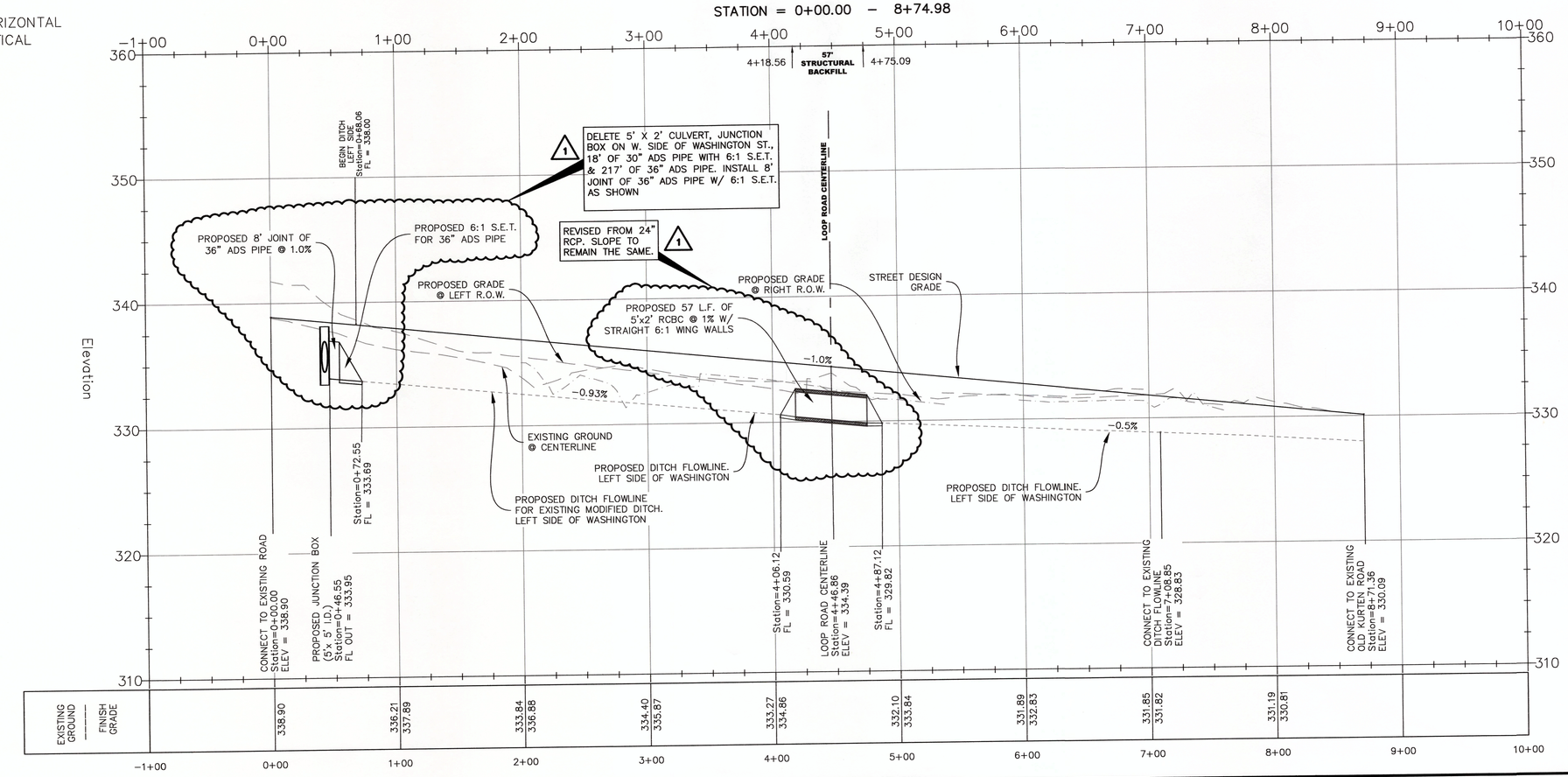
SCALE: 1"=50' HORIZONTAL
1"=5' VERTICAL



DESIGNED BY:	K.M.
DRAWN BY:	S.J.H
APPROVED:	K.M.
JOB NO:	E0506600

DON DURDEN, INC
d.b.a. CIVIL ENGINEERING CONSULTANTS
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P.O. BOX 4087 77805
FAX: (979) 848-8252
REGISTRATION #F-2214
SAN ANTONIO / LAREDO
BRYAN / COLLEGE STATION

STATE OF TEXAS
KENT M. LAZA
65923
REGISTERED
PROFESSIONAL ENGINEER

10/23/2016

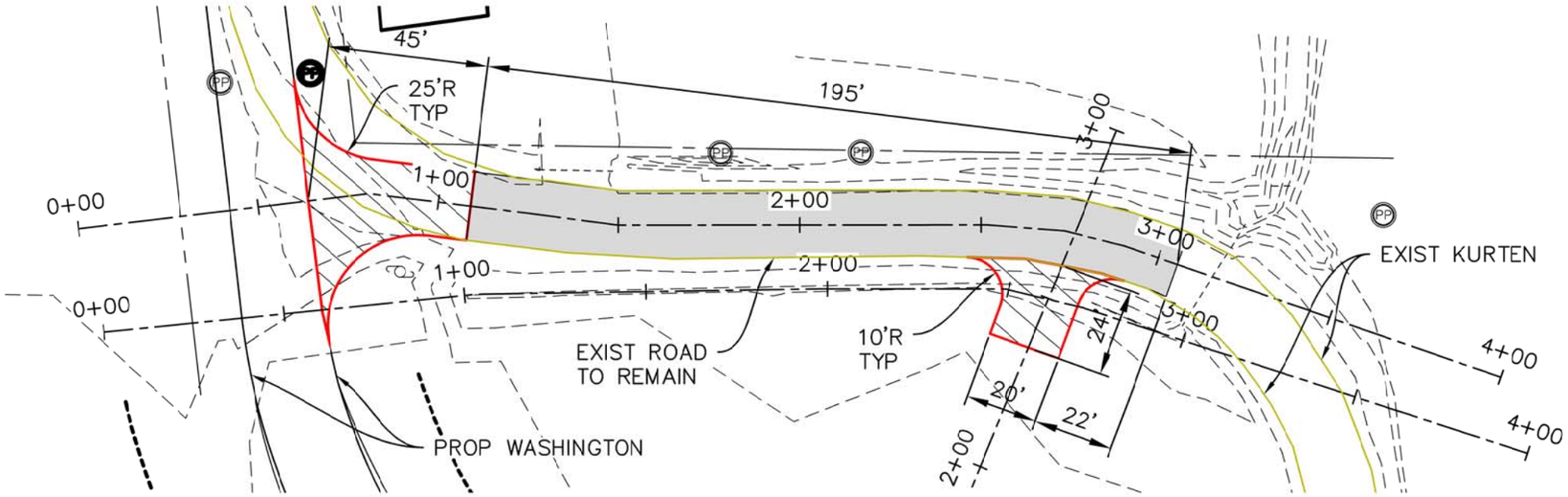
THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY KENT M. LAZA, P.E. #65923 ON OCTOBER 19, 2015 CIVIL ENGINEERING CONSULTANTS TEXAS BOARD OF PROFESSIONAL FIRM REGISTRATION #F-2214.

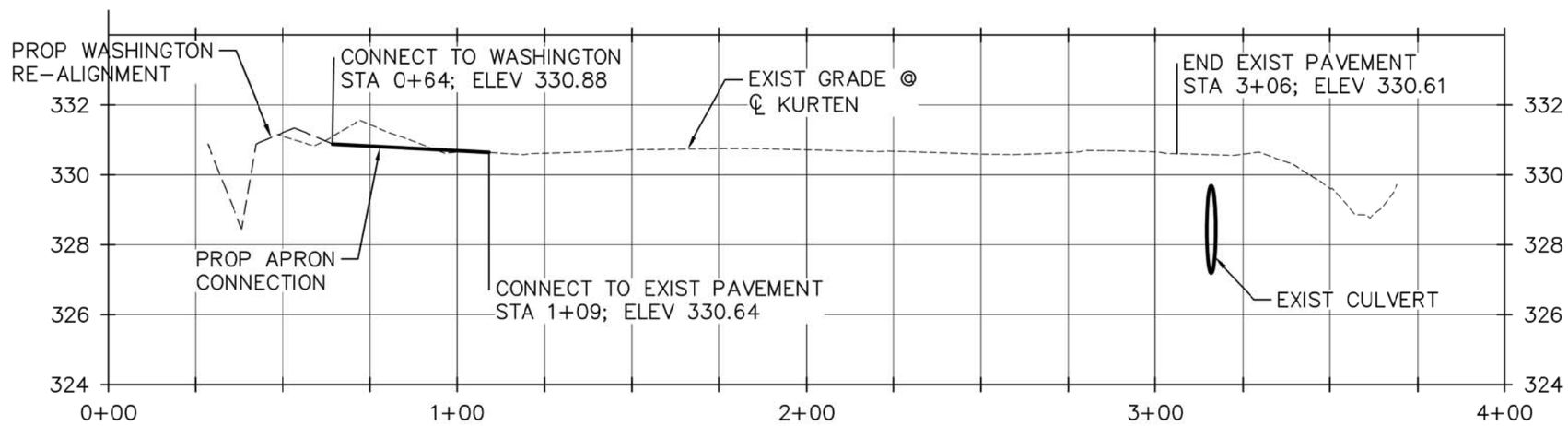
REV	DATE	DESCRIPTION
1	3/17/16	STORM SEWER REVISIONS & ADDITIONAL DIMENSIONS

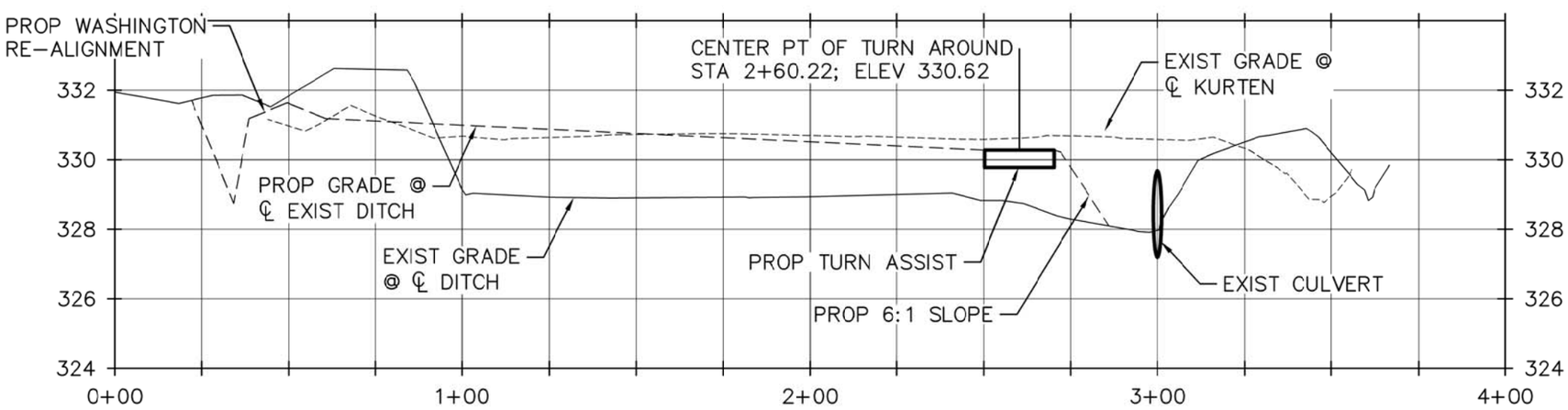
CITY OF BRYAN PROJECT # 572-D5-1303

CITY OF BRYAN - CEMETERY EXPANSION
BRYAN, TX
WASHINGTON ST. PLAN & PROFILE

SHEET NO.
C3.1







CITY OF BRYAN
Bryan/College Station

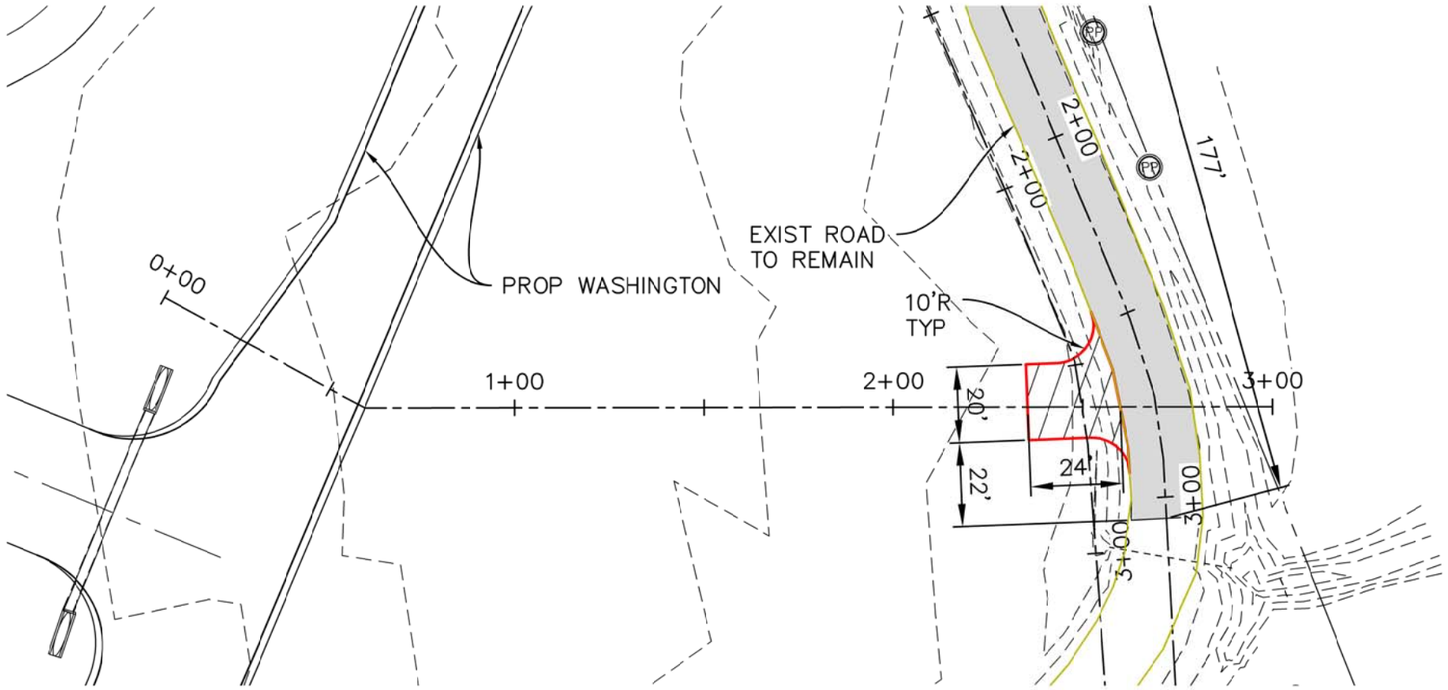
This seal appearing on this document was authorized by Patricia Syzdek Edwards, P.E., 121496. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act. This document is released for bidding purposes on March 29, 2016.

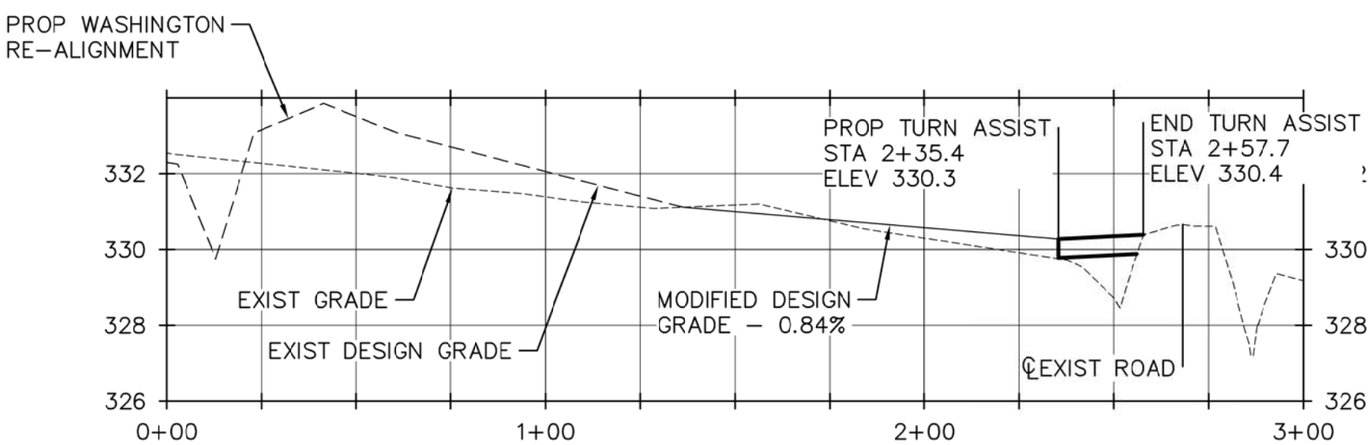
CEMETERY EXPANSION PROJECT
KURTEN APRON REVISION

DRAWN BY:	PSE
DATE:	03/2016
APPR BY:	PSE
SCALE:	1"=40'H 1"=4'V
PROJECT NO:	572-D5-1303

REV.	DATE	DESCRIPTION

SHEET 1 OF 2





CITY OF BRYAN

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CEMETERY EXPANSION PROJECT
KURTEN APRON REVISION

DRAWN BY:	PSE
DATE:	03/2016
APPR BY:	PSE
SCALE:	1"=40'H 1"=4'V
PROJECT NO:	572–D5–1303

REV.	DATE	DESCRIPTION

SHEET 2 OF 2

Geotechnical Engineering Report

City of Bryan Cemetery Expansion

Bryan, Texas

March 23, 2016

Terracon Project No. A1165034.R1

Prepared for:

City of Bryan
Bryan, Texas

Prepared by:

Terracon Consultants, Inc.
College Station, Texas

Offices Nationwide
Employee-Owned
Established in 1965
terracon.com

Terracon

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

March 23, 2016

City of Bryan
P.O. Box 1000
Bryan, Texas 77805

Attn: Ms. Patricia Edwards, P.E.

Re: Geotechnical Engineering Report
City of Bryan Expansion Pavement Recommendations
Bryan, Texas
Terracon Project No A1165034.R1

Dear Ms. Edwards:

Terracon Consultants, Inc. (Terracon) is pleased to submit our geotechnical engineering report for the project referenced above in Bryan, Texas. We trust that this report is responsive to your project needs. Please contact us if you have any questions or if we can be of further assistance.

We appreciate the opportunity to work with you on this project and look forward to providing additional geotechnical engineering and construction materials testing services in the future.

Sincerely,
Terracon Consultants, Inc.
(Texas Firm Registration No.: F-3272)

STATE OF TEXAS
JOSEPH D. HILL
118592
LICENSED
PROFESSIONAL ENGINEER

Joseph D. Hill, P.E.
Senior Staff Geotechnical Engineer

Alton G. Rogers, P.E.
Senior Associate / Office Manager

Enclosures

Copies Submitted: Addressee: (1) Bound, & (1) Electronic

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APPENDIX A – FIELD EXPLORATION

Exhibit A-1	Site Location Plan
Exhibit A-2	Boring Location Plan
Exhibit A-3	Field Exploration Description
Exhibit A-4 through A-10	Boring Logs

APPENDIX B – LABORATORY TESTING

Exhibit B-1	Laboratory Testing

APPENDIX C – SUPPORTING DOCUMENTS

Exhibit C-1	General Notes
Exhibit C-2	Unified Soil Classification

EXECUTIVE SUMMARY

This geotechnical engineering report has been prepared for the proposed construction of asphaltic concrete roadways within the City of Bryan Cemetery and improvements to the existing Washington Avenue, located in Bryan, Texas. We understand that the roadways within the cemetery are planned to be concrete and Washington Avenue is planned to be hot mix asphaltic concrete. Seven test borings, designated B-1 through B-7, were drilled to depths of about 5 feet within the area of the proposed roadways.

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. A summary of our findings and recommendations are provided below:

- Groundwater was not observed during or upon the completion of dry drilling. Details for each boring can be found on the Boring Logs in Appendix A of this report.
- The flexible pavement section should consist of 2.0 to 2.5 inches of asphaltic concrete over 8.0 to 10.0 inches of base material with chemically treated subgrade.
- The Portland cement concrete pavement section should consist of 5.0 to 7.0 inches of reinforced concrete with chemically treated subgrade.

This summary should be used in conjunction with the entire report for design purposes. Details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **"5.0 GENERAL COMMENTS"** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
CITY OF BRYAN CEMETERY EXPANSION
BRYAN, TEXAS

Project No. A1165034.R1
March 23, 2016

1.0 INTRODUCTION

Terracon Consultants, Inc. (Terracon) is pleased to submit our geotechnical engineering report for the proposed construction of asphaltic concrete roadways within the City of Bryan Cemetery and improvements to the existing Washington Avenue, located in Bryan, Texas. We understand that the roadways within the cemetery are planned to be concrete and Washington Avenue is planned to be hot mix asphaltic concrete. Seven test borings, designated B-1 through B-7, were drilled to depths of about 5 feet within the area of the proposed roadways. This project was authorized by Mr. Paul Kasper, City Engineer for Bryan, Texas, through signature of our "Agreement for Services" on March 3, 2016. This report was performed according to Terracon Proposal No. PA1165034.R1, dated March 3, 2016.

The purpose of this geotechnical engineering report is to describe the subsurface conditions observed at the seven test borings drilled for this project, analyze and evaluate the test data, and provide recommendations with respect to:

- Site and subgrade preparation; and
- Pavement design guidelines.

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Project location	See Appendix A, Exhibit A-1, Site Location Plan
Site layout	See Appendix A, Exhibit A-2, Boring Location Plan
Proposed improvements	The construction of several concrete roadways within the cemetery and asphaltic concrete for Washington Avenue.
Final grading	Within approximately one to two feet of existing grade.

2.2 Site Description

Item	Description
Site location	The site is located northwest of the existing City of Bryan Cemetery, located northeast of the intersection of North Washington Avenue and Plum Street in Bryan, Texas.
Existing conditions	The area is currently undeveloped; the site had recently been stripped of the upper 6 to 12 inches of topsoil.
Existing topography	Relatively level.

3.0 SUBSURFACE CONDITIONS

3.1 Geology

The Yegua formation is a geological formation deposited in the Eocene geologic age and formed by high constructive fluvial influenced deposition, as well as high destructive tide dominated marine deposition. The Yegua formation consists primarily of clays and silts, medium- grained sand and sandstone, as well as limestone and iron-ore concretions. Localized lignite deposits are common. The sedimentary lithological constituents consist of greenish- gray to chocolate colored clays and silts, buff white to yellow secondary sandstone, and tertiary lenses of limestone and lignite. This Formation extends 600 to 1,000 feet below the surface.

3.2 Typical Profile

Based on the results of the borings, subsurface conditions on the project sites can be generalized as silty clays with varying amounts of sand.

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report.

3.3 Groundwater

Groundwater was not observed at the borings during or upon completion of dry drilling. These groundwater measurements are considered short-term, since the borings were open for a short time period. On a long-term basis, groundwater may be present within the depths explored. Additionally, groundwater will fluctuate seasonally with climatic changes and should be evaluated at the time of construction.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

The following recommendations are based upon the data obtained in our field and laboratory programs, project information provided to us, and on our experience with similar subsurface and site conditions.

4.1 Geotechnical Considerations

The near-surface soils observed at the borings exhibited an increased silt and sand content. These soils are moisture sensitive and may become weak with elevated moisture contents and present construction difficulties. If wet and soft conditions are present at the time of construction, remedial efforts may be necessary for preparation of the surficial soils in the building and pavement areas to create a working surface. Remedial effort options are discussed in the **"4.2.2 Wet Weather/Soft Subgrade Considerations"** section.

4.2 Earthwork

Construction areas should be stripped of vegetation, topsoil, and debris/unsuitable surface material. Roots of trees should be grubbed to full depths. Care should be taken to replace or recompact all soil removed or loosened by removal of tree roots and stumps. Proper site drainage should be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

Once final subgrade elevations have been achieved, the exposed subgrade should be carefully proofrolled with a 20-ton pneumatic roller or equivalent equipment, such as a fully loaded dump truck, to detect weak zones in the subgrade. Special care should be exercised when proofrolling areas containing fill soils to detect soft/weak areas within the fill soils. Weak areas detected during proofrolling, as well as zones of fill containing organic matter and debris, should be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in-situ soils. Proofrolling should be performed under the direct observation of the geotechnical engineer or his/her representative.

Subsequent to proofrolling, and just prior to placement of fill, the exposed subgrade within the construction area should be evaluated for moisture and density. If the moisture and/or density do not meet the criteria described in the **"4.2.1 Compaction Requirements"** section for on-site soils, the subgrade should be scarified to a minimum depth of 6 inches, moisture adjusted and compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density.

Select fill and on-site soils to be used at this site for grade adjustments should meet the following criteria:

Fill Type	USCS Classification	Acceptable Location for Placement
On-site soils	Varies	The on-site soils appear suitable for use as fill within the pavement areas, provided they are free of organics and debris.

If blended or mixed soils are intended for use to construct the building pad, Terracon should be contacted to provide additional recommendations. Blended or mixed soils do not occur naturally. These soils are a blend of sand and clay and will require mechanical mixing at the site with a pulvermixer. If these soils are not mixed thoroughly to break down the clay clods and blend-in the sand to produce a uniform soil matrix, the fill material may be detrimental to the slab performance. If blended soils are used, we recommend that additional samples of the blended soils, as well as the clay clods, be obtained prior to and during earthwork operations to evaluate if the blended soils can be used in lieu of select fill. The actual type and amount of mechanical mixing at the site will depend on the amount of clay and sand, and properties of the clay.

4.2.1 Compaction Requirements

ITEM	DESCRIPTION
Fill lift thickness	The fill soils should be placed on prepared surfaces in lifts not to exceed 8 inches loose measure, with compacted thickness not to exceed 6 inches.
Compaction requirements	■ Select fill and on-site soils should be compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density. ■ The select fill soils should be moisture adjusted to within 2 percent of the optimum moisture content. ■ The on-site clay soils should be moisture conditioned to between optimum and +4 percent of the optimum moisture content.

Prior to any filling operations, samples of the proposed borrow and on-site materials should be obtained for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.

4.2.2 Wet Weather/Soft Subgrade Considerations

Construction operations may encounter difficulties due to wet and/or soft surface soils becoming a general hindrance to equipment, especially following periods of wet weather. If the subgrade cannot be adequately compacted to the minimum densities as described previously, one of the following measures will be required: 1) removal and replacement with select fill, 2) chemical treatment of the soil to dry and improve the stability of the subgrade, or 3) drying by natural means if the schedule allows. Based on our experience with similar soils in this area, chemical treatment is the most efficient and effective method to increase the supporting value of wet and weak subgrade. Terracon should be contacted for additional recommendations if chemical treatment is planned due to soft and wet subgrade.

4.2.3 Grading and Drainage

Flatwork and pavements will be subject to post construction movement. Maximum grades practical should be used for paving and flatwork to prevent water from ponding. Allowances in final grades should also consider post-construction movement of flatwork, particularly if such movement would be critical. Where paving or flatwork abuts the structure, effectively seal and maintain joints to prevent surface water infiltration.

4.3 Pavements

Based on the subsurface conditions, we anticipate that the pavement subgrade will generally consist of on-site silty clayey soils. We recommend that the top 8 inches of the finished subgrade soils directly beneath the pavements be chemically treated. Chemical treatment will increase the supporting value of the subgrade and decrease the effect of moisture on subgrade soils. This 8 inches of treatment is a required part of the pavement design and is not a part of site and subgrade preparation for wet/soft subgrade conditions.

The on-site soils should be treated with cement at a rate of 3 percent cement by dry weight of soil, which is typically equivalent to about 20 pounds of cement per square yard per 8-inch depth and 30 pounds of cement per square yard per 12-in depth. The subgrade soils should be treated in accordance with TXDOT 2014 Standard Specification Item 275 for cement treated subgrade.

Once the subgrade is properly prepared, both flexible pavement systems (consisting of asphaltic concrete and base material) and Portland cement concrete pavement systems may be considered for this project. Detailed traffic loads and frequencies were not available. However,

we anticipate that traffic will consist primarily of passenger vehicles combined with garbage trucks and large multi-axle delivery trucks from time to time in the driveway areas.

Tabulated in the following table are the assumed traffic frequencies and loads used to design pavement sections for this project.

Pavement Area	Traffic Design Index	Description
Automobile Parking Areas	DI-1	Light traffic (Few vehicles heavier than passenger cars, no regular use by heavily loaded two axle trucks.) (EAL[(1)] < 6)
Driveways (Light Duty)	DI-2	Medium to light traffic (Similar to DI-1 including not over 50 loaded two axle trucks or lightly loaded larger vehicles per day. No regular use by heavily loaded trucks with three or more axles.) (EAL = 6-20)
Driveways and Truck Traffic Areas (Medium Duty)	DI-3	Medium traffic (Including not over 300 heavily loaded two axle trucks plus lightly loaded trucks with three or more axles and no more than 30 heavily loaded trucks with more than three axles per day.) (EAL = 21-75)

[1] Equivalent daily 18-kip single-axle load applications.

Listed below are pavement component thicknesses, which may be used as a guide for pavement systems at the site for the traffic classifications stated herein. These systems were derived based on general characterization of the subgrade. Specific testing (such as CBR's, resilient modulus tests, etc.) was not performed for this project to evaluate the support characteristics of the subgrade. The table below provides two treated subgrade thicknesses, depending on if the construction is performed during dry or wet weather. This should be evaluated immediately prior to construction.

Flexible Pavement System (dry conditions)			
Component	**Material Thickness, Inches**		
	DI-1	**DI-2**	**DI-3**
Asphaltic Concrete	2.0	2.5	2.75
Base Material	8.0	8.0	8.0
Treated Subgrade (Dry weather)	8.0	8.0	8.0
Treated Subgrade (Wet weather)	12.0	12.0	12.0

Portland Cement Concrete Pavement System			
Component	**Material Thickness, Inches**		
	DI-1	**DI-2**	**DI-3**
Reinforced Concrete	5.0	6.0	7.0
Treated Subgrade	8.0	8.0	8.0

Presented below are our recommended material requirements for the various pavement sections.

Portland Cement Concrete Pavement – The materials and properties of reinforced concrete pavement shall meet applicable requirements in the ACI Manual of Concrete Practice. The Portland cement concrete mix should have a minimum 28-day compressive strength of 3,500 psi.

Reinforcing Steel - Reinforcing steel should consist of the following:

DI-1: #3 bars spaced at 18 inches or #4 bars spaced at 24 inches on centers in both directions.
DI-2: #3 bars spaced at 12 inches or #4 bars spaced at 18 inches on centers in both directions.
DI-3: #4 bars spaced at 18 inches on centers in both directions.

Control Joint Spacing – ACI recommendations indicate that control joints should be spaced at about 30 times the thickness of the pavement. Furthermore, ACI recommends a maximum control joint spacing of 12.5 feet for 5-inch pavements and a maximum control joint spacing of 15 feet for 6-inch or thicker pavements. Sawcut control joints should be cut within 6 to 12 hours of concrete placement.

Expansion Joint Spacing – ACI recommendations indicate that regularly spaced expansion joints may be deleted from concrete pavements. Therefore, the installation of expansion joints is optional and should be evaluated by the design team.

Dowels at Expansion Joints – The dowels at expansion joints should be spaced at 12-inch centers and consist of the following:

DI-1: 5/8-inch diameter, 12-inches long with 5-inch embedment
DI-2: 3/4-inch diameter, 14-inches long with 6-inch embedment
DI-3: 7/8-inch diameter, 14-inches long with 6-inch embedment

Hot Mix Asphaltic Concrete Surface Course – The asphaltic concrete surface course should be plant mixed, hot laid Type D (Fine Graded Surface Course) meeting the specifications requirements in TxDOT 2014 Standard Specifications Item 340. Specific criteria for the job specifications should include compaction to within an air void range of 5 to 9 percent calculated using the maximum theoretical specific gravity mix measured by TxDOT Tex-227-F. The asphalt

cement content by percent of total mixture weight should be within ± 0.5 percent asphalt cement from the job mix design.

Base Material – Base material should be composed of crushed limestone or crushed concrete meeting the requirements of TxDOT 2014 Standard Specifications Item 247, Type A or D, Grade 1-2. The base material should be compacted to at least 95 percent of the Modified Effort (ASTM D 1557) maximum dry density at moisture content within 2 percent of the optimum moisture content.

Cement Treated Subgrade – Pavement subgrade soils should be treated with cement in accordance with TXDOT 2014 Standard Specifications Item 275. Based on our local experience, we recommend the use of at least 20 pounds of cement per square yard of area to be treated for the recommended 8-inch thickness (and 30 pounds of cement per square yard for the 12-inch thickness) of cement treated subgrade soil be used for planning and estimating. The cement and soil should be thoroughly dry-mixed to a uniform consistency, the moisture content should be adjusted to within 3 percent of optimum, and the mixture should be compacted to at least 95 percent of the material's maximum dry unit weight determined by ASTM D 698. Compaction should be completed within 2 hours of the addition of water to the dry-mixed materials.

Preferably, traffic should be kept off the treated subgrade for about 7 days to facilitate curing of the soil - chemical mixture; in addition, the subgrade is not suitable for heavy construction traffic prior to paving.

Post-construction subgrade movements and some cracking of pavements are not uncommon for clay subgrade conditions such as those observed at this site. Although chemical treatment will help to reduce such movement/cracking, this movement/cracking cannot be economically eliminated.

Related civil design factors such as subgrade drainage, shoulder support, cross-sectional configurations, surface elevations and environmental factors which will significantly affect the service life must be included in the preparation of the construction drawings and specifications. Normal periodic maintenance will be required.

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventative maintenance. The following recommendations should be implemented to help promote long-term pavement performance:

- Site grading should be designed to drain away from the pavements, preferably at a minimum grade of 2 percent;
- The subgrade and the pavement surface should be designed to promote proper surface drainage, preferably at a minimum grade of 2 percent;
- Install joint sealant and seal cracks immediately;

- Extend curbs into the treated subgrade for a depth of at least 4 inches to help reduce moisture migration into the subgrade soils beneath the pavement section; and
- Place compacted, low permeability clayey backfill against the exterior side of the curb and gutter.

Preventative maintenance should be planned and provided for the pavements at this site. Preventative maintenance activities are intended to slow the rate of pavement deterioration, and consist of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Prior to implementing any maintenance, additional engineering observations are recommended to determine the type and extent of preventative maintenance.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation installation, and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, and bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other services should be undertaken.

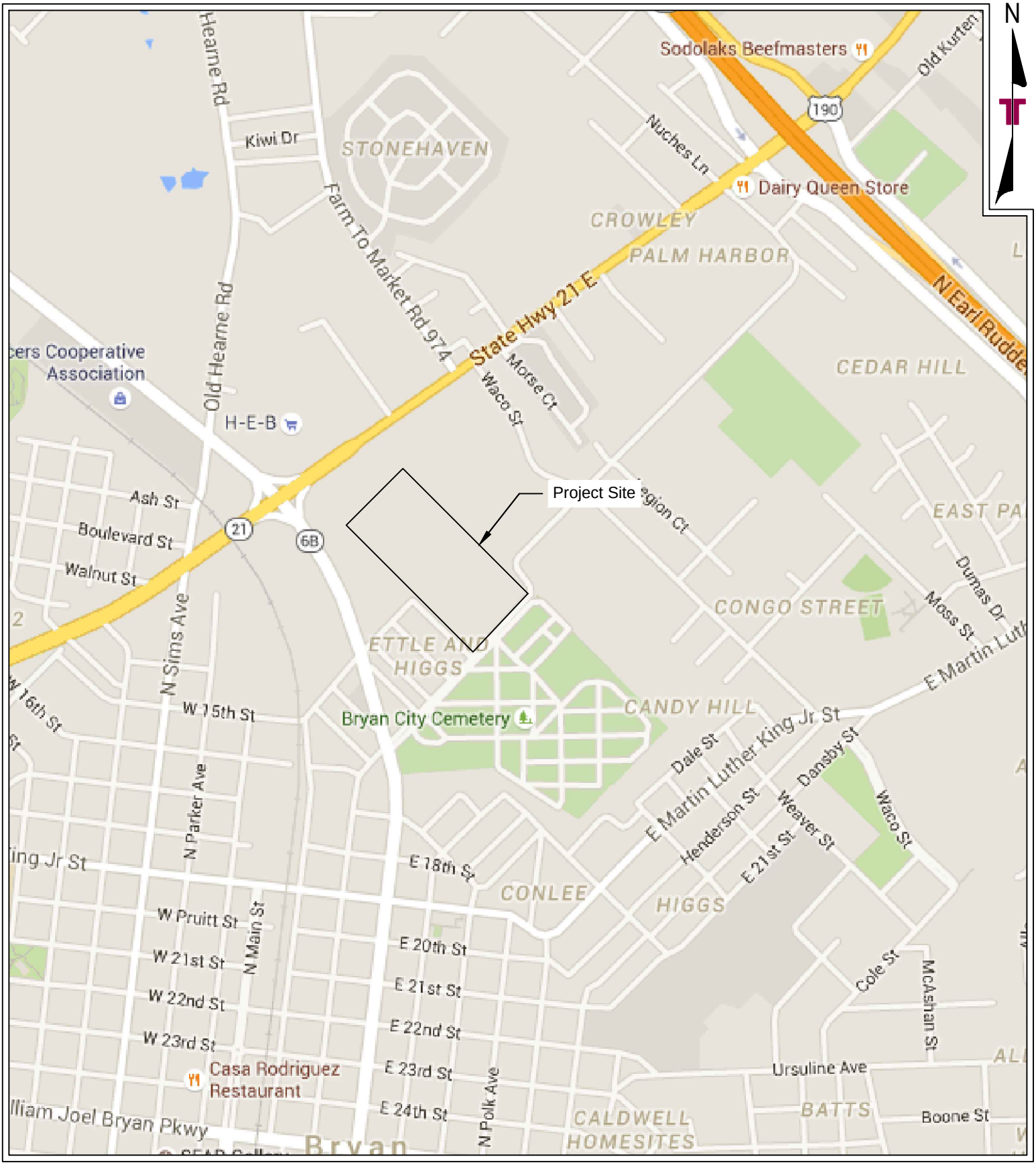
For any excavation construction activities at this site, all Occupational Safety and Health Administration (OSHA) guidelines and directives should be followed by the Contractor during construction to insure a safe working environment. In regards to worker safety, OSHA Safety and Health Standards require the protection of workers from excavation instability in trench situations.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical

engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION



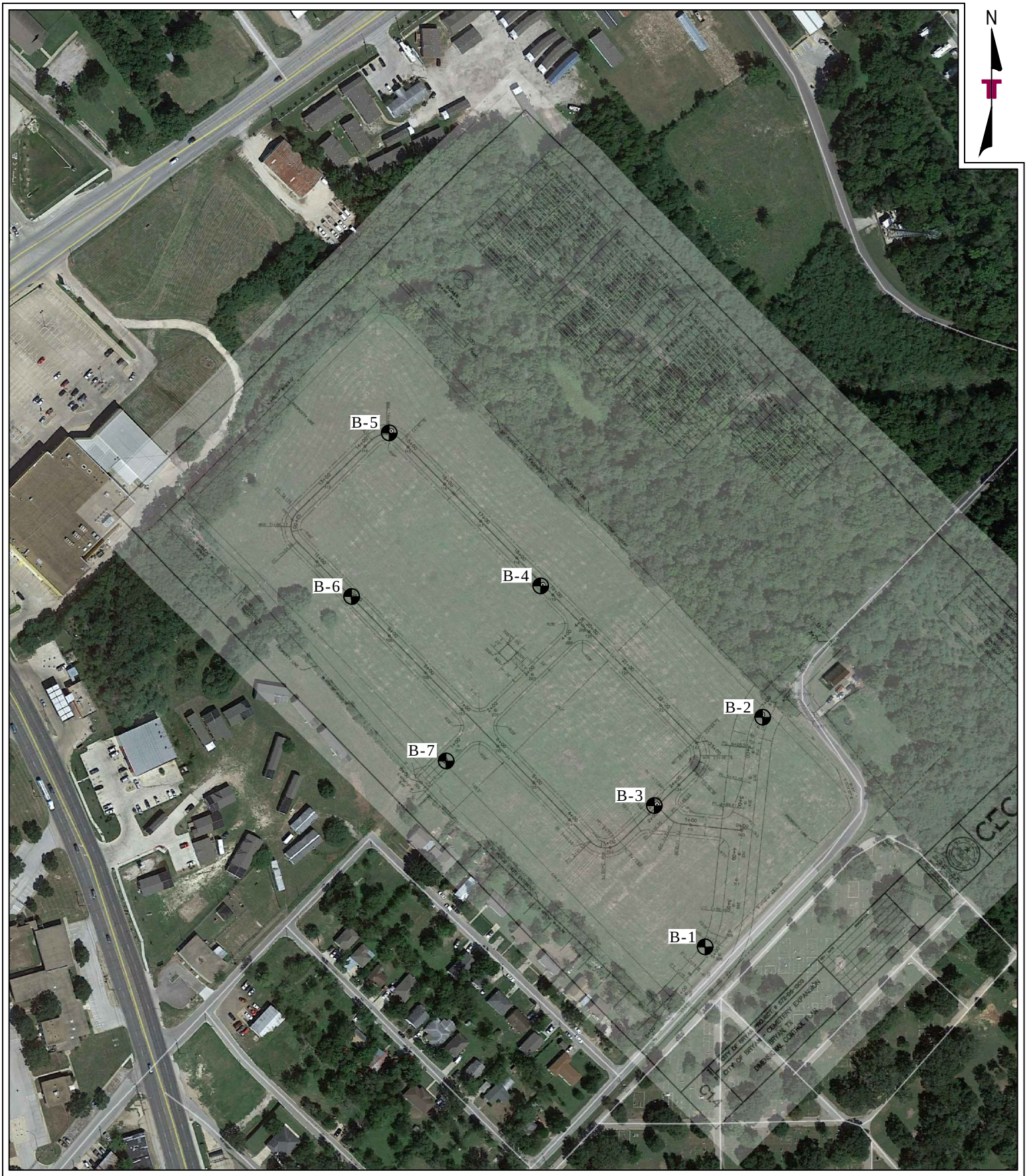
1,000' 0 500' 1,000'

SCALE IN FEET

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mng. JDH	Project No. A1165034	Terracon Consulting Engineers & Scientists	SITE LOCATION PLAN
Drawn By: JDH	Scale: AS SHOWN	6198 Imperial Loop, College Station, Texas 77845	City of Bryan Cemetery Expansion
Checked By: JDH	File No: A1165034	PH. (979) 846-3767 FAX. (979) 846-7604	Bryan, Texas
Approved By: AGR	Date: 03-22-2016		Exhibit A-1

N:\Projects\2016\A1165034\Working Files\Diagrams-Drawings-Figures\A1165034.dwg : A-1-SiteLocationPlan



250' 0 125' 250'

SCALE IN FEET

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

N:\Projects\2016\A1165034\Working Files\Diagrams-Drawings-Figures\A1165034.dwg : A-2-BoringLocationPlan

Project Mng. JDH	Project No. A1165034
Drawn By: JDH	Scale: AS SHOWN
Checked By: JDH	File No: A1165034
Approved By: AGR	Date: 03-22-2016

Terracon
Consulting Engineers & Scientists
6198 Imperial Loop College Station, Texas 77845
PH. (979) 846-3767 FAX. (979) 846-7604

BORING LOCATION PLAN

City of Bryan Cemetery Expansion
Bryan, Texas

Exhibit

A-2

Field Exploration Description

As requested by the client, subsurface conditions were evaluated by drilling seven test borings, designated B-1 through B-7, to depths of about 5 feet within the area of the proposed roadways. The borings were drilled using all-terrain vehicle mounted drilling equipment at the approximate locations shown on the Boring Location Plan, Exhibit A-2 of Appendix A. The borings were located by measuring from existing site features shown on the drawing provided to us without the use of surveying equipment. Boring depths were measured from existing grade at the time of our field program. Upon completion of our field program, the borings were backfilled with soil cuttings.

The Boring Logs, presenting the subsurface soil descriptions, type of sampling used, and additional field data, are presented on Exhibits A-4 through A-10 of Appendix A. The General Notes, which defines the terms used on the logs, are presented on Exhibit C-1 of Appendix C. The Unified Soil Classification System is presented on Exhibit C-2 of Appendix C.

Soils for which good quality open-tube samples could not be recovered were obtained by means of the Standard Penetration Test (SPT). This test consists of measuring the number of blows (N) required for a 140-pound hammer free falling 30 inches to drive a standard split-spoon sampler 12 inches into the subsurface material after being seated six inches. This blow count or SPT N-value is used to evaluate the stratum.

A CME automatic SPT hammer was used in advancing the split-barrel sampler at the borings. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT N-values and soil properties are based on the lower efficiency cathead and rope method. The higher efficiency of an automatic SPT hammer affects the SPT N-value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method.

Samples were removed from samplers in the field, visually classified, and appropriately sealed in sample containers to preserve their in-situ moisture contents. Samples were returned to our laboratory in College Station, Texas.

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 we are notified otherwise.

BORING LOG NO. B-1

PROJECT: City of Bryan Cemetery

CLIENT: City of Bryan, Texas
Bryan, Texas

SITE: Washington Avenue and Plum Street
Bryan, Texas

GRAPHIC LOG	LOCATION See Exhibit A-2 / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS		STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), dark tan, medium stiff to stiff, with silt				1.0 (HP)					23		40-17-23	45
					2.5 (HP)								
					4.0 (HP)								
	5.0	5											
	Boring Terminated at 5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry augured to termination depth

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6198 Imperial Loop
College Station, TX

Boring Started: 3/4/2016
Boring Completed: 3/4/2016
Drill Rig: 6620DT
Driller: Chris
Project No.: A1165034
Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A1165034.GPJ

BORING LOG NO. B-2

PROJECT: City of Bryan Cemetery

CLIENT: City of Bryan, Texas
Bryan, Texas

SITE: Washington Avenue and Plum Street
Bryan, Texas

GRAPHIC LOG	LOCATION See Exhibit A-2 / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS		STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
	SILTY CLAYEY SAND (SC-SM), dark tan, loose to medium dense				1.5 (HP)								
	2.0												
	SANDY LEAN CLAY (CL), dark tan, medium stiff to stiff, with silt				2.5 (HP)					19		41-16-25	58
					4.0 (HP)								
	5.0												
	Boring Terminated at 5 Feet	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry augured to termination depth

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6198 Imperial Loop
College Station, TX

Boring Started: 3/4/2016
Boring Completed: 3/4/2016
Drill Rig: 6620DT
Driller: Chris
Project No.: A1165034
Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A1165034.GPJ

BORING LOG NO. B-3

PROJECT: City of Bryan Cemetery

CLIENT: City of Bryan, Texas
Bryan, Texas

SITE: Washington Avenue and Plum Street
Bryan, Texas

LOCATION See Exhibit A-2

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS		STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
	SANDY FAT CLAY (CH), with silt, dark tan, medium stiff to stiff				4.0 (HP)					23		54-18-36	62
					4.0 (HP)								
	4.0 **SANDY LEAN CLAY (CL)**, tan, medium stiff to stiff				4.5 (HP)					12		37-22-15	
	5.0 ***Boring Terminated at 5 Feet***	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry augured to termination depth

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6198 Imperial Loop
College Station, TX

Boring Started: 3/4/2016
Boring Completed: 3/4/2016
Drill Rig: 6620DT
Driller: Chris
Project No.: A1165034
Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A1165034.GPJ

BORING LOG NO. B-4

PROJECT: City of Bryan Cemetery

CLIENT: City of Bryan, Texas
Bryan, Texas

SITE: Washington Avenue and Plum Street
Bryan, Texas

GRAPHIC LOG	LOCATION See Exhibit A-2 / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS		STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
	SANDY FAT CLAY (CH), with silt, dark tan, medium stiff to stiff												
										24		54-21-33	63
	- with calcareous nodules below 5 feet												
	5.0	5											
	Boring Terminated at 5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry augured to termination depth

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6198 Imperial Loop
College Station, TX

Boring Started: 3/4/2016
Boring Completed: 3/4/2016
Drill Rig: 6620DT
Driller: Chris
Project No.: A1165034
Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A1165034.GPJ

BORING LOG NO. B-5

PROJECT: City of Bryan Cemetery

CLIENT: City of Bryan, Texas
Bryan, Texas

SITE: Washington Avenue and Plum Street
Bryan, Texas

GRAPHIC LOG	LOCATION See Exhibit A-2 / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS		STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), dark tan, medium dense				3.5 (HP)					13		31-19-12	
					3.5 (HP)								
	4.0 **SANDY LEAN CLAY (CL)**, with silt, tan, soft to medium stiff, - with ferrous nodules				1.0 (HP)								
	5.0 ***Boring Terminated at 5 Feet***	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry augured to termination depth

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6198 Imperial Loop
College Station, TX

Boring Started: 3/4/2016
Boring Completed: 3/4/2016
Drill Rig: 6620DT
Driller: Chris
Project No.: A1165034
Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A1165034.GPJ

BORING LOG NO. B-6

PROJECT: City of Bryan Cemetery

CLIENT: City of Bryan, Texas
Bryan, Texas

SITE: Washington Avenue and Plum Street
Bryan, Texas

LOCATION See Exhibit A-2

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS		STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
	SANDY FAT CLAY (CH), dark tan, medium stiff				2.0 (HP)								
	2.0												
	CLAYEY SAND (SC), tan, medium dense				4.5 (HP)					20		56-18-38	35
					4.5 (HP)								
	5.0												
	Boring Terminated at 5 Feet	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry augured to termination depth

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6198 Imperial Loop
College Station, TX

Boring Started: 3/4/2016
Boring Completed: 3/4/2016
Drill Rig: 6620DT
Driller: Chris
Project No.: A1165034
Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A1165034.GPJ

BORING LOG NO. B-7

PROJECT: City of Bryan Cemetery

CLIENT: City of Bryan, Texas
Bryan, Texas

SITE: Washington Avenue and Plum Street
Bryan, Texas

GRAPHIC LOG	LOCATION See Exhibit A-2 / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS		STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), dark tan, medium stiff to stiff				3.0 (HP)					23		39-19-20	50
					2.5 (HP)								
	4.0 **FAT CLAY WITH SAND (CH)**, tan, stiff				4.5 (HP)					18		54-17-37	77
	5.0 ***Boring Terminated at 5 Feet***	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry augured to termination depth

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6198 Imperial Loop
College Station, TX

Boring Started: 3/4/2016	Boring Completed: 3/4/2016
Drill Rig: 6620DT	Driller: Chris
Project No.: A1165034	Exhibit: A-10

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL A1165034.GPJ

APPENDIX B

LABORATORY TESTING

Laboratory Testing

Soil samples were tested in the laboratory to measure their dry unit weight and natural water content. Unconfined compression tests were performed on selected samples and a calibrated hand penetrometer was used to estimate the approximate unconfined compressive strength of some cohesive samples. The calibrated hand penetrometer has been correlated with unconfined compression tests and provides a better estimate of soil consistency than visual examination alone. Selected samples were also classified using the results of Atterberg Limits and grain size analysis testing. The test results are provided on the Boring Logs included in Appendix A and in the "**3.2 Typical Profile**" section of this report.

Descriptive classifications of the soils indicated on the boring logs are in general accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report. Classification of the soil samples was generally determined by visual manual procedures.

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-$^{3}/_{8}$" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2" O.D., 3" O.D., unless otherwise noted	PA:	Power Auger (Solid Stem)
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	BCR:	Before Casing Removal
WCI:	Wet Cave in	WD:	While Drilling	ACR:	After Casing Removal
DCI:	Dry Cave in	AB:	After Boring	N/E:	Not Encountered

Water levels indicated on the Boring Logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 - 15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 50	Dense
> 50	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	≥ 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75 to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

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UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

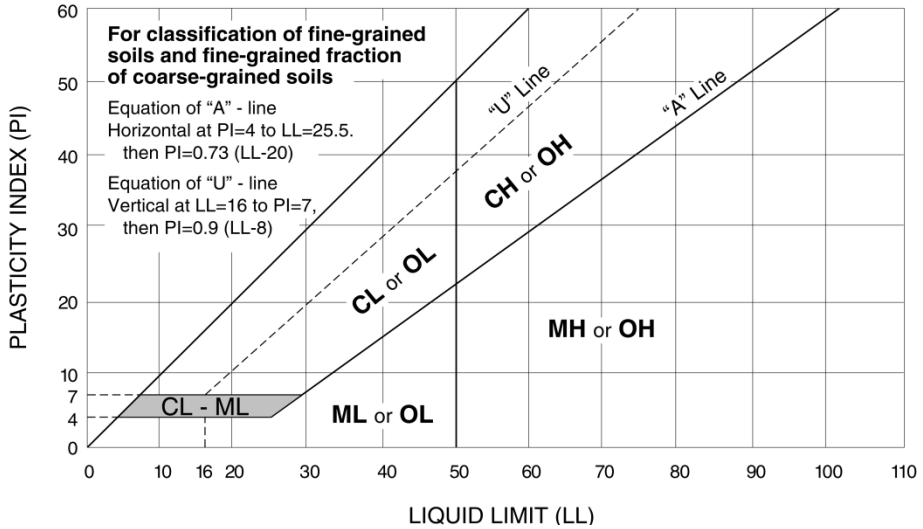

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Exhibit C-2